SUMMIT
GEOENGINEERING SERVICES

GEOTECHNICAL REPORT

New Office Building
19 Union Wharf
Portland, Maine

Prepared for:

Proprietors of Union Wharf
36 Union Wharf
Portland, Maine 04101

Prepared by:

Summit Geoengineering Services
145 Lisbon St.
Lewiston, Maine

Project #15167
October 2015

October 14, 2015
SGS #15167

Charlie Poole
Proprietors of Union Wharf
36 Union Wharf
Portland, Maine 04101

Reference: Geotechnical Report, New Office Building
19 Union Wharf, Portland, Maine

Dear Charlie;

Summit Geoengineering Services, Inc. (SGS) has completed a geotechnical investigation for the proposed office building at the site referenced above. Our scope of services included the drilling of 3 borings 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 Description

The project consists of constructing a new 3-story office building at 19 Union Wharf in Portland, Maine. The new building will be a traditional steel frame with light gage metal, sheathed and clad with a metal panel system or a structural wood framed building sheathed and clad with a metal panel system for the exterior walls. The new building will be constructed in the footprint of an existing single story pre-engineered metal building.

Based on contour mapping from the City of Portland GIS, the exterior grade around the existing building increases from elevation 8 feet on the southern end to elevation 9 feet on the northern end. The finish floor elevation of the building is approximately 8.5 feet. The existing building is an open-span steel framed structure with an asphalt floor. We anticipate that the proposed grades will match the existing grades.

2.0 Subsurface Exploration

Summit Geoengineering Services (SGS) observed the subsurface conditions at the site with the drilling of 3 borings on August 18, 2015 and October 6, 2015. Split spoon sampling was performed on the first day of the borings, and SGS returned on the second date to probe to refusal in order to determine bedrock elevation. Refusal was encountered at depths ranging from 103.5 to 108.0 feet. The borings were performed using 3” vibrated casing. Continuous split spoon sampling was conducted in general accordance with ASTM D1586 from the ground surface to the top of the soft silty clay layer to collect blow counts and soil samples for visual classification. Once the soft clay layer was encountered, sampling was terminated, and SGS returned on October 6, 2015 and probed to refusal in the same boring locations.

Locations of the borings were marked by SGS prior to drilling by measuring from the existing building. These locations can be seen in the SGS Exploration Plan in Appendix. The boring logs are included in Appendix B.

SGS performed a subsurface exploration directly to the north of the site in 2014. This exploration included three borings and one Cone Penetration Test (CPT). The CPT was performed directly adjacent to the northwest corner of the existing building location, and the closest boring was approximately 100 feet away. The cone log is included in Appendix B. Results from these explorations were included in the geotechnical analyses in providing foundation recommendations.

3.0 Subsurface Conditions

3.1 Soil

The soil at the site generally consists of ***asphalt*** overlying ***fill*** overlying ***marine sediments*** overlying ***bedrock.***

3.1.1 ***Asphalt.*** The asphalt layer was at the surface of all of the boring locations and ranges from 3” to 5.5” thick.

3.1.2 ***Fill.*** The fill can generally be broken into two sub-layers. The upper layer consists of brown to dark gray silt with little to some gravel and sand, and trace clay. This layer was located directly below the pavement, except in Borings B-101, which contained a thin layer of silty clay in between this layer and the pavement. It is loose to compact, humid, and ranges in thickness from 2 feet to 3.5 feet. Standard Penetration Test blow counts (SPT-N) in this layer ranged from 4 to 22 with an average of 11. It classifies as SM or ML in accordance with the Unified Soil Classification System.

The lower portion of the fill consisted of alternating layers of olive silty clay/clayey silt and black silt. The olive silty clay/clayey silt is a reworked fill that is humid to wet, very soft to loose, and contains some ash and brick fragments. The black silt contains no to some sand, ash, gravel, and brick fragments. There is a slight to strong petroleum odor throughout the lower sub-layer of fill. Likely timber cribbing was encountered in this sub-layer in Boring B-101 and B-103 at depths of 10.5 feet and 8 feet, respectively. SPT-N in this layer ranges from 2 to 17 with an average of 9. It ranges in thickness from 7 feet to 14 feet and classifies as ML, CL, or SM in accordance with the Unified Soil Classification System.

3.1.3 ***Marine Sediment.*** The marine sediment deposit was encountered in all of the borings and is described as gray to olive gray clayey silt with trace to some sand, little organics and shell pieces, and occasional organic odor. It ranges in depth below ground surface from 12.5 feet to 16.5 feet and likely extends close to the bedrock surface (a thickness of up to 93.5 feet). It is wet, soft to very soft, and ranges in SPT-N from “weight of hammer” to 10 with an average of 5 (assuming that “weight of hammer” is equivalent to an SPT-N of 0). Moisture content of collected marine sediment samples from Boring B-2 (performed in 2014 approximately 100 feet north of the proposed building location) ranges from 38.8% to 58.8%. Liquid Limit and Plastic Limit of a tested sample was 39 and 20, respectively. The marine sediment classifies as CL or ML in accordance with the Unified Soil Classification System.

The CPT performed at the corner of the building during SGS’s previous investigation encountered refusal at approximately 77 feet. It is likely that this was a confined dense layer of sand within the marine sediment deposit.

3.2 Groundwater

The groundwater at the site is highly influenced by the tide elevation. Based on tidal data published by the Maine Department of Environmental Protection, the highest annual tide for the Portland area is elevation 6.5 feet. During the explorations, groundwater was observed to range from depth 2.7 feet below ground surface to 5.5 feet below ground surface (approximate elevation of 2.5 feet to 5 feet). We anticipate that groundwater reaches elevation 6.5 feet during high tide conditions.

3.3 Bedrock

Bedrock was encountered in Borings B-101 and B-103 at depths of 103.5 feet and 108.0 feet, respectively (elevation -95.0 feet and -100.0 feet, respectively). According to the Maine Geological Survey, bedrock at the site is of the Precambrian Z Spring Point Formation consisting of green schist and amphibolites facies ranging from and mafic to felsic volcanic rock.

4.0 Evaluation

At this time, specific building loads are not available for the proposed structure. However, based on roughly estimated dead loads and live loads for buildings of this size and height and the soil properties, we anticipate that a conventional frost wall foundation will result in excessive settlements that are not tolerable for this building type. The settlement calculations were based on data collected from our geotechnical exploration at the site, and also included laboratory test results of clay samples collected from the boring from the adjacent site as well as CPT data. Predicted settlements of column footings and spread footings supported by a shallow foundation are estimated to be anywhere from 2.5 inches to 4 inches. We believe these magnitudes of settlement are unacceptable for the proposed building.

Alternative foundations considered for the new building included a structural mat, helical piles (intermediate foundation), preload, and piles (deep foundation). Due to cost, feasibility, time constraints, and physical site constraints, the helical piles and preload options are not recommended for this site. Total settlement of a structural mat foundation was computed to be in the range of 2 to 3 inches. Based on the above, we believe that a pile-supported foundation is the most economical and reliable foundation type to support the anticipated exterior and interior column and wall loads. The ground floor slab can be constructed as a "floating" slab supported on the improved existing soil. We recommend that the columns and load bearing elements of the new building be supported by steel H-piles or pipe piles end bearing on bedrock.

If the slab subgrade preparation and construction recommendations from this report are followed, the ground floor slab for the new structure can be supported on grade and will not need piles. It will be important to minimize slab settlements so a gap (or "lip") does not develop between the slab and the foundation. To do this, and to mitigate slab cracking from localized weak subgrade location, subgrade preparation procedures are provided in Section 5.2.

5.0 Foundation Recommendations

5.1 Pile Foundation Recommendations

Based on anticipated design loads of the new building, we recommend all interior and exterior continuous and isolated footings be supported on steel H-piles or pipe piles bearing on bedrock. Bedrock depths encountered during the explorations indicate that the pile lengths will range from approximately 103 feet to 108 feet. The first floor slab can be supported on grade (Section 5.2).

We recommend that steel piles be designed and installed in accordance with the International Building Code 2015 (IBC 2015), Section 1810. The designed piles should be verified with a WEAP analysis to ensure that compressive driving stresses do not exceed the allowable capacity of the piles. To ensure that the pipe piles can be properly driven through potential obstructions in the fill, such as timber cribbing, we recommend that all piles be capped with a steel conical tip (if pipe piles are used) or a steel driving shoe (if H-piles are used) welded to the end of the pile. The piles can be designed using the soil parameters from the Table below:

PILE DESIGN PARAMETERS		
Parameter	**Existing Fill**	**Native Silt/Clay**
Moist unit weight	120 pcf	108 pcf
Undrained Shear Strength (i.e. cohesion)	0 psf	300 psf + 12psf/ft depth*
Effective friction angle	25^0	0^0
Earth Pressure Coefficient (compression)	1.00	1.00
Earth Pressure Coefficient (tension)	0.70	0.70
Lateral Modulus	300 kcf	150 kcf
Friction Factor (steel and soil)	0.25	0.20

* We recommend that the cohesion for the native silt/clay described above be taken as either 300 psf at the top of the layer with an added 12 psf per foot of depth, or taken as 600 psf throughout the entire layer.

5.1.1 Lateral Support

Once the pile type and diameter have been determined, the allowable lateral load should be established. We recommend that the allowable lateral capacity of the installed piles be taken as a maximum of 3 tons per pile, but may be less for smaller diameter piles. All soil within a 3 foot width beyond the edge of the pile in all directions should be proofrolled with a minimum of 4 passes in each of two perpendicular directions with a 5-ton (operating weight) vibratory roller.

We recommend that piles within a pile group be spaced at a minimum of 4 times the diameter of the pile center to center. We further recommend that piles within a pile group which are spaced parallel to the direction of horizontal loading should be spaced at a minimum of 6 times the diameter of the pile center to center. Piles spaced closer than this will result in overlapping stress distributions in the soil and cause lateral capacity to be reduced.

Lateral capacity can also be developed by the soil resistance against the pile caps and grade beams. If the lateral deflection of the pile cap or grade beam is greater than 0.005 feet per foot of grade beam/pile cap depth, the passive resistance of the soil will be mobilized. We recommend that the allowable lateral capacity of the soil against pile caps and grade beams be taken as 375 psf per foot of depth perpendicular to the lateral force applied (passive equivalent fluid pressure) for this condition. If lateral deflections are less than 0.005 feet per foot of depth, we recommend an allowable lateral capacity of 70 psf per foot of depth (at-rest equivalent fluid pressure) for this condition. These soil resistances assume that Foundation Backfill (FB, Section 5.3) is compacted to 95 percent of its maximum dry density, determined in accordance with ASTM D1557, and that the design moist unit weight of the soil is a minimum of 130 pounds per cubic foot (pcf).

Pile Cap and Grade Beam Lateral Resistance	
Lateral Deflection	**Lateral Soil Resistance**
< 0.005 ft/ft of depth	70 psf/ft of depth
> 0.005 ft/ft of depth	375 psf/ft of depth

5.1.2 Corrosion Protection

Due to the various composition of the upper fill soil, the potential presence of corrosive material, and the presence of salt water, we recommend that corrosion resistance measures be taken to protect the long-term integrity of the piles. In the order of preference, these measures include:

- If pipe piles are used, filling the piles with concrete
- Increasing the size of the steel pile to account for area loss over time
- Coating the pipe pile with a corrosion inhibitor

To increase the corrosion protection, more than one of the above mentioned methods can be used. The corrosion rate of an uncoated steel pipe pile is estimated to be in the order of 0.002 in/year.

5.1.3 Uplift Resistance

We recommend that the uplift capacity of the H-piles or pipe piles be taken as the cohesion of the silty clay multiplied by the surface area of the pile embedded in the native silty clay. Additional uplift capacity includes the dead weight of the pile, pile cap, soil above the pile cap, and friction of the mobilized soil. We recommend that a factor of safety of 2.5 be used in the cohesion uplift capacity and the soil friction and a factor of safety of 1.0 be used for all of the dead weight calculations. If needed, a viable way to increase the uplift capacity is by increasing the size of the pile cap and the volume of soil above the pile cap.

5.1.4 Pile Splices

We anticipate that pile splices will be required for the installed piles. The design of all pile splices should be in accordance with IBC 2015 Section 1810.3.6.

5.2 Slabs on Grade

We understand that the first floor of the new building will likely consist of office space or similar use. We have assumed that the finish floor elevation will approximately match the existing finish floor elevation and that entire floor area will be heated. The subgrade encountered in the explorations consisted of silty sand, sandy silt, and silty clay underlain by clay and silt fill and timber cribbing. To accommodate for potential long-term settlement occurring from soil migration into the timber cribbing and to mitigate pavement/slab cracking from differential settlement caused by localized soft areas, we recommend that slabs in heated areas be constructed on a minimum of 24” of compacted Structural Fill (SF, see table below for gradation requirements) overlying a non-woven geotextile (Mirafi 1160N or equivalent) placed on proofrolled subgrade. For slabs in unheated areas, the thickness of SF should be increased to 30.” The geotextile should span the entire building footprint and be extended a minimum of 3 feet beyond the edge of the building footprint in all directions.

All soil exposed in the excavation below the SF and geotextile should be proofrolled with a minimum of 4 passes in each of two perpendicular directions with a 10 ton minimum (operating weight) roller set on static mode. The excavation should be completely dewatered. Any exposed soft or unsuitable soil should be removed and replaced with ¾” crushed stone. SGS should be retained to perform a subgrade inspection before the placement of the subgrade geotextile layer.

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

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

The maximum particle size should be limited to 4 inches. Structural Fill should be placed in 6 to 12 inch lifts and should be compacted to a minimum of 95% of its maximum dry density, determined in accordance with ASTM D1557.

For the conditions described above, the slab can be designed using a subgrade modulus value of 150 pci.

5.3 Frost Protection and Foundation Backfill

Based on a 10-year design air freezing index of 1,200 degree F days for the Portland, Maine region, the bottom of all pile caps, grade beams, and foundation walls exposed to freezing temperatures should be constructed at a minimum depth of 4 feet below finish exterior grade. We recommend that these elements be backfilled with Foundation Backfill (FB). The portion of FB passing the 3” sieve size should meet the following gradation requirements:

FOUNDATION BACKFILL (FB)	
Sieve Size	**Percent finer**
3 inch	100
¼ inch	25 to 100
No. 40	0 to 50
No. 200	0 to 7

Reference: MDOT Specification 703.06, Type E

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 bottom of pile caps, grade beams, and footings in heated areas should be constructed at a minimum of 2 feet below finish floor elevation.

5.4 Non-Bearing Foundation Walls

We recommend that all load bearing foundation walls and columns for the new building be supported by deep foundations. However, non-bearing foundation walls can be constructed directly on the existing soil. Assuming the subgrade preparation recommendations outlined in Section 5.2 are followed, non-bearing foundation walls can be proportioned using an allowable bearing capacity of 1,000 psf.

Exterior walls exposed to freezing temperatures should be constructed at a minimum depth of 4 feet below finish grade. We recommend that all exposed native soils beneath constructed walls be proofrolled with a minimum of 4 passes with a walk behind plate compactor. Soft, wet, or unsuitable soils should be removed and replaced with compacted SF or ¾” crushed stone. Walls should be backfilled using FB placed in accordance with the methods outlined in Section 4.3.

5.5 Seismic Site Class and Design Criteria

Based on shear wave velocity measurements collected during the CPT on the adjacent site and laboratory testing on collected samples, the site classifies as Site Class E “soft clay soil” in accordance with the 2012 International Building Code. The following seismic site coefficients should be used:

SEISMIC DESIGN COEFFICIENTS	
Seismic Coefficient	**Site Class E**
Short period spectral response (S_S)	0.240
1 second spectral response (S_1)	0.078
Maximum factored spectral response (S_{MS})	0.601
1 second factored spectral response (S_{M1})	0.273
Design short period spectral response (S_{DS})	0.401
Design 1 second spectral response (S_{D1})	0.182

5.6 Groundwater Considerations

Based on an approximate finish floor elevation of 8.5 feet, a 4 foot required frost depth, and a highest annual tide of 6.5 feet, we anticipate that groundwater levels may be periodically at or above the bottom of footing and grade beam elevation. Accordingly, we recommend that perimeter underdrains be constructed around all of the foundation walls and grade beams. Underdrains should consist of 6-inch diameter, perforated PVC pipe surrounded by a minimum of 6 inches of crushed stone wrapped in filter fabric. The underdrains should be placed at the base of the foundation and outlet to a free draining location or pumped if necessary. An alternative to installing underdrains is to design the pile caps and grade beams with an uplift pressure computed based on a groundwater elevation of 6.5 feet.

5.0 Testing and Field Monitoring Recommendations

All piles should be installed to an ultimate capacity equal to the allowable axial capacity multiplied by a factor of safety of 2.5. To ensure that this capacity is developed, and to avoid over-stressing of the installed piles, we recommend dynamic pile testing (PDA) be performed on select piles in accordance with ASTM D4945. If desired, the piles can be designed with a maximum allowable capacity of 40 tons to preclude the need for PDA testing.

We recommend that a detailed pile-driving log for each pile be performed and reviewed to evaluate pile installation and consistency. The contractor or a qualified technician can record the pile-driving logs. If the contractor is selected to record the pile driving logs, we recommend that SGS review the logs and verify that the piles are being installed within the design recommendations.

We recommend that the skin friction values generated by the compressive load test (ASTM D4945) be evaluated to verify the field uplift capacity.

Field testing for lateral pile capacity is not required.

6.0 Construction Considerations

All existing foundation elements and slab/asphalt should be removed in its entirety from within the building footprint. We understand that the foundation type of the existing structure is unknown. If it is a shallow frost wall on spread footing foundation, the entire frost walls and footings should be removed. If the foundation includes piles, the foundation walls, pile caps, and grade beams should be removed and piles should be cut to allow for the placement of the geotextile below the 24” Structural Fill layer below the slab.

If the foundation for the existing building includes piles, consideration should be given to avoid interference between the new piles and the existing piles.

Based on the groundwater levels observed from our explorations, we anticipate that groundwater will be encountered within the foundation and slab excavations during high tide periods. We believe that dewatering can be accomplished relatively easily by conventional shallow sumps. Diversion and control of surface water should be performed to prevent water flow from adjacent wet areas or from rain or snowmelt from entering the excavations.

All exposed native soil which will be load bearing (under slabs, pile caps, and grade beams) should be proofrolled with a minimum of 4 passes in each of two perpendicular directions with a 5-ton (operating weight) vibratory roller.

General excavations within the silty clay soil, if encountered, will be susceptible to softening when wet. If subgrade softening does occur, we recommend over excavation and replacement with a minimum of 6 inches of ¾” crushed stone. The placed crushed stone should be compacted with a minimum of 4 passes with a walk-behind plate compactor.

Although unanticipated, excavations deeper than 4 feet should be sloped no greater than 1.5H to 1V. These slopes are based on the current OSHA Excavation Guidelines.

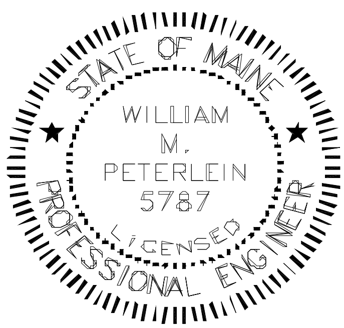
7.0 <u>Closure</u>

Our recommendations are based on professional judgment and generally accepted principles of geotechnical engineering. Some changes in subsurface conditions from those presented in this report may occur. Should these conditions differ materially from those described in this report, SGS should be notified so that we can re-evaluate our recommendations. Furthermore, SGS should be notified should pile material change, expected fill height increase, or pile refusal is encountered more than 20 feet deeper or shallower than elevation -105 feet.

Building foundation loads were not available for this report. Once the foundation (and slab) loads have been determined, SGS should be notified so we can confirm the recommendations in this report are valid.

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,
Summit Geoengineering Services, Inc.

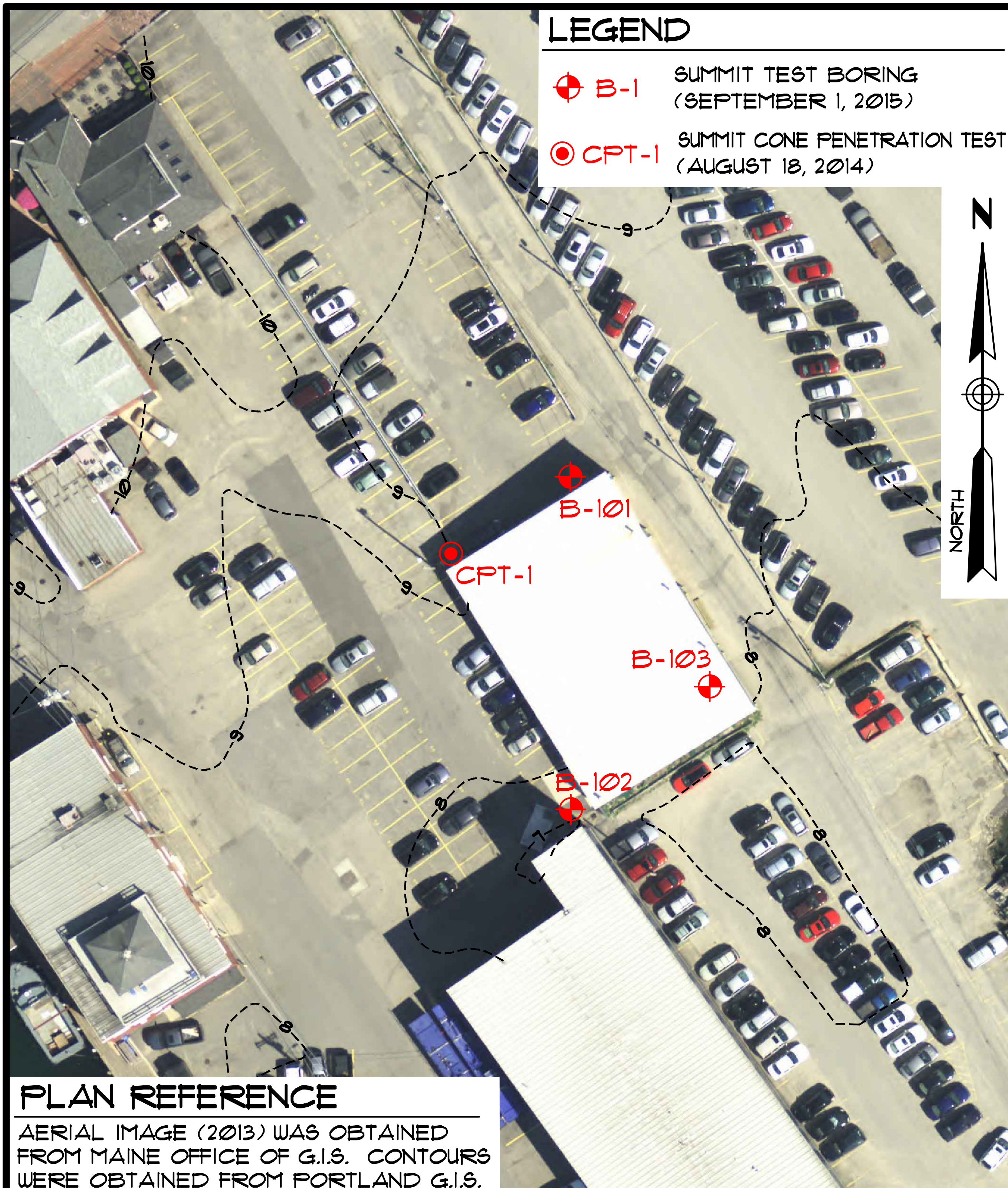


Mathew Hardison, EI
Geotechnical Engineer

William M. Peterlein, PE
Principal Geotechnical Engineer

APPENDIX A

EXPLORATION PLAN



PLAN REFERENCE

AERIAL IMAGE (2013) WAS OBTAINED FROM MAINE OFFICE OF G.I.S. CONTOURS WERE OBTAINED FROM PORTLAND G.I.S.

TEST BORING LOCATION PLAN
PROPOSED OFFICE BUILDING

UNION WHARF - PORTLAND, MAINE

PREPARED FOR

PROPRIETORS OF UNION WHARF

DATE: 9-3-2015	DRAWN BY: KRF	CHECKED BY: WMP
JOB: 15167	SCALE: 1" = 50'	FILE: 15167 BOR

145 LISBON ST. - SUITE 601
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APPENDIX B

EXPLORATION 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

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

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		

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SOIL BORING LOG

Project:	New Office Building	Boring #:	**B-101**
Location:	16 Union Wharf	Project #:	15167
City, State:	Portland, Maine	Sheet:	1 of 2
		Chkd by:	

Drilling Co:	Summit Geoengineering Services	Boring Elevation:	8.5 ft. +/-
Driller:	C. Coolidge, P.E.	Reference:	City of Portland GIS countour mapping
Summit Staff:	M. Hardison, E.I.	Date started: 9/1/2015	Date Completed: 10/6/2015

DRILLING METHOD		SAMPLER	
Vehicle:	Tracked	Length:	24" SS
Model:	AMS Power Probe	Diameter:	2"OD/1.5"ID
Method:	3" Casing	Hammer:	140 lb
Hammer Style:	Auto	Method:	ASTM D1586

ESTIMATED GROUND WATER DEPTH

Date	Depth	Elevation	Reference
9/1/2015	5.5 ft	3.0 ft.	4.5' of casing in hole, 10:00 am

Depth (ft.)	No.	Pen/Rec (in)	Depth (ft)	blows/6"	N_{60}	SAMPLE DESCRIPTION	Geological/ Test Data	Geological Stratum
						3" Pavement Surface, crumbly and poor condition		PAVEMENT
1	S-1	24/8	0.5 to 2.5	8		Olive Silty CLAY, stiff, humid, CL	PP = 4,000 psf	
				8				
2				5				FILL
				9		Brown Gravelly SILT, little Sand, dry to humid, loose,		
3	S-2	24/2	2.5 to 4.5	6		ML		
				6				
4				6		same as above, cobble piece in spoon tip		
				6				
5	S-3	24/6	4.5 to 6.5	6		Brown Gravelly SAND, little to some Silt, humid, loose,		
				2		brick fragment, SM	Groundwater	
6				2				
				1			PP < 500 psf	
7	S-4	24/20	6.5 to 8.5	2		Olive gray Silty CLAY, frequent black streaking, soft,		
				3		occasional wood pieces, white Ash in spoon tip, wet, CL		
8				9				
				3				
9	S-5	24/24	8.5 to 10.5	1		same as above, occasional shells, no ash, angular rock		
				1		fragments in spoon tip		
10				1				
				12				
11	S-6	24/12	10.5 to 12.5	21*		same as above	PP < 500 psf	
				10		*driller remark: blow count may be due to timber		
12				8		cribbing		
				4		Black ASH, little gray Gravel and Silt, petroleum odor		
13	S-7	24/16	12.5 to 14.5	2		Gray Clayey SILT, trace Sand and Gravel, wet, very		
				1		loose, SM		MARINE SEDIMENTS
14				3				
				2				
15	S-8	24/24	14.5 to 16.5	2		same as above, frequent wood pieces		
				2			PP < 500 psf	
16				2				
				2				
17	S-9	24/24	16.5 to 18.5	1		Gray Clayey SILT, trace Sand, wet, very loose, organic		
				2		odor, frequent shell pieces, ML		
18				3				
				3				
19	S-10	24/24	18.5 to 20.5	2		same as above		
				3				
20				2				
				3				
21	S-11	24/24	20.5 to 22.5	1		same as above, some fine Sand seams		
				3				
22				3				
				3		Gray Silty CLAY, wet, soft to stiff, CL	PP = 4,000 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

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-101
Project:	New Office Building	Project #:	15167
Location:	16 Union Wharf	Sheet:	2 of 2
City, State:	Portland, Maine	Chkd by:	

Drilling Co:	Summit Geoengineering Services	Boring Elevation:	8.5 ft. +/-
Driller:	C. Coolidge, P.E.	Reference:	City of Portland GIS countour mapping
Summit Staff:	M. Hardison, E.I.	Date started: 9/1/2015	Date Completed: 10/6/2015

DRILLING METHOD		SAMPLER	
Vehicle:	Tracked	Length:	24" SS
Model:	AMS Power Probe	Diameter:	2"OD/1.5"ID
Method:	3" Casing	Hammer:	140 lb
Hammer Style:	Auto	Method:	ASTM D1586

ESTIMATED GROUND WATER DEPTH			
Date	Depth	Elevation	Reference
9/1/2015	5.5 ft	3.0 ft. +/-	4.5' of casing in hole, 10:00 am

Depth (ft.)	No.	Pen/Rec (in)	Depth (ft)	blows/6"	N_{60}	SAMPLE DESCRIPTION	Geological/ Test Data	Geological Stratum
21						sample from 20.5 feet to 22.5 feet (see previous log for sample information)		
22								MARINE SEDIMENT
						Gray Silty CLAY, wet, soft to stiff, CL		
23				PROBE				
24						Attempted Field Vane at 24' depth, could not push past 23.5'. Failed field vane attempted at 23.5', (maximum reading of 50 ft-lbs, no shearing occurred, likely sand seam)		
25								
26								
27						Probed with vibrated speartip		
28								
						Note: Future probe will be advanced to refusal		
103								
								BEDROCK

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

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

Project:	New Office Building	Boring #:	**B-102**
Location:	16 Union Wharf	Project #:	15167
City, State:	Portland, Maine	Sheet:	1 of 1
		Chkd by:	

Drilling Co:	Summit Geoengineering Services	Boring Elevation:	7.5 ft. +/-
Driller:	C. Coolidge, P.E.	Reference:	City of Portland GIS countour mapping
Summit Staff:	M. Hardison, E.I.	Date started: 9/1/2015	Date Completed: 9/1/2015

DRILLING METHOD		SAMPLER		ESTIMATED GROUND WATER DEPTH			
Vehicle:	Tracked	Length:	24" SS	Date	Depth	Elevation	Reference
Model:	AMS Power Probe	Diameter:	2"OD/1.5"ID	9/1/2015	5.0 ft	2.5 ft. +/-	casing pulled, 2:10 pm
Method:	3" Casing	Hammer:	140 lb				
Hammer Style:	Auto	Method:	ASTM D1586				

Depth (ft.)	No.	Pen/Rec (in)	Depth (ft)	blows/6"	N_{60}	**SAMPLE DESCRIPTION**	Geological/ Test Data	Geological Stratum
						5.5" Pavement Surface, crumbly and poor condition		PAVEMENT
1	S-1	24/6	0.5 to 2.5	8		Dark brown to black Sandy SILT, little Gravel, trace Clay,		
				5		loose, Clay in spoon tip, SM		
2				3				FILL
				2				
3	S-2	24/5	2.5 to 4.5	2		Olive gray Clayey SILT, large brick fragment at 4' depth,		
				2		wood (decomposed) pieces, humid, loose, ML	PP < 500 psf	
4				4				
				4				
5	S-3	24/10	4.5 to 6.5	3		same as above, little black Ash, few brick pieces, black	Groundwater	
				4		staining from Ash		
6				6				
				5				
7	S-4	24/10	6.5 to 8.5	5		same as above, wet, slight petroleum odor		
				5				
8				5				
				5				
9	S-5	24/12	8.5 to 10.5	5		Black Sandy SILT, little to some black Ash, occasional		
				3		brick fragments, wet, trace white Ash and Clay, ML		
10				3				
				5				
11	S-6	24/16	10.5 to 12.5	3		same as above, slight petroleum odor		
				3				
12				5				
				5				
13	S-7	24/14	12.5 to 14.5	2		same as above, increasing petroleum odor and white		
				7		Ash content		
14				7				
				13				
15	S-8	24/12	14.5 to 16.5	2		Black Sandy SILT, little black and white Ash, trace Clay,		
				3		wood pieces, ML		
16				4				
				3				
17	S-9	24/24	16.5 to 18.5	2		Gray Clayey SILT, little to some Sand, very soft to		
				3		soft, wet, ML		
18				2				MARINE SEDIMENTS
				3				
19	S-10	24/24	18.5 to 20.5	3		same as above, wood and shells, strong organic odor		
				5				
20				5				
				5				
				PROBE		Probed ahead with vibrated speartip		
						Note: Future probe will be advanced to refusal		
80								
						End of Probe at 80', no refusal		

Granular Soils		Cohesive Soils		% Composition	NOTES:	Soil Moisture Condition
Blows/ft.	Density	Blows/ft.	Consistency	ASTM D2487	PP = Pocket Penetrometer, MC = Moisture Content LL = Liquid Limit, PI = Plastic Index	Dry: S = 0%
0-4	V. Loose	<2	V. soft		Bedrock Joints	Humid: S = 1 to 25%
5-10	Loose	2-4	Soft	< 5% Trace	Shallow = 0 to 35 degrees	Damp: S = 26 to 50%
11-30	Compact	5-8	Firm	5-15% Little	Dipping = 35 to 55 degrees	Moist: S = 51 to 75%
31-50	Dense	9-15	Stiff	15-30% Some	Steep = 55 to 90 degrees	Wet: S = 76 to 99%
>50	V. Dense	16-30	V. Stiff	> 30% With		Saturated: S = 100%
		>30	Hard		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

Project:	New Office Building	Boring #:	**B-103**
Location:	16 Union Wharf	Project #:	15167
City, State:	Portland, Maine	Sheet:	1 of 1
		Chkd by:	

Drilling Co:	Summit Geoengineering Services	Boring Elevation:	8.0 ft. +/-
Driller:	C. Coolidge, P.E.	Reference:	City of Portland GIS countour mapping
Summit Staff:	M. Hardison, E.I.	Date started: 9/1/2015	Date Completed: 10/6/2015

DRILLING METHOD		SAMPLER	
Vehicle:	Tracked	Length:	24" SS
Model:	AMS Power Probe	Diameter:	2"OD/1.5"ID
Method:	3" Casing	Hammer:	140 lb
Hammer Style:	Auto	Method:	ASTM D1586

ESTIMATED GROUND WATER DEPTH

Date	Depth	Elevation	Reference
9/1/2015	2.7 ft	5.3 ft. +/-	5' casing in hole, 3:30 pm

Depth (ft.)	No.	Pen/Rec (in)	Depth (ft)	blows/6"	N_{60}	SAMPLE DESCRIPTION	Geological/ Test Data	Geological Stratum
						5" Asphalt Surface, fair to good condition		ASPHALT
1	S-1	24/6	0.5 to 2.5	8		Light tan Silty SAND, little Gravel, humid, compact, SM		
				9				
2				13				FILL
				11		Dark gray to brown Sandy SILT, trace Clay and Gravel,		
3	S-2	24/5	2.5 to 4.5	7		humid, ML	Groundwater	
				6				
4				5		same as above		
				3		5" Olive Silty CLAY, slight black streaking, slight	PP = 3,000 psf	
5						petroleum odor, intermixed Sand and Gravel, CL	to 6,000 psf	
	S-3	24/10	5 to 7	9		Light brown Gravelly SILT, wet, trace Clay and Sand,		
6				4		compact, ML		
				8				
7				8		same as above, timber pieces in spoon tip (likely timber		
	S-4	24/6	7 to 9	5		cribbing)		
8				50/5				
						Refusal on likely timber cribbing, offset hole 1' and		
9						drove casing to 10' depth:		
10								
	S-5	24/16	10 to 12	4		Light brown Silty fine to medium SAND, wet, loose, SM		
11				3				
				4				
12				1		Black SILT, little to some black Ash, trace Clay, wet,		
	S-6	24/10	12 to 14	1		black Ash in spoon tip, slight petroleum odor, ML		
13				2				
				4		same as above, little Sand, strong petroleum odor		
14				2				
15								
	S-7	24/24	15 to 17	WH		Olive gray Silty CLAY, little intermixed Sand, frequent		MARINE SEDIMENT
16				WH		wood pieces, strong organic odor, wet, very soft, CL		
				WH				
17				WH				
18				PROBE				
19								
20								
107								
108								
						End of Probe at 108', refusal on likely Bedrock		BEDROCK

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
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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
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Bedrock Joints
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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

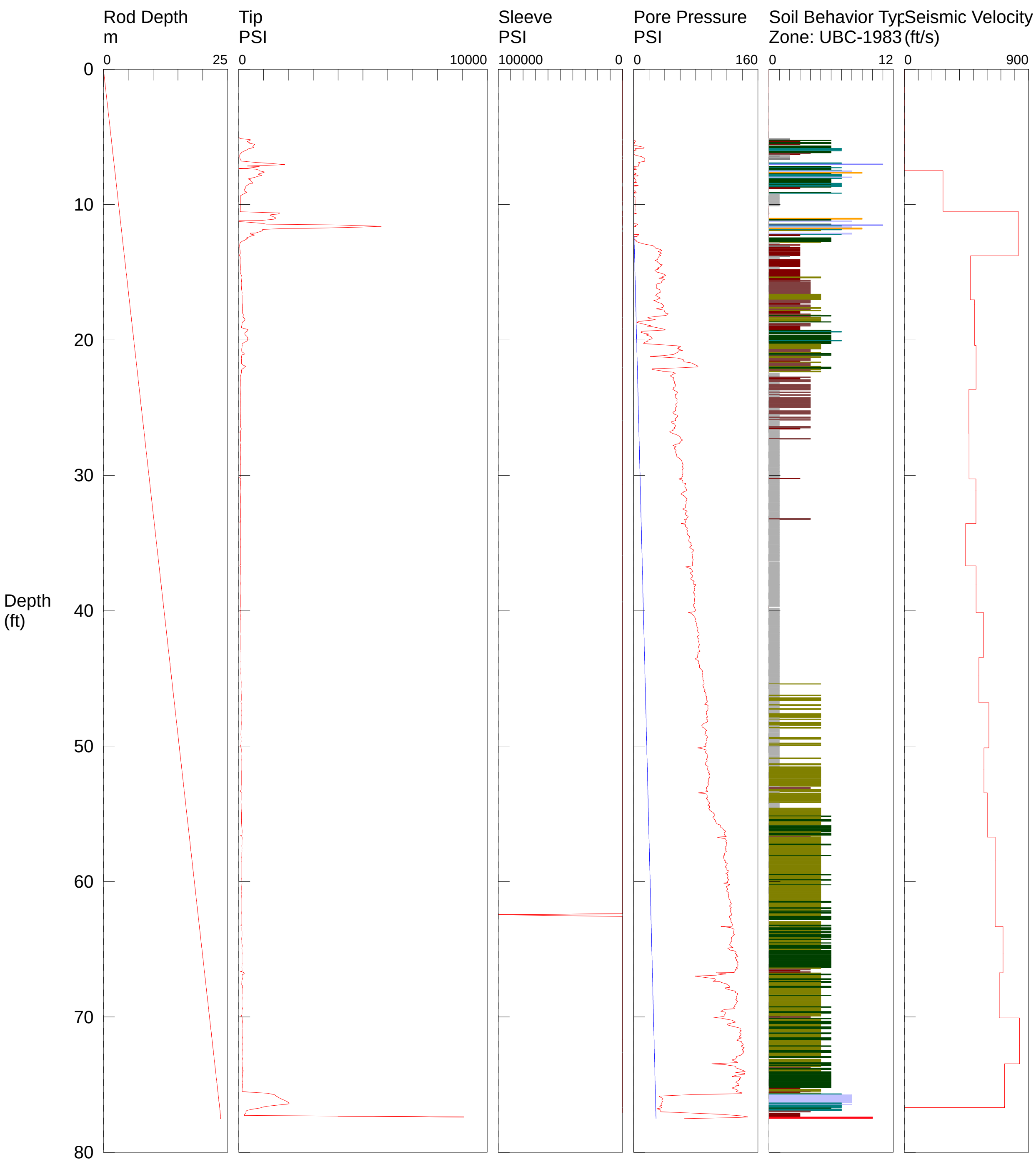
Soil Moisture Condition
Dry: S = 0%
Humid: S = 1 to 25%
Damp: S = 26 to 50%
Moist: S = 51 to 75%
Wet: S = 76 to 99%
Saturated: S = 100%

Widgery Wharf

COMPANY: Summit Geoengineering Services
FILENAME:
TEST ID: cpt1
PROJECT: 14137
SITE: Widgery Wharf

LOCATION: cpt1
OPERATOR: C. Coolidge, P.E.
CREW: B. Peterlein, P.E.
CLIENT: Archetype
CLIENT REP:

TEST DATE: Mon 18/Aug/2014
START TIME: 14:54:28
GPS: 0, 0, 0, 0, 0
WEATHER: CLEAR



COMMENTS:

1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

APPENDIX C

LABORATORY TEST RESULTS

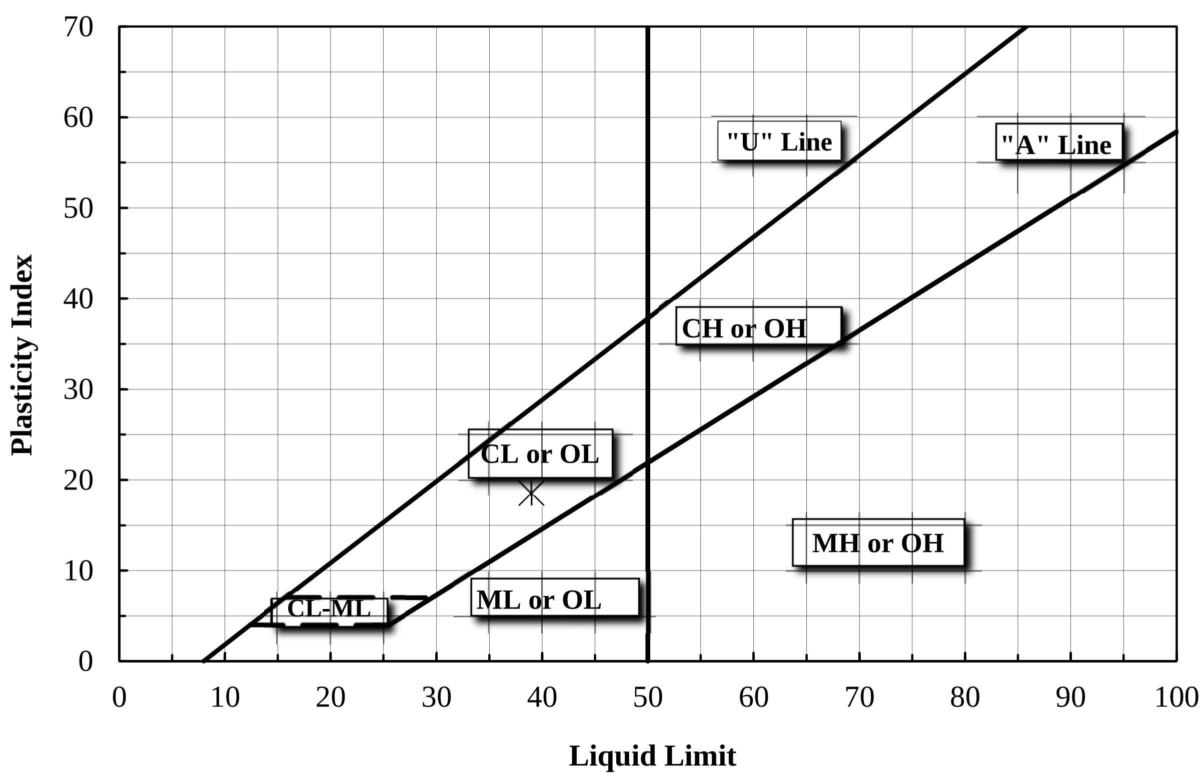
ATTERBERG LIMIT TEST - ASTM D4318

Method "A" (Multi-point)

PROJECT NAME:	Widgery Wharf	PROJECT NUMBER:	14137
CLIENT:	Archetype Architects	SAMPLE NUMBER:	UT-1
SOURCE:	Boring B-2	DEPTH:	20' - 22'
DATE:	8/21/2014	TECHNICIAN:	Erika Hawksley, E.I.

DATA

Source	Depth	LL	PL	PI	Classification
B-2	20' - 22'	39	20	19	Gray Silty CLAY, CL



Notes:

145 Lisbon Street (PO Box 7216), Lewiston, Maine 04243, (207) 576-3313
173 Pleasant Street, Rockland, Maine 04841, (207) 318-7761

Laboratory Determination of Water (Moisture) Content of Soil ASTM D2216 / D4643

PROJECT NAME:	Widgery Wharf	PROJECT #:	14137.0
CLIENT:	Archetype Architects	DRYING METHOD:	Oven Dried
SOURCE:	Boring B-2	DESCRIPTION:	Various Clay Samples
DATE:	8/19/2014	TECHNICIAN:	Erika Hawksley, E.I.

Location	Sample No.	Depth	Moisture Content	Remarks
B-2	S-3	5' - 7'	24.5%	
B-2	S-4	7' - 9'	25.1%	
B-2	S-7	15' - 17'	58.8%	Organic particles & odor
B-2	S-8	17' - 19'	54.8%	Organic particles & odor
B-2	S-9	25' - 27'	38.8%	

REMARKS:

145 Lisbon Street (PO Box 7216), Lewiston, Maine 04243, (207) 576-3313
173 Pleasant Street, Rockland, Maine 04841, (207) 318-7761