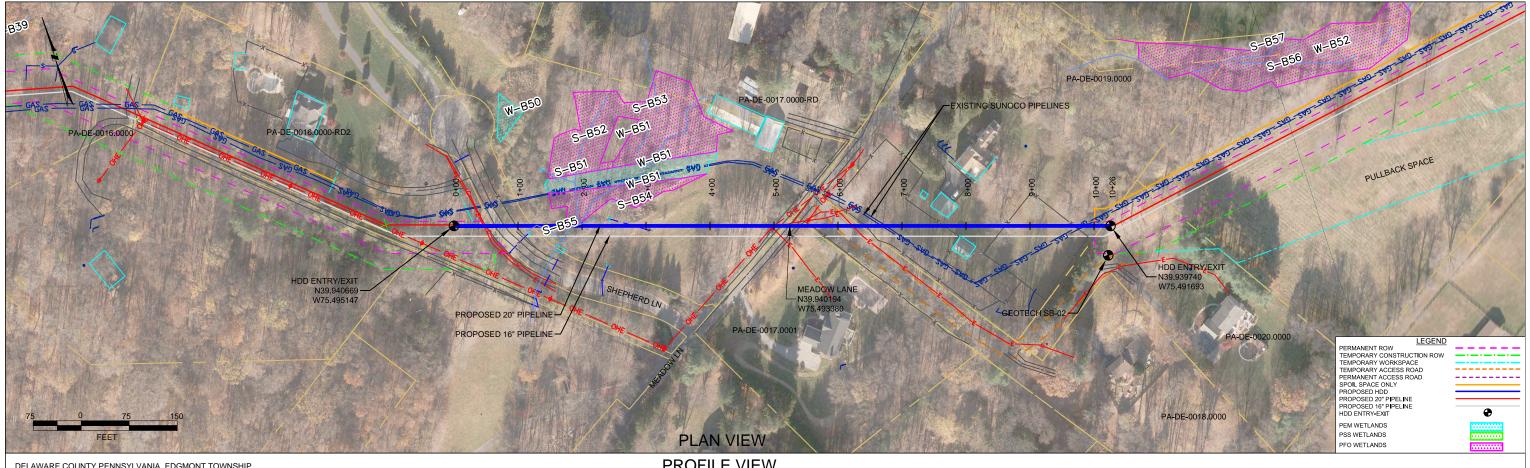
HDD PA-DE-0016.0000-RD (S-B55)

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 129 feet northwest of stream B55. The drill will pass 18 feet under this stream. 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 clay, silty sand, and gneiss.

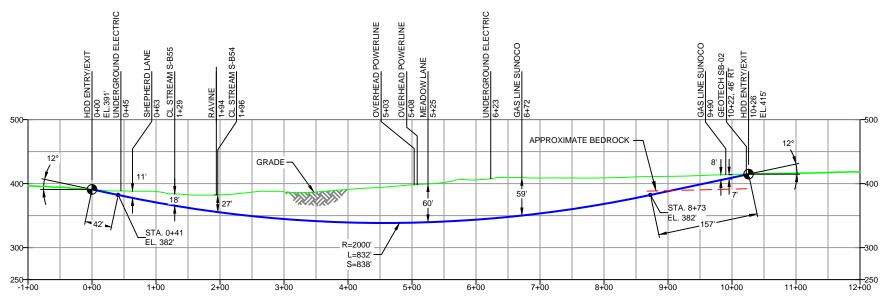


DELAWARE COUNTY PENNSYLVANIA, EDGMONT TOWNSHIP S3-0570

GEOTECH SB-02 -NG EL. 416' -TOPSOIL (0' - 0.3') -GROUNDWATER (9.5') -SM (0.3' - 21.0') -WEATHERED GNEISS (21.0' - 22.3') -COMPLETION DEPTH EL. 393.5'

OTE: REFER TO TEST BORING LOG S3-0570 FOR OMPLETE SOIL MATERIAL DESCRIPTION

PROFILE VIEW



- 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=):1026'
 HDD PIPE LENGTH (S=):1037
 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.

				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-6.04	то	ES-6.05	EROSION & SEDIMENT PLAN								
STATIONING IS BASED ON HORIZONTAL DISTANCES. ROONEY ENGINEERING, INC. AND SUNOCO PIPELINE, LP ARE NOT RESPONSIBLE FOR LOCATION	SHEET 3	то	SHEET 3	AERIAL SITE PLAN	EP1	REVISED PER PADEP COMMENTS	MRS (05/09/16	RMB	05/09/16	AAW	05/09/16
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	03/15/16	RMB	03/15/16	AAW	03/15/16
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	JAM (03/17/15	RMB	03/27/15	AAW	03/27/15
	DWG NO		DWG NO	DESCRIPTION	NO.	DESCRIPTION	BY	DATE	СНК	DATE	APP	DATE

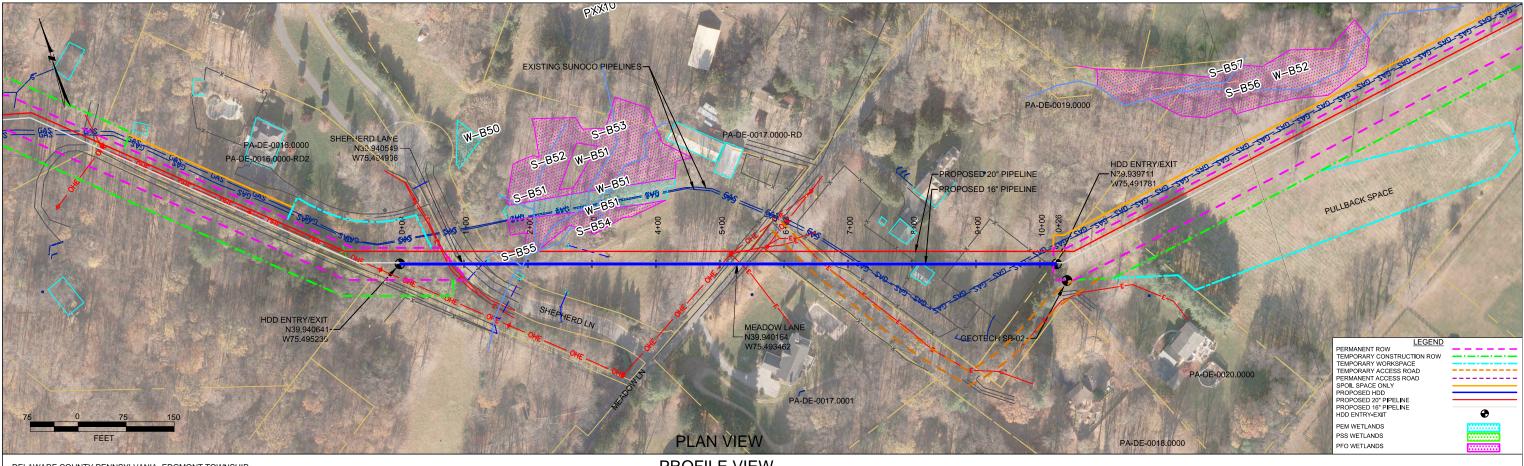


(303) 792-5911

20-INCH HORIZONTAL DIRECTIONAL DRILL MEADOW LANE PENNSYLVANIA PIPELINE PROJECT TETRA TECH ROONEY

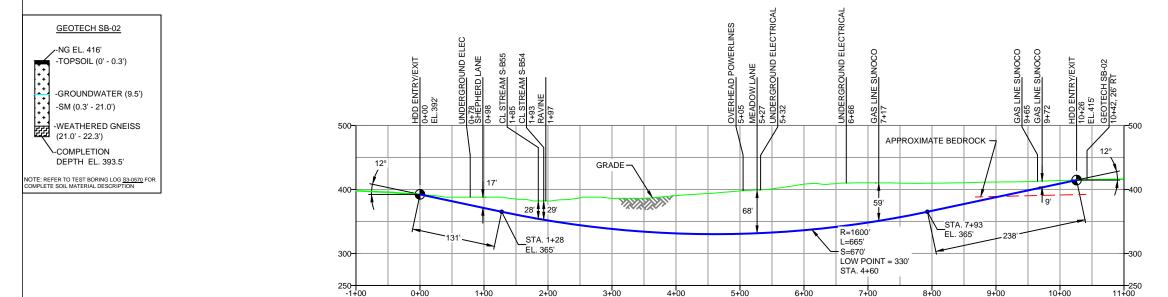
SCALE:	1"=150'	DWG. NO: PA-DE-0016.0000-RD

SUNOCO PIPELINE, L.P.



DELAWARE COUNTY PENNSYLVANIA, EDGMONT TOWNSHIP S3-0570-16





1+00

0+00

3+00

4+00

5+00

- 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=):1026'
 HDD PIPE LENGTH (S=):1039'
 16" x 0.438" W.T., X-70, APISL, PSL2, ERW, BFW
 COATING: 14-16 MILS FEE WITH 30-35 MIL ARO (POWERCRETE R95)

2+00

- 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.

9+00

10+00

- SUNOCO PIPELINE, L.P.'S HORIZONTAL DIRECTIONAL DRILL INADVERTENT RETURN CONTINGENCY PLAN WILL BE IMPLEMENTED AT ALL TIMES.
 SUNDCO 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. DRAWING				REVISIONS						
1. ALL COORDINATES SHOWN ARE IN LATITUDE AND LONGITUDE. ALL MSL ELEVATIONS ARE NAD83	ES-6.04	то	ES-6.05	EROSION & SEDIMENT PLAN								
STATIONING IS BASED ON HORIZONTAL DISTANCES. ROONEY ENGINEERING, INC. AND SUNOCO PIPELINE, LP ARE NOT RESPONSIBLE FOR LOCATION	SHEET 3	то	SHEET 3	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.					EP1	REVISED PER PADEP COMMENTS	MRS	05/09/16	RMB	05/09/16	AAW	05/09/16
LP, FOR ANY DAMAGES RESULTING FROM ERRORS OR OMISSIONS THEREIN.					EP		MRS	03/15/16	RMB	03/15/16	AAW	03/15/16
4. CONTRACTOR IS RESPONSIBLE FOR LOCATING ALL UTILITIES. CONTACT ONE CALL AT 811 PRIOR TO DIGGING.					В	ADDED GEOTECH INFO	MRS	10/01/15	RMB	10/01/15	AAW	10/01/15
5. SUNOCO EMERGENCY HOTLINE NUMBER IS #1-800-786-7440.					А	ISSUED FOR BID	MRS	08/31/15	RMB	08/31/15	AAW	08/31/15
	DWG NO		DWG NO	DESCRIPTION	NO.	DESCRIPTION	BY	DATE	СНК	DATE	APP	DATE



Sunoco Logistics Partners L.P.

16-INCH HORIZONTAL DIRECTIONAL DRILL MEADOW LANE

TETRA TECH ROONEY (303) 792-5911

PENNSYLVANIA PIPELINE PROJECT

SUNOCO PIPELINE, L.P.

SCALE: 1"=150' DWG. NO: PA-DE-0016.0000-RD-16



LEGEND:

© Geotechnical Soil Boring (SB) Locations



GEOTECHNICAL BORING LOCATIONS HDD S3-0570 DELAWARE COUNTY, EDGMONT TWP, 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 PI	UNOCO PENNSYLVANIA PIPELINE PROJECT						
Project Location:	SHEPPARD LANE, GLEN MIL	Page 1 of 1						
HDD No.:	S3-0570	Dates(s) Drilled: 10-27-15	Inspector:	J. COSTELLO				
Boring No.:	SB-01	Drilling Method: SPT - ASTM D1586	Driller:	E. ODGEN				
Drilling Contractor:	HAD DRILLING	Groundwater Depth (ft): 13.5	Total Depth (ft):	17.0				
Boring Location Coordi	nates:	39° 56′ 26.28″ N						

Domig	Location	ii Oooraii	iatoo.				70 20 71.00 11					
Sample	Sample	Depth (ft)	Strata D	Depth (ft)		Strata	Description of Materials	6" 1		ent Blo	*	N
No.	From	То	From	То	Recov. (in)	(USCS)	Description of Materials	0 11	icreme	HIL BIO	NS	N
			0.0	0.1			TOPSOIL (1")					
1	3.0	5.0	0.1		20	01	GRAYISH BROWN SILTY CLAY, TRACE FINE SAND, TRACE FINE	1	4	5	7	9
				7.0		CL	GRAVEL.					
2	8.0	10.0	7.0		16		DR, VARIEGATED BROWN AND DARK BROWN FINE TO MEDIUM SAND	2	6	5	5	11
						0.4	WITH A LITTLE SILT, TRACE FINE ROCK FRAGMENTS.					
3	13.0	15.0			22	SM	DR, BROWN FINE TO MEDIUM SAND AND SILT, TRACE ROCK	2	13	18	13	31
				17.0			FRAGMENTS.					
							AUGER REFUSAL AT 17'.					
							WATER LEVEL THROUGH AUGERS AT 13.5'.					
							CAVED AT 15', WATER LEVEL ON CAVE AT 13.5'.					
-												
								<u> </u>				
								<u> </u>				
					-			-	-			
								<u> </u>	<u> </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.



TETRA TECH

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

TEST BORING LOG

Project Name:	SUNOCO PENNSYLVANIA P	UNOCO PENNSYLVANIA PIPELINE PROJECT Project No.: 103IP34						
Project Location:	1556 MEADOW LANE, GLEN	556 MEADOW LANE, GLEN MILLS, PA						
HDD No.:	S3-0570	Dates(s) Drilled: 07-08-15	Inspector:	E. WATT				
Boring No.:	SB-02	Drilling Method: SPT - ASTM D1586	Driller:	S. HOFFER				
Drilling Contractor:	HAD DRILLING	Groundwater Depth (ft): 9.5	Total Depth (ft):	22.3				
Boring Location Coord	dinates:	39° 56′ 22.668″ N	75° 29' 30.259" V	V				

Donning	Lucation	i Coordii	iaics.				39 30 22.000 N					
Sample	Sample	Depth (ft)	Strata D	Depth (ft)	Recov. (in)	Strata	Description of Materials	Description of Materials 6" Increme		ent Blo	ws *	N
No.	From	То	From	То	Ŗ.	(USCS)	Description of Waterials	U "	10101110	THE BIO		'`
			0.0	0.3			TOPSOIL (3")					
1	3.0	5.0	0.3		18		DR, VARIEGATED LIGHT BROWN AND GRAY FINE TO MEDIUM SAND	1	4	4	6	8
							AND SILT (USCS: SM).					
2	8.0	10.0			24		DR, VARIEGATED BROWN AND ORANGE BROWN MICACEOUS FINE	2	2	3	4	5
						SM	SAND AND SILT.					
3	13.0	15.0			15	Sivi	DR, VARIEGATED GRAY, WHITE, BRWON AND LIGHT BROWN	9	18	17	20	35
							MICACEOUS FINE SAND AND SILT, TRACE FINE GNIESS ROCK FRAGS					
4	18.0	18.5			4		DR, VARIEGATED GRAY, WHITE, BRWON AND LIGHT BROWN	50/6"				>50
				21.0			MICACEOUS FINE SAND, SOME SILT, TRACE FINE GNIESS ROCK FRAC					
5	22.0	22.3	21.0		2		GRAY TO DARK GRAY FINE TO COARSE GNEISS ROCK	50/5"				>50
				22.3			FRAGMENTS (PARTIALLY WEATHERED GNIESS).					
							AUGER REFUSAL AT 22'.					
							AUGER GRINDING AT 21'.					
							WET ON SPOON AT 13'.					
							WATER LEVEL THROUGH AUGERS AT 16'.					
							CAVED AT 13', WET.					
					-							
									-		-	<u> </u>
											-	-
]								l				

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 \$3-0570

	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	То	(ASTM D2216)	(ASTM D1140)	Limit, %	Limit, %	Index, %	(ASTM D2487)
		1	3.0	5.0	23.2	85.4	40	23	17	CL
	SB-01	2	8.0	10.0	14.1	19.1	-	-	-	-
		3	13.0	15.0	18.3	47.6	-	-	-	-
S3-0570		1	3.0	5.0	25.2	45.3	NV	NP	NP	SM
	SB-02	2	8.0	10.0	43.1	44.3	-	•	-	-
	36-02	3	13.0	15.0	2.1	45.2	-	-	-	-
		4	18.0	18.5	10.1	24.7	-	-	-	-

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

REGIONAL GEOLOGY SUMMARY SUNOCO PENNSYLVANIA PIPELINE PROJECT HDD S3-0570

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 /
S3-0570		Felsic gneiss - Light, medium grained; includes rocks of			Felsic gneiss; Secondary -		Ranges from 15 to 40 ft bgs,	
35-0370		probable sedimentary origin.	Generally level	(Precambrian age)	paragneiss	Unknown	Avg. 25 ft bgs (.25 mile radius)	

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>	N (blows)*	Particle S	ize Identifica	tion
Very Loose	5 or less	Boulders	8 in. diame	
Loose	6 to 10			
Medium Dense	11 to 30	Cobbles	3 to 8 in. di	
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
very bense	51 01 more	Sand	Coarse (C)	No. 4 to No. 10 sieve
				(4.75mm-2.00mm)
Relative Proporti	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	Site, ciay	2000 111011 0	110. 200 5.616 (10.07 11111)

COHESIVE SOILS

(Silt, Clay & Combinations)

Consistency	N (blows)*	Plasticity	
Very Soft	3 or less	Degree of Plasticity	Plasticity Index
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			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 ⁽¹⁾	nbols ⁽¹⁾	$C_{u=\frac{D_{60}}{D_{10}}} \text{ greater than 4:} C_{c=\frac{(D_{30})2}{D_{10} \times D_{60}}} \text{ between 1 and 3}$	
			GP	Poorly graded gravels, gravel- sand mixtures, little or no fines		ng dual syr	Not meeting C_u or C_c requirements for GW	
		Gravel with fines (Appreciable amount of fines)	GM	Silty gravels, gravel-sand-silt mixtures		W, GP, SW, SP M. GC, SM, SC forderline cases requiri	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: $C_{c=\frac{1}{L}}$	(D ₃₀)2 D ₁₀ x D ₆₀ between 1 and 3
			SP	Poorly graded sands, gravelly sands, little or no fines		Less than 5 More than 12 5 to 12	Not meeting C_u or C_c require	ments for SW
		Sands with fines (Appreciable amount of fines)	SM	Silty sands, sand- silt mixtures	Determ Jepending		Atterberg limits below A Line or I p less than 4	Limits Plotting in hatched
			SC	Clayey sands, sand-clay mixtures			Atterberg limits above A line with I p greater than 7	
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.
Fine-grained soils (More than half of material is smaller than No. 200 sieve)	Silts and clays (Liquid limit less than 50)	ML	sands, rock fi	s and very fine lour, silty or clayey r clayey silts with iy	60 A Line:			
		CL	Inorganic clays of low to medium plasticity, gravelly clays , sandy clays, silty clays, lean clays		PI = 0.73(LL - 20) U Line: PI = 0.9(LL - 8)			
		OL	Organic silts clays of low	and organic silty plasticity	% (PI), %	0		, or Or
	Silts and Clays (Liquid limit greater than 50)	MH		s, micaceous or s fine sandy or silty silts	Plasticity Index (PI), %		Juge / F	MH or OH
		СН	Inorganic clays of high plasticity, fat clays		Plasi		Character	
		ОН	Organic clays of medium to high plasticity, organic 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.