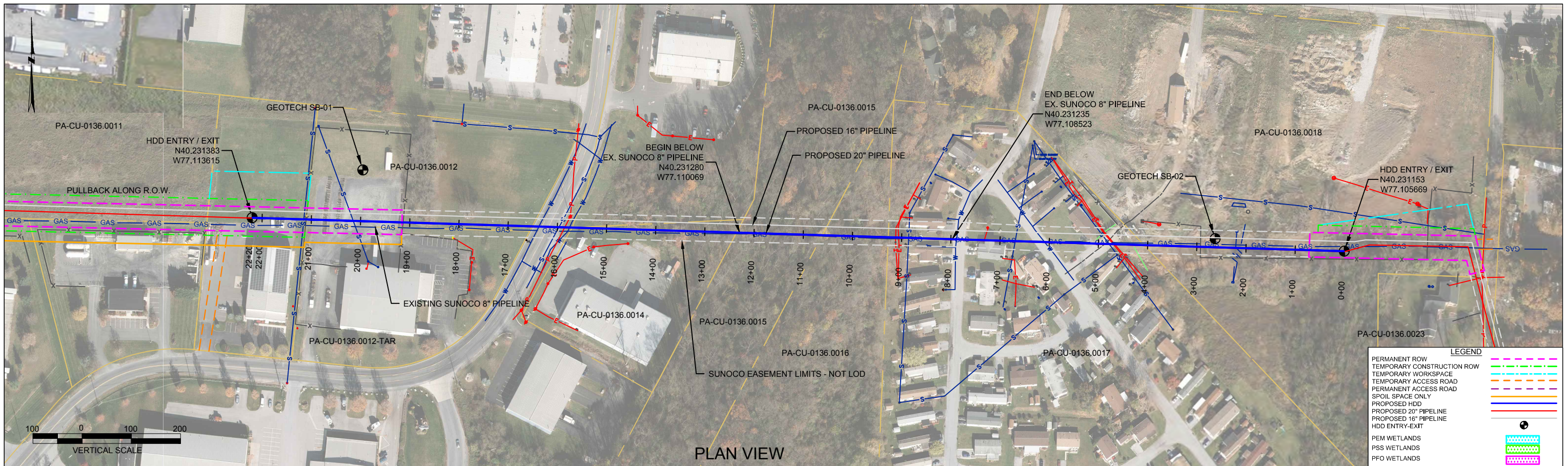


HDD PA-CU-0136.0012-RD

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 580 feet from the western edge of Roadway Drive and enter/exit 1,580 feet from the eastern edge. The horizontal directional drill will enter/exit 1,100 feet from the western edge of the Appalachian Trail and enter/exit 1,130 feet from the eastern edge. The drill will pass 45 feet below the road and will be 65 feet beneath the trail. The geotechnical results, as well as other data points, were used to determine the entry/exit angles, and depths to pass through the best substrates while maintaining the pipe integrity (e.g., no large bends). According to the geotechnical report primary substrate being drilled through is crystalline limestone below layers of silt. Based on the geotechnical report and the drill profile minimal inadvertent returns are expected.

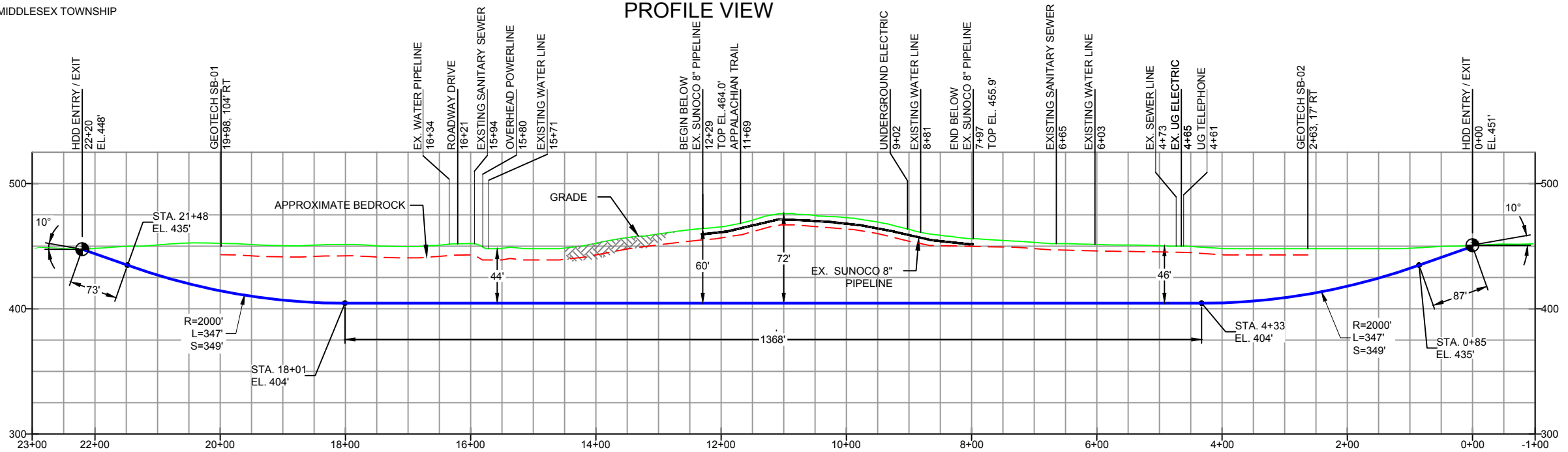


CUMBERLAND COUNTY, PENNSYLVANIA - MIDDLESEX TOWNSHIP
S2-0230

PROFILE VIEW

GEOTECH SB-01
-NG EL. 450'
-GRAVEL (0.0' - 0.2')
-SILT (USCS:MH) (0.2' - 18.0')
-LIMESTONE (18.0' - 18.1')
-COMPLETION DEPTH EL. 432'
GEOTECH SB-02
-NG EL. 448'
-SILT (USCS:MH) (0.0' - 6.5')
-SILT/LIMESTONE (6.5' - 9.8')
-COMPLETION DEPTH EL. 438'

NOTE: REFER TO TEST BORING LOG S2-0230 FOR COMPLETE SOIL MATERIAL DESCRIPTION



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)=2220'
HDD PIPE LENGTH (S)=2226'
20" x 0.456" W.T., X-65, API5L, PSL2, ERW, 8FW
COATING: 14-16 MILS FBE WITH 30-35 MIL ARO (POWERCRETE R95)
- INTERNAL DESIGN PRESSURE 1480 PSIG (SEAM FACTOR 1.0, DESIGN FACTOR 0.50).
- INSTALLATION METHOD: HORIZONTAL DIRECTIONAL DRILL (HDD).
- PIPELINE WARNING MARKERS SHALL BE INSTALLED ON BOTH SIDES OF ALL ROAD, RAILWAY, AND STREAM CROSSINGS.
- CARRIER PIPE NOT ENCASED.
- PIPE / AMBIENT TEMPERATURE MUST BE NO LESS THAN 30°F DURING PULLBACK WITHOUT PRIOR WRITTEN APPROVAL FROM THE ENGINEER.
- CONDUCT 4-HOUR PRE-INSTALLATION HYDROTEST OF HDD PIPE STRING TO MINIMUM 1850 PSIG.
- SEE SUNOCO PENNSYLVANIA PIPELINE PROJECT ESRI WEBMAP FOR ACCESS ROAD ALIGNMENT.
- SUNOCO PIPELINE, L.P.'S HORIZONTAL DIRECTIONAL DRILL INADVERTENT RETURN CONTINGENCY PLAN WILL BE IMPLEMENTED AT ALL TIMES.
- SUNOCO PIPELINE, L.P.'S EROSION AND SEDIMENTATION CONTROL PLAN WILL BE IMPLEMENTED AT ALL TIMES.

NOTES

- ALL COORDINATES SHOWN ARE IN LATITUDE AND LONGITUDE. ALL MSL ELEVATIONS ARE NAD83
- STATIONING IS BASED ON HORIZONTAL DISTANCES.
- ROONEY ENGINEERING, INC. AND SUNOCO PIPELINE, LP ARE NOT RESPONSIBLE FOR LOCATION OF FOREIGN UTILITIES SHOWN IN PLOT PLAN OR PROFILE. THE INFORMATION SHOWN HEREON IS FURNISHED WITHOUT LIABILITY ON THE PART OF ROONEY ENGINEERING, INC. AND SUNOCO PIPELINE, LP. FOR ANY DAMAGES RESULTING FROM ERRORS OR OMISSIONS THEREIN.
- CONTRACTOR IS RESPONSIBLE FOR LOCATING ALL UTILITIES. CONTACT ONE CALL AT 811 PRIOR TO DIGGING.
- SUNOCO EMERGENCY HOTLINE NUMBER IS #1-800-786-7440.

REF. DRAWING	NO.	DESCRIPTION
ES-4.65	TO ES-4.66	EROSION & SEDIMENT PLAN
SHEET 39	TO SHEET 40	AERIAL SITE PLAN
DWG NO	DWG NO	DESCRIPTION

REVISIONS	NO.	DESCRIPTION
EP2	REVISED PER PADEP COMMENTS RECEIVED 09-06-16	
EP1	REVISED PER PADEP COMMENTS	
EP		
C	ADDED GEOTECH INFO	
B	ISSUED FOR BID	
A	ISSUED FOR REVIEW	
BY	DATE	CHK

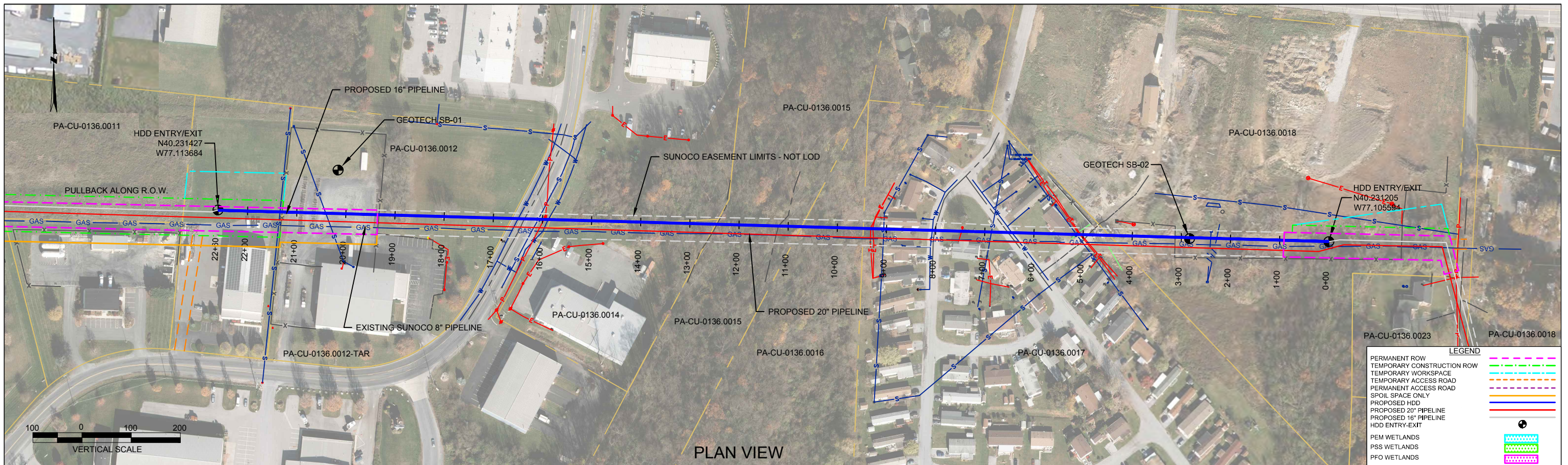
Sunoco Logistics Partners L.P.

TETRA TECH ROONEY
(303) 792-5911

SUNOCO PIPELINE, L.P.

20-INCH HORIZONTAL DIRECTIONAL DRILL
APPALACHIAN TRAIL
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=200'
DWG. NO: PA-CU-0136.0012-RD



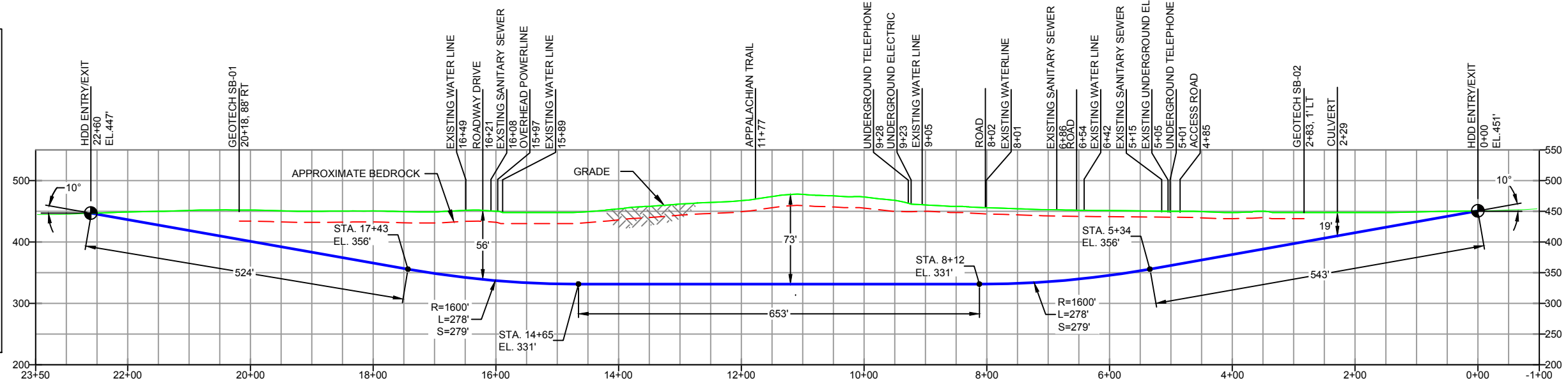
PLAN VIEW

CUMBERLAND COUNTY, PENNSYLVANIA - MIDDLESEX TOWNSHIP
S2-0230-16

GEOTECH SB-01	
NG EL. 450'	
GRAVEL (0.0' - 0.2')	
SILT (USCS:MH) (0.2' - 18.0')	
LIMESTONE (18.0' - 18.1')	
COMPLETION DEPTH EL. 432'	
GEOTECH SB-02	
NG EL. 448'	
SILT (USCS:MH) (0.0' - 6.5')	
SILT/LIMESTONE (6.5' - 9.8')	
COMPLETION DEPTH EL. 438'	

NOTE: REFER TO TEST BORING LOG S2-0230 FOR COMPLETE SOIL MATERIAL DESCRIPTION

PROFILE VIEW



DESIGN AND CONSTRUCTION:

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- DESIGNED IN ACCORDANCE WITH CFR 49 195 & ASME B31.4
- CROSSING PIPE SPECIFICATION:
HDD HORZ. LENGTH (L)=2260'
HDD PIPE LENGTH (S)=2278'
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.
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- SEE SUNOCO PENNSYLVANIA PIPELINE PROJECT ESRI WEBMAP FOR ACCESS ROAD ALIGNMENT.
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NOTES

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

REF. DRAWING

ES-4.65	TO	ES-4.66	EROSION & SEDIMENT PLAN
SHEET 39	TO	SHEET 40	AERIAL SITE PLAN
DWG NO.		DWG NO.	DESCRIPTION

REVISIONS

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	05/10/16	RMB	05/10/16	AAW	05/10/16
EP		JTW	11/23/15	RMB	11/23/15	AAW	11/23/15
B	ADDED GEOTECH INFO	MRS	09/15/15	RMB	09/15/15	AAW	09/15/15
A	ISSUED FOR BID	MRS	08/31/15	RMB	08/31/15	AAW	08/31/15
		BY	DATE	CHK	DATE	APP	DATE

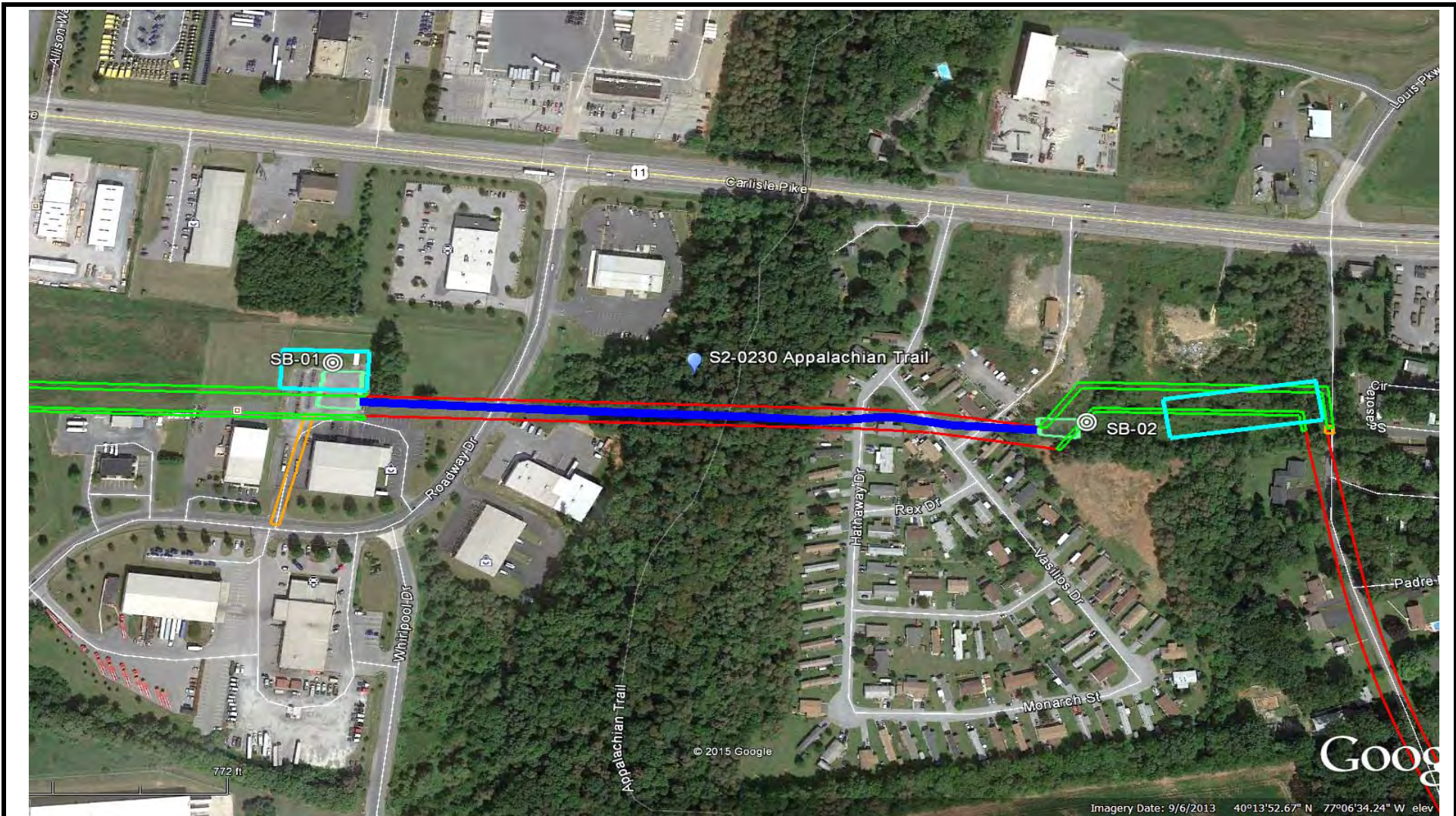
Sunoco Logistics Partners L.P.

TETRA TECH ROONEY
(303) 792-5911

SUNOCO PIPELINE, L.P.

16-INCH HORIZONTAL DIRECTIONAL DRILL
APPALACHIAN TRAIL
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=200' DWG. NO. PA-CU-0136.0012-RD-16



LEGEND:

⊙ Geotechnical Soil Boring (SB) Locations



GEOTECHNICAL BORING LOCATIONS
 HDD S2-0230
 CUMBERLAND COUNTY, MIDDLESEX 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:		ROADWAY DRIVE, CARLISLE, PA			Page 1 of 1	
HDD No.:	S2-0230	Dates(s) Drilled: 01-27-15		Inspector: E. WATT		
Boring No.:	SB-01	Drilling Method: SPT - ASTM D1586		Driller: S. HOFFER		
Drilling Contractor: HAD DRILLING		Groundwater Depth (ft): SEE BELOW		Total Depth (ft): 20.0		

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			GRAVEL/STONE BASE						
1	3.0	5.0	0.2		13	MH	ORANGE BROWN ELASTIC SILT. (USCS: MH).	1	2	3	4	5	
2	8.0	10.0			24		ORANGE BROWN ELASTIC SILT.	4	4	4	1	8	
3	13.0	15.0			19		ORANGE BROWN ELASTIC AND WET SILT, TRACE ROCK FRAGMENTS.	2	2	2	2	4	
				18.0			(USCS: MH).						
4	18.0	18.1	18.0	18.1	1		FRAGMENTED PIECES OF WEATHERED LIMESTONE.	50/1"				0	
							AUGER REFUSAL AT 18'. OFF-SET BORING 20' AND CONTINUOUSLY AUGERED TO REFUSAL AT 20'.						
							REFUSAL MATERIAL MIGHT BE A RESULT OF BOULDERY SUBSURFACE CONDITIONS.						
							WET ON SPOON AT 18', WATER LEVEL NOT ENCOUNTERED THROUGH AUGERS. DRY AND CAVED AT 18'.						
							PERCHED WATER CONDITIONS MAY EXIST.						

Notes/Comments:
Pocket Pentrometer Testing
 S1: 1.5 TSF
 S2: 1.75 TSF
 S3: < 0.5 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: ROADWAY DRIVE, CARLISLE, PA			Page 1 of 1		
HDD No.: S2-0230		Dates(s) Drilled: 01-27-15		Inspector: E. WATT	
Boring No.: SB-02		Drilling Method: SPT - ASTM D1586		Driller: S. HOFFER	
Drilling Contractor: HAD DRILLING		Groundwater Depth (ft): NOT ENCOUNTERED		Total Depth (ft): 10.0	

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	0.0			NO TOPSOIL.					
1	3.0	5.0	0.0			MH	ORANGE BROWN ELASTIC SILT, WITH TRACE LIMESTONE FRAGMENTS (USCS: MH).	2	4	24	24	28
				6.5								
2	8.0	9.8	6.5			MH/GM	INTERLAYERED LAYERS OF ORANGE BROWN SILT AND LIMESTONE FRAGMENTS.	27	12	6	50/3"	18
				9.8								
							AUGER REFUSAL AT 10'. OFF-SET BORING AND CONTINUOUSLY AUGERED TO REFUSAL AT 9'. OFF-SET BORING AGAIN AND CONTINUOUSLY AUGURED TO REFUSAL AT 8.8'.					
							REFUSAL MATERIAL MIGHT BE A RESULT OF BOULDERY SUBSURFACE CONDITIONS.					
							CAVED AND DRY AT 10'.					

Notes/Comments:
Pocket Pentrometer Testing
 S1: 2.75 TSF

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

* Number of blows of 140 lb. Hammer dropped 30 in. required to drive 2 in. split-spoon sampler in 6 in. increments.
 N: Number of blows to drive spoon from 6" to 18" interval.

**GEOTECHNICAL LABORATORY TESTING SUMMARY
SUNOCO PENNSYLVANIA PIPELINE PROJECT
HDD S2-0230**

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, %	
S2-0230	SB-01	1	3.0	5.0	36.5	100.0	61	39	22	MH
		2	8.0	10.0	30.1	95.0	-	-	-	-
		3	13.0	15.0	49.0	96.5	55	34	21	MH
	SB-02	1	3.0	5.0	40.2	96.7	54	32	22	MH

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

**REGIONAL GEOLOGY SUMMARY
SUNOCO PENNSYLVANIA PIPELINE PROJECT
HDD S2-0230**

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
S2-0230	Appalachian Trail	SB-01	St. Paul Group - consists of buff-colored magnesium limestone and very finely crystalline birdseye limestone at its top and base.	Level terrain	St. Paul Group	Crystalline limestone, chert, and dolomite (St. Paul)	1,500	Variable; 5-50 ft bgs, average DTB ~ 10-20 ft bgs	Fractured limestone noted on boring logs. Yields range 5-30 gpm
		SB-02							Very finely crystalline, "birdseye" limestone at top and base, granular fossiliferous limestone, black chert, and dolomite in middle

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

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				
		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.