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MEMORANDUM

To: Stephen Repasch, Bethlehem Authority Executive Director

From: Philip E. Gauffreau, PE, Discipline Leader, Geotechnical Services
 Ronald B. Madison, PE, Regional Client Manager

Date: June 22, 2016

Re: PennEast Pipeline Impact Study Recommendations
 Wild Creek Watershed and Public Water Supply Facilities
 Bethlehem Authority Properties, Carbon & Monroe Counties, PA
MC Project No.14002428B

Per your request, Maser Consulting is providing this memorandum to summarize the proposed PennEast Pipeline Impact Study reviews, and to provide our recommendations for consideration by you and the Bethlehem Authority as part of the continued discussions with PennEast Pipeline Company, LLC (PennEast) regarding their request for a utility easement through the Bethlehem Authority properties and rights-of way in Carbon and Lehigh Counties, Pennsylvania. The PennEast Pipeline Proposed Route is illustrated on the attached web-site screen shots (6/3/16).

Our initial discussions began in December 2014, and our efforts were kicked off with Bethlehem Authority in the form of a file review and site tour to the Watershed properties on April 17, 2015. Maser Consulting prepared a Preliminary NG Pipeline Study dated July 10, 2015, which outlines ten (10) specific preliminary recommendations. We also provided a minor Addendum Memorandum regarding the Blue Mountain Revised NG Pipeline Alignment dated August 14, 2015. These documents were reviewed by the Bethlehem Authority and forwarded to PennEast with cover letters dated July 16, 2015 and August 19, 2015, respectively, and copied to the Federal Energy Regulatory Commission (FERC), PADEP, Bethlehem City Council, and other elected officials of the Bethlehem Water service area.

PennEast provided a response letter dated October 9, 2015 which addressed each of the ten (10) preliminary study recommendations. In addition, PennEast began meeting with the Bethlehem Authority Staff and their consultants regarding mitigation plans and improvements to better protect the Authority's infrastructure. The City of Bethlehem provided PennEast with water system plans and reports pertinent to the proposed NG pipeline easement. The use of trenchless excavation methods was discussed at a meeting between the Bethlehem Authority Staff, PennEast and their consultants, and these alternatives were presented in a PennEast cover letter dated November 19, 2015. In late 2015, the lead consultant for PennEast began geotechnical investigations to explore alternate means of NG pipeline construction. The latest reports provided by PennEast are entitled:



- Geophysical Investigation Summary, Bethlehem Water Tunnel Crossing, Danielsville, PA (Blue Mt.), prepared by Hatch Mott MacDonald, dated May 9, 2016;
- Beltzville Lake Crossing Horizontal Directional Drilling (HDD) Geotechnical Exploration Study, prepared by Hatch Mott MacDonald, dated May 11, 2016.

The memorandum follows the outline of the Preliminary NG Pipeline Impact Study dated July 10, 2015, addresses each of the ten (10) recommendations, and the PennEast responses from their October 9, 2015 letter. This memorandum provides a summary of the follow-up discussions, geotechnical investigations, and further recommendations. This memorandum does not repeat the executive summary and/or background information previously presented, but only provides reference to these prior documents.

Summary of July 2015 NG Pipeline Impact Recommendations and October 2015 Response:

1. Alternate NG Pipeline Route East of the Bethlehem Authority Watershed: We had recommended that PennEast avoid encroachment of the 22,000-acre Bethlehem Authority Watershed by pursuing a pipeline alignment route to the east. PennEast responded that this eastern alternate would cause “significant increase in the number of landowners directly impacted by the Project and a significant reduction in the amount of co-location with existing utility rights-of-way” as presented in their October 9, 2015 Exhibit BA-1. Although avoiding the watershed to the east is preferred, we recognize that PennEast has been investigating the route of least impact to residential property and the environment. It is unlikely that a route revision to the east is feasible.
2. Alternate NG Pipeline Route West of the Bethlehem Authority Watershed: We had recommended that PennEast avoid encroachment of the 22,000-acre Bethlehem Authority Watershed by pursuing a pipeline alignment route to the west from that currently proposed. PennEast responded that this western alternate would cause “an increase in the amount of co-location and shift the proposed route 1,000 feet west of Wire Ridge Tunnel,” but poses “constructability and engineering challenges” as presented in their Exhibit BA-2. Through follow-up meetings, PennEast provided additional topographical and geotechnical exhibits that support the challenges of avoiding the watershed to the west.
3. Provide Detailed Mapping of the Proposed Route Indicating Authority Infrastructure: We provided PennEast with digital copies of the original 1939 design plans for the Wild Creek Reservoir, as well as the raw water transmission mains and rock bore water transmission tunnels through Wire Ridge and Blue Mountain. PennEast provided updated route mapping in plan and profile views, Exhibits BA-4A through BA-5B. This led to an improved understanding by PennEast regarding the sensitivity of the Authority infrastructure and motivation to seek a safer construction design to better avoid impact to the water transmission facilities. This resulted in the exploration of trenchless



construction methods and some alignment revisions, as presented in the PennEast “Proposed 36” Pipeline HDD Exhibit Plan & Profile Pohopoco Creek and Wild Creek HDD” dated last revised 3/18/16 (reduced plan attached). We support the currently proposed horizontal directional drilling (HDD) method of routing the NG Pipeline 6,100 linear feet underground, starting near Pohopoco Drive, continuing south under Beltzville Lake, continuing approximately 100+ feet below the Bethlehem Authority water transmission lines, and ending 300 feet south east of the Wire Ridge Tunnel Portal.

4. Improved Co-Location: We had recommended that additional co-location would lessen impact to the Authority’s managed woodlands and natural habitats. PennEast responded that it would “coordinate with other owners of adjacent easements” and “develop specific and industry approved protocols for construction adjacent to the Authority’s easements”. We have not yet received the PennEast referenced protocols.

It is our understanding that PennEast will follow the standards of: the Pipeline and Hazardous Materials Safety Administration (PHMSA), the American National Standards Institute (ANSI), the American Society of Mechanical Engineers (ASME), and the American Society for Testing and Materials (ASTM) ; in particular, the Location Classifications for Design and Construction (Class 1 rural, through Class 4, densely populated area). Allowable pipe stresses, as a percentage of specified minimum yield strength (SMYS) decreases as the Location Class level increases. It is our understanding that the general classification for the rural Bethlehem Watershed would be Class 1. However, due to the sensitive nature of the watershed and its importance as a potable water resource to over a hundred thousand customers, we recommend that higher level of pipeline Design and Construction Classification be employed. This would reduce the probability of a catastrophic failure and potential negative impact to Bethlehem Authority drinking water assets.

Maser Consulting issued a Preliminary Impact Study Addendum Memorandum dated August 14, 2015 objecting to the PennEast revised route over Blue Mountain which would cross over the Bethlehem Authority transmission rock bore tunnel in two separate locations. PennEast provided follow-up geotechnical investigation and Exhibits BA-6A & BA-6B dated 5/9/16 (attached).

We worked with the Bethlehem Authority Staff to issue the National Park Service letter dated January 5, 2016 (attached) to gain support for an alternative crossing of the Appalachian Trail to the east and avoid the proposed double NG pipeline crossing of the water transmission rock bore tunnel at Blue Mountain. The alternate route provided in the “Potential PPL Co-Location” Exhibit would increase the co-location of PennEast with both PPL and Buckeye easements over Blue Mountain and also reduce the environmental impact of new woodland clear-cut easements. Should NG Pipeline route remain over the Bethlehem Authority Blue Mountain Tunnel, we recommend that the use of explosive materials for trench rock excavation be prohibited within 2,000 feet of the water tunnel.



We still recommend improved co-location of the proposed NG Pipeline easement and Lovitt Road, north of Pohopoco Drive.

5. Increased Distance from Wild Creek Earthen Dam: We recommended that PennEast increase the separation distance between their proposed NG pipeline rout and the base of the 1939 Wild Creek Earthen Dam. We had also recommended that PennEast provide more geotechnical investigation as well. PennEast agreed to additional geotechnical investigation and the exploration of trenchless construction methods. The proposed HDD excavation begins approximately 500 feet to the south of the intersection of Lovitt Road and Pohopoco Drive. The base of the Wild Creek Earthen Dam is located approximately 1,600 feet northeast of this intersection and the proposed NG pipeline to be installed with open cut construction. We still have some concerns regarding the proximity of the earthen dam and shock wave of a catastrophic NG pipeline failure or explosion.

We are not aware of industry standards regarding minimum separation distance between proposed NG pipelines and earthen dams, maximum allowable vibration thresholds for earthen dams, or models for estimating the magnitude and propagation of blast shock wave vibrations based upon the local geology. However, if such models exist, we recommend that PennEast demonstrate that the potential blast magnitude would not cause damage to the 1939 earthen dam. In the absence of such models, we again recommend that higher level of pipeline Design and Construction Classification be employed within the Bethlehem Watershed, which would reduce the probability of a catastrophic failure near the dam.

6. Horizontal & Vertical Profile Mapping and Further Geotechnical Studies: We expressed our concern regarding the geology, horizontal and vertical separations proposed, and the potential impact of blasting and other construction vibratory impacts on the Authority's infrastructure. PennEast agreed to additional geotechnical investigation and the exploration of trenchless construction methods (see pages 5 & 6 of this memo).
7. Loss of Authority Property Management Revenues: We recommended that PennEast address revenue losses to the Authority through their Carbon Credits and timber harvesting. PennEast responded by reducing the proposed permanently maintained right-of-way width and will negotiate regarding revenue losses. We recommend that these negotiations include an annual maintenance of right-of-way fee and insurance bonding.
8. Potential for Increased Trespassers: We expressed our concerns that the proposed easements would increase trespassers and recommend that fencing and gates be implemented. PennEast responded with a shared concern and a commitment to work with the Authority to mitigate this concern. We recommend that PennEast provide the



detailed plans to Bethlehem Authority for review and comment prior to Construction of any permanent facilities.

9. More Detailed Geological Mapping along NG Pipeline Route: We requested and PennEast provided more detailed geologic mapping along the proposed and alternative NG pipeline routes. The recently received Geotechnical and Geophysical Investigation Reports are reviewed below.

10. Improvements to Bethlehem Authority Existing Infrastructure: We recommended that PennEast study the feasibility of providing redundant equal facilities and/or alternate means of insurance bonding. PennEast responded with a commitment to discuss these concerns. Follow-up meetings held with PennEast resulted in their better understanding of the complex Bethlehem Authority water system and the fact that the current emergency interconnections with adjacent water systems may have insufficient capacity to meet the 14,000,000 gallon per day average daily demand provided by the primary Bethlehem Authority Pocono source infrastructure. As such, we recommend that future negotiations include annual maintenance of right-of-way fee. PennEast should provide a bond sufficient to fund emergency measures necessary to meet average daily demand should a catastrophic NG pipeline failure negatively impact Bethlehem Authority drinking water assets.

Hatch Mott MacDonald, May 2016 Geotechnical and Geophysical Studies:

- *Geophysical Investigation Summary, Bethlehem Water Tunnel Crossing, Danielsville, PA (Blue Mountain)*

HMM commissioned a geophysical evaluation of the geologic conditions at the proposed Southern Crossing Location of the PennEast pipeline over the BA water transmission tunnel on the south side of Blue Mountain, where the vertical distance between the pipeline and tunnel would only be about 75 feet. The seismic refraction study revealed the presence of three layers of soil overburden at this location, to a total depth of about 40 to 50 feet. The proposed pipe trench will only be about 7 to 8 feet deep at this location, indicating that it can be completed using conventional excavation equipment (i.e. no blasting would be required).

HMM also compared published typical vibration levels for such conventional equipment (e.g. a large bulldozer) operating at the ground surface (attenuated by the vertical distance to the tunnel), to published industry standard values for the vibration damage threshold for such structures as the tunnel. They were able to demonstrate that the actual vibration levels would be an order of magnitude less than those that might induce damage to the tunnel.



We concur with HMM's conclusion that these data indicate that the proposed pipeline construction activities would have a minimal probability of having a negative impact on the water tunnel structure at this location. However, we recommend that a vibration monitoring program be implemented during construction at this location to confirm that the assumptions made will not be exceeded. Such a program would include contingency protocols if vibration measurements exceed certain thresholds.

- *Beltzville Lake Crossing Horizontal Directional Drilling (HDD) Geotechnical Exploration Study*

HMM conducted a thorough geotechnical study along the proposed 6,100-foot long, 36-inch diameter horizontal directional drilling (HDD) alignment beneath Pohopoco Creek and Wild Creek. The majority of the HDD will be drilled through massive shale and or slate bedrock, which should be satisfactory for the HDD method. A vertical separation of 117 feet is expected at the point where the HDD will pass beneath the BA's water pipeline. Elsewhere, an artesian groundwater condition was encountered in Boring B-15 at a depth of 128 feet, which will have to be accounted for by the procedures implemented by the HDD contractor. Supplemental vibration monitoring conducted while drilling and coring at Borings B-15 and B-16 did not register any readings of significance.

We believe that this geotechnical report will provide valuable information during the final design, specification, bidding, and construction of the HDD. We recommend that The Bethlehem Authority be permitted to review the final construction documents and submittals related to the HDD to confirm that various procedures and contingencies will be implemented to protect the water pipeline, as well as the ground surface at the entry and exit points. Similarly, the BA should perform periodic, independent oversight of the HDD construction activities, including participation in pre-construction and progress meetings.

Concluding Recommendations:

- A. We recommend further alignment to the existing rights-of-way for Lovitt Road north of Pohopoco Drive.
- B. We support the use of HDD trenchless NG pipeline construction as currently proposed under Beltzville Lake and Wire Ridge Tunnel.
- C. We recommend PennEast increase in the Design and Construction Classification for proposed NG pipeline within the Bethlehem Authority Watershed to reduce the probability of catastrophic failure and better protect the water supply infrastructure.: Class 2 within the Bethlehem Watershed; and Class 3 within 2,000 feet of an Bethlehem



Authority infrastructure (earthen dam, water transmission pipeline, and/or water transmission tunnel).

- D. We recommend continued negotiations with PennEast and the National Park Service to shift the Blue Mountain NG pipeline crossing eastward to co-locate with the existing PPL and Buckeye Pipeline easements. This would eliminate the double crossing of the rock bore Blue Mt. raw water tunnel. Should NG Pipeline route remain over the Bethlehem Authority Blue Mountain Tunnel, we recommend PennEast prohibited the use of explosive materials for trench rock excavation within 2,000 feet of the water tunnel.
- E. We recommend PennEast provide the annual compensation for the Bethlehem Authority loss of woodland and carbon credits.
- F. We recommend PennEast provide detailed construction and easement restoration plans to ensure the proposed NG pipeline easement does not cause an increase in trespassers within the Bethlehem Authority Watershed.
- G. We recommend PennEast provide annual maintenance fees and a bond sufficient to fund emergency measures necessary to meet average daily demand should a catastrophic NG pipeline failure negatively impact Bethlehem Authority drinking water assets.
- H. We recommend PennEast provide detailed plans and specifications for the proposed NG pipeline construction, including HDD and open trench construction vibration monitoring plans. PennEast should provide the Bethlehem Authority continued escrow funds to the Bethlehem Authority for incurrence of legal/engineering consulting fees through design review, construction, and operational phases of the proposed NG pipeline.
- I. We recommend that the PennEast NP pipeline access be exclusive to only the currently proposed 36-inch diameter natural gas pipeline and that any future increase in the pipeline size or future co-location of any other pipeline by PennEast or others be prohibited.



PennEast Pipeline Proposed Route

June 3, 2016

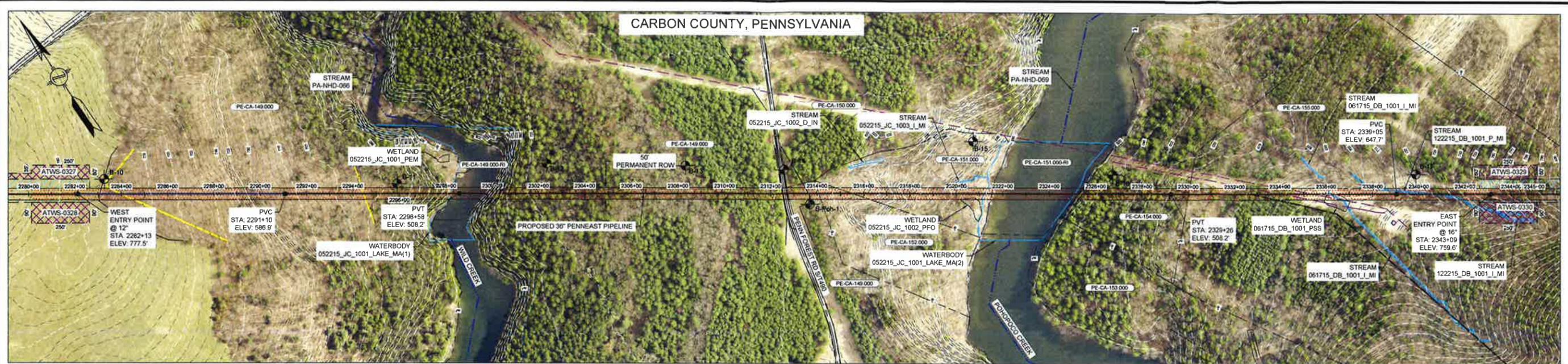




PennEast Pipeline Proposed Route

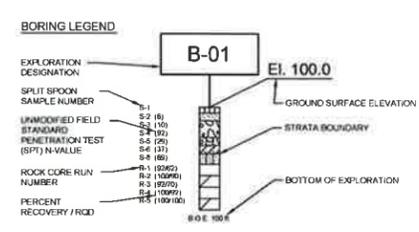
June 3, 2016



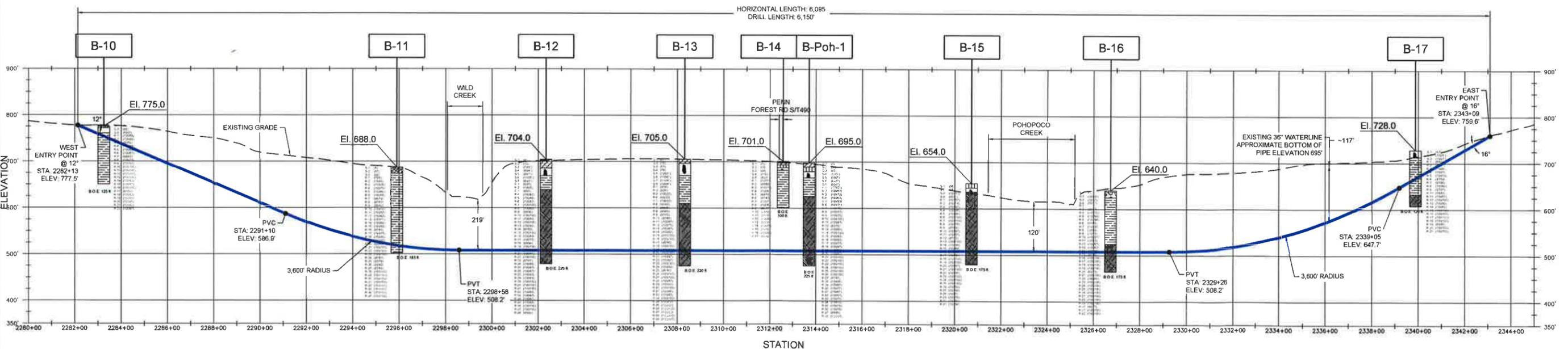
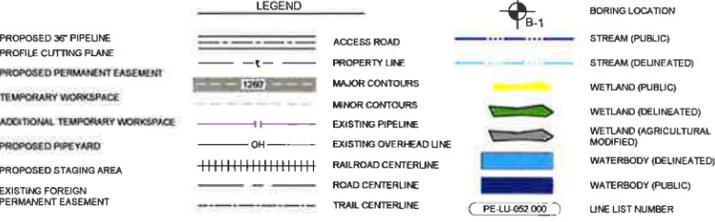
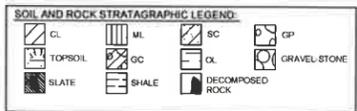
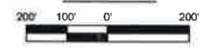


DRAFT CONCEPTUAL HDD NOTES:

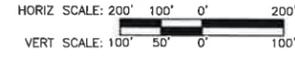
1. THE HDD BORE PATH DEPICTED ON THIS DRAWING IS CONSIDERED "DRAFT CONCEPTUAL" AND IS SUBJECT TO CHANGE BASED ON GEOTECHNICAL DATA, TOPOGRAPHICAL SURVEY, AND/OR ADDITIONAL INFORMATION REGARDING BIOLOGICAL FEATURE DELINEATIONS. THE HDD BORE PATH WILL BE ISSUED AS "FINAL CONCEPTUAL" AFTER COLLECTION AND EVALUATION OF BOTH TOPOGRAPHICAL SURVEY AND GEOTECHNICAL DATA AND AFTER BIOLOGICAL FEATURE DELINEATIONS ARE FINAL.
2. EXISTING CONTOURS TAKEN FROM PICTOMETRY, 2015.
3. FINAL EQUIPMENT LAYOUT AND GRADING WITHIN THE DEPICTED WORKSPACES IS BY OTHERS.
4. EROSION AND SEDIMENT CONTROL IS NOT DEPICTED ON THIS DRAWING. REFER TO ESCGP PLANS FOR EROSION AND SEDIMENT CONTROL REQUIREMENTS.
5. ALL PERSONNEL AND EQUIPMENT SHALL REMAIN WITHIN THE PERMITTED LIMIT OF DISTURBANCE DEPICTED ON THIS DRAWING UNLESS OTHERWISE AUTHORIZED BY THE CLIENT.
6. SOIL BORING LOCATIONS OFF RIGHT-OF-WAY ARE APPROXIMATE IN PROFILE. SOIL BORINGS PERFORMED IN FEBRUARY 2016.
7. UTILITY LOCATIONS SHOWN ARE APPROXIMATE AND SHALL BE FIELD VERIFIED. PENNSYLVANIA LAW REQUIRES AT LEAST 48 HOURS AND NO MORE THAN TEN (10) WORKING DAYS NOTICE BEFORE EXCAVATION OR DEMOLITION.
8. STATIONING ON THIS DRAWING REFLECTS UPSTREAM STATION EQUATION. STATIONING IS SUBJECT TO CHANGE BASED ON PROJECT PROGRESSION.



POHOPOCO AND WILD CREEKS HDD PLAN VIEW



POHOPOCO AND WILD CREEK HDD PROFILE



- NOTES:
1. THE CONTOURS & IMAGERY SHOWN WERE PROVIDED BY PICTOMETRY, 2015.
 2. UTILITIES SHOWN WERE DIGITIZED FROM IMAGERY AND ALL LOCATIONS ARE APPROXIMATE.

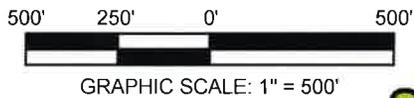
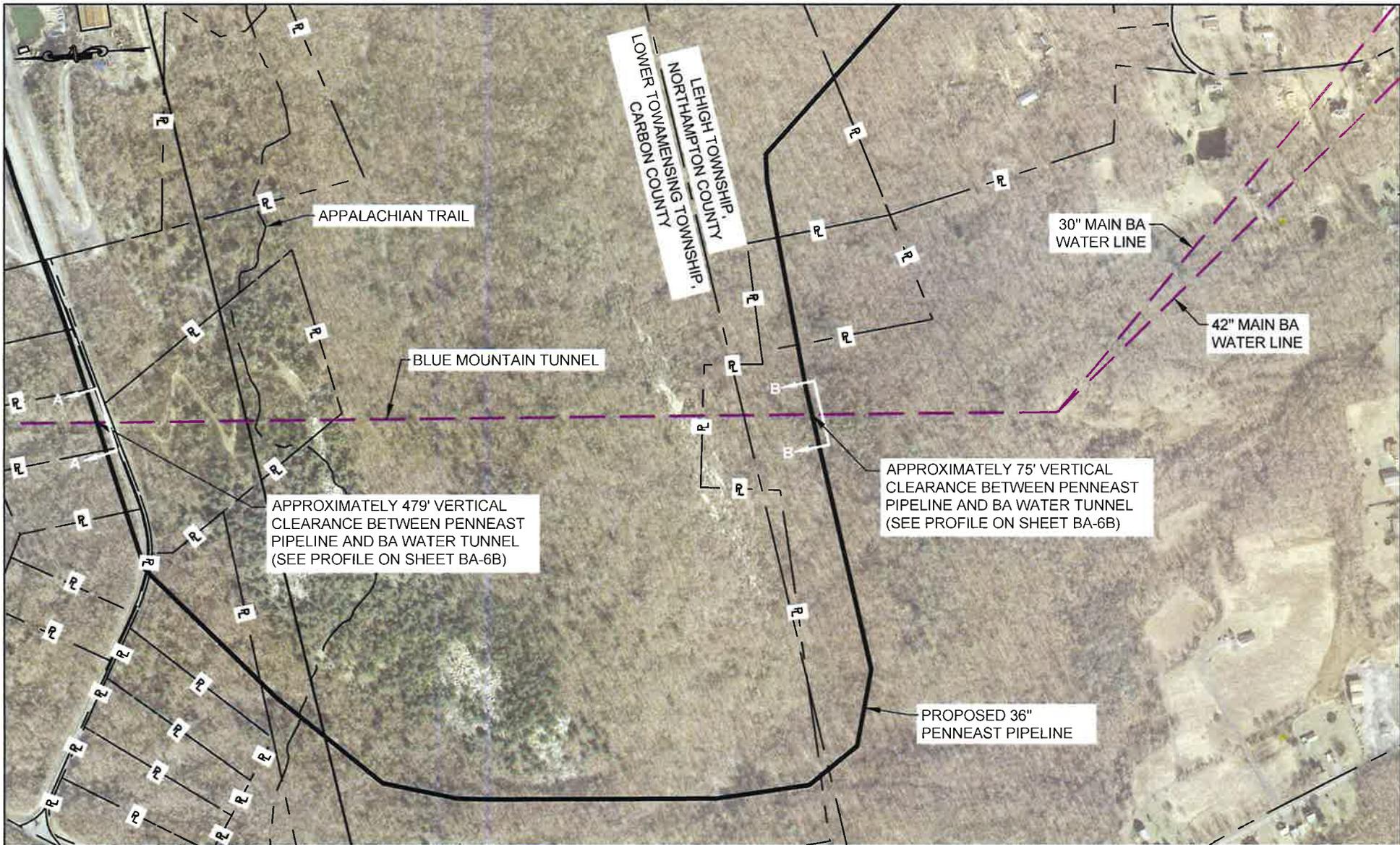
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000-03-01-008	ALIGNMENT SHEET	B	PRELIMINARY ISSUE	12/17/2014	QPS	QPS	QPS
000-03-01-009	ALIGNMENT SHEET	C	FERC DRAFT FILING	4/13/2015	QPS	QPS	QPS
		D	FERC FINAL FILING	9/23/2015	HMM	HMM	HMM
		E	ISSUED FOR BID	10/23/2015	HMM	HMM	HMM
		F	SUPPLEMENTAL FERC FILING	03/18/2016	HMM	HMM	HMM

APPROVALS	DATE	DATE
DRAWN BY: HMM	11/8/2015	
CHECKED BY: HMM	11/8/2015	
ENG. APPROVAL: HMM		
PJM APPROVAL: HMM		

PREPARED FOR: **PennEast PIPELINE**

PREPARED BY: **Hatch Mott MacDonald**

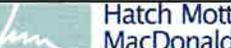
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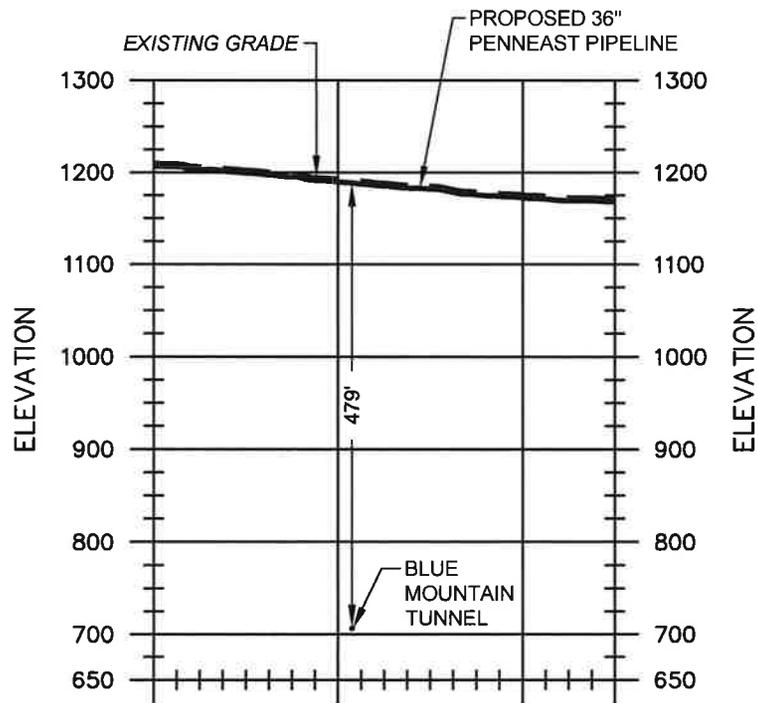


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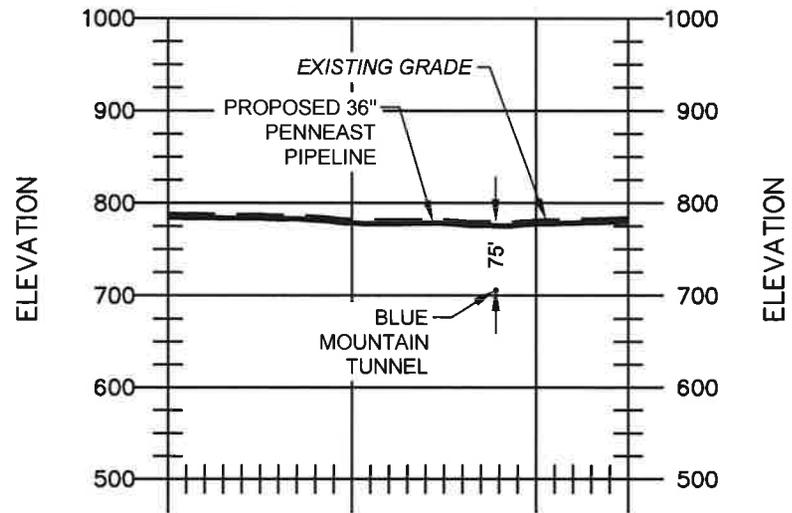


PENNEAST PIPELINE PROJECT
 BETHLEHEM AUTHORITY
 BLUE MOUNTAIN OVERVIEW
 CARBON & NORTHAMPTON COUNTY, PA

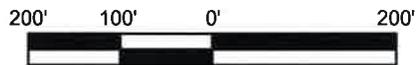
JOB NUMBER: 353754
 DRAWING NUMBER: BA-6A



SECTION A-A



SECTION B-B



HORIZONTAL SCALE: 1" = 200'



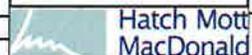
VERTICAL SCALE: 1" = 200'



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PREPARED BY:



PENNEAST PIPELINE PROJECT
 BETHLEHEM AUTHORITY
 BLUE MOUNTAIN CROSS SECTIONS
 CARBON & NORTHAMPTON COUNTY, PA

JOB NUMBER

353754

DRAWING NUMBER

BA-6B

BETHLEHEM AUTHORITY

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STEPHEN REPASCH
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CONSULTING ENGINEERS
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POLICE - SPECIAL OFFICER

MASER CONSULTING P.A.

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January, 5, 2016

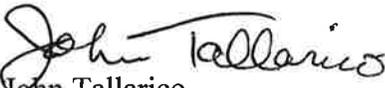
Ms. Wendy Janssen, Superintendent
NPS Appalachian Trail Park Office
P.O. Box 50
Harper's Ferry, WV 25425

The Bethlehem Authority (Authority) and the City of Bethlehem (City) would like to express our collective concerns regarding the current proposed route of the PennEast Pipeline (pipeline) over Blue Mountain as it crosses the Appalachian Trail in Pennsylvania. As you may be aware, the Authority and the City own and operate the drinking water system that serves over 115,000 people in the City and ten surrounding municipalities. The water transmission main that transports the pristine drinking water supply from Wild Creek Reservoir in Carbon County to the customers in both Lehigh and Northampton Counties in the greater Lehigh Valley, tunnels through the Blue Mountain in the vicinity of the proposed pipeline.

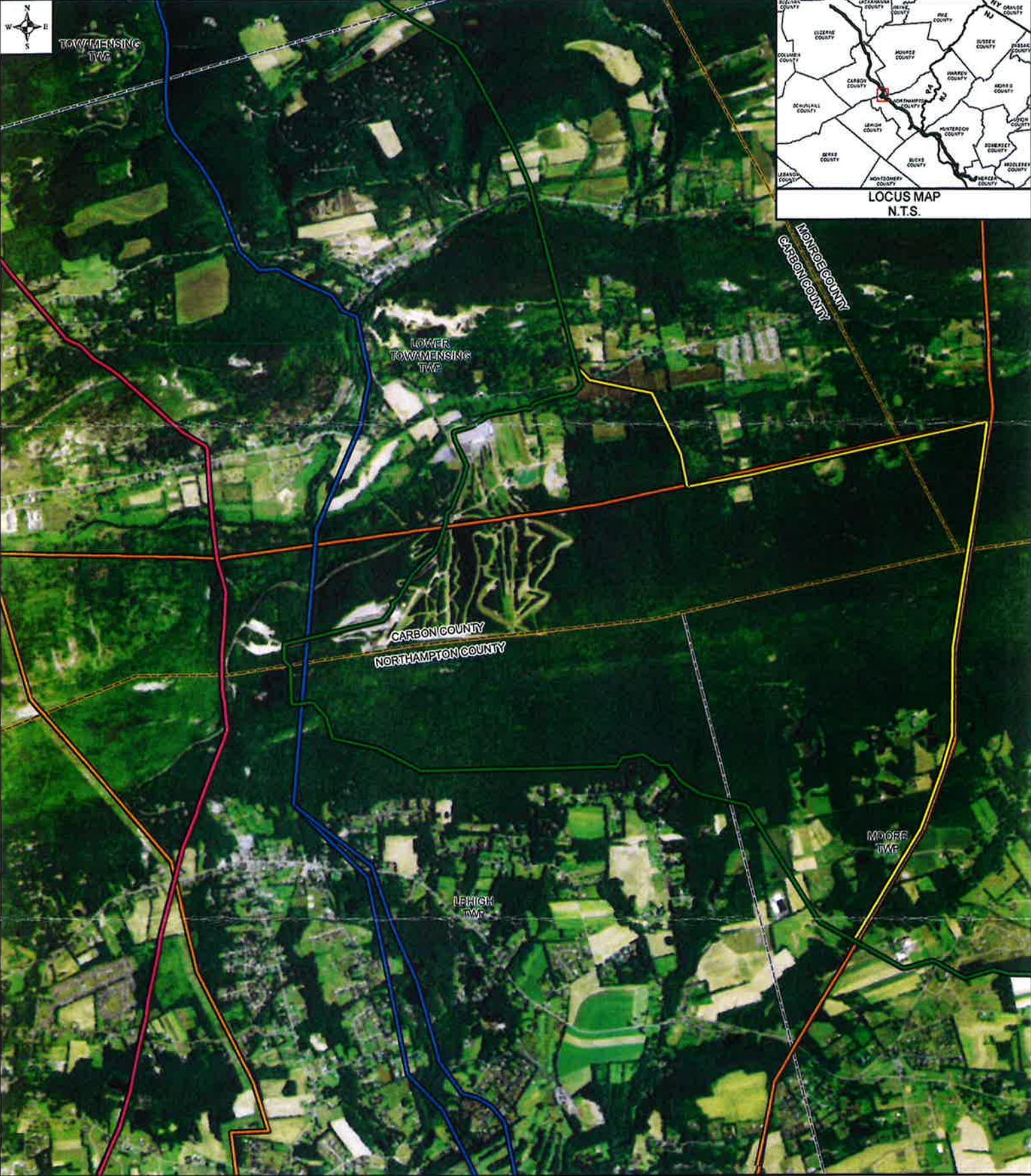
It is our understanding that PennEast had proposed a route over Blue Mountain to the east of the current proposed route (see attachment), only to have the National Park Service reject the eastern route in favor of the current route. Given this, the Authority and the City oppose the current proposed route, and strongly support the eastern proposed route for the pipeline, as the current route is in conflict with the water transmission tunnel that is the sole water transmission main carrying the drinking water to over 115,000 residents that rely on the high quality water. The formerly proposed eastern route for the pipeline avoids the above mentioned conflict and offers a much greater degree of protection for the water transmission main and drinking water supply for our customers.

The Authority and the City thank you for your cooperation and trust you understand the gravity of the situation with the pipeline conflict with the water transmission tunnel, and that you will reconsider your position with regard to the eastern route for the pipeline. If you have any questions or require additional information, please contact Stephen Repasch, Executive Director, Bethlehem Authority at (610) 865-7090.

Sincerely,


John Tallarico
Chairman, Bethlehem Authority

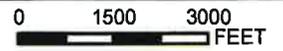

Robert J. Donchez
Mayor, City of Bethlehem



LEGEND

- PENNEAST ROUTE
- PROPOSED PPL CO-LOCATION ROUTE
- BUCKEYE PIPELINE
- PPL POWERLINE
- BAWATERLINE
- COUNTY
- MUNICIPALITY

POTENTIAL PPL CO-LOCATION
CARBON, MONROE & NORTHAMPTON COUNTIES, PENNSYLVANIA





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July 10, 2015

VIA E-MAIL & U.S. MAIL

Mr. Stephen Repasch
Executive Director
Bethlehem Authority
10 East Church Street
Bethlehem, PA 18018

Re: Preliminary NG Pipeline Impact Study
Wild Creek Watershed and Public Water Supply Facilities
Carbon County, PA
MC Proposal No. 14002428P

Dear Mr. Repasch:

Maser Consulting, P.A. is pleased to have this opportunity to serve you and the Bethlehem Authority in providing this Preliminary NG Pipeline Impact Study.

The PennEast Pipeline Co., LLC (PennEast) has proposed a 108-mile natural gas pipeline connecting the Marcellus Shale area of Luzern County, PA to the Transco Trenton-Woodbury interconnection in southern New Jersey (see PennEast Pipeline Overall Map enclosed). The currently proposed alignment would cross Bethlehem Authority property in Carbon County just west of the reservoirs. The intent of this preliminary NG Pipeline Impact Study is to identify and preliminarily qualify the potential negative impacts the PennEast NG Pipeline may have on the Bethlehem Authority watershed, water supply, reservoir dams and water supply transmission assets (see Maser Consulting Study Area Exhibit enclosed). It is also believed that the Bethlehem Authority will share this study with both PennEast and the Federal Energy Regulatory Commission (FERC).

Executive Summary:

The Bethlehem Authority owns over 22,000 acres within Carbon and Monroe Counties, with the Wild Creek Watershed comprising almost 14,000 of these acres. The watershed is the primary drinking water supply to over 115,000 people and 1,315 commercial and industrial customers. The Wild Creek earth filled dam and the single water transmission line and rock bore Wire Ridge Tunnel were constructed in 1939. There is no redundancy to replace the 33 million gallons per day (MGD) potable water conveyance capacity to the City of Bethlehem and ten other municipalities, should these 75 year facilities be compromised by the PennEast Pipeline during construction, operations, or a catastrophic accident. Therefore, we recommend that PennEast redesign the proposed NG pipeline route to avoid the Bethlehem Authority Watershed, its reservoirs and its water transmission lines to the fullest extents possible and as described further in Recommendation No. 1, listed on Page 7 of this impact study.



Background Information:

On April 17, 2015, Maser Consulting met with representatives from both the Bethlehem Authority and the City of Bethlehem to review the existing maps, plans, and prior reports pertinent to the proposed study area. This meeting was followed by a visit to the Carbon County watershed study area with the Authority and City representatives to observe the site conditions, take photos and gain insight to the potential impacts of the proposed NG pipeline.

Per the PennEast Pipeline Project web-site, the latest proposed pipeline route was last revised March 2015 (<http://penneastpipeline.com/proposed-route/>). We also received individual property aerial photo exhibits which were provided by PennEast to Bethlehem Authority dated January 27, 2015. It is our understanding that the Bethlehem Authority has begun a dialog with PennEast and has requested more detail mapping of the Authority property along the proposed pipeline alignment.

In response to a PennEast invitation letter dated May 19, 2015, the Bethlehem Authority Executive Director and a Maser Consulting representative attended the PennEast property owner information session held at Flagstaff Ballroom in Jim Thorpe, PA on June 3, 2015. A general PennEast power-point presentation was provided, as well as an opportunity to view the PennEast electronic detailed mapping in the area of the Bethlehem Authority Watershed. With the assistance of the PennEast consultants, we were allowed to create detailed map screen-shots. These screen-shot maps were then e-mailed to each of us. The Bethlehem Authority and the City of Bethlehem provided Maser Consulting the following documents as supplemental background resources for our reference and can be provided to both PennEast and FERC:

- 1939 Bethlehem Municipal Water Authority, Wild Creek Gravity Water Supply Construction drawings (partial set, individual sheets enclosed); including reservoir earth fill dam plans, cross-sections, and test pit data; water supply Tunnel #2 (Wire Ridge Tunnel under SR-209) plan and longitudinal section; pipe tunnel portal, pressure tunnel and section details;
- 1996 Final Report, Inspection of the Blue Mountain and Wire Ridge Tunnel Portals – Wild Creek Transmission Main prepared for the City of Bethlehem (Report cover enclosed);
- 2012 Bethlehem Authority, Wild Creek & Tunkhannock Creek Watershed Forest Management Plan (Condensed Version), prepared by Woodland Management Services & The Nature Conservancy (Cover and Three Exhibits enclosed);
- 2014 PADEP Bureau of Waterways Engineering, Division of Dam Safety, Wild creek Dam Inspection Report, City of Bethlehem (Operator) Bethlehem Authority (Owner) (Cover enclosed).
- June 3, 2015 PennEast meeting, fifteen (15) separate screen-shot maps (see Maser Consulting list and description of each screen-shot map enclosed);
- June 30, 2015 Woodland Management Services, Inc. Report entitled “Proposed PennEast Pipeline Footprint Impact on Timber Related Revenue and Costs”.

1.0 Initial Kick-off Meeting and Site Visit Areas of Concern:

Based upon the April kick-off meeting and site tour with representatives of the Bethlehem Authority and the City of Bethlehem, three areas of focus emerged (See Maser Consulting Study Area Exhibit):

- A. Headwaters of Wild Creek: In Penn Forest Township, the proposed NG pipeline is aligned generally north to south, and generally parallel and just east of the PA Turnpike Northeast



Extension I-476. The proposed NG pipeline will traverse the headwaters and cross Wild Creek which is tributary to Penn Forest Reservoir. Penn Forest Reservoir is tributary to the Wild Creek Reservoir. These two impoundments and their entire watershed are the source of the City of Bethlehem potable water supply. This public water system serves the City of Bethlehem and ten other surrounding municipalities with approximately 36,000 billing accounts serving a population of approximately 115,000 people and 1,315 commercial and industrial customers.

- B. Wild Creek Dam: In Towamensing Township, the proposed NG pipeline will traverse Beltzville State Park approximately 2,000 feet southwest of the toe of Wild Creek Dam. This earth fill dam was constructed in 1939. The dam has a top length of 1,076 feet, top width of 30 feet and maximum bottom width of 1,000 feet. The top height is 155 feet above the creek. The reservoir has a capacity of 3.9 billion gallons of water (see attached exhibit plans).
- C. Wire Ridge Tunnel: In Towamensing Township, the proposed NG pipeline will traverse under Beltzville Lake, over Wire Ridge and under PennDOT State Route 209. The NG pipeline will be aligned in close proximity and parallel to the water transmission line from Wild Creek Reservoir to the City of Bethlehem; and then cross the water transmission line. The water transmission line was constructed in 1939 as a 38-inch steel pipe (minimum 2 feet of cover) from the dam control building, under Wild Creek (now Beltzville Lake) to the northern Portal #4. A newer 36-inch transmission line was constructed in parallel from the dam control building to the connection chamber just upstream of Portal #4; both lines are used.

From the northern Portal #4, a single 38-inch steel transmission main rests on concrete cradles within a 6-foot diameter arched concrete lined tunnel, through Wire Ridge for approximately 330 linear feet (LF). The transmission line then transitions to approximately 2,400 LF of a single rock bore, 48-inch concrete lined pressure pipe. The maximum depth of the pressure pipe tunnel below the top of Wire Ridge and PennDOT SR 209 is approximately 225 vertical feet. The southern Portal #3 is again a single 38-inch steel transmission main resting on concrete cradles within a 6-foot diameter arched concrete lined tunnel, approximately 268 LF. The total Wire Ridge Tunnel is approximately 3,000 LF. South of Wire Ridge and Portal #3, the transmission main continues as a 38-inch steel pipe and a newer parallel 42-inch pipe towards the similarly constructed Blue Mountain Tunnel.

2.0 Potential Geotechnical Impacts

To gain an understanding of the potential geotechnical-related impacts that the proposed natural gas pipeline may have on the watershed infrastructure, we researched the regional geology at the Wild Creek Dam and the Wire Ridge Tunnel sites. These areas are located within the Blue Mountain Section of the Ridge and Valley Physiographic Province. Specifically, the regional geology consists of alternating exposed formations of sedimentary rock, (e.g. siltstone, shale, and sandstone), generally striking in a northeast – southwest alignment. These formations are folded over each other forming a syncline or anticline; and weathered to create the observed ridge and valley topography.

- Wild Creek Dam – Locally, the Wild Creek Dam is mapped to be underlain by two bedrock formations. The northern portion and majority of the dam is underlain by the Trimmers Rock Formation consisting of a siltstone and shale, while the southernmost portion is underlain by the



Mahantango Formation consisting of shale and siltstone. The proposed pipeline will cross over four rock formations at its closest proximity the Wild Creek Dam, including in order from north to south the Marcellus Formation (black shale, localized limestone), the Mahantango Formation, the Trimmers Rock Formation, and the Towamensing Member of the Catskill Formation (sandstone, siltstone, shale). Two faults are also mapped between the pipeline alignment and the earthen dam.

- Wire Ridge Tunnel – The Wire Ridge Tunnel crossing is mapped along the contact line between the Towamensing Member of the Catskill Formation and the Trimmers Rock Formation.

Geotechnical concerns may arise during the period of NG pipeline installation, particularly with respect to the potential rock blasting construction techniques. Other concerns may also arise from a potential future NG pipeline failure and resulting catastrophic explosion blast from the high pressure dry gas, that could send a shock wave through rock formations.

- Headwaters of Wild Creek: Provided standard erosion and sedimentation controls, stream crossing details, etc. are implemented during the NG pipeline construction, we believe the risk to the headwaters associated with routine construction can be successfully managed. Similarly, assuming that standard construction protocols for trench rock blasting are implemented (if blasting becomes necessary), we believe the risk associated with this routine construction practice to be low.
- Wild Creek Dam: Wild Creek Dam is an earthen filled dam constructed in 1939 and is supported on the Trimmers Rock Formation and the Mahantango Formation.

Provided that standard protocols for trench rock blasting (pre-blasting plan, vibration monitoring, blasting mats, etc.) are implemented (should blasting become necessary to install the NG pipeline), we believe the risk to the dam associated with this routine construction practice to be low, as the earth filled dam is approximately 1,600 LF from the NG pipeline (See detailed Screen-shot Map BA_5).

A catastrophic NG pipeline explosion and resulting shockwave could potentially damage (or ultimately cause a breach of) the 1939 earth fill dam. Such an event would likely result in significant environmental impacts, hazards to downstream properties, and human safety. In addition, the loss or partial loss of Wild Creek Reservoir for an extended period of time would have a significant impact upon the Bethlehem Authority Water Supply.

A recent evaluation of the condition of the Wild Creek Dam is provided within the Wild Creek Dam Inspection Report by Cherry, Weber, & Associates, dated October 2014. PennEast should be provided with a copy of this report and prior to NG pipeline construction, conduct an updated survey of the dam to establish the pre-construction condition.

- Wire Ridge Tunnel: Wire Ridge Tunnel is a single water transmission supply line to the City of Bethlehem. From the current NG pipeline mapping provided, the proposed NG pipeline will be installed approximately 67 LF from the shallow (minimum 2' cover) 1939 steel water transmission line north of Wire Ridge Tunnel Portal #4 (See detailed Screen-shot Map BA_11).



We understand Bethlehem Authority has been informed that PennEast has revised its proposed alignment to cross the Bethlehem transmission line at the top of Wire Ridge (near SR-209) to increase the separation by an approximate vertical 200 feet. We believe this is one positive change (See detailed Screen-shot Map BA_10).

If blasting is required to permit the NG pipeline installation, we believe the risk to the tunnel associated with this routine construction practice to be low, provided standard protocols for trench rock blasting are implemented (pre-blasting plan, vibration monitoring, blasting mats, etc.).

- D. A catastrophic NG pipeline explosion and resulting shockwave could damage or cause a breach of the 1939 rock bore pressure pipe. The temporary loss of the Wire Ridge transmission tunnel would leave the Bethlehem Authority with no means of supply of potable drinking water for approximately 115,000 people and 1,315 commercial and industrial customers.

The condition of the water transmission tunnel and pipelines are documented in the 1996 Wire Ridge Tunnel Inspection Report, by Gannett Fleming, Inc. PennEast should be provided with a copy of this report and prior to NG pipeline construction, conduct an updated survey of the tunnel and water transmission line to establish the pre-construction condition.

3.0 Potential Environmental Impact:

In the early 1930's, the Bethlehem Authority began purchasing properties for its public water supply. The Bethlehem Authority now owns over 22,000 acres within Carbon and Monroe Counties, with the Wild Creek Watershed comprising almost 14,000 of these acres. The Bethlehem Authority has been good stewards of this land and has teamed with the Woodland Management Service and The Nature Conservancy to use their property assets to be part of the "Working Woodlands" program. These properties have also been included in the Voluntary Carbon Standard (VCS) and provide carbon credits for sale in the marketplace. The 2012 Watershed Forest Management Plan is a comprehensive document and provides a full description of the Bethlehem Authority natural assets (see The Natural Conservancy excerpt map exhibits). The watershed is the primary drinking water supply to over 115,000 people. As such, it is of "high conservation value". In additions, "the mesic till barrens community type of the Pocono Plateau, which dominates several thousand acres of the Bethlehem Authority property, is home to rare and endangered species of plants, birds, and insects and is considered to be the only natural community of its kind in the world." Through the Forest Management Plan, the Bethlehem Authority also gains annual revenue from carefully planned timber harvests.

The proposed PennEast NG pipeline will cross Bethlehem Authority woodland watershed. The anticipated 36-inch pipeline will be installed within a cleared right-of-way, which is proposed to be 50 feet wide. In addition to the watershed and natural habitat, the loss of these woodlands will reduce the Bethlehem Authority annual VCS carbon credits and timber harvest revenues.

- A. Within the Headwaters of Wild Creek Study Area, the same environmental concerns as described above exist. Other petroleum pipelines exist in close proximity to the proposed NG pipeline within the headwaters. A catastrophic NG pipeline explosion and shockwave could rupture or damage the much older nearby liquid petroleum pipelines. Leaks from these pipelines could in



turn cause environmental impacts to the Wild Creek Watershed and the Bethlehem Authority Water Supply.

The construction activities must include strict adherence to the NPDES Permit regulations for erosion and sedimentation control (E&S). The proposed earth disturbance within the watershed would be tributary to the Penn Forest Reservoir and the Bethlehem Authority drinking water supply. Failure of E&S best management practice (BMP) facilities could result in run-off pollution, siltation and construction equipment fuel contamination of the water supply.

Future NG pipeline maintenance activities pose the same disturbance concerns as above. The potential of a NG pipeline explosion could also cause the same pollution in a more catastrophic manner.

- B. The proposed NG pipeline below the Wild Creek Dam would pose minimal environmental concerns for the Bethlehem Authority properties.
- C. Wire Ridge Tunnel itself would have minimal environmental concerns from the proposed NG pipeline with the exception of E&S impacts to the shallow transmission line. It is possible that the steep slopes of Wire Ridge would increase erosion from the NG pipeline construction and could reduce the limited soil cover over the water transmission pipe.

4.0 Potential Utility Operations Impact:

- A. The headwaters of Wild Creek include the Bethlehem Authority land impacted by the proposed NG pipeline tributary to both the Penn Forest Reservoir and the Wild Creek Reservoir. Any of the above-referenced sources of pollution may negatively impact the drinking water supply for more than 115,000 people. Pollutants that are settleable would be of minimal concern other than long term siltation of the reservoirs. However, soluble and light insoluble pollutants such as oils and/or petroleum products have the potential of passing through the reservoirs and may cause operational problems and/or contamination of the Bethlehem Water Filtration Plant located in Lehigh Township, Northampton County.

The Bethlehem Authority maintains a police force for the protection of the water supply and the watershed assets. The proposed NG Pipeline clear right-of-way will cause increased security challenges both during and after construction. All-terrain vehicles (ATV) are difficult trespassers for the Bethlehem Authority Police to control.

- B. Wild Creek Dam was last inspected in October of 2014 by the PADEP, Division of Dam Safety and was found to be “in very good condition and actively maintained”. The reconstructed Penn Forest Reservoir (6.0 billion gallons) provides controlled release to supplement the Wild Creek Reservoir (3.9 billion gallons). There is not a piped connection from the Penn Forest Reservoir to the lower Wild Creek Reservoir intake tower. Therefore, damage to or failure of the Wild Creek Dam caused by the NG pipeline construction or a catastrophic explosion would compromise the water supply of both reservoirs.



The Bethlehem Authority watershed and its transmission mains can convey up to 33 million gallons per day (MGD) to the City of Bethlehem and ten other municipalities. Should this source water be incapacitated, the City has emergency interconnection agreements with five adjacent utilities. However, these emergency interconnections would provide only a total of 5.04 MGD of water supply.

- C. Wire Ridge and Blue Mountain Tunnels are both single rock bores for the water transmission line connecting the Bethlehem Authority Watershed to the Lehigh Township, Northampton County Water Filtration Plant. There is no redundant transmission to replace the Wire Ridge Tunnel. Therefore, damage to or failure of the Wire Ridge Tunnel, caused by the NG pipeline construction or a catastrophic explosion would compromise the water supply of 115,000 people.

5.0 Recommendations:

Maser Consulting recommends that the Bethlehem Authority and the City of Bethlehem continue the dialog with representatives of PennEast and FERC. This dialog should include meetings between PennEast, Bethlehem Authority, and the City of Bethlehem. We recommend that this Preliminary Bethlehem Authority NG Pipeline Impact Study Letter report also be provided to PennEast Pipeline with all of the same background Bethlehem Authority and City of Bethlehem reports and plans referenced herein.

We believe a significant amount of further research is necessary and should be provided by PennEast to evaluate the potential negative impacts to the Bethlehem Authority's infrastructure, and how each impact will be avoided and/or mitigated sufficiently. It is important that PennEast understand that the Bethlehem Authority is steward of more than 22,000 acres of land and the entire drinking water supply to the City of Bethlehem, ten other municipalities, and over 115,000 people. As such, we recommend that the following list of concerns be addressed by PennEast prior to moving forward with the current alignment for the proposed 36-inch natural gas pipeline:

1. Given the scope of the currently proposed 108 mile NG pipeline and the significance of the Bethlehem Authority Watershed as described above, we recommend that PennEast choose an alternate route to the east of the Wild Creek Watershed. This would avoid potential impacts to the Bethlehem Water Supply, Wild Creek Dam, and the need to cross the water transmission main depended upon by over 115,000 people. An example of such an alternate route is provided and would have significantly less impact to the watershed and potentially no impact to the reservoir dams and the water transmission lines (See detailed Screen-shot Map BA_15). This is a general representation of an alternate eastern NG pipeline route. The eastern side of the Bethlehem Authority Watershed includes existing fire lanes, public and private lanes which could be utilized for NG pipeline right-of way. If PennEast would pursue such an alternate route to the east of the Bethlehem Authority Watershed, the majority of the concerns listed above would be minimized or eliminated.
2. We strongly recommend the above eastern alternative NG pipeline route around the Bethlehem Authority Watershed. Should this not be feasible, we would then recommend a western alternative NG pipeline route which would utilize existing utility easements for co-location west of the Bethlehem Watershed and away from the Wild Creek Dam. The western alternative NG



pipeline route would cross SR 209 approximately 1,000 feet west of the currently proposed NG pipeline crossing, which would better protect the water transmission line and Wire Ridge Tunnel. The western alternative NG pipeline route would maintain the north to south alignment, approximately 1,000 feet west of the water transmission line to the top of Blue Mountain and then turn east to cross over the water transmission line Blue Mountain Tunnel and continue east to the current NG pipeline alignment south of Blue Mountain. This western alternative NG pipeline route would pass in close proximity to Blue Mountain Ski Area and will provide greater vertical distance between the NG pipeline and the water transmission line Blue Mountain Tunnel.

3. Should the above alternate routes not be feasible, we recommend that PennEast provide more detailed mapping of the proposed alignment at suitable scale which includes all of the Bethlehem Authority assets including: water shed properties and tributary streams; Wild Creek Dam; and the water transmission lines from the dam to and beyond the Wire Ridge Tunnel. We believe that PennEast will better understand the concerns when they plot the 1939 dam, water transmission main and tunnels alongside their currently proposed NG pipeline route.
4. The Bethlehem Authority Watershed properties include other generally parallel (north-south) petroleum and overhead electric transmission rights-of ways. We recommend that PennEast provide additional investigation of the benefits of co-locating the proposed NG pipeline within these existing rights-of-ways, as well as their concerns (See detailed Screen-shot Map BA_1, BA_2 & BA_3). Such benefits may include less construction and maintenance disturbance of woodlands and natural habitats. Such additional concerns may include the potential of one utility's catastrophic failure causing multiple utility failures. Issues of watershed security and sabotage should be discussed. We believe PennEast should provide a detailed report to address these and other alternative rights-of-way strategies.
5. The preceding discussion explains the significance of the 1939 earth filled Wild Creek Dam. We recommend that PennEast reassess the proposed NG pipeline alignment to increase its distance from the dam (See detailed Screen-shot Map BA_5 & BA_12). In addition, PennEast should provide more geotechnical and geophysical investigation (including geologic research) along the proposed NG pipeline, and between it and the Wild Creek Dam. These geologic data should be analyzed to better understand the potential impact that vibrations from construction blasting, or shockwaves from a catastrophic blast, would have on the earth fill dam. For both cases, PennEast should establish maximum allowable threshold vibration levels (frequency, amplitude, and duration) for the dam, provide analytical evidence that the thresholds would not be exceeded during either of these events, and develop monitoring programs for construction. If necessary, PennEast should also provide strategies to mitigate or eliminate such potential negative impacts to the dam.
6. Similarly, the preceding discussion explains the significance of the 1939 Wire Ridge rock bore tunnel and transmission lines from the dam. We recommend that PennEast reassess the proposed NG pipeline alignment to avoid crossing the water transmission lines (See detailed Screen-shot Map BA_7, through BA_14). Otherwise, detailed horizontal and vertical profile mapping should be provided for the newly proposed revised alignment for a crossing of the transmission line at SR 209. In addition, PennEast should provide more geotechnical and geophysical investigation (including geologic research) along the proposed NG pipeline and along the tunnel and water transmission lines. These geologic data should be analyzed to better understand the potential



impact that vibrations from construction blasting, or shockwaves from a catastrophic blast, would have on the tunnel and water transmission lines. For both cases, PennEast should establish maximum allowable threshold vibration levels (frequency, amplitude, and duration) for the tunnel and water transmission lines, provide analytical evidence that the thresholds would not be exceeded during either of these events, and develop monitoring programs for construction. If necessary, PennEast should also provide strategies to mitigate or eliminate such potential negative impacts to the tunnel and water transmission lines.

7. We recommend that PennEast address the Bethlehem Authority's potential loss of property management revenue which may be caused by the proposed right-of way; both in terms of VCS carbon credits and timber harvest. Please refer to the Woodland Management Services, Inc. report entitled "Proposed PennEast Pipeline Footprint Impact on Timber Related Revenue and Costs".
8. We recommend that PennEast address the Bethlehem Authority's concerns regarding the proposed right-of-way clearing and the potential increase of trespassers on the Bethlehem Authority watershed property. A specific concern is an increase in all-terrain vehicles (ATV) trespassers. PennEast should work with the Bethlehem Authority Special Police to install suitable gates at strategic access locations along the proposed NG pipeline right-of-way.
9. We recommend that PennEast provide detailed mapping along the proposed NG pipeline route and/or alternate routes. This mapping should include geologic information including formation, age, major and minor lithology, faults, and karst specific features including identification of carbonate bedrock, sinkholes, swallow holes and caves. PennEast should also conduct thorough geophysical investigations along any and all portions of the proposed alignment overlying carbonate based bedrock. The techniques should minimally include 2-dimensional resistivity surveys, ground penetrating radar, and gravity surveys, as appropriate, based on location and potential nearby interferences. This data should be evaluated in order to provide both an assessment and proposed mitigation measures of potential karst specific issues including soil piping, sinkhole formation and aggravation from changes to recharge quantity and location resulting from the pipeline alignment.
10. Given the significance of the potential impairment and/or permanent damage to the Bethlehem Public Water Supply and the lack of redundant equal facilities, we recommend that PennEast provide a study of the feasibility to provide improvements to Bethlehem Authority infrastructure. These improvements may include strengthening the Wild Creek Dam and/or providing a redundant water transmission main tunnel through Wire Ridge. In addition, alternate means of insurances may be viable alternatives to posting of long term bonding.



MC Project No.14002428A
Bethlehem Authority
Preliminary NG Pipeline Impact Study
Page 10 of 10

Please do not hesitate to contact this office should you have any questions with regard to this document.

Very truly yours,

MASER CONSULTING P.A.

A handwritten signature in black ink, appearing to read 'Ronald B. Madison', with a long horizontal flourish extending to the right.

Ronald B. Madison, P.E.
Regional Client Manager

A handwritten signature in black ink, appearing to read 'Philip E. Gauffreau', with a long horizontal flourish extending to the right.

Philip E. Gauffreau, P.E.
Discipline Leader, Geotechnical Services

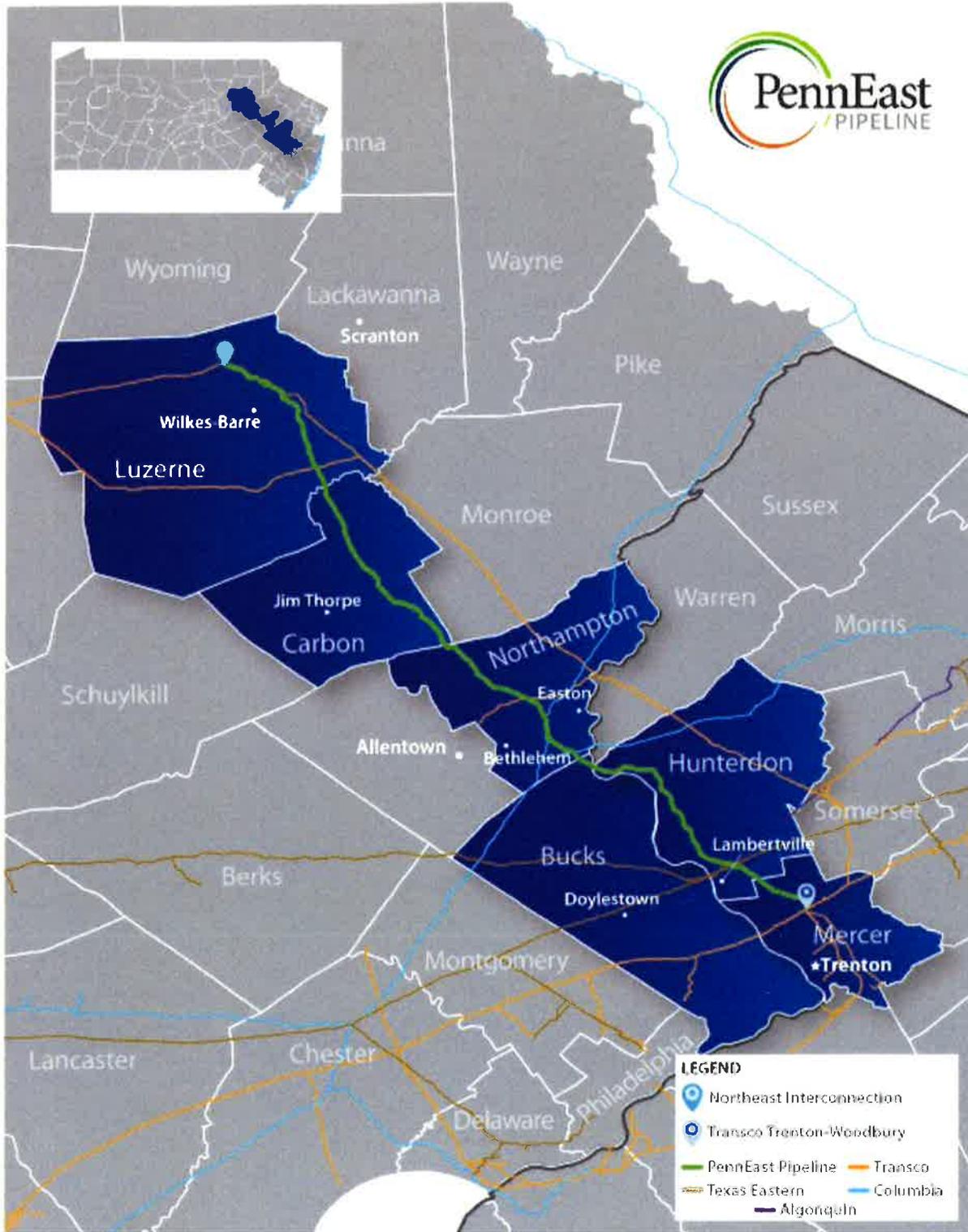
A handwritten signature in black ink, appearing to read 'Robert L. Zelle', with a long horizontal flourish extending to the right.

Robert L. Zelle, P.G.
Director of Environmental Service

RMB/PEG/eak

Enclosures:

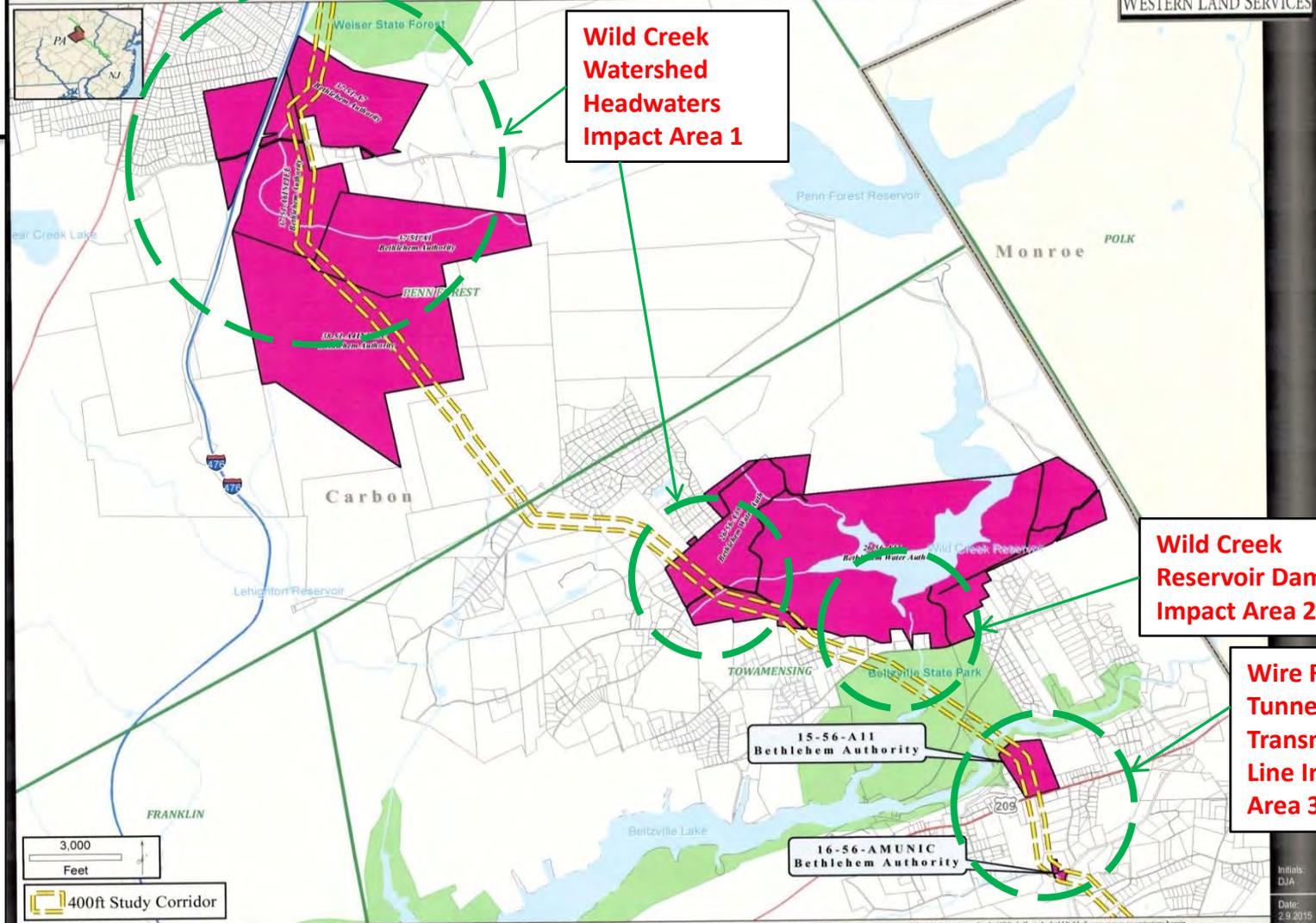
1. PennEast Pipeline Overall Map
2. Maser Consulting – Bethlehem Authority Study Area Exhibit
3. BMWA – Wild Creek Dam , 1939 (Partial Set)
4. BMWA – Wire Ridge Tunnel #2, 1939 (Partial Set)
5. Wire Ridge Tunnel 1996 Inspection Report
6. The Nature Conservancy 2012 Cover and 3 Exhibits
7. Wild Creek Dam 2014 Inspection Report Cover and Checklist
8. PennEast Pipeline Detailed Map Descriptions and Screenshot Maps (15)
9. June 30, 2015 Woodland Management Services, Inc. Report entitled “Proposed PennEast Pipeline Footprint Impact on Timber Related Revenue and Costs”.



PennEast Pipeline Project - Bethlehem Authority Overview



Impact Study Area Map



Wild Creek Watershed Headwaters Impact Area 1

Wild Creek Reservoir Dam Impact Area 2

Wire Ridge Tunnel Water Transmission Line Impact Area 3

15-56-A11
Bethlehem Authority

16-56-AMUNIC
Bethlehem Authority

3,000 Feet
400ft Study Corridor

Initials: DJA
Date: 2.9.2015

This map is the property of Western Land Services Inc. (WLS). A license to use is granted on the condition that reliance on any information contained herein is at the user's own risk as WLS does not make any representations or warranties as to the accuracy or completeness of the contents. Accordingly, WLS shall not be held liable for any errors or omissions herein.

Not to Scale

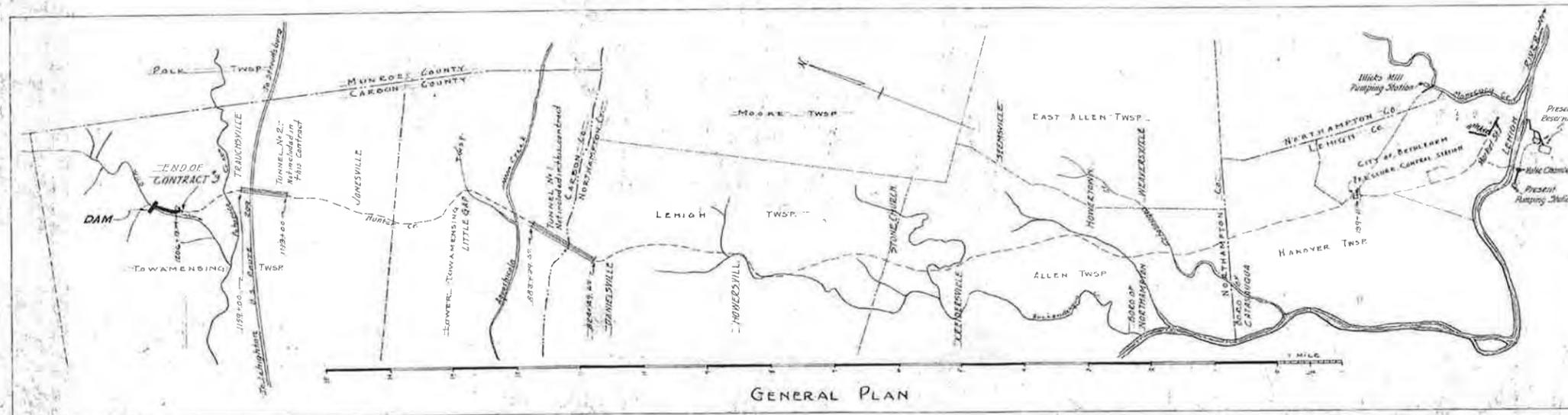
BETHLEHEM MUNICIPAL WATER AUTHORITY

BETHLEHEM, PENNSYLVANIA

WILD CREEK GRAVITY WATER SUPPLY

DRAWINGS FOR CONSTRUCTION OF RESERVOIR DAM AND MISCELLANEOUS APPURTENANCES WILD CREEK GRAVITY WATER SUPPLY

TOWAMENSING TWP CARBON CO.
MARCH 1, 1939.
DOCKET PA. 2123-F
CONTRACT NO 5

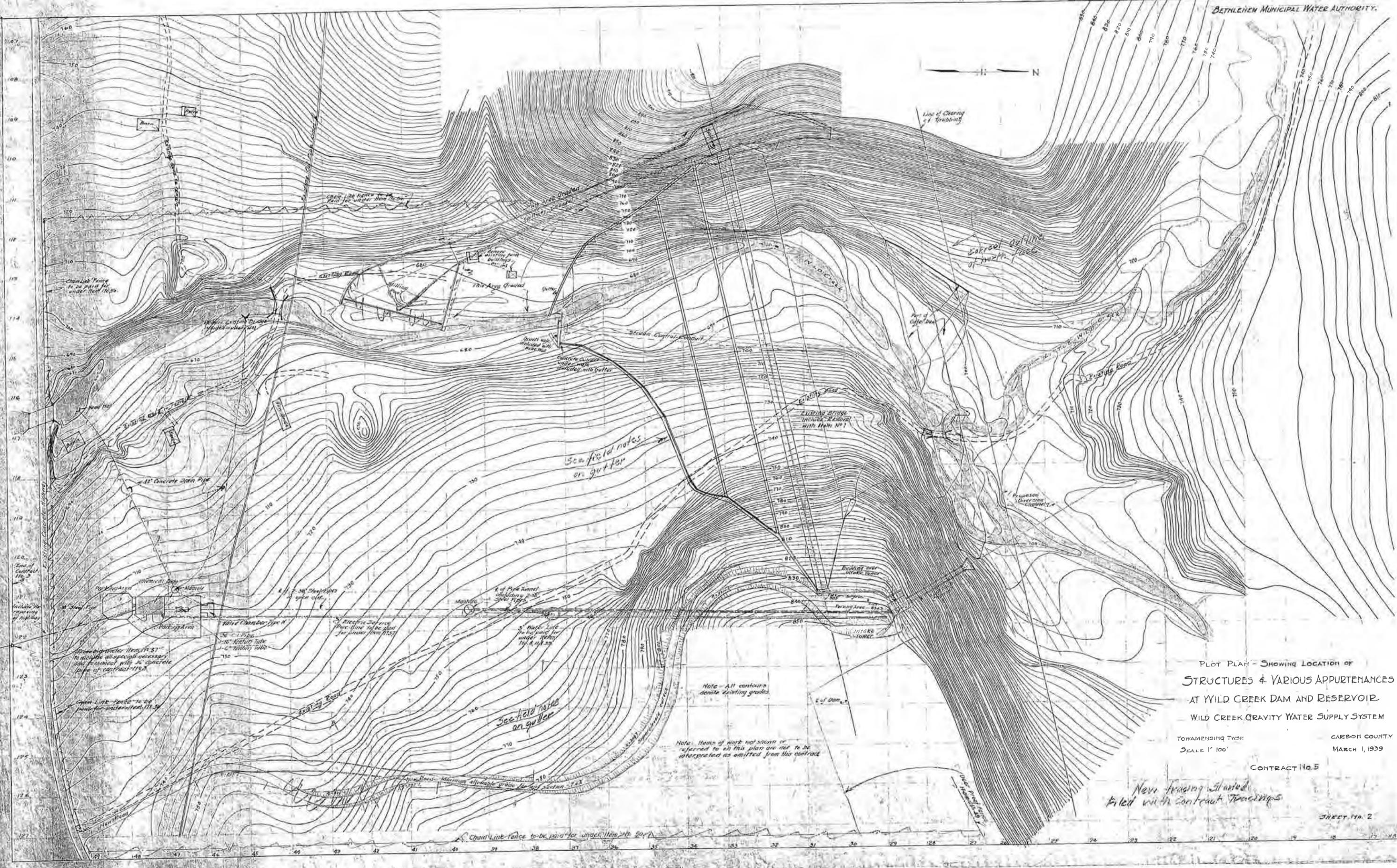


LIST OF DRAWINGS

Sheet No	Title Sheet
1	Title Sheet
2	General Location Plan
3	Clearing & Grubbing Area
4	Plan, Cofferdam & Stream Control Conduit
5	Details
6	Plans, Earth Fill Dam
7	Miscellaneous Sections Earth Fill Dam
8	Test Borings & Geological Interpretation
9	Test Pits
10	Location of Boron Areas
11	Location of Quarries
12	Plan, Spillway, Spillway Channel & Stilling Pool
13	Details, Spillway & Stilling Pool
14	Details, Spillway Channel
15	Plan, Intake Tower & Approach Channel
16	Details, Rocks, Stags, Screens, etc.
17	Rack Lifter, Crane Sling, & Rope Road
18	Plans, Intake Tower Superstructure
19	Elevations
20	Details
21	Tunnel Plans
22	Special Manhole & M.H. for Tunnel #3
23	Valve Chamber Type H
24	Piping, Roadway Drains & Manhole
25	Plot & Floor Plans, Chem. Control Bldg.
26	Elevs. & Details
27	Structural Layout
28	Plumbing, Piping & Electrical
29	Heating Layout
30	Water Stage Recorder, Bldg. etc.
31	Top Soil Removal & Deer Proof Fence
32	Overflow Basins, Drains, etc.
33	Drain Line for Valve Chamber Type A
34	Pipe Line & Head Wall of Illick's Mill
35	Market Street Feeder Main
36	Eighth Avenue

Leonard M. Travelling
PRINCIPAL ASSISTANT ENGINEER

Robert J. Fox
CONSULTING ENGINEER SHEET 1



PLOT PLAN - SHOWING LOCATION OF
 STRUCTURES & VARIOUS APPURTENANCES
 AT WILD CREEK DAM AND RESERVOIR
 WILD CREEK GRAVITY WATER SUPPLY SYSTEM
 TOWAMENSING TWP. CARBON COUNTY
 SCALE 1" 100' MARCH 1, 1939

CONTRACT No. 5

*New tracing attached
filed with contract tracings*

SHEET No. 2

Note - All contours denote existing grades.

Note - Items of work not shown or referred to on this plan are not to be interpreted as omitted from this contract.

See field notes on gutter

See field notes on gutter

Line of Clearing of Grading

Carroll outline of masonry face

Part of Cofferdam

Existing Bridge include Redwood with Deck No. 1

Existing over intake tower

E of Dam

Chain Link Fence to be paid for under item 218 20 ft

Area

Open Lot Fence to be paid for under item 115 50

Neat Hill

Port Area

Port Area

Chain Link Fence to be paid for under item 115 50

Neat Hill

Chain Link Fence to be paid for under item 218 20 ft

Chain Link Fence to be paid for under item 115 50

Area

BETHLEHEM MUNICIPAL WATER AUTHORITY



A

B

For detail of this area refer to Sheet #4

See Outline on Attached Sheet

For detail of this area refer to Sheet #12, 3/12
A-A-B-C-D

Drill Hole H

Drill Hole D

E DAM

For Details of this area refer to Drawing 2-A

Downstream face to be studded with rock placed to prevent scouring and to be planted with honeysuckle as required under item 54

Stone Gutter

Toe of Dam

Stone Gutter

B
See Sheet #7

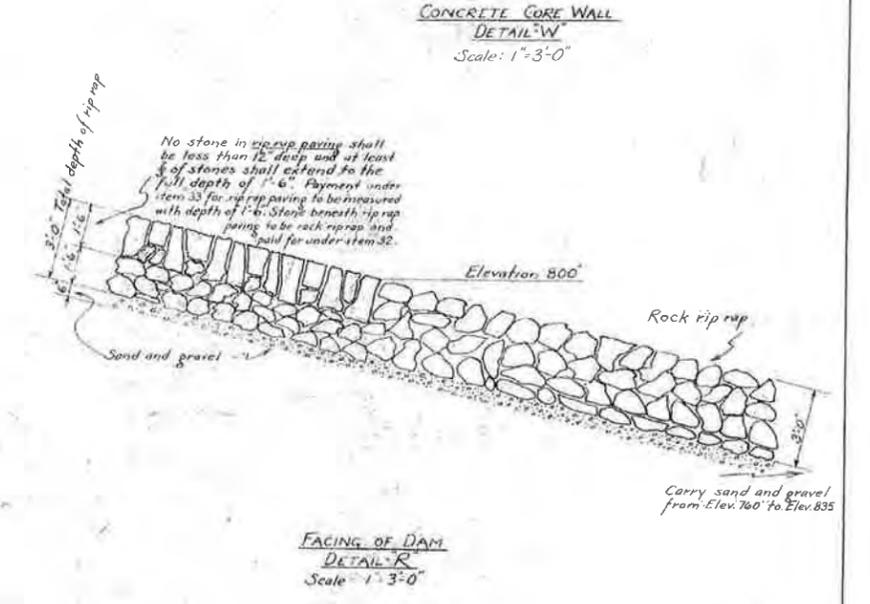
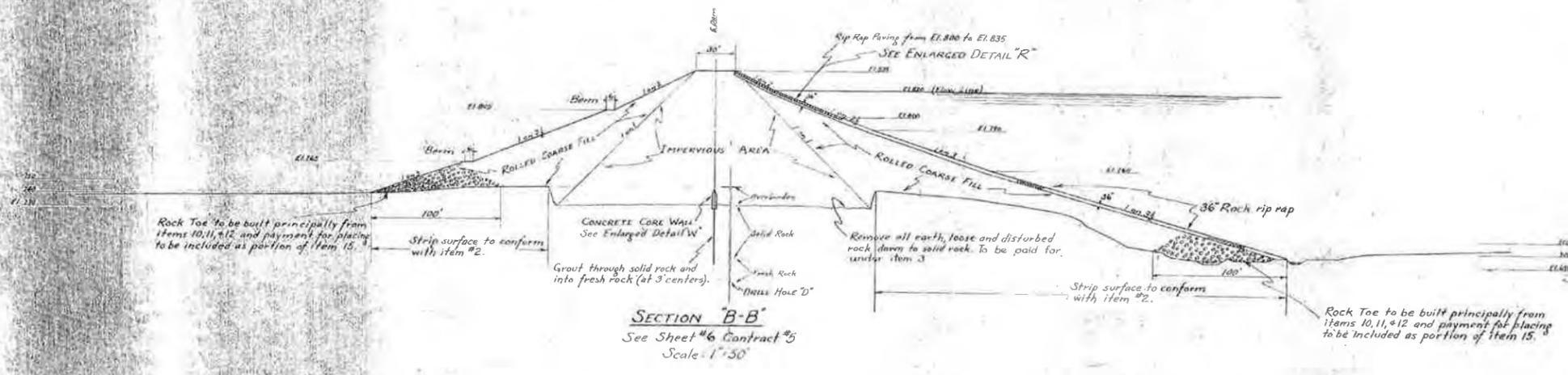
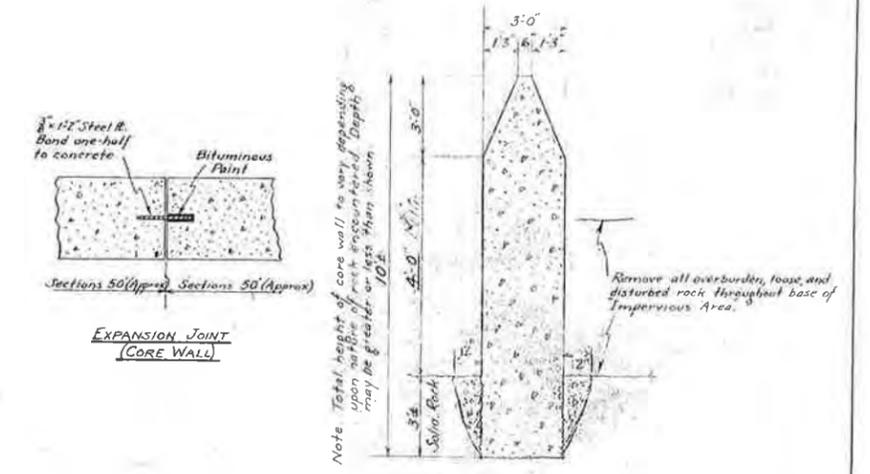
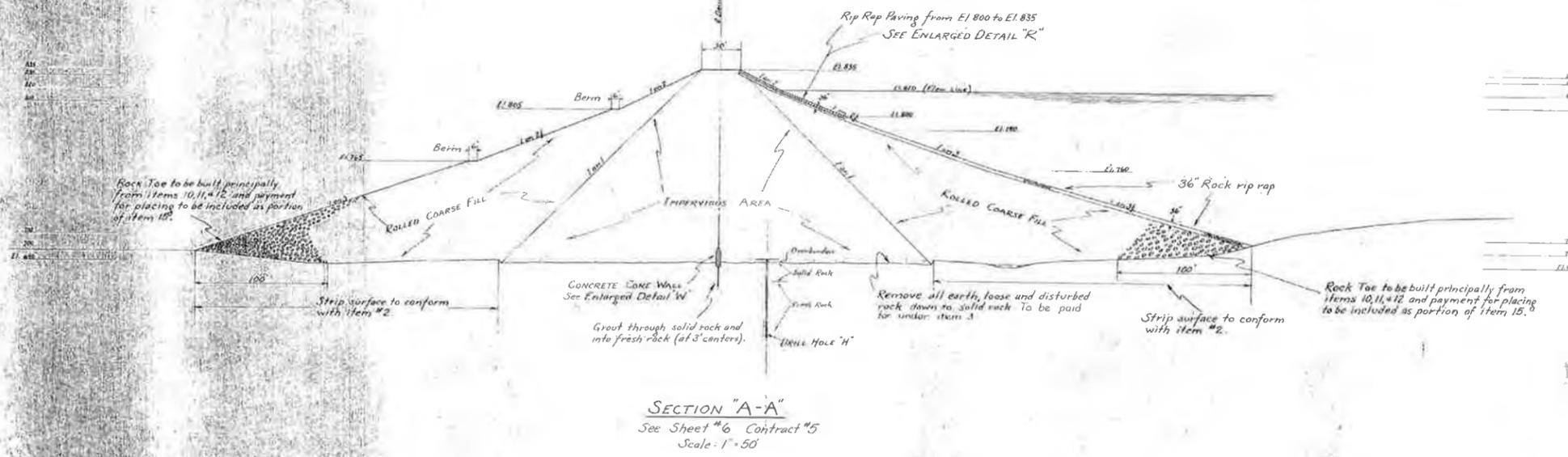
For detail of this area refer to Sheet #4 and 5-A-B-C-D

A
See Sheet #7

PLAN OF
EARTH FILL DAM
AT
WILD CREEK
Scale: 1" = 50' March 1, 1939

SHEET NUMBER 6
OF CONTRACT #5

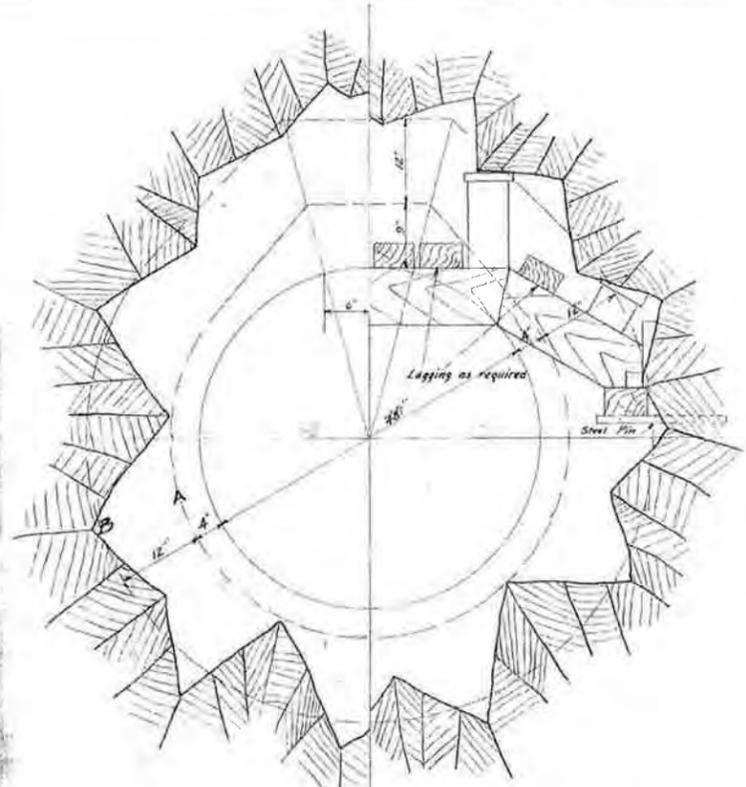




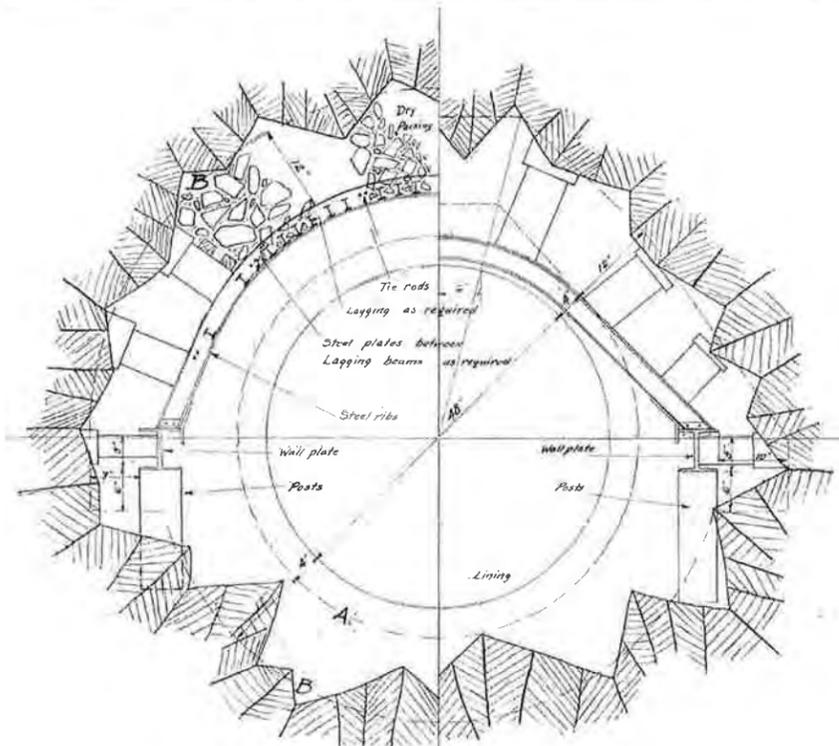
PAYMENT

CLEARING AND GRUBBING	ITEM 1
EARTH EXCAVATION	ITEM 3
ROCK EXCAVATION	ITEM 10
STRIPPING	ITEM 2
ROLLED FILL INCLUDING ROCK TOE	ITEM 15+16
CONCRETE CORE WALL	ITEM 19
DRILLING	ITEM 21+22
GROUT PIPES	ITEM 23
GROUTING	ITEM 24, 25, 26, +27
ROCK RIP RAP	ITEM 32
ROCK RIP RAP PAVING	ITEM 33
EXPANSION JOINTS	ITEM 30

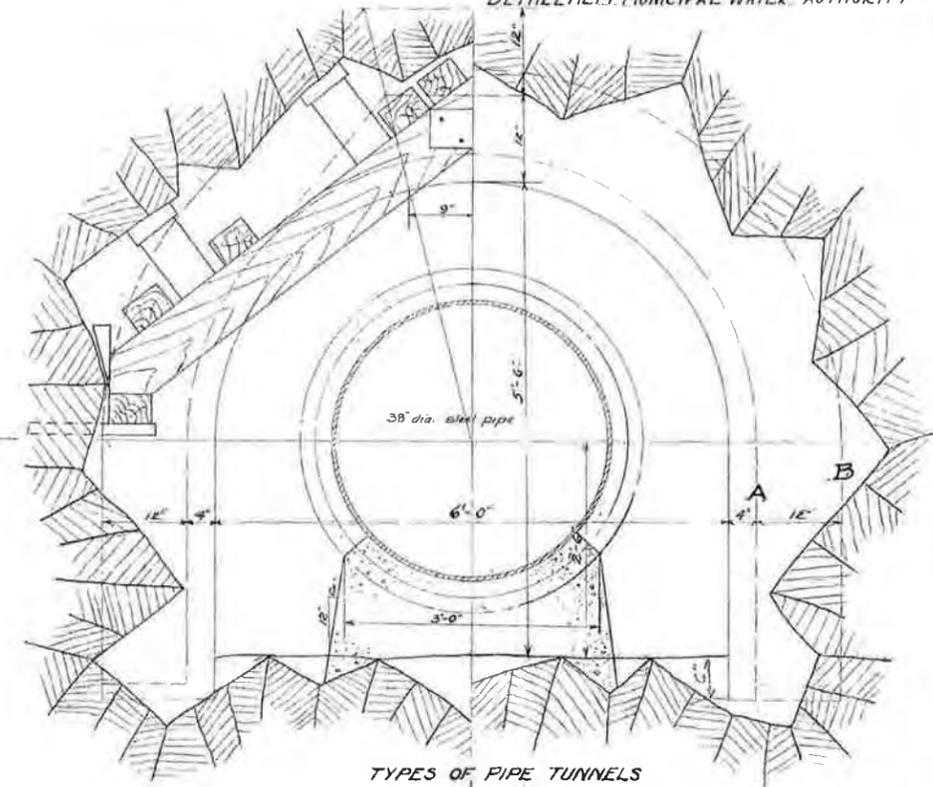
MISCELLANEOUS SECTIONS OF EARTH FILL DAM AT WILD CREEK
Scale: 1"=50' and 1"=3'
March 1, 1939



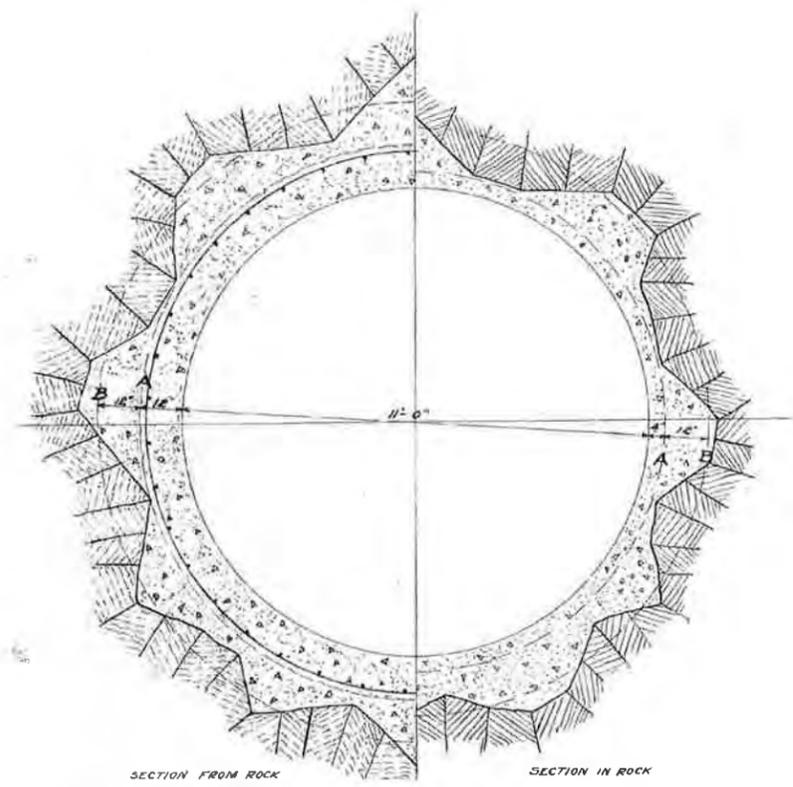
TYPE A 13.5
TYPES OF PRESSURE TUNNELS



TYPE B 13.5
TYPES OF PRESSURE TUNNELS

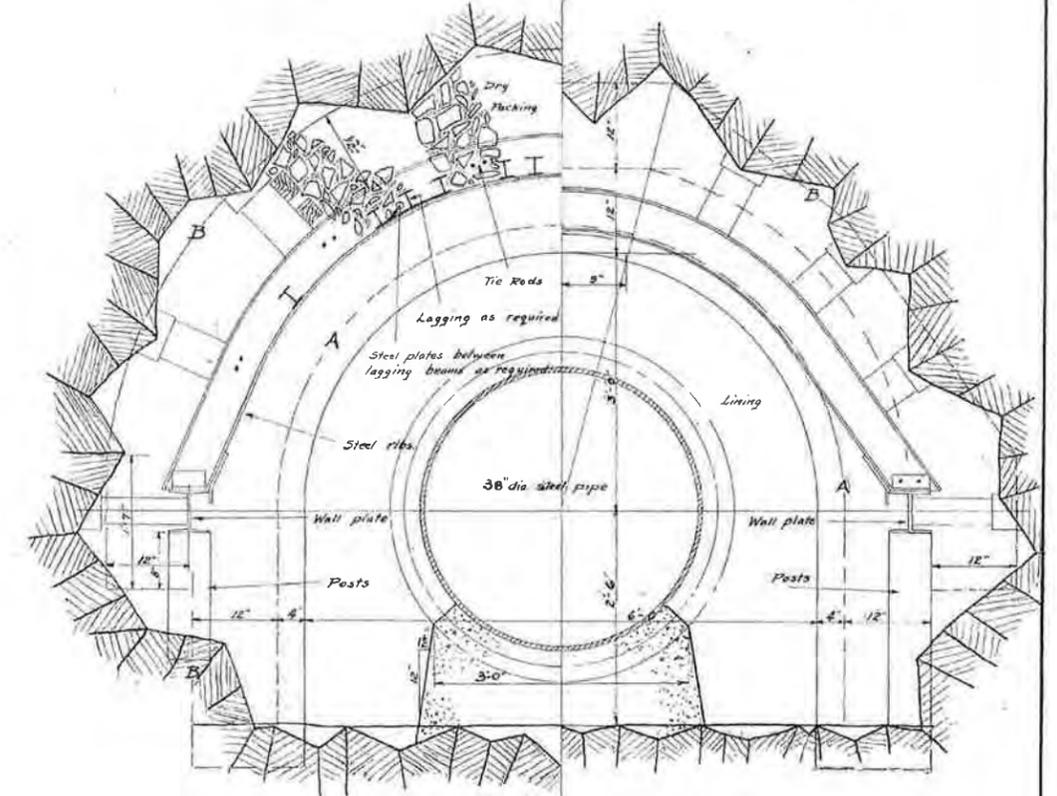


TYPES OF PIPE TUNNELS



SECTION FROM ROCK TO SURFACE
SECTION IN ROCK
SECTIONS OF SHAFT

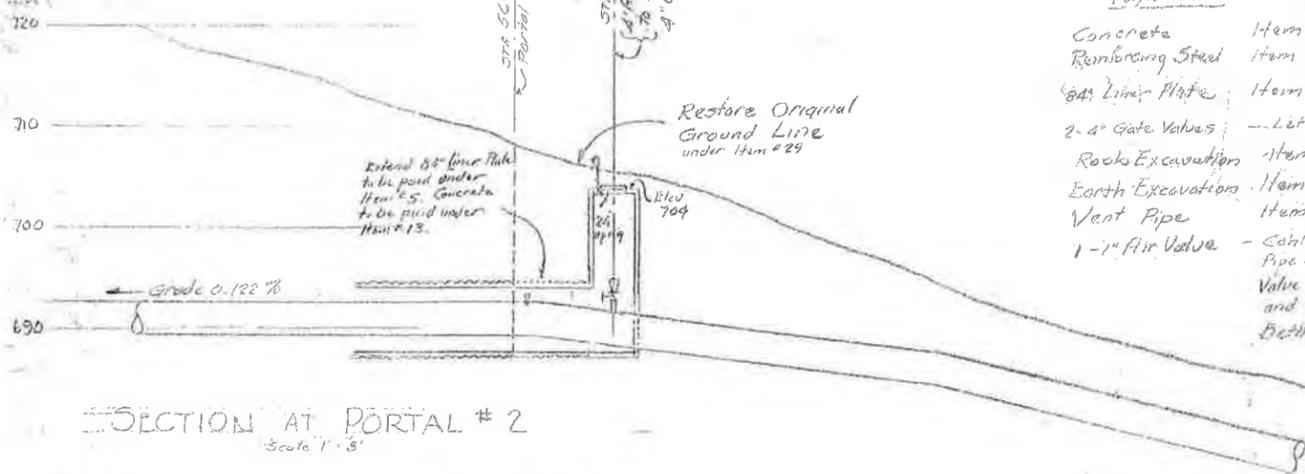
NEVER INCLUDED IN CONTRACT PLANS



TYPES OF PIPE TUNNELS

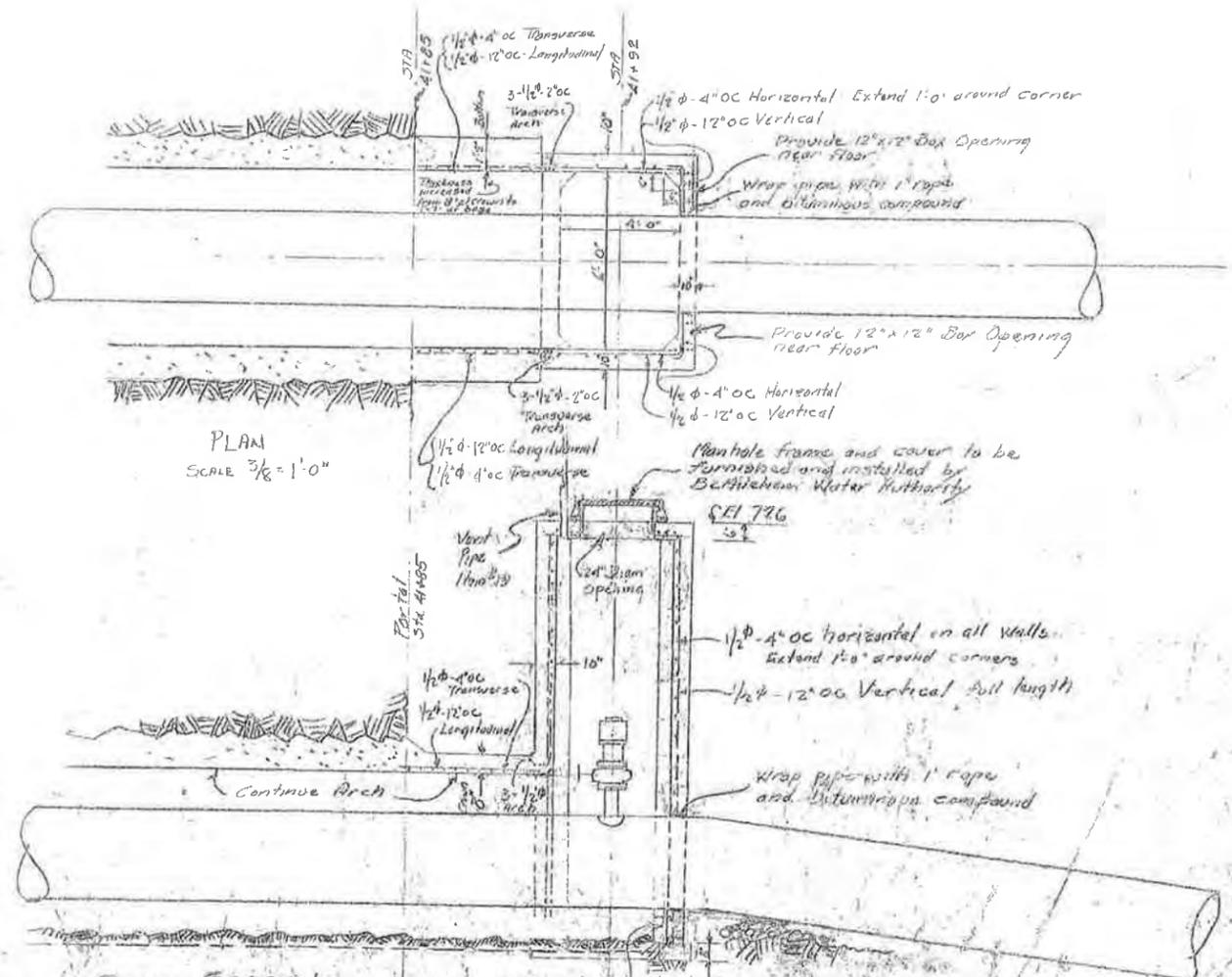
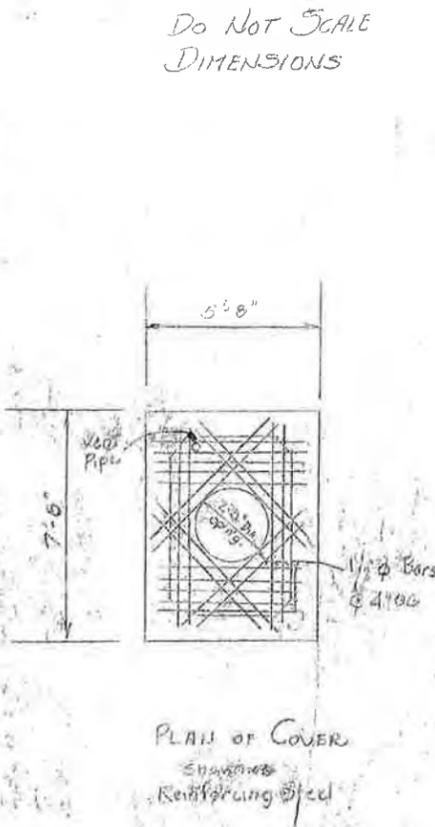
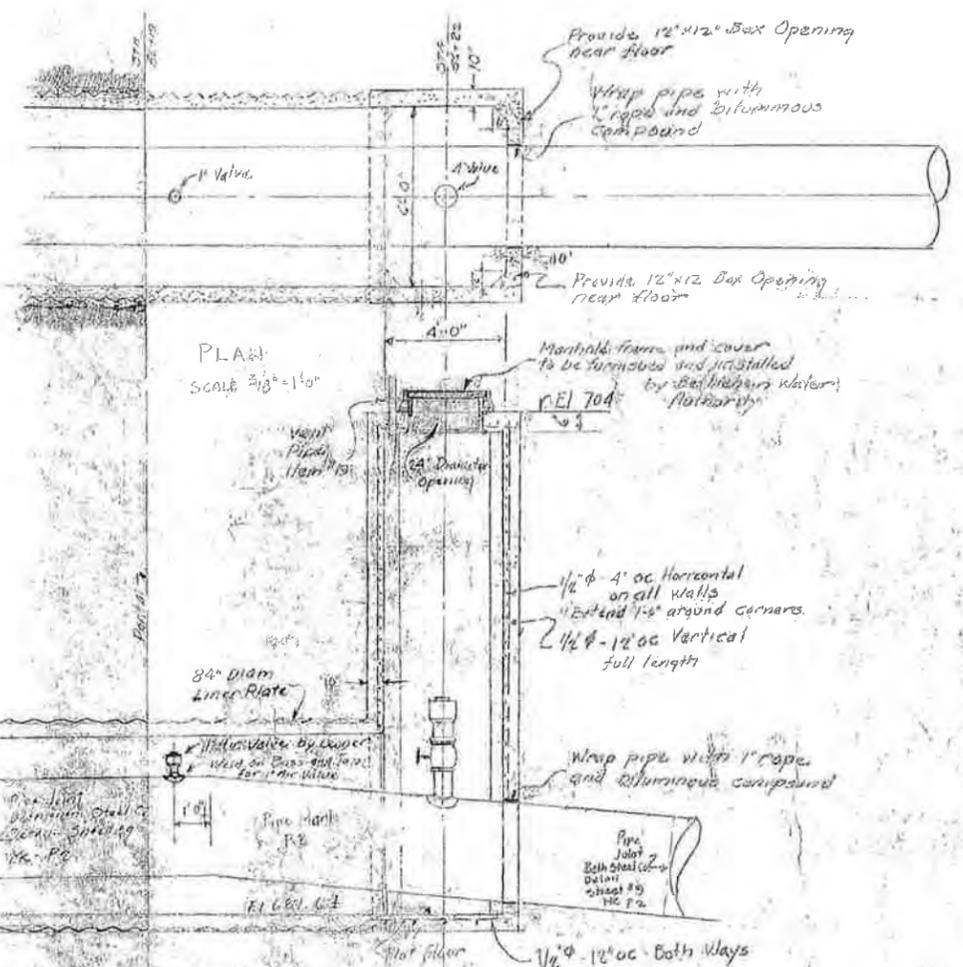
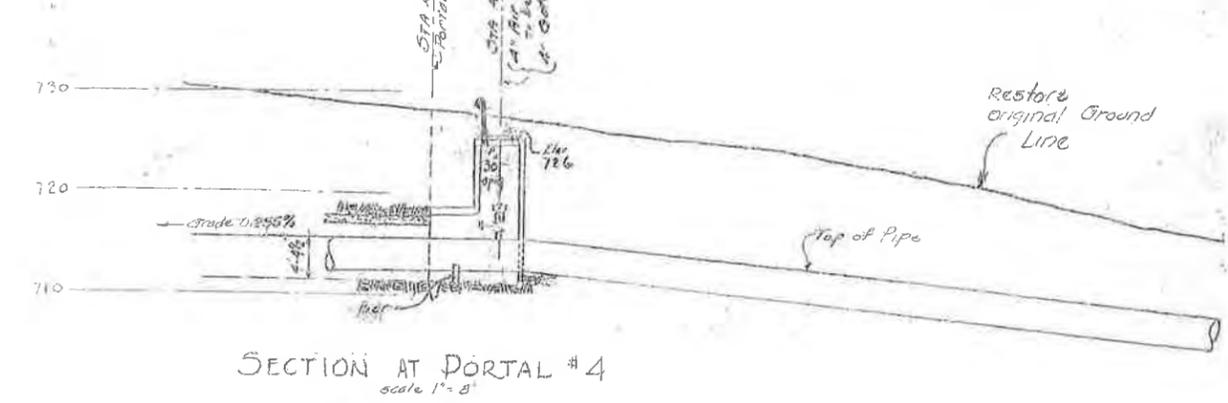
PLANS FOR THE CONSTRUCTION OF TUNNEL #1 AND TUNNEL #2 OF THE WILD CREEK GRAVITY WATER SUPPLY SYSTEM FOR THE BETHLEHEM MUNICIPAL WATER AUTHORITY

JAN 16, 1939



Payment

Concrete	Item # 13
Reinforcing Steel	Item # 12
84" Liner Plate	Item # 5
2-4" Gate Valves	Letter
Rocks Excavation	Item # 3
Earth Excavation	Item # 29
Vent Pipe	Item # 19
1-1" Air Valve	Contractor to Top Pipe Line for 1" Air Valve. Value will be furnished and installed by the Bethlehem Water Authority



PLAN SHOWING HOUSING FOR 4" GATE VALVE & 4" AIR RELEASE & VACUUM VALVE

PORTAL # 2 AND PORTAL # 4

WILD GREEN GRAVITY WATER SUPPLY

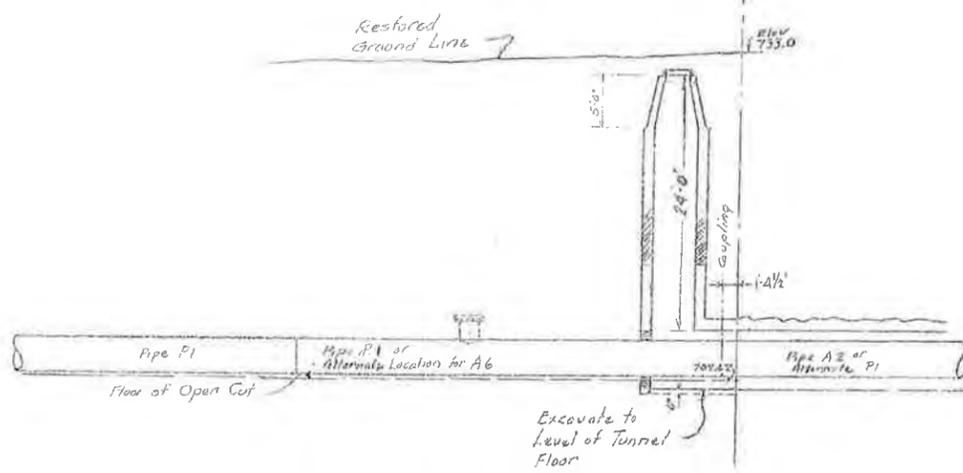
CONTRACT # 4

DATE 9/23/09 Rev 1/14/10

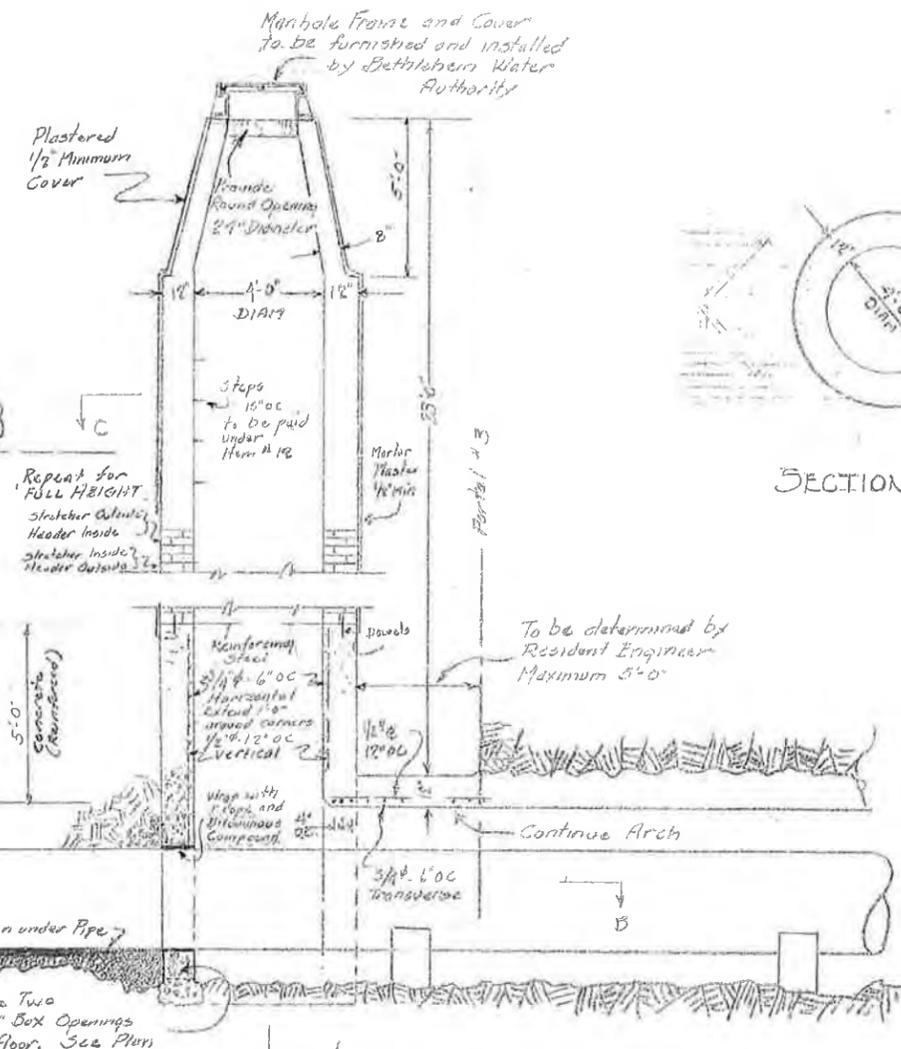
SCALE As Shown Rev 1/14/10

SHEET No 6 - 9

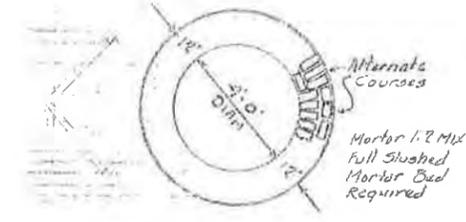
BETHLEHEM MUNICIPAL WATER AUTHORITY



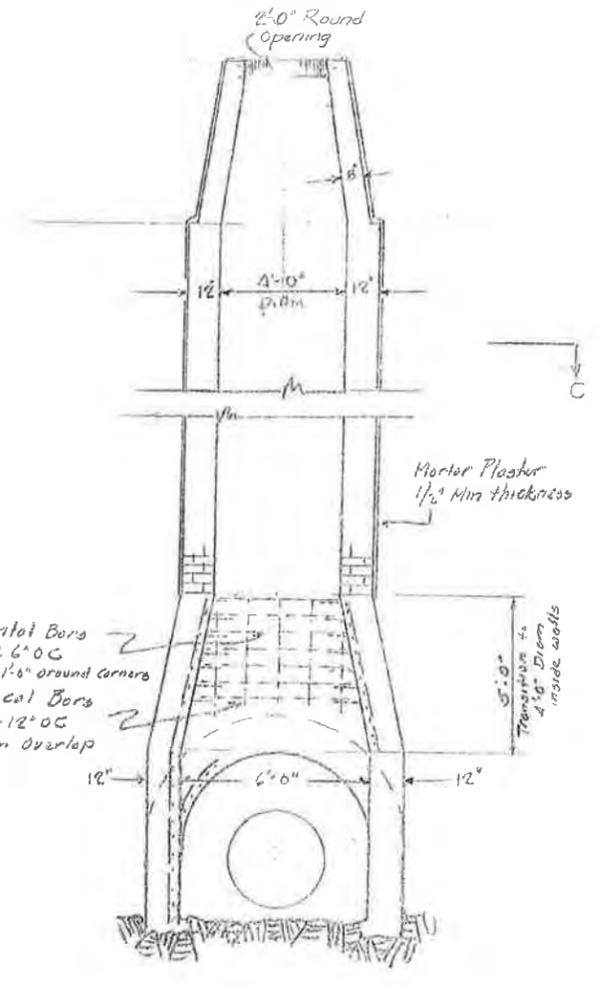
SECTION AT PORTAL #3
SCALE 1" = 8'-0"



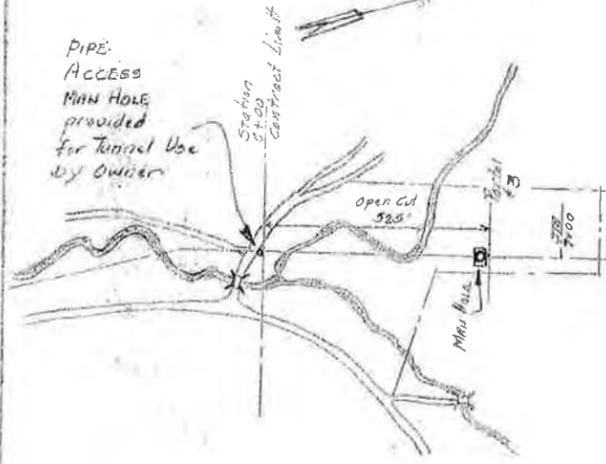
DETAIL OF SECTION
SCALE 3/8" = 1'-0"



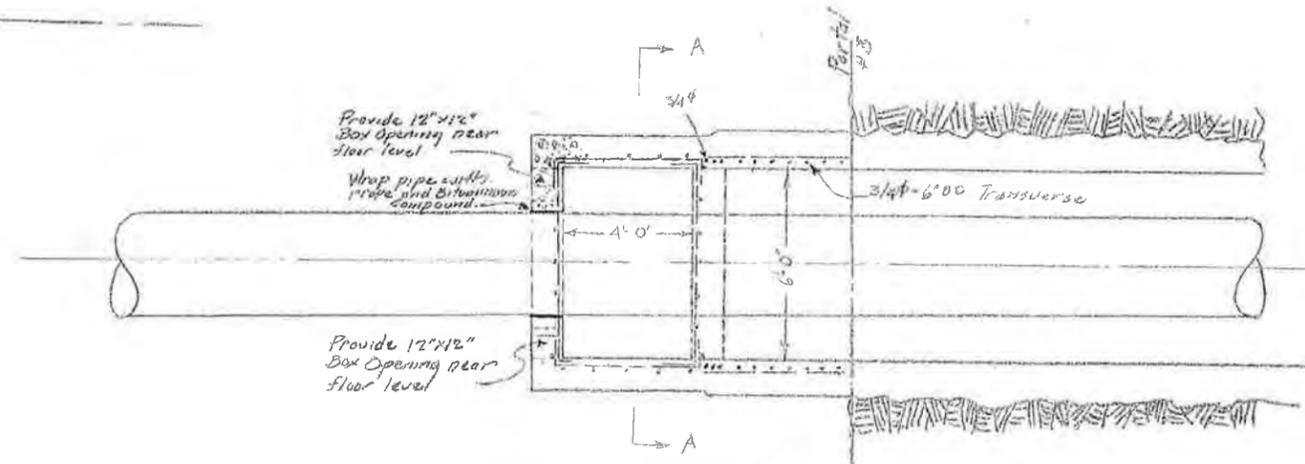
SECTION C-C



SECTION A-A



PLOT PLAN PORTAL #3



SECTION B-B
SCALE 3/8" = 1'-0"

Payment

Rock Excavation	Item #9
Reinforcing Steel	Item #12
Concrete Masonry	Item #13
Earth Excavation	Item #29
Brick Masonry	Item #13

PLAN SHOWING
ACCESS MAN-HOLE for PORTAL #3
WILD CREEK GRAVITY WATER SUPPLY
CONTRACT # 4

SCALE - AS NOTED

REVISED FEB 8, 1940
JUNE 25, 1940 - Brock Staff

SHEET No. 8

*The City of Bethlehem,
Department of Public Works*

**Final Report
Inspection of The Blue
Mountain and Wire
Ridge Tunnel Portals-
Wild Creek
Transmission Main**

September 1996

Gannett Fleming, Inc.



Harrisburg, Pa.



BETHLEHEM AUTHORITY

Wild Creek & Tunkhannock Creek Watershed Forest Management Plan (Condensed Version)

prepared by:

Woodland Management Services & The Nature Conservancy

Bethlehem Authority: Stephen Repasch, Dan Meixell, et. al.,
Woodland Management Services: Robin Wildemuth, Josh Flad
The Nature Conservancy: Fran Price, Mike Eckley, et. al.,

Owner: Bethlehem Authority

Board Members: John Tallarico – Chairman
Vaughn Gower – Vice Chairman
Richard Master – Secretary
Mark Jobs – Treasurer
LauraLynne Burtner – Assistant Secretary/Treasurer

Owner Contact: 10 E. Church Street, Room B311, Bethlehem, PA 18018
phone: 610/865-7090; srepasch@bethlehem-pa.gov

Land Manager: 308 Egypt Road, Tafton, PA 18464
phone: 570/857-1072; wms1@hughes.net

Tract Location: Tunkhannock - Latitude 41° 03' 00"N / Longitude 75° 27' 05"W

Tract Location: Wild Creek - Latitude 40° 56' 00"N / Longitude 75° 35' 00"W

County/State: Carbon & Monroe County, Pennsylvania

Township: Tunkhannock, Chestnut Hill, Jackson, Polk, Tobyhanna, Penn Forest, & Towamensing

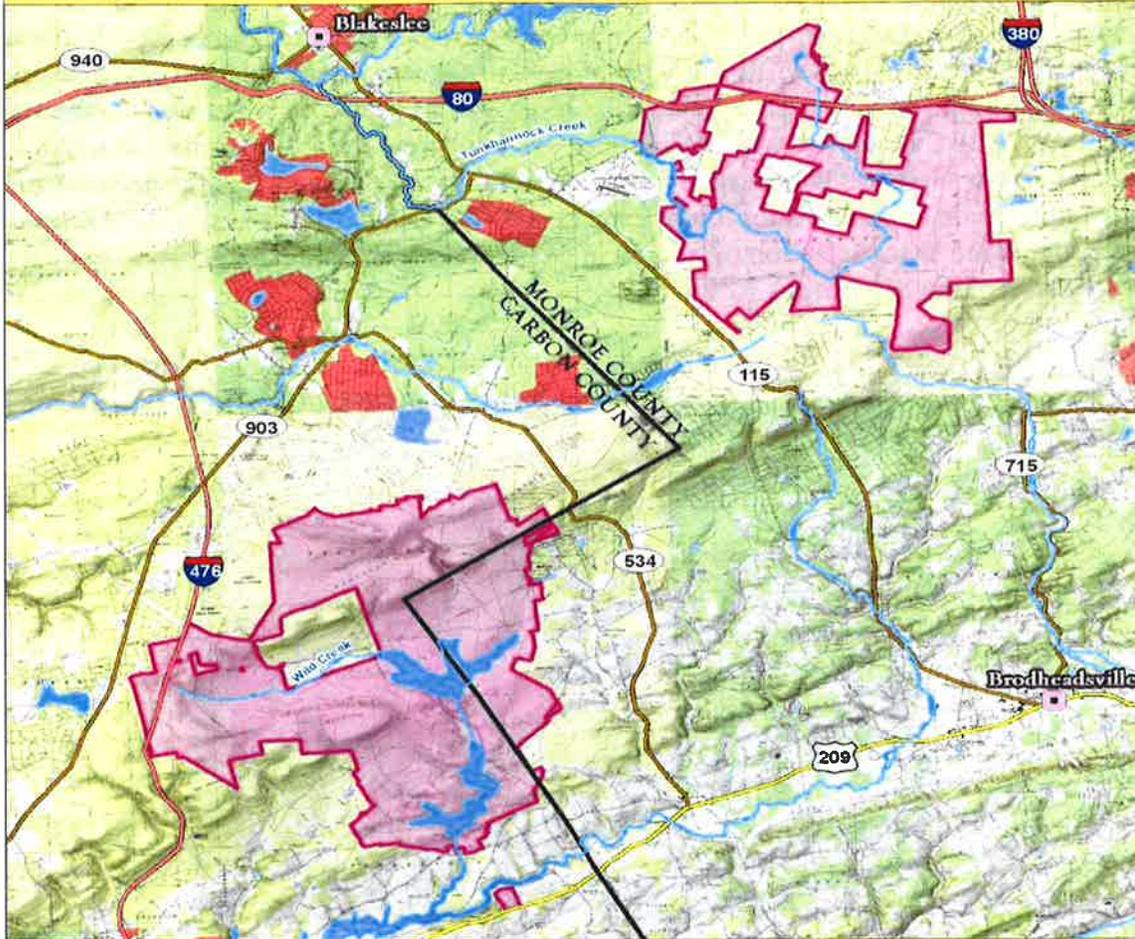
Tract Size: Wild Creek – 13,799 acres; Tunkhannock – 8,578 acres

FSC Certification: TNC PA Forest Conservation Program: Certified Resource Manager
FSC Certificate Number: SW-FM/CoC-000238

Implemented: 2012

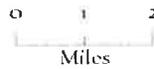
FSC Audited: 2012

BETHLEHEM AUTHORITY WORKING WOODLANDS PROJECT



- Bethlehem Authority Property
- Lakes & Ponds
- Rivers & Streams
- Interstates
- U.S. Routes
- State Roads
- Towns

March 2011

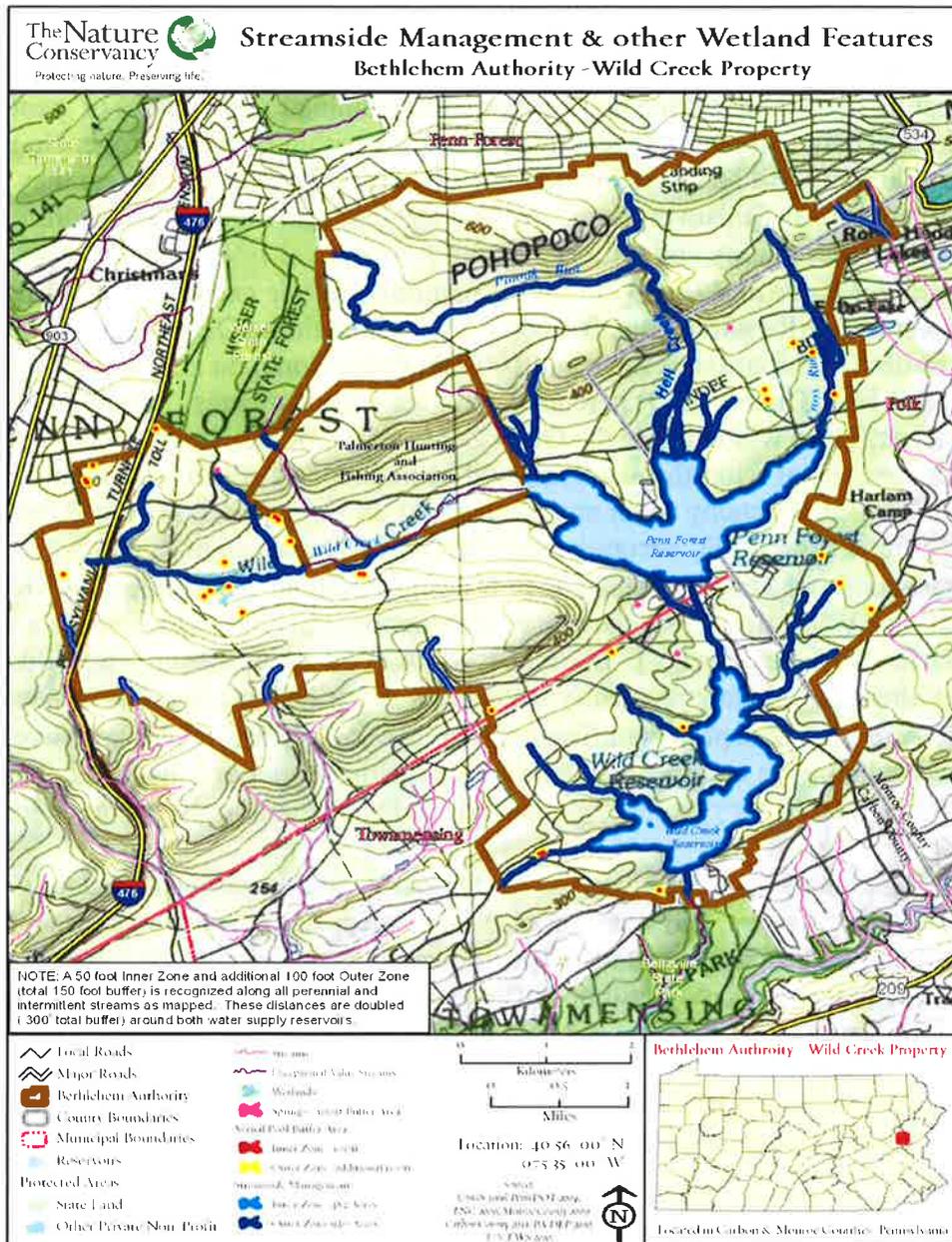


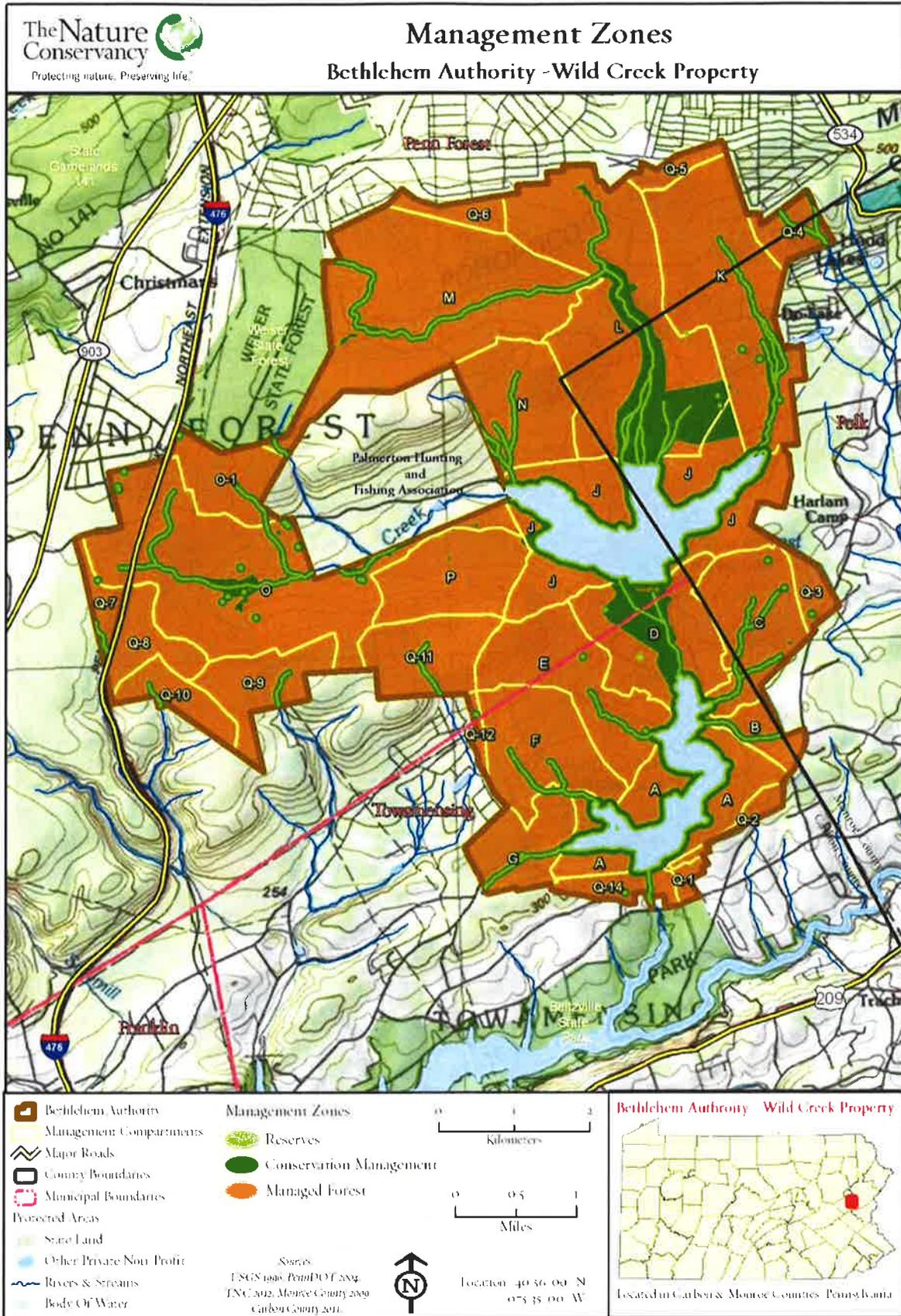
Data Sources
Bethlehem Authority lands from Carbon County (2011) and Monroe County (2009) parcel datasets



establishment/protection of large down and dead woody material; This management zone will be extended outward another 100' where features exist which are conducive to amphibian breeding to protect and enhance this habitat; there will be no broadcast herbicide application within the total buffer.

- o Existing skid trails within wetland buffers will be decommissioned as appropriate.
- o No disturbance or timber harvest activities will occur within wetlands. Wetland buffers will be developed on a case by case basis to ensure exemplary water quality and Exceptional Value wetlands are maintained. Characteristics to evaluate when determining appropriate buffer widths include the steepness and erodibility of surrounding hill slopes, soil permeability and infiltration rates and capacities, as well as the density and type of buffer vegetative cover. Mechanical or silvicultural operations within buffers are permitted solely for the restoration, maintenance, and creation of wetland or riparian values or water quality protection. This could include invasives control, permitted stream crossing construction, or sanitation harvesting to protect stream banks from destabilizing windthrow or culvert pipes from blockage.





**DELAWARE RIVER BASIN
TOWAMENSING TOWNSHIP, CARBON COUNTY
PENNSYLVANIA**

WILD CREEK DAM

NDI ID No. PA-00609
DEP ID No. 13-083

INSPECTION REPORT

Prepared For

**CITY of BETHLEHEM (Operator)
BETHLEHEM AUTHORITY (Owner)**

Bethlehem, Pennsylvania

October 2014

S. Repasch
J.A. Andrews
M. Pennella

DAM INSPECTION CHECKLIST
Department of Environmental Protection
Bureau of Waterways Engineering
Division of Dam Safety

NAME OF DAM: Wild Creek DamDEP DAM NO.: 13-083LOCATION: Municipality: TowamensingCounty: CarbonDEP CLASSIFICATION DATA: Size: Class AHazard: Category 1**PHYSICAL DATA:**Type of Dam: Zoned EarthfillHeight of Dam: 135 feetNormal Pool Storage Capacity: 17,143 ac-ft**ELEVATIONS:**Normal Pool: 820 feet mslPool at Inspection: 820.14 feet mslTailwater at Inspection: flowingDAM OWNER: Bethlehem AuthorityOPERATOR: City of BethlehemADDRESS: 10 East Church StreetBethlehem, PAPHONE: (610)-865-7090FAX NO.: (610)-865-7042E-MAIL ADDRESS: srepasch@bethlehem-pa.gov

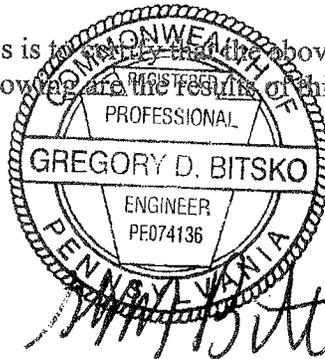
A completed and signed Dam Owners Notice Checklist is to accompany this Inspection Checklist.

PERSONS PRESENT AT INSPECTION:

<u>Name</u>	<u>Title/Position</u>	<u>Representing</u>
<u>Michael Pennella</u>	<u>Chief Watershed Operator</u>	<u>City of Bethlehem</u>
<u>Eric T. DeRicco, C.E.T.</u>	<u>Engineering Geologist</u>	<u>Cherry Weber & Associates</u>
<u>Larry Clevinger, M.E.C.I.</u>	<u>Field Inspector</u>	<u>Cherry Weber & Associates</u>
_____	_____	_____

DATE OF INSPECTION: 10/03/2014WEATHER: Mostly Cloudy, BreezyTEMPERATURE: 60°F

This is to certify that the above dam has been inspected and the following are the results of this inspection.



 Signature of Registered Professional Engineer
 (P.E. Seal Required)

12/15/14
 Date

PennEast Pipeline Information Session held June 3, 2015
Bethlehem Authority Detailed Mapping Screen-Shot Maps

Maser Consulting, P.A. received the 15 PennEast NG Pipeline - Screen-Shot Maps on June 5, 2015. The description of each screen-shot map (attached) is listed below:

BA_1: This area is within Penn Forest Township Bethlehem Authority (BA) watershed headwaters, along Reservoir Road, west of Penn Forest Reservoir. North is at top of all screen-shot maps. The PennEast mile post markers run from north of Wilkes-Barre south to Trenton (MP-37 is thirty-seven miles south from the proposed NG pipeline origin). The lime green line with mile post markers is the proposed NG pipeline route. The red shaded area on either side is the 50' wide permanent right-of-way. The shaded yellow area is the temporary 100' wide construction easement. The brown shaded areas are anticipated additional construction easements. The orange lines are the limit of the 400' wide environmental study corridor. The purple lines are other existing liquid petroleum pipelines. The yellow lines are existing over-head electrical transmission lines.

BA_2: This area is within the Penn Forest Twp. BA watershed headwaters and the proposed crossing of Wild Creek, west of and tributary to Penn Forest Reservoir.

BA_3: This area is within the Towamensing Twp. BA watershed headwaters and the proposed crossing of a creek, along Lovitt Road, west of and tributary to Wild Creek Reservoir.

BA_4: This area is similar to BA_3 along Lovitt Road, west of and tributary to Wild Creek Reservoir.

BA_5: This area is within BA and Beltzville State Park land, south and west of Wild Creek Dam, crossing Pohopoco Drive. Here the proposed NG Pipeline MP 42.8 was measured 1600 feet from the toe of the Wild Creek earth fill dam.

BA_6: This area is south of the Pohopoco Drive, crossing Penn Forest Road and under Beltzville Lake at MP 43.5.

BA_7: This area is south of Beltzville Lake, north of SR 209. The NG pipeline pivots very near the Wire Ridge Tunnel northern Portal #4 (square concrete slab near MP 43.8).

BA_8: This is a zoomed-in screen-shot of the Wire Ridge Tunnel northern Portal #4 (square concrete slab near MP 43.8).

BA_9: This area is south of SR 209. The Wire Ridge Tunnel southern Portal #3 is located between Strohl's Valley Rd and Spruce Hollow Rd (square concrete slab just west of blue shaded pond).

BA_10: This screen-shot includes a red line drawn from portal to portal along the Wire Ridge Tunnel water transmission line and the proposed SR 209 crossing.

BA_11: This zoomed-in screen-shot shows the red line as the BA water transmission line is extended along the tree-cut easement, north towards Wild Creek Dam. The pinch point near MP 43.7 was measured only 67 feet from the red water transmission line.

BA_12: This screen-shot shows the red line as the BA water transmission line from the Wild Creek Dam treatment building to Wire Ridge Portal #3. The green NG line runs parallel and close to the red water transmission line.

BA_13: This area is south of Wire Ridge Portal #3. The water transmission line continues southward, west of Spruce Hollow Road.

BA_14: This screen-shot shows a brown shaded construction easement line under the green NG pipeline, with brown squares at either end. This represents the NG pipeline proposed horizontal directional drilling route to cross under Beltzville Lake.

BA_15: This screen-shot shows the entire BA Watershed region. The PennEast NG pipeline route appears blue along the MP markers. The route travels north to south around the west side of the BA water supply reservoirs and crosses the water transmission line. We drew the green line which represents an alternate NG pipeline route east of the BA watershed. This alternate route would not cross the water transmission line.

BA_1

MP 37

MP 37.1

MP 37.2

MP 37.3

Reservoir Rd

© 2015 Google

Google earth

435 ft

Imagery Date: 5/19/2012 lat 40.940383° lon -75.633451° elev 0 ft eye alt 1936 ft

Tour Guide

1992



BA_2

MP 37.7

MP 37.8

MP 37.9

© 2015 Google

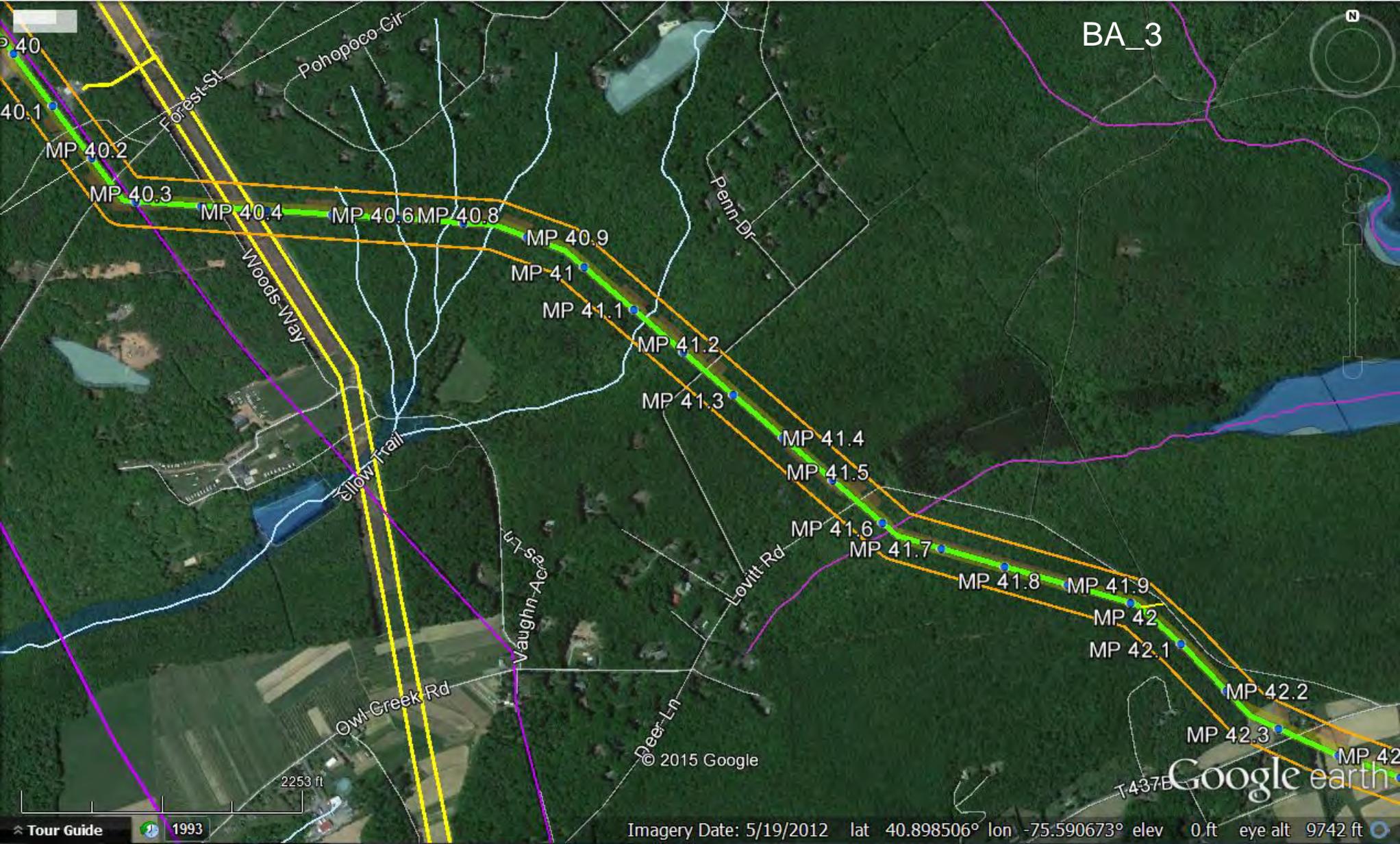
Google earth

Tour Guide 1992

Imagery Date: 5/19/2012 lat 40.931735° lon -75.633821° elev 0 ft eye alt 1747 ft



BA_3



40

40.1

MP 40.2

MP 40.3

MP 40.4

MP 40.6

MP 40.8

MP 40.9

MP 41

MP 41.1

MP 41.2

MP 41.3

MP 41.4

MP 41.5

MP 41.6

MP 41.7

MP 41.8

MP 41.9

MP 42

MP 42.1

MP 42.2

MP 42.3

MP 42

Forest St

Pohopoco Cir

Penn Dr

Woods Way

Yellow Trail

Vaughn Acres Ln

Lovitt Rd

Deer Ln

Owl Creek Rd

T437E

© 2015 Google

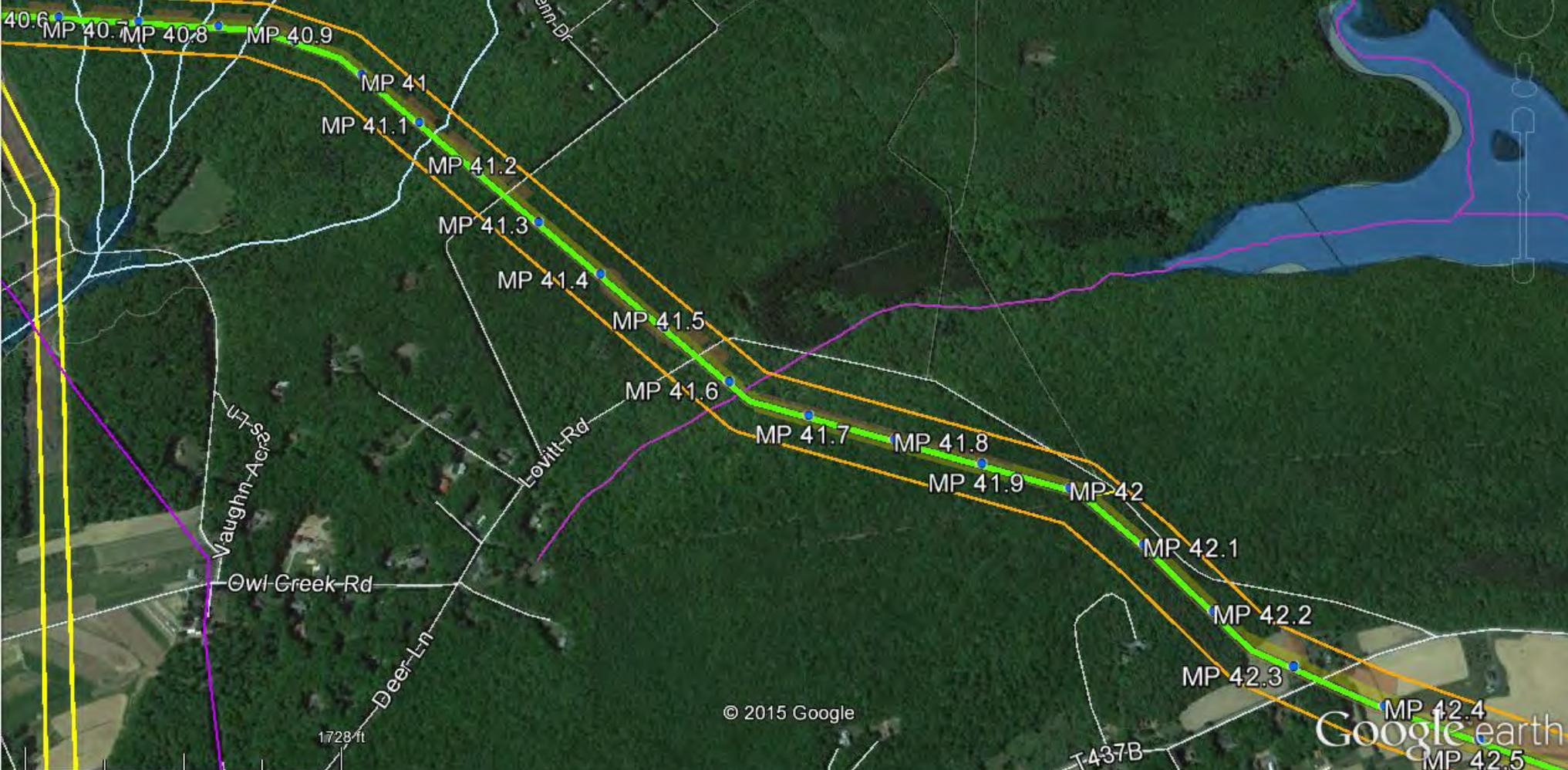
Google earth

Tour Guide

1993

Imagery Date: 5/19/2012 lat 40.898506° lon -75.590673° elev 0 ft eye alt 9742 ft

BA_4





BA_5

41.9

MP 42

MP 42.1

MP 42.2

MP 42.3

MP 42.4

MP 42.5

MP 42.6

MP 42.7

MP 42.8

T-437B

Betty Ln

Norman Dr

968 ft

© 2015 Google

Google earth

Tour Guide

1993

Imagery Date: 5/19/2012 lat 40.892725° lon -75.568845° elev 0 ft eye alt 4305 ft

BA_6

T422B

Pohopoco-Dr

MP 42.7

MP 42.8

MP 42.9

MP 43

MP 43.1

MP 43.2

MP 43.3

MP 43.4

MP 43.5

MP 43.6

Gross St

Lower-Gil
Twin

© 2015 Google

Google earth

1148 ft

Tour Guide

1993

lat 40.889905° lon -75.554975° elev 0 ft eye alt 5117 ft

BA_7

43.4

MP 43.5

MP 43.6

MP 43.7

MP 43.8

MP 43.9

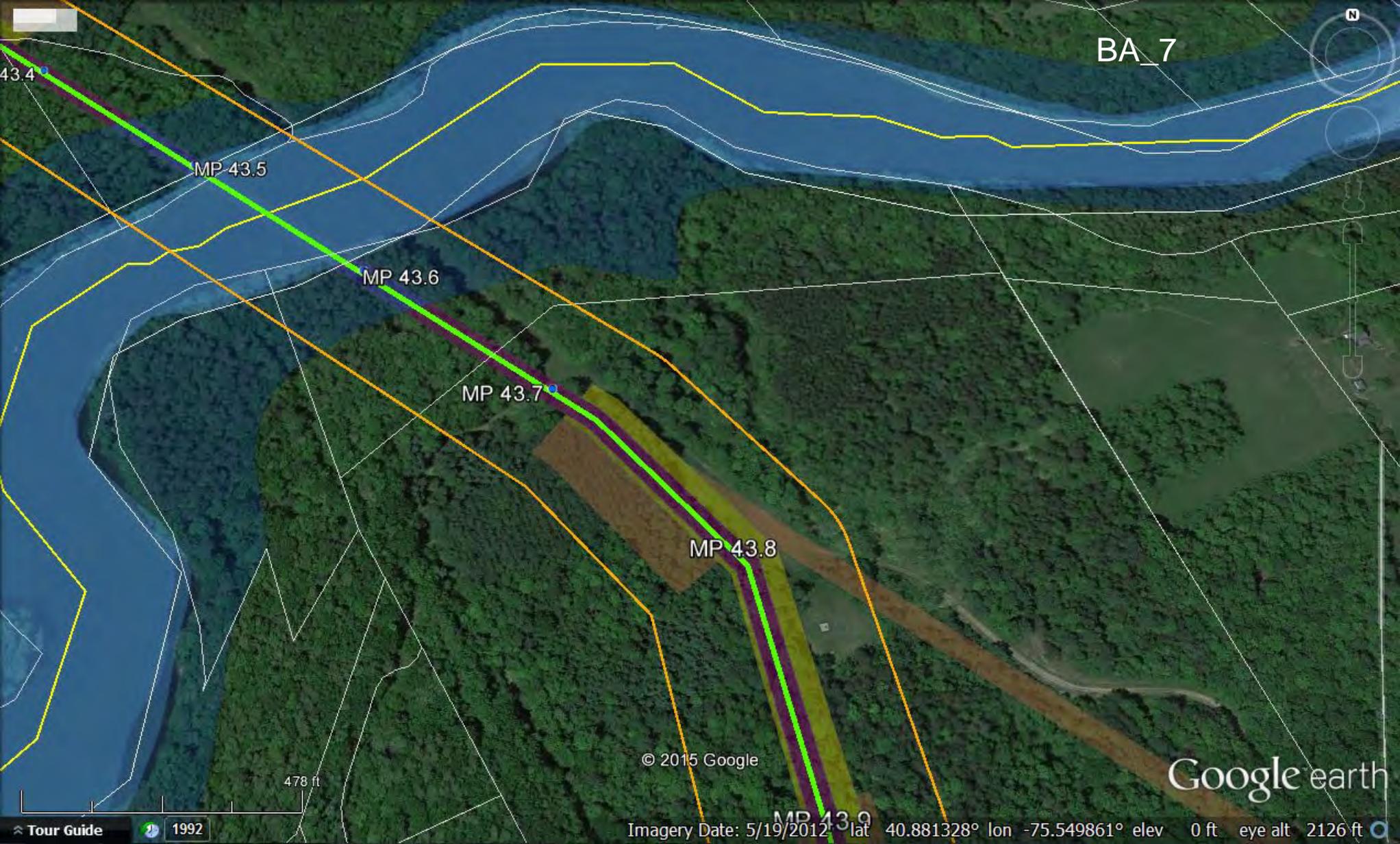
© 2015 Google

Google earth

Imagery Date: 5/19/2012 lat 40.881328° lon -75.549861° elev 0 ft eye alt 2126 ft

Tour Guide 1992

478 ft



BA_8

MP 43.8



© 2015 Google

Google earth



Tour Guide 1992

Imagery Date: 5/19/2012 lat 40.880350° lon -75.549003° elev 0 ft eye alt 493 ft

BA_9



MP 44.5

MP 44.6

MP 44.7

Serpentine Ln

Spruce Hollow Rd

Spruce Hollow Rd

Strohl-Valley Rd

335 ft

© 2015 Google

Google earth

Tour Guide

1992

Imagery Date: 5/19/2012 lat 40.870707° lon -75.544051° elev 0 ft eye alt 1489 ft

BA_10

MP 43.7

MP 43.8

MP 43.9

MP 44

MP 44.1

MP 44.2

MP 44.3

MP 44.4

MP 44.5

MP 44.6

MP 44.7

Firehouse Rd

James Ln

Palm Dr

Sleepy Hollow Ln

Platypus Dr

209

Interchange Rd

Anderson Dr

Barbara Ave

Strohl

Strohl

2011

Spruce Hollow Rd

Beers Country Rd

Strohl Valley Rd

Leopold Rd

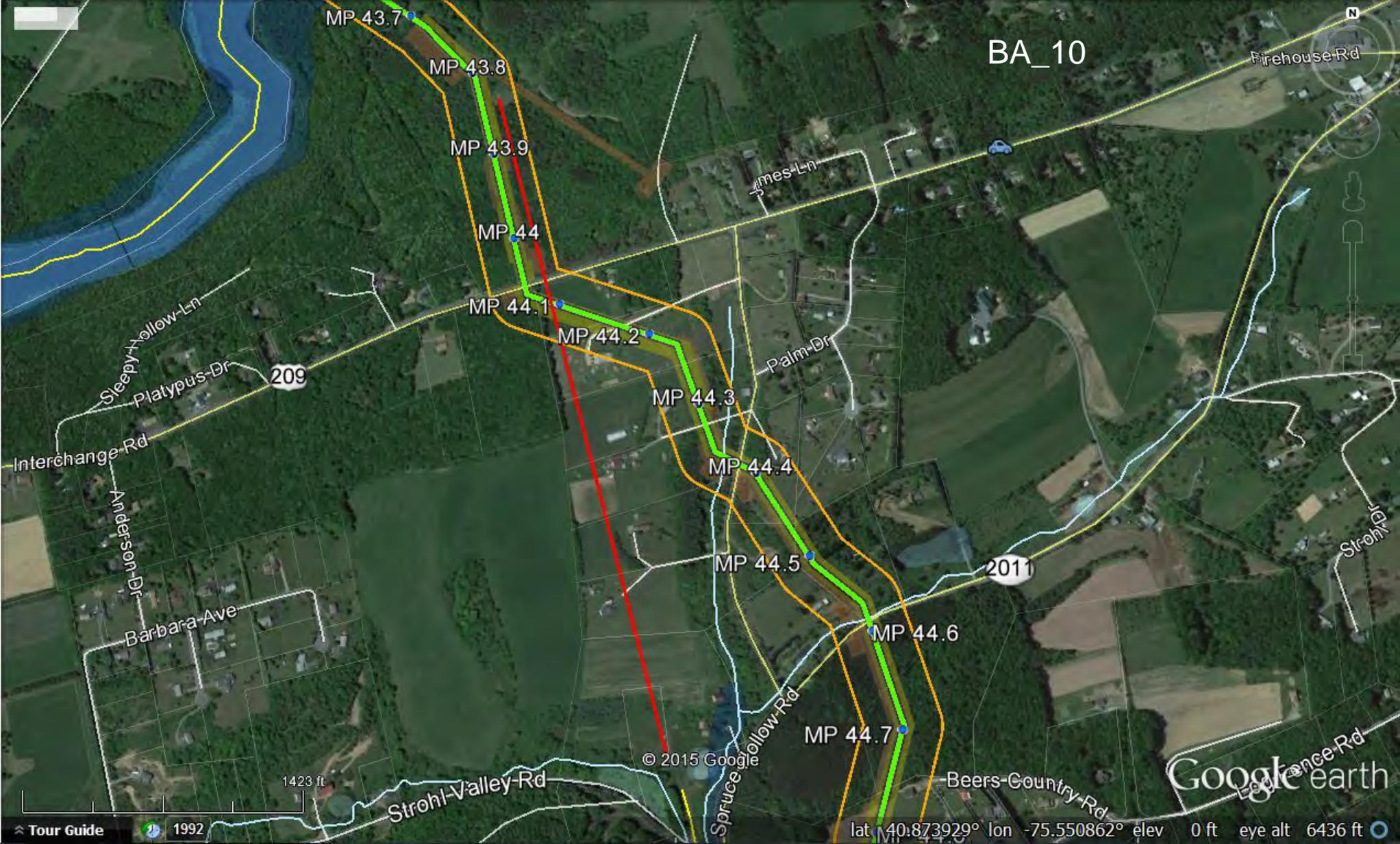
Google earth

© 2015 Google

lat 40.873929° lon -75.550862° elev 0 ft eye alt 6436 ft

Tour Guide 1992

1423 ft



BA_11

3.4

MP 43.5

MP 43.6

MP 43.7

MP 43.8

MP 43.9

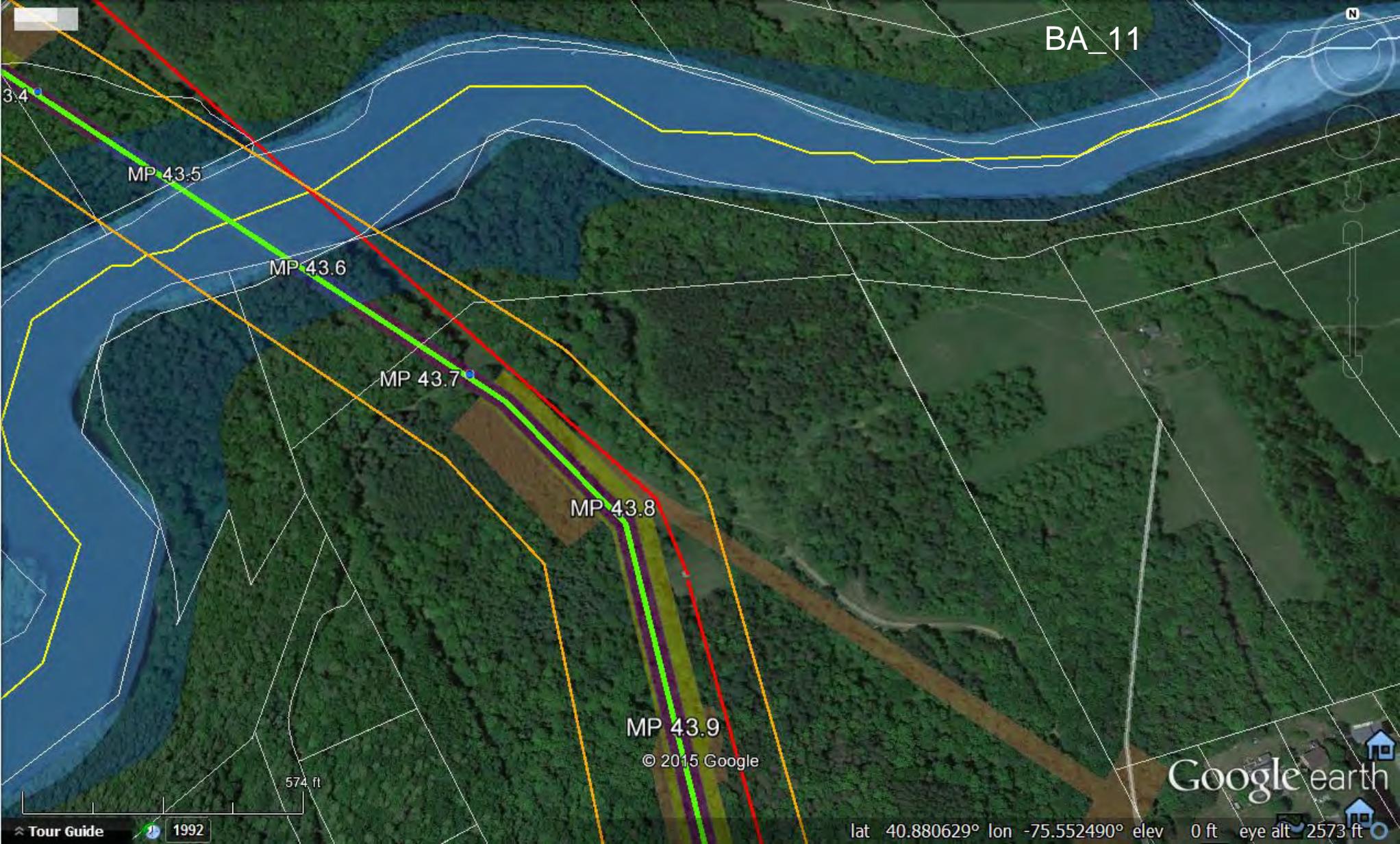
© 2015 Google

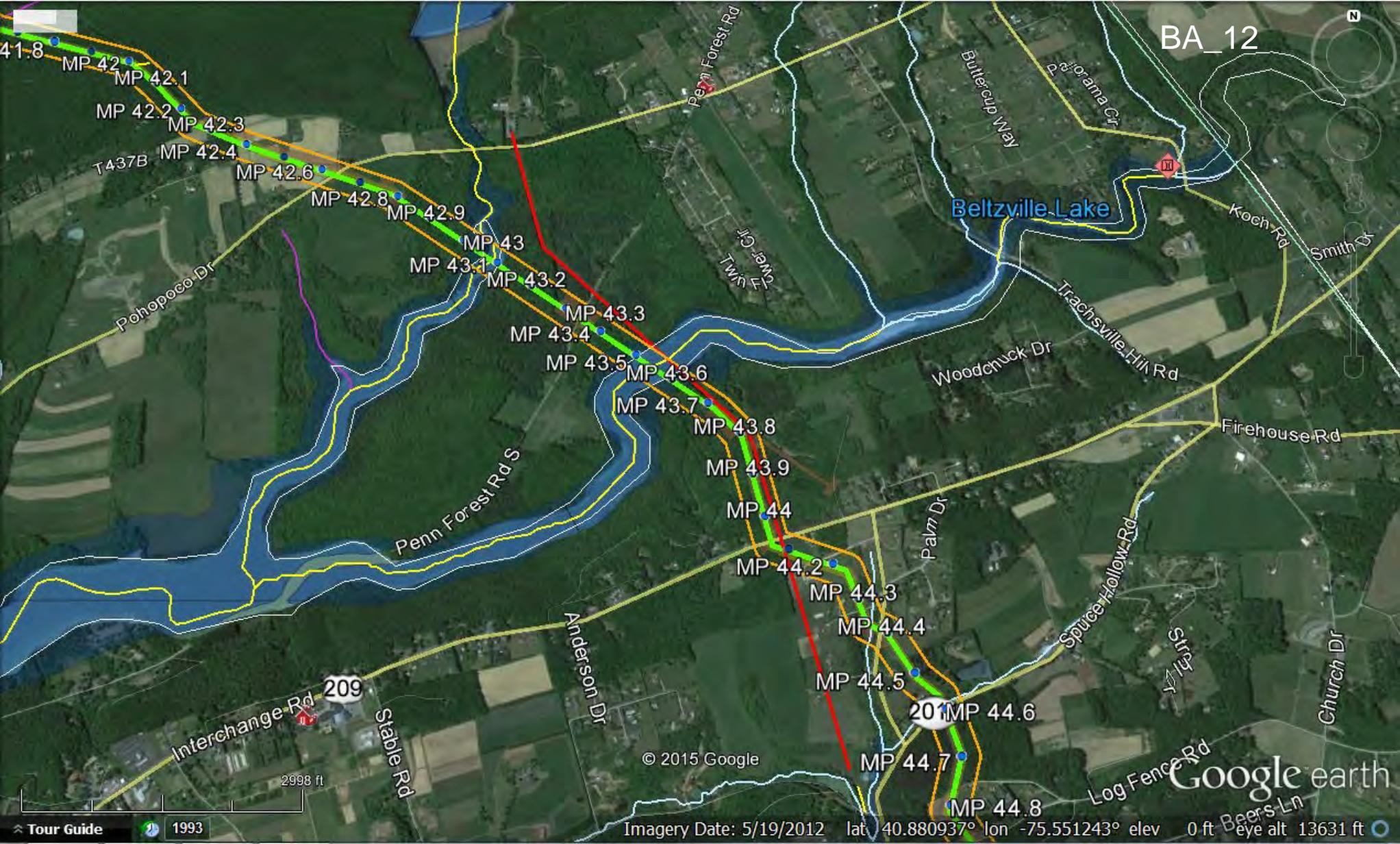
Google earth

Tour Guide 1992

lat 40.880629° lon -75.552490° elev 0 ft eye alt 2573 ft

574 ft





Beltzville Lake

209

201

© 2015 Google

Google earth

2998 ft

Interchange Rd

Stable Rd

Anderson Dr

Palm Dr

Spicer Hollow Rd

Log Fence Rd

Beers Ln

Church Dr

Firehouse Rd

Trachsville Hill Rd

Woodchuck Dr

Koch Rd

DeJorama Cr

Buttercup Way

Penn Forest Rd

J.D. J.W. Co. Twp. Pa.

Penn Forest Rd S

Pohopoco Dr

T437B

MP 42.1

MP 42.2

MP 42.3

MP 42.4

MP 42.6

MP 42.8

MP 42.9

MP 43

MP 43.1

MP 43.2

MP 43.3

MP 43.4

MP 43.5

MP 43.6

MP 43.7

MP 43.8

MP 43.9

MP 44

MP 44.2

MP 44.3

MP 44.4

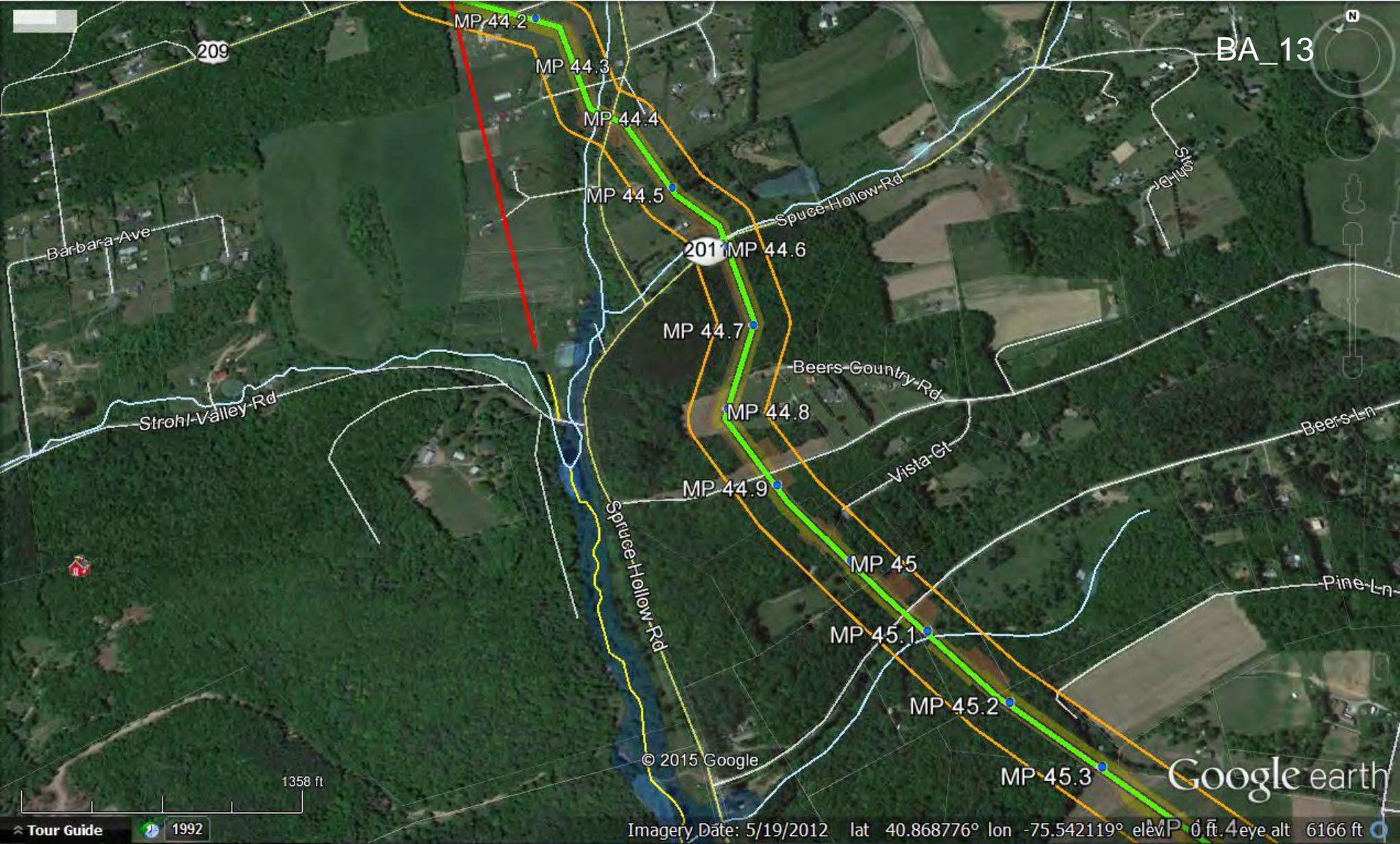
MP 44.5

MP 44.6

MP 44.7

MP 44.8





BA_13

209

MP 44.2

MP 44.3

MP 44.4

MP 44.5

201 MP 44.6

MP 44.7

MP 44.8

MP 44.9

MP 45

MP 45.1

MP 45.2

MP 45.3

Barbara-Ave

Strohl-Valley-Rd

Spruce-Hollow-Rd

Spruce-Hollow-Rd

Beers-Country-Rd

Vista-Gt

Beers-Ln

Pine-Ln

© 2015 Google

Google earth

Tour Guide

1992

Imagery Date: 5/19/2012 lat 40.868776° lon -75.542119° elev 0 ft.4 eye alt 6166 ft

BA_14



MP 43.2

MP 43.3

MP 43.4

MP 43.5

MP 43.6

MP 43.7

MP 43.8

MP 43.9

Penn Forest Rd

James Ln

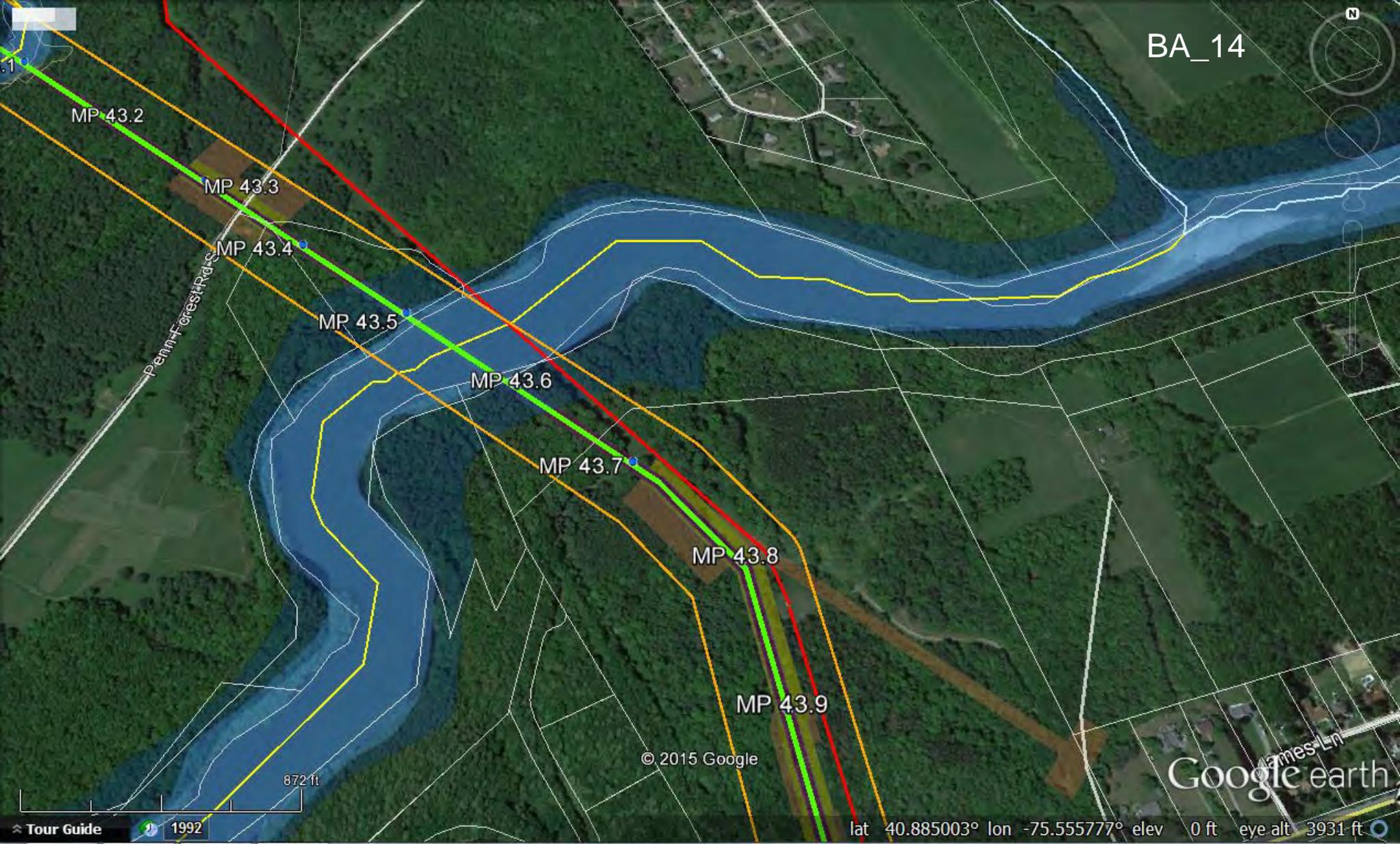
© 2015 Google

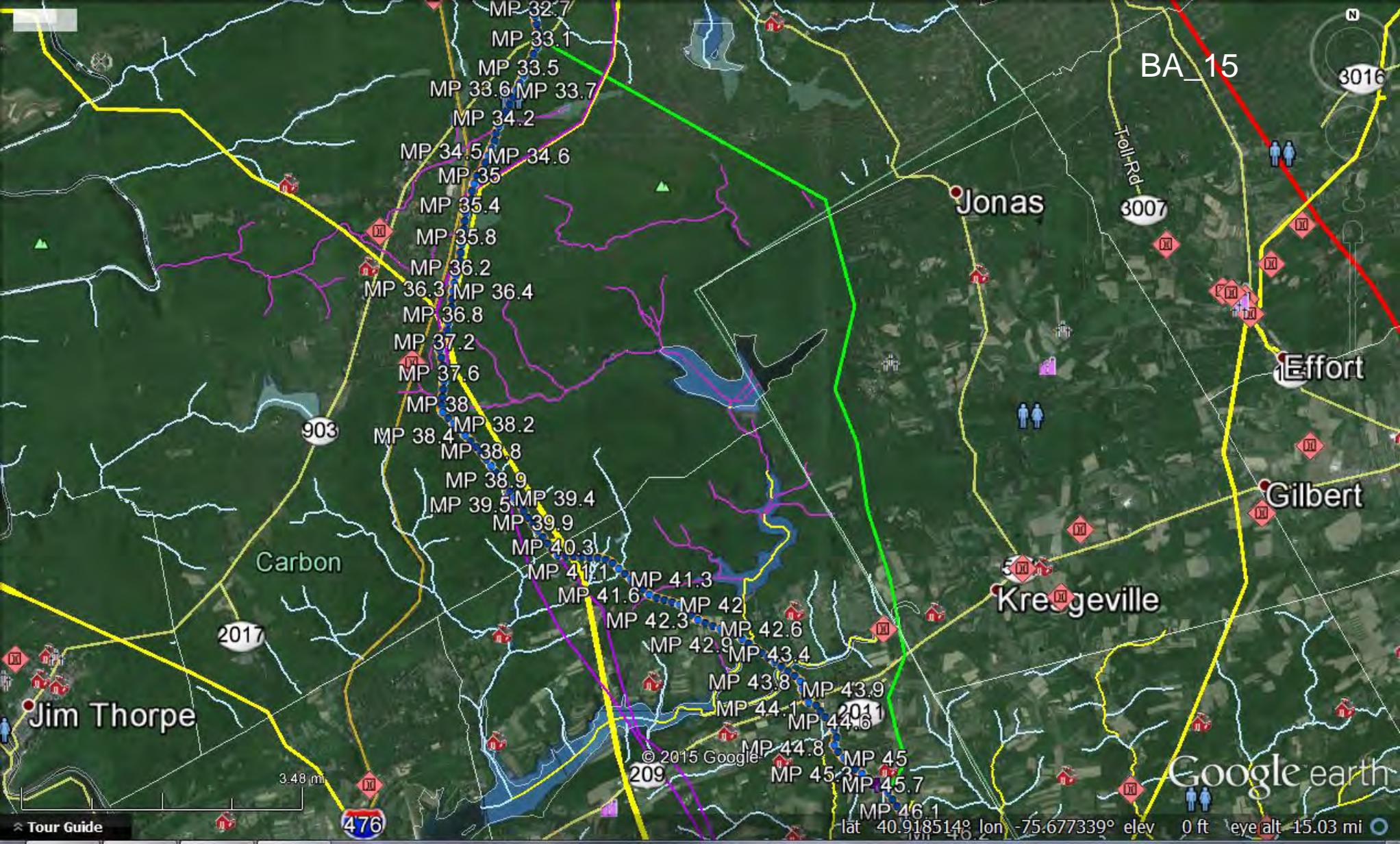
Google earth

872 ft

lat 40.885003° lon -75.555777° elev 0 ft eye alt 3931 ft

Tour Guide 1992





MP 32.7
MP 33.1
MP 33.5
MP 33.6 MP 33.7
MP 34.2

MP 34.5 MP 34.6
MP 35
MP 35.4
MP 35.8
MP 36.2
MP 36.3 MP 36.4
MP 36.8
MP 37.2
MP 37.6
MP 38
MP 38.2
MP 38.4 MP 38.8
MP 38.9
MP 39.5 MP 39.4
MP 39.9
MP 40.3

MP 41.1 MP 41.3
MP 41.6 MP 42
MP 42.3 MP 42.6
MP 42.9 MP 43.4
MP 43.8 MP 43.9
MP 44.1 MP 44.6
MP 44.8 MP 45
MP 45.3 MP 45.7
MP 46.1

BA_15

3016

3007

903

2017

476

209

201

Jim Thorpe

Carbon

Jonas

Effort

Gilbert

Kreggeville

Google earth

3.48 mi

Tour Guide

lat 40.9185148 lon -75.677339° elev 0 ft eye alt 15.03 mi



308 Egypt Road · Tafton, PA 18464
570-390-4286
email: rrwilderdmuth@gmail.com

**Proposed Penn East Pipeline Footprint
Impact on Timber Related Revenue and Costs**

on Bethlehem Authority Lands in Penn Forest & Towamensing Twps., Carbon County

PURPOSE OF APPRAISAL

The purpose of this report is to estimate the current market value of timber, associated costs and loss of timber related revenue including carbon credit revenue on the footprint of approximately 44 acres proposed for clearing as part of the Penn East Pipeline Project.

INTENDED USER/FUNCTION OF APPRAISAL

The client and intended user of this report is Bethlehem Authority, 10 East Church Street, Bethlehem, PA 18018 and any designee. The function of this report is restricted to the parties referenced for their use in valuing the timber and timber related impacts on the subject property for planning purposes.

PROPERTY RIGHTS APPRISED

The purpose of this report is to establish an estimate of timber related fair market value and potential damages from the proposed subject project. Rights include impacts on a Carbon Trading Contract currently in place and intended to be extended through the Working Woodlands Program for the foreseeable future under a 60 year Conservation Easement on the Bethlehem Authority lands.

DATE OF VALUE ESTIMATE

The report establishes an estimate of timber related revenue and cost impacts as of June 29, 2015.

CERTIFICATION:

I certify that to the best of my knowledge:

- The statements of fact contained in this report are true and correct.
- The report, analysis, opinions, and conclusions are limited only by the reported assumptions and limiting conditions, and are based on my professional experience and unbiased analysis, opinions, and conclusions (including other timber valuations of this type and purpose).
- My engagement for this assignment was not contingent on reporting predetermined results and my compensation for completing this project is not contingent on reporting a predetermined value that favors the cause of a client.
- I have personally inspected the subject property.

BACKGROUND

The Bethlehem Authority (BA) owns approximately 13,800 acres in Carbon County and the western corner of Monroe County known as the Wild Creek Tract. This property is the location of the two reservoirs, namely the Wild Creek and Penn Forest, and the associated watersheds which supply high quality drinking water to the City of Bethlehem. In 2012 the BA entered the Working Woodlands Program through the Nature Conservancy (TNC) which included a Forest Stewardship Council (FSC) approved Forest Management Plan on the property, a 60 year Conservation Easement to protect the watershed, and development of carbon trading projects which integrate with the FSC Management Plan on the property's timber resources. Woodland Management Services, Inc. (WMS) completed two forest inventories in cooperation with TNC foresters, the first in 2011 which served as a basis for the FSC Management Plan and a second in 2013 which served as a basis for the Carbon Trading Contracts which have ensued. WMS has continued to implement the FSC Management Plan with ongoing budgeted timber harvests which are limited under the carbon trading contracts to a fraction of the net forest growth on the property in order to fulfill requirements for carbon capture by the forest.

Over the past 3 years, the BA Forest Management Plan has generated timber revenue of approximately \$124,000/yr while pursuing silvicultural management to increase the growth rates and health of the forest in pursuit of increased carbon capture and carbon trading revenues. Each year, budgeted harvests are verified through a third party audit process and calculations are completed on projected growth, removals, and associated carbon credits as VCU's (Voluntary Carbon Units). The proposed pipeline project will clear forestland on the subject property with loss of the value of the forest products and prevent use of the footprint for future value growth of forest products. The removal of the tons of wood fiber will result in an initial debit against the calculated VCU's, costing the BA revenue in year one of the carbon contract and also the loss of future carbon capture credits with the acres removed from the carbon project. In addition, the episode of conversion from forest timber types to pipeline land use will require mapping, acreage adjustments and verification during the following audit period which will add to verification costs in the year following construction. The following assessment will estimate the combined timber revenue and cost impacts of the Penn East Pipeline Proposal on the BA forest resource.

PROCEDURES

To calculate the acres affected by the Penn East Proposal and the associated standing timber volumes, we used one of the screen shots provided by the company of the current approximate path of the proposed pipeline to digitize a 100 foot wide pipeline shapefile within ArcGIS software to represent the permanent and temporary construction footprint that would be cleared. This shapefile was then overlaid on the forest stands layer created during the past forest inventory efforts on the property to allow estimates of each forest type affected and the standing timber volumes estimated for each from those datasets. This allowed a calculation of the total sawtimber volume in units of thousand board feet (Mbf) and pulpwood in units of green tons. To assign values to the forest products, we used the price index published in the *PA Timber Market Report, Northeast Region, by the Penn State Cooperative Extension for the 1st quarter of 2015*. This index is based on survey data collected from sawmills, consulting foresters and Bureau of Forestry timber sales by time period and region of the state and is published at <http://extension.psu.edu/natural-resources/forests/timber-market-report>.

In addition to the loss of value in the current standing timber volumes, BA will also experience a loss in value of the future growth of the forest as it continues to grow toward a final harvest at maturity. To calculate this loss in value, it was assumed that the current management plan would preserve and manage the affected acres for an additional 20 years before the final harvest through a sequence of periodic thinnings and shelterwood cuts to withdraw some of the accumulated value of the stands. During this time period, biological growth is estimated to be 2% per year and sawtimber prices were escalated at 1.5% per year (based on 10 year price trends reported in Penn State Timber Market Report) to model annual increases in value over the 20 year period and the results discounted at 5% to arrive at a NPV (net present value) of this future value stream. The estimated value of the standing timber on the footprint of the proposed pipeline along with the NPV of the lost future growth is \$63,195. Results of this analysis are included in the Appendices.

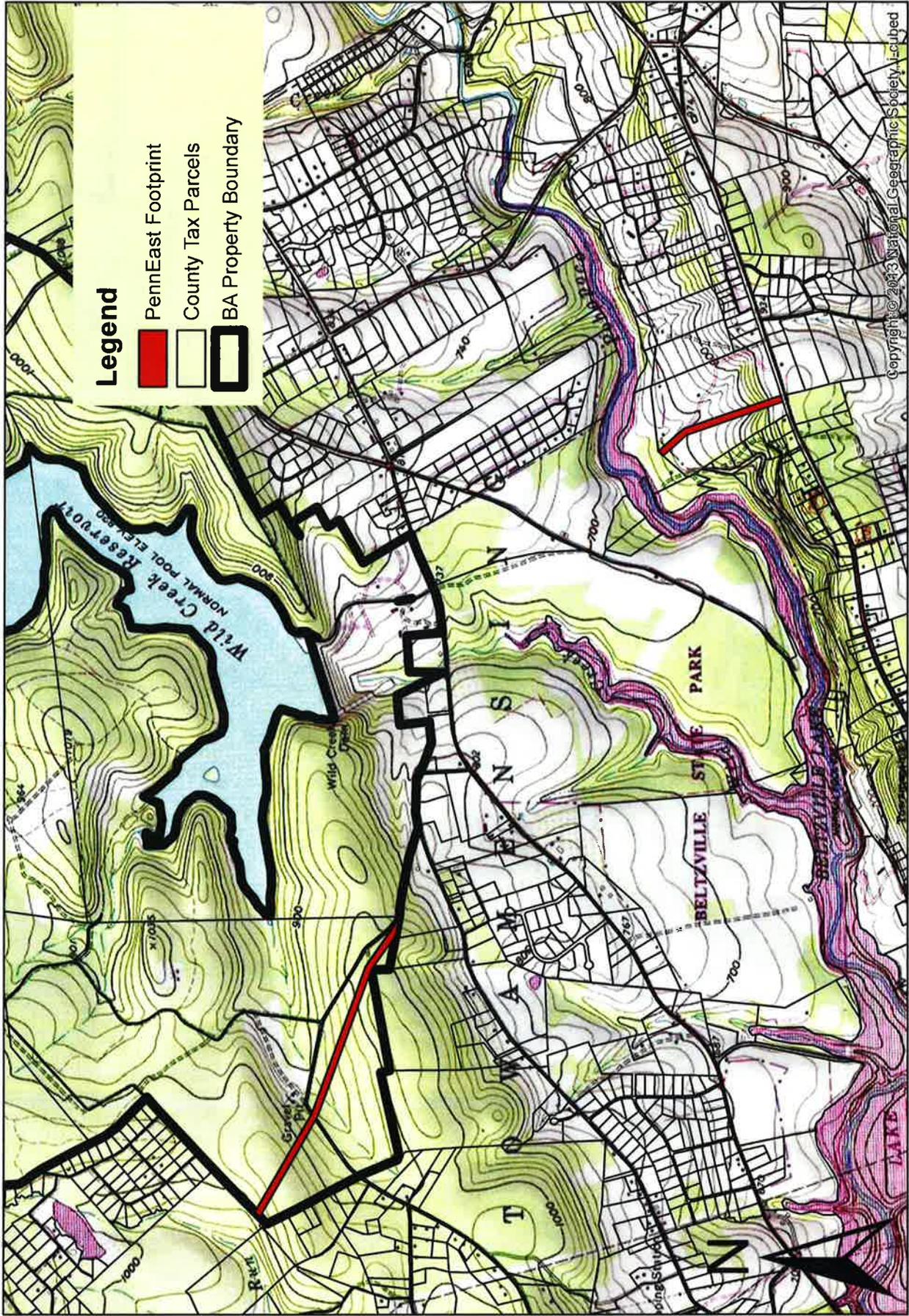
To estimate the impact on the carbon trading contracts from the conversion of the affected acres to non-forested land use, we used the estimated total green tons on the footprint of the pipeline to anticipate the impact on Voluntary Carbon Units (VCU's) and total revenue through consultations with Blue Source, the Carbon Project developer. The largest impact would be in the year the pipeline was cleared, as any removals would be deducted from annual credits. Market value of the VCU's varies year to year based on negotiations with markets and contract valuations. For this analysis we assumed \$11/VCU with an annual escalation of 3% in the market value based on recent trends. This event of pipeline construction would also require detailed mapping and reporting of the change in total standing tons, the adjustments to forest type acres in the carbon model, and audit and verification of the activities and calculations. This was estimated at an incremental project cost of \$3,000 during the first year following construction. The project developer also estimated that there would be a net loss of 80 VCU's per year based on the loss of acreage going forward and BA would see reduced revenues over an extended time period. We used a 30 year analysis period and a 5% discount rate to calculate the NPV of this lost future revenue. Total lost revenue/costs estimated for the carbon trading contracts for the proposed pipeline clearing are estimated at \$88,289. Results of this analysis are included in the Appendices.

CONCLUSIONS

We examined the anticipated loss of forest cover and value, both current and future for the anticipated footprint of the proposed Penn East Pipeline across the BA Wild Creek property. We estimated approximately 40 acres of mixed oak and red maple forests would be cleared with impacts on current standing timber value, future timber growth, carbon credit payments both current and future, and carbon reporting/auditing costs. The total NPV of these combined impacts is estimated at \$151,484.

APPENDICES

BA - Penn East Pipeline Footprint Wild Creek South



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Penn East Proposed Footprint - Timber Appraisal
Forest Product Component

6/29/2015

Current Standing Volume Estimates

Forest Type	Acres	Estimated Mbf Sawtimber	Estimated \$/Mbf #	Estimated Tons Pulpwood	Estimated \$/Ton	Total Value
Dry Oak	31	71.9	\$358	1147	\$4.00	\$30,328
Mixed Oak	8	26.1	\$358	406	\$4.00	\$10,968
Red Maple	1	2.7	\$257	28	\$4.00	\$806
TOTALS	40	100.7		1581		\$42,102

- Timber Prices from PA Timber Market Report, 1st Quarter 2015, Penn State Coop Extension

NPV of Loss of Timber Growing Potential on 40 Acres of Maturing Forestland

- Assume:
- 2% Growth Rate of Current Standing Timber Volumes
 - 1.5% Escalation Rate of Sawtimber Prices (Avg 10 year escalation Mixed Oak and Soft Maple)
 - 5% Discount Rate in Calculation of NPV of Future Growth
- Growth Period of 20 Years to Timber Maturity and Regeneration of Forest

NPV of 40 Acres of Timber Growth over 20 Years: **\$21,093**

Total Timber Value \$63,195

Penn East Proposed Footprint - Timber Appraisal
Carbon Revenue Component

Initial Conversion of 42 Acres to Pipeline Use

Green Tons of wood cleared and removed would be a debit against Carbon Storage Credits on Property

Project Loss Year 1 6,000 VCU's \$11/VCU Total **\$66,000**

Incremental reporting/auditing costs of the land clearing activity throug **\$3,000**

Project Loss Future Years (based on 30 year revenue stream)

80 VCUs/yr \$11/VCU escalating at 3% per year

NPV of 30yr Cashflow Total **\$19,288.99**

Carbon Credit Revenue Loss TOTALS **\$88,288.99**

Timber Growth NPV

Carbon Credit Loss

Timber Growth NPV				Carbon Credit Loss			
Year 0	MBF	Price	Value	Year	VCU's	Price	Revenue
	100.7	\$355	\$35,748.50	1	80	\$11.00	\$880
1	102.714	\$360	\$37,010.42	2	80	\$11.33	\$906
2	104.7683	\$366	\$38,316.89	3	80	\$11.67	\$934
3	106.8636	\$371	\$39,669.48	4	80	\$12.02	\$962
4	109.0009	\$377	\$41,069.81	5	80	\$12.38	\$990
5	111.1809	\$382	\$42,519.57	6	80	\$12.75	\$1,020
6	113.4046	\$388	\$44,020.51	7	80	\$13.13	\$1,051
7	115.6726	\$394	\$45,574.44	8	80	\$13.53	\$1,082
8	117.9861	\$400	\$47,183.22	9	80	\$13.93	\$1,115
9	120.3458	\$406	\$48,848.78	10	80	\$14.35	\$1,148
10	122.7527	\$412	\$50,573.15	11	80	\$14.78	\$1,183
11	125.2078	\$418	\$52,358.38	12	80	\$15.23	\$1,218
12	127.7119	\$424	\$54,206.63	13	80	\$15.68	\$1,255
13	130.2662	\$431	\$56,120.12	14	80	\$16.15	\$1,292
14	132.8715	\$437	\$58,101.16	15	80	\$16.64	\$1,331
15	135.5289	\$444	\$60,152.13	16	80	\$17.14	\$1,371
16	138.2395	\$450	\$62,275.50	17	80	\$17.65	\$1,412
17	141.0043	\$457	\$64,473.83	18	80	\$18.18	\$1,455
18	143.8244	\$464	\$66,749.75	19	80	\$18.73	\$1,498
19	146.7009	\$471	\$69,106.02	20	80	\$19.29	\$1,543
20	149.6349	\$478	\$71,545.46	21	80	\$19.87	\$1,589
				22	80	\$20.46	\$1,637
				23	80	\$21.08	\$1,686
				24	80	\$21.71	\$1,737
				25	80	\$22.36	\$1,789
				26	80	\$23.03	\$1,843
				27	80	\$23.72	\$1,898
				28	80	\$24.43	\$1,955
				29	80	\$25.17	\$2,013
				30	80	\$25.92	\$2,074

Incremental Value Growth

Year 0	MBF	Price	Value	Incremental Value Growth
	100.7	\$355	\$35,748.50	
1	102.714	\$360	\$37,010.42	\$1,261.92
2	104.7683	\$366	\$38,316.89	\$1,306.47
3	106.8636	\$371	\$39,669.48	\$1,352.59
4	109.0009	\$377	\$41,069.81	\$1,400.33
5	111.1809	\$382	\$42,519.57	\$1,449.76
6	113.4046	\$388	\$44,020.51	\$1,500.94
7	115.6726	\$394	\$45,574.44	\$1,553.92
8	117.9861	\$400	\$47,183.22	\$1,608.78
9	120.3458	\$406	\$48,848.78	\$1,665.57
10	122.7527	\$412	\$50,573.15	\$1,724.36
11	125.2078	\$418	\$52,358.38	\$1,785.23
12	127.7119	\$424	\$54,206.63	\$1,848.25
13	130.2662	\$431	\$56,120.12	\$1,913.49
14	132.8715	\$437	\$58,101.16	\$1,981.04
15	135.5289	\$444	\$60,152.13	\$2,050.97
16	138.2395	\$450	\$62,275.50	\$2,123.37
17	141.0043	\$457	\$64,473.83	\$2,198.33
18	143.8244	\$464	\$66,749.75	\$2,275.93
19	146.7009	\$471	\$69,106.02	\$2,356.27
20	149.6349	\$478	\$71,545.46	\$2,439.44

NPV @5% = \$21,092.99

NPV @ 5% for 30 yrs \$19,288.99



Pennsylvania Woodlands

TIMBER MARKET REPORT

Courtesy of The Pennsylvania State University
Cooperative Extension

1st Quarter
2015
January-March

Pulpwood Stumpage...

Private and Other Public Pulpwood Stumpage

Region	Hardwood Pulp (\$/ton)			
	Low	Avg	High	(n)#
Northeast	*	\$4.13	*	2
Southeast	*	\$3.25	*	2
Northwest	\$0.83	\$2.15	\$4.50	13
Southwest	*	\$4.00	*	2

	Softwood Pulp (\$/ton)			
	Low	Avg	High	(n)#
	^	^	^	1
	^	^	^	1
	\$0.83	\$4.25	\$10.00	6
	^	^	^	1

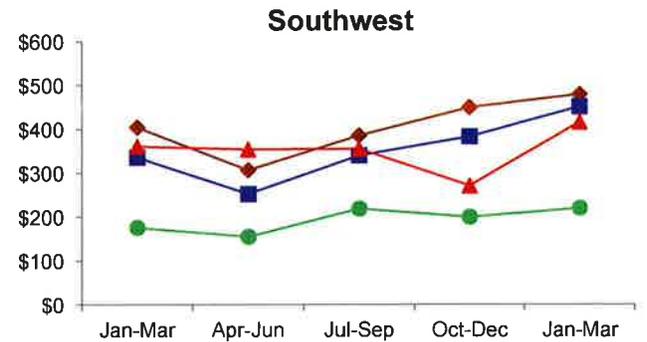
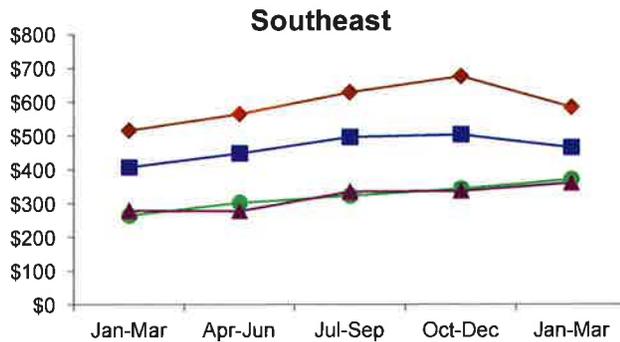
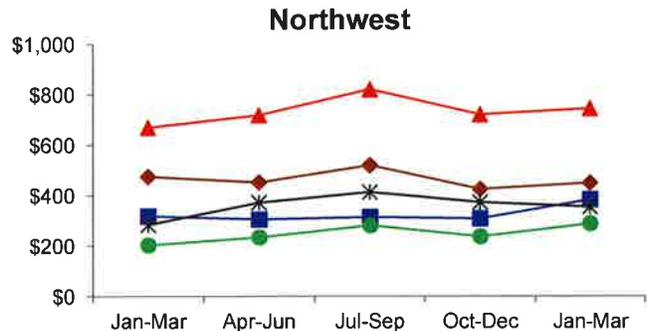
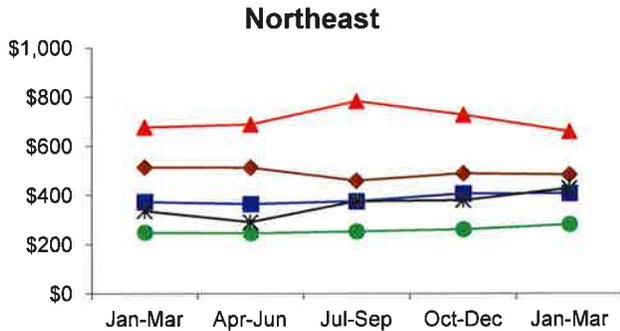
Bureau of Forestry Pulpwood Stumpage

Region	Hardwood Pulp (\$/ton)			
	Low	Avg	High	(n)#
Northeast	\$1.62	\$4.64	\$13.29	9
Southeast				0
Northwest	\$7.28	\$7.92	\$8.57	3
Southwest	\$1.73	\$4.85	\$6.24	5

	Softwood Pulp (\$/ton)			
	Low	Avg	High	(n)#
	\$2.14	\$6.71	\$17.51	9
				0
	\$9.59	\$10.44	\$11.30	3
	\$2.28	\$6.28	\$8.23	5

^ No prices are reported for samples with only a single respondent.

* Ranges are not reported for samples with fewer than three respondents.



◆ No. Red Oak ■ White Oak ▲ Black Cherry ● White Ash ✱ Hard Maple

Pennsylvania Woodlands
TIMBER MARKET REPORT

January-March 2015

Stumpage Prices

(\$ per MBF International 1/4")

Species by Region	Minus 1 Std Dev	Average	Plus 1 Std Dev	N#
NORTHEAST				
Northern Red Oak	\$377	\$483	\$588	12
White Oak	\$285	\$407	\$529	11
Mixed Oak	\$277	\$358	\$439	11
Black Cherry	\$146	\$659	\$1,173	4
White Ash	\$189	\$280	\$370	5
Hard Maple	\$340	\$428	\$516	3
Soft Maple	\$171	\$257	\$343	13
Yellow-Poplar	\$196	\$259	\$321	4
Misc. Hardwoods	\$39	\$53	\$66	2
White Pine	\$62	\$181	\$300	2
Hemlock	\$24	\$137	\$250	3
SOUTHEAST				
Northern Red Oak	\$480	\$584	\$688	6
White Oak	\$368	\$464	\$561	6
Mixed Oak	\$344	\$445	\$546	6
Black Cherry	\$674	\$695	\$715	2
White Ash	\$356	\$370	\$384	2
Hard Maple	\$0	\$560	\$0	1
Soft Maple	\$210	\$262	\$314	3
Yellow-poplar	\$303	\$360	\$417	2
Misc. Hardwoods	\$192	\$226	\$260	6
White Pine	\$0	\$0	\$0	0
Hemlock	\$0	\$0	\$0	0
NORTHWEST				
Northern Red Oak	\$273	\$450	\$627	14
White Oak	\$237	\$383	\$529	8
Mixed Oak	\$0	\$506	\$1,171	11
Black Cherry	\$443	\$745	\$1,047	19
White Ash	\$209	\$286	\$364	11
Hard Maple	\$223	\$354	\$486	12
Soft Maple	\$176	\$263	\$350	19
Yellow-poplar	\$74	\$124	\$173	10
Misc. Hardwoods	\$21	\$80	\$140	14
White Pine	\$25	\$57	\$89	5
Hemlock	\$2	\$67	\$133	7
SOUTHWEST				
Northern Red Oak	\$359	\$479	\$599	8
White Oak	\$359	\$451	\$542	6
Mixed Oak	\$188	\$321	\$454	8
Black Cherry	\$256	\$416	\$576	6
White Ash	\$80	\$219	\$358	4
Hard Maple	\$123	\$303	\$484	4
Soft Maple	\$122	\$227	\$333	7
Yellow-poplar	\$131	\$221	\$312	6
Misc. Hardwoods	\$9	\$97	\$186	4
White Pine	\$13	\$64	\$115	2
Hemlock	\$23	\$39	\$55	2

#n is the number of responses used to calculate the price statistics.

Conversion Factors:

Doyle Price = 1.695 x International 1/4" Price | Scribner Price=1.159 x International 1/4" Price

Document Content(s)

Final Maser Report 062216 (1).PDF.....1-16

FERC DEIS Letter 090916.PDF.....17-15

Preliminary NG Pipeline Impact Study Report.docx 071015.PDF.....16-69