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Geotechnical Report

Proposed Apartment Building

155 Sheridan Street, Portland, Maine

SUMMIT
GEOENGINEERING SERVICES

Client
BD Sheridan LLC
1266 Furnace Brook Parkway
Suite 300
Quincy, MA 02169

Project #: 16030
Date: 5/15/17

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May 15, 2017
Summit #16030

BD Sheridan LLC
1266 Furnace Brook Parkway
Suite 300
Quincy, MA 02169
Attn: Rich and Bernie

Reference: Geotechnical Engineering Report – Proposed Apartment Building
155 Sheridan Street, Portland, Maine

Dear Rich and Bernie;

Summit Geoengineering Services, Inc. (SGS) has completed a geotechnical investigation for the proposed apartment building at the site referenced above. Our scope of services included the drilling of 3 borings within the proposed development area, performing laboratory testing on collected samples, and preparing this geotechnical report summarizing our findings and providing geotechnical recommendations.

Our scope of services for this project did not include an environmental site assessment or further investigation for the presence or absence of hazardous or toxic material on, below, or around the site. Any statements in this report, or on the soil boring logs, regarding odors or unusual and suspicious conditions observed are for informational purposes and are not intended to constitute an environmental assessment.

1.0 Project and Site Description

We understand that the project consists of the construction of a new 4 story apartment building on the east side of Sheridan Street with a footprint of approximately 8,500 square feet. We further understand that the first floor will consist of at-grade parking and will have a finish floor elevation (FFE) of 111.50'. The three floors above the parking floor will consist of apartments units. The building will be accessed via Sheridan Street.

Based on the Site Grading Plan prepared by Acorn Engineering, existing grades at the site slope steeply upwards in a northeasterly direction starting at an elevation of 114 feet at Sheridan Street up to an elevation of approximately 156 feet at the top of the slope. A permanent soldier pile and lagging wall will be constructed along the south, east, and north portions of the site to

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retain the existing slope with a maximum exposed height of 24 feet. There will be a flat benched lawn area between the pile/lagging wall and the east wall of the new building with a length of approximately 25 feet. A combination of surface grading and retaining walls will be used to slope down along the north and south sides of the building. There will be an elevated stairwell at the eastern corner of the lot connecting Sumner Park to the third floor of the new building. We understand that a cast in place wall will be constructed to create this stairwell area.

2.0 Subsurface Explorations and Laboratory Testing

2.1 Subsurface Explorations

SGS observed the subsurface conditions at the site with the drilling of 3 borings on March 10, 2016. All explorations were performed by Northern Test Boring, under direct supervision of SGS, using a Diedrich D-50 tracked drill rig. Borings B-1, B-2, and B-3 were terminated in the native glacial till at depths of 50 feet, 32 feet, and 12 feet, respectively. All borings were advanced using rotary wash 4” inside diameter steel casing. During the borings, split spoon sampling (*ASTM D1586*) was performed at 5 foot intervals. An observation well was installed in Boring B-1 to a depth of 41.5 feet below ground surface. The well consists of 2” PVC screen for the bottom 10 feet and 2” PVC riser from the top of the screen to the ground surface.

The borings were located by SGS prior to drilling by taping/pacing from existing features. The borings were survey located by Titcomb Associates after completion. These locations can be seen in the SGS Exploration Plan in Appendix A. The boring logs can be found in Appendix B.

2.2 Laboratory Testing

Laboratory testing was performed on fill/reworked native soil specimens collected from split spoon samples obtained during Boring B-2 at depth of 5’ to 7’ and 10’ to 12’. One Grain Size Analysis (*ASTM D422*), one Atterberg Limit Test (*ASTM D4318)*, and one Direct Shear Test (*ASTM D3080*) was performed on samples of the fill/reworked native soil. Due to the similarity of the soil composition between samples S-2 (5’ – 7’ depth) and S-3 (10’ – 12’ depth), these samples were combined in order to create a representative sample of the entire fill/reworked native soil layer. A summary of the results are presented below. Detailed results can be found in Appendix C.

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Table 1: Laboratory Test Results

GRAIN SIZE ANALYSIS RESULTS – FILL/REWORKED NATIVE						
Boring	**Sample**	**Depth (ft.)**	**Composition**			**USCS**
			Gravel	Sand	Silt/Clay	
B-2	S-2 & S-3	5 to 12	9.8%	51.4%	38.8%	SM-SC

USCS = Unified Soil Classification System, SM-SC = Silty Sand/Clayey Sand

Fill/Reworked Native (B-2, S-2 and S-3, 5' to 12'):

Liquid Limit: 17
Plastic Limit: 13
Plasticity Index: 4
Drained Friction Angle (ϕ'): 43.3^o
Cohesion Intercept (c): 0 psf

3.0 Subsurface Conditions

3.1 Soil

The following subsurface layers and thicknesses were encountered in our geotechnical investigation, starting from the ground surface:

- ***Topsoil***, 24 inches (absent in Boring B-3)
- ***Fill or Fill/Reworked Native*** 6.0 feet to 12.0 feet
- ***Glacial Till***, greater than 4 feet to greater than 42 feet

Topsoil. The topsoil at the site was encountered in Borings B-1 and B-2 and is described as dark brown to black silt with little fine sand, trace clay, and frequent rootlets and organics. The topsoil is very loose to soft, moist, and classifies as ML in accordance with the Unified Soil Classification System (USCS).

Fill or Fill/Reworked Native. The fill and fill/reworked native soil was encountered in all of the borings directly below the topsoil, where present. In general, the fill encountered in Borings B-1 and B-3 (top and bottom of the slope, respectively) consists of granular/man-made fill and the fill encountered in Boring B-2 (middle of slope) consists primarily of reworked native soil.

The fill encountered in Borings B-1 and B-3 ranges in thickness from 6 feet to 8 feet and is described as dark tan to black silty sand with no to trace clay. Wood pieces were encountered at the bottom of the fill layer in Boring B-1 and few glass pieces were intermixed in the fill layer in Boring B-3. Standard Penetration Number (SPT-N) of the fill ranges from 4 to 25 with an average of 11 blows per foot (bpf). The fill is very loose to compact, humid to moist, and classifies as SM in general accordance with USCS.

The fill/reworked native soil encountered in Boring B-2 is 12 feet thick and is described as olive gray clayey sand with little to some silt and little gravel. The two SPT-N values in the fill/reworked native are 9 and 23. Laboratory grain size testing indicated the composition of the fill/reworked native to be 9.8% gravel, 51.4% sand, and 38.8% fines. Atterberg limit testing on the fines content of the soil resulted in a Liquid Limit of 17, a Plastic Limit of 13, and a Plasticity Index of 4. Direct shear results indicate an internal effective friction angle of 43.3 degrees with an assumed cohesion intercept of 0 psf. The soil is humid, stiff, and classifies as SM-SC in general accordance with USCS.

Glacial Till. The glacial till layer was encountered in all of the borings, ranging from 8 feet to 14 feet below ground surface and extends to the bottom of all of the explorations where the borings were terminated. The glacial till is described as gray to gray-brown silt with little to some clay, sand, and gravel. The layer is compact to very dense, humid to wet, and contains cobbles throughout. SPT-N in the glacial till ranges from 22 to greater than 100 with an approximate average of 54 blows per foot.

We have prepared a cross section showing the interpreted subsurface conditions for soil layering and groundwater elevations in Appendix A.

3.2 Groundwater

On the day of the explorations, groundwater was encountered in Borings B-1 and B-2 (observed on the collected samples) at depths of 11.0 feet and 20.0 feet, respectively (elevation 119.5 feet to 144.0 feet). Groundwater appears to start in the upper portion of the glacial till layer, approximately following the slope of the ground surface.

An observation well was installed in Boring B-1 to a depth of 41.5 feet below ground surface. The well consists of 2" PVC screen for the bottom 10 feet and 2" PVC riser from the top of the screen extending up to the ground surface. See the table below for groundwater measurements collected at various dates after the well was installed.

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Table 2: Observation Well Readings

OBSERVATION WELL MEASUREMENTS – BORING B-1		
Date	**Depth to Groundwater (ft)**	**Approximate Groundwater Elevation (ft.)**
3/12/16	11.2 ft.	143.8 ft
4/19/2016	10.7 ft.	144.3 ft
6/16/2016	11.6 ft.	143.4 ft
4/3/2017	10.0 ft.	145.0 ft

3.3 Bedrock

Bedrock was not encountered in the explorations at the site (which were terminated at elevation 102.5 feet to 107.5 feet). Mapping by the Maine Geological Survey indicates the bedrock at the site is of the Precambrian Z Spring Point Formation consisting of green schist and amphibolites facies ranging from mafic to felsic volcanic rock.

4.0 Geotechnical Evaluation

Based on our understanding of the proposed project, we believe that the new building and the associated development is feasible from a geotechnical standpoint. The building can be constructed using conventional spread footings on frost wall with a slab-on-grade. The proposed retaining walls should be designed using the recommendation provided in this report. There geotechnical challenges associated with the proposed development include:

- A deep excavation for the construction of the new building foundation. These walls will also act as permanent retaining walls along the existing slopes surrounding the site. Maximum exposed retaining wall heights for various walls throughout the site will include the following:
  - Pile and lagging wall: 27 feet
  - Cast-in-place concrete walls in northeast corner: 24 feet
  - Cast-in-place concrete walls for building foundation: 20 feet
  - Segmental block retaining walls: 12 feet
- Presence of groundwater within the building foundation excavation
- Presence of groundwater at and above the finish floor elevation (FFE).
- Potential for subgrade softening of the exposed silty/clayey glacial till in the building foundation excavations

Due to the sloping existing topography, multiple retaining walls will be required to create the flat building area for construction of the foundation. Based on preliminary concepts proposed by Structural Integrity, Inc. and the grading plan prepared by Acorn Engineering, we understand that this will be accomplished using a combination of pile and lagging walls, cast-in-place concrete walls, and segmental block retaining walls.

We understand that soil anchors are being avoided if possible for the new project. We anticipate that to complete the building foundation construction, a relatively complex staged construction scheme will need to be developed, utilizing internally braced systems with concrete or sheet pile deadmen. We have attempted to cover all geotechnical design recommendations for potential bracing/shoring schemes within this report. If additional recommendations are needed based on updated or refined concepts, we should be notified in order to provide these. Also, final design computations for the shoring and retaining walls should be provided to us so we can verify that the assumed soil and water conditions match the recommendations provided in this report. Geotechnical design parameters have been provided in Section 6.0

Groundwater was encountered at or near the surface of the glacial till layer, which is approximately 6 to 12 feet below the existing ground surface. We anticipate that groundwater will be encountered within the building excavation and will require de-watering for construction. Groundwater will also have to be considered in the design of the floor slab and retaining walls.

The native glacial till soil encountered in the explorations was dense, gravelly silt with little clay and sand. We believe that this soil will provide adequate support for the proposed building, but may be susceptible to softening if exposed to rainwater or groundwater seepage through the exposed surface. Proper subgrade improvement recommendations have been provided in Section 5.1.

5.0 Geotechnical Recommendations – Proposed Building Foundation

5.1 Foundation Bearing Pressure

Based on the proposed grades, we anticipate that the native glacial till soil will be exposed beneath footings for the building. Assuming that the recommendations below are followed, we recommend an allowable bearing pressure of 3,000 psf be used to proportion the footings for the new building. If the recommendations provided below are followed, we anticipate that post construction total settlement will be less than 1 inch and differential settlement within the building will be less than a deflection of 1/300 (δ/L deflection divided by span length) between column footings. The following recommendations apply to the footings construction at both sites:

- All topsoil, pavement, and existing building elements are removed from within the proposed building footprint prior to excavation of the footing trenches.
- All footings exposed to freezing temperatures are constructed at the recommended frost protection depth of 4.0 feet below exterior finish grade. Interior footings should be constructed at a minimum depth of 2.0 feet below FFE.
- If the exposed soil at the bottom of footing trenches is granular (no clay), it is proofrolled with a minimum of 4 passes with a large plate compactor or vibratory roller. Proofrolling should be performed on dry, unfrozen soils. The groundwater surface should be dewatered a minimum of 12" below the bottom of the new footings during proofrolling and construction of the footings. If the exposed soil is cohesive, proofrolling of the subgrade is not necessary.
- If soft/unsuitable soils or man-made materials are encountered at the bottom of the excavation, they should be removed and replaced with ¾" crushed stone prior to proofrolling. If a significant amount of soft/unsuitable soils are encountered, SGS should be notified.

5.2 Frost Protection

The design air freezing index for the Portland area is approximately 1,200 degree F days (10 year, 90% probability). Based on this, a total of 4.0 feet of frost protection should be provided for the exterior footings and interior footings exposed to freezing temperatures. Interior footings constructed in continuously heated areas can be constructed a depth of 2.0 feet below interior grade.

We recommend that the exterior of all foundation elements exposed to freezing temperatures be backfilled with Foundation Backfill (FB). The portion of FB passing the 3" sieve size should meet the following gradation requirements:

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Table 3: Foundation Backfill - Soil Gradation

FOUNDATION BACKFILL	
Sieve Size	**Percent Finer**
3 inch	100
¼ inch	25 to 100
No. 40	0 to 50
No. 200	0 to 6*

Reference: MDOT Specification 703.06, Type E (2014)
*Reduced from 7% to 6% from Type E Standard

Maximum particle size should be limited to 6 inches. Foundation backfill should be placed in 6 to 12 inch lifts and compacted to 95% of its optimum dry density determined in accordance with ASTM D1557. The compaction requirement can be reduced to 90% beneath landscaped areas.

5.3 Seismic Design

Based on the summary of field results we recommend Site Class D be used in accordance with the 2012 or 2015 International Building Code. The following seismic site coefficients should be used:

Table 4: Seismic Design Coefficients

SUBGRADE SITE SEISMIC DESIGN COEFFICIENTS - IBC	
Seismic Coefficient	**Site Class D**
Short period spectral response (S_S)	0.240
1 second spectral response (S_1)	0.078
Maximum short period spectral response (S_{MS})	0.385
Maximum 1 second spectral response (S_{M1})	0.187
Design short period spectral response (S_{DS})	0.256
Design 1 second spectral response (S_{D1})	0.125

Subgrade conditions are not considered susceptible to liquefaction during seismic events.

5.4 Groundwater Control

Based on observed groundwater levels, groundwater is anticipated to be above the finish floor elevation (FFE) for the proposed building. Based on this we recommend perimeter underdrains be installed along the entire exterior foundation walls for the buildings. Perimeter underdrains should consist of 6 inch rigid perforated PVC placed adjacent to the exterior footings and surrounded by a minimum of 12 inches of crushed stone wrapped in filter fabric to prevent clogging from the migration of the fine soil particles in the foundation backfill soils. The underdrain pipe should outlet to a location where it will be free flowing. Where exposed at the ground surface, the ends of pipes should be screened or otherwise protected from entry and nesting of wildlife, which could cause clogging.

5.5 Ground Floor Slab-on-Grade and/or Pavement

This section provides recommendations for a concrete slab-on-grade or pavement surface in the event that both types of surface are used for the ground floor area. Additionally, this section will provide recommendations for both heated and unheated conditions. Assuming that the FFE is at or near 111.5 feet, we anticipate that native glacial till will be exposed in the slab excavation.

5.5.1 Concrete Slab-on-Grade

We recommend that the slab for the new building be constructed on a minimum of 12" of Structural Fill (SF, see table below) or ¾" crushed stone. We anticipate that the exposed native till will be stiff, cohesive soil and will not require proofrolling. However, if the exposed soil becomes softened from exposure to water (i.e., rain water, surface runoff, seeping groundwater, etc.), all softened areas should be overexcavated and replaced with ¾" crushed stone. If the slab area is unheated, the slab subgrade thickness should be increased to 24" and the slab should be constructed on 2" of rigid insulation. Alternatively, the subgrade soil thickness could be increased to 48" (including the slab) if rigid insulation is not used.

The portion of SF passing the 3" sieve shall meet the following gradation requirements:

Table 5: Structural Fill - Soil Gradation

STRUCTURAL FILL (SF)	
Sieve Size	**Percent finer**
3 inch	100
½ inch	35 to 80
¼ inch	25 to 65
No. 40	0 to 30
No. 200	0 to 7

Reference: MDOT Specification 703.06, Type D

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The maximum SF particle size should be limited to 6 inches. Structural Fill should be placed in 6 to 12 inch lifts and should be compacted to a minimum of 95 percent of its maximum dry density, determined in accordance with ASTM D1557. If ¾” crushed stone is used, it should be placed in 12” lifts and be compacted with a minimum of 4 passes in each of two perpendicular directions with a vibratory roller. For the conditions described above, the slab can be designed using a subgrade modulus value of 175 pci.

The mean annual freezing index for the Portland area is estimated at 1,200 degree days. Based on the subgrade and mean annual freezing index, the anticipated mean annual frost penetration depth is 36 inches.

5.5.2 Pavement

The mean annual freezing index for the Portland area is estimated at 1,200 degree days. Based on the subgrade and mean annual freezing index, the anticipated mean annual frost penetration depth is 36 inches.

We recommend a minimum total section thickness of 18 inches for pavement in unheated areas. The Subbase soil thickness can be reduced to 6” if the area is continuously heated. We further recommend that the pavement section consist of the following materials:

Table 6: Pavement Section Thicknesses

MATERIAL	THICKNESS (in)	SPECIFICATION
Asphalt Surface Course	1	MDOT 703.09 Type 9.5 mm or Type 12.5 mm
Asphalt Binder Course	2	MDOT 703.09 Type 19 mm
Base Soil	3	MDOT 703.06 Type A
Subbase Soil	12	MDOT 703.06 Type D

For portions of the pavement subjected to light traffic loads of cars and light trucks we recommend MDOT Type 9.5mm surface course. The following specifications are for MDOT base and subbase gravel:

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Table 7: Pavement Base and Subbase Gradations

SIEVE SIZE	Percent Passing a 3-inch Sieve	
	MDOT Type A (Base)	MDOT Type D (Subbase)
3 Inch	100	100
2 Inch	100	--
½ Inch	45 – 70	35 – 80
¼ Inch	30 – 55	25 – 65
No. 40	0 – 20	0 – 30
No. 200	0 – 6	0 – 7

Reference: MDOT Specification 703.06, Aggregate for Base and Subbase (2014)

The recommendations above can be used for exterior pavement areas.

6.0 Retaining Wall Design Recommendations

There are various retaining walls proposed throughout the new development area. Based on preliminary concepts proposed by Structural Integrity, Inc. and the grading plan prepared by Acorn Engineering, we understand that retaining walls at the new site may consist of pile and lagging walls, cast-in-place concrete walls, and segmental block retaining walls. The following table presents soil parameters to be used in the structural design of the retaining walls:

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Table 8: Retaining Wall Design Parameters

GEOTECHNICAL PARAMETERS – RETAINING WALL DESIGN				
PARAMETER	**EXISTING FILL/REWORKED NATIVE**	**GLACIAL TILL**	**[1]STRUCTURAL FILL**	**[1]GRAVEL BORROW and FOUNDATION BACKFILL**
Total Unit Weight (γ_t)	125 pcf	130 pcf	135 pcf	130 pcf
Submerged Unit Weight (γ_B)	63 pcf	68 pcf	73 pcf	68 pcf
Effective Friction Angle (ϕ')	[2]33°	36°	34°	32°
Cohesion (c)	0 psf	1,000 psf	0 psf	0 psf
Interface Friction Angle (δ), Precast Conc.	17°	22°	24°	22°
Interface Friction Angle (δ), C.I.P. Conc.	19°	26°	28°	26°
Interface Friction Angle (δ), Wood	19°	24°	25°	24°
Adhesion (c_a)	0 psf	0 psf	0 psf	0 psf

[1]**Note:** Soil Parameters for Structural Fill and Gravel Borrow assume that the fill is placed in 12” maximum lifts and compacted to 95% of the dry density in accordance with ASTM D1557
[2]**Note:** Friction angle of existing fill/reworked native soil was determined using a Factor of Safety of 1.30 on the laboratory test result. The purpose of the FOS is to account for soil variability and for scaling factor from small-scale (laboratory) results to large scale (field) results.

Active and passive earth pressures can be calculated based on the above soil properties and the corresponding backslope/toeslope angles behind and in front of the walls. Earth pressures can be calculated using the Rankine or the Coulomb theories, whichever the designer feels is more appropriate. The Rankine theory will provide a more conservative coefficient that the Coulomb theory (wall batter and soil-wall interface friction are ignored using Rankine). Equivalent fluid pressure on the foundation walls can be calculated by multiplying the applicable earth pressure coefficient by the soil unit weight.

Active earth pressure can be used for calculating soil load on walls which are designed to anticipate a horizontal deflection of the following magnitude:

Table 9: Required Deflections for Active Earth Pressure Design

RETAINED SOIL	REQUIRED DEFLECTION (% of Total Height)
Native Glacial Till	1.0% of total wall height
Structural Fill	0.05% of total wall height
Gravel Borrow	0.20% of total wall height
Foundation Backfill	0.20% of total wall height

If the proposed retaining wall is restricted against horizontal deflection or is not designed to accommodate the deflections in the table above, at-rest earth pressure should be used in the wall design.

6.1 Segmental Block Retaining Walls

Multiple segmental block retaining walls are proposed along both sides of the new building with a maximum exposed height of approximately 12 feet. We recommend that the segmental block walls be designed by a qualified Maine Licensed Professional Engineer. An underdrain system should be provided continuously behind the retaining wall near its base to prevent the buildup of hydrostatic pressures. All underdrains should consist of 4" or 6" rigid perforated PVC surrounded by a minimum of 6 inches of ¾" crushed stone and filter fabric to prevent clogging from the migration of the fine soil particles in the foundation backfill soils. There should be a minimum of 12" of crushed stone behind the entire wall between the back of the concrete and the wall backfill to allow for any infiltrated water behind the wall to drain down to the underdrain pipe. Underdrains should outlet through the end of the walls to a location where the outlet will be free flowing.

All topsoil, loose soil, or organic soil should be removed entirely from within the proposed retaining wall footprint prior to construction of the footing or leveling pad. We anticipate that the retaining walls will be constructed in imported fill after the building foundation is constructed. We recommend that the leveling pad consist of a minimum 12" thick layer of ¾" crushed stone. A geotextile fabric (such as Mirafi 180N) should be used if native soil is located beneath the wall. We recommend that the exposed soil beneath the leveling pad be proofrolled prior to placing the crushed stone. We recommend that the walls be designed using a minimum live load surcharge of 100 psf for temporary construction behind the wall. If applicable, surcharge loading should be increased if higher loads are anticipated behind the wall. Passive resistance of embedded portions of the wall should be ignored.

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Segmental block retaining walls should be designed in accordance with the National Concrete Masonry Association (NCMA), 3rd Edition design manual. Soil properties presented in Table 8 can be used in the retaining wall design. Retaining wall backfill for gravity retaining walls and reinforced soil for geogrid reinforced retaining walls should consist of Structural Fill (SF, Table 5) and be compacted to 95% of its maximum dry density in accordance with ASTM D1557. The maximum particle size should be limited to 4 inches.

The retaining wall can be designed using an allowable net bearing pressure of 3,000 psf assuming the recommendations above are followed. Since segmental blocks are tolerable of some differential settlement, the blocks do not need to be constructed to full frost depth. Based on our explorations, we do not believe that a global stability analysis is necessary for the proposed retaining wall. We recommend that the final wall design be made available for SGS to review prior to construction.

6.2 Cast-in-Place Concrete Walls (Building Foundation Walls)

Soil properties presented in Table 8 can be used in the cast-in-place concrete wall designs.

We recommend that retaining walls be backfilled with FB meeting the gradation requirements presented in Section 5.3. FB should be compacted to 95% of its maximum dry density in accordance with ASTM D1557. Geotextile (Mirafi 180N or equivalent) should be placed between the native soil and the FB.

We recommend that underdrains be installed at the base of retaining walls to prevent the build-up of hydrostatic pressures. The underdrain should consist of 6" rigid perforated PVC surrounded by a minimum of 6 inches of crushed stone and filter fabric to prevent clogging from the migration of the fine soil particles in the foundation backfill soils. The underdrain pipes should outlet to a location where they will be free flowing.

6.3 Pile and Lagging Wall

We understand that a pile and lagging wall will be constructed along the south, east, and north sides of the site. We further understand that the pile and lagging wall will be used for the temporary excavation for construction of the building foundation, but will also remain in place permanently as a retaining wall for the lawn area at the east end of the site. Permanent exposed wall heights are a maximum of approximately 27 feet.

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We understand that soil anchors are being avoided if possible for the new project. We anticipate that to complete the building foundation construction, a relatively complex staged construction scheme will need to be developed, utilizing internally braced systems with concrete or sheet pile deadmen used in conjuction with the pile and lagging wall. The soil properties provided in Table 8 can be used for the design of the pile and lagging wall.

We recommend that the pile and lagging walls be designed to account for differential hydrostatic load behind the wall at an elevation of 140.0 feet.

7.0 Stormwater Considerations

Based on the "Stormwater Details" sheet contained in the plan set prepared by Acorn Engineering, we understand that two underdrained subsurface sand filter (USSF) with StormTech MC-4500 storage units are proposed on the east end of the new building. We further understand that the bottom of the USSF units is 120.2 feet, approximately 9 feet above the slab FFE.

If installed correctly, the perimeter drains around the building foundation walls will control groundwater below the FFE of 111.5 feet. Therefore groundwater is not anticipated to impact the USSF units.

8.0 Earthwork Considerations

The table below summarizes the OSHA general excavation guidelines for occupied excavations for the soils encountered in our geotechnical explorations. All permissible slopes below apply to soil above groundwater table:

Table 10: OSHA Permissible Slopes

OSHA Excavation Slopes		
Soil	**OSHA Classification**	**Permissible Slope**
Existing Fill/Reworked Native	Type B	1H:1V
Glacial Till	Type A	0.75H:1V
Granular Fill	Type C	1.5H:1V

The above permissible slopes are for soil above the groundwater table. If any excavated soil is found to be below the groundwater table and is not de-watered, the permissible slope for the submerged soil is 1.5H to 1V. Any excavations greater than 20 feet should be designed by a qualified Maine Licensed Professional Engineer.

After construction of the building foundation, backfilling will be required on the west, north, and east sides of the building. The exterior of the foundation walls should be backfilled with Foundation Backfill (see Table 3), and areas beneath proposed segmental block retaining walls should be backfilled with Structural Fill (see Table 5). All other areas can be backfill with Gravel Borrow (GB). The portion of SF passing the 3” sieve shall meet the following gradation requirements:

Table 11: Gravel Borrow - Soil Gradation

GRAVEL BORROW (GB)	
Sieve Size	**Percent finer**
¼ inch	0 to 70
No. 200	0 to 10.0

Reference: MDOT Specification 703.19, Gravel Borrow

The maximum GB particle size should be limited to 6 inches. GB should be placed in 6 to 12 inch lifts and should be compacted to a minimum of 95 percent of its maximum dry density, determined in accordance with ASTM D1557.

Surface water should be redirected from excavation areas. Where softened, we recommend the subgrade at the base of the excavation be over-excavated and replaced with a minimum of 12 inches of Crushed Stone. Crushed Stone should be should be tamped to lock the stone structure together. Crushed Stone should meet the following gradation specification:

Table 12: 3/4" Crushed Stone Gradation

CRUSHED STONE ¾ INCH	
Sieve Size	**Percent finer**
1 inch	100
¾ inch	90 to 100
½ inch	20 to 55
⅜ inch	0 to 15
No. 4	0 to 5

Reference: MDOT Specification 703.13, Crushed Stone ¾-Inch (2014)

In general, we anticipate that groundwater will enter the excavations. Dewatering may consist of shallow sumps at the base of the excavation. Diversion and control of surface water should be performed to prevent water flow from rain or snowmelt from entering the excavations.

We recommend that a qualified geotechnical consultant be retained to monitor and test soil materials used during construction and confirm that soil conditions and construction methods are consistent with this report.

9.0 Closure

Our recommendations are based on professional judgment and generally accepted principles of geotechnical engineering and project information provided by others. Some changes in subsurface conditions from those presented in this report may occur. Should these conditions or the proposed development differ from those described in this report, SGS should be notified so that we can re-evaluate our recommendations.

We highly recommend that all retaining wall designs be made available to SGS for review in order to verify that the design conditions are consist with the recommendations provided in this report.

It is recommended that this report be made available in its entirety to contractors for informational purposes and be incorporated in the construction Contract Documents. We recommend that SGS be retained to review final construction documents relevant to the recommendations in this report.

We appreciate the opportunity to serve you during this phase of your project. If there are any questions or additional information is required, please do not hesitate to call.

Sincerely yours,

Mathew Hardison, EI
Geotechnical Engineer

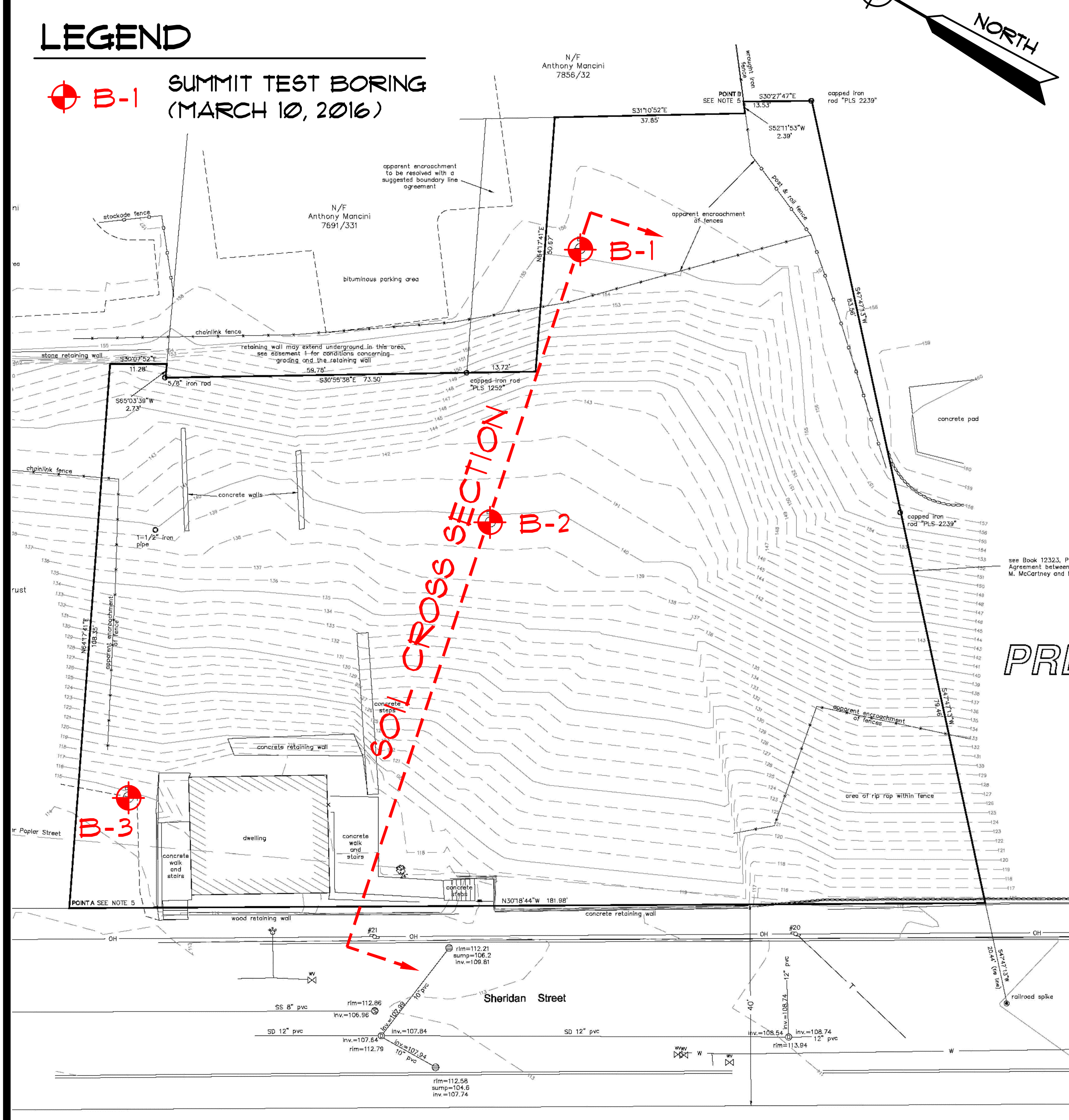
William M. Peterlein, PE
President & Principal Engineer

APPENDIX A

FIGURES

PLAN REFERENCE

"PLAN OF EXISTING CONDITIONS SURVEY", DATED MARCH 4, 2016, PRAPRED BY TITCOMB ASSOCIATES.



TEST BORING LOCATION PLAN
PROPOSED RESIDENTIAL BUILDING

153 - 165 SHERIDAN STREET - PORTLAND, MAINE

PREPARED FOR

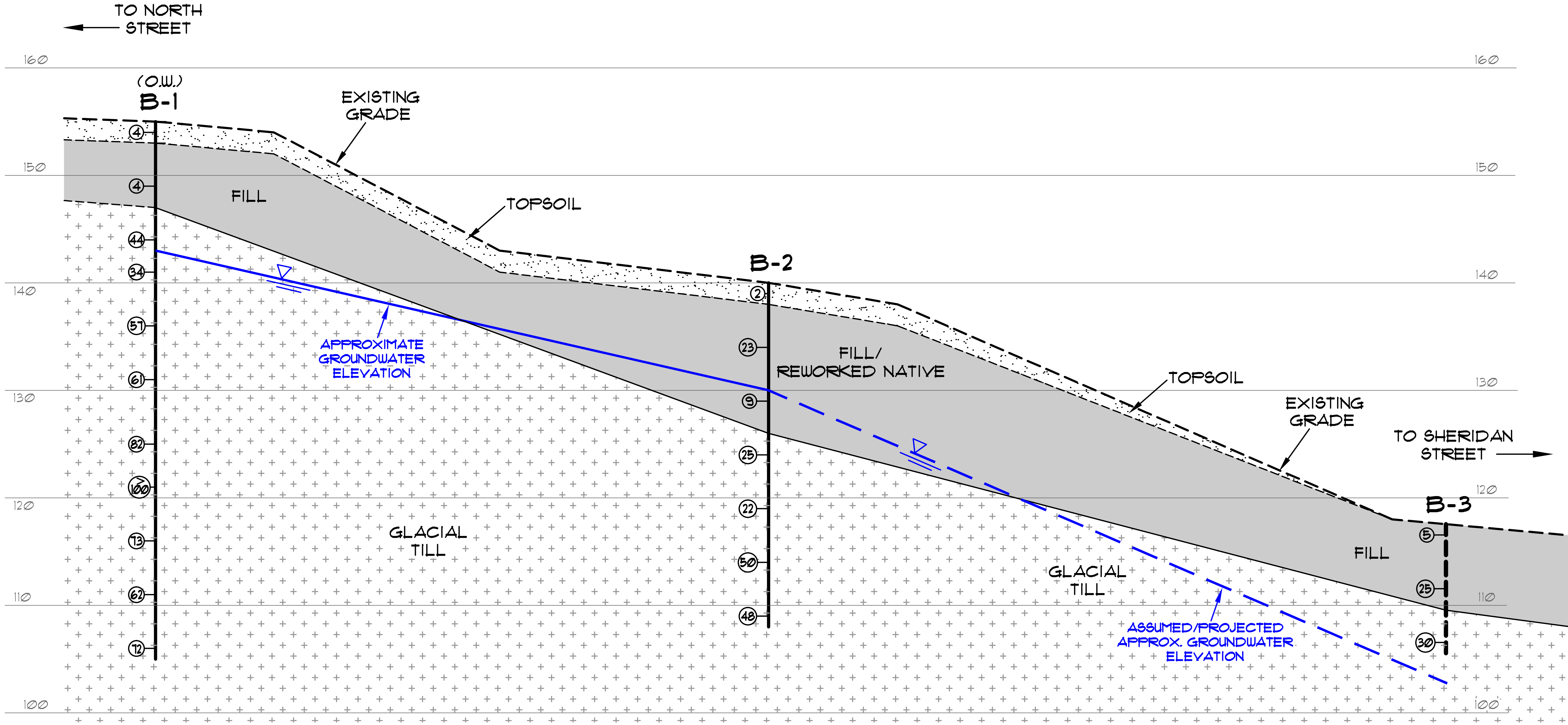
BD SHERIDAN LLC

DATE: 3-18-2016	DRAWN BY: KRF	CHECKED BY: WMP
JOB: 16030	SCALE: 1" = 30'	FILE: 16030 BOR

145 LISBON ST. - SUITE 601
LEWISTON, ME 04240
Tel.: (207) 576-3313

173 PLEASANT STREET
ROCKLAND, ME 04841
Tel.: (207) 318-7761

SUMMIT
GEOENGINEERING SERVICES
www.summitgeoeng.com



SOIL DESCRIPTION & OSHA SLOPE CLASSIFICATION

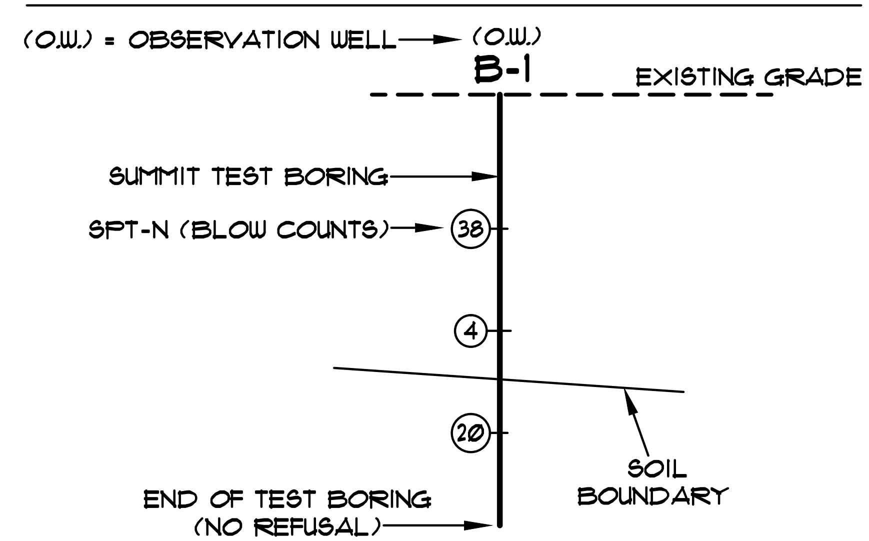
"FILL" - DARK BROWN TO TAN, SILTY SAND OR SANDY SILT, LOOSE TO COMPACT, OCCASIONAL WOOD OR GLASS PIECES. (OSHA TYPE C, 1.5H : 1V)

"FILL/REWORDED NATIVE" - OLIVE GRAY CLAYEY SILT, LITTLE SAND & GRAVEL, STIFF. (OSHA TYPE B, 1H : 1V)

"GLACIAL TILL" - GRAY GRAVELLY SILT, LITTLE SAND & CLAY, COMPACT TO DENSE. (OSHA TYPE A, 0.75H : 1V)

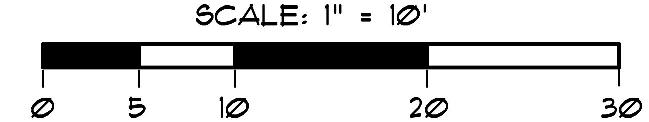
NOTE: ALLOWABLE OSHA SLOPES SHOWN APPLY TO SOIL ABOVE THE GROUNDWATER TABLE AND ARE FOR SHORT-TERM CONSTRUCTION CONDITIONS. OSHA SLOPES BELOW GROUNDWATER ARE 1.5H : 1V. PERMANENT SLOPES MAY BE STEEPER.

LEGEND



THE ACTUAL LOCATION OF THE B-3 TEST BORING IS 40'± TO THE NORTH. DATA WAS EXTRAPOLATED TO THIS LOCATION BASED ON SIMILAR GEOLOGY

SCALE: 1" = 10'



REVISED: MARCH 30, 2016 - BLOW COUNT * ON B-2

PROJECT: PROPOSED RESIDENTIAL BUILDING
153 - 165 SHERIDAN STREET - PORTLAND, MAINE

CLIENT: BD SHERIDAN LLC

TITLE: SOIL CROSS SECTION

SCALE: 1" = 10'
DRAWN BY: KRF
DATE: MARCH 21, 2016
APPR. BY: WAP

145 LISBON ST. - SUITE 601
LEWISTON, ME 04240
Tel.: (207) 576-3313

173 PLEASANT STREET
ROCKLAND, ME 04841
Tel.: (207) 318-7161

SUMMIT GEOENGINEERING SERVICES

PROJ.#: 16030
FIGURE: 1

APPENDIX B

BORING LOGS

EXPLORATION COVER SHEET

The exploration logs are prepared by the geotechnical engineer from both field and laboratory data. Soil descriptions are based upon the Unified Soil Classification System (USCS) per ASTM D2487 and/or ASTM D2488 as applicable. Supplemental descriptive terms for estimated particle percentage, color, density, moisture condition, and bedrock may also be included to further describe conditions.

Drilling and Sampling Symbols:

SS = Split Spoon Sample
UT = Thin Wall Shelby Tube
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RW = Rotary Wash
SV = Shear Vane
PP = Pocket Penetrometer
RC = Rock Core Sample
FV = Field Vane Shear Test
PS = Concrete Punch Sample

Hyd = Hydraulic Advancement of Drilling Rods
Push = Direct Push of Drilling Rods
WOH = Weight of Hammer
WOR = Weight of Rod
PI = Plasticity Index
LL = Liquid Limit
W = Natural Water Content
USCS = Unified Soil Classification System
Su = Undrained Shear Strength
Su(r) = Remolded Shear Strength

Water Level Measurements:

Water levels indicated on the boring logs are the levels measured in the boring at the times indicated. In pervious soils, the indicated elevations are considered reliable groundwater levels. In impervious soils, the accurate determination of groundwater elevations may not be possible, even after several days of observations. Groundwater monitoring wells may be required to record accurate depths and fluctuation.

Gradation Description and Terminology:

Boulders:	Over 12 inches
Cobbles:	12 inches to 3 inches
Gravel:	3 inches to No.4 sieve
Sand:	No.4 to No. 200 sieve
Silt:	No. 200 sieve to 0.005 mm
Clay:	less than 0.005 mm

Trace:	Less than 5%
Little:	5% to 15%
Some:	15% to 30%
Silty, Sandy, etc.:	Greater than 30%

Density of Granular Soils and Consistency of Cohesive Soils:

CONSISTENCY OF COHESIVE SOILS		DENSITY OF GRANULAR SOILS	
SPT N-value blows/ft	**Consistency**	**SPT N-value blows/ft**	**Relative Density**
0 to 2	Very Soft	0 to 4	Very Loose
2 to 4	Soft	5 to 10	Loose
5 to 8	Firm	11 to 30	Compact
9 to 15	Stiff	31 to 50	Dense
16 to 30	Very Stiff	>50	Very Dense
>30	Hard		

SUMMIT GEOENGINEERING SERVICES

SOIL BORING LOG

Boring #:	B-1 (OW)		
Project:	New Apartment Building	Project #:	16030
Location:	153 - 165 Sheridan Street	Sheet:	1 of 3
City, State:	Portland, Maine	Chkd by:	

Drilling Co:	Northern Test Boring	Boring Elevation:	155.0 ft. +/-
Driller:	Mike Nadeau	Reference:	"Existing Conditions Survey, 153-165 Sheridan St." by Titcomb Dated 3/4/16
Summit Staff:	M. Hardison, E.I.	Date started: 3/10/2016	Date Completed: 3/10/2016

DRILLING METHOD		SAMPLER	
Vehicle:	ATV	Length:	24" SS
Model:	Diedrich D-50	Diameter:	2"OD/1.5"ID
Method:	3" Case Wash	Hammer:	140 lb
Hammer Style:	Auto	Method:	ASTM D1586

ESTIMATED GROUND WATER DEPTH

Date	Depth	Elevation	Reference
3/12/2016	11.2 ft.	143.8 ft. +/-	2 days after completion of boring
4/19/2016	10.7 ft.	144.3 ft. +/-	40 days after completion of boring
6/16/2016	11.6 ft.	143.4 ft. +/-	86 days after completion of boring

Depth (ft.)	No.	Pen/Rec (in)	Depth (ft)	blows/6"	Elev. (ft.)	SAMPLE DESCRIPTION	Geological/ Test Data	Geological Stratum
	S-1	24/6	0 to 2	3		Dark brown to black SILT, little fine Sand, trace Clay, rootlets and organics, very loose, damp, ML		
1				2				TOPSOIL
				2				
2				2	153.0'			
3								FILL
4								
5								
	S-2	24/16	5 to 7	1		Dark tan to brown Silty SAND, wood pieces in spoon tip, very loose, humid, SM		
6				2				
				2				
7				1				
8					147.0'			
						Dense drilling encountered at 8.0' depth		
9								GLACIAL TILL
10								
	S-3	24/24	10 to 12	11		Gray-brown fine Gravelly SILT, little Sand and Clay, hard, humid, ML	PP >> 9,000 psf	
11				17				
				27			Groundwater ▽	
12				21				
13								
	S-4	24/20	13 to 15	13		same as above, some Cobble pieces	PP >> 9,000 psf	
14				13				
				21				
15				20				
16								
17								
18								
	S-5	24/24	18 to 20	25		Gray-brown Silty GRAVEL, trace Sand and Clay, very dense, humid, GM		
19				30				
				27				
20				27				
21								
22								

Granular Soils		Cohesive Soils		% Composition
Blows/ft.	Density	Blows/ft.	Consistency	ASTM D2487
0-4	V. Loose	<2	V. soft	
5-10	Loose	2-4	Soft	< 5% Trace
11-30	Compact	5-8	Firm	5-15% Little
31-50	Dense	9-15	Stiff	15-30% Some
>50	V. Dense	16-30	V. Stiff	> 30% With
		>30	Hard	

NOTES: PP = Pocket Penetrometer, MC = Moisture Content
LL = Liquid Limit, PI = Plastic Index, FV = Field Vane Test
Su = Undrained Shear Strength, Su(r) = Remolded Shear Strength

Bedrock Joints
Shallow = 0 to 35 degrees
Dipping = 35 to 55 degrees
Steep = 55 to 90 degrees

Boulders = diameter > 12 inches, Cobbles = diameter < 12 inches and > 3 inches
Gravel = < 3 inch and > No 4, Sand = < No 4 and >No 200, Silt/Clay = < No 200

Soil Moisture Condition
Dry: S = 0%
Humid: S = 1 to 25%
Damp: S = 26 to 50%
Moist: S = 51 to 75%
Wet: S = 76 to 99%
Saturated: S = 100%

SUMMIT GEOENGINEERING SERVICES	**SOIL BORING LOG**	Boring #:	**B-1 (OW)**
	Project: New Apartment Building	Project #:	16030
	Location: 153 - 165 Sheridan Street	Sheet:	2 of 3
	City, State: Portland, Maine	Chkd by:	

Drilling Co:	Northern Test Boring	Boring Elevation:	155.0 ft. +/-
Driller:	Mike Nadeau	Reference:	"Existing Conditions Survey, 153-165 Sheridan St." by Titcomb Dated 3/4/16
Summit Staff:	M. Hardison, E.I.	Date started: 3/10/2016	Date Completed: 3/10/2016

DRILLING METHOD		SAMPLER		ESTIMATED GROUND WATER DEPTH			
Vehicle:	ATV	Length:	24" SS	Date	Depth	Elevation	Reference
Model:	Diedrich D-50	Diameter:	2"OD/1.5"ID	3/12/2016	11.2 ft.	143.8 ft. +/-	2 days after completion of boring
Method:	3" Case Wash	Hammer:	140 lb				
Hammer Style:	Auto	Method:	ASTM D1586				

Depth (ft.)	No.	Pen/Rec (in)	Depth (ft)	blows/6"	Elev. (ft.)	SAMPLE DESCRIPTION	Geological/ Test Data	Geological Stratum
23								
	S-6	24/28	23 to 25	13		Gray Gravelly SAND, little Silt, trace Clay, very dense,		GLACIAL TILL
24				22		humid to moist, SP-SM		
				39				
25				29				
26								
27								
28								
29								
	S-7	24/20	29 to 31	40		same as above, little Clay, some Silt		
30				34				
				48				
31				47				
32								
33								
	S-8	24/20	33 to 35	33		Gray SILT, little Sand and Clay, trace Gravel, very		
34				37		dense, humid to moist, ML		
				50/4"				
35								
36								
37								
38								
	S-9	24/18	38 to 40	27		same as above		
39				31				
				42				
40				43				
41								
42								
43								
	S-10	24/24	43 to 45	15		same as above		
44				30				
				32				
				40				

Granular Soils		Cohesive Soils		% Composition
Blows/ft.	Density	Blows/ft.	Consistency	ASTM D2487
0-4	V. Loose	<2	V. soft	
5-10	Loose	2-4	Soft	< 5% Trace
11-30	Compact	5-8	Firm	5-15% Little
31-50	Dense	9-15	Stiff	15-30% Some
>50	V. Dense	16-30	V. Stiff	> 30% With
		>30	Hard	

NOTES: PP = Pocket Penetrometer, MC = Moisture Content
LL = Liquid Limit, PI = Plastic Index, FV = Field Vane Test
Bedrock Joints Su = Undrained Shear Strength, Su(r) = Remolded Shear Strength
Shallow = 0 to 35 degrees
Dipping = 35 to 55 degrees
Steep = 55 to 90 degrees

Boulders = diameter > 12 inches, Cobbles = diameter < 12 inches and > 3 inches
Gravel = < 3 inch and > No 4, Sand = < No 4 and >No 200, Silt/Clay = < No 200

Soil Moisture Condition
Dry: S = 0%
Humid: S = 1 to 25%
Damp: S = 26 to 50%
Moist: S = 51 to 75%
Wet: S = 76 to 99%
Saturated: S = 100%

SUMMIT GEOENGINEERING SERVICES	SOIL BORING LOG	Boring #: B-1 (OW)
	Project: New Apartment Building	Project #: 16030
	Location: 153 - 165 Sheridan Street	Sheet: 3 of 3
	City, State: Portland, Maine	Chkd by:

Drilling Co: Northern Test Boring	Boring Elevation: 155.0 ft. +/-
Driller: Mike Nadeau	Reference: "Existing Conditions Survey, 153-165 Sheridan St." by Titcomb Dated 3/4/16
Summit Staff: M. Hardison, E.I.	Date started: 3/10/2016 Date Completed: 3/10/2016

DRILLING METHOD		SAMPLER	
Vehicle:	ATV	Length:	24" SS
Model:	Diedrich D-50	Diameter:	2"OD/1.5"ID
Method:	3" Case Wash	Hammer:	140 lb
Hammer Style:	Auto	Method:	ASTM D1586

ESTIMATED GROUND WATER DEPTH

Date	Depth	Elevation	Reference
3/12/2016	11.2 ft.	143.8 ft. +/-	2 days after completion of boring

Depth (ft.)	No.	Pen/Rec (in)	Depth (ft)	blows/6"	Elev. (ft.)	SAMPLE DESCRIPTION	Geological/ Test Data	Geological Stratum
46								GLACIAL TILL
47								
48	S-11	24/24	48 to 50	56		Gray SILT, little Sand and Clay, trace Gravel, very dense, humid to moist, ML		
49				38				
				34				
50				44	105.0'			
						End of Boring at 50.0', no refusal		
51								
52						Monitoring Well Installed:		
						2" PVC Well Screen from 41.5' to 31.5'		
53						2" PVC Riser Pipe from 31.5' to ground surface		
54								
55								
56								
57								
58								
59								
60								
61								
62								
63								
64								
65								
66								
67								

Granular Soils		Cohesive Soils		% Composition
Blows/ft.	Density	Blows/ft.	Consistency	ASTM D2487
0-4	V. Loose	<2	V. soft	
5-10	Loose	2-4	Soft	< 5% Trace
11-30	Compact	5-8	Firm	5-15% Little
31-50	Dense	9-15	Stiff	15-30% Some
>50	V. Dense	16-30	V. Stiff	> 30% With
		>30	Hard	

NOTES: PP = Pocket Penetrometer, MC = Moisture Content
LL = Liquid Limit, PI = Plastic Index, FV = Field Vane Test
Bedrock Joints Su = Undrained Shear Strength, Su(r) = Remolded Shear Strength
Shallow = 0 to 35 degrees
Dipping = 35 to 55 degrees
Steep = 55 to 90 degrees

Boulders = diameter > 12 inches, Cobbles = diameter < 12 inches and > 3 inches
Gravel = < 3 inch and > No 4, Sand = < No 4 and >No 200, Silt/Clay = < No 200

Soil Moisture Condition
Dry: S = 0%
Humid: S = 1 to 25%
Damp: S = 26 to 50%
Moist: S = 51 to 75%
Wet: S = 76 to 99%
Saturated: S = 100%

SUMMIT GEOENGINEERING SERVICES

SOIL BORING LOG

Boring #:	**B-2**		
Project:	New Apartment Building	Project #:	16030
Location:	153 - 165 Sheridan Street	Sheet:	1 of 2
City, State:	Portland, Maine	Chkd by:	

Drilling Co:	Northern Test Boring	Boring Elevation:	139.5 ft. +/-
Driller:	Mike Nadeau	Reference:	"Existing Conditions Survey, 153-165 Sheridan St." by Titcomb Dated 3/4/16
Summit Staff:	M. Hardison, E.I.	Date started:	3/10/2016 Date Completed: 3/10/2016

DRILLING METHOD		SAMPLER	
Vehicle:	ATV	Length:	24" SS
Model:	Diedrich D-50	Diameter:	2"OD/1.5"ID
Method:	2.25" ID H.S.A.	Hammer:	140 lb
Hammer Style:	Auto	Method:	ASTM D1586

ESTIMATED GROUND WATER DEPTH

Date	Depth	Elevation	Reference
3/10/2016	20.0 ft.	119.5 ft. +/-	observed on samples

Depth (ft.)	No.	Pen/Rec (in)	Depth (ft)	blows/6"	Elev. (ft.)	SAMPLE DESCRIPTION	Geological/ Test Data	Geological Stratum
	S-1	24/20	0 to 2	2		Black SILT, frequent roots, rootlets, and organics, soft,		
1				1		damp, ML		TOPSOIL
				1				
2				1	137.5'			
3								FILL/REWORKED
								NATIVE
4								
5								
	S-2	24/10	5 to 7	9		Olive gray Clayey SAND, little to some Silt, little Gravel,	PP = 4,000 psf to	
6				12		humid, stiff, SM-SC	6,000 psf	
				11				
7				10			Gravel % = 9.8%	
							Sand % = 51.4%	
8							Fines % = 38.8%	
9							LL = 17	
							PI = 4	
10								
	S-3	26/16	10 to 12	3		same as above	PP = 3,000 psf	
11				5				
				4				
12				5				
13								
14					125.5'			
15								GLACIAL TILL
	S-4	24/12	15 to 17	8		Gray SILT, little Sand and Clay, trace Gravel, very		
16				13		dense, humid to moist, ML		
				12				
17				9				
18								
19								
20							∇ Groundwater	
	S-5	24/24	20 to 22	8		same as above, wet		
21				11				
				11			PP = 5,000 psf	
22				13			to 9,000 psf	

Granular Soils		Cohesive Soils		% Composition	Soil Moisture Condition
Blows/ft.	Density	Blows/ft.	Consistency	ASTM D2487	Dry: S = 0%
0-4	V. Loose	<2	V. soft		Humid: S = 1 to 25%
5-10	Loose	2-4	Soft	< 5% Trace	Damp: S = 26 to 50%
11-30	Compact	5-8	Firm	5-15% Little	Moist: S = 51 to 75%
31-50	Dense	9-15	Stiff	15-30% Some	Wet: S = 76 to 99%
>50	V. Dense	16-30	V. Stiff	> 30% With	Saturated: S = 100%
		>30	Hard		

NOTES: PP = Pocket Penetrometer, MC = Moisture Content
LL = Liquid Limit, PI = Plastic Index, FV = Field Vane Test
Su = Undrained Shear Strength, Su(r) = Remolded Shear Strength

Bedrock Joints
Shallow = 0 to 35 degrees
Dipping = 35 to 55 degrees
Steep = 55 to 90 degrees

Boulders = diameter > 12 inches, Cobbles = diameter < 12 inches and > 3 inches
Gravel = < 3 inch and > No 4, Sand = < No 4 and >No 200, Silt/Clay = < No 200

SUMMIT GEOENGINEERING SERVICES

SOIL BORING LOG

Boring #:	B-2		
Project:	New Apartment Building	Project #:	16030
Location:	153 - 165 Sheridan Street	Sheet:	2 of 2
City, State:	Portland, Maine	Chkd by:	

Drilling Co:	Northern Test Boring	Boring Elevation:	139.5 ft. +/-
Driller:	Mike Nadeau	Reference:	"Existing Conditions Survey, 153-165 Sheridan St." by Titcomb Dated 3/4/16
Summit Staff:	M. Hardison, E.I.	Date started:	3/10/2016 Date Completed: 3/10/2016

DRILLING METHOD		SAMPLER	
Vehicle:	ATV	Length:	24" SS
Model:	Diedrich D-50	Diameter:	2"OD/1.5"ID
Method:	2.25" ID H.S.A.	Hammer:	140 lb
Hammer Style:	Auto	Method:	ASTM D1586

ESTIMATED GROUND WATER DEPTH

Date	Depth	Elevation	Reference
3/10/2016	20.0 ft.	119.5 ft. +/-	observed on samples

Depth (ft.)	No.	Pen/Rec (in)	Depth (ft)	blows/6"	Elev. (ft.)	SAMPLE DESCRIPTION	Geological/ Test Data	Geological Stratum
23								
						Dense drilling starting at 23'		GLACIAL TILL
24								
25								
	S-6	24/24	25 to 27	23		Gray SILT, little Sand and Clay, trace Gravel, very		
26				23		dense, humid to moist, ML		
				27				
27				28				
28								
29								
30								
	S-7	24/24	30 to 32	20		same as above		
31				23				
				25				
32				27	107.5'			
						End of Boring at 32.0', no refusal		
33								
34								
35								
36								
37								
38								
39								
40								
41								
42								
43								
44								

Granular Soils		Cohesive Soils		% Composition
Blows/ft.	Density	Blows/ft.	Consistency	ASTM D2487
0-4	V. Loose	<2	V. soft	
5-10	Loose	2-4	Soft	< 5% Trace
11-30	Compact	5-8	Firm	5-15% Little
31-50	Dense	9-15	Stiff	15-30% Some
>50	V. Dense	16-30	V. Stiff	> 30% With
		>30	Hard	

NOTES: PP = Pocket Penetrometer, MC = Moisture Content
LL = Liquid Limit, PI = Plastic Index, FV = Field Vane Test
Bedrock Joints Su = Undrained Shear Strength, Su(r) = Remolded Shear Strength
Shallow = 0 to 35 degrees
Dipping = 35 to 55 degrees
Steep = 55 to 90 degrees

Boulders = diameter > 12 inches, Cobbles = diameter < 12 inches and > 3 inches
Gravel = < 3 inch and > No 4, Sand = < No 4 and >No 200, Silt/Clay = < No 200

Soil Moisture Condition
Dry: S = 0%
Humid: S = 1 to 25%
Damp: S = 26 to 50%
Moist: S = 51 to 75%
Wet: S = 76 to 99%
Saturated: S = 100%

SUMMIT GEOENGINEERING SERVICES

SOIL BORING LOG

Boring #:	B-3		
Project:	New Apartment Building	Project #:	16030
Location:	153 - 165 Sheridan Street	Sheet:	1 of 1
City, State:	Portland, Maine	Chkd by:	

Drilling Co:	Northern Test Boring	Boring Elevation:	114.5 ft. +/-
Driller:	Mike Nadeau	Reference:	"Existing Conditions Survey, 153-165 Sheridan St." by Titcomb Dated 3/4/16
Summit Staff:	M. Hardison, E.I.	Date started: 3/10/2016	Date Completed: 3/10/2016

DRILLING METHOD		SAMPLER	
Vehicle:	ATV	Length:	24" SS
Model:	Diedrich D-50	Diameter:	2"OD/1.5"ID
Method:	2.25" ID H.S.A.	Hammer:	140 lb
Hammer Style:	Auto	Method:	ASTM D1586

ESTIMATED GROUND WATER DEPTH

Date	Depth	Elevation	Reference
3/10/2016	-	-	none encountered

Depth (ft.)	No.	Pen/Rec (in)	Depth (ft)	blows/6"	Elev. (ft.)	SAMPLE DESCRIPTION	Geological/ Test Data	Geological Stratum
	S-1	24/10	0 to 2	3		Dark brown - black Silty SAND, few glass pieces, little		
1				2		to trace Clay, rootlets, moist, loose, SM		FILL
				3				
2				3				
3								
4								
5								
	S-2	24/1	5 to 7	7		no recovery, Sandy SILT in tip		
6				15				
				10				
7				10				
8					106.5'			
9								GLACIAL TILL
10								
	S-3	24/24	10 to 12	10		Gray Clayey SILT, little Gravel and Sand, humid,	PP > 9,000 psf	
11				15		very stiff, ML		
				15				
12				18	102.5'			
						End of Exploration at 12.0, no refusal		
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								

Granular Soils		Cohesive Soils		% Composition
Blows/ft.	Density	Blows/ft.	Consistency	ASTM D2487
0-4	V. Loose	<2	V. soft	
5-10	Loose	2-4	Soft	< 5% Trace
11-30	Compact	5-8	Firm	5-15% Little
31-50	Dense	9-15	Stiff	15-30% Some
>50	V. Dense	16-30	V. Stiff	> 30% With
		>30	Hard	

NOTES: PP = Pocket Penetrometer, MC = Moisture Content
LL = Liquid Limit, PI = Plastic Index, FV = Field Vane Test
Su = Undrained Shear Strength, Su(r) = Remolded Shear Strength

Bedrock Joints
Shallow = 0 to 35 degrees
Dipping = 35 to 55 degrees
Steep = 55 to 90 degrees

Boulders = diameter > 12 inches, Cobbles = diameter < 12 inches and > 3 inches
Gravel = < 3 inch and > No 4, Sand = < No 4 and >No 200, Silt/Clay = < No 200

Soil Moisture Condition
Dry: S = 0%
Humid: S = 1 to 25%
Damp: S = 26 to 50%
Moist: S = 51 to 75%
Wet: S = 76 to 99%
Saturated: S = 100%

APPENDIX C

LABORATORY TEST RESULTS

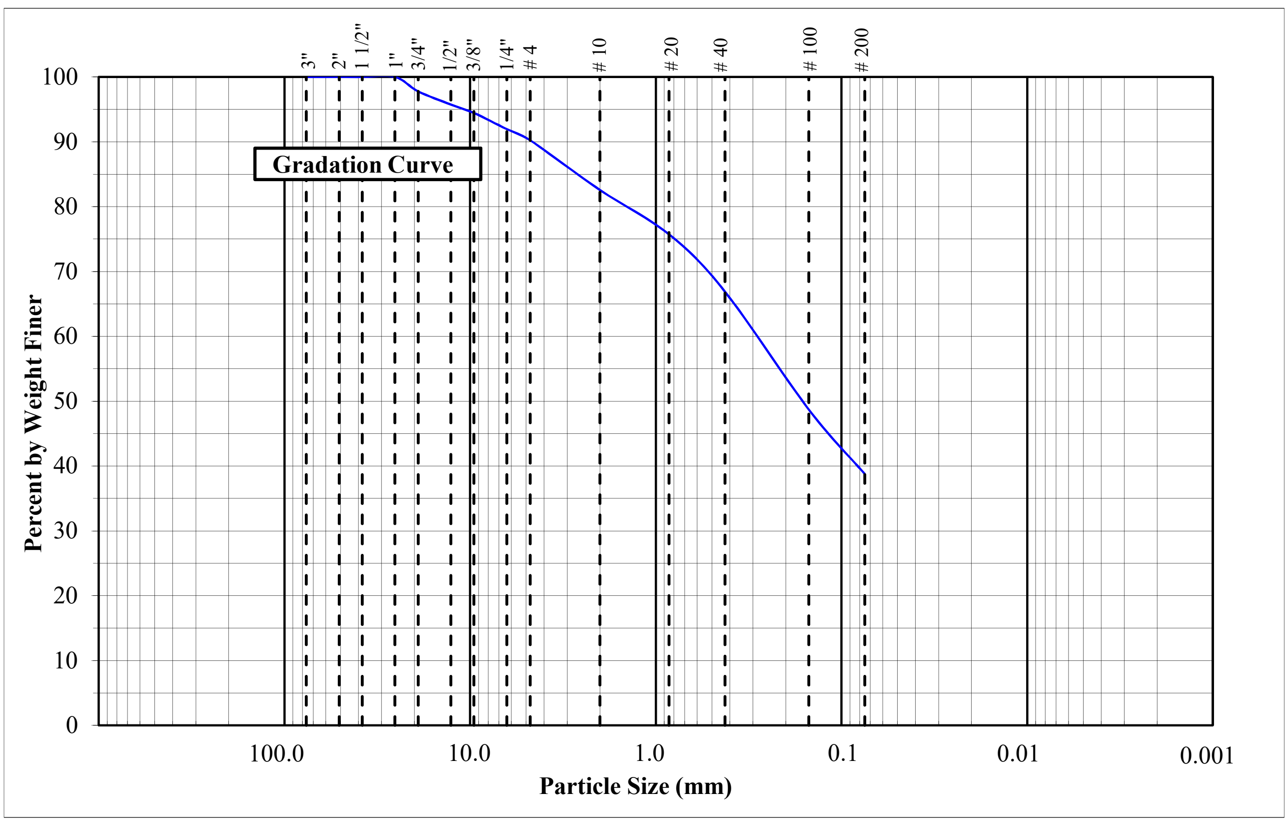
SUMMIT
GEOENGINEERING SERVICES

GRAIN SIZE ANALYSIS - ASTM D422

PROJECT NAME:	New Apartment Building	PROJECT NUMBER:	16030
CLIENT:	BD Sheridan, LLC	SAMPLE NUMBER:	B-2, S-2 & S-3
SOURCE:	Boring B-2, 5'-12'	DESCRIPTION:	SAND, some Silt & Clay, little Gravel, SM-SC
DATE:	3/25/2016	TECHNICIAN:	Erika Stewart, E.I.

DATA

PARTICLE SIZE mm		% BY WT FINER
76.20	(3 in)	100.0
50.80	(2 in)	100.0
38.10	(1-1/2 in)	100.0
25.40	(1 in)	100.0
19.05	(3/4 in)	97.8
12.70	(1/2 in)	95.7
9.53	(3/8 in)	94.4
6.35	(1/4 in)	92.0
4.75	(No. 4)	90.2
2.00	(No. 10)	82.6
0.85	(No. 20)	75.7
0.43	(No. 40)	66.9
0.15	(No. 100)	48.7
0.075	(No. 200)	38.8



REMARKS: Moisture Content = 11.4%

145 Lisbon Street (PO Box 7216) Lewiston, Maine (207) 576-3313
173 Pleasant Street, Rockland, Maine 04841, (207) 318-7761

SUMMIT GEOENGINEERING SERVICES

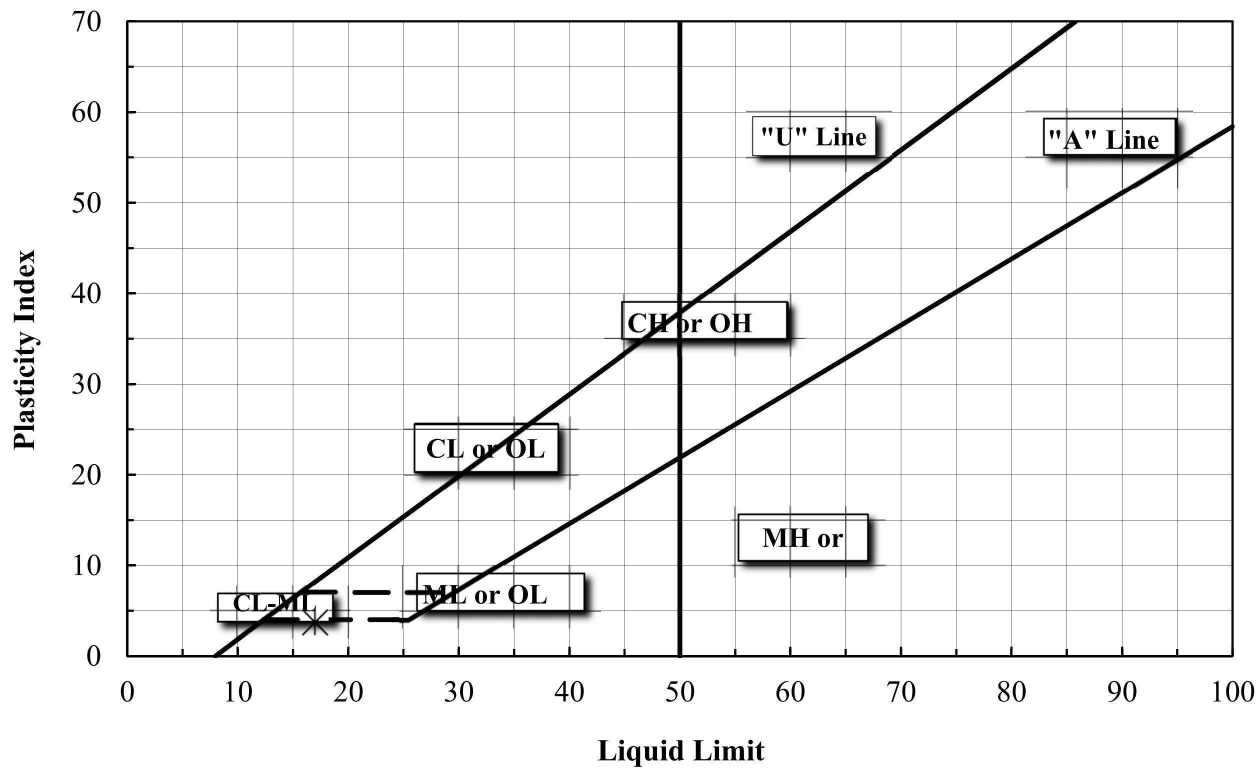
ATTERBERG LIMIT TEST - ASTM D4318

Method "A" (Multi-point)

PROJECT NAME:	New Apartment Building	PROJECT NUMBER:	16030
CLIENT:	BD Sheridan, LLC	SAMPLE NUMBER:	B-2, S-2 & S-3
SOURCE:	Fill / Reworked Native	DEPTH:	5'-12'
DATE:	3/28/2016	TECHNICIAN:	Erika Stewart, E.I.

DATA

Source	Depth	LL	PL	PI	Classification
B-2	5'-12'	17	13	4	Gray SAND, some Silt & Clay, little Gravel, SM-SC



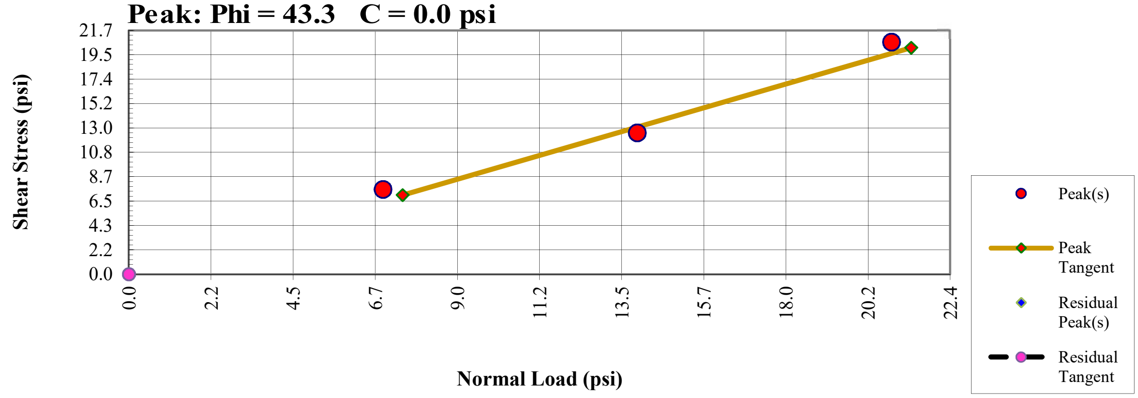
Notes: Sample was screened on the #40 sieve to remove gravel and med-coarse sand before performing Atterberg Limit test.

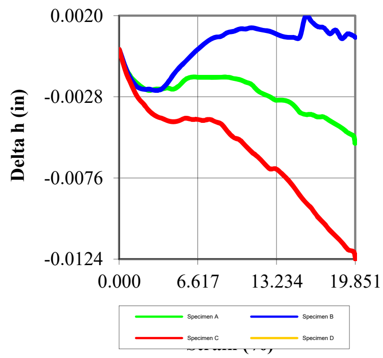
Summit Geoengineering Services

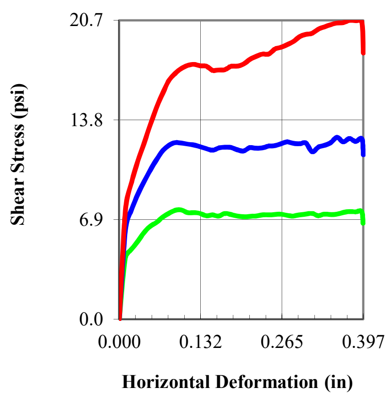
Direct Shear Test (ASTM D3080)

Checked By: Craig Coolidge, P.E. Date: 4/4/2016

Peak: Phi = 43.3 C = 0.0 psi







Initial	Specimen A	Specimen B	Specimen C	Specimen D
Moisture (%)	16.51	15.95	15.13	
Density (pcf)	118.01	121.21	121.10	
Void Ratio	0.428	0.391	0.392	
Saturation (%)	100.00	100.00	100.00	
Diameter (in)	2.000	2.000	2.000	
Height (in)	0.750	0.750	0.750	

Final	A	B	C	D
Moisture (%)	12.58	12.92	11.74	
Density (pcf)	118.01	122.23	121.10	
Void Ratio	0.428	0.379	0.392	
Saturation (%)	96.52	100.00	100.00	
Diameter (in)	2.000	2.000	2.000	
Height (in)	0.710	0.693	0.687	
Normal Stress (psi)	6.9	13.9	20.8	
Peak Stress (psi)	7.6	12.6	20.7	
Residual Stress (psi)				
Strain (%)	19.823	17.702	19.851	
Rate (in/min)	0.005	0.005	0.005	

Project Date	
Date	3/29/16

Project:	New Apartment Building
Location:	Sheridan Street, Portland, ME
Project Number:	16030
Boring Number	B-2
Sample Number:	S-2 & S-3
Depth:	5'-12'
Sample Type:	Remolded
Description:	Gray SAND, some Silt & Clay, little Gravel, SM-SC
Test Type:	Direct Shear
Remarks:	

Failure Photographs			
N/A	N/A	N/A	N/A

Tested By: Erika Stewart, E.I. Date: 4/4/2016