

HDD PA-AL-0001.0000-RR (W38)

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 420 feet from the western edge of a potential grassy wetland (W38) and enter/exit 760 feet from the eastern edge. The horizontal directional drill will enter/exit 200 feet from the western edge of the CSX Railroad and enter/exit 950 feet from the eastern edge. The western edge Bunola Road is 580 feet from the anticipated entry/exit of the drill while the eastern edge of the road is 570 feet from the eastern entry/exit of the drill. The drill will cross below the CSX Railroad at 28 feet, the wetland W38 at 35 feet, and Bunola Road at 45 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 reports the primary substrate at all of the crossings is estimated to be silty sands and clay. Based on the geotechnical reports, the drill profile, and the previous drill data no inadvertent returns are expected.



Source: Topo data from USGS DLG; Roads from DelDOT

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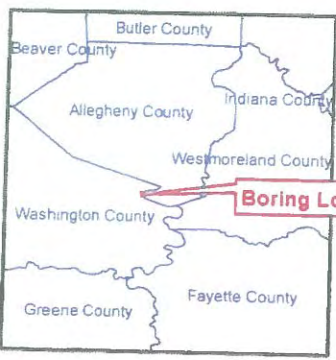


Figure
Boring Location HDD-09
Sunoco Mariner East Project
Allegheny County, PA



1 inch = 500 feet

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 Toll Free: (800) 462-0910
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Source: Topo data from USGS DLG. Roads from DelDOT

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Figure
Boring Location HDD-10
Sunoco Mariner East Project
Allegheny County, PA



1 inch = 500 feet

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TETRA TECH
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TEST BORING LOG

Project Name: SUNOCO MARINER EAST			Project No.: 103IP2762		
Project Location: ALLEGHANY COUNTY, PA			Page 1 of 1		
Test Boring No.: HDD-09		Dates(s) Drilled: 09/09/13		Inspector: E. WATT	
Drilling Contractor: CONNELLY		Drilling Method: SPT - ASTM D1586		Driller: K. KERCH	
Surface Elevation (ft):		Groundwater Depth (ft): 24.5		Total Depth (ft): 78.5	

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		6	SM	LIGHT BROWN FINE TO MEDIUM SAND WITH A TRACE OF SANDSTONE GRAVEL, AND A LITTLE SILT (HISTORIC FILL).	3	4	5	9	
2	8.5	10.0		12.0	2		LIGHT BROWN FINE TO MEDIUM SAND WITH A TRACE OF SANDSTONE GRAVEL, AND A LITTLE SILT (HISTORIC FILL).	3	3	5	8	
3	13.5	15.0	12.0		10	CL	MOTTLED BROWN AND GRAY SILTY CLAY, TRACE MICA, TRACE TO LITTLE SILT. USCS: CL	2	3	3	6	
4	18.5	20.0			18		BROWN SILTY CLAY WITH SOME FINE SAND, TRACE MICA.	3	3	3	6	
5	23.5	25.0		27.0	18	SM	BROWN SANDY CLAY, TRACE MICA.	1	1	2	3	
6	28.5	30.0	27.0		1		BROWN FINE TO MEDIUM SAND WITH A LITTLE SILT.	2	3	3	6	
7	33.5	35.0			18		BROWN FINE TO MEDIUM SAND WITH A LITTLE SILT.	3	3	6	9	
8	38.5	40.0			18		BROWN FINE TO MEDIUM SAND WITH A LITTLE SILT. 2" BLACK SEAM PRESENT (LIGNITE?)	1	3	4	7	
9	43.5	45.0			18		BROWN FINE TO MEDIUM SAND WITH A LITTLE SILT.	3	4	7	11	
10	48.5	50.0			18		BROWN FINE TO MEDIUM SAND WITH A LITTLE SILT. 2" BLACK SEAM PRESENT (LIGNITE?).	3	6	7	13	
11	53.5	55.0			18		BROWN FINE TO MEDIUM SAND WITH A LITTLE SILT, WITH A LITTLE FINE GRAVEL, INTERLAYERED WITH "LIGNITE?".	3	17	30	47	
12	58.5	60.0			17		BROWN FINE TO COARSE SAND WITH A LITTLE SILT, WITH A LITTLE FINE GRAVEL.	8	16	17	33	
13	63.5	65.0	62.0		18		SC	DECOMPOSED ROCK WEATHERED TO A MULT-COLORED FINE TO MEDIUM SAND, WITH SOME CLAY.	19	32	50	82
14	68.5	68.6		68.6	<1			LIGHT GRAY PARTIALLY WEATHERED SILTSTONE.	50/1"			
							AUGER REFUSAL AT 68.5'.					
							ROCK CORING					
RUN 1	68.5	73.5	68.5			ROCK*	ROCK CORING: 88% RECOVERY, 37% RQD					
RUN 2	73.5	78.5		78.5			ROCK CORING: 95% RECOVERY, 58% RQD					
							*PREDOMINATELY GRAY AND GREENISH GRAY SILTSTONE, WITH A THIN SEAM OF CALCEROUS CLAYSTONE, AND A THIN SEAM OF GRAY LIMESTONE.					

Notes/Comments:
Pocket Penetrometer Testing
 S3: 0.75 TSF
 S4: 0.75 TSF
 S13: > 4 TSF

WET ON SPOON AT 28.0'.
 WATER LEVEL THROUGH AUGERS AT 24.5'.

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.



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TEST BORING LOG

Project Name: SUNOCO MARINER EAST			Project No.: 103IP2762		
Project Location: ALLEGHANY COUNTY, PA			Page 1 of 1		
Test Boring No.:	HDD-10	Dates(s) Drilled:	06/11/13	Inspector:	E. WATT
Drilling Contractor:	CONNELLY	Drilling Method:	SPT - ASTM D1586	Driller:	T. REDMAN
Surface Elevation (ft):		Groundwater Depth (ft):	49.5'	Total Depth (ft):	55.5

Sample No.	Sample Depth (ft)		Strata Depth (ft)		Recov. (ft)	Strata (USCS)	Description of Materials	6" Increment Blows *			N
	From	To	From	To							
1	3.5	5.0	0.0		18	SM	BROWN FINE TO MEDIUM SAND, TRACE FINE GRAVEL, APPEARS	4	7	8	15
				4.5			TO BE POTENTIAL FILL MATERIAL.				
				4.5			MOTTLED BROWN AND GRAY SILTY CLAY WITH A LITTLE				
			7.0		CL	FINE SAND.					
2	8.5	10.0	7.0		16	SM	MEDIUM BROWN FINE SAND WITH A LITTLE SILT.	6	6	8	14
3	13.5	15.0			13		MEDIUM BROWN FINE SAND WITH A LITTLE SILT.	5	8	8	16
4	18.5	20.0			14		MEDIUM BROWN FINE SAND WITH A LITTLE SILT.	7	8	8	16
5	23.5	25.0			14		MEDIUM BROWN FINE SAND WITH A LITTLE SILT.	5	6	8	14
6	28.5	30.0			10		MEDIUM BROWN CLAYEY FINE TO MEDIUM SAND.	WH	1	2	3
			32.0								
7	33.5	35.0	32.0		18	CL	GRAY TO BROWN SILTY CLAY WITH A LITTLE FINE SAND.	3	5	7	12
8	38.5	40.0			18		GRAY SILTY CLAY WITH A LITTLE FINE SAND; USCS: CL	3	6	5	11
9	43.5	45.0			9		GRAY SILTY CLAY WITH A LITTLE FINE SAND, TRACE COARSE	6	8	10	18
							GRAVEL.				
10	48.5	50.0			6		GRAYGRAVELLY AND SANDY CLAY.	8	10	12	22
11	53.5	55.0			16		REDDISH BROWN SILTY CLAY, WITH VARYING AMOUNTS OF	31	30	27	57
			55.5				FINE SAND.				
12	55.5	55.5	55.5		<1		AUGER REFUSAL AT 55.0'. PIECES OF LIGHT GRAY TO REDDISH	50/0"			
			55.5				BROWN PARTIALLY WEATHERED SILTSTONE OR CLAYSTONE.				
							MOIST IN SPOON AT 29'; HOWEVER, NO WATER WITHIN AUGERS.				
							WATER LEVEL THROUGH AUGERS AT 49.5'.				

Notes/Comments:

Pocket Penetrometer Testing
 S1: 2.5 TSF
 S7: 2.25 TSF
 S8: 1.25 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	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 ⁽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	MH or OH			
		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.