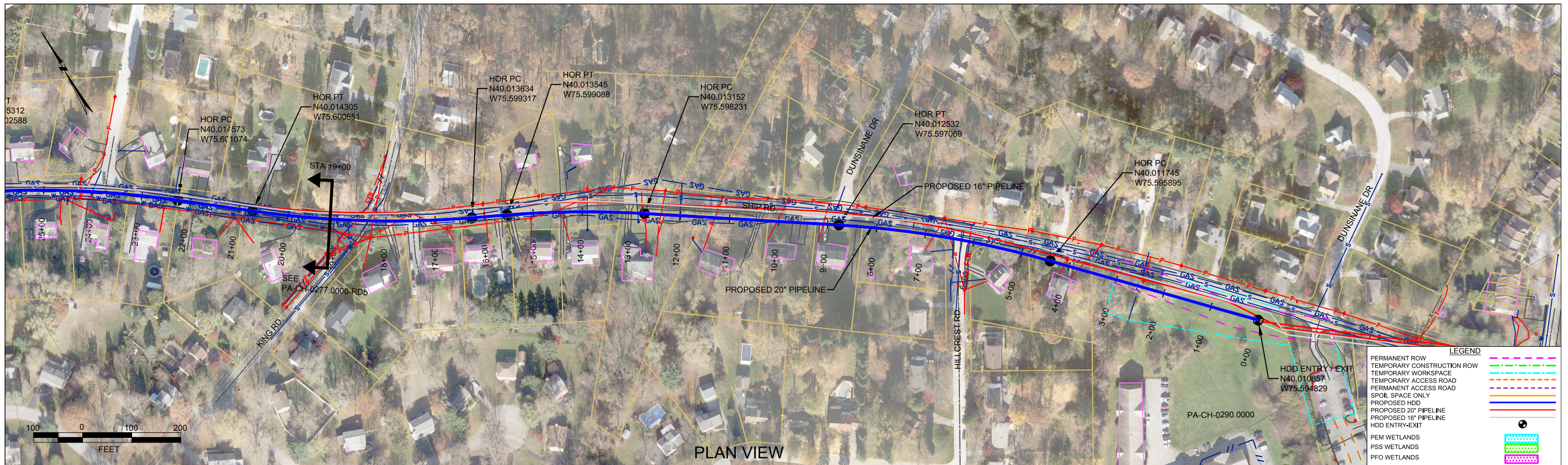


***HDD PA-CH-0277.0000-RD (Ship Road)***

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.

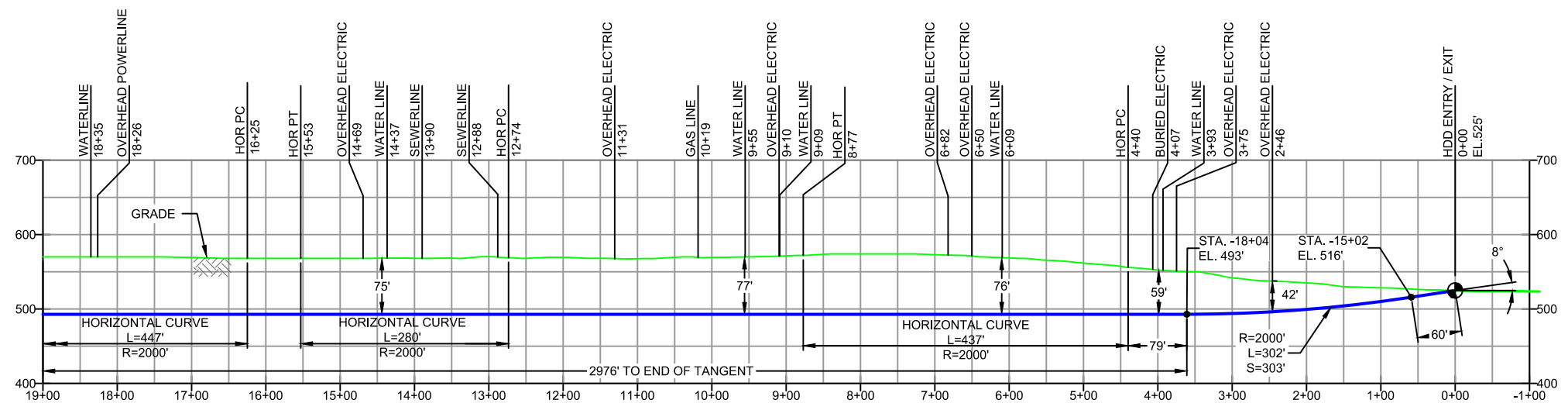
The drill will enter/exit 242 feet northwest of Ship Road. The drill will continue under Ship Road for approximately 2000 feet. This point is 1550 feet northwest of the southeast entry/exit point. The drill will pass between 20 and 77 feet under this road. Using the results of the geotechnical investigation, 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 silty sand, phyllite, and schist.



PLAN VIEW

CHESTER COUNTY, PENNSYLVANIA - WEST WHITELAND TOWNSHIP  
S3-0410A

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): 3780'  
HDD PIPE LENGTH (S): 3785'  
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.

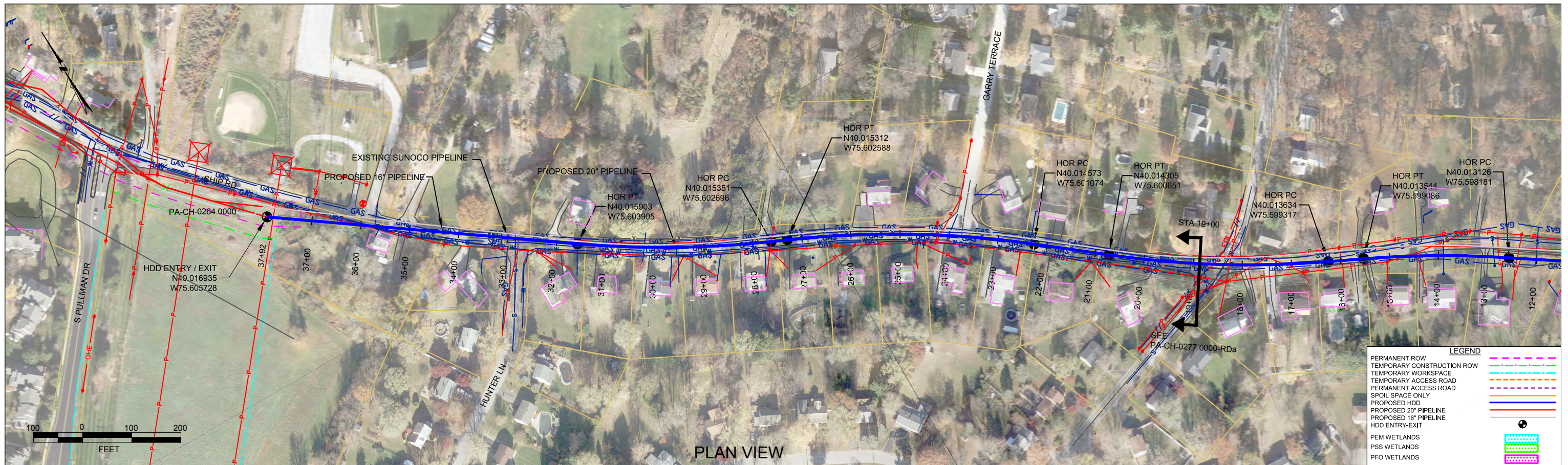
NOTES	
1.	ALL COORDINATES SHOWN ARE IN LATITUDE AND LONGITUDE. ALL MSL ELEVATIONS ARE NAD83
2.	STATIONING IS BASED ON HORIZONTAL DISTANCES
3.	ROONEY ENGINEERING, INC. AND SUNOCO PIPELINE, LP ARE NOT RESPONSIBLE FOR LOCATION OF FOREIGN UTILITIES SHOWN IN PLOT PLAN OR PROFILE. THE INFORMATION SHOWN HEREON 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-6.52	TO ES-6.54	EROSION & SEDIMENT PLAN	
SHEET 34	TO SHEET 36	AERIAL SITE PLAN	EP1 REVISED PER PADEP COMMENTS
			EP
			C ISSUED FOR BID
			B ISSUED FOR BID
			A ISSUED FOR REVIEW
DWG NO	DWG NO	DESCRIPTION	NO.

REVISIONS					
MRS	05/18/16	RMB	05/18/16	AAW	05/18/16
MRS	12/07/15	RMB	12/07/15	AAW	12/07/15
DLM	08/21/15	RMB	08/21/15	AAW	08/21/15
DLM	07/31/15	RMB	07/31/15	AAW	07/31/15
RTT	03/26/15	RMB	03/26/15	AAW	03/26/15
BY	DATE	CHK	DATE	APP	DATE

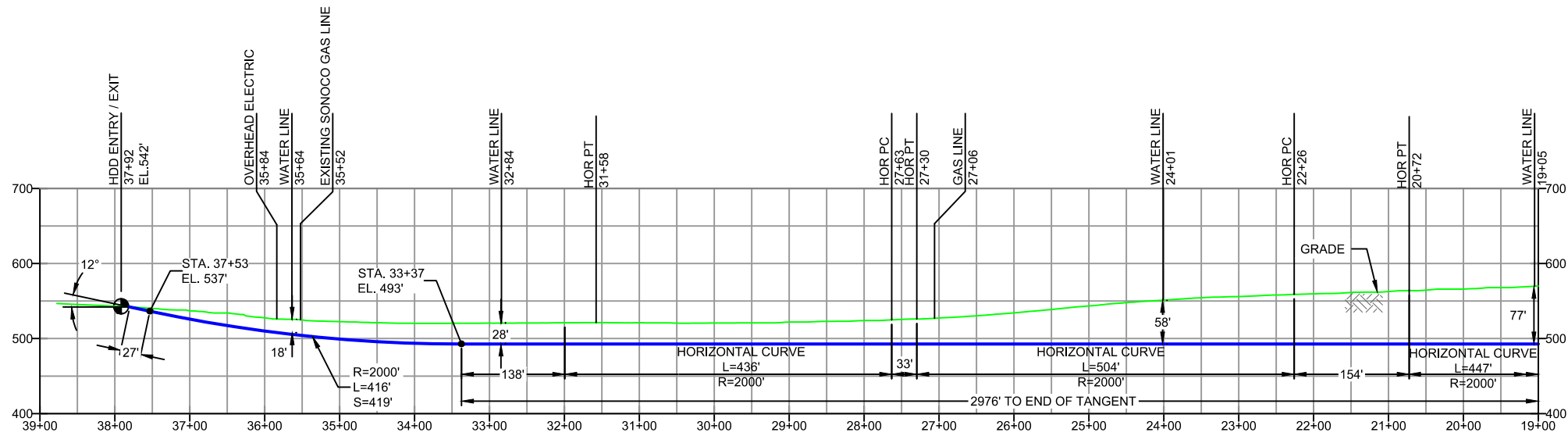


<b>SUNOCO PIPELINE, L.P.</b>	
20-INCH HORIZONTAL DIRECTIONAL DRILL SHIP ROAD/KING ROAD PENNSYLVANIA PIPELINE PROJECT	
SCALE: 1"=200'	DWG. NO: PA-CH-0277.0000-RDa



CHESTER COUNTY, PENNSYLVANIA - WEST WHITELAND TOWNSHIP  
S3-0410A

**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)=3780'  
 HDD PIPE LENGTH (S)=3785'  
 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
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- 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.
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- SUNOCO EMERGENCY HOTLINE NUMBER IS #1-800-786-7440.

REF. DRAWING	NO.	DESCRIPTION	NO.	DESCRIPTION
ES-6.52	TO	ES-6.54	EROSION & SEDIMENT PLAN	
SHEET 34	TO	SHEET 36	AERIAL SITE PLAN	
			EP1	REVISED PER PADEP COMMENTS
			EP	
			C	ISSUED FOR BID
			B	ISSUED FOR BID
			A	ISSUED FOR REVIEW

**REVISIONS**

BY	DATE	CHK	DATE	APP	DATE
MRS	05/11/16	RMB	05/11/16	AAW	05/11/16
MRS	12/07/15	RMB	12/07/15	AAW	12/07/15
DLM	08/21/15	RMB	08/21/15	AAW	08/21/15
DLM	07/31/15	RMB	07/31/15	AAW	07/31/15
RTT	03/26/15	RMB	03/26/15	AAW	03/26/15

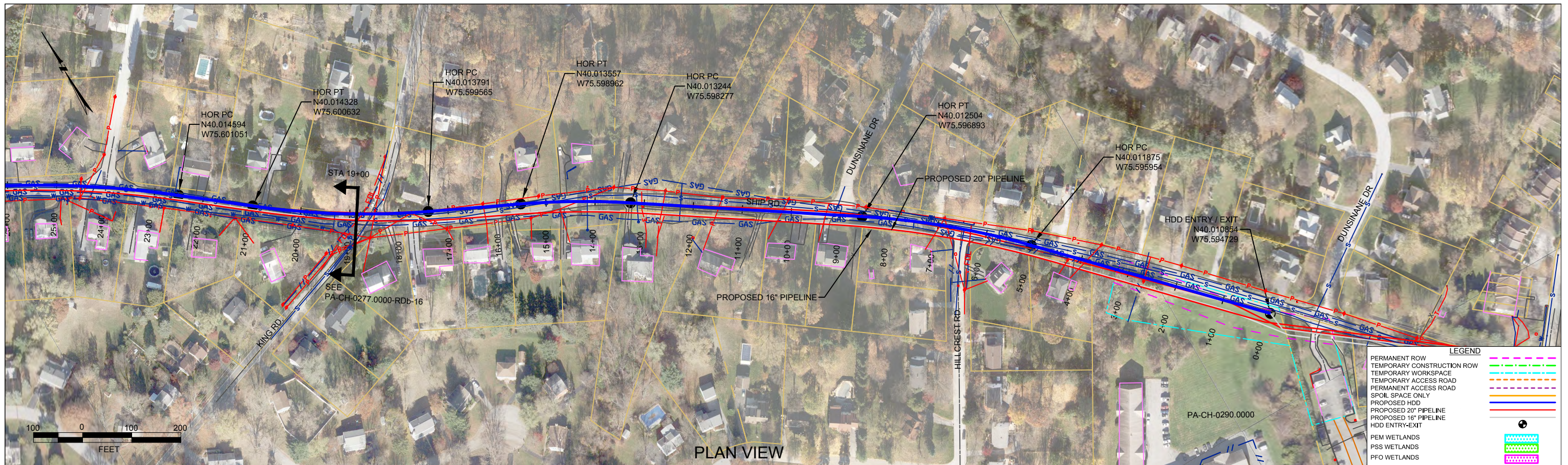
**Sunoco Logistics Partners L.P.**

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

**SUNOCO PIPELINE, L.P.**

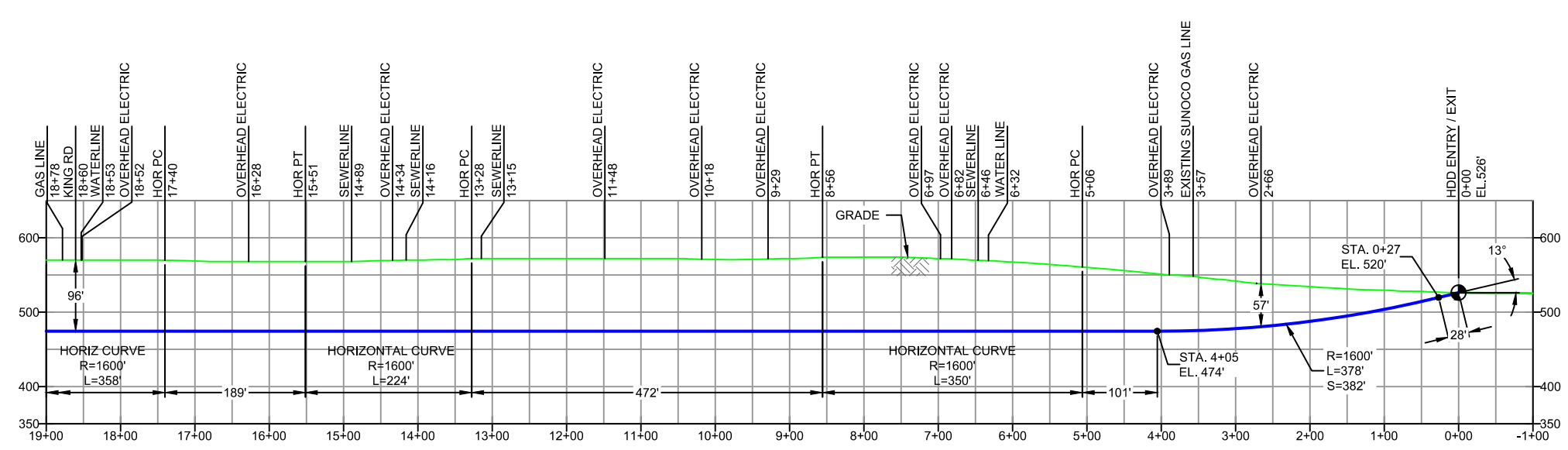
**20-INCH HORIZONTAL DIRECTIONAL DRILL SHIP ROAD/KING ROAD PENNSYLVANIA PIPELINE PROJECT**

SCALE: 1"=200'    DWG. NO: PA-CH-0277.0000-RDb



CHESTER COUNTY, PENNSYLVANIA - WEST WHITELAND TOWNSHIP  
S3-0410A-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): 3828'  
HDD PIPE LENGTH (S): 3839'  
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.
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  - SUNOCO PIPELINE, L.P.'S HORIZONTAL DIRECTIONAL DRILL INADVERTENT RETURN CONTINGENCY PLAN WILL BE IMPLEMENTED AT ALL TIMES.
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**NOTES**

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

REF. DRAWING	NO.	DESCRIPTION	NO.	DESCRIPTION
ES-6.52	TO	ES-6.54	EROSION & SEDIMENT PLAN	
SHEET 34	TO	SHEET 36	AERIAL SITE PLAN	
		EP1	REVISED PER PADEP COMMENTS	MRS 05/11/16 RMB 05/11/16 AAW 05/11/16
		EP		MRS 12/07/15 RMB 12/07/15 AAW 12/07/15
		A	ISSUED FOR BID	MRS 08/31/15 RMB 08/31/15 AAW 08/31/15

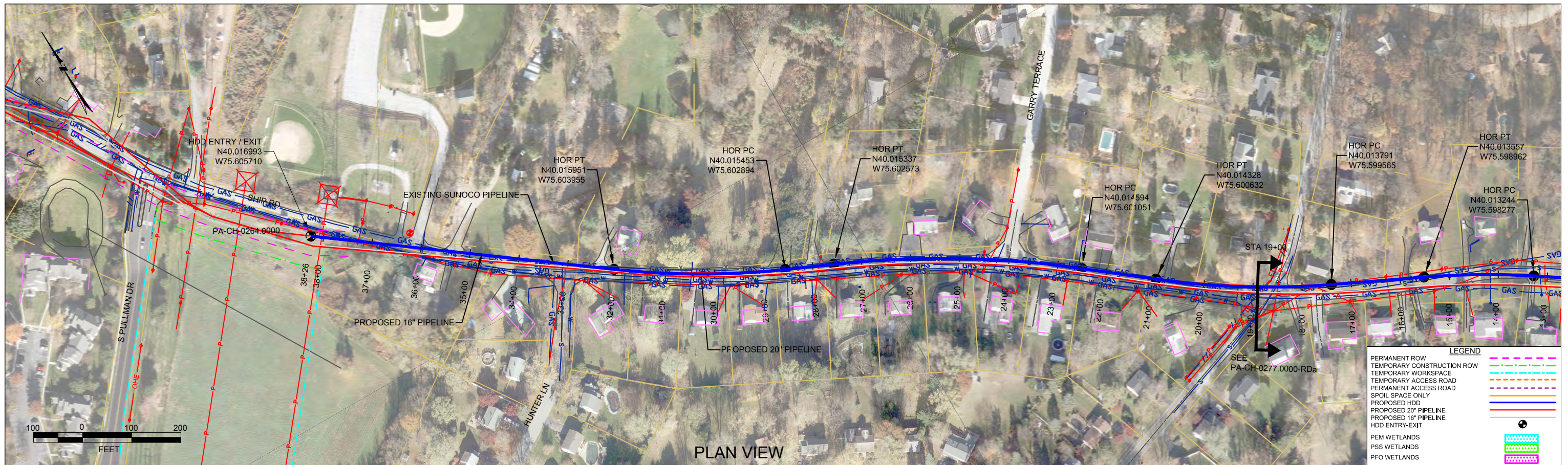
**Sunoco Logistics Partners L.P.**

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

**SUNOCO PIPELINE, L.P.**

16-INCH HORIZONTAL DIRECTIONAL DRILL  
SHIP ROAD/KING ROAD  
PENNSYLVANIA PIPELINE PROJECT

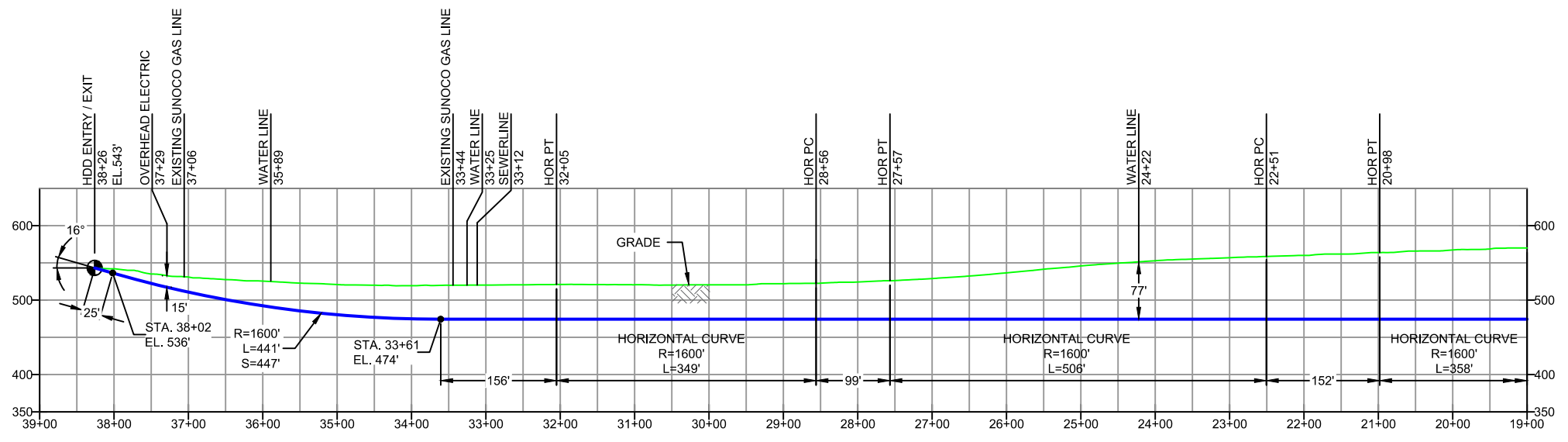
SCALE: 1"=200' DWG. NO: PA-CH-0277.0000-RDa-16



PLAN VIEW

CHESTER COUNTY, PENNSYLVANIA - WEST WHITELAND TOWNSHIP  
S3-0410B-16

PROFILE VIEW



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  - INTERNAL DESIGN PRESSURE 1480 PSIG (SEAM FACTOR 1.0, DESIGN FACTOR 0.50).
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		EP1	REVISED PER PADEP COMMENTS
		EP	
		A	ISSUED FOR BID
DWG NO	DWG NO	DESCRIPTION	DESCRIPTION

BY	DATE	CHK	DATE	APP	DATE
MRS	05/11/16	RMB	05/11/16	AAW	05/11/16
MRS	12/07/15	RMB	12/07/15	AAW	12/07/15
MRS	08/31/15	RMB	08/31/15	AAW	08/31/15

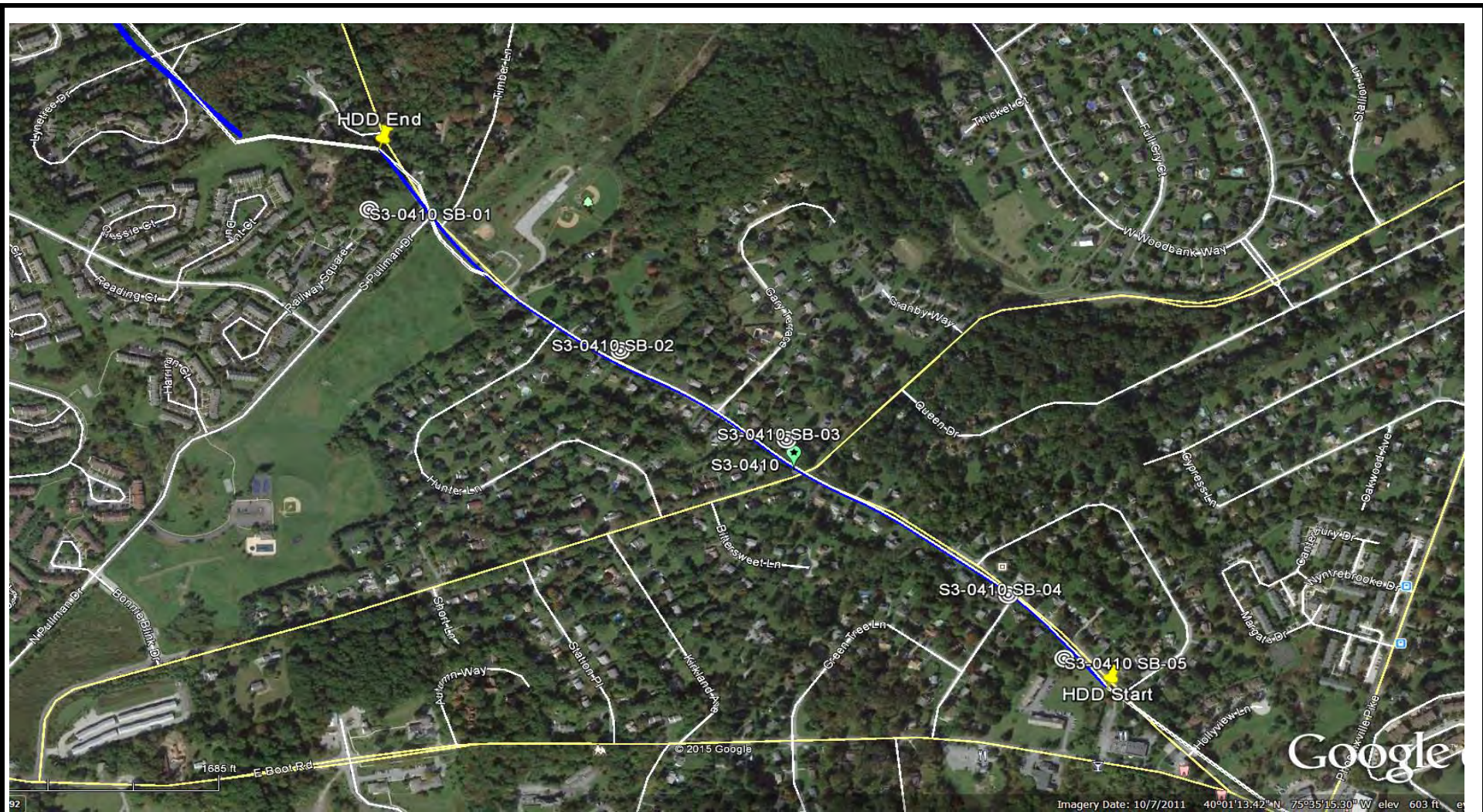
**Sunoco Logistics Partners L.P.**

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


**SUNOCO PIPELINE, L.P.**

16-INCH HORIZONTAL DIRECTIONAL DRILL  
SHIP ROAD/KING ROAD  
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=200'    DWG. NO: PA-CH-0277.0000-RDb-16



**LEGEND:**

 Geotechnical Soil Boring (SB) Locations



GEOTECHNICAL BORING LOCATIONS  
 HDD S3-0410  
 CHESTER COUNTY, WEST WHITELAND 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: RAILWAY SQUARE, EXTON STATION COMMUNITY, PA			Page 1 of 1		
HDD No.: S3-0410		Dates(s) Drilled: 06-16-15		Inspector: E. WATT	
Boring No.: SB-01		Drilling Method: SPT - ASTM D1586		Driller: S. HOFFER	
Drilling Contractor: HAD DRILLING		Groundwater Depth (ft): NOT ENCOUNTERED		Total Depth (ft): 30.0	
Boring Location Coordinates:			40° 1' 4.13" N		75° 36' 26.93" 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		24	SM	BROWN AND ORANGE BROWN FINE TO MEDIUM SAND AND SILT, WITH A LITTLE FINE TO COARSE GRAVEL.	5	5	6	8	11	
2	8.0	10.0	6.5		24	ML	VARIEGATED ORANGE BROWN, LIGHT BROWN AND LIGHT GRAY SILT AND FINE TO MEDIUM SAND, TRACE FINE GRAVEL.	2	6	6	11	12	
3	13.0	15.0	11.5		24	SM	DR SCHIST, VARIEGATED GRAY, LIGHT GRAY, BROWN FINE TO MEDIUM SAND, A LITTLE SILT, MICACEOUS LAYERS.	4	31	40	48	71	
4	18.0	18.6			7		DR SCHIST, VARIEGATED GRAY, LIGHT GRAY, BROWN FINE TO MEDIUM SAND AND SILT, MICACEOUS LAYERS. (USCS: SM).	10	50/1"			>50	
5	23.0	23.2			2		VARIEGATED GRAY, LIGHT GRAY, BROWN PARTIALLY WEATHERED SCHIST.	50/2"				>50	
6	28.0	28.1			1		VARIEGATED GRAY, LIGHT GRAY, BROWN PARTIALLY WEATHERED SCHIST.	50/1"				>50	
				30.0									
							AUGERED TO 30'.						
							CAVED AND DRY AT 27'.						

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: 1403 SHIP ROAD, WEST CHESTER, PA			Page 1 of 1		
HDD No.: S3-0410		Dates(s) Drilled: 11-16-15		Inspector: J. COSTELLO	
Boring No.: SB-03		Drilling Method: SPT - ASTM D1586		Driller: E. OGDEN	
Drilling Contractor: HAD DRILLING		Groundwater Depth (ft): 53.0		Total Depth (ft): 61.0	
Boring Location Coordinates:			40° 0' 51.94" N		75° 36' 0.97" 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	0.2			TOPSOIL (2")					
1	3.0	5.0	0.2		16	SM	DR, REDDISH BROWN FINE TO MEDIUM SAND, SOME SILT, LAYERED WITH PARTIALLY WEATHERED SCHIST.	1	3	5	7	8
2	8.0	10.0	9.0		24	ML	DR (SCHIST), VARIAGATED REDDISH BROWN, ORANGE BROWN SILT AND F-M SAND, LAYERED WITH PARTIALY WEATHERED SCHIST.	4	11	13	15	24
3	13.0	15.0			24		DR (SCHIST), VARIAGATED REDDISH BROWN, ORANGE BROWN SILT SOME, F-M SAND, LAYERED WITH PARTIALY WEATHERED SCHIST.	1	5	7	9	12
4	18.0	20.0			24		SAME (USCS: ML)	2	5	12	27	17
				21.0								
5	23.0	23.8	21.0		8	SM	DR, BROWN F-M SAND, MICACEOUS, WITH A LITTLE SILT, WITH LAYERING OF PARTIALLY WEATHERED SCHIST.	25	50/4"			>50
6	28.0	28.9			8	SM	SAME	7	50/5"			>50
				34.0								
7	33.0	35.0	34.0		17	SM/GM	DR, BROWN FINE TO MEDIUM SAND, TRACE SILT, AND F-C QUARTZ GRAVEL.	5	9	7	6	16
				36.0								
8	38.0	38.8	36.0		8	SM	DR, VARIAGATED REDDISH BROWN AND BROWN PARTIALLY WEATHERED SCHIST.	19	50/4"			>50
9	43.0	44.2			9		DR, VARIAGATED REDDISH BROWN AND BROWN PARTIALLY WEATHERED SCHIST. (USCS: SM).	13	50	50/2"		>50
10	48.0	49.2			13		DR, VARIAGATED REDDISH BROWN AND BROWN PARTIALLY WEATHERED SCHIST.	7	50	50/2"		>50
11	53.0	54.5		56.0	16	SM	SAME	4	22	50		72
							AUGER REFUSAL AT 56'.					
							<u>ROCK CORING</u>					
RUN 1	56.0	61.0	56.0		20		HIGHLY WEATHERED AND FRACTURED SCHIST, VARIAGATED, TRACE MICA.	TCR: 33%, SCR: 2%, RQD: 0%				
				61.0			COULD NOT ADVANCE CORE BARREL DEEPER DUE TO HOLE COLLAPSE					
							CAVED AT 55'.					
							WET ON SPOON AT 53'.					
							WATER LEVEL THROUGH AUGERS AT 53'.					

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: 1312 HILLCREST ROAD, WEST CHESTER, PA		Page 1 of 1	
HDD No.: S3-0410	Dates(s) Drilled: 11-18-15	Inspector: J. COSTELLO	
Boring No.: SB-04	Drilling Method: SPT - ASTM D1586	Driller: E. OGDEN	
Drilling Contractor: HAD DRILLING	Groundwater Depth (ft): NOT ENCOUNTERED	Total Depth (ft): 29.0	
Boring Location Coordinates:		40° 0' 43.74" N 75° 35' 47.22" 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 (3")						
1	3.0	5.0	0.3		13	ML	DR, BROWN TO REDDISH BROWN SANDY SILT, LAYERED WITH	1	4	6	7	10	
				4.0			PARTIALLY WEATHERED SCHIST.						
2	8.0	10.0	4.0		20	SM	DR, VARIEGATED BROWN, GRAY, REDDISH BROWN FINE TO MEDIUM	9	11	13	20	24	
							SAND, TRACE SILT, LAYERED WITH PARTIALLY WEATHER. SHCIST.						
3	13.0	14.3			16		DR, VARIEGATED BROWN, GRAY, AND REDDISH BROWN	8	22	50/4"		>50	
							PARTIALLY WEATHERED SCHIST.						
4	18.0	19.5			20		SAME (USCS: SM).	2	9	50		59	
5	23.0	23.8			12	SAME	9	50/3"			>50		
6	28.0	28.7			9	SAME	15	50/2"			>50		
				29.0									
							AUGER REFUSAL AT 29'.						
							CAVED AND DRY AT 25'.						

Notes/Comments:  
Pocket Penetrometer Testing DR: DECOMPOSED ROCK  
 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.



**TETRA TECH**

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**TEST BORING LOG**

Project Name: SUNOCO PENNSYLVANIA PIPELINE PROJECT			Project No.: 103IP3406		
Project Location: NORTHWYN CT APTS, 803 BOOT ROAD, WEST CHESTER, PA			Page 1 of 1		
HDD No.: S3-0410		Dates(s) Drilled: 08-04-15		Inspector: J. COSTELLO	
Boring No.: SB-05		Drilling Method: SPT - ASTM D1586		Driller: E. OGDEN	
Drilling Contractor: HAD DRILLING		Groundwater Depth (ft): 8.0		Total Depth (ft): 24.4	
Boring Location Coordinates:			40° 0' 40.30" N		75° 35' 43.63" 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	0.5			TOPSOIL (6")						
1	3.0	5.0	0.5		16	SM	DR, VARIEGATED BROWN FINE TO MEDIUM SAND (WITH LAYERS OF MICA SCHIST), SOME SILT.	1	4	4	4	8	
2	8.0	10.0			15		DR, VARIEGATED BROWN AND REDDISH BROWN FINE TO MEDIUM SAND, SOME SILT, MICACEOUS.	1	4	5	7	9	
3	13.0	15.0			12		DR, GRAY AND REDDISH BROWN FINE TO MEDIUM SAND (WITH LAYERS OF MICA SCHIST), SOME SILT.	1	5	10	21	15	
4	18.0	20.0			14		HIGHLY WEATHERED GRAY SCHIST.	7	5	21	27	26	
				23.5									
5	23.0	24.4	23.5		14		DARK GRAY HIGHLY WEATHERED TO PARTIALLY WEATHERED SCHIST.	7	32	50/5"		>50	
				24.4									
							AGUER REFUSAL AT 24'.						
							WET ON SPOON AT 8'.						
							WATER LEVEL THROUGH AUGERS AT 8'.						
							CAVED AT 21.5', WATER LEVE ON CAVE AT 2.5'.						
							<b>PETROLEUM ODORS APPARENT WITHIN SAMPLES 3 TO 5, AND DURING AUGURING.</b>						

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 S3-0410**

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					
S3-0410	SB-03	1	56	61	33	2	0	56	61	Heavily	Schist	Massive	White/ brown/ greenish	Rubble, no sample collected

**GEOTECHNICAL LABORATORY TESTING SUMMARY**  
**SUNOCO PENNSYLVANIA PIPELINE PROJECT**  
**HDD S3-0410**

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, %	
S3-0410	SB-01	2	8.0	10.0	26.0	63.3	-	-	-	-
		3	13.0	15.0	8.3	18.9	-	-	-	-
		4	18.0	18.6	10.4	46.3	30	24	6	SM
		5	23.0	23.2	7.3	7.5	-	-	-	-
		6	28.0	28.1	2.4	10.5	-	-	-	-
	SB-02	1	3.0	5.0	25.2	85.3	39	28	11	ML
		3	13.0	13.4	2.6	15.7	-	-	-	-
		5	23.0	23.5	4.6	28.3	-	-	-	-
		7	33.0	33.4	8.4	30.7	NV	NP	NP	SM
		8	38.0	38.4	3.8	31.3	-	-	-	-
		10	48.0	48.8	6.1	30.4	-	-	-	-
	SB-03	12	55.0	55.0	7.9	21.9	-	-	-	-
		2	8.0	10.0	21.0	59.0	-	-	-	-
		4	18.0	20.0	21.9	77.9	34	26	9	ML
		6	28.0	28.9	5.7	15.5	-	-	-	-
		7	33.0	35.0	5.0	6.9	-	-	-	-
		9	43.0	44.2	16.1	37.4	NV	NP	NP	SM
	SB-04	11	53.0	54.5	12.0	9.9	-	-	-	-
		2	8.0	10.0	5.8	9.4	-	-	-	-
		3	13.0	14.3	4.0	11.7	-	-	-	-
		4	18.0	19.5	17.5	28.4	NV	NP	NP	SM
		5	23.0	23.8	3.4	16.6	-	-	-	-
		6	28.0	28.7	2.5	16.5	-	-	-	-
SB-05	1	3.0	5.0	19.6	32.7	-	-	-	-	
	2	8.0	10.0	22.4	28.5	-	-	-	-	

**Notes:**

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

**REGIONAL GEOLOGY SUMMARY  
SUNOCO PENNSYLVANIA PIPELINE PROJECT  
HDD S3-0410**

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
S3-0410		SB-01	<b>Octoraro Formation</b> - Includes albite-chlorite schist, phyllite, some hornblende gneiss, and granitized members.	Moderately sloping to the North	Octoraro Formation (Probably Lower Paleozoic)	Schist; secondary: phyllite; other types: gneiss, gneissoid	Unknown	Widely ranging from 3 to 65 ft bgs, Avg. 27 ft bgs (.5 mile radius)	
		SB-02		Gently to moderately sloping to the North					
		SB-03		Generally level					
		SB-04		Generally level, slightly sloping to the North					
		SB-05		Generally level, slightly sloping to the South					

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	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.