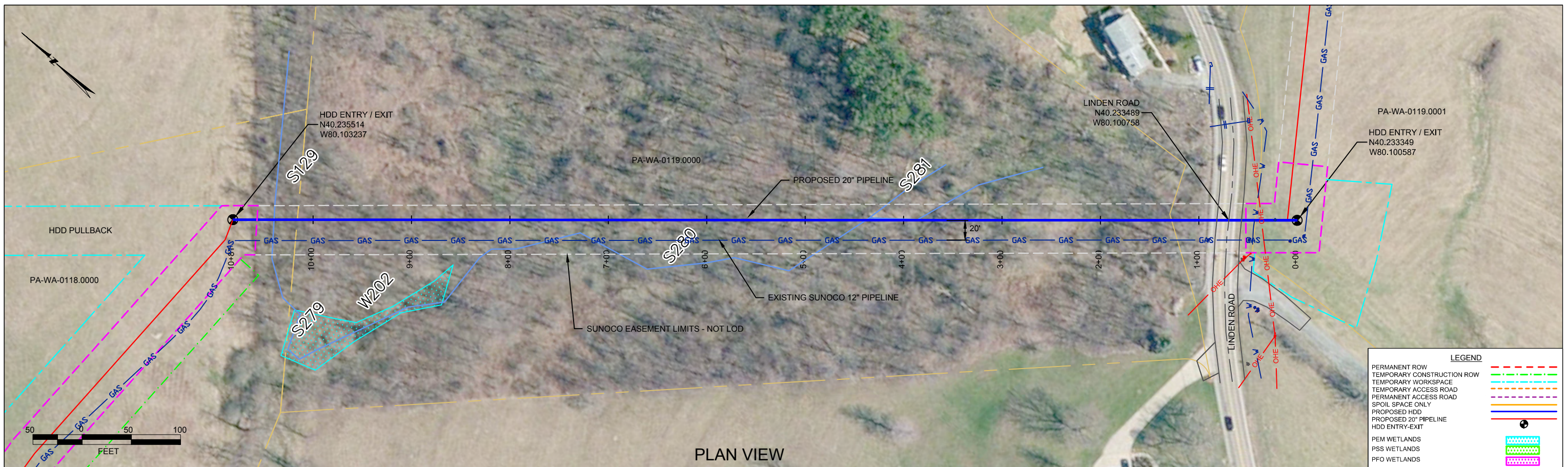


HDD PA-WA-0119.0000-RD (S129, S279, S280, S281, W202)

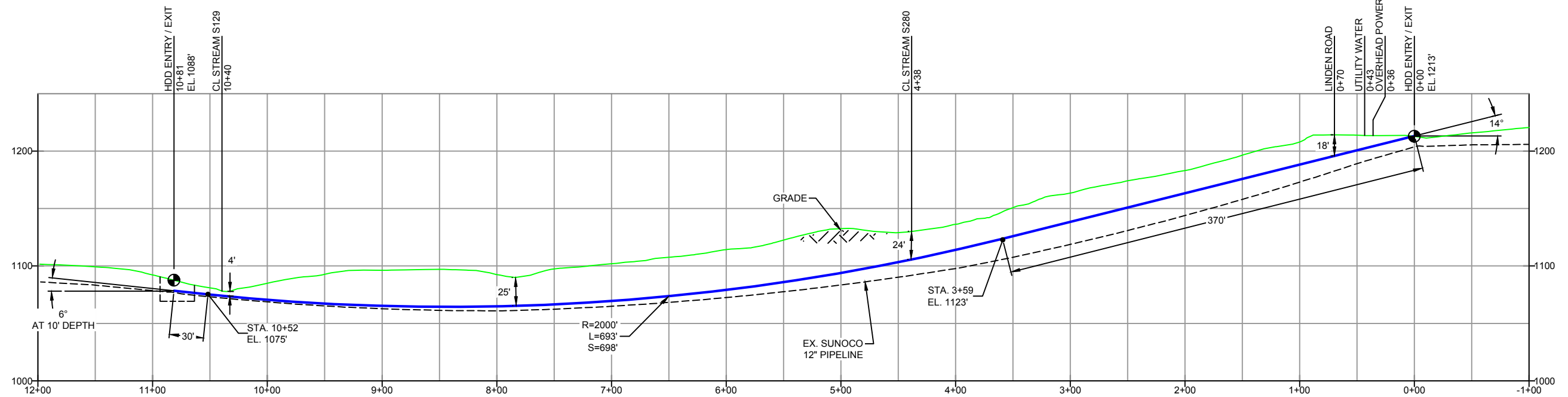
Given the design, the threat of inadvertent return has been reduced to the maximum extent practicable and in this case that threat is considered to be low. Implementing this design, along with adherence to the Pennsylvania Pipeline Project Inadvertent Return Contingency Plan will ensure inadvertent impacts,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

The drill will enter/exit 30 feet from the western edge of a Stream 129 (S129) and enter/exit 1000 feet from the eastern edge. The horizontal directional drill will enter/exit 650 feet from the western edge of streams 280 and 281 (S280, S281) and enter/exit 430 feet from the eastern edge. The drill will cross below S129 at 4 feet and S280/S281 at 25 feet. The 20" drill will parallel the existing ME1 12" pipeline drill. The geotechnical results from the previous drill, as well as other data points, were used to determine the entry/exit angles, and depths to pass through the best substrates while maintaining the pipe integrity (e.g., no large bends). According to the geotechnical report the primary substrate at both crossings (S129 and S280/S281) is estimated to be rock. Based on the geotechnical report, the drill profile, and the previous drill data minimal inadvertent returns are expected.



PLAN VIEW
PROFILE VIEW

WASHINGTON COUNTY, PENNSYLVANIA - NORTH STRABANE TOWNSHIP
S1B-0080



- 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=): 1081'
HDD PIPE LENGTH (S=): 1098'
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

- 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-1.35	TO	ES-1.35	EROSION & SEDIMENT PLAN							
SHEET 22	TO	SHEET 22	AERIAL SITE PLAN							
			EP2	REVISED PER PADEP COMMENTS RECEIVED 09-06-16	MRS	09/30/16	RMB	09/30/16	AAW	09/30/16
			EP1	REVISED PER PADEP COMMENTS	MRS	05/17/16	RMB	05/17/16	AAW	05/17/16
			EP		DLM	03/15/16	RMB	03/15/16	AAW	03/15/16
DWG NO	DWG NO	DESCRIPTION	NO.	DESCRIPTION	BY	DATE	CHK	DATE	APP	DATE

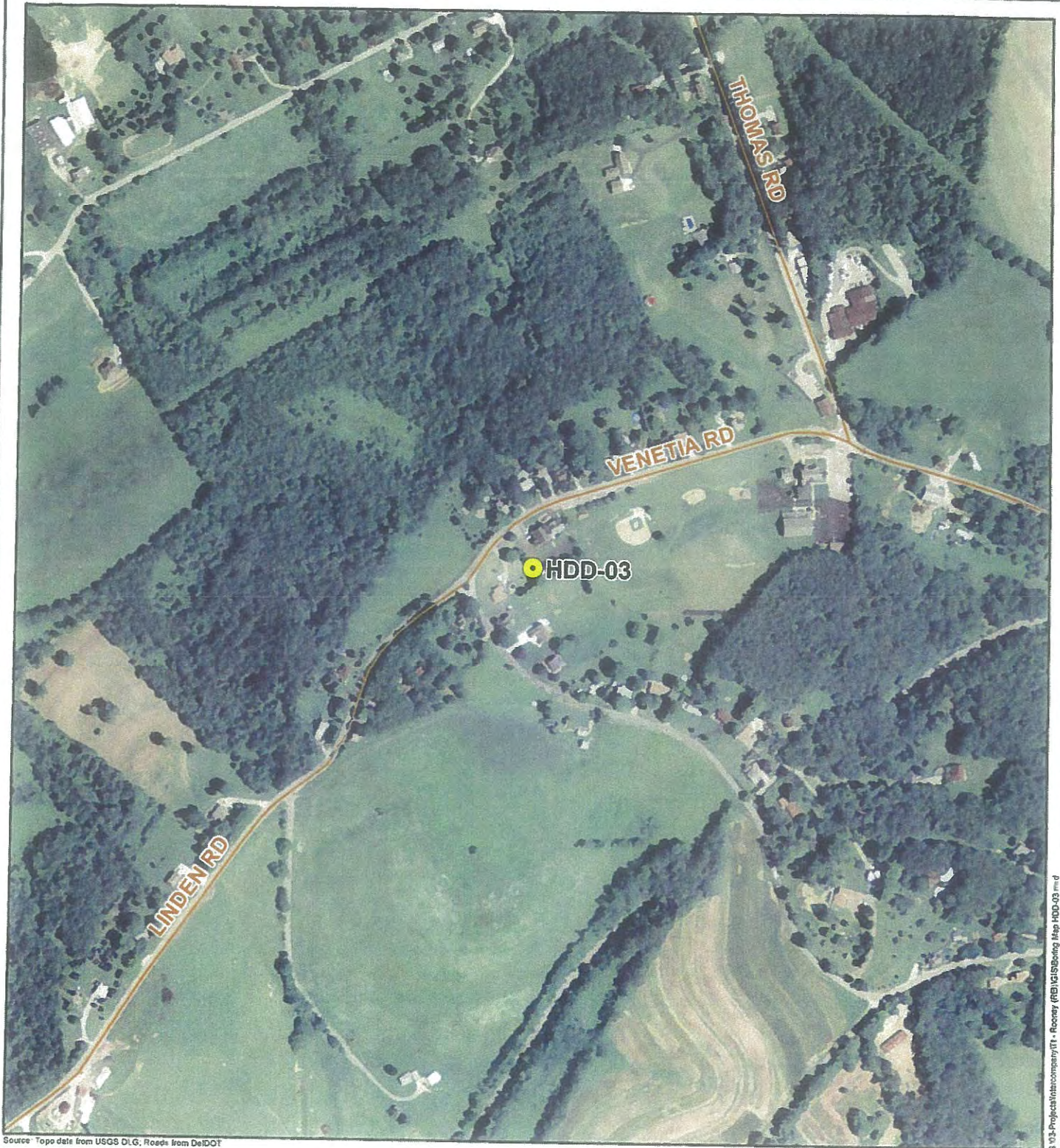
Sunoco Logistics Partners L.P.

TETRA TECH ROONEY
(303) 792-5911

SUNOCO PIPELINE, L.P.

20-INCH HORIZONTAL DIRECTIONAL DRILL
LINDEN ROAD
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=100'
DWG. NO: PA-WA-0119.0000-RD

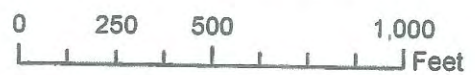


Source: Topo data from USGS DLG, Roads from DelDOT

S:\03-Projects\InfoCompany\IT - Rooney (R)\GIS\Boring Map HDD-03.mxd



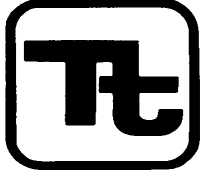
Figure
Boring Location HDD-03
Sunoco Mariner East Project
Washington County, PA



1 inch = 500 feet

Tt Tetra Tech, Inc.
 Phone: (302) 738-7551
 Toll Free: (800) 462-0910
 www.tetrattech.com

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TETRA TECH

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

TEST BORING LOG

Project Name: SUNOCO MARINER EAST			Project No.: 103IP2762		
Project Location: WASHINGTON COUNTY, PA			Page 1 of 1		
Test Boring No.: HDD-03		Dates(s) Drilled: 06/12/13		Inspector: E. WATT	
Drilling Contractor: CONNELLY		Drilling Method: SPT - ASTM D1586		Driller: T. REDMAN	
Surface Elevation (ft):			Groundwater Depth (ft): Not Encountered		Total Depth (ft): 23.2

Sample No.	Sample Depth (ft)		Strata Depth (ft)		Recov. (in)	Strata (USCS)	Description of Materials	6" Increment Blows *			N
	From	To	From	To							
1	3.5	5.0	0.0		15	CL	MOTTLED BROWN AND GRAY SILTY CLAY WITH A LITTLE FINE SAND, TRACE MICA. USCS: CL	4	5	8	13
				7.5							
2	8.5	10.0	7.5		12	ML	BLACK CLAYEY SILT, TRACE FINE SAND. HAS APPEARANCE OF COAL?	9	10	11	21
				11.0							
3	13.5	15.0	11.0		18	ML/SM	BROWN TO GRAY SILT AND FINE SAND (WEATHERED SANDSTONE/SHALE)	20	25	15	40
4	18.5	19.4			11			BROWN TO GRAY FINE SAND AND SILT (WEATHERED SANDSTONE/SHALE). ROCK FRAGMENTS IN SPOON TIP.	30	50/5"	
5	23.0	23.3	19.0	23.3			PARTIALLY WEATHERED LIGHT GRAY SILTSTONE.	50/3"			
							AUGER REFUSAL ENCOUNTERED AT 23.0'.				
							OFF-SITE BORING AND CONTINUOUSLY DRILLED TO AUGER REFUSAL AT 22.0 FEET.				

Notes/Comments:
Pocket Pentrometer Testing
 S1: 2.75 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.

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 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 ⁽¹⁾					
		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 ± 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.