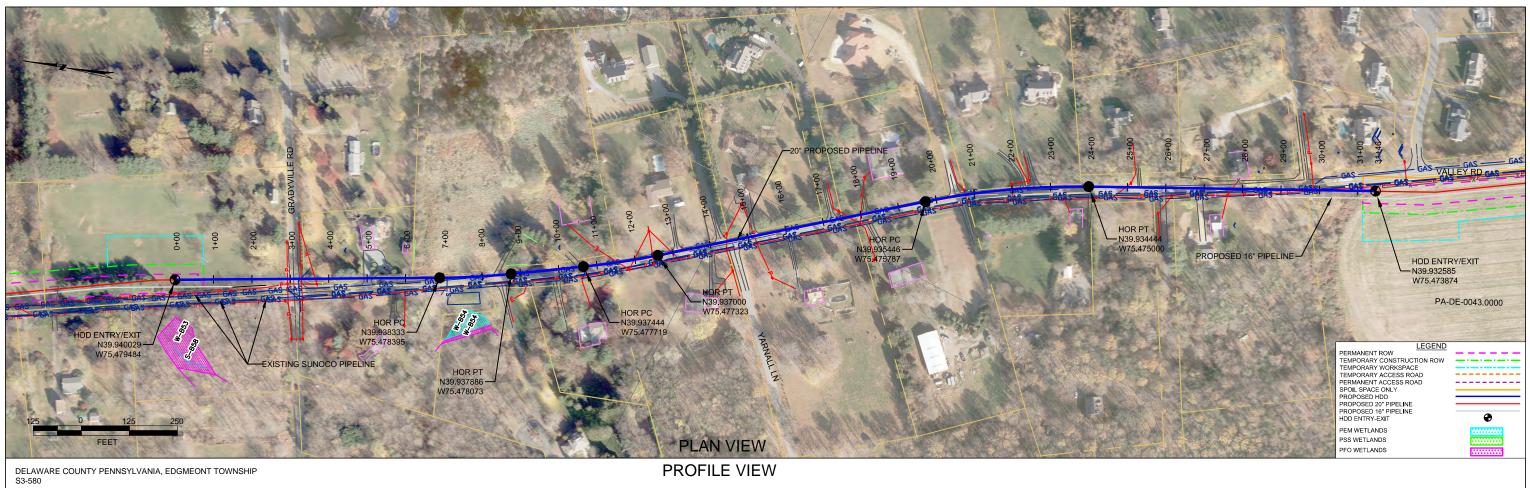
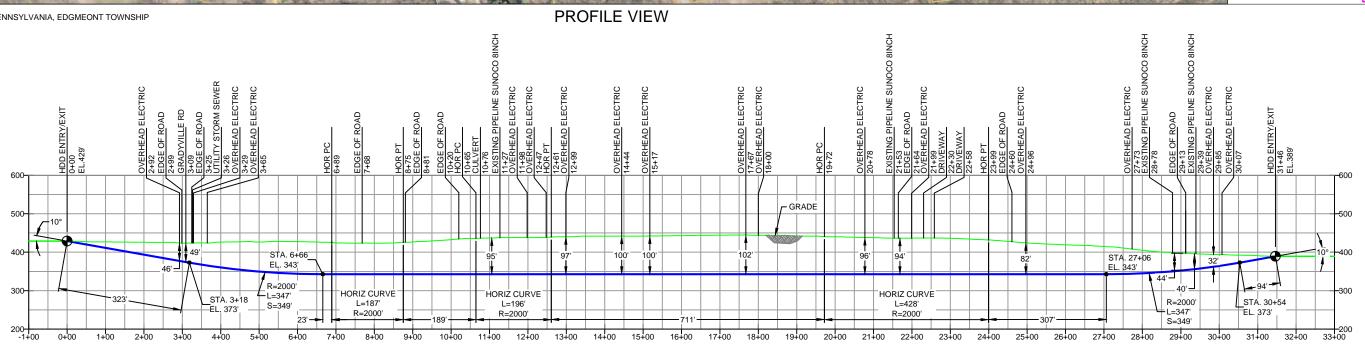
HDD PA-DE-0032.0000-RD (Valley Road)

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 798 feet northwest of Valley Road. The drill will continue under Valley Road for approximately 2115 feet. This point is 233 feet northwest of the southeast entry/exit point. The drill will pass between 49 and 102 feet under this road. 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 clayey sand, silty sand, schist, and gneiss.





- DESIGN AND CONSTRUCTION:

 1. CONTRACTOR SHALL FIELD VERIFY DEPTH OF ALL EXITING UTILITIES SHOWN OR NOT SHOWN ON THIS DRAWING.

 2. 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.

 3. DESIGNED IN ACCORDANCE WITH CFR 49 195 & ASME B31.4

 4. CROSSING PIPE SPECIFICATION:

 HOD HORZ. LENGTH (L=):3146'
 HDD PIPE LENGTH (S=):3156'
 20" X 0.456" W.T., X-65, APISL, PSL2, ERW, BFW
 COATING: 14-16 MILS FEE WITH 30-35 MIL ARO (POWERCRETE R95)

- INTERNAL DESIGN PRESSURE 1480 PSIG (SEAM FACTOR 1.0, DESIGH FACTOR 0.50).
 INSTALLATION METHOD: HORIZONTAL DIRECTIONAL DRILL (HDD).
 PIPIELINE 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.

L				COATING: 14-16 MILS F	BE WITH	30-35 MIL ARO (POWERCRETE R95)						
	NOTES		REF. D	RAWING		REVISIONS						
	1. ALL COORDINATES SHOWN ARE IN LATITUDE AND LONGITUDE. ALL MSL ELEVATIONS ARE NAD83	ES-6.07	TO ES-6.09	EROSION & SEDIMENT PLAN								
	STATIONING IS BASED ON HORIZONTAL DISTANCES. ROONEY ENGINEERING, INC. AND SUNOCO PIPELINE, LP ARE NOT RESPONSIBLE FOR LOCATION	SHEET 4	TO SHEET 5	AERIAL SITE PLAN	EP1	REVISED PER PADEP COMMENTS	MRS	05/10/16	RMB	05/10/16	AAW (05/10/16
	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.				EP		MRS	02/26/16	RMB	02/26/16	AAW (02/26/16
	LP, FOR ANY DAMAGES RESULTING FROM ERRORS OR OMISSIONS THEREIN.				С	ISSUED FOR BID	DLM	08/21/15	RMB	08/21/15	AAW (08/21/15
	 CONTRACTOR IS RESPONSIBLE FOR LOCATING ALL UTILITIES. CONTACT ONE CALL AT 811 PRIOR TO DIGGING. 				В	ISSUED FOR BID	DLM	07/31/15	RMB	07/31/15	AAW (07/31/15
	5. SUNOCO EMERGENCY HOTLINE NUMBER IS #1-800-786-7440.				Α	ISSUED FOR REVIEW	RTT	03/27/15	RMB	03/27/15	AAW (03/27/15
		DWG NO	DWG NO	DESCRIPTION	NO.	DESCRIPTION	BY	DATE	СНК	DATE	APP	DATE



20-INCH HORIZONTAL DIRECTIONAL DRILL GRADYVILLE RD

TH.	TETRA TECH (303) 792–5911	ROONEY
ت	(303) 792-5911	

PENNSYLVANIA PIPELINE PROJECT

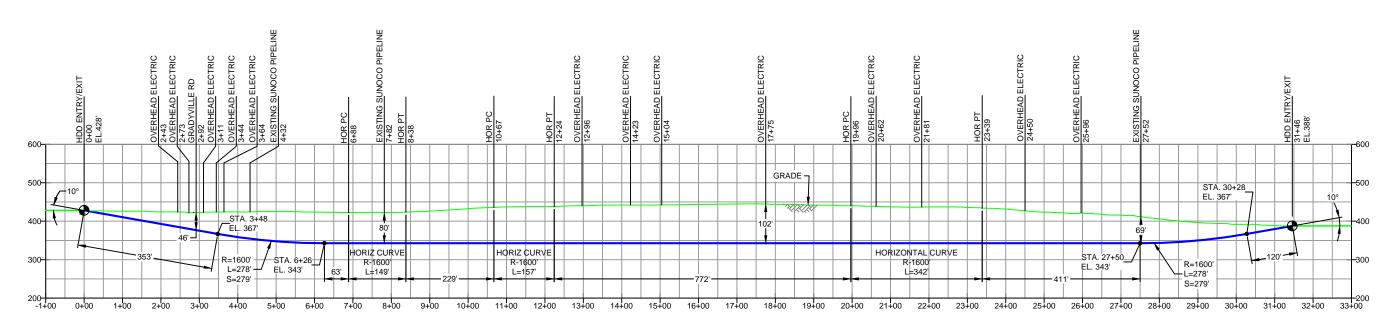
SUNOCO PIPELINE, L.P.

SCALE: 1"=250' DWG. NO: PA-DE-0032.0000-RD



S3-0580-16





- DESIGN AND CONSTRUCTION:

 1. CONTRACTOR SHALL FIELD VERIFY DEPTH OF ALL EXITING UTILITIES SHOWN OR NOT SHOWN ON THIS DRAWING.

 1. 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.

 3. DESIGNAED IN ACCORDANCE WITH CFR 49 195 & ASME B31.4

 4. CROSSING PIPE SPECIFICATION:
 HDD HORZ. LENGTH (L=):3146'
 HDD PIPE LENGTH (S=):3154'
 16' x 0.438' WT. X.70, APISL. PSL2. ERW. RFW

- 16" x 0.438" W.T., X-70, API5L, PSL2, ERW, BFW

- INTERNAL DESIGN PRESSURE 1480 PSIG (SEAM FACTOR 1.0, DESIGH FACTOR 0.50).
 INSTALLATION METHOD: HORIZONTAL DIRECTIONAL DRILL (HDD).
 PIPIELINE 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.

				COATING: 14-16 MILS FE	BE WITH	30-35 MIL ARO (POWERCRETE R95)						
NOTES			REF. DR	AWING		REVISIONS						
1. ALL COORDINATES SHOWN ARE IN LATITUDE AND LONGITUDE. ALL MSL ELEVATIONS ARE NAD83	ES-6.07	то	ES-6.09	EROSION & SEDIMENT PLAN								
STATIONING IS BASED ON HORIZONTAL DISTANCES. ROONEY ENGINEERING, INC. AND SUNOCO PIPELINE, LP ARE NOT RESPONSIBLE FOR LOCATION	SHEET 4	то	SHEET 5	AERIAL SITE PLAN								
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.					EP1	REVISED PER PADEP COMMENTS	MRS	05/10/16	RMB	05/10/16	AAW (J5/10/16
4. CONTRACTOR IS RESPONSIBLE FOR LOCATING ALL UTILITIES. CONTACT ONE CALL AT 811 PRIOR TO DIGGING.					EP		MRS	02/26/16	RMB	02/26/16	AAW (02/26/16
5. SUNOCO EMERGENCY HOTLINE NUMBER IS #1-800-786-7440.					Α	ISSUED FOR BID	MRS	08/31/15	RMB	08/31/15	AAW (08/31/15
	DWG NO		DWG NO	DESCRIPTION	NO.	DESCRIPTION	BY	DATE	CHK	DATE	APP	DATE



Sunoco Logistics

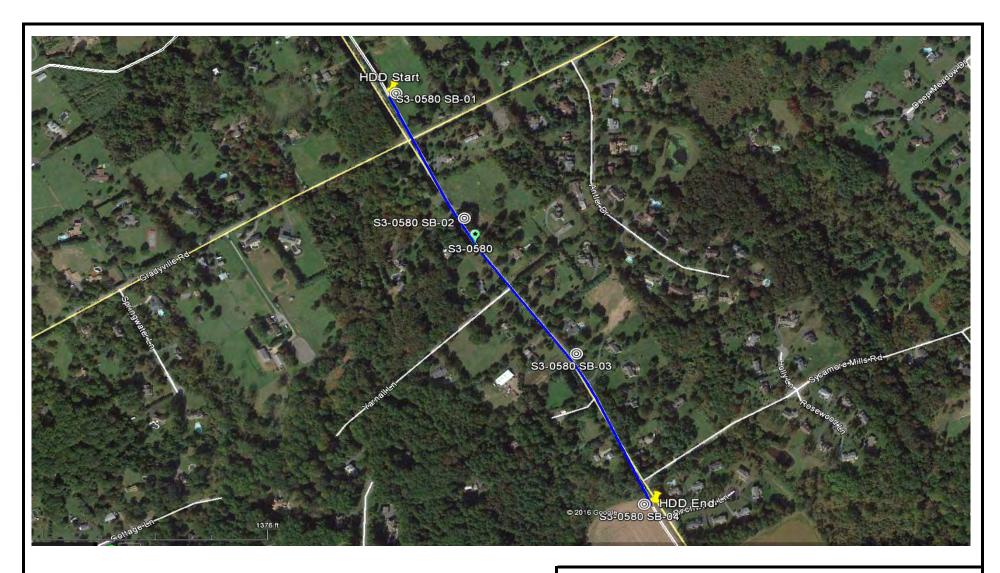
16-INCH HORIZONTAL DIRECTIONAL DRILL GRADYVILLE RD

SUNOCO PIPELINE, L.P.

TŁ.	TETRA TECH (303) 792-5911	ROONEY
رت	(303) 792-5911	

PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=250' DWG. NO: PA-DE-0032.0000-RD-16



LEGEND:

© Geotechnical Soil Boring (SB) Locations



GEOTECHNICAL BORING LOCATIONS
HDD S3-0580
DELAWARE COUNTY, EDGMONT TWP, PA
SUNOCO PENNSYLVANIA PIPELINE PROJECT



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

TEST BORING LOG

Project Name:	SUNOCO PENNSYLVANIA PI	PELINE PROJECT	Project No.: 103IP3406	
Project Location:	VALLEY ROAD, GLEN MILLS,	PA	Page 1 of 1	
HDD No.:	S3-0580	Dates(s) Drilled: 12-15-15	Inspector:	J. COSTELLO
Boring No.:	SB-01	Drilling Method: SPT - ASTM D1586	Driller:	E. OGDEN
Drilling Contractor:	HAD DRILLING	Groundwater Depth (ft): 8.0	Total Depth (ft):	14.0
Boring Location Coording	nates:	39°56'24.27"N	75°28'45.65"W	

		iatoo.				70 20 10:00 11					
Sample I	Depth (ft)	Strata D	Depth (ft)	<u>ج</u> و	Strata	Description of Materials	6" 1		nt Dia	*	NI.
From	То	From	То	Rec (ir	(USCS)	Description of Materials	6 1	ncreme	ent Bio	ws "	N
		0.0	0.7			TOPSOIL (8")					
3.0	5.0	0.7		16	-00	DR, REDDISH BROWN WITH BLACK MOTTLES, FINE SAND AND SILTY	1	4	5	7	9
			6.5		SC	CLAY, WITH A LITTLE FINE ROCK FRAGS. (USCS: SC)					
8.0	10.0	6.5		20	014	DR, REDDISH BROWN TO ORANGE BROWN FINE SAND WITH SOME	4	5	3	3	8
			13.5		SIVI	SILT, TRACE FINE ROCK FRAGMENTS.					
13.0	13.8	13.5	14.0	7		PARTIALLY WEATHERED SCHIST OR GNEISS.	8	50/4"			>50
							<u> </u>				
							 				1
							+				-
							<u> </u>				-
						AUGER REFUSAL AT 14'. OFF-SET BORING AND CONTINUOUSLY	 				-
							+				-
						AGGENES TO NEL GONE M. TOM.	+				-
						WATER LEVEL THROUGH AUGERS AT 8'	+				
							+				-
						CAVED AND WELLAT 13.	\vdash				₩
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	3.0 8.0	3.0 5.0 8.0 10.0	From To From 0.0 0.0 3.0 5.0 0.7 8.0 10.0 6.5	From To From To 0.0 0.7 3.0 5.0 0.7 6.5 6.5 8.0 10.0 6.5 13.5 13.5	From To From To Section 0.0 0.7 0.7 16 3.0 5.0 0.7 6.5 8.0 10.0 6.5 20 13.5 13.5 13.5	3.0 5.0 0.7 16 SC 8.0 10.0 6.5 20 SM	0.0 0.7 TOPSOIL (8")	13.0 10.0 0.7 16 SC DR, REDDISH BROWN WITH BLACK MOTTLES, FINE SAND AND SILTY 1 1 1 1 1 1 1 1 1	10.0 0.7 TOPSOIL (8")	13.0 10.0 0.7 TOPSOIL (8") 16 50 16 50 16 50 17 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10	10

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.



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:	1320 VALLEY ROAD, GLEN	MILLS, PA		Page 1 of 1
HDD No.:	S3-0580	Dates(s) Drilled: 11-01-15	Inspector:	J. COSTELLO
Boring No.:	SB-02	Drilling Method: SPT - ASTM D1586	Driller:	E. OGDEN
Drilling Contractor:	HAD DRILLING	Groundwater Depth (ft): 8.0	Total Depth (ft):	31.0
Boring Location Coor	dinates:	39°56'16.13"N	75°28'40.42"W	

From						Description of Materials	6" I	ncreme	nnt Dlai	MC *	N
1 10111	То	From	То	Recov. (in)	(USCS)	Description of Materials	0 1	liciente	SIIL DIO	WS	IN
		0.0	0.2			TOPSOIL (2")					
3.0	5.0	0.2		18		DARK REDDISH BROWN FINE TO MEDIUM SAND WITH SOME SILT,	2	2	4	6	6
						TRACE MICA.					
8.0	10.0			24	CM	DR, BROWN TO GRAY FINE TO MEDIUM SAND, SOME F-C UNWEATHERE	15	21	31	38	52
					SIVI	GRAVEL, A LITTLE SILT.					
13.0	13.8			11		DR, BROWN TO GRAY FINE TO MEDIUM SAND, SOME F-C UNWEATHERE	22	50/4"			>50
			16.0			GRAVEL, A LITTLE SILT. (USCS: SM)					
18.0	19.4	16.0		12	LLY	INTERLAYERS OF GRAY F-M SAND AND PARTIALLY WEATHERED	23	38	50/5"		>50
					ARTIA ED RC	GNEISS.					
23.0	24.2			14	M - P/ THERI	INTERLAYERS OF GRAY, WHITE, BRWON F-M SAND AND PARTIALLY	6	24	50/2"		>50
			24.0		GM/S WEAT	WEATHERED GNEISS.					
						AUGER REFUSAL AT 24'.					
						ROCK CORING					
24.0	26.0	24.0		15		INTENSELY FRACTURED GRAY GNEISS, WITH DECOMPOSED	TCR: 6	3%, SCI	R: 25%,	RQD: 0	%
					X	ZONES.					
26.0	29.0			27	300	MODERATELY FRACTURED GRAY GNEISS	TCR: 7	5%, SCI	R: 44%,	RQD: 4	⊥ 2%
29.0	31.0		31.0	20.5		GRAY GNEISS	TCR: 8	5%, SCI	R: 73%,	RQD: 7	3%
						CAVED AT 24'.					
						CORE TESTING RESULTS (DEPTH 29-29 5'):					
						·					
						3.1.1 112.3111. 110.01 01					
								-			\vdash
											<u> </u>
	3.0 8.0 13.0 18.0 23.0	3.0 5.0 8.0 10.0 13.0 13.8 18.0 19.4 23.0 24.2 24.0 26.0 26.0 29.0	3.0 5.0 0.2 8.0 10.0 13.0 13.8 18.0 19.4 16.0 23.0 24.2 24.0 26.0 24.0 26.0 29.0	3.0 5.0 0.2 8.0 10.0 13.0 13.8 18.0 16.0 23.0 24.2 24.0 26.0 24.0 26.0 29.0 29.0	3.0 5.0 0.2 18 8.0 10.0 24 13.0 13.8 11 18.0 19.4 16.0 12 23.0 24.2 14 24.0 24.0 15 26.0 29.0 27	3.0 5.0 0.2 18 8.0 10.0 24 13.0 13.8 11 16.0 12 23.0 24.2 14 24.0 26.0 24.0 15 26.0 29.0 27	10.0 0.2 18 18 10.0 10.0 24 24 24 24 26.0 29.0 29.0 27 24 24 24 26.0 29.0 29.0 27 24 24 24 24 24 24 24	10.0 0.2 18 18 18 19.0 19.4 16.0 19.4 16.0 19.4 16.0 24.0 24.0 26.0 29.0 29.0 31.0	10.0 0.2 18 18 19.4 16.0 12 14 16.0 14 16.0 14 16.0 14 16.0 14 16.0 14 16.0 14 16.0 15 16 16 16 16 16 16 16	10.0 0.2 18 16.0 19.4 16.0 12 14 14 14 15 14 15 14 15 15	10.0 0.2 18 TOPSOIL (2') 18 10.0 0.2 18 18 19 10.0 19.0 16.0 16.0 16.0 16.0 16.0 16.0 16.0 17 16.0 17 16.0 17 16.0 17 16.0 17 16.0 17 16.0 17 16.0 17 17 17 17 17 17 17 1

Notes/Comments:

Pocket Pentrometer Testing

DR: DECOMPOSED ROCK

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

N: Number of blows to drive spoon from 6" to 18" interval.

^{*} Number of blows of 140 lb. Hammer dropped 30 in. required to drive 2 in. split-spoon sampler in 6 in. increments.



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

TEST BORING LOG

Project Name:	SUNOCO PENNSYLVANIA PI	PELINE PROJECT		Project No.: 103IP3406
Project Location:	1243 VALLEY ROAD, GLEN M	IILLS, PA		Page 1 of 1
HDD No.:	S3-0580	Dates(s) Drilled: 02-24-16	Inspector:	E. WATT
Boring No.:	SB-03	Drilling Method: SPT - ASTM D1586	Driller:	D. BOLZE
Drilling Contractor:	CGC	Groundwater Depth (ft): NOT ENCOUNTERED	Total Depth (ft):	17.5
Boring Location Coording	nates:	39° 56′ 7.31″ N	75° 28' 31.84" W	

Bonning	Location	ii Oooiaii	iatoo.				70 20 7:01 11					
Sample No.	Sample	Depth (ft)	Strata D	Depth (ft)	Recov.	Strata	Deparintion of Materials	6" 1	ncreme	ont Dia	*	N
No.	From	То	From	То	Rec (ir	(USCS)	Description of Materials	0 11	icreme	eni bic	W5	IN
			0.0	0.2			TOPSOIL (2")					
1	3.0	5.0	0.2				ORANGE BROWN MICACEOUS FINE TO MEDIUM SAND WITH SOME	7	4	3	5	7
						SM	SILT (USCS: SM).					
2	8.0	8.0		8.0			NO RECOVERY	50/0"				
							AUGER REFUSAL AT 8'.					
							ROCK CORING					
RUN 1	8.0	11.0	8.0	9.1	11		MODERATELY TO INTENSELY FRACTURED GNEISS.	TCR: 3	0%, SC	R: 19%,	RQD: 1	9% I
							OFFSET BORING BECAUSE AUGERS WERE MADE OUT OF PLUMB	+				
								_	-			
							DURING AUGER GRINDING TO 8'. AUGERED TO REFUSAL AT 5'.	+-				
							DOCK CODING	+				
DUNA	F 0	0.0	F 0		04		ROCK CORING	TOD: 5	00/ 00	D: 00/ I	20D: 00	,
RUN 1	5.0	8.0	5.0		21	ROCK	VERY INTENSELY FRACTURED GNEISS (HIGHLY WEATHERED ROCK) VERY INTENSELY FRACTURED GNEISS (HIGHLY WEATHERED ROCK)				RQD: 0%	
RUN 2	8.0	12.0		47.5	24	RO	,				RQD: 0%	
RUN 3	12.0	17.5		17.5	38		VERY INTENSELY FRACTURED GNEISS (HIGHLY WEATHERED ROCK)	TCR: 5	7%, SC	R: 26%,	RQD: 7	%
								_				
								-				
								-				
								-	-			
								-	-			
								-	-			
								+	-			
								+-				
							CORE TESTING RESULTS (DEPTH 12.5-13'):					
							COMPRESSIVE STRENGTH: 12,574 PSI					
							UNIT WEIGHT: 158.4 PCF					
								+				
								+				
								+				
								1				
		1		1			<u>I</u>					

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.



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

TEST BORING LOG

Project Name:	SUNOCO PENNSYLVANIA PI	PELINE PROJECT	Project No.: 103IP3406	
Project Location:	VALLEY ROAD, GLEN MILLS,	PA	Page 1 of 1	
HDD No.:	S3-0580	Dates(s) Drilled: 10-13-15	Inspector:	E. WATT
Boring No.:	SB-04	Drilling Method: SPT - ASTM D1586	Driller:	E. OGDEN
Drilling Contractor:	HAD DRILLING	Groundwater Depth (ft): 19.0	Total Depth (ft):	30.0
Boring Location Coordin	nates:	39° 55′ 57.39″ N	75° 28' 26.63" W	

Sample Sample Depth (ft) Strata De		Depth (ft)	Recov. (in)	Strata	Description of Materials	6" 1	ncreme	ont Dio	NC *	N		
No.	From	То	From	То	Rec (ir	(USCS)	Description of Materials	0 11	icieine	ziil DIO	ws	IN
			0.0	0.7			TOPSOIL (8")					
1	3.0	5.0	0.7		16		DR, VARIEGATED LIGHT BROWN, BROWN, ORANGE BROWN FINE	2	4	6	7	10
							TO MEDIUM MICACEOUS SAND AND SILT.					
2	8.0	10.0			21		DR, VARIEGATED LIGHT BROWN, BROWN, ORANGE BROWN FINE	1	2	3	6	5
							MICACOUS SAND WITH SOME SILT.					
3	13.0	15.0			24		DR, VARIGATED TAN, DARK GRAY, BROWN, MICACEOUS FINE SAND,	1	2	3	4	5
						SM	SOME SILT.					
4	18.0	20.0			24		DR, VARIGATED TAN, DARK GRAY, BROWN, MICACEOUS FINE SAND	2	3	4	9	7
							AND SILT. (USCS: SM).					
5	23.0	25.0			24		DR, VARIEGATED BROWN, GRAY, WHITE, ORANGE BROWN FINE TO	2	7	12	18	19
							MEDIUM MICACEOUS SAND, SOME SILT.					
6	28.0	30.0		30.0	24		SAME.	3	12	1	41	13
								1				
								1				
							WET ON SPOON AT 16'					
							WATER LEVEL THROUGH AUGERS AT 19'					
							CAVED AT 26', WATER LEVEL ON CAVE AT 19'.					
								1				
								1				
								-				
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								 	-			
						-		+-	 			
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						-		┼				

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.

GEOTECHNICAL LABORATORY TESTING SUMMARY SUNOCO PENNSYLVANIA PIPELINE PROJECT HDD \$3-0580

	Test				Water	Percent	Atterburg	Limits (AS	TM D4318)	USCS
HDD	Boring	Sample	Depth of S	Sample (ft.)	Content, %	Silts/Clays, %	Liquid	Plastic	Plasticity	Classif.
No.	No.	No.	From			(ASTM D1140)	Limit, %	Limit, %	Index, %	(ASTM D2487)
		1	3.0	5.0	32.7	39.4	37	23	14	SC
	SB-01	2	8.0	10.0	59.2	29.1	-	-	-	-
		3	13.0	13.8	48.5	26.8	-	-	-	-
		1	3.0	5.0	35.8	38.4	-	-	-	-
	SB-02	2	8.0	10.0	5.2	11.5	-	-	-	-
		3	13.0	13.8	16.9	33.0	NV	NP	NP	SM
		4	18.0	19.4	7.3	25.7	-	-	-	-
S3-0580		5	23.0	24.2	14.6	24.8	-	-	-	-
	SB-03	1	3.0	5.0	37.4	39.9	NV	NP	NP	SM
		1	3.0	5.0	27.3	49.1	-	-	-	-
		2	8.0	10.0	23.3	30.7	-	-	-	-
	SD 04	3	13.0	15.0	29.3	26.4	-	-	-	-
	SB-04	4	18.0	20.0	32.8	42.0	42	30	12	SM
		5	23.0	25.0	21.9	27.7	-	-	-	-
		6	28.0	30.0	9.5	24.6	-	-	-	-

	Rock Core Testing Results								
Boring	Core	Approximate	Compressive	Unit					
No.	Run	Depth (ft)	Strength (psi)	Weight (pcf)					
SB-03	3	12.5-13.0	12,574	158.4					
SB-02	2	29.0-29.5	11,076	176.6					

Notes:

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

ROCK CORE DESCRIPTION SUMMARY SUNOCO PENNSYLVANIA PIPELINE PROJECT HDD S3-0580

			Core De	epth (ft)		Depth (ft)			Bedding					
Location	Boring No.	Core Run	From	То	TCR (%)	SCR (%)	RQD (%)	From	То	Weathering	Classification	Thickness (ft)	Color	Discontinuity Data
		1	24	26	63	25	0			29 Moderate	Gneiss	Massive (thin mica foliations)	Gray	Fractures ranging
	SB-02	2	26	29	75	44	42	24	29					from 18° to 22°, Avg. 21°; fractures parallel to foliation, no
		3	29	31	85	73	73							bedding visible
S3-0580		1	5	8	58	0	0							Rubble
		2	8	12	50	8	0		47.5	17.5 Heavily	Gneiss	Massive (thin	Massive (thin mica Gray foliations)	One large piece, the rest of the core was rubble
	SB-03	3	12	17.5	57	26	7	5	17.3					Fractures ranging from 0° to 90°, Avg. 18° (based on larger, intact pieces)

REGIONAL GEOLOGY SUMMARY SUNOCO PENNSYLVANIA PIPELINE PROJECT HDD \$3-0580

HDD No.	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
	SB-01	Felsic gneiss - Light, medium grained; includes rocks of probable sedimentary origin.	Gently sloping to the south	Felsic gneiss (Precambrian age)	Secondary -	No information found during	Ranges from 45 to 55 ft bgs, Avg. 46 ft bgs (.25 mile radius)	formations; Setters metaquartzite, Cockeysville
S3-0580 ·	SB-02		Generally level, slightly sloping to the west					
	SB-03		Generally level			literature review		
	SB-04		Generally level					

<u>Note</u>: 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>	N (blows)*	Particle Si	ize Identifica:	tion	
Very Loose	5 or less	<u>Particle Si</u> Boulders	8 in. diamet		
Loose	6 to 10	Cobbles 3 to 8 in. diameter			
Medium Dense	11 to 30				
Dense	31to 50	Gravel	Coarse (C)	3 in. to ¾ in. sieve	
Very Dense	51 or more		Fine (F)	¾ in. to No. 4 sieve	
•		Sand	Coarse (C)	No. 4 to No. 10 sieve	
				(4.75mm-2.00mm)	
Relative Proportion	ons		Medium	No. 10 to No. 40 sieve	
Description Term	<u>Percent</u>		(M)	(2.00mm – 0.425mm)	
Trace	1 - 10		Fine (F)	No. 40 to No. 200 sieve	
Little	11 - 20			(0.425 – 0.074mm)	
Some	21 - 35	Silt/Clay	Less Than a	No. 200 sieve (<0.074mm)	
And	36 - 50	, ,		,	

COHESIVE SOILS

(Silt, Clay & Combinations)

Consistency	N (blows)*	Plasticity	
Very Soft	3 or less	<u>Degree of Plasticity</u>	<u>Plasticity Index</u>
Soft	4 to 5	None to Slight	0 - 4
Medium Stiff	6 to 10	Slight	5 - 7
Stiff	11 to 15	Medium	8- 22
Very Stiff	16 to 30	High to Very High	> 22
Hard	31 or more	, ,	

ROCK (Rock Cores)

Rock	Rock			
Quality Designation	Quality <u>Descripti</u>			
(RQD), %	<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			Typical Descriptions			Laboratory Classification	ons		
	n is larger	Clean gravel (Little or no fines)	GW	Well-graded gravels, gravel- sand mixtures, little or no fines		nbols ⁽¹⁾	$C_{u=\frac{D_{60}}{D_{10}}}$ greater than 4: $C_{c=} \frac{(D_{30})2}{D_{10} \times D_{60}}$ between 1 and 3			
(6)	Gravels coarse fraction o. 4 sieve size	Clean (Little or	GP	Poorly graded gravels, gravel- sand mixtures, little or no fines	curve. 00 sieve),	GW, GP, SW, SP GM. GC, SM, SC Borderline cases requiring dual symbols ⁽¹⁾	Not meeting C_u or C_c requirements for GW			
o. 200 sieve	Gravels More than half of coarse fraction is larger than No. 4 sieve size	Gravel with fines (Appreciable amount of fines)	GM	Silty gravels, gravel-sand-silt mixtures	grain size (than No. 2		Atterberg limits below A Line or I p less than 4	Limits plotting in hatched zone with ! p between 4 and 7 are		
d Soils ger than No	More tha	Gravel v (Appre amount	GC	Clayey gravels, gravel-sand-clay mixtures	ravel from g on smaller i ssified as fol N, GP, SW, M. GC, SM, rderline ca	Atterberg limits above A line with I p greater than 7				
Coarse Grained Soils f material is larger tha	maller than	ands io fines)	sw	Well graded sands, gravely sands, little or no fines	of sand and of fines (fraced soils are cla	Less than 5 percent G More than 12 percent G 5 to 12 percent B	$C_{u=\frac{D_{60}}{D_{10}}}$ greater than 6: $C_{c=\frac{(D_{30})2}{D_{10} \times D_{60}}}$ between 1 and 3			
Coarse Grained Soils (More than half of material is larger than No. 200 sieve)	Sands (More than half of coarse fraction is smaller than No. 4 Sieve)	Clean sands (Little or no fines)	SP	Poorly graded sands, gravelly sands, 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:		Not meeting C_u or C_c requirements for SW			
N)		n fines able fines)	SM	Silty sands, sand- silt mixtures	Determ Jepending		Atterberg limits below A Line or I p less than 4	Limits Plotting in hatched		
	(More than	Sands with fines (Appreciable amount of fines)	SC	Clayey sands, sand-clay mixtures			Atterberg limits above A line with I p greater than 7	zone with I p between 4 and 7 are borderline cases requiring use of dual symbols		
Major	Divisions	Group Symbols	Typical Descriptions		For soils p When w _{l.}	lotting nearly is near 50 us	on A line use dual symbols i.e ., l p e CL-CH or ML-MH. Take near as	= 29.5, w _L =60 gives CH-MH. ± 2 percent.		
	ıys han 50)	ML	sands, rock fi	s and very fine lour, silty or clayey r clayey silts with iy	60	O A Line:				
200 sieve)	Silts and clays Jimit less than 50)	CL	plasticity, gra	ys of low to medium velly clays , sandy ays, lean clays	5(U Line:	1 1	Or I		
is r than No.	Silt (Liquid li	OL	Organic silts clays of low	and organic silty plasticity	% (PI), %	0		, or Or		
Fine-grained soils (More than half of material is smaller than No. 200 sieve)	quid limit 50)	MH		s, micaceous or s fine sandy or silty silts	Plasticity Index (PI), %		Juge / F	MH or OH		
Fin half of mat	Silts and Clays (Liquid limit greater than 50)	СН	Inorganic clar	ys of high plasticity,	- Plasti		Cretor			
(More than	Silts ar 9	ОН	Organic clays	s of medium to high anic silts	7		ML or OL	0 70 80 90 100		
	Highly organic soils	Pt	Peat and othe	er highly organic			Liquid Limit (LL			

⁽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.