Engineering a Sustainable Future

October 25, 2012
File No. 85970.00

Mr. Robert J. Faulkner, PE
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Re: Geotechnical Preliminary Design Report
Pine Point Crossing Bridge over B&M Railroad
Scarborough, Maine
Bridge No. 5260
MaineDOT PIN: 18229.00

Dear Mr. Faulkner:

This report presents Nobis Engineering, Inc.'s (Nobis) preliminary geotechnical recommendations related to the reuse of the substructures for the existing MaineDOT Bridge No. 5260 located on Pine Point Road over the B&M railway in Scarborough, Maine, as shown on Figure 1. This report is subject to the limitations in Appendix E.

In summary, we understand that the current state of the project is to evaluate the reuse of the existing abutments and piers to raise the superstructure to provide the required clearance for the trains. If the existing substructures are not reused, we understand the existing structure will be completely replaced with either a four span structure or a two span alternative to the south of the existing bridge. Based on boring logs provided in the 1953 construction drawings, and the borings observed by Nobis, soils below the east and west abutments consist of loose to dense sand fill over natural soil consisting of medium dense silty sand with varying amounts of clay over dense glacial till. The soils below the piers consist of natural soil consisting of medium dense silty sand with varying amounts of clay over dense glacial till.

EXISTING BRIDGE

The existing bridge is located on a seasonally busy highway that connects Pine Point to Route 1. The bridge carries Pine Point Road over both the B&M railway and Snow Canning Road, a gravel road that serves a commercial property and a residential property to the north. The bridge is a four span structure constructed around 1954 with dimensions of approximately 195 feet long and 35 feet wide. The superstructure consists of steel I-beam girders supporting a 6-inch concrete deck with a 5-inch asphalt wearing surface. The bridge abutments are monolithic cast-in-place structures founded in the embankment fill. The abutments were designed for a maximum toe pressure of 1.25 tons/ft^2. The bridge piers are founded on shallow spread footings at each column. The piers were designed for a maximum bearing pressure of 1.5 tons/ft^2.

Information on the existing bridge is based on our review of the original construction drawings dated May 1953. See Appendix D for selected sheets of the 1953 Construction Drawings.

Elevations on these original drawings are based on an unknown vertical datum. The horizontal datum used in this report and on the current drawings is based on North American Datum of 1983 (NAD83), the vertical datum is based on North American Vertical Datum of 1988 (NAVD88). We used the following adjustments in relation to the elevations: NAVD88 + 58 feet = "unknown vertical datum."

The existing surface of the bridge ranges from approximately El. 40 to 35 sloping down from west to east. The grade at the B&M rail line below the bridge is at approximately El. 15. The bridge provides approximately 19 feet of vertical clearance at the controlling location over the western track.

PROPOSED BRIDGE

We understand that the existing bridge is currently being evaluated. If the substructures can be used, a new superstructure will be constructed. If the substructures cannot be reused, a new two or four span bridge will be constructed south of the current alignment. Our evaluation is based upon AASHTO LRFD Bridge Design Specifications, 6th Edition - 2012.

SUBSURFACE EXPLORATIONS

Nobis recently coordinated and observed the drilling of five (5) borings (BB-SBMR-101 through BB-SBMR-105) at the abutments and piers completed by Northern Test Boring, Inc. on August 10 through 13, 2012.

The original 1953 Construction Drawings show logs for a total of twelve (12) borings drilled in December 1953. Seven (7) of the borings were drilled at the abutments and piers, and five (5) were drilled at the approach embankment to the east. The location of these previous explorations and the accuracy of those logs have not been verified by Nobis.

The locations of the borings are shown on Figure 1 and the boring logs for the recent and previous explorations are in Appendix A.

Laboratory testing was also completed as discussed in the Laboratory Testing Results section below.

SUBSURFACE CONDITIONS

Overall Site

The subsurface conditions across the bridge site are relatively consistent, with varying soil layer thicknesses. The 1950s drawings indicate that the grades east and west of the tracks were raised with granular borrow approximately 25 to 30 feet at the bridge and up to 35 feet along the east approach embankment. The drawings indicate that the soft organic deposits were also excavated and replaced with granular borrow. Generally the borings indicate that the soil profile consists of a loose to medium dense granular fill, overlying a medium dense natural silty sand deposit containing varying amounts of clay, overlying dense to very dense glacial till, overlying bedrock. In general, the silty sand deposit exhibits a non-plastic behavior at the in situ moisture content, even though up to 15% clay was present. The soil layers show a downward sloping

trend to the east, similar to the former ground and bedrock surface as shown on Figure 2, an interpretive subsurface profile.

Cores were taken approximately 10 feet into the bedrock at each recent boring location. The bedrock generally consisted of dark gray, fine grained, hard, fresh to slightly weathered Phyllite with moderately dipping, closely spaced, and tight to open joints. This rock appears to match the Phyllite described in the Kittery Formation of which this area is mapped in the Bedrock Geology of the Portland 1:100,000 Quadrangle, 1998. The Rock Quality Designations (RQD) for the bedrock ranged from 19% to 84%, but were generally around 50% or greater. The exception was the rock core performed at boring BB-SBMR-104 which consisted of moderately to highly weathered rock that contained a large amount of fractures, and had RQD values between 19% and 44%. At this location, approximately 600 gallons of water was lost during the coring, likely due to the open and weathered fractures, and open pores in the rock.

Groundwater at the site was encountered at elevations ranging between approximately El. 7 to El. 15.5. The hydraulic gradient appears to be sloping downward to the east which is consistent with the natural slope of the land. Tidal activity may potentially cause fluctuations in the groundwater. Groundwater will fluctuate with season, construction activities, and drilling activities and levels in the borings may not represent stabilized groundwater levels.

Abutment No. 1 (West)

Based on the 1953 Construction Drawings, the bottom of the Abutment No. 1 footing is approximately at El. 30. Soil boring BB-SBMR-105 was drilled approximately 6 feet from the back side of this abutment and approximately 10 feet north of the centerline of the road, at approximate El. 40.1. The soils encountered consisted of approximately 25 feet of loose to medium dense sand fill with little amounts of gravel and trace to little amounts of silt, overlying approximately 5 feet of loose silty sand with varying amounts of clay, overlying approximately 21 feet of dense to very dense glacial till, overlying bedrock at a total depth of approximately 51 feet at El. -10.7. The original 1953 borings drilled at this abutment were B-1 and B-10, which encountered similar soil conditions as BB-SBMR-105. Based on the 1953 Construction Drawings and borings, we anticipate that Abutment No. 1 bears on 15 feet of loose to medium dense sandy fill with approximately 4.5 feet of embedment.

Abutment No. 2 (East)

Based on the 1953 Construction Drawings, the bottom of the Abutment No. 2 footing is approximately at El. 25.5. Soil boring BB-SBMR-101 was drilled approximately 5 feet behind the abutment and approximately 10 feet north of the centerline of the road, at approximate El. 35.2. The soils encountered consisted of medium dense sand fill with little gravel and trace amounts of silt to a depth of approximately 11 feet, overlying approximately 15 feet of medium dense crushed gravel or fractured rock fill, overlying approximately 17 of medium dense silty sand with varying amounts of clay, overlying approximately 48 feet of dense to very dense glacial till, overlying bedrock at a total depth of approximately 91 feet at El. -55.6. The original 1953 borings drilled at this abutment were B-6 and B-7, which encountered similar soil conditions as BB-SBMR-101. Based on the 1953 Construction Drawings and borings, we anticipate that Abutment No. 2 bears on 15 feet of medium dense sandy fill with approximately 4 feet of embedment.

Piers

There are three piers supporting the bridge superstructure, Pier 1 to the west, Pier 2 at the center, and Pier 3 to the east. Per the 1953 Construction Drawings, the bottom of footing elevation is approximately El. 8.5 for Pier 1, El. 7.5 for Pier 2, and El. 6 for Pier 3. Soil borings BB-SBMR-104 drilled near the northwest corner of Pier 1 through the bridge deck, BB-SBMR-103 was drilled at ground level near the southeast corner of Pier 2, and BB-SBMR-102 was drilled at ground level near the southeast corner of Pier 3. The soils encountered at the three boring locations consisted of approximately 5 to 7.5 feet of loose to medium dense sand fill containing varying amounts of silt and gravel, overlying between 4 and 14 feet of medium dense silty sand with varying amounts of clay, overlying approximately 20 to 30 feet of dense to very dense glacial till, overlying bedrock. The original 1953 soil borings, which included B-11 at Pier 1, B-9 at Pier 2, and B-8 at Pier 3, encountered soil conditions similar to that of the recent borings. Based on the 1953 Construction Drawings, we anticipate that the Piers bear on the medium dense silty sand layer with varying amounts of clay with approximately 7 feet of embedment.

Approach Embankments

Subsurface data at the west approach embankment is limited to the information obtained from the borings performed at Abutment No. 1, which includes recent boring BB-SBMR-105, and original 1953 borings B-1 and B-10. The west approach embankment appears to be comprised of sand fill with little gravel and trace to little silt, as shown in boring BB-SBMR-105. The underlying soils of the embankment consist of silty sand, overlying dense glacial till.

The east approach embankment appears to be comprised of sand fill with little gravel and trace amounts of silt, overlying a crushed gravel or fractured rock fill, as shown in boring BB-SBMR-101. West of original STA 8+75 to Abutment No.2, the underlying soils of the embankment consist of silty sand, overlying dense glacial till. From original STA 8+75 east to STA 10+30, per the 1953 Construction Drawings, the underlying soft organic material was to be removed and replaced with granular borrow as shown on the cross sections. East of STA 10+30, layers of peat were encountered above loose silty sand as shown in boring B-2, but the removal was not specified. The embankment east of original STA 10+30 was pre-loaded with a minimum 5 foot thick surcharge of soil.

Laboratory Testing Results

Select samples were submitted for laboratory testing to analyze grain size distribution, Atterberg limits, moisture content, pH, and sulfate and chloride concentrations. Grain size distribution was used to verify soil classification, and to determine fines content and clay percentage of the bearing soils. Atterberg limits were performed to evaluate the behavior of the soil materials containing higher fines contents. In general, the soils evaluated were low in plasticity with PI values of 11 or less. Natural moisture contents of the samples were taken to evaluate the percentage of water that each sample contained, as well as to compare the in situ moisture with the liquid and plastic limits. Overall, the natural moisture contents did not exceed approximately 10% by weight of the sample. The natural moisture contents of the samples tested for Atterberg limits were less than or equal to the low plastic limit, indicating that the in situ soil will generally behave as granular soils.

Testing performed to evaluate the concrete deterioration potential of the soil included pH, sulfates, and chlorides testing. The minimum pH value of the soils tested was 5.6. Per

AASHTO LRFD Bridge Design Specifications, 2012 Section 10.7.5, soils with a pH of less than 5.5 are indicative of a potential concrete deterioration situation. The highest level of sulfate concentrations measured in the laboratory testing was 220 ppm, which is lower than the maximum value of 1,000 ppm in soil as identified in AASHTO LRFD Bridge Design Specifications, 2012 Section 10.7.5 as being indicative of a potential concrete deterioration situation. The highest chloride content measured in the laboratory testing was 170 ppm, which is lower than the maximum value of 500 ppm as identified in AASHTO LRFD Bridge Design Specifications, 2012 Section 10.7.5 as being indicative of a potential concrete deterioration situation. Therefore, the testing results indicate that concrete deterioration from these environmental conditions would not be a concern.

The laboratory test results are presented in Appendix B.

GEOTECHNICAL ENGINEERING RECOMMENDATIONS

We understand the evaluation of the substructures will be performed in accordance with AASHTO LRFD Bridge Design Specifications, 6th Edition, 2012.

Primary Geotechnical Issues

1. Existing global stability of the Abutments: The factor of safety for global stability of the embankments is less than 1.5 as discussed below;
2. Frost embedment: The abutment foundations are embedded less than the depth of frost penetration as discussed below; and
3. Underlying soils east of Abutment No. 2 contain organics: If a new alignment of the bridge is elected, placement of embankment soils over these organic materials may induce settlement as discussed below.

Existing Substructure Foundation Recommendations

Nobis understands the abutments and piers are currently being evaluated for re-use. We recommend the following for use in the structural evaluation if re-use is determined:

- The Abutment No.1 footing bearing on loose to medium dense existing sandy fill soils over natural soil should be evaluated using LRFD for a maximum factored bearing capacity, q_R, of 3.6 ksf based on a bearing performance factor (ϕ_b) of 0.45. This bearing capacity is based on a soil friction (ϕ_f) of 32° and a unit weight (γ) of 125 pcf for the bearing soils. Refer to Appendix C for calculations. The factored bearing capacity is greater than the maximum toe pressure of 1.25 tons/ft^2 as indicated in the 1953 Construction Drawings, which was designed using ASD and a Factor of Safety of 3. Since it is likely that the new superstructure will apply loads similar to that of the existing superstructure, we do not anticipate further settlement of this abutment. However, a global slope stability analysis was performed based on the existing conditions, as discussed below, and the factor of safety was determined to be less than 1.5. Soil improvement methods may be required in order to reuse this abutment foundation.

- The Abutment No. 2 footing bearing on medium dense existing sandy fill soils over natural soil should be evaluated using LRFD for a maximum factored bearing capacity, q_R, of 3.6 ksf based on a bearing performance factor (ϕ_b) of 0.45. This bearing capacity is based on a soil friction (ϕ_f) of 33° and a unit weight (γ) of 125 pcf for the bearing soils. Refer to Appendix C

for calculations. The factored bearing capacity is greater than the maximum toe pressure of 1.25 tons/ft^2 as indicated in the 1953 Construction Drawings, which was designed using ASD and a Factor of Safety of 3. Since it is likely that the new superstructure will apply loads similar to that of the existing superstructure, we do not anticipate further settlement of this abutment. However, a global slope stability analysis was performed based on the existing conditions, as discussed below, and the factor of safety was determined to be less than 1.5. Soil improvement methods may be required in order to reuse this abutment foundation.

- The Pier footings bearing on medium dense existing silty sand soil should be evaluated using LRFD for a maximum factored bearing capacity, q_R, of 4 ksf based on a bearing performance factor (ϕ_b) of 0.45. This bearing capacity is based on a soil friction (ϕ_f) of 34° and a unit weight (γ) of 130 pcf for the bearing soil, and was limited based on a maximum settlement of 1 inch. Refer to Appendix C for calculations. The factored bearing capacity is greater than the maximum earth pressure of 1.5 tons/ft^2 as indicated in the 1953 Construction Drawings, which was designed using ASD and a Factor of Safety of 3. Since it is likely that the new superstructure will apply loads similar to that of the existing superstructure, we do not anticipate further settlement of the piers.

- A sliding coefficient of friction (tan δ) of 0.6 is recommended for the abutment footings. A sliding resistance factor (ϕ_τ) of 0.8 for cast-in-place concrete on sand is recommended. The passive resistance of the soil in front of the footing should be neglected.

- The depth of frost penetration was determined using Table 5-1 and Figure 5-1 of the MaineDOT Bridge Design Guide, and was estimated at a depth of approximately 75.5 inches (6.3 feet), see Appendix C for calculation. The bottom of the abutment foundations appear to be approximately 4 feet below reveal grades and the pier foundations appear be approximately 7 feet below existing grades. The abutments do not have adequate embedment for frost protection. The soil beneath the abutments consists of granular borrow as specified in the 1953 Construction Drawings. The specification for granular borrow per MaineDOT states that the material may contain up to 20% fines passing the #200 sieve. Samples of the granular borrow that were laboratory tested for gradation contained approximately 9% to 12% fines. This material is considered to be frost susceptible. Therefore, additional frost protection measures are required for the existing abutments to satisfy current guidelines.

- We recommend that the existing abutments and walls be evaluated based on a retained soil with the following values:

Friction angle, ϕ	= 32 degrees
Unit Weight	= 125 pcf
Cohesion	= 0
Active Earth pressure coeff.	= 0.31
Passive Earth pressure coeff.	= 3.25
At-Rest Earth pressure coeff.	= 0.47

Global Stability

Nobis evaluated the global stability of the existing abutments. The stability analysis was performed assuming that the existing foundations apply the full 1.25 tons/ft^2 maximum

recommended load. Based on our analysis, the factor of safety of the embankment supporting Abutment No. 1 is approximately 1.19 and the factor of safety of the embankment supporting Abutment No. 2 is approximately 1.21, for overall external global stability. The required factor of safety for overall external global stability is a minimum of 1.5. Therefore, the embankments supporting the existing abutments do not provide adequate resistance against a global failure. Refer to Appendix C for calculations.

Approach Embankment Realignment

We understand that if the complete bridge replacement option is chosen, the approach embankments may potentially be expanded further to the south. Additionally, the existing approaches may be raised an additional 2 feet to increase the bridge clearance from the railroad tracks. Due to the existence of compressible materials including clay, peat and other organic soils at these locations, as shown in the recent 2012 and original 1953 borings, additional fill placement over this area may induce settlement over time. Nobis recommends that settlement analyses be performed once the approach embankment configuration is determined, prior to construction, if this realignment occurs. Depending upon the results of the analyses, a preload period may be required to allow the soils enough time to compress prior to asphalt placement. Additional soil boring explorations at the approach embankments are required.

New Foundation Option

The recommended bearing conditions of the replacement pier and abutment foundations will ultimately depend on the proposed loading of these structures. The shallow bearing condition of the existing pier foundations has shown low bearing capacities. The advantages of being able to utilize this bearing condition for the replacement option is that the foundation may be constructed with conventional methods of excavation and dewatering. If proposed bearing pressures make standard spread footings impractical, deeper foundation or soil improvement options would be required. One concern regarding the use of a shallow foundation replacement option is the existence of clay within the bearing soils. This condition will require additional subsurface boring investigations and settlement analyses to confirm consolidation of the clay is not possible.

Analysis of the shallow bearing conditions of the existing abutment foundations have shown bearing capacities that are similar to that required in the original design. However, the governing limitation on the original bearing condition is its affect on global slope stability and frost embedment, which has a factor of safety less than required. In order to maintain a shallow foundation option for the abutments, they will likely have to be placed further back from the top of the embankment, be placed deeper into the embankment, and/or the embankment itself will require modification. Another option would be to apply ground improvement methods to the bearing soil such as jet grout columns, for which the shallow foundations would be founded on. Otherwise, deep foundations would be required to transfer the loads to the glacial till layer.

Seismic Design

Standard Penetration Test (SPT)-N values from the recently performed borings were used to determine the seismic site class using Method B (Table C3.10.3.1-1). Based on the SPT-N values, the abutments and piers are in a Site Class “D”.

The seismic parameters developed for the bridge are provided below:

Mapped Ground and Spectral Response Coefficients (AASHTO GM-2.1 program):

- Peak Horizontal Acceleration (PGA): 0.088g
- Horizontal Response Spectral Acceleration, 0.2 Sec (S_S): 0.175g
- Horizontal Response Spectral Acceleration, 1.0 Sec (S_1): 0.044g

Site Class: D (Table 3.10.3.1-1):

- Site Factors for Site Class "D" (AASHTO GM-2.1 program): Zero-Period (F_{pga}) = 1.6, Short-Period, 0.2 Sec (F_a) = 1.6, and Long Period, 1.0 Sec (F_v) = 2.4.

- Design Spectral Response Parameters for Site Class "D" (AASHTO GM-2.1 program): A_S = 0.141g, S_{DS} = 0.280g, S_{D1} = 0.107g.

Per LRFD Article 3.10.6 the site is assigned Seismic Zone 1 based on a calculated S_{D1} of 0.107g.

Calculations for the seismic site classification are included in Appendix C.

Thank you for the opportunity to be of service. Should you require additional information, please contact us.

Very truly yours,
Nobis Engineering, Inc.

Kurtis Amidon, P.E.
Senior Project Manager

Kurt Jelinek, P.E.
Senior Project Manager

Justin P. Mailloux, P.E.
Project Engineer

Attachments:
Figure 1: Boring Location Plan
Figure 2: Centerline Subsurface Profile
Appendix A: Boring Logs
Appendix B: Laboratory Test Results
Appendix C: Calculations
Appendix D: Existing Construction Drawings
Appendix E: Limitations

FIGURES

NOTES:

1. THE BASE PLAN WAS DEVELOPED FROM .DGN FILES OBTAINED FROM CLOUGH HARBOUR AND ASSOCIATES (CHA) ON SEPTEMBER 14, 2012.
2. LOCATIONS AND SITE FEATURES DEPICTED HEREON ARE APPROXIMATE AND GIVEN FOR ILLUSTRATIVE PURPOSES.
3. ELEVATIONS ARE BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).

LEGEND

BB–SBMR–101 — APPROXIMATE LOCATION OF BORINGS PERFORMED BY NOBIS IN SEPTEMBER 2012

B–1 — APPROXIMATE LOCATION OF BORINGS PERFORMED BY OTHERS IN 1953

0 30' 60'

GRAPHIC SCALE

EXISTING BRIDGE

PINE POINT ROAD

SNOW CANNING ROAD

ABUTMENT NO. 1

PIER NO. 1

PIER NO. 2

PIER NO. 3

ABUTMENT NO. 2

B–1 B–3 B–4 B–5 B–6 B–7 B–8 B–9 B–10 B–11

BB–SBMR–101 BB–SBMR–102 BB–SBMR–103 BB–SBMR–104 BB–SBMR–105

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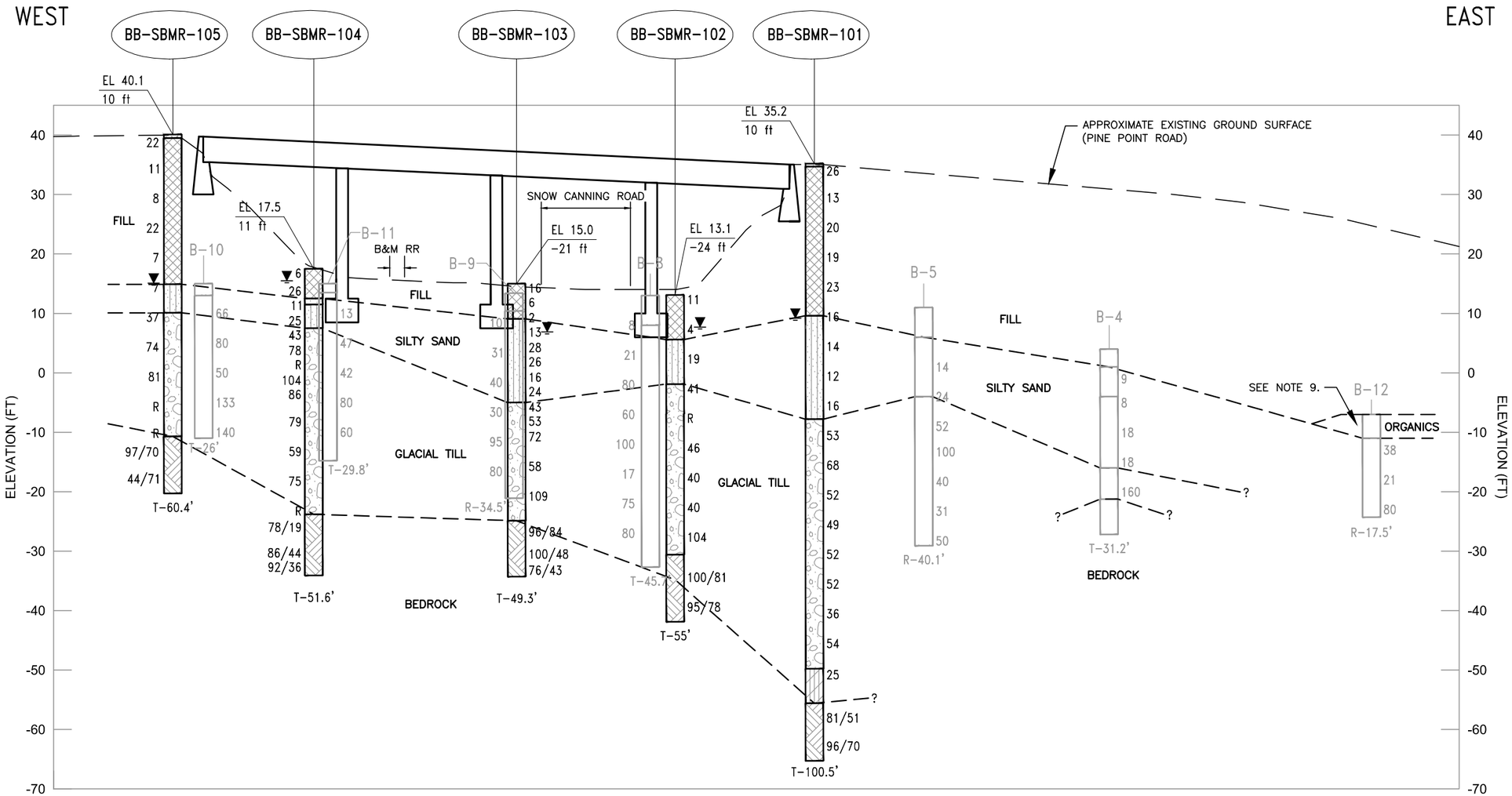
FIGURE 1

BORING LOCATION PLAN
PINE POINT CROSSING BRIDGE OVER B&M RAILROAD
SCARBOROUGH, MAINE

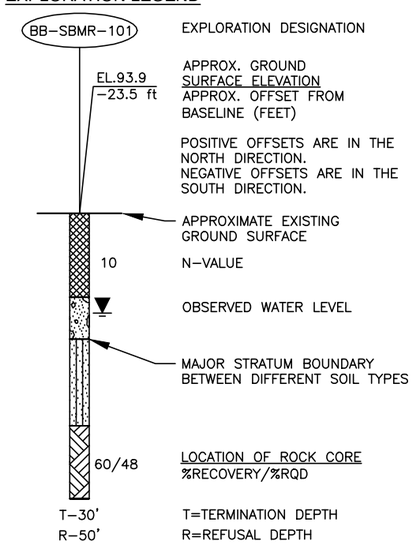
DRAWN BY:	AMR	APPROVED BY:	JPM
PROJECT NO.	85970.00	DATE:	OCTOBER 2012



NOTES:

1. REFER TO FIGURE 1 FOR LOCATIONS OF EXPLORATIONS.
2. THE BASELINE OF THIS PROFILE IS ALONG THE EXISTING ROADWAY CENTERLINE.
3. LINES REPRESENTING THE STRATA HAVE BEEN INTERPOLATED FROM A LIMITED NUMBER OF EXPLORATIONS AND ACTUAL CONDITIONS MAY VARY FROM CONDITIONS SHOWN.
4. APPROXIMATE TOP OF BEDROCK BASED ON ONE INTERPRETATION OF AVAILABLE SUBSURFACE DATA. THE TOP OF BEDROCK IS BASED ON WIDELY SPACED EXPLORATIONS AND ACTUAL CONDITIONS SHOULD BE EXPECTED TO VARY FROM THIS PROFILE.
5. SOIL DESCRIPTIONS ON THE PROFILES ARE GENERALIZED. REFER TO THE TEST BORING LOGS FOR DETAILED DESCRIPTIONS.
6. ELEVATIONS SHOWN ARE IN FEET AND REFER TO THE NORTH AMERICAN VERTICAL DATUM (NAVD 88) OF 1988.
7. N-VALUES SHOWN ON BB-SBMR-SERIES BORINGS ARE CORRECTED TO N60.
8. EXISTING B-SERIES BORINGS N-VALUES ARE BASED ON 275 LB HAMMER DROPPING 15 INCHES FOR A VARIETY OF SAMPLERS AS DESCRIBED ON THE LOGS.
9. THE 1953 CONSTRUCTION DRAWINGS INDICATE THAT THE SOFT ORGANIC DEPOSITS ENCOUNTERED IN THIS LAYER WERE EXCAVATED AND REPLACED WITH GRANULAR BORROW BENEATH THE ROADWAY.

EXPLORATION LEGEND



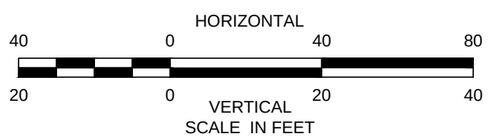


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FIGURE 2

INTERPRETIVE SUBSURFACE PROFILE
PINE POINT CROSSING BRIDGE OVER B&M RAILROAD
SCARBOROUGH, MAINE

DRAWN BY:	AMR	APPROVED BY:	JPM
PROJECT NO.	85970.00	DATE:	OCTOBER 2012

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APPENDIX A: BORING LOGS

1. Boring Logs by Nobis
2. Original 1953 Borings by Others

1. Boring Logs by Nobis

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GROUP SYMBOLS	TYPICAL NAMES
COARSE-GRAINED SOILS (more than half of material is larger than No. 200 sieve size)	GRAVELS (more than half of coarse fraction is larger than No. 4 sieve size)	CLEAN GRAVELS (little or no fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines
			GP	Poorly-graded gravels, gravel sand mixtures, little or no fines
		GRAVEL WITH FINES (Appreciable amount of fines)	GM	Silty gravels, gravel-sand-silt mixtures.
			GC	Clayey gravels, gravel-sand-clay mixtures.
	SANDS (more than half of coarse fraction is smaller than No. 4 sieve size)	CLEAN SANDS (little or no fines)	SW	Well-graded sands, gravelly sands, little or no fines
			SP	Poorly-graded sands, gravelly sand, little or no fines.
		SANDS WITH FINES (Appreciable amount of fines)	SM	Silty sands, sand-silt mixtures
			SC	Clayey sands, sand-clay mixtures.
FINE-GRAINED SOILS (more than half of material is smaller than No. 200 sieve size)	SILTS AND CLAYS (liquid limit less than 50)		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity.
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
			OL	Organic silts and organic silty clays of low plasticity.
	SILTS AND CLAYS (liquid limit greater than 50)		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
			CH	Inorganic clays of high plasticity, fat clays.
			OH	Organic clays of medium to high plasticity, organic silts
	HIGHLY ORGANIC SOILS		Pt	Peat and other highly organic soils.

Desired Soil Observations: (in this order)

Color (Munsell color chart)
Moisture (dry, damp, moist, wet, saturated)
Density/Consistency (from above right hand side)
Name (sand, silty sand, clay, etc., including portions - trace, little, etc.)
Gradation (well-graded, poorly-graded, uniform, etc.)
Plasticity (non-plastic, slightly plastic, moderately plastic, highly plastic)
Structure (layering, fractures, cracks, etc.)
Bonding (well, moderately, loosely, etc., if applicable)
Cementation (weak, moderate, or strong, if applicable, ASTM D 2488)
Geologic Origin (till, marine clay, alluvium, etc.)
Unified Soil Classification Designation
Groundwater level

TERMS DESCRIBING DENSITY/CONSISTENCY

Coarse-grained soils (more than half of material is larger than No. 200 sieve): Includes (1) clean gravels; (2) silty or clayey gravels; and (3) silty, clayey or gravelly sands. Consistency is rated according to standard penetration resistance.

Modified Burmister System

Descriptive Term	Portion of Total
trace	0% - 10%
little	11% - 20%
some	21% - 35%
adjective (e.g. sandy, clayey)	36% - 50%

Density of Cohesionless Soils	Standard Penetration Resistance N-Value (blows per foot)
Very loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

Fine-grained soils (more than half of material is smaller than No. 200 sieve): Includes (1) inorganic and organic silts and clays; (2) gravelly, sandy or silty clays; and (3) clayey silts. Consistency is rated according to shear strength as indicated.

Consistency of Cohesive soils	SPT N-Value blows per foot	Approximate Undrained Shear Strength (psf)	Field Guidelines
Very Soft	WOH, WOR, WOP, <2	0 - 250	Fist easily Penetrates
Soft	2 - 4	250 - 500	Thumb easily penetrates
Medium Stiff	5 - 8	500 - 1000	Thumb penetrates with moderate effort
Stiff	9 - 15	1000 - 2000	Indented by thumb with great effort
Very Stiff	16 - 30	2000 - 4000	Indented by thumbnai
Hard	>30	over 4000	Indented by thumbnail with difficulty

Rock Quality Designation (RQD):

$$RQD = \frac{\text{sum of the lengths of intact pieces of core* > 100 mm}}{\text{length of core advance}}$$

*Minimum NQ rock core (1.88 in. OD of core)

Correlation of RQD to Rock Mass Quality

Rock Mass Quality	RQD
Very Poor	<25%
Poor	26% - 50%
Fair	51% - 75%
Good	76% - 90%
Excellent	91% - 100%

Desired Rock Observations: (in this order)

Color (Munsell color chart)
Texture (aphanitic, fine-grained, etc.)
Lithology (igneous, sedimentary, metamorphic, etc.)
Hardness (very hard, hard, mod. hard, etc.)
Weathering (fresh, very slight, slight, moderate, mod. severe, severe, etc.)
Geologic discontinuities/jointing:
- -dip (horiz - 0-5, low angle - 5-35, mod. dipping - 35-55, steep - 55-85, vertical - 85-90)
- -spacing (very close - <5 cm, close - 5-30 cm, mod. close 30-100 cm, wide - 1-3 m, very wide >3 m)
- -tightness (tight, open or healed)
- -infilling (grain size, color, etc.)

Formation (Waterville, Ellsworth, Cape Elizabeth, etc.)
RQD and correlation to rock mass quality (very poor, poor, etc.)
ref: AASHTO Standard Specification for Highway Bridges 17th Ed. Table 4.4.8.1.2A
Recovery

Maine Department of Transportation
Geotechnical Section
Key to Soil and Rock Descriptions and Terms
Field Identification Information

Sample Container Labeling Requirements:

PIN	Blow Counts
Bridge Name / Town	Sample Recovery
Boring Number	Date
Sample Number	Personnel Initials
Sample Depth	

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Pine Point Road over B&M Railroad
Location: Scarborough, Maine

Boring No.: BB-SBMR-101
PIN: 18229.00

Driller:	Northern Test Boring	**Elevation (ft.)**	35.2	**Auger ID/OD:**	2-1/4" / 5"
Operator:	Mike Nadeau / Adam Woodbrey	**Datum:**	NAVD 88	**Sampler:**	1-3/8" Split-Spoon
Logged By:	J. Mailloux (Nobis Engineering)	**Rig Type:**	ATV / Diedrich D50	**Hammer Wt./Fall:**	140# / 30"
Date Start/Finish:	Sep 10, 2012 / Sep 10, 2012	**Drilling Method:**	HSA / Drive & Wash	**Core Barrel:**	NQ-2"
Boring Location:	See Boring Location Plan	**Casing ID/OD:**	4" / 4.5"	**Water Level*:**	26.0' bgs
Hammer Efficiency Factor:	0.719	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
MD = Unsuccessful Split Spoon Sample attempt
U = Thin Wall Tube Sample
MU = Unsuccessful Thin Wall Tube Sample attempt
V = Insitu Vane Shear Test, PP = Pocket Penetrometer
MV = Unsuccessful Insitu Vane Shear Test attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = weight of 140lb. hammer
WOR/C = weight of rods or casing
WO1P = Weight of one person
S_u = Insitu Field Vane Shear Strength (psf)
T_v = Pocket Torvane Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw field SPT N-value
Hammer Efficiency Factor = Annual Calibration Value
N_{60} = SPT N-uncorrected corrected for hammer efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
$S_{u(lab)}$ = Lab Vane Shear Strength (psf)
WC = water content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	1D	24/12	0.50 - 2.50	8/10/12/8	22	26		34.70	7" ASPHALT (0.50) 1D: Brown, moist, medium dense, gravelly SAND, trace Silt. (Fill).	
5	2D	24/17	5.00 - 7.00	5/5/6/6	11	13			2D: Brown, moist, medium dense, SAND, little Silt, little Gravel. (Fill).	WC=7.2% Fines Content:13%
10	3D	24/19	10.00 - 12.00	7/9/8/7	17	20			3D-A: (0-7") Brown, moist, medium dense, SAND, little fine Gravel, trace Silt. (Fill). 3D-B: (7-19") Gray/Brown, moist, medium dense, SAND, some Gravel, trace Silt, trace brick pieces. (Fill).	WC=6% Fines Content:9%
15	4D	24/14	15.00 - 17.00	5/6/10/10	16	19			4D: Gray, dry, medium dense, sandy GRAVEL, trace Silt. (Fractured Rock Fill).	
20	5D	24/14	20.00 - 22.00	12/10/9/7	19	23			5D: Gray/Brown, moist, medium dense, gravelly SAND, trace Silt. (Fractured Rock Fill).	
25	6D	24/17	25.00 - 27.00	12/9/4/3	13	16	104	9.53	6D-A: (0-8") Gray, moist, medium dense, gravelly SAND, trace Silt. (Fill). (25.67) 6D-B: (8-11") Orange, wet, medium dense, fine to medium SAND, some Silt, trace Clay. Rolled to 1/8". (Original Ground Surface). 6D-C: (11-17") Gray, wet, medium dense, fine SAND, some Silt, trace fine Gravel, trace Clay. (Silty Sand).	pH=5.6
							112			
							161			
							125			
30							120			

Remarks:

Augered top 25 feet to GW, then switched to Drive & Wash.
Drilled open hole starting at 30 feet below ground surface.
Approximately 15 gallons water lost during coring.
Borehole repaired by filling with auger cuttings, letting sit overnight to settle, then placing cold patch.

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.

* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Pine Point Road over B&M Railroad
Location: Scarborough, Maine

Boring No.: BB-SBMR-101
PIN: 18229.00

Driller:	Northern Test Boring	**Elevation (ft.)**	35.2	**Auger ID/OD:**	2-1/4" / 5"
Operator:	Mike Nadeau / Adam Woodbrey	**Datum:**	NAVD 88	**Sampler:**	1-3/8" Split-Spoon
Logged By:	J. Mailloux (Nobis Engineering)	**Rig Type:**	ATV / Diedrich D50	**Hammer Wt./Fall:**	140# / 30"
Date Start/Finish:	Sep 10, 2012 / Sep 10, 2012	**Drilling Method:**	HSA / Drive & Wash	**Core Barrel:**	NQ-2"
Boring Location:	See Boring Location Plan	**Casing ID/OD:**	4" / 4.5"	**Water Level*:**	26.0' bgs
Hammer Efficiency Factor:	0.719	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
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SSA = Solid Stem Auger
HSA = Hollow Stem Auger
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WOH = weight of 140lb. hammer
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WO1P = Weight of one person
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T_v = Pocket Torvane Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw field SPT N-value
Hammer Efficiency Factor = Annual Calibration Value
N_{60} = SPT N-uncorrected corrected for hammer efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
$S_{u(lab)}$ = Lab Vane Shear Strength (psf)
WC = water content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
30	7D	24/14	30.00 - 32.00	5/6/6/5	12	14				7D: Gray, wet, medium dense, SAND, some Silt, little Gravel, little Clay. (Silty Sand).	
35	8D	24/13	35.00 - 37.00	6/6/4/7	10	12				8D: Gray, wet, medium dense, SAND, some Silt, little Gravel, trace Clay. Rolled to 1/8". (Silty Sand).	WC=10% Fines Content:36% LL=14 PL=11 PI=3
40	9D	24/14	40.00 - 42.00	5/5/8/8	13	16				9D: Gray, wet, medium dense, SAND, some Silt, little Clay, trace fine Gravel. Rolled to 1/16". (Silty Sand).	
								-7.80		43.00 Increased roller bit resistance at 43.0' bgs.	
45	10D	24/22	45.00 - 47.00	15/23/21/26	44	53				10D: Gray, wet, dense, SAND, some Silt, little Gravel, trace Clay. (Till).	WC=8.3% Fines Content:40%
50	11D	24/15	50.00 - 52.00	12/30/27/42	57	68				11D: Gray, wet, very dense, SAND, little Silt, little fine Gravel. (Till).	
55	12D	24/20	55.00 - 57.00	18/22/21/23	43	52				12D: Gray, wet, dense, SAND, little Silt, trace fine Gravel, trace Clay. (Glacial Till).	
60											

Remarks:

Augered top 25 feet to GW, then switched to Drive & Wash.
Drilled open hole starting at 30 feet below ground surface.
Approximately 15 gallons water lost during coring.
Borehole repaired by filling with auger cuttings, letting sit overnight to settle, then placing cold patch.

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Pine Point Road over B&M Railroad
Location: Scarborough, Maine

Boring No.: BB-SBMR-101
PIN: 18229.00

Driller:	Northern Test Boring	**Elevation (ft.)**	35.2	**Auger ID/OD:**	2-1/4" / 5"
Operator:	Mike Nadeau / Adam Woodbrey	**Datum:**	NAVD 88	**Sampler:**	1-3/8" Split-Spoon
Logged By:	J. Mailloux (Nobis Engineering)	**Rig Type:**	ATV / Diedrich D50	**Hammer Wt./Fall:**	140# / 30"
Date Start/Finish:	Sep 10, 2012 / Sep 10, 2012	**Drilling Method:**	HSA / Drive & Wash	**Core Barrel:**	NQ-2"
Boring Location:	See Boring Location Plan	**Casing ID/OD:**	4" / 4.5"	**Water Level*:**	26.0' bgs
Hammer Efficiency Factor:	0.719	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
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SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = weight of 140lb. hammer
WOR/C = weight of rods or casing
WO1P = Weight of one person
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C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
60	13D	24/16	60.00 - 62.00	14/20/21/23	41	49				13D: Gray, wet, dense, SAND, some Silt, little Gravel. (Till).	
65	14D	24/11	65.00 - 67.00	15/17/26/20	43	52				14D: Gray, wet, dense, SAND, some Silt, little Gravel, little Clay. (Till).	WC=10% Fines Content:53% Clay Content:22% LL=18 PL=10 PI=8
70	15D	24/21	70.00 - 72.00	14/19/24/32	43	52				15D: Gray, wet, dense, SAND, some Silt, little Clay, trace fine Gravel. (Till).	
75	16D	24/15	75.00 - 77.00	11/12/18/26	30	36				16D: Gray, wet, dense, SAND, some Silt, little Clay, trace fine Gravel. (Till).	
80	17D	20.5/4	80.00 - 81.71	16/19/26/50-2.5"	45	54				17D: Gray, wet, dense, SAND, some Silt, little Clay, with coarse Gravel stuck in spoon. (Till).	
85	18D	24/9	85.00 - 87.00	10/11/10/17	21	25		-49.80		85.00 18D: Gray, wet, very stiff, CLAY, some Silt, little fine to medium Sand.	
90										Increased drilling resistance at 89.5 feet.	

Remarks:

Augered top 25 feet to GW, then switched to Drive & Wash.
Drilled open hole starting at 30 feet below ground surface.
Approximately 15 gallons water lost during coring.
Borehole repaired by filling with auger cuttings, letting sit overnight to settle, then placing cold patch.

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Pine Point Road over B&M Railroad
Location: Scarborough, Maine

Boring No.: BB-SBMR-101
PIN: 18229.00

Driller:	Northern Test Boring	**Elevation (ft.)**	35.2	**Auger ID/OD:**	2-1/4" / 5"
Operator:	Mike Nadeau / Adam Woodbrey	**Datum:**	NAVD 88	**Sampler:**	1-3/8" Split-Spoon
Logged By:	J. Mailloux (Nobis Engineering)	**Rig Type:**	ATV / Diedrich D50	**Hammer Wt./Fall:**	140# / 30"
Date Start/Finish:	Sep 10, 2012 / Sep 10, 2012	**Drilling Method:**	HSA / Drive & Wash	**Core Barrel:**	NQ-2"
Boring Location:	See Boring Location Plan	**Casing ID/OD:**	4" / 4.5"	**Water Level*:**	26.0' bgs
Hammer Efficiency Factor:	0.719	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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WOH = weight of 140lb. hammer
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N-uncorrected = Raw field SPT N-value
Hammer Efficiency Factor = Annual Calibration Value
N_{60} = SPT N-uncorrected corrected for hammer efficiency
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WC = water content, percent
LL = Liquid Limit
PL = Plastic Limit
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G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
90	19D	9.5/9.5	90.00 - 90.79	9/50-3.5"				-55.60		19D: Gray, wet, dense, SILT, some Clay, some Sand, trace fine Gravel. 90.80	
	R1	54/44	91.00 - 95.50	RQD=51%						Split-Spoon and Roller Bit refusal at 90.8' bgs. Advanced roller bit to 91' bgs. Bedrock: Black, fine grained, metamorphic, hard, fresh to slightly weathered, PHYLLITE, with moderately dipping, closely spaced, tight to healed joints.	
95	R2	60/57.5	95.50 - 100.50	RQD=70%						R1: Rock Mass Quality: Fair Core Times (min:sec) 91.0'-92.0' 4:40 92.0'-93.0' 4:30 93.0'-94.0' 8:20 94.0'-95.0' 4:40 95.0'-95.5' 4:30 81% Recovery R2: Rock Mass Quality: Fair Core Times (min:sec) 95.5'-96.0' 1:30 96.0'-97.0' 3:00 97.0'-98.0' 3:00 98.0'-99.0' 3:00 99.0'-100.0' 3:00 100.0'-100.5' 1:30 96% Recovery	
100								-65.30		100.50 **Bottom of Exploration at 100.50 feet below ground surface.**	
105											
110											
115											
120											

Remarks:

Augered top 25 feet to GW, then switched to Drive & Wash.
Drilled open hole starting at 30 feet below ground surface.
Approximately 15 gallons water lost during coring.
Borehole repaired by filling with auger cuttings, letting sit overnight to settle, then placing cold patch.

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.

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Boring No.: BB-SBMR-101

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Pine Point Road over B&M Railroad
Location: Scarborough, Maine

Boring No.: BB-SBMR-102
PIN: 18229.00

Driller:	Northern Test Boring	**Elevation (ft.)**	13.1	**Auger ID/OD:**	2-1/4" / 5"
Operator:	Mike Nadeau / Adam Woodbrey	**Datum:**	NAVD 88	**Sampler:**	1-3/8" Split-Spoon
Logged By:	J. Mailloux (Nobis Engineering)	**Rig Type:**	ATV / Diedrich D50	**Hammer Wt./Fall:**	140# / 30"
Date Start/Finish:	Sep 11, 2012 / Sep 12, 2012	**Drilling Method:**	HSA / Drive & Wash	**Core Barrel:**	NQ-2"
Boring Location:	See Boring Location Plan	**Casing ID/OD:**	4" / 4.5"	**Water Level*:**	5.4' bgs
Hammer Efficiency Factor:	0.719	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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SSA = Solid Stem Auger
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Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	1D	24/7	0.00 - 2.00	4/5/4/5	9	11			1D: Brown, moist, loose, SAND, some Silt, trace fine Gravel, trace Organics, with piece of plastic. (Topsoil Fill).	
5	2D	24/5	5.00 - 7.00	2/1/2/2	3	4			2D: Brown, wet, loose, SAND, some Silt, little fine Gravel, trace Organics (roots). (Fill).	
								5.60	7.50	
10	3D	24/19	10.00 - 12.00	3/6/10/9	16	19	25		3D: Gray/Black, wet, medium dense, SAND, some Silt, little fine Gravel, trace Clay . Rolled to 1/8". Slight unidentifiable odor and black staining, no sheen. (Silty Sand).	WC=10% Fines Content:37% LL=14 PL=11 PI=3 pH=5.6
							28			
							30			
							31			
							34			
15	4D	24/13	15.00 - 17.00	7/14/20/14	34	41		-1.90	15.00	
									4D: Gray, wet, dense, SAND, some Silt, little Gravel, little Clay. (Till).	
20	5D	7/6	20.00 - 20.58	12/50-1"					5D: Gray, wet, very dense, SAND, some Silt, trace fine Gravel, trace Clay. (Till). Possible rock at tip. Not retrieved. Possible cobble at 20.6 feet.	
25	6D	24/6	25.00 - 27.00	28/19/19/20	38	46			6D: Gray, wet, dense, SAND, little Silt, little fine Gravel. (Till).	
30										

Remarks:

Switched from HSA to casing at 10 feet. Cased to 15 feet then started open hole.
Approximately 15 gallons water lost during 10 feet of coring.
Borehole was filled with auger cuttings.

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.

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Boring No.: BB-SBMR-102

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Pine Point Road over B&M Railroad
Location: Scarborough, Maine

Boring No.: BB-SBMR-102
PIN: 18229.00

Driller:	Northern Test Boring	**Elevation (ft.)**	13.1	**Auger ID/OD:**	2-1/4" / 5"
Operator:	Mike Nadeau / Adam Woodbrey	**Datum:**	NAVD 88	**Sampler:**	1-3/8" Split-Spoon
Logged By:	J. Mailloux (Nobis Engineering)	**Rig Type:**	ATV / Diedrich D50	**Hammer Wt./Fall:**	140# / 30"
Date Start/Finish:	Sep 11, 2012 / Sep 12, 2012	**Drilling Method:**	HSA / Drive & Wash	**Core Barrel:**	NQ-2"
Boring Location:	See Boring Location Plan	**Casing ID/OD:**	4" / 4.5"	**Water Level*:**	5.4' bgs
Hammer Efficiency Factor:	0.719	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
30	7D	24/18	30.00 - 32.00	15/17/16/16	33	40			7D: Gray, wet, dense, SAND, little Silt, trace fine Gravel. (Till).	
35	8D	24/16	35.00 - 37.00	11/14/19/22	33	40			8D: Gray, wet, dense, SAND, little Silt, little fine Gravel, trace Clay. (Till).	
40	9D	24/0	40.00 - 42.00	29/38/49/60	87	104			9D: No Recovery High blows possibly due to pushing stone.	
								-30.60	43.70	
45	R1	60/60	45.00 - 50.00	RQD=81%					Encountered possible bedrock at 43.7' bgs. Driller advanced auger to 45.0' bgs to verify. Bedrock: Black/Gray, fine grained, metamorphic, hard, fresh to very slightly weathered, PHYLLITE, with low to moderately dipping, closely to moderately closely spaced, tight joints. R1: Rock Mass Quality: Good Core Times (min:sec) 45'-46' 2:40 46'-47' 2:55 47'-48' 2:35 48'-49' 3:00 49'-50' 3:10 100% Recovery	
50	R2	60/57	50.00 - 55.00	RQD=78%					R2: Rock Mass Quality: Good Core Times (min:sec) 50'-51' 4:50 51'-52' 4:00 52'-53' 2:25 53'-54' 2:10 54'-55' 1:35 95% Recovery	
55								-41.90	55.00	
60									**Bottom of Exploration at 55.00 feet below ground surface.**	

Remarks:

Switched from HSA to casing at 10 feet. Cased to 15 feet then started open hole.
Approximately 15 gallons water lost during 10 feet of coring.
Borehole was filled with auger cuttings.

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.

* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.

Boring No.: BB-SBMR-102

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Pine Point Road over B&M Railroad
Location: Scarborough, Maine

Boring No.: BB-SBMR-103
PIN: 18229.00

Driller:	Northern Test Boring	**Elevation (ft.)**	15.0	**Auger ID/OD:**	2-1/4" / 5"
Operator:	Mike Nadeau / Adam Woodbrey	**Datum:**	NAVD 88	**Sampler:**	1-3/8" Split-Spoon
Logged By:	J. Mailloux (Nobis Engineering)	**Rig Type:**	ATV / Diedrich D50	**Hammer Wt./Fall:**	140# / 30"
Date Start/Finish:	Sep 13, 2012 / Sep 13, 2012	**Drilling Method:**	HSA / Drive & Wash	**Core Barrel:**	NQ-2"
Boring Location:	See Boring Location Plan	**Casing ID/OD:**	4" / 4.5"	**Water Level*:**	8.1' bgs
Hammer Efficiency Factor:	0.719	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
MD = Unsuccessful Split Spoon Sample attempt
U = Thin Wall Tube Sample
MU = Unsuccessful Thin Wall Tube Sample attempt
V = Insitu Vane Shear Test, PP = Pocket Penetrometer
MV = Unsuccessful Insitu Vane Shear Test attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = weight of 140lb. hammer
WOR/C = weight of rods or casing
WO1P = Weight of one person
S_u = Insitu Field Vane Shear Strength (psf)
T_v = Pocket Torvane Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw field SPT N-value
Hammer Efficiency Factor = Annual Calibration Value
N_{60} = SPT N-uncorrected corrected for hammer efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
$S_{u(lab)}$ = Lab Vane Shear Strength (psf)
WC = water content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	1D	24/20	0.00 - 2.00	6/6/7/8	13	16			1D: Dark Brown, moist, medium dense, SAND, little Gravel, little Silt, trace coal ash. (Fill).	
	2D	24/13	2.00 - 4.00	5/3/2/2	5	6			2D: Brown, wet, loose, silty fine to medium SAND, trace fine Gravel. (Fill).	
5	3D	24/23	5.00 - 7.00	2/1/1/4	2	2		9.08	3D-A: (0-11") Gray/Brown, wet, very loose, silty SAND, trace fine Gravel. (Fill).	
									5.92	
	4D	24/24	7.00 - 9.00	5/6/5/6	11	13	36		3D-B: (11-23") Gray, wet, very loose, silty fine to medium SAND, trace fine Gravel. (Silty Sand) 4D: Gray, wet, loose, fine to medium SAND, some Silt, little Clay, trace fine Gravel. (Silty Sand).	Fines Content:42% Clay Content:14%
							41			
							45			
10	5D	24/17	10.00 - 12.00	5/12/11/9	23	28			5D: Gray, wet, medium dense, SAND, some Silt, trace fine Gravel, trace Clay. Rolled to 1/4". (Silty Sand).	
	6D	24/17	12.00 - 14.00	11/11/11/11	22	26			6D: Gray, wet, medium dense, SAND, some Silt, trace fine Gravel, trace Clay. Rolled to 1/8". (Silty Sand).	
15	7D	24/17	15.00 - 17.00	7/5/7/8	13	16			7D: Gray, wet, medium dense, SAND, some Silt, trace fine Gravel, trace Clay. Rolled to 1/4". (Silty Sand).	
	8D	24/20	17.00 - 19.00	13/9/11/14	20	24			8D: Gray, wet, medium dense, SAND, some Silt, little Clay, trace fine Gravel. Rolled to 1/16". (Silty Sand).	
20								-5.00	20.00	
	9D	24/22	20.00 - 22.00	12/17/19/20	36	43			9D: Gray, wet, dense, SAND, some silt, trace fine Gravel, trace Clay. (Till).	WC=8.4% Fines Content:39%
	10D	24/18	22.00 - 24.00	20/22/22/24	44	53			10D: Gray, wet, dense, SAND, some Silt, trace fine Gravel, trace Clay. (Till).	
25	11D	24/21	25.00 - 27.00	15/28/32/18	60	72			11D: Gray, wet, very dense, SAND, some Silt, trace fine Gravel, trace Clay. (Till).	
30										

Remarks:

Augered to 5' bgs, then switched to casing. Pushed casing to 6.5' bgs. Drove Casing to 10' bgs then drilled open hole.
Possible cobbles 19-20' bgs.
Rock core stuck in barrel during R2 core at 24". At 49.3' bgs the tooth matrix sheaved off the bit and could no longer advance. Approximately 10 gallons of water lost during coring.
Borehole repaired by filling up with cuttings and mounding in case of settlement.

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.

* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.

Boring No.: BB-SBMR-103

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Pine Point Road over B&M Railroad
Location: Scarborough, Maine

Boring No.: BB-SBMR-103
PIN: 18229.00

Driller:	Northern Test Boring	**Elevation (ft.)**	15.0	**Auger ID/OD:**	2-1/4" / 5"
Operator:	Mike Nadeau / Adam Woodbrey	**Datum:**	NAVD 88	**Sampler:**	1-3/8" Split-Spoon
Logged By:	J. Mailloux (Nobis Engineering)	**Rig Type:**	ATV / Diedrich D50	**Hammer Wt./Fall:**	140# / 30"
Date Start/Finish:	Sep 13, 2012 / Sep 13, 2012	**Drilling Method:**	HSA / Drive & Wash	**Core Barrel:**	NQ-2"
Boring Location:	See Boring Location Plan	**Casing ID/OD:**	4" / 4.5"	**Water Level*:**	8.1' bgs
Hammer Efficiency Factor:	0.719	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
MD = Unsuccessful Split Spoon Sample attempt
U = Thin Wall Tube Sample
MU = Unsuccessful Thin Wall Tube Sample attempt
V = Insitu Vane Shear Test, PP = Pocket Penetrometer
MV = Unsuccessful Insitu Vane Shear Test attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = weight of 140lb. hammer
WOR/C = weight of rods or casing
WO1P = Weight of one person
S_u = Insitu Field Vane Shear Strength (psf)
T_v = Pocket Torvane Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw field SPT N-value
Hammer Efficiency Factor = Annual Calibration Value
N_{60} = SPT N-uncorrected corrected for hammer efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
$S_{u(lab)}$ = Lab Vane Shear Strength (psf)
WC = water content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
30	12D	24/23	30.00 - 32.00	22/24/24/26	48	58				12D: Gray, wet, dense, SAND, some Silt, trace fine Gravel, with 3" layer of SAND, trace Silt at 30.5' bgs (sample taken). (Till).	
35	13D	23/21	35.00 - 36.92	25/40/51/50-5"	91	109				13D: Gray, wet, very dense, SAND, some Silt, little Clay, trace Gravel. (Till).	
40	R1	65/62.5	40.00 - 45.42	RQD=84%				-24.90		39.90 Encountered possible bedrock at 39.9' bgs. Advanced Roller Bit to 40.0' bgs. Bedrock: Black/Gray, fine grained, metamorphic, hard, fresh to moderately weathered, PHYLLITE, with moderately dipping, closely to moderately closely spaced, tight to open joints, gray sandy silt infill at top joint. R1: Rock Mass Quality: Good Core Times (min:sec) 40'-41' 2:25 41'-42' 2:10 42'-43' 3:05 43'-44' 2:35 44'-45' 2:30 45'-45.4' 1:00 96% Recovery	
45	R2	24/24	45.40 - 47.40	RQD=48%						R2: Rock Mass Quality: Poor Core Times (min:sec) 45.4'-46.4' 2:10 46.4'-47.4' 2:50 100% Recovery	
	R3	23/17.5	47.40 - 49.32	RQD=43%				-34.30		R3: Rock Mass Quality: Poor Core Times (min:sec) 47.4'-48.4' 4:00 48.4'-49.3' 3:00 76% Recovery 49.30 **Bottom of Exploration at 49.30 feet below ground surface.**	
50											
55											
60											

Remarks:

Augered to 5' bgs, then switched to casing. Pushed casing to 6.5' bgs. Drove Casing to 10' bgs then drilled open hole.
Possible cobbles 19-20' bgs.
Rock core stuck in barrel during R2 core at 24". At 49.3' bgs the tooth matrix sheaved off the bit and could no longer advance. Approximately 10 gallons of water lost during coring.
Borehole repaired by filling up with cuttings and mounding in case of settlement.

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.

* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.

Boring No.: BB-SBMR-103

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Pine Point Road over B&M Railroad
Location: Scarborough, Maine

Boring No.: BB-SBMR-104
PIN: 18229.00

Driller:	Northern Test Boring	**Elevation (ft.)**	17.5	**Auger ID/OD:**	N/A
Operator:	Mike Nadeau / Adam Woodbrey	**Datum:**	NAVD 88	**Sampler:**	1-3/8" Split-Spoon
Logged By:	J. Mailloux (Nobis Engineering)	**Rig Type:**	ATV / Diedrich D50	**Hammer Wt./Fall:**	140# / 30"
Date Start/Finish:	Sep 12, 2012 / Sep 12, 2012	**Drilling Method:**	Drive & Wash	**Core Barrel:**	NQ-2"
Boring Location:	See Boring Location Plan	**Casing ID/OD:**	4" / 4.5"	**Water Level*:**	2.0' bgs
Hammer Efficiency Factor:	0.719	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
MD = Unsuccessful Split Spoon Sample attempt
U = Thin Wall Tube Sample
MU = Unsuccessful Thin Wall Tube Sample attempt
V = Insitu Vane Shear Test, PP = Pocket Penetrometer
MV = Unsuccessful Insitu Vane Shear Test attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = weight of 140lb. hammer
WOR/C = weight of rods or casing
WO1P = Weight of one person
S_u = Insitu Field Vane Shear Strength (psf)
T_v = Pocket Torvane Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw field SPT N-value
Hammer Efficiency Factor = Annual Calibration Value
N_{60} = SPT N-uncorrected corrected for hammer efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
$S_{u(lab)}$ = Lab Vane Shear Strength (psf)
WC = water content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	1D	24/11	0.00 - 2.00	5/2/3/4	5	6	16		1D: Brown, moist, loose, SAND, little Silt, little Gravel, trace Organics. (Fill).	
							31			
							31			
	2D	24/7	3.00 - 5.00	9/14/8/4	22	26	30		2D: Brown, moist, medium dense, SAND, some Gravel, little Silt. (Fill). Rock stuck in tip of spoon.	
							31			
5	3D	24/12	5.00 - 7.00	5/4/5/6	9	11	42	12.50	5.00	
							71	11.50	3D-A: (0-5") Brown, wet, loose, fine SAND, little Silt, trace Organics, with black organic seam at top. 6.00	pH=6.0
							83		3D-B (5-12") Gray, wet, loose, SAND, little Silt, trace fine Gravel. (Silty Sand).	
	4D	24/19	8.00 - 10.00	7/8/13/11	21	25			4D: Gray, wet, medium dense, fine SAND, some Silt, trace Clay, trace fine Gravel. Rolled to 1/4". (Silty Sand).	WC=10.1% Fines Content:37%
10	5D	24/18	10.00 - 12.00	14/18/18/21	36	43		7.50	10.00 5D: Gray, wet, dense, SAND, little Silt, little Gravel, trace Clay. (Till).	WC=8% LL=14 PL=10 PI=4
	6D	24/21	13.00 - 15.00	25/29/36/44	65	78			6D: Gray, wet, very dense, SAND, some Silt, little fine Gravel, trace Clay. (Till).	
15	7D	15/11	15.00 - 16.25	29/55/50-3"					7D: Gray, wet, very dense, SAND, some Silt, little Gravel, trace Clay. (Till). Refusal due to full spoon from wash spoils.	
	8D	24/21	18.00 - 20.00	30/42/45/60	87	104			8D: Gray, wet, very dense, fine SAND, some Silt, trace fine Gravel, trace Clay. (Till).	
20	9D	24/20	20.00 - 22.00	36/36/36/34	72	86			9D: Gray, wet, very dense, SAND, some Silt, little fine Gravel, trace Clay. (Till).	
25	10D	24/19	25.00 - 27.00	21/26/40/42	66	79			10D: Grat, wet, very dense, SAND, some Silt, little Gravel, trace Clay. (Till).	
30										

Remarks:

BB-SBMR-104 drilled through bridge deck to ground surface 22.0' below deck. Deck core obtained. 5" Asphalt, 6" Concrete Bridge Deck. Cased to 8.0' bgs then started drilling open hole. At approximately 35.0' bgs driller noted loss of drilling water. Lost approximaetly 100 gallons. During coring of R1 and R2 lost approximately 300 gallons of water. During coring of R3 lost approximately 300 gallons of water.
Borehole reparied by filling with large stones. Bridge deck reparied by filling with high strength quick set concrete. Concrete left to cure one hour before allowing traffic.

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.

* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Pine Point Road over B&M Railroad
Location: Scarborough, Maine

Boring No.: BB-SBMR-104
PIN: 18229.00

Driller:	Northern Test Boring	**Elevation (ft.)**	17.5	**Auger ID/OD:**	N/A
Operator:	Mike Nadeau / Adam Woodbrey	**Datum:**	NAVD 88	**Sampler:**	1-3/8" Split-Spoon
Logged By:	J. Mailloux (Nobis Engineering)	**Rig Type:**	ATV / Diedrich D50	**Hammer Wt./Fall:**	140# / 30"
Date Start/Finish:	Sep 12, 2012 / Sep 12, 2012	**Drilling Method:**	Drive & Wash	**Core Barrel:**	NQ-2"
Boring Location:	See Boring Location Plan	**Casing ID/OD:**	4" / 4.5"	**Water Level*:**	2.0' bgs
Hammer Efficiency Factor:	0.719	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
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R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = weight of 140lb. hammer
WOR/C = weight of rods or casing
WO1P = Weight of one person
S_u = Insitu Field Vane Shear Strength (psf)
T_v = Pocket Torvane Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw field SPT N-value
Hammer Efficiency Factor = Annual Calibration Value
N_{60} = SPT N-uncorrected corrected for hammer efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
$S_{u(lab)}$ = Lab Vane Shear Strength (psf)
WC = water content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
30	11D	24/20	30.00 - 32.00	25/25/24/29	49	59			11D: Gray, wet, dense, SAND, some Silt, little Gravel, trace Clay. (Till).	
35	12D	24/21	35.00 - 37.00	17/29/34/64	63	75			12D: Gray, wet, very dense, SAND, some Silt, little fine Gravel, little Clay. (Till).	
									Possible cobble at 38.0' bgs.	
40	13D	15.5/14	40.00 - 41.29	18/24/50-3.5"					13D: Gray, wet, very dense, SAND, some Silt, little fine Gravel, trace Clay. (Till).	
								-23.80	41.30	
	R1	54/42	42.00 - 46.50	RQD=19%					Encountered bedrock at 41.3' bgs, advanced bit to 42.0' bgs to verify. Bedrock: Black/Gray, fine grained, metamorphic, hard to soft, moderately to highly weathered, PHYLLITE, with moderately to steeply dipping, very closely to closely spaced, open to healed joints. R1: Rock Mass Quality: Very Poor Core Times (min:sec) 42.0'-43.0' 2:50 43.0'-44.0' 1:50 44.0'-45.0' 1:30 45.0'-46.0' 1:30 46.0'-46.5' 1:00 78% Recovery Core sample from 2"-12" likely pulverized due to being stuck in core barrel.	
45	R2	36/31	46.50 - 49.50	RQD=44%					R2: Rock Mass Quality: Poor Core Times (min:sec) 46.5'-47.0' 1:10 47.0'-48.0' 1:05 48.0'-49.0' 2:30 49.0'-49.5' 0:35 86% Recovery Core sample stuck at 49.5' bgs.	
50	R3	25/23	49.50 - 51.58	RQD=36%				-34.10	R3: Rock Mass Quality: Poor Core Times (min:sec) 49.5'-50.0' 1:25 50.0'-51.0' 4:30 51.0'-51.6' 2:20 92% Recovery Core sample stuck at 51.6' bgs. Coring terminated.	
55									51.60	
60									**Bottom of Exploration at 51.60 feet below ground surface.**	

Remarks:

BB-SBMR-104 drilled through bridge deck to ground surface 22.0' below deck. Deck core obtained. 5" Asphalt, 6" Concrete Bridge Deck. Cased to 8.0' bgs then started drilling open hole. At approximately 35.0' bgs driller noted loss of drilling water. Lost approximaetly 100 gallons. During coring of R1 and R2 lost approximately 300 gallons of water. During coring of R3 lost approximately 300 gallons of water.
Borehole reparied by filling with large stones. Bridge deck reparied by filling with high strength quick set concrete. Concrete left to cure one hour before allowing traffic.

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Boring No.: BB-SBMR-104

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Pine Point Road over B&M Railroad
Location: Scarborough, Maine

Boring No.: BB-SBMR-105
PIN: 18229.00

Driller:	Northern Test Boring	**Elevation (ft.)**	40.1	**Auger ID/OD:**	2-1/4" / 5"
Operator:	Mike Nadeau / Adam Woodbrey	**Datum:**	NAVD 88	**Sampler:**	1-3/8" Split-Spoon
Logged By:	J. Mailloux (Nobis Engineering)	**Rig Type:**	ATV / Diedrich D50	**Hammer Wt./Fall:**	140# / 30"
Date Start/Finish:	Sep 11, 2012 / Sep 11, 2012	**Drilling Method:**	HSA / Drive & Wash	**Core Barrel:**	NQ-2"
Boring Location:	See Boring Location Plan	**Casing ID/OD:**	4" / 4.5"	**Water Level*:**	25.0' bgs wet sample
Hammer Efficiency Factor:	0.719	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = weight of 140lb. hammer
WOR/C = weight of rods or casing
WO1P = Weight of one person
S_u = Insitu Field Vane Shear Strength (psf)
T_v = Pocket Torvane Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw field SPT N-value
Hammer Efficiency Factor = Annual Calibration Value
N_{60} = SPT N-uncorrected corrected for hammer efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
$S_{u(lab)}$ = Lab Vane Shear Strength (psf)
WC = water content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	1D	24/17	0.60 - 2.60	12/10/8/8	18	22		39.50	7.75" ASPHALT — 0.60	
									1D: Brown, moist, medium dense, SAND, some Gravel, trace Silt. (Fill).	
5	2D	24/16	5.00 - 7.00	5/5/4/3	9	11			2D: Brown, moist, loose, SAND, little fine Gravel, trace Silt. (Fill).	
10	3D	24/16	10.00 - 12.00	5/4/3/2	7	8			3D: Brown, moist, loose, SAND, little Gravel, trace Silt. (Fill).	WC=6.8% Fines Content:9%
15	4D	24/20	15.00 - 17.00	9/9/9/9	18	22			4D: Brown, moist, medium dense, SAND, little Gravel, little Silt. (Fill).	
20	5D	24/15	20.00 - 22.00	5/3/3/2	6	7			5D: Brown, moist, medium dense, SAND, little fine Gravel, little Silt. (Fill).	
							59			
							64			
							70			
							75			
25	6D	24/16	25.00 - 27.00	6/3/3/4	6	7	20	14.90	6D-A: (0-2") Brown, wet, loose, SAND, some fine Gravel, little Silt. (Fill). — 25.20	pH=6.2
							40		6D-B: (2-16") Gray, wet, loose, fine to medium SAND, some Silt, trace fine Gravel, trace Organics (roots) with 1" Peat layer at top of spoon. (Silty Sand).	
							46			
							66			
30							82			

Remarks:

Switched from HSA to Drive & Wash at 20.0' bgs.
Started drilling roller bit open hole at 30.0' bgs.
Approximately 15 gallons water lost during coring.
Borehole was repaired by filling with auger cuttings, letting sit overnight to settle, then placing cold patch.

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.

* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Pine Point Road over B&M Railroad
Location: Scarborough, Maine

Boring No.: BB-SBMR-105
PIN: 18229.00

Driller:	Northern Test Boring	**Elevation (ft.)**	40.1	**Auger ID/OD:**	2-1/4" / 5"
Operator:	Mike Nadeau / Adam Woodbrey	**Datum:**	NAVD 88	**Sampler:**	1-3/8" Split-Spoon
Logged By:	J. Mailloux (Nobis Engineering)	**Rig Type:**	ATV / Diedrich D50	**Hammer Wt./Fall:**	140# / 30"
Date Start/Finish:	Sep 11, 2012 / Sep 11, 2012	**Drilling Method:**	HSA / Drive & Wash	**Core Barrel:**	NQ-2"
Boring Location:	See Boring Location Plan	**Casing ID/OD:**	4" / 4.5"	**Water Level*:**	25.0' bgs wet sample
Hammer Efficiency Factor:	0.719	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
MD = Unsuccessful Split Spoon Sample attempt
U = Thin Wall Tube Sample
MU = Unsuccessful Thin Wall Tube Sample attempt
V = Insitu Vane Shear Test, PP = Pocket Penetrometer
MV = Unsuccessful Insitu Vane Shear Test attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = weight of 140lb. hammer
WOR/C = weight of rods or casing
WO1P = Weight of one person
S_u = Insitu Field Vane Shear Strength (psf)
T_v = Pocket Torvane Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw field SPT N-value
Hammer Efficiency Factor = Annual Calibration Value
N_{60} = SPT N-uncorrected corrected for hammer efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
$S_{u(lab)}$ = Lab Vane Shear Strength (psf)
WC = water content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Sample Information

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
30	7D	24/17	30.00 - 32.00	14/17/14/10	31	37		10.10	30.00 — 7D: Gray, wet, dense, SAND, some Silt, trace Gravel, trace Clay. (Till).	
35	8D	24/22	35.00 - 37.00	19/28/34/36	62	74			8D: Gray, wet, very dense, SAND, some Silt, little Gravel, little Clay. (Till).	WC=8.2% Fines Content:41%
40	9D	24/22	40.00 - 42.00	25/37/31/32	68	81			9D: Gray, wet, very dense, SAND, some Silt, little Gravel, little Clay. (Till).	
45	10D	16.5/15	45.00 - 46.38	32/54/50-4.5"					10D: Gray, wet, very dense, SAND, some Silt, trace fine Gravel. (Till).	
50	11D	1/0	50.00 - 50.08	50-1"					11D: No Recovery Advanced roller bit from 50.0' bgs to 50.8' bgs into rock.	
	R1	60/58	50.80 - 55.80	RQD=70%				-10.70	50.80 — Bedrock: Black/Gray, fine grained, metamorphic, hard, fresh to very slightly weathered, PHYLLITE, with moderately dipping, closely spaced, tight joints. R1: Rock Mass Quality: Fair Core Times (min:sec) 50.8'-51.8' 4:30 51.8'-52.8' 4:30 52.8'-53.8' 5:00 53.8'-54.8' 5:00 54.8'-55.8' 5:00 97% Recovery	
55	R2	55/24	55.80 - 60.38	RQD=71%					R2: Rock Mass Quality: Poor Core Times (min:sec) 55.8'-56.8' 3:00 56.8'-57.8' 3:30 57.8'-58.8' 7:00	
60										

Remarks:

Switched from HSA to Drive & Wash at 20.0' bgs.
Started drilling roller bit open hole at 30.0' bgs.
Approximately 15 gallons water lost during coring.
Borehole was repaired by filling with auger cuttings, letting sit overnight to settle, then placing cold patch.

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.

* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Pine Point Road over B&M Railroad
Location: Scarborough, Maine

Boring No.: BB-SBMR-105
PIN: 18229.00

Driller:	Northern Test Boring	**Elevation (ft.)**	40.1	**Auger ID/OD:**	2-1/4" / 5"
Operator:	Mike Nadeau / Adam Woodbrey	**Datum:**	NAVD 88	**Sampler:**	1-3/8" Split-Spoon
Logged By:	J. Mailloux (Nobis Engineering)	**Rig Type:**	ATV / Diedrich D50	**Hammer Wt./Fall:**	140# / 30"
Date Start/Finish:	Sep 11, 2012 / Sep 11, 2012	**Drilling Method:**	HSA / Drive & Wash	**Core Barrel:**	NQ-2"
Boring Location:	See Boring Location Plan	**Casing ID/OD:**	4" / 4.5"	**Water Level*:**	25.0' bgs wet sample
Hammer Efficiency Factor:	0.719	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
MD = Unsuccessful Split Spoon Sample attempt
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SSA = Solid Stem Auger
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WOH = weight of 140lb. hammer
WOR/C = weight of rods or casing
WO1P = Weight of one person
S_u = Insitu Field Vane Shear Strength (psf)
T_v = Pocket Torvane Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw field SPT N-value
Hammer Efficiency Factor = Annual Calibration Value
N_{60} = SPT N-uncorrected corrected for hammer efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
$S_{u(lab)}$ = Lab Vane Shear Strength (psf)
WC = water content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
60								-20.30		59.8'-60.4' 3:00 44% Recovery RQD and Recovery likely inaccurate. Core bound in barrel at 2.0' and driller forced coring eqiupment for remaining 2.6' likely pulverizing sample. Coring time increased at 2.0' and driller used higher pressure on the equipment to advance. 60.40 **Bottom of Exploration at 60.40 feet below ground surface.**	
65											
70											
75											
80											
85											
90											

Remarks:

Switched from HSA to Drive & Wash at 20.0' bgs.
Started drilling roller bit open hole at 30.0' bgs.
Approximately 15 gallons water lost during coring.
Borehole was repaired by filling with auger cuttings, letting sit overnight to settle, then placing cold patch.

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.

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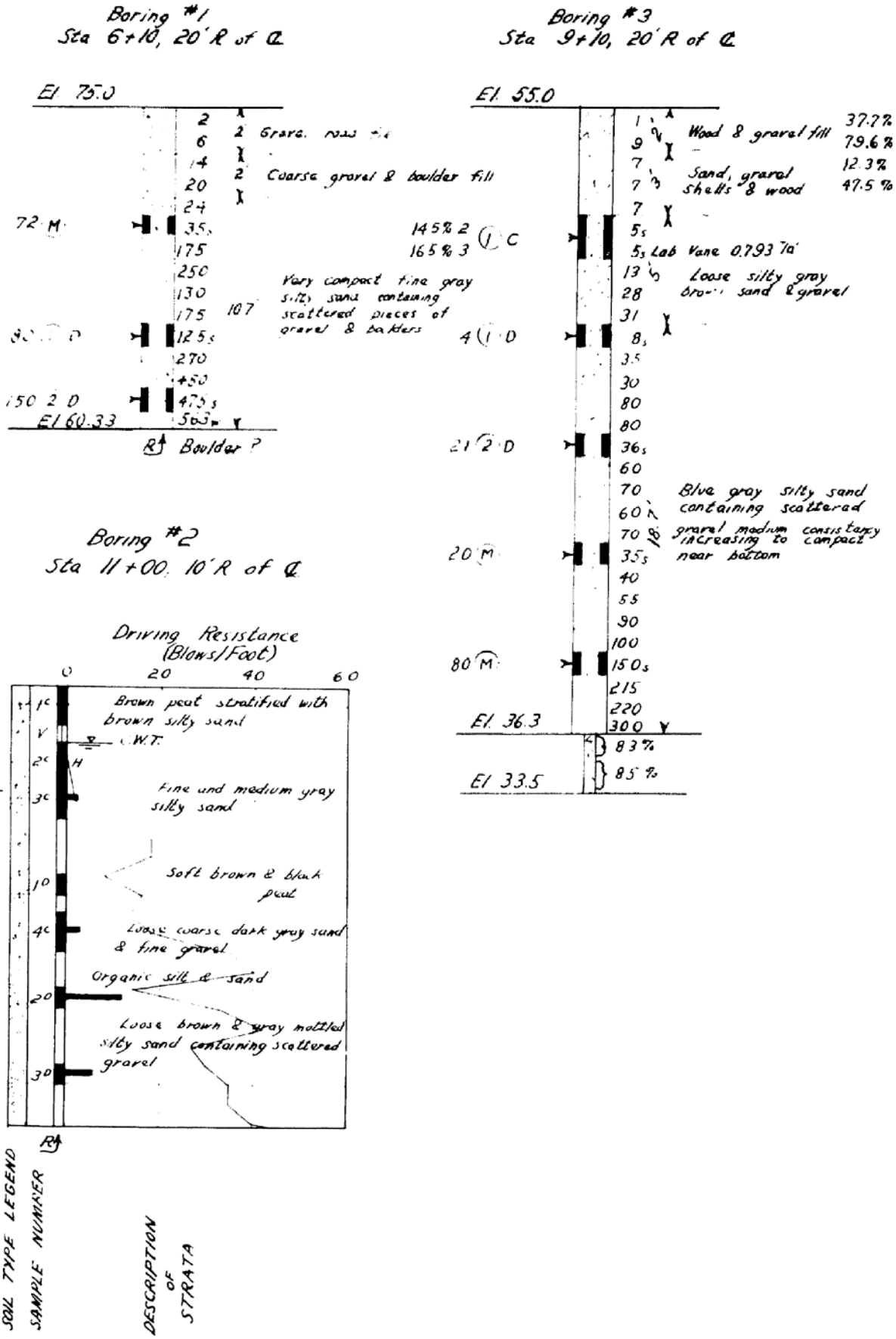
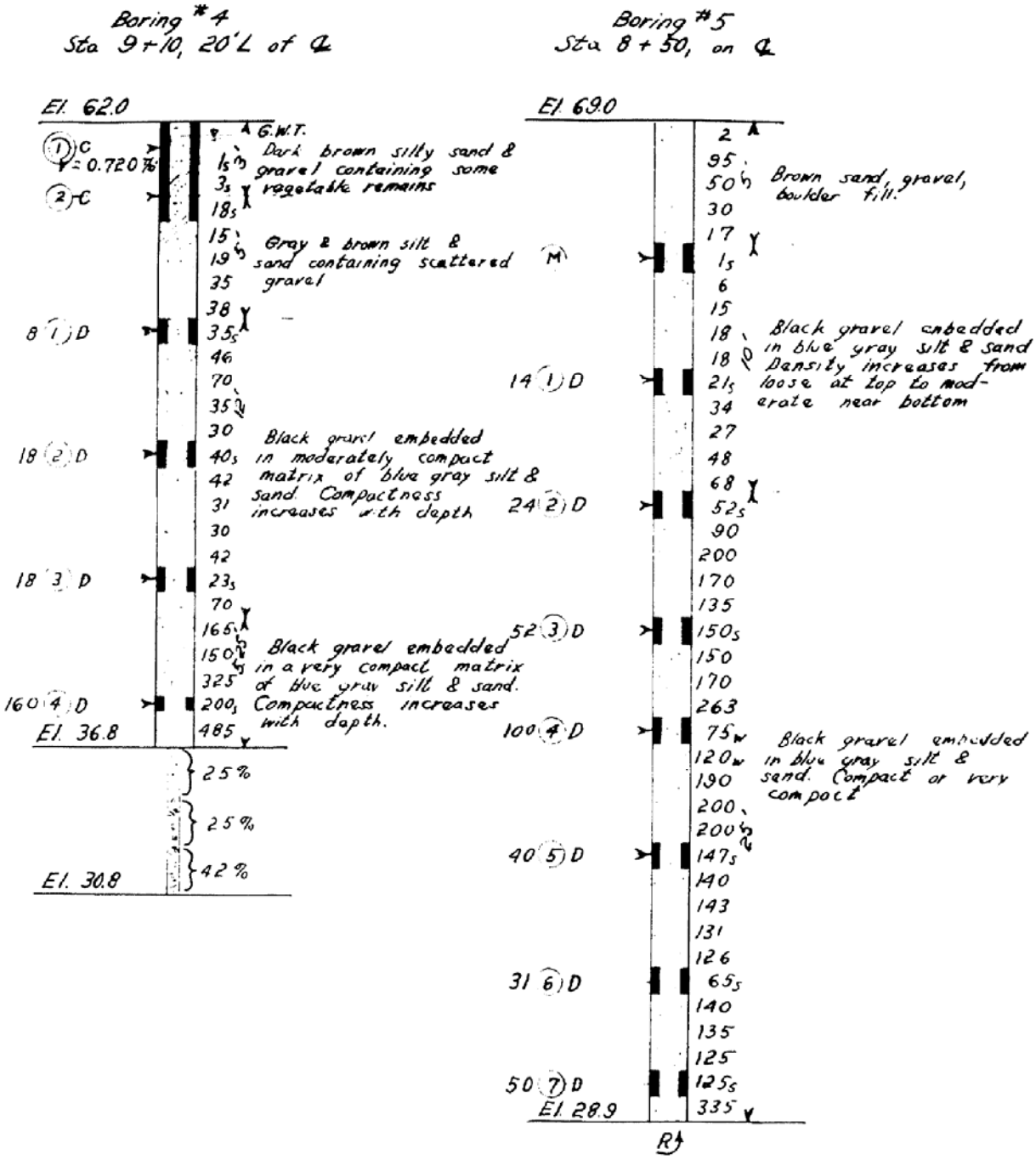
Boring No.: BB-SBMR-105

2. Original 1953 Borings by Others

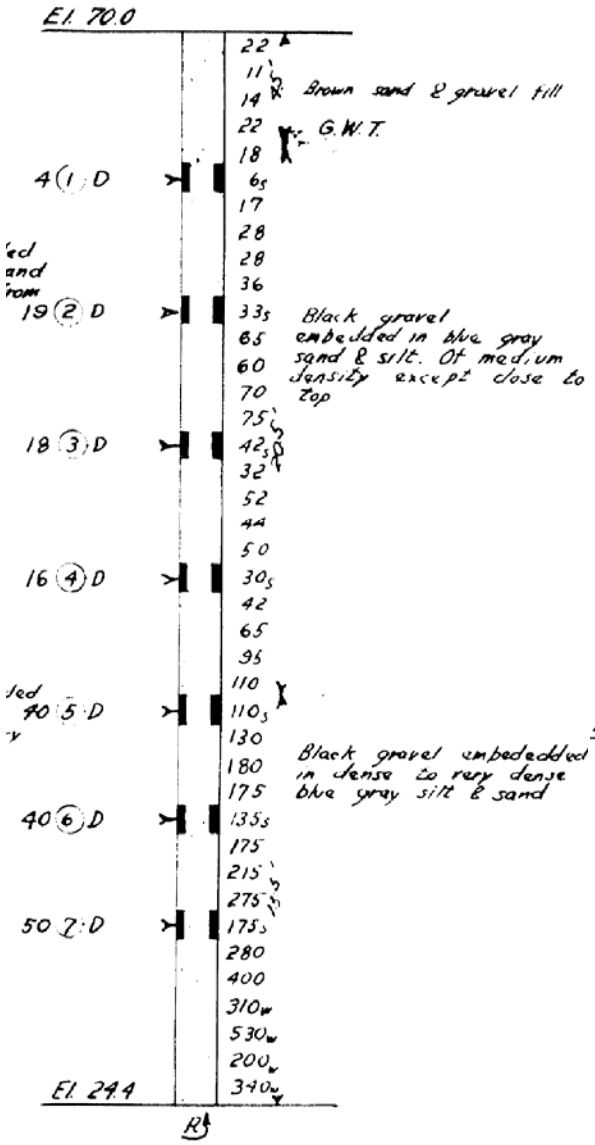
Pine Point Crossing over Boston & Maine Railroad
Scarborough, Maine
December 1953 Borings

BORING NOTES	LOG SHEETS	DETAIL SHEETS
1. Scales as noted on drawings.		
2. Casing size as noted on drawings..		
3. Ground water table indicated thus:		
4. Number of blows of 275# hammer falling 18 inches required to drive extra heavy casing one foot indicated thus:	40	(graphical)
5. W, S, or V indicate respectively that the hole was washed, sampled, or ranud ahead of casing.		
6. Location and designation of "dry" samples taken in 58H sampler #1290s indicated thus:	D	1D
7. Location and designation of "dry" samples taken in 2" O.D. 18 ga. seamless tubing indicated thus:	C	1C
8. Location and designation of "dry" samples taken in 3½" O.D., 16 ga. seamless tubing indicated thus:	U	1U
9. Location and designation of wash samples indicated thus:	W	1W
10. Unsuccessful attempts to secure dry sample indicated thus:	M	M
11. Number of blows of 275# hammer falling 15" required to drive sampling spoon or seamless tubing one foot indicated thus:	20	(graphical)
12. Sampling spoon or seamless tubing driven by static load not exceeding ½ ton indicated thus:	J	J
13. Sampling spoon or seamless tubing driven by static weight of drill rods and 275# hammer indicated thus:	H	H
14. Where no resistance is specified sampling spoon or seamless tubing was driven by the static weight of drill rods.		
15. Natural water contents, given as percent of dry weight, are indicated thus:	31% 20	graphical
16. Bottom of boring indicated thus:		
17. Refusal of drill rods or casing indicated thus:	R	R
18. Recovery of rock core by size "E" diamond bit indicated thus:	71%	71%

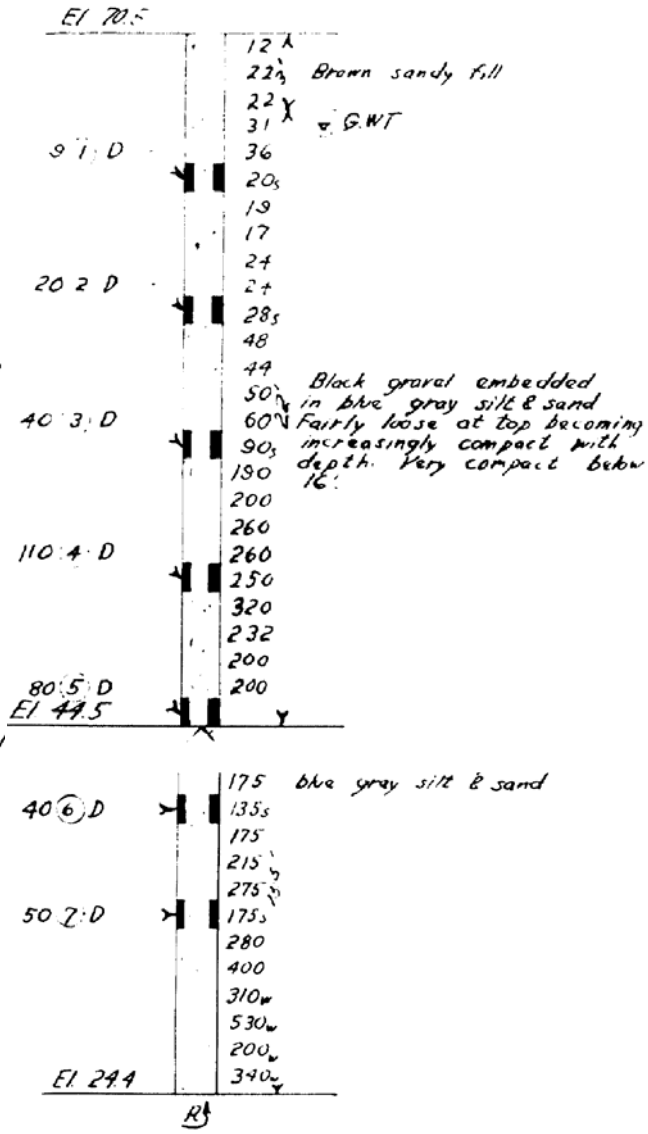

Boring #1
Sta 6+10, 20' R of ℄
El 75.0
2
6
14
20
24
35s
175
250
130
175
125s
270
450
475s
563
2 Grave. rock fill
2 Coarse gravel & boulder fill
72 M
145% 2
165% 3
1 C
Very compact fine gray silty sand containing scattered pieces of gravel & boulders
107
4 1 D
150 2 D
El 60.33
Rt Boulder ?
Boring #3
Sta 9+10, 20' R of ℄
El. 55.0
1
9
7
7
7
5s
5s Lab Vane 0.793 Ta
13
28
31
8s
3.5
30
80
80
36s
60
70
60
70
35s
40
55
90
100
150s
215
220
300
Wood & gravel fill
37.7%
79.6%
12.3%
47.5%
Sand, gravel shells & wood
Loose silty gray brown sand & gravel
4 1 D
21 2 D
Blue gray silty sand containing scattered gravel medium consistency increasing to compact near bottom
18
20 M
80 M
El. 36.3
83%
85%
El 33.5
Boring #2
Sta 11+00, 10' R of ℄
Driving Resistance (Blows/Foot)
0
20
40
60
60
55
50
45
40
1c
V
2c
3c
1D
4c
2D
3D
H
Brown peat stratified with brown silty sand
G.W.T.
Fine and medium gray silty sand
Soft brown & black peat
Loose coarse dark gray sand & fine gravel
Organic silt & sand
Loose brown & gray mottled silty sand containing scattered gravel
Rt
ELEVATION
SOIL TYPE LEGEND
SAMPLE NUMBER
DESCRIPTION OF STRATA


Boring #4
Sta 9+10, 20'L of ℄
El. 62.0
G.W.T.
(1) C
= 0.720%
(2) C
Dark brown silty sand & gravel containing some vegetable remains
Gray & brown silt & sand containing scattered gravel
8 (1) D
Black gravel embedded in moderately compact matrix of blue gray silt & sand. Compactness increases with depth
18 (2) D
18 (3) D
Black gravel embedded in a very compact matrix of blue gray silt & sand. Compactness increases with depth.
160 (4) D
El. 36.8
25%
25%
42%
El. 30.8
Boring #5
Sta 8+50, on ℄
El. 69.0
Brown sand, gravel, boulder fill.
(M)
Black gravel embedded in blue gray silt & sand. Density increases from loose at top to moderate near bottom
14 (1) D
24 (2) D
52 (3) D
Black gravel embedded in blue gray silt & sand. Compact or very compact
100 (4) D
40 (5) D
31 (6) D
50 (7) D
El. 28.9
R

Boring #6
Sta 8+15, 15' R of ℄



Boring #7
Sta. 8+15, 15' L of ℄



Boring #8
Sta 7+60, on ℄

El. 71.0

7
G.W.T
28
28 Loose brown sand & gravel fill
14
9 1 D 10s
18
19
20
24
21 2 D 48s
54
77
73
70
80 3 D 120s
170
150
150
180
60 4 D 130s
210 Blue gray silty sand containing scattered black gravel. Fairly loose consistency to 15' Very compact at greater depths
240
420
100 5 D 200s
160
300
280
325
17 6 D 70s
120
310
225
205
75 M 137s
162
205
110w
145
250
80 7 D 230s
350
100w
450w
160w
375

El. 25.3

Boring #9
Sta 7+15, on ℄

El. 71.4

12
16 Brown sand & gravel fill
10
12
16
G.W.T
10 1 D 8s
13
12
16
22
31 2 D 28s
70
85
85
90
40 3 D 65s
115
140 Blue gray silty sand containing scattered gravel loose at top, moderately dense to 25', very dense below 25'
140
115
30 4 D 37s
70
100
85
80
95 5 D 55s
110
130
120
110
80 6 D 136s
160
160
375

El. 46.9

R

Boring #10
Sta 6+10, 20' L of ℄

El. 73.0

Peaty sand & gravel

3
12
38
75
66 (1) D — 58s
102
138
403
110
80 (2) D — 110s
500w
195w
45w
135w
Blue gray silty sand containing scattered gravel. Very compact except in uppermost few feet.
50 (5) D — 100s
145
167
186
315
133 (4) D — 120w
105w
95w
125w
140 (5) D
El 47.0

R

Boring #11
Sta. 6+53, on ℄

El 73.0

2
Peaty brown silt & sand
12
15
16
30
13 (1) D — 15s
17
18
45
90
47 (2) D — 90s
160
113w
17w
19w
Blue gray silty sand containing scattered gravel. Moderately to highly compact except in uppermost 6'.
42 (3) D — 19w
8w
8w
21w
115w
80 (4) D — 14w
15w
23w
36w
48w
60 (5) D — 25w
205
240
350
60w
El 7.2

Boring #12
Sta. 10+00, 10' L of ℄

El 51.0

86%
16.2%
81.7%
121.0%
1 (U) — 3s
VC 180% — 2s
Vane Strength 0274 — 5v
Soft dark gray & brown stratified peat, course sand & gravel & shells
M. — 6s
7s
Vane Strength >120 — 45v
38 (1) D — 52s
90
110
47
57w
Moderately dense blue gray silty sand containing scattered gravel. Very compact in lowest 5'
21 (2) D — 55s
112
123
225
80 (3) D — 90w
El 53.7 — 175s

R

APPENDIX B: LABORATORY TEST RESULTS

GeoTesting EXPRESS

Client:	Nobis Engineering, Inc.		
Project:	Pine Point Road over B&M Railroad		
Location:	Scarborough, ME	Project No:	GTX-12313
Boring ID: ---	Sample Type: ---	Tested By:	jek
Sample ID:---	Test Date: 10/16/12	Checked By:	jdt
Depth : ---	Sample Id: ---		

Moisture Content of Soil - ASTM D 2216-05

Boring ID	Sample ID	Depth	Description	Moisture Content,%
BB-SBMR-101	2D	---		7.2
BB-SBMR-101	3D-B	---		6
BB-SBMR-101	10D	---		8.3
BB-SBMR-103	9D	---		8.4
BB-SBMR-104	4D	---		10.1
BB-SBMR-105	3D	---		6.8
BB-SBMR-105	8D	---		8.2

Notes: Temperature of Drying : 110° Celsius

GeoTesting EXPRESS

Client:	Nobis Engineering, Inc
Project Name:	Pine Point Road Over B&M Railroad
Project Location:	Scarborough, ME
GTX #:	12313
Test Date:	10/16/12
Tested By:	jek
Checked By:	jdt

pH of Soil by ASTM D 4972

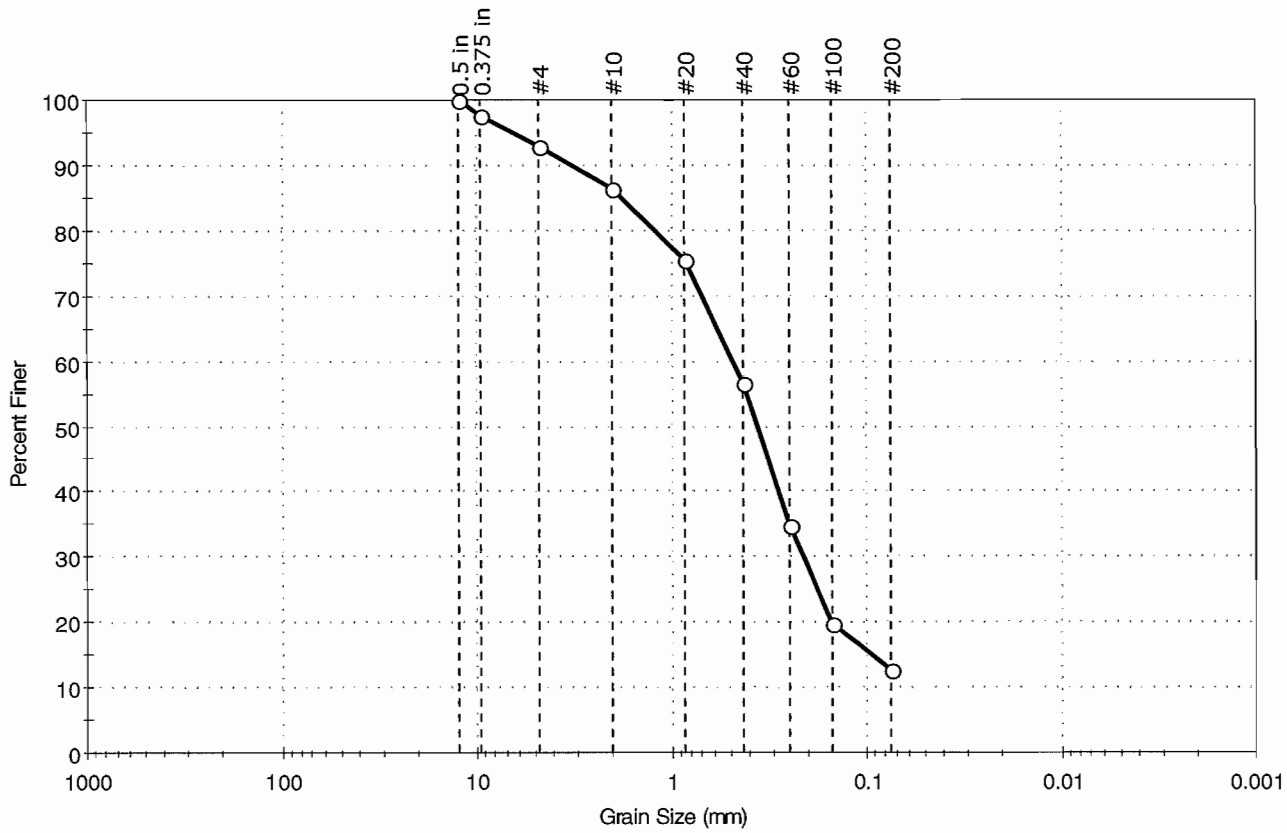
Boring ID	Sample ID	Depth, ft	Description	pH of Soil in	
				Distilled Water	Calcium Chloride
BB-SBMR-101	6D-BC	---		5.9	5.6
BB-SBMR-102	---	9-10		5.6	5.6
BB-SBMR-104	3D-B	---		6.2	6.0
BB-SBMR-105	6D-3	---		6.3	6.2

Notes: Method A, pH meter used
Sample preparation: screened through a #10 sieve

GeoTesting EXPRESS

Client:	Nobis Engineering, Inc.		
Project:	Pine Point Road over B&M Railroad		
Location:	Scarborough, ME	Project No:	GTX-12313
Boring ID: BB-SBMR-101	Sample Type: jar	Tested By:	jbr
Sample ID:2D	Test Date: 10/11/12	Checked By:	jdt
Depth : ---	Test Id: 251767		
Test Comment: ---			
Sample Description:			
Sample Comment: ---			

Particle Size Analysis - ASTM D 422-63 (reapproved 2002)



% Cobble	% Gravel	% Sand	% Silt & Clay Size
--	7.0	80.4	12.6

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.5 in	12.50	100		
0.375 in	9.50	98		
#4	4.75	93		
#10	2.00	86		
#20	0.85	76		
#40	0.42	57		
#60	0.25	35		
#100	0.15	20		
#200	0.075	13		

Coefficients

D_{85} = 1.7968 mm D_{30} = 0.2124 mm

D_{60} = 0.4792 mm D_{15} = 0.0945 mm

D_{50} = 0.3611 mm D_{10} = 0.0584 mm

C_u = N/A C_c = N/A

Classification

ASTM N/A

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

Sample/Test Description

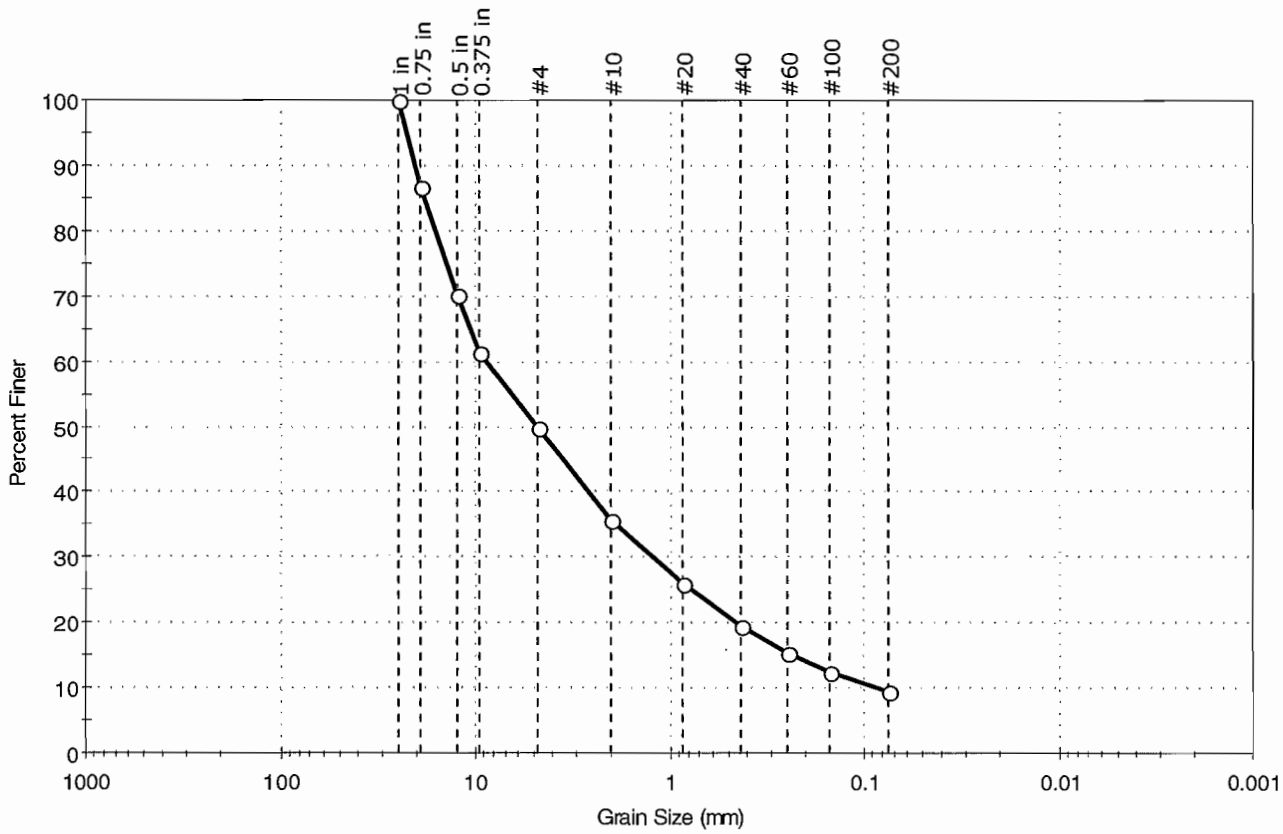
Sand/Gravel Particle Shape : ROUNDED

Sand/Gravel Hardness : HARD

GeoTesting EXPRESS

Client:	Nobis Engineering, Inc.		
Project:	Pine Point Road over B&M Railroad		
Location:	Scarborough, ME	Project No:	GTX-12313
Boring ID: BB-SBMR-101	Sample Type: jar	Tested By:	jbr
Sample ID:3D-B	Test Date: 10/15/12	Checked By:	jdt
Depth : ---	Test Id: 251768		
Test Comment: ---			
Sample Description:			
Sample Comment: ---			

Particle Size Analysis - ASTM D 422-63 (reapproved 2002)



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	50.3	40.3	9.4

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1 in	25.00	100		
0.75 in	19.00	87		
0.5 in	12.50	70		
0.375 in	9.50	61		
#4	4.75	50		
#10	2.00	36		
#20	0.85	26		
#40	0.42	19		
#60	0.25	15		
#100	0.15	12		
#200	0.075	9		

Coefficients

D_{85} = 18.2255 mm	D_{30} = 1.2179 mm
D_{60} = 8.7165 mm	D_{15} = 0.2367 mm
D_{50} = 4.8201 mm	D_{10} = 0.0864 mm
C_u = 100.885	C_c = 1.970

Classification

ASTM N/A

AASHTO Stone Fragments, Gravel and Sand (A-1-a (0))

Sample/Test Description

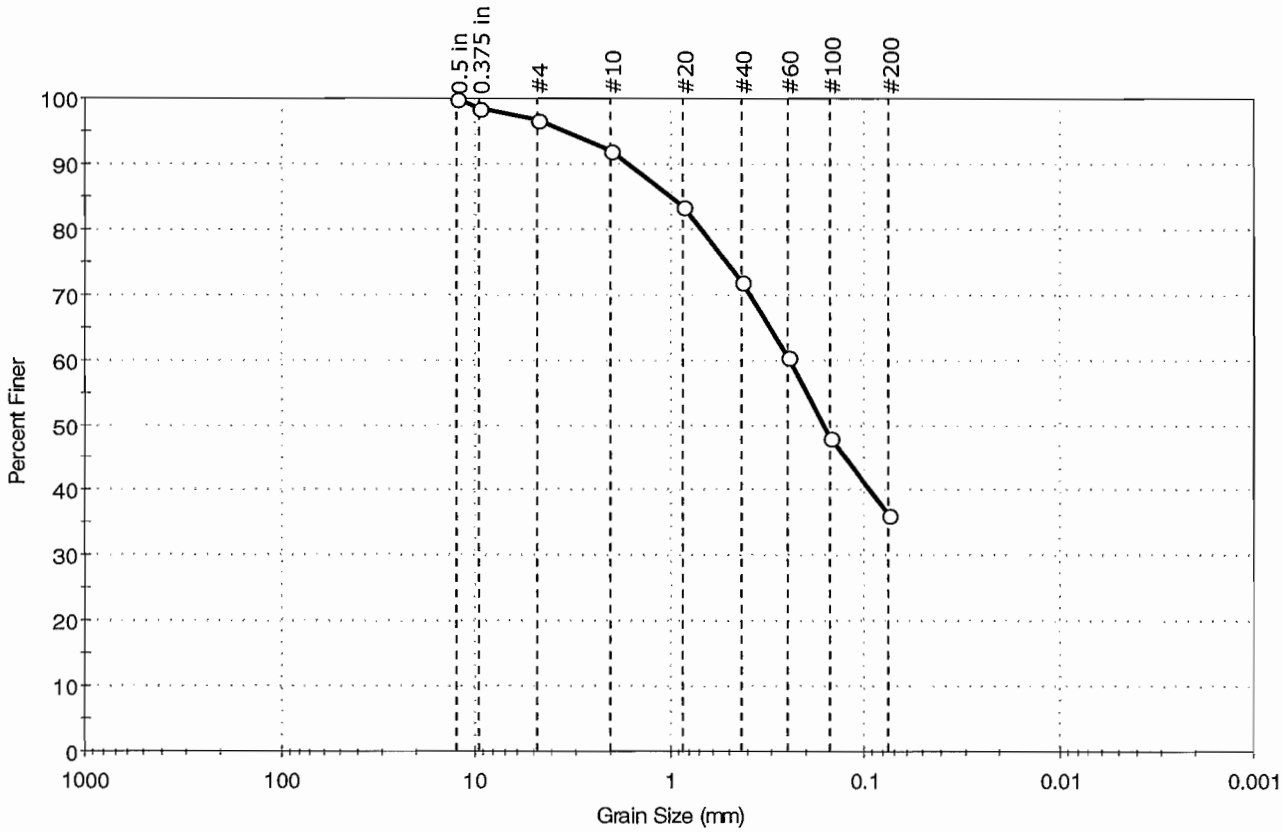
Sand/Gravel Particle Shape : ROUNDED

Sand/Gravel Hardness : HARD

GeoTesting EXPRESS

Client:	Nobis Engineering, Inc.		
Project:	Pine Point Road over B&M Railroad		
Location:	Scarborough, ME	Project No:	GTX-12313
Boring ID: BB-SBMR-101	Sample Type: jar	Tested By:	jbr
Sample ID:8D	Test Date: 10/15/12	Checked By:	jdt
Depth : ---	Test Id: 251769		
Test Comment: ---			
Sample Description:			
Sample Comment: ---			

Particle Size Analysis - ASTM D 422-63 (reapproved 2002)



% Cobble	% Gravel	% Sand	% Silt & Clay Size
--	3.2	60.6	36.2

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.5 in	12.50	100		
0.375 in	9.50	99		
#4	4.75	97		
#10	2.00	92		
#20	0.85	83		
#40	0.42	72		
#60	0.25	60		
#100	0.15	48		
#200	0.075	36		

Coefficients

D_{85} = 0.9922 mm D_{30} = N/A
D_{60} = 0.2452 mm D_{15} = N/A
D_{50} = 0.1626 mm D_{10} = N/A
C_u = N/A C_c = N/A

Classification

ASTM Silty sand (SM)

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

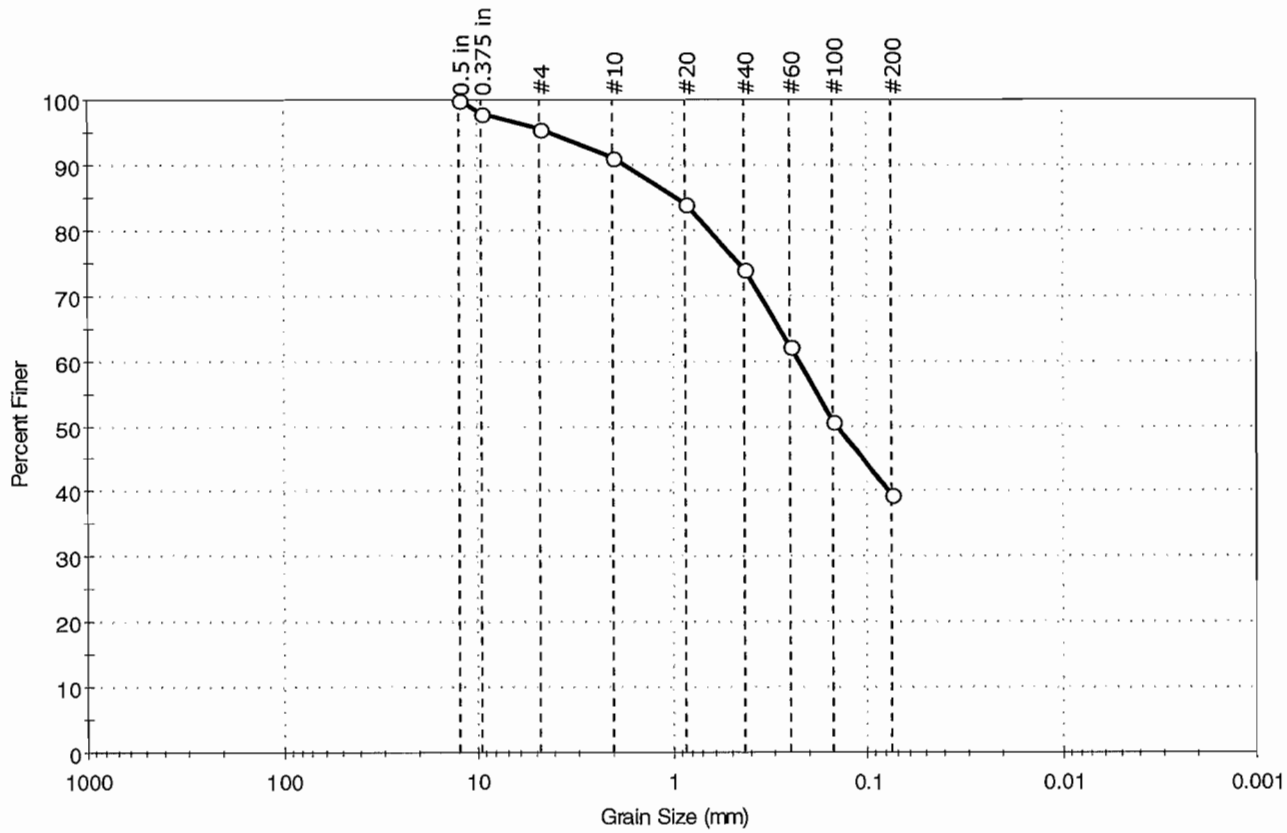
Sand/Gravel Particle Shape : ROUNDED

Sand/Gravel Hardness : HARD

GeoTesting EXPRESS

Client:	Nobis Engineering, Inc.		
Project:	Pine Point Road over B&M Railroad		
Location:	Scarborough, ME	Project No:	GTX-12313
Boring ID: BB-SBMR-101	Sample Type: jar	Tested By:	jbr
Sample ID:10D	Test Date: 10/15/12	Checked By:	jdt
Depth : ---	Test Id: 251770		
Test Comment: ---			
Sample Description:			
Sample Comment: ---			

Particle Size Analysis - ASTM D 422-63 (reapproved 2002)



% Cobble	% Gravel	% Sand	% Silt & Clay Size
--	4.4	55.9	39.7

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.5 in	12.50	100		
0.375 in	9.50	98		
#4	4.75	96		
#10	2.00	91		
#20	0.85	84		
#40	0.42	74		
#60	0.25	62		
#100	0.15	51		
#200	0.075	40		

Coefficients

D_{85} = 0.9558 mm D_{30} = N/A
D_{60} = 0.2272 mm D_{15} = N/A
D_{50} = 0.1443 mm D_{10} = N/A
C_u = N/A C_c = N/A

Classification

ASTM N/A

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ROUNDED

Sand/Gravel Hardness : HARD

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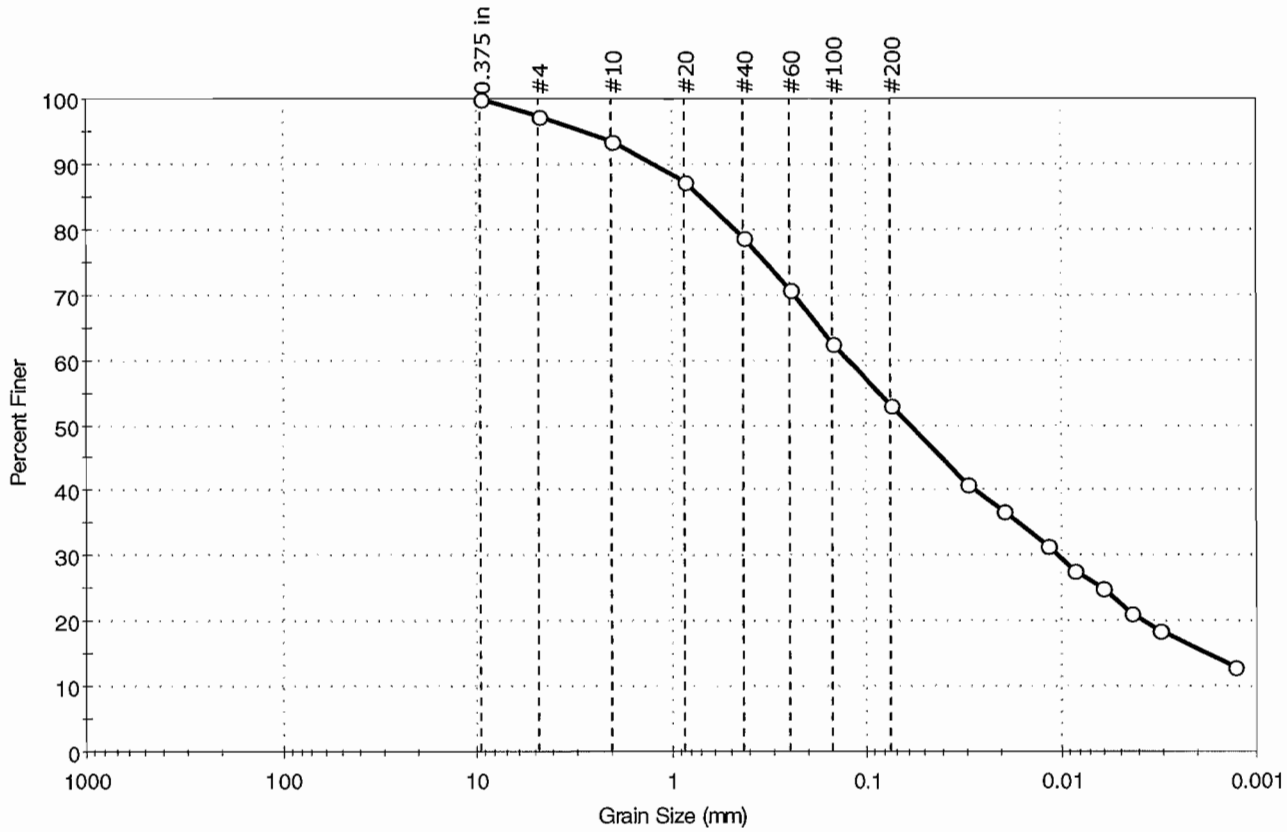
GeoTesting EXPRESS

Client:	Nobis Engineering, Inc.		
Project:	Pine Point Road over B&M Railroad		
Location:	Scarborough, ME	Project No:	GTX-12313
Boring ID: BB-SBMR-101	Sample Type: jar	Tested By:	jbr
Sample ID:14D	Test Date: 10/16/12	Checked By:	jdt
Depth : ---	Test Id: 252462		
Test Comment: ---			
Sample Description:			
Sample Comment: ---			

Particle Size Analysis - ASTM D 422-63 (reapproved 2002)



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	2.7	44.1	53.2

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.375 in	9.50	100		
#4	4.75	97		
#10	2.00	93		
#20	0.85	87		
#40	0.42	79		
#60	0.25	71		
#100	0.15	62		
#200	0.075	53		
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0305	41		
---	0.0197	37		
---	0.0117	32		
---	0.0085	28		
---	0.0061	25		
---	0.0044	21		
---	0.0031	19		
---	0.0013	13		

Coefficients

D_{85} = 0.7099 mm	D_{30} = 0.0102 mm
D_{60} = 0.1248 mm	D_{15} = 0.0018 mm
D_{50} = 0.0593 mm	D_{10} = 0.0008 mm
C_u = N/A	C_c = N/A

Classification

ASTM Sandy lean clay (CL)

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

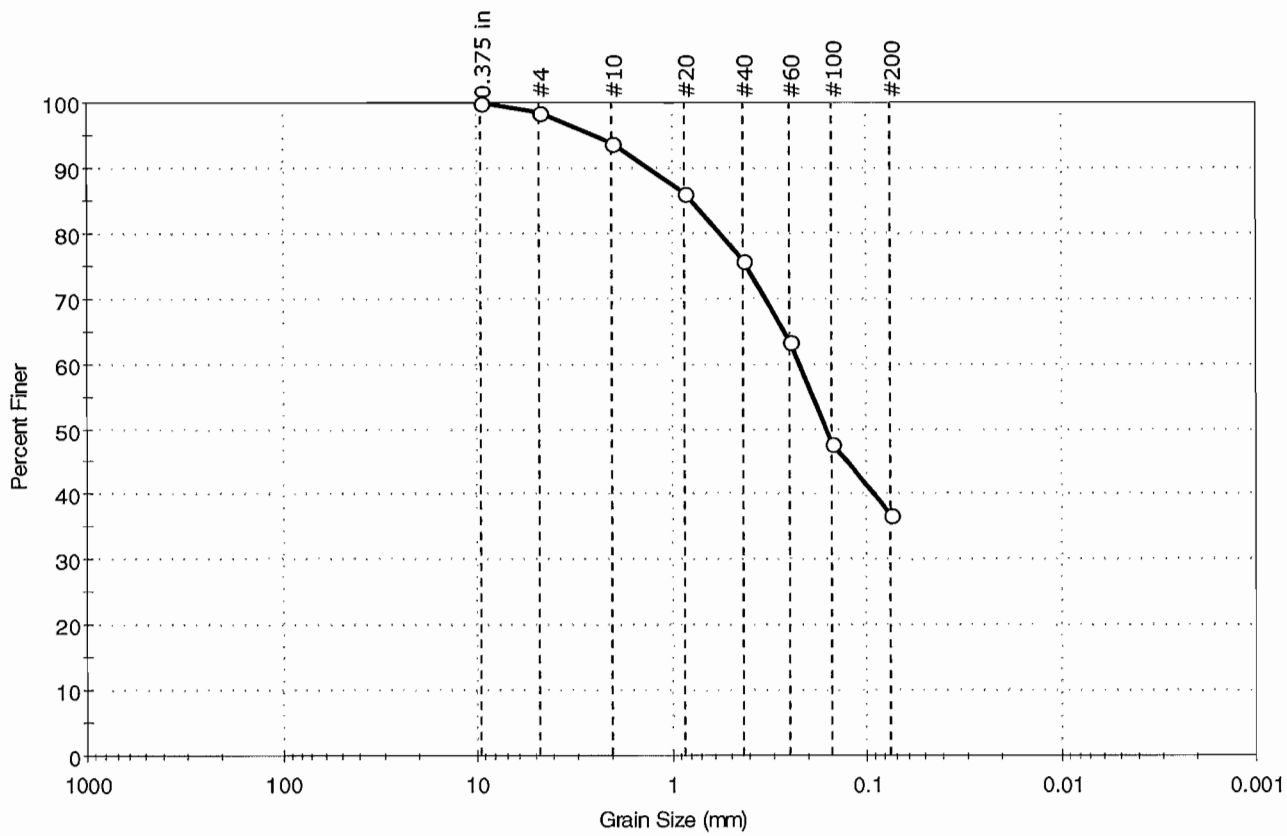
Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

GeoTesting EXPRESS

Client:	Nobis Engineering, Inc.		
Project:	Pine Point Road over B&M Railroad		
Location:	Scarborough, ME	Project No:	GTX-12313
Boring ID: BB-SBMR-102	Sample Type: jar	Tested By:	jbr
Sample ID:3D	Test Date: 10/15/12	Checked By:	jdt
Depth : ---	Test Id: 251772		
Test Comment: ---			
Sample Description:			
Sample Comment: ---			

Particle Size Analysis - ASTM D 422-63 (reapproved 2002)



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	1.3	61.8	36.9

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.375 in	9.50	100		
#4	4.75	99		
#10	2.00	94		
#20	0.85	86		
#40	0.42	76		
#60	0.25	63		
#100	0.15	48		
#200	0.075	37		

Coefficients

D_{85} = 0.7826 mm D_{30} = N/A
D_{60} = 0.2241 mm D_{15} = N/A
D_{50} = 0.1610 mm D_{10} = N/A
C_u = N/A C_c = N/A

Classification

ASTM Silty sand (SM)

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

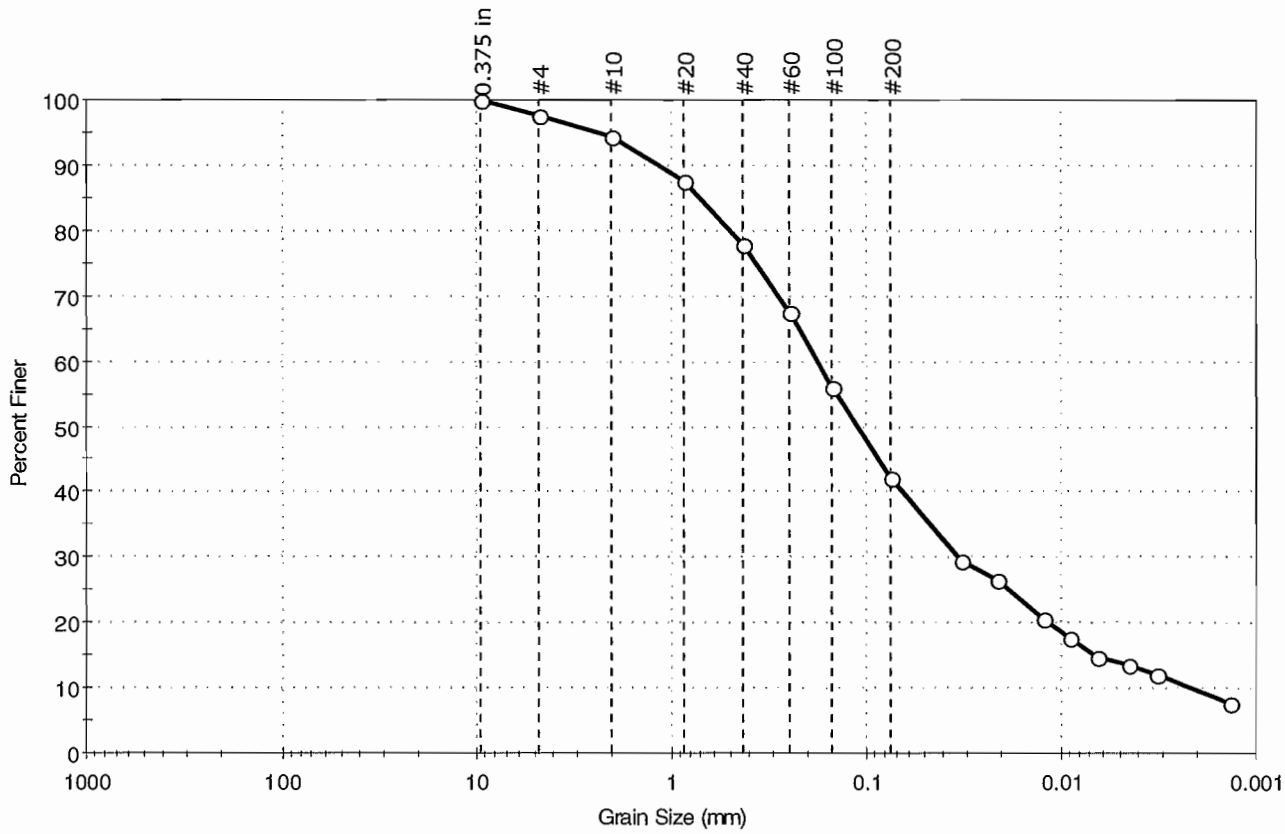
Sand/Gravel Particle Shape : ROUNDED

Sand/Gravel Hardness : HARD

GeoTesting EXPRESS

Client:	Nobis Engineering, Inc.		
Project:	Pine Point Road over B&M Railroad		
Location:	Scarborough, ME	Project No:	GTX-12313
Boring ID: BB-SBMR-103	Sample Type: jar	Tested By:	jbr
Sample ID:4D	Test Date: 10/15/12	Checked By:	jdt
Depth : ---	Test Id: 251778		
Test Comment: ---			
Sample Description:			
Sample Comment: ---			

Particle Size Analysis - ASTM D 422-63 (reapproved 2002)



% Cobble	% Gravel	% Sand	% Silt & Clay Size
--	2.3	55.5	42.2

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.375 in	9.50	100		
#4	4.75	98		
#10	2.00	94		
#20	0.85	88		
#40	0.42	78		
#60	0.25	68		
#100	0.15	56		
#200	0.075	42		
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0324	29		
---	0.0214	27		
---	0.0123	21		
---	0.0090	18		
---	0.0064	15		
---	0.0045	14		
---	0.0032	12		
---	0.0014	8		

Coefficients

D_{85} = 0.7072 mm	D_{30} = 0.0336 mm
D_{60} = 0.1787 mm	D_{15} = 0.0066 mm
D_{50} = 0.1107 mm	D_{10} = 0.0021 mm
C_u = N/A	C_c = N/A

Classification

ASTM Silty sand (SM)

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ROUNDED

Sand/Gravel Hardness : HARD

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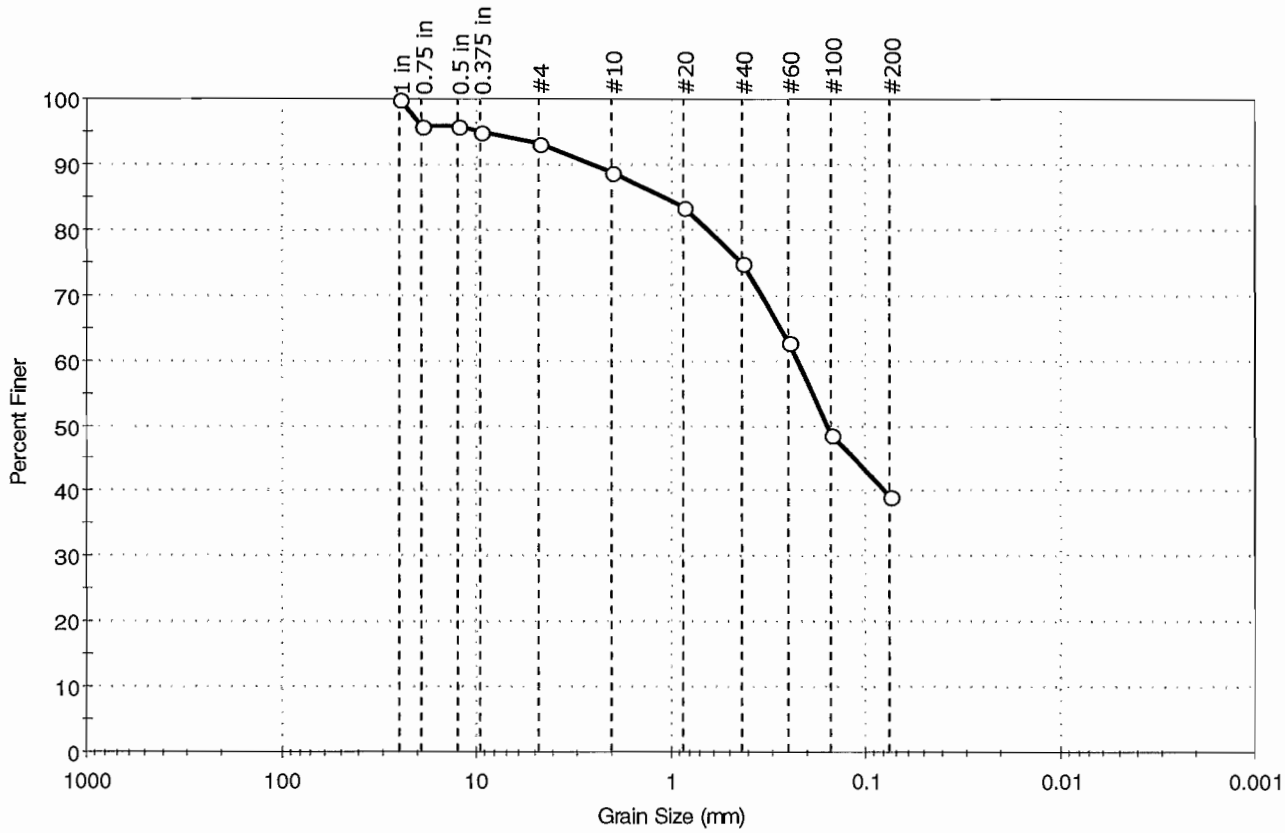
GeoTesting EXPRESS

Client:	Nobis Engineering, Inc.		
Project:	Pine Point Road over B&M Railroad		
Location:	Scarborough, ME	Project No:	GTX-12313
Boring ID: BB-SBMR-103	Sample Type: jar	Tested By:	jbr
Sample ID:9D	Test Date: 10/16/12	Checked By:	jdt
Depth : ---	Test Id: 251773		
Test Comment: ---			
Sample Description:			
Sample Comment: ---			

Particle Size Analysis - ASTM D 422-63 (reapproved 2002)



% Cobble	% Gravel	% Sand	% Silt & Clay Size
--	6.7	54.2	39.1

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1 in	25.00	100		
0.75 in	19.00	96		
0.5 in	12.50	96		
0.375 in	9.50	95		
#4	4.75	93		
#10	2.00	89		
#20	0.85	84		
#40	0.42	75		
#60	0.25	63		
#100	0.15	49		
#200	0.075	39		

Coefficients

D_{85} = 1.0734 mm D_{30} = N/A
D_{60} = 0.2255 mm D_{15} = N/A
D_{50} = 0.1574 mm D_{10} = N/A
C_u = N/A C_c = N/A

Classification

ASTM N/A

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ROUNDED

Sand/Gravel Hardness : HARD

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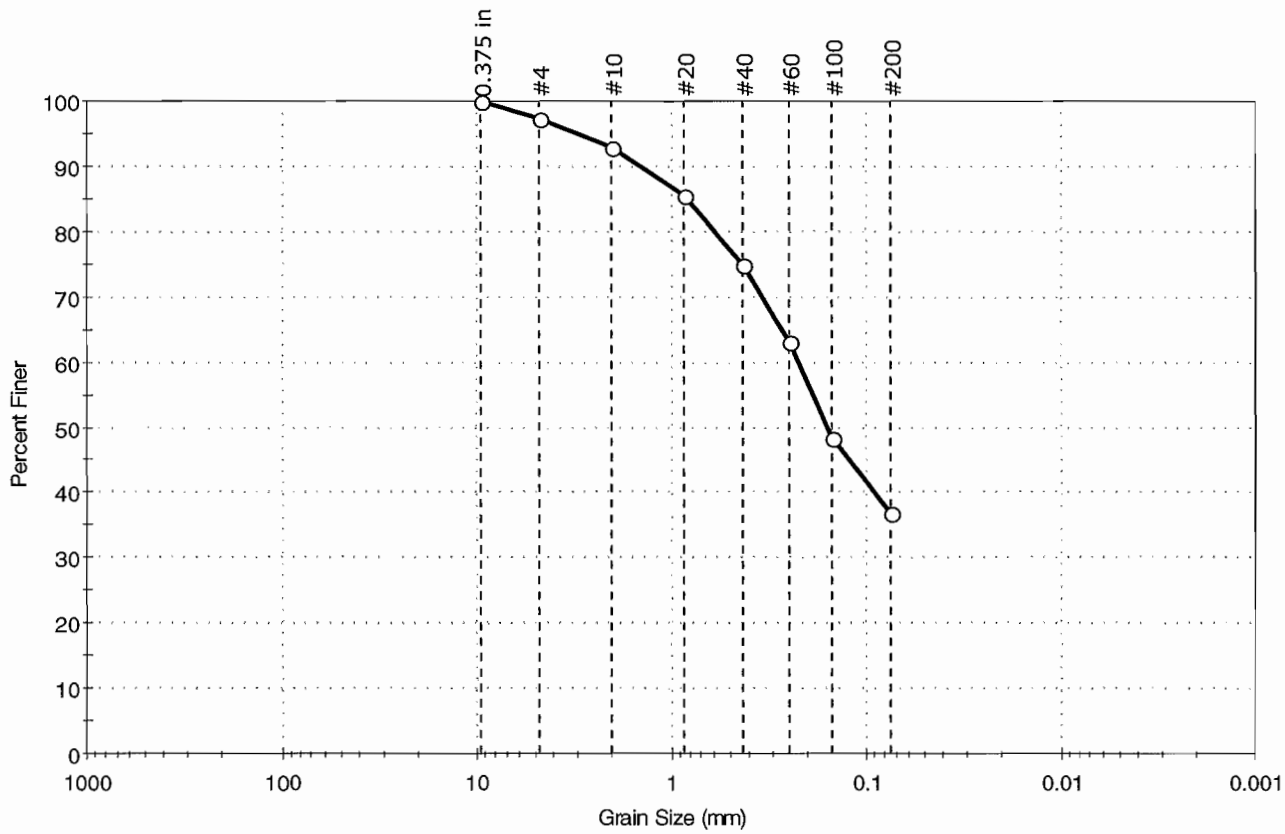
GeoTesting EXPRESS

Client:	Nobis Engineering, Inc.		
Project:	Pine Point Road over B&M Railroad		
Location:	Scarborough, ME	Project No:	GTX-12313
Boring ID: BB-SBMR-104	Sample Type: jar	Tested By:	jbr
Sample ID:4D	Test Date: 10/15/12	Checked By:	jdt
Depth : ---	Test Id: 251774		
Test Comment: ---			
Sample Description:			
Sample Comment: ---			

Particle Size Analysis - ASTM D 422-63 (reapproved 2002)



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	2.6	60.6	36.8

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.375 in	9.50	100		
#4	4.75	97		
#10	2.00	93		
#20	0.85	86		
#40	0.42	75		
#60	0.25	63		
#100	0.15	48		
#200	0.075	37		

Coefficients

D_{85} = 0.8189 mm D_{30} = N/A
D_{60} = 0.2250 mm D_{15} = N/A
D_{50} = 0.1585 mm D_{10} = N/A
C_u = N/A C_c = N/A

Classification

ASTM N/A

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ROUNDED

Sand/Gravel Hardness : HARD

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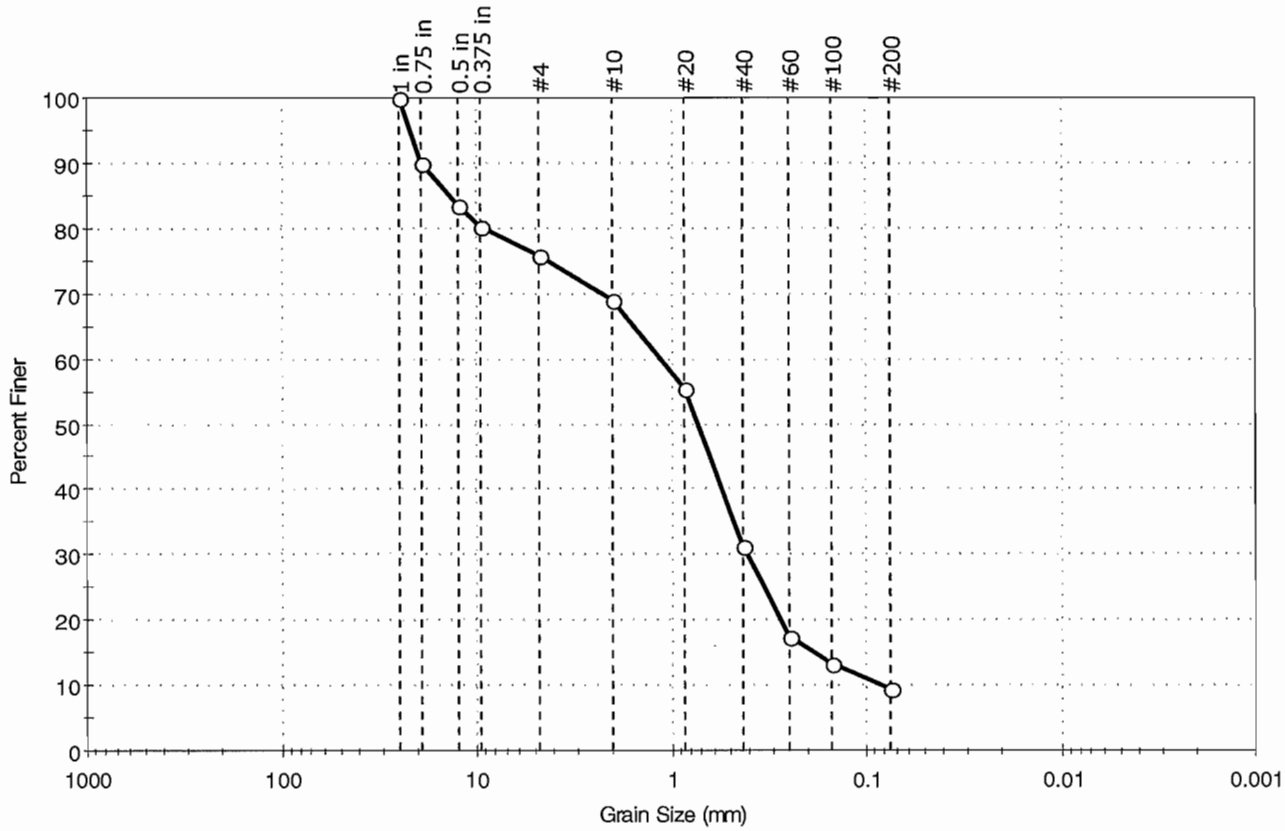
GeoTesting EXPRESS

Client:	Nobis Engineering, Inc.		
Project:	Pine Point Road over B&M Railroad		
Location:	Scarborough, ME	Project No:	GTX-12313
Boring ID: BB-SBMR-105	Sample Type: jar	Tested By:	jbr
Sample ID:3D	Test Date: 10/15/12	Checked By:	jdt
Depth : ---	Test Id: 251775		
Test Comment: ---			
Sample Description:			
Sample Comment: ---			

Particle Size Analysis - ASTM D 422-63 (reapproved 2002)



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	24.2	66.4	9.4

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1 in	25.00	100		
0.75 in	19.00	90		
0.5 in	12.50	84		
0.375 in	9.50	80		
#4	4.75	76		
#10	2.00	69		
#20	0.85	55		
#40	0.42	31		
#60	0.25	18		
#100	0.15	13		
#200	0.075	9		

Coefficients

D_{85} = 13.7404 mm	D_{30} = 0.4049 mm
D_{60} = 1.1361 mm	D_{15} = 0.1849 mm
D_{50} = 0.7279 mm	D_{10} = 0.0834 mm
C_u = 13.622	C_c = 1.730

Classification

ASTM N/A

AASHTO Stone Fragments, Gravel and Sand (A-1-b (0))

Sample/Test Description

Sand/Gravel Particle Shape : ROUNDED

Sand/Gravel Hardness : HARD

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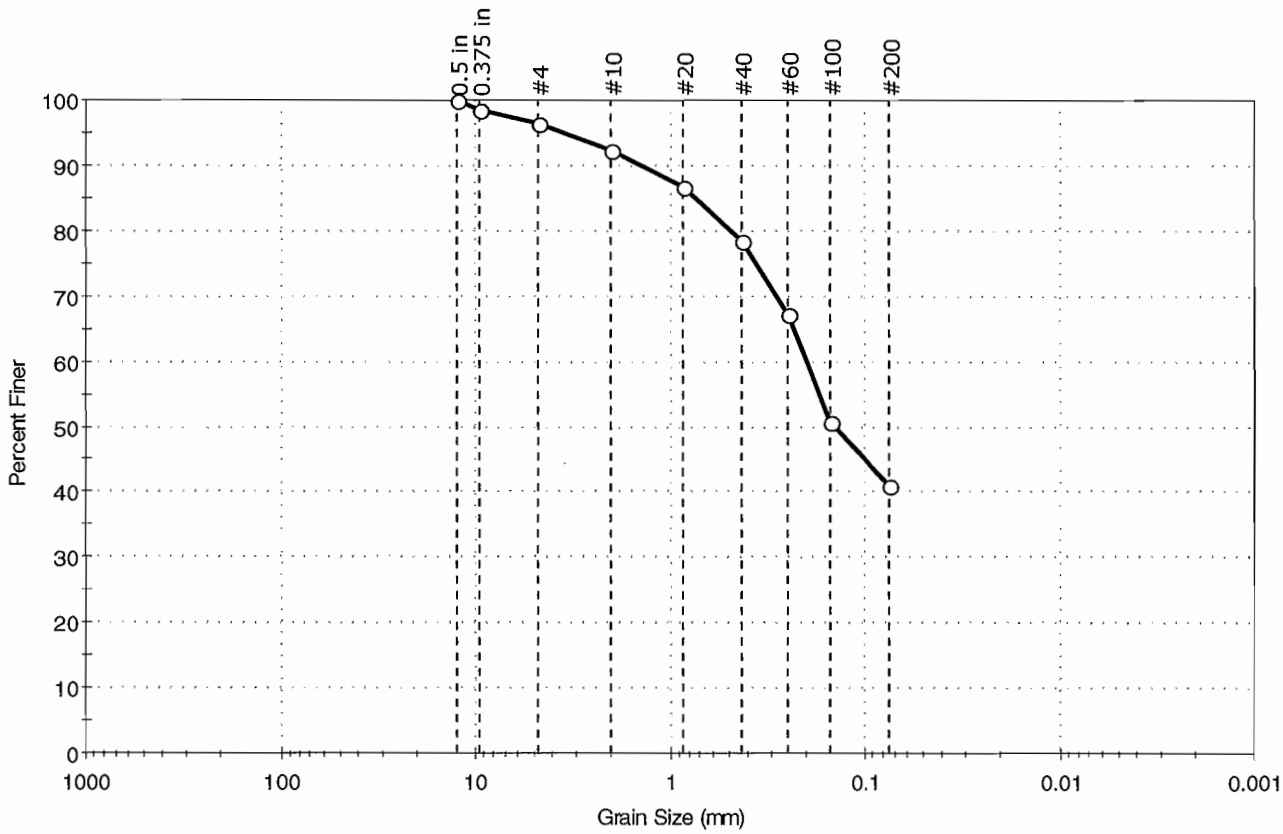
GeoTesting EXPRESS

Client:	Nobis Engineering, Inc.		
Project:	Pine Point Road over B&M Railroad		
Location:	Scarborough, ME	Project No:	GTX-12313
Boring ID: BB-SBMR-105	Sample Type: jar	Tested By:	jbr
Sample ID:8D	Test Date: 10/15/12	Checked By:	jdt
Depth : ---	Test Id: 251776		
Test Comment: ---			
Sample Description:			
Sample Comment: ---			

Particle Size Analysis - ASTM D 422-63 (reapproved 2002)



% Cobble	% Gravel	% Sand	% Silt & Clay Size
--	3.7	55.2	41.1

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.5 in	12.50	100		
0.375 in	9.50	99		
#4	4.75	96		
#10	2.00	92		
#20	0.85	87		
#40	0.42	78		
#60	0.25	67		
#100	0.15	51		
#200	0.075	41		

Coefficients

D_{85} = 0.7397 mm D_{30} = N/A

D_{60} = 0.1997 mm D_{15} = N/A

D_{50} = 0.1427 mm D_{10} = N/A

C_u = N/A C_c = N/A

Classification

ASTM N/A

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ROUNDED

Sand/Gravel Hardness : HARD

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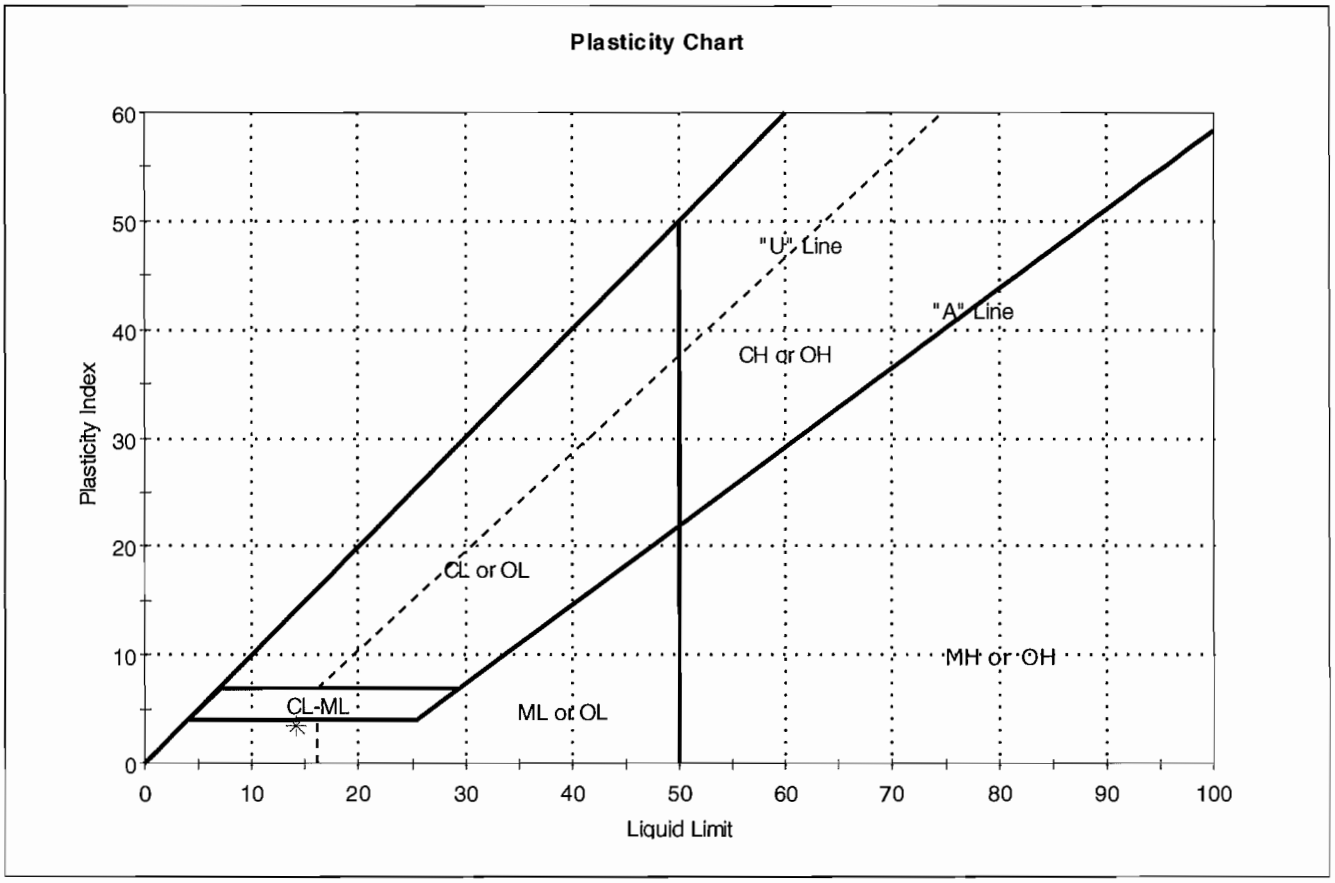
GeoTesting EXPRESS

Client:	Nobis Engineering, Inc.		
Project:	Pine Point Road over B&M Railroad		
Location:	Scarborough, ME	Project No:	GTX-12313
Boring ID: BB-SBMR-101	Sample Type: jar	Tested By:	cam
Sample ID:8D	Test Date: 10/15/12	Checked By:	jdt
Depth : ---	Test Id: 251779		
Test Comment: ---			
Sample Description:			
Sample Comment: ---			

Atterberg Limits - ASTM D 4318-05



Symbol	Sample ID	Boring	Depth	Natural Moisture Content,%	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
*	8D	-SBMR-1	---	10	14	11	3	0	Silty sand (SM)

Sample Prepared using the WET method

28% Retained on #40 Sieve

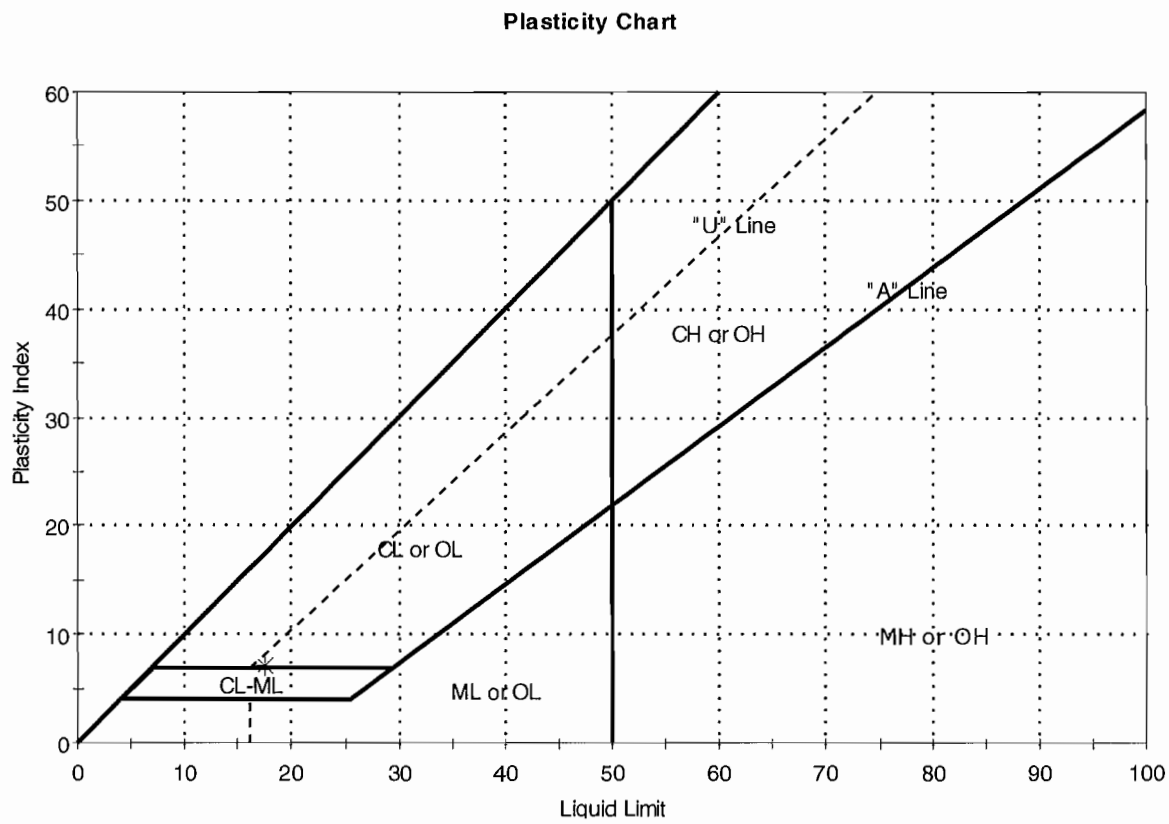
Dry Strength: LOW

Dilentancy: SLOW

Toughness: LOW

Client:	Nobis Engineering, Inc.		
Project:	Pine Point Road over B&M Railroad		
Location:	Scarborough, ME	Project No:	GTX-12313
Boring ID: BB-SBMR-101	Sample Type: jar	Tested By:	cam
Sample ID:14D	Test Date: 10/15/12	Checked By:	jdt
Depth : ---	Test Id: 251780		
Test Comment: ---			
Sample Description:			
Sample Comment: ---			

Atterberg Limits - ASTM D 4318-05



Symbol	Sample ID	Boring	Depth	Natural Moisture Content,%	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
✳	14D	-SBMR-1	---	10	18	10	8	0	Sandy lean clay (CL)

Sample Prepared using the WET method

21% Retained on #40 Sieve

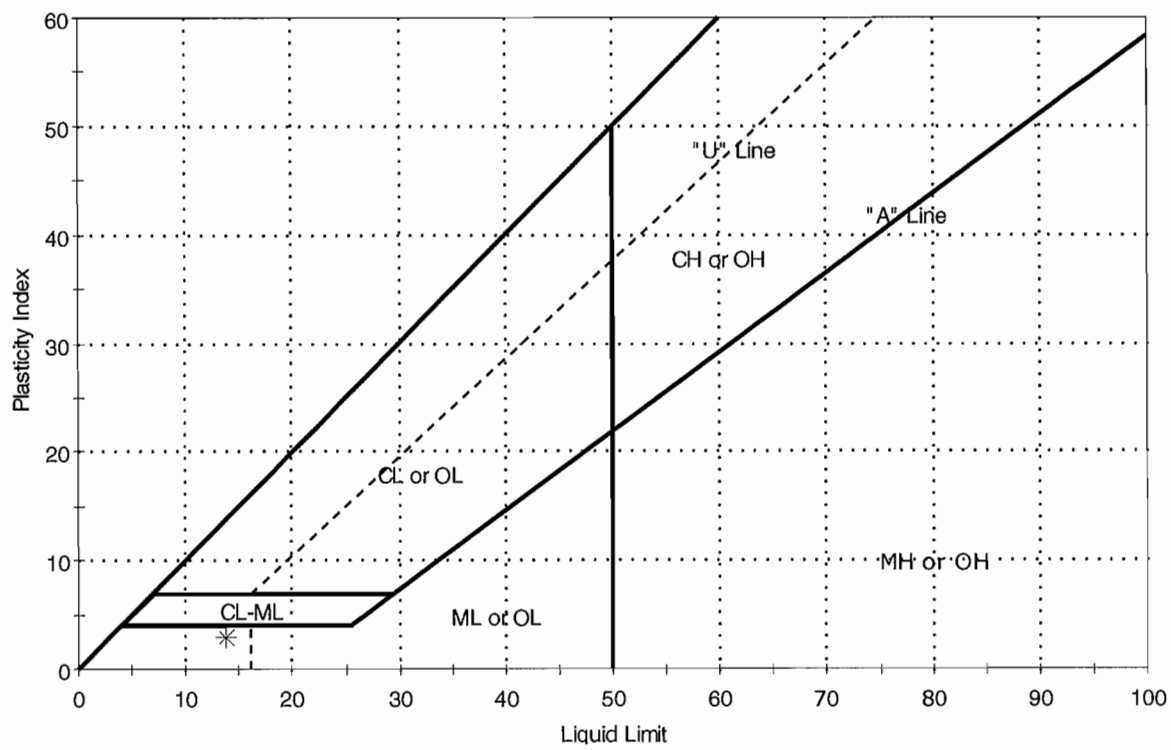
Dry Strength: HIGH

Dilentancy: SLOW

Toughness: LOW

Client:	Nobis Engineering, Inc.		
Project:	Pine Point Road over B&M Railroad		
Location:	Scarborough, ME	Project No:	GTX-12313
Boring ID: BB-SBMR-102	Sample Type: jar	Tested By:	cam
Sample ID:3D	Test Date: 10/15/12	Checked By:	jdt
Depth : ---	Test Id: 251781		
Test Comment: ---			
Sample Description:			
Sample Comment: ---			

Atterberg Limits - ASTM D 4318-05



Symbol	Sample ID	Boring	Depth	Natural Moisture Content,%	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
✳	3D	-SBMR-1	---	10	14	11	3	0	Silty sand (SM)

Sample Prepared using the WET method

24% Retained on #40 Sieve

Dry Strength: HIGH

Dilentancy: SLOW

Toughness: LOW

GeoTesting EXPRESS

Client:	Nobis Engineering, Inc.				
Project:	Pine Point Road over B&M Railroad				
Location:	Scarborough, ME			Project No:	GTX-12313
Boring ID:	BB-SBMR-103	Sample Type:	jar	Tested By:	cam
Sample ID:	4D	Test Date:	10/15/12	Checked By:	jdt
Depth :	---	Test Id:	251782		
Test Comment:	---				
Sample Description:					
Sample Comment:	---				

Atterberg Limits - ASTM D 4318-05

Sample Determined to be non-plastic

Symbol	Sample ID	Boring	Depth	Natural Moisture Content,%	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
*	4D	-SBMR-1	---	9	n/a	n/a	n/a	n/a	Silty sand (SM)

22% Retained on #40 Sieve

Dry Strength: HIGH

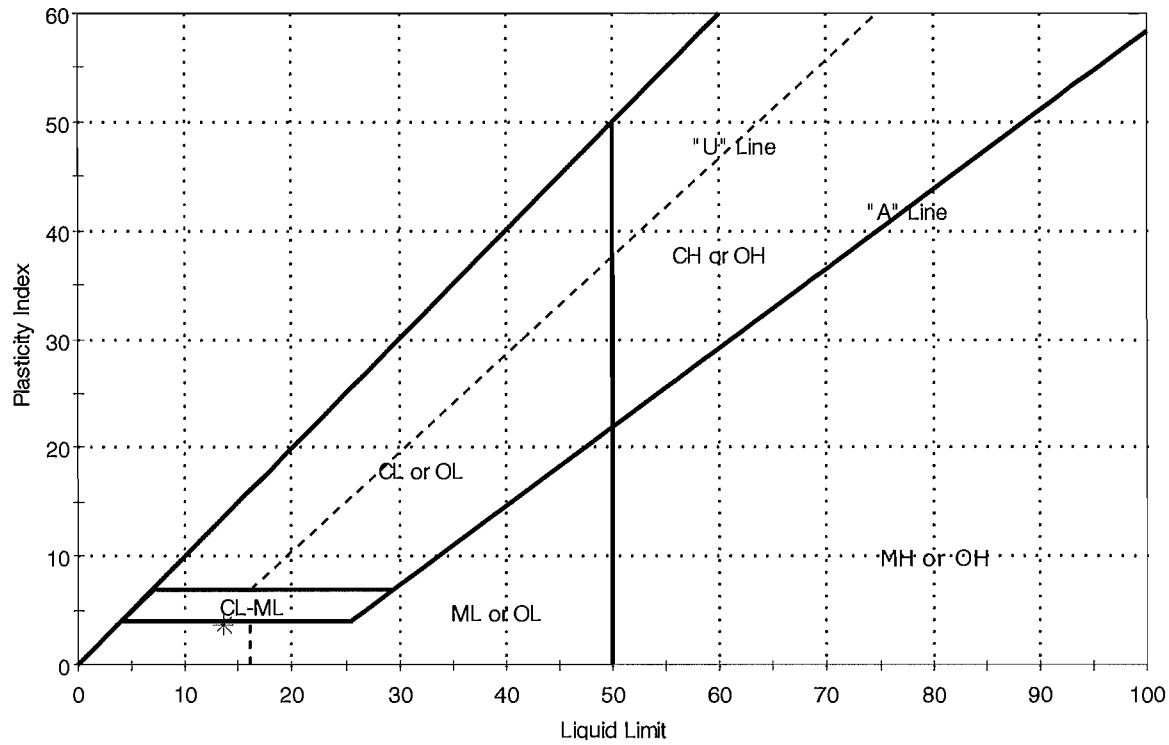
Dilentancy: RAPID

Toughness: n/a

The sample was determined to be Non-Plastic

Client:	Nobis Engineering, Inc.		
Project:	Pine Point Road over B&M Railroad		
Location:	Scarborough, ME	Project No:	GTX-12313
Boring ID: BB-SBMR-104	Sample Type: jar	Tested By:	cam
Sample ID:5D	Test Date: 10/11/12	Checked By:	jdt
Depth : ---	Test Id: 251783		
Test Comment: ---			
Sample Description:			
Sample Comment: ---			

Atterberg Limits - ASTM D 4318-05



Symbol	Sample ID	Boring	Depth	Natural Moisture Content,%	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
*	5D	-SBMR-1	---	8	14	10	4	0	

Sample Prepared using the WET method

Dry Strength: VERY HIGH

Dilentancy: SLOW

Toughness: LOW

Project Name:	PINE POINT RD. OVER B&M RR	**Lab Number:**	L1218419
Project Number:	GTX : 12313	**Report Date:**	10/16/12

SAMPLE RESULTS

Lab ID:	L1218419-01	Date Collected:	10/12/12 00:00
Client ID:	BB-SBMR-104,3D-B	Date Received:	10/11/12
Sample Location:	SCARBOROUGH, ME	Field Prep:	Not Specified
Matrix:	Soil		

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Solids, Total	92		%	0.10	NA	1	-	10/13/12 11:00	30,2540G	TA
Chloride	43		mg/kg	10	--	1	-	10/15/12 12:06	1,9251	LA
Sulfate	ND		mg/kg	110	--	1	-	10/15/12 16:30	1,9038	MP

Project Name:	PINE POINT RD. OVER B&M RR	**Lab Number:**	L1218419
Project Number:	GTX : 12313	**Report Date:**	10/16/12

SAMPLE RESULTS

Lab ID:	L1218419-02	Date Collected:	10/12/12 00:00
Client ID:	BB-SBMR-101,6D-BC	Date Received:	10/11/12
Sample Location:	SCARBOROUGH, ME	Field Prep:	Not Specified
Matrix:	Soil		

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Solids, Total	88		%	0.10	NA	1	-	10/13/12 11:00	30,2540G	TA
Chloride	48		mg/kg	10	--	1	-	10/15/12 12:06	1,9251	LA
Sulfate	ND		mg/kg	110	--	1	-	10/15/12 16:30	1,9038	MP

Project Name:	PINE POINT RD. OVER B&M RR	**Lab Number:**	L1218419
Project Number:	GTX : 12313	**Report Date:**	10/16/12

SAMPLE RESULTS

Lab ID:	L1218419-03	Date Collected:	10/12/12 00:00
Client ID:	BB-SBMR-105,6D-B	Date Received:	10/11/12
Sample Location:	SCARBOROUGH, ME	Field Prep:	Not Specified
Matrix:	Soil		

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Solids, Total	80		%	0.10	NA	1	-	10/13/12 11:00	30,2540G	TA
Chloride	23		mg/kg	12	--	1	-	10/15/12 12:07	1,9251	LA
Sulfate	ND		mg/kg	120	--	1	-	10/15/12 16:30	1,9038	MP

Project Name:	PINE POINT RD. OVER B&M RR	**Lab Number:**	L1218419
Project Number:	GTX : 12313	**Report Date:**	10/16/12

SAMPLE RESULTS

Lab ID:	L1218419-04	Date Collected:	10/12/12 00:00
Client ID:	BB-SBMR-102,9-10FT.	Date Received:	10/11/12
Sample Location:	SCARBOROUGH, ME	Field Prep:	Not Specified
Matrix:	Soil		

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Solids, Total	91		%	0.10	NA	1	-	10/13/12 11:00	30,2540G	TA
Chloride	170		mg/kg	11	--	1	-	10/15/12 12:11	1,9251	LA
Sulfate	220		mg/kg	110	--	1	-	10/15/12 16:30	1,9038	MP

APPENDIX C: CALCULATIONS

1. Bearing Capacity of Existing Substructures
2. Frost Depth Evaluation
3. Global Slope Stability Analysis
4. Seismic Site Classification

1. Bearing Capacity of Existing Substructures

Calculated by: JPM **Date**: 10/5/2012
Checked by: BTW **Date**: 10/17/2012

Bearing Resistance Calculation for Existing Abutment No. 1 (West)

Objective: Evaluate bearing resistance based on 1953 Construction Drawings and observed site conditions.

Source :
AASHTO LRFD Bridge Design Specifications: 6th Edition - 2012

Bearing Soil Properties/Subsurface Information

Unit Weight of Bearing Soil (γ)	125.0 pcf		Estimated value for embankment fill
Unit Weight of Soil Above Footing (γ)	125.0 pcf		Estimated value for embankment fill
Cohesion of Bearing Soil (c)	0		
Friction Angle of Bearing Soil (ϕ')	32 degs		Estimated value for embankment fill
Bearing Soil Type	Embankment Fill		
Soil Description	Loose fine to coarse SAND, some fine to coarse Gravel, little Silt		
Footing EL.	El. 25.5 (NAVD 88)		
Depth to Groundwater	25.0 ft	(BB-SBMR-105)	
Average N Value From Borings:	8		
Ground Surface El.	El. 39.7 (NAVD 88)		
Ground Slope	25 degs		
Footing Geometry			**Table Key**
Eccentricities	e_B, e_L		H = Horizontal Load
Minimum Footing Depth (D_f)	4.0 ft	Per 1953 Plans	V = Vertical Load
Width (B)	7.0 ft	Per 1953 Plans	$\mathbf{e_B}$ = Base Eccentricity
Length (L)	46.0 ft	Per 1953 Plans	$\mathbf{e_L}$ = Length Eccentricity
Effective Width (B')	$B' = B - 2e_B$		$\mathbf{q_R}$ = Factored Bearing Resistance
Effective Length (L')	$L' = L - 2e_L$		$\mathbf{q_n}$ = Nominal Bearing Resistance
Load Angle	90.0 degs		ϕ_b = Resistance Factor

Notes:
1) Existing footing dimensions found in original 1953 Construction Drawings
2) Example bearing resistance calculation can be found on page 2
3) Bearing resistance determined without loads
4) Inclination factors were not used because loads were not provided and D/B' approximately equals 1.
However, effective footing width (B') was conservatively estimated as 4.5 feet to account for potential eccentricity.
5) Bearing resistance values assume footings bear on existing sandy fill soils
6) A subsurface cross-section of this abutment is on page 9

Calculated by: JPM **Date**: 10/5/2012
Checked by: BTW **Date**: 10/17/2012

Abutment No. 1 (West) - Bearing Resistance Calculation B'=4.5 ft.

Factored Bearing Resistance: $q_R = q_n * \phi_b$

Resistance Factor (ϕ_b) =	0.45		Tb. 10.5.5.2.2-1
Nominal Resistance (q_n) =			
$q_n = c*N_{cqm} + 0.5*\gamma*B'*N_{\gamma qm}*C_{w\gamma}$			Eq. 10.6.3.1.2a-1
$N_{cqm} = N_{cq}*s_c*i_c$			Eq. 10.6.3.1.2a-2
Bearing Capacity Factor (N_{cq}) =	N/A	(c=0)	Tb. 10.6.3.1.2c-1
Shape Correction Factor (s_c) =	1.00		Assume = 1 due to omission of N_q
Load Inclination Factor (i_c) =			
$i_c = i_q - [(1-i_q)/N_q-1)]$ =	1.00		N/A
N_{cqm} =	N/A		
$N_{\gamma qm} = N_{\gamma q}*s_\gamma*i_\gamma$			Eq. 10.6.3.1.2a-4
Bearing Capacity Factor ($N_{\gamma q}$)	30		Fig. 10.6.3.1.2c-2
Shape Correction Factor (s_γ)	0.96		Tb. 10.6.3.1.2a-3
Load Inclination Factor (i_γ)			
$i_\gamma = [1-H/(V+cB'L'\cot\phi_f)]^{n+1}$	1.00		N/A (See Notes)
$n = [2+(L'/B')/(1+L'/B')]\cos^2\theta$	1.91		Eq. 10.6.3.1.2a-9
$+ 2+(B'/L')/(1+(B'/L')]\sin^2\theta$			
Vertical Load (V) in kips	-		Unknown
Horizontal Load (H) in kips	-		Unknown
$N_{\gamma qm}$=	28.83		
Groundwater Coefficients			Tb. 10.6.3.1.2a-2
($C_{w\gamma}$)	1.00		
q_n=	8.1 ksf		
q_R=	3.6 ksf		

Calculated by: JPM **Date**: 10/5/2012
Checked by: BTW **Date**: 10/17/2012

Bearing Resistance Calculation for Existing Abutment No. 2 (East)

Objective: Evaluate bearing resistance based on 1953 Construction Drawings and observed site conditions.

Source :
AASHTO LRFD Bridge Design Specifications: 6th Edition - 2012

Bearing Soil Properties/Subsurface Information

Unit Weight of Bearing Soil (γ)	125.0 pcf		Estimated value for embankment fill
Unit Weight of Soil Above Footing (γ)	125.0 pcf		Estimated value for embankment fill
Cohesion of Bearing Soil (c)	0		
Friction Angle of Bearing Soil (ϕ')	33 degs		Estimated value for embankment fill
Bearing Soil Type	Embankment Fill		
Soil Description	Medium dense fine to coarse SAND, some fine to coarse Gravel, little Silt		
Footing EL.	El. 25.5 (NAVD 88)		
Depth to Groundwater	26.0 ft	(BB-SBMR-101)	
Average N Value From Borings:	20		
Ground Surface El.	El. 35.1 (NAVD 88)		
Ground Slope	29 degs		

Footing Geometry			**Table Key**
Eccentricities	e_B, e_L		H = Horizontal Load
Minimum Footing Depth (D_f)	4.0 ft	Per 1953 Plans	V = Vertical Load
Width (B)	7.0 ft	Per 1953 Plans	$\mathbf{e_B}$ = Base Eccentricity
Length (L)	46.0 ft	Per 1953 Plans	$\mathbf{e_L}$ = Length Eccentricity
Effective Width (B')	$B' = B - 2e_B$		$\mathbf{q_R}$ = Factored Bearing Resistance
Effective Length (L')	$L' = L - 2e_L$		$\mathbf{q_n}$ = Nominal Bearing Resistance
Load Angle	90.0 degs		ϕ_b = Resistance Factor

Notes:
1) Existing footing dimensions found in original 1953 Construction Drawings
2) Example bearing resistance calculation can be found on page 4
3) Bearing resistance determined without loads
4) Inclination factors were not used because loads were not provided and D/B' approximately equals 1.
However, effective footing width (B') was conservatively estimated as 4.5 feet to account for potential eccentricity.
5) Bearing resistance values assume footings bear on existing sandy fill soils
6) A subsurface cross-section of this abutment is on page 11

Calculated by: JPM **Date**: 10/5/2012
Checked by: BTW **Date**: 10/17/2012

Abutment No. 2 (East) - Bearing Resistance Calculation B'=4.5 ft.

Factored Bearing Resistance: $q_R = q_n * \phi_b$

Resistance Factor (ϕ_b) =	0.45		Tb. 10.5.5.2.2-1
Nominal Resistance (q_n) =			
$q_n = c*N_{cqm} + 0.5*\gamma*B'*N_{\gamma qm}*C_{w\gamma}$			Eq. 10.6.3.1.2a-1
$N_{cqm} = N_{cq}*s_c*i_c$			Eq. 10.6.3.1.2a-2
Bearing Capacity Factor (N_{cq}) =	N/A	(c=0)	Tb. 10.6.3.1.2c-1
Shape Correction Factor (s_c) =	1.00		Assume = 1 due to omission of N_q
Load Inclination Factor (i_c) =			
$i_c = i_q - [(1-i_q)/N_q-1)]$ =	1.00		N/A
N_{cqm} =	N/A		
$N_{\gamma qm} = N_{\gamma q}*s_\gamma*i_\gamma$			Eq. 10.6.3.1.2a-4
Bearing Capacity Factor ($N_{\gamma q}$)	30		Fig. 10.6.3.1.2c-2
Shape Correction Factor (s_γ)	0.96		Tb. 10.6.3.1.2a-3
Load Inclination Factor (i_γ)			
$i_\gamma = [1-H/(V+cB'L'\cot\phi_f)]^{n+1}$	1.00		N/A (See Notes)
$n = [2+(L'/B')/(1+L'/B')]\cos^2\theta$	1.51		Eq. 10.6.3.1.2a-9
$+ 2+(B'/L')/(1+(B'/L')]\sin^2\theta$			
Vertical Load (V) in kips	-		Unknown
Horizontal Load (H) in kips	-		Unknown
$N_{\gamma qm}$=	28.83		
Groundwater Coefficients			Tb. 10.6.3.1.2a-2
($C_{w\gamma}$)	1.00		
q_n=	8.1 ksf		
q_R=	3.6 ksf		

Calculated by: JPM **Date**: 10/5/2012
Checked by: BTW **Date**: 10/17/2012

Bearing Resistance Calculation for Piers

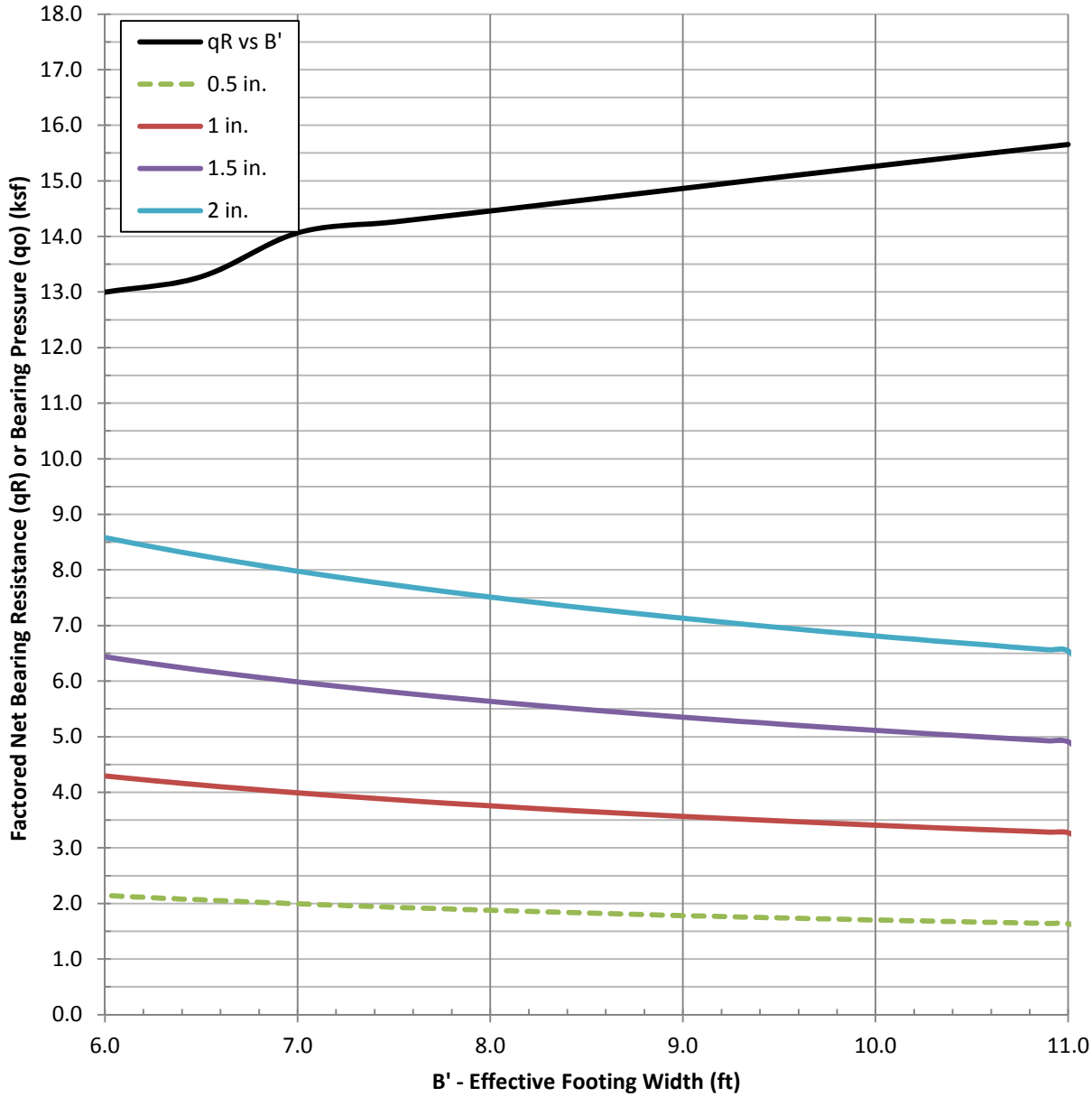
Objective: Evaluate bearing resistance based on 1953 Construction Drawings and observed site conditions.

Source :
AASHTO LRFD Bridge Design Specifications: 6th Edition - 2012

Bearing Soil Properties/Subsurface Information

Unit Weight of Bearing Soil (γ)	130.0 pcf		Estimated value for Silty Sand
Unit Weight of Soil Above Footing (γ)	120.0 pcf		Estimated value for backfill soil
Cohesion of Bearing Soil (c)	0		
Friction Angle of Bearing Soil (ϕ')	33 degs		Estimated value for Silty Sand
Bearing Soil Type	Natural Silty Sand		
Soil Description	Medium dense fine to coarse SAND, some Silt, trace Gravel		
Footing EL.	El. 7.5 (NAVD 88)		Average between borings
Depth to Groundwater	2.0 ft		Average between borings
Average N Value From Borings:	20		Average between borings
Ground Surface El.	El. 15 (NAVD 88)		Average between borings
Footing Geometry			**Table Key**
Eccentricities	e_B, e_L		H = Horizontal Load
Minimum Footing Depth (D_f)	7.0 ft	Per 1953 Plans	V = Vertical Load
Width (B)	11.0 ft	Per 1953 Plans	$\mathbf{e_B}$ = Base Eccentricity
Length (L)	11.0 ft	Per 1953 Plans	$\mathbf{e_L}$ = Length Eccentricity
Effective Width (B')	$B' = B - 2e_B$		$\mathbf{q_R}$ = Factored Bearing Resistance
Effective Length (L')	$L' = L - 2e_L$		$\mathbf{q_n}$ = Nominal Bearing Resistance
Load Angle	90.0 degs		ϕ_b = Resistance Factor

Notes:
1) Existing footing dimensions found in original 1953 Construction Drawings
2) Example bearing resistance and settlement calculations can be found on pages 7 and 8
3) Bearing resistance determined without loads
4) Inclination factors were not used because loads were not provided and D/B' approximately equals 1.
However, effective footing width (B') was conservatively estimated as 6.5 feet to account for potential eccentricity.
5) Bearing resistance values assume footings bear on natural silty sand soil
6) A subsurface cross-section of Pier 2 is on page 10
7) Graph created using a range of effective footing dimensions can be found on page 6



Notes:

qR = Factored Bearing Resistance - Strength Limit State (enter graph with B' and read qR)

qo = Maximum Bearing Pressure - Service Limit State (enter graph with qo and read settlement at B')

1. q_R vs B' line and settlement curves developed using footing dimensions found on original 1954 Construction Drawings.

2. Bearing capacity and settlements are based on soil Υ = 130 pcf, ϕ = 33°, E_s = 2.5 ksi, v = 0.25.

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Pine Point Crossing over B&M Railroad
Project No. 85970.00
Page: 6 of 11

Calculated by: JPM Date: 10/5/2012
Checked by: BTW Date: 10/17/2012

Calculated by: JPM **Date**: 10/5/2012
Checked by: BTW **Date**: 10/17/2012

Piers - Bearing Resistance Calculation B'=6.5 ft.

Factored Bearing Resistance: $q_R = q_n * \phi_b$

Resistance Factor (ϕ_b) =	0.45	Tb. 10.5.5.2.2-1
Nominal Resistance (q_n) =		
$q_n = c*N_{cm} + \gamma*D_f*N_{qm}*C_{wq} + 0.5*\gamma*B'*N_{\gamma m}*C_{w\gamma}$		Eq. 10.6.3.1.2a-
$N_{qm} = N_q*s_q*d_q*i_q$		Eq. 10.6.3.1.2a-
Bearing Capacity Factor (N_q)	26.1	Tb. 10.6.3.1.2a-
Shape Correction Factor (s_q)	1.38	Tb. 10.6.3.1.2a-
Load Inclination Factor (i_q)		
$i_q = [1-H/(V+cB'L'\cot\phi_f)]^n$	1.00	N/A (See Notes)
$n = [2+(L'/B')/(1+L'/B')]\cos^2\theta$	1.63	Eq. 10.6.3.1.2a-9
$+ 2+(B'/L')/(1+(B'/L')]\sin^2\theta$		
Vertical Load (V) in Kips	-	Unknown
Horizontal Load (H) in Kips	-	Unknown
Load Angle (θ)	-	Unknown
Depth Correction Factor (d_q)	1.22	Tb. 10.6.3.1.2a-
N_{qm}=	44.11	
$N_{cm} = N_c*s_c*i_c$		Eq. 10.6.3.1.2a-
Bearing Capacity Factor (N_c) =	38.6	Tb. 10.6.3.1.2a-1
Shape Correction Factor (s_c) =	1.40	Tb. 10.6.3.1.2a-3
Load Inclination Factor (i_c) =		
$i_c = i_q - [(1-i_q)/N_q-1)]$ =	1.00	N/A (See Notes)
N_{cm} =	54.02	
$N_{\gamma m} = N_\gamma*s_\gamma*i_\gamma$		Eq. 10.6.3.1.2a-
Bearing Capacity Factor (N_γ)	35.2	Tb. 10.6.3.1.2a-1
Shape Correction Factor (s_γ)	0.76	Tb. 10.6.3.1.2a-
Load Inclination Factor (i_γ)		
$i_\gamma = [1-H/(V+cB'L'\cot\phi_f)]^{n+1}$	1.00	N/A (See Notes)
2) Example beari $n = [2+(L'/B')/(1+L'/B')]\cos^2\theta$	1.63	Eq. 10.6.3.1.2a-9
3) Reference tabl $+ 2+(B'/L')/(1+(B'/L')]\sin^2\theta$		
Vertical Load (V) in kips	-	Unknown
Horizontal Load (H) in kips	-	Unknown
$N_{\gamma m}$=	26.88	
Groundwater Coefficients		Tb. 10.6.3.1.2a-
(C_{wq})	0.64	
8) Graph created using a ran ($C_{w\gamma}$)	0.50	
q_n=	29.5 ksf	
q_R=	13.3 ksf	

Calculated by: JPM **Date**: 10/5/2012
Checked by: BTW **Date**: 10/17/2012

Settlement Calculation for Piers

Source :
AASHTO LRFD Bridge Design Specifications: 6th Edition - 2012

$$S_e = \frac{(q_o(1-v^2)\sqrt{A'})}{144*E_s*\beta_z}$$ Eq. 10.6.2.4.2-1

q_o= applied vertical stress (ksf)
v = Poisson's Ratio
A'= effective area of footing (ft^2)
E_s= youngs modulus of elasticity (ksi)
β_z= shape factor

Soil Properties/Subsurface Information

Unit Weight of Bearing Soil (γ)	130.0 pcf	Estimated value for Silty Sand
Cohesion of Bearing Soil (c)	0	
Friction Angle of Bearing Soil (ϕ')	33 degs	Estimated value for Silty Sand
Bearing Soil Type	Natural Silty Sand	
Soil Description	Medium dense fine to coarse SAND, some Silt, trace Gravel	
Average N Value from Borings:	20	

Calculations:

B' (ft)=	6.5			v =	0.25	Tb. C10.4.6.3-1
L' (ft)=	11	L'/B'	1.7	E_s=	2.5	Tb. C10.4.6.3-1
A' (ft)=	71.5			β_z=	1.09	Tb. 10.6.2.4.2-1

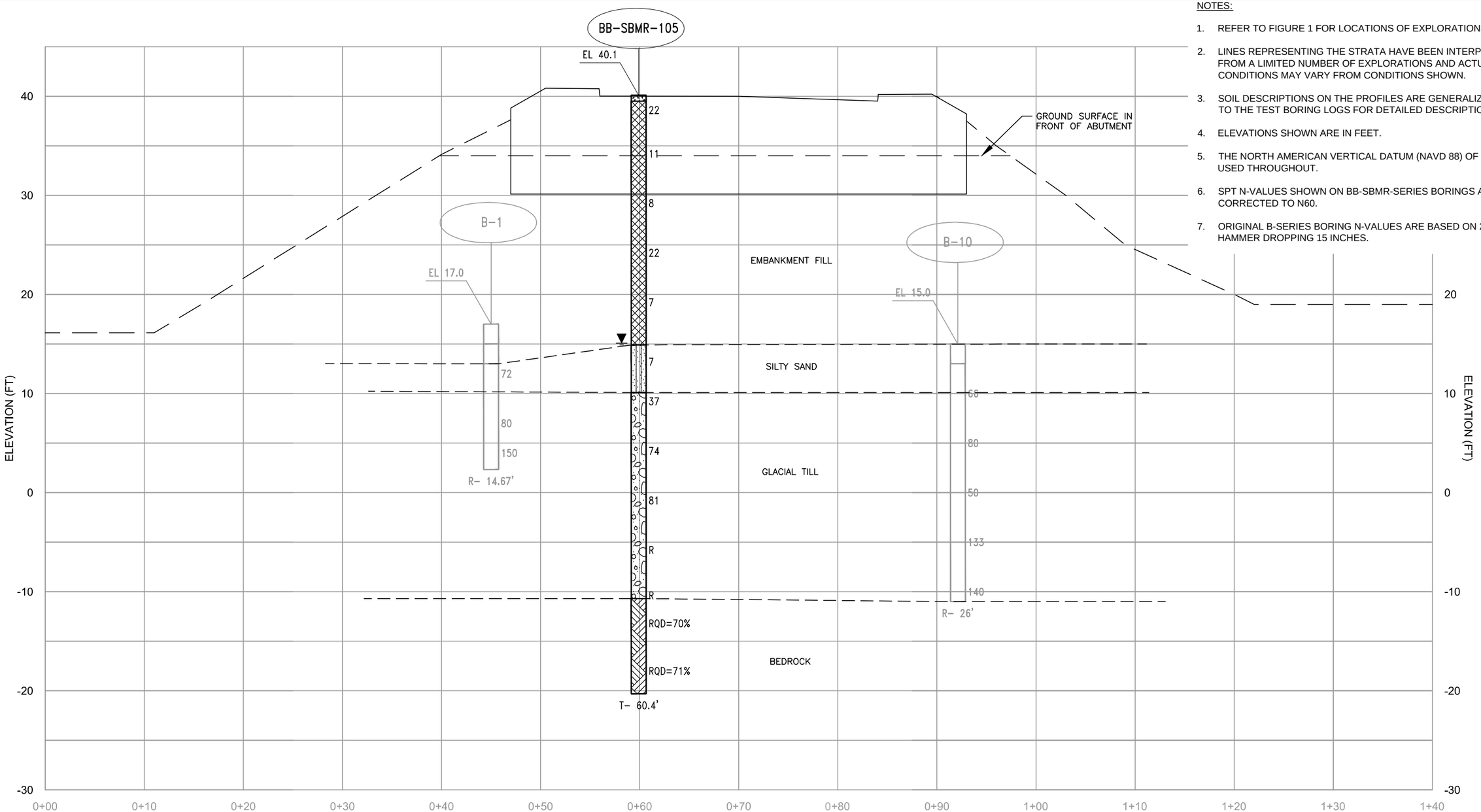
Assumed Settlement, S_e (in)	Applied Vertical Stress, q_o (ksf)
1.00	4.1
2.00	8.3
3.00	12.4

Notes:

1. Bearing capacity and settlement calculations assume that the Pier footings are embedded 7 feet and placed on the medium dense silty sand layer.
2. Elastic Modulus estimated as medium dense silty sand.

NOTES:

1. REFER TO FIGURE 1 FOR LOCATIONS OF EXPLORATIONS.
2. LINES REPRESENTING THE STRATA HAVE BEEN INTERPOLATED FROM A LIMITED NUMBER OF EXPLORATIONS AND ACTUAL CONDITIONS MAY VARY FROM CONDITIONS SHOWN.
3. SOIL DESCRIPTIONS ON THE PROFILES ARE GENERALIZED. REFER TO THE TEST BORING LOGS FOR DETAILED DESCRIPTIONS.
4. ELEVATIONS SHOWN ARE IN FEET.
5. THE NORTH AMERICAN VERTICAL DATUM (NAVD 88) OF 1988 IS USED THROUGHOUT.
6. SPT N-VALUES SHOWN ON BB-SBMR-SERIES BORINGS ARE CORRECTED TO N60.
7. ORIGINAL B-SERIES BORING N-VALUES ARE BASED ON 275 LB HAMMER DROPPING 15 INCHES.



HORIZONTAL

20 0 10 20

20 0 10 20

VERTICAL

SCALE IN FEET

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FIGURE 3

SUBSURFACE PROFILE - ABUTMENT NO. 1
PINE POINT ROAD OVER B&M RAILROAD
SCARBOROUGH, MAINE

DRAWN BY:	AMR	APPROVED BY:	JM
PROJECT NO.	85970.00	DATE:	SEPTEMBER 2012

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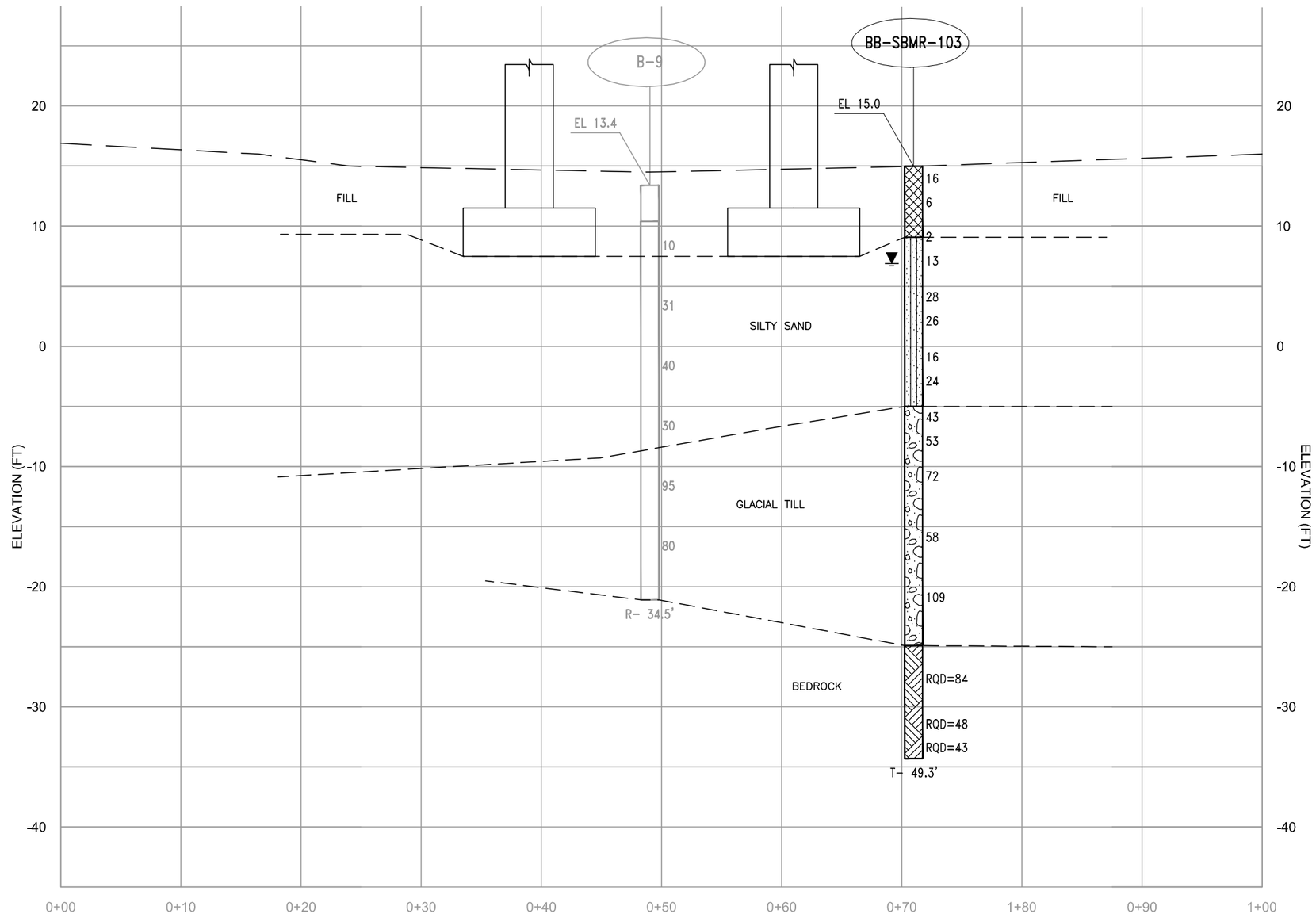

NOTES:

1. REFER TO FIGURE 1 FOR LOCATIONS OF EXPLORATIONS.
2. LINES REPRESENTING THE STRATA HAVE BEEN INTERPOLATED FROM A LIMITED NUMBER OF EXPLORATIONS AND ACTUAL CONDITIONS MAY VARY FROM CONDITIONS SHOWN.
3. SOIL DESCRIPTIONS ON THE PROFILES ARE GENERALIZED. REFER TO THE TEST BORING LOGS FOR DETAILED DESCRIPTIONS.
4. ELEVATIONS SHOWN ARE IN FEET.
5. THE NORTH AMERICAN VERTICAL DATUM (NAVD 88) OF 1988 IS USED THROUGHOUT.
6. SPT N-VALUES SHOWN ON BB-SBMR-SERIES BORINGS ARE CORRECTED TO N60.
7. ORIGINAL B-SERIES BORING N-VALUES ARE BASED ON 275 LB HAMMER DROPPING 15 INCHES.

HORIZONTAL
20 0 10 20
20 0 10 20
VERTICAL
SCALE IN FEET

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FIGURE 4

SUBSURFACE PROFILE - PIER NO. 2
PINE POINT ROAD OVER B&M RAILROAD
SCARBOROUGH, MAINE

DRAWN BY:	AMR	APPROVED BY:	JM
PROJECT NO.	85970.00	DATE:	SEPTEMBER 2012

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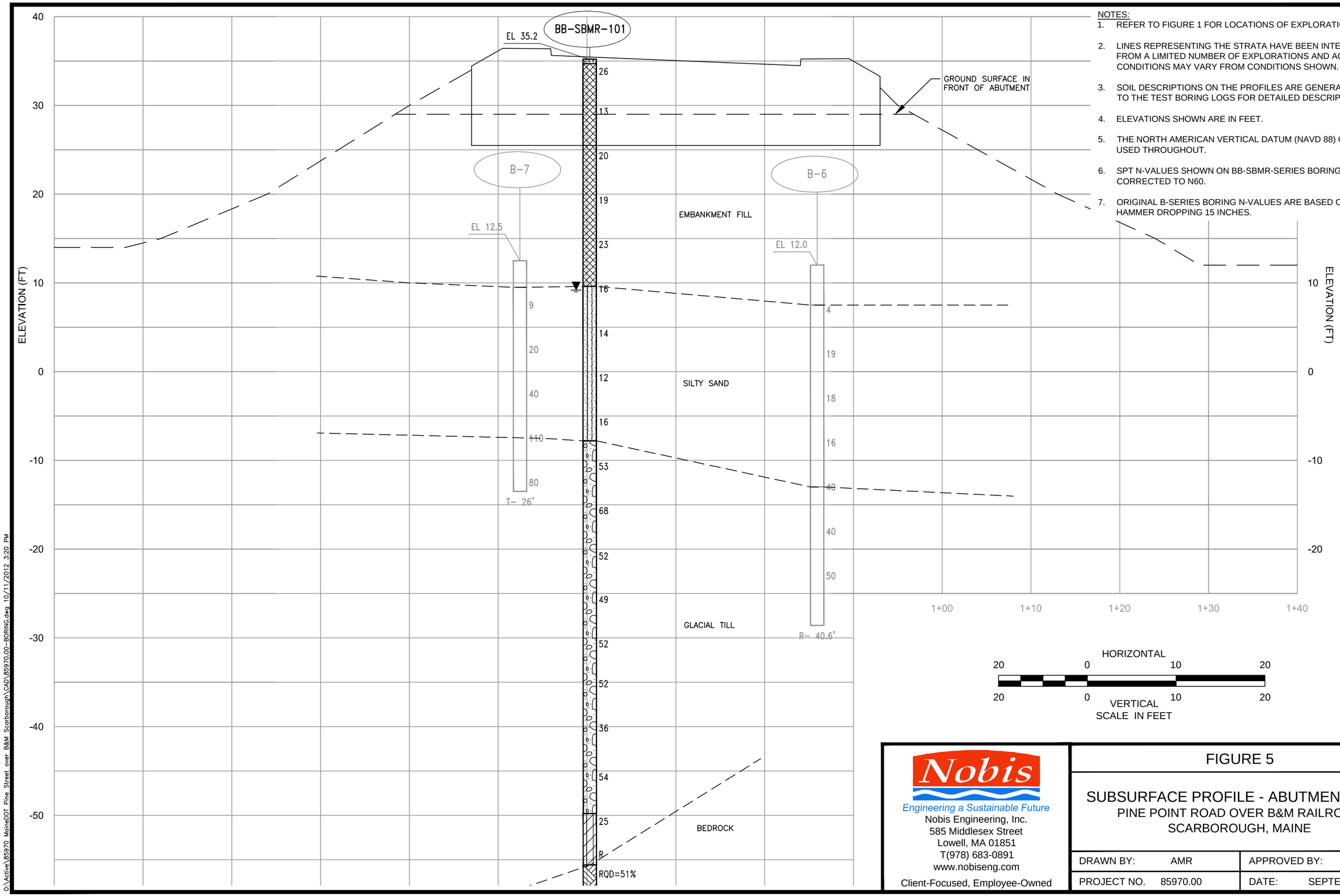

NOTES:

1. REFER TO FIGURE 1 FOR LOCATIONS OF EXPLORATIONS.
2. LINES REPRESENTING THE STRATA HAVE BEEN INTERPOLATED FROM A LIMITED NUMBER OF EXPLORATIONS AND ACTUAL CONDITIONS MAY VARY FROM CONDITIONS SHOWN.
3. SOIL DESCRIPTIONS ON THE PROFILES ARE GENERALIZED. REFER TO THE TEST BORING LOGS FOR DETAILED DESCRIPTIONS.
4. ELEVATIONS SHOWN ARE IN FEET.
5. THE NORTH AMERICAN VERTICAL DATUM (NAVD 88) OF 1988 IS USED THROUGHOUT.
6. SPT N-VALUES SHOWN ON BB-SBMR-SERIES BORINGS ARE CORRECTED TO N60.
7. ORIGINAL B-SERIES BORING N-VALUES ARE BASED ON 275 LB HAMMER DROPPING 15 INCHES.

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FIGURE 5

SUBSURFACE PROFILE - ABUTMENT NO. 2
PINE POINT ROAD OVER B&M RAILROAD
SCARBOROUGH, MAINE

DRAWN BY:	AMR	APPROVED BY:	JM
PROJECT NO.	85970.00	DATE:	SEPTEMBER 2012

O:\Active\85970 MaineDOT Pine Street over B&M Scarborough\CAD\85970.00-BORING.dwg 10/11/2012 3:20 PM

2. Frost Depth Evaluation

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SHEET NO. _____ OF _____
CALCULATED BY AMR DATE 10-9-12
CHECKED BY JPM DATE 10/17/12
SCALE N-7-S

Estimate Frost Penetration Depth

Reference: Maine DOT Bridge Design Guide Section 5.2.1

Assumed
Soil Conditions: Coarse Grained
WC = 10%

Design Freezing Index: 1275 ← interpolated from Figure 5-1

Depth of Frost Penetration: 75.5 inches = 6.3 feet ← interpolated from Table 5-1

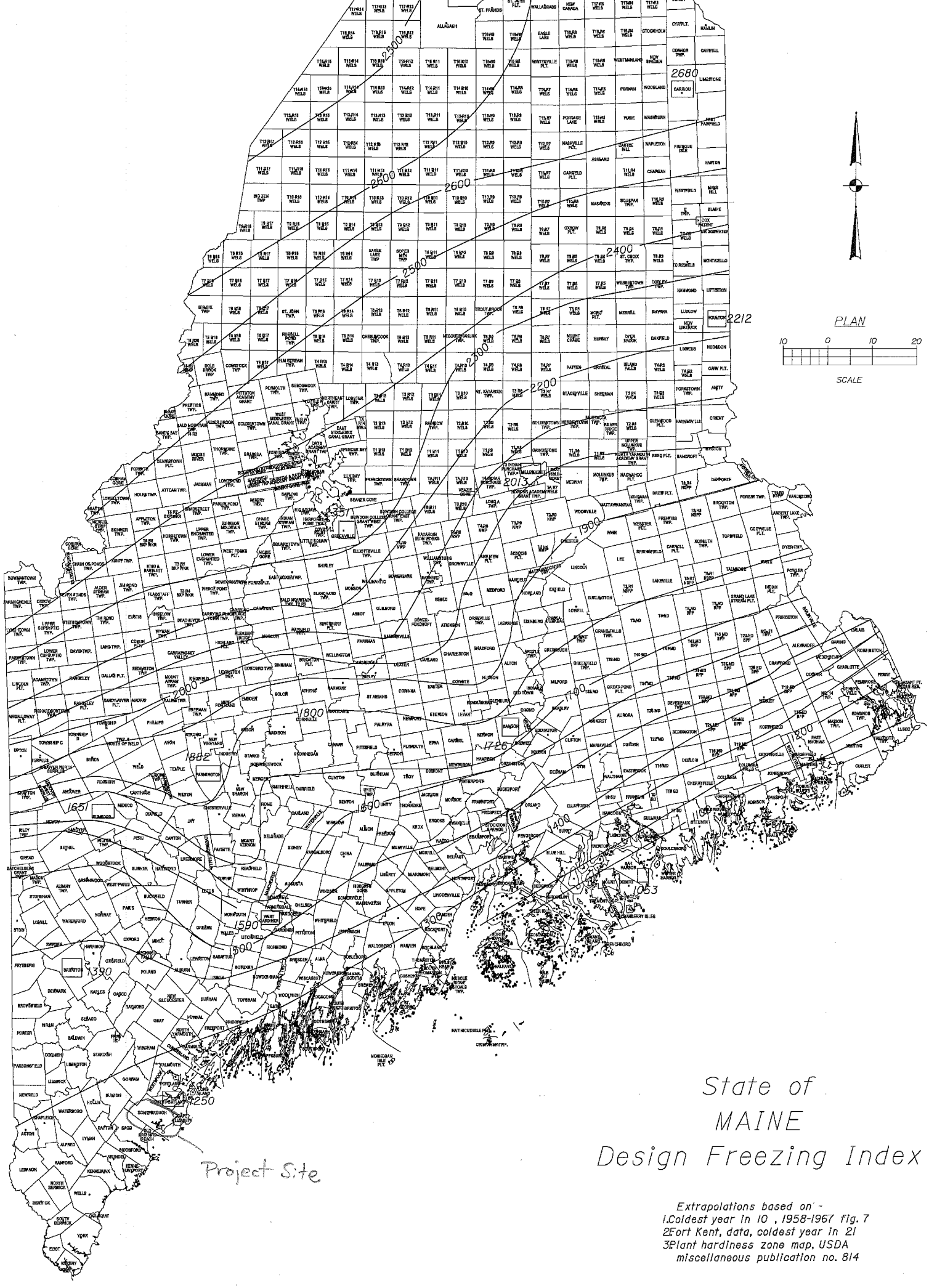
In order to estimate the depth of frost penetration at a site, Table 5-1 has been developed using the Modified Berggren equation and Figure 5-1 Maine Design Freezing Index Map. The use of Table 5-1 assumes site specific, uniform soil conditions where the Geotechnical Designer has evaluated subsurface conditions. Coarse-grained soils are defined as soils with sand as the major constituent. Fine-grained soils are those having silt and/or clay as the major constituent. If the make-up of the soil is not easily discerned, consult the Geotechnical Designer for assistance. In the event that specific site soil conditions vary, the depth of frost penetration should be calculated by the Geotechnical Designer.

Table 5-1 Depth of Frost Penetration

Design Freezing Index	Frost Penetration (in)					
	Coarse Grained			Fine Grained		
	w=10%	w=20%	w=30%	w=10%	w=20%	w=30%
1000	66.3	55.0	47.5	47.1	40.7	36.9
1100	69.8	57.8	49.8	49.6	42.7	38.7
1200	73.1	60.4	52.0	51.9	44.7	40.5
1275 → 1300	76.3	63.0	54.3	54.2	46.6	42.2
1400	79.2	65.5	56.4	56.3	48.5	43.9
1500	82.1	67.9	58.4	58.3	50.2	45.4
1600	84.8	70.2	60.3	60.2	51.9	46.9
1700	87.5	72.4	62.2	62.2	53.5	48.4
1800	90.1	74.5	64.0	64.0	55.1	49.8
1900	92.6	76.6	65.7	65.8	56.7	51.1
2000	95.1	78.7	67.5	67.6	58.2	52.5
2100	97.6	80.7	69.2	69.3	59.7	53.8
2200	100.0	82.6	70.8	71.0	61.1	55.1
2300	102.3	84.5	72.4	72.7	62.5	56.4
2400	104.6	86.4	74.0	74.3	63.9	57.6
2500	106.9	88.2	75.6	75.9	65.2	58.8
2600	109.1	89.9	77.1	77.5	66.5	60.0

Note: Where the Freezing Index and/or water content is between the presented values, linear interpretation may be used to determine the frost penetration.

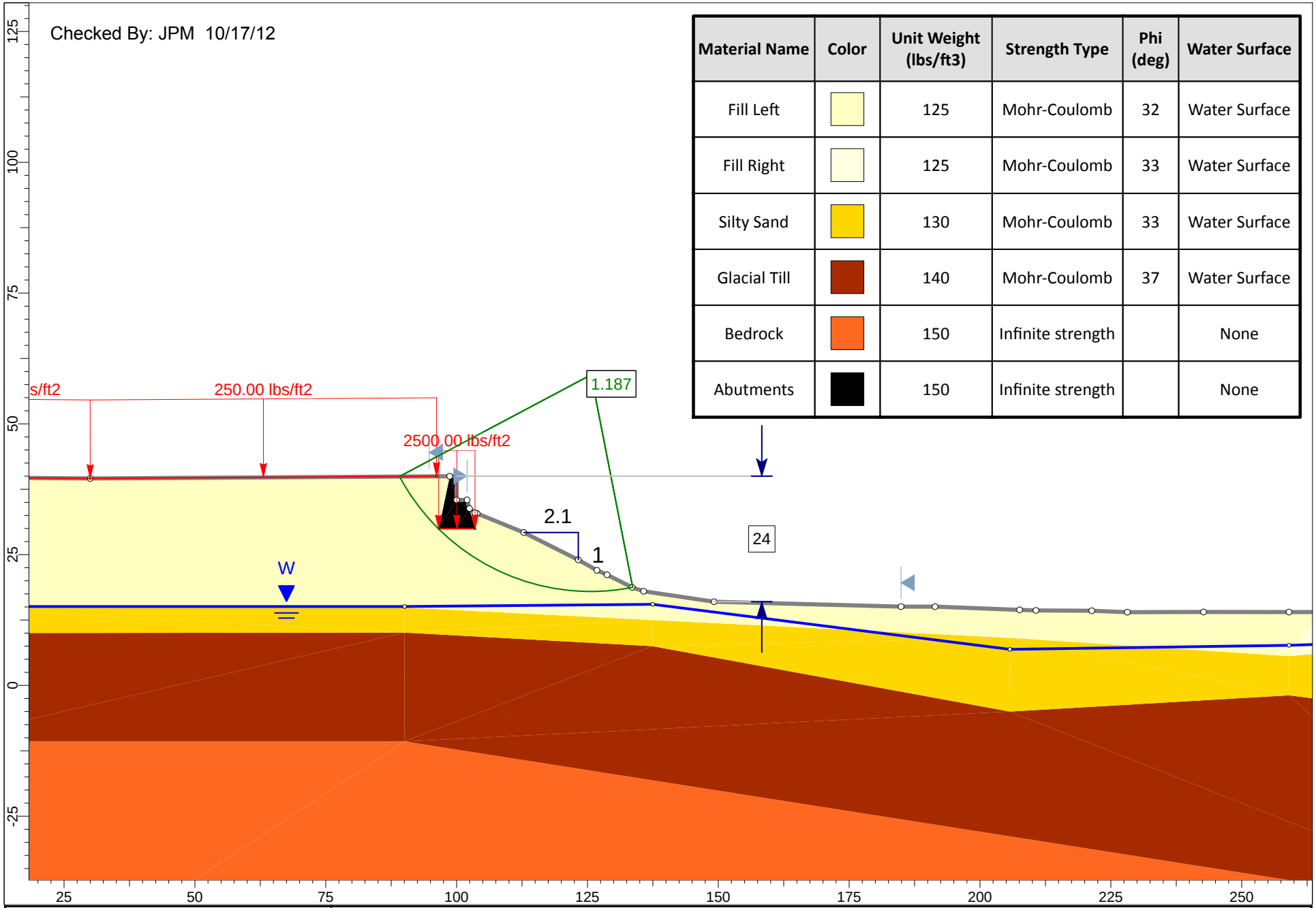
Figure 5-1 Maine Design Freezing Index Map



3. Global Slope Stability Analysis

Checked By: JPM 10/17/12

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Phi (deg)	Water Surface
Fill Left		125	Mohr-Coulomb	32	Water Surface
Fill Right		125	Mohr-Coulomb	33	Water Surface
Silty Sand		130	Mohr-Coulomb	33	Water Surface
Glacial Till		140	Mohr-Coulomb	37	Water Surface
Bedrock		150	Infinite strength		None
Abutments		150	Infinite strength		None



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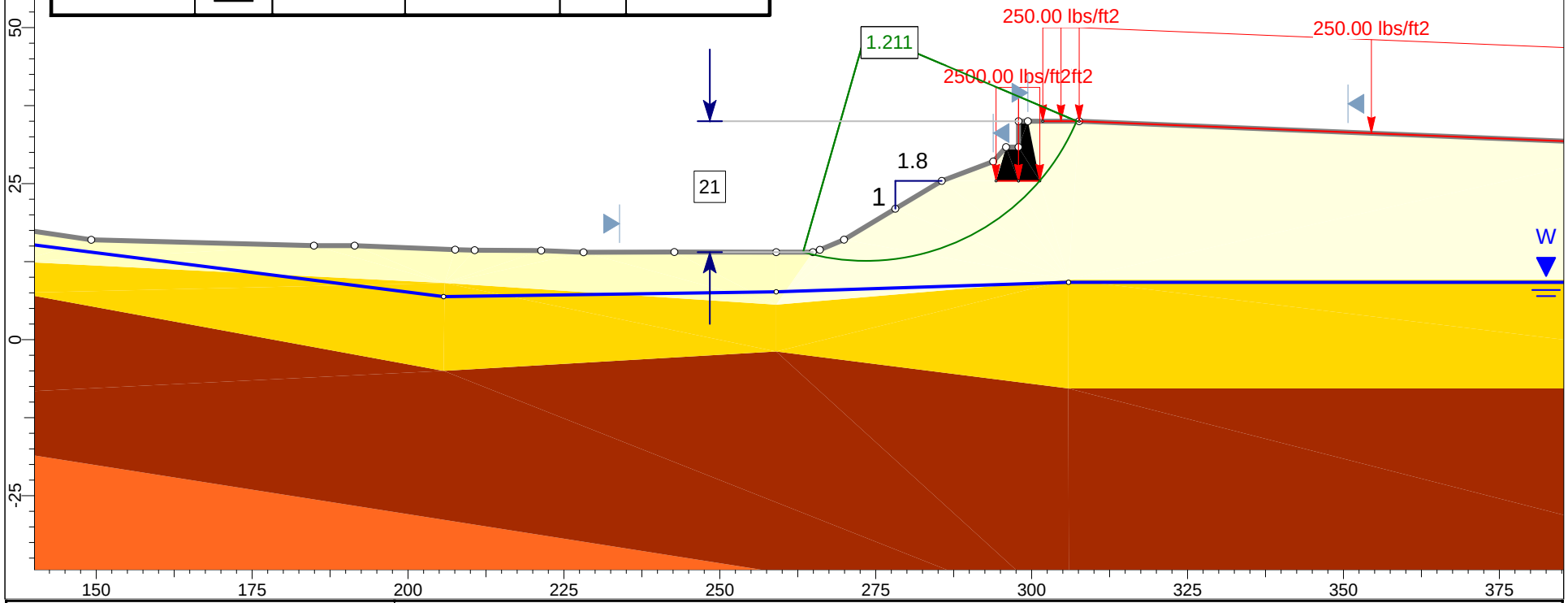
Project	Pine Point Road over B&M Railroad		
Analysis Description	Slope Stability - West Abutment		
Drawn By	J. Kalafatis	Scale 1:300	Company Nobis Engineering
Date	10/10/2012		File Name West Abutment.slim

Checked By: JPM 10/17/12

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Phi (deg)	Water Surface
Fill Left		125	Mohr-Coulomb	32	Water Surface
Fill Right		125	Mohr-Coulomb	33	Water Surface
Silty Sand		130	Mohr-Coulomb	33	Water Surface
Glacial Till		140	Mohr-Coulomb	37	Water Surface
Bedrock		150	Infinite strength		None
Abutments		150	Infinite strength		None



Nobis
Engineering a Sustainable Future
SLIDEINTERPRET 6.019

Project	Pine Point Road over B&M Railroad		
Analysis Description	Slope Stability - East Abutment		
Drawn By: J. Kalafatis	Scale: 1:300	Company: Nobis Engineering	
Date: 10/10/2012		File Name: East Abutment.slim	

4. Seismic Site Classification

Engineering a Sustainable Future

Project No. 85970.00 | Pine Point Crossing over B&M Railroad | Calculated by: JPM
October 10, 2012 | Scarborough, ME | Checked by: AMR

Seismic Site Classification

Purpose: Determine seismic site classification for Pine Point Crossing Bridge over B&M Railroad site in accordance with AASHTO Bridge Design Specifications, Sixth Edition, 2012.

Reference: AASHTO Bridge Design Specifications, Sixth Edition, 2012.

Solution:

- Evaluate geotechnical data in order to determine if Site Class F soils are present.
- Determine site class using Table 3.10.3.1-1 – Site Class Definitions, attached.

The boring logs indicate that clays or peats following the criteria of Table 3.10.3.1-1 under Site Class F do not occur at the bridge site. Therefore, the site does **not** classify as Site Class F**.**

Categorize into one of the site classes in Table 3.10.3.1-1 using Method B (Table C3.10.3.1-1). The SPT N for cohesionless soil layers in the top 100 ft was calculated in accordance with Method B. See attached spreadsheets.

The following table summarizes the seismic site classification at the respective boring locations.

Summary of Seismic Site Classification:

Boring No.	N bar (N)	Seismic Site Classification
BB-SBMR-101	28	D
BB-SBMR-102	41	D
BB-SBMR-103	43	D
BB-SBMR-104	64	C
BB-SBMR-105	31	D

Conclusion:
The seismic site classification for the overall Pine Point Crossing Bridge over B&M Railroad site is **D**.

SEISMIC GROUND SHAKING HAZARD DESIGN SPECTRA:

AS = 0.141
SDS = 0.280
SD1 = 0.107
SITE CLASS = D

Nobis Engineering, Inc.
585 Middlesex Street
Lowell, MA 01851
T (978) 683-0891

Determine Seismic Site Classification Using AASHTO Bridge Design Specifications, 2012.

Data from Boring BB-SBMR-101

Layer	Depth Range		Thickness (d_i)	N_i	d_i/N_i
	Start [ft]	End [ft]	[ft]	blows/ft	
1	0	25.7	25.7	20	1.285
2	25.7	43	17.3	15	1.153
3	43	85	42	52	0.808
5	85	90.8	5.8	25	0.232
6	90.8	100	9.2	100	0.092
SUM			**100**		**3.570**

N bar	**28**

Site Class D - Stiff Soil

Data from Boring BB-SMBR-102

Layer	Depth Range		Thickness (d_i)	N_i	d_i/N_i
	Start [ft]	End [ft]	[ft]	blows/ft	
1	0	7.5	7.5	8	0.938
2	7.5	15	7.5	19	0.395
3	15	43.7	28.7	53	0.542
4	43.7	100	56.3	100	0.563
SUM			**100**		**2.437**

N bar	**41**

Site Class D - Stiff Soil

Data from Boring BB-SBMR-103

Layer	Depth Range		Thickness (d_i)	N_i	d_i/N_i
	Start [ft]	End [ft]	[ft]	blows/ft	
1	0	5.9	5.9	8	0.738
2	5.9	20	14.1	21	0.671
3	20	39.9	19.9	65	0.306
4	39.9	100	60.1	100	0.601
SUM			**100**		**2.316**

N bar	**43**

Site Class D - Stiff Soil

Determine Seismic Site Classification Using AASHTO Bridge Design Specifications, Fifth Edition, 2010.

Data from Boring BB-104

Layer	Depth Range		Thickness (d_i)	N_i	d_i/N_i
	Start [ft]	End [ft]	[ft]	blows/ft	
1	0	5	5	16	0.313
2	5	6	1	11	0.091
3	6	10	4	25	0.160
4	10	41.3	31.3	77	0.406
5	41.3	100	58.7	100	0.587
SUM			**100**		**1.557**

N bar	**64**

Site Class C - Very Dense Soil

Data from Boring BB-SBMR-105

Layer	Depth Range		Thickness (d_i)	N_i	d_i/N_i
	Start [ft]	End [ft]	[ft]	blows/ft	
1	0	25.2	25.2	14	1.800
2	25.2	30	4.8	7	0.686
3	30	50.8	20.8	73	0.285
4	50.8	100	49.2	100	0.492
SUM			**100**		**3.263**

N bar	**31**

Site Class D - Stiff Soil

2007 AASHTO Bridge Design Guidelines
AASHTO Spectrum for 7% PE in 75 years
Latitude = 43.546000
Longitude = -070.351000
Site Class B
Data are based on a 0.05 deg grid spacing.

Period (sec)	Sa (g)	
0.0	0.088	PGA - Site Class B
0.2	0.175	Ss - Site Class B
1.0	0.044	S1 - Site Class B

Conterminous 48 States
2007 AASHTO Bridge Design Guidelines
Spectral Response Accelerations SDs and SD1
Latitude = 43.546000
Longitude = -070.351000
As = FpgaPGA, SDs = FaSs, and SD1 = FvS1
Site Class D - Fpga = 1.60, Fa = 1.60, Fv = 2.40
Data are based on a 0.05 deg grid spacing.

Period (sec)	Sa (g)	
0.0	0.141	As - Site Class D
0.2	0.280	SDs - Site Class D
1.0	0.107	SD1 - Site Class D

Table 3.10.3.1-1—Site Class Definitions

Site Class	Soil Type and Profile
A	Hard rock with measured shear wave velocity, $\bar{v}_s > 5{,}000$ ft/s
B	Rock with 2,500 ft/sec $< \bar{v}_s < 5{,}000$ ft/s
C	Very dense soil and soil rock with 1,200 ft/sec $< \bar{v}_s < 2{,}500$ ft/s, or with either $\bar{N} > 50$ blows/ft, or $\bar{s}_u > 2.0$ ksf
D	Stiff soil with 600 ft/s $< \bar{v}_s < 1{,}200$ ft/s, or with either $15 < \bar{N} < 50$ blows/ft, or $1.0 < \bar{s}_u < 2.0$ ksf
E	Soil profile with $\bar{v}_s < 600$ ft/s or with either $\bar{N} < 15$ blows/ft or $\bar{s}_u < 1.0$ ksf, or any profile with more than 10 ft of soft clay defined as soil with $PI > 20$, $w > 40$ percent and $\bar{s}_u < 0.5$ ksf
F	Soils requiring site-specific evaluations, such as: • Peats or highly organic clays ($H > 10$ ft of peat or highly organic clay where H = thickness of soil) • Very high plasticity clays ($H > 25$ ft with $PI > 75$) • Very thick soft/medium stiff clays ($H > 120$ ft)

Exceptions: Where the soil properties are not known in sufficient detail to determine the site class, a site investigation shall be undertaken sufficient to determine the site class. Site classes E or F should not be assumed unless the authority having jurisdiction determines that site classes E or F could be present at the site or in the event that site classes E or F are established by geotechnical data.

where:

$\bar{v}_s$ = average shear wave velocity for the upper 100 ft of the soil profile

$\bar{N}$ = average Standard Penetration Test (SPT) blow count (blows/ft) (ASTM D1586) for the upper 100 ft of the soil profile

$\bar{s}_u$ = average undrained shear strength in ksf (ASTM D2166 or ASTM D2850) for the upper 100 ft of the soil profile

PI = plasticity index (ASTM D4318)

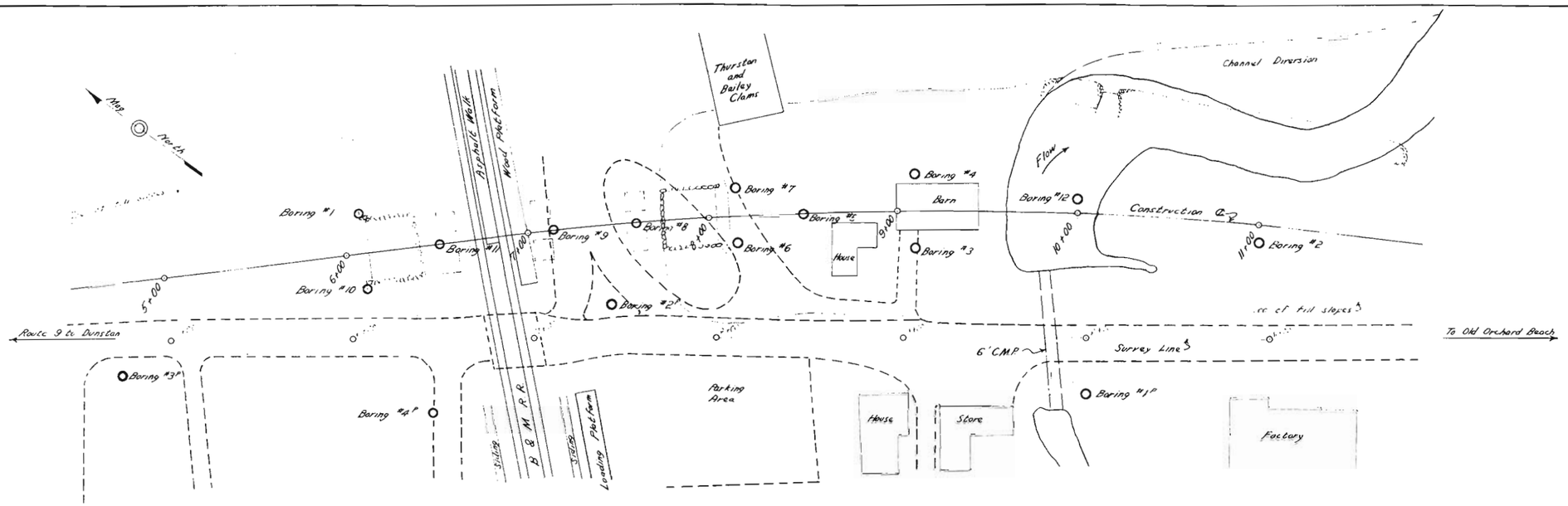
w = moisture content (ASTM D2216)

Table C3.10.3.1-1—Steps for Site Classification

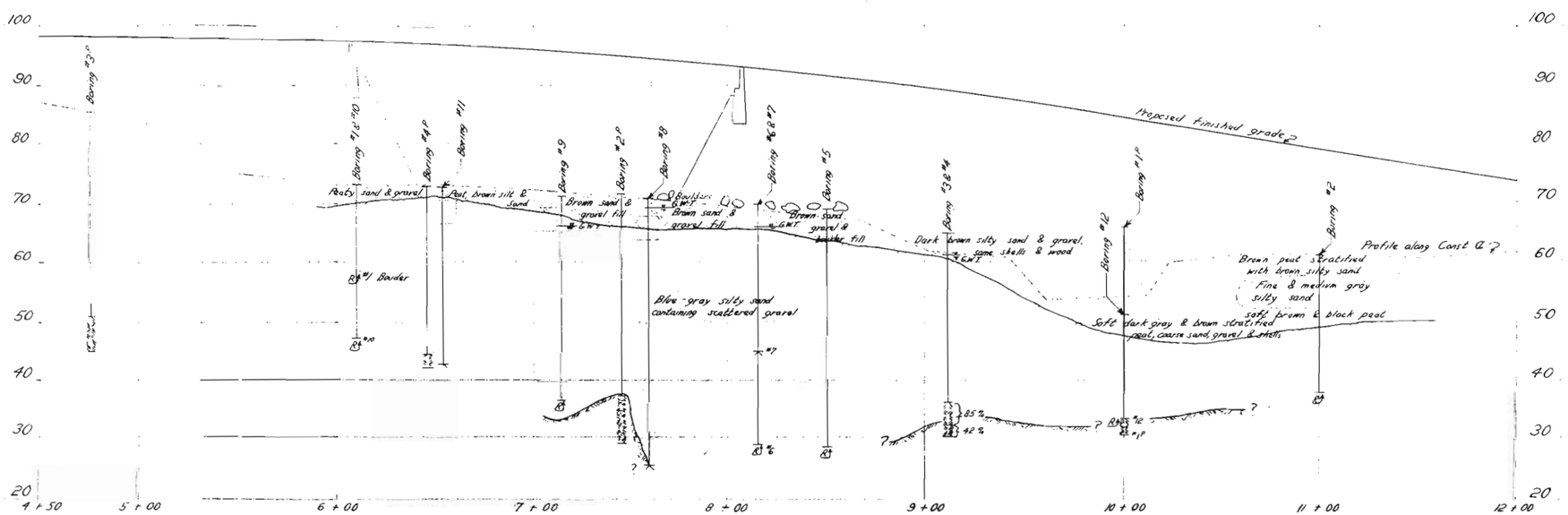
Step	Description
1	Check for the three categories of Site Class F in Table 3.10.3.1-1 requiring site-specific evaluation. If the site corresponds to any of these categories, classify the site as Site Class F and conduct a site-specific evaluation.
2	Check for existence of a soft layer with total thickness > 10 ft, where soft layer is defined by $s_u < 0.5$ ksf, $w > 40\%$, and $PI > 20$. If these criteria are met, classify site as Site Class E.
3	Categorize the site into one of the site classes in Table 3.10.3.1-1 using one of the following three methods to calculate: • $\bar{v}_s$ for the top 100 ft ($\bar{v}_s$ method) • $\bar{N}$ for the top 100 ft ($\bar{N}$ method) • $\bar{N}_{ch}$ for cohesionless soil layers ($PI < 20$) in the top 100 ft and $\bar{s}_u$ for cohesive soil layers ($PI > 20$) in the top 100 ft ($\bar{s}_u$ method) To make these calculations, the soil profile is subdivided into n distinct soil and rock layers, and in the methods below the symbol i refers to any one of these layers from 1 to n. **Method A: $\bar{v}_s$ method** The average $\bar{v}_s$ for the top 100 ft is determined as: $\bar{v}_s = \dfrac{\sum_{i=1}^{n} d_i}{\sum_{i=1}^{n} \dfrac{d_i}{v_{si}}}$ where: $\sum_{i=1}^{n} d_i = 100$ ft v_{si} = shear wave velocity in ft/s of a layer d_i = thickness of a layer between 0 and 100 ft **Method B: $\bar{N}$ method** The average $\bar{N}$ for the top 100 ft shall be determined as: $\bar{N} = \dfrac{\sum_{i=1}^{n} d_i}{\sum_{i=1}^{n} \dfrac{d_i}{N_i}}$ where: N_i = Standard Penetration Test blow count of a layer (not to exceed 100 blows/ft in the above expression)

Note: When using Method B, $\bar{N}$ values are for cohesionless soils and cohesive soil and rock layers within the upper 100 ft. Where refusal is met for a rock layer, N_i should be taken as 100 blows/ft.

APPENDIX D: EXISTING CONSTRUCTION DRAWINGS



PLAN
Scale 1" = 30'



PROFILE
Scales: Hor. 1" = 30'
Vert. 1" = 10'

SOILS ENGINEERING—GRAY
TRACE—FLYNT

BRIDGE—5260

STATE HIGHWAY COMMISSION
BRIDGE DIVISION

PINE POINT CROSSING
OVER
BOSTON & MAINE RAILROAD
IN THE TOWN OF
SCARBORO
CUMBERLAND COUNTY
STRATIGRAPHIC PROFILE

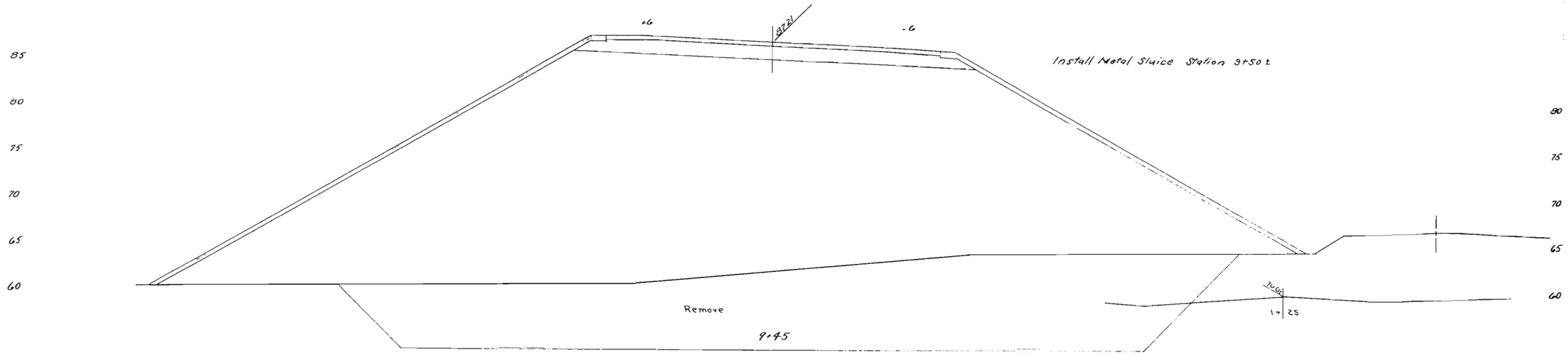
SHEET 7 OF 32 AUGUSTA, MAINE DEC., 1953

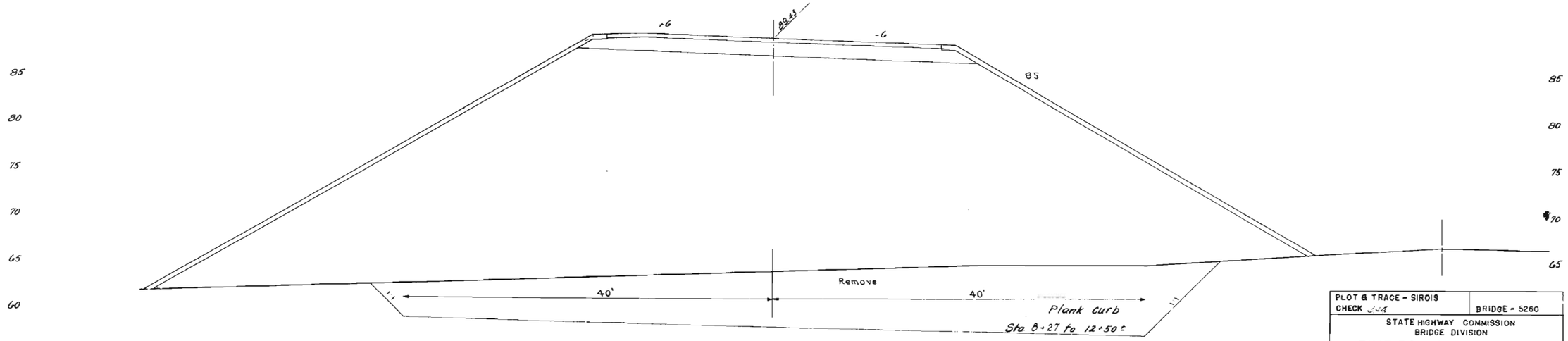
Revised & checked, May 21, 1954, H.D.H.

60-65

0 1 2 3 4 5 INCHES

SG-0112(1) 12 32





All material removed as herein indicated shall be paid for as "Muck Excavation."

9+00

Remove all overlaying soft organic material Sta. 8+73 to 10+30 within the limits shown on the cross sections.

Also remove, to a depth of 5 feet below the existing ground, all soft material within the limits shown on sheet 20 for the culvert at Sta. 10+00 downstream from the excavation shown in the cross sections.

Replace all material so removed with Granular Borrow.

PLOT & TRACE - SIR019 CHECK JCA	BRIDGE - 5260

STATE HIGHWAY COMMISSION
BRIDGE DIVISION

PINE POINT CROSSING

OVER

BOSTON & MAINE RAILROAD

IN THE TOWN OF

SCARBORO
CUMBERLAND COUNTY

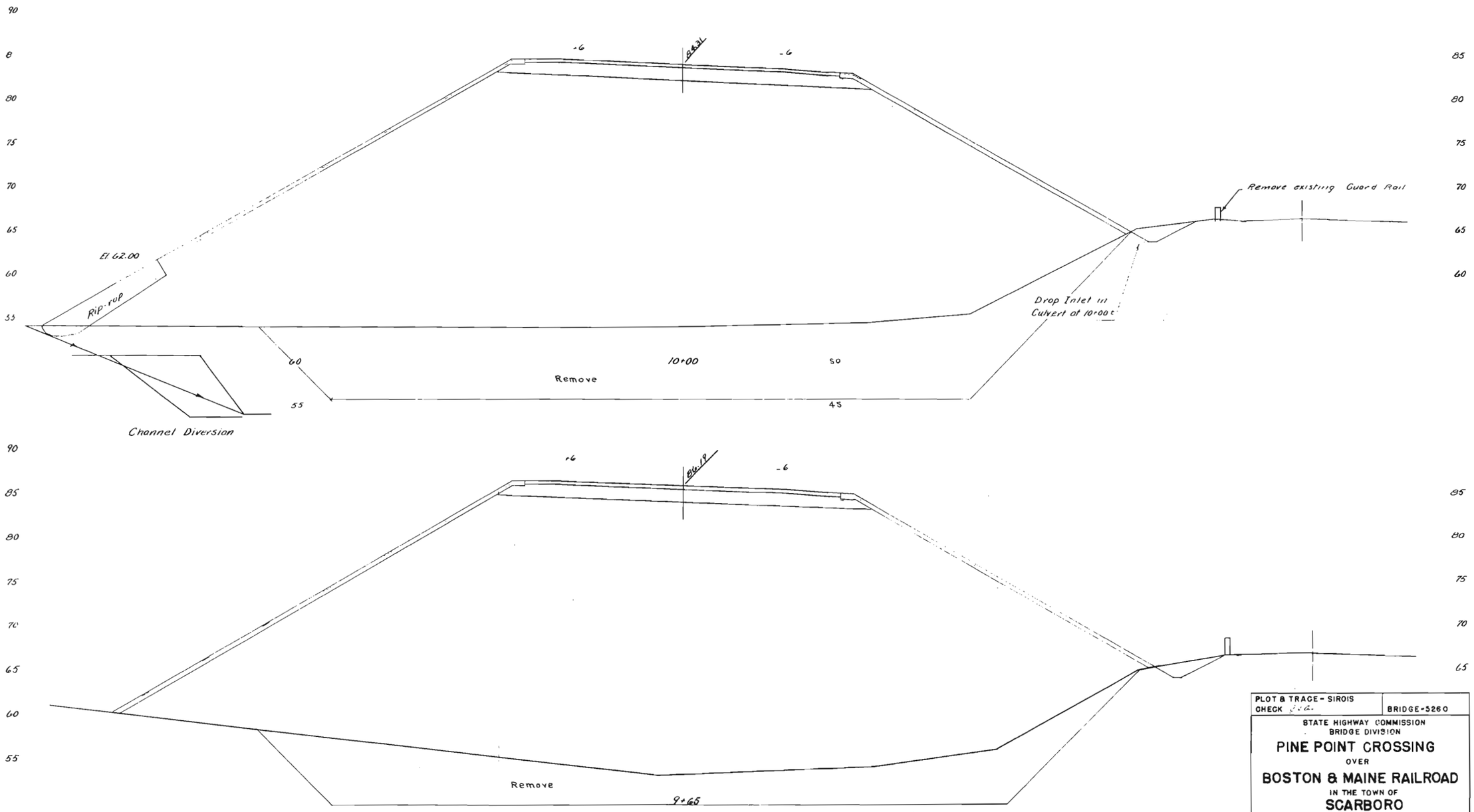
CROSS - SECTIONS

SHEET 12 OF 32 AUGUSTA, MAINE MAY 1953

& checked, May 21, 1954, H.D.H.

60-71

0 1 2 3 4 5 INCHES



PLOT & TRACE - SIROIS	
CHECK J.L.G.	BRIDGE-3260

STATE HIGHWAY COMMISSION
BRIDGE DIVISION

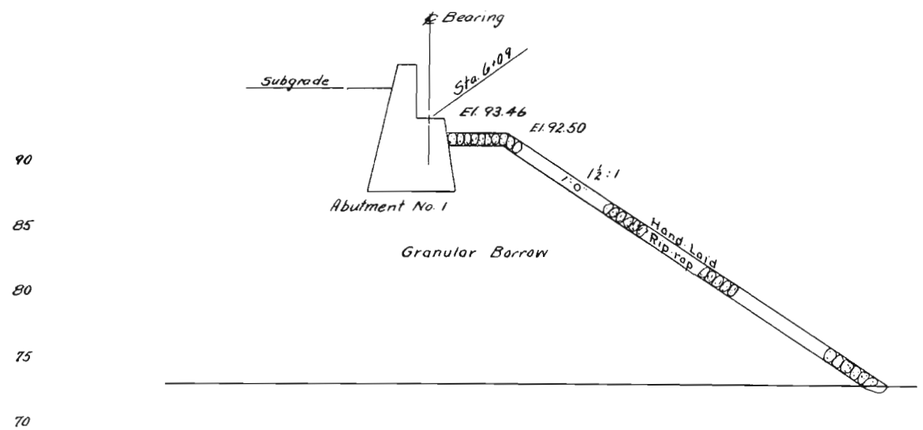
PINE POINT CROSSING
OVER
BOSTON & MAINE RAILROAD
IN THE TOWN OF
SCARBORO
CUMBERLAND COUNTY
CROSS - SECTIONS

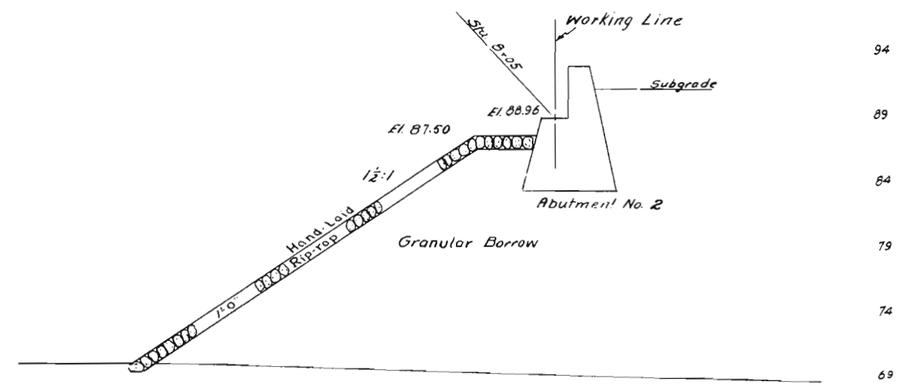
SHEET 13 OF 32 AUGUSTA, MAINE MAY 1953

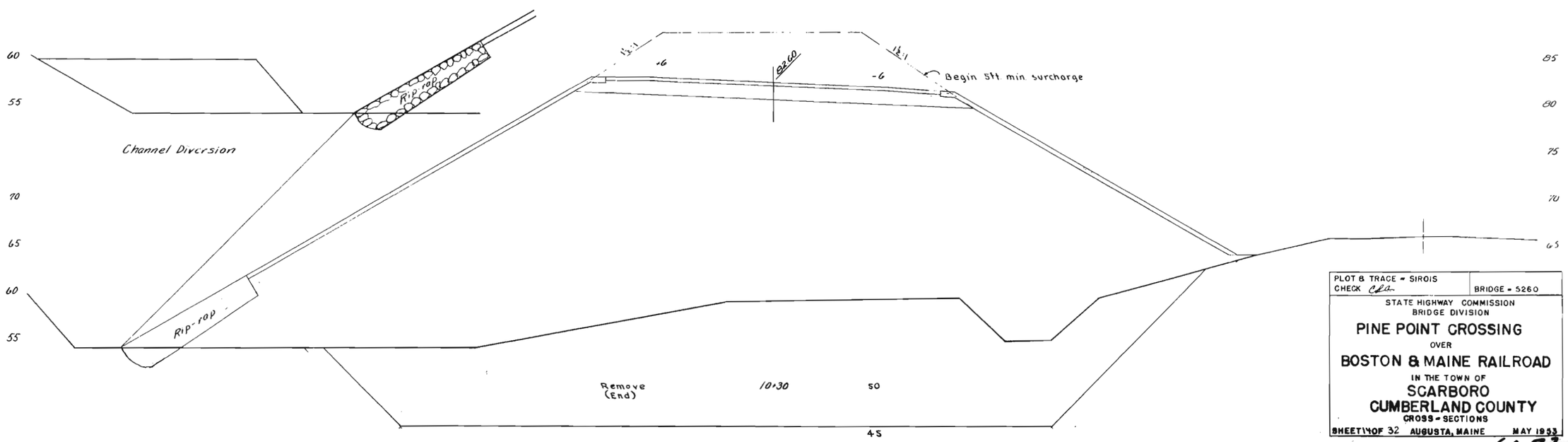
Revised & checked, May 21, 1954, H.D.H.

60-72

0 1 2 3 4 5 INCHES







PLOT & TRACE - SIROIS
CHECK Cfd
BRIDGE - 5260

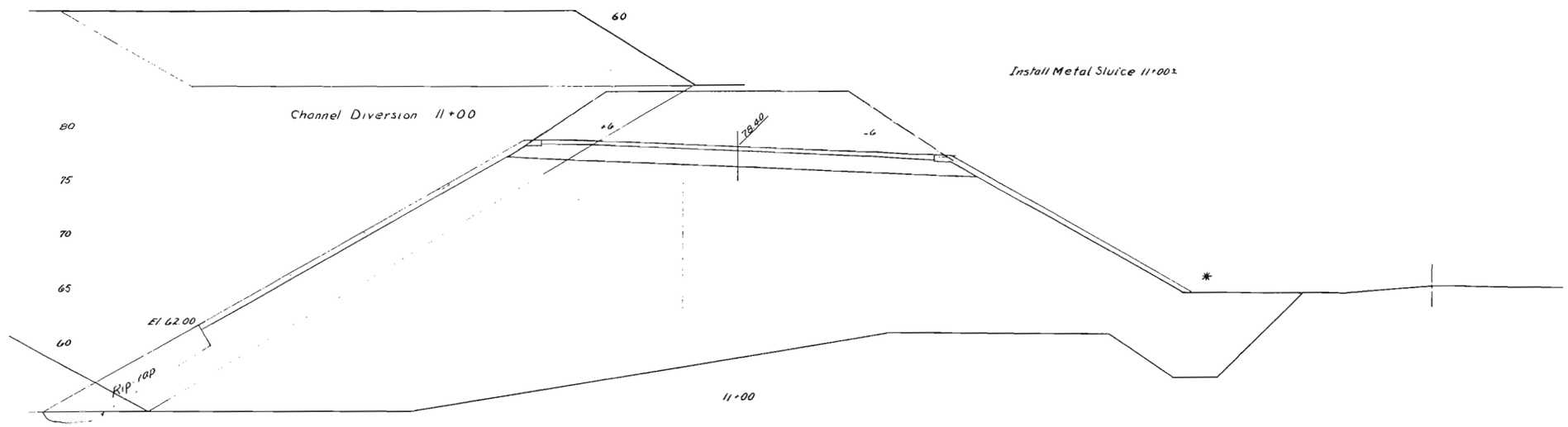
STATE HIGHWAY COMMISSION
BRIDGE DIVISION

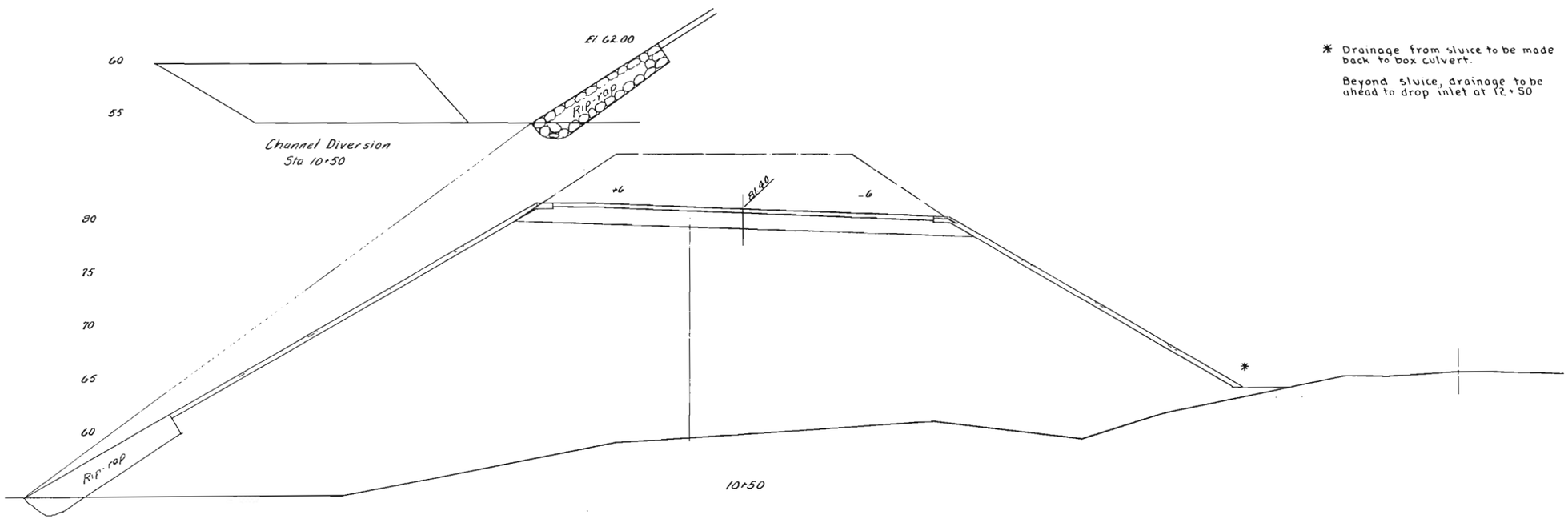
PINE POINT CROSSING
OVER
BOSTON & MAINE RAILROAD
IN THE TOWN OF
SCARBORO
CUMBERLAND COUNTY
CROSS - SECTIONS

SHEET 14 OF 32 AUGUSTA, MAINE MAY 1953

Revised & checked, May 21, 1954, H.D.H. 60-73

0 1 2 3 4 5 INCHES





✱ Drainage from sluice to be made back to box culvert.

Beyond sluice, drainage to be ahead to drop inlet at 12+50

PLOT & TRACE - SIROIS CHECK	BRIDGE-5260

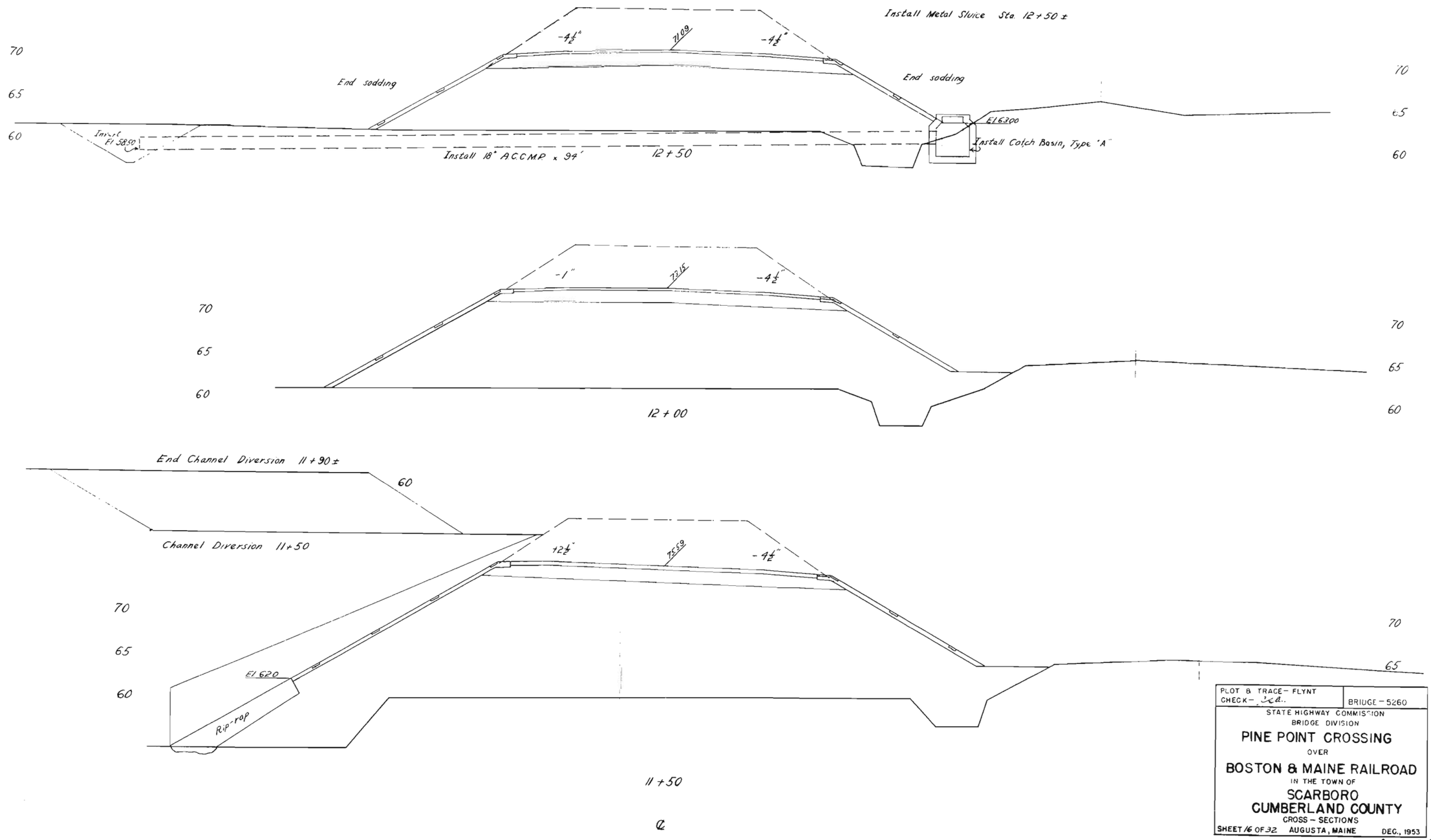
STATE HIGHWAY COMMISSION
BRIDGE DIVISION

PINE POINT CROSSING
OVER
BOSTON & MAINE RAILROAD
IN THE TOWN OF
SCARBORO
CUMBERLAND COUNTY
CROSS-SECTIONS

SHEET 15 OF 32 AUGUSTA, MAINE MAY 1953

60-74

0 1 2 3 4 5 INCHES



PLOT & TRACE – FLYNT
CHECK – J.C.A.

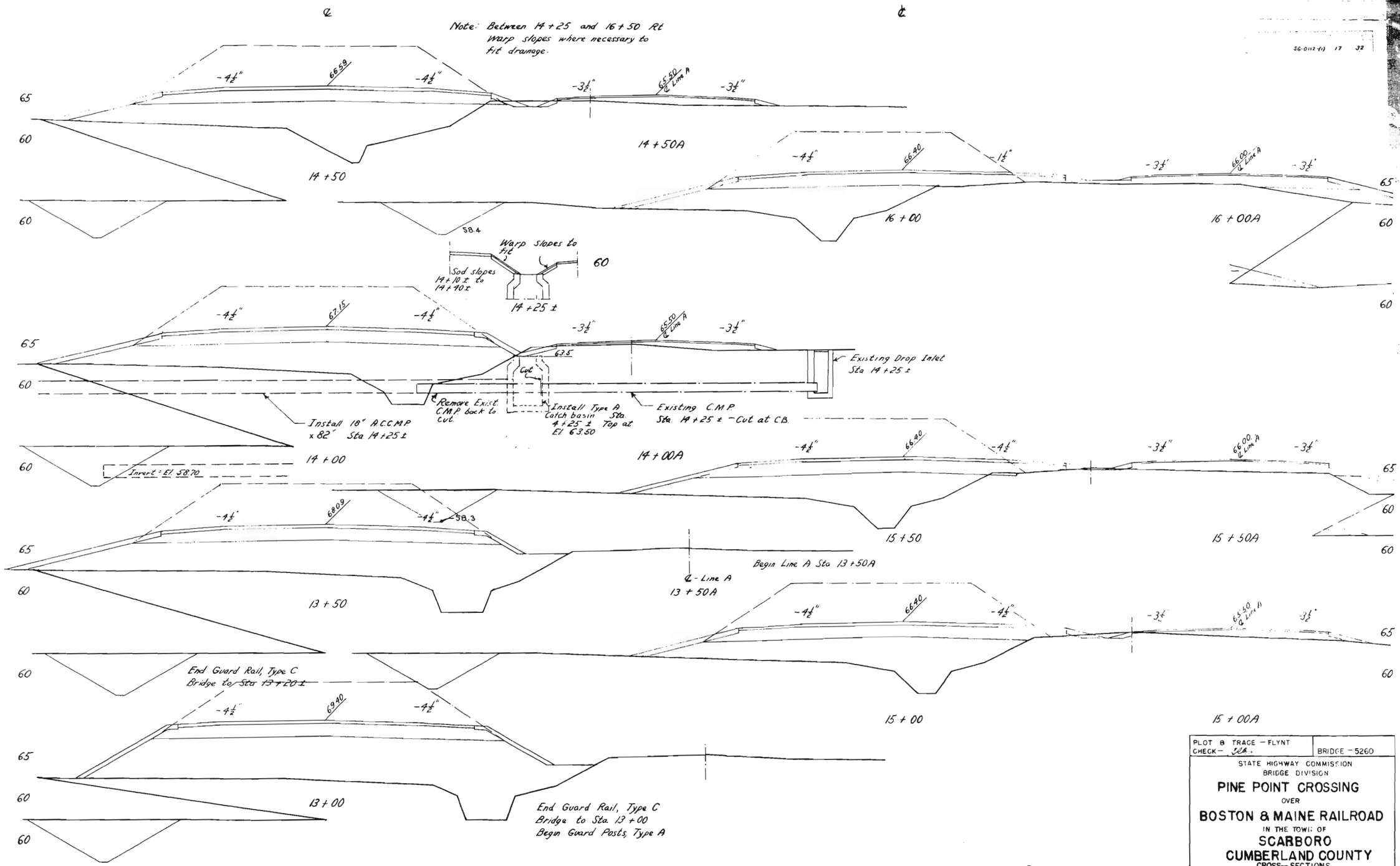
BRIDGE – 5260

STATE HIGHWAY COMMISSION
BRIDGE DIVISION

PINE POINT CROSSING
OVER
BOSTON & MAINE RAILROAD
IN THE TOWN OF
SCARBORO
CUMBERLAND COUNTY
CROSS – SECTIONS

SHEET 16 OF 32 AUGUSTA, MAINE DEC., 1953

60-75



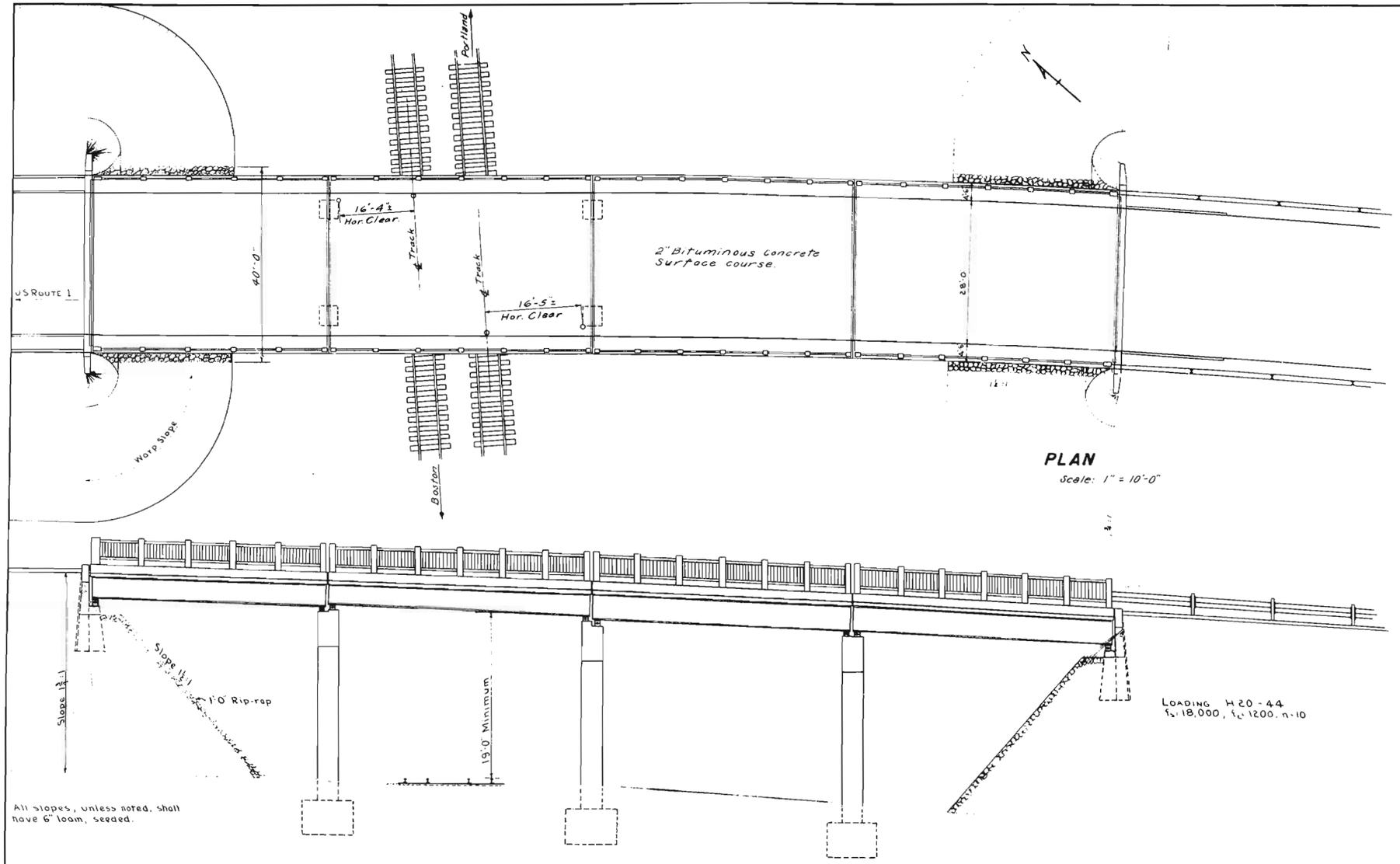
PLOT & TRACE — FLYNT CHECK —	BRIDGE — 5260

STATE HIGHWAY COMMISSION
BRIDGE DIVISION

PINE POINT CROSSING
OVER
BOSTON & MAINE RAILROAD
IN THE TOWN OF
SCARBORO
CUMBERLAND COUNTY
CROSS—SECTIONS

SHEET 17 OF 32 AUGUSTA, MAINE DEC., 1953

60-76



PLAN

Scale: 1" = 10'-0"

ELEVATION

Scale: Horz. 1" = 10'-0", Vert. 1" = 6'-0"

CONCRETE CLASSIFICATION:
Class A - Roadway slab, sidewalks, approach curbs and [piers above footings.
Class B - Abutments, pier footings.
Class Y - Rail posts.

DETAIL - MCDOUGAL	BRIDGE - 5260
TRACE - MCDOUGAL	

STATE HIGHWAY COMMISSION
BRIDGE DIVISION

PINE POINT CROSSING
OVER
BOSTON & MAINE RAILROAD
IN THE TOWN OF
SCARBORO
CUMBERLAND COUNTY

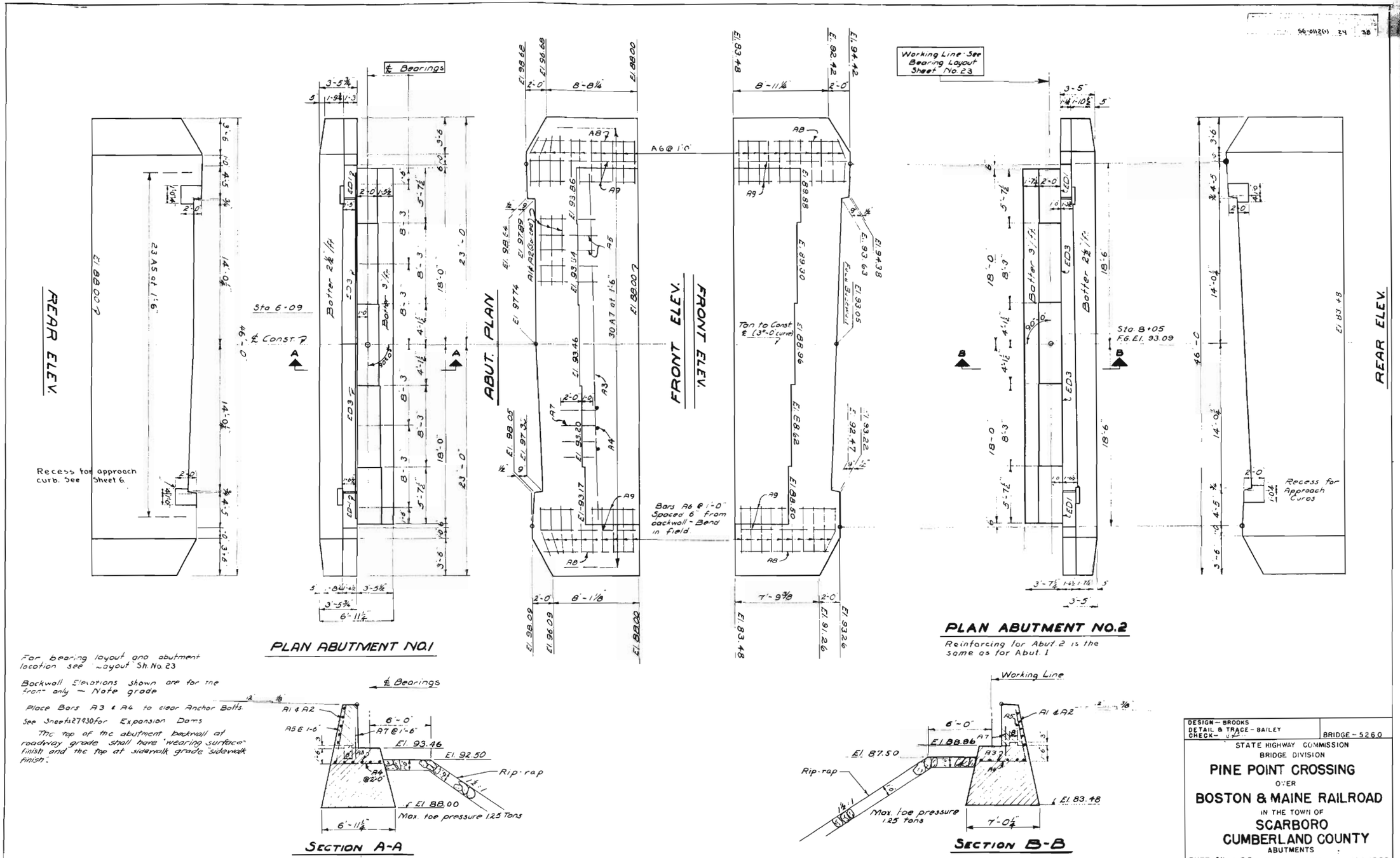
GENERAL PLAN

SHEET 22 OF 32 AUGUSTA, MAINE APRIL 1953

Revised + checked, May 21, 1954, H.D.H.

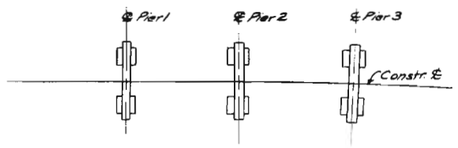
60-81

0 1 2 3 4 5 INCHES

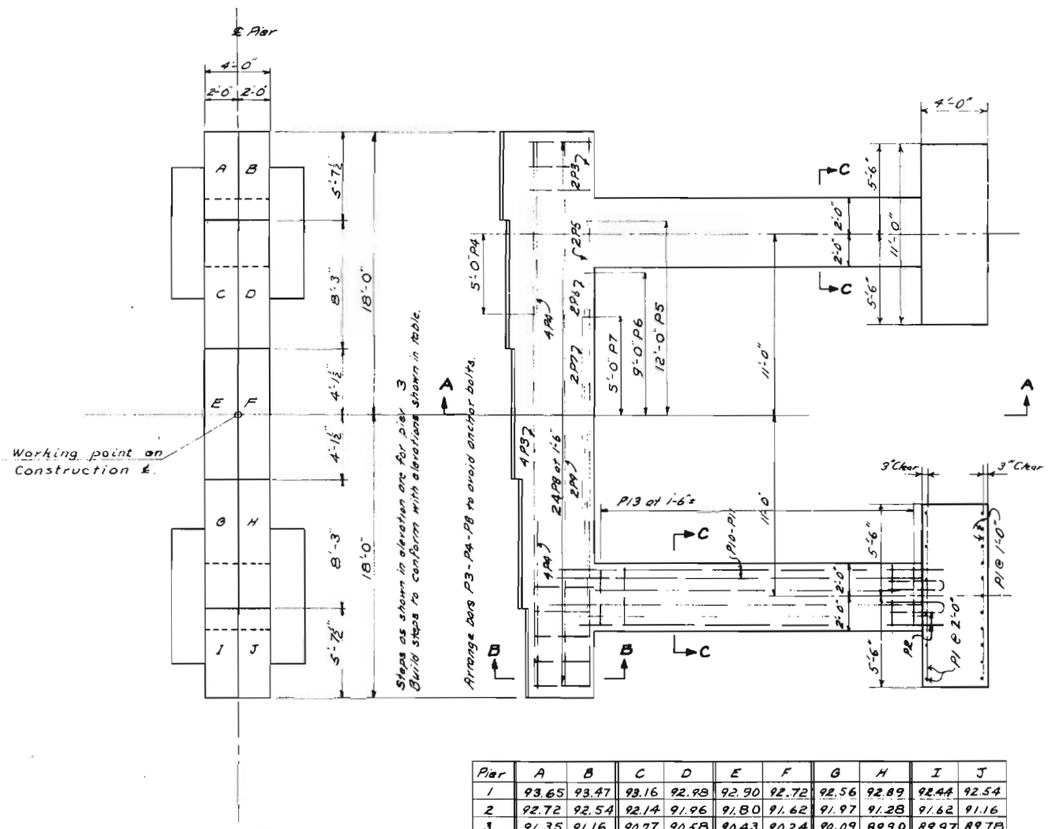


Revised & checked, May 21, 1954, K.D.H.

60-83

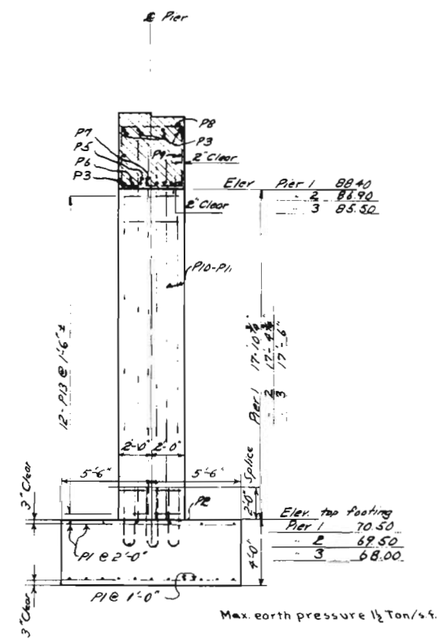


For detailed layout of piers and bearing areas see sheet no. 23

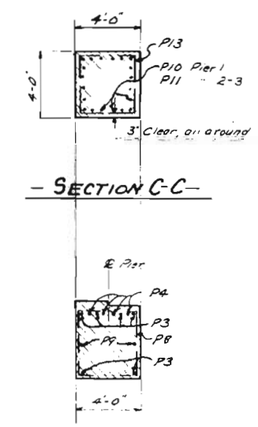


— PLAN PIER —

— ELEVATION —



— SECTION A-A —



— SECTION C-C —

— SECTION B-B —

Pier	A	B	C	D	E	F	G	H	I	J
1	93.65	93.47	93.16	92.98	92.90	92.72	92.56	92.89	92.44	92.54
2	92.72	92.54	92.14	91.96	91.80	91.62	91.97	91.28	91.62	91.16
3	91.35	91.16	90.77	90.58	90.43	90.24	90.09	89.90	89.97	89.78

— STEP ELEVATIONS —

Step elevations are the same as bearing elevations.

Added 1½T/s.f. March 1954 C.W.S.

Revised & checked, May 21, 1954, H.D.H.

DESIGN — BROOKS
TRACE — BACHELDER
CHECK — [illegible]

BRIDGE — 5260

STATE HIGHWAY COMMISSION
BRIDGE DIVISION

PINE POINT CROSSING

OVER

BOSTON & MAINE RAILROAD

IN THE TOWN OF

SCARBORO
CUMBERLAND COUNTY

PIERS

SHEET 25 OF 32 AUGUSTA, MAINE MAY 1953

60-84

0 1 2 3 4 5 INCHES

APPENDIX E: LIMITATIONS

LIMITATIONS

Subsurface Conditions

1) The analyses and conclusions in this report are based in part upon data obtained from subsurface explorations completed by others. Nobis has not verified the accuracy of the test boring logs. The nature and extent of variations between these explorations and actual conditions may not become evident until further exploration. If variations appear evident, it will be necessary to re-evaluate the conclusions and recommendations of this report.

2) The generalized soil conditions described in the text are intended to convey trends in subsurface conditions and have been developed from five test boring. Actual soil conditions are likely to vary. Refer to the test boring logs for more specific information.

3) Water level readings have been made in the test borings at the time and under the conditions stated on the boring logs. Fluctuations in the level of groundwater will occur due to variations in rainfall and other factors different from those prevailing at the time measurements were made.

Review

1) In the event that any changes in the nature, design, or location of the proposed project are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and conclusions of this report modified or verified in writing by Nobis Engineering, Inc. It is recommended that this firm be provided the opportunity for a general review of final design and specifications in order that earthwork and foundation recommendations may be properly interpreted and implemented in the design and specifications.

Use of Report

1) This report provides the details of the subsurface exploration program prepared for the proposed re-use or replacement of MaineDOT bridge number 5260, Pine Point Road located over the B&M railroad tracks in Scarborough, ME. This work has been completed in accordance with generally accepted geotechnical engineering practices and is for preliminary design purposes only. Contractors reviewing this report should do so with the understanding that its scope is limited to preliminary design considerations only. No other warranty, expressed or implied, is made.