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ENGINEERING | EXPLORATION | EXPERIENCE

Geotechnical Report

Proposed Building

50 Cove Street, Portland, Maine

Client
Random Orbit, Inc,
30 Danforth Street
Portland, Maine 04101

SUMMIT
GEOENGINEERING SERVICES

Project #: 17004
Date: 9/21/17
REV: 9/24/17

September 21, 2017
REV: September 24, 2017
Summit #17004

Attn: Peter Bass
Random Orbit, Inc.
30 Danforth Street
Portland, Maine 04101

Reference: Geotechnical Engineering Report – Proposed Building
50 Cove Street, Portland, Maine

Dear Peter;

Summit Geoengineering Services, Inc. (SGS) has completed a geotechnical investigation for the proposed building at the site referenced above. Our scope of services included the excavation of two test pits in the area of the proposed buildings, performing laboratory testing on collected samples, and preparing this preliminary geotechnical report summarizing our findings and providing initial foundation concepts for budgeting and planning purposes.

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 test pit 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 building at the site referenced above with a footprint of approximately 4,500 square feet. We understand that the new building will be two stories, will be framed with metal stud or wood studs, and will have a slab-on-grade finish floor elevation (FFE) approximately 1.5 to 2 feet above existing grade. We further understand that the proposed building will have a line of support columns in the centerline of the building.

The proposed site is located at 50 Cove Street in Portland, Maine. Existing grades at the site are approximately flat at an elevation of 9 feet (based on City of Portland GIS). The proposed building is located in between to existing buildings.

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2.0 Subsurface Explorations and Laboratory Testing

2.1 Subsurface Explorations

Summit Geoengineering Services (SGS) observed the subsurface conditions at the site with the excavation of 2 test pits on February 8, 2017. The excavations were performed by Eastern Excavation, Inc. using a CAT 308 tracked excavator under direct supervision of SGS. Test pits TP-1 and TP-2 were excavated to 9.0 and 9.2 feet below ground surface, respectively. Both test pits were terminated in the existing fill. The location of the test pits in shown in the Test Pit Location Plan in Appendix A. The test pit logs can be found in Appendix B.

2.2 Laboratory Testing

Laboratory testing consisted of a grain size analysis (*ASTM D6913* on a sample of the upper fill collected from Test Pit TP-2 at a depth of 2.1’ to 3.4’ below ground surface. A summary of the grain size results are presented in the table below. Detailed results of the test are included in Appendix C.

GRAIN SIZE ANALYSIS RESULTS – EXISTING FILL						
Test Pit	**Sample**	**Depth**	**Composition**			**[1]USCS**
			Gravel	Sand	Fines	
TP-2	S-1	2.1’ to 3.4’	36%	57%	7%	SP-SM

[1]Unified Soil Classification System

3.0 Subsurface Conditions

3.1 Soil

In general, the subsurface conditions at the site consist of ***pavement*** overlying ***fill***. Both test pits were terminated in the fill layer. We anticipate that the fill is underlain by glacial marine deposits consisting of soft clay and silty sand.

The ***pavement*** ranged in thickness from 1.5” to 3” and is in fair condition at the north end of the site and poor to fair condition at the south end.

The ***fill*** was encountered in both of the test pits directly below the pavement and can generally be split into two sub-layers. The upper sub-layer ranges in thickness from 3.2 feet to 4.6 feet

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and is described as light brown to black gravel with little to some sand and silt. Trace glass, wood, metal, and brick pieces are present in the upper layer, but in general this portion of the fill is mostly granular. The fill soil was frozen to a depth of 10" to 24", and below this the upper fill was humid and compact. A grain size was performed on a collected sample and resulted in a gravel content of 36%, a sand content of 57%, and a fines content of 7%. This material classifies as SP-SM in general accordance with the Unified Soil Classification System (USCS).

The surface of the lower fill sub-layer ranges in depth from 3.4 feet to 4.8 feet below existing ground surface, and ranges in thickness from 4.2 feet to 5.8 feet (to the termination depth of the test pits) and consists primarily of ash with intermixed silt, sand, brick, glass, wood, ceramic, metal, and other man-made debris. In general, this layer is in a loose state and appears to have been dumped without compaction. At a depth of 7 feet in TP-2, the fill is intermixed with native silty clay soil. The lower fill sub-layer is humid to wet, loose, and visually classifies as ML in general accordance with USCS.

Bedrock was not encountered in either of the test pits.

3.2 Groundwater

On the day of the test pits, groundwater was encountered within the lower fill layer ranging in depth from 7.2 feet to 7.4 feet below ground surface. Groundwater tends to fluctuate due to seasonal changes, rainfall, or snowmelt, therefore the measurements collected on the day of the explorations may not reflect long-term groundwater levels.

4.0 Geotechnical Evaluation

The primary concerns for the proposed building from a geotechnical standpoint include the following:

- Potential for excessive settlement due to the compressibility of the lower fill layer.
- Potential for localized settlement due to the degradation of organic materials within the lower fill layer resulting in differential settlement.

At a depth of approximately 3.5 to 4 feet, the fill transitions into generally man-made materials consisting of glass, plastic, ceramic, wood, brick, ash, and other deleterious materials with some intermixed silt, sand, and clay. This portion of the existing fill was likely dumped at the site without compaction, which is evidenced from the relatively easy digging with the excavator bucket during the test pits.

Due to the compressibility of the lower fill at the site and the presence of organics, the key for reducing post-construction settlement of the new building will be to minimize concentrated loads applied to the lower fill layer and to distribute column and wall loads as evenly as possible.

Conventional spread footing foundations act to support building loads by transferring stress into the soils via concentrated loads beneath spread footings or isolated footing elements. For this site, it will be critical to spread the load out as evenly as possibly throughout the fill layer and allow for the foundation to "bridge" localized settlements.

Based on our current understanding of the proposed building, we recommend that the foundation consist of a structural mat. Assuming a FFE approximately 18" to 24" above existing grade and a structural mat thickness of 12", we anticipate that a fill thickness of 6" to 12" will be required to raise the grade.

To further reduce contact pressures and more evenly distribute loads, we have provided subgrade preparation recommendations in Section 5.0. These include proofrolling, overexcation and installation of a triaxial geogrid, and fill recommendations.

5.0 Geotechnical Recommendations

5.1 Slab Subgrade Preparation and Design

Based on the soil conditions encountered in our explorations, we anticipate that existing fill will be exposed at the bottom of the slab subgrade excavation. We recommend that the structural mat for the proposed building be constructed with thickened edges extending 24" below exterior finish grade with a minimum of 2" of rigid insulation along the entire exterior and interior of perimeter walls for frost protection as shown in the detail in Appendix A. If the recommendations below are followed, the structural mat can be designed using an allowable contact pressure of 500 psf. This contact pressure should include the dead weight of the slab. Total settlement is expected to be less than 1.5" and differential settlement is expected to remain within tolerable limits for the structure. This allowable bearing pressure is based on the following:

- All existing pavement is removed in its entirety from within the building footprints.
- Fill placed within the building footprints is limited to 2 feet.
- Any fill placed within the building footprint consists of Structural Fill (SF) or ¾" crushed stone placed in 6" to 8" lifts.
- The entire building footprint is overexcavated to a depth of 6" below bottom of thickened edge of slab. This should be approximately 30" below existing grade.

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- All unsuitable soils and existing rubble (granite block, abandoned pipes, etc.) exposed in the footing excavations are removed and stabilized by overexcavating a minimum of 12" and installing ¾" crushed stone over a non-woven geotextile in place of the removed material.
- The exposed soil in the excavation is proofrolled with a minimum of 12 passes with a heavy vibratory roller.
- TriAx TX160 triaxial geogrid is installed on top of proofrolled subgrade for entire building footprint area, and extended a minimum of 5 feet beyond all building edges. Seams are overlapped a minimum of 12"
- Footings are constructed on dry, unfrozen soils.
- The exterior haunch is structurally tied to the mat to prevent concentrated loads beneath the haunch.

SGS should be retained to observe the foundation subgrade prior to installing the triaxial geogrid.

We recommend that the imported fill beneath the slab consist of Structural Fill (SF, see table below). 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 6 inches. Structural Fill should be placed in 6 to 8 inch lifts and should be compacted to a minimum of 95 percent 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.

5.2 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 feet of frost protection should be provided for the exterior footings and interior footings exposed to freezing temperatures. With an

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embedment depth of 24” below finish grade and a minimum rigid insulation thickness of 2”, the 4 feet of frost protection will be provided. Rigid insulation should be installed as shown on the detail in Appendix A.

We recommend that the exterior of all foundation elements exposed to freezing temperatures be backfilled with Foundation Backfill (FB). FB should consist of mineral soil free from frozen, organic, or otherwise deleterious material with less than 6% by weight passing the No. 200 sieve. Maximum particle size should be limited to 6”. 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.

5.3 Groundwater Control

Based on our test pit explorations, groundwater is anticipated to be below the bottom of footing elevation. However, due to the potential for surface runoff, anecdotal evidence of groundwater rise in this area, and to protect the shallow foundation from potentially detrimental frost action, we recommend perimeter underdrains be installed along the exterior foundation walls for the entire building. In addition, we recommend exterior grades slope away from the building if possible to reduce runoff water from infiltrating the foundation backfill soils.

Perimeter underdrains should consist of 4 inch rigid perforated PVC placed adjacent to the exterior footings and surrounded by a minimum of 6 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 be 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.

5.4 Seismic Design

Based on the soil encountered in our test pit explorations, we recommend the building be designed using Site Class D “stiff soil profile” in accordance with the International Building Code (IBC) 2012/2015. The following seismic site coefficients should be used:

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SUBGRADE SITE SEISMIC DESIGN COEFFICIENTS - IBC	
Seismic Coefficient	**Site Class D**
Short period spectral response (S_S)	0.241
1 second spectral response (S_1)	0.078
Maximum short period spectral response (S_{MS})	0.385
Maximum 1 second spectral response (S_{M1})	0.188
Design short period spectral response (S_{DS})	0.257
Design 1 second spectral response (S_{D1})	0.125

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

6.0 Construction Considerations

The existing fill is classified as OSHA Type C soil. Based on this, general occupied excavations less than a depth of 20 feet are limited to a maximum side slope of 1.5 horizontal to 1 vertical in the existing fill soil.

Tests for man-made chemicals were not part of the scope of our investigation. Recommend that all excavated fill remain on site.

Surface water should be redirected from excavation areas. Where softened, we recommend the subgrade at the base of the footing or slab 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:

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 do not anticipate groundwater within footing excavations. If localized perched groundwater is encountered, 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.

There is a possibility that existing fill can be reused as Foundation Backfill (FB) and Structural Fill (SF). If this is desired, sufficient grain size testing should be performed on representative samples of the material to confirm its accordance with the gradation requirements.

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.

SGS should be contacted so we can make a site visit to observe the subgrade soil after proofrolling and prior to placement of the triaxial geogrid.

7.0 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 recommend that all retaining wall designs and shoring designs be made available to SGS for review in order to verify that the design conditions are consistent 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.

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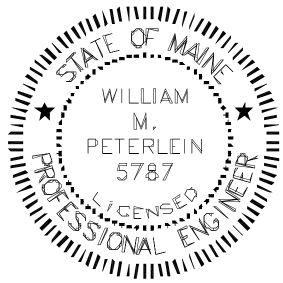
We appreciate the opportunity to serve you during this phase of your project. If there are any questions or additional information is required, please do not hesitate to call.

Sincerely,
Summit Geoengineering Services, Inc.



Mathew Hardison, EI
Geotechnical Engineer

William M. Peterlein, PE
President & Principal Engineer

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APPENDIX A

FIGURES

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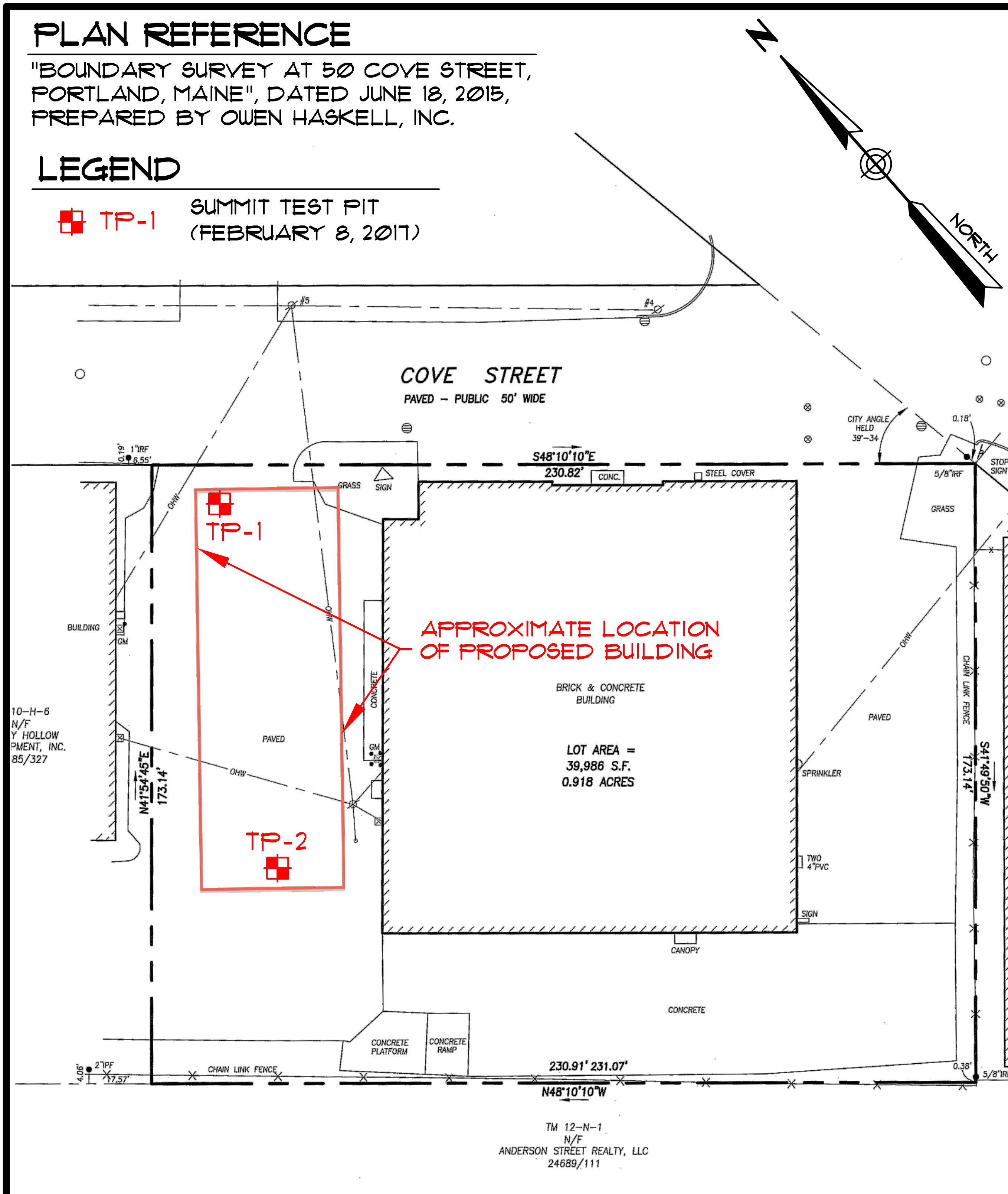
PLAN REFERENCE

"BOUNDARY SURVEY AT 50 COVE STREET, PORTLAND, MAINE", DATED JUNE 18, 2015, PREPARED BY OWEN HASKELL, INC.

LEGEND

TP-1 SUMMIT TEST PIT (FEBRUARY 8, 2017)



TEST PIT LOCATION PLAN
PROPOSED BUILDING

50 COVE STREET - PORTLAND, MAINE

PREPARED FOR

RANDOM ORBIT, INC.

DATE: 2-14-2017	DRAWN BY: KRF	CHECKED BY: WMP
JOB: 17004	SCALE: 1" = 40'	FILE: 17004 TP

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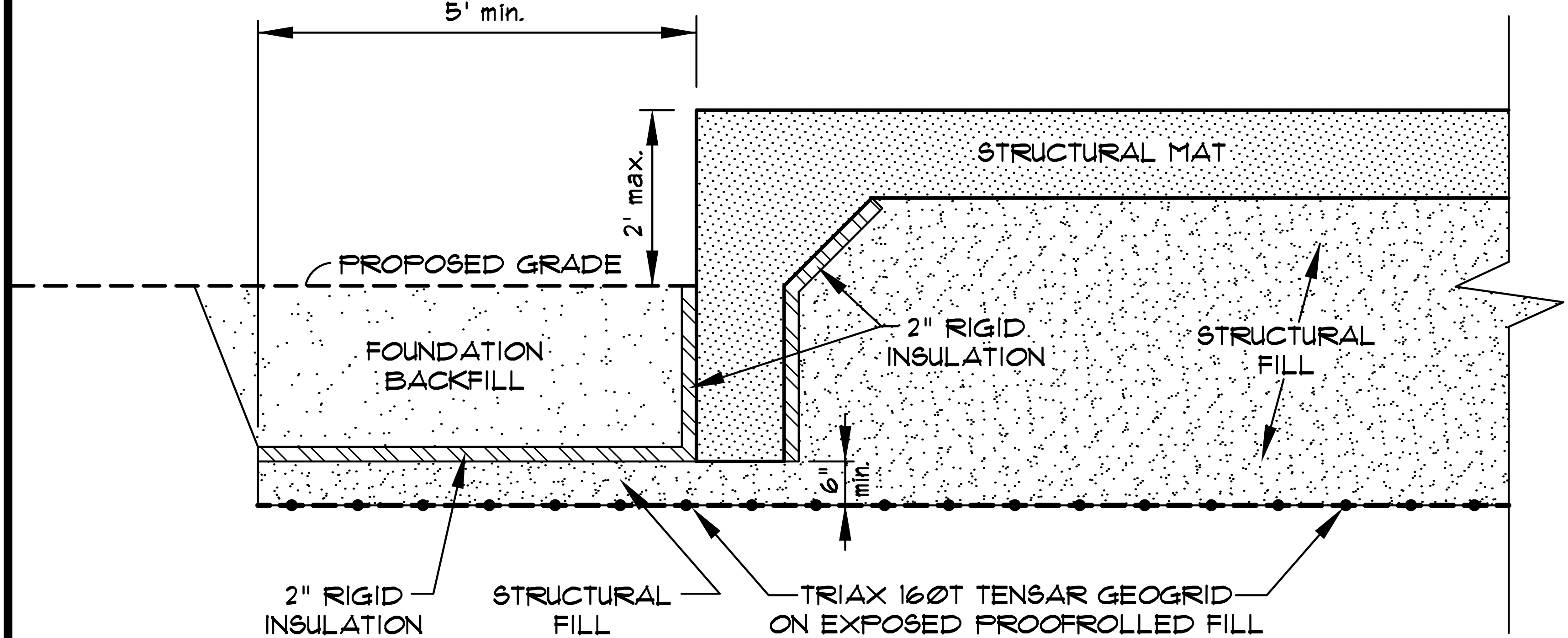

DATE: SEPT. 21, 2017
JOB: 17268
FILE: 17268 XS
DRAWN BY: KRF
CHECKED BY: WMP
NOT TO SCALE

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SUBGRADE PREPARATION RECOMMENDATIONS

PROPOSED BUILDING

50 COVE STREET - PORTLAND, MAINE

PREPARED FOR

RANDOM ORBIT, INC.

APPENDIX B
TEST PIT LOGS

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TEST PIT LOG

Test Pit #	TP-1	Project #:	17004
Project:	Proposed Building 50 Cove Street Portland, Maine	Groundwater:	7.2' depth
Contractor:	Eastern Excavation, Inc.	Ground Surface Elevation:	9.0 feet +/-
Equipment:	CAT 308 Excavator	Reference:	City of Portland GIS Contour Mapping
Summit Staff:	M. Hardison	Date: 2/8/2017	Weather: 25^{o} Sunny

Depth (ft)	DESCRIPTION: ENGINEERING	DESCRIPTION: GEOLOGIC/GENERAL
	3" of Pavement, fair condition	PAVEMENT
1	Light brown to dark brown medium to coarse Sandy GRAVEL, trace to little Silt, frozen (top 10"), GP	3"
		FILL
2		Large concrete piece from 4" depth to 26" depth
	Black Sandy SILT, trace glass, wood, and nails (mostly	2.2'
3	granular), humid, compact, ML	
4		
5		
	White ASH, intermixed glass, wood, metal, ceramic,	4.8'
6	trace to little Sand and Silt, moist, loose	Easy Digging
7		
	same as above, wet	▽ Groundwater
8		
9		
	End of Test Pit at 9.0', no refusal	
10		
11		
12		
13		
14		
15		
16		
17		

SUMMIT GEOENGINEERING SERVICES

TEST PIT LOG

Project:	Proposed Building 50 Cove Street Portland, Maine	Test Pit #	**TP-2**
		Project #:	17004
		Groundwater:	7.4' depth
Contractor:	Eastern Excavation, Inc.	Ground Surface Elevation:	9.0 feet +/-
Equipment:	CAT 308 Excavator	Reference:	City of Portland GIS Contour Mapping
Summit Staff:	M. Hardison	Date: 2/8/2017	Weather: 25° Sunny

Depth (ft)	DESCRIPTION: ENGINEERING	DESCRIPTION: GEOLOGIC/GENERAL
	1.5" to 2" of Pavement, fair to poor condition	PAVEMENT
1–2	Dark brown to black Sandy GRAVEL, little to some Silt, trace Brick fragments, frozen (24" depth) humid, compact, GP-GM	2" FILL
3	Light brown Gravelly SAND, little Silt, humid, compact, SP	2.2'
4–6	Black-stained SILT, little to some white Ash, loose, moist, frequent glass, ceramic, plastic, wood, brick pieces, ML increasing Ash content	3.4' (increase in man-made fill material) Easy Digging
7–9	Blue-gray Silty CLAY with intermized Wood (lumber) pieces, occasional cermaic and glass, soft, CL White ASH with little Sand, Silt, and Clay intermixed, wood (lumber), wet, loose	6.8' ▽ Groundwater Glass bottles recovered from Fill
10–17	End of Test Pit at 9.2', no refusal	

APPENDIX C

LABORATORY TEST RESULTS

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GRAIN SIZE ANALYSIS - ASTM D6913

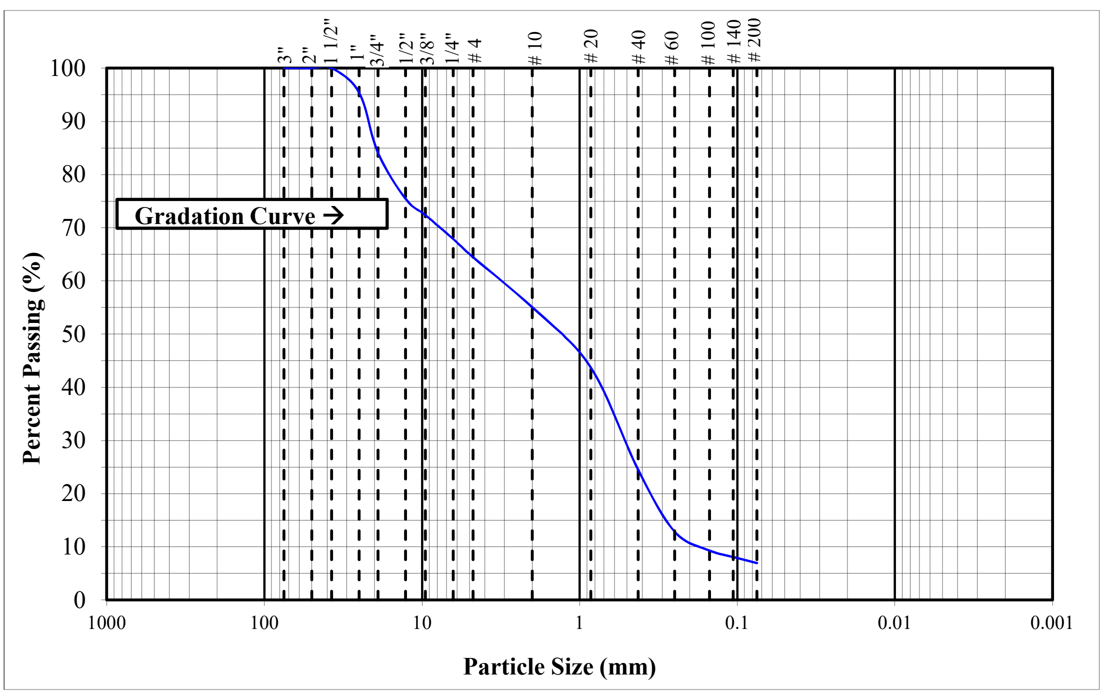
PROJECT NAME:	Proposed Building	PROJECT #:	17004
PROJECT LOCATION:	50 Cove Street, Portland, ME	EXPLORATION #:	TP-2
CLIENT:	Random Orbit, Inc.	SAMPLE #:	S-1
TECHNICIAN:	Erika Stewart, E.I., Brett Deyling, P.E.	SAMPLE DEPTH:	26" - 41"
SOIL DESCRIPTION:	Gravelly SAND, little Silt, SP-SM	TEST DATE:	2/16/2017

TEST PROCEDURE

Sample Source: Test Pit	**Sieve Stack:** Composite	**Specimen Procedure:** Moist
Test Method: Method A	**Separating Sieve(s):** 3/8 Inch	**Dispersion Type:** Tap Water

DATA

STANDARD SIEVE DESIGNATION (mm)	ALTERNATIVE SIEVE DESIGNATION (in)	PERCENT PASSING (%)
75	(3 in)	100
50	(2 in)	100
37.5	(1-1/2 in)	100
25.0	(1 in)	95
19.0	(3/4 in)	84
12.7	(1/2 in)	75
9.5	(3/8 in)	72
6.35	(1/4 in)	68
4.75	(No. 4)	64
2.00	(No. 10)	55
0.850	(No. 20)	44
0.425	(No. 40)	24
0.250	(No. 60)	13
0.150	(No. 100)	9
0.106	(No. 140)	8
0.075	(No. 200)	7



REMARKS: Moisture Content = 4.5%.

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