HDD PA-CH-0088.0000-RD (W-Q76, S-Q83, W-Q77, and S-Q86)

Given the design, the threat of inadvertent return has been reduced to the maximum extent practicable and based on geotechnical data, the threat will otherwise be considered to be low. However, due to inadvertent return on a previous HDD in this area, the threat in this area is considered to be medium. The previous inadvertent return was 100 gallons of drilling fluid that penetrated the stream. Sand bags, a vacuum truck, wheel barrows, and hand tools were used to clean up the spill. There was no erosion and the land was restored to its original condition with 80% of the vegetation returning. For this reason, we recommend additional inspection while the drill is being performed. 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 550 feet northwest of wetland Q76. The drill will pass 40 feet under the northwestern most boundary of the wetland and 33 feet under the southeastern most boundary of the wetland. Stream Q83 runs along the southeastern most boundary of this wetland. 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 sand and felsic gneiss.

The drill will enter/exit 1085 feet northwest of wetland Q77 and enter/exit 1480 feet southeast of this wetland. The drill will pass 30 feet under the northwestern most boundary of the wetland and 30 feet under the southeastern most boundary of the wetland. Stream Q86 runs along the southeastern most boundary of this wetland. 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 sand and felsic gneiss.

Legend

- HDD Path
- Proposed Centerline

DRAWN	CHECKED	APPROVED	DATE	REV NO.	DESCRIPTION
AW	RB	RB	11/21/16	A	ISSUED FOR REVIEW

PREPARED BY: TETRA (303) 79

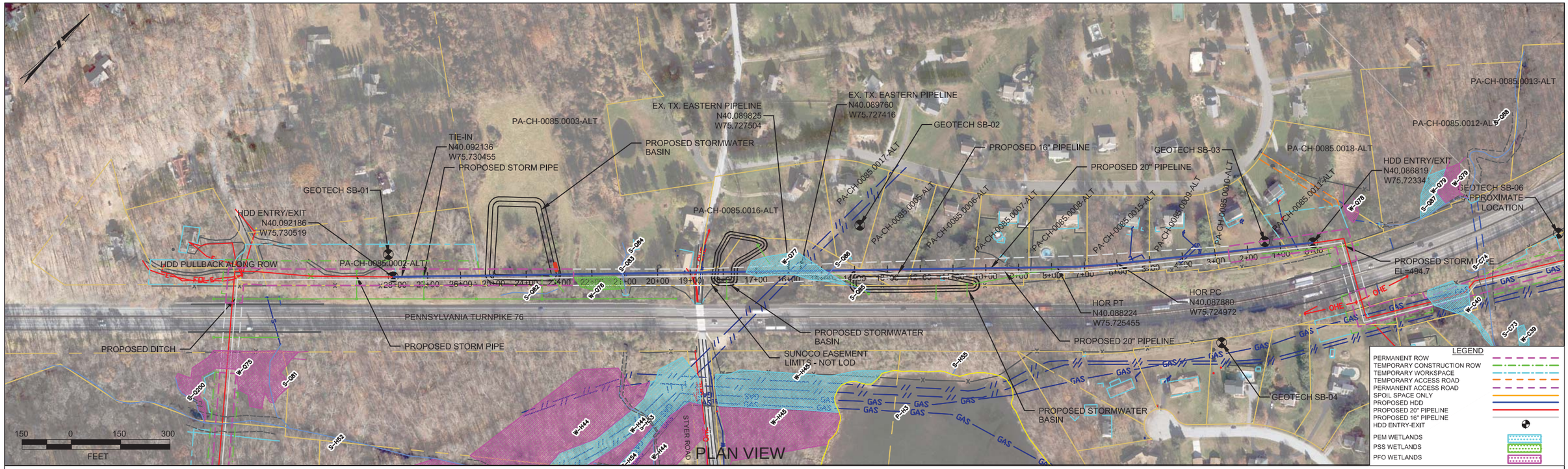
Sunoco Pipeline L.P.

PENNSYLVANIA PIPELINE PROJECT

INADVERTENT RETURN ASSESSMENTS

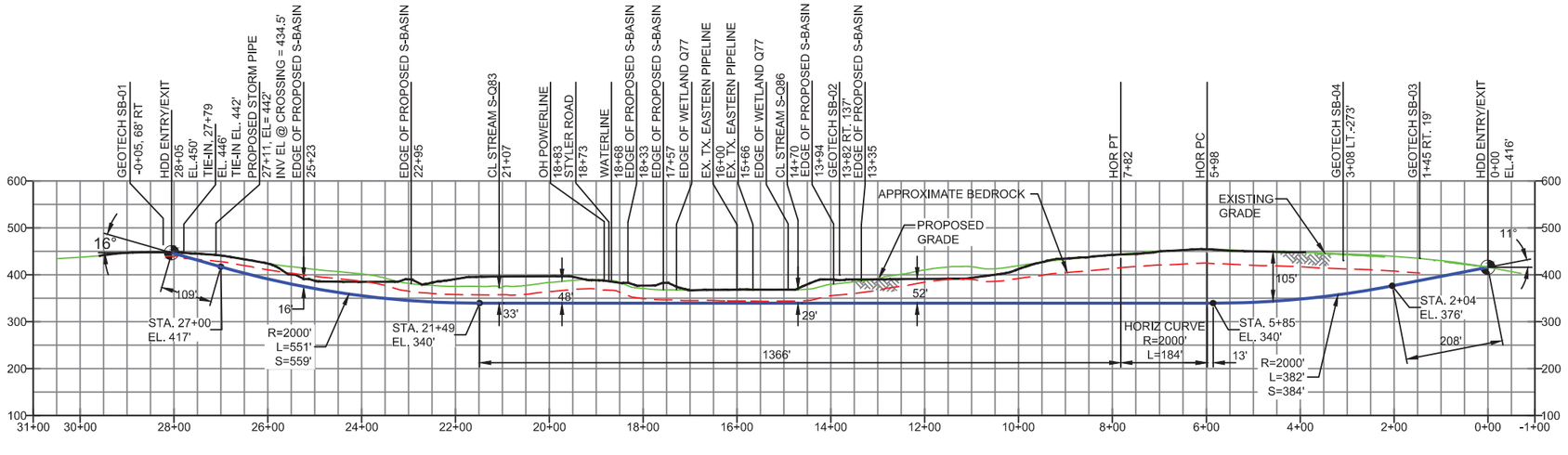
DRAWN:	AW	CHECKED:	RB
DATE:	11/21/16	SCALE:	AS SHOWN

PA-CH-0088-RD-HDD



CHASTER COUNTY, PA - UPPER UWCHLAN TOWNSHIP
S3-0280

PROFILE VIEW



GEOTECH SB-01
- NG EL. 456'
- TOPSOIL (0' - 0.2')
- SM (0.2' - 12.0')
- GNEISS (12.0' - 12.2')
- COMPLETION DEPTH EL. 444'

GEOTECH SB-02
- NG EL. 400'
- TOPSOIL (0' - 0.3')
- ML (0.3' - 6.5')
- ML (6.5' - 21.5')
- SM (21.5' - 23.5')
- WEATHERED GNEISS (23.5' - 25.2')
- COMPLETION DEPTH EL. 375'

GEOTECH SB-03
- NG EL. 435'
- TOPSOIL (0' - 0.3')
- ML (0.3' - 6.5')
- ML (6.5' - 16.5')
- SM (16.5' - 23.0')
- WEATHERED GNEISS (23.0' - 24.0')
- COMPLETION DEPTH EL. 411'

NOTE: REFER TO TEST BORING LOG S3-0280 FOR COMPLETE SOIL MATERIAL DESCRIPTION

GEOTECH SB-04
- NG EL. 431'
- TOPSOIL (0' - 0.5')
- ML (0.5' - 3.5')
- SM (3.5' - 31.4')
- WEATHERED GNEISS (31.4' - 32.0')
- FRACTURED GNEISS (32.0' - 37.0')
- COMPLETION DEPTH EL. 394'

GEOTECH SB-06
- NG EL. 434'
- TOPSOIL (0' - 0.3')
- SM (0.3' - 30.0')
- GROUNDWATER (23.0')
- COMPLETION DEPTH EL. 404'

NOTE: REFER TO TEST BORING LOG S3-0280 FOR COMPLETE SOIL MATERIAL DESCRIPTION

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:
   HDD HORZ. LENGTH (L=):2805'
   HDD PIPE LENGTH (S=):2823'
   20" x 0.456" W.T., X-65, API5L, PSL2, ERW, BFW
   COATING: 14-16 MILS FBE WITH 30-35 MIL ARO (POWERCRETE R95)
5. INTERNAL DESIGN PRESSURE 1480 PSIG (SEAM FACTOR 1.0, DESIGH FACTOR 0.50).
6. INSTALLATION METHOD: HORIZONTAL DIRECTIONAL DRILL (HDD).
7. PIPELINE WARNING MARKERS SHALL BE INSTALLED ON BOTH SIDES OF ALL ROAD, RAILWAY, AND STREAM CROSSINGS.
8. CARRIER PIPE NOT ENCASED.
9. PIPE / AMBIENT TEMPERATURE MUST BE NO LESS THAN 30°F DURING PULLBACK WITHOUT PRIOR WRITTEN APPROVAL FROM THE ENGINEER.
10. CONDUCT 4-HOUR PRE-INSTALLATION HYDROTEST OF HDD PIPE STRING TO MINIMUM 1850 PSIG.
11. SEE SUNOCO PENNSYLVANIA PIPELINE PROJECT ESRI WEBMAP FOR ACCESS ROAD ALIGNMENT.
12. SUNOCO PIPELINE, L.P.'S HORIZONTAL DIRECTIONAL DRILL INADVERTENT RETURN CONTINGENCY PLAN WILL BE IMPLEMENTED AT ALL TIMES.
13. 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

ES-6.24	TO	ES-6.26	EROSION & SEDIMENT PLAN
SHEET 14	TO	SHEET 15	AERIAL SITE PLAN

DWG NO		DWG NO	DESCRIPTION

REVISIONS

NO.	DESCRIPTION	BY	DATE	CHK	DATE	APP	DATE
EP2	REVISED PER PADEP COMMENTS RECEIVED 09-06-16	MRS	09/30/16	RMB	09/30/16	AAW	09/30/16
EP1	REVISED FOR PADEP COMMENTS	JTW	05/05/16	RMB	05/05/16	AAW	05/05/16
EP		MRS	02/26/16	RMB	02/26/16	AAW	02/26/16
0	ISSUED FOR CONSTRUCTION	MRS	02/19/16	RMB	02/19/16	AAW	02/19/16

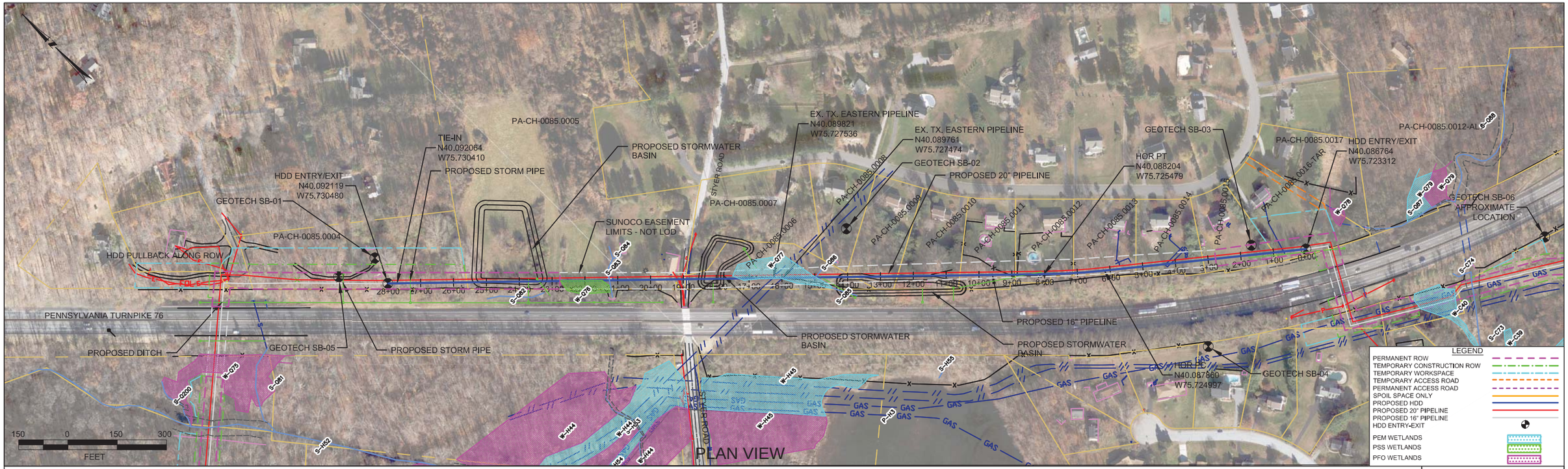
Sunoco Logistics Partners L.P.

TETRA TECH ROONEY
(303) 792-5911

SUNOCO PIPELINE, L.P.

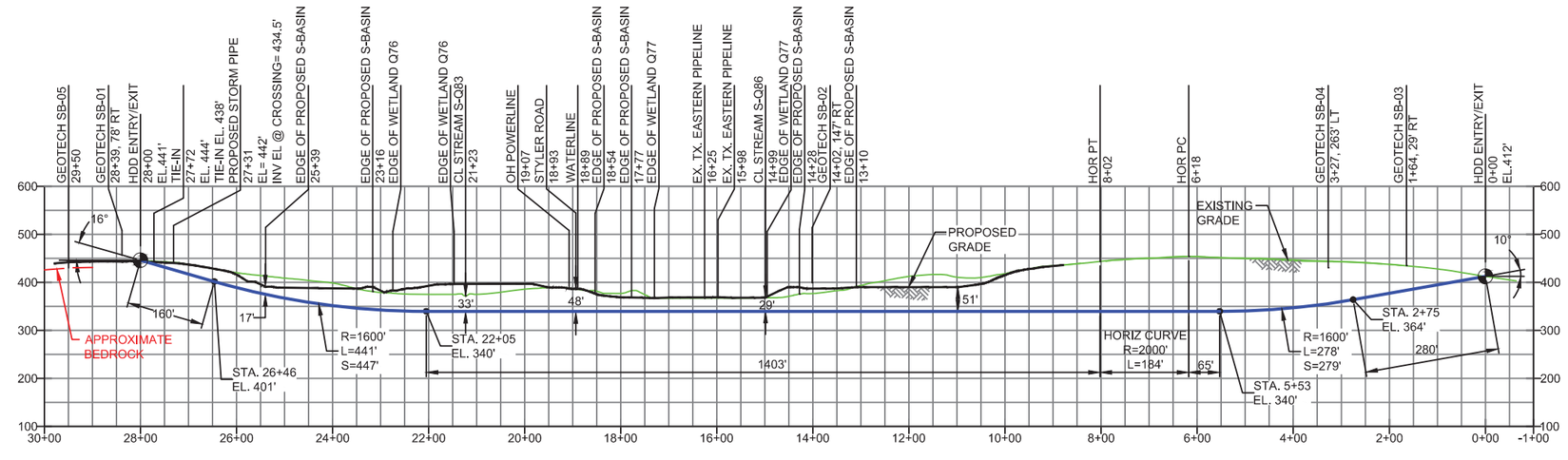
20-INCH HORIZONTAL DIRECTIONAL DRILL
PENNSYLVANIA TURNPIKE 76
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=300' | DWG. NO: PA-CH-0088.0000-RD

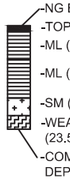


CHASTER COUNTY, PA - UPPER UWCHLAN TOWNSHIP
S3-0280-16

PROFILE VIEW

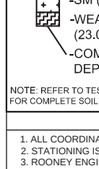


GEOTECH SB-01



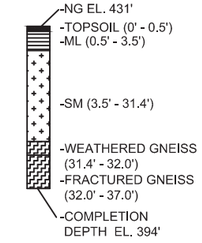
GEOTECH SB-02

GEOTECH SB-03

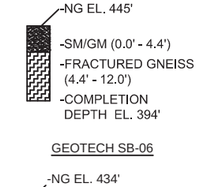


NOTE: REFER TO TEST BORING LOG S3-0280 FOR COMPLETE SOIL MATERIAL DESCRIPTION

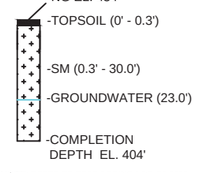
GEOTECH SB-04



GEOTECH SB-05



GEOTECH SB-06



NOTE: REFER TO TEST BORING LOG S3-0280 FOR COMPLETE SOIL MATERIAL DESCRIPTION

DESIGN AND CONSTRUCTION:

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3. DESIGNED IN ACCORDANCE WITH CFR 49 195 & ASME B31.4
4. CROSSING PIPE SPECIFICATION:
   HDD HORZ. LENGTH (L=): 2800'
   HDD PIPE LENGTH (S=): 2819'
   16" x 0.438" W.T., X-70, API5L, PSL2, ERW, BFW
   COATING: 14-16 MILS FBE WITH 30-35 MIL ARO (POWERCRETE R95)
5. INTERNAL DESIGN PRESSURE 1480 PSIG (SEAM FACTOR 1.0, DESIGH FACTOR 0.50).
6. INSTALLATION METHOD: HORIZONTAL DIRECTIONAL DRILL (HDD).
7. PIPELINE WARNING MARKERS SHALL BE INSTALLED ON BOTH SIDES OF ALL ROAD, RAILWAY, AND STREAM CROSSINGS.
8. CARRIER PIPE NOT ENCASED.
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11. SEE SUNOCO PENNSYLVANIA PIPELINE PROJECT ESRI WEBMAP FOR ACCESS ROAD ALIGNMENT.
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NOTES

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

REF. DRAWING

DWG NO		DWG NO	DESCRIPTION
ES-6.24	TO	ES-6.26	EROSION & SEDIMENT PLAN
SHEET 14	TO	SHEET 15	AERIAL SITE PLAN

REVISIONS

NO.	DESCRIPTION	BY	DATE	CHK	DATE	APP	DATE
EP2	REVISED PER PADEP COMMENTS RECEIVED 09-06-16	MRS	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
0	ISSUED FOR CONSTRUCTION	MRS	02/19/16	RMB	02/19/16	AAW	02/19/16

Sunoco Logistics Partners L.P.

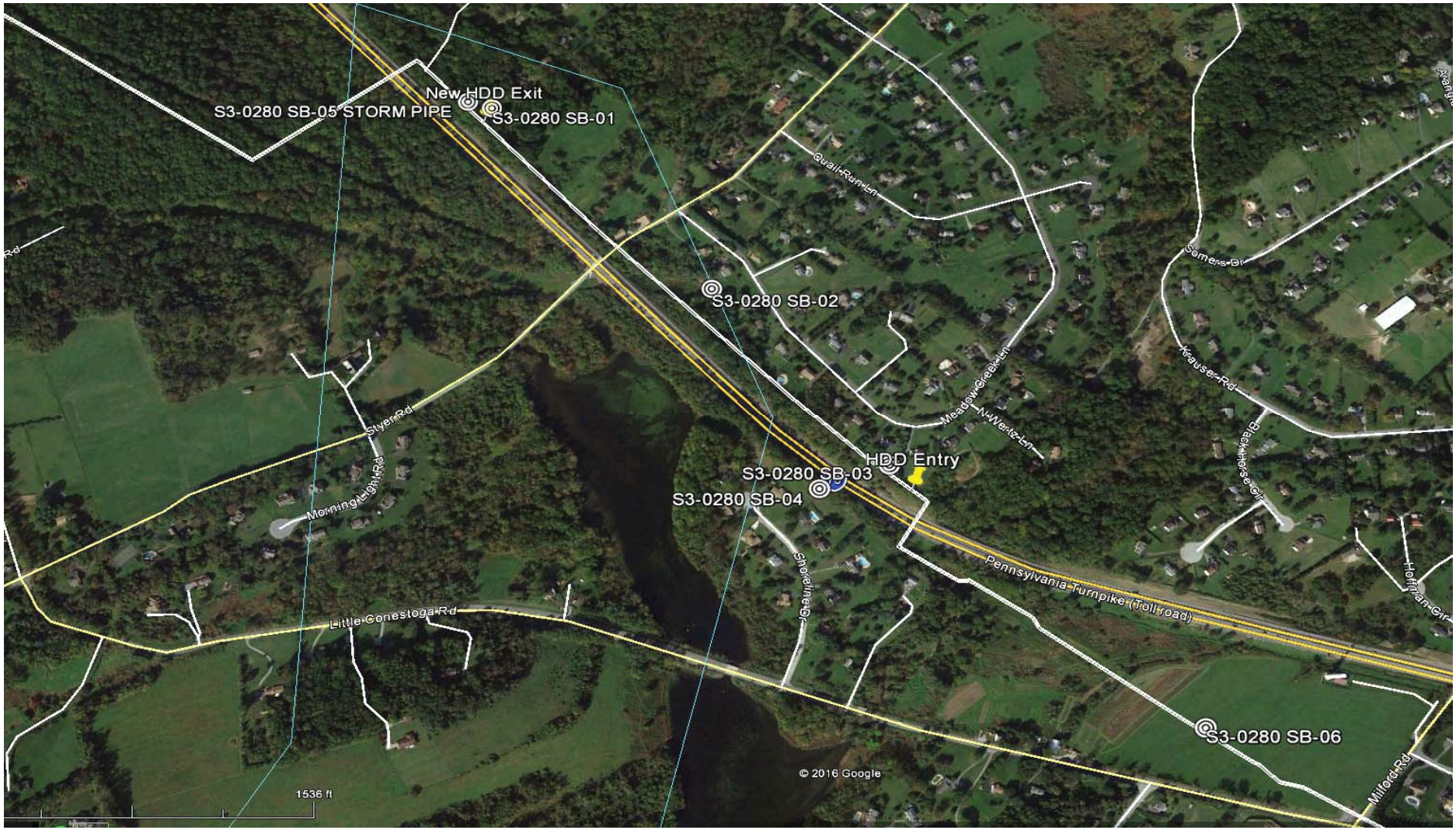
TETRA TECH ROONEY
(303) 792-5911

SUNOCO PIPELINE, L.P.

16-INCH HORIZONTAL DIRECTIONAL DRILL
PENNSYLVANIA TURNPIKE 76
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=300'

DWG. NO: PA-CH-0088.0000-RD-16



LEGEND:

Geotechnical Soil Boring (SB) Locations

TETRA TECH

GEOTECHNICAL BORING LOCATIONS
HDD S3-0280
CHESTER COUNTY, UPPER UWCHLAN 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:	GREENRIDGE ROAD, GLENMORE, PA		Page 1 of 1
HDD No.:	S3-0280	Dates(s) Drilled: 01-06-16	Inspector: E. WATT
Boring No.:	SB-01 (REROUTE)	Drilling Method: SPT - ASTM D1586	Driller: E. OGDEN
Drilling Contractor:	HAD DRILLING	Groundwater Depth (ft): NOT ENCOUNTERED	Total Depth (ft): 12.2
Boring Location Coordinates:		40° 5'32.44"N	75°43'49.36"W

Sample No.	Sample Depth (ft) From	Sample Depth (ft) To	Strata Depth (ft) From	Strata Depth (ft) To	Recov. (in)	Strata (USCS)	Description of Materials	6" Increment Blows *				N
			0.0	0.2			TOPSOIL (2")					
1	3.0	4.6	0.2		12	SM	DR, VARIEGATED BROWN, LIGHT BROWN, WHITE MICACEOUS F-M	7	25	37	50/1"	**62**
							SAND, SOME SILT, A LITTLE F-C UNWEATHERED GNEISS GRAVEL.					
2	8.0	8.6			4		DR, VARIEGATED BROWN, LIGHT BROWN, WHITE MICACEOUS F-M	50	50/1"			**>50**
				12.0			SAND, A LITTLE SILT, A LITTLE F-C UNWEATHERED GNEISS GRAVEL.					
3	12.0	12.2	12.0	12.2	1		PARTIALLY WEATHERED FELSIC GNEISS.	50/2"				**>50**
							AUGERS STARTED GRINDING AT 3' TO 4'.					
							AUGER REFUSAL AT 12'.					
							CAVED AND DRY AT 11'.					
							OFFSET BORING 20' WEST, MADE TWO ATTEMPTS TO AUGER					
							DEEPER, COULD NOT GET PAST 5' BEFORE REFUSAL.					

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.

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:	64 MEADOW CREEK LANE, GLENMORE, PA		Page 1 of 1
HDD No.:	S3-0280	Dates(s) Drilled: 01-21-16	Inspector: E. WATT
Boring No.:	SB-02 (REROUTE)	Drilling Method: SPT - ASTM D1586	Driller: E. OGDEN
Drilling Contractor:	HAD DRILLING	Groundwater Depth (ft): NOT ENCOUNTERED	Total Depth (ft): 25.2
Boring Location Coordinates:		40° 5' 22.78" N	75° 43' 35.78" W

Sample No.	Sample Depth (ft) From	Sample Depth (ft) To	Strata Depth (ft) From	Strata Depth (ft) To	Recov. (in)	Strata (USCS)	Description of Materials	6" Increment Blows *				N
			0.0	0.3			TOPSOIL (3")					
1	3.0	5.0	0.3		2	ML	ORANGE BROWN SILT AND FINE SAND, TRACE FINE GRAVEL.	1	4	3	7	**7**
				6.5								
2	8.0	10.0	6.5		12		DR, VARIEGATED BROWN SILT WITH SOME FINE SAND, TRACE IRON	5	8	11	12	**19**
							STAINING.					
3	13.0	14.8			22	ML	SAME (USCS: ML)	2	35	45	50/4"	**80**
4	18.0	20.0			24		SAME	1	8	15	22	**23**
				21.5								
5	23.0	23.8	21.5		10	SM	DR, VARIEGATED BROWN FINE SAND AND SILT.	7	50/4"			**>50**
				23.5			(USCS: SM)					
6	25.0	25.2	23.5	25.2	1		BROWN WEATHERED TO PARTIALLY WEATHERED FELSIC GNEISS.	50/2"				**0**
							AUGER REFUSAL AT 25'.					
							CAVED AND DRY AT 24'.					
							BORING LOCATION 30' TO 40' HIGHER IN ELEVATION THAN ROW.					

Notes/Comments:

Pocket Pentrometer Testing
S1: 2.0 TSF
S2: 3.5 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:	40 MEADOW CREEK LANE, GLENMORE, PA		Page 1 of 1
HDD No.:	S3-0280	Dates(s) Drilled: 01-21-16	Inspector: E. WATT
Boring No.:	SB-03 (REROUTE)	Drilling Method: SPT - ASTM D1586	Driller: E. OGDEN
Drilling Contractor:	HAD DRILLING	Groundwater Depth (ft): NOT ENCOUNTERED	Total Depth (ft): 24.0
Boring Location Coordinates:		40° 5' 13.62" N	75° 43' 25.296" W

Sample No.	Sample Depth (ft) From	Sample Depth (ft) To	Strata Depth (ft) From	Strata Depth (ft) To	Recov. (in)	Strata (USCS)	Description of Materials	6" Increment Blows *				N
			0.0	0.3			TOPSOIL (3")					
1	3.0	5.0	0.3		22	ML	BROWN AND ORANGE BROWN MICACEOUS SILT AND FINE SAND,	1	4	5	7	**9**
				6.5			TRACE FINE GNEISS GRAVEL.					
2	8.0	10.0	6.5		16	ML	DR, VARIEGATED BROWN AND WHITE MICACEOUS SILT AND FINE	3	9	14	21	**23**
							SAND.					
3	13.0	14.8			24		DR, VARIEGATED BROWN AND WHITE MICACEOUS SILT AND FINE	4	8	20	37	**28**
				16.5			SAND, TRACE FINE UNWEATHERED GNEISS GRAVEL. (USCS: ML)					
4	18.0	19.2	16.5		9	SM	DR, VARIEGATED BROWN AND WHITE MICACEOUS FINE SAND AND	3	50	50/2"		**>50**
				23.0			SILT, TRACE FINE UNWEATHERED GNEISS GRAVEL. (USCS: SM)					
5	23.0	23.6	23.0	24.0	2		WEATHERED TO PARTIALLY WEATHERED GNEISS.	50	50/1"			**>50**
							AUGER REFUSAL AT 24'.					
							CAVED AND DRY AT 23'.					
							ATTEMPTED TO CORE, BUT DUE TO VERY DENSE DRILLING, AUGERS					
							BECAME OUT OF PLUMB, AND DRILLER COULD NOT GET CORE					
							BARREL THROUGH TO ROCK DEPTH. BECAME LATE, AND LO					
							DID NOT WANT RIG TO BE LEFT OR RETURN NEXT DAY.					

Notes/Comments:

Pocket Pentrometer Testing
S1: 2.0 TSF
S2: 3.5 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:	SHORELINE DRIVE, DOWNINGTOWN, PA		Page 1 of 1
HDD No.:	S3-0280	Dates(s) Drilled: 05-21-15	Inspector: E. WATT
Boring No.:	SB-04	Drilling Method: SPT - ASTM D1586	Driller: S. HOFFER
Drilling Contractor:	HAD DRILLING	Groundwater Depth (ft): NOT ENCOUNTERE	Total Depth (ft): 37.0
Boring Location Coordinates:		40° 5' 12.456" N	75° 43' 29.328" W

Sample No.	Sample Depth (ft) From	Sample Depth (ft) To	Strata Depth (ft) From	Strata Depth (ft) To	Recov. (in)	Strata (USCS)	Description of Materials	6" Increment Blows *				N
			0.0	0.5			TOPSOIL (6")					
			0.5	3.5		ML	BROWN SIILTY CLAY WITH SOME FINE SAND.					
1	3.0	5.0	3.5		24		ORANGE BROWN FINE TO MEDIUM SAND WITH SOME SILT, TRACE	9	7	8	10	**15**
							FINE GNEISS GRAVEL.					
2	8.0	10.0			13		LIGHT BROWN TO GREENISH BROWN FINE TO MEDIUM SAND WITH	9	32	50		**82**
							SOME SILT, TRACE FINE OXIDIZED GNEISS GRAVEL.					
3	13.0	14.9			17		BROWN AND LIGHT GRAY FINE TO MEDIUM SAND WITH SOME SILT,	11	43	34	50/5"	**77**
							TRACE FINE GNEISS GRAVEL (USCS: SM).					
4	18.0	18.9			8	SM	DECOMPOSED GNEISS WEATHERED TO A FINE TO MEDIUM SAND WITH	3	50/5"			**>50**
							A LITTLE SILT, WITH A LITTLE UNWEATHERED F-C GRAVEL.					
5	23.0	23.6			5		DECOMPOSED GNEISS WEATHERED TO A FINE TO MEDIUM SAND WITH	12	50/1"			**>50**
							A LITTLE SILT, WITH A LITTLE UNWEATHERED F-C GRAVEL.					
6	28.0	28.6			6		DECOMPOSED GNEISS WEATHERED TO A FINE TO MEDIUM SAND WITH	15	50/1"			**>50**
							SOME SILT, WITH A LITTLE UNWEATHERED F-C GRAVEL.					
7	31.4	32.0	31.4	32.0	7		WHITE AND LIGHT GRAY PARTIALY WEATHERED GNEISS.	3	50/2"			**>50**
							AUGER REFUSAL AT 31.4'.					
							ROCK CORING					
RUN 1	32.0	32.7			8.5		MODERATELY FRACTURED GNEISS	TCR: 100%, SCR: 94%, RQD: 94%				
RUN 2	32.7	34.9			52	ROCK	VERTY INTENSELY FRACTURED GNEISS.	TCR: 100%, SCR: 19%, RQD: 13%				
	34.9	35.8					MODERATELY FRACTURED GNEISS					
	35.8	37.0					VERTY INTENSELY FRACTURED GNEISS.					
							USED HIGH VOLUME OF WATER DURING CORING. ALL WATER					
							WAS LOST IN FORMATION (I.E., NO WATER CAME OUT OF AUGERS).					
							CORE TESTING RESULTS (RUN 2, DEPTH 35-35.7'):					
							COMPRESSIVE STRENGTH: 1,520 PSI					
							UNIT WEIGHT: 173.8 PCF					

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.

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TEST BORING LOG

Project Name:	SUNOCO PENNSYLVANIA PIPELINE PROJECT		Project No.: 103IP3406
Project Location:	GREENRIDGE ROAD, GLENMORE, PA		Page 1 of 1
HDD No.:	S3-0280	Dates(s) Drilled: 02-23-16	Inspector: E. WATT
Boring No.:	SB-05	Drilling Method: SPT - ASTM D1586	Driller: D. BOLZE
Drilling Contractor:	CGC	Groundwater Depth (ft): NOT ENCOUNTERE	Total Depth (ft): 12.0
Boring Location Coordinates:		40° 5' 32.84" N	75° 43' 50.87" W

Sample No.	Sample Depth (ft) From	Sample Depth (ft) To	Strata Depth (ft) From	Strata Depth (ft) To	Recov. (in)	Strata (USCS)	Description of Materials	6" Increment Blows *				N
							INITIALLY ENCOUNTERED AUGER REFUSAL AT 2.5', OFFSET 9' WEST					
							AND AUGERED TO 3'.					
1	3.0	3.8	0.0		7		GRAY FINE TO MEDIUM SAND WITH A LITTLE SILT, SOME FINE TO	13	50/3"			**>50**
							COARSE UNWEATHERED GNEISS GRAVEL.					
							AUGER REFUSAL AT 4.2'. OFF-SET 13' NORTH FROM ORIGINAL					
						SM/ GM	LOCATION.					
2	3.0	4.2			10		GRAY AND BROWN FINE TO MEDIUM SAND, SOME SILT, TRACE	12	13	50/3"		**>50**
				4.4			FINE TO COARSE UNWEATHERED GNEISS GRAVEL. (USCS: SM)					
							AUGER REFUSAL AT 4.4'.					
							ROCK CORING					
RUN 1	4.4	8.0	4.4		34	FRACTURED ROCK	GRAY MODERATELY FRACTURED FELSIC GNEISS	TCR: 79%, SCR: 58%, RQD: 44%				
RUN 2	8.0	12.0			12		GRAY MODERATELY FRACTURED FELSIC GNEISS. **NO RECOVERY**	TCR: 25%, SCR: 17%, RQD: 10%				
				12.0			**FROM 10' TO 12' (LIKELY SOIL MATERIAL).**					
							CORE TESTING RESULTS (RUN 1, DEPTH 7'-8'):					
							COMPRESSIVE STRENGTH: 7,688 PSI					
							UNIT WEIGHT: 161.1					

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.

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TEST BORING LOG

Project Name:	SUNOCO PENNSYLVANIA PIPELINE PROJECT		Project No.: 103IP3406
Project Location:	LITTLE CONESTOGA ROAD, DOWNINGTOWN, PA		Page 1 of 1
HDD No.:	S3-0280	Dates(s) Drilled: 05-20-15	Inspector: E. WATT
Boring No.:	SB-06	Drilling Method: SPT - ASTM D1586	Driller: S. HOFFER
Drilling Contractor:	HAD DRILLING	Groundwater Depth (ft): 23.0	Total Depth (ft): 30.0
Boring Location Coordinates:		40° 5' 1.030" N	75° 43' 7.844" W

Sample No.	Sample Depth (ft) From	Sample Depth (ft) To	Strata Depth (ft) From	Strata Depth (ft) To	Recov. (in)	Strata (USCS)	Description of Materials	6" Increment Blows *				N
			0.0	0.3			TOPSOIL (4")					
1	3.0	5.0	0.3		19		LIGHT BROWN AND BROWN FINE TO MEDIUM SAND WITH SOME	1	5	12	17	**17**
							SILT, A LITTLE FINE TO COARSE GRAVEL.					
2	8.0	10.0			22		LIGHT GRAY MICACEOUS FINE TO MEDIUM SAND AND SILT	2	5	5	8	**10**
3	13.0	15.0			24		LIGHT GRAY MICACEOUS FINE TO MEDIUM SAND AND SILT	1	2	4	6	**6**
						SM	(USCS: SM)					
4	18.0	20.0			24		ALTERNATING BANDS OF BROWN, LIGHT GRAY, AND WHITE FINE	WH	WH	3	13	**3**
							SAND AND SILT , TRACE FINE GRAVEL.					
5	23.0	25.0			24		ALTERNATING BANDS OF BROWN, LIGHT GRAY, AND WHITE FINE	1	2	7	11	**9**
							SAND AND SILT , TRACE FINE GRAVEL. (USCS: SM).					
6	28.0	30.0			24		BROWN AND WHITE MICACEOUS FINE SAND AND SILT, WITH A LITTLE	2	8	14	18	**22**
				30.0			FINE TO COARSE GRAVEL.					
							WATER LEVEL THROUGH AUGERS AT 23'.					
							CAVED AT 27', WATER LEVEL ON CAVE AT 23'.					
							SAMPLES 2 THRU 6 ARE HIGHLY DECOMPOSED ROCK SOILS.					
							(SOILS THAT HAVE BEEN WEATHERED IN-PLACE FROM ROCK)					

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.

ROCK CORE DESCRIPTION SUMMARY
SUNOCO PENNSYLVANIA PIPELINE PROJECT
HDD S3-0280

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					
S3-0280	SB-4	1	32	32.7	100	94	94	32	34.5	Slight	Graphitic Gneiss	2.5	Light Gray	Fractures ranging from 10° to 70°, Avg. 47.5°
		2	32.7	37	100	19	13	34.5	37	Slight to moderate	Gneiss	Massive	Gray w/ dark gray	Fractures ranging from 10° to 80°, Avg. 46°; Foliation dipping approx.
	SB-5	1	4.4	8	79	58	44	4.4	12	Slight	Gneiss	Massive	Light gray/ gray	Fractures ranging from 2° to 46°, Avg. 26°
		2	8	12	25	17	10							

GEOTECHNICAL LABORATORY TESTING SUMMARY
SUNOCO PENNSYLVANIA PIPELINE PROJECT
HDD S3-0280

HDD No.	Test Boring No.	Sample No.	Depth of Sample (ft.) From	Depth of Sample (ft.) To	Water Content, % (ASTM D2216)	Percent Silts/Clays, % (ASTM D1140)	Atterburg Limits (ASTM D4318) Liquid Limit, %	Atterburg Limits (ASTM D4318) Plastic Limit, %	Atterburg Limits (ASTM D4318) Plasticity Index, %	USCS Classif. (ASTM D2487)
S3-0280	SB-01	1	3.0	4.6	8.2	23.6	NV	NP	NP	SM
		2	8.0	8.6	5.7	18.2	-	-	-	-
	SB-02	2	8.0	10.0	21.9	71.5	-	-	-	-
		3	13.0	14.8	14.0	84.7	36	27	9	ML
		4	18.0	20.0	19.2	73.4	-	-	-	-
		5	23.0	23.8	7.0	43.0	32	25	7	SM
	SB-03	1	3.0	5.0	19.9	57.4	-	-	-	-
		2	8.0	10.0	11.8	52.3	-	-	-	-
		3	13.0	14.8	13.1	59.4	34	26	8	ML
		4	18.0	19.2	10.2	42.0	30	23	7	SM
	SB-04	2	8.0	10.0	11.6	34.1	-	-	-	-
		3	13.0	14.9	12.4	34.0	31	24	7	SM
		4	18.0	18.9	8.3	19.6	-	-	-	-
		5	23.0	23.6	3.7	16.5	-	-	-	-
		6	28.0	28.6	5.1	24.6	-	-	-	-
	SB-05	1	3.0	3.8	5.4	16.9	-	-	-	-
		2	3.0	4.2	15.7	36.1	30	23	7	SM
	SB-06	2	8.0	10.0	25.2	44.9	-	-	-	-
		3	13.0	15.0	31.8	46.2	36	25	11	SM
		4	18.0	20.0	21.7	39.9	-	-	-	-
		5	23.0	25.0	20.9	44.9	37	26	11	SM
		6	28.0	30.0	18.3	44.3	-	-	-	-

Rock Core Testing Results				
Boring No.	Core Run	Approximate Depth (ft)	Compressive Strength (psi)	Unit Weight (pcf)
SB-04	2	35.0-35.7	1,520	173.8
SB-05	1	7.0 to 8.0	7,688	161.1

Notes:

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

REGIONAL GEOLOGY SUMMARY
SUNOCO PENNSYLVANIA PIPELINE PROJECT
HDD S3-0280

HDD No.	NAME	BORING NO.	REGIONAL GEOLOGY DESCRIPTION	BEDROCK FORMATION	GENERAL ROCK TYPE	APPROX MAX FM THICKNESS (FT)	DEPTH TO ROCK (Ft bgs) based on nearby well drilling logs	NOTES / COMMENTS
S3-0280	Marsh Creek State Park and Park Road	SB-01	**Graphitic felsic gneiss** - Medium grained, medium to dark gray; locally gneissic, predominantly feldspar and quartz, plus dark accessories and various alteration minerals.	Graphitic felsic gneiss (PreCambrian)	Graphitic felsic gneiss	No information found during literature review	Ranges from 4 to 46 ft bgs, avg 26 ft bgs (.25 mile radius)	southwest to northeast oriented fault south of the SB-01 and SB-05
		SB-02					Widely ranges from 6 to 102 ft bgs (.25 mile radius)	
		SB-05					Ranges from 4 to 46 ft bgs, avg 26 ft bgs (.25 mile radius)	southwest to northeast oriented fault south of the SB-01 and SB-05
		SB-03	**Banded mafic gneiss** - Dark, fine to medium grained; includes rocks of probable sedimentary origin; may be equivalent to "PZmgh."	Banded mafic gneiss (PreCambrian)	Mafic gneiss	No information found during literature review	Ranges from 6 to 75 ft bgs, avg 32 ft bgs (.25 mile radius)	
		SB-04			Mafic gneiss			
		SB-06	**Metadiabase** - Dark-gray, fine-grained intrusives; locally, mineralogy is altered and unit has greenish color.	Metadiabase (PreCambrian)	Mafic metavolcanic rock	Mostly in thin dikes, but a few over 100 ft	Ranges from 4 to 50 ft bgs, avg 23ft bgs (.25 mile radius)	Mapped as a mafic dike, may not be encountered. Difficult to excavate except where fractured. Occurs as a limited isolated intrusion; not a formation per say.

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)

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

Relative Proportions

Description Term	*Percent*
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 (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)	

COHESIVE SOILS

(Silt, Clay & Combinations)

Consistency	***N (blows)****
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

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

ROCK

(Rock Cores)

Rock Quality Designation (RQD), %	***Rock Quality Description***
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).

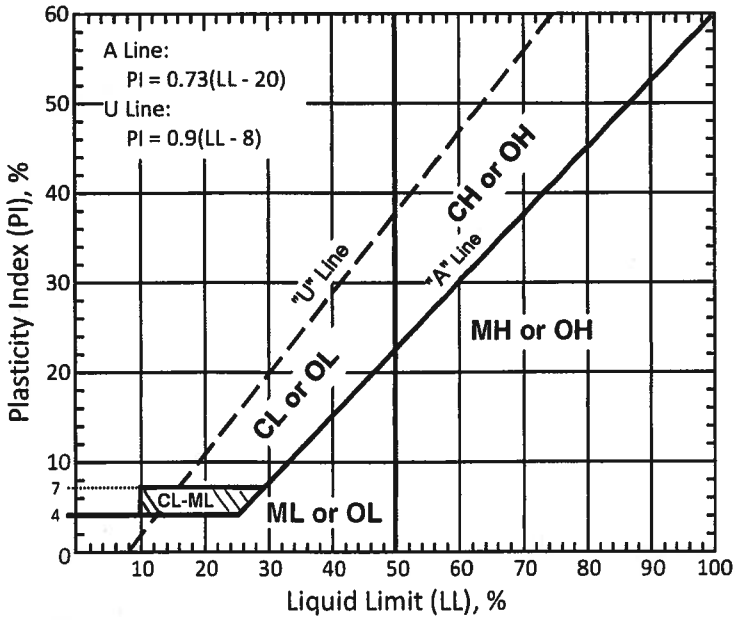
Groundwater observations were made at the times indicated. Groundwater elevations fluctuate throughout a given year, depending on actual field porosity and variations in seasonal and annual precipitation.

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	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[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	
			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, gravely 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	

Major Divisions		Group Symbols	Typical Descriptions
Fine-grained soils (More than half of material is smaller than No. 200 sieve)	Silts 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
	Silts 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

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.



(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.