EXHIBIT B

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December 21, 2011

Via Electronic Mail: efiling@ferc.gov

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, NE, Room 1A
Washington, DC 20426

Re: Comments on Environmental Assessment of the Northeast Upgrade Project, Docket No. CP11-161-000

Dear Ms. Bose:

On behalf of the intervenors, the New Jersey Highlands Coalition, the New Jersey Chapter of the Sierra Club, and the Delaware Riverkeeper Network, we respectfully submit the following comments on the environmental assessment ("EA") of the Northeast Upgrade Project ("Project") proposed by Tennessee Gas Pipeline Company ("TGP"). For the reasons explained below, the EA cannot serve as the basis for an adequate hard look at the Project's environmental impacts or support a finding of no significant impact ("FONSI"). To the contrary, available evidence demonstrates that the Project will significantly affect the quality of the human environment and that a full environmental impact statement ("EIS") should be prepared to ensure that the Federal Energy Regulatory Commission (the "Commission" or "FERC") satisfies its obligations under the National Environmental Policy Act ("NEPA"), 42 U.S.C. §§ 4321 *et seq.*

I. The Northeast Upgrade Project Will Significantly Affect the Quality of the Human Environment.

FERC's conclusion that the Project will have no significant environmental impacts is unsupportable in the face of evidence demonstrating the potential severity of the Project's impacts. The determination of whether a project will "significantly affect[] the quality of the human environment," depends on considerations of "both context and intensity." 40 C.F.R. § 1508.27.[1] As is set forth below, both the context and intensity of the Project's impacts mandate a finding of significant impacts and the preparation of an EIS. *See* 42 U.S.C. § 4332(2)(C) (an EIS must be prepared for all "major Federal actions significantly affecting the

[1] The Council on Environmental Quality is authorized "to establish regulations setting forth environmental review procedures to be followed by federal agencies." Advocates for Transp. Alternatives, Inc. v. U.S. Army Corps of Eng'rs, 453 S. Supp.2d 289, 299 (D. Mass. 2006) (citing 42 U.S.C. §§ 4342, 4344).

quality of the human environment").

With regard to context, "the significance of an action must be analyzed in several contexts such as society as a whole (human, national), the affected region, the affected interests, and the locality." 40 C.F.R. § 1508.27(a). The context of this Project necessarily includes the rapid development of the Marcellus Shale, which has been marked by repeated episodes of environmental destruction and whose cumulative impacts on the human environment have never been examined by any local, state, or federal agency. The context of the Project also includes the fact that the pipeline looping segments will be constructed almost exclusively in high value resource areas and special protection waters designated by local, state, and federal agencies, including habitat for numerous federal and state endangered and threatened species.

Intensity "refers to the severity of impact." 40 C.F.R. § 1508.27(b). Ten factors "should be considered in evaluating intensity." 40 C.F.R. § 1508.27. A finding of cumulatively significant impacts (factor 7) alone demands an EIS. *See Kern v. U.S. Bureau of Land Mgmt.*, 284 F.3d 1062, 1076 (9th Cir. 2002) ("[A]n EA may be deficient if it fails to include a cumulative impact analysis or to tier to an EIS that has conducted such an analysis."); *Friends of the Earth, Inc. v. U.S. Army Corps of Eng'rs*, 109 F. Supp.2d 30, 43 (D.D.C. 2000) ("[T]he significant cumulative impacts of the multiple casino projects . . . warrant the preparation of an EIS. On this . . . criterion alone, it appears that an EIS is required.") (citations omitted). As few as two of the other factors together can invalidate a FONSI and require an EIS. *See, e.g.*, *Nat'l Parks & Conservation Ass'n v. Babbitt*, 241 F.3d 722, 731–37 (9th Cir. 2001) ("*NPCA*"), *abrogated on other grounds by Monsanto Co. v. Geertson*, 130 S. Ct. 2743 (2010).

In the case of the Project, at least nine of the ten intensity factors – including cumulative impacts – weigh heavily in favor of a finding of severe and significant impacts necessitating analysis in an environmental impact statement:

> (2) The degree to which the proposed action affects public health or safety.
> (3) Unique characteristics of the geographic area such as proximity to historic or cultural resources, park lands, prime farmlands, wetlands, wild and scenic rivers, or ecologically critical areas.
> (4) The degree to which the effects on the quality of the human environment are likely to be highly controversial.
> (5) The degree to which the possible effects on the human environment are highly uncertain or involve unique or unknown risks.
> (6) The degree to which the action may establish a precedent for future actions with significant effects or represents a decision in principle about a future consideration.
> (7) Whether the action is related to other actions with individually insignificant but cumulatively significant impacts. Significance exists if it is reasonable to anticipate a cumulatively significant impact on the environment. Significance cannot be avoided by terming an action temporary or by breaking it down into small component parts.
> (8) The degree to which the action may adversely affect districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of

> Historic Places or may cause loss or destruction of significant scientific, cultural, or historical resources.
> (9) The degree to which the action may adversely affect an endangered or threatened species or its habitat that has been determined to be critical under the Endangered Species Act of 1973.
> (10) Whether the action threatens a violation of Federal, State, or local law or requirements imposed for the protection of the environment.

40 C.F.R. § 1508.27. Consideration of each of these factors indisputably leads to a finding that a FONSI cannot be supported in this case. The Project will have significant impacts and FERC must therefore prepare an EIS.

While NEPA regulations do not contain page limits for EA's, the Council has generally advised agencies to keep the length of EA's to not more than approximately 10-15 pages. Some agencies expressly provide page guidelines (e.g., 10-15 pages in the case of the Army Corps). To avoid undue length, the EA may incorporate by reference background data to support its concise discussion of the proposal and relevant issues. CEQ itself has addressed the appropriateness, or lack thereof, of an EA for a complex project resulting in voluminous documentation:

> 36b. Under what circumstances is a **lengthy EA** appropriate?
>
> A. Agencies should avoid preparing lengthy EAs except in unusual cases, where a proposal is so complex that a concise document cannot meet the goals of Section 1508.9 and where it is extremely difficult to determine whether the proposal could have significant environmental effects. **In most cases, however, a lengthy EA indicates that an EIS is needed.**[2]*****

Consistent with CEQ's guidance, intervenors' expert John A. Thonet, PE, PF, of Thonet and Associates, Inc., *Environmental Planning & Engineering Design Consultants* concluded:

> The Environmental Assessment (EA) provided is voluminous, rather than being a brief and concise document as intended by NEPA. The document consists of about 250 pages of text, tables, maps, and appendices that clearly document that the project will result in environmental impacts to over 800 acres of land over the 40-mile long project area . . . . The environmental impacts described in the EA are sufficient to support a finding that the project is likely to have significant environmental impacts, contrary to the EA's "Finding of No Significant Impact" (FONSI).

John A. Thonet, PE, PF, Comments on Environmental Assessment (hereinafter "Thonet Comments") at 17-18 (annexed as Exhibit A hereto).

[2] http://ceq.hss.doe.gov/nepa/regs/40/30-40.HTM#36.

* All online materials are readily available on the internet; intervenors will submit them to FERC upon request.

II. Analysis of the NEPA Intensity Factors.

A. The Project Poses a Significant Threat to Public Health and Safety.

The "degree to which the proposed action affects public health or safety," 40 C.F.R. § 1508.27(b)(2), favors a finding of significance. TGP's pipeline safety record, the age of the original pipeline to which the Project will be looped, and the proximity of the Project to numerous hazardous waste sites raise numerous and significant public health and safety concerns that must be assessed in an EIS.

The transmission of highly flammable natural gas creates significant risks of loss of life and major property damage. The U.S. Department of Transportation's Pipeline and Hazardous Materials Safety Administration reports that, in the past twenty years, significant on-shore gas transmission incidents have caused 43 fatalities, 219 injuries requiring in-patient hospitalization, and over $1 billion in property damage resulting from significant on-shore gas transmission incidents.[3] Within the past year alone, three pipeline segments owned and operated by TGP have exploded, causing large fires, forcing residential evacuations, and threatening public safety.[4] Two other TGP pipeline segments experienced significant failures during the same time period, resulting in the release of natural gas into the environment.[5] TGP's safety record is of particular concern because this Project will add pipeline loops to an existing 24-inch diameter transmission pipeline installed in the *mid-1950s*. Older pipelines have a higher frequency of corrosion incidents because corrosion is a time-dependent process. *See* EA at 2-118. The proposed addition will therefore cause significantly more highly combustible natural gas to flow through nearly 60 year-old transmission infrastructure.[6] The age of the original pipeline, coupled with TGP's disturbing history of pipeline accidents, raises significant questions about TGP's ability to safely construct and operate this Project.

In addition, this Project will traverse parts of Pennsylvania and New Jersey that have numerous existing hazardous waste sites and landfills. The EA identifies no fewer than thirty-five hazardous waste sites within 1,700 feet of the Project. EA at 2-79. Of particular note is the 500 acre Ringwood Mines/Landfill Site in Ringwood, New Jersey, located upgradient and just 500 feet from the project. EA at 2-80. While this site has been the focus of remediation efforts

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[3] *Stakeholder Communications*, U.S. DEP'T OF TRANSP., PIPELINE AND HAZARDOUS MATERIALS SAFETY ADMIN., http://primis.phmsa.dot.gov/comm/reports/safety/SigPSI.html?nocache=9740#_ngtrans (last visited Dec. 18, 2011).

[4] *See Pipeline Blast, Blaze Under Investigation*, CLARION LEDGER, (Nov. 22, 2011 11:11 PM), http://www.clarionledger.com/article/20111123/NEWS/111230334/Pipeline-blast-blaze-under-investigation; Cheri Russo & Bethany Venable, *Morgan Co. Pipeline Explosion*, WOUB PUBLIC MEDIA, (Nov. 16, 2011 9:04 AM), http://woub.org/2011/11/16/explosion-reported-northern-athens-county; *Gas Explosion Rocks Ohio Countryside*, FOX NEWS (Feb. 11, 2011), http://www.foxnews.com/us/2011/02/11/gas-explosion-rocks-ohio-countryside/.

[5] *See* In the Matter of Tennessee Gas Pipeline Company, CPF No. 3-2011-1001S, U.S. Dep't of Transp. (2011), *available at* http://primis.phmsa.dot.gov/comm/reports/enforce/documents/320111001S/320111001S_Consent%20Agreement_03312011.pdf; In the Matter of Tennessee Gas Pipeline Company, CPF No. 4-2010-1007H, U.S. Dep't of Transp. (2010), *available at* http://primis.phmsa.dot.gov/comm/reports/enforce/documents/420101007H/420101007H_CAO_12032010.pdf;

[6] The original transmission pipe was installed before 1971 and therefore does not have modern external protective coating or a cathodic protection system, subjecting it to an increased corrosion rate over modern pipe. *See* EA at 2-119.

almost continually since 1984, additional hazardous material continues to be discovered on site.[7] Because the proximity of these sites to the Project area raises significant public health and safety concerns, FERC must conduct an EIS to fully assess these risks.

B. The Project Will Affect Numerous Unique Geographic Areas And May Cause Destruction of Significant Scientific, Cultural, and Historical Resources.

The "[u]nique characteristics of the geographic area" strongly favor a finding of significant impacts requiring the preparation of an EIS in this case, as does "[t]he degree to which the action . . . may cause loss or destruction of significant scientific, cultural, or historical resources." 40 C.F.R. § 1508.27(b)(3), (b)(8). Each of the five pipeline loops will pass through or near one or more of the six categories of unique geographic characteristics identified by CEQ regulations as pertinent to a significance determination, including "historic or cultural resources, park lands, prime farmlands, wetlands, wild and scenic rivers, or ecologically critical areas." *Id*. Numerous courts have required the preparation of an EIS when a proposed major federal action has the potential to significantly impact sensitive and protected resources such as those in proximity to the Northeast Upgrade Project. *See, e.g., Anglers of the Au Sable v. U.S. Forest Serv.*, 402 F.Supp.2d 826, 832 (E.D. Mich. 2005) (determining that plaintiffs raised a substantial question as to whether an EIS should have been prepared in a proceeding for a preliminary injunction where the proposed action could "cause significant impacts to old-growth and other forest stands and the wildlife they harbor" and was located within the nesting area of an endangered species and close to a state "Natural Area" and a state "Natural River"); *Patterson v. Exon*, 415 F. Supp. 1276, 1281–82 (D. Neb. 1976) (holding that the agency should have prepared an EIS where the proposed project would entail "considerable grading and tree removal" in area "rich in scenic beauty"); *Concerned Residents of Buck Hill Falls v. Grant*, 388 F. Supp. 394, 398 (M.D. Pa. 1975) (holding that the Soil Conservation Service erred in failing to prepare an EIS because it "did not explore in depth all the adverse impacts to the aquatic life" in a high value trout stream that would be impacted by the proposed Project).

An astounding number of unique resource areas that will be adversely affected by the Project. Each of the five pipeline loops will cross through sensitive and unique vegetative communities. EA at 2-38, 2-39. Loop 317 will cross the Susquehanna River Trail, a Nationwide Rivers Inventory waterbody, and the U.S. Route 6 Grand Army of the Republic Highway Trail. EA at 2-71, 2-72. Loop 323 will cross the Delaware State Forest, High Point State Park, the Appalachian National Scenic Trail, and the Clove Brook Road Corridor Important Bird Area. EA at 2-73, 2-74, 2-45. Loop 323 will also cross the Delaware River, a National Wild and Scenic River. EA at 2-13. Loop 325 is located entirely within the Highlands Region, and will cross the Long Pond Ironworks State Park, the Monksville Reservoir, and Ringwood State Park. EA at 2-75, 2-76, 2-78, 2-79. The pipeline loops will also cross more than seven miles of prime farmland, EA at 2-4, dozens of high quality and exceptional waterbodies that serve as coldwater and warmwater fisheries, EA at 2-19, and almost fifty acres of wetlands, EA at 2-25.

[7] *See Ringwood Mines/Landfill Site*, U.S. ENVTL. PROT. AGENCY, www.epa.gov/region2/superfund/npl/ringwood/ (last visited Dec. 18, 2011).

The exceptional value of these unique resource areas cannot be disputed. National Wild and Scenic Rivers, like the Delaware River, are so designated because they "possess outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values." *See* 16 U.S.C. § 1271. Similarly, river segments on the Nationwide Rivers Inventory, such as the Susquehanna River, "possess one or more 'outstandingly remarkable' natural or cultural values judged to be of more than local or regional significance."[8] Congress has recognized the Highlands Region for the "importance of [its] water, forest, agricultural, wildlife, recreational, and cultural resources."[9] The public lands and resources protected at the state level that will be adversely affected by this Project are no less remarkable. For example, the Clove Brook Road Corridor Important Bird Area consists of "largely intact forests . . . [that] provide valuable breeding habitat for several species of raptors including state-endangered northern goshawks and red-shouldered hawks, state-threatened barred owls, and state-special concern Cooper's hawks." EA at 2-45.

The EA clearly demonstrates the Project's potential to significantly affect these unique and sensitive areas. The areas affected by the Project serve as habitat for four federally listed threatened or endangered species, the Bald Eagle, and sixty-five state endangered, threatened, or special concern species. EA at 2-47, 2-53, 2-54. *See also infra* Part II.G. The Project will permanently convert approximately eighty acres of forested land, potentially leading to increased erosion, fragmentation, and edge habitat, which could "decrease the quality of habitat for forest wildlife species." EA at 2-36. Construction of the Project will substantially degrade an additional 265.4 acres of forested land, which the EA admits will take "many years to regenerate." EA at 2-36, 2-80. The Project will also cause "a permanent conversion of previously forested wetland areas to non-forested wetland areas," which "could result in changes in wetland functions and values by altering the amount of sunlight or other environmental conditions in the wetland, primarily wildlife habitat." EA at 2-28. Further, "[l]ong-term impacts on fishery resources could occur if the stream contours are permanently modified in the area of the crossing or the adjacent riparian vegetation does not recover." EA at 2-21. These are only some of the known risks posed by the Project; as discussed *infra* in Part II.D, FERC has failed to collect and analyze a significant amount of data that is highly relevant to assessing the potential impact of the Project on these unique geographic areas.

The EA's conclusion that these unique and sensitive areas will not be significantly affected by the Project appears to rely largely on baseless conclusions and unsupported expectations. With respect to the potential impact of the Project on wetlands, for example, the EA states that "[i]n general . . . it is expected that the affected wetlands would continue to provide important ecological functions such as sediment/toxicant retention, nutrient removal, flood attenuation, groundwater recharge/discharge, and wildlife habitat." EA at 2-28. The EA offers similarly unsupported "expectations" in its analysis of forest fragmentation, stating that "[i]t is expected that most wildlife, such as birds and larger mammals, would temporarily relocate to adjacent available habitat as construction activities approach" and then "would be expected to return and colonize post-construction habitats." EA at 2-43. The agency staff's unsubstantiated "belie[f] that the overall permanent conversion of wildlife would be minor due to

[8] *See Nationwide Rivers Inventory*, NAT'L PARK SERV., http://www.nps.gov/ncrc/programs/rtca/nri/ (last visited Dec. 18, 2011).
[9] Highlands Conservation Act, Pub. L. No. 108-421, 118 Stat. 2375 (2004).

the aforementioned collocation and the large expanse of forested land available in the Project area" and baseless conclusion that "[i]t is not likely that the addition of 25 feet of permanently cleared right-of-way would impede the movement of most [though not all] forest interior species" does not satisfy FERC's duty to take a hard look at the impacts of this Project on the many unique and sensitive areas noted above. EA at 2-43 (insert added). The ecological importance of these areas demands further study beyond that contained in the EA.

C. The Environmental Impacts of the Project Are Highly Controversial

Pursuant to NEPA, a major federal action is controversial when "a substantial dispute exists as to the size, nature, or effect of the . . . action." *See, e.g., LaFlamme v. FERC*, 852 F.2d 389, 400–01 (9th Cir. 1988) (citations and quotations omitted). As the appended statements of independent experts and the comments from NJDEP demonstrate, many of the impacts of the Project and the conclusions reached in the EA are highly disputed. For example, environmental consultant Kevin Heatley took issue with FERC's conclusion in Section 2.3.2.2 regarding wildlife impacts. Heatley found that "ROW expansion will decrease soil moisture levels in the adjacent forest floor and leaf litter resulting in fundamental changes in soil chemistry and biota. **The ROW expansion, coupled with the associated edge effects, is likely to present a barrier to movement of sensitive species.**" Keven Heatley, Comments on the EA at 7 (annexed as Exhibit B hereto). He also found that "the creation of additional edge habitat, in combination with a linear corridor, is likely to result in chronic, localized infestations of undesirable species . . . ." *Id.* at 9. Heatley concluded that the "failure to address these areas of concern will assure undesirable, cascading impacts which will eventually undermine the ecological integrity of forested systems adjacent to the project area." *Id.* at 13.

Additionally, the EA does not take into account serious impacts of the construction on important natural and cultural resource values that are outside of and beyond the construction site itself. Such impacts include increased forest fragmentation that destroys critical interior forest habitat conditions adjacent to the ROW and degrades habitat conditions for hundreds or thousands of feet perpendicular to the ROW. Construction noise adversely affecting wildlife behavior hundreds of feet or more away from the actual construction is not considered. Scenic and historic resources and viewsheds at some distance from the construction site itself can be permanently degraded.

There are long-term impacts of access route and ROW construction that are permanent and irreversible – soil compaction, the spread of invasive, non-native species of plants, pathogens and animals, and the permanent loss of public trust resources of native flora and fauna that can never recover within the permanently altered habitat.

Agencies cannot assume that restorative measures will succeed, as the record on restorative practices proves that restorative measures fail due to poor design and planning, poor follow-up, insufficient resources, deer browse, off-road vehicle impacts, drought, and weed invasive species capturing the site, ultimately resulting in a complete loss of the sensitive natural resource components that were originally present.

Offsite impacts currently reported include that heavy precipitation on Tennessee Gas

Pipeline's recent construction on the steep slopes of Hamburg Mountain State Wildlife Management Area and Bearfort Mountain in Wawayanda State Park, approved earlier by the State, has caused massive erosion, mudslides, siltation and degradation of public and private properties, including Category One waterways, lakes and ponds. Experience shows that attempts to repair this kind of damage are merely cosmetic. The loss of public trust resources can never be recovered, and the soil loss and disturbance will result in an irreversible compositional shift to weedy, unremarkable species characteristic of degraded ecosystems. *Id.*

As amply demonstrated in these comments and the attached expert reports, the controversial nature of the Project supports the preparation of an EIS.

D. The Possible Effects of the Project on the Quality of the Human Environment Are Highly Uncertain.

The fifth intensity factor directs agencies to evaluate "[t]he degree to which the possible effects on the human environment are highly uncertain or involve unique or unknown risks" when evaluating the potential significance of a project's impacts on the environment and the necessity of an EIS. 40 C.F.R. § 1508.2(b)(5). Possible effects are highly uncertain where, as here, an EA reveals significant gaps in data collection. Thus, a FONSI cannot be supported "where uncertainty may be resolved by further collection of data, or where the collection of such data may prevent speculation of potential effects." *NPCA*, 241 F.3d at 732-33 (finding a FONSI indefensible where the agency proposed a monitoring program to understand the effects of increased ship traffic on the environment in an EA rather than implement the program and analyze the relevant data before issuing a FONSI).

Incomplete data collection compels the preparation of an EIS because "[t]he purpose of an EIS is to obviate the need for speculation by insuring that available data are gathered and analyzed prior to the implementation of the proposed action." *Sierra Club v. U.S. Forest Serv.*, 843 F.2d 1190, 1195 (9th Cir. 1988) (finding an agency's decision not to prepare an EIS unreasonable where the agency failed to gather and address relevant data bearing on cumulative impacts and the impact of the project on state water quality standards); *see also Ocean Advocates v. U.S. Army Corps of Eng'rs*, 402 F.3d 846 (9th Cir. 2005) (determining that an agency erred in issuing a FONSI where it failed to gather data to assess increased traffic resulting from the proposed project). An agency's "lack of knowledge does not excuse the preparation of an EIS; rather it requires the [agency] to do the necessary work to obtain it." *Id.* at 733. FERC's failure to collect key information, described below, not only raises questions about the sufficiency of the EA but also affirmatively militates in favor of the preparation of an EIS because it creates significant uncertainty regarding the extent of the Project's impacts.

The EA reveals a striking failure to gather or assess data vital to understanding the geology of the Project area. For example, while "[t]he majority of the Project areas is located in an area considered to be moderately to highly susceptible to landslides," TGP has not yet conducted field surveys "to assess the potential risk of slope failure during construction or operation of the pipeline." EA at 2-2. TGP has similarly failed to identify the location of karst features in the Project area, notwithstanding the fact that "nearly all of Loop 323 and portions of Loop 325 would traverse areas of potential karst terrain." EA at 2-3. TGP has also failed to

identify which areas of the Project will necessitate the use of blasting during construction, including wetlands, which is of particular concern because "[]82 percent[] of the proposed pipeline loops would cross shallow bedrock." EA at 2-3, 2-24.

The EA further indicates that the revegetation potential of much of the Project is unknown. According to the EA, "[a]pproximately 55 percent (22.3 miles) of the proposed loops would be underlain by stony/rocky soils[,] . . . [a]bout 19 percent (7.6 miles) of the proposed pipeline loops would cross droughty soils," and "[a]n additional 60 percent (24.2 miles) of the soils that would be crossed have an average slope of greater than 8 percent." EA at 2-6. All of these factors "may make the establishment of vegetation difficult." *Id.*

The potential for the Project to harm water resources is similarly uncertain. Of particular concern, the EA discloses that TGP has not yet developed a mitigation plan for the construction and operation of Loop 325 through the Highlands Region, "which provides the majority of potable water used in northern and central New Jersey." EA at 2-11 ("TGP *would* develop a Comprehensive Mitigation Plan during construction and operation of the Project . . . ." (emphasis added)). Further, the EA notes that blasting "could potentially impact the water quality and capacity of nearby water supply wells." EA at 2-12. However, it is clear that the scope of this potential impact has not been assessed because, as noted above, TGP has not yet determined where blasting will occur. Moreover, while the EA acknowledges that dry crossings of the Susquehanna River and the Monksville Reservoir could be necessary if the proposed horizontal directional drilling (HDD) fails, it offers no assessment of what impacts an alternative crossing method would have on these waterbodies, nor does it indicate that information on any potential impacts has even been collected. EA at 2-17.

As described *infra* in Part II.G, TGP has thus far failed to submit numerous required surveys and final reports regarding federal threatened and endangered species, including reports for the federally threatened bog turtle, EA at 2-48, and surveys for the federally endangered dwarf wedgemussel, EA at 2-51, the small whorled pogonia, EA at 2-51, and the bald eagle, EA at 2-53. The EA indicates that TGP has also failed to complete or submit surveys for state-listed rare plants, EA at 2-53, timber rattlesnakes, EA at 2-54, mussels, EA at 2-55, and blue-spotted salamanders, EA at 2-55.

TGP has also failed to complete cultural resource surveys on portions of the Project area in Pennsylvania and New Jersey. EA at 2-90. Likewise, Phase II archaeological surveys for the Project have not been completed. EA at 2-91. Further, the Ramapough Lenape Nation has informed FERC that the Phase IA background information report "miss[ed] some local sources of information, including some known sites" of importance to the tribe, calling into question the adequacy of those reports presently completed. EA at 2-89.

Environmental consultant John Thonet summarizes all of the EIS-type environmental, historic preservation and cultural resource studies that need to be completed to ensure that the natural and human environment is adequately protected. With all of the following survey results still outstanding, the degree of uncertainty is immense:

- An updated Phase 1A survey report for New Jersey;
- Phase 1 cultural resources survey report(s) for any previously unreported areas for Pennsylvania and New Jersey, including the Revised TGP Alternative B route and the Wallkill River Mitigation Site;
- Phase II site evaluation reports, as required, to provide NRHP-eligibility recommendations for sites in Pennsylvania and New Jersey, including additional gemorphological testing;
- Any other reports, plans, or special studies, not yet submitted, including archaeological site avoidance and treatment plans, historic architectural avoidance plans, and unanticipated discovery plans.
- Comments on the cultural resource reports and plans from the PA SHPO, NJ SHPO, and any other consulting parties; and
- The records of continued consultation with the Ramapough Lenape Nation, Delaware Nation, the Delaware Tribe of Indians, the Oneida Indian Nation, the Eastern Shawnee Tribe of Oklahoma, and the Stockbridge Munsee Community of Wisconsin, and any other American Indian tribe that have not yet been filed.

Thonet Comments at 16. In addition to the above studies, Thonet points out that the recommendation is for the action not to commence until all of the following consultations have occurred:

- The Advisory Commission on Historic Preservation (ACHP) is afforded an opportunity to comment if historic properties would be adversely affected
- The FERC staff reviews and the Director of OEP approves the cultural resources reports and plans, and notifies TGP in writing that treatment plans/mitigation measures may be implemented and/or construction may proceed.
- TGP files, for review and written approval of the Director of OEP, a plan detailing the additional noise mitigation measures TGP would use to ensure that the noise levels attributable to the 24-hour HDD activities do not exceed an Ldn of 55 dBA at the Noise Sensitive Areas (NSAs) near the Susquehanna River HDD entry site.
- TGP files noise surveys with the Secretary after placing the authorized units at the Compressor Stations 321 and 323 in service. If the noise attributable to the operation of all the equipment at the identified compressor stations at full load exceeds an Ldn of 55 dBA at the nearby NSAs, then TGP shall install additional noise controls to meet the level
- Within 1 year of each station's in-service date. TGP shall confirm compliance with the above requirement by filing a second set of noise surveys with the Secretary after it installs the additional noise controls.

Id. at 16-17.

Furthermore, intervenors' experts and the NJDEP identify a significant number of failures to adequately study, collect data or assess impacts of the proposed project. These egregious omissions include:

- Examination of the increase in forest edge effects resulting from the expansion of the ROW.
- Analysis of potential impacts to interior forest species.
- Spatial analysis of the landscape level configuration of the forest system.
- Analysis of potential increases in tree mortality associated with increased edge.
- Analysis of the impact of increased edge effect on long term forest successional trajectory and associated biodiversity.
- Evaluation of the effect on species of the loss of structural and functional diversity of tree canopy.
- Analysis of the impact that expansion of the ROW will have on white-tailed deer herbivory.
- Discussion of the threat of invasive species incursions and its threat to forest health.
- Evaluation of the cumulative impact of Marcellus Shale development.
- Identification of abandoned iron mines within the Project area.
- Vegetation inventory and documented rare plant species or ecological communities.
- Direct and indirect emissions estimates for Volatile Organic Compounds and Oxides of Nitrogen for contractor and pipe yards.
- Location of all proposed access roads and culvert crossings.
- Surveys and survey protocols for several threatened and endangered species.

NEPA does not permit agencies to "act first and study later." *NPCA*, 241 F.3d at 734. The missing information discussed above, in addition to the missing information regarding cumulative impacts identified in Part II.F, "is precisely the information and understanding that is required *before* a decision that may have a significant adverse impact on the environment is made." *Id*. at 733 (emphasis in original). In order to fully identify the true direct, indirect, and cumulative impacts of the Project, FERC must collect and assess the identified missing information in an EIS.

E. The Project Is Likely to Establish a Precedent for Future Actions With Significant Effects.

"The degree to which the action may establish a precedent for future actions with significant effects or represents a decision in principle about a future consideration," 40 C.F.R. § 1508.27(b)(6), further supports a finding that the Project will have significant impacts. The inquiry here is whether "approval of a single action will establish a precedent for other actions which may cumulatively have a negative impact on the environment." *Anderson v. Evans*, 371 F.3d 475, 493 (9th Cir. 2004) (holding that federal agencies erred in failing to consider the precedential effect of approving an incidental take quota for whale hunting). For instance, in finding this factor to weigh in favor of significance and concluding that an EIS was required before the permitting of three casinos on the Mississippi coast, the District Court for the District of Columbia noted: "With the proliferation of casinos along the Mississippi coast, the [USACE] may feel bound to the conclusions reached in the FONSIs issued in these cases, thereby allowing the FONSIs to serve as precedent for future casino projects." *Friends of the Earth v. U.S. Army Corps of Eng'rs*, 109 F. Supp. 2d 30, 43 (D.D.C. 2000). Here, the rapid pace of pipeline development in the Marcellus Shale region necessarily will entail the construction of numerous federally regulated facilities, including the New Jersey-New York Expansion Project (Docket

No. CP11-56), posing a serious risk that FERC will feel bound to the conclusions presented in the EA when evaluating future project proposals. Because the Project almost exclusively crosses high-valued protected lands and water resources, issuing a FONSI would establish precedent for future actions having significant impacts on similarly exceptional natural resources. The Commission staff should conduct a full EIS because the precedential value of this Project is substantial and the issuance of a FONSI could open the floodgates to detrimental impacts on highly valued natural resources.

F. The Project Will Have Cumulatively Significant Impacts on the Environment.

The EA's treatment of cumulative impacts falls short of what is required by NEPA. The EA fails to consider the full scope of impacts. It also assesses the identified impacts without providing any detailed or quantified data to support the analysis. Finally, the EA impermissibly relies entirely on presumed compliance with permitting requirements and proposed mitigation plans to justify its conclusion that no significant cumulative impacts will result from the Project. Such inadequacies render the cumulative impacts analysis insufficient as a matter of law, and the EA therefore cannot support the FONSI recommended by the Commission staff. Because it is reasonable to anticipate that the Project, together with connected and similar projects, will have a cumulatively significant impact on the environment, significance exists and necessitates the preparation of an EIS. 40 C.F.R. § 1508.27(b)(7).

1. The EA Fails to Consider the Full Scope of Impacts.

Under NEPA and its implementing regulations, 40 C.F.R. §§ 1500–08, federal agencies must consider the direct, indirect, and cumulative impacts of the Project and all connected, cumulative, and similar actions. 40 C.F.R. §§ 1508.8, 1508.25. The CEQ regulations implementing NEPA, which are binding on federal agencies, *Andrus v. Sierra Club*, 442 U.S. 347, 358 (1979), provide that actions are connected if they:

> (i) Automatically trigger other actions which may require environmental impact statements.
> (ii) Cannot or will not proceed unless other actions are taken previously or simultaneously.
> (iii) Are interdependent parts of a larger action and depend on the larger action for their justification.

Id. § 1508.25(a)(1). "Similar actions" are those that "have similarities that provide a basis for evaluating their environmental consequences together, such as common timing or geography." *Id.* § 1508.25(a)(3). The regulations also provide that agencies should analyze similar actions in a single impact statement "when the best way to assess adequately the combined impacts of similar actions or reasonable alternatives is to treat them in a single impact statement." *Id.*

Direct impacts "are caused by the action and occur at the same time and place." 40 C.F.R. § 1508.8. 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." *Id.* Cumulative impacts are:

> impact[s] on the environment which result[] 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. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

40 C.F.R. § 1508.7. In preparing an EA adequate to support a FONSI, agencies must adhere to the CEQ standards outlined above. *See Kern v. U.S. Bureau of Land Mgmt.*, 284 F.3d 1062, 1076 (9th Cir. 2002) (discussing CEQ guidance and broad consensus among Circuit courts that EAs must address cumulative impacts).

The EA states that its cumulative impacts analysis considers actions that:

- impact a resource area potentially affected by the Project;
- cause this impact within all, or part of, the Project area; and
- cause this impact within all, or part, of the time span for the potential impact of the Project.

EA at 2-121. FERC staff also represent that they have "considered existing or reasonably foreseeable actions expected to affect similar resources during similar time periods with the Project." *Id.* In fact, however, the EA fails to consider the full scope of connected and similar actions as well as the cumulative impacts arising from the full scope of actions.

Remarkably, the EA fails to assess the additive effect of the Project together with the effects of existing or reasonably foreseeable gas development activities in the Project area, including the impacts of gas exploration and production and the construction and operation of well pads, access roads, gathering lines, compressor stations, and other infrastructure. Instead, the Commission staff merely acknowledges "general development of the Marcellus Shale" upstream activities, specifically but inadequately addresses existing wells and gathering systems, and ultimately dismisses upstream activities as "outside the scope of [the cumulative impacts] analysis because the exact location, scale, and timing of future facilities are unknown." EA at 2-125. Additionally, Commission staff argues that "the potential cumulative impacts of Marcellus Shale drilling activities are not sufficiently causally related to the Project to warrant the comprehensive consideration of those impacts in this EA." *Id.*

As a preliminary matter, Commission staff is misguided when it argues, as it did in the Marc I issuance, that because "the Commonwealth of Pennsylvania regulates the siting, permitting, construction and operation of Marcellus Shale wells in Pennsylvania" and "[t]he Commission plays no role, or retains any control over them," it is "not required to consider the wells' correlative environmental impacts." Cent. N.Y. Oil and Gas Co., 137 FERC ¶ 61,121 (Nov. 14, 2011). Commission staff appears to rely on *U.S. Dep't of Transp. v. Public Citizen*, 541 U.S. 752 (2004), which held:

> where an agency has no ability to prevent a certain effect due to its limited statutory authority over the relevant actions, the agency cannot be considered a legally relevant 'cause' of the effect. Hence, under NEPA and the implementing CEQ regulations, the agency need not consider these effects in its EA when determining whether its action is a 'major Federal action.'

Id. at 770. In determining that there was no causal link, the Supreme Court stressed that "a critical feature" to its decision was that the FMCSA had "*no ability* to countermand the President's lifting of the moratorium or otherwise categorically to exclude Mexican motor carriers from operating within the United States." *Id.* at 766 (emphasis added).

Whereas the FMCSA had "no ability" whatsoever to prevent or otherwise affect the entrance of Mexican carriers, and therefore the impact of such carriers was not an "effect" the FMCSA had to consider in its EA, FERC's exclusive jurisdiction over the interstate pipeline system grants it substantial statutory authority to affect development of Marcellus Shale upstream activities. Because development of upstream activities in the Marcellus region may only proceed if the Commission continues to expand access to market through the interstate pipeline system, the Commission is, in effect, a gatekeeper able to promote, prevent, or otherwise affect such activities. "[W]hen an agency serves effectively as a 'gatekeeper' for private action, that agency can no longer be said to have "no ability to prevent a certain effect [under the *Public Citizen* rule]." *Humane Soc. of U.S. v. Johanns*, 520 F. Supp. 2d 8, 25 (D.D.C. 2007). Because the Commission in fact has substantial capability, rather than no ability whatsoever, to prevent upstream development of Marcellus activities, the holding in *Public Citizen* is not controlling here, and the Commission must consider the cumulative impacts of Marcellus development in determining whether the Project is a major Federal action under NEPA.

Nonetheless, Commission staff argues that Marcellus Shale drilling activities are not "sufficiently causally related" to the Project so as to require comprehensive cumulative impact analysis in the EA. EA at 2-121. "NEPA requires 'a reasonably close causal relationship' between the environmental effect and the alleged cause," a requirement the Supreme Court interprets as analogous to reasonable foreseeability in torts. *U.S. Dep't of Transp. v. Public Citizen*, 541 U.S. at 767. Marcellus Shale development activities in Pennsylvania, particularly those in and around the pipeline's service area, are reasonably foreseeable consequences of the Project, and their effects must therefore be considered as cumulative impacts in determining whether the Project is a major Federal action under NEPA.

The long duration of Marcellus shale development is not dispositive as to whether it has a reasonably close causal relationship to the Project. Indeed, "[r]easonable forecasting and speculation is . . . implicit in NEPA, and we must reject any attempt by agencies to shirk their responsibilities under NEPA by labeling any and all discussion of future environmental effects as 'crystal ball inquiry.'" *Kern v. U.S. Bureau of Land Mgmt.*, 284 F.3d 1062, 1072 (9th Cir. 2002) (quoting *Scientists' Inst. for Pub. Info. v. Atomic Energy Comm'n*, 481 F.2d 1079, 1092 (D.C.Cir.1973)). The cumulative impact analysis, in the EA's own words, must encompass consideration of actions that cause an effect within "all, or part, of the time span" of the proposed Project's effects. EA at 121. The EA states, albeit vaguely, that the Project will have effects for "several years," *id.* at 2-28—or permanently, in the case of new right-of-way—and that

Marcellus Shale development in the area of the Project will be ongoing for twenty to forty years. *Id.* at 2-131. Thus, by the EA's own terms, the effects of Marcellus development will have effects within "all, or part, of the time span" of the Project's effects, and Marcellus development should therefore be included in the cumulative impacts analysis.

Nor is the broad geographic scope of Marcellus shale development dispositive as to whether it has a reasonably close causal relationship to the Project. The EA admits that the geographic scope of the cumulative impacts analysis should encompass consideration of actions that "impact a resource area potentially affected by the proposed project" and "cause this effect within all or part of the proposed project area." EA at 2-121. Publicly available maps of permitted gas wells in Pennsylvania show the locations of wells already drilled in the Pennsylvania counties to be crossed by the Project as well as the locations newly-permitted well sites.[10] By simply stating, in general terms, how many wells will be drilled in the entire state of Pennsylvania, and failing to provide more detail or analysis, particularly where such details are available from publicly available sources, the Commission falls far short of its obligations under NEPA. *See* EA at 2-125. The Commission quite simply cannot argue that the location, scale, and timing of wells impacting the Project area are "unknown" when numerous wells are already permitted and relevant data on them is widely-available on-line.

Moreover, the Commission can ascertain with reasonable certainty and specificity the locations of existing and future wells that the Project itself will directly facilitate. The EA states that the Project is intended to provide Chesapeake Energy Marketing, Inc. and Statoil Natural Gas, LLC with 636,000 dekatherms per day of capacity. EA at 1-1. Maps prepared by the Bradford County Planning Commission, for example, offer a wealth of information the Commission has ignored, including the precise location of Chesapeake-owned permits and active wells along a proposed gathering pipeline that would connect with the TGP pipeline system of which the Project is an expansion.[11] Because Chesapeake would have no incentive to drill such wells or propose such a gathering line without the access to market provided by the Project, the cumulative impacts of such wells have a reasonably close causal relationship to the Project. That the Commission made no attempt to consider such specific, publicly available information further indicates the inadequacy of the EA.

Though the Commission need not know the "exact location, scale, and timing" of upstream Marcellus development to include its impacts in the EA, information about the "exact location [and] scale" of existing upstream facilities is available. Nevertheless, nowhere in the EA does the Commission acknowledge such information, let alone analyze it. Moreover, knowledge of future upstream activities is sufficiently certain to compel consideration of their cumulative impacts. The instant case is analogous to *Thomas v. Peterson*, where the Ninth Circuit considered whether an EA prepared by the Forest Service for a forest road had to consider possible timber sales facilitated by the road that might occur in the future. 753 F.2d 754

[10] *See* Pennsylvania Dep't of Envtl. Prot., Permits Issued & Wells Drilled Maps, *available at* http://www.dep.state.pa.us/dep/deputate/minres/oilgas/2011PermitDrilledmaps.htm (last visited Dec. 4, 2011) (providing links to Pennsylvania state maps showing location of wells drilled 2008 - 2011 and wells for which permits have been issued during 2011).

[11] Maps of Natural Gas Development in Bradford County, *available at* http://www.bradfordcountypa.org/Natural-Gas.asp?specifTab=2 (last visited Dec. 4, 2011) (containing links to various maps, including "Overall Gas Activity Map," "Company Gas Map," "Gas Line Map," and "Quarterly Progression").

(9th Cir. 1985). The court held that the cumulative impacts of the road together with any timber sales that might occur in the future had to be considered together. The court rejected a contention that "the sales are too uncertain and too far in the future for their impacts to be analyzed along with the road," reasoning that "if the sales are sufficiently certain to justify construction of the road, then they are sufficiently certain for their environmental impacts to be analyzed along with those of the road." *Id.* at 760. Indeed, it is difficult to conceive of a more analogous situation. The Commission staff concedes that further upstream Marcellus development is sufficiently certain—particularly in and around the Project area—to justify construction of the Project. Thus, the impacts of such development are sufficiently certain to be included as cumulative impacts of the Project.

In the face of the foregoing information and analysis, the Commission cannot in good faith conclude either that the effects of past, present, and reasonably foreseeable upstream Marcellus shale development do not have a "reasonably close causal relation" to the Project, or that they are entirely unknown and, thus, outside the scope of analysis. Indeed, the foregoing does not even consider the availability of comprehensive studies—such as the New York State Department of Environmental Conservation's Revised Draft SGEIS for High-Volume Hydraulic Fracturing,[12] and other scientific and policy literature—which systematically address the impacts of shale gas development, and which the EA entirely ignores. Although "'foreseeing the unforeseeable' is not required, an agency must use its best efforts to find out all that it reasonably can." *City of Davis v. Coleman*, 521 F.2d 661, 676 (9th Cir. 1975). FERC cannot rely on the EA to meet this obligation.

2. The Cumulative Impacts Analysis Is Devoid of Detailed, Reasoned Conclusions and Quantified Information.

Consideration of cumulative effects pursuant to NEPA requires "some quantified or detailed information," because "[w]ithout such information, neither the courts nor the public, in reviewing the [agency's] decisions, can be assured that the [agency] provided the hard look that it is required to provide." *Neighbors of Cuddy Mountain v. U.S. Forest Serv.*, 137 F.3d 1372, 1379 (9th Cir. 1998); *see also Klamath-Siskiyou Wildlands Ctr. v. Bureau of Land Mgmt.*, 387 F.3d 989, 993–94 (9th Cir. 2004) ("A proper consideration of the cumulative impacts of a project requires some quantified or detailed information; general statements about possible effects and some risk do not constitute a hard look absent a justification regarding why more definitive information could not be provided." (internal quotation marks and citations omitted); *Lands Council v. Powell*, 395 F.3d 1019, 1028 (9th Cir. 2004) (An agency must provide "a sufficiently detailed catalogue of past, present, and future projects, and provide adequate analysis about how these projects, and differences between these projects, are thought to have impacted the environment."). This cumulative analysis "must be more than perfunctory; it must provide 'a useful analysis of the cumulative impacts of past, present, and future projects.'" *Ocean Advocates v. U.S. Army Corps of Eng'rs*, 402 F.3d 846, 868 (9th Cir. 2005) (citations omitted). The cumulative impact analysis in the Northeast Upgrade Project EA is inadequate because it presents only general, perfunctory analyses and fails to provide quantified or detailed information to support its conclusions.

[12] *Available at* http://www.dec.ny.gov/energy/75370.html.

To the extent the Commission staff considers upstream Marcellus activities, it fails to provide any quantified or detailed account of such activities, or consider their cumulative impacts. The EA includes a general acknowledgment that wells exist throughout the region, but fails to provide more specific and relevant information. EA at 2-125. This information is widely available. For example, the Bradford County Planning Commission and the Pennsylvania DEP both provide comprehensive quantitative and geographic data as to the locations of active wells and drilling permits. Given the availability of such and other data, the discussion of this matter in the EA is woefully inadequate when it merely concludes that "it is likely that drilling would continue through the construction of the Project, but the exact extent of such drilling is unknown." EA at 2-125. Indeed, the Commission staff could use such information to quantify the "increased long-term emissions of criteria pollutants, HAPs, and GHGs within the region," EA at 2-133, and consider how such emissions might contribute to climate change or impact the public health under 40 C.F.R. § 1508.27(b)(2), instead of disregarding such significant impacts as "outside the scope of our analysis." EA at 2-133. The EA's GHG and Climate Change analysis is similarly deficient, as it only considers direct emissions, rather than including the more substantial indirect emissions cumulatively resulting from the Project. *See* NJDEP Comments on the EA, at 14.

Likewise, the EA simply catalogs existing and reasonably foreseeable gathering systems, but without analyzing their cumulative impacts. EA at 2-122. The EA states that such projects will have "similar" impacts as the Project, but perfunctorily concludes that "land requirements for construction would typically be less for gathering systems due to the installation of smaller diameter pipeline." EA at 2-126. Presumably, the Commission staff reasons that because impacts would be less significant for gathering systems, more comprehensive analysis is unnecessary. But cumulative impact analysis is precisely intended to analyze "individually minor but collectively significant actions," such as the development of gathering systems in the Project area. 40 C.F.R. § 1508.7. Finally, for the reasons discussed in the preceding section, the EA should also detail and analyze impacts from upstream activities beyond wells and gathering systems, including impacts from other reasonably foreseeable activities such as the construction and operation of access roads, compressor stations, and other infrastructure. Consequently, notwithstanding the completely hollow assertion that the "analysis specifically included the development of natural gas reserves in the Marcellus Shale," EA at 2-134, the Commission staff's finding of no significant cumulative impact is unsubstantiated by any detailed or quantified information and is thus inadequate to support a hard look at the full environmental impacts of the Project.

The EA is likewise inadequate in considering the combined environmental impacts of related existing and reasonably foreseeable pipelines within the Commission's jurisdiction. The EA identifies ten existing or proposed pipelines within fifty miles of the Project area, totaling at least 240 miles of new or improved pipeline construction. EA at 2-123–124. Five of these projects will either connect or be adjacent to the Project. EA at 2-126. However, the EA provides absolutely no detailed information or analysis relating to the additive environmental impacts of these past, present, and proposed actions. Indeed, the discussion of locations, timing, and pipeline lengths concludes, without further explanation, that "all of the above FERC jurisdictional projects would be constructed and maintained in accordance with our approved procedures and other construction, operation, and mitigation measures that may be required by federal, state, or local permitting authorities, further reducing the potential for cumulative

impacts." EA at 2-127. But nowhere does the EA actually say what those cumulative impacts might be, or provide a useful basis for concluding that mitigation efforts will be sufficient to prevent significant impacts.

In particular, the EA fails to analyze the cumulative impact of the related 300 Line project. As the EA provides, the "Northeast Upgrade Project would fill gaps in 300 Line Project." EA at 2-123. To the extent these are connected and similar actions, the impacts of both should have been considered in a single EA. Regardless, the cumulative impacts of the 300 Line and this Project must be considered together in making a significance determination for the Project. In considering cumulative effects of an action in conjunction with past actions, CEQ guidance requires "analysis and a concise description of the identifiable present effects of past actions to the extent that they are relevant and useful in analyzing whether the reasonably foreseeable effects of the agency proposal for action and its alternatives may have a continuing, additive and significant relationship to those effects."[13] Moreover, an adequate cumulative effects analysis does not merely account for the isolated sum effects of past, present, and reasonably foreseeable actions, since "different actions may produce effects that interact to produce cumulative effects greater than the sum of the effects" in a "synergistic" manner.[14] The Northeast Upgrade Project closes out the remaining gaps left in the TGP 300 Line expansion project, thus completing a new and expanded ROW. In determining whether the Project is a major federal action, the aggregate and synergistic impacts of these combined projects must be considered together. But the EA entirely excludes any specific, detailed, or analytic consideration of the relationship between the 300 Line and Northeast Upgrade Project.

With regard to groundwater resources, the EA first notes that the "Project construction could have a minor, temporary, and localized effect on groundwater and surface water resources." EA at 2-129. However, "[s]ignificance cannot be avoided by terming an action temporary or by breaking it down into small component parts." 40 C.F.R. § 1508.27(b)(7). Moreover, the EA makes no attempt to consider the cumulative impact on water resources of the Project together with related pipelines in the Project area. In *Klamath-Siskiyou Wildlands Ctr. v. Bureau of Land Mgmt.*, the court found that a cumulative impact analysis that qualitatively identified the impacts of various projects as "unchanged," "improved," or "degraded," and "major" or "minor," was inadequate because "[t]he reader is not told what data the conclusion was based on, or why objective data cannot be provided." 387 F.3d 989, 994 (9th Cir. 2004). Here, the EA fails even to provide a general assessment of water impacts from other jurisdictional pipelines, let alone any objective data, quantified analysis, or reasoned basis for concluding that "the Project and other FERC jurisdictional projects in the area would not have a significant adverse impact on water resources." EA at 2-130. Analysis of cumulative impacts on water resources from gas wells and upstream Marcellus development more generally is likewise inadequate, as it relies almost entirely on compliance with state permitting requirements and other laws to determine that no significant cumulative impacts will result. The flaws in this approach are discussed in greater detail in Section I.F.3, below.

[13] Council on Environmental Quality, "Guidance on the Consideration of Past Actions in Cumulative Effects Analysis" (June 2005) *available at* http://www.nepa.gov/nepa/regs/Guidance_on_CE.pdf.
[14] CEQ, "Considering Cumulative Effects Under the National Environmental Policy Act" (January 1997), *available at* http://ceq.hss.doe.gov/nepa/ccenepa/ccenepa.htm. *See also Kleppe, 427 U.S. at 410, 96 S.Ct. 2718* (requiring single EIS where multiple actions may have "synergistic" effects).

With respect to vegetation and wildlife, the EA provides that "[r]ight-of-way clearing and grading and other construction activities associated with the Project would result in the removal of vegetation; alteration of wildlife habitat; displacement of wildlife; and other potential secondary effects such as increased population stress, predation, and the establishment of invasive plant species." EA at 2-131. The EA concedes that "[w]hen projects are constructed in the same general location and time frame, they could have a cumulative impact on local vegetation and wildlife communities," and notes that further Marcellus development would include "clearing for access roads, well pads, gathering systems, and other facilities." *Id.* But the EA entirely fails to detail or analyze whether Marcellus activities or other related actions might have a cumulatively significant impact on vegetation and wildlife. For example, the EA does not identify the acreage or location of wetlands and forests impacted by related interstate pipelines, or consider how such impacts might have an additive and synergistic impact on vegetation, wildlife habitat, recreation, and aesthetics. Such a discussion is not even perfunctory: it is simply lacking, and is therefore inherently deficient and cannot support the FONSI for this Project.

The EA further concludes, by means of a self-defeating comparison, that the Project will have *no* significant impact on vegetation because Marcellus development will by contrast have an *enormous* impact: "38,000 to 90,000 acres of forest could be cleared in Pennsylvania by 2030 due to Marcellus Shale development activities." *Id.* This information demonstrates that the EA is inadequate, and it in fact supports interveners' contention that the Project will have enormously significant cumulative impacts on the environment, as an integral component in the development of upstream Marcellus Shale activities. Notwithstanding its admissions, the EA does not state any conclusion about the actual significance of the Project's effects on vegetation and wildlife—much less "specific, reasoned conclusions"—nor does it provide hard data justifying a FONSI as to cumulative impacts on those resources.

The absence of reasoned conclusions and quantified data supporting the conclusion of no significant cumulative impacts also is evident in the EA's cumulative impact analysis of land use, visual resources, and recreation. The EA concedes that "[o]ther projects that we considered in the area would affect land use and result in temporary and long term visual impacts, and could impact recreational activities and special interest areas if crossed by the projects." *Id.* at 2-132. It goes on to acknowledge that "[t]he impact of Marcellus Shale development activities on land use, recreation, special interest areas, and visual resources would vary widely depending on the location of specific facilities and access roads." *Id.* However, as in the previous sections, the EA entirely fails to address with even minimal detail or analysis what these varied impacts will likely be, or how they might contribute cumulatively to the Project's impacts. Likewise, the EA only describes in general and abstract terms how expansion of the ROW from 50 to 75 feet—permanently eliminating 78 acres of forest—might impact land use, visual resources, and recreation. *Id.* But an appropriately quantified cumulative impact analysis requires an evaluation of actual environmental effects, not mere recitation of land use statistics. While "[a] calculation of the total number of acres to be harvested in the watershed is a necessary component of a cumulative effects analysis, . . . it is not a sufficient description of the actual environmental effects that can be expected from logging those acres." *Klamath-Siskiyou*, 387 F.3d at 995.

The EA is similarly deficient in assessing the cumulative impact of the Project, together with similar and connected projects, on soils, air quality, noise, socioeconomics, and special interest areas. Because the EA repeatedly fails to analyze the cumulative impacts of the Project together with related actions, and because the information it does provide is not sufficiently quantified or detailed, the EA does not support a FONSI.

3. Instead of Performing an Independent Assessment of Cumulative Impacts, the EA Impermissibly Relies on Compliance with Other Agencies' Permitting Requirements as the Basis for a FONSI.

Throughout the cumulative impacts analysis, FERC staff abdicates its NEPA responsibilities by categorically deferring to standards administered by other agencies, without independently assessing anticipated impacts. *See, e.g., Calvert Cliffs' Coordinating Comm. v. U.S. Atomic Energy Comm'n*, 449 F.2d 1109, 1123 (D.C. Cir. 1971) (holding that lead agency's deferral to standards of other agencies neglected NEPA's "mandated balancing analysis"); *Limerick Ecology Action, Inc. v. U.S. Nuclear Regulatory Comm'n*, 869 F.2d 719, 729 (3d Cir. 1989) (concluding that Nuclear Regulatory Commission's ("NRC's") finding of adequate protection under the Atomic Energy Act ("AEA") does not preclude further consideration of environmental impacts under NEPA). In *Limerick*, a citizens' group challenged the grant of a license to a nuclear power plant based on NRC's violation of NEPA by failing adequately to consider severe accident mitigation design alternatives. *Id.* at 722. NRC rejected consideration of design alternatives because it concluded that a finding of adequate protection of public health and safety under the AEA precluded further analysis under NEPA. *Id.* at 729. The Third Circuit rejected NRC's conclusion:

> The language of NEPA indicates that Congress did not intend that it be precluded by the AEA. Section 102 of NEPA requires agencies to comply "to the fullest extent possible." 42 U.S.C. § 4332. Although NEPA imposes responsibilities that are purely procedural, *see* [*Vermont Yankee Nuclear Power Corp. v. Natural Resources Defense Council, Inc.*, 435 U.S. 519, 558 (1978)], there is no language in NEPA itself that would permit its procedural requirements to be limited by the AEA. Moreover, there is no language in AEA that would indicate AEA precludes NEPA. The legislative history of the phrase "to the fullest extent possible" indicates that Congress intended that NEPA not be limited by other statutes by implication. The proposed language, which was replaced by "to the fullest extent possible" in the current statute, stated that "nothing in this Act shall increase, decrease or change any responsibility or authority of any Federal official or agency created by any other provision of law." [Conf. Rep. No. 765, 91st Cong., 1st Sess. 9-10, *reprinted in* 1969 U.S.C.C.A.N. 2751, 2767, 2770.] The Conference Report stated that "[t]he purpose of the new language is to make it clear that each agency of the Federal Government shall comply with the directives [of section 102] unless the existing law applicable to such agency's operations expressly prohibits or makes full compliance with one of the directives impossible." *Id.* The Report concluded that "it is the intent of the conferees that the provision 'to the fullest extent possible' shall not be used by any Federal agency as a means of avoiding compliance with the directives set out in section 102." *Id.* Hence, the legislative history unequivocally supports LEA's contention

> that the AEA cannot preclude application of NEPA by implication. The Commission in the case *sub judice* does not maintain that the AEA contains express provisions prohibiting compliance with NEPA, nor does it argue that compliance is impossible.

Id. Commenting on the legislative history further, the Court stated that "as suggested by the legislative history, compliance with NEPA is required unless specifically excluded by statute or existing law makes compliance impossible." *Id*. Finally, there are no cases "indicating that exclusion of consideration of an issue under the AEA requires exclusion of the same issue from consideration under NEPA." *Id*.

To the extent that the EA addresses impacts related to gas development, it does not independently assess the impacts from such activities and only points to compliance with other agencies' permitting requirements as a basis for concluding that no significant cumulative impacts exist. *See, e.g.*, EA at 2-129 (noting concerns about potential impacts of natural gas wells on groundwater, then describing in general terms oil and gas well rules adopted by the Pennsylvania Department of Environmental Protection ("PADEP") without further assessment or reasoned conclusion about the cumulative impacts of gas wells and the Project);[15] *id.* at 2-130 (noting that flowback water from fracking operations could threaten water quality but concluding no cumulative impacts exist on the basis that PADEP promulgated regulations addressing the issue and PADEP required operators to implement [best management practices] during construction and operation of upstream facilities); *id.* at 2-133 (conceding that "[o]peration of the Project, Marcellus Shale drilling activities, and other projects would also contribute cumulatively to existing air emissions" but dismissing these impacts on the grounds that the "[t]he Project's associated operating emissions would be mitigated by federal, state, and local permits and approvals).

Such blind acceptance of presumed compliance with standards implemented by another agency as a basis for a FONSI does not suffice as a hard look under NEPA. In *Calvert Cliffs'*, the Atomic Energy Commission ("AEC") promulgated rules governing environmental review in licensing decisions, which similarly would have allowed the AEC to accept a project's compliance with the environmental requirements implemented by other agencies as a showing that the project would have no significant impacts for purposes of NEPA. *See Calvert Cliffs'*, 449 F.2d at 1122. The D.C. Circuit rejected this approach:

[15] Since adoption of the new rules, there have been repeated reports of methane migration into streams and groundwater serving water wells in areas of active gas drilling, including in Bradford and Lycoming Counties. *See, e.g.*, Associated Press, *Pa. Probes Gas in Lycoming Wells* (June 17, 2011) (noting contamination of wells, Little Muncy Creek, and the Susquehanna River), *available at* http://www.philly.com/philly/business/124054549.html. Moreover, a cursory review of violations posted on PADEP's website shows that noncompliance with legal requirements is rife within the industry. *See, e.g.*, PADEP, Oil and Gas Inspections, Violations, Enforcement (Jan.–Apr. 2011), *available at* http://www.dep.state.pa.us/dep/deputate/minres/oilgas/OGInspectionsViolations/2011/2011MarcellusViolations.xls, (revealing, for example, that an operator named "Alpha Shale Res LP" received a notice of violation on February 18, 2011 for "failure to implement Special Protection BMPs for HQ [High Quality] or EV [Exceptional Value] stream.") Plainly, the regulations alone are inadequate to protect underground sources of drinking water.

> Certification by another agency that its own environmental standards are satisfied involves an entirely different kind of judgment [than the case-by-case balancing judgment mandated by NEPA]. Such agencies, without overall responsibility for the particular federal action in question, attend only to one aspect of the problem: the magnitude of certain environmental costs. They simply determine whether those costs exceed an allowable amount. Their certification does not mean that they found no environmental damage whatever. In fact, there may be significant environmental damage (*e.g.*, water pollution), but not quite enough to violate applicable (*e.g.*, water quality) standards. . . . The only agency in a position to make [the balancing] judgment is the agency with overall responsibility for the proposed federal action . . . .

Id. at 1123. As the court pointed out, permitting requirements "essentially establish a *minimum condition*" for approval of a project, *id.* at 1125 (emphasis in original), and do not necessarily indicate whether a project's impacts will be significant as understood in the NEPA context. Moreover, AEC's "abdicati[on] entirely to other agencies' certifications, neglected the mandated balancing analysis," which had the effect of precluding the public from "raising a wide range of environmental issues in order to affect particular Commission decisions," and thereby "subverted" NEPA's "special purpose." *Id.* at 1123. Deferral to the standards of other agencies, without further analysis, is an impermissible delegation of an agency's NEPA responsibilities.

Here, the EA subverts NEPA's purpose by repeatedly pointing to oil and gas well permitting standards as reason for concluding that the Project will have no significant cumulative impacts when considered in the context of Marcellus Shale gas development. *See, e.g.*, EA at 2-129 (noting that during construction, pipeline projects would be required to implement best management practices developed by PADEP, including appropriate erosion and sediment control measures; "[i]mplementation of these measures would avoid or minimize cumulative impacts"); *id.* at 2-130 (noting the "potential impact of Marcellus Shale development on surface water resources" and concluding that recent regulations by Susquehanna River Basin Commission ("SRBC") suffice to "protect surface and groundwater resources from potential impacts associated with the development of the Marcellus Shale"); *id.* at 2-133 ("[I]t is anticipated that Marcellus Shale development activities would result in increased long-term emissions of criteria pollutants, HAPs, and GHGs within the region." However, the Project's emissions would be mitigated by federal, state, and local permits and approvals, and thus, it is not "anticipated to contribute to the cumulative impact."). The EA fails to recognize, however, that gas well development is not even subject to the requirements on which the FERC staff relies for its unfounded conclusions. *See* 25 Pa. Code § 102.5 (exempting oil and gas activities on less than five acres from obtaining an erosion and sedimentation permit); *id.* § 102.14 (exempting oil and gas activities from riparian buffer requirements "so long as any existing riparian buffer is undisturbed to the extent practicable"); 25 Pa. Code § 127.14(a)(8) (exempting most oil and gas exploration and production facilities and operations that include wells and associated equipment and processes from obtaining air permits[16]). Additionally, under *Limerick*, the EA's reliance on other agencies' regulations does not supplant the requirement for thorough NEPA analysis.

[16] The regulation allows PADEP to exempt "sources and classes of sources determined to be of minor significance by the Department." 25 Pa. Code § 127.14(a)(8). PADEP published a guidance that lists the sources (including the

Moreover, even if environmental requirements did apply and effectively mitigated impacts from any single project, categorical reliance on compliance with such requirements for a FONSI for the Project would fail to constitute a hard look for the reasons identified by the D.C. Circuit in *Calvert Cliffs'*. The permit requirements of individual agencies establish minimum standards regarding specific resources that typically are applied to specific projects in isolation from each other. Relying on compliance with such requirements, without providing an independent assessment of impacts and quantified information to support a detailed and reasoned conclusion, fails to satisfy NEPA and prevents the public from understanding the full cumulative impacts of the Project.

G. The Project May Adversely Affect Several Endangered and Threatened Species and Their Habitat.

Federal agencies must consider the "degree to which the action may adversely affect an endangered or threatened species or its habitat that has been determined to be critical under the Endangered Species Act of 1973" when assessing whether an action is significant. 40 C.F.R. § 1508.27(b)(9). Recognizing that "NEPA cases have generally required agencies to file environmental impact statements when the . . . action would be environmentally 'significant,'" the Supreme Court has linked adverse effects on endangered species with significance under NEPA, concluding that "the loss of *any* endangered species has been determined by Congress to be environmentally 'significant.'" *Tennessee Valley Auth. v. Hill*, 437 U.S. 153, 188 (1978) (emphasis added). Therefore, Congress's prioritizing of conservation suggests that an effect on endangered species can be enough in and of itself to constitute a significant action.

Thorough and complete survey data is especially important when assessing an action's impact. The Ninth Circuit has held that incomplete survey information mandates an EIS: "*an EIS is mandated* where uncertainly may be resolved by further collection of data or where the collection of such data may prevent 'speculation on potential . . . effects.'" *NPCA*, 241 F.3d at 734 (emphasis added). Furthermore, surveys should be completed early in the process when possible so that the risk to species may be assessed most effectively. *N. Slope Borough v. Andrus*, 642 F.2d 589, 608 (D.C. Cir. 1980). This is because, "[t]he earlier in the progress of a project a conflict (between a species and the project) is recognized, the easier it is to design an alternative consistent with the requirements of the act, or to abandon the proposed action . . . . The relevant statutes-ESA, NEPA . . . all insist on foresight." *Id.* (internal citations omitted). For the Eastern District of California, the absence of updated species survey data was enough to "render[] the overall conclusions uncertain." *Klamath-Siskiyou Wildlands Ctr. v. U.S. Forest Serv.*, 373 F. Supp. 2d 1069, 1080-83 (E.D. Cal. 2004). Without "*updated* . . . survey data" there is no way to know the full effects on the species: "effects of the project [are] highly uncertain and involve unknown risks which could be resolved by updated protocol surveys." *Id*. (emphasis added). The court held that the effect was potentially significant, "particularly in light of the lack of data regarding the current number and dispersal of owls within the project area." *Id*. Therefore, incomplete survey information on the effects for endangered species cannot be relied upon to support a FONSI; instead, a lack of thorough data strongly supports the need for an EIS.

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exemptions for natural gas activities) to be exempt from obtaining air permits under this regulation. BUREAU OF AIR QUALITY, PA. DEP'T OF ENVTL. PROTECTION, AIR QUALITY PERMIT EXEMPTIONS, at 6–7 (2003).

District courts have weighted the ninth CEQ factor heavily. The likelihood that a project may affect an endangered species due to direct disturbance, disruption of breeding, and fragmentation of habitat is "an important factor supporting the need for an EIS." *Klamath-Siskiyou,* 373 F. Supp. 2d at 1081. Complete extirpation of a species has not been required, and the "project need not jeopardize the continued existence of a threatened or endangered species to have a 'significant' effect on the environment." *Id.* at 1080. (citing *Greater Yellowstone Coalition v. Flowers,* 359 F.3d 1257, 1275–76 (10th Cir.2004)). "Viability is a standard under the ESA and the NFMA, not under NEPA." *Id.* Furthermore, courts have required careful analysis and not just conclusory statements: "mere perfunctory or conclusory language [in an EA] will not be deemed to constitute an adequate record and cannot serve to support the agency's decision not to prepare an EIS. *Citizen Advocates for Responsible Expansion, Inc. (I-Care) v. Dole*, 770 F.2d 423, 434 (5th Cir. 1985).

Destruction of an endangered or threatened species' habitat is also important when assessing a project's impact. The Ninth Circuit has held that parallel habitat conservation projects do not "stand in for the loss of designated critical habitat and found a determination that habitat loss would not adversely modify critical habitat for the Northern Spotted Owl arbitrary and capricious. *Gifford Pinchot Task Force v. U.S. Fish & Wildlife Serv.*, 378 F.3d 1059, 1076 (9th Cir. 2004), *amended by* 387 F.3d 968 (9th Cir. 2004). Destruction of "a significant percentage of the suitable habitat . . . is an important factor supporting the need for an EIS." *Klamath-Siskiyou,* 373 F. Supp. 2d at 1081. Destruction of large portions of a species' habitat can "have an impact on that species which is 'significant' under any reasonable definition of that term" and "local extirpation can be a significant impact." *Sierra Club v. Norton*, 207 F. Supp. 2d 1310, 1326-27 (S.D. Ala. 2002). Species do not need to be found directly in the project area to be considered: where an agency failed to analyze impacts to species which were in the "vicinity" of a proposed airport, a finding of no significant impact on species "*strain[ed] credulity*." *California v. U.S. Dept. of Transp.*, 260 F. Supp. 2d 969, 978 (N.D. Cal. 2003) (emphasis added).

Finally, although mitigation plans have been used in the past to avoid preparing an EIS, courts have a high standard for what constitutes a sufficient mitigation plan. Mitigation measures must be thoroughly "developed" and "more than a 'mere listing' of measures." *NPCA*, 241 F.3d at 734; s*ee also Ohio Valley Envtl. Coal. v. Hurst*, 604 F. Supp. 2d 860, 889 (S.D.W. Va. 2009); *Klamath-Siskiyou,* 373 F. Supp. 2d at 1085. "Where an agency has not even studied the potential effectiveness of mitigation measures, and there is a 'paucity of analytic data' to support its conclusions, it may not rely on those measures in finding no significant impact." *NPCA*, 241 F.3d at 734. An agency may not "act first and study later." *Id.* A "decision to issue a FONSI in reliance on mitigation plans that had not even been defined, much less analyzed, [is] arbitrary and capricious." *W. Land Exch. Project v. U.S. Bureau of Land Mgmt.*, 315 F. Supp. 2d 1068, 1091-92 (D. Nev. 2004). Therefore, mitigation plans must be thoroughly analyzed to be valid.

The FWS identified four federally listed threatened or endangered species and one other federally protected species within the Project area, including the Indiana bat, the bog turtle, and the dwarf wedgemussel. For each of these species, the EA cites to incomplete survey results. For the surveys that do exist, the EA consistently fails to describe survey methodology or to

analyze any data. Furthermore, the EA repeatedly acknowledges habitat destruction but fails to carefully examine its impact, and where mitigation plans are in place, the EA barely discusses them. Instead, it describes the plan briefly, with no analysis of how much mitigation will be achieved. Therefore, the EA fails to take a hard look at the effect of threatened and endangered species, and it cannot support a FONSI.

1. Indiana Bat

The inadequacy of survey results is particularly apparent for the Indiana bat, a federally endangered species which has been found within the Project area. EA at 2-49. Loop 325 is "within foraging range of a known maternity colony of Indiana bat"; moreover, a bat was captured along Loop 321 in Pike County, Pennsylvania. *Id.* Yet despite the likely presence of bats, the surveys completely avoided the area of the proposed route around the Delaware Water Gap National Recreation Area ("DWGNRA") and portions of Loop 321. EA at 2-49. The omission of key regions of potential bat habitat from the surveys drastically undercuts their reliability. When considered in conjunction with the fact that additional survey reports are still not pending, the amount of uncertainty in regard to this endangered species is astounding (see Part II.G.D, *supra*). The EA does not discuss mitigation in depth, but recommends that TGP file "final mitigation plans for forest resources in the Highlands Preservation Area and on state-owned lands" to specify trees suitable for the Indiana bat roost habitat. EA at 2-50. It also recommends that FERC complete any necessary section 7 consultation once these surveys are filed. *Id.*

The EA provides absolutely no information about survey methodology, and this lack of transparency generates a certain amount of skepticism. Regardless of the methodology, however, the results of the surveys which have been conducted should be viewed with skepticism because of the dire situation of the species. Dr. DeeAnn Reeder, a prominent bat biologist and professor at Bucknell University, has critiqued other bat surveys because bats in the Northeastern US are "under assault" from both wind turbines and a "deadly emerging infectious disease 'White Nose Syndrome' (WNS)." Comments of DeeAnn M. Reeder, Ph.D. (hereinafter "Reeder Comments"), included in Earthjustice Comments on Environmental Assessment of MARC I Hub Line Project, Docket No. CP10-480-000 (hereinafter "EJ Comments") (annexed as Exhibit C hereto). Even if there had been no bats found in the project area, the failure to detect individual members of an endangered species facing the additional stress of White-Nose Syndrome ("WNS") would not be surprising and would not support a FONSI on this imperiled species. Reeder Comments. There has been a seventy-two percent decline in the Indiana bat population in recent years, attributable in large part to the spread of WNS, and "detection of this already rare species has become even more difficult." *Id.* Dr. Reeder calls their decline a "wildlife disaster of unprecedented proportions" and affirms that because of the low numbers of the species, "standard survey methods will be completely inadequate." *Id.*

The FWS guidelines for netting Indiana bats support Dr. Reeder's position: "Although the capture of bats confirms their presence, failure to catch bats does not confirm their absence. There are many instances in which the netting effort was as extensive as outlined below and Indiana bats were caught only with additional effort." United States Fish and Wildlife Service, Guidelines for Netting Indiana Bats 1 (1997). The surveying should not be mistaken to

conclusively determine effect on a population: "[a] typical mist net survey provides insufficient data to determine population size or structure. It is an attempt to determine presence or probable absence of the species." *Id.* The guidelines cite a number of conditions, including inclement weather, kind of equipment, and moonlight conditions that can influence the presence or absence of bats in the mist nets. *Id.* at 2. With no detailed information about the methodology of the survey, it is not possible to assess the validity of the information. However, given the fact that a bat was found, and that even the failure to find a bat would not be indicative of a bat's absence, the surveys raise considerable questions about the extent of the bat population and how critical this habitat is for the Indiana bat. Thus, the EA's consideration of the Project's impact on bats is inadequate and cannot support a FONSI.

In addition to the inadequacy of survey results, the EA's treatment of habitat destruction and mitigation measures is insufficient. For the eastern 2.5 miles of proposed Loop 325, the FWS recommends "a seasonal restriction on tree clearing", "minimizing the acreage of tree clearing", "flagging and preferentially preserving high-quality potential roost trees", ant that TGP provide a plan for minimizing habitat impacts around the known maternity colony." EA at 2-49. FERC's "recommendation" to TGP, however, does not account for all of these issues. Though TGP has committed to a seasonal restriction of vegetation clearing "within 2.5 miles of known roosts or capture sites from April 1 to September 30, it has not committed to the additional aspects of the FWS' recommended mitigation measures." EA at 2-49. Notably, FERC does not mandate any plan for minimizing habitat impacts around the known maternity colony. Although FERC alludes to a plan of tree planting schedules, which it says will "minimize impacts on forested areas" there is no evaluation of the lasting impact of habitat destruction. EA at 2-50. The inadequacy of survey results, lack of habitat destruction analysis, and the lack of adequate mitigation measures indicate that the finding of no significant impact for bat species is unsupported.

2. Bog Turtle

The bog turtle is a federally threatened turtle that has the potential to occur within the project area. Although TGP completed some bog turtle surveys, the methodology is not included in the EA, which only indicates that visual presence/absence surveys were performed in four of the six wetlands and no bog turtles were found. EA at 2-48. However a Phase I survey of the remaining portion of Loop 323 which was conducted in October 2011 "is pending." EA at 2-48. FERC admits that "consultation [is not] concluded until the FWS reviews the remaining Phase I and Phase II survey reports . . . . . Further consultation would be necessary if the remaining survey reports document the presence of bog turtles or bog turtle habitat." *Id.* Therefore, FERC makes a "recommendation" to TGP that it not begin construction of Loop 323 until 1) TGP files the results of the surveys with the New Jersey field office of the FWS and the Secretary; 2) FERC completes "any necessary section 7 consultation with the FWS" and 3) TGP receives "written notification from the Director of OEP that construction and/or use of mitigation (including implementation of conservation measures) may begin." *Id.* FERC's framing here and throughout the EA as "recommendations" what should be necessary preconditions casts doubt on whether measures to mitigate harms to the species in the project area will ever be undertaken. Although the pipeline crosses key potential habitat for the bog turtle, FERC has not demanded or

received complete survey results, nor has it sufficiently addressed habitat destruction or mitigation measures to justify its FONSI.

3. Dwarf Wedgemussel

The dwarf wedgemussel is a federally endangered freshwater mussel which "has been known to inhabit the Delaware River [near the project area and] . . . has *known occurrences* in the location where Loop 317 and Loop 323 cross the Susquehanna River, Wyalusing Creek, and the Delaware River" EA at 2-50 (emphasis added). In New Jersey, the EA cites to "only a few known occurrences including one along a portion of the upper Delaware River and at a location downstream of Big Flat Brook." *Id.* Despite the EA's reference to these known occurrences of the dwarf wedgemussel, TGP's surveys revealed "[n]o live or dead specimens . . . during the survey efforts." The EA concludes that no additional surveys are needed "as long as the crossing of the Delaware River can be completed using the HDD crossing method." *Id.* Furthermore, though TGP has thus far failed to complete surveys for a 2.9 mile segment of Loop 323, FERC prematurely concludes that the Project is not likely to adversely affect the dwarf wedgemussel. EA at 2-51.

Without disclosing any methodology for the survey, the EA concludes that there is an absence of dwarf wedgemussel, despite the fact that it refers to known occurrences of the endangered species in the Project area. *See* EA at 2-50-51. Moreover, the reliance on the HDD crossing to justify a lack of additional surveying is premature because "TGP has not developed a contingency crossing method for the Delware River HDD crossing." EA at 2-16. Should a problem occur with the HDD crossing, the EA suggests that there could be additional adverse effects on dwarf wedgemussel. Moreover, although the EA acknowledges that a frac-out, the accidental release of drilling mud into the water, could "affect fisheries or other aquatic organisms by settling in and temporarily inundating the[ir] habitats," it does not discuss any mitigation measures to address and minimize the potential for habitat destruction. EA at 2-18.

The Ninth Circuit has ruled that an EIS is mandated where uncertainty may be resolved by further collection of data. *NPCA*, 241 F.3d at 734. The inadequacy of survey results for the dwarf wedgemussel, as well as the Indiana bat and the bog turtle ignores this circuit court decision. Moreover, courts have encouraged surveys to be completed early in the process. *See N. Slope Borough*, 642 F.2d at 608. The survey deficiencies for each of these endangered species leave a great deal of uncertainty regarding the effect on imperiled species. Therefore, the EA has not sufficiently considered the potential effect of the project on endangered and threatened species.

Not only did the EA fail to provide complete survey data and adequate mitigation plans, but TGP also obscured crucial reports concerning wildlife species of concern. TGP requested privileged and confidential treatment for the following essential wildlife surveys:

- New Jersey Freshwater Mussel Survey
- New Jersey Timber Rattlesnake Survey
- New Jersey Red-Shouldered Hawk and Barred Owl Surveys
- New Jersey Bog Turtle Survey

- New Jersey Red-Headed Woodpecker and Golden-Winged Warbler Survey
- The final Timber Rattlesnake Den Habitat Survey Report for Pennsylvania, dated October 21, 2011
- The final Indiana Bat and Eastern Small-Footed Bat Mist Net Survey, Hibernacula Searches, and Habitat Assessments, dated October 20, 2011, submitted to the U.S. Fish and Wildlife Service - Pennsylvania Field Office
- The final Indiana Bat and Eastern Small-Footed Bat Mist Net Survey, Hibernacula Searches, and Habitat Assessments, dated October 20, 2011, submitted to the Pennsylvania Game Commission
- Wood Turtle Habitat Assessment and Survey for New Jersey

On November 9, 2011, intervenors filed a letter requesting that TGP's applications for privilege be denied because they were legally insufficient under 18 C.F.R. § 388.112. As stated in the November 9, 2011 letter, any claim that information warrants confidential treatment requires a statement requesting such privilege "for *some or all* of the information in a document," and must articulate "the *justification* for *special treatment* of the information." 18 C.F.R. § 388.112(b) (emphasis added). However, TGP did not present an affirmative argument as to why it should be granted the "special treatment", *id.*, of confidentiality, nor did it indicate whether the alleged need for confidentiality extended to the entire document or only to certain sections which can be redacted and subsequently released. As an intervenor in this matter, we should have been entitled to review the updated reports; similar studies have been released to intervenors in other dockets, including but not limited to Docket # CP10-80-000 (the Marc I Pipeline). Therefore, our ability to review and comment on the EA has been limited, and we reserve the right to comment further on the impact to species of concern.

H. It Is Reasonable to Anticipate that the Project Will Threaten a Violation of Federal, State, and Local Law Requirements Imposed for the Protection of the Environment.

Finally, the potential for the Project to "threaten[] a violation of Federal, State, or local law or requirements imposed for the protection of the environment" calls for a finding of significance. 40 C.F.R. § 1508.27(b)(10). This factor requires agencies to consider, among other laws, "state requirements imposed for environmental protection to determine whether the action will have a significant impact on the human environment." *Sierra Club v. U.S. Forest Serv.*, 843 F.2d 1190, 1195 (9th Cir. 1988). In *U.S. Forest Service*, the Forest Service failed to address whether or not timber sales would increase sedimentation and turbidity in a local stream and therefore potentially violate California's water quality standards. *Id.* The Ninth Circuit viewed the EA's failure to address the impact of logging on state water quality standards as a violation of 40 C.F.R § 1508.27(b)(10). *Id.* The court concluded that, "substantial questions [were] raised concerning the potential adverse effects of harvesting these timber sales, [and] an EIS should have been prepared." *Id.* Notably, no actual violation needs to be proven to necessitate an EIS, merely the potential for a violation. *See, e.g., U.S. Forest Serv.*, 843 F.2d at 1195. This threat is "forward-looking," meaning that it deals with prospective violations and does not require proof of past violations. *See Sierra Club v. Van Antwerp*, 661 F.3d 1147 (D.C. Cir. 2011). Therefore, the risk that a law may be broken in the future weighs in favor of an EIS.

When considering the possibility that the Project will threaten a violation of legal requirements, it is relevant that TGP is making the same promises and representations in its EA for the Northeast Upgrade Project that it made, and subsequently failed to implement, in the EA for the 300 Line Project. In the 300 Line EA, for example, TGP indicated that it intended to exclusively use dry cut, rather than open-cut, construction methods for waterbody crossings where there was perceptible flow. One of many such claims which were interspersed throughout the EA was that:

> [t]he greatest potential impacts of construction on surface waters would result from an increase in sediment loading and turbidity. The highest levels of sediment would be generated by use of the wet open-cut method. However, as noted above, TGP would not utilize the wet open-cut method to cross any waterbodies with perceptible flow at the time of the crossing.

300 Line EA at 2-19. In the EA for the Northeast Upgrade Project, TGP makes an identical promise:

> [t]he greatest potential impacts of construction on surface waters would result from an increase in sediment loading and turbidity. The highest levels of sediment would be generated by use of the wet open-cut method. However, as noted above, TGP would not use the wet open-cut method to cross any waterbodies with perceptible flow at the time of the crossing, unless a dry crossing is impractical due to site-specific conditions.

EA at 2-17. Despite the repeated claim that use of the open-cut method would be minimized in the 300 Line Project, TGP did not follow through with that promise, specifically at the West Branch of the Lackwaxen in Pike County, where a wet open-cut crossing method was utilized, thus adversely impacting the ecosystem in ways that were not addressed in the 300 Line EA. NJDEP warns that "FERC should be aware that TGP's planned crossing methods are know [sic] to change during the review process increasing the likelihood of additional environmental impacts to threatened and endangered species habitat and increased turbidity for aquatic biota, oval water quality, and water supply." NJDEP Comments on the EA at 16, para. 5. The fact that TGP has made identical guarantees in the past and has failed to adhere to them weighs heavily against its credibility. TGP's past conduct is particularly relevant in assessing the risk that the Northeast Upgrade Project will violate the Clean Water Act, the Federal Safe Drinking Water Act, and the Pennsylvania Clean Streams Act, discussed in Parts I.H.6-8 *infra*. It is also relevant to the evaluation of the threat to endangered species, such as the dwarf wedgemussel, which depends on the successful implementation of the HDD crossing method. *See* Part II.G.3 *supra*; EA at 2-50 (concluding that no additional surveys for the species are needed "as long as the crossing of the Delaware River can be completed using the HDD crossing method"). TGP's past conduct, therefore, can be relevant to the consideration of the risk of violating the following federal, state, and local regulations.

1. Endangered Species Act

At the Federal level, the Endangered Species Act of 1973 ("ESA") recognizes the "esthetic, ecological, educational, historical, recreational, and scientific value" of species threatened with extinction and declares that it the "policy of Congress that all Federal . . . agencies shall seek to conserve endangered species and threatened species." 16 U.S.C. § 1531. Conservation is not passive; rather, it is "the use of all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to [the Act] are no longer necessary." 16 U.S.C. § 1532(3). The ESA further requires that critical habitat not be destroyed or adversely modified. 16 U.S.C. § 1536(a)(2). It is Congress's express purpose that federal agencies should prioritize conservation of endangered and threatened species. *Id.*

The Supreme Court has recognized an agency's responsibility to protect wildlife as national policy. Congress's intent in enacting the ESA was "to halt and reverse the trend towards species extinction, whatever the cost." *Tennessee Valley Authority v. Hill*, 437 U.S. 153 (1978) (emphasis added). The Act's legislative history

> reveals an explicit congressional decision to require agencies to afford first priority to the declared national policy of saving endangered species. The pointed omission of the type of qualifying language previously included in endangered species legislation reveals a conscious decision by Congress to give endangered species priority over the "primary missions" of federal agencies . . . . [T]he plain language of the Act, buttressed by its legislative history, shows clearly that Congress viewed the value of endangered species as "incalculable."

Id. at 184–86. In *Tennessee Valley*, the Supreme Court stopped a nearly-finished dam project because of a threat to the critical habitat of the snail darter. *Id.* The decision in this case "made abundantly clear that [the] ESA mandates affirmative preservation of endangered life" and "is a potent environmental control." *N. Slope Borough v. Andrus*, 642 F.2d 589, 607 (D.C. Cir. 1980). Subsequently, district courts have cited the Supreme Court's language when addressing a defendant's need "to place the Indiana bat, an endangered species, at the top of its priority list." *House v. U.S. Forest Serv., U.S. Dept. of Agric.*, 974 F. Supp. 1022, 1027-28 (E.D. Ky. 1997). The ESA is a powerful Federal law that prioritizes the preservation of the environment, and agencies are compelled to consider it thoroughly when assessing an action's significance.

As mentioned above, a number of federally endangered species including the Indiana bat, the bog turtle, and the dwarf wedgemussel are potentially affected by this project, both directly and indirectly through habitat destruction and fragmentation, not to mention disruption from noise and potential impacts on food supply. Part II.G, *supra*, describes in detail the potential for implicating the ESA. In addition to the federally listed species, the FWS has requested FERC consider the effects on four federally petitioned species so that section 7 consultations can be facilitated if they become listed before Project construction: the Eastern small-footed bat, Northern long-eared bat, golden-winged warbler, and the American eel. The potential that so many endangered species will be affected, coupled with the absence of complete survey results for the majority of those species, creates a strong risk of violating the ESA. However, the EA's

treatment of federally petitioned species and their habitats is so cursory that it ignores the threat of a future violation of federal law in relation to these species. The inadequacy of the EA is particularly apparent with regard to the Northern long-eared bat, which was found during mist net surveys. EA at 2-52. Bat biologist and professor Dr. Reeder emphasizes that "[a]t our current population levels, every single bat is important to preserving the species." Reeder Comments. Considering the decline of bat populations in general, it is essential to consider not only the impact of proposed projects on the Indiana bat, but also all bat species:

> Given the extreme declines in bat populations in the northeastern Pennsylvania region, the Mammal Technical Committee of the Pennsylvania Biological Survey has petitioned the Pennsylvania Game Commission to list little brown bats, *northern long-eared bats*, and tricolored bats as endangered. . . . Given the threats facing Indiana bats and other imperiled bat species detected in the Project area, *the welfare of every individual bat is vital to the preservation of these species.*

EJ Comments at 19 (emphasis added). However, the EA ignores the importance of the Northern long-eared bat and provides no evaluation of the expected impact on the species' habitat. Instead, the EA cites to TGP's plan to clear between September 1 and March 31 in Pennsylvania and August 1 and March 14 in New Jersey "to avoid impacts on Northern longeared bats that may roost in the Project area." EA at 2-52. The EA fails to discuss these habitat impacts or how they will be avoided by the clearing schedule, and it fails to acknowledge the relationship between the Northern long-eared bats and the Indiana bat.

The other petitioned species do not fare any better in terms of the depth of analysis they receive in the EA. For example, impacts on the American eel, which is "known to inhabit the Susquehanna and Delaware Rivers" are dismissed as "not anticipated" because of TGP's plan to use a HDD crossing method. EA at 2-52. However, a frac-out, which occurred as recently as May 2011, is not unlikely. *See Pipeline Accident*, supra note 18. Therefore, the EA's failure to evaluate the potential for violating the ESA with regard to currently endangered and petitioned species renders the EA inadequate under NEPA and an EIS should be prepared.

2. The Migratory Bird Treaty Act and the Bald and Golden Eagles Protection Act

The Bald and Golden Eagles Protection Act ("BGEPA") prohibits the taking of "any bald eagle . . . or any golden eagle, alive or dead" as well as any part, nest or egg. 16 U.S.C. § 668. To "take" is defined not only as to "wound, kill, [or] capture" but also to "molest or disturb." 16 U.S.C. § 668c. The Migratory Bird Treaty Act ("MBTA") makes it "unlawful at any time, by any means or in any manner, to . . . take, capture, [or] kill . . . any migratory bird, any part, nest, or egg of any such bird" without a permit. 16 U.S.C.A. § 703. Executive Order No. 13,186 requires agencies to identify "where unintentional take is likely to have a measurable negative effect on migratory bird populations and to avoid or minimize adverse impacts on migratory birds . . . and emphasizes species of concern." EA at 2-44. Violation of the MBTA for taking or killing a migratory bird is a strict-liability offense. *United States v. Apollo Energies, Inc.*, 611 F.3d 679, 684 (10th Cir. 2010). In *Apollo*, oil drilling operators were found in violation of the

act when dead migratory birds were found lodged in a piece of their oil drilling equipment. *Id.* The Tenth Circuit found that birds that died after crawling into the oil equipment to nest could form the basis for a finding that the act had been violated, and that no form of scienter was required. *Id.*

The impact on eagles and other migratory birds has already been demonstrated. As of February 2011, two bald eagle nests have been identified by TGP's field surveys in the project area. EA at 2-53. However, there has been no ultimate evaluation of the impacts on eagle habitat and instead TGP will work with the states "to determine whether potential adverse effects on bald eagle populations and habitat may result from the Project." EA at 2-53. However, NEPA does not permit agencies to "act first and study later." *NPCA*, 241 F.3d at 734. And the Ninth Circuit states unequivocally that the absence of complete survey results is no excuse for incomplete information: "an EIS is mandated where uncertainly may be resolved by further collection of data or where the collection of such data may prevent 'speculation on potential . . . effects.'" *Id.* Therefore, the absence of complete information on the bald eagle suggests at the very least that an EIS is called for.

The EA only indicates that "[t]he greatest potential to impact migratory birds would occur if Project activities . . . take place during the nesting season." EA at 2-44. Citing destruction of nests and mortality of eggs and unfledged young birds, as well as destruction of habitat presenting a "long-term impact for migratory birds that depend on forest" the analysis does not indicate what the impact will be if the work is conducted outside of that timeframe. Although species included in the FWS Birds of Conservation Concern may also occur in the project area, FERC does not address this possibility, merely stating "that the Project is not likely to result in the need to list any migratory birds under the ESA." EA at 2-45. The EA indicates that Pennsylvania and New Jersey Field Offices of the FWS recommended that TGP conduct vegetative clearing "between September 1 and March 31 in Pennsylvania and between August 1 and March 14 in New Jersey." EA at 2-44–45. There is no indication of whether or not these limitations have been included in a FWS permit. The EA's treatment of the laws governing migratory birds is conclusory. Although FERC identifies legal requirements, it indicates only that the greatest impact would occur during nesting season. There is a complete absence of an analysis of the damage to birds and nests outside of nesting season, or the effect on bird habitat and food supply. This failure to thoroughly analyze the law and its requirements, along with the potential impacts of the project on the migratory bird and eagle habitat supports the argument that the EA is inadequate under NEPA.

3. The New Jersey Endangered and Nongame Species Conservation Act, the New Jersey Natural Heritage Program, and the Division of Land Use Regulation

In New Jersey, the Natural Heritage Program (NJNHP) the Endangered and Nongame Species Program, and the Division of Land Use Regulation are responsible for administering state endangered species laws. The Endangered and Nongame Species Conservation Act declares it is New Jersey policy to "insure [the] continued participation in the ecosystem" of all forms of wildlife, that species indigenous to New Jersey should be "accorded special protection" to maintain and enhance their numbers, and that New Jersey should "assist in the protection of

species or subspecies of wildlife which are deemed to be endangered elsewhere." N.J.S.A. § 23:2A-2.

The Project implicates 46 threatened, endangered, and special concern species in New Jersey. Surveys found timber rattlesnakes and northern copperheads in the Project area. EA at 2-55. Timber rattlesnakes have also been located at the Mahwah Meter Station and are expected to be impacted by the Spectra Pipeline. NJDEP Comments at 8. Therefore, in light of the two projects, the timber rattlesnake population is likely to suffer from cumulative impacts which, as discussed *supra* in Part II.F.1, must be taken into consideration under NEPA. TGP indicates that it will use "route deviations" to avoid impacts on these species. However, the EA provides no analysis of the effects of these deviations, nor is any species-specific data included. The mitigation plans, far from being developed, are mere lists, just as the kind of undeveloped "'mere listing' of measures" rejected by the Ninth Circuit. *NPCA*, 241 F.3d at 734. Red-shouldered hawks and barred owls were also observed, with results of the "vernal surveys . . . pending." Additionally, regarding mussel species of concern, TGP says it will use the HDD crossing method to avoid impacts, but in the event of a frac-out would implement other measures. EA at 2-54. Once again, survey results are incomplete and "TGP stated it would conduct field assessments . . . . Results of the habitat assessment are pending." *Id*. at 2-55. A frac-out from HDD of a pipeline is not an unlikely scenario: in fact, one occurred under a Pennsylvania stream in May 2011.[17] Despite the likelihood of a frac-out or of TGP's use of a wet open-cut crossing, however, the EA includes neither an impact analysis nor mitigation plans for the potential effect on the mussel species.

In addition to the risk of violating the above regulations, the EA fails to address other requirements as well. During NJDEP's preliminary screening for threatened and endangered species in the project area, it evaluated areas under the jurisdiction of the Flood Hazard Area control Act and the Freshwater Wetlands Protection Act, which the EA disregards. NJDEP's screening indicated regulated watercourses with suitable habitat either in the Project area or within 1 mile downstream for wood turtle (*Glyptemys insculpta*), bog turtle (*Glyptemys muhlenbergii*), and brook floater (*Alasmidonta varicose*), which are "critically dependant upon the regulated watercourse" and will require a 150' riparian zone. The screening also indicated wetland habitats suitable for State or federally listed species which would require an Exceptional resource value and adjacent transition areas.

The EA concludes that "construction and operation of the project would result in short- and long-term impacts on wildlife and wildlife habitat. These impacts are expected to be minor given the mobile nature of most wildlife in the area, the availability of similar habitat adjacent and near the project, and the compatible nature of the restored right of way with species occurring in the area." EA at 2-44. Heatley rejects this conclusion, finding instead that the project "is likely to present a barrier to movement of sensitive species." Heatley Comments on the EA at 7. NJDEP agrees with Heatley, questioning:

> How can Tennessee Gas determine that either the short- or long-term impacts will be 'minor' to New Jersey's wildlife. Repiles and amphibians show strong site

[17] *See Pipeline Accident, Rain Cited in Buffalo Creek Spill*, PITTSBURGH TRIBUNE-REVIEW (May 12, 2011), http://www.pittsburghlive.com/x/pittsburghtrib/s_736535.html.

> fidelity to critical habitats and home ranges. Destruction of such habitats and/or the widening of the right-of-way (potentially increasing the risk of traveling across the right-of-way) could impact local populations. For rare species and species with delayed maturation and/or low fecundity, this could be detrimental to those local populations; the loss or decline of which could then contribute to genetic isolation.

NJDEP Comments on the EA at 7.

NJDEP concludes that "FERC can not clearly understand the full environmental impact of the proposed project on threatened and endangered species populations and habitat and should not approve the application" until additional materials and review have been completed. NJDEP Comments on the EA at 17, para. 10. The EA makes absolutely no reference to any of these regulations. The effect of the project on species which are critically dependant on the affected area must be evaluated in an EIS.

4. New York Endangered Species Act N.Y.ECL s. 11-0535.

In New York, rare species are protected under the NY Endangered Species Act, N.Y.ECL § 11-0535, which prohibits the "taking" of any endangered or threatened species of fish, shellfish, crustacean or wildlife," without permit. N.Y. Envtl. Conserv. Law § 11-0535. Taking is defined broadly and includes not only killing wildlife but "all lesser acts such a disturbing, harrying or worrying" the animal. N.Y. Envtl. Conserv. Law § 11-0103. A bald eagle was found in the vicinity of the Port Jervis, New York, pipe yard. EA at 2-55. This fact also implicates the MBTA and the BGEPA. See *supra* at Part II.H.2.

Aside from listing that rare species are protected by N.Y.ECL § 11-0535, the EA offers no analysis of which species might be implicated by it or whether or not there is a threat of violating the law with regard to any of the endangered species mentioned. The EA also lists a number of rare plant species, with survey results pending. It does not, however, address whether or not the rare species threaten a violation of the New York law. Instead, it indicates that "[w]here necessary, TGP would transplant individuals to locations outside the construction workspace or permanent right-of-way." EA at 2-56. This kind of conclusory statement is what the Fifth Circuit warned against when it indicated that "mere perfunctory or conclusory language will not be deemed to constitute an adequate record and cannot serve to support the agency's decision not to prepare an EIS." *Citizen Advocates For Responsible Expansion, Inc. (I-Care) v. Dole*, 770 F.2d 423, 434 (5th Cir. 1985). Furthermore, the EA's failure to address the bald eagles found in the vicinity of the Port Jervis pipe yard in relation to the MBTA and the BGEPA, along with the lack of thorough analysis for other species highlights the need for an EIS.

5. Pennsylvania

Pennsylvania also monitors the taking of endangered species. 30 Pa. Cons. Stat. Ann. § 2305. For the reptile, mammal, bird, mussel, and plant species of concern in the Pennsylvania project area, FERC conducts the same superficial treatment in the EA that it has for all endangered species. See generally, EA at 2-53. Although timber rattlesnakes were "documented

along portions of Loop 321," the EA specifies only that "all gestating snakes" were outside of the workspace. Id. However, there is no additional information about the snakes that were not gestating, or what the habitat implications would be. Instead, survey results are still pending, and "TGP stated it would conduct Phase II denning surveys" which have not been completed. EA at 2-54. As for mitigation plans, TGP says only that it will employ snake monitors, conduct daily sweeps, and use route deviations. *Id.* This conclusory treatment of a mitigation plan is far from the level of detail which courts have required under NEPA and again falls under the "mere perfunctory or conclusory language" forbidden by the Fifth Circuit. *Citizen Advocates For Responsible Expansion, Inc. (I-Care) v. Dole*, 770 F.2d at 434.

6. Clean Water Act

Section 401 of the Clean Water Act ("CWA") requires that proposed dredge and fill activities under Section 404 be reviewed and certified by the state agency so that the project meets state water quality standards. The designated state agencies in question are the PADEP and the NJDEP. EA at 2-22. However, there is no extensive analysis of the proposed dredge and fill activities and whether they met state requirements. Instead, FERC relies on the assumption that all permit requirements will be met.

The project would impact 49.1 acres of wetlands, consisting of 24.09 acres of emergent wetlands, 1.9 acres of scrub-shrub wetland, and 22.4 acres of forested wetlands. 5.55 acres of wetlands would be permanently impacted, 5.5 of them forested. EA at 2-25. While FERC includes a table with sensitive water bodies (EA at 2-13), it does not explain in depth the impact of the Project other than to say that it will be crossing the Monksville Reservoir and Valentine Brook, the public water supply in Milford Township. EA at 2-13.

7. Federal Safe Drinking Water Act

The Project would cross four sole source aquifers ("SSA"). These aquifers supply at least 50 percent of the drinking water consumed in the area, and there are few to no alternative drinking water sources that could supply those who depend on it. EA at 2-9. The Northwest New Jersey 15 Basin SSA, which the project will cross, was designated under the Federal Safe Drinking Water Act in June 1988. *Id.* Additionally, the project will impact the NJ Coastal Plain SSA, a principal source of drinking water for Mercer and Middlesex Counties; Loop 323 will pass over the EPA-designated upstream headwater area. EA at 2-9.

Loop 325 would also cross the New Jersey Highlands Planning and Preservation areas, which provide the majority of potable water used in northern and central New Jersey. Plans for mitigation are not described in detail. Instead, they are discussed prospectively: "TGP *would* develop a comprehensive Mitigation Plan for implementation during construction and operation of the Project through the Highlands Region. The Comprehensive Mitigation Plan *would* be submitted as part of a Highlands Applicability Determination and *would* identify the specific water resources that would be affected by the Project and the measures designed to avoid, minimize, and mitigate adverse impacts on water resources." EA at 2-11. The lack of a developed mitigation plan and reliance on a hypothetical future scenario interferes with the ability to assess the impact on drinking water.

The EA acknowledges that the risk of water contamination is real. Thirty-five sites have been identified as hazardous waste sites within 1,700 feet of Loops 323 and 325. EA at 2-11. "Shallow groundwater could be vulnerable to contamination caused by inadvertent surface spills of hazardous materials used during construction." EA at 2-12. Furthermore, "[p]roject construction, including blasting, fueling activities, and accidental spills of hazardous substances could potentially impact the water quality and capacity of nearby water supply wells." *Id.* Despite these observations, the EA speaks only generally about waste contamination: "In general, chemical releases that occurred nearby and upgradient from the Project would be *more likely to* impact the construction work area than would more distant releases or releases located sidegradient or downgradient from the work area. Thus, TGP does not expect to encounter any issues associated with contamination or hazardous waste during construction." *Id.* This logic is flawed. The claim that another potential scenario would be more harmful than the Project does not demonstrate that the current scenario does not have significant adverse environmental impact. Nor does the EA present any evaluation of particular hazardous waste sites or any kind of specific mitigation plan, other than to say that "any impacts on water systems would be repaired." *Id.*

The process for hydrostatic testing is discussed briefly and vaguely: it will require nearly 8 million gallons of water, may use additives and discharge into water sources. *See generally* EA at 2-14. And while the waterbody crossing methods are discussed briefly in the EA and the potential for frac-outs to impact aquatic organisms is discussed, there is no mention of the potential human health impacts of a frac-out. EA at 2-16. Therefore, the EA's lack of attention to the risk of violating the Federal Safe Drinking Water Act indicates that the EA cannot support a FONSI.

8. Pennsylvania Clean Streams Act

The Clean Streams Act makes it unlawful to discharge "any substance of any kind or character resulting in pollution as herein defined." 35 Pa. Stat. Ann. § 691.401. The Tennessee Gas Pipeline Company has already earned a reputation for accumulating up to 45 violations of the Clean Streams Law, documented in ten Pike County inspection reports in September 2011. These 45 violations occurred only from the short time period between June 22 and September 19 and reflect "17 instances in which dirt and sediment were discharged into Pennsylvania waters and pollution was documented . . . seven cases [of] . . . work site conditions that had a potential for water pollution, and 21 examples of failure to implement or maintain effective erosion and sediment best management practices."[18]

In Pennsylvania, the DEP does not assess penalties for violations until after the project is finished. However, the track record of the Tennessee Gas Pipeline does more than threaten that violations will incur. Instead, the repeated culture of violation implies a near certainty that the project will violate clean water laws, and therefore requires the preparation of an EIS.

[18] Beth Brelje, *Pike Conservation Official Fed Up with Gas Company's Violations*, POCONO RECORD, (Sept. 20, 2011), http://www.poconorecord.com/apps/pbcs.dll/article?AID=/20110920/NEWS/109200330/-1/rss01.

9. Fisheries in general

In Pennsylvania, the Project would cross 32 water bodies supporting warm water fisheries and 29 water bodies supporting coldwater fisheries, as well as 25 high quality-designated water bodies, 7 exceptional value-designated water bodies, 1 Class A Trout Stream, and 2 Wild trout designated water bodies in Pennsylvania. EA at 2-19. Pennsylvania affords special protections to high quality or exceptional value water bodies and may designate waters to be managed for trout. *Id.* "In New Jersey, the Project would cross 29 water bodies designated for trout production or trout maintenance that are considered to be coldwater fisheries, and 25 water bodies designated as non-trout that are considered to be warmwater fisheries." *Id*.

FERC identifies the risks to the water from construction, including "direct contact by construction equipment with fish, fish eggs, and other aquatic organisms including fish prey and forage species" as well as the removal of riparian vegetation and the "introduction of pollutants." EA at 2-21. There is also the possibility that construction would "delay migrating fish from reaching upstream spawning areas or delay downstream movement of juveniles." *Id*. However, far from discussing any mitigation methods, the EA merely identifies what the greatest risks will be, including "increased sedimentation" which can impact fish eggs and juvenile fish survival, diversity and health, and spawning habitat. *Id*. Furthermore, the "primary impact" that might take place from a HDD is the release of drilling mud during a frac-out, and "in larger quantities the release of drilling mud into a waterbody could affect fisheries or other aquatic organisms by settling in and temporarily inundating the habitats used by these species." EA at 2-18. Once again, no mitigation measures are discussed sufficiently in the EA.

In Earth Justice's comments on the 300 Line, Susan Beecher, Executive Director of the Pike County Conservation District, stated that there has not been adequate protection for water resources from the sedimentation caused by transmission line construction. Ms. Beecher indicates:

> the transmission line construction process almost guarantees severe water resources impacts because there is too much earth disturbance over prolonged periods to allow for adequate installation and maintenance of erosion and sedimentation controls, timely inspections, and effective enforcement. She notes that standard BMPs are not effective, especially on steep slopes, and that additional protections are needed, such as phased construction of the pipeline. She also has observed that FERC-approved environmental inspectors typically *are inadequate to ensure compliance with Pennsylvania law and regulations*, and she recommends that an *independent* third-party inspector with stop-work authority – ideally CCD staff – be employed to monitor and enforce compliance.

EJ Comments at 18 (first emphasis added).

The EA has done little more than identify the statutes that may apply; it has not indicated whether or not TGP will be in compliance with them. Instead of assuming that TGP will be meeting all permitting requirements, FERC should do a careful investigation of methodology and mitigation measures to ensure not only preservation of important species but also that the project

is in compliance with all federal, local and state clean water laws. Without a more thorough analysis of the potential impacts of the process on laws and regulations, the EA cannot support a FONSI.

For the reasons set forth herein, and in the attached expert reports, intervenors respectfully request that FERC comply with NEPA and prepare an EIS.

Respectfully Submitted,

Susan J. Kraham
Edward Lloyd
Columbia Environmental Law Clinic
Counsel for New Jersey Highlands Coalition
New Jersey Chapter of the Sierra Club
Delaware Riverkeeper Network

_____

By: Susan J. Kraham

EXHIBIT A

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December 19, 2011

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Re: Comments on Environmental Assessment
OEP/DG2E/Gas1, Tennessee Gas Pipeline Company
Northeast Upgrade Project - Docket No. CP11-161-000

Dear Ms. Kraham:

In accordance with your request, Thonet Associates, Inc., *Environmental Planning & Engineering Design Consultants*, provides the Columbia Law School - Environmental Law Clinic with these comments regarding the *Environmental Assessment* for the Tennessee Gas Pipeline Company's proposed Northeast Upgrade Project.

Qualifications of the Preparer of these Comments

The undersigned is the founder and principal of Thonet Associates, Inc., a 31-year old environmental consulting firm located in New Jersey. My professional resume is attached hereto.

Investigations

In preparing the comments contained herein, Thonet Associates reviewed the *Environmental Assessment* (EA) for the proposed project, dated November 2011, including all appendices, prepared by the staff of the Federal Energy Regulatory Commission (FERC) with cooperation and assistance of the US Fish and Wildlife Service and US Army Corps of Engineers.

Comments

Based on review of the *Environmental Assessment* for the Northeast Upgrade Project, Thonet Associates can provide the following comments at this time:

1. Proposed Action:
   a. Introduction:

      The EA's introduction indicates that FERC's principal purposes in preparing the EA document were as follows:

      1) To identify and assess potential impacts of the proposed action on the natural and human environment;
      2) To assess reasonable alternatives to the proposed action that would avoid or minimize adverse effects to the environment; and

3) To identify and recommend specific mitigation measures, as necessary, to minimize environmental impacts.

Section 1508.9 of the President's Council on Environmental Quality (CEQ) regulations adopted pursuant to National Environmental Policy Act ("NEPA" or "the Act") defines *"Environmental assessment" to mean "...a concise [emphasis added] public document for which a Federal Agency is responsible that serves to:*

1) Briefly [emphasis added] provide sufficient evidence and analysis for determining whether to prepare an environmental impact statement or a finding of significant impact;

2) Aid the agency's compliance with the Act when no environmental impact statement is necessary; and

3) Facilitate preparation of a statement when one is necessary.

The definition also indicates that an Environmental Assessment "...shall include brief discussions of the need for the proposal, of alternatives as required by section 102(2)(E), of the environmental impacts of the proposed action and alternatives, and a listing of agencies and persons consulted.

The EA for this project, prepared by FERC, with the assistance of the US Army Corps of Engineers (COE) and the US Fish and Wildlife Service (FWS), is a 250 page document, consisting of 191 pages of text with six (6) attached appendices providing an additional 59 pages of maps, tables and engineering drawings. It is neither "brief" nor "concise" as intended by the regulations.

The voluminous nature of this EA reflects the complexity and magnitude of the project being proposed and its potential to have environmental impacts, all of which needed to be examined in the EA. As a result, the document appears more "EIS-like" than "EA-like," despite the fact that the environmental analyses provided are significantly less than would be provided in a full EIS.

The voluminous nature of the EA, suggests that, by the project's very nature, it is simply too large and complex tor a "Finding of No Significant Impact" (FONSI) without a detailed EIS having been prepared.

In addition, the voluminous nature of the EA, together with the limited amount of time provided for comments, might actually serve to deter public comment, rather than encourage it, which would be, in and of itself, a negative impact upon the process intended by NEPA.

b. Project Purpose and Need:

This section of the EA references 20 pages of USGS maps showing the route of the proposed pipeline and the locations of associated proposed facilities.

The fact that it takes 20 pages of USGS maps to illustrate the location of the project "speaks for itself" in terms of the magnitude of the project and the

many miles and acres of land that would be disturbed in constructing the project.

I reiterate my above conclusion that, by the project's very nature, it is simply too large and complex for a "Finding of No Significant Impact," without a detailed EIS having been prepared.

This section of the EA also indicates that Tennessee Gas Pipeline (TPG) is proposing the Northeast Upgrade Project in order to,

> "...expand the natural gas delivery capacity to the northeast region of the United States by up to 636,000 dekatherms per day (Dth/d)..."
>
> And that,
>
> "...TPG has signed binding precedent agreements with two shippers, Chesapeake Energy Marketing, Inc, and Statoil Natural Gas, LLC, for all of the additional firm transportation capacity resulting from the Project..."
>
> And that,
>
> "TPG contends [emphasis added] that, without construction of the Project, it would be unable to meet the shippers' expressed need for additional capacity on TGP's system."

A review of the EA's references includes no record of any of the EA preparers ever communicating independently with either Chesapeake Energy Marketing, Inc. or Statoil Natural Gas to verify these shippers' reasons and basis for entering into the above-referenced "binding contracts" and no reference to any lawyer independently reviewing just how "binding" those contracts really are.

In addition, I would hasten to point out that the contracts represent a "demand" for the gas transport service that the pipeline would provide. However, "demand," differs significantly from "need."

The EA goes on to state that,

> "...the Project would help alleviate the already constrained pipeline capacity in the region and would contribute to the Commission's goal of transporting more natural gas to markets by providing access to diversified and newly developed natural gas supplies..." and further states that,
>
> "Currently, there is approximately 7 billion cubic feet per day (Bcf/d) of natural gas pipeline capacity on four interstate pipeline systems, including TGP, to transport gas through Pennsylvania into the northeast region of the United States. However, all four pipeline systems, including TGP, are currently fully subscribed in this region during the peak heating season."

A review of the references in the EA reveals that none of the preparers of the EA consulted with (or even named) the other three interstate pipeline systems

that TPG claims are all "fully subscribed in this region during the peak heating season."

Finally, the EA states that,

> "TPG asserts [emphasis added] that increasing natural gas production within Pennsylvania would further exacerbate the constrained pipeline capacity situation in the northeast as natural gas production in Pennsylvania approaches 2.5 Bcf/d in 2011 and is projected to exceed 13 Bcf/d by 2020. According to TGP [emphasis added], volumes delivered into TGP's system from the region have increased from about 25 million cubic feet per day to 1Bcf/d within the last 2 years."

From reviewing all of the above statements contained in the EA, it does not appear that the preparers of the EA independently evaluated the "need" for the proposed project but rather just accepted TGP's assertions in that regard.

In order to properly assess the project's need, the preparers of the EA must not only independently verify TGP's assertions as to "demand" as presented in the EA, they must also examine the trends in energy use over the past five years or so to determine if the need for energy in general, and for natural gas in particular, in the northeast service area, is rising as quickly as represented in the EA, and what other energy companies, other than TGP specifically, and the natural gas industry in general, are doing to meet future energy needs in the Northeast United States. Those other companies could be the source of valid "alternatives" that would render the proposed project unnecessary.

Absent a valid analysis and determination of "need," the EA, as currently presented, fails to meet the EA requirements of Section 1508.9 of the CEQ NEPA regulations and there is simply no justification for imposing the proposed project's environmental impacts over multiple states.

c. Scope of the Environmental Assessment:

In this section of the EA, the preparers of the EA indicate that, during the EA's scoping process, commenter's had expressed concern regarding the environmental impacts associated with producing natural gas from Marcellus Shale. In the EA, FERC acknowledges that,

> "... FERC jurisdictional (interstate) transmission facilities are being built in response to this new source [Marcellus Shale] of gas supply..." and that, "...many production facilities have already been permitted and/or constructed in the region, creating a network through which natural gas may flow along various pathways to local users or the interstate pipeline system, including TGP's existing 300 Line system."

The EA goes on to state that,

> "...We have identified existing and proposed Marcellus Shale production facilities in proximity to the Project and have considered them within the context of cumulative impacts in the Project area..."

What this means is that the impacts associated with producing natural gas from Marcellus Shale were not evaluated except to the limited extend discussed in Section 2.10, Cumulative Impacts of the EA.

In Section 2.10, the EA indicates that in 2005 only about 0.5 Bcf/day of natural gas was being produced in Marcellus Shale projects in Pennsylvania but that as development of Marcellus Shale continues, Pennsylvania forecasts 7.5 Bcf/day by 2015 and 13.4 Bcf/day by 2020.

The EA also reports that the USGS estimates that Marcellus Shale contains a technically recoverable mean of 84 trillion cubic feet (tcf) of natural gas and also reports that the United State's currently utilizes approximately 23 tcf of gas and concludes that Marcellus Shale represents a significant natural gas deposit in close proximity to the high population centers of northeastern United States."

However, FERC claims it has no jurisdiction over "upstream" production facilities for extracting natural gas from Marcellus Shale and readily acknowledges that,

> "...we do not examine the impacts of Marcellus Shale upstream facilities to the same extent as the Project facilities in this EA..." and that "...A more specific analysis of Marcellus Shale upstream facilities is outside the scope of this analysis because the exact location, scale, and timing of future facilities are unknown. In addition, the potential cumulative impacts of Marcellus Shale drilling activities are not sufficiently causally related to the Project to warrant the comprehensive consideration of those impacts in this EA."

I must respectfully disagree. Interstate gas pipelines are the interstate "highways" for gas "transport" between states.

Much the same as federal interstate highways have been shown to promote "sprawl" development throughout the United States with significant environmental and energy-related impacts associated with that sprawl, interstate gas pipelines that service potential Marcellus Shale production areas similarly encourage the development of upstream Marcellus Shale projects, and all of the environmental impacts associated with those developments.

Both Chesapeake Energy Marketing, Inc. and Statoil Natural Gas are involved, both jointly and severally in the production of natural gas from Marcellus Shale in Pennsylvania.

Accordingly, while the Marcellus Shale projects themselves are not within FERC's jurisdiction, the impacts of those projects that will be served by TGP's interstate gas pipeline should be examined because without the interstate pipeline, the incentive to mine gas from Marcellus Shale for out-of-state export, would simply not exist. It is the pipeline itself that would be promoting

the Marcellus Shale drilling, and the pipeline should not be constructed if it results in significant negative impacts, including secondary impacts.

The "need" cited by TGP for the proposed pipeline appears to be solely based on TGP's contracts with two large energy companies, Chesapeake Energy's and Statoil Natural Gas, and the natural gas is undoubtedly coming from Marcellus Shale natural gas production facilities that are projected to be completed in Pennsylvania in the future.

Thus, the TGP pipeline is just one element of a Marcellus Shale gas production/transport system to provide out-of-state energy users with Marcellus Shale produced natural gas from instate, in this case, from Pennsylvania.

The entire jurisdictional interstate pipeline project is indeed being driven by the "projected" demand that would be generated by natural gas production from Marcellus Shale in Pennsylvania. The preparers of the EA specifically acknowledge this fact in Section 1.6 of the EA entitled "Nonjurisdictional Facilities."

In my professional opinion, Marcellus Shale natural gas production is inextricably linked to the TGP's interstate pipeline proposal. Therefore, since studying the impacts of interstate pipelines is within FERC's jurisdiction and the pipeline itself, without question, will encourage additional Marcellus Shale mining for natural gas in Pennsylvania for export to other states, the secondary impacts associated with Marcellus Shale development are indeed an impact associated with the interstate pipeline and thus should be included in an EIS for this project.

Absent inclusion of the potentially major environmental impacts that the proposed interstate pipeline would cause by encouraging and supporting natural gas development and production from Marcellus Shale, the EA is simply incomplete.

d. Proposed Facilities:

The EA describes the proposed facilities as follows:

1) Below grade construction:

The construction of 40.3 miles of new 30-inch diameter pipeline loop segments in five separate segments located in Bradford, Wayne and Pike Counties within Pennsylvania and Sussex, Passaic and Bergen Counties in New Jersey. 46 percent (18.5 miles) of the pipeline loops would be located in New Jersey with the remaining 54 percent (21.8 miles) located in Pennsylvania.

84 percent of the pipeline loops would be collocated within TGP's existing 24-inch-diameter 300 Line pipeline (33.8 miles), with the remaining 16 percent (6.4 miles), known as Loop 325, to be constructed outside of the existing rights-of-way, within the "Preservation Area" of the New Jersey

Highlands region, including installation of more than one-half mile of pipeline loop below and across Monksville Water Supply Reservoir.

The EA indicates that an alternative that would completely avoid the Highlands region is not feasible.

However, a viable alternative, rejected by FERC, does exist. That alternative, while substantially longer, could be constructed to minimize impact to the Highlands Region. This alternative would also eliminate the need to install the pipeline directly under Monksville Reservoir.

FERC's reason for rejecting this alternative was that it was not environmentally preferable to the proposed route since it was longer and impacted similar resource areas in New Jersey and New York.

Unlike the EA's other reviews of alternative routes, no detailed comparison of the environmental impacts of these two alternatives was provided in the EA.

Accordingly, the EA's conclusion that the route that avoids the NJ Highlands and thus, also eliminates the need to cross under Monksville Reservoir, is environmentally unacceptable, is unsupported by any detailed environmental analysis contained in the EA.

2) Above-grade construction:

The EA indicates that the proposed buried pipeline project would include the following additional "above-grade" activities and construction:

a) Construction of twelve (12) Contractor/Pipe yards affecting 216.1 acres of land, including seven (7) yards in Pennsylvania, four (4) yards in New Jersey and one (1) yard in New York.

b) Modification of 52, non-public, existing roads to be used as access roadways, affecting 53.1 acres of land.

c) 46.8 acres of disturbance for "Additional Temporary Workspace."

d) Modifications to four (4) existing compressor stations including three (3) in Pennsylvania and one (1) in New Jersey that would affect 42 acres of land.

e) Removal of the majority of equipment within the existing Mahwah Meter Station in Bergen County, NJ, and located on 0.2 acres of land leased by TPG from Algonquin Gas Transmission Company, and construction of a new meter station on 2.0 acres adjacent to that existing meter station.

f) Installation of new 30-inch diameter mainline valve (MLV) assemblies and a pig launcher or receiver, as appropriate, to accommodate internal cleaning and inspection of the proposed pipeline loop 319 in Pennsylvania, loop 323 in Pennsylvania and New Jersey, and loop 325 in New Jersey.

Figure 1.5-1 from the EA follows this page and provides an "Overview Map" of the Northeast Upgrade Project.

About 450.1 acres of land would be disturbed to construct the pipeline itself, not including an additional 360.3 acres of land disturbance for additional temporary workspace, construction of above-grade facilities, access roads and contractor/pipe yards. Thus the project's total land disturbance would be 810.3 acres.

Following construction, TGP would "allow" all but 120.6 acres of the disturbed land to revert to previous conditions, most of which (119.4 acres) would be permanently maintained pipeline rights-of-way.

I reiterate my above conclusion that, by the project's very nature, including over 800 acres of land disturbance over a 40 mile length across three counties in Pennsylvania and three counties in New Jersey, it is simply too large and complex for a "Finding of No Significant Impact," without a detailed EIS having been prepared.

e. Construction Procedures:

This section of the EA references the proposed project's *Environmental Construction Plans* (ECPs) and notes that,

> "Draft plans have been filed with FERC but are too voluminous to included in this EA..." [Footnote 7, page 1-13 of the EA].

The plans are available for viewing on the FERC website.

In addition, the EA indicates that TGP would implement a *Spill Prevention Control and Countermeasure Plan* (SPCC Plan), a *Waste Management Plan, a Horizontal Directional Drill Contingency Plan* (HDD Plan), *Traffic Control Plans* for Pennsylvania and New Jersey, a *Blasting Plan, Invasive Species Management Plans* (ISMPs) for Pennsylvania and New Jersey, and *Procedures Guiding the Discovery of Unanticipated Cultural Resources and Human Remains.*

I reiterate my above conclusion that, by the project's very nature, including over 800 acres of land disturbance over a 40 mile length across three counties in Pennsylvania and three counties in New Jersey, it is simply too large and complex for a "Finding of No Significant Impact," without a detailed EIS having been prepared.

The fact that the detailed construction plans for the project are "too voluminous" to be included in the EA, and that seven (7) additional "plans" are needed to address TGP's proposed efforts to minimize environmental impacts, further supports this finding.

f. Permits, Approvals, and Regulatory Requirements:

The EA indicates that TGP is committed to obtaining all necessary environmental permits and provides a list of 32 environmental permits that would be required for the project.

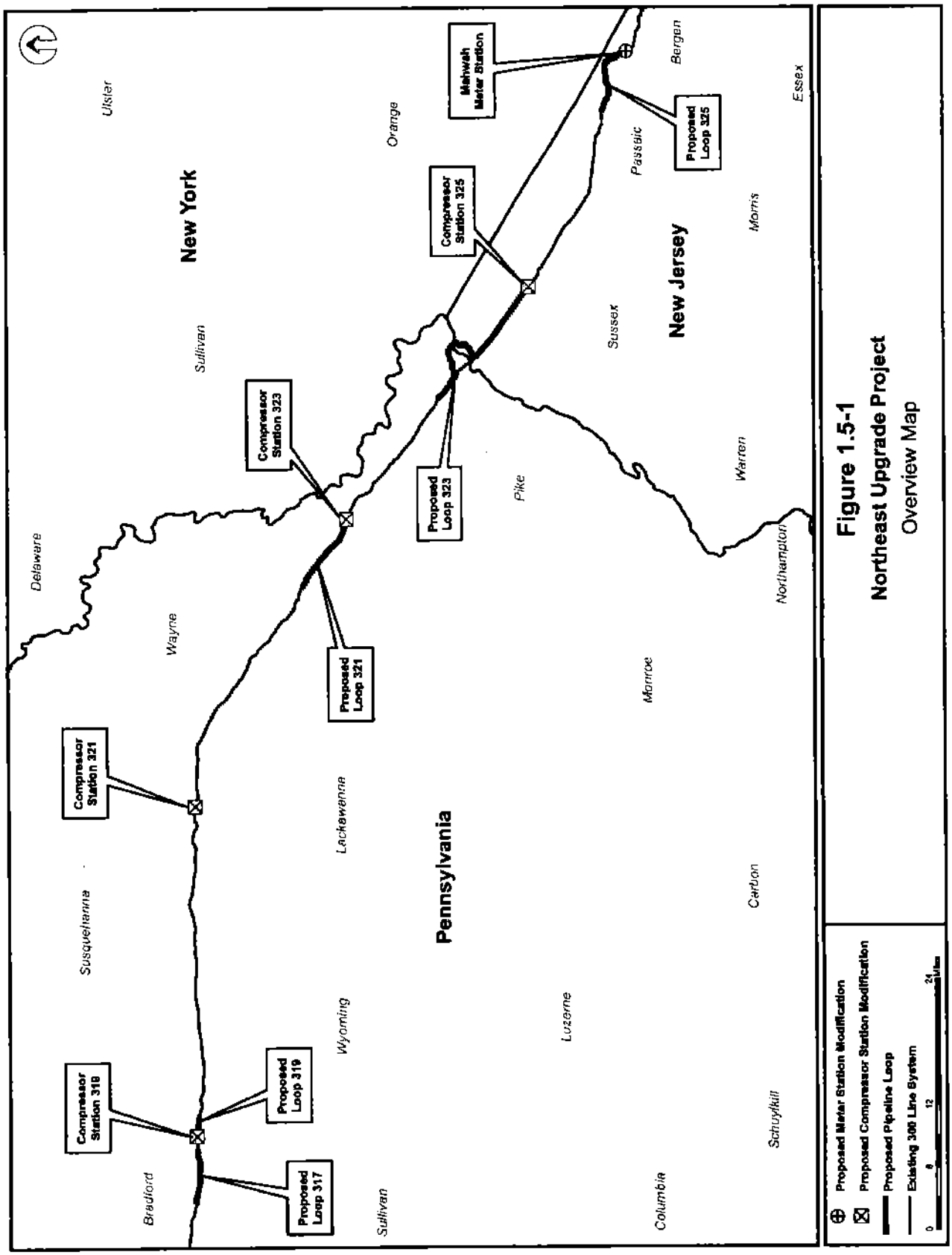


Figure 1.5-1
Northeast Upgrade Project
Overview Map

There is no presentation made as to what the permit requirements would be for each of the 32 permits or approvals needed, nor any professional reports and/or opinion letters addressing the likelihood that the project, as presently proposed, would be capable of complying with the applicable permit requirements.

The ability to meet the environmental permitting requirements is a "feasibility" issue.

Absent reports or opinion letters prepared by qualified environmental permitting professionals indicating that based on review of the proposed plans, the project would, in all likelihood be capable of complying with all environmental permitting requirements, there is no assurance that the proposed project is even capable, as currently proposed, of meeting the applicable environmental standards of Pennsylvania, New Jersey and New York.

Accordingly a "Finding of No Significant Impact" is premature.

An EIS would need to comprehensively address all applicable environmental regulations and the ability of the project to meet those regulations.

g. Future Plans and Abandonment:

This section of the EA confirms that the "need" for the project is based on projected natural gas production from within existing and proposed Marcellus Shale production areas.

Thus, it is clear that the construction of the proposed interstate pipeline would facilitate and support natural gas development within Pennsylvania for transport to out-of-state customers, resulting environmental impacts associated with the mining of Marcellus Shale for natural gas.

Absent the availability of an interstate pipeline, there would be less natural gas development in Marcellus Shale areas and less environmental impacts.

2. Environmental Analysis:

a. Topographic conditions:

The EA's Environmental Analysis section does not include a subsection addressing existing topographic conditions along and within the route proposed for the proposed pipeline and its associated facilities.

An area's existing topography can impact upon the construction of the project and the project itself can impact the existing topography, thus causing other environmental impacts affecting water resources, fisheries, wetlands, and vegetation and wildlife.

The failure of the EA to examine and describe the existing topography within the project area, as well as the project's potential consequences (impacts) with regard to the existing topography, renders the EA incomplete and without sufficient basis to reach it's stated finding that the project would have "no significant impact."

b. Geology and soils:

The EA acknowledges that the project could have the following impacts on soils:

1) Clearing removes protective vegetative cover and exposes soils to the effects of wind, rain and runoff, which increase the potential for soil erosion and sedimentation in sensitive areas.
2) Grading, spoil storage and equipment traffic can compact soil, reducing porosity and increasing runoff potential.
3) Trenching of stony/rocky or shallow-to-bedrock soils can bring stones or rock fragments to the surface that could interfere with agricultural practices and hinder restoration of the right-of-way.
4) Construction activities can also affect soil fertility and facilitate the dispersal and establishment of weeds.
5) Contamination from spills or leaks of fuels, lubricants, and coolant from construction equipment could adversely affect soils.

The EA then indicates that TGP would implement its Project-specific *Environmental Construction Plan* (ECP) which includes various measures aimed at minimizing and controlling soil erosion, stockpiling topsoil, removal of excess rock from the top 12-inches of the soil, and restoring the construction work areas to preconstruction contours.

The above-listed impacts to soils and the proposed measures to minimize those impacts are typical of virtually any construction project.

The EA also indicates that of the 40.3 acres of land area within the pipeline construction area, 82 percent exhibit a shallow depth to bedrock (5 feet or less), 52 percent exhibit "unstable" soils, 55% has stony/rocky soils, and 38 percent are "hydric" or wetland soils.

With regard to depth to bedrock, the EA acknowledges that the project areas generally exhibit a shallow depth to bedrock and that blasting may be required.

With regard to controlling soil erosion by wind or runoff, the ability to control erosion and the potential impacts of that erosion, depend whether or not the soils are located within a wetland (hydric soils) or proximate to wetlands or streams, and whether or not the soils in "cut" areas are stable or unstable.

In this instance, the EA establishes that much of the work area will be in and/or near wetlands and streams and that much of the areas' soils are unstable. Thus, controlling soil erosion is of particular importance and more difficult in steeply sloping areas where more "cutting" may be required.

The complete absence of a section in the EA to address the project areas' existing topography makes it impossible to assess the reasonableness of the conclusion reached by the EA that the proposed project would have "no significant impact," since it is the existing topography, together with the project's proposed grading plans, that will determine the degree to which soil erosion will be difficult to control.

c. Water Resources, Fisheries and Wetlands:

The EA indicates that the pipeline would need to cross 50 perennial streams and 52 intermittent streams.

In New Jersey, the project would cross 29 Trout Production or Trout Maintenance waters (coldwater fisheries). In Pennsylvania, the project would cross 25 high quality-designated waterbodies, 7 exceptional value-designated waterbodies, 1 Class A Trout Stream, and 2 Wild Trout-designated waterbodies.

Many of the streams affected by the pipeline crossings are "sensitive" waters such as FW-1, Category One, High Quality Waters, and public water supply waters in New Jersey.

The EA also indicates that the pipeline project would also need to cross nearly 5.6 miles of freshwater wetlands associated with over 175 wetland crossings and impacting 49.1 acres of wetlands.

The EA also indicates that the proposed pipeline must cross three (3) particularly large waterbodies, those being the Susquehanna River, the Delaware River, and Monksville Reservoir and that the proposed method of crossing these waterbodies would be the Horizontal Direction Drilling (HDD) method. TGP, recognizing that the HDD Method of crossing could fail in any or all of these three crossings, specified HDD "Contingency Methods" to be used in the event of failure.

I reiterate my above conclusion that, by the project's very nature, including over 800 acres of land disturbance over a 40 mile length across three counties in Pennsylvania and three counties in New Jersey, it is simply too large and complex for a "Finding of No Significant Impact," without a detailed EIS having been prepared.

The fact that this project will need to cross, and thus impact, at least temporarily, 102 perennial and intermittent streams and 175 freshwater wetland areas is supportive of this conclusion.

The EA identifies the following impacts to surface water resources, wetlands and fisheries:

1) Clearing and grading of streambanks, in-stream blasting and trenching, trench dewatering, and backfilling could affect waterbodies through an increased sediment loading and turbidity levels, reduced dissolved oxygen concentrations, stream warming, and introduction of chemical discharges from spills of fuels/lubricants.
2) Construction of the project could alter wetland value due to vegetation clearing and could also impact water quality within the wetland due to sediment loading or inadvertent spills of fuel or chemicals.
3) The Project could also impact aquatic resources including fisheries.
   a) Increases in sediment loading and turbidity within and immediately downstream of the construction work area, thus adversely affecting fish eggs and juvenile fish survival, benthic community diversity and health, and spawning habitat.
   b) Direct contact by construction equipment with fish, fish eggs, and other aquatic organisms including fish prey and forage species.
   c) Alteration or removal of adjacent riparian vegetation and aquatic habitat cover, which in forested areas could affect fish populations that may be present downstream of construction activities by reducing shade and cover and increasing water temperature.
   d) Introduction of pollutants.
   e) Delaying of migrating fish from reaching upstream spawning areas or delaying downstream movement of juveniles.
   f) Impingement or entrainment of fish and other biota associated with the use of water pumps, including hydrostatic test water.

The EA goes on to explain the mitigation measures proposed to minimize the above impacts to surface waters, wetlands and fisheries including:

1) Following the TGP's ECPs and SPCC Plan.
2) Collocating 84 percent of the proposed 40.3-mile loop length within the existing right-of-way and generally limiting the width of the construction right-of-way to 75 feet within wetlands.
3) Locating Additional Temporary Workspace areas at least 50 feet away from wetland boundaries except where site conditions warrant otherwise.
4) Selection of the most appropriate type of waterbody crossing method aimed at minimizing impacts;
5) Employing specific procedures that TGP would implement during hydrostatic test water withdrawal and discharge and use of the HDD method technique to minimize sedimentation and turbidity.

6) Limiting in-stream work to the time periods required by federal and state agencies to minimize fisheries impacts.
7) Allowing revegetation of wetlands and riparian vegetation to take place.
8) Providing Wetland Mitigation Plans.

The EA also states that, "Riparian cover on affected areas would be expected to recover over several months to several years and that a strip of riparian vegetation, at least 25 feet wide would be allowed to revegetate to pre-construction condition over the entire width of the right-of-way except for a 10-foot wide strip centered over the pipeline that may be maintained in an herbaceous state. In addition, trees would not be permitted to grow within 15 feet of the pipeline.

If a 10-foot wide strip centered over the pipeline is maintained in an herbaceous state and no trees would be permitted to become established within 15 feet of the pipeline 30-inch (2.5 feet) pipeline, then an area of 32.5 feet would be maintained without trees for all of the stream crossings.

Revegetation by herbaceous cover and emergent wetland vegetation would take 1 to 3 years. Revegetation by scrub-shrub vegetation would take years and revegetation by trees would take many years.

For wetland crossings, the EA states, "...all of forested and scrub-shrub wetlands that would be impacted during operation would be permanently converted to emergent wetland types due to vegetation maintenance requirements." [page 2-25]

Please note that forested and scrub-shrub wetlands have a completely different hydrologic condition from that of emergent wetlands. As a result, it is unlikely that TGP would be able to establish emergent wetland vegetation over the pipeline without also altering the hydrology of the immediate area.

The reality is that the project proposes to impact over 100 natural streams and 5.6 miles of freshwater wetland crossings at 175 different locations along the proposed pipeline. The impacts of this proposed work, by the enormous numbers alone, are significant and warrant a full EIS.

d. Vegetation and Wildlife:

The EA indicates that, in addition to the construction of the pipeline disturbing about 49 acres of freshwater wetlands, the construction would also disturb about 267 acres of forested lands. Thus, about 72 percent of the project's total acreage would involve the disturbance of freshwater wetlands and forested lands and the upland and wetland wildlife associated with those habitats including about 70 species of common wildlife, 29 species of "Birds of Conservation Concern," and five (5) federally listed and protected species known or potentially occurring within the project area.

The EA makes numerous recommendations to TGP requiring that before construction of certain portions of the project takes place that certain needed wildlife studies or surveys be conducted and/or reported, including a Phase I bog turtle survey, the results of mist net surveys for Indiana bats, results of outstanding habitat assessments for the dwarf wedge mussel, the results of all outstanding small whorled pogonia surveys, the results of any outstanding surveys for Pennsylvania and New Jersey state-listed species.

In essence, the EA is making a finding of "no significant impact" before all of the wildlife studies are completed and reported to the appropriate review agencies and then is leaving the final review and commenting on those studies to those review agencies.

This would appear to be the same as requiring that EIS-level analyses be conducted but then not providing those EIS-level analyses to the public for review and comment.

3. FERC Staff Conclusions and Recommendations:

Based on the TGP's application and supplements, together with the environmental analyses contained in the EA, the FERC Office of Energy Products (OEP) concluded that,

"...approval of the Project would not constitute a major federal action significantly affecting the quality of the human environment..." as long as "...TGP's proposed measures and our recommended mitigation measures..." are implemented.

The OEP staff then recommended that the FERC Order contain a "finding of no significant impact" and included six (6) pages of mitigation measures. The recommended mitigation measures included, but were not limited to the following:

a. TGP shall follow the construction procedures and mitigation measures described in its application and supplements (including responses to staff data requests) and as identified in the EA, unless modified by the Order.

Thus, the OEP recognizes and acknowledges that "modifications" to the project's approved construction procedures and mitigation measures may be necessary in order to adequately protect the environment.

b. The Director of OEP has delegated authority to take whatever steps are necessary to ensure the protection of all environmental resources during construction and operation of the Project and with this authority shall allow the modification of conditions of the Order and the design and implementation of any additional measures deemed necessary (including stop-work authority) to assure continued compliance with the intent of the environmental conditions as well as the avoidance or mitigation of adverse environmental impact resulting from the Project construction and operation.

Thus, the OEP recognizes and acknowledges that "additional measures" may be needed to adequately protect the environment.

c. TGP shall file with the Secretary detailed alignment maps/sheets and aerial photographs at a scale of not smaller than 1:6,000, identifying all route realignments or facility relocations, and staging areas, pipe storage yards, new access roads, and other areas that would be used or disturbed and have not been previously identified in filings with the Secretary, requesting approval of same in writing;

   Examples of alterations requiring approval include all route realignments and facility location changes resulting from:

   1) Implementation of cultural resources mitigation measures;
   2) Implementation of endangered, threatened, or special concern species mitigation measures;
   3) Recommendations by state regulatory authorities; and
   4) Agreements with individual landowners that affect other landowners or could affect sensitive environmental areas.

   For each area of the project for which an alteration is requested, the request must include a description of the existing land use/cover type, documentation of landowner approval, whether any cultural resources or federally listed threatened or endangered species would be affected, and whether any other environmentally sensitive areas are within or abutting the area.

   Thus, the OEP recognizes and acknowledges that "alterations" to the pipeline's route alignment and facility locations may be required as a result of the need to implement environmental mitigation measures aimed at protecting T&E and/or special concern species and/or cultural resources or to meet, as yet unknown recommendations by PA and NJ State regulatory agencies or to otherwise protect sensitive environmental areas.

d. TPG shall not begin construction of Loop 323 until:

   1) TGP files with the Secretary and the NJ Field Office of the FWS, the results of;
      a) A Phase I bog turtle survey;
      b) Outstanding habitat assessments for the dwarf wedge mussel; and
      c) All outstanding small whorled pogonia surveys.
   2) The FERC staff completes any necessary section 7 consultation with the FWS.

      Thus, the OEP acknowledges that additional "EIS-type" studies must be completed along Loop 323, prior to construction, to ensure that the environment is adequately protected.

e. TPG shall not begin construction of Loops 321, 323, and 325 until:

   1) TGP files with the Secretary the results of mist net surveys for Indiana bats along the unsurveyed portions of Loops 321 and 323;

2) TGP files with the NJ Field Office of the FWS and the Secretary the final mitigation plans for forest resources in the Highlands Preservation Area and on state-owned lands in New Jersey, that specifies the approximate number of each tree species it would replant that are suitable for Indiana bat roost habitat; and

3) FERC staff completes any necessary section 7 consultation with the FWS.

Thus, the OEP acknowledges that additional "EIS-type" studies must be completed along Loops 321, 323 and 325, prior to construction, to ensure that the environment is adequately protected.

f. TGP shall not begin construction of facilities, including pipeline loops and compressor stations, meter stations, and/or all staging, storage, or temporary work areas and new or to-be-improved access roads until:

1) TPG files the following additional environmental and cultural resources studies and surveys with the Secretary:

a) An updated Phase 1A survey report for New Jersey;

b) Phase 1 cultural resources survey report(s) for any previously unreported areas for Pennsylvania and New Jersey, including the Revised TGP Alternative B route and the Wallkill River Mitigation Site;

c) Phase II site evaluation reports, as required, to provide NRHP-eligibility recommendations for sites in Pennsylvania and New Jersey, including additional gemorphological testing;

d) Any other reports, plans, or special studies, not yet submitted, including archaeological site avoidance and treatment plans, historic architectural avoidance plans, and unanticipated discovery plans.

e) Comments on the cultural resource reports and plans from the PA SHPO, NJ SHPO, and any other consulting parties; and

f) The records of continued consultation with the Ramapough Lenape Nation, Delaware Nation, the Delaware Tribe of Indians, the Oneida Indian Nation, the Eastern Shawnee Tribe of Oklahoma, and the Stockbridge Munsee Community of Wisconsin, and any other American Indian tribe that have not yet been files.

2) The Advisory Commission on Historic Preservation (ACHP) is afforded an opportunity to comment if historic properties would be adversely affected; and

3) The FERC staff reviews and the Director of OEP approves the cultural resources reports and plans, and notifies TGP in writing that treatment plans/mitigation measures may be implemented and/or construction may proceed.

4) TGP files, for review and written approval of the Director of OEP, a plan detailing the additional noise mitigation measures TGP would use to ensure that the noise levels attributable to the 24-hour HDD activities do

not exceed an L_{dn} of 55 dBA at the Noise Sensitive Areas (NSAs) near the Susquehanna River HDD entry site.

5) TGP files noise surveys with the Secretary after placing the authorized units at the Compressor Stations 321 and 323 in service. If the noise attributable to the operation of all the equipment at the identified compressor stations at full load exceeds an L_{dn} of 55 dBA at the nearby NSAs, then TGP shall install additional noise controls to meet the level within 1 year of each station's in-service date. TGP shall confirm compliance with the above requirement by filing a second set of noise surveys with the Secretary after it installs the additional noise controls.

Thus, the OEP recognizes and acknowledges that prior to commencing the project, there are numerous "EIS-type" environmental, historic preservation and cultural resource studies that need to be completed in order to assure that the natural and human environment is adequately protected.

The above, so-called "mitigation measures," are <u>not</u> mitigation measures at all. They are "conditions of approval" being recommended by FERC that clearly recognize that the project's design, and even its route alignment, is not yet finalized and that numerous, additional environmental and cultural resources studies need to be completed and submitted before FERC would even consider permitting the project to proceed to construction.

These additional environmental and cultural resources studies are usually done as part of a detailed Environmental Impact Statement (EIS), subject to public review.

FERC, in providing its formal "conclusions and recommendations," as presented in the EA, has formally acknowledged that it needs more environmental and cultural resource studies and quite possibly route realignments and other facility modifications, in addition to several different types of environmental mitigation plans, before it can render an "unconditional" finding of no significant impact and thus permit the project to be built.

Simply put, at this point in time, the EA provides all of the information needed to document that FERC has no valid basis for issuing the project a finding of no significant impact.

Conclusions and Recommendations

Based on our findings, as reflected in the above comments, Thonet Associates provides the following conclusions and recommendations:

1. The Environmental Assessment (EA) provided is voluminous, rather than being a brief and concise document as intended by NEPA.

   The document consists of about 250 pages of text, tables, maps, and appendices that clearly document that the project will result in environmental impacts to over 800 acres of land over the 40-mile long project area.

In particular, the EA documents that 72 percent of pipeline project area consists of forests and freshwater wetland habitats, with construction taking place across more than 100 streams and through 175 freshwater wetland areas, many of which are documented as being environmentally sensitive and important, such as Category One streams, trout streams, intermediate and exceptional resource value wetlands and major public water supplies.

The environmental impacts described in the EA are sufficient to support a finding that the project is likely to have significant environmental impacts, contrary to the EA's "Finding of No Significant Impact" (FONSI).

Accordingly, I recommend that FERC issue a finding that the project has the potential to result in significant environmental impacts and require that a full EIS be prepared and submitted.

2. The preparers of the EA did not independently evaluate the "need" for the proposed project but rather just accepted TGP's assertions that the project was needed because TGP had already secured binding contracts for the additional capacity. While the contracts may support a finding that there is a "demand" for the additional pipeline capacity, "demand" is not the same as "need."

   In order to properly assess the project's need, the preparers of the EA must not only independently verify TGP's assertions as presented in the EA regarding "demand," they must also examine the trends in energy use to determine if the need for energy in general, and natural gas in particular, in the proposed service area, is rising as quickly as represented in the EA, and what other energy companies, other than TGP specifically, and the natural gas industry in general, are doing to meet future energy needs in the proposed service area. Those other companies could be the source of valid "alternatives" that would render the proposed project unnecessary.

   Absent a valid analysis and determination of "need," the EA, as currently presented, fails to meet the EA requirements of Section 1508.9 of the CEQ NEPA regulations.

   Simply put, there is no justification for imposing the proposed project's multitude of environmental impacts over multiple states, as documented in the EA, in the absence of a demonstration of "need."

   I recommend an EIS for the project be prepared and that it include a valid analysis of the "need" for the project.

3. A driving force behind the proposed interstate gas pipeline project is the significant increase in natural gas production being projected in Pennsylvania's Marcellus Shale areas. Indeed, absent a method of transporting the natural gas produced in Pennsylvania to out-of-state customers, there is simply no reason for mining the enormous amount of natural gas from Marcellus Shale projected because the in-state demand would not equal the projected supply.

Hence, the availability of an interstate gas pipeline of adequate size to handle the projected increase in natural gas production, would serve to encourage and support the continued development of Pennsylvania's Marcellus Shale natural gas resources. In this manner, the environmental impacts associated with the mining of natural gas from Marcellus Shale should be considered to be secondary impacts of the new pipeline.

Absent inclusion of the potentially significant environmental impacts that the proposed interstate pipeline would cause by encouraging and supporting natural gas development and production from Marcellus Shale, the EA is incomplete. After all, the purpose of the EA is to discuss anticipated environmental impacts.

I recommend that an EIS be prepared for the project that considers these secondary impacts that the project would cause.

4. Unlike the EA's other reviews of alternative routes, no detailed comparison is provided in the EA regarding the environmental impacts of the proposed alignment across the NJ Highlands and the alternative alignment that would avoid, to a great extent, encroachment into the NJ Highlands Region.

   Accordingly, the EA's conclusion that the alternative route, that avoids the NJ Highlands and thus, would also eliminate the need to cross under Monksville Reservoir, would produce greater impacts than the proposed route, is simply unsupported by any detailed environmental analysis contained in the EA.

   I recommend that a detailed environmental impact analysis be prepared and submitted so that these two alternatives can truly be compared regarding environmental impacts.

5. A common and usual procedure for evaluating the reasonableness and feasibility of development projects involves professional reports and/or opinion letters prepared by qualified environmental permitting professionals indicating that based on review of the proposed plans, the project would, in all likelihood be capable of complying with all applicable environmental permitting requirements. No such reports or opinion letters were included in the EA.

   Absent such reports or opinion letters, there can be no real assurance that the proposed project is even capable of meeting the applicable environmental standards of Pennsylvania, New Jersey and New York. Accordingly the "Finding of No Significant Impact" is premature.

   I recommend that an EIS be prepared and that the EIS comprehensively address all applicable environmental regulations and the ability of the project to meet those regulations.

6. The EA fails to examine and describe the existing topography within the project area, as well as the project's potential consequences (impacts) with regard to the existing topography.

   The failure to even discuss the project area's topography and the project's impacts on topography renders the EA incomplete and without sufficient basis to reach it's stated finding that the project would have "no significant impact."

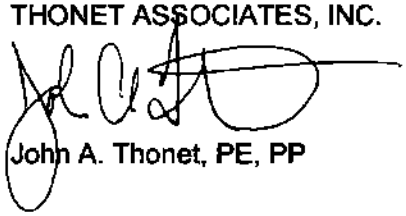
I recommend that an EIS for the project be prepared and that it include consideration of the project areas' topography and the project's impacts on the topography.

On behalf of Thonet Associates, Inc., I thank the Columbia Law School - Environmental Law Clinic for this opportunity to provide these comments.

If your have any questions regarding this report, please don't hesitate to call me.

Very truly yours,

THONET ASSOCIATES, INC.



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Professional History

Thonet Associates, Inc. **1980 - Present**
Environmental Planning and Engineering Design
Founder and President

About the Firm: Thonet Associates, Inc. is Mr. Thonet's private consulting practice. Mr. Thonet applies his expertise in environmental sciences, engineering and land use planning to the design of land development projects and land use planning programs.

Services include the preparation of environmental assessments and impact statements, wetland studies, threatened and endangered (T&E) species investigations, natural resources inventories, flood plain and flood control studies, stormwater management, development feasibility studies, environmentally-based community master plans, and environmental zoning and land development ordinances. Mr. Thonet also facilitates environmental permitting for land development projects and provides expert testimony in the fields of environmental science, engineering and land use planning.

Established in 1980, Thonet Associates has provided consulting services for more than 30 years on behalf of over 1,000 public and private clients in over 100 municipalities in New Jersey, Pennsylvania, New York, Massachusetts, Michigan, West Virginia, Georgia and North Carolina.

The firm's size has varied from a maximum of ten (10) full-time and part-time employees to a minimum of two (2) employees, depending on economic conditions and Mr. Thonet's professional objectives at any given time. At the present time, the firm is comprised of Mr. Thonet and his administrative assistant.

Mr. Thonet is a best known for his work relating to flood plain and stormwater management, freshwater wetlands delineations and protection, and environmentally based land use planning and design. He regularly collaborates with a professional biologist/naturalist with regard to studies and analyses regarding freshwater wetlands and T&E species, as well as with other environmental, engineering, and planning professionals, as needed to fulfill the needs of his clients.

Education: Mr. Thonet has Bachelor of Science (BS) and Master of Science (MS) degrees in Forest Engineering (Civil Engineering/Forestry) from the State University of New York (SUNY) College of Environmental Science and Forestry (ESF) at Syracuse. In these programs, Mr. Thonet studied environmental science and forestry at ESF while studying civil engineering at Syracuse University (SU).

Mr. Thonet received his BS degree in 1972 and his MS degree in 1975, following completion of his Master's Thesis, in absentia. Mr. Thonet received BS and MS diplomas from both ESF and SU for his studies while attending ESF.

The SUNY College of ESF is the oldest and most distinguished institution in the United States that focuses on the study of the environment. Today, ESF has grown into the largest college in the nation devoted to the environment. Mr. Thonet is the founding Chairman of the *Environmental Resources and Forest Engineering (ERFEG) Advisory Board* at ESF and is currently a member of that advisory board.

The advisory board works with the faculty of the department of Environmental Resources and Forest Engineering with regard to ABET accreditation and programs designed to ensure that students are well prepared to serve the needs of industry and the public upon graduation.

In addition, Mr. Thonet serves on the Advisory Board to the Department of Civil and Environmental Engineering at Syracuse University's L.C. Smith College of Engineering and Computer Science, a board providing the same function for Syracuse's Civil Engineering Department as the ERFEG Advisory Board does for ESF.

Mr. Thonet's professional education in the environmental sciences and engineering also includes:

- Graduate study in hydraulic design of structures from Polytechnic Institute of New York;
- Continuing education certificate in Urban Hydrology from Penn State University;
- Continuing education classes and/or certificates from Rutgers University regarding environmentally-related subjects including:
    - Stream restoration;
    - On-site wastewater treatment and disposal systems;
    - Underground storage tanks;
    - Glacial deposits in New Jersey;
    - Threatened and endangered species;
    - Desktop mapping with ArcView,
    - Methodologies of delineating wetlands based on vegetation, soils, and hydrology.

Professional Licenses, Registrations and Certificates: Mr. Thonet holds the following professional licenses, registrations and certificates related to his work with Thonet Associates, Inc.:

- Professional Engineer (PE) in New Jersey, Massachusetts, Pennsylvania, and Michigan
- Professional Engineer (Retired) in West Virginia
- Professional Planner (PP) in New Jersey
- Certificate of Training - Wetland Delineation Certification Program Rutgers University – US Army Corps of Engineers

Professional Societies:

- American Planning Association (APA)
- Urban Land Institute (ULI)
- American Society of Civil Engineers (ASCE)
- Society of American Foresters (SAF)

Environmental Organizations:

- New Jersey Highlands Coalition - Former Treasurer and Trustee
- New Jersey Environmental Lobby - Trustee

Professional Publications and Speaking Engagements

- Author, *Drainage Basin Characteristics and Energy Losses in the Rainfall-Runoff Process,* A thesis submitted in partial fulfillment of the requirements for a Master of Science degree from the SUNY College of Environmental Science and Forestry, Syracuse, NY, April 1975
- Co-author, Technical Report, Development Suitability - St. Lawrence-Eastern Ontario Shoreline Study, Applied Forestry Research Institute (AFRI), Syracuse, NY, 1977
- Author, *Floodplain and Stormwater Management Regulations - Their Relationship to Each Other and to the Environmental Zoning Aspects of Land Use Planning,* Proceedings, International Symposium on Urban Hydrology, Hydraulics and Sediment Control, 1981
- Co-author, *Environmental Land Use Regulations vs. Discriminatory Zoning Practices,* ASCE International Convention and Exposition, NYC, 1981
- Author, No Net Increase - A Stormwater Management Philosophy, ANJEC Report, 1996
- Author, *Stormwater Control Ordinance for Lands Within the Great Swamp Watershed Overlay Zone,* a "model" stormwater ordinance prepared under contract to the Great Swamp Watershed Association, 1996
- Author, Chapter 13, "Floodplains" and Section 17.3, "New Jersey's Stream Encroachment Regulations", *Environmental Permitting Handbook,* McGraw Hill, 2000
- Speaker, *Stormwater Management in New Jersey,* ANJEC Commissioners' Course, 1982 and 1983
- Speaker, *Stormwater and Groundwater Management with Respect to NPS Pollution,* ANJEC Commissioners' Course, 1989
- Speaker, *Environmental Aspects of the Site Plan/Subdivision Review Process,* NJ Federation of Planning Officials, Educational Meeting at the Northern Area NJFPO, 1989
- Speaker, *Taking the Mystery out of Stormwater Management,* Monmouth County Water Resources Associates Public Workshop of Stormwater Management, 1990
- Speaker, *Stormwater Management and Hydrology in the Great Swamp Watershed,* NJDEP's Great Swamp Watershed Advisory Committee, 1990
- Speaker, *The Art of Managing Non-Point Source Pollution,* ANJEC Environmental Commissioners' Course, 1991

- Speaker, *Planning for and with Natural Systems,* ANJEC's New Jersey Environmental Congress, 1993
- Speaker, *No Net Increase – A Stormwater Management Philosophy for the Highlands,* Highlands Research Symposium II, Applying Ecological Knowledge to Land Use Decision-Making, Workshop of Wetlands and Stormwater Management, 1996
- Speaker, *Stormwater Management – What Can We Do Other Than Detention Basins?* - A presentation to the Tinton Falls Mayor and Council, Planning Board, Environmental Commission and Stormwater Work Group, Tinton Falls Municipal Building, Council Chambers, 1999
- Speaker, *Planning for BMPs: A new Approach to Stormwater Management in Your Towns,* ANJEC's New Jersey Environmental Congress, 1999
- Speaker, *New Jersey's Newly Proposed Stormwater Management Rules,* ANJEC presentation to Medford Township in association with the Woodford Cedar Run Wildlife Refuge, 2003
- Speaker, *New Jersey's Newly Proposed Stormwater Management Regulations,* ANJEC Environmental Commission Training to Protect Natural Resources, Vineland, NJ 2003
- Speaker, *The Importance of Infiltration in New Jersey's New Stormwater Management Regulations,* Soil and Water Conservation Society, Firman E. Bear Chapter, Forest Resource Education Center, Jackson, NJ, 2004
- Speaker, *New Jersey's New Stormwater Management Regulations,* Ringwood Borough Township Council, 2004
- Speaker, *New Jersey's Proposed/Adopted Stormwater Regulations,* the New Jersey Chapter of the American Society of Landscape Architects, Atlantic City, NJ 2004
- Speaker, *New Jersey's Stormwater Management Regulations,* ANJEC Environmental Commission Training to Protect Natural Resources, East Amwell, NJ 2004
- Speaker, *New Jersey's New Stormwater Management Rules in Relation to Stream and Riparian Corridor Protection,* Sussex & Warren County Farmland & Open Space Roundtable, Waterloo Village Meeting House, Stanhope, NJ, 2004
- Speaker, *New Jersey's New Stormwater Management Rules,* Burlington County Board of Chosen Freeholders and the Rancocas Creek Watershed Management Area Public Advisory Committee's Third Annual Stormwater Management Conference, New Jersey EcoComplex, Columbus, NJ, 2004
- Speaker, *Stormwater in Development Review and Zoning,* Session I Workshop, ANJEC 32nd Annual Environmental Congress, 2005
- Speaker, *An Example of the Precautionary Principle in New Jersey – The Highlands Water Planning & Protection Act – Will the Regional Master Plan Reflect the Intent?* - Conference on The Precautionary Principle, sponsored by the Environmental Education Fund, The Environmental Studies Program of Seton Hall University, The Science and Environmental Health Network, and Public Employees for Environmental Responsibility, 2008
- Speaker, *Municipal Planning Incorporating Natural Systems,* Hunterdon County Green Table, South Branch Watershed Association, Echo Hill Environmental Center, Stanton Station, NJ 2008

Herley Industries, Inc. **1991 - 2011**
Chairman of the Board of Directors (2010-2011)
Secretary of the Corporation (2003-2010)
Member of the Board of Directors (1991-2011)

Concurrently with running Thonet Associates, Inc., Mr. Thonet served for 20 years as a corporate director on the Board of Directors of Herley Industries, Inc. Herley Industries is a leading supplier of microwave technology for use in the United States defense industry and for allied militaries.

In 2009, following two years of disappointing financial performance and extraordinary legal difficulties, Herley's Board of Directors initiated a Board-level evaluation of the underlying reasons for Herley's declined performance and began to formulate a strategic plan aimed at restoring the company's financial performance and resolving the legal disputes that were creating uncertainty regarding the company's long-term financial condition.

The plan developed by the Board was a bold one, calling for replacing the company's Chairman, CEO, COO, and CFO as well as the division manager of Herley's largest division, in addition to some fundamental changes in priorities and focus. Mr. Thonet played an active role in evaluating the reasons for Herley's problems and in formulating the Board's strategic plan for recovery.

As part of the proposed changes, in January of 2010, Herley's Board of Directors asked Mr. Thonet to accept a full-time position with the company as its highest ranking executive officer, Chairman, at least until such time as Herley's financial and legal problems had been resolved. Mr. Thonet accepted the offer and the challenge it represented.

When Mr. Thonet became Chairman, Herley employed just over 1,000 employees worldwide, with domestic manufacturing facilities in Pennsylvania, Massachusetts, Florida, and New Jersey and overseas facilities in the United Kingdom and Israel. Despite possessing an experienced and competent work force, Herley's revenues were declining and the firm had lost millions of dollars during the preceding two years.

In fiscal 2010, Herley's newly appointed management team lead Herley to revenues of over $188 million, the highest revenues in Herley's 45-year history. In addition, in the last quarter of fiscal 2010, Herley negotiated settlements regarding two of its most significant lawsuits and did so in a manner that permitted the company to put those legal matters behind it without the need to incur additional long-term debt.

With record revenues and significantly reduced uncertainty regarding the company's long-term financial condition in light of its reduced legal entanglements, Mr. Thonet announced to its shareholders that, going forward, Herley would simultaneously "look in two directions" in formulating its future...looking to grow the company through acquisitions, while at the same time, looking to merge the company with another defense company of similar or larger size. The message was well received by the street and Herley's stock price began to realize its true potential.

In the first half of fiscal 2011, as a result of improved internal efficiencies orchestrated by Herley's management team, Herley's financial performance continued to improve with both record revenues and record earnings for the first and second quarters, and the last of Herley's litigation matters successfully resolved.

In the third quarter of fiscal 2011, Mr. Thonet directed the company's CFO to use the company's available cash resources to pay down virtually all of the long-term debt while simultaneously orchestrating the merger of Herley with another defense company in March of 2011 for a sales price of $270 million, approximately 44% more that the company's street value when Mr. Thonet assumed the position of Chairman 15 months earlier.

On April 16, 2011, having completed his work at Herley, Mr. Thonet returned to his private consulting practice, Thonet Associates, Inc.

Mr. Thonet continues to hold a *Certificate of Director Education* awarded by the NACD Corporate Directors Institute of the National Association of Corporate Directors (NACD) and remains a member of the NACD.

Main Street South Orange, Inc. **1991-1998**
A downtown revitalization organization
Co-Chairman of the Board of Trustees (1993 - 1998)
Chairman – Economic Development Committee (1992-1993)
Chairman – Public Improvements Subcommittee (1991-1992)

Mr. Thonet and his family resided in South Orange, NJ from 1980 through 2003 and in 1989, he and his wife acquired a small office building in the center of town from which Thonet Associates, Inc. operated until 2003.

In 1991, Main Street South Orange, Inc. (MSSO) was formed as a not-for-profit, volunteer-based organization whose goal was to revitalize downtown South Orange by stimulating business opportunity, historic preservation, and community growth.

Thonet Associates' business sign for "environmental planning and design services," caught the attention of the newly appointed executive director of MSSO who then approached Mr. Thonet and requested that he consider volunteering his expertise as a professional planner and engineer to help MSSO in the accomplishment of its mission.

Mr. Thonet agreed to help and initially volunteered to serve as the Chairman of MSSO's newly formed "Public Improvements" subcommittee, responsible for preparing concept plans for a new streetscape for South Orange Avenue.

For the next eight years, Mr. Thonet continued to provide his professional planning and engineering expertise, as a volunteer, to the redevelopment of the Village of South Orange, chairing the subcommittee that prepared concept plans for and promoted a new, traffic calming, downtown streetscape, chairing the Economic Development Committee that brought a vibrant Farmers' Market into downtown South Orange, establishing the "Village Center" promotional newspaper to inform the public of all the great new things going on in the Village Center, and ultimately serving as the elected Co-Chairman of MSSO's Board of Trustees, a position he held for the next five years, during MSSO's most formative period. During this period, the volunteer-based MSSO worked in concert with South Orange's elected officials, and the township's hired design professionals, to promote and realize MSSO's revitalization goals and objectives.

In the process of professionally guiding the MSSO program, Mr. Thonet utilized the well-respected "Main Street Four Point Approach" to downtown revitalization as well as his many years of experience as a small business owner and as a professional accustomed to dealing with governmental agencies and process. South Orange went on to become one of New Jersey's "success stories" in downtown revitalization.

In January of 1998, Mr. Thonet's last year as Co-Chairman, South Orange's revitalized streetscape and traffic-calming design was featured on the cover of Engineering News Record (ENR) with the headline, "Taking Back Main Street."

Mr. Thonet is particularly proud of South Oranges' success and the role he played in helping South Orange to realize that success, both as a professional and as a volunteer.

Model "No Net" Stormwater Management Ordinance — 1995 - 1996

Author, under contract to the Great Swamp Watershed Association

In 1995, the Great Swamp Watershed Association (GSWA) hired Thonet Associates, Inc. to prepare a model "no net" stormwater ordinance, meaning one that would result in no net increase in stormwater rates and volumes, no net increase in soil erosion and stream channel erosion, and no increase in nonpoint source pollution associated with stormwater runoff. This was significantly different from New Jersey's stormwater regulations, mimicked by most New Jersey municipalities that simply required no increase in peak rates of runoff.

The intent was to provide this ordinance to all municipalities within the contributing drainage area of Great Swamp and encourage those municipalities to adopt the ordinance in order to protect the special water and ecological resources of Great Swamp.

The ordinance was a precursor to New Jersey's new stormwater management regulations promulgated eight years later, in 2004, and the ordinance incorporates many of the same and similar provisions to New Jersey's new regulations.

As a result of the GSWA's efforts in this regard, the "no net" stormwater ordinance prepared by Thonet Associates became the first stormwater ordinance of its kind to be voluntarily adopted by some municipalities in the State of New Jersey. Today, as a result of New Jersey's new stormwater rules, all municipalities are required to have similar stormwater ordinances to that developed by the Thonet Associates for the GSWA in 1996.

Both Mr. Thonet and the GSWA voluntarily contributed the knowledge gained in developing the "no net" model ordinance to the NJDEP during its long process of preparing and adopting New Jersey's new Stormwater Management regulations and Best Management Practices (BMP) manual. Mr. Thonet received a letter from the NJDEP in 2004 thanking him for his input to this process. In pertinent part, the thank you letter states,

> "Thank you for you input in the development of the New Jersey Stormwater Best Management Practices Manual. Your experience, expertise, and commitment of time an energy were instrumental in the successful completion of this task..." [Lawrence J. Baier, Director, NJDEP, Division of Watershed Management, June 28, 2004]

The New Jersey Stormwater Best Management Practices Manual includes Mr. Thonet in its "Acknowledgements" section as one of the individuals that the NJDEP thanks "...for their technical input and assistance during the development of the manual."

Mr. Thonet is particularly proud of his professional contributions to the specialized field of stormwater management in the State of New Jersey.

Prior to 1980:

Mr. Thonet founded Thonet Associates in 1980 and, with the exception of January 2010 through April of 2011 (16 months), when he served as Chairman of Herley Industries, Inc., he has continuously provided environmental consulting services with Thonet Associates.

Prior to 1980, Mr. Thonet worked for other companies. Mr. Thonet's pre-1980 experience includes the following:

- **1979-1980:** Associate, Dresdner Associates, PA, *Land Use and Environmental Planning Consultants*, Summit, NJ
- **1974-1979:** Project Manager and Civil Engineer, Tippetts-Abbett-McCarthy-Stratton (TAMS), *Engineers and Architects*, New York, NY

- **1973–1974**: Environmental Engineer, Power Authority of the State of New York (PASNY), New York, NY
- **1972-1973**: Graduate/Teaching Assistant in Hydrology and Structures I, SUNY College of Environmental Science and Forestry, Syracuse, NY
- **1972**: Engineering Researcher, Applied Forestry Research Institute (AFRI), Syracuse, NY

EXHIBIT B

Kevin Heatley, LEED AP

Employment

2010 – current	Biohabitats, Inc., Baltimore, MD, Senior Scientist
2006 - 2010	Biohabitats Invasive Species Management, Inc., ISM Vice President
2005 - 2006	Penn State College of Technology, Williamsport, PA, Substitute Instructor, Natural Resource Management Department
2005 - 2006	Invasive Plant Control, Inc., Nashville, TN, Director of Development Northeast Region
1997 – 2005	ACRT Inc., Akron, OH, Senior Forester/Regional Manager
1984 – 1994	Bartlett Tree Experts, Lancaster, PA, Area Manager/Arboricultural Consultant

Education

Masters Environmental Pollution Control, Penn State University, Harrisburg, PA, 2006
B.S., Natural Resource Management, Cook College, Rutgers University, New Brunswick, New Jersey 1982

Professional Registration

Certified Arborist #PD-0029, 2000
LEED Accredited Professional for New Construction (USGBC), 2009

Experience

Mr. Heatley has over 20 years of experience in the environmental sector with an extensive background in ecosystem characterization, integrated vegetation management, invasive species suppression and community-based forestry. As a senior ecologist at Biohabitats, Mr. Heatley is responsible for technical and logistical oversight of restoration projects across the continental United States. His work has primarily focused upon the urban/rural interface and on incorporating green infrastructure into sustainable land use planning and management. An expert in the field of invasive species suppression, Mr. Heatley designed the first fully integrated invasive treatment prioritization model in the United States for Fairfax County, Va. He has successfully integrated resource valuation modeling into strategic and budgetary management plans for a variety of land management entities. He has also been instrumental in providing the conceptual design for a leading GIS-based vegetation management software system.

In addition to his technical expertise, Mr. Heatley is skilled at conducting entertaining and informative public speaking engagements and professional workshops. He has lectured on a variety of natural resource topics throughout the United States and the Caribbean.

Representative Project Experience

NPS Revegetation Eastern States IDIQ, Eastern US. Mr. Heatley successfully served as the Biohabitats project manager on a 2.5 million dollar National Park Service Revegetation IDIQ contract. He coordinated and lead project planning and technical assistance services on a wide variety of ecological restoration task orders including revegetation, invasive species control, plant procurement, seeding, plant protection efforts, marsh restoration, and site characterization. Biohabitats has subsequently been awarded a $20 million dollar follow-up contract for National Park Service revegetation services across the Eastern United States and the Caribbean. Mr. Heatley is currently the project manager and technical lead on this contract.

Burgundy Farm Country Day School Ecological Site Assessment, *Alexandria, VA.* Biohabitats Inc. performed an ecological assessment of the campus and developed recommendations for the sustainable use and conservation of the school's asset. Proactive identification of both ecological assets and landscape challenges enabled the School to cost-effectively integrate site ecology into the master planning process.

Fairfax County Parks Invasive Plant Site Prioritization Model, *Fairfax County, VA.* Biohabitats ISM developed a comprehensive response strategy and site treatment prioritization model as a decision-making tool to be used by the Park Authority to rank the relative value of different sites within their approximately 24,000-acre park system. Based on the principle of "protect the best first" the model shifted the focus in the parks system away from "acres treated" towards "acres restored," allowing the County to maximize the return on its investment in invasive plant control by assuring that treatment sites reflect both the core ecological and cultural values that exist.

Lehigh University, *Bethlehem PA.* Desiring to more fully understand potential atmospheric carbon mitigation opportunities on the college campus, Lehigh University contracted with Biohabitats to undertake an analysis of the direct sequestration and avoided emissions associated with the schools landscape tree cover. Utilizing US Forest Service models, Mr. Heatley performed a comprehensive inventory of 600 acres of naturalized forest and over 220 landscape trees. Information gathered was integrated into strategic recommendations for enhancing this forest benefit and achieving a sustainable level of forest canopy.

Duke University, *Durham NC.* Concerned about the need to understand the ecological processes occurring in a high-visibility, centrally-located stand of campus woodland, Duke University contracted with Biohabitats to undertake an ecological analysis and natural capitol valuation of the campus area known as "Chapel Woods". Mr. Heatley inventoried the vegetation, performed an assessment of the functional benefits, and developed a management plan focused upon forest sustainability. As a function of this effort, Mr. Heatley also performed invasive species suppression within the forest understory.

Valley Road Stream Restoration and Riparian Wetland Creation, *Hagerstown, MD.* Mr. Heatley provided technical recommendations and coordinated invasive plant species suppression in support of the Valley Road Stream Restoration project in Hagerstown, MD. Project involved restoration of an urbanized stream corridor and significant modification of a highly disturbed riparian plant community.

Reforestation Consulting & Invasive Species Suppression, *Rockville, MD.* In order to assure the success of a reforestation effort on a 220 acre tract in Rockville, MD., Fallsgrove Associates, a private development firm, contracted with Biohabitats ISM to oversee tree planting and invasive species suppression. Biohabitats ISM developed and implemented a sampling protocol assessing tree stocking levels and produced biannual reports on supplemental planting levels needed to assure adequate canopy cover. As a component of this effort Biohabitats ISM performed planting contractor coordination and oversight. Biohabitats ISM also created a phased, multi-year, invasive plant suppression strategy. After conducting a comprehensive evaluation of the percent cover for each of the invasive species present on the site, Biohabitats ISM created a target metric for measuring the effectiveness of invasive control efforts. Seasonally selective treatments are currently being undertaken by Biohabitats ISM.

Woodland Restoration of Episcopal High School Alexandria, *Alexandria, VA.* Driven by a desire to integrate a 35 acre woodland resource into the fabric of campus life, the Episcopal High School of Alexandria, Va. contracted with Biohabitats ISM to develop a sustainable campus forest management plan and implement invasive species suppression. This effort involved campus ecosystem characterization, functional benefits modeling, and stakeholder vision sessions. Botanical communities on campus were defined and their respective ecosystem services, in the form of air pollutant interception and carbon sequestration, quantified. Several action items identified during the plan development have subsequently been implemented by Biohabitats including; trail design and construction, ecotone modification, and invasive species suppression. Ecotone modification involved the development of a forest edge planting plan addressing issues of wind vectoring and regeneration. Invasive species interventions have been conducted during 2007 and 2008 in a phased approach designed to enhance native regeneration and minimize opportunities for additional invasive colonization of the woodland.

Episcopal High School, *Baton Rouge, LA.* Recognizing the need to integrate sustainable design principles into future development on their 40 acre campus, the Episcopal High School contracted with Biohabitats (in conjunction with NK Architects) to develop a new Master Plan for the school. Mr. Heatley coordinated Biohabitats participation and involvement in this interactive process. He was directly

responsible for developing recommendations and strategies addressing stormwater retrofitting, green infrastructure expansion, and natural capital valuation.

Missionary Ridge Noxious Weed Inventory and Treatment, *Durango, CO.* During the final year of a three year project, Mr. Heatley provided technical oversight and coordinated the GPS/GIS component of the Missionary Ridge invasive species mapping and suppression effort. As part of an adaptive management approach, data collection protocols were modified and additional field staff were hired and trained by Mr. Heatley.

Woodland Management Plan for Episcopal High School, *Alexandria, VA.* Located in the Washington DC metropolitan area, the 150 years of stable land ownership at Episcopal High School has resulted in a significant legacy woodland on the campus. Recognizing the inherent educational, recreational, and inspirational value of their forest, the school contracted with Biohabitats to develop an integrated woodland management plan. The development of this plan involved a GIS-based forest stand delineation, ecological characterization, invasive plant mapping, ecosystem benefits modeling, and stakeholder vision session. As the project manager, Kevin Heatley developed the final document which provides a framework for sustainable management of this green component of the school infrastructure.

Fort Detrick, *Frederick MD.* The US Army operates Fort Detrick on over 1,200 acres of property in Frederick MD. The mixed land use pattern and competing mission objectives create special challenges regarding natural resource management. To aid in understanding field conditions and assist in budgetary justification, Fort Detrick contracted with Mr. Kevin Heatley (in conjunction with Heartwood Consulting LLC.) to undertake a resource analysis and characterization. The primary components of this project included: a GPS Landscape Tree Inventory (with tagging), GIS Database Integration, UFORE Modeling of the Environmental Impact of Forest Stands, and a Five Year Management Plan (with economic tree valuation). Mr. Heatley in addition was contracted with Fort Detrick to undertake a carbon mitigation feasibility analysis. This project examined the potential to use green infrastructure in the mitigation of vehicular greenhouse gas emissions on the base.

Representative Project Experience Prior to Biohabitats

Atkins Arboretum, *Ridgely MD.* Encompassing 400 acres on the Eastern Shore of Maryland, Atkins Arboretum is a unique facility that highlights native plant communities. With strong educational and research objectives as the primary focus of its efforts, the Arboretum enlisted the aid of Kevin Heatley (ACRT Inc.) to develop and implement a GIS-based vegetation database. Mr. Heatley supervised all aspects of the project including; high resolution aerial photogrammetry, GPS mapping of plant communities, the establishment of a thematic research plot layer, and the construction of a multi-thematic, GIS-based, vegetation database.

Tree Preservation Specifications Manual for Association for Zoological Horticulture, *Allison Park, PA.* The Association for Zoological Horticulture, an organization representing the interests of botanists, horticulturalists, and landscape professionals involved with the management of vegetation in zoological parks, contracted with Mr. Heatley for the creation of a set of standard tree preservation specifications. This document was initiated in response to excessive canopy loss during infrastructure construction and renovation projects. It was designed to promote an integrated, comprehensive approach to tree conservation appropriate for vegetation management within the challenging environment of a zoological park. It also contains an extensive specifications section suitable for use as an attachment on construction contracts.

Villanova University Five-Year Canopy Management Plan, *Villanova, PA.* Mr. Heatley as the project manager provided high resolution aerial photogrammetry, GPS/GIS vegetation and infrastructure mapping, and database design, of approximately 250 acres of this historic campus located in Villanova, Pennsylvania.

Swan Point Cemetery Five-Year Canopy Management Plan, *Providence, RI.* Mr. Heatley as the project manager provided GPS/GIS vegetation and infrastructure mapping, "seamless" GIS providing a work tracking database, and budget information of over 300 acres of this historic cemetery located in downtown Providence, Rhode Island.

Professional Associations

Society of American Foresters
International Society of Arboriculture
Society of College & University Planners

Selected Publications, Technical Reports & Presentations

Greater Everglades Ecosystem Restoration Conference, Naples, Fl, July 2010

Land Trust Alliance Annual Rally, Portland , OR, November 2009

Professional Grounds Management Society, Louisville, KY, October 2009

Mid-Atlantic Exotic Pest & Plant Council, Johnstown, PA. July 2009

Society of American Foresters, Western New York Chapter, April 2008

11th Caribbean Urban Forestry Conference, St. Croix, Virgin Islands, June 2006

St. Croix Environmental Association Tree Conservation Workshop, St. Croix, Virgin Islands, June 2006

Southeast Exotic Pest & Plant Council Annual Meeting, Raleigh, NC, May 2006

Association for Zoological Horticulture, *Tree Preservation Specifications Manual* (Industry Standard), 2005

Penn State Invasive Pest, Plants & Weeds Workshop, Luzerne County, PA, October 2005

Professional Review & Comment

On

Tennessee Gas Pipeline Co.

Northeast Upgrade Project

Federal Energy Regulatory Commission

Environmental Assessment

December 20, 2011

Prepared for:

Columbia Environmental Law Clinic

Prepared By:

Kevin Heatley, M.EPC LEED AP

Restoration Ecologist

EXECUTIVE SUMMARY

This review of the Federal Energy Regulatory Commission (FERC) Environmental Assessment of the Tennessee Gas Pipeline Company Northeast Upgrade Project was prepared in response to a request by the Columbia Environmental Law Clinic to provide expert opinion on issues of terrestrial and restoration ecology. The ecological integrity, and long term viability, of forested landscapes is directly related to both the temporal scale and spatial distribution of site disturbances. While the total acreage of a disturbance may be small, if it occurs over an extended period of time and disrupts or modifies population dispersal it can have disproportionate impacts Mitigation of land disturbance effects, such as those associated with the proposed Northeast Upgrade Project, is critical to ecological sustainability.

FERC indicates that the principal purposes in preparing the Environmental Assessment (EA) are to:

- Identify and assess potential impacts on the natural and human environment that would result from the implementation of the proposed action;
- Assess reasonable alternatives to the proposed action that would avoid or minimize adverse effects to the environment; and
- Identify and recommend specific mitigation measures, as necessary, to minimize environmental impacts

However, as currently written, the document fails to achieve these objectives as it does not fully evaluate several key ecological impacts. In particular, the EA is inadequate with respect to analyses of the following:

- Forest Edge Effects
- Adjacent Forest Regeneration, Structure, and Function
- Biological Invasion by Invasive Species
- Cumulative Impacts of Marcellus Shale Expansion

Unfortunately, the mitigation measures proposed also fail to properly address the landscape-level connectivity issues associated with the expansion of this linear infrastructure. Of significant concern is the failure of the EA to discuss the probable impacts associated with invasive species incursions and to include details of the proposed Invasive Species Management Plans mentioned for both Pennsylvania and New Jersey.

DISCUSSION

A careful review and analysis of the FERC Northeast Upgrade Project EA reveals a number of areas of concern with respect to the maintenance of the ecological integrity of terrestrial ecosystems. The EA describes this project as consisting of approximately 40.3 miles of 30 inch pipeline contained in five separate pipeline loops located in both Pennsylvania and New Jersey. Eighty-four percent (84%) of this pipeline will be collocated with Tennessee Gas Pipeline Company's (TGP) existing 24 inch pipeline. The remaining sixteen percent (16%) of the expansion would occur outside of the existing right of way (ROW) in a 6.4 mile loop between Pike County, PA. and Sussex County, NJ. In addition, the project includes

modifications to four existing compressor stations, the construction of a new metering station, installation of associated appurtenant aboveground facilities and the development of contactor yards and access roads.

As upland forest covers approximately fifty-three percent (53%) of the pipeline route, it is the dominant cover type impacted by the proposed project. The project will entail a doubling of the average existing ROW width from 25 to 50 feet along the collocated sections of the pipeline and a new linear clearing of approximately 25 feet in width for the stand-alone loop. It is anticipated that the total forest disturbance from the project will result in the permanent conversion of approximately 80 acres of forested land into open ROW or industrial land. No estimate is provided for the spatial impacts to adjacent forest as a result of expanded edge effects and the resulting diminution of core forest habitat.

Forest fragmentation as a result of anthropogenic landscape modification is well recognized within biogeographic theory and conservation biology as a leading cause of local species extinctions (extirpation). It can also cause dramatic shifts in the floral and faunal composition of woodland communities. Sub-lethal impacts to floral and faunal populations (population isolation, reduced genetic fitness and diversity) have also been associated with disruptions to forest connectivity (Clark, et.al. 2010). For instance, fragmentation and the resulting increase in parasitic cowbird activity has been implicated in reduced nesting success for interior forest-dwelling, migratory birds (Robinson, Thompson, et.al. 1995).

While New Jersey is not underlain by shale gas reserves, recent modeling work performed by the Pennsylvania Chapter of The Nature Conservancy indicates that approximately

2/3rds of the Marcellus well pads to be built in Pennsylvania will be located in what is currently forested habitat (TNC 2010). The associated connective infrastructure of access roads and pipeline right-of-ways are critical components of the natural gas extraction process. These linear features play an important role in both forest fragmentation and the cumulative determination of the ultimate number and density distribution of Marcellus well pads.

Fragmentation also creates an increase in the amount of forest edge (the interface between forest and non-forest). This transitional zone or "ecotone" is fundamentally different in structure and functionality from an interior forest system. Edge habitat is characterized by increased light levels on the forest floor, reduced soil moisture, and a high degree of biological invasion from non-native invasive organisms. Dramatic changes can occur in the soil chemistry and associated micro biota. The top layer of the soil profile, the rich organic duff, begins to dry out and the primary decomposition community begins to shift from fungal to bacterial. More than mere esoteric considerations of interest to the scientific community, these changes have direct economic implications to both landowners and society. Invasive species, for instance, have been estimated to cost the U.S. economy approximately $120 billion dollars per year (Pimintel et al. 2004).

Invasive organisms within terrestrial forest environments tend to be early successional species that respond favorably to site disturbance. Disruption of native plant cover and the exposure of the forest floor to sunlight provide an opportunity for these organisms to establish satellite populations. These populations eventually radiate out into the adjacent forest, displacing native species and retarding desirable tree regeneration (Bennet et al.

2011). Dispersal (vectoring) mechanisms and/or corridors are required in order for these non-native species to colonize new locations and the pipeline ROW's associated with natural gas extraction and transmission are ideally configured to serve this function.

Invasive species suppression along disturbed ROW's and the eventual restoration of these locations to forested systems will require resources of a significant financial and temporal scale. While published information is scarce, it is in the professional experience of restoration practitioners in this region that the reasonable reconstruction of forest canopy and understory diversity can cost between $4,000 to $10,000 per acre. The suppression of invasive plant species is also a major, recurring expense with the initial years' treatment often costing between $1,000 to $2,500 per acre. Invasive treatment in subsequent years typically drops in cost by approximately 50% per year over the first three years.

Forests also filter contaminants, moderate stream temperatures and buffer flow volumes associated with precipitation events. They are the structural foundation upon which the ecological integrity and health of the regions aquatic biological resources are built. The link between percent forest cover and water quality is clearly established in the scientific literature. As an example, reductions in forest cover are directly correlated with negative changes in water chemistry, such as increases in nitrogen, phosphorus, sodium, chlorides, and sulfates, and with reductions in stream marcroinvertebrate diversity (Jackson and Sweeny 2010).

It is from within this conceptual framework that a review of the FERC Northeast Upgrade Project Environmental Assessment was undertaken and the following concerns identified;

Forest Edge Effects –

- While the EA makes frequent mention of the beneficial aspects of collocating the expansion loops within the existing ROW, it fails to properly examine the increase in edge effects resulting from a doubling of the current ROW width. Edge impacts can penetrate far beyond the physical footprint of the disturbance. A minimum buffer area of 300 foot is a common rule of thumb in conservation biology planning. While the EA tangentially discusses edge effects in section 2.3.2.2, no analysis of potential impacts to interior forest species such as the nesting success of neo-tropical migratory birds is undertaken.
- Doubling the ROW width to 50 feet will increase the penetration of edge effects due to increases in light and temperature levels on the forest floor and the subsequent reduction in soil and humus moisture levels. While the linear feet of edge may remain constant, the increase in the width of the ROW will result in additional affected forest acreage. The conversion figure given of 80 acres is misleading. An estimate of the depth of the forest edge impact should be provided along with an analysis of cascading ecological consequences.
- No spatial analysis is provided of the landscape-level configuration of the forest systems adjacent to the ROW. As such, an informed analysis of the impact to core forest systems and landscape connectivity is not possible. Depending upon the size and shape of adjacent interior forest patches, the additional penetration of edge effects from ROW width expansion may have a disproportionate impact on core habitat. The EA should include a spatial analysis of edge effects with respect to

adjacent forest connectivity and patch size in the order to support the assertion that the project impacts to wildlife and wildlife habitat will be "minor".

- Section 2.3.2.2 indicates that, "These impacts are expected to be minor given the mobile nature of most wildlife in the area, the availability of similar habitat adjacent and near the Project, and the compatible nature of the restored right-of-way with species occurring in the area". This statement in unsupportable given our current understanding of the ecological consequences of edge effects upon sensitive forest species such as salamanders and other amphibians. The ROW expansion will decrease soil moisture levels in the adjacent forest floor and leaf litter resulting in fundamental changes in soil chemistry and biota. The ROW expansion, coupled with the associated edge effects is likely to present a barrier to movement of sensitive species.
- No analysis of potential increases in tree mortality associated with enhanced wind vectors along the forest edge is provided.

Adjacent Forest Regeneration, Structure, Function

- No discussion or analysis is present regarding the impact that increasing edge effects will have upon long term forest successional trajectory and associated biodiversity. Changes in the depth of edge effects penetrating into the forest may change the regeneration potential of desirable tree species due to lowered soil moisture levels and competition from early successional, invasive species.
- Increases in mortality amongst mature, canopy-level trees along the disturbance edge are likely to occur due to construction damage to root systems, changes in soil

moisture levels, and catastrophic wind throw. The loss of this structural and functional diversity should be evaluated with respect to species such as the Indiana Bat that utilize structurally rich tree canopy. Mitigation strategies to enhance tree retention in the buffer zone between the core forest and the ROW should be developed.

- Despite the overwhelming scientific consensus regarding the disruptive role that excessive white-tailed deer (*Odocoileus virginianus*) herbivory has upon forest regeneration and associated biodiversity (Latham, et.al. 2005), the EA ignores the impact that expansion of the ROW will have upon this key species. Additional ROW and the associated early successional species will likely increase local deer population levels with resulting damage to adjacent forest resources. A full examination of this impact, along with mitigation strategies, is warranted.

Biological Invasion by Invasive Species

- With the exception of section 2.2.4.2 (Wetland Crossing Methods, General Impacts, and Mitigation) and section 2.3.1.2 (General Impacts and Mitigation) the EA does not discuss the threat of invasive species incursions. As invasive species colonization and establishment of new sites is facilitated by disturbance and a transport/vectoring pathway (such as a linear ROW corridor) this impact component is likely to be significant in both scope and scale.
- The EA should clearly define the regional authority to be adhered to when determining target invasive species of concern. New organisms may become

established during the service life of this infrastructure and the ability to respond with appropriate intervention tactics is vital to forest health.

- It is recommended that section 2.3 be expanded to include an analysis of the threat potential to forest health from the inadvertent introduction and facilitation of the spread of invasive terrestrial invertebrates and pathogens. The current analysis only mentions, however briefly, invasive plants.
- Section 2.3.1.2 recommends that TGP be responsible for "the removal of invasive species from the right-of-way..." and that monitoring and reapplication of herbicides would be managed on an "as-needed" basis for the first five years after construction. Given that edge habitat and periodic mowing of the right-of-way will continuously promote the incursion and establishment of invasive species, and that the invasive seed bank within the soil can last for 10 to 15 years for many species, TGP should be held responsible for invasive monitoring and treatment for the service life of the ROW. Should this not occur, upon cessation of periodic treatment invasive plants will become re-established and adversely affect forest and ecosystem functioning.
- Section 2.3 should also be expanded to include an analysis of the impact that increases in forest edge habitat will have upon the incursion and establishment of invasive plant species. Edge habitat is inherently attractive to the type of plant species that display invasive characteristics. Periodic re-infestation of edge habitat by invasive plant species is highly probable given the high light levels and frequent deposition of wind-borne and bird-deposited seeds. The creation of additional edge habitat in combination with a linear corridor is likely to result in chronic, localized infestations of undesirable species that will require regular, and expensive, control

interventions. The creation of forest edge is, in and of itself, an important precursor to biological invasion.

- Section 2.3 should be expanded to provide a measurable metric, such as percent cover reduction from pre-disturbance levels, for quantifying levels of invasive control. The recommendation strategy that, TGP be responsible for "the removal of invasive species from the right-of-way..."is inherently unrealistic and unworkable. Seed sources for the most common invasive plant species in NJ and PA are ubiquitous in the environment. Effective invasive species control for these already established organisms is suppression, not eradication. Suppression must be conducted until such time as a self-regenerating assemblage of native species effectively dominates the site. In the case of the ROW, this would be upon decommissioning of the pipeline.

- Section 2.3.1.2 fails to provide a spatial framework for the area of invasive species control responsibility. Invasive species are highly mobile and akin to a wildfire in their dispersal from initial point of infestation. At a minimum, TGP should be required to manage invasive infestations within the forest buffer zone. Failure to do so will result in migration of these species off-site and the transfer of the financial burden of control onto adjacent property owners.
- As prevention is more cost effective than control, requirements should be adopted for independent site inspections by a qualified ecologist on no less than a six month basis. Failing to provide for frequent site inspections assures compliance will be minimal.

Cumulative Impacts of Marcellus Shale Extraction

- Section 2.10 claims to follow the methodology set forth by the Council on Environmental Quality and EPA regarding criteria for inclusion of differing projects in a cumulative impacts analysis. As such, the cumulative impact of Marcellus Shale development is included in the EA analysis. However, the causal relationship between pipeline capacity expansion and the facilitation of Marcellus development is not explored. The EA merely makes the unsupported statement that, "...the cumulative impacts of Marcellus Shale drilling activities are not sufficiently causally related to the Project to warrant the comprehensive consideration of those impacts in this EA." This is puzzling as the expansion is obviously being planned as a conduit for additional gas extracted from the Marcellus.
- The EA also arbitrarily restricts consideration of the cumulative project impacts to the construction phase. This allows the EA to indicate that the cumulative impacts, when compared to the Marcellus build-out timeframe of 20 to 40 years, are not significant. However, the impacts to vegetation and wildlife do indeed continue to occur throughout the life of the pipeline and the service life of the transmission system is designed for decades of service. During this time the pipeline will be facilitating the transfer of Marcellus gas. As such, a more comprehensive analysis of Marcellus impacts is warranted.

Summary

As currently written, the FERC Environmental Assessment of the Northeast Upgrade Project does not provide an adequate assessment of the likely forest ecology impacts associated with the pipeline system. It also fails to recommend potential mitigation strategies and options that would offset and reduce the full impacts anticipated for native terrestrial ecosystems. Protection of these terrestrial ecosystems is critical to the continued health of the regions' aquatic and terrestrial resources. Inadequate attention has been given to the following vital considerations; Forest Edge Effects, Adjacent Forest Regeneration, Structure & Function, Biological Invasion by Invasive Species, and the Cumulative Impacts of Marcellus Shale Extraction. Failure to address these areas of concern will assure undesirable, cascading impacts will eventually undermine the ecological integrity of forested systems adjacent to the project area.

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EARTHJUSTICE

ALASKA CALIFORNIA FLORIDA MID-PACIFIC NORTHEAST NORTHERN ROCKIES
NORTHWEST ROCKY MOUNTAIN WASHINGTON, DC INTERNATIONAL

July 11, 2011

Via Electronic Mail: efiling@ferc.gov
Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, NE, Room 1A
Washington, DC 20426

Re: Comments on Environmental Assessment of MARC I Hub Line Project, Docket No. CP10-480-000

Dear Ms. Bose:

On behalf of the proposed interveners, Coalition for Responsible Growth and Resource Conservation, Damascus Citizens for Sustainability, and Sierra Club, we respectfully submit the following comments on the environmental assessment ("EA") of the MARC I Hub Line Project ("Project") proposed by Central New York Oil and Gas Company, LLC ("CNYOG"). For the reasons explained below, the EA cannot serve as the basis for a hard look at the Project's environmental impacts or support a finding of no significant impact ("FONSI"). To the contrary, the available evidence demonstrates that the Project will significantly affect the quality of the human environment and that a full environmental impact statement ("EIS") should be prepared to ensure that the Federal Energy Regulatory Commission ("FERC" or the "Commission") satisfies its obligations under the National Environmental Policy Act ("NEPA"), 42 U.S.C. §§ 4321–4370f (2006).

The inadequacy of the EA and the failure to prepare an EIS are particularly disturbing because the Project is proposed to slice through one of the few remaining areas of northeastern Pennsylvania that is still unmarred by intensive gas development. The pipeline corridor would be located within the Endless Mountains Heritage Region, where "there would be a permanent conversion of forest land to open land." EA at 63–64. "The landscape in the Project vicinity contains substantial forested habitat, including interior habitat," which is "the migratory bird habitat of greatest abundance and sensitivity."[1] *Id.* at 48. The Project is "within the range of the [endangered] Indiana bat." *Id.* at 50. In addition, "the Project would be within HQ or EV watersheds,"[2] crossing at least 111 waterbodies, *id.* at 34, including a creek within the Coldwater Heritage Program, *id.* at 63. In most of Sullivan County, these areas are still intact and pristine, available for outdoor recreational activities that can be pursued only in quiet, verdant spaces.

[1] Exhibit A to these comments includes a series of maps illustrating some of the vulnerable natural resources on which the Project and newly developed gas wells and infrastructure will have significant impacts.

[2] "HQ" refers to "high quality," and "EV" refers to "exceptional value."

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All of this will change radically and irretrievably, if the Project provides the "enhanced market access" to gas wells that is its express purpose. The proposed interveners oppose the Project, as inconsistent with public convenience and necessity, and they urge the Commission at the very least to prepare an EIS before transforming this rural retreat into an industrial zone.

I. The EA Cannot Support a FONSI.

The EA for the Project has omitted too much required information and analysis to support a FONSI. Most importantly, the EA lacks an adequate analysis of cumulative impacts, fails to evaluate key alternatives to the Project, and reveals repeated neglect to collect or analyze information needed to support its recommendations. Deficiencies in the issue-specific discussions of impacts, detailed below, further undermine the sufficiency of the EA.

A. The Cumulative Impacts Analysis in the EA Is Inadequate.

The EA's treatment of cumulative impacts falls short of what is required by NEPA. First, the EA fails to consider the full scope of impacts. It also assesses the identified impacts without providing any detailed or quantified data to support the analysis. Finally, the EA impermissibly relies entirely on presumed compliance with permitting requirements to justify its conclusion that no significant cumulative impacts will result from the Project. As is explained below, such inadequacies render the cumulative impacts analysis legally insufficient, and the EA therefore cannot support the FONSI recommended by FERC staff.

1. The EA Fails to Consider the Full Scope of Impacts.

Under NEPA and its implementing regulations, 40 C.F.R. Pts. 1500–08 (2010), federal agencies must consider the direct, indirect, and cumulative impacts of the Project and all connected, cumulative, and similar actions. *See* 40 C.F.R. § 1508.25.

Actions are connected if they:

(i) Automatically trigger other actions which may require environmental impact statements.

(ii) Cannot or will not proceed unless other actions are taken previously or simultaneously.

(iii) Are interdependent parts of a larger action and depend on the larger action for their justification.

Id. § 1508.25(a)(1). The Council on Environmental Quality ("CEQ") regulations implementing NEPA define "similar actions" as those that "have similarities that provide a basis for evaluating their environmental consequences together, such as common timing or geography." *Id.* The regulations also provide that agencies should analyze similar actions in a single impact statement "when the best way to assess adequately the combined impacts of similar actions or

reasonable alternatives is to treat them in a single impact statement." *Id.* § 1508.25(a)(3). Under the CEQ regulations, cumulative impacts, are:

> impact[s] on the environment which result[] 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. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

Id. §§ 1508.7–1508.8. These standards also apply when an agency prepares an EA.

The EA states that its cumulative impacts analysis assesses actions that:

- impact a resource area potentially affected by the proposed project;
- cause this [e]ffect within all or part of the proposed project area; and
- cause this [e]ffect with[in] all, or part, of the time span for the potential [e]ffect from the Project.

EA at 96. FERC staff also represent that they have "considered existing or reasonably foreseeable actions expected to affect similar resources during similar time periods with the Project." *Id*. In fact, however, the EA fails to assess the full range of connected and similar actions as well as the cumulative impacts within this identified scope.

Most significantly, the EA fails to assess the additive effect of the Project together with the effects of existing or reasonably foreseeable gas development activities in the Project area, including the impacts of gas exploration and production and the construction and operation of well pads, access roads, gathering lines, compressor stations, and other infrastructure. Instead, FERC staff summarily dismisses the Commission's obligation to consider the effects of these connected actions, citing "the wide extent of the Marcellus Shale" and the "development of the natural gas reserves . . . [over] 20 to 40 years." EA at 102. On those grounds, the EA states that "the exact location, scale, and timing of future Marcellus Shale upstream facilities that could potentially contribute to cumulative impacts in the proposed project area is unknown and, thus, outside the scope of [the cumulative impacts] analysis." *Id.*

Notably, this excuse addresses only "future Marcellus Shale upstream facilities." *Id.* The EA does not even purport to explain why it has ignored past and present development, despite its (highly misleading) statement that "[d]rilling activities for Marcellus Shale natural gas reserves are ongoing throughout the proposed project area in Pennsylvania."[3] *Id.* at 101

[3] In fact, a wide belt of Sullivan County has remained largely free of drilling activities, presumably for lack of ready access to transmission lines. *See* Exhibit A at 1. South of MP16, only three wells have been drilled in the entire county. But for the Project, which is designed expressly to create "enhanced market access to Marcellus Shale Producers," EA at 110, this large undisturbed area could remain protected from

The EA further acknowledges that "[i]mpacts of these drilling activities are associated with well pad development, improvement of existing dirt and paved roads, and construction of gathering systems and rights-of-way." *Id*. *N*evertheless, FERC staff makes no attempt to assess the additive effect of the Project together with the known environmental effects of those activities. Rather, in defiance of NEPA, the EA explicitly identifies past and present actions with environmental impacts in the Project area, yet entirely fails to look, much less to take a hard look, at those impacts.

With respect to reasonably foreseeable activities, neither the long temporal duration nor the broad geographic extent of the gas development absolves FERC of its duty to take a hard look at cumulative environmental impacts. That development of Marcellus Shale reserves "is expected to take 20 to 40 years," *id.* at 102, does not exempt it from consideration in the EA. The cumulative impact analysis, in the EA's own words, must encompass consideration of actions that cause an effect within "all, or part, of the time span" of the proposed Project's effects. *Id.* at 96. Strikingly, 20 to 40 years is precisely the time span over which even FERC staff predict impacts on forested land temporarily cleared for construction, *see id.* at 55 ("[I]t would take between 20 and 40 years for some of the trees in these areas to regenerate to preconstruction condition . . . ."), and there necessarily would be impacts on permanently cleared land during that period. The EA thus excludes consideration of effects of gas development activities that are encompassed within the temporal scope of a proper cumulative impact analysis.

The same is true for the geographic scope of the required cumulative impact analysis. The EA admits that the geographic scope of the cumulative impacts analysis should encompass consideration of actions that "impact a resource area potentially affected by the proposed project" and "cause this effect within all or part of the proposed project area." *Id.* at 96. Publicly available maps of permitted gas wells in Pennsylvania show the locations of wells that already have been drilled in the three counties to be crossed by the Project as well as the locations of wells that have been permitted for drilling.[4] FERC cannot avoid providing a thorough analysis of the impacts of *past and present* wells, which in turn provide evidence of the impacts of *future* wells, and staff cannot argue that the location, scale, and timing of future wells that are already mapped and permitted are "unknown."

The EA also ignores other resources that could be used to define reasonable build-out scenarios for the cumulative impacts analysis required under NEPA. FERC already has privileged information identifying three potential customers for the Project. Those customers could not have executed Precedent Agreements without having plans to ship a collective

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all the adverse environmental impacts of gas exploration and production. The site of active drilling identified in the EA, *id.* at 101, is in Bradford County.

[4] *See* Pennsylvania Dep't of Envtl. Prot., Permits Issued & Wells Drilled Maps, *available at* http://www.dep.state.pa.us/dep/deputate/minres/oilgas/2011PermitDrilledmaps.htm (last visited July 7, 2011) (providing links to Pennsylvania state maps showing location of wells drilled 2008-2011 and wells for which permits have been issued during 2011).

550,000 Dth/day of gas through the pipeline.[5] We understand that CNYOG expects to learn shortly where the shippers plan to tap into the Project, providing further information about the location of gathering lines and well development. There is no evidence in the EA that staff made any effort to obtain this or any other information in the shippers' possession that would readily assist FERC in assessing cumulative impacts. Nor does the EA analyze information about compressor stations in the Project region, even though the proposed interveners filed with FERC a list of air permit applications for compressors noticed in the Pennsylvania Bulletin.[6] That list demonstrates the ready availability to FERC of information about the locations of connections to gas pipelines and the extent of predicted air emissions from the facilities.

Maps prepared by the Bradford County Planning Commission also offer a wealth of information that FERC has ignored.[7] The maps show 1,666 wells permitted in the County – 1.4 per square mile – just in the three years between July 2008 and April 2011, as well as already constructed and proposed transmission and gathering lines. In addition, potential sources of water and soil pollution, including impoundments and treatment facilities, have been mapped. If the Planning Commission can obtain such detailed information for Bradford County, FERC should be able to obtain comparable information for Sullivan and Lycoming Counties. Even without that data, the Bradford County maps offer a blueprint for intensive gas drilling over just three years, which the MARC I can be expected to accelerate in Lycoming County and to induce in Sullivan County – where the absence of a transmission line has deterred gas development.

Independent experts also may be consulted to assist the Commission in developing accounts of reasonably foreseeable gas development. Dr. Terry Engelder, Professor of Geosciences at Pennsylvania State University, estimates that approximately 2,500 wells could be developed on approximately 300–500 well pads in Sullivan County.[8] Scientists at The Nature Conservancy have estimated that 60,000 wells could be drilled over 20 years on between 6,000 and 15,000 new well pads statewide, with the densest development in the southwestern, north-central, and northeastern parts of the state – where the three counties directly affected by the Project are located.[9] In the Nature Conservancy study, one of the factors that correlated with the likely development of gas wells was the proximity to pipelines.[10]

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[5] *See* Abbreviated Application of Central New York Oil and Gas Company LLC for Certificate of Public Convenience and Necessity (MARC I Project), FERC Docket No. CP10-480-000, at 6 (Aug. 6, 2010).
[6] *See* Comments of Coalition for Responsible Growth & Resource Conservation, Damascus Citizens for Sustainability, and Sierra Club on the MARC I Hub Line Project, FERC Docket No. CP10-480-000, Submittal 20110308-5064, Exhibit 4 (filed Mar. 8, 2011).
[7] Maps of Natural Gas Development in Bradford County, http://www.bradfordcountypa.org/Natural-Gas.asp?specifTab=2 (last visited July 5, 2011) (containing links to various maps, including "Overall Gas Activity Map," "Company Gas Map," "Gas Line Map," and "Quarterly Progression"); *see also* Exhibit A.
[8] *See* Statement of Terry Engelder, Ph.D. (July 6, 2011) (annexed hereto as Exhibit B).
[9] The Nature Conservancy, *Pennsylvania Energy Impacts Assessment*: *Report 1 Marcellus Shale Natural Gas and Wind* 5 (2010) [hereinafter TNC Report], *available at*

Finally, FERC does not need to know the precise location, scale, and timing of each individual well that will be developed in the Project region to analyze the cumulative impacts of the Project. The Nature Conservancy used aerial photographs of existing wells and infrastructure, for example, to estimate land clearance per well and the associated impacts on forests, freshwater habitats, species of conservation concern, and outdoor recreation. As long ago as December 2009, the New York State Department of Environmental Conservation ("DEC") collected a substantial amount of information about the impacts of a typical Marcellus Shale well in its Draft Supplemental Generic Environmental Impact Statement ("DSGEIS") for New York's oil and gas regulatory program, and on July 8, 2011, DEC released a partial revision of the DSGEIS.[11] Those documents offer far more analysis than is contained in the EA, citing literature that has been ignored by FERC staff. Moreover, experience in Pennsylvania during the last three years of intensive drilling has offered additional insight into the predictable effects of shale gas development, including the frequency of leaks, spills, blowouts, and other incidents affecting the waters of the state as well as pollution from gas wastewater disposal and air emissions.

In the face of all this information and analysis, the authors of the EA cannot just throw up their hands and claim that gas development impacts are "unknown and, thus, outside the scope of our analysis." EA at 102. Although "'foreseeing the unforeseeable' is not required, an agency must use its best efforts to find out all that it reasonably can." *City of Davis v. Coleman*, 521 F.2d 661, 676 (9th Cir. 1975). FERC cannot rely on the EA to meet this obligation.

2. The Cumulative Impacts Analysis Is Devoid of Detailed, Reasoned Conclusions and Quantified Information.

Consideration of cumulative effects pursuant to NEPA requires "some quantified or detailed information," because "[w]ithout such information, neither the courts nor the public, in reviewing the [agency's] decisions, can be assured that the [agency] provided the hard look that it is required to provide." *Neighbors of Cuddy Mountain v. U.S. Forest Serv.*, 137 F.3d 1372, 1379 (9th Cir. 1998); *see also Klamath-Siskiyou Wildlands Ctr. v. Bureau of Land Mgmt.*, 387 F.3d 989, 993–94 (9th Cir. 2004) ("A proper consideration of the cumulative impacts of a project requires some quantified or detailed information; general statements about possible effects and some risk do not constitute a hard look absent a justification regarding why more definitive information could not be provided.") (internal quotation marks and citations omitted). The cumulative impact analysis in the MARC I EA is inadequate because it presents only general, conclusory statements and fails to provide quantified or detailed information to support its conclusions.

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http://www.nature.org/media/pa/tnc_energy_analysis.pdf (annexed as Exhibit F to Reply to Answer of CNYOG to Comments of Earthjustice on Scope of Environmental Assessment for the MARC I Hub Line Project, Submittal 20101214-5089 (Dec. 14, 2010)).

[10] *Id.* at 13.

[11] The DSGEIS is available at http://www.dec.ny.gov/energy/58440.html, and the Preliminary Revised DSGEIS is available at http://www.dec.ny.gov/energy/75370.html.

With regard to groundwater resources, for instance, the EA first notes that the construction and operation of four nearby pipeline projects will use "appropriate or required procedures . . . to minimize or avoid impacts." EA at 103. The EA then notes that the Project will have only a "minor effect on groundwater resources." *Id.* The EA then summarily concludes, without providing any details or quantified data, that "construction and operation of the Project are not expected to have a significant adverse or cumulative impact on groundwater resources." *Id.* at 104. The EA provides no factual details, quantified analysis, or reasoned basis for concluding that "minimized" (but still real) impacts of the four projects (much less the impacts of well development, which already is associated with groundwater contamination in Bradford and Lycoming Counties), when added to the supposedly "minor effect" of the MARC I, will not be cumulatively significant. The EA's conclusory reliance on compliance with permitting requirements and laws to determine that no significant cumulative impacts will result is seen throughout the analysis. The flaws in this approach are discussed in greater detail in Section I(A)(3), below.

Relatedly, the EA fails to provide any quantified or detailed assessment of the combined environmental impacts of the Project together with four nearby pipeline projects. In *Klamath-Siskiyou*, the court found that a cumulative impact analysis that qualitatively identified the impacts of various projects as "unchanged," "improved," or "degraded," and "major" or "minor," was inadequate because "[t]he reader is not told what data the conclusion was based on, or why objective data cannot be provided." 387 F.3d at 994. The Project's EA is similarly inadequate in the way it describes the impacts of nearby projects in the most general terms, notes the "minor" impact from the Project, and repeatedly concludes that the Project will not have a cumulatively significant impact, without providing any data to support its conclusion or an explanation why objective data cannot be provided.

With respect to vegetation and wildlife impacts, for instance, the EA acknowledges that "[t]he development of the Project and other projects in the area could result in habitat fragmentation," but summarily concludes that "[t]he potential for habitat fragmentation from the Project would be reduced because the temporary workspace would be allowed to return to pre-existing conditions." EA at 106. The EA recognizes, however, that forest "impacts within temporary workspaces would be long-term" – on the order of *20–40 years*. *Id.* at 55. It also acknowledges that the Project will require *permanent* clear-cutting where the right-of-way is forested, *id.*, and that "[t]he combination of drill pads and production facilities and pipelines could alter the vegetation in the area, changing species composition and reducing overall fitness," *id.* at 106. Notwithstanding these admissions, the EA does not state any conclusion about the significance of these effects for vegetation and wildlife – much less "specific, reasoned conclusions" – nor does it provide hard data justifying a FONSI as to cumulative impacts on those resources.

The absence of reasoned conclusions and quantified data supporting the conclusion of no significant cumulative impacts also is evident in the EA's cumulative impact analysis of land

use, visual resources, and recreation. *See id.* The EA concedes that "Project impacts on the same land types impacted by development of the [Marcellus Shale] gas reserves could have cumulative land use impacts on these resources." *Id.* The EA further acknowledges that "[v]isual impacts created by the recovery of the Marcellus Shale gas reserves would include: maintained rights-of-way for gathering pipelines; well pads; compressor stations; meter stations; and gas processing facilities," and that "[i]f the recovery of the Marcellus Shale gas reserves took place in areas that are useful for recreational activities at the same time and location as the Project, cumulative recreational impacts could be anticipated." *Id.* The EA nevertheless concludes, without further factual detail or quantified data, that because "project-related disturbed areas would revert to pre-construction conditions" and the "proposed project construction would only temporarily affect recreational activities in the immediate construction area[,] as would most gas recovery activities," significant long-term cumulative impacts are not anticipated. *Id.*

Not only is this conclusion unsupported by "quantified or detailed information," it also is unsupported by reason and contradicted by other statements in the EA. The "temporary" nature of impacts from the proposed project construction is illusory, given that the EA has conceded that the 20–40 year time period for temporary clearings to return to preconstruction condition means that "*impacts within temporary workspaces would be long-term*." EA at 56 (emphasis added). Thus, FERC staff cannot rely on the fact that "project-related disturbed areas would revert to pre-construction conditions" to dismiss the significance of activities that the EA otherwise concedes "could have cumulative land use impacts." Similarly, reliance on the fact that Project construction "would only temporarily affect recreational activities" as a basis for the conclusion that no significant long-term cumulative impacts are anticipated is unsupportable. The failure even to mention the usurpation of traditional hunting, fishing, birdwatching, and hiking areas by loud and intrusive gas development activity only compounds the deficiencies of the analysis.

An appropriately quantified cumulative impact analysis requires an evaluation of actual environmental effects, not mere recitation of land use statistics. Thus, while "[a] calculation of the total number of acres to be harvested in the watershed is a necessary component of a cumulative effects analysis, . . . it is not a sufficient description of the actual environmental effects that can be expected from logging those acres." *Klamath-Siskiyou*, 387 F.3d at 995. Here, too, the EA fails. The EA lists the number of acres of wetlands and forest affected by four other pipeline projects, but it does not identify the location of these affected acres, relate them to the wetlands or woodlands affected by the Project, or provide any actual assessment of the cumulative effects on those resources. Nor is there any effort to quantify the impacts of well development on freshwater habitats or forests, notwithstanding the availability of The Nature Conservancy's model for doing so and DEC's endorsement of that approach. Such a perfunctory discussion is inherently deficient and cannot support the FONSI for this Project. *See id.* at 994 ("The analysis must be more than perfunctory; it must provide a useful analysis of the cumulative impacts of past, present, and future projects.") (internal quotation marks and citations omitted).

3. In Lieu of Providing the Required Independent Assessment of Cumulative Impacts, the EA Impermissibly Invokes Compliance with Other Agencies' Permitting Requirements as the Basis for a FONSI.

Throughout the cumulative impacts analysis, FERC staff abdicates its NEPA responsibilities by categorically deferring to standards administered by other agencies, without independently assessing anticipated impacts. *See Calvert Cliffs' Coordinating Comm. v. U.S. Atomic Energy Comm'n*, 449 F.2d 1109, 1123 (D.C. Cir. 1971) (holding that lead agency's deferral to standards of other agencies neglected NEPA's "mandated balancing analysis"). To the extent that the EA addresses impacts related to gas development, it does not independently assess the impacts from such activities and only points to compliance with other agencies' permitting requirements as a basis for concluding that no significant cumulative impacts exist. *See, e.g.*, EA at 103 (noting concerns about potential impacts of natural gas wells on groundwater, then describing in general terms oil and gas well rules adopted by the Pennsylvania Department of Environmental Protection ("PADEP") without further assessment or reasoned conclusion about the cumulative impacts of gas wells and the Project);[12] *id.* (noting that the construction of four nearby pipeline projects would use "appropriate or required procedures near water wells or when crossing well-head protection areas" and concluding that "significant adverse or cumulative impact on groundwater resources" are not expected); *id.* at 105 (conceding that "[d]rilling, production, and gathering activities . . . could impact wetlands," but dismissing these impacts on the grounds that the U.S. Army Corps of Engineers ("USACE") "would oversee permitting of wetland impacts" and "PADEP has developed [best management practices] for the construction and operation of upstream oil and gas production facilities").

Such blind acceptance of presumed compliance with standards implemented by another agency as a basis for a FONSI does not suffice as a hard look under NEPA. In *Calvert Cliffs'*, the Atomic Energy Commission ("AEC") promulgated rules governing environmental review in licensing decisions, which similarly would have allowed the AEC to accept a project's compliance with the environmental requirements implemented by other agencies as a showing that the project would have no significant impacts for purposes of NEPA. *See* 449 F.2d at 1122. The D.C. Circuit rejected this approach:

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[12] Since adoption of the new rules, there have been repeated reports of methane migration into streams and groundwater serving water wells in areas of active gas drilling, including in Bradford and Lycoming Counties. *See, e.g.*, Associated Press, *Pa. Probes Gas in Lycoming Wells* (June 17, 2011) (noting contamination of wells, Little Muncy Creek, and the Susquehanna River), *available at* http://www.philly.com/philly/business/124054549.html. Moreover, a cursory review of violations posted on PADEP's website shows that noncompliance with legal requirements is rife within the industry. *See, e.g.*, PADEP, Oil and Gas Inspections, Violations, Enforcement (Jan.–Apr. 2011), *available at* http://www.dep.state.pa.us/dep/deputate/minres/oilgas/OGInspectionsViolations/2011/2011MarcellusViolations.xls. Plainly, the regulations alone are inadequate to protect underground sources of drinking water.

> Certification by another agency that its own environmental standards are satisfied involves an entirely different kind of judgment [than the case-by-case balancing judgment mandated by NEPA]. Such agencies, without overall responsibility for the particular federal action in question, attend only to one aspect of the problem: the magnitude of certain environmental costs. They simply determine whether those costs exceed an allowable amount. Their certification does not mean that they found no environmental damage whatever. In fact, there may be significant environmental damage (*e.g.*, water pollution), but not quite enough to violate applicable (*e.g.*, water quality) standards. . . . The only agency in a position to make [the balancing] judgment is the agency with overall responsibility for the proposed federal action . . . .

Id. at 1123. As the court pointed out, permitting requirements "essentially establish a *minimum condition*" for approval of a project, *id.* at 1125 (emphasis in original), and do not necessarily indicate whether a project's impacts will be significant as understood in the NEPA context. Moreover, AEC's "abdicati[on] entirely to other agencies' certifications, neglected the mandated balancing analysis," which had the effect of precluding the public from "raising a wide range of environmental issues in order to affect particular Commission decisions," and thereby "subverted" NEPA's "special purpose." *Id.* at 1123. Deferral to the standards of other agencies, without further analysis, is an impermissible delegation of an agency's NEPA responsibilities.

Here, the EA subverts NEPA's purpose by repeatedly pointing to oil and gas well permitting standards as reason for concluding that the Project will have no significant cumulative impacts when considered in the context of Marcellus Shale gas development. *See, e.g.*, EA at 104 (noting that pipeline projects "would be required to implement appropriate erosion control measures during construction and to comply with the PADEP's permitting requirements"); *id.* at 105 (drilling, production, and gathering activities "would also comply with any federal, state, and local requirements to maintain erosion control devices to limit erosion and sedimentation"); *id.* at 108 ("Other permanent sources of noise associated with the Marcellus Shale development activities such as drilling, pumping station, gathering and intrastate compression facilities would be required to meet any local noise requirements, which may reduce overall cumulative impacts."). The EA fails to recognize, however, that gas well development is not even subject to the requirements on which the FERC staff relies for its unfounded conclusions. *See* 25 Pa. Code § 102.5 (exempting oil and gas activities on less than five acres from obtaining an erosion and sedimentation permit); *id.* § 102.14 (exempting oil and gas activities from riparian buffer requirements "so long as any existing riparian buffer is undisturbed to the extent practicable").

Moreover, even if environmental requirements did apply and effectively mitigated impacts from any single project, categorical reliance on compliance with such requirements for a FONSI for the Project would fail to constitute a hard look for the reasons identified by the D.C. Circuit in *Calvert Cliffs'*. The permit requirements of individual agencies establish minimum standards regarding specific resources that typically are applied to specific projects in

isolation from each other. Relying on compliance with such requirements, without providing an independent assessment of impacts and quantified information to support a detailed and reasoned conclusion, fails to satisfy NEPA and prevents the public from understanding the full cumulative impacts of the Project.

B. The EA's Failure to Consider Any Alternative to the Project That Would Not Require Greenfield Development Violates NEPA.

The EA's failure to consider a reasonable range of alternatives frustrates the fundamental purpose of NEPA: to inform the public and decision-makers of the environmental consequences of a proposed action. The discussion of alternatives is at the heart of this process, yet the EA provides no meaningful consideration of alternatives to FERC's authorization of CNYOG's construction and operation of the MARC I Project. Specifically, the EA fails to consider alternative pipeline routes that would meet CNYOG's stated objectives while minimizing the environmental impacts of the project.

Under NEPA, "all agencies of the Federal Government shall study, develop, and describe appropriate alternatives to recommended courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources." 42 U.S.C. § 4332(2)(E) ("Section 102(2)(E)"). This requirement applies to the preparation of both EISs and EAs. *See*, *e.g.*, *Gov't of the Province of Manitoba v. Salazar*, 691 F. Supp. 2d 37, 45–46 (D.D.C. 2010) (applying Section 102(2)(E) alternatives analysis requirement to the EA for a water supply project). Here, the EA violates NEPA's requirements by failing to identify any alternative that would not involve the construction of a new corridor through areas untouched by gas development or pipeline construction in Sullivan County.

While the EA refers to "pipeline route alternatives and variations," it fails to consider any alternative route or variation that would not involve "greenfield" development, *i.e.*, the construction of a new corridor through previously undisturbed land. *See* EA at 111. This deficiency is particularly glaring given the ecologically sensitive nature of the area through which CNYOG proposes to build its pipeline. The "route alternatives" that are identified in the EA (Routes A, B, and C) represent minor variations of the same pipeline path – an approximately 39-mile-long right-of-way that cuts through the Endless Mountains of Sullivan County in order to connect the TGP and Transco transmission lines – and all of those routes are located within, at most, five miles of each other. *See* EA at 112–14, App. 7. Whether the Project is sited along Route A, B, or C, construction will result in similarly adverse and significant impacts to the environment because any one of these routes will entail the permanent alteration of hundreds of acres of land, including the clearing of trees and the likely disturbance of more than a hundred streams.

The EA states that "collocation of the Project with existing utility and road rights-of-way" was investigated and that "[FERC's] review of topographic and aerial photos of the project area show that there are no existing generally north-south trending corridors that might

be followed to accomplish the purpose of the Project." EA at 111. However, at least two north-south corridors between the TGP and Transco lines – an existing corridor to the west and a soon-to-be-constructed one to the east of the proposed Project route[13] – were not even mentioned in the EA's discussion of alternatives.[14] Locating the Project along the same right-of-way as another pipeline, such as the Williams Springville or the PVR gathering lines, would substantially reduce the Project's impacts, especially its forest fragmentation impacts.[15] The PVR gathering line is located about 38 miles to the west of CNYOG's proposed route; the Williams Springville gathering line will connect to the TGP pipeline just 15 miles from where CNYOG has proposed to connect the Project to the TGP pipeline. FERC's failure to include a discussion of these feasible, environmentally preferable alternatives was unreasonable and renders the EA – and any FONSI that is based upon it – inadequate.

The EA fails to include a discussion of the less destructive alternative routes, even though they can achieve CNYOG's objectives. According to the EA, the primary purpose of the Project is "to provide enhanced market access to Marcellus Shale Producers and expanded transportation and storage options to shippers on TGP, Transco, CNYOG, and Millennium,"[16] EA at 110, yet the EA fails to consider any alternative that would fulfill this purpose other than a pipeline that cuts a new corridor through the Endless Mountains of Sullivan County. Because expanding transmission capacity does not necessitate the location of a pipeline through Sullivan County and because an alternative that collocates the Project with another pipeline right-of-way would have a "significant environmental advantage over the Project," *id.*, the EA cannot reasonably fail to consider such an alternative.

CNYOG also could provide enhanced market access to Marcellus Shale producers – albeit producers with wells in different locations – with a collocated transmission line. Such an alternative would not facilitate development in the pristine areas of Sullivan County, but industrializing that zone is not one of CNYOG's stated objectives. (If, in fact, the unstated but real purpose of the Project is to open Sullivan County's intact forest and sensitive watersheds to

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[13] A map depicting the location of two north-south gathering lines – the Penn Virginia Resource Partners, L.P. ("PVR") gathering line in Lycoming County and the William Springville gathering line in Wyoming County – is annexed as Exhibit C hereto. The pipeline corridors are approximate because the proposed interveners do not have access to alignment sheets for the lines.

[14] The EA acknowledges the existence of the PVR gathering line, listing it as an "unrelated project" in the cumulative impacts section. *See* EA at 98.

[15] Indeed, FERC regulations recognize that an EA may be prepared for a project that normally would require an EIS, when a proposed transmission line is located wholly within existing a pipeline right-of-way. *See* 18 C.F.R. § 380.6(a)(3).

[16] The EA identifies as one of its selection criteria for alternative routes, the "ability to meet the project objectives of providing an additional 367 MMcf/d to Georgia Power" as one of FERC's evaluation criteria for selecting alternatives. EA at 110. Obviously, this objective is irrelevant to the Project, and the quoted text apparently was lifted from an EA that FERC prepared in 2009 for the expansion of certain pipeline facilities in Georgia, Mississippi, and Alabama. *See* FERC, South System Expansion III Project and Joint Pipeline Expansion Phase II Project Environmental Assessment 92, FERC Docket Nos. CP09-36-000 & CP09-40-000 (June 2009).

intensive drilling, the EA's failure to analyze the significant impacts of that foreseeable and measurable activity in its discussion of cumulative impacts is all the more inexcusable.) In sum, an alternative that avoids greenfield development is technically feasible and practical, has a significant environmental advantage over the Project, and satisfies the Project's goals. Until FERC takes a hard look at that alternative to its proposed action, a FONSI cannot be justified.

C. FERC Has Not Collected, and the EA Has Not Analyzed, Information That Is Essential to Assessing the Significance of Project Impacts.

NEPA is an "environmental full disclosure law." *Monroe Cnty. Conservation Council, Inc. v. Volpe*, 472 F.2d 693, 697 (2d Cir. 1972). It requires that an agency obtain and consider detailed information concerning environmental impacts, and it "ensures that an agency will not act on incomplete information, at least in part, by ensuring that the public will be able to analyze and comment on an action's environmental implications." *Ohio Valley Envtl. Coal. v. U.S. Army Corps of Eng'rs*, 674 F. Supp. 2d 783, 792 (S.D. W.Va. 2009) (internal quotation marks and citations omitted). The information provided to the public "must be of high quality" because "[a]ccurate scientific analysis, expert agency comments, and public scrutiny are essential to implementing NEPA." 40 C.F.R. § 1500.1(b).

The EA fails to meet this standard. Not only is the cumulative impacts analysis devoid of necessary detail and analysis, *see supra* Section I(A)(2), but the discussion of direct impacts lacks factual support and reasoned analysis. All too often, key information relevant to the significance determination has been neither collected nor made available for public review. Indeed, the EA was released even though CNYOG has yet to respond to numerous data requests issued by FERC staff. *See* Exhibit D (summarizing unanswered questions). The EA therefore gives the impression of an agency in such great haste to grant CNYOG's application that it is prepared to make a decision before the necessary information is in. The refusal to collect data required to assess impacts or the efficacy of mitigation measures is inconsistent with FERC's obligations under NEPA.

1. Key Information about the Impacts of the Project Is Missing.

The EA for the Project clearly reveals that FERC has not yet collected or analyzed much needed data and information about the potential environmental impacts of the Project. FERC has failed to evaluate fully the potential impacts to the environment resulting from blasting that will be required for Project construction because CNYOG has not identified where it anticipates blasting. *See* EA at 26. The Project area, and the well development areas for which the Project will provide market access, have not been inspected for noxious weeds or other invasive plant species, and "CNYOG has not yet addressed how it would control potential invasive species". *Id.* at 44–45. CNYOG has not completed cultural resource surveys for over five miles of pipeline corridor, two access roads, proposed compressor station locations, or wareyards – much less for the foreseeable gas development zone. *Id.* at 69–70. CNYOG also has not submitted a revised tree clearing window to allow FERC to analyze the Project's full impacts on migratory birds,

nor has it performed "field surveys for several [bird] species that are vulnerable to forest fragmentation and wetland or stream damage." *Id.* at 49. Moreover, the EA offers no analysis of potential impacts on migratory birds in areas opened by the Project to gas exploration and production, including Important Bird Areas on both sides of the Project corridor in Sullivan and Lycoming Counties.[17]

Information relevant to the Project's potential impacts on water resources and fisheries also has not been collected or assessed. FERC has failed to evaluate potential impacts resulting from the proximity of this Project to an active coal mine, areas of methane-contaminated groundwater in both Bradford and Lycoming Counties, and other sources of water pollution, such as well sites, impoundments, and waste treatment plants. *See infra* Section I(D)(4). Although CNYOG "anticipates that the Project would be hydrostatically-tested in three separate test sections, with the longest section being about 20 miles long and requiring 3.84 million gallons of water," the company has not yet identified the locations from which it will withdraw and discharge the large amount of water that will be required for hydrostatic testing. EA at 37–38. Further, despite receiving comments regarding the Project's potential impacts on private water wells, FERC has still not obtained "survey data for domestic water wells that may be within 150 feet of access roads." *Id.* at 32. Nor has FERC collected data regarding wild trout streams, preferring instead to accept CNYOG's word that it will to "route[] the proposed waterbody crossings in an attempt to avoid any known coldwater trout fishing holes." *Id.* at 39. The presence of unassessed waters in the vicinity of the Project, and the discovery of native trout in recently assessed waters nearby, confirm that FERC has not secured the information it needs to support a FONSI.[18]

NEPA does not permit agencies to "act first and study later." *Nat'l Parks & Conservation Ass'n v. Babbitt*, 241 F.3d 722, 734 (9th Cir. 2001) ("*NPCA*"), *abrogated on other grounds by Monsanto Co. v. Geerston*, 130 S. Ct. 2743 (2010). The missing information discussed above, in addition to the missing information identified in Exhibit D, "is precisely the information and understanding that is required *before* a decision that may have a significant adverse impact on the environment is made." *Id*. at 733 (emphasis in original). Granting CNYOG's application, even with conditions requiring submission of information before construction begins, defeats NEPA's purpose, when there is so much missing information that could be collected before the Commission's decision is made. *Id.* (stating that an agency's "lack of knowledge does not excuse the preparation of an EIS; rather it requires the [agency] to do the necessary work to obtain it"). FERC therefore may not adopt a FONSI, until it fills the gaps in the EA with sufficiently detailed information and analysis to provide a full and accurate assessment of the direct, indirect, and cumulative impacts of the Project.

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[17] *See* Comments of Audubon Pennsylvania on Environmental Assessment of MARC 1 Hub Line Project, No. CP10-480-000, Submittal 20110707-5038 (filed July 7, 2011) [hereinafter Audubon PA Comment].
[18] Wild trout populations have been identified in recent surveys of previously unassessed streams. *See infra* Section I(D)(3)(d).

2. The Discussion of Mitigation Measures Is Impermissibly Perfunctory.

An agency must evaluate the efficacy of mitigation measures proposed in an EA to support a FONSI. *See Blue Mountains Biodiversity Project v. Blackwood*, 161 F.3d 1208, 1214 (9th Cir. 1998) (questioning the efficacy of a series of BMPs that were based on conditions not sufficiently similar to those of the conditions of the project area and determining that the discussion of the mitigation measures in the EA was not sufficient to support a FONSI); *NCPA*, 241 F.3d at 734–35 (determining that the National Park Service erred in issuing a FONSI in part because the agency did not assess the anticipated effects of the proposed mitigation measures); *Klamath-Siskiyou Wildlands Ctr. v. U.S. Forest Serv.*, 373 F. Supp. 2d 1069, 1082–83 (E.D. Cal. 2004) (finding a FONSI inadequate where the success of the mitigation measures proposed in the EA was uncertain). An agency may not rely on "[a] perfunctory description or mere listing of mitigation measures, without supporting analytical data . . . to support a finding of no significant impact." *NPCA*, 241 F.3d at 733 (internal quotation marks and citations omitted). FERC's discussions of numerous proposed mitigation measures in the EA fall far short of these requirements.

In *NPCA*, the court pointed to "a paucity of analytic data to support the [agency's] conclusion that the mitigation measures would be adequate" in reaching its determination that the agency had failed to show that an EIS was not necessary. *Id.* at 734. The court noted that the agency "did not conduct a study of the anticipated effects of the mitigation measures nor did it provide criteria for an ongoing examination of them or for taking any needed corrective action (except for the plan to conduct 'studies')." *Id.* The EA was inadequate because "speculative and conclusory statements are insufficient to demonstrate that the mitigation measures" support a FONSI. 241 F.3d at 735.

The EA for the Project is similarly deficient. For example, the EA admits: "Potential impacts to wildlife resulting from project construction would include habitat disturbance, displacement, and mortality. Habitat disturbance includes the direct loss (temporary or permanent) of vegetation communities as a result of project construction and/or operation." EA at 46–47. The EA dismisses these potentially significant impacts in a cursory discussion of mitigation measures:

> Once construction ceases and the right-of way-is restored, wildlife would return. Impacts to wildlife would be minimized in part by conducting and timing construction activities in accordance with guidance from regulatory agencies. Required restoration of wildlife habitat would be conducted in accordance with state agency rules and guidance.

Id. at 47. FERC's assumption that wildlife will return when the right-of-way is restored is completely unsubstantiated. *See id.* at 55 (noting that "it [will] take between 20 and 40 years for some of the trees in [the Project area] to regenerate to preconstruction condition"). FERC's perfunctory conclusion that impacts to wildlife will be mitigated by unidentified rules and guidance provided by state agencies is also unsupported by any data. The EA fails to describe

the rules and guidance that will be followed, identifies no studies or monitoring programs that establish the effectiveness of the wildlife restoration techniques that ostensibly will be required, and does not consider any alternatives in the event that these measures prove to be ineffective. FERC cannot conclude that this Project will not have a significant impact on the environment without this analysis. *See NPCA*, 241 F.3d at 733.

The EA is similarly inadequate with regard to its discussion of mitigation measures for crossing Loyalsock Creek, an Exceptional Value waterbody, "where steep side slopes could be of concern and where fracturing of the solid rock stream bottom would be required." EA at 35. To mitigate the impacts to the Creek, the EA proposes that CNYOG follow its Erosion and Sedimentation Control Plan ("ESCP"), implement a site-specific plan prepared for PADEP, and "comply with any additional protective measures required from the PADEP and USACE permit." *Id.* CNYOG has not yet received its permit from PADEP or USACE, *see* EA at 5, and neither the ESCP proposed in August 2010 nor the site-specific crossing plan prepared for PADEP, *id.* App. 2; Supplemental Data Responses of CNYOG, attachment 16b (Nov. 17, 2010), specifically addresses the fact that Loyalsock Creek is in non-attainment for water quality. Because the EA does not disclose whether the impairment of Loyalsock Creek has resulted in the contamination of sediments in the stream banks, it is impossible to determine whether disturbance of those soils could contribute to the water quality violation. The EA thus fails to show that the BMPs and mitigation measures proposed are sufficiently tailored to the conditions of the Project area to support a conclusion that they will be effective. *See Blue Mountains Biodiversity Project*, 151 F.3d at 1214.

The EA for the Project is replete with conclusory references to mitigation measures and BMPs that have not been analyzed. *See, e.g.*, EA at 24 (noting that "the Project would cross several steep slopes" but failing to evaluate whether BMPs and CNYOG's ECSP will successfully prevent slope failure); *id.* at 27 (revealing that "most of the southern half of the Project is classified as having soils with serious erosion potential" without providing data or studies to support its perfunctory conclusion that "CNYOG would adequately mitigate the potential for erosion . . . by implementing the erosion control measures in [its] ESCP"); *id.* at 28–29 (concluding summarily that CNYOG's ESCP and County Conservation District guidelines will mitigate impacts resulting from soil compaction, the introduction of rock into topsoil, and poor revegetation potential); *id.* at 31, 103 (acknowledging that pipeline construction "could affect groundwater resources" but failing to describe or evaluate the "standard and specialized construction techniques" CNYOG will use to mitigate this potential impact); *id.* at 37 (relying on NPDES permit conditions to mitigate against impacts from discharges of hydrostatic test water even though the applications have not been filed and the permit terms are unknown); *id.* at 41 (asserting that FERC "believe[s] implementation of the wetland construction and restoration procedures described in sections VIII and IX of CNYOG's ESCP are adequate to minimize impacts on wetlands" without offering data, studies, or other forms of information to support this conclusion); *id.* at 45 (failing to explain why the "availability of adjacent habitat" will be sufficient to mitigate the "permanent and long-term impacts on forested habitats along the pipeline right-of-way corridor"); *id.* at 64 (failing to provide measures to mitigate for "long-term

to permanent impacts to resources" in the Endless Mountain Heritage Region); *id.* at 104–05 (relying largely on federal and state permit conditions to mitigate against cumulative impacts to surface waters and wetlands without evaluating the efficacy of the mitigation measures in the referenced permits); *id.* at 106 (summarily concluding that "[t]he potential for habitat fragmentation resulting from the Project would be reduced because the temporary workspace would be allowed to return to pre-existing conditions" after stating that "[t]he combination of drill pads and production facilities and pipelines could alter the vegetation in the area, changing species composition and reducing overall fitness"); *id.* at 108 (failing to offer or analyze any data to support the assertion that there will be no "significant cumulative noise impacts on the local noise environment" because all permanent sources of noise "would be required to meet any local noise requirements"). Because the data needed to assess the efficacy of those measures is simply missing from the document, FERC cannot conclude that the Project will have no significant environmental impacts.[19]

D. There Are Serious Flaws in the Issue-Specific Impact Analyses.

1. Impacts on Forested Land and Related Resources

John H. Quigley, former Secretary of the Pennsylvania Department of Conservation and Natural Resources ("DCNR"), has submitted a report (annexed as Exhibit F hereto) identifying a number of serious problems in the EA, based on his experience with gas development on state forested land. As he explains, the EA focuses too narrowly on the direct impacts of the pipeline within its proposed corridor and minimizes the significance of admittedly long-term effects and permanent fragmentation. By refusing to consider gas and infrastructure development that is already proposed or is reasonably foreseeable, the EA disregards evidence of impacts that, cumulatively with those of the Project, will be significant. *See supra* Section I(A). Mr. Quigley, like DEC, endorses The Nature Conservancy study as a useful methodology for predicting likely cumulative impacts. He also identifies crucial information that is missing from the EA and questions the EA's failure to discuss in detail BMPs developed by DCNR to minimize the impacts of gas well and right-of-way development in forests. All of these errors and omissions raise serious questions about the environmental significance of the Project.

2. Water Resources

The EA reveals a very high risk to the Susquehanna River from the HDD design. To avoid contaminating groundwater needed for Cargill's production facilities, the HDD will be "as shallow as possible" under the river. *See* EA at 32. The risk of a frac-out and a discharge of drilling fluids and sediments into the river increases as the distance between the wellbore and the base of the river decreases. The EA identifies no mitigation measures for the increased

[19] In addition to providing a full analysis of the mitigation measures adumbrated in the EA, the Commission should require implementation of the supplemental measures listed in Exhibit E.

turbidity, release of toxic drilling chemicals, or harm to wildlife, including rare freshwater mussels, that would occur if the HDD breaches the river bottom.[20]

Although CNYOG has made some efforts to accommodate Cargill – and thereby has increased the risk to the Susquehanna River – there is little discussion of mitigation measures, other than those specifically addressed to Cargill, in the event that those efforts fail. The EA states that the drill path is being located "so any release of drilling fluid *should f*ollow an upward path," EA at 32 (emphasis added), but it thereby acknowledges that the plan may fail. The only proposal for addressing such a contingency identified in the EA is the use of a "thicker drilling mud." *Id.* The EA does not disclose whether there are other users of the groundwater that could be contaminated by "any lost circulation events," but it does reveal that CNYOG has not yet prepared an emergency response plan for groundwater contamination in the event of a frac-out.

In addition, the EA inappropriately relies exclusively on CNYOG's ESCP to protect against sedimentation of special protection waters and other streams in the Project area. *See supra* Section I(A)(3). For the reasons stated by Susan Beecher, Executive Director of the Pike County Conservation District, ESCPs approved by FERC and PADEP have not been adequately protecting water resources from the sedimentation caused by transmission line construction. In her statement (a copy of which is annexed as Exhibit G hereto), Ms. Beecher explains that the transmission line construction process almost guarantees severe water resources impacts because there is too much earth disturbance over prolonged periods to allow for adequate installation and maintenance of erosion and sedimentation controls, timely inspections, and effective enforcement. She notes that standard BMPs are not effective, especially on steep slopes, and that additional protections are needed, such as phased construction of the pipeline. She also has observed that FERC-approved environmental inspectors typically are inadequate to ensure compliance with Pennsylvania law and regulations, and she recommends that an *independent* third-party inspector with stop-work authority – ideally CCD staff – be employed to monitor and enforce compliance.[21] The experience of Ms. Beecher throws substantial doubt on the ability of the EA to support a FONSI.

[20] A frac-out from HDD of a pipeline under a Pennsylvania stream occurred as recently as May 2011. *See Pipeline Accident, Rain Cited in Buffalo Creek Spill,* Pittsburgh Tribune-Review (May 12, 2011), *available at* http://www.pittsburghlive.com/x/pittsburghtrib/s_736535.html.

[21] Daniel L. Alters, a biologist and environmental pollution control expert employed by PADEP for 35 years, made the same recommendation in his comments. *See* Comment of Daniel L. Alters, FERC Docket No. CP10-480-000, Submittal 20110707-5093 (filed July 7, 2011). He also criticizes the failure of the EA to discuss in detail the impacts of using a wet cut to cross the Susquehanna River in the event that HDD fails. We endorse his analysis and recommendations and incorporate them by reference here.

3. Wildlife and Botanical Species of Concern

a. Bats

The U.S. Fish and Wildlife Service has confirmed that the proposed Project location is within the range of the Indiana bat (*Myotis sodalis*), a species that is federally listed as endangered. *See* EA, App. 5 at 6. While surveyors commissioned by CNYOG did not capture any Indiana bats within the immediate Project area, the failure to detect individual animals of an endangered species that is facing the additional stress of White-Nose Syndrome ("WNS") is unsurprising and does not support a finding that the Project will not adversely impact this already imperiled species. Dr. DeeAnn Reeder, a prominent bat biologist and professor at Bucknell University, has prepared a critique of the bat surveys conducted by CNYOG's consultants (annexed as Exhibit H hereto) to which we respectfully refer the Commission.

According to Dr. Reeder, the survey methods upon which CNYOG's consultants relied are wholly inadequate in light of the dramatic declines in bat populations in the northeastern United States. Given a 72 percent decline in the Indiana bat population in recent years, attributable in large part to the spread of WNS, detection of this already rare species has become even more difficult. In order to obtain a serious assessment of the presence of Indiana bats in the vicinity of the Project, more intensive surveys must be conducted.

In addition to the Project's impact on Indiana bats and their habitat, Dr. Reeder recommends that the Commission consider the impacts of the Project on the habitats of other bat species. Given the extreme declines in bat populations in the northeastern Pennsylvania region, the Mammal Technical Committee of the Pennsylvania Biological Survey has petitioned the Pennsylvania Game Commission to list little brown bats, northern long-eared bats, and tri-colored bats as endangered. CNYOG's mist netting surveys resulted in the capture of bats from each of these species (as well as big brown bats and red bats). *See* EA, App. 5 at 13. Nevertheless, the EA failed to evaluate the impact of the Project on those species of concern.

Given the threats facing Indiana bats and other imperiled bat species detected in the Project area, the welfare of every individual bat is vital to the preservation of these species. Thus, the EA's consideration of the Project's impact on bats is inadequate and cannot support a FONSI.

b. Migratory Birds

The EA's assessment of impacts on migratory birds is premature and unsubstantiated, because critical underlying information about impacts and mitigation measures has yet to be ascertained. As noted in Section I(C)(1), above, the Migratory Bird Impact Assessment has not been revised in response to the Commission's request.[22] The requested revisions are substantial,

[22] *See* FERC, Sixth Set of Environmental Data Requests No. 1 (Apr. 21, 2011).

and include data on the Project's specific impacts on habitat, data from additional sources recommended by the Pennsylvania Game Commission ("PGC"), and appropriate measures to mitigate the Project's impacts. Moreover, CNYOG has not yet provided a revised construction window for the purpose of mitigating tree clearing impacts to migratory birds. *See* EA at 49. Without this information, the Commission has no basis for a reasoned assessment of the Project's impacts.

CNYOG also has not yet responded to PGC's call for field surveys for several species vulnerable to anticipated Project impacts.[23] CNYOG engaged in a conference call with representatives from PGC and U.S. Fish and Wildlife Service in response to the Commission's request that it follow up on the need for additional field surveys. CNYOG's notes from the call indicate that copies of "additional guidance on field survey techniques were provided by [PGC staff] on April 25 and April 26, respectively."[24] The Applicant has provided no indication, however, that it has conducted any additional field work since that time.

The proposed interveners endorse the critique presented by Audubon Pennsylvania, which has identified several deficiencies in the EA's analysis that make the FONSI unsupportable.[25] First, the EA fails to recognize the ecological significance of the Project area to migratory forest-dwelling birds. Forest lands in Bradford, Sullivan, and Lycoming Counties are identified by the PGC as "Critical Interior Forest Bird Habitat," which reflects their tremendous importance to a dozen or so species of interior forest-dwelling birds.

Audubon's comments also note that the EA fails to consider well-established scientific knowledge – specifically, the edge effect – in assessing impacts on forest ecosystems and forest-dependent birds. Instead, the EA considers only the impacts of cleared acreage, thereby substantially underestimating the Project's environmental impacts. It is well-recognized that the creation of new edges in previously intact forests alters light, humidity, tree canopy, and other habitat conditions, with detrimental effects on forest ecology and sensitive species evolved to depend on the unique conditions of interior forests. Audubon notes that a proper consideration of edge effects would translate into Project impacts on 2,284–3,589 acres of forest, rather than the 326.3 acres of the cleared corridor considered in the EA.

Finally, Audubon's comments reiterate the common call for consideration of indirect and cumulative Project impacts, including the impacts from related non-jurisdictional facilities and projects, such as well development, gathering lines, and gas processing facilities. Audubon

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[23] *See* EA at 49 ("The PGC also believes that there should be field surveys for several species that are vulnerable to forest fragmentation and wetland or stream damage."); FERC, Sixth Set of Environmental Data Requests No. 2 (Apr. 21, 2011) (requesting that CNYOG contact PGC regarding the need for further field surveys and provide a summary of this consultation and any revisions to the Migratory Bird Assessment resulting from this consultation).

[24] Response of Central New York Oil and Gas Co. to Sixth Set of Environmental Data Requests dated April 21, 2011, No. 2 (May 2, 2011).

[25] *See* Audubon PA Comment.

points to the plethora of publicly available resources that could inform the Commission's consideration of these impacts for past, present, and reasonably foreseeable actions. Audubon concludes, based on its knowledge of Pennsylvania's forest ecosystems and bird species and the EA's failure to accurately account for the totality of direct, indirect, and cumulative impacts, that the Project likely will have significant impacts on forest habitat and migratory bird populations.

c. Fisheries

The EA's assessment of fisheries impacts is controverted by an experienced fish biologist. *See* Comments of Harvey Katz, Ph.D. (annexed as Exhibit I hereto). Dr. Katz notes that at least three of the five fish species identified in Table B.3-2 of the EA as "major fish species known to occur in the Project area,"[26] actually do not inhabit the water basin in the Project area. Moreover, at least nine other "indicator" species of particular sensitivity that *do* occur in the Project area are nowhere mentioned in the EA's analysis of fisheries. Specific impacts on fisheries of concern in the Project area therefore are virtually unexamined in the EA.

The EA also fails to recognize that there are numerous unassessed waters in the vicinity of the Project, many of which provide habitat for wild trout populations. Dr. Jonathan Niles, a biologist at Susquehanna University, is working with the Pennsylvania Fish and Boat Commission ("PFBC") on a survey of unassessed waters in the area, focusing on streams located within six miles of the right-of-way and therefore likely to be affected by gas development projects connected to the pipeline. As set forth in his report (annexed as Exhibit J hereto), his research team has discovered wild Brook Trout and Brown Trout in many of those streams.[27] The EA fails even to recognize that Brook Trout are known to occur in the Project area. *See* EA at 38, Table B.3-2. As Dr. Niles indicates, an EIS should be prepared to assess the impacts of the Project, cumulatively with those of gas development, on the wild trout populations in the previously unassessed streams.[28]

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[26] It is unclear where FERC staff obtained this information. The EA's citation for the information it uses in Table B.3-2 appears to be a 2010 Pennsylvania Fish and Boat Commission source, "County Guide for Bradford, Sullivan and Lycoming." *See* EA at 38; *id.*, App. 9 at 2. However, the website provided for this source does not appear to contain the information that FERC staff sets forth in the table.

[27] Appended to the report is a list of unassessed streams subject to the current survey. The streams that Dr. Niles has examined are highlighted in yellow.

[28] We endorse the comments of Trout Unlimited, filed July 11, 2011, which similarly identify the recent discovery of wild trout in previously-unassessed streams within six miles of the Project. Trout Unlimited emphasizes the unique characteristics of the affected area, the uncertain impacts of the Project on trout populations and trout waters, and the potentially significant cumulative impacts of the Project in calling upon FERC to prepare a comprehensive EIS.

d. State Botanical Species of Concern

DNCR and the Pennsylvania Natural Heritage Program ("PNHP") identified six state botanical species of concern that might be in the Project area, and the PNHP review also found one reptile and several mussel species. *See id.* at 51. CNYOG's commissioned study found habitat along the pipeline route that would support the plant species, but did not find examples of the species in the areas to which CNYOG had been able to secure access. In its most recent letter of April 13, 2011, DCNR reiterated that there still are outstanding unresolved issues regarding potential impacts to species of concern.[29] FERC staff fails to acknowledge that letter and simply announces: "We believe that with the completion of the surveys and consultation with the DCNR, impacts to the state-listed plant species of concern can be avoided." *Id.* at 52. The surveys should be completed and approved by both DCNR and PNHP, before a significance determination is made.

4. Contaminated Sites

Despite its recognition that the water quality of the Loyalsock Creek has been impaired by the drainage of metals and acidic water from an abandoned mine, *see id.* at 34, the EA includes no discussion of the potential adverse environmental impacts the Project could cause given the proximity of such contaminated sites. CNYOG has adopted a "wait and see" approach, offering to notify "the appropriate agencies" if contaminated material is encountered during construction, but the company has neither conducted studies nor articulated an affirmative plan that would identify contaminated sites in advance of construction.[30] This tactic is unacceptable. The Commission must identify contaminated sites that are located in the vicinity of the Project, including other abandoned or active coal mines, consider the possibility that construction activities might exacerbate contamination from the sites, and identify measures to avoid or minimize any such impacts.

A number of surface and underground coal mines – in addition to the reclamation project that is resulting in discharges to Loyalsock Creek – are located in close proximity to the proposed Project route.[31] In addition, the EA mentions "200 permits for active surface mines in Bradford, Sullivan, and Lycoming Counties." EA at 20. Aside from one reference to a bluestone quarry, however, the EA does not identify any of these sites, let alone analyze how

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[29] *See* Letter from Rebecca Bowen, Envtl. Review Manager, DCNR, to Kimberly Bose, Secretary, FERC, FERC Docket No. CP10-480-000 (Apr. 13, 2011).

[30] *See* Response of Central New York Oil And Gas Company LLC to the First Environmental Data Request dated Sept. 7, 2010, at 28, FERC Docket No. CP10-480-000, Submittal No. 20100928-5114 (Sept. 27, 2010).

[31] Surface and underground mines and quarries located within a quarter of a mile of the proposed Project route are depicted on the map attached hereto as Exhibit K. Other reclamation projects in the tri-county area are depicted on the map prepared by the Eastern Pennsylvania Coalition for Abandoned Mine Reclamation. *See* Earthjustice, Additional Comments of Coalition for Responsible Growth & Resource Conservation, Damascus Citizens for Sustainability, and Sierra Club on the MARC I Hub Line Project, FERC Docket No. CP10-480-000 (May 25, 2011).

the Project and gas development associated with it might interact with the mines or mine wastes to produce adverse environmental impacts.

That omission is especially stark given the EA's recognition of the risk that the pipeline trench could serve as a conduit for contamination. *See id.* at 31 (noting PADEP's acknowledgment that "the transfer of acidic material from the local siltstone and shale through the pipeline trench to the groundwater" presented a "major risk" to the Laporte Borough's drinking water supply).[32] Given this admission, the possibility that Project construction activities could create a hydraulic connection between contaminated areas and wetlands, high quality or exceptional value streams, and other water resources should be analyzed.

Finally, current gas well drilling activities in both Bradford and Lycoming Counties, not far from the pipeline corridor, have been linked to the migration of methane gas into drinking water supplies.[33] Moreover, at least two gas wells in the vicinity of the Project in Sullivan and Lycoming Counties have been cited for other water quality violations, and one required the replacement of drinking water supplies.[34] Because the Project will induce new well drilling in Bradford, Sullivan, and Lycoming Counties, FERC should analyze the risk that the pipeline trench will serve as a conduit for contaminants into groundwater.

5. Socio-Economic Impacts

Economics, planning, and finance consultants at ECONorthwest prepared a report (annexed hereto as Exhibit M) assessing the socioeconomic and cumulative effects analyses in the EA. The report concludes that the EA's assessment is incomplete because it fails to consider fully the direct and indirect socioeconomic effects of the Project, omits any discussion of cumulative socioeconomic effects, and fails to adequately describe other cumulative impacts. Because of these deficiencies, the report concludes, the EA does not provide decision-makers or stakeholders a complete and accurate assessment of the Project's impacts and cannot support a FONSI.

With respect to the EA's inadequate assessment of socioeconomic impacts, the ECONorthwest report notes that FERC staff failed to assess the direct and indirect socioeconomic impacts of the Project consistent with guidance provided by the U.S. Environmental Protection Agency ("EPA"), the Office of Management and Budget, and the National Research Council. Rather than provide a thorough assessment of both positive and

[32] The EA dismisses PADEP's recommendation that engineered backfill be used to prevent movement of acidic material through the pipeline trench, but does not explain how or why it reached that conclusion other than by stating that "CNYOG consulted with Pennsylvania Department of Transportation which indicated that use of engineered fill is not appropriate in this type of construction." EA at 31. The mere fact that the Department of Transportation ("DOT") holds a view different from that of PADEP does not offer sufficient information by which FERC can evaluate which position is correct.

[33] *See supra* note 12.

[34] Inspection Reports are annexed as Exhibit L hereto.

negative, and both short-term and long-term effects of the Project, the EA's socioeconomic analysis described only potential positive, short-term impacts of the Project, ignoring both negative impacts and long-term consequences.

The report further notes that the EA omitted any discussion of potential cumulative impacts on socioeconomic resources, including the short and long-term impacts on jobs and income, property values, and quality of life. Furthermore, FERC staff failed to utilize readily available information to assess the impacts of past, present, and reasonably foreseeable gas development activities. The EA's assessment of cumulative impacts on the six resources areas it does analyze – water, vegetation, wildlife, land use, air quality, and noise – therefore failed to paint an accurate picture of anticipated Project impacts. To fill in these gaps in the current assessment and to assist the Commission in fulfilling its duties under NEPA, the report outlines potential cumulative impacts that should have been considered in the EA, including the socioeconomic dimensions of the Project's cumulative impacts on natural resources. The wide scope of unexamined adverse impacts of the Project on traditional and sustainable recreation and tourism industries and the lost value of ecosystem services militate not only against adoption of a FONSI but also in favor of denying the application as inconsistent with the public interest.

6. Air Quality and Greenhouse Gases

The EA failed adequately to analyze the cumulative impacts of the Project on air quality, including greenhouse gases. Project operations will cause emissions of a variety of harmful air pollutants, including more than 70 tons per year of nitrogen oxides ("NOx"), more than 22 tons per year of volatile organic compounds ("VOCs"), and more than 12 tons of hazardous air pollutants ("HAPs"), including almost five tons of formaldehyde.[35] The Project also will lead to new emissions of greenhouse gases ("GHGs") of almost 69,000 tons per year carbon dioxide equivalent.[36] The EA admitted that "Marcellus Shale gas extraction activities would result in increased long-term emissions of criteria pollutants, HAPs, and GHGs within the region," EA at 107, but simply declines to make any effort to evaluate those emissions cumulatively with Project emissions. The FONSI is unsupported without that analysis.

The failure even to consider cumulative impacts on ozone levels raises serious questions about the recommended environmental significance determination. Although Bradford, Sullivan, and Lycoming Counties currently are designated as in attainment with the National Ambient Air Quality Standard ("NAAQS") for ozone, 40 C.F.R. § 81.339, the EA lacks the analysis necessary to show that the standard will continue to be met over time. NOx and VOCs are precursors of ozone. Intensive gas development and its associated infrastructure in other rural areas of the United States have vastly increased emissions of NOx and VOCs and have

[35] Letter from Shannon P. Coleman, Attorney, Husch Blackwell, to Kimberly Bose, Secretary, FERC, Exhibit 2, Tables 9.2-10, 9.2-11, FERC Docket No. CP10-480-000, Submittal No. 20110630-5100 (June 30, 2011).

[36] *Id*. at Table 9.2-14.

pushed at least one region into non-attainment for ozone.[37] The potential for violating the standard in the Project region is enhanced by EPA's proposal to tighten the NAAQS for ozone from 0.075 parts per million to between 0.060 and 0.070 parts per million.[38] A PADEP analysis of EPA's proposal showed, in fact, that Lycoming County is likely to exceed the new ozone standard at the bottom, middle and top of the range proposed by EPA.[39]

The proposed federal standard is designed to address the serious health impacts of elevated ozone levels. It would provide:

increased protection for children and other 'at risk' populations against an array of [ozone]-related adverse health effects that range from decreased lung function and increased respiratory symptoms to serious indicators of respiratory morbidity including emergency department visits and hospital admissions for respiratory causes, and possibly cardiovascular-related morbidity as well as total non-accidental and cardiopulmonary mortality.[40]

Once the proposed standard is in effect, the cumulative emissions of precursors to ozone pollution by the Project and new gas development, including additional compressors and other equipment, will exacerbate the violation predicted for Lycoming County and could push Bradford and Sullivan Counties into non-attainment. Even without the new standard, the EA cannot support a FONSI without an analysis of those emissions on ozone levels and public health in the Project region.

7. Low-Frequency Noise

The EA additionally fails to analyze the potential health effects of low-frequency noise emitted during Project operations. The Applicant's noise study, submitted as part of Resource Report 9, did not quantify expected low-frequency noise production, nor do the identified noise mitigation measures address low-frequency noise.[41] These are important omissions, as compressor stations are known to emit low-frequency noise, and have been responsible for

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[37] *See* Al Armendariz, *Emissions from Natural Gas Production in the Barnett Shale Area and Opportunities for Cost-Effective Improvements* (2009), *available at* http://www.edf.org/documents/9235_Barnett_Shale_Report.pdf; Wendy Koch, *Wyoming's Smog Exceeds Los Angeles' Due to Gas Drilling*, USA Today (Mar. 9, 2011), *available at* http://content.usatoday.com/communities/greenhouse/post/2011/03/wyomings-smog-exceeds-los-angeles-due-to-gas-drilling/1.

[38] *See* National Ambient Air Quality Standard for Ozone, 75 Fed. Reg. 2,938 (Jan. 19, 2010).

[39] Arlene Shulman & George Mentzer, PADEP, NAAQS Reconsiderations: Proposed Rules for Lead Monitoring and Ozone Standard, 5-6 (2010), *available at* http://www.dep.state.pa.us/dep/subject/advcoun/aqtac/2010/2-18-10/OzoneLeadNAAQS.pdf (last visited June 21, 2011). PADEP did not present data on Bradford or Sullivan County, which currently are not monitored for ozone levels.

[40] National Ambient Air Quality Standards for Ozone, *supra* note 38, at 2,938.

[41] *See* Resource Report 9, Air and Noise Quality (MARC I Hub Line) 9-44 (Aug. 2010).

noise-related health impacts in Texas, such as insomnia and ruptured ear drums.[42] Excessive exposure to low-frequency can cause vibroacoustic disease, symptoms of which include cardiovascular damage and genotoxic effects.[43] Other physiological and psychological effects of low-frequency noise range from headaches and depression, to increased cortisol production and shortness of breath, and can be compounded in the presence of vibrations.[44]

II. The MARC I Project Will Significantly Affect the Quality of the Human Environment.

The Commission's conclusion that the Project will have no significant environmental impacts is unsupportable in the face of evidence demonstrating the potential severity of the Project's impacts. As is set forth below, both the context and intensity of the Project's impacts call for a finding of significant impacts and the preparation of an EIS. *See* 42 U.S.C. § 4332(2)(C) (an EIS must be prepared for all "major Federal actions significantly affecting the quality of the human environment").

The determination of whether a project will "significantly affect[] the quality of the human environment," depends on considerations of "both context and intensity." 40 C.F.R. § 1508.27. With regard to context:

> [T]he significance of an action must be analyzed in several contexts such as society as a whole (human, national), the affected region, the affected interests, and the locality. Significance varies with the setting of the proposed action. For instance, in the case of a site-specific action, significance would usually depend upon the effects in the locale rather than in the world as a whole. Both short-and long-term effects are relevant.

Id. at § 1508.27(a). The context of the Project necessarily includes the exploding development of the Marcellus Shale gas play in northeastern Pennsylvania, which has been marked by repeated episodes of environmental destruction and whose cumulative environmental impacts have never been examined by any local, state, or federal agency. The context of the Project also includes the pristine and unspoiled landscape and natural resources of Sullivan County and the Endless Mountains region, through which the Project will cut. Moreover, the affected interests to be considered within this context include the recreation and tourism industries that rely on these natural resources and form a mainstay of the local economy and way of life in the affected region.

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[42] John Burnett, *Health Issues Follow Natural Gas Drilling in Texas*, NPR, Nov. 3, 2009, *available at* http://www.npr.org/templates/story/story.php?storyId=120043996; Peter Gorman, *Un-Well, Concerns are mounting over health effects of gas drilling*, Fort Worth Weekly, Oct. 29, 2008, *available at* http://archive.fwweekly.com/content.asp?article=7262.

[43] N.A.A. Castelo Branco & M. Alves-Pereira, *Vibroacoustic disease*, 6(23) Noise & Health 3 (2004).

[44] J. Feldmann & F.A. Pitten, *Effects of low frequency noise on man- a case study*, 7(25) Noise & Health 23 (2004); Geoff Leventhall, U.K. Dep't for Environment, Food and Rural Affairs, *A Review of Published Research on Low Frequency Noise and its Effects* 41–42 (2003).

"Where conduct conforms to existing uses, its adverse consequences will usually be less significant than when it represents a radical change." *Hanly v. Kleindienst*, 471 F.2d 823, 831 (2d Cir. 1972) (noting for instance, that "one more highway in an area honeycombed with roads usually has less of an adverse impact than if it were constructed through a roadless public park); *see also North Carolina v. Fed. Aviation Admin.*, 957 F.2d 1125, 1132 (4th Cir. 1992) ("To the extent that [the proposed use] conforms to existing uses, the environmental impact will generally be less significant than that produced by substantial revision."). The construction of the Project – a greenfield pipeline accepting gas from gathering systems to be installed throughout a scenic, undisturbed region – presents a radical change. Each of the factors weighing in favor of intensity, discussed below, must be viewed in this context.

Intensity, which "refers to the severity of impact," 40 C.F.R. § 1508.27(b), is "relate[d] to the degree to which the agency action affects the locale and interests identified in the context part of the inquiry." *NPCA*, 241 F.3d at 731. Ten factors "should be considered in evaluating intensity." 40 C.F.R. § 1508.27. A finding of cumulatively significant impacts (factor 7) alone demands an EIS, s*ee Kern v. U.S. Bureau of Land Mgmt.*, 284 F.3d 1062, 1076 (9th Cir. 2002) ("[A]n EA may be deficient if it fails to include a cumulative impact analysis or to tier to an EIS that has conducted such an analysis."); *Friends of the Earth, Inc. v. U.S. Army Corps of Eng'rs*, 109 F. Supp. 2d 30, 43 (D.D.C. 2000) ("[T]he significant cumulative impacts of the multiple casino projects . . . warrant the preparation of an EIS. On this . . . criterion alone, it appears that an EIS is required.") (citations omitted), while as few as two of the other factors together can invalidate a FONSI and call for an EIS, *see, e.g.*, *NPCA*, 241 F.3d at 731–37 (finding the uncertainty and controversy factors invalidated the FONSI). In the case of the Project, at least six of the ten factors – including cumulative impacts – weigh heavily in favor of a finding of severe and significant impacts:

(3) Unique characteristics of the geographic area such as proximity to historic or cultural resources, park lands, prime farmlands, wetlands, wild and scenic rivers, or ecologically critical areas.

(4) The degree to which the effects on the quality of the human environment are likely to be highly controversial.

(5) The degree to which the possible effects on the human environment are highly uncertain or involve unique or unknown risks.

(6) The degree to which the action may establish a precedent for future actions with significant effects or represents a decision in principle about a future consideration.

(7) Whether the action is related to other actions with individually insignificant but cumulatively significant impacts. Significance exists if it is reasonable to anticipate a cumulatively significant impact on the environment. Significance cannot be avoided by terming an action temporary or by breaking it down into small component parts. . . .

(9) The degree to which the action may adversely affect an endangered or threatened species or its habitat that has been determined to be critical under the Endangered Species Act of 1973.

40 C.F.R. § 1508.27. Consideration of each of these factors reasonably leads to a finding that the Project will have significant impacts, for which an EIS must be prepared.

A. The Affected Region Is Unique and of Ecological Importance.

The "[u]nique characteristics of the geographic area such as proximity to . . . park lands, prime farmlands, wetlands, wild and scenic rivers, or ecologically critical areas," 40 C.F.R. § 1508.27(b)(3), favor a finding of significant impacts. The Endless Mountains region of Pennsylvania is home to the federally endangered Indiana bat and timber rattlesnake and numerous species of conservation concern.[45] The region also serves as the nesting and feeding grounds for vulnerable species of migratory birds.[46] The counties through which the Project will slice contain EV and HQ waters entitled to special protection under Pennsylvania law.[47] Additionally, previously unassessed streams within six miles of the proposed Project corridor recently have been found inhabited by wild trout. *See supra* Section I(D)(3)(c) and Exhibit I. The abundance and vitality of these natural resources underlie the tourism and recreation industries that have long thrived in this region and provide a sustainable economy.

The EA acknowledges that "the Project would consist of greenfield construction in previously-undisturbed forest habitat," EA at 50, yet fails to consider the unique characteristics of the region and its ecological resources in the context of escalating gas development activities. For instance, the impact of the Project, including the cumulative impacts of associated gas development induced by the pipeline, on the local tourism and recreation economy escapes any mention in the EA's socioeconomic analysis. *See supra* Section I(D)(4) and Exhibit M.

B. The Environmental Impacts of the Project Are Controversial.

"The degree to which the effects on the quality of the human environment are likely to be highly controversial," 40 C.F.R. § 1508.27(b)(4), also supports a finding of intensity and significant impacts for the Project. Impacts are controversial where there is "a substantial dispute [about] the size, nature, or effect" of the action. *Blue Mountains Biodiversity Project*, 161 F.3d at 1212. "A substantial dispute exists when evidence, raised prior to the preparation of an EIS or FONSI, casts serious doubt upon the reasonableness of an agency's conclusions." *NPCA*, 241 F.3d at 736 (internal quotation marks and citations omitted).

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[45] *See* Terrestrial Vertebrates of Pennsylvania: A Complete Guide to Species of Conservation Concern, (Michael A. Steele, et al., ed. 2010).

[46] *Id.*; *see* Audubon PA Comment (noting that the Project area is in "one of the most important forest communities in Pennsylvania in terms of richness of biodiversity of forest-obligate bird species").

[47] PADEP recently recognized the heightened safeguards to which EV and HQ streams are entitled, by agreeing to revoke expedited permitting for gas wells in special protection watersheds. *See* Donald Gilliland, *DEP to Make Gas Wells Near High Quality Streams Go through Full Permitting Process*, The Patriot-News (July 7, 2011), *available at* http://www.pennlive.com/midstate/index.ssf/2011/07/dep_to_make_gas_wells_near_hig.html.

The controversial nature of the Project's impacts reflects more than mere opposition to the Project.[48] As the appended statements and separately filed comments from a range of independent experts demonstrate, persons trained in many of the fields relevant to assessment of Project impacts dispute the EA's approach and raise substantial questions about its conclusions. For example, former DCNR Commissioner John Quigley questions the adequacy of the EA's analysis of forest fragmentation. *See supra* Section I(D)(1) and Exhibit F. Daniel Alters, an environmental pollution control expert and former Water Programs Manager for PADEP, criticizes the EA's failure to analyze the possibility of a wet open-cut crossing of the Susquehanna River. *See supra* Section I(D)(2). Dr. DeeAnn Reeder disputes the sufficiency of bat survey methods that fail to take into account the implications of White Nose Syndrome for bat populations in northeast Pennsylvania. *See supra* Section I(D)(3)(a) and Exhibit H. Aquatic biologist Dr. Harvey Katz disagrees with the EA's assessment of fisheries, which omits consideration of many key indicator species that could be expected to inhabit the Project area. *See supra* Section I(D)(3)(c) and Exhibit I. Biologist Dr. Jonathan Niles also points to the unknown effects, including cumulative effects, of the Project on recently-discovered wild trout populations in previously-unassessed streams in the affected area. *See supra* Section I(D)(3)(c) and Exhibit J. The economists of ECONorthwest point out the failure of the EA to address the value of ecosystem services cumulatively lost because of Project construction and operation. *See supra* Section I(D)(5) and Exhibit M. Under these circumstances, the controversial nature of the Project weighs in favor of preparing an EIS. *See, e.g.*, *Sierra Club v. Babbitt*, 69 F. Supp. 2d 1202, 1220 (E.D. Cal. 1999) (finding that the controversy factor weighed in favor of an EIS where disagreement among experts raised substantial questions about environmental impacts and the need for an EIS).

C. The Breadth of Information Missing from the EA and the Lack of Evidence Demonstrating the Effectiveness of Identified Mitigation Measures Make the Project's Impacts Highly Uncertain.

The failure to collect key information and to provide needed analyses in the EA, *see supra* Section I(C) and Exhibit D, not only raises questions about the sufficiency of the EA but also affirmatively militates in favor of an EIS, because it increases the uncertainty of the Project's impacts. *See Blue Mountains Biodiversity Project,* 161 F.3d at 1213–14 (mandating preparation of an EIS when effects are highly uncertain or involve unique or unknown risks); 40 C.F.R. § 1508.27(b)(5) (identifying "[t]he degree to which the possible effects on the human environment are highly uncertain" as a factor to be considered in evaluating the severity of impacts). "[W]here uncertainty may be resolved by further collection of data, . . . or where the collection of such data may prevent speculation on potential . . . effects," an agency must prepare an EIS. *NPCA*, 241 F.3d at 732–33 (internal quotation marks and citations omitted)

[48] An outpouring of public protest has been expressed in more than 20,000 comments that have been submitted to the Commission. The comments raise concerns with inadequacies in the EA and highlight the potentially significant impacts of the Project.

(finding a FONSI indefensible where the agency proposed a monitoring program to understand the effects of increased ship traffic on the environment, rather than first implementing the program and analyzing the relevant data in the EA). The EA's unexplained deferral of data collection and analysis, especially with respect to cumulative impacts, leaves the effects of the Project highly uncertain and weighs in favor of a finding of significance.

D. The Project's Encroachment into an Area Largely Free of Gas Development Will Establish a Precedent for Future Actions with Significant Effects.

"The degree to which the action may establish a precedent for future actions with significant effects or represents a decision in principle about a future consideration," 40 C.F.R. § 1508.27(b)(6), further weighs in favor of a finding that the Project will have significant impacts. The inquiry here is whether "approval of a single action will establish a precedent for other actions which may cumulatively have a negative impact on the environment." *Anderson v. Evans*, 371 F.3d 475, 493 (9th Cir. 2004). For instance, in finding this factor to weigh in favor of significance and concluding that an EIS was required before the permitting of three casinos on the Mississippi coast, the D.C. District Court noted: "With the proliferation of casinos along the Mississippi coast, the [USACE] may feel bound to the conclusions reached in the FONSIs issued in these cases, thereby allowing the FONSIs to serve as precedent for future casino projects." *Friends of the Earth v. U.S. Army Corps of Eng'rs*, 109 F. Supp. 2d 30, 43 (D.D.C. 2000). Because the rapid pace of pipeline development in the Marcellus Shale region includes the proposed construction of numerous federally regulated facilities, there is a serious risk that FERC will feel bound to the conclusions presented in the EA.

E. It Is Reasonable to Anticipate That the Project Will Have Cumulatively Significant Impacts on the Environment.

"Whether the action is related to other actions with individually insignificant but cumulatively significant effects," 40 C.F.R. § 1508.27(b)(7), also favors a finding of significance for the Project. As is set forth in detail above, *see supra* Section I(A), there is a large and growing body of available evidence about the rapid pace and broad scale of future gas well and associated infrastructure development, as well as the potential impacts of the construction and operation of those facilities, both individually and cumulatively, which strongly suggests that the Project will have a significant effect on the human environment. This factor alone supports preparation of an EIS.

F. The MARC I Project May Adversely Affect the Endangered Indiana Bat.

Finally, "[t]he degree to which the action may adversely affect an endangered or threatened species . . . under the Endangered Species Act," 40 C.F.R. § 1508.27(b)(9), calls for a finding of significance. "[A] project need not jeopardize the continued existence of a threatened or endangered species to have a "significant" effect on the environment," *Klamath-Siskiyou Wildlands Ctr.*, 373 F. Supp. 2d at 1080, and "the extent of a species' overall decline is a factor

that courts have considered in weighing this factor. *See, e.g., Found. for N. Am. Wild Sheep v. U.S. Dept. of Agric.*, 681 F.2d 1172, 1182 (9th Cir. 1982). Dr. DeeAnn Reeder's critique of the outdated methodology used by CNYOG's consultant in its Indiana bat surveys suggests that the Project's impacts on that endangered species will be substantially greater than the EA discloses. *See supra* Section I(D)(3)(a) and Exhibit H. This factor, too, argues for preparation of an EIS for the Project.

III. Conclusion

The EA for the Project recommends a FONSI only because it ignores the foreseeable and radical transformation of largely unpopulated and undisturbed forests, grasslands, and wetlands into an intensively industrialized gas development zone. FERC can endorse that recommendation only by blinding itself to the severe and well documented impacts of intensive gas exploration and production and by refusing to consider alternatives that will be less disruptive of rural communities and heritage areas. Because disregarding readily ascertained information would subvert the purpose and violate the requirements of NEPA, we urge the Commission to reject the FONSI and to prepare a full EIS for the Project. In the alternative, FERC should deny the application as inconsistent with the public interest.

Respectfully submitted,

Deborah Goldberg

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Deborah Goldberg, Managing Attorney
Hannah Chang, Associate Attorney
Bridget Lee, Associate Attorney
Briana Dema, Legal Intern

EXHIBITS

A. Maps of Sullivan County, Bradford County, and Sensitive Resources in Project Area, Data Sources

B. Statement of Terry Engelder, Ph.D

C. Maps of Alternative Routes and Sensitive Resources, Data Sources

D. Missing/Incomplete Information Chart

E. Supplemental Mitigation Measures

F. Comments of John Quigley, former Secretary of the Pennsylvania Department of Conservation and Natural Resources

G. Statement of Susan Beecher, Executive Director, Pike County Conservation District

H. Comments of DeeAnn M. Reeder, Ph.D.

I. Comments of Harvey M. Katz, Ph.D.

J. Comments of Jonathan Niles, Ph.D.

K. Map of Quarries and Coal Mines

L. Marquardt Well Inspection Reports

M. An Economic Review of the Environmental Assessmemt of the MARC I Hub Line Project, ECONorthwest

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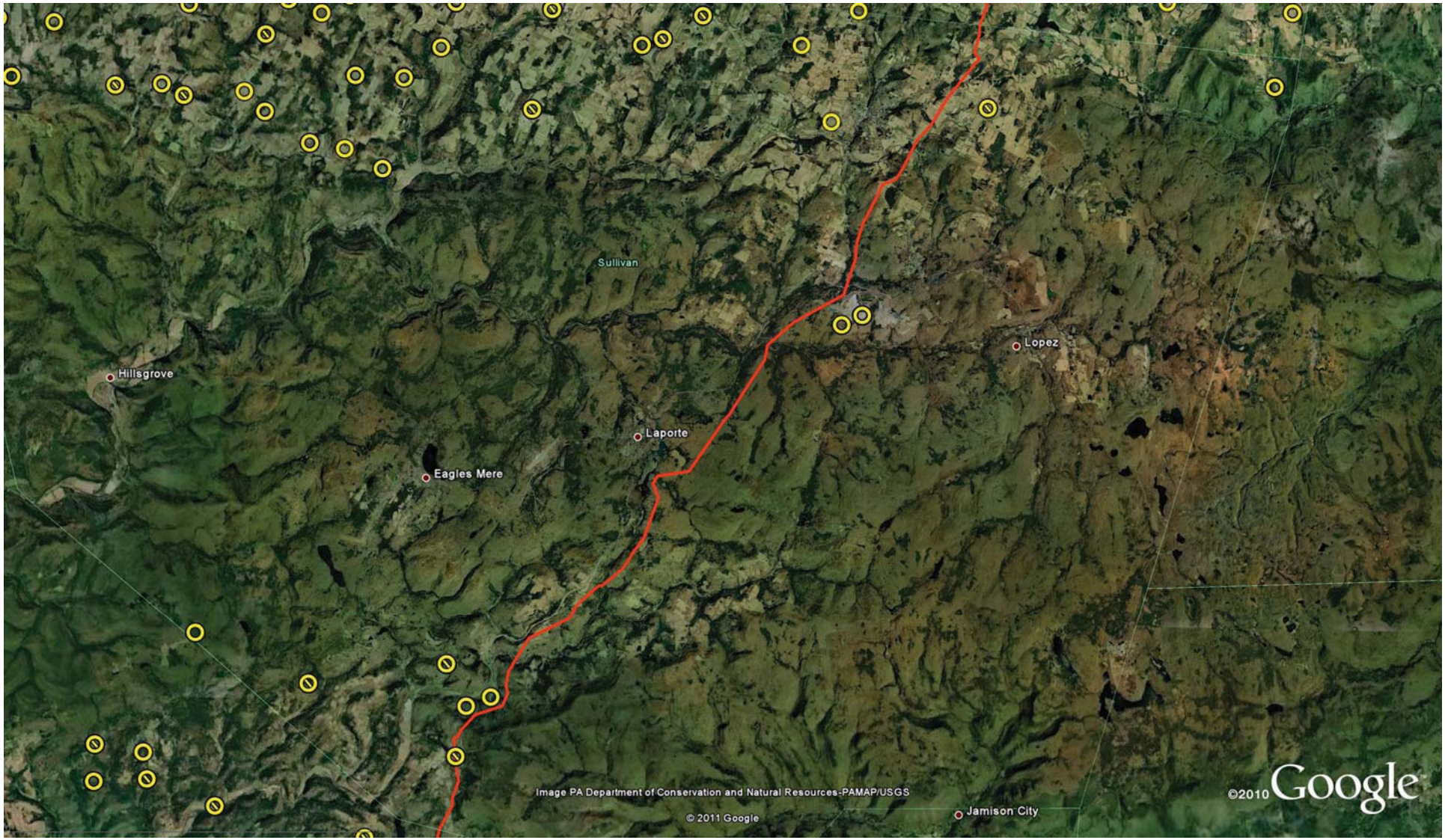
EXHIBIT A

1. **Sullivan County Google Earth Imagery**
2. **MARC I Route and Forest Matrix Blocks**
3. **MARC I Route and Contiguous Forest Patches**
4. **MARC I Route and Core Habitat Areas for Species of Special Concern**
5. **MARC I Route and Water Resources**
6. **MARC I Route and Trout Habitat**
7. **Bradford County Pipelines and Wells**
8. **Bradford County Gas Development**
9. **Mapping Data Sources**

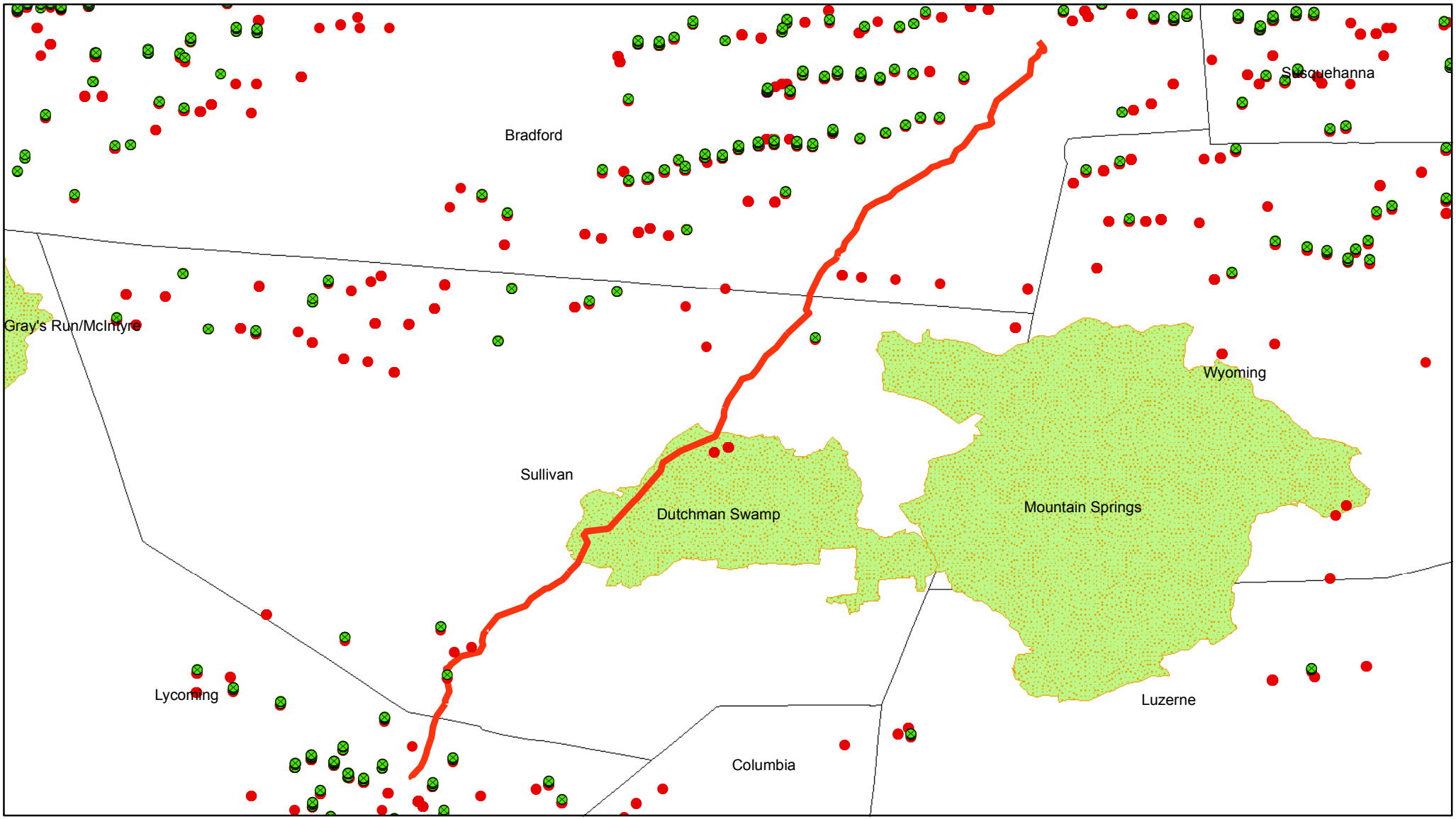


Drilled Marcellus Shale natural gas wells

Permitted, but not yet drilled, Marcellus Shale natural gas wells

MARC I Gas Pipeline

EARTHJUSTICE



MARC I Gas Pipeline

Matrix Forest Blocks

Drilled Marcellus Shale Natural Gas Wells

Permitted, But Not Yet Drilled, Marcellus Shale Natural Gas Wells

N

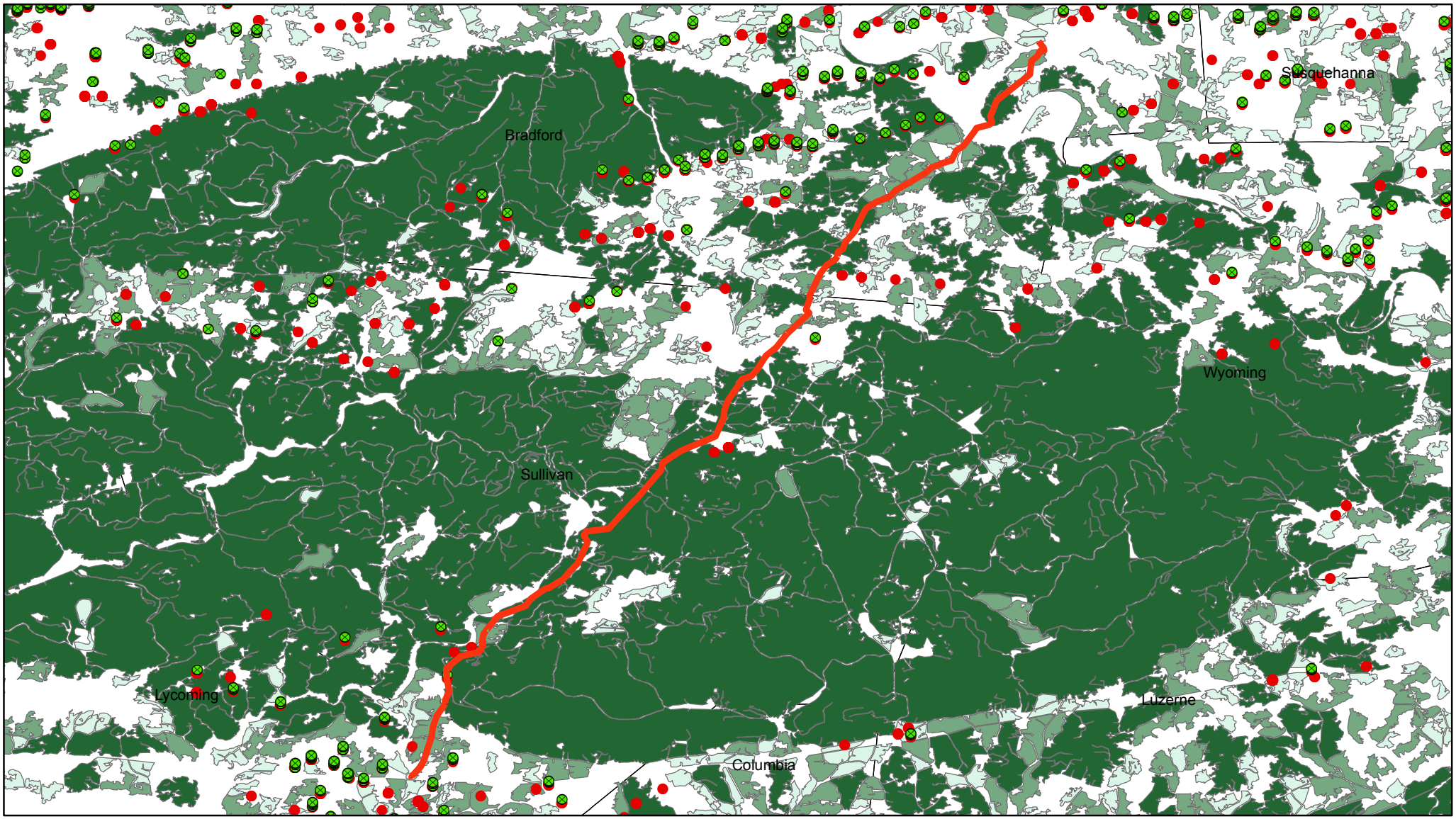
3 0 3

Miles

ESRI Technology CONSERVATION

EMG, 4-6-11

EARTHJUSTICE



MARC I Gas Pipeline

Drilled Marcellus Shale Natural Gas Wells

Permitted, But Not Yet Drilled, Marcellus Shale Natural Gas Wells

Contiguous Forest Patches

Acreage

100-250

250-500

>500

N

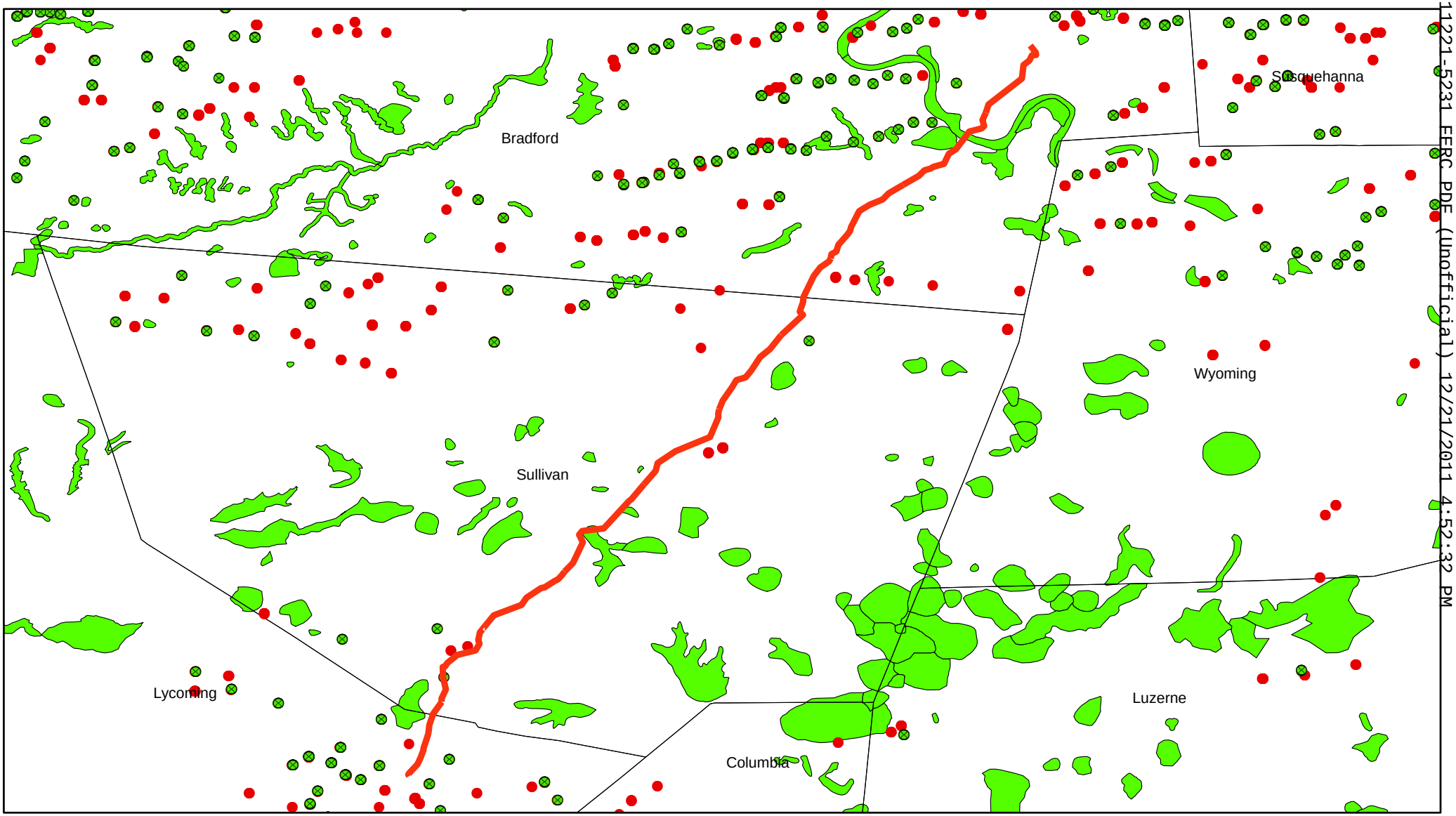
3 0 3

Miles

ESRI Technology CONSERVATION

EMG, 4-6-11

EARTHJUSTICE



MARC I Gas Pipeline

Core Habitat Areas for Species of Concern

Drilled Marcellus Shale Natural Gas Wells

Permitted, But Not Yet Drilled, Marcellus Shale Natural Gas Wells

N

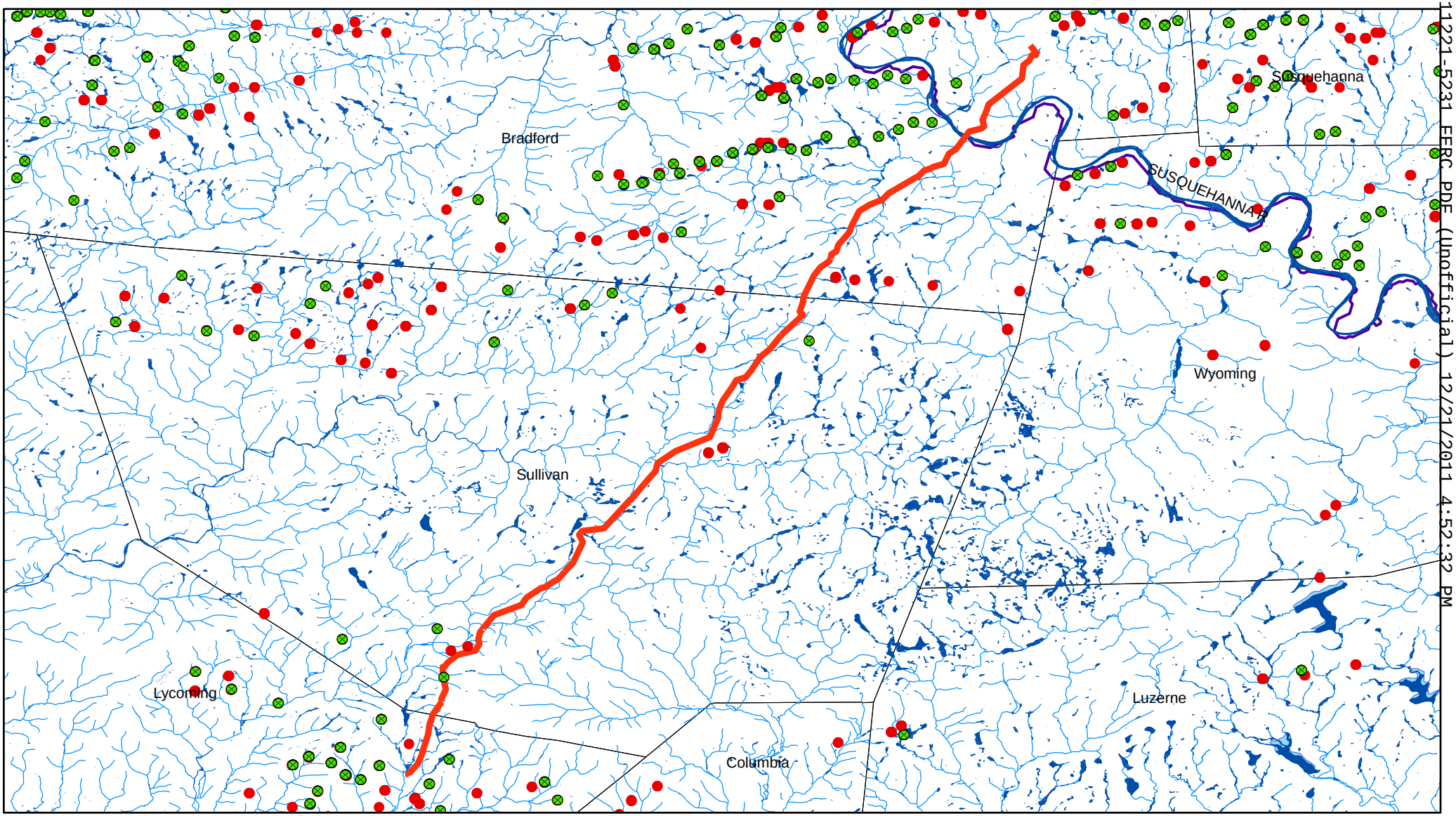
3 0 3

Miles

ESRI CONSERVATION

EMG, 4-6-11

EARTHJUSTICE



MARC I Gas Pipeline

Drilled Marcellus Shale Natural Gas Wells

Permitted, But Not Yet Drilled, Marcellus Shale Natural Gas Wells

Wetlands

Stream Detail

Major Rivers

Lakes

N

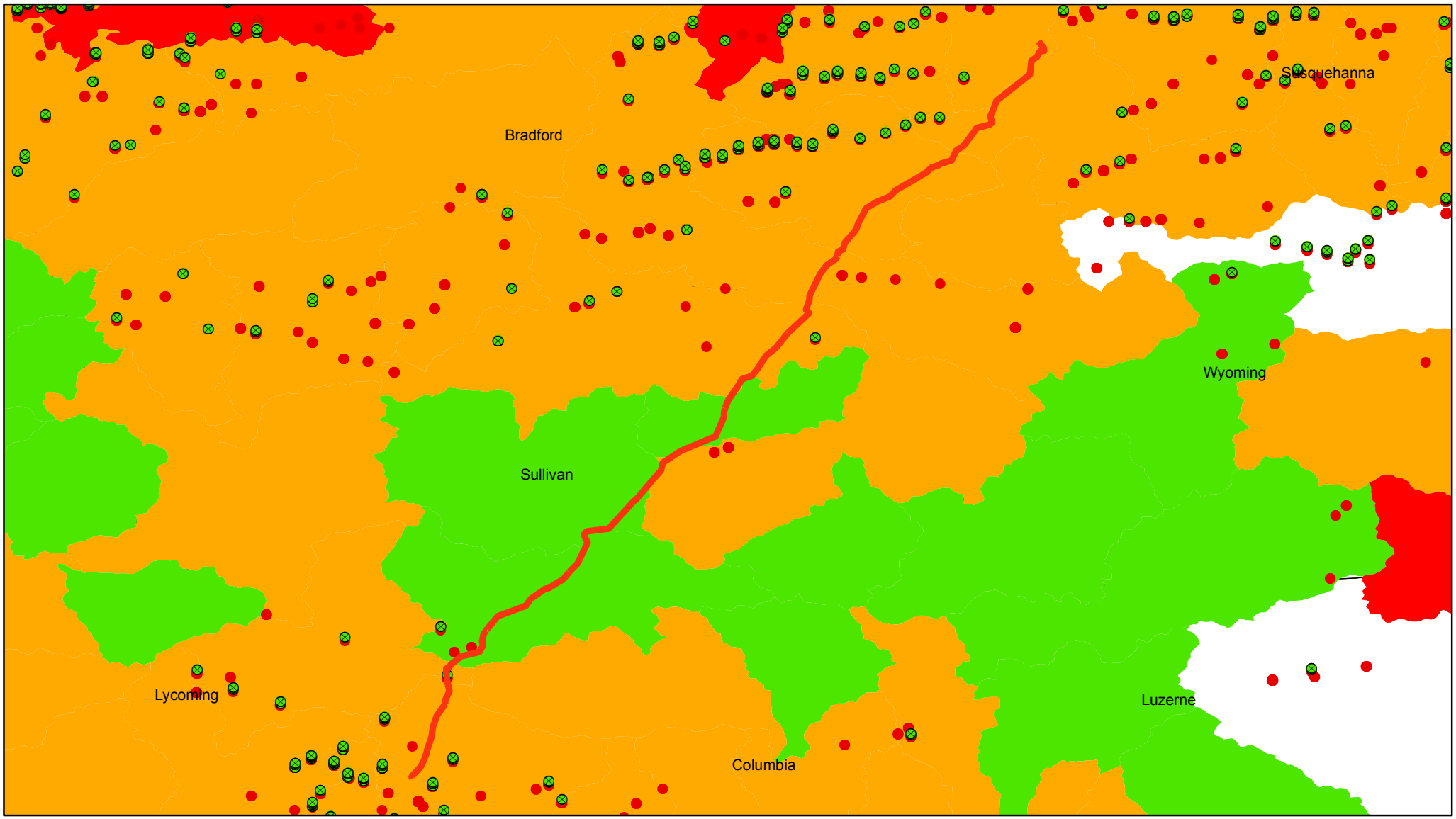
3 0 3

Miles

ESRI

EMG, 4-6-11

EARTHJUSTICE



MARC I Gas Pipeline

Drilled Marcellus Shale Natural Gas Wells

Permitted, But Not Yet Drilled, Marcellus Shale Natural Gas Wells

Pennsylvania Brook Trout-- Habitat Integrity
Conservation Success Index Score

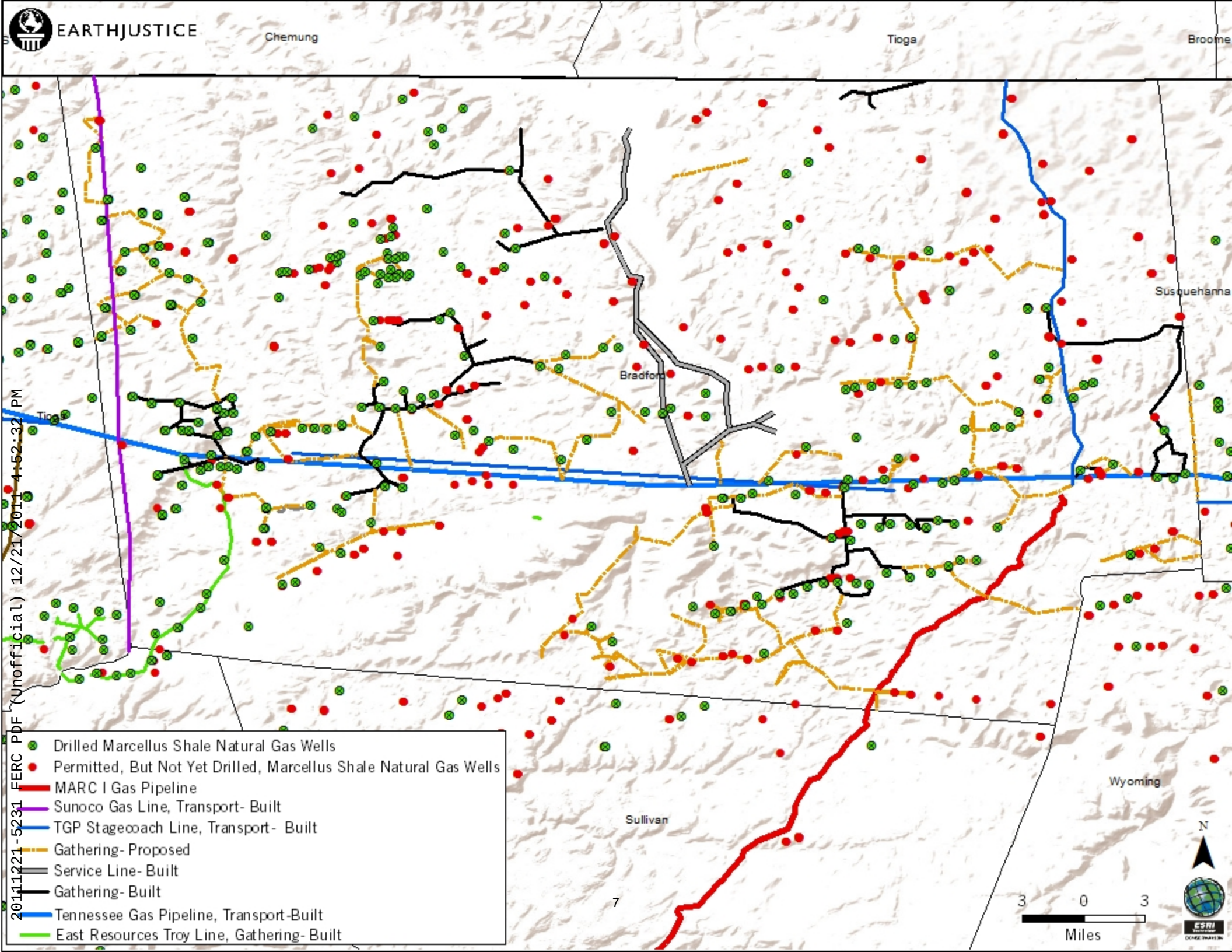
- 21 - 25
- 16 - 20
- 11 - 15
- 5 - 10

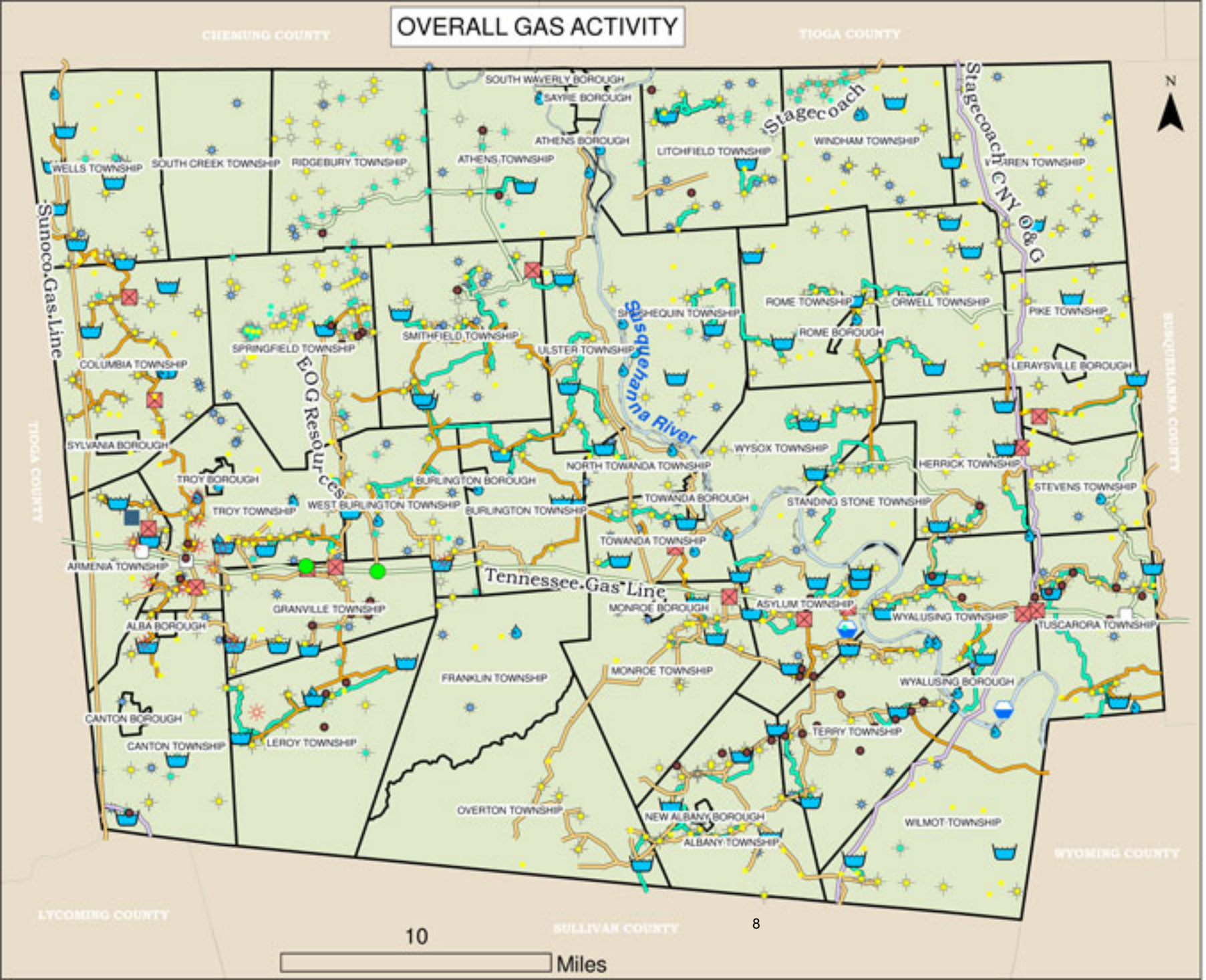
N

3 0 3
Miles

ESRI Technology CONSERVATION

EMG, 4-6-11


EARTHJUSTICE
Chemung
Tioga
Broome
Susquehanna
Bradford
Tioga
Sullivan
Wyoming
Drilled Marcellus Shale Natural Gas Wells
Permitted, But Not Yet Drilled, Marcellus Shale Natural Gas Wells
MARC I Gas Pipeline
Sunoco Gas Line, Transport- Built
TGP Stagecoach Line, Transport- Built
Gathering- Proposed
Service Line- Built
Gathering- Built
Tennessee Gas Pipeline, Transport-Built
East Resources Troy Line, Gathering- Built
N
3 0 3
Miles
20111221-5231 FERC PDF (Unofficial) 12/21/2011 4:52:32 PM


OVERALL GAS ACTIVITY
CHEMUNG COUNTY
TIOGA COUNTY
BRADFORD COUNTY
WYOMING COUNTY
LYCOMING COUNTY
SULLIVAN COUNTY
N
SOUTH WAVERLY BOROUGH
SAYRE BOROUGH
ATHENS BOROUGH
ATHENS TOWNSHIP
LITCHFIELD TOWNSHIP
WINDHAM TOWNSHIP
WARREN TOWNSHIP
WELLS TOWNSHIP
SOUTH CREEK TOWNSHIP
RIDGEBURY TOWNSHIP
Stagecoach
Stagecoach CNY O&G
Sunoco Gas Line
SPRINGFIELD TOWNSHIP
SMITHFIELD TOWNSHIP
ULSTER TOWNSHIP
SHESHEQUIN TOWNSHIP
ROME TOWNSHIP
ORWELL TOWNSHIP
PIKE TOWNSHIP
ROME BOROUGH
LERAYSVILLE BOROUGH
COLUMBIA TOWNSHIP
Susquehanna River
EOG Resources
SYLVANIA BOROUGH
WYSOX TOWNSHIP
NORTH TOWANDA TOWNSHIP
HERRICK TOWNSHIP
TROY BOROUGH
BURLINGTON BOROUGH
STEVENS TOWNSHIP
TROY TOWNSHIP
WEST BURLINGTON TOWNSHIP
BURLINGTON TOWNSHIP
TOWANDA BOROUGH
STANDING STONE TOWNSHIP
TOWANDA TOWNSHIP
ARMENIA TOWNSHIP
Tennessee Gas Line
GRANVILLE TOWNSHIP
MONROE BOROUGH
ASYLUM TOWNSHIP
WYALUSING TOWNSHIP
TUSCARORA TOWNSHIP
ALBA BOROUGH
FRANKLIN TOWNSHIP
MONROE TOWNSHIP
WYALUSING BOROUGH
CANTON BOROUGH
TERRY TOWNSHIP
CANTON TOWNSHIP
LEROY TOWNSHIP
OVERTON TOWNSHIP
NEW ALBANY BOROUGH
WILMOT TOWNSHIP
ALBANY TOWNSHIP
10
Miles
Legend
SRBC
All Other Sources
Source
SRBC; DEP permit
County Database
Permitted Features
HORIZONTAL GAS WELL
VERTICAL GAS WELL
WATER IMPOUNDMENT
WATER TREATMENT FACILITY
WATER WITHDRAWAL
METER STATION
SUBSTATION
COMPRESSOR STATION
TAP LOCATION
DEP Wells April 2011
Gas Lines
Pipe Size
2" - 10"
12" - 18"
20" - 24"
30" - 36"
Water Lines
All Dry Hydrants
APRIL 11, 2011

MAPPING DATA SOURCES

Map Entitled "Overall Gas Activity"

Bradford County Planning Commission, "Overall Gas Activity," Apr. 11, 2011, http://www.bradfordcountypa.org/Natural-Gas.asp?specifTab=2

MARC I Gas Pipeline

Resource Report I, General Project Description (MARC I Hub Line), Docket No. CP10-480-000, at 53-62 (Aug. 6, 2010).

Permitted Marcellus Shale Natural Gas Wells

- This data has been compiled by users of fractracker.org, but is all based upon DEP data and mapped by latitude and longitude. Wells are shown in green to indicate that they've been drilled if they have produced gas (according to the first dataset linked below), or have a "spud date" (according to the second dataset linked below).
- Source: Pennsylvania Department of Environmental Protection
- Links: http://www.marcellusreporting.state.pa.us/OGREReports/Modules/DataExports/DataExports.aspx; http://www.dep.state.pa.us/dep/deputate/minres/OILGAS/RIG10.htm

Matrix Forest Blocks

- Matrix sites are large contiguous areas whose size and natural condition allow for the maintenance of ecological processes, viable occurrences of matrix forest communities, embedded large and small patch communities, and embedded species populations. The goal of the matrix forest selection was to identify viable examples of the dominant forest types that, if protected and allowed to regain their natural condition, would serve as critical source areas for all species requiring interior forest conditions or associated with the dominant forest types.
- Source: The Nature Conservancy (TNC) Eastern Conservation Science, 2006
- Received via email from Brad Stratton (bstratton@tnc.org)

Contiguous Forest Patches

- This dataset represents forest patches (areas of contiguous forest cover) greater than 100 acres in Pennsylvania and is the final output of a model built in ArcGIS Model Builder by B. Eichelberger of the Western Pennsylvania Conservancy (WPC) / Pennsylvania Natural Heritage Program, and modified by T. Gagnolet of The Nature Conservancy (TNC). Input datasets were prepared by T. Gagnolet and R. Ralls of TNC.

  The following land cover types were selected from the 2006 National Land Cover Database (NLCD) to create this dataset: deciduous forest, coniferous forest, mixed [deciduous-coniferous] forest, scrub-shrub, woody wetland, and emergent wetland.

Patches were delineated based on non-forest edge (from the NLCD), electric transmission lines and natural gas pipelines (from Ventyx, LLC, December 2010), and roads and railroads (from 2006 ESRI StreetMap data).
- The Nature Conservancy and Western Pennsylvania Conservancy, March 2011
- Received via email from Brad Stratton (bstratton@tnc.org)

Core Habitat Areas for Species of Concern

- Data compiled by the Western Pennsylvania Conservancy, but based upon the County Natural Heritage Inventory program of the Pennsylvania Natural Heritage Program. County Natural Heritage Inventories focus on areas that are the best examples of ecological resources in a county. Although agricultural lands and open space may be included as part of inventory areas, the emphasis for the designation and delineation of the areas are the ecological values present. Important selection criteria for Natural Heritage Areas are the existence of habitat for plants and animals of special concern, the existence of uncommon or especially important natural communities, and the size and landscape context of a site containing good quality natural features. Large areas and areas that are minimally disturbed by development provide the backbone that links habitats and allows plants and animals to shift and move across sizable portions of the landscape. Core Habitat areas are intended to identify the essential habitat of the species of concern or natural community that can absorb very little activity or disturbance without substantial impact to the natural features.
- Source: Western Pennsylvania Conservancy
- Link: http://data.fractracker.org/cbi/dataset/datasetPreviewPage?uuid=~01f7df5cb6ab0611df9798e2ebc6d2c179 (downloaded through ArcGIS online)

Rivers and Streams

- Detailed river and stream data
- USGS and USEPA data
- Dataset available within ArcGIS software

Wetlands

- This data set represents the extent, approximate location and type of wetlands and deepwater habitats in the conterminous United States. These data delineate the areal extent of wetlands and surface waters as defined by Cowardin et al. (1979). Certain wetland habitats are excluded from the National mapping program because of the limitations of aerial imagery as the primary data source used to detect wetlands. These habitats include seagrasses or submerged aquatic vegetation that are found in the intertidal and subtidal zones of estuaries and near shore coastal waters. Some deepwater reef communities (coral or tuberficid worm reefs) have also been excluded from the inventory. These habitats, because of their depth, go undetected by aerial imagery. By

policy, the Service also excludes certain types of "farmed wetlands" as may be defined by the Food Security Act or that do not coincide with the Cowardin et al. definition.

- Source: U.S. Fish and Wildlife Service, Division of Habitat and Resouce Conservation
- http://www.fws.gov/wetlands/Data/DataDownload.html

Pennsylvania Brook Trout—Habitat Integrity

- Displays Brook Trout Habitat Conservation Success Index (CSI) scores, developed by Trout Unlimited, which account for land stewardship, watershed connectivity, watershed conditions, water quality, and flow regime. Higher CSI scores indicate better conditions for Brook Trout.
- Explanation of CSI scores available at http://tucsi.tu.org/Documents/CSI-user-guide.pdf
- Source: Trout Unlimited
- Received via email from Matthew Mayfield (mmayfield@tu.org)

EXHIBIT B

Statement of Terry Engelder, Ph.D.
July 6, 2011

I am a Professor of Geosciences at Pennsylvania State University and previously served on the staffs of the U.S. Geological Survey, Texaco, and Columbia University. My CV is appended to this statement. I was approached by Earthjustice to provide my professional opinion on the potential extent of Marcellus Shale gas development in Sullivan County, PA.

I estimate that full gas development in Sullivan County will result in the construction and operation of approximately 316—500 drill pads and approximately 2,528 wells. This estimate is based on a standard calculation that is widely-used for estimating the extent of Marcellus Shale gas development. It is well-established that each square mile of land can sustain one drill pad with eight wells. Some percentage of land in any given area cannot be utilized for gas development, however, as a result of a number of factors, including subsurface faults, surface access, and topography. A standard "risking estimate" for this percentage of inaccessible land is roughly 30 percent.

In the case of Sullivan County, which has a total area of 452 square miles, a standard 30 percent risking estimate translates into approximately 316 square miles of Sullivan County that can be drilled to access Marcellus Shale gas resources, which in turn translates into 316 drill pads and 2,528 wells in the county. I estimate that it will take 20-30 years for this development to occur.

TERRY ENGELDER

Department of Geosciences
The Pennsylvania State University
University Park, Pennsylvania 16802
(814-865-3620)

Education

1968 B.S. in Geology, Pennsylvania State University

1972 M.S. in Geology, Yale University

1973 Ph.D. in Geology, Texas A&M University

Professional Experience

1965	Geologist, Bradley Producing Co., Wellsville, New York
1966-1967	Hydrologist, U. S. Geological Survey, Albany, New York, GS-4
1968	Geologist, Texaco, Inc.
1970-1973	Research Assistant, Center for Tectonophysics, Texas A&M University
1973-1974	Research Scientist, Lamont-Doherty Geological Observatory of Columbia University
1974-1979	Research Associate, Lamont-Doherty Geological Observatory of Columbia University
1979-1980	Lecturer, Columbia University
1979-1983	Senior Research Associate, Lamont-Doherty Geological Observatory of Columbia University
1983-1985	Senior Research Scientist, Lamont-Doherty Geological Observatory of Columbia University
1985-1990	Associate Professor of Geosciences, Pennsylvania State University
1990-Present	Professor of Geosciences, Pennsylvania State University

Honors and Awards

Phi Eta Sigma - Honor Society, 1965
Fellowship - Geological Society of America, 1989
Wilson Distinguished Teaching Award - The Pennsylvania State University, 1992
Geological Society of Washington - Second Place Paper, 1992
John and Cynthia Oualline Lecturer in Geological Sciences, University of Texas, 1993
Phi Kappa Phi – Honor Society, 2004

Fellowships:

Fulbright Senior Fellowship, Macquarie University, Syndey, Australia, 1984
French-American Foundation Fellowship, France, 2001-2002

Guest Professorship:

Erherzog Johann Technical University, Graz, Austria, 1999
Università di Perugia, Perugia, Italy, 2004

Visiting Scholar:

TotalFinaElf, CSTJF Pau, France, 2001-2002

Editorships, National Committees, Peer Review Panels

Co-Editor-in-Chief, Tectonophysics, 1993-1999
Associate Editor, Journal of Geophysical Research, 1980-1982
Associate Editor, Geological Society of America Bulletin, 1980-1982
Associate Editor, Tectonophysics, 1986-1993
U.S. National Committee for Rock Mechanics, Study on Research Requirements for Rock Mechanics, 1980
AGU Representative to the National Committee for Rock Mechanics,

1979-1982
Glomar Explorer Downhole Experiments Panel, 1980
Conference Organizer: Geological Society of America, Penrose Conference on "Pressure Solution and Dissolution Phenomena in Geology", 1980
Program Chairman: American Geophysical Union, Tectonophysics
Program Chairman, Eastern AGU meeting, 1982, 1983
Peer Review Panels: U.S. Geological Survey Earthquake Prediction Program, 1978, 1979;
The U.S. Department of Energy, Office of Basic Energy Sciences Contracts Program, 1992, 1993
Board of Directors - DOSECC, 1989-1991

Former Graduate Students

	Degree	**Employers**
Richard Plumb	Ph.D. 82'	Geologist, Schlumberger, Cambridge, UK then Houston, TX
Stephen Marshak	Ph.D. 83'	Ass. then Assoc. then Professor then Dept. Head, Univ. of Illinois, Urbanna, ILL
Paul Scott	M.S. 89'	Geologist, British Petroleum, Houston, TX then earth science teacher Schenectady, NY
Alfred Lacazette	Ph.D. 91'	Texaco Research, Houston, then Western Atlas, Houston, then private consultant
Amy Freeman	M.S. 91'	Engineer, Williamsport, PA., then minority recruiting for College of Engineering, PSU
Irene Meglis	Ph.D. 92'	Postdoctoral Fellow, Queens Univ. ONT, Canada then Memorial University NFLD
John Leftwich	Ph.D. 93'	Ass. Professor, Old Dominion, Norfolk, VA, then Shell Offshore, New Orleans

Michael Gross	Ph.D. 93'	Ass. then Assoc. Prof., Florida International U., Miami, FL
Mark Fischer	Ph.D. 94'	EXXON Production Res.,Houston then Ass. & Assoc. Prof., U. North. Illinois, Dekalb, ILL
Staci Loewy	M.S. 95'	Geologist, EXXON Production Res., Houston then Ph.D. Univ. Texas, Austin then adjunct faculty at U. of North Carolina.
Amgad Younes	Ph.D. 96'	Postdoc. Fell., Royal Holloway, London then Stanford, CA, then Marathon Oil, Denver, CO, then Royal Dutch Shell, Netherlands
David McConaughy	M.S. 97’	Shell Offshore, New Orleans then environmental firm, Pittsburgh
Laura Silliphant	M.S, 98’	Geologist, Anadarko Petroleum, Houston, TX and Alaska then consultant Alaska
Michael Scanlin	Ph.D. 00’	Assoc. Prof., Elizabethtown College, Elizabethown, PA
Christie Rogers	M.S., 02’	Exxon-Mobil, Houston
Laura Savalli	M.S., 03’	Chevron-Texaco, Houston
Redescal Uzcategui	Ph.D. 04’	Assoc. Prof., Simon Bolivar U., Caracus, Ven.
Amy Whitaker	Ph.D. 04’	Chevron-Texaco, Houston
Meryl Towarak	M.S. 06’	US Bureau of Land Management
Brett Nadan	M.S. 06’	Boston School District

Former Undergraduate Theses (after 1992)

	Degree	Thesis Title
David A. Cox	B.S. 93’	The effect of local fold anomalies on the geologic nature of the Tusseyville Fault, Centre Hall, Pennsylvania
Jennifer A. Mullen	B.S. 93’	Strain analysis of Axemann Limestone using the Fry method
Paul D. Pinkerton	B.S. 96’	Petrographic characteristics of the Elk Basin sandstones and their correlation with joint spacing
Paul N. Hagin	B.S. 97’	Joint spacing statistics in thick, homogeneous shales of the Catskill Delta Complex on the Appalachian Plateau: Finger Lakes Region, New York
Diana K. Latta	B.S. 97’	The role of flexural slip during the formation of folds in Devonian clastic rocks of the Appalachian Plateau
Jason C. Ruf	B.S. 97’	Analysis of joint and vein spacing in the Brallier Formation, Huntingdon, PA
Megan M. Kovach	B.S. 98’	The effect of Lithology on the persistence of joint orientations through marine to fluvial depositional environments in the Catskill Delta near Port Matilda, PA
Ben. Haith	B.S. 99’	Origin of slip along systematic cross-fold joints in the Genesee Group of the Finger Lakes District, New York
Brian M. Gaul	B.S. 99’	Effect of bedding dip on elevation of sandstone ridges in the vicinity of State College, Pennsylvania.
Douglas A. Myers	B.S. 01’	Relative age of a smaller-scale joint set formed between large-scale jint zones in the Navajo sandstone at Zion National Park, Utah: Analysis based on joint spacing statistics and joint interaction

Jennifer K. Bobich	B.S.,02’	The role of tectonically driven fluids in the formation of the Ouachita fold and thrust belt: Characterization and relative timing of quartz veins
Ryan J. McAleer	B.S. 04’	Concretions in the Llewellyn Formation, Bear Valley strip mine, Shamokin, PA: Ridge inclusions in a deformable matrix

RESEARCH INTERESTS

Laboratory Research

1. mechanical properties of rocks affecting strain relaxation (1974-1996)

2. fluid transport of properties of rocks, mainly permeability of joints (1976-1985)

3. geochemistry of rock-water interaction (1980-1985)

4. experiments in fracture toughness in rocks (1987-present)

5. microfabric of crystalline rocks (1980-present)

Field Research

1. A study of the characteristics of fault zones in the Cordilleran Region, 1971-72, 1979-80

2. Strain relaxation and hydraulic fracture in situ stress measurements in northeastern United States and California, 1974-1993

3. In situ ultrasonic properties of rock, 1978-1995

4. Fracture Analysis - Appalachian Basin, NY-PA-Virginia, Salt Range (Pakistan), Monterey Formation, CA, Michigan Basin, MI, Elk Basin, WY, Bristol Channel, Somerset (England), Paradox Basin, UT, Zion National Park, UT, Dinosaur National Monument, UT, 1978-present

5. Strain Analysis in foreland fold and thrust belts - Appalachian Basin, Apennines (Italy), Patagonian Andes (Chile), 1976-present

6. In situ conditions in overpressured sedimentary basins, 1989-present

7. Regional patterns in rift and grain of New England granites, 2002-present

Theoretical Analyses

1.Development of natural hydraulic fractures 1985 - present

2.Development of stress in overpressured sedimentary basins, 1989 – present

3.Mechanical properties of rock controlling fracture spacing (1985-present)

4.Coupling between pore pressure and stress in basins (1994-present)

TERRY ENGELDER

PUBLICATION VITA

THESIS

Engelder, T. , 1973, Quartz fault gouge: Its generation and effect on the frictional properties of sandstones, Ph.D. dissertation, Texas A&M University, College Station, Texas, 153 p.

BOOKS

Engelder, T., 1993, Stress Regimes in the Lithosphere: Princeton Press, Princeton, New Jersey, 451 p.

MAJOR VOLUMES AS EDITOR OR CO-EDITOR

The Oertel Volume: Engelder, T., ed, 1995, 30 Years of Tectonophysics, A Volume in Honour of Gerhard Oertel: Tectonophysics, v. 247, Nos 1-4.

The Logan Volume: Chester, F.M., Engelder, T. and Shimamoto, T., eds, 1998, Rock Deformation: The Logan Volume: Tectonophysics, v. 295, Nos 1-2.

The Hancock Volume: Cosgrove, J.W. and Engelder, T., eds, 2004, The Initiation, Propagation, and Arrest of Joints and Other Fractures: Geological Society, London, Special Publications, 231.

PAPERS: PEER REVIEWED JOURNALS

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Engelder, T., 1994, Review of “Structural Geology” by S.K. Ghosh, Tectonophysics: v. 231, p. 347-349.

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Engelder, T., 2007, Review of “Fundamentals of Structural Geology” by D.D. Pollard and R.A. Fletcher, Computers & Geoscience:

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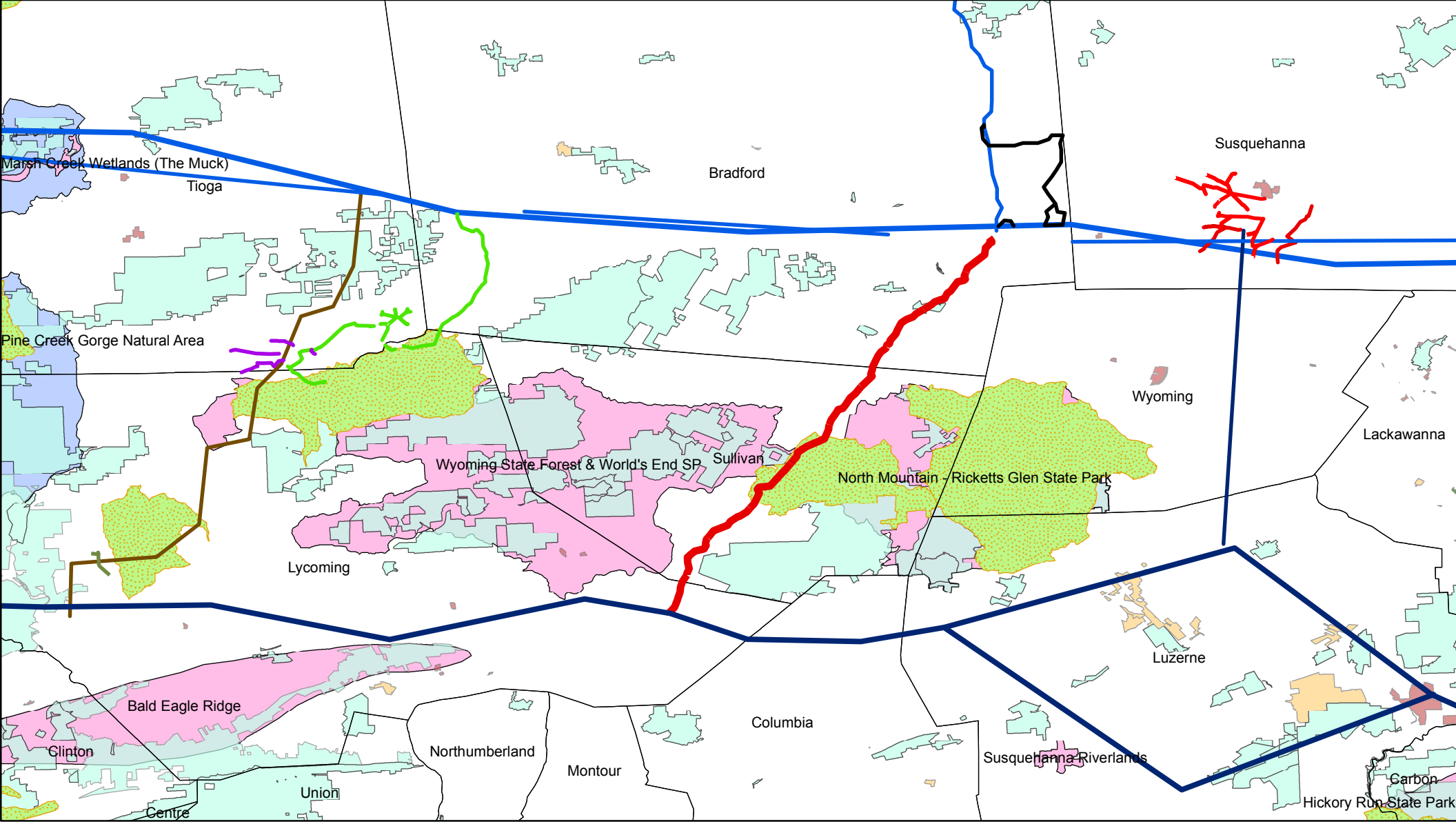
EXHIBIT C

1. **North-South Pipelines and Vulnerable/Protected Environments**
2. **North-South Pipelines and Trout Habitat**
3. **Mapping Data Sources**



MARC I Gas Pipeline

Existing Gas Transmission Lines

- El Paso Corporation--Tennessee Gas Pipeline and TGP Looping Segments; Stagecoach Line
- Williams Energy Transco
- Audubon Important Bird Areas- Core Areas
- Audubon Important Bird Areas- Conservation Areas
- The Nature Conservancy Matrix Forest Blocks

Existing or Pending (Permitted) North-South Pipelines

- PVR Trunkline
- Williams Energy Springville Gathering Line
- Cabot Gathering Line
- Anadarko Gathering Line
- SWEPI Gathering Lines
- Existing Gathering LInes, Company Unknown
- East Resources Troy Gathering System

PA Protected Areas Ownership

- Federal Land
- Native American Land
- State Land
- Regional/Local Land
- Private Conservation Land
- Joint Ownership/Unknown
- Private Land

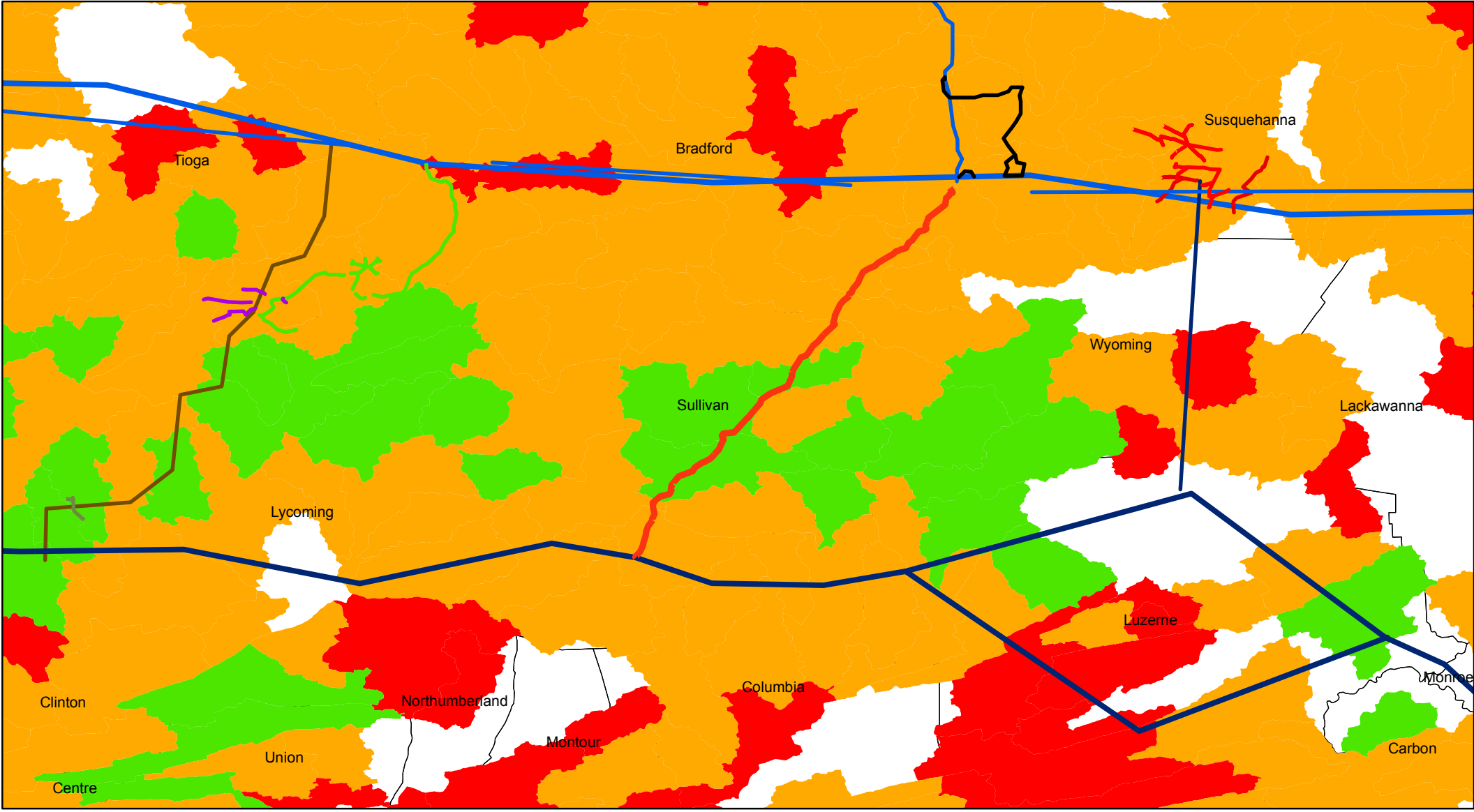
EARTHJUSTICE

N

6 0 6

Miles

ESRI CONSERVATION



MARC I Gas Pipeline

Existing Gas Transmission Lines

El Paso Corporation--Tennessee Gas Pipeline and TGP Looping Segments; Stagecoach Line

Williams Energy Transco

Existing or Pending (Permitted) North-South Pipelines

PVR Trunkline

Williams Energy Springville Gathering Line

Cabot Gathering Line

Anadarko Gathering Line

SWEPI Gathering Lines

Existing Gathering LInes, Company Unknown

East Resources Troy Gathering System

Pennsylvania Brook Trout--Habitat Integrity

Conservation Success Index Score

21 - 25

16 - 20

11 - 15

5 - 10

EARTHJUSTICE

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ESRI Technology CONSERVATION

EMG, 4-6-11

MAPPING DATA SOURCES

MARC I Gas Pipeline

Resource Report I, General Project Description (MARC I Hub Line), Docket No. CP10-480-000, at 53-62 (Aug. 6, 2010).

Matrix Forest Blocks

- Matrix sites are large contiguous areas whose size and natural condition allow for the maintenance of ecological processes, viable occurrences of matrix forest communities, embedded large and small patch communities, and embedded species populations. The goal of the matrix forest selection was to identify viable examples of the dominant forest types that, if protected and allowed to regain their natural condition, would serve as critical source areas for all species requiring interior forest conditions or associated with the dominant forest types.
- Source: The Nature Conservancy (TNC) Eastern Conservation Science, 2006
- Received via email from Brad Stratton (bstratton@tnc.org)

State Protected Areas

- The data set includes all lands that are permanently secured against conversion to development either by direct fee ownership or permanent easements. Protected areas in Pennsylvania include Federal, Native American, State, Regional/Local, and Private Conservation lands.
- Source: Conservation Biology Institute
- Link: http://databasin.org/protected-center/features/PAD-US-CBI

Audubon Important Bird Areas

- Important Bird Areas, or IBAs, are sites that provide essential habitat for one or more species of bird. IBAs include sites for breeding, wintering, and/or migrating birds. IBAs may be a few acres or thousands of acres, but usually they are discrete sites that stand out from the surrounding landscape. IBAs may include public or private lands, or both, and they may be protected or unprotected.
- Source: Audubon Pennsylvania
- Received via email from Stephanie Orndorff (sorndorff@audubon.org)

Pennsylvania Brook Trout—Habitat Integrity

- Displays Brook Trout Habitat Conservation Success Index (CSI) scores, developed by Trout Unlimited, which account for land stewardship, watershed connectivity, watershed conditions, water quality, and flow regime. Higher CSI scores indicate better conditions for Brook Trout.
- Explanation of CSI scores available at http://tucsi.tu.org/Documents/CSI-user-guide.pdf
- Source: Trout Unlimited
- Received via email from Matthew Mayfield (mmayfield@tu.org)

Other Gas Pipelines

Anadarko Gathering Line
40 Pa.B. 6692, Nov. 20, 2010, http://www.pabulletin.com/secure/data/vol40/40-47/2206c.html

Cabot Gathering Lines
39 Pa.B. 5031, Aug. 22, 2009, http://www.pabulletin.com/secure/data/vol39/39-34/1564c.html

40 Pa.B. 7245, Dec. 18, 2010, http://www.pabulletin.com/secure/data/vol40/40-51/2409c.html

41 Pa.B. 362, Jan. 15, 2011 http://www.pabulletin.com/secure/data/vol41/41-3/85d.html

41 Pa.B. 858, Feb. 12, 2011, http://www.pabulletin.com/secure/data/vol41/41-7/257c.html

East Resources Troy Gathering System
39 Pa.B. 5450, Sept. 19, 2009, http://www.pabulletin.com/secure/data/vol39/39-38/1727c.html

40 Pa.B. 7245, Dec. 18, 2010, http://www.pabulletin.com/secure/data/vol40/40-51/2409a.html

41 Pa.B. 362, Jan. 15, 2011, http://www.pabulletin.com/secure/data/vol41/41-3/85b.html

41 Pa.B. 1790, Apr. 2, 2011, http://www.pabulletin.com/secure/data/vol41/41-14/567d.html

El Paso Corporation—TGP Looping Segments
41 Pa.B. 1790, Apr. 2, 2011, http://www.pabulletin.com/secure/data/vol41/41-14/567d.html

41 Pa.B. 2131, Apr. 23, 2011, http://www.pabulletin.com/secure/data/vol41/41-17/685c.html

41 Pa.B. 2338, May 7, 2011, http://www.pabulletin.com/secure/data/vol41/41-19/767d.html

PVR Trunkline
Penn Virginia Resource Partners, L.P, "RBC MLP Conference Emerging Shale Plays," at 10 (Nov. 18, 2010), *available at* http://phx.corporate-ir.net/External.File?item=UGFyZW50SUQ9NDA0OTIwfENoaWxkSUQ9NDEzNjA2fFR5cGU9MQ==&t=1

Stagecoach Line and "Existing Gathering Lines—Company Unknown"
Bradford County Planning Commission, "Gas Line Map," Apr. 11, 2011, http://www.bradfordcountypa.org/Natural-Gas.asp?specifTab=2

SWEPI Gathering Lines
41 Pa.B. 1530, Mar. 19, 2011, http://www.pabulletin.com/secure/data/vol41/41-12/452b.html

41 Pa.B. 2011, Apr. 16, 2011, http://www.pabulletin.com/secure/data/vol41/41-16/658a.html

41 Pa.B. 2704, May 28, 2011, http://www.pabulletin.com/secure/data/vol41/41-22/885d.html

Williams Springville Gathering Line
41 Pa.B. 2231, Apr. 30, 2011, http://www.pabulletin.com/secure/data/vol41/41-18/726b.html ("To install, operate, and maintain a 24" Natural Gas Gathering Pipeline from a point (Lat. 41° 42.752573` N, Long. 75° 55.084310` W) North of Springville, PA in the county of Susquehanna to a point (Lat. 41° 20.725316` N, Long. 75° 56.498261` W) Northeast of Dallas, PA in the county of Luzerne where it will connect the northern gas fields to the Transco Pipeline for distribution to market.")

Williams Transco and El Paso Corporation—Tennessee Gas Pipeline
"Central New York Oil and Gas Company, LLC Announces a Non-Binding Open Season for North-South Project," at 1 (June 2008), http://www.stagecoachstorage.com/ExternalFiles/SitesIP/stagecoach/Docs/NORTH-SOUTH%20Open%20Season%20Package.pdf.

EXHIBIT D

I. MISSING OR INCOMPLETE RESPONSES TO FERC STAFF'S DATA REQUESTS

Data Request Set	Status
First Environmental Data Request	
Request #8	CNYOG failed to provide the information requested in parts (a)-(c) and (e) regarding its cathodic protection system. It will not provide plans for the cathodic protection system until after construction.
Request #13	CNYOG failed to provide the detailed special construction techniques requested by FERC. It stated that "[a]ll site specific plans will be submitted to FERC as they are completed."
Request #16	CNYOG failed to explain the specific Project impacts on each waterbody.
Request #23	CNYOG has not confirmed whether it has completed all consultations necessary to verify the distances and directions of the Project from drinking water systems.
Request #26	CNYOG failed to address how Loyalsock Creek's non-attainment for water quality would impact Project construction, or how that impact would be mitigated.
Request #30	CNYOG's site-specific plan for crossing the Susquehanna River fails to explain how the Sandstone and Shale Aquifer and the Unconsolidated Sand and Gravel Aquifer might be impacted by HDD.
Request #33	CNYOG failed to provide the requested Environmental Management Plan, instead stating that the Environmental Management Plan consists of the use of best management practices.
Request #35	CNYOG failed to provide specific withdrawal and discharge locations for hydrostatic test water.
Request #37	CNYOG's Erosion and Sedimentation Control fails to adequately address trench dewatering.
Request #38	CNYOG failed to verify whether the U.S. Army Corps of Engineers will require compensation for wetland impacts.
Request #48	CNYOG failed to provide the requested site-specific mitigation plans for impacts to soils in agricultural areas or the CCD recommendations for issues such as soil compaction, erosion, and topsoil segregation.
Request #66	CNYOG failed to provide information regarding proposed and reasonably foreseeable air emissions in the airshed for a cumulative air impacts analysis.
Request #69	CNYOG failed to provide information regarding other projects in the area for a cumulative noise impacts analysis.
Request #71	CNYOG failed to identify the state listed threatened and endangered species that would be impacted by Alternative Route A.
Request #73	CNYOG failed to provide data to supports its answer that Alternative Route B would potentially have significant adverse impacts on natural communities.

Data Request Set	Status
Request #77	CNYOG failed to provide milepost locations for the state protected areas that would be crossed by alternative Route B-2.
Second Environmental Data Request	
Request #8	CNYOG's site-specific plan for Loyalsock Creek does not include specific measures to address non-attainment for water quality.
Third Environmental Data Request	
Request #13	CNYOG failed to provide FERC with copies of required permits for hydrostatic test water discharges.
Request #15	CNYOG's draft Migratory Bird Impact Assessment fails to respond fully to this request. CNYOG has not filed a final Migratory Bird Impact Assessment.
Request #16	CNYOG failed to provide a general discussion regarding habitat fragmentation that would result from construction and operation of the Project.
Request #17	CNYOG's draft Migratory Bird Impact Assessment fails to respond fully to this request. CNYOG has not filed a final Migratory Bird Impact Assessment.
Fourth Environmental Data Request	
Request #2	CNYOG failed to provide the requested information for site 36BR0295. CNYOG has not filed additional results for deep testing along the Susquehanna River.
Fifth Environmental Data Request	
Request #1	CNYOG failed to provide a revised Migratory Bird Impact Assessment.
Request #4	CNYOG failed to provide a HDD avoidance plan for site 36BR0295. CNYOG has not filed additional results for deep testing along the Susquehanna River.
Sixth Environmental Data Request	
Request #1	CNYOG has not yet revised its Migratory Bird Impact Assessment.

II. OUTSTANDING OR INCOMPLETE PERMITS/CONSULTATIONS

Agency/Entity	Permit/ Consultation	Status	EA Pages
Federal			
Advisory Council on Historic Preservation	Section 106 of the National Historic Preservation Act	Cultural resource studies not yet complete.	69-70
U.S. Army Corps of Engineers	Clean Water Act Section 404 Permits	Permit terms unknown.	5, 36, 41
U.S. Army Corps of Engineers	Rivers and Harbor Act Section 10 Permits	Permit terms unknown.	5, 36
U.S. Department of Agriculture (USDA) Farm Services Agency, Bradford, Lycoming, and Sullivan Counties	Conservation Reserve Program (CRP) and Conservation Reserve Enhancement Program (CREP)	Results of ongoing coordination with CRP and CREP landowners unknown.	5
USDA, Natural Resources Conservation Service (NRCS)	NRCS Conservation Programs	NRCS requirements unknown.	5, 26-27
U.S. Fish and Wildlife Service	Consultation: Migratory Bird Impact Assessment	Migratory Bird Impact Assessment not yet finalized.	48-49
State			
PA Department of Conservation and Natural Resources, Bureau of Forestry	Threatened and Endangered Species Consultations: Plant Species	Status of updated survey results for plant species of concern unknown.	5, 52-53
PA Department of Environmental Protection (PADEP)	Clean Water Act Section 401 Certification	Certification not yet issued.	41
PADEP	Erosion and Sediment Control General Permit	Permit terms unknown.	5
PADEP	NPDES Hydrostatic Test Discharge Permit	Permit application not yet filed.	5, 13, 37
PADEP	NPDES Stormwater Permit	Permit application not yet filed.	5

Agency/Entity	Permit/ Consultation	Status	EA Pages
PADEP	Water Obstruction and Encroachment Permits	Permit terms unknown.	5, 36
PA Fish and Boat Commission	Blasting Permits	Permits not yet filed.	35
PA Game Commission	Consultation: Migratory Bird Impact Assessment	Migratory Bird Impact Assessment not yet finalized. CNYOG has not agreed to implement all PGC recommendations.	48-49
PA Natural Heritage Program	Consultation: Plant Species of Concern	Status of updated survey results for plant species of concern unknown.	6, 53
PA State Historic Preservation Office, Pennsylvania Historical and Museum Commission	Consultation/Clearance: Cultural Resources	Cultural resource studies not yet complete.	6, 69-71
Local			
Bradford County Conservation District	Erosion and Sediment Control Plan (ESCP) Approval	Approval not yet obtained.	6, 26-27
Lycoming County Conservation District	ESCP Approval	Approval not yet obtained.	6, 26-27
Lycoming County Planning & Community Development Department	Zoning Application for Road Crossings	Status unknown.	6
Sullivan County Conservation District	ESCP Approval	Approval not yet obtained.	6, 26-27
Sullivan County Planning & Economic Development Office	Land Development Plan for Compressor Station	Status unknown.	6

III. OUTSTANDING OR INCOMPLETE PLANS

Plan	Status	EA Pages
Avoidance plan for site 36BR0295	Not yet developed.	70
Blasting Plan for bluestone quarry	Not yet developed.	21
Drilling Fluid Management and Monitoring Plan for HDD	Could not be located in FERC docket.	52
Emergency Response Plan	Not yet developed.	68
Environmental Management Plan for the discharge of hydrostatic test water	Not yet developed.	37
Erosion and Sedimentation Control Plan	Not yet finalized.	App. 2
Invasive Species Management Plan	Not yet developed.	45
Memorandum of Understanding with Lake Mokoma Association	Not yet developed.	63
Migratory Bird Impact Assessment	Not yet finalized.	App. 4
Plan to allow access for bluestone quarry operation across pipeline right-of-way	Not yet developed.	21
Plan for construction on or next to residential properties	Not yet developed.	56
Site-specific plans for corrosion protection system	Not yet developed.	2
Stormwater Pollution Prevention Plan	Could not be located in FERC docket.	17

EXHIBIT E

Supplemental Mitigation Measures

I. GEOLOGY

- *Slumping and Micro-Landslide Mitigation Plan:* Prior to construction, Applicant shall file, for review and written approval, site-specific mitigation plans to minimize potential slumping and micro-landslides in areas of steep slopes.[1]
- *Abandoned Mines Investigation and Plan:* Prior to construction, Applicant shall file the results of its preconstruction geological investigation to evaluate if abandoned mines are present in the project area. If abandoned mines are present, Applicant shall file a plan to address abandoned mine hazards and file documentation of consultation with the U.S. Bureau of Land Management and appropriate state geologists in the development of these plans for the review and written approval by the Director of FERC's Office of Energy Projects ("OEP").[2]

II. WATER RESOURCES AND WETLANDS

- *Compensatory Wetland Mitigation Plan:* Prior to construction, Applicant shall complete its consultations with the U.S. Army Corps of Engineers, the Pennsylvania Department of Environmental Protection, and other applicable agencies and organizations to develop a compensatory wetland mitigation plan. The plan shall include details regarding the amount, location, and types of mitigation proposed; specific performance standards to measure the success of the mitigation; and remedial measures, as necessary, to ensure that compensatory mitigation is successful. Applicant shall file the compensatory wetland mitigation plan, including any associated agency agreements or approvals, for the review and written approval of the Director of OEP.[3]
- *Well Yield and Water Quality Reports:* Applicant shall file a report with FERC in the event that any complaints are received concerning well yield or water quality. The report shall identify how Applicant proposes to resolve the complaint, provide a temporary source of water supply, and replace any water supply system that it damages during construction and cannot repair to its former capacity and quality.[4]

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[1] *See Bison Pipeline LLC*, 131 FERC ¶ 61,013, at app. para. 12 (FERC Apr. 9, 2010).

[2] *See Ruby Pipeline LLC*, 131 FERC ¶ 61,007, at app. para. 14 (FERC Apr. 5, 2010).

[3] *See Florida Gas Transmission Company, LLC*, 129 FERC ¶ 61,150, at app. C para. 19 (FERC Nov. 19, 2009).

[4] *See Port Barre Investments, LLC d/b/a/Bobcat Gas Storage*, 126 FERC ¶ 61,240, at app. B para. 12 (FERC Mar. 19, 2009).

III. VEGETATION AND WILDLIFE

- *Equipment Wash Stations:* During construction, Applicant shall establish equipment wash stations to reduce the spread of noxious weeds.[5]
- *Equipment Disinfection Plan:* Applicant shall implement an equipment disinfection plan to incorporate one or more of the following measures during construction as equipment enters and exits watersheds crossed by the project and as equipment exits all water bodies known to contain pathogens and nonnative aquatic species that can be spread by contact with construction equipment. Applicant shall remove mud and debris from equipment and either:
    - (a) keep the equipment dry for at least 10 days prior to use;
    - (b) spray or soak the equipment with 1) a 10-percent chlorine bleach solution, 2) a 1:1 solution of Formula 409 household cleaner, or 3) a 1:15 solution of Sparquat 256 institutional cleaner, making sure to keep the equipment moist with the cleaner for at least 10 minutes; or
    - (c) spray or soak the equipment with steam or water greater than 130 degrees Fahrenheit for at least 10 minutes.
    - Additionally, if Applicant identifies any invasive water organism on any equipment as it leaves a waterbody or wetland, Applicant shall report the sighting to the appropriate state conservation office and implement disinfection measures on all equipment as it leaves the infected waterbody or wetland.[6]

IV. LAND USE, RECREATION, AND AESTHETICS

- *Facility Visual Screening Plans:* Applicant shall develop a visual screening plan for the compressor stations that addresses shape, color, lighting, motion sensors, or ground cover at these locations, for review and written approval by the Director of OEP prior to construction.[7]
- *Pipeline Construction Screening Plan*: Prior to construction of the pipeline, Applicant shall file a vegetative visual screening plan for the review and written approval by the Director of OEP to minimize the removal of trees and to replace trees that would be removed for pipeline construction.[8]

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[5] *See Bison Pipeline LLC*, 131 FERC ¶ 61,013, at app. para. 18 (FERC Apr. 9, 2010).

[6] *See Ruby Pipeline LLC*, 131 FERC ¶ 61,007, at app. para. 34 (FERC Apr. 5, 2010).

[7] *See ETC Tiger Pipeline, LLC*, 131 FERC ¶ 61,010, at app. para. 26 (FERC Apr. 7, 2010).

[8] *See Florida Gas Transmission Company, LLC*, 129 FERC ¶ 61,150, at app. C para. 37 (FERC Nov. 19, 2009).

- *Residential Plans:* Prior to construction of the pipeline, Applicant shall provide individual site-specific residential plans to the owner of each residence located within 200 feet of construction work areas and provide the owner one month to review and comment on these plans. Applicant shall file these plans along with any comments from the property owner(s) with FERC for review and written approval by the Director of OEP. The site-specific residential plans shall include:
    - (1) A dimensioned site plan that clearly shows:
        - i. The location of the residence in relation to the new pipeline and any existing pipelines and/or other utilities (including septic systems);
        - ii. The boundaries of all permanent and temporary construction work areas;
        - iii. Other nearby structures and residential features (including decks, pools, swings, fences, driveways, etc.); indicating, which would be removed and any areas with restrictions after construction;
        - iv. Trees and other landscaping; indicating which would be removed and where trees would not be allowed after construction;
        - v. The location of topsoil and subsoil storage piles;
        - vi. Equipment travel lanes;
        - vii. Safety fencing and other safety features; and
        - viii. The distances between construction work areas and permanent structures.
    - (2) A detailed description of the construction techniques that will be used (such as reduced pipeline separation, centerline adjustment, use of stove-pipe or drag-section techniques, working over existing pipelines, pipeline crossover, bore, utility crossing, etc.);
    - (3) An estimation of the amount of time required for construction;
    - (4) A description of restoration and revegetation measures and procedures for the property.[9]

V. CULTURAL RESOURCES

- *Completion of Cultural Resource Surveys:* Applicant shall not begin construction of facilities or begin use of any staging, temporary work areas, and access

[9] *See Transcontinental Gas Pipeline Corporation*, 124 FERC ¶ 61,1160, at app. B para. 17 (FERC Aug. 14, 2008).

roads in areas which have not been surveyed until Applicant completes required cultural surveys of areas to which access was denied and files reports and the State Historic Preservation Office comments on the reports.[10]

VI. AIR QUALITY AND NOISE

- *Additional HDD Noise Mitigation:* Prior to construction at the Horizontal Directional Drilling ("HDD") entry sites Applicant shall file for the review and written approval of the Director of OEP:
  - (a) additional noise mitigation measures to minimize impacts on noise sensitive areas (NSA); and
  - (b) the calculated noise levels with these additional measures.[11]

VII. RELIABILITY AND SAFETY

- *Hazardous and Contaminated Materials Management Plan:* Applicant shall develop a hazardous and contaminated materials management plan that identifies the procedures that would be implemented during construction to identify, test, treat, and dispose of such materials in accordance with the appropriate state and federal regulations. This plan shall be filed prior to construction.[12]
- *Residential Access and Traffic Mitigation Plan:* Prior to construction of the pipeline, Applicant shall file with FERC for review and written approval by the Director of OEP, a Residential Access and Traffic Mitigation Plan that identifies potential road closures, and measures that Applicant would implement to minimize construction traffic impacts on affected residents. This plan shall identify procedures for notifying residents about planned road closures and disturbances.[13]

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[10] *See Southern Natural Gas Company et al.*, 128 FERC ¶ 61,198, at app. para. 23 (FERC Aug. 27, 2009).

[11] *See Florida Gas Transmission Company, LLC*, 129 FERC ¶ 61,150, at app. C para. 40 (FERC Nov. 19, 2009).

[12] *See ETC Tiger Pipeline, LLC*, 131 FERC ¶ 61,010, at app. para. 14 (FERC Apr. 7, 2010).

[13] *See Transcontinental Gas Pipeline Corporation*, 124 FERC ¶ 61,1160, at app. B para. 27 (FERC Aug. 14, 2008).

EXHIBIT F

Comments on MARC I Hub Line Project Environmental Assessment
Project docket number (CP10-480-000)

By

John Quigley
John H Quigley LLC

My name is John Quigley. I served as Secretary of the Pennsylvania Department of Conservation and Natural Resources (DCNR) from April 2009 to January 2011 in the cabinet of Governor Edward Rendell. Prior to that appointment, I worked for the agency for four years in several capacities, including overseeing strategic initiatives and operations, and as chief of staff. I offer the comments below on the potentially significant environmental effects of the proposed MARC1 project and the proposed measures to avoid or lessen environmental impacts, in hope that the cutting-edge work of DCNR and others that I will reference can inform FERC's fuller consideration of the cumulative impacts of the MARC1 project.

The wave of natural gas development that is sweeping over Pennsylvania will have profound economic and environmental impacts on the Commonwealth. As a former policymaker and leader of the agency of state government charged with being the chief steward of the Pennsylvania's natural resources, and having studied the issues carefully, I am convinced that the cumulative impacts of the Marcellus play will dwarf all of Pennsylvania's previous waves of resource extraction - oil, timber, and coal mining - combined.

Individual projects like the proposed MARC1 project will accumulate across the state in the coming years. It is essential that each be considered fully, with cumulative impacts at the core of the analysis.

The key questions, in my view as they relate to the MARC1 project, are:

- whether FERC will be able to strike the necessary balance between resource extraction and resource conservation and ensure that the development of shale gas resources proceeds in a sustainable manner;
- whether FERC will fully consider the cumulative impacts of Marcellus-related development; and
- whether FERC will insist on the implementation of what are truly best management practices – an understanding of which is necessarily an evolving one, requiring the adoption of a continuous improvement approach – in permitting individual projects like MARC1.

These questions are critically important to Pennsylvania's future.

Models exist for FERC to draw upon. Some come from Pennsylvania's state forest system.

Pennsylvania's state forest was the first state forest in the country to be certified as well managed[1] by the Forestry Stewardship Council[2]. It is the longest-certified state forest in the nation. DCNR's management of Pennsylvania's state forest meets the international gold standard for environmentally and socially responsible forestry, and the agency's professionals are among the finest in the nation.

I have not only witnessed first-hand the significant impacts – the damage - of gas development on state forest lands; more importantly, I have listened intently to the concerns of the professional foresters and land managers at DCNR, whom, I believe it is fair to say, are extremely concerned about the cumulative impacts of natural gas and pipeline development on Pennsylvania's public and private forests. I draw upon the totality of my experience with these peerless land managers in offering these comments, and will specifically point to DCNR's work as examples of the kind of cumulative impacts analysis and source of best practice that must be reviewed, considered, and compared in a cumulative impact assessment of the MARC1 project. Application of such standards provides the best hope for Marcellus development in Pennsylvania to be sustainable.

Specific comments follow.

1. The EA is focused only on the pipeline corridor and understates potential cumulative impacts.

The cumulative impacts of the MARC1 pipeline – which will disturb significant contiguous forest patches – are seriously understated. At a minimum, the EA should consider both the clearing requirements and the edge-effect damage to forest habitat as a result of pipeline construction that will be described below.

As stated in the EA:

> Based on the modified (January 2011) project facilities, construction of the proposed project facilities would affect about 591.9 acres. This total includes the construction right-of-way, ATWS, access roads, wareyards, and aboveground facilities. Operation of the Project would require about 248.7 acres for the permanent right-of-way, aboveground facilities, and permanent access roads. The remaining 343.2 acres of temporary workspaces would be restored and returned to previous land use…

[1] http://www.dcnr.state.pa.us/forestry/certification.aspx
[2] http://www.fscus.org/

> Much of the Project would consist of greenfield construction in previously-undisturbed forest habitat…
>
> We have reviewed the U.S. Forest Service's National Forest Inventory and Analysis database for Bradford, Sullivan, and Lycoming Counties and determined that there are over 1.2 million acres of forest cover in the three counties crossed by the Project. In comparison, the Project would permanently convert less than 170 acres from forested land to vegetated open or scrub shrub land. The width of the permanent right-of-way would be limited to 50 feet and adjacent temporary workspace would be allowed to revert to woody shrubs and adjacent forested land would remain available for wildlife habitat and watershed functions.

In my judgment, based on my professional observations of the magnitude of clearing and disruption attendant to similar gas development projects, as well as my understanding of the scientific work of respected conservation organizations[3], the EA takes a very narrow view that seriously understates cumulative impacts.

Cumulative impacts are "impact[s] on the environment which result 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."[4]

It is critical that for this and future projects that will arise from unconventional gas drilling in Pennsylvania, regulators get the scope of analysis right, and fully comply with both the letter and spirit of the law. It is no exaggeration to say that the future of the Commonwealth will be shaped by the cumulative impacts of this gas play.

The Marcellus formation underlies two thirds of Pennsylvania. At least 7 million acres - 25% of the land area of the state – has been leased for drilling. About 3,000 Marcellus wells have been drilled in Pennsylvania so far. Over the next several decades, 60,000 to as many as 200,000[5] wells (estimates vary widely) will be drilled. Thousands of miles of roads, gathering lines, pipelines, and industrial infrastructure will be constructed.

It is essential that governmental agencies take a hard, scientific look at cumulative impacts. The incremental impact of the MARC I Hub Line on present and future land use, vegetation, wildlife, listed species, and water resources, must be added to the impacts of other past, present, and reasonably foreseeable future actions.

The EA falls far short of this requirement.

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[3] The Nature Conservancy, Audubon Pennsylvania, Western Pennsylvania Conservancy, and the Pinchot Institute for Conservation, for example

[4] 40 C.F.R. § 1508.7 (2010)

[5] http://www.thecourierexpress.com/tricountysundaytrilocal/922561-349/marcellus-shale-gas-risks-.....html

Given the scope of the Marcellus gas play, the future is reasonably forseeable. The cumulative impacts of the proposed MARC1 project are similarly forseeable. But this is not reflected in the EA.

The Nature Conservancy[6] recently released a *Pennsylvania Energy Impacts Assessment*[7], the first of two reports looks at the impacts to Pennsylvania's forests from development of natural gas, wind, wood biomass, and associated electric and gas transmission lines.

I have tremendous respect for TNC's work based on my six years of experience at DCNR, during which I worked closely with TNC and others on landscape-level conservation, as well as on the specific impacts of energy development (wind power) on forested lands.[8] DCNR relies heavily on TNC's advice and expertise, and I have seen the efficacy of TNC's analytical methods in ensuring protections for Pennsylvania's public lands.

TNC's estimated impacts of natural gas development are particularly relevant to the MARC1 EA. I believe that TNC's *Energy Impacts Assessment Report* sets out a minimum methodological standard that should be employed by FERC in considering the cumulative impacts of individual gas development projects like the proposed MARC1 project.

TNC points out that in considering the impacts of land clearing involved in natural gas development activities - including pipeline development -

> Adjacent lands can also be impacted, even if they are not directly cleared. This is most notable in forest settings where clearings fragment contiguous forest patches, create new edges, and change habitat conditions for sensitive wildlife and plant species that depend on "interior" forest conditions. Forest ecologists call this the "edge effect." While the effect is somewhat different for each species, research has shown measurable impacts often extend at least 330 feet (100 meters) forest adjacent to an edge…As large forest patches become progressively cut into smaller patches, populations of forest interior species decline.
>
> To assess the potential interior forest habitat impact, we created a 100 meter buffer into forest patches from new edges created by well pad and associated infrastructure development. For those well sites developed in forest areas or along forest edges (about half of assessed sites), an average of 21 acres of interior forest habitat was lost.

TNC has estimated the impact of as many as 60,000 wells that could be drilled across the state by 2030. (I believe that this number is very conservative.) They looked at the total

[6] http://www.nature.org/index.htm
[7] http://www.nature.org/media/pa/pa_energy_assessment_report.pdf
[8] http://www.dcnr.state.pa.us/wind/index.aspx

amount of land that will be cleared or disturbed for well pads, new or expanded roads, gathering pipelines, and water impoundments.

TNC's study found that by 2030, between 38,000 to 90,000 acres of forest could be cleared for new Marcellus gas wells in Pennsylvania. These clearings will disrupt forest ecosystems and could threaten forest interior species in an additional 91,000 to 220,000 forest acres adjacent to Marcellus development.

These lands contain nearly 40 percent of Pennsylvania's globally rare and threatened species.

TNC found that aquatic habitats are at risk, too. Nearly 80 percent of the state's most intact brook trout watersheds could see at least some Marcellus gas development during the next twenty years.

Part 2 of the Assessment will be released soon. In it, TNC looks at the impact of the pipelines that will be built to get all that Marcellus gas to market. Again, this analysis is particularly relevant to the MARC1 EA.

The sobering news is that the overall impact from pipeline development in Pennsylvania is likely to exceed the impact from well pads and roads.

TNC's preliminary estimates are that between 10,000 and 15,000 miles of new gathering lines will be built, leading to an estimated loss of 50,000 to 120,000 acres of natural habitat and additional damage to 300,000 to 900,000 acres of adjacent forest.

Further, at least 1,700 miles of new transport lines are projected, leading to an estimated minimum loss of 14,000 acres of natural habitat and damage to an additional 50,000 acres of adjacent forest.

So, TNC's total estimates for cumulative impacts to Pennsylvania's forests from Marcellus natural gas development are between 102,000 and 210,000 acres of forest cleared, and additional 440,000 to 1.1 million acres of forest habitat disruption.

That's a grand total of between 543,000 and 1.3 million acres of forest lost or harmed.

Forests cover 17 million acres of our state. So TNC's estimate translates into damage to between about 3 and 8 percent of the state's forest from gas development.

Because many of the state's largest and most intact – and sensitive - forest patches could be fragmented, the results of damaging what seems like a relatively small percentage of the total forest could be disproportionately severe.

According to maps developed by Earthjustice, as many as 26 companies have existing or proposed pipeline or gathering line projects in northeastern Pennsylvania and southern New York. There are an additional 19 companies developing wells but not pipelines

(and 7 companies doing both). Thus, there are a total of 45 companies developing pipelines and/or wells in the region. The future is reasonably forseeable. The impacts from the proposed MARC1 project must be considered cumulatively from these reasonably forseeable activities.

2. CNYOG has not yet developed information on critical aspects of the project. No decision should be made until this information is placed before the public for review.

In my experience at DCNR, full transparency and robust engagement with stakeholders and the public in developing public land management policy and processes has resulted in stronger environmental protections, a better, shared understanding of the resource, and better public policy. A public presentation and discussion of all of the facts is an indispensible part of that process. All of the facts on the MARC1 project are not yet before stakeholders and the public:

- CYNOG has not provided survey data for domestic water wells that may be within 150 feet of access roads.
- CYNOG has not provided a revised construction window with respect to its MBTA responsibilities
- CYNOG has yet to address how it would control potential invasive species, and must develop an Invasive Species Management Plan to identify, prevent, and treat potential invasive and exotic plant species infestations.
- Consultation with the USFWS with respect to endangered bat populations has not yet been completed.
- CNYOG has conducted cultural resources surveys to identify archaeological sites and architectural resources, but to date, 10 tracts (about 5.1 miles) of pipeline corridor and two access roads have not been surveyed due to lack of landowner access. Proposed compressor station locations and wareyards also have not been surveyed. The report of additional testing conducted along the north side of the Susquehanna River has not yet been filed with the Commission. The SHPO has not yet had an opportunity to comment on dust/vibration mitigation measures.

No decisions should be made until this information is presented to the public for review and comment.

3. The EA indicates that CYNOG has agreed to implement certain BMPs, including storm water, water withdrawal during hydrostatic testing, erosion and sedimentation, SPCC, and various DEP BMPs. A comprehensive review of BMPs should be undertaken and the most protective BMPs prescribed for each

aspect of the project.

The future of Pennsylvania depends upon the precedents the MARC 1 EA sets.

The EA says:

> Due to the implementation of specialized construction techniques and carefully developed resource protection and mitigation plans designed to minimize and control environmental impacts for the Project as a whole, only small cumulative effects are anticipated when the impacts of the Project are added to the identified ongoing projects in the immediate area.

The scale of Marcellus development in Pennsylvania, as indicated by the TNC report, is unprecedented in the state's history. An understanding of the cumulative impacts of that development is only beginning to emerge. Similarly, best management practices are in a state of evolution. Significant new work has been done on developing BMPs to govern various aspects of natural gas development. For example, the Pinchot Institute for Conservation[9] has published a set of Marcellus-specific BMPs[10] that discuses the importance of co-location of pipeline and other infrastructure to reduce environmental impacts from development. Work by the PA DCNR shows us the importance of pre-planning, how environmental impacts can be avoided, buffered, or minimized; and how disturbed areas can be reclaimed.[11] The agency's environmental review process is exemplary. DCNR has developed and is using Guidelines for Right-of-Way Development on Pennsylvania State Forest and State Park Lands[12], and has recently issued new guidelines[13] for administering oil and gas activities on state forest lands in a sustainable manner that were developed collaboratively with stakeholders. The guidelines include BMPs for:

- Pipelines
- Compressor stations
- Vegetation Management
- Invasive Plants
- Restoration
- Recreation

All of this work by DCNR arises out of the agency's conservation mission and its commitment to sustainable management of the state forest system. DCNR is responsible for achieving a balance between resource extraction, recreation, and habitat conservation. In developing its policies, DCNR applies the best available science and provides for extensive stakeholder input and public comment.

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[9] www.pinchot.org
[10] http://www.pinchot.org/uploads/download?fileId=946
[11] http://www.dcnr.state.pa.us/forestry/naturalgasexploration/impacts/index.htm
[12] http://www.dcnr.state.pa.us/forestry/ROW/Guidelines/Guidelines%20for%20ROW%20Development.pdf
[13] http://www.dcnr.state.pa.us/ucmprd1/groups/public/documents/document/dcnr_004055.pdf

DCNR's track record of success in sustainably managing the state forest is ample evidence of the importance of this approach to the future of the Commonwealth - and the transferability of this work to FERC's consideration of MARC1 and other proposed projects.

DCNR's BMPs were intended to set a high environmental bar on the public lands. If the gas industry – drillers and pipeline companies alike - is capable of meeting DCNR's collaboratively-developed BMPs on the public lands, there is no reason it cannot meet the same standards statewide. The BMPs agreed to by CYNOG should be compared by FERC to the above resources, and the most protective practices should be required.

It is also important to understand that field is so new that no one is really sure whether what we currently regard as BMPs will truly be effective. The Exxon pipeline that recently spilled 150,000 gallons of crude oil into the Yellowstone River was fully compliant with current regulations and BMPs. Thus, FERC must commit to a continuous improvement process, so that as management issues and necessary BMPs are developed and refined, the environmental bar can be raised sufficiently to account for all of the risks as they are currently understood. It is not enough to simply accept an applicant's proposed BMPs. They should be compared by FERC to the best current science and practice to ensure that they equal or exceed them. This, I believe, is a fundamental duty in meeting the spirit of the law.

Conclusion

The EA, in my professional judgment, is deficient. The environmental impacts from the proposed MARC1 project and the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions must be more carefully and thoroughly considered, and the manner in which the project moves forward must be given additional scrutiny.

JOHN H. QUIGLEY

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EXPERIENCE

January, 2011 – Present **Principal** John H. Quigley LLC

- Provide strategic advice and consulting services for public, non-profit, and private sector clients.

April, 2010 – January, 2011 **Secretary** Commonwealth of Pennsylvania
Department of Conservation and
Natural Resources (DCNR)
Harrisburg, PA

- Department head and member of the Governor's Cabinet responsible for the management of 117 state parks and 2.1 million acres of state forest land; providing formation on the state's ecological and geologic resources; and establishing community conservation partnerships with grants and technical assistance to benefit rivers, trails, greenways, local parks and recreation, regional heritage parks, open space and natural areas. 3200 employees; annual budget $341 million. Appointment unanimously confirmed by the Pennsylvania Senate on April 14, 2010.

April, 2009 – April, 2010 **Acting Secretary** PA DCNR, Harrisburg, PA

- Appointed by Governor and nominated as Secretary.

March 2008 – April, 2009 **Chief of Staff** PA DCNR, Harrisburg, PA

- Manage the Department in the absence of the Secretary. Monitors all key initiatives. Serve as the primary contact person for the Secretary's Office and acts on behalf of the Secretary with Deputy Secretaries and Bureau/Office Directors, senior program managers, policy staff, other departments, and external stakeholders in identifying operations issues, establishing goals and objectives, and formulating policies, strategic plans, and legislative strategies. Lead carbon/alternative energy work for the agency.

July, 2006 – March 2008 **Director of Legislation and Strategic Initiatives**
PA DCNR, Harrisburg, PA

- Serve as the primary contact person for the Secretary's Office and acts on behalf of the Secretary with Deputy Secretaries and Bureau/Office Directors, senior program managers, and policy staff in identifying operations issues, establishing goals and objectives, and formulating policies, strategic plans, and legislative strategies. Lead carbon/alternative energy work for the agency.

February, 2005 – July, 2006 **Director of Operations** PA DCNR, Harrisburg, PA

- Act of behalf of the Secretary in coordinating and managing cross-Bureau/Office activities and projects, oversee status of projects/major issues, and provide direction to Deputy Secretaries/Bureau Directors. . Lead carbon/alternative energy work for the agency.

June, 2003 – February, 2005 **Government Relations Manager** Citizens for Pennsylvania's Future, Harrisburg, PA

- Develop policy/legislative/regulatory analyses, draft model legislation, represent PennFuture before administrative and legislative bodies, regulatory agencies, and the general public, and lobby members of the PA General Assembly and Administration and PA Congressional delegations.

December, 2002 – May, 2003 **Community Relations Manager** Alcoa KAMA, Hazleton, PA

- Designed community relations plan for Alcoa Kama and represent company to all levels of government, private stakeholders, and the media.

February, 2001 – December, 2002 **Project Manager** Alcoa KAMA, Hazleton, PA

- Organize and manage the implementation of a new management information system in eight Kama plants in the U.S., Canada, and Europe.

March, 2000 - February, 2001 **Credit Manager** Kama Corporation, Hazleton, PA

- Responsible for $250 million in annual accounts receivable and managing A/R department staff. Eliminated substantial A/R backlog in less than one year.

October, 1998 - March, 2000 **Operations Accounting Manager** Wise Foods, Inc., Berwick, PA

- Coordinated development, operation, and maintenance of standard cost system for all company plants.

August, 1999 - December, 2000 **Evening Instructor in Economics** The Pennsylvania State University Hazleton Campus

- Taught introductory micro- and macroeconomics.

June, 1996 - October, 1998 **Business Analyst** Wise Foods, Inc., Berwick, PA

- Sole responsibility for company-wide sales, product, and distributor profitability analysis and reporting that was instrumental in increasing overall profit margins by $600M - 18% - in the first year.

1995 - 1997 and 2000 - 2001 **Public affairs columnist** *Times Leader* newspaper Wilkes-Barre, PA

- Wrote a column on local public affairs, progressing from monthly to weekly.

1988 - 1995 **Mayor** City Of Hazleton, PA

- Served two terms (8 years) as first full-time Mayor of a 3rd Class city population 23,000 under a new form of government enacted in 1988.

1983 - 1987 **Executive Director** Alliance to Revitalize Center-city Hazleton, Inc. (ARCH), Hazleton, PA

- Conceived, organized, directed the establishment of, and managed a successful public-private economic development corporation which merged municipal, corporate, and non-profit funding.

EDUCATION

- Master of Public Administration (MPA), Lehigh University, Bethlehem, PA, 1983
- B.A. in Political Economy, with highest honors, Bloomsburg State College, Bloomsburg, PA, 1981
- Graduate Study in Business Administration, Wilkes University, Wilkes-Barre, PA, 1981
- Graduate Study in Economics, Lehigh University, Bethlehem, PA, 1986-7
- Economic Development Financing Training Program, The National Development Council, 1985

PAST AFFILIATIONS/ACTIVITIES

- Chesapeake Bay Commission Biofuels Advisory Panel
- Vice Chairman, PA Department of Environmental Protection Climate Change Advisory Committee
- Chairman, Pennsylvania Wind and Wildlife Collaborative
- President, Board of Directors, Hazleton Community Development Corporation, Inc.
- President, Board of Directors, Alliance to Revitalize Center-city Hazleton, Inc. (ARCH)
- Vice Chairman, Redevelopment Authority of the City of Hazleton
- Board of Directors, Pennsylvania Downtown Center
- Luzerne County Solid Waste Advisory Committee
- Lackawanna-Luzerne Transportation Study Coordinating Committee
- Board member, United Way of Greater Hazleton
- Board member, Serento Gardens Alcoholism and Drug Services, Inc.
- Facilitator, Leadership Hazleton
- Greater Hazleton Area Partners in Education
- Coach, Greater Hazleton Youth Soccer Association

HONORS

- Governmental Award, Pennsylvania Recreation and Parks Society, 2010
- Green Power Leader Award, Citizens for Pennsylvania's Future, 2007

EXHIBIT G

Pike County PCCD Conservation District

556 Route 402, Hawley, PA 18428
Phone (570) 226-8220 Fax (570) 226-8222 e-mail: pikecd@pikepa.org
www.pikeconservation.org

July 8, 2011

RE: Gas Transmission Pipeline Construction and Water Resource Impacts

My name is Susan Beecher, and I am the Executive Director of the Pike County (Pennsylvania) Conservation District (PCCD). In that capacity, and under a delegation agreement with the Pennsylvania Department of Environmental Protection (PADEP), I review erosion and sediment (E&S) control plans for federally-regulated gas transmission pipeline construction in the County. I also conduct site inspections and respond to citizen complaints to ensure that pipeline construction is proceeding in compliance with the E&S plans and PADEP E&S and Stormwater Management Regulations and the Clean Streams Law. I have been actively involved in the review and oversight of the Columbia Gas Pipeline Line 1278 Replacement (currently about 70% complete), the Tennessee Gas Pipeline 300 Line Project (just beginning construction) and the Tennessee Gas Pipeline Northeast Upgrade Project (currently in the planning stages) in Pike County.

In the 22 years I have been working to promote land and water resources protection in Pike County, I have not seen the volume of sediment pollution in waterways that I am seeing from construction of these federal transmission lines. Sadly, the greatest impacts are occurring in smaller headwater high quality and exceptional value streams. There are a number of factors which I believe are contributing to the problems I am seeing.

The process of pipeline construction promoted by the companies and approved by FERC makes it incredibly difficult to prevent violations. Right of way widths are increasing, additional "temporary workspace" requests are granted without question, and formerly forested areas are being converted to grass with little consideration for associated riparian impacts or post-construction stormwater volume increases. The entire right of way is cleared and graded early in the project and remains in an unstabilized state for long periods of time. Disturbed approaches to wetlands and stream crossings, often with very steep slopes and totally inadequate vegetated buffer strips (10 feet is the norm) are particularly prone to uncontrolled runoff and sediment discharge. The companies construct the project this way because it saves time and money, but the process almost guarantees water resources impacts because there is too much earth disturbance over prolonged periods to allow for adequate E&S best management practice (BMP) installation and maintenance, timely inspections and effective enforcement. This construction activity should be phased, as is a standard requirement for many other types of construction activities, to limit the areal extent and duration of earth disturbance and provide for more timely stabilization of at least the sensitive riparian areas.

Because of the level of earth disturbance and the nature of pipeline construction, the standard E&S BMPs typically employed on these transmission line projects are not adequate to maintain water quality in Pike County's Special Protection Waters. Waterbars are repeatedly compromised by heavy equipment. Silt socks or silt fence, designed to be used in concert with waterbars, are

overwhelmed when the waterbars fail. When runoff is not removed from the disturbed right of way, mud-caked timber bridges and mats over wetlands and streams provide a direct conduit for sediment to enter waterbodies. Maintenance of these BMPs, particularly in areas of steep slopes adjacent to waterbodies where the right of way remains disturbed for weeks or months at a time, is a constant problem. Dewatering BMPs for filtering pumped water are often not properly located nor supervised to adequately filter water to meet Special Protection Waters antidegradation requirements. I would recommend the use of vegetated filter strips (a minimum of 50 feet) and a more selective removal of trees at all waterbody crossings during pipeline construction. Vegetative buffers are an important and effective sediment control BMP. In addition, I believe that in Special Protection Watersheds, there should be more emphasis on horizontal drilling or boring under streams and other sensitive areas when it is technically possible rather than open cut trenching.

In my experience, the environmental inspection system for these projects is flawed because the environmental inspectors are not *independent* third party inspectors; they report to the company or the company-paid environmental consulting firm. A truly independent inspector with stop-work authority is necessary to ensure compliance. I have recommended during the plan review and permitting phase of these and other large projects that the companies fund adequate PCCD staff to conduct the inspections and file reports with both the Pennsylvania Department of Environmental Protection (DEP) and the Federal Energy Regulatory Commission (FERC). The PCCD inspectors are more knowledgeable about local conditions and resources than imported inspectors and have a longstanding commitment to protection of those resources. Another alternative would be to have the companies pay the County to hire independent inspectors that report back to the County.

In addition, at least some site inspections should be coordinated so that all agencies participate at once. In my experience, companies intentionally schedule the PCCD inspections on different days than FERC inspections and thereby avoid opportunities for better regulatory oversight and collaboration. Because inspection records are not shared automatically among the PCCD, DEP, and FERC, enforcement efforts are delayed, pollution continues to occur and prevention of violations is undermined. PCCD has documented similar violations repeatedly in the same locations or at multiple locations over periods of weeks, with corrective actions on the part of the company coming very slowly. DEP permits typically require permittees to “self-report” but this is obviously not effective because problems are proliferating.

In summary, the processes for permitting, constructing and inspecting federal gas transmission pipeline projects need to be better coordinated and implemented to improve the outcomes for water resources protection. It is important that FERC look at the broader picture and evaluate the cumulative impacts of all current and proposed federal transmission line projects on water resources in Pike County and in the region.

Susan Beecher, Executive Director
Pike County Conservation District

EXHIBIT H

Department of Biology
Bucknell University
Lewisburg, Pennsylvania 17837

Phone: 570-577-1124
Fax: 570-577-3537

July 8, 2011

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, NE, Room 1A
Washington, DC 20426

Dear Secretary Bose,

I am writing to comment on the MARC I Hub Line Project. I am a bat biologist and an Associate Professor of Biology at Bucknell University. I am also a Research Associate of the Division of Mammals at the National Museum of Natural History, a part of the Smithsonian Institution in Washington, DC. While I am not an expert on Indiana bats *per se*, I have worked with bats for the past 11 years, and am recognized internationally as an expert in bat behavior, ecology, and physiology. A copy of my CV is attached.

The proposed MARC I Hub pipeline will connect CNYOG's Stagecoach Storage Facility and South Lateral with the Tennessee Gas Pipeline Company's ("TGP") 300 Line and the Transcontinental Gas Pipeline Corporation's ("Transco") Leidy Line. In addition to the approximately 39-mile pipeline, this project will also include the construction of two compressor stations with associated meter and regulator facilities, interconnect facilities from producers along the Hub Line, utilities and access roads, and the construction of lay down yards and staging areas.

This pipeline is slated to cut through the Endless Mountains and will open up hundreds of acres of pristine forest in Sullivan County to gas drilling activities. While I generally support development of the resources of the Marcellus Shale, I believe that such development ***must*** be done slowly and carefully, with minimal impact.

The proposed pipeline traverses the habitat of the endangered Indiana bat, as well as a number of other bat species (e.g., big brown bats, northern long-eared bats, little brown bats, red bats, and tri-colored bats). Most importantly, significant **forest fragmentation** will accompany this development and will adversely impact wildlife. This is especially true for Indiana bats. Habitat within the proposed pipeline consists of northern hardwood and mixed deciduous/coniferous forests, riparian corridors, forested corridors leading to vernal ponds/wetlands and agricultural fields, forested ridgetops, and residential woodlots – all of which are important bat habitats. Loss of bats due to construction efforts will likely be permanent as bats have very little potential for increasing population size.

I have reviewed the results of the survey performed by Wildlife Specialists, LLC. While they have, for the most part, followed the letter of the law in performing their analysis, it appears that, in a few instances, they did not have access to the sites first identified as most appropriate for setting nets (thus some trapping locations were potentially less than ideal), they had some evenings cut short by inclement weather, and that they had some bats escape prior to identification. **Finally, only the immediate areas along the pipeline have been surveyed, not any of the accessory roads, compressor stations, and staging areas. While these components of the project are not on forested land, bats are also known to use non-forested areas, and these locations should have been surveyed for bat activity as well. Thus, I view the surveys conducted as incomplete.**

Unfortunately, bats in the Northeastern US are under assault from a number of other forces, including wind turbines and most importantly, the deadly emerging infectious disease 'White-Nose Syndrome" (WNS). Over the past two years, the population of Indiana bats in the Northeast has declined by an estimated 72% (Turner, Reeder, and Coleman, 2011. A Five-year Assessment of Mortality and Geographic Spread of White-Nose Syndrome in North American Bats and a Look to the Future, Bat Research News, vol 52) (attached hereto). For the six species of bats thus far significantly affected by WNS, the overall decline is estimated at 88%. This is a wildlife disaster of unprecedented proportions. Two of the six species (Indiana bats, *Myotis sodalis*, and small-footed bats, *M. leibii*) are already listed as threatened or endangered in the state of Pennsylvania. Based upon documented declines, the Mammal Technical Committee of the Pennsylvania Biological Survey (which advises the Game Commission) has petitioned the Game Commission to grant endangered status to an additional three species (little brown bats, *M. lucifugus*, northern long-eared bats, *M. septentrionalis*, and tricolored bats, *Perimyotis subflavus*). Tragically, formal listing of these species is lagging behind the rapid rate of decline.

The cumulative effect of each of these assaults is that Indiana bats, and in fact most of the bat species in the Northeastern US, will occur in such low numbers that standard survey methods will be completely inadequate. The rarity of a species, by definition, results in lowered probability of detection. Using the measures that were determined adequate under previous bat population sizes, the surveyors predictably detected very few bats, of any species. This should not be interpreted as indicating no impact on wildlife. **Rather, more intensive surveys throughout the entire action area should be conducted in order to accurately predict the outcome of the proposed development.** For example, the current federal guidelines for conducting Indiana bat surveys dictate that 420 'units of effort' (UE, where 1 UE = $1m^2$ of net in place for one hour) are required per site. If this level of effort is required to detect an Indiana bat on the landscape at previous population levels, 1500 UE should now be required to reflect the fact that the population has declined by 72%. If I were conducting similar surveys for research purposes, I would certainly deem 420 UE inadequate to determine if Indiana bats occurred in a particular area.

In addition, the FERC should consider the impacts on other species of concern (including *M. leibii, M. lucifugus, M. septentrionalis,* and *P. subflavus*) in order to truly assess the environmental impacts of the proposed project. In this case, letter-of-the-law compliance with the ESA is wholly inadequate for analyzing the impacts of these sorts of projects on already plummeting bat populations. Bat populations are already at critically low levels, and the effects of this and similar projects may serve to make a bat situation worse. **At our current population**

levels, every single bat is important to preserving the species.

I strongly urge the FERC to make the results of these surveys, along with all commentary on them, available for a thorough public review prior to any construction or pre-construction activities.

Please feel free to contact me if you have any questions.

Sincerely,

DeeAnn M. Reeder, PhD
Associate Professor

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RESEARCH INTERESTS

- Global mammalian biodiversity
- Comparative physiology and behavior in mammals, especially bats
- Stress responsiveness in nature
- Eco-immunology
- Physiological and behavioral changes across life history stages and in response to the changing environment
- White-nose syndrome (WNS) in bats; hibernation physiology

TEACHING INTERESTS

- Comparative Animal Physiology
- Organismal Biology
- Mammalogy
- Behavioral Neuroendocrinology/ Hormones and Behavior

EDUCATION

Sept. 2001 – Aug. 2004 **Post-doctoral Fellow**. Department of Biology, Boston University (Advisors: Dr. Eric P. Widmaier, Dr. Thomas H. Kunz).

Dec. 1997 – Aug. 2001 **Ph.D**. Animal Behavior. University of California, Davis. Dissertation title: The Biology of Parenting in the Monogamous Titi Monkey (*Callicebus moloch*). (Advisor: Dr. Sally P. Mendoza; Co-advisor: Dr. William A. Mason).

Sept. 1995 – Dec. 1997 **M.S.** Animal Behavior. University of California, Davis. (Advisor: Dr. Sally P. Mendoza; Co-advisor: Dr. William A. Mason).

Aug. 1987 – May 1991 **B.A.** Zoology (with distinction). University of California, Berkeley.

PROFESSIONAL EXPERIENCE

2010-present **Associate Professor,** Department of Biology, **Associated Faculty,** Animal Behavior, Bucknell University, Lewisburg, PA

2008-present **Research Associate**, National Museum of Natural History, Smithsonian Institution

2005- 2010 **Assistant Professor,** Department of Biology, **Associated Faculty,** Animal Behavior, Bucknell University, Lewisburg, PA

Sept. 2001-Aug. 2005 **Research Fellow/Research Associate**, Department of Biology, Boston University, Boston, MA

Spring 2001 **Visiting Instructor**, University of the South, Sewanee, TN

SELECTED PUBLICATIONS (* indicates student co-author)

Books

D. E. Wilson and **D. M. Reeder** (eds.). 2005. Mammal Species of the World, A Taxonomic and Geographic Reference, Third Edition. The Johns Hopkins University Press, Baltimore, MD, 2 volumes, 2,142 pp.

D. E. Wilson and **D. M. Reeder** (eds.). 1993. Mammal Species of the World, A Taxonomic and Geographic Reference, Second Edition. Smithsonian Institution Press, Washington D.C., 1206 pp. *Choice Outstanding Academic Book.*

Research Papers & Peer-reviewed Book Chapters (* indicates student co-author)

G. G. Turner, **D. M. Reeder,** and J. T. H. Coleman. 2011. A Five-year Assessment of Mortality and Geographic Spread of White-Nose Syndrome in North American Bats, with a Look at the Future. Update of White-Nose Syndrome in bats. Bat Research News, 52:13-27.

Kunz, T.H., J.T. Foster, W.F. Frick, A.M. Kilpatrick, G.F. McCracken, M.S. Moore, J.D. Reichard, **D.M. Reeder,** and A.H. Robbins. 2011. White-nose syndrome: an overview of ongoing and future research needs. Pp. 195-209. In: Proceedings of Protection of Threatened Bats at Coal Mines: A Technical Interactive Forum (K.C. Vories and A.H. Caswell, eds.). USDOI Office of Surface Mining and Coal Research Center, Southern Illinois University, Carbondale, Illinois.

Steele, M. A., **D. M. Reeder**, T. J. Maret, and M. C. Brittingham. 2010. Critical and emerging issues in the conservation of terrestrial vertebrates. Pp. 390-398 In, Terrestrial Vertebrates of Concern in Pennsylvania: Management Conservation and Research, Steele, M. A., M. C. Brttingham, T. J. Maret, and J. F. Merritt, editors. Johns Hopkins University Press, Baltimore Maryland.

D. M. Reeder and E. P. Widmaier. 2009. Hormone Analysis. Pp. 554-563 In, Ecological and Behavioral Methods for the Study of Bats. Second Edition. T. H. Kunz and S. Parsons (eds). The Johns Hopkins University Press, Baltimore, MD.

G. G. Turner and **D. M. Reeder**. 2009. Update of White-Nose Syndrome in bats, September 2009. Bat Research News, 50(3), 47-53.

K. N. Weaver*, S. E. Alfano*, A. R. Kronquist*, and **D. M. Reeder**. 2009. Healing rates of wing punch wounds in free-ranging little brown myotis (*Myotis lucifugus*). Acta Chiropterologica, 11:220-223.

D. M. Reeder and G. R. [G. G.] Turner. 2008. Working together to combat 'White-Nose Syndrome' in Northeastern US bats; a report of the June 2008 meeting on White-Nose Syndrome held in Albany, NY. Bat Research News, 49(3), 75-78.

B. L. Pearson*, P. G. Judge, **D. M. Reeder**. 2008. Effectiveness of saliva collection and enzyme-immunoassay for the quantification of cortisol in socially-housed baboons. American Journal of Primatology, 70, 1-7.

D. M. Reeder, K. M. Helgen, and D. E. Wilson. 2007. Global Trends and Biases in New Mammal Species Discoveries. Occasional Papers, Museum of Texas Tech University, 269:1-36.

D. M. Reeder, H. Raff, T. H. Kunz, and E. P. Widmaier. 2006. Characterization of Pituitary-Adrenocortical Activity in the Malayan Flying Fox (*Pteropus vampyrus*). Journal of Comparative Physiology, B, Biochemical, Systemic, and Environmental Physiology, 176(6):513-519.

D. M. Reeder, N. S. Kosteczko*, T. H. Kunz, and E. P. Widmaier. 2006. The hormonal and behavioral response to group formation, seasonal changes and restraint stress in the highly social Malayan Flying Fox (*Pteropus vampyrus*) and the less social Little Golden-mantled Flying Fox (*P. pumilus*) (Chiroptera: Pteropodidae). Hormones & Behavior, 49:484-500 [2005 epub].

D. M. Reeder and K. M. Kramer. 2005. Stress in free-ranging mammals: integrating physiology, ecology, and natural history. Journal of Mammalogy, 86(2):225-235.

D. M. Reeder, E. P. Widmaier, and T. H. Kunz. 2004. Baseline and stress-induced glucocorticoids during reproduction in the variable flying fox, *Pteropus hypomelanus* (Chiroptera: Pteropodidae). Journal of Experimental Zoology Part A: Comparative Experimental Biology, 301:682-690.

D. M. Reeder, N. S. Kosteczko*, T. H. Kunz, and E. P. Widmaier. 2004. Changes in baseline and stress-induced glucocorticoid levels during the active period in free-ranging male and female little brown myotis, *Myotis lucifugus* (Chiroptera: Vespertilionidae). General and Comparative Endocrinology, 136:260-269.

D. M. Reeder. 2003. The potential for cryptic female choice in primates: Behavioral, physiological, and anatomical considerations. Pp. 255-303 *In*, C. B. Jones (ed.). Sexual Selection and Reproductive Competition in Primates: New Perspectives and Directions. American Society of Primatologists, Norman, OK.

C. Schradin, **D. M. Reeder**, S. P. Mendoza and G. Anzenberger. 2003. Prolactin and paternal care: Comparison of three species of monogamous New World monkeys. Journal of Comparative Psychology, 117(2):166-175.

S. P. Mendoza, **D. M. Reeder**, and W. A. Mason. 2002. The nature of proximate mechanisms underlying primate social systems: Simplicity and redundancy. Evolutionary Anthropology, 11 (Suppl. 1):112-116.

F. R. Cole, **D. M. Reeder**, and D. E. Wilson. 1994. A synopsis of distribution patterns and the conservation of mammal species. Journal of Mammalogy, 75(2):266-276.

Reviews

D. M. Reeder. 2002. Review of Walker's Primates of the World. American Journal of Primatology. 56(4): 251-252.

D. M. Reeder. 2000. Review. The Integrative Neurobiology of Affiliation by C. S. Carter, I. I. Lederhendler, and B. Kirkpatrick (Eds.). Journal of Mammalogy, 81:909-912.

D. M. Reeder. 1997. A New World Compendium. Review of New World Primates: Ecology, Evolution, and Behavior, edited by Warren G. Kinzey. American Journal of Primatology, 43:361-363.

SELECTED GRANTS, AWARDS, AND HONORS (PI unless otherwise noted)

Research Grant, National Science Foundation, Organism-Environmental Interactions Program (IOS). 2011-2014 (**Pending).** *Collaborative Research: Using Comparative Transcriptome and Immunological Analyses to "Connect the Dots" for Bats Affected by "White-Nose Syndrome"* " $440,418, **D. M. Reeder (PI**), Ken A. Field, co-PI.

Research Grant, The Eppley Foundation for Research, Inc. 2011-2012**.** *Exploring Links Between Mammalian Biodiversity and Disease Ecology in South Sudan – a Poorly Studied Former Conflict Zone.* $25,000. **D. M. Reeder (PI)**, Marianne Moore (co-PI).

Research Grant, Wildlife Management Institute. 2011-2012. *Laboratory and Field Testing of Treatments for White Nose Syndrome: Immediate Funding Need for the Northeast Region*. $100,000.

Research Grant, United States Fish & Wildlife Service. 2010-2012. *Who Will Survive? Exploring Individual, Sex, and Species Differences in Susceptibility and Resistance to WNS*. $409,469, **D. M. Reeder (PI),** C. K. R.Willis and J. Franck (co-PIs).

Research Grant, United States Fish & Wildlife Service. 2010-2012. *Evaluating the pathogenicity of North American and European strains of Geomyces destructans in cave bats, tree bats, and other mammalian hibernators***.** $293,701, C. K. R. Willis (PI), D. S. Blehert, P. M. Cryan, V. Misra, and **D.M. Reeder** (co-PIs).

Waitt Research Grant, National Geographic Society. 2010-2011. *Mammals of Southern Sudan: Exploring Biodiversity in a Former Conflict Zone.* $14,945.00.

Woodtiger Fund: Private research grant for white-nose syndrome research. 2010-2011. $50,000.00.

Research Grant, State Wildlife Grants (SWG) Program. 2010-2011. *Fighting the good fight against Geomyces destructans (Gd): Evaluating non-invasive anti-Gd treatments and testing the ability of WNS-rehabilitated bats to resist Gd infection during hibernation.* $105,746.29.

International Research Travel Grant, Bucknell University, 2009-2010. *Mammals of the Eastern Equatoria State of Southern Sudan: Exploring Biodiversity and Disease Vectors in a Former Conflict Zone.* $3000.00.

Scholarly Development Grant, Bucknell University, 2010. *Understanding the Emerging Infectious Disease 'White-nose Syndrome' in Bats: Immune Competence and Energetic Strategies in Healthy and Dying Bats.* Summer stipend: $4000.00.

Research Grant, United States Fish & Wildlife Service. 2008-2009. *Assessing Immune Competence in bats naturally affected by WNS and in bats artificially infected by the suspected white-nose syndrome (WNS) pathogen.* $68,687.00.

Research Grant, Pennsylvania Department of Conservation and Natural Resources. 2008-2009. *Studying White Nose Syndrome & Associated Physiological & Behavioral Processes in Pennsylvania Bats.* $50,725.00.

Research Grant, Bat Conservation International. 2008-2009**.** *Studying Immune Competence in Bats to help understand the effects of White Nose Syndrome*. $5883.00.

Research Grant, Wildlife Management Institute. 2008-2009. *Exploring the Connection Between Arousal Patterns in Hibernating Bats and White Nose Syndrome: Immediate Funding Needs for the Northeast Region*. $50,000.00.

Research Grant, Department of the Interior, Science on the Landscape program. 2008-2009. *Demonstrating a Causal Link Between a Geomyces spp. Fungus and White-Nose Syndrome in Little Brown Myotis (Myotis lucifugus)* Collaborator; Dr. David Blehert is Principle Investigator

Scholarly Development Grant, Bucknell University, 2008. *Ecophysiology in bats: exploring the relationships between hormones, immune function, and the environment.* Summer stipend: $4000.00.

International Research Travel Grant, Bucknell University, 2007-2008. *Mammals of the Eastern Equatoria State of Southern Sudan: Effects of Decades of Civil War and the Repatriation of Human Refugees.* $3000.00.

Jane W. Griffith Faculty Fellowship, Bucknell University. 2005-2007. Start-up funds.

Individual post-doctoral National Research Service Award, National Institute of Child Health and Human Development, *Integrating Social Processes, Stress, and Reproduction*. 2001-2004.

Faculty Development Grant, University of the South. *Social Behavior, Stress, and Reproductive Physiology Before and After Infant Birth in the Seasonally Breeding Island Flying Fox (Pteropus hypomelanus)*. 2001.

Top Student Prize for presentation at the Annual Meeting, 2001, Society for Behavioral Neuroendocrinology.

Individual pre-doctoral National Research Service Award, National Institute of Mental Health, *Comparative Responses to Chronic Stress in Primates*. 1997-2001.

Fellow, Professors for the Future program, University of California, Davis. 1999-2000.

Selected participant, Program in College Teaching, University of California, Davis. 1999-2000.

Tracy & Ruth Risdon Storer Fellowship, University of California, Davis. 1996-2000.

Award for Outstanding Graduate Student Teacher, University of California, Davis, 1999.

General Grant, Leakey Foundation. *Mechanisms Regulating the Origin of Paternal Care in Titi Monkeys.* 1999.

Floyd and Mary Schwall Dissertation Fellowship in Medical Research. 1999.

Annual Top Student Prize for Outstanding Presentation, American Society of Primatologists, 1998.

Named Alumni Scholar, University of California, Berkeley, 1991; Alumni Scholar, University of California, Berkeley, 1987-1991.

SELECTED PROFESSIONAL SERVICE

Recording Secretary (officer position) and Member of the Board of Directors, American Society of Mammalogists, 2006-2011.

Treasurer, North American Society for Bat Research, 2009-present.

Chair, Checklist Committee, American Society of Mammalogists. 2004-present. Committee member 1991-2004.

Member of the Grants-in-Aid Committee, Resolutions Committee, and Planning and Finance Committee, American Society of Mammalogists. 2006-present.

Member of the Mammal Technical Committee of the Pennsylvania Biological Survey, 2006-present.

Member of the Scientific Advisory Board, Lubee Bat Conservancy, 2005-present.

Guest Editor: The Northeastern Naturalist, 2008.

Ad-hoc reviewer: Acta Zoologica Sinica; Acta Theriologica; African Bat Conservation News; American Journal of Physiology R; American Journal of Primatology; The American Midland Naturalist; The American Naturalist; Behavioral Ecology and Sociobiology; Brazilian Journal of Medical and Biological Research; Comparative Biochemistry and Physiology; Conservation Biology; General and Comparative Endocrinology; Journal of Mammalogy; Journal of Wildlife Diseases; Journal of Zoology; Hormones and Behavior; The Leakey Foundation; National Geographic Society; Physiological and Biochemical Zoology; Physiology & Behavior; PLoS Biology; Proceedings of the Royal Society B Biological Sciences; Trends in Endocrinology and Metabolism; The Wilson Journal of Ornithology; Wildlife Research.

Working Group for the National Center for Ecological Analysis and Synthesis: *Synthesis of the biodiversity knowledge base: towards a global database of terrestrial vertebrate distributions.* Organized and led meeting of the mammals' subgroup. University of California, Santa Barbara, 2001-2003.

Organized symposium *Stress in Nature: Impact on Physiology, Ecology, and Natural History of Mammals* for the 2003 annual meeting of the American Society of Mammalogists.

Education Committee, Society for Behavioral Neuroendocrinology, 2001-2003. Reviewed travel grant applications, judged posters, created website on "Guidelines for giving an effective poster presentation" http://www.sbne.org/Meeting/2002/2002poster_guide.htm

SELECTED PROFESSIONAL PRESENTATIONS (* indicates student co-author)

D. M. Reeder. 2011. Bat and rodent diversity in South Sudan: Field studies in a former conflict zone. Presented at the 2011 annual meeting of the American Society of Mammalogists, Portland, Oregon.

D. M. Reeder. 2011. Who Will Survive? Tracking the Deadly "White Nose Syndrome" in Bats. Invited speaker, Fordham University, New York.

S. A. Brownlee and **D. M. Reeder**. **2010.** Behavior of bats with White Nose Syndrome. Presented at the 2010 annual meeting of the American Society of Mammalogists, Laramie, Wyoming.

L. E. Grieneisen, G. G. Turner, and **D. M. Reeder**. 2010. Hibernacula microclimate and White Nose Syndrome susceptibility. Presented at the 2010 annual meeting of the American Society of Mammalogists, Laramie, Wyoming.

D. M. Reeder. 2010. Tracking a Killer: Studying "White Nose Syndrome" in Bats. Invited speaker, Shippensburg University, Pennsylvania.

C. L. Frank, **D. M. Reeder**, A. Hicks, and R. Rudd. The effects of White Nose Syndrome (WNS) on bat hibernation. Presented at the 2010 annual meeting of the Society for Integrative and Comparative Biology, Seattle, Washington.

D. M. Reeder, R. Jacob*, C. L. Frank, E. R. Britzke, G. G. Turner, A. Kurta, A. C. Hicks, S. R. Darling, and C. W. Stihler. Altered arousal patterns and suppressed immunity in little brown myotis (*Myotis lucifugus*) affected by white-nose syndrome. Presented at the 2009 annual North American Symposium for Bat Research, Portland, OR.

D. M. Reeder, C. L. Frank, E. R. Britzke, G. R. Turner et al. Hibernation arousal patterns in little brown myotis (*Myotis lucifugus*) affected by white-nose syndrome. Presented at the 2009 annual meeting of the American Society of Mammalogists, Fairbanks, Alaska.

D. M. Reeder. Hibernation arousal patterns in little brown myotis affected by white-nose syndrome. May 2009. Presented at the White Nose Syndrome Science Strategy II Meeting, Austin, Texas.

D. M. Reeder. Mysterious white nose syndrome killing northeastern bats: History and current research. March 2009. Presented to the Seven Mountains Audubon Society.

R. Jacob*, J. B. Kobilis*, and **D. M. Reeder**. Seasonal variation of immune function in Vespertilionid bats. Presented at the 2008 annual North American Symposium for Bat Research, Scranton, PA.

M. E. Vodzak* and **D. M. Reeder**. Preliminary survey of the bats of Eastern Equitoria, Southern Sudan. Presented at the 2008 annual North American Symposium for Bat Research, Scranton, PA.

A. G. Remeika*, M. E. Vodzak*, C. J. Ostroski*, S. M. Wasilko*, and **D. M. Reeder**. Glucocorticoid hormone responses to harp trap and mistnet capture in lactating, post-lactating, and pre-migratory Myotis lucifugus. Presented at the 2008 annual North American Symposium for Bat Research, Scranton, PA.

J. B. Kobilis*, K. J. Piatt*, and **D. M. Reeder**. Arousal patterns during hibernation in captive little brown bats *Myotis lucifugus.* Presented at the 2008 annual North American Symposium for Bat Research, Scranton, PA.

K. N. Weaver*, A. R. Kronquist*, S. E. Alfano*, and **D. M. Reeder**. Assessment of wound healing rates in free-ranging little brown bats Myotis lucifugus. Presented at the 2008 annual North American Symposium for Bat Research, Scranton, PA.

M. E. Vodzak*, A. G. Remeika*, Scott M. Wasilko*, and **D. M. Reeder**. Response to capture varies by reproductive state but not capture method in little brown bats (*Myotis lucifugus*). Presented at the 2008 annual meeting of the American Society of Mammalogists, Brookings, South Dakota.

R. Jacob*, and D. M. Reeder. Immune function during hibernation in big brown bats (*Eptesicus fuscus*). Presented at the 2008 annual meeting of the American Society of Mammalogists, Brookings, South Dakota.

D. M. Reeder. Eco-immunology in bats. June 2008. Presented at the White Nose Syndrome conference, Albany, NY.

B. L. Pearson*, P. G. Judge, **D. M. Reeder**, and L. Smart*. Salivary cortisol and self-directed behavioral responses to short-term crowding in hamadryas baboons (*Papio hamadryas hamadryas*). Presented at the 2007 annual meeting of the American Society of Primatologists.

D. M. Reeder, S. M. Wasilko*, C. J. Ostroski*. Is capture in harp traps stressful to little brown bats (*Myotis lucifugus*)? Presented at the 2007 annual meeting of the North East Bat Working Group Annual Meeting, North Branch, NJ.

D. M. Reeder. Bats of Pennsylvania. January 2007. Presented to the Seven Mountains Audubon Society.

D. M. Reeder, C. J. Ostroski*, H. L. Rogers*, T. H. Kunz, and E. P. Widmaier. Male-male competition across the breeding season in the Malayan Flying Fox (*Pteropus vampyrus*). Presented at the 2006 annual meeting of the American Society of Mammalogists.

D. M. Reeder. Comparative Ecophysiology in Bats: Seasonal and Stress-responsive Changes in Glucocorticoid Hormones. Presented at the 2006 annual meeting of the North East Bat Working Group Annual Meeting, East Stroudsburg University, PA.

D. M. Reeder, K. M. Helgen, and D. E. Wilson. 270 new mammal species described since 1993: Who, what, when, where, and why. Presented at the 2005 annual meeting of the American Society of Mammalogists, Amherst, MA.

D. M. Reeder, T. H. Kunz, and E. P. Widmaier. 2004. Behavioral and physiological responses to group formation in the Malayan Flying Fox (*Pteropus vampyrus*) vary by sex and group type. Presented at the 2004 annual meeting of the Society for Integrative and Comparative Biology.

D. M. Reeder. 2003. Behavioral endocrinology of reproduction in bats: changes in glucocorticoid hormones and social influences on endocrine and immune function. Invited speaker for the seminar series in Integrative Reproductive Biology, University of Florida, Gainesville, Florida.

D. M. Reeder, N. S. Kosteczko*, T. H. Kunz, and E. P. Widmaier. 2003. Baseline and Stress-Induced Glucocorticoid Hormone Levels in Free-Ranging Little Brown Myotis (*Myotis lucifugus*) During the Active Period. Presented at the 2003 annual North American Symposium for Bat Research.

D. M. Reeder, N. S. Kosteczko*, T. H. Kunz, and E. P. Widmaier. 2003. Changes in baseline and stress induced glucocorticoid levels during the active period in free-ranging male and female little brown bats. Presented at the 2003 annual meeting of the American Society of Mammalogists.

D. M. Reeder, E. P. Widmaier, T. H. Kunz. 2002. The Hormonal and Behavioral Response to Group Formation and Acute Stress in the Solitary Little Golden-Mantled Flying Fox (*Pteropus pumilus*). Presented at the 2002 annual North American Symposium for Bat Research.

D. LeBlanc, **D. M. Reeder**, N. S. Kosteczko*. 2002. Individual Marking of Captive Flying Foxes for Behavioral Observations. Presented at the 2002 annual North American Symposium for Bat Research.

N. S. Kosteczko*, **D. M. Reeder**, and T. H. Kunz. 2002. Social Preferences and Sociability of the Solitary Little Golden-mantled Flying Fox (*Pteropus pumilus*) and the Social Island Flying Fox (*P. hypomelanus*). Presented at the 2002 annual North American Symposium for Bat Research.

D. M. Reeder. 2002. Social Behavior in the Monogamous Titi Monkey (Callicebus): Hormonal Changes Across Major Reproductive Events. Presented at the University of Virginia.

D. M. Reeder, E. P. Widmaier, T. H. Kunz. 2002. Stress responsiveness in the solitary little golden-mantled flying fox (*Pteropus pumilus*): Glucocorticoids, testosterone, and behavior. Presented at the 2002 annual meeting of the Society for Behavioral Neuroendocrinology.

D. M. Reeder, S. P. Mendoza, C. Schradin, W. A. Mason, and G. Anzenberger. 2001. Behavioral and hormonal components of paternal care in the monogamous titi monkey (*Callicebus moloch*). Presented at the 2001 annual meeting of the Society for Behavioral Neuroendocrinology.

D. M. Reeder. 2000. Social Behavior in the Monogamous Titi Monkey (*Callicebus moloch*): Hormonal Changes Across Major Reproductive Events. Invited speaker for the Anthropology colloquium for 2000, Anthropology Institute and Museum, University of Zurich, Switzerland.

D. M. Reeder, C. Schradin, S. P. Mendoza, W. A. Mason, and G. Anzenberger. 2000. Behavioral and hormonal components of paternal care in the monogamous titi monkey (*Callicebus moloch*). Presented at the 2000 annual meeting of the American Society of Mammalogists.

D. M. Reeder, S. P. Mendoza, and W. A. Mason. 1999. Social Behavior in the Monogamous Titi Monkey (*Callicebus moloch*): Hormonal Changes Across Major Reproductive Events. Presented as a part of the Seminar Series in Animal Behavior at the University of California at Davis.

D. M. Reeder. 1999. Why be monogamous? Lessons from birds and mammals. Public Lecture. UC Davis Summer Sessions Faculty Speaker Series.

D. M. Reeder, S. P. Mendoza, and W. A. Mason. 1999. Regulation of Paternal Care in the Monogamous Titi Monkey (*Callicebus moloch*): Alterations of Hypothalamic-Pituitary-Adrenal Responsiveness. Presented at the 1999 annual meeting of the Society for Behavioral Neuroendocrinology.

D. M. Reeder, S. P. Mendoza, and W. A. Mason. 1999. Behavioral and Physiological Components of Parental Care in the Monogamous Titi Monkey (*Callicebus moloch*). Presented at the 1999 annual meeting of the American Society of Mammalogists.

D. M. Reeder, S. P. Mendoza, and W. A. Mason. 1998. Social behavior and sexual motivation across the reproductive cycle in titi monkeys (*Callicebus moloch*): Concealment or communication of ovulation? Presented at the 1998 annual meeting of the American Society of Primatologists.

D. M. Reeder, C. R. Valverde, and S. P. Mendoza. 1998. Assessing the anti-fertility properties of intrauterine neem treatment in titi monkeys (*Callicebus moloch*). Presented at the 1998 annual meeting of the American Society of Primatologists.

K. Moody, J. Norcross, D. Bernhards, **D. Reeder**, J. Zehr, and J.D. Newman. 1994. Common Marmoset Colony: Management, Maintenance, and Monkey Business. Presented at the symposium on the Primate Family Callitrichidae.

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A Five-year Assessment of Mortality and Geographic Spread of White-nose Syndrome in North American Bats and a Look to the Future

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Overview

The presence of an unusual fungal infection and aberrant behavior in hibernating bats was first described in New York during winter 2006–2007. The disease was dubbed white-nose syndrome (WNS) after the most prominent field sign—white fungus on the muzzle and other areas of exposed skin. The fungus, newly described as *Geomyces destructans*, also produces characteristic skin lesions on the wing and other membranes of bats (Blehert et al., 2009; Courtin et al., 2010; Meteyer et al., 2009) and probably is the causative agent of the disease (Blehert et al., 2009; Gargas et al., 2009). In this review, we briefly summarize the current state of knowledge, including estimates of mortality for a five-state region, and describe a national plan for managing WNS. Our report is not meant to be a comprehensive review of the ever-expanding literature, but we do include a bibliography of peer-reviewed publications concerning WNS.

Geographic and Taxonomic Spread

White-nose syndrome was first noticed at Howe's Cave, near Albany, New York, in February 2006 (Blehert et al., 2009; Turner and Reeder, 2009). Currently, the presence of WNS in hibernating bats has been confirmed using histopathological criteria (Meteyer et al., 2009) at more than 190 sites in 16 states and 4 Canadian provinces (Fig. 1). Three additional states are considered suspect for the disease. Evidence of *G. destructans* has been obtained from bats not associated with any hibernaculum in Delaware, and *G. destructans* also has been identified on bats from three hibernacula in Missouri and Oklahoma through polymerase-chain-reaction (PCR) techniques, although infection in each of the three states could not be confirmed by histopathology. The detection of *G. destructans* on a bat in western Oklahoma indicates that the fungus has spread ca. 2,200 km from the original site in New York.

Infection with *G. destructans* and significant mortality associated with WNS has been documented in six species: big brown bat (*Eptesicus fuscus*), small-footed bat (*Myotis leibii*), little brown bat (*M. lucifugus*), northern long-eared bat (*M. septentrionalis*), Indiana bat (*M. sodalis*), and tricolored bat (*Perimyotis subflavus*). Rates of mortality vary among species (Table 1), although reasons for the variation are unknown. *G. destructans* also has been isolated from three additional species—southeastern bat (*M. austroriparius*), gray bat (*M. grisescens*), and cave bat (*M. velifer*)—but without histological evidence of tissue damage or reports of mortality. In summer 2009, researchers convening at a WNS Science Strategy Meeting in Austin, Texas, estimated that at least one million bats had died from WNS (Kunz and Tuttle, 2009). Given the spread to new hibernacula and significant mortality noted across the region since this estimate (Fig. 1; Table 1), we believe that the number of bats that have died from WNS is surely much greater.

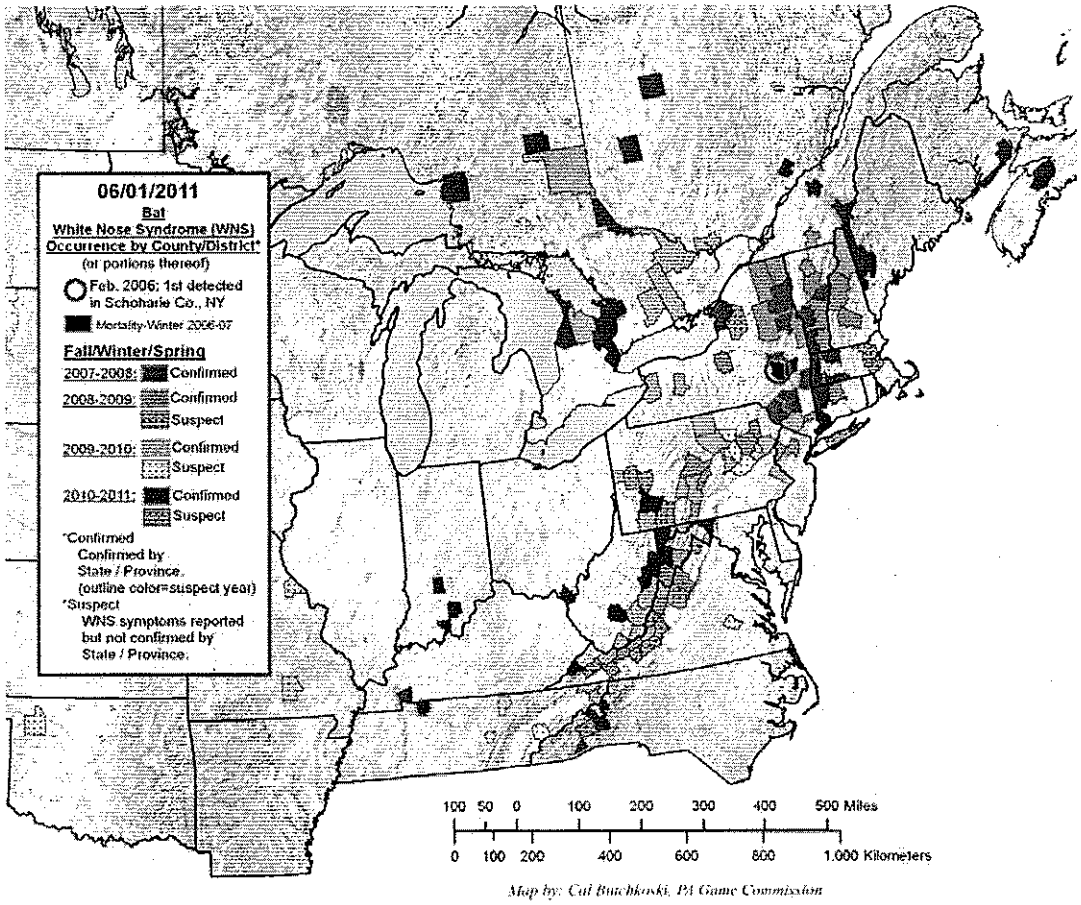

Figure 1. Current distribution of WNS in North America, showing progression of the disease over time and status ("confirmed" or "suspect") of each region as of 23 May 2011 (map may be viewed in color at http://www.fws.gov/WhiteNoseSyndrome; map by C. Butchkoski). A site (cave, county, state, etc.) is labeled as confirmed only if histopathological examination of a bat from a hibernaculum documents "a specific pattern of fungal colonization in the epidermis, which may extend to invasion of the dermis and connective tissue" (http://www.nwhc.usgs.gov/disease_information/white-nose_syndrome/wns_definitions.jsp; see details in Meteyer et al., 2009). Simple presence of hyphae or conidia, a positive fungal culture, or PCR-positive results, without fulfillment of the histopathological criteria, result in a site being categorized as suspect. In this report, a bat with simple evidence of *G. destructans* or even with histopathological signs of WNS that is found away from any hibernaculum also results in that geographic area being labeled as suspect (e.g., Delaware).

Epizootiology of WNS

Causation.—Geomyces destructans is the causative agent of the characteristic skin lesions seen on the exposed skin and in the hair follicles of affected bats (Blehert et al., 2009; Courtin et al., 2010; Meteyer et al., 2009). Although experiments are underway to determine whether *G. destructans* is the causal agent underlying WNS, the results are not yet available, and the mechanism by which an infection of the skin with *G. destructans* kills bats is unclear. In addition to studies examining the relationship between *G. destructans* and mortality, other projects that are underway include investigation of the microfauna of wing membranes and the potential roles they may play in differential survival among species or sites; exploration of various treatments for clearing fungal

infection in hibernating bats; molecular studies of the transcriptome of infected and healthy individuals, which will reveal patterns of up- and down-regulated genes, thus providing insight into responses to WNS and other potential pathogens; investigations of physiological and behavioral responses/ symptoms, including water/electrolyte balance and function of the immune system; determination of variations in species susceptibility, including non-volant mammals; and examination of the relationship between microclimate of the hibernacula and progression of the disease. Although some of this research does not require definitive identification of the causative agent, the operating assumption of most biologists within the WNS-research community is that *G. destructans* is responsible for the disease.

Anecdotal observations of bats infected by *G. destructans* may shed light on the mechanisms underlying mortality. For example, affected bats exhibit aberrant behavior including altered sensory thresholds; tremors of the forearms as they crawl; flying in daylight and collisions with large stationary objects, such as the side of a building; and excessive thirst, as evidenced by licking snow or flying for prolonged periods over small areas of open water (Hendricks and Hendricks, 2010). Either starvation and/or loss of electrolytic homeostasis could potentially explain these symptoms. Courtin et al. (2010) noted reduced (but varied) fat reserves in affected bats, which is likely due to shifts in arousal patterns during hibernation (D. M. Reeder, unpublished data), whereas Cryan et al. (2010) hypothesized that fungal attacks are disrupting physiological functions of the wing, particularly the bat's ability to maintain water balance. These are areas that hopefully will receive more attention in the near future.

Geographic origin.—Infection of bats by *G. destructans* without subsequent mass mortality has been recorded widely across Europe (Martinkova et al., 2010; Puechmaille et al., 2010, 2011; Šimonovičov et al., 2011; Wibbelt et al., 2010). For example, Martinkova et al. (2010) examined archived photographs taken since 1994 of greater than 6,000 bats in the Czech Republic and Slovakia, and their findings indicated the presence of *G. destructans* in those countries since at least 1995. These authors also noted that the incidence of visible fungus on the greater mouse-eared bat (*M. myotis*) increased from 2% in 2007 to 14% in 2010, but despite that increase, the population of bats actually grew. This inter-year variation could represent natural fluctuation in abundance of *G. destructans* or differential detection, but the lack of significant mortality and widespread geographic occurrence of the fungus suggest that *G. destructans* has been present in Europe for at least a decade (and likely longer) and that once the fungus becomes established in hibernacula, it persists. The lack of substantial mortality in European bats indicates that they are likely resistant to *G. destructans* and that *G. destructans* represents a novel pathogen for North American species.

Factors influencing transmission and spread.—Two modes of transmission of *G. destructans* have been proposed: bat-to-bat, via direct contact between animals, and hibernaculum-to-bat, via exposure to spores of *G. destructans* that were present on a roosting substrate, whether they were brought their by other bats or by humans. Bat-to-bat transmission is especially likely for those species that typically cluster during hibernation, such as little brown bats and Indiana bats. Given the temporal and geographical distribution of WNS, the scientific community investigating the disease generally agrees that bats can spread the fungus from site to site and to one another. The strongest evidence for interbat transmission comes from the infection of animals at numerous sites that were secured

Table 1. WNS-induced mortality of six species of hibernating bats from 42 sites in New York, Pennsylvania, Vermont,

		Species								
		Myotis lucifugus			*Myotis sodalis*			*Myotis septentrionalis*		
Site Name (Year WNS confirmed)	Pre-/Post-WNS Count Year	Pre-WNS Count[a]	Post-WNS Count	% Change	Pre-WNS Count (Year)[b]	Post-WNS Count	% Change	Pre-WNS Count	Post-WNS Count	% Change
New York										
Barton Hill Mine (2008)	2007/2011				9,393	7,398	-21%			
Baryte 'Garden of Dina' Mine (2007)	2006/2010	1	3	200%				6	0	-100%
Bartyes Cave (2009)	1986/2011	24	1	-96%				12	0	-100%
Bennett Hill Hitchcock Mine (2009)	2003/2011	17,399	1,669	-90%				26	11	-58%
Clarksville Cave (2008)	2006/2010	21	0	-100%				2	0	-100%
Eagle Cave (2009)[c]	1985/2011	2,587	4,324	67%				7	0	-100%
Gage's Cave (2007)	1985/2011	940	40	-96%				1	0	-100%
Glen Park Cave (2008)	2003/2011	151	10	-93%	1,908 (2007)	433	-77%			
Hailes Cave (2007)	2005/2011	15,374	1,496	-90%	685	0	-100%	14	4	-71%
Hasbrouck Mine (2009)	2006/2011	2,922	1,218	-58%						
Howe Cave (2006)	2005/2011	1,213	29	-98%				5	0	-100%
Howes Quarry Mine (2008)	1995/2010	42	1	-98%				6	0	-100%
Jamesville Quarry Cave (2009)	2003/2011	1,346	573	-57%	4,171 (2005)	251	-94%	2	1	-50%
Knox Cave (2007)	2001/2011	1,820	354	-81%				5	0	-100%
Lawrenceville Mine (2009)	2004/2011	293	6	-98%	57	71	25%	25	0	-100%
Main Graphite Mine (2008)	2000/2010	183,542	2,049	-99%	109 (2007)	0	-100%	440	0	-100%
Martin Mine (2008)	2004/2010	720	6	-99%				44	0	-100%
Schoharie Cavern (2007)	1999/2010	953	22	-98%				18	0	-100%
South Bethlehem Cave (2008)	2005/2011	100	0	-100%						
Walter Williams Preserve (2008)	1999/2010	87,401	16,673	-81%	13,014 (2007)	122	-99%	1	1	0%
Williams Fire Pit Mine (2008)	2002/2011	0	323	32,300%	0	718	71,800%	3	0	-100%
Williams Hotel Mine (2008)[d]	2003/2011				24,317 (2007)	6,389	-74%			
Williams Lake Mine (2008)	2003/2011	9,432	24	-100%	1,003 (2007)	11	-99%			

Virginia, and West Virginia, that have had WNS for at least 2 years.

Species											
Myotis leibii			*Perimyotis subflavus*			*Eptesicus fuscus*					
Pre-WNS Count	Post-WNS Count	% Change	Pre-WNS Count	Post-WNS Count	% Change	Pre-WNS Count	Post-WNS Count	% Change	**Pre-WNS Grand Total**	**Post-WNS Grand Total**	**% Change**
									9,393	**7,398**	**-21%**
			1	3	200%	7	15	114%	**15**	**21**	**40%**
			1	0	-100%	1	16	1,500%	**38**	**17**	**-55%**
183	398	117%	9	6	-33%	51	51	0%	**17,668**	**2,135**	**-88%**
			59	4	-93%				**82**	**4**	**-95%**
53	43	-19%				0	1	100%	**2,647**	**4,368**	**65%**
			27	0	-100%				**968**	**40**	**-96%**
			1	2	100%	14	3	-79%	**2,074**	**448**	**-78%**
15	1	-93%	45	9	-80%	1	0	-100%	**16,134**	**1,510**	**-91%**
						1,659	729	-56%	**4,581**	**1,947**	**-57%**
88	29	-67%	42	4	-90%	13	10	-23%	**1,361**	**72**	**-95%**
			47	0	-100%	0	1	100%	**95**	**2**	**-98%**
			0	2	200%				**5,519**	**827**	**-85%**
11	5	-55%	57	0	-100%				**1,893**	**359**	**-81%**
15	4	-73%	288	6	-98%	72	37	-49%	**750**	**124**	**-83%**
721	485	-33%	194	2	-99%	18	9	-50%	**185,024**	**2,545**	**-99%**
7	9	29%	112	4	-96%	135	31	-77%	**1,018**	**50**	**-95%**
0	1	100%	55	0	-100%	0	1	100%	**1,026**	**24**	**-98%**
17	26	53%	26	5	-81%	41	20	-51%	**184**	**51**	**-72%**
34	9	-74%	13	0	-100%	220	84	-62%	**100,683**	**16,889**	**-83%**
0	2	200%	1	0	-100%	5	71	1,320%	**9**	**1,114**	**1,2278%**
3	0	-100%				131	50	-62%	**24,451**	**6,439**	**-74%**
11	7	-36%	30	0	-100%	120	270	125%	**10,596**	**312**	**-97%**

Table 1 (cont.)

Site Name (Year WNS confirmed)	Pre-/Post-WNS Count Year	*Myotis lucifugus* Pre-WNS Count	*Myotis lucifugus* Post-WNS Count	*Myotis lucifugus* % Change	*Myotis sodalis* Pre-WNS Count (Year)[a]	*Myotis sodalis* Post-WNS Count	*Myotis sodalis* % Change	*Myotis septentrionalis* Pre-WNS Count	*Myotis septentrionalis* Post-WNS Count	*Myotis septentrionalis* % Change
New York (cont.)										
Williams Mine #7-8 (2008)	2002/2011	531	33	-94%	0	18	1,800%	2	0	-100%
Williams Mine #9-10 (2008)	2002/2011	1	35	3,400%						
Williams Mine #11 (2008)	2007/2011	54	1	-98%						
New York Totals and % Difference		**326,867**	**28,890**	**-91%**	**54,657**	**15,411**	**-72%**	**619**	**17**	**-97%**
Pennsylvania										
Alexander (2008)	2006/2010	1,604	8	-100%				30	0	-100%
Durham (2009)	2004/2011	7,356	161	-98%				881	2	-100%
Mt Rock (2009)	2005/2011	20	6	-70%						
Nuangola (2008)	2008/2011	224	0	-100%				6	0	-100%
Shindle (2008)[e]	2008/2010	2,276	3	-100%				19	0	
Woodward (2009)	2010/2011	2,749	20	-99%	3	0	-100%	4	0	-100%
Pennsylvania Totals and % Difference		**14,229**	**198**	**-99%**	**3**	**0**	**-100%**	**940**	**2**	**-100%**
Vermont										
Brandon Silver Mine (2009)	2009/2011	86	4	-95%	2	3	50%	27	0	-100%
Camp Brook Mine (2009)	2009/2011	40	0	-100%				21	0	-100%
Dover Iron Mine (2009)	2009/2011	518	22	-96%				12	0	-100%
E. Magnesia Talc Mine (2009)	2009/2011	768	84	-86%				35	3	-91%
Ely Copper Mine (2009)	2004/2011	531	4	-99%				41	0	-100%
Vermont Totals and % Difference		**1,943**	**114**	**-94%**	**2**	**3**	**50%**	**136**	**3**	**-98%**
Virginia										
Breathing Cave (2009)	2001/2011	701	475	-32%				7	9	29%
Newberry-Bane (2009)	2009/2011	4,143	557	-87%	208	146	-30%			
Virginia Totals and % Difference		**4,844**	**1,032**	**-79%**	**208**	**146**	**-30%**	**7**	**9**	**29%**
West Virginia										
Cave Mountain (2009)	2007/2011	209	17	-92%						
Hamilton (2008)	2007/2011	43	1	-98%						
Trout (2009)	2007/2011	142	8	-94%	158	90	-43%	4	0	-100%
West Virginia Totals and % Difference		**394**	**26**	**-93%**	**158**	**90**	**-43%**	**4**	**0**	**-100%**
All States Combined Totals and % Difference		**348,277**	**30,260**	**-91%**	**55,028**	**15,650**	**-72%**	**1,706**	**31**	**-98%**

[a] A blank indicates that no data on that species were provided by the state agency.
[b] Some sites in New York had visits to survey specifically for Indiana bats (*Myotis sodalis*) on dates more recent than the full site survey presented; in these
[c] Eagle Cave represents a significant increase, but this anomaly is likely due to the 25 years since the previous survey.
[d] The survey of the Williams Hotel Mine does not include counts for little brown bats (*Myotis lucifugus*), because the state biologist omitted them for
[e] Shindle Iron Mine was confirmed in December 2008, and although it qualified as 2 years, the site should be considered one full season of mortality; it

Myotis leibii			*Perimyotis subflavus*			*Eptesicus fuscus*					
Pre-WNS Count	Post-WNS Count	% Change	Pre-WNS Count	Post-WNS Count	% Change	Pre-WNS Count	Post-WNS Count	% Change	**Pre-WNS Grand Total**	**Post-WNS Grand Total**	**% Change**
0	2	200%	34	0	-100%	17	12	-29%	**584**	**65**	**-89%**
0	12	1200%				7	61	771%	**8**	**108**	**1,250%**
						61	6	-90%	**115**	**7**	**-94%**
1158	**1033**	**-11%**	**1042**	**47**	**-95%**	**2573**	**1478**	**-43%**	**386,916**	**46,876**	**-88%**
0	1	100%	16	1	-94%	0	1	100%	**1,650**	**11**	**-99%**
2	0	-100%	167	16	-90%	1	1	0%	**8,407**	**180**	**-98%**
1	1	0%	20	2	-90%	79	54	-32%	**120**	**63**	**-48%**
			12	9	-25%	36	2	-94%	**278**	**11**	**-96%**
			39	0	-100%				**2,334**	**3**	**-100%**
3	4	33%	30	0	-100%	17	4	-76%	**2,806**	**28**	**-99%**
6	**6**	**0%**	**284**	**28**	**-90%**	**133**	**62**	**-53%**	**15,595**	**296**	**-98%**
9	1	-89%	4	1	-75%	9	3	-67%	**137**	**12**	**-91%**
			0	1					**61**	**1**	**-98%**
			6	0	-100%				**536**	**22**	**-96%**
			0	0		8	5	-38%	**811**	**92**	**-89%**
122	90	-26%	5	6	20%	146	126	-14%	**845**	**226**	**-73%**
131	**91**	**-31%**	**15**	**8**	**-47%**	**163**	**134**	**-18%**	**2,390**	**353**	**-85%**
0	8	800%	513	408	-20%	12	21	75%	**1,233**	**921**	**-25%**
4	1	-75%	233	219	-6%	7	4	-43%	**4,595**	**927**	**-80%**
4	**9**	**125%**	**746**	**627**	**-16%**	**19**	**25**	**32%**	**5,828**	**1,848**	**-68%**
			151	8	-95%	6	2	-67%	**366**	**27**	**-93%**
			437	2	-100%				**480**	**3**	**-99%**
4	3	-25%	432	63	-85%	25	12	-52%	**765**	**176**	**-77%**
4	**3**	**-25%**	**1020**	**73**	**-93%**	**31**	**14**	**-55%**	**1,611**	**206**	**-87%**
1303	**1142**	**-12%**	**3107**	**783**	**-75%**	**2919**	**1713**	**-41%**	**412,340**	**49,579**	**-88%**

instances the year of the survey for Indiana bats follows the number of Indiana bats.

potential inaccuracies.
only was included because the mortality could not increase significantly with another year.

from human visitation and where no management or handling of bats occurred prior to arrival of WNS, such as the Shindle Iron Mine in Mifflin County, Pennsylvania (G. Turner, unpublished data).

The responses of a bat to WNS are surely contributing to the spread of the disease. Severely infected bats emerge prematurely from hibernation, and if they survive long enough and enter a different hibernaculum, the likelihood of transmission is probably high, because they presumably carry a large load of fungal spores. Many bats swarm at one site, yet hibernate at another (Humphrey and Cope, 1976), suggesting that infected bats know the location of other hibernacula. If infected bats survive the winter, their ability to retain viable spores and transmit *G. destructans* to healthy colony members in summer is unknown. Likewise, male bats that use hibernacula throughout summer may transmit *G. destructans* to other bats or sites during fall swarming.

Although bats are surely transmitting *G. destructans* to one another, more controversial is the occurrence of inadvertent human-assisted spread of the disease. Fungal spores are durable and easily can become attached to clothing or gear. Caving equipment used at a confirmed site did carry fungal spores having the distinctive shape of those of *G. destructans* (J. Okoniewski, unpublished data), and further research on this mode of transmission is ongoing. If in fact *G. destructans* was transported to North America from Europe, anthropogenic transmission via contaminated gear or clothing (and not bat-to-bat transmission) is the most parsimonious scenario for the initial infection. Furthermore, movement of the fungus to clean sites, hundreds or thousands of kilometers beyond the original epicenter in New York, might explain the rapid spread of WNS. To date, evidence for the anthropogenic spread of *G. destructans* remains largely anecdotal, but this fact does not diminish the very real risks posed by human action. Unintentional, human-assisted movement of pathogens is certainly not without historical precedent (e.g., the chytrid fungal disease in amphibians—Rosenblum et al., 2010) and is a grave concern to managers of animal health worldwide.

Significant variation exists in the time between detection of visible fungus and mass mortality. At some sites, we have observed the appearance of visible fungus on only a few animals during a particular winter, with further development of the disease and deaths not occurring until the next year or even later (e.g., Layton Fire Clay Mine, Fayette County, Pennsylvania). In other cases (e.g., Shindle Iron Mine), the progression from detection of a single bat with visible fungus to large-scale mortality has happened in a matter of weeks.

Once a bat is exposed to *G. destructans* at a particular location, a myriad of factors could influence progression of WNS. Understanding these factors is facilitated by considering the disease triangle (Fig. 2), which relates the potential dynamics of the host (bats of potentially multiple species), the pathogen (presumably *G. destructans*), and the environment (the hibernacula, but possibly active-season environments), as well as interactions between these variables. For example, questions such as how many spores are needed to establish infection (the loading dose) are best studied by considering the species of bat (different species and perhaps different sexes may vary in susceptibility), the time of year, and the nature of the hibernaculum (e.g., infections in sites with ambient temperature below the optimal growth temperature of *G. destructans* may progress more slowly). Likewise, understanding the timing of spread within a site and the rate of death once the fungus is visible will require analyses of these same variables.

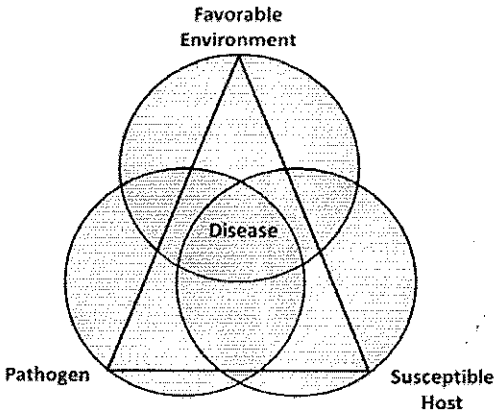

Figure 2. The disease triangle, showing the interrelationships between hosts, pathogens, and environment. A disease (WNS) occurs when a specific pathogen (presumably *Geomyces destructans*) infects susceptible hosts (hibernating bats) under certain environmental conditions (cold damp hibernacula, in which bats use torpor and effectively suppress their immune systems, allowing relatively unchecked fungal growth).

Patterns of Mortality

What is the overall decline of hibernating bats? Are there differences in mortality among species? Are there changes in mortality as the disease progresses across a region? These are some of the most frequently asked questions regarding the impacts of WNS, and biologists are just now starting to examine such issues. Unfortunately, answering these questions relies on accurately estimating/counting the number of bats in hibernacula, and multiple confounding variables make this a difficult task.

Difficulties encountered during winter surveys.—One variable affecting the accuracy of winter surveys is behavioral differences among species. For example, some species, such as big brown bats and small-footed bats are tolerant of low ambient temperatures and hibernate in highly variable conditions. They are often the last bats to enter and the first to leave a hibernaculum. Counts of these species, even those made in midwinter, often vary tremendously. This is likely due to variation in average ambient temperatures during a particular winter, which in turn affects whether the bats are in a particular cave or mine.

Timing of surveys may also play a significant role in differences among bat counts. Because winter surveys of some WNS-affected sites have been pushed from the typical mid-winter period to a time closer to natural emergence (to reduce potential stress on bats), early emerging species, such as big brown bats, and/or individuals affected with WNS may have already left, thus biasing these censuses. Finally, species preferences in roosting location during hibernation (e.g., northern long-eared bats prefer deep cracks) can result in significant underestimates of some species.

Even though most state agencies that perform the counts attempt to assign the same experienced surveyors to the same sites, misidentification of species is possible, especially for those bats that cluster in mixed-species groups and for those that are structurally similar. The physical size of the site, number of bats present, number of passages that surveyors cannot access, and amount of disturbance during the hibernating period can undermine accurate censuses.

The arrival of WNS in a site further affects the accuracy of counts. One of the hallmark signs that a site is affected is the shifting of roost sites within the hibernaculum and the premature exit of affected bats in winter, often months before food is available. Depending upon the time of the survey, this phenomenon may result in underestimates of winter abundance, whereas in other sites, numbers may initially increase during the first year of infection. For example, at Hall's Cave in Huntingdon County, Pennsylvania, total population size jumped from 75 bats before

WNS to 1,800 bats during the winter that WNS arrived, with a drop to 31 bats in the following year; surveys of surrounding sites did not detect similar changes in numbers. It is difficult to draw conclusions from the small number of these occurrences, but the increases may be due either to movement of bats away from nearby, high-mortality sites or to movement of bats within the site from hidden passages to areas closer to the entrance where they are more easily counted. The more pertinent question regarding the derivation of mortality numbers is whether or not to use these peaks in any estimate.

Prior to the arrival of WNS in new geographic areas, the collection of accurate population counts will allow a better understanding of WNS-related declines than may currently be possible in affected areas of the East. In addition, inclusion of data from the active season (e.g., counts at maternity colonies, acoustic surveys, and trapping during fall swarming—Brooks, 2011; Dzal et al., 2010) ultimately may help achieve a more accurate picture of total declines.

Current status of bat populations.—For the analysis presented herein, we utilized data for 42 sites from five states—New York, Pennsylvania, Vermont, Virginia, and West Virginia (Table 1). We limited our analysis to sites with confirmed mortality for at least 2 years, to control for some of the variation described earlier and have focused on counts derived from a consistent level of effort across years. Although some sites have many historical counts where numbers could have been averaged, many others do not, so for consistency, we present only data from the most recent census conducted prior to WNS and the latest count following confirmation of the disease. To reduce stochastic variation and/or issues relating to small samples, we added the count for each species at each site within a state to obtain average mortality estimates per species per state. We then combined data from all states to obtain an estimate of regional change in species composition and abundance. Finally, we aggregated all counted bats, regardless of species, to report the overall change in the total hibernating population for each state and the region. Note that the important number is the percent change in species by state, not absolute numbers, because our 42 sites represent only a fraction of known hibernacula in the region.

At our 42 sites, we saw a precipitous decline in the number of hibernating bats after WNS, from 412,340 to 49,579 animals, for an overall decrease of 88% (Table 1). All six species declined, but there were notable differences among species. Northern long-eared bats decreased by 98% (1,706 to 31 bats); little brown bats, 91% (348,277 to 30,260); tricolored bats, 75% (3,107 to 783); Indiana bats, 72% (55,028 to 15,650); big brown bats, 41% (2,919 to 1,713), and small-footed bats, 12% (1,303 to 1,142). The species with smaller reductions are hopefully less susceptible or more resistant to *G. destructans*, but it is possible that they are just declining at a slower rate, with total mortality rates eventually reaching those of the other species.

When examined by state, we see an overall decline of 98% in Pennsylvania, 88% in New York, 87% in West Virginia, 85% in Vermont, and 69% in Virginia. Although differences among states in overall mortality may be real, undersampling of sites and biased sampling of certain species (e.g., Indiana bats) also may contribute. As previously mentioned, increased accuracy of surveys and eventual inclusion of active-season data will improve our understanding of mortality by species and region. Unfortunately, our mortality estimates are in line with the mathematical models of Frick et al. (2010), who predict that the once-abundant and ubiquitous little brown bat has the potential to become extinct in the Northeast in only 7–30 years; a similar fate may await

Indiana, northern long-eared, and tricolored bats.

The differences in mortality among species also have affected composition of the hibernating assemblage (Fig. 3). For example, prior to WNS, little brown bats comprised 84.5% of all hibernating bats at the 42 sites used in this analysis, with Indiana bats at 13.4%. After WNS, little brown bats now represent only 61% of all bats, and Indiana bats have increased to 31.6% of the overall population.

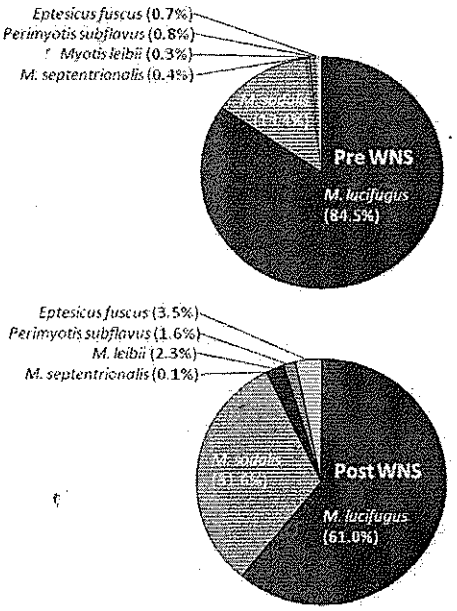

Figure 3. Changes in overall species composition for the six affected species of bats after 2 years of WNS-associated mortality (Table 1).

The National Plan

A final version of a national response plan, *A National Plan for Assisting States, Federal Agencies, and Tribes in Managing White-Nose Syndrome in Bats*, was released in May 2011 (http://www.fws.gov/WhiteNoseSyndrome/). The purpose of the national plan is to guide the reactions of federal, state, and tribal agencies and their partners to WNS. The plan has been developed with input from multiple agencies and establishes an organizational structure for the national response, with defined roles for agencies, stakeholders, and the research community. Oversight of implementation of the plan is provided by two committees—an executive committee and a steering committee—both of which were formally established during winter 2010–2011. The plan also officially institutes seven working groups to address the myriad needs of a national response: communications and outreach, conservation and recovery, data and technical information management, diagnostics, disease management, disease surveillance, and epidemiological and ecological research. The national plan will integrate and support state and regional response plans for WNS and is not intended to replace planning at the local/regional level.

The national plan for WNS is based on similar disease-response plans that have been implemented in the past (e.g., chronic wasting disease in cervids—http://www.cwd-info.org/index.php/fuseaction/policy.policy), and is essentially a formalization of coordinated efforts that were initiated in 2008. The final version of the plan is intended to be static, although implementation of the plan will be an adaptive process, allowing incorporation of new information and guidance, as they become available and/or necessary. The individual working groups will be responsible for developing and maintaining the various components of the action items identified for each element of the plan. The implementation of national strategies will help standardize management practices, including disease surveillance and population monitoring, to ensure consistency in data collection and to facilitate

interpretation of results at the continental scale. Because the national plan incorporates a number of actions and efforts that have been used to address WNS over the past 3 years, many elements of the plan are already in service. Existing and future guidance will continually be improved upon so that the WNS implementation plan will be an evolving system rather than a static document.

The Future of White-nose Syndrome?

While WNS continues to spread, not all news is bad news and several surprising findings offer rays of hope. For example, WNS has been confirmed in two hibernacula in West Virginia that harbor nearly 50% of the entire population of the endangered Virginia big-eared bat (*Corynorhinus townsendii virginianus*). Despite mortality of other species in those sites, no fungal infection has been found in the Virginia big-eared bat. Likewise, although *G. destructans* was detected in Oklahoma and Missouri in 2009–2010, histological examination showed that the infected bats were not suffering from WNS, and no new cases were detected in 2010–2011 in either state. Only one of four sites in Tennessee in which *G. destructans* was detected in 2009–2010 was confirmed by histology in 2010–2011, and despite an active surveillance program in Kentucky, WNS was not detected in that state until late spring 2011. Finally, limited evidence from the Northeast, mainly in the form of consistent annual counts at a few locations, suggests that some populations may have stabilized, albeit at much smaller sizes than before WNS. For example, surveys that occurred at Hailes Cave in New York before WNS estimated a hibernating population of 15,374 bats. Following the advent of WNS, annual surveys from winter 2007–2008 to 2010–2011, recorded 7,258; 1,443; 1,000; 1,198; and 1,496 bats.

Despite these few sources of optimism, the overall predictions for WNS are dire and researchers have really just begun to understand how the putative pathogen affects bats and spreads between individuals and populations. As many as 25 species of hibernating bats in North America may be susceptible to *G. destructans*, representing millions of individuals. To succeed in combating this threat, the size of the research community that is involved must increase significantly, with concomitant increases in funding. Efforts must be made not only to study the basic biology of this newly emerging disease, but also to generate a toolkit of mitigation strategies. Only when armed with more information and with mechanisms for fighting WNS can we truly have hope for the bats that hibernate in North America's mines and caves.

Acknowledgments

We acknowledge first and foremost the New York Department of Environmental Conservation, Vermont Fish and Wildlife Department, Virginia Department of Inland Game and Fisheries, and West Virginia Department of Natural Resources, for contributing unpublished data, and particularly S. Darling, R. Von Linden, C. Herzog, C. Stihler, and R. Reynolds, for contributing site-specific data. We also thank all managers and landowners for access, especially the Pennsylvania Department of Conservation and Natural Resources, R. Burd, S. Grinnen, and P. Rendin, along with the National Speleological Society and a multitude of grottos for providing access to caves and for restricting human visitation. We also thank C. Butchkoski for his continual effort to provide the most up-to-date maps depicting locations of WNS.

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A Five-year Assessment of Mortality and Geographic Spread of White-nose Syndrome in North American Bats and a Look to the Future

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Overview

The presence of an unusual fungal infection and aberrant behavior in hibernating bats was first described in New York during winter 2006–2007. The disease was dubbed white-nose syndrome (WNS) after the most prominent field sign—white fungus on the muzzle and other areas of exposed skin. The fungus, newly described as *Geomyces destructans*, also produces characteristic skin lesions on the wing and other membranes of bats (Blehert et al., 2009; Courtin et al., 2010; Meteyer et al., 2009) and probably is the causative agent of the disease (Blehert et al., 2009; Gargas et al., 2009). In this review, we briefly summarize the current state of knowledge, including estimates of mortality for a five-state region, and describe a national plan for managing WNS. Our report is not meant to be a comprehensive review of the ever-expanding literature, but we do include a bibliography of peer-reviewed publications concerning WNS.

Geographic and Taxonomic Spread

White-nose syndrome was first noticed at Howe's Cave, near Albany, New York, in February 2006 (Blehert et al., 2009; Turner and Reeder, 2009). Currently, the presence of WNS in hibernating bats has been confirmed using histopathological criteria (Meteyer et al., 2009) at more than 190 sites in 16 states and 4 Canadian provinces (Fig. 1). Three additional states are considered suspect for the disease. Evidence of *G. destructans* has been obtained from bats not associated with any hibernaculum in Delaware, and *G. destructans* also has been identified on bats from three hibernacula in Missouri and Oklahoma through polymerase-chain-reaction (PCR) techniques, although infection in each of the three states could not be confirmed by histopathology. The detection of *G. destructans* on a bat in western Oklahoma indicates that the fungus has spread ca. 2,200 km from the original site in New York.

Infection with *G. destructans* and significant mortality associated with WNS has been documented in six species: big brown bat (*Eptesicus fuscus*), small-footed bat (*Myotis leibii*), little brown bat (*M. lucifugus*), northern long-eared bat (*M. septentrionalis*), Indiana bat (*M. sodalis*), and tricolored bat (*Perimyotis subflavus*). Rates of mortality vary among species (Table 1), although reasons for the variation are unknown. *G. destructans* also has been isolated from three additional species—southeastern bat (*M. austroriparius*), gray bat (*M. grisescens*), and cave bat (*M. velifer*)—but without histological evidence of tissue damage or reports of mortality. In summer 2009, researchers convening at a WNS Science Strategy Meeting in Austin, Texas, estimated that at least one million bats had died from WNS (Kunz and Tuttle, 2009). Given the spread to new hibernacula and significant mortality noted across the region since this estimate (Fig. 1; Table 1), we believe that the number of bats that have died from WNS is surely much greater.

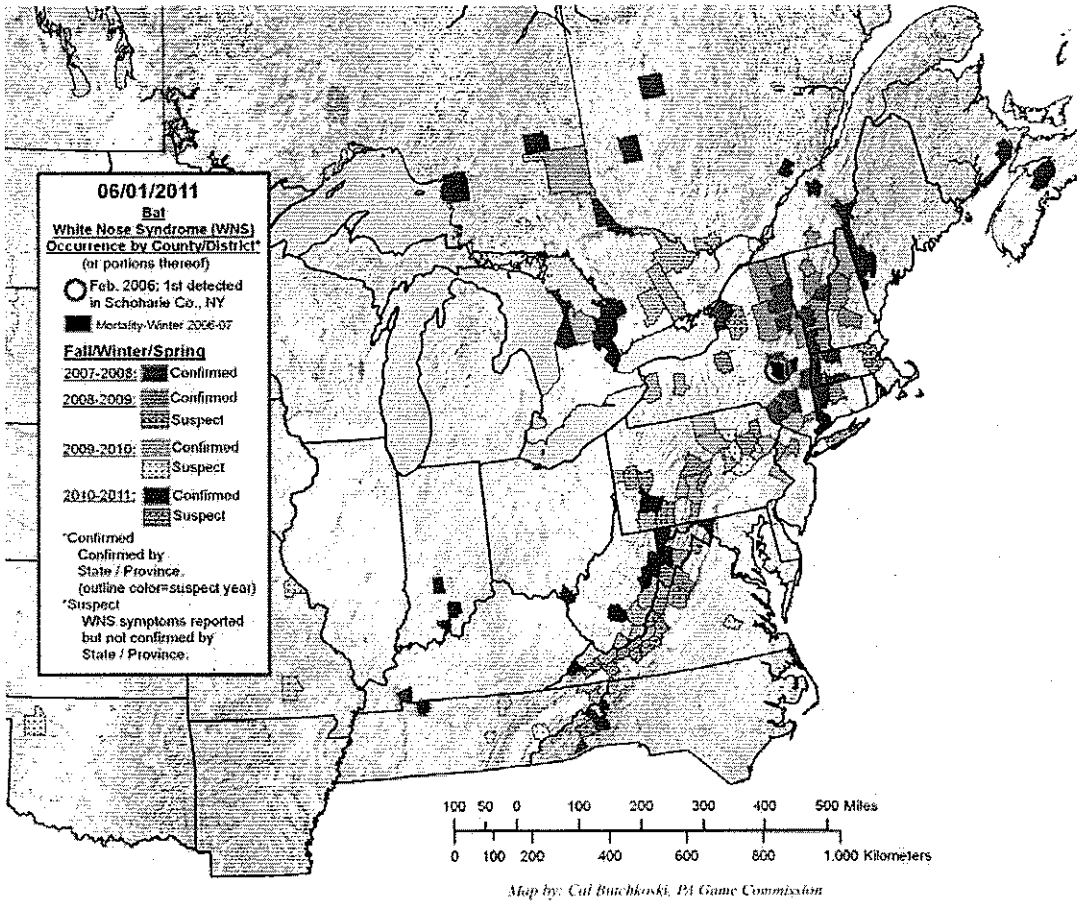

Figure 1. Current distribution of WNS in North America, showing progression of the disease over time and status ("confirmed" or "suspect") of each region as of 23 May 2011 (map may be viewed in color at http://www.fws.gov/WhiteNoseSyndrome; map by C. Butchkoski). A site (cave, county, state, etc.) is labeled as confirmed only if histopathological examination of a bat from a hibernaculum documents "a specific pattern of fungal colonization in the epidermis, which may extend to invasion of the dermis and connective tissue" (http://www.nwhc.usgs.gov/disease_information/white-nose_syndrome/wns_definitions.jsp; see details in Meteyer et al., 2009). Simple presence of hyphae or conidia, a positive fungal culture, or PCR-positive results, without fulfillment of the histopathological criteria, result in a site being categorized as suspect. In this report, a bat with simple evidence of *G. destructans* or even with histopathological signs of WNS that is found away from any hibernaculum also results in that geographic area being labeled as suspect (e.g., Delaware).

Epizootiology of WNS

Causation.—Geomyces destructans is the causative agent of the characteristic skin lesions seen on the exposed skin and in the hair follicles of affected bats (Blehert et al., 2009; Courtin et al., 2010; Meteyer et al., 2009). Although experiments are underway to determine whether *G. destructans* is the causal agent underlying WNS, the results are not yet available, and the mechanism by which an infection of the skin with *G. destructans* kills bats is unclear. In addition to studies examining the relationship between *G. destructans* and mortality, other projects that are underway include investigation of the microfauna of wing membranes and the potential roles they may play in differential survival among species or sites; exploration of various treatments for clearing fungal

infection in hibernating bats; molecular studies of the transcriptome of infected and healthy individuals, which will reveal patterns of up- and down-regulated genes, thus providing insight into responses to WNS and other potential pathogens; investigations of physiological and behavioral responses/ symptoms, including water/electrolyte balance and function of the immune system; determination of variations in species susceptibility, including non-volant mammals; and examination of the relationship between microclimate of the hibernacula and progression of the disease. Although some of this research does not require definitive identification of the causative agent, the operating assumption of most biologists within the WNS-research community is that *G. destructans* is responsible for the disease.

Anecdotal observations of bats infected by *G. destructans* may shed light on the mechanisms underlying mortality. For example, affected bats exhibit aberrant behavior including altered sensory thresholds; tremors of the forearms as they crawl; flying in daylight and collisions with large stationary objects, such as the side of a building; and excessive thirst, as evidenced by licking snow or flying for prolonged periods over small areas of open water (Hendricks and Hendricks, 2010). Either starvation and/or loss of electrolytic homeostasis could potentially explain these symptoms. Courtin et al. (2010) noted reduced (but varied) fat reserves in affected bats, which is likely due to shifts in arousal patterns during hibernation (D. M. Reeder, unpublished data), whereas Cryan et al. (2010) hypothesized that fungal attacks are disrupting physiological functions of the wing, particularly the bat's ability to maintain water balance. These are areas that hopefully will receive more attention in the near future.

Geographic origin.—Infection of bats by *G. destructans* without subsequent mass mortality has been recorded widely across Europe (Martinkova et al., 2010; Puechmaille et al., 2010, 2011; Šimonovičov et al., 2011; Wibbelt et al., 2010). For example, Martinkova et al. (2010) examined archived photographs taken since 1994 of greater than 6,000 bats in the Czech Republic and Slovakia, and their findings indicated the presence of *G. destructans* in those countries since at least 1995. These authors also noted that the incidence of visible fungus on the greater mouse-eared bat (*M. myotis*) increased from 2% in 2007 to 14% in 2010, but despite that increase, the population of bats actually grew. This inter-year variation could represent natural fluctuation in abundance of *G. destructans* or differential detection, but the lack of significant mortality and widespread geographic occurrence of the fungus suggest that *G. destructans* has been present in Europe for at least a decade (and likely longer) and that once the fungus becomes established in hibernacula, it persists. The lack of substantial mortality in European bats indicates that they are likely resistant to *G. destructans* and that *G. destructans* represents a novel pathogen for North American species.

Factors influencing transmission and spread.—Two modes of transmission of *G. destructans* have been proposed: bat-to-bat, via direct contact between animals, and hibernaculum-to-bat, via exposure to spores of *G. destructans* that were present on a roosting substrate, whether they were brought their by other bats or by humans. Bat-to-bat transmission is especially likely for those species that typically cluster during hibernation, such as little brown bats and Indiana bats. Given the temporal and geographical distribution of WNS, the scientific community investigating the disease generally agrees that bats can spread the fungus from site to site and to one another. The strongest evidence for interbat transmission comes from the infection of animals at numerous sites that were secured

Table 1. WNS-induced mortality of six species of hibernating bats from 42 sites in New York, Pennsylvania, Vermont,

		Species								
		Myotis lucifugus			*Myotis sodalis*			*Myotis septentrionalis*		
Site Name (Year WNS confirmed)	Pre-/Post-WNS Count Year	Pre-WNS Count[a]	Post-WNS Count	% Change	Pre-WNS Count (Year)[b]	Post-WNS Count	% Change	Pre-WNS Count	Post-WNS Count	% Change
New York										
Barton Hill Mine (2008)	2007/2011				9,393	7,398	-21%			
Baryte 'Garden of Dina' Mine (2007)	2006/2010	1	3	200%				6	0	-100%
Bartyes Cave (2009)	1986/2011	24	1	-96%				12	0	-100%
Bennett Hill Hitchcock Mine (2009)	2003/2011	17,399	1,669	-90%				26	11	-58%
Clarksville Cave (2008)	2006/2010	21	0	-100%				2	0	-100%
Eagle Cave (2009)[c]	1985/2011	2,587	4,324	67%				7	0	-100%
Gage's Cave (2007)	1985/2011	940	40	-96%				1	0	-100%
Glen Park Cave (2008)	2003/2011	151	10	-93%	1,908 (2007)	433	-77%			
Hailes Cave (2007)	2005/2011	15,374	1,496	-90%	685	0	-100%	14	4	-71%
Hasbrouck Mine (2009)	2006/2011	2,922	1,218	-58%						
Howe Cave (2006)	2005/2011	1,213	29	-98%				5	0	-100%
Howes Quarry Mine (2008)	1995/2010	42	1	-98%				6	0	-100%
Jamesville Quarry Cave (2009)	2003/2011	1,346	573	-57%	4,171 (2005)	251	-94%	2	1	-50%
Knox Cave (2007)	2001/2011	1,820	354	-81%				5	0	-100%
Lawrenceville Mine (2009)	2004/2011	293	6	-98%	57	71	25%	25	0	-100%
Main Graphite Mine (2008)	2000/2010	183,542	2,049	-99%	109 (2007)	0	-100%	440	0	-100%
Martin Mine (2008)	2004/2010	720	6	-99%				44	0	-100%
Schoharie Cavern (2007)	1999/2010	953	22	-98%				18	0	-100%
South Bethlehem Cave (2008)	2005/2011	100	0	-100%						
Walter Williams Preserve (2008)	1999/2010	87,401	16,673	-81%	13,014 (2007)	122	-99%	1	1	0%
Williams Fire Pit Mine (2008)	2002/2011	0	323	32,300%	0	718	71,800%	3	0	-100%
Williams Hotel Mine (2008)[d]	2003/2011				24,317 (2007)	6,389	-74%			
Williams Lake Mine (2008)	2003/2011	9,432	24	-100%	1,003 (2007)	11	-99%			

Virginia, and West Virginia, that have had WNS for at least 2 years.

Species											
Myotis leibii			*Perimyotis subflavus*			*Eptesicus fuscus*					
Pre-WNS Count	Post-WNS Count	% Change	Pre-WNS Count	Post-WNS Count	% Change	Pre-WNS Count	Post-WNS Count	% Change	**Pre-WNS Grand Total**	**Post-WNS Grand Total**	**% Change**
									9,393	**7,398**	**-21%**
			1	3	200%	7	15	114%	**15**	**21**	**40%**
			1	0	-100%	1	16	1,500%	**38**	**17**	**-55%**
183	398	117%	9	6	-33%	51	51	0%	**17,668**	**2,135**	**-88%**
			59	4	-93%				**82**	**4**	**-95%**
53	43	-19%				0	1	100%	**2,647**	**4,368**	**65%**
			27	0	-100%				**968**	**40**	**-96%**
			1	2	100%	14	3	-79%	**2,074**	**448**	**-78%**
15	1	-93%	45	9	-80%	1	0	-100%	**16,134**	**1,510**	**-91%**
						1,659	729	-56%	**4,581**	**1,947**	**-57%**
88	29	-67%	42	4	-90%	13	10	-23%	**1,361**	**72**	**-95%**
			47	0	-100%	0	1	100%	**95**	**2**	**-98%**
			0	2	200%				**5,519**	**827**	**-85%**
11	5	-55%	57	0	-100%				**1,893**	**359**	**-81%**
15	4	-73%	288	6	-98%	72	37	-49%	**750**	**124**	**-83%**
721	485	-33%	194	2	-99%	18	9	-50%	**185,024**	**2,545**	**-99%**
7	9	29%	112	4	-96%	135	31	-77%	**1,018**	**50**	**-95%**
0	1	100%	55	0	-100%	0	1	100%	**1,026**	**24**	**-98%**
17	26	53%	26	5	-81%	41	20	-51%	**184**	**51**	**-72%**
34	9	-74%	13	0	-100%	220	84	-62%	**100,683**	**16,889**	**-83%**
0	2	200%	1	0	-100%	5	71	1,320%	**9**	**1,114**	**1,2278%**
3	0	-100%				131	50	-62%	**24,451**	**6,439**	**-74%**
11	7	-36%	30	0	-100%	120	270	125%	**10,596**	**312**	**-97%**

Table 1 (cont.)

Site Name (Year WNS confirmed)	Pre-/Post-WNS Count Year	*Myotis lucifugus* Pre-WNS Count	*Myotis lucifugus* Post-WNS Count	*Myotis lucifugus* % Change	*Myotis sodalis* Pre-WNS Count (Year)[a]	*Myotis sodalis* Post-WNS Count	*Myotis sodalis* % Change	*Myotis septentrionalis* Pre-WNS Count	*Myotis septentrionalis* Post-WNS Count	*Myotis septentrionalis* % Change
New York (cont.)										
Williams Mine #7-8 (2008)	2002/2011	531	33	-94%	0	18	1,800%	2	0	-100%
Williams Mine #9-10 (2008)	2002/2011	1	35	3,400%						
Williams Mine #11 (2008)	2007/2011	54	1	-98%						
New York Totals and % Difference		**326,867**	**28,890**	**-91%**	**54,657**	**15,411**	**-72%**	**619**	**17**	**-97%**
Pennsylvania										
Alexander (2008)	2006/2010	1,604	8	-100%				30	0	-100%
Durham (2009)	2004/2011	7,356	161	-98%				881	2	-100%
Mt Rock (2009)	2005/2011	20	6	-70%						
Nuangola (2008)	2008/2011	224	0	-100%				6	0	-100%
Shindle (2008)[e]	2008/2010	2,276	3	-100%				19	0	
Woodward (2009)	2010/2011	2,749	20	-99%	3	0	-100%	4	0	-100%
Pennsylvania Totals and % Difference		**14,229**	**198**	**-99%**	**3**	**0**	**-100%**	**940**	**2**	**-100%**
Vermont										
Brandon Silver Mine (2009)	2009/2011	86	4	-95%	2	3	50%	27	0	-100%
Camp Brook Mine (2009)	2009/2011	40	0	-100%				21	0	-100%
Dover Iron Mine (2009)	2009/2011	518	22	-96%				12	0	-100%
E. Magnesia Talc Mine (2009)	2009/2011	768	84	-86%				35	3	-91%
Ely Copper Mine (2009)	2004/2011	531	4	-99%				41	0	-100%
Vermont Totals and % Difference		**1,943**	**114**	**-94%**	**2**	**3**	**50%**	**136**	**3**	**-98%**
Virginia										
Breathing Cave (2009)	2001/2011	701	475	-32%				7	9	29%
Newberry-Bane (2009)	2009/2011	4,143	557	-87%	208	146	-30%			
Virginia Totals and % Difference		**4,844**	**1,032**	**-79%**	**208**	**146**	**-30%**	**7**	**9**	**29%**
West Virginia										
Cave Mountain (2009)	2007/2011	209	17	-92%						
Hamilton (2008)	2007/2011	43	1	-98%						
Trout (2009)	2007/2011	142	8	-94%	158	90	-43%	4	0	-100%
West Virginia Totals and % Difference		**394**	**26**	**-93%**	**158**	**90**	**-43%**	**4**	**0**	**-100%**
All States Combined Totals and % Difference		**348,277**	**30,260**	**-91%**	**55,028**	**15,650**	**-72%**	**1,706**	**31**	**-98%**

[a] A blank indicates that no data on that species were provided by the state agency.
[b] Some sites in New York had visits to survey specifically for Indiana bats (*Myotis sodalis*) on dates more recent than the full site survey presented; in these
[c] Eagle Cave represents a significant increase, but this anomaly is likely due to the 25 years since the previous survey.
[d] The survey of the Williams Hotel Mine does not include counts for little brown bats (*Myotis lucifugus*), because the state biologist omitted them for
[e] Shindle Iron Mine was confirmed in December 2008, and although it qualified as 2 years, the site should be considered one full season of mortality; it

Myotis leibii			*Perimyotis subflavus*			*Eptesicus fuscus*					
Pre-WNS Count	Post-WNS Count	% Change	Pre-WNS Count	Post-WNS Count	% Change	Pre-WNS Count	Post-WNS Count	% Change	**Pre-WNS Grand Total**	**Post-WNS Grand Total**	**% Change**
0	2	200%	34	0	-100%	17	12	-29%	**584**	**65**	**-89%**
0	12	1200%				7	61	771%	**8**	**108**	**1,250%**
						61	6	-90%	**115**	**7**	**-94%**
1158	**1033**	**-11%**	**1042**	**47**	**-95%**	**2573**	**1478**	**-43%**	**386,916**	**46,876**	**-88%**
0	1	100%	16	1	-94%	0	1	100%	**1,650**	**11**	**-99%**
2	0	-100%	167	16	-90%	1	1	0%	**8,407**	**180**	**-98%**
1	1	0%	20	2	-90%	79	54	-32%	**120**	**63**	**-48%**
			12	9	-25%	36	2	-94%	**278**	**11**	**-96%**
			39	0	-100%				**2,334**	**3**	**-100%**
3	4	33%	30	0	-100%	17	4	-76%	**2,806**	**28**	**-99%**
6	**6**	**0%**	**284**	**28**	**-90%**	**133**	**62**	**-53%**	**15,595**	**296**	**-98%**
9	1	-89%	4	1	-75%	9	3	-67%	**137**	**12**	**-91%**
			0	1					**61**	**1**	**-98%**
			6	0	-100%				**536**	**22**	**-96%**
			0	0		8	5	-38%	**811**	**92**	**-89%**
122	90	-26%	5	6	20%	146	126	-14%	**845**	**226**	**-73%**
131	**91**	**-31%**	**15**	**8**	**-47%**	**163**	**134**	**-18%**	**2,390**	**353**	**-85%**
0	8	800%	513	408	-20%	12	21	75%	**1,233**	**921**	**-25%**
4	1	-75%	233	219	-6%	7	4	-43%	**4,595**	**927**	**-80%**
4	**9**	**125%**	**746**	**627**	**-16%**	**19**	**25**	**32%**	**5,828**	**1,848**	**-68%**
			151	8	-95%	6	2	-67%	**366**	**27**	**-93%**
			437	2	-100%				**480**	**3**	**-99%**
4	3	-25%	432	63	-85%	25	12	-52%	**765**	**176**	**-77%**
4	**3**	**-25%**	**1020**	**73**	**-93%**	**31**	**14**	**-55%**	**1,611**	**206**	**-87%**
1303	**1142**	**-12%**	**3107**	**783**	**-75%**	**2919**	**1713**	**-41%**	**412,340**	**49,579**	**-88%**

instances the year of the survey for Indiana bats follows the number of Indiana bats.

potential inaccuracies.
only was included because the mortality could not increase significantly with another year.

from human visitation and where no management or handling of bats occurred prior to arrival of WNS, such as the Shindle Iron Mine in Mifflin County, Pennsylvania (G. Turner, unpublished data).

The responses of a bat to WNS are surely contributing to the spread of the disease. Severely infected bats emerge prematurely from hibernation, and if they survive long enough and enter a different hibernaculum, the likelihood of transmission is probably high, because they presumably carry a large load of fungal spores. Many bats swarm at one site, yet hibernate at another (Humphrey and Cope, 1976), suggesting that infected bats know the location of other hibernacula. If infected bats survive the winter, their ability to retain viable spores and transmit *G. destructans* to healthy colony members in summer is unknown. Likewise, male bats that use hibernacula throughout summer may transmit *G. destructans* to other bats or sites during fall swarming.

Although bats are surely transmitting *G. destructans* to one another, more controversial is the occurrence of inadvertent human-assisted spread of the disease. Fungal spores are durable and easily can become attached to clothing or gear. Caving equipment used at a confirmed site did carry fungal spores having the distinctive shape of those of *G. destructans* (J. Okoniewski, unpublished data), and further research on this mode of transmission is ongoing. If in fact *G. destructans* was transported to North America from Europe, anthropogenic transmission via contaminated gear or clothing (and not bat-to-bat transmission) is the most parsimonious scenario for the initial infection. Furthermore, movement of the fungus to clean sites, hundreds or thousands of kilometers beyond the original epicenter in New York, might explain the rapid spread of WNS. To date, evidence for the anthropogenic spread of *G. destructans* remains largely anecdotal, but this fact does not diminish the very real risks posed by human action. Unintentional, human-assisted movement of pathogens is certainly not without historical precedent (e.g., the chytrid fungal disease in amphibians—Rosenblum et al., 2010) and is a grave concern to managers of animal health worldwide.

Significant variation exists in the time between detection of visible fungus and mass mortality. At some sites, we have observed the appearance of visible fungus on only a few animals during a particular winter, with further development of the disease and deaths not occurring until the next year or even later (e.g., Layton Fire Clay Mine, Fayette County, Pennsylvania). In other cases (e.g., Shindle Iron Mine), the progression from detection of a single bat with visible fungus to large-scale mortality has happened in a matter of weeks.

Once a bat is exposed to *G. destructans* at a particular location, a myriad of factors could influence progression of WNS. Understanding these factors is facilitated by considering the disease triangle (Fig. 2), which relates the potential dynamics of the host (bats of potentially multiple species), the pathogen (presumably *G. destructans*), and the environment (the hibernacula, but possibly active-season environments), as well as interactions between these variables. For example, questions such as how many spores are needed to establish infection (the loading dose) are best studied by considering the species of bat (different species and perhaps different sexes may vary in susceptibility), the time of year, and the nature of the hibernaculum (e.g., infections in sites with ambient temperature below the optimal growth temperature of *G. destructans* may progress more slowly). Likewise, understanding the timing of spread within a site and the rate of death once the fungus is visible will require analyses of these same variables.

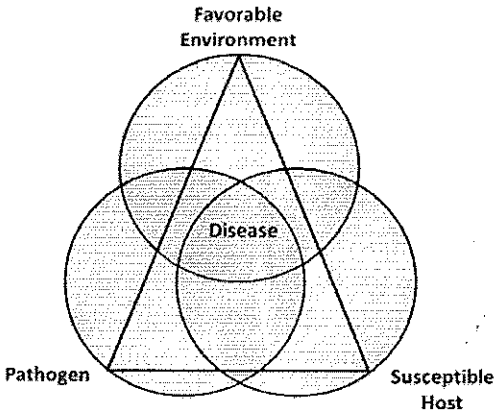

Figure 2. The disease triangle, showing the interrelationships between hosts, pathogens, and environment. A disease (WNS) occurs when a specific pathogen (presumably *Geomyces destructans*) infects susceptible hosts (hibernating bats) under certain environmental conditions (cold damp hibernacula, in which bats use torpor and effectively suppress their immune systems, allowing relatively unchecked fungal growth).

Patterns of Mortality

What is the overall decline of hibernating bats? Are there differences in mortality among species? Are there changes in mortality as the disease progresses across a region? These are some of the most frequently asked questions regarding the impacts of WNS, and biologists are just now starting to examine such issues. Unfortunately, answering these questions relies on accurately estimating/counting the number of bats in hibernacula, and multiple confounding variables make this a difficult task.

Difficulties encountered during winter surveys.—One variable affecting the accuracy of winter surveys is behavioral differences among species. For example, some species, such as big brown bats and small-footed bats are tolerant of low ambient temperatures and hibernate in highly variable conditions. They are often the last bats to enter and the first to leave a hibernaculum. Counts of these species, even those made in midwinter, often vary tremendously. This is likely due to variation in average ambient temperatures during a particular winter, which in turn affects whether the bats are in a particular cave or mine.

Timing of surveys may also play a significant role in differences among bat counts. Because winter surveys of some WNS-affected sites have been pushed from the typical mid-winter period to a time closer to natural emergence (to reduce potential stress on bats), early emerging species, such as big brown bats, and/or individuals affected with WNS may have already left, thus biasing these censuses. Finally, species preferences in roosting location during hibernation (e.g., northern long-eared bats prefer deep cracks) can result in significant underestimates of some species.

Even though most state agencies that perform the counts attempt to assign the same experienced surveyors to the same sites, misidentification of species is possible, especially for those bats that cluster in mixed-species groups and for those that are structurally similar. The physical size of the site, number of bats present, number of passages that surveyors cannot access, and amount of disturbance during the hibernating period can undermine accurate censuses.

The arrival of WNS in a site further affects the accuracy of counts. One of the hallmark signs that a site is affected is the shifting of roost sites within the hibernaculum and the premature exit of affected bats in winter, often months before food is available. Depending upon the time of the survey, this phenomenon may result in underestimates of winter abundance, whereas in other sites, numbers may initially increase during the first year of infection. For example, at Hall's Cave in Huntingdon County, Pennsylvania, total population size jumped from 75 bats before

WNS to 1,800 bats during the winter that WNS arrived, with a drop to 31 bats in the following year; surveys of surrounding sites did not detect similar changes in numbers. It is difficult to draw conclusions from the small number of these occurrences, but the increases may be due either to movement of bats away from nearby, high-mortality sites or to movement of bats within the site from hidden passages to areas closer to the entrance where they are more easily counted. The more pertinent question regarding the derivation of mortality numbers is whether or not to use these peaks in any estimate.

Prior to the arrival of WNS in new geographic areas, the collection of accurate population counts will allow a better understanding of WNS-related declines than may currently be possible in affected areas of the East. In addition, inclusion of data from the active season (e.g., counts at maternity colonies, acoustic surveys, and trapping during fall swarming—Brooks, 2011; Dzal et al., 2010) ultimately may help achieve a more accurate picture of total declines.

Current status of bat populations.—For the analysis presented herein, we utilized data for 42 sites from five states—New York, Pennsylvania, Vermont, Virginia, and West Virginia (Table 1). We limited our analysis to sites with confirmed mortality for at least 2 years, to control for some of the variation described earlier and have focused on counts derived from a consistent level of effort across years. Although some sites have many historical counts where numbers could have been averaged, many others do not, so for consistency, we present only data from the most recent census conducted prior to WNS and the latest count following confirmation of the disease. To reduce stochastic variation and/or issues relating to small samples, we added the count for each species at each site within a state to obtain average mortality estimates per species per state. We then combined data from all states to obtain an estimate of regional change in species composition and abundance. Finally, we aggregated all counted bats, regardless of species, to report the overall change in the total hibernating population for each state and the region. Note that the important number is the percent change in species by state, not absolute numbers, because our 42 sites represent only a fraction of known hibernacula in the region.

At our 42 sites, we saw a precipitous decline in the number of hibernating bats after WNS, from 412,340 to 49,579 animals, for an overall decrease of 88% (Table 1). All six species declined, but there were notable differences among species. Northern long-eared bats decreased by 98% (1,706 to 31 bats); little brown bats, 91% (348,277 to 30,260); tricolored bats, 75% (3,107 to 783); Indiana bats, 72% (55,028 to 15,650); big brown bats, 41% (2,919 to 1,713), and small-footed bats, 12% (1,303 to 1,142). The species with smaller reductions are hopefully less susceptible or more resistant to *G. destructans*, but it is possible that they are just declining at a slower rate, with total mortality rates eventually reaching those of the other species.

When examined by state, we see an overall decline of 98% in Pennsylvania, 88% in New York, 87% in West Virginia, 85% in Vermont, and 69% in Virginia. Although differences among states in overall mortality may be real, undersampling of sites and biased sampling of certain species (e.g., Indiana bats) also may contribute. As previously mentioned, increased accuracy of surveys and eventual inclusion of active-season data will improve our understanding of mortality by species and region. Unfortunately, our mortality estimates are in line with the mathematical models of Frick et al. (2010), who predict that the once-abundant and ubiquitous little brown bat has the potential to become extinct in the Northeast in only 7–30 years; a similar fate may await

Indiana, northern long-eared, and tricolored bats.

The differences in mortality among species also have affected composition of the hibernating assemblage (Fig. 3). For example, prior to WNS, little brown bats comprised 84.5% of all hibernating bats at the 42 sites used in this analysis, with Indiana bats at 13.4%. After WNS, little brown bats now represent only 61% of all bats, and Indiana bats have increased to 31.6% of the overall population.

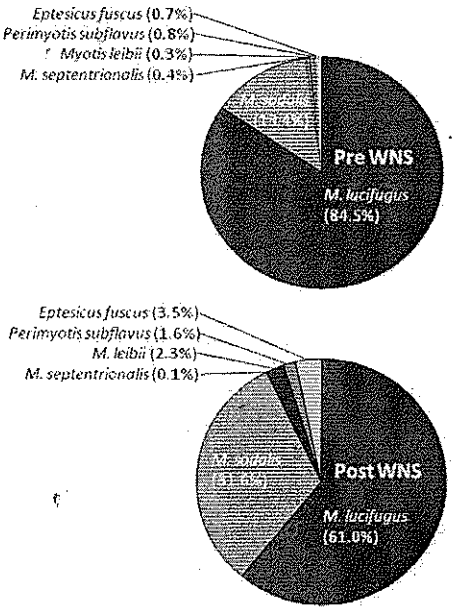

Figure 3. Changes in overall species composition for the six affected species of bats after 2 years of WNS-associated mortality (Table 1).

The National Plan

A final version of a national response plan, *A National Plan for Assisting States, Federal Agencies, and Tribes in Managing White-Nose Syndrome in Bats*, was released in May 2011 (http://www.fws.gov/WhiteNoseSyndrome/). The purpose of the national plan is to guide the reactions of federal, state, and tribal agencies and their partners to WNS. The plan has been developed with input from multiple agencies and establishes an organizational structure for the national response, with defined roles for agencies, stakeholders, and the research community. Oversight of implementation of the plan is provided by two committees—an executive committee and a steering committee—both of which were formally established during winter 2010–2011. The plan also officially institutes seven working groups to address the myriad needs of a national response: communications and outreach, conservation and recovery, data and technical information management, diagnostics, disease management, disease surveillance, and epidemiological and ecological research. The national plan will integrate and support state and regional response plans for WNS and is not intended to replace planning at the local/regional level.

The national plan for WNS is based on similar disease-response plans that have been implemented in the past (e.g., chronic wasting disease in cervids—http://www.cwd-info.org/index.php/fuseaction/policy.policy), and is essentially a formalization of coordinated efforts that were initiated in 2008. The final version of the plan is intended to be static, although implementation of the plan will be an adaptive process, allowing incorporation of new information and guidance, as they become available and/or necessary. The individual working groups will be responsible for developing and maintaining the various components of the action items identified for each element of the plan. The implementation of national strategies will help standardize management practices, including disease surveillance and population monitoring, to ensure consistency in data collection and to facilitate

interpretation of results at the continental scale. Because the national plan incorporates a number of actions and efforts that have been used to address WNS over the past 3 years, many elements of the plan are already in service. Existing and future guidance will continually be improved upon so that the WNS implementation plan will be an evolving system rather than a static document.

The Future of White-nose Syndrome?

While WNS continues to spread, not all news is bad news and several surprising findings offer rays of hope. For example, WNS has been confirmed in two hibernacula in West Virginia that harbor nearly 50% of the entire population of the endangered Virginia big-eared bat (*Corynorhinus townsendii virginianus*). Despite mortality of other species in those sites, no fungal infection has been found in the Virginia big-eared bat. Likewise, although *G. destructans* was detected in Oklahoma and Missouri in 2009–2010, histological examination showed that the infected bats were not suffering from WNS, and no new cases were detected in 2010–2011 in either state. Only one of four sites in Tennessee in which *G. destructans* was detected in 2009–2010 was confirmed by histology in 2010–2011, and despite an active surveillance program in Kentucky, WNS was not detected in that state until late spring 2011. Finally, limited evidence from the Northeast, mainly in the form of consistent annual counts at a few locations, suggests that some populations may have stabilized, albeit at much smaller sizes than before WNS. For example, surveys that occurred at Hailes Cave in New York before WNS estimated a hibernating population of 15,374 bats. Following the advent of WNS, annual surveys from winter 2007–2008 to 2010–2011, recorded 7,258; 1,443; 1,000; 1,198; and 1,496 bats.

Despite these few sources of optimism, the overall predictions for WNS are dire and researchers have really just begun to understand how the putative pathogen affects bats and spreads between individuals and populations. As many as 25 species of hibernating bats in North America may be susceptible to *G. destructans*, representing millions of individuals. To succeed in combating this threat, the size of the research community that is involved must increase significantly, with concomitant increases in funding. Efforts must be made not only to study the basic biology of this newly emerging disease, but also to generate a toolkit of mitigation strategies. Only when armed with more information and with mechanisms for fighting WNS can we truly have hope for the bats that hibernate in North America's mines and caves.

Acknowledgments

We acknowledge first and foremost the New York Department of Environmental Conservation, Vermont Fish and Wildlife Department, Virginia Department of Inland Game and Fisheries, and West Virginia Department of Natural Resources, for contributing unpublished data, and particularly S. Darling, R. Von Linden, C. Herzog, C. Stihler, and R. Reynolds, for contributing site-specific data. We also thank all managers and landowners for access, especially the Pennsylvania Department of Conservation and Natural Resources, R. Burd, S. Grinnen, and P. Rendin, along with the National Speleological Society and a multitude of grottos for providing access to caves and for restricting human visitation. We also thank C. Butchkoski for his continual effort to provide the most up-to-date maps depicting locations of WNS.

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Francl, K.E., D.W. Sparks, V. Brack, Jr., and J. Timpone. 2011. White-nose syndrome and wing damage index scores among summer bats in the northeastern United States. Journal of Wildlife Diseases, 47:41–48.

Foley, J., D. Clifford, K. Castle, P. Cryan, and R.S. Ostfeld. 2011. Investigating and managing the rapid emergence of white-nose syndrome, a novel, fatal, infectious disease of hibernating bats. Conservation Biology, 25:223–231.

Frick, W.F., D.S. Reynolds, and T.H. Kunz. 2010. Influence of climate and reproductive timing on demography of little brown myotis *Myotis lucifugus*. Journal of Animal Ecology, 79:128–136.

Frick, W.F., et al. 2010. An emerging disease causes regional population collapse of a common North American bat species. Science, 329:679–682.

Gargas, A., et al. 2009. *Geomyces destructans* sp nov associated with bat white-nose syndrome. Mycotaxon, 108:147–154.

Hallam, T.G., and G.F. McCracken. 2011. Management of the panzootic white-nose syndrome through culling of bats. Conservation Biology, 25:189–194.

Hendricks, P., and L.M. Hendricks. 2010. Water acquisition during daylight by free-ranging *Myotis* bats. Northwestern Naturalist, 91:336–338.

Humphrey, S.R. and J.B. Cope. 1976. Population ecology of the little brown bat, *Myotis lucifugus*, in Indiana and north-central Kentucky. American Society of Mammalogists, Special Publication, 4:1–81.

Kannan, K., S.H. Yun, R.J. Rudd, and M. Behr. 2010. High concentrations of persistent organic pollutants including PCBs, DDT, PBDEs and PFOS in little brown bats with white-nose syndrome in New York, USA. Chemosphere, 80:613–618.

Kunz, T.H., and M.D. Tuttle. 2009. White Nose Syndrome Science Strategy Meeting II. http://www.batcon.org/pdfs/whitenose/WNS2FinalReport.pdf. Accessed 3 June 2011.

Kunz, T.H., et al. 2011. White-nose syndrome: an overview of ongoing and future research needs. Pp. 195–209 *in* Proceedings of Protection of Threatened Bats at Coal Mines: A Technical Interactive Forum (K.C. Vories and A.H. Caswell, eds.). U.S. Department of the Interior, Office of Surface Mining and Coal Research Center, Southern Illinois University, Carbondale, Illinois.

Lindner, D.L., et al. 2010. DNA-based detection of the fungal pathogen *Geomyces destructans* in soil from bat hibernacula. Mycologia, doi:10.3852/10–262.

Lorch, J.M., et al. 2010. Rapid polymerase chain reaction diagnosis of white-nose syndrome in bats. Journal of Veterinary Diagnostic Investigation, 22:224–230.

Martinková, N., et al. 2010. Increasing incidence of *Geomyces destructans* fungus in bats from the Czech Republic and Slovakia. PloS One, 5:e13853.

Meteyer, C.U., et al. 2009. Histopathologic criteria to confirm white-nose syndrome in bats. Journal of Veterinary Diagnostic Investigation, 21:411–414.

Puechmaille, S.J., et al. 2010. White-nose syndrome fungus (*Geomyces destructans*) in bat, France. Emerging Infectious Diseases, 16:290–293.

Puechmaille, S.J., et al. 2011. Pan-European distribution of white-nose syndrome fungus (*Geomyces destructans*) not associated with mass mortality. PLoS One, 6:e19167.

Reeder, D.M., and G.G. Turner. 2008. Working together to combat white-nose syndrome: a report of a meeting on 9–11 June 2008, in Albany, New York. Bat Research News, 49:75–78.

Reichard, J.D., and T.H. Kunz. 2009. White-nose syndrome inflicts lasting injuries to the wings of little brown myotis (*Myotis lucifugus*). Acta Chiropterologica, 11:457–464.

Rosenblum, E.B., J. Voyles, T.J. Poorten, and J.E. Stajich. 2010. The deadly chytrid fungus: a story of an emerging pathogen. PLoS Pathogens, 6:e1000550.

Šimonovičov, A., D. Pangallo, K. Chovanová, and B. Lehotská. 2011.

Geomyces destructans associated with bat disease WNS detected in Slovakia. Biologica, 66:562–564.

Steele, M.A., D.M. Reeder, T.J. Maret, and M.C. Brittingham. 2010. Critical and emerging issues in the conservation of terrestrial vertebrates. Pp. 390–398 *in* Terrestrial vertebrates of concern in Pennsylvania: management, conservation and research (M.A. Steele, M.C. Brittingham, T.J. Maret, and J.F. Merritt, eds.). Johns Hopkins University Press, Baltimore Maryland.

Storm, J.J., and J.G. Boyles. 2010. Body temperature and body mass of hibernating little brown bats *Myotis lucifugus* in hibernacula affected by white-nose syndrome. Acta Theriologica, 56:123–127.

Turner, G.G., and D.M. Reeder. 2009. Update of white-nose syndrome in bats, September 2009. Bat Research News, 50:47–53.

Veilleux, J.P. 2008. Current status of white-nose syndrome in the northeastern United States. Bat Research News, 49:15–17.

Wibbelt, G., et al. 2010. White-nose syndrome fungus (*Geomyces destructans*) in bats, Europe. Emerging Infectious Diseases, 16:1237–1243.

Wibbelt, G., M.S. Moore, T. Schountz, and C.C. Voigt. 2010. Emerging diseases in Chiroptera: why bats? Biology Letters, 6:438–440.

Wilder, A.P., W.F. Frick, K.E. Langwig, and T.H. Kunz. 2011. Risk factors associated with mortality from white-nose syndrome among hibernating bat colonies. Biology Letters, doi:10.1098/rsbl.2011.0355.

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RESEARCH INTERESTS

- Global mammalian biodiversity
- Comparative physiology and behavior in mammals, especially bats
- Stress responsiveness in nature
- Eco-immunology
- Physiological and behavioral changes across life history stages and in response to the changing environment
- White-nose syndrome (WNS) in bats; hibernation physiology

TEACHING INTERESTS

- Comparative Animal Physiology
- Organismal Biology
- Mammalogy
- Behavioral Neuroendocrinology/ Hormones and Behavior

EDUCATION

Sept. 2001 – Aug. 2004 **Post-doctoral Fellow**. Department of Biology, Boston University (Advisors: Dr. Eric P. Widmaier, Dr. Thomas H. Kunz).

Dec. 1997 – Aug. 2001 **Ph.D**. Animal Behavior. University of California, Davis. Dissertation title: The Biology of Parenting in the Monogamous Titi Monkey (*Callicebus moloch*). (Advisor: Dr. Sally P. Mendoza; Co-advisor: Dr. William A. Mason).

Sept. 1995 – Dec. 1997 **M.S.** Animal Behavior. University of California, Davis. (Advisor: Dr. Sally P. Mendoza; Co-advisor: Dr. William A. Mason).

Aug. 1987 – May 1991 **B.A.** Zoology (with distinction). University of California, Berkeley.

PROFESSIONAL EXPERIENCE

2010-present **Associate Professor,** Department of Biology, **Associated Faculty,** Animal Behavior, Bucknell University, Lewisburg, PA

2008-present **Research Associate**, National Museum of Natural History, Smithsonian Institution

2005- 2010 **Assistant Professor,** Department of Biology, **Associated Faculty,** Animal Behavior, Bucknell University, Lewisburg, PA

Sept. 2001-Aug. 2005 **Research Fellow/Research Associate**, Department of Biology, Boston University, Boston, MA

Spring 2001 **Visiting Instructor**, University of the South, Sewanee, TN

SELECTED PUBLICATIONS (* indicates student co-author)

Books

D. E. Wilson and **D. M. Reeder** (eds.). 2005. Mammal Species of the World, A Taxonomic and Geographic Reference, Third Edition. The Johns Hopkins University Press, Baltimore, MD, 2 volumes, 2,142 pp.

D. E. Wilson and **D. M. Reeder** (eds.). 1993. Mammal Species of the World, A Taxonomic and Geographic Reference, Second Edition. Smithsonian Institution Press, Washington D.C., 1206 pp. *Choice Outstanding Academic Book.*

Research Papers & Peer-reviewed Book Chapters (* indicates student co-author)

G. G. Turner, **D. M. Reeder,** and J. T. H. Coleman. 2011. A Five-year Assessment of Mortality and Geographic Spread of White-Nose Syndrome in North American Bats, with a Look at the Future. Update of White-Nose Syndrome in bats. Bat Research News, 52:13-27.

Kunz, T.H., J.T. Foster, W.F. Frick, A.M. Kilpatrick, G.F. McCracken, M.S. Moore, J.D. Reichard, **D.M. Reeder,** and A.H. Robbins. 2011. White-nose syndrome: an overview of ongoing and future research needs. Pp. 195-209. In: Proceedings of Protection of Threatened Bats at Coal Mines: A Technical Interactive Forum (K.C. Vories and A.H. Caswell, eds.). USDOI Office of Surface Mining and Coal Research Center, Southern Illinois University, Carbondale, Illinois.

Steele, M. A., **D. M. Reeder**, T. J. Maret, and M. C. Brittingham. 2010. Critical and emerging issues in the conservation of terrestrial vertebrates. Pp. 390-398 In, Terrestrial Vertebrates of Concern in Pennsylvania: Management Conservation and Research, Steele, M. A., M. C. Brttingham, T. J. Maret, and J. F. Merritt, editors. Johns Hopkins University Press, Baltimore Maryland.

D. M. Reeder and E. P. Widmaier. 2009. Hormone Analysis. Pp. 554-563 In, Ecological and Behavioral Methods for the Study of Bats. Second Edition. T. H. Kunz and S. Parsons (eds). The Johns Hopkins University Press, Baltimore, MD.

G. G. Turner and **D. M. Reeder**. 2009. Update of White-Nose Syndrome in bats, September 2009. Bat Research News, 50(3), 47-53.

K. N. Weaver*, S. E. Alfano*, A. R. Kronquist*, and **D. M. Reeder**. 2009. Healing rates of wing punch wounds in free-ranging little brown myotis (*Myotis lucifugus*). Acta Chiropterologica, 11:220-223.

D. M. Reeder and G. R. [G. G.] Turner. 2008. Working together to combat 'White-Nose Syndrome' in Northeastern US bats; a report of the June 2008 meeting on White-Nose Syndrome held in Albany, NY. Bat Research News, 49(3), 75-78.

B. L. Pearson*, P. G. Judge, **D. M. Reeder**. 2008. Effectiveness of saliva collection and enzyme-immunoassay for the quantification of cortisol in socially-housed baboons. American Journal of Primatology, 70, 1-7.

D. M. Reeder, K. M. Helgen, and D. E. Wilson. 2007. Global Trends and Biases in New Mammal Species Discoveries. Occasional Papers, Museum of Texas Tech University, 269:1-36.

D. M. Reeder, H. Raff, T. H. Kunz, and E. P. Widmaier. 2006. Characterization of Pituitary-Adrenocortical Activity in the Malayan Flying Fox (*Pteropus vampyrus*). Journal of Comparative Physiology, B, Biochemical, Systemic, and Environmental Physiology, 176(6):513-519.

D. M. Reeder, N. S. Kosteczko*, T. H. Kunz, and E. P. Widmaier. 2006. The hormonal and behavioral response to group formation, seasonal changes and restraint stress in the highly social Malayan Flying Fox (*Pteropus vampyrus*) and the less social Little Golden-mantled Flying Fox (*P. pumilus*) (Chiroptera: Pteropodidae). Hormones & Behavior, 49:484-500 [2005 epub].

D. M. Reeder and K. M. Kramer. 2005. Stress in free-ranging mammals: integrating physiology, ecology, and natural history. Journal of Mammalogy, 86(2):225-235.

D. M. Reeder, E. P. Widmaier, and T. H. Kunz. 2004. Baseline and stress-induced glucocorticoids during reproduction in the variable flying fox, *Pteropus hypomelanus* (Chiroptera: Pteropodidae). Journal of Experimental Zoology Part A: Comparative Experimental Biology, 301:682-690.

D. M. Reeder, N. S. Kosteczko*, T. H. Kunz, and E. P. Widmaier. 2004. Changes in baseline and stress-induced glucocorticoid levels during the active period in free-ranging male and female little brown myotis, *Myotis lucifugus* (Chiroptera: Vespertilionidae). General and Comparative Endocrinology, 136:260-269.

D. M. Reeder. 2003. The potential for cryptic female choice in primates: Behavioral, physiological, and anatomical considerations. Pp. 255-303 *In*, C. B. Jones (ed.). Sexual Selection and Reproductive Competition in Primates: New Perspectives and Directions. American Society of Primatologists, Norman, OK.

C. Schradin, **D. M. Reeder**, S. P. Mendoza and G. Anzenberger. 2003. Prolactin and paternal care: Comparison of three species of monogamous New World monkeys. Journal of Comparative Psychology, 117(2):166-175.

S. P. Mendoza, **D. M. Reeder**, and W. A. Mason. 2002. The nature of proximate mechanisms underlying primate social systems: Simplicity and redundancy. Evolutionary Anthropology, 11 (Suppl. 1):112-116.

F. R. Cole, **D. M. Reeder**, and D. E. Wilson. 1994. A synopsis of distribution patterns and the conservation of mammal species. Journal of Mammalogy, 75(2):266-276.

Reviews

D. M. Reeder. 2002. Review of Walker's Primates of the World. American Journal of Primatology. 56(4): 251-252.

D. M. Reeder. 2000. Review. The Integrative Neurobiology of Affiliation by C. S. Carter, I. I. Lederhendler, and B. Kirkpatrick (Eds.). Journal of Mammalogy, 81:909-912.

D. M. Reeder. 1997. A New World Compendium. Review of New World Primates: Ecology, Evolution, and Behavior, edited by Warren G. Kinzey. American Journal of Primatology, 43:361-363.

SELECTED GRANTS, AWARDS, AND HONORS (PI unless otherwise noted)

Research Grant, National Science Foundation, Organism-Environmental Interactions Program (IOS). 2011-2014 (**Pending).** *Collaborative Research: Using Comparative Transcriptome and Immunological Analyses to "Connect the Dots" for Bats Affected by "White-Nose Syndrome"* " $440,418, **D. M. Reeder (PI**), Ken A. Field, co-PI.

Research Grant, The Eppley Foundation for Research, Inc. 2011-2012**.** *Exploring Links Between Mammalian Biodiversity and Disease Ecology in South Sudan – a Poorly Studied Former Conflict Zone.* $25,000. **D. M. Reeder (PI)**, Marianne Moore (co-PI).

Research Grant, Wildlife Management Institute. 2011-2012. *Laboratory and Field Testing of Treatments for White Nose Syndrome: Immediate Funding Need for the Northeast Region*. $100,000.

Research Grant, United States Fish & Wildlife Service. 2010-2012. *Who Will Survive? Exploring Individual, Sex, and Species Differences in Susceptibility and Resistance to WNS*. $409,469, **D. M. Reeder (PI),** C. K. R.Willis and J. Franck (co-PIs).

Research Grant, United States Fish & Wildlife Service. 2010-2012. *Evaluating the pathogenicity of North American and European strains of Geomyces destructans in cave bats, tree bats, and other mammalian hibernators***.** $293,701, C. K. R. Willis (PI), D. S. Blehert, P. M. Cryan, V. Misra, and **D.M. Reeder** (co-PIs).

Waitt Research Grant, National Geographic Society. 2010-2011. *Mammals of Southern Sudan: Exploring Biodiversity in a Former Conflict Zone.* $14,945.00.

Woodtiger Fund: Private research grant for white-nose syndrome research. 2010-2011. $50,000.00.

Research Grant, State Wildlife Grants (SWG) Program. 2010-2011. *Fighting the good fight against Geomyces destructans (Gd): Evaluating non-invasive anti-Gd treatments and testing the ability of WNS-rehabilitated bats to resist Gd infection during hibernation.* $105,746.29.

International Research Travel Grant, Bucknell University, 2009-2010. *Mammals of the Eastern Equatoria State of Southern Sudan: Exploring Biodiversity and Disease Vectors in a Former Conflict Zone.* $3000.00.

Scholarly Development Grant, Bucknell University, 2010. *Understanding the Emerging Infectious Disease 'White-nose Syndrome' in Bats: Immune Competence and Energetic Strategies in Healthy and Dying Bats.* Summer stipend: $4000.00.

Research Grant, United States Fish & Wildlife Service. 2008-2009. *Assessing Immune Competence in bats naturally affected by WNS and in bats artificially infected by the suspected white-nose syndrome (WNS) pathogen.* $68,687.00.

Research Grant, Pennsylvania Department of Conservation and Natural Resources. 2008-2009. *Studying White Nose Syndrome & Associated Physiological & Behavioral Processes in Pennsylvania Bats.* $50,725.00.

Research Grant, Bat Conservation International. 2008-2009**.** *Studying Immune Competence in Bats to help understand the effects of White Nose Syndrome*. $5883.00.

Research Grant, Wildlife Management Institute. 2008-2009. *Exploring the Connection Between Arousal Patterns in Hibernating Bats and White Nose Syndrome: Immediate Funding Needs for the Northeast Region*. $50,000.00.

Research Grant, Department of the Interior, Science on the Landscape program. 2008-2009. *Demonstrating a Causal Link Between a Geomyces spp. Fungus and White-Nose Syndrome in Little Brown Myotis (Myotis lucifugus)* Collaborator; Dr. David Blehert is Principle Investigator

Scholarly Development Grant, Bucknell University, 2008. *Ecophysiology in bats: exploring the relationships between hormones, immune function, and the environment.* Summer stipend: $4000.00.

International Research Travel Grant, Bucknell University, 2007-2008. *Mammals of the Eastern Equatoria State of Southern Sudan: Effects of Decades of Civil War and the Repatriation of Human Refugees.* $3000.00.

Jane W. Griffith Faculty Fellowship, Bucknell University. 2005-2007. Start-up funds.

Individual post-doctoral National Research Service Award, National Institute of Child Health and Human Development, *Integrating Social Processes, Stress, and Reproduction*. 2001-2004.

Faculty Development Grant, University of the South. *Social Behavior, Stress, and Reproductive Physiology Before and After Infant Birth in the Seasonally Breeding Island Flying Fox (Pteropus hypomelanus)*. 2001.

Top Student Prize for presentation at the Annual Meeting, 2001, Society for Behavioral Neuroendocrinology.

Individual pre-doctoral National Research Service Award, National Institute of Mental Health, *Comparative Responses to Chronic Stress in Primates*. 1997-2001.

Fellow, Professors for the Future program, University of California, Davis. 1999-2000.

Selected participant, Program in College Teaching, University of California, Davis. 1999-2000.

Tracy & Ruth Risdon Storer Fellowship, University of California, Davis. 1996-2000.

Award for Outstanding Graduate Student Teacher, University of California, Davis, 1999.

General Grant, Leakey Foundation. *Mechanisms Regulating the Origin of Paternal Care in Titi Monkeys.* 1999.

Floyd and Mary Schwall Dissertation Fellowship in Medical Research. 1999.

Annual Top Student Prize for Outstanding Presentation, American Society of Primatologists, 1998.

Named Alumni Scholar, University of California, Berkeley, 1991; Alumni Scholar, University of California, Berkeley, 1987-1991.

SELECTED PROFESSIONAL SERVICE

Recording Secretary (officer position) and Member of the Board of Directors, American Society of Mammalogists, 2006-2011.

Treasurer, North American Society for Bat Research, 2009-present.

Chair, Checklist Committee, American Society of Mammalogists. 2004-present. Committee member 1991-2004.

Member of the Grants-in-Aid Committee, Resolutions Committee, and Planning and Finance Committee, American Society of Mammalogists. 2006-present.

Member of the Mammal Technical Committee of the Pennsylvania Biological Survey, 2006-present.

Member of the Scientific Advisory Board, Lubee Bat Conservancy, 2005-present.

Guest Editor: The Northeastern Naturalist, 2008.

Ad-hoc reviewer: Acta Zoologica Sinica; Acta Theriologica; African Bat Conservation News; American Journal of Physiology R; American Journal of Primatology; The American Midland Naturalist; The American Naturalist; Behavioral Ecology and Sociobiology; Brazilian Journal of Medical and Biological Research; Comparative Biochemistry and Physiology; Conservation Biology; General and Comparative Endocrinology; Journal of Mammalogy; Journal of Wildlife Diseases; Journal of Zoology; Hormones and Behavior; The Leakey Foundation; National Geographic Society; Physiological and Biochemical Zoology; Physiology & Behavior; PLoS Biology; Proceedings of the Royal Society B Biological Sciences; Trends in Endocrinology and Metabolism; The Wilson Journal of Ornithology; Wildlife Research.

Working Group for the National Center for Ecological Analysis and Synthesis: *Synthesis of the biodiversity knowledge base: towards a global database of terrestrial vertebrate distributions.* Organized and led meeting of the mammals' subgroup. University of California, Santa Barbara, 2001-2003.

Organized symposium *Stress in Nature: Impact on Physiology, Ecology, and Natural History of Mammals* for the 2003 annual meeting of the American Society of Mammalogists.

Education Committee, Society for Behavioral Neuroendocrinology, 2001-2003. Reviewed travel grant applications, judged posters, created website on "Guidelines for giving an effective poster presentation" http://www.sbne.org/Meeting/2002/2002poster_guide.htm

SELECTED PROFESSIONAL PRESENTATIONS (* indicates student co-author)

D. M. Reeder. 2011. Bat and rodent diversity in South Sudan: Field studies in a former conflict zone. Presented at the 2011 annual meeting of the American Society of Mammalogists, Portland, Oregon.

D. M. Reeder. 2011. Who Will Survive? Tracking the Deadly "White Nose Syndrome" in Bats. Invited speaker, Fordham University, New York.

S. A. Brownlee and **D. M. Reeder**. **2010.** Behavior of bats with White Nose Syndrome. Presented at the 2010 annual meeting of the American Society of Mammalogists, Laramie, Wyoming.

L. E. Grieneisen, G. G. Turner, and **D. M. Reeder**. 2010. Hibernacula microclimate and White Nose Syndrome susceptibility. Presented at the 2010 annual meeting of the American Society of Mammalogists, Laramie, Wyoming.

D. M. Reeder. 2010. Tracking a Killer: Studying "White Nose Syndrome" in Bats. Invited speaker, Shippensburg University, Pennsylvania.

C. L. Frank, **D. M. Reeder**, A. Hicks, and R. Rudd. The effects of White Nose Syndrome (WNS) on bat hibernation. Presented at the 2010 annual meeting of the Society for Integrative and Comparative Biology, Seattle, Washington.

D. M. Reeder, R. Jacob*, C. L. Frank, E. R. Britzke, G. G. Turner, A. Kurta, A. C. Hicks, S. R. Darling, and C. W. Stihler. Altered arousal patterns and suppressed immunity in little brown myotis (*Myotis lucifugus*) affected by white-nose syndrome. Presented at the 2009 annual North American Symposium for Bat Research, Portland, OR.

D. M. Reeder, C. L. Frank, E. R. Britzke, G. R. Turner et al. Hibernation arousal patterns in little brown myotis (*Myotis lucifugus*) affected by white-nose syndrome. Presented at the 2009 annual meeting of the American Society of Mammalogists, Fairbanks, Alaska.

D. M. Reeder. Hibernation arousal patterns in little brown myotis affected by white-nose syndrome. May 2009. Presented at the White Nose Syndrome Science Strategy II Meeting, Austin, Texas.

D. M. Reeder. Mysterious white nose syndrome killing northeastern bats: History and current research. March 2009. Presented to the Seven Mountains Audubon Society.

R. Jacob*, J. B. Kobilis*, and **D. M. Reeder**. Seasonal variation of immune function in Vespertilionid bats. Presented at the 2008 annual North American Symposium for Bat Research, Scranton, PA.

M. E. Vodzak* and **D. M. Reeder**. Preliminary survey of the bats of Eastern Equitoria, Southern Sudan. Presented at the 2008 annual North American Symposium for Bat Research, Scranton, PA.

A. G. Remeika*, M. E. Vodzak*, C. J. Ostroski*, S. M. Wasilko*, and **D. M. Reeder**. Glucocorticoid hormone responses to harp trap and mistnet capture in lactating, post-lactating, and pre-migratory Myotis lucifugus. Presented at the 2008 annual North American Symposium for Bat Research, Scranton, PA.

J. B. Kobilis*, K. J. Piatt*, and **D. M. Reeder**. Arousal patterns during hibernation in captive little brown bats *Myotis lucifugus.* Presented at the 2008 annual North American Symposium for Bat Research, Scranton, PA.

K. N. Weaver*, A. R. Kronquist*, S. E. Alfano*, and **D. M. Reeder**. Assessment of wound healing rates in free-ranging little brown bats Myotis lucifugus. Presented at the 2008 annual North American Symposium for Bat Research, Scranton, PA.

M. E. Vodzak*, A. G. Remeika*, Scott M. Wasilko*, and **D. M. Reeder**. Response to capture varies by reproductive state but not capture method in little brown bats (*Myotis lucifugus*). Presented at the 2008 annual meeting of the American Society of Mammalogists, Brookings, South Dakota.

R. Jacob*, and D. M. Reeder. Immune function during hibernation in big brown bats (*Eptesicus fuscus*). Presented at the 2008 annual meeting of the American Society of Mammalogists, Brookings, South Dakota.

D. M. Reeder. Eco-immunology in bats. June 2008. Presented at the White Nose Syndrome conference, Albany, NY.

B. L. Pearson*, P. G. Judge, **D. M. Reeder**, and L. Smart*. Salivary cortisol and self-directed behavioral responses to short-term crowding in hamadryas baboons (*Papio hamadryas hamadryas*). Presented at the 2007 annual meeting of the American Society of Primatologists.

D. M. Reeder, S. M. Wasilko*, C. J. Ostroski*. Is capture in harp traps stressful to little brown bats (*Myotis lucifugus*)? Presented at the 2007 annual meeting of the North East Bat Working Group Annual Meeting, North Branch, NJ.

D. M. Reeder. Bats of Pennsylvania. January 2007. Presented to the Seven Mountains Audubon Society.

D. M. Reeder, C. J. Ostroski*, H. L. Rogers*, T. H. Kunz, and E. P. Widmaier. Male-male competition across the breeding season in the Malayan Flying Fox (*Pteropus vampyrus*). Presented at the 2006 annual meeting of the American Society of Mammalogists.

D. M. Reeder. Comparative Ecophysiology in Bats: Seasonal and Stress-responsive Changes in Glucocorticoid Hormones. Presented at the 2006 annual meeting of the North East Bat Working Group Annual Meeting, East Stroudsburg University, PA.

D. M. Reeder, K. M. Helgen, and D. E. Wilson. 270 new mammal species described since 1993: Who, what, when, where, and why. Presented at the 2005 annual meeting of the American Society of Mammalogists, Amherst, MA.

D. M. Reeder, T. H. Kunz, and E. P. Widmaier. 2004. Behavioral and physiological responses to group formation in the Malayan Flying Fox (*Pteropus vampyrus*) vary by sex and group type. Presented at the 2004 annual meeting of the Society for Integrative and Comparative Biology.

D. M. Reeder. 2003. Behavioral endocrinology of reproduction in bats: changes in glucocorticoid hormones and social influences on endocrine and immune function. Invited speaker for the seminar series in Integrative Reproductive Biology, University of Florida, Gainesville, Florida.

D. M. Reeder, N. S. Kosteczko*, T. H. Kunz, and E. P. Widmaier. 2003. Baseline and Stress-Induced Glucocorticoid Hormone Levels in Free-Ranging Little Brown Myotis (*Myotis lucifugus*) During the Active Period. Presented at the 2003 annual North American Symposium for Bat Research.

D. M. Reeder, N. S. Kosteczko*, T. H. Kunz, and E. P. Widmaier. 2003. Changes in baseline and stress induced glucocorticoid levels during the active period in free-ranging male and female little brown bats. Presented at the 2003 annual meeting of the American Society of Mammalogists.

D. M. Reeder, E. P. Widmaier, T. H. Kunz. 2002. The Hormonal and Behavioral Response to Group Formation and Acute Stress in the Solitary Little Golden-Mantled Flying Fox (*Pteropus pumilus*). Presented at the 2002 annual North American Symposium for Bat Research.

D. LeBlanc, **D. M. Reeder**, N. S. Kosteczko*. 2002. Individual Marking of Captive Flying Foxes for Behavioral Observations. Presented at the 2002 annual North American Symposium for Bat Research.

N. S. Kosteczko*, **D. M. Reeder**, and T. H. Kunz. 2002. Social Preferences and Sociability of the Solitary Little Golden-mantled Flying Fox (*Pteropus pumilus*) and the Social Island Flying Fox (*P. hypomelanus*). Presented at the 2002 annual North American Symposium for Bat Research.

D. M. Reeder. 2002. Social Behavior in the Monogamous Titi Monkey (Callicebus): Hormonal Changes Across Major Reproductive Events. Presented at the University of Virginia.

D. M. Reeder, E. P. Widmaier, T. H. Kunz. 2002. Stress responsiveness in the solitary little golden-mantled flying fox (*Pteropus pumilus*): Glucocorticoids, testosterone, and behavior. Presented at the 2002 annual meeting of the Society for Behavioral Neuroendocrinology.

D. M. Reeder, S. P. Mendoza, C. Schradin, W. A. Mason, and G. Anzenberger. 2001. Behavioral and hormonal components of paternal care in the monogamous titi monkey (*Callicebus moloch*). Presented at the 2001 annual meeting of the Society for Behavioral Neuroendocrinology.

D. M. Reeder. 2000. Social Behavior in the Monogamous Titi Monkey (*Callicebus moloch*): Hormonal Changes Across Major Reproductive Events. Invited speaker for the Anthropology colloquium for 2000, Anthropology Institute and Museum, University of Zurich, Switzerland.

D. M. Reeder, C. Schradin, S. P. Mendoza, W. A. Mason, and G. Anzenberger. 2000. Behavioral and hormonal components of paternal care in the monogamous titi monkey (*Callicebus moloch*). Presented at the 2000 annual meeting of the American Society of Mammalogists.

D. M. Reeder, S. P. Mendoza, and W. A. Mason. 1999. Social Behavior in the Monogamous Titi Monkey (*Callicebus moloch*): Hormonal Changes Across Major Reproductive Events. Presented as a part of the Seminar Series in Animal Behavior at the University of California at Davis.

D. M. Reeder. 1999. Why be monogamous? Lessons from birds and mammals. Public Lecture. UC Davis Summer Sessions Faculty Speaker Series.

D. M. Reeder, S. P. Mendoza, and W. A. Mason. 1999. Regulation of Paternal Care in the Monogamous Titi Monkey (*Callicebus moloch*): Alterations of Hypothalamic-Pituitary-Adrenal Responsiveness. Presented at the 1999 annual meeting of the Society for Behavioral Neuroendocrinology.

D. M. Reeder, S. P. Mendoza, and W. A. Mason. 1999. Behavioral and Physiological Components of Parental Care in the Monogamous Titi Monkey (*Callicebus moloch*). Presented at the 1999 annual meeting of the American Society of Mammalogists.

D. M. Reeder, S. P. Mendoza, and W. A. Mason. 1998. Social behavior and sexual motivation across the reproductive cycle in titi monkeys (*Callicebus moloch*): Concealment or communication of ovulation? Presented at the 1998 annual meeting of the American Society of Primatologists.

D. M. Reeder, C. R. Valverde, and S. P. Mendoza. 1998. Assessing the anti-fertility properties of intrauterine neem treatment in titi monkeys (*Callicebus moloch*). Presented at the 1998 annual meeting of the American Society of Primatologists.

K. Moody, J. Norcross, D. Bernhards, **D. Reeder**, J. Zehr, and J.D. Newman. 1994. Common Marmoset Colony: Management, Maintenance, and Monkey Business. Presented at the symposium on the Primate Family Callitrichidae.

F. R. Cole, **D. M. Reeder**, and D. E. Wilson. 1993. Distribution Patterns and the Conservation of Mammal Species. Presented at the 1993 annual meeting of the American Society of Mammalogists.

D. E. Wilson and **D. M. Reeder**. 1993. Mammal Species of the World – A Multimedia Approach. Presented at the 1993 annual meeting of the American Society of Mammalogists.

D. E. Wilson and **D. M. Reeder**. 1992. Mammal Species of the World – The Sequel. Presented at the 1992 annual meeting of the American Society of Mammalogists.

PROFESSIONAL ASSOCIATIONS

American Society of Mammalogists (Life Member)
North American Society for Bat Research

EXHIBIT I

Comments of Harvey M. Katz, Ph.D.
July 8, 2011

I am an aquatic biologist with Masters and Doctoral degrees in fisheries biology. As indicated in my CV, which is attached to these comments, my 28-year career as a fisheries biologist included work for the U.S. Fish and Wildlife Service and as an adjunct assistant professor of biology.

I have reviewed the Environmental Assessment (EA) submitted to the Federal Energy Regulatory Commission (FERC) by Central New York Oil and Gas Company LLC (CNYOG) in support of the proposed MARC I Hubline. Based on my professional experience, the EA's assessment of impacts on fish and aquatic environment at its proposed water crossings is deficient.

First, the EA fails to use existing science and guidance in assessing impacts. There are long-standing methodologies developed by biologists to measure the effect of human activity on the natural environment. The Index of Biotic Integrity (IBI) (Karr 1981), for instance, is "an effective and adaptable tool, capable of detecting changes in the biological integrity of surface waters" (Grabarkiewicz and Davis 2008). In general, the IBI evaluates changes in fish assemblages, using an integrated multimetric approach based on two fundamental community characteristics: (1) species composition and richness and (2) ecological factors. These two characteristics can be further broken down into seven overarching community traits: (a) species richness, (b) species composition, (c) presence of indicator species, (d) trophic function, (e) fish abundance, (f) reproductive function, and (g) reproductive condition. In addition to the IBI, the U.S. Environmental Protection Agency (EPA) has provided guidance on using freshwater fishes as biological indicators (Grabarkiewicz and Davis 2008).

The EA's failure to utilize and consider well-established science and guidance in assessing the Project's impacts on fisheries is notable. At a minimum, I recommend that the IBI and the protocol outlined in Grabarkiewicz and Davis be followed in determining the Project's impacts. Alternatively, a complete and comprehensive Environmental Impact Statement should be produced to describe how the MARC I Hubline will affect these aquatic communities and ecosystems.

The EA's fisheries analysis is further deficient because it lists five species of "representative game species known to occur in the project area within the Susquehanna River Basin" (EA at 38). Of these five species, three are not relevant – Channel Catfish, Walleye, Muskellunge – because they are either not present or are only incidental (not common) in the waters that the Project would impact. On the other hand, nine species of fish that are common to the headwaters of the Susquehanna River, whose tributaries would be affected by the MARC I Hubline, are not mentioned in the EA:

- Rainbow Trout
- Brook Trout

- Longnose Dace
- Margined Madtom
- Tessellated Darter
- Banded Darter
- Shield Darter
- Mottled Sculpin
- Slimy Sculpin

These species of fish not only are common to the headwaters of the Susquehanna River (Cooper 1983) but they are among the more sensitive to and intolerant of environmental perturbations (Grabarkiewicz and Davis 2008). If the MARC I pipeline is installed as currently proposed, it is these species that will be the first to demonstrate the impact of the pipeline's intrusion into their environment. An analysis that does not even consider the Project's impacts on these species is incomplete.

Finally, another significant deficiency in the EA's fisheries analysis is its failure to consider impacts on macrobiotic organisms, many of which are insects, and which form the food base for larger aquatic organisms (fish, amphibians, etc.).

For all of these reasons, and based on my expertise, I disagree with the EA's assessment and conclusion that the Project will have no significant impacts on fisheries and the aquatic environment.

Literature Cited:

Cooper, E.L. (1983). Fishes of Pennsylvania and the Northeastern United States, The Pennsylvania State University Press, PA. 243 pp.

Grabarkiewicz, J.D. and Davis, W.S. (2008). An Introduction to Freshwater Fishes as Biological Indicators, EPA-260-R-08-016 November 2008. 79 pp.

Karr, J.R. (1981). Assessment of biotic integrity using fish communities. Fisheries 6(6):21-27.

HARVEY M. KATZ

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phone: 570.433.4681 email: katzhm@verizon.net

Education

Ph.D.	Fisheries Biology	University of Massachusetts	1976
M.S.	Fisheries Biology	University of Massachusetts	1974
B.S.	Biology	Monmouth University	1961

Professional Experience

1989 - present	Independent Consultant, Presenter, Speaker, Writer
1987 – 1989	Assistant Professor of Biology, Indiana University of Pennsylvania
1981 – 1987	Visiting Scholar & Environmental Institute Director. Drew University
1976 – 1981	Corporate Senior Consulting Biologist, Envirosphere (NY City)
1969 – 1976	Research Assistant, University of Massachusetts
1964 – 1969	US Fish & Wildlife Service Biologist, Sandy Hook (NJ) Marine Laboratory
1962 – 1964	Biology Laboratory Director, Monmouth University

Scholarly/Professional Activity (Selected examples noted)

* Invited presenter at workshops & professional/technical meetings.
* Published and presented refereed papers, abstracts, articles and essays.
* Consultant to environmental, civic, community, professional, higher education organizations.
* Prepared corporate reports

EXAMPLES

Papers & Presentations:

- Katz, H.M., *et al*. A large experimental aquarium system for marine pelagic fishes. Trans. Amer. Fish. Soc. (1967) 96. 143–150.
- Katz, H.M. *et al.* Use of an environmental quality index for understanding & management of aquatic habitats. Fisheries Society of the British Isles International Meeting (1985).
- Katz, H.M., *et al.* Quantification of tributary effect on pollution abatement. Annals NY Acad. Sci. (1987) 494, 430-431.

Consultantships:

- American Littoral Society. Critical review of Historic Smithville Development Corporation's environmental impact statement on effects of water quality.1982.
- Upper Rockaway River Watershed Association (NJ). Suitability of Rockaway River for trout. 1982.
- Harding Township (NJ) Environmental Commission. Harding Plaza proposal environmental impact- critical analysis. 1984.

Corporate Reports:

- Envirosphere Company – prepared for Jersey Central Power & Light Company. Annual adult equivalent loss of fish. 1979.
- Envirosphere Company – prepared for US Dept. of Energy. Synthesis gas demonstration plant (Baskett, KY) – environmental report. 1979.

Supported Projects (Selected examples noted)

* Grants, fellowships, major gifts and in-kind support.

EXAMPLES

- Grants: $71,800 Geraldine R. Dodge Fdn. Ecology of Great Swamp & Rockaway River, NJ. 1983-1985
- Grant: $ 5,000 Earthwatch/Center for Field Research. 1982
- Grant: $2,500 NJ Dept. Envirnonmental Protection. 1983

Other

* Member American Fisheries Society (1966 – present)
* Pennsylvania Forest Steward (2001 – present)
* Steering Committee: Susquehanna River Conservation Plan – Lower West Branch
* Founding member/Board Treasurer: Coalition for Responsible Growth & Resource Conservation (CRGRC)
* Lt. Colonel, US Army Reserve (retired 1989)
* Private Pilot
* Publisher of aviation publication (retired 1999)

EXHIBIT J

July 11, 2011

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, NE, Room 1A
Washington, DC 20426

Re: Comments on the Environmental Assessment of the MARC I Hub Line Project,
Docket number CP10-480-000

Dear Ms. Bose:

I am writing in regard to the MARC I project proposed by the Central New York Oil and Gas Company. This project would most assuredly have a significant environmental impact. As such, the project warrants a full Environmental Impact Statement prepared by your agency.

Your agency's initial Environmental Assessment overlooked key impacts such as:

- crossing of native trout streams;
- the cumulative environmental impacts of the numerous gas wells expected as a result of the MARC I line;
- water quality degradation due to pipeline construction very close to active and former coal mining areas and other contaminated sites;
- habitat degradation from forest fragmentation;
- degradation of scenic and recreational resources and associated economic impacts to the region's tourism economy.

Currently, my research team at Susquehanna University in conjunction with the Pennsylvania Fish and Boat Commission is surveying previously unassesed streams within a 6 mile buffer of the proposed pipeline.

To date we have found wild trout within the following previously unassessed watersheds:

Watershed	**Latitude &**	**Longitude of Mouth**	**Species**
Payne Run	41.515794	-76.410342	Brown & Brook Trout
Rock Run	41.506765	-76.514563	Brook Trout
Rock Run	41.466204	-76.433589	Brook Trout
Dutchman Run	41.450288	-76.451210	Brook Trout
Mill Run	41.462448	-76.487164	Brook Trout
Bear Run	41.463516	-76.501161	Brook Trout
Conklin Run	41.419624	-76.482971	Brook Trout
Sand Run	41.429130	-76.487667	Brook Trout
Lopez Pond Br.	41.379266	-76.400558	Brook Trout
South Branch	41.37861	-76.404167	Brook Trout
Rock Run	41.378887	-76.411942	Brook Trout

Watershed	Latitude &	Longitude of Mouth	Species
Tublick Run	41.382778	-76.431114	Brook Trout
Peters Creek	41.382500	-76.437775	Brook Trout
Big Run	41.380001	-76.444168	Brown Trout
Cherry Run	41.374168	-76.467224	Brook Trout
Long Brook	41.369720	-76.488052	Brook Trout
Slip Run	41.356388	-76.533890	Brook & Brown Trout
Santee Creek	41.47180	-76.25871	Brook Trout
Sherman Run	41.454435	-76.351945	Brook trout
Yellow Run	41.507486	-76.504345	Brook and Brown Trout

More time is needed for PA Fish and Boat Commission to determine the classification of these Wild Trout Streams that were previously unassessed at the time of FERCs initial Environmental Assessment.

The status of these streams was previously unknown before FERC's initial Environmental Assessment. These streams are now known to contain wild trout populations. As a result of this new information, a full EIS is needed.

In addition, several other streams with previously unknown status are also being looked at within the MARC 1 corridor. It is vital that this work on these unassessed waters in the MARC 1 corridor be completed prior a decision on the permit application.

Sincerely,

Jonathan Niles, Ph.D.

Named Unnassessed Streams – Wyalusing Creek basin
HUC10: North Branch Wyalusing Creek

List provided by: Robert Weber, Biologist, PA Fish and Boat Commission

		Mouth		
Watername	**Tributary to**	**Latitude**	**Longitude**	**Listed?**
Bennett Creek	Wyalusing Creek	41.756944	76.180000	N

Named Unassessed Streams – Tuscarora Creek (4D)
HUC10: Tuscarora Creek (0205010614

		Mouth		
Watername	**Tributary to**	**Latitude**	**Longitude**	**Listed?**
North Branch Sugar Run	Sugar Run	41.637222	76.295278	N
Rock Cabin Run	Sugar Run Creek	41.591389	76.237778	N
Mill Creek	Tuscarora Creek	41.699444	76.134167	N
Dug Road Creek	Tuscarora Creek	41.701667	76.133333	N

Named Unassessed Streams – Towanda Creek (4C)
HUC10: North Branch Towands Creek

		Mouth		
Watername	**Tributary to**	**Latitude**	**Longitude**	**Listed?**
French Creek	South Br Towanda Creek	41.588889	76.431944	N
Bowman Creek	South Br Towanda Creek	41.569722	76.396944	N

Named Unassessed Streams – Mehoopany Creek (4G)
HUC10: North Fork Mehoopany Creek (0205010609)

		Mouth		
Watername	**Tributary to**	**Latitude**	**Longitude**	**Listed?**
Cherry Ridge Run	Mehoopany Creek	41.391989	76.275556	N
Red Brook	Stony Brook	41.476389	76.184444	N
Scouten Brook	Mehoopany Creek	41.484722	76.135556	Y
White Brook	Mehoopany Creek	41.498611	76.129722	N
Smith Cabin	North Br Mehoopany Creek	41.526944	76.283611	N

Named Unnassessed Streams – Little Loyalsock Creek basin
HUC10: Little Loyalsock Creek

		Mouth		
Watername	**Tributary to**	**Latitude**	**Longitude**	**Listed?**
Marsh Run	Little Loyalsock Creek	41.522839	76.403824	N*
- No trout, however we sampled an un-named trib to this located at 41.53446, -76.39728. This tributary had 1 Brown Trout length 234mm				
Payne Run	Little Loyalsock Creek	41.515794	76.410342	N*
- 2 Brown trout (125-149mm) and 1 brook trout (225-249mm)				
Wampole Run	Little Loyalsock Creek	41.504556	76.459133	N*
- 2 Brown Trout (125-149mm)				
Lick Creek (Cherry Mills)	Little Loyalsock Creek	41.508037	76.466668	N*
- 3 Brown Trout (3 over 200mm)				
Mill Creek	Little Loyalsock Creek	41.508694	76.488470	N*
- 1 Brook Trout (184mm)				
Yellow Run	Little Loyalsock Creek	41.507486	76.504345	N*
- Brook and Brown Trout				
- over 60 trout, 30 were more than 6 inches(150mm), 15 of which were more than 7 inches (175mm)				
Rock Run	Little Loyalsock Creek	41.506765	76.514563	N*
- 64 Brook Trout pass 1				
- 17 brook trout pass 2				
- 11 brook trout pass 3				
300m sampled, avg width 4.1m				

Named Unnassessed Streams – Upper Loyalsock Creek basin (Source to Ltl Loyalsock Creek)
HUC10: Loyalsock Creek

		Mouth		
Watername	**Tributary to**	**Latitude**	**Longitude**	**Listed?**
Rocky Run	Santee Creek	41.462327	76.280982	N
- No trout pH was 4.88				
Santee Creek	Loyalsock Creek	41.453889	76.288889	N*
- No trout at mouth with Loyalsock, did a 2nd site.				
- 3 Brook trout (108,200,47mm) - sampled at 41.47180, -76.25871				
Pigeon Creek	Loyalsock Creek	41.460395	76.323290	N*
Snorting Buck Hollow	Painter Den Creek	41.389374	76.358368	N
Spring Brook	Painter Den Creek	41.401573	76.331272	N
Bear Swamp Run	Wolf Run	41.393025	76.310042	N
Painter Den Creek	Lopez Creek	41.431279	76.323798	N
Cabin Run	Lopez Creek	41.432279	76.321519	N
Lopez Creek	Loyalsock Creek	41.458744	76.334121	N*
- 3 Brook Trout (1 over 200mm)				

Waternname	Tributary to	Mouth Latitude	Mouth Longitude	Listed?
Sherman Run	Loyalsock Creek	41.454435	76.351945	N*
- 5 Brook trout				
Ellis Creek	Loyalsock Creek	41.450229	76.376372	N*
- 2 Brook Trout				
Floodwood Creek	Loyalsock Creek	41.450639	76.436829	N*
Rock Run	Birch Run	41.466204	76.433589	N*
- 5 brook trout (4>125mm)				
- 110m length, 5.8 avg width				
Dutchman Run	Loyalsock Creek	41.450288	76.451210	N*
- 2 brook trout	100m length, 6.4m avg width			
Mill Run	Loyalsock Creek	41.462448	76.487164	N*
- 2 brook trout	102m length, 6.8m avg width			
Bear Run	Loyalsock Creek	41.463516	76.501161	N*
- 19 brook trout pass 1 (3>125mm)				
- 101m length, 4.4m avg width				
Conklin Run	Lake Mokoma	41.419624	76.482971	N*
- 4 brook trout (3>125mm)				
- 103m length, 4.1m avg width				
Sand Run	Mill Creek	41.429130	76.487667	N*
- 6 brook trout (2> 125mm)				
- 100m length, 2.2m avg width				
Mill Creek	Loyalsock Creek	41.459999	76.510559	Y*
- 3 Brook trout (140,214,239 mm)				
- 101 m length, 5.4 m avg width				
Coal Run	Loyalsock Creek	41.460794	76.521589	N*
- 12 brook trout (1>125mm)				
- 105 m length, 1.7m avg width				

Named Unnassessed Streams – East Branch Fishing Creek basin (5C)
HUC10: East Branch Fishing Creek

Waternname	Tributary to	Mouth Latitude	Mouth Longitude	Listed?
Deep Hollow	West Branch Fishing Creek	41.309444	76.482500	N
Big Run	West Branch Fishing Creek	41.299444	76.457778	N
Gallows Run	West Branch Fishing Creek	41.337778	76.430833	N

Named Unnassessed Streams – Little Muncy Creek basin
HUC10: Little Muncy Creek

Mouth

Watername	Tributary to	Latitude	Longitude	Listed?
Buck Run	Little Muncy Creek	41.257127	76.504899	N
West Creek	West Branch Ltl Muncy Ck	41.269265	76.528552	N
West Branch Ltl Muncy Ck	Little Muncy Creek	41.251265	76.533101	N
Little Indian Run	Little Muncy Creek	41.242500	76.560837	Y
Marsh Run	Beaver Run	41.269734	76.591841	N
Beaver Run	Little Muncy Creek	41.239920	76.603231	N
Big Run	Little Muncy Creek	41.231676	76.609234	N
Jakes Run	Little Muncy Creek	41.209291	76.634116	N
German Run	Little Muncy Creek	41.197219	76.637700	N
Broad Run	Little Muncy Creek	41.186524	76.669396	N

Named Unnassessed Streams – Muncy Creek basin

HUC10: Muncy Creek

Watername	Tributary to	Mouth Latitude	Mouth Longitude	Listed?
Lopez Pond Branch	Muncy Creek	41.379266	76.400558	Y
- 20 brook trout pass 1. Vary in size from YOY to 165mm. - 100m length, avg width 2.3m				
South Branch	Muncy Creek	41.378613	76.404167	Y
- 22 Brook trout (2 were 150-174, 1 was 175-200, 4 were 100-150, rest were YOY 100m site length, avg width 1.7m				
Dry Hollow	Muncy Creek	41.379166	76.407501	Y
- Very little water - No trout - pH 6.34, temp 14.7 C				
Rock Run	Muncy Creek	41.378887	76.411942	Y
- Very little water - 2 Brook Trout (102 and 146mm) - 102m site length avg width 1.0m				
Tublick Run	Muncy Creek	41.382778	76.431114	Y
- 11 trout (1 over 150mm) - 102 m site length				
Peters Creek	Muncy Creek	41.382500	76.437775	Y
- 304m site - 3 passes - 75 trout total (16 over 150mm)				
Big Run	Muncy Creek	41.380001	76.444168	Y
- 1 Brown Trout (243mm) - 101 m site				

Watername	Tributary to	Mouth Latitude	Mouth Longitude	Listed?
Cherry Run	Muncy Creek	41.374168	76.467224	Y

- 302 m site
- 3 passes
- 65 brook trout (3 over 175mm)

Long Brook	Muncy Creek	41.369720	76.488052	Y

- 102 m site
- 6 brook trout (3 over 200 mm, 2 175-200mm)

Slip Run	Muncy Creek	41.356388	76.533890	Y

- 107 m site
- 9 Brook trout (3 over 225mm)
- 1 brown Trout (172mm)

Mackeys Run	The Outlet	41.385357	76.592059	Y
Mosey Run	Big Run (Sonestown)	41.361389	76.552498	Y
Spring Run	Muncy Creek	41.319975	76.620611	N
Lick Run	Muncy Creek	41.308056	76.663056	N
Little Sugar Run	Sugar Run	41.233654	76.699505	N
Sugar Run	Gregs Run	41.228234	76.714337	N
Gregs Run	Muncy Creek	41.221469	76.719557	N

JONATHAN M. NILES

Curriculum Vitae

A. BIOGRAPHICAL INFORMATION:

Addresses

Susquehanna University
Department of Biology
210C New Science Building
514 University Avenue
Selinsgrove, PA 17870

niles@susqu.edu
office phone (570) 372-4707
cell. phone (304) 288-8879
fax (570) 372-2752

Education

Ph.D. Forest Resources Science: Fisheries Resources, West Virginia University, May 2010
Dissertation title: Brook trout response to canopy and large woody debris manipulations in Appalachian streams.

M.S. Fisheries and Wildlife Resources, West Virginia University, December 2004.
Thesis title: Larval Fish Use of Experimental Rock Structures in the Kanawha River, West Virginia.

B.A. Biology, St. Mary's College of Maryland, May 2000.

Employment

Susquehanna University, Visiting Assistant Professor, August 2010-present
West Virginia University, Post-Doctoral Researcher, Jan. 2010-August 2010
West Virginia University, University Fellow, 2009
West Virginia University, Graduate Research Assistant, 2002-2008
West Virginia University, Graduate Teaching Assistant, Biology, 2001-2002
Environmental Scientist, American Land Concepts, 2001
Natural Resource Biologist I, Maryland Department of Natural Resources, 2000

B. TEACHING

Courses Taught

Spring 2011
Systematic Biology, Susquehanna University, 22 students
Issues in Biology: Environmental Biology, Susquehanna University, 25 students
Issues in Biology Lab: Environmental Biology, Susquehanna University, 25 students

Fall 2010
Ecology, Evolution, and Heredity, Susquehanna University, 21 students
Ecology, Evolution, and Heredity Lab, Susquehanna University, 17 students

Introduction to Ecology, Susquehanna University, 23 students
Fall 2009
Environmental biology, West Virginia University, 12 students

Summer 2009
Marine ecology, West Virginia University, 12 students

Spring 2008
Wildlife ecosystem ecology, West Virginia University, 42 students

Summer 2007
Marine ecology, West Virginia University, 11 students

Spring 2002
Introduction to biology, West Virginia University, 4 sections, 24 students

Fall 2001
Introduction to biology, West Virginia University, 4 sections, 24 students

Recent Guest Lectures
Spring 2011
Limnology, St. Mary's College of Maryland, March 8, 2011

Fall 2010
BIOL 500: Disaster Impacts, Susquehanna University, November 18, 2010
Impacts of Hurricane Katrina on Gulf Coast Fisheries and Ecosystems, 1 lecture.
ENGL 100: Writing and Thinking, Susquehanna University, November 29, 2010
Introduction to scientific writing, 2 lectures.

Spring 2010
Wildlife ecosystem ecology, West Virginia University, 4 lectures and 2 labs.
Advanced wildlife and fisheries management, West Virginia University, 2 lectures.
Forest wildlife management, West Virginia University, 2 labs.

Fall 2009
Wildlife and fisheries techniques, West Virginia University, 2 lectures and 2 labs.
Intro to fisheries management, West Virginia University, 1 lecture and 1 lab.

Spring 2009
Wildlife ecosystem ecology, West Virginia University, 2 lectures and 2 labs.

Fall 2008
Wildlife and fisheries techniques, West Virginia University, 2 lectures and 2 labs.

C. RESEARCH

Research Grants

Unassessed Water's Initiative Support. The Foundation for Pennsylvania Watersheds. $10,000. May 2011.

Undergraduate Research Partner Program. The Degenstein Foundation. $7,405. May 2011.

Aquatic Ecology Research Enhancement Grant. The Degenstein Foundation. $10,225. May 2011.

Pennsylvania's Unassessed Water's Initiative. Pennsylvania Fish and Boat Commission. $5,000. April 2011.

Faculty Research Grant. Susquehanna University. $2,600. April 2011.

Faculty Technology Grant. Susquehanna University. $2,500. February 2011.

Pennsylvania's Unassessed Water's Initiative. Summer Research Partners Program. Susquehanna University. $2,860. February 2011.

Mahatango Creek watershed assessment. Summer Research Partners Program. Susquehanna University. $2,860. February 2011.

Faculty Mini Grant. Susquehanna University. $1,000. February 2011.

D. PUBLICATIONS

Articles in peer-reviewed journals:

Hafs, A.W., **J. M. Niles,** and K. J. Hartman. (In Press) Efficiency of Gastric Lavage on Age-0 Brook Trout (*Salvelinus fontinalis*) and the Influence on Growth and Survival. North American Journal of Fisheries Management.

Niles, J. M. and K. J. Hartman. 2011. Temporal distribution and taxonomic composition differences of larval fish in a large navigable river: a comparison of artificial dike structures and natural habitat. River Research and Applications. 27(1):23-32.

Sweka, J. A., K. J. Hartman, and **J. M. Niles**. 2010. Long-term effects of large woody debris addition on stream habitat and brook trout populations. Journal of Fish and Wildlife Management. 1(2):146-151.

Niles, J. M. and K. J. Hartman. 2009. Larval fish use of artificial rock structures on a navigable river. North American Journal of Fisheries Management. 29:1035-1045.

Niles, J. M. and K. J. Hartman. 2007. Comparison of three larval fish gears to sample shallow water sites on a navigable river. North American Journal of Fisheries Management. 27:1126-1138.

Articles in Review:

Niles, J. M., K. J. Hartman, and P. D. Keyser. (In Review) Short-term effects of beaver dam removal on brook trout in an Appalachian headwater stream. Northeastern Naturalist.

Studinski, J. M., K. J. Hartman, **J. M. Niles**, and P. D. Keyser. (In review) The effects of riparian timber harvest and large woody debris addition on stream temperature, sedimentation, and morphology. Hydrobiologia.

Articles in preparation:

Niles, J. M. and K. J. Hartman. The effect of riparian canopy removal and large woody debris additions on brook trout populations in central Appalachian streams.

Niles, J. M. and K. J. Hartman. Terrestrial invertebrate inputs to Appalachian streams after riparian canopy removal and their importance to brook trout.

Studinski, J., **J. M. Niles,** and K. J. Hartman. Selective foraging of terrestrial invertebrates by brook trout in an headwater stream.

Non-refereed Published Reports:

Niles, J. M., and R.W. Paul. April 2000. A study of imperviousness in Hilton Run, St. Mary's County, Maryland and its impact on biotic integrity. For: Department of Biology, St. Mary's College of Maryland, St. Mary's City, MD.

Published Abstracts:

Niles, J. M and K. J. Hartman. 2007. Brook trout response to canopy and large woody debris manipulations in Appalachian streams. Proceedings of the Sixty-first Annual Conference of the Southeastern Association of Fish and Wildlife Agencies. 61:110.

Niles, J. M. A study of imperviousness in Hilton Run, St. Mary's County, Maryland and its impact on biotic integrity. In: Paul, R.W. and Tanner, C.E. 2002. The St. Mary's River Project: Preserving Maryland's Legacy, Final Report Year 2. Report to U.S. H.U.D.; Grant # B-00-SP-MD-0450.

Niles, J. M. A study of imperviousness in Hilton Run, St. Mary's County, Maryland and its impact on biotic integrity. In: Paul, R.W. and Tanner, C.E. 2001. The St. Mary's River Project: Preserving Maryland's Legacy, Final Report Year 1. Report to U.S. EPA; Grant # X-983090-01.

E. PROFESSIONAL PRESENTATIONS

Invited:

Niles, J. M. 2011. Riparian forest and stream interactions: The importance of terrestrial invertebrates to brook trout in Appalachian streams. Invited speaker. Natural Science and Mathematics Colloquium. St. Mary's College of Maryland.

Niles, J. M. 2011. A modified method to determine feeding ecology of young-of-year salmonids in Appalachian streams. Invited lecture. Department of Environmental Policy, University of California-Davis.

Niles, J. M., A. W. Hafs, and K. J. Hartman. 2010. Feeding ecology of young-of-year brook trout in Appalachian headwater streams. Headwater Streams 4 Symposium, Annual meeting of the American Fisheries Society, Pittsburgh, PA, September 12-16, 2010.

Niles, J. M. and K. J. Hartman. 2009. Riparian timber harvest using BMP's as a potential management tool for brook trout habitat enhancement in Appalachian headwater streams. Headwater Streams III Symposium, Annual meeting of the American Fisheries Society, Nashville, Tennessee, August 31-September 4, 2009.

Niles, J. M., K. J. Hartman, and B. K. Keplinger. 2008. Appalachian brook trout and their dietary analysis and their linkage to riparian zone manipulation. Headwater Streams Symposium, Annual meeting of the American Fisheries Society, Ottawa, Ontario, Canada, August 17-21, 2008

Niles, J. M. and K. J. Hartman. 2007. Role of geology, habitat and landscape features in structuring brook trout populations in headwater streams. Headwaters at the Nexus Symposia, Annual meeting of the American Fisheries Society, San Francisco, California, September 2-7, 2007.

Other presentations:

Niles, J. M. and K. J. Hartman. 2008. Brook trout response to canopy and large woody debris manipulations in Appalachian Streams. Annual meeting of the Southern Division of the American Fisheries Society, Wheeling, West Virginia, March 1-2, 2008.

Niles, J. M. and K. J. Hartman. 2007. Brook trout response to canopy and large woody debris manipulations in Appalachian Streams. Annual meeting of the Southeastern Association of Fish and Wildlife Agencies, Charleston, West Virginia, October 21-24, 2007.

Niles, J. M. and K. J. Hartman. 2005. Potential effects of canopy removal and large woody debris additions on brook trout. Annual meeting of the West Virginia Chapter of the American Fisheries Society. Flatwoods, West Virginia. February, 2005.

Niles, J. M. and K. J. Hartman. 2004. Larval Fish Use of Experimental Rock Structures in the Kanawha River, West Virginia. Annual meeting of the American Fisheries Society, Madison, Wisconsin, September, 2004.

Niles, J. M. and K. J. Hartman. 2004. Comparison of three larval fish gears to sample shallow water sites on a navigable river. Annual meeting of the West Virginia Chapter of the American Fisheries Society, Clarksburg, West Virginia, March, 2004.

Niles, J. M. and K. J. Hartman. 2003. Larval Fish Use of Experimental Rock Structures in the Kanawha River, West Virginia. Annual meeting of the West Virginia Chapter of the American Fisheries Society, Morgantown, West Virginia, April 24, 2003.

Niles, J. M. and K. J. Hartman. 2001. Rock Structures as Larval Fish Habitat in the Kanawha River, West Virginia. Annual symposium of the Wildlife Habitat Council, Washington D.C., November, 2001.

Posters:

Niles, J. M. and K. J. Hartman. 2007. Removal of a beaver pond and its effects on brook trout. Annual meeting of the West Virginia Chapter of the American Fisheries Society, Morgantown, West Virginia, February, 2007.

Niles, J. M. and K. J. Hartman. 2006. Removal of a beaver pond and its effects on brook trout. Annual meeting of the American Fisheries Society, Lake Placid, New York, September, 2006.

Niles, J. M. and K. J. Hartman. 2001. Rock Structures as Larval Fish Habitat in the Kanawha River, West Virginia. Annual symposium of the Wildlife Habitat Council, Washington D.C., November, 2001.

Organized sessions:
Co-chairman and organizer, Headwater streams symposia, AFS National Meeting 2010
Symposia organizer, Headwater streams III, AFS National Meeting 2009

F. HONORS AND AWARDS

West Virginia University Dissertation Fellowship, August 2009.
Skinner Memorial Travel Award, American Fisheries Society, August, 2008.
Hoyt Teaching Fellowship, Academic year 2007-2008, Division of Forestry and Natural Resources, West Virginia University
Robert E. Stitzel Graduate Student Support Award, August, 2007, Davis College of Agriculture, Forestry and Consumer Sciences. West Virginia University
Wildlife Habitat Council 13th Annual Symposium Scholarship Winner, November, 2001

G. SERVICE

University
Faculty-in-residence, Susquehanna University, 2010-2011
Head Coach, Susquehanna Men's Rugby Club, 2010-2011
Faculty advisor, Susquehanna Men's Rugby Club, 2010-2011
Head Coach, WVU Men's Rugby Club, 2005-2010
WVU Recreational Field Re-development Committee Member, 2008-2010
Treasurer, West Virginia University Chapter of the American Fisheries Society, 2004-2008

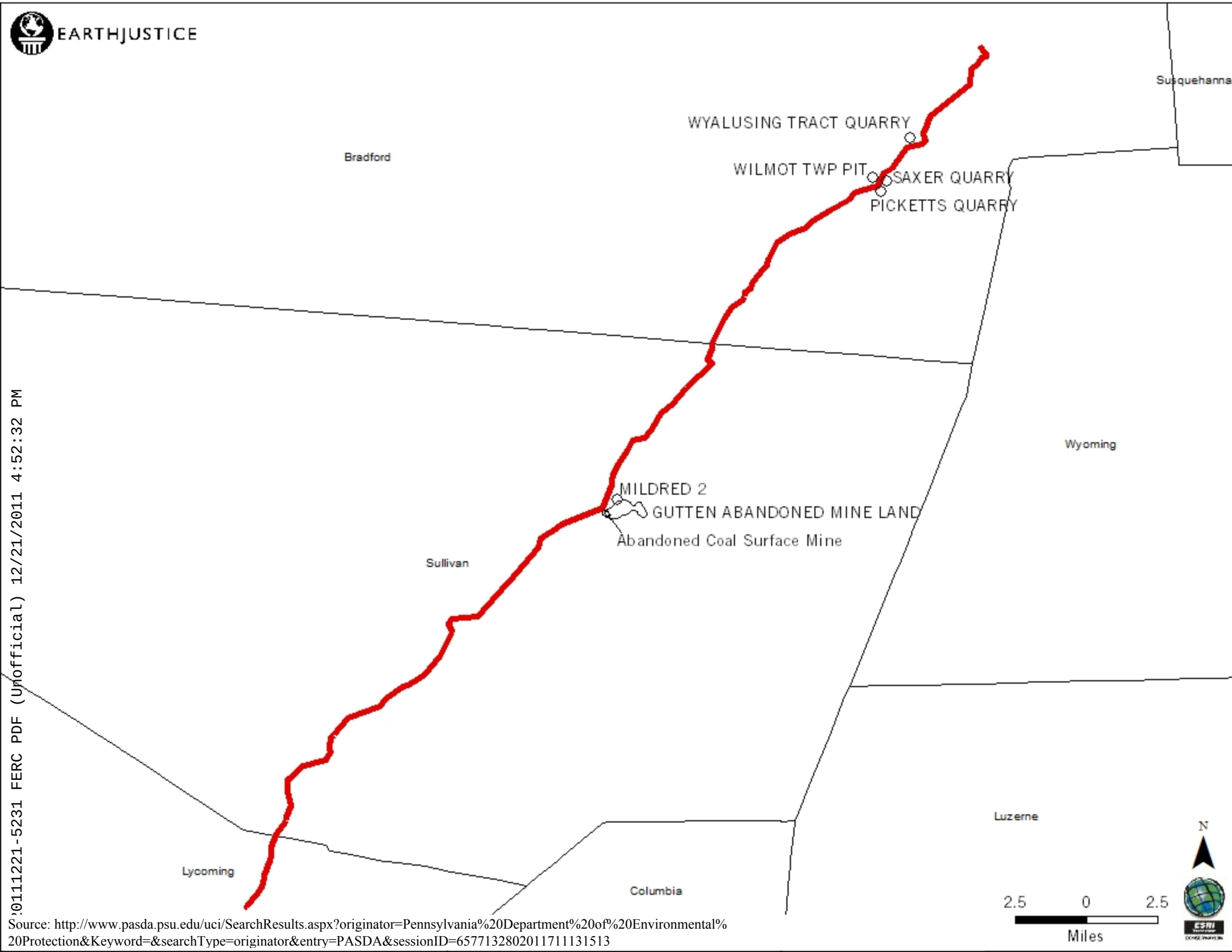
Professional
Best Paper Committee, North American Journal of Fisheries Management, 2008
Best Paper Committee, Transactions of the American Fisheries Society, 2008
Best Paper Committee, Transactions of the American Fisheries Society, 2007
Southern Division Rep., American Fisheries Society Student Education Subsection, 2007-2008

Manuscript reviews for 13 articles in 6 international journals: Hydrobiologia, Fisheries Management and Ecology, North American Journal of Fisheries Management, Transactions of the American Fisheries Society, Journal of Fish Biology, and Rivers Research and Applications

H. PROFESSIONAL MEMBERSHIPS

American Fisheries Society
American Fisheries Society Education Section
American Fisheries Society Student Subsection of Education Section
Pennsylvania Chapter of the American Fisheries Society

EXHIBIT K



Source: http://www.pasda.psu.edu/uci/SearchResults.aspx?originator=Pennsylvania%20Department%20of%20Environmental%20Protection&Keyword=&searchType=originator&entry=PASDA&sessionID=6577132802011711131513

EXHIBIT L

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION
NORTHCENTRAL REGIONAL OFFICE

December 30, 2010

CERTIFIED MAIL NO. 7010 0290 0003 1042 7709

Eric Schmidley
Science Applications International Corp.
180 Gordon Drive, Suite 110
Exton, PA 19341

Re: Comments to Corrective Action Workplan
XTO Marquardt Well Pad release
Penn Township, Lycoming County

Dear Mr. Schmidley:

The Department has reviewed the information submitted via e-mail on December 20, 2010 regarding the proposed work needed to address the November 16, 2010 release from the Maraquardt well pad of industrial wastewater from oil and gas operations. The Department has the following comments:

- Groundwater has been documented to be impacted by the sampling results of the spring discharge. As was discussed in both a Department's field inspection report and during the initial meetings at our office, monitoring wells are necessary to document the extent of impact to groundwater (waters of the Commonwealth). If you would like to perform the EM survey prior to the installation of the monitoring wells, in order to better locate the wells, that is acceptable, however the EM survey should be conducted as soon as possible, as the wells should be installed no later than February 15, 2011. In addition, a work plan with proposed well locations should be submitted to the Department no less then one week before the wells are to be installed. If the well locations are selected based on the EM data, the EM results should also be submitted as part of the Work Plan.

- The spring is contaminated above the in-stream criteria for surface water. This represents an ongoing discharge in violation of the Clean Streams Law. The spring should be monitored weekly until the levels meet in-stream criteria for chloride(250 ug/L). At that time the Department will entertain a request, in writing, to reduce the sampling frequency.

- The ongoing discharges from the spring also indicates that a source area for the chloride contamination remains present. Therefore additional soil should be removed from the drainage ditches and other areas where elevated chloride is present in order to abate the ongoing discharge

208 West Third Street | Suite 101 | Williamsport, PA 17701-6448

Phone 570.321-6525 | Fax 570.327.3420 www.depweb.state.pa.us

that is causing the violations. In our experience, sample analytical results below 1500 mg/kg chlorides will not adversely impact the environment or cause vegetative stress. We would recommend that this level be used as a screening level to guide the soil excavation. Following the excavation additional sampling should be conducted to document the chloride levels remaining in the soil. The Department should be notified 48 hours before the additional soil excavation begins. The soil excavation should be conducted by February 1, 2011

- The additional soil removal discussed above should occur before any liner systems are installed in the ditches.

- Any sampling data collected by XTO as part of their pre-drill sampling should be submitted for all residences near the Marquardt well pad that were previously identified as potentially impacted (the residences that were previously tested and supplied bottled water as a precaution). This information should be submitted to the Department by January 15, 2011.

- Copies of the truck hauling receipts for the liquids stored in the tank system at the well pad should be submitted to the Oil and Gas Program by January 15, 2011. Any other disposal receipts for the water and soil removed as part of the remediation should also be submitted to the Department, along with analytical results.

If you have any questions about the Department's expectations and time frames outlined above please feel free to contact me at 570.327.3779 or ldicello@state.pa.us.

Sincerely,

Laura M. DiCello
Geologic Specialist
Special Projects Section
Environmental Cleanup

Randy Farmerie, P.G.
Professional Geologist Manager
Special Projects Section
Environmental Cleanup

cc: Ben Kissel - XTO
Dave Engle
Jeremy Daniel
File

SENDER: *COMPLETE THIS SECTION*

- Complete items 1, 2, and 3. Also complete item 4 if Restricted Delivery is desired.
- Print your name and address on the reverse so that we can return the card to you.
- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to:

Eric Schmidley
Science Application
International Corp
180 Gordon Dr. Suite 110
Exton PA 19341

COMPLETE THIS SECTION ON DELIVERY

A. Signature

X Joanne E. Fryer ☐ Agent ☐ Addressee

B. Received by *(Printed Name)* C. Date of Delivery

D. Is delivery address different from item 1? ☐ Yes
If YES, enter delivery address below: ☐ No

3. Service Type
☑ Certified Mail ☐ Express Mail
☐ Registered ☑ Return Receipt for Merchandise
☐ Insured Mail ☐ C.O.D.

4. Restricted Delivery? *(Extra Fee)* ☐ Yes

7010 0290 0003 1042 7709

(Transfer from service label)

PS Form 3811, February 2004 Domestic Return Receipt 102595-02-M-1540

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208 West Third Street
Suite 101
Williamsport, PA 17701-6448

6D

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION
NORTHCENTRAL REGIONAL OFFICE

December 30, 2010

CERTIFIED MAIL NO. 7010 0290 0003 1042 7709

Eric Schmidley
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Sincerely,

Laura M. DiCello
Geologic Specialist
Special Projects Section
Environmental Cleanup

Randy Farmerie, P.G.
Professional Geologist Manager
Special Projects Section
Environmental Cleanup

cc: Ben Kissel - XTO
Dave Engle
Jeremy Daniel
File

Department of Environmental Protection	GENERAL INSPECTION REPORT	Environmental Cleanup Program

Name and Location of Facility or Site:	Entry Time Date:	Exit Time Date:
Marquardt Well Pad – XTO 301 Marquardt Road Hughesville, PA	12/30/10 1110	12/30/10 1155
	Site # 742279	Municipality: Penn Twp.
	PF # 736738	
	Inspection # 1939825	County: Lycoming

Name, Address of Responsible Official:	Title: EH&S Manager	
Mr. Ben Kissel XTO Energy 395 Airport Road Indiana, PA 15701	Telephone: 724-549-8287	Contact: X Yes ☐ No

OBSERVATIONS: The Department performed an inspection of the above referenced facility to document the current site status and to check the stockpiled soil pile that was generated from excavation activities. Minuteman personnel were onsite loading the stockpiled soil into roll-off containers and were taking it for proper disposal at a landfill. Most of the stockpiled soil had been loaded into roll-off containers and were awaiting transportation, except for what appeared to be approximately 2-3 roll-off containers worth of soil, which was still located on plastic.

The Department inspected the drainage ditches that had been excavated. Excavation appears to average approximately 1.5 feet in the drainage ditch and deeper in the drainage trenches that appear in locations where either a culvert or ditch turn is located. A pump was in place to remove water that gathered from the western side of the well pad. Standing water in the ditch was frozen at this time. Erosion material was placed on the western side of the well pad that was excavated to control erosion. It appeared that hoses were in place to pump water that gathered in the ditch nearest the farm field, but this hose was not completely connected to the pump on the well pad. The water in this ditch was also frozen at this time.

No excavation has taken place beyond the fenced farm field or the corn field.

A Corrective Action Work Plan (CAWP) was submitted to the Department. Based on the findings of that report and what was documented today, there are ongoing violations of the Pennsylvania Clean Streams Law and the Solid Waste Management Act for the soil, groundwater, and surface water contamination that occurred from a release of industrial wastewater from the Oil and Gas operations on November 16, 2010.

VIOLS – 602171, 602172, 602177

Inspector Name:	Inspector Signature:	Title:	Date:
Laura M. DiCello	Laura M. DiCello	Geologic Specialist	12/30/10
Name of Person Interviewed:	Signature of Person Interviewed:	Title:	Date:
---------- Will be	mailed to Ben Kissel at above --	address	----- - ------

Department of Environmental Protection	GENERAL INSPECTION REPORT	Environmental Cleanup Program

Name and Location of Facility or Site:	County	Municipality

ADDITIONAL OBSERVATIONS:

Inspector Name:	Inspector Signature:	Title:	Date:

5500-FM-OG0016a Rev. 5/2009

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
OIL AND GAS MANAGEMENT PROGRAM

INSPECTION REPORT

DEP USE ONLY	Inspection Record # 1939434
Complaint Record #	Enforcement Record #

DEP Office	Northcentral Regional Office	Phone: 570-327-3636	Permit or Reg. # 37-113-20025
Address	208 West Third Street, Suite 101	Fax: 570-327-3565	Project #
	Williamsport, PA 17701-6448		Farm Name & Well # Marquardt 1H
Operator Name	Chief Oil & Gas LLC		County Sullivan
Address	6051 Wallace Rd, Suite 210		Municipality Shrewsbury Township
	Wexford, PA 15090		Latitude: 41° 21' 10.03" N
	DEP ID #		Longitude: 76° 34' 22.73" W

Inspection Code:
- ☐ BDREL – Bond Release
- ☐ CEI – Compliance Evaluation
- ☐ COMPL – Complaint Inspection
- ☐ DRALT – Drilling or Alteration
- ☐ FLWUP - Follow- Up
- ☐ PLUG – Plugging
- ☐ RDSPR – Road Spreading
- ☐ RESTR – Site Restoration
- ☒ RTNC - Routine

Other: ☐ Permit Expired ☐ Alt/Meth. ☐ Annulus Open ☐ Cement Returns ☐ Recommend Bond Release

Location	Insp.	Violation
Site ID Sign	X	
Well Tag	X	58 PS §601.201(h)
Distance Restrict		
E/S Plan on Site	X	
E/S Controls	X	
Encroachments		
Site Restoration		
Drilling-Plugging		
Notification		
B.O.P.		
Casing		
Monument		
Waste Mgmt.		
Top Hole Water		
Fluids Mgmt.		
Impoundment/pit		
Pollution Prevent.		
Residual Waste		

Driller's Log Information — Depth:

Fresh Water Amt / Depth	Salt Water Amt / Depth	Coal Thickness / Depth	Formations Oil / Depth	Formations Gas / Depth

Drilling / Plugging

Filling Material & Plugs	From	To

Casing & Tubing

Size	Pulled	Left

Compliance Assistance	Code	Code	Inspection Results	Code Viols

Remarks:

The Department conducted a routine inspection of the site on December 28, 2010. The Department was represented by Jason Yufer, Water Quality Specialist. The Department observed that the E&S controls have been installed at the site. The Department observed that all exposed soil at the site has been covered with erosion control blankets. No erosion problems were observed at the site. The Department observed that the 1H well has been drilled and fracked at the site. The well did not have the permit number installed on the well. This is a violation of 58 PS §601.201(h). The Department observed the seep at the toe of the pad fill area as reported by Rich Adams on December 13, 2010. The Department observed that there are 2 seeps approximately 15 feet apart at the toe of the slope. The north seep was completely frozen during the inspection. The Department was able to collect a sample from the southern seep. **(Continued)**

Sample No.	Location/Description	DEP Rep:	
2408040	Southern Seep at toe of fill area	(signature)	Date: 12/28/10
		(print name) Jason Yufer	Time: 1515

INSPECTION REPORT PAGE 2

Remarks (Continued):
Field measurements collected from the southern seep were as follows:
pH – 6.58
Salinity – 703
TDS – 957
Conductivity - 1366

PERMIT OR REGISTRATION NUMBER	DEP Rep:	
113-20025	(signature)	Date: 12/28/10
	(print name) Jason Yufer	Time: 1515

~~H3-20025~~ Chief Marquardt
Shrewsbury Twp.
Sullivan Co.

Yufer, Jason

From: Richard Adams [radams@chiefog.com]
Sent: Thursday, December 30, 2010 12:50 PM
To: Richard Adams; Yufer, Jason; Engle, David; Ryder, John
Cc: Matthew Barch
Subject: RE: seep at the Marquardt

Attached results from the seep at bottom of the Marquardt. I just got these this week. Latest field chem (12/29, uncalibrated) is:

pH - 6.63
Cond - 1204
TDS - 753
Sal - 534
Temp - 4.4

RA

L. Richard Adams, P.E.
Environmental Compliance Manager
Chief Oil & Gas LLC
700 Fairfield Rd
Montoursville, PA 17754
570-368-4490 (office)
570-368-4494 (fax)
724-799-7247 (cell)
radams@chiefog.com

From: Richard Adams
Sent: Monday, December 13, 2010 12:06 PM
To: 'jyufer@state.pa.us'; 'Engle, David'; 'Ryder, John'
Cc: Matthew Barch
Subject: seep at the Marquardt

Jason, Dave, John,

We have discovered an iron seep at the base of the fill slope of the Marquardt well pad in Sullivan Co. We believe it is a seep caused by the movement of rain water and snow melt through the native rock that was blasted and used as well pad fill --- and that some of that rock may have some iron and aluminum pyrites in it. I have not seen the seep yet, so I will not estimate the flow but accounts seem to indicate it might be on the order of a gallon per minute --- don't quote me on that.

We have field chem on the seep that shows low pH and TDS around 348 mg/l. There is

iron staining and and what I think is an aluminum precipitate slime. We are sampling for complete inorganic scan with Barium and Strontium and TOC to make sure that it is not orginating from any release on the pad. This well had a toe frac done some weeks ago, but everything on this pad has been conducted on plastic containment.

Will keep you advised as we get sample results, and then take appropriate action.

L. Richard Adams, P.E.
Environmental Compliance Manager
Chief Oil & Gas LLC
700 Fairfield Rd
Montoursville, PA 17754
570-368-4490 (office)
570-368-4494 (fax)
724-799-7247 (cell)
radams@chiefog.com

ANALYTICAL LABORATORY SERVICES, INC.
www.analyticallab.com
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ACCREDITED IN ACCORDANCE WITH nelac
34 Dogwood Lane - Middletown, PA 17057 Phone: 717-944-5541 Fax: 717-944-1430

Certificate of Analysis

Project Name:	RUSH 3-DAY TAT - Marquardt Unit -	Workorder:	9881067
Purchase Order:		Workorder ID:	Marquardt Unit

Mr. Rich Adams
Chief Oil and Gas LLC
6051 Wallace Road Ext.
Suite 210
Wexford, PA 15090

December 21, 2010

Dear Mr. Adams,

Enclosed are the analytical results for samples received by the laboratory on Thursday, December 16, 2010

ALSI is a National Environmental Laboratory Accreditation Program (NELAP) accredited laboratory and as such, certifies that all applicable test results meet the requirements of NELAP.

If you have any questions regarding this certificate of analysis, please contact Shannon Butler (Project Coordinator) or Anna G Milliken (Laboratory Manager) at (717) 944-5541.

Please visit us at www.analyticallab.com for a listing of ALSI's NELAP accreditations and Scope of Work, as well as other links to Water Quality documentation on the internet.

NOTE: ALSI has changed the report generation tool and while we have tried to retain the existing format, you will notice some changes in the laboratory report. Please feel free to contact ALSI in case you have any questions.

Analytical Laboratory Services, Inc.

This page is included as part of the Analytical Report and must be retained as a permanent record thereof.

Anna G Milliken
Laboratory Manager

ANALYTICAL LABORATORY SERVICES, INC.
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ACCREDITED IN ACCORDANCE WITH nelac
34 Dogwood Lane - Middletown, PA 17057 Phone: 717-944-5541 Fax: 717-944-1430

SAMPLE SUMMARY

Workorder: 9881067 Marquardt Unit

Discard Date: 01/04/2011

Lab ID	Sample ID	Matrix	Date Collected	Date Received	Collected By
9881067001	Fill Seep	Water	12/15/10 10:35	12/16/10 12:45	Customer

Workorder Comments:

Notes

-- Samples collected by ALSI personnel are done so in accordance with the procedures set forth in the ALSI Field Sampling Plan (20 - Field Services Sampling Plan).
-- All Waste Water analyses comply with methodology requirements of 40 CFR Part 136.
-- All Drinking Water analyses comply with methodology requirements of 40 CFR Part 141.
-- Unless otherwise noted, all quantitative results for soils are reported on a dry weight basis.
-- The Chain of Custody document is included as part of this report.

Standard Acronyms/Flags

J, B	Indicates an estimated value between the Method Detection Limit (MDL) and the Practical Quantitation Limit (PQL) for the analyte
U	Indicates that the analyte was Not Detected (ND)
N	Indicates presumptive evidence of the presence of a compound
MDL	Method Detection Limit
PQL	Practical Quantitation Limit
RDL	Reporting Detection Limit
ND	Not Detected - indicates that the analyte was Not Detected at the RDL
Cntr	Analysis was performed using this container
RegLmt	Regulatory Limit
LCS	Laboratory Control Sample
MS	Matrix Spike
MSD	Matrix Spike Duplicate
DUP	Sample Duplicate
%Rec	Percent Recovery
RPD	Relative Percent Difference

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ANALYTICAL RESULTS

Workorder: 9881067 Marquardt Unit

Lab ID: 9881067001 Date Collected: 12/15/2010 10:35 Matrix: Water
Sample ID: Fill Seep Date Received: 12/16/2010 12:45

Parameters	Results	Flag	Units	RDL	Method	Prepared	By	Analyzed	By	Cntr
PETROLEUM HC's										
Diesel Range Organics C10-C28	ND		mg/L	0.16	SW846 8015D	12/17/10	SAS	12/17/10 23:33	KJH	B1
Surrogate Recoveries	*Results*	*Flag*	*Units*	*Limits*	*Method*	*Prepared*	*By*	*Analyzed*	*By*	*Cntr*
o-Terphenyl (S)	106		%	26-139	SW846 8015D	12/17/10	SAS	12/17/10 23:33	KJH	B1
WET CHEMISTRY										
Alkalinity, Total	58		mg/L	5	SM20-2320 B			12/17/10 12:54	SAD	A
Chloride	295		mg/L	25.0	EPA 300			12/17/10 05:49	J1H	A
Hardness	695	1	mg/L	63	SM20-2340 C			12/21/10 12:12	LMM	A
Nitrate-N	1.4	2	mg/L	0.20	EPA 300			12/18/10 11:33	J1H	A
Oil/Grease Hexane Extractable	ND		mg/L	2.0	EPA 1664A			12/17/10 09:00	NJA	G
pH	6.83	3	pH_Units		SM20-4500-H B			12/17/10 12:54	SAD	A
Specific Conductance	1050		umhos/cm	1	SM20-2510 B			12/17/10 12:54	SAD	A
Sulfate	21.5		mg/L	2.0	EPA 300			12/18/10 11:33	J1H	A
Surfactants (MBAS)	ND		mg/L	0.025	SM20-5540 C			12/16/10 21:00	SAD	F
Total Dissolved Solids	668		mg/L	5	SM20-2540 C			12/17/10 15:10	KAK	A
Total Organic Carbon (TOC)	4.1		mg/L	1.0	SM20-5310B			12/17/10 08:00	PAG	E
Total Suspended Solids	ND		mg/L	5	SM20-2540 D			12/17/10 02:10	LJF	A
METALS										
Aluminum, Total	ND		mg/L	0.050	EPA 200.7	12/20/10	KMK	12/21/10 08:49	JWK	D1
Barium, Total	0.076		mg/L	0.0050	EPA 200.7	12/20/10	KMK	12/21/10 08:49	JWK	D1
Calcium, Total	52.6		mg/L	0.050	EPA 200.7	12/20/10	KMK	12/21/10 08:49	JWK	D1
Iron, Total	0.51		mg/L	0.030	EPA 200.7	12/20/10	KMK	12/21/10 08:49	JWK	D1
Magnesium, Total	6.9		mg/L	0.050	EPA 200.7	12/20/10	KMK	12/21/10 08:49	JWK	D1
Manganese, Total	3.6		mg/L	0.0025	EPA 200.7	12/20/10	KMK	12/21/10 08:49	JWK	D1
Sodium, Total	30.4		mg/L	0.25	EPA 200.7	12/20/10	KMK	12/21/10 08:49	JWK	D1
Strontium, Total	0.11		mg/L	0.0025	EPA 200.7	12/20/10	KMK	12/21/10 08:49	JWK	D1

Sample Comments:

MBAS calculated as LAS molecular weight 342 g/mol.

Anna G Milliken
Laboratory Manager

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Workorder: 9881067 Marquardt Unit

PARAMETER QUALIFIERS\FLAGS

[1] The result reported for the Total Hardness analysis was higher than the result for the TDS analysis. The results reported are within the precision limits established by the method.

[2] The sample was originally run within hold time, but required further analysis that exceeded hold time.

[3] This sample was received at the laboratory after the holding time for this analysis had expired.

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CHAIN OF CUSTODY/ REQUEST FOR ANALYSIS

ALL SHADED AREAS MUST BE COMPLETED BY THE CLIENT / SAMPLER. INSTRUCTIONS ON THE BACK.

Page 1 of 1
Courier: FedEx
Tracking #:
* 9 8 8 1 0 6 7 *

Co. Name: Jonathan B Hafer
Contact (Report to): Cummings Riter Consult. Phone: (814) 777-3727
Address: 10 Duff Road, Suite 500, Pittsburgh PA, 15235 Send To: => 108 Basin St. Port Matilda PA 16870
Bill to (if different than Report to): Chief Oil & Gas LLC PO#:
Project Name/#: Marquardt Unit ALSI Quote #:
TAT: [ ] Normal-Standard TAT is 10-12 business days. [X] Rush-Subject to ALSI approval and surcharges.
Date Required:
Approved By: Rich McClure
Email? [X] Y JHafer@Cummingsriter.com & radams@chiefog...
Fax? Y No:

**Container Type	PL	PL	PL	AG	PL	AG	AG
**Container Size	1L	500mL	500mL	125mL	2L	1L	1L
Preservative	None	None	HNO_3	HCl	None	H_2SO_4	H_2SO_4

ANALYSES/METHOD REQUESTED — Enter Number of Containers Per Analysis

Sample Description/Location (as it will appear on the lab report)	COC Comments	Sample Date	Military Time	*G or C	**Matrix	pH, SpC, NO3, Cl, TDS, TSS, SO4	Alkalinity	Hardness, Total metals (Al, Ba, Ca, Mg, Fe, Mn, Na, Sr)	TOC	MBAS (Surfactants)	Oil & Grease	Diesel Range Organic (TPH)
1 Marquardt Fill Seep		12/15/10	10:13	G	GW	1	X					
2 " " "		12/15/10	10:18	G	GW		1					
3 " " "		12/15/10	10:26	G	GW			1				
4 " " "		12/15/10	10:26	G	GW				1			
5 " " "		12/15/10	10:20	G	GW					1		
6 " " "		12/15/10	10:35	G	GW						1	
7 " " "	Fixed with H_2SO_4	12/15/10	10:33	G	GW							1
8												

Receipt Information (completed by Receiving Lab)
Received by: [initials]
Cooler Temp: 3°C
Therm. ID: 10133 [initials]
No. of Coolers:
Notes:

Check	Y/N
Correct containers?	(Y)
Correct sample volume?	(Y)
Correct preservation?	(Y)
Headspace/Volatiles?	—
Custody seals Present?	(N)
(If present) Seals intact?	Y N
Received on ice?	(Y)
COC/Labels complete/accurate?	(Y)
Container in good condition?	(Y)

Circle appropriate Y or N.

SAMPLED BY (Please Print): Jonathan B Hafer
LOGGED BY (signature): [signature] 12/16/10 1519
REVIEWED BY (signature): [signature] 12-17-10 1149

Relinquished By / Company Name	Date	Time	Received By / Company Name	Date	Time
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EDDs Required? [ ] If yes, format type: Other
DOD Criteria Required?
SDWA Forms? yes [ ] yes [ ] yes [ ] yes [ ]
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*G=Grab; C=Composite
**Matrix: AI=Air; DW=Drinking Water; GW=Groundwater; OI=Oil; OL=Other Liquid; SL=Sludge; SO=Soil; WP=Wipe; WW=Wastewater
***Container Type: AG-Amber Glass; CG-Clear Glass; PL-Plastic. Container Size: 250ml, 500ml, 1L, 8oz., etc. Preservative: HCl, HNO3, NaOH, etc.
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EXHIBIT M

An Economic Review of the Environmental Assessment of the MARC I Hub Line Project

July 2011

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ECONorthwest specializes in economics, planning, and finance. Founded in 1974, we're one of the oldest independent economic consulting firms in the Pacific Northwest. ECONorthwest has extensive experience applying rigorous analytical methods to examine the benefits, costs, and other economic effects of environmental and natural resource topics for a diverse array of public and private clients throughout the United States and across the globe.

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I. INTRODUCTION AND SUMMARY

Central New York Oil and Gas Company (CNYOG) proposes to build a natural gas pipeline and related facilities in Sullivan, Bradford, and Lycoming Counties in northeastern Pennsylvania. The MARC I Hub Line Project (the Project) would connect two existing natural-gas pipelines to provide access to interstate markets for natural gas produced from the Marcellus Shale formation.[1]

As part of its review of CNYOG's request for a Certificate of Public Convenience and Necessity to construct and operate the pipeline, the Federal Energy Regulatory Commission (FERC) conducted an Environmental Assessment (EA) of the Project, pursuant to the requirements of the National Environmental Policy Act (NEPA). FERC released the EA in May of 2011. The EA purports to describe the environmental effects of the Project, including the socioeconomic effects. It also includes a section intended to discuss the potential cumulative effects of the Project.

FERC's EA of the Project focuses on the impacts of constructing and operating the pipeline and associated compression facilities. FERC determined that it was inappropriate to include in its analysis the effects of facilities intended to connect to the pipeline, such as production wells and gathering pipelines related to developing the Marcellus Shale, because their locations are currently unknown and speculative.[2] FERC purports to include these activities, however, within its assessment of the cumulative effects of the Project.[3]

Earthjustice asked ECONorthwest to review FERC's EA of the MARC I Hub Line Project and assess the completeness and accuracy of the socioeconomic and cumulative effects analyses. This report presents our findings. Our review assesses FERC's analysis of the direct and indirect effects on socioeconomic resources and its analysis of cumulative effects, including the environmental and socioeconomic effects of developing the Marcellus Shale in northeastern Pennsylvania.

To complete our assessment, we have reviewed information related to the potential impacts associated with development of the Marcellus Shale, and descriptions of impacts from other reasonably foreseeable pipeline projects in the region. We have also reviewed peer-reviewed, academic, and government publications on topics related to

- The socioeconomic effects of pipeline development, shale-gas extraction, and similar energy-development activities
- The socioeconomic dimensions of pipeline and natural-gas-development effects on the environment and related ecosystem services, such as the degradation of water quality and forest habitat

[1] Federal Energy Regulatory Commission (FERC). 2011. *MARC I Hub Line Project, Environmental Assessment.* Docket No. CP10-480-000. May. Pg. 1.

[2] FERC 2011, Pg. 3.

[3] FERC 2011, Pg. 4.

- The economic importance of natural, physical, social, and human capital in northeastern Pennsylvania, focusing on Sullivan, Bradford, and Lycoming Counties

In our review, we identify three major shortcomings in FERC's EA of the Project that arise because it fails to fully identify and consider the socioeconomic impacts of the Project itself, and the impacts of reasonably foreseeable projects that overlap in time and/or space with those of the Project, and together, produce cumulative impacts. Specifically, the EA:

1. Fails to fully describe and consider the **direct and indirect** socioeconomic effects of the Project.
2. Omits a discussion of **cumulatively significant socioeconomic effects**.
3. Fails to adequately describe the **other cumulatively significant effects**.

Because of these deficiencies, the EA does not fully describe the range of potential environmental consequences of the Project. As such, the EA provides decision makers and stakeholders with an incomplete and inaccurate assessment of the Project's potential impacts, and so fails to support the proposed finding that the Project will have no significant impact.

In the following sections, we outline the evidence for each of these shortcomings, and present information that FERC should have considered as it prepared its EA of the MARC I Hub Line Project.

II. DIRECT AND INDIRECT SOCIOECONOMIC EFFECTS

The EA identifies these categories of socioeconomic impacts that would arise from the construction and operation of the pipeline:[4]

- Changes in population in the study area
- Expenditures on materials and labor within and outside the region
- Increased demand for temporary housing
- Increased demand for public services
- Revenues from property taxes assessed on the Project and other taxes on project-related expenditures
- Changes in property values

In other sections, the EA mentions the Project's potential impacts on other resources—such as water resources, vegetation and wildlife, recreation, traffic and access, and air quality—that contribute to the social and economic well-being of nearby residents and communities.[5] It does not discuss the socioeconomic implications of these impacts, however. Its failure to do so leaves its overall description and assessment of the Project's socioeconomic effects incomplete.

The failure to address thoroughly the socioeconomic effects of the Project's impacts on environmental resources contravenes widely accepted guidance for impact analysis. The U.S. Environmental Protection Agency (EPA), the Office of Management and Budget (OMB), and the National Research Council (NRC) have each provided guidance toward the sound evaluation of the economic effects of regulatory and non-regulatory actions. This guidance reflects generally-recognized professional standards for conducting economic analyses. In its *Guidelines for Preparing Economic Analysis,* EPA sets forth recommendations that complete economic analyses should consider three separate, but equally important dimensions along which economic consequences may materialize: benefits and costs, economic impacts, and distribution of effects. The *Guidelines* further state that unless an analysis is broad in scope and embraces even impacts for which there are no monetary data, it cannot provide the public and decision-makers with the relevant economic information on which to make a decision.[6] This guidance rests, in part, on recent reports from the EPA's Science Advisory Board and the NRC that underscore the importance of considering the value of impacts to ecosystem services in the context of environmental decisions.[7] OMB offers similar guidance, directing analysts to provide quantitative and qualitative descriptions of the benefits and costs of actions that

[4] FERC 2011, Pp. 67–69.

[5] FERC 2011, Pgs. 29, 43, 63, 66, 72.

[6] U.S. Environmental Protection Agency. 2010. *Guidelines for Preparing Economic Analyses.* Report No. EPA-240-R-10-001. December.

[7] U.S. Environmental Protection Agency, Science Advisory Board. 2009. *Valuing the Protection of Ecological Systems and Services.* Report No. EPA-SAB-09-012. May. and National Research Council. 2005. *Valuing Ecosystem Services.* National Academies Press: Washington D.C.

transparently describe the nature, timing, likelihood, location, and distribution of benefits and costs.[8]

The EA fails to fully describe the direct and indirect effects of the Project consistent with this professional guidance. It does not include a thorough discussion of the positive and negative effects of the Project. For some categories of effects, such as employment and income effects, for example, the EA describes potential positive changes but omits any discussion of potential offsetting, negative changes. It focuses on the short-run economic consequences of the Project and fails to adequately address the long-run consequences, especially those indirect effects that arise as firms, individuals, and communities respond to the effects of constructing and maintaining the Project. It also fails to analyze the impacts at all potentially-affected scales of impact (e.g., an individual, a locality, a region, the nation), or consider distributional issues.

Here we illustrate of the types of information FERC should have considered as it described the direct and indirect socioeconomic effects of the Project.

Direct and Indirect Effects on Jobs and Income. FERC states that constructing and operating the Project would increase job opportunities and income, although it does not state the relevant geography across which these impacts would materialize. It emphasizes that the workforce of an estimated 300 to 500 workers would "largely be comprised"[9] of workers from outside the region for the short duration of construction, raising the possibility that an increase in employment locally might be offset by a reduction elsewhere. FERC further describes that the operation of the Project would require just 10 workers. FERC does not indicate if these would likely be local or non-local workers, nor if the positions would require new hires or draw on existing employees.[10] FERC further ignores the potential impacts on jobs and incomes in sectors not directly linked to the Project. Evidence from other communities that have experienced natural-gas-related development suggests that, while construction and operation activities can increase job opportunities and incomes in the short-run, the long-run outcomes of such development are more mixed and persistent.[11] Offsetting impacts on jobs and income, for example, may occur in industries that rely on resources that are otherwise consumed by the Project. Degradation of bird habitat resulting from a pipeline, for example might reduce related jobs and incomes in the recreation and tourism industry. These offsets may be temporary in nature, from tourists who avoid the area during construction or cannot find hotel or motel vacancies because they are taken up by non-local project workers. They may be permanent, to the extent that the pipeline

[8] Office of Management and Budget. 2003. *Circular A-4 to the Heads of Executive Agencies and Establishments Regarding Regulatory Analysis*. September 17.

[9] FERC 2011, Pg. 68.

[10] FERC 2011, Pg. 68.

[11] Jacquet, J. 2009. "Energy Boomtowns & Natural Gas: Implications for Marcellus Shale Local Governments & Rural Communities." Pennsylvania State University, Northeast Regional Center for Rural Development. Report No. 43. Retrieved on July 7, 2011, from http://nercrd.psu.edu/publications/rdppapers/rdp43.pdf; Kay, D. "The Economic Impact of Marcellus Shale Gas Drilling. What Have we Learned? What are the Limitations?" Cornell University. Working Paper Series: A Comprehensive Economic Impact Analysis of Natural Gas Extraction in the Marcellus Shale. April.

facilitates more wide-spread development that changes the supply or character of recreational activities, causing people to recreate elsewhere. FERC ignores these indirect, long-term impacts on jobs and income that may arise as a result of the Project. FERC also fails to discuss the distributional consequences of the Project related to jobs and income, which are often unevenly spread across local populations.

Direct and Indirect Effects on Public Services. FERC provides an incomplete description and assessment of the Project's potential impacts on public services. It briefly discusses the short-term increase in demand for some local public services that would result from the influx of construction workers, but does not describe the impact on other services or the long-term effects.[12] FERC focuses on just one type of services, emergency response services, claims that CNYOG would coordinate with local law enforcement agencies, fire departments, and emergency medical services, and states that the demand for these services would diminish when the temporary workforce leaves the area.[13] FERC fails, however, to include any meaningful discussion of the potential effects of the influx of temporary workers and construction activities on local government services, such as law enforcement, medical care, road maintenance crews, social services, and waste management. The literature suggests that local governments are often unprepared for the short-term, rapid increases in out-of-town populations that can accompany large-scale infrastructure projects.[14] The increased demands can impose increased costs on local departments, increasing response times and reducing the level of services available for resident populations.[15] The increased costs and impacts on infrastructure can leave service providers unable to sustain normal levels of service to existing residents not just during a project, but also after a project's workers have moved on. FERC's analysis does not adequately address these issues, leaving local governments vulnerable to increased and uncompensated costs, and potentially eroding social capital in the local communities.[16]

Direct and Indirect Effects on Property Values. Although FERC describes comments it received about the impact the Project would have on property values, it fails to include any meaningful discussion of what the Project's impact would be.[17] In fact, FERC admits that the Project could affect property values when it says "this is not to say that the Project would not affect resale values."[18] Several studies have found that the presence of pipelines on or adjacent to residential property does not adversely affect their value: homes near pipelines sold for prices close to the prices for similar homes not near the

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[12] FERC 2011, Pg. 68.

[13] FERC 2011, Pg. 68.

[14] Jacquet 2009.

[15] Pammer, W., J. Jaquet, R. Howe, and L. Sullivan. 2009. *Impacts to Local Governments and Municipalities from Natural Gas Drilling*. Cornell Cooperative Extension: Natural Gas Development Resource Center. Ithaca, NY. May 4th, 2009.

[16] Sugarloaf Project Alliance. 2008. *Sugarloaf Pipeline Project: Social Impact Assessment*. February.

[17] FERC 2011, Pg. 69.

[18] FERC 2011, Pg. 69.

pipeline. These studies provide no evidence, however, that the value of properties with easements and adjacent to the Project will not be affected during its expected life, especially in the event of a failure of the pipeline itself or another nearby pipeline. Another group of studies looks at the effect of pipelines on property values following a rupture or spill. These studies, suggest, in fact, that they can affect residential property values, as residents and prospective buyers perceive an increased risk associated with living nearby the pipeline and capitalize that risk into the value of property.[19] FERC's analysis fails to consider this evidence or to provide a complete discussion of the Project's potential impacts on property values.

Direct and Indirect Effects on Value of Ecosystem Services. "Ecosystem services are the direct and indirect contributions that ecosystems make to the well-being of human populations."[20] To the extent that the Project would affect ecosystems and their ability to make such contributions, it would have socioeconomic impacts. FERC acknowledges that the Project would affect ecosystems, describing its impacts to environmental resources, such as water quality, vegetation and wildlife, air quality, and other components that make up the region's ecosystem. It focuses on these impacts from a biophysical perspective, however, ignoring their potential socioeconomic dimensions. In doing so, it fails to provide a complete evaluation of the socioeconomic consequences of the Project.

In recent years, there has been growing attention toward investigating the impacts of industrial and commercial activities by studying their effects on ecosystem goods and services.[21] Some ecosystem goods and services have economic value when they are extracted, as when water is diverted from a stream to irrigate crops. Others have value *in situ* within the ecosystem, as when people travel to the forest to watch birds or hike. The list of goods and services provided by the region's ecosystems, illustrated in Table 1, is long and growing as scientists learn more about the inner workings of ecosystems and people find new ways to derive benefits from them.

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[19] Hansen, J.L. E.D. Benson, and D.A. Hagen (2006) "Environmental Hazards and Residential Property Values: Evidence from a Major Pipeline Event." *Land Economics* 82(4): 529-541.; Simons, R.A. (1999) "The Effect of Pipeline Ruptures on Noncontaminated Residential Easement-Holding Property in Fairfax County." *The Appraisal Journal* 67(3): 255-63.; Simons, R.A., K. Winston-Geideman, B.A. Mikelbank (2001) "The Effects of an Oil Pipeline Rupture on Single Family House Prices." *The Appraisal Journal* 69(4): 410-18.

[20] EPA SAB 2009, p. 12.

[21] Daily, G.C. 1997. *Nature's Services: Societal Dependence on Natural Ecosystem*. Washington, D.C.: Island Press;, EPA SAB 2009; NRC 2005.

Table 1. Summary of Ecosystem Goods and Services[22]

Examples of Ecosystem Goods and Services					
1	Production and regulation of water	7	Production of food for humans	12	Production of ornamental resources
2	Formation and retention of soil	8	Production of raw materials for industry	13	Production of aesthetic resources
3	Regulation of atmosphere and climate	9	Pollination of wild plants and agricultural crops	14	Production of recreational resources
4	Regulation of floods and other disturbances	10	Biological control of pests and diseases	15	Production of spiritual and cultural resources
5	Regulation of nutrients and pollution	11	Production of genetic and medicinal resources	16	Production of scientific and educational resources
6	Provision of fish and wildlife habitat				

In most times and places, there are insufficient resources to satisfy all the demands for all of the ecosystem goods and services in Table 1. Hence, there is competition for the resources and, when resources are used to produce one set of goods and services, the demands for others go unmet. This may occur, for instance, when trees are cleared for a right-of-way, compromising wildlife habitat and reducing the value people derive from viewing wildlife in their natural surroundings.

Some ecosystem goods and services, such as recreational opportunities and scenic vistas, contribute directly to the well-being of people who have access to them. Their contribution to consumers' well-being makes them economically important in their own right, but they have additional economic importance when they shape the quality of life people enjoy from a place, thereby influencing location decisions of households and firms. These so-called *quality of life* amenities are discussed in more detail in the next section.

Other ecosystem goods and services are important in that they fulfill demands that do not necessarily entail a conscious, explicit use of natural resources. These are called environmental values. There are two general categories: nonuse, or passive use values and values of goods and services that generally go unrecognized. Passive use values arise whenever people place a value on maintaining some aspect of the environment, even though they do not use it and have no intention to do so. Research has documented passive values for maintaining the existence of species threatened with extinction, for example, and for special natural areas, such as national parks. They also can materialize when people want to maintain a particular cultural or ecological characteristic of a resource, as when people want to maintain the existence of landscapes associated with traditional agriculture or native wilderness, for enjoyment by future generations.

[22] Adapted by ECONorthwest from De Groot, R.S., M.A. Wilson, and R.M.J. Boumans. 2002. "A Typology for the Classification, Description and Valuation of Ecosystem Functions, Goods and Services." *Ecological Economics* 41 (3): 393-408; and Daily, G.C. 1997. *Nature's Services: Societal Dependence on Natural Ecosystem*. Washington, D.C.: Island Press.

Environmental values also can be important when a water-related ecosystem provides valuable services that people generally consume without being aware of them. Some scientists and economists believe many services have great economic value, even though people generally are unaware of their importance.[23] Environmental values typically increase as people learn more about the environment and the services it provides.[24]

By affecting the supply of environmental resources available in the region, the Project has the potential to produce impacts on the value people derive from the region's ecosystem services. By failing to describe these impacts, either quantitatively or qualitatively, FERC's analysis of the Project's socioeconomic impacts is incomplete.

Direct and Indirect Effects on Quality of Life. As mentioned in the previous section, FERC fails to describe the Project's potential impacts on the region's amenities that contribute to residents' quality of life. These impacts may have important socioeconomic consequences. The nearer people live to amenities, the lower their cost of using them. Thus, consumers can increase their economic well-being by living in a place that offers recreational opportunities, pleasant scenery, wildlife viewing, and other amenities making important contributions to their quality of life. Quality-of-life amenities can be powerful drivers of economic development. Differences in quality of life explain about half the interstate variation in job growth,[25] and the quality of life available in rural Pennsylvania is a major factor influencing why many households come to and stay in the region. Some residents in the Project area undoubtedly could enjoy higher earnings living elsewhere, such as Philadelphia or New York City, but choose not to do so because their overall economic welfare—the sum of their earnings plus quality of life—is higher here.[26] FERC fails to examine the Project's potential impacts on the interrelationship among the region's amenities, quality of life, and economy.

Another, related impact that FERC fails to consider in its analysis of socioeconomic impacts is the potential for the Project to adversely affect the value residents derive from the amenities of their properties on or adjacent to the Project. Some of these amenities, which may include scenic views, solitude and quietude, sense of safety, and sense of privacy may be captured in the market price of individual properties. For example, many people are willing to pay more for a house with a view than for an equivalent house without a view. The market price, however, may not fully capture the value an existing property owner derives from these amenities. Economic studies have shown that people often demand a higher price to give up things they value than they would otherwise be willing to pay to acquire them. This effect, known as the endowment effect,

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[23] Daily, G.C. 1997.

[24] Blomquist, G.C. and J.C. Whitehead. 1998. "Resource Quality Information and Validity of Willingness to Pay in Contingent Valuation." *Resource and Energy Economics* 20 (2): 179-196.

[25] Partridge, M.D. and D.S. Rickman. 2003. "The Waxing and Waning of Regional Economies: the Chicken-Egg Question of Jobs Versus People." *Journal of Urban Economics* 53: 76-97.

[26] Power, T.M. 2005. "The Supply of and Demand for Natural Amenities: An Overview of Theory and Concepts." In *Amenities and Rural Development: Theory, Methods, and Public Policy.* G.P. Green, S.C. Deller, D.W. Marcouiller, eds. Cheltenham: Edward Elgar Publishing Limited; and Hand, M.S., J.A. Thacher, D.W. McCollum, and R.P. Berrens. 2008. "Intra-Regional Amenities, Wages, and Home Prices: The Role of Forests in the Southwest." *Land Economics* 84 (4): 635- 651.

is a manifestation of another concept economists call loss aversion. Loss aversion means that an individual's willingness to accept payment to give something up is greater than their willingness to pay to acquire it.[27] To fully describe and assess the Project's socioeconomic impacts on residents living nearby, FERC must explicitly examine its interactions with both the endowment effect and loss aversion.

[27] Kahneman, D. J.L. Knetsch, and R.H. Thaler. 1991. "Anomalies: The Endowment Effect, Loss Aversion, and Status Quo Bias." *The Journal of Economic Perspectives* 5:1 (193-206).

III. CUMULATIVE IMPACTS

A cumulative impact, in the context of NEPA, is "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. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time."[28]

Two projects need not be directly related to produce cumulative impacts, so long as the resources they impact are related in some way, either in time or in space, or both.[29] Cumulative effects can occur in a variety of ways. They might be the result of additive effects of multiple projects that interact in a linear fashion, effectively "stacking" impacts. They might have opposite effects, offsetting each other. They may have synergistic effects, combining to exceed the additive effect alone. This may occur, for example, when a threshold for change is reached for a social, economic, or ecological variable, beyond which the impact becomes apparent, or increases in significance more quickly.[30]

In the EA, FERC identifies six potential impacts of the Project that it views as relevant to the cumulative impacts analysis.[31] The EA entirely omits a discussion of the potential cumulative nature of impacts to socioeconomics, and it does not offer an explanation or justification for this omission.[32] The resources it does include in the cumulative impact analysis are

- Water resources (groundwater, surface water, and wetlands)
- Vegetation
- Wildlife
- Land Use (including recreation, special interest areas, and visual resources)
- Air Quality
- Noise

In the context of this EA, FERC purports to identify past, present, and reasonably foreseeable future actions potentially relevant to the cumulative impact analysis. It singles out five that likely would actually produce impacts that, when combined with

[28] 40 C.F.R. 1508.7.

[29] Council on Environmental Quality. 1997. *Considering Cumulative Effects under the National Environmental Policy Act*. Retrieved on July 6, 2011, from http://ceq.hss.doe.gov/nepa/ccenepa/ccenepa.htm.

[30] Contant, C.K. and L.L. Wiggins. 1993. "Toward Defining and Assessing Cumulative Impacts: Practical and Theoretical Considerations." In *Environmental Analysis: The NEPA Experience*. S.G. Hilderbrad and J.B. Cannon. Pp. 336–356.

[31] FERC 2011, Pg. 103.

[32] FERC 2011, Pg. 67.

the incremental impacts of the Project, would produce potentially cumulatively-significant impacts. The projects include:[33]

- TGP's Northeast Supply Diversification Project
- 300 Line Project
- Northeast Upgrade Project
- North-South Project
- Development of the Marcellus Shale Gas Reserves

Although FERC includes the development of the Marcellus Shale in its analysis of cumulative effects, its analysis is incomplete and inadequately supported. It fails to consider widely available information, from the project area itself and from other areas, about the actual impacts of shale-gas development at a scale that is likely to occur in the study area after pipeline conveyance becomes available. As a result, it does not describe the full range of cumulative effects that potentially could result if both the Project and the other reasonably foreseeable projects are implemented as currently anticipated.

In this section, we outline some of the readily available information available to characterize the potential impacts of the development of the Marcellus Shale Gas Reserves in Bradford, Sullivan, and Lycoming Counties (the three-county area). Based on this information, we describe the shortcomings of FERC's analysis of cumulative impacts in two areas: its omission of cumulative impacts of socioeconomic effects; and its incomplete discussion of the cumulative impacts related to the six resources it does describe. We begin by summarizing the available information on the development of the Marcellus Shale Gas Reserves in the three-county area, including the likely extent of development at full build-out and the processes that likely would be employed to extract the natural gas.

A. Description of the Potential Development of the Marcellus Shale Gas Reserves

The EA considers oil and gas wells, including Marcellus Shale natural gas development, under unrelated projects that have potential cumulative impacts. The EA notes "drilling has occurred and will continue to occur in the counties where the Project would be constructed" in Lycoming, Sullivan, and Bradford Counties.[34] The EA does not, however, include the cumulative impacts of future gas wells and other facilities that would deliver gas from Marcellus Shale to the Project's pipeline, called upstream facilities, because "the exact location, scale, and timing of future Marcellus Shale upstream facilities…is unknown and, thus, outside the scope of our analysis."[35]

This conclusion, however, contradicts the information on the location, scale, and timing of the development of future Marcellus Shale facilities that is widely available, and

[33] FERC 2011, Pg. 103.

[34] FERC 2011, Pg. 98.

[35] FERC 2011, Pg. 102.

sufficient to make a general estimate of the scale and magnitude of the potential impacts. There are currently 70 drilled Marcellus Shale natural gas wells within a 6-mile area around the proposed MARC I Gas Pipeline, including 42 wells in Bradford County, PA, 22 wells in Lycoming County, 4 wells in Sullivan County, and 2 in Wyoming County.[36] In that 6-mile area, there are also 48 permitted wells that have not yet been drilled, including 23 permitted wells in Bradford County; 14 permitted wells in Lycoming County; 8 permitted wells in Sullivan County, and 3 permitted wells in Wyoming County.[37] Clearly, the area is poised to see a rise in Marcellus shale development, particularly if the MARC I pipeline provides access to markets, encourages developers to drill new wells, and owners of wells to operate them. Overall assessments of the potential development are readily available. In one of these, Terry Engelder, Professor of Geosciences at Pennsylvania State University, estimates that Sullivan County will reach full gas development in 20 to 30 years, which "will result in the construction and operation of approximately 316–500 drill pads and approximately 2,528 wells."[38]

Industry reports corroborate the likely expansion of well development in Sullivan, Bradford, and Lycoming counties after the MARC I pipeline goes online. The Project's sponsor has provided some of this corroboration, claiming in one statement that "The response to our proposed MARC I pipeline development was outstanding. Not only did we receive expected volume interest from local distribution companies seeking to enhance their supply portfolio and increase reliability, but *we also confirmed strong interest from local producers with development rights in the high profile Marcellus shale that exists the length of the pipeline* [italics added]."[39]

The potential future natural-gas development related to the Project would have a non-trivial footprint across the landscape of the region, if it resembles development patterns and uses techniques that have occurred elsewhere in the Marcellus Shale and in similar shale-gas formations. In the Marcellus Shale, the average amount of forest cleared for a well pad and associated infrastructure is almost 9 acres.[40] Well spacing occurs, on average, separated by 40 to 160 acres per well.[41] A report by the U.S. Department of the

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[36] Earthjustice. 2011. "Maps with 6-Mile Development Zone." April. On file with ECONorthwest.

[37] These numbers likely underestimate the number of gas wells that could potentially take advantage of the MARC I pipeline. Evidence from Bradford County shows gathering lines longer than the 6-mile diameter we used in our illustration above. Bradford County Natural Gas Information, http://www.bradfordcountypa.org/Natural-Gas.asp .

[38] Engelder, T. 2011. "Statement of Professor Terry Engelder, Ph.D." July 6. Exhibit B to Foregoing Comments of the Proposed Interveners.

[39] Inergy. 2008. "Inergy Announces Successful MARC I Hub Line Open Season." August 6. Retrieved on July 7, 2011, from http://investor.inergypropane.com/phoenix.zhtml?c=132026&p=irol-newsArticle&ID=1184555&highlight.

[40] The Nature Conservancy, Audubon, and Western Pennsylvania Conservancy. 2010. *Pennsylvania Energy Sprawl Impacts Assessment: Presentation to the Board of Directors, Audubon Pennsylvania.* Draft Results. October 15.

[41] Ground Water Protection Council and ALL Consulting. 2009. "Modern Shale Gas Development in the United States: A Primer." U.S. Department of Energy, Office of Fossil Energy and National Energy Technology Laboratory. DE-FG26-04NT5455. April. Pg. 21.

Interior of the Fayetteville Shale in Arkansas showed a typical horizontal well pad and its related roads and utilities occupies a total of 6.9 acres. The analysis found 4 horizontal wells completed from a single well pad, with roads and utilities, would disturb 7.4 acres.[42]

The gas-well development potentially influenced by the Project also would have a non-trivial impact on the region's water resources. Current development practices in the Marcellus Shale involve the drilling of both horizontal and vertical wells. In this process, drillers use up to 300,000 gallons of water per day, per well.[43] After completion of the drilling process, developers pump a site-specific mix of water, friction reducing additives, biocides, oxygen scavengers, and acids, into the well to widen the shale fractures and release natural gas.[44] This is the hydraulic fracturing process. Some wells can be hydrofractured multiple times over their productive life.[45] Water is also used during the fracturing process, which can use up to 9 million gallons per fracture (usually over about a week).[46] Marcellus Shale development uses trucks to deliver water and liquid additives and to haul out wastewater, known as flowback. In the delivery of water alone, the process requires approximately 890 to 1340 truckloads of water per wellsite.[47] Because of its weight, the delivery of 364 loads of water to one site is the equivalent of 3.5 million car trips.[48] These increases in truck traffic usually occur in a short time period—often spanning only the length of the initial 20- to 30- day drilling and completion period.[49]

The potential gas-well development would also directly affect the region's labor markets. The economic impacts of well development usually occur in two distinct phases: the development (or drilling) phase and the production phase. As Figure 1 shows, the development phase accounts for over 98 percent of the natural-gas industry workforce at a drilling site.[50] Data from the U.S. Bureau of Labor and Statistics indicate that workers in the natural gas industry earn a mean hourly wage of $31 per hour and

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[42] U.S. Department of the Interior. 2008. *Reasonably Foreseeable Development Scenario for Fluid Minerals: Arkansas.* Prepared for the Bureau of Land Management Easter States Jackson Field Office. March.

[43] Penn State. 2011. "Water Withdrawals for Development of Marcellus Shale in Pennsylvania." Marcellus Education Fact Sheet. College of Agricultural Sciences: Agricultural Research and Cooperative Extension.

[44] Randall, C.J. 2010. "Hammer Down: A Guide to Protecting Local Roads Impacted by Shale Gas Drilling." Working Paper Series: A Comprehensive Economic Impact Analysis of Natural Gas Extraction in the Marcellus Shale. December.

[45] Penn State. 2011. Pg. 3.

[46] Penn State. 2011. Pg. 3.

[47] Randall, C.J. 2010.

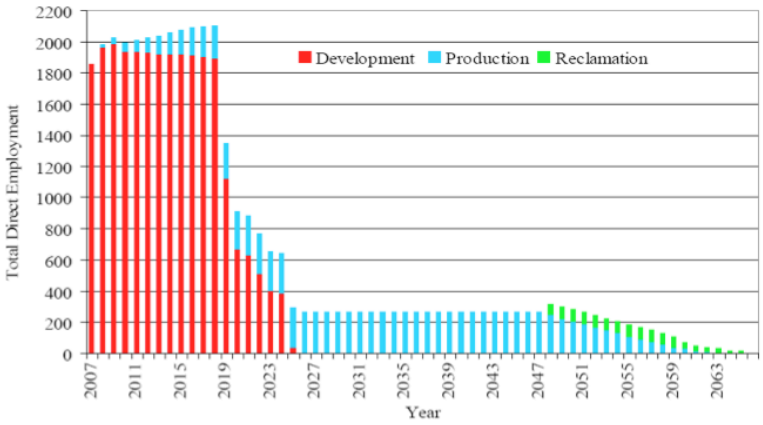
[48] Randall, C.J. 2010.

[49] Ground Water Protection Council and ALL Consulting. 2009.

[50] Jacquet, J. 2011.

benefits.[51] The majority of these jobs, however, go to experienced workers from outside the region, and disappear when drilling is complete.[52]

Figure 1. Distribution of Direct Employment During Phases of Gas Development[53]



This description of the reasonably foreseeable development and production activities that might occur in the region, perhaps in response to influence from the Project, provides context for identifying the cumulative socioeconomic effects FERC could have and should have described and assessed in the EA. The following sections illustrate the types of effects and the information available to FERC for describing and assessing them.

B. Potential Cumulative Socioeconomic Impacts

Sufficient information exists for FERC to describe and assess cumulative socioeconomic effects associated with (1) jobs and incomes, (2) tax revenues, (3) property values, (4) public services, (5) quality of life, and (6) values derived from ecosystem services.

1. Jobs and Income

The information provided above indicates the Project's impacts on jobs and incomes would interact with those of foreseeable development and operation of gas wells in the region to have cumulative, short- and long-term effects on labor markets. FERC recognizes the Project would generate short-term increases in jobs and income from construction activities, mostly for non-local workers, at least at first.[54] If anticipated well-development activities ramp up concurrent with the pipeline construction, additional

[51] U.S. Bureau of Labor Statistics. 2010. *National Industry-Specific Occupational Employment and Wage Estimates.* NAICS 221200 - Natural Gas Distribution.

[52] Kay, D. 2011.

[53] Jacquet, J. 2011.

[54] Jacquet, J. 2011.

increases in jobs and income associated with drilling (described above) would occur at the same time, and across the same region as the Project. This activity could result in additive, cumulative effects on the local market for labor and on the levels of income generated from development activities.

If impacts on jobs occur in a full-employment economy as industry officials and some economists predict, it could result in offsetting cumulative effects, by drawing labor away from other potential economic opportunities. Even in an economy that hasn't fully recovered from the Great Recession, the increase in jobs for gas development may draw employees with technical and regulatory expertise and other specialized skills away from other sectors of the economy, resulting in additional offsetting effects through increased competition for and cost of some types of labor at the local level, an effect that one researcher has documented in Bradford and Lycoming Counties:

> *[L]ocal businesses may compete with each other and the new extractive industry for skilled workers (e.g., mechanics, heavy equipment operators, truck drivers). This competition leads to a shortage of skilled workers and strains the ability of local businesses to provide commensurate wages and benefits.*[55]
>
> *Price inflation and competition for workers were also reported in Bradford County. One key informant stated: "I have friends in the automobile dealership business. They are losing mechanics, because the gas companies are paying ...a much more lucrative wage. . ." Rent, fuel, and food prices also rose as providers responded to increased demand.*[56]

Researchers point out that, even if overall positive effects on jobs and incomes materialize in the region, the distribution of effects from gas development are likely to be uneven across some populations and sectors of the economy, and the long-run effects are very likely to be mixed, with important consequences for a thorough assessment of cumulative effects:

> *Key informants in [Bradford, Lycoming, Washington, and Steuben Counties] worried that Marcellus Shale development might lead to a "gap between the haves and the have-nots." Participants saw clear divisions between who would benefit and who would bear the burden of development.*[57]
>
> *Mixed economic results are likely even in the short run. The rising tide is not likely to lift all boats: there will be losing constituencies among communities and individuals who are displaced or left behind. The experience of many economies based on extractive industries is a warning that their short-term gains frequently fail to translate into lasting, community-wide economic development. Most alarmingly, in recent decades credible research evidence has*

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[55] Brasier, K., M. Filteau, D. McLaughlin, J. Jacquet, R. Stedman, T. Kelsey, and S. Goetz. 2011. "Residents' Perceptions of Community and Environmental Impacts from Development of Natural Gas in the Marcellus Shale: A Comparison of Pennsylvania and New York Cases." *Journal of Rural Social Sciences*. 26(1): 32-61.

[56] Brasier et al. 2011.

[57] Brasier et al. 2011.

grown showing that resource dependent communities can and often do end up worse off than they would have been without exploiting their extractive sector reserves.[58]

The volatility of fossil fuel markets poses obstacles to the stability and long-term security of economic growth in energy-producing regions. Fossil fuel extraction, especially when prices are high, creates an enormous amount of wealth, most of which currently leaves the region. Employment in fossil fuel extraction also is driven by price, which changes rapidly.[59]

In reality, the economic impact may very well be negative. And the likelihood is that gas drilling would adversely affect other economic activities such as tourism and sport fishing and hunting. To some extent gas drilling and these other industries are likely to be mutually exclusive. The net effect is what must be considered.[60]

Measuring or predicting this "net effect" is far from a straightforward task, especially since much of the economic boost related to drilling will come via short term boom/bust cycles in a region that has struggled long term with outmigration and disinvestment trends.[61]

2. Tax Revenues

It is important to note that the impacts on tax revenues, described as a significant benefit in many shale-gas developments in other parts of the United States, do not apply in Pennsylvania, because natural gas is not subject to property tax, leasing and royalty incomes are not subject to local earned income taxes, and most drilling equipment is exempt from the state sales tax.[62] But gas-related expenditures do affect tax revenues. Many of the potential cumulative effects described in the preceding section will be accompanied by effects on tax revenues. Expenditures associated with the Project, plus expenditures on foreseeable development of and production from gas wells in the region likely will have a combined effect on state and local tax revenues.

Researchers have noted indirect increases in revenues related to sales tax and employee withholding taxes as drilling increases the number of jobs and overall economic activity in areas already experiencing development within the Marcellus Shale formation. One study finds, "counties with 150 or more Marcellus wells experienced an 11.36 percent increase in state sale tax collections between 2007 and 2011," which was significantly larger than increases to counties with fewer wells and counties with no wells.[63]

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[58] Kay, D. 2011.

[59] Headwaters Economics. 2011. "Fossil Fuel Extraction and Western Economies." April.

[60] Brasier et al. 2011.

[61] Kay, D. 2011.

[62] 61 Pa. Code §32.35 Mining; Hamill, S. 2010. "2002 court case proved windfall for shale drillers." Pittsburgh Post Gazette. September 28.; Brasier et al. 2011; Pennsylvania Budget and Policy Center. 2011. "Representation without Taxation: How Natural Gas Producers Escape Taxes in Pennsylvania." April.

[63] Penn State. 2011. "State Tax Implications of Marcellus Shale: What the Pennsylvania Data Say in 2010." Marcellus Education Fact Sheet. College of Agricultural Sciences: Agricultural Research and Cooperative Extension.

Quantifying the impacts on tax revenues requires careful analysis. Many newly created, gas-related jobs are filled by non-permanent and transient workers, which means both income tax and retail tax revenue will be lower than anticipated, as earned income leaves the region with the workers, who spend less locally than local workers otherwise would.[64] Moreover, increased government spending on public services to meet the increased demands of the workforce and construction activities may partly or entirely offset increases in tax revenues.[65]

3. Property Values

Assuming the Project is implemented and gas-well development accelerates in the three-county region, property values likely will not remain unaffected. The changes may be positive for some properties, negative for others, and would, as FERC correctly points out, depend on a variety of different factors.[66] While further investigation is required to determine the direction and magnitude of the Project's effect on property values the effects likely would materialize only for properties in close proximity to the pipeline and related facilities. The development of new wells, however, likely would have more widespread effects across the region. The cumulative effects may exhibit threshold characteristics, where values across the region remain largely unaffected until a critical point is reached and non-linear effects occur.

Several findings from the literature suggest the cumulative effects could be negative for many properties:

> *[T]he distance to an industrial site has a statistically significant negative effect on the value of residential properties. However, the effect is largely localized within a relatively short distance from the nearest industrial site.*[67]

> *Single-family homes and small lots may decline in value. There have been reports that banks are reluctant to give mortgages for properties with a gas lease or even for properties nearby leased land. It would be very difficult to find a buyer for a home if mortgages are unavailable or if the home's drinking water is contaminated. In Wise County, Texas, in the Barnett Shale region, it has been reported that real estate appraisers have discounted valuations by as much as 75% if a property has a gas well.*[68]

> *[In Alberta, Canada] property values are negatively correlated with the number of sour gas wells and flaring oil batteries within 4 km of the property. Indices reflecting health hazards associated with potential rates of H2S release (based on information from Emergency Response Plans and Zones) also have a significant negative association with property prices.*

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[64] Barth, J. 2010.

[65] Brasier et al. 2011.

[66] FERC 2011, Pg. 69.

[67] de Vor, F. and H.LF. de Groot. 2009. "The Impact of Industrial Sites on Residential Property Values: A hedonic pricing analysis for the Netherlands." Annual International RSA Conference: Leuven, Belgium. April 6th-8th, 2009.

[68] Barth, J. 2010.

> *The findings suggest that oil and sour gas facilities located within 4 km of rural residential properties significantly affect their sale price."*[69]

The value of some properties may increase—a result of increased demand for housing and the contribution to value of the potential royalty income from gas-well development:

> *Rental rates will probably increase due to the influx of transient workers, hotel occupancy rates may increase, and some parts of Pennsylvania have experienced this in the Marcellus play. The value of large tracts of land may increase if they are desirable for gas leases.*[70]

An additional factor that FERC should consider within the context of cumulative effects on property values is the response of mortgage lenders to the increasing specter of wide-spread gas development in close proximity to residential properties. Evidence from New York suggests that some lenders are reluctant—and in some cases possibly legally prohibited—from authorizing mortgages on some residential properties with surface or subsurface rights to gas development.[71]

4. Public Services

The Project and foreseeable gas-well development likely would produce cumulative demands for public services and on the ability of local jurisdictions to provide them.

> *For local governments the population influx as a result of Marcellus construction "comes with added costs, both in the short run and in the long run. The consistent theme is that local governments – counties, cities, townships, villages – are subjected to a wide range of demands for new services or increased levels of service, and that the administrative capacity, staffing levels, equipment, and outside expertise needed to meet those demands are beyond anything that has been budgeted."*[72]

Communities in Bradford County, where gas development in already underway, have experienced stresses on public services:

> *The lack of housing created problems for social service agencies trying to place low-income and homeless residents in temporary housing. State police in Bradford County were citing more traffic violations, and the correctional facility had detained three out-of-state natural gas workers on misdemeanors – one had a warrant for a felony charge in Texas. Bradford County key informants also believed that, unless a severance tax was enacted and revenues*

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[69] Boxall, P. W. Chan, and M. McMillan. 2005. "The impact of oil and natural gas facilities on rural residential property values: a spatial hedonic analysis." *Resource and Energy Economics*. 27: 248-269.

[70] Barth, J. 2010.

[71] May, G. 2011. "Gas and Oil Leases Impact on Residential Lending." Residential Mortgage Lending Tompkins Trust Company. March.

[72] Christopherson, S. and N. Rightor. 2011. "How Should We Think About the Economic Consequences of Shale Gas Drilling?" Working Paper Series: A Comprehensive Economic Impact Analysis of Natural Gas Extraction in the Marcellus Shale. May.

distributed back to local governments, county and municipal taxes would have to increase to meet the rise in demand for social services.[73]

5. Quality of Life

Many residents of the three-county area have chosen to live in the region because of its natural amenities, strong community, and attractive quality of life. In a previous section we describe the importance of these attributes to the economic strength of the region, and its continued ability to attract and retain people. In a study of the potential effects of well development on community and social values, one resident expressed exactly this sentiment:

"[It's] such a beautiful place to live. I've turned down many opportunities to go other places and work for bigger pay, but it's such a beautiful ... and a pleasant place to live that I hate to see those values be degraded."[74]

Attributes that affect quality of life may be especially sensitive to cumulative effects from the Project and accompanying gas-well development. The potential quality-of-life impacts are well-documented, stemming from rapid changes in the variables described above and in the region's stock of social capital and in its natural capital, described in the next section.

Rapid growth in boomtowns is also linked with mixed social impacts…rapid population growth associated with the development of industry can increase stress, change individuals' patterns of interactions within communities, decrease community cohesion, and change a community's character.[75]

Individuals' quality of life, ties to community members, and mental and physical health can also be affected, leading to increases in social problems (e.g., crime, substance abuse) and overall disorganization. This increases stress on local organizations and community services, and creates a lower standard of living for persons detached from the extractive-related economy.[76]

6. Values Derived from Ecosystem Services

We introduce the importance of considering the Project's impacts on ecosystem services and the socioeconomic dimensions associated with those impacts in Section II. The Project and reasonably foreseeable gas-well development in the three-county region would cumulatively reduce the supply of valuable ecosystem services through their adverse impacts on water-quality, vegetation and wildlife, and other related resources. These impacts would produce adverse socioeconomic consequences to the extent that they decrease the value of goods and services available to Pennsylvanians and out-of-

[73] Brasier et al. 2011.

[74] Brasier et al. 2011.

[75] Brasier et al. 2011.

[76] Brasier et al. 2011.

state visitors. This decrease would occur primarily by diminishing the supply of capital necessary to provide goods and services.[77]

The Project's cumulative impacts would affect, directly and indirectly, the region's stock of natural capital. Natural capital is a term used to describe the inventory of nature's physical building blocks (e.g., trees, water, fish, soil, etc.) and the functional interconnections between the building blocks, which together form ecosystems.[78] Ecosystems are dynamic systems that support physical, chemical, and biological processes that influence flows, storage, and transformation of matter and energy.[79] These "ecosystem processes" contribute to the maintenance and accumulation of the building blocks of natural capital, and in this way, are inextricably interrelated with the concept of natural capital. The Project and accompanying gas-well development would reduce the region's supply of natural capital and the associated ecosystem processes, for example, by clearing trees and creating fragmented forest habitat for sensitive bird species.[80]

These changes in natural capital may be quantifiable in biophysical terms, but they do not produce economic costs directly (either quantifiable or unquantifiable). Instead, reductions in natural capital lead to changes in goods and services people value, which are called ecosystem services. Ecosystem services describe the ways in which humans derive value from what nature provides. The cumulative impacts on natural capital would change the types and quantities of ecosystem services people can derive from a particular area, and by doing so, produce economic or costs (or benefits, if the types or quantities of ecosystem services are enhanced).

The economic value of the ecosystem services impacted by the Project and other reasonably foreseeable actions is a measure of their contribution to individuals' quality of life, or to the productivity of businesses and communities. This value can materialize in different ways. Figure 2 demonstrates the major categories of economic value for ecosystem services. The left side of Figure 2 shows use value, perhaps the clearest type of economic value. Direct use value describes the value associated with the direct use of an ecosystem service, such as spending a day fishing. Indirect use value describes the ecosystem services that precede that direct service, such as the aquatic habitat that nurtures and provides refuge for the targeted fish.

The right side of Figure 2 shows passive use value, which represents nature's values that exist when there is no direct or indirect use of an ecosystem. Passive use values are less obvious than use values, but—in some instances—can represent a greater total value because they incorporate demands from a larger population. Figure 2 separates passive use value into two categories. One, called existence value, comes from people's desire

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[77] Economists use the term capital to describe resources commonly used to produce things people value (e.g., different types of goods and services).

[78] Daily, G.C. 1997.

[79] Campbell 2009.

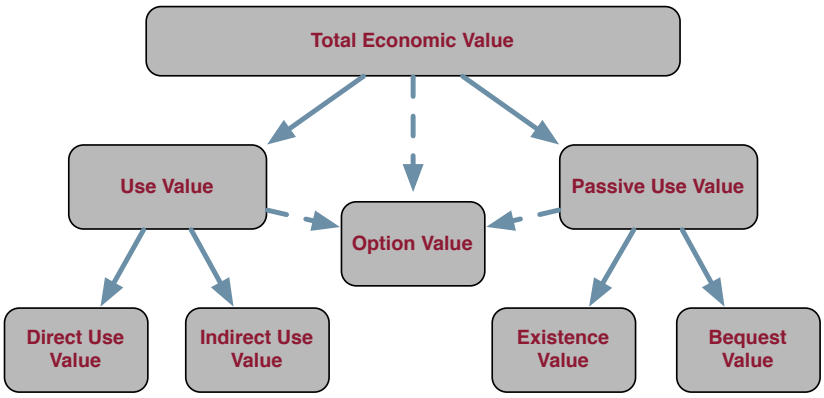
[80] *See*: Audubon. 2011. "Re: Docket No CP10-480-000, Environmental Assessment of MARC I Hub Line Project." July 8.

for the continued existence of a species, landscape, or some other aspect of an ecosystem, or of the ecosystem as a whole. The other, called bequest value, arises because people desire to ensure that the ecosystem will be available for enjoyment by future generations.

Typically, these passive use values are described in terms of an individual's willingness to pay for an object's current or future existence. For example, if an individual is willing to pay a given sum to prevent the elimination of a tidal wetland, then this amount represents the existence value she places on the wetland. Similarly, if she is willing to donate a given sum to a conservation fund dedicated to maintaining healthy tidal wetlands into the future, this amount represents the bequest value she places on them.

The middle of Figure 2 shows another component of the total value, called option value. An option value refers to the benefit of maintaining an opportunity to derive services from an ecosystem in the future. It can originate from either side of Figure 2. Sometimes, market prices exist that provide information useful for quantifying option values, but not always.

Figure 2. Components of Total Economic Value



Below, we illustrate the values associated with the Project's cumulative impacts on three environmental resources: water quality, vegetation and wildlife, and recreation. Other cumulative impacts likely would diminish the supply and value of additional ecosystem services, including, but not limited to those related to air quality, other changes in land use (especially agricultural land uses), and soils. To provide a complete analysis of the Project's cumulative effects, FERC should conduct a thorough review of the Project's potential impacts on ecosystem services, referring back to Table 1 presented in Section II, and present a discussion of the socioeconomic dimensions of these impacts. FERC's analysis should include not just an assessment of the cumulative impacts across the region, but the distributional consequences of those cumulative impacts. Some individuals and communities may experience negative impacts without gaining any benefits from the Project; it is important to identify where these distributional inequities may occur, so decision-makers can respond appropriately.

Water Quality and Quantity. FERC acknowledges in the EA that both the Project and the development of the Marcellus Shale in the three-county area would have impacts to

water quality.[81] Any impacts the Project might have on water quality in the area would interact cumulatively with the impacts of gas wells. Voluminous evidence exists regarding these potential impacts and concern about their environmental and socioeconomic consequences:

- The Susquehanna River Basin Commission (SRBC) considers all water used in hydrofracturing to be consumptively lost to the system.[82]

- While the water volumes needed to drill and fracture wells are large, they generally represent a small percentage of total water resource use in a basin. This water, however, is generally used over a short period of time, and it is "consumed" rather than returned to its source, because it has to be hauled away and treated. When competing demands for this water from growing populations and increasing industrial and commercial purposes, the demands from gas-well development may be difficult to meet, especially in some locations. If there is low stream flow at the time water is required, this could negatively affect fish and other aquatic life, fishing, recreational activities, municipal water supplies, and industries such as power plants.[83]

- Other major concerns for water resources arising from pipeline and gas-well development include erosion and sedimentation and the treatment and safe disposal of produced water.[84]

- Gas-well development in the Marcellus Shale can directly compromise water quality during several stages of development. Construction creates erosion and siltation. Drilling through aquifers may contaminate drinking-water supplies. Chemicals added to fracking fluid may leak into the ground and contaminate aquifers and surface water supplies.[85]

- Despite increased regulation of well casings, fracking fluid, and wastewater disposal, risks persist: "direct contamination of groundwater as a result of fracturing procedures appears to be highly unlikely; however, subsurface impacts as a result of wellbore cementing practices and improper balancing of well pressures can and have occurred. While these events may be rare, they can result in significant contamination of local drinking water sources."[86] A recent review of proposed

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[81] FERC 2011, Pg. 104.

[82] Penn State 2010.

[83] The League of Women Voters of Pennsylvania. 2010. "Marcellus Shale Natural Gas: Environmental Impact." Marcellus Shale Natural Gas Extraction Study 2009-2010.

[84] Soeder, D. and W.M. Kappel. 2009. "Water Resrouces and Natural Gas Production from the Marcellus Shale." *U.S. Department of the Interior, Fact Sheet 2009-2032*. U.S. Geological Survey (USGS). May.

[85] LWVP 2009.

[86] Riha, S. and B. Rahm. 2010. "Framework for Assessing Water Resource Impacts from Shale Drilling. Cornell University. Working Paper Series: A Comprehensive Economic Impact Analysis of Natural Gas Extraction in the Marcellus Shale. April.

fracking wells in New York state concluded that migrating fracking fluids can contaminate surface aquifers.[87]

- "Gas drilling impacts on water resources can also be classified as arising from certain or uncertain events. Events that are certain include those integral to the drilling process such as water withdrawal and wastewater production and treatment. These events can be planned for and closely regulated, and their magnitude is directly related to the pace and scale of gas drilling development. Uncertain events can be considered accidents. While they can be anticipated, in the sense that they are likely to occur at some point, their occurrence and consequences are highly uncertain over time and space. Uncertain events include surface runoff, spills and leaks, as well as subsurface events related to well integrity."[88]

- From 1992 to 2008 there were at least nine reported cases of gas migration at operating wells in Pennsylvania, resulting in three fatalities. In the last two years, there have been numerous instances of well blowouts and explosions, drinking water contamination and illegal discharges, surface water spills, and instances of improper wastewater treatment leading to high levels of TDS in rivers and streams. These accidents include a "catastrophic failure" of a blowout preventer in Clearfield County, PA that spewed 35,000 gallons of wastewater and natural gas into the air for 16 hours; leaks from improper well casings that contaminated at least nine drinking water wells with methane; a spill of approximately 250 barrels of diluted hydraulic fracturing fluids that killed at least 168 fish and other aquatic life; and an incident of gas migration that caused a house to explode in Jefferson County, resulting in three fatalities. Abandoned wells, many of which are in unknown locations, have also caused stray gas to migrate to the surface and contaminate the environment. Since 1998 there have been 38 investigations of stray gas migration from abandoned wells in homes, commercial buildings, private water wells and groundwater aquifers, in a church, a campground, and a senior care home that resulted in temporary evacuation.[89]

- A Pennsylvanian resident whose water supply came from a natural artesian spring, reported that drilling conducted by a fracking company contaminated his water source. PA DEP brought him and his neighbors bottled drinking water and installed a 2,000 gallon tank for non-potable water. "A pristine, beautiful cold spring is now totally destroyed," Hilyer said, "Now I have a tank of junk water, and I'm living off creek and boiled water." The next door neighbors report that "having an endless supply of fresh, clean, cold water was the added plus in their decision to purchase the home."[90]

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[87] Meyers, T. 2009. Comments of Natural Resources Defence Council, et al. on the Draft Supplemental Generic Environmental Impact Statement on the Oil, Gas and Solution Mining Regulatory Program, Attachment E (December 30).

[88] Riha, S. and B. Rahm 2010.

[89] Michaels, C., J. Simpson, and W. Wegner. 2010. "Fractured Communities: Case Studies of the Environmental Impacts of Industrial Gas Drilling." Riverkeeper. September.

[90] Zemach, H. 2008. "Gibbs Hill homeowners lose water supply after fracking." Ridgeway Record. August.

- PA DEP fined Talisman Energy $15,506 for a November 2009 spill that sent over 4,200 gallons of hydraulic fracturing flowback fluid into a wetland and a tributary of Webier Creek, which drains into the Tioga River, a coldwater fishery.[91] This year, the PA DEP fined Chesapeake Energy more than $1 million for water-quality violations in Bradford County related to hydraulic fracturing.[92]

Several studies demonstrate that the people of Pennsylvania value clean, unpolluted water:

- Households in the Susquehanna River Basin are willing to pay, on average, $25 for remediation of acid mine drainage damage in the basin. Households outside the basin were willing to pay $34, a result explained by higher levels of education and sensitivity to acid mine drainage among some populations outside the basin.[93]

- Residents in western Pennsylvania valued improvements in water quality in a stream that went from "moderately polluted" to "unpolluted," in terms of its ability to support fish species, from $27 to $51 per household per year for five years. Residents valued improvements that raised water quality from "severely polluted" to "unpolluted" at $76 to $112 per household per year for five years.[94]

These potential impacts on water quality have important implications for the assessment of cumulative socioeconomic effects that FERC should have included in the EA. Water irreversibly polluted by the pipeline or by gas-well development would no longer be available for other uses. Pollution of water supplies for households and communities leaves them exposed to hazards when they use the water, restricts their use of the water, causes them to incur costs to remove the pollutants or find substitute supplies, or all of the above. Even when water has not been polluted, households and communities experience a reduction in well-being from the uncertainty that results when gas-related activities create the potential that pollution may manifest itself in the future. These and related socioeconomic effects must be addressed if the EA is to provide a comprehensive, accurate assessment of the Project's cumulative socioeconomic effects.

Vegetation and Wildlife. The Project and gas-well development will each affect the natural landscape by displacing vegetation, wetlands, and other types of ecosystems. These ecosystems provide a valuable stream of goods and services, such as air purification including absorbing greenhouse gases, clean water (described previously), and recreation (described next). They are also valuable in their own right. Both temporary and permanent disturbance of these habitats, and the species that depend on them, are likely to accelerate as gas-well development increases. The Nature Conservancy estimates that each well pad could disturb up to 30 acres of forest habitat,

[91]Micheals et al. 2010.

[92] Kusnetz, N. 2011. "PA Officials Issue Largest Fine Ever to Gas Driller." ProPublica. May 17.

[93] Hansen et al. 2008.

[94] Farber, S. and B. Griner. 2000. "Valuing watershed quality improvements using conjoint analysis." *Ecological Economics*. 34: 63-76.

directly and indirectly through edge effects.[95] Overlaying potential well sites and remaining intact forest patches suggests that a considerable area of forested landscape in Bradford County, especially, may become fragmented and less suitable for providing certain types of habitat for sensitive wildlife populations, such as songbirds.[96] The goods and services people derive from the acres the Project would directly affect may be limited, compared to the current supply available in the region, but as more acres of natural landscape are converted to well pads, roads, and commercial and industrial facilities to support gas-well development, these resources may become more scarce. When cumulative impacts lead to scarcity, the impacts may rapidly become non-linear: as things become scarce, they become more valuable. Thus, the values we present in the following paragraphs may actually underestimate the actual losses people experience in the long-run.

Forest Habitat. In 2009, researchers conducted several meta-analyses estimating various use and passive use values associated with forestland. In estimating the passive use value of forestland, the researchers compiled data from 23 relevant studies.[97] Their results identify per-acre estimates for passive use values by geographic region and forest biome. They estimated the marginal, per-acre passive-use value associated with forests in Pennsylvania at $294 per year. This value estimates society's total willingness to pay for intact forest land. Insofar as this estimate considers only passive use values, it likely underestimates the total economic value people place on protecting these resources, because direct users of forest habitat likely are willing to pay more. It also likely underestimates the value because, as human populations and incomes grow in Pennsylvania and elsewhere, the marginal value of forest land probably will increase.

Wetland Habitat. Wetlands are a well-studied habitat type that provides well-documented values for a wide array of ecosystem goods and services. Table 2 provides several estimated values for the ecosystem services provided by wetlands. The first set of rows estimates the values associated with several different wetlands that researchers assumed provide only a single type of service. In many cases, a wetland may provide multiple services, however. The range of values associated with single-service wetlands is about $5–$9,200 per acre per year depending on the ecosystem service.[98] Another estimate, based on the net primary productivity of various landscapes in the U.S. National Wildlife Refuge System suggests that the ecosystem service values of wetlands, generally, may be about $2,400–$12,400 per acre per year.[99] These estimates come from meta-analyses of many individual site-

[95] The Nature Conservancy et al. 2010.

[96] The Naturel Conservancy et al. 2010.

[97] Chiabai, A., C.M. Travisi, H. Ding, A. Markandya, and P.A.L.D. Nunes. 2010. "Economic Valuation of Forest Ecosystem Services: Methodology and Monetary Estimates." *Cost of Policy Inaction: The Case of Not Meeting the 2010 Biodiversity Target.*

[98] Woodward, R., and Y. Wui. 2001. "The Economic Value of Wetland Services: A Meta-Analysis". *Ecological Economics*. 37: 257-270.

[99] Ingraham, M. and S. Foster. 2008. "The Value of Ecosystem Services Provided by the US National Wildlife Refuge System in the Contiguous US." *Ecological Economics*. 67:608-618.

specific studies. The New Jersey Department of Environmental Protection calculated the value of ecosystem goods and services provided by freshwater wetlands within its borders at about $14,000 per acre per year.[100]

Table 2. Value of Ecosystem Services Associated with Wetland Habitat ($/Acre/Year)

Single-Service Wetlands		
Single-Service Wetland Type	**Mean Value**	**Range of Values**
Flood Attenuation	$645	$146–$2,865
Water Quality	$684	$207–$2,260
Water Quantity	$208	$10–$4,216
Recreational Fishing	$585	$156–$2,201
Commercial Fishing	$1,276	$177–$9,214
Bird Hunting	$115	$41–$323
Bird Watching	$1,988	$866–$4,562
Amenity	$5	$2–$23
Habitat	$502	$156–$1,609
Storm Protection	$389	$18–$8,433
General Wetlands from US National Wildlife Refuge System		
Base Value of Net Primary Productivity		$2,400–$12,400

Source: Woodward, R., and Y. Wui. 2001. "The Economic Value of Wetland Services: A Meta-Analysis". *Ecological Economics*. 37: 257-270; Ingraham, M. and S. Foster. 2008. "The Value of Ecosystem Services Provided by the US National Wildlife Refuge System in the Contiguous US." *Ecological Economics*. 67:608-618.

Sensitive Species. Bradford County has six threatened, six endangered, and one candidate species, the Timber Rattlesnake at the state level. NatureServe, a non-profit conservation organization, which independently analyzes and rates species health, classifies three of Bradford County's species globally vulnerable, and, at the state level, 24 as vulnerable, 22 as imperiled, and 13 as critically imperiled.[101]

Lycoming County has six threatened, 11 endangered, and one candidate species, the Timber Rattlesnake at the state level. NatureServe classifies six of Lycoming County's species as globally vulnerable, and one as globally imperiled. NatureServe rates 33 of Lycoming County's species as vulnerable, 23 as imperiled, and 25 as critically imperiled.

[100] New Jersey Department of Environmental Protection. 2007. *Valuing New Jersey's Natural Capital: An Assessment of the Economic Value of the State's Natural Resources*. April.

[101] NatureServe. 2011. Retrieved on July 8, 2011 from http://www.natureserve.org/.

Sullivan County has 13 threatened species, 17 endangered species, and one candidate species, the Timber Rattlesnake. NatureServe classifies four species in Sullivan County as globally vulnerable. At the state level, NatureServe classifies 34 species as vulnerable, 32 as imperiled, and 33 as critically imperiled.

In addition to the species listed above, the Myotis sodalis (Indiana Myotis), a bat listed as an endangered species by the U.S. Fish & Wildlife Service, has habitat in and around the area of the Project.[102] There is little literature describing the benefits humans derive from bats. To the extent that the Project decreases bat populations in region, it could decrease economic well-being in two ways:

- The Project could decrease the pest-suppression benefits bats provide to agriculture
- The Project could decrease the benefits individuals derive from knowing the Indiana Myotis exist, despite potentially never interacting with the species directly.

Many bats, including the Indiana Myotis, prey on insects that are potentially harmful to agriculture.[103] A recent study quantified the economic value associated with bat predation in terms of the resulting agricultural benefits, at the county level. The study extrapolated the results of a study focused on the benefits of bat predation in a cotton-dominated agricultural landscape in south-central Texas, which found that bats provided pest-suppression services worth $12 to $173/acre of agricultural land.[104] Insofar as the Project reduces this service bats provide, it would decrease the economic well-being farmers derive from the pest suppression bats provide.

Wildlife contribute to people's economic well-being, either because they know they exist, have the option to enjoy them or see that their children enjoy them in the future, or engage in recreation, subsistence hunting, sightseeing, or some other direct use of the resources. The Indiana Myotis has received federal endangered status. Economic research has shown that people place a considerable value on the continued survival of sensitive species, such as those listed as threatened or endangered. Table 3 lists the results from several economic analyses examining household willingness to pay to protect sensitive species. The estimates included in the table are limited to birds valued by U.S. or New England households. Bats, of course, are mammals, and the species included in Table 3 are all birds. The data, however, serve to provide support for the notion of value attributable to sensitive species with habitat near the Project. Insofar as it threatens the health of Indiana Myotis populations, the Project also may impose higher costs for governments, firms, and households that engage in future activities that affect the species, and higher

[102] U.S. Fish and Wildlife Service. "Species Profile." Retrieved on 7 July 2011, from http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=A000.

[103] Kunz, T., E. Braun de Torrez, D. Bauer, T. Lobova, and T. Fleming. 2011. "Ecosystem Services Provided by Bats." *Annals of the New York Academy of Sciences*. 1-38.

[104] Boyles, J., P. Cryan, G. McCracken, T. Kunz. 2011. "Economic Importance of Bats in Agriculture." *Science*. 332: 41-42.

costs for governments charged with monitoring species status and ensuring their protection.[105]

Table 3. Household Willingness to Pay (WTP) to Protect Sensitive Species

Species	Survey Region	Willingness to Pay	Annual or Lump-sum
Wild turkey	New England	$12.75 - $17.20	Annual Payment
Red-cockaded woodpecker	U.S.	$14.72 - $22.92	Annual Payment
Peregrine falcon	Maine	$36.14	Lump-sum Payment
Mexican spotted owl	U.S.	$77.10	Annual Payment

Source: Richardson, L. and J. Loomis. 2009. "The Total Economic Value of Threatened, Endangered and Rare Species: An Updated Meta-Analysis." *Ecological Economics*. 68: 1535-1548.

Recreation. The Project, in concert with gas-well development in northeast Pennsylvania, likely would produce cumulative impacts on recreational benefits derived from the natural resources in Sullivan, Bradford, and Lycoming Counties. These impacts would materialize insofar as they would negatively affect water quantity, water quality, air quality, wildlife habitat, visual aesthetics, archeological and historical sites, and peace and quiet.. Additional impacts might occur as they cumulatively affect traffic and congestion, and the demand for lodging.

The region that would experience cumulative impacts from the Project and gas-well development in northeast Pennsylvania, including Bradford, Lycoming, and Sullivan Counties, contains several different parcels of State Game Land, as well as Tamarack Run Natural Area, World's End State Park, Ricketts Glen State Park, Kettle Creek Wild Area, and Kettle Creek Gorge Natural Area.[106] These designated spaces provide several recreation opportunities including hunting, fishing, hiking, and wildlife viewing. In addition to these areas, private lands throughout the region offer a wide variety of recreation opportunities:

- Lands, including county parks, a state park, State Game Land, and private lands in Bradford County provide residents and visitors with recreation opportunities such as hiking, picnicking, fishing, biking, wildlife viewing, and hunting.[107]
- Residents of Lycoming County say they participated in many types of recreation in the County's public parks and State Game Lands, including picnicking and enjoying open space, and exercising for fitness. Residents of Lycoming County alone visited five public recreation areas in 2003 at a rate of about 232,543 visits

[105] Wilcove, D. and L. Chen. 1998. "Management Costs for Endangered Species." *Conservation Biology*. 12(6): 1405-1407.

[106] Pennsylvania Game Commission. "State Game Land Maps." Retrieved on 7 July 2011, from http://www.portal.state.pa.us/portal/server.pt/community/state_game_lands/11363.

[107] Bradford County, Pennsylvania. 2010. *Bradford County Parks Master Plan*. September.

per year, or 2 visits per resident of the County per year (this does not include residents from elsewhere that participated in recreation activities in the County).[108]

- Lycoming's 2008 Recreation Plan identifies several key goals related to water-based recreation in the county, including improving water quality, increasing the number of public facilities, and improving their quality.[109]
- Sullivan County is home to many high-quality nature-based recreation opportunities. World's End State Park is known for its sightseeing, hunting, fishing, boating, hiking, camping, and various winter activities.[110] In Ricketts Glen State Park, visitors boat, swim, hunt, camp, and use hiking and equestrian trails.[111] Sullivan County also has two natural areas: Kettle Creek Gorge and Tamarack Run, which also provide water-based and land-based recreation opportunities.[112]

Outdoor recreation plays an important role in the economy. Across the state of Pennsylvania, in 2006, resident anglers spent about $16 per person per day on trip-related, equipment, and other expenditures while non-resident anglers spent about $26 per person per day for a total of about $1.4 billion (in 2011 dollars). Resident hunters spent about $15 per person per day on trip-related, equipment, and other expenditures while non-resident anglers spent about $17 per person per day for a total of about $1.8 billion. Resident wildlife watchers (away from their homes) spent about $25 per person per day on trip-related, equipment, and other expenditures while non-resident wildlife watchers spent about $50 per person per day for a total of about $1.6 billion.[113] There are insufficient data to breakdown these expenditures to the county level, but some of the statewide expenditures likely went to individuals providing goods and services and communities within Bradford, Lycoming, and Sullivan Counties. Table 4 shows that, in 1999, thousands of individuals purchased fishing licenses and boat registrations in the three counties, and many of those individuals likely spent time and additional money on fishing and boat-related recreation in the three counties. Furthermore, state park attendance in the three counties was over 400,000 in 1999.[114] Some of the individuals visiting these parks likely were from the area, others may have travelled long distances.

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[108] County of Lycoming, Pennsylvania. 2003. *Lycoming County Recreation Survey*. March.

[109] Lycoming County. 2008. *Comprehensive Recreation, Parks, and Open Space/Greenway Plan*. April.

[110] *Worlds End State Park*. Retrieved on July 8, 2011, from http://www.dcnr.state.pa.us/stateparks/parks/worldsend.aspx.

[111] *Ricketts Glen State Park*. Retrieved on July 8, 2011, from http://www.dcnr.state.pa.us/stateparks/parks/rickettsglen.aspx.

[112] *County Natural Heritage Inventories*. Retrieved on July 8, 2011, from http://www.naturalheritage.state.pa.us/CNHI.aspx.

[113] U.S. Fish and Wildlife Service. 2008. *2006 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation: Pennsylvania*. FHW/06-PA.

[114] Pennsylvania State Data Center. 2000. *Research Brief: Recreational Licenses and State Park Attendance are Popular in Pennsylvania*. September.

In both cases, the individuals visiting the state parks likely spent money on goods and services related to their trips.

Table 4. Fishing Licenses, Boat Registrations, and State Park Attendance in 1999

County	Fishing Licenses	Boat Registrations	State Park Attendance
Bradford County	7,908	2,950	87,126
Lycoming County	15,280	6,114	119,239
Sullivan County	1,557	335	201,877

Source: Pennsylvania State Data Center. 2000. *Research Brief: Recreational Licenses and State Park Attendance are Popular in Pennsylvania.* September.

These data illustrate the importance of recreational activity for the residents of the three-county area. The region's high-quality resources attract visitors from other parts of Pennsylvania and the United States as well. Insofar as the Project and the accompanying development of and production by gas wells in the counties would diminish the quality of quantity of recreational opportunities in the area, they would cumulatively reduce the number of or duration of recreation trips, recreation-based expenditures, and related jobs, incomes, and tax revenues in the three counties.

They also would have cumulative effects on the economic well-being of recreationists. Oftentimes, individuals participating in recreation activities derive benefits from their experience in excess of the money they spent to participate in the activity. The difference between what they would be willing to pay and what they actually pay to participate in a recreation activity represents the second component of value, called consumer surplus. Consumer surplus is important because it registers improvements in economic well-being: if someone can pay just a little to enjoy fishing, boating, or some other activity that is worth a lot, then he or she is economically better off.

Table 5 contains estimated values of the consumer surplus derived from several different types of recreation activities available in Bradford, Lycoming, and Sullivan Counties. The table contains the average value among Northeast studies, the average value from studies across the nation, as well as the full range of recorded values. The economic importance of recreation is increasing in importance overall: more people are recreating more often, and willing to pay greater amounts to do so. The study from which these values are drawn indicates that they are growing faster than inflation, with the value of an outdoor recreational activity-day growing by about $1 per year.[115]

The analytical steps FERC must take to describe the potential cumulative impacts on recreational services are well understood. For example, to determine the impacts on hiking, it first must identify all hiking trails that the Project would affect directly. Current information indicates it would intersect the Loyalsock Hiking Trail. Then, it must identify gas-well developments that also would interfere with each trail, estimate

[115] Rosenberger, R. and J. Loomis. 2001. *Benefit Transfer of Outdoor Recreation Use Values: A Technical Document Supporting the Forest Service Strategic Plan (2000 Revision)*. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. General Technical Report No. RMRS-GTR-72.

the cumulative, potential impact on the number of hiking trips, and calculate the socioeconomic changes that would result. Table 5 shows the average consumer surplus associated with a day of hiking is nearly $90 per person in the Northeastern United States. Additional data would provide the basis for estimating the change in expenditures that would accompany the changes in hiking on each trail, and the likelihood that hikers would shift their focus to other trails or to other activities.

Table 5. Consumer Surplus per Recreation Day for Various Recreation Activities ($/Person/Recreation Day)

Recreation Activity	Northeast Mean	National Mean	National Range
Birdwatching	$41.69	$35.40	$6.94 - $93.84
Camping	$39.60	$44.48	$2.43 - $268.54
Fishing	$38.99	$56.40	$2.49 - $665.96
General Recreation	$20.18	$41.98	$1.70 - $307.98
Hiking	$89.92	$36.88	$0.48 - $313.40
Mountain biking	$48.95	$88.24	$24.95 - $353.65
Picnicking	$67.51	$49.59	$10.69 - $170.72
Sightseeing	$145.23	$44.06	$0.78 - $250.88
Swimming	$26.56	$51.05	$2.63 - $160.67
Wildlife viewing	$37.43	$50.66	$2.87 - $416.06

Source: Loomis, J. 2005. *Updated Outdoor Recreation Use Values on National Forests and Other Public Lands*. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. General Technical Report PNW-GTR-658.

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