intertek psi

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May 1, 2019

Mr. Eric Fallon, P.E.
Senior Project Engineer
CT Consultants, Inc.
3875 Embassy Parkway, Suite 200
Akron, OH 44333
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Re: Geotechnical Subsurface Exploration Report
Proposed Brentwood Sanitary Trunk Sewer
Barberton, Summit County, Ohio
PSI Project No.: 0142-1896

Dear Mr. Fallon:

Per your request, Professional Service Industries, Inc. (PSI) is pleased to submit this Geotechnical Engineering Services Report for the above referenced project. The results of this exploration, together with our recommendations, are to be found in the accompanying report.

After the plans and specifications are complete, PSI should review the final design and specifications in order to verify that the earthwork and recommendations are properly interpreted and implemented. **It is considered imperative that the geotechnical engineer and/or its representative be present during earthwork operations and foundation installations to observe the field conditions with respect to the design assumptions and specifications. PSI will not be held responsible for interpretations and field quality control observations made by others.**

Respectfully submitted,

PROFESSIONAL SERVICE INDUSTRIES, INC.

Joseph Corrigan Project Engineer	Surya Thapa, P.E. Geotechnical Department Manager	A. Veeramani, P.E. Director/Principal Consultant

Subsurface Exploration Report

For the Proposed

Brentwood Sanitary Trunk Sewer
Barberton, Summit County, Ohio

Prepared for

CT Consultants, Inc.
3875 Embassy Parkway, Suite 200
Akron, OH 44333

Prepared by

Professional Service Industries, Inc.
5555 Canal Road
Cleveland, OH 44125

PSI Project No. 0142-1896

Joseph Corrigan
Project Engineer

Surya Thapa, P.E.
Geotechnical Department Manager

A. Veeramani, P.E.
Director/Principal Consultant

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1 PROJECT INFORMATION

1.1 PROJECT AUTHORIZATION

This report presents the results of a geotechnical subsurface exploration and evaluation conducted for CT Consultants in connection with the proposed Brentwood Sanitary Trunk Sewer along the Van Hyning Run Creek in the City of Barberton, Summit County, Ohio. PSI's services for this project were performed in accordance with PSI Proposal No. 0142-266753, dated January 18, 2019. Authorization to perform this exploration and analysis was in the form of Purchase Order No. 9029-19, signed by Mr. Peter J. Formica, Principal of CT Consultants, Inc. on February 6, 2019.

1.2 PROJECT DESCRIPTION

Project information has been provided Mr. Eric Fallon of CT Consultants, Inc. Based on the provided information, it is understood that the proposed project will involve installation of a new sanitary sewer line along the Van Hyning Run Creek in the City of Barberton, Summit County, Ohio. The total project length of the sewer line will be approximately 6,900 feet. The sewer line will be about 8 to 18 inches in diameter, and the bottom of the sewer line will range from 5 to 35 feet below the existing surface grades. No other information is available at the time of this report submittal.

The geotechnical recommendations presented in this report are based on the available project information, the proposed building location and orientation of the building on the site and the subsurface materials described in this report. If any of the information we have been given or have assumed is incorrect, please contact us so that we may amend the recommendations presented accordingly. PSI will not be responsible for the implementation of its recommendations when it is not notified of changes in the project.

1.3 PURPOSE AND SCOPE OF SERVICES

The purpose of this study was to evaluate the soil and groundwater conditions at the site to provide recommendations, from a geotechnical engineering viewpoint, relative to the design and installation of the proposed Sanitary Trunk Sewer. Our scope for this service included a project site reconnaissance, drilling and sampling nine (9) test borings, completing a laboratory testing program, and submitting an engineering analysis and evaluation of the subsurface materials.

The scope of services did not include an environmental assessment for the presence or absence of wetlands or hazardous or toxic materials in the soil, surface water, groundwater, or air, on or below or around this site. Any statements in this report or on the boring logs regarding odors, colors or unusual or suspicious items or conditions are strictly for the information of the client.

2 SITE AND SUBSURFACE CONDITIONS

2.1 SITE LOCATION AND DESCRIPTION

The proposed Sanitary Trunk Sewer Project, for which this subsurface exploration has been performed, is located along the Van Hyning Creek Run and adjacent to various roadways in Barberton, Ohio. The surface of the site along

the sewer alignment is covered primarily with topsoil, with some areas covered in pavement or sand and gravel base. Surface drainage was good to fair at the time of the field drilling operations. PSI recommends that any existing utility lines be checked and marked prior to construction activities.

2.2 SUBSURFACE CONDITIONS

The general subsurface conditions at the site were explored with a total of nine (9) test borings. The test borings were drilled to depths of approximately 10 to 30 feet below the existing surface grades. The approximate boring locations are shown on the Boring Location Plan presented in the *Appendix* of this report. The locations for the test borings were selected by PSI and located in the field relative to existing site features and based on site accessibility and the presence of below ground utilities.

The borings were advanced utilizing 3¼ inch inside diameter, hollow-stem auger drilling methods. Soil samples were routinely obtained during the drilling process. Selected soil samples were later tested in the laboratory to obtain soil material properties for the foundation, floor slabs and pavement recommendations. Drilling, sampling, and laboratory testing was accomplished in general accordance with ASTM procedures.

The types of subsurface materials encountered in the test borings have been visually classified. The results of the visual classifications, Standard Penetration tests, moisture contents and water level observations are presented on the boring logs in the *Appendix* of this report. Representative samples of the soils were placed in sample jars, and are now stored in the laboratory for further analysis, if requested. Unless notified to the contrary, all samples will be disposed of after 60 days following the date of this report.

The surface of the site at test boring locations B-12 and B-20 was covered with a 13-inch-thick layer of sand and gravel base material. The surface of the site at test boring locations B-13 through B-19 was covered with a 4- to 13-inch-thick layer of topsoil.

Underlying the surface materials encountered at test boring locations B-12, B-18, and B-20, a layer of fill material was encountered. The fill material extended to depths ranging from 2 to 3.5 feet below the existing grade. The fill material consisted primarily of silty sand and lean clay, with varying amounts of gravel and concrete fragments. Additionally, a concrete slab was encountered in test boring B-12 at an approximate depth of 1.5 to 2 feet below the existing grade. The fill material exhibited moisture contents ranging from 9 to 21 percent. The cohesive fill material exhibited a stiff consistency, and the granular fill material exhibited a loose to very dense relative density, based on the Standard Penetration tests.

Underlying the surface and fill materials encountered at the test boring locations, natural soils were encountered at all test boring locations, extending to the terminal depths of 10 to 30 feet below the surface grade at each boring location. The natural soils consisted primarily of silty or clayey sand, clayey gravel, sandy or clayey silt, and sandy lean clay, with varying amounts of organics and rock fragments. The natural soils exhibited moisture contents ranging from 5 to 44 percent. The natural cohesive soils exhibited a soft to hard consistency, and the natural granular soils exhibited a very loose to very dense relative density, based on the Standard Penetration tests.

The subsurface description is of a generalized nature provided to highlight the major strata encountered. The boring logs included in the Appendix should be reviewed for specific information at the individual boring locations. The stratifications shown on the boring logs represent the conditions only at the actual test positions. Variations may

occur and should be expected between the boring locations. The stratifications represent the approximate boundary between the subsurface materials, and the transition may be gradual or not clearly defined.

2.3 GROUNDWATER LEVEL MEASUREMENTS

Groundwater was encountered in all test borings except B-15, at depths ranging from 2.0 to 14.5 feet below the existing grade during the drilling operations. Note that groundwater levels fluctuate seasonally as a function of rainfall. During a time of year or weather different from the time of drilling, there may be a considerable change in the water table. Furthermore, the water levels in the boreholes often are not representative of the actual groundwater level, because the boreholes remain open for a relatively short time. Therefore, we recommend that the contractor determine the actual groundwater levels at the time of construction to evaluate groundwater impact on the construction procedures.

3 EVALUATION AND RECOMMENDATIONS

3.1 SANITARY FORCE MAIN EXCAVATION SUPPORT

Based on the information provided by CT Consultants, it appears that the proposed Sanitary Trunk Sewer will bear within the area's natural soil formation. In view of the results of the test boring operations, laboratory test studies, analysis and provided information, consideration should be given to the following factors in the design and installation of the proposed structures.

Based on the provided location of the proposed Sanitary Force Main and as per OSHA excavation regulations, open cut excavation is possible up to a maximum depth of twenty (20) feet. The excavation slopes should follow OSHA guidelines for type 'C' soils. If temporary excavation support is required, the contractor or specialty subcontractor should be responsible to design and install the required system. For the various subsurface formations encountered, the following soil parameters may be adopted for determining lateral earth pressures:

Type of Soil	Unit Weight (pcf)	Effective Strength	Undrained Strength
Clayey Silt/Organic Silt/Fill	120	$\phi' = 18°$, $C' = 25$ psf	$\phi = 0°$, $C = 500$ psf
Clayey Gravel	120	$\phi' = 30°$, $C' = 0$ psf	$\phi = 30°$, $C = 0$ psf

The design groundwater depth should be determined based on the actual groundwater conditions encountered in the field during construction.

3.2 SANITARY FORCE MAIN PIPE SUPPORT

For the structural and functional integrity of the utilities, it is imperative that the pipes have adequate foundation, i.e., the subsurface materials should have adequate support capabilities and also be able to provide uniform bedding to the pipe. The bedding may be provided either with shaped bottom and tamped backfill, or by compacted granular bedding with tamped backfill. The granular bedding should meet the specification for Type 2 bedding (i.e., ODOT's Construction and Material Specifications Item #603.04). The bedding shall extend up around the pipe for a depth of

6 inches or 30 percent of the outside diameter of the pipe, whichever is greater. The remainder of the backfill should be compacted soil. Granular bedding not only provides firm uniform support for the pipe but also stabilizes the trench bottom.

3.3 MANHOLE STRUCTURES

Within the area's overburden soils, freestanding excavations will not be possible for the proposed manhole structures. Therefore, a lateral support system will be required for the manhole excavations. The magnitude of the lateral earth pressures may be calculated utilizing the previously outlined soil parameters.

It is recommended that the maximum soil bearing pressures resulting from the above-discussed loading conditions, as well as the weight of the manhole and other facilities associated with the structure should not exceed 1,000 psf. Based on the recommended bearing pressure, the anticipated settlement will be less than 1.0-inch. It is recommended that suitability of the bearing surfaces be verified by the project's geotechnical engineer.

3.4 BACKFILL OPERATIONS

Any backfill required against the manhole structures and utility trench should consist of freely draining granular materials. The backfill is to be placed on a controlled lift-by-lift basis. Individual fill lifts are to be of maximum 8-inch loose measure thickness, and each individual lift is to be adjusted in moisture content to within plus or minus 2 percent of the optimum moisture content as determined by ASTM D-698. The fill materials are to be systematically compacted, such that an in-place density of at least 98 percent of the maximum laboratory density as determined by the above-referenced ASTM method is achieved.

It must be recognized that, over a time period, the backfill against the manholes will be saturated. Under this circumstance it is possible that the bottom slab for the manhole will be subjected to hydrostatic uplift that should be considered in the design. Uplift may be resisted either by assuring that the dead loads of the proposed structure counter balance the buoyancy forces or by providing a system of pressure relief valves. Lateral pressures acting on the manholes can be defined based on the effective strength parameters recommended in a previous section plus hydrostatic pressure. Specifications should require that the resulting fill materials' densities be verified by test measurements conducted by the geotechnical engineer.

4 CONSTRUCTION CONSIDERATIONS

4.1 GROUNDWATER CONTROL AND DRAINAGE

Groundwater was encountered in all test borings except B-15, at depths ranging from 2.0 to 14.5 feet below the existing grade during the drilling operations. However, groundwater and/or seepage could be encountered during foundation excavation and construction. Accordingly, a gravity drainage system, sump pump or other conventional dewatering procedure, as deemed necessary by the field conditions, should be implemented throughout construction such that the groundwater is controlled and maintained at an elevation of at least 2 feet below the excavation bottom at all times. Every effort should be made to keep the excavations dry if water is encountered.

Water should not be allowed to collect near the foundation or floor slab areas of the building either during or after construction. Undercut or excavated areas should be sloped toward one corner to facilitate removal of any collected

rainwater, groundwater or surface runoff. Positive site drainage should be provided to reduce infiltration of surface water around the perimeter of the building and beneath the floor slab. Overall site area drainage is to be arranged in a manner such that the possibility of water impounding below slab-on-grade areas and over the structural fill is prevented.

4.2 EXCAVATIONS

In Federal Register, Volume 54, No. 209 (October, 1989), the United States Department of Labor, Occupational Safety and Health Administration (OSHA) amended its "Construction Standards for Excavations, 29 CFR, Part 1926, Subpart P." This document was issued to better insure the safety of workers entering trenches or excavations. It is mandated by this federal regulation that all excavations, whether they be utility trenches, basement excavations or foundation excavations, be constructed in accordance with the new OSHA guidelines. It is our understanding that these regulations are being strictly enforced. If they are not followed closely, the owner and the contractor could be liable for substantial penalties.

The contractor is solely responsible for designing and constructing stable, temporary excavations and should shore, slope, or bench the sides of the excavations as required to maintain stability of both the excavation sides and bottom. The contractor's "responsible person" as defined in "CFR Part 1926," should evaluate the soil exposed in the excavations as part of the contractor's safety procedures. In no case should slope height, slope inclination, or excavation depth, including utility trench excavation depth, exceed those specified in local, state, and federal safety regulations.

We are providing this information solely as a service to our client. PSI is not assuming responsibility for construction site safety or the contractor's activities; such responsibility is not being implied and should not be inferred. If the excavations are left open and exposed to the elements for a significant length of time, desiccation of the clays may create minute shrinkage cracks which could allow large pieces of clay to collapse or slide into the excavation.

Materials removed from the excavation should not be stockpiled immediately adjacent to the excavation, inasmuch as this load may cause a sudden collapse of the embankment.

4.3 WEATHER CONSIDERATIONS

The soils encountered at this site are known to be sensitive to disturbances caused by construction traffic and to changes in moisture content. During wet weather periods, increases in the moisture content of the soil can cause significant reduction in the soil strength and support capabilities. Care should be exercised during the grading operations at the site. Due to the fine-grained nature of the surficial soils, the traffic of heavy equipment, including heavy compaction equipment, may very well create pumping and a general deterioration of those soils in the presence of water. Therefore, the grading should, if at all possible, be performed during a dry season. A layer of crushed stone may be required to allow the movement of construction traffic over the site during the rainy season. The contractor should maintain positive site drainage and if wet/pumping conditions occur, the contractor will be responsible to over excavate the wet soils and replace them with a properly compacted engineered fill. During wet seasons, limestone stabilization may be required to place engineered fill.

5 GEOTECHNICAL RISK

The concept of risk is an important aspect of the geotechnical evaluation. The primary reason for this is that the analytical methods used to develop geotechnical recommendations do not comprise an exact science. Site exploration identifies actual subsurface conditions only at those points where samples are taken. A geotechnical report is based on conditions that existed at the time of the subsurface exploration. The analytical tools which geotechnical engineers use are generally empirical and must be used in conjunction with engineering judgment and experience. Therefore, the solutions and recommendations presented in the geotechnical evaluation should not be considered risk-free and, more importantly, are not a guarantee that the interaction between the soils and the proposed structure will perform as planned. The engineering recommendations presented in the preceding sections constitute PSI's professional estimate of those measures that are necessary for the proposed structure to perform according to the proposed design based on the information generated and referenced during this evaluation, and PSI's experience in working with these conditions.

6 REPORT LIMITATIONS

The recommendations submitted are based on the available subsurface information obtained by PSI and design details furnished by Mr. Eric Fallon of CT Consultants, Inc. for the proposed project. If there are any revisions to the plans for the proposed project, or if deviations from the subsurface conditions noted in this report are encountered during construction, PSI should be retained to determine if changes in the recommendations are required. If PSI is not retained to perform these functions, PSI will not be responsible for the impact of those conditions on the geotechnical recommendations for the project.

The Geotechnical Engineer warrants that the findings, recommendations, specifications, or professional advice contained herein, have been presented after being prepared in accordance with generally accepted professional engineering practice in the fields of foundation engineering, soil mechanics and engineering geology. No other warranties are implied or expressed. After the plans and specifications are complete, it is recommended that PSI be provided the opportunity to review the final design and specifications, in order to verify that the earthwork and recommendations are properly interpreted and implemented. At that time, it may be necessary to submit supplementary recommendations. This report has been prepared for the exclusive use of CT Consultants, for the specific application to the proposed Brentwood Sanitary Trunk Sewer Project in the City of Barberton, Summit County, Ohio.

APPENDIX A	SOIL BORING LOCATION PLAN
APPENDIX B	BORING LOGS
APPENDIX C	GRAIN SIZE GRAPH
APPENDIX D	GENERAL NOTES
APPENDIX E	USCS SOIL CLASSIFICATION CHART

intertek psi	Brentwood Sanitary Trunk Sewer Cleve-Mass Road Norton, Summit County, OH	Prepared By: JC Date: 3/22/19 Not to Scale	Boring Location Plan PSI Project No. 0142-1896

BORING B-12

DATE STARTED:	4/12/19	DRILL COMPANY:	PSI, Inc.
DATE COMPLETED:	4/12/19	DRILLER: T.S.	LOGGED BY: J.C.
COMPLETION DEPTH	20.0 ft	DRILL RIG:	CME-55
BENCHMARK:	N/A	DRILLING METHOD:	Hollow Stem Auger
ELEVATION:	N/A	SAMPLING METHOD:	2-in SS
LATITUDE:		HAMMER TYPE:	Automatic
LONGITUDE:		EFFICIENCY	87%
STATION: N/A	OFFSET: N/A	REVIEWED BY:	A.V.
REMARKS:			

Water		
While Drilling	13.5	feet
Upon Completion	14.5	feet
Caved @	N/A	

BORING LOCATION:

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	Additional Remarks
	0					11" Sand & Gravel CONCRETE	CONCRETE			
				1	4	Very Dense, Moist, Brown Silty SAND with Gravel, Trace Concrete Fragments	FILL	50/5	9	
						6" CONCRETE Slab	CONCRETE			
						Loose to Medium Dense, Moist, Brown to Gray Silty SAND with Gravel				
				2	8			4-6-8 N=14	10	
	5			3	5			3-3-3 N=6	7	
				4	8			3-3-2 N=5	14	
	10						SM			
				5	7			4-5-5 N=10	11	LL = 17 PL = 12 Fines=43.1%
	15									
				6	9			3-4-5 N=9	11	
	20									

STANDARD PENETRATION TEST DATA
N in blows/ft ◎
× Moisture ◪ PL ✚ LL
0 25 50
STRENGTH, tsf
▲ Qu ✳ Qp
0 2.0 4.0

intertek psi

Professional Service Industries, Inc.
5555 Canal Road
Cleveland, OH 44125
Telephone: (216) 447-1335

PROJECT NO.: 0142-1896
PROJECT: Brentwood Sanitary Trunk Sewer
LOCATION: City of Barberton
Summit County

The stratification lines represent approximate boundaries. The transition may be gradual.

BORING B-13

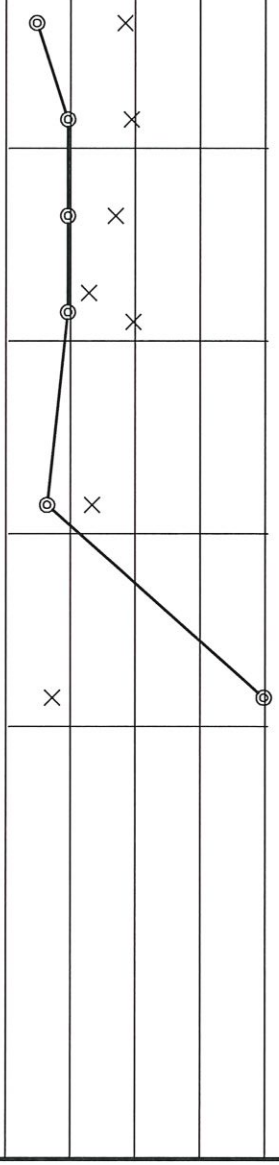
DATE STARTED:	4/16/19	**DRILL COMPANY:**	PSI, Inc.
DATE COMPLETED:	4/16/19	**DRILLER:** T.S.	**LOGGED BY:** J.C.
COMPLETION DEPTH	20.0 ft	**DRILL RIG:**	CME-55
BENCHMARK:	N/A	**DRILLING METHOD:**	Hollow Stem Auger
ELEVATION:	N/A	**SAMPLING METHOD:**	2-in SS
LATITUDE:		**HAMMER TYPE:**	Automatic
LONGITUDE:		**EFFICIENCY**	87%
STATION: N/A	**OFFSET:** N/A	**REVIEWED BY:**	A.V.
REMARKS:			

Water		
While Drilling	13.5	feet
Upon Completion	10.0	feet
Caved @	N/A	

BORING LOCATION:

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	Additional Remarks
	0					12" TOPSOIL	TOPSOIL			
				1	16	Loose to Medium Dense, Moist, Brown Silty SAND with Gravel		1-2-4 N=6	23	
				2	14		SM	2-5-7 N=12	24	
	5			3	16			3-7-5 N=12	21	
				4	15	Stiff to Hard, Moist to Wet, Gray Sandy SILT, Some Thin Gravel Seams		5-5-7 N=12	16 25	
	10									
				5	6	** Wet Sand & Gravel Seam	ML	2-3-5 N=8	17	
	15									
				6	13	**Trace Rock Fragments @ 19.5'		13-21-29 N=50	9	
	20									

STANDARD PENETRATION TEST DATA
N in blows/ft ◎
× Moisture ◪ PL ✚ LL
0 25 50
STRENGTH, tsf
▲ Qu ✳ Qp
0 2.0 4.0



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BORING B-14

DATE STARTED:	4/16/19	DRILL COMPANY:	PSI, Inc.
DATE COMPLETED:	4/16/19	DRILLER: T.S.	LOGGED BY: J.C.
COMPLETION DEPTH	30.0 ft	DRILL RIG:	CME-55
BENCHMARK:	N/A	DRILLING METHOD:	Hollow Stem Auger
ELEVATION:	N/A	SAMPLING METHOD:	2-in SS
LATITUDE:		HAMMER TYPE:	Automatic
LONGITUDE:		EFFICIENCY	87%
STATION: N/A	OFFSET: N/A	REVIEWED BY:	A.V.
REMARKS:			

Water		
While Drilling	13.5 feet
Upon Completion	None
Caved @	13.0

BORING LOCATION:

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	Additional Remarks
	0					12" TOPSOIL	TOPSOIL			
				1	16	Soft, Moist, Brown Sandy Lean CLAY	CL	1-1-2 N=3	24	
				2	17	Medium Dense to Loose, Moist, Brown Silty SAND with Gravel		2-4-7 N=11	26	
	5			3	13		SM	3-3-2 N=5	11	
				4	13			2-2-2 N=4	7	
	10			5	17	Very Stiff, Moist, Brown Clayey SILT, Some Sand, Trace Gravel	ML	7-11-14 N=25	16	LL = 20 PL = 15 Fines=65.5%
	15					Medium Dense to Very Dense, Moist, Brown Silty SAND with Gravel				
				6	17		SM	17-26-32 N=58	10	>>
	20									
				7	11			28-50/5	11	>>
	25					** Gray @ 26.5				
				8	9			7-13-15 N=28	16	
	30									

STANDARD PENETRATION TEST DATA
N in blows/ft ◎
× Moisture ◪ PL ✚ LL
0 25 50

STRENGTH, tsf
▲ Qu ✳ Qp
0 2.0 4.0

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Summit County

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BORING B-15

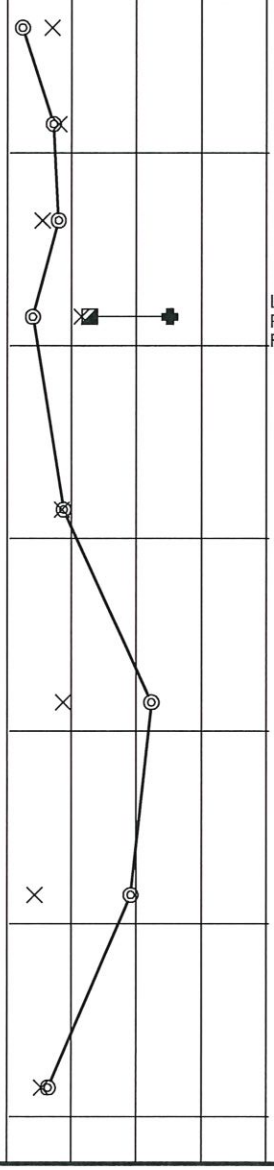
DATE STARTED:	4/15/19	DRILL COMPANY:	PSI, Inc.
DATE COMPLETED:	4/15/19	DRILLER: T.S.	LOGGED BY: J.C.
COMPLETION DEPTH	30.0 ft	DRILL RIG:	CME-55
BENCHMARK:	N/A	DRILLING METHOD:	Hollow Stem Auger
ELEVATION:	N/A	SAMPLING METHOD:	2-in SS
LATITUDE:		HAMMER TYPE:	Automatic
LONGITUDE:		EFFICIENCY	87%
STATION: N/A	OFFSET: N/A	REVIEWED BY:	A.V.
REMARKS:			

Water		
While Drilling	None	
Upon Completion	None	
Caved @	5.0	

BORING LOCATION:

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	Additional Remarks
	0					10" TOPSOIL	TOPSOIL			
				1	13	Very Loose to Medium Dense, Moist, Brown Clayey SAND with Gravel		1-1-2 N=3	9	
				2	8			4-4-5 N=9	10	
	5			3	6			3-5-5 N=10	7	
				4	9			2-3-2 N=5	14	LL = 31 PL = 16 Fines=12.3%
	10									
				5	13		SC	4-5-6 N=11	11	
	15									
				6	13			8-14-14 N=28	11	
	20									
				7	13			6-12-12 N=24	5	
	25									
				8	15			6-4-4 N=8	7	
	30									

STANDARD PENETRATION TEST DATA
N in blows/ft ◎
× Moisture ◪ PL ✚ LL
0 25 50
STRENGTH, tsf
▲ Qu ✳ Qp
0 2.0 4.0



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BORING B-16

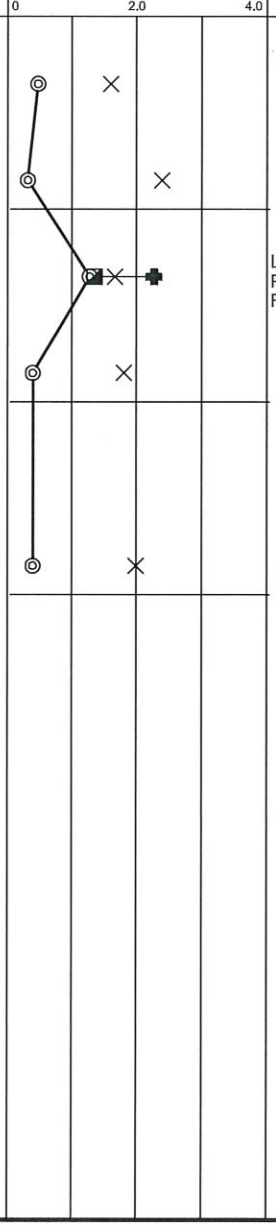
DATE STARTED:	4/16/19	DRILL COMPANY:	PSI, Inc.
DATE COMPLETED:	4/16/19	DRILLER: T.S.	LOGGED BY: J.C.
COMPLETION DEPTH	15.0 ft	DRILL RIG:	CME-55
BENCHMARK:	N/A	DRILLING METHOD:	Hollow Stem Auger
ELEVATION:	N/A	SAMPLING METHOD:	2-in SS
LATITUDE:		HAMMER TYPE:	Automatic
LONGITUDE:		EFFICIENCY	87%
STATION: N/A	OFFSET: N/A	REVIEWED BY:	A.V.
REMARKS:			

Water		
While Drilling	6.0	feet
Upon Completion	10.0	feet
Caved @	N/A	

BORING LOCATION:

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	Additional Remarks
	0					13" TOPSOIL	TOPSOIL			
				1	11	Medium Stiff, Moist, Brown, Sandy Lean CLAY, Trace Gravel	CL	2-3-3 N=6	20	
				2	9	Soft, Moist, Black SILT, with Organics	ML	1-2-2 N=4	30	
	5			3	4	Medium Dense to Loose, Wet, Brown Clayey GRAVEL With Sand	GC	4-9-7 N=16	21	LL = 28 PL = 17 Fines=18.8%
				4	10			3-3-2 N=5	23	
	10									
				5	18			1-2-3 N=5	25	
	15									

STANDARD PENETRATION TEST DATA
N in blows/ft ◎
× Moisture ◪ PL ✚ LL
0 25 50
STRENGTH, tsf
▲ Qu ✳ Qp
0 2.0 4.0



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Professional Service Industries, Inc.
5555 Canal Road
Cleveland, OH 44125
Telephone: (216) 447-1335

PROJECT NO.: 0142-1896
PROJECT: Brentwood Sanitary Trunk Sewer
LOCATION: City of Barberton
Summit County

The stratification lines represent approximate boundaries. The transition may be gradual.

BORING B-17

DATE STARTED:	4/16/19	DRILL COMPANY:	PSI, Inc.
DATE COMPLETED:	4/16/19	DRILLER: T.S.	LOGGED BY: J.C.
COMPLETION DEPTH	15.0 ft	DRILL RIG:	CME-55
BENCHMARK:	N/A	DRILLING METHOD:	Hollow Stem Auger
ELEVATION:	N/A	SAMPLING METHOD:	2-in SS
LATITUDE:		HAMMER TYPE:	Automatic
LONGITUDE:		EFFICIENCY	87%
STATION: N/A	OFFSET: N/A	REVIEWED BY:	A.V.
REMARKS:			

Water		
While Drilling	10.0	feet
Upon Completion	None	
Caved @	6.5	

BORING LOCATION:

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	STANDARD PENETRATION TEST DATA N in blows/ft ◎ × Moisture ◪ PL ✚ LL (0 25 50) STRENGTH, tsf ▲ Qu ✳ Qp (0 2.0 4.0)	Additional Remarks
	0					8" TOPSOIL	TOPSOIL				
				1	8	Very Loose to Medium Dense, Moist to Wet, Brown Silty SAND with Gravel		1-1-1 N=2	14		
				2	11			2-3-14 N=17	11		
	5			3	14		SM	2-3-4 N=7	13		
				4	9	** Wet @ 10'		3-5-4 N=9	13		
	10										
				5	14			3-8-9 N=17	16		
	15										

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BORING B-18

DATE STARTED:	4/15/19	DRILL COMPANY:	PSI, Inc.
DATE COMPLETED:	4/15/19	DRILLER: T.S.	LOGGED BY: J.C.
COMPLETION DEPTH	15.0 ft	DRILL RIG:	CME-55
BENCHMARK:	N/A	DRILLING METHOD:	Hollow Stem Auger
ELEVATION:	N/A	SAMPLING METHOD:	2-in SS
LATITUDE:		HAMMER TYPE:	Automatic
LONGITUDE:		EFFICIENCY	87%
STATION: N/A	OFFSET: N/A	REVIEWED BY:	A.V.
REMARKS:			

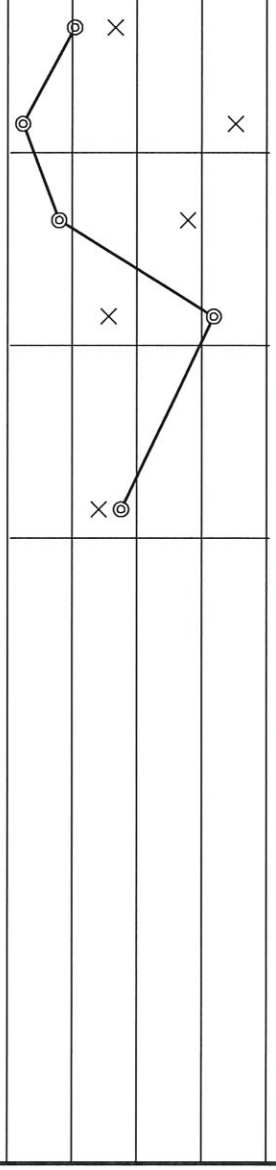
Water		
While Drilling	3.5	feet
Upon Completion	2.0	feet
Caved @	N/A	

BORING LOCATION:

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	Additional Remarks
	0					4" TOPSOIL	TOPSOIL			
				1	10	Stiff, Moist, Brown Lean CLAY, Some Sand/Gravel/Concrete Fragments	FILL	6-7-6 N=13	21	
				2	18	Soft, Moist, Dark Gray SILT, Trace Sand/Organics	ML	3-1-2 N=3	44	
	5			3	10			1-3-7 N=10	35	
				4	10	Medium Dense to Dense, Wet, Brown to Gray Silty SAND with Gravel	SM	14-20-20 N=40	20	
	10									
	15			5	13			7-10-12 N=22	18	

STANDARD PENETRATION TEST DATA
N in blows/ft ◎
× Moisture ◪ PL ✚ LL
0 25 50

STRENGTH, tsf
▲ Qu ✳ Qp
0 2.0 4.0



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Summit County

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BORING B-19

DATE STARTED:	4/12/19	**DRILL COMPANY:**	PSI, Inc.
DATE COMPLETED:	4/12/19	**DRILLER:** T.S.	**LOGGED BY:** J.C.
COMPLETION DEPTH	15.0 ft	**DRILL RIG:**	CME-55
BENCHMARK:	N/A	**DRILLING METHOD:**	Hollow Stem Auger
ELEVATION:	N/A	**SAMPLING METHOD:**	2-in SS
LATITUDE:		**HAMMER TYPE:**	Automatic
LONGITUDE:		**EFFICIENCY**	87%
STATION: N/A	**OFFSET:** N/A	**REVIEWED BY:**	A.V.
REMARKS:			

Water		
While Drilling	6.0	feet
Upon Completion	4.5	feet
Caved @	N/A	

BORING LOCATION:

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	STANDARD PENETRATION TEST DATA N in blows/ft ◎ × Moisture ◪ PL ✚ LL (0, 25, 50) STRENGTH, tsf ▲ Qu ✳ Qp (0, 2.0, 4.0)	Additional Remarks
	0					13" TOPSOIL	TOPSOIL				
				1	14	Soft to Stiff, Moist, Brown Lean CLAY, Trace Sand/Gravel/Organics	CL	2-4-5 N=9	18		
				2	0			2-2-2 N=4	42		
	5										
				3	7	Loose to Medium Dense, Wet, Brown to Gray Silty SAND with Gravel	SM	2-3-5 N=8	17		
				4	12			3-6-10 N=16	12		
	10										
				5	6			19-8-10 N=18	10		
	15										

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Summit County

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BORING B-20

DATE STARTED:	4/12/19	**DRILL COMPANY:**	PSI, Inc.
DATE COMPLETED:	4/12/19	**DRILLER:** T.S.	**LOGGED BY:** J.C.
COMPLETION DEPTH	10.0 ft	**DRILL RIG:**	CME-55
BENCHMARK:	N/A	**DRILLING METHOD:**	Hollow Stem Auger
ELEVATION:	N/A	**SAMPLING METHOD:**	2-in SS
LATITUDE:		**HAMMER TYPE:**	Automatic
LONGITUDE:		**EFFICIENCY**	87%
STATION: N/A	**OFFSET:** N/A	**REVIEWED BY:**	A.V.
REMARKS:			

Water		
While Drilling	7.0	feet
Upon Completion	None	
Caved @	N/A	

BORING LOCATION:

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	STANDARD PENETRATION TEST DATA N in blows/ft ◎ × Moisture ◪ PL ✚ LL (0–25–50) STRENGTH, tsf ▲ Qu ✳ Qp (0–2.0–4.0)	Additional Remarks
	0					12" Sand & Gravel BASE	BASE				
				1	9	Loose, Moist, Brown Silty SAND with Gravel	FILL	6-7-3 N=10	10		
	5			2	14	Loose to Medium Dense, Moist to Wet, Brown to Gray Silty SAND With Gravel		2-3-4 N=7	25		
				3	13 ▽		SM	4-6-5 N=11	14		LL = 22 PL = 16 Fines=20.5%
	10			4	12			2-2-3 N=5	20		

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PROJECT NO.: 0142-1896
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LOCATION: City of Barberton
Summit County

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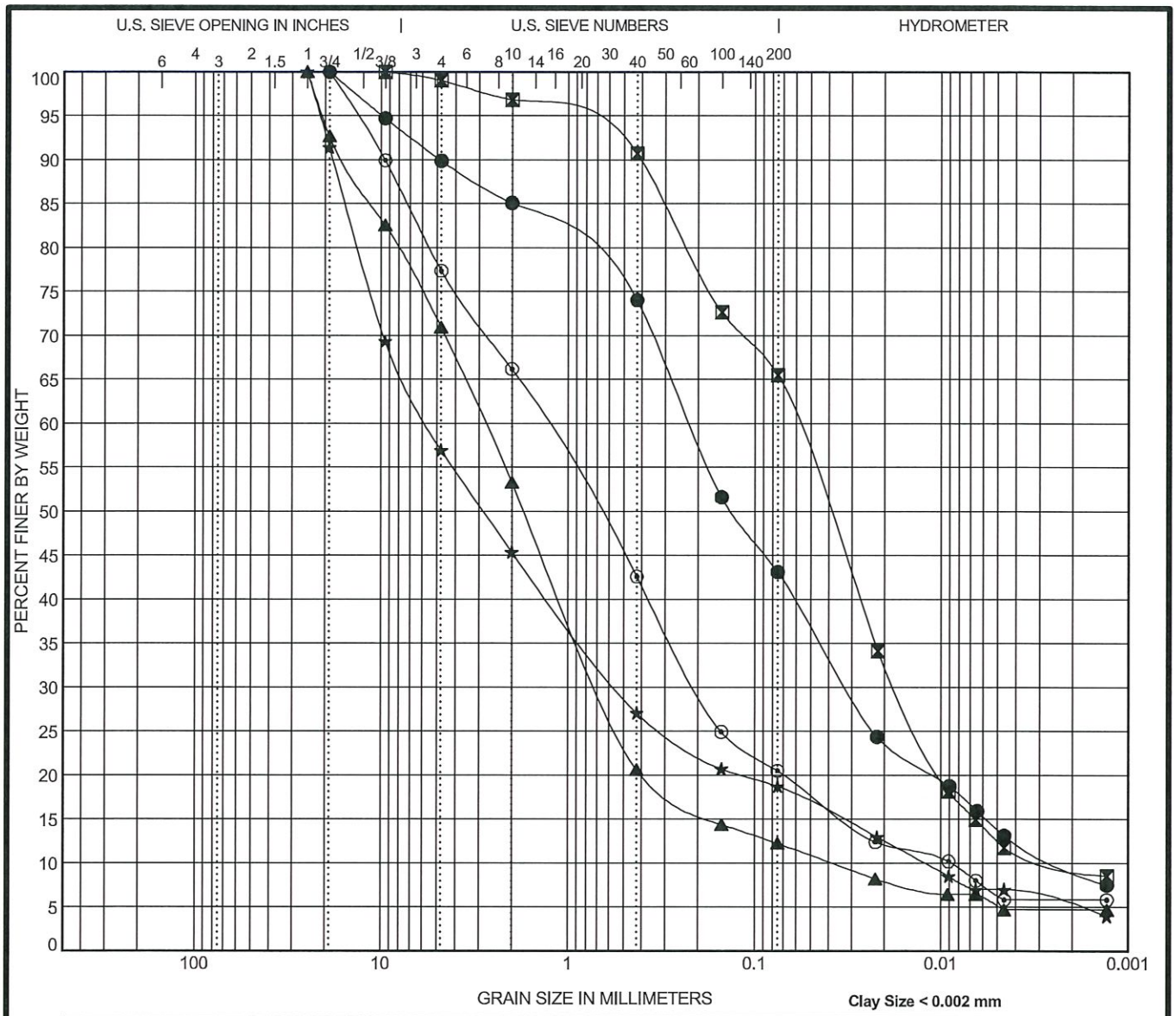

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	B-12	14.3	Silty SAND, Little Gravel (SM)	17	12	5	2.00	97.59
⊠	B-14	14.3	Clayey SILT, Some Sand (CL-ML)	20	15	5	2.16	26.28
▲	B-15	9.3	Clayey SAND with Gravel (SC)	31	16	15	4.16	73.00
★	B-16	6.8	Clayey GRAVEL with Sand (GC)	28	17	11	4.32	462.11
⊙	B-20	6.8	Silty SAND with Gravel (GC)	22	16	6	3.49	151.43

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	B-12	14.3	19	0.221	0.032	0.002	10.1	46.8	33.7	9.4
⊠	B-14	14.3	9.5	0.06	0.017	0.002	1.0	33.5	55.9	9.7
▲	B-15	9.3	25	2.778	0.663	0.038	29.1	58.7	7.5	4.7
★	B-16	6.8	25	5.629	0.544	0.012	43.0	38.2	13.7	5.0
⊙	B-20	6.8	19	1.331	0.202	0.009	22.6	56.8	14.7	5.9

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GRAIN SIZE DISTRIBUTION

Project: Brentwood Sanitary Trunk Sewer
PSI Job No.: 0142-1896
Location: City of Barberton
Summit County

GENERAL NOTES

SAMPLE IDENTIFICATION

The Unified Soil Classification System (USCS), AASHTO 1988 and ASTM designations D2487 and D-2488 are used to identify the encountered materials unless otherwise noted. Coarse-grained soils are defined as having more than 50% of their dry weight retained on a #200 sieve (0.075mm); they are described as: boulders, cobbles, gravel or sand. Fine-grained soils have less than 50% of their dry weight retained on a #200 sieve; they are defined as silts or clay depending on their Atterberg Limit attributes. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size.

DRILLING AND SAMPLING SYMBOLS

SFA: Solid Flight Auger - typically 4" diameter flights, except where noted.
HSA: Hollow Stem Auger - typically 3¼" or 4¼ I.D. openings, except where noted.
M.R.: Mud Rotary - Uses a rotary head with Bentonite or Polymer Slurry
R.C.: Diamond Bit Core Sampler
H.A.: Hand Auger
P.A.: Power Auger - Handheld motorized auger
SS: Split-Spoon - 1 3/8" I.D., 2" O.D., except where noted.
ST: Shelby Tube - 3" O.D., except where noted.
BS: Bulk Sample
PM: Pressuremeter
CPT-U: Cone Penetrometer Testing with Pore-Pressure Readings

SOIL PROPERTY SYMBOLS

N: Standard "N" penetration: Blows per foot of a 140 pound hammer falling 30 inches on a 2-inch O.D. Split-Spoon.
N_{60}: A "N" penetration value corrected to an equivalent 60% hammer energy transfer efficiency (ETR)
Q_u: Unconfined compressive strength, TSF
Q_p: Pocket penetrometer value, unconfined compressive strength, TSF
w%: Moisture/water content, %
LL: Liquid Limit, %
PL: Plastic Limit, %
PI: Plasticity Index = (LL-PL),%
DD: Dry unit weight, pcf
▼,▽,▼ Apparent groundwater level at time noted

RELATIVE DENSITY OF COARSE-GRAINED SOILS

Relative Density	N - Blows/foot
Very Loose	0 - 4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	50 - 80
Extremely Dense	80+

ANGULARITY OF COARSE-GRAINED PARTICLES

Description	Criteria
Angular:	Particles have sharp edges and relatively plane sides with unpolished surfaces
Subangular:	Particles are similar to angular description, but have rounded edges
Subrounded:	Particles have nearly plane sides, but have well-rounded corners and edges
Rounded:	Particles have smoothly curved sides and no edges

GRAIN-SIZE TERMINOLOGY

Component	Size Range
Boulders:	Over 300 mm (>12 in.)
Cobbles:	75 mm to 300 mm (3 in. to 12 in.)
Coarse-Grained Gravel:	19 mm to 75 mm (¾ in. to 3 in.)
Fine-Grained Gravel:	4.75 mm to 19 mm (No.4 to ¾ in.)
Coarse-Grained Sand:	2 mm to 4.75 mm (No.10 to No.4)
Medium-Grained Sand:	0.42 mm to 2 mm (No.40 to No.10)
Fine-Grained Sand:	0.075 mm to 0.42 mm (No. 200 to No.40)
Silt:	0.002 mm to 0.075 mm
Clay:	<0.002mm to <0.005 mm depending on agency

PARTICLE SHAPE

Description	Criteria
Flat:	Particles with width/thickness ratio > 3
Elongated:	Particles with length/width ratio > 3
Flat & Elongated:	Particles meet criteria for both flat and elongated

RELATIVE PROPORTIONS OF FINES

Descriptive Term	% Dry Weight
Trace:	< 5%
With:	5% to 12%
Modifier:	>12%

GENERAL NOTES

(Continued)

CONSISTENCY OF FINE-GRAINED SOILS

Q_U - TSF	N - Blows/foot	Consistency
0 - 0.25	0 - 2	Very Soft
0.25 - 0.50	2 - 4	Soft
0.50 - 1.00	4 - 8	Firm (Medium Stiff)
1.00 - 2.00	8 - 15	Stiff
2.00 - 4.00	15 - 30	Very Stiff
4.00 - 8.00	30 - 50	Hard
8.00+	50+	Very Hard

MOISTURE CONDITION DESCRIPTION

Description	Criteria
Dry:	Absence of moisture, dusty, dry to the touch
Moist:	Damp but no visible water
Wet:	Visible free water, usually soil is below water table

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term	% Dry Weight
Trace:	< 15%
With:	15% to 30%
Modifier:	>30%

STRUCTURE DESCRIPTION

Description	Criteria
Stratified:	Alternating layers of varying material or color with layers at least ¼-inch (6 mm) thick
Laminated:	Alternating layers of varying material or color with layers less than ¼-inch (6 mm) thick
Fissured:	Breaks along definite planes of fracture with little resistance to fracturing
Slickensided:	Fracture planes appear polished or glossy, sometimes striated

Description	Criteria
Blocky:	Cohesive soil that can be broken down into small angular lumps which resist further breakdown
Lensed:	Inclusion of small pockets of different soils
Layer:	Inclusion greater than 3 inches thick (75 mm)
Seam:	Inclusion 1/8-inch to 3 inches (3 to 75 mm) thick extending through the sample
Parting:	Inclusion less than 1/8-inch (3 mm) thick

SCALE OF RELATIVE ROCK HARDNESS

Q_U - TSF	Consistency
2.5 - 10	Extremely Soft
10 - 50	Very Soft
50 - 250	Soft
250 - 525	Medium Hard
525 - 1,050	Moderately Hard
1,050 - 2,600	Hard
>2,600	Very Hard

ROCK BEDDING THICKNESSES

Description	Criteria
Very Thick Bedded	Greater than 3-foot (>1.0 m)
Thick Bedded	1-foot to 3-foot (0.3 m to 1.0 m)
Medium Bedded	4-inch to 1-foot (0.1 m to 0.3 m)
Thin Bedded	1¼-inch to 4-inch (30 mm to 100 mm)
Very Thin Bedded	½-inch to 1¼-inch (10 mm to 30 mm)
Thickly Laminated	1/8-inch to ½-inch (3 mm to 10 mm)
Thinly Laminated	1/8-inch or less "paper thin" (<3 mm)

ROCK VOIDS

Voids	Void Diameter
Pit	<6 mm (<0.25 in)
Vug	6 mm to 50 mm (0.25 in to 2 in)
Cavity	50 mm to 600 mm (2 in to 24 in)
Cave	>600 mm (>24 in)

GRAIN-SIZED TERMINOLOGY

(Typically Sedimentary Rock)

Component	Size Range
Very Coarse Grained	>4.76 mm
Coarse Grained	2.0 mm - 4.76 mm
Medium Grained	0.42 mm - 2.0 mm
Fine Grained	0.075 mm - 0.42 mm
Very Fine Grained	<0.075 mm

ROCK QUALITY DESCRIPTION

Rock Mass Description	RQD Value
Excellent	90 -100
Good	75 - 90
Fair	50 - 75
Poor	25 -50
Very Poor	Less than 25

DEGREE OF WEATHERING

Slightly Weathered: Rock generally fresh, joints stained and discoloration extends into rock up to 25 mm (1 in), open joints may contain clay, core rings under hammer impact.

Weathered: Rock mass is decomposed 50% or less, significant portions of the rock show discoloration and weathering effects, cores cannot be broken by hand or scraped by knife.

Highly Weathered: Rock mass is more than 50% decomposed, complete discoloration of rock fabric, core may be extremely broken and gives clunk sound when struck by hammer, may be shaved with a knife.

SOIL CLASSIFICATION CHART

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

MAJOR DIVISIONS			SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		(LITTLE OR NO FINES)		GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
		(APPRECIABLE AMOUNT OF FINES)		GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
		(LITTLE OR NO FINES)		SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES		SM	SILTY SANDS, SAND - SILT MIXTURES
		(APPRECIABLE AMOUNT OF FINES)		SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	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 SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

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