Federal Energy Regulatory Commission

Office of Energy Projects

March 2016

Tennessee Gas Pipeline Company, L.L.C **Docket No. CP15-148-000**

Susquehanna West Project

Environmental Assessment

Washington, DC 20426

FEDERAL ENERGY REGULATORY COMMISSION
WASHINGTON, D.C. 20426

OFFICE OF ENERGY PROJECTS

In Reply Refer To:
OEP/DG2E/Gas 2
Tennessee Gas Pipeline Company, L.L.C.
Docket No. CP15-148-000

TO THE PARTY ADDRESSED:

The staff of the Federal Energy Regulatory Commission (FERC or Commission) has prepared this environmental assessment (EA) for the Susquehanna West Project (Project) proposed by Tennessee Gas Pipeline Company (TGP) in the above-referenced docket. TGP requests authorization to construct pipeline facilities in Pennsylvania to increase east-to-west natural gas delivery capacity in the region by approximately 145,000 dekatherms per day.

The EA assesses the potential environmental effects of the construction and operation of the Project in accordance with the requirements of the National Environmental Policy Act (NEPA). The FERC staff concludes that approval of the proposed Project, with appropriate mitigating measures, would not constitute a major federal action significantly affecting the quality of the human environment.

TGP's proposed Project involves construction of approximately 8.1 miles of 36-inch-diameter looping pipeline in two segments and modifications at three existing compressor stations, two of which would include increased compression at the station.

The FERC staff mailed copies of the EA to federal, state, and local government representatives and agencies; elected officials; environmental and public interest groups; Native American tribes; potentially affected landowners and other interested individuals and groups; newspapers and libraries in the project area; and parties to this proceeding. In addition, the EA has been placed in the public files of FERC and is available for viewing on the FERC's website at www.ferc.gov using the eLibrary link. A limited number of copies of the EA are available for distribution and public inspection at:

Federal Energy Regulatory Commission
Public Reference Room
888 First Street NE, Room 2A
Washington, DC 20426
(202) 502-8371

Any person wishing to comment on the EA can do so. Your comments should focus on the potential environmental effects, reasonable alternatives, and measures to lessen or avoid environmental impacts. The more specific your comments, the more useful they will be. To ensure that the Commission has the opportunity to consider your comments prior to making its decision on this Project, it is important that we receive your comments in Washington, DC on or before **April 18, 2016**.

For your convenience, there are three methods you can use to file your comments with the Commission. In all instances, please reference the project docket number (CP15-148-000) with your submission. The Commission encourages electronic filing of comments and has expert staff available to assist you at 202-502-8258 or efiling@ferc.gov.

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

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

(3) You can file a paper copy of your comments at the following address:

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

Any person seeking to become a party to the proceeding must file a motion to intervene pursuant to Rule 214 of the Commission's Rules of Practice and Procedures (18 Code of Federal Regulations 385.214).[1] Only intervenors have the right to seek rehearing of the Commission's decision. The Commission grants affected landowners and others with environmental concerns intervenor status upon showing good cause by stating that they have a clear and direct interest in this proceeding which no other parties can adequately represent. **Simply filing environmental comments will not give you intervenor status, but you do not need intervenor status to have your comments considered.**

[1] See the previous discussion on the methods for filing comments.

Additional information about the Project is available from the Commission's Office of External Affairs at **(866) 208-FERC** or on the FERC website (www.ferc.gov) using the eLibrary link. Click on the eLibrary link, click on "General Search" and enter the docket number excluding the last three digits in the Docket Number field (i.e., CP15-148). Be sure you have selected an appropriate date range. For assistance, please contact FERC Online Support at FercOnlineSupport@ferc.gov or toll free at (866) 208-3676, or for TTY, contact (202) 502-8659. The eLibrary link also provides access to the texts of formal documents issued by the Commission, such as orders, notices, and rulemakings.

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

TABLE OF CONTENTS

LIST OF TABLES

LIST OF APPENDICES

TECHNICAL ACRONYMS

AERMOD	American Meteorological Society/Environmental Protection Agency Regulatory Model Improvement Committee Dispersion Model
AQCR	Air Quality Control Regions
ATWS	additional temporary workspaces
BGEPA	Bald and Golden Eagle Protection Act
BMPs	best management practices
CAA	Clean Air Act of 1970 and its amendments
CEQ	Council on Environmental Quality
Certificate	Certificate of Public Convenience and Necessity
CFR	Code of Federal Regulations
CH_4	methane
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalents
Commission	Federal Energy Regulatory Commission
CS	Compressor Station
dB	decibels
dBA	A-weighted decibels
DTI	Dominion Transmission, Inc.
E&SCP	Erosion and Sediment Control Plan
EA	environmental assessment
EI	environmental inspector
EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency
ESCGP	Erosion and Sediment Control General Permit
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FWS	U.S. Fish and Wildlife Service
GHG	greenhouse gas
HAP	hazardous air pollutants
HDD	horizontal directional drill
hp	horsepower
HQ-CWF	High Quality Cold Water Fishery
LAER	lowest achievable emission rate
L_{dn}	day-night sound level
L_{eq}	equivalent sound level
Liberty Power Project	Panda Power Funds Liberty Power Project
m	meter
MBTA	Migratory Bird Treaty Act
Memorandum	Memorandum of Understanding on Natural Gas Transportation Facilities
MP	milepost
N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NED	Northeast Energy Direct
NEPA	National Environmental Policy Act
NESHAP	National Emissions Standards for Hazardous Air Pollutants
NEUP	TGP's Northeast Upgrade Project
NGA	Natural Gas Act
NNSR	Nonattainment New Source Review

NO_2	nitrogen dioxide
NO_x	nitrogen oxides
NOI	*Notice of Intent to Prepare an Environmental Assessment for the Proposed Susquehanna West Project and Request for Comments on Environmental Issues*
NPDES	National Pollution Discharge Elimination System
NRHP	National Register of Historic Places
NRTW	Naturally Reproducing Trout Waters
NSA	noise sensitive areas
NSD	TGP's Northeast Supply Diversification Project
O_3	ozone
OEP	Office of Energy Projects
Order	Commission's Order
OTR	Ozone Transport Region
Pa. Code	Pennsylvania Code
PADCNR	Pennsylvania Department of Conservation and Natural Resources
PADEP	Pennsylvania Department of Environmental Protection
PAFBC	Pennsylvania Fish and Boat Commission
PAGC	Pennsylvania Game Commission
PEM	palustrine emergent
PennDOT	Pennsylvania Department of Transportation
PERT	Program Evaluation Review Technique
PFO	palustrine forested
PHMSA	Pipeline Hazardous Material and Safety Administration
Plan	Commission's Upland Erosion Control, Revegetation, and Maintenance Plan
PM_{10}	particulate matter with an aerodynamic diameter less than or equal to 10 microns
$PM_{2.5}$	particulate matter with an aerodynamic diameter less than or equal to 2.5 microns
PNDI	Pennsylvania Natural Diversity Index
Procedures	Commission's Wetland and Waterbody Construction and Mitigation Procedures
Project	Susquehanna West Project
PSD	Prevention of Significant Deterioration
PSS	palustrine scrub-shrub
PTE	potential-to-emit
SHPO	Pennsylvania State Historic Preservation Office
SIP	State Implementation Plans
SO_2	sulfur dioxide
SPCC Plan	Spill Prevention, Control, and Countermeasures Plan
TGP	Tennessee Gas Pipeline Company
TGP's Plan and Procedures	TGP's project-specific Plan and Procedures
tpy	tons per year
TSF	Trout Stocked Fishery
USC	U.S. Code
USDOT	U.S. Department of Transportation
USGS	U.S. Geological Survey
VOC	volatile organic compounds
µg	micrograms

A. PROPOSED ACTION

1. INTRODUCTION

The staff of the Federal Energy Regulatory Commission (Commission or FERC) has prepared this environmental assessment (EA) to assess the environmental effects of the natural gas pipeline facilities proposed by Tennessee Gas Pipeline Company (TGP). We[1] prepared this EA in compliance with the requirements of the National Environmental Policy Act of 1969 (NEPA), Title 40 of the Code of Federal Regulations (CFR), Parts 1500-1508 [40 CFR 1500-1508], and with the Commission's implementing regulations under 18 CFR 380.

On April 2, 2015, TGP filed an application with the Commission in Docket No. CP15-148-000 under section 7(c) of the Natural Gas Act (NGA) and Part 157 of the Commission's regulations. TGP seeks authorization to construct, own, and operate a new natural gas pipeline loop[2] and modify existing compressor stations to increase east-to-west natural gas delivery capacity along TGP's 300 Line system. The project is referred to as the Susquehanna West Project (Project or proposed Project).

Our EA is an integral part of the Commission's decision on whether to issue TGP a Certificate of Public Convenience and Necessity (Certificate) to construct and operate the proposed facilities. Our principal purposes in preparing this EA are to:

- identify and assess potential impacts on the natural and human environment that could result from implementation of the proposed actions;
- identify and recommend reasonable alternatives and specific mitigation measures, as necessary, to avoid or minimize project-related environmental impacts; and
- facilitate public involvement in the environmental review process.

2. PURPOSE AND NEED

TGP states that the purpose of the Project is to increase east-to-west transportation in order to respond to the needs of a contracted shipper. The Project would allow TGP to provide approximately 145,000 dekatherms per day of natural gas capacity on TGP's 300 Line to provide long-term firm transportation service to the Project Shipper, Statoil, which fully subscribed to the firm transportation capacity to be created by the Project. This transportation capacity would serve an existing downstream customer.

Under Section 7(c) of the NGA, the Commission determines whether interstate natural gas transportation facilities are in the public convenience and necessity and, if so, grants a Certificate to construct and operate them. The Commission bases its decisions on technical competence, financing, rates, market demand, gas supply, environmental impact, long-term feasibility, and other issues concerning a proposed project.

---

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

[2] A loop is a pipeline that is constructed adjacent to another pipeline, typically in the same right-of-way, for the purpose of increasing capacity in this portion of the system.

3. PROPOSED FACILITIES

The proposed Project consists of:

- constructing two new loops that total 8.1 miles of 36-inch-diameter natural gas pipeline, along and adjacent to TGP's existing right-of-way on its 300 Line, located in Tioga and Bradford Counties, Pennsylvania. The Western Loop is approximately 6.2 miles in length and located west of TGP's Compressor Station (CS) 315. The Eastern Loop is approximately 1.9 miles in length and located east of CS 315;

- modifying two existing compressor stations, CS 317 and CS 319 in Bradford County, Pennsylvania in order to increase compression capacity. An existing Solar Mars 100 turbine would be relocated from CS 319 to CS 317, resulting in an increase of 16,000 horsepower (hp) at CS 317. A new 20,500 hp Solar Titan 130 compressor unit at CS 319, which replaces the Solar Mars 100 turbine, would result in a net increase of 4,500 hp at CS 319. Additional piping modifications and minor equipment modifications would occur at both CS 317 and CS 319; and

- conducting piping and equipment modifications at CS 315 in Tioga County, Pennsylvania.

Maps showing the location of the proposed facilities are included in appendix A (see figures 1 and 2).

TGP anticipates conducting tree clearing beginning November 2016 (outside of northern long-eared bat habitat) and ending no later than March 2017. All remaining construction activities would commence in the fourth quarter of 2016 or the second quarter of 2017.

4. PUBLIC PARTICIPATION AND COMMENT

On June 10, 2015, the Commission issued a *Notice of Intent to Prepare an Environmental Assessment for the Proposed Susquehanna West Project and Request for Comments on Environmental Issues* (NOI). The NOI was mailed to interested parties including federal, state, and local officials; agency representatives; Native American tribes; local libraries and newspapers; and property owners affected by the proposed facilities. This notice opened the scoping period for 30 days. We received several comments during the scoping period in response to the NOI. Written comments regarding environmental issues were received from the Pennsylvania Department of Environmental Protection (PADEP); the Pennsylvania Department of Conservation and Natural Resources (PADCNR); the Pennsylvania Department of Transportation (PennDOT); the Stockbridge-Munsee Community Band of Mohican Indians; and the Allegheny Defense Project. The comments primarily concerned impacts on air quality, state-listed species, state roads, and state forest lands. Comments received during the scoping period are addressed in the applicable sections of the EA.

5. LAND REQUIREMENTS

The new pipeline loop segments would be installed within TGP's existing permanent right-of-way and parallel to its existing 300 Line system, offset approximately 25 feet to the south of the 300-1 line. TGP would construct the new Line 300-3 using either a 110-foot-wide or 125-foot-wide construction right-of-way in uplands. Approximately 4.1 miles of the new pipeline loop segments would be constructed within the Tioga State Forest. Outside of the Tioga State Forest, the typical upland construction right-of-way width would total 125 feet, consisting of a 30-foot-wide temporary workspace,

a 70-foot-wide portion of the existing permanent easement associated with the 300 Line system, and a new 25-foot-wide area adjacent to the existing 300 Line system permanent easement that would be maintained as permanent easement for the new pipeline loop. Within the Tioga State Forest, the typical upland construction right-of-way would total 110 feet wide, consisting of a 45-foot-wide temporary workspace, a 52-foot-wide portion of the existing permanent easement associated with the 300 Line system, and a new 13-foot-wide permanent easement adjacent to the existing 300 Line system permanent easement for the new pipeline loop. In wetlands, the construction right-of-way would be reduced to 75 feet wide or less. Typical right-of-way diagrams for construction and operation of the proposed pipeline outside of and within the Tioga State Forest are included in appendix A (see figures 3 and 4).

Construction requirements include all temporary workspace areas, existing permanent easement or fee property, new permanent easement, and access roads associated with the Project. The footprint of all project-related disturbances during construction (Construction Workspace) is estimated at 204.4 acres. Table A.5-1 provides a summary of the acreages of land required for construction and new land requirements for operation (permanent impacts) of the Project.

Operation of the Project would require a 50-foot-wide permanent right-of-way centered on the pipeline in most areas. TGP proposes to use 25 feet of existing right-of-way associated with the existing permanent easement of the 300 Line system and to add 25 feet of new permanent easement. The typical width of TGP's existing permanent right-of-way for the 300 Line system is 150 feet outside of the Tioga State Forest. As a result of the Project, the proposed total permanent easement would increase to 175 feet outside of the Tioga State Forest.

Within the Tioga State Forest, the typical width of TGP's existing permanent right-of-way for the 300 Line system is 75 feet. For operations purposes, TGP would acquire an additional 10-foot-wide easement within the Tioga State Forest for the loop pipeline, adjacent to the existing permanent easement for lines 300-1 and 300-2. This includes adding 13 feet of new permanent easement to the south of the proposed pipeline and relinquishing 3 feet of existing permanent easement to the north of the proposed pipeline. As a result of the Project, the proposed total permanent easement would increase to 85 feet within of the Tioga State Forest.

The Project would require approximately 62.0 acres of permanent right-of-way for operation, of which 21.9 acres would be new permanent right-of-way, as detailed in table A.5-1.

Although TGP has identified areas where additional temporary workspace would be required, additional or alternative areas could be identified in the future due to changes in site-specific construction requirements. TGP would be required to file information on each of those areas for review and approval prior to use.

5.1 Access Roads, Staging Area/Pipe Yard, and Additional Temporary Workspace

TGP proposes to use eleven public (local municipal) and private roads to access the construction right-of-way for the Western and Eastern Loops. TGP would conduct improvements for some of the existing non-public access roads. For the Western Loop, two new access roads would be constructed, four existing roads would require widening or other improvements to accommodate construction traffic, and three access roads are existing roads that do not require improvements. For the Eastern Loop, both access roads are existing private roads that would require widening or other improvements to accommodate construction traffic. The acreage of impact from the expansion of these access roads is included in table A.5-1.

Extra workspace, including additional temporary workspaces (ATWS) and staging areas, are typically required at road, railroad, existing utility, pipeline interconnections, wetland, and waterbody crossings, as well as aboveground facility locations. These workspaces vary in size and depend on site-specific conditions and the construction method or need. TGP has identified seven staging areas and 21 areas of ATWS required for the construction of the Project, which are listed in table 3 of appendix B.

TABLE A.5-1

Land Requirements

Project Component	Construction Workspace (acres) [a]	New Permanent Right-of-Way (acres) [b]	Existing Permanent Right-of-Way (acres) [c]
WESTERN LOOP			
Pipeline Facilities	83.9	14.6	28.3
Additional Temporary Workspace	1.9	0.0	0.0
Staging Areas	2.4	0.0	0.0
Access Roads	10.5	1.5	0.0
Western Loop – Pipeline Facilities Subtotal	**98.7**	**16.0**	**28.3**
EASTERN LOOP			
Pipeline Facilities	26.0	5.6	11.8
Additional Temporary Workspace	0.2	0.0	0.0
Staging Areas	1.4	0.0	0.0
Access Roads	0.6	0.2	0.0
Eastern Loop – Pipeline Facilities Subtotal	**28.2**	**5.8**	**11.8**
PIPE YARD			
Pipe Yard at Tioga River	4.8	0.0	0.0
CS 315 [d]			
Temporary Workspace	5.9	0.0	0.0
Permanent Aboveground Component	5.0	0.0	0.0
CS 315 Subtotal	**10.9**	**0.0**	**0.0**
CS 317 [d]			
Temporary Workspace	15.7	0.0	0.0
Permanent Aboveground Component	16.5	0.0	0.0
CS 317 Subtotal	**32.2**	**0.0**	**0.0**
CS 319 [d]			
Temporary Workspace	22.2	0.0	0.0
Permanent Aboveground Component	7.4	0.0	0.0
CS 319 Subtotal	**29.6**	**0.0**	**0.0**
Project Totals	**204.4**	**21.9**	**40.1**

[a] Areas disturbed by construction activities, including 110-foot-wide or 125-foot-wide construction right-of-way. Access roads include acreage of improvements, including widening and construction of new roads.

[b] New 25-foot-wide or 10-foot-wide permanent easement acquired for the operation of 300-3 Line, adjacent to existing permanent easement for 300-1 and 300-2 Lines, excluding temporary construction right-of-way.

[c] Portion of existing 300 Line system permanent right-of-way to be use for the operation of the proposed Project.

[d] Land impacts at compressor stations would occur within the existing property boundaries.

One approximately 5-acre pipe yard, near the Tioga River, would also be used. Total acreages for extra workspace and the proposed pipe yard are detailed in table A.5-1. None of the areas of ATWS or the pipe yard would be used for pipeline operation.

The FERC's *Wetland and Waterbody Construction and Mitigation Procedures* (Procedures) require that extra work areas would be located at least 50 feet away from the water's edge and/or wetland boundaries, unless site-specific approval is granted. TGP has requested several extra work areas within 50 feet of the edge of a waterbody or the boundary of a wetland. Each of these locations and site-specific justifications for the alternate measures from the FERC's Procedures are provided in table A.5-2 below.

TABLE A.5-2

Additional Temporary Workspaces Located within 50 Feet of a Wetland or Waterbody

Location / Pipeline Milepost (MP)	Name of Feature or Field ID [a]	Description [b]	Site-Specific Justification for Alternate Measure
WESTERN LOOP [c]			
MP 0.04	W16	ATWS on west side of W16 has 8-foot-wide buffer from wetland boundary Located at kick-off near trap site	Additional spoil area and staging required to construct the western tie-in facility. Limited space available due to existing active pipelines within the construction right-of-way.
EASTERN LOOP [c]			
MP 0.23	W4 & Catlin Hollow Creek (S7)	ATWS on west side of wetland/stream complex for Catlin Hollow Creek has 1- to 3-foot-wide buffer to wetland boundary.	Limited space due to road, stream, and wetland crossing. Additional workspace needed for equipment storage for boring equipment.
MP 1.87	W3	ATWS has no buffer (0 feet) between workspace and wetland W3.	Allows for additional spoil storage and staging area for the eastern tie-in facility. Limited space available due to presence of existing active pipelines within the construction right-of-way.

[a] Field ID number corresponds to identification number in the project alignment sheets, issued 1/20/2016. W = wetland; S = stream or waterbody.

[b] Data is based on field survey completed for the Project, which is depicted on the alignment sheets.

[c] Milepost references in the pipeline loops correspond to the new 36-inch-diameter pipeline lateral, Line 300-3.

We have reviewed each of these locations and the site-specific justifications provided by TGP and find them to be acceptable. The appropriate implementation of erosion control measures in these locations would provide adequate protection for the adjacent resource.

6. CONSTRUCTION, OPERATION, AND MAINTENANCE PROCEDURES

The proposed facilities would be designed, constructed, tested, operated, and maintained in accordance with the U.S. Department of Transportation (USDOT) Minimum Federal Safety Standards in 49 CFR 192. The USDOT's regulations are intended to ensure adequate protection for the public and to prevent natural gas facility accidents and failures. Part 192 specifies material selection and qualification, minimum design requirements, and protection from internal, external, and atmospheric corrosion.

TGP proposes to follow the construction procedures and mitigation measures contained in the Commission's *Upland Erosion Control, Revegetation, and Maintenance Plan* (Plan) and Procedures,[3] with three alternate measures to the FERC Procedures regarding ATWS wetland and waterbody set-backs (see table A.5-2), slope breakers, and wetland seed and mulch requirements, which are discussed in section B.2.3. We have reviewed these proposed alternate measures to the FERC's Procedures and find them acceptable. Therefore, TGP would follow its project-specific Plan and Procedures (TGP's Plan and

[3] Copies of the Plan and Procedures may be accessed on our website (http://www.ferc.gov/industries/gas/enviro/guidelines.asp) or obtained through our Office of External Affairs at 1-866-208-3372.

Procedures), which include these approved alternate measures. TGP would incorporate these alternate measures into its Erosion and Sediment Control Plan (E&SCP), which would be finalized and submitted to the Commission prior to construction.

TGP would use conventional techniques for buried pipeline construction and aboveground facility construction and follow the requirements set forth in its Plan and Procedures to ensure safe, stable, and reliable transmission facilities consistent with Commission and USDOT specifications.

In addition to its Plan and Procedures, TGP has prepared an acceptable *Spill Prevention, Control, and Countermeasures Plan* (SPCC Plan) which contains measures to prevent and respond to any inadvertent releases of hazardous materials as well as notification procedures in the event of a release.

TGP would use at least one full-time environmental inspector (EI) during construction of the Project. The EI would be on site during project construction activities to ensure compliance with the construction procedures contained in TGP's Plan and Procedures. A full list of the EI's duties is presented in section II.B of TGP's Plan. The EI's responsibilities include:

- ensuring compliance with applicable federal, state, and local environmental permits;
- ordering corrective actions for acts that violate the environmental conditions of the Commission's Certificate, or any other authorizing document;
- ensuring compliance with site-specific construction and restoration plans or other mitigation measures and landowner agreements; and
- maintaining construction status reports.

TGP would conduct environmental training sessions in advance of construction to ensure that all individuals working on the Project are familiar with the environmental mitigation measures appropriate to their jobs and the EI's authority.

6.1 Pipeline Construction

TGP would conduct construction activities during daylight hours for 10 hours per day, 6 days per week; however, 24-hour construction activities may occur on a limited basis due to site conditions, specialized construction techniques, and/or weather-related events. Twenty-four hour activities would be limited to the installation of pipe utilizing the horizontal directional drill (HDD) technique (further described in section A.6.1.6), the running of water pumps during hydrostatic testing, and trenching activities in areas with open-trench timing restrictions.

To comply with USDOT specifications, TGP would hydrostatically test all pipeline facilities prior to placing them in service. Hydrostatic testing is further discussed in section B.2.2.

6.1.1 Clearing and Grading

Clearing operations involve removing vegetation, including trees, within the construction right-of-way or construction work areas. TGP's proposed pipeline loops consist mainly of forested and open land. TGP would clear trees along the pipeline right-of-way between September 1st and March 31st as required by the U.S. Fish and Wildlife Service (FWS) to avoid impacts on migratory birds. In the event that tree clearing is required outside of this window, TGP would implement additional mitigation measures. TGP would clear trees along the Western Loop of the pipeline and pipe yard between

November 15th and March 31st, as required by the FWS to avoid impacts on the federally listed northern long-eared bat. Felled trees may be left on the right-of-way (except in wetlands, waterbodies, and other sensitive resources) until grading activities commence in the spring to further minimize ground disturbance.

After clearing is complete, TGP would install temporary erosion control devices along the limits of wetland boundaries within the construction right-of-way. Grading of the construction right-of-way would be necessary for the movement of heavy equipment and safe passage for work crews.

6.1.2 Trenching

In accordance with TGP's Plan, measures would be employed to minimize soil erosion during trenching. In addition, measures such as installing trench breakers would be taken to prevent the flow of water through the trench.

To minimize impacts on residential lands, topsoil would be segregated from subsoil during trenching and would remain segregated during construction to avoid loss due to mixing with subsoil material. Upon completion of backfilling operations, the topsoil would be replaced over the graded area. TGP would utilize either full right-of-way topsoil segregation, which involves removal and segregation of topsoil over the entire construction right-of-way prior to commencing construction, or ditch-plus-spoil-side topsoil segregation, which involves removal and segregation of topsoil from the excavation ditch and spoil storage area prior to commencing construction, as requested by the landowner or as required by the Tioga County Conservation District.

The trench would be at least 14 inches wider than the diameter of the pipe. Typically, the trench for a pipeline must be excavated to a depth which allows for a minimum of 36 inches of cover in accordance with USDOT regulations. However, at crossings of foreign pipelines, utilities, or other structures the trench may be buried deeper to allow for a minimum of 12 inches of clearance.

A total of 17 public and private roads would be crossed by the Project. The Western Loop would cross eight private roadways and four public roads, two of which are crossed multiple times (i.e., Tower Road and Baldwin/Baldwin Run Road). All of these roads would be crossed using the open-cut construction technique. The Eastern Loop would cross three private roadways and two public roads. One public road, Catlin Hollow Road, would be crossed using the conventional bore method, and the remaining four roads along the Eastern Loop would be crossed using the open-cut construction technique. For all road crossings, TGP would ensure that construction activities do not prohibit the passage of vehicles and make provisions for traffic management during construction as necessary.

PennDOT provided comments regarding potential socioeconomic impacts associated with road crossings. Additional detail regarding road crossing impacts are included in section B.5.

6.1.3 Pipe Stringing, Preparation, and Lowering In

Pipe stringing involves moving the pipe into position along the construction right-of-way in a continuous line parallel to the excavated trench in preparation for subsequent lineup and welding operations. The pipe is then bent, where necessary, to conform to changes in the direction of the alignment and natural ground contours. After the pipe has been bent, it would be lined-up and welded, and then the welds and pipe coating are inspected. Side-boom tractors are used to lower the pipe into the trench. Trench dewatering would be performed in accordance with TGP's Plan and Procedures.

6.1.4 Backfilling and Grade Restoration

After the pipe is lowered into the trench, the trench would be backfilled using the material originally excavated from the trench. Topsoil would not be used for padding the pipeline. In some cases, additional backfill material from other sources may be used. In areas where topsoil has been segregated, the subsoil would be placed in the bottom of the trench, followed by replacing the topsoil over the subsoil layer. The surface of the construction work space would be graded to conform to pre-existing contours of the adjoining area, except for a slight crown of soil over the trench (in upland areas only) to compensate for natural subsidence of the backfill material.

6.1.5 Cleanup and Restoration

Weather and soil conditions permitting, final cleanup would occur within 20 days after the trench is backfilled (within 10 days in residential areas). After backfilling is complete, all disturbed areas would be graded to the original contours, any remaining debris properly disposed of, permanent erosion controls constructed or installed, and the right-of-way seeded with an appropriate seed mix. Examples of typical erosion control devices include slope breakers, sediment barriers (such as silt fence or straw bales), and mulch. All restoration activities would be completed according to TGP's Plan and Procedures. Seeding would be completed according to the recommendations of the National Resource Conservation Service, the applicable County Conservation Districts, and landowner agreements.

6.1.6 Special Pipeline Construction Procedures

TGP would use special construction techniques when constructing across waterbodies, wetlands, roads and railroads, and residential areas, as described below.

Waterbody Crossings

TGP has proposed to cross all waterbodies using dry crossing techniques. TGP would cross ephemeral waterbodies and ditches where there is no perceptible flow at the time of crossing, using standard upland crossing techniques. TGP would maintain adequate equipment on site to conduct a dry-ditch crossing should perceptible flow occur during construction.

The proposed crossing method for each of the waterbodies in the Project area is included in section B.2.1.

Dry-Ditch Crossing Method

A dry-ditch waterbody crossing consists of either a flume crossing or a dam-and-pump crossing. A flume crossing involves diverting the flow of water across the construction work area through one or more flume pipes placed in the waterbody. Sandbags or other diversion structures would be placed directly in the waterbody upstream and downstream of the pipeline centerline to divert the water flow through the flume pipes. The trench line would be isolated and pumped dry, allowing construction crews to excavate the trench and install the pipe. Downstream water flow would be maintained until the trench is backfilled, at which time the dams and flume pipe would be removed.

The dam-and-pump crossing method involves using pumps and hoses instead of flumes to move water around the construction work area. Water flow would be maintained while the pipeline is installed and the trench backfilled. After backfilling, the dams, pumps, and hoses would be removed and the banks restored and stabilized.

To the extent possible, streambeds would be returned to their preconstruction contours, and stream and river banks restored to their preconstruction condition and allowed to re-vegetate in accordance with TGP's Plan and Procedures and applicable permit conditions.

Wetland Crossings

Wetland boundaries would be delineated and marked in the field prior to construction activities. The pipeline construction right-of-way in wetlands would be limited to 75 feet. Woody vegetation within the construction right-of-way would be cut off at ground level and removed from the wetlands, leaving the root systems intact. The pulling of tree stumps and grading activities would be limited to the area directly over the trench line unless it is determined that safety-related construction constraints require grading or the removal of stumps from the working side of the right-of-way. Construction equipment operating in wetland areas would be limited to that needed to clear the right-of-way, dig the trench, install the pipeline, backfill the trench, and restore the right-of-way. Topsoil segregation would be utilized in unsaturated wetlands to preserve the existing seed bank and aid in the successful restoration of the disturbed wetland. Trench plugs would be installed as necessary to maintain wetland hydrology.

The specific crossing procedures used to install the pipeline across wetlands would depend on the level of soil stability and saturation encountered during construction. Construction across unsaturated soils that can support the weight of equipment would be conducted in a manner similar to the upland construction procedures. In areas that are proposed for conventional open trench construction, but where soil conditions may not support the weight of equipment, timber mats would be used to minimize disturbance to wetland hydrology and maintain soil structure.

The push-pull method of construction could be used in inundated or saturated conditions where wetland soils and hydrology cannot support conventional pipe laying equipment, or in areas that have significant quantities of water that would allow for the pipe to be floated over the open trench. With this method, construction and excavation equipment would work from temporary work surfaces, and a prefabricated pipeline segment would be pulled or floated into position then sunk with buoyancy control devices and placed in the trench.

Horizontal Directional Drill / Conventional Bore Method

The HDD method allows for trenchless construction across an area by drilling a hole below the depth of a conventional lay, and then pulling a prefabricated section of pipe through the hole. This method is used to avoid direct impacts on sensitive environmental features or areas that otherwise present difficulties for standard pipeline construction.

To begin each crossing, a drill rig would be placed on the entry side of the HDD and a small pilot hole would be drilled along a predetermined path beneath the wetland, waterbody, or roadway. The pilot hole would be progressively enlarged through a process called reaming. A reaming tool would be installed at the end of the drill string on the exit side of the pilot hole, and then drawn back to the drill rig to enlarge the hole. Several passes with progressively larger reaming tools could be needed to enlarge the hole to a sufficient diameter to accommodate the pipeline. During this process, drilling fluid, or mud, consisting of bentonite clay and water would be circulated through the hole to remove drill cuttings and maintain the integrity of the hole. Once the reaming process is complete, a prefabricated segment of pipe would be attached to the drill string on the exit side of the crossing and pulled back through the hole toward the drill rig.

Conventional bore is similar to the HDD crossing method, but involves excavating a pit on each side of the feature, placing boring equipment within the pits, boring a hole under the feature, and pulling a section of pipe through the hole. Table A.6.-1 summarizes the wetlands to be crossed by HDD or conventional bore for the Project.[4]

TABLE A.6-1

Wetlands to be Crossed by Horizontal Directional Drill or Conventional Bore

Name of Feature	Beginning Milepost	Ending Milepost	Length (feet)	Crossing Method
Wetland W18	0.7	0.9	688	HDD
Wetland W17	0.9	1.0	149	HDD
Wetland W11	3.9	4.0	255	Conventional Bore

Road and Railroad Crossings

Construction across paved roads, highways, and railroads would be conducted in accordance with TGP's Plan and Procedures and requirements identified in road and railroad crossing permits or approvals. Roads, highways, and railroads where traffic cannot be detoured would be crossed using the conventional subsurface boring or HDD beneath the roadbed or railroad (see table B.4-3). Typically, there would be little or no disruption to traffic at road, highway, or railroad crossings during boring or HDD operations. Roads where traffic can be detoured would be crossed via open cut.

6.2 Aboveground Facility Construction

The piping and compressor modifications at TGP's existing CS 317 and CS 319 would be located within the fence line of existing compressor station facilities. At CS 315, most modifications would remain within the existing fence line for this facility; however, the existing security fence line and existing access road would be expanded to include a new transformer and disconnect switch at CS 315. To facilitate construction, temporary workspace would also be required outside the fence line of each of these compressor stations; however, all the permanent and temporary workspace would remain within TGP's existing property boundaries.

During construction, the sites for the aboveground facilities would be cleared of vegetation, as necessary, and graded. Erosion control devices would be installed as needed to prevent erosion and offsite impacts in accordance with TGP's Plan and applicable state permit requirements. Access to the aboveground facilities would be provided by existing public or private roads. After construction, all temporary workspaces would be revegetated in accordance with TGP's Plan. In addition, fencing would be replaced around compressor station facilities for security purposes.

7. PERMITS, APPROVALS, AND REGULATORY REQUIREMENTS

TGP would obtain all necessary federal, state, and local permits, licenses, and clearances related to construction of the proposed facilities. All relevant permits and approvals would be provided to the respective contractors who would be required to be familiar with and adhere to applicable requirements. See table A.7-1 for a list of the permits and approvals required for the Project.

[4] Detailed crossing plans for each of the HDDs can be viewed on the FERC Internet website at http://www.ferc.gov as part of TGP's September 22, 2015 supplemental filing. Using the "eLibrary" link, select "Advanced Search" from the eLibrary menu and enter 20150923-5174 in the "Accession Number" field. The figures are also available for public inspection at the FERC's Public Reference Room in Washington, DC (call (202) 502-8317 for instructions).

Any non-federal permits or requirements would need to be consistent with the conditions of any Commission Certificate for the Project. The Commission encourages cooperation between interstate pipelines and local authorities. However, if such authorities prohibit or unnecessarily delay TGP from meeting its obligations under the Commission's Order (Order), their requirements would be preempted by the Certificate. TGP would be required to comply with all reasonable requirements of a state or local approval.

TABLE A.7-1

Federal, State, and Local Permits, Approvals, and Consultations

Permit/Approval	Issuing Agency	Project Status
FEDERAL		
Section 7(c) of the Natural Gas Act, Certificate of Public Convenience and Necessity	FERC	Application filed on April 2, 2015
Consultation for Section 7, Endangered Species Act (ESA) and Bald and Golden Eagle Protection Act (BGEPA)	FWS, Pennsylvania Field Office	Consultation completed on September 30, 2015
Migratory Bird Treaty Act consultation	FWS	*Migratory Bird Impact Assessment and Conservation Plan* was submitted by TGP on August 5, 2015. Consultation completed September 30, 2015.
Section 404 of the Clean Water Act (CWA), Dredge and Fill Permit / Authorization – Pennsylvania State Programmatic General Permit-4 (PASPGP-4)	U.S. Army Corps of Engineers, Baltimore District	Application submitted April 2, 2015
STATE – PENNSYLVANIA		
Section 401 of the CWA, Water Quality Certification PA Code Title 25, Chapter 105 Water Obstruction and Encroachment Permits	Pennsylvania Department of Environmental Protection (PADEP), Regional Bureaus of Watershed Management	Application submitted April 2, 2015: estimated permit issuance July 2016.
National Pollution Discharge Elimination System (NPDES) – Hydrostatic Test Water Discharge Permit, PAG-10 General Permit authorization for discharges associated with 8.1 mile pipeline	PADEP, Bureau of Point and Non-Point Source Management	Existing permits issued on January 1, 2013 for compressor station facilities will be used.
NPDES - Hydrostatic Test Water Discharge Permit, PAG-10 General Permit authorization for discharges at Compressor Stations	PADEP, Bureau of Point and Non-Point Source Management	Application to be submitted in second Quarter 2017
Erosion and Sediment Control General Permit (ESCGP-2) for Earth Disturbance / NPDES-Stormwater authorization	PADEP, Bureau of Waterways	Application submitted October 3, 2015
State-listed Threatened and Endangered Species Consultation	PADCNR	State-listed plant species survey report was provided to PADCNR on July 31, 2015 and additional information was provided October 12, 2015. Consultation with the PADCNR is ongoing.
State-listed Threatened and Endangered Species Consultation	Pennsylvania Game Commission	Consultation completed November 14, 2014
State-listed Threatened and Endangered Species Consultation	Pennsylvania Fish and Boat Commission	Consultation completed July 23, 2015
Section 106 of the National Historic Preservation Act consultation	Pennsylvania Historic and Museum Commission, Bureau for Historic Preservation / State Historic Preservation Officer (SHPO)	Consultation completed September 9, 2015

Table A.7-1

Federal, State, and Local Permits, Approvals, and Consultations (cont'd)

Permit/Approval	Issuing Agency	Project Status
License for Right-of-Way across Tioga State Forest land	PADCNR, Bureau of Forestry	Application was submitted January 23, 2015
Request for Determination of changes of Minor Significance and Exception from Plan Approval/Operating Permit under PA Code §127.14 or §127.449 for CS 315	PADEP, Bureau of Air Quality	Application was submitted April 2, 2015
Clean Air Act and PA Code Title 25, Chapter 127, Air Plan approval for CS 317	PADEP, Bureau of Air Quality	Application was submitted April 2, 2015
Clean Air Act and PA Code Title 25, Chapter 127, Air Plan approval for CS 319	PADEP, Bureau of Air Quality	Application was submitted April 2, 2015
LOCAL/COUNTY – PENNSYLVANIA		
Erosion and Sedimentation Control Plan review for 8.1-mile pipeline and minor equipment modifications at CS 315	Tioga County Conservation District	Application was submitted October 3, 2015
Erosion and Sedimentation Control Plan review for minor equipment modifications at CS 317	Bradford County Conservation District	To be submitted July 2016
Erosion and Sedimentation Control Plan review for minor equipment modifications at CS 319	Bradford County Conservation District	Existing permit issued October 10, 2013 for CS 319 will be used

B. ENVIRONMENTAL ANALYSIS

Construction and operation of the Project would have temporary, short-term, long-term, and permanent impacts. As discussed throughout this EA, temporary impacts are defined as occurring only during the construction phase. Short-term impacts are defined as lasting up to three years. Long-term impacts would eventually recover, but require more than three years. Permanent impacts are defined as lasting throughout the life of the Project.

1. GEOLOGY AND SOILS

1.1 Geology

The proposed Project would be located in north-central Pennsylvania and intersect two physiographic sections of the Appalachian Plateaus Province. All of the Western Loop, approximately 1.5 miles of the Eastern Loop, and CS 315 would be located in the Deep Valleys Section. The remaining 0.4 mile of the Eastern Loop, CS 317 and CS 319, and the pipe yard would be located in the Glaciated Low Plateau Section (PADCNR, 2015a). The Deep Valleys Section is characterized by very deep, steep-sloped valleys that are separated by narrow, flat to gently sloping uplands. Some of the deepest valleys in the section have a relief of over 1,000 feet. The Glaciated Low Plateaus consist of rounded hills and broad to narrow valleys. Much of the surficial geologic material is glacial till that was deposited mainly in the valley bottoms and margins. There are four Pennsylvanian- to Devonian-aged sedimentary bedrock formations crossed by the proposed project facilities: the Huntley Mountain Formation, Pottsville Formation, Catskill Formation, and Lock Haven Formation (U.S. Geological Survey [USGS], 2015). Elevations in the project area range from approximately 1,000 to 2,300 feet above mean sea level. Topography in the project area ranges from nearly level to very steep, with average slopes ranging from 0 to 20 percent (Soil Survey Staff, 2015a and 2015b).

1.1.1 Blasting

Shallow bedrock or large boulders may be encountered during excavation activities for the pipeline and compressor station facilities. Along the Western Loop, the depth to bedrock is estimated to be between 20 to 40 inches below the surface for 5.1 miles (83 percent) of the route. The entire route of the Eastern Loop is estimated to contain bedrock within 5 feet of the surface, including approximately 1.4 miles (74 percent) of the route crossing shallow bedrock within 20 to 40 inches of the surface and the remaining 0.5 mile (26 percent) of the route crossing shallow bedrock within 40 to 120 inches of the surface (Soil Survey Staff, 2015a).

At CS 315, the majority of the proposed construction workspace is located within an area of shallow bedrock, where depth to bedrock is estimated to be present between 20 to 40 inches deep. Only small, isolated areas of shallow bedrock are estimated to be present at CS 317 and CS 319.

Although shallow bedrock or boulders may be encountered along portions of the Project, blasting is not anticipated to be necessary during construction. TGP would excavate through shallow bedrock using either an excavator equipped with rock teeth, a dozer-drawn ripper, or a pneumatic ram depending on the extent of the rock and its qualities. If blasting is determined to be necessary, TGP would obtain any required federal, state, and local blasting approvals and implement the appropriate safety precautions.

1.1.2 Mineral Resources

Seven active natural gas wells, three inactive natural gas wells, and one active surface quarry were identified within 0.5 mile of the Project (PADEP, 2015a, 2015b, 2015c). All of these wells are over

1,100 feet from the proposed project facilities, and the surface quarry is located approximately 800 feet south of CS 319.

No impacts on existing natural gas wells are anticipated as a result of project construction or operation. Although there is one active mining operation in the vicinity of the Project, the construction footprint at CS 319 would not be affected. Construction and operation of the Project would not affect the operations of this mining facility.

1.1.3 Geologic Hazards

Geologic hazards are natural, physical conditions that can result in damage to land and structures or injury to people. Such hazards typically include seismicity (e.g., earthquakes, surface faults, and soil liquefaction), landslides, flooding, and land subsidence. Conditions necessary for the development of other geologic hazards, including regional subsidence, avalanches, and volcanism, are not present in the project area. In general, the potential for geologic hazards to significantly affect construction or operation of the project facilities is low.

Historically, seismicity in the proposed project area has been very low. The Project does not cross any active faults (USGS, 2006). Soil liquefaction is a phenomenon often associated with seismic activity in which saturated, non-cohesive soils temporarily lose their strength and liquefy when subjected to forces such as intense and prolonged ground shaking. Areas susceptible to liquefaction may include soils that are generally sandy or silty and located along rivers, streams, lakes, and shorelines or in areas with shallow groundwater. Soil conditions necessary for liquefaction to occur are likely present in the project area. However, due to the low potential for a seismic event that would cause strong and prolonged ground shaking, the potential for soil liquefaction to occur is very low. In summary, the seismic hazard for the project area is low; therefore, impacts from seismic activity are not expected.

Landslides involve the downslope movement of earth materials under a force of gravity due to natural or man-made causes. Landslide susceptibility is categorized as high in vicinity of mileposts (MPs) 1.4 to 2.2 and 2.6 to 3.2 of the Western Loop (Delano and Wilshusen, 1999). These areas have steep slopes on both sides of the crossings of the Left Straight Run (MP 1.5), which has a maximum slope of 55 percent, and Right Straight Run (MP 2.9), which has a maximum slope of 40 percent. For the Eastern Loop, the majority of the route (MP 0.3 to line terminus) is located within an area categorized as moderate landslide susceptibility. This categorization is associated with moderately steep slopes of a maximum slope of 37 percent, located west of the Catlin Hollow Creek crossing (MP 0.2). The areas surrounding the remaining project facilities are categorized as having low landslide susceptibility. The potential for slope failure and erosion during construction would be minimized by TGP implementing the measures in TGP's Plan and Procedures.

The greatest potential for flash flooding to occur in the project area would be along waterbodies during or after a large storm event with significant precipitation over a short period of time. The Catlin Hollow Creek crossing at MP 0.2 of the Eastern Loop and the proposed pipe yard near the Tioga River are located in a 100-year flood zone (Federal Emergency Management Agency [FEMA], 2014). Construction of TGP's facilities through FEMA flood zones would be designed and constructed in accordance to USDOT standards and all applicable stormwater regulations and permits. Impacts on flood zones would be temporary and minor. TGP would restore all project areas to preconstruction contours, including the areas within the 100-year floodplain. No post-construction impacts related to flooding are anticipated.

Land subsidence is the sinking or downward settling of the earth's surface and may be caused by dissolution of bedrock, subsurface mining, or pumping of oil. Karst terrain features such as sinkholes,

caves, and caverns can form as a result of the long-term action of groundwater on soluble carbonate rocks (e.g., limestone and dolostone). While some of the bedrock formations along the proposed pipeline route contain carbonate rocks, the Project is not located in areas considered by the USGS to be highly susceptible to subsidence due to dissolution of the supporting bedrock (Weary and Doctor, 2014). No subsurface mining operations were identified within 0.5 mile of the project facilities (PADEP, 2015a). The project facilities would be designed and built in accordance with USDOT standards (49 CFR 192), which would provide adequate protection from washouts, floods, unstable soils, landslides, or other hazards that may cause the pipe to move or sustain abnormal loads. Based on the implementation of these measures and compliance with the USDOT standards, we conclude that the risk of landslide hazards on the Project is low.

1.1.4 Paleontology

The project area is underlain by Paleozoic sedimentary rocks which have the potential to contain marine fossils. The Project does not cross any sites identified as "Heritage Geology Sites" by PADCNR. Although fossil specimens may be encountered during construction activities, no impacts on sensitive paleontological resources are anticipated during construction. If unique or significant fossil specimens are discovered during excavation activities, TGP would notify the PADCNR's Bureau of Topographic and Geologic Survey upon discovery.

The overall effect of the Project on topography and geology would be minor, and significant adverse effects on geological resources are not anticipated. Based on the low probability of localized earth movements or geological hazards in the vicinity of the Project, we also do not anticipate impacts attributable to such geological movements or hazards.

1.2 Soils

Construction activities that create soil disturbance, such as clearing, grading, trench excavation, backfilling, and the movement of construction equipment along the right-of-way, would result in temporary, minor impacts on soil resources. Soil characteristics could affect construction performance or increase the potential for adverse construction-related soil impacts. The most significant activities that have the potential to reduce soil quality are inadvertently mixing topsoil with subsoil, bringing excess rocks to the surface, compacting soil by heavy equipment, and disrupting surface and subsurface drainage patterns. Table B.1-1 summarizes the soil characteristics in the project area.

Soils most susceptible to erosion by water are typified by bare or sparse vegetative cover, non-cohesive soil particles with low infiltration rates, and moderate to steep slopes. Approximately 42 percent of the Western Loop and 77 percent of the Eastern Loop contain soils affected by construction that are considered highly water erodible. Nearly all of the construction area at CS 315 is located within soils that are considered highly water erodible. Less than 1 percent of the soils affected by construction at CS 319 are considered highly water erodible. No highly water erodible soils were identified as present at CS 317 or the pipe yard. None of the soils are highly susceptible to wind erosion.

During construction, topsoil and subsoil would be disturbed during grading and trenching activities and the movement of heavy equipment. Implementation of proper topsoil segregation would help to ensure post-construction revegetation success, thereby minimizing loss of soil fertility and the potential for long-term erosion problems.

There is a potential for construction activities to introduce rock into topsoil during excavation in areas of shallow depth to bedrock. TGP would attempt to use mechanical methods such as a pneumatic ram, ripping or conventional excavation to excavate through the bedrock, where possible. Rock

excavated from the trench may be used to backfill the trench only to the top of the existing bedrock profile. Rock not returned to the trench would be considered construction debris and disposed of appropriately. Excess rock would be removed from at least the top 12 inches of soil in all residential areas, as well as other areas at the landowner's request, to ensure the rock in the area disturbed by construction is similar to adjacent undisturbed areas.

TABLE B.1-1

Summary of Soil Characteristics in the Project Area (in acres)

Facility	Total Acres [a]	Prime Farmland [b]	Highly Erodible		Compaction Prone [e]	Revegetation Concerns [f]
			Water [c]	Wind [d]		
PIPELINE FACILITIES						
Western Loop	85.8	4.6	35.7	0.0	5.7	80.0
Eastern Loop	26.2	6.7	20.3	0.0	0.1	26.1
ABOVEGROUND FACILITIES						
CS 315	10.9	0.0	10.9	0.0	0.1	11.0
CS 317	32.2	0.0	0	0.0	30.7	1.4
CS 319	29.6	10.4	<0.1	0.0	19.2	10.4
ANCILLARY FACILITIES						
Access Roads [g]	11.1	1.3	2.5	0.0	1.3	9.8
Pipe Yard	4.8	1.5	0.0	0.0	0.5	4.3
STAGING AREAS	3.8	1.2	0.2	0.0	0.1	3.8
Project Total	**204.4**	**25.7**	**69.6**	**0.0**	**57.7**	**146.8**

Sources: Soil Survey Staff, 2015a, 2015b

[a] Values within rows may not add up to the totals listed for each facility because soils may occur in more than one characteristic class or may not occur in any class listed in the table.

[b] As designated by the Natural Resources Conservation Service. Includes soils that are considered prime if a limiting factor is mitigated (e.g., artificial drainage).

[c] Includes land in capability subclasses IVe through VIIe and soils with an average slope greater than or equal to 9 percent.

[d] Includes soils in wind erodibility groups 1 and 2.

[e] Includes soils in somewhat poor, poor, and very poor drainage classes with surface textures of sandy clay loam or finer.

[f] Includes coarse-textured soils (sandy loams and coarser) that are moderately well to excessively drained.

[g] Includes temporary access roads that would be utilized during construction and permanent roads that would be utilized during the operation and maintenance of the pipeline.

Construction equipment traveling over wet soils could disrupt the soil structure, reduce pore space, increase runoff potential, and cause rutting. Less than 6 percent of the soils that would be affected by construction of the pipeline loops are considered compaction-prone soils. Approximately 95 percent of workspace at CS 317, 65 percent of workspace at CS 319, and less than 1 percent of workspace at CS 315 would be located within soils that are considered prone to compaction. TGP would minimize compaction and rutting impacts during construction in soft or saturated soils by using measures outlined in its Plan, Procedures, and E&SCP. Measures such as restricting vehicular traffic, reducing loads, employing lower ground-pressure equipment, and re-scheduling certain activities may be used during periods when soil moisture is high. Soil compaction mitigation, such as deep ripping using a paraplow or similar implement, would also be performed in severely compacted residential areas.

A total of approximately 13 percent of the soils in the project area are considered prime farmland. However, none of this prime farmland is currently being used for agricultural production. Given that these areas are not active agricultural areas and TGP would follow its Plan, we conclude that impacts on prime farmland would be adequately minimized. The operation of the new pipeline would not preclude the future use of prime farmland soils for agricultural purposes.

The clearing and grading of soils with poor revegetation potential could result in a lack of adequate vegetation following construction and restoration of the right-of-way, which could lead to increased erosion, a reduction in wildlife habitat, and adverse visual impacts. Approximately 72 percent of the soils that would be affected by the Project are considered to have revegetation concerns. TGP would restore and revegetate the disturbed areas according to its Plan, which includes specifications for soil amendments, working with local soil conservation authorities or other agencies to obtain seed mixture recommendations, and post-construction monitoring to ensure the effectiveness of revegetation and permanent erosion control devices during facility operation. To minimize or prevent potential impacts due to soil erosion and sedimentation during construction, TGP would utilize the erosion and sedimentation controls outlined its Plan, Procedures, and E&SCP. Erosion control devices would be maintained until the right-of-way is successfully revegetated. Temporary erosion controls, including slope breakers and sediment barriers (e.g., hay bales and silt fences), would be installed following initial ground disturbance to control runoff and prevent sediment transport off the construction right-of-way. Temporary erosion controls would be maintained throughout construction of the Project. During construction, the effectiveness of these temporary erosion control devices would be monitored by TGP's EIs. Following successful revegetation of construction areas, temporary erosion control devices would be removed. Permanent erosion controls would be installed, as appropriate, to ensure the successful restoration of the project area. The effectiveness of revegetation and permanent erosion control devices would be monitored by operating personnel during the long-term operation and maintenance of the project facilities in accordance with the provisions in TGP's Plan. With the implementation of these measures, we conclude that impacts would be minimized in areas with poor revegetation potential.

Contamination from spills or leaks of fuels, lubricants, and coolant from construction equipment could adversely affect soils. However, the impacts of such contamination are typically minor because of the low frequency and volumes of spills and leaks. Measures outlined in TGP's SPCC Plan would be implemented to reduce potential impacts on soils from spills of the hazardous materials used during construction. These measures include regularly inspecting equipment to ensure it is in good working order, properly training employees regarding the handling of fuels and other hazardous materials, and promptly reporting any spills to the appropriate agencies. We have reviewed TGP's SPCC Plan and find it acceptable.

Implementation of the measures outlined in TGP's Plan, Procedures, and E&SCP would minimize soil impacts and facilitate revegetation of disturbed areas. Further, TGP would implement its SPCC Plan to reduce the potential impacts on soils from spills of hazardous materials used during construction and manage contaminated soils should they be encountered. Given the impact minimization and mitigation measures described above, we conclude that soils would not be significantly affected by construction and operation of the Project.

1.3 Groundwater Resources

The Project would cross three watersheds: the Tioga, Pine, and Upper Susquehanna-Tunkhannock (USGS, 2014). Portions of the Western Loop are within the Mississippian principal aquifer, which consists of productive sandstone and carbonate-rock aquifers (USGS, 1997). The remaining project facilities are generally underlain by surficial aquifers consisting of glacial outwash and stream-valley alluvium. Wells in these aquifers are typically shallow and used for residential or limited agricultural uses. No U.S. Environmental Protection Agency (EPA) sole source aquifers (aquifers that supply at least 50 percent of the drinking water consumed in an area) were identified within the project area.

Water supply wells within the vicinity of the project area were identified based on field surveys and a review of data provided by Pennsylvania agencies and databases. A total of 14 private wells were

identified within 150 feet of the proposed project facilities and are identified in table B.1-2. No wellhead protection areas were identified to be affected by the project facilities. TGP would offer pre- and post-construction well water testing to the owners of all wells within 150 feet of the proposed construction workspace to document water quality and flow and to establish a baseline for comparison in the event of construction impacts. If testing were to reveal that impacts on nearby wells occurred as a result of construction, then TGP would provide an alternate source of water and/or other appropriate compensation to the landowner.

TABLE B.1-2

Private Water Supply Wells within 150 Feet of the Proposed Facilities

Facility	Milepost	Township	Approximate Distance (feet) from Centerline	Approximate Distance (feet) from Construction Work Area	Notes
PIPELINE FACILITIES					
Western Loop	5.4	Delmar	236	143	Domestic Well
	5.8	Delmar	78	0	Domestic Well
	6.1	Middlebury	221	131	Institutional Well
Eastern Loop	0.1	Charleston	178	97	Domestic Well
	0.2	Charleston	233	136	Domestic Well
	0.2	Charleston	14	0	Domestic Well
	1.2	Charleston	150	50	Domestic Well
	1.8	Charleston	110	70	Domestic Well
ABOVEGROUND FACILITIES					
CS 315	N/A	Charleston	N/A	0	TGP-Private/Industrial Well
CS 317	N/A	Troy	N/A	0	TGP-Private/Industrial Well
	N/A	Troy	N/A	0	TGP-Private/Industrial Well
CS 319	N/A	Wyalusing	N/A	0	TGP-Private/Industrial Well
ANCILLARY FACILITIES					
Access Roads	PAR 3	Middlebury	221	131	Institutional Well
Pipe Yard	N/A	Tioga	N/A	0	Industrial Well
Staging Areas	None	--	--	--	--

Construction activities are not likely to result in significant impacts on groundwater resources because the majority of construction would involve shallow, temporary, and localized excavation. Trench excavation could intersect the water table in low-lying areas where groundwater is near the surface (e.g., wetlands) but, in general, the depth to groundwater would be below the excavated trench. Groundwater resources could also be temporarily affected due to changes in overland water flow and recharge caused by clearing and grading of the project right-of-way. In addition, near-surface soil compaction caused by heavy construction vehicles could reduce the soil's ability to absorb water in these isolated areas. During construction, local water table elevations could be affected by trenching and backfilling, which could temporarily affect wells near the construction area. In instances where trench dewatering would be required, all trench water would be discharged into well-vegetated upland areas to allow the water to infiltrate back into the ground, thereby minimizing any long-term effects on the water table. Groundwater movement and levels would quickly return to baseline conditions, as surficial aquifers in the project area exhibit relatively fast recharge rates. Groundwater is not anticipated to be used a hydrostatic test water source.

The disturbance of soils along the trench line would offer a preferential path for groundwater movement resulting in changes to permanent flow patterns. However, in accordance with TGP's

Procedures, permanent trench plugs would be installed at regular intervals within the trench to deter groundwater movement along the trench line.

The direct and indirect impacts described above would be temporary and would not significantly affect groundwater resources. Impacts would be avoided or minimized by the use of construction techniques contained in TGP's Plan and Procedures (e.g., temporary and permanent trench plugs), which incorporate the measures in FERC's Plan. Upon completion of construction, TGP would restore the ground surface as closely as practicable to original contours and revegetate the right-of-way to facilitate restoration of preconstruction overland flow and recharge patterns.

Regulatory databases were reviewed to identify known hazardous waste sites that could interfere with construction of the Project. Disturbance of contaminated soils could release and expose hazardous chemicals bound within the soil that could then reach surface waterbodies and/or groundwater. Review of databases did not identify any known hazardous waste sites within 0.25 mile of the Project. We also reviewed PADEP's Regulated Storage Tank Cleanup Incidents database, which includes leaking petroleum storage tanks. No regulated storage tank cleanup sites were identified within 0.25 mile of the project area (PADEP, 2015d). Therefore, the Project is not likely to disturb contaminated sediments or encounter contaminated groundwater.

Inadvertent surface spills of hazardous materials used during construction could contaminate shallow groundwater. To minimize the potential impacts associated with inadvertent spills, TGP has prepared an acceptable SPCC Plan. This plan includes measures designed to prevent hazardous materials from reaching groundwater, such as scheduling equipment and vehicle inspections to identify leaks, storing fuels within secondary containment structures, and refueling equipment at least 100 feet away from waterbodies and wells. In the event that a spill should occur, TGP's SPCC Plan identifies appropriate actions that would be taken to remediate and clean up the spill.

Based on TGP's proposed construction techniques and the implementation of minimization and mitigation measures, we conclude that construction and operation of the Project would not result in significant long-term or permanent impacts on the quality of groundwater resources proximate to the project area.

2. WATER RESOURCES AND WETLANDS

2.1 Surface Water Resources

The Project would cross a total of nine waterbodies. Of the six waterbodies crossed by the Western Loop, one is perennial, two are intermittent, and three are ephemeral. One perennial and two intermittent waterbodies are crossed by the Eastern Loop. One additional waterbody crosses under an access road through an existing culvert: no modifications to the road are proposed and the existing culvert prevents impacts on the waterbody at this crossing. No waterbodies would be affected by the construction of any aboveground facilities. Table B.2-1 provides details regarding the waterbodies crossed by the Project, water quality designations, and potential project impacts.

TABLE B.2-1

Waterbody Crossings

Waterbody ID	Waterbody Name	Location (Milepost/ Access Road)	Waterbody Type	Bank-to-Bank Crossing Width (feet)	Linear Distance of Waterbody Crossing (feet)	Area of Stream Crossing (ft^2) Within Construction Workspace	State Water Quality Classification [a]	Construction Crossing Method [b]
WESTERN LOOP								
S15	Bear Wallow Branch	0.5	Ephemeral	1	91	91	HQ-CWF	Dry
S13	Left Straight Run	1.6	Perennial	6	89	534	HQ-CWF	Dry
S11	Wildcat Hol	2.1	Intermittent	10	81	810	HQ-CWF	Dry
S9	Unnamed Tributary to Right Straight Run	2.7	Ephemeral	1	155	155	Drain to HQ-CWF	Dry
S10	Right Straight Run	3.0	Intermittent	5	79	395	HQ-CWF	Dry
S8	Unnamed Tributary to Spoor Hollow Brook	4.5	Ephemeral	2.5	31	77.5	Drain to TSF	Temporary Road Crossing
EASTERN LOOP								
S7	Catlin Hollow Creek	0.2	Perennial	25	51	1,275	TSF	Dry
S6	Unnamed Tributary to Crooked Creek	0.6	Intermittent	5	118	590	TSF	Dry
S3	Unnamed Tributary to Crooked Creek	1.4	Intermittent	6	51	306	TSF	Dry
CS 315, 317 & 319								
-	-	-	-	-	-	-	-	-
PIPE YARD								
-	-	-	-	-	-	-	-	-
ACCESS ROADS								
S14	Left Straight Run	NA	Intermittent	8	0	0	HQ-CWF	Existing Culvert

[a] Pennsylvania Code, Chapter 93, Designated Water Uses and Water Quality Criteria. HQ-CWF = High Quality Cold Water Fishery; TSF = Trout Stocked Fishery.

[b] Streams with no perceptible flow at the time of crossing would be crossed using an open cut crossing method. Dry crossings (dam and pump or flume crossings) would be used for streams with perceptible flow at the time of crossing, unless otherwise authorized by applicable regulatory agencies.

TGP would cross all waterbodies using a dry crossing method. Dry waterbody crossing methods are further described in section A.6.1.6. TGP would use clean gravel or native cobbles for the upper 1 foot of trench backfill in all waterbodies classified as cold-water fisheries, which includes all the streams crossed by the Western Loop. In accordance with TGP's Procedures, the streambanks would be reestablished to preconstruction contours and stabilized with an erosion control fabric or similar product. Erosion and sediment control devices such as silt fence and slope breakers would be installed across the right-of-way to reduce streambank and upland erosion and sediment transport into the waterbody, and stream banks would be seeded with an approved seed mixture. A vegetated buffer at least 25 feet wide adjacent to waterbodies would be revegetated to preconstruction conditions over the entire width of the right-of-way, except for a 10-foot-wide strip centered over the pipeline that may be periodically mowed and maintained in an herbaceous state so that shrubs and trees cannot reestablish themselves. In addition, trees would not be allowed to grow within 15 feet of the pipeline.

TGP would also monitor the progress of restoration at these crossings for 3 years or until restoration is successful, and would take additional restoration measures if necessary. Riparian cover on affected stream banks would be expected to recover over several months to several years. Erosion controls would be maintained and monitored throughout restoration, and removed once restoration is deemed successful.

TGP has indicated that the Pennsylvania Fish and Boat Commission (PAFBC) has requested to restrict instream work in designated trout waters during the following time windows except as required to install or remove equipment bridges:

1. Exceptional Value and Natural Reproducing Wild Trout Streams – January 1 through September 30; and

2. Class A Wild Trout Streams – April 2 through September 30.

Because these time windows differ from the time windows required section V.B.1 of our Procedures, we require evidence of the state agency's approval for the proposed time windows conflicts. Section V.B.1 a. requires that instream work occur in coldwater fisheries between June 1 through September 30. Because TGP has not yet received the Chapter 105 Water Obstruction and Encroachment Permit for the Project, we are unable to verify these PAFBC recommended instream work windows. To ensure that these resources are crossed in accordance with appropriate permitting window requirements, **we recommend that:**

- **<u>Prior to construction</u>, TGP should file with the Secretary a copy of the final Chapter 105 Water Obstruction and Encroachment Permit for the Project documenting the instream work windows for the following 10 waterbodies: Bear Wallow Branch, Left Straight Run, Wildcat Hollow, Unnamed Tributary to Right Straight Run, Right Straight Run, Unnamed Tributary to Spoor Hollow Brook, Catlin Hollow Creek, two Unnamed Tributaries to Crooked Creek, and Left Straight Run, as requested by the PAFBC, and incorporate the appropriate time windows into its final construction plans.**

Impacts on surface water resources from project construction would depend on a number of factors, including the size of the waterbody, flow at the time of crossing, duration of construction, and streambed composition. The greatest potential impacts would likely result from an increase in sediment loading and turbidity. Given the dry crossings proposed, sediment loading and turbidity impacts would primarily result from clearing and grading of stream banks, trench dewatering, installation of flume pipes

or construction of dams, the loosening of the streambed soil from trenching and subsequent backfilling, as well as silt-laden runoff from the construction right-of-way.

TGP identified one stream crossing where locating ATWS within 50 feet of a waterbody would be necessary: ATWS within 0 feet (immediately adjacent) of Stream S7 (Catlin Hollow Creek). TGP would install all appropriate erosion control devices to prevent off-site sedimentation, install signs to identify and protect resources, and follow appropriate stabilization methods during and after construction to ensure waterbodies are adequately protected. This area and associated site-specific justification for the alternate measure are provided in table A.5-2. We have reviewed TGP's plan for crossing this stream and find that in combination with TGP's Procedures it would adequately protect the resource. We have determined that the proposed location of the ATWS is acceptable.

Construction-related impacts would be limited primarily to short periods of increased turbidity before installation of the pipeline, during the installation of the upstream and downstream dams, and following pipeline installation when the dams are removed and flow across the restored work area is reestablished. We conclude that if completed in accordance with the construction and restoration methods described above and TGP's Plan, Procedures, and E&SCP, the impacts on waterbodies would be minor and temporary.

2.2 Hydrostatic Test Water

Hydrostatic testing is a process in which a pipeline is tested for leaks using a pressurized medium, such as water, which ensures the integrity of facilities and the pipeline. The process is generally carried out after backfilling and after completion of other construction activities. TGP would be required to hydrostatically test all pipe in accordance with USDOT pipeline safety regulations. A hydrostatic test involves filling the lowered-in pipeline with water and pressurizing the pipeline above its maximum allowable operating pressure. The pressure in the pipeline is then monitored for several hours. If a drop in pressure is recorded, TGP would examine the pipelines to determine if any leaks have occurred. After each test, the hydrostatic test water would be discharged into well-vegetated upland areas using an energy dissipation device to reduce impacts on soil erosion in accordance with TGP's Procedures. TGP would obtain water for hydrostatic testing from an offsite surface water location (listed in table B.2-2 below) or a municipal water source and truck the water to the test site location. As indicated in the TGP's Procedures, prior to water withdrawal, TGP would notify appropriate state agencies at least 48 hours prior to testing, inspect all pipeline welds prior to hydrostatic testing, and locate test manifolds outside of wetland and riparian areas where practicable. During testing, TGP would screen intake hoses to prevent fish entrainment, maintain adequate flow rates, keep pumps at least 100 feet from any wetland or waterbody, and implement secondary containment and refueling per TGP's SPCC plan. TGP has identified three upland locations to discharge the hydrostatic test water.

TABLE B.2-2

Hydrostatic Test Water Volumes and Sources

Pipe Test Section	Source [a]	Volume of Water (gallons)	Discharge Location
WESTERN LOOP			
0.00–6.21	Tioga River, Tioga Reservoir	1,700,000	MP 1.63
EASTERN LOOP			
0.00–0.64	Crooked Creek, Catlin Hollow	200,000	MP 0.24
0.64–1.88	Crooked Creek, Catlin Hollow	350,000	MP 1.36
TOTAL		**2,250,000**	

[a] Potential water source includes surface and municipal water sources. If it is determined that flow rate in the waterbody is inadequate for water withdrawal, an alternate source location with adequate flow rates or municipal sources would be used.

Table B.2-2 identifies the hydrostatic test segments, volumes of water that would be needed for each hydrostatic test, and discharge locations. TGP would obtain all applicable permits prior to withdrawal and discharge of any hydrostatic test water. TGP does not anticipate the use of any additives, but should additives be required, TGP would submit details to FERC for review and approval of any chemicals proposed for use. Given that TGP would discharge to uplands and adhere to all permit requirements, such as use of erosion control measures, impacts on waterbodies from hydrostatic testing activities are expected to be temporary and minor.

2.3 Wetlands

Wetlands are areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support a prevalence of wetland vegetation adapted for life in saturated soil conditions. Wetlands can be a source of substantial biodiversity and serve a variety of functions that include providing wildlife habitat, recreational opportunities, flood control, and naturally improving water quality.

TGP conducted field delineation surveys to determine the presence of wetlands within project workspaces. The surveys determined that 13 wetlands would be affected, 12 of which are located in the workspace for the Western Loop and 1 of which is located in the workspace for the Eastern Loop. No wetlands were identified within workspace for the aboveground facilities, access roads, or pipe yard. See table 1 of appendix B for a summary of wetlands crossed by the pipeline.

TGP plans to reduce the width of the construction right-of-way at all wetland crossings to no greater than 75 feet wide. Construction of the pipeline loops would affect a total of 1.01 acres of wetland (0.92 acre of palustrine emergent wetland [PEM], 0.05 acre of palustrine scrub-shrub wetland [PSS] and 0.04 acre of palustrine forested wetland [PFO]), of which 0.25 acre of impacts (0.21 acre of PEM and 0.04 acre of PFO) would occur within the temporary workspace proposed during construction. Wetlands within the temporary workspace would return to their preconstruction condition following restoration. Approximately 0.71 acre of PEM wetlands and 0.05 acre of scrub-shrub wetland that will be converted to emergent wetland fall within the permanent right-of-way. All wetlands disturbed by construction would be restored. See table 2 of appendix B for a breakdown of wetland and impact types for wetlands crossed by the pipeline.

Impacts on three wetlands (W11, W17, and W18) would be minimized or avoided through the use of either a conventional bore or HDD. The conventional bore/HDD construction method is further described in section A.6.1.6.

TGP would construct pipeline segments through wetlands in accordance with its Procedures and state and federal permitting requirements. If wetland soils are non-saturated at the time of construction and able to support construction equipment, TGP would use standard pipeline construction techniques. If soils are saturated, TGP would construct a temporary travel lane to support equipment that would be fully removed following construction. To preserve natural seed stock and increase revegetation potential, TGP would segregate up to 12 inches of topsoil during trenching and return it to the trench during backfilling after replacing the subsoil. Erosion controls consisting of silt fence and/or stacked hay bales would be installed at wetland boundaries to prevent sedimentation from adjacent upland areas.

The primary impacts of project construction on wetlands would be the alteration of wetland vegetation due to clearing and the mixing of topsoil and subsoil from rutting, excavation, and compaction. Construction could also affect water quality within the wetland due to sediment loading or inadvertent spills of fuel or chemicals. In general, TGP would minimize wetland impacts by collocating the proposed loops (Western Loop and Eastern Loop) with its existing 300 Line right-of-way and by implementing the measures outlined in its Procedures and SPCC Plan. Because the construction right-of-way would overlap a portion of the existing permanent right-of-way of TGP's 300 Line, the new permanent right-of-way requirements are adequately minimized.

The FERC Procedures requires that all ATWS must be set back at least 50 feet from wetlands unless conditions warrant modification of this requirement and the applicant provides site-specific justification for why the minimum set back cannot be obtained (see FERC Procedures section VI.B). TGP has identified three wetland crossings that would require the use of ATWS within 50 feet of the wetland boundary. The location of these areas and site-specific justification are provided in table A.5-2.

In addition to the placement of ATWS within 50 feet of wetlands W3, W4, and W16, TGP has requested the following two additional alternate measures to the FERC Procedures regarding wetlands (see FERC Procedures section VI.C):

1. Permanent slope breakers may not be installed at wetland boundaries if the permanent slope breakers may alter the wetland characteristics. TGP would use temporary slope breakers (straw/hay bales) at wetland boundaries until restoration is complete.

2. TGP would restore wetlands using seed and mulch as required by Pennsylvania agencies or as recommended by the County Conservation District Offices.

We have reviewed these alternate measures as well as those identified in table A.5-2, find that they are consistent with the intent of our Procedures, and find them acceptable. Our Procedures are designed to provide adequate protection of water resources during construction. We conclude that these alternate measures would provide an equal level of protection of wetlands during construction and result in a sufficient level of restoration success.

Impacts on wetlands would be greatest during and immediately following construction. Most of these effects would be short term in nature and would diminish as wetland functionality recovers and eventually reaches preconstruction conditions. Wetlands affected within the temporary workspace would be allowed to revert to preconstruction conditions following completion of construction. Vegetation within emergent wetlands would regenerate quickly (typically within 1 to 3 years). Because these areas are naturally open and herbaceous, there would be little to no permanent impacts on emergent wetlands.

Impacts on scrub-shrub and forested wetlands would last longer than those on emergent wetlands. Woody vegetation may take several years to regenerate to its original density. Furthermore, annual mowing and maintenance of a 10-foot-wide herbaceous strip centered over the pipeline, and removal of trees taller than 15 feet within 15 feet of the pipeline centerline, would result in a long-term, permanent impact by converting previously scrub-shrub vegetated wetland areas to emergent wetland areas.

TGP is currently working with PADEP and the U.S. Army Corps of Engineers to develop an appropriate mitigation plan to offset the permanent (including long-term restoration) conversion impacts on scrub-shrub wetlands. The mitigation may involve tree and shrub plantings in the temporary workspace or the purchase of wetland credits.

Although construction would result in permanent conversion of wetland habitats, TGP would minimize these impacts by locating the construction right-of-way to overlap a portion of its existing 300 Line permanent right-of-way. Furthermore, this would limit the conversion of wetlands from forested and scrub-shrub to emergent wetlands to a total area of 0.09 acre (0.04 acre of forested wetland and 0.05 acre of scrub-shrub wetland). Based on the mitigation and restoration measures proposed by TGP, we conclude that wetland impacts associated with the construction and operation of the Project would be sufficiently minimized and do not represent a significant impact to these resources.

3. VEGETATION, WILDLIFE, AND FISHERIES

3.1 Vegetation

The project area consists of upland forest, agricultural, open lands, and developed lands. Typical forest communities in the project area include upland forests of deciduous, coniferous, or mixed deciduous and coniferous species; immature hardwood, coniferous, and mixed forests; sapling-shrub communities; and shrub communities. Deciduous forests include hardwoods such as beech, sugar maple, and wild black cherry, along with sugar maple-basswood forests and aspen/gray birch forests. Conifer species include eastern hemlock and eastern white pine. Shrubs include blueberry, serviceberry, speckled alder, winterberry, and American elder. Herbaceous layers encountered within the project area are dominated by sedges, rushes, and sensitive ferns, along with upland northern oatgrass, bracken, cow-wheat, and bluestem. Agricultural areas consist of pasture and cultivated cropland. Open lands include maintained/industrial areas and maintained right-of-way communities, which consist of lawn grasses, goldenrods, asters, dandelion, bedstraw, clover, and numerous other species that are advantageous in maintained areas. Much of the Project parallels existing right-of-way, consisting of successional field, meadow, or maintained cover types. Developed lands are described as residential areas and existing fenced industrial areas such as compressor stations and meter stations.

Three vegetative communities of special concern have been identified as potentially occurring in the project area by the PADCNR Bureau of Forestry, including herbaceous vernal ponds, hemlock palustrine forests, and leatherleaf-bog rosemary peatlands. Target species from the PADCNR Bureau of Forestry that could be present in the project area include cranesbill, few-seeded sedge, northeastern bulrush, soft-leaved sedge, Clinton's wood fern, creeping snowberry, marsh bedstraw, lesser panicled sedge, and broad-leaved willow. Additionally, the FWS also identified the northern bulrush as a federally listed, endangered plant located within the project area.

TGP completed surveys for the above-mentioned target species and identified soft-leaved sedge, Clinton's wood fern, cranesbill, and northeastern bulrush within the project area, along with hemlock palustrine forests and herbaceous vernal ponds. TGP has designed the project workspace to avoid impacts on these species/communities and is proposing to cross a wetland containing the northeastern

bulrush using HDD crossing methods to avoid impacts on the northeastern bulrush, as further detailed in section 3.4.1.

Noxious weeds are a concern along both the proposed Western and Eastern Loops due to the potential for spreading as a result of soil disturbances associated with construction activities. In addition, noxious weeds can outcompete native vegetation and change the composition of native vegetation communities. Fourteen species of noxious plants were identified within the proposed project area. These species included spotted knapweed, crownvetch, Japanese stiltgrass, and reed canarygrass as the most prevalent species. TGP would implement its *Noxious and Invasive Weed Control Plan* to minimize the potential for the establishment and spread of noxious weeds during and after construction. Measures implemented through the *Noxious and Invasive Weed Control Plan* include requiring contractors to ensure that work vehicles arrive at the site clean and weed-free and using compressed air or other means to remove soil and propagules from machinery and vehicles to prevent their transport to other sections of the right-of-way. We have reviewed this plan and find it acceptable.

After construction is complete, the project right-of-way and all temporary work areas would be revegetated according to measures contained in TGP's Plan and E&SCP. Land disturbance associated with the construction of the Western Loop of the pipeline would primarily occur within forested areas and open land. Land disturbance associated with the construction of the Eastern Loop of the pipeline would primarily occur within open lands. Land disturbance associated with the pipe yard and aboveground facilities associated with the Project would occur within existing industrial areas. A detailed breakdown of the area of land disturbance for each land use type and project activity is provided in section B.4.

As outlined in section B.4, the total acreage affected by the proposed pipeline (Western and Eastern loops), ATWS, staging areas, pipe yards, and access roads is 131.7, with 69.7 acres of temporary disturbance and 62.0 acres associated with the permanent right-of-way. An additional 72.7 acres of disturbance is proposed associated with modifications to aboveground facilities. The Project would result in 58.7 acres of impact (45 percent of the total footprint) to open lands and 53.3 acres of impact to forested lands (40 percent of the overall project footprint). The remaining areas affected by project construction would be to roadways, residential, and industrial areas. Of the 53.3 acres of impact to forested lands, 33.1 acres would be temporary impacts during construction, and the remaining 20.2 acres would be associated with the new permanent right-of-way. Forest impacts would be considered long term, as the clearing of mature, woody vegetation would result in the greatest degree of change in terms of vegetation strata, appearance, and habitat. The reestablishment of native woody vegetation within forested areas would be encouraged in the temporary impact areas to limit the amount of permanent impacts; however, natural restoration of preconstruction forest densities is expected to take 30 to 50 years. To mitigate impacts on forests, the Project is co-located with the existing maintained right-of-way of the 300 Line, shifting the edge effect to the edge of the new maintained right-of-way associated with the Project, avoiding additional habitat fragmentation.

After construction, TGP would revegetate all temporary work areas in accordance with its Plan, and all other areas would be maintained in permanent operational use. Land outside the permanent easement would be permitted to revegetate naturally, which would be a short-term impact (3 to 12 months to reach preconstruction densities) for open land, and would be a long-term impact (30 to 50 years to reach preconstruction densities) for forested areas.

The staging areas and temporary workspaces would eventually revegetate to their preconstruction condition. Given that the proposed project route is collocated within TGP's existing right-of-way, impacts on forested vegetation would be minimized to the extent possible. In addition, all of the proposed aboveground facilities are located adjacent to existing aboveground facilities and within existing facility property boundaries that are previously developed and disturbed industrial areas and would not

significantly alter the vegetative communities at these sites. Therefore, we conclude that the Project would not have a significant impact on vegetation in the project area.

3.2 Wildlife

The project area consists of upland forests, open lands, agricultural lands, developed lands, and wetlands. Common wildlife and habitat types found in the project area are presented in table 2 of appendix B.

Potential impacts on wildlife include habitat removal and construction-related ground disturbance and noise. Some individuals could be inadvertently injured or killed by construction equipment; however, more mobile species such as birds and mammals would likely relocate to other nearby suitable habitat to avoid the project area once construction activities commence. The temporary disturbance of local habitat is not expected to have population-level effects on wildlife because the amount of habitat crossed represents only a small portion of the habitat available to wildlife throughout the proposed project area, and much of the project area would return to preconstruction use. The widening of cleared areas within forested habitat could affect species that are intolerant of edge habitat, such as interior-dwelling bird species. However, long-term impacts from habitat alteration would be further minimized by the implementation of mitigation measures contained in TGP's Plan, which would ensure revegetation of most areas disturbed by construction. Therefore, we conclude that the Project would not have a significant impact on wildlife or their habitat in the project area.

3.2.1 Migratory Birds

Migratory birds are species that nest in the United States and Canada during the summer and then migrate to and from the tropical regions of Mexico, Central and South America, and the Caribbean for the non-breeding season. Migratory birds are protected under the Migratory Bird Treaty Act ([MBTA]-16 U.S. Code [USC] 703-711), and Bald and Golden Eagles are additionally protected under the Bald and Golden Eagle Act (16 USC 668-668d). The MBTA, as amended, prohibits the taking, killing, possession, transportation, and importation of migratory birds, their eggs, parts, and nests. Executive Order 13186 (66 Federal Register 3853) was enacted in 2001 to, among other things, ensure that environmental analyses of federal actions evaluate the impacts of federal actions on migratory birds. Executive Order 13186 directs federal agencies to identify where unintentional take is likely to have a measurable negative effect on migratory bird populations; avoid or minimize adverse impacts on migratory birds through enhanced collaboration with the FWS; emphasize species of concern, priority habitats, and key risk factors, and give particular focus to population-level impacts.

Construction activities would occur during the nesting season for migratory birds (generally April 1 to August 31). Therefore, direct and indirect impacts on migratory birds could result from construction. Examples of potential impacts include habitat loss, disruption of foraging adults, and abandonment or destruction of active nests. The Project may have a short-term impact on migratory species of birds that may nest in or near the rights-of-way. TGP would avoid or minimize direct impacts on migratory birds by conducting clearing activities of natural or semi-natural habitats (e.g., forests, woodlots, reverting fields, fencerows, shrubby areas) outside of the nesting season for migratory birds within the project area (April 1 to August 31).

This EA also discusses several plans (e.g., TGP's Plan, Procedures, E&SCP, and SPCC Plan) that contain project-specific mitigation measures that would reduce the extent and duration of impacts on migratory bird habitat, actively and naturally allow a great majority of the construction right-of-way to return to preconstruction condition, and limit the potential effects from spills or environmental contamination. Two Important Bird Areas known as the Pine Creek Gorge Natural Area, which is located

within the Susquehanna Headwaters Important Bird Area, and the Marsh Creek Wetlands, are located in the vicinity of the project area. The western portion of the pipeline is contained within the Susquehanna Headwaters Important Bird Area and parallels the existing right-of-way, which would minimize impacts. Approximately 45.8 acres of temporary disturbance would occur as a result of project construction through the Susquehanna Headwaters Important Bird Area, 19.4 acres of which would be through forest habitat (see table B.4-1). CS 315 is within 0.50 mile of the Marsh Creek Wetlands Important Bird Area and would not result in any habitat impacts other than negligible noise increases.

Executive Order 13186 also requires the federal agency to identify where unintentional "take" (i.e., the unintended death, harm, or harassment) is likely to have a measurable negative effect on migratory bird populations. We conclude that adult birds relocating to avoid construction is an impact of limited duration that would not result in a substantial or long-term change in migration patterns through the area nor constitute a population-level impact.

Due to the potential for impacts on tree-nesting birds in forested areas within the proposed project area, TGP intends to implement bird conservation measures and best management practices (BMPs), including conducting tree felling activities outside of the nesting season (April 1 to August 31) to preclude avian species from nesting within the site. In the event unforeseeable issues arise that result in TGP being unable to conduct tree-felling activities outside of the nesting season, TGP would coordinate with the FWS regarding appropriate conservation measures that could be implemented between April 1 and August 31. Direct effects to shrub- or ground-dwelling non-sensitive birds (i.e., those not on special conservation lists or that do not have significantly reduced populations) would not result in long-term or significant population-level impacts. Habitat loss has been minimized to the extent practicable by co-locating the Eastern and Western Loops adjacent to the existing TGP right-of-way. TGP submitted an MBTA Impact Assessment and Conservation Plan to the FWS on August 5, 2015. In a letter dated September 30, 2015, the FWS stated that the agency supports the proposed conservation plan, which includes minimization measures to reduce adverse impacts on migratory birds. We concur.

Bald Eagle

The bald eagle is no longer a federally listed endangered or threatened species under the Endangered Species Act, but is still protected under the Bald and Golden Eagle Protection Act (BGEPA) and the MBTA. TGP has not performed a survey for bald eagles within the project area; however, no known nests occur in the project area. TGP would notify the FWS in the event that an eagle nest is encountered in the project area.

During operation of the Project, vegetative maintenance clearing would occur outside of the nesting season in accordance with TGP's Plan.

For the reasons listed above, we conclude that the construction and operation of the Project would not significantly affect migratory bird species within the project area.

3.3 Fisheries

The proposed Project crosses ten waterbodies, six of which are classified or drain to streams classified as High Quality-Cold Water Fisheries (HQ-CWF). Three of the waterbodies are designated as Trout Stocked Fisheries (TSF), and one waterbody drains to a TSF. Two waterbodies are also designated or drain to waterbodies designated as Class A Wild Trout Waters by the PAFBC. One of the HQ-CWF waterbodies is within a proposed access road crossing, but is already culverted and would not be affected by project construction. No waterbodies would be affected by the proposed aboveground facilities. Table B.3-1 outlines waterbodies identified as potential fisheries resources of special concern.

The Project would not cross any waterbodies designated as wild and scenic rivers at the federal level. Pine Creek is designated a Pennsylvania Scenic River by the Commonwealth of Pennsylvania under the Pennsylvania Scenic Rivers Act (Pamphlet Law 1277, Act No. 283, as amended by Act 110, 1982). However, this designation applies to an approximately 23-mile portion of Pine Creek in the Pine Creek Gorge area. The Project does not cross Pine Creek, but crosses several tributaries that drain to Pine Creek, including an unnamed tributary to Right Straight Run, Right Straight Run, Wildcat Hol, and Left Straight Run. The Project does not cross any Trout Stocked Fishery-designated streams, as designated by the PAFBC. However, the Project does cross two unnamed tributaries to Hills Creek, which are PAFBC-designated Approved Trout Waters. Approved Trout Waters contain significant portions that are open to public fishing and are stocked with trout by the PAFBC.

Based on our analysis, we determined that there are no threatened or endangered species present in any of the waterbodies crossed by the Project, as further discussed in section 3.4. TGP would adhere to the timing restrictions and implementation of water quality protection standards for construction in accordance with regulations and procedures set by the FERC and state regulatory agencies. Per TGP's Procedures, construction in Exceptional Value and Naturally Reproducing Wild Trout Streams would occur from January 1 through September 30, and construction in Class A Wild Trout Streams would occur from April 2 through September 30. We have included a condition in section B.2.1 requesting a copy of the Chapter 105 Water Obstruction and Encroachment Permit from the PADEP documenting approval of the proposed in-stream construction windows for this project. For the reasons described above, we conclude that the Project would not significantly affect fisheries within the project area.

TABLE B.3-1

Fisheries Resources of Special Concern within the Project Area

Milepost	Waterbody Name	Width of Crossing (feet)	Comments [a]
WESTERN LOOP			
0.5	Bear Wallow Branch	1	HQ-CWF
1.6	Left Straight Run	6	HQ-CWF
2.1	Wildcat Hollow	10	HQ-CWF
2.7	Unnamed tributary to Right Straight Run	1	Drains to HQ-CWF and Class A Wild Trout Water [b]
3.0	Right Straight Run	5	HQ-CWF; Class A Wild Trout Water
4.5	Unnamed tributary to Spoor Hollow Brook	2.5	Drains to TSF
EASTERN LOOP			
0.2	Caitlin Hollow Creek	25	TSF
0.6	Unnamed tributary to Crooked Creek	5	TSF
1.4	Unnamed tributary to Crooked Creek	6	TSF
ACCESS ROADS			
N/A	Left Straight Run	8	HQ-CWF

[a] Pennsylvania Code, Chapter 93, Designated Water Uses and Water Quality Criteria. HQ-CWF = High Quality Cold Water Fishery; TSF = Trout Stocked Fishery

[b] Class A Wild Trout Waters as designated by the PAFBC.

3.4 Special Status Species

Special status species are those species for which state or federal agencies provide an additional level of protection by law, regulation, or policy. Included in this category are federally listed species that

are protected under the Endangered Species Act or are considered as candidates for such listing by the FWS, those species that are state-listed as threatened or endangered, and state species of special concern. Information on species potentially occurring in the project area is presented in table B.3-2.

As outlined in sections 3.4.1 and 3.4.2 below, special status species may be present in the project area. However, through the completion of field surveys, correspondence with agencies, implementation of BMPs, and incorporation of regulatory guidelines in project activities, construction and operation of the project is not likely to adversely affect special status species. In a letter dated September 30, 2015, the FWS indicated that with TGP's proposed avoidance of two vernal ponds within the right-of-way, use of sediment barriers, and implementation of the *Noxious and Invasive Weed Control Plan*, the Project is not likely to adversely affect the northeastern bulrush. Additionally, the FWS indicated that with the implementation of seasonal tree clearing in the project areas where the northern long-eared bat is potentially present (Western Loop and pipe yard) between November 15 and March 31, the Project is not likely to adversely affect the northern long-eared bat.

TABLE B.3-2

Federally and State-Listed Species Potentially Occurring in the Project Area

Species	Scientific Name	Status [a]	Western Loop	Eastern Loop	CS 315	CS 317	CS 319	Pipe Yard	Access Roads
Northeastern bulrush	*Scirpus ancistrochaetus*	FE, PE	X	X					X
Northern long-eared bat	*Myotic sodalist*	FE	X					X	X
Bald eagle	*Haliaeetus leucocephalus*	BGEPA	X	X					X
Cranesbill	*Geranium bicknellii*	PE	X						
Few-seeded sedge	*Carex oligosperma*	PT	X						
Soft-leaved sedge	*Carex disperma*	PR	X	X					
Clinton's wood fern	*Dryopteris clintoniana*	N	X	X					
Creeping snowberry	*Gaultheria hispidula*	PR	X						
Marsh bedstraw	*Galium trifidum*	N		X					
Lesser panicled sedge	*Carex diandra*	PT		X					
Broad-leaved willow	*Salix myricoides*	N		X					
Timber rattlesnake	*Crotalus horridus*	CS	X	X	X				

[a] Status abbreviations: FE = FWS/federally threatened; PE = Pennsylvania endangered; PT = Pennsylvania threatened; PR = Pennsylvania rare; CS = Candidate Species under review for further listing by the PAFBC

3.4.1 Federally Listed Species

TGP, acting as the project non-federal representative to FERC, initiated informal consultation with the FWS, PADCNR Bureau of Forestry, PAFBC, and Pennsylvania Game Commission (PAGC) in October 2014 and reviewed the Pennsylvania Natural Diversity Index (PNDI) for the project area. TGP conducted initial habitat surveys of the project area in October and December of 2014. Additional

surveys were conducted in the spring and summer of 2015 at the recommendation of the FWS and state agencies. TGP's review of the PNDI and correspondence with the FWS Pennsylvania Field Office indicated that the northeastern bulrush and northern long-eared bat, both federally listed species may occur in the project area. The PNDI review also identified the potential presence of the bald eagle, a delisted but protected species under the MBTA and BGEPA, in the project area.

Northeastern Bulrush

Northeastern bulrush is a plant species typically found in ponds, wet depressions, shallow sinkholes, vernal pools, small emergent wetlands, or beaver-influenced wetlands. TGP conducted a survey using a qualified field botanist in July 2015 to identify potentially suitable northeastern bulrush habitat within the project area. The survey results identified populations of northeastern bulrush in two wetland areas within the project right-of-way. The survey results were submitted to the FWS on July 31, 2015. To reduce impacts on northeastern bulrush within the project area, TGP intends to use conventional bore drilling methods to avoid disturbing these two wetlands. Given TGP's proposed crossing method and installation of sediment barriers, and well as implementation of the *Noxious and Invasive Weed Control Plan*, we conclude that the Project *may affect, but is not likely to adversely affect* the northeastern bulrush. FWS concurred with this determination in its letter dated September 30, 2015. As such, consultation for this species is complete under the Endangered Species Act.

Northern Long-Eared Bat

The northern long-eared bat was formally listed as a federally threatened species in April 2015. Northern long-eared bats occur in widespread, but uncommon, patterns in forest habitats. During the winter, the bat hibernates in caves and underground mines. Individuals may travel up to 35 miles from their summer habitat to their winter hibernacula. Summer roosting habitat, including maternity roosts, includes tree cavities, exfoliating bark, snags of dead or dying trees, and man-made structures (e.g., barns). TGP conducted mist net surveys for bats along the pipeline right-of-way in June 2015, in accordance with FWS protocols issued by the PAGC. The survey resulted in the capture of 49 bats of four species, including the northern long-eared bat. Two northern-long eared bats were tracked to unique roosts. The results of the survey were submitted to the FWS on July 31, 2015. To reduce impacts on the northern long-eared bat, TGP intends to implement a 1.5-mile buffer around the centroid of each of the identified roost trees and follow tree clearing restrictions required by the FWS. Tree clearing would occur between November 15 and March 31 for the Western Loop and pipe yard area to minimize impacts on the northern long-eared bat. Given these buffer and seasonal clearing restrictions, we conclude that the Project *may affect, but is not likely to adversely affect* the northern long-eared bat. FWS concurred with this determination in its letter dated September 30, 2015. As such, consultation for this species is complete under the Endangered Species Act.

3.4.2 State-Listed Species

State-listed threatened and endangered species in Pennsylvania are protected under Title 58, Part II of the Pennsylvania Code (Pa. Code). The PAGC, the PAFBC, and the PADCNR are the three agencies responsible for administering this law. Mammals and birds are under the jurisdiction of the PAGC. Fish, reptiles, amphibians, and aquatic organisms are under the jurisdiction of the PAFBC. Plants, natural communities, terrestrial invertebrates, and geological features are under the jurisdiction of the PADCNR.

The PAGC indicated in correspondence dated November 6, 2014, that there was no anticipated impact to state-listed species within the project area.

The PAFBC indicated in correspondence dated October 28, 2014, that the timber rattlesnake, a state-listed candidate species, has known critical habitat in the proximity of the project area. TGP conducted a Phase I habitat evaluation for the timber rattlesnake in December 2014, and a Phase II presence/absence survey in July 2015. In correspondence dated August 5, 2015, the PAFBC indicated that it did not foresee the proposed Project resulting in adverse impacts on the timber rattlesnake. The project area may be used as foraging habitat by timber rattlesnakes, and there is a potential to encounter the species during project activities. As part of its environmental training program for construction personnel, TGP would advise workers of the potential for encountering the species. Workers would be instructed in methods to avoid encountering timber rattlesnake and that timber rattlesnakes are a state-protected species and are not to be harmed.

The PADCNR Bureau of Forestry indicated in correspondence dated November 20, 2014, that nine state-listed plant species are potentially located within the project area. The species identified by the Bureau of Forestry include cranesbill, few-seeded sedge, northeastern bulrush, soft-leaved sedge, Clinton's wood fern, creeping snowberry, marsh bedstraw, lesser panicled sedge, and broad-leaved willow. TGP completed surveys for target plant species, and identified soft-leaved sedge, Clinton's wood fern, cranesbill, and northeastern bulrush within the project area, along with hemlock palustrine forests and herbaceous vernal ponds. TGP has designed the project workspace to avoid impacts on these species/communities and is working with the PADCNR to obtain project clearance.

For the reasons listed above, and through continued coordination with the state regulatory agencies, we conclude that the Project would not significantly affect state-listed species within the project area.

4. LAND USE, RECREATION, AND VISUAL RESOURCES

4.1 Land Use

The Project involves the construction and operation of pipeline facilities, which include a Western Loop, an Eastern Loop, and a temporary pipe yard. The Project also involves modifications to three existing compressor stations. The following section discusses land use impacts associated with the construction and operation of the Project.

4.1.1 Pipeline Facilities

Construction of the pipeline facilities, which includes ATWS, access roads, and a pipe yard, would disturb approximately 131.7 acres of land, of which 62.0 acres would be maintained permanent right-of-way, of which approximately 21.9 acres would be new right-of-way. The remaining 69.7 acres would consist of temporary workspace, ATWS, or part of the existing 300 Line right-of-way, all of which would revert back to previous land use following construction. Table B.4-1 summarizes the land use types that would be crossed by the pipeline facilities.

Operation of the Project would require a 50-foot-wide permanent right-of-way centered on the pipeline in most areas. TGP proposes to use 25 feet of existing right-of-way associated with the existing permanent easement of the 300 Line system and to add 25 feet of new permanent easement. The typical width of TGP's existing permanent right-of-way for the 300 Line system is 150 feet outside of the Tioga State Forest. As a result of the Project, the proposed total permanent easement would increase to 175 feet outside of the Tioga State Forest.

Within the Tioga State Forest, the typical width of TGP's existing permanent right-of-way for the 300 Line system is 75 feet. For operational purposes, TGP would acquire an additional 10-foot-wide

easement within the Tioga State Forest for the loop pipeline, adjacent to the existing permanent easement for lines 300-1 and 300-2. This includes adding 13 feet of new permanent easement to the south of the proposed pipeline and relinquishing 3 feet of existing permanent easement to the north of the proposed pipeline. As a result of the Project, the proposed total permanent easement would increase to 85 feet within of the Tioga State Forest.

The land use types that would be traversed by the pipeline facilities include forested land, undeveloped open space, roadways, and residential. These land uses are described below.

Forested Lands

Construction of the pipelines would affect approximately 53.3 acres of forested lands, which include approximately 4.5 acres of ATWS and staging areas.

Approximately 20.2 acres of forested land would be permanently affected during the operation of the pipeline facilities. The forest acreage affected by construction includes portions of five residential parcels along the Western Loop. All of the trees within the right-of-way would be removed during clearing and preparation of the right-of-way. A 50-foot-wide permanent easement would be maintained in an herbaceous state over the centerline, which would prohibit the growth of woody species. Land outside the easement would be permitted to revegetate naturally, which is expected to take 30 to 50 years to reach preconstruction forest densities. The clearing of forested lands, for the usable life of the pipeline, would be a long-term impact. Because the pipelines are proposed to be located adjacent to and within existing pipeline rights-of-way, tree clearing would be minimized to the greatest extent practicable.

Open Land

Construction of the pipelines would affect approximately 58.7 acres of open land, of which approximately 38.6 acres would be permanent right-of-way affected during operation of the pipeline facilities. Open land consists of maintained herbaceous vegetation that comprises the majority of the existing 300 Line right-of-way. Impacts on open land would be short term and occur primarily during construction. It would take an estimated 3 to 12 months for open land vegetation to return to its pre-existing condition. Vegetation in the operational right-of-way would be permanently maintained in an herbaceous state. Given its current use on the existing pipeline rights-of-way, open land would not be significantly affected by the pipeline facilities.

Residential

Construction of the pipelines would affect approximately 2.6 acres of developed residential land, of which approximately 0.9 acre would be affected during operation of the pipeline facilities. This excludes the forested residential properties crossed by the Western Loop that are discussed under forested lands. These areas would be restored to preconstruction conditions, except that trees and certain other residential activities, such as digging for foundations, would not be permitted within the permanent right-of-way.

TABLE B.4-1

Acreage Affected by Construction and Operations of the Pipeline Facilities

Land Use Category	Temporary Construction Workspace (acres)[a]	Permanent Right-of-Way (acres) [b]	Total
WESTERN LOOP			
Forest	26.4	19.4 [c]	45.8
Roadways	0.4	0.4	0.8
Open land	14.2	23.1	37.3
Residential [d]	0	0	0
Western Loop Total	**41.0**	**42.9**	**83.9**
EASTERN LOOP			
Forest	2.2	0.8 [c]	3.0
Roadways	0.2	0.2	0.4
Open land	5.9	15.5	21.4
Residential	0.3	0.9	1.2
Eastern Loop Total	**8.6**	**17.4**	**26.0**
ATWS AND STAGING AREA			
Western Loop ATWS and Staging Areas			
Forest	4.3	0	4.3
Developed-Industrial	<0.1	0	<0.1
Open land	<0.1	0	<0.1
Eastern Loop ATWS and Staging Areas			
Forest	0.2	0	0.2
Residential	1.4	0	1.4
ATWS and Staging Area Total	**5.9**	**0**	**5.9**
PIPE YARD			
Industrial	4.8	0	4.8
Pipe Yard Total	**4.8**	**0**	**4.8**
ACCESS ROADS			
Western Loop ATWS and Staging Area			
Roadways	9.0	1.5	10.5
Eastern Loop ATWS and Staging Area			
Roadways	0.4	0.2	0.6
Access Roads Total	**9.4**	**1.7**	**11.1**
PIPELINE FACILITIES TOTAL	**69.7**	**62.0**	**131.7**

[a] Includes land that would only be affected by construction.

[b] Includes land that would be used for project construction and new and existing permanent right-of-way that would be affected by operations. [c] A portion of the tree clearing would include trees that have encroached on the existing permanent right-of-way associated with the 300 Line system.

[d] The Western Loop would cross five forested residential parcels for approximately 0.37 linear mile. The acreage associated with this crossing is included in the Forest land use type.

There are four residences located within 50 feet of the pipeline workspace and identified in table B.4-2. In order to minimize the impact on these residents, TGP would implement the following measures:

- restoring all lawn areas and landscaping in accordance with TGP's Plan and individual landowner agreements immediately after backfilling;
- fencing the construction work area adjacent to the residence for 100 feet in both directions to ensure that construction crews, materials, and equipment do not encroach the residence throughout the open trench phases of pipe installation; and
- attempting to reduce the construction area to maintain a 25-foot-wide construction workspace for a distance of 100 feet on either side of a residence or structure, where possible.

TABLE B.4-2

Residences within 50 Feet of Project Construction Workspace

Nearest Pipeline Milepost	Distance to Edge of Workspace (feet)	Distance to Pipeline Centerline (feet)
WESTERN LOOP		
4.11	34	59
5.27	39	120
5.80	40	120
EASTERN LOOP		
0.20 [a]	0	12

[a] Structure is currently owned by TGP.

TGP has not proposed to remove any structures outside of its existing easement as part of the Project. One structure already within the permanent right-of-way would be removed by TGP; however, this activity is not associated with the Project. Should TGP determine that a structure (i.e., shed) must be removed outside the easement due to unforeseen circumstances, it would compensate the landowner for relocation or removal.

Roadways

The pipelines would cross public (local municipal) roadways or private driveways at 20 locations. These roads range from dirt or gravel tracks to paved public roads. At Sand Road, which TGP is proposing to cross using horizontal directional drilling, and Catlin Hollow Road, which TGP is proposing to cross via conventional bore, traffic would not be affected. On all other roadway crossings where TGP would use an open-cut, there would be impacts on traffic. TGP would maintain an open traffic lane during construction except for a period of time during the lowering-in of the pipeline segment. TGP would employ police detail as necessary to ensure the orderly passage of vehicles and pedestrians during periods when only a single travel lane is maintained. Table B.4-3 details the roads that would be crossed by the pipeline facilities.

TABLE B.4-3

Public Roads Crossed by the Pipeline Facilities

County	Township	Milepost	Road Name	Crossing Method
WESTERN LOOP				
Tioga	Shippen	0.7	Sand Road	HDD
Tioga	Chatham	2.4	Private road off Tower Road	Open Cut
Tioga	Chatham	3.1	Strait Run Road	Open Cut
Tioga	Chatham	3.2	Tower Road	Open Cut
Tioga	Chatham	3.4	Tower Road	Open Cut
Tioga	Chatham	3.8	Baldwin Road	Open Cut
Tioga	Delmar	4.3	Private drive off Baldwin Road	Open Cut
Tioga	Delmar	4.7	Private drive off Baldwin Run Road	Open Cut
Tioga	Delmar	5.3	Private drive off Baldwin Run Road	Open Cut
Tioga	Delmar	5.4	Private drive off Baldwin Run Road	Open Cut
Tioga	Delmar	5.6	Baldwin Run Road	Open Cut
Tioga	Delmar	5.6	Private drive off Baldwin Run Road	Open Cut
Tioga	Delmar	5.7	Private drive off Baldwin Run Road	Open Cut
Tioga	Delmar	5.8	Baldwin Run Road	Open Cut
Tioga	Delmar	5.9	Private drive off Baldwin Run Road	Open Cut
EASTERN LOOP				
Tioga	Charleston	0.1	Private drive off Muck Road	Open Cut
Tioga	Charleston	0.2	Catlin Hollow Road	Conventional Bore
Tioga	Charleston	0.3	Private drive off Catlin Hollow Road	Open Cut
Tioga	Charleston	1.2	Private drive off Ding Dang Road	Open Cut
Tioga	Charleston	1.7	Ding Dang Road	Open Cut

Aboveground Facilities

The piping and compressor modifications at TGP's existing CS 317 and CS 319 would be located within the fence line of existing compressor station facilities. These facilities are industrial in character and have no trees within the fence line. At CS 315, most modifications would remain within the existing fence line for this facility; however, the existing security fence line and existing access road would be expanded to include a new transformer and disconnect switch at CS 315. To facilitate construction, temporary workspace would also be required outside the fence line of each of these compressor stations; however, all the permanent and temporary workspace would remain within TGP's existing property boundaries. No new visual screening is proposed for these existing compressor stations.

4.1.2 Additional Temporary Work Space

TGP identified certain areas where it determines site-specific conditions require the use of ATWS outside of the proposed 125-foot-wide pipeline construction right-of-way. ATWS would be required in areas where the proposed pipeline route crosses wetlands and waterbodies, existing utilities, roads, and at pipeline interconnections. Impacts associated with ATWS are shown in table B.4-1 above. A list of ATWS associated with the Project is included in table 3 of appendix B. We have reviewed these workspaces and their justification and find them acceptable.

In addition to ATWS at various locations along the proposed pipeline route, TGP proposes to use five staging areas and one pipe yard within Tioga County to support construction activities. These staging areas and ATWS would temporarily affect about 9.4 acres of land, consisting of mainly forested lands. Impacts associated with the staging areas are shown in table B.4-1 above. Staging areas are detailed in table 3 of appendix B. Upon completion of construction, the staging areas would be restored

in accordance with TGP's Plan, and prior use of the sites (in this case, forested land) would resume. The use of the staging areas would not result in any permanent impacts on land use, although the clearing of forested lands, for the usable life of the pipeline, would be a long-term impact. As discussed above for temporary pipeline right-of-way, natural restoration of preconstruction forest densities is expected to take at least 30 to 50 years.

4.1.3 Access Roads

Existing public roads and the construction right-of-way would be used for primary access to the pipelines during construction. TGP proposes to construct five new non-public roads and modify six existing public and non-public roads for access during construction and operations, as presented in table B.4-4. Negotiations with landowners are ongoing to determine if access road improvements would become permanent. This analysis assumes that the only permanent access roads are those listed in table B.4-4. These existing roads have a dirt or gravel surface and would require minor modifications such as grading, light vegetative brush removal, and tree clearing. The surface type of existing roads used for temporary access would not be permanently changed.

Modifications to existing roads would temporarily affect approximately 11.1 acres of land during construction. TGP proposes to construct five new roads that would be maintained as permanent access to the right-of-way. These new access roads would permanently affect 1.7 acres of land during operation of the pipeline facilities.

TABLE B.4-4

Non-Public Access Roads to be Used during Construction of the Pipeline Facilities

County	Township	Access Road Number	Milepost	Access Road Type	Existing Road Surface Type	Project Modifications	Length of Road (feet)	Area Affected		
								Temporary Only (acres)	Permanent (acres)	Total Affected by Project (acres)
WESTERN LOOP										
Tioga	Shippen	PAR-5	0.0	Permanent	Gravel	New access	125	0.3	<0.1	0.3
Tioga	Shippen	TAR-1	0.4	Temporary	Gravel	Add stone, widening, tree clearing/trimming.	2,811	1.9	0	1.9
Tioga	Shippen	TAR-2	1.5	Temporary	Gravel	Add stone, widening, tree clearing/trimming.	1,065	0.7	0	0.7
Tioga	Shippen	TAR-3	1.8	Temporary	Gravel	Add stone, widening, tree clearing/trimming.	4,480	3.1	0	3.1
Tioga	Chatham	PAR-1	2.5	Permanent	Gravel	None	1,592	0.7	0.4	1.1
Tioga	Chatham	TAR-4	3.7	Temporary	Gravel	Add stone	1,018	0.7	0	0.7
Tioga	Delmar	PAR-2	4.4	Permanent	Gravel	None	1,984	1.0	0.4	1.4
Tioga	Delmar	TAR-5	5.3	Temporary	Gravel	None	473	<0.1	0	<0.1
Tioga	Delmar/Middlebury	PAR-3	5.9	Permanent	Gravel	New Access	1,985	0.6	0.6	1.2
EASTERN LOOP										
Tioga	Charleston	TAR-6	1.7	Temporary	Gravel	Add stone, widening	100	<0.1	0	<0.1
Tioga	Charleston	PAR-4	1.8	Permanent	Gravel	Grading, add stone, widening, tree clearing/trimming.	824	0.4	0.2	0.6
PIPELINE FACILITIES TOTALS								**9.4**	**1.7**	**11.1**

[a] Area affected within existing roadbed.

[b] Area affected outside of existing roadbed, including widening.

4.1.4 Aboveground Facilities

The modifications to aboveground facilities for the Project would only affect existing industrial lands. The industrial lands affected by the Project are comprised of three existing compressor stations. Impacts from construction and operation of the aboveground facilities are described in table B.4-5.

TABLE B.4-5

Acreage Affected by Construction and Operations of the Aboveground Facilities

Facility	County, State	Approximate Milepost [a]	Land Requirements		Present Land Use
			Construction (acres)	Operations (acres) [b]	
CS 315	Tioga, PA	0 (Eastern Loop)	10.9	0	Industrial
CS 317	Bradford, PA	NA	32.2	0	Industrial
CS 319	Bradford, PA	NA	29.6	0	Industrial
TOTALS			**72.7**	**0**	

[a] CS 317 and CS 319 are not part of or adjacent to the pipeline right-of-way.
[b] Includes only new land required as a result of the Project.

All of the aboveground facilities would be located at existing compressor stations, within the existing property boundaries. Therefore, the majority of the impacts would be on lands already used for industrial purposes. Impacts on the industrial facilities are expected to be minor and temporary given that these facilities are owned by TGP. The impacts on day-to-day operations would not be significant. The construction activities at CS 315, CS 317, and CS 319 would affect 72.7 acres of industrial lands during construction and no additional acres for operation (beyond the existing footprint of those facilities).

Because the aboveground facilities are already owned by project sponsors and activities would occur on industrial lands, we conclude that the aboveground facilities would not pose a significant impact on land use.

4.2 Recreation and Special Use Areas

TGP consulted with state and federal land managing agencies to determine if recreational lands would be crossed by the proposed facilities. The Western Loop of the proposed pipeline facilities would cross portions of Tioga State Forest, six public recreational trails, three Pennsylvania-designated Landscape Conservation Areas, one Pennsylvania-designed Important Bird Area, a lumber heritage area, and two private gun clubs, as listed in table B.4-6. In addition, the Eastern Loop of the proposed pipeline facilities would pass within approximately 200 feet of the Catlin Hollow Road House, a structure that is eligible for inclusion on the National Register of Historic Places (NRHP), and approximately 0.25 mile from an Important Bird Area.

Approximately 4.4 miles of the Western Loop would be within Tioga State Forest. Originally acquired to protect the headwaters of Pine Creek, Tioga State Forest encompasses approximately 161,890 acres in Bradford and Tioga Counties, Pennsylvania (PADCNR, 2015b). Current recreational opportunities in the forest include hiking, camping, fishing, boating, bicycling, horseback riding, and winter sports activities such as snowmobiling and cross-country skiing. The primary impacts on the forest during construction and operation of the Project would be the disruption of the trails listed in table B.4-6, as well as impacts related to noise and visual resources. Noise impacts associated with project construction and operation are discussed in section B.7.2. Visual resources are discussed in section B.4.3. Disruption of recreational trails would be temporary—lasting approximately 1 day per

trail. TGP would provide advance notice to trail users and detours, and would ensure that proper safety measures are in place during construction. All trails would be returned to their previous condition.

TABLE B.4-6

Public Land and Designated Recreation, Scenic, or Other Areas in the Project Vicinity

Facility	County, State	Approximate Mileposts	Length of Crossing (feet) (Pipelines Only)
Tioga State Forest	Tioga, PA	0.0–4.1	21,384
Tioga State Forest	Tioga, PA	4.8–5.0	1,214
Bear Wallow Wetland LCA	Tioga, PA	0.4–0.6	1,056
Left Strait Run Trail [a]	Tioga, PA	1.4	14
Broad Ridge Trail [a]	Tioga, PA	2.4	8
Jim Close Trail [a]	Tioga, PA	3.6	8
Stone Trail [a]	Tioga, PA	3.7	15
Canada Run Bog LCA	Tioga, PA	3.7–4.6	4,752
Oil Well Hollow Trail	Tioga, PA	5.1	8
East Branch Canada Run Headwaters LCA [b]	Tioga, PA	5.2	0
Matson Trail	Tioga, PA	5. 6	10
Three Springs Gun Club	Tioga, PA	5.8	105
Camp North Country Rod and Gun Club	Tioga, PA	5.9–6.0	792
Susquehanna Headwaters Important Bird Area	Tioga, PA	0.0–6.2	32,736

[a] Trails within Tioga State Forest

[b] Crossed by temporary workspace only

The pipelines would cross 14 properties associated with the Pennsylvania Department of Agriculture's Clean and Green Program, as shown in table B.4-7.

The Program was created under the Pennsylvania Farmland and Forest Land Assessment Act with the goal of preserving agricultural and forested lands. The program provides a tax incentive to individuals participating in the program by taxing the property on the "use value" of the land rather than its market value. Property owners would be able to realize a modest tax savings by preserving forest or agricultural land.

In order to qualify for the program, landowners must have a minimum of 10 acres of contiguous agricultural, open, or forested lands. Because the tracts of lands that would be crossed by the Project were already fragmented by the 300 Line, linear construction would not result in new forest fragmentation. While open and agricultural lands would revert to their previous use following construction, there would be some permanent loss of forested lands. While lands devoted to "subsurface transmission and gathering" of natural gas may still receive the state's preferential tax rates (Pa. Code 137b.73a), if clearing were to reduce the amount of contiguous forested lands to less than 10 acres, the Project could result in disqualification of some properties from the Clean and Green Program. This would result in a long-term financial impact on the affected property owner. In such a case, TGP proposes to compensate Clean and Green Program property landowners for such impacts.

TABLE B.4-7

Pennsylvania Department of Agriculture Clean and Green Properties Crossed by the Project

Township	County	Approximate Mileposts
WESTERN LOOP		
Delmar	Tioga	4.4–4.5
Delmar	Tioga	5.4–5.5
Delmar	Tioga	5.6–5.7
Delmar	Tioga	5.7–5.8
Delmar	Tioga	5.9–6.0
Middlebury	Tioga	6.0–6.1
Middlebury	Tioga	6.1–6.2
Middlebury	Tioga	6.2
EASTERN LOOP		
Charleston	Tioga	0.1–0.2
Charleston	Tioga	0.2–0.3
Charleston	Tioga	0.3–0.8
Charleston	Tioga	0.9–1.4
Charleston	Tioga	1.4–1.7
Charleston	Tioga	1.7–1.9

To ensure that construction does not affect the eligibility of parcels for the Clean and Green Program, **we recommend that**:

- **Prior to construction, TGP should file with the Secretary, for the review and written approval of the Director of the Office of Energy Projects (OEP), a plan to reduce tree clearing on each parcel of land enrolled in the Clean and Green Program that would be crossed by the Western Loop or Eastern Loop as necessary to ensure the property remains eligible for the program. In the event TGP is not able to avoid disqualifying a property from the program, TGP should describe how it would compensate the affected landowner.**

No other recreational areas, scenic vistas, national trails, or other federally administered lands were identified within the project area. We conclude that recreational opportunities and special interest areas would not be significantly affected by the Project.

4.3 Visual Resources

4.3.1 Pipeline Facilities

The primary impacts of the pipeline facilities on visual resources would occur during active construction and affect forest, open lands, and wetlands. No visually sensitive areas were identified during review of the project facilities. The impacts would include the presence of construction equipment, materials and personnel, and disturbance of vegetation and soils. These construction impacts would be temporary, as construction would take approximately 4 months, culminating in the fall of 2017. During restoration of the disturbed areas, the rights-of-way would be characterized by mixed areas of new vegetation and bare soils. It is expected that revegetation of the rights-of-way would begin in the fall of 2017 and early in the spring of 2018.

Following construction, TGP would fully restore all disturbed areas. The visual appearance of these areas would return to their preconstruction conditions within 2 to 3 years in open lands, and emergent wetlands. Scrub-shrub wetlands may take longer than 3 years to return to preconstruction

conditions. Construction would have a permanent impact on some forested lands. Forested lands cleared for ATWS and the temporary construction corridor could take up to 30 to 50 years to return to their preconstruction conditions depending on availability of nutrients and water during the restoration period. Furthermore, clearing of forested lands for the permanent easement would result in a permanent visual change, as these areas would be maintained in an herbaceous state.

All of the pipeline facilities would be located within or adjacent to TGP's existing 300 Line right-of-way. These areas are already subject to the visual impact of a utility corridor. Clearing of forested lands adjacent to the existing 300 Line would widen the corridor by 25 feet. We conclude that locating the proposed pipelines adjacent to the 300 Line would not result in significant adverse effects on visual resources.

4.3.2 Aboveground Facilities

The aboveground facilities associated with the Project would represent minimal change in visual conditions. All of the aboveground facilities associated with the Project would be located within existing industrial facilities owned by TGP. These facilities currently have an existing visual impact on the surrounding areas depending on the direction and viewpoint from which they are seen. By locating the proposed facilities next to existing structures, the visual impact would generally be minimized. Furthermore, no new areas would be subject to visual impacts.

Proposed construction at existing CS 315 includes new and upgraded bays for cooling equipment, a new electrical motor control center building, and a shift in the existing access road to accommodate these facilities. These activities would require 5.0 acres of land, all of which would be within the existing property boundary.

Proposed construction at CS 317 includes replacing the existing compressor facility, reorienting existing and installing additional equipment on the property, and construction of two new buildings. These activities would require 16.5 acres of land, all of which would be within the existing property boundary.

Proposed construction at CS 319 includes replacing the existing compressor facility and reorienting existing and installing additional equipment on the property. These activities would require 7.4 acres of land, all of which would be within the existing property boundary.

TGP has not proposed any new visual screening for its aboveground facilities; however, it would leave existing trees and vegetation in place along roadways to buffer the view of the new buildings and ancillary equipment from motorists. To a casual observer or passerby, it is not expected that any significant visual changes would be perceptible once these facilities are complete.

5. SOCIOECONOMICS

The potential socioeconomic impacts on the affected areas would be short term due to the relatively short construction period. Population influx into the affected areas would occur due to the temporary construction workers required for the Project. This temporary population increase could have minor impacts on local services (fire, medical, police).

Construction of the Project would result in some beneficial impacts on the affected areas. The hiring of local and non-local workers during the construction period would provide some economic benefit due to purchases of temporary housing, food, and other services during construction. TGP anticipates one full-time permanent position would be generated for continued operation of the project

facilities. In addition, some construction materials may also be purchased locally. The Project would contribute tax revenues to the local areas during operation.

Due to the scope, the Project would not be expected to have a significant economic impact on the project area.

We received a comment from PennDOT requesting the consideration of potential socioeconomic impacts associated with state road crossings in our analysis. As described in section B.4.1, the Project would cross local public (municipal) and private roads at 20 locations. None of these roads are considered state roads. As stated in section B.4.1, TGP would maintain an open traffic lane during construction except during the lowering-in of the pipeline. Therefore, traffic impacts associated with the Project would be short term and temporary in nature. We have concluded that project construction would not result in socioeconomic impacts due to road crossings. Also, see section 4.1.1, Roadways discussion.

6. CULTURAL RESOURCES

Section 106 of the National Historic Preservation Act, as amended, requires the FERC to take into account the effects of its undertakings on properties listed or eligible for listing in the NRHP, and to afford the Advisory Council on Historic Preservation an opportunity to comment. TGP, as a non-federal party, is assisting us in meeting our obligations under Section 106 and its implementing regulations at 36 CFR 800.

TGP completed archaeological surveys for the Project and provided a *Phase I Archaeological Investigation Report* (Peltier et al., 2015) and *Addendum Phase I Archaeological Investigation Report* (Peltier and Padamonsky, 2015) to the FERC and the Pennsylvania State Historic Preservation Office (SHPO). The surveys included a 400-foot-wide corridor for the western loop, a 600-foot-wide corridor for the Eastern Loop, expansion areas of the three compressor stations, proposed access roads, and all auxiliary/support facilities (i.e., pipe/staging areas). A total of 596.7 acres was surveyed. No archaeological sites were discovered during the surveys completed for the Project, and no further archaeological investigations were recommended. In letters dated April 21 and September 9, 2015, the SHPO concurred with the reports and their recommendations. We concur also.

TGP completed a historic architecture survey for the Project and provided a *Phase I Historic Architecture Survey Report* (Peltier, 2015) to the FERC and the SHPO. The survey included "all areas from which there exists a view to or from the project right-of-way for the pipeline corridor, access roads, and yards; and, the locations of new project facilities or facility upgrades." The survey identified one previously documented property, the Catlin Hollow Road Property, which is eligible for listing in the NRHP but is located outside the project footprint. The survey also identified two new historic structures: 1822 Catlin Hollow Road, which is located within the project footprint; and 90 Muck Road, which is located outside the project footprint and was therefore not evaluated. The report recommended that project construction and operation would not adversely affect the Catlin Hollow Road Property; 1822 Catlin Hollow Road was not eligible for the NRHP; and no further investigation of 90 Muck Road. In a letter dated April 20, 2015, the SHPO concurred with the report's recommendations, including no effect on the Catlin Hollow Road Property. We concur also.

In letters dated November 11, December 3, and December 5, 2014, TGP provided project information to the following 15 Native American tribes with historic ties to the region: the Absentee-Shawnee Tribe of Oklahoma, Cayuga Nation of Indians, Delaware Nation, Delaware Tribe of Indians, Eastern Shawnee Tribe of Oklahoma, Oneida Indian Nation, Oneida Nation of Wisconsin, Onondaga Indian Nation, Seneca-Cayuga Tribe of Oklahoma, Seneca Nation of Indians, Shawnee Tribe,

Stockbridge-Munsee Community Band of Mohican Indians, St. Regis Mohawk Tribe, Tonawanda Seneca Nation, and Tuscarora Nation.

In a letter dated February 11, 2015, the Delaware Nation stated that the location of the Project does not endanger cultural or religious sites of interest to the Delaware Nation, but requested to be contacted in the event of inadvertent archaeological discoveries during construction.

Based on follow-up phone conversations, the Seneca Nation of Indians and the St. Regis Mohawk Tribe stated that they had no concerns regarding the Project.

We sent our notice of application and NOI to the same 15 tribes. The Stockbridge-Munsee Community Band of Mohican Indians indicated that the Project would be outside of the tribe's area of interest. No other responses to our correspondences have been received.

TGP provided FERC and the SHPO with an Unanticipated Discovery Plan to address the unexpected discovery of archaeological resources and human remains during construction. We requested minor revisions to this plan. TGP provided a revised plan that we find acceptable. To date, the SHPO has not provided comments on the revised plan.

Based on the results of the cultural resource surveys and consultation with the SHPO and Native American tribes, we believe that construction and operation of TGP's proposed facilities would not have a significant impact on cultural resources.

7. AIR QUALITY AND NOISE

7.1 Air Quality

Air quality can be affected by both construction and operation of the proposed facilities. The EPA has established National Ambient Air Quality Standards (NAAQS) for criteria pollutants for the purpose of protecting human health (primary standards) and public welfare (secondary standards). The EPA set NAAQS for the following air contaminants designated as "criteria pollutants:" nitrogen dioxide (NO_2), carbon monoxide (CO), ozone (O_3), sulfur dioxide (SO_2), lead, particulate matter with an aerodynamic diameter less than or equal to 10 microns (PM_{10}), and particulate matter with an aerodynamic diameter less than or equal to 2.5 microns ($PM_{2.5}$). These NAAQS reflect the relationship between pollutant concentrations and health and welfare effects and are supported by sound scientific evidence. The states implement and enforce the NAAQS through State Implementation Plans (SIP), which must be approved by the EPA. The state of Pennsylvania implements its SIP through the PADEP.

Air quality control regions (AQCR) are areas established for air quality planning purposes in which SIPs describe how ambient air quality standards would be achieved and maintained. AQCRs were established by the EPA and local agencies, in accordance with Section 107 of the Clean Air Act of 1970 and its amendments (CAA), as a means to implement the CAA and comply with the NAAQS through SIPs. The CAA is the basic federal statute governing air pollution. AQCRs are intra- and interstate regions such as large metropolitan areas where improvement of the air quality in one portion of the AQCR requires emission reductions throughout the AQCR. Each AQCR, or portion thereof, is designated based on compliance with the NAAQS. AQCR designations fall under three categories as follows: "attainment/unclassifiable" (areas in compliance with the NAAQS or not able to be classified on the basis of available information as meeting or not meeting the NAAQS), "nonattainment" (areas not in compliance with the NAAQS), or "maintenance" (areas that are currently in attainment but were previously classified as nonattainment and are afforded additional protection to ensure that they remain in attainment). Areas in nonattainment with the NAAQS for any criteria pollutant are held to more

restrictive air emissions limits when determining whether a facility is a "major source" under federal programs.

An Ozone Transport Region (OTR) is a region where the transfer of air pollutants from one or more states contributes significantly to a violation of the NAAQS in one or more other states.[6] The Northeast OTR is comprised of 11 northeastern states, including Pennsylvania. O_3 forms when there is a reaction between nitrogen oxides (NO_x) and volatile organic compounds (VOC): as a result, O_3 formation cannot be directly controlled. Limiting NO_x and VOC emissions would result in a lower potential for O_3 formation.

In Pennsylvania, Bradford and Tioga Counties are in AQCR 151 - Northeast Pennsylvania Intrastate.[7] All counties associated with the Project are in attainment with the NAAQS; however, because the Project would be constructed in the Northeast OTR, all counties are considered to be in moderate nonattainment with the NAAQS for O_3 for air permitting purposes. Pipeline facilities in nonattainment areas are held to more restrictive air permitting standards.

7.1.1 Air Quality Construction Impacts and Mitigation

Emissions associated with construction activities generally include exhaust from construction non-road equipment and commuting and on-road construction vehicles; fugitive dust associated with vehicle movement at the project sites; fugitive dust associated with trenching, backfilling, and other earth-moving activities; and venting of natural gas to the atmosphere. Exhaust emissions would depend on the equipment used and the horsepower-hours of operation. The quantity of fugitive dust emissions would depend on the moisture content and texture of the soils that would be disturbed.

Construction of TGP's pipeline would last approximately 4 months depending upon site-specific conditions. Modifications to CS 315, CS 317, and CS 319 would last approximately 6 months each. A summary of the Project's potential construction emissions is presented in table B.7-1. As shown in table B.7-1, the construction potential emissions do not exceed general conformity *de minimis* thresholds for the pollutants subject to general conformity.

In order to minimize fugitive dust emissions, TGP has committed to implementing mitigation measures such as:

- requiring contractors to meet all federal, state, and local air quality regulations and emission standards applicable to their equipment;
- limiting the area of earth to be disturbed;
- applying water or dust suppressants to disturbed areas, as necessary;
- covering open hauling trucks with tarps, as necessary, and using paved roads for construction and vehicle traffic, wherever practical;
- limiting vehicle speeds as required;
- responding promptly to any significant particulate emission concerns that occur during construction by evaluating the source of emissions; and

[6] Title 42 of the USC, chapter 85, part D, subpart 1, section 7506(a).

[7] This data is provided in 40 CFR 81, subpart C, section 107 – Attainment Status Designations.

- stabilizing disturbed areas upon completion of construction activity.

TABLE B.7-1

Construction Emissions Summary (tons per year) [a]

Source	NOx	CO	VOC	PM_{10}	$PM_{2.5}$	SO_2	HAPs [b]	CO_2e [c]
CS 315								
Fugitive Dust	-	-	-	1.2	0.1	-	-	-
Non-Road Engines	0.2	0.2	<0.1	<0.1	<0.1	<0.1	<0.1	32
On-Road Engines	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	45
Venting	-	-	0.1	-	-	-	<0.1	528
CS 317								
Fugitive Dust	-	-	-	12.4	1.2	-	-	-
Non-Road Engines	0.8	0.6	0.1	<0.1	<0.1	<0.1	<0.1	148
On-Road Engines	0.1	0.6	<0.1	<0.1	<0.1	<0.1	<0.1	363
Venting	-	-	0.2	-	-	-	<0.1	2,119
CS 319								
Fugitive Dust	-	-	-	6.5	0.7	-	-	-
Non-Road Engines	0.4	0.2	0.1	<0.1	<0.1	<0.1	<0.1	76
On-Road Engines	0.1	0.2	<0.1	<0.1	<0.1	<0.1	<0.1	141
Venting	-	-	0.2	-	-	-	<0.1	1,186
PIPELINE CONSTRUCTION								
Fugitive Dust	-	-	-	80.1	29.0	-	-	-
Non-Road Engines	4.8	14.3	0.7	0.3	0.3	<0.1	0.2	1,233
On-Road Engines	0.5	2.3	<0.1	<0.1	<0.1	<0.1	<0.1	1,293
Venting	-	-	2.2	-	-	-	<0.1	21,854
TOTAL	**6.9**	**18.5**	**3.6**	**100.6**	**31.4**	**0.1**	**0.2**	**29,018**

[a] Construction emissions would occur within one calendar year (2017).
[b] HAPs = hazardous air pollutants
[c] CO_2e = carbon dioxide equivalents

In addition, TGP would be required to comply with 25 Pa. Code 123.1, which regulates fugitive dust emissions.

Emissions from construction equipment exhaust would be temporary in nature. Once construction activities in the project area are completed, fugitive dust and construction vehicle/equipment emissions associated with the pipeline and compressor station construction would return to preconstruction levels. Therefore, we conclude that emissions associated with the construction phase of the Project would not result in a significant impact on local air quality.

7.1.2 Air Quality Operations Impacts and Mitigation

New air emissions would result from operation of the proposed facilities at CS 317 and CS 319. Table B.7-2 presents the potential-to-emit (PTE) emissions of criteria pollutants, hazardous air pollutants (HAPs), and greenhouse gas (GHG) emissions as carbon dioxide equivalents (CO_2e) for each station. The PTE emissions represent the maximum capacity of a stationary source to emit any air pollutant, although actual operational emissions may be less. No new air emission sources are being

installed at CS 315. Therefore, a quantitative impact assessment of air quality impacts due to the Project at CS 315 was not conducted. A small amount of additional operational emissions would be generated by pipeline blowdown events. These events would be minor, infrequent, and typically associated with pipeline maintenance activities.

TABLE B.7-2

Estimated Facility Wide Potential-to-Emit for Operations Emissions (tons per year)

Source	NO_x	CO	VOC	PM_{10}	$PM_{2.5}$	SO_2	HAPs	CO_2e
CS 317								
Existing PTE (Emergency Generator)	0.8	0.5	0.2	<0.1	<0.1	<0.1	0.1	111
PTE of New Units (Compressor Turbine, Boiler, Fugitive Emissions)	30.7	37.5	3.3	3.6	3.6	7.5	1.7	71,569
New Station PTE Following the Project	31.5	38.0	3.5	3.6	3.6	7.5	1.8	71,680
CS 319								
Existing PTE (Solar Mars 100 turbine, Emergency Generator, Misc. Boilers & Heaters, Pipeline Components)	32.1	39.5	3.9	3.8	3.8	1.9	1.8	74,236
PTE of New Units (Compressor Turbine, Fugitives)	37.2	51.9	3.9	4.4	4.4	9.2	2.0	85,533
PTE of Compressor to be removed	-30.4	-37.2	-1.6	-3.7	-3.7	-1.9	-1.7	-73,010
New Station PTE Following the Project [a]	38.9	54.2	6.2	4.5	4.5	9.2	2.1	86,759
FEDERAL AIR QUALITY REGULATIONS: MAJOR SOURCE THRESHOLDS								
GHG Mandatory Reporting	N/A	N/A	N/A	N/A	N/A	N/A	N/A	25,000
Prevention of Significant Deterioration (PSD)	250	250	250	250	250	250	N/A	75,000 [b]
Nonattainment New Source Review	100	N/A	50	N/A	N/A	N/A	N/A	N/A
Title V	100	100	50	100	100	100	25 [c]	N/A

[a] The total post-project potential emissions consists of the existing sources and new proposed sources, minus the emissions from the compressor to be removed.

[b] Sources must currently be PSD major-sources for the GHG threshold to apply.

[c] 25 tons per year for all HAPs combined.

TGP would minimize operational impacts by using natural gas as the sole fuel in all new combustion equipment and implementing best available technology controls on the new combustion turbine. The best available technology controls would include low-NO_x combustors to limit NO_x emissions and an oxidation catalyst to reduce CO, VOC, and organic HAP emissions. The Project would also employ good combustion practices and perform vendor recommended operational and maintenance activities on the combustion equipment. In addition to mitigating impacts from the combustion activities, TGP would implement leak detection and repair program using audible, visual, and olfactory detection

methods on a monthly basis and annual inspections using a forward looking infrared camera to minimize fugitive emissions from the natural gas compression operations. The turbines proposed for the Project are also designed with dry seals, which reduce fugitive emissions as compared to those with wet seals.

Additionally, TGP would implement other measures to minimize potential fugitive emissions as recommended in EPA's Gas Star program. TGP would install electric starters on the turbines and would not use gas starters. TGP would implement the following practices to reduce natural gas venting with fewer compressor engine startups and improve engine ignition:

- the turbines would not be vented prior to normal startup except after an extended shutdown or compressor maintenance;
- the turbines would be equipped with the state of the art ignition system to reduce the frequency of false starts;
- TGP would operate the turbines optimally minimizing the number of start and stops; and
- the turbines would be equipped with an automated surge control systems to avoid over pressurization and relief.

Finally, in order to reduce emissions when taking compressors off-line, the turbine compressor system would be relieved to the atmosphere only during maintenance, repairs, and extended shutdown.

7.1.3 Federal Air Quality Regulations

During operation, CS 317 and CS 319 would emit quantities of regulated air pollutants and would be subject to federal and state air quality regulations that are driven by the CAA. The provisions of the CAA that are potentially relevant to this Project are discussed below.

7.1.4 Greenhouse Gases

On September 22, 2009, the EPA issued the final Mandatory Reporting of Greenhouse Gases Rule. It requires reporting of GHG emissions from suppliers of fossil fuels and facilities that emit greater than or equal to 25,000 metric tons[8] of GHG per year. On June 3, 2010, the EPA tailored the applicability criteria for stationary sources and modification projects.[9]

GHGs occur in the atmosphere both naturally and as a result of human activities, such as the burning of fossil fuels. These gases are the integral components of the atmosphere's greenhouse effect that warms the earth's surface and moderates day/night temperature variation. The primary GHGs produced by fossil fuel combustion are water, carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). During construction and operation of this Project, these GHGs would be emitted from non-electrical construction equipment and any compressors, boilers, and generators. Emissions of GHGs are typically expressed in terms of CO_2e, where the potential of each gas to increase heating in the atmosphere is expressed as a multiple of the heating potential of CO_2, or its global warming potential.[10] Table B.7-1 summarizes the estimated PTE GHG emissions for CS 317 and CS 319.

---

8 A metric ton is 2,205 pounds, or approximately 1.1 tons.

9 75 FR 31514

10 The EPA uses the 100-year global warming potential in its analyses for GHGs, as listed in the *Intergovernmental Panel of Climate Change's Second Assessment Report*.

The combustion-related GHG emissions from operation of the Project would exceed 25,000 metric tons per year (tpy). TGP would calculate GHG emissions from the combustion sources using the Tier 1 approach, as outlined in the rule, and would submit its GHG report to the EPA by March 31 of each calendar year, as required.

7.1.5 Prevention of Significant Deterioration

Prevention of Significant Deterioration (PSD) federal review regulations are intended to protect the national public health and welfare as well as preserve the existing air quality in areas of special national or regional scenic, natural, recreational, or historic value where regulated pollutant levels are in compliance with the NAAQS. PSD regulations impose specific limits on the amount of pollutants that new major sources or major modifications at existing stationary sources may contribute to existing air quality levels. In addition, for existing sources that exceed the major-source-threshold levels, modifications that exceed the PSD significant-emissions-increase rates are subject to PSD regulations.

CS 317 and CS 319 are currently minor sources with respect to PSD. As presented in table B.7-2, PTE for both CS 317 and CS 319 following the Project would continue to be below PSD thresholds for all applicable pollutants.

7.1.6 New Source Performance Standards

New Source Performance Standards, codified at 40 CFR 60, establish emission limits and requirements for monitoring, reporting, and record keeping for specific emission source categories. New Source Performance Standards apply to new, modified, or reconstructed sources. Subpart KKKK of 40 CFR 60, *Standards of Performance for Stationary Combustion Turbines*, would apply to the CS 317 and CS 319 turbines because the heat input at peak load would be greater than 10 million British thermal units per hour. The turbines would be required to meet specific emission limits, and performance testing, monitoring, recordkeeping, and reporting requirements would apply.

7.1.7 Nonattainment New Source Review

Because all counties associated with the Project are designated as moderate nonattainment for O_3, Nonattainment New Source Review (NNSR) requirements may apply. NNSR regulations apply to new major stationary sources or modifications to existing major stationary sources within an area designated as nonattainment with the NAAQS. Both CS 317 and CS 319 are located within the Northeast OTR; therefore, emissions associated with the modifications to these stations may be subject to NNSR. NNSR programs are customized for each nonattainment area, although all programs must require (1) the installation of equipment having the lowest achievable emission rate, or LAER; (2) emission offsets; and (3) the opportunity for public involvement. NNSR significance levels are 100 tpy for NO_x and 50 tpy for VOC.

CS 317 and CS 319 are currently minor sources with respect to PSD. As presented in table B.7-2, the proposed emissions of NO_x and VOC associated with the modifications to CS 317 and CS 319 are less than the NNSR significance levels; therefore, the Project would not be subject to NNSR.

7.1.8 Title V Operating Permit

The Title V Operating Permit Program, as described in 40 CFR 70, requires major sources of air emissions and certain listed non-major sources to obtain a federal operating permit. The major source emissions thresholds for determining the need for a Title V Operating Permit in OTRs are shown in table B.7-2. Both CS 317 and CS 319 are existing minor sources and are not subject to Title V Operating

Permit requirements. As presented in table B.7-2, the total station PTE for CS 317 and CS 319 following project implementation would still be less than Title V Operating Permit thresholds; therefore, TGP would not be required to obtain a Title V Operating Permit as a result of the Project.

7.1.9 General Conformity

A general conformity applicability analysis is required for any part of the Project occurring in nonattainment or maintenance areas for criteria pollutants. Section 176(c) of the CAA requires federal agencies to ensure that federally approved or funded projects conform to the applicable approved SIP. Such activities must not:

- cause or contribute to any new violation of any standard in any area;
- increase the frequency or severity of any existing violation of any standard in any area; or
- delay timely attainment of any standard or any required interim emission reductions or other milestones in any area.

General conformity does not apply to federal actions in attainment areas or unclassifiable/ attainment areas, including attainment areas located within an OTR. As detailed in section 7.1, all project activities would occur within unclassifiable/attainment areas; therefore, general conformity rules do not apply to the Project.

7.1.10 National Emissions Standards for Hazardous Air Pollutants

National Emissions Standards for Hazardous Air Pollutants (NESHAP) apply to major sources of HAPs. A major source under NESHAP is defined as a source with PTE emissions exceeding 25 tpy for all HAPs or 10 tpy for individual HAPs. Neither CS 317 nor CS 319 would qualify as major sources under NESHAP; therefore, these facilities would not be subject to NESHAP regulations.

7.1.11 State Air Quality Regulations

CS 317 and CS 319 currently have minor source air permits that were provided by PADEP. The addition of the new equipment at CS 317 and CS 319 would require a permit modification known as a Plan Approval. The Minor Source Plan Approval air permit applications for CS 317 and CS 319 were submitted to PADEP in April 2015.

As previously mentioned, CS 315 would not have any changes to combustion equipment or other stationary sources, and no new emission sources would be installed; therefore, the proposed changes to CS 315 would not require preconstruction air permitting. However, TGP submitted a Request for Determination to the PADEP to seek an exemption from plan approval requirements for physical changes of minor significance pursuant to 25 Pa. Code 127.14(c)(2) in March 2015.

Pennsylvania has adopted the NAAQS, but maintains additional air quality standards under 25 Pa. Code. Fugitive emissions regulations are outlined in 25 Pa. Code section 123.1. For accepted fugitive emissions activities/sources, which include construction of buildings, clearing of land, and stockpiling of material, this section states that the following requirements must be met: 1) the emissions are of minor significance with respect to causing air pollution; and 2) the emissions are not preventing or interfering with the attainment or maintenance of an ambient air quality standard.

7.1.12 Air Quality Modeling Analysis

TGP completed air emissions modeling to estimate potential air quality impacts associated with the proposed new emission sources at CS 317 and CS 319 using the EPA's American Meteorological Society / EPA Regulatory Model Improvement Committee Dispersion Model (AERMOD) consistent with EPA and PADEP air quality modeling procedures and guidance. The results of the air modeling analysis includes project-related impacts, existing background air quality, and a comparison of project impacts combined with background air quality for comparison to the NAAQS. The air quality modeling results for CS 317 are presented in table B.7-3, and the results for CS 319 are presented in table B.7-4.

TABLE B.7-3

Air Quality Modeling Results for Compressor Station 317

Pollutant	Averaging Period	Significant Impact Level (µg/m³) [a]	Maximum Impact Concentration (µg/m³) [b]	Significant Impact Area (km)	NAAQS Compliance Concentration (µg/m³) [c]	Ambient Background (µg/m³)	Total Impact (µg/m³) [d]	NAAQS (µg/m³)
SO_2	3-hour	25	0.34	N/A	2.70	40.09	42.79	1,300
	1-hour	7.8	0.60	N/A	4.70	27.34	32.04	196
PM_{10}	24-hour	5	0.34	N/A	0.22	32.0	32.22	150
$PM_{2.5}$	Annual	0.3	0.02	N/A	0.02	6.57	6.59	12.0
	24-hour	1.2	0.25	N/A	0.13	18.03	18.16	35
CO	8-hour	500	309	N/A	250	573	823	10,000
	1-hour	2000	1079	N/A	1035	574	1609	40,000
NO_2 [e]	Annual	1	0.14	N/A	0.14	18.07	18.21	100
	1-hour	7.5	22.56	7.23	15.97	75.83	91.80	188

[a] µg/m³ = micrograms/cubic meter

[b] Maximum predicted concentration

[c] NAAQS compliance concentration is the maximum predicted concentration consistent with the ambient background concentration used to demonstrate compliance with the NAAQS (e.g., 1-hour NO_2 NAAQS compliance is based on a 3-year average of the 98th percentile (8th highest) of the annual distribution of the maximum daily 1-hour average).

[d] Total Impact (µg/m³) = NAAQS Compliance Concentration (µg/m³) plus the Ambient Background (µg/m³).

[e] EPA default NO_X to NO_2 conversion rates of 0.8 (1-hour NO_2) and 0.75 (annual NO_2) applied to predicted NO_2 concentrations.

TABLE B.7-4
Air Quality Modeling Results for Compressor Station 319

Pollutant	Averaging Period	Significant Impact Level (µg/m³)	Maximum Impact Concentration (µg/m³)[a]	Significant Impact Area (km)	NAAQS Compliance Concentration (µg/m³)[b]	Ambient Background (µg/m³)	Total Impact (µg/m³)[c]	NAAQS (µg/m³)
SO_2	3-hour	25	1.50	N/A	0.12	40.09	41.33	1,300
	1-hour	7.8	2.02	N/A	0.10	27.34	28.34	196
PM_{10}	24-hour	5	0.21	N/A	0.09	32.0	32.10	150
$PM_{2.5}$	Annual	0.3	0.01	N/A	0.01	6.57	6.58	12.0
	24-hour	1.2	0.11	N/A	0.04	18.03	18.07	35
CO	8-hour	500	384	N/A	324	573	897	10,000
	1-hour	2000	832	N/A	727	574	1301	40,000
NO_2	Annual	1	0.07 [d]	N/A	0.07 [d]	18.07	18.14	100
	1-hour	7.5	12.06 [d]	0.26	3.31 [d]	75.83	79.14	188

[a] Maximum predicted concentration

[b] NAAQS compliance concentration is the maximum predicted concentration consistent with the ambient background concentration used to demonstrate compliance with the NAAQS (e.g. 1-hour NO_2 NAAQS compliance is based on a 3-year average of the 98th percentile (8th highest) of the annual distribution of the maximum daily 1-hour average).

[c] Total Impact (µg/m³) = NAAQS Compliance Concentration (µg/m³) plus the Ambient Background (µg/m³).

[d] EPA default NO_X to NO_2 conversion rates of 0.8 (1-hour NO_2) and 0.75 (annual NO_2) applied to predicted NO_2 concentrations.

As presented in tables B.7-3 and B.7-4, the air quality impacts associated with the new emissions from CS 317 and CS 319, when combined with existing background levels, would be below NAAQS for all pollutants.

While there would be an increase in air emissions as a result of operation of the new compressor units, table B.7-2 shows that air emissions would be below major-source thresholds for all federal air permitting programs. Furthermore, tables B.7-3 and B.7-4 demonstrate that air emissions associated with CS 317 and CS 319 would be in compliance with the NAAQS, respectively.

TGP would be required to comply with all applicable federal and state regulations, as previously discussed in this section. The new emission sources associated with CS 317 and CS 319 would be subject to air emission permits as issued by the PADEP, which would include emission limits and monitoring requirements. Furthermore, TGP has proposed air emission mitigation measures to limit emissions. Our analyses demonstrate that the Project, as proposed, would not have a significant adverse impact on air quality in the project area.

7.2 Noise

Construction and operation of the Project would affect the local noise environment. Two measurements used by federal agencies to relate the time-varying quality of environmental noise to its known effects on people are the equivalent sound level (L_{eq}) and the day-night sound level (L_{dn}). The L_{eq} is an A-weighted sound level containing the same sound energy as instantaneous sound levels measured over a specific time period. Noise levels are perceived differently, depending on length of exposure and time of day. The L_{dn} takes into account the duration and time the noise is encountered. An additional 10 decibels (dB) are added to late night through early morning (10:00 p.m. to 7:00 a.m.) noise exposures to account for people's greater sensitivity to sound during nighttime hours. An L_{dn} of 55 decibels on the A-weighted scale (dBA) is equivalent to a continuous L_{eq} noise level of 48.6 dBA.

The noticeable noise increase threshold for humans is about 3 dBA. A 5 dBA increase is clear for humans, while an increase of 10 dBA is perceived to be a doubling of noise levels.

The EPA has indicated that an L_{dn} of 55 dBA protects the public from indoor and outdoor activity interference. We have adopted this criterion and use it to evaluate the potential noise impact from operation of compressor facilities. The State of Pennsylvania and Bradford County do not have any noise requirements directly applicable to the Project. Tioga County has specific regulations regarding natural gas compressor stations in its Subdivision and Land Development Ordinance. Section 710.01.1 of this ordinance indicates that certain equipment, including compressors, needs to be enclosed in buildings. Section 710.01.2 regulates overall sound levels facilities, but the limits (60 dBA L_{eq} at receiver property lines) are less restrictive than the FERC requirements; therefore, the more conservative FERC noise criterion has been presented in this analysis. For TGP's proposed CS 315 in the Borough of Wellsboro, Tioga County; CS 317 in the Borough of Troy, Bradford County; and CS 319 in the Borough of Wyalusing, Bradford County, there are no numerical decibel limits in the local ordinances that are directly applicable to the Project.

7.2.1 Construction Activities

Construction activities associated with the Project would be performed with standard heavy equipment such as track-excavators, backhoes, bulldozers, dump trucks, and cement trucks. The most prevalent sound source during construction would be internal combustion engines used to power the construction equipment. Construction activities would temporarily increase ambient sound levels in the immediate vicinity of the compressor station construction sites, while noise associated with pipeline construction for the Project would be transitory in nature. Most construction activities would be limited to daytime hours, with the exception of a limited number of 24-hour activities, such as the installation of the HDD, the running of water pumps during hydrostatic testing, and trenching activities in areas with open-trench timing restrictions. Further, weather-related events such as prolonged or heavy rainfall may necessitate specific 24-hour construction activities in order to maintain the project schedule. The entry and exit sites for the proposed HDD are located within a large expanse of forested area within the Tioga State Forest. There are no residences, churches, schools, or other noise sensitive areas (NSA) within 0.5 mile of the HDD entry and exit sites; therefore, HDD activities associated with the Project are not likely to affect NSAs.

The majority of the project construction activities would not affect nighttime noise levels as it would be limited to daylight hours. Those activities that would occur during nighttime hours would occur away from NSAs or for isolated periods of time; therefore, no significant construction noise impacts are anticipated.

7.2.2 Compressor Station Operation

TGP conducted an acoustical analysis to predict noise impacts associated with the compressor station modifications proposed for the Project, including completing ambient noise surveys. Figures 5, 6, and 7 in appendix A display maps of the nearest NSAs to the CS 315, CS 317, and CS 319 sites, respectively.

The proposed changes to CS 315 as a result of the Project consist of an upgrade to the cooling system; no new compression is proposed for CS 315. The estimated noise attributable to operation of CS 315 at the nearby NSAs is presented in table B.7-5.

TABLE B.7-5

Noise Impacts for Modifications at Compressor Station 315

NSA [a]	Distance and Direction from Station	Ambient Sound Level (L_{dn}, dBA)	Estimated Sound Level of Added Equipment (Gas Cooler Bay) (L_{dn}, dBA)	Estimated Combined Sound Level (Ambient + Added Equipment) (L_{dn}, dBA)	Estimated Change (dB)
1	840 SE	50	46	51	1
2	1,010 ESE	48	43	50	1
3	1,180 E	46	41	47	1
4	1,190 NNE	49	38	49	<1
5	1,980 NW	48	21	48	<1
6	2,540 SSW	49	33	49	<1
7	1,950 SW	48	35	48	<1

[a] All NSAs are residences within a 1-mile radius of the compressor station.

The results of the noise modeling results presented in table B.7-5 for CS 315 does not include any additional noise mitigation measures and demonstrates that sound contribution associated with the Project would be less than our 55 dBA L_{dn} noise criteria.

Modifications to CS 317 planned as a part of the Project include demolishing an existing compressor building and constructing a new building to house a compressor to be relocated from CS 319. The estimated noise attributable to operation of CS 317 at nearby NSAs is presented in table B.7-6.

TABLE B.7-6

Noise Impacts for Modifications at Compressor Station 317

NSA [a]	Distance and Direction from Station	Ambient Sound Level (L_{dn}, dBA)	Estimated Sound Level of Added Equipment (Solar Mars 100 Compressor Unit) (L_{dn}, dBA)	Estimated Combined Sound Level (Ambient + Added Equipment) (L_{dn}, dBA)	Estimated Change (dB)
1	1,920 S	49	44	50	1
2	3,860 W	42	39	46	4
3	2,410 NW	50	46	52	2
4	2,470 N	47	46	52	5
5	2,720 NNE	42	47	48	6
6	2,750 ENE	42	44	46	4

[a] All NSAs are residences within a 1-mile radius of the compressor station.

As shown in table B.7-6, noise from the added compressor unit would be less than 55 dBA L_{dn}, but would increase the ambient noise by as much as 5 dBA at NSA 4 and 6 dBA at NSA 5, which would be a clearly noticeable increase in noise at these NSAs.

The acoustical analysis provided in table B.7-6 assumes the following mitigation measures are implemented at CS 317:

- acoustically-designed compressor building;
- acoustically-designed compressor pipe lagging;
- compressor turbine exhaust silencer; and
- compressor turbine inlet silencer and filter.

Modifications to CS 319 planned as a part of the Project include removal of a compressor, to be relocated to CS 317, and replacing it with a new compressor. The estimated noise attributable to operation of CS 319 at the nearby NSAs is presented in table B.7-7.

TABLE B.7-7

Noise Impacts for Modifications at Compressor Station 319

NSA [a]	Distance & Direction from Station	Ambient Sound Level (L_{dn}, dBA)	Estimated Sound Level of Added Equipment (Solar Titan 130 Compressor Unit) (L_{dn}, dBA)	Estimated Combined Sound Level (Ambient + Added Equipment) (L_{dn}, dBA)	Estimated Change (dB)
1	690 SSW	50	51	54	3
2	1,030 SE	51	46	52	1
3	1,360 NE	52	42	53	<1
4	2,420 NNE	44	35	45	<1
5	3,220 NW	45	33	45	<1

[a] All NSAs are residences within a 1-mile radius of the compressor station.

As shown in table B.7-7, noise from the added compressor unit at CS 319 would be less than 55 dBA L_{dn}, but would increase the ambient noise by as much as 3 dBA at NSA 1, which would be a noticeable increase in noise at this NSA. The acoustical analysis provided in table B.7-7 accounts for the removal of an existing compressor unit and assumes that the following mitigation measures are implemented at CS 319:

- acoustically-designed compressor building;
- acoustically-designed compressor pipe lagging;
- compressor turbine exhaust silencer; and
- compressor turbine inlet silencer and filter.

TGP has committed to implementing appropriate noise-abatement measures to ensure compliance with the FERC noise criterion of 55 dBA L_{dn}, including the mitigation measures described above.

TGP's estimated noise levels at the modified stations would meet our criterion; however, to ensure that the noise mitigation measures are properly implement and that noise levels attributable to operation of CS 315, CS 317, and CS 319 would not exceed reasonable levels at nearby NSAs , **we recommend that:**

- **TGP should make all reasonable efforts to ensure its predicted noise levels from CS 315, CS 317, and CS 319 are not exceeded at nearby NSAs and file noise surveys showing this with the Secretary no later than 60 days after placing the three compressor stations in service (i.e., after project modification). If full load condition noise surveys of one or more of the stations are not possible, TGP should file interim survey(s) at the maximum possible horsepower load and file the full load survey(s) within 6 months. However, if the noise attributable to the operation of CS 315, CS 317, and/or CS 319 at full load exceeds an L_{dn} of 55 dBA at any of the nearby NSAs, TGP should file a report on what changes are needed and should install additional noise controls to meet the level within 1 year of the in-service date. TGP should confirm compliance with this requirement by filing a second noise survey with the Secretary no later than 60 days after it installs the additional noise controls.**

Blowdowns, which would occur infrequently, involve venting natural gas from the compressor station into the atmosphere. No changes to blowdown equipment are proposed from CS 315 and CS 319; therefore, noise from blowdown events at CS 315 and CS 319 would not change. TGP is proposing to install new blowdown equipment at CS 317. Based on measurements at similar compressor station configurations, measured sound levels at 30 meters (100 feet) from unmitigated blowdown events typically range from 106 to 114 dBA. Assuming similar performance for the CS 317 blowdown events, received sound levels at the nearest NSA exceed the FERC criterion of 55 dBA. Those that occur as a result of normal station operation, such as commissioning of the compressor units or maintenance, would be mitigated with a blowdown silencer. This silencer would be designed to reduce blowdown noise to 77 dBA at 30 meters (100 feet). The nearest NSA to CS 317 would experience a total noise level of approximately 51 dBA at 585 meters (1,920 feet). Noise levels associated with unplanned blowdown events may be higher; however, these events would be infrequent and would not represent a significant noise impact.

Based on the estimated sound levels, adherence to noise regulations, and our recommendation, we conclude that the noise attributable to operation of CS 315, CS 317, and CS 319 would not cause a significant impact on the noise environment in the project area.

8. RELIABILITY AND SAFETY

The transportation of natural gas by pipeline involves some incremental risk to the public due to the potential for the accidental release of natural gas. The greatest hazard is a fire or explosion following a major pipeline rupture.

Methane, the primary component of natural gas, is colorless, odorless, and tasteless. It is not toxic, but is classified as a simple asphyxiate, possessing a slight inhalation hazard. If breathed in high concentration, oxygen deficiency can result in serious injury or death. Methane has an auto-ignition temperature of 1,000 degrees Fahrenheit and is flammable at concentrations between 5 and 15 percent in air. An unconfined mixture of methane and air is not explosive; however, it may ignite if there is an ignition source. A flammable concentration within an enclosed space in the presence of an ignition source can explode. It is buoyant at atmospheric temperatures and disperses rapidly in air.

8.1 Safety Standards

The USDOT is mandated to provide pipeline safety under Title 49 USC Chapter 601. The USDOT's Pipeline Hazardous Material and Safety Administration (PHMSA), acting through the Office of Pipeline Safety, administers the national regulatory program to ensure the safe transportation by pipeline of natural gas and other hazardous materials. The PHMSA develops safety regulations and other approaches to risk management that ensure safety in the design, construction, testing, operation, maintenance, and emergency response of pipeline facilities. Many of the regulations are written as performance standards that set the level of safety to be attained and allow the pipeline operator to use various technologies to achieve safety.

PHMSA ensures that people and the environment are protected from the risk of pipeline incidents. This work is shared with state agency partners and others at the federal, state, and local level. Section 5(a) of the Natural Gas Pipeline Safety Act provides for a state agency to assume all aspects of the safety program for intrastate facilities by adopting and enforcing the federal standards, while section 5(b) permits a state agency that does not qualify under section 5(a) to perform certain inspection and monitoring functions. Title 49 of the USC, Chapter 601, section 60105(a) provides for a state agency to assume all aspects of the safety program for intrastate facilities, through certification by the Office of Pipeline Safety, by adopting and enforcing the federal standards. State agencies must apply for certification annually. Section 60105(b) permits a state agency that does not qualify under section 60105(a) to perform certain inspection and monitoring functions. A state agency may also act as the USDOT's interstate agent, which allows the agency to inspect interstate facilities within its boundaries; however, the USDOT is responsible for enforcement actions. In Pennsylvania, the Office of Pipeline Safety regulates and inspects interstate natural gas transmission pipelines.

Under the *Memorandum of Understanding on Natural Gas Transportation Facilities* (Memorandum) dated January 15, 1993, between the USDOT and FERC, the USDOT has the exclusive authority to promulgate federal safety standards used in the transportation of natural gas. Section 157.14(a)(9)(vi) of the FERC's regulations require that an applicant certify that it will design, install, inspect, test, construct, operate, replace, and maintain the facility for which a certificate is requested in accordance with federal safety standards and plans for maintenance and inspection; or shall certify that it has been granted a waiver of the requirements of the safety standards by the USDOT in accordance with section 3(e) of the Natural Gas Pipeline Safety Act. FERC accepts this certification and does not impose additional safety standards other than the USDOT standards. If FERC becomes aware of an existing or potential safety problem, there is a provision in the Memorandum to promptly alert the USDOT. The Memorandum also provides for referring complaints and inquiries made by state and local governments and the general public involving safety matters related to pipelines under the FERC's jurisdiction. FERC also participates as a member of the USDOT's Technical Pipeline Safety Standards Committee, which determines whether proposed safety regulations are reasonable, feasible, and practicable.

The proposed pipeline and aboveground facilities associated with the Project must be designed, constructed, operated, and maintained in accordance with the USDOT *Minimum Federal Safety Standards* in 49 CFR 192. The regulations are intended to ensure adequate protection for the public and to prevent natural gas facility accidents and failures. The USDOT specifies material selection and qualification; minimum design requirements; and protection from internal, external, and atmospheric corrosion.

The USDOT also defines area classifications based on population density in the vicinity of the pipeline and specifies more rigorous safety requirements for populated areas. The class location unit is an area that extends 220 yards on either side of the centerline of any continuous 1-mile length of pipeline. The four area classifications are:

- Class 1 – location with 10 or fewer buildings intended for human occupancy;
- Class 2 – location with more than 10 but fewer than 46 buildings intended for human occupancy;
- Class 3 – location with 46 or more buildings intended for human occupancy or where the pipeline lies within 100 yards of any building or small well-defined outside area occupied by 20 or more people on at least 5 days a week for 10 weeks in any 12-month period; and
- Class 4 – location where buildings with four or more stories aboveground are prevalent.

Class locations representing more populated areas require higher safety factors in pipeline design, testing, and operation. Pipe wall thickness and pipeline design pressures, hydrostatic test pressures, maximum allowable operating pressure, inspection and testing of welds, and frequency of pipeline patrols and leak surveys must also conform to higher standards in more populated areas. The Project would be entirely within Class 1 locations. If a subsequent increase in population density adjacent to the right-of-way results in a change in the pipeline's class location, TGP would reduce the maximum allowable operating pressure or replace the segment with pipeline of sufficient grade and wall thickness, if required to comply with the USDOT regulations for the new class location.

The Pipeline Safety Improvement Act of 2002 requires operators to develop and follow a written integrity management program that contains all the elements described in 49 CFR 192.911 and addresses the risks on each transmission pipeline segment. Specifically, the law establishes an integrity management program that applies to all high-consequence areas. TGP's proposed pipeline route would not cross any high-consequence areas, alleviating the need for further consideration relative to 49 CFR 192.761.

Part 192 of 49 CFR prescribes the minimum standards for operating and maintaining pipeline facilities, including the requirement to establish a written plan governing these activities. Under 49 CFR 192.615, each pipeline operator must also establish an emergency plan that includes procedures to minimize the hazards in a natural gas pipeline emergency. Key elements of the plan include procedures for:

- receiving, identifying, and classifying emergency events, gas leakage, fires, explosions, and natural disasters;
- establishing and maintaining communications with local fire, police, and public officials, and coordinating emergency response;
- emergency shutdown of the system and safe restoration of service;
- making personnel, equipment, tools, and materials available at the scene of an emergency; and
- protecting people first and then property, and making them safe from actual or potential hazards.

Part 192 of 49 CFR requires that each operator must establish and maintain liaison with the appropriate fire, police, and public officials to learn the resources and responsibilities of each organization that may respond to a natural gas pipeline emergency and to coordinate mutual assistance. The operator must also establish a continuing education program to enable customers, the public, government officials, and those engaged in excavation activities to recognize a gas pipeline emergency and report it to appropriate public officials.

8.2 Pipeline Accident Data

The USDOT requires all operators of natural gas transmission pipelines to notify the National Response Center following the detection of a significant incident and to submit a report within 30 days to PHMSA. Significant incidents are defined in 49 CFR 191.3 as a release of gas that results in one or more of the following consequences:

- a death or personal injury requiring hospitalization;
- property damage, excluding cost of gas lost, of more than $50,000, in 1984 dollars;[11] and
- unintentional estimated gas loss of three million cubic feet or more.

Incidents may also include events that are determined to be significant in the judgment of the operator even though they do not meet the criteria above (USDOT PHMSA, 2015a). In 2013, approximately 320,200 miles of gas transmission and gathering pipelines were subject to this reporting requirement (USDOT, 2015). During the 20-year period from 1995 through 2014, a total of 972 significant incidents were reported nationwide for onshore natural gas transmission pipelines. Table B.8-1 identifies causes of significant incidents for onshore natural gas transmission pipelines.

TABLE B.8-1

Causes of Significant Incidents for Onshore Natural Gas Transmission Pipelines

Cause of Incident	Number of Incidents	Percentage of Total
Corrosion	168	17.3
Pipeline Material Defect, Weld or Equipment Failure	299	30.8
Excavation (third party damage)	190	19.5
Natural Force Damage	81	8.3
Outside Force Damage (fire, explosion, vehicle damage, previous damage, and intentional damage)	55	5.7
Incorrect Operation	38	3.9
All Other Causes (miscellaneous unknown causes)	141	14.5
TOTAL	**972**	**100.0**

Source: USDOT PHMSA, 2015c.

The dominant causes of pipeline incidents from 1995 to 2014 were construction material defects and equipment failure, constituting 30.8 percent of all significant incidents. The pipelines included in the data set in table B.8-1 vary in terms of age, diameter, and level of corrosion control. Each variable influences the incident frequency that may be expected for a specific segment of pipeline.

[11] $50,000 in 1984 dollars is approximately $114,600 as of January 2015 (Consumer Price Index, Bureau of Labor Statistics. Available online at http://www.bls.gov/data/inflation_calculator.htm. Accessed September 2015).

Damage by outside force and natural forces were the cause in 14 percent of significant pipeline incidents from 1995 to 2014. These result from earth movements due to soil settlement, washouts, or geological hazards; weather effects such as winds, storms, and thermal strains; and willful damage.

Older pipelines have a higher frequency of outside forces incidents partly because their location may be less well known and not as well marked as newer lines. In addition, older pipelines contain a disproportionate number of smaller diameter pipelines, which have a greater rate of outside forces incidents. Small diameter pipelines can be more easily crushed or broken by mechanical equipment or earth movements.

Since 1982, operators have been required to participate in "One Call" public utility programs in populated areas to minimize unauthorized excavation activities in the vicinity of pipelines. The "One Call" program is a service used by public utilities and some private sector companies (e.g., oil pipelines and cable television) to provide preconstruction information to contractors or other maintenance workers on the underground location of pipes, cables, and culverts.

8.3 Impact on Public Safety

According to the USDOT PHMSA, from 1995 to 2014 there was an annual average of 49 significant incidents and two fatalities per year (USDOT PHMSA, 2015b). The majority of the fatalities associated with gas pipelines involved local distribution pipelines. These are natural gas pipelines that distribute natural gas to homes and businesses after transportation through interstate transmission pipelines and are not regulated by FERC. From 1991 to 2010, there was an average of 80 significant gas distribution incidents and 15 fatalities per year. From 2006 to 2010, there was a total of 13 gas distribution industry and 39 public fatalities (USDOT PHMSA, 2011). In general, distribution lines are smaller diameter pipes, plastic pipes, and older pipelines that are more susceptible to damage. In addition, distribution systems do not have large rights-of-way or pipeline markers common to FERC-regulated gas transmission pipelines.

The nationwide totals of accidental fatalities from various man-made and natural hazards are listed in table B.8-2, which provides a relative measure of the industry-wide safety of natural gas transmission pipelines. Table B.8-2 includes the average annual fatalities that occurred on natural gas transmission lines over a 20-year period between 1995 and 2014. Direct comparisons between accident categories should be made cautiously, however, because individual exposures to hazards are not uniform among the categories. Furthermore, the fatality rate is much lower than the fatalities from natural hazards such as lightning, tornados, floods, earthquakes, etc.

The available data show that natural gas transmission pipelines continue to be a safe, reliable means of energy transportation. The number of significant incidents distributed over approximately 303,000 miles of natural gas transmission pipelines nationwide indicates the risk is low for an incident at any given location (USDOT, 2015b). Thus, based on TGP’s compliance with state and federal safety standards, we conclude that the operation of the Project would represent only a slight increase in risk to the nearby public.

TABLE B.8-2

Nationwide Accidental Deaths [a]

Type of Accident	Annual Fatalities
All accidents	128,200
Poisoning	39,000
Motor Vehicle	35,900
Falls	26,100
Suffocation	4,600
Drowning	3,700
Fire, smoke inhalation, burns	3,200
Tornadoes [b] (10-year average, 2005–2014)	110
Floods [b] (10-year average, 2005–2014)	71
Lightning [b] (10-year average, 2005–2014)	32
Natural gas distribution lines [c] (average 1995–2014)	14
Natural gas transmission and gathering pipelines [c] (average 1995–2014)	2

[a] All data, unless otherwise noted, reflects 2009 statistics from the National Safety Council (2011), "Injury Facts 2001 Edition."
[b] National Oceanic and Atmospheric Administration (2015)
[c] USDOT PHMSA (2015a)

9. CUMULATIVE IMPACTS

The first European settlements in Pennsylvania date back to the mid-seventeenth century. However, indigenous peoples who lived in large settlements and associated satellite villages occupied the state more than 15,000 years ago. Currently, the state is the sixth most populated state in America. Consequently, the natural environment has been modified numerous times over a very long period of occupation.

In accordance with NEPA, we identified other actions located in the vicinity of the proposed project facilities and evaluated the potential for a cumulative impact on the environment. As defined by the Council on Environmental Quality (CEQ), a cumulative effect is the impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes such other actions. The CEQ guidance states that an adequate cumulative effects analysis may be conducted by focusing on the current aggregate effects of past actions without delving into the historical details of individual past actions. In this analysis, we consider the impacts of past projects within the regions of influence as part of the affected environment (environmental baseline) which was described and evaluated in the preceding environmental analysis. However, present effects of past actions that are relevant and useful are also considered.

As described in section B of this is EA, constructing and operating the Project would temporarily and permanently impact the environment. The Project would impact geology, soils, water resources, wetlands, vegetation, fish, wildlife, cultural resources, some land uses, recreation, visual resources, air quality, and noise. However, throughout section B of this EA, we determined that the proposed Project would have only minimal or temporary impacts on these resources, with the exception of impacts on forested land, forested and scrub-shrub wetlands, noise, and air quality (further discussed below). We also conclude that nearly all of the project-related impacts would be contained within or adjacent to the temporary construction right-of-way and ATWS. For example, erosion control measures included in TGP's construction and restoration plans would keep disturbed soils within work areas. For other resources, the contribution to regional cumulative impacts is lessened by the expected recovery of

ecosystem function. For example, vegetative communities would be cleared, but restoration would proceed immediately following construction. Additionally, we determined that visual impacts would not be significant at any discrete location along the proposed loops.

As noted above, the proposed Project is expected to have longer-term or permanent impacts on certain resources, including forested and scrub-shrub wetlands. Project impacts on wetlands range from short-term to permanent. Impacts on forested and scrub-shrub wetlands include long-term construction impacts and permanent operational impacts from clearing and maintenance activities. However, project impacts on these resources are minimal, including 0.1 acre of long-term impact to both forested and scrub-shrub wetlands associated with construction, as well as <0.1 acre and 0.1 acre of permanent impacts on forested and scrub-shrub wetlands, respectively, from operation of the Project. These impacts would be limited to the conversion of the vegetative cover, and these areas would retain their hydrologic function as a wetland. The proposed Project would also impact emergent wetlands, but following revegetation, these wetlands transition relatively quickly back into a community with functionality similar to that of the preconstruction state (typically within 1 to 3 years, but closer to 1 year or less in the project area). As a result, although project impacts include long-term and permanent impact to wetlands, the extent of these impacts is minimal and would not be significant; therefore, we conclude that the project would not contribute to cumulative impacts on wetland resources.

Regarding impacts on noise, project impacts associated with construction activities would be temporary and transitory. In addition, there are no residences, churches, schools, or other NSAs within 0.5 mile of the HDD entry and exit sites; therefore, HDD activities associated with the Project are not likely to impact NSAs. TGP's estimated operational noise levels at the modified stations would meet our noise criterion, although they would result in noticeable long-term noise increases at certain NSAs. No existing or proposed facilities were identified in our analysis with the potential to contribute to cumulative noise impacts. While other TGP projects have resulted in increased noise levels at the compressor stations proposed to be modified as part of the Project, these changes have been accounted for in the noise analysis presented in section B.7.2. Based on the estimated sound levels and localized nature of the changes associated with the Project, adherence to noise regulations, and our recommendations, we conclude that the long-term noise changes attributable to operation of CS 315, CS 317, and CS 319 would not contribute to a cumulative impact on the noise environment in the project area.

Based on the collocation of the project pipeline with existing rights-of-way, TGP's implementation of impact avoidance, minimization, and mitigation measures as described in their construction and restoration plans, and their adherence to our recommendations, we find that most of the project impacts would be largely limited to the 8.1-mile-long corridor followed by the pipeline.[12] Furthermore, we find that the impacts of the Project discussed above would generally be localized and minimal. Therefore, we conclude that project impacts would not be significant and would not contribute to cumulative impacts, with the possible exception of impacts on forested lands and air quality. As a result, we have related the scope of our analysis to the magnitude of environmental impacts on forested lands and air quality.

Consistent with the CEQ guidance and to determine cumulative impacts, we expanded the geographic boundaries of our review into regions of influence as described below. Actions located outside the regions of influence are generally not evaluated because their potential to contribute to a cumulative impact diminishes with increasing distance from the Project. Based on the forested land and air quality impacts of the Project as identified and described in this EA, and consistent with the CEQ

[12] Please note this narrow corridor is not the expanded area of our cumulative impacts review, it is only the area directly affected by the Project.

guidance, we have determined that the following resource-specific regions of influence are appropriate to assess cumulative impacts:

- Impacts on forested lands would be largely contained within or adjacent to proposed project workspaces. Due to the localized nature of potential project impacts on these resources, cumulative impacts were assessed for other projects occurring within a ½-mile radius of the proposed Project; and
- Temporary impacts on air quality, including fugitive dust, would be largely limited to areas immediately around active construction. Project-specific modeling was used to determine the appropriate region of influence for longer-term impacts on air quality. Based on this modeling, the proposed Project's region of influence was determined to be 7.2 kilometers (4.5 miles) from CS 317 and 0.3 kilometer (0.2 mile) from CS 319. However, the area evaluated for potential cumulative impacts was extended beyond the Project's region of influence to approximately 10 kilometers (6.2 miles) to account for emission sources that could have a significant air impact when combined with project impacts.

Table 4 of appendix B identifies present and reasonably foreseeable projects or actions that occur within the regions of influence identified above. These projects were identified by a review of publicly available information; aerial and satellite imagery; consultations with federal, state, and local agencies/officials and development authorities; and information provided by TGP, affected landowners, and concerned citizens.

The actions considered in our cumulative impact analysis may vary from the proposed Project in nature, magnitude, and duration. These actions are included based on the likelihood of completion near the proposed construction time span, and only projects with either ongoing impacts or that are "reasonably foreseeable" future actions were evaluated. Existing or reasonably foreseeable actions that would be expected to affect similar resources during similar periods as the proposed Project were considered further. The anticipated cumulative impacts of the proposed Project and these other actions are discussed below, as well as any pertinent mitigation actions.

The Allegheny Defense Project provided comments requesting consideration of direct, indirect, and cumulative effects of the proposed Project (including shale natural gas extraction); consideration of connected, cumulative, and similar actions; and the preparation of a programmatic environmental impact statement (EIS). We discuss potential cumulative effects below, including identification of projects considered in this assessment. Resource-specific direct and indirect project impacts are addressed throughout section B of this EA. Consistent with previous Commission Determinations and as further discussed below, while this cumulative impact analysis considers natural gas production well and associated gathering line development, it is unknown when, or even if, these wells would be drilled. Therefore, we conclude that an in-depth analysis of Marcellus Shale wells is outside the scope of the analysis in this EA because the exact location, scale, and timing of these facilities are unknown. Regarding preparation of a programmatic EIS, the proposed Project represents regional development by private industry and is not part of a comprehensive federal program. Therefore, a programmatic EIS is not required.

9.1 Identified Projects

Based on the regions of influence described above for forested lands and air quality cumulative impacts, we identified 16 other projects and development activities that were considered in the cumulative

impact assessment. These projects include both FERC jurisdictional projects as well as other, non-jurisdictional projects.

The following projects listed in table 4 of appendix B are further considered in the analysis of forested land and/or air quality cumulative impacts:

- TGP's Rose Lake Expansion Project,
- TGP's Northeast Upgrade Project (NEUP),
- TGP's Northeast Supply Diversification Project (NSD),
- TGP's Northeast Energy Direct (NED) Project,
- TGP's 300-Line Project,
- TGP's and National Fuel Gas Supply Corporation's Northeast ConneXion – NY/NJ Project,
- Panda Power Funds' Liberty Power Project (Liberty Power Project), and
- natural gas wells.

Overall descriptions of these projects are provided in table 4 of appendix B, and more detailed descriptions are provided below.

The above-listed TGP projects are currently in service, with the exception of the NED Project. All of these projects are accounted for in the air quality cumulative assessment; however, only the Rose Lake Expansion Project and the 300-Line Project involved impacts on forested lands within the ½-mile region of influence for the proposed Project. Therefore, only these two projects are included in the assessment of forested land cumulative impacts.

TGP's Rose Lake Expansion Project involved the same compressor stations as the proposed Project and was placed in-service in late 2014. Specifically, the Rose Lake Expansion Project involved the addition of a 12,630-hp turbine-compressor package at CS 315, replacement of an existing compressor with a new unit at CS 317, and in-place abandonment of two existing 4,500-hp compressor units and replacement with a new 16,000-hp turbine compressor package at CS 319. Additionally, ancillary equipment and piping modifications were installed at CS 315, CS 317, and CS 319.

TGP's NEUP Project included construction of 40 miles of pipeline in five loops and modification to existing compressor stations in Pennsylvania and New Jersey. Within Bradford County, TGP's NEUP included 7.4 miles of pipeline loop near CS 319 collocated with TGP's existing 300 Line pipeline, as well as modifications to CS 319 that did not involve additional compression.

TGP's NSD Project included 6.8 miles of pipeline loop in Tioga and Bradford Counties extending west from CS 317 and parallel to TGP's existing 300 Line (Loop 315), as well as modifications to CS 317 that did not involve additional compression. Other project activities included modifications to existing compressor and metering stations in Pennsylvania and New York.

On November 20, 2015, TGP filed an application for the NED Project and is anticipating an in-service date of November 2018 (subject to FERC approval). The NED Project includes 32 miles of

pipeline looping on TGP's 300-Line, 40 miles of new pipeline generally collocated with the Constitution Pipeline Project, modifications to CS 319, addition of one new compressor station, and upgrades to TGP's pipeline system in other states. Within Bradford County, the NED Project includes construction of two pipeline looping segments along the existing 300-Line. One looping segment would begin at CS 317 and extend east approximately 22.9 miles, and the second looping segment would begin at CS 319 and extend east approximately 9.1 miles, terminating in Susquehanna County. Modifications to CS 319 include restaging the existing compressor, adding an exhaust silencer, and modifying the existing station pipeline to accommodate the new pipeline loops.

TGP's 300-Line Project included construction of eight pipeline loops, construction of two compressor stations, and modification of seven compressor stations. Activities in Tioga and Bradford Counties (in whole or in part) included installation of five pipeline looping segments and modifications to CS 315, CS 317, and CS 319. Within Tioga and Bradford Counties, the pipeline loops included the following:

- Loop 313, a 17-mile loop in between CS 313 and CS 315. Four miles of this loop are located in Tioga County, and 13 miles are located in Potter County;
- Loop 315, a 17-mile loop in between CS 315 and CS 317;
- Loop 317, a 22.5-mile loop in between CS 317 and CS 319;
- Loop 319A, a 1.2-mile loop extending just west of CS 319; and
- Loop 319, a 16.7-mile loop in between CS 312 and CS 323. Approximately 2.7 miles of this loop are located in Bradford County, and 14 miles are located in Susquehanna County.

The 300-Line Project compressor station modifications in Tioga and Bradford Counties included installation of one 16,000-hp compressor unit at CS 315, replacement of an existing compressor with a new compressor unit at CS 317, and re-staging of two existing compressor units at CS 319.

TGP and National Fuel Gas Supply Corporation's Northeast ConneXion NY/NJ Project included the installation of 6 miles of pipeline loop along the 300 Line in Bradford and Susquehanna Counties and addition of compression and upgrades at existing compressor stations and metering stations in Pennsylvania and New Jersey. Two miles of pipeline loop extended east from CS 317, and 4 miles of looping was located east of CS 319, approximately 1 mile of which was located in Bradford County and 3 miles of which were located in Susquehanna County. In addition, CS 317 was uprated with software changes.

The Liberty Power Project is an 829-megawatt combined cycle power plant proposed to be located in Bradford County, Pennsylvania, approximately 17 kilometers (11 miles) from the proposed Project at the closest point. The Liberty Power Project would be a major PSD source, with NO_x emissions greater than 250 tpy. Although the Liberty Power Project is outside of the proposed Project's Significant Impact Area for air quality, because it would be a new major emission source in proximity to the proposed Project, an evaluation of the Liberty Power Project was included in the cumulative air quality modeling analysis.

Clearing and construction activities associated with natural gas well development could result in impacts on forested lands. While natural gas production wells also constitute a source of operational emissions, the emission sources do not trigger air permitting thresholds and emissions are not quantified.

We believe air quality impacts associated with natural gas production is minimal and would not contribute to cumulative impacts. In addition, compliance with the applicable federal and PADEP air quality regulations would avoid or minimize significant cumulative construction-related air quality impacts of natural development activities in the proposed project area. Therefore, air quality impacts of natural gas development were not evaluated as part of the air quality cumulative assessment. Natural gas well development activities are outside of the Commission's jurisdiction and are under the jurisdiction of the PADEP and other resource agencies. Existing and planned natural gas wells identified in PADEP's online database (PADEP, 2015e) within ½ mile of the proposed project area are included in table 4 of appendix B and were assessed related to forested land cumulative impacts.

In addition to the TGP projects described above, there are two other TGP projects currently under review by the Commission associated with the 300 Line: the Triad Expansion and Orion Projects. While these projects are not located within the region of influence for cumulative project impacts and were not evaluated in the cumulative impact assessment, a description of these projects is provided on table 4 of appendix B and below to inform the cumulative impact analysis.

The Triad Expansion Project includes construction of approximately 7 miles of new pipeline and auxiliary facilities along TGP's existing 300-Line. Auxiliary facilities consist of crossover and connecting facilities, a new pig launcher, a pig receiver, and an additional odorant facility at CS 321. The Orion Project includes the construction of approximately 12.9 miles of new looping pipeline and associated facilities. Modifications would also be made to the existing CS 323. The Triad Expansion and Orion Projects are located more than 20 miles away from the proposed Project.

9.2 Potential Cumulative Impacts of the Proposed Action

9.2.1 Forested Lands

Impacts on forested lands include long-term construction impacts and permanent operational impacts from clearing and maintenance activities. This analysis considers cumulative impacts on forested areas from the Project and other existing and planned projects within ½ mile. The other projects considered in this analysis include TGP's Rose Lake Expansion Project, TGP's 300-Line Project, and the natural gas wells identified on table 4, appendix B.

Within the region of influence of CS 315 and the Eastern Loop of the proposed Project, the Rose Lake Expansion Project impacted 3.9 acres and 1.6 acres of forested land for construction and operation, respectively. In addition, a portion of the 315 Loop associated with the 300-Line Project was constructed within the region of influence of the Eastern Loop of the proposed Project. Overall, the 17-mile 315 Loop impacted 82.6 acres of forested land for construction and 14.3 acres of forested land for operation; however, only approximately 2.5 miles of this loop was located within the proposed project area of influence. Detailed quantification of impacts on forested lands are not available specifically for this 2.5-mile section of the 315 Loop; however, for the purpose of this assessment, we assumed that forested land impacts were evenly distributed along the 17-mile loop. Therefore, about 14 percent of the total 315 Loop impacts, or 11.6 acres and 2 acres of construction and operational impacts, respectively, were assumed to be located within the proposed project area of influence. Project impacts associated with the Eastern Loop include 2.2 acres and 0.8 acres of construction and operational impacts, respectively.

The 300-Line Project and the proposed Project are looping projects, and previous Commission analyses have concluded that forest fragmentation is reduced with the collocation of looping projects (as compared to new, greenfield pipelines) because most of the forested lands impacted are already bisected by an existing right-of-way (FERC, 2015). In addition, forested land impacts associated with the Rose Lake Expansion Project were located adjacent to TGP's existing compressor stations and only required

expansion of previously disturbed areas. We acknowledge, however, that these types of impacts widen the right-of-way corridor and move the edge effects into new areas of forest. Restoration of areas cleared for construction would proceed immediately following project completion. Because the Rose Lake Expansion and 300-Line Projects have already been placed in service, some of the construction impacts associated with these projects have had time to begin regeneration, which lessens the regional cumulative impacts with the proposed future construction of the proposed Project.

Of the natural gas wells described on table 4 of appendix B, one well (East Resources' Goodwin 7 well) was permitted but not constructed, and the seven Talisman wells are horizontal wells associated with a single pad in proximity to CS 317. The proposed piping and compressor modifications at TGP's existing CS 317 would be located within the fence line of the existing compressor station facility and would not impact forested lands, and, consequently, not contribute to cumulative impacts. The remaining well, Seneca Resources Group's DCNR 007 1V 50529 well, was constructed on forested lands based on a review of aerial photography. We estimated the forested impacts associated with the development of this well to be approximately 2 acres, based on a review of recent aerial photography.

In addition to the assessment of cumulative impacts, we are including a summary of additive impacts associated with the TGP 300-Line projects proximal to the proposed Project. Although the majority of the impacts described below are not within the area of influence for cumulative impacts for the Project, this information is provided to disclose total regional impacts associated with TGP's 300-Line system.

The additive forested land impacts from the existing and planned 300-Line projects in proximity to the proposed Project in Tioga and Bradford Counties are summarized in table B.9-1.

TABLE B.9-1

Summary of Cumulative Upland Forest Impacts for the Project and TGP 300-Line Projects

	Upland Forest (acres)[a]	
Project	Construction	Operation
300-Line Project [b]	281.2	50.3
Northeast ConneXion - NY/NJ Project [c]	1.5	0.4
NSD Project [d]	36.2	15.2
NEUP Project [e]	27.4	7.6
Rose Lake Expansion Project [f]	3.9	1.6
NED Project [g]	6.9	2.2
Susquehanna West [h]	50.6	7.7
Total	**407.7**	**85.0**

[a] Impact acreages are associated with project activities in Tioga and Bradford Counties, Pennsylvania
[b] 300-Line Project EA, table 2.4.1-1 (February 2010).
[c] Northeast ConneXion – NY/NJ Project EA, table 6 (October 2005).
[d] The Northeast Supply Diversification and Ellisburg to Craigs Project EAs, table 12 (June 2011).
[e] The Northeast Upgrade Project EA, table 2.4.1-1 (November 2011).
[f] Rose Lake Expansion Project EA, section 2.2 (February 2013).
[g] NED Project, Resource Report No. 2 Water Use and Quality, table 8.1-1 (November 2015).

The impacts on forested lands summarized in table B.9-1 are not continuous. Forested tracts are interspersed with various agricultural areas and other cleared, non-forested areas throughout the project areas, and the projects generally include loops immediately adjacent to an existing maintained right-of-

way. Consequently, forest fragmentation is already an existing condition of the environment. In addition, the impacts did not occur simultaneously in time, but were scattered over a multi-year period.

Estimations of forest cover are approximately 482,498 acres in Tioga County, and 404,106 acres in Bradford County (Homer et al., 2015). Based on the 886,604 acres of forest over these two counties, the long-term impact of forested areas cleared amounts to 0.05 percent of the total forest available and a permanent conversion of 0.01 percent of the total forest available. This analysis concludes that the additive 300-Line impacts on forested lands are not significant when considered in the context of existing forest resources in Tioga and Bradford Counties, Pennsylvania, and the collocation of the projects with TGP's existing 300 Line.

We conclude that the proposed Project, when considered with other existing and planned projects in the cumulative impact area of influence, would not significantly contribute to cumulative impacts on forested lands.

9.2.2 Air Quality

As discussed in section B.7.1, the proposed Project would not result in significant air quality impacts; however, the potential exists for air quality emissions during construction and/or during operation of the proposed Project to combine with other emissions and create a significant cumulative impact.

Emissions associated with construction and installation of natural gas pipelines and aboveground facilities generally include the following: 1) exhaust emissions from construction equipment, 2) fugitive dust emissions associated with construction vehicle movement on unpaved surfaces, and 3) fugitive dust associated with trenching, backfilling, and other earth-moving activities. Construction emissions for pipeline transmission projects are temporary, intermittent, and highly localized along the right-of-way and/or at aboveground facility sites. Once construction activities in an area are completed, fugitive dust and construction equipment emissions subside and the project's construction-related impact on air quality terminates. Construction-related air quality impacts are limited to the immediate area surrounding the construction right-of-way or aboveground facility site. Because construction air emission disperse rapidly following completion of construction, the applicable timeframe for cumulative construction-related air quality impacts is considered to be within Project's construction timeline.

Because pipeline construction moves through an area quickly, air emissions associated with the past projects along TGP's 300 Line system and other past FERC-jurisdictional projects were intermittent and short term. The majority of these impacts are minimized further because the construction activities occurred over a large geographical area, with the exception of the Rose Lake Expansion Project and the 300-Line Project's Loop 315. The proposed Western and Eastern Loops of the proposed Project are near the Rose Lake Expansion Project and 300-Line Project's Loop 315. However, the construction time frame (temporal scope) of these projects is different, as the Rose Lake Expansion Project was constructed in 2014, and the 300-Line Project was constructed in 2011.

The NED, Triad Expansion, and Orion Projects are future projects that may be constructed, subject to FERC approval, and also expand the 300 Line system. However, the proposed Project is greater than 25 miles away from the Triad Expansion and Orion Projects. Because these projects are located outside of the region of influence for the proposed Project, cumulative impacts with these projects were not evaluated in this assessment. A portion of the Eastern Loop would be located in Bradford County, which would also be affected by a portion of the NED Project. Nevertheless, the construction-related air quality impacts from the proposed Project would be highly localized and primarily limited to the construction right-of-way and construction timeframe. Further, the construction schedule of the

proposed Project would likely not coincide with that of the NED Project, and thereby minimize any significant cumulative air quality impacts.

Compliance with the applicable federal and PADEP air quality regulations would avoid or minimize significant cumulative construction-related air quality impacts of other land development activities. In particular, construction of the Liberty Power Project in Bradford County will be required to implement state jurisdictional BMPs to minimize construction-related impacts on air quality. Because the construction-related air quality impacts from the proposed Project would be highly localized and primarily limited to the construction right-of-way, it is unlikely to overlap with construction impacts associated with the Liberty Power Project.

When considered with past and future TGP projects, the ongoing natural gas drilling activities, and other FERC non-jurisdictional projects, we do not find a significant construction-related cumulative impact on air quality from the proposed Project.

We also evaluated the potential cumulative air quality impacts from operational emissions at CS 317 and CS 319. A cumulative modeling analysis was completed for the 1-hour averaging period for NO_2, as the air quality modeling analyses completed for the proposed modifications to CS 317 and CS 319 resulted in an exceedance of the significant impact level for this pollutant (all other parameters were below SILs). Within the modeling analyses completed for the compressor stations, the Significant Impact Area for the highest modeled concentration of 1-hour NO_2 was determined to be 7.2 kilometers from CS 317 and 0.3 kilometer from CS 319; however, the area evaluated for potential cumulative impacts was extended out to 10 kilometers. The modeling analysis included the modifications to CS 317 and CS 319 as part of the Rose Lake Expansion Project, as well as the Liberty Power Project.

Table B.9-1 presents the results of the cumulative modeling analysis. The maximum cumulative impact concentration shown in table B.9-1 included the impacts resulting from CS 317, CS 319, the TGP Rose Lake Expansion Project, and the Liberty Power Project. The proposed Project's contribution is the maximum impact observed based on the modeling from just CS 317 and CS 319 at the location of the Maximum Cumulative Impact Concentration. The maximum cumulative impact concentration was then added to the representative ambient concentration and compared to the NAAQS. As shown in table B.9-1, the resulting maximum cumulative impact concentration for 1-hour NO_2 would be well below the NAAQS. Furthermore, the cumulative impact analysis does not show an increase in the maximum predicted cumulative impacts above that which is predicted from CS 317 alone. Therefore, we conclude that while there would be cumulative air quality impacts associated with the proposed Project, these impacts would not be significant.

TABLE B.9-1

Cumulative Modeling Results for the Project Area (µg/m^3) [a]

Pollutant	Averaging Period	Maximum Cumulative Impact Concentration (µg/m³) [b]	Project Contribution Impact Concentration (µg/m³) [c]	Ambient Background (µg/m³)	Maximum Cumulative Impact + Ambient Background (µg/m³) [d]	NAAQS (µg/m^3)	% NAAQS
NO_2	1-hour	22.56	22.56	75.83	98.40	188	52%

[a] µg/m³ = micrograms per cubic meter

[b] Maximum Cumulative Impact Concentration: The maximum impact observed when taking into consideration the impacts resulting from CS 317, CS 319, the TGP Rose Lake Expansion Project, and the Liberty Power Project.

[c] Project Contribution Impact Concentration: The maximum impact observed based on the modeling from just CS 317 and CS 319 at the location of the Maximum Cumulative Impact Concentration. (Note: the maximum predicted impact for the proposed Project was observed from the modeling performed for CS 317).

[d] Maximum Cumulative Impact + Ambient Background = Maximum Cumulative Impact Concentration (only) and the Ambient Background concentration.

9.3 Conclusion

We identified recently completed, ongoing, and planned projects in the proposed project area that met the criteria for inclusion in the cumulative impacts study. Based on our analysis, we concluded that the potential exists for cumulative impacts on upland forested areas and air quality as a result of construction and operation of the proposed Project.

Construction and operation of the Project would impact forested resources. We identified other projects in a ½ mile radius of the Project, notably the Rose Lake Expansion Project, the 300-Line's 315 Loop, and natural gas well development in the project vicinity. However, our analysis concluded that the Project effects on forest resources, when combined with other impacts on forested areas within the Project's region of influence, would not result in a significant impact on forest resources in the project area.

Cumulative impacts on air quality are possible due to construction and operation of the proposed Project. However, we concluded in our analysis that the construction related air impacts would be minimal and localized and would not result in a significant cumulative impact. We also evaluated operational emissions associated with the Project in combination with other nearby sources of air emissions. We conclude that the Project, when combined with other nearby sources of air emissions, would not result in a significant cumulative impact to air quality.

Therefore, we conclude that the construction and operation of the Project, when combined with other past, present, and foreseeable future projects, would not result in cumulative significant impacts.

C. ALTERNATIVES

As required by NEPA and Commission policy, we identified and evaluated alternatives to the specific natural gas transmission facilities (and locations) comprising the Project as proposed by the Applicant in their application and associated supplements. Specifically, we evaluated the no action or postponed action alternative, and system alternatives. Aboveground facility site alternatives (including compressor station equipment alternatives) and alternative pipeline routes were not identified.

The purpose of this evaluation is to determine whether an alternative would be preferable to the proposed action. We generally consider an alternative to be preferable to a proposed action using three evaluation criteria, as discussed in greater detail below. These criteria include the alternative meets the stated purpose of the project, it is technically and economically feasible and practical, and it offers a significant environmental advantage over a proposed action.

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

1. PUBLIC COMMENTS

As described in section 1.1, the Commission received several comments expressing concern about the Project. The comments primarily concerned impacts on air quality, state-listed species, state roads, and state forest lands. Comments received during the scoping period are addressed in the applicable sections of the EA. None of the environmental comment received suggested that we evaluate specific alternatives.

2. EVALUATION PROCESS

Through environmental comparison and application of our professional judgement, each alternative is considered to a point where it becomes clear if the alternative could or could not meet the three evaluation criteria. To ensure a consistent environmental comparison and to normalize the comparison factors, we generally use desktop sources of information (e.g., publicly available data, GIS data, aerial imagery) and assume the same right-of-way widths and general workspace requirements. Where appropriate, we also use site-specific information (e.g., field surveys or detailed designs). As described previously, our environmental analysis and this evaluation only considers quantitative data (e.g., acreage or mileage) and uses common comparative factors such as total length, amount of collocation, and land requirements. Our evaluation also considers impacts on both the natural and human environments. Impacts on the natural environment include wetlands, forested lands, geology, and other common environmental resources. Impacts on the human environment include residences, roads, utilities, and industrial and commercial development near construction workspaces. In recognition of the competing interests and the different nature of impacts resulting from an alternative that sometimes exist (i.e., impacts on the natural environment versus impacts on the human environment), we also consider other factors that are relevant to a particular alternative or discount or eliminate factors that are not relevant or may have less weight or significance.

The purpose of the Project, which is described in greater detail in section A.2, is to increase east-to-west transportation in order to meet the needs of a contracted shipper. Therefore, a preferable alternative must create similar transportation capabilities as those of the proposed action. An alternative that would significantly reduce or eliminate the price competitiveness of the transported natural gas would not satisfy the purpose for the project and is not a preferable alternative to the proposed action.

Many alternatives are technically and economically feasible. Technically practical alternatives, with exceptions, would generally require the use of common construction methods. An alternative that would require the use of a new, unique, or experimental construction method may not be technically practical because the required technology is not available or unproven. Economically practical alternatives would result in an action that generally maintains the price competitive nature of the proposed action. Generally, we do not consider the cost of an alternative as a critical factor unless the added cost to design, permit, and construct the alternative would render the project economically impractical.

Determining if an alternative provides a significant environmental advantage requires a comparison of the impacts on each resource as well as an analysis of impacts on resources that are not common to the alternatives being considered. The determination must then balance the overall impacts and all other relevant considerations. In comparing the impact between resources (factors), we also considered the degree of impact anticipated on each resource. Ultimately, an alternative that results in equal or minor advantages in terms of environmental impact would not compel us to shift the impacts from the current set of landowners to a new set of landowners.

One of the goals of an alternatives analysis is to identify alternatives that avoid significant impacts. In section B, we evaluated each environmental resource potentially affected by the Project and concluded that constructing and operating the Project would not significantly impact these resources. Consistent with our conclusions, the value gained by further reducing the (not significant) impacts of the Project when considered against the cost of relocating the route/facility to a new set of landowners was also factored into our evaluation.

3. NO-ACTION OR POSTPONED ACTION ALTERNATIVE

Under the No-Action Alternative, TGP would not implement the proposed action. The No-Action Alternative would avoid the potential environmental impacts associated with construction of the Project; however, the Project's objective would not be met, of TGP to meet increased demand for transmission capacity on its 300 Line System.

Other natural gas transmission companies would be required to increase their capacity and construct new facilities to meet the known demand for additional capacity. Such actions would likely transfer impacts from one location to another, but would not eliminate or necessarily reduce impacts and may have larger environmental impacts than the Project. Consequently, the No-Action Alternative would also not provide a significant environmental advantage over the proposed Project.

4. SYSTEM ALTERNATIVES

System alternatives are alternatives to the proposed actions that would meet the project objectives, but would use existing or modified pipeline systems or a different configuration of pipeline facilities that would render all or part of the proposed facilities unnecessary.

There is significant fuel conversion-driven demand in the United States for additional supplies of natural gas to supply utility companies and other users. Because TGP currently operates a transmission system in the northeast, TGP can supply the increased demand for natural gas in this area using

efficiencies afforded by its existing system. The Project has firm purchaser commitment and can meet the demand sooner than a hypothetical project not yet planned or committed. Therefore, we did not consider any system alternatives involving the use of other (non-TGP) natural gas pipeline systems.

We evaluated technically feasible system alternatives in terms of their ability to meet the project objectives, namely to provide firm transportation capacity for 145,000 dekatherms per day to the Middle Atlantic and New England regions of the United States and to Canada. Two options are feasible: new pipeline looping and new compression.

New Pipeline Looping Alternative

Looping involves expanding the existing pipeline system by modifying existing facilities and using existing rights-of-way to increase the capacity of the existing pipeline. Looping installs a segment of pipeline adjacent to an existing pipeline and connected to the existing pipeline at both ends. The hydraulics of the system determine the location and sizing of the loops.

We evaluated installing an additional 13.6 miles of 36-inch-diameter pipeline looping on the east side of CS 317, in lieu of increasing compression at CS 317. This alternative would not eliminate the need for the entire Project and would require an additional 207.6 acres of temporary construction workspace and 81.8 acres of new right-of-way; however, it would eliminate the need to expand CS 317. When compared to the proposed Project, the additional pipeline loop would require 15 additional waterbody crossings and approximately 1,500 feet of additional wetland disturbance, approximately half of which would be forested wetlands. A more detailed comparison of this alternative to the Project is presented in table C.2-1. None of the other environmental criteria compare favorably with the Project, although the alternative would require one less compressor station modification than the Project and would decrease the total amount of new compression needed by 16,000 hp. The reduction of compression would translate into a reduction in criteria pollutant, HAP, and GHG emissions. Additionally noise impacts association with the Project would not be experienced at nearby NSAs.

While the looping alternative would meet the purpose and need and is technically and economically feasible and practical, it presents no environmental advantage over the proposed Project.

New/Additional Compression Alternative

Compression options involve either the addition of more compressor horsepower at existing facilities or the installation of a new compressor station facility. To achieve the project objectives, including providing the same reliability and flexibility as the proposed Project, we identified one possible compression alternative. This alternative requires development of a new compressor station requiring approximately 40 acres of new greenfield construction. The compressor station would add approximately 12,000 hp of capacity over the proposed Project to overcome the loss of capacity from loop elimination.

The area identified as meeting the hydrologic needs for the Project has areas of open fields and agricultural lands; however, the cleared areas located near this area may or may not be available for development of a compressor station. Construction would require some clearing and permanent land use conversion of the 40-acre area and would present a new source of air emissions and noise. It would, however, eliminate the need for 8.1 miles of new pipeline construction, which would eliminate 8 waterbody crossings, 11 road crossings, and impacts on wetlands and other land use impacts along the pipeline route. A more detailed comparison of this alternative to the proposed Project is presented in table C.2-1. The alternative would have higher criteria pollutants, HAP, and GHG emissions than the proposed Project. This alternative meets the purpose and need, is technically feasible, and has some environmental advantages as well as disadvantages over the proposed Project. This alternative would

have different environmental impacts from the proposed Project; however, the impacts associated with this alternative would be comparable or possibly lower. The impacts of the compressor station noise source and aboveground facility are permanent, while the bulk of the proposed Project impacts are temporary (such as waterbody crossings) or adjacent to the existing right-of-way.

In balancing impacts on different resources, we conclude that the compression alternative would not provide a significant environmental advantage over the proposed Project.

Table C.2-1 summarizes the comparison of the looping and compression alternatives to the proposed Project.

TABLE C.2-1

Comparison of System Alternatives

Aspect	Unit	Proposed Project	Looping Alternative	Compression Alternative
Length of new pipeline	Miles	8.1	21.7	0
Construction ROW	Acres	155.3	330.3	0
New permanent ROW	Acres	31.2	132.1	0
New aboveground facility land impacts	Acres	0	0	40
Structures within 150 feet	Number	10	25	2
Wetlands crossed	Feet	2,015	3,537	0
Waterbodies crossed	Number	8	23	0
Steep terrain crossed	Feet	362	1,113	0
Forested areas affected	Acres	33.1	116.7 [a]	0–40 acres
Agricultural land affected	Acres	0	103.6	0–40
Additional compression	Horsepower	20,500	-16,000	12,000
New noise source	Number	0	0	1
New air emission source	Number	0	0	1

[a] Forested impacts for the looping alternative based upon a 75-foot construction right-of-way and forested crossing length.

5. ALTERNATIVE PIPELINE ROUTES

Route alternatives are alternatives that differ from the proposed route and may be major and deviate from the proposed route for an extended distance or minor and deviate from the proposed route for a short distance. The proposed routes for the pipeline loops are primarily co-located within and adjacent to TGP's existing 300 Line right-of-way, which is currently comprised of the 300-1 and 300-2 Lines. Any newly identified alternative pipeline route would involve development of new right-of-way that may not offer the benefits of using existing right-of-way for workspace that the Project does. Since the Project is co-located within existing rights-of-way, we did not identify any routing alternatives that could offer a significant environmental advantage over the proposed Project. In addition, we did not receive any stakeholder comments requesting that we consider any pipeline route alternatives.

6. ABOVEGROUND FACILITY SITE ALTERNATIVES

Because CS 315, CS 317, and CS 319 are existing facilities and the proposed modifications at these stations would be completed within the existing property boundaries, our review of the proposed Project found no significant environmental impacts that would drive an evaluation of additional alternatives. We also did not receive any alternative compressor station site alternatives from stakeholders during our scoping and review process.

D. CONCLUSIONS AND RECOMMENDATIONS

Based on the analysis in this EA, we have determined that if TGP constructs and operates the proposed facilities in accordance with its application and supplements and the staff's recommended mitigation measures, approval of this proposal would not constitute a major federal action significantly affecting the quality of the human environment. We recommend that the Order contain a finding of no significant impact and include the mitigation measures listed below as conditions to any Certificate the Commission may issue.

1. 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. TGP must:

    a. request any modification to these procedures, measures, or conditions in a filing with the Secretary;

    b. justify each modification relative to site-specific conditions;

    c. explain how that modification provides an equal or greater level of environmental protection than the original measure; and

    d. receive approval in writing from the Director of the OEP **before using that modification**.

2. 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. This authority shall allow:

    a. the modification of conditions of the Order; and

    b. 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 project construction and operation.

3. **Prior to any construction**, TGP shall file an affirmative statement with the Secretary, certified by a senior company official, that all company personnel, EIs, and contractor personnel will be informed of the EI's authority and have been or will be trained on the implementation of the environmental mitigation measures appropriate to their jobs **before** becoming involved with construction and restoration activities.

4. The authorized facility locations shall be as shown in the EA, as supplemented by filed alignment sheets. **As soon as they are available, and before the start of construction**, TGP shall file with the Secretary any revised detailed survey alignment maps/sheets at a scale not smaller than 1:6,000 with station positions for all facilities approved by the Order. All requests for modifications of environmental conditions of the Order or site-specific clearances must be written and must reference locations designated on these alignment maps/sheets.

TGP's exercise of eminent domain authority granted under NGA section 7(h) in any condemnation proceedings related to the Order must be consistent with these authorized facilities and locations. TGP's right of eminent domain granted under NGA section 7(h) does not authorize them to increase the size of their natural gas facilities to accommodate future needs or to acquire a right-of-way for a pipeline to transport a commodity other than natural gas.

5. TGP shall file with the Secretary detailed alignment maps/sheets and aerial photographs at a scale 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. Approval for each of these areas must be explicitly requested in writing. For each area, the request must include a description of the existing land use/cover type, documentation of landowner approval, whether any cultural resources or federally listed threatened or endangered species would be affected, and whether any other environmentally sensitive areas are within or abutting the area. All areas shall be clearly identified on the maps/sheets/aerial photographs. Each area must be approved in writing by the Director of OEP **before construction in or near that area**.

   This requirement does not apply to extra workspace allowed by our Plan and/or minor field realignments per landowner needs and requirements that do not affect other landowners or sensitive environmental areas such as wetlands.

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

   a. implementation of cultural resources mitigation measures;

   b. implementation of endangered, threatened, or special concern species mitigation measures;

   c. recommendations by state regulatory authorities; and

   d. agreements with individual landowners that affect other landowners or could affect sensitive environmental areas.

6. **At least 60 days before construction begins**, TGP shall file an Implementation Plan with the Secretary for review and written approval by the Director of OEP. TGP must file revisions to their plan as schedules change. The plan shall identify:

   a. how TGP will implement the construction procedures and mitigation measures described in its application and supplements (including responses to staff data requests), identified in the EA, and required by the Order;

   b. how TGP will incorporate these requirements into the contract bid documents, construction contracts (especially penalty clauses and specifications), and construction drawings so that the mitigation required at each site is clear to onsite construction and inspection personnel;

   c. the number of EIs assigned, and how TGP will ensure that sufficient personnel are available to implement the environmental mitigation;

d. TGP personnel, including EIs and contractors, who will receive copies of the appropriate material;

e. the location and dates of the environmental compliance training and instructions TGP will give to all personnel involved with construction and restoration (initial and refresher training as the Project progresses and personnel change);

f. TGP personnel (if known) and specific portion of TGP's organization having responsibility for compliance;

g. the procedures (including use of contract penalties) TGP will follow if noncompliance occurs; and

h. for each discrete facility, a Gantt or Program Evaluation Review Technique (PERT) chart (or similar project scheduling diagram), and dates for:

i. the completion of all required surveys and reports;
ii. the environmental compliance training of onsite personnel;
iii. the start of construction; and
iv. the start and completion of restoration.

7. Beginning with the filing of its Implementation Plan, TGP shall file updated status reports with the Secretary on a **biweekly basis until all construction and restoration activities are complete**. On request, these status reports will also be provided to other federal and state agencies with permitting responsibilities. Status reports shall include:

a. an update on efforts to obtain the necessary federal authorizations;

b. the construction status of the Project, work planned for the following reporting period, and any schedule changes for stream crossings or work in other environmentally-sensitive areas;

c. a listing of all problems encountered and each instance of noncompliance observed by the EI(s) during the reporting period (both for the conditions imposed by the Commission and any environmental conditions/permit requirements imposed by other federal, state, or local agencies);

d. a description of the corrective actions implemented in response to all instances of noncompliance, and their cost;

e. the effectiveness of all corrective actions implemented;

f. a description of any landowner/resident complaints which may relate to compliance with the requirements of the Order, and the measures taken to satisfy their concerns; and

g. copies of any correspondence received by TGP from other federal, state, or local permitting agencies concerning instances of noncompliance, and TGP's response.

8. **Prior to receiving written authorization from the Director of OEP to commence construction of any project facilities**, TGP shall file with the Secretary documentation

that it has received all applicable authorizations required under federal law (or evidence of waiver thereof).

9. TGP must receive written authorization from the Director of OEP **before placing the Project into service**. Such authorization will only be granted following a determination that rehabilitation and restoration of the right-of-way and other areas affected by the Project are proceeding satisfactorily.

10. **Within 30 days of placing the authorized facilities in service**, TGP shall file an affirmative statement with the Secretary, certified by a senior company official:

    a. that the facilities have been constructed in compliance with all applicable conditions, and that continuing activities will be consistent with all applicable conditions; or

    b. identifying which of the Certificate conditions the company has complied with or will comply with. This statement shall also identify any areas affected by the Project where compliance measures were not properly implemented, if not previously identified in filed status reports, and the reason for noncompliance.

11. **Prior to construction,** TGP shall file with the Secretary a copy of the final Chapter 105 Water Obstruction and Encroachment Permit for the Project documenting the instream work windows for the following 10 waterbodies: Bear Wallow Branch, Left Straight Run, Wildcat Hollow, Unnamed Tributary to Right Straight Run, Right Straight Run, Unnamed Tributary to Spoor Hollow Brook, Catlin Hollow Creek, two Unnamed Tributaries to Crooked Creek, and Left Straight Run, as requested by the PAFBC, and incorporate the appropriate time windows into its final construction plans.

12. **Prior to construction,** TGP shall file with the Secretary, for the review and written approval of the Director of OEP, a plan to reduce tree clearing on each parcel of land enrolled in the Clean and Green Program that would be crossed by the Western Loop or Eastern Loop as necessary to ensure the property remains eligible for the program. In the event TGP is not able to avoid disqualifying a property from the program, TGP shall describe how it would compensate the affected landowner.

13. TGP shall make all reasonable efforts to ensure its predicted noise levels from CS 315, CS 317, and CS 319 are not exceeded at nearby NSAs and file noise surveys showing this with the Secretary **no later than 60 days** after placing the three compressor stations in service (i.e., after project modification). If full load condition noise surveys of one or more of the stations are not possible, TGP shall file interim survey(s) at the maximum possible horsepower load and file the full load survey(s) **within 6 months**. However, if the noise attributable to the operation of CS 315, CS 317, and/or CS 319 at full load exceeds an L_{dn} of 55 dBA at any of the nearby NSAs, TGP shall file a report on what changes are needed and should install additional noise controls to meet the level **within 1 year** of the in-service date. TGP should confirm compliance with this requirement by filing a second noise survey with the Secretary **no later than 60 days** after it installs the additional noise controls.

E. REFERENCES

Council on Environmental Quality. 1997. Considering Cumulative Effects under the National Environmental Policy Act. January 1997. 122 pp.

Delano, H. L. and J. P. Wilshusen. 1999. Landslide susceptibility in the Williamsport 1- by 2-degree quadrangle: Pennsylvania. Environmental Geology Report 9. Pennsylvania Geological Survey.

Federal Emergency Management Agency. 2014. National Flood Hazard Layer (Official). Available online at http://fema.maps.arcgis.com/home/. Accessed October 2015.

Federal Energy Regulatory Commission. 2015. Order on Remand: Issued November 19, 2015. Available online at https://www.ferc.gov/whats-new/comm-meet/2015/111915/C-2.pdf. Accessed February 2016.

Homer, C.G., J. A. Dewitz, L. Yang, S. Jin, P. Danielson, G. Xian, J. Coulston, N. D. Herold, J. D. Wickham, and K. Megown. 2015. Completion of the 2011 National Land Cover Database for the conterminous United States—representing a decade of land cover change information. Photogrammetric Engineering and Remote Sensing, v. 81, no. 5, p. 345–354.

Intergovernmental Panel on Climate Change. 1995. Contribution of Working Group I to the Second Assessment Report of the Intergovernmental Panel on Climate Change. Edited by J.T. Houghton, L.G. Meira Filho, B.A. Callander, N. Harris, A Kattenberg and K. Maskell. Available online at https://www.ipcc.ch/ipccreports/sar/wg_I/ipcc_sar_wg_I_full_report.pdf. Accessed December 2015.

Johnson, N., T. Gagnolet, R. Ralls, E. Zimmerman, B. Eichelberger, C. Tracey, G. Kreitler, S. Orndorff, J. Tomlinson, S. Bearer, S. Sargent. 2010. Pennsylvania Energy Impacts Assessment Report 1: Marcellus Shale Natural Gas and Wind. The Nature Conservancy, Harrisburg, PA.

Johnson, N., T. Gagnolet, R. Ralls, J. Stevens. 2011. Pennsylvania Energy Impacts Assessment. Report 2: Natural Gas Pipelines. The Nature Conservancy, Harrisburg, PA.

National Oceanic and Atmospheric Administration, Office of Climate, Water, and Weather Services. 2015. National Hazard Statistics, 10-Year Average (2005–2014). Weather Fatalities. Available online at http://www.weather.gov/om/hazstats.shtml. Accessed September 2015.

National Safety Council. 2011. Injury Facts® 2011 Edition. Itasca, Illinois. 210 pp.

Peltier, R. 2015. Phase I Historic Architecture Survey Report, Susquehanna West Pipeline Project. ER# 2015-0261-042-A, Tioga and Bradford Counties, February 2015. Technical report prepared for Tennessee Gas Pipeline Company, LLC by Tetra Tech, Inc.

Peltier, R. and S. Padamonsky. 2015. Addendum Phase I Archaeological Investigations Report, Susquehanna West Project, Tioga County, Pennsylvania. ER# 2015-0261-042-A, July 2015. Technical Report prepared for Tennessee Gas Pipeline Company, LLC by Tetra Tech, Inc.

Peltier, R., B. Locking, and S. Padamonsky. 2015. Phase I Archaeological Investigations Report, Susquehanna West Pipeline Project. ER# 2015-0261-042-A, Tioga and Bradford Counties, February 2015. Technical report prepared for Tennessee Gas Pipeline Company, LLC by Tetra Tech, Inc.

Pennsylvania Department of Conservation and Natural Resources. 2015a. *Landforms of Pennsylvania.* Available online at http://www.dcnr.state.pa.us/topogeo/field/map13/index.htm. Accessed October 2015.

Pennsylvania Department of Conservation and Natural Resources. 2015b. Tioga State Forest. Available online at http://www.dcnr.state.pa.us/forestry/stateforests/tioga/. Accessed October 5, 2015.

Pennsylvania Department of Environmental Protection. 2015a. Coal Mining Operations. Available online at http://www.pasda.psu.edu/. Accessed October 2015.

Pennsylvania Department of Environmental Protection. 2015b. Industrial Mineral Mining Operations. Available online at http://www.pasda.psu.edu/. Accessed October 2015.

Pennsylvania Department of Environmental Protection. 2015c. Oil & Gas Locations – Conventional Unconventional. Available online at http://www.pasda.psu.edu/. Accessed October 2015.

Pennsylvania Department of Environmental Protection. 2015d. Regulated Storage Tank Cleanup Incidents Database. Available online at http://www.depreportingservices.state.pa.us/ReportServer/Pages/ReportViewer.aspx?/Cleanup/Tank_Cleanup_Incidents. Accessed December 2015.

Pennsylvania Department of Environmental Protection. 2015e. Oil and Gas Reports (online database). Available online athttp://www.depreportingservices.state.pa.us/ReportServer/Pages/ReportViewer.aspx?/Oil_Gas/Wells_Drilled_By_County. Accessed October 2015.

PADEP. 2015f. Environmental Facility Application Compliance Tracking System (eFACTS) online databased. Available online at http://www.ahs.dep.pa.gov/eFACTSWeb/default.aspx. Accessed February 2016.

Soil Survey Staff, Natural Resources Conservation Service, U.S. Department of Agriculture. 2015a. Web Soil Survey. Available online at http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm. Accessed October 2015.

Soil Survey Staff, Natural Resources Conservation Service, U.S. Department of Agriculture. 2015b. Official Soil Series Descriptions. Available online at https://soilseries.sc.egov.usda.gov/osdname.asp. Accessed October 2015.

Tiner, Ralph W. 2010. Wetlands of the Northeast: Results of the National Wetlands Inventory. U.S. Fish and Wildlife Service, Northeast Region, Hadley, MA. 71 pp.

U.S. Department of Transportation. 2015. U.S. Oil and Gas Pipeline Mileage. Available online at http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/national_transportation_statistics/html/table_01_10.html. Accessed September 2015.

U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration. 2011. Significant Pipeline Incidents by Cause: Significant Incident Details: 1991-2010, Natural Gas Transmission.

U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration. 2015a. Significant Pipeline Incidents by Cause: Significant Incident Details: 1995-2014, Natural Gas Transmission.

U.S. Department of Transportation Pipeline Hazardous Material and Safety Administration. 2015b. Significant Incident 20-Year Trend: 20-Year Average (1995–2014). Available online at http://opsweb.phmsa.dot.gov/primis_pdm/significant_inc_trend.asp. Accessed September 2015.

U.S. Department of Transportation Pipeline Hazardous Material and Safety Administration. 2015c. Pipeline Incident 20-Year Trends: All-Reported Incident 20-Year Trend. Available online at http://opsweb.phmsa.dot.gov/primis_pdm/significant_inc_trend.asp. Accessed September 2015.

U.S. Environmental Protection Agency. 1999. Consideration of Cumulative Impacts in EPA Review of NEPA Documents. EPA 315-R-99-002/May 1999.

U. S. Fish and Wildlife Service. 2015. National Wetlands Inventory Website. U.S. Department of the Interior, Fish and Wildlife Service, Washington, D.C. Available online at http://www.fws.gov/wetlands/. Accessed February 2016.

U.S. Forest Service. 2016a. Pennsylvania's Forests 2009. Available online at http://www.fs.fed.us/nrs/pubs/rb/rb_nrs82.pdf. Accessed January 2016.

U.S. Forest Service. 2016b. Trends in New Jersey Forests. USFS Northeastern Research Station. Available online at http://www.fs.fed.us/ne/newtown_square/publications/brochures/pdfs/state_forests/nj_forest.pdf . Accessed January 2016.

U.S. Forest Service. 2016c. New York State Forests. Available online at http://www.dec.ny.gov/lands/309.html. Accessed January 2016.

U.S. Geological Survey. 1997. Ground Water Atlas of the United States: Delaware, Maryland, New Jersey, North Carolina, Pennsylvania, Virginia, West Virginia. Available online at http://pubs.usgs.gov/ha/ha730/gwa.html. Accessed October 2015.

U.S. Geological Survey. 2006. Quaternary Fault and Fold Database of the United States. Available online at http://earthquake.usgs.gov/hazards/qfaults/http://earthquakes.usgs.gov/regional/qfaults/. Accessed October 2015.

U.S. Geological Survey. 2014. 1:250,000-scale Hydrologic Units of the United States. Available online at http://water.usgs.gov/GIS/metadata/usgswrd/XML/huc250k.xml. Accessed October 2015.

U.S. Geological Survey. 2015. Pennsylvania geologic map data. Available online at http://mrdata.usgs.gov/geology/state/state.php?state=PA. Accessed October 2015.

Weary, D.J., and D.H. Doctor. 2014. Karst in the United States: A digital map compilation and database. U.S. Geological Survey Open-File Report 2014-1156. Available online at http://pubs.usgs.gov/of/2014/1156/. Accessed October 2015.

APPENDIX A

PROJECT MAPS

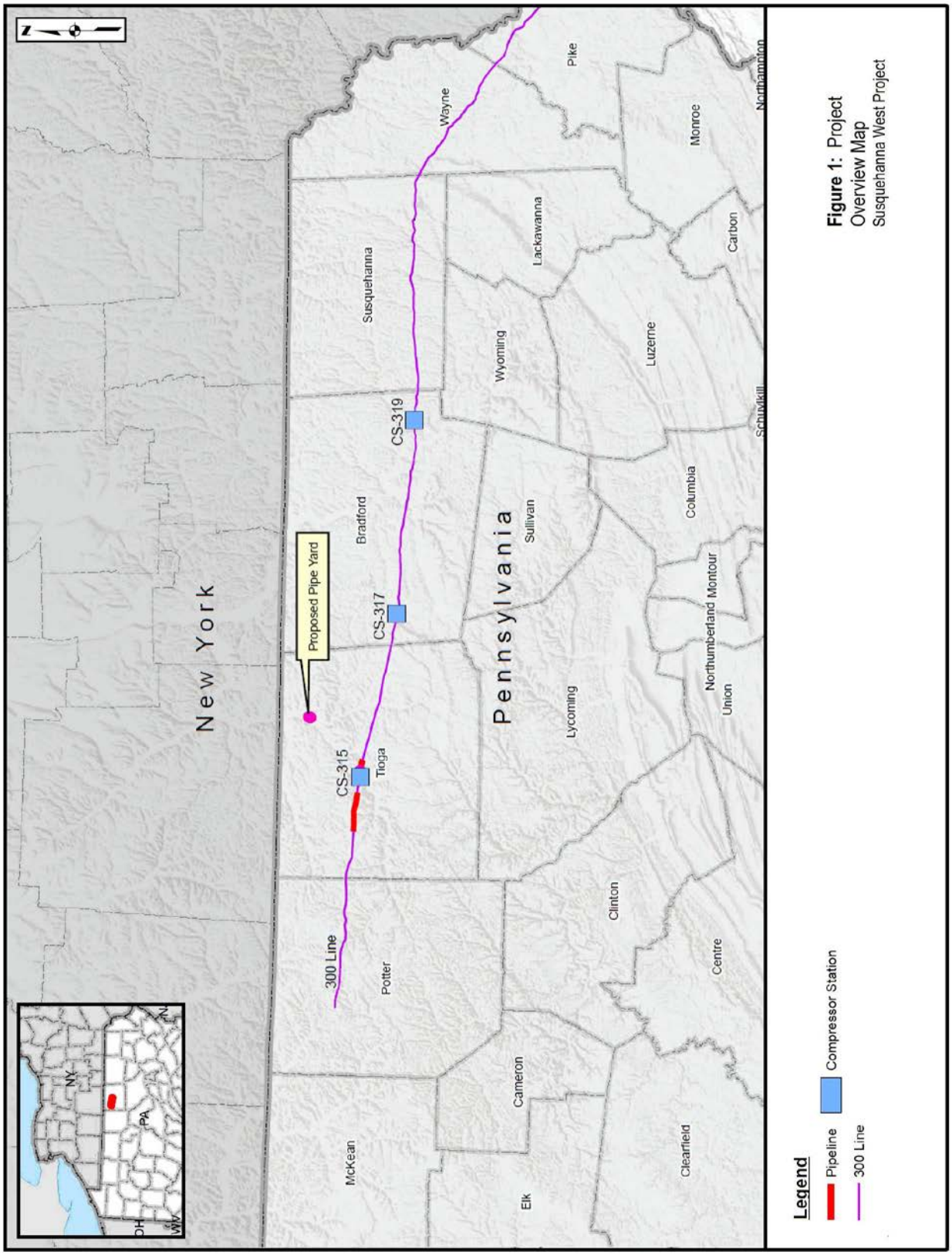


Figure 1: Project Overview Map
Susquehanna West Project

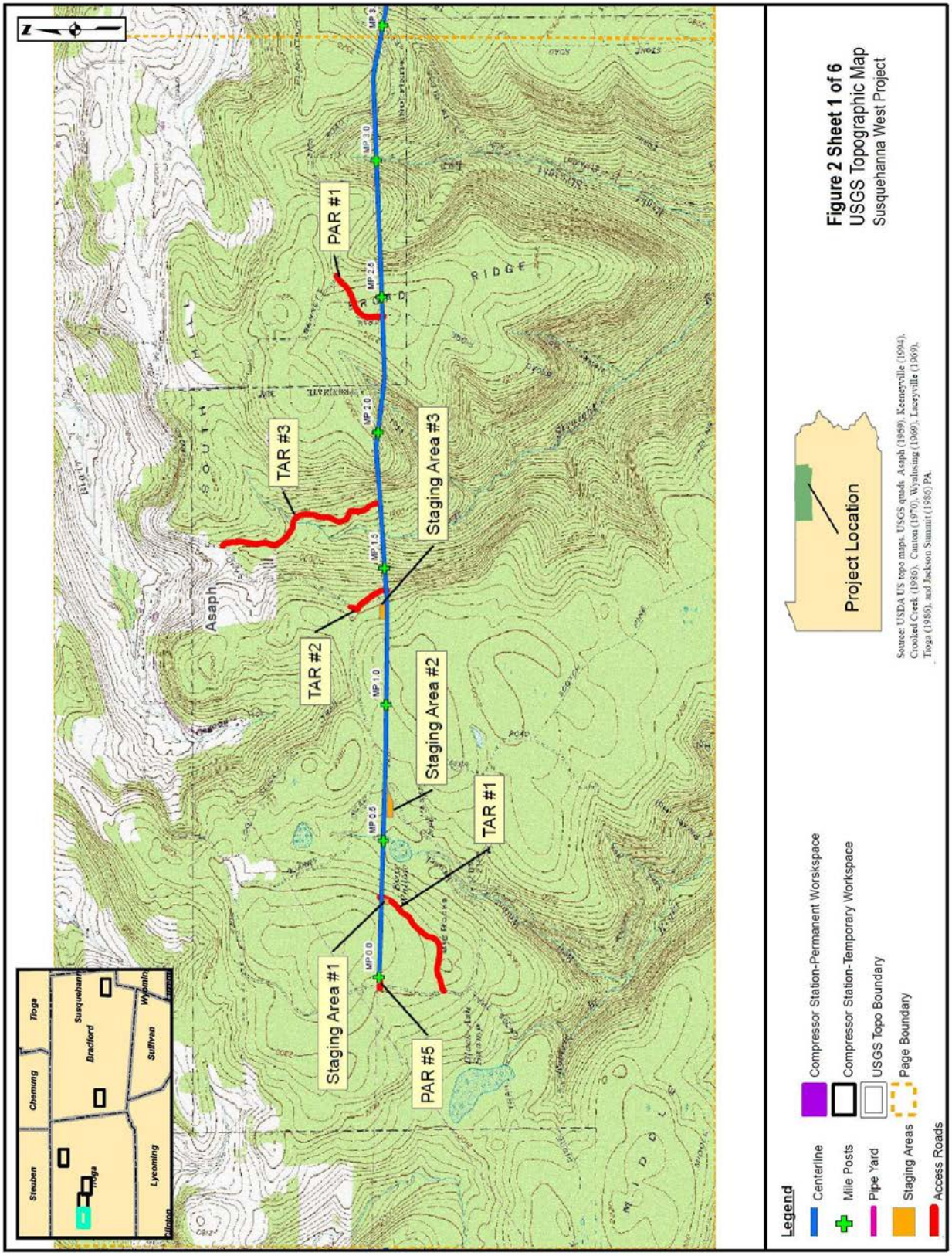


Figure 2 Sheet 1 of 6
USGS Topographic Map
Susquehanna West Project

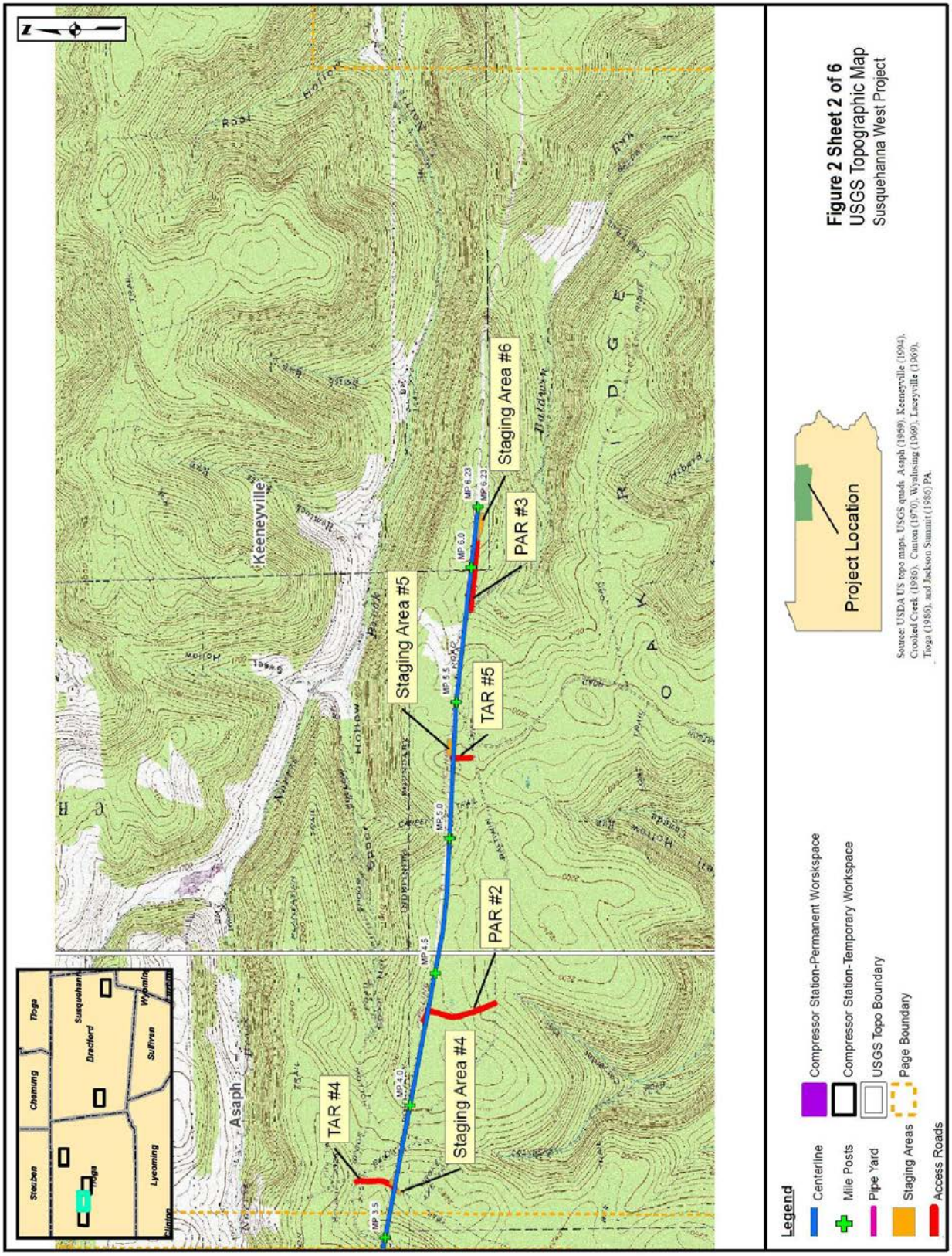


Figure 2 Sheet 2 of 6
USGS Topographic Map
Susquehanna West Project

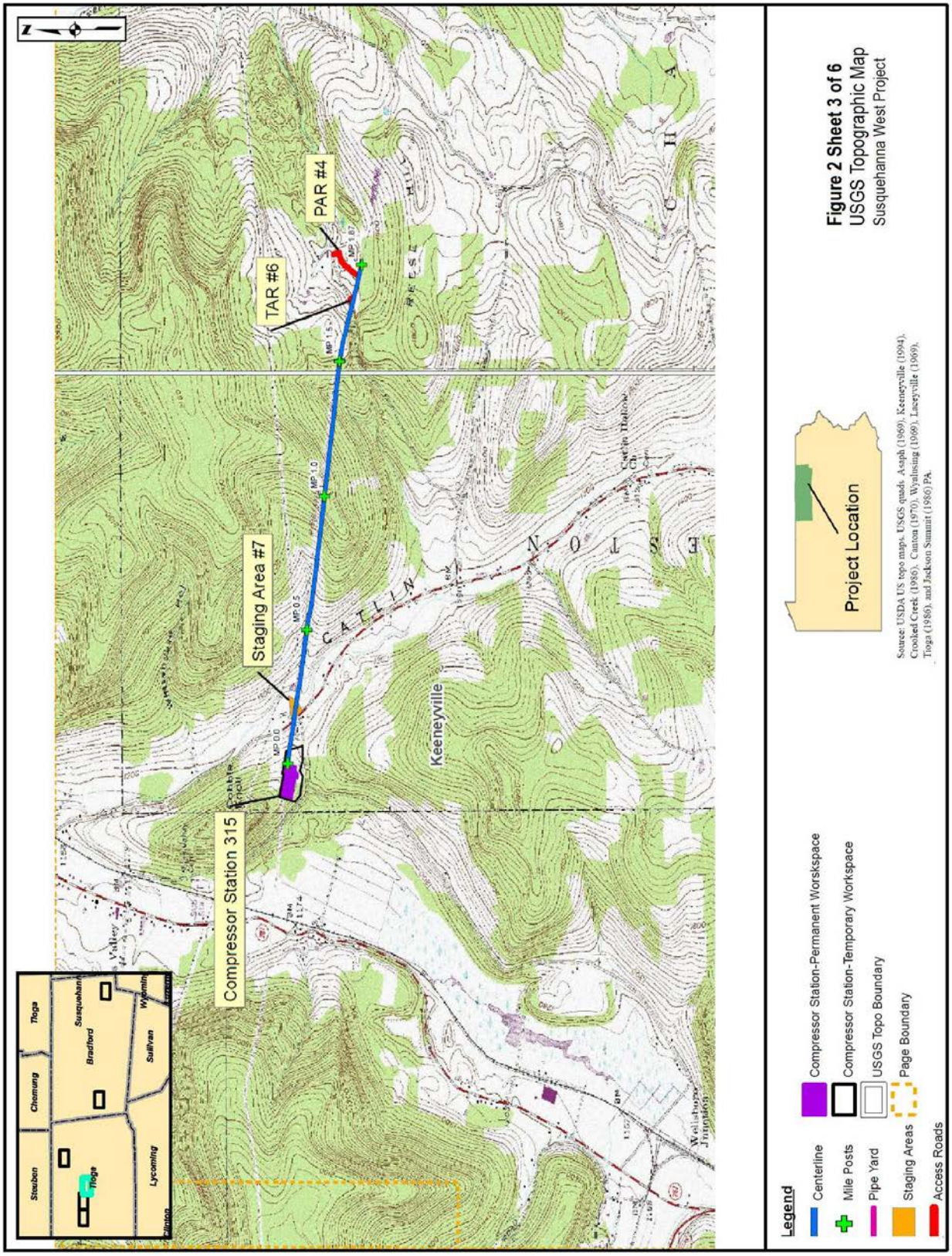


Figure 2 Sheet 3 of 6
USGS Topographic Map
Susquehanna West Project

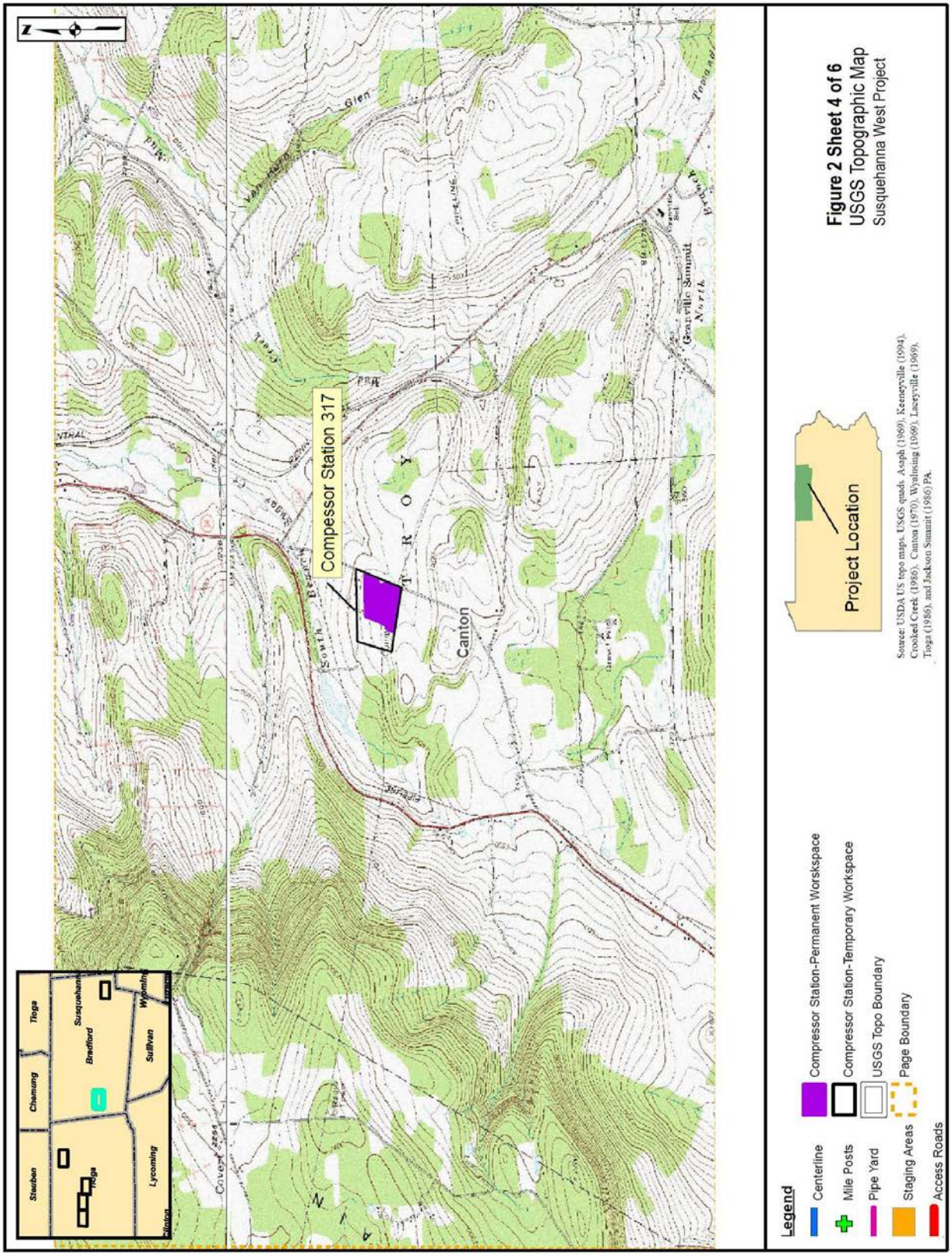
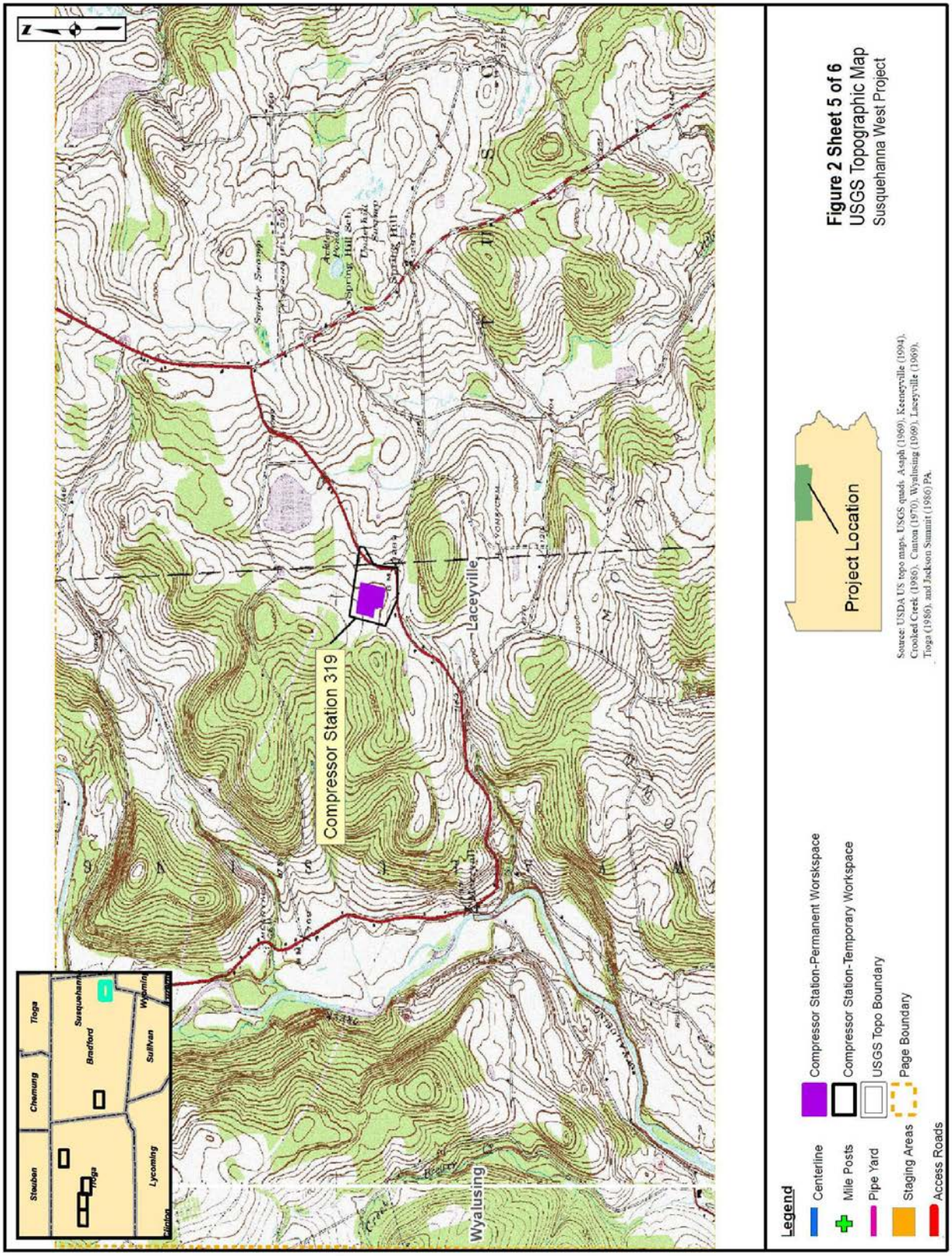


Figure 2 Sheet 4 of 6
USGS Topographic Map
Susquehanna West Project


Compressor Station 319
Laceyville
Wyalusing
Project Location
Legend
Centerline
Mile Posts
Pipe Yard
Staging Areas
Access Roads
Compressor Station-Permanent Workspace
Compressor Station-Temporary Workspace
USGS Topo Boundary
Page Boundary
Source: USDA US topo maps. USGS quads: Asaph (1969), Keeneyville (1994), Crooked Creek (1986), Canton (1970), Wyalusing (1969), Laceyville (1969), Tioga (1986), and Jackson Summit (1986) PA.
Figure 2 Sheet 5 of 6
USGS Topographic Map
Susquehanna West Project

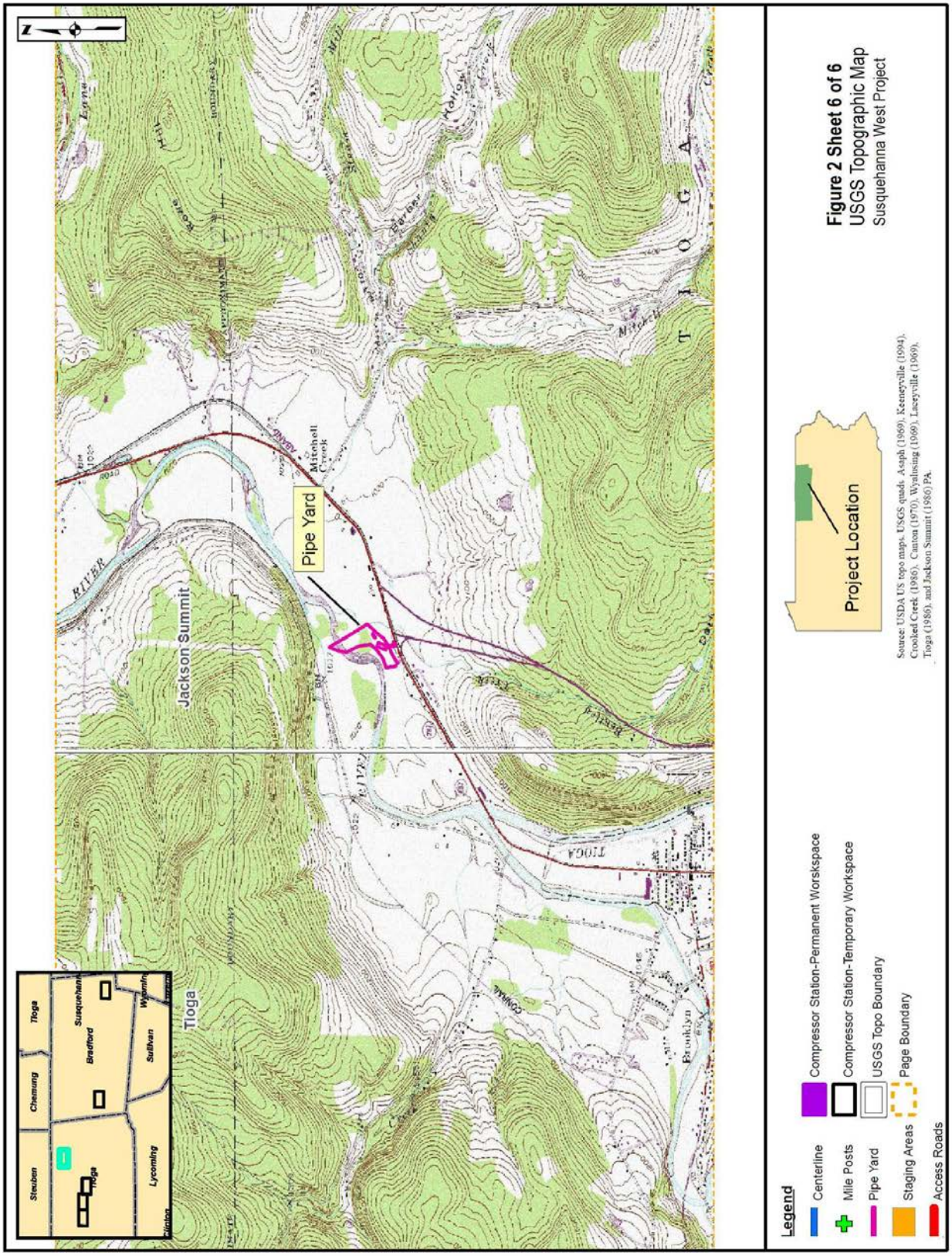
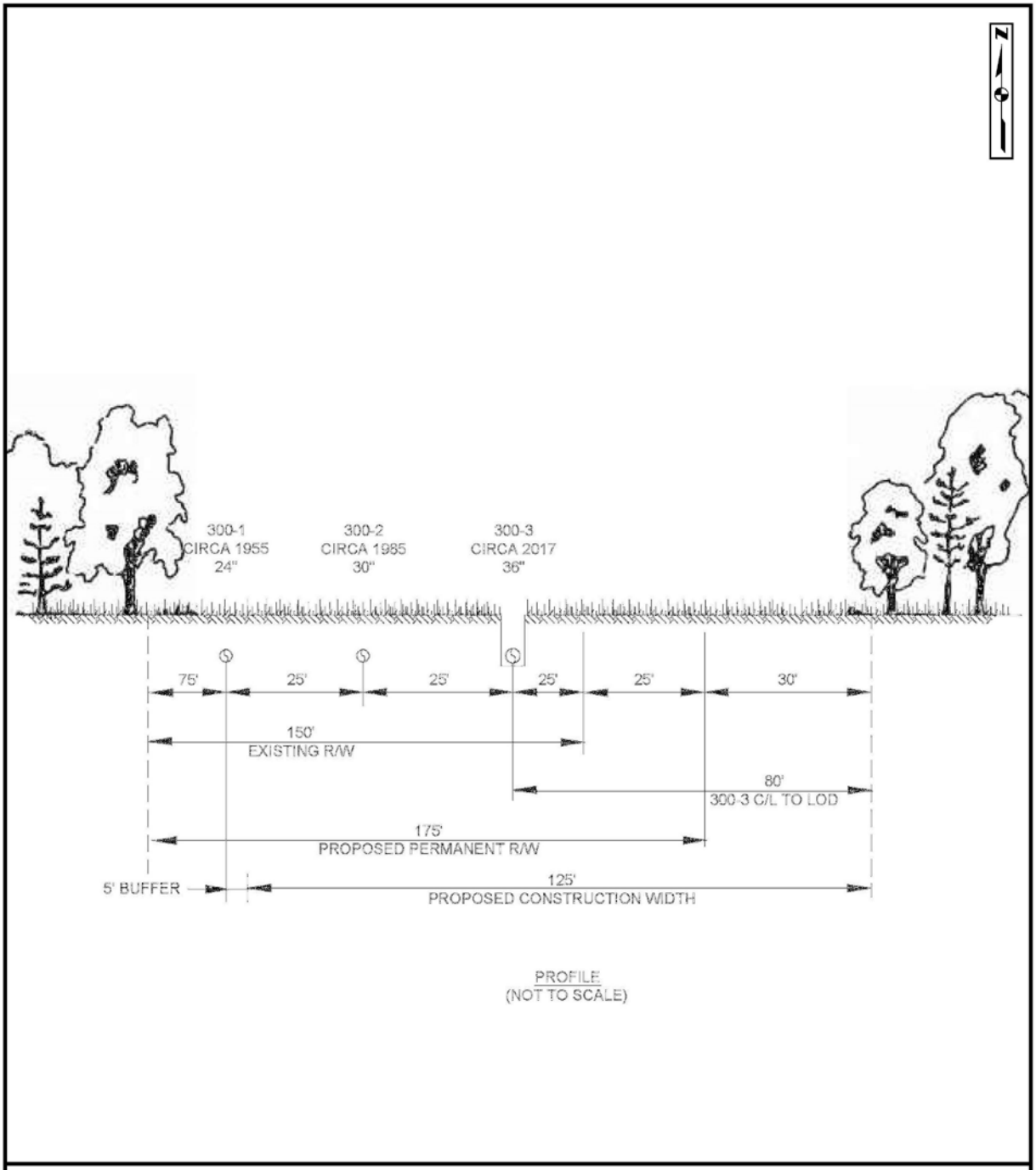
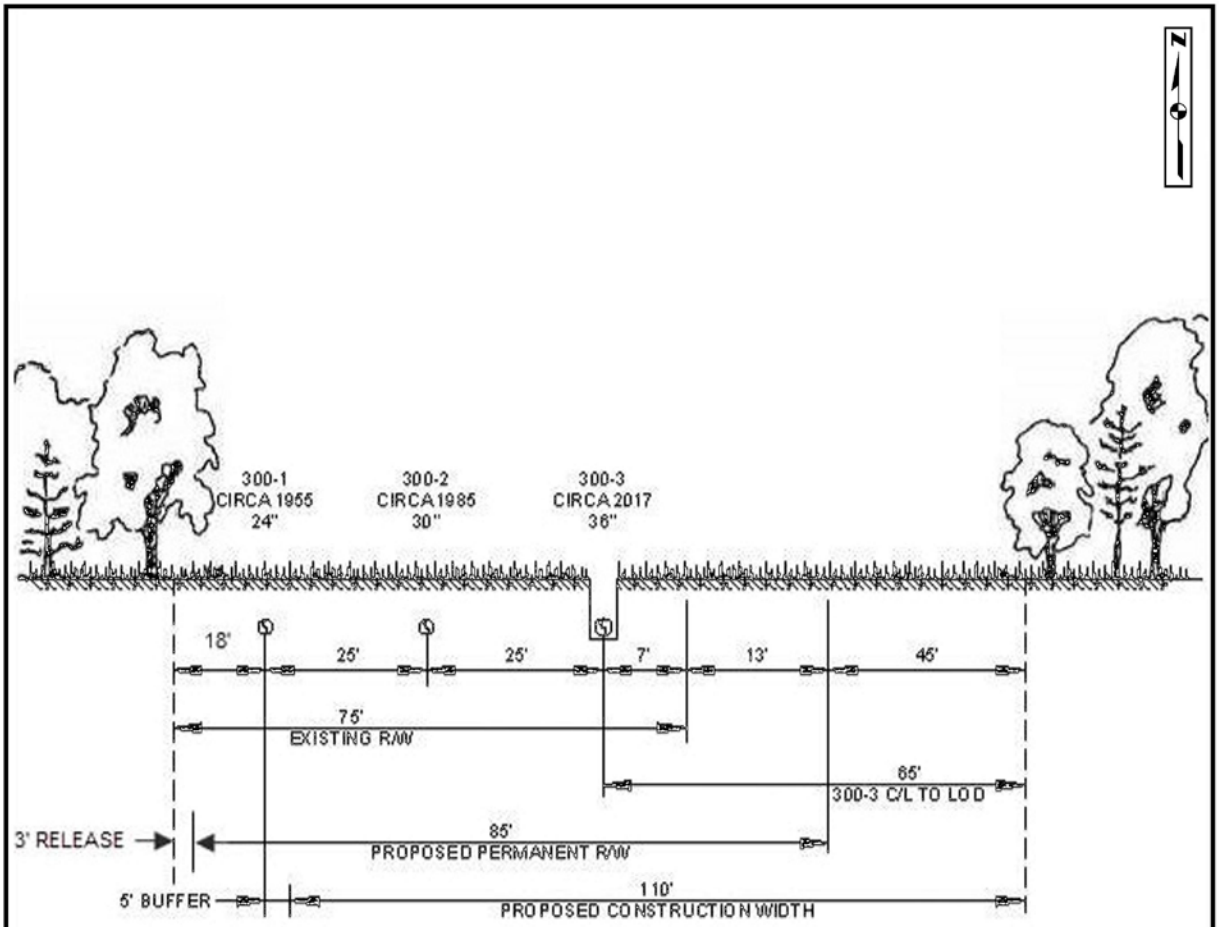


Figure 2 Sheet 6 of 6
USGS Topographic Map
Susquehanna West Project



NOTES:
DESIGNED IN ACCORDANCE WITH TITLE 49-PART 192 OF MINIMUM FEDERAL SAFETY STANDARDS AND GPTC GUIDE FOR GAS TRANSMISSION AND DISTRIBUTION PIPING SYSTEMS, LATEST EDITION

Figure 3
Susquehanna West Project
Typical Right-of-Way Cross Section outside of Tioga State Forest



PROFILE
(NOT TO SCALE)

DISTANCE DESCRIPTION	LICENSED 1965	PROPOSED 2017
℄ TO ℄	26'	26'
INCREASE IN PERMANENT R/W	23'	10'
CONSTRUCTION WIDTH	93'	110'

NOTES:

1. DUE TO AGE AND DEPTH, NO WORK IS ALLOWED WITHIN 5 FEET OF THE 24" PIPELINE.

NOTES:
DESIGNED IN ACCORDANCE WITH TITLE 49-PART 192 OF MINIMUM FEDERAL SAFETY STANDARDS AND GPTC GUIDE FOR GAS TRANSMISSION AND DISTRIBUTION PIPING SYSTEMS, LATEST EDITION

Figure 4
Susquehanna West Project
Typical Right-of-Way Cross Section in Tioga State Forest

Figure 5
Susquehanna West Project
Compressor Station 315
Closest Noise-Sensitive Areas

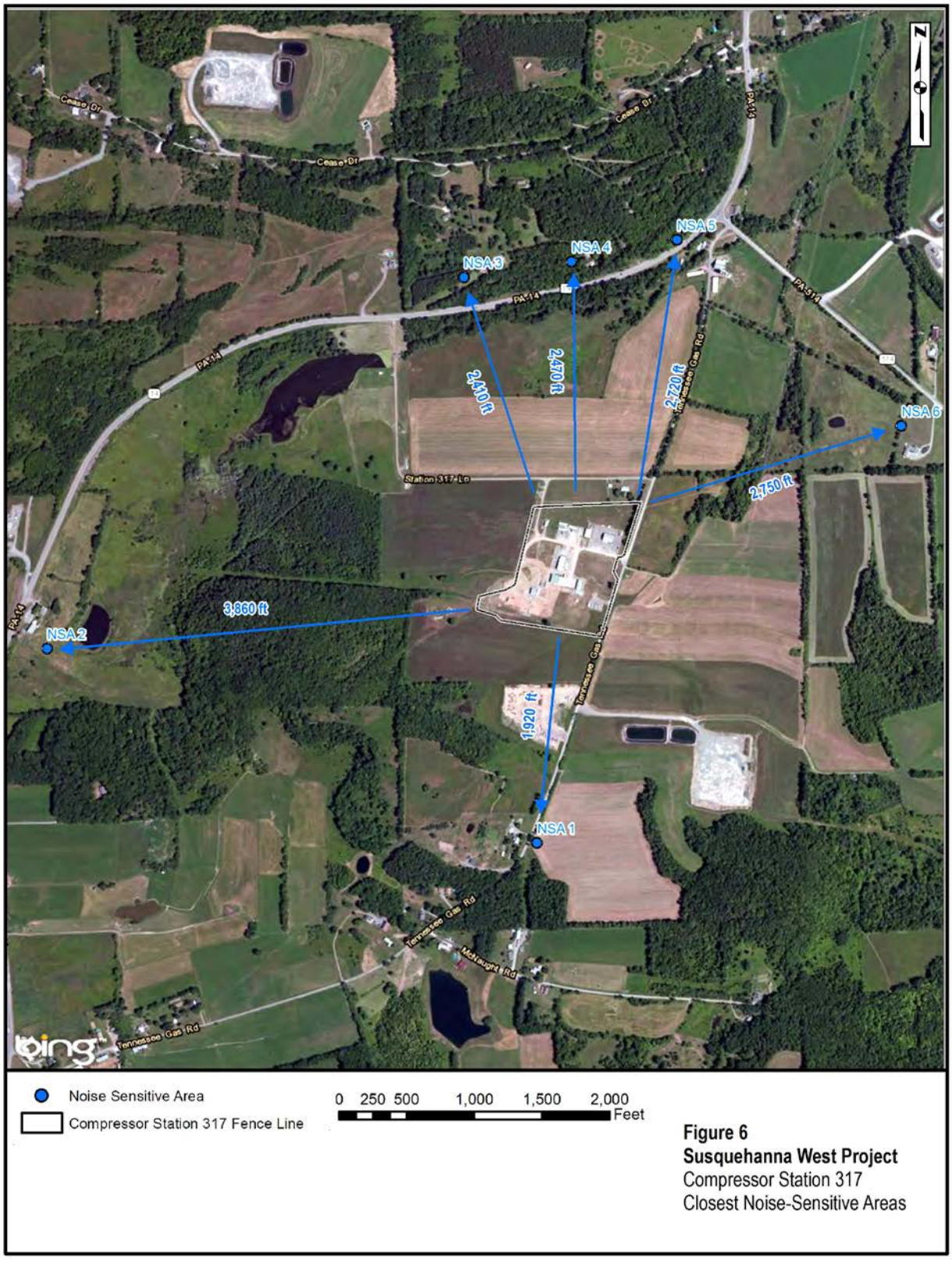


Figure 6
Susquehanna West Project
Compressor Station 317
Closest Noise-Sensitive Areas

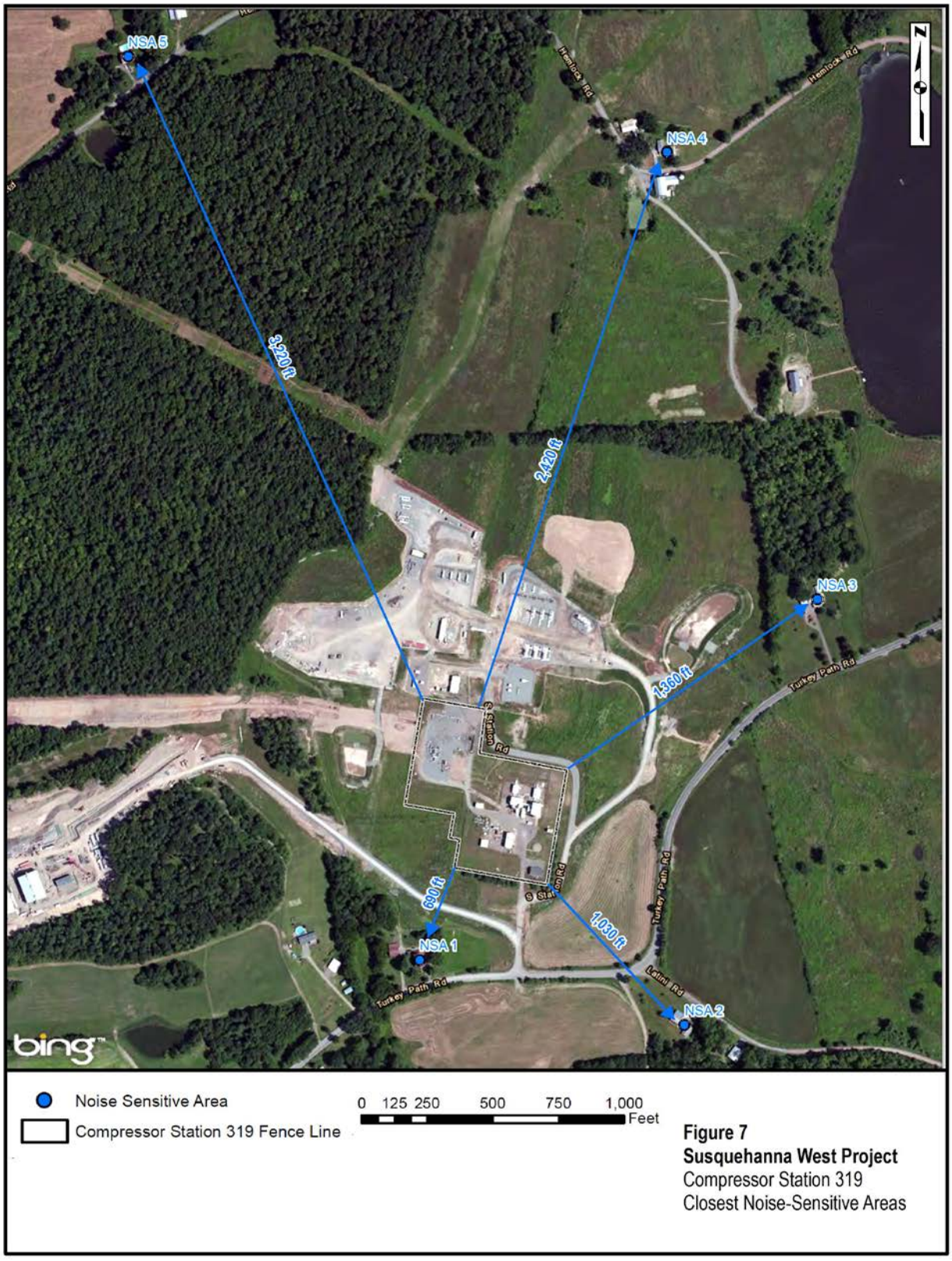


Figure 7
Susquehanna West Project
Compressor Station 319
Closest Noise-Sensitive Areas

APPENDIX B

OVERSIZED TABLES

TABLE 1

Wetland Crossings

Wetland ID	Beginning Milepost	Ending Milepost	Length of Centerline Crossing (feet)	Wetland Type [a]	Temporary Construction Workspace Impact [b] (acres)	Permanent Impacts (acres)		Total Construction Workspace Impacts (acres) [e]
						New and Existing Permanent Right-of-Way for Project Operations [c]	10-Foot Mowed and Maintained Area w/in Right-of-Way [d]	
WESTERN LOOP								
W16	0.04	0.08	(198/0) 198[f]	PEM/PFO	(0.06 PEM/ 0.03 PFO) 0.09	(0.18 PEM/ 0 PFO) 0.18	(0.04 PEM/ 0 PFO) 0.04	(0.24 PEM/ 0.03 PFO) 0.27
W19	0.44	0.51	14	PEM	0.02	0.01	0	0.03
W18	0.74	0.91	(688/0) 688	PEM/PFO	(0 PEM/ 0 PFO) 0	(0 PEM/ 0 PFO) 0	(0 PEM/ 0 PFO) 0	(0 PEM/ 0 PFO) 0
W17	0.93	0.97	(149/0) 149	PEM/PFO	(0 PEM/ 0 PFO) 0	(0 PEM/ 0 PFO) 0	(0 PEM/ 0 PFO) 0	(0 PEM/ 0 PFO) 0
W15	1.10	1.13	(90/0) 90	PEM/PFO	(0.05 PEM/ 0.01 PFO) 0.06	(0.09 PEM/ 0 PFO) 0.09	(0.02 PEM/ 0 PFO) 0.02	(0.14 PEM/ 0.01 PFO) 0.15
W14	1.54	1.55	0	PEM	0.02	0	0	0.02
W13	1.62	1.63	85	PEM	0.02	0.06	0.02	0.08
W12	1.67	1.75	46	PEM	0.04	0.05	0.01	0.09
W11	3.89	3.95	(110/202) 312	PEM/PSS	(0 PEM/ 0 PSS) 0	(0 PEM/ 0 PSS) 0	(0 PEM/ 0 PSS) 0	0
W10	4.26	4.33	255	PEM	0	0	0	0
W9	4.36	4.37	28	PEM	0	0.01	0	0.01
W8	4.58	4.61	74	PEM	0	0.08	0.02	0.08
Western Loop Total					**(0.21 PEM/ 0 PSS/ 0.04 PFO) 0.25**	**(0.48 PEM/ 0 PSS/ 0 PFO) 0.48**	**(0.11 PEM/ 0 PSS/ 0 PFO) 0.11**	**(0.69 PEM/ 0 PSS/ 0.04 PFO) 0.73**

TABLE 1

Wetland Crossings (cont'd)

Wetland ID	Beginning Milepost	Ending Milepost	Length of Centerline Crossing (feet)	Wetland Type [a]	Temporary Construction Workspace Impact [b] (acres)	Permanent Impacts (acres)		Total Construction Workspace Impacts (acres) [e]
						New and Existing Permanent Right-of-Way for Project Operations [c]	10-Foot-Mowed and Maintained Area w/in Right-of-Way [d]	
EASTERN LOOP								
W4	0.24	0.32	(<1/31) 31	PEM/PSS	(0 PEM/ 0 PSS) 0	(0.23 PEM/ 0.05 PSS) 0.28	(0.06 PEM/ 0.01 PSS) 0.07	(0.23 PEM/ 0.05 PSS) 0.28
Eastern Loop Total					**(0 PEM/ 0 PSS) 0**	**(0.23 PEM/ 0.05 PSS) 0.28**	**(0.06 PEM/ 0.01 PSS) 0.07**	**(0.23 PEM/ 0.05 PSS) 0.28**
COMPRESSOR STATIONS								
-	-	-	-	-	-	-		-
PIPE YARD								
-	-	-	-	-	-	-		-
ACCESS ROADS								
-	-	-	-	-	-	-		-
PROJECT TOTAL					**(0.21 PEM/ 0 PSS/ 0.04 PFO) 0.25**	**(0.71 PEM/ 0.05 PSS/ 0 PFO) 0.76**	**(0.17 PEM/ 0.01 PSS/ 0 PFO) 0.18**	**(0.92 PEM/ 0.05 PSS/ 0.04 PFO) 1.01**

[a] Cowardin classification wetland types: PEM = Palustrine Emergent; PSS = Palustrine Scrub-Shrub; PFO = Palustrine Forested

[b] Temporary construction workspace consists of a varying width temporary easement (from 0–45 feet wide) within the construction ROW. No wetlands are located in proposed ATWS areas.

[c] Permanent impacts for *New Operations Right-of-Way* consist of an additional 25-foot-wide new permanent easement for Line 300-3 and the adjacent existing 300 Line permanent easement for Lines 300-1 and 300-2. Construction workspace for the Project will overlap for varying widths with the existing permanent right-of-way easement. Includes conversion impacts associated with maintenance of the ROW

[d] Acreage for "10-Foot Mowed and Maintained area w/in ROW" is included in the previous column as part of the acreage for "New and Existing Permanent Right-of-Way for Line 300-3 Operations".

[e] Construction workspace consists of the temporary construction workspace, existing permanent easement, and new permanent easement for Line 300-3.

[f] Wetland type and size are based on field survey determination. Information is broken down by wetland type within parenthesis, while numbers outside of parentheses indicate the total of all wetland types for a given wetland.

TABLE 2

Common Wildlife in the Project Area

	Species	
Wildlife Habitats	Common Name	Scientific Name
UPLAND FOREST	White-tailed deer	*Oedicoileus virginiana*
	Deer mouse	*Peromyscus maniculartus*
	Eastern chipmunk	*Tamias striatus*
	Eastern cottontail	*Sylvilagus floridanus*
	Gray squirrel	*Sciurus carolinensis*
	Little brown bat	*Myotis lucifugus*
	Opossum	*Didelphis virginiana*
	Porcupine	*Erethizon dorsatum*
	Raccoon	*Procyon lotor*
	Red fox	*Vulpes vulpes*
	Striped skunk	*Mephitis mephitis*
	Eastern American toad	*Bufo americanus*
	Green frog	*Rana clamitans melanota*
	Northern copperhead	*Agkistrodon contortrix mokasen*
	Northern red salamander	*Pseudotriton ruber ruber*
	Spotted salamander	*Ambystoma maculatum*
	Spotted turtle	*Clemmys guttata*
	Wood turtle	*Clemmys insculpta*
	American crow	*Corvus brachyrhynchos*
	Blue jay	*Cyanocitta cristata*
	Downy woodpecker	*Picoides pubescens*
	Eastern screech-owl	*Megascops asio*
	European starling	*Sturnus vulgaris*
	Great horned owl	*Bubo virginianus*
	Ruffed grouse	*Bonasa umbellus*
	Sharp-shinned hawk	*Accipiter striatus*
	Tufted titmouse	*Baeolophus bicolor*
AGRICULTURAL	Bog lemming	*Synaptomys cooperi*
	Coyote	*Canis latrans*
	Deer mouse	*Peromyscus maniculartus*
	Eastern chipmunk	*Tamias striatus*
	Eastern cottontail	*Sylvilagus floridanus*
	Meadow vole	*Microtus pennsylvanicus*
	Opossum	*Didelphis virginiana*
	Raccoon	*Procyon lotor*
	Red fox	*Vulpes vulpes*
	Striped skunk	*Mephitis mephitis*
	White-tailed deer	*Oedicoileus virginiana*
	Woodchuck	*Marmota monax*
	Eastern American toad	*Bufo americanus*
	Eastern hognose snake	*Heterodon platyrhinos*
	Northern black racer	*Coluber constrictor constrictor*
	American crow	*Corvus brachyrhynchos*
	American kestrel	*Falco sparverius*
	American robin	*Turdus migratorius*
	Blue jay	*Cyanocitta cristata*
	European starling	*Sturnus vulgaris*
	Song sparrow	*Melospiza melodia*
	Tufted titmouse	*Baeolophus bicolor*
	Yellow-rumped warbler	*Dendroica coronate*

TABLE 2

Common Wildlife in the Project Area (cont'd)

	Species	
Wildlife Habitats	Common Name	Scientific Name
DEVELOPED LANDS	Deer mouse	*Peromyscus maniculartus*
	Eastern cottontail	*Sylvilagus floridanus*
	Gray squirrel	*Sciurus carolinensis*
	Opossum	*Didelphis virginiana*
	Raccoon	*Procyon lotor*
	Striped skunk	*Mephitis mephitis*
	White-tailed deer	*Oedicoileus virginiana*
	Woodchuck	*Marmota monax*
	Eastern American toad	*Bufo americanus*
	Eastern milk snake	*Lampropeltus triangulum*
	Northern brown snake	*Storeia dekayi dekayi*
	American crow	*Corvus brachyrhynchos*
	American kestrel	*Falco sparverius*
	American robin	*Turdus migratorius*
	Blue jay	*Cyanocitta cristata*
	European starling	*Sturnus vulgaris*
	Song sparrow	*Melospiza melodia*
	Tufted titmouse	*Baeolophus bicolor*
	Turkey vulture	*Cathartes aura*
FORESTED WETLANDS	Beaver	*Castor Canadensis*
	Eastern cottontail	*Sylvilagus floridanus*
	Little brown bat	*Myotis lucifugus*
	Mink	*Mustela vison*
	Muskrat	*Ondatra zibethicus*
	Northern flying squirrel	*Glaucomys sabrinus*
	Raccoon	*Procyon lotor*
	White-tailed deer	*Oedicoileus virginiana*
	American bullfrog	*Rana catesbeiana*
	Eastern American toad	*Bufo americanus*
	Green frog	*Rana clamitans melanota*
	Northern copperhead	*Agkistrodon contortrix mokasen*
	Northern gray tree frog	*Hyla versicolor*
	Northern spring peeper	*Pseudacris crucifer*
	Spotted salamander	*Ambystoma maculatum*
	Spotted turtle	*Clemmys guttata*
	Wood turtle	*Clemmys insculpta*
	Canada goose	*Branta Canadensis*
	Great blue heron	*Ardea Herodias*
	Mallard	*Anas platyrhynchos*
	Wood duck	*Aix sponsa*

Table 3

Additional Temporary Workspaces and Staging Areas Associated with the Project

County	Township	Nearest Milepost	Dimensions of ATWS [a] (feet)	Area Affected (acres)	Existing Land Use	Justification [b]
WESTERN LOOP						
Tioga	Shippen	0.0	75 x 25	<0.1	Forest	Pe / We
Tioga	Shippen	0.4	100 x 100	0.2	Forest	S
Tioga	Shippen	0.7	300 x 150 (triangle)	0.5	Forest	S / R
Tioga	Shippen	1.0	25 x 600	0.3	Forest	We
Tioga	Shippen	1.3	325 x 200	1.5	Forest	Wa
Tioga	Shippen	2.1	20 x 100	<0.1	Forest	Wa
Tioga	Chatham	2.3	25 x 300	0.2	Forest	R
Tioga	Chatham	2.4	25 x 500	0.3	Forest / Roadway	R
Tioga	Chatham	2.7	20 x 150	<0.1	Forest	Wa
Tioga	Chatham	2.7	20 x 150	<0.1	Forest	Wa
Tioga	Chatham	3.0	20 x 140	<0.1	Forest /Open	Wa / R
Tioga	Chatham	3.1	20 x 600	0.3	Forest	R
Tioga	Chatham	3.7	100 x 100 (x 2)	0.5	Forest	S
Tioga	Chatham	3.9	25 x 200	0.1	Forest	We
Tioga	Delmar	4.0	25 x 330	0.2	Forest	We
Tioga	Delmar	5.6	25 x 150	<0.1	Forest / Open	R
Tioga	Delmar	5.8	25 x 150	<0.1	Forest	R
Tioga	Middlebury	6.1	100 x 400	1.1	Forest	Pe / S
Western Loop Total				**5.5**		
EASTERN LOOP						
Tioga	Charleston	0.1	5 x 150	<0.1	Industrial	Pe (within CS 315 boundary)
Tioga	Charleston	0.2	300 x 500 (triangle)	1.7	Residential	We
Tioga	Charleston	1.3	20 x 100	<0.1	Open	Wa
Tioga	Charleston	1.7	20 x 75	<0.1	Forest	R
Tioga	Charleston	1.7	20 x 100	<0.1	Forest	R
Eastern Loop Total				**1.8**		
PIPE YARD						
Tioga	Tioga	NA	Irregular Shape	11.2	Industrial	Pipe Yard

[a] Dimensions are approximate.

[b] Justifications for use of ATWS include A = Access road; Pe = Pipeline start/endpoint; R = roadway crossing; S = staging area; Wa = waterbody crossing; We = wetland crossing.

TABLE 4

Existing and Future Projects Identified in the Project Area

Project Name	Location	Nearest Facility Location (Distance to Project)	Project Description	Affected Resource	Status	Date of Construction Activities
FERC JURISDICTIONAL PROJECTS						
TGP's Rose Lake Expansion Project, Docket No. CP13-3-000	Tioga and Bradford Counties, PA	CS 315, CS 317, CS 319 (0.0 miles)	Compressor station modifications at the same compressor stations proposed for modification by the project (CS 315, CS 317, CS 319)	AQ, FO	Approved	Placed in service November 1, 2014
TGP's Northeast Upgrade Project, Docket No. CP11-161-000	Bradford, Wayne, and Pike Counties, PA; and Sussex, Passaic and Bergen Counties, NJ	CS 319 (0.0 miles)	Compressor station modification at CS 319, 40 miles of pipeline in 5 loops, and modification to three other existing compressor stations in Pennsylvania and New Jersey	AQ	Approved	Placed in service November 1, 2013
TGP's Northeast Supply Diversification (NSD) Project, Docket No. CP11-30-000	Tioga and Bradford Counties, PA	CS 315 and CS 317 (0.0 miles)	Construction of 6.77 miles of pipeline looping between CS 315 and CS 317 and pig receiver at CS 317	AQ	Approved	Placed in service November 1, 2012
TGP's Northeast Energy Direct (NED) Project, Docket No. PF14-22-000 CP16-21-000	Bradford and Susquehanna Counties, PA; and Counties in NY, MA, NH, and CT	CS 317 and CS 319 (0.0 miles)	Pennsylvania facilities include 32 miles of pipeline looping on TGP's 300-Line and 40 miles of new pipeline generally collocated with the Constitution Pipeline Project. Modifications to CS 319 and addition of one new compressor station. Upgrades to TGP's pipeline system in other states.	AQ	Application for Certificate of Public Convenience and Necessity submitted November 20, 2015	Expected in service November 2018

TABLE 4

Existing and Future Projects Identified in the Project Area (cont'd)

Project Name	Location	Nearest Facility Location (Distance to Project)	Project Description	Affected Resource	Status	Date of Construction Activities
TGP's 300-Line Project, Docket No. CP09-444-000	Potter, Tioga, Bradford, Susquehanna, Wayne, Pike, Venango, and McKean Counties, PA	CS 317 and CS 319 (0.0 miles)	Construction of eight pipeline loops on TGP's 300-Line, construction of two compressor stations, and modification of seven compressor stations, including CS 315, CS 317, and CS 319.	AQ, FO	Approved	In service October 2011
TGP's and National Fuel Gas Supply Corporation's Northeast ConneXion NY/NJ Project CP-05-355	Potter, Bradford, and Susquehanna, Counties, PA; and Bergen and Sussex Counties, NJ	CS 317 (0.0 miles)	Construct approximately 6 miles of new pipeline loops on TGP's 300-Line, additional compression at CS 313, upgrades at CS 317, upgrades at Ramsey Meter Station, and additional incremental capacity at CS 325,	AQ	Approved	In-service November 2006
TGP's Triad Expansion Project, Docket No. CP15-520-000	Susquehanna, PA	Upstream Tie-In (24.7 miles)	Construct approximately 7.0 miles of new pipeline and necessary operations facilities along TGP's existing 300-Line. Auxiliary facilities consist of crossover and connecting facilities, a new pig launcher, pig receiver, and an additional odorant facility at CS 321.	N/A	Application for Certificate of Public Convenience and Necessity submitted June 19, 2015; FERC Notice of Intent to Prepare an EA issued August 5, 2015	Construction expected to begin as early as the fourth quarter of 2016. Anticipated in service date November 1, 2017
TGP's Orion Project, Docket No. CP-16-4-000	Wayne and Pike Counties, PA	CS 319 (23.2 miles)	Construction of approximately 12.93 miles of new pipeline and associated facilities looping TGP's existing 300-Line. Modifications will also be made to the existing CS 323.	N/A	Application for Certificate of Public Convenience and Necessity submitted October 9, 2015, FERC Notice of Intent to Prepare an EA issued November 23, 2015	Construction is expected to begin as early as January 2017. Anticipated in service date June 1, 2018

TABLE 4

Existing and Future Projects Identified in the Project Area (cont'd)

Project Name	Location	Nearest Facility Location (Distance to Project)	Project Description	Affected Resource	Status	Date of Construction Activities
NON-FERC JURISDICTIONAL PROJECTS						
Panda Power Funds' Liberty Power Project	Bradford County, PA	CS 319 (10.4 miles)	Construction of a natural gas-fueled generating station.	AQ	Future	Construction in progress. Expected in service first quarter 2016
Natural Gas Well Seneca Resources Group (DCNR 007 1V 50259)	Tioga County, PA	Western Loop (0.19 miles)	Vertical Gas Well	FO	Regulatory Inactive	Permit Date: 4/12/2010 Well Drilling Date: 9/9/2010
Natural Gas Well East Resources Inc. (Goodwin 7)	Tioga County, PA	Eastern Loop (0.22 miles)	Vertical Gas Well	FO	Proposed but never materialized	Well was never constructed
Natural Gas Well Talisman Energy USA Inc. (Shedden 01 027 03 D 6H)	Bradford County, PA	CS 317 (0.25 miles)	Horizontal Gas Well	FO	Active	Permit Date: 7/26/2011 Well Drilling Date: 9/19/2011
Natural Gas Well Talisman Energy USA Inc. (Shedden D 2 H)	Bradford County, PA	CS 317 (0.28 miles)	Horizontal Gas Well	FO	Active	Permit Date: 2/4/2009 Well Drilling Date: 2/15/2009
Natural Gas Well Talisman Energy USA Inc. (Shedden 01 027 02 D 5H)	Bradford County, PA	CS 317 (0.25 miles)	Horizontal Gas Well	FO	Active	Permit Date: 7/26/2011 Well Drilling Date: 9/20/2011
Natural Gas Well Talisman Energy USA Inc. (Shedden D 1H)	Bradford County, PA	CS 317 (0.27 miles)	Horizontal Gas Well	FO	Active	Permit Date: 2/4/2009 Well Drilling Date: 2/15/2009
Natural Gas Well Talisman Energy USA Inc. (Shedden 01 026 03 D 4H)	Bradford County, PA	CS 317 (0.26 miles)	Horizontal Gas Well	FO	Active	Permit Date: 7/26/2011 Well Drilling Date: 9/18/2011

TABLE 4

Existing and Future Projects Identified in the Project Area (cont'd)

Project Name	Location	Nearest Facility Location (Distance to Project)	Project Description	Affected Resource	Status	Date of Construction Activities
Natural Gas Well Talisman Energy USA Inc. (Shedden 01 026 03 D 7H)	Bradford County, PA	CS 317 (0.26 miles)	Horizontal Gas Well	FO	Active	Permit Date: 7/26/2011 Well Drilling Date: 9/16/2011
Natural Gas Well Talisman Energy USA Inc. (Shedden D 3H)	Bradford County, PA	CS 317 (0.28 miles)	Horizontal Gas Well	FO	Active	Permit Date: 2/4/2009 Well Drilling Date: 2/15/2009

PA = Pennsylvania; NJ = New Jersey; NY = New York; MA = Massachusetts; NH = New Hampshire; CT = Connecticut; AQ = Air Quality Resources; FO = Forested Land Resources; N/A = Not Applicable

APPENDIX C

LIST OF PREPARERS

LIST OF PREPARERS

1. FEDERAL ENERGY REGULATORY COMMISSION

Allen, Christine E. – **Project Manager**

B.S., Marine Biology, 2005, University of North Carolina, Wilmington

Anis, Shahid – **Air Quality and Noise, Reliability and Safety**

M.S., Energy, Resources, and Environment, 1977, George Washington University

B.S., Mechanical Engineering, 1974, University of Maryland

Boros, Laurie – **Cultural Resources**

B.A., Anthropology/Archaeology, 1980, Queens College, City University of New York

Rodgers, Keith – **Groundwater, Geology and Soils**

B.S., Geological Sciences with Geochemistry Option, 2004, Virginia Polytechnic Institute

M.E., Water Resources, 2008, University of Arizona

2. NATURAL RESOURCE GROUP, LLC/ENVIRONMENTAL RESOURCES MANAGEMENT

Lowell, Fran – **Project Director**

M.A., Public Affairs (Energy, Environment, and Technology Policy), 1992, University of Minnesota, Twin Cities

B.A., Biology, 1976, Dowling College

Enright, Troy – **Project Manager, Quality Assurance Review, Introduction**

B.S., Environmental Science, 2003, University of Minnesota, Twin Cities

Bishop, Alicia – **Deputy Project Manager, Introduction**

B.S., Animal Ecology and Environmental Studies, 1993, Iowa State University

Afon, Adeyinka – **Air Quality and Noise**

M.S.E., Environmental Process Engineering, 2004, Johns Hopkins University

B.S., Chemical Engineering, 2001, Ladoke Akintola University of Technology, Nigeria

Arrison, Julie – **Surface Water and Wetlands**

B.S., Ecology, 1994, University of Florida

Buckless, Mike – **Geology, Groundwater, and Soils**

B.S., Environmental Science, 2013, University of Rhode Island

Essick, Christine – **Cumulative Impacts**

M.E.N.G., Engineering Science, 2001, Pennsylvania State University

B.S., Biology, 1989, West Chester University

Graham, Clive – **Socioeconomics**

M.Sc., Urban Planning and Policy Management, 1986, Johns Hopkins University

Hempy-Mayer, Kara – **Technical Editor**

M.S., Botany and Plant Pathology, 2004, Oregon State University

B.S., Biology, 1998, University of Massachusetts

Lockard, Greg – **Cultural Resources**

Ph.D., Anthropology, 2005, University of New Mexico

Sussman, Benjamin – **Land Use**

M.C.R.P., City and Regional Planning, 2002, Georgia Institute of Technology

B.S.; Science, Technology, and Society; 1998; Stanford University

Swain, Kelli – **Fish, Wildlife, and Vegetation**

M.S., Geography, 2010, University of Nevada, Reno

B.S., Marine Chemistry, 2008, Eckerd College

Yamashiro, Daniel – **Reliability and Safety**

M.S., Geological Sciences, 1984, California State University Northridge

B.S., Geological Sciences, 1986, California State University Northridge

Young, Carol – **Alternatives**

M.E., Civil Engineering, 1992, University of Virginia

B.S., Civil Engineering, 1984, University of Massachusetts

Document Content(s)