Preliminary Geotechnical Report

Maine Turnpike
Exit 44 Southbound On-Ramp
Improvements MM 44.3
Scarborough, Maine

Prepared for:
Maine Turnpike Authority

Prepared by:
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Sign-off Sheet

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1.0 Introduction

This report presents the results of our geotechnical exploration and analysis for the widening of the southbound lanes at Exit 44 in Scarborough, Maine. Widening the existing southbound roadway embankment will allow two on-ramp travel lanes to accelerate properly with the two mainline travel lanes and merging into three mainline travel lanes. The proposed widening will consist of adding fill over the existing embankment side slopes along the western side of the southbound lanes. The maximum width of the widening is approximately 15 feet and the maximum thickness of fill is approximately 4 feet. The maximum width and height of the new embankment fill is in the area of the Nonesuch River crossing. The maximum grade of the new embankment slope will be 1.5 horizontal to 1.0 vertical (1.5H:1V).

Our scope of work consisted of drilling two test borings, performing laboratory testing on selected soils samples, evaluating the subsurface conditions, reviewing existing geotechnical data, and providing geotechnical engineering recommendations for the design of the expanded roadway embankment.

Elevations in this report are in feet and referenced to the vertical datum NAVD 88.

2.0 Subsurface Information

2.1 LOCAL GEOLOGY

The Site is located within the coastal area of Maine. The surficial soils in the project area are primarily mapped (Surficial Geology of the Portland 1:100,000 Quadrangle, Maine, Maine Geological Survey Open File No. 06-1) as marine regressive deposits consisting of sand, gravel, and silt deposited in shallow marine water during the late-glacial regression of the sea. In the areas along the Nonesuch River the soils are mapped as wetland soils consisting of peat, muck, and/or fine-grained inorganic sediments. Stream terraces consisting of sand and gravel are also mapped along the Nonesuch River. The surficial map indicates the surficial deposits overlie the Presumpscot Formation which consists of silt and clay sized particles deposited in deep ocean water. The deposit typically has a stiff crust underlain by a very soft normally consolidated layer that is compressible.

Based on the bedrock information obtained from the Maine Geological Survey (Bedrock Geology of the Prouts Neck Quadrangle (Scale 1:24,000), Maine Geological Survey Open File No. 03-95) the bedrock in the project area is the Elliot Bedrock Formation described as a fine-grained, medium buff gray, calcareous and ankeritic chlorite-muscovite quartz phyllite, with thin regularly alternating interlayers of dark gray chlorite-muscovite phyllite.

2.2 EXISTING SUBSURFACE INFORMATION

Existing subsurface information was available from a report prepared by SW Cole Engineering and titled "Explorations and Geotechnical Engineering Services, Maine Turnpike Widening, Nonesuch River Crossing (Mile 41.40), Scarborough, Maine" dated September 21, 1999. The report was prepared for the extension of the culvert that conveys the Nonesuch River below the Maine Turnpike as part of the widening of the

north bound lanes. Two test borings were drilled as part of the exploration program that encountered granular fill material to depths of 5.5 and 10.4 feet below the ground surface. The fill is underlain by a natural deposit of sand and silt to depths of 11 and 23 feet below the ground surface. Silty clay of the Presumpscot Formation was encountered to depths of 81 and 92 feet below the ground surface. The formation had very soft consistency. A layer of very dense glacial till was encountered in one test boring and was 13 feet thick. Bedrock was encountered at 92 and 94 feet below the ground surface which corresponds to El. -81.2 and El. -77.7.

A total of 18 field vane shear tests were conducted in the borings. Based on the boring logs, the vane shear tests produced a shear strength range of 770 to 1,040 pounds per square foot (psf). Two test results were greater than 1,090 psf.

Laboratory testing consisted of natural moisture content, gradation test, Atterberg Limits, one-dimensional consolidation, unconfined soil compression strength test, and rock compressive strength tests. In summary, the natural moisture content of the silty clay ranged from 28.6 to 48.2 percent, the plasticity index ranged from 9.0 to 18.3, the unconfined compressive strength of the silty clay ranged from 760 to 1430 psf and the compressive strength of the bedrock ranged from 2,330 to 5,230 pounds per square inch (psi). The consolidation tests conducted on the silty clay of the Presumpscot Formation produced the following results:

Table 1 – Summary of Engineering Properties from SW Cole Report

Sample ID	Depth (ft)	Maximum Past Pressure (psf)	C_c	C_r	e_o	CR	RR	Moisture Content (%)
B41-1, 1C	15 – 17	3,200	0.27	0.03	0.92	0.141	0.016	33.1
B41-1, 2C	25 – 27	4,000	0.28	0.03	0.90	0.147	0.016	33.5
B41-1, 3C	35 – 37	3,100	0.57	0.04	1.17	0.263	0.018	42.5
B41-1, 4C	44 – 46	2,900	0.50	0.05	1.26	0.221	0.022	48.2
B41-1, 5C	57 - 59	4,300	0.60	0.04	1.17	0.276	0.018	44.1

Where: C_c = Compression index; Cr = Recompression index; e_o = Initial void ratio; CR = Modified compression ratio; RR = Modified recompression ratio

Values of for secondary compression (Cα) and coefficient of consolidation (Cv) were not provided in the SW Cole report. For our calculations, Cα was assumed to be 0.01 and Cv was assumed to be 0.10 ft^2/day.

2.3 SUBSURFACE EXPLORATION

The exploration program consisted of drilling two test boring designated B-1 and B-2 between April 3 and 6, 2017. Field vane shear testing was conducted at the location of boring B-1 to evaluate the undrained shear strength of the marine clay deposit.

The location of the test borings are shown on the attached Figure 2. The test borings were drilled by New England Boring Contractors of Hermon, Maine. Track-mounted Mobile B-53 drill rig equipped with 4-inch diameter flush-joint steel casing was used to advance the borings.

Soil samples were obtained by driving a 24-inch long, 2-inch outside diameter split spoon sampler with a 140-pound auto hammer falling 30 inches, in substantial accordance with ASTM D1586, the Standard Penetration Test (SPT). The blows for each 6-inches of penetration are recorded for a total of 24-inches. The sum of the blows required to drive the sampler from 6-inches to 18-inches of penetration is referred to as the Standard Penetration Resistance, or N-value, which is an index of measure of in-situ soil density or consistency. N values for granular soils less than 5 are considered to be very loose; between 5 and 10 loose; between 11 and 30 medium dense; between 31 and 50 dense; and greater than 50 very dense. For cohesive soils, N values less than 2 are considered to be very soft; between 2 and 4 soft; between 4 and 8 firm; between 8 and 15 stiff; between 15 and 30 very stiff; and greater than 30 hard.

The drill rig was equipped with an automatic hammer for the SPT test. Automatic hammers typically have a higher efficiency than safety hammers and therefore a hammer energy correction factor (CF) is needed to determine the SPT N60 value. Based on a report entitled "SPT Energy Testing" prepared by GZA dated March 31, 2017 and provided by New England Boring Contractors, the automatic hammer used for the test borings has an efficiency of 67.7 percent which results in a hammer energy correction factor of 1.13. The raw SPT values were multiplied by the appropriate correction factors to determine the SPT N60 values. Both the raw SPT values and SPT N60 values are recorded on the boring logs.

Soil samples from the test borings were visually classified in the field by Stantec personnel and confirmed using laboratory test data results. The boring logs include visual descriptions and laboratory test results. The boring locations were determined by measuring from existing site features.

Rock core samples were obtained from boring B-2 using a NX double-walled core barrel. The rock core was transported to the New Hampshire office of Stantec and visually described by a geotechnical engineer.

Two undisturbed Shelby tube samples were obtained from the clay deposit. The samples were obtained using a hydraulically actuated fixed piston tube sampler. The Shelby tubes were allowed to set 15 minutes after being pushed into the clay and then slowly rotated two revolutions prior to extraction from the borehole. After extraction, the samples were preserved using internal wax seals (capped at the ends and a wax seal was applied to the ends of the tubes). The samples were secured vertically and transported to the laboratory. Testing has not been scheduled for these samples.

In-situ field vane shear testing was conducted at the location of the two test borings. The vane shear testing equipment was supplied by the Hermon office of NEBC and consisted of a vane with a diameter of 2-3/8 inches and a height of 5 inches. The rod connected to the vanes had a diameter of 3/8 inch and the lightweight rods used to lower the vane into the borehole had a diameter of ½ inch. A torque wrench measuring foot-pounds was used to record the torque. The field testing and data reduction was performed in general accordance with ASTM D2573/D2573M-13. The raw torque reading and the calculated undrained shear strength are presented on the boring logs for the disturbed and remolded tests. The undrained shear strength includes a vane correction factor in accordance with the Appendix of ASTM D2573/D2573M-13. The results are summarized in the table below.

Table 2 – Results of Field Vane Shear Testing

Boring No.	Test No.	Depth (feet)	Undisturbed		Remolded	
			Traw (ft-lb)	Su (psf)	Traw (ft-lb)	Su (psf)
B-1	V-1	29.4 – 30.0	41.5	1,259	3.5	106
	V-2	30.4 - 310	35.0	1,062	5.5	167
	V-3	39.4 – 40.0	21.0	637	3.75	114
	V-4	40.4 - 41.0	27.5	835	6.5	197
	V-5	49.4 – 50.0	28.5	835	3.5	106
	V-6	50.4 - 51.0	25.0	733	2.5	76
	V-7	59.4 – 60.0	31.5	885	2.1	64
	V-8	60.4 – 61.0	25.0	703	1.5	46
	V-9	69.4 – 70.0	22.5	673	0.5	15
	V-10	70.4 – 71.0	25.0	867	1.0	30

The boring logs are provided in Appendix A. A photograph of the bedrock core obtained from B-2 is provided in Appendix B.

A summary of the boring locations and ground surface elevation located in the toll plaza area, exit 1 area and northbound turnaround area is provided in Table 3 below.

Table 3 – Boring Locations and Elevations in Tolling Area

Boring	Station	Offset	Location	Ground Elev. (ft)	Top of Bedrock	
					Depth (ft)	Elev. (ft)
B-1	2145+95	68 LT	170 feet south of the Nonesuch River	29.0	116	-87.0
B-2	2194+04	58 LT	140 feet north of the Nonesuch River	29.5	79.5	-48.5

3.0 Summarized Subsurface Conditions

The subsurface conditions encountered in the borings are based on widely spaced explorations and variations should be anticipated. In general, the test borings encountered a granular embankment fill overlying a thin deposit of sand, a 63 to 92 feet thick deposit of marine clay, underlain by bedrock. Bedrock was cored at the location of boring B-2. The soil samples were described in accordance with the modified Burmister system. A key for the Burmister system is provided in Appendix A prior to the boring logs. The

subsurface conditions at the site are typical of coastal Maine and are summarized in the following paragraphs.

3.1 ASPHALT PAVEMENT

Asphalt pavement was encountered at B-2 and was 5 inches thick.

3.2 EMBANKMENT FILL

Fill was encountered at both boring locations and was approximately 15 feet thick. The fill generally consisted of light brown or brown, medium to fine sand, trace fine gravel, and little to trace silt. The recorded N-values ranged from 6 to 49 bpf, indicating a variable loose to dense consistency.

3.3 SAND DEPOSIT

A natural sand deposit was encountered below the fill at the location of B-1. The sand was approximately 9 feet thick. The deposit generally consisted of gray, medium to fine sand, little silt or gray/brown, silt and fine sand. The recorded N-values ranged from 19 to 20 bpf, indicating a medium dense consistency.

3.4 MARINE CLAY DEPOSIT

A deposit of marine clay was encountered at B-1 and B-2 below the sand deposit or embankment fill and was 92 and 63 feet thick, respectively. The upper 11 to 15 feet of the deposit was described as a light brown, clayey silt, or silty clay. The recorded N-values ranged from 3 to 6 bpf, indicating a soft to medium stiff consistency. This upper portion of the clay appears to be the stiff crust which is typically present over the softer underlying clay. Below the crust layer, the majority of the clay was described as gray silty clay with recorded N-values of either weight of hammer (WOH) or weight of rods (WOR), indicating a very soft consistency.

3.5 BEDROCK

Based on drilling resistance, bedrock at B-1 and B-2 was encountered at depths of 116 and 78 feet below the ground surface corresponding to El -87 and -48.5. Because bedrock was encountered at a shallower depth at B-2 than B-1, bedrock was cored at the location of boring B-2 to verify the presence of bedrock. The bedrock was described as hard, fresh, dark gray, aphanitic phyllite. The joints are low to moderately dipping, closely to moderately closely spaced, and tight to open.

The cores were measured for percent recovery and rock quality designation (RQD). The recovery for the core runs was 88 and 100 percent. RQD is a rough measure of the degree of jointing or fracture in a rock mass, measured as a percentage of the drill core run. High-quality rock has an RQD of more than 75%; lower quality rock has an RQD of less than 50%. The RQD of the bedrock cores was 23 and 100 percent, indicating very poor mass quality to excellent quality. Photographs of the rock cores are included in Appendix B.

3.6 GROUNDWATER

Groundwater levels were observed in borings B-1 and B-2 at the time of drilling to be at 11 feet below the ground surface, which corresponds to El 18 and El 18.5, respectively. Given the proximity to the Nonesuch River the groundwater is expected to generally coincide with the water in the river channel. Groundwater will vary over time due to seasonal changes in precipitation and temperature, snowmelt, and surrounding and on-site drainage characteristics.

4.0 Laboratory Testing

Laboratory tests were conducted on representative soil samples obtained from the test borings to assist in classification and to evaluate engineering properties. Laboratory testing consisted of grain size distribution, moisture content, and Atterberg Limits. Soil testing was conducted by GeoTesting Express of Acton, MA. Results of the tests are included in Appendix C and are summarized in Tables 2 through 4 below.

Table 4 – Grain Size Distribution Summary

Boring No.	Sample No.	Depth (feet)	Stratum/Soil Description	Moisture Content	Percent Gravel	Percent Sand	Percent Fines
B-1	SS-4	6-8	Embankment Fill Coarse to fine SAND, trace Gravel, trace Silt	--	4.0	90.0	6.0
B-1	SS-8	19-21	Sand Deposit Medium to fine SAND, little Silt	--	0	87.0	13.0
B-2	SS-3	8-10	Embankment Fill Medium to fine SAND, trace Gravel, trace Silt	--	1.0	93.0	6.0

Table 5 – Summary of Atterberg Limits

Boring No.	Sample No.	Depth (feet)	Stratum	MC (%)	LL	PL	PI
B-1	SS-10	29–31	Marine Clay	26	28	17	11
B-1	SS-12	39-41	Marine Clay	28	27	16	11
B-1	SS-13	49-51	Marine Clay	38	35	19	16
B-1	SS-15	59-61	Marine Clay	48	45	22	23
B-1	SS-17	67-71	Marine Clay	43	32	19	13
B-1	SS-21	94-96	Marine Clay	35	28	18	10
B-1	SS-24	109-111	Marine Clay	31	22	14	8
B-2	SS-7	29-31	Marine Clay	31	23	17	6
B-2	SS-11	49-51	Marine Clay	44	33	20	13
B-2	SS-15	69-71	Marine Clay	37	28	19	9

Where: MC = Moisture Content; LL = Liquid Limit; PL = Plastic Limit; PI = Plasticity Index

5.0 Discussions and Recommendations

Our recommendations provided below are based upon the subsurface information obtained, laboratory test data, and our understanding of the proposed construction. In general, the two significant concerns are (1) stability of the proposed side slopes and (2) the settlement of the roadway due to the proposed grade increases. Based on the 10 percent design plans, the area of largest grade raise is located immediately south and north of the Nonesuch River. The settlement and stability concerns are discussed in the paragraphs below. Table 6 provides a summary of the conditions encountered at each boring location and Table 7 provides the soil engineering parameters used in our analyses.

Table 6 – Generalized Soil Profile at Test Boring Locations

Soil Stratum	Boring B-1		Boring B-2	
	Approximate Thickness (feet)	Elevation (feet)	Approximate Thickness (feet)	Elevation (feet)
Existing Embankment Fill	15	29 to 14	15	29.5 to 14.5
Sand	10	14 to 5	--	--
Stiff Clay (Crust)	15	5 to -10	11	14.5 to 3.5
Soft Clay	77	-10 to -78	52	3.5 to -48.5
Top of Bedrock	--	-78	--	-48.5

Table 7 – Summary of Soil Strength Parameters

Soil Stratum	Unit Weight, γ_m (pcf)	Drained Conditions		Undrained Conditions	
		Effective Friction Angle, φ' (Degrees)	Cohesion, c' (psf)	Friction Angle, φ (Degrees)	Cohesion, c (psf)
Proposed and Existing Embankment Fill	125	34	0	34	0
Sand	120	30	0	30	0
Clay Crust	110	30	0	0	1,000 - 1,200[1]
Soft Clay	105	30	0	0	600 – 800[2]

Notes: (1) Based on corrected N values greater the 3 blows per foot and field vane shear testing.
(2) Based on field vane shear test and depends on location and depth.

5.1 SLOPE STABILTY

The stability of the proposed embankments was analyzed using the computer program Slope/W which is part of the GeoStudio suite of programs. Cross sections at Station 2146+00 and Station 2149+00 were determined to be the two most critical sections based on the height of the proposed fill and the proposed 2H:1V side slope. At both station locations, the maximum thickness of the new roadway fill is approximately 4 feet. The remainder of the slopes along the project are generally 1 to 3 feet in height. Based on AASHTO criteria, slopes that do not support a structure require a factor of safety greater than 1.3.

The analyses were conducted such that potential failure surface within the underlying marine clay deposit were evaluated. However, the analyses indicate the critical surfaces are primarily within the existing embankment fill. The underlying clay deposit does not have a significant influence on the stability of the proposed embankment. Based on our analysis and the subsurface conditions encountered, the proposed slopes will have short term (undrained) and long term (drained) factor of safety greater than the required minimum of 1.3.

The stability calculations are presented in Appendix D.

Table 8 – Slope Stability Summary

Embankment Location	Baseline for Stationing	Factor of Safety		Minimum Required Factor of Safety
		Undrained	Drained	
Sta. 2146+00	Maine Turnpike Center Line	1.65	1.64	1.3
Sta. 2149+00	Maine Turnpike Center Line	1.64	1.57	1.3

5.2 SETTLEMENT

The proposed roadway widening will increase the pressure on the underlying clay deposit. Due to the soft to very soft consistency of the clay, consolidation of the clay deposit will occur over time resulting in settlement of the newly placed fill and the adjacent roadway. Settlement analyses were conducted at Stations 2146+00 and 2149+00, which is the area where the largest amount of fill will be placed and thus the largest amount of settlement will occur. This settlement will occur over an assumed span of 25 years and will generally consist of primary settlement. The estimated settlement is summarized in the table below and represents the area between Stations 2144+00 to 2149+00 where the fill heights are on the order of 4 feet. Settlement in the roadway to the south (Stations 2136+00 to 2144+00) and north (Stations 2149+00 to 2167+00) will be less because the fill height in those locations generally range between 1 to 3 feet.

Table 9 – Summary of Settlement Analyses

Station	Maximum Fill Height	Estimated Settlement	
		Location	Magnitude (inches)
2146+00	4 feet	Mainline Center Line	Negligible
		37 LT (middle of SB barrel)	0.60
		75 LT (edge of pavement)	1.4
2149+00	4 feet	Mainline Center Line	Negligible
		37 LT (middle of SB barrel)	0.40
		75 LT (edge of pavement)	1.3

The proposed settlement may cause cracking and distortion of the pavement surface which could impact pavement performance. The pavement settlement may affect the drainage of stormwater runoff from the pavement surface. Because the settlement is expected to be greater along the outside edge of the pavement surface, the pitch of the roadway surface will increase which will help surface water drainage. The pavement in the areas of the fill will require periodic shimming and maintenance due to the settlement.

6.0 Construction Considerations

6.1 EMBANKMENT SLOPES CONSTRUCTION

Construction of embankment slopes shall be conducted in accordance with Section 203, Excavation and Embankment. Maximum lift thickness and minimum compaction requirement are provided in Section 203. The embankments should be constructed of soil meeting the requirements of MaineDOT Item No. 703.18, Common Borrow.

Prior to placing fill for embankment construction, existing vegetation, unsuitable existing fill materials, asphalt, topsoil and other organic or deleterious material should be removed to expose suitable subgrade soils. Where proposed slopes are constructed against existing slopes, the existing slope should be continuously benched by excavating steps into the existing slope in accordance with Standard Specification Section 203.09 of the MaineDOT Standard Specifications. The entire area of the new embankment should be placed in horizontal lifts and compacted. Unsuitable materials should not be wasted in the outer portion of fill slopes. Offsite waste disposal areas shall be established in accordance with Section 203.06 of the MaineDOT Standard Specifications.

We anticipate that slopes that are 2 Horizontal to 1 vertical or flatter will be treated with loam and seed to provide long term erosion control. Short-term protection can be provided by utilizing temporary erosion control matting, MaineDOT Item No. 613.319.

Based on the 60% design plans, the slope above and adjacent to the Nonesuch River culvert (Sta. 2146+90 to Sta. 2148+50) will have a grade of 1.5H:1V and will be treated with 4 feet of heavy rip-rap underlain by a geotextile. This proposed treatment will provide a stable slope at the proposed grade of 1.5H:1V.

Unsuitable soils or soils that become disturbed during construction should be completely excavated from the subgrade and replaced with compacted granular borrow. Granular borrow should conform to MaineDOT Standard Specification 703.19, Granular Borrow. The granular borrow should be compacted to 92 percent of the Modified Proctor maximum dry density (AASHTO T-180).

6.2 TRENCH EXCAVATIONS

If trench excavations are required for below ground utilities, then the contractor should prevent surface water from entering trench excavation and install a dewatering system to remove groundwater that enters the excavation to allow fill to be placed in-the-dry. OSHA standards for trenches shall be enforced by the contractor.

6.3 CONSTRUCTION DEWATERING

Dewatering is not expected to be necessary for this project. However, should dewatering be necessary the system should be capable of lowering the groundwater to a depth of 2 feet below the bottom of the excavation. It should be noted that the marine clay soil at the site is highly sensitive to moisture and will lose strength when saturated. Sumps should be equipped with filter fabric to prevent the loss of fine-grained soils during pumping. Water pumped from the excavations should be discharged to settling ponds or frack tanks to allow fine particles to settle out prior to discharge. Water should be discharged in accordance with all applicable permits and regulations.

7.0 Limitations

7.1 USE OF REPORT

This report has been prepared for the exclusive use of the Maine Turnpike Authority and their respective assigns and designees. This report is not intended for the use or reliance of other (third) parties, without the express consent of Stantec and Maine Turnpike Authority. Any use, which a third party makes of this report, or any reliance on decisions made based on this report, is the responsibility of such third parties. Further, the findings of this study apply only to the specific Site and project described herein. The findings herein are inapplicable to other Sites, and to developments of different grading, layout, loading, and performance requirements. Stantec accepts no responsibility for damages, real or perceived, suffered by parties as a result of decisions made or actions based on the unintended and/or inappropriate use of this report.

This Geotechnical Report provides recommendations, and is intended for informational use, requiring interpretation by the owner, design team, and contractor for the design and construction of the project, and interpretation of final quantities and construction costs. The Geotechnical Report is not intended, or suitable, by itself, for use as a technical specification or to determine quantities. Anticipated quantities

and/or costs may be provided in the Geotechnical Report; such information is an Engineer's interpretation, and may vary dramatically from contractor bids, which are based on potentially differing interpretations, and several other variables not available or considered by the Engineer.

7.2 SUBSEQUENT INVOLVEMENT

The geotechnical process incorporates initial exploration and recommendations as summarized herein, and is followed by continuous involvement during key design and construction benchmarks. The recommendations provided herein are based on preliminary information and assumptions regarding proposed site grading, structural loading and performance requirements. It is recommended that Stantec review final foundation, grading, and other applicable plans to assess whether or not these recommendations require modification.

During construction, additional soil samples should be analyzed in the laboratory for moisture content, gradation, and moisture density relationship tests to evaluate the reuse of onsite soils (existing fill and natural sand strata) as backfill material.

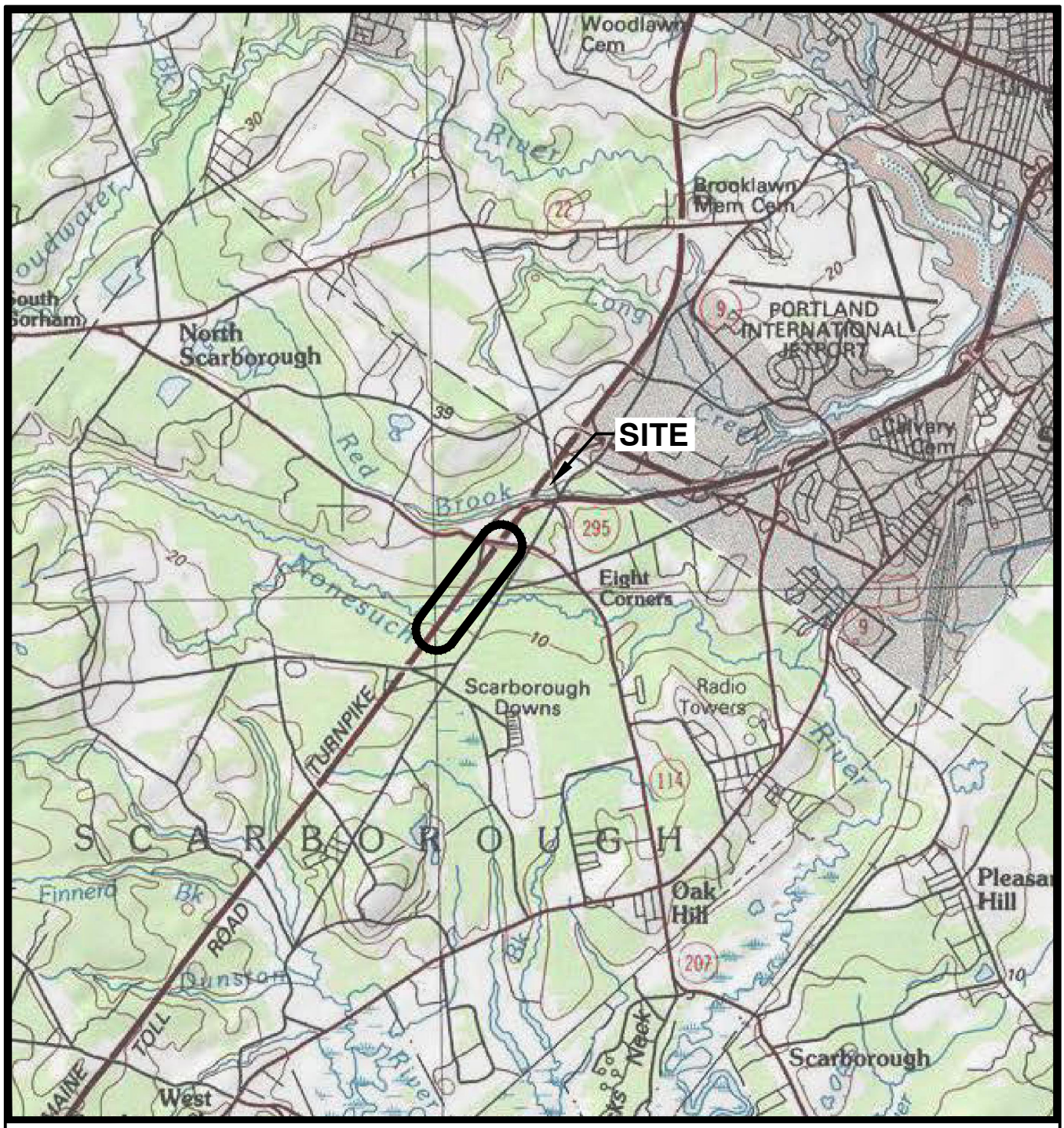
Stantec should be retained to observe excavations and subgrade preparation to assess whether the intent of these recommendations is followed during construction, and whether or not other appropriate and/or cost-effective solutions may be warranted based on the actual conditions encountered. Further, a soil exploration is a random sampling of a Site. Should any conditions at the Site at any point during the project be encountered that differ from those summarized in the report, Stantec should be notified immediately in order to permit reassessment of these conditions and the recommendations contained in the report.

7.3 REPRESENTATION AND INTERPRETATION OF DATA

Surficial and subsurface information presented herein is based on field measurements obtained during the course of the exploration and site reconnaissance. The precision and accuracy of surficial data is a function of the references, benchmarks, methods and instruments employed, as summarized in the report. Subsurface data is based on measurements within the borehole or test pit using the sampling methods described on the exploration logs. The completeness, precision, and accuracy of such data is a function of the frequency and type of exploration and sampling employed, as well as the precision and accuracy of the surface location and elevation of the borehole, and may vary from actual conditions encountered during excavations. Subsurface conditions between, beyond and below explorations, may vary dramatically from the nearest exploration, due to natural geologic action, deposition and weathering, or man-made activities.

Groundwater levels were recorded during the time periods and frequencies noted on the explorations. It is important to note that groundwater levels are disrupted by the exploration, and require equilibration periods to determine actual hydrostatic levels, which exceed the duration of the measurement period. Multiple hydrostatic groundwater levels may exist, including perched or trapped water, which may not necessarily be accurately represented by one water level reading. Groundwater levels fluctuate due to seasonal variations, adjacent surface water bodies, precipitation, and on-Site and nearby land use.

Figures



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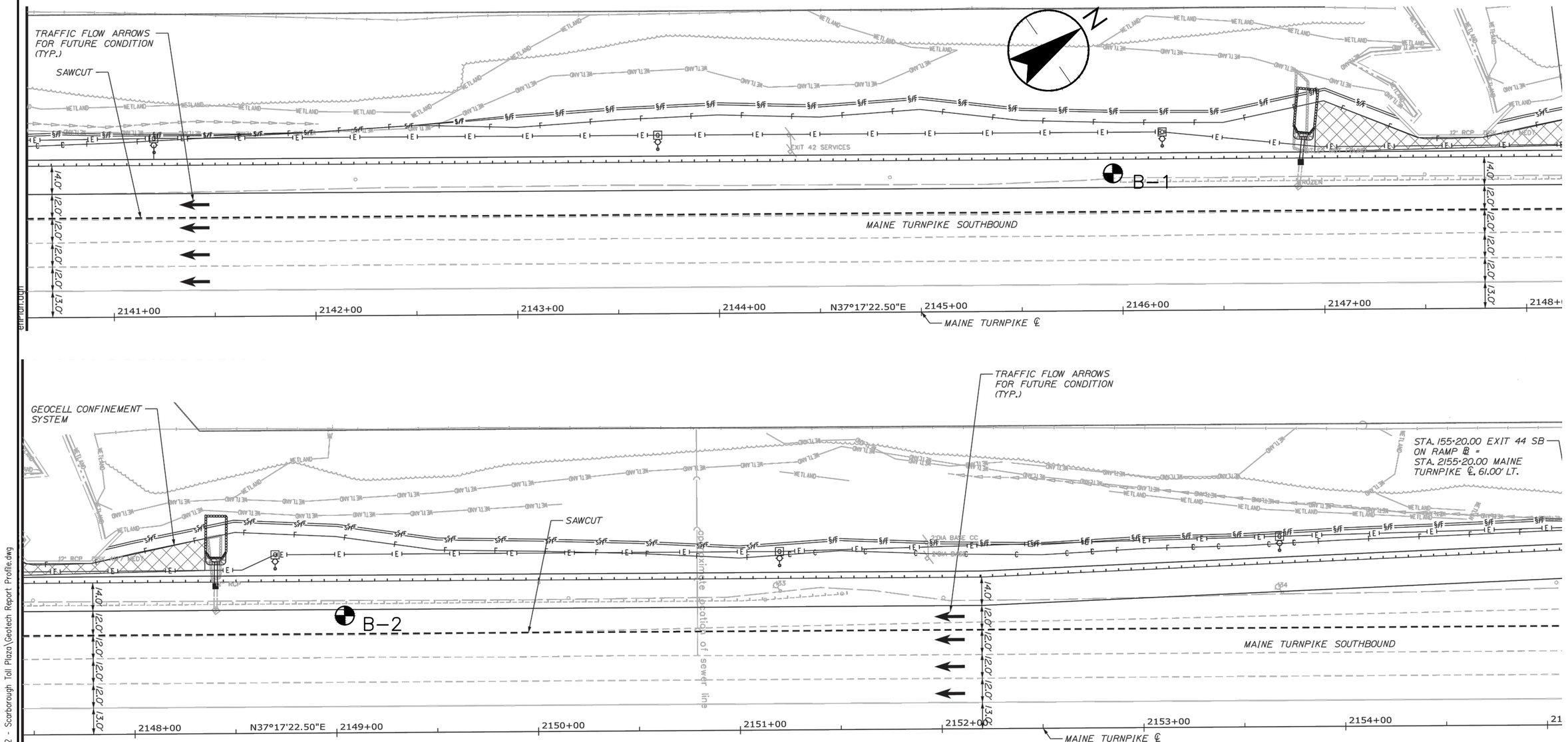
Client/Project
MAINE TURNPIKE AUTHORITY
EXIT 44 SOUTHBOUND ON RAMP
SCARBOROUGH, ME

Figure No.
1

Title
SITE LOCATION PLAN



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JUNE, 2016
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Legend

B-1 BORING LOCATION

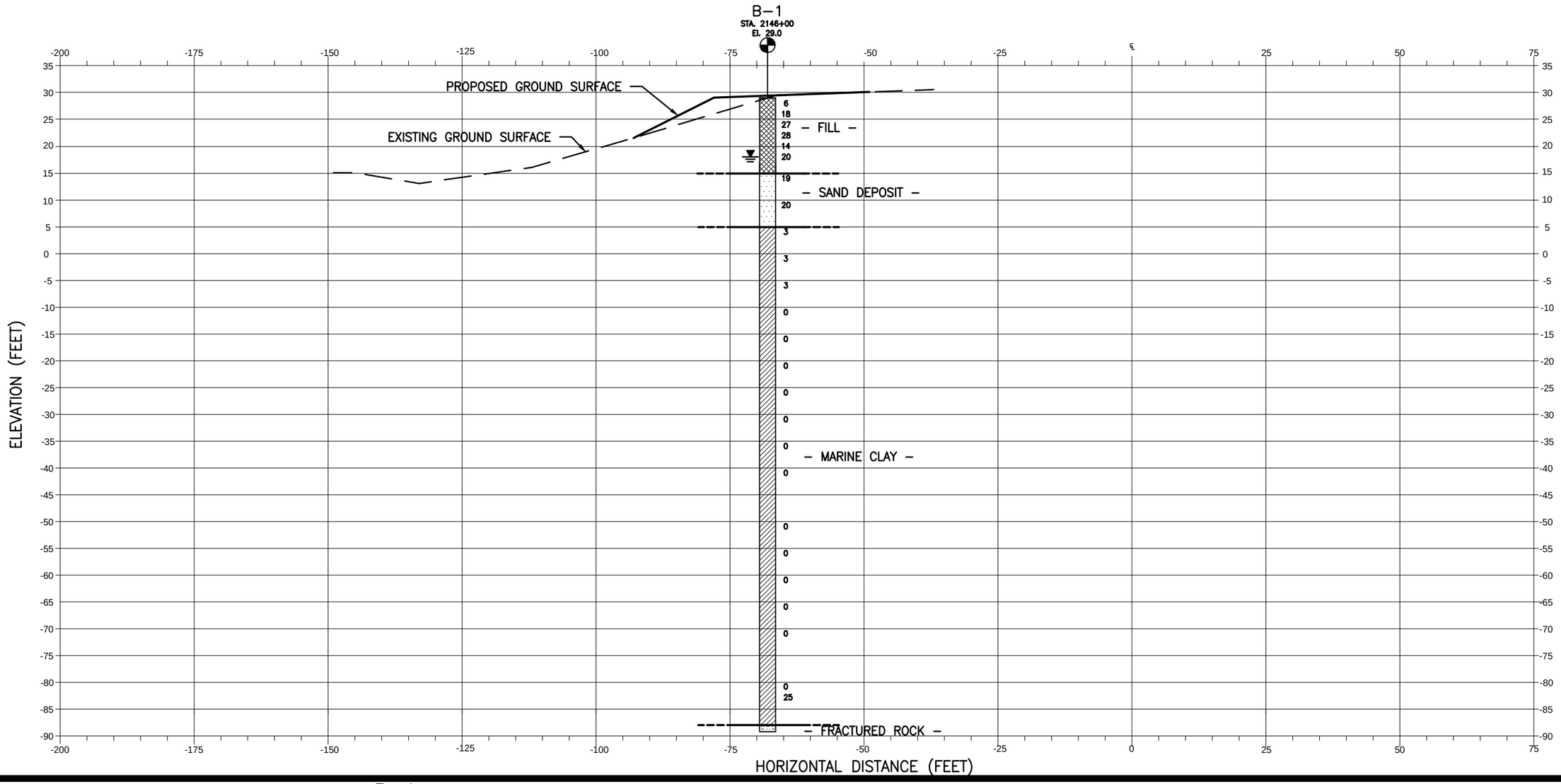
Notes

1. TEST BORINGS B-1 AND B-2 WERE DRILLED DURING THE PERIOD FROM APRIL 3 THROUGH APRIL 6, 2017. THE BORINGS WERE DRILLED BY EQUIPMENT OWNED AND OPERATED BY NEW ENGLAND BORING CONTRACTORS OF DERRY, NH, UNDER THE SUPERVISION OF STANTEC PERSONNEL.

Client/Project
MAINE TURNPIKE AUTHORITY
EXIT 44 SOUTHBOUND ON RAMP
SCARBOROUGH, ME

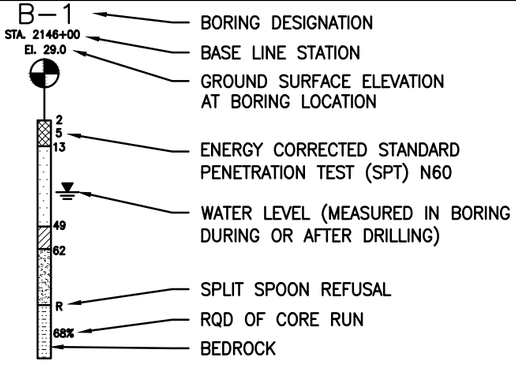
Figure No.
2

Title
BORING LOCATION PLAN



BORING LEGEND

= FILL
= SAND
= MARINE CLAY
= BEDROCK



Notes

1) SUBSURFACE CROSS SECTION WAS DEVELOPED FROM THE 10% SUBMISSION PLANS ENTITLED "EXIT 44 SOUTHBOUND ON RAMP IMPROVEMENTS MILE 44.3" DATED MARCH 10, 2017, PREPARED BY STANTEC.

2) THE LOCATIONS OF THE TEST BORINGS WERE DETERMINED BY TAPPING FROM SITE FEATURES.

3) ELEVATIONS SHOWN ON THIS PLAN ARE IN FEET AND REFERENCED TO NAVD 1988.

4) THE TOP OF BEDROCK WAS DETERMINED BY SPLIT SPOON REFUSAL. THE ELEVATION SHOULD BE CONSIDERED APPROXIMATE.

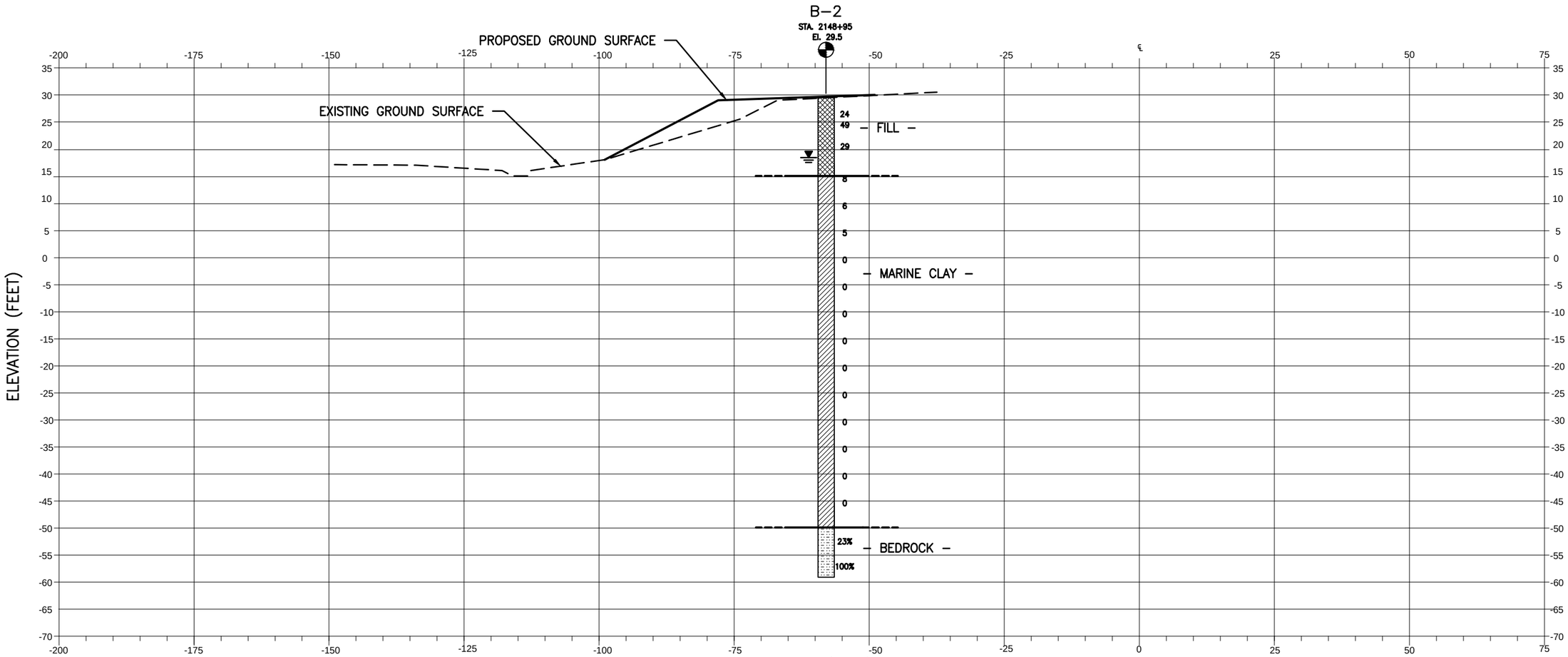
5) THE CROSS SECTION SHOWS THE GENERAL SUBSURFACE CONDITIONS IN THE AREA OF STATION 2146+00. THE STRATA LINES SHOWN ON THE CROSS SECTION ARE BASED ON THE TEST BORINGS AND SHOULD BE CONSIDERED APPROXIMATE. THE ACTUAL STRATA BOUNDARIES WILL VARY.

Stantec
Stantec Consulting Services Inc.
5 Dartmouth Dr, Suite 101
Auburn NH 03032 U.S.A.
Tel. 603.669.8672

Client/Project
MAINE TURNPIKE AUTHORITY
EXIT 44 SOUTHBOUND ON RAMP
SCARBOROUGH, ME

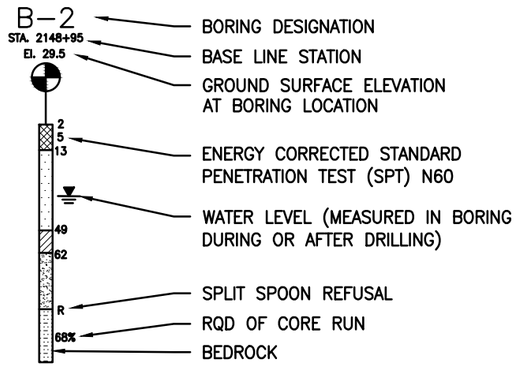
Figure No.
3

Title
SUBSURFACE CROSS SECTION
STATION 2146+00



BORING LEGEND

= FILL
= SAND
= MARINE CLAY
= SILTY SAND
= Bedrock



Notes

1) SUBSURFACE CROSS SECTION WAS DEVELOPED FROM THE 10% SUBMISSION PLANS ENTITLED "EXIT 44 SOUTHBOUND IMPROVEMENTS MILE 44.3" DATED MARCH 10, 2017, PREPARED BY STANTEC.

2) THE LOCATIONS OF THE TEST BORINGS WERE DETERMINED BY TAPING FROM SITE FEATURES.

3) ELEVATIONS SHOWN ON THIS PLAN ARE IN FEET AND REFERENCED TO NAVD 1988.

4) THE CROSS SECTION SHOWS THE GENERAL SUBSURFACE CONDITIONS IN THE AREA OF STATION 2149+00. THE STRATA LINES SHOWN ON THE CROSS SECTION ARE BASED ON THE TEST BORINGS AND SHOULD BE CONSIDERED APPROXIMATE. THE ACTUAL STRATA BOUNDARIES WILL VARY.

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Auburn NH 03032 U.S.A.
Tel. 603.669.8672

Client/Project
MAINE TURNPIKE AUTHORITY
EXIT 44 SOUTHBOUND RAMP
SCARBOROUGH, ME

Figure No.
4

Title
SUBSURFACE CROSS SECTION
STATION 2149+00

Appendix A

Boring Logs

Stantec

BOREHOLE LOG

B-1

CLIENT **Maine Turnpike Authority**

LOCATION **Exit 44, Scarborough, ME**

EXPLORATION DATE **4/3/2017 to 4/4/2017**

WATER LEVEL **11 feet b.g.s.**

PROJECT No. **195311370**

EXPLORATION No. **B-1**

DATUM **NAVD 88**

Station 2145+95 ft
Offset 68 ft LT
Mainline Baseline

DEPTH (ft)	ELEVATION (ft)	MATERIAL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SPT blows / 6"	SPT N-Value	SPT N60-Value
	29.0						in.			
0		Loose, brown, medium to fine SAND, some Silt, trace Gravel, dry			SS	1	7	1 2 3 2	5	6
	27.0	Medium dense, brown, medium to fine SAND, trace Gravel, trace Silt, moist			SS	2	12	4 6 10 15	16	18
	25.0	Medium dense, brown, medium to fine SAND, some Silt, moist			SS	3	21	8 12 12 12	24	27
5	23.0	Medium dense, brown, medium to fine SAND, some Silt, trace Gravel, brown			SS	4	15	10 12 13 14	25	28
	21.0	Medium dense, brown, coarse to medium SAND, some fine Sand, moist			SS	5	16	4 6 6 7	12	14
	19.0	Medium dense, brown, coarse to medium SAND, some fine Sand, trace Silt, wet at 11'		▽	SS	6	13	7 8 10 15	18	20
10	17.0	-EMBANKMENT FILL-								
	15.0	Medium dense, gray/brown SILT and fine Sand, moist			SS	7	12	3 8 9 8	17	19
	13.0									
15	10.0	Medium dense, gray fine SAND, moist			SS	8	11	7 8 10 12	18	20
	8.0	-SAND DEPOSIT-								
20	7.0									

Standard Penetration Test, blows/foot ●

10 20 30 40 50 60 70 80 90

Driller: New England Boring Contractors; Supervisor: NEB: Brad Enos, Stantec: Jason Ward

Rig Type: Track Mounted Mobile Drill B-53; Hammer: Auto Hammer; 4" diam. Drive and Wash, 2" Split Spoon Sampler

△ Unconfined Compression Test

□ Field Vane Test ■ Remolded

✖ Pocket Penetrometer / Torvane

Continued Next Page

Stantec

BOREHOLE LOG

B-1

CLIENT **Maine Turnpike Authority**

LOCATION **Exit 44, Scarborough, ME**

EXPLORATION DATE **4/3/2017 to 4/4/2017**

WATER LEVEL **11 feet b.g.s.**

PROJECT No. **195311370**

EXPLORATION No. **B-1**

DATUM **NAVD 88**

Station 2145+95 ft
Offset 68 ft LT
Mainline Baseline

DEPTH (ft)	ELEVATION (ft)	MATERIAL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY in.	SAMPLES SPT blows / 6"	SPT N-Value	SPT N60-Value
	6.0									
	5.0	Soft, gray clayey SILT No recovery on first attempt due to gravel in tip of spoon. Spoon sent back down again.			SS	9	0	6 1 2 1	3	3
25	3.0	-MARINE CLAY-								
	0.0	Soft, gray silty CLAY V- 1 29.4-30.0 ft: Tmax=41.5 ft-lb/Tr=3.5ft-lb Su=1259 psf/106 psf			SS	10	21	1 3 WOH WOH	3	3
30	-2.0	V- 2 30.4-31 ft: Tmax=35.0 ft-lb/Tr=5.5ft-lb Su=1062 psf/167 psf Attempted Shelby tube from 34'-36'. Penetrated 6 inch into clay layer. Discarded sample.								
	-5.0	Soft, gray clayey SILT with a fine sand layer			SS	11	23	WOH 1 2 WOH	3	3
35	-7.0									
	-10.0	Very soft, gray clayey SILT V- 3 39.4-40.0 ft: Tmax=21.0 ft-lb/Tr=3.75ft-lb Su=637 psf/114 psf			SS	12	0	WOR/24"	-	-
40	-12.0	V- 4 40.4-41.0 ft: Tmax=27.5 ft-lb/Tr=6.5ft-lb Su=835 psf/197								
	-15.0									

Standard Penetration Test, blows/foot ●

10 20 30 40 50 60 70 80 90

Driller: New England Boring Contractors; Supervisor: NEB: Brad Enos, Stantec: Jason Ward

Rig Type: Track Mounted Mobile Drill B-53; Hammer: Auto Hammer; 4" diam. Drive and Wash, 2" Split Spoon Sampler

△ Unconfined Compression Test

□ Field Vane Test ■ Remolded

✖ Pocket Penetrometer / Torvane

Continued Next Page

Stantec

BOREHOLE LOG

B-1

CLIENT **Maine Turnpike Authority**

LOCATION **Exit 44, Scarborough, ME**

EXPLORATION DATE **4/3/2017 to 4/4/2017**

WATER LEVEL **11 feet b.g.s.**

PROJECT No. **195311370**

EXPLORATION No. **B-1**

DATUM **NAVD 88**

Station 2145+95 ft
Offset 68 ft LT
Mainline Baseline

DEPTH (ft)	ELEVATION (ft)	MATERIAL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY in.	SPT blows / 6"	SPT N-Value	SPT N60-Value
45		PushedShelby Tube from 44 to 46 feet.			U	1	23	PUSH	-	-
	-17.0									
	-20.0	Very soft, gray silty CLAY V- 5 49.4-50.0 ft: Tmax=28.5 ft-lb/Tr=3.5ft-lb Su=835 psf/106 psf			SS	13	0	WOR/24"	-	-
50	-22.0	V- 6 50.4-51.0 ft: Tmax=25.0 ft-lb/Tr=2.5ft-lb Su=733 psf/76 psf -MARINE CLAY-								
	-25.0	Very soft, dark silty CLAY			SS	14	24	WOR/24"	-	-
55	-27.0									
	-30.0	Very soft, gray silty CLAY V- 7 59.4-60.0 ft: Tmax=31.5 ft-lb/Tr=2.1ft-lb Su=885 psf/64 psf			SS	15	22	WOR/24"	-	-
60	-32.0	V- 8 60.4-61.0 ft: Tmax=25.0 ft-lb/Tr=1.5ft-lb Su=703 psf/46 psf								
	-35.0	Very soft, gray silty CLAY			SS	16	24	WOR/24"	-	-
65	-37.0									

Standard Penetration Test, blows/foot ●

10 20 30 40 50 60 70 80 90

Driller: New England Boring Contractors; Supervisor: NEB: Brad Enos, Stantec: Jason Ward

Rig Type: Track Mounted Mobile Drill B-53; Hammer: Auto Hammer; 4" diam. Drive and Wash, 2" Split Spoon Sampler

△ Unconfined Compression Test

□ Field Vane Test ■ Remolded

✖ Pocket Penetrometer / Torvane

Continued Next Page

Stantec

BOREHOLE LOG

B-1

CLIENT **Maine Turnpike Authority**

LOCATION **Exit 44, Scarborough, ME**

EXPLORATION DATE **4/3/2017 to 4/4/2017**

WATER LEVEL **11 feet b.g.s.**

PROJECT No. **195311370**

EXPLORATION No. **B-1**

DATUM **NAVD 88**

Station 2145+95 ft
Offset 68 ft LT
Mainline Baseline

DEPTH (ft)	ELEVATION (ft)	MATERIAL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY in.	SPT blows / 6"	SPT N-Value	SPT N60-Value
	-40.0	Very soft, gray silty CLAY V- 9 69.4-70.0 ft: Tmax=22.5 ft-lb/Tr=0.5ft-lb Su=673 psf/15 psf			SS	17	13	WOR/24"	-	-
70	-42.0	V- 10 70.4-71.0 ft: Tmax=25.0 ft-lb/Tr=1.0ft-lb Su=867 psf/30 psf -MARINE CLAY-								
	-45.0	Pushed Shelby Tube from 66 to 68 feet.			U	2	23	PUSH	-	-
75	-47.0									
	-50.0	Very soft, gray silty CLAY			SS	18	4	WOR/24"	-	-
80	-52.0									
	-55.0	No recovery. Yellow catch basket			SS	19	0	WOR/24"	-	-
85	-57.0									

Standard Penetration Test, blows/foot ●

10 20 30 40 50 60 70 80 90

Driller: New England Boring Contractors; Supervisor: NEB: Brad Enos, Stantec: Jason Ward

Rig Type: Track Mounted Mobile Drill B-53; Hammer: Auto Hammer; 4" diam. Drive and Wash, 2" Split Spoon Sampler

△ Unconfined Compression Test

□ Field Vane Test ■ Remolded

✖ Pocket Penetrometer / Torvane

Continued Next Page

Stantec

BOREHOLE LOG

B-1

CLIENT **Maine Turnpike Authority**

LOCATION **Exit 44, Scarborough, ME**

EXPLORATION DATE **4/3/2017 to 4/4/2017**

WATER LEVEL **11 feet b.g.s.**

PROJECT No. **195311370**

EXPLORATION No. **B-1**

DATUM **NAVD 88**

Station 2145+95 ft
Offset 68 ft LT
Mainline Baseline

DEPTH (ft)	ELEVATION (ft)	MATERIAL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY in.	SPT blows / 6"	SPT N-Value	SPT N60-Value
	-60.0	No recovery. 1/2 blue catch basket. Clay is gettting pulled out of spoon			SS	20	0	WOR/24"	-	-
90	-62.0									
	-65.0	Very soft, grey silty CLAY Collected with new blue catch basket			SS	21	24	WOR/24"	-	-
95	-67.0	-MARINE CLAY-								
	-70.0	Very soft, gray silty CLAY			SS	22	18	WOR/24"		-
100	-72.0									
	-75.0	Very soft, gray silty CLAY			SS	23	24	WOR/24"	-	-
105	-77.0									
	-80.0	Very soft, gray silty CLAY								
110										

Standard Penetration Test, blows/foot ●
10 20 30 40 50 60 70 80 90

Driller: New England Boring Contractors; Supervisor: NEB: Brad Enos, Stantec: Jason Ward
Rig Type: Track Mounted Mobile Drill B-53; Hammer: Auto Hammer; 4" diam. Drive and Wash, 2" Split Spoon Sampler

△ Unconfined Compression Test
□ Field Vane Test ■ Remolded
✖ Pocket Penetrometer / Torvane

Continued Next Page

Stantec

BOREHOLE LOG

B-1

CLIENT **Maine Turnpike Authority**

LOCATION **Exit 44, Scarborough, ME**

EXPLORATION DATE **4/3/2017 to 4/4/2017**

WATER LEVEL **11 feet b.g.s.**

PROJECT No. **195311370**

EXPLORATION No. **B-1**

DATUM **NAVD 88**

DEPTH (ft)	ELEVATION (ft)	MATERIAL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (in.)	SAMPLES SPT blows / 6"	SAMPLES SPT N-Value	SPT N60-Value
110					SS	24	24	WOR/24"	-	-
	-82.0	Very stiff, gray silty CLAY, with fine gray sand lenses			SS	25	24	WOR 10 12 12	22	25
	-84.0	-MARINE CLAY-								
115	-87.0	Weathered Rock			SS	26	20	21 53 100/2.5"	R	-
	-88.2	Bottom of boring 117.2 feet below ground surface. Split spoon refusal. 2145+95 68ft LT								
120										
125										
130										

Station 2145+95 ft
Offset 68 ft LT
Mainline Baseline

Standard Penetration Test, blows/foot ●

10 20 30 40 50 60 70 80 90

Driller: New England Boring Contractors; Supervisor: NEB: Brad Enos, Stantec: Jason Ward

Rig Type: Track Mounted Mobile Drill B-53; Hammer: Auto Hammer; 4" diam. Drive and Wash, 2" Split Spoon Sampler

△ Unconfined Compression Test
□ Field Vane Test ■ Remolded
✖ Pocket Penetrometer / Torvane

STN13-GEO-I-VOC SCARBOROUGH EXIT 44 BORING LOGS.GPJ JW NHP.GDT 5/4/17

Stantec

BOREHOLE LOG

B-2

CLIENT **Maine Turnpike Authority**

LOCATION **Exit 44, Scarborough, ME**

EXPLORATION DATE **4/5/2017 to 4/6/2017**

WATER LEVEL **11 feet b.g.s**

PROJECT No. **195311370**

EXPLORATION No. **B-2**

DATUM **NAVD 88**

Station 2149+04 ft
Offset 58 ft LT
Mainline Baseline

DEPTH (ft)	ELEVATION (ft)	MATERIAL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SPT blows / 6"	SPT N-Value	SPT N60-Value
	29.5						in.			
0	29.1	5 Inches of ASPHALT								
	27.5	Medium dense, light brown, medium to fine SAND, moist			SS	1		10 11 10 14	21	24
	25.5	Dense, brown, medium to fine SAND and Silt, some Gravel, moist			SS	2		13 18 25 23	43	49
5	23.5	-EMBANKMENT FILL-								
	21.5	Medium dense, light brown, fine SAND, trace medium and coarse Sand, dry			SS	3		10 12 14 16	26	29
10	19.5			▽						
	15.5	Loose, brown, medium to fine SAND and Silt, wet			SS	4		5 3 4 11	7	8
15	14.5	Medium stiff, gray SILT and fine Sand								
	13.5	-MARINE CLAY-								
	10.5	Medium stiff, gray, SILT and Clay, with medium to fine Sand seams			SS	5		2 2 3 8	5	6
20	8.5									

Standard Penetration Test, blows/foot ●

10 20 30 40 50 60 70 80 90

Driller: New England Boring Contractors; Supervisor: NEB: Brad Enos, Stantec: Jason Ward

Rig Type: Track Mounted Mobile Drill B-53; Hammer: Auto Hammer; 4" diam. Drive and Wash, 2" Split Spoon Sampler

△ Unconfined Compression Test

□ Field Vane Test ■ Remolded

✖ Pocket Penetrometer / Torvane

Continued Next Page

Stantec

BOREHOLE LOG

B-2

CLIENT **Maine Turnpike Authority**

LOCATION **Exit 44, Scarborough, ME**

EXPLORATION DATE **4/5/2017 to 4/6/2017**

WATER LEVEL **11 feet b.g.s**

PROJECT No. **195311370**

EXPLORATION No. **B-2**

DATUM **NAVD 88**

Station 2149+04 ft
Offset 58 ft LT
Mainline Baseline

DEPTH (ft)	ELEVATION (ft)	MATERIAL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY in.	SPT blows / 6"	SPT N-Value	SPT N60-Value
25	5.5	Soft, gray, SILT and Clay			SS	6		WOH 2 2 1	4	5
	3.5									
	0.5	Very soft, gray, silty CLAY			SS	7		WOH/24"	-	-
30	-1.5	-MARINE CLAY-								
	-4.5	Very soft, gray, silty CLAY			SS	8		WOR/24"	-	-
35	-6.5									
	-9.5	Very soft, gray, silty CLAY			SS	9		WOR/24"	-	-
40	-11.5									
	-14.5									

Standard Penetration Test, blows/foot ●

10 20 30 40 50 60 70 80 90

Driller: New England Boring Contractors; Supervisor: NEB: Brad Enos, Stantec: Jason Ward

Rig Type: Track Mounted Mobile Drill B-53; Hammer: Auto Hammer; 4" diam. Drive and Wash, 2" Split Spoon Sampler

△ Unconfined Compression Test

□ Field Vane Test ■ Remolded

✖ Pocket Penetrometer / Torvane

Continued Next Page

Stantec

BOREHOLE LOG

B-2

CLIENT **Maine Turnpike Authority**

LOCATION **Exit 44, Scarborough, ME**

EXPLORATION DATE **4/5/2017 to 4/6/2017**

WATER LEVEL **11 feet b.g.s**

PROJECT No. **195311370**

EXPLORATION No. **B-2**

DATUM **NAVD 88**

Station 2149+04 ft
Offset 58 ft LT
Mainline Baseline

DEPTH (ft)	ELEVATION (ft)	MATERIAL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY in.	SAMPLES SPT blows / 6"	SAMPLES SPT N-Value	SPT N60-Value
45		Very soft, dark gray, silty CLAY			SS	10		WOR/24"	-	-
	-16.5									
	-19.5	Very soft, dark gray CLAY and silt								
50					SS	11		WOR/24"	-	-
	-21.5	-MARINE CLAY-								
	-24.5	Very soft, dark gray, silty CLAY								
55					SS	12		WOR/24"	-	-
	-26.5									
	-29.5	Very soft, dark gray, sitly CLAY								
60					SS	13		WOR/24"	-	-
	-31.5									
	-34.5	Very soft, dark gray, silty CLAY								
65					SS	14		WOR/24"	-	-
	-36.5									

Standard Penetration Test, blows/foot ●

10 20 30 40 50 60 70 80 90

Driller: New England Boring Contractors; Supervisor: NEB: Brad Enos, Stantec: Jason Ward

Rig Type: Track Mounted Mobile Drill B-53; Hammer: Auto Hammer; 4" diam. Drive and Wash, 2" Split Spoon Sampler

△ Unconfined Compression Test

□ Field Vane Test ■ Remolded

✖ Pocket Penetrometer / Torvane

Continued Next Page

Stantec

BOREHOLE LOG

B-2

CLIENT **Maine Turnpike Authority**

LOCATION **Exit 44, Scarborough, ME**

EXPLORATION DATE **4/5/2017 to 4/6/2017**

WATER LEVEL **11 feet b.g.s**

PROJECT No. **195311370**

EXPLORATION No. **B-2**

DATUM **NAVD 88**

Station 2149+04 ft
Offset 58 ft LT
Mainline Baseline

DEPTH (ft)	ELEVATION (ft)	MATERIAL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY in.	SPT blows / 6"	SPT N-Value	SPT N60-Value
	-39.5	Very soft, dark gray, silty CLAY with fine silty seams			SS	15		WOR/24"	-	-
70	-41.5	-MARINE CLAY-								
	-44.5	Very soft, dark gray, silty CLAY, with fine silty Sand seams			SS	16		WOR/24"	-	--
75	-46.5									
	-48.5	Fractured bedrock. Roller cutting hard at 79.5 feet.								
	-50.1	Hard, fresh, dark gray, aphnaitic, PHYLLITE. Joints are moderately dipping, closely spaced, tight to open.			C	1	42			
80		Recovery: 42 inches/88 percent RQD: 11 inches/23 percent								
	-54.1	Hard, fresh, dark gray, aphnaitic, PHYLLITE. Joints are low to moderately dipping, moderately closely spaced, tight to open.			C	2	60			
85		Recovery: 60in (100%) RQD: 60in (100%)								

Standard Penetration Test, blows/foot ●

10 20 30 40 50 60 70 80 90

Driller: New England Boring Contractors; Supervisor: NEB: Brad Enos, Stantec: Jason Ward

Rig Type: Track Mounted Mobile Drill B-53; Hammer: Auto Hammer; 4" diam. Drive and Wash, 2" Split Spoon Sampler

△ Unconfined Compression Test

□ Field Vane Test ■ Remolded

✖ Pocket Penetrometer / Torvane

Continued Next Page

BOREHOLE LOG

B-2

CLIENT **Maine Turnpike Authority**

LOCATION **Exit 44, Scarborough, ME**

EXPLORATION DATE **4/5/2017 to 4/6/2017**

WATER LEVEL **11 feet b.g.s**

PROJECT No. **195311370**

EXPLORATION No. **B-2**

DATUM **NAVD 88**

Station 2149+04 ft
Offset 58 ft LT
Mainline Baseline

DEPTH (ft)	ELEVATION (ft)	MATERIAL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY in.	SPT blows / 6"	SPT N-Value	SPT N60-Value
	-59.1	Bottom of boring at 88.6 feet in bedrock. 2149+04 58 ft LT								

Standard Penetration Test, blows/foot ●

10 20 30 40 50 60 70 80 90

90 95 100 105 110

Driller: New England Boring Contractors; Supervisor: NEB: Brad Enos, Stantec: Jason Ward

Rig Type: Track Mounted Mobile Drill B-53; Hammer: Auto Hammer; 4" diam. Drive and Wash, 2" Split Spoon Sampler

△ Unconfined Compression Test

□ Field Vane Test ■ Remolded

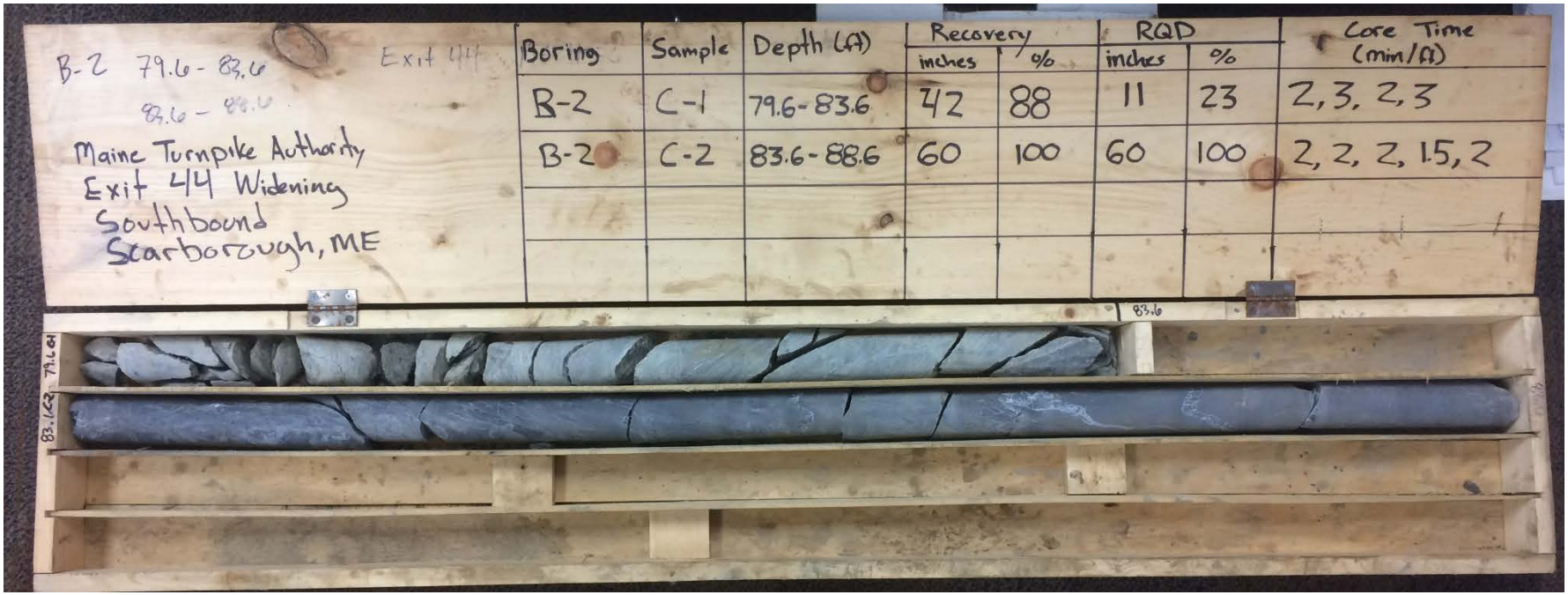
✖ Pocket Penetrometer / Torvane

STN13-GEO-I-VOC SCARBOROUGH EXIT 44 BORING LOGS.GPJ JW NHP.GDT 5/4/17

Appendix B

Rock Core Photo

APPENDIX C
Maine Turnpike Exit 44
Scarborough, ME



B-2, C-1
B-2, C-2

B-2, C-1-

B-2, C-2-

B-2, C-1-

B-2, C-2-

B-2, C-1-

B-2, C-2-

B-2, C-1-

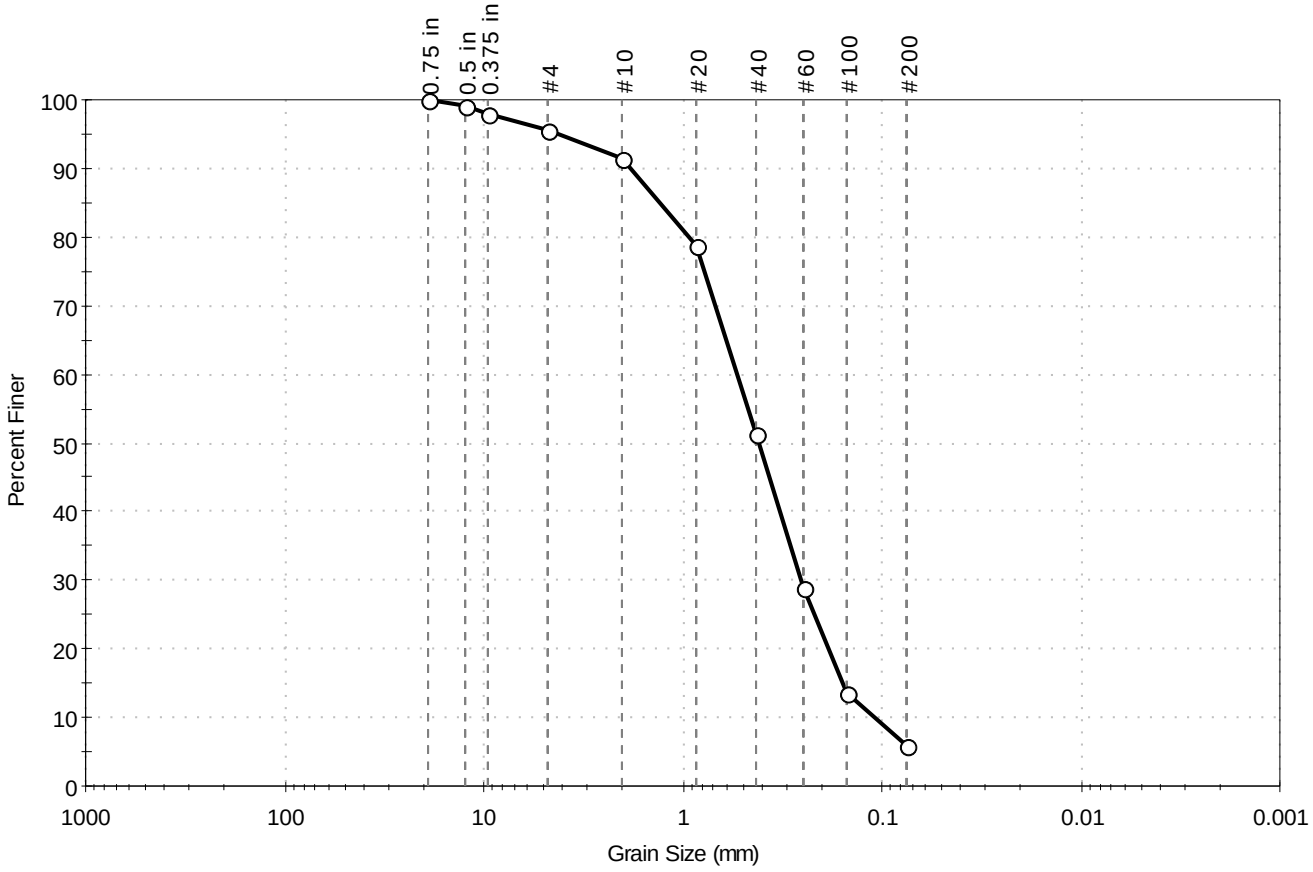
B-2, C-2-

Appendix C

Laboratory Test Results

Client:	Stantec Inc.				
Project:	I-95 Exit 44 Widening				
Location:	Scarborough, ME			Project No:	GTX-306267
Boring ID:	B-1	Sample Type:	jar	Tested By:	jbr
Sample ID:	S-4	Test Date:	04/13/17	Checked By:	emm
Depth :	6-8	Test Id:	408397		
Test Comment:	---				
Visual Description:	Moist, brownish yellow sand with silt				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



%Cobble	%Gravel	%Sand	%Silt & Clay Size
---	4.4	89.6	6.0

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.75 in	19.00	100		
0.5 in	12.50	99		
0.375 in	9.50	98		
#4	4.75	96		
#10	2.00	91		
#20	0.85	79		
#40	0.42	51		
#60	0.25	29		
#100	0.15	14		
#200	0.075	6.0		

Coefficients

D_{85} = 1.2990 mm	D_{30} = 0.2563 mm
D_{60} = 0.5295 mm	D_{15} = 0.1568 mm
D_{50} = 0.4124 mm	D_{10} = 0.1076 mm
C_u = 4.921	C_c = 1.153

Classification

ASTM N/A

AASHTO Fine Sand (A-3 (1))

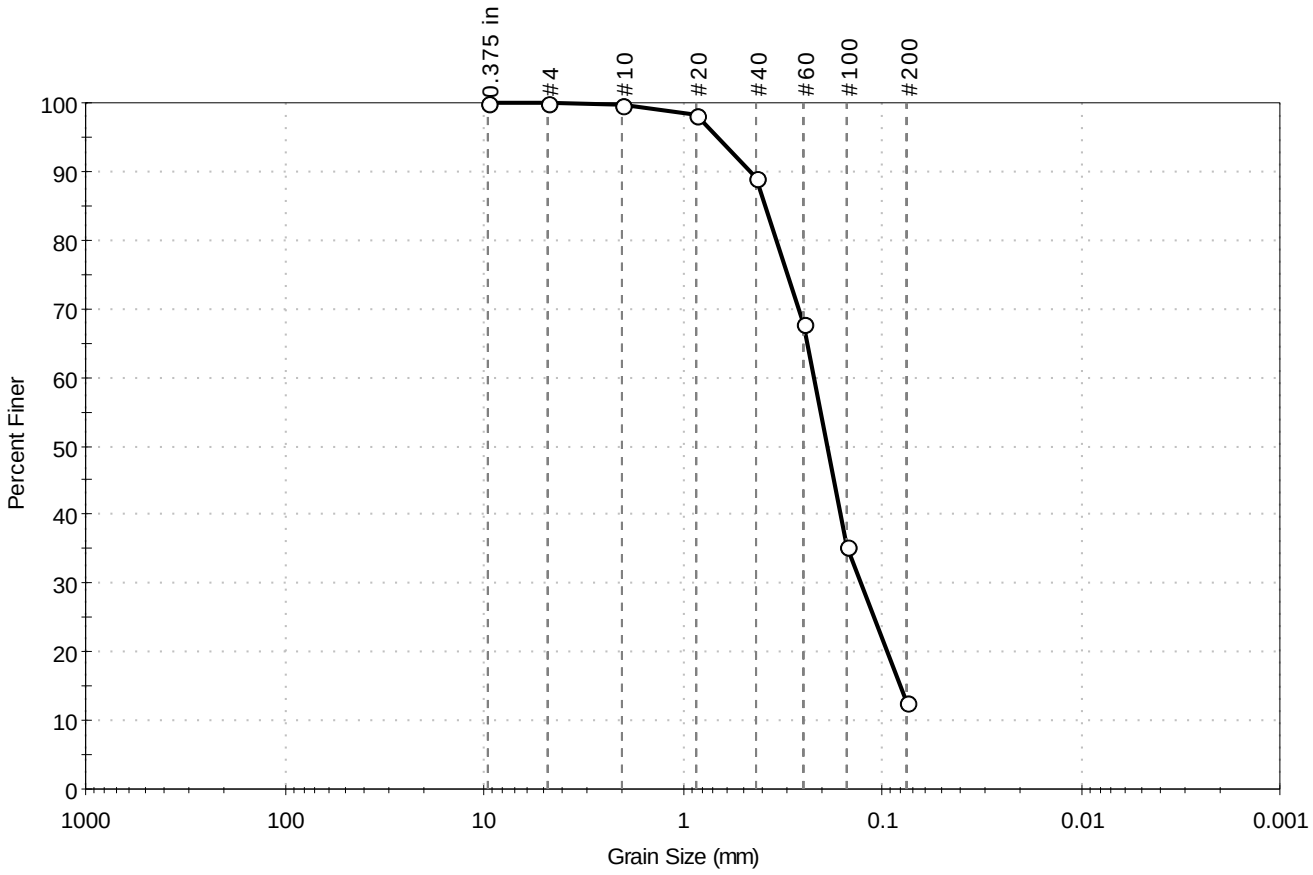
Sample / Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

Client:	Stantec Inc.				
Project:	I-95 Exit 44 Widening				
Location:	Scarborough, ME			Project No:	GTX-306267
Boring ID:	B-1	Sample Type:	jar	Tested By:	jbr
Sample ID:	S-8	Test Date:	04/13/17	Checked By:	emm
Depth :	19-21	Test Id:	408396		
Test Comment:	---				
Visual Description:	Moist, gray silty sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



%Cobble	%Gravel	%Sand	%Silt & Clay Size
---	0.1	87.2	12.7

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.375 in	9.50	100		
#4	4.75	100		
#10	2.00	100		
#20	0.85	98		
#40	0.42	89		
#60	0.25	68		
#100	0.15	35		
#200	0.075	13		

Coefficients

D_{85} = 0.3828 mm	D_{30} = 0.1270 mm
D_{60} = 0.2211 mm	D_{15} = 0.0805 mm
D_{50} = 0.1888 mm	D_{10} = N/A
C_u = N/A	C_c = N/A

Classification

ASTM N/A

AASHTO Silty Gravel and Sand (A-2-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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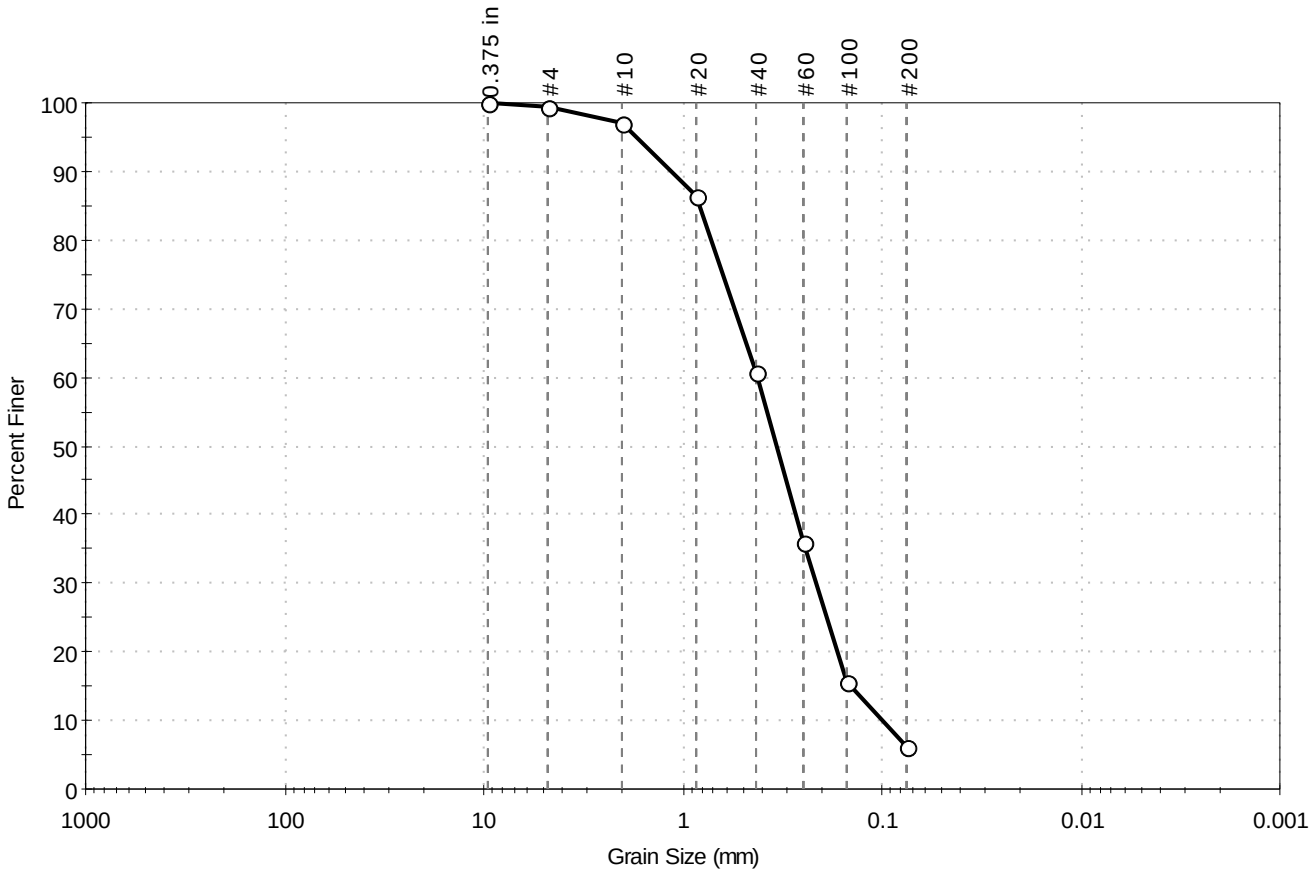
Client:	Stantec Inc.				
Project:	I-95 Exit 44 Widening				
Location:	Scarborough, ME			Project No:	GTX-306267
Boring ID:	B-2	Sample Type:	jar	Tested By:	jbr
Sample ID:	S-3	Test Date:	04/13/17	Checked By:	emm
Depth :	8-10	Test Id:	408395		
Test Comment:	---				
Visual Description:	Moist, light brownish yellow sand with silt				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



%Cobble	%Gravel	%Sand	%Silt & Clay Size
---	0.6	93.2	6.2

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.375 in	9.50	100		
#4	4.75	99		
#10	2.00	97		
#20	0.85	87		
#40	0.42	61		
#60	0.25	36		
#100	0.15	16		
#200	0.075	6.2		

Coefficients

D_{85} = 0.8160 mm	D_{30} = 0.2149 mm
D_{60} = 0.4187 mm	D_{15} = 0.1420 mm
D_{50} = 0.3378 mm	D_{10} = 0.0988 mm
C_u = 4.238	C_c = 1.116

Classification

ASTM N/A

AASHTO Fine Sand (A-3 (1))

Sample / Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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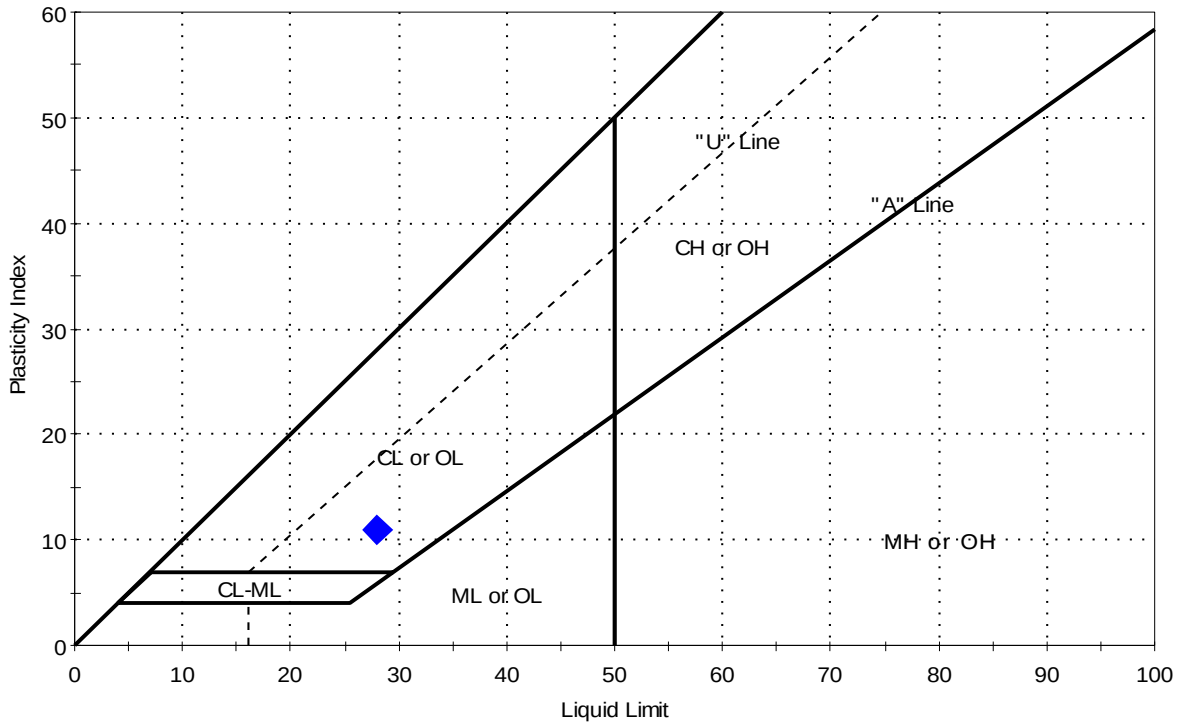
Client:	Stantec Inc.				
Project:	I-95 Exit 44 Widening				
Location:	Scarborough, ME			Project No:	GTX-306267
Boring ID:	B-1	Sample Type:	jar	Tested By:	cam
Sample ID:	S-10	Test Date:	04/14/17	Checked By:	emm
Depth :	29-31	Test Id:	408391		
Test Comment:	---				
Visual Description:	Moist, gray clay				
Sample Comment:	---				

Atterberg Limits - ASTM D4318

Plasticity Chart



Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	S-10	B-1	29-31	26	28	17	11	0.8	

Sample Prepared using the WET method

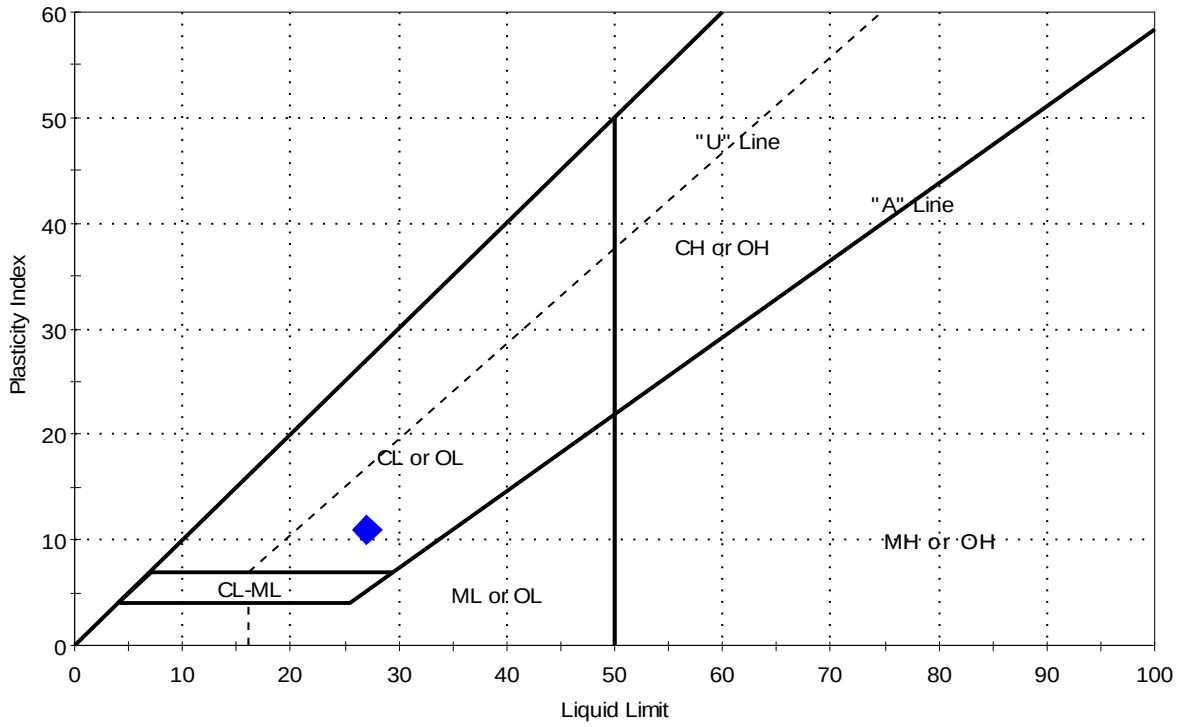
Dry Strength: VERY HIGH

Dilatancy: SLOW

Toughness: LOW

Client:	Stantec Inc.				
Project:	I-95 Exit 44 Widening				
Location:	Scarborough, ME			Project No:	GTX-306267
Boring ID:	B-1	Sample Type:	jar	Tested By:	cam
Sample ID:	S-12	Test Date:	04/14/17	Checked By:	emm
Depth :	39-41	Test Id:	408390		
Test Comment:	---				
Visual Description:	Moist, gray clay				
Sample Comment:	---				

Atterberg Limits - ASTM D4318



Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	S-12	B-1	39-41	28	27	16	11	1.1	

Sample Prepared using the WET method

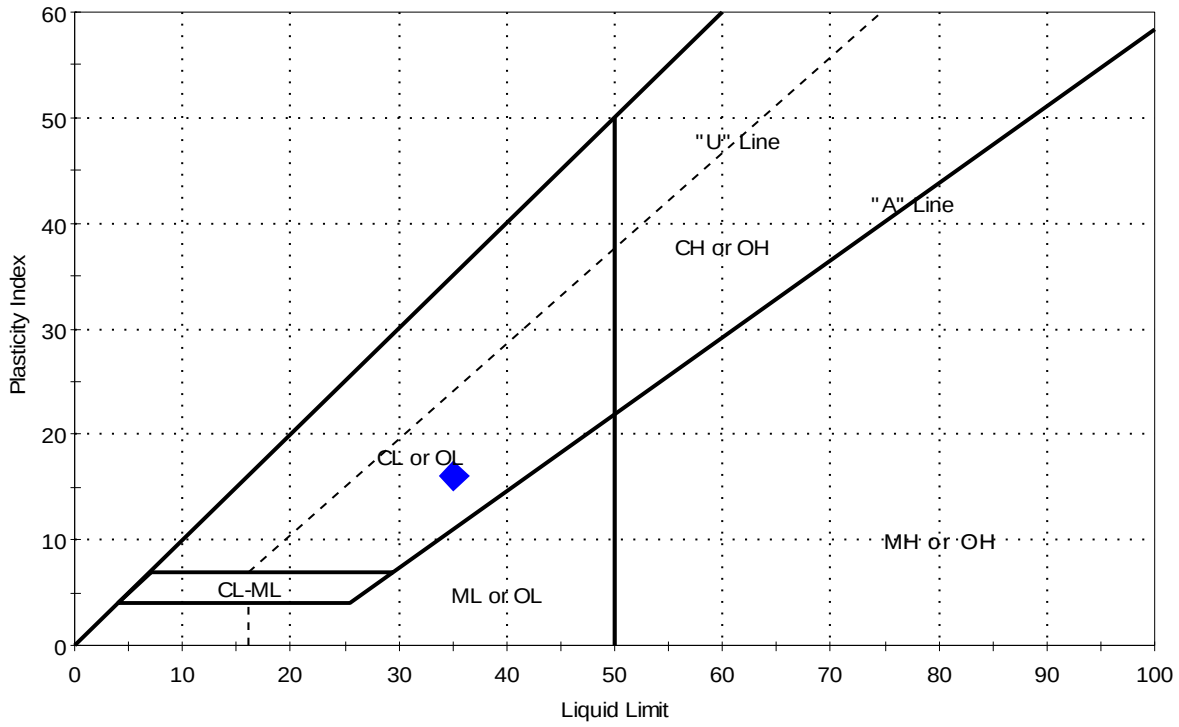
Dry Strength: VERY HIGH

Dilatancy: SLOW

Toughness: LOW

Client:	Stantec Inc.				
Project:	I-95 Exit 44 Widening				
Location:	Scarborough, ME			Project No:	GTX-306267
Boring ID:	B-1	Sample Type:	jar	Tested By:	cam
Sample ID:	S-13	Test Date:	04/13/17	Checked By:	emm
Depth :	49-51	Test Id:	408389		
Test Comment:	---				
Visual Description:	Moist, gray clay				
Sample Comment:	---				

Atterberg Limits - ASTM D4318



Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	S-13	B-1	49-51	38	35	19	16	1.2	

Sample Prepared using the WET method

Dry Strength: VERY HIGH

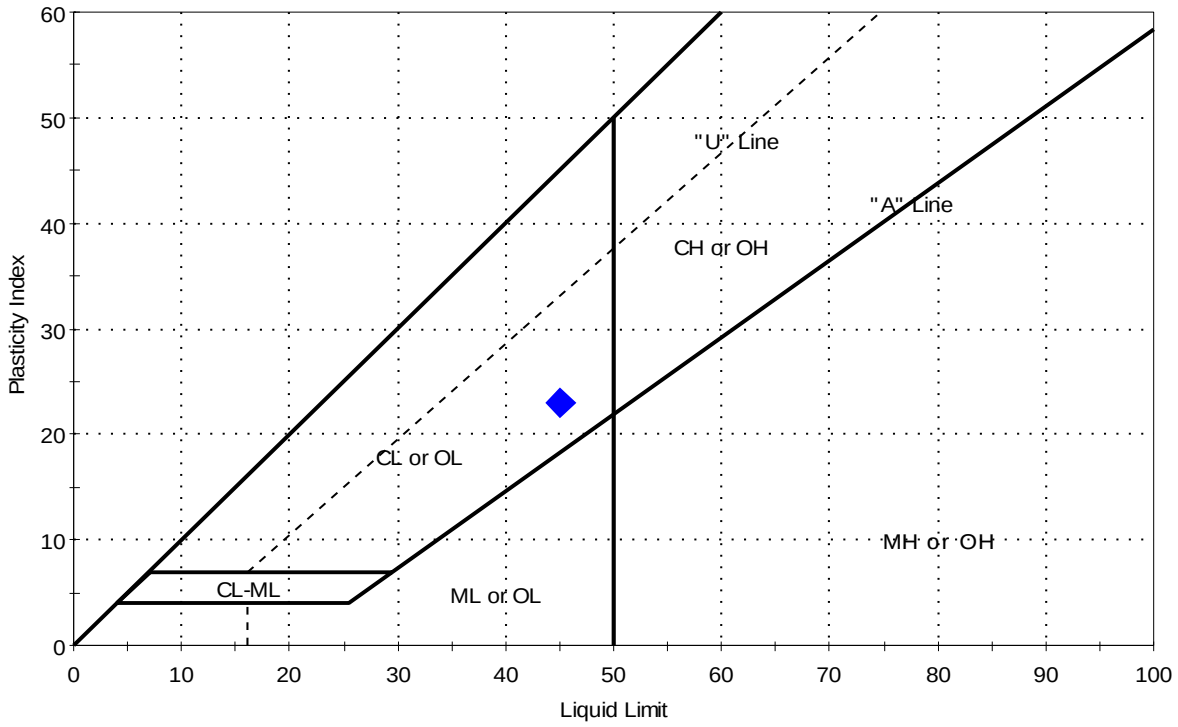
Dilatancy: SLOW

Toughness: LOW

Client:	Stantec Inc.				
Project:	I-95 Exit 44 Widening				
Location:	Scarborough, ME			Project No:	GTX-306267
Boring ID:	B-1	Sample Type:	jar	Tested By:	cam
Sample ID:	S-15	Test Date:	04/14/17	Checked By:	emm
Depth :	59-61	Test Id:	408388		
Test Comment:	---				
Visual Description:	Moist, gray clay				
Sample Comment:	---				

Atterberg Limits - ASTM D4318

Plasticity Chart



Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	S-15	B-1	59-61	48	45	22	23	1.1	

Sample Prepared using the WET method

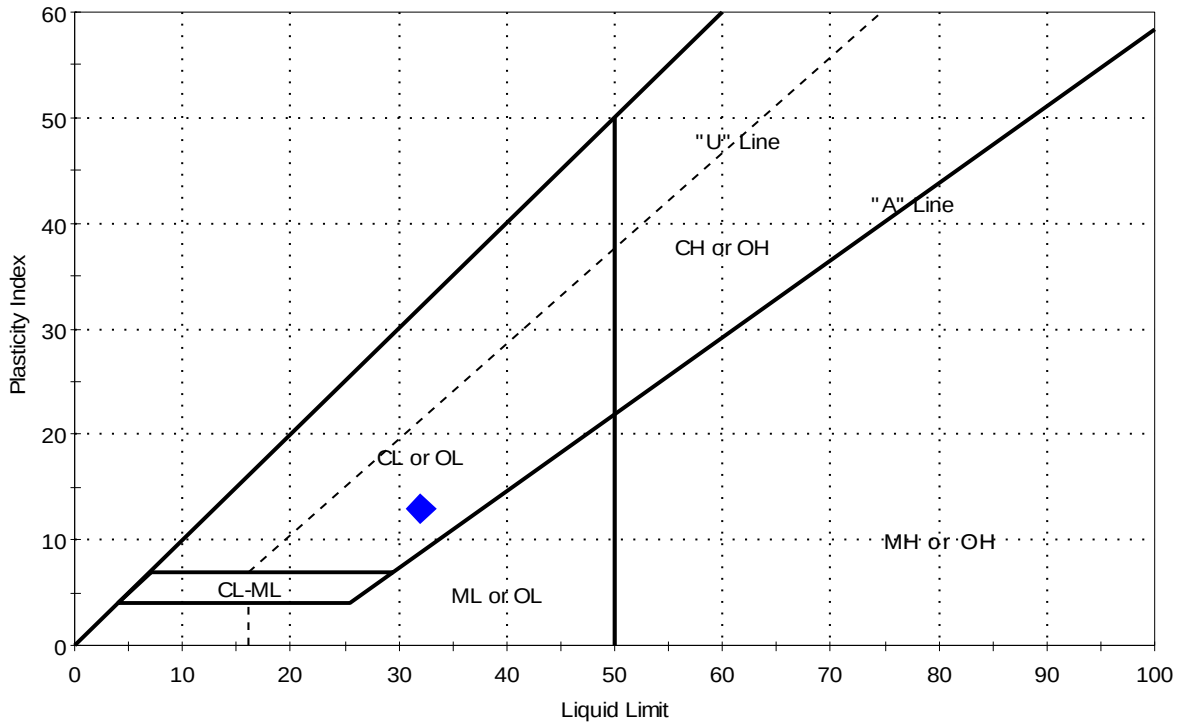
Dry Strength: VERY HIGH

Dilatancy: SLOW

Toughness: LOW

Client:	Stantec Inc.				
Project:	I-95 Exit 44 Widening				
Location:	Scarborough, ME			Project No:	GTX-306267
Boring ID:	B-1	Sample Type:	jar	Tested By:	cam
Sample ID:	S-17	Test Date:	04/14/17	Checked By:	emm
Depth :	69-71	Test Id:	408387		
Test Comment:	---				
Visual Description:	Wet, gray clay				
Sample Comment:	---				

Atterberg Limits - ASTM D4318



Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	S-17	B-1	69-71	43	32	19	13	1.8	

Sample Prepared using the WET method

Dry Strength: VERY HIGH

Dilatancy: SLOW

Toughness: LOW

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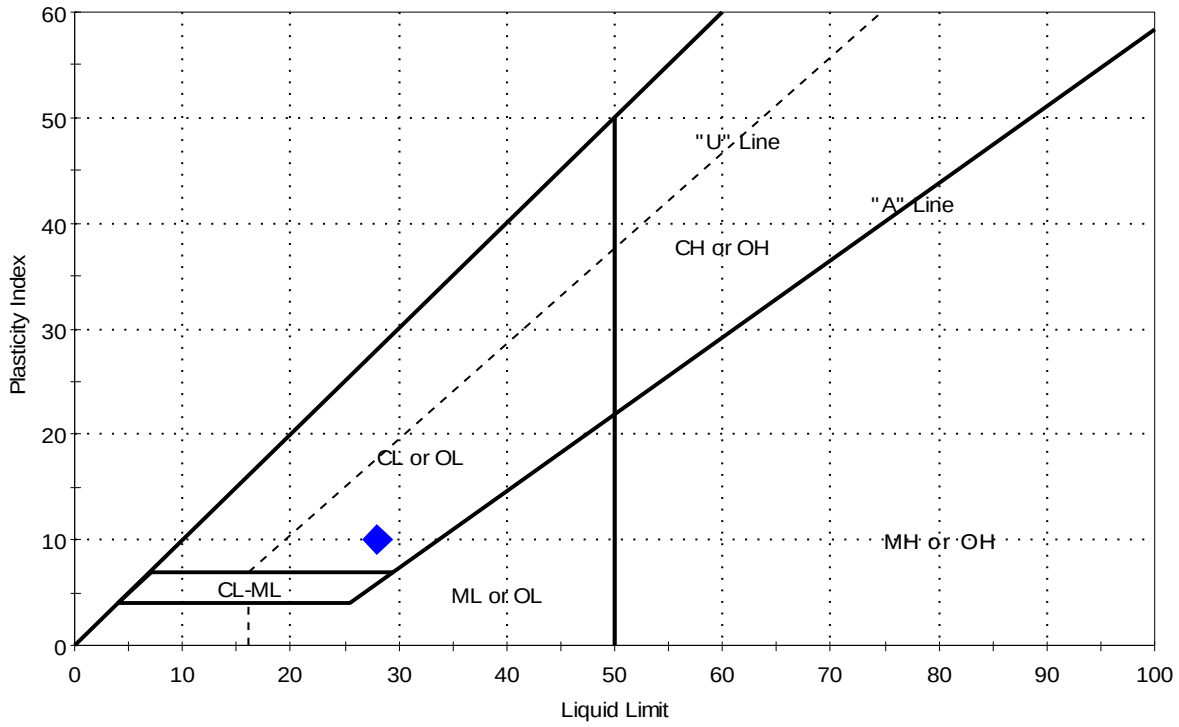
Client:	Stantec Inc.				
Project:	I-95 Exit 44 Widening				
Location:	Scarborough, ME			Project No:	GTX-306267
Boring ID:	B-1	Sample Type:	jar	Tested By:	cam
Sample ID:	S-21	Test Date:	04/14/17	Checked By:	emm
Depth :	94-96	Test Id:	408386		
Test Comment:	---				
Visual Description:	Wet, gray clay				
Sample Comment:	---				

Atterberg Limits - ASTM D4318

Plasticity Chart



Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	S-21	B-1	94-96	35	28	18	10	1.7	

Sample Prepared using the WET method

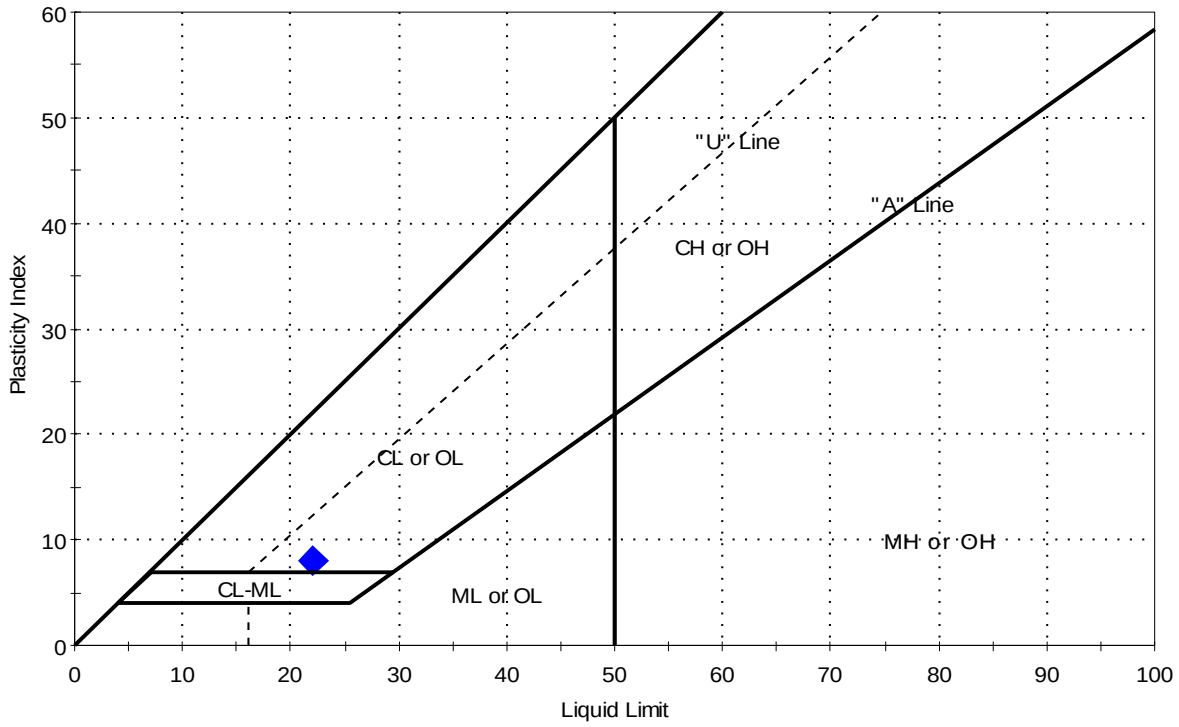
Dry Strength: VERY HIGH

Dilatancy: SLOW

Toughness: LOW

Client:	Stantec Inc.				
Project:	I-95 Exit 44 Widening				
Location:	Scarborough, ME			Project No:	GTX-306267
Boring ID:	B-1	Sample Type:	jar	Tested By:	cam
Sample ID:	S-24	Test Date:	04/14/17	Checked By:	emm
Depth :	109-111	Test Id:	408398		
Test Comment:	---				
Visual Description:	Wet, gray clay				
Sample Comment:	---				

Atterberg Limits - ASTM D4318



Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	S-24	B-1	109-111	31	22	14	8	2.2	

Sample Prepared using the WET method

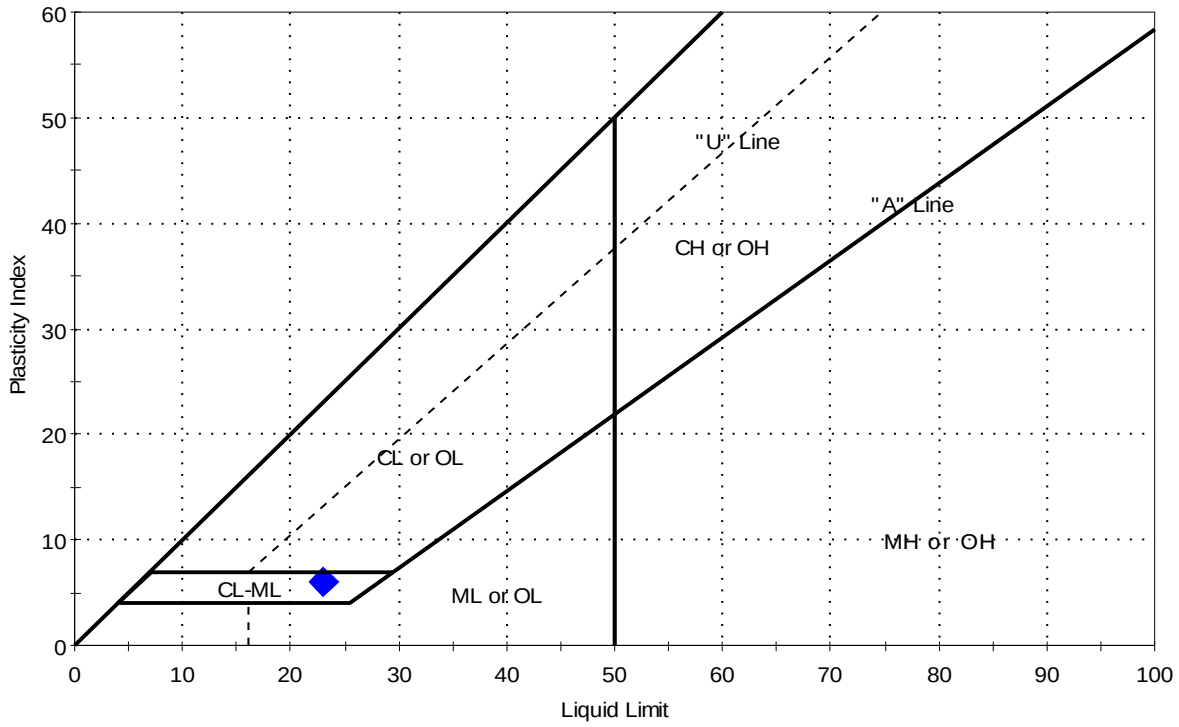
Dry Strength: VERY HIGH

Dilatancy: SLOW

Toughness: LOW

Client:	Stantec Inc.				
Project:	I-95 Exit 44 Widening				
Location:	Scarborough, ME			Project No:	GTX-306267
Boring ID:	B-2	Sample Type:	jar	Tested By:	cam
Sample ID:	S-7	Test Date:	04/14/17	Checked By:	emm
Depth :	29-31	Test Id:	408392		
Test Comment:	---				
Visual Description:	Moist, gray silty clay				
Sample Comment:	---				

Atterberg Limits - ASTM D4318



Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	S-7	B-2	29-31	31	23	17	6	2.4	

Sample Prepared using the WET method

Dry Strength: VERY HIGH

Dilatancy: SLOW

Toughness: LOW

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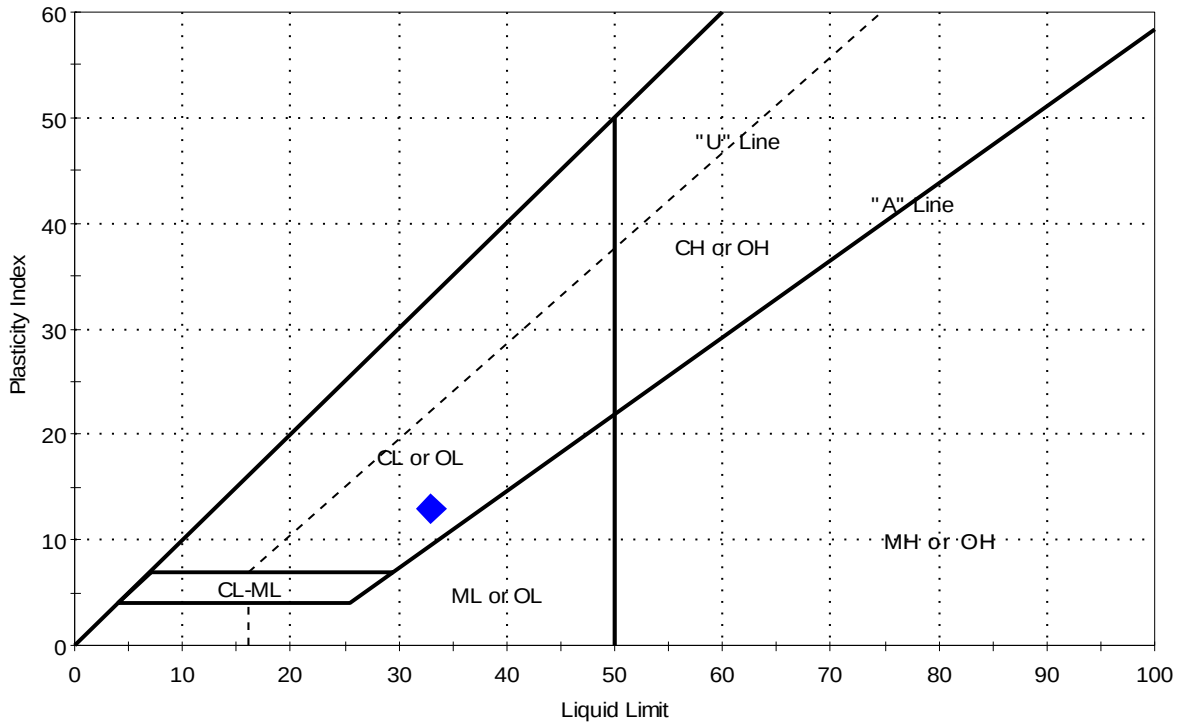
Client:	Stantec Inc.				
Project:	I-95 Exit 44 Widening				
Location:	Scarborough, ME			Project No:	GTX-306267
Boring ID:	B-2	Sample Type:	jar	Tested By:	cam
Sample ID:	S-11	Test Date:	04/17/17	Checked By:	emm
Depth :	49-51	Test Id:	408393		
Test Comment:	---				
Visual Description:	Wet, dark gray clay				
Sample Comment:	---				

Atterberg Limits - ASTM D4318



Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	S-11	B-2	49-51	44	33	20	13	1.8	

Sample Prepared using the WET method

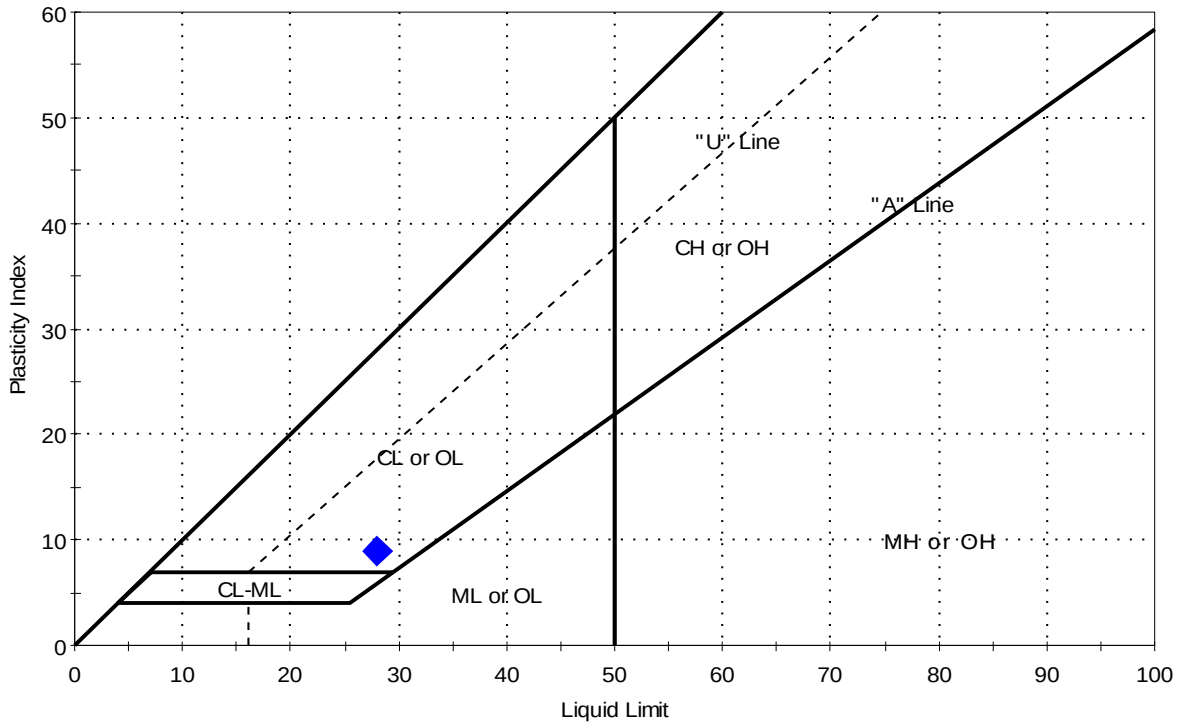
Dry Strength: VERY HIGH

Dilatancy: SLOW

Toughness: LOW

Client:	Stantec Inc.				
Project:	I-95 Exit 44 Widening				
Location:	Scarborough, ME			Project No:	GTX-306267
Boring ID:	B-2	Sample Type:	jar	Tested By:	cam
Sample ID:	S-15	Test Date:	04/17/17	Checked By:	emm
Depth :	69-71	Test Id:	408394		
Test Comment:	---				
Visual Description:	Wet, gray clay				
Sample Comment:	---				

Atterberg Limits - ASTM D4318



Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	S-15	B-2	69-71	37	28	19	9	2	

Sample Prepared using the WET method

Dry Strength: VERY HIGH

Dilatancy: SLOW

Toughness: LOW

Appendix D

Calculations

SOIL STRENGTH PROPERTIES

Stantec

Purpose: Estimate soil parameters for the various soils at the site.

Given: Test Boring Logs B-1 and B-2
Laboratory Test Results
Field Vane shear testing
1999 - SW Cole Report

Existing Embankment Fill

Typical Unit weight = 125 pcf

N_{60} = 6, 18, 27, 28, 14, 20, 24, 49, 29

Ave N_{60} = 24

$\phi = 57 - 27 e^{(-0.014)N} = 34.7°$

Use $\phi = 34°$ ✓ Typical for Compacted granular Fill

Use $c = 0$ psf

Proposed Embankment Fill

Use same as existing Fill

$\gamma_m = 125$ pcf
$\phi = 34°$
$c = 0$ psf

Designed by: Trey Dykstra 4/2017 Checked by: 4/2017

Stantec

Sand Deposit

N_{60} = 19, 20

Ave N_{60} = 20

$\phi = 54 - 27e^{(-0.014\,N)}$

$\phi = 33.5°$

Use $\phi = 30°$ because of high silt content

γ_m = 120 pcf (Typical value)

C = 0 psf (non-cohesive)

Marine Clay - Crust

Drained ϕ: Based on PI = 8 to 16

$\phi = 31°$ to 34°

Figure 5-21 FHWA NHI 06-088

Use $\phi = 30°$

Cohesion = 0 psf

Unit Weight γ_m = 110 pcf (based on prior projects)

Undrained $\phi = 0$

cohesion = 1,000 to 1,200 psf based on field vane shear

γ_m = 110 pcf

Designed by: Trey Dykstra 4/2017 Checked by: 4/2017

Stantec

Marine Clay - Soft

Drained ϕ: Based on PI = 8 to 16

ϕ = 31° to 34°
Figure 5-21 FHWA NHI 06-088
Use ϕ = 30°

Cohesion = 0 psf

Unit weight γ_m = 105 pcf (based on prior projects)

Undrained ϕ = 0

Cohesion = 600 - 800 psf based on field vane shear.

Unit weight γ_m = 105 pcf

Consolidation Data

Use C_c, C_r and e_o from 1999 S.W. Cole Report

Calculate CR and RR

$$CR = \frac{C_c}{1+e_o} \qquad RR = \frac{C_r}{1+e_o}$$

For C_α use 0.01

C_v use 0.10 ft²/day

Designed by: Trey Dykstra 4/2017 Checked by: 4/2017

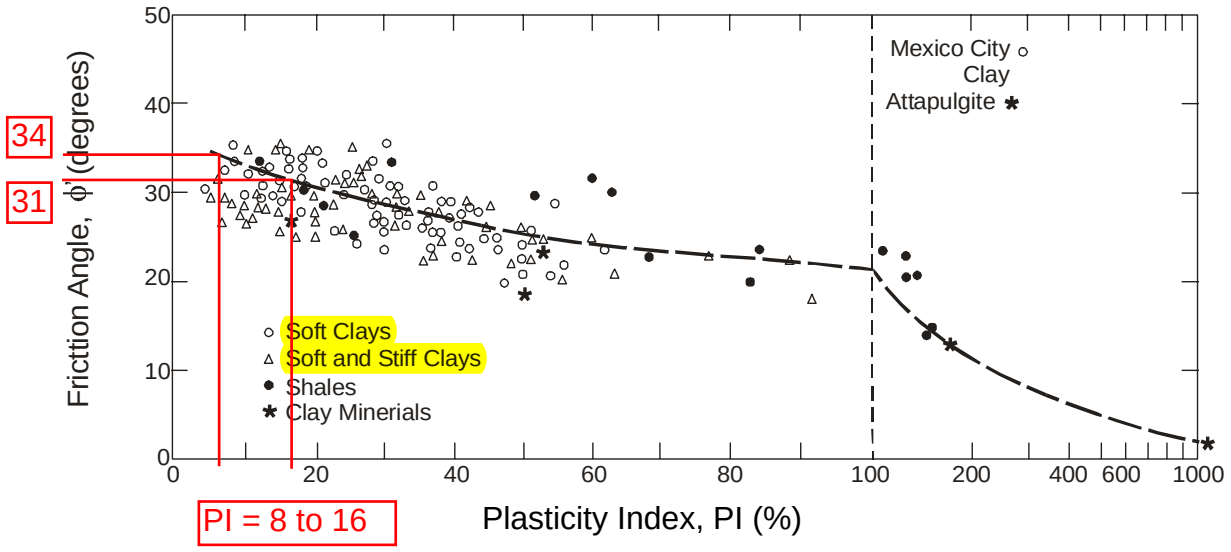


Figure 5-21. Relationships between ϕ and PI. (after Terzaghi, *et al.*, 1996).

5.5.6.3 Shear Strength of Cohesionless Soils

Because of their high permeability, pore water pressures do not build up significantly when cohesionless soils are subjected to shearing forces. The complication of total and effective stresses is therefore avoided and the phenomenon of apparent cohesion, or undrained shear strength does not occur. Consequently, the shear strength of cohesionless soils is defined exclusively in terms of frictional resistance between the grains, as measured by the angle of shearing resistance, ϕ. Typical values of ϕ for sands and gravels are given in Figure 5-22 as a function of dry unit weight and relative density. The material types indicated in the figure relate to the Unified Classification System (USCS).

Figure 5-22 requires determination of relative density. A reasonable estimate of relative density can be obtained from Figure 5-23. Figure 5-23 was originally developed based on data obtained using rope and cathead operated hammers. Thus, it is recommended that an energy corrected SPT N-value, i.e., N_{60}, be used as shown in Figure 5-23. However, note that Figure 5-23 is a function of both N-value and the vertical effective overburden pressure, p_o. Therefore, N_{60}-value should not be corrected for overburden pressure, i.e., C_N=1.0 (see Section 3.7.2) while using Figure 5-23.

Vane Dimensions

D = 2.375 inches

H = 5 inches

PI = 18

Boring	Test	Depth Top	Depth Bottom	Elevation 30	Undisturbed Traw (ft-lb)	Undisturbed Su-fv (psf)	PI	Cor. Factor u_v	Undisturbed Su (psf)	Remolded Traw (ft-lb)	Remolded Su-fv (psf)	Remolded Su (psf)
B-1	V-1	29.4	30	0	41.5	1398	11	0.901	1259	3.5	118	106
	V-2	30.4	31	-1	35.0	1179	11	0.901	1062	5.5	185	167
	V-3	39.4	40	-10	21.0	708	11	0.901	637	3.75	126	114
	V-4	40.4	41	-11	27.5	927	11	0.901	835	6.5	219	197
	V-5	49.4	50	-20	28.5	960	16	0.870	835	3.5	118	106
	V-6	50.4	51	-21	25.0	842	16	0.870	733	2.5	84	76
	V-7	59.4	60	-30	31.5	1061	23	0.834	885	2.1	71	64
	V-8	60.4	61	-31	25.0	842	23	0.834	703	1.5	51	46
	V-9	69.4	70	-40	22.5	758	13	0.888	673	0.5	17	15
	V-10	70.4	71	-41	29.0	977	13	0.888	867	1	34	30

CONSOLIDATION PROPERTIES

EXPLORATIONS AND GEOTECHNICAL ENGINEERING SERVICES
MAINE TURNPIKE WIDENING
NONESUCH RIVER CROSSING (MILE 41.40)
SCARBOROUGH, MAINE

99-264 S SEPTEMBER 21, 1999

TABLE OF CONTENTS

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91 Water St., P. O. Box 220, Caribou, ME 04736 TEL (207) 496-1511 FAX (207) 496-1501
33 Londonderry Rd., #6, Londonderry, NH 03053 TEL (603) 437-9600 FAX (603) 437-9656
RR 3, Box 7230, China Road, Winslow, ME 04901 TEL (207) 873-4283 FAX (207) 873-4977

99-264 S

September 21, 1999

HNTB Corporation
Attention: Mr. Robert Driscoll
233 Oxford Street, Suite 30C
Portland, ME 04101

Subject: Explorations and Geotechnical Engineering Services
Maine Turnpike Widening
Nonesuch River Crossing (Mile 41.40)
Scarborough, Maine

1.0 INTRODUCTION

1.1 Scope of Work

In accordance with our Agreement dated June 23, 1999, we have made a subsurface investigation for widening the Maine Turnpike for the Nonesuch River Crossing in Scarborough, Maine. The purpose of the investigation was to explore the subsurface conditions and provide geotechnical recommendations relative to the proposed construction. The investigation has included the making of two test borings and laboratory testing. The contents herein are subject to the limitations set forth in Attachment A.

In conjunction with the road widening, the existing culvert conveying the river beneath the Maine Turnpike will be lengthened. Based on our conversations with HNTB Corporation, we understand that design at this location has not commenced to date. We understand that you are requesting results from the test boring and laboratory testing work at this time, and our geotechnical evaluation is to follow as project planning progresses. We understand that Test Pit TP41-1, planned over the culvert, will be made at a future date.

2.0 EXPLORATION AND TESTING

2.1 Exploration

Two test borings, designated B41-1 and B41-2, were made at the site during the period June 30 through July 06, 1999 by Great Works Pump and Test Boring, Inc. of Berwick, Maine. The test boring locations were selected by HNTB Corporation. Field survey of the borings was provided by others.

The two borings were made along the toe of the east portion of the Maine Turnpike road embankment, roughly 16 to 17 feet below pavement level. Borings B41-1 and B41-2 were advanced to depths of 105 and 103 feet, respectively. Soil samples were generally obtained at 5-foot intervals using Standard Penetration Testing procedures. Five "undisturbed" Shelby tube samples were obtained in Boring B41-1 for laboratory strength and compressibility testing. Rock core samples were obtained in both borings.

The exploration locations are shown on Sheet 1. Boring logs are attached as Sheets 2 through 7. Rock core logs are attached as Sheets 8 and 9. A key to the notes and symbols used on the logs is attached as Sheet 10.

2.2 Laboratory Testing

Soil and rock core samples were visually examined and classified in our laboratory. Laboratory testing performed on selected samples included three soil gradation tests, five one-dimensional consolidation tests, five Atterberg Limits tests (plasticity), three unconfined soil compressive strength tests, eighteen water content tests, and two rock core compressive strength tests. One consolidation test (B41-1, Sample 4C – see Sheet 15) was apparently influenced by sample disturbance.

Gradation test results are shown on Sheet 11. One-dimensional consolidation test results are shown on Sheets 12 through 16. The remaining test results are presented on the boring logs.

3.0 SUBSURFACE CONDITIONS

3.1 Soils

Materials encountered during the exploration program are fills, sands and silts, silty clays, glacial till and bedrock. Fills consist primarily of loose brown sand (or silty sand) and extend to depths of approximately 5.5 and 10.4 feet at Borings B41-1 and B41-2, respectively.

The fills are underlain by loose gray and gray-brown sands and silts extending to depths of about 11 to 13 feet. In Boring B41-2, these materials grade to a medium dense gray sand with some silt (i.e., on the order of 5 to 12 percent silt) to a depth of approximately 20 feet. The gray sand is underlain by a layer of loose gray silty sand extending to a depth of 23.5 feet.

The sands and silts are underlain by medium consistency gray silty clay containing numerous sand and silt lenses and layers. The gray silty clay extends to depths of 81 and 92 feet in Borings B41-1 and B41-2, respectively.

In Boring B41-1, the silty clay is underlain by glacial till, consisting of dense gray gravelly silty sand with cobbles and boulders. The glacial till was not encountered in Boring B41-2.

Bedrock consists of phyllite, with Rock Quality Designator values varying from 17% to 63%. The bedrock surface is 94.0 and 92.0 at Borings B41-1 and B41-2, respectively, corresponding to elevations –81.2 and –77.7.

For more information relative to the borings, please refer to the attached logs.

3.2 Groundwater

Groundwater was observed in Boring B41-1 at a depth of 3.85 feet one day after completion. Groundwater was observed in Boring B41-2 at a depth of 11.4 feet. We expect that the 3.85 feet level more closely reflected groundwater conditions at the time of the explorations. Groundwater levels will fluctuate seasonally.

4.0 PRELIMINARY EVALUATION

The predominant materials encountered in the two test borings were loose fills overlying loose to medium dense sands and silts which, in turn, overlies medium consistency silty clay. Glacial till and bedrock were encountered well below the ground surface.

The presence of the loose granular materials and underlying silty clay will impact both slope stability and settlements related to embankment construction. Slope stability and the potential for settlements will need to be evaluated as project planning progresses.

The silty clay is compressible and susceptible to consolidation-related settlements. Laboratory consolidation testing data indicate that the silty clay beneath the toe of the existing embankment is over-consolidated (i.e., the silty clay has historically been exposed to stresses greater than the present stresses) to a depth of about 35 feet. A comparison of stresses prior to embankment construction, after embankment construction (near the toe of slope) and maximum past pressures based on laboratory testing is shown on Sheet 17. The data indicate that there is on the order of 1.45 and 1.7 ksf of over-consolidation at depths of about 16 and 26 feet, respectively. Below 35 feet, the silty clay appears to be normally consolidated or has relatively minor amounts of over-consolidation.

Silty clays encountered beneath the toe of the embankment have consolidated under the influence of the existing Maine Turnpike construction. Consolidation under added loads generally strengthens clayey soils. It is likely that silty clays located outside of the existing embankment are softer in consistency, and potentially more compressible (i.e., normally consolidated closer to the ground surface).

5.0 CLOSURE

We look forward to making our geotechnical evaluation of the findings as project planning progresses. In the interim, please do not hesitate to contact us if questions arise or if we may be of further assistance.

Very truly yours,

S. W. COLE ENGINEERING, INC.

Anthony J. Hersh, P.E.

AJH:slh

F:\PROJECTS\1999\99-264 Maine Turnpike\99-264 S Revised Report2 - Nonesuch.doc

STATE OF MAINE
ANTHONY
J.
HERSH
#7675
PROFESSIONAL ENGINEER

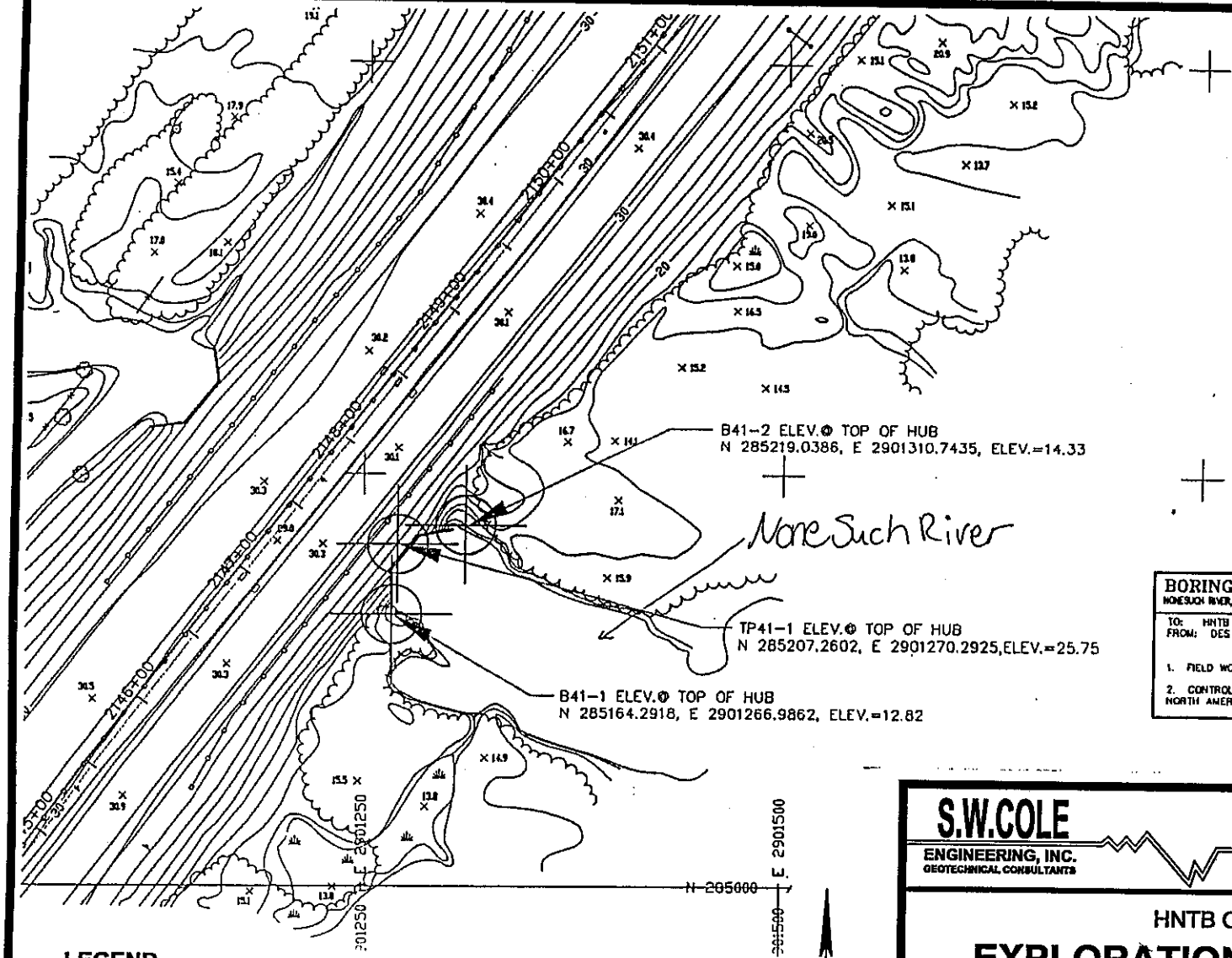
ATTACHMENT A
LIMITATIONS

This report has been prepared for the exclusive use of HNTB Corporation for specific application to the Maine Turnpike Widening at Nonesuch River Crossing (Mile 41.40) in Scarborough, Maine. S. W. COLE ENGINEERING, INC. has endeavored to conduct the work in accordance with generally accepted soil and foundation engineering practices. No other warranty, expressed or implied, is made.

The soil profiles described in the report are intended to convey general trends in subsurface conditions. The boundaries between strata are approximate and are based upon interpretation of exploration data and samples.

Observations have been made during exploration work to assess site groundwater levels. Fluctuations in water levels will occur due to variations in rainfall, temperature, and other factors.

DAR, S. W. Cole Engineering, Inc. 09-16-99 8:03 AM 99-264 NONE SUCH RIVER EXPLORATION LOCATION BASE.dwg



BORING LOCATIONS
NONESUCH RIVER, SCARBOROUGH

TO: HNTB
FROM: DES LAURIERS & ASSOCIATES

1. FIELD WORK WAS CONDUCTED AUGUST 20, 1999.
2. CONTROL BASED ON THE MAINE STATE PLANE COORDINATE SYSTEM AND NORTH AMERICAN VERTICAL DATUM (NAVD 1988) WAS PROVIDED BY HNTB.

LEGEND

⊕ Approximate Test Boring Location

NOTE :
Base map plan provided by
HNTB CORPORATION.

S.W.COLE
ENGINEERING, INC.
GEOTECHNICAL CONSULTANTS

HNTB CORPORATION

EXPLORATION LOCATION PLAN

Proposed Maine Turnpike Widening
Nonesuch River Crossing
Scarborough, Maine

Job No.	99-264 S	Scale	1" = 100'
Date :	09/16/99	Sheet	1

S.W.COLE ENGINEERING, INC.
GEOTECHNICAL CONSULTANTS

BORING LOG

BORING NO.: B-41-1
SHEET: 1 OF 3
PROJECT NO.: 99-264 S
DATE START: 06-30-99
DATE FINISH: 07-01-99
ELEVATION: 12.82'
SWC REP.: TJG

PROJECT / CLIENT: PROPOSED MAINE TURNPIKE WIDENING / HNTB CORPORATION
LOCATION: NONESUCH RIVER SCARBOROUGH, MAINE
DRILLING FIRM: GREAT WORKS TEST BORING INC. DRILLER: JEFF

	TYPE	SIZE I.D.	HAMMER WT	HAMMER FALL
CASING:	HW	4"	300 LB.	24"
SAMPLER:	SS	1 3/8"	140 LB	30"
CORE BARREL:	NQ2			

WATER LEVEL INFORMATION
3.85' ON 7/2/99

CASING BLOWS PER FOOT	SAMPLE NO.	PEN.	REC.	DEPTH @ BOT	SAMPLER BLOWS PER 6" 0-6	6-12	12-18	18-24	DEPTH	STRATA & TEST DATA
PUSH									0.1'	DARK BROWN SAND, TRACE OF SILT WITH ORGANICS
	1D	24"	18"	2.0'	1	4	4	4		BROWN SILTY SAND, TRACE OF ROOTS (FILL)
									5.5'	~ LOOSE ~
	2D	24"	17"	7.0'	WOH	WOH	WOH	WOH		GRAY BROWN SILTY SAND, TRACE OF GRAVEL, ORGANICS
										~ LOOSE ~
									11.0'	
	3D	24"	17"	12.0'	2	2	4	1		GRAY SILTY CLAY WITH SAND AND SILT LAYERS AND LENSES
										~ MEDIUM CONSISTENCY ~
	1C	24"		17.0'						W = 28.6% to 33.1%
										Sv = 0.82/0.08 ksf, Wl= 27.2
										Sv = 0.87/0.15 ksf, Wp = 17.6
	4D	24"	24"	22.0'	WOM	WOM	WOM	WOM		w = 34.6%
	2C	24"		27.0'						qu = 1.2 ksf, W = 31.4% to 33.5%
										Sv = 0.97/0.10 ksf, Wl= 28.6
										Sv = 0.92/0.11 ksf, Wp = 19.6
	5D	24"	24"	32.0'	WOR	WOR	WOR	WOR		w = 35.3%
	3C	24"		37.0'						qu = 0.76 ksf, W = 32.3% to 42.5%
										Sv = 0.81/0.07 ksf, Wl= 34.0
										Sv = 0.77/0.07 ksf, Wp = 19.8

SAMPLES:
D = SPLIT SPOON
C = 3" SHELBY TUBE
U = 3.5" SHELBY TUBE

SOIL CLASSIFIED BY:
[ ] DRILLER - VISUALLY
[X] SOIL TECH. - VISUALLY
[X] LABORATORY TEST

REMARKS:
STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.

BORING NO.: B-41-1

S.W.COLE ENGINEERING, INC.
GEOTECHNICAL CONSULTANTS

BORING LOG

BORING NO.: B-41-1
SHEET: 2 OF 3
PROJECT NO.: 99-264 S
DATE START: 06-30-99
DATE FINISH: 07-01-99
ELEVATION: 12.82'
SWC REP.: TJG

PROJECT / CLIENT: PROPOSED MAINE TURNPIKE WIDENING / HNTB CORPORATION
LOCATION: NONESUCH RIVER SCARBOROUGH, MAINE
DRILLING FIRM: GREAT WORKS TEST BORING INC. DRILLER: JEFF

	TYPE	SIZE I.D.	HAMMER WT	HAMMER FALL
CASING:	HW	4"	300 LB.	24"
SAMPLER:	SS	1 3/8"	140 LB	30"
CORE BARREL:	NQ2			

WATER LEVEL INFORMATION
3.85' ON 7/2/99

CASING BLOWS PER FOOT	SAMPLE NO.	PEN.	REC.	DEPTH @ BOT	SAMPLER BLOWS PER 6" 0-6	6-12	12-18	18-24	DEPTH	STRATA & TEST DATA
PUSH										
	6D	24"	4"	42.0'	WOR	WOR	WOR	WOR		GRAY SILTY CLAY WITH SAND AND SILT LAYERS AND LENSES ~ MEDIUM CONSISTENCY ~
	4C	12"		46.0'						W = 45.6% to 48.2% WI = 36.6 Wp = 18.3 W= 47.7%
	7D	24"	24"	48.0'	WOR	WOR	2	5		Sv = 0.92/0.07 ksf Sv = 1.09/0.05 ksf Sv = 1.02/0.11 ksf
	5C	24"		59.0'						qu = 1.43 ksf Sv = 1.02/0.16 ksf W = 39.8% to 44.1% WI = 30.4 Wp = 22.0 (SHELLS OBSERVED IN WASH WATER AT 60'-65')
	8D	24"	2"	62.0'	WOR	WOR	WOR	WOH		
	9D	24"	24"	67.0'	WOR	WOR	WOR	WOR		W = 39.1%
WOR										
	10D	24"	24"	72.0'	WOR	WOR	WOR	WOR		W = 35.8%
PUSH										
	11D	24"	19"	77.0'	WOR	WOR	WOR	WOR		W = 37.0%

SAMPLES:
D = SPLIT SPOON
C = 3" SHELBY TUBE
U = 3.5" SHELBY TUBE

SOIL CLASSIFIED BY:
[ ] DRILLER - VISUALLY
[X] SOIL TECH. - VISUALLY
[X] LABORATORY TEST

REMARKS: TUBE SAMPLE 4C ENCOUNTERED STIFF LAYER AT 46'

STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.

BORING NO.: B-41-1

S.W.COLE ENGINEERING, INC.
GEOTECHNICAL CONSULTANTS

BORING LOG

BORING NO.: B-41-1
SHEET: 3 OF 3
PROJECT NO.: 99-264 S
DATE START: 06-30-99
DATE FINISH: 07-01-99
ELEVATION: 12.82'
SWC REP.: TJG
WATER LEVEL INFORMATION
3.85' ON 7/2/99

PROJECT / CLIENT: PROPOSED MAINE TURNPIKE WIDENING / HNTB CORPORATION
LOCATION: NONESUCH RIVER SCARBOROUGH, MAINE
DRILLING FIRM: GREAT WORKS TEST BORING INC. DRILLER: JEFF

	TYPE	SIZE I.D.	HAMMER WT	HAMMER FALL
CASING:	HW	4"	300 LB.	24"
SAMPLER:	SS	1 3/8"	140 LB	30"
CORE BARREL:	NQ2			

CASING BLOWS PER FOOT	SAMPLE NO.	PEN.	REC.	DEPTH @ BOT	SAMPLER BLOWS PER 6" 0-6	6-12	12-18	18-24	DEPTH	STRATA & TEST DATA
PUSH									81.0'	GRAY SILTY CLAY WITH SAND AND SILT LAYERS AND LENSES
	12D	24"	24"	82.0'	WOR	WOR	8	7		
47										GRAY GRAVELLY SILTY SAND WITH COBBLES, BOULDER AT 93.0' TO 93.6'+/- (GLACIAL TILL)
75										
	13D	12"	9"	86.0'	47	52				
126										~ DENSE ~
118										
131										
75										
49	14D	24"	11"	92.0'	16	33	29	20		
42/8"										
300/8"									94.0'	
										BEDROCK (DARK GRAY PHYLLITE WITH CALCITE VEINS) ROCK CORE COMPRESSIVE STRENGTH 5230 psi
	1R	60"	58"	100.0'						RQD = 22%
	2R	60"	58.8"	105.0'					105.0'	RQD = 63%
										BOTTOM OF EXPLORATION AT 105.0'

SAMPLES:
D = SPLIT SPOON
C = 3" SHELBY TUBE
U = 3.5" SHELBY TUBE

SOIL CLASSIFIED BY:
[ ] DRILLER - VISUALLY
[X] SOIL TECH. - VISUALLY
[X] LABORATORY TEST

REMARKS:
STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.

BORING NO.: B-41-1

S.W.COLE ENGINEERING, INC.
GEOTECHNICAL CONSULTANTS

BORING LOG

BORING NO.: B-41-2
SHEET: 1 OF 3
PROJECT NO.: 99-264 S
DATE START: 07-02-99
DATE FINISH: 07-06-99
ELEVATION: 14.33'
SWC REP.: TJG

PROJECT / CLIENT: PROPOSED MAINE TURNPIKE WIDENING / HNTB CORPORATION
LOCATION: NONESUCH RIVER SCARBOROUGH, MAINE
DRILLING FIRM: GREAT WORKS TEST BORING INC. DRILLER: JEFF

	TYPE	SIZE I.D.	HAMMER WT	HAMMER FALL
CASING:	HW	4"	300 LB.	24"
SAMPLER:	SS	1 3/8"	140 LB	30"
CORE BARREL:	NQ2			

WATER LEVEL INFORMATION
11.4' AFTER COMPLETION

CASING BLOWS PER FOOT	SAMPLE NO.	PEN.	REC.	DEPTH @ BOT	SAMPLER BLOWS PER 6" 0-6	6-12	12-18	18-24	DEPTH	STRATA & TEST DATA
PUSH									0.5'	BARK MULCH
	1D	24"	11"	2.0'	WOH	1	WOH	1		BROWN SAND, SOME GRAVEL, TRACE OF SILT (FILL) ~ LOOSE ~
	2D	24"	9	7.0'	1	2	1	2	10.4'	
	3D	24"	10"	12.0'	2	2	1	1	13.0'	GRAY SANDY SILT WITH WOOD, ORGANICS ~ LOOSE ~
26	4D	24"	10"	17.0'	5	6	10	11		GRAY SAND, SOME SILT, TRACE OF GRAVEL WITH WOOD, ORGANICS ~ MEDIUM DENSE ~
17										
26										
35									20.0'	
21										
21	5D	24"	10"	22.0'	7	3	2	4	23.5'	GRAY SILTY SAND WITH CLAYEY SILT LAYERS ~ LOOSE ~
20										
18										
18										
PUSH										
	6D	24"	24"	27.0'	WOR	WOM	WOM	WOM		W = 30.3%
										Sv = 1.02/0.13 ksf
										Sv = 0.93/0.14 ksf
										GRAY SILTY CLAY WITH SAND AND SILT LENSES AND LAYERS
	7D	24"	24"	32.0'	WOH	WOH	WOH	WOH		W = 32.0%
										~ MEDIUM CONSISTENCY ~
	8D	24"	24"	37.0'	WOR	WOR	WOM	WOM		W = 31.5%
										Sv = 1.04/0.11 ksf
										Sv > 1.09 ksf

SAMPLES:
D = SPLIT SPOON
C = 3" SHELBY TUBE
U = 3.5" SHELBY TUBE

SOIL CLASSIFIED BY:
[ ] DRILLER - VISUALLY
[X] SOIL TECH. - VISUALLY
[X] LABORATORY TEST

REMARKS:
STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.

BORING NO.: B-41-2

S.W.COLE
ENGINEERING, INC.
GEOTECHNICAL CONSULTANTS

BORING LOG

BORING NO.: B-41-2
SHEET: 2 OF 3
PROJECT NO.: 99-264 S
DATE START: 07-02-99
DATE FINISH: 07-06-99
ELEVATION: 14.33'
SWC REP.: TJG

PROJECT / CLIENT: PROPOSED MAINE TURNPIKE WIDENING / HNTB CORPORATION
LOCATION: NONESUCH RIVER SCARBOROUGH, MAINE
DRILLING FIRM: GREAT WORKS TEST BORING INC. DRILLER: JEFF

	TYPE	SIZE I.D.	HAMMER WT	HAMMER FALL
CASING:	HW	4"	300 LB.	24"
SAMPLER:	SS	1 3/8"	140 LB	30"
CORE BARREL:	NQ2			

WATER LEVEL INFORMATION
11.4' AFTER COMPLETION

CASING BLOWS PER FOOT	SAMPLE NO.	PEN.	REC.	DEPTH @ BOT	SAMPLER BLOWS PER 6" 0-6	6-12	12-18	18-24	DEPTH	STRATA & TEST DATA
PUSH										
	9D	24"	24"	42.0'	WOR	WOR	WOM	WOH		W = 32.3%
										GRAY SILTY CLAY WITH SAND AND SILT LENSES AND LAYERS
										~ MEDIUM CONSISTENCY ~
	10D	24"	24"	47.0'	WOH	WOH	WOH	WOH		Sv = 0.92/0.08 ksf
										Sv > 1.09 ksf
	11D	24"	21"	52.0'	WOR	WOH	WOH	WOH		W = 42.3%
	12D	24"	4"	57.0'	WOR	WOR	WOR	WOR		Sv = 0.97/0.05 ksf
										Sv = 0.98/0.07 ksf
	13D	24"	24"	62.0'	WOR	WOR	WOR	WOR		W = 38.4%
	14D	24"	8"	67.0'	WOR	WOR	WOR	WOR		
	15D	24"	20"	72.0'	WOR	WOR	WOR	WOR		W = 36.3%
	16D	24"	23"	77.0'	WOR	WOR	WOR	WOR		

SAMPLES:
D = SPLIT SPOON
C = 3" SHELBY TUBE
U = 3.5" SHELBY TUBE

SOIL CLASSIFIED BY:
[ ] DRILLER - VISUALLY
[X] SOIL TECH. - VISUALLY
[X] LABORATORY TEST

REMARKS:
STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.

BORING NO.: B-41-2

S.W.COLE
ENGINEERING, INC.
GEOTECHNICAL CONSULTANTS

BORING LOG

BORING NO.: B-41-2
SHEET: 3 OF 3
PROJECT NO.: 99-264 S
DATE START: 07-02-99
DATE FINISH: 07-06-99
ELEVATION: 14.33'
SWC REP.: TJG

PROJECT / CLIENT: PROPOSED MAINE TURNPIKE WIDENING / HNTB CORPORATION
LOCATION: NONESUCH RIVER SCARBOROUGH, MAINE
DRILLING FIRM: GREAT WORKS TEST BORING INC. DRILLER: JEFF

	TYPE	SIZE I.D.	HAMMER WT	HAMMER FALL
CASING:	HW	4"	300 LB.	24"
SAMPLER:	SS	1 3/8"	140 LB	30"
CORE BARREL:	NQ2			

WATER LEVEL INFORMATION
11.4' AFTER COMPLETION

CASING BLOWS PER FOOT	SAMPLE NO.	PEN.	REC.	DEPTH @ BOT	SAMPLER BLOWS PER 6" 0-6	6-12	12-18	18-24	DEPTH	STRATA & TEST DATA
PUSH										
	17D	24"	24"	82.0'	WOR	WOR	WOR	WOR		
										GRAY SILTY CLAY WITH SAND AND SILT LENSES AND LAYERS
37										
29	18D	24"	1"	87.0'	WOR	WOR	WOR	WOR		~ MEDIUM CONSISTENCY ~
28										
30										
30										
33										
28	19D	24"	24"	92.0'	WOR	WOR	WOR	WOR	92.0'	
30/25"										
										BEDROCK (DARK GRAY PHYLLITE WITH CALCITE VEINS) ROCK CORE COMPRESSIVE STRENGTH 2330 psi
	1R	60"	58.8"	98.0'						RQD = 17%
	2R	60"	55.8"	103.0'					103.0'	RQD = 55.8%
										BOTTOM OF EXPLORATION AT 103.0'

SAMPLES:
D = SPLIT SPOON
C = 3" SHELBY TUBE
U = 3.5" SHELBY TUBE

SOIL CLASSIFIED BY:
[ ] DRILLER - VISUALLY
[X] SOIL TECH. - VISUALLY
[X] LABORATORY TEST

REMARKS:
STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.

7

BORING NO.: B-41-2

S.W.COLE
ENGINEERING, INC.
GEOTECHNICAL CONSULTANTS

PROJECT NUMBER 99-264

ROCK CORE LOG

PROJECT NAME/LOCATION Flag Pond Rd - Saco
Maine Turnpike

BORING NUMBER B41-1
CORE SIZE NQ2 SHEET 1 OF 1

LOGGED BY MGJ DATE 7/22/99
CHECKED BY DATE

DEPTH BELOW SURFACE (Ft.)	CORE RUN	CORE INTERVAL (In.)	CORE RECOVERY (In.)	RQD (%)	ROCK QUALITY	GRAPHIC LOG	ROCK DESCRIPTION AND IDENTIFICATION
						94.0	Top of Bedrock not observed
95.0	R1	60"	58"	13.44/60 22%	very poor		dark gray phyllite containing 5% calcite veins, tr. sulfide minerals (pyrite) - laminated foliation, fresh weathering, moderately soft, joint angles @ 30°, 50°
100.0	R2	60"	58.8"	37.8/60 63%	fair		same as above
105.0							not recovered
							bottom of exploration @ 105.0' depth below surface

S.W.COLE
ENGINEERING, INC.
GEOTECHNICAL CONSULTANTS

PROJECT NUMBER 99-264

ROCK CORE LOG

PROJECT NAME/LOCATION Flag Pond Road - Saco Maine Turnpike
BORING NUMBER B41-2
CORE SIZE NQ2 SHEET 1 OF 1
LOGGED BY MGJ DATE 7/22/99
CHECKED BY _____ DATE _____

DEPTH BELOW SURFACE (Ft.)	CORE RUN	CORE INTERVAL (In.)	CORE RECOVERY (In.)	RQD (%)	ROCK QUALITY	GRAPHIC LOG	ROCK DESCRIPTION AND IDENTIFICATION
92.0'							top of bedrock
93.0'							not observed
	R1	60"	58.8	10.2/60.0 = 17%	Very Poor		dark gray phyllite with calcite veins @ 5± and trace sulfide minerals - laminated foliation, fresh weathering, moderately soft, joint angles @ 40, 50, 60°
98.0'							
	R2	6.0"	55.8	30/60 = 50%	Poor/Fair		
103.0'							bottom of exploration at 103.0' depth

KEY TO THE NOTES & SYMBOLS
Test Boring and Test Pit Explorations

All stratification lines represent the approximate boundary between soil types and the transition may be gradual.

Key to Symbols Used:

w	-	water content, percent (dry weight basis)
q_u	-	unconfined compressive strength, kips/sq. ft. - based on laboratory unconfined compressive test
S_v	-	field vane shear strength, kips/sq. ft.
L_v	-	lab vane shear strength, kips/sq. ft.
q_p	-	unconfined compressive strength, kips/sq. ft. based on pocket penetrometer test
O	-	organic content, percent (dry weight basis)
W_L	-	liquid limit - Atterberg test
W_P	-	plastic limit - Atterberg test
WOH	-	advance by weight of hammer
WOM	-	advance by weight of man
WOR	-	advance by weight of rods
HYD	-	advance by force of hydraulic piston on drill
RQD	-	Rock Quality Designator - an index of the quality of a rock mass. RQD is computed from recovered core samples.
γ_T	-	total soil weight
γ_B	-	buoyant soil weight

Description of Proportions:

0 to 5% TRACE
5 to 12% SOME
12 to 35% "Y"
35+% AND

REFUSAL: **Test Boring Explorations** - Refusal depth indicates that depth at which, in the drill foreman's opinion, sufficient resistance to the advance of the casing, auger, probe rod or sampler was encountered to render further advance impossible or impracticable by the procedures and equipment being used.

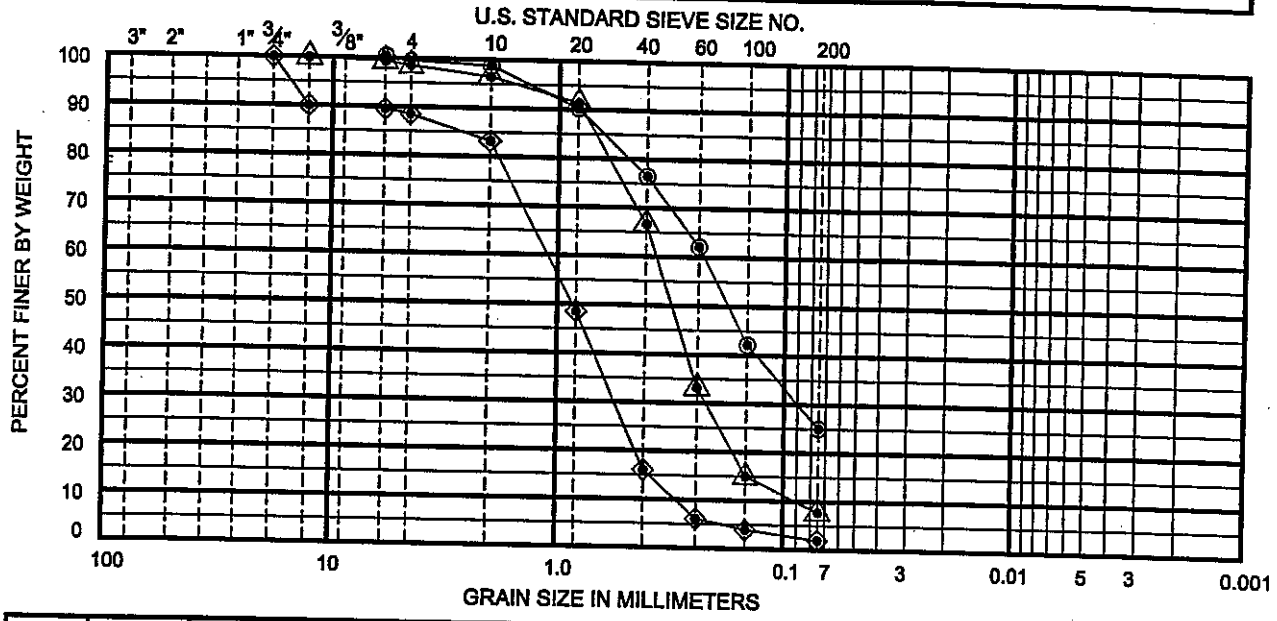
REFUSAL: **Test Pit Explorations** - Refusal depth indicates that depth at which sufficient resistance to the advance of the backhoe bucket was encountered to render further advance impossible or impracticable by the procedures and equipment being used.

Although refusal may indicate the encountering of the bedrock surface, it may indicate the striking of large cobbles, boulders, very dense or cemented soil, or other buried natural or man-made objects or it may indicate the encountering of a harder zone after penetrating a considerable depth through a weathered or disintegrated zone of the bedrock.

JOB NO. 99-264 S

GRAIN SIZE ANALYSIS

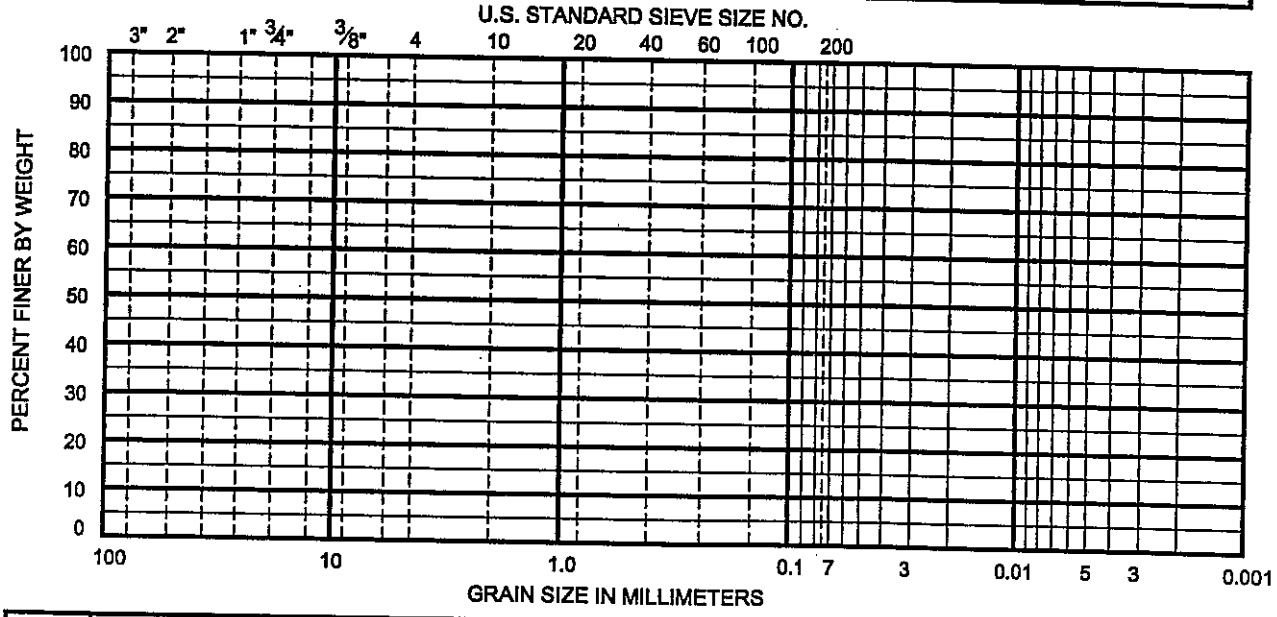
COBBLE	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COA.	MEDIUM	FINE	



PLOT	SOURCE	SAMP.	DEPTH	CLASSIFICATION	W %
◉	B41-1	2D	5'-7'	SILTY SAND, TRACE OF GRAVEL	
◈	B41-2	2D	5'-7'	SAND, SOME GRAVEL, TRACE OF SILT	
△	B41-2	4D	15'-17'	SAND, SOME SILT, TRACE OF GRAVEL	

GRAIN SIZE ANALYSIS

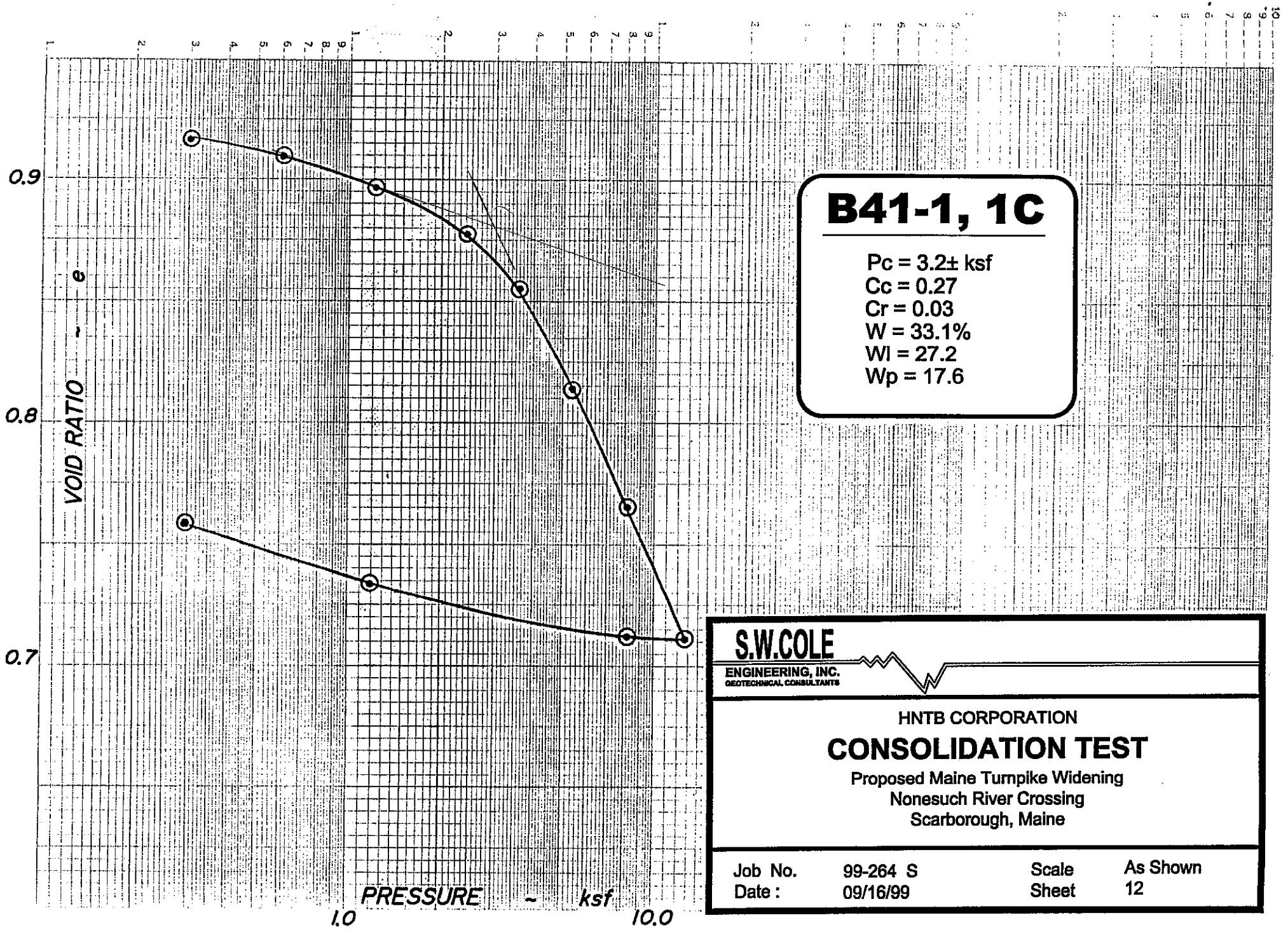
COBBLE	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COA.	MEDIUM	FINE	



PLOT	SOURCE	SAMP.	DEPTH	CLASSIFICATION	W %

99-264 GS nonesuch river.dwg
09-16-99 12:32 PM
DAR, S. W. Cole Engineering, Inc.

46 6013



B41-1, 1C

Pc = 3.2± ksf
Cc = 0.27
Cr = 0.03
W = 33.1%
Wl = 27.2
Wp = 17.6

S.W.COLE
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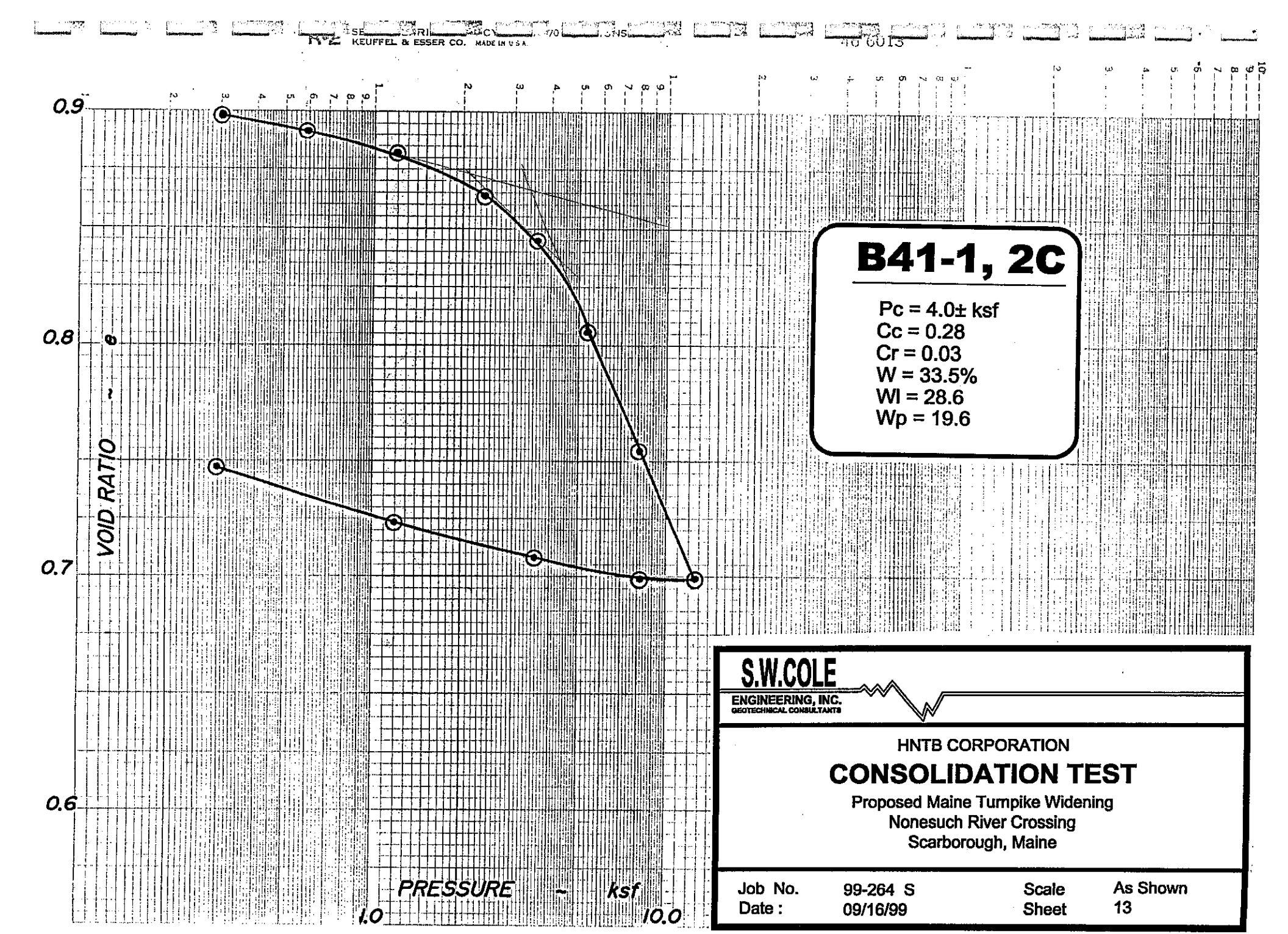
GEOTECHNICAL CONSULTANTS

HNTB CORPORATION

CONSOLIDATION TEST

Proposed Maine Turnpike Widening
Nonesuch River Crossing
Scarborough, Maine

Job No.	99-264 S	Scale	As Shown
Date :	09/16/99	Sheet	12



S.W.COLE
ENGINEERING, INC.
GEOTECHNICAL CONSULTANTS

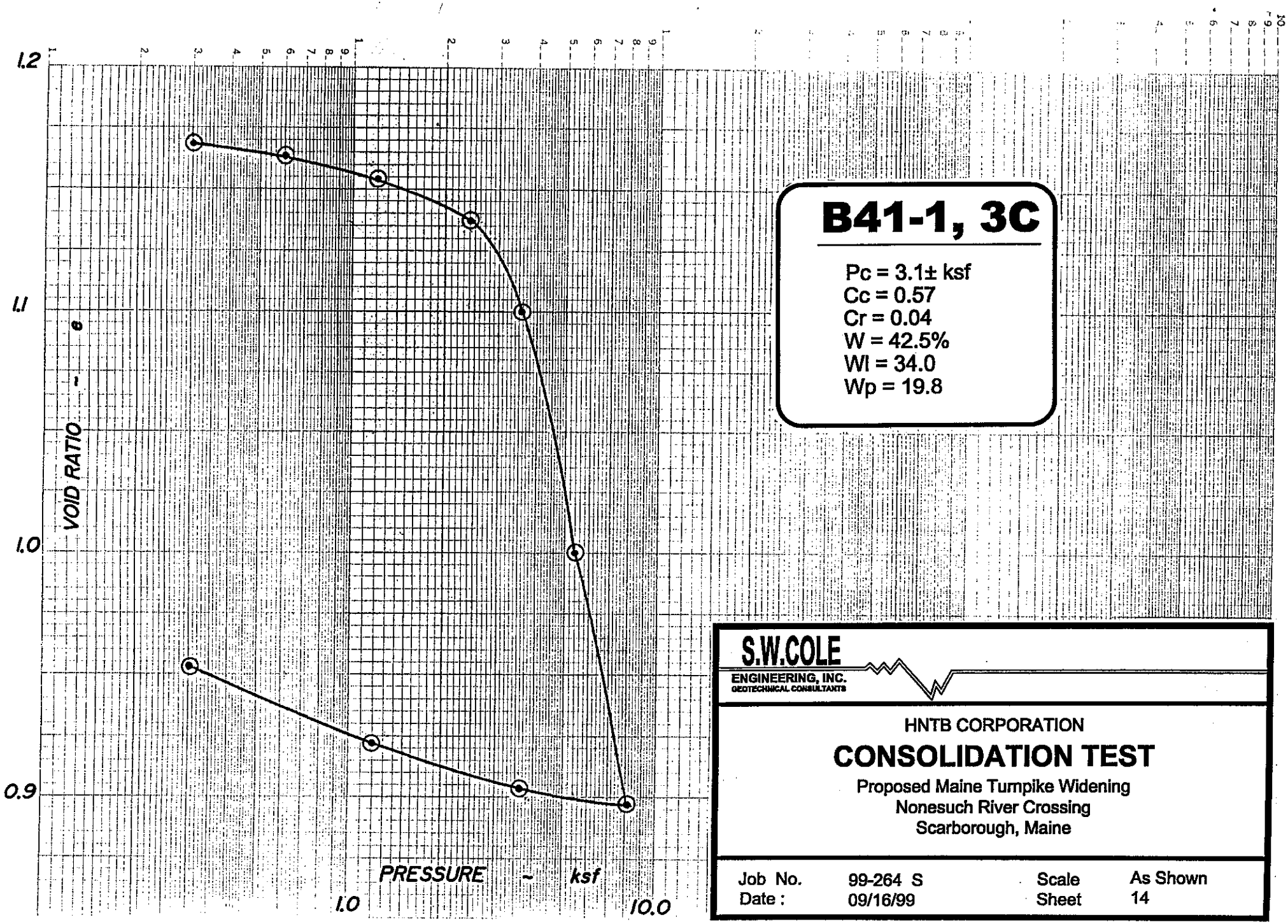
HNTB CORPORATION

CONSOLIDATION TEST

Proposed Maine Turnpike Widening
Nonesuch River Crossing
Scarborough, Maine

Job No.	99-264 S	Scale	As Shown
Date :	09/16/99	Sheet	13

46 6013



B41-1, 3C

Pc = 3.1± ksf
Cc = 0.57
Cr = 0.04
W = 42.5%
Wl = 34.0
Wp = 19.8

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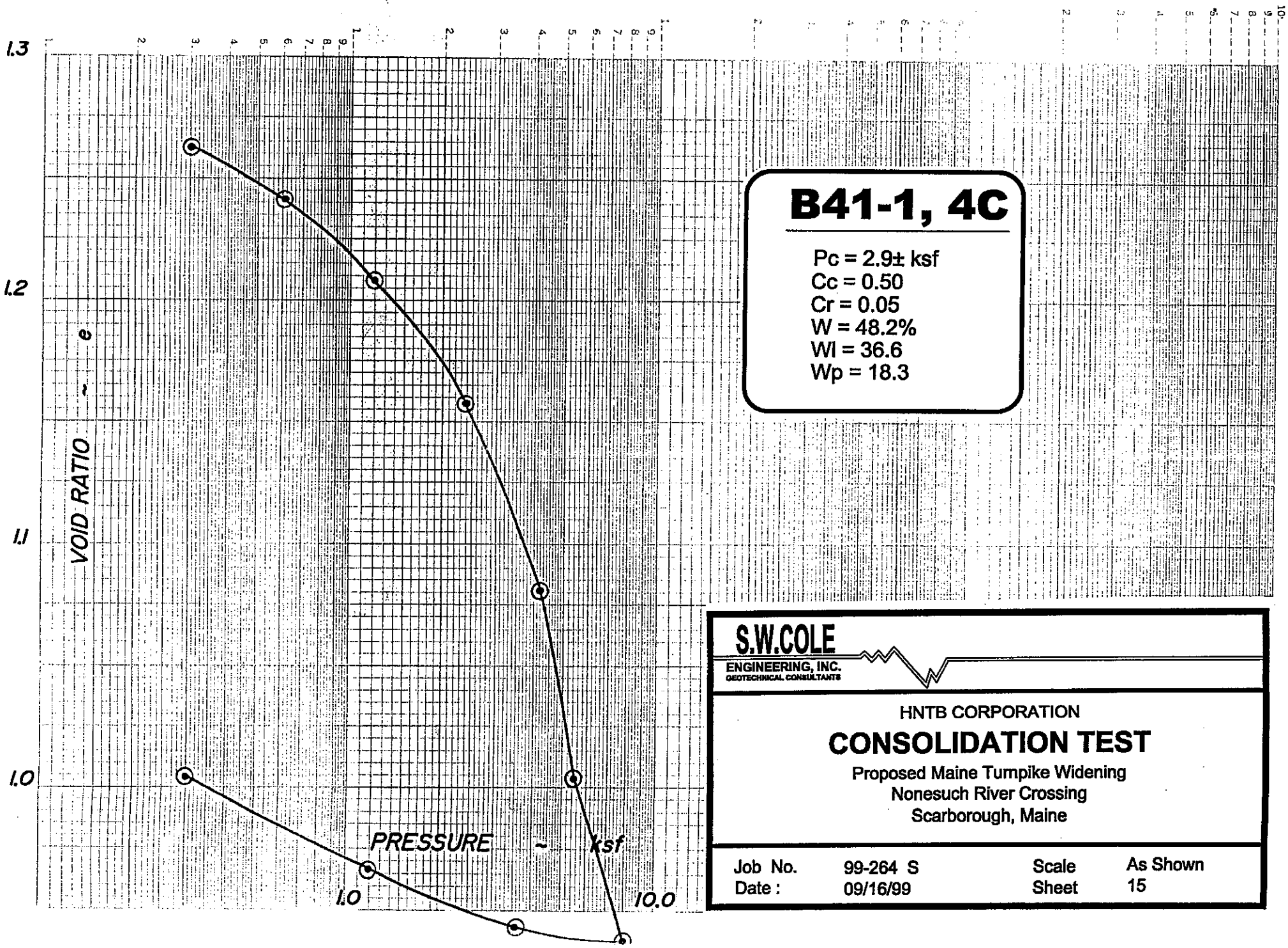
HNTB CORPORATION

CONSOLIDATION TEST

Proposed Maine Turnpike Widening
Nonesuch River Crossing
Scarborough, Maine

Job No.	99-264 S	Scale	As Shown
Date :	09/16/99	Sheet	14



B41-1, 4C

Pc = 2.9± ksf
Cc = 0.50
Cr = 0.05
W = 48.2%
Wl = 36.6
Wp = 18.3

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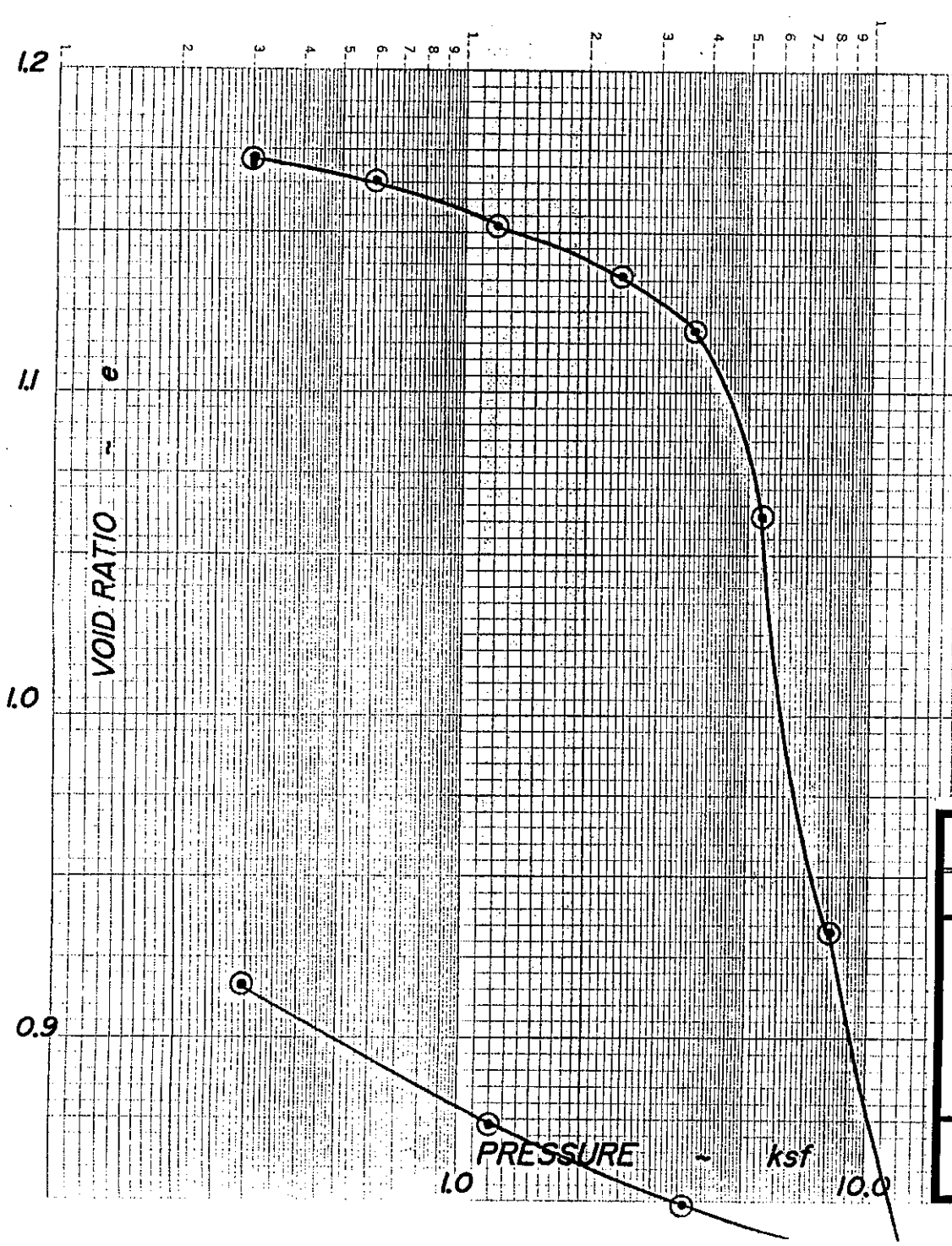
HNTB CORPORATION

CONSOLIDATION TEST

Proposed Maine Turnpike Widening
Nonesuch River Crossing
Scarborough, Maine

Job No.	99-264 S	Scale	As Shown
Date :	09/16/99	Sheet	15

46 6013



B41-1, 5C

Pc = 4.3± ksf
Cc = 0.60
Cr = 0.04
W = 44.1%
Wl = 30.4
Wp = 22.0

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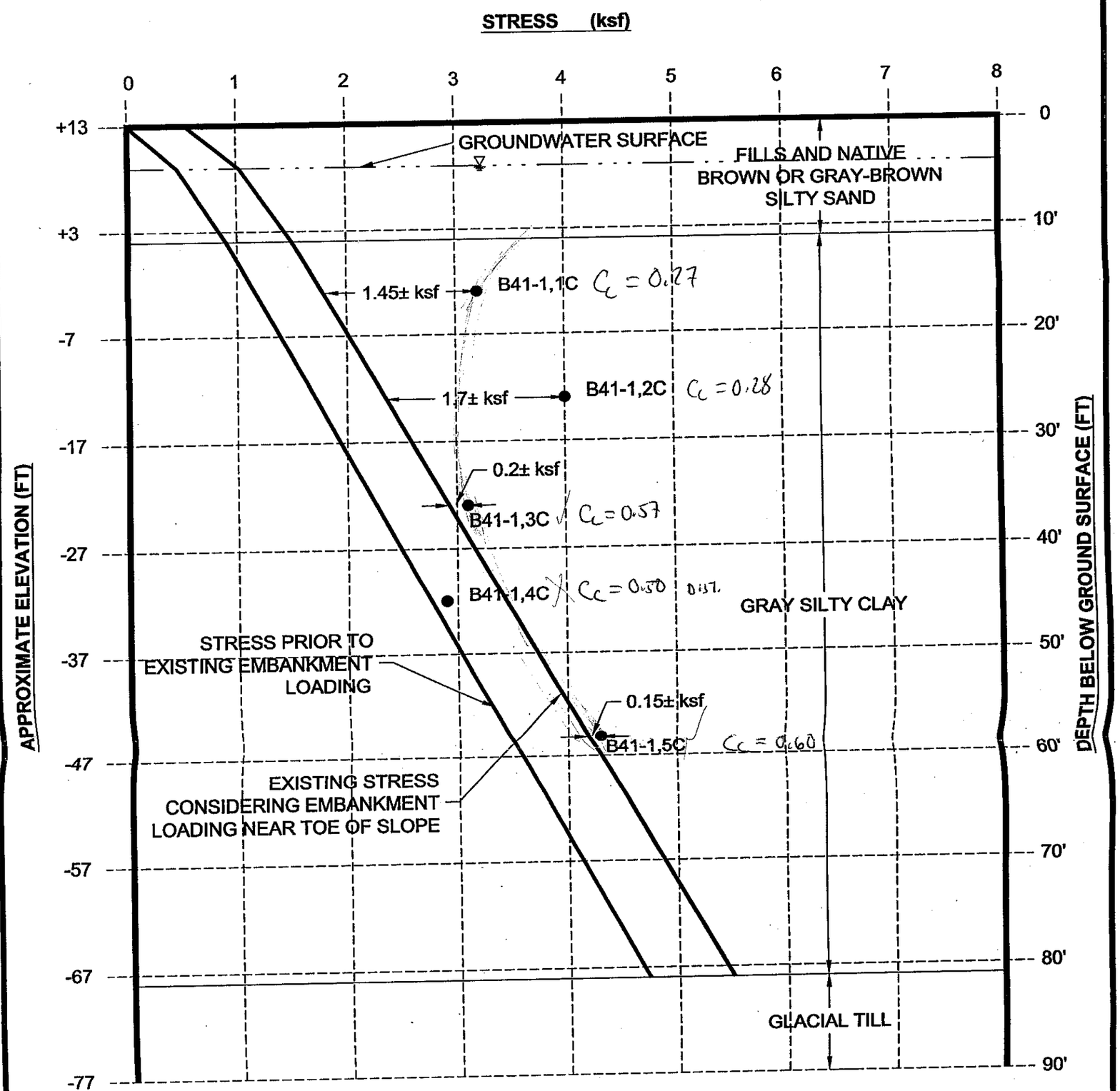
GEOTECHNICAL CONSULTANTS

HNTB CORPORATION

CONSOLIDATION TEST

Proposed Maine Turnpike Widening
Nonesuch River Crossing
Scarborough, Maine

Job No.	99-264 S	Scale	As Shown
Date :	09/16/99	Sheet	16



LEGEND

- ● Maximum past pressure based on laboratory testing for samples obtained in B41-1

NOTE :

1.) Sample 4C appeared to be influenced by sample disturbance.

S.W.COLE ENGINEERING, INC. GEOTECHNICAL CONSULTANTS

HNTB CORPORATION

STRESS DISTRIBUTION

Proposed Maine Turnpike Widening
Nonesuch River Crossing
Scarborough, Maine

Job No.	99-264 S	Scale	As Shown
Date :	09/21/99	Sheet	17

STABILITY ANALYSIS

Maine Turnpike: Exit 44 Widening
Scarborough, ME

Station 2146+00
Slope Stability Analysis: Drained Condition

Name: Proposed Embankment Fill
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 0 psf
Phi': 34 °

Traffic Surcharge = 250 psf

1.64

Propose… …kment Fill

Existing Roadway Fill

Name: Existing Roadway Fill
Unit Weight: 125 pcf
Cohesion': 0 psf
Phi': 34 °

Sand

Name: Sand
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 30 °

Marine Clay - Crust (drained)

Name: Marine Clay - Crust (drained)
Unit Weight: 110 pcf
Cohesion': 0 psf
Phi': 30 °

Marine Clay - Soft (drained)

Name: Marine Clay - Soft (drained)
Unit Weight: 105 pcf
Cohesion': 0 psf
Phi': 30 °

Bedrock

Elevation - feet

40 35 30 25 20 15 10 5 0 -5 -10 -15 -20 -25 -30 -35 -40 -45 -50 -55 -60 -65 -70 -75 -80 -85 -90

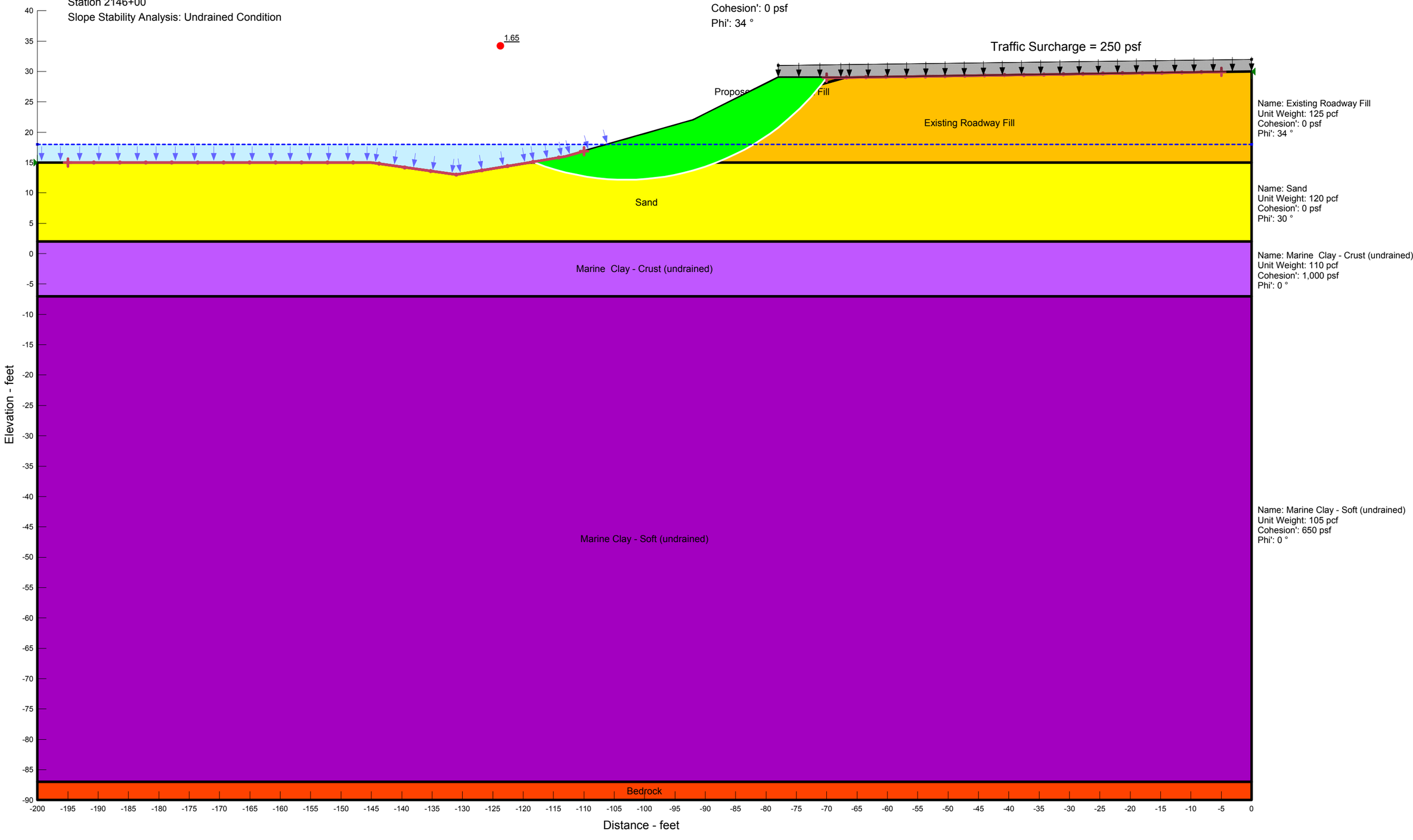
-200 -195 -190 -185 -180 -175 -170 -165 -160 -155 -150 -145 -140 -135 -130 -125 -120 -115 -110 -105 -100 -95 -90 -85 -80 -75 -70 -65 -60 -55 -50 -45 -40 -35 -30 -25 -20 -15 -10 -5 0

Distance - feet

Maine Turnpike: Exit 44 Widening
Scarborough, ME

Station 2146+00
Slope Stability Analysis: Undrained Condition

Name: Proposed Embankment Fill
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 0 psf
Phi': 34 °



Name: Existing Roadway Fill
Unit Weight: 125 pcf
Cohesion': 0 psf
Phi': 34 °

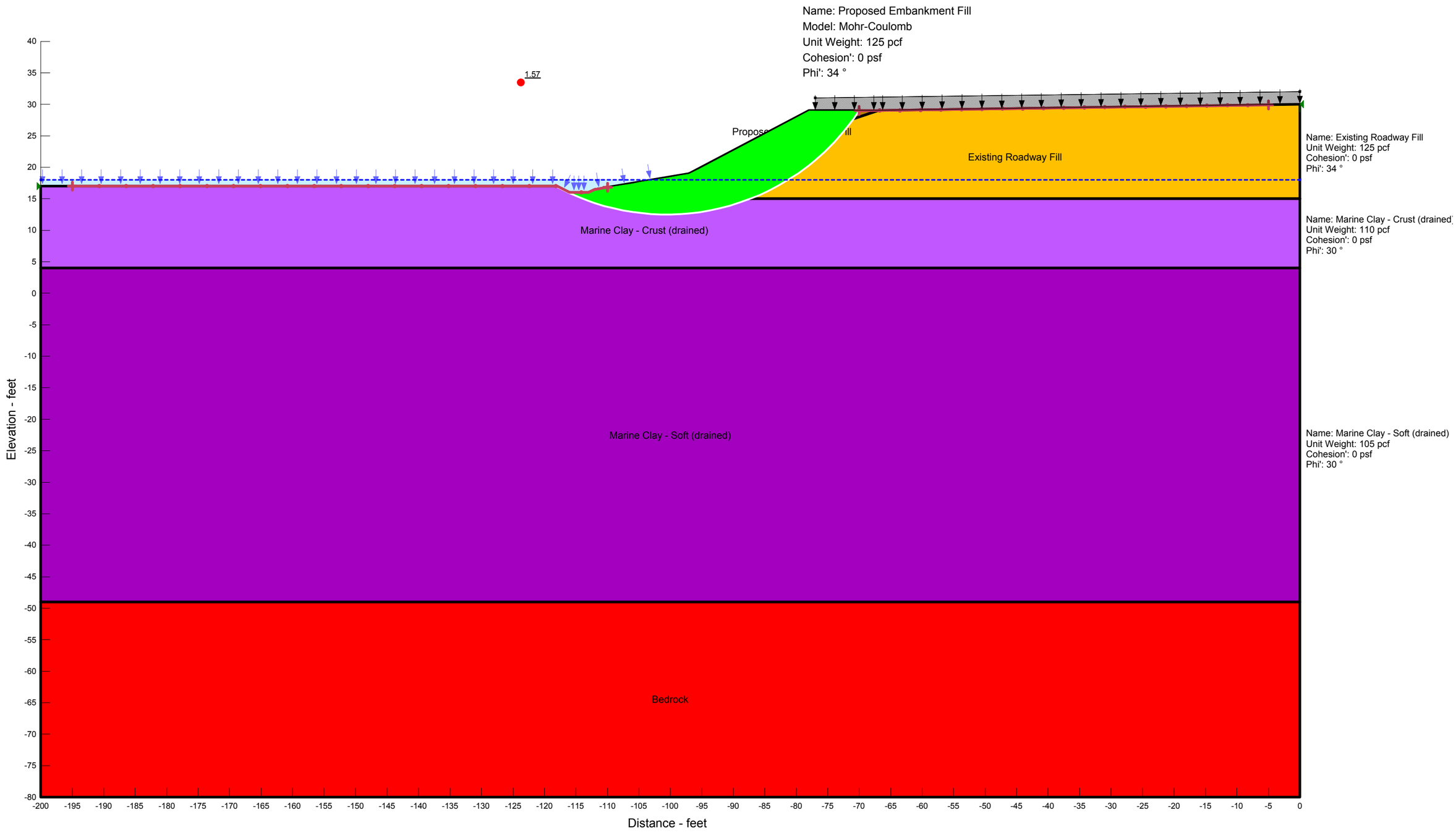
Name: Sand
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 30 °

Name: Marine Clay - Crust (undrained)
Unit Weight: 110 pcf
Cohesion': 1,000 psf
Phi': 0 °

Name: Marine Clay - Soft (undrained)
Unit Weight: 105 pcf
Cohesion': 650 psf
Phi': 0 °

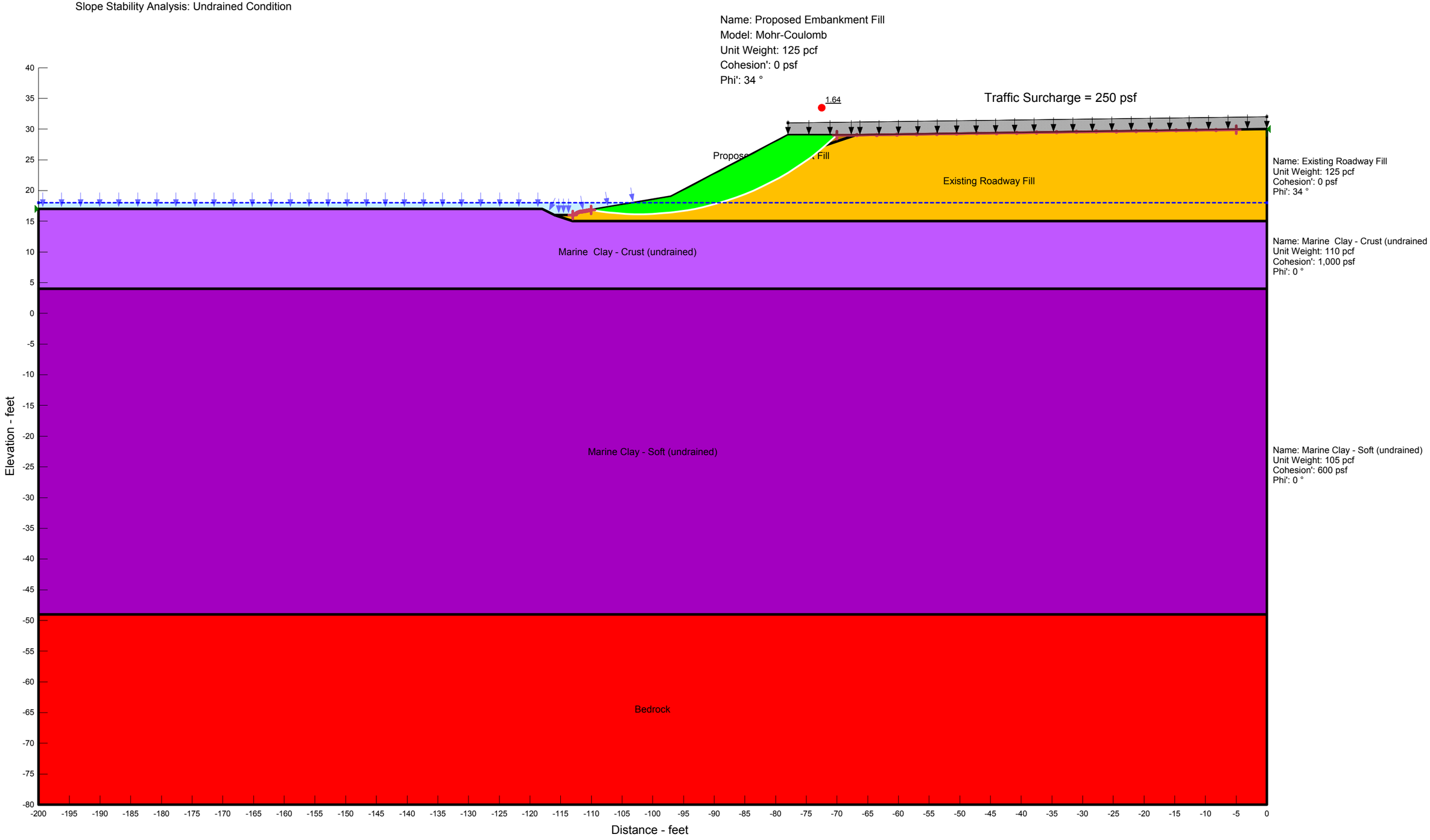
Maine Turnpike: Exit 44 Widening
Scarborough, ME

Station 2146+00
Slope Stability Analysis: Drained Condition



Maine Turnpike: Exit 44 Widening
Scarborough, ME

Station 2149+00
Slope Stability Analysis: Undrained Condition



SETTLEMENT ANALYSIS

Exit 44 Toll Plaza

Settlement Estimate

Location Station 2146+00

Pr = Proposed

Ex = Existing

Elev. (ft)	Max Past Pressure	Stresses for GeoStudio: Edge of Pavement OFFSET 75 LT Ex Eff Stress	Edge of Pavement OFFSET 75 LT Pr Eff Stress	Middle of SB Barrel OFFSET 37 RT Ex Eff Stress	Middle of SB Barrel OFFSET 37 RT Pr Eff Stress
-1	3240	2358	2450	2768	2782
-17	3040	2944	3010	3442	3463
-36	3815	3725	3775	4213	4240
-57	4960	4575	4617	4987	5017
-77	6060	5393	5430	5762	5791

Location of Analysis			Based on Plots	PRIMARY SETTLEMENT: Marine Clay - Crust			Marine Clay - Soft			Settlement	Time for 90% Consol: Cv (ft2/day)		Time	Secondary Settlement (inches): Upper Clay		Lower Clay		Total
Station	Offset	Area	(CR or RR)	CR	RR	Ho	CR	RR	Ho	(inches)	Virgin	Recomp	(years)	Ca - Virgin	Ca-Recomp	Ca - Virgin	Ca-Recomp	(inches)
2146+00	75 LT	Edge of Pavement	Use RR	0.144	0.016	12				0.04	0.10	0.10	49.2	0.010	0.010	0.010	0.010	-0.12
			Use CR				0.253	0.019	20	0.58								
			Use CR				0.253	0.019	20	0.35								
			Use RR				0.253	0.019	20	0.24								
			Use RR				0.253	0.019	20	0.18								
									Total	**1.40**								
2146+00	37 LT	Middle of SB Barrel	Use RR	0.144	0.016	12				0.01	0.10	0.10	49.2	0.010	0.010	0.010	0.010	-0.12
			Use CR				0.253	0.019	20	0.16								
			Use CR				0.253	0.019	20	0.17								
			Use RR				0.253	0.019	20	0.16								
			Use RR				0.253	0.019	20	0.13								
									Total	**0.62**								

Input for Unit Weights:

	(PCF)
Proposed Fill	125
Existing Fill	125
Upper Clay	110
Lower Clay	105

Primary Consolidation

For stresses increases completely in the virgin range:
$Sc = (CR)(Ho)\text{Log}\ (\sigma'_{pr}/\sigma'_{ex})$

For stresses increases completely in the recompression range:
$Sc = (RR)(Ho)\text{Log}\ (\sigma'_{pr}/\sigma'_{ex})$

Time to complete primary consolidation

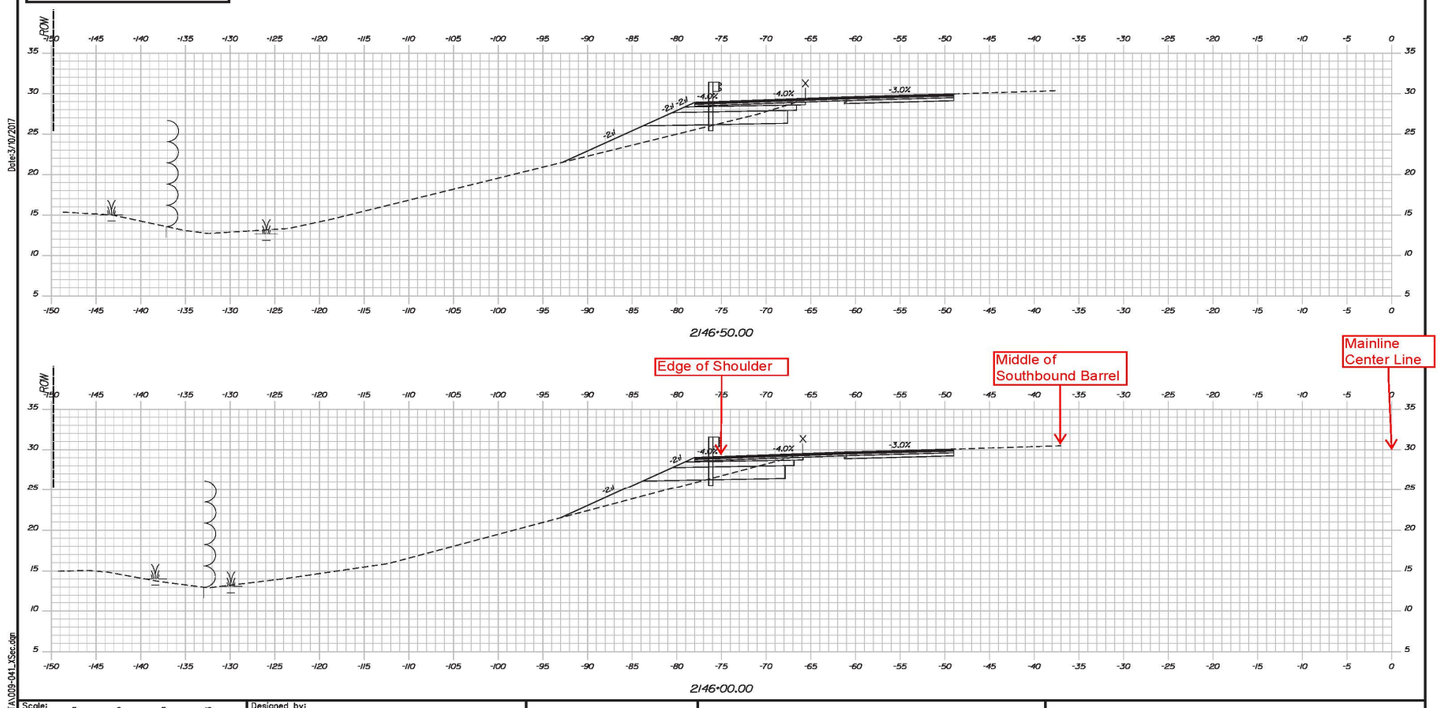
$t = T^*(H_{dr})^2/Cv$ Double drainage conditions

$T = 0.848$

Secondary Consolidation

Assume 50 years life span. Secondary settlement starts at the end of primary and stops at 50 years.
Use $e_p = 1.0$ (slightly conservative assumption)
$Ss = (C\alpha/(1+e_p))^*(Ho)^*(\Delta\text{Log } t)$

10% SUBMISSION
3/10/2017



Date:3/10/2017

Filename: ...\HIGHWAY\MST\A1009-041_XSec.dgn

Scale: 5 0 5 10 Scale of Feet

No.	Revision	By	Date

Designed by: Stantec

CONSULTANT PROJECT MANAGER: GREG EDWARDS, PE

	By	Date		By	Date
Designed	TFD	3\10\17	Checked	LEM	3\10\17
Drawn	PLP	3\10\17	In Charge of	GAE	3\10\17

STANTEC CONSULTING SERVICES INC.
482 PAYNE ROAD
SCARBOROUGH, ME 04074
TEL (207) 887-3448
FAX (207) 883-3376

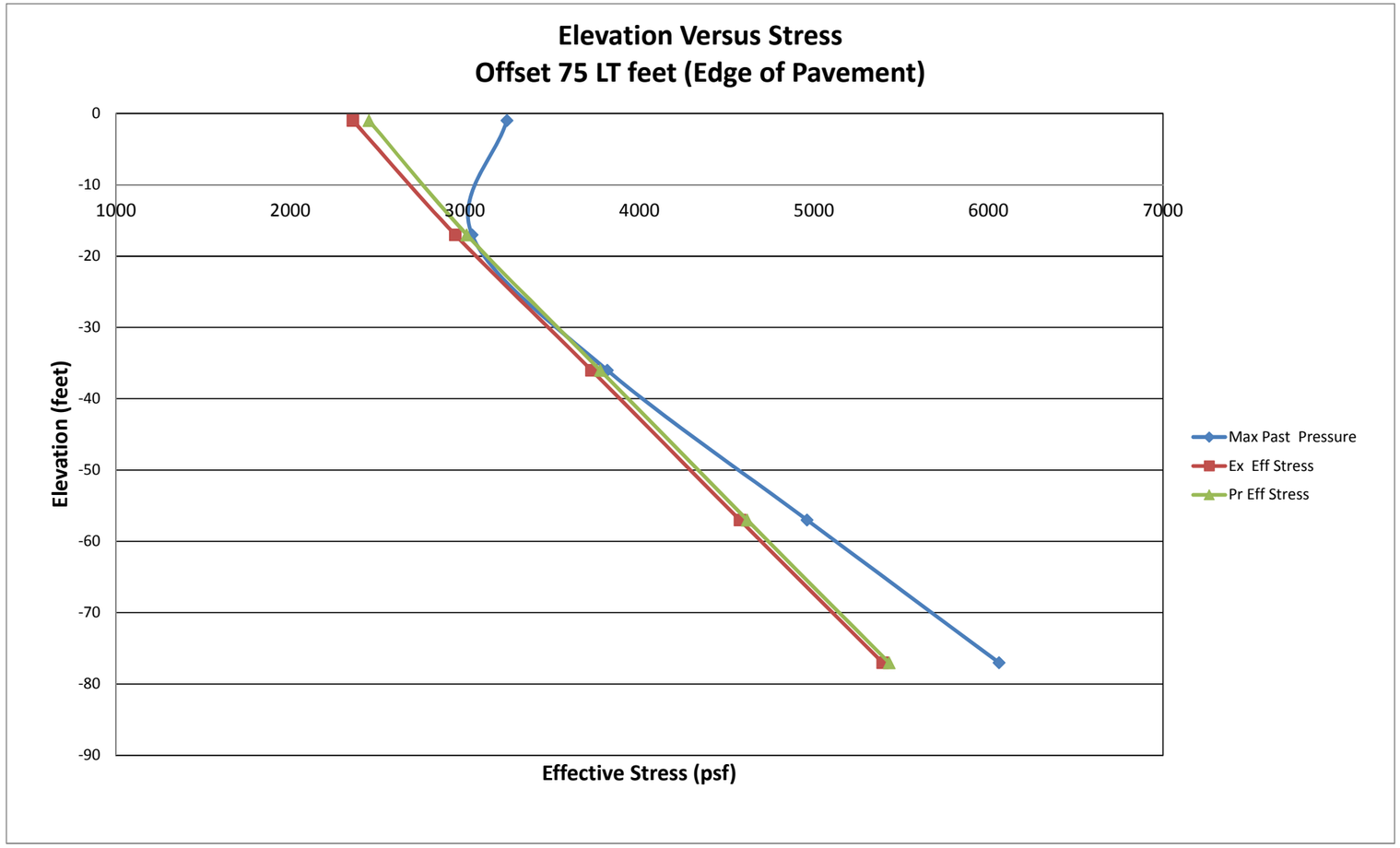
MAINE TURNPIKE

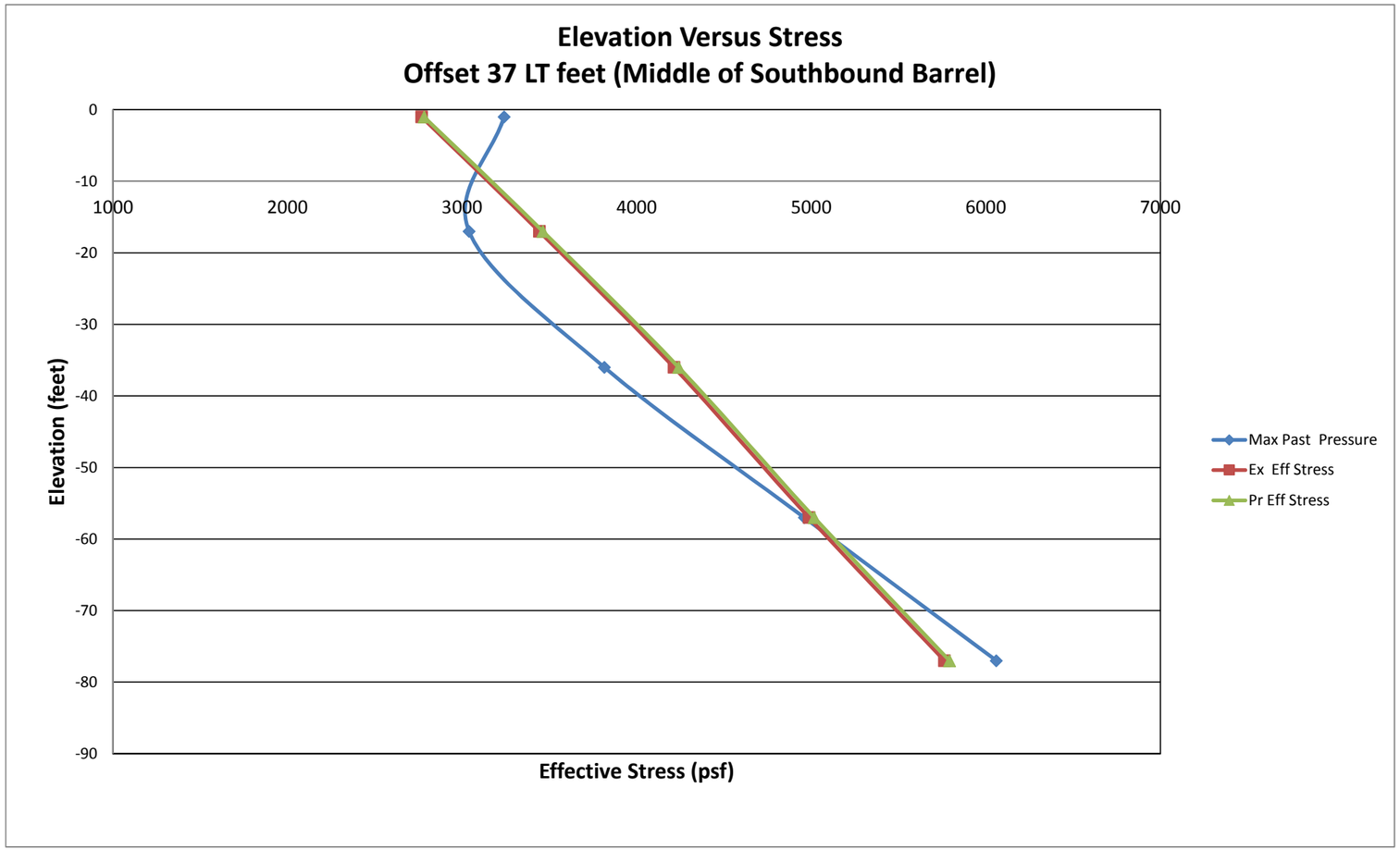
THE GOLD STAR MEMORIAL HIGHWAY

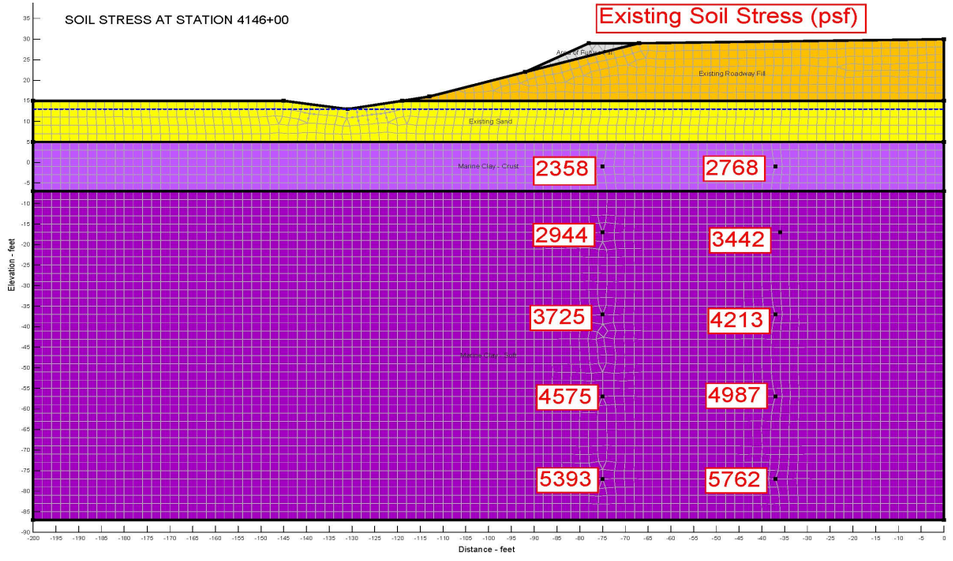
MTA PROJECT MANAGER: RALPH NORWOOD, IV, PE, PTOE

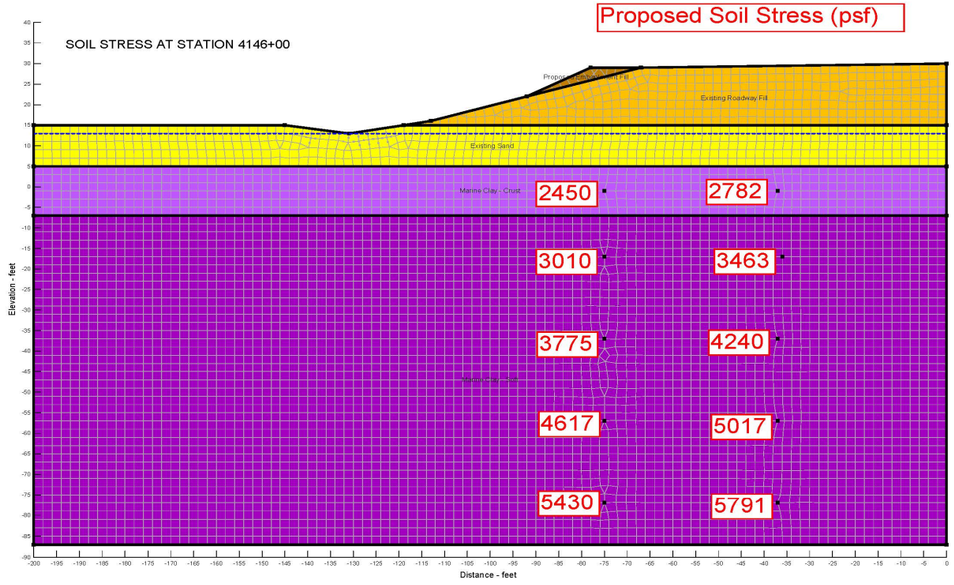
EXIT 44
SOUTHBOUND ON RAMP IMPROVEMENTS
STA. 2146+00.00 TO STA. 2146+50.00

SHEET NUMBER:
CONTRACT:2018.XX 19 OF 41


Elevation Versus Stress
Offset 75 LT feet (Edge of Pavement)
Elevation (feet)
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
1000
2000
3000
4000
5000
6000
7000
Effective Stress (psf)
Max Past Pressure
Ex Eff Stress
Pr Eff Stress


Elevation Versus Stress
Offset 37 LT feet (Middle of Southbound Barrel)
Elevation (feet)
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
1000
2000
3000
4000
5000
6000
7000
Effective Stress (psf)
Max Past Pressure
Ex Eff Stress
Pr Eff Stress


Existing Soil Stress (psf)
SOIL STRESS AT STATION 4146+00
Existing Roadway Fill
Existing Sand
Marine Clay - Crust
2358
2768
2944
3442
3725
4213
4575
4987
5393
5762
Elevation - feet
Distance - feet


Proposed Soil Stress (psf)
SOIL STRESS AT STATION 4146+00
Existing Roadway Fill
Existing Sand
Marine Clay - Crust
2450
2782
3010
3463
3775
4240
4617
5017
5430
5791
Elevation - feet
Distance - feet

Exit 44 Toll Plaza

Settlement Estimate

Location Station 2149+00

Pr = Proposed

Ex = Existing

Elev. (ft)	Max Past Pressure	Stresses for GeoStudio: Edge of Pavement OFFSET 75 LT Ex Eff Stress	Edge of Pavement OFFSET 75 LT Pr Eff Stress	Middle of SB Barrel OFFSET 37 RT Ex Eff Stress	Middle of SB Barrel OFFSET 37 RT Pr Eff Stress
9	3440	1623	1797	2049	2054
-6	3140	2198	2322	2698	2717
-26	3265	3009	3100	3519	3551
-43	4200	3687	3764	4175	4209

Location of Analysis			Based on Plots	PRIMARY SETTLEMENT: Marine Clay - Crust			Marine Clay - Soft			Settlement	Time for 90% Consol: Cv (ft2/day)		Time	Secondary Settlement (inches): Upper Clay		Lower Clay		Total
Station	Offset	Area	(CR or RR)	CR	RR	Ho	CR	RR	Ho	(inches)	Virgin	Recomp	(years)	Ca - Virgin	Ca-Recomp	Ca - Virgin	Ca-Recomp	(inches)
2149+00	75 LT	Edge of Pavement	Use RR	0.144	0.016	11				0.09	0.10	0.10	23.1	0.010	0.010	0.010	0.010	0.03
			Use RR				0.253	0.019	20	0.11								
			Use CR				0.253	0.019	20	0.79								
			Use CR				0.253	0.019	12	0.33								
									Total	**1.31**								
2149+00	37 LT	Middle of SB Barrel	Use RR	0.144	0.016	11				0.00	0.10	0.10	23.1	0.010	0.010	0.010	0.010	0.03
			Use RR				0.253	0.019	20	0.01								
			Use CR				0.253	0.019	20	0.24								
			Use CR				0.253	0.019	12	0.13								
									Total	**0.38**								

Input for Unit Weights:

	(PCF)
Proposed Fill	125
Existing Fill	125
Upper Clay	110
Lower Clay	105

Primary Consolidation

For stresses increases completely in the virgin range:
$Sc = (CR)(Ho)\text{Log}\ (\sigma'_{pr}/\sigma'_{ex})$

For stresses increases completely in the recompression range:
$Sc = (RR)(Ho)\text{Log}\ (\sigma'_{pr}/\sigma'_{ex})$

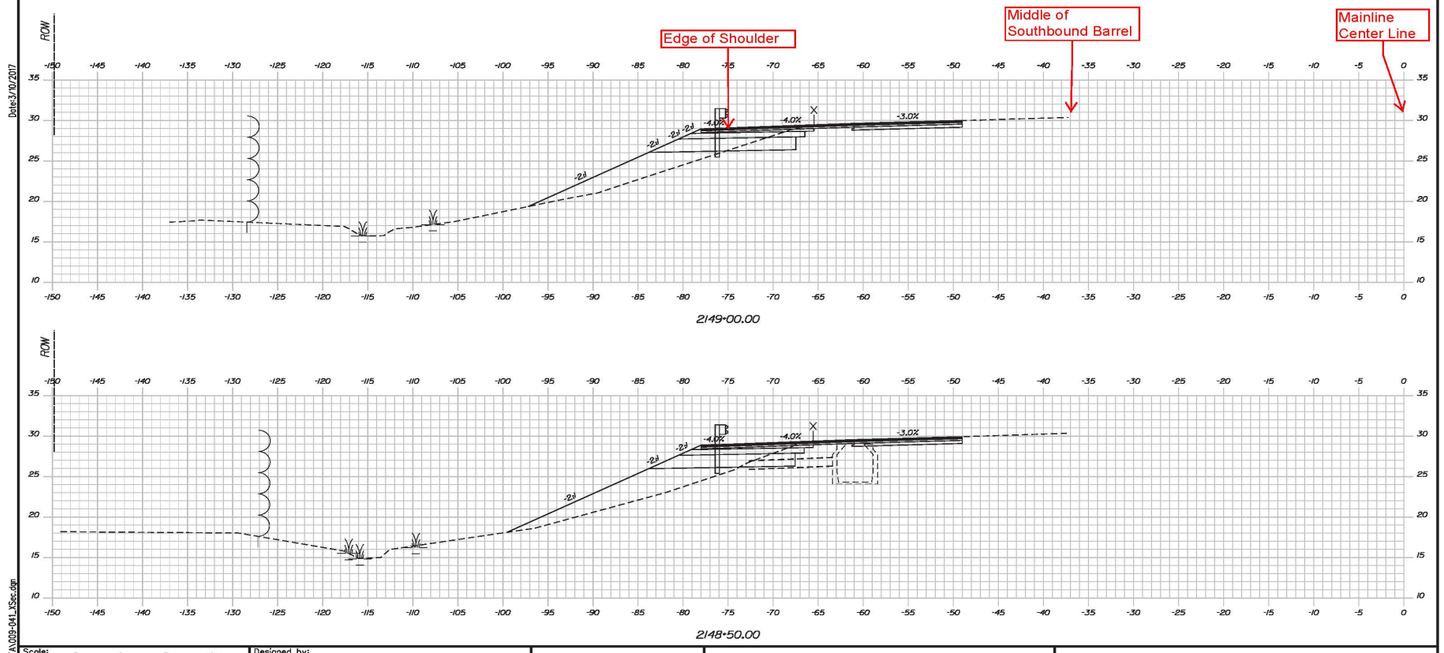
Time to complete primary consolidation

$t = T^*(H_{dr})^2/Cv$ Double drainage conditions
T = 0.848

Secondary Consolidation

Assume 50 years life span. Secondary settlement starts at the end of primary and stops at 50 years.
Use $e_p = 1.0$ (slightly conservative assumption)
$Ss = (C\alpha/(1+e_p))^*(Ho)^*(\Delta\text{Log } t)$

10% SUBMISSION
3/10/2017



Date:3/10/2017

Filename: ...\HIGHWAY\MSTA\009-041_XSec.dgn

Scale: 5 0 5 10 Scale of Feet

Designed by: Stantec

No.	Revision	By	Date

CONSULTANT PROJECT MANAGER: GREG EDWARDS, PE

	By	Date		By	Date
Designed	TFD	3\10\17	Checked	LEM	3\10\17
Drawn	PLP	3\10\17	In Charge of	GAE	3\10\17

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MAINE TURNPIKE

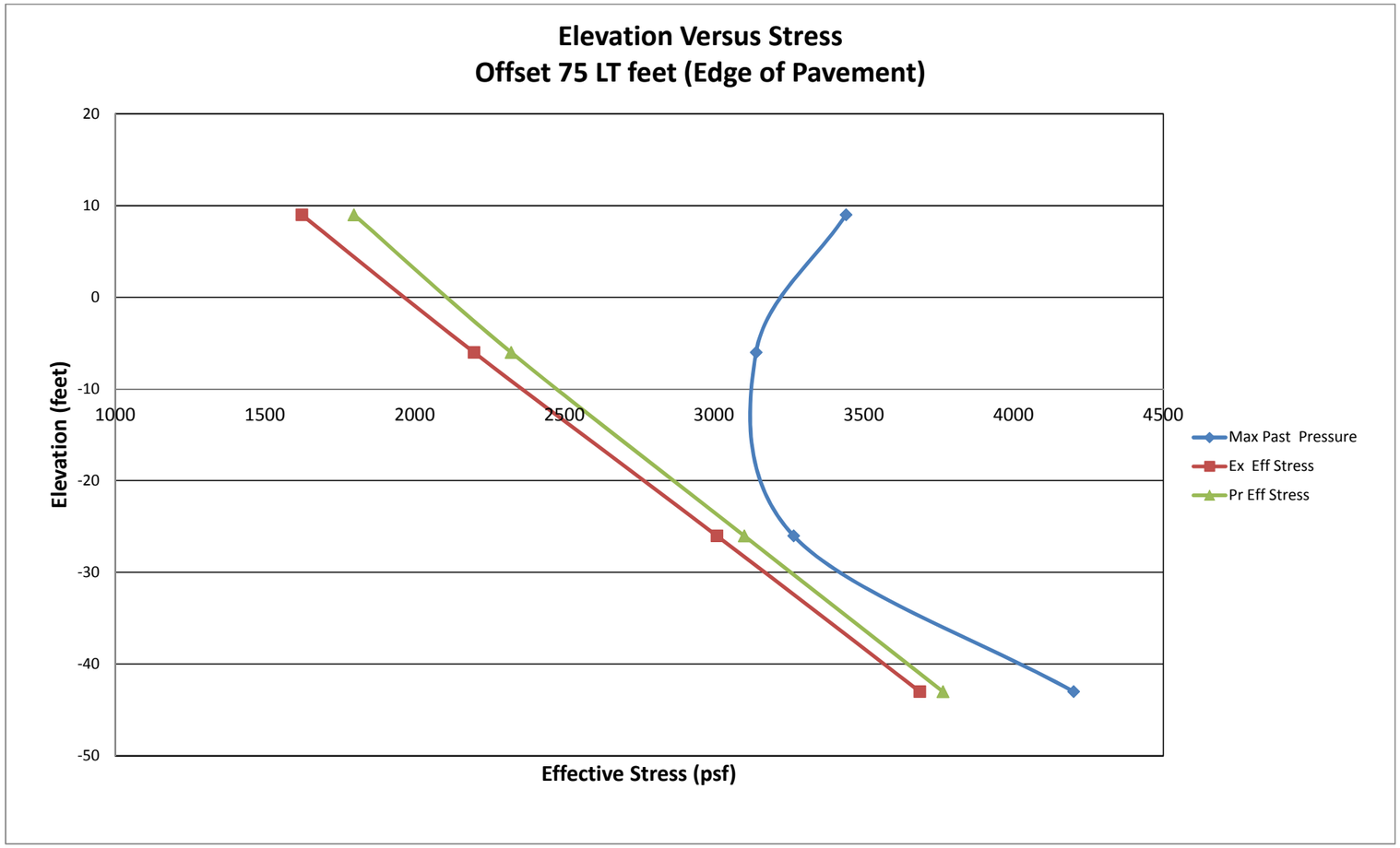
THE GOLD STAR MEMORIAL HIGHWAY

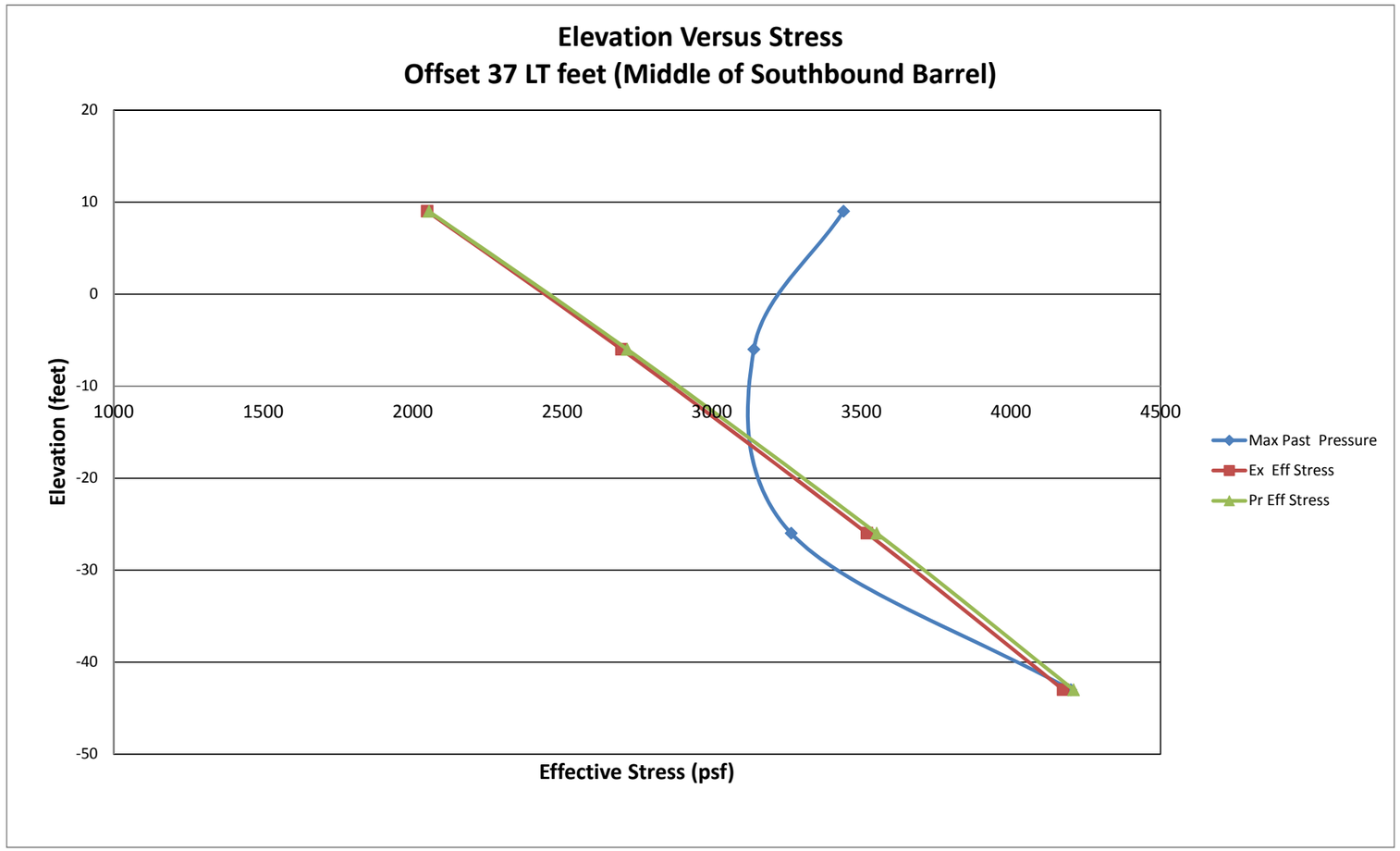
MTA PROJECT MANAGER: RALPH NORWOOD, IV, PE, PTOE

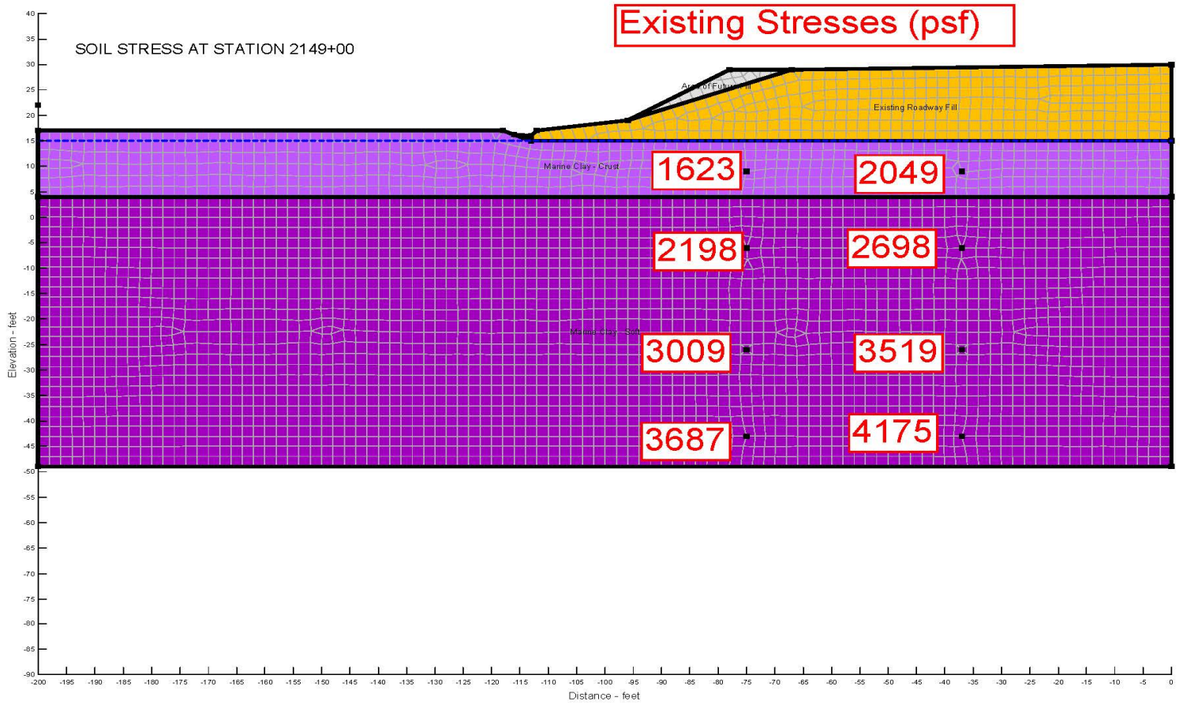
EXIT 44
SOUTHBOUND ON RAMP IMPROVEMENTS
STA. 2148+50.00 TO STA. 2149+00.00

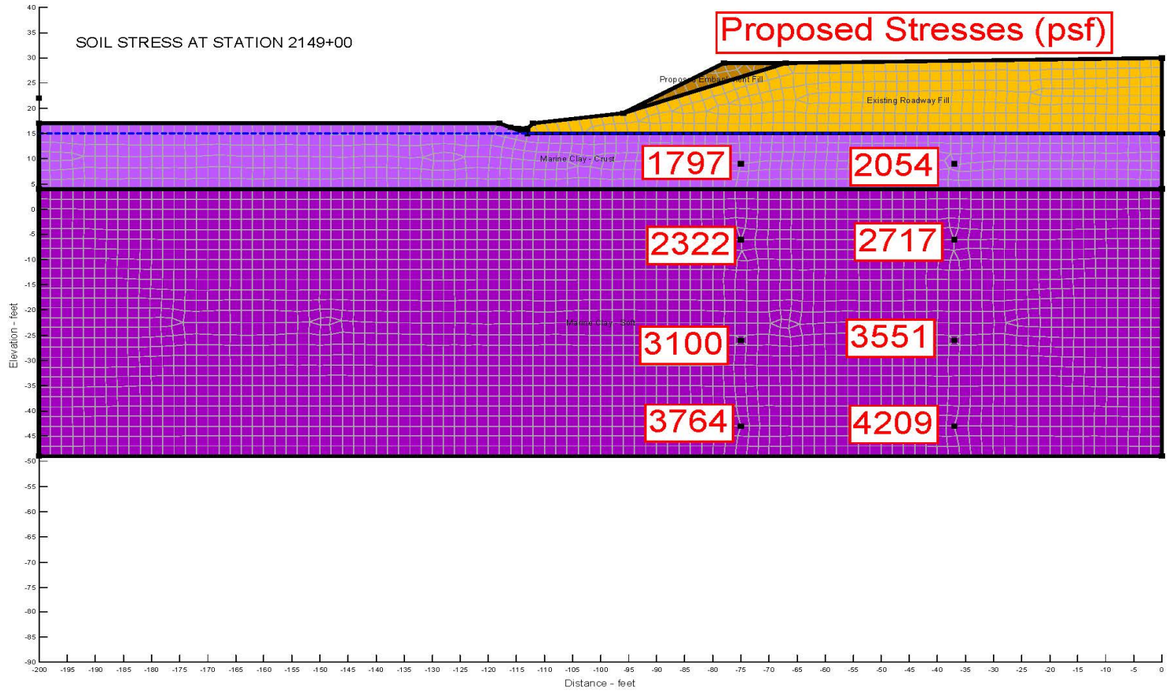
CONTRACT:2018.XX

SHEET NUMBER: 22 OF 41


Elevation Versus Stress
Offset 75 LT feet (Edge of Pavement)
Elevation (feet)
20
10
0
-10
-20
-30
-40
-50
1000
1500
2000
2500
3000
3500
4000
4500
Effective Stress (psf)
Max Past Pressure
Ex Eff Stress
Pr Eff Stress


Elevation Versus Stress
Offset 37 LT feet (Middle of Southbound Barrel)
Elevation (feet)
20
10
0
-10
-20
-30
-40
-50
1000
1500
2000
2500
3000
3500
4000
4500
Effective Stress (psf)
Max Past Pressure
Ex Eff Stress
Pr Eff Stress


Existing Stresses (psf)
SOIL STRESS AT STATION 2149+00
Existing Roadway Fill
Marine Clay - Crust
1623
2049
2198
2698
3009
3519
3687
4175
Elevation - feet
Distance - feet


SOIL STRESS AT STATION 2149+00
Proposed Stresses (psf)
Proposed Embankment Fill
Existing Roadway Fill
Marine Clay - Crust
1797
2054
2322
2717
Marine Clay - Soft
3100
3551
3764
4209
Elevation - feet
Distance - feet