

Before the
Pennsylvania Public Utility Commission

**BARTONSVILLE 138 KV
TRANSMISSION TAP REBUILD
PROJECT**

ATTACHMENTS IN SUPPORT OF THE
Letter of Notification

Application Docket No. _____

Submitted by: PPL Electric Utilities Corporation



ATTACHMENT 1
BARTONSVILLE 138 KV TRANSMISSION TAP REBUILD PROJECT
NECESSITY STATEMENT

TABLE OF CONTENTS

<u>SECTION</u>	<u>TOPIC</u>	<u>PAGE</u>
A.	INTRODUCTION.....	1-1
B.	TRANSMISSION SYSTEM PLANNING PROCESS.....	1-2
C.	EXISTING SYSTEM.....	1-5
D.	DEFINITION OF THE PROBLEM.....	1-5
E.	PROPOSED SOLUTION.....	1-6

LIST OF FIGURES

Figure 1-1. One-Line Diagram of Existing Transmission Facilities.....	1-9
Figure 1-2. Map of Existing Transmission Facilities.....	1-10
Figure 1-3. One-Line Diagram of Proposed Transmission Facilities	1-11
Figure 1-4. Map of Proposed Transmission Facilities	1-12

ATTACHMENT 1
BARTONSVILLE 138 KV TRANSMISSION TAP REBUILD PROJECT
NECESSITY STATEMENT

A. INTRODUCTION

PPL Electric Utilities Corporation (“PPL Electric”) proposes to rebuild the existing single-circuit Bartonsville 138 kV Transmission Tap located in Monroe County, Pennsylvania (the Project”) for double-circuit 138 kV operation. The proposed Project involves rebuilding approximately 3.2 miles of existing single-circuit 138 kV transmission tap between the PPL Electric Monroe – Jackson #1 and #2 138 kV Transmission Lines in Pocono Township, Monroe County and the PPL Electric Bartonsville 138-12 kV Substation in Stroud Township, Monroe County, Pennsylvania. As explained below, the existing Bartonsville 138 kV Transmission Tap has reached the end of its useful life and the facilities must be replaced in order to continue to provide safe and reliable service. The proposed rebuild of the Bartonsville 138 kV Transmission Line is a part of PPL Electric’s Asset Optimization Strategy, and involves rebuilding the line to meet all current design and lightning protection standards. The modernization of the line will help ensure reliable and continuous service to customers in Monroe County. Additionally, as described in detail below, PPL Electric will add a second circuit to the Bartonsville 138 kV Transmission Tap which will allow the Bartonsville 138-12 kV Substation to be converted to a more reliable configuration.

The estimated cost to site, design and construct the proposed Bartonsville 138 kV Transmission Tap is approximately \$8.9 million.¹ Subject to the Commission’s approval, the Project has a scheduled construction start date of April 2018 to meet an in-service date of May 2019.

¹ The estimated cost for the proposed Project is an order-of-magnitude estimate developed using averages of recent costs for similar projects and without an in-depth analysis of field investigation. The estimated cost is subject to change as the constructability of the Project, sequence of construction, and other factors that may affect cost are identified and analyzed as the Project progresses.

B. TRANSMISSION SYSTEM PLANNING PROCESS

The nation's interconnected transmission grid serves as the backbone for the safe and reliable delivery of large amounts of electricity from generating stations over substantial distances to customers served by transmission and local distribution systems. It is critically important that this interconnected transmission system (transmission grid) be planned and designed to be highly reliable so that reliable electric service can be provided under peak and all loading conditions and when certain elements of the system are out of service (system contingencies) due to planned or unplanned outages.

System Planning is the process that assures that the transmission system can supply electricity to all customer loads in a manner that is reliable and economical. This System Planning process assures that both the Bulk Electric System (BES)² and non-Bulk Electric System (non-BES)³ are planned and constructed so that:

- They are able to accommodate forecasted system flows during summer and winter peak load;
- They can adequately serve each customer's need with regard to capacity, voltage and reliability for all load levels throughout the daily load cycle;
- They can sustain probable contingencies and disturbances with minimal customer service interruptions; and
- They are in conformance with North American Electric Reliability Corporation (NERC), PJM Interconnection, LLC ("PJM"), and the Transmission Owner's reliability criteria for all normal and emergency operating conditions.

PJM is a FERC-approved Regional Transmission Organization (RTO) charged with ensuring the reliability of the electric transmission system under its functional control (100 kV and above), and coordinating the movement of electricity in all or parts of thirteen states and the District of

² Bulk Electric System (BES) – Includes transmission facilities operated at voltages of 100 kV or higher.

³ Non-Bulk Electrical System (non-BES) – Includes transmission facilities operated at voltages less than 100 kV.

Columbia, including most of Pennsylvania. In order to ensure reliable transmission service, PJM prepares an annual Regional Transmission Expansion Plan (RTEP)⁴ to identify system reinforcements that are required to, among other things, meet the NERC Reliability Standards, PJM reliability planning criteria, and Transmission Owner reliability criteria.

PJM conducts RTEP studies in conjunction with its Transmission Owners and applies NERC, regional, and Transmission Owner reliability criteria to specific conditions on the transmission system. PJM's RTEP is an annual process that encompasses a comprehensive series of detailed analyses to ensure power continues to flow reliably to customers under stringent reliability criteria set by NERC. PJM's manual 14B⁵ outlines the RTEP process and reliability criteria used for this process. As mentioned in manual 14B, every year PJM performs various reliability tests such as Baseline Thermal, Baseline Voltage, Load Deliverability, Generation Deliverability and Baseline Stability to ensure safe, reliable operation of the electric grid.

When the studies show an inability of the transmission system to meet specific reliability criteria under these conditions, PJM opens an RTEP Window in accordance with FERC Order 1000⁶ to solicit bids and approve optimal solutions to resolve the criteria violation.

PPL Electric, as a Transmission Owner and member of PJM, undertakes an independent analysis of both its BES transmission facilities, and its non-BES transmission facilities in concert with the PJM RTEP process. PPL Electric identifies all conditions where the future system does not meet the NERC criteria, PJM reliability criteria, or PPL Electric Transmission Owner criteria. In this way, PPL Electric actively participates in the PJM RTEP process, and through this participation

⁴ PJM's RTEP process is currently set forth in Schedule 6 of PJM's Amended and Restated Operating Agreement ("Schedule 6"). Schedule 6 governs the process by which PJM's members rely on PJM to prepare an annual regional plan for the enhancement and expansion of the transmission facilities to ensure long-term, reliable electric service consistent with established reliability criteria. In addition, Schedule 6 addresses the procedures used to develop the RTEP, the review and approval process for the RTEP, the obligation of transmission owners to build transmission upgrades included in the RTEP, and the process by which interregional transmission upgrades will be developed.

⁵ PJM Manual 14B is available at <http://www.pjm.com/~media/documents/manuals/m14b.ashx>

⁶ <http://www.ferc.gov/industries/electric/indus-act/trans-plan.asp>

PPL Electric provides results of its independent studies to PJM for consideration and inclusion in the PJM RTEP.

Alternatives that can mitigate violations to the reliability criteria are developed and analyzed to ensure that the PPL Electric transmission system meets the reliability criteria. Estimated costs and lead times to implement the reinforcements are prepared. PPL Electric then proposes solutions to PJM through an RTEP window. If the project is awarded to PPL Electric, it then becomes a baseline RTEP project.

PPL Electric's Transmission Owner criteria address thermal, voltage, short circuit, and stability limits specific to the PPL Electric zone and also ensure compliance with NERC and PJM reliability criteria. These criteria ensure adequate and appropriate levels of electric service to PPL Electric customers in accordance with good utility practices. In addition to these criteria, PPL Electric plans the system according to its own Transmission System Development Standards.

In addition to NERC, PJM, and Transmission Owner criteria-based projects, PPL Electric also initiates projects based on the Transmission System Development Standards. These projects address local load growth, provide load restoration flexibility, and replace poor performing transmission assets in order to provide an advanced level of reliability on the local system.

PPL Electric has developed an Asset Optimization Strategy that is incorporated into the Transmission System Development Standards. A significant portion of the system infrastructure is either approaching the end of or has exceeded its expected or useful life. The Asset Optimization Strategy was developed to systematically identify and modernize these aging facilities. The measures used to identify and prioritize the equipment and lines that qualify for this work include, but are not limited to: age, condition, operational issues, maintainability of the equipment, criticality of the equipment or line, line loading, and circuit performance. Once equipment has been identified and assessed under the above measures, it will be put into the Capital Budget for replacement under the Asset Optimization Strategy.

Projects created to support PPL Electric's Transmission System Development Standards are presented to PJM stakeholders at either a TEAC or Sub-Regional RTEP meeting and are assigned a Supplemental project number in the RTEP. PJM incorporates these projects into the power flow model which they use to perform various reliability analyses for the RTEP.

As explained below, the proposed Project is necessary to replace facilities that have reached the end of their useful life and to meet PPL Electric Transmission System Development Standards.

C. EXISTING SYSTEM

The Bartonsville 138 kV Transmission Tap extends approximately 3.2 miles from the Monroe – Jackson #1 and #2 138 kV Transmission lines located in Pocono Township, Monroe County to the Bartonsville 138-12 kV Substation located in Stroud Township, Monroe County. The existing Bartonsville 138 kV Transmission Tap is configured in a double tap, single feed arrangement. For approximately 0.1 mile, the line is double-circuit for two spans from the Monroe – Jackson #1 and #2 138 kV Transmission Lines to a pole where it is connected together into one single-circuit. The first four structures along the double-circuit segment are steel monopoles that were installed in 2009 and will not be rebuilt as part of this Project. The remaining approximately 3.1-mile existing single-circuit section of the Bartonsville 138 kV Transmission Tap primarily consists of 58 wood poles and 795 ACSR (aluminum-conductor steel-reinforced) conductor.

The Bartonsville 138 kV Transmission Tap serves the existing Bartonsville 138-12 kV Substation, which is a distribution substation serving customers located in Monroe County. A one-line diagram and map of the existing system is shown in **Figures 2-1** and **2-2**.

D. DEFINITION OF THE PROBLEM

As explained above, PPL Electric has adopted an Asset Optimization Strategy to address and modernize deteriorated existing facilities across PPL Electric's transmission system. PPL Electric analyzed the Bartonsville 138 kV Transmission Tap and concluded that the 58 wood

structures have reached the end of their reliable service life. The majority of the wood structures on the Bartonville 138 kV Transmission Tap were identified as having a cellon material treatment.⁷ At the time of installation, cellon treated wood poles were believed to be an economic technology and were thought to have the same life expectancy as wood poles with alternative treatments. Since the installation of the cellon treated wood poles, wood pole manufacturers have determined that cellon treated wood poles do not last as long as wood poles with alternative treatments. Cellon treated wood poles have been found to have insufficient penetration of wood preservatives. Over time as the wood ages and splits, the poles become susceptible to advanced aging through internal wood rot, insect infestation, and ultimately pole failure. As a result of the short service life, cellon treated wood poles were discontinued for use at PPL Electric, and manufacturers recommend the replacement of all cellon treated wood poles that are at or near the end of their service life.

Additionally, PPL Electric's analysis concluded that the conductors, hardware, and splices on the existing Bartonville 138 kV Transmission Tap have reached the end of their reliable service life and should be rehabilitated or replaced. Failure of the degraded Bartonville 138 kV Transmission Tap will result in significant outages to customers served from the Bartonville 138/12 kV Substation. In the current double tap, single feed configuration, if the single circuit were to have an outage caused by a downed tree or other event the entire substation would be without power.

E. PROPOSED SOLUTION

PPL Electric evaluated the cost to rehabilitate the Bartonville 138 kV Transmission Tap and concluded that the total cost to rehabilitate the line would be greater than the cost to rebuild the line in place. Therefore, the rebuild of the Bartonville 138 kV Transmission Tap is the most

⁷ Cellon treated wood poles are pressure-impregnated with a wood preservative, such as pentachlorophenol (penta), through a process commonly known as the cellon process.

prudent and effective option. The proposed reconstruction is consistent with PPL Electric's Asset Optimization Strategy.

The approximately 3.2-mile Bartonsville 138 kV Transmission Tap will be reconstructed with new steel monopoles, double-circuit conductors and an optical ground wire. The existing 58 wood pole structures will be replaced with double-circuit steel monopoles. The first four structures on the line will be reused. Two of these structures are steel monopoles and the other two are switch poles, all of which were installed in 2009 and can support the new double circuit line.

The entire line will be constructed for double-circuit 138 kV operation. The addition of the second circuit allows the Bartonsville 138-12 kV Substation to be converted to a more reliable configuration with a second transmission source. The second transmission source allows customers served from the Bartonsville 138-12 kV Substation to continue to receive electric service in the event that one circuit experiences a fault. The more reliable substation configuration also allows the Bartonsville 138-12 kV Substation to serve a greater amount of load and provide power to more customers in the event a nearby substation experienced an outage. Rebuilding 138 kV lines for double-circuit 138 kV operation is consistent with PPL Electric's planning and reliability practices. A one-line diagram and a map of the proposed system are shown in **Figures 2-3 and 2-4**.

The proposed rebuild of the Bartonsville 138 kV Transmission Tap will bring the line into compliance with current design standards, including increased vertical ground clearance, increased phase spacing for galloping⁸ loop consideration, and installation of steel monopole structures for optimal structure longevity. The Project will also increase the lightning protection of the transmission line to reduce the frequency of momentary outages experienced by customers. Additionally, as a part of the Project, PPL Electric will be installing MOLBAB

⁸ Galloping is a wind-induced oscillation of the wires which could potentially cause the wires to come into contact or flashover causing an outage. The consequences of galloping are mitigated by providing adequate wire-to-wire and wire-to-object clearances.

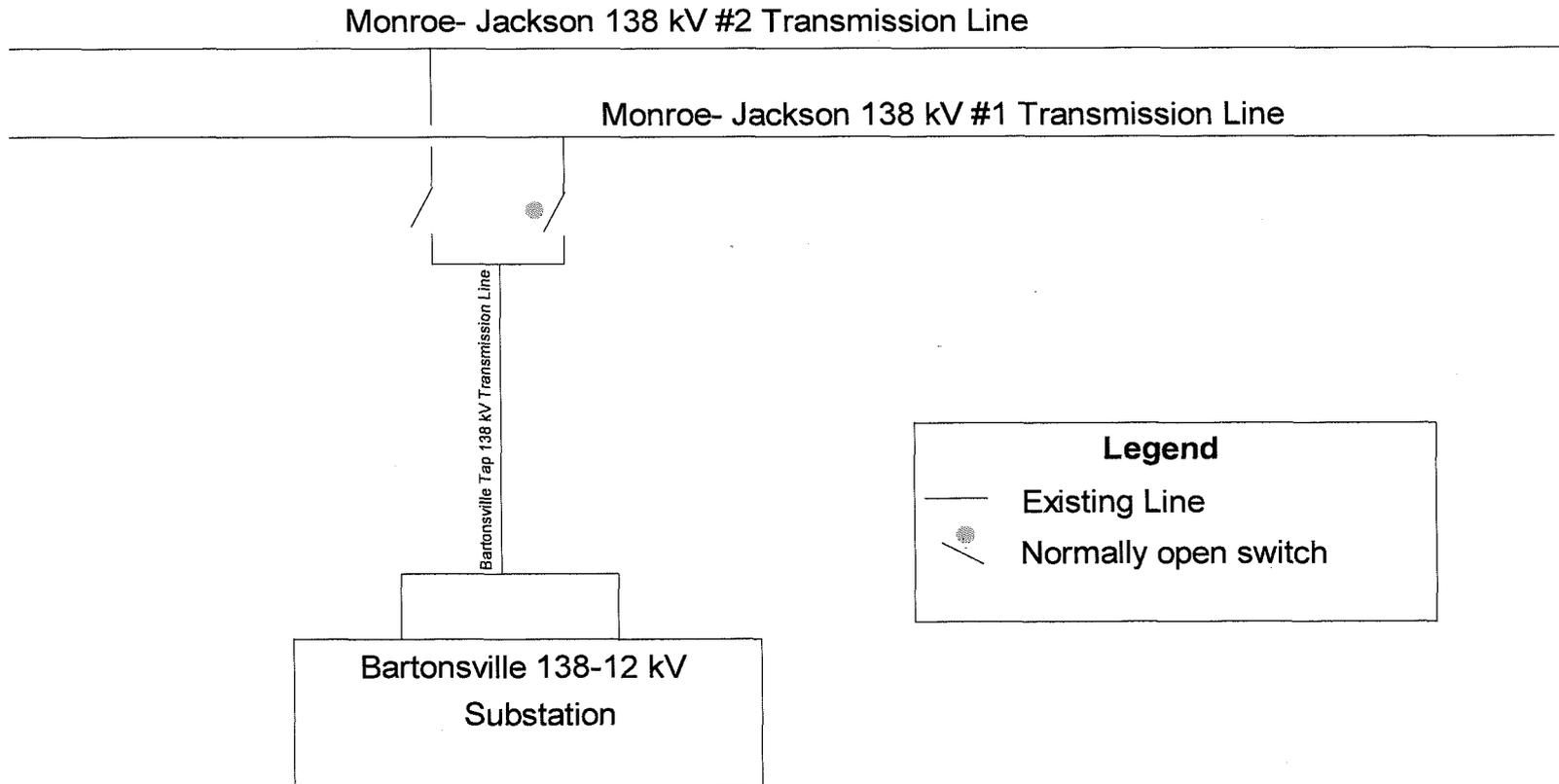
(motor-operated load break air break) switches that will allow for remote sectionalizing of the transmission system to restore service to customers in instances of sustained outages or during various operational scenarios.

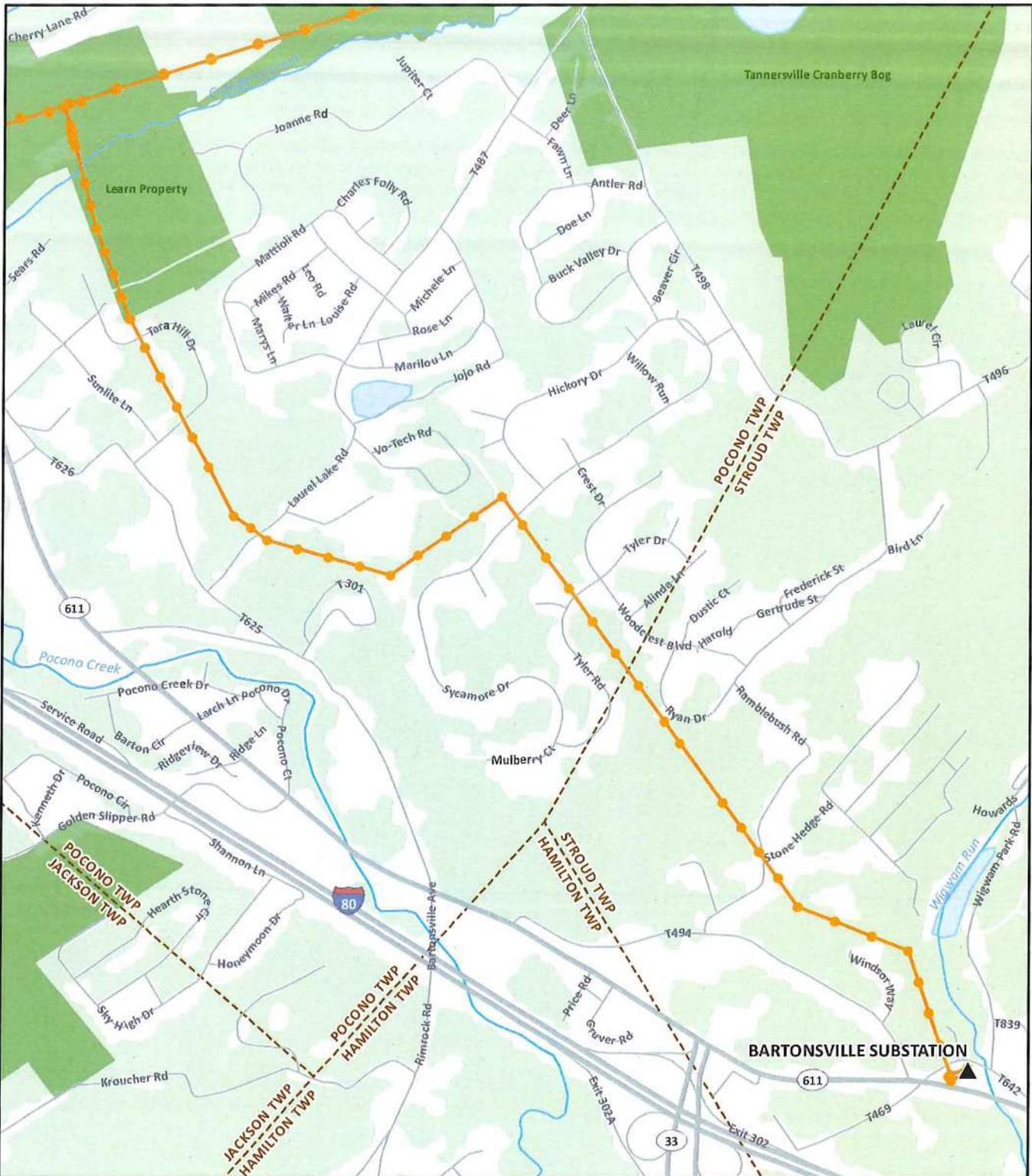
After completion of this Project, the customers served from the Bartonsville 138-12 kV Substation will experience improved service reliability. The second circuit will allow for improved operational flexibility and increased transfer capability, thereby contributing to quicker restoration times and a higher level of reliability for the customers served from the Bartonsville 138-12 kV Substation.

The proposed Project has been presented at a PJM Mid-Atlantic Sub-Regional RTEP stakeholder meeting and PJM assigned the supplemental project number s1031.

This Project is necessary to enable PPL Electric to continue to provide reliable service now and into the future. Therefore, PPL Electric requests Commission approval to complete this Project.

Figure 1-1. One-Line Diagram of Existing Transmission Facilities





- ▲ Substation
- Existing 138 kV Transmission Line
- - - Municipality Boundary
- Local Park/Conservation
- Forested Area

N
▲

Coordinate System:
PA State Plane North
Datum: NAD 83

November 02, 2017

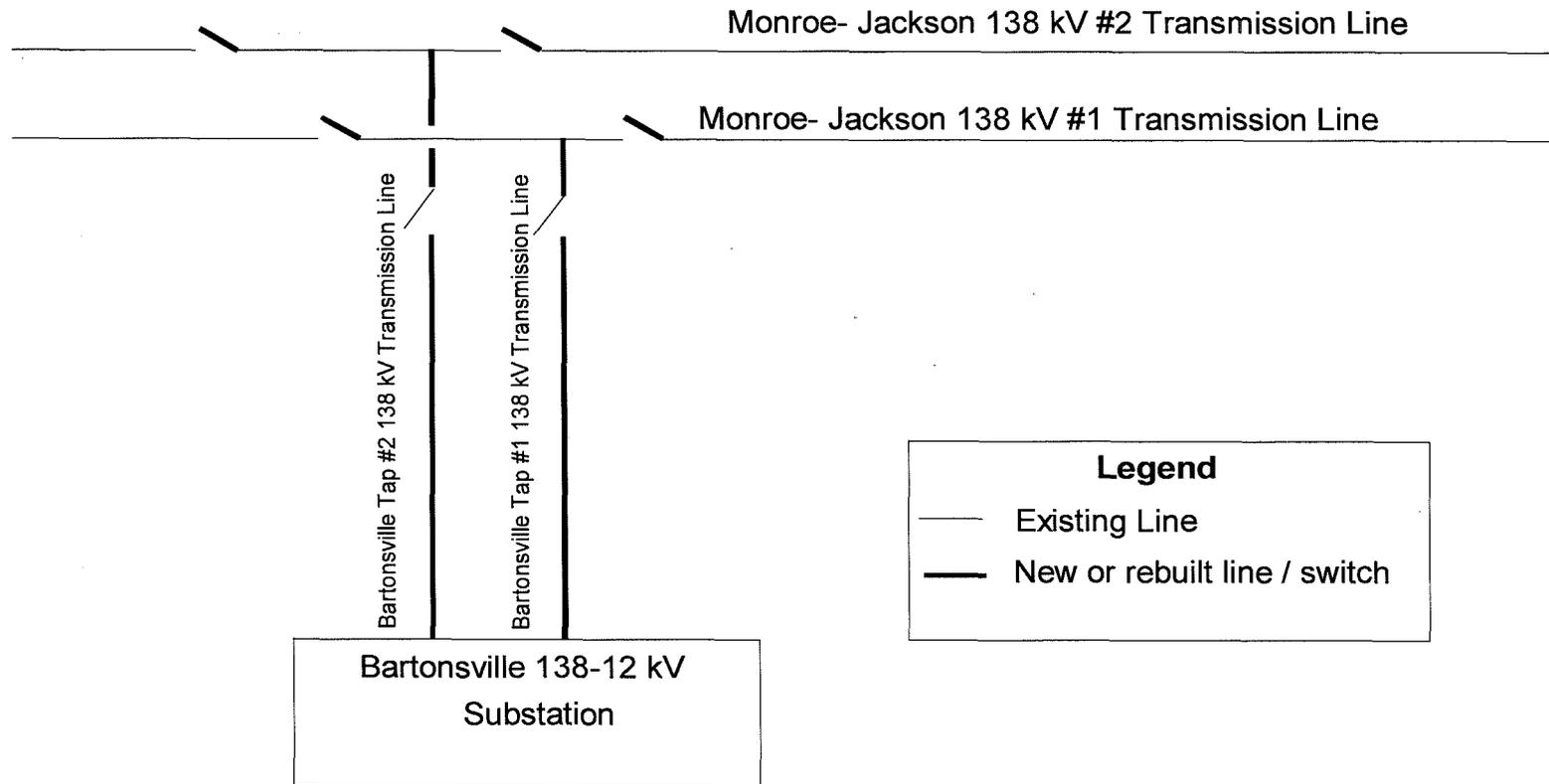


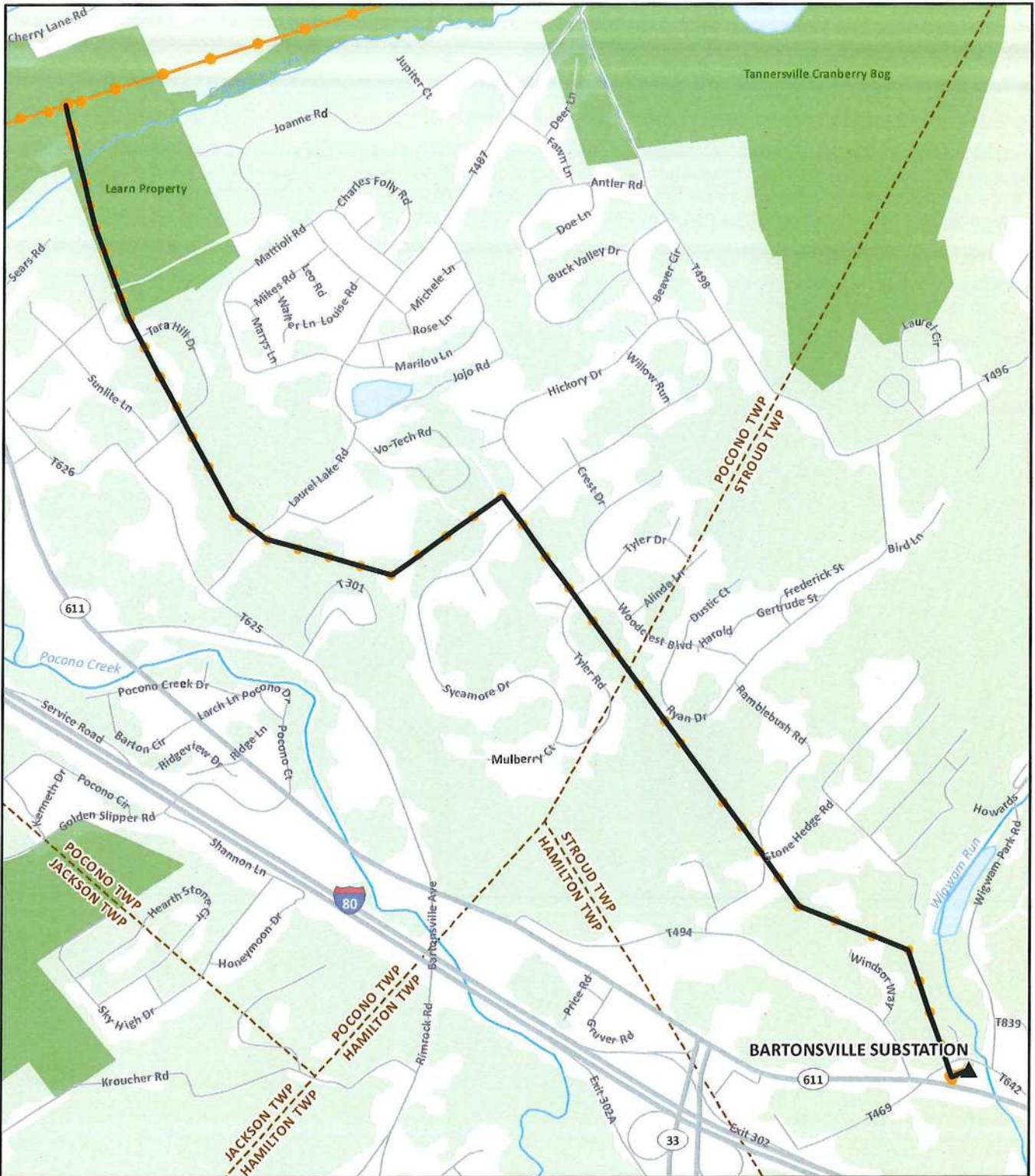
Figure 1-2: Existing Facilities
Bartonsville Tap 138 kV
Transmission Line Rebuild Project

ppl **Louis Berger**

0 500 1,000 2,000
Feet

Figure 1-3. One-Line Diagram of Proposed Transmission Facilities





- ▲ Substation
- Bartonsville Tap Rebuild Centerline
- Existing 138 kV Transmission Line
- - - Municipality Boundary
- Local Park/Conservation
- Forested Area

N

▲

Coordinate System:
PA State Plane North
Datum: NAD 83

November 02, 2017

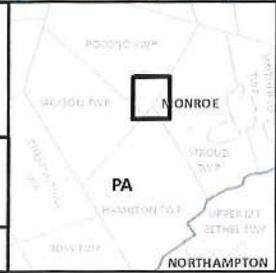


Figure 1-4: Proposed Facilities

Bartonsville Tap 138 kV
Transmission Line Rebuild Project

0 500 1,000 2,000
Feet

ATTACHMENT 2
BARTONSVILLE 138 KV TRANSMISSION TAP REBUILD PROJECT
ENGINEERING DESCRIPTION

TABLE OF CONTENTS

<u>SECTION</u>	<u>TOPIC</u>	<u>PAGE</u>
A.	INTRODUCTION.....	2-1
B.	DESCRIPTION OF THE PROPOSED LINES.....	2-1
C.	MAGNETIC FIELD MANAGEMENT.....	2-3

LIST OF FIGURES

Figure 2-1.	Typical Double-Circuit 138 kV Tension Structure.....	2-5
Figure 2-2.	Typical Double-Circuit 138 kV Angle Suspension Structure.....	2-6
Figure 2-3.	Typical Double-Circuit 138 kV Tangent Suspension Structure	2-7
Figure 2-4.	Typical Double-Circuit 138 kV 2-Pole Angle Tension Structure.....	2-8
Figure 2-5.	Typical Single-Circuit 138 kV 2-Pole Side Tension Structure.....	2-9

ATTACHMENT 2
BARTONSVILLE 138 KV TRANSMISSION TAP REBUILD PROJECT
ENGINEERING DESCRIPTION

A. INTRODUCTION

PPL Electric Utilities Corporation (“PPL Electric”) proposes to rebuild the approximately 3.2-mile single-circuit Bartonsville 138 kV Transmission Tap (the “Project”) for double-circuit 138 kV operation. As explained in Attachment 1, the existing Bartonsville 138 kV Transmission Tap has exceeded its useful life and the facilities must be replaced to continue to provide reliable service into the future.

B. DESCRIPTION OF THE PROPOSED LINE

The approximately 3.2-mile Bartonsville 138 kV Transmission Tap will be reconstructed with new self-weathering steel monopoles, high capacity conductors, and two fiber optic ground wires (OPGW). The existing right-of-way is 100 feet in width. PPL Electric has designed the rebuilt Bartonsville 138 kV Transmission Tap to fit within the existing right-of-way. No additional ROW is needed to construct the Project. All new structures will be located in close proximity to the existing structures, and one structure will be relocated approximately 40 feet from the existing structure location in order to avoid a wetland. No new structures will be located on any property that currently does not have an existing structure.

Currently there are a total of 58 wood and 4 tubular steel structures along the Bartonsville 138 kV Transmission Tap. The existing 58 wood poles will be replaced with 51 new, double-circuit, steel monopoles with upswept arms with glass 138 kV insulator assemblies. As discussed in Attachment 1, the first four existing monopoles along the Bartonsville 138 kV Transmission Tap were installed in 2009 and will not be rebuilt as part of this Project.

The existing structures range in height from 61 to 84 feet with an average height of 72 feet. The new steel monopoles are expected to range between 79 and 106 feet in height, with an average height of approximately 87 feet. All new poles will be self-supported, either direct embedded or on concrete caisson foundations.

Figures 2-1 through 2-5 depict typical structure types that will be used for the Project.

The Project will utilize six power conductors and two overhead ground wires. The power conductors will be 556.5 kcmil,¹ 24/7 stranding, ACSR² conductors. The overhead ground wires will be 0.567-inch diameter Optical Ground Wires (OPGW).

The rebuilt lines will be designed according to, and generally exceed, all National Electrical Safety Code (NESC) minimum standards. Design specifications and safety rules practiced by PPL Electric are included in Attachment 4.

The minimum conductor-to-ground clearance will be 31 feet which occurs at a maximum thermal conductor temperature of 125°C (257°F). The design minimum conductor clearances and conductor thermal ratings for the reconstructed lines are shown in Tables 2-1 and 2-2.

¹ A kcmil is a thousand circular mils. A circular mil is the cross-sectional area of a wire one mil in diameter, where 1 kcmil = 0.5067 mm².

² Aluminum conductor steel reinforced.

Table 2-1. Design for Minimum Conductor Clearances for 556.5 kcmil 24/7 strand ACSR³	
Condition	Transmission Double-Circuit Design Clearance-to-Ground
Heavy Ice (1" ice at 0°C ambient temperature)	31 feet
Predicted extreme thermal load (125°C conductor temperature)	31 feet
Predicted blowout (6 lbs., 16°C, ambient temperature)	31 feet

Table 2-2. Conductor Thermal Rating 556.5 kcmil 24/7 Stranding ACSR 125°C Maximum Conductor			
Condition	Ambient Temperature (°C)	Wind Speed (Ft./sec)	Ampacity (Amps)
Summer Normal	35	0	806
Winter Normal	10	0	929
Summer Emergency	35	2.533	1054
Winter Emergency	10	2.533	1187

The estimated cost to design and construct the Project is approximately \$8.9 million. Subject to the Commission's approval, the Project has a scheduled construction start date of April 2018 to meet an in-service date of May 2019.

C. MAGNETIC FIELD MANAGEMENT

PPL Electric's Magnetic Field Management Program is applied to new and reconstructed transmission line projects. The company does not believe that the current scientific evidence demonstrates that magnetic fields cause any adverse health effects or pose a health or safety danger to the public. Nevertheless, PPL Electric has determined, as a matter of policy, to design its new and rebuilt transmission lines to reduce magnetic fields when that can be done at low or no cost and consistent with functional requirements. PPL Electric's Magnetic Field Management Program has been developed to implement that policy decision. To reduce magnetic field exposures, the program generally

³ Clearances based on an initial maximum tension of 6,000-10,000 pounds at ½ inch ice, 0°F, 4# wind and maximum ruling span of 200-1250 feet.

prescribes the use of a line design that provides higher ground clearance than NESC standards and reverse phasing of new double-circuit lines where it is feasible to do so at low or no cost.

The Project will be designed with clearances that are at least 5 feet higher than NESC standards and typically 10 feet above NESC minimum. However, the line will not use reverse phasing because the existing Monroe – Jackson #1 and #2 138 kV Transmission Lines are not reversed phase and would require significant cost and complexity to reverse phase the lines.

Figure 2-1. Typical Double-Circuit 138 kV Tension Structure

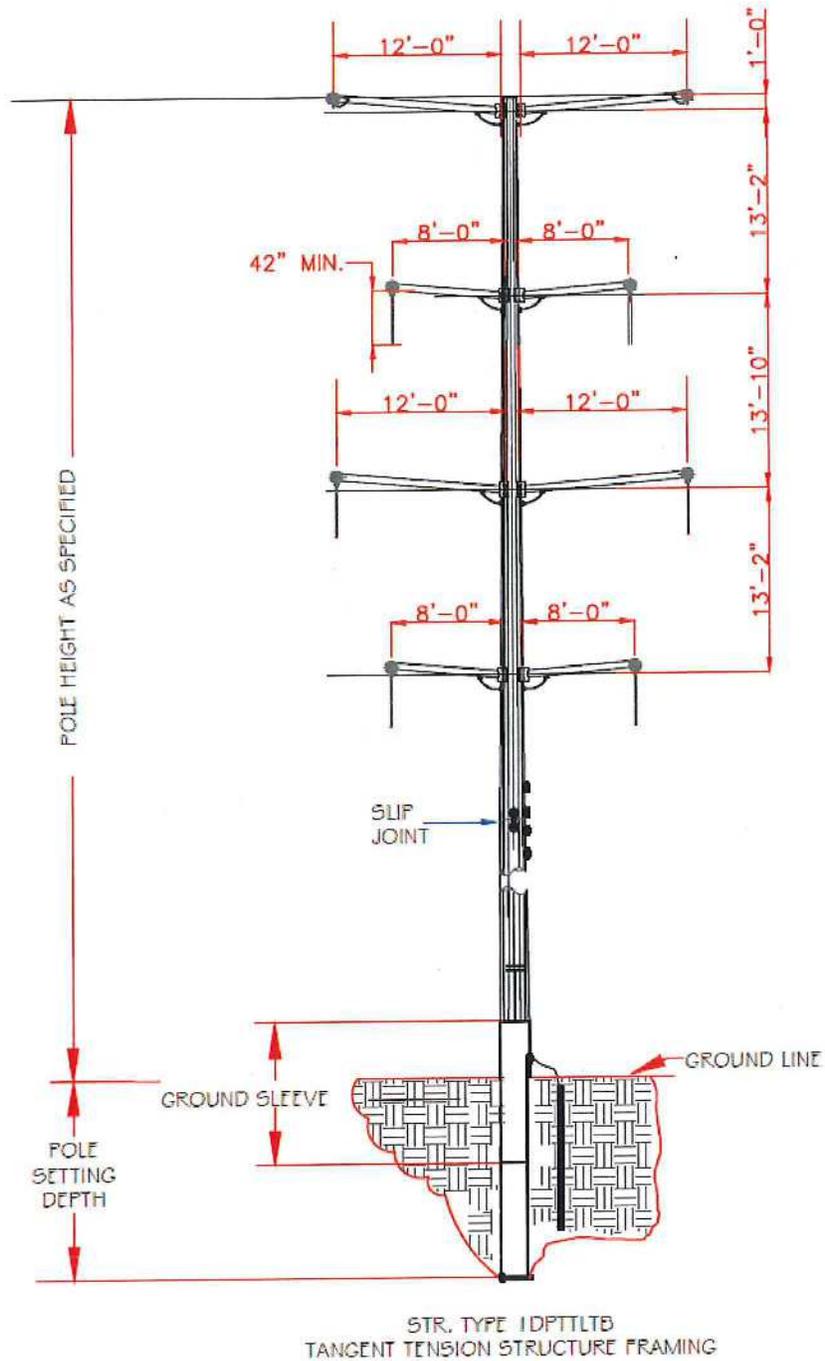


Figure 2-2. Typical Double-Circuit 138 kV Angle Suspension Structure

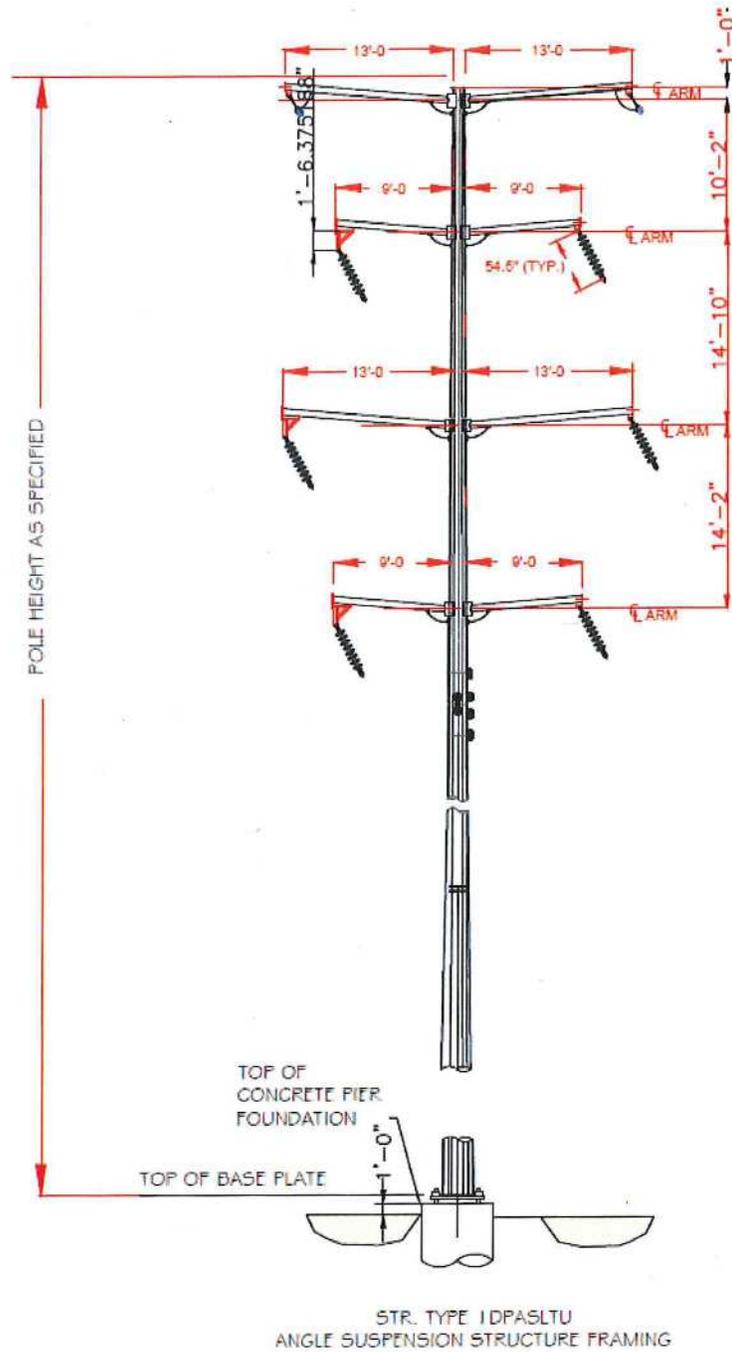


Figure 2-3. Typical Double-Circuit 138 kV Tangent Suspension Structure

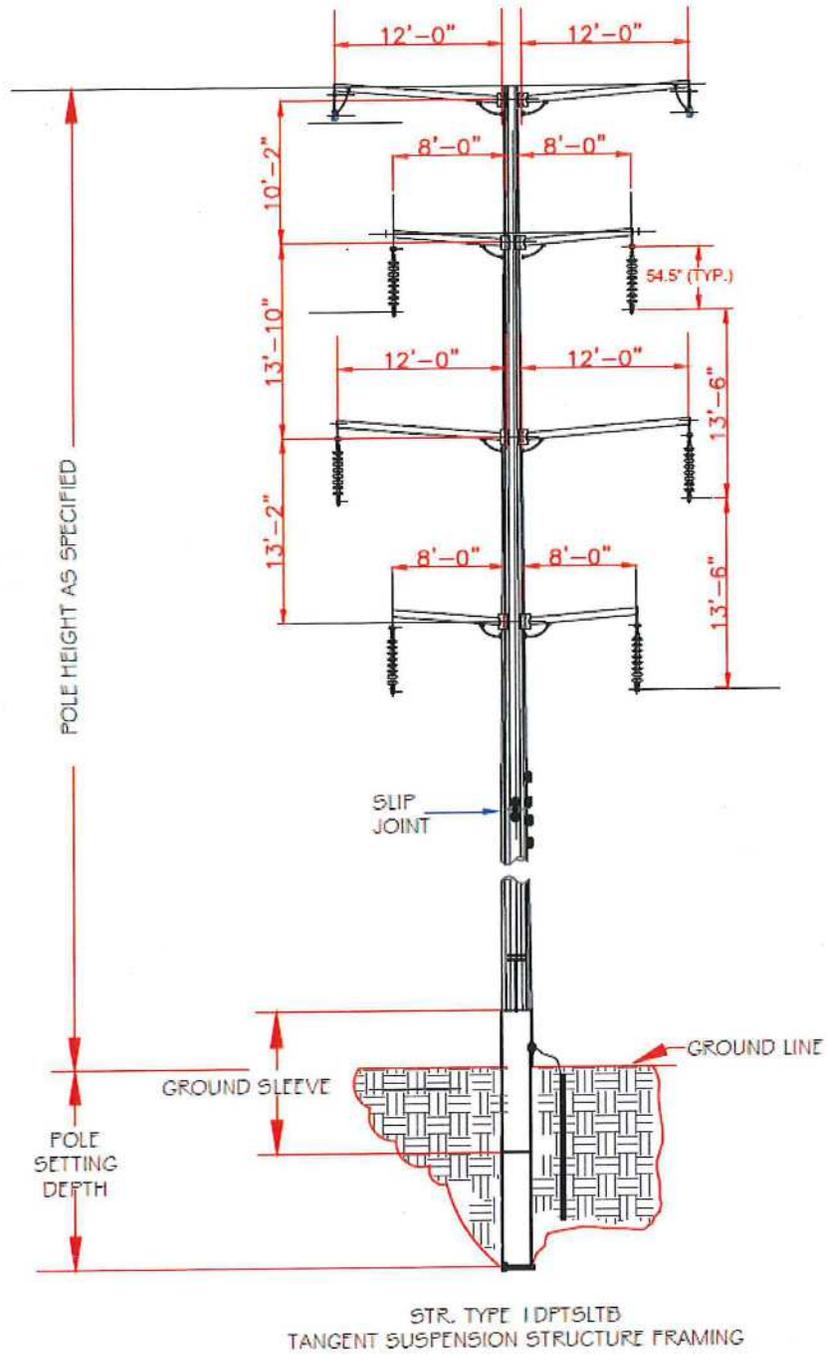


Figure 2-4. Typical Double-Circuit 138 kV 2-Pole Angle Tension Structure

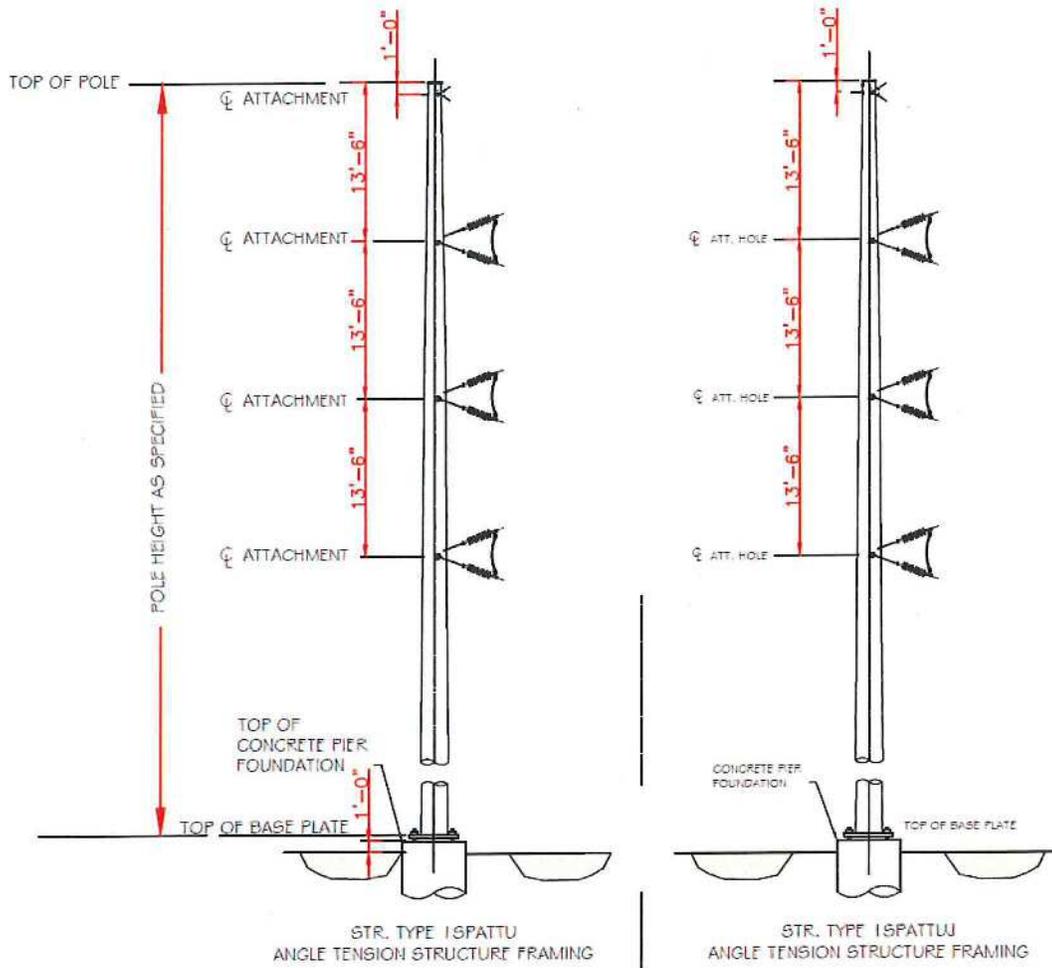
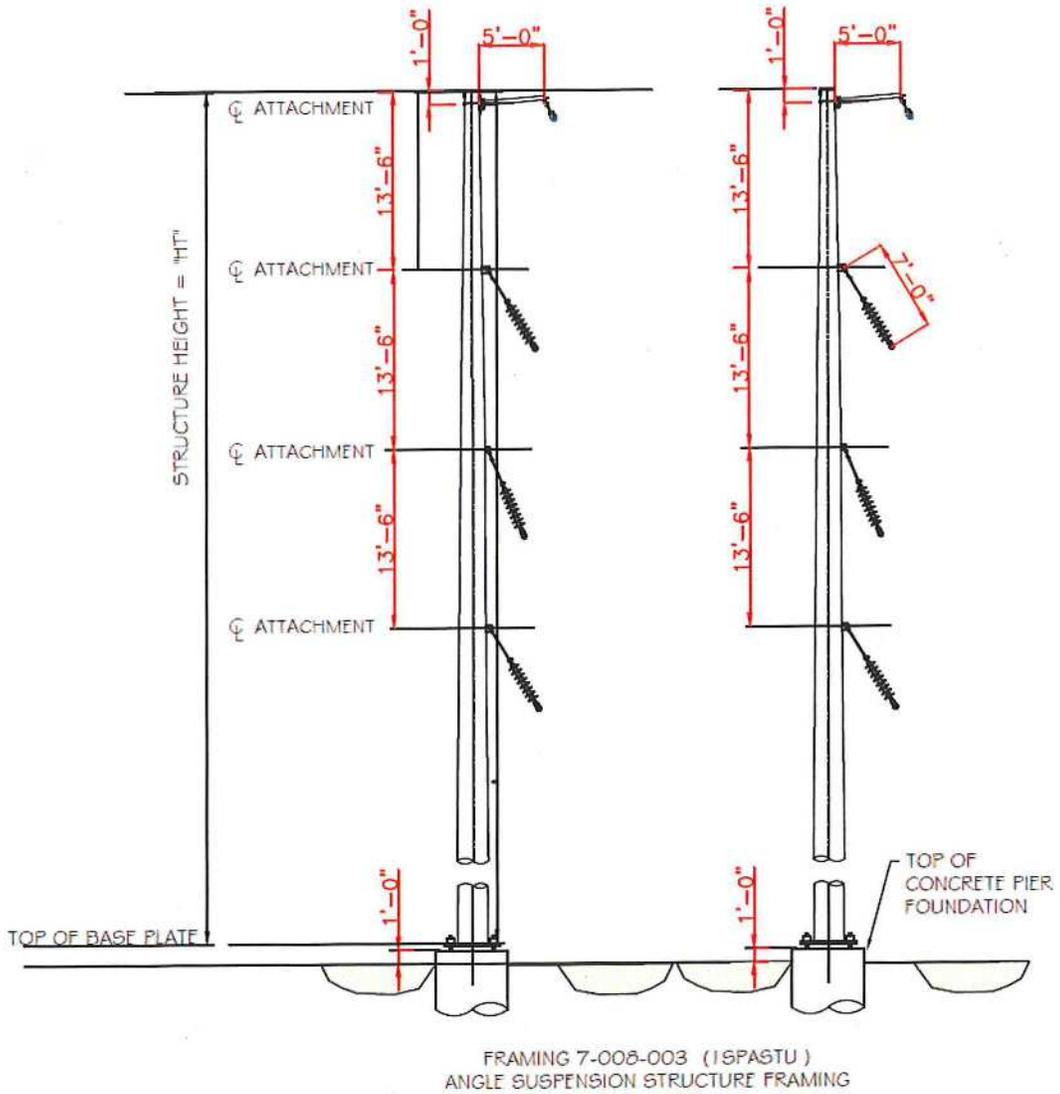


Figure 2-5. Typical Single-Circuit 138 kV 2-Pole Side Tension Structure



ATTACHMENT 3
BARTONSVILLE 138 KV TRANSMISSION TAP REBUILD PROJECT
DESCRIPTION OF THE RIGHT OF WAY

TABLE OF CONTENTS

<u>SECTION</u>	<u>TOPIC</u>	<u>PAGE</u>
A.	INTRODUCTION.....	3-1
B.	DESCRIPTION OF THE RIGHT OF WAY	3-1
C.	CULTURAL RESOURCES.....	3-3
D.	LAND USE AND NATURAL FEATURES	3-4
E.	THREATENED AND ENDANGERED SPECIES	3-5

LIST OF FIGURES

Figure 3-1 Aerial Exhibit.....	END OF ATTACHMENT
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ATTACHMENT 3
BARTONSVILLE 138 KV TRANSMISSION TAP REBUILD PROJECT
DESCRIPTION OF THE RIGHT OF WAY

A. INTRODUCTION

As explained in Attachment 1, PPL Electric Utilities Corporation (“PPL Electric”) seeks Pennsylvania Public Utility Commission (“PUC” or the “Commission”) approval to rebuild the approximately 3.2-mile single-circuit Bartonsville 138 kV Transmission Tap for double-circuit 138 kV operation in order to improve electric reliability in the region (the “Project”). This attachment provides a description of the right of way (“ROW”).

B. DESCRIPTION OF THE RIGHT OF WAY

The proposed Project is explained in detail in Attachment 1 and an engineering description of the rebuilt line is provided in Attachment 2. The Project is located within Stroud and Pocono townships in Monroe County, Pennsylvania. PPL Electric has discussed the proposed Project with representatives from Monroe County and Stroud and Pocono townships, none of which had any objection to the Project. **Figure 3-1** is an aerial exhibit of the Project that identifies property owners crossed by the Project.

As shown in **Figure 3-1**, the existing line taps the Monroe – Jackson #1 and #2 138 kV Transmission Line and heads generally southeast through forested areas and residential areas, including the Learn conservation easement, which is a large forested parcel owned by Pocono Township that is open to the public and primarily used for hunting. Just before crossing Laurel Lake Road, the route turns southeast/east, skirting around the Monroe County Area Vocational Tech School and traversing behind residences. Just north of Tyler Drive, the route turns south, crossing through a mix of residential development and forested areas. The route terminates at the Bartonsville 138-12 kV Substation. Stroud Township plans to construct a new shopping center (“Route 611 Plaza”) located adjacent to the intersection of the Bartonsville 138-12 kV Substation and Wigwam Park Road. Through this area, the new structures will be placed within

close proximity of the existing structures within the existing ROW. PPL Electric does not anticipate any impacts to the proposed Route 611 Plaza.

The existing ROW for the Bartonsville 138 kV Transmission Tap is 100 feet in width. As explained in Attachment 2, the proposed Project will be rebuilt entirely within the existing ROW. No new rights are required for the construction, operation or maintenance of the Project.

As explained in Attachment 2, the existing outdated structures range from approximately 61 feet to 84 feet in height, with an average structure height of 72 feet. The new structures for the rebuilt Bartonsville 138 kV Transmission Tap will have an average height of approximately 87 feet. Although the new structures will increase in height as compared to the existing outdated structures and a second circuit will be installed, impacts are anticipated to be minimal because the average structure height is only increasing by approximately 15 feet.

No structures will be placed on a property that does not already have an existing pole. All but one of the new structures will be placed within approximately 10 feet of the existing structures. PPL Electric anticipates that one new structure will be relocated approximately 40 feet from the existing structure location to avoid wetlands and environmental impacts, as further explained in Attachment 2. This shift is not anticipated to result in a significant impact to the property owners because there is already a structure located on the property and the residence is located over 450 feet from the proposed structure.

The existing ROW is currently maintained in accordance with PPL Electric's Vegetation Management Program. All vegetation management will occur within PPL Electric's existing right of way. Only limited tree clearing within the ROW is anticipated as part of this Project. In areas where any vegetation management is required, PPL Electric will apply its "Specifications for Initial Clearing and Control of Vegetation On or Adjacent to Electric Line Right of way Through Use of Herbicides, Mechanical and Hand Clearing Techniques" to minimize any potential impacts.

In summary, PPL Electric does not believe the proposed Bartonsville 138 kV Transmission Tap project will result in a substantial alteration of the ROW for the following reasons:

- The line will be constructed entirely within existing ROW.
- No new rights are required for the construction, operation or maintenance of the Project.
- The addition of a second circuit will not require PPL Electric to acquire any additional ROW or tree clearing rights.
- The average structure height is only increasing by approximately 15 feet.
- With the exception of one structure that must be relocated to avoid wetlands and environmental impacts, all new structures will be located in close proximity to the existing structure locations.
- No structures will be placed on a property that does not already have an existing pole.

C. CULTURAL RESOURCES

PPL Electric conducted a review of the online Pennsylvania State Historic Preservation Office ("SHPO") Bureau for Historic Preservation ("BHP") Cultural Resources Geographic Information System ("CRGIS") database to determine if National Register of Historic Places ("NRHP")-listed or eligible historic properties are located in the Project vicinity. Based on this review, several historic architectural resources are located within 1 mile of the Project; however, none of these resources are NRHP-listed or eligible. Twenty-eight resources are identified as undetermined status with insufficient data necessary to determine whether these sites are eligible for the NRHP. One resource is identified as an "aggregate file" and its NHRP-eligibility is

undetermined. No previously identified archaeological sites are located within 1 mile of the Project.

PPL Electric submitted a letter to the SHPO on November 10, 2017. The SHPO's November 28, 2017 response indicated that no archaeological resources are anticipated to be affected by the Project. The SHPO response indicated that additional information was needed in order to determine the potential effect of the Project on above-ground historic properties. PPL Electric will continue to consult with the SHPO to avoid potential impacts to cultural resources.

D. LAND USE AND NATURAL FEATURES

Impacts to land use are anticipated to be minimal because the Project will be constructed within the existing ROW and no additional right of way will be required to complete the Project. PPL Electric will use and update previously established access roads for construction to the extent practical to further reduce interference with existing uses and minimize land use impacts.

No communication towers, pipelines, or other utilities will be affected by the proposed Project. The closest airport is the Stroudsburg-Pocono Airport, which is located approximately 6 miles east of the Project. PPL Electric does not anticipate any interference with airport operations because the Project is located a substantial distance from the airport and new facilities will be generally similar in height to the existing facilities that they are replacing. However, PPL Electric will file any required documentation with both the Federal Aviation Administration and the Pennsylvania Department of Transportation, Bureau of Aviation.

A Natural Area Inventory ("NAI") has been prepared by The Nature Conservancy in association with the Pennsylvania Natural Heritage Program ("PNHP") for Monroe County (1999). The Project does not cross any NAI areas. One NAI area, the Tannersville Cranberry Bog, is located in close proximity to the Project. The Tannersville Cranberry Bog NAI is located approximately 0.2 miles west of the Project and consists of a wetland system containing three natural communities (Boreal Conifer Swamp, Acidic Broadleaf Swamp, and Glacial Bog), three plant species of concern and one animal species of concern. The Project is not expected to impact the

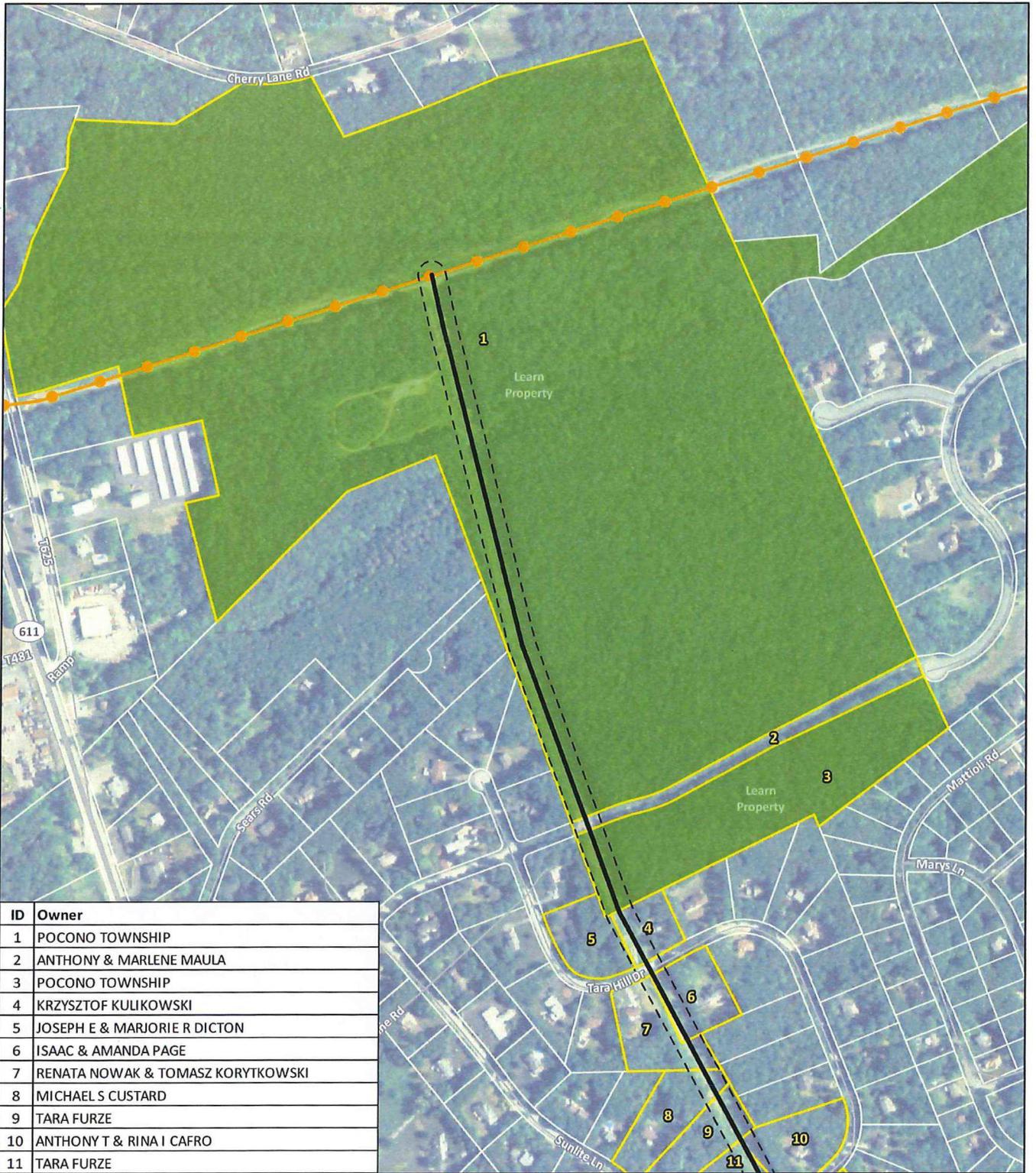
Tannersville Cranberry Bog NAI because the Project will be rebuilt within the existing, cleared ROW, which does not traverse this NAI area. The Project will not affect any other unique geological, scenic, or natural areas.

PPL Electric retained an environmental consultant to identify and delineate all wetlands and watercourses within the Project Area. The Project will span seven wetlands and two streams. However, it is anticipated the Project will have no additional impacts on streams or wetlands because the entire Project will be built within the existing, cleared right of way, and because the new monopole structures will be located to avoid impacts to wetland and streams. PPL Electric will obtain all necessary permits from the Pennsylvania Department of Environmental Protection and the United States Army Corps of Engineers and will comply with all of the terms and conditions placed on those permits. PPL Electric will also prepare any required soil erosion and sedimentation control plans and obtain National Pollutant Discharge Elimination System (NPDES) permits and will comply with any conditions placed on those permits.

E. THREATENED AND ENDANGERED SPECIES

PPL Electric conducted an online PNDI database review on October 6, 2017¹. Based on this review, the Pennsylvania Game Commission (“PGC”), Pennsylvania Fish and Boat Commission (“PFBC”), and the Pennsylvania Department of Conservation and Natural Resources (“DCNR”) reported that the Project will not impact any threatened and endangered species, or special concern species and resources located within the Project area. The U.S. Fish and Wildlife Service (“USFWS”) indicated that the Project is located within range of the federally threatened bog turtle (*Clemmys muhlenbergii*). PPL Electric retained a qualified bog turtle surveyor to conduct a Phase 1 bog turtle habitat assessment. Based on the Phase I bog turtle survey, it was determined that none of the wetlands within the ROW contained necessary hydrology, soils, and/or vegetation to support bog turtle habitat. Therefore, no impacts to threatened and endangered species are anticipated.

¹ Project Search ID: PNDI-633095



ID	Owner
1	POCONO TOWNSHIP
2	ANTHONY & MARLENE MAULA
3	POCONO TOWNSHIP
4	KRZYSZTOF KULIKOWSKI
5	JOSEPH E & MARJORIE R DICTON
6	ISAAC & AMANDA PAGE
7	RENATA NOWAK & TOMASZ KORYTKOWSKI
8	MICHAEL S CUSTARD
9	TARA FURZE
10	ANTHONY T & RINA I CAFRO
11	TARA FURZE

	Substation
	Bartonville Tap Rebuild Centerline
	Existing ROW
	Existing 138 kV Transmission Line
	ROW Parcel
	Parcel boundary shown with white outline
	Local Park/Conservation

Sources: Imagery (NAIP) Municipalities/COUNTIES (PASDA) Roads (ESRI)
Coordinate System: PA State Plane North Datum: NAD 83
November 02, 2017

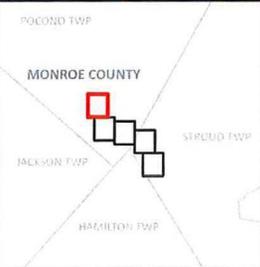
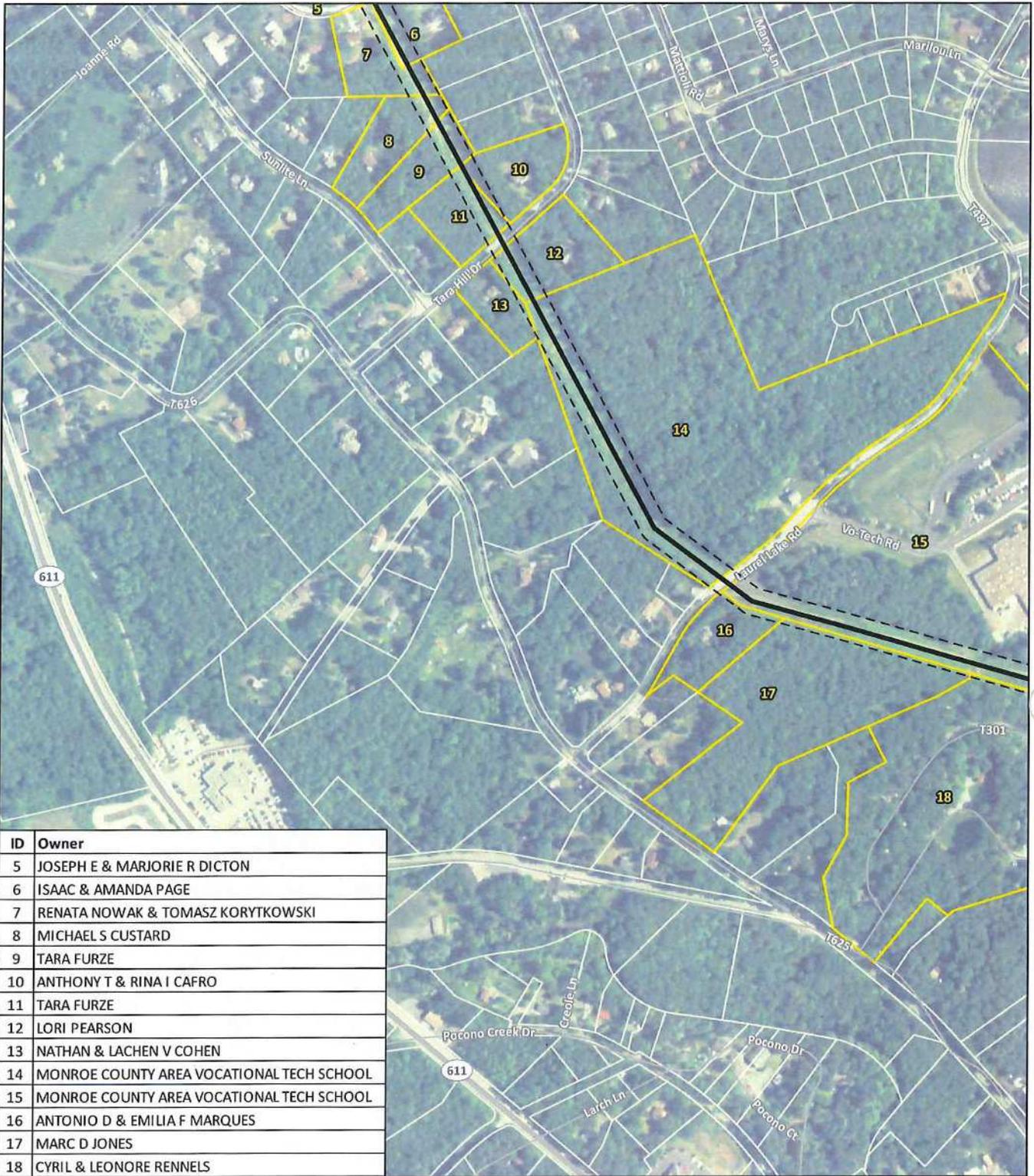


Figure 3-1a: Aerial Exhibit
Bartonville Tap 138 kV
Transmission Line Rebuild Project

0 150 300 600 Feet



ID	Owner
5	JOSEPH E & MARJORIE R DICTON
6	ISAAC & AMANDA PAGE
7	RENATA NOWAK & TOMASZ KORYTKOWSKI
8	MICHAEL S CUSTARD
9	TARA FURZE
10	ANTHONY T & RINA I CAFRO
11	TARA FURZE
12	LORI PEARSON
13	NATHAN & LACHEN V COHEN
14	MONROE COUNTY AREA VOCATIONAL TECH SCHOOL
15	MONROE COUNTY AREA VOCATIONAL TECH SCHOOL
16	ANTONIO D & EMILIA F MARQUES
17	MARC D JONES
18	CYRIL & LEONORE RENNELS

- Substation
- Bartonsville Tap Rebuild Centerline
- Existing ROW
- Existing 138 kV Transmission Line
- ROW Parcel
- Parcel boundary shown with white outline
- Local Conservation Area

Sources:
 Imagery (NAIP)
 Municipalities/Counties (PASDA)
 Roads (ESRI)

Coordinate System:
 PA State Plane North
 Datum: NAD 83

November 02, 2017

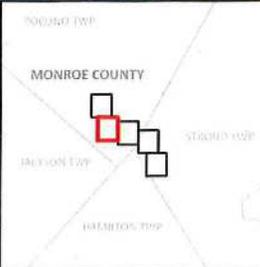
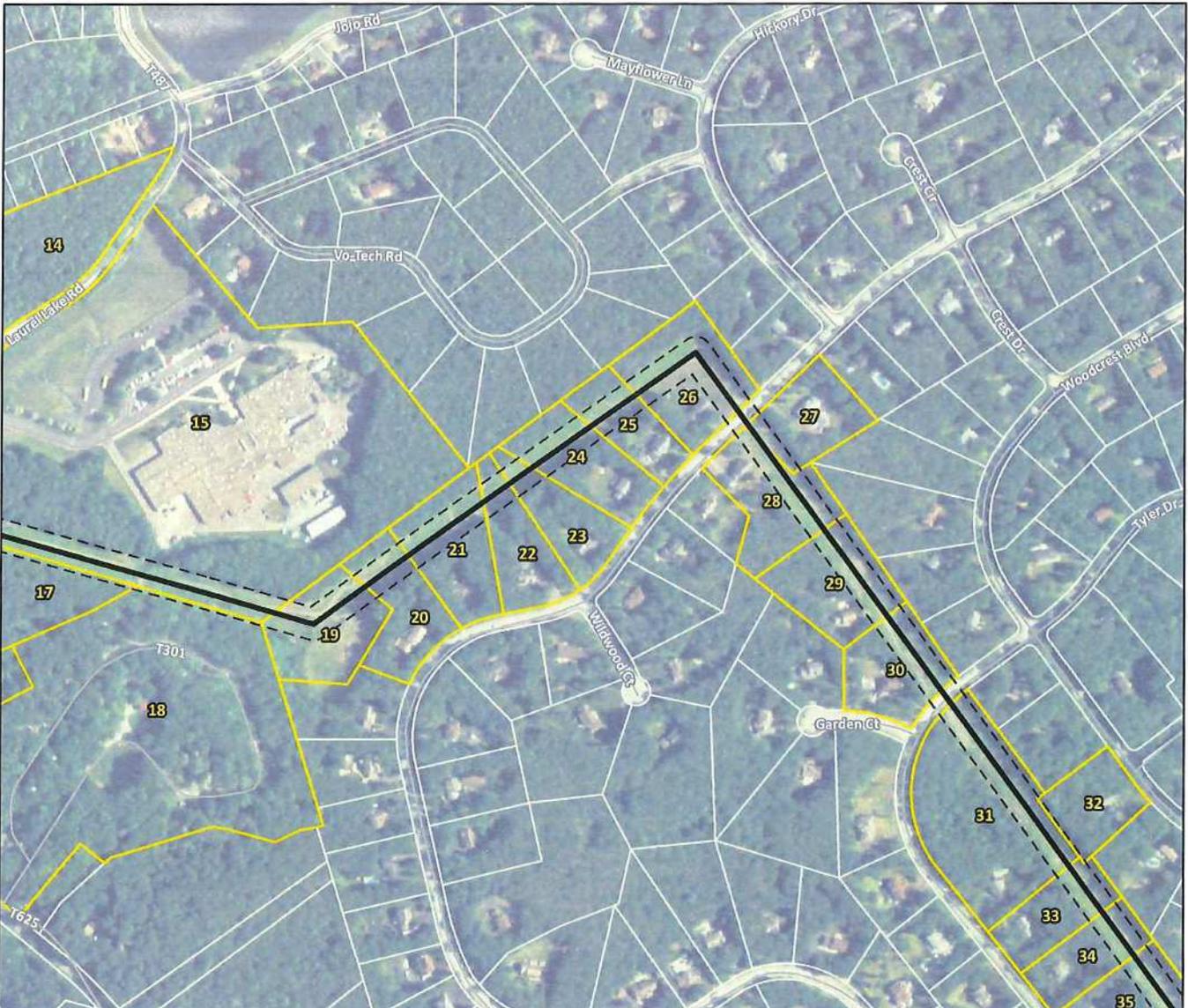


Figure 3-1b: Aerial Exhibit
 Bartonsville Tap 138 kV
 Transmission Line Rebuild Project

0 150 300 600 Feet



ID	Owner	ID	Owner
14	MONROE COUNTY AREA VOCATIONAL TECH SCHOOL	26	RAYON HENRY
15	MONROE COUNTY AREA VOCATIONAL TECH SCHOOL	27	RONALD BATSON
16	ANTONIO D & EMILIA F MARQUES	28	GEORGE W REID III
17	MARC D JONES	29	MARK E WILSON
18	CYRIL & LEONORE RENNELS	30	ANDRZEJ & GRAZYNA MIERZWINSKI
19	WOODLANDS-CRANBERRY COMMUNITY INC	31	JAMES RYAN TAYLOR
20	RICHARD C & CAROLYN E WEAKLAND	32	DEBORAH A LAW
21	CATHARINE NEWBERRY	33	MARIE M BERTRAND
22	DAVID T JAEDER	34	ANN E SUMMA
23	KIERAN A LAVIN	35	CYNTHIA L MILLER
24	FRANCISZEK & BOZENA SLESZYNSKI	36	BENJAMIN C WOLFE & DAWN M VIGILANTE
25	MRH SUB I LLC	37	SALVATORE ZITO

- Substation
- Bartonsville Tap Rebuild Centerline
- Existing ROW
- Existing 138 kV Transmission Line
- ROW Parcel
- Parcel boundary shown with white outline
- Local Conservation Area

Sources:
 Imagery (NAIP)
 Municipalities/Counties (PASDA)
 Roads (ESRI)

Coordinate System:
 PA State Plane North
 Datum: NAD 83

November 02, 2017

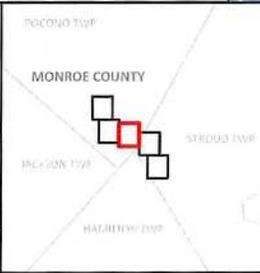
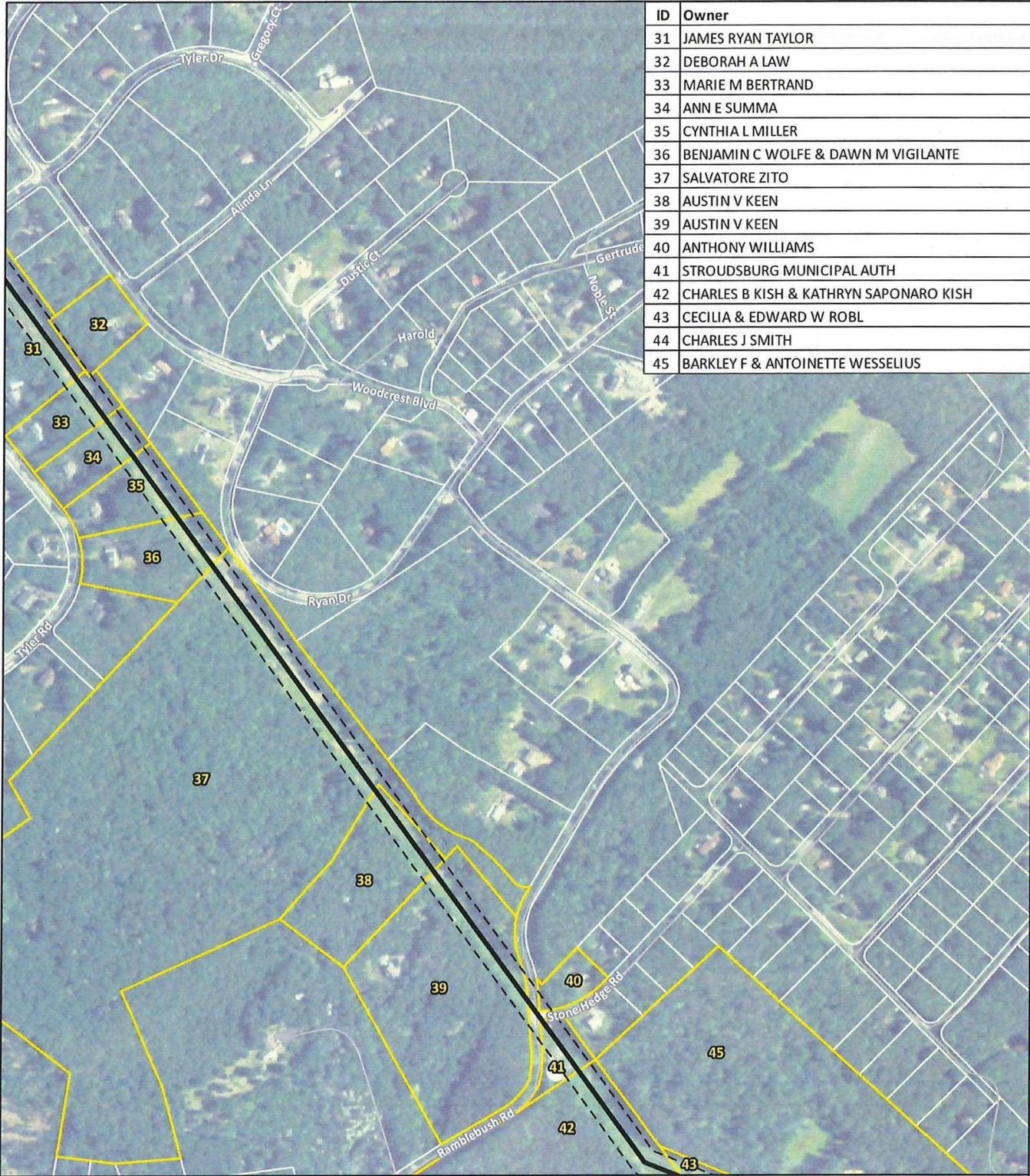


Figure 3-1c: Aerial Exhibit
 Bartonsville Tap 138 kV
 Transmission Line Rebuild Project

0 150 300 600 Feet



ID	Owner
31	JAMES RYAN TAYLOR
32	DEBORAH A LAW
33	MARIE M BERTRAND
34	ANN E SUMMA
35	CYNTHIA L MILLER
36	BENJAMIN C WOLFE & DAWN M VIGILANTE
37	SALVATORE ZITO
38	AUSTIN V KEEN
39	AUSTIN V KEEN
40	ANTHONY WILLIAMS
41	STROUDSBURG MUNICIPAL AUTH
42	CHARLES B KISH & KATHRYN SAPONARO KISH
43	CECILIA & EDWARD W ROBL
44	CHARLES J SMITH
45	BARKLEY F & ANTOINETTE WESSELIUS

- Substation
- Bartonsville Tap Rebuild Centerline
- Existing ROW
- Existing 138 kV Transmission Line
- ROW Parcel
- Parcel boundary shown with white outline
- Local Conservation Area

Sources:
 Imagery (NAIP)
 Municipalities/Countries (PASDA)
 Roads (ESRI)

Coordinate System:
 PA State Plane North
 Datum: NAD 83

November 02, 2017

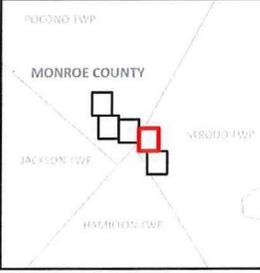


Figure 3-1d: Aerial Exhibit
 Bartonsville Tap 138 kV
 Transmission Line Rebuild Project

0 150 300 600 Feet



ID	Owner
39	AUSTIN V KEEN
40	ANTHONY WILLIAMS
41	STROUDSBURG MUNICIPAL AUTH
42	CHARLES B KISH & KATHRYN SAPONARO KISH
43	CECILIA & EDWARD W ROBL
44	CHARLES J SMITH
45	BARKLEY F & ANTOINETTE WESSELIUS
46	FRANCIS C & ELIZABETH DISALVO
47	ROBERT J & JACQUELINE FURBECK
48	PEDRO M & ROCHELLE I SANTOS
49	KATHY A & STACEY STRICKLIN
50	DEPG PARCEL D LLC
51	DEPG BARTONVILLE ROUTE 611 PLAZA LP
52	DEPG BARTONVILLE ROUTE 611 PLAZA LP
53	DEPG BARTONVILLE ROUTE 611 PLAZA LP
54	DEPG BARTONVILLE ROUTE 611 PLAZA LP
55	TOWNSHIP OF STROUD
56	PPL
57	HAFEEZ M & KHALIDA H CHOUDHARY

▲ Substation

— Bartonville Tap Rebuild Centerline

- - - Existing ROW

— Existing 138 kV Transmission Line

□ ROW Parcel

□ Parcel boundary shown with white outline

□ Local Conservation Area

Sources:
Imagery (NAIP)
Municipalities/Counties (PASDA)
Roads (ESRI)

Coordinate System:
PA State Plane North
Datum: NAD 83

November 02, 2017

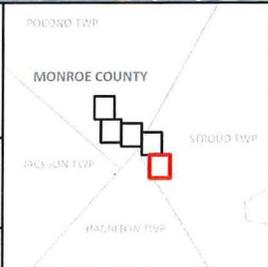


Figure 3-1e: Aerial Exhibit
Bartonville Tap 138 kV
Transmission Line Rebuild Project

0 150 300 600 Feet

ATTACHMENT 4
BARTONSVILLE TAP 138 KV TRANSMISSION LINE REBUILD PROJECT
PPL ELECTRIC DESIGN CRITERIA AND SAFETY PRACTICES

TABLE OF CONTENTS

<u>SECTION</u>	<u>TOPIC</u>	<u>PAGE</u>
A.	DESIGN CONSIDERATIONS	4-1
B.	PERIODIC MAINTENANCE PROGRAM ON ALL TRANSMISSION LINES	4-3
C.	PERSONNEL SAFETY RULES	4-4
D.	MAGNETIC FIELD MANAGEMENT PLAN.....	4-5

LIST OF TABLES

TABLE 4-1.	69 kV VERTICAL CLEARANCE TO GROUND	4-2
TABLE 4-2.	138 kV VERTICAL CLEARANCE TO GROUND	4-2
TABLE 4-3.	230 kV VERTICAL CLEARANCE TO GROUND	4-3
TABLE 4-4.	500 kV VERTICAL CLEARANCE TO GROUND	4-3

ATTACHMENT 4
BARTONSVILLE TAP 138 KV TRANSMISSION LINE REBUILD PROJECT
DESIGN CRITERIA AND SAFETY PRACTICES

A. DESIGN CONSIDERATIONS

PPL Electric's new and rebuilt transmission lines will be designed according to, and generally exceed, all NESC minimum standards. The NESC is a set of rules to safeguard people during the installation, operation, and maintenance of electric power lines. The NESC contains the basic provisions considered necessary for the safety of employees and the public. Although it is not intended as a design specification, its provisions establish minimum design requirements. PPL Electric has developed design specifications and safety rules which meet or surpass all requirements specified by the NESC.

The NESC includes loading requirements and clearances for the design, construction, and operation of power lines. The "loads" on conductors and supporting structures are the mechanical forces that develop from the weight of the conductors, the weight of ice on the conductors, plus wind pressure on the conductors and supporting structures. Loading requirements are the loads on the conductors and structures that are anticipated assuming certain ice and wind conditions. Loading requirements always contain "safety factors" to allow for unknown or unanticipated contingencies. The clearances and loading requirements contained in the NESC are designed to maintain public safety. PPL Electric transmission line design standards meet or surpass the NESC clearances and loading requirements.

For example, the NESC specifies strength and loading rules based on three different "grades of construction" for conductors and supporting structures:

- Grade B – This grade of construction provides the highest margin of safety and is required when the pole supports spans that cross limited access highways, railroads, and waterways.
- Grade C – This grade of construction is most common and provides a basic margin of safety. It is often utilized for the typical power and joint-use distribution pole.
- Grade N – This is the lowest grade of construction and is most often used for emergency and temporary construction.

PPL Electric designs all of its transmission lines for Grade B construction. The use of Grade B design and construction translates to higher levels of structural reliability and safety to withstand the environmental conditions of ice and/or wind loading, which provides a higher margin of safety.

Another example is the design parameters utilized to account for ice and wind loadings on the wires and structure. The conductor sags and tensions along with the structure loading used in line designs are the result of various ice and wind combinations. PPL Electric's transmission lines are designed to exceed NESC requirements by accounting for additional load cases with various ice and wind loading conditions not required by NESC. This means that PPL Electric lines are designed to operate safely and reliably during extreme inclement weather even more severe than assumed by the NESC. In addition, where practicable, PPL Electric transmission lines are designed with more clearance to the ground than required by the NESC. The tables below compare PPL Electric's general conductor to ground design and the NESC minimum ground clearances for lines of various voltages.

TABLE 4-1. 69 kV VERTICAL CLEARANCE TO GROUND		
Surface Underneath Conductors	NESC Standard Clearance	PPL Conductor Clearances
Roads, streets, alleys	19.2 Ft.	30 Ft.
Other land traversed by vehicles (such as cultivated field, forest, etc.)	19.2 Ft.	30 Ft.
Spaces accessible to pedestrians only	15.2 Ft.	30 Ft.
Railroad tracks	27.2 Ft.	31.5 Ft.

TABLE 4-2. 138 kV VERTICAL CLEARANCE TO GROUND		
Surface Underneath Conductors	NESC Standard Clearance	PPL Conductor Clearances
Roads, streets, alleys	20.6 Ft.	31 Ft.
Other land traversed by vehicles (such as cultivated field, forest, etc.)	20.6 Ft.	31 Ft.
Spaces accessible to pedestrians only	16.6 Ft.	31 Ft.
Railroad tracks	28.6 Ft.	35 Ft.

TABLE 4-3. 230 kV VERTICAL CLEARANCE TO GROUND		
Surface Underneath Conductors	NESC Standard Clearance	PPL Conductor Clearances
Roads, streets, alleys	22.4 Ft.	33 Ft.
Other land traversed by vehicles (such as cultivated field, forest, etc.)	22.4 Ft.	33 Ft.
Spaces accessible to pedestrians only	18.4 Ft.	33 Ft.
Railroad tracks	30.4 Ft.	35 Ft.

TABLE 4-4. 500 kV VERTICAL CLEARANCE TO GROUND		
Surface Underneath Conductors	NESC Standard Clearance	PPL Conductor Clearances
Roads, streets, alleys	28.4 Ft.	40 Ft.
Other land traversed by vehicles (such as cultivated field, forest, etc.)	28.4 Ft.	40 Ft.
Spaces accessible to pedestrians only	24.4 Ft.	40 Ft.
Railroad tracks	36.4 Ft.	53 Ft.

A relay protection system is also used on PPL Electric's transmission lines to protect the public safety, as well as the equipment on the transmission system. Relay protection is installed for all transmission lines to automatically de-energize the line in the unlikely event that the line or supporting structure fails and the line contacts the ground.

B. PERIODIC MAINTENANCE PROGRAM ON ALL TRANSMISSION LINES

To ensure continued public safety and integrity of service, a periodic maintenance and inspection program is implemented for every transmission line. The program is administered through the use of helicopter patrols, with supplemental foot patrols as needed. Helicopter patrols are performed on all lines on a predetermined frequency, depending on voltage level. The two-man helicopter crew flies parallel and above the line so that the observer can look for signs of line damage or deterioration and observe clearances between vegetation and conductors. The observations are included in a report that is forwarded to the appropriate department for corrective action.

C. PERSONNEL SAFETY RULES

Overall PPL Electric designs and constructs projects with high regards to both public and employee safety, and follows or exceeds all codes and requirements. The following are a few, but not all, of the PPL Electric safety rules that demonstrate the Company's dedication to employee and contractor safety:

- Work procedures have been developed to allow work to be performed on energized facilities in a safe manner. When lines or apparatus are removed from service to be worked on, the Energy Control Process system is applied. This system provides that a red tag must be physically placed on the control handle of the de-energized equipment.
- The red tag may be removed only after proper authorization to energize the equipment.
- Various other tags are used for limited operations and informational purposes.
- Employees or contractors will not apply or remove a tag or change the status of tagged equipment unless authorized.
- Temporary safety grounds are used on de-energized facilities for employee lineman safety during maintenance, construction, or reconstruction work. Safety grounds are wires connecting the de-energized facility to an electrical ground. If the facility should be energized, the safety grounds will divert the current directly to ground and reduce the likelihood of personal injury.
- Before applying grounds, a test is done to confirm that the line is de-energized. The voltage test device is checked before and after use to assure reliability.
- Poles or structures are inspected and examined for structural integrity before climbing. If there is any reason to believe that a pole is unsafe, it is stabilized before work is performed. Appropriate safety gear in the form of body belts, safety straps, hard hats, gloves, etc., is worn by linemen during line work activity.

D. MAGNETIC FIELD MANAGEMENT PLAN

PPL Electric's Magnetic Field Management Program is applied to new and reconstructed transmission line projects. In order to lower magnetic field exposures, the program generally prescribes the use of a line design that provides ground clearances higher than the minimum NESC ground clearance and reverse phasing of new double circuit lines where it is feasible to do so at low or no cost. The implementation of additional modifications to reduce magnetic field levels, are considered, provided those modifications can be made at low or no cost and will not interfere with the operation of the line.