

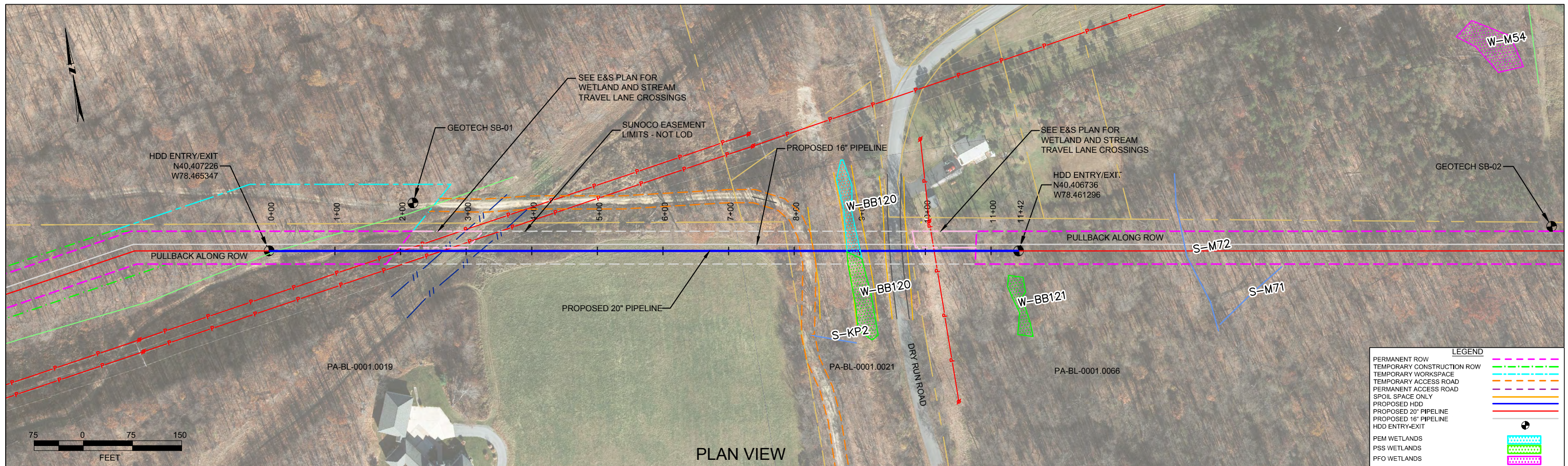
**Attachment A  
HDD Table  
Blair County**

<b>Drawing Name</b>	<b>Drill Name</b>	<b>County</b>	<b>Township</b>	<b>Drill Location</b>	<b>Risk Assessment Level (Low / Medium / High)</b>
PA-BL-0001.0021-RD.pdf	Dry Run Road	Blair	Juniata	N: 40.407226 W: 78.465347	low
PA-BL-0001.0027-RD.pdf	Old US 220 HWY	Blair	Blair	N: 40.409174 W: 78.443121	low
PA-BL-0001.0032-RD.pdf	I-99	Blair	Blair	N: 40.409164 W: 78.435948	low
PA-BL-0001.0048-RR.pdf	Everett RR/ Reservoir Rd	Blair	Blair	N: 40.414526 W: 78.377863	medium
PA-BL-0001.0094-WX.pdf	Frankstown Branch Juniata River	Blair	Frankstown	N: 40.440804 W: 78.331104	medium
PA-BL-0122.0000-WX.pdf	Juniata River	Blair	Frankstown	N: 40.435117 W: 78.299463	low
PA-BL-0126.0000-RD.pdf	Piney Creek	Blair	Woodbury	N: 40.433702 W: 78.269501	low

**HDD PA-BL-0001.0021-RD (BB-120)**

Given the design, the threat of inadvertent return has been reduced to the maximum extent practicable and in this case that threat is considered to be *low*. Implementing this design, along with adherence to the Pennsylvania Pipeline Project Inadvertent Return Contingency Plan will ensure inadvertent impacts, if they were to occur, are also minimized to the maximum extent.

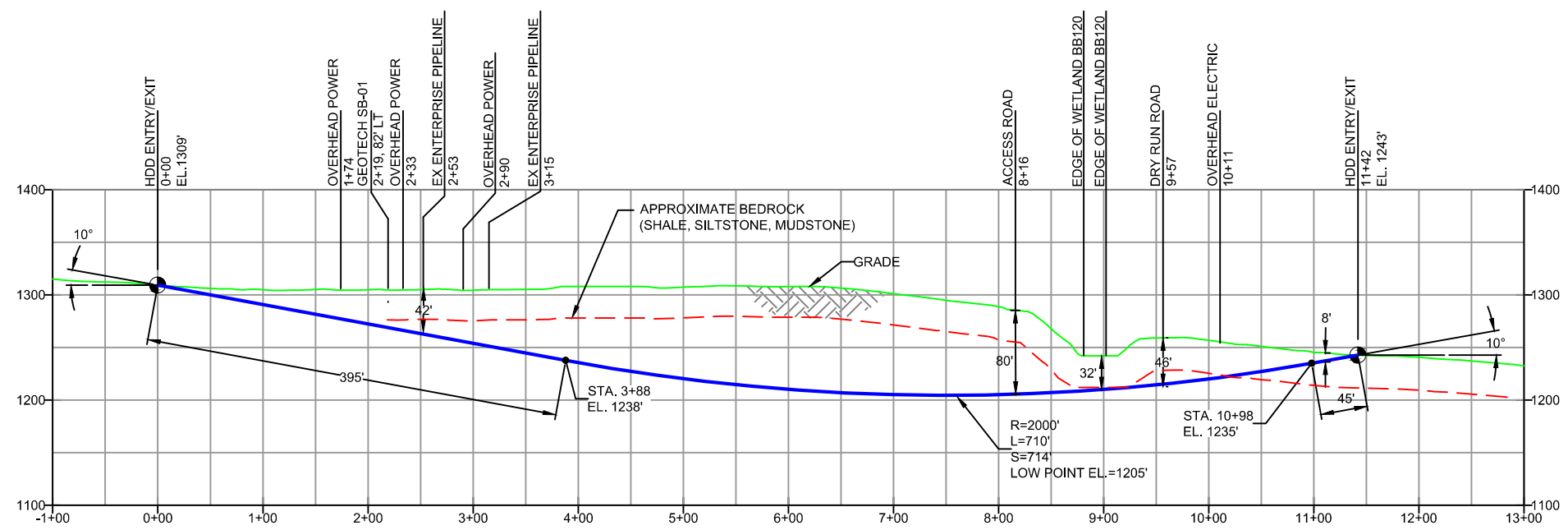
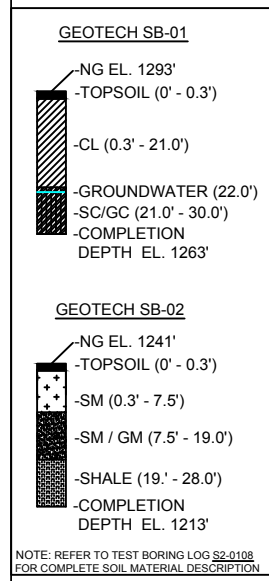
The drill will enter/exit 900 feet from the edge of the western most boundary of the wetland W-BB120. The drill will pass 20 feet under wetland W-BB120. Using the results of the geotechnical investigation, as well as several other data points, the entry/exit, angles, and depths have been configured to pass through the best substrates while maintaining pipe integrity (e.g., no large bends). The majority of the substrate that will be passed through is estimated to be silty clay to fine coarse sand at the western end of the wetland and shale, siltstone, to mudstone at the central part of the wetland and shale, siltstone, to mudstone at the eastern portion of the wetland. The drill will continue from the eastern most boundary of the wetland W-BB120 and will enter/exit 200 feet from the eastern most edge of wetland W-BB120.



BLAIR COUNTY, PA - JUNIATA TOWNSHIP  
S2-0108

PLAN VIEW

PROFILE VIEW



- DESIGN AND CONSTRUCTION:
- CONTRACTOR SHALL FIELD VERIFY DEPTH OF ALL EXISTING UTILITIES SHOWN OR NOT SHOWN ON THIS DRAWING.
  - THE MINIMUM SEPARATION DISTANCE FROM EXISTING SUBSURFACE UTILITIES SHALL NOT BE LESS THAN 10 FEET AS MEASURED FROM THE OUTSIDE EDGE OF THE UTILITY TO OUTSIDE OF PROPOSED PIPELINE.
  - DESIGNED IN ACCORDANCE WITH CFR 49 195 & ASME B31.4
  - CROSSING PIPE SPECIFICATION:  
HDD HORZ. LENGTH (L)=1142'  
HDD PIPE LENGTH (S)=1152'  
20" x 0.456" W.T., X-65, API 5L PSL2, ERW, BFW  
COATING: 14-16 MILS FBE WITH 30-35 MIL ARO (POWERCURE OR ENGINEER APPROVED EQUAL)
  - INTERNAL DESIGN PRESSURE 1480 PSIG (SEAM FACTOR 1.0, DESIGN FACTOR 0.50).
  - INSTALLATION METHOD: HORIZONTAL DIRECTIONAL DRILL (HDD).
  - PIPELINE WARNING MARKERS SHALL BE INSTALLED ON BOTH SIDES OF ALL ROAD, RAILWAY, AND STREAM CROSSINGS.
  - CARRIER PIPE NOT ENCASED.
  - PIPE / AMBIENT TEMPERATURE MUST BE NO LESS THAN 30°F DURING PULLBACK WITHOUT PRIOR WRITTEN APPROVAL FROM THE ENGINEER.
  - CONDUCT 4-HOUR PRE-INSTALLATION HYDROTEST OF HDD PIPE STRING TO MINIMUM 1850 PSIG.
  - SEE SUNOCO PENNSYLVANIA PIPELINE PROJECT ESRI WEBMAP FOR ACCESS ROAD ALIGNMENT.
  - SUNOCO PIPELINE, L.P.'S HORIZONTAL DIRECTIONAL DRILL INADVERTENT RETURN CONTINGENCY PLAN WILL BE IMPLEMENTED AT ALL TIMES.
  - SUNOCO PIPELINE, L.P.'S EROSION AND SEDIMENTATION CONTROL PLAN WILL BE IMPLEMENTED AT ALL TIMES.

NOTES

- ALL COORDINATES SHOWN ARE IN LATITUDE AND LONGITUDE. ALL MSL ELEVATIONS ARE NAD83
- STATIONING IS BASED ON HORIZONTAL DISTANCES.
- ROONEY ENGINEERING, INC. AND SUNOCO PIPELINE, LP ARE NOT RESPONSIBLE FOR LOCATION OF FOREIGN UTILITIES SHOWN IN PLOT PLAN OR PROFILE. THE INFORMATION SHOWN HEREON IS FURNISHED WITHOUT LIABILITY ON THE PART OF ROONEY ENGINEERING, INC. AND SUNOCO PIPELINE, LP. FOR ANY DAMAGES RESULTING FROM ERRORS OR OMISSIONS THEREIN.
- CONTRACTOR IS RESPONSIBLE FOR LOCATING ALL UTILITIES. CONTACT ONE CALL AT 811 PRIOR TO DIGGING.
- SUNOCO EMERGENCY HOTLINE NUMBER IS 1-800-786-7440.

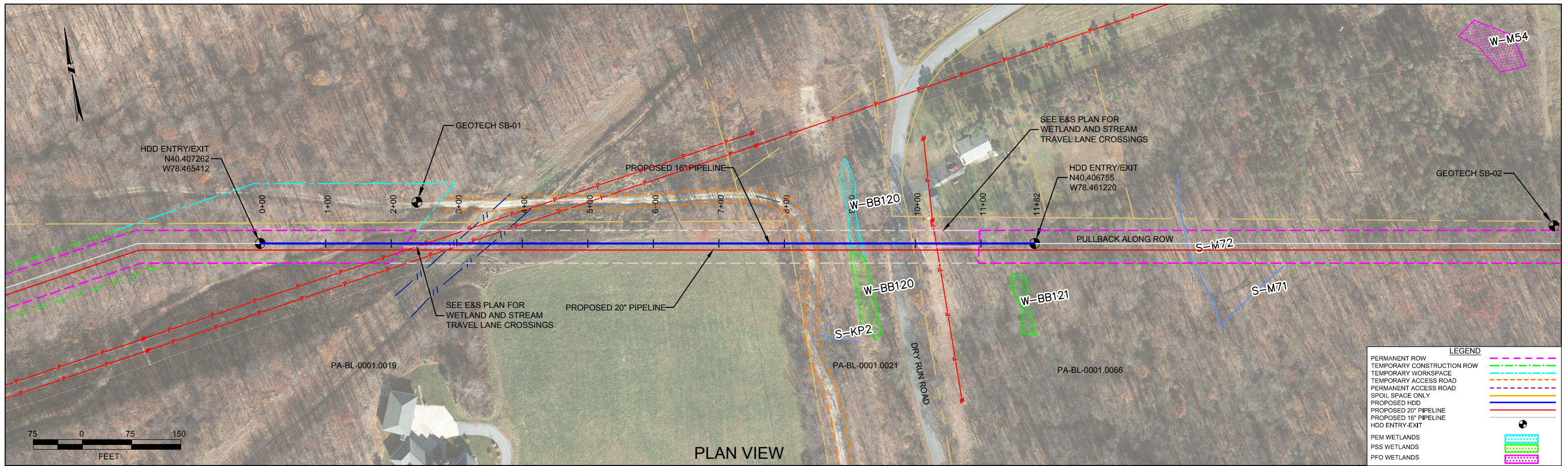
REF. DRAWING		REVISIONS	
ES-3.17	TO ES-3.18	NO.	DESCRIPTION
SHEET 10	SHEET 11	EP2	REVISED PER PADEP COMMENTS RECEIVED 09-06-16
		EP1	REVISED PER PADEP COMMENTS
		EP	
		C	ADDED GEOTECH INFO
		B	ISSUED FOR BID
		A	ISSUED FOR REVIEW
DWG NO	DWG NO	NO.	DESCRIPTION

BY	DATE	CHK	DATE	APP	DATE
DLM	09/30/16	RMB	09/30/16	AAW	09/30/16
MRS	05/09/16	RMB	05/09/16	AAW	05/09/16
MRS	02/26/16	RMB	02/26/16	AAW	02/26/16
MRS	09/03/15	RMB	09/03/15	AAW	09/03/15
DLM	07/31/15	RMB	07/31/15	AAW	07/31/15
RTT	03/20/15	RMB	03/20/15	AAW	03/20/15

SUNOCO PIPELINE, L.P.

20-INCH HORIZONTAL DIRECTIONAL DRILL  
DRY RUN ROAD  
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=150' DWG. NO: PA-BL-0001.0021-RD



PLAN VIEW

LEGEND	
PERMANENT ROW	
TEMPORARY CONSTRUCTION ROW	
TEMPORARY WORKSPACE	
TEMPORARY ACCESS ROAD	
PERMANENT ACCESS ROAD	
SPOIL SPACE ONLY	
PROPOSED HDD	
PROPOSED 20" PIPELINE	
PROPOSED 16" PIPELINE	
HDD ENTRY-EXIT	
PEM WETLANDS	
PSS WETLANDS	
PFO WETLANDS	

BLAIR COUNTY, PA - JUNIATA TOWNSHIP  
S2-0108-16

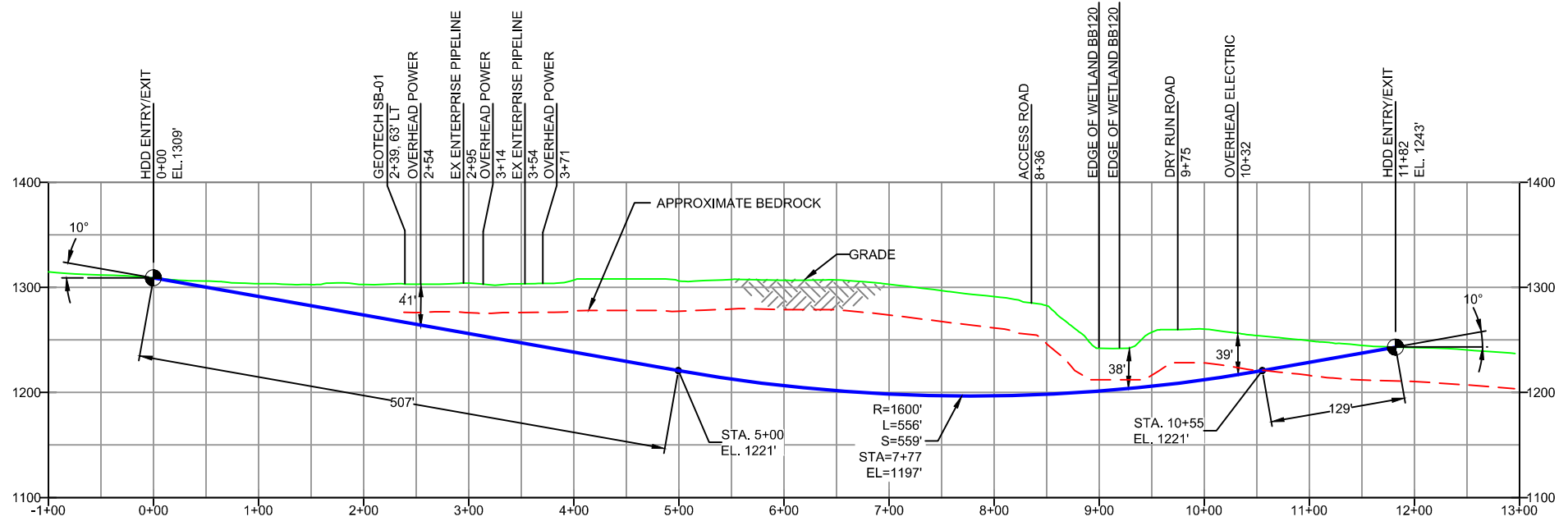
PROFILE VIEW

GEOTECH SB-01	
-NG EL. 1293'	-TOPSOIL (0' - 0.3')
-CL (0.3' - 21.0')	
-GROUNDWATER (22.0')	-SC/GC (21.0' - 30.0')
-COMPLETION DEPTH EL. 1263'	

GEOTECH SB-02	
-NG EL. 1241'	-TOPSOIL (0' - 0.3')
-SM (0.3' - 7.5')	
-SM / GM (7.5' - 19.0')	
-SHALE (19.0' - 28.0')	
-COMPLETION DEPTH EL. 1213'	

NOTE: REFER TO TEST BORING LOG S2-0108 FOR COMPLETE SOIL MATERIAL DESCRIPTION



- DESIGN AND CONSTRUCTION:
- CONTRACTOR SHALL FIELD VERIFY DEPTH OF ALL EXISTING UTILITIES SHOWN OR NOT SHOWN ON THIS DRAWING.
  - THE MINIMUM SEPARATION DISTANCE FROM EXISTING SUBSURFACE UTILITIES SHALL NOT BE LESS THAN 10 FEET AS MEASURED FROM THE OUTSIDE EDGE OF THE UTILITY TO OUTSIDE OF PROPOSED PIPELINE.
  - DESIGNED IN ACCORDANCE WITH CFR 49 195 & ASME B31.4
  - CROSSING PIPE SPECIFICATION:  
HDD HORZ. LENGTH (L-): 1182'  
HDD PIPE LENGTH (S-): 1195'  
16" x 0.438" W.T., X-70, APISL, PSL2, ERW, BFW  
COATING: 14-16 MILS FBE WITH 30-35 MIL ARO (POWERCRETE R95)
  - INTERNAL DESIGN PRESSURE 1480 PSIG (SEAM FACTOR 1.0, DESIGN FACTOR 0.50).
  - INSTALLATION METHOD: HORIZONTAL DIRECTIONAL DRILL (HDD).
  - PIPELINE WARNING MARKERS SHALL BE INSTALLED ON BOTH SIDES OF ALL ROAD, RAILWAY, AND STREAM CROSSINGS.
  - CARRIER PIPE NOT ENCASED
  - PIPE / AMBIENT TEMPERATURE MUST BE NO LESS THAN 30°F DURING PULLBACK WITHOUT PRIOR WRITTEN APPROVAL FROM THE ENGINEER
  - CONDUCT 4-HOUR PRE-INSTALLATION HYDROTEST OF HDD PIPE STRING TO MINIMUM 1850 PSIG.
  - SEE SUNOCO PENNSYLVANIA PIPELINE PROJECT ESRI WEBMAP FOR ACCESS ROAD ALIGNMENT.
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  - SUNOCO PIPELINE, L.P.'S EROSION AND SEDIMENTATION CONTROL PLAN WILL BE IMPLEMENTED AT ALL TIMES.

NOTES	
1.	ALL COORDINATES SHOWN ARE IN LATITUDE AND LONGITUDE. ALL MSL ELEVATIONS ARE NAD83
2.	STATIONING IS BASED ON HORIZONTAL DISTANCES
3.	ROONEY ENGINEERING, INC. AND SUNOCO PIPELINE, LP ARE NOT RESPONSIBLE FOR LOCATION OF FOREIGN UTILITIES SHOWN IN PLOT PLAN OR PROFILE. THE INFORMATION SHOWN HEREON IS FURNISHED WITHOUT LIABILITY ON THE PART OF ROONEY ENGINEERING, INC. AND SUNOCO PIPELINE, LP. FOR ANY DAMAGES RESULTING FROM ERRORS OR OMISSIONS THEREIN.
4.	CONTRACTOR IS RESPONSIBLE FOR LOCATING ALL UTILITIES. CONTACT ONE CALL AT 811 PRIOR TO DIGGING.
5.	SUNOCO EMERGENCY HOTLINE NUMBER IS #1-800-786-7440.

REF. DRAWING		REVISIONS	
ES-3.17	TO ES-3.18	EROSION & SEDIMENT PLAN	
SHEET 10	TO SHEET 11	AERIAL SITE PLAN	EP2 REVISED PER PADEP COMMENTS RECEIVED 09-06-16
			EP1 REVISED PER PADEP COMMENTS
			EP
			B ADDED GEOTECH INFO
			A ISSUED FOR BID
DWG NO	DWG NO	DESCRIPTION	NO. DESCRIPTION

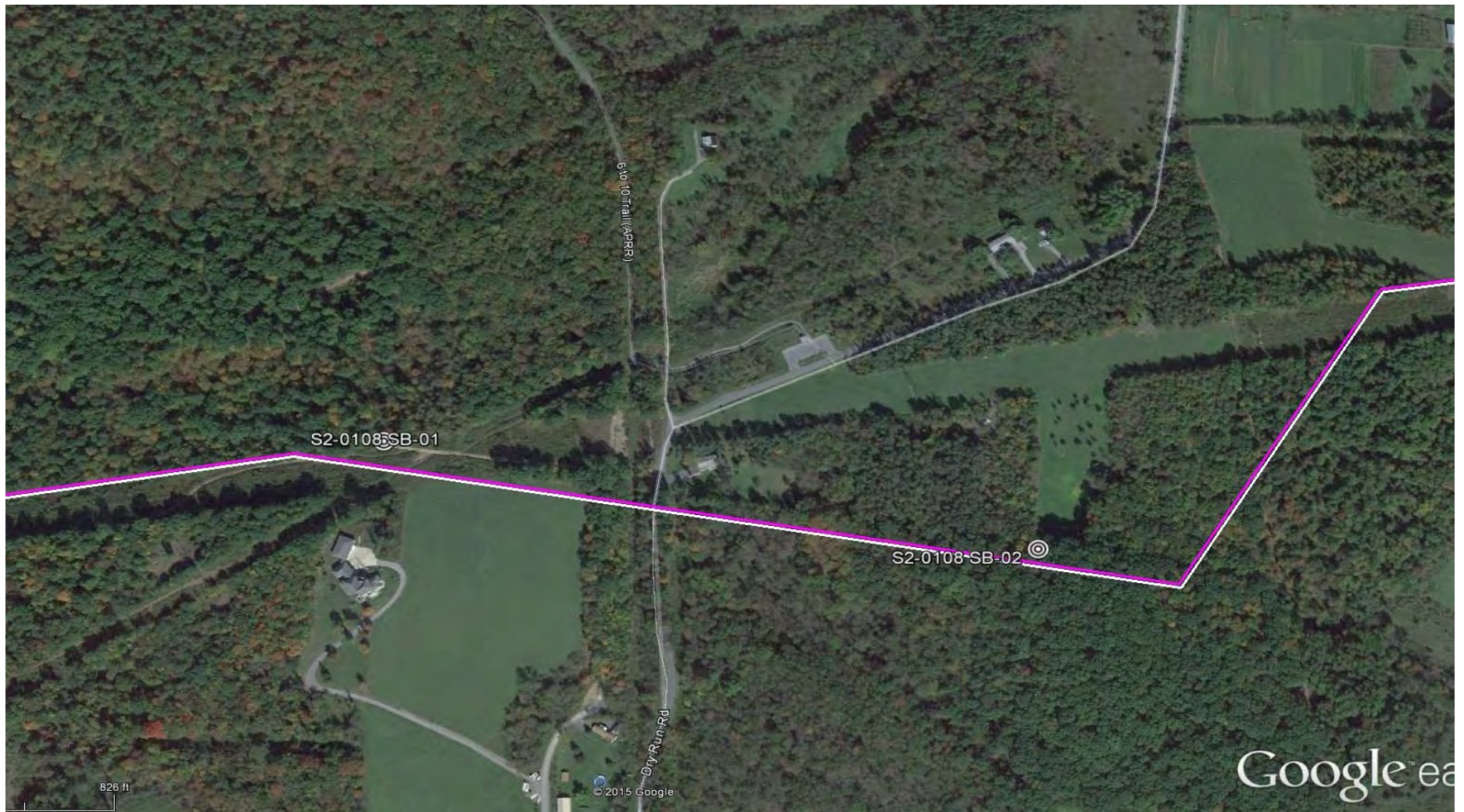
**Sunoco Logistics Partners L.P.**

**TETRA TECH ROONEY**  
(303) 792-5911

**SUNOCO PIPELINE, L.P.**

16-INCH HORIZONTAL DIRECTIONAL DRILL  
DRY RUN ROAD  
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=150' DWG. NO: PA-BL-0001.0021-RD-16



**LEGEND:**

⊙ Geotechnical Soil Boring (SB) Locations



GEOTECHNICAL BORING LOCATIONS  
HDD S2-0108  
BLAIR COUNTY, JUNIATA TOWNSHIP, PA  
SUNOCO PENNSYLVANIA PIPELINE PROJECT



**TETRA TECH**

240 Continental Drive, Suite 200  
 Newark, Delaware 19713  
 302.738.7551  
 fax: 302.454.5988

**TEST BORING LOG**

Project Name: SUNOCO PENNSYLVANIA PIPELINE PROJECT			Project No.: 103IP3406		
Project Location: DRY RUN ROAD, DUNCANSVILLE, PA			Page 1 of 1		
HDD No.: S2-0108		Dates(s) Drilled: 04-21-15		Inspector: E. WATT	
Boring No.: SB-01		Drilling Method: SPT - ASTM D1586		Driller: S. HOFFER	
Drilling Contractor: HAD DRILLING		Groundwater Depth (ft): 22.0		Total Depth (ft): 30.0	
Boring Location Coordinates:			40° 24' 26.389" N		78° 27' 52.301" W

Sample No.	Sample Depth (ft)		Strata Depth (ft)		Recov. (ft)	Strata (USCS)	Description of Materials	6" Increment Blows *				N	
	From	To	From	To									
			0.0	0.3			TOPSOIL (4")						
1	3.0	5.0	0.3		17	CL	MOTTLED BROWN AND GRAY SILTY CLAY, TRACE FINE SAND, TRACE FINE GRAVEL. (USCS: CL).	3	6	12	12	18	
2	8.0	9.8			24		GRAY AND BROWN SILTY CLAY AND FINE TO COARSE SAND, WITH SOME FINE SHALE GRAVEL.	1	22	43	50/4"	65	
3	13.0	13.9	9.5		9	CL	DECOMPOSED SHALE WEATHERED TO A SILTY CLAY AND FINE TO COARSE SAND AND GRAVEL.	3	50/5"			>50	
4	18.0	18.9			10		DECOMPOSED SHALE WEATHERED TO A SILTY CLAY AND FINE TO COARSE SAND AND GRAVEL. (USCS: CL)	15	50/5"			>50	
5	23.0	23.8	21.0		7	SC/GC	DECOMPOSED GRAY SHALE WEATHERED TO A CLAYEY FINE TO COARSE SAND AND GRAVEL.	8	50/4"			>50	
6	28.0	28.9			10		DECOMPOSED GRAY SHALE WEATHERED TO A CLAYEY FINE TO COARSE SAND AND GRAVEL.	6	50/5"			>50	
				30.0									
							AUGURED TO 30'.						
							WET ON SPOON AT 8'. NO WATER WITHIN AUGERS.						
							WATER LEVEL THROUGH AUGERS AT 22'						
							CAVED AT 29', WATER LEVEL ON CAVE AT 21'.						

Notes/Comments:  
Pocket Pentrometer Testing  
 S1: > 4 TSF

Strata (USCS) Designations are approximated based on visual review, except where indicated in Description of Materials.

\* Number of blows of 140 lb. Hammer dropped 30 in. required to drive 2 in. split-spoon sampler in 6 in. increments.  
 N: Number of blows to drive spoon from 6" to 18" interval.



**GEOTECHNICAL LABORATORY TESTING SUMMARY  
SUNOCO PENNSYLVANIA PIPELINE PROJECT  
HDD S2-0108**

HDD No.	Test Boring No.	Sample No.	Depth of Sample (ft.)		Water Content, % (ASTM D2216)	Percent Silts/Clays, % (ASTM D1140)	Atterburg Limits (ASTM D4318)			USCS Classif. (ASTM D2487)
			From	To			Liquid Limit, %	Plastic Limit, %	Plasticity Index, %	
S2-0108	SB-01	1	3.0	5.0	15.5	93.0	39	22	17	CL
		2	8.0	9.8	15.6	51.5	-	-	-	-
		3	13.0	13.9	7.5	55.4	-	-	-	-
		4	18.0	18.9	10.3	79.9	33	22	11	CL
		5	23.0	23.8	5.5	37.5	-	-	-	-
	SB-02	1	3.0	5.0	5.3	34.2	29	23	6	SM
		2	8.0	9.8	3.2	18.3	-	-	-	-
		3	13.0	13.9	5.2	16.2	-	-	-	-
		4	18.0	18.9	1.5	10.4	-	-	-	-

Notes:

- 1) Sample depths based on feet below grade at time of exploration.

**REGIONAL GEOLOGY SUMMARY  
SUNOCO PENNSYLVANIA PIPELINE PROJECT  
HDD S2-0108**

HDD No.	NAME	BORING NO.	REGIONAL GEOLOGY DESCRIPTION	GENERAL TOPOGRAPHIC SETTING	BEDROCK FORMATION	GENERAL ROCK TYPE	APPROX MAX FM THICKNESS (FT)	DEPTH TO ROCK (Ft bgs) based on nearby well drilling logs	NOTES / COMMENTS
S2-108	Glass	SB-01	<b>Brallier and Harrell Formations (undivided)</b> - composed of interbedded light-gray, graded, siliceous siltstone beds and light-gray, hard, silty shales, <u>sparsely fossiliferous</u> .	Ridge & Valley	Brallier-Harrell	Interbedded subfissile shales, f-c. thinly bedded siltstone and sandstones	up to 3,400	4-30	Turbidite (Bouma) sequence Facie Type II, sharp planar bases, undulatory cracks
		SB-02	<b>Scherr Formation</b> - composed of siltstone, shale, and some sandstone and mudstone. Similar to Brallier Fm but more coarse-grained		Scherr	Siltstone-sandstone, shale, and mudstone; light olive gray; marine fossils	1,000		Similar to Brallier Fm but more coarse-grained. Yields 2 to 10 gpm

*Note : Source of well log data - <http://www.dcnr.state.pa.us/topogeo/groundwater/pagwis/records/index.htm>. All other sources as referenced in comments section.*

**ROCK CORE DESCRIPTION SUMMARY  
SUNOCO PENNSYLVANIA PIPELINE PROJECT  
HDD S2-0108**

Location	Boring No.	Core Run	Core Depth (ft)		TCR (%)	SCR (%)	RQD (%)	Depth (ft)		Weathering	Classification	Bedding Thickness (ft)	Color	Discontinuity Data
			From	To				From	To					
S2-0108	SB-02	1	19	23	79	31	0	19	28	Moderate	Shale	Very thin beds, Massive formation	Light gray	Fractures along bedding throughout cores; approximate Avg. 15°
		2	23	28	95	58	0							

# FIELD DESCRIPTION AND LOGGING SYSTEM FOR SOIL EXPLORATION

## GRANULAR SOILS

(Sand, Gravel & Combinations)

<u>Density</u>	<u>N (blows)*</u>
Very Loose	5 or less
Loose	6 to 10
Medium Dense	11 to 30
Dense	31 to 50
Very Dense	51 or more

### Relative Proportions

<u>Description Term</u>	<u>Percent</u>
Trace	1 - 10
Little	11 - 20
Some	21 - 35
And	36 - 50

### Particle Size Identification

Boulders	8 in. diameter or more
Cobbles	3 to 8 in. diameter
Gravel	Coarse (C) 3 in. to ¾ in. sieve Fine (F) ¾ in. to No. 4 sieve
Sand	Coarse (C) No. 4 to No. 10 sieve (4.75mm-2.00mm) Medium No. 10 to No. 40 sieve (M) (2.00mm – 0.425mm) Fine (F) No. 40 to No. 200 sieve (0.425 – 0.074mm)
Silt/Clay	Less Than a No. 200 sieve (<0.074mm)

## COHESIVE SOILS

(Silt, Clay & Combinations)

<u>Consistency</u>	<u>N (blows)*</u>
Very Soft	3 or less
Soft	4 to 5
Medium Stiff	6 to 10
Stiff	11 to 15
Very Stiff	16 to 30
Hard	31 or more

### Plasticity

<u>Degree of Plasticity</u>	<u>Plasticity Index</u>
None to Slight	0 - 4
Slight	5 - 7
Medium	8 - 22
High to Very High	> 22

## ROCK

(Rock Cores)

<u>Rock Quality Designation (RQD), %</u>	<u>Rock Quality Description</u>
0-25	Very Poor
25-50	Poor
50-75	Fair
75-90	Good
90-100	Excellent

**\*N - Standard Penetration Resistance.** Driving a 2.0" O.D., 1-3/8" I.D. sampler a distance of 18 inches into undisturbed soil with a 140 pound hammer free falling a distance of 30.0 inches. The number of hammer blows to drive the sampler through each 6 inch interval is recorded; the number of blows required to drive the sampler through the final 12 inch interval is termed the Standard Penetration Resistance (SPR) N-value. For example, blow counts of 6/8/9 (through three 6-inch intervals) results in an SPR N-value of 17 (8+9).

**Groundwater** observations were made at the times indicated. Groundwater elevations fluctuate throughout a given year, depending on actual field porosity and variations in seasonal and annual precipitation.

**UNIFIED SOIL CLASSIFICATION SYSTEM [Casagrande (1948)]**

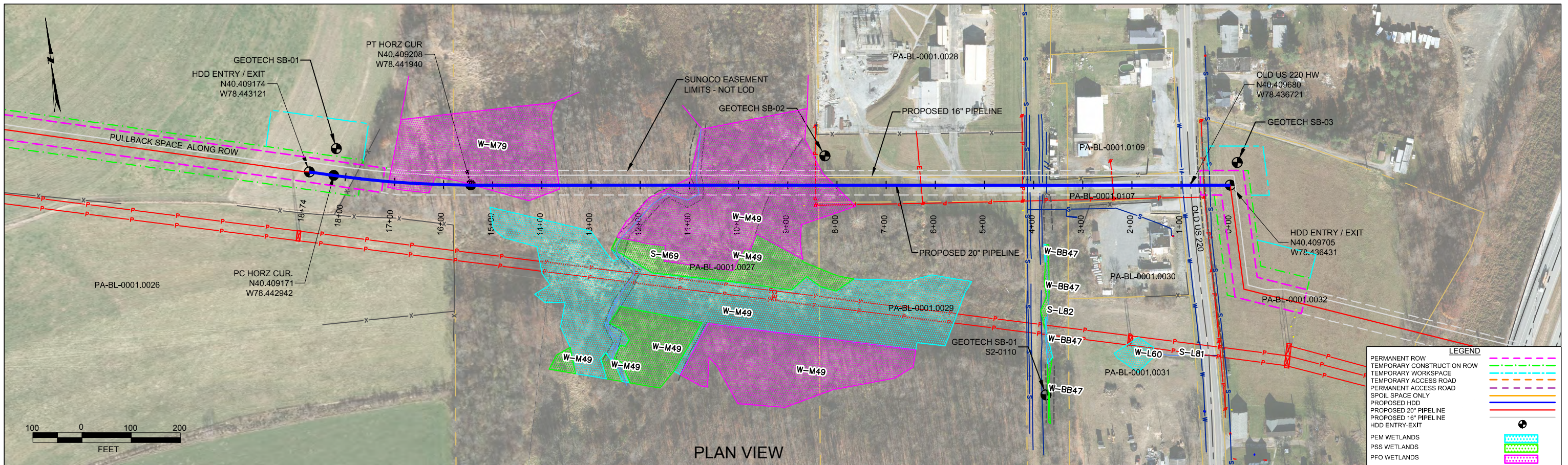
Major Divisions		Group Symbols	Typical Descriptions	Laboratory Classifications			
Coarse Grained Soils (More than half of material is larger than No. 200 sieve)	Gravels (More than half of coarse fraction is larger than No. 4 sieve size)	Clean gravel (Little or no fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4: $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3  Not meeting $C_u$ or $C_c$ requirements for GW		
			GP	Poorly graded gravels, gravel-sand mixtures, little or no fines			
		Gravel with fines (Appreciable amount of fines)	GM	Silty gravels, gravel-sand-silt mixtures	Atterberg limits below A Line or $I_p$ less than 4	Limits plotting in hatched zone with $I_p$ between 4 and 7 are borderline cases requiring use of dual symbols	
			GC	Clayey gravels, gravel-sand-clay mixtures	Atterberg limits above A line with $I_p$ greater than 7		
	Sands (More than half of coarse fraction is smaller than No. 4 Sieve)	Clean sands (Little or no fines)	SW	Well graded sands, gravelly sands, little or no fines	$C_u = \frac{D_{60}}{D_{10}}$ greater than 6: $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3  Not meeting $C_u$ or $C_c$ requirements for SW		
			SP	Poorly graded sands, gravelly sands, little or no fines			
		Sands with fines (Appreciable amount of fines)	SM	Silty sands, sand-silt mixtures	Atterberg limits below A Line or $I_p$ less than 4	Limits Plotting in hatched zone with $I_p$ between 4 and 7 are borderline cases requiring use of dual symbols	
			SC	Clayey sands, sand-clay mixtures	Atterberg limits above A line with $I_p$ greater than 7		
		Determine Percentage of sand and gravel from grain size curve. Depending on Percentage of fines (fraction smaller than No. 200 sieve), coarse-grained soils are classified as follows:  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 <sup>(1)</sup>					
		Major Divisions		Group Symbols	Typical Descriptions	For soils plotting nearly on A line use dual symbols i.e., $I_p = 29.5$ , $w_L = 60$ gives CH-MH. When $w_L$ is near 50 use CL-CH or ML-MH. Take near as $\pm 2$ percent.	
Fine-grained soils (More than half of material is smaller than No. 200 sieve)	Silt and clays (Liquid limit less than 50)	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity				
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays				
		OL	Organic silts and organic silty clays of low plasticity				
	Silt and Clays (Liquid limit greater than 50)	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts				
		CH	Inorganic clays of high plasticity, fat clays				
		OH	Organic clays of medium to high plasticity, organic silts				
	Highly organic soils	Pt	Peat and other highly organic soils				

(1) Borderline classifications, used for soils possessing characteristics of two groups, are designated by combinations of group symbols. For example: GW-GC. well-graded gravel-sand mixture with clay binder.

***HDD PA-BL-0001.0027-RD (W-M79) (S-M69) (W-M49)***

Given the design, the threat of inadvertent return has been reduced to the maximum extent practicable and in this case that threat is considered to be *low*. Implementing this design, along with adherence to the Pennsylvania Pipeline Project Inadvertent Return Contingency Plan will ensure inadvertent impacts, if they were to occur, are also minimized to the maximum extent.

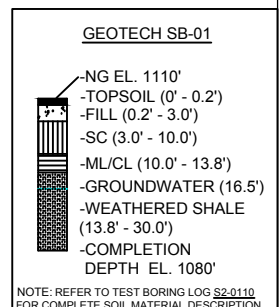
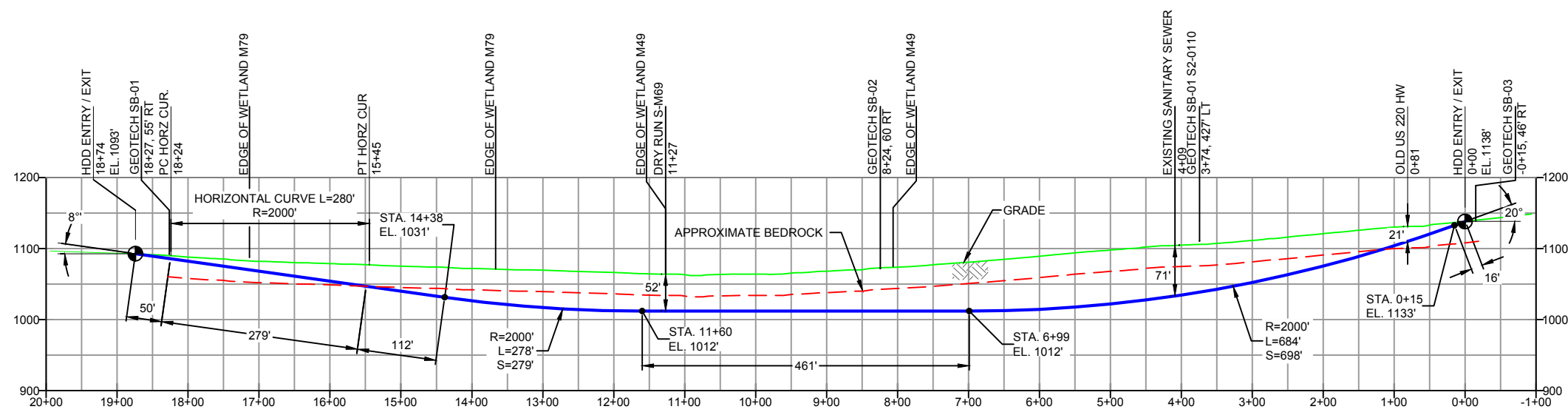
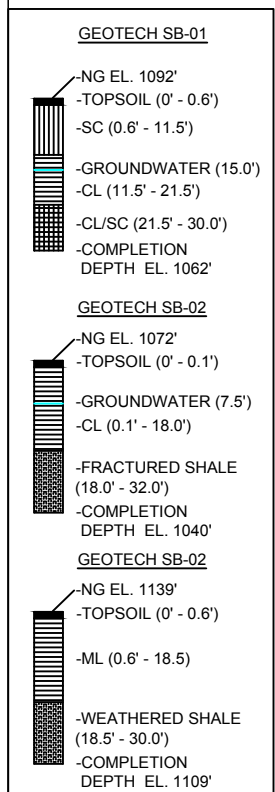
The drill will enter/exit 180 feet from the edge of the western most boundary of wetland W-M79. The drill will pass 350 feet under wetland W-M7. Using the results of the geotechnical investigation, as well as several other data points, the entry/exit, angles, and depths have been configured to pass through the best substrates while maintaining pipe integrity (e.g., no large bends). The majority of the substrate that will be passed through at this point is estimated to be fine to medium sand to clay at the western end of the wetland, soft silty clay at the central part of the wetland, and fine medium sand to clay at the eastern portion of the wetland. The drill will continue under the eastern most boundary of wetland W-M79 and will travel 230 feet to the western most edge of stream S-M69. The drill will pass beneath stream S-M69 for a total of 5 feet. The majority of the substrate that will be passed through is estimated to be soft silty clay. The drill will continue beneath stream S-M69 and will enter the western most edge of wetland W-M49. The drill will pass 320 feet under the wetland W-M49. The majority of the substrate that will be passed through is estimated to be shale. The drill will continue beneath wetland W-M49 and will enter/exit 900 feet from the eastern most edge of wetland W-M49.



PLAN VIEW

BLAIR COUNTY PENNSYLVANIA, BLAIR TOWNSHIP  
S2-0109

PROFILE VIEW



- DESIGN AND CONSTRUCTION:
- CONTRACTOR SHALL FIELD VERIFY DEPTH OF ALL EXISTING UTILITIES SHOWN OR NOT SHOWN ON THIS DRAWING.
  - THE MINIMUM SEPARATION DISTANCE FROM EXISTING SUBSURFACE UTILITIES SHALL NOT BE LESS THAN 10 FEET AS MEASURED FROM THE OUTSIDE EDGE OF THE UTILITY TO OUTSIDE OF PROPOSED PIPELINE.
  - DESIGNED IN ACCORDANCE WITH CFR 49 195 & ASME B31.4
  - CROSSING PIPE SPECIFICATION:  
HDD HORZ. LENGTH (L=): 1874'  
HDD PIPE LENGTH (S=): 1895'  
20" x 0.456" W.T., X-65, API5L, PSL2, ERW, BFW  
COATING: 14-16 MILS FBE WITH 30-35 MIL ARO (POWERCRETE R95)
  - INTERNAL DESIGN PRESSURE 1480 PSIG (SEAM FACTOR 1.0, DESIGN FACTOR 0.50).
  - INSTALLATION METHOD: HORIZONTAL DIRECTIONAL DRILL (HDD).
  - PIPELINE WARNING MARKERS SHALL BE INSTALLED ON BOTH SIDES OF ALL ROAD, RAILWAY, AND STREAM CROSSINGS.
  - CARRIER PIPE NOT ENCASED.
  - PIPE / AMBIENT TEMPERATURE MUST BE NO LESS THAN 30°F DURING PULLBACK WITHOUT PRIOR WRITTEN APPROVAL FROM THE ENGINEER.
  - CONDUCT 4-HOUR PRE-INSTALLATION HYDROTEST OF HDD PIPE STRING TO MINIMUM 1850 PSIG.
  - SEE SUNOCO PENNSYLVANIA PIPELINE PROJECT ESRI WEBMAP FOR ACCESS ROAD ALIGNMENT.
  - SUNOCO PIPELINE, L.P.'S HORIZONTAL DIRECTIONAL DRILL INADVERTENT RETURN CONTINGENCY PLAN WILL BE IMPLEMENTED AT ALL TIMES.
  - SUNOCO PIPELINE, L.P.'S EROSION AND SEDIMENTATION CONTROL PLAN WILL BE IMPLEMENTED AT ALL TIMES.

NOTE: REFER TO TEST BORING LOG S2-0109 FOR COMPLETE SOIL MATERIAL DESCRIPTION

- NOTES
- ALL COORDINATES SHOWN ARE IN LATITUDE AND LONGITUDE. ALL MSL ELEVATIONS ARE NAD83
  - STATIONING IS BASED ON HORIZONTAL DISTANCES.
  - ROONEY ENGINEERING, INC. AND SUNOCO PIPELINE, LP ARE NOT RESPONSIBLE FOR LOCATION OF FOREIGN UTILITIES SHOWN IN PLOT PLAN OR PROFILE. THE INFORMATION SHOWN HEREON IS FURNISHED WITHOUT LIABILITY ON THE PART OF ROONEY ENGINEERING, INC. AND SUNOCO PIPELINE, LP. FOR ANY DAMAGES RESULTING FROM ERRORS OR OMISSIONS THEREIN.
  - CONTRACTOR IS RESPONSIBLE FOR LOCATING ALL UTILITIES. CONTACT ONE CALL AT 811 PRIOR TO DIGGING.
  - SUNOCO EMERGENCY HOTLINE NUMBER IS #1-800-786-7440.

REF. DRAWING		REVISIONS		
ES-3.21	TO ES-3.22	EROSION & SEDIMENT PLAN	EP2 REVISED PER PADEP COMMENTS RECEIVED 09-06-16	
SHEET 13	TO SHEET 14	AERIAL SITE PLAN	EP1 REVISED PER PADEP COMMENTS	
			EP	
			C ADDED GEOTECH INFO	
			B ISSUED FOR BID	
			A ISSUED FOR REVIEW	
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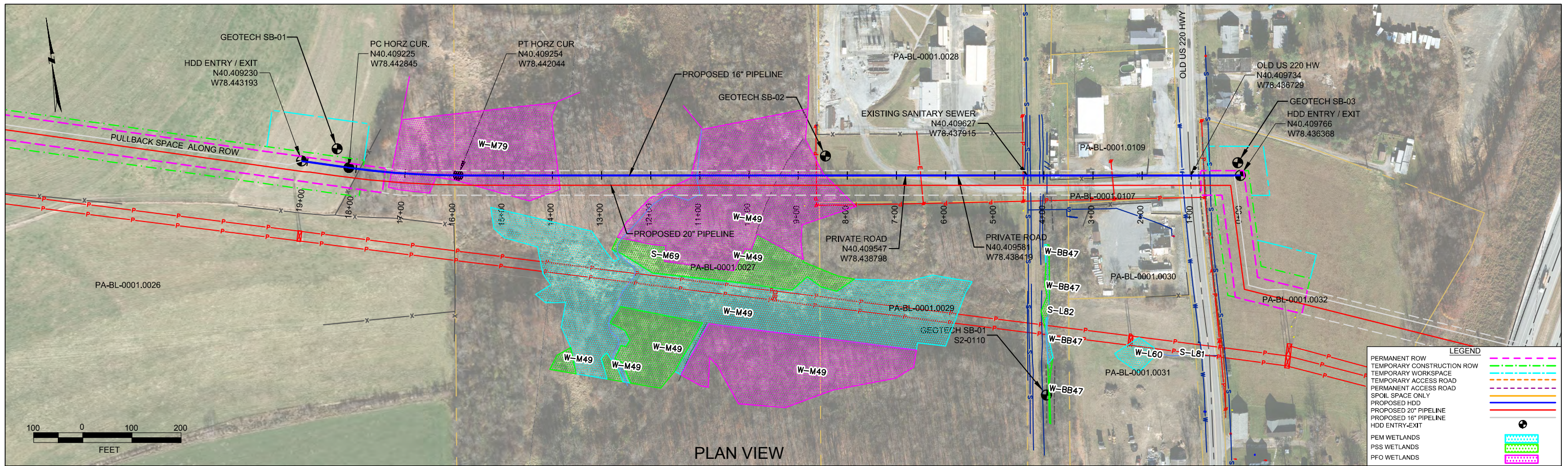
**Sunoco Logistics  
Partners L.P.**

**TETRA TECH ROONEY**  
(303) 792-5911

**SUNOCO PIPELINE, L.P.**

20-INCH HORIZONTAL DIRECTIONAL DRILL  
OLD US 220 HWY  
PENNSYLVANIA PIPELINE PROJECT

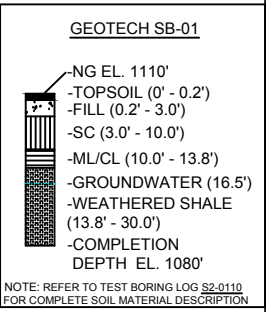
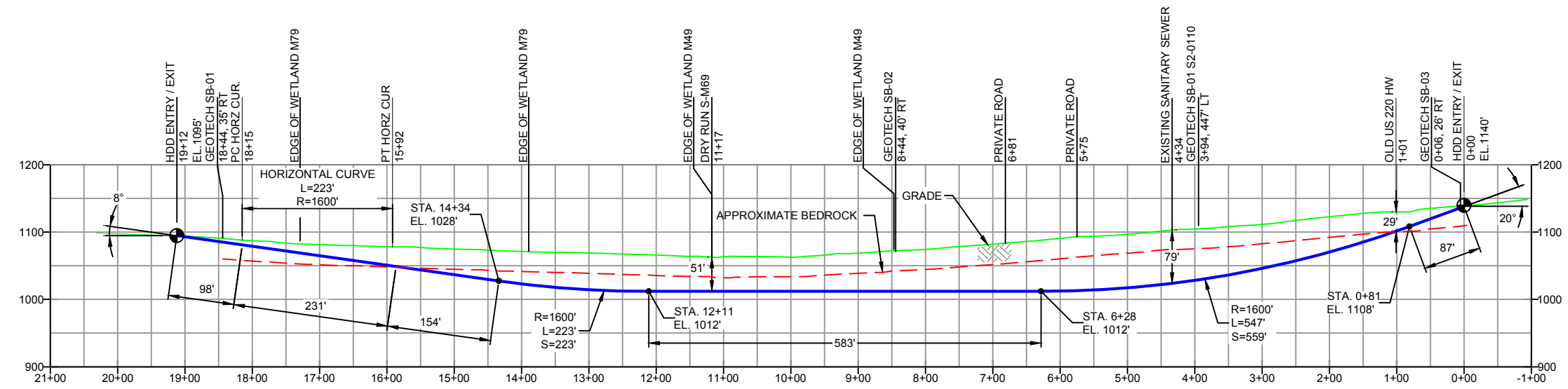
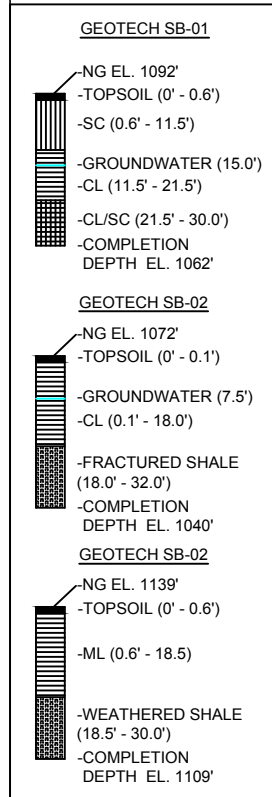
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PLAN VIEW

BLAIR COUNTY PENNSYLVANIA, BLAIR TOWNSHIP  
S2-0109-16

PROFILE VIEW



NOTE: REFER TO TEST BORING LOG S2-0109 FOR COMPLETE SOIL MATERIAL DESCRIPTION

NOTE: REFER TO TEST BORING LOG S2-0110 FOR COMPLETE SOIL MATERIAL DESCRIPTION

- DESIGN AND CONSTRUCTION:
- CONTRACTOR SHALL FIELD VERIFY DEPTH OF ALL EXISTING UTILITIES SHOWN OR NOT SHOWN ON THIS DRAWING.
  - THE MINIMUM SEPARATION DISTANCE FROM EXISTING SUBSURFACE UTILITIES SHALL NOT BE LESS THAN 10 FEET AS MEASURED FROM THE OUTSIDE EDGE OF THE UTILITY TO OUTSIDE OF PROPOSED PIPELINE.
  - DESIGNED IN ACCORDANCE WITH CFR 49 195 & ASME B31.4
  - CROSSING PIPE SPECIFICATION:  
HDD HORZ. LENGTH (L): 1912'  
HDD PIPE LENGTH (S): 1935'  
16" x 0.438" W.T., X-70, API 5L, PSL2, ERW, BFW  
COATING: 14-16 MILS FBE WITH 30-35 MIL ARO (POWERCRETE R95)
  - INTERNAL DESIGN PRESSURE 1480 PSIG (SEAM FACTOR 1.0, DESIGN FACTOR 0.50).
  - INSTALLATION METHOD: HORIZONTAL DIRECTIONAL DRILL (HDD).
  - PIPELINE WARNING MARKERS SHALL BE INSTALLED ON BOTH SIDES OF ALL ROAD, RAILWAY, AND STREAM CROSSINGS.
  - CARRIER PIPE NOT ENCASED.
  - PIPE / AMBIENT TEMPERATURE MUST BE NO LESS THAN 30°F DURING PULLBACK WITHOUT PRIOR WRITTEN APPROVAL FROM THE ENGINEER.
  - CONDUCT 4-HOUR PRE-INSTALLATION HYDROTEST OF HDD PIPE STRING TO MINIMUM 1850 PSIG.
  - SEE SUNOCO PENNSYLVANIA PIPELINE PROJECT ESRI WEBMAP FOR ACCESS ROAD ALIGNMENT.
  - SUNOCO PIPELINE, L.P.'S HORIZONTAL DIRECTIONAL DRILL INADVERTENT RETURN CONTINGENCY PLAN WILL BE IMPLEMENTED AT ALL TIMES.
  - SUNOCO PIPELINE, L.P.'S EROSION AND SEDIMENTATION CONTROL PLAN WILL BE IMPLEMENTED AT ALL TIMES.

- NOTES
- ALL COORDINATES SHOWN ARE IN LATITUDE AND LONGITUDE. ALL MSL ELEVATIONS ARE NAD83
  - STATIONING IS BASED ON HORIZONTAL DISTANCES
  - ROONEY ENGINEERING, INC. AND SUNOCO PIPELINE, LP ARE NOT RESPONSIBLE FOR LOCATION OF FOREIGN UTILITIES SHOWN IN PLOT PLAN OR PROFILE. THE INFORMATION SHOWN HEREON IS FURNISHED WITHOUT LIABILITY ON THE PART OF ROONEY ENGINEERING, INC. AND SUNOCO PIPELINE, LP. FOR ANY DAMAGES RESULTING FROM ERRORS OR OMISSIONS THEREIN.
  - CONTRACTOR IS RESPONSIBLE FOR LOCATING ALL UTILITIES. CONTACT ONE CALL AT 811 PRIOR TO DIGGING.
  - SUNOCO EMERGENCY HOTLINE NUMBER IS #1-800-786-7440.

REF. DRAWING		REVISIONS	
DWG NO	DESCRIPTION	NO.	DESCRIPTION
ES-3.21	TO ES-3.22	EP2	REVISED PER PADEP COMMENTS RECEIVED 09-06-16
SHEET 13	TO SHEET 14	EP1	REVISED PER PADEP COMMENTS
		EP	
		B	ADDED GEOTECH INFO
		A	ISSUED FOR BID

**Sunoco Logistics  
Partners L.P.**

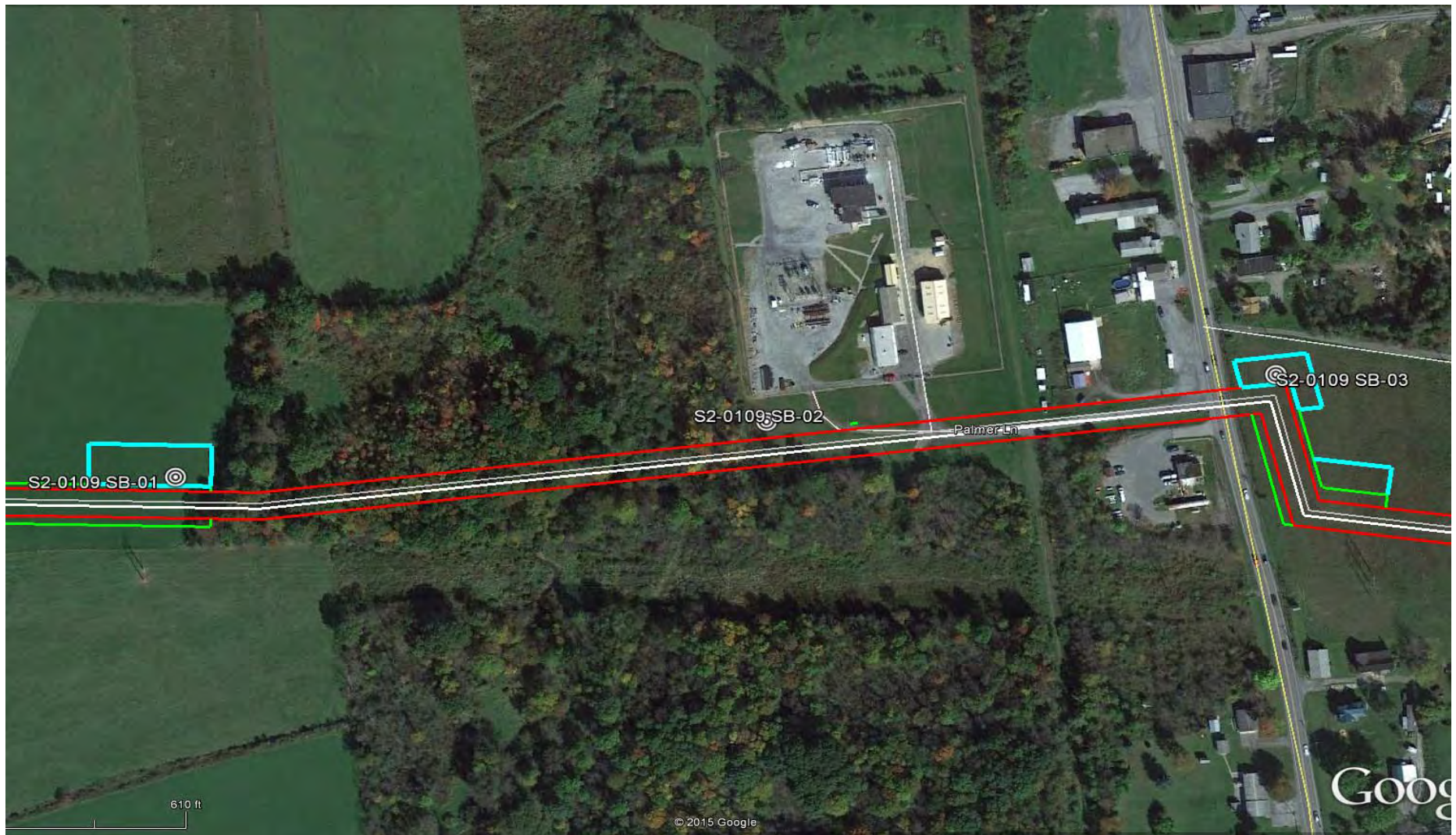
**SUNOCO PIPELINE, L.P.**

16-INCH HORIZONTAL DIRECTIONAL DRILL  
OLD US 220 HWY  
PENNSYLVANIA PIPELINE PROJECT

**TETRA TECH ROONEY**  
(303) 792-5911

SCALE: 1"=200'

DWG. NO: PA-BL-0001.0027-RD-16



**LEGEND:**

⊙ Geotechnical Soil Boring (SB) Locations



**TETRA TECH**

GEOTECHNICAL BORING LOCATIONS  
HDD S2-0109  
BLAIR COUNTY, BLAIR TOWNSHIP, PA  
SUNOCO PENNSYLVANIA PIPELINE PROJECT



**TETRA TECH**

240 Continental Drive, Suite 200  
 Newark, Delaware 19713  
 302.738.7551  
 fax: 302.454.5988

**TEST BORING LOG**

Project Name: SUNOCO PENNSYLVANIA PIPELINE PROJECT			Project No.: 103IP3406		
Project Location: MILL ROAD, DUNCANSVILLE, PA			Page 1 of 1		
HDD No.: S2-0109		Dates(s) Drilled: 09-10-15		Inspector: E. WATT	
Boring No.: SB-01		Drilling Method: SPT - ASTM D1586		Driller: M. HYNES	
Drilling Contractor: HYNES		Groundwater Depth (ft): 15.0		Total Depth (ft): 30.0	
Boring Location Coordinates:			40° 24' 33.565" N		78° 26' 34.559" W

Sample No.	Sample Depth (ft)		Strata Depth (ft)		Recov. (ft)	Strata (USCS)	Description of Materials	6" Increment Blows *				N
	From	To	From	To								
			0.0	0.6			TOPSOIL (7")					
1	3.0	5.0	0.6		14	SC	DR WEATHERED TO A BROWN AND GRAY FINE TO MEDIUM SAND AND CLAY, TRACE UNWEATHERED SHALE FRAGS.	5	5	7	7	12
2	8.0	10.0			24		DR WEATHERED TO A BROWN AND GRAY FINE TO MEDIUM SAND, WITH SOME SILTY CLAY, TRACE UNWEATHERED SHALE FRAGS.	4	7	7	8	14
				11.5		CL	DR, MOTTLED GRAY, BROWN, ORANGE BRWN. SILTY CLAY, SOFT AT 15'. (USCS: CL)					
3	13.0	15.0	11.5		20		GRAY CLAY.	4	5	6	6	11
4	18.0	20.0			15			4	5	5	6	10
				21.5		CL/SC	DR, VARIEGATED (REDDISH BRWN, YELLOWISH BRWN, GRAY) SILTY CLAY & F-SAND, WITH UNWEATHERED SHALE FRAGS. (USCS: CL/SC)					
5	23.0	25.0	21.5		14		DR, VARIEGATED (REDDISH BROWN, YELLOWISH BROWN, GRAY)	9	22	36	50	58
6	28.0	29.3		30.0	14		25	15	50/3"		>50	
							AUGER STARTED GRINDING AT 25'.					
							WET ON SPOON AT 15'.					
							WATER LEVEL THROUGH AUGERS AT 15'					
							CAVED AT 14', WATER LEVEL ON CAVE AT 14'.					

Notes/Comments:  
Pocket Pentrometer Testing  
 S2: > 4 TSF  
 S3: 1.75 TSF  
 S4: 1.5 TSF  
 DR: DECOMPOSED ROCK

Strata (USCS) Designations are approximated based on visual review, except where indicated in Description of Materials.

\* Number of blows of 140 lb. Hammer dropped 30 in. required to drive 2 in. split-spoon sampler in 6 in. increments.  
 N: Number of blows to drive spoon from 6" to 18" interval.



**TETRA TECH**

240 Continental Drive, Suite 200  
 Newark, Delaware 19713  
 302.738.7551  
 fax: 302.454.5988

**TEST BORING LOG**

Project Name: SUNOCO PENNSYLVANIA PIPELINE PROJECT			Project No.: 103IP3406		
Project Location: PALMER LAND, DUNCANSVILLE, PA			Page 1 of 1		
HDD No.: S2-0109		Dates(s) Drilled: 09-10/11-15		Inspector: E. WATT	
Boring No.: SB-02		Drilling Method: SPT - ASTM D1586		Driller: M. HYNES	
Drilling Contractor: HYNES		Groundwater Depth (ft): 7.5		Total Depth (ft): 32.0	
Boring Location Coordinates:			40° 24' 34.575" N		78° 26' 21.778" W

Sample No.	Sample Depth (ft)		Strata Depth (ft)		Recov. (in)	Strata (USCS)	Description of Materials	6" Increment Blows *				N	
	From	To	From	To									
			0.0	0.1			TOPSOIL (2")						
1	3.0	5.0	0.1		20	CL	MOTTLED (GRAY AND BROWN) SILTY CLAY AND FINE TO MEDIUM SAND, TRACR F-ROCK FRAGS.	3	3	4	6	7	
2	8.0	10.0			12		MOTTLED (BROWN AND ORANGE BROWN) SILTY CLAY AND FINE TO MEDIUM SAND, TRACT FINE SANDSTONE GRAVEL. (USCS: CL)	6	10	8	8	18	
3	13.0	15.0			23		GRAY AND DARK GRAY SILTY CLAY AND FINE TO MEDIUM SAND, TRACE FINE SANDSTONE GRAVEL.	1	1	1	1	2	
				18.0									
4	18.0	20.0	18.0	22.0	5		DARK GRAY PARTIALLY WEATHERED SHALE.	50/5"				>50	
							AUGER REFUSAL AT 22'.						
							ROCK CORING						
RUN 1	22.0	24.5	22.0		22	SHALE	DARK GRAY INTENSELY FRACTURED DARK GRAY SHALE.	TCR: 73%, SCR: 28%, RQD: 0%					
RUN 2	24.5	29.5			44		DARK GRAY INTENSELY FRACTURED CALCEROUS SHALE.	TCR: 73%, SCR: 38%, RQD: 18%					
RUN 3	29.5	32.0		32.0	30		DARK GRAY MODERATELY FRACTURED CALCEROUS SHALE.	TCR: 100%, SCR: 83%, RQD: 63%					
							WET ON SPOON AT 8'.						
							WATER LEVEL THROUGH AUGERS AT 7.5'.						
							CORE TESTING RESULTS (DEPTH 29-29.5'):						
							COMPRESSIVE STRENGTH: 3,040 PSI						
							UNIT WEIGHT: 166.6 PCF						
							CORE TESTING RESULTS (DEPTH 30-30.5'):						
							COMPRESSIVE STRENGTH: 3,430 PSI						
							UNIT WEIGHT: 179.4 PCF						

Notes/Comments:  
Pocket Pentrometer Testing  
 4': 3.5 TSF DR: DECOMPOSED ROCK

Strata (USCS) Designations are approximated based on visual review, except where indicated in Description of Materials.

\* Number of blows of 140 lb. Hammer dropped 30 in. required to drive 2 in. split-spoon sampler in 6 in. increments.  
 N: Number of blows to drive spoon from 6" to 18" interval.



**ROCK CORE DESCRIPTION SUMMARY  
SUNOCO PENNSYLVANIA PIPELINE PROJECT  
HDD S2-0109 PALMER LANE**

Location	Boring No.	Core Run	Core Depth (ft)		TCR (%)	SCR (%)	RQD (%)	Depth (ft)		Weathering	Classification	Bedding Thickness (ft)	Color	Discontinuity Data
			From	To				From	To					
S2-0109	SB-2	1	22	24.5	73	28	0	22	32	Moderate	Shale (Potential limestone)	Massive	Dark Gray	Fractures ranging from 0° to 20°, Avg. 12°
		2	24.5	29.5	73	38	17.5							
		3	29.5	32	100	83	63							

**GEOTECHNICAL LABORATORY TESTING SUMMARY  
SUNOCO PENNSYLVANIA PIPELINE PROJECT  
HDD S2-0109 PALMER LAND**

HDD No.	Test Boring No.	Sample No.	Depth of Sample (ft.)		Water	Percent	Atterburg Limits (ASTM D4318)			USCS
			From	To	Content, % (ASTM D2216)	Silts/Clays, % (ASTM D1140)	Liquid Limit, %	Plastic Limit, %	Plasticity Index, %	Classif. (ASTM D2487)
S2-0109	SB-01	1	3.0	5.0	10.2	41.5	-	-	-	-
		2	8.0	10.0	11.9	34.3	-	-	-	-
		3	13.0	15.0	24.9	98.7	36	23	13	CL
		5	23.0	25.0	16.0	51.2	33	21	12	CL/SC
		6	28.0	29.3	17.2	51.0	-	-	-	-
	SB-02	1	3.0	5.0	20.5	69.2	-	-	-	-
		2	8.0	10.0	26.5	75.2	43	25	18	CL
		3	13.0	15.0	29.4	57.5	-	-	-	-
		4	18.0	20.0	12.8	13.6	-	-	-	-
	SB-03	1	3.0	5.0	14.2	67.0	-	-	-	-
		2	8.0	10.0	14.8	63.3	33	25	18	ML
		3	13.0	15.0	13.6	79.6	35	26	9	ML
		4	18.0	20.0	13.2	60.0	-	-	-	-

Rock Core Testing Results				
Boring No.	Core Run	Approximate Depth (ft)	Compressive Strength (psi)	Unit Weight (pcf)
SB-02	2	29 - 29.5	3,040	166.6
SB-02	3	30 - 30.5	3,430	179.4

**Notes:**

- 1) Sample depths based on feet below grade at time of exploration.

**REGIONAL GEOLOGY SUMMARY  
SUNOCO PENNSYLVANIA PIPELINE PROJECT  
HDD S2-0109 PALMER LANE**

HDD No.	NAME	BORING NO.	REGIONAL GEOLOGY DESCRIPTION	GENERAL TOPOGRAPHIC SETTING	BEDROCK FORMATION	GENERAL ROCK TYPE	APPROX MAX FM THICKNESS (FT)	DEPTH TO ROCK (Ft bgs) based on nearby well drilling logs	NOTES / COMMENTS
S2-109	Palmer Lane	SB-01	<b>Hamilton Group</b> - The Mahantango Formation and the underlying Marcellus Formation make up the Hamilton Group.	Gentle slope upwards to the east, mix of farmland and woods	Mahatango (aka Hamilton Group)	Shale-siltstone, laminated, fossiliferous			
		SB-02							
		SB-03	<b>Onondaga and Old Port Formation</b> (undivided) consists of two members - the upper Selinsgrove Limestone and the lower calcereous Needmore Shale.		Onadaga-Old Port	Limestone and calcareous shale with occasional chert	100-200	4-32	

*Note : Source of well log data - <http://www.dcnr.state.pa.us/topogeo/groundwater/pagwis/records/index.htm>. All other sources as referenced in comments section.*

# FIELD DESCRIPTION AND LOGGING SYSTEM FOR SOIL EXPLORATION

## GRANULAR SOILS

(Sand, Gravel & Combinations)

<u>Density</u>	<u>N (blows)*</u>
Very Loose	5 or less
Loose	6 to 10
Medium Dense	11 to 30
Dense	31 to 50
Very Dense	51 or more

### Relative Proportions

<u>Description Term</u>	<u>Percent</u>
Trace	1 - 10
Little	11 - 20
Some	21 - 35
And	36 - 50

### Particle Size Identification

Boulders	8 in. diameter or more
Cobbles	3 to 8 in. diameter
Gravel	Coarse (C) 3 in. to ¾ in. sieve Fine (F) ¾ in. to No. 4 sieve
Sand	Coarse (C) No. 4 to No. 10 sieve (4.75mm-2.00mm) Medium No. 10 to No. 40 sieve (M) (2.00mm – 0.425mm) Fine (F) No. 40 to No. 200 sieve (0.425 – 0.074mm)
Silt/Clay	Less Than a No. 200 sieve (<0.074mm)

## COHESIVE SOILS

(Silt, Clay & Combinations)

<u>Consistency</u>	<u>N (blows)*</u>
Very Soft	3 or less
Soft	4 to 5
Medium Stiff	6 to 10
Stiff	11 to 15
Very Stiff	16 to 30
Hard	31 or more

### Plasticity

<u>Degree of Plasticity</u>	<u>Plasticity Index</u>
None to Slight	0 - 4
Slight	5 - 7
Medium	8 - 22
High to Very High	> 22

## ROCK

(Rock Cores)

<u>Rock Quality Designation (RQD), %</u>	<u>Rock Quality Description</u>
0-25	Very Poor
25-50	Poor
50-75	Fair
75-90	Good
90-100	Excellent

**\*N - Standard Penetration Resistance.** Driving a 2.0" O.D., 1-3/8" I.D. sampler a distance of 18 inches into undisturbed soil with a 140 pound hammer free falling a distance of 30.0 inches. The number of hammer blows to drive the sampler through each 6 inch interval is recorded; the number of blows required to drive the sampler through the final 12 inch interval is termed the Standard Penetration Resistance (SPR) N-value. For example, blow counts of 6/8/9 (through three 6-inch intervals) results in an SPR N-value of 17 (8+9).

**Groundwater** observations were made at the times indicated. Groundwater elevations fluctuate throughout a given year, depending on actual field porosity and variations in seasonal and annual precipitation.

**UNIFIED SOIL CLASSIFICATION SYSTEM [Casagrande (1948)]**

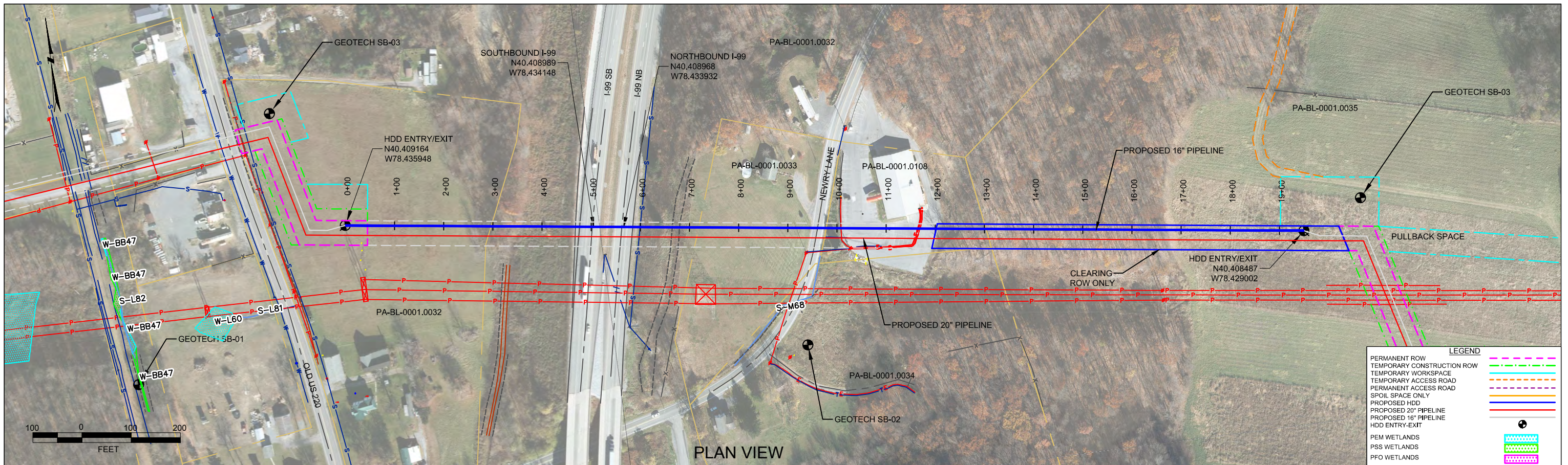
Major Divisions		Group Symbols	Typical Descriptions	Laboratory Classifications			
Coarse Grained Soils (More than half of material is larger than No. 200 sieve)	Gravels More than half of coarse fraction is larger than No. 4 sieve size	Clean gravel (Little or no fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4: $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3  Not meeting $C_u$ or $C_c$ requirements for GW		
			GP	Poorly graded gravels, gravel-sand mixtures, little or no fines			
		Gravel with fines (Appreciable amount of fines)	GM	Silty gravels, gravel-sand-silt mixtures	Atterberg limits below A Line or $I_p$ less than 4	Limits plotting in hatched zone with $I_p$ between 4 and 7 are borderline cases requiring use of dual symbols	
			GC	Clayey gravels, gravel-sand-clay mixtures	Atterberg limits above A line with $I_p$ greater than 7		
	Sands (More than half of coarse fraction is smaller than No. 4 Sieve)	Clean sands (Little or no fines)	SW	Well graded sands, gravelly sands, little or no fines	$C_u = \frac{D_{60}}{D_{10}}$ greater than 6: $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3  Not meeting $C_u$ or $C_c$ requirements for SW		
			SP	Poorly graded sands, gravelly sands, little or no fines			
		Sands with fines (Appreciable amount of fines)	SM	Silty sands, sand-silt mixtures	Atterberg limits below A Line or $I_p$ less than 4	Limits Plotting in hatched zone with $I_p$ between 4 and 7 are borderline cases requiring use of dual symbols	
			SC	Clayey sands, sand-clay mixtures	Atterberg limits above A line with $I_p$ greater than 7		
		Determine Percentage of sand and gravel from grain size curve. Depending on Percentage of fines (fraction smaller than No. 200 sieve), coarse-grained soils are classified as follows:  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 <sup>(1)</sup>					
		Major Divisions		Group Symbols	Typical Descriptions	For soils plotting nearly on A line use dual symbols i.e., $I_p = 29.5$ , $w_L = 60$ gives CH-MH. When $w_L$ is near 50 use CL-CH or ML-MH. Take near as $\pm 2$ percent.	
Fine-grained soils (More than half of material is smaller than No. 200 sieve)	Silt and clays (Liquid limit less than 50)	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity				
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays				
		OL	Organic silts and organic silty clays of low plasticity				
	Silt and Clays (Liquid limit greater than 50)	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts				
		CH	Inorganic clays of high plasticity, fat clays				
		OH	Organic clays of medium to high plasticity, organic silts				
	Highly organic soils	Pt	Peat and other highly organic soils				

(1) Borderline classifications, used for soils possessing characteristics of two groups, are designated by combinations of group symbols. For example: GW-GC. well-graded gravel-sand mixture with clay binder.

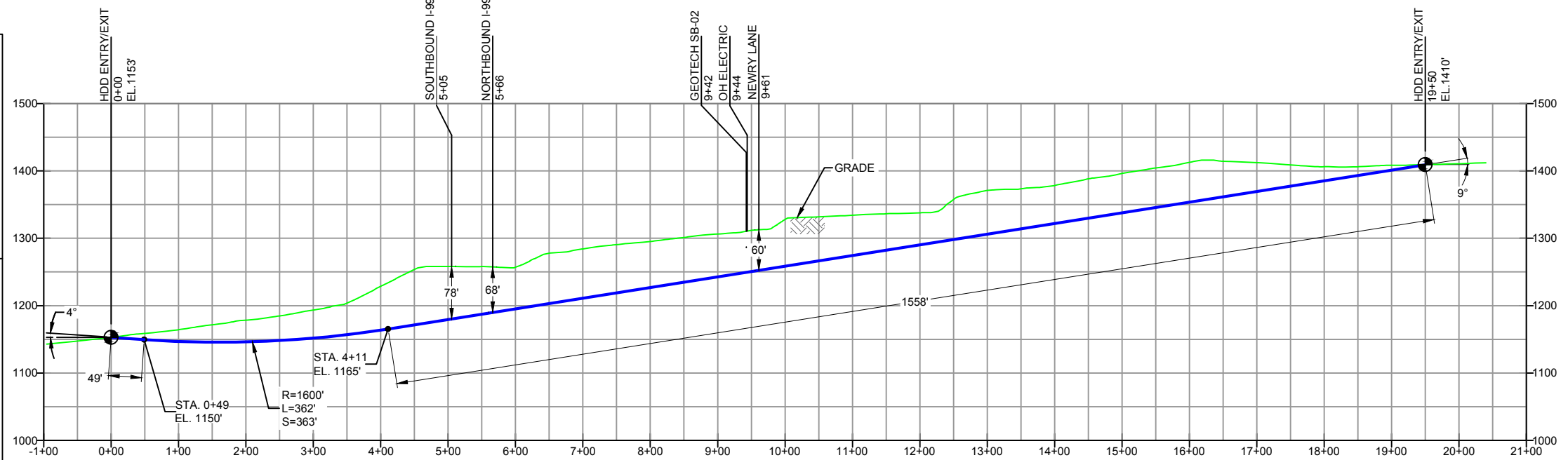
***HDD PA-BL-0001.0032-RD (S-M68)***

Given the design, the threat of inadvertent return has been reduced to the maximum extent practicable and in this case that threat is considered to be *low*. Implementing this design, along with adherence to the Pennsylvania Pipeline Project Inadvertent Return Contingency Plan will ensure inadvertent impacts, if they were to occur, are also minimized to the maximum extent.

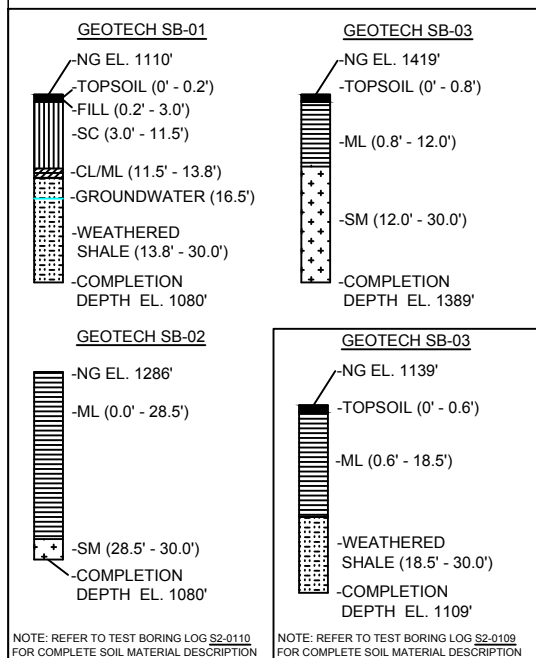
The drill will enter/exit 970 feet from the edge of the western most boundary of the stream S-M68. The drill will travel beneath stream S-M68 for 7 feet. Using the results of the geotechnical investigation, as well as several other data points, the entry/exit, angles, and depths have been configured to pass through the best substrates while maintaining pipe integrity (e.g., no large bends). The majority of the substrate that will be passed through is estimated to be sand with some fine to coarse sandstone gravel. The drill will continue beneath stream S-M68 and will enter/exit 970 feet from the eastern most edge of stream S-M68.



PROFILE VIEW



BLAIR COUNTY PENNSYLVANIA, BLAIR TOWNSHIP  
S2-0110-16



DESIGN AND CONSTRUCTION:

- CONTRACTOR SHALL FIELD VERIFY DEPTH OF ALL EXISTING UTILITIES SHOWN OR NOT SHOWN ON THIS DRAWING.
- THE MINIMUM SEPARATION DISTANCE FROM EXISTING SUBSURFACE UTILITIES SHALL NOT BE LESS THAN 10 FEET AS MEASURED FROM THE OUTSIDE EDGE OF THE UTILITY TO OUTSIDE OF PROPOSED PIPELINE.
- DESIGNED IN ACCORDANCE WITH CFR 49 195 & ASME B31.4
- CROSSING PIPE SPECIFICATION:  
HDD HORZ. LENGTH (L=): 1950'  
HDD PIPE LENGTH (S=): 1970'  
16" x 0.438" W.T., X-70, API5L, PSL2, ERW, 8FW  
COATING: 14-16 MILS FBE WITH 30-35 MIL ARO (POWERCRETE R95)
- INTERNAL DESIGN PRESSURE 1480 PSIG (SEAM FACTOR 1.0, DESIGN FACTOR 0.50).
- INSTALLATION METHOD: HORIZONTAL DIRECTIONAL DRILL (HDD).
- PIPELINE WARNING MARKERS SHALL BE INSTALLED ON BOTH SIDES OF ALL ROAD, RAILWAY, AND STREAM CROSSINGS.
- CARRIER PIPE NOT ENCASED.
- PIPE / AMBIENT TEMPERATURE MUST BE NO LESS THAN 30°F DURING PULLBACK WITHOUT PRIOR WRITTEN APPROVAL FROM THE ENGINEER.
- CONDUCT 4-HOUR PRE-INSTALLATION HYDROTEST OF HDD PIPE STRING TO MINIMUM 1850 PSIG.
- SEE SUNOCO PENNSYLVANIA PIPELINE PROJECT ESRI WEBMAP FOR ACCESS ROAD ALIGNMENT.
- SUNOCO PIPELINE, L.P.'S HORIZONTAL DIRECTIONAL DRILL INADVERTENT RETURN CONTINGENCY PLAN WILL BE IMPLEMENTED AT ALL TIMES.
- SUNOCO PIPELINE, L.P.'S EROSION AND SEDIMENTATION CONTROL PLAN WILL BE IMPLEMENTED AT ALL TIMES.

**NOTES**

- ALL COORDINATES SHOWN ARE IN LATITUDE AND LONGITUDE. ALL MSL ELEVATIONS ARE NAD83
- STATIONING IS BASED ON HORIZONTAL DISTANCES.
- ROONEY ENGINEERING, INC. AND SUNOCO PIPELINE, LP ARE NOT RESPONSIBLE FOR LOCATION OF FOREIGN UTILITIES SHOWN IN PLOT PLAN OR PROFILE. THE INFORMATION SHOWN HEREON IS FURNISHED WITHOUT LIABILITY ON THE PART OF ROONEY ENGINEERING, INC. AND SUNOCO PIPELINE, LP. FOR ANY DAMAGES RESULTING FROM ERRORS OR OMISSIONS THEREIN.
- CONTRACTOR IS RESPONSIBLE FOR LOCATING ALL UTILITIES. CONTACT ONE CALL AT 811 PRIOR TO DIGGING.
- SUNOCO EMERGENCY HOTLINE NUMBER IS #1-800-786-7440.

REF. DRAWING		EROSION & SEDIMENT PLAN		REVISIONS							
ES-3.22	TO	ES-3.23									
SHEET 14	TO	SHEET 14	AERIAL SITE PLAN	EP2	REVISED PER PADEP COMMENTS RECEIVED 09-06-16	DLM	10/07/16	RMB	10/07/16	AAW	10/07/16
				EP1	REVISED PER PADEP COMMENTS	MRS	05/09/16	RMB	05/09/16	AAW	05/09/16
				EP		MRS	02/26/16	RMB	02/26/16	AAW	02/26/16
				B	ADDED GEOTECH INFO	MRS	09/03/15	RMB	09/03/15	AAW	09/03/15
				A	ISSUED FOR BID	MRS	08/31/15	RMB	08/31/15	AAW	08/31/15
DWG NO	TO	DWG NO	DESCRIPTION	NO.	DESCRIPTION	BY	DATE	CHK	DATE	APP	DATE

**Sunoco Logistics  
Partners L.P.**

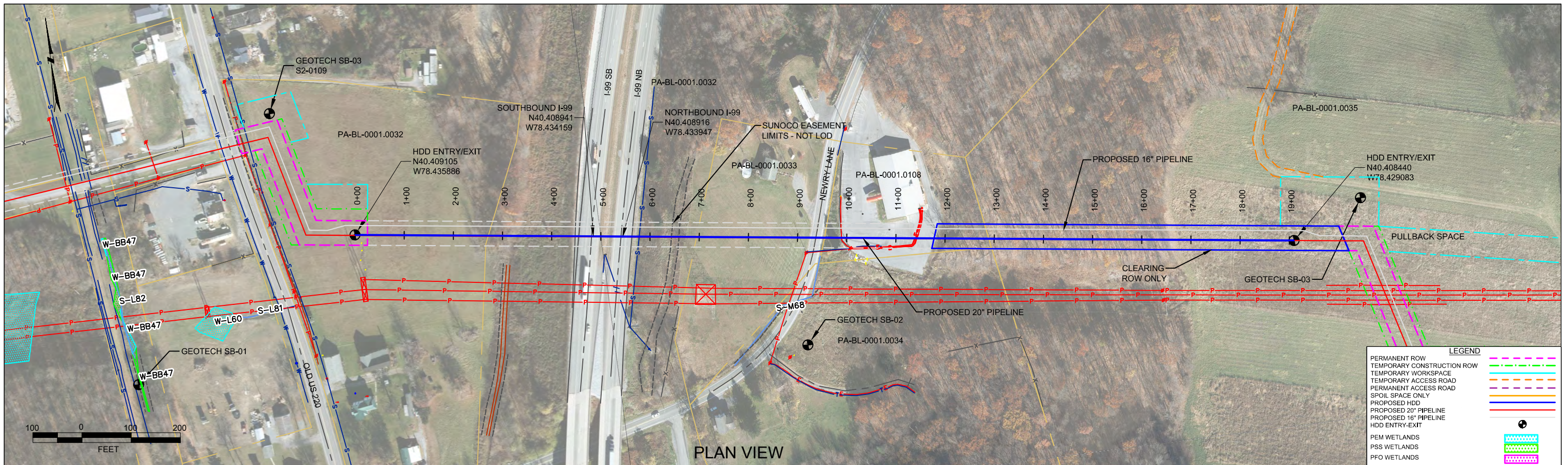
**SUNOCO PIPELINE, L.P.**

16-INCH HORIZONTAL DIRECTIONAL DRILL  
I-99  
PENNSYLVANIA PIPELINE PROJECT

**TETRA TECH ROONEY**  
(303) 792-5911

SCALE: 1"=200'

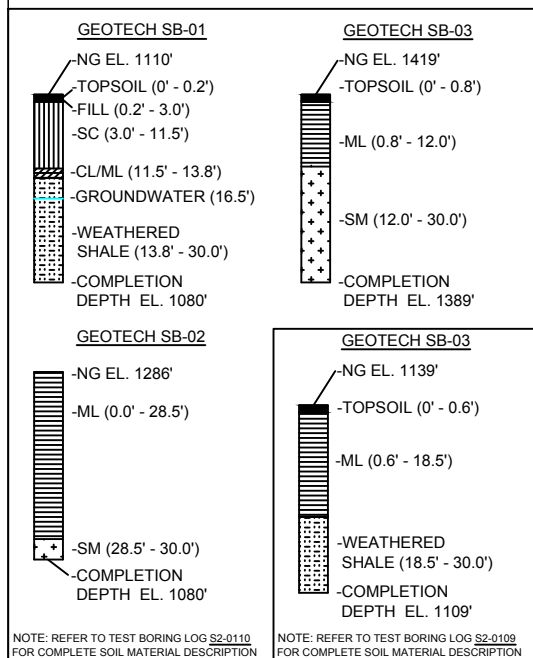
DWG. NO: PA-BL-0001.0032-RD-16



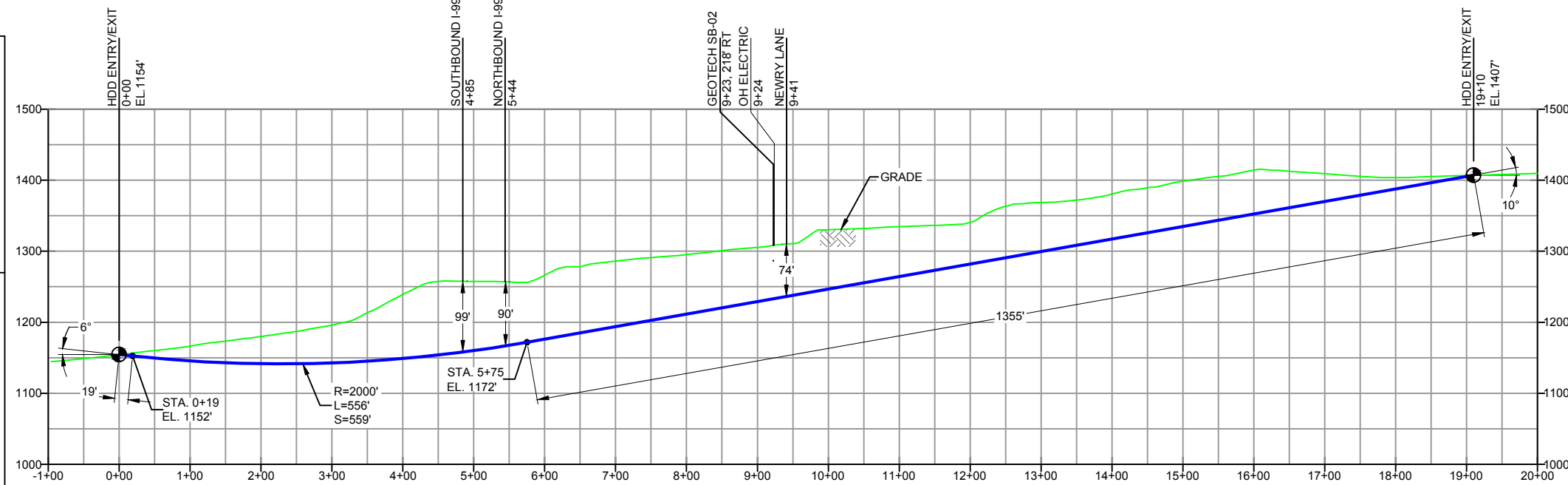
PLAN VIEW

BLAIR COUNTY PENNSYLVANIA, BLAIR TOWNSHIP  
S2-0110

PROFILE VIEW



NOTE: REFER TO TEST BORING LOG S2-0110 FOR COMPLETE SOIL MATERIAL DESCRIPTION  
NOTE: REFER TO TEST BORING LOG S2-0109 FOR COMPLETE SOIL MATERIAL DESCRIPTION



DESIGN AND CONSTRUCTION:

- CONTRACTOR SHALL FIELD VERIFY DEPTH OF ALL EXISTING UTILITIES SHOWN OR NOT SHOWN ON THIS DRAWING.
- THE MINIMUM SEPARATION DISTANCE FROM EXISTING SUBSURFACE UTILITIES SHALL NOT BE LESS THAN 10 FEET AS MEASURED FROM THE OUTSIDE EDGE OF THE UTILITY TO OUTSIDE OF PROPOSED PIPELINE.
- DESIGNED IN ACCORDANCE WITH CFR 49 195 & ASME B31.4
- CROSSING PIPE SPECIFICATION:  
HDD HORZ. LENGTH (L=): 1910'  
HDD PIPE LENGTH (S=): 1933'  
20" x 0.456" W.T., X-65, API5L, PSL2, ERW, 8FW  
COATING: 14-16 MILS FBE WITH 30-35 MIL ARO (POWERCRETE R95)
- INTERNAL DESIGN PRESSURE 1480 PSIG (SEAM FACTOR 1.0, DESIGN FACTOR 0.50).
- INSTALLATION METHOD: HORIZONTAL DIRECTIONAL DRILL (HDD).
- PIPELINE WARNING MARKERS SHALL BE INSTALLED ON BOTH SIDES OF ALL ROAD, RAILWAY, AND STREAM CROSSINGS.
- CARRIER PIPE NOT ENCASED.
- PIPE / AMBIENT TEMPERATURE MUST BE NO LESS THAN 30°F DURING PULLBACK WITHOUT PRIOR WRITTEN APPROVAL FROM THE ENGINEER.
- CONDUCT 4-HOUR PRE-INSTALLATION HYDROTEST OF HDD PIPE STRING TO MINIMUM 1850 PSIG.
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NOTES

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- CONTRACTOR IS RESPONSIBLE FOR LOCATING ALL UTILITIES. CONTACT ONE CALL AT 811 PRIOR TO DIGGING.
- SUNOCO EMERGENCY HOTLINE NUMBER IS #1-800-786-7440.

REF. DRAWING		EROSION & SEDIMENT PLAN		REVISED PER PADEP COMMENTS RECEIVED 09-06-16	
ES-3.22	TO	ES-3.23		EP2	
SHEET 14	TO	SHEET 14	AERIAL SITE PLAN	EP1	REVISED PER PADEP COMMENTS
				EP	
				C	ADDED GEOTECH INFO
				B	ISSUED FOR BID
				A	ISSUED FOR REVIEW
DWG NO	DWG NO	DESCRIPTION	NO.	DESCRIPTION	

REVISIONS					
DLM	09/30/16	RMB	09/30/16	AAW	09/30/16
MRS	05/09/16	RMB	05/09/16	AAW	05/09/16
MRS	02/26/16	RMB	02/26/16	AAW	02/26/16
MRS	09/03/15	RMB	09/03/15	AAW	09/03/15
MRS	07/31/15	RMB	07/31/15	AAW	07/31/15
JAM	03/25/15	RMB	03/25/15	AAW	03/25/15
BY	DATE	CHK	DATE	APP	DATE

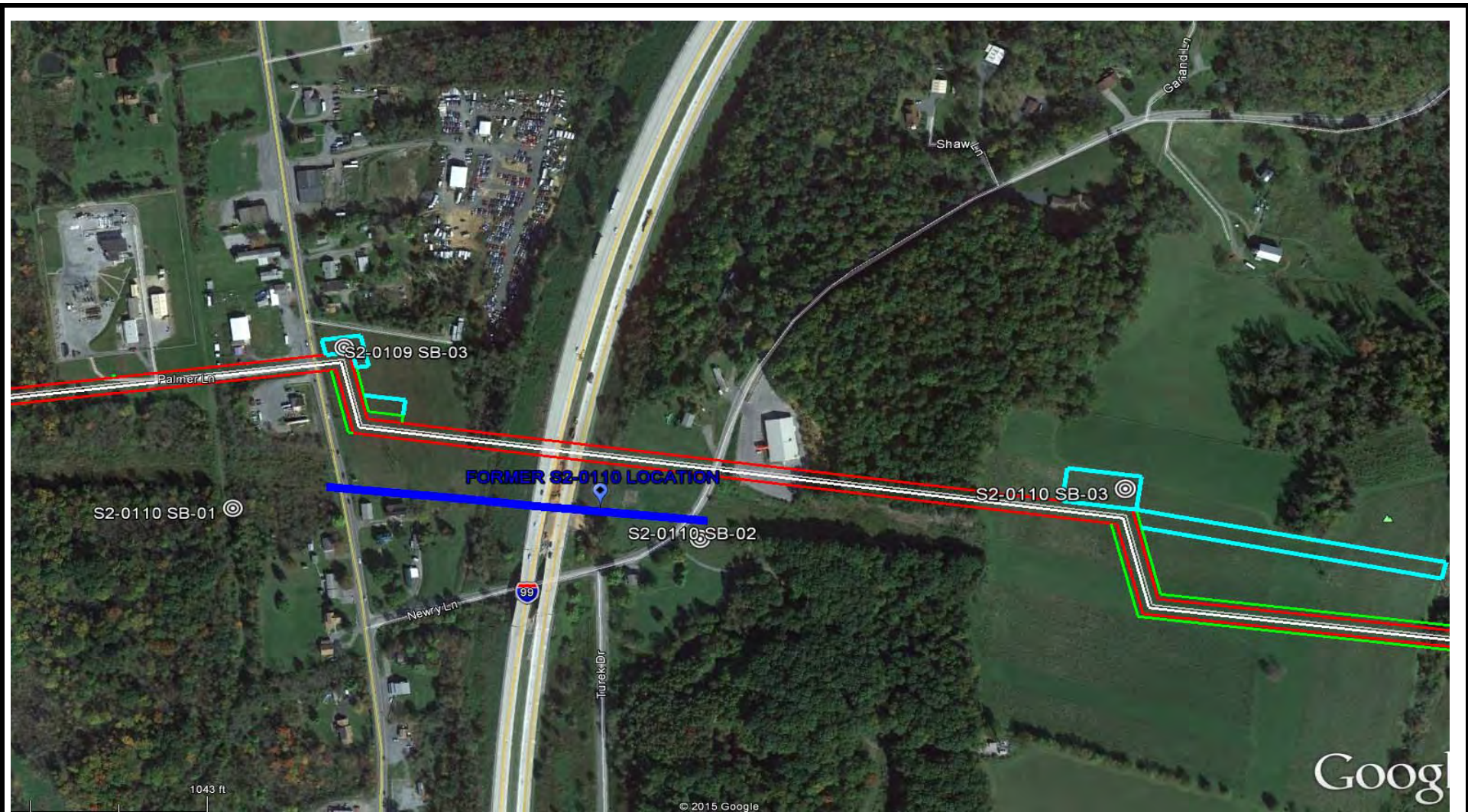
**Sunoco Logistics  
Partners L.P.**

**TETRA TECH ROONEY**  
(303) 792-5911

**SUNOCO PIPELINE, L.P.**

20-INCH HORIZONTAL DIRECTIONAL DRILL  
I-99  
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=200'    DWG. NO: PA-BL-0001.0032-RD



**LEGEND:**

⊙ Geotechnical Soil Boring (SB) Locations



GEOTECHNICAL BORING LOCATIONS  
 HDD S2-0110  
 BLAIR COUNTY, BLAIR TOWNSHIP, PA  
 SUNOCO PENNSYLVANIA PIPELINE PROJECT









**TETRA TECH**

240 Continental Drive, Suite 200  
 Newark, Delaware 19713  
 302.738.7551  
 fax: 302.454.5988

**TEST BORING LOG**

Project Name: SUNOCO PENNSYLVANIA PIPELINE PROJECT		Project No.: 103IP3406	
Project Location: NEWRY LANE, DUNCANSVILLE, PA		Page 1 of 1	
HDD No.: S2-0110	Dates(s) Drilled: 09-11-15	Inspector: E. WATT	
Boring No.: SB-03	Drilling Method: SPT - ASTM D1586	Driller: M. HYNES	
Drilling Contractor: HYNES	Groundwater Depth (ft): NOT ENCOUNTERED	Total Depth (ft): 30.0	
Boring Location Coordinates: 40° 24' 31.083" N		78° 25' 42.782" W	

Sample No.	Sample Depth (ft)		Strata Depth (ft)		Recov. (ft)	Strata (USCS)	Description of Materials	6" Increment Blows *				N	
	From	To	From	To									
			0.0	0.8			TOPSOIL (10")						
1	3.0	5.0	0.8		18	ML	BROWN TO MOTTLED LIGHT BROWN, ORANGE BROWN SILT AND FINE SAND, TRACE UNWEATHERED SANDSTONE F-GRAVEL.	4	5	4	5	9	
2	8.0	10.0			22		SAME (USCS: ML).	16	17	14	12	31	
				12.0									
3	13.0	15.0	12.0		19	SM	LIGHT BROWN, BROWN, GRAY PARTIALLY WEATHERED SANDSTONE (F-C SAND AND F-C GRAVEL), LITTLE SILT).	15	17	28	13	45	
4	18.0	20.0			21		MOTTLED (LIGHT GRAY, BROWN) FINE TO MEDIUM SAND WITH SOME SILT, WITH A LITTLE F-C SANDSTONE GRAVEL.	20	17	16	17	33	
5	23.0	25.0			24		MOTTLED (LIGHT GRAY, BROWN) FINE TO MEDIUM SAND AND SILT, WITH A LITTLE F-C SANDSTONE GRAVEL. (USCS: SM).	11	12	27	37	39	
6	28.0	29.9		30.0	10		SAME.	28	30	29	50/5"	>50	
							AUGERED TO 30'.						
							AUGER GRINDING STARTED AT 12. DIFFICULT AND SLOW DRILLING FROM THERE TO 30'.						
							CAVED AND DRY AT 17'.						

Notes/Comments:  
Pocket Pentrometer Testing DR: DECOMPOSED ROCK  
 S5: > 4 TSF  
 S2: 3.0 TSF

Strata (USCS) Designations are approximated based on visual review, except where indicated in Description of Materials.

\* Number of blows of 140 lb. Hammer dropped 30 in. required to drive 2 in. split-spoon sampler in 6 in. increments.  
 N: Number of blows to drive spoon from 6" to 18" interval.

**REGIONAL GEOLOGY SUMMARY  
SUNOCO PENNSYLVANIA PIPELINE PROJECT  
HDD S2-0110**

HDD No.	NAME	BORING NO.	REGIONAL GEOLOGY DESCRIPTION	GENERAL TOPOGRAPHIC SETTING	BEDROCK FORMATION	GENERAL ROCK TYPE	APPROX MAX FM THICKNESS (FT)	DEPTH TO ROCK (Ft bgs) based on nearby well drilling logs	NOTES / COMMENTS
S2-0110	I-99	SB-01	<b>Onondaga and Old Port Formation (undivided)</b> consists of two members - the upper Selinsgrove Limestone and the lower calcareous Needmore Shale.	Upland to mid-ridge sloping steeply upward to the east	Onondaga-Old Port	Limestone and calcareous shale with occasional chert	100-200	4-32	Yields 5-10 gpm (within 0.5-mile radius)
		SB-02							
		SB-03							

*Note : Source of well log data - <http://www.dcnr.state.pa.us/topogeo/groundwater/pagwis/records/index.htm>. All other sources as referenced in comments section.*

**GEOTECHNICAL LABORATORY TESTING SUMMARY  
SUNOCO PENNSYLVANIA PIPELINE PROJECT  
HDD S2-0110**

HDD No.	Test Boring No.	Sample No.	Depth of Sample (ft.)		Water Content, % (ASTM D2216)	Percent Silts/Clays, % (ASTM D1140)	Atterburg Limits (ASTM D4318)			USCS Classif. (ASTM D2487)
			From	To			Liquid Limit, %	Plastic Limit, %	Plasticity Index, %	
S2-0109	SB-03	1	3.0	5.0	14.2	67.0	-	-	-	-
		2	8.0	10.0	14.8	63.3	33	25	18	ML
		3	13.0	15.0	13.6	79.6	35	26	9	ML
		4	18.0	20.0	13.2	60.0	-	-	-	-
S2-0110	SB-01	1	3.0	5.0	13.8	38.2	-	-	-	-
		2	8.0	10.0	12.9	39.5	34	23	11	SC
		3	13.0	15.0	13.1	80.1	-	-	-	-
		4	18.0	20.0	16.6	88.6	35	24	11	ML/CL
		5	23.0	24.1	15.6	64.2	-	-	-	-
		6	28.0	28.8	11.1	30.0	-	-	-	-
	SB-02	1	3.0	5.0	2.2	60.4	-	-	-	-
		2	8.0	10.0	11.9	53.4	-	-	-	-
		3	13.0	15.0	31.4	74.9	46	30	16	ML
		4	18.0	20.0	31.6	68.4	-	-	-	-
		5	23.0	25.0	39.6	98.9	45	34	11	ML
		6	28.0	30.0	24.7	22.4	-	-	-	-
	SB-03	2	8.0	10.0	22.4	53.5	34	26	8	ML
		3	13.0	15.0	12.2	15.8	-	-	-	-
		4	18.0	20.0	18.4	35.6	-	-	-	-
		5	23.0	25.0	24.3	47.0	NL	NP	NV	SM
		6	28.0	29.9	21.3	40.9	-	-	-	-

Notes:

- 1) Sample depths based on feet below grade at time of exploration.

# FIELD DESCRIPTION AND LOGGING SYSTEM FOR SOIL EXPLORATION

## GRANULAR SOILS

(Sand, Gravel & Combinations)

<u>Density</u>	<u>N (blows)*</u>
Very Loose	5 or less
Loose	6 to 10
Medium Dense	11 to 30
Dense	31 to 50
Very Dense	51 or more

### Particle Size Identification

Boulders	8 in. diameter or more
Cobbles	3 to 8 in. diameter
Gravel	Coarse (C) 3 in. to ¾ in. sieve
	Fine (F) ¾ in. to No. 4 sieve
Sand	Coarse (C) No. 4 to No. 10 sieve (4.75mm-2.00mm)
	Medium (M) No. 10 to No. 40 sieve (2.00mm – 0.425mm)
	Fine (F) No. 40 to No. 200 sieve (0.425 – 0.074mm)
Silt/Clay	Less Than a No. 200 sieve (<0.074mm)

### Relative Proportions

<u>Description Term</u>	<u>Percent</u>
Trace	1 - 10
Little	11 - 20
Some	21 - 35
And	36 - 50

## COHESIVE SOILS

(Silt, Clay & Combinations)

<u>Consistency</u>	<u>N (blows)*</u>
Very Soft	3 or less
Soft	4 to 5
Medium Stiff	6 to 10
Stiff	11 to 15
Very Stiff	16 to 30
Hard	31 or more

### Plasticity

<u>Degree of Plasticity</u>	<u>Plasticity Index</u>
None to Slight	0 - 4
Slight	5 - 7
Medium	8 - 22
High to Very High	> 22

## ROCK

(Rock Cores)

<u>Rock Quality Designation (RQD), %</u>	<u>Rock Quality Description</u>
0-25	Very Poor
25-50	Poor
50-75	Fair
75-90	Good
90-100	Excellent

**\*N - Standard Penetration Resistance.** Driving a 2.0" O.D., 1-3/8" I.D. sampler a distance of 18 inches into undisturbed soil with a 140 pound hammer free falling a distance of 30.0 inches. The number of hammer blows to drive the sampler through each 6 inch interval is recorded; the number of blows required to drive the sampler through the final 12 inch interval is termed the Standard Penetration Resistance (SPR) N-value. For example, blow counts of 6/8/9 (through three 6-inch intervals) results in an SPR N-value of 17 (8+9).

**Groundwater** observations were made at the times indicated. Groundwater elevations fluctuate throughout a given year, depending on actual field porosity and variations in seasonal and annual precipitation.

**UNIFIED SOIL CLASSIFICATION SYSTEM [Casagrande (1948)]**

Major Divisions		Group Symbols	Typical Descriptions	Laboratory Classifications			
Coarse Grained Soils (More than half of material is larger than No. 200 sieve)	Gravels More than half of coarse fraction is larger than No. 4 sieve size	Clean gravel (Little or no fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3  Not meeting $C_u$ or $C_c$ requirements for GW		
			GP	Poorly graded gravels, gravel-sand mixtures, little or no fines			
		Gravel with fines (Appreciable amount of fines)	GM	Silty gravels, gravel-sand-silt mixtures	Atterberg limits below A Line or $I_p$ less than 4	Limits plotting in hatched zone with $I_p$ between 4 and 7 are borderline cases requiring use of dual symbols	
			GC	Clayey gravels, gravel-sand-clay mixtures	Atterberg limits above A line with $I_p$ greater than 7		
	Sands (More than half of coarse fraction is smaller than No. 4 Sieve)	Clean sands (Little or no fines)	SW	Well graded sands, gravelly sands, little or no fines	$C_u = \frac{D_{60}}{D_{10}}$ greater than 6; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3  Not meeting $C_u$ or $C_c$ requirements for SW		
			SP	Poorly graded sands, gravelly sands, little or no fines			
		Sands with fines (Appreciable amount of fines)	SM	Silty sands, sand-silt mixtures	Atterberg limits below A Line or $I_p$ less than 4	Limits Plotting in hatched zone with $I_p$ between 4 and 7 are borderline cases requiring use of dual symbols	
			SC	Clayey sands, sand-clay mixtures	Atterberg limits above A line with $I_p$ greater than 7		
		Determine Percentage of sand and gravel from grain size curve. Depending on Percentage of fines (fraction smaller than No. 200 sieve), coarse-grained soils are classified as follows:  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 <sup>(1)</sup>					
		Major Divisions		Group Symbols	Typical Descriptions	For soils plotting nearly on A line use dual symbols i.e., $I_p = 29.5$ , $w_L = 60$ gives CH-MH. When $w_L$ is near 50 use CL-CH or ML-MH. Take near as $\pm 2$ percent.	
Fine-grained soils (More than half of material is smaller than No. 200 sieve)	Silt and clays (Liquid limit less than 50)	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity				
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays				
		OL	Organic silts and organic silty clays of low plasticity				
	Silt and Clays (Liquid limit greater than 50)	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts				
		CH	Inorganic clays of high plasticity, fat clays				
		OH	Organic clays of medium to high plasticity, organic silts				
	Highly organic soils	Pt	Peat and other highly organic soils				

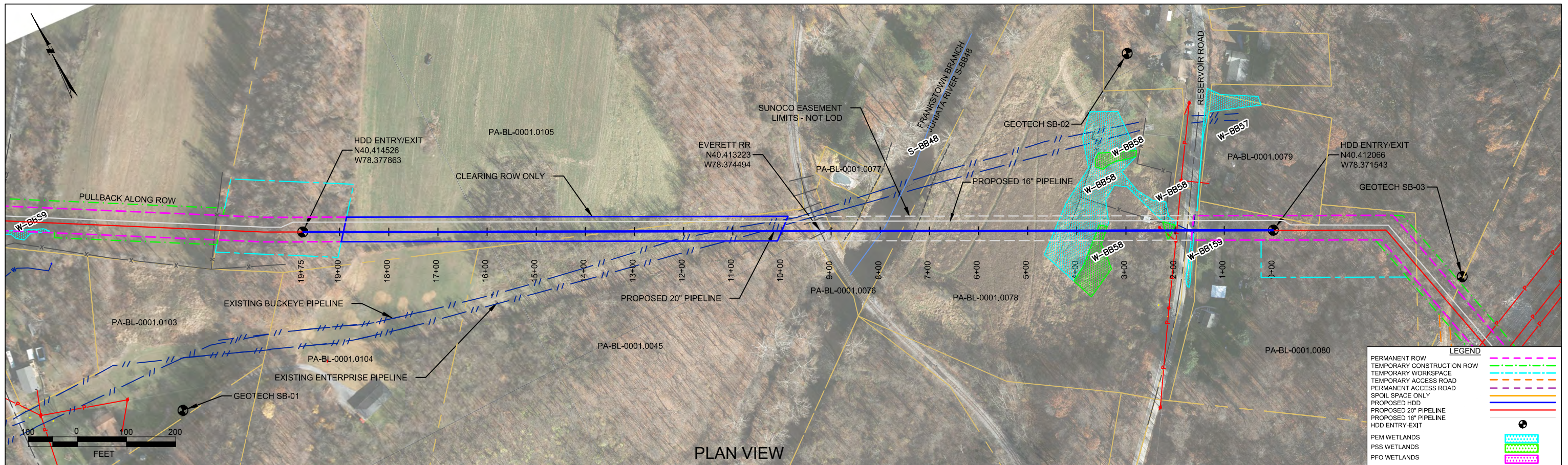
(1) Borderline classifications, used for soils possessing characteristics of two groups, are designated by combinations of group symbols. For example: GW-GC. well-graded gravel-sand mixture with clay binder.

**HDD PA-BL-0001.0048-RR (S-BB48) (W-BB58)**

Given the design, the threat of inadvertent return has been reduced to the maximum extent practicable and in this case that threat is considered to be *medium*. Implementing this design, along with adherence to the Pennsylvania Pipeline Project Inadvertent Return Contingency Plan will ensure inadvertent impacts, if they were to occur, are also minimized to the maximum extent.

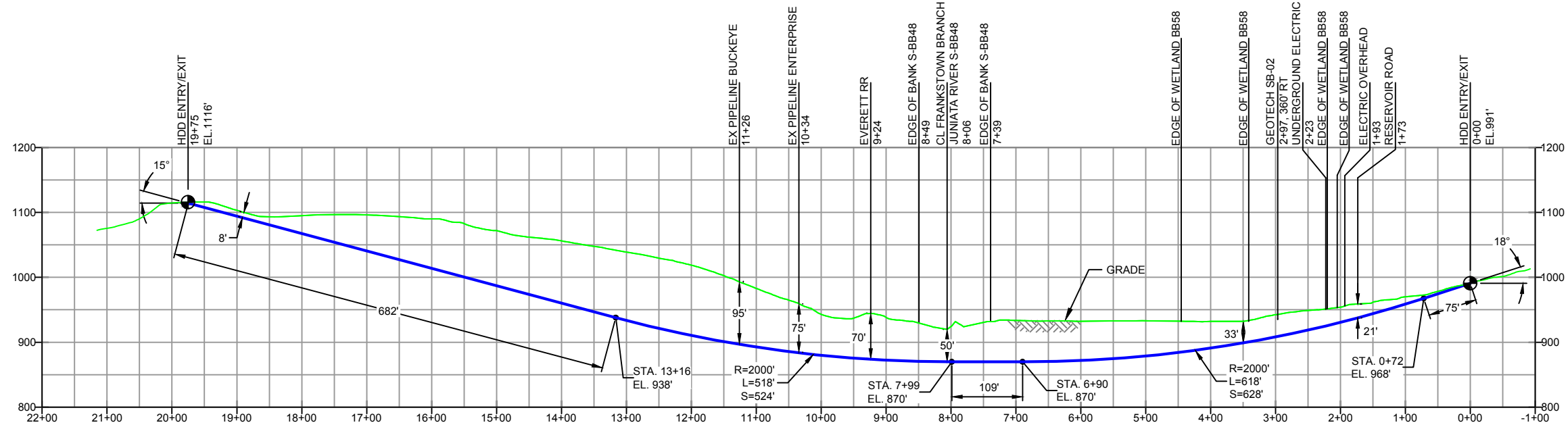
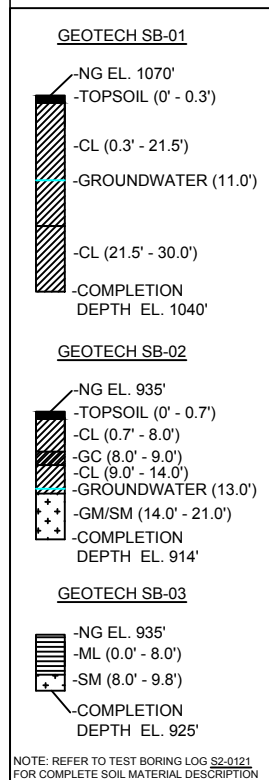
The drill will enter/exit 1155 feet from the edge of the western most boundary of the stream S-BB48. The drill will travel beneath stream S-BB48 for 120 feet. Using the results of the geotechnical investigation, as well as several other data points, the entry/exit, angles, and depths have been configured to pass through the best substrates while maintaining pipe integrity (e.g., no large bends). The majority of the substrate that will be passed through is estimated to be calcareous shale. The drill will continue beneath the eastern most boundary of the stream S-BB48 and will travel 280 feet from the eastern most edge of stream S-BB48 to the western most edge of wetland W-BB58. The drill will pass 105 feet under the wetland W-BB58 starting at the western most boundary. The majority of the substrate that will be passed through is estimated to be calcareous shale. The drill will continue beneath wetland W-BB48 and will enter/exit 350 feet from the eastern most edge of wetland W-BB48.

With the water level in the geotechnical bores at 14 feet and the drill going through calcareous shale and limestone the environmental risk for inadvertent returns is medium. As such it is recommended that additional inspection in the area surrounding the drill be in place to monitor for potential inadvertent returns along the drill.



BLAIR COUNTY, PENNSYLVANIA - BLAIR TOWNSHIP  
S2-0121

PROFILE VIEW



- DESIGN AND CONSTRUCTION:
- CONTRACTOR SHALL FIELD VERIFY DEPTH OF ALL EXISTING UTILITIES SHOWN OR NOT SHOWN ON THIS DRAWING.
  - THE MINIMUM SEPARATION DISTANCE FROM EXISTING SUBSURFACE UTILITIES SHALL NOT BE LESS THAN 10 FEET AS MEASURED FROM THE OUTSIDE EDGE OF THE UTILITY TO OUTSIDE OF PROPOSED PIPELINE.
  - DESIGNED IN ACCORDANCE WITH CFR 49 195 & ASME B31.4
  - CROSSING PIPE SPECIFICATION:  
HDD HORZ. LENGTH (L): 1975'  
HDD PIPE LENGTH (S): 2018'  
20" x 0.456" W.T., X-65, API5L, PSL2, ERW, BFW  
COATING: 14-16 MILS FBE WITH 40 MILS MIN. ARO (POWERCRETE R95)
  - INTERNAL DESIGN PRESSURE 1480 PSIG (SEAM FACTOR 1.0, DESIGN FACTOR 0.50 (HOOP STRESS)).
  - INSTALLATION METHOD: HORIZONTAL DIRECTIONAL DRILL (HDD).
  - PIPELINE WARNING MARKERS SHALL BE INSTALLED ON BOTH SIDES OF ALL ROAD, RAILWAY, AND STREAM CROSSINGS.
  - CARRIER PIPE NOT ENCASED.
  - PIPE / AMBIENT TEMPERATURE MUST BE NO LESS THAN 30°F DURING PULLBACK WITHOUT PRIOR WRITTEN APPROVAL FROM THE ENGINEER.
  - CONDUCT 4-HOUR PRE-INSTALLATION HYDROTEST OF HDD PIPE STRING TO MINIMUM 1850 PSIG.
  - PIPELINE AND CROSSING TO BE INSTALLED AND MAINTAINED IN ACCORDANCE WITH LAST APPROVED AMERICAN RAILWAY ENGINEERING AND MAINTENANCE OF WAY ASSOCIATION SPECIFICATIONS FOR PIPELINES CONVEYING FLAMMABLE AND NON-FLAMMABLE SUBSTANCES.
  - BLASTING NOT PERMITTED.
  - SEE SUNOCO PENNSYLVANIA PIPELINE PROJECT ESRI WEBMAP FOR ACCESS ROAD ALIGNMENT.

NOTES

- ALL COORDINATES SHOWN ARE IN LATITUDE AND LONGITUDE. ALL MSL ELEVATIONS ARE NAD83
- STATIONING IS BASED ON HORIZONTAL DISTANCES
- ROONEY ENGINEERING, INC. AND SUNOCO PIPELINE, LP ARE NOT RESPONSIBLE FOR LOCATION OF FOREIGN UTILITIES SHOWN IN PLOT PLAN OR PROFILE. THE INFORMATION SHOWN HEREON IS FURNISHED WITHOUT LIABILITY ON THE PART OF ROONEY ENGINEERING, INC. AND SUNOCO PIPELINE, LP. FOR ANY DAMAGES RESULTING FROM ERRORS OR OMISSIONS THEREIN.
- CONTRACTOR IS RESPONSIBLE FOR LOCATING ALL UTILITIES. CONTACT ONE CALL AT 811 PRIOR TO DIGGING.
- SUNOCO EMERGENCY HOTLINE NUMBER IS #1-800-786-7440.

REF. DRAWING	NO.	DESCRIPTION	NO.	DESCRIPTION
ES-3.32 TO ES-3.34	TO	EROSION & SEDIMENT PLAN	EP2	REVISED PER PADEP COMMENTS RECEIVED 09-06-16
SHEET 20 TO SHEET 20	TO	AERIAL SITE PLAN	EP1	REVISED PER PADEP COMMENTS
			EP	
			C	ADDED GEOTECH INFO
			B	ISSUED FOR BID
			A	ISSUED FOR REVIEW

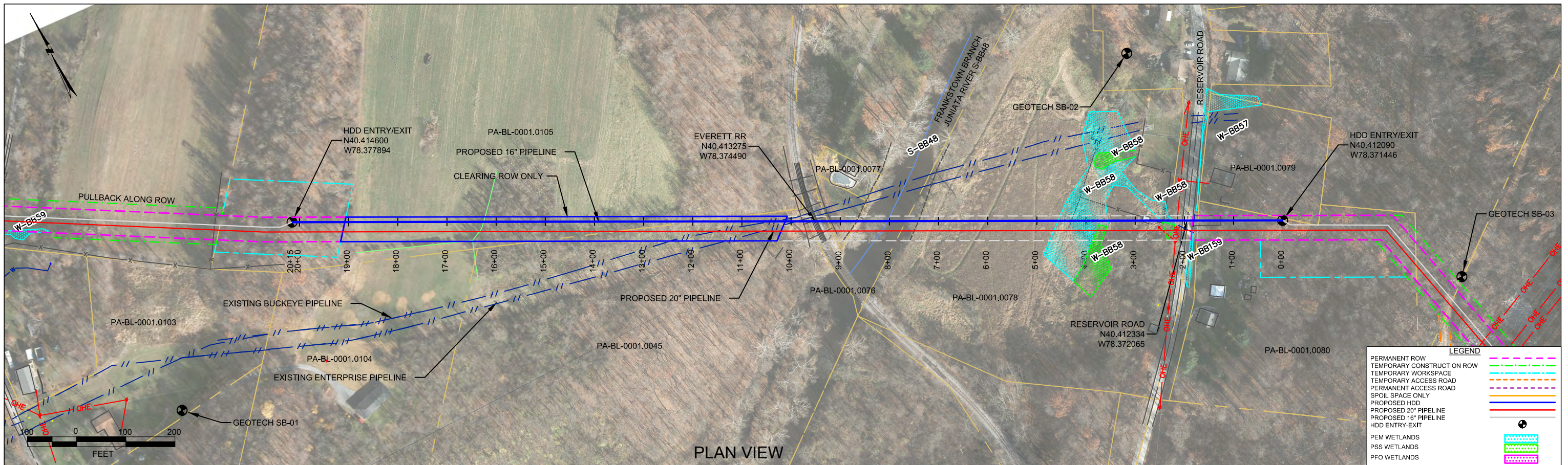
**Sunoco Logistics Partners L.P.**

**TETRA TECH ROONEY**  
(303) 792-5911

**SUNOCO PIPELINE, L.P.**

20-INCH HORIZONTAL DIRECTIONAL DRILL  
EVERETT RR/ RESERVIOR RD  
PENNSYLVANIA PIPELINE PROJECT

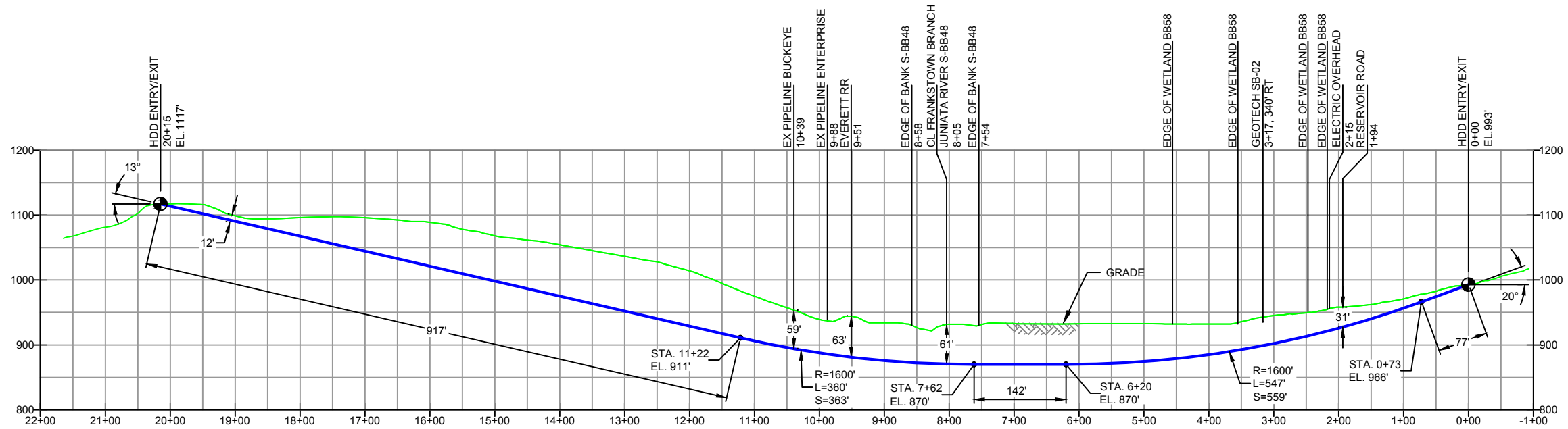
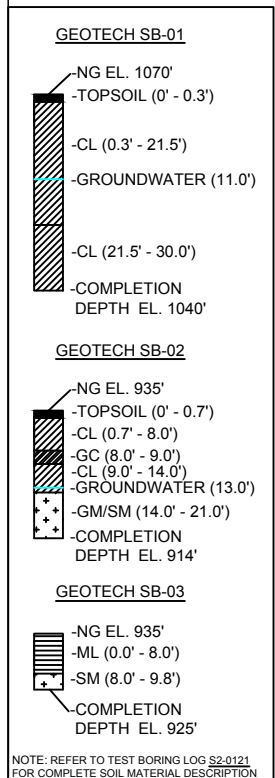
SCALE: 1"=200' DWG. NO. PA-BL-0001.0048-RR



PLAN VIEW

BLAIR COUNTY, PENNSYLVANIA - BLAIR TOWNSHIP  
S2-0121-16

PROFILE VIEW



DESIGN AND CONSTRUCTION:

- CONTRACTOR SHALL FIELD VERIFY DEPTH OF ALL EXISTING UTILITIES SHOWN OR NOT SHOWN ON THIS DRAWING.
- THE MINIMUM SEPARATION DISTANCE FROM EXISTING SUBSURFACE UTILITIES SHALL NOT BE LESS THAN 10 FEET AS MEASURED FROM THE OUTSIDE EDGE OF THE UTILITY TO OUTSIDE OF PROPOSED PIPELINE.
- DESIGNED IN ACCORDANCE WITH CFR 49 195 & ASME B31.4
- CROSSING PIPE SPECIFICATION:  
HDD HORZ. LENGTH (L=): 2015'  
HDD PIPE LENGTH (S=): 2058'  
16" x 0.438" W.T., X-70, API5L, PSL2, ERW, BFW  
COATING: 14-16 MILS FBE WITH 40 MILS MIN. ARO (POWERCRETE R95)
- INTERNAL DESIGN PRESSURE 1480 PSIG (SEAM FACTOR 1.0, DESIGN FACTOR 0.50 (HOOP STRESS)).
- INSTALLATION METHOD: HORIZONTAL DIRECTIONAL DRILL (HDD).
- PIPELINE WARNING MARKERS SHALL BE INSTALLED ON BOTH SIDES OF ALL ROAD, RAILWAY, AND STREAM CROSSINGS.
- CARRIER PIPE NOT ENCASED.
- PIPE / AMBIENT TEMPERATURE MUST BE NO LESS THAN 30°F DURING PULLBACK WITHOUT PRIOR WRITTEN APPROVAL FROM THE ENGINEER.
- CONDUCT 4-HOUR PRE-INSTALLATION HYDROTEST OF HDD PIPE STRING TO MINIMUM 1850 PSIG.
- PIPELINE AND CROSSING TO BE INSTALLED AND MAINTAINED IN ACCORDANCE WITH LAST APPROVED AMERICAN RAILWAY ENGINEERING AND MAINTENANCE OF WAY ASSOCIATION SPECIFICATIONS FOR PIPELINES CONVEYING FLAMMABLE AND NON-FLAMMABLE SUBSTANCES.
- BLASTING NOT PERMITTED.
- SEE SUNOCO PENNSYLVANIA PIPELINE PROJECT ESRI WEBMAP FOR ACCESS ROAD ALIGNMENT.

NOTES

- ALL COORDINATES SHOWN ARE IN LATITUDE AND LONGITUDE. ALL MSL ELEVATIONS ARE NAD83
- STATIONING IS BASED ON HORIZONTAL DISTANCES.
- ROONEY ENGINEERING, INC. AND SUNOCO PIPELINE, LP ARE NOT RESPONSIBLE FOR LOCATION OF FOREIGN UTILITIES SHOWN IN PLOT PLAN OR PROFILE. THE INFORMATION SHOWN HEREON IS FURNISHED WITHOUT LIABILITY ON THE PART OF ROONEY ENGINEERING, INC. AND SUNOCO PIPELINE, LP. FOR ANY DAMAGES RESULTING FROM ERRORS OR OMISSIONS THEREIN.
- CONTRACTOR IS RESPONSIBLE FOR LOCATING ALL UTILITIES. CONTACT ONE CALL AT 811 PRIOR TO DIGGING.
- SUNOCO EMERGENCY HOTLINE NUMBER IS #1-800-786-7440.

REF. DRAWING

ES-3.32	TO	ES-3.34	EROSION & SEDIMENT PLAN
SHEET 20	TO	SHEET 20	AERIAL SITE PLAN

REVISIONS

NO.	DESCRIPTION	BY	DATE	CHK	DATE	APP	DATE
EP2	REVISED PER PADEP COMMENTS RECEIVED 09-06-16	DLM	10/07/16	RMB	10/07/16	AAW	10/07/16
EP1	REVISED PER PADEP COMMENTS	MRS	05/18/16	RMB	05/18/16	AAW	05/18/16
EP		MRS	11/13/15	RMB	11/13/15	AAW	11/13/15
B	ADDED GEOTECH INFO	MRS	09/03/15	RMB	09/03/15	AAW	09/03/15
A	ISSUED FOR BID	MRS	08/14/15	RMB	08/14/15	AAW	08/14/15

**Sunoco Logistics Partners L.P.**

**TETRA TECH ROONEY**  
(303) 792-5911

SUNOCO PIPELINE, L.P.

16-INCH HORIZONTAL DIRECTIONAL DRILL  
EVERETT RR/ RESERVIOR RD  
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=200' DWG. NO: PA-BL-0001.0048-RR-16



**LEGEND:**

⊙ Geotechnical Soil Boring (SB) Locations



**TETRA TECH**

GEOTECHNICAL BORING LOCATIONS

HDD S2-0121

BLAIR COUNTY, BLAIR TOWNSHIP, PA

SUNOCO PENNSYLVANIA PIPELINE PROJECT





**TETRA TECH**

240 Continental Drive, Suite 200  
 Newark, Delaware 19713  
 302.738.7551  
 fax: 302.454.5988

**TEST BORING LOG**

Project Name: SUNOCO PENNSYLVANIA PIPELINE PROJECT			Project No.: 103IP3406		
Project Location: RESERVOIR ROAD, HOLLIDAYSBURG, PA			Page 1 of 1		
HDD No.: S2-0121		Dates(s) Drilled: 04-22-15		Inspector: E. WATT	
Boring No.: SB-02		Drilling Method: SPT - ASTM D1586		Driller: S. HOFFER	
Drilling Contractor: HAD DRILLING		Groundwater Depth (ft): 13.0		Total Depth (ft): 21.0	
Boring Location Coordinates:			40° 24' 47.940" N		78° 22' 18.857" W

Sample No.	Sample Depth (ft)		Strata Depth (ft)		Recov. (ft)	Strata (USCS)	Description of Materials	6" Increment Blows *				N	
	From	To	From	To									
			0.0	0.7			TOPSOIL (8")						
1	3.0	5.0	0.7		19	CL	MOTTLED (REDDISH BROWN, BROWN, GRAY) SILTY CLAY WITH SOME FINE SAND.	1	5	5	10	10	
			8.0	9.0		GC	CLAYEY GRAVEL LENSE (ANGULAR QUARTZ, FINE TO COARSE)						
2	8.0	10.0	9.0		10	CL	MOTTLED BROWN AND GRAY SILTY CLAY WITH SOME FINE SAND, TRACE TO LITTLE FINE TO COARSE GRAVEL. (USCS: CL)	22	22	10	12	32	
			14.0										
3	13.0	14.7	14.0		17	GM/SM	DARK GRAY DECOMPOSED LIMESTONE, WEATHERED TO A F-C GRAVEL, SOME F-M SAND, SOME SILT.	8	9	40	50/2"	49	
4	18.0	18.5			4	GM/SM	DARK GRAY DECOMPOSED LIMESTONE, WEATHERED TO A F-C GRAVEL, SOME F-M SAND, SOME SILT.	50/6"				>50	
			21.0										
							AUGER REFUSAL AT 21'.						
							WET ON SPOON AT 14'						
							WATER LEVEL THROUGH AUGERS AT 13'						
							CAVED AT 14', WATER LEVEL ON CAVE AT 9'.						

Notes/Comments:  
Pocket Pentrometer Testing  
 4': 3.5 TSF  
 9': > 4 TSF

Strata (USCS) Designations are approximated based on visual review, except where indicated in Description of Materials.

\* Number of blows of 140 lb. Hammer dropped 30 in. required to drive 2 in. split-spoon sampler in 6 in. increments.  
 N: Number of blows to drive spoon from 6" to 18" interval.



**TETRA TECH**

240 Continental Drive, Suite 200  
 Newark, Delaware 19713  
 302.738.7551  
 fax: 302.454.5988

**TEST BORING LOG**

Project Name: SUNOCO PENNSYLVANIA PIPELINE PROJECT			Project No.: 103IP3406		
Project Location: RESERVOIR ROAD, HOLLIDAYSBURG, PA			Page 1 of 1		
HDD No.: S2-0121		Dates(s) Drilled: 09-12-15		Inspector: E. WATT	
Boring No.: SB-03		Drilling Method: SPT - ASTM D1586		Driller: M.HYNES	
Drilling Contractor: HYNES		Groundwater Depth (ft): NOT ENCOUNTERED		Total Depth (ft): 9.8	
Boring Location Coordinates:			40° 24' 40.873" N		78° 22' 13.688" W

Sample No.	Sample Depth (ft)		Strata Depth (ft)		Recov. (in)	Strata (USCS)	Description of Materials	6" Increment Blows *				N	
	From	To	From	To									
							NO TOPSOIL						
1	3.0	5.0	0.0		9	ML	FILL: MATRIX OF SILT, FINE TO MEDIUM SAND, FINE TO COARSE GRAVEL. (USCS: ML).	6	3	3	8	6	
2	8.0	9.8		9.8	14	SM	ORANGE BROWN, LIGHT BROWN, AND LIGHT GRAY FINE TO MEDIUM SAND AND SILT, WITH A LITTLE F-C GRAVEL. (POTENTIAL FILL).	8	12	23	50/3"	35	
							AUGER REFUSAL AT 10'.						
							FIVE ATTEMPTS WERE MADE TO DRILL THROUGH FILL ZONE WITH NO SUCCESS (ATTEMPTS WERE MADE ALONG EDGE OF ACCESS ROAD). DEEPEST AT THESE ATTEMPTS WAS 3' BEFORE HITTING REFUSAL. DECISION BY TT/REI WAS TO ABANDON THIS LOCATION.						

Notes/Comments:  
Pocket Pentrometer Testing

Strata (USCS) Designations are approximated based on visual review, except where indicated in Description of Materials.

\* Number of blows of 140 lb. Hammer dropped 30 in. required to drive 2 in. split-spoon sampler in 6 in. increments.  
 N: Number of blows to drive spoon from 6" to 18" interval.



**REGIONAL GEOLOGY SUMMARY  
SUNOCO PENNSYLVANIA PIPELINE PROJECT  
HDD S2-0121**

HDD No.	NAME	BORING NO.	REGIONAL GEOLOGY DESCRIPTION	GENERAL TOPOGRAPHIC SETTING	BEDROCK FORMATION	GENERAL ROCK TYPE	APPROX MAX FM THICKNESS (FT)	DEPTH TO ROCK (Ft bgs) based on nearby well drilling logs	NOTES / COMMENTS
S2-0120		SB-02	<b>Keyser/Tonoloway Fm</b> -dark-gray, highly fossiliferous, crystalline to nodular limestone with shaly limestone near its top. <b>Wills Creek Fm</b> -variegated gray, grayish-red, yellowish-gray and greenish-gray calcareous shale with interbedded limestone, dolomite, and sandstone zones	Upland to mid-ridge	Keyser / Tonoloway Fm- Wills Creek Fm	Shale - calcareous shale-siltston-limestone-dolomite (Tonoloway) to Claystone-silty claystone-argillaceous limestone (Wills)	400	3-13	
S2-0121	Reservoir Road	SB-01	<b>Onondaga and Old Port Formation</b> (undivided) consists of two members - the upper Selinsgrove Limestone and the lower calcerous Needmore Shale.	Ridge & Valley	Onondaga-Old Port	Limestone and calcareous shale with occasional chert	100-200	4-32	
		SB-02	<b>Wills Creek Fm</b> -variegated gray, grayish-red, yellowish-gray and greenish-gray calcareous shale with interbedded limestone, dolomite, and sandstone zones		Wills Creek Fm	Calcareous shale	445-620	12-28	
		SB-03	<b>Clinton Group</b> -contains the Keefer and Rose Hill Formations. The <u>Keefer Formation</u> is a light-gray to yellowish-brown, very fine to coarse-grained, fossiliferous, siliceous sandstone that is locally hematitic or conglomeratic. It is well bedded with beds thin to thick and crossbedded. It is about 24 to 55 feet thick. The <u>Rose Hill Formation</u> is a light-olive-gray shale, with some siltstone and two grayish-red to reddish-black sandstone units. The upper shale contains interbedded limestone.		Clinton Group (Keefer and Rose Hill Fms)	sandstone to siltstone (Keefer) to shale with siltston (Rose Hill)	890	12-28	

*Note* : Source of well log data - <http://www.dcnr.state.pa.us/topogeo/groundwater/pagwis/records/index.htm>. All other sources as referenced in comments section.

**GEOTECHNICAL LABORATORY TESTING SUMMARY  
SUNOCO PENNSYLVANIA PIPELINE PROJECT  
HDD S2-0121**

HDD No.	Test Boring No.	Sample No.	Depth of Sample (ft.)		Water Content, % (ASTM D2216)	Percent Silts/Clays, % (ASTM D1140)	Atterburg Limits (ASTM D4318)			USCS Classif. (ASTM D2487)
			From	To			Liquid Limit, %	Plastic Limit, %	Plasticity Index, %	
S2-0120	SB-02	1	3.0	5.0	6.5	17.0	-	-	-	-
		3	13.0	15.0	10.8	11.0	-	-	-	-
		4	18.0	20.0	6.1	20.0	-	-	-	-
		5	23.0	25.0	13.4	33.3	-	-	-	-
		6	28.0	30.0	7.7	19.2	-	-	-	-
S2-0121	SB-01	1	3.0	5.0	20.9	76.5	-	-	-	-
		2	8.0	10.0	18.6	82.9	-	-	-	-
		3	13.0	15.0	20.1	99.4	38	20	19	CL
		4	18.0	20.0	31.7	95.7	-	-	-	-
		5	23.0	25.0	24.6	73.2	41	24	17	CL
	SB-02	1	3.0	5.0	15.7	71.6	-	-	-	-
		2	8.0	10.0	15.3	74.7	39	22	17	CL
		3	13.0	14.7	7.9	25.0	-	-	-	-
		4	18.0	18.5	3.7	18.3	-	-	-	-
	SB-03	1	3.0	5.0	17.2	69.9	31	24	7	ML
2		8.0	9.8	5.1	39.7	-	-	-	-	

**Notes:**

- 1) Sample depths based on feet below grade at time of exploration.

# FIELD DESCRIPTION AND LOGGING SYSTEM FOR SOIL EXPLORATION

## GRANULAR SOILS

(Sand, Gravel & Combinations)

<u>Density</u>	<u>N (blows)*</u>
Very Loose	5 or less
Loose	6 to 10
Medium Dense	11 to 30
Dense	31 to 50
Very Dense	51 or more

### Particle Size Identification

Boulders	8 in. diameter or more
Cobbles	3 to 8 in. diameter
Gravel	Coarse (C) 3 in. to ¾ in. sieve Fine (F) ¾ in. to No. 4 sieve
Sand	Coarse (C) No. 4 to No. 10 sieve (4.75mm-2.00mm) Medium (M) No. 10 to No. 40 sieve (2.00mm – 0.425mm) Fine (F) No. 40 to No. 200 sieve (0.425 – 0.074mm)
Silt/Clay	Less Than a No. 200 sieve (<0.074mm)

### Relative Proportions

<u>Description Term</u>	<u>Percent</u>
Trace	1 - 10
Little	11 - 20
Some	21 - 35
And	36 - 50

## COHESIVE SOILS

(Silt, Clay & Combinations)

<u>Consistency</u>	<u>N (blows)*</u>
Very Soft	3 or less
Soft	4 to 5
Medium Stiff	6 to 10
Stiff	11 to 15
Very Stiff	16 to 30
Hard	31 or more

### Plasticity

<u>Degree of Plasticity</u>	<u>Plasticity Index</u>
None to Slight	0 - 4
Slight	5 - 7
Medium	8 - 22
High to Very High	> 22

## ROCK

(Rock Cores)

<u>Rock Quality Designation (RQD), %</u>	<u>Rock Quality Description</u>
0-25	Very Poor
25-50	Poor
50-75	Fair
75-90	Good
90-100	Excellent

**\*N - Standard Penetration Resistance.** Driving a 2.0" O.D., 1-3/8" I.D. sampler a distance of 18 inches into undisturbed soil with a 140 pound hammer free falling a distance of 30.0 inches. The number of hammer blows to drive the sampler through each 6 inch interval is recorded; the number of blows required to drive the sampler through the final 12 inch interval is termed the Standard Penetration Resistance (SPR) N-value. For example, blow counts of 6/8/9 (through three 6-inch intervals) results in an SPR N-value of 17 (8+9).

**Groundwater** observations were made at the times indicated. Groundwater elevations fluctuate throughout a given year, depending on actual field porosity and variations in seasonal and annual precipitation.

**UNIFIED SOIL CLASSIFICATION SYSTEM [Casagrande (1948)]**

Major Divisions		Group Symbols	Typical Descriptions	Laboratory Classifications		
Coarse Grained Soils (More than half of material is larger than No. 200 sieve)	Gravels More than half of coarse fraction is larger than No. 4 sieve size	Clean gravel (Little or no fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4: $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3  Not meeting $C_u$ or $C_c$ requirements for GW	
			GP	Poorly graded gravels, gravel-sand mixtures, little or no fines		
		Gravel with fines (Appreciable amount of fines)	GM	Silty gravels, gravel-sand-silt mixtures	Atterberg limits below A Line or $I_p$ less than 4  Atterberg limits above A line with $I_p$ greater than 7	Limits plotting in hatched zone with $I_p$ between 4 and 7 are borderline cases requiring use of dual symbols
			GC	Clayey gravels, gravel-sand-clay mixtures		
	Sands (More than half of coarse fraction is smaller than No. 4 Sieve)	Clean sands (Little or no fines)	SW	Well graded sands, gravelly sands, little or no fines	$C_u = \frac{D_{60}}{D_{10}}$ greater than 6: $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3  Not meeting $C_u$ or $C_c$ requirements for SW	
			SP	Poorly graded sands, gravelly sands, little or no fines		
		Sands with fines (Appreciable amount of fines)	SM	Silty sands, sand-silt mixtures	Atterberg limits below A Line or $I_p$ less than 4  Atterberg limits above A line with $I_p$ greater than 7	Limits Plotting in hatched zone with $I_p$ between 4 and 7 are borderline cases requiring use of dual symbols
			SC	Clayey sands, sand-clay mixtures		
		Determine Percentage of sand and gravel from grain size curve. Depending on Percentage of fines (fraction smaller than No. 200 sieve), coarse-grained soils are classified as follows:  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 <sup>(1)</sup>				
		Major Divisions		Group Symbols	Typical Descriptions	For soils plotting nearly on A line use dual symbols i.e., $I_p = 29.5$ , $w_L = 60$ gives CH-MH. When $w_L$ is near 50 use CL-CH or ML-MH. Take near as $\pm 2$ percent.
Fine-grained soils (More than half of material is smaller than No. 200 sieve)	Silt and clays (Liquid limit less than 50)	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity			
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays			
		OL	Organic silts and organic silty clays of low plasticity			
	Silt and Clays (Liquid limit greater than 50)	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts			
		CH	Inorganic clays of high plasticity, fat clays			
		OH	Organic clays of medium to high plasticity, organic silts			
	Highly organic soils	Pt	Peat and other highly organic soils			

(1) Borderline classifications, used for soils possessing characteristics of two groups, are designated by combinations of group symbols. For example: GW-GC. well-graded gravel-sand mixture with clay binder.

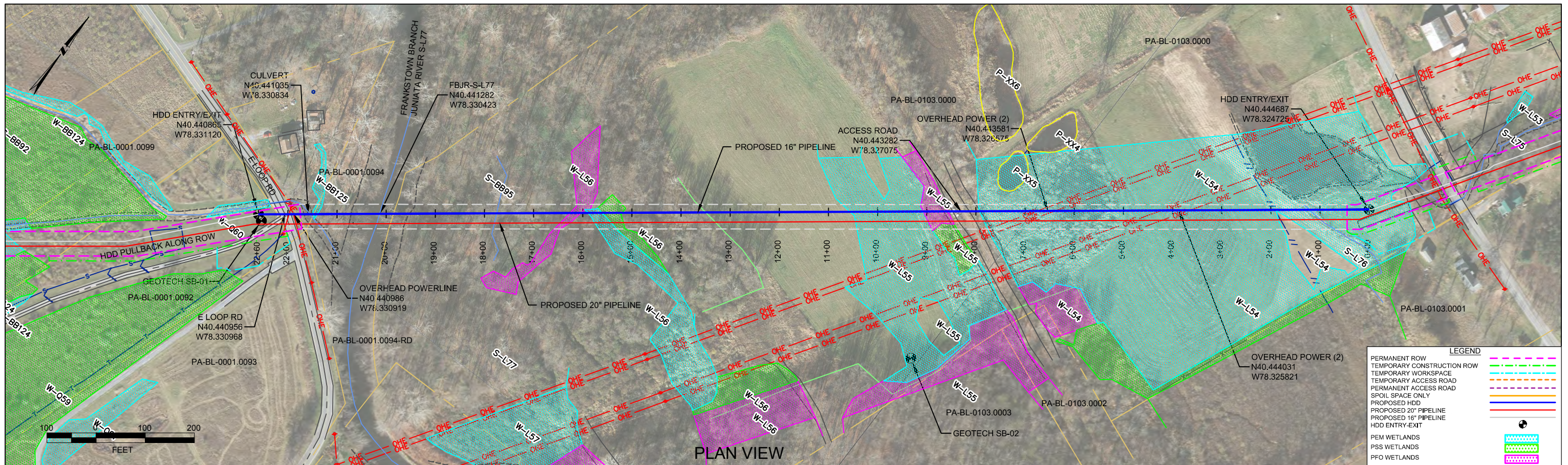
**HDD PA-BL-0001.0094-WX (S-BB92) (S-L77) (S-BB95) (W-L56) (W-L55) (W-L54) (S-L76)**

Given the design, the threat of inadvertent return has been reduced to the maximum extent practicable and in this case that threat is considered to be *medium*. Implementing this design, along with adherence to the Pennsylvania Pipeline Project Inadvertent Return Contingency Plan will ensure inadvertent impacts, if they were to occur, are also minimized to the maximum extent.

The drill will enter/exit 130 feet from the edge of the western most boundary of the stream S-BB92. The drill will travel beneath stream S-BB92 for 7 feet. Using the results of the geotechnical investigation, as well as several other data points, the entry/exit, angles, and depths have been configured to pass through the best substrates while maintaining pipe integrity (e.g., no large bends). The majority of the substrate that will be passed through is estimated to be decomposed shale, weathered to a silty fine to medium sand and gravel. The drill will continue beneath the eastern most boundary of the stream S-BB92 and will travel 110 feet from the eastern most edge of stream S-BB92 to the western most edge of stream S-L77. The drill will pass 55 feet under the stream S-L77. The majority of the substrate that will be passed through is estimated to be partially weathered shale. The drill will travel from the eastern most edge of stream S-L77 for 180 feet to the western most boundary of stream S-BB95. The drill will pass 8 feet under stream S-BB95. The majority of the substrate that will be passed through is estimated to be partially weathered shale. The drill will travel from the eastern most edge of stream S-BB95 for 130 feet to the western most boundary of wetland W-L56. The drill will travel 130 feet under wetland W-L56. The majority of the substrate that will be passed through is estimated to be partially weathered shale. The drill will travel from the eastern most edge of stream W-L56 for 450 feet to the western most boundary of wetland W-L55. The drill will travel 200 feet under wetland W-L55. The majority of the substrate that will be passed through is estimated to be partially weathered shale. The drill will travel from the eastern most edge of stream W-L55 for 60 feet to the western most boundary of wetland W-L54. The drill will travel 685 feet under wetland W-L54. The majority of the substrate that will be passed through is estimated to be partially weathered shale to highly fractured gray shale. The drill will travel under stream S-L76 for 7 feet. The majority of the substrate that will be passed through is estimated to be partially weathered shale to highly fractured gray shale. The drill will continue to travel for 96 feet under wetland W-L54 where it will enter/exit at the eastern most edge of wetland W-L54. The majority of the substrate that will be passed through is estimated to be highly fractured gray shale. The drill will travel 330 feet from the eastern most edge of stream W-L54 where it will enter/exit.

The medium designation for risk of inadvertent returns is based on a few factors. The drill will be travelling through fractured shale with layers of medium sand and fine to coarse gravel above which may allow the drilling fluid to reach the surface. The eastern entry/exit of the drill is within the wetland L54 where the drilling fluid could permeate the surface more readily. As such it is recommended that additional inspection in the area surrounding the drill be in place to monitor for potential inadvertent returns along the drill.

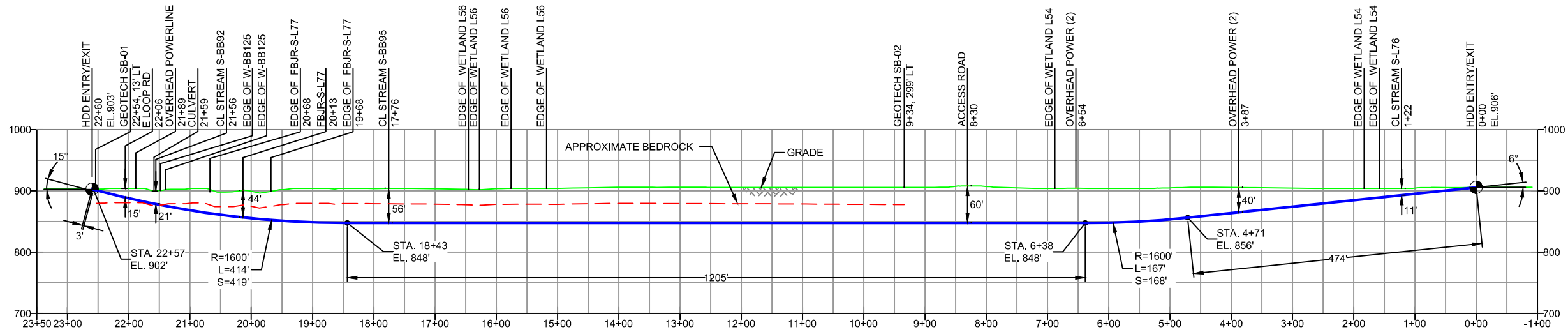
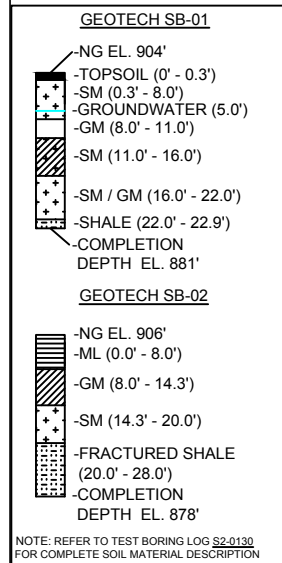




PLAN VIEW

BLAIR COUNTY, PENNSYLVANIA - FRANKSTOWN TOWNSHIP  
S2-0130-16

PROFILE VIEW



- DESIGN AND CONSTRUCTION:
- CONTRACTOR SHALL FIELD VERIFY DEPTH OF ALL EXISTING UTILITIES SHOWN OR NOT SHOWN ON THIS DRAWING.
  - THE MINIMUM SEPARATION DISTANCE FROM EXISTING SUBSURFACE UTILITIES SHALL NOT BE LESS THAN 10 FEET AS MEASURED FROM THE OUTSIDE EDGE OF THE UTILITY TO OUTSIDE OF PROPOSED PIPELINE.
  - DESIGNED IN ACCORDANCE WITH CFR 49 195 & ASME B31.4
  - CROSSING PIPE SPECIFICATION:  
HDD HORZ. LENGTH (L-): 1788'  
HDD PIPE LENGTH (S-): 1794'  
16" x 0.438" W.T., X-70, API5L, PSL2, ERW, BFW  
COATING: 14-16 MILS FBE WITH 30-35 MIL ARO (POWERCRETE R95)
  - INTERNAL DESIGN PRESSURE 1480 PSIG (SEAM FACTOR 1.0, DESIGN FACTOR 0.50).
  - INSTALLATION METHOD: HORIZONTAL DIRECTIONAL DRILL (HDD).
  - PIPELINE WARNING MARKERS SHALL BE INSTALLED ON BOTH SIDES OF ALL ROAD, RAILWAY, AND STREAM CROSSINGS.
  - CARRIER PIPE NOT ENCASED
  - PIPE / AMBIENT TEMPERATURE MUST BE NO LESS THAN 30°F DURING PULLBACK WITHOUT PRIOR WRITTEN APPROVAL FROM THE ENGINEER.
  - CONDUCT 4-HOUR PRE-INSTALLATION HYDROTEST OF HDD PIPE STRING TO MINIMUM 1850 PSIG.
  - SEE SUNOCO PENNSYLVANIA PIPELINE PROJECT ESRI WEBMAP FOR ACCESS ROAD ALIGNMENT.
  - SUNOCO PIPELINE, L.P.'S HORIZONTAL DIRECTIONAL DRILL INADVERTENT RETURN CONTINGENCY PLAN WILL BE IMPLEMENTED AT ALL TIMES.
  - SUNOCO PIPELINE, L.P.'S EROSION AND SEDIMENTATION CONTROL PLAN WILL BE IMPLEMENTED AT ALL TIMES.

NOTES

- ALL COORDINATES SHOWN ARE IN LATITUDE AND LONGITUDE. ALL MSL ELEVATIONS ARE NAD83
- STATIONING IS BASED ON HORIZONTAL DISTANCES
- ROONEY ENGINEERING, INC. AND SUNOCO PIPELINE, LP ARE NOT RESPONSIBLE FOR LOCATION OF FOREIGN UTILITIES SHOWN IN PLOT PLAN OR PROFILE. THE INFORMATION SHOWN HEREON IS FURNISHED WITHOUT LIABILITY ON THE PART OF ROONEY ENGINEERING, INC. AND SUNOCO PIPELINE, LP. FOR ANY DAMAGES RESULTING FROM ERRORS OR OMISSIONS THEREIN.
- CONTRACTOR IS RESPONSIBLE FOR LOCATING ALL UTILITIES. CONTACT ONE CALL AT 811 PRIOR TO DIGGING.
- SUNOCO EMERGENCY HOTLINE NUMBER IS #1-800-786-7440.

REF. DRAWING	NO.	DESCRIPTION	NO.	DESCRIPTION	
ES-3.44	TO	ES-3.46	EROSION & SEDIMENT PLAN	EP2	REVISED PER PADEP COMMENTS RECIVED 09-06-16
SHEET 29	TO	SHEET 29	AERIAL SITE PLAN	EP1	REVISED PER PADEP COMMENTS
				EP	
				C	REDESIGN
				B	ADDED GEOTECH INFO
				A	ISSUED FOR BID

**Sunoco Logistics Partners L.P.**

**TETRA TECH ROONEY**  
(303) 792-5911


**SUNOCO PIPELINE, L.P.**

16-INCH HORIZONTAL DIRECTIONAL DRILL  
FRANKSTOWN BRANCH JUNIATA RIVER  
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=200' DWG. NO: PA-BL-0001.0094-WX-16



**LEGEND:**

 Geotechnical Soil Boring (SB) Locations



**TETRA TECH**

GEOTECHNICAL BORING LOCATIONS  
HDD S2-0130 E LOOP ROAD  
BLAIR COUNTY, FRANKSTOWN TOWNSHIP, PA  
SUNOCO PENNSYLVANIA PIPELINE PROJECT





**GEOTECHNICAL LABORATORY TESTING SUMMARY  
SUNOCO PENNSYLVANIA PIPELINE PROJECT  
HDD S2-0130 E Loop Road**

HDD No.	Test Boring No.	Sample No.	Depth of Sample (ft.)		Water Content, % (ASTM D2216)	Percent Silts/Clays, % (ASTM D1140)	Atterburg Limits (ASTM D4318)			USCS Classif. (ASTM D2487)
			From	To			Liquid Limit, %	Plastic Limit, %	Plasticity Index, %	
S2-0130	SB-01	1	3.0	5.0	11.6	20.2	-	-	-	-
		2	8.0	10.0	18.3	24.3	-	-	-	-
		3	13.0	13.5	9.6	22.8	-	-	-	-
		4	18.0	18.8	5.7	28.7	NL	NP	NP	SM/GM
	SB-02	1	3.0	5.0	16.3	53.3	33	25	8	ML
		2	8.0	10.0	13.6	12.0	-	-	-	-
		3	13.0	15.0	11.4	42.1	30	24	6	SM
		4	18.0	18.8	14.0	34.8	-	-	-	-

Notes:

- 1) Sample depths based on feet below grade at time of exploration.

**ROCK CORE DESCRIPTION SUMMARY  
SUNOCO PENNSYLVANIA PIPELINE PROJECT  
HDD S2-0130 E LOOP ROAD**

Location	Boring No.	Core Run	Core Depth (ft)		TCR (%)	SCR (%)	RQD (%)	Depth (ft)		Weathering	Classification	Bedding Thickness (ft)	Color	Discontinuity Data
			From	To				From	To					
S2-0130	SB-02	1	20	23	100	22	0	20	28	Heavily	Shale	Very thin beds, Massive formation	Light gray	Very broken up, nearly horizontal bedding; fractures along bedding surfaces, nearly horizontal
		2	23	28	100	17	0							

**REGIONAL GEOLOGY SUMMARY  
SUNOCO PENNSYLVANIA PIPELINE PROJECT  
HDD S2-0130 E Loop Road**

HDD No.	NAME	BORING NO.	REGIONAL GEOLOGY DESCRIPTION	GENERAL TOPOGRAPHIC SETTING	BEDROCK FORMATION	GENERAL ROCK TYPE	APPROX MAX FM THICKNESS (FT)	DEPTH TO ROCK (Ft bgs) based on nearby well drilling logs	NOTES / COMMENTS
S2-0130	E. Loop Rd.	SB-01	<b>Brallier and Harrell Formations (undivided)</b> - composed of interbedded light-gray, graded, siliceous siltstone beds and light-gray, hard, silty shales, sparsely fossiliferous.	Valley Floor	Brallier-Harrell	The beds of <u>Brallier</u> are mostly thin; however, the shales may be very thick. The <u>Harrell</u> Formation consists of well-bedded, fissile to very thin, gray to black silty shale with thin argillaceous limestone, calcareous shale, and limestone nodules at the base.	1,800 (Brallier)	11-30	Yields range from 5 to 20 gpm
		SB-02					100-200 (Harrell)		

*Note : Source of well log data - <http://www.dcnr.state.pa.us/topogeo/groundwater/pagwis/records/index.htm>. All other sources as referenced in comments section.*

# FIELD DESCRIPTION AND LOGGING SYSTEM FOR SOIL EXPLORATION

## GRANULAR SOILS

(Sand, Gravel & Combinations)

<u>Density</u>	<u>N (blows)*</u>
Very Loose	5 or less
Loose	6 to 10
Medium Dense	11 to 30
Dense	31 to 50
Very Dense	51 or more

### Particle Size Identification

Boulders	8 in. diameter or more
Cobbles	3 to 8 in. diameter
Gravel	Coarse (C) 3 in. to ¾ in. sieve
	Fine (F) ¾ in. to No. 4 sieve
Sand	Coarse (C) No. 4 to No. 10 sieve (4.75mm-2.00mm)
	Medium No. 10 to No. 40 sieve (M) (2.00mm – 0.425mm)
	Fine (F) No. 40 to No. 200 sieve (0.425 – 0.074mm)
Silt/Clay	Less Than a No. 200 sieve (<0.074mm)

### Relative Proportions

<u>Description Term</u>	<u>Percent</u>
Trace	1 - 10
Little	11 - 20
Some	21 - 35
And	36 - 50

## COHESIVE SOILS

(Silt, Clay & Combinations)

<u>Consistency</u>	<u>N (blows)*</u>
Very Soft	3 or less
Soft	4 to 5
Medium Stiff	6 to 10
Stiff	11 to 15
Very Stiff	16 to 30
Hard	31 or more

### Plasticity

<u>Degree of Plasticity</u>	<u>Plasticity Index</u>
None to Slight	0 - 4
Slight	5 - 7
Medium	8 - 22
High to Very High	> 22

## ROCK

(Rock Cores)

<u>Rock</u> <u>Quality Designation</u> <u>(RQD), %</u>	<u>Rock</u> <u>Quality Descripti</u> <u>on</u>
0-25	Very Poor
25-50	Poor
50-75	Fair
75-90	Good
90-100	Excellent

**\*N - Standard Penetration Resistance.** Driving a 2.0" O.D., 1-3/8" I.D. sampler a distance of 18 inches into undisturbed soil with a 140 pound hammer free falling a distance of 30.0 inches. The number of hammer blows to drive the sampler through each 6 inch interval is recorded; the number of blows required to drive the sampler through the final 12 inch interval is termed the Standard Penetration Resistance (SPR) N-value. For example, blow counts of 6/8/9 (through three 6-inch intervals) results in an SPR N-value of 17 (8+9).

**Groundwater** observations were made at the times indicated. Groundwater elevations fluctuate throughout a given year, depending on actual field porosity and variations in seasonal and annual precipitation.

**UNIFIED SOIL CLASSIFICATION SYSTEM [Casagrande (1948)]**

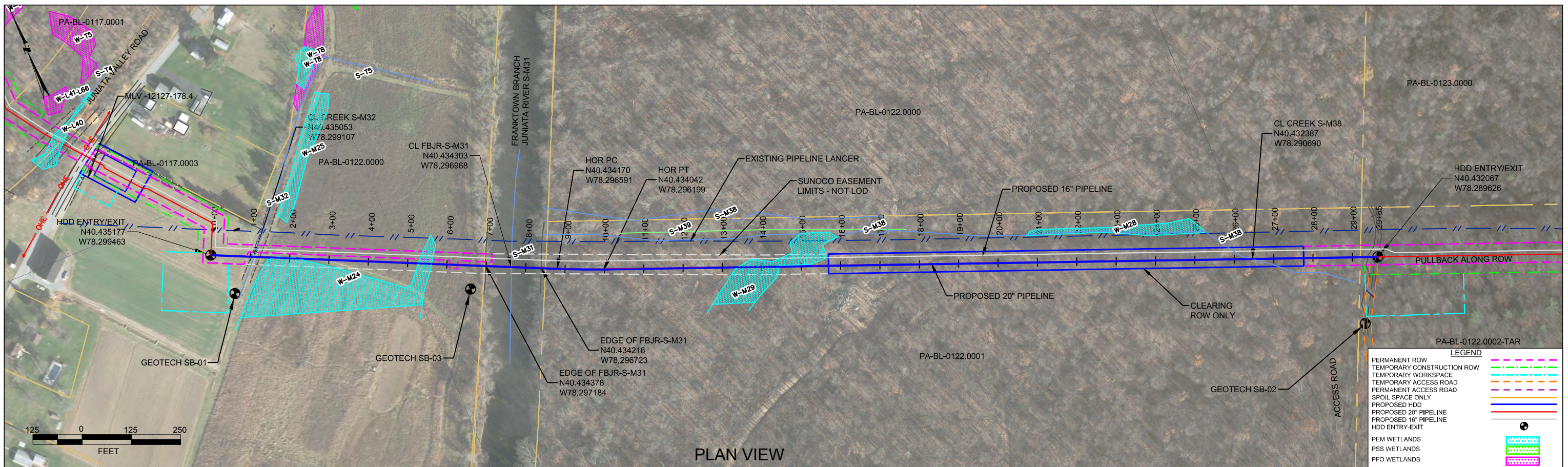
Major Divisions		Group Symbols	Typical Descriptions	Laboratory Classifications				
Coarse Grained Soils (More than half of material is larger than No. 200 sieve)	Gravels (More than half of coarse fraction is larger than No. 4 sieve size)	Clean gravel (Little or no fines)	GW Well-graded gravels, gravel-sand mixtures, little or no fines	Determine Percentage of sand and gravel from grain size curve. Depending on Percentage of fines (fraction smaller than No. 200 sieve), coarse-grained soils are classified as follows:  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 <sup>(1)</sup>	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4: $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3			
		GP Poorly graded gravels, gravel-sand mixtures, little or no fines	Not meeting $C_u$ or $C_c$ requirements for GW					
		Gravel with fines (Appreciable amount of fines)	GM Silty gravels, gravel-sand-silt mixtures		Atterberg limits below A Line or $I_p$ less than 4	Limits plotting in hatched zone with $I_p$ between 4 and 7 are borderline cases requiring use of dual symbols		
			GC Clayey gravels, gravel-sand-clay mixtures		Atterberg limits above A line with $I_p$ greater than 7			
	Sands (More than half of coarse fraction is smaller than No. 4 Sieve)	Clean sands (Little or no fines)	SW Well graded sands, gravelly sands, little or no fines		$C_u = \frac{D_{60}}{D_{10}}$ greater than 6: $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3			
			SP Poorly graded sands, gravelly sands, little or no fines		Not meeting $C_u$ or $C_c$ requirements for SW			
		Sands with fines (Appreciable amount of fines)	SM Silty sands, sand-silt mixtures		Atterberg limits below A Line or $I_p$ less than 4	Limits Plotting in hatched zone with $I_p$ between 4 and 7 are borderline cases requiring use of dual symbols		
			SC Clayey sands, sand-clay mixtures		Atterberg limits above A line with $I_p$ greater than 7			
						For soils plotting nearly on A line use dual symbols i.e., $I_p = 29.5$ , $w_L = 60$ gives CH-MH. When $w_L$ is near 50 use CL-CH or ML-MH. Take near as $\pm 2$ percent.		
		Fine-grained soils (More than half of material is smaller than No. 200 sieve)	Silt and clays (Liquid limit less than 50)		ML Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity			
CL Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays								
OL Organic silts and organic silty clays of low plasticity								
Silt and Clays (Liquid limit greater than 50)	MH Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts							
	CH Inorganic clays of high plasticity, fat clays							
	OH Organic clays of medium to high plasticity, organic silts							
Highly organic soils	Pt Peat and other highly organic soils							

(1) Borderline classifications, used for soils possessing characteristics of two groups, are designated by combinations of group symbols. For example: GW-GC. well-graded gravel-sand mixture with clay binder.

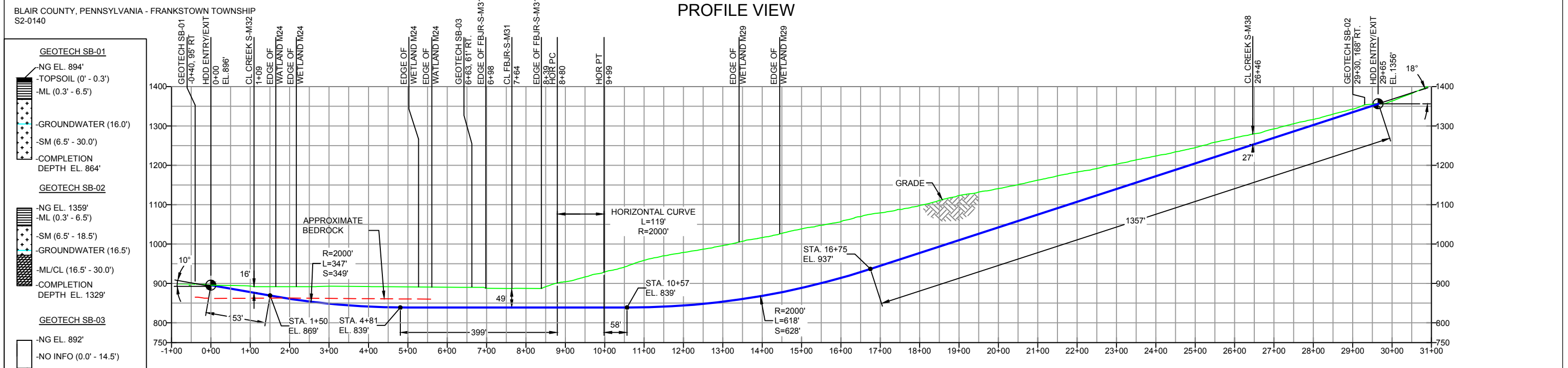
***HDD PA-BL-0122.0000-WX (S-M32) (W-M24) (S-M31) (W-M29) (S-M38)***

Given the design, the threat of inadvertent return has been reduced to the maximum extent practicable and in this case that threat is considered to be *low*. Implementing this design, along with adherence to the Pennsylvania Pipeline Project Inadvertent Return Contingency Plan will ensure inadvertent impacts, if they were to occur, are also minimized to the maximum extent.

The drill will enter/exit 90 feet from the edge of the western most boundary of the stream S-M32. The drill will travel beneath stream S-M32 for 6 feet. Using the results of the geotechnical investigation, as well as several other data points, the entry/exit, angles, and depths have been configured to pass through the best substrates while maintaining pipe integrity (e.g., no large bends). The majority of the substrate that will be passed through is estimated to be fine silty sand. The drill will continue through the eastern most boundary of the stream S-M32 and will travel 30 feet to the western most edge of wetland W-M24. The drill will pass 420 feet under the wetland W-M24. The majority of the substrate that will be passed through is estimated to be fractured rock. The drill will continue beneath the eastern most boundary of the wetland W-M24 and will travel 160 feet to the western most edge of stream S-M31. The drill will continue beneath stream S-M31 for 130 feet. The majority of the substrate that will be passed through is estimated to be unfractured to moderately fractured gray limestone. The drill will continue beneath the eastern most boundary of the stream S-M31 and will travel 500 feet to the western most edge of wetland W-M29. The drill will continue beneath wetland W-M29 for 105 feet. The majority of the substrate that will be passed through is estimated to be dry weathered silt and clay with little fine to medium sand. The drill will continue beneath the eastern most boundary of wetland W-M29 and will travel 1020 feet to the western most edge of stream S-M38. The drill will continue beneath stream S-M38 for 8 feet. The majority of the substrate that will be passed through is estimated to be dry weathered silt and clay with little fine to medium sand. The drill will travel 230 feet from the eastern most edge of stream S-M38 where it will enter/exit.



PLAN VIEW



PROFILE VIEW

**NOTES:**

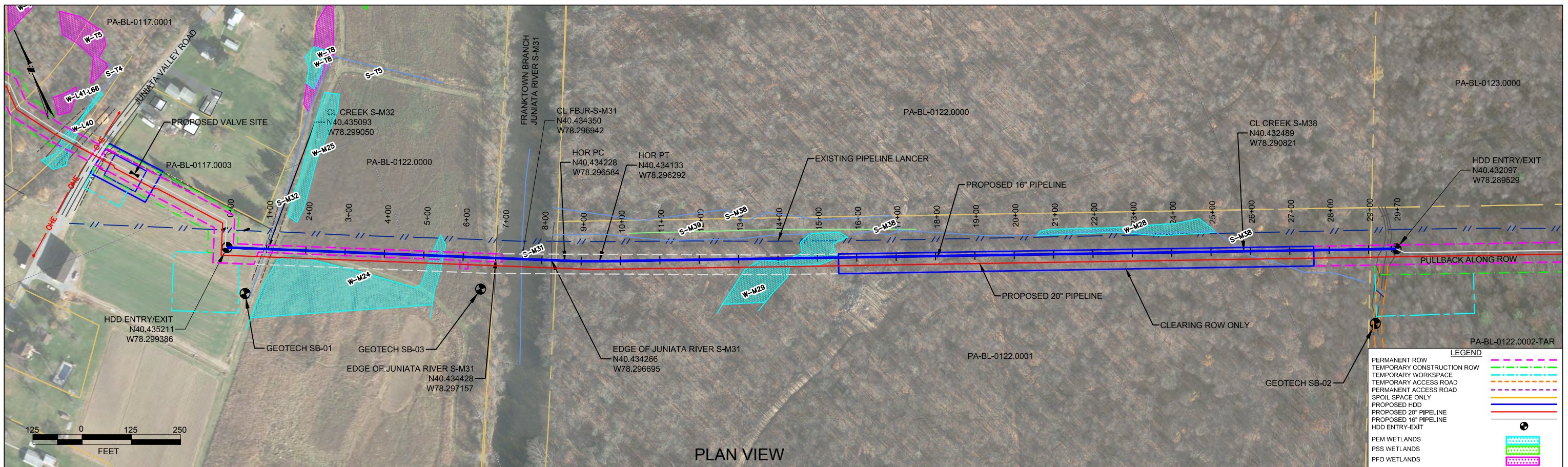
- ALL COORDINATES SHOWN ARE IN LATITUDE AND LONGITUDE. ALL MSL ELEVATIONS ARE NAD83
- STATIONING IS BASED ON HORIZONTAL DISTANCES.
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- CONTRACTOR IS RESPONSIBLE FOR LOCATING ALL UTILITIES. CONTACT ONE CALL AT 811 PRIOR TO DIGGING.
- SUNOCO EMERGENCY HOTLINE NUMBER IS #1-800-786-7440.

**DESIGN AND CONSTRUCTION:**

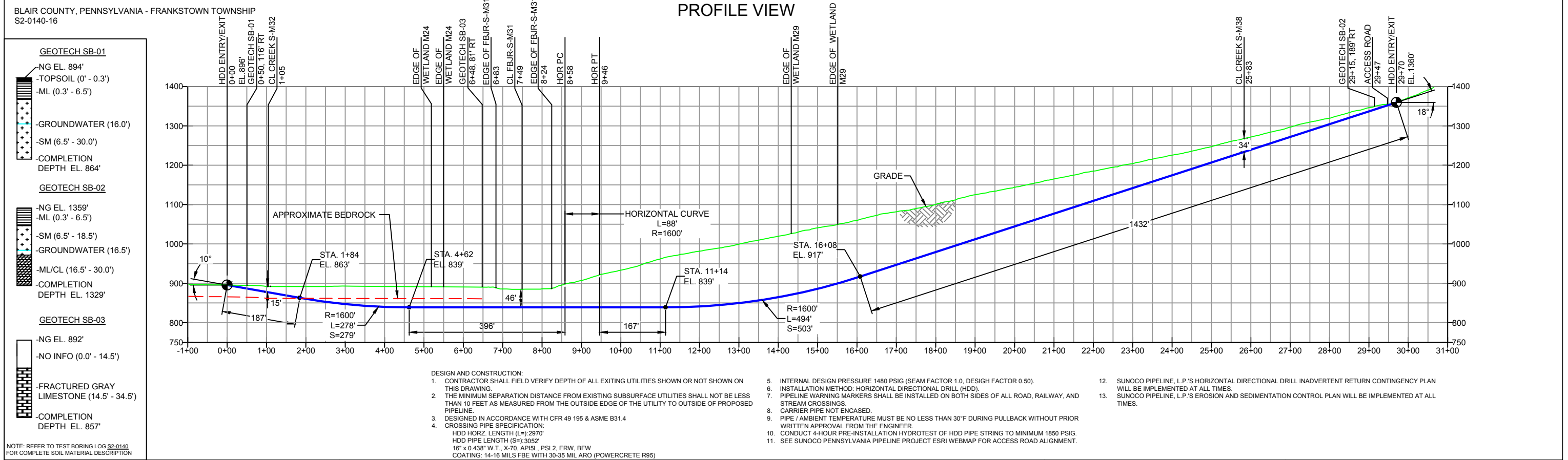
- CONTRACTOR SHALL FIELD VERIFY DEPTH OF ALL EXISTING UTILITIES SHOWN OR NOT SHOWN ON THIS DRAWING.
- THE MINIMUM SEPARATION DISTANCE FROM EXISTING SUBSURFACE UTILITIES SHALL NOT BE LESS THAN 10 FEET AS MEASURED FROM THE OUTSIDE EDGE OF THE UTILITY TO OUTSIDE OF PROPOSED PIPELINE.
- DESIGNED IN ACCORDANCE WITH CFR 49 195 & ASME B31.4
- CROSSING PIPE SPECIFICATION:  
HDD HORZ. LENGTH (L): 2965'  
HDD PIPE LENGTH (S): 3063'  
20" x 0.456" W.T., X-65, API5L, PSL2, ERW, BFW  
COATING: 14-16 MILS FBE WITH 30-35 MIL ARO (POWERCRETE R95)
- INTERNAL DESIGN PRESSURE 1480 PSIG (SEAM FACTOR 1.0, DESIGN FACTOR 0.50).
- INSTALLATION METHOD: HORIZONTAL DIRECTIONAL DRILL (HDD).
- PIPELINE WARNING MARKERS SHALL BE INSTALLED ON BOTH SIDES OF ALL ROAD, RAILWAY, AND STREAM CROSSINGS.
- CARRIER PIPE NOT ENCASED.
- PIPE / AMBIENT TEMPERATURE MUST BE NO LESS THAN 30°F DURING PULLBACK WITHOUT PRIOR WRITTEN APPROVAL FROM THE ENGINEER.
- CONDUCT 4-HOUR PRE-INSTALLATION HYDROTEST OF HDD PIPE STRING TO MINIMUM 1850 PSIG.
- SEE SUNOCO PENNSYLVANIA PIPELINE PROJECT ESRI WEBMAP FOR ACCESS ROAD ALIGNMENT.
- SUNOCO PIPELINE, L.P.'S HORIZONTAL DIRECTIONAL DRILL INADVERTENT RETURN CONTINGENCY PLAN WILL BE IMPLEMENTED AT ALL TIMES.
- SUNOCO PIPELINE, L.P.'S EROSION AND SEDIMENTATION CONTROL PLAN WILL BE IMPLEMENTED AT ALL TIMES.

NOTES		REF. DRAWING		REVISIONS		SUNOCO PIPELINE, L.P.							
1. ALL COORDINATES SHOWN ARE IN LATITUDE AND LONGITUDE. ALL MSL ELEVATIONS ARE NAD83	ES-3.51	TO	ES-3.53	EROSION & SEDIMENT PLAN	EP2	REVISED PER PADEP COMMENTS RECEIVED 09-06-16	DLM	09/30/16	RMB	09/30/16	AAW	09/30/16	<b>SUNOCO PIPELINE, L.P.</b>  20-INCH HORIZONTAL DIRECTIONAL DRILL JUNIATA RIVER PENNSYLVANIA PIPELINE PROJECT  SCALE: 1"=250'    DWG. NO: PA-BL-0122.0000-WX
2. STATIONING IS BASED ON HORIZONTAL DISTANCES.	SHEET 33	TO	SHEET 34	AERIAL SITE PLAN	EP1	REVISED PER PADEP COMMENTS	MRS	05/18/16	RMB	05/18/16	AAW	05/18/16	
3. ROONEY ENGINEERING, INC. AND SUNOCO PIPELINE, LP ARE NOT RESPONSIBLE FOR LOCATION OF FOREIGN UTILITIES SHOWN IN PLOT PLAN OR PROFILE. THE INFORMATION SHOWN HEREON IS FURNISHED WITHOUT LIABILITY ON THE PART OF ROONEY ENGINEERING, INC. AND SUNOCO PIPELINE, LP. FOR ANY DAMAGES RESULTING FROM ERRORS OR OMISSIONS THEREIN.					EP		MRS	03/15/16	RMB	03/15/16	AAW	03/15/16	
4. CONTRACTOR IS RESPONSIBLE FOR LOCATING ALL UTILITIES. CONTACT ONE CALL AT 811 PRIOR TO DIGGING.					C	ADDED GEOTECH INFO	MRS	09/04/15	RMB	09/04/15	AAW	09/04/15	
5. SUNOCO EMERGENCY HOTLINE NUMBER IS #1-800-786-7440.					B	ISSUED FOR BID	JAM	07/31/15	RMB	07/31/15	AAW	07/31/15	
					A	ISSUED FOR REVIEW	JAM	03/24/15	RMB	03/24/15	AAW	03/24/15	
	DWG NO		DWG NO	DESCRIPTION	NO.	DESCRIPTION	BY	DATE	CHK	DATE	APP	DATE	





PLAN VIEW



BLAIR COUNTY, PENNSYLVANIA - FRANKSTOWN TOWNSHIP  
S2-0140-16

- GEOTECH SB-01**
- NG EL. 894'
  - TOPSOIL (0' - 0.3')
  - ML (0.3' - 6.5')
  - GROUNDWATER (16.0')
  - SM (6.5' - 30.0')
  - COMPLETION DEPTH EL. 864'
- GEOTECH SB-02**
- NG EL. 1359'
  - ML (0.3' - 6.5')
  - SM (6.5' - 18.5')
  - GROUNDWATER (16.5')
  - ML/CL (16.5' - 30.0')
  - COMPLETION DEPTH EL. 1329'
- GEOTECH SB-03**
- NG EL. 892'
  - NO INFO (0.0' - 14.5')
  - FRACTURED GRAY LIMESTONE (14.5' - 34.5')
  - COMPLETION DEPTH EL. 857'

NOTE: REFER TO TEST BORING LOG S2-0140 FOR COMPLETE SOIL MATERIAL DESCRIPTION

**NOTES**

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- SUNOCO EMERGENCY HOTLINE NUMBER IS #1-800-786-7440.

**REF. DRAWING**

ES-3.51	TO	ES-3.53	EROSION & SEDIMENT PLAN
SHEET 33	TO	SHEET 34	AERIAL SITE PLAN
			EP2 REVISED PER PADEP COMMENTS RECEIVED 09-06-16
			EP1 REVISED PER PADEP COMMENTS
			EP
			B ADDED GEOTECH INFO
			A ISSUED FOR BID
DWG NO	DWG NO	DESCRIPTION	NO.

**REVISIONS**

BY	DATE	CHK	DATE	APP	DATE
DLM	10/07/16	RMB	10/07/16	AAW	10/07/16
MRS	05/09/16	RMB	05/09/16	AAW	05/09/16
MRS	11/23/15	RMB	11/23/15	AAW	11/23/15
MRS	09/04/15	RMB	09/04/15	AAW	09/04/15
MRS	08/31/15	RMB	08/31/15	AAW	08/31/15

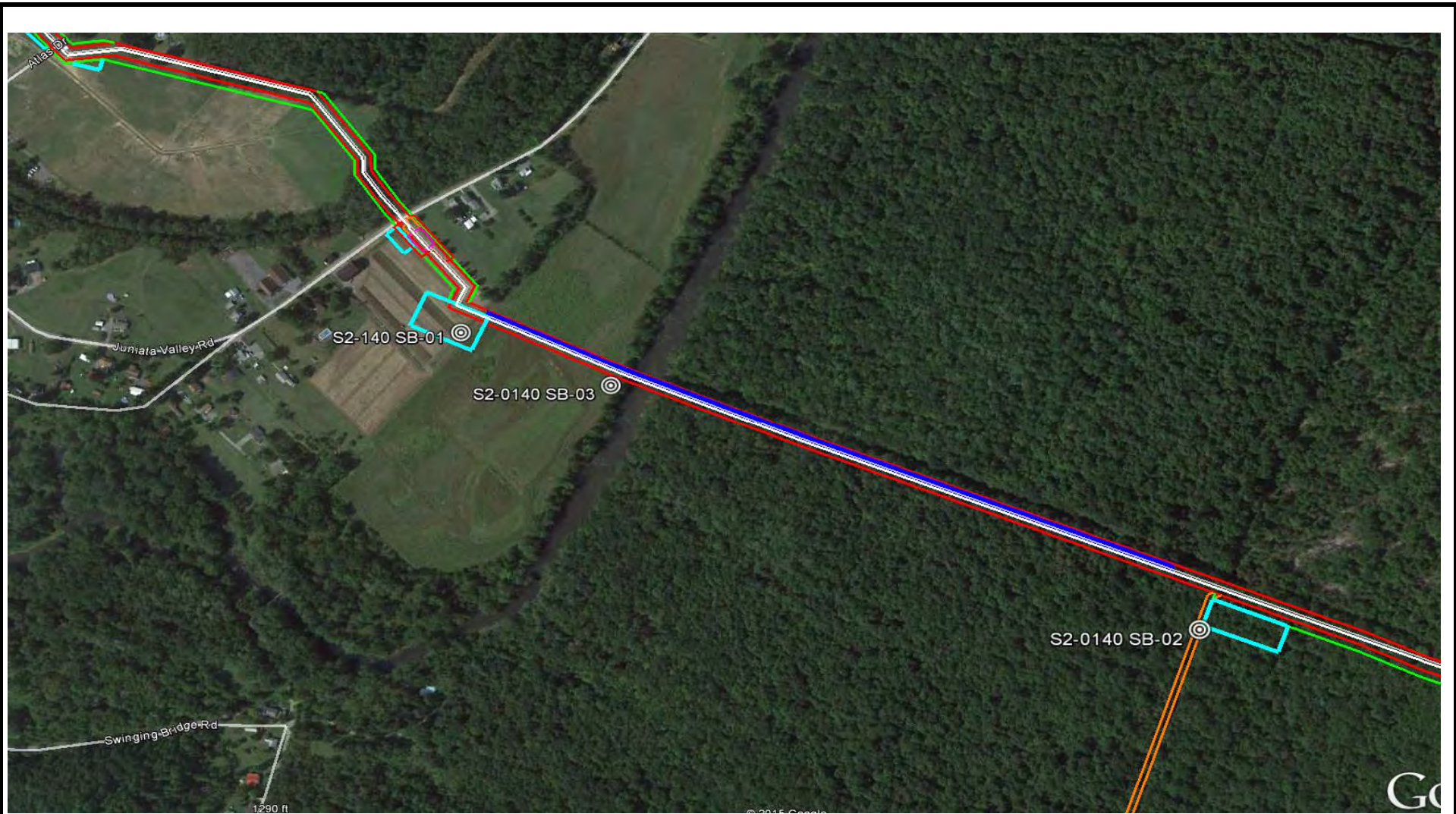
**Sunoco Logistics Partners L.P.**

**TETRA TECH ROONEY**  
(303) 792-5911

**SUNOCO PIPELINE, L.P.**

16-INCH HORIZONTAL DIRECTIONAL DRILL  
JUNIATA RIVER  
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=250'  
DWG. NO: PA-BL-0122.000-WX-16



**LEGEND:**

⊙ Geotechnical Soil Boring (SB) Locations



**TETRA TECH**

GEOTECHNICAL BORING LOCATIONS  
HDD S2-0140  
BLAIR COUNTY, FRANKSTOWN TOWNSHIP, PA  
SUNOCO PENNSYLVANIA PIPELINE PROJECT







**TETRA TECH**

240 Continental Drive, Suite 200  
 Newark, Delaware 19713  
 302.738.7551  
 fax: 302.454.5988

**TEST BORING LOG**

Project Name: SUNOCO PENNSYLVANIA PIPELINE PROJECT			Project No.: 103IP3406		
Project Location: JUNIATA VALLEY ROAD, HOLLISDAYSBURG, PA			Page 1 of 1		
HDD No.: S2-0140		Dates(s) Drilled: 09-25-15		Inspector: E. WATT	
Boring No.: SB-03		Drilling Method: SPT - ASTM D1586		Driller: K. KERSH	
Drilling Contractor: CONNELLY		Groundwater Depth (ft):		Total Depth (ft): 34.5	
Boring Location Coordinates:			40° 26' 3.373" N		78° 17' 50.560" W

Sample No.	Sample Depth (ft)		Strata Depth (ft)		Recov. (in)	Strata (USCS)	Description of Materials	6" Increment Blows *				N
	From	To	From	To								
							<b>AUGERED CONTINUOUSLY TO REFUSAL AT 14.5'.</b>					
							<u>ROCK CORING</u>					
RUN 1	14.5	19.5	14.5	15.4	60	FRACTURED ROCK	VERY INTENSELY TO INTENSELY FRACTURED GRAY LIMESTONE.	TCR: 100%, SCR: 22%, RQD: 17%				
			15.4	19.0			VERY INTENSELY FRACTURED GRAY CALCEROUS SHALE.					
			19.0				MODERATELY FRACTURED GRAY LIMESTONE.					
RUN 2	19.5	24.5		21.0	60		VERY INTENSELY FRACTURED GRAY LIMESTONE.	TCR: 100%, SCR: 20%, RQD: 15%				
			21.0	23.4			VERY INTENSELY FRACTURED LIMESTONE.					
			23.4				MODERATELY TO INTENSELY FRACTURED GRAY LIMESTONE.					
RUN 3	24.5	29.5		25.7	54		INTENSELY TO VERY INTENSELY FRACTURED GRAY LIMESTONE.	TCR: 90%, SCR: 49%, RQD: 43%				
			25.7				SLIGHTLY TO MODERATELY FRACTURED GRAY LIMESTONE WITH					
				28.0			CALCITE DEPOSITS.					
			28.0	28.3			VERY INTENSELY FRACTURED GRAY CALCEROUS SHALE.					
			28.3	31.9		SLIGHTLY TO MODERATELY FRACTURED GRAY LIMESTONE.						
RUN 4	29.5	34.5	31.9	32.6	60	INTENSELY FRACTURED GRAY LIMESTONE.	TCR: 100%, SCR: 68%, RQD: 68%					
			32.6			UNFRACTURED TO MODERATELY FRACTURED GRAY LIMESTONE						
				34.5		WITH CALCITE DEPOSITS.						
							<u>CORE TESTING RESULTS (DEPTH 29.5-30'):</u>					
							COMPRESSIVE STRENGTH: 8,050 PSI					
							UNIT WEIGHT: 163.1 PCF					

Notes/Comments: Pocket Pentrometer Testing DR: DECOMPOSED ROCK

Strata (USCS) Designations are approximated based on visual review, except where indicated in Description of Materials.

\* Number of blows of 140 lb. Hammer dropped 30 in. required to drive 2 in. split-spoon sampler in 6 in. increments.  
 N: Number of blows to drive spoon from 6" to 18" interval.

**ROCK CORE DESCRIPTION SUMMARY  
SUNOCO PENNSYLVANIA PIPELINE PROJECT  
HDD S2-0140**

Location	Boring No.	Core Run	Core Depth (ft)		TCR (%)	SCR (%)	RQD (%)	Depth (ft)		Weathering	Classification	Bedding Thickness (ft)	Color	Discontinuity Data
			From	To				From	To					
S2-0140	SB-03	1	14.5	19.5	100	22	17	14.5	34.5	Moderate	Limestone	Massive	Gray	Fractures ranging from 6° to 56°, Avg. 31°; Occasional shaly cleavage to fractures
		2	19.5	24.5	100	20	15							
		3	24.5	29.5	90	49	43							
		4	29.5	34.5	100	68	68							

**GEOTECHNICAL LABORATORY TESTING SUMMARY  
SUNOCO PENNSYLVANIA PIPELINE PROJECT  
HDD S2-0140**

HDD No.	Test Boring No.	Sample No.	Depth of Sample (ft.)		Water Content, % (ASTM D2216)	Percent Silts/Clays, % (ASTM D1140)	Atterburg Limits (ASTM D4318)			USCS Classif. (ASTM D2487)
			From	To			Liquid Limit, %	Plastic Limit, %	Plasticity Index, %	
S2-0140	SB-01	1	3.0	5.0	10.3	63.1	31	24	7	ML
		2	8.0	8.9	4.3	29.5	-	-	-	-
		4	18.0	18.7	5.9	15.4	-	-	-	-
		6	28.0	28.3	5.1	27.4	-	-	-	-
	SB-02	1	3.0	5.0	12.3	56.4	-	-	-	-
		3	13.0	15.0	16.5	33.1	33	22	11	SM
		4	18.0	20.0	14.5	86.3	-	-	-	-
		5	23.0	25.0	15.2	81.8	35	24	11	ML/CL
		6	28.0	30.0	14.3	91.6	-	-	-	-

Rock Core Testing Results				
Boring No.	Core Run	Approximate Depth (ft)	Compressive Strength (psi)	Unit Weight (pcf)
SB-03	4	29.5 - 30.0	8,050	163.1

**Notes:**

- 1) Sample depths based on feet below grade at time of exploration.

**REGIONAL GEOLOGY SUMMARY  
SUNOCO PENNSYLVANIA PIPELINE PROJECT  
HDD S2-0140**

HDD No.	NAME	BORING NO.	REGIONAL GEOLOGY DESCRIPTION	GENERAL TOPOGRAPHIC SETTING	BEDROCK FORMATION	GENERAL ROCK TYPE	APPROX MAX FM THICKNESS (FT)	DEPTH TO ROCK (Ft bgs) based on nearby well drilling logs	NOTES / COMMENTS
S2-0140	Frankstown	SB-01	<b>Hamilton Group</b> - The Mahantango Formation and the underlying Marcellus Formation make up the Hamilton Group.	Ridge and Valley	Mahatango (aka Hamilton Group)	Shale-siltstone, laminated, fossiliferous			
		SB-02	<b>Bloomsburg and Mifflintown Formations</b> , undivided - The <u>Bloomsburg</u> Formation is predominantly red shale and siltstone. <u>Mifflintown</u> is Interbedded dark-gray shale and medium-gray fossiliferous limestone		Bloomsburg and Mifflintown Formations	predominantly red shale and siltstone.			
		SB-03	<b>Onondaga and Old Port Formation</b> (undivided) consists of two members - the upper Selinsgrove Limestone and the lower calcerous Needmore Shale.		Onondaga-Old Port	Limestone and calcareous shale with occasional chert	100-200	4-32	

*Note : Source of well log data - <http://www.dcnr.state.pa.us/topogeo/groundwater/pagwis/records/index.htm>. All other sources as referenced in comments section.*

# FIELD DESCRIPTION AND LOGGING SYSTEM FOR SOIL EXPLORATION

## GRANULAR SOILS

(Sand, Gravel & Combinations)

<u>Density</u>	<u>N (blows)*</u>
Very Loose	5 or less
Loose	6 to 10
Medium Dense	11 to 30
Dense	31 to 50
Very Dense	51 or more

### Particle Size Identification

Boulders	8 in. diameter or more
Cobbles	3 to 8 in. diameter
Gravel	Coarse (C) 3 in. to ¾ in. sieve
	Fine (F) ¾ in. to No. 4 sieve
Sand	Coarse (C) No. 4 to No. 10 sieve (4.75mm-2.00mm)
	Medium (M) No. 10 to No. 40 sieve (2.00mm – 0.425mm)
	Fine (F) No. 40 to No. 200 sieve (0.425 – 0.074mm)
Silt/Clay	Less Than a No. 200 sieve (<0.074mm)

### Relative Proportions

<u>Description Term</u>	<u>Percent</u>
Trace	1 - 10
Little	11 - 20
Some	21 - 35
And	36 - 50

## COHESIVE SOILS

(Silt, Clay & Combinations)

<u>Consistency</u>	<u>N (blows)*</u>
Very Soft	3 or less
Soft	4 to 5
Medium Stiff	6 to 10
Stiff	11 to 15
Very Stiff	16 to 30
Hard	31 or more

### Plasticity

<u>Degree of Plasticity</u>	<u>Plasticity Index</u>
None to Slight	0 - 4
Slight	5 - 7
Medium	8 - 22
High to Very High	> 22

## ROCK

(Rock Cores)

<u>Rock Quality Designation (RQD), %</u>	<u>Rock Quality Description</u>
0-25	Very Poor
25-50	Poor
50-75	Fair
75-90	Good
90-100	Excellent

**\*N - Standard Penetration Resistance.** Driving a 2.0" O.D., 1-3/8" I.D. sampler a distance of 18 inches into undisturbed soil with a 140 pound hammer free falling a distance of 30.0 inches. The number of hammer blows to drive the sampler through each 6 inch interval is recorded; the number of blows required to drive the sampler through the final 12 inch interval is termed the Standard Penetration Resistance (SPR) N-value. For example, blow counts of 6/8/9 (through three 6-inch intervals) results in an SPR N-value of 17 (8+9).

**Groundwater** observations were made at the times indicated. Groundwater elevations fluctuate throughout a given year, depending on actual field porosity and variations in seasonal and annual precipitation.

**UNIFIED SOIL CLASSIFICATION SYSTEM [Casagrande (1948)]**

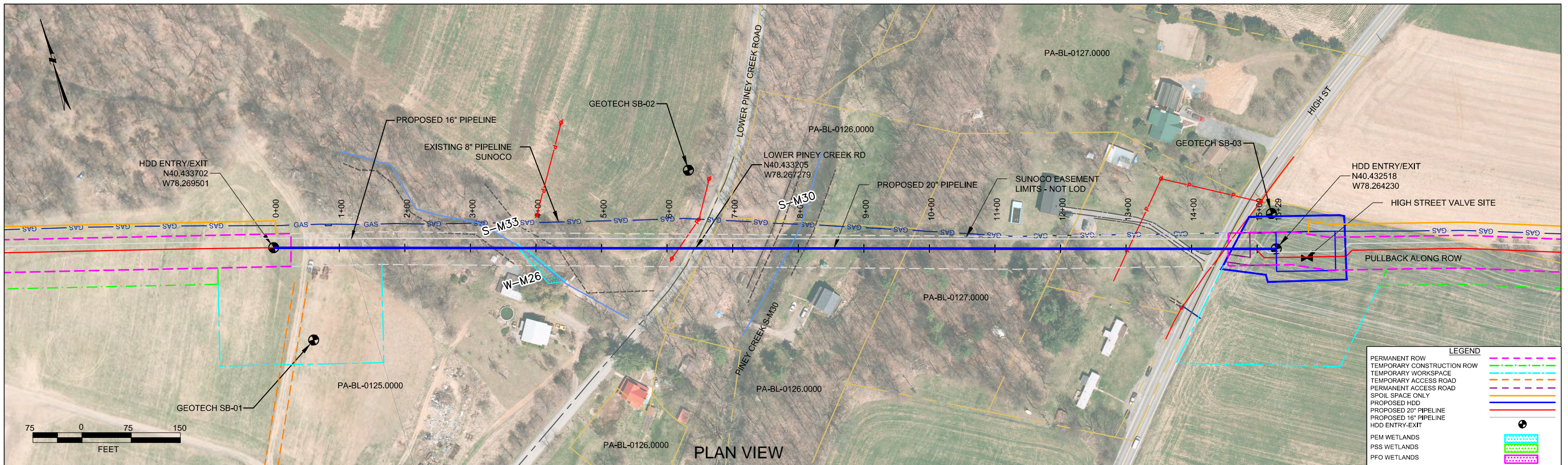
Major Divisions		Group Symbols	Typical Descriptions	Laboratory Classifications			
Coarse Grained Soils (More than half of material is larger than No. 200 sieve)	Gravels (More than half of coarse fraction is larger than No. 4 sieve size)	Clean gravel (Little or no fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4: $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3  Not meeting $C_u$ or $C_c$ requirements for GW		
			GP	Poorly graded gravels, gravel-sand mixtures, little or no fines			
		Gravel with fines (Appreciable amount of fines)	GM	Silty gravels, gravel-sand-silt mixtures	Atterberg limits below A Line or $I_p$ less than 4	Limits plotting in hatched zone with $I_p$ between 4 and 7 are borderline cases requiring use of dual symbols	
			GC	Clayey gravels, gravel-sand-clay mixtures	Atterberg limits above A line with $I_p$ greater than 7		
	Sands (More than half of coarse fraction is smaller than No. 4 Sieve)	Clean sands (Little or no fines)	SW	Well graded sands, gravelly sands, little or no fines	$C_u = \frac{D_{60}}{D_{10}}$ greater than 6: $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3  Not meeting $C_u$ or $C_c$ requirements for SW		
			SP	Poorly graded sands, gravelly sands, little or no fines			
		Sands with fines (Appreciable amount of fines)	SM	Silty sands, sand-silt mixtures	Atterberg limits below A Line or $I_p$ less than 4	Limits Plotting in hatched zone with $I_p$ between 4 and 7 are borderline cases requiring use of dual symbols	
			SC	Clayey sands, sand-clay mixtures	Atterberg limits above A line with $I_p$ greater than 7		
		Determine Percentage of sand and gravel from grain size curve. Depending on Percentage of fines (fraction smaller than No. 200 sieve), coarse-grained soils are classified as follows:  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 <sup>(1)</sup>					
		Major Divisions		Group Symbols	Typical Descriptions	For soils plotting nearly on A line use dual symbols i.e., $I_p = 29.5$ , $w_L = 60$ gives CH-MH. When $w_L$ is near 50 use CL-CH or ML-MH. Take near as $\pm 2$ percent.	
Fine-grained soils (More than half of material is smaller than No. 200 sieve)	Silt and clays (Liquid limit less than 50)	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity				
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays				
		OL	Organic silts and organic silty clays of low plasticity				
	Silt and Clays (Liquid limit greater than 50)	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts				
		CH	Inorganic clays of high plasticity, fat clays				
		OH	Organic clays of medium to high plasticity, organic silts				
	Highly organic soils	Pt	Peat and other highly organic soils				

(1) Borderline classifications, used for soils possessing characteristics of two groups, are designated by combinations of group symbols. For example: GW-GC. well-graded gravel-sand mixture with clay binder.

***HDD PA-BL-0126.0000-RD (W-M26) (S-M33) (S-M30)***

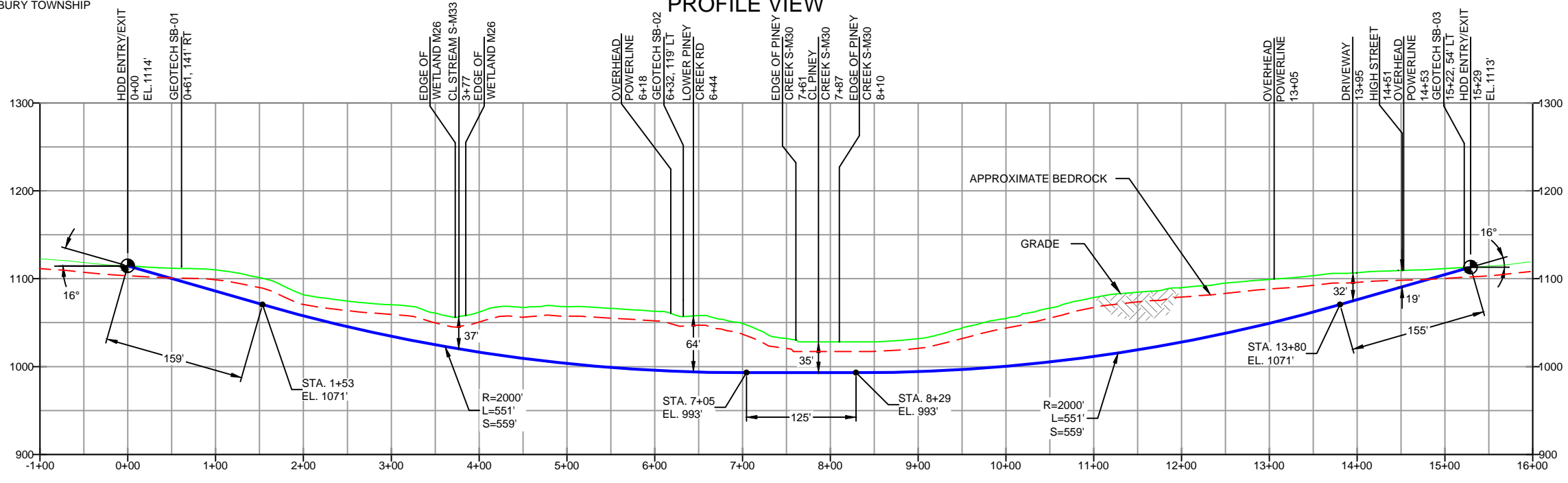
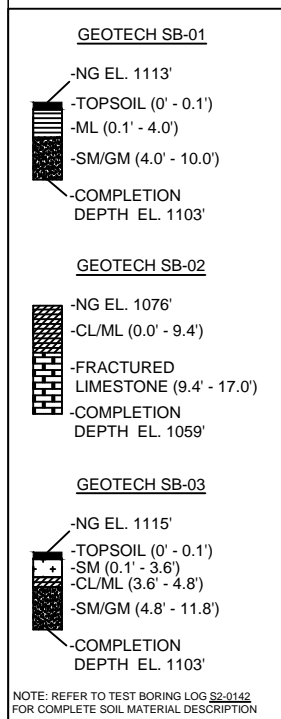
Given the design, the threat of inadvertent return has been reduced to the maximum extent practicable and in this case that threat is considered to be *low*. Implementing this design, along with adherence to the Pennsylvania Pipeline Project Inadvertent Return Contingency Plan will ensure inadvertent impacts, if they were to occur, are also minimized to the maximum extent.

The drill will enter/exit 400 feet from the edge of the western most boundary of the wetland W-M26. The drill will travel beneath W-M26 and stream S-M33 for 15 feet. Using the results of the geotechnical investigation, as well as several other data points, the entry/exit, angles, and depths have been configured to pass through the best substrates while maintaining pipe integrity (e.g., no large bends). The majority of the substrate that will be passed through is estimated to be fractured limestone. The drill will continue beneath the eastern most boundary of the wetland W-M26 and stream S-M33 and will travel 380 feet from the eastern most edge of wetland W-M26 and stream S-M33 to the western most edge of stream S-M30. The drill will pass 32 feet under the stream S-M30 starting at the western most boundary. The majority of the substrate that will be passed through is estimated to be fractured limestone. The drill will continue beneath stream S-M30 and will enter/exit 580 feet from the eastern most edge of stream S-M30.



BLAIR COUNTY, PENNSYLVANIA - WOODBURY TOWNSHIP  
S2-0142

PROFILE VIEW



DESIGN AND CONSTRUCTION:

- CONTRACTOR SHALL FIELD VERIFY DEPTH OF ALL EXISTING UTILITIES SHOWN OR NOT SHOWN ON THIS DRAWING.
- THE MINIMUM SEPARATION DISTANCE FROM EXISTING SUBSURFACE UTILITIES SHALL NOT BE LESS THAN 10 FEET AS MEASURED FROM THE OUTSIDE EDGE OF THE UTILITY TO OUTSIDE OF PROPOSED PIPELINE.
- DESIGNED IN ACCORDANCE WITH CFR 49 195 & ASME B31.4
- CROSSING PIPE SPECIFICATION:  
HDD HORZ. LENGTH (L=): 1529'  
HDD PIPE LENGTH (S=): 1556'  
20" x 0.456" W.T., X-65, API5L, PSL2, ERW, 8FW  
COATING: 14-16 MILS FBE WITH 30-35 MIL ARO (POWERCRETE R95)
- INTERNAL DESIGN PRESSURE 1480 PSIG (SEAM FACTOR 1.0, DESIGN FACTOR 0.50).
- INSTALLATION METHOD: HORIZONTAL DIRECTIONAL DRILL (HDD).
- PIPELINE WARNING MARKERS SHALL BE INSTALLED ON BOTH SIDES OF ALL ROAD, RAILWAY, AND STREAM CROSSINGS.
- CARRIER PIPE NOT ENCASED.
- PIPE / AMBIENT TEMPERATURE MUST BE NO LESS THAN 30°F DURING PULLBACK WITHOUT PRIOR WRITTEN APPROVAL FROM THE ENGINEER.
- CONDUCT 4-HOUR PRE-INSTALLATION HYDROTEST OF HDD PIPE STRING TO MINIMUM 1850 PSIG.
- SEE SUNOCO PENNSYLVANIA PIPELINE PROJECT ESRI WEBMAP FOR ACCESS ROAD ALIGNMENT.
- SUNOCO PIPELINE, L.P.'S HORIZONTAL DIRECTIONAL DRILL INADVERTENT RETURN CONTINGENCY PLAN WILL BE IMPLEMENTED AT ALL TIMES.
- SUNOCO PIPELINE, L.P.'S EROSION AND SEDIMENTATION CONTROL PLAN WILL BE IMPLEMENTED AT ALL TIMES.

- NOTES
- ALL COORDINATES SHOWN ARE IN LATITUDE AND LONGITUDE. ALL MSL ELEVATIONS ARE NAD83
  - STATIONING IS BASED ON HORIZONTAL DISTANCES.
  - ROONEY ENGINEERING, INC. AND SUNOCO PIPELINE, LP ARE NOT RESPONSIBLE FOR LOCATION OF FOREIGN UTILITIES SHOWN IN PLOT PLAN OR PROFILE. THE INFORMATION SHOWN HEREON IS FURNISHED WITHOUT LIABILITY ON THE PART OF ROONEY ENGINEERING, INC. AND SUNOCO PIPELINE, LP. FOR ANY DAMAGES RESULTING FROM ERRORS OR OMISSIONS THEREIN.
  - CONTRACTOR IS RESPONSIBLE FOR LOCATING ALL UTILITIES. CONTACT ONE CALL AT 811 PRIOR TO DIGGING.
  - SUNOCO EMERGENCY HOTLINE NUMBER IS #1-800-786-7440.

REF. DRAWING		REVISIONS		
ES-3.57	TO ES-3.58	EROSION & SEDIMENT PLAN	EP2 REVISED PER PADEP COMMENTS RECEIVED 09-06-16	
SHEET 41	TO SHEET 41	AERIAL SITE PLAN	EP1 REVISED PER PADEP COMMENTS	
			EP	
		C	ADDED GEOTECH INFO	
		B	ISSUED FOR BID	
		A	ISSUED FOR REVIEW	
DWG NO	DWG NO	DESCRIPTION	NO.	DESCRIPTION

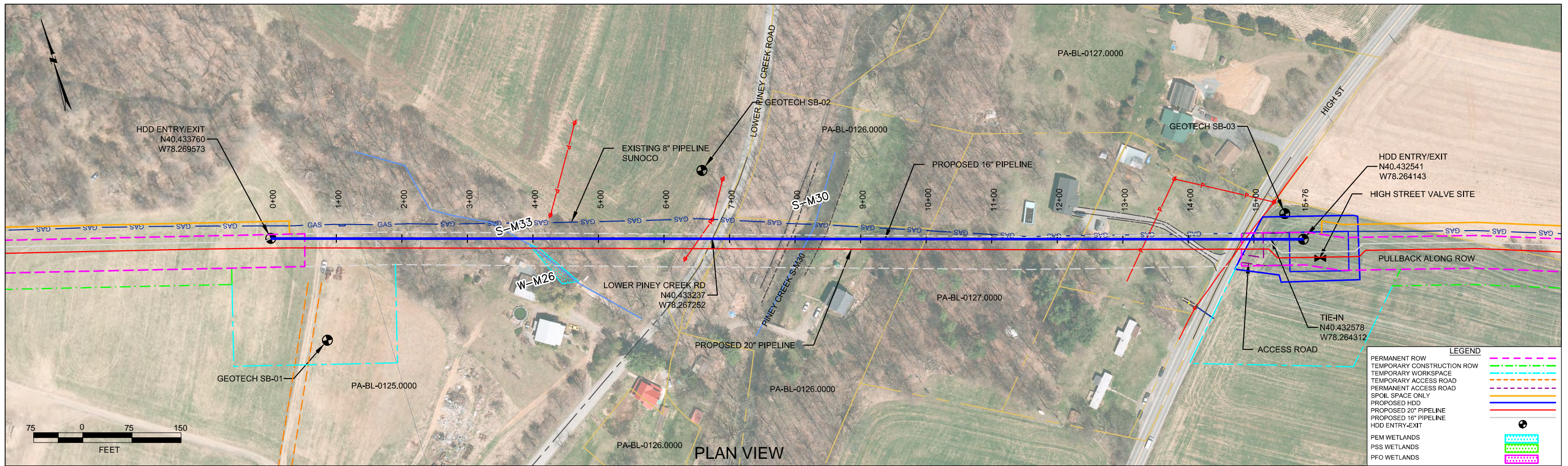
**Sunoco Logistics  
Partners L.P.**

**TETRA TECH ROONEY**  
(303) 792-5911

**SUNOCO PIPELINE, L.P.**

20-INCH HORIZONTAL DIRECTIONAL DRILL  
PINEY CREEK  
PENNSYLVANIA PIPELINE PROJECT

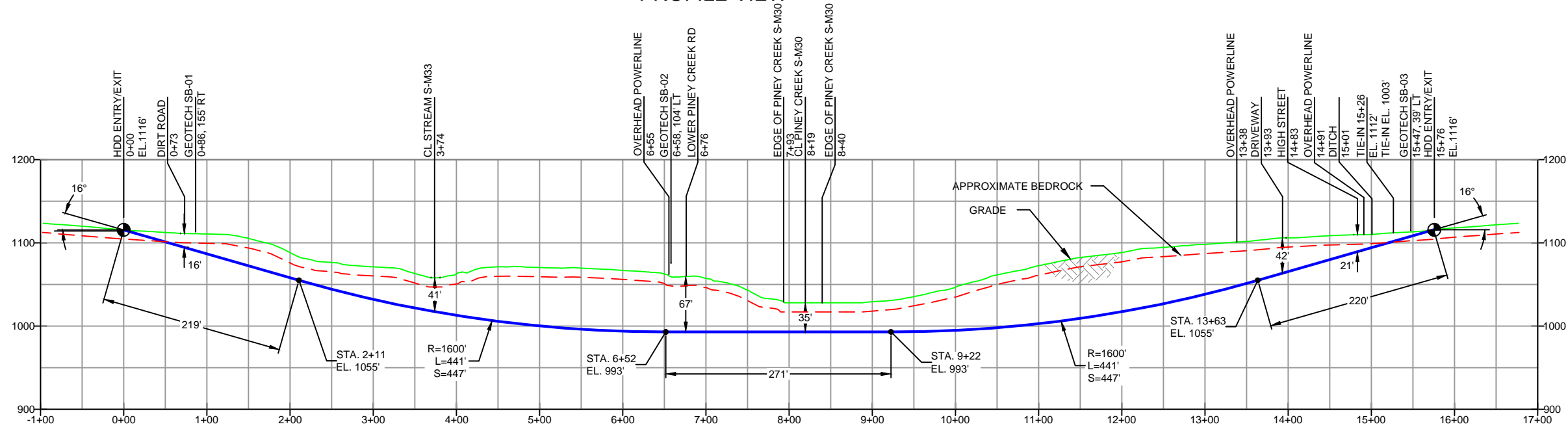
SCALE: 1"=150'	DWG. NO: PA-BL-0126.000-RD
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BLAIR COUNTY, PENNSYLVANIA - WOODBURY TOWNSHIP  
S2-0142-16

PROFILE VIEW

GEOTECH SB-01	
-NG EL. 1113'	-TOPSOIL (0' - 0.1')
-ML (0.1' - 4.0')	-SM/GM (4.0' - 10.0')
-COMPLETION DEPTH EL. 1103'	
GEOTECH SB-02	
-NG EL. 1076'	-CL/ML (0.0' - 9.4')
-FRACTURED LIMESTONE (9.4' - 17.0')	
-COMPLETION DEPTH EL. 1059'	
GEOTECH SB-03	
-NG EL. 1115'	-TOPSOIL (0' - 0.1')
-SM (0.1' - 3.6')	-CL/ML (3.6' - 4.8')
-SM/GM (4.8' - 11.8')	
-COMPLETION DEPTH EL. 1103'	



- DESIGN AND CONSTRUCTION:
- CONTRACTOR SHALL FIELD VERIFY DEPTH OF ALL EXISTING UTILITIES SHOWN OR NOT SHOWN ON THIS DRAWING.
  - THE MINIMUM SEPARATION DISTANCE FROM EXISTING SUBSURFACE UTILITIES SHALL NOT BE LESS THAN 10 FEET AS MEASURED FROM THE OUTSIDE EDGE OF THE UTILITY TO OUTSIDE OF PROPOSED PIPELINE.
  - DESIGNED IN ACCORDANCE WITH CFR 49 195 & ASME B31.4
  - CROSSING PIPE SPECIFICATION:  
HDD HORZ. LENGTH (L): 1575'  
HDD PIPE LENGTH (S): 1604'  
16" x 0.438" W.T., X-70, API5L, PSL2, ERW, BFW  
COATING: 14-16 MILS FBE WITH 30-35 MIL ARO (POWERCRETE R95)
  - INTERNAL DESIGN PRESSURE 1480 PSIG (SEAM FACTOR 1.0, DESIGN FACTOR 0.50).
  - INSTALLATION METHOD: HORIZONTAL DIRECTIONAL DRILL (HDD).
  - PIPELINE WARNING MARKERS SHALL BE INSTALLED ON BOTH SIDES OF ALL ROAD, RAILWAY, AND STREAM CROSSINGS.
  - CARRIER PIPE NOT ENCASED
  - PIPE / AMBIENT TEMPERATURE MUST BE NO LESS THAN 30°F DURING PULLBACK WITHOUT PRIOR WRITTEN APPROVAL FROM THE ENGINEER
  - CONDUCT 4-HOUR PRE-INSTALLATION HYDROTEST OF HDD PIPE STRING TO MINIMUM 1850 PSIG.
  - SEE SUNOCO PENNSYLVANIA PIPELINE PROJECT ESRI WEBMAP FOR ACCESS ROAD ALIGNMENT.
  - SUNOCO PIPELINE, L.P.'S HORIZONTAL DIRECTIONAL DRILL INADVERTENT RETURN CONTINGENCY PLAN WILL BE IMPLEMENTED AT ALL TIMES.
  - SUNOCO PIPELINE, L.P.'S EROSION AND SEDIMENTATION CONTROL PLAN WILL BE IMPLEMENTED AT ALL TIMES.

NOTES

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- CONTRACTOR IS RESPONSIBLE FOR LOCATING ALL UTILITIES. CONTACT ONE CALL AT 811 PRIOR TO DIGGING.
- SUNOCO EMERGENCY HOTLINE NUMBER IS #1-800-786-7440.

REF. DRAWING		REVISIONS	
DWG NO	DESCRIPTION	NO.	DESCRIPTION
ES-3.57	EROSION & SEDIMENT PLAN	EP2	REVISED PER PADEP COMMENTS RECEIVED 09-06-16
SHEET 41	AERIAL SITE PLAN	EP1	REVISED PER PADEP COMMENTS
		EP	
		B	ADDED GEOTECH INFO
		A	ISSUED FOR BID

**Sunoco Logistics  
Partners L.P.**

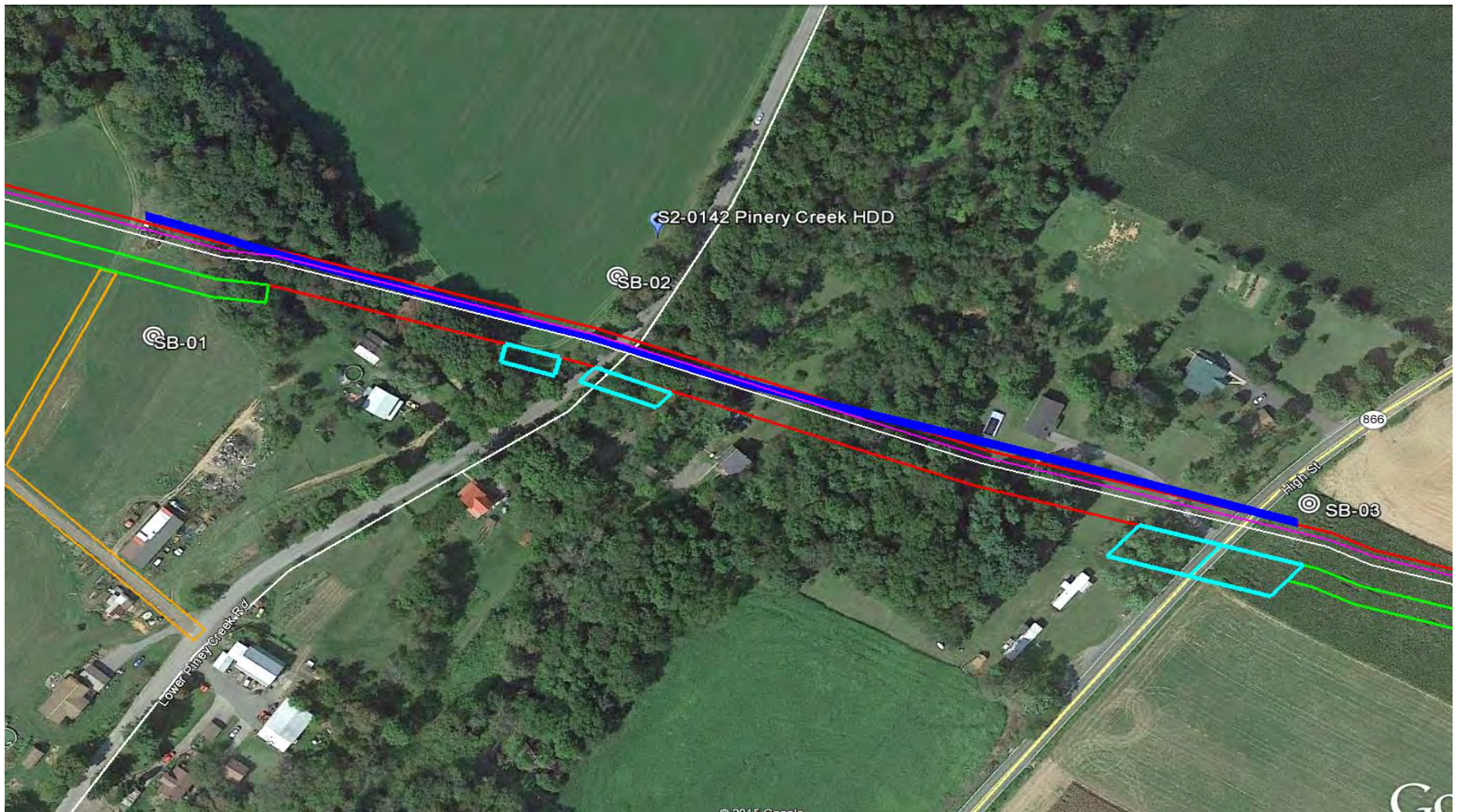
**SUNOCO PIPELINE, L.P.**

16-INCH HORIZONTAL DIRECTIONAL DRILL  
PINEY CREEK  
PENNSYLVANIA PIPELINE PROJECT

**TETRA TECH ROONEY**  
(303) 792-5911

SCALE: 1"=150'

DWG. NO: PA-BL-0126.0000-RD-16



**LEGEND:**

🎯 Geotechnical Soil Boring (SB) Locations



GEOTECHNICAL BORING LOCATIONS  
HDD S2-0142  
BLAIR COUNTY, WOODBURY TOWNSHIP, PA  
SUNOCO PENNSYLVANIA PIPELINE PROJECT



**TETRA TECH**

240 Continental Drive, Suite 200  
 Newark, Delaware 19713  
 302.738.7551  
 fax: 302.454.5988

**TEST BORING LOG**

Project Name:	SUNOCO PENNSYLVANIA PIPELINE PROJECT	Project No.:	103IP3406
Project Location:	LOWER PINEY CREEK ROAD, WILLIAMSBURG, PA	Page 1 of 1	
HDD No.:	S2-0142	Dates(s) Drilled:	01-11-15
Boring No.:	SB-01	Inspector:	E. WATT
Drilling Contractor:	HAD DRILLING	Drilling Method:	SPT - ASTM D1586
		Driller:	S. HOFFER
		Groundwater Depth (ft):	NOT ENCOUNTERED
		Total Depth (ft):	10.0

Sample No.	Sample Depth (ft)		Strata Depth (ft)		Recov. (ft)	Strata (USCS)	Description of Materials	6" Increment Blows *				N	
	From	To	From	To									
			0.0	0.1			TOPSOIL (<1")						
1	3.0	5.0	0.1	4.0	11	ML	ORANGE BROWN SILT WITH SOME FINE SAND.	1	2	33	45	35	
			4.0				GRAY FINE TO COARSE SAND AND GRAVEL WITH A LITTLE SILT (WEATHERED LIMESTONE?)						
2	8.0	8.4			3	SM/ GM	GRAY FINE TO COARSE SAND AND FINE GRAVEL (WEATHERED LIMESTONE?).	50/5"					
				10.0									
							AUGER REFUSAL AT 10'. OFF-SET BORING 21' SOUTH AND CONTINUOUSLY AUGERED TO REFUSAL AT 8'. OFF-SET AGAIN AND CONTINUOUSLY AUGERED TO REFUSAL AT 8.5 FEET. DRY AND CAVED AT 8'.						

Notes/Comments:  
Pocket Pentrometer Testing DR: DECOMPOSED ROCK

Strata (USCS) Designations are approximated based on visual review, except where indicated in Description of Materials.

\* Number of blows of 140 lb. Hammer dropped 30 in. required to drive 2 in. split-spoon sampler in 6 in. increments.  
 N: Number of blows to drive spoon from 6" to 18" interval.





**TETRA TECH**

240 Continental Drive, Suite 200  
 Newark, Delaware 19713  
 302.738.7551  
 fax: 302.454.5988

**TEST BORING LOG**

Project Name: SUNOCO PENNSYLVANIA PIPELINE PROJECT			Project No.: 103IP3406		
Project Location: PA 866 (HIGH STREET), WILLIAMSBURG, PA			Page 1 of 1		
HDD No.: S2-0142		Dates(s) Drilled: 01-13-15		Inspector: E. WATT	
Boring No.: SB-03		Drilling Method: SPT - ASTM D1586		Driller: S. HOFFER	
Drilling Contractor: HAD DRILLING		Groundwater Depth (ft): NOT ENCOUNTERED		Total Depth (ft): 11.8	

Sample No.	Sample Depth (ft)		Strata Depth (ft)		Recov. (ft)	Strata (USCS)	Description of Materials	6" Increment Blows *				N
	From	To	From	To								
			0.0	0.1			TOPSOIL (1")					
1	3.0	5.0	0.1		13	SM	LIGHT GRAY FINE SAND WITH SOME SILT, WITH A LITTLE FINE GRAVEL.	4	12	18	12	30
			3.6	4.8		CL/ML	ORANGE BROWN CLAY AND SILT, TRACE FINE SAND.					
2	8.0	8.4	4.8		3	SM/GM	GRAY FINE TO COARSE SAND AND GRAVEL WITH A SOME SILT (WEATHERED LIMESTONE?)	50/5"				
3	11.0	11.1		11.8	0		NO RETURN.	50/1"				
							AUGER REFUSAL AT 11'. OFF-SET BORING AND CONTINUOUSLY AUGERED TO REFUSAL AT 11.8'.					
							STARTED GRINDING BETWEEN 6 AND 7'.					
							DRY AND CAVED AT 9.5'.					

Notes/Comments:  
Pocket Pentrometer Testing DR: DECOMPOSED ROCK  
 S1 (AT 4'): 2.5 TSF S1 SAMPLE TAKEN FROM CLAY/SILT PORTION.

Strata (USCS) Designations are approximated based on visual review, except where indicated in Description of Materials.

\* Number of blows of 140 lb. Hammer dropped 30 in. required to drive 2 in. split-spoon sampler in 6 in. increments.  
 N: Number of blows to drive spoon from 6" to 18" interval.

**GEOTECHNICAL LABORATORY TESTING SUMMARY  
SUNOCO PENNSYLVANIA PIPELINE PROJECT  
HDD S2-0142**

HDD No.	Test Boring No.	Sample No.	Depth of Sample (ft.)		Water Content, % (ASTM D2216)	Percent Silts/Clays, % (ASTM D1140)	Atterburg Limits (ASTM D4318)			USCS Classif. (ASTM D2487)
			From	To			Liquid Limit, %	Plastic Limit, %	Plasticity Index, %	
S2-0142	SB-01	1	3.0	5.0	3.1	19.8	-	-	-	-
		2	8.0	8.4	6.2	30.5	-	-	-	-
	SB-02	1	3.0	5.0	25.4	95.5	-	-	-	-
		2	8.0	9.4	27.7	63.2	32	23	9	CL/ML
	SB-03	1	3.0	5.0	30.5	96.6	34	25	11	CL/ML
		2	8.0	8.4	3.2	29.6	-	-	-	-

Rock Core Testing Results				
Boring No.	Core Run	Approximate Depth (ft)	Compressive Strength (psi)	Unit Weight (pcf)
SB-02	2	14	16,180	174.5

**Notes:**

- 1) Sample depths based on feet below grade at time of exploration.

**REGIONAL GEOLOGY SUMMARY  
SUNOCO PENNSYLVANIA PIPELINE PROJECT  
HDD S2-0140**

HDD No.	NAME	BORING NO.	REGIONAL GEOLOGY DESCRIPTION	GENERAL TOPOGRAPHIC SETTING	BEDROCK FORMATION	GENERAL ROCK TYPE	APPROX MAX FM THICKNESS (FT)	DEPTH TO ROCK (Ft bgs) based on nearby well drilling logs	NOTES / COMMENTS
S2-0142	Piney Creek Road	SB-01	Coburn Formation - consists of medium-gray to very dark gray, fossiliferous limestone and shaly limestone	Upland to mid-ridge	Coburn	Highly fossiliferous limestones and black shaly limestones to increasingly argillaceous		5-37	Karst conditions may be present, numerous depressions are mapped
		SB-02							Yields 6-25 gpm
		SB-03							The lower and middle portions of the Coburn Formation consist of interbedded crystalline, highly fossiliferous (conodonts) limestones and black shaly limestones, and the upper Coburn becomes increasingly argillaceous as it grades into the overlying Antes Shale.

*Note* : Source of well log data - <http://www.dcnr.state.pa.us/topogeo/groundwater/pagwis/records/index.htm>. All other sources as referenced in comments section.

**ROCK CORE DESCRIPTION SUMMARY  
SUNOCO PENNSYLVANIA PIPELINE PROJECT  
HDD S2-0142**

Location	Boring No.	Core Run	Core Depth (ft)		TCR (%)	SCR (%)	RQD (%)	Depth (ft)		Weathering	Classification	Bedding Thickness (ft)	Color	Discontinuity Data
			From	To				From	To					
S2-142	SB-2	1	9	12	94	22	17	9	12	Moderate	Limestone	Massive	Light Gray	Slightly fractured, Avg. Dip 37° (20° - 45°); Calcite infilling of small fractures
S2-142	SB-2	2	12	17	92	56	54	12	17	Moderate	Limestone	Massive	Light Gray	Slightly fractured, Avg. Dip 28° (15° - 60°); Calcite infilling of small fractures

# FIELD DESCRIPTION AND LOGGING SYSTEM FOR SOIL EXPLORATION

## GRANULAR SOILS

(Sand, Gravel & Combinations)

<u>Density</u>	<u>N (blows)*</u>
Very Loose	5 or less
Loose	6 to 10
Medium Dense	11 to 30
Dense	31 to 50
Very Dense	51 or more

### Particle Size Identification

Boulders	8 in. diameter or more
Cobbles	3 to 8 in. diameter
Gravel	Coarse (C) 3 in. to ¾ in. sieve
	Fine (F) ¾ in. to No. 4 sieve
Sand	Coarse (C) No. 4 to No. 10 sieve (4.75mm-2.00mm)
	Medium No. 10 to No. 40 sieve (M) (2.00mm – 0.425mm)
	Fine (F) No. 40 to No. 200 sieve (0.425 – 0.074mm)
Silt/Clay	Less Than a No. 200 sieve (<0.074mm)

### Relative Proportions

<u>Description Term</u>	<u>Percent</u>
Trace	1 - 10
Little	11 - 20
Some	21 - 35
And	36 - 50

## COHESIVE SOILS

(Silt, Clay & Combinations)

<u>Consistency</u>	<u>N (blows)*</u>
Very Soft	3 or less
Soft	4 to 5
Medium Stiff	6 to 10
Stiff	11 to 15
Very Stiff	16 to 30
Hard	31 or more

### Plasticity

<u>Degree of Plasticity</u>	<u>Plasticity Index</u>
None to Slight	0 - 4
Slight	5 - 7
Medium	8 - 22
High to Very High	> 22

## ROCK

(Rock Cores)

<u>Rock</u> <u>Quality Designation</u> <u>(RQD), %</u>	<u>Rock</u> <u>Quality Descripti</u> <u>on</u>
0-25	Very Poor
25-50	Poor
50-75	Fair
75-90	Good
90-100	Excellent

**\*N - Standard Penetration Resistance.** Driving a 2.0" O.D., 1-3/8" I.D. sampler a distance of 18 inches into undisturbed soil with a 140 pound hammer free falling a distance of 30.0 inches. The number of hammer blows to drive the sampler through each 6 inch interval is recorded; the number of blows required to drive the sampler through the final 12 inch interval is termed the Standard Penetration Resistance (SPR) N-value. For example, blow counts of 6/8/9 (through three 6-inch intervals) results in an SPR N-value of 17 (8+9).

**Groundwater** observations were made at the times indicated. Groundwater elevations fluctuate throughout a given year, depending on actual field porosity and variations in seasonal and annual precipitation.

**UNIFIED SOIL CLASSIFICATION SYSTEM [Casagrande (1948)]**

Major Divisions		Group Symbols	Typical Descriptions	Laboratory Classifications			
Coarse Grained Soils (More than half of material is larger than No. 200 sieve)	Gravels More than half of coarse fraction is larger than No. 4 sieve size	Clean gravel (Little or no fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3  Not meeting $C_u$ or $C_c$ requirements for GW		
			GP	Poorly graded gravels, gravel-sand mixtures, little or no fines			
		Gravel with fines (Appreciable amount of fines)	GM	Silty gravels, gravel-sand-silt mixtures	Atterberg limits below A Line or $I_p$ less than 4	Limits plotting in hatched zone with $I_p$ between 4 and 7 are borderline cases requiring use of dual symbols	
			GC	Clayey gravels, gravel-sand-clay mixtures	Atterberg limits above A line with $I_p$ greater than 7		
	Sands (More than half of coarse fraction is smaller than No. 4 Sieve)	Clean sands (Little or no fines)	SW	Well graded sands, gravelly sands, little or no fines	$C_u = \frac{D_{60}}{D_{10}}$ greater than 6; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3  Not meeting $C_u$ or $C_c$ requirements for SW		
			SP	Poorly graded sands, gravelly sands, little or no fines			
		Sands with fines (Appreciable amount of fines)	SM	Silty sands, sand-silt mixtures	Atterberg limits below A Line or $I_p$ less than 4	Limits Plotting in hatched zone with $I_p$ between 4 and 7 are borderline cases requiring use of dual symbols	
			SC	Clayey sands, sand-clay mixtures	Atterberg limits above A line with $I_p$ greater than 7		
		Determine Percentage of sand and gravel from grain size curve. Depending on Percentage of fines (fraction smaller than No. 200 sieve), coarse-grained soils are classified as follows:  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 <sup>(1)</sup>					
		Major Divisions	Group Symbols	Typical Descriptions		For soils plotting nearly on A line use dual symbols i.e., $I_p = 29.5$ , $w_L = 60$ gives CH-MH. When $w_L$ is near 50 use CL-CH or ML-MH. Take near as $\pm 2$ percent.	
Fine-grained soils (More than half of material is smaller than No. 200 sieve)	Silt and clays (Liquid limit less than 50)	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity				
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays				
		OL	Organic silts and organic silty clays of low plasticity				
	Silt and Clays (Liquid limit greater than 50)	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts				
		CH	Inorganic clays of high plasticity, fat clays				
		OH	Organic clays of medium to high plasticity, organic silts				
	Highly organic soils	Pt	Peat and other highly organic soils				

(1) Borderline classifications, used for soils possessing characteristics of two groups, are designated by combinations of group symbols. For example: GW-GC. well-graded gravel-sand mixture with clay binder.