SUMMIT
GEOENGINEERING SERVICES

GEOTECHNICAL REPORT

Bayside Bowl Addition
71 Hanover Street
Portland, Maine

Prepared for:

BOPO, LLC
58 Alder Street
Portland, Maine 04101

Prepared by:

Summit Geoengineering Services
145 Lisbon St.
Lewiston, Maine

Project #15285
January 2016

SUMMIT
GEOENGINEERING SERVICES

January 21, 2016
SGS #15285

Dale Akeley
BOPO, LLC
58 Alder Street
Portland, Maine 04101

Reference: Geotechnical Report, Proposed Bayside Bowl Building Addition
71 Hanover Street, Portland, Maine

Dear Dale;

Summit Geoengineering Services, Inc. (SGS) has completed a geotechnical investigation for the proposed building addition at the site referenced above. Our scope of services included the drilling of 2 borings and one cone penetration test (CPT) within the proposed addition footprint, performing laboratory testing on collected samples, and preparing this geotechnical report summarizing our findings and providing geotechnical recommendations.

Ransom Consulting, Inc. performed subsurface explorations at this site in 2015 for the construction of the proposed addition and furnished a report titled "Geotechnical Engineering Report, Proposed Bayside Bowl Addition, 71 Hanover Street, 138 Kennebec Street, and Portions of 58 Alder Street" dated April 8, 2005. We have included some data (primarily refusal depth and strata change depths) into our analysis.

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

We understand that the project consists of a new addition on the west side of the Bayside Bowl facility at the site referenced above. The addition will attach to the west side of the existing building, consist of 2 stories with a roof deck, and have a footprint of approximately 14,000 square feet. We understand that the finish floor elevation of the lower slab area is approximately elevation 12.5 feet, at or near the existing ground surface.

The project site is located at 58 Alder Street in Portland, Maine and is bordered by Kennebec Street to the north, Hanover Street to the west, Lancaster Street to the south, and the existing Bayside Bowl facility to the east. The site was the previous location of the sand/salt storage for

the City of Portland public works. Currently, the site is a parking lot for Bayside Bowl. The site is paved and relatively flat, with grades ranging from approximately elevation 11 feet to 13 feet, increasing in elevation in a southerly direction. Cut/fill for the construction of the addition is anticipated to be 12" or less.

Preliminary structural loads provided to us by Structural Integrity, Inc. for the new addition is as follows:

Interior Columns = Ranges from 15 kips to 110 kips
Exterior Columns = Ranges from 10 kips to 75 kips

2.0 Exploration and Laboratory Testing

2.1 Exploration

SGS observed the subsurface conditions at the site with the drilling of 2 borings and 1 cone penetration test (CPT) on January 6 and 7, 2016. All explorations were performed by SGS using a Power Probe 9500-VTR tracked drill rig. Two of the explorations (B-1 and CPT-1) were drilled to refusal, ranging in depth from 44.0 feet to 52.1 feet below ground surface. The third boring (B-2) was terminated at a sand seam encountered at 26.3 feet depth.

The two borings were advanced using 3" diameter steel casing. During the borings, split spoon sampling was conducted in general accordance with ASTM D1586 to collect blow counts and soil samples. In situ field vane shear testing was performed in Boring B-2, starting at 13' depth, at 1 to 2 foot intervals using a vane with a diameter of 2" and a height of 4.3." Additionally, three Shelby tubes were collected in the silty clay during Boring B-1 at depths 15 feet, 20 feet, and 25 feet below existing ground surface for subsequent laboratory testing.

A Cone Penetration Test (CPT) was performed to determine the thicknesses of the subsurface layers and obtain engineering properties of the clay. CPT-1 was advanced to a depth of 52.1 feet below ground surface where refusal was encountered. The CPT was performed with a single point hollow stem anchor set to a depth of 5 feet. CPT-1 was performed using a Vertek 5 ton digital cone pushed at a constant rate (2 cm/s). Parameters obtained included cone resistance (q_c), sleeve friction (f_s), and piezocone pore pressure (u), and shear wave velocity (V_s). A dissipation test was performed at a depth of 16' to obtain drainage properties.

The locations of the borings and CPT were marked by SGS prior to the day of drilling by measuring from existing landmarks. These locations can be seen in the SGS Exploration Plan in Appendix A. A copy of the Boring Logs, Cone Log, and dissipation test can be found in Appendix B.

2.2 Laboratory Testing

Moisture content (*ASTM D4634*), Atterberg Limit (*ASTM D4318*), and one-dimensional consolidation (*ASTM D2435*) tests were performed by SGS on selected clay samples collected from Borings B-1 and B-2. Index testing of the clay is summarized in the table below:

LABORATORY TESTING SUMMARY							
Boring	**Sample**	**Description**	**Depth (ft)**	**Moisture**	**LL**	**PI**	**USCS**
B-1	S-3B	Soft Clay	10.9' – 12.0'	38.9%	-	-	CL
B-1	UT-1	Soft Clay	17'	44.4%	47	23	CL
B-1	UT-2	Soft Clay	22'	34.9%	-	-	CL
B-1	UT-3	Soft Clay w/ Sand Seams	27'	28.0%	-	-	CL
B-2	S-1	Clay & Sand	5' – 7'	35.8%	-	-	CL
B-2	S-2	Stiff Clay w/ Trace Sand	10' – 12'	32.5%	-	-	CL

Moisture = Existing water content, LL = Liquid Limit, PI = Plasticity Index, USCS = Unified Soil Classification System, CL = Lean Clay

The one-dimensional consolidation test was performed on the Shelby Tube sample collected at a depth of 15 feet from Boring B-1. The test indicated the following consolidation properties of the tested specimen.

Preconsolidation Pressure (σ'_p) = **3,300 psf**
Recompression Index (C_r) = **0.06**
Virgin Compression Index = (C_c) = **0.66**

Detailed results of the laboratory tests are included in Appendix C.

3.0 Subsurface Conditions

3.1 Soil

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

- Pavement, 3 to 4 inches
- Fill, 5 feet to 7 feet
- Glacial Marine, 18 feet to 26 feet
- Glacial Till, 21 feet
- Bedrock/Dense Refusal, 44.0 to 52.1 feet depth

3.1.1 Pavement. The pavement at the site ranges in thickness from 3" to 4"

3.1.2 Fill. The fill layer was encountered in all of the borings at the site and is described as dark brown to black silty sand with little to some gravel. Black ash, white ash, and brick fragments were present throughout most of the fill layer. Standard Penetration Number Blow Counts (SPT-N) in the fill ranged from 7 to 11 with an average of 9 blows per foot (bpf). The fill is dry to humid, loose to compact, and terminates at approximately 5 to 7 feet below ground surface. A very strong petroleum odor was omitted from the recovered CPT rods in this layer. Ransom

reported encountering a very soft layer within the fill at 5 feet to 7 feet depth where the split spoon sample was advanced by only the weight of hammer. Based on the findings from our boring explorations, there is a significant amount of non-granular and potentially marginal foundation bearing material in the fill layer, which will require subgrade improvements. The fill classifies as SM or SP-SM in accordance with the Unified Soil Classification System.

3.1.3 Glacial Marine Soil. The glacial marine soil was encountered from 5 to 7 feet below ground surface in all of the borings and can be split into two sub-layers.

The upper sub-layer is approximately 4 to 6 feet thick and is described as olive brown to gray stiff silty clay or sand with trace to no gravel, little to some silt, and no to some clay. This upper sub-layer directly underlies the fill, and terminates at the start of the soft clay layer. It is mottled, damp to wet, very loose to firm, and ranges in pocket penetrometer measurements (a rough estimate of unconfined compressive strength) from 1,000 psf to 2,500 psf. SPT-N values in this layer range from 1 to 4 and averages 2 bpf. This layer classifies as CL, SP, or SP-SM in accordance with the Unified Soil Classification System.

The lower sub-layer is approximately 18 feet to 22 feet thick and is described as gray silty clay with occasional fine sand and silt seams. It is wet, very soft, and has pocket penetrometer measurements ranging from 1,000 psf to less than 500 psf. Laboratory testing from collected split spoon samples and Shelby tube sample in the clay resulted in moisture contents ranging from 28.0% to 44.4% (generally increasing with depth), a Liquid Limit of 47, and a Plasticity Index of 23. Field vane shear testing results in this layer range from 475 psf to 775 psf. It classifies as CL in accordance with the Unified Soil Classification System.

3.1.4 Glacial till. Glacial till was encountered in the borings ranging from 29 feet to 33 feet below existing ground surface and extended to refusal at 44.0 feet to 52.1 feet. Samples of the glacial till were not recovered during the explorations, but based on the probe resistance and CPT classification it is presumed to be relatively dense and granular soil.

3.2 Groundwater

On the day of the explorations, groundwater depth was measured to range from 7.0 feet to 8.2 feet below ground surface (approximate elevation of 6.0 feet to 3.8 feet). Elevations are based on interpolation from the City of Portland GIS contours. Mottling of the silty clay at 5’ – 7’ depth in Boring B-2 indicates that the groundwater elevation at the site may rise seasonally or during wet periods.

3.3 Bedrock

Presumed bedrock was encountered at the site ranging from 44.0 feet to 52.1 feet below existing ground surface. Previous explorations by Ransom encountered refusal (presumed bedrock) at 35 to 39 feet below surface. We believe that this was likely the top of the dense glacial till layer and bedrock is slightly deeper than this, closer to 45 to 55 feet. Based on the explorations, bedrock appears to slope slightly downwards in a westerly direction. 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

There are two primary geotechnical issues for the construction of the addition:

Firstly, the presence of soft, silty clay at the site poses a risk for total and differential settlement of the addition when stressed by the building loads. Settlement of the clay will be a combination of elastic (immediate) settlement, and consolidation (time-dependent) settlement. The magnitude of settlement depends on the building loads, the elevation and size of the footings, and clay properties.

A consolidation analysis of the soft, silty clay layer was performed based on preliminary building loads provided to us. It should be noted that our analysis assumed less than 1 feet of fill throughout the building footprint. Based on a combination of Cone Penetration Test (CPT) measurements, field vane shear test values, and laboratory consolidation testing, we were able to obtain consolidation parameters and "stress history" estimates of the clay deposit. It appears that the clay at the site has been previously loaded, likely either from a previous soil deposit, the sand/salt storage piles, or both. Thus, the settlement of the clay from presumed building loads will remain within tolerable limits.

Secondly, there is a soft and compressible sand/silt/clay layer directly below the fill at the site and extending to the top of the clay layer. While this layer is relatively thin when compared to the extent of the clay, it will be directly beneath any footings and will be subject to high stresses. Some locations of this deposit resulted in Standard Penetration Blow Counts (SPT-N) as low as 1 from our explorations, and Weight of Hammer (approximate value of 0) from the Ransom Explorations.

A settlement analysis of this sand/silt/clay layer was performed based on in situ (current) conditions, and resulted in unacceptable settlement magnitudes. However, if this layer is improved via proofrolling, and the subgrade beneath the footings is improved from the use of crushed stone and geotextile, the estimated settlements are significantly reduced and will remain within tolerable limits.

Assuming that the recommendations presented in this report are followed, the addition can be constructed as a slab-on-grade with conventional shallow footings. Subgrade improvement recommendations are outlined in Section 5.0.

5.0 Foundation Recommendations

5.1. Allowable Bearing Pressure

We recommend that all interior and exterior footings be proportioned using an allowable bearing pressure of 2,000 psf. We anticipate that total settlement of the footings will not exceed 1.2" and

differential settlement will be on the order of 0.002 ft/ft or less. The allowable bearing pressure is based on the following:

- All pavement, topsoil, and other deleterious materials 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 3’ below exterior finish grade, constructed on a minimum of 12” of ¾” crushed stone.
- Exposed soil at the bottom of footing trenches is proofrolled with a minimum of 4 passes with a 5 ton minimum operating weight vibratory roller. Proofrolling should be performed on dry, unfrozen soils. If soft or unsuitable soil is encountered at the bottom of the excavation, it 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.
- All footings, interior and exterior, are constructed on a heavy woven geotextile fabric beneath 12 inches of ¾” crushed stone. Fabric should consist of a woven geotextile with a minimum tensile strength of 1,100 lb/ft at 2% strain (such as Mirafi HP770, or equivalent).
- The geotextile should be extended beyond both edges of continuous footings a distance equal to the width of the footing, on both sides. For isolated footings, the geotextile should be extended a minimum of ½ the footing width beyond all edges.
- Fill placed within the building footprint is limited to a maximum depth of 1 to 2 feet.

It is critical to ensure that the footings are as high up as possible in the soil profile to reduce the load applied to the clay layer. This is accomplished by incorporating the 12” of crushed stone beneath the footings towards the 4’ frost protection depth and constructing the bottom of footing 3’ below finish exterior grade.

Additionally, a vibratory roller is highly recommended for compaction of the subgrade. The required excavation width of geotextile for all of the footings should allow enough area to fit a vibratory roller in the footing excavations.

5.2 Foundation Wall Design Parameters

We recommend the following parameters be used for the foundation design:

PARAMETER	FOUNDATION BACKFILL (Section 5.4)	EXISTING FILL	CRUSHED STONE
Total Natural (moist) Unit Weight (γ_t)	130 pcf [1]	120 pcf	110 pcf
Saturated (buoyant) Unit Weight (γ_s)	68 pcf [1]	58 pcf	48 pcf
Friction Coefficient (f)	0.50	0.50	0.60
Active Earth Pressure Coefficient (K_a)	0.28	0.30	.25
Passive Earth Pressure Coefficient (K_p)	3.57	1.33	4.00
At Rest Earth Pressure Coefficient (K_o)	0.47	0.47	0.38
Uplift Earth Pressure Coefficient (K_u)	0.90	0.93	0.96
Internal Friction Angle (ϕ_c)	32^0 [1]	32^0	38^0
Cohesion (c)	0 psf	0 psf	0 psf

[1] Based on 95% compaction of Foundation Backfill by ASTM D1557, Modified Proctor Test Method

Based on the subgrade preparation recommendations provided in Section 5.1, crushed stone can be assumed to be the soil at the base of the footing and foundation backfill can be assumed to be the soil on the exterior of the foundation wall.

Uplift capacity for the foundation is developed by the weight of the foundation, the weight of the mobilized soil above the footings, and the frictional resistance of the mobilized soil. If additional uplift capacity is required during the foundation design, we recommend that the footing width be increased, as opposed to increasing the depth of the footing. We highly recommend that the bottom of footing elevation be kept at 3 feet below exterior grade.

5.3 Slab-on-Grade

The slab subgrade material encountered in the explorations consisted of existing fill, containing significant amounts of ash, brick, coal, and other and non-mineral urban fill. We recommend that slabs in heated areas be constructed on a minimum of 18” of compacted Structural Fill (SF, see table below for gradation requirements). Prior to the placement of any SF, the exposed subgrade should be proofrolled with a minimum of 4 passes in each of two perpendicular directions. All proofrolled soil should be unsaturated, unfrozen, and free of unsuitable/deleterious materials. Unsuitable/deleterious materials should be removed and replaced with compacted SF or ¾” crushed stone. If significant amounts of these materials are exposed in the slab excavation, SGS should be notified immediately. The SF should be placed in two 9” lifts.

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 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.

5.4 Frost Protection and Foundation Backfill

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 feet of frost protection should be provided for the exterior footings. Since the footings will be constructed on 12 inches of drained crushed stone, the bottom of exterior footings may be constructed at a depth of 3 feet below the exterior finished 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:

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.

5.5 Seismic Site Class and Design Criteria

Based on shear wave velocity measurements collected during the CPT at the 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 – 2012 IBC	
Seismic Coefficient	**Site Class E**
Short period spectral response (S_S)	0.241
1 second spectral response (S_1)	0.078
Maximum factored spectral response (S_{MS})	0.603
1 second factored spectral response (S_{M1})	0.274
Design short period spectral response (S_{DS})	0.402
Design 1 second spectral response (S_{D1})	0.182

No liquefiable soils were encountered in our subsurface exploration.

5.6 Groundwater Considerations

Groundwater was found to range from 7.0 to 8.2 feet below ground surface on the day of our explorations. However, apparent from the mottling of the stiff silty clay in B-2, groundwater is anticipated to rise up seasonally or during wet periods, such as snowmelt or high rainfall. Based on this, we recommend that perimeter underdrains be installed along the entire perimeter of exterior foundations. We recommend that underdrains consist of 4-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.

6.0 Construction Considerations

Based on the groundwater levels observed from our explorations, we do not anticipate that groundwater will be encountered within the building excavations. 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 proofrolling should be performed on unsaturated, unfrozen soil.

Footings and slabs should not be constructed on frozen soils. All frozen soil should be removed and replaced with compacted SF, and should not be allowed to re-freeze prior to concrete placement. After concrete has been placed, the subgrade should be protected from freezing using soil cover or insulated blankets.

Once a foundation plan is developed, SGS should be retained to review these documents to confirm their accordance with our recommendations.

Due to the high fines content, native soils and existing fill at the site is not suitable for reuse as SF or FB.

Excavations deeper than 4 feet should be sloped no greater than 1.5H to 1V for fill or previously disturbed soils and 0.75H:1V for the stiff silty clay soil. Excavations below groundwater should be limited to 1.5H to 1V. These slopes are based on the current OSHA Excavation Guidelines.

8.0 Closure

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, or should building loads and configurations change significantly, SGS should be notified so that we can re-evaluate our recommendations.

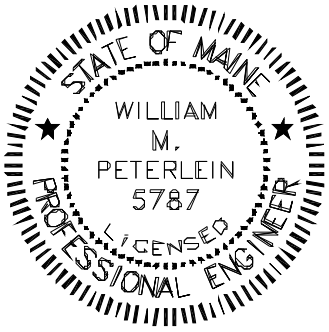
We recommend that a qualified geotechnical consultant be retained to monitor and test soil materials used during construction and confirm that soil conditions and construction methods are consistent with this report. We recommend that SGS be retained to review the final foundation plan before construction begins.

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
President & Principal Engineer



APPENDIX A

EXPLORATION LOCATION PLAN

LEGEND

B-1 SUMMIT TEST BORING (JANUARY 6, 2016)

CPT-1 SUMMIT CONE PENETRATION TEST (JANUARY 7, 2016)

PLAN REFERENCE

AERIAL IMAGE (2012) OBTAINED FROM MAINE OFFICE OF G.I.S.

EXPLORATION LOCATION PLAN
BAYSIDE BOWL ADDITION

71 HANOVER ST. & 138 KENNEBEC ST. - PORTLAND, ME

PREPARED FOR

DALE AKELEY

DATE: 1-11-2016	DRAWN BY: KRF	CHECKED BY: WMP
JOB: 15285	SCALE: 1" = 60'	FILE: 15285 MAPS

145 LISBON ST. - SUITE 601
LEWISTON, ME 04240
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APPENDIX B

EXPLORATION LOGS

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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	Trace:	Less than 5%
Cobbles:	12 inches to 3 inches	Little:	5% to 15%
Gravel:	3 inches to No.4 sieve	Some:	15% to 30%
Sand:	No.4 to No. 200 sieve	Silty, Sandy, etc.:	Greater than 30%
Silt:	No. 200 sieve to 0.005 mm		
Clay:	less than 0.005 mm		

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:	Bayside Bowl Addition	Boring #:	**B-1**
Location:	71 Hanover Street	Project #:	15285
City, State:	Portland, Maine	Sheet:	1 of 2
		Chkd by:	

Drilling Co:	Summit Geoengineering Services	Boring Elevation:	11.5 feet +/-
Driller:	Craig Coolidge, P.E.	Reference:	Site Measurements by Ransom Consulting on 3/12/15 to 3/13/15
Summit Staff:	Mat Hardison, E.I.	Date started: 1/6/2016	Date Completed: 1/6/2016

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
1/6/2016	7.5 feet	4.0 feet +/-	10' casing in hole

Depth (ft.)	No.	Pen/Rec (in)	Depth (ft)	blows/6"	N_{60}	SAMPLE DESCRIPTION	Geological/ Test Data	Geological Stratum
	GS-1	24/24	0 to 2	PUSH		Pavement, 4" thick		PAVEMENT
1						Reddish brown Gravelly SAND, little to some Silt, humid, SP-SM		FILL
2						Black coal ASH, some intermixed Sand and Silt, little		
	S-1	24/16	2 to 4	3		white Ash, trace brick, humid to dry, compact		
3				4				
				3				
4				5				
5								
	S-2	24/20	5 to 7	6		top 3" sample: brick fragments		
6				6		Dark reddish-brown Silty SAND, little intermixed black		
				5		Ash, moist (increasing moisture @ 6.5')		
7				5				
							Groundwater	
8								GLACIAL MARINE
9								
10								
	S-3	24/24	10 to 12	1		Gray medium to coarse SAND, trace gravel, trace Silt,		
11				1		wet, very loose, SP		
				1		Dark gray Silty CLAY, soft to very soft, wet, CL	PP = 1000 psf	
12				1			PP = 500 psf	
							MC = 38.9%	
13								
14								
15								
	UT1	30/26	15 to 17.5	PUSH		Gray Silty CLAY, wet, very soft, black organic streaking,		
16						CL	MC = 44.4%	
							LL = 47	
17							PI = 23	
18								
19								
20								
	UT2	20/26	20 to 22.5	PUSH		same as above		
21							MC = 34.9%	
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

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%

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SOIL BORING LOG

Project:	Bayside Bowl Addition	Boring #:	B-1
Location:	71 Hanover Street	Project #:	15285
City, State:	Portland, Maine	Sheet:	2 of 2
		Chkd by:	

Drilling Co:	Summit Geoengineering Services	Boring Elevation:	11.5 feet +/-
Driller:	Craig Coolidge, P.E.	Reference:	Site Measurements by Ransom Consulting on 3/12/15 to 3/13/15
Summit Staff:	Mat Hardison, E.I.	Date started: 1/6/2016	Date Completed: 1/6/2016

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
1/6/2016	7.5 feet	4.0 feet +/-	10' casing in hole

Depth (ft.)	No.	Pen/Rec (in)	Depth (ft)	blows/6"	N_{60}	SAMPLE DESCRIPTION	Geological/ Test Data	Geological Stratum
23								GLACIAL MARINE
24								
25								
	UT3	30/25	25 to 27.5	PUSH		Gray Silty CLAY, wet, very soft, black organic streaking,		
26						CL	MC = 28.0%	
27								
28								
				PROBE		Completed remainder of exploration with rod probe:		
29								
30								
31								
32								
33								
						Denser drilling encountered @ 33'		
34								
35								
36								
37								
						Very dense starting at 37'		
38								
39								
40								
41								
42								
43								
44								
						End of Exploration at 44.0', Probe Refusal		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

Boring #: **B-2**

Project:	Bayside Bowl Addition	Project #:	15285
Location:	71 Hanover Street	Sheet:	1 of 2
City, State:	Portland, Maine	Chkd by:	

Drilling Co:	Summit Geoengineering Services	Boring Elevation:	13.0 feet +/-
Driller:	Craig Coolidge, P.E.	Reference:	Site Measurements by Ransom Consulting on 3/12/15 to 3/13/15
Summit Staff:	Mat Hardison, E.I.	Date started: 1/6/2016	Date Completed: 1/6/2016

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
1/6/2016	7.0 feet	6.0 feet +/-	casing pulled

Depth (ft.)	No.	Pen/Rec (in)	Depth (ft)	blows/6"	N_{60}	SAMPLE DESCRIPTION	Geological/ Test Data	Geological Stratum
	GS-1	24/24	0 to 2	PUSH		Pavement, 3" thick		PAVEMENT
1						Dark brown Silty SAND, little Gravel, humid, SM		FILL
2								
3								
4						Casing advance becomes soft @ 3.5', possible Ash or loose FILL		
5								
	S-1	24/24	5 to 7	2		Olive brown Silty CLAY, firm to soft, heavily mottled at	PP = 2,500 psf	
6				2		bottom of sample, damp, CL	MC = 35.8%	GLACIAL MARINE
				2			PP = 2,000 psf	
7				3			PP = 1,000 psf	
8								
9								
10								
	S-2	24/24	10 to 12	WH		Gray Clayey SAND, little to some Silt, very loose, wet		
11				1		SC-SM		
				WH		Gray Silty CLAY, very soft, wet, CL	PP < 500 psf	
12				1			MC = 32.5%	
						Advanced field vane from 12' depth using hydraulic push		
13								
	FV1		13 to 13.5			s_u = *1,000 psf, s_{ur} = 150 psf		
14						*likely influenced by Sand/Silt seam		
	FV2		14 to 14.5			s_u = 475 psf, s_{ur} = 100 psf		
15								
16	FV3		15.5 to 16			s_u = 500 psf, s_{ur} = 50 psf		
17								
18	FV4		17.5 to 18			s_u = 525 psf, s_{ur} = 100 psf		
19								
20	FV5		19.5 to 20			s_u = 550 psf, s_{ur} = 75 psf		
21								
22	FV6		21.5 to 22			s_u = 550 psf, s_{ur} = 100 psf		

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, FVT = field vane shear test
Bedrock Joints s_u = undrained shear strength, s_{ur} = remolded shear strength
Shallow = 0 to 35 degrees
Dipping = 35 to 55 degrees
Steep = 55 to 90 degrees

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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:	Bayside Bowl Addition	Boring #:	B-2
Location:	71 Hanover Street	Project #:	15285
City, State:	Portland, Maine	Sheet:	2 of 2
		Chkd by:	

Drilling Co:	Summit Geoengineering Services	Boring Elevation:	13.0 feet +/-
Driller:	Craig Coolidge, P.E.	Reference:	Site Measurements by Ransom Consulting on 3/12/15 to 3/13/15
Summit Staff:	Mat Hardison, E.I.	Date started: 1/6/2016	Date Completed: 1/6/2016

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
1/6/2016	7.0 feet	6.0 feet +/-	casing pulled

Depth (ft.)	No.	Pen/Rec (in)	Depth (ft)	blows/6"	N_{60}	SAMPLE DESCRIPTION	Geological/ Test Data	Geological Stratum
23								GLACIAL MARINE
						seam encountered during push @ 23.5'		
24	FV7		23.5 to 24			s_u = 675 psf, s_{ur} = 125 psf		
25								
26	FV8		25.5 to 26			s_u = 775 psf, s_{ur} = 200 psf		
27						Dense layer encountered at 26.3', could not advance field vane, boring terminated		
28								
29								
30								
31								
32								
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	
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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, FVT = field vane shear test
Bedrock Joints s_u = undrained shear strength, s_{ur} = remolded shear strength
Shallow = 0 to 35 degrees
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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%

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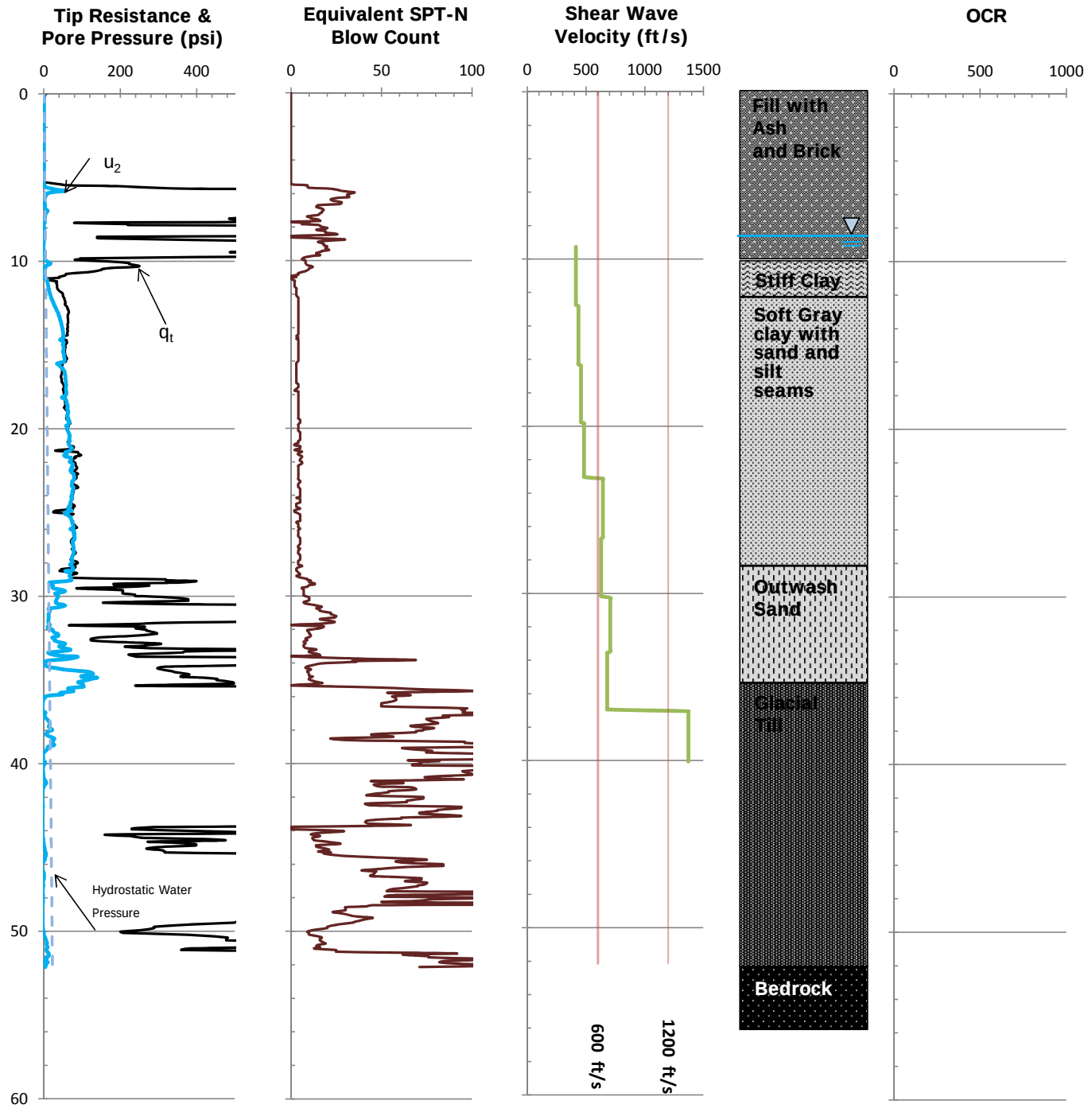
PIEZOCONE PENETRATION LOG

Project:	Bayside Bowl Addition	Test Number:	CPT-1
Location:	71 Hanover Street	Sheet:	1 of 1
	Portland, Maine	Project Number:	15285
		Method:	ASTM D5778
		Weather:	35° Sunny

Cone ID:	Vertek #4644.101	Test Elevation:	12.0 feet +/-
Cone Type:	VTK 5 Ton Digital Cone	Reference:	Site Measurements by Ransom Consulting on 3/12/15 to 3/13/15
Piezocone:	Silicone Single Filter	Date started:	1/7/2016 Date Completed: 1/7/2016
Push Rig:	AMS Power Probe 9500 VTR	ESTIMATED GROUND WATER DEPTH	
Anchor Style:	Single Point Hollow Stem Anchor	Date / Depth / Elevation / Reference	
Performed By:	Craig Coolidge, P.E.	1/7/2016 / 8.2' / 3.8 feet +/- / After test in open hole	



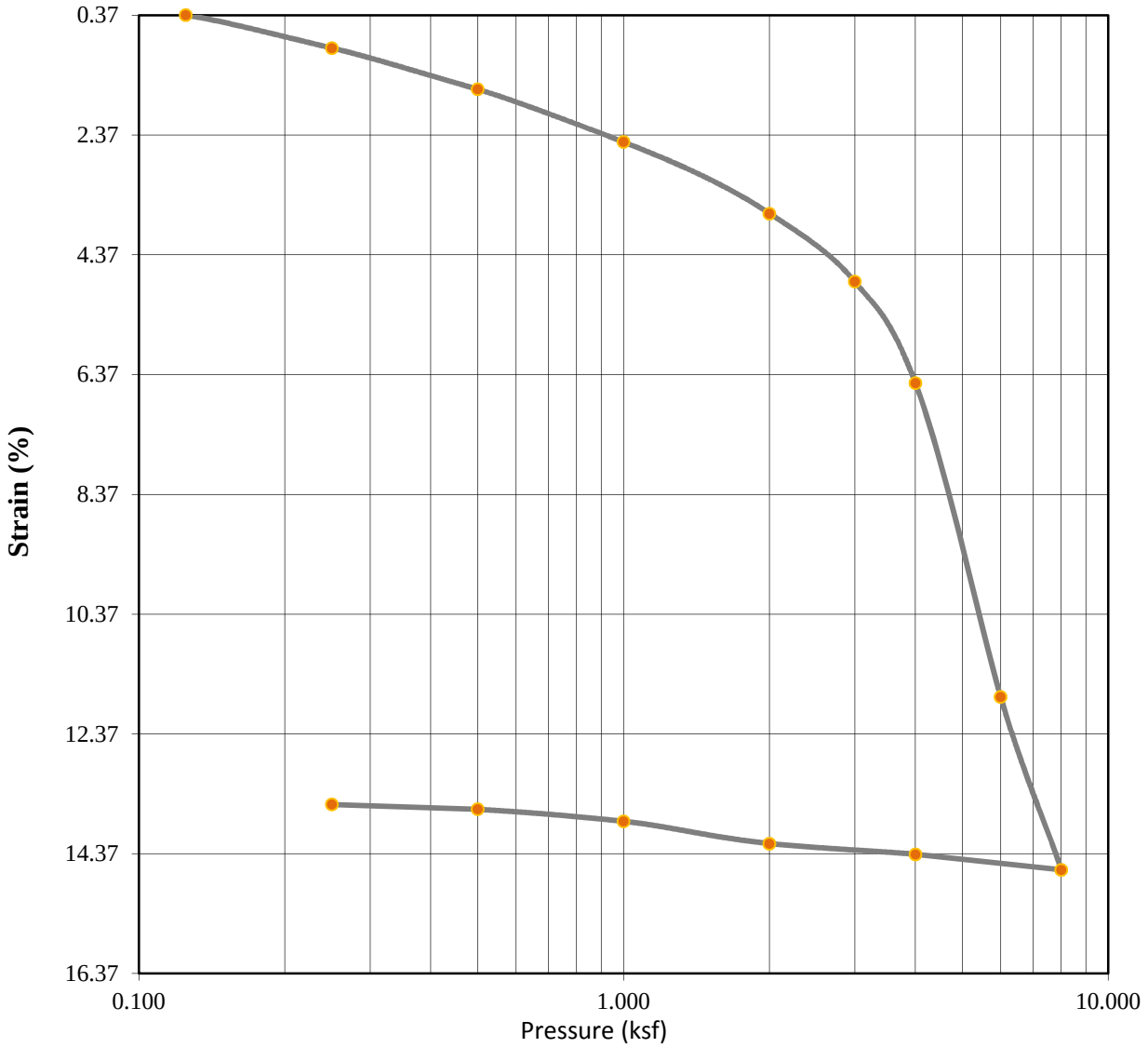
NOTES:

Soil Profile based on interpretation of CPT measurements and nearby borings
Shear Wave Velocity test (V_s) performed at 3.3 feet (1-meter) increments
Abrupt push refusal encountered at depth of 52.1 feet

APPENDIX C

LABORATORY TEST RESULTS

One-Dimensional Consolidation Test
ASTM D2435



	Before	After				
			σ'_p (Casagrande)	3,300 psf	**Test Date:**	1/7/2016
Moisture (%):	47.54	36.56	**Liquid Limits:**	47		
Dry Density (pcf):	74.15	87.04	**Plastic Limits:**	24		
Saturation (%):	102.34	107.56	**Plasticity Index (%):**	23	**C_c:** 0.66	
Void Ratio:	1.2269	0.9252	**Specific Gravity:**	2.650	**C_r:** 0.06	

Sample Description: Gray Silty Clay, CL

Project Number: 15285 **Depth:** 16'

Sample Number: UT-1, 15'-17.5' **Boring Number:** B-1

Project: Bayside Bowl Addition

Client: Dale Akeley c/o Landry/French Construction

Location: UT-1, 16'

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

PROJECT NAME:	Bayside Bowl Additon	PROJECT #:	15285
CLIENT:	Dale Akeley c/o Landry/French Construction	DRYING METHOD:	Oven Dried
SOURCE:	Borings B-1 & B-2	DESCRIPTION:	Various Clay Samples
DATE:	1/8/2016	TECHNICIAN:	Erika Stewart, E.I.

Location	Sample No.	Depth	Moisture Content	Remarks
B-1	S-3B	10.9' - 12'	38.9%	Black organics, odor, & fine sand
B-1	UT-1	17'	44.4%	Black organic streaks
B-1	UT-2	22'	34.9%	
B-1	UT-3	27'	28.0%	Fine sand seams / layers
B-2	S-1	5' - 7'	35.8%	
B-2	S-2	10' - 12'	32.5%	Trace fine sand

REMARKS:

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

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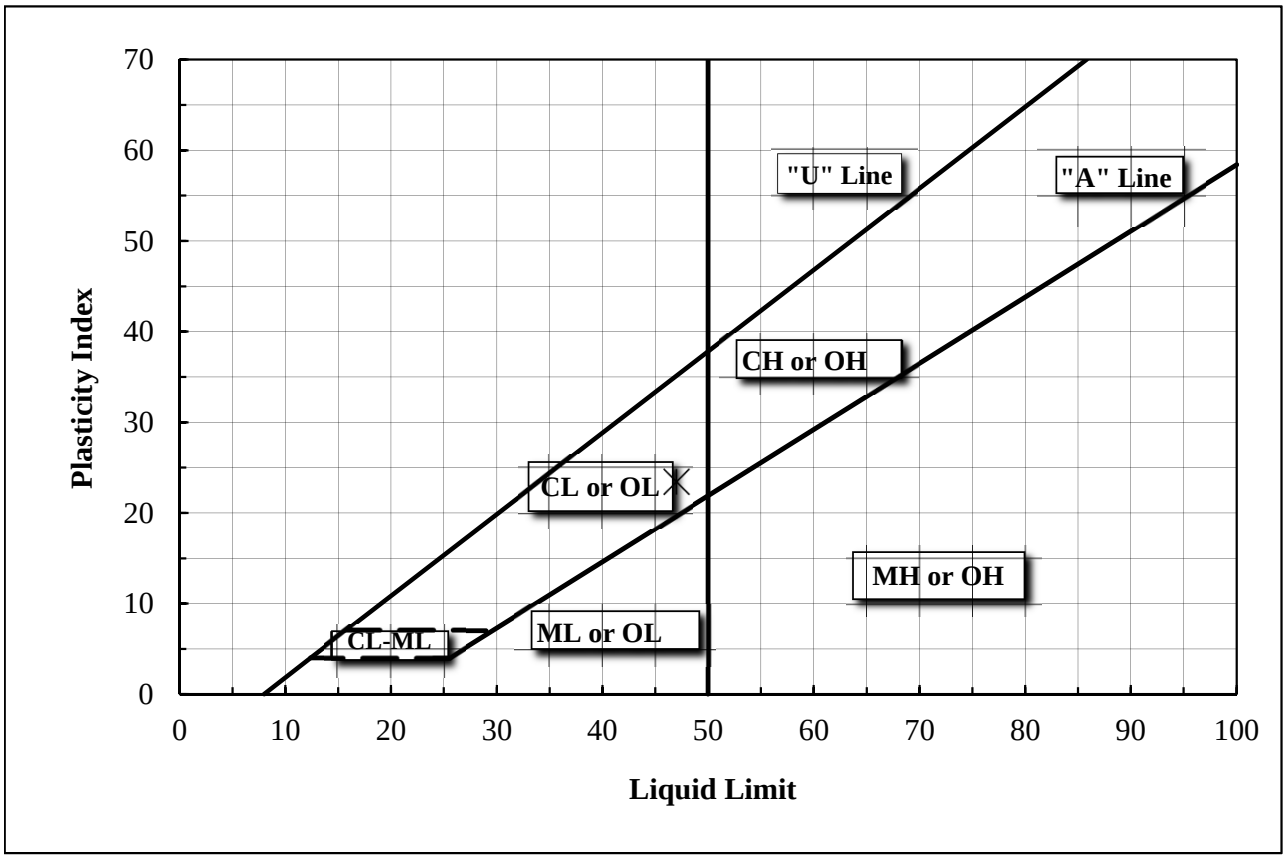
ATTERBERG LIMIT TEST - ASTM D4318

Method "A" (Multi-point)

PROJECT NAME:	Bayside Bowl Addition	PROJECT NUMBER:	15285
CLIENT:	Dale Akeley c/o Landry/Frech Construction	SAMPLE NUMBER:	UT-1
SOURCE:	Boring B-1	DEPTH:	15' - 17.5'
DATE:	1/11/2016	TECHNICIAN:	Erika Stewart, E.I.

DATA

Source	Depth	LL	PL	PI	Classification
B-1	15' - 17.5'	47	24	23	Gray Silty CLAY, black organics, CL



Notes: