



Geological Data Report Interstate 80 Crossing

PennEast Pipeline Project

August 5th, 2019

PennEast Pipeline Project
353754-MM-E-E-028 RevD

1001 Corporate Drive
Suite 100
Canonsburg, PA 15317
724-514-5576

One Meridian Blvd.
Suite 2C01
Wyomissing, PA 19610
610-373-7999

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Executive summary

The following summary of the geological conditions at the Interstate 80 HDD Crossing is based on our completed subsurface investigation program and background geological research. Four borings (B-I80-1 through B-I80-4) were completed to depths of between 115ft and 220ft below ground surface.

The ground conditions encountered during the investigation were relative consistent across all holes. Around 100ft of soils over glacial till was observed atop the bedrock. The till contained granular and cohesive units and was generally of dense and stiff consistency. Some low strength layers were encountered within the till and layers of dense gravels/cobbles can also be expected within the till. Bedrock conditions consisted of interbedded sandstone, mudstone and sandstone. High core recovery and RQD values were obtained in the majority of rock coring.

1 Introduction

As requested by the PennEast Pipeline Company, LLC. (PennEast), Mott MacDonald has conducted a subsurface investigation for the proposed 115 mile, 36-inch diameter high pressure natural gas pipeline that spans from Luzerne County, Pennsylvania to Mercer County, New Jersey. The purpose of the subsurface investigation is to gather information for the design and proposed construction of the pipeline via Horizontal Directional Drilling (HDD) methods.

This report summarizes information gathered from our desktop study and the findings from our subsurface investigation conducted during the months of April, October, and December 2016 along the proposed HDD alignment crossing Interstate 80 (I-80) in Kidder Township, Pennsylvania.

2 Subsurface Exploration Program

2.1 Boring Locations

Four borings (B-I80-1 through B-I80-4) were scheduled along the proposed 3,000 feet pipeline alignment, which extends northwest to southeast of I-80 crossing area. Two of the proposed borings, B-I80-1 and B-I80-2, are located on the north side of the I-80 crossing, and the two remaining borings, B-I80-3 and B-I80-4, are located on the south side of I-80 crossing. All four borings, B-I80-1 through B-I80-4, have been completed, and can be used for general characteristics of the soils and rocks in the immediate area.

A Locus Map and Boring Location Plan are provided in Attachments A and B, respectively.

2.2 Sampling Activities

Drilling and sampling activities were conducted by Craig Test Boring Co. Inc. of Mays Landing, New Jersey, and overseen and logged by a qualified Mott MacDonald geotechnical representative under the direction of a Professional Engineer licensed in the Commonwealth of Pennsylvania. Soil and rock samples were taken in accordance with the American Society of Testing and Material (ASTM) D1586-99 and ASTM D2113, respectively. Soil samples were typically taken at 5 foot intervals using a standard 2-inch split spoon. The Standard Penetration Test (SPT) was also performed at each split spoon sample to obtain an N-Value¹. Soils were classified in the field in accordance with the ASTM D2488 classifications. Upon split spoon or roller bit refusal, rock coring began and proceeded until proposed termination depth of the boring.

Rock coring was completed using NQ-series core equipment and retrieved with a double-barrel NQ series wireline setup. Rock cores were measured for recovery and RQD², logged for discontinuities, and were described based on type, color, hardness, weathering, and dip angle. Boring and coring logs, as well as core photos of the completed borings are provided in Attachment C. A boring schedule is presented in Table 1 below.

Table 1: Boring Elevations and Depths

Boring Number	Approximate Ground Surface Elevation ^a (feet)	Boring Termination Depth (feet)
B-I80-1	1,760	115
B-I80-2	1,762	160
B-I80-3	1,756	220
B-I80-4	1,758	220

^a Based on North American Vertical Datum of 1988

Upon completion, each borehole was grouted using a mixture of bentonite and Portland cement. Additionally, the work areas disturbed by the drill rig, vehicles, and other equipment were levelled to its previous grade, and then seeded and hayed as necessary.

¹ N-Value is the sum of the blows from the second and third 6 inches of penetration.

² RQD is Rock Quality Designation and is the percentage of rock core that is in pieces of larger than 4 inches.

3 Local Geology

3.1 Geology

The I-80 crossing site (HDD-14) extends across the Spechty Kopf Formation as per the Pennsylvania Department of Conservation and Natural Resources (PADCNR) geology maps. The Spechty Kopf Formation is of Mississippian and Devonian age, and is described as fine to medium grained, crossbedded sandstone, siltstone, and local polymictic diamictite, pebbly mudstone and conglomerate.

The PADCNR geology maps also indicate that there are no known faults within the immediate vicinity referencing a three-mile radius of the crossing area.

Although the proposed crossing alignment falls within the mapped outlines of the Spechty Kopf Formation, it is possible that other formations may encroach along the proposed pipeline alignment.

3.2 Karst Formations and Abandoned Mines

No known Karst features have been mapped on either side of I-80. According to the Pennsylvania Department of Environmental Protection (PADEP) Pennsylvania Abandoned Mine Land Inventory.

3.3 Surficial Geology

Surficial mapping from the Natural Resources Conservation Service (NRCS) Web Soil Survey database indicates that two major mapped units exist within the I-80 crossing alignment. These are the Morris Channery Silt Loam and Muck and Peat. The soils of the Morris Channery Silt Loam unit are somewhat poorly drained and are generally mapped as 51% silt, 33% sand, and 16% clay. Morris Channery Silt loam has a moderate rating for the corrosion of concrete, and a high rating for the corrosion of steel. The Muck and Peat unit consists of 84.5% organic content. The Muck and Peat unit has a moderate rating for the corrosion of concrete, and a high rating for the corrosion of steel. Refer to the geologic reference in Attachment D of this report.

3.4 Structural Geology

The bedrock at the proposed crossing of I-80 is part of a set of plunging folds. Consequently, the local strikes and dips vary with location relative to the crests and troughs. No bedrock exposures were available at the immediate site due to the soil cover. The area is mapped as a swampy area developed on a glacier-deposited end moraine. The angle of dip can be estimated from measured dips of bedding-planes observed in the vertical core samples, the strike can be inferred from published mapping of the bedrock structure.

Bedrock geological mapping of the area of the Black Creek HDD crossing (Sevon 1975) shows that the crossing is mid-way between a synclinal fold axis to the northwest and an anticlinal axis to the southeast. These axes are parallel and trend N65°E. In the cross sections, the folds are shown as more or less symmetrical, consequently, the axes will be approximately vertical. The folds are plunging to the southwest and the crossing is generally located on the north west flank of the plunging anticline.

Fracture orientations measured within boreholes include bedding planes and joints. Some of the boreholes drilled recovered highly fractured rock which makes the identification and isolation of specific joint sets and bedding orientations challenging. The average dip angle across all the fractures measured was 17 degrees. Isolating the bedding fracture orientations and prioritizing the boreholes which are closer to the crossing an average representative angle of 30 degrees is recommended for overall bedding orientation.

Based upon review of published documents and project boreholes an average bedrock strike and dip of N60°E, 30° NW is presented (dip-dip direction : 30-330).

4 Subsurface Description

The subsurface conditions encountered during our investigation are provided below.

4.1 North of Interstate 80

The major strata encountered during the subsurface investigation on the North side of I-80 (B-I80-1 and B-I80-2) are described below, and presented in the approximate order found, from existing ground surface to the bottom of the exploration.

- > **TOPSOIL:** Was encountered at the top of the subsurface investigation for both borings B-I80-1 and B-I80-2. The topsoil was approximately 5 to 6 inches thick and contained roots.
- > **GLACIAL TILL:** Was encountered below the topsoil in both borings. The glacial till consisted of gravel, sand, silt, and clay. The silt and clay strata were characterized as soft to hard in terms of consistency, and the sand and gravel strata were characterized as medium dense to very dense in terms of relative density. The thickness of this stratum was approximately 80 feet in boring B-I80-1, and 100 feet in boring B-I80-2.
- > **MUDSTONE:** Was encountered beneath the glacial till stratum at 80 feet below ground surface (BGS) in boring B-I80-1. The Mudstone was generally described as reddish brown to brownish yellow, medium to fine grained, highly to completely weathered, very weak to weak rock. The dip angles of discontinuities ranged from 0 to 83 degrees. The rock core recovery values ranged from 92 to 100% and the RQDs ranged between 0% and 7%. The thickness of this stratum was 20 feet.
- > **SILTSTONE:** Was encountered beneath the glacial till at 100 feet BGS in borings B-I80-1 and B-I80-2. In boring B-I80-1, the Siltstone was described as pebbly, olive gray to reddish brown, medium to fine grained, highly weathered, weak rock. Boring B-I80-1 was terminated in this stratum at 115 feet BGS. A 5-foot thick Siltstone stratum was encountered in boring B-I80-2, and it was described as yellowish red to reddish brown, medium to fine grained, highly weathered, weak rock. The dip angles of discontinuities ranged from 10 to 89 degrees. The rock core recovery values ranged from 87 to 100%, and the RQDs ranged between 0 and 13%.
- > **SANDSTONE:** Was encountered below the Siltstone in boring B-I80-2. This stratum was generally described as olive gray to reddish brown, medium to fine grained, moderately weathered to fresh, strong to very strong Sandstone. The Sandstone was also described to be partly conglomerate. This stratum was encountered at 135 feet BGS and at 145 feet BGS. The dip angles of discontinuities ranged from 0 to 67 degrees. The rock core recovery values ranged between 97 to 100%, and the RQDs ranged between 60 and 100%, with lower RQDs from 15 to 35% observed between 125 feet and 135 feet BGS. Boring B-I80-2 was terminated in this stratum at 160 feet BGS.
- > **SANDY SILTSTONE:** Was encountered from 135 to 145 feet BGS in boring B-I80-2. It was generally described as olive gray to reddish brown, medium to fine grained, slightly weathered to fresh, strong Sandy Siltstone. The Sandy Siltstone was also described to be partly conglomerate. The dip angles of discontinuities ranged from 2 to 71 degrees. The rock core recovery values were 100%, and the RQDs ranged from 70 to 88%. The thickness of this stratum was 10 feet.

4.2 South of Interstate 80

The major strata encountered during the subsurface investigation on the south side of I-80 (B-I80-3 and B-I80-4) are described below, and presented in the approximate order found, from existing ground surface to the bottom of the exploration.

- > **TOPSOIL:** Was encountered below the ground surface in boring B-I80-4. The thickness of the topsoil was approximately 3 inches.
- > **GLACIAL TILL:** Was encountered below the topsoil in both borings. The glacial till consisted of gravel, sand, silt, and clay. The silt and clay strata were characterized as soft to hard in terms of consistency, and the sand and gravel strata were characterized as medium dense to very dense in terms of relative density. The thickness of this stratum was approximately 95 feet in boring B-I80-3, and 100 feet in boring B-I80-4.
- > **SANDSTONE:** Was encountered beneath the glacial till approximately at 95 feet BGS in B-I80-3, and below the Siltstone in boring B-I80-4 at 115 feet BGS. The Sandstone was generally described as reddish brown to dark gray, very fine to coarse grained, highly weathered to fresh, weak to very strong rock. A 2-foot layer of conglomerate was observed at 131 feet BGS in B-I80-3, and it was described as red and white, fine grained, fresh, medium strong rock. The dip angles of discontinuities typically ranged from 0 to 40 degrees. The rock core recovery values ranged from 62 to 75% in the top 10 feet of bedrock, but the rock core values were generally 100 percent in B-I80-3. The RQDs ranged from 0 to 100%, with RQDs predominately above 67%. Boring B-I80-3 was terminated in this stratum at 220 feet BGS.
- > **SILTSTONE:** Was encountered beneath glacial till in boring B-I80-4 approximately at 100 feet BGS and at 200 feet BGS. The Siltstone was described as reddish brown to greenish gray, fine to medium grained, slightly to highly weathered, weak to medium strong rock. The dip angles of discontinuities generally ranged between 0 to 35 degrees, but predominately ranging between 10 and 35 degrees. The rock core recovery values ranged from 95 to 100%, and the RQDs ranged from 23 to 82%. The thickness of this stratum ranged from 5 to 15 feet.
- > **QUARTZITE:** Was encountered beneath the Siltstone approximately at 205 feet BGS in B-I80-4. This stratum was generally described as gray, fine grained, fresh, very strong rock. The dip angles of discontinuities ranged from 5 to 80 degrees. The rock core recovery values were 100 percent, and the RQDs ranged from 62 to 90%. Boring B-I80-4 was terminated in this stratum at 220 feet BGS.

4.3 Ground Water

Ground water observations were made during borehole drilling. The borehole logs record soil moisture observations and periodic ground water measurements. During multiple day drilling, whenever possible, a ground water measurement was made each morning prior to recommencing drilling, this allows water levels to re-stabilize overnight.

See borehole logs for detailed ground water observations. Boreholes encounter perched water during shallow drilling (around 10ft to 40ft depth) and a deeper water was then encountered at (around 85ft to 120ft depth) when rock coring.

5 Laboratory Testing

As directed by Mott MacDonald, soil and rock core samples were submitted to Craig Testing Laboratories, Inc. of Mays Landing, NJ, and TerraSense, LLC of Totowa, NJ.

5.1 Soil Testing Program

The following tests were performed by Craig Testing Laboratories, Inc.:

- > ASTM D4318 – Atterberg Limits
- > ASTM D422 – Grain Size Analysis
- > ASTM D422 – Grain Size Analysis with Hydrometer
- > ASTM D2937 – Unit Weight Determination
- > ASTM D2216 – Water Content

5.2 Soil Testing Results

The results below are a summary of the laboratory testing performed for the initial investigation. Complete testing results are provided in Attachment E.

Table 2a: Soil Testing Results

Boring No.	Sample	Depth	% Passing No. 4	% Passing No. 10	% Passing No. 40	% Passing No. 200	% Clay	% Silt	Water Content (%)
B-I80-1	S-9	40' – 42'	77.5	70.3	55.0	34.5	10.9	23.6	N/A
	S-10	45' – 47'	70.1	64.8	53.3	37.5	13.0	24.5	14.6
	S-11	50' – 52'	82.6	76.1	60.0	43.2	19.7	23.5	12.6
	S-12	55' – 57'	76.4	71.6	61.8	46.3	N/A	N/A	15.7
	S-13	60' – 62'	79.2	73.4	59.2	44.1	19.6	24.5	13.7
	S-14	65' – 67'	88.3	82.6	70.8	54.3	25.4	28.9	N/A
B-I80-4	S-2	5' -7'	87.8	82.4	67.0	38.5	15.3	23.2	N/A
	S-4	15' – 17'	89.2	83.1	69.0	47.3	19.4	27.9	N/A
	S-7	30' – 32'	85.0	77.3	63.0	40.9	18.4	22.5	N/A
	S-9	40' – 42'	78.6	72.8	61.4	40.7	19.9	20.8	N/A
	S-11	50' – 52'	85.1	76.1	61.8	43.6	22.5	21.1	N/A
	S-14	65' - 67'	89.9	82.2	68.1	47.3	24.4	22.9	N/A
	S-15	70' – 72'	77.0	70.5	59.5	42.3	23.7	18.6	N/A
	S-17	80' – 82'	86.9	82.0	72.0	56.4	33.1	23.3	N/A
S-19	90' – 92'	98.5	97.0	89.0	73.2	22.6	50.6	N/A	

N/A: Test not performed

Table 3b: Soil Testing Results

Boring No.	Sample	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Water Content (%)
B-180-1	S-10	45' – 47'	28	15	13	14.6
	S-11	50' – 52'	29	16	13	12.6
	S-13	60' – 62'	27	15	15	13.7

5.3 Rock Testing Program

The following tests were performed by Craig Testing Laboratories, Inc.:

- > **ASTM D7012 Method D- Uniaxial Compressive Strength of Rock**
- > **Unit Weight of Oven Dried Rock**

The following tests were performed by TerraSense, LLC:

- > **ASTM D5731 – Point Load Unconfined Compressive Strength of Rock – Diametral and Axial**
- > **ASTM D3967 – Splitting Tensile Strength**

5.4 Rock Testing Results

The results below are a summary of the laboratory testing performed for the initial investigation. Complete testing results are provided in Attachment E.

Table 4: Rock Testing Results

Boring No.	Run No.	Depth (feet)	Point Load Unconfined Compressive Strength of Rock – Diametral* (psi)	Point Load Unconfined Compressive Strength of Rock – Axial (psi)	Uniaxial Compressive Strength of Rock (psi)	Unit Weight of Oven Dried Rock (pcf)	Splitting Tensile Strength* (psi)
B-180-2	R-2	106.5' – 107.2'	21,149	8,639	N/A	N/A	N/A
	R-2	107.4' – 108.1'	N/A	N/A	7,803	N/A	N/A
	R-3	110.9' – 111.5'	N/A	N/A	N/A	171.4	N/A
	R-3	113.3' – 114.2'	N/A	N/A	N/A	171	1,431
	R-4	116' – 116.6'	9,095	6,849	N/A	N/A	N/A
	R-4	116.9' – 117.5'	N/A	N/A	6,603	N/A	N/A
B-180-3	R-19	185' – 185.7'	25,886	16,216	N/A	N/A	N/A
	R-19	185.7' – 186.4'	N/A	N/A	16,672	N/A	N/A
	R-20	190.3' – 190.4'	N/A	N/A	N/A	N/A	3,027
	R-20	190.4' – 190.5'	N/A	N/A	N/A	N/A	1,459
	R-20	191.3' – 192'	N/A	N/A	N/A	170	N/A
	R-21	195.3' – 196.1'	9,328	17,804	N/A	N/A	N/A
	R-21	196.1' – 197.7'	N/A	N/A	20,440	N/A	N/A
B-180-4	R-2	106.45' – 107.25'	5086	9002	N/A	N/A	N/A
	R-2	107.45' – 108.55'	N/A	N/A	5,713	N/A	N/A
	R-3	110.2' – 111'	N/A	N/A	N/A	N/A	1150
	R-3	113.65' – 114.35'	N/A	N/A	N/A	170.4	N/A

Boring No.	Run No.	Depth (feet)	Point Load Unconfined Compressive Strength of Rock – Diametral* (psi)	Point Load Unconfined Compressive Strength of Rock – Axial (psi)	Uniaxial Compressive Strength of Rock (psi)	Unit Weight of Oven Dried Rock (pcf)	Splitting Tensile Strength* (psi)
	R-4	116' – 116.65'	6474	7435	N/A	N/A	N/A
	R-4	119' – 119.65'	N/A	N/A	10,950	N/A	N/A
	R-5	120' – 120.3'	N/A	N/A	N/A	N/A	1377
	R-5	121.7' – 122.3'	N/A	N/A	N/A	170.5	N/A

N/A: Test not performed

*If two results were given for the diametral point load test or the splitting tensile strength test, an average of the two was taken

6 References

Sevon, W.D. 1975a. Geology and mineral resources of the Hickory Run and Blakeslee quadrangles, Carbon and Monroe Counties, Pennsylvania. Commonwealth of Pennsylvania. Department of Environmental Resources. Bureau of Topographic and Geologic Survey. Atlas 194cd.

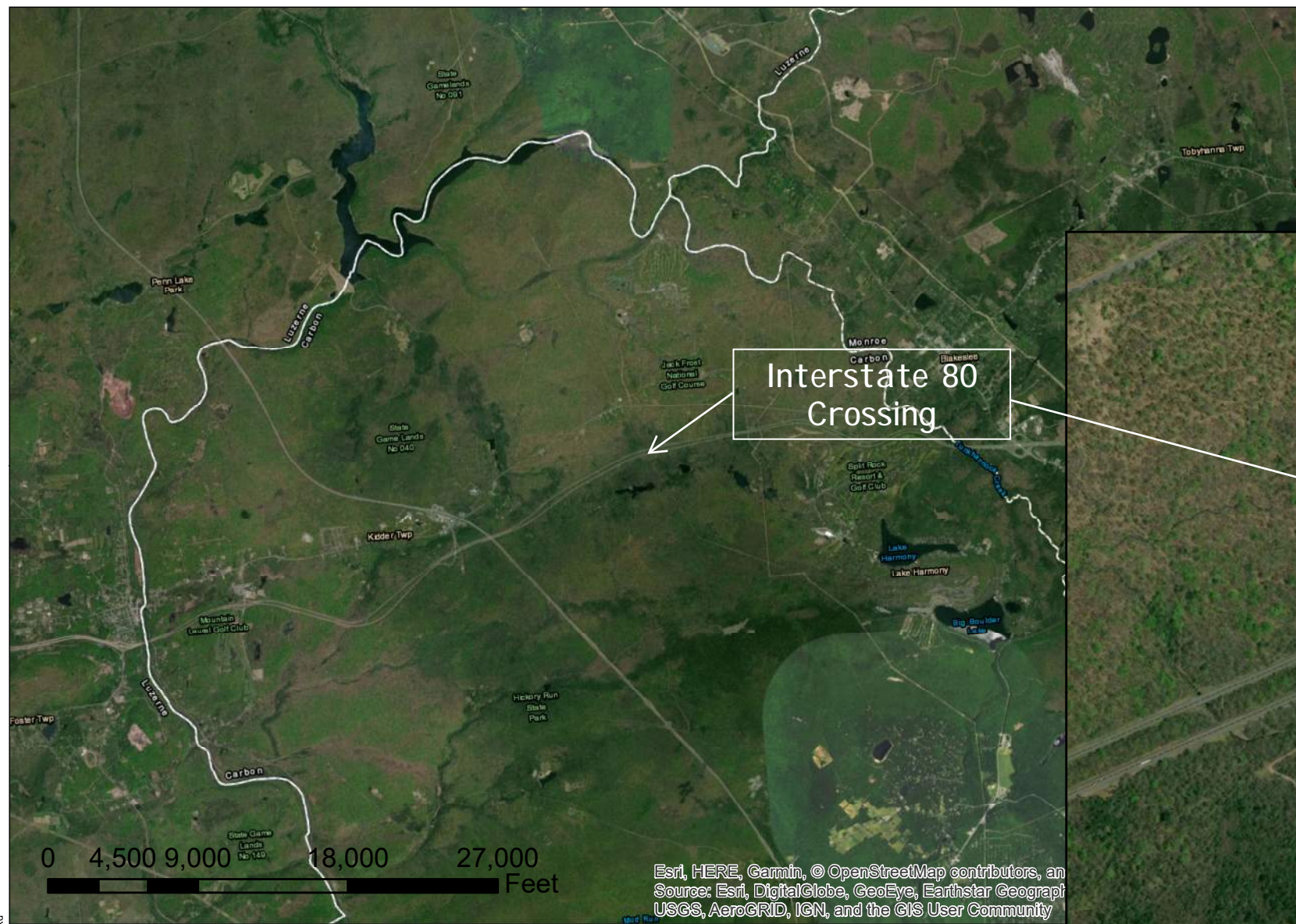
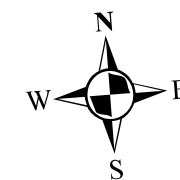
Sevon, W.D. 1975b. Geology and mineral resources of the Christmans and Pohopoco Mountain quadrangles, Carbon and Monroe Counties, Pennsylvania. Commonwealth of Pennsylvania. Department of Environmental Resources. Bureau of Topographic and Geologic Survey. Atlas 195ab.

7 Limitations

The results and recommendations presented in this report are largely based on subsurface information from the borings from the April, October, and December 2016 subsurface investigations, and our use of generally accepted analytical procedures. If further investigation or laboratory testing reveals significant differences in the subsurface conditions, Mott MacDonald should be given the opportunity to review and modify our recommendations, if appropriate.

Appendices

A. Locus Map / Site Vicinity Map



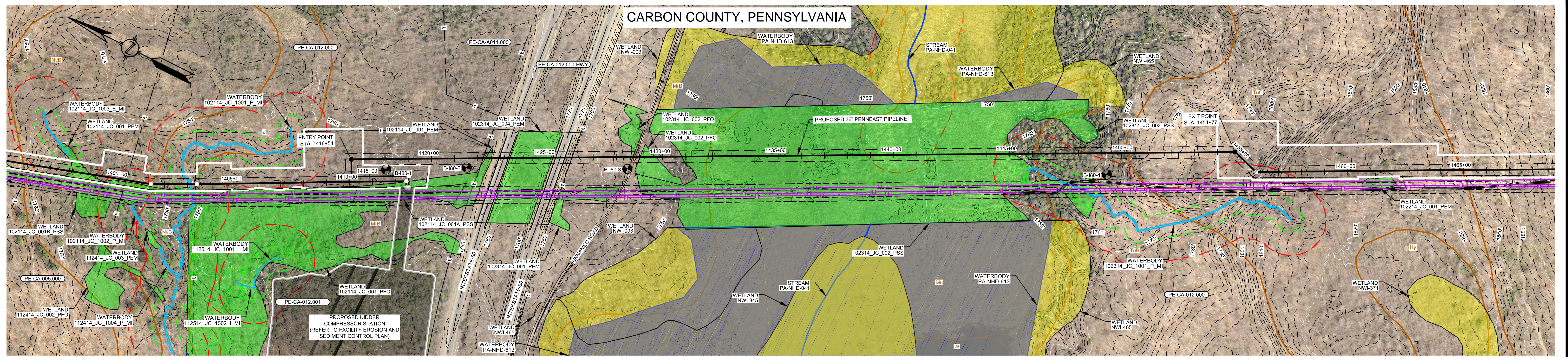
P:\353754_PennEast\Geotechnical\008-HDD\14 - Interstate 80 Crossing\Drawings\Bore Location Plan\B0 Site Vicinity Map.mxd

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 MOTT MACDONALD Certificate No. 24GA28016600	Client PENNEAST PIPELINE							Designed	JWN		Eng check		Title PENNEAST PIPELINE PROJECT INTERSTATE 80 CROSSING CARBON COUNTY, PENNSYLVANIA		
								Drawn	JWN		Coordination				
								Dwg Check	DC		Approved	VAS			
								Scale at 11" x 17" AS SHOWN		Status	Rev	Security			
		0	12/15/2018												
		Rev	Date	Drawn	Description	Ch'k'd	App'd	Project Number	353754	B/O	1	Total	1	Drawing Number	353754-I80-GT-LOC

IMAGE SOURCE: OGRIP

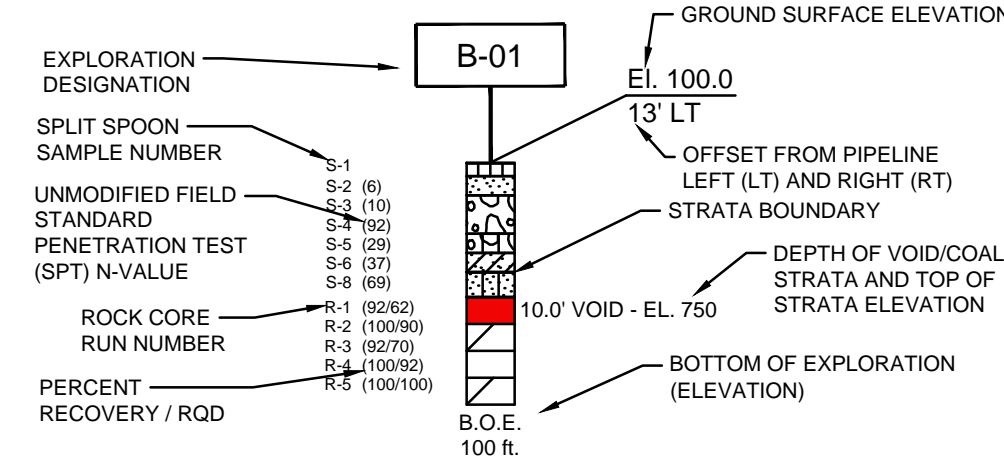
B. Boring Location Plan and Alignment



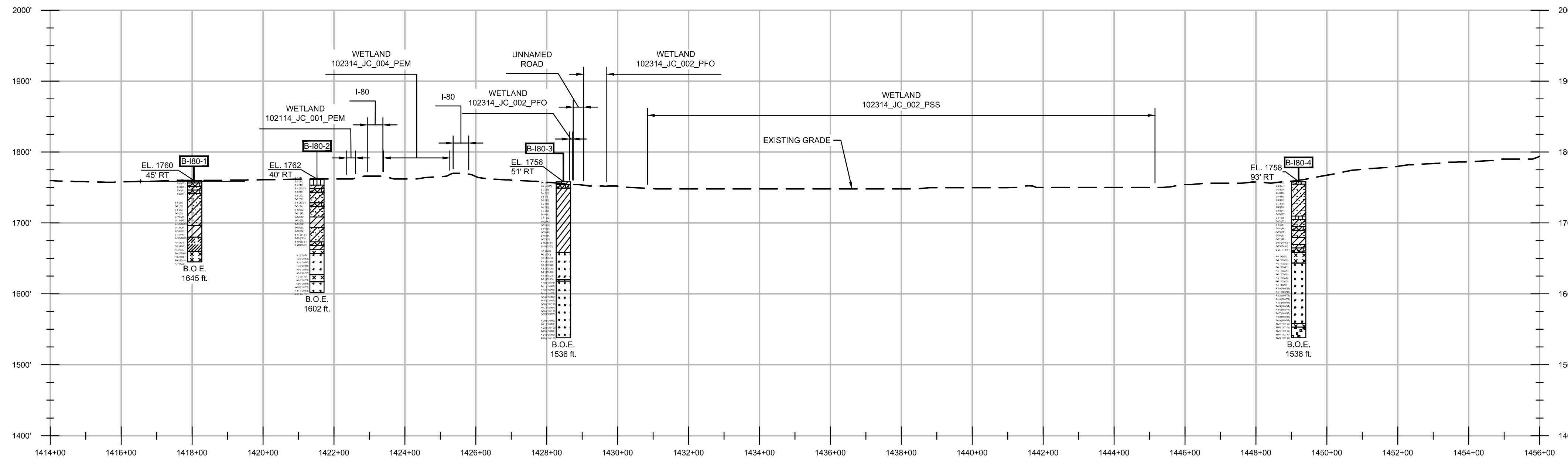
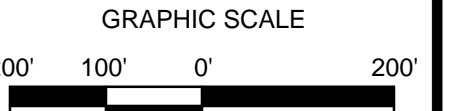
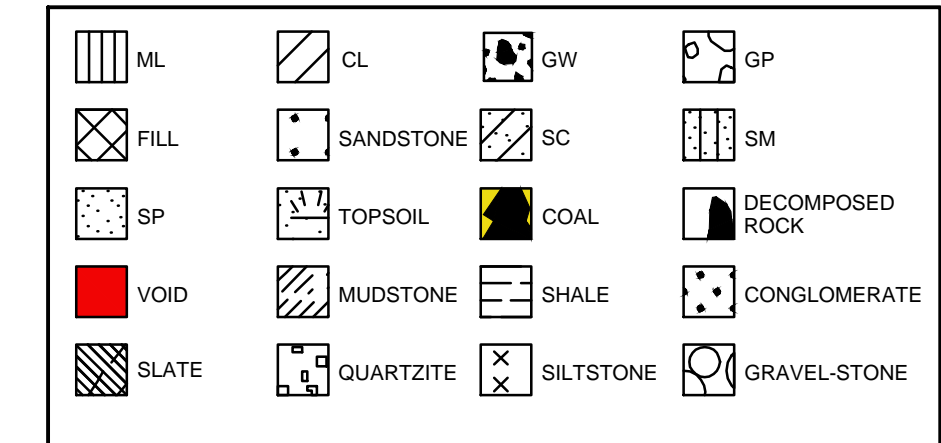
NOTES:
 1. CROSS SECTIONS PRESENTS SUMMARY BOREHOLE LOG GRAPHICS, SEE FULL BOREHOLE LOG FOR DETAILS.

INTERSTATE 80 HDD PLAN VIEW
 SCALE: 1" = 200'

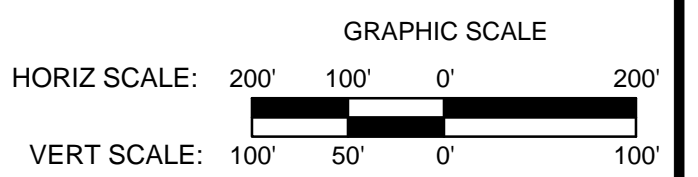
BORING LEGEND



SOIL AND ROCK STRATAGRAPHIC LEGEND:



INTERSTATE 80 HDD PROFILE
 HORIZONTAL SCALE: 1" = 200'
 VERTICAL SCALE: 1" = 100'



NOTES:
 1. THE CONTOURS AND IMAGERY SHOWN WERE PROVIDED BY PICTOMETRY, 2015. ADDITIONAL CONTOURS AND IMAGERY SUPPLEMENTED FROM PASDA.
 2. EXISTING FEATURE SURVEYED PERFORMED BY MOTT MACDONALD 2015 THRU 2018. ADDITIONAL FEATURES DIGITIZED FROM IMAGERY. ALL LOCATIONS ARE APPROXIMATE AND SHALL BE VERIFIED BY CONTRACTOR.
 3. PROPERTY LINES DEPICTED ON THIS PLAN ARE BASED ON GIS TAX MAP DATA AND RECTIFIED PROPERTY LINES AND ARE NOT THE RESULT OF A BOUNDARY SURVEY.
 4. WATERBODY INFORMATION PROVIDED BY AECOM 2015 THRU 2018.

REFERENCE DRAWINGS		REVISIONS		
DWG. NO.	TITLE	REVISIONS	DATE	DRAWN
000-03-01-054	ALIGNMENT SHEET	A	ISSUED FOR PADEP	10/2018
000-03-01-055	ALIGNMENT SHEET			
000-03-07-013	HDD EXHIBIT PLAN AND PROFILE			

APPROVALS		
DRAWN BY	DATE	
RJP (MM)	10/15/2018	
CHECKED BY	DATE	
CAF (MM)	10/15/2018	
ENG. APPROVAL	DATE	
MDN (MM)	10/15/2018	
P.M. APPROVAL	DATE	
MAW (MM)	10/15/2018	

CLIENT APPROVAL	
DATE	

PREPARED FOR

PENNEAST PIPELINE PROJECT		
GEOLOGICAL INVESTIGATION PROFILE DRAWING		
PROPOSED 36" PIPELINE		
HDD EXHIBIT PLAN AND PROFILE		
INTERSTATE 80 HDD		
CARBON COUNTY, PENNSYLVANIA		
SCALE	DRAWING NO.	REVISION
AS SHOWN	000-03-07-013-GT	A

G:\PENNEAST\030754 - PENNEAST PIPELINE - EPC\MID\PROD\STATE PERMIT\WORK\PA\DRAG\ING\EROSION SEDIMENT CONTROL PLAN\HDD_DETAILS\GEO\TECH_SPECIFIC_HDDS\000-03-07-013-GT.DWG DUM64749

C. Boring Logs and Core Photographs

SOIL/ROCK BORING LOG LEGEND

USCS Group Symbol

UNIFIED SOIL CLASSIFICATION SYSTEM AND SYMBOL CHART				
COARSE-GRAINED SOILS (more than 50% of material is larger than No. 200 sieve size.)		FINE-GRAINED SOILS (more than 50% of material is smaller than No. 200 sieve size.)		
Gravels More than 50% of coarse fraction larger than N.4 sieve size	Clean Gravels (Less than 5% fines)		SILTS AND CLAYS Liquid limit less than 50%	
	GW	Well-graded gravels, gravel-sand mixtures, little or no fines		ML
	GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines		CL
	Gravels with fines (More than 12% fines)		OL	
	GM	Silty gravels, gravel-sand-silt mixtures	MH	
GC	Clayey gravels, gravel-sand-clay mixtures	CH		
Sands More than 50% of coarse fraction larger than N.4 sieve size	Clean Sands (Less than 5% fines)		SILTS AND CLAYS Liquid limit 50% or greater	
	SW	Well-graded sands, gravelly sands, little or no fines		OH
	SP	Poorly-graded sands, gravelly sands, little or no fines	HIGHLY ORGANIC SOILS	
	Sands with fines (More than 12% fines)			PT
	SM	Silty sands, sand-silt mixtures		
SC	Clayey sands, sand-clay mixtures			
<small>Determine percentages of sand and Gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows:</small> Less than 5 percent GW, GP, SW, SP More than 12 percent GM, GC, SM, SC 5 to 12 percent Borderline cases requiring dual symbols				

Infilling

Description	Symbol
Clay	CI
Silt	SI
Sand	SD
Calcite	CA
Carbonate	C
Dolomite	DO
Gypsum/Tale	GY
Hematite	HE
Limonite	L
Quartz	QZ
Chlorite	CH
Pyrite	PY
Iron Oxide Staining	FE
Styrolite	ST
Not Determined	X
None	N
Healed	H

Discontinuity Spacing

Description	Symbol	Spacing (in.)
Extremely Close	EC	< 0.75
Very Close	VC	0.75 – 2.5
Close	C	2.5 – 8.0
Moderate	M	8 – 24
Wide	W	24 – 80
Very Wide	VW	80 – 240
Extremely Wide	EW	> 240

Weathering of Rock Mass

Description	Symbol	Criteria	Grade
Fresh (Unweathered)	FR	No visible sign of rock material weathering, except slight discoloration on major discontinuity surfaces.	I
Slightly Weathered	SL	Discoloration indicates weathering of rock material and discontinuity surfaces. All rock material may be discolored by weathering and may be somewhat weaker than externally than in its fresh condition.	II
Moderately Weathered	M	Less than half of the rock material is decomposed and/or disintegrated to soil. Fresh or discolored rock is present either as a continuous framework or as corestones.	III
Highly Weathered	H	More than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discolored rock is present either as a discontinuous framework or as corestones.	IV
Completely Weathered	C	All rock material is decomposed and/or disintegrated to soil. The original mass structure remains largely intact.	V
Residual Soil	RS	All rock material is converted to soil. The mass structure and material fabric are destroyed. There is a large change in volume, but the soil has not been significantly transported.	VI

Spacing Type

Description	Symbol	Spacing (in.)
Joint	J	A natural fracture along which no displacement has occurred. May occur in parallel groups called sets.
Shear	S	A natural fracture along which differential movement has occurred. May be slickensided or striated.
Fault	F	A natural fracture along which displacement has occurred. Usually lined with gouge and slickensides.
Vein	V	A thin, sheet-like igneous intrusion into a fissure.
Bedding Joint	B	Joints that occur along bedding planes.
Foliation Joint	FJ	Joints that occur parallel to the foliation of a rock mass.
Shear Zone	SZ	Zone of fractured rock and gouge bordering the displacement plane.

Roughness

Intermediate Scale	Symbol	Small Scale	Symbol
Stepped	S	Rough	R
Undulating	U	Smooth	Sm
Planar	P	Slickensided	K
Not Determined	X	Wavy	Wa
		Not Determined	X

Weathering/Alteration of Discontinuity Surfaces

Description	Symbol	Criteria
Fresh	FR	No visible sign of weathering on the rock discontinuity surfaces.
Discolored	DS	Discoloration of rock material discontinuity surfaces. Degree of discoloration and specific discolored mineral constituents (if applicable) indicated.
Disintegrated	DG	Discontinuity surface rock material is weathered to a soil with the rock material fabric intact. Rock material is friable, but the mineral grains are not decomposed.
Decomposed	DE	Discontinuity surface rock material is weathered to a soil with the rock material fabric intact and with some or all mineral grains decomposed.

Field Strength

Description	Criteria	Grade	Approx. Range of Uniaxial Compressive Strength (psi)
Extremely Weak	Indented by thumbnail.	R0	40 – 150
Very Weak	Crumbles under firm blows with point of geological hammer, can be peeled by a pocket knife.	R1	150 – 700
Weak	Can be peeled by a pocket knife with difficulty, shallow indentations made by firm blow with point of geological hammer.	R2	700 – 4,000
Medium Strong	Cannot be scraped or peeled with a pocket knife, specimen can be fractured with single firm blow of geological hammer.	R3	4,000 – 7,000
Strong	Specimen requires more than one blow of geological hammer to fracture it.	R4	7,000 – 15,000
Very Strong	Specimen requires many blows of geological hammer to fracture it.	R5	15,000 – 36,000
Extremely Strong	Specimen can only be chipped with geological hammer.	R6	>36,000

Aperture

Description	Symbol	Aperture (in.)	
Very Tight	VT	< 0.004	"Closed" Features
Tight*	T	0.004 – 0.010	
Partly Open	PO	0.01 – 0.02	
Open**	O	0.02 – 0.10	"Gapped" Features
Moderately Wide	MW	0.1 – 0.4	
Wide	W	> 0.4	
Very Wide	VW	0.4 – 4.0	"Open" Features
Extremely Wide	EW	4.0 – 40.0	
Cavernous	CA	> 40	

Project: PennEast Pipeline Project
Location: Interstate 80, Carbon County, Pennsylvania
Client: PennEast Pipeline

Project No.: 353754
Project Manager: Vatsal Shah
Project Director: Michael Wilcox

Soil Log Graphic Legend



CL: USCS Low Plasticity Clay



GC: USCS Clayey Gravel



ML: USCS Silt



SC: USCS Sandy Clay to Clayey Sand



SM: USCS Silty Sand



TOPSOIL: Topsoil

Rock Log Graphic Legend



CONGLOMERATE - Conglomerate



MUDSTONE - Mudstone



QUARTZITE - Quartz and Quartzite



SANDSTONE - Sandstone



SILTSTONE - Siltstone



Ground Water Level

(Note that due to drilling process disturbance the ground water levels obtained during drilling are not as representative as those obtained from monitoring wells)

This legend reports all soil and rock graphics which have been used in the logs of this project only.

Project: PennEast Pipeline Project
Location: Interstate 80, Carbon County, Pennsylvania
Client: PennEast Pipeline
Drilling Co.: Craig Test Boring Co., Inc.
Driller/Helper: Paul Mullins /Nick Beehler

Project No.: 353754
Project Mgr: Vatsal Shah
Field Eng. Staff: Jonathan Nelson
Date/Time Started: October 18, 2016 at 11:00 am
Date/Time Finished: October 19, 2016 at 1:50 pm

Elevation: 1762 ft.	Vertical Datum: NAVD 1988	Boring Location: 450 feet North of I-80	Coord.: N: 41.081977 E: -75.659638
Item	Casing	Sampler	Core Barrel
Type	HW	SS	NQ2
Length (ft)	5	2	5
Inside Dia. (in.)	4	1.375	2.0
Hammer Wt. (lb.)	140	140	-
Hammer Fall (in.)	30	30	-
Rig Make & Model: CME-750X			
Hammer Type			
<input type="checkbox"/> Truck	<input type="checkbox"/> Tripod	<input type="checkbox"/> Cat-Head	<input type="checkbox"/> Safety
<input checked="" type="checkbox"/> ATV	<input type="checkbox"/> Geoprobe	<input checked="" type="checkbox"/> Winch	<input type="checkbox"/> Doughnut
<input type="checkbox"/> Track	<input type="checkbox"/> Air Track	<input checked="" type="checkbox"/> Roller Bit	<input checked="" type="checkbox"/> Automatic
<input type="checkbox"/> Skid	<input type="checkbox"/>	<input type="checkbox"/> Cutting Head	<input type="checkbox"/>
Drilling Fluid			Drill Rod Size:
<input type="checkbox"/> Bentonite			Casing Advance
<input type="checkbox"/> Polymer			Mud Rotary
<input checked="" type="checkbox"/> Water			
<input type="checkbox"/> None			

Depth/ Elev. (ft)	Sample No. / Interval (ft)	Rec. (in)	Sample Blows per 6"	Stratum Graphic	USCS Group Symbol	Visual - Manual Identification & Description (Density/consistency, color, Group Name, constituents, particle size, structure, moisture, optional descriptions, geologic interpretation, Symbol)	Field Tests				Remarks	
							Dilatancy	Toughness	Plasticity	Dry Strength		
1760	S-1 0.0'- 2.0'	17	1		ML	0.4 Top (5") TOPSOIL with roots	-	-	-	-		
			2			Bottom (19") Soft, Brownish yellow Sandy SILT with Gravel, moist (ML)	-	-	-	-		
			2				-	-	-	-		
			2				-	-	-	-		
5	S-2 5.0'- 7.0'	20	7		GC	3.5	Medium dense, Brownish yellow Clayey GRAVEL, moist (GC)	-	L	L	L	Gravel is Decomposed Sandstone.
			7				-	-	-	-		
			10				-	-	-	-		
			9				-	-	-	-		
10	S-3 10.0'- 12.0'	12	24		SC	8.5	Medium dense, Brownish yellow Clayey SAND with Gravel, moist (SC)	-	L	L	L	
			9				-	-	-	-		
			11				-	-	-	-		
			9				-	-	-	-		
15	S-4 15.0'- 17.0'	2	7		GC	13.5	Medium dense, Brownish yellow Clayey GRAVEL, wet (GC)	-	-	-	-	Gravel is Decomposed Sandstone.
			5				-	-	-	-		
			6				-	-	-	-		
			7				-	-	-	-		
						18.5		-	-	-	-	
							-	-	-	-		
							-	-	-	-		
							-	-	-	-		

Water Level Data						Sample Type		Notes:
Date	Time	Elapsed Time (hr)	Depth in feet to:			O	T	
			Bot. of Casing	Bottom of Hole	Water	Open End Rod	Thin-Wall Tube	
10/19/16	7:45	-	30.0	37.0	8.3			
10/20/16	7:45	-	30.0	115.0	85.55			
						U	Undisturbed Sample	
						S	Split Spoon Sample	
						G	Geoprobe	

Field Test Legend: Dilatancy: N - None S - Slow R - Rapid Plasticity: NP - Non-Plastic L - Low M - Medium H - High
 Toughness: L - Low M - Medium H - High Dry Strength: N - None L - Low M - Medium H - High VH - Very High

NOTES: 1.) "ppd" denotes soil sample average diametral pocket penetrometer reading. 2.) "ppa" denotes soil sample average axial pocket penetrometer reading.
 3.) Maximum Particle Size is determined by direct observation within limitations of sampler size. 4.) Soil identifications and field tests based on visual-manual methods per ASTM D2488.

Depth/ Elev. (ft)	Sample No. / Interval (ft)	Rec. (in)	Sample Blows per 6"	Stratum Graphic	USCS Symbol Group	Visual - Manual Identification & Description (Density/consistency, color, Group Name, constituents, particle size, structure, moisture, optional descriptions, geologic interpretation, Symbol)	Field Tests				Remarks*
							Dilatancy	Toughness	Plasticity	Dry Strength	
1740	S-5 20.0'- 22.0'	13	6 6 11 8		SC	Medium dense, Reddish brown Clayey SAND with Gravel, moist (SC)	-	L	L	-	
25	S-6 25.0'- 27.0'	10	20 16 21 10		SC	Dense, Reddish brown Clayey SAND with Gravel, moist (SC)	-	L	L	-	
30	S-7 30.0'- 32.0'	16	9 11 17 10		SC	Medium dense, Reddish brown Clayey SAND with Gravel, wet (SC)	-	-	-	-	
1730											
35	S-8 35.0'- 37.0'	9	10 8 14 13	SC	Medium dense, Reddish brown Clayey SAND with Gravel, wet (SC)	-	L	L	-		
40	S-9 40.0'- 42.0'	14	10 14 14 14	SC	Medium dense, Reddish brown Clayey SAND with Gravel, wet (SC) 41' - 41.2' medium to fine grained Sandstone fragments	-	-	-	-		
1720											
45	S-10 45.0'- 47.0'	17	13 13 16 22	SC	Medium dense, Reddish brown Clayey SAND with Gravel, trace Cobble fragments, wet (SC)	-	L	L	L		

NOTES:

PROJECT NO.:

353754

BORING NO.:

B-180-1

NOTES: 1.) "ppd" denotes soil sample average diametral pocket penetrometer reading. 2.) "ppa" denotes soil sample average axial pocket penetrometer reading.
3.) Maximum Particle Size is determined by direct observation within limitations of sampler size. 4.) Soil identifications and field tests based on visual-manual methods per ASTM D2488.

Depth/ Elev. (ft)	Sample No. / Interval (ft)	Rec. (in)	Sample Blows per 6"	Stratum Graphic	USCS Symbol Group	Visual - Manual Identification & Description (Density/consistency, color, Group Name, constituents, particle size, structure, moisture, optional descriptions, geologic interpretation, Symbol)	Field Tests				Remarks*
							Dilatancy	Toughness	Plasticity	Dry Strength	
50	S-11 50.0'- 52.0'	18	9 21 47 61/6"		SC	Very dense, Reddish brown Clayey SAND with Gravel, wet (SC)	-	L	L	-	
1710											
55	S-12 55.0'- 57.0'	11	11 50/5"		SC	Very dense, Reddish brown Clayey SAND with Gravel, wet (SC)	-	-	-	-	Refusal at 55.9 feet BGS. Gravel is angular to rounded Decomposed Sandstone and Siltstone.
60	S-13 60.0'- 62.0'	17	10 13 26 21		SC	Dense, Reddish brown Clayey SAND with Gravel, wet (SC)	-	L	L	-	
1700											
65	S-14 65.0'- 67.0'	22	17 20 25 24		CL	Hard, Reddish brown Sandy CLAY, wet (CL)	-	L	L	M	
70	S-15 70.0'- 72.0'	21	12 18 28 28		CL	Hard, Reddish brown Sandy CLAY with Gravel, wet (CL)	-	L	L	M	
1690											
75	S-16	15	28		CL	Hard, Reddish brown Lean CLAY with Gravel and Sand, moist (CL)	-	M	M	M	

NOTES: PROJECT NO.: **353754** BORING NO.: **B-180-1**

NOTES: 1.) "ppd" denotes soil sample average diametral pocket penetrometer reading. 2.) "ppa" denotes soil sample average axial pocket penetrometer reading.
3.) Maximum Particle Size is determined by direct observation within limitations of sampler size. 4.) Soil identifications and field tests based on visual-manual methods per ASTM D2488.

Depth/ Elev. (ft)	Sample No. / Interval (ft)	Rec. (in)	Sample Blows per 6"	Stratum Graphic	USCS Symbol Group	Visual - Manual Identification & Description (Density/consistency, color, Group Name, constituents, particle size, structure, moisture, optional descriptions, geologic interpretation, Symbol)	Field Tests				Remarks*	
							Dilatancy	Toughness	Plasticity	Dry Strength		
	75.0'- 77.0'		40 50/3"									
80						80.0 Top of Rock at 80 feet BGS. See Rock Coring Log.						
1680												
85												
90												
1670												
95												
100												
1660												

Project: PennEast Pipeline Project
Location: Interstate 80, Carbon County, Pennsylvania
Client: PennEast Pipeline
Drilling Co.: Craig Test Boring Co., Inc.
Driller/Helper: Paul Mullins /Nick Beehler

Project No.: 353754
Project Mgr: Vatsal Shah
Field Eng. Staff: Jonathan Nelson
Date/Time Started: October 18, 2016 at 11:00 am
Date/Time Finished: October 19, 2016 at 1:50 pm

Elevation: 1762 ft.		Vertical Datum: NAVD 1988		Boring Location: 450 feet North of I-80		Coord.: N: 41.081977 E: -75.659638	
Item	Casing	Core Barrel	Core Bit	Horizontal Datum: NAD 1983		Drilling Method: Wireline	
Type	HW	NQ2	Imp. Diamond	Rig Make & Model: CME-750X			
Length (ft)	5	5	3.25				
Inside Dia. (in.)	4	2.0	2.0				

Depth/ Elev. (ft)	Avg Core Rate (min /ft)	Depth (ft)	Run/ (Box) No.	Rec (in. / %)	RQD (in / %)	Rock Core		Stratum Graphic	Visual Identification, Description and Remarks (Rock type, colour, texture, weathering, field strength, discontinuity spacing, optional additional geological observations)	Depth (ft.)	Discontinuities						Remarks
						Hard.	Weath				Type	Dip	Rgh	Wea	Aper	Infill	
									SEE TEST BORING LOG FOR OVERBURDEN DETAILS								
		80.0							MUDSTONE, Reddish brown, medium to fine grained, completely weathered, very weak, extremely close to very close spaced discontinuities 80' - 85' Highly Fractured zone								Rig chatter from 80 to 100 feet BGS.
1680	1.50																
	1.30																
	1.70		R-1	28 47%	0 0%	R1	C			82.00	J	0	U,Sm	DE	VW	SI	
	2.10																
	2.20																
85		85.0							Pebbly MUDSTONE, Reddish brown to brownish yellow, medium to fine grained, highly weathered, weak, extremely close to close spaced discontinuities 85' - 90' Highly Fractured zone								Loss of water from 85.5 to 85.7 feet BGS.
	1.70									86.20	J	18	S,Sm	DG	MW	SI	
	2.60																
	2.20		R-2	55 92%	4 7%	R2	H			87.00	J	36	S,R	DG	MW	SI	
	2.50																
	3.00																
		90.0															
90		90.0							Pebbly MUDSTONE, Reddish brown to brownish yellow, medium to fine grained, highly weathered, weak, extremely close to close spaced discontinuities								
	3.50									90.40	J	15	U,Sm	DS	MW	N	
	3.90																
1670									91.7' - 92.6' Vertical Fracture								
	4.10		R-3	56 93%	4 7%	R2	H			92.40	J	40	U,R	DS	MW	SI	
	4.50																
		95.0															
95		95.0							Pebbly MUDSTONE, Reddish brown to olive gray, medium to fine grained, highly weathered, weak, extremely close to close spaced discontinuities 95' - 100' Highly Fractured zone								
	3.10									95.90	B	28	U,R	DG	MW	SI	
	4.70																
	5.20		R-4	60 100%	0 0%	R2	H			97.00	J	83	P,R	DS	T	N	
	4.50																
		100.0															
	4.70									98.50	B	17	P,Sm	DS	O	N	
										99.20	J	27	U,Sm	DG	O	Fe	
		100.0															

Water Level Data						Notes:
Date	Time	Elapsed Time (hr)	Depth in feet to:			
			Bot. of Casing	Bottom of Hole	Water	
10/19/16	7:45	-	30.0	37.0	8.3	
10/20/16	7:45	-	30.0	115.0	85.6	

Depth/ Elev. (ft)	Avg Core Rate (min /ft)	Depth (ft)	Run/ (Box) No.	Rec. (in. / %)	RQD (in. / %)	Rock Core		Stratum Graphic	Visual Identification, Description and Remarks (Rock type, colour, texture, weathering, field strength, discontinuity spacing, optional additional geological observations)	Depth (ft.)	Discontinuities						Remarks	
						Hard.	Weath				(See Legend for Rock Description System)							
											Type	Dip	Rgh	Wea	Aper	Infill		
	3.30	100.0						x x x x	Pebbly SILTSTONE, Olive gray to reddish brown, medium to fine grained, highly weathered, weak, extremely close to close spaced discontinuities 100' - 105' Highly Fractured zone	100.70	J	10	U,Sm	DG	MW	Fe	Loss of water from 100.5 - 100.6 feet BGS.	
	4.50							x x x x		101.30	B	25	U,Sm	DG	MW	Fe		
1660	5.20		R-5	60 100%	4 7%	R2	H	x x x x		102.50	J	25	S,Sm	DS	MW	N		
	4.10							x x x x		103.40	J	48	U,Sm	DS	MW	Fe		
	5.10							x x x x		103.80	J	30	U,Sm	DS	T	Sl		
105	105.0							x x x x		Pebbly SILTSTONE, Olive gray to reddish brown, medium to fine grained, highly weathered, weak, extremely close to close spaced discontinuities 105' - 110' Highly Fractured zone	105.40	J	16	U,Sm	DS	O		Fe
	4.10							x x x x			106.20	J	7	U,Sm	DS	MW		Fe
	5.50							x x x x			107.30	B	70	U,Sm	DG	MW		SD
	4.70		R-6	58 97%	8 13%	R2	H	x x x x			107.90	F	89	U,R	DS	O		N
	6.50							x x x x			108.70	J	49	U,Sm	DS	O		Fe
	4.30							x x x x	Pebbly SILTSTONE, Olive gray to reddish brown, medium to fine grained, highly weathered, weak, extremely close to close spaced discontinuities 110' - 115' Highly Fractured zone		110.30	J	54	U,Sm	DS	O	Fe	Partly Conglomerate.
110	110.0							x x x x		112.20	J	69	U,Sm	DS	VW	Fe		
	5.70							x x x x		113.10	J	44	U,Sm	DS	O	Fe		
1650	5.10							x x x x		113.90	J	13	U,Sm	DS	MW	N		
	6.70		R-7	52 87%	4 7%	R2	H	x x x x	114.50	J	51	P,Sm	DE	VW	N			
115	115.0							x x x x	115.0									
									End of Boring at 115 feet BGS. Borehole grouted with cement and bentonite hole plug.									



Figure B-I80-1.1
B-I80-1 Box 1 Runs 1-4 Dry



Figure B-I80-1.2
B-I80-1 Box 1 Runs 1-4 Wet

MOTT
MACDONALD M M

PennEast Pipeline Project
Rock Core Photographs

BORING NO.:
B-I80-1



Figure B-180-1.3
 B-180-1 Box 2 Runs 5-7 Dry



Figure B-180-1.4
 B-180-1 Box 2 Runs 5-7 Wet

Project: PennEast Pipeline Project
Location: Interstate 80, Carbon County, Pennsylvania
Client: PennEast Pipeline
Drilling Co.: Craig Test Boring Co., Inc.
Driller/Helper: Paul Mullins /Nick Beehler

Project No.: 353754
Project Mgr: Vatsal Shah
Field Eng. Staff: Jonathan Nelson
Date/Time Started: October 13, 2016 at 9:15 am
Date/Time Finished: October 18, 2016 at 9:00 am

Elevation: 1764 ft.	Vertical Datum: NAVD 1988	Boring Location: 90 feet North of I-80	Coord.: N: 41.081137 E: -75.659037
Item	Casing	Sampler	Core Barre
Type	HW	SS	NQ2
Length (ft)	5	2	5
Inside Dia. (in.)	4	1.375	2.0
Hammer Wt. (lb.)	140	140	-
Hammer Fall (in.)	30	30	-
Rig Make & Model: CME-750X			
Hammer Type			
Drilling Fluid: NAD 1983			
Drill Rod Size:			
Casing Advance			
Mud Rotary			

Depth/ Elev. (ft)	Sample No. / Interval (ft)	Rec. (in)	Sample Blows per 6"	Stratum Graphic	USCS Group Symbol	Visual - Manual Identification & Description (Density/consistency, color, Group Name, constituents, particle size, structure, moisture, optional descriptions, geologic interpretation, Symbol)	Field Tests				Remarks
							Dilatancy	Toughness	Plasticity	Dry Strength	
1760 5	S-1 0.0'- 2.0'	16	1 2 2 4		ML	0.5 Top (6") TOPSOIL with roots Bottom (18") Soft, Yellowish red SILT, moist (ML)	-	L	L	L	
	S-2 5.0'- 7.0'	19	7 9 15 16		ML	Very stiff, Yellowish red SILT with Gravel, moist (ML)	-	L	L	L	
	S-3 10.0'- 12.0'	10	6 5 7 9		SC	8.5 Medium dense, Yellowish red Clayey SAND with Gravel, wet (SC)	-	L	L	L	
	S-4 15.0'- 17.0' 15.5'-	1	50/3"		GC	13.5 18.5 Very dense, Yellowish red Clayey GRAVEL, wet (GC) Boulders present	-	-	-	-	Rig chatter at 15.5 feet BGS.

Water Level Data						Sample Type	Notes:
Date	Time	Elapsed Time (hr)	Depth in feet to:			O Open End Rod T Thin-Wall Tube U Undisturbed Sample S Split Spoon Sample G Geoprobe	PP = Pocket Penetrometer TV = Torvane
			Bot. of Casing	Bottom of Hole	Water		
10/17/16	8:00	-	95.0	115.0	37.2		
10/18/16	8:30	-	95.0	160.0	111		

Field Test Legend: Dilatancy: N - None S - Slow R - Rapid Plasticity: NP - Non-Plastic L - Low M - Medium H - High
 Toughness: L - Low M - Medium H - High Dry Strength: N - None L - Low M - Medium H - High VH - Very High

NOTES: 1.) "ppd" denotes soil sample average diametral pocket penetrometer reading. 2.) "ppa" denotes soil sample average axial pocket penetrometer reading.
 3.) Maximum Particle Size is determined by direct observation within limitations of sampler size. 4.) Soil identifications and field tests based on visual-manual methods per ASTM D2488.

Depth/ Elev. (ft)	Sample No. / Interval (ft)	Rec. (in)	Sample Blows per 6"	Stratum Graphic	USCS Symbol Group	Visual - Manual Identification & Description (Density/consistency, color, Group Name, constituents, particle size, structure, moisture, optional descriptions, geologic interpretation, Symbol)	Field Tests				Remarks*
							Dilatancy	Toughness	Plasticity	Dry Strength	
1740 25	S-5 20.0'- 22.0'	13	9 9 14 29		SC	Medium dense, Reddish brown Clayey SAND with Gravel, wet (SM)	-	L	L	L	
	S-6 25.0'- 27.0'		12								
30	S-7 30.0'- 32.0'	13		9 9 12 12		SC	Medium dense, Reddish brown Clayey SAND with Gravel, wet (SM)	-	L	L	L
1730 35	S-8 35.0'- 37.0'	6	7 50/2"		GC	Very dense, Reddish brown Clayey GRAVEL, wet (GM)	-	L	L	L	
40	S-9 40.0'- 42.0'	15	13 10 14 19		SC	Medium dense, Yellowish red Clayey SAND with Gravel, wet (SC)	-	-	-	-	
1720 45	S-10 45.0'- 47.0'	19	13 13 19 18		SC	Dense, Reddish brown Clayey SAND with Gravel, trace cobble fragments, wet (SC)	-	L	L	L	

NOTES:

PROJECT NO.:

353754

BORING NO.:

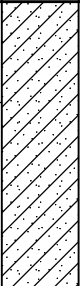
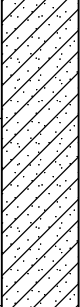
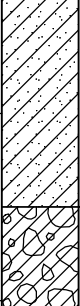
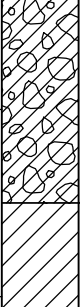
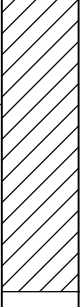
B-180-2

NOTES: 1.) "ppd" denotes soil sample average diametral pocket penetrometer reading. 2.) "ppa" denotes soil sample average axial pocket penetrometer reading.
3.) Maximum Particle Size is determined by direct observation within limitations of sampler size. 4.) Soil identifications and field tests based on visual-manual methods per ASTM D2488.

Depth/ Elev. (ft)	Sample No. / Interval (ft)	Rec. (in)	Sample Blows per 6"	Stratum Graphic	USCS Symbol Group	Visual - Manual Identification & Description (Density/consistency, color, Group Name, constituents, particle size, structure, moisture, optional descriptions, geologic interpretation, Symbol)	Field Tests				Remarks*
							Dilatancy	Toughness	Plasticity	Dry Strength	
50	S-11 50.0'- 52.0'	16	17 14 34 34		SC	Dense, Reddish brown Clayey SAND with Gravel, wet (SC)	-	L	L	L	
1710					53.5						
55	S-12 55.0'- 57.0'	22	10 28 21 22		CL	Hard, Yellowish red Sandy CLAY, trace Gravel, wet (CL)	-	M	M	M	PP = 3.8 tsf TV = 0.48 tsf
60	S-13 60.0'- 62.0'	24	9 14 21 23		CL	Hard, Yellowish red Sandy CLAY, trace Gravel, wet (CL)	-	M	M	M	PP = 4.0 tsf TV = 0.66 tsf
1700											
65	S-14 65.0'- 67.0'	24	11 14 19 20	CL	Hard, Yellowish red Sandy CLAY, trace Gravel, wet (CL)	-	M	M	M	PP = 3.5 tsf TV = 0.85 tsf	
70	S-15 70.0'- 72.0'	20	58 21 42 42		SC	Very dense, Yellowish red Clayey SAND with Gravel, wet (SC)	-	L	L	L	
1690					68.5						
75	S-16	23	9	SC	Dense, Yellowish red Clayey SAND with Gravel, wet (SC)	-	L	L	L	PP = 4.0 tsf	

NOTES: PROJECT NO.: **353754** BORING NO.: **B-180-2**

NOTES: 1.) "ppd" denotes soil sample average diametral pocket penetrometer reading. 2.) "ppa" denotes soil sample average axial pocket penetrometer reading.
3.) Maximum Particle Size is determined by direct observation within limitations of sampler size. 4.) Soil identifications and field tests based on visual-manual methods per ASTM D2488.

Depth/ Elev. (ft)	Sample No. / Interval (ft)	Rec. (in)	Sample Blows per 6"	Stratum Graphic	USCS Symbol Group	Visual - Manual Identification & Description (Density/consistency, color, Group Name, constituents, particle size, structure, moisture, optional descriptions, geologic interpretation, Symbol)	Field Tests				Remarks*
							Dilatancy	Toughness	Plasticity	Dry Strength	
	75.0'- 77.0'		13 19 20								TV = 0.76 tsf
80	S-17 80.0'- 82.0'	17	43 42 61/5"		SC	Very dense, Dark brown to yellowish red Clayey SAND with Gravel, wet (SC)	-	L	L	L	
85	S-18 85.0'- 87.0'	20	18 46 59 50/3"		SC	Very dense, Yellowish red Clayey SAND with Gravel, wet (SC)	-	L	L	L	PP = 3.5 tsf
90	S-19 90.0'- 92.0'	3	50/3"		GC	Very dense, Yellowish red Clayey GRAVEL with Sand, wet (GC)	-	L	L	-	Gravel is Decomposed Shale.
95	S-20 95.0'- 97.0'	15	45 56/4"		CL	Hard, Yellowish red Lean CLAY with Sand, trace Gravel, wet (CL)	-	L	L	L	PP = 3.0 tsf
100						100.0 Top of Rock at 100 feet BGS. See Rock Coring Log.					

NOTES:

PROJECT NO.:
353754

BORING NO.:
B-180-2

NOTES: 1.) "ppd" denotes soil sample average diametral pocket penetrometer reading. 2.) "ppa" denotes soil sample average axial pocket penetrometer reading.
3.) Maximum Particle Size is determined by direct observation within limitations of sampler size. 4.) Soil identifications and field tests based on visual-manual methods per ASTM D2488.

Project: PennEast Pipeline Project
Location: Interstate 80, Carbon County, Pennsylvania
Client: PennEast Pipeline
Drilling Co.: Craig Test Boring Co., Inc.
Driller/Helper: Paul Mullins /Nick Beehler

Project No.: 353754
Project Mgr: Vatsal Shah
Field Eng. Staff: Jonathan Nelson
Date/Time Started: October 13, 2016 at 9:15 am
Date/Time Finished: October 18, 2016 at 9:00 am

Elevation: 1764 ft.	Vertical Datum: NAVD 1988	Boring Location: 90 feet North of I-80	Coord.: N: 41.081137 E: -75.659037
Item	Casing	Core Barrel	Core Bit
Type	HW	NQ2	Imp. Diamond
Length (ft)	5	5	3.25
Inside Dia. (in.)	4	2.0	2.0
Horizontal Datum: NAD 1983			Drilling Method: Wireline
Rig Make & Model: CME-750X			

Depth/Elev. (ft)	Avg Core Rate (min/ft)	Depth (ft)	Run/ (Box) No.	Rec (in. / %)	RQD (in / %)	Rock Core		Stratum Graphic	Visual Identification, Description and Remarks (Rock type, colour, texture, weathering, field strength, discontinuity spacing, optional additional geological observations)	Depth (ft.)	Discontinuities						Remarks
						Hard.	Weath				Type	Dip	Rgh	Wea	Aper	Infill	
									SEE TEST BORING LOG FOR OVERBURDEN DETAILS								
		2.00						x x x	SILTSTONE, Yellowish red to reddish brown, medium to fine grained, highly weathered, weak, extremely close to close spaced discontinuities								
		2.00						x x x	100' - 102.5' Highly Fractured zone								
		2.70	R-1	60	0	R2	H	x x x									
		3.00		100%	0%			x x x		103.00	J	19	U,Sm	DG	MW	ML	
		3.00						x x x		103.60	J	22	U,R	DS	MW	ML	
		5.70						x x x									
		105.0						x x x									
		105.0						x x x		105.0							
		3.00						.	SANDSTONE, Olive gray to reddish brown, medium to fine grained, slightly weathered, strong, extremely close to moderately spaced discontinuities								Partly Conglomerate.
		2.70						.		106.10	J	0	P,Sm	DS	T	N	
		2.90	R-2	60	50	R4	SL	.									
		3.50		100%	83%			.		108.20	J	0	P,Sm	DS	MW	ML	
		3.50						.		109.20	J	22	U,Sm	FR	T	N	
		110.0						.									
		110.0						.	SANDSTONE, Olive gray to reddish brown, medium to fine grained, slightly weathered, strong, extremely close to moderately spaced discontinuities								Partly Conglomerate.
		3.00						.		110.80	J	22	U,Sm	DS	O	ML	
		3.40						.		111.70	J	12	U,Sm	DS	O	ML	
		2.70	R-3	60	40	R4	SL	.		112.10	J	10	U,R	DS	PO	ML	
		2.50		100%	67%			.		112.60	J	10	U,Sm	DS	O	N	
		2.20						.		113.10	J	9	U,Sm	DS	O	N	
		115.0						.		113.30	J	10	U,Sm	DS	MW	N	
		115.0						.									
		2.70						.	SANDSTONE, Olive gray to reddish brown, medium to fine grained, fresh, very strong, very close to moderately spaced discontinuities								Partly Conglomerate.
		3.60						.		115.60	J	4	P,Sm	DS	T	N	
		3.70	R-4	60	54	R4	FR	.		115.90	J	3	U,Sm	DS	T	SD	
		4.10		100%	90%			.		116.60	J	9	U,Sm	DS	T	SD	
		3.20						.		116.90	J	4	U,Sm	DS	T	SD	
		120.0						.		117.40	J	6	U,Sm	DS	T	N	
								.		118.00	B	29	S,Sm	DS	T	L	
								.		118.20	J	15	U,Sm	FR	T	N	
								.		119.00	J	19	U,Sm	DS	T	SD	

Water Level Data						Notes:
Date	Time	Elapsed Time (hr)	Depth in feet to:			
			Bot. of Casing	Bottom of Hole	Water	
10/17/16	8:00	-	95.0	115.0	37.2	
10/18/16	8:30	-	95.0	160.0	111.0	

Depth/ Elev. (ft)	Avg Core Rate (min /ft)	Depth (ft)	Run/ (Box) No.	Rec. (in. / %)	RQD (in. / %)	Rock Core		Stratum Graphic	Visual Identification, Description and Remarks (Rock type, colour, texture, weathering, field strength, discontinuity spacing, optional additional geological observations)	Depth (ft.)	Discontinuities						Remarks
						Hard.	Weath.				(See Legend for Rock Description System)						
											Type	Dip	Rgh	Wea	Aper	Infill	
	2.50	120.0						•••••	SANDSTONE, Olive gray to reddish brown, medium to fine grained, slightly weathered, very strong, extremely close to moderately spaced discontinuities	120.40	J	0	U,Sm	FR	T	N	Partly Conglomerate. Loss of water from 120 to 130 feet BGS.
	3.70						•••••	120.80		J	3	U,Sm	DS	T	Fe		
	4.10		R-5	60 100%	49 82%	R4	SL	•••••		121.60	J	67	U,R	FR	MW	N	
	4.20							•••••		122.40	J	10	S,Sm	FR	O	L	
1640								•••••		123.40	J	0	U,Sm	DS	T	L	
	3.80							•••••		124.00	J	0	U,Sm	DS	O	L	
	125.0							•••••		124.60	J	6	U,Sm	FR	T	N	
125	4.50	125.0						•••••	SANDSTONE, Olive gray to reddish brown, medium to fine grained, moderately weathered, strong, extremely close to moderately spaced discontinuities 125' - 126.4' Highly Fractured zone								
	2.40							•••••	125.60	B	3	U,Sm	DS	O	N		
	4.10		R-6	60 100%	22 37%	R4	M	•••••	126.40	B	10	U,Sm	DS	O	Fe		
	5.30							•••••	127.70	J	7	U,Sm	FR	T	N		
	7.10							•••••	128.40	J	11	U,Sm	DS	T	Fe		
130	130.0							•••••	129.40	J	14	U,Sm	DS	T	Fe		
	4.20	130.0						•••••	SANDSTONE, Yellowish red to reddish brown, medium to fine grained, moderately weathered, strong, extremely close to close spaced discontinuities							Partly Conglomerate.	
	4.20							•••••	130.40	J	8	U,Sm	DS	T	N		
	5.20		R-7	58 97%	9 15%	R4	M	•••••	130.65	J	50	S,Sm	DS	MW	Fe		
	3.40							•••••	131.70	B	72	U,Sm	DS	MW	Fe		
1630	5.00							•••••	132.50	B	3	U,Sm	DS	O	Fe		
	135.0							•••••	132.90	J	17	U,Sm	DS	W	N		
135	3.10	135.0						•••••	134.00	J	3	U,Sm	FR	T	N		
	5.20							•••••	134.70	B	61	U,Sm	DS	O	Fe		
	6.00		R-8	60 100%	42 70%	R4	SL	•••••	135.0	Sandy SILTSTONE, Olive gray to reddish brown, medium to fine grained, slightly weathered, strong, extremely close to moderately spaced discontinuities							
	3.70							•••••	135.70	J	36	U,Sm	DS	O	QZ		
	7.30							•••••	135.90	B	2	U,R	DS	O	Fe		
140	5.10	140.0						•••••	136.50	J	26	U,Sm	FR	T	N		
	4.15							•••••	137.50	J	71	S,Sm	FR	O	N		
	3.90		R-9	60 100%	53 88%	R4	FR	•••••	138.30	B	11	U,R	FR	T	N		
	3.70							•••••	139.00	J	45	U,Sm	FR	T	N		
1620	3.20	140.0						•••••	140.00	J	3	U,Sm	FR	O	N		
145	145.0							•••••	140.40	J	13	U,Sm	DS	O	N		
	145.0							•••••	141.10	J	25	U,Sm	FR	T	N		
								•••••	142.40	J	19	P,Sm	FR	T	N		
								•••••	142.90	J	20	U,Sm	FR	T	N		
								•••••	144.10	J	17	P,Sm	DS	T	N		
								•••••	145.0	Sandy SILTSTONE, Olive gray to reddish brown, medium to fine grained, fresh, strong, close to moderately spaced discontinuities							Partly Conglomerate.
								•••••									



Figure B-I80-2.1
 B-I80-2 Box 1 Runs 1-4 Dry



Figure B-I80-2.2
 B-I80-2 Box 1 Runs 1-4 Wet

MOTT
 MACDONALD M M

PennEast Pipeline Project
 Rock Core Photographs

BORING NO.:
 B-I80-2



Figure B-I80-2.3
B-I80-2 Box 2 Runs 5-8 Dry



Figure B-I80-2.4
B-I80-2 Box 2 Runs 5-8 Wet

MOTT
MACDONALD M M

PennEast Pipeline Project
Rock Core Photographs

BORING NO.:
B-I80-2



Figure B-180-2.5
B-180-2 Box 3 Runs 9-12 Dry



Figure B-180-2.6
B-180-2 Box 3 Runs 9-12 Wet

MOTT
MACDONALD M M

PennEast Pipeline Project
Rock Core Photographs

BORING NO.:
B-180-2

Project: PennEast Pipeline Project
Location: Interstate 80, Carbon County, Pennsylvania
Client: PennEast Pipeline
Drilling Co.: Craig Test Boring Co., Inc.
Driller/Helper: Paul Mullins /Nick Beehler

Project No.: 353754
Project Mgr: Vatsal Shah
Field Eng. Staff: TJ Liveston
Date/Time Started: April 25, 2016 at 10:15 am
Date/Time Finished: April 29, 2016 at 9:45 am

Elevation: 1756 ft. **Vertical Datum:** NAVD 1988 **Boring Location:** Off FFF Access Road and East of Buckeye Pipeline ROW. **Coord.:** N: 41.079426 E: -75.65791



Item: Casing Sampler Core Barrel **Horizontal Datum:** NAD 1983
Type: HW SS NQ2 **Rig Make & Model:** CME-750X **Hammer Type:** Safety Bentonite Polymer Water None
Length (ft): 5 2 5 Truck Tripod Cat-Head Doughnut Automatic None
Inside Dia. (in.): 4 1.375 2.0 ATV Geoprobe Winch Roller Bit Cutting Head
Hammer Wt. (lb.): 140 140 - Track Air Track Skid
Hammer Fall (in.): 30 30 -

Depth/ Elev. (ft)	Sample No. / Interval (ft)	Rec. (in)	Sample Blows per 6"	Stratum Graphic	USCS Group Symbol	Visual - Manual Identification & Description (Density/consistency, color, Group Name, constituents, particle size, structure, moisture, optional descriptions, geologic interpretation, Symbol)	Field Tests				Remarks
							Dilatancy	Toughness	Plasticity	Dry Strength	
	S-1 0.0'- 2.0'	14	WOH 1 0 4		CL	Very soft, Brown Sandy CLAY, moist (CL)	-	-	-	-	PP=0.25 tsf. TV=N/A
5	S-2 5.0'- 7.0'	4	8 28 50/4"		GC	Very dense, Reddish brown Clayey GRAVEL, wet (GC)	-	-	-	-	
10	S-3 10.0'- 12.0'	12	5 14 9 9		CL	Very stiff, Reddish brown Gravelly CLAY, wet (CL)	-	-	-	-	PP=2.0 tsf. TV=N/A
15	S-4 15.0'- 17.0'	14	12 11 12 6		CL	Stiff, Reddish brown Gravelly CLAY, wet (CL)	-	-	-	-	PP=2.0 tsf. TV=N/A

Water Level Data						Sample Type		Notes:
Date	Time	Elapsed Time (hr)	Depth in feet to:			O	T	
			Bot. of Casing	Bottom of Hole	Water			U

Field Test Legend: Dilatancy: N - None S - Slow R - Rapid Plasticity: NP - Non-Plastic L - Low M - Medium H - High
 Toughness: L - Low M - Medium H - High Dry Strength: N - None L - Low M - Medium H - High VH - Very High

NOTES: 1.) "ppd" denotes soil sample average diametral pocket penetrometer reading. 2.) "ppa" denotes soil sample average axial pocket penetrometer reading.
 3.) Maximum Particle Size is determined by direct observation within limitations of sampler size. 4.) Soil identifications and field tests based on visual-manual methods per ASTM D2488.







Depth/ Elev. (ft)	Sample No. / Interval (ft)	Rec. (in)	Sample Blows per 6"	Stratum Graphic	USCS Symbol Group	Visual - Manual Identification & Description (Density/consistency, color, Group Name, constituents, particle size, structure, moisture, optional descriptions, geologic interpretation, Symbol)	Field Tests				Remarks*
							Dilatancy	Toughness	Plasticity	Dry Strength	
	S-5 20.0'- 22.0'	16	1 1 3 4		CL	Soft, Reddish brown Gravelly CLAY, wet (CL)	-	-	-	-	PP=1.0 tsf. TV=N/A
25	S-6 25.0'- 27.0'	14	11 5 8 8		CL	Stiff, Reddish brown Gravelly CLAY, wet (CL)	-	-	-	-	PP=3.0 tsf. TV=N/A
30	S-7 30.0'- 32.0'	8	4 12 15 12		CL	Very stiff, Reddish brown Gravelly CLAY with Sand, wet (CL)	-	-	-	-	PP=0.5 tsf. TV=N/A
35	S-8 35.0'- 37.0'	0	8 7 8 11		CL	No Recovery	-	-	-	-	
40	S-9 40.0'- 42.0'	18	6 10 12 14		CL	Very stiff, Reddish brown Gravelly CLAY, wet (CL)	-	-	-	-	PP=2.5 tsf. TV=N/A
45	S-10 45.0'- 47.0'	8	16 34 37 18		CL	Hard, Reddish brown Gravelly CLAY with Sand, wet (CL)	-	-	-	-	PP=2.5 tsf. TV=N/A

NOTES:

PROJECT NO.:
353754

BORING NO.:
B-180-3

NOTES: 1.) "ppd" denotes soil sample average diametral pocket penetrometer reading. 2.) "ppa" denotes soil sample average axial pocket penetrometer reading.
3.) Maximum Particle Size is determined by direct observation within limitations of sampler size. 4.) Soil identifications and field tests based on visual-manual methods per ASTM D2488.

Depth/ Elev. (ft)	Sample No. / Interval (ft)	Rec. (in)	Sample Blows per 6"	Stratum Graphic	USCS Symbol Group	Visual - Manual Identification & Description (Density/consistency, color, Group Name, constituents, particle size, structure, moisture, optional descriptions, geologic interpretation, Symbol)	Field Tests				Remarks*
							Dilatancy	Toughness	Plasticity	Dry Strength	
50	S-11 50.0'- 52.0'	2	12 14 20 46		CL	Hard, Reddish brown Gravelly CLAY with Sand, wet (CL)	-	-	-	-	PP=N/A TV=N/A
55	S-12 55.0'- 57.0'	18	9 16 24 22		CL	Hard, Reddish brown Gravelly CLAY with Sand, wet (CL)	-	-	-	-	PP=4.0 tsf. TV=N/A
60	S-13 60.0'- 62.0'	18	14 16 20 23		CL	Hard, Reddish brown Gravelly CLAY with Sand, wet (CL)	-	-	-	-	PP=4.0 tsf. TV=N/A
65	S-14 65.0'- 67.0'	20	13 15 21 22		CL	Hard, Reddish brown Gravelly CLAY with Sand, wet (CL)	-	-	-	-	PP=2.5 tsf. TV=N/A
70	S-15 70.0'- 72.0'	20	13 19 27 42		CL	Hard, Reddish brown Gravelly CLAY with Sand, wet (CL)	-	-	-	-	PP=4.0 tsf. TV=N/A
75	S-16	16	39		CL	Hard, Reddish brown Gravelly CLAY with Sand, wet (CL)	-	-	-	-	PP=3.5 tsf.

NOTES:

PROJECT NO.:

353754

BORING NO.:

B-180-3

NOTES: 1.) "ppd" denotes soil sample average diametral pocket penetrometer reading. 2.) "ppa" denotes soil sample average axial pocket penetrometer reading.

3.) Maximum Particle Size is determined by direct observation within limitations of sampler size. 4.) Soil identifications and field tests based on visual-manual methods per ASTM D2488.

Depth/ Elev. (ft)	Sample No. / Interval (ft)	Rec. (in)	Sample Blows per 6"	Stratum Graphic	USCS Symbol Group	Visual - Manual Identification & Description (Density/consistency, color, Group Name, constituents, particle size, structure, moisture, optional descriptions, geologic interpretation, Symbol)	Field Tests				Remarks*
							Dilatancy	Toughness	Plasticity	Dry Strength	
1680	75.0'- 77.0'		48 46 52								TV=N/A
80	S-17 80.0'- 82.0'	6	25 28 40 58		CL	Hard, Reddish brown Gravelly CLAY with Sand, wet (CL)	-	-	-	-	PP=3.5 tsf. TV=N/A
85	S-18 85.0'- 87.0'	6	32 48 50/5"		CL	Hard, Reddish brown Gravelly CLAY with Sand, wet (CL)	-	-	-	-	PP=N/A TV=N/A
90	S-19 90.0'- 92.0'	2	50/5"		CL	Hard, Reddish brown Gravelly CLAY with Sand, wet (CL)	-	-	-	-	PP=N/A TV=N/A
95						95.0 Top of Rock at 95 feet BGS. See Rock Coring Log.					
1660											
100											

NOTES:

PROJECT NO.:
353754

BORING NO.:
B-180-3

NOTES: 1.) "ppd" denotes soil sample average diametral pocket penetrometer reading. 2.) "ppa" denotes soil sample average axial pocket penetrometer reading.
3.) Maximum Particle Size is determined by direct observation within limitations of sampler size. 4.) Soil identifications and field tests based on visual-manual methods per ASTM D2488.

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Location: Interstate 80, Carbon County, Pennsylvania
Client: PennEast Pipeline
Drilling Co.: Craig Test Boring Co., Inc.
Driller/Helper: Paul Mullins /Nick Beehler

Project No.: 353754
Project Mgr: Vatsal Shah
Field Eng. Staff: TJ Liveston
Date/Time Started: April 25, 2016 at 10:15 am
Date/Time Finished: April 29, 2016 at 9:45 am

Elevation: 1756 ft.		Vertical Datum: NAVD 1988		Boring Location: Off FFF Access Road and East of Buckeye Pipeline ROW.		Coord.: N: 41.079426 E: -75.65791	
Item	Casing	Core Barrel	Core Bit	Horizontal Datum: NAD 1983		Drilling Method: Wireline	
Type	HW	NQ2	Imp. Diamond	Rig Make & Model: CME-750X			
Length (ft)	5	5	3.25				
Inside Dia. (in.)	4	2.0	2.0				

Depth/Elev. (ft)	Avg Core Rate (min /ft)	Depth (ft)	Run/ (Box) No.	Rec (in. / %)	RQD (in / %)	Rock Core		Stratum Graphic	Visual Identification, Description and Remarks (Rock type, colour, texture, weathering, field strength, discontinuity spacing, optional additional geological observations)	Depth (ft.)	Discontinuities <small>(See Legend for Rock Description System)</small>						Remarks	
						Hard.	Weath				Type	Dip	Rgh	Wea	Aper	Infil		
1660	3.10	95.0							SEE TEST BORING LOG FOR OVERBURDEN DETAILS									
	3.10																	
	3.10		R-1	37 62%	4 7%	R2	H											
	3.10																	
100	3.10	100.0							SANDSTONE, Red, very fine to medium grained, highly weathered, weak, very close to close spaced discontinuities 95'-96.3' Highly Fractured zone 96.6'-100' Highly Fractured zone 100'-100.4' Highly Fractured zone 100.7'-101.1' Highly Fractured zone 101.8'-102' Highly Fractured zone 102.45'-102.7' Highly Fractured zone 103.6'-103.8' Highly Fractured zone									
	3.10	100.0								100.60	J	15	U,R	DS	PO	Res		
	3.6									101.25	J	0	U,R	DS	O	Res		
	3.6									101.40	J	0	S,R	DS	O	Res		
	3.6									101.65	J	0	S,R	DS	O	Fgmts		
	3.6		R-2	45 75%	0 0%	R2	H			101.8'	J	0	U,R	DS	PO	N		
	3.6									102.30	J	0	U,R	FR	PO	N		
	3.6									102.60	J	0	U,R	DS	PO	Res		
	3.6									102.90	J	0	U,R	DS	O	Res		
	3.6									102.95	J	5	S,R	DS	O	Res		
105	3.6	105.0							103.00	J	0	U,R	DS	PO	Res			
	3.6								103.50	J	0	P,R	FR	PO	N			
	3.6								103.75	J	0	P,R	FR	PO	N			
1650	9.00	105.0							SANDSTONE, Dark gray and red, very fine to medium grained, slightly weathered, medium strong, very close to close spaced discontinuities 105'-105.1' Highly Fractured zone 105.6'-105.8' Highly Fractured zone 106.5'-106.7' Highly Fractured zone 108'-108.2' Highly Fractured zone	105.30	J	0	S,R	FR	T	N		
	9.00									105.40	J	0	U,R	FR	PO	N		
	9.00									106.00	J	15	U,R	DS	PO	ST		
	9.00									106.20	J	0	P,R	DS	PO	ST		
	9.00									106.30	J	0	U,R	DS	PO	ST		
	9.00		R-3	60 100%	24 40%	R3	SL			106.90	J	0	U,R	DS	PO	ST		
	9.00									107.20	J	5	S,R	DS	PO	ST		
	9.00									107.60	J	0	S,R	DS	O	Fgmts		
	9.00									108.60	J	0	S,R	DS	PO	ST		
	9.00									108.80	J	0	S,R	DS	PO	ST		
110	9.10	110.0							SANDSTONE, Gray to red, fine to medium grained, slightly weathered, medium strong, close spaced discontinuities	109.70	J	5	U,R	DS	PO	ST		
	9.10									109.70	J	5	U,R	DS	PO	ST		
	9.10									110.50	J	0	U,R	FR	T	N		
	9.10									110.65	J	0	U,R	FR	PO	N		
	9.10									111.30	J	0	U,R	FR	T	N		
	9.10		R-4	60 100%	48 80%	R3	SL			112.00	J	0	U,R	FR	T	N		
	9.10									112.50	J	0	U,R	FR	T	N		
	9.10									112.80	J	10	S,R	FR	T	N		
	9.10									113.25	J	10	S,R	DS	PO	Sa		
	9.10									113.80	J	10	S,R	FR	VT	N		
	9.10								114.10	J	5	U,R	FR	T	N			
	9.10								114.40	J	5	U,R	FR	T	N			
	9.10								114.60	J	5	S,R	FR	PO	N			

Water Level Data						Notes:
Date	Time	Elapsed Time (hr)	Depth in feet to:			
			Bot. of Casing	Bottom of Hole	Water	

Depth/ Elev. (ft)	Avg Core Rate (min /ft)	Depth (ft)	Run/ (Box) No.	Rec. (in. / %)	RQD (in. / %)	Rock Core		Stratum Graphic	Visual Identification, Description and Remarks (Rock type, colour, texture, weathering, field strength, discontinuity spacing, optional additional geological observations)	Depth (ft.)	Discontinuities							Remarks									
						Hard.	Weath.				(See Legend for Rock Description System)																
											Type	Dip	Rgh	Wea	Aper	Infill											
1640	9.00	115.0	R-5	60 100%	48 80%	R3	FR		SANDSTONE, Dark gray to red, fine to coarse grained, fresh, medium strong, very close to moderately spaced discontinuities Frequent conglomerates	114.80	J	5	P,R	FR	T	N											
	115.70									J	5	S,R	FR	PO	Sa												
	116.10									J	0	P,R	FR	T	N												
	116.80									J	0	U,R	FR	T	Fgmts												
	116.90									J	5	U,R	FR	T	N												
	117.60									J	0	U,R	DG	PO	Res												
	117.90									J	0	U,R	FR	PO	Sa												
	118.10									J	10	U,R	DS	O	Sa												
	118.60									J	0	U,R	FR	T	N												
	119.00									J	0	U,R	FR	T	N												
119.20	J	0	U,R	FR	T	N																					
119.40	J	30	U,R	FR	O	Sa																					
120	7.90	120.0	R-6	60 100%	45 75%	R3	FR		SANDSTONE, Dark gray to red, fine to coarse grained, fresh, medium strong, very close to moderately spaced discontinuities Conglomerates present	120.20	J	5	U,R	FR	PO	Sa											
	120.60									J	0	U,R	FR	T	N												
	120.90									J	5	U,R	FR	T	N												
	121.90									J	5	U,R	FR	T	N												
	122.40									J	0	U,R	DS	PO	ST												
	123.00									J	5	U,R	FR	VT	N												
	123.10									J	0	U,R	FR	VT	N												
	123.90									J	25	U,R	FR	PO	N												
	124.10									J	15	U,R	FR	PO	N												
	124.35									J	0	U,R	FR	T	N												
124.43	J	5	U,R	FR	T	N																					
125	7.80	125.0	R-7	60 100%	51 85%	R3	FR		SANDSTONE, Dark gray to red, fine to medium grained, fresh, medium strong, very close to medium spaced discontinuities	125.50	J	0	U,R	FR	PO	Sa											
	127.10									J	0	S,R	FR	T	N												
	127.20									J	0	S,R	FR	T	N												
	128.20									J	0	U,R	FR	T	N												
	128.50									J	0	P,R	FR	T	N												
	128.80									J	0	U,R	FR	T	N												
	129.10									J	5	U,R	FR	T	N												
	130.25									J	0	U,R	DG	O	Sa												
	130.70									J	20	U,R	FR	PO	Sa												
	131.00									J	0	U,R	FR	T	N												
130	7.20	130.0	R-8	60 100%	44 73%	R3	FR		SANDSTONE, Dark gray to red, fine to medium grained, highly weathered, medium strong, very close to medium spaced discontinuities 131.2'-131.3' Highly Fractured zone	131.40	J	45	S,R	FR	T	N											
	131.90									J	0	S,R	FR	T	N												
	132.35									J	0	S,R	DG	O	N												
	132.80									J	0	U,R	FR	T	N												
	133.30									J	10	P,R	DS	T	ST												
	133.50									J	15	U,R	FR	O	Fgmts												
	134.50									J	10	U,R	FR	T	N												
	135.30									J	5	U,R	FR	PO	Fgmts												
	135.60									J	5	S,R	FR	O	Fgmts												
	135									6.60	135.0	R-9	60 100%	44 73%	R3	FR			SANDSTONE, Dark gray to red, fine to medium grained, fresh, medium strong, close to moderately spaced discontinuities	138.00	J	0	P,R	FR	T	N	
138.30		J	0	S,R	FR	T	N																				
138.60		J	5	P,R	FR	T	N																				
139.00		J	0	S,R	FR	T	N																				
139.30		J	5	P,R	FR	VT	N																				
139.60		J	5	U,R	FR	T	N																				
140		140.0	140.0							SANDSTONE, Dark gray to red, fine to medium grained, fresh, medium strong, very close to							139.60			J	5	U,R	FR	T	N		
		140.0															J			5	U,R	FR	T	N			
		140.0															J			5	U,R	FR	T	N			
		140.0															J			5	U,R	FR	T	N			

NOTES:

PROJECT NO.: **353754**

Boring No.: **B-180-3**

Depth/ Elev. (ft)	Avg Core Rate (min /ft)	Depth (ft)	Run/ (Box) No.	Rec. (in. / %)	RQD (in. / %)	Rock Core		Stratum Graphic	Visual Identification, Description and Remarks (Rock type, colour, texture, weathering, field strength, discontinuity spacing, optional additional geological observations)	Depth (ft.)	Discontinuities						Remarks
						Hard.	Weath.				(See Legend for Rock Description System)						
											Type	Dip	Rgh	Wea	Aper	Infill	
6.50										140.30	J	0	U,R	FR	T	N	
										140.50	J	5	S,R	FR	PO	N	
6.50										141.20	J	15	U,R	FR	T	N	
										141.25	J	15	U,R	FR	T	N	
6.50		R-10		60 100%	43 72%	R3	FR			142.50	J	5	U,R	FR	PO	Fgmts	
6.50										143.75	J	15	U,R	FR	O	Fgmts	
										144.00	J	30	S,R	FR	O	N	
										144.10	J	30	S,R	FR	O	N	
										144.50	J	20	U,R	FR	VT	N	
										144.70	J	10	U,R	FR	T	N	
145		145.0															
										145.50	J	0	P,R	DG	PO	Sa	
										145.65	J	0	S,R	FR	PO	Sa	
										145.80	J	5	S,R	FR	PO	Sa	
										146.10	J	45	U,R	FR	PO	Sa	
1610										146.50	J	40	P,R	FR	T	N	
										146.80	J	10	U,R	FR	T	N	
										147.00	J	0	U,R	FR	T	N	
		R-11		60 100%	40 67%	R3	FR			147.60	J	5	U,R	FR	T	N	
										148.65	J	0	S,R	FR	VT	N	
										149.00	J	50	P,R	FR	T	Fgmts	
										149.10	J	5	S,R	FR	PO	Sa	
										149.50	J	40	S,R	FR	T	N	
150		150.0															
										151.20	J	5	S,R	FR	VT	N	
										151.40	J	5	U,R	FR	VT	N	
										151.90	J	40	S,R	FR	T	N	
		R-12		60 100%	54 90%	R3	FR			152.40	J	0	U,R	DG	O	Fgmts	
										152.80	J	0	S,R	FR	T	N	
										153.00	J	0	S,R	FR	O	Fgmts	
										153.75	J	5	S,R	FR	VT	N	
										154.60	J	0	S,R	FR	T	N	
155		155.0															
										155.20	J	40	P,R	DS	T	Fgmts	
										155.40	J	15	P,R	FR	T	N	
										155.60	J	15	P,R	FR	T	N	
1600										156.00	J	10	P,R	FR	T	N	
										156.80	J	55	P,R	FR	T	N	
		R-13		60 100%	45 75%	R3	FR			158.10	J	10	U,R	FR	T	N	
										159.00	J	0	U,R	FR	VT	N	
										159.30	J	10	U,R	FR	PO	N	
										159.60	J	5	S,R	FR	T	N	
160		160.0															
										160.25	J	5	U,R	FR	T	N	
										160.60	J	185	S,R	FR	O	Fgmts	
										162.60	J	70	S,R	DS	PO	Sa	
										163.05	J	0	U,R	DG	O	Res	
		R-14		60 100%	51 85%	R3	FR										
165		165.0															
										165.70	J	15	P,R	FR	T	N	

Depth/ Elev. (ft)	Avg Core Rate (min /ft)	Depth (ft)	Run/ (Box) No.	Rec. (in. / %)	RQD (in. / %)	Rock Core		Stratum Graphic	Visual Identification, Description and Remarks (Rock type, colour, texture, weathering, field strength, discontinuity spacing, optional additional geological observations)	Depth (ft.)	Discontinuities						Remarks
						Hard.	Weath.				(See Legend for Rock Description System)						
											Type	Dip	Rgh	Wea	Aper	Infill	
	8.00									166.20	J	0	U,R	FR	T	N	
										166.80	J	15	U,R	FR	T	N	
	8.00		R-15	60 100%	58 97%	R3	FR			168.00	J	30	U,R	FR	T	N	
	8.00									169.30	J	5	S,R	FR	T	N	
170		170.0								169.80	J	0	S,R	FR	PO	N	
	8.00									171.30	J	5	U,R	FR	T	N	
										172.50	J	5	U,R	FR	T	N	
	8.00		R-16	60 100%	60 100%	R3	FR			174.10	J	5	U,R	FR	T	N	
		170.0								174.50	J	5	U,R	FR	T	N	
175		175.0								174.85	J	5	U,R	FR	T	N	
	8.00									175.80	J	0	S,R	FR	T	N	
1580										176.20	J	15	U,R	FR	T	N	
	8.00		R-17	60 100%	58 97%	R3	FR			179.30	J	10	U,R	FR	T	N	
										181.60	J	15	U,R	FR	VT	N	
180		180.0								182.50	J	0	U,R	FR	T	N	
	8.00									182.90	J	0	U,R	FR	T	N	
			R-18	60 100%	60 100%	R3	FR			184.00	MB						
	8.00									184.60	MB						
185		185.0								185.70	J	5	S,R	FR	T	N	
	8.00									186.40	J	5	U,R	FR	T	N	
1570										186.60	J	5	P,R	FR	T	N	
	8.00		R-19	60 100%	58 97%	R3	FR			188.40	J	5	U,R	FR	T	N	
										189.50	J	60	S,R	FR	T	N	
190		190.0								191.30	J	5	U,R	FR	T	N	
	8.00																

Depth/ Elev. (ft)	Avg Core Rate (min /ft)	Depth (ft)	Run/ (Box) No.	Rec. (in. / %)	RQD (in. / %)	Rock Core		Stratum Graphic	Visual Identification, Description and Remarks (Rock type, colour, texture, weathering, field strength, discontinuity spacing, optional additional geological observations)	Depth (ft.)	Discontinuities						Remarks	
						Hard.	Weath				(See Legend for Rock Description System)							
											Type	Dip	Rgh	Wea	Aper	Infill		
	12.10		R-25	60 100%	60 100%	R4	FR											
	12.10																	
	12.10																	
220		220.0							220.0									
									End of Boring at 220 feet BGS. Borehole grouted with cement and bentonite hole plug.									
225																		
1530																		
230																		
235																		
1520																		
240																		



Figure B-I80-3.1
B-I80-3 Box 1 Runs 1-4 Dry



Figure B-I80-3.2
B-I80-3 Box 1 Runs 1-4 Wet



Figure B-180-3.3
B-180-3 Box 2 Runs 5-8 Dry



Figure B-180-3.4
B-180-3 Box 2 Runs 5-8 Wet



Figure B-I80-3.5
B-I80-3 Box 3 Runs 9-12 Dry



Figure B-I80-3.6
B-I80-3 Box 3 Runs 9-12 Wet



Figure B-I80-3.7
B-I80-3 Box 4 Runs 13-16 Dry



Figure B-I80-3.8
B-I80-3 Box 4 Runs 13-16 Wet



Figure B-I80-3.9
B-I80-3 Box 5 Runs 17-20 Dry



Figure B-I80-3.10
B-I80-3 Box 5 Runs 17-20 Wet



Figure B-I80-3.11
B-I80-3 Box 6 Runs 21-24 Dry



Figure B-I80-3.12
B-I80-3 Box 6 Runs 21-24 Wet



Figure B-I80-3.13
B-I80-3 Box 7 Run 25 Dry



Figure B-I80-3.14
B-I80-3 Box 7 Run 25 Wet

Project: PennEast Pipeline Project **Project No.:** 353754
Location: Interstate 80, Carbon County, Pennsylvania **Project Mgr:** Vatsal Shah
Client: PennEast Pipeline **Field Eng. Staff:** Jonathan Nelson/Bernard Cortes
Drilling Co.: Craig Test Boring Co., Inc. **Date/Time Started:** December 28, 2016 at 10:30 am
Driller/Helper: Paul Mullins /Nick Beehler **Date/Time Finished:** December 29, 2016 at 9:20 am

Elevation: 1758.2 ft.	Vertical Datum: NAVD 1988	Boring Location: Approximately 40 feet South of staked location	Coord.: N: 41.074328 E: -75.654571
Item	Casing	Sampler	Core Barre
Type	HW	SS	NQ2
Length (ft)	5	2	5
Inside Dia. (in.)	4	1.375	2.0
Hammer Wt. (lb.)	140	140	-
Hammer Fall (in.)	30	30	-
Rig Make & Model: CME-750X			
Hammer Type		Drilling Fluid	
<input type="checkbox"/> Truck	<input type="checkbox"/> Tripod	<input type="checkbox"/> Cat-Head	<input type="checkbox"/> Safety
<input checked="" type="checkbox"/> ATV	<input type="checkbox"/> Geoprobe	<input checked="" type="checkbox"/> Winch	<input type="checkbox"/> Doughnut
<input type="checkbox"/> Track	<input type="checkbox"/> Air Track	<input checked="" type="checkbox"/> Roller Bit	<input checked="" type="checkbox"/> Automatic
<input type="checkbox"/> Skid	<input type="checkbox"/> Cutting Head	<input type="checkbox"/> None	<input type="checkbox"/> None
Drill Rod Size:			Casing Advance
			Mud Rotary

Depth/ Elev. (ft)	Sample No. / Interval (ft)	Rec. (in)	Sample Blows per 6"	Stratum Graphic	USCS Group Symbol	Visual - Manual Identification & Description (Density/consistency, color, Group Name, constituents, particle size, structure, moisture, optional descriptions, geologic interpretation, Symbol)	Field Tests				Remarks
							Dilatancy	Toughness	Plasticity	Dry Strength	
	S-1 0.0'- 2.0'	8	5 5 7 3		SM	0.3 3" - TOPSOIL Bottom (3") - Medium dense, Brownish yellow Silty SAND, with Gravel, moist (SM)	-	-	-	-	
5	S-2 5.0'- 7.0'	9	7 8 19 10		SC	3.5 Medium dense, Reddish brown Clayey SAND, trace Gravel, wet (SC)	-	L	L	L	Gravel is Sandstone fragments.
10	S-3 10.0'- 12.0'	13	6 8 12 9		SC	Medium dense, Reddish brown Clayey SAND with Gravel, wet (SC)	-	L	L	L	
15	S-4 15.0'- 17.0'	12	6 6 9 13		SC	Medium dense, Reddish brown Clayey SAND, trace Gravel, wet (SC)	-	L	L	L	

Water Level Data			Sample Type			Notes:
Date	Time	Elapsed Time (hr)	Depth in feet to:	Bot. of Casing	Bottom of Hole	

Field Test Legend: Dilatancy: N - None S - Slow R - Rapid Plasticity: NP - Non-Plastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High Dry Strength: N - None L - Low M - Medium H - High VH - Very High

NOTES: 1.) "ppd" denotes soil sample average diametral pocket penetrometer reading. 2.) "ppa" denotes soil sample average axial pocket penetrometer reading.
3.) Maximum Particle Size is determined by direct observation within limitations of sampler size. 4.) Soil identifications and field tests based on visual-manual methods per ASTM D2488.

Depth/ Elev. (ft)	Sample No. / Interval (ft)	Rec. (in)	Sample Blows per 6"	Stratum Graphic	USCS Symbol Group	Visual - Manual Identification & Description (Density/consistency, color, Group Name, constituents, particle size, structure, moisture, optional descriptions, geologic interpretation, Symbol)	Field Tests				Remarks*
							Dilatancy	Toughness	Plasticity	Dry Strength	
	S-5 20.0'- 22.0'	9	5 7 8 8		SC	Medium dense, Reddish brown Clayey SAND with Gravel, wet (SC)	-	L	L	L	
25	S-6 25.0'- 27.0'	9	12 11 13 13		SC	Medium dense, Reddish brown Clayey SAND with Gravel, wet (SC)	-	L	L	M	Gravel is Sandstone fragments.
1730											
30	S-7 30.0'- 32.0'	8	23 22 23 12		SC	Dense, Reddish brown Clayey SAND with Gravel, wet (SC)	-	L	L	L	
35	S-8 35.0'- 37.0'	13	6 7 13 10		SC	Medium dense, Reddish brown Clayey SAND with Gravel, wet (SC)	-	M	M	M	
1720											
40	S-9 40.0'- 42.0'	11	11 12 12 14		SC	Medium dense, Reddish brown Clayey SAND with Gravel, wet (SC)	-	L	L	L	
45	S-10 45.0'- 47.0'	15	12 8 9 11		SC	Medium dense, Reddish brown Clayey SAND with Gravel, wet (SC)	-	L	L	M	

NOTES:

PROJECT NO.:

353754

BORING NO.:

B-180-4

NOTES: 1.) "ppd" denotes soil sample average diametral pocket penetrometer reading. 2.) "ppa" denotes soil sample average axial pocket penetrometer reading.
3.) Maximum Particle Size is determined by direct observation within limitations of sampler size. 4.) Soil identifications and field tests based on visual-manual methods per ASTM D2488.

Depth/ Elev. (ft)	Sample No. / Interval (ft)	Rec. (in)	Sample Blows per 6"	Stratum Graphic	USCS Symbol Group	Visual - Manual Identification & Description (Density/consistency, color, Group Name, constituents, particle size, structure, moisture, optional descriptions, geologic interpretation, Symbol)	Field Tests				Remarks*
							Dilatancy	Toughness	Plasticity	Dry Strength	
1710					SC	Dense, Reddish brown Clayey SAND with Gravel, wet (SC)	-	L	L	M	PP = N/A TV = N/A
50	S-11 50.0'- 52.0'	15	12 18 21 18								
55	S-12 55.0'- 57.0'	14	22 15 18 17								
1700											
60	S-13 60.0'- 62.0'	12	56 18 23 17		SC	Dense, Reddish brown Clayey SAND with Gravel, wet (SC)	-	L	L	M	Boulder from 60 to 61 feet BGS.
65	S-14 65.0'- 67.0'	16	14 12 28 42								
1690											
70	S-15 70.0'- 72.0'	19	14 16 23 24		SC	Dense, Reddish brown Clayey SAND with Gravel, wet (SC)	-	L	L	M	Cobble from 66.5 to 66.8 fee BGS.
75	S-16	18	17								
					SC	Very dense, Reddish brown Clayey SAND, trace Gravel, wet (SC)	-	L	L	M	

NOTES:

PROJECT NO.:

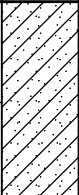
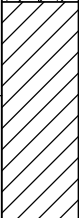
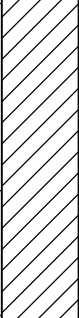

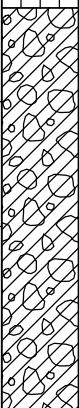
353754

BORING NO.:

B-180-4

NOTES: 1.) "ppd" denotes soil sample average diametral pocket penetrometer reading. 2.) "ppa" denotes soil sample average axial pocket penetrometer reading.

3.) Maximum Particle Size is determined by direct observation within limitations of sampler size. 4.) Soil identifications and field tests based on visual-manual methods per ASTM D2488.

Depth/ Elev. (ft)	Sample No. / Interval (ft)	Rec. (in)	Sample Blows per 6"	Stratum Graphic	USCS Symbol Group	Visual - Manual Identification & Description (Density/consistency, color, Group Name, constituents, particle size, structure, moisture, optional descriptions, geologic interpretation, Symbol)	Field Tests				Remarks*	
							Dilatancy	Toughness	Plasticity	Dry Strength		
	75.0'- 77.0'		28 34 32									
1680					78.5							
80	S-17 80.0'- 82.0'	14	13 15 27 27		CL	Hard, Reddish brown Sandy CLAY with Gravel, wet (CL)	-	M	M	M	PP = N/A TV = N/A	
85	S-18 85.0'- 87.0'	4	31 75 >50/2"		CL	Hard, Reddish brown Sandy CLAY, wet (CL)	-	M	M	M	PP = N/A TV = N/A	
1670					88.5							
90	S-19 90.0'- 92.0'	14	26 71 64/4"		ML	Hard, Reddish brown Sandy SILT, wet (ML)	-	L	L	H		
95	S-20 95.0'- 97.0'	5	70/5"		GC	Very dense, Reddish brown Clayey GRAVEL, wet (GC)	-	L	L	L		
1660					100.0							
100						Top of Rock at 100 feet BGS. See Rock Core Log.						

NOTES:

PROJECT NO.:

353754

BORING NO.:

B-180-4

NOTES: 1.) "ppd" denotes soil sample average diametral pocket penetrometer reading. 2.) "ppa" denotes soil sample average axial pocket penetrometer reading.
3.) Maximum Particle Size is determined by direct observation within limitations of sampler size. 4.) Soil identifications and field tests based on visual-manual methods per ASTM D2488.

Project: PennEast Pipeline Project
Location: Interstate 80, Carbon County, Pennsylvania
Client: PennEast Pipeline
Drilling Co.: Craig Test Boring Co., Inc.
Driller/Helper: Paul Mullins /Nick Beehler

Project No.: 353754
Project Mgr: Vatsal Shah
Field Eng. Staff: Jonathan Nelson/Bernard Cortes
Date/Time Started: December 28, 2016 at 10:30 am
Date/Time Finished: December 29, 2016 at 9:20 am

Elevation: 1758.2 ft.		Vertical Datum: NAVD 1988		Boring Location: Approximately 40 feet South of staked location		Coord.: N: 41.074328 E: -75.654571	
Item	Casing	Core Barrel	Core Bit	Horizontal Datum: NAD 1983			
Type	HW	NQ2	Imp. Diamond	Drilling Method: Wireline			
Length (ft)	5	5	3.25	Rig Make & Model: CME-750X			
Inside Dia. (in.)	4	2.0	2.0				

Depth/ Elev. (ft)	Avg Core Rate (min /ft)	Depth (ft)	Run/ (Box) No.	Rec (in. / %)	RQD (in / %)	Rock Core		Stratum Graphic	Visual Identification, Description and Remarks (Rock type, colour, texture, weathering, field strength, discontinuity spacing, optional additional geological observations)	Depth (ft.)	Discontinuities						Remarks
						Hard.	Weath				Type	Dip	Rgh	Wea	Aper	Infill	
									SEE TEST BORING LOG FOR OVERBURDEN DETAILS								
	3.50	100.0						x x x	SILTSTONE, Reddish brown to greenish gray, fine grained, highly weathered, weak, extremely close to moderately spaced discontinuities								
	3.30							x x x									
	3.40		R-1	57 95%	14 23%	R2	H	x x x		102.10	J	0	U,Sm	DG	VW	ML	
	3.10							x x x									
	3.30							x x x		103.70	J	14	U,Sm	DG	O	ML	
	3.30							x x x		104.30	J	14	U,Sm	DS	T	N	
105		105.0						x x x									
	3.80							x x x	SILTSTONE, Reddish brown to greenish gray, fine to medium grained, slightly weathered, medium strong, close to moderately spaced discontinuities								
	3.70							x x x		105.90	J	11	U,Sm	DS	T	N	
	3.50		R-2	60 100%	49 82%	R3	SL	x x x		106.40	J	14	U,Sm	FR	T	N	
	3.50							x x x		107.40	J	17	U,Sm	DS	O	N	
1650								x x x									
	3.10							x x x		108.60	J	17	U,Sm	DS	O	N	
	3.10	110.0						x x x		109.70	J	22	U,Sm	DS	O	N	
110		110.0						x x x	SILTSTONE, Reddish brown fine to medium grained, slightly weathered, medium strong, close to moderately spaced discontinuities								
	3.30							x x x		111.00	J	35	U,Sm	FR	T	N	
	3.30							x x x		111.20	J	33	U,Sm	DS	PO	Fe	
	3.60		R-3	60 100%	39 65%	R3	SL	x x x		112.30	S	71	U,Sm	DS	PO	N	
	3.10							x x x									
	3.00							x x x		113.60	J	6	S,Sm	DS	MW	N	
	3.00	115.0						x x x		114.40	J	10	U,R	DS	O	ML	
115		115.0						x x x									
	3.10							.	SANDSTONE, Reddish brown to greenish gray, fine grained, slightly weathered, medium strong, close to moderately spaced discontinuities								
	3.20							.		115.80	J	7	U,Sm	DS	O	ML	
	3.00		R-4	60 100%	43 72%	R3	SL	.		116.60	J	21	U,Sm	FR	T	N	
	2.80							.		117.30	J	26	U,Sm	DS	PO	N	
1640								.									
	3.10							.		118.40	J	18	P,R	DS	PO	ML	
		120.0						.		119.00	J	7	U,Sm	DS	PO	N	

Water Level Data						Notes:
Date	Time	Elapsed Time (hr)	Depth in feet to:			
			Bot. of Casing	Bottom of Hole	Water	

Depth/ Elev. (ft)	Avg Core Rate (min /ft)	Depth (ft)	Run/ (Box) No.	Rec. (in. / %)	RQD (in. / %)	Rock Core		Stratum Graphic	Visual Identification, Description and Remarks (Rock type, colour, texture, weathering, field strength, discontinuity spacing, optional additional geological observations)	Depth (ft.)	Discontinuities						Remarks
						Hard.	Weath.				(See Legend for Rock Description System)						
											Type	Dip	Rgh	Wea	Aper	Infill	
	2.70	120.0							SANDSTONE, Reddish brown, fine grained, slightly weathered, strong, close to moderately spaced discontinuities	120.60	J	10	U,Sm	FR	PO	N	
	2.90									121.30	J	10	U,Sm	FR	T	N	
	3.10		R-5	60 100%	42 70%	R4	SL			122.30	J	15	U,Sm	FR	T	N	
	2.90									123.30	J	10	U,Sm	FR	PO	N	
	3.00									124.10	J	7	U,Sm	FR	T	N	
125		125.0							SANDSTONE, Reddish brown, fine grained, slightly weathered, strong, close to moderately spaced discontinuities								
	3.20									125.70	J	85	S,Sm	FR	MW	N	
	3.00									126.30	J	0	U,Sm	FR	O	N	
	3.20		R-6	60 100%	47 78%	R4	SL			126.90	J	10	U,Sm	FR	T	N	
1630	2.90									127.70	J	15	U,Sm	FR	T	N	
	3.30								128.50	J	18	P,Sm	FR	O	N		
		130.0							SANDSTONE, Reddish brown to greenish gray, fine to medium grained, slightly weathered, strong, close to moderately spaced discontinuities	129.30	J	5	P,R	FR	O	N	
130	3.60									131.40	J	0	U,Sm	FR	T	N	
	3.00									133.00	J	11	U,Sm	FR	T	N	
	3.00		R-7	60 100%	47 78%	R4	SL			133.70	J	0	U,Sm	FR	T	N	
	3.10									134.40	J	10	U,Sm	FR	T	N	
	2.90								SANDSTONE, Reddish brown to greenish gray, fine to medium grained, slightly weathered, strong, close to moderately spaced discontinuities	135.80	J	7	P,Sm	FR	O	N	
135		135.0								138.10	J	10	U,Sm	FR	MW	N	
	3.10									138.90	J	10	S,Sm	FR	O	N	
	3.10		R-8	60 100%	44 73%	R4	SL			139.40	J	11	U,Sm	FR	O	N	
1620	3.00									141.00	J	9	U,Sm	FR	O	N	
	3.30								141.40	J	12	U,Sm	FR	PO	N		
140		140.0							SANDSTONE, Reddish brown to greenish gray, slightly weathered, strong, close to moderately spaced discontinuities	142.30	J	5	U,Sm	FR	T	N	
	2.90									143.20	J	22	U,Sm	FR	O	N	
	3.10									144.00	J	22	U,R	FR	T	N	
	3.00		R-9	57 95%	42 70%	R4	SL										
145		145.0															

NOTES:

PROJECT NO.: **353754**

Boring No.: **B-180-4**

Depth/ Elev. (ft)	Avg Core Rate (min /ft)	Depth (ft)	Run/ (Box) No.	Rec. (in. / %)	RQD (in. / %)	Rock Core		Stratum Graphic	Visual Identification, Description and Remarks (Rock type, colour, texture, weathering, field strength, discontinuity spacing, optional additional geological observations)	Depth (ft.)	Discontinuities						Remarks
						Hard.	Weath.				(See Legend for Rock Description System)						
											Type	Dip	Rgh	Wea	Aper	Infill	
	2.00									171.10	J	35	P,R	FR	T	N	
										171.60	J	30	P,Sm	FR	T	N	
	2.00	R-15	60 100%	57 95%	R3	FR				172.20	J	30	P,R	FR	PO	N	
	2.00									173.00	J	20	P,R	FR	PO	N	
										173.50	J	20	P,R	FR	PO	N	
	2.00									174.20	J	20	P,Sm	FR	T	N	
175	175.0									174.70	MB						
	4.00									175.80	MB						
	5.00									176.00	MB						
	5.00	R-16	60 100%	46 77%	R5	FR				177.40	J	20	P,Sm	FR	T	N	
1580	5.00									178.00	J	20	P,R	FR	T	N	
	5.00									178.50	J	20	P,R	FR	T	N	
	5.00									179.20	J	30	P,R	FR	T	N	
180	180.0									179.80	MB						
	4.00									180.50	J	20	P,R	FR	PO	N	
	5.00									181.30	J	20	P,R	FR	PO	N	
	5.00	R-17	60 100%	52 87%	R5	FR				181.80	J	20	P,R	FR	T	N	
	5.00									182.60	J	20	P,R	FR	T	N	
	5.00									183.50	J	20	P,R	FR	T	N	
	5.00									183.90	J	20	P,R	FR	T	N	
	5.00									184.30	J	20	P,R	FR	T	N	
185	185.0									184.70	J	20	P,R	FR	T	N	
	4.00									185.30	MB						
	4.00									185.50	J	20	P,R	FR	T	N	
	4.00									186.40	J	10	P,R	FR	T	N	
	4.00	R-18	60 100%	50 83%	R5	FR				187.30	J	10	P,R	FR	T	N	
1570	4.00									188.10	J	30	P,R	FR	T	N	
	4.00									188.90	J	50	P,R	FR	T	N	
	4.00									189.40	J	40	P,Sm	FR	O	N	
190	190.0									189.70	J	50	P,Sm	FR	T	N	
	3.00									190.70	J	50	P,Sm	FR	T	N	
	3.00									191.40	J	50	P,Sm	FR	T	N	
	3.00	R-19	60 100%	51 85%	R5	FR				192.90	J	40	P,Sm	FR	T	N	
	3.00									193.60	MB						
195	195.0																
	3.00																
	3.00																



Figure B-180-4.1
 B-180-4 Box 1 Runs 1-4 Dry



Figure B-180-4.2
 B-180-4 Box 1 Runs 1-4 Wet



Figure B-180-4.3
B-180-4 Box 2 Runs 5-8 Dry



Figure B-180-4.4
B-180-4 Box 2 Runs 5-8 Wet



Figure B-I80-4.5
B-I80-4 Box 3 Runs 9-12 Dry



Figure B-I80-4.6
B-I80-4 Box 3 Runs 9-12 Wet



Figure B-I80-4.7
B-I80-4 Box 4 Runs 13-16 Dry



Figure B-I80-4.8
B-I80-4 Box 4 Runs 13-16 Wet



Figure B-180-4.9
B-180-4 Box 5 Runs 17-20 Dry

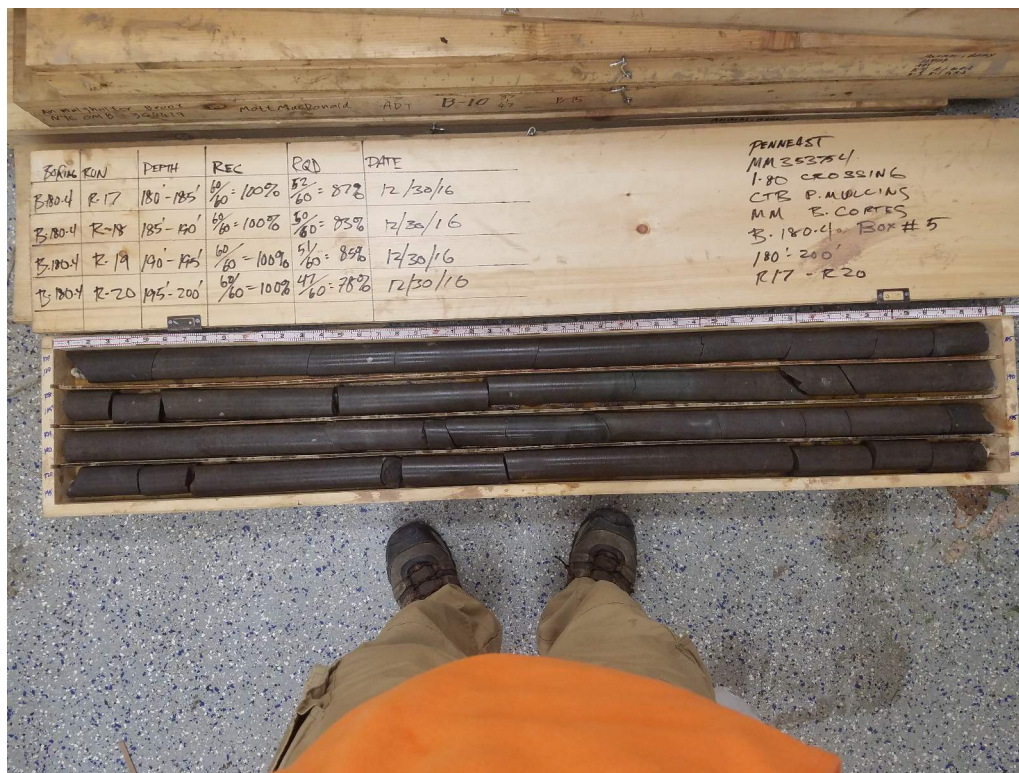


Figure B-180-4.10
B-180-4 Box 5 Runs 17-20 Wet



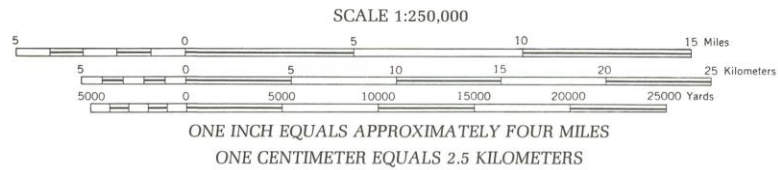
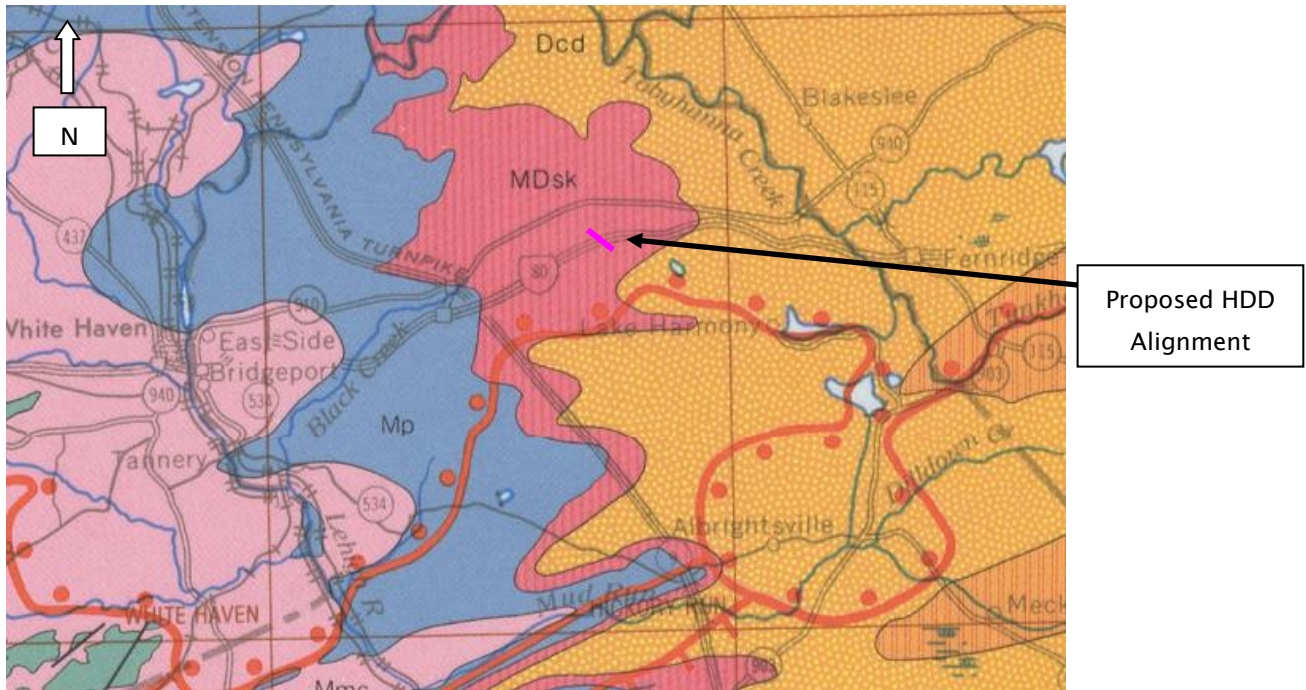
Figure B-180-4.11
B-180-4 Box 6 Runs 21-24 Dry



Figure B-180-4.12
B-180-4 Box 6 Runs 21-24 Wet

D. Geologic Background References

Figure 1: Bedrock Geology



Notes:

1. The proposed HDD alignment falls within the Marcellus Formation (Dm).
2. Geologic Imaging taken from:
 - a. Berg, T.M., Edmunds, W.E., Geyer, A.R., and others, compilers, 1980, Geologic map of Pennsylvania (2nd ed.): Pennsylvania Geological Survey, 4th ser., Map 1, 3 sheets, scale 1:250,000.

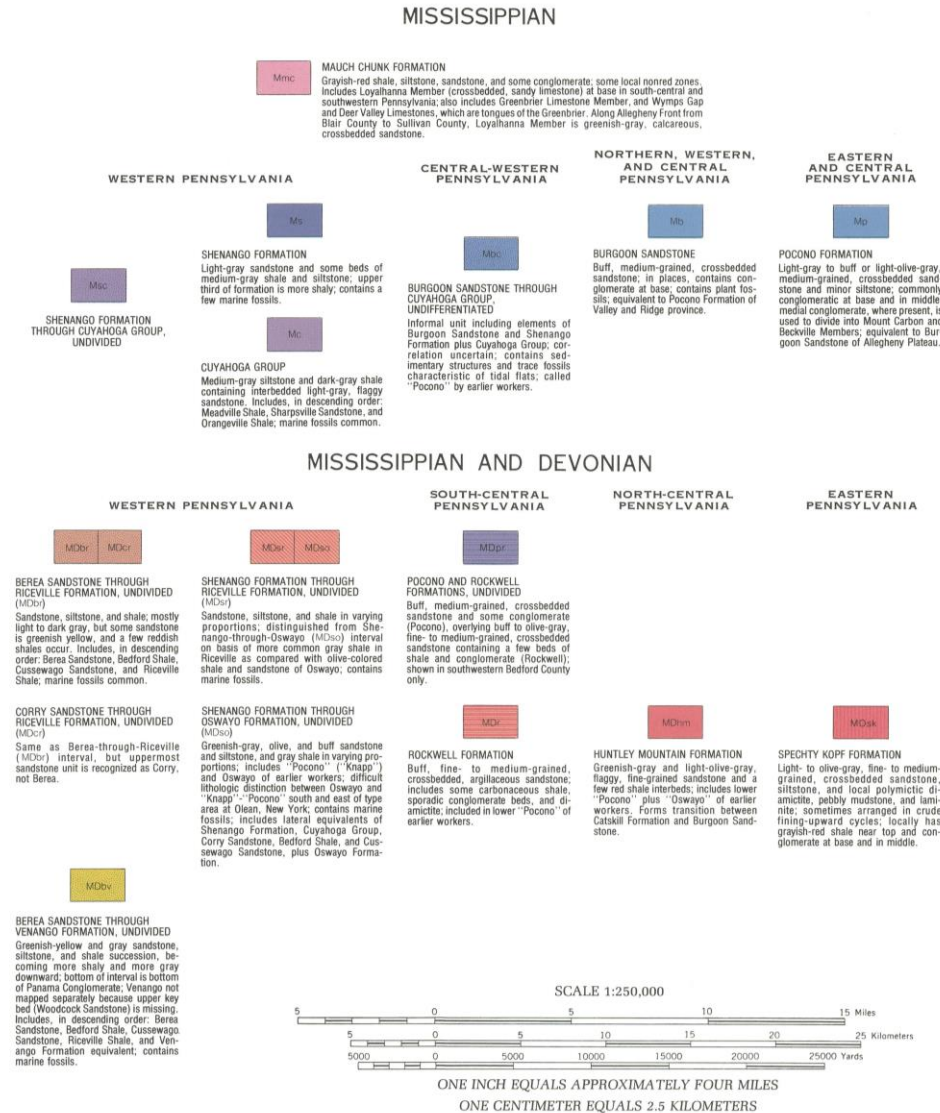
Geological Map of Pennsylvania: Bedrock Formation Legend



1. Note: Geologic Legend taken from:

- a. Berg, T.M., Edmunds, W.E., Geyer, A.R., and others, compilers, 1980, Geologic map of Pennsylvania (2nd ed.): Pennsylvania Geological Survey, 4th ser., Map 1, 3 sheets, scale 1:250,000.

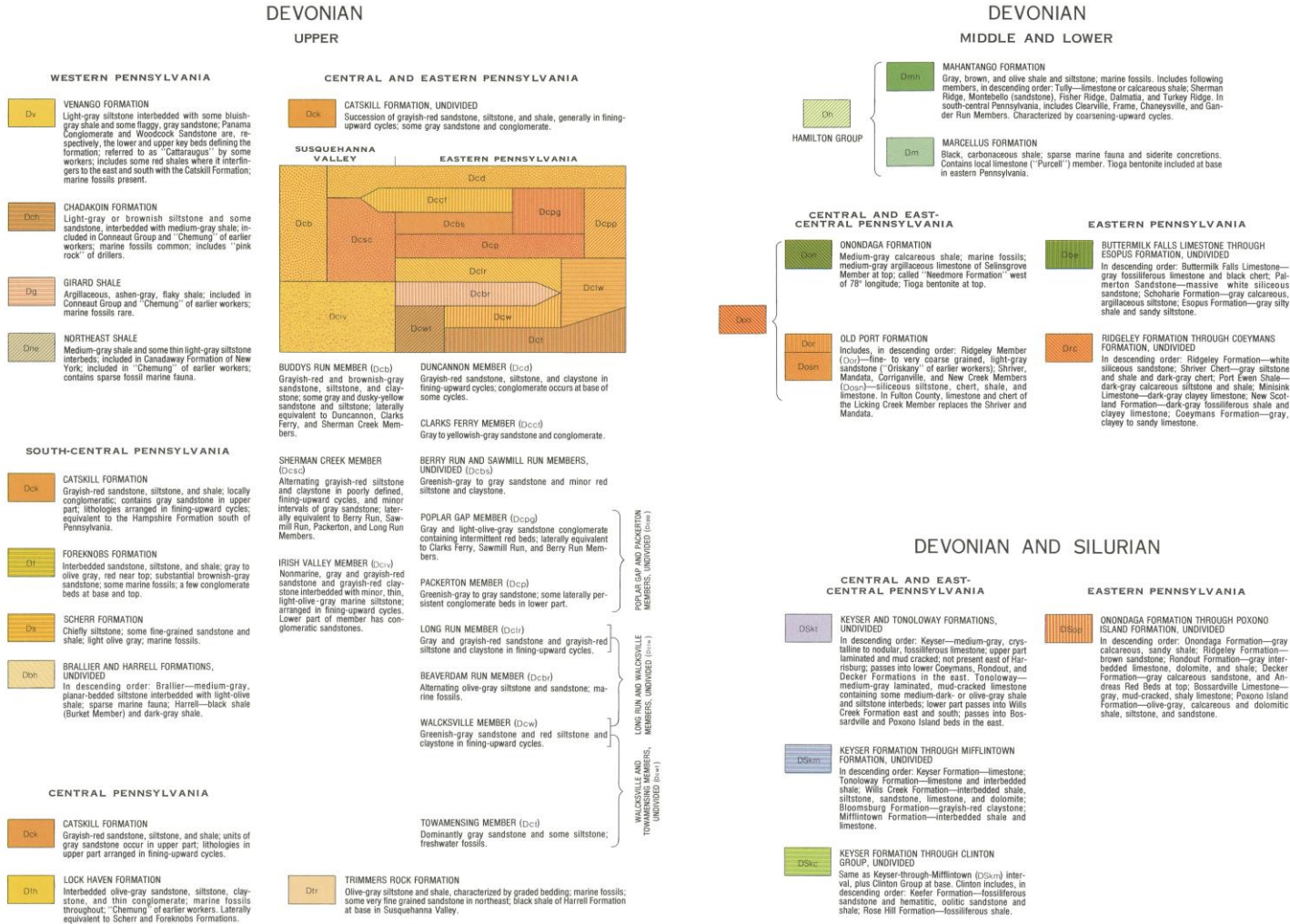
Geological Map of Pennsylvania: Bedrock Formation Legend



1. Note: Geologic Legend taken from:

- a. Berg, T.M., Edmunds, W.E., Geyer, A.R., and others, compilers, 1980, Geologic map of Pennsylvania (2nd ed.): Pennsylvania Geological Survey, 4th ser., Map 1, 3 sheets, scale 1:250,000.

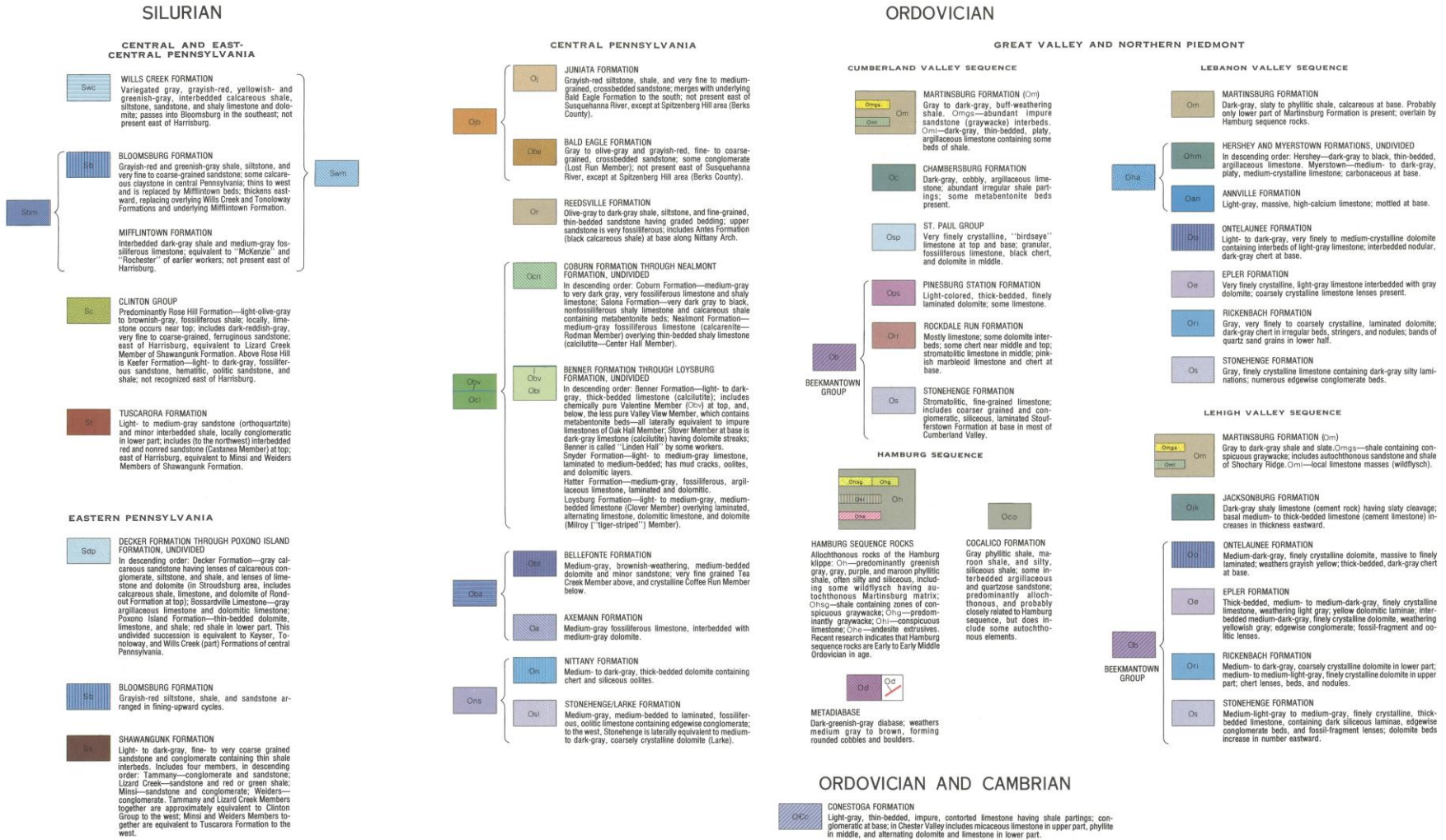
Geological Map of Pennsylvania: Bedrock Formation Legend



1. Note: Geologic Legend taken from:

- a. Berg, T.M., Edmunds, W.E., Geyer, A.R., and others, compilers, 1980, Geologic map of Pennsylvania (2nd ed.): Pennsylvania Geological Survey, 4th ser., Map 1, 3 sheets, scale 1:250,000.

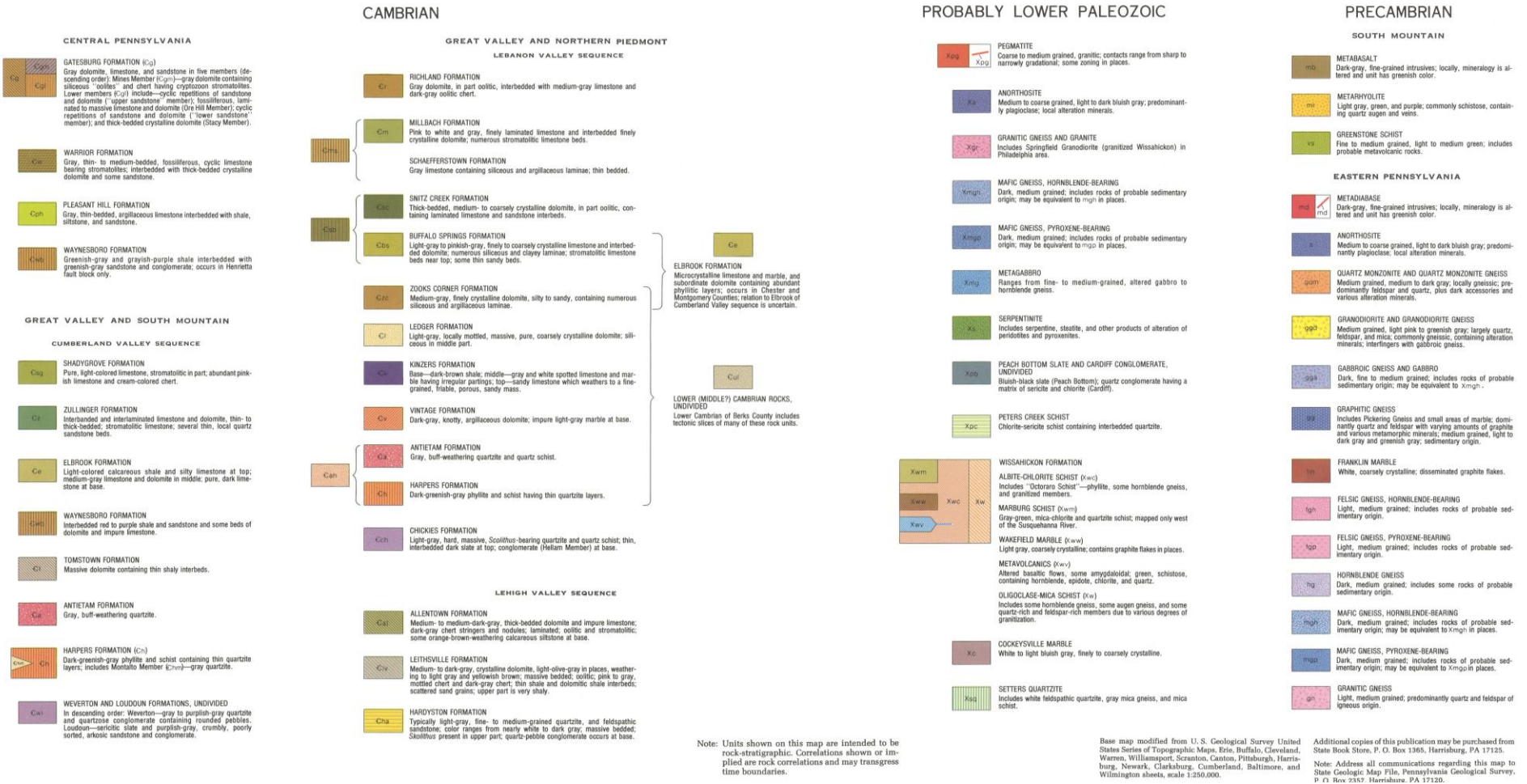
Geological Map of Pennsylvania: Bedrock Formation Legend



1. Note: Geologic Legend taken from:

- Berg, T.M., Edmunds, W.E., Geyer, A.R., and others, compilers, 1980, Geologic map of Pennsylvania (2nd ed.): Pennsylvania Geological Survey, 4th ser., Map 1, 3 sheets, scale 1:250,000.

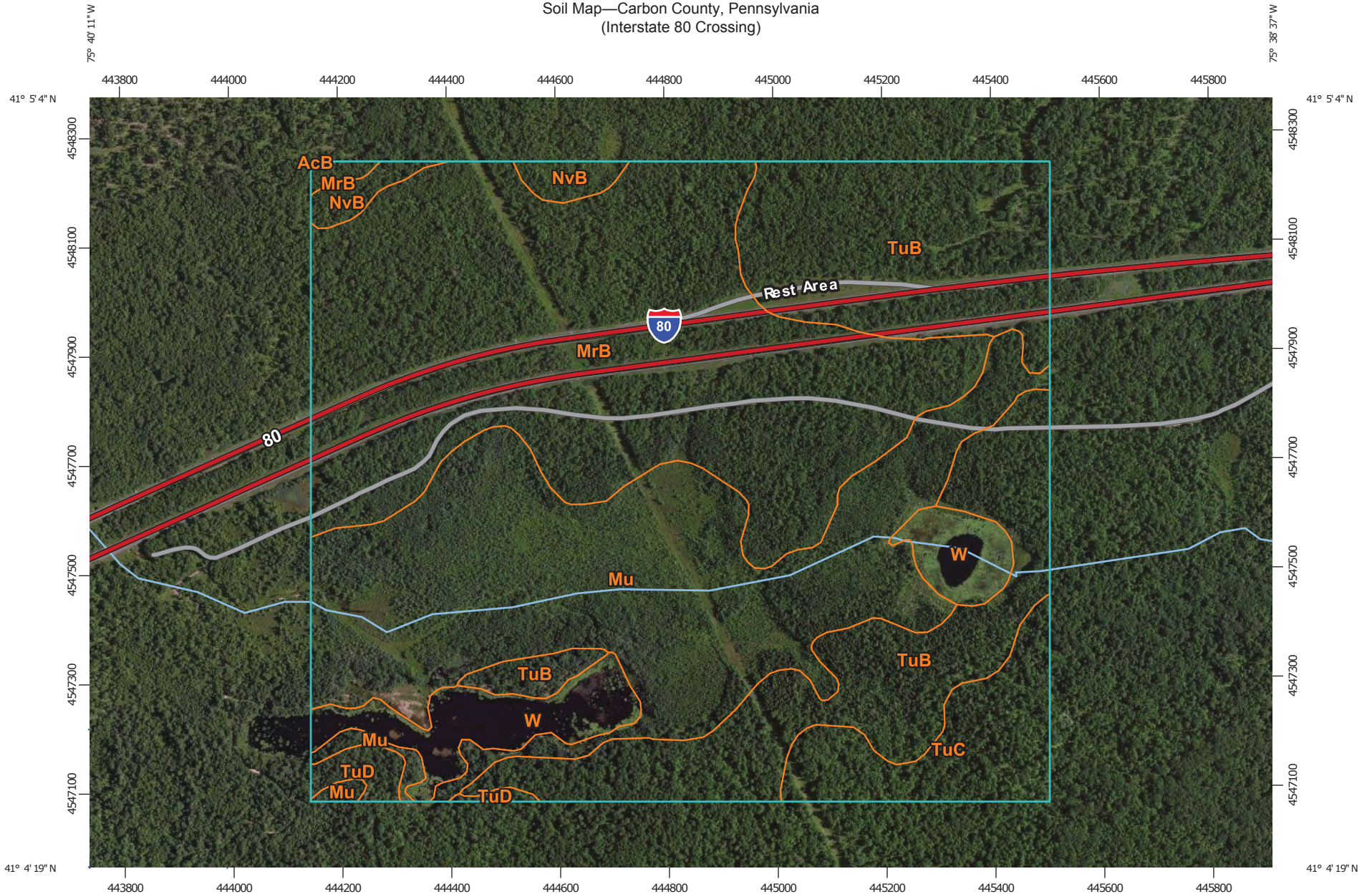
Geological Map of Pennsylvania: Bedrock Formation Legend



1. Note: Geologic Legend taken from:

a. Berg, T.M., Edmunds, W.E., Geyer, A.R., and others, compilers, 1980, Geologic map of Pennsylvania (2nd ed.): Pennsylvania Geological Survey, 4th ser., Map 1, 3 sheets, scale 1:250,000.

Soil Map—Carbon County, Pennsylvania
(Interstate 80 Crossing)



Map Scale: 1:9,930 if printed on A landscape (11" x 8.5") sheet.

0 100 200 400 600 Meters


0 450 900 1800 2700 Feet

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N WGS84



MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

 Soil Map Unit Polygons

 Soil Map Unit Lines

 Soil Map Unit Points

Special Point Features



Blowout



Borrow Pit



Clay Spot



Closed Depression



Gravel Pit



Gravelly Spot



Landfill



Lava Flow



Marsh or swamp



Mine or Quarry



Miscellaneous Water



Perennial Water



Rock Outcrop



Saline Spot



Sandy Spot



Severely Eroded Spot



Sinkhole



Slide or Slip



Sodic Spot



Spoil Area



Stony Spot



Very Stony Spot



Wet Spot



Other



Special Line Features

Water Features



Streams and Canals

Transportation



Rails



Interstate Highways



US Routes



Major Roads



Local Roads

Background



Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: <http://websoilsurvey.nrcs.usda.gov>
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Carbon County, Pennsylvania
Survey Area Data: Version 13, Nov 16, 2015

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Mar 20, 2011—Jul 5, 2011

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Carbon County, Pennsylvania (PA025)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
AcB	Albrights very stony loam, 0 to 8 percent slopes	0.0	0.0%
MrB	Morris channery silt loam, 0 to 8 percent slopes, extremely stony	140.6	35.6%
Mu	Muck and Peat	109.7	27.8%
NvB	Norwich soils, 0 to 8 percent slopes, extremely stony	5.7	1.5%
TuB	Tunkhannock gravelly loam, 3 to 8 percent slopes	93.0	23.6%
TuC	Tunkhannock gravelly loam, 8 to 15 percent slopes	20.9	5.3%
TuD	Tunkhannock gravelly loam, 15 to 25 percent slopes	3.7	0.9%
W	Water	21.3	5.4%
Totals for Area of Interest		395.0	100.0%

Carbon County, Pennsylvania

MrB—Morris channery silt loam, 0 to 8 percent slopes, extremely stony

Map Unit Setting

National map unit symbol: 2vxct
Elevation: 330 to 2,460 feet
Mean annual precipitation: 31 to 70 inches
Mean annual air temperature: 39 to 52 degrees F
Frost-free period: 105 to 180 days
Farmland classification: Not prime farmland

Map Unit Composition

Morris, extremely stony, and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Morris, Extremely Stony

Setting

Landform: Hills, mountains
Landform position (two-dimensional): Summit, footslope
Landform position (three-dimensional): Interfluve, base slope
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Loamy till from reddish sandstone, siltstone, and shale

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material
A - 1 to 5 inches: channery silt loam
Bw - 5 to 12 inches: channery silt loam
Eg - 12 to 16 inches: channery silt loam
Bx - 16 to 60 inches: channery silt loam
C - 60 to 72 inches: channery loam

Properties and qualities

Slope: 0 to 8 percent
Percent of area covered with surface fragments: 7.0 percent
Depth to restrictive feature: 10 to 22 inches to fragipan
Natural drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D

Minor Components

Norwich, extremely stony

Percent of map unit: 5 percent
Landform: Depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave

Wellsboro, extremely stony

Percent of map unit: 5 percent
Landform: Hills, mountains
Landform position (two-dimensional): Backslope, shoulder
Landform position (three-dimensional): Interflue, side slope, head slope
Down-slope shape: Convex, concave
Across-slope shape: Convex, linear

Data Source Information

Soil Survey Area: Carbon County, Pennsylvania
Survey Area Data: Version 13, Nov 16, 2015

Carbon County, Pennsylvania

Mu—Muck and Peat

Map Unit Setting

National map unit symbol: I38s
Elevation: 600 to 1,800 feet
Mean annual precipitation: 30 to 50 inches
Mean annual air temperature: 46 to 50 degrees F
Frost-free period: 120 to 180 days
Farmland classification: Not prime farmland

Map Unit Composition

Hemists and similar soils: 90 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hemists

Setting

Landform: Depressions
Parent material: Organic material

Typical profile

Oa - 0 to 60 inches: muck

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat):
Moderately high to high (0.20 to 6.00 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very high (about 23.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8w
Hydrologic Soil Group: A/D

Minor Components

Morris

Percent of map unit: 5 percent

Data Source Information

Soil Survey Area: Carbon County, Pennsylvania

Survey Area Data: Version 13, Nov 16, 2015

E. Laboratory Data



GEOTECHNICAL LABORATORY TESTING RESULTS



CLIENT: Mott MacDonald
 111 Wood Ave South
 Iselin, New Jersey 08830-4112

PROJECT: Penn East Pipeline
 Interstate 80

CTL # 548000AS
CTB # 150167

DATE: November 15, 2016

ATTN: Ms. Erica A. Vigliorolo

CHECKED BY: Eduardo M. Freire, P.E.
 Geotechnical Laboratory Manager

SAMPLES RECEIVED: October 28, 2016

SAMPLES TESTED: 10/28/16 - 11/11/16

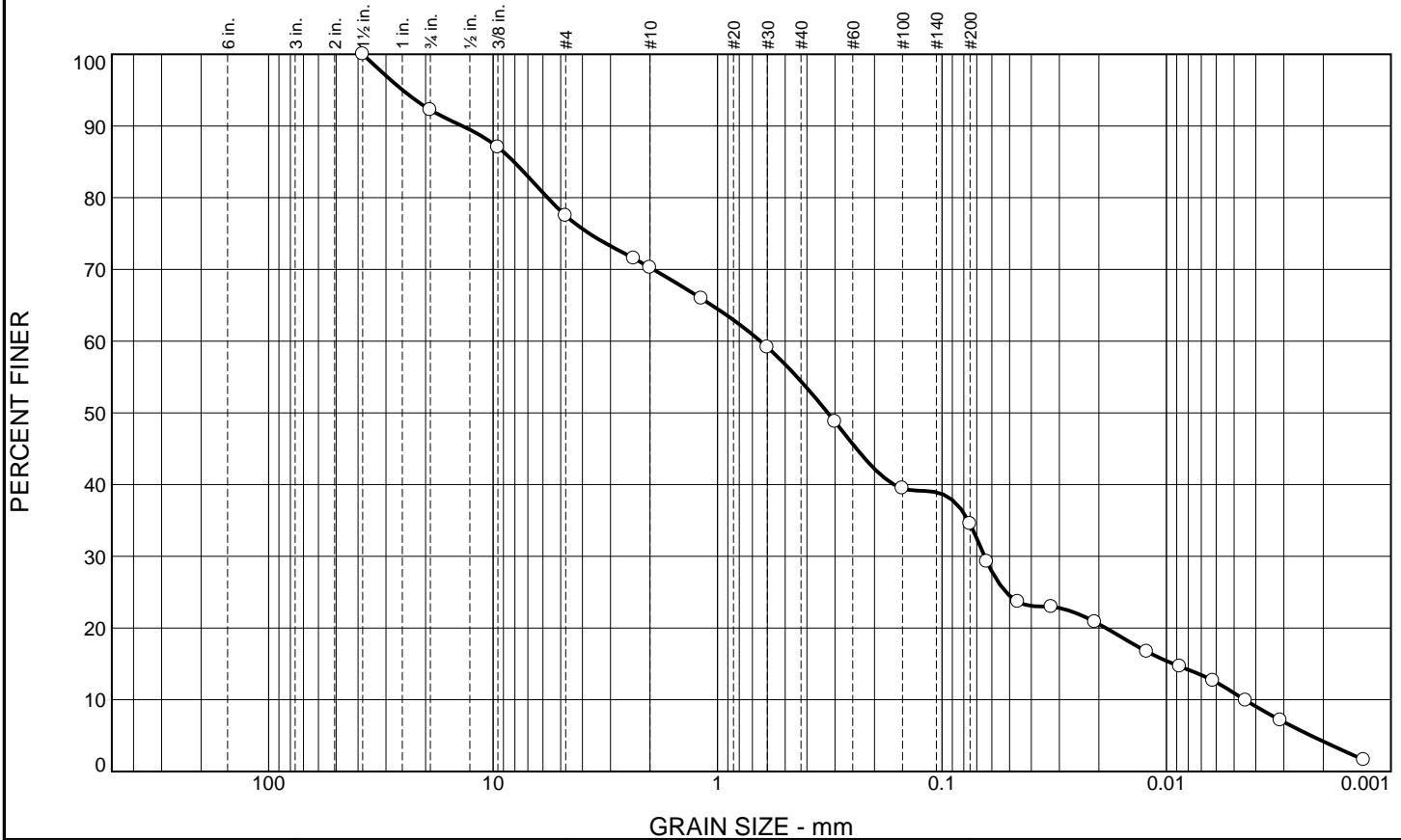
LAB TECHNICIAN(S): J. Veach, J. Landy, A. Midgette

Test Boring No.	Sample No.	Depth (ft)	Water Content (%) (ASTM D2216)	Atterberg Limits (ASTM D4318)			Particle Size Analysis (Sieve Only)* (ASTM D422)	Particle Size Analysis with Hydrometer* (ASTM D422)	Total Unit Weight Determination (pcf)	Sulfate (mg/L) (ASTM D4327)	Chloride (mg/L) (ASTM D4327)	pH of Soil (ASTM G51)	Consolidation* (ASTM D2435)	UU Triaxial* (ASTM D2860)	CU Triaxial (ASTM D4767)	Soil Perm. Class Rating (NJAC 7-9A-6.3)						
				LL	PL	PI										A	B					
B-180-1	S-9	40-42						PSA-1	**													
	S-10	45-47	14.6	28	15	13		PSA-2														
	S-11	50-52	12.6	29	16	13		PSA-3														
	S-12	55-57	15.7				PSA-4															
	S-13	60-62	13.7	27	15	12		PSA-5														
	S-14	65-67						PSA-6	138.2													
Billing Total:			1	3			1	5	1													

Comments/Remarks: *See attached Plates

** Sample not suitable for testing. Sample was disturbed/crushed in jar.

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	7.8	14.7	7.2	15.9	19.9	23.6	10.9

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
.75	92.2		
.375	87.0		
#4	77.5		
#8	71.5		
#10	70.3		
#16	65.9		
#30	59.1		
#50	48.8		
#100	39.5		
#200	34.5		

Material Description
Brown-red silty\clayey SAND with gravel

Atterberg Limits
LL= PL= PI=

Coefficients
D₈₅= 8.0680 D₆₀= 0.6442 D₅₀= 0.3225
D₃₀= 0.0647 D₁₅= 0.0093 D₁₀= 0.0045
C_u= 143.85 C_c= 1.45

Classification
USCS= SM\SC

Remarks

* (no specification provided)

Source of Sample: B-I80-1 Depth: 40'-42'
Sample Number: S-9

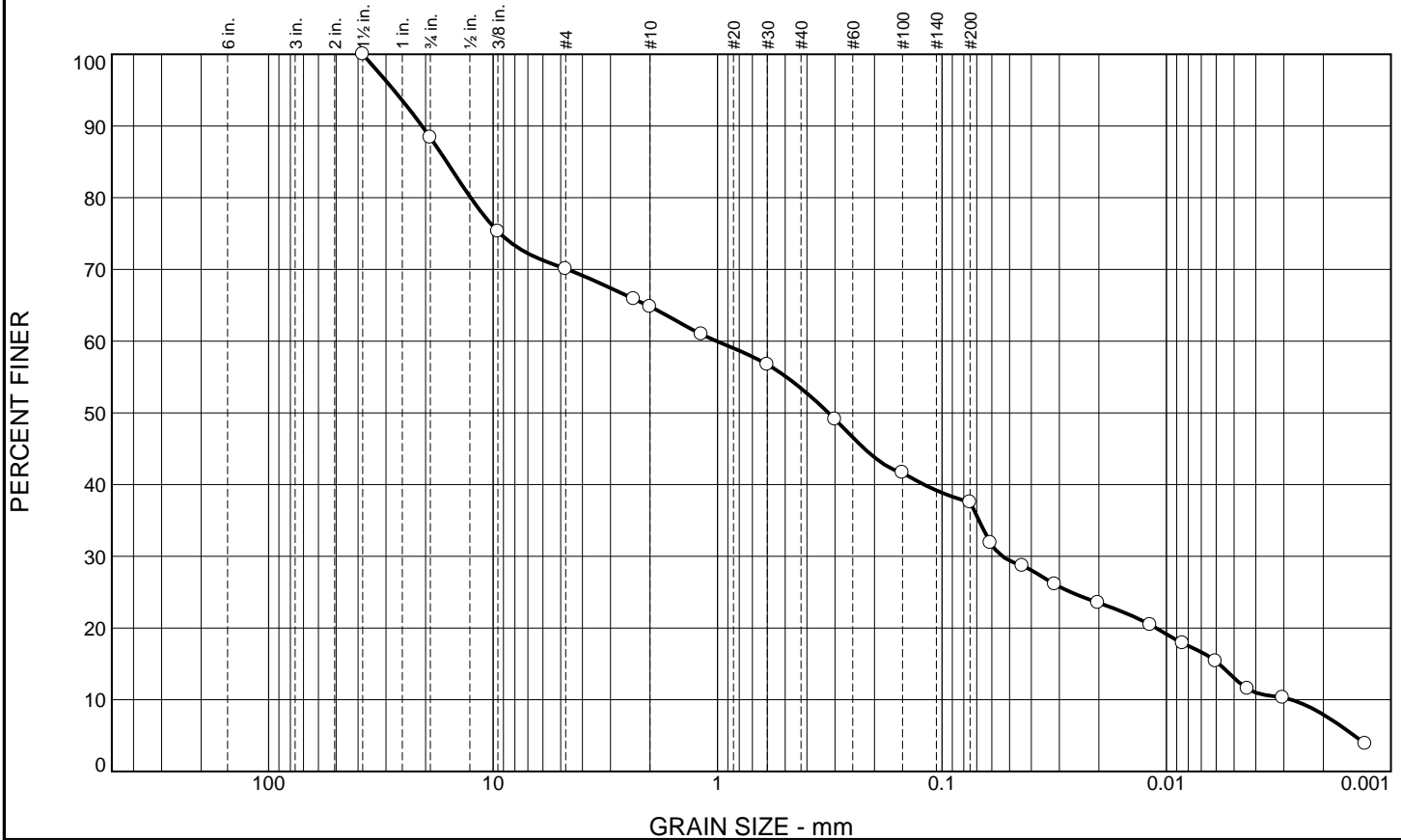
Date: 11/11/16



Client: Mott MacDonald
Project: Penn East Pipeline
Interstate 80
Project No: 548000AS

Plate PSA-1

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	11.6	18.3	5.3	11.4	15.9	24.5	13.0

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
.75	88.4		
.375	75.3		
#4	70.1		
#8	65.9		
#10	64.8		
#16	61.0		
#30	56.7		
#50	49.1		
#100	41.7		
#200	37.5		

Material Description

Brown-red clayey SAND with gravel

Atterberg Limits

LL= 28 PL= 15 PI= 13

Coefficients

D₈₅= 16.1085 D₆₀= 1.0092 D₅₀= 0.3207
D₃₀= 0.0539 D₁₅= 0.0058 D₁₀= 0.0028
C_u= 363.48 C_c= 1.04

Classification

USCS= SC

Remarks

Water Content (WC): 14.6%

* (no specification provided)

Source of Sample: B-I80-1 Depth: 45'-47'
Sample Number: S-10

Date: 11/11/16



Client: Mott MacDonald
Project: Penn East Pipeline
Interstate 80
Project No: 548000AS

Plate PSA-2

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	17.4	6.5	15.7	17.2	23.5	19.7

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.375	87.8		
#4	82.6		
#8	77.5		
#10	76.1		
#16	70.2		
#30	64.3		
#50	55.5		
#100	47.5		
#200	43.2		

Material Description
Brown-red clayey SAND with gravel

Atterberg Limits
LL= 29 PL= 16 PI= 13

Coefficients
D₈₅= 7.1055 D₆₀= 0.4129 D₅₀= 0.2032
D₃₀= 0.0222 D₁₅= 0.0033 D₁₀= 0.0026
C_u= 157.51 C_c= 0.46

Classification
USCS= SC

Remarks
WC: 12.6%

* (no specification provided)

Source of Sample: B-I80-1 Depth: 50'-52'
Sample Number: S-11

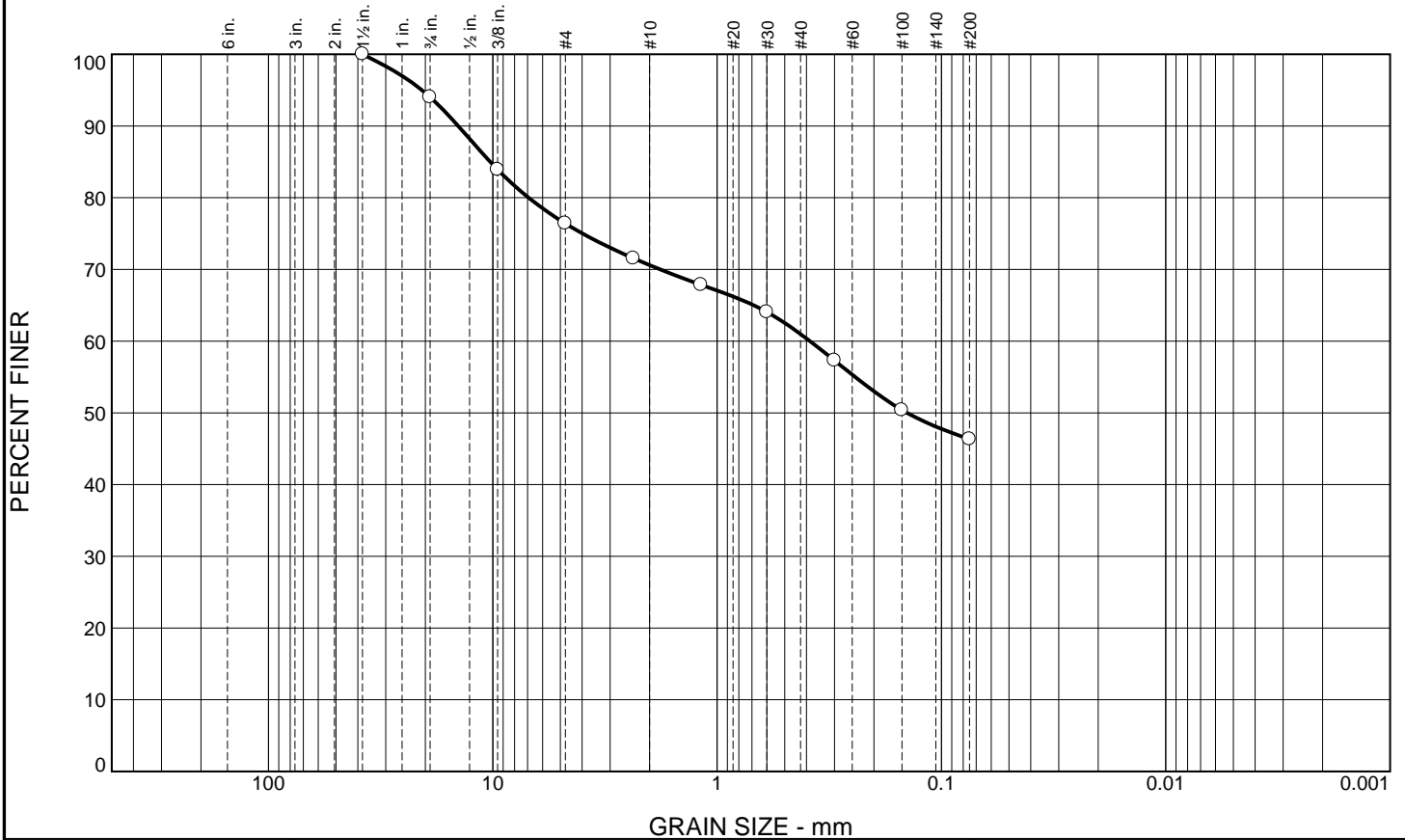
Date: 11/11/16



Client: Mott MacDonald
Project: Penn East Pipeline
Interstate 80
Project No: 548000AS

Plate PSA-3

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	6.0	17.6	5.8	9.6	14.7	46.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
.75	94.0		
.375	83.9		
#4	76.4		
#8	71.6		
#16	67.8		
#30	64.1		
#50	57.3		
#100	50.4		
#200	46.3		

Material Description

Brown-red silty\clayey SAND with gravel

Atterberg Limits

LL= PL= PI=

Coefficients

D₈₅= 10.2690 D₆₀= 0.3856 D₅₀= 0.1424
D₃₀= D₁₅= D₁₀=
C_u= C_c=

Classification

USCS= SM\SC

Remarks

WC: 15.7%

* (no specification provided)

Source of Sample: B-I80-1
Sample Number: S-12

Depth: 55'-57'

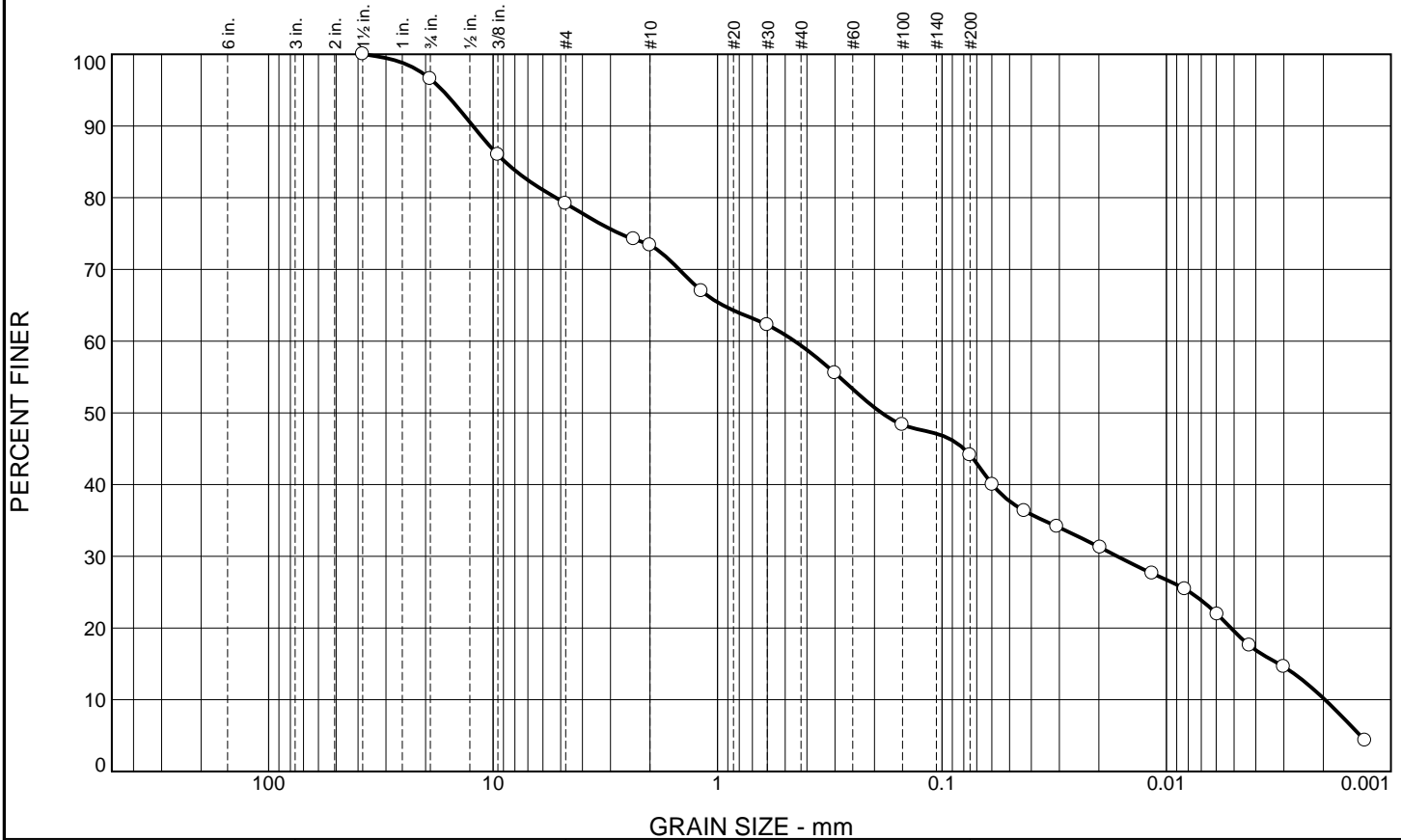
Date: 11/11/16



Client: Mott MacDonald
Project: Penn East Pipeline
Interstate 80
Project No: 548000AS

Plate PSA-4

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	3.4	17.4	5.8	14.0	15.3	24.5	19.6

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
.75	96.6		
.375	86.0		
#4	79.2		
#8	74.2		
#10	73.4		
#16	67.0		
#30	62.3		
#50	55.6		
#100	48.3		
#200	44.1		

Material Description
Brown-red clayey SAND with gravel

Atterberg Limits
LL= 27 PL= 15 PI= 12

Coefficients
D₈₅= 8.8419 D₆₀= 0.4530 D₅₀= 0.1859
D₃₀= 0.0166 D₁₅= 0.0032 D₁₀= 0.0020
C_u= 230.36 C_c= 0.31

Classification
USCS= SC

Remarks
WC: 13.7%

* (no specification provided)

Source of Sample: B-I80-1 Depth: 60'-62'
Sample Number: S-13

Date: 11/11/16



Client: Mott MacDonald
Project: Penn East Pipeline
Interstate 80
Project No: 548000AS

Plate PSA-5

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	11.7	5.7	11.9	16.4	28.9	25.4

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.375	94.4		
#4	88.3		
#8	83.6		
#10	82.6		
#16	77.4		
#30	73.6		
#50	66.6		
#100	58.8		
#200	54.4		

Material Description

Brown-red sandy SILT\CLAY

Atterberg Limits

LL= PL= PI=

Coefficients

D₈₅= 2.9974 D₆₀= 0.1738 D₅₀= 0.0575
D₃₀= 0.0069 D₁₅= 0.0020 D₁₀= 0.0016
C_u= 107.12 C_c= 0.17

Classification

USCS= CL:H\ML:H

Remarks

* (no specification provided)

Source of Sample: B-I80-1
Sample Number: S-14

Depth: 65'-67'

Date: 11/11/16



Client: Mott MacDonald
Project: Penn East Pipeline
Interstate 80

Project No: 548000AS

Plate PSA-6



GEOTECHNICAL LABORATORY TESTING RESULTS



CLIENT: Mott MacDonald
 111 Wood Ave South
 Iselin, New Jersey 08830-4112

PROJECT: Penn East Pipeline
 I-80, Carbon County, PA

CTL # 548000AX
CTB # 150167

DATE: January 20, 2017

ATTN: Ms. Erica A. Vigliorolo

CHECKED BY: Eduardo M. Freire, P.E.
 Geotechnical Laboratory Manager

SAMPLES RECEIVED: January 9, 2017

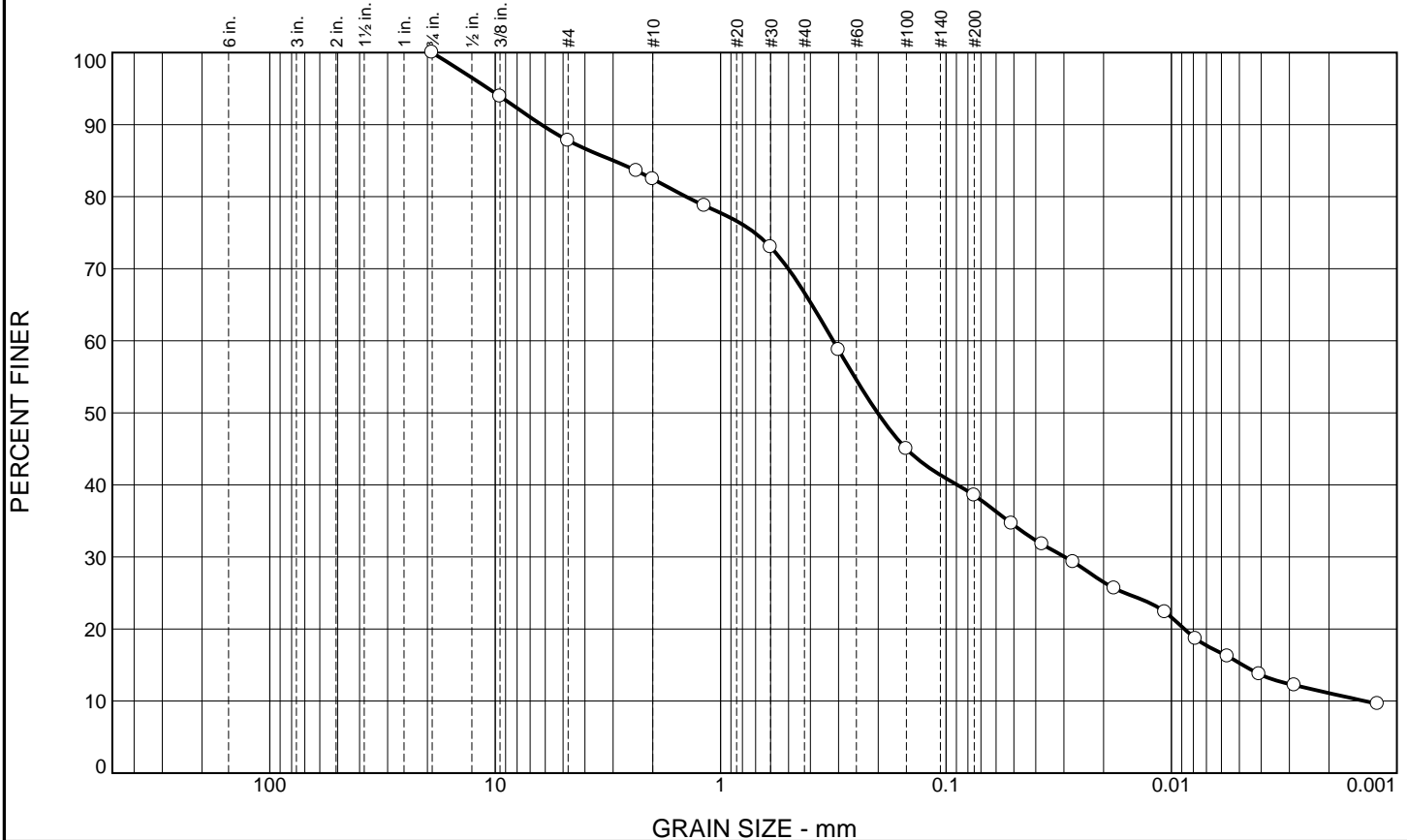
SAMPLES TESTED: 1/9/17 - 1/20/17

LAB TECHNICIAN(S): J. Veach, J. Landy, A. Midgette

Test Boring No.	Sample No.	Depth (ft)	Water Content (%) (ASTM D2216)	Atterberg Limits (ASTM D4318)			Particle Size Analysis (Sieve Only)* (ASTM D422)	Particle Size Analysis with Hydrometer* (ASTM D422)	Total Unit Weight Determination (pcf)	Sulfate (mg/L) (ASTM D4327)	Chloride (mg/L) (ASTM D4327)	pH of Soil (ASTM G51)	Consolidation* (ASTM D2435)	UU Triaxial* (ASTM D2860)	CU Triaxial (ASTM D4767)	Soil Perm. Class Rating (NJAC 7-9A-6.3)						
				LL	PL	PI										A	B					
B-180-4	S-2	5-7						PSA-1														
	S-4	15-17						PSA-2														
	S-7	30-32						PSA-3														
	S-9	40-42						PSA-4														
	S-11	50-52						PSA-5														
	S-14	65-67						PSA-6														
	S-15	70-72						PSA-7														
	S-17	80-82						PSA-8														
S-19	90-92						PSA-9															
Billing Total:								9														

Comments/Remarks: *See attached Plates

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	12.2	5.4	15.7	28.2	23.2	15.3

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.375	93.9		
#4	87.8		
#8	83.6		
#10	82.4		
#16	78.8		
#30	73.0		
#50	58.7		
#100	45.0		
#200	38.5		

Material Description

Brown silty/clayey SAND

Atterberg Limits

LL= PL= PI=

Coefficients

D₈₅= 2.9830 D₆₀= 0.3167 D₅₀= 0.2013
D₃₀= 0.0297 D₁₅= 0.0048 D₁₀= 0.0014
C_u= 228.30 C_c= 2.01


Classification

USCS= SM\SC

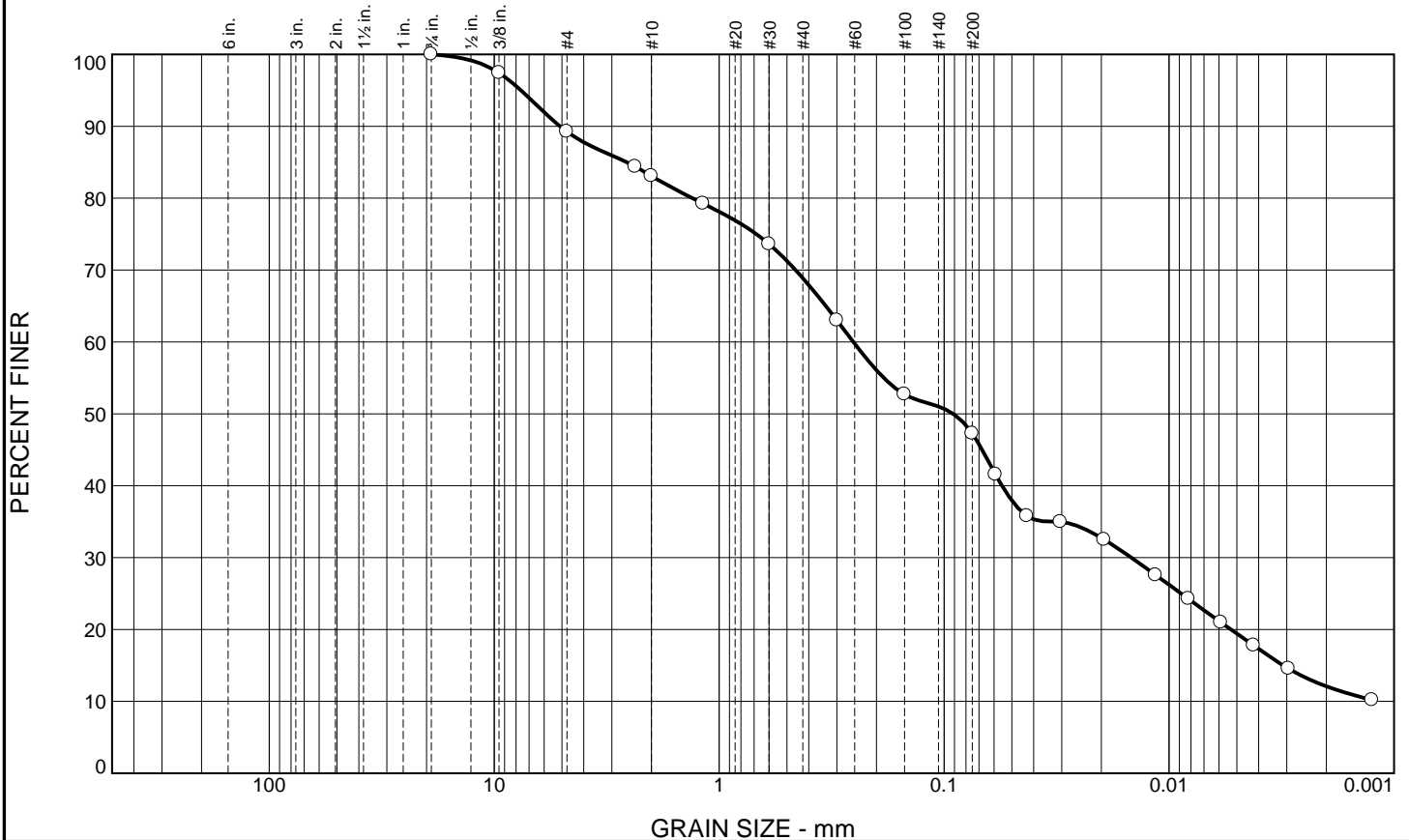
Remarks

* (no specification provided)

Source of Sample: B-I80-4 Depth: 5'-7' Date: 1/20/17
Sample Number: S-2

 <p style="font-size: small;">www.craigtestinglabs.com Mays Landing, NJ 609-625-1700</p>	<p>Client: Mott MacDonald</p> <p>Project: Penn East Pipeline Project I-80, Carbon County, PA</p> <p>Project No: 548000AX</p>	<p>Plate PSA-1</p>
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Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	10.8	6.1	14.2	21.6	27.9	19.4

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.375	97.4		
#4	89.2		
#8	84.4		
#10	83.1		
#16	79.3		
#30	73.6		
#50	63.0		
#100	52.7		
#200	47.3		

Material Description

Brown silty\clayey SAND

Atterberg Limits

LL= PL= PI=

Coefficients

D₈₅= 2.5759 D₆₀= 0.2534 D₅₀= 0.0912
D₃₀= 0.0147 D₁₅= 0.0031 D₁₀=
C_u= C_c=

Classification

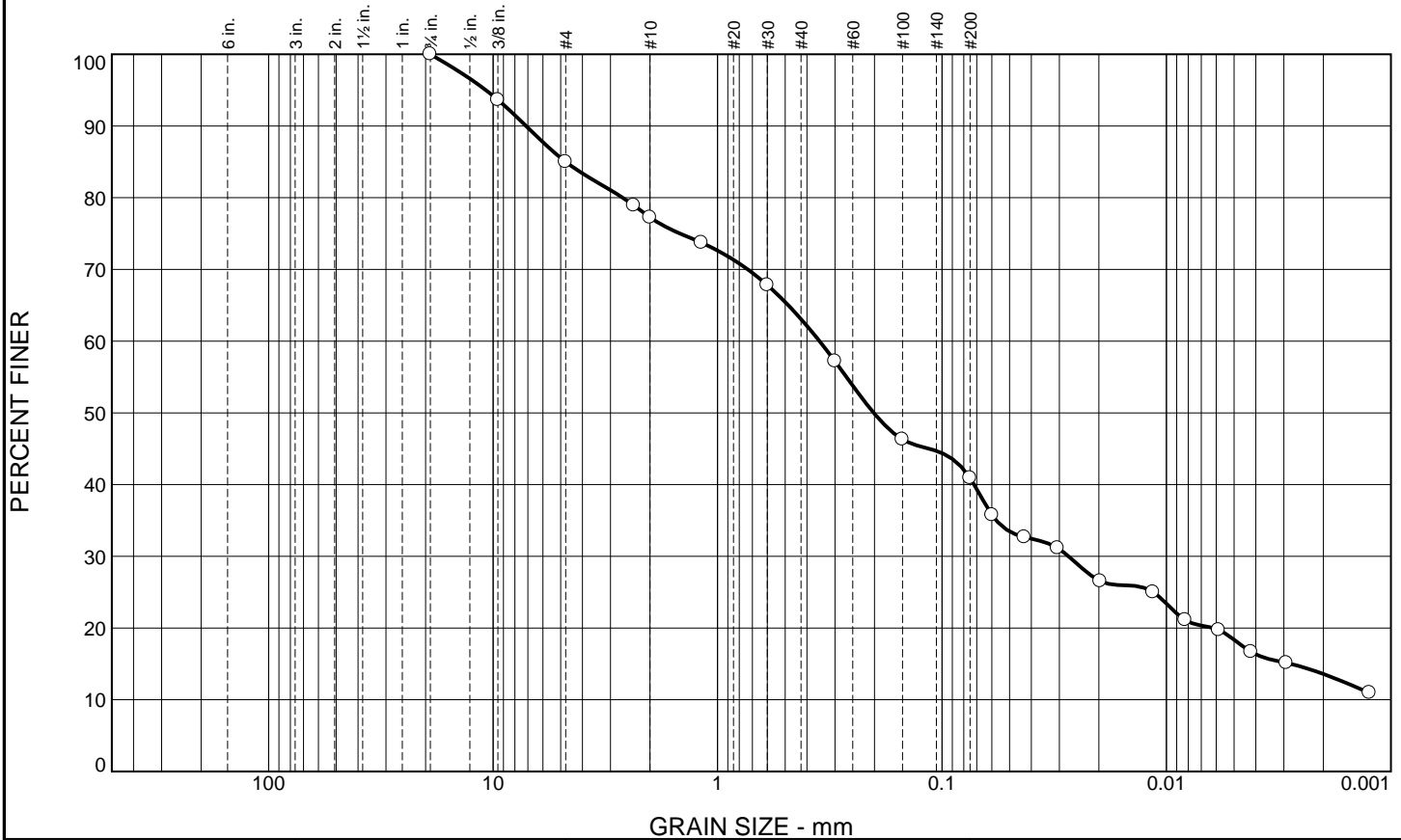
USCS= SM\SC

Remarks

* (no specification provided)

Source of Sample: B-I80-4 Depth: 15'-17' Date: 1/20/17
Sample Number: S-4

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	15.0	7.7	14.2	22.2	22.5	18.4

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.375	93.6		
#4	85.0		
#8	78.9		
#10	77.3		
#16	73.7		
#30	67.8		
#50	57.2		
#100	46.3		
#200	40.9		

Material Description

Brown silty/clayey SAND with gravel

Atterberg Limits

LL= PL= PI=

Coefficients

D₈₅= 4.7475 D₆₀= 0.3515 D₅₀= 0.2016
D₃₀= 0.0273 D₁₅= 0.0028 D₁₀=
C_u= C_c=

Classification

USCS= SM\SC

Remarks

* (no specification provided)

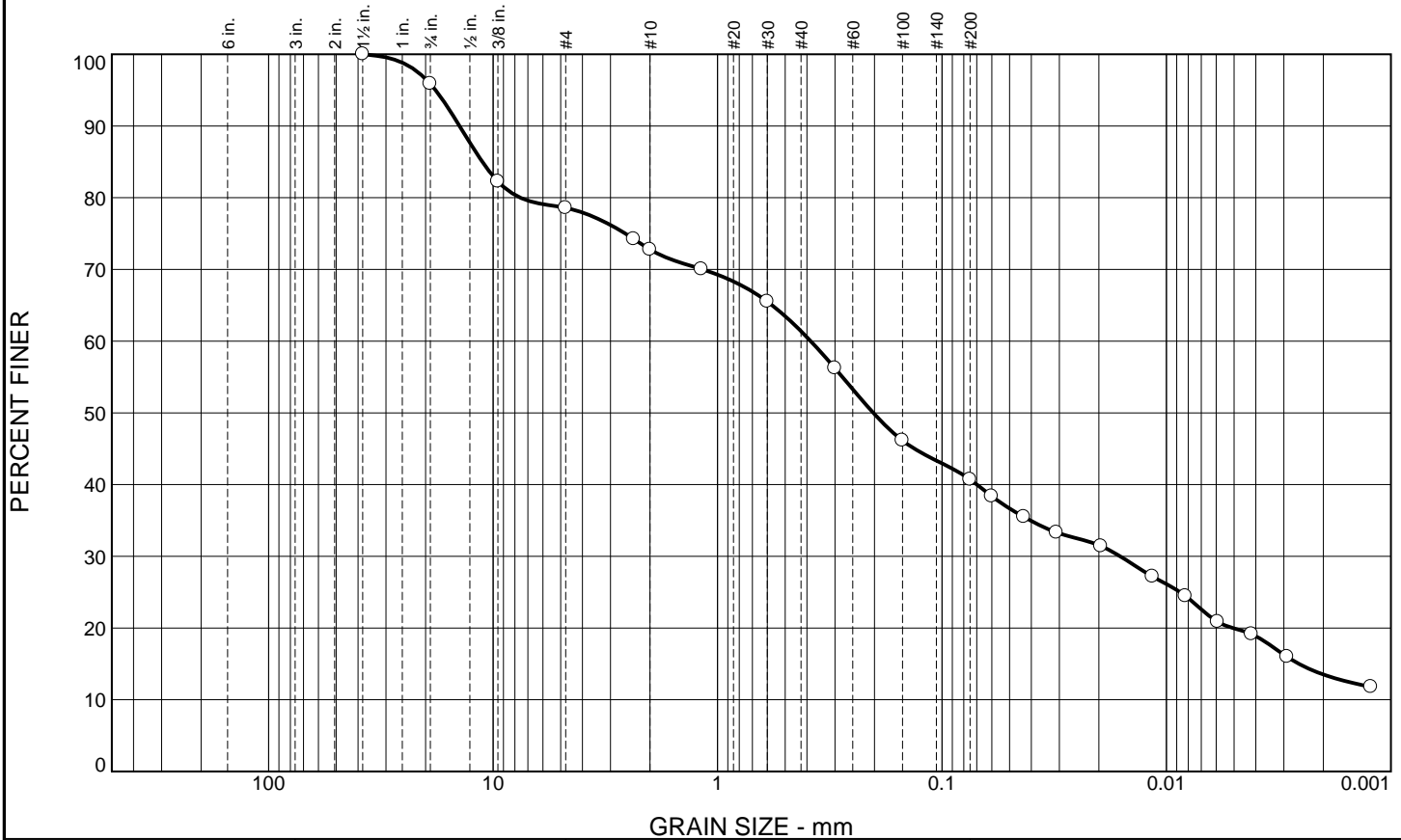
Source of Sample: B-I80-4 Depth: 30'-32' Date: 1/20/17
Sample Number: S-7



Client: Mott MacDonald
Project: Penn East Pipeline Project
I-80, Carbon County, PA
Project No: 548000AX

Plate PSA-3

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	4.1	17.3	5.8	11.4	20.7	20.8	19.9

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
.75	95.9		
.375	82.3		
#4	78.6		
#8	74.2		
#10	72.8		
#16	70.1		
#30	65.5		
#50	56.2		
#100	46.1		
#200	40.7		

Material Description
Red-brown silty/clayey SAND with gravel

Atterberg Limits
LL= PL= PI=

Coefficients
D₈₅= 11.1716 D₆₀= 0.3847 D₅₀= 0.2024
D₃₀= 0.0161 D₁₅= 0.0026 D₁₀=
C_u= C_c=

Classification
USCS= SM\SC

Remarks

* (no specification provided)

Source of Sample: B-I80-4 Depth: 40'-42'
Sample Number: S-9

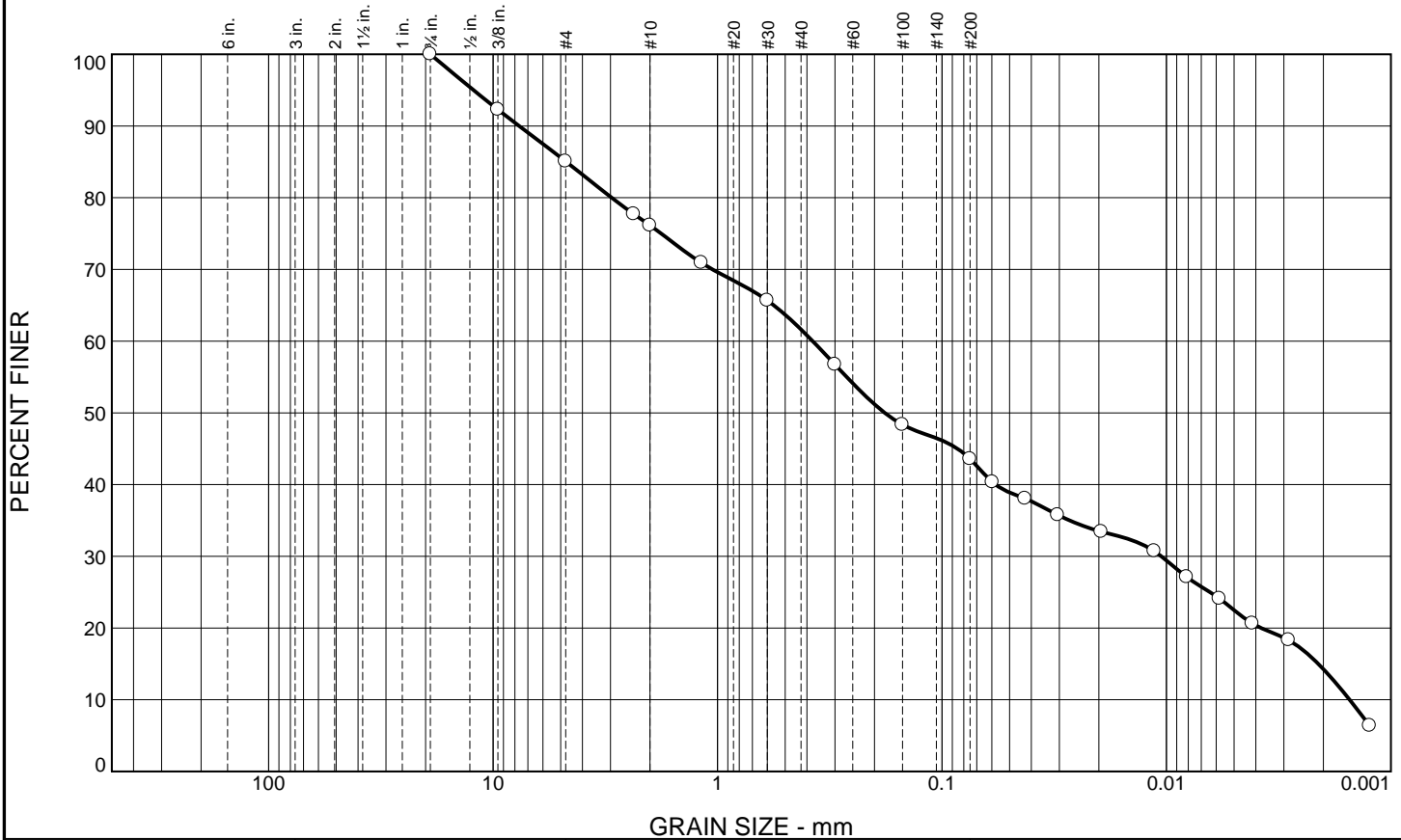
Date: 1/20/17



Client: Mott MacDonald
Project: Penn East Pipeline Project
I-80, Carbon County, PA
Project No: 548000AX

Plate PSA-4

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	14.9	9.0	14.5	18.0	21.1	22.5

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.375	92.3		
#4	85.1		
#8	77.7		
#10	76.1		
#16	70.9		
#30	65.7		
#50	56.7		
#100	48.4		
#200	43.6		

Material Description
Red-brown silty\clayey SAND

Atterberg Limits
LL= PL= PI=

Coefficients
D₈₅= 4.7233 D₆₀= 0.3767 D₅₀= 0.1800
D₃₀= 0.0105 D₁₅= 0.0021 D₁₀= 0.0015
C_u= 246.50 C_c= 0.19

Classification
USCS= SM\SC

Remarks

* (no specification provided)

Source of Sample: B-I80-4 Depth: 50'-52'
Sample Number: S-11

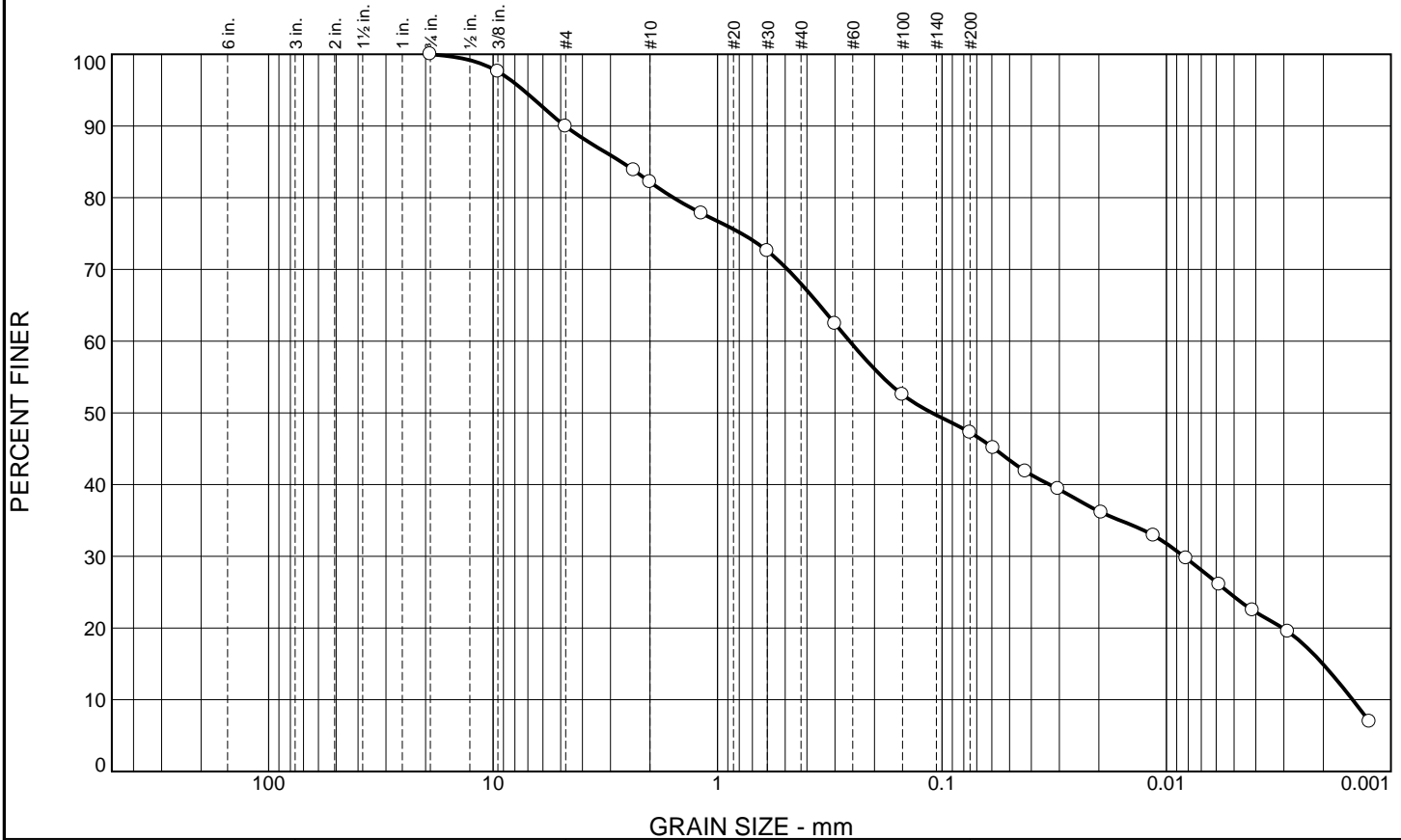
Date: 1/20/17



Client: Mott MacDonald
Project: Penn East Pipeline Project
I-80, Carbon County, PA
Project No: 548000AX

Plate PSA-5

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	10.1	7.7	14.2	20.7	22.9	24.4

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.375	97.6		
#4	89.9		
#8	83.8		
#10	82.2		
#16	77.8		
#30	72.6		
#50	62.4		
#100	52.5		
#200	47.3		

Material Description
Red-brown silty\clayey SAND

Atterberg Limits
LL= PL= PI=

Coefficients
D₈₅= 2.6852 D₆₀= 0.2581 D₅₀= 0.1109
D₃₀= 0.0084 D₁₅= 0.0020 D₁₀= 0.0015
C_u= 174.20 C_c= 0.18

Classification
USCS= SM\SC

Remarks

* (no specification provided)

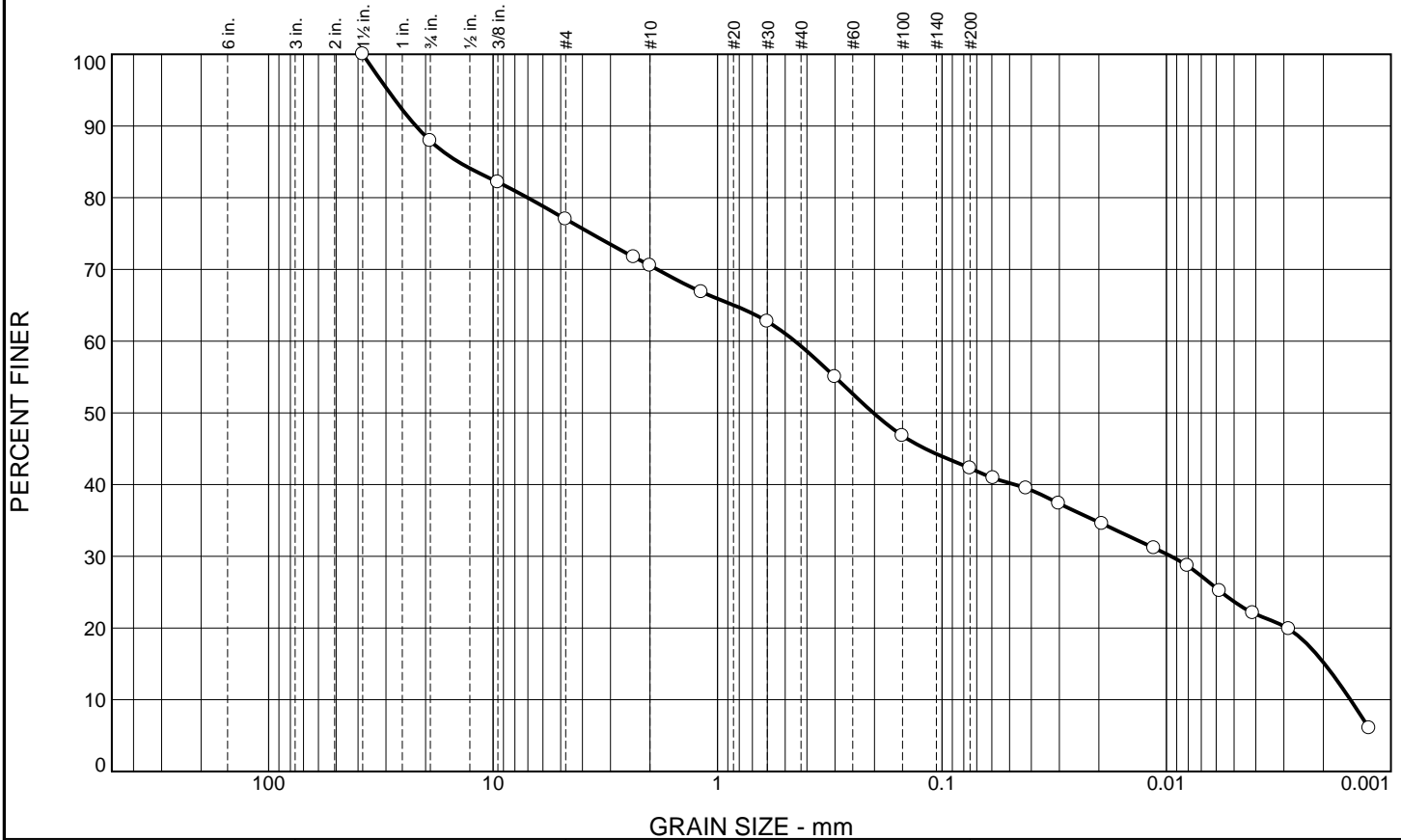
Source of Sample: B-I80-4 Depth: 65'-67' Date: 1/20/17
Sample Number: S-14



Client: Mott MacDonald
Project: Penn East Pipeline Project
I-80, Carbon County, PA
Project No: 548000AX

Plate PSA-6

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	12.1	10.9	6.5	11.2	17.0	18.6	23.7

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
.75	87.9		
.375	82.2		
#4	77.0		
#8	71.7		
#10	70.5		
#16	66.9		
#30	62.7		
#50	55.0		
#100	46.8		
#200	42.3		

Material Description
Red-brown silty/clayey SAND with gravel

Atterberg Limits
LL= PL= PI=

Coefficients
D₈₅= 14.3035 D₆₀= 0.4521 D₅₀= 0.2023
D₃₀= 0.0095 D₁₅= 0.0020 D₁₀= 0.0015
C_u= 298.41 C_c= 0.13

Classification
USCS= SM\SC

Remarks

* (no specification provided)

Source of Sample: B-I80-4 Depth: 70'-72'
Sample Number: S-15

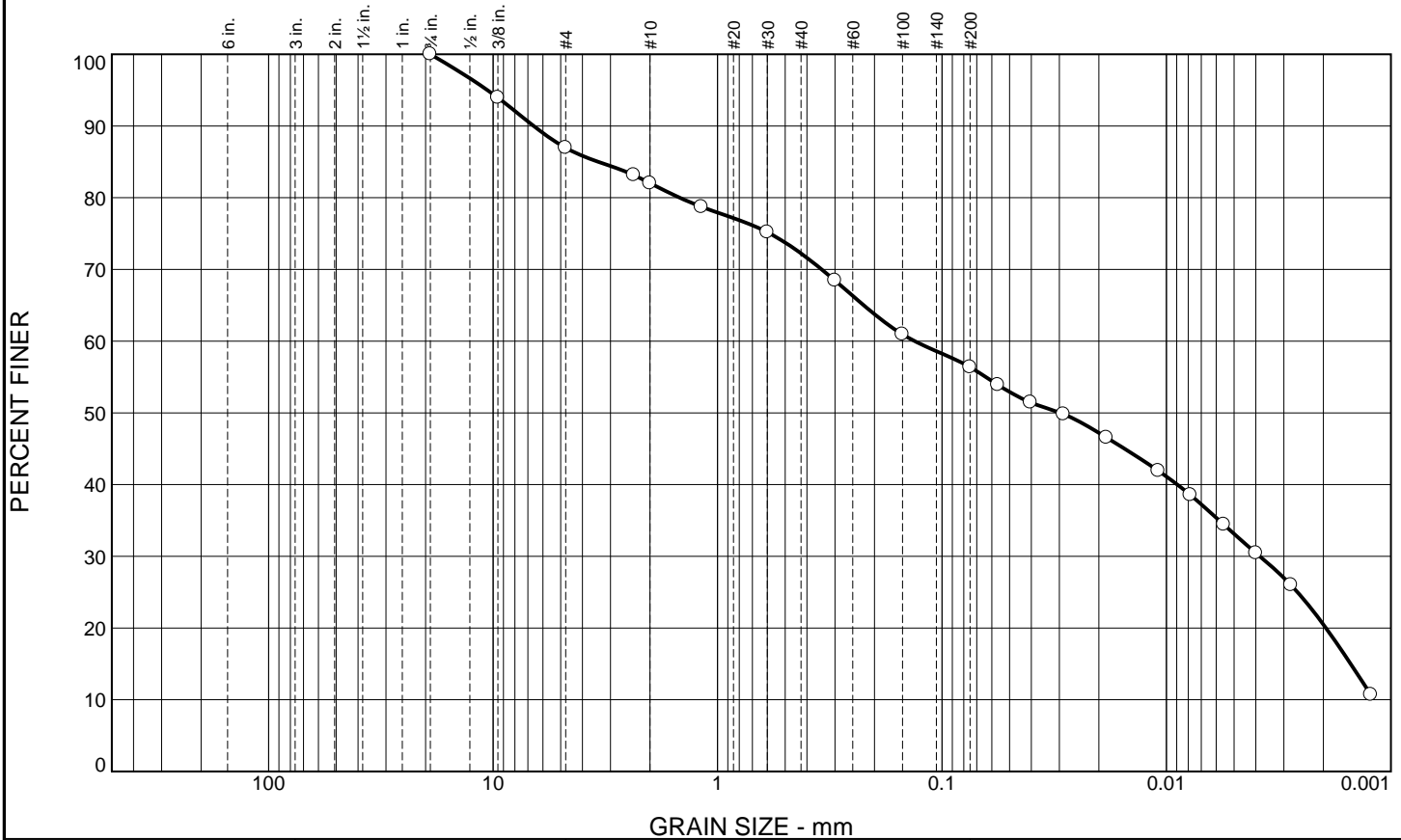
Date: 1/20/17



Client: Mott MacDonald
Project: Penn East Pipeline Project
I-80, Carbon County, PA
Project No: 548000AX

Plate PSA-7

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	13.1	4.9	9.8	15.8	23.3	33.1

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.375	93.9		
#4	86.9		
#8	83.1		
#10	82.0		
#16	78.7		
#30	75.2		
#50	68.5		
#100	60.9		
#200	56.4		

Material Description
Red-brown sandy SILT\CLAY

Atterberg Limits
LL= PL= PI=

Coefficients
D₈₅= 3.3943 D₆₀= 0.1323 D₅₀= 0.0297
D₃₀= 0.0038 D₁₅= 0.0015 D₁₀=
C_u= C_c=

Classification
USCS= CL:H\ML:H

Remarks

* (no specification provided)

Source of Sample: B-I80-4
Sample Number: S-17

Depth: 80'-82'

Date: 1/20/17



Client: Mott MacDonald
Project: Penn East Pipeline Project
I-80, Carbon County, PA
Project No: 548000AX

Plate PSA-8

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.5	1.5	8.2	15.6	50.6	22.6

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375	100.0		
#4	98.5		
#8	97.8		
#10	97.0		
#16	94.9		
#30	91.2		
#50	85.9		
#100	80.4		
#200	73.2		

Material Description

Red-brown SILT\CLAY with sand

Atterberg Limits

LL= PL= PI=

Coefficients

D₈₅= 0.2733 D₆₀= 0.0564 D₅₀= 0.0427
D₃₀= 0.0088 D₁₅= 0.0031 D₁₀= 0.0023
C_u= 24.10 C_c= 0.59

Classification

USCS= CL:H\ML:H

Remarks

* (no specification provided)

Source of Sample: B-I80-4
Sample Number: S-19

Depth: 90'-92'

Date: 1/20/17



Client: Mott MacDonald
Project: Penn East Pipeline Project
I-80, Carbon County, PA
Project No: 548000AX

Plate PSA-9



GEOTECHNICAL LABORATORY TESTING RESULTS



CLIENT: Mott MacDonald
 111 Wood Ave South
 Iselin, NJ 08830-4112

PROJECT: Penn East
 Interstate 80

CTL # 548000AR
CTB # 150167

DATE: November 9, 2016

ATTN: Ms. Erica Vigliorolo

CHECKED BY: Eduardo M. Freire, P.E.
 Geotechnical Laboratory Manager

SAMPLES RECEIVED: October 27, 2016

SAMPLES TESTED: 10/27/16 - 11/8/16

LAB TECHNICIAN(S): J. Veach and A. Midgette

Test Boring No.	Sample No.	Depth (ft)	Water Content (%) (ASTM D2216)	Atterberg Limits (ASTM D4318)			Rock Unconfined Compression w/ Stress-Strain (ASTM D7012-D)*	Unit Weight of Oven Dried Rock (pcf)	Point Load Strength (ASTM D5731)	Sulfate (mg/L) (ASTM D4327)	Chloride (mg/L) (ASTM D4327)	pH of Soil (ASTM G51)	Consolidation* (ASTM D2435)	UU Triaxial* (ASTM D2860)	CU Triaxial (ASTM D4767)	Soil Perm. Class Rating (NJAC 7-9A-6.3)						
				LL	PL	PI										A	B					
B-I80-2	R-2	107.4-108.1					RC-1															
	R-3	110.9-111.5						171.4														
	R-4	116.9-117.5					RC-2															
Billing Total:							2	1														

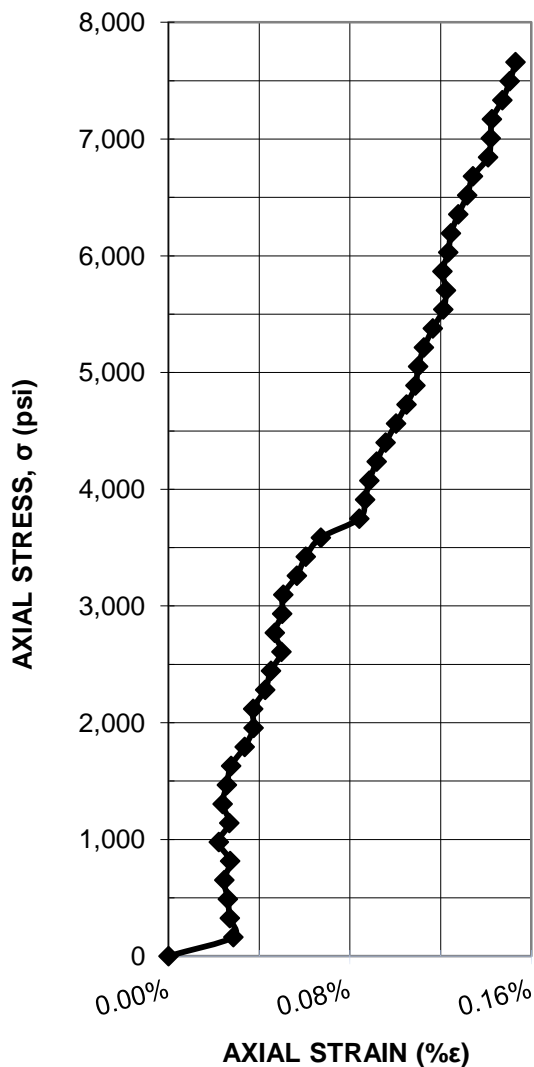
Comments/Remarks: *See attached Plates

ROCK UNCONFINED COMPRESSION TEST WITH STRESS-STRAIN CURVE REPORT

(ASTM D 7012 - Method D)

Client: Mott MacDonald Test Date: November 7, 2016 Plate : RC-1
 Project: Penn East Pipeline Project - Interstate 80 CTL #: 548000AR
 Boring No.: B-I80-2 Core Run: R-2 Depth (ft): 107.4-108.1 Tested By: J. Veach
 Description: Olive gray to reddish brown SANDSTONE Checked By: E. Freire
 Core Data: Avg. Length (inch) = 4.865 Avg. Diameter (inch) = 1.977
 L/D Ratio (2.0 to 2.5) = 2.46 Area (inch²) = 3.068
 Dry Unit Weight (pcf) 170.2 Note: Test specimen not prepared in accordance with D4543

AXIAL STRESS-STRAIN CURVE



ROCK SPECIMEN PHOTOGRAPHS



BEFORE



AFTER

UNIAXIAL COMPRESSIVE STRENGTH, σ_u : 7,803 psi = 7.8 ksi

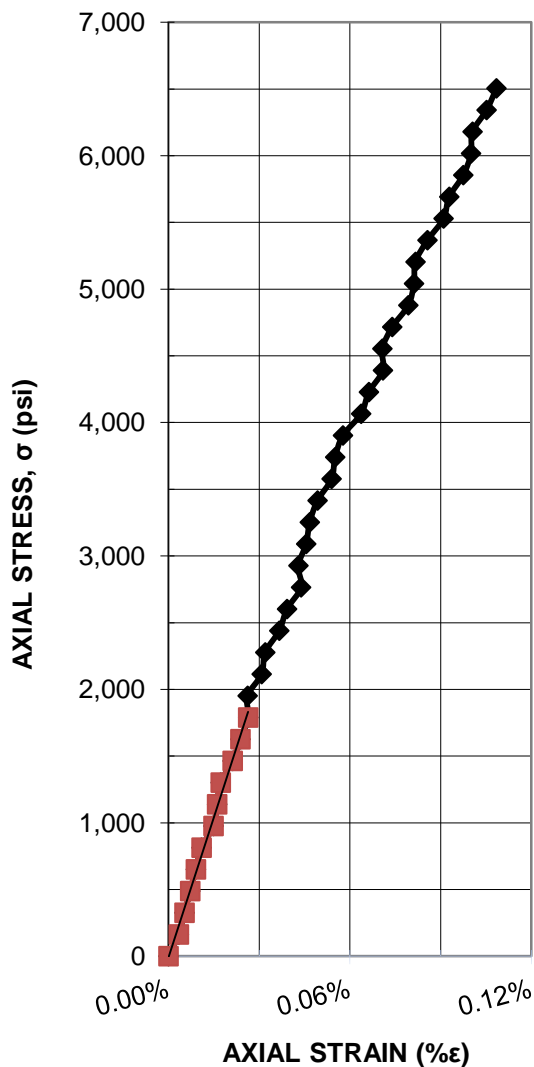
ESTIMATED YOUNG'S MODULUS, E: - psi (No suitable linear portion to estimate)

ROCK UNCONFINED COMPRESSION TEST WITH STRESS-STRAIN CURVE REPORT

(ASTM D 7012 - Method D)

Client:	<u>Mott MacDonald</u>	Test Date:	<u>November 7, 2016</u>	Plate :	<u>RC-2</u>
Project:	<u>Penn East Pipeline Project - Interstate 80</u>			CTL #:	<u>548000AR</u>
Boring No.:	<u>B-I80-2</u>	Core Run:	<u>R-4</u>	Depth (ft):	<u>116.9-117.5</u>
				Tested By:	<u>J. Veach</u>
Description:	<u>Olive gray to reddish brown SANDSTONE</u>			Checked By:	<u>E. Freire</u>
Core Data:	Avg. Length (inch) =	<u>4.839</u>	Avg. Diameter (inch) =	<u>1.979</u>	
	L/D Ratio (2.0 to 2.5) =	<u>2.45</u>	Area (inch ²) =	<u>3.074</u>	
	Dry Unit Weight (pcf)	<u>169.2</u>	Note: Test specimen not prepared in accordance with D4543		

AXIAL STRESS-STRAIN CURVE



ROCK SPECIMEN PHOTOGRAPHS



BEFORE



AFTER


UNIAXIAL COMPRESSIVE STRENGTH, σ_u : 6,603 psi = 6.6 ksi

ESTIMATED YOUNG'S MODULUS, E: 6.79E+06 psi (Avg. Linear Portion of Curve, shown)

**Mott MacDonald #353754AE01
Penn East Pipeline - Interstate 80
SUMMARY OF ROCK TESTING**

SAMPLE IDENTIFICATION			STATE PROPERTIES			ENGINEERING PROPERTY TESTS					REMARKS
Boring	Run	Depth	WATER CONTENT (1) (%)	TOTAL UNIT WGT. (pcf)	DRY UNIT WGT. (pcf)	TEST TYPE (2)	ORIENTATION (3)	POINT LOAD TEST (ASTM D5731)		Brazilian (ASTM D3967)	
								STRENGTH INDEX Is(50) (MPa)	ESTIMATED (4) COMPRESSIVE STRENGTH (psi)	SPLITTING TENSILE STRENGTH (psi)	
B-I80-2	R-2	106.5-107.2	0.2			PL	Diametral	6.5	21149		
B-I80-2	R-2	106.5-107.2				PL	Axial	2.5	8639		
B-I80-2	R-3	113.4-113.5	0.3	172	171	ST	A			1196	
B-I80-2	R-3	113.5-113.6	0.3	171	171	ST	B			1666	
B-I80-2	R-4	116.0-116.6	0.3			PL	Diametral	2.7	9095		
B-I80-2	R-4	116.0-116.6				PL	Axial	2.2	6849		

- Notes:
- (1) Water contents determined after trimming and shearing.
 - (2) Test Type Abbreviations: PL: Point Load, ST: Splitting Tensile.
 - (3) Diametral orientation across core along bedding plane, axial perpendicular to bedding plane. A and B approximately perpendicular to other.
 - (4) Compressive Strength determined using generalized "K" factor in ASTM D5731

Depth:		
Load Orientation:	Diametral	Axial
Length to nearest free end, L (mm)	24.6	24.7
Specimen Width, W (mm)	50.1	50.1
D (mm)	46.0	41.0
D' (mm)	46.0	41.0
D _e (mm)	46.0	51.2
Failure Load, P (lb)	3227	1472
Point Load (N)	14354	6548
Point Load (Mpa)	6.53	2.53
Index, Is50 (psi)	950	370
Unconfined Compressive Strength (psi)	21149	8639
Specimen /Failure photo		
Tare No.	M-16	
Wet + Tare (gm)	250.82	
Dry + Tare (gm)	250.39	
Tare (gm)	50.69	
Water Content%	0.22	
Comments	Invalid Break	

Test by: RAT

Test Date: 11/4/2016

Reviewed by: GET

Penn East Pipeline		POINT LOAD STRENGTH INDEX OF ROCK ASTM D5731
Interstate 80		
Mott MacDonald	353754AE01	Boring: B-I80-2 Run: R-2 Depth: 106.5-107.2 ft.
TerraSense, LLC	7978-16001(13)	

SPLITTING TENSILE (Brazilian) TEST

ASTM D 3967

Project Number: 7978-16001(13)

Test by: GT

Boring: B-I80-2

Project Name: Penn East Pipeline Interstate 80

Test Date: 11/4/16

Run: R-3

SPECIMEN READINGS

Test Number: A

Depth: 113.4-113.5

Specimen mass(gm): 134.66

Thickness (inch)	Diameter (inch)
0.981	1.972
0.979	1.971
0.979	1.972
Average 0.979	1.972

Thickness / Diameter, (t/d): 0.50

t/D ratio between 0.2 and 0.75 yes

Largest Grain Diameter inch

Data Acquisition File B-I80-2R3A

Maximum Load 3626 lb

After Test

Container No.: M31

Initial Mass + cont. (g): 183.94

Dry Mass + cont. (g): 183.49

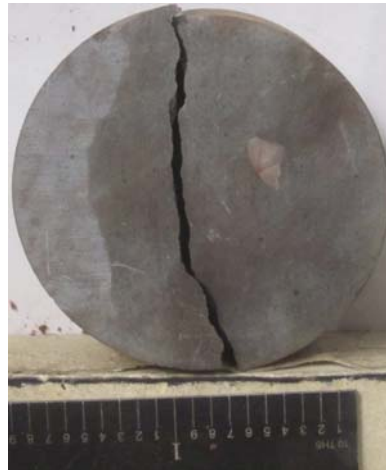
Mass of cont. (g): 49.41

Water content (%): 0.34

Total unit weight (pcf): 171.60

Dry unit weight (pcf): 171.03

Splitting Tensile Strength (psi) 1195.59



Failure Photo

Test Number: B

Depth: 113.5-113.6

Specimen mass(gm): 132.68

Thickness (inch)	Diameter (inch)
0.961	1.972
0.970	1.975
0.965	1.972
Average 0.965	1.973

Thickness / Diameter, (t/d): 0.49

t/D ratio between 0.2 and 0.75 yes

Largest Grain Diameter inch

Data Acquisition File B-I80-2R3B

Maximum Load 4982 lb

After Test

Container No.: M39

Initial Mass + cont. (g): 181.71

Dry Mass + cont. (g): 181.32

Mass of cont. (g): 49.64

Water content (%): 0.30

Total unit weight (pcf): 171.33

Dry unit weight (pcf): 170.82

Splitting Tensile Strength (psi) 1665.53

Mott MacDonald

353754AE01

Penn East Pipeline



**DATA SHEET
SPLITTING TENSILE STRENGTH TEST**

TerraSense, LLC

7978-16001(13)

Interstate 80

**Boring: B-I80-2
Run: R-3 Depth: 113.4-113.6 ft.**

Depth:		
Load Orientation:	Diametral	Axial
Length to nearest free end, L (mm)	31.8	30.7
Specimen Width, W (mm)	50.3	50.3
D (mm)	51.0	32.0
D' (mm)	51.0	32.0
D _e (mm)	51.0	45.2
Failure Load, P (lb)	1571	1044
Point Load (N)	6988	4644
Point Load (Mpa)	2.71	2.17
Index, Is50 (psi)	390	310
Unconfined Compressive Strength (psi)	9095	6849
Specimen /Failure photo		
Tare No.	M-26	
Wet + Tare (gm)	228.27	
Dry + Tare (gm)	227.81	
Tare (gm)	51.5	
Water Content%	0.26	
Comments		

Test by: RAT

Test Date: 11/4/2016

Reviewed by: GET

Penn East Pipeline		POINT LOAD STRENGTH INDEX OF ROCK ASTM D5731
Interstate 80		
Mott MacDonald	353754AE01	Boring: B-I80-2 Run: R-4 Depth: 116.0-116.6 ft.
TerraSense, LLC	7978-16001(13)	



GEOTECHNICAL LABORATORY TESTING RESULTS



CLIENT: Hatch Mott MacDonald
111 Wood Ave South
Iselin, NJ 08830-4112

PROJECT: Penn East
Interstate 80

CTL # 548000AH
CTB # 150167

DATE: May 16, 2016

ATTN: Ms. Erica Vigliorolo

CHECKED BY: Eduardo M. Freire, P.E.
Geotechnical Laboratory Manager

SAMPLES RECEIVED: May 3, 2016

SAMPLES TESTED: 5/3/16 - 5/13/16

LAB TECHNICIAN(S): J. Veach and A. Midgette

Test Boring No.	Sample No.	Depth (ft)	Water Content (%) (ASTM D2216)	Atterberg Limits (ASTM D4318)			Rock Unconfined Compression w/ Stress-Strain (ASTM D7012-D)/y/*	Unit Weight of Oven Dried Rock (pcf)	Point Load Strength (ASTM D5731)	Sulfate (mg/L) (ASTM D4327)	Chloride (mg/L) (ASTM D4327)	pH of Soil (ASTM G51)	Consolidation* (ASTM D2435)	UU Triaxial* (ASTM D2860)	CU Triaxial (ASTM D4767)	Soil Perm. Class Rating (NJAC 7-9A-6.3)	
				LL	PL	PI										A	B
B-180-3	R-19	185.7-186.4					RC-3										
	R-20	191.3-192						170.0									
	R-21	196.1-197.7					RC-4										
Billing Total:							4	2									

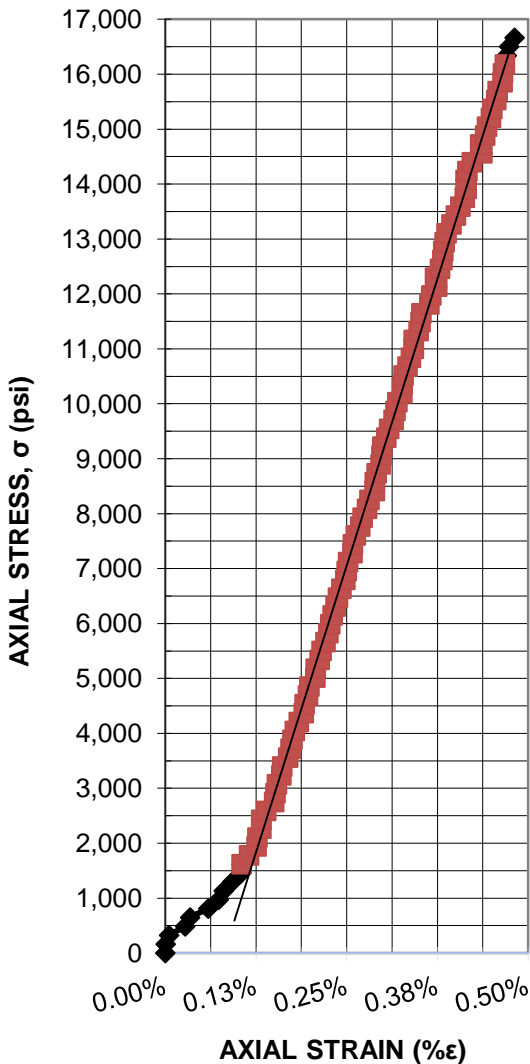
Comments/Remarks: *See attached Plates

ROCK UNCONFINED COMPRESSION TEST WITH STRESS-STRAIN CURVE REPORT

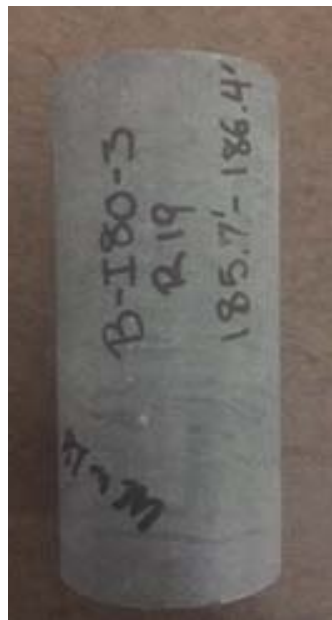
(ASTM D 7012 - Method D)

Client:	<u>Hatch Mott MacDonald</u>	Test Date:	<u>May 12, 2016</u>	Plate :	<u>RC-3</u>
Project:	<u>Penn East - Lockatong Creek Crossing</u>			CTL #:	<u>548000AI</u>
Boring No.:	<u>B-180-3</u>	Core Run:	<u>R-19</u>	Depth (ft):	<u>185.7-186.4</u>
				Tested By:	<u>J. Veach</u>
Description:	<u>Gray-red SANDSTONE</u>			Checked By:	<u>E. Freire</u>
Core Data:	Avg. Length (inch) =	<u>4.765</u>	Avg. Diameter (inch) =	<u>1.984</u>	
	L/D Ratio (2.0 to 2.5) =	<u>2.40</u>	Area (inch ²) =	<u>3.091</u>	
	Dry Unit Weight (pcf)	<u>170.0</u>			Note: Test specimen not prepared in accordance with D4543

AXIAL STRESS-STRAIN CURVE



ROCK SPECIMEN PHOTOGRAPHS



BEFORE



AFTER

UNIAXIAL COMPRESSIVE STRENGTH, σ_u : 16,672 psi = 16.7 ksi

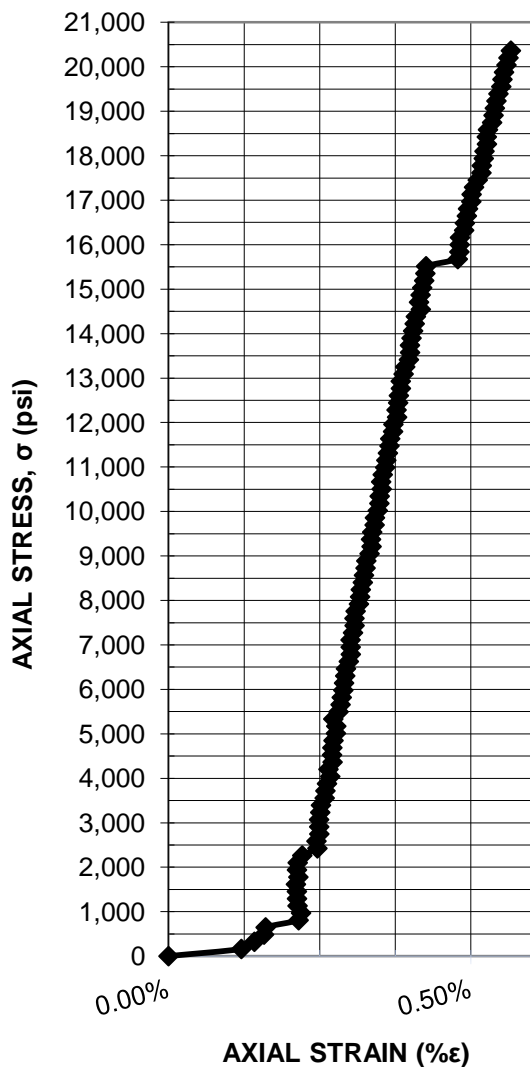
ESTIMATED YOUNG'S MODULUS, E: 4.01E+06 psi (Avg. Linear Portion of Curve, shown)

ROCK UNCONFINED COMPRESSION TEST WITH STRESS-STRAIN CURVE REPORT

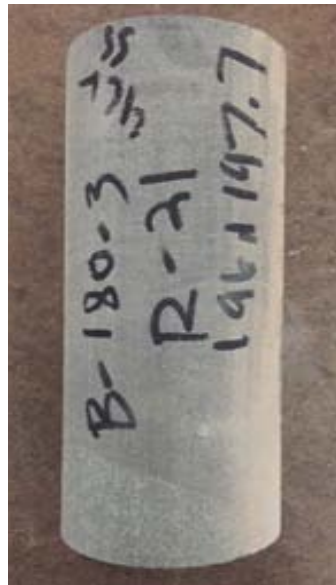
(ASTM D 7012 - Method D)

Client:	<u>Hatch Mott MacDonald</u>	Test Date:	<u>May 12, 2016</u>	Plate :	<u>RC-4</u>
Project:	<u>Penn East - Lockatong Creek Crossing</u>			CTL #:	<u>548000AI</u>
Boring No.:	<u>B-180-3</u>	Core Run:	<u>R-21</u>	Depth (ft):	<u>196.1-197.7</u>
				Tested By:	<u>J. Veach</u>
Description:	<u>Gray SANDSTONE</u>			Checked By:	<u>E. Freire</u>
Core Data:	Avg. Length (inch) =	<u>4.751</u>	Avg. Diameter (inch) =	<u>1.985</u>	
	L/D Ratio (2.0 to 2.5) =	<u>2.39</u>	Area (inch ²) =	<u>3.094</u>	
	Dry Unit Weight (pcf)	<u>169.8</u>			Note: Test specimen not prepared in accordance with D4543

AXIAL STRESS-STRAIN CURVE



ROCK SPECIMEN PHOTOGRAPHS





BEFORE



AFTER

UNIAXIAL COMPRESSIVE STRENGTH, σ_u : 20,440 psi = 20.4 ksi

ESTIMATED YOUNG'S MODULUS, E: - psi (No Suitable Avg. Linear Portion of Curve)

Depth:		
Load Orientation:	Diametral	Axial
Length to nearest free end, L (mm)	26.5	25.9
Specimen Width, W (mm)	50.4	50.4
D (mm)	51.0	29.0
D' (mm)	51.0	29.0
D _e (mm)	51.0	43.1
Failure Load, P (lb)	4443	2324
Point Load (N)	19763	10338
Point Load (Mpa)	7.67	5.20
Index, Is50 (psi)	1110	750
Unconfined Compressive Strength (psi)	25886	16216
Specimen /Failure photo		
Tare No.	M-7	
Wet + Tare (gm)	196.55	
Dry + Tare (gm)	196.25	
Tare (gm)	51.31	
Water Content%	0.21	
Comments		

Test by: RAT

Test Date: 5/3/2016

Reviewed by: GET

Penn East Pipeline		POINT LOAD STRENGTH INDEX OF ROCK ASTM D5731
Lockatong Creek Crossing, Interstate 80		
Mott MacDonald	353754AE01	Boring: B-180-3 Run: R-19 Depth: 185-185.7 ft.
TerraSense, LLC	7978-16001	

SPLITTING TENSILE (Brazilian) TEST

ASTM D 3967

Project Number: 7978-16001

Test by: AM

Sta: B-180-3

Project Name: Penn East Pipeline Lockatong Creek Crossing, Interstate 80

Test Date: 5/3/16

Run: R-20

SPECIMEN READINGS

Test Number: A
Depth: 190.3-190.4

Specimen mass(gm): 145.64

Thickness (inch)	Diameter (inch)
1.064	1.984
1.060	1.984
1.055	1.985

Average 1.059 1.984

Thickness / Diameter, (t/d): 0.53

t/D ratio between 0.2 and 0.75 yes

Data Acquisition File B1803-R20A

Maximum Load 9994 lb

After Test

Container No.: LA-120

Initial Mass + cont. (g): 178.36

Dry Mass + cont. (g): 178.32

Mass of cont. (g): 34.71

Water content (%): 0.03

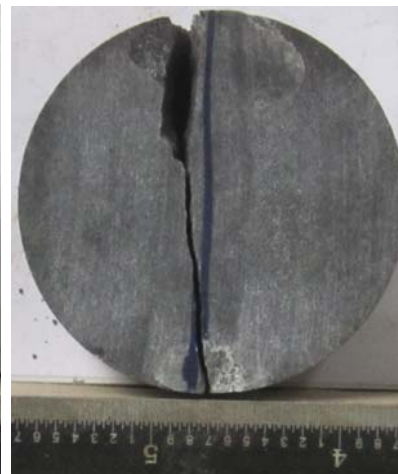
Total unit weight (pcf): 169.42

Dry unit weight (pcf): 169.37

Splitting Tensile Strength (psi) 3027.45



A



B

Failure Photo

Test Number: B
Depth: 190.4-190.5

Specimen mass(gm): 135.47

Thickness (inch)	Diameter (inch)
0.983	1.981
0.982	1.982
0.981	1.984

Average 0.982 1.982

Thickness / Diameter, (t/d): 0.50

t/D ratio between 0.2 and 0.75 yes

Data Acquisition File B1803-R20B

Maximum Load 4460 lb

After Test

Container No.: LB-1

Initial Mass + cont. (g): 166.91

Dry Mass + cont. (g): 166.75

Mass of cont. (g): 32.89

Water content (%): 0.12

Total unit weight (pcf): 170.34

Dry unit weight (pcf): 170.14

Splitting Tensile Strength (psi) 1458.94

Mott MacDonald

353754AE01

Penn East Pipeline



**DATA SHEET
SPLITTING TENSILE STRENGTH TEST**

TerraSense, LLC

7978-16001

Lockatong Creek Crossing, Interstate 80

**Sta: B-180-3
Run: R-20 Depth: 190.3-190.5 ft.**

Depth:		
Load Orientation:	Diametral	Axial
Length to nearest free end, L (mm)	34.2	25.3
Specimen Width, W (mm)	50.4	50.4
D (mm)	51.0	25.0
D' (mm)	51.0	25.0
D _e (mm)	51.0	40.0
Failure Load, P (lb)	1612	2334
Point Load (N)	7171	10382
Point Load (Mpa)	2.78	5.86
Index, Is50 (psi)	400	850
Unconfined Compressive Strength (psi)	9328	17804
Specimen /Failure photo		
Tare No.	M-33	
Wet + Tare (gm)	225.08	
Dry + Tare (gm)	224.63	
Tare (gm)	50.94	
Water Content%	0.26	
Comments		

Test by: RAT

Test Date: 5/3/2016

Reviewed by: GET

Penn East Pipeline		POINT LOAD STRENGTH INDEX OF ROCK ASTM D5731
Lockatong Creek Crossing, Interstate 80		
Mott MacDonald	353754AE01	Boring: B-180-3 Run: R-21 Depth: 195.3-196.1 ft.
TerraSense, LLC	7978-16001	



GEOTECHNICAL LABORATORY TESTING RESULTS



CLIENT: Mott MacDonald
 111 Wood Ave South
 Iselin, NJ 08830-4112

PROJECT: Penn East
 I-80 Carbon County, PA

CTL # 548000AY
CTB # 150167

DATE: January 24, 2017

ATTN: Ms. Erica Vigliorolo

CHECKED BY: Eduardo M. Freire, P.E.
 Geotechnical Laboratory Manager

SAMPLES RECEIVED: January 9, 2017

SAMPLES TESTED: 1/9/17 - 1/23/17

LAB TECHNICIAN(S): J. Veach

Test Boring No.	Sample No.	Depth (ft)	Water Content (%) (ASTM D2216)	Atterberg Limits (ASTM D4318)			Rock Unconfined Compression w/ Stress-Strain (ASTM D7012-D)*	Unit Weight of Oven Dried Rock (pcf)	Point Load Strength (ASTM D5731)	Sulfate (mg/L) (ASTM D4327)	Chloride (mg/L) (ASTM D4327)	pH of Soil (ASTM G51)	Consolidation* (ASTM D2435)	UU Triaxial* (ASTM D2860)	CU Triaxial (ASTM D4767)	Soil Perm. Class Rating (NJAC 7-9A-6.3)						
				LL	PL	PI										A	B					
B-I80-4	R-2	107.45-108.55					RC-1															
	R-3	113.65-114.36						170.4														
	R-4	119-199.65					RC-2															
	R-5	121.7-122.3						170.5														
Billing Total:							2	2														

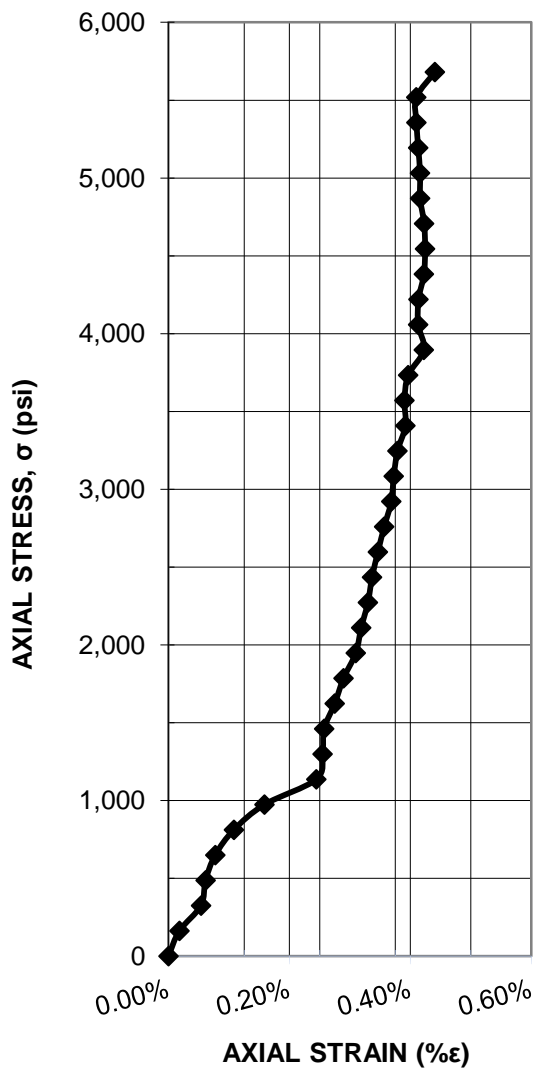
Comments/Remarks: *See attached Plates

ROCK UNCONFINED COMPRESSION TEST WITH STRESS-STRAIN CURVE REPORT

(ASTM D 7012 - Method D)

Client:	<u>Mott MacDonald</u>	Test Date:	<u>January 23, 2017</u>	Plate :	<u>RC-1</u>
Project:	<u>Penn East - I-80 Carbon County, PA</u>			CTL #:	<u>548000AY</u>
Boring No.:	<u>B-180-4</u>	Core Run:	<u>R-2</u>	Depth (ft):	<u>107.45-108.55</u>
				Tested By:	<u>J. Veach</u>
Description:	<u>Reddish brown SILTSTONE</u>			Checked By:	<u>E. Freire</u>
Core Data:	Avg. Length (inch) =	<u>4.735</u>	Avg. Diameter (inch) =	<u>1.981</u>	
	L/D Ratio (2.0 to 2.5) =	<u>2.39</u>	Area (inch ²) =	<u>3.081</u>	
	Dry Unit Weight (pcf)	<u>171.9</u>			Note: Test specimen not prepared in accordance with D4543

AXIAL STRESS-STRAIN CURVE



ROCK SPECIMEN PHOTOGRAPHS



UNIAXIAL COMPRESSIVE STRENGTH, σ_u : 5,713 psi = 5.7 ksi

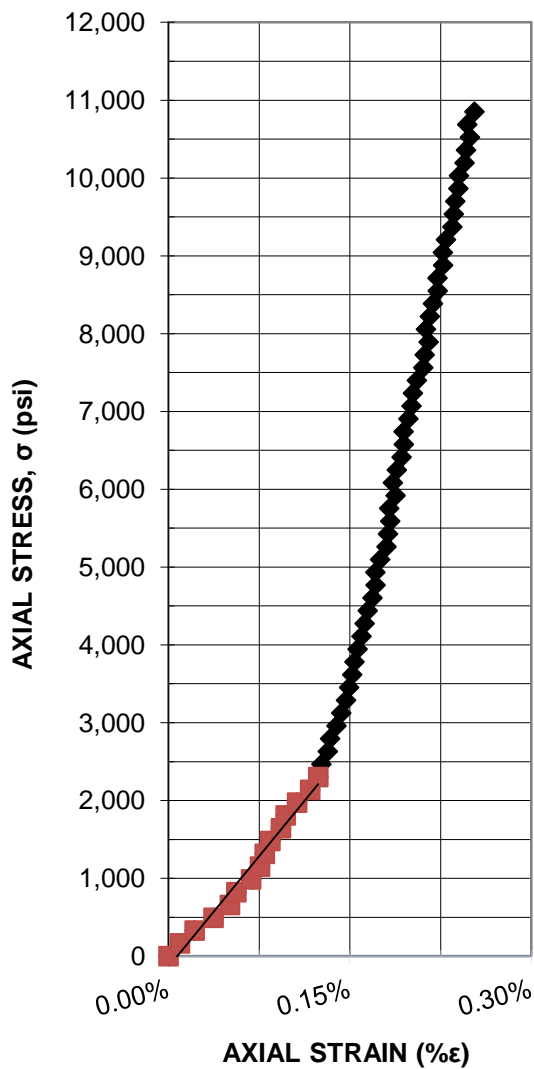
ESTIMATED YOUNG'S MODULUS, E: - psi (No suitable linear portion to estimate)

ROCK UNCONFINED COMPRESSION TEST WITH STRESS-STRAIN CURVE REPORT

(ASTM D 7012 - Method D)

Client: Mott MacDonald Test Date: January 23, 2017 Plate : RC-2
 Project: Penn East - I-80 Carbon County, PA CTL #: 548000AY
 Boring No.: B-180-4 Core Run: R-4 Depth (ft): 119-119.65 Tested By: J. Veach
 Description: Reddish brown SANDSTONE Checked By: E. Freire
 Core Data: Avg. Length (inch) = 4.852 Avg. Diameter (inch) = 1.968
 L/D Ratio (2.0 to 2.5) = 2.47 Area (inch²) = 3.041
 Dry Unit Weight (pcf) 169.7 Note: Test specimen not prepared in accordance with D4543

AXIAL STRESS-STRAIN CURVE



ROCK SPECIMEN PHOTOGRAPHS



BEFORE

AFTER

UNIAXIAL COMPRESSIVE STRENGTH, σ_u : 10,950 psi = 10.9 ksi

ESTIMATED YOUNG'S MODULUS, E: 1.86E+06 psi (Avg. Linear Portion of Curve, shown)

Mott MacDonald #353754AE01
Penn East Pipeline - I-80 Carbon County, PA
SUMMARY OF ROCK TESTING



SAMPLE IDENTIFICATION			STATE PROPERTIES			ENGINEERING PROPERTY TESTS					REMARKS
Boring	Run	Depth	WATER CONTENT (1) (%)	TOTAL UNIT WGT. (pcf)	DRY UNIT WGT. (pcf)	TEST TYPE (2)	ORIENTATION (3)	POINT LOAD TEST (ASTM D5731)		Brazilian (ASTM D3967)	
								STRENGTH INDEX Is(50) (MPa)	ESTIMATED (4) COMPRESSIVE STRENGTH (psi)	SPLITTING TENSILE STRENGTH (psi)	
B-180-4	R-2	106.45-107.25	0.4			PL	Diametral	1.5	5086		
B-180-4	R-2	106.45-107.25				PL	Axial	3.0	9002		
B-180-4	R-3	110.3-110.4	0.4	172	172	ST	A			1099	
B-180-4	R-3	110.4-110.5	0.4	172	172	ST	B			1200	
B-180-4	R-4	116-116.65	0.3			PL	Diametral	1.9	6474		
B-180-4	R-4	116-116.65				PL	Axial	2.1	7435		
B-180-4	R-5	120.05-120.15	0.3	171	171	ST	A			1677	
B-180-4	R-5	120.15-120.25	0.3	172	171	ST	B			1076	

- Notes:
- (1) Water contents determined after trimming and shearing.
 - (2) Test Type Abbreviations: PL: Point Load, ST: Splitting Tensile.
 - (3) Diametral orientation across core along bedding plane, axial perpendicular to bedding plane. A and B approximately perpendicular to other.
 - (4) Compressive Strength determined using generalized "K" factor in ASTM D5731

Reviewed by: GET
Date: 1/11/2017

TerraSense, LLC
45H Commerce Way
Totowa, NJ 07512

Project No.: 7978-16001(17))
File: RockSum17.xlsx
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Depth:		
Load Orientation:	Diametral	Axial
Length to nearest free end, L (mm)	28.3	24.5
Specimen Width, W (mm)	50.3	50.3
D (mm)	50.0	27.0
D' (mm)	50.0	25.0
D _e (mm)	50.0	40.0
Failure Load, P (lb)	853	1181
Point Load (N)	3794	5253
Point Load (Mpa)	1.52	2.97
Index, Is50 (psi)	220	430
Unconfined Compressive Strength (psi)	5086	9002
Specimen /Failure photo		
Tare No.	M-36	
Wet + Tare (gm)	220.15	
Dry + Tare (gm)	219.46	
Tare (gm)	49.43	
Water Content%	0.41	
Comments		

Test by: RAT

Test Date: 1/6/2017

Reviewed by: GET

Penn East Pipeline		POINT LOAD STRENGTH INDEX OF ROCK ASTM D5731
I-80		
Carbon County, PA		
Mott MacDonald	353754AE01	Boring: B-180-4 Run: R-2 Depth: 106.45-107.25 ft.
TerraSense, LLC	7978-16001(17)	

SPLITTING TENSILE (Brazilian) TEST

ASTM D 3967

Project Number: 7978-16001(17)

Test by: AM

Boring: B-180-4

Project Name: Penn East Pipeline I-80 Carbon County, PA

Test Date: 1/6/17

Run: R-3

SPECIMEN READINGS

Test Number: A
Depth: 110.3-110.4

Specimen mass(gm): 126.06

Thickness (inch)	Diameter (inch)
0.911	1.979
0.904	1.978
0.910	1.975

Average 0.908 1.977

Thickness / Diameter, (t/d): 0.46

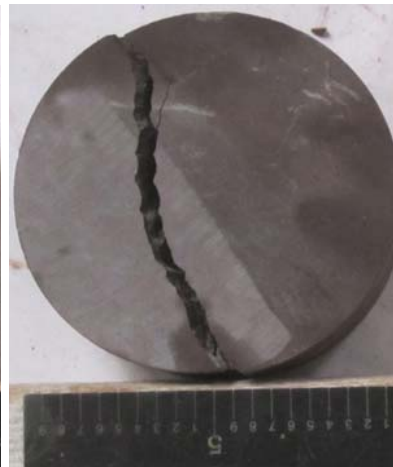
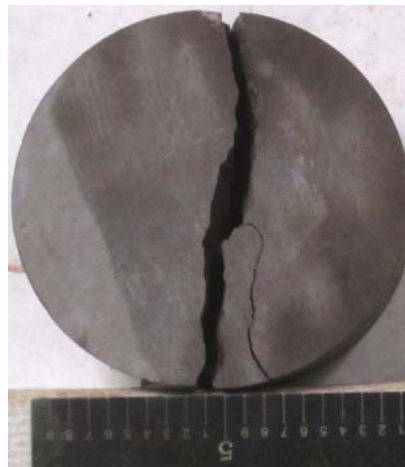
t/D ratio between 0.2 and 0.75 yes

Largest Grain Diameter inch

Data Acquisition File B180-4-R3A

Maximum Load lb

After Test	
Container No.:	<u>M4</u>
Initial Mass + cont. (g):	<u>176.63</u>
Dry Mass + cont. (g):	<u>176.12</u>
Mass of cont. (g):	<u>51.30</u>
Water content (%):	<u>0.41</u>
Total unit weight (pcf):	<u>172.24</u>
Dry unit weight (pcf):	<u>171.54</u>
Splitting Tensile Strength (psi)	<u>1098.73</u>



Failure Photo

Test Number: B
Depth: 110.4-110.5

Specimen mass(gm): 119.29

Thickness (inch)	Diameter (inch)
0.859	1.980
0.855	1.979
0.857	1.979

Average 0.857 1.979

Thickness / Diameter, (t/d): 0.43

t/D ratio between 0.2 and 0.75 yes



Largest Grain Diameter inch

Data Acquisition File B180-4-R3B

Maximum Load lb

After Test	
Container No.:	<u>M23</u>
Initial Mass + cont. (g):	<u>169.29</u>
Dry Mass + cont. (g):	<u>168.82</u>
Mass of cont. (g):	<u>51.08</u>
Water content (%):	<u>0.40</u>
Total unit weight (pcf):	<u>172.41</u>
Dry unit weight (pcf):	<u>171.72</u>
Splitting Tensile Strength (psi)	<u>1200.31</u>

Mott MacDonald	353754AE01	Penn East Pipeline	DATA SHEET SPLITTING TENSILE STRENGTH TEST Boring: B-180-4 Run: R-3 Depth: 110.3-110.5 ft.
TerraSense, LLC	7978-16001(17)	I-80 Carbon County, PA	

Depth:		
Load Orientation:	Diametral	Axial
Length to nearest free end, L (mm)	28.3	25.5
Specimen Width, W (mm)	50.2	50.2
D (mm)	50.0	47.0
D' (mm)	50.0	47.0
D _e (mm)	50.0	54.8
Failure Load, P (lb)	1076	1364
Point Load (N)	4786	6067
Point Load (Mpa)	1.91	2.11
Index, Is50 (psi)	280	310
Unconfined Compressive Strength (psi)	6474	7435
Specimen /Failure photo		
Tare No.	M-24	
Wet + Tare (gm)	265.78	
Dry + Tare (gm)	265.11	
Tare (gm)	50.99	
Water Content%	0.31	
Comments		

Test by: RAT

Test Date: 1/5/2017

Reviewed by: GET

Penn East Pipeline		POINT LOAD STRENGTH INDEX OF ROCK ASTM D5731
I-80 Carbon County, PA		
Mott MacDonald	353754AE01	
TerraSense, LLC	7978-16001(17)	Boring: B-180-4 Run: R-4 Depth: 116-116.65 ft.

SPLITTING TENSILE (Brazilian) TEST

ASTM D 3967

Project Number: 7978-16001(17)

Test by: AM

Boring: B-180-4

Project Name: Penn East Pipeline I-80 Carbon County, PA

Test Date: 1/6/17

Run: R-5

SPECIMEN READINGS

Test Number: A
Depth: 120.05-120.15

Specimen mass(gm): 116.39

Thickness (inch)	Diameter (inch)
0.850	1.970
0.851	1.970
0.849	1.971

Average 0.850 1.970

Thickness / Diameter, (t/d): 0.43

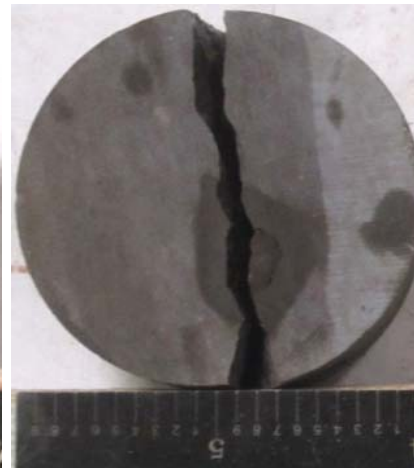
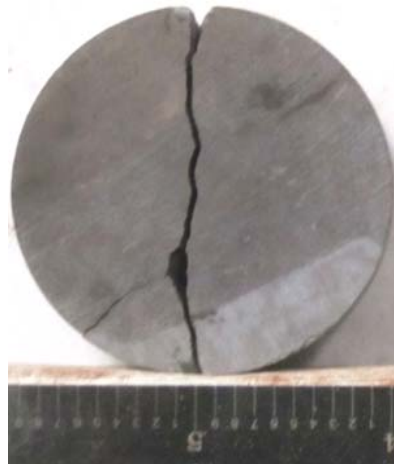
t/D ratio between 0.2 and 0.75 yes

Largest Grain Diameter inch

Data Acquisition File B180-4-R5A

Maximum Load 4409 lb

	After Test
Container No.:	<u>M31</u>
Initial Mass + cont. (g):	<u>165.40</u>
Dry Mass + cont. (g):	<u>165.02</u>
Mass of cont. (g):	<u>49.39</u>
Water content (%):	<u>0.33</u>
Total unit weight (pcf):	<u>171.21</u>
Dry unit weight (pcf):	<u>170.65</u>
Splitting Tensile Strength (psi)	<u>1676.71</u>



Failure Photo

Test Number: B
Depth: 120.15-120.25

Specimen mass(gm): 119.15

Thickness (inch)	Diameter (inch)
0.871	1.966
0.872	1.966
0.874	1.967

Average 0.872 1.966

Thickness / Diameter, (t/d): 0.44

t/D ratio between 0.2 and 0.75 yes

Largest Grain Diameter inch

Data Acquisition File B180-4-R5B

Maximum Load 2896 lb

	After Test
Container No.:	<u>M10</u>
Initial Mass + cont. (g):	<u>169.95</u>
Dry Mass + cont. (g):	<u>169.58</u>
Mass of cont. (g):	<u>51.83</u>
Water content (%):	<u>0.31</u>
Total unit weight (pcf):	<u>171.51</u>
Dry unit weight (pcf):	<u>170.97</u>
Splitting Tensile Strength (psi)	<u>1075.51</u>

Mott MacDonald

353754AE01

Penn East Pipeline

**DATA SHEET
 SPLITTING TENSILE STRENGTH TEST**

TerraSense, LLC

7978-16001(17)

I-80 Carbon County, PA

**Boring: B-180-4
 Run: R-5 Depth: 120.05-120.25 ft.**