DESIGN/BUILD GEOTECHNICAL

GEOPIER®

Delivering the Geopier Foundation System

Design Submittal for:

Geopier Foundation Support

For

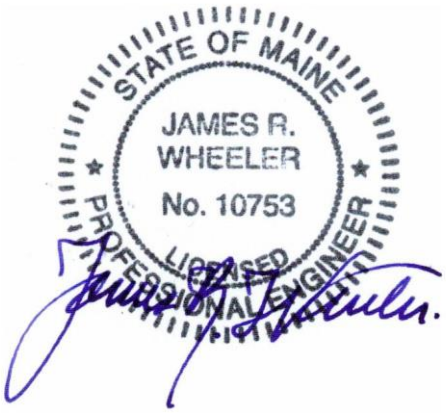
Mixed Use Development
York and High Streets
Portland, Maine

Project Number:

GNE-01207

Opechee Construction Corporation, Belmont, NH

March 7, 2016 ME-45198



James R. Wheeler, PE
Maine Registration No. 10753

DESIGN/BUILD GEOTECHNICAL

GEOPIER®

Delivering the Geopier Foundation System

Design Submittal for Geopier Ground Support
Mixed Use Development
Portland, ME

1.0 Introduction

The design of a Geopier ground support system has been completed to support column footings for a portion of the Mixed Use Development project to be constructed at York and High Streets, Portland, Maine. The purpose of the Geopier ground support for this project is to eliminate the need for over excavation and replacement of existing fill and to provide higher bearing pressure for spread footings while providing settlement control. The design has been developed to limit post-construction settlement of footings to less than ½-in and differential settlement of adjacent footings to less than ½-in. Differential settlement between Geopier and non-Geopier supported foundation elements is the responsibility of others.

2.0 Design Information

The design is based on drawings S.101 “Foundation Plan” and GS1.01 “Parking Garage Fnd. Plan” dated February 26, 2016 prepared by Becker Structural Engineers, foundation loads provided by Becker Structural Engineers and received via email on February 10 and 29, 2016, and the Geotechnical Report prepared by S.W. Cole Engineering, Inc., dated August 31, 2015.

A general description of the subsurface conditions, described in the referenced geotechnical report indicates that the subsurface soils consist of up to 9 feet of loose to medium dense silty sand Fill over up to 16 feet of loose to medium dense sand or silty sand. Beneath the sand or silty sand, very dense Glacial Till or Bedrock was noted at depths ranging from 4 to 28 feet below ground surface where the borings were terminated at auger or probe refusal. Ground water was encountered 7 to 14 feet below ground surface at the time the borings/probes were completed.

A subsurface exploration location plan, subsurface profiles, and logs of completed explorations are included herein at the end of Attachment D for information and reference.

2.1 Design Approach

The Geopier ground support design consists of estimating the capacity, modulus, and allowable bearing pressure of Geopier elements and developing a corresponding composite Geopier/matrix soil bearing pressure to be used to size spread footings. Geopier elements are designed for each column or wall footing based on provided loads, anticipated subsurface conditions, footing sizes, anticipated settlement and constructability.

For this project, Geopier design parameters have been selected in response to the anticipated engineering characteristics of the overburden soils. Based on our evaluations, the following parameters were utilized for design of the ground support for the proposed building:

- Geopier Modulus: 250 pounds per cubic inch (pci)
- Geopier Diameter: 20 inches
- Geopier Drill Depth: Approximately 7 to 19 ft.
- Geopier Capacity: 70 kips
- Footing Bearing Pressure: 4,000 pounds per square foot (psf)
- Soil Stiffness Modulus: 25 pci
- Aggregate Pier Elastic Modulus Fill or silty sand– 3,750 ksf
- Matrix Soil Elastic Modulus Fill or silty sand – 375 ksf
- Lower Zone Elastic Modulus: 5,000 ksf in glacial till or on bedrock

Geopier design calculations were performed in general accordance with the Geopier Foundation Design Manual and are summarized in Attachment A. Geopier element design shall be confirmed by conducting modulus testing on one element installed at the site. Geopier Modulus Test forms and proposed modulus test set up are included in Attachment B.

3.0 Geopier Element Layout and Specifications

Geopier elements will be installed in accordance with the referenced layout plans and specification requirements as shown in the Geopier Layout Plan, Construction Notes and Typical Details included as Attachment C.

4.0 Quality Control

During Geopier element installation, a full time Quality Control (QC) Representative will be present on site to verify and report all QC installation procedures and prepare Daily Aggregate Pier Progress Reports. A Geopier Schedule, summarizing the key installation aspects of individual rammed aggregate piers, QC Procedures and QC Reporting forms to be used during construction are included as Attachment D.

5.0 Site Pad Preparation and Foundation Construction

A temporary working pad shall be constructed at approximately El. 29.5 to El. 37 across the building footprint. In any pre-trench excavation that may be completed to remove potential obstructions and other portions of the footprint where fill must be placed to achieve the temporary working pad grade, the fill to be placed shall consist of on-site *granular* soils or imported common *granular* fill with a maximum particle size of 6 inches that is placed in lifts not exceeding 1 ft. in thickness measured before compaction. Each lift of fill shall be placed within approximately $\pm$ 2% of optimum moisture content and compacted with a minimum of four

systematic passes of heavy construction equipment, loaded trucks, a static steel wheel roller, or other alternative means to achieve approximately 92% Modified Proctor compaction. Soft areas, as may be evidenced by weaving under construction traffic shall be removed, refilled, and compacted to provide 92% Modified Proctor compaction and a safe trafficable subgrade from which Geopier construction may be completed. Placement of non-granular (cohesive silt and/or clay) fill shall not be permitted without prior review and written approval of the proposed fill material and placement procedures by the Geopier Designer. All fill placement and compaction work shall be observed and documented by the Owner's Geotechnical Representative and copies of reports summarizing the completion of this work in general accordance with the requirements included herein shall be submitted to Design/Build Geotechnical at the completion of the work.

Following the installation of Geopier elements, foundation excavation, subgrade protection and subsequent backfill placement shall be completed in accordance with the requirements included on drawing GEO-2.0 - Geopier Details and shall be observed and documented by the Owner's Geotechnical Representative or an Independent Testing Agency. At the completion of this work, a report from the Geotechnical Representative or Testing Agency shall be provided to the Geopier Designer confirming that this work was completed in accordance with project specifications and requirements included in the Geopier Design submittal.

DESIGN/BUILD GEOTECHNICAL

GEOPIER®

Delivering the Geopier Foundation System

Design Submittal for Geopier Ground Support
Mixed Use Development
Portland, ME

Attachment A:
Geopier Element Design Calculations

GEOPIER DESIGN METHODOLOGY FOR SUPPORT OF SPREAD FOOTINGS

Geopier soil reinforcing elements are designed to control foundation settlements to the project design criteria. Foundation settlements are estimated by summing the estimated settlement in the *Geopier*-reinforced zone (the "upper zone") and the estimated settlement in the zone of soil below the bottoms of the *Geopier* elements (the "lower zone") in accordance with the methodology described by Lawton et al. (1994).

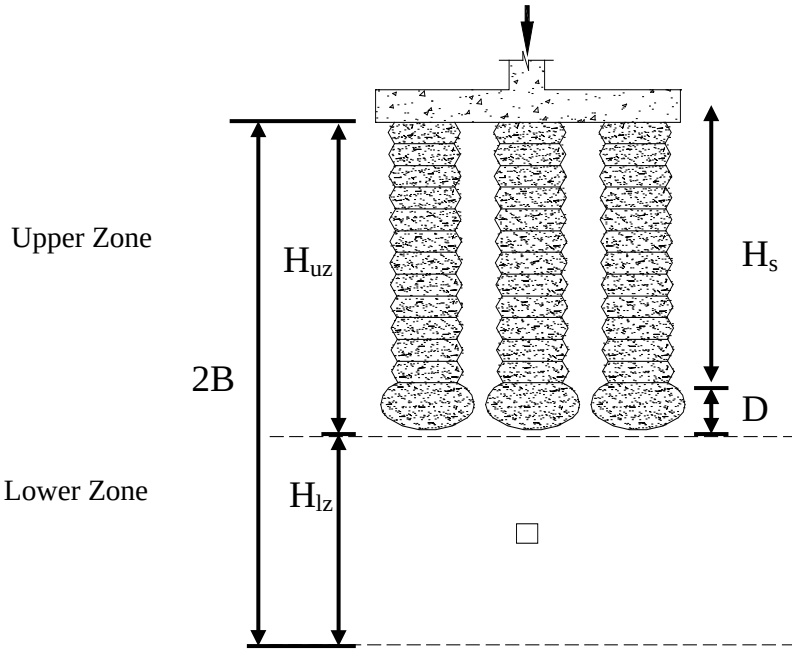


Figure 1: *Geopier* two-layer settlement approach

Upper Zone Settlement Calculations - Overview

Upper zone settlement calculations implement a spring analogy as shown in Figure 2. The *Geopier* elements act as stiff springs; the matrix soil between the piers acts as softer springs. The stiff *Geopier* elements attract a larger percentage of footing-bottom stress than the soft springs. By assuming that the footing is perfectly rigid, the top of *Geopier* stress may be computed using Equation 1:

$$\text{top-of-pier stress} = q_g = q \left[\frac{R_s}{R_s R_a - R_a + 1} \right] \qquad (1)$$

where q is the average footing-bottom stress, R_s is the ratio of the stiffness of the *Geopier* elements and the matrix soil, and R_a is the ratio of the area coverage of the *Geopier* elements to the gross footprint area.

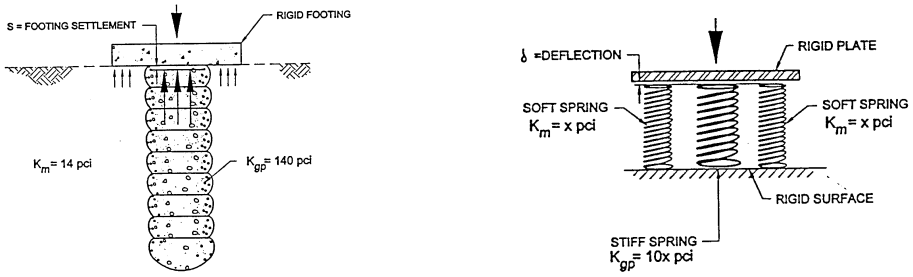


Figure 2: *Geopier* design spring analogy

The stiffness ratio, R_s, may be defined as the ratio of the spring constants of the *Geopier* (k_g) and the matrix soil (k_m), where k_g and k_m are expressed in units of pressure/deflection. The matrix soil spring constant is established using conventional geotechnical correlations and approaches. The *Geopier* spring constant is estimated using a database of spring constants established from past *Geopier* modulus tests and then verified with a modulus test performed at the project site.

Once the top-of-*Geopier* stress (q_g) is established from Equation 1, the settlement in the Upper Zone (s_{uz}) is simply computed as the ratio of q_g to the *Geopier* spring constant (k_g):

$$s_{uz} = q_g / k_g \quad . \qquad (2)$$

Lower Zone Settlement Calculations - Overview

Settlements within the "lower zone" (zone of soils beneath the upper zone which receives lower intensity footing stresses) are computed using conventional geotechnical settlement methods that involve: estimating the depth of stress influence below the footing bottom (typically taken as twice the footing width for square footings), estimating the footing-induced stress in the lower zone (established using conventional influence factor charts), and estimating the compressibility of the lower zone soils. Lower zone settlements (s_{lz}) in granular soils are estimated with the equation:

$$s_{lz} = q\ I\ H_{lz} / E_s \qquad (3)$$

where q is the average footing-bottom stress, I is the stress influence factor in the lower zone, H_{lz} is the thickness of the lower zone, and E_s is the secant modulus of the soil in the lower zone.

The estimated settlement of *Geopier*-supported footings (s) is determined by summing the upper zone and lower zone settlement values:

$$s = s_{uz} + s_{lz} \quad (4)$$

Evaluation of Estimated Settlement

Using the previously described settlement evaluation procedure, settlement calculations were completed to estimate settlement for strip footings and the interior column footings to be constructed for the project. These estimates are summarized on the following spreadsheets. As indicated in these calculations, estimated settlements for the strip and column footings range from 0.4 to 0.6 in. (total dead plus live load including construction phase loading and post construction loading) and suggest a maximum anticipated differential settlement of less than 0.5 in between adjacent column footings.

***GEOPIER*® Foundation Company**

Project: **Mixed Use Development, Portland, ME** Garage

No.: GNE-01207

Engnr: CJD/JBF/JRW MTOPS = 18.9 ksf

Date: 3/4/2016

GEOPIER®

SQUARE FOOTINGS

Version 3.0.6 August 2013

INPUT PARAMETER VALUES:

Parameter	Symb	Val.
RAP diameter (in)	d	20
Depth to groundwater (ft)	dgw	10
Total unit weight of soil (pcf)	g	120
Soil frict. angle (degr)	f	28
Max. hor. pressure (psf)	pmax	2500
From Table 4.2:		
RAP cell cap. (kips)	Qcell	70
Footing bearing press. (ksf)	qall	4
RAP stiffn. modulus (pci)	kg	250
Soil stiffness modulus (pci)	km	25

TOP OF PIER STRESS - SQUARE FOOTINGS

			1	2	3	4	5		
Parameter	Symb	Equation	F13 A/1	F10 1 Line	F10 1.5 Line	F10 A/2	F8 H/2		
Column load (kips)	P		803	400	350	360	242		
Estimated footing width (ft)	Br	sqrt(P/qall)	14.17	10.00	9.35	9.49	7.78		
Selected footing width (ft)	B		13	10	10	10	8		
Footing contact pressure	q	P/(B*B)	4.75	4.00	3.50	3.60	3.78		
Estimated No. RAP elems	Nr	P/Qcell	11.5	5.7	5.0	5.1	3.5		
Selected No. RAP elems	N		14	6	5	5	4		
Area replacement ratio	Ra	N*Ag/(B*B)	0.181	0.131	0.109	0.109	0.136		
Stiffness ratio	Rs	kg/km	10.0	10.0	10.0	10.0	10.0		
Stress at top of GP (ksf)	qg	q*Rs/(Rs*Ra-Ra+1)	18.09	18.36	17.66	18.17	16.98		
Load at top of GP (kips)	Qg	qg*Ag	39.5	40.1	38.5	39.6	37.0		

SHAFT LENGTH REQUIREMENTS

Depth of Embedment	Df		5.0	3.8	3.8	3.3	3.3		
Trial shaft length (ft)	Hs		9.5	9.5	9.5	9.5	7.8		
Drill depth (ft)	Hdrill	Df+Hs	15	13	13	13	11		
Frictional resistance force (kips)	Qs	fs*pi*d*Hs	63	60	60	58	46		
Allowable tensile resistance (kips)	Qsall	Qs/2	32	30	30	29	23		
Allowable end-bearing rest. (kips)	Qeb	Qeb	12	12	12	12	12		
Is shaft long enough?		Qs+Qeb>Pcdem?	**ok**	**ok**	**ok**	**ok**	**ok**		

INPUT PARAMETER VALUES:

Upper Zone Elastic Parameters		
Parameter	Sym	Val
Pier Modulus Layer 1 (ksf)	Eg1	3750
Pier Modulus Layer 2 (ksf)	Eg2	3750
Pier Modulus Layer 3 (ksf)	Eg3	3750
Pier Modulus Layer 4 (ksf)	Eg4	3750
Pier Modulus Layer 5 (ksf)	Eg5	3750
Soil Modulus Layer 1 (ksf)	Em1	375
Soil Modulus Layer 2 (ksf)	Em2	375
Soil Modulus Layer 3 (ksf)	Em3	375
Soil Modulus Layer 4 (ksf)	Em4	375
Soil Modulus Layer 5 (ksf)	Em5	375

UPPER ZONE SETTLEMENT - SQUARE FOOTINGS

Parameter	**Symb**	Equation							
UZ Settlement Approach		1-Stiffness, 2-Modulus	1	1	1	1	1		
Thickness of UZ sublayer 1(ft)	H_{uz1}								
Thickness of UZ sublayer 2 (ft)	H_{uz2}								
Thickness of UZ sublayer 3 (ft)	H_{uz3}								
Thickness of UZ sublayer 4 (ft)	H_{uz4}								
Thickness of UZ sublayer 5 (ft)	H_{uz5}								
Total UZ Thickness OK?		Huz = Hs + d							
Composite Modulus Layer 1 (ksf)	E_{comp1}	Eg1Ra + Em1(1-Ra)							
Composite Modulus Layer 2 (ksf)	E_{comp2}	Eg2Ra + Em2(1-Ra)							
Composite Modulus Layer 3 (ksf)	E_{comp3}	Eg3Ra + Em3(1-Ra)							
Composite Modulus Layer 4 (ksf)	E_{comp4}	Eg4Ra + Em4(1-Ra)							
Composite Modulus Layer 5 (ksf)	E_{comp5}	Eg5Ra + Em5(1-Ra)							
Sett. of LZ sublayer 1 (in)	s_{uz1}	qg/kg or q*Is-vag*H/Ecomp	0.50	0.51	0.49	0.50	0.47		
Sett. of LZ sublayer 2 (in)	s_{uz2}	$q*Is-2*H_{uz2}/E_{comp2}$	N/A	N/A	N/A	N/A	N/A		
Sett. of LZ sublayer 3 (in)	s_{uz3}	$q*Is-3*H_{uz3}/E_{comp3}$	N/A	N/A	N/A	N/A	N/A		
Sett. of LZ sublayer 4 (in)	s_{uz4}	$q*Is-4*H_{uz4}/E_{comp4}$	N/A	N/A	N/A	N/A	N/A		
Sett. of LZ sublayer 5 (in)	s_{uz5}	$q*Is-5*H_{uz5}/E_{comp5}$	N/A	N/A	N/A	N/A	N/A		
Total Upper Zone Settlement (in)	s_{uz}	qg/kg	0.50	0.51	0.49	0.50	0.47		

INPUT PARAMETER VALUES:

Parameter	Symb	Val.
Allowable end-bearing (kips)	Qeb	12
E or c_ε for LZ sublyr 1	E_1 / $c_{\varepsilon1}$	5000
E or c_ε for LZ sublyr 2	E_2 / $c_{\varepsilon2}$	5000
E or c_ε for LZ sublyr 3	E_3 / $c_{\varepsilon3}$	5000
E or c_ε for LZ sublyr 4	E_4 / $c_{\varepsilon4}$	5000
E or c_ε for LZ sublyr 5	E_5 / $c_{\varepsilon5}$	5000
Calc. settlement to X*B	X	2

LOWER ZONE SETTLEMENTS - SQUARE FOOTINGS

Parameter	Symb	Equation	F13 A/1	F10 1 Line	F10 1.5 Line	F10 A/2	F8 H/2		
Dpth to bottm of LZ from ftg (ft)	X*B	X*B	26	20	20	20	16		
Upper zone thickness (ft)	H_{uz}	Hs+d	11.2	11.2	11.2	11.2	9.5		
Lower zone thickness (ft)	H_{lz}	H2b-Hlz	14.9	8.9	8.9	8.9	6.6		
Thickness of LZ sublayer 1(ft)	H_{lz1}		2.98	1.78	1.78	1.78	1.32		
Thickness of LZ sublayer 2 (ft)	H_{lz2}		2.98	1.78	1.78	1.78	1.32		
Thickness of LZ sublayer 3 (ft)	H_{lz3}		2.98	1.78	1.78	1.78	1.32		
Thickness of LZ sublayer 4 (ft)	H_{lz4}		2.98	1.78	1.78	1.78	1.32		
Thickness of LZ sublayer 5 (ft)	H_{lz5}		2.98	1.78	1.78	1.78	1.32		
Total LZ thickness ok?			**ok**	**ok**	**ok**	**ok**	**ok**		
E or c_ε for LZ sublyr 1	E_1 / $c_{\varepsilon1}$	E (ksf) or c_ε	5000	5000	5000	5000	5000		
E or c_ε for LZ sublyr 2	E_2 / $c_{\varepsilon2}$	E (ksf) or c_ε	5000	5000	5000	5000	5000		
E or c_ε for LZ sublyr 3	E_3 / $c_{\varepsilon3}$	E (ksf) or c_ε	5000	5000	5000	5000	5000		
E or c_ε for LZ sublyr 4	E_4 / $c_{\varepsilon4}$	E (ksf) or c_ε	5000	5000	5000	5000	5000		
E or c_ε for LZ sublyr 5	E_5 / $c_{\varepsilon5}$	E (ksf) or c_ε	5000	5000	5000	5000	5000		
Initial stress for sublyr 1 (ksf)	P'_{o1}		1.641	1.540	1.540	1.506	1.394		
Initial stress for sublyr 2 (ksf)	P'_{o2}		1.813	1.642	1.642	1.608	1.471		
Initial stress for sublyr 3 (ksf)	P'_{o3}		1.984	1.745	1.745	1.711	1.547		
Initial stress for sublyr 4 (ksf)	P'_{o4}		2.156	1.847	1.847	1.813	1.623		
Initial stress for sublyr 5 (ksf)	P'_{o5}		2.328	1.950	1.950	1.916	1.699		
Ftg stress on sublyr 1 (ksf)	ΔP1	q*I	1.67	1.02	0.89	0.92	0.89		
Ftg stress on sublyr 2 (ksf)	ΔP2	q*I	1.22	0.82	0.72	0.74	0.73		
Ftg stress on sublyr 3 (ksf)	ΔP3	q*I	0.92	0.67	0.59	0.60	0.61		
Ftg stress on sublyr 4 (ksf)	ΔP4	q*I	0.71	0.56	0.49	0.50	0.51		
Ftg stress on sublyr 5 (ksf)	ΔP5	q*I	0.57	0.47	0.41	0.42	0.44		
Sett. of LZ sublayer 1 (in)	s_{lz1}	DP1*Hlz1/E1	0.01	0.00	0.00	0.00	0.00		
Sett. of LZ sublayer 2 (in)	s_{lz2}	DP2*Hlz2/E2	0.01	0.00	0.00	0.00	0.00		
Sett. of LZ sublayer 3 (in)	s_{lz3}	DP3*Hlz3/E3	0.01	0.00	0.00	0.00	0.00		
Sett. of LZ sublayer 4 (in)	s_{lz4}	DP4*Hlz4/E4	0.01	0.00	0.00	0.00	0.00		
Sett. of LZ sublayer 5 (in)	s_{lz5}	DP5*Hlz5/E5	0.00	0.00	0.00	0.00	0.00		
Total lower zone sett. (in)	s_{lz}	$s_{lz1}+s_{lz2}+s_{lz3}+s_{lz4}+s_{lz5}$	0.0	0.0	0.0	0.0	0.0		
Total UZ + LZ settlement (in)	s		0.5	0.5	0.5	0.5	0.5		

***GEOPIER*® Foundation Company**

Project: **Mixed Use Development, Portland, ME** Residential Building

No.: GNE-01207

Engnr: CJD/JBF/JRW MTOPS = 18.9 ksf

Date: 3/4/2016

GEOPIER®

SQUARE FOOTINGS

Version 3.0.6 August 2013

INPUT PARAMETER VALUES:

Parameter	Symb	Val.
RAP diameter (in)	d	20
Depth to groundwater (ft)	dgw	10
Total unit weight of soil (pcf)	g	120
Soil frict. angle (degr)	f	28
Max. hor. pressure (psf)	pmax	2500
From Table 4.2:		
RAP cell cap. (kips)	Qcell	70
Footing bearing press. (ksf)	qall	4
RAP stiffn. modulus (pci)	kg	250
Soil stiffness modulus (pci)	km	25

TOP OF PIER STRESS - SQUARE FOOTINGS

Parameter	Symb	Equation	8 F8 F/8	9 F6 E/12.5	10 F4 E/11	11 F6.5 C/3 Equiv.
Column load (kips)	P		205	115	60	190
Estimated footing width (ft)	Br	sqrt(P/qall)	7.16	5.36	3.87	6.89
Selected footing width (ft)	B		8	6	4	7
Footing contact pressure	q	P/(B*B)	3.20	3.19	3.75	3.88
Estimated No. RAP elems	Nr	P/Qcell	2.9	1.6	0.9	2.7
Selected No. RAP elems	N		3	2	1	3
Area replacement ratio	Ra	N*Ag/(B*B)	0.102	0.121	0.136	0.134
Stiffness ratio	Rs	kg/km	10.0	10.0	10.0	10.0
Stress at top of GP (ksf)	qg	q*Rs/(Rs*Ra-Ra+1)	16.68	15.28	16.84	17.61
Load at top of GP (kips)	Qg	qg*Ag	36.4	33.3	36.7	38.4

SHAFT LENGTH REQUIREMENTS

Depth of Embedment	Df		6.3	5.2	4.9	5.5
Trial shaft length (ft)	Hs		12.2	13.8	14.2	7.5
Drill depth (ft)	Hdrill	Df+Hs	19	19	19	13
Frictional resistance force (kips)	Qs	fs*pi*d*Hs	84	94	96	50
Allowable tensile resistance (kips)	Qsall	Qs/2	42	47	48	25
Allowable end-bearing rest. (kips)	Qeb	Qeb	12	12	12	12
Is shaft long enough?		Qs+Qeb>Pcdem?	**ok**	**ok**	**ok**	**ok**

INPUT PARAMETER VALUES:

Upper Zone Elastic Parameters		
Parameter	Sym	Val
Pier Modulus Layer 1 (ksf)	Eg1	3750
Pier Modulus Layer 2 (ksf)	Eg2	3750
Pier Modulus Layer 3 (ksf)	Eg3	3750
Pier Modulus Layer 4 (ksf)	Eg4	3750
Pier Modulus Layer 5 (ksf)	Eg5	3750
Soil Modulus Layer 1 (ksf)	Em1	375
Soil Modulus Layer 2 (ksf)	Em2	375
Soil Modulus Layer 3 (ksf)	Em3	375
Soil Modulus Layer 4 (ksf)	Em4	375
Soil Modulus Layer 5 (ksf)	Em5	375

UPPER ZONE SETTLEMENT - SQUARE FOOTINGS

Parameter	**Symb**	Equation							
UZ Settlement Approach		1-Stiffness, 2-Modulus	1	1	1	1			
Thickness of UZ sublayer 1(ft)	H_{uz1}								
Thickness of UZ sublayer 2 (ft)	H_{uz2}								
Thickness of UZ sublayer 3 (ft)	H_{uz3}								
Thickness of UZ sublayer 4 (ft)	H_{uz4}								
Thickness of UZ sublayer 5 (ft)	H_{uz5}								
Total UZ Thickness OK?		Huz = Hs + d							
Composite Modulus Layer 1 (ksf)	E_{comp1}	Eg1Ra + Em1(1-Ra)							
Composite Modulus Layer 2 (ksf)	E_{comp2}	Eg2Ra + Em2(1-Ra)							
Composite Modulus Layer 3 (ksf)	E_{comp3}	Eg3Ra + Em3(1-Ra)							
Composite Modulus Layer 4 (ksf)	E_{comp4}	Eg4Ra + Em4(1-Ra)							
Composite Modulus Layer 5 (ksf)	E_{comp5}	Eg5Ra + Em5(1-Ra)							
Sett. of LZ sublayer 1 (in)	s_{uz1}	qg/kg or q*Is-vag*H/Ecomp	0.46	0.42	0.47	0.49			
Sett. of LZ sublayer 2 (in)	s_{uz2}	$q*Is-2*H_{uz2}/E_{comp2}$	N/A	N/A	N/A	N/A			
Sett. of LZ sublayer 3 (in)	s_{uz3}	$q*Is-3*H_{uz3}/E_{comp3}$	N/A	N/A	N/A	N/A			
Sett. of LZ sublayer 4 (in)	s_{uz4}	$q*Is-4*H_{uz4}/E_{comp4}$	N/A	N/A	N/A	N/A			
Sett. of LZ sublayer 5 (in)	s_{uz5}	$q*Is-5*H_{uz5}/E_{comp5}$	N/A	N/A	N/A	N/A			
Total Upper Zone Settlement (in)	s_{uz}	qg/kg	0.46	0.42	0.47	0.49			

INPUT PARAMETER VALUES:

Parameter	Symb	Val.
Allowable end-bearing (kips)	Qeb	12
E or c_ε for LZ sublyr 1	E_1 / $c_{\varepsilon1}$	5000
E or c_ε for LZ sublyr 2	E_2 / $c_{\varepsilon2}$	5000
E or c_ε for LZ sublyr 3	E_3 / $c_{\varepsilon3}$	5000
E or c_ε for LZ sublyr 4	E_4 / $c_{\varepsilon4}$	5000
E or c_ε for LZ sublyr 5	E_5 / $c_{\varepsilon5}$	5000
Calc. settlement to X*B	X	2

LOWER ZONE SETTLEMENTS - SQUARE FOOTINGS

Parameter	Symb	Equation	F8 F/8	F6 E/12.5	F4 E/11	F6.5 C/3			
Dpth to bottm of LZ from ftg (ft)	X*B	X*B	16	12	8	14			
Upper zone thickness (ft)	H_{uz}	Hs+d	13.9	15.5	15.9	9.2			
Lower zone thickness (ft)	H_{lz}	H2b-Hlz	2.2	-3.5	-7.9	4.9			
Thickness of LZ sublayer 1(ft)	H_{lz1}		0.44			0.98			
Thickness of LZ sublayer 2 (ft)	H_{lz2}		0.44			0.98			
Thickness of LZ sublayer 3 (ft)	H_{lz3}		0.44			0.98			
Thickness of LZ sublayer 4 (ft)	H_{lz4}		0.44			0.98			
Thickness of LZ sublayer 5 (ft)	H_{lz5}		0.44			0.98			
Total LZ thickness ok?			**ok**	**No LZ**	**No LZ**	**ok**			
E or c_ε for LZ sublyr 1	E_1 / $c_{\varepsilon1}$	E (ksf) or c_ε	5000	5000	5000	5000			
E or c_ε for LZ sublyr 2	E_2 / $c_{\varepsilon2}$	E (ksf) or c_ε	5000	5000	5000	5000			
E or c_ε for LZ sublyr 3	E_3 / $c_{\varepsilon3}$	E (ksf) or c_ε	5000	5000	5000	5000			
E or c_ε for LZ sublyr 4	E_4 / $c_{\varepsilon4}$	E (ksf) or c_ε	5000	5000	5000	5000			
E or c_ε for LZ sublyr 5	E_5 / $c_{\varepsilon5}$	E (ksf) or c_ε	5000	5000	5000	5000			
Initial stress for sublyr 1 (ksf)	P'_{o1}		1.801	1.817	1.821	1.497			
Initial stress for sublyr 2 (ksf)	P'_{o2}		1.826	1.817	1.821	1.553			
Initial stress for sublyr 3 (ksf)	P'_{o3}		1.851	1.817	1.821	1.610			
Initial stress for sublyr 4 (ksf)	P'_{o4}		1.877	1.817	1.821	1.666			
Initial stress for sublyr 5 (ksf)	P'_{o5}		1.902	1.817	1.821	1.723			
Ftg stress on sublyr 1 (ksf)	ΔP1	q*I	0.44	0.22	0.11	0.80			
Ftg stress on sublyr 2 (ksf)	ΔP2	q*I	0.41	0.22	0.11	0.68			
Ftg stress on sublyr 3 (ksf)	ΔP3	q*I	0.39	0.22	0.11	0.59			
Ftg stress on sublyr 4 (ksf)	ΔP4	q*I	0.37	0.22	0.11	0.51			
Ftg stress on sublyr 5 (ksf)	ΔP5	q*I	0.35	0.22	0.11	0.44			
Sett. of LZ sublayer 1 (in)	s_{lz1}	DP1*Hlz1/E1	0.00	0.00	0.00	0.00			
Sett. of LZ sublayer 2 (in)	s_{lz2}	DP2*Hlz2/E2	0.00	0.00	0.00	0.00			
Sett. of LZ sublayer 3 (in)	s_{lz3}	DP3*Hlz3/E3	0.00	0.00	0.00	0.00			
Sett. of LZ sublayer 4 (in)	s_{lz4}	DP4*Hlz4/E4	0.00	0.00	0.00	0.00			
Sett. of LZ sublayer 5 (in)	s_{lz5}	DP5*Hlz5/E5	0.00	0.00	0.00	0.00			
Total lower zone sett. (in)	s_{lz}	$s_{lz1}+s_{lz2}+s_{lz3}+s_{lz4}+s_{lz5}$	0.0	0.0	0.0	0.0			
Total UZ + LZ settlement (in)	s		0.5	0.4	0.5	0.5			

***GEOPIER*® Foundation Company**

Project: **Mixed Use Development, Portland, ME** Residential Building

No.: GNE-01207

Engnr: CJD/JBF/JRW MTOPS = 18.9 ksf

Date: 3/4/2016

GEOPIER®

CONTINUOUS FOOTINGS

Version 3.0.6 August 2013

INPUT PARAMETER VALUES:

Parameter	Symb	Val.
RAP diameter (in)	d	28.3
Depth to groundwater (ft)	dgw	10
Total unit weight of soil (pcf)	g	120
Soil frict. angle (degr)	f	28
Max. hor. pressure (psf)	pmax	2500
From Table 4.2:		
RAP cell cap. (kips)	Qcell	70
Footing bearing press. (ksf)	qall	4
RAP stiffn. modulus (pci)	kg	250
Soil stiffness modulus (pci)	km	25

TOP OF PIER STRESS - CONTINUOUS FOOTINGS

Parameter	Symb	Equation	Wall Type 1 Piers 119/120	Wall Type 2 Piers 103/104	Wall Type 3 Piers 97/98			
Wall Load (kips/ft)	p		28.35	21.6	21.2			
Estimated Geopier spacing (ft)	sreq	Qcell/p	2.47	3.24	3.30			
Selected Geopier spacing (ft)	s		6.5	8.5	7.46			
Estimated footing width (ft)	Breq	p/qall	7.09	5.40	5.30			
Selected footing width (ft)	B		9	9	8			
Contact pressure (ksf)	q	p/B	3.15	2.40	2.65			
Area replacement ratio	Ra	Ag/(B*s)	0.075	0.057	0.073			
Stiffness ratio	Rs	kg/km	10.0	10.0	10.0			
Stress at top of GP (ksf)	qg	q*Rs/(Rs*Ra-Ra+1)	18.84	15.85	15.98			
Load at top of GP (kips)	Qg	qg*Ag	82.3	69.2	69.8			

SHAFT LENGTH REQUIREMENTS

Depth of Embedment	Df		2.8	2.3	2.3			
Trial shaft length (ft)	Hs		8.8	9.3	11.3			
Drill depth (ft)	Hdrill	Df+Hs	12	12	14			
Frictional resistance force (kips)	Qs	fs*pi*d*Hs	72	74	94			
Allowable tensile resistance (kips)	Qsall	Qs/2	36	37	47			
Allowable end-bearing rest. (kips)	Qeb	Qeb	12	12	12			
Is shaft long enough?		Qs+Qeb>Pcdem?	**ok**	**ok**	**ok**			

INPUT PARAMETER VALUES:

Upper Zone Elastic Parameters Parameter	Sym	Val
Pier Modulus Layer 1 (ksf)	Eg1	3750
Pier Modulus Layer 2 (ksf)	Eg2	3750
Pier Modulus Layer 3 (ksf)	Eg3	3750
Pier Modulus Layer 4 (ksf)	Eg4	3750
Pier Modulus Layer 5 (ksf)	Eg5	3750
Soil Modulus Layer 1 (ksf)	Em1	375
Soil Modulus Layer 2 (ksf)	Em2	375
Soil Modulus Layer 3 (ksf)	Em3	375
Soil Modulus Layer 4 (ksf)	Em4	375
Soil Modulus Layer 5 (ksf)	Em5	375

UPPER ZONE SETTLEMENT - CONTINUOUS FOOTINGS

Parameter	**Symb**	Equation						
UZ Settlement Approach		1-Stiffness, 2-Modulus	1	1	1			
Thickness of UZ sublayer 1(ft)	H_{uz1}							
Thickness of UZ sublayer 2 (ft)	H_{uz2}							
Thickness of UZ sublayer 3 (ft)	H_{uz3}							
Thickness of UZ sublayer 4 (ft)	H_{uz4}							
Thickness of UZ sublayer 5 (ft)	H_{uz5}							
Total UZ Thickness OK?		Huz = Hs +d						
Composite Modulus Layer 1 (ksf)	E_{comp1}	Eg1Ra + Em1(1-Ra)						
Composite Modulus Layer 2 (ksf)	E_{comp2}	Eg2Ra + Em2(1-Ra)						
Composite Modulus Layer 3 (ksf)	E_{comp3}	Eg3Ra + Em3(1-Ra)						
Composite Modulus Layer 4 (ksf)	E_{comp4}	Eg4Ra + Em4(1-Ra)						
Composite Modulus Layer 5 (ksf)	E_{comp5}	Eg5Ra + Em5(1-Ra)						
Sett. of LZ sublayer 1 (in)	s_{uz1}	qg/kg or q*Is-vag*H/Ecomp	0.52	0.44	0.44			
Sett. of LZ sublayer 2 (in)	s_{uz2}	q*Is-2*H_{uz2}/E_{comp2}	N/A	N/A	N/A			
Sett. of LZ sublayer 3 (in)	s_{uz3}	q*Is-3*H_{uz3}/E_{comp3}	N/A	N/A	N/A			
Sett. of LZ sublayer 4 (in)	s_{uz4}	q*Is-4*H_{uz4}/E_{comp4}	N/A	N/A	N/A			
Sett. of LZ sublayer 5 (in)	s_{uz5}	q*Is-5*H_{uz5}/E_{comp5}	N/A	N/A	N/A			
Total Upper Zone Settlement (in)	s_{uz}	qg/kg	0.52	0.44	0.44			

INPUT PARAMETER VALUES:

Parameter	Symb	Val.
Allowable end-bearing (kips)	Qeb	12
E or c_ε for LZ sublyr 1	E_1 / $c_{\varepsilon1}$	5000
E or c_ε for LZ sublyr 2	E_2 / $c_{\varepsilon2}$	5000
E or c_ε for LZ sublyr 3	E_3 / $c_{\varepsilon3}$	5000
E or c_ε for LZ sublyr 4	E_4 / $c_{\varepsilon4}$	5000
E or c_ε for LZ sublyr 5	E_5 / $c_{\varepsilon5}$	5000
Calc. settlement to X*B	X	5

LOWER ZONE SETTLEMENTS

Parameter	Symb	Equation	119/120	103/104	97/98			
Dpth to bottm of LZ from ftg (ft)	X*B	X*B	45	45	40			
Upper zone thickness (ft)	H_{uz}	Hs+d	11.2	11.7	13.7			
Lower zone thickness (ft)	H_{lz}	H2b-Hlz	33.9	33.4	26.4			
Thickness of LZ sublayer 1(ft)	H_{lz1}		6.78	6.68	5.28			
Thickness of LZ sublayer 2 (ft)	H_{lz2}		6.78	6.68	5.28			
Thickness of LZ sublayer 3 (ft)	H_{lz3}		6.78	6.68	5.28			
Thickness of LZ sublayer 4 (ft)	H_{lz4}		6.78	6.68	5.28			
Thickness of LZ sublayer 5 (ft)	H_{lz5}		6.78	6.68	5.28			
Total thickness ok?			**ok**	**ok**	**ok**			
E or c_ε for LZ sublyr 1	E_1 / $c_{\varepsilon1}$	E (ksf) or c_ε	5000	5000	5000			
E or c_ε for LZ sublyr 2	E_2 / $c_{\varepsilon2}$	E (ksf) or c_ε	5000	5000	5000			
E or c_ε for LZ sublyr 3	E_3 / $c_{\varepsilon3}$	E (ksf) or c_ε	5000	5000	5000			
E or c_ε for LZ sublyr 4	E_4 / $c_{\varepsilon4}$	E (ksf) or c_ε	5000	5000	5000			
E or c_ε for LZ sublyr 5	E_5 / $c_{\varepsilon5}$	E (ksf) or c_ε	5000	5000	5000			
Initial stress for sublyr 1 (ksf)	P'_{o1}		1.626	1.623	1.698			
Initial stress for sublyr 2 (ksf)	P'_{o2}		2.016	2.007	2.002			
Initial stress for sublyr 3 (ksf)	P'_{o3}		2.407	2.392	2.306			
Initial stress for sublyr 4 (ksf)	P'_{o4}		2.797	2.777	2.610			
Initial stress for sublyr 5 (ksf)	P'_{o5}		3.188	3.162	2.914			
Ftg stress on sublyr 1 (ksf)	ΔP1	q*I	1.17	0.87	0.80			
Ftg stress on sublyr 2 (ksf)	ΔP2	q*I	0.82	0.62	0.61			
Ftg stress on sublyr 3 (ksf)	ΔP3	q*I	0.63	0.48	0.49			
Ftg stress on sublyr 4 (ksf)	ΔP4	q*I	0.51	0.39	0.41			
Ftg stress on sublyr 5 (ksf)	ΔP5	q*I	0.43	0.32	0.35			
Sett. of LZ sublayer 1 (in)	s_{lz1}	DP1*Hlz1/E1	0.02	0.01	0.01			
Sett. of LZ sublayer 2 (in)	s_{lz2}	DP2*Hlz2/E2	0.01	0.01	0.01			
Sett. of LZ sublayer 3 (in)	s_{lz3}	DP3*Hlz3/E3	0.01	0.01	0.01			
Sett. of LZ sublayer 4 (in)	s_{lz4}	DP4*Hlz4/E4	0.01	0.01	0.01			
Sett. of LZ sublayer 5 (in)	s_{lz5}	DP5*Hlz5/E5	0.01	0.01	0.00			
Total lower zone sett. (in)	s_{lz}	s_{lz1}+s_{lz2}+s_{lz3}+s_{lz4}+s_{lz5}	0.1	0.0	0.0			
Total UZ + LZ settlement (in)	s		0.6	0.5	0.5			

***GEOPIER*® Foundation Company**

Project: **Mixed Use Development, Portland, ME** Garage

No.: GNE-01207

Engnr: CJD/JBF/JRW MTOPS = 18.9 ksf

Date: 3/4/2016

GEOPIER®

SQUARE FOOTINGS

Version 3.0.6 August 2013

INPUT PARAMETER VALUES:

Parameter	Symb	Val.
RAP diameter (in)	d	20
Depth to groundwater (ft)	dgw	10
Total unit weight of soil (pcf)	g	120
Soil frict. angle (degr)	f	28
Max. hor. pressure (psf)	pmax	2500
From Table 4.2:		
RAP cell cap. (kips)	Qcell	70
Footing bearing press. (ksf)	qall	4
RAP stiffn. modulus (pci)	kg	250
Soil stiffness modulus (pci)	km	25

TOP OF PIER STRESS - SQUARE FOOTINGS

			1	2	3	4	5		
Parameter	Symb	Equation	F13 A/1	F10 1 Line	F10 1.5 Line	F10 A/2	F8 H/2		
Column load (kips)	P		803	400	350	360	242		
Estimated footing width (ft)	Br	sqrt(P/qall)	14.17	10.00	9.35	9.49	7.78		
Selected footing width (ft)	B		13	10	10	10	8		
Footing contact pressure	q	P/(B*B)	4.75	4.00	3.50	3.60	3.78		
Estimated No. RAP elems	Nr	P/Qcell	11.5	5.7	5.0	5.1	3.5		
Selected No. RAP elems	N		14	6	5	5	4		
Area replacement ratio	Ra	N*Ag/(B*B)	0.181	0.131	0.109	0.109	0.136		
Stiffness ratio	Rs	kg/km	10.0	10.0	10.0	10.0	10.0		
Stress at top of GP (ksf)	qg	q*Rs/(Rs*Ra-Ra+1)	18.09	18.36	17.66	18.17	16.98		
Load at top of GP (kips)	Qg	qg*Ag	39.5	40.1	38.5	39.6	37.0		

SHAFT LENGTH REQUIREMENTS

Depth of Embedment	Df		5.0	3.8	3.8	3.3	3.3		
Trial shaft length (ft)	Hs		9.5	9.5	9.5	9.5	7.8		
Drill depth (ft)	Hdrill	Df+Hs	15	13	13	13	11		
Frictional resistance force (kips)	Qs	fs*pi*d*Hs	63	60	60	58	46		
Allowable tensile resistance (kips)	Qsall	Qs/2	32	30	30	29	23		
Allowable end-bearing rest. (kips)	Qeb	Qeb	12	12	12	12	12		
Is shaft long enough?		Qs+Qeb>Pcdem?	**ok**	**ok**	**ok**	**ok**	**ok**		

INPUT PARAMETER VALUES:

Upper Zone Elastic Parameters		
Parameter	Sym	Val
Pier Modulus Layer 1 (ksf)	Eg1	3750
Pier Modulus Layer 2 (ksf)	Eg2	3750
Pier Modulus Layer 3 (ksf)	Eg3	3750
Pier Modulus Layer 4 (ksf)	Eg4	3750
Pier Modulus Layer 5 (ksf)	Eg5	3750
Soil Modulus Layer 1 (ksf)	Em1	375
Soil Modulus Layer 2 (ksf)	Em2	375
Soil Modulus Layer 3 (ksf)	Em3	375
Soil Modulus Layer 4 (ksf)	Em4	375
Soil Modulus Layer 5 (ksf)	Em5	375

UPPER ZONE SETTLEMENT - SQUARE FOOTINGS

Parameter	**Symb**	Equation							
UZ Settlement Approach		1-Stiffness, 2-Modulus	1	1	1	1	1		
Thickness of UZ sublayer 1(ft)	H_{uz1}								
Thickness of UZ sublayer 2 (ft)	H_{uz2}								
Thickness of UZ sublayer 3 (ft)	H_{uz3}								
Thickness of UZ sublayer 4 (ft)	H_{uz4}								
Thickness of UZ sublayer 5 (ft)	H_{uz5}								
Total UZ Thickness OK?		Huz = Hs + d							
Composite Modulus Layer 1 (ksf)	E_{comp1}	Eg1Ra + Em1(1-Ra)							
Composite Modulus Layer 2 (ksf)	E_{comp2}	Eg2Ra + Em2(1-Ra)							
Composite Modulus Layer 3 (ksf)	E_{comp3}	Eg3Ra + Em3(1-Ra)							
Composite Modulus Layer 4 (ksf)	E_{comp4}	Eg4Ra + Em4(1-Ra)							
Composite Modulus Layer 5 (ksf)	E_{comp5}	Eg5Ra + Em5(1-Ra)							
Sett. of LZ sublayer 1 (in)	s_{uz1}	qg/kg or q*Is-vag*H/Ecomp	0.50	0.51	0.49	0.50	0.47		
Sett. of LZ sublayer 2 (in)	s_{uz2}	$q*Is-2*H_{uz2}/E_{comp2}$	N/A	N/A	N/A	N/A	N/A		
Sett. of LZ sublayer 3 (in)	s_{uz3}	$q*Is-3*H_{uz3}/E_{comp3}$	N/A	N/A	N/A	N/A	N/A		
Sett. of LZ sublayer 4 (in)	s_{uz4}	$q*Is-4*H_{uz4}/E_{comp4}$	N/A	N/A	N/A	N/A	N/A		
Sett. of LZ sublayer 5 (in)	s_{uz5}	$q*Is-5*H_{uz5}/E_{comp5}$	N/A	N/A	N/A	N/A	N/A		
Total Upper Zone Settlement (in)	s_{uz}	qg/kg	0.50	0.51	0.49	0.50	0.47		

INPUT PARAMETER VALUES:

Parameter	Symb	Val.
Allowable end-bearing (kips)	Qeb	12
E or c_ε for LZ sublyr 1	E_1 / $c_{\varepsilon1}$	5000
E or c_ε for LZ sublyr 2	E_2 / $c_{\varepsilon2}$	5000
E or c_ε for LZ sublyr 3	E_3 / $c_{\varepsilon3}$	5000
E or c_ε for LZ sublyr 4	E_4 / $c_{\varepsilon4}$	5000
E or c_ε for LZ sublyr 5	E_5 / $c_{\varepsilon5}$	5000
Calc. settlement to X*B	X	2

LOWER ZONE SETTLEMENTS - SQUARE FOOTINGS

Parameter	Symb	Equation	F13 A/1	F10 1 Line	F10 1.5 Line	F10 A/2	F8 H/2		
Dpth to bottm of LZ from ftg (ft)	X*B	X*B	26	20	20	20	16		
Upper zone thickness (ft)	H_{uz}	Hs+d	11.2	11.2	11.2	11.2	9.5		
Lower zone thickness (ft)	H_{lz}	H2b-Hlz	14.9	8.9	8.9	8.9	6.6		
Thickness of LZ sublayer 1(ft)	H_{lz1}		2.98	1.78	1.78	1.78	1.32		
Thickness of LZ sublayer 2 (ft)	H_{lz2}		2.98	1.78	1.78	1.78	1.32		
Thickness of LZ sublayer 3 (ft)	H_{lz3}		2.98	1.78	1.78	1.78	1.32		
Thickness of LZ sublayer 4 (ft)	H_{lz4}		2.98	1.78	1.78	1.78	1.32		
Thickness of LZ sublayer 5 (ft)	H_{lz5}		2.98	1.78	1.78	1.78	1.32		
Total LZ thickness ok?			**ok**	**ok**	**ok**	**ok**	**ok**		
E or c_ε for LZ sublyr 1	E_1 / $c_{\varepsilon1}$	E (ksf) or c_ε	5000	5000	5000	5000	5000		
E or c_ε for LZ sublyr 2	E_2 / $c_{\varepsilon2}$	E (ksf) or c_ε	5000	5000	5000	5000	5000		
E or c_ε for LZ sublyr 3	E_3 / $c_{\varepsilon3}$	E (ksf) or c_ε	5000	5000	5000	5000	5000		
E or c_ε for LZ sublyr 4	E_4 / $c_{\varepsilon4}$	E (ksf) or c_ε	5000	5000	5000	5000	5000		
E or c_ε for LZ sublyr 5	E_5 / $c_{\varepsilon5}$	E (ksf) or c_ε	5000	5000	5000	5000	5000		
Initial stress for sublyr 1 (ksf)	P'_{o1}		1.641	1.540	1.540	1.506	1.394		
Initial stress for sublyr 2 (ksf)	P'_{o2}		1.813	1.642	1.642	1.608	1.471		
Initial stress for sublyr 3 (ksf)	P'_{o3}		1.984	1.745	1.745	1.711	1.547		
Initial stress for sublyr 4 (ksf)	P'_{o4}		2.156	1.847	1.847	1.813	1.623		
Initial stress for sublyr 5 (ksf)	P'_{o5}		2.328	1.950	1.950	1.916	1.699		
Ftg stress on sublyr 1 (ksf)	ΔP1	q*I	1.67	1.02	0.89	0.92	0.89		
Ftg stress on sublyr 2 (ksf)	ΔP2	q*I	1.22	0.82	0.72	0.74	0.73		
Ftg stress on sublyr 3 (ksf)	ΔP3	q*I	0.92	0.67	0.59	0.60	0.61		
Ftg stress on sublyr 4 (ksf)	ΔP4	q*I	0.71	0.56	0.49	0.50	0.51		
Ftg stress on sublyr 5 (ksf)	ΔP5	q*I	0.57	0.47	0.41	0.42	0.44		
Sett. of LZ sublayer 1 (in)	s_{lz1}	DP1*Hlz1/E1	0.01	0.00	0.00	0.00	0.00		
Sett. of LZ sublayer 2 (in)	s_{lz2}	DP2*Hlz2/E2	0.01	0.00	0.00	0.00	0.00		
Sett. of LZ sublayer 3 (in)	s_{lz3}	DP3*Hlz3/E3	0.01	0.00	0.00	0.00	0.00		
Sett. of LZ sublayer 4 (in)	s_{lz4}	DP4*Hlz4/E4	0.01	0.00	0.00	0.00	0.00		
Sett. of LZ sublayer 5 (in)	s_{lz5}	DP5*Hlz5/E5	0.00	0.00	0.00	0.00	0.00		
Total lower zone sett. (in)	s_{lz}	$s_{lz1}+s_{lz2}+s_{lz3}+s_{lz4}+s_{lz5}$	0.0	0.0	0.0	0.0	0.0		
Total UZ + LZ settlement (in)	s		0.5	0.5	0.5	0.5	0.5		

***GEOPIER*® Foundation Company**

Project: **Mixed Use Development, Portland, ME** Garage

No.: GNE-01207

Engnr: CJD/JBF/JRW MTOPS = 18.9 ksf

Date: 3/4/2016

GEOPIER®

CONTINUOUS FOOTINGS

Version 3.0.6 August 2013

INPUT PARAMETER VALUES:

Parameter	Symb	Val.
RAP diameter (in)	d	20
Depth to groundwater (ft)	dgw	10
Total unit weight of soil (pcf)	g	120
Soil frict. angle (degr)	f	28
Max. hor. pressure (psf)	pmax	2500
From Table 4.2:		
RAP cell cap. (kips)	Qcell	70
Footing bearing press. (ksf)	qall	4
RAP stiffn. modulus (pci)	kg	250
Soil stiffness modulus (pci)	km	25

TOP OF PIER STRESS - CONTINUOUS FOOTINGS

Parameter	Symb	Equation	North Wall
Wall Load (kips/ft)	p		11
Estimated Geopier spacing (ft)	sreq	Qcell/p	6.36
Selected Geopier spacing (ft)	s		8
Estimated footing width (ft)	Breq	p/qall	2.75
Selected footing width (ft)	B		5.5
Contact pressure (ksf)	q	p/B	2.00
Area replacement ratio	Ra	Ag/(B*s)	0.050
Stiffness ratio	Rs	kg/km	10.0
Stress at top of GP (ksf)	qg	q*Rs/(Rs*Ra-Ra+1)	13.83
Load at top of GP (kips)	Qg	qg*Ag	30.2

SHAFT LENGTH REQUIREMENTS

Depth of Embedment	Df		2.9
Trial shaft length (ft)	Hs		9.5
Drill depth (ft)	Hdrill	Df+Hs	12
Frictional resistance force (kips)	Qs	fs*pi*d*Hs	56
Allowable tensile resistance (kips)	Qsall	Qs/2	28
Allowable end-bearing rest. (kips)	Qeb	Qeb	12
Is shaft long enough?		Qs+Qeb>Pcdem?	**ok**

INPUT PARAMETER VALUES:

Upper Zone Elastic Parameters		
Parameter	Sym	Val
Pier Modulus Layer 1 (ksf)	Eg1	3750
Pier Modulus Layer 2 (ksf)	Eg2	3750
Pier Modulus Layer 3 (ksf)	Eg3	3750
Pier Modulus Layer 4 (ksf)	Eg4	3750
Pier Modulus Layer 5 (ksf)	Eg5	3750
Soil Modulus Layer 1 (ksf)	Em1	375
Soil Modulus Layer 2 (ksf)	Em2	375
Soil Modulus Layer 3 (ksf)	Em3	375
Soil Modulus Layer 4 (ksf)	Em4	375
Soil Modulus Layer 5 (ksf)	Em5	375

UPPER ZONE SETTLEMENT - CONTINUOUS FOOTINGS

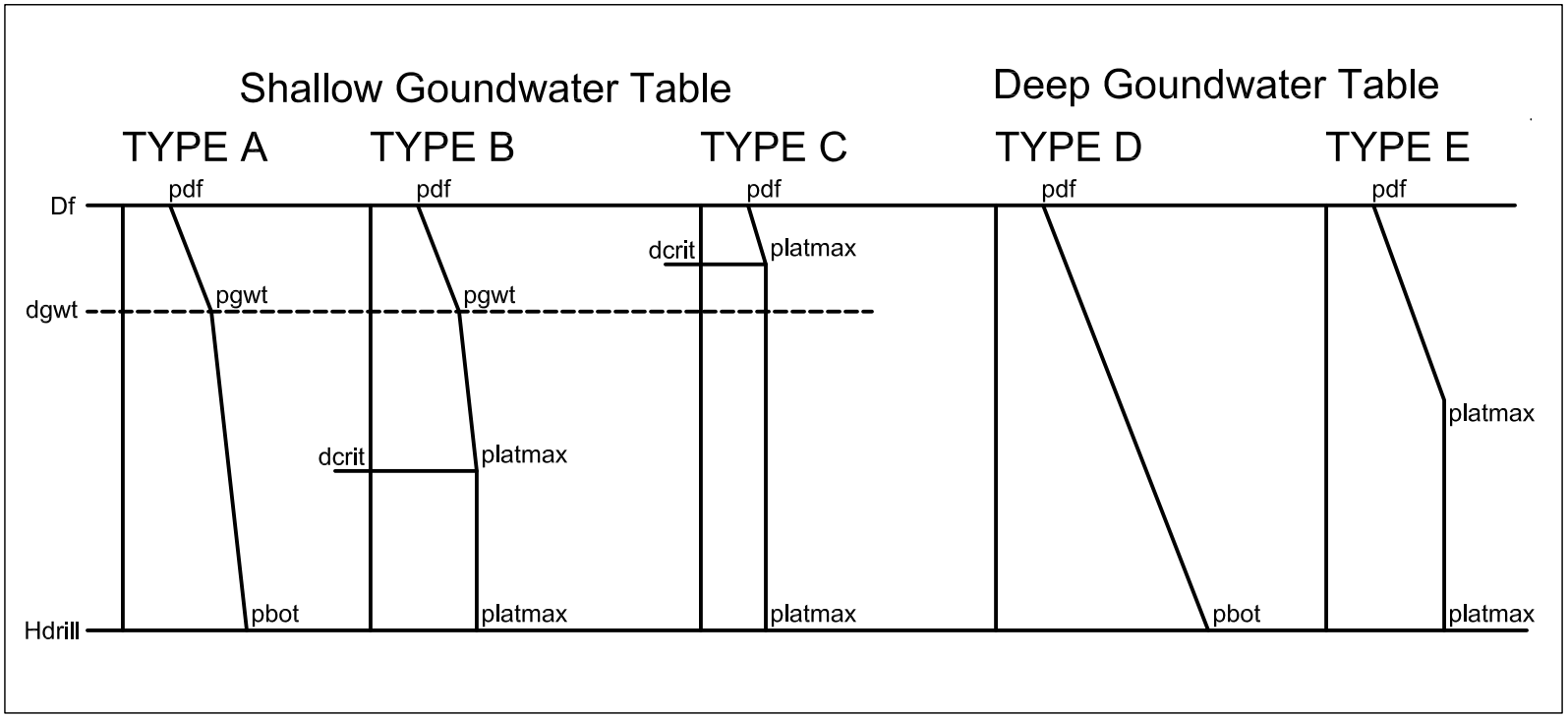
Parameter	**Symb**	Equation	
UZ Settlement Approach		1-Stiffness, 2-Modulus	1
Thickness of UZ sublayer 1(ft)	H_{uz1}		
Thickness of UZ sublayer 2 (ft)	H_{uz2}		
Thickness of UZ sublayer 3 (ft)	H_{uz3}		
Thickness of UZ sublayer 4 (ft)	H_{uz4}		
Thickness of UZ sublayer 5 (ft)	H_{uz5}		
Total UZ Thickness OK?		Huz = Hs +d	
Composite Modulus Layer 1 (ksf)	E_{comp1}	Eg1Ra + Em1(1-Ra)	
Composite Modulus Layer 2 (ksf)	E_{comp2}	Eg2Ra + Em2(1-Ra)	
Composite Modulus Layer 3 (ksf)	E_{comp3}	Eg3Ra + Em3(1-Ra)	
Composite Modulus Layer 4 (ksf)	E_{comp4}	Eg4Ra + Em4(1-Ra)	
Composite Modulus Layer 5 (ksf)	E_{comp5}	Eg5Ra + Em5(1-Ra)	
Sett. of LZ sublayer 1 (in)	s_{uz1}	qg/kg or q*Is-vag*H/Ecomp	0.38
Sett. of LZ sublayer 2 (in)	s_{uz2}	$q*Is-2*H_{uz2}/E_{comp2}$	N/A
Sett. of LZ sublayer 3 (in)	s_{uz3}	$q*Is-3*H_{uz3}/E_{comp3}$	N/A
Sett. of LZ sublayer 4 (in)	s_{uz4}	$q*Is-4*H_{uz4}/E_{comp4}$	N/A
Sett. of LZ sublayer 5 (in)	s_{uz5}	$q*Is-5*H_{uz5}/E_{comp5}$	N/A
Total Upper Zone Settlement (in)	s_{uz}	qg/kg	0.38

INPUT PARAMETER VALUES:

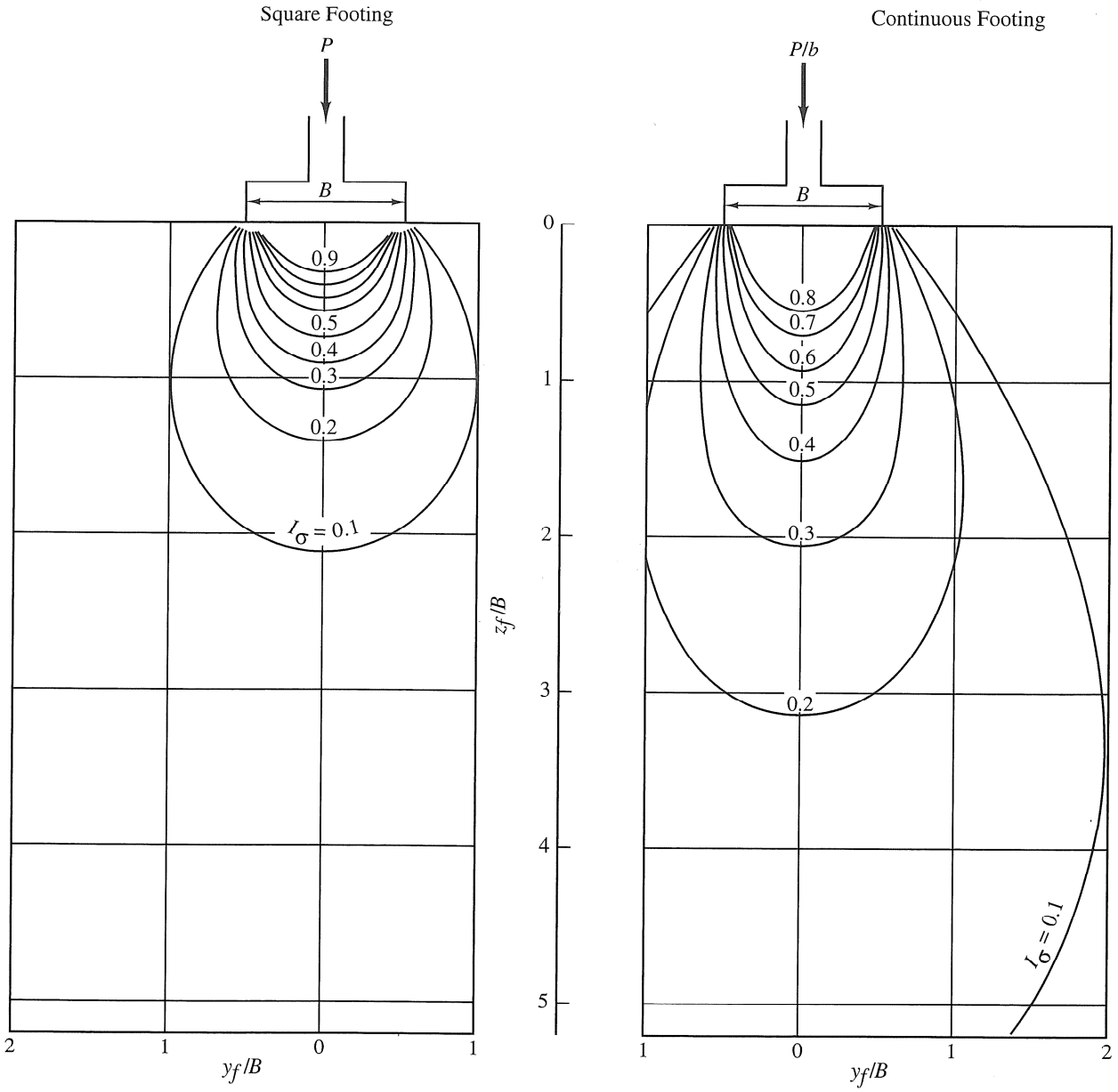
Parameter	Symb	Val.
Allowable end-bearing (kips)	Qeb	12
E or c_ε for LZ sublyr 1	E_1 / $c_{\varepsilon 1}$	5000
E or c_ε for LZ sublyr 2	E_2 / $c_{\varepsilon 2}$	5000
E or c_ε for LZ sublyr 3	E_3 / $c_{\varepsilon 3}$	5000
E or c_ε for LZ sublyr 4	E_4 / $c_{\varepsilon 4}$	5000
E or c_ε for LZ sublyr 5	E_5 / $c_{\varepsilon 5}$	5000
Calc. settlement to X*B	X	5

LOWER ZONE SETTLEMENTS

Parameter	Symb	Equation	North Wall
Dpth to bottm of LZ from ftg (ft)	X*B	X*B	27.5
Upper zone thickness (ft)	H_{uz}	Hs+d	11.2
Lower zone thickness (ft)	H_{lz}	H2b-Hlz	16.4
Thickness of LZ sublayer 1(ft)	H_{lz1}		3.28
Thickness of LZ sublayer 2 (ft)	H_{lz2}		3.28
Thickness of LZ sublayer 3 (ft)	H_{lz3}		3.28
Thickness of LZ sublayer 4 (ft)	H_{lz4}		3.28
Thickness of LZ sublayer 5 (ft)	H_{lz5}		3.28
Total thickness ok?			**ok**
E or c_ε for LZ sublyr 1	E_1 / $c_{\varepsilon 1}$	E (ksf) or c_ε	5000
E or c_ε for LZ sublyr 2	E_2 / $c_{\varepsilon 2}$	E (ksf) or c_ε	5000
E or c_ε for LZ sublyr 3	E_3 / $c_{\varepsilon 3}$	E (ksf) or c_ε	5000
E or c_ε for LZ sublyr 4	E_4 / $c_{\varepsilon 4}$	E (ksf) or c_ε	5000
E or c_ε for LZ sublyr 5	E_5 / $c_{\varepsilon 5}$	E (ksf) or c_ε	5000
Initial stress for sublyr 1 (ksf)	P'_{o1}		1.530
Initial stress for sublyr 2 (ksf)	P'_{o2}		1.719
Initial stress for sublyr 3 (ksf)	P'_{o3}		1.908
Initial stress for sublyr 4 (ksf)	P'_{o4}		2.097
Initial stress for sublyr 5 (ksf)	P'_{o5}		2.286
Ftg stress on sublyr 1 (ksf)	ΔP1	q*I	0.53
Ftg stress on sublyr 2 (ksf)	ΔP2	q*I	0.43
Ftg stress on sublyr 3 (ksf)	ΔP3	q*I	0.36
Ftg stress on sublyr 4 (ksf)	ΔP4	q*I	0.30
Ftg stress on sublyr 5 (ksf)	ΔP5	q*I	0.26
Sett. of LZ sublayer 1 (in)	s_{lz1}	DP1*Hlz1/E1	0.00
Sett. of LZ sublayer 2 (in)	s_{lz2}	DP2*Hlz2/E2	0.00
Sett. of LZ sublayer 3 (in)	s_{lz3}	DP3*Hlz3/E3	0.00
Sett. of LZ sublayer 4 (in)	s_{lz4}	DP4*Hlz4/E4	0.00
Sett. of LZ sublayer 5 (in)	s_{lz5}	DP5*Hlz5/E5	0.00
Total lower zone sett. (in)	s_{lz}	$s_{lz1}+s_{lz2}+s_{lz3}+s_{lz4}+s_{lz5}$	0.0
Total UZ + LZ settlement (in)	s		0.4



Lateral Earth Pressure Cases to Determine Average Earth Pressure



y_f = horizontal distance from centerline of footing
z_f = depth below bottom of footing
B = footing width
I_σ = stress inflence factor

Boussinesq Influence Chart (after Newmark)

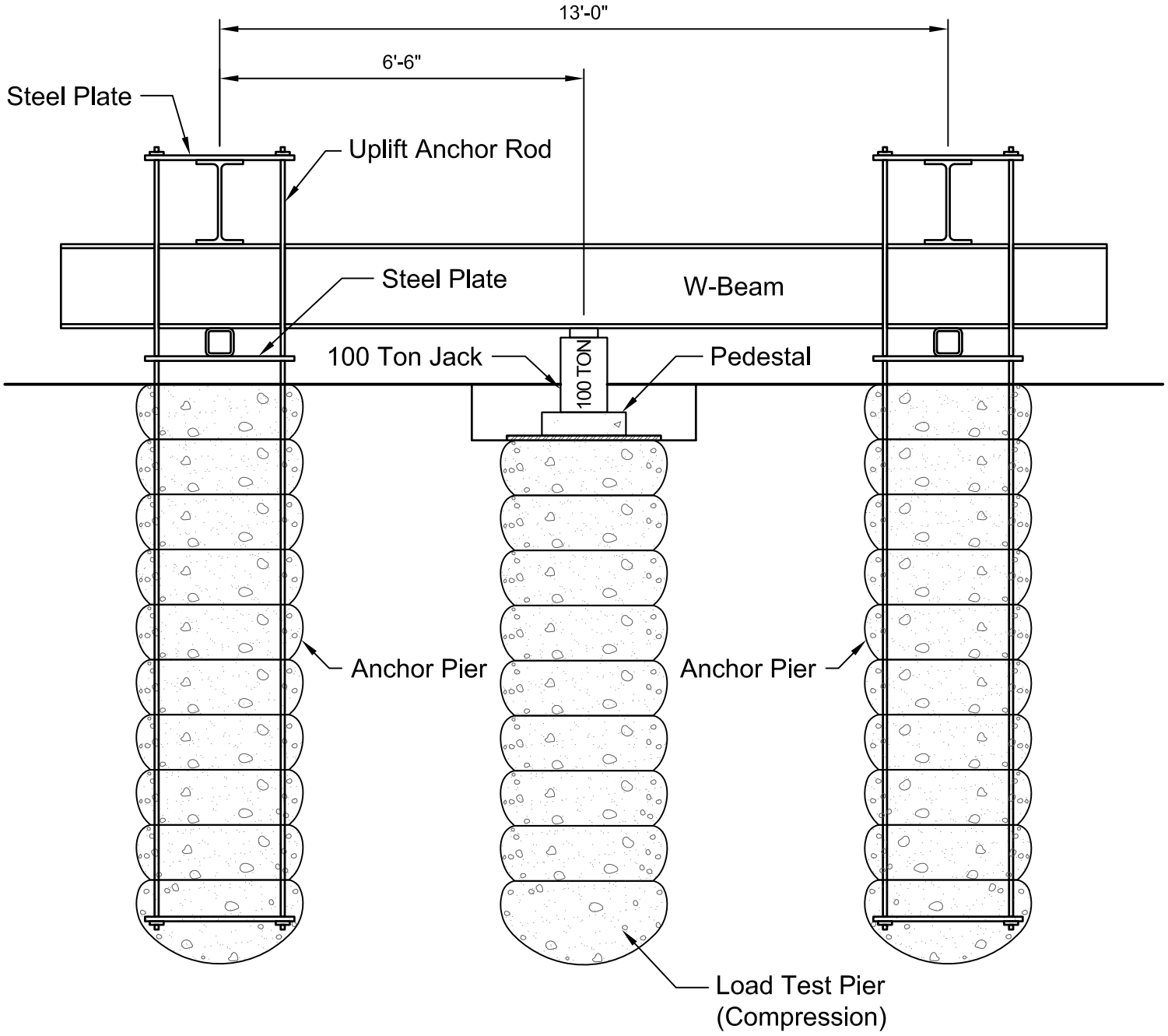
DESIGN/BUILD GEOTECHNICAL

GEOPIER®

Delivering the Geopier Foundation System

Design Submittal for Geopier Ground Support
Mixed Use Development
Portland, ME

Attachment B:
Geopier Element Modulus Test Forms



Typical Modulus Load Test Setup

At the discretion of the Geopier Installer, Helical Anchors or dead weight may be substituted for Anchor Piers

DESIGN/BUILD GEOTECHNICAL

Representing *GEOPIER* Foundation Company - GNE

GEOPIER®

GEOPIER MODULUS LOAD TEST SCHEDULE

Project Number: GNE-01207
Project Name: Mixed Use Development
Project Location: Portland, ME
Date: 3/4/2016

Maximum *GEOPIER* Design Stress: 18,920 psf — Maximum top-of pier stress estimated at F10 Footing located at D/8, piers 240 to 244
Geopier Diameter: 20 in.
Pier Area: 2.18 sf

Load No.	Ram Load, (tons)	Geopier Stress, (psf)	Percent of Design Stress	Minimum Duration	Maximum Duration	Remarks
	1.03	946	5.0%	N/A	N/A	Seating load
1	3.44	3,154	16.7%	15 min	60 min	
2	6.88	6,306	33.3%	15 min	60 min	
3	10.32	9,460	50.0%	15 min	60 min	
4	13.76	12,614	66.7%	15 min	60 min	
5	17.20	15,766	83.3%	15 min	60 min	
6	20.64	18,920	100.0%	15 min	60 min	
7	24.07	22,068	116.6%	60 min	240 min	Creep $\leq$ 0.01 in/hr
8	27.52	25,226	133.3%	15 min	60 min	
9	30.96	28,380	150.0%	15 min	60 min	
10	20.64	18,920	100.0%	N/A	N/A	Rebound, unload
11	13.62	12,487	66.0%	N/A	N/A	Rebound, unload
12	6.81	6,244	33.0%	N/A	N/A	Rebound, unload
13	1.03	946	5.0%	N/A	N/A	Rebound, unload

Notes:

1 - The Geopier element to be used in the modulus load testing should be a Rammed Aggregate Pier installed in a manner similar to production. The modulus load test should be performed in a non-organic soil area in accessible location within or close to the building footprint and preferably close to boring B-205, B-207, probe P-212, Probe 214 or probe P-215 that is agreeable to the general contractor and the engineer.

2 - The modulus load test shall be performed to a stress not less than 150% of the design maximum top-of-Geopier stress indicated in the Geopier Design Calculations.

3 - The modulus load test Geopier element shall be installed from the proposed working grade at El. 29.5 to a depth consistent with the nearby Geopier elements that have been summarized on the Geopier Schedule with a base constructed at bedrock or at practical refusal on hard till.

4 - One telltale shall be installed at the base of pier. Telltale deflections shall be monitored concurrent with top of Geopier deflections during the modulus load test.

5 - The modulus load test setup shall be as shown on the attached sketch "Typical Modulus Load Test Setup". At the discretion of the Geopier Installer, helical anchors or dead weight may be used in lieu of uplift Geopiers to provide adequate reaction during modulus load testing.

6 - A representative of the owner's geotechnical consultant should be present to witness the load test.

DESIGN/BUILD GEOTECHNICAL

GEOPIER®

Delivering the Geopier Foundation System

Design Submittal for Geopier Ground Support
Mixed Use Development
Portland, ME

Attachment C:
Geopier Location Plan, Construction Notes & Specifications

(See enclosed GEO-Series Drawings)

DESIGN/BUILD GEOTECHNICAL

GEOPIER®

Delivering the Geopier Foundation System

Design Submittal for Geopier Ground Support
Mixed Use Development
Portland, ME

Attachment D:
Geopier Schedule and Quality Control Forms

DESIGN/BUILD GEOTECHNICAL

Representing *Geopier* Foundation Company - GNE

GEOPIER®

GEOPIER SCHEDULE

Project Number: GNE-01207
Project Name: Mixed Use Development
Project Location: Portland, ME
Date: 3/4/2016

FF Elev, Structural
FF Elev. Civil VARIES

RETAIL BUILDING

Pier		Design	Footing Design Data, ft			Design Installation Data, ft				Proposed Geopier Geometry		
No.	Type	Capacity kg, kips	Type	Depth Below FFE	Bottom Elev.	Surface Elev.	Est. Drill Depth	Calc. Top Depth	Top Depth	Bottom El, ft	Top El, ft.	Shaft Length, ft
1	RAP	70	F6	2.83	27.17	29.5	15	1.3	1.3	15.0	27.17	12.2
2	RAP	70	F6	2.83	27.17	29.5	15	1.3	1.3	15.0	27.17	12.2
3	RAP	70	Strip	4.66	25.34	29.5	15	3.2	3.2	15.0	25.34	10.3
4	RAP	70	F6	5.16	24.84	29.5	17	3.7	3.7	13.0	24.84	11.8
5	RAP	70	F6	5.16	24.84	29.5	17	3.7	3.7	13.0	24.84	11.8
6	RAP	70	F6	5.16	24.84	29.5	17	3.7	3.7	13.0	24.84	11.8
7	RAP	70	Strip	6.00	24.00	29.5	17	4.5	4.5	13.0	24.00	11.0
8	RAP	70	Strip	5.50	24.00	29.5	17	4.5	4.5	13.0	24.00	11.0
9	RAP	70	F6	6.00	23.50	29.5	19	5.0	5.0	11.0	23.50	12.5
10	RAP	70	F6	6.00	23.50	29.5	19	5.0	5.0	11.0	23.50	12.5
11	RAP	70	F6	6.00	23.50	29.5	19	5.0	5.0	11.0	23.50	12.5
12	RAP	70	F7	6.34	23.16	29.5	19	5.3	5.3	11.0	23.16	12.2
13	RAP	70	F7	6.34	23.16	29.5	19	5.3	5.3	11.0	23.16	12.2
14	RAP	70	F7	6.34	23.16	29.5	19	5.3	5.3	11.0	23.16	12.2
15	RAP	70	F4.5	4.00	26.00	29.5	19	2.5	2.5	11.0	26.00	15.0
16	RAP	70	F4.5	4.00	26.00	29.5	19	2.5	2.5	11.0	26.00	15.0
17	RAP	70	F8	6.67	22.83	29.5	19	5.7	5.7	11.0	22.83	11.8
18	RAP	70	F8	6.67	22.83	29.5	19	5.7	5.7	11.0	22.83	11.8
19	RAP	70	F8	6.67	22.83	29.5	19	5.7	5.7	11.0	22.83	11.8
20	RAP	70	Strip	5.50	24.00	29.5	19	4.5	4.5	11.0	24.00	13.0
21	RAP	70	Strip	5.50	24.00	29.5	19	4.5	4.5	11.0	24.00	13.0
22	RAP	70	F4.5	5.67	23.83	29.5	19	4.7	4.7	11.0	23.83	12.8
23	RAP	70	Strip	5.50	24.00	29.5	19	4.5	4.5	11.0	24.00	13.0
24	RAP	70	Strip	5.50	24.00	29.5	19	4.5	4.5	11.0	24.00	13.0
25	RAP	70	F8	6.67	22.83	29.5	19	5.7	5.7	11.0	22.83	11.8
26	RAP	70	F8	6.67	22.83	29.5	19	5.7	5.7	11.0	22.83	11.8
27	RAP	70	F8	6.67	22.83	29.5	19	5.7	5.7	11.0	22.83	11.8
28	RAP	70	F8	6.67	22.83	29.5	19	5.7	5.7	11.0	22.83	11.8
29	RAP	70	Strip	5.50	24.00	29.5	19	4.5	4.5	11.0	24.00	13.0
30	RAP	70	Strip	5.50	24.00	29.5	19	4.5	4.5	11.0	24.00	13.0
31	RAP	70	F6	6.00	23.50	29.5	19	5.0	5.0	11.0	23.50	12.5
32	RAP	70	F6	6.00	23.50	29.5	19	5.0	5.0	11.0	23.50	12.5
33	RAP	70	Strip	5.50	24.00	29.5	19	4.5	4.5	11.0	24.00	13.0
34	RAP	70	F7	6.34	23.16	29.5	19	5.3	5.3	11.0	23.16	12.2
35	RAP	70	F7	6.34	23.16	29.5	19	5.3	5.3	11.0	23.16	12.2
36	RAP	70	F7	6.34	23.16	29.5	19	5.3	5.3	11.0	23.16	12.2
37	RAP	70	Strip	5.50	24.00	29.5	19	4.5	4.5	11.0	24.00	13.0
38	RAP	70	F6	6.00	23.50	29.5	19	5.0	5.0	11.0	23.50	12.5
39	RAP	70	F6	6.00	23.50	29.5	19	5.0	5.0	11.0	23.50	12.5
40	RAP	70	Strip	5.50	24.00	29.5	19	4.5	4.5	11.0	24.00	13.0
41	RAP	70	Strip	5.50	24.00	29.5	19	4.5	4.5	11.0	24.00	13.0
42	RAP	70	F9	6.67	22.83	29.5	19	5.7	5.7	11.0	22.83	11.8
43	RAP	70	F9	6.67	22.83	29.5	19	5.7	5.7	11.0	22.83	11.8
44	RAP	70	F9	6.67	22.83	29.5	19	5.7	5.7	11.0	22.83	11.8
45	RAP	70	F9	6.67	22.83	29.5	19	5.7	5.7	11.0	22.83	11.8
46	RAP	70	Strip	4.74	25.34	29.5	19	3.2	3.2	11.0	25.34	14.3
47	RAP	70	F4	4.91	25.17	29.5	19	3.3	3.3	11.0	25.17	14.2
48	RAP	70	Strip	4.74	25.34	29.5	19	3.2	3.2	11.0	25.34	14.3
49	RAP	70	F7	5.58	24.50	29.5	19	4.0	4.0	11.0	24.50	13.5
50	RAP	70	F7	5.58	24.50	29.5	19	4.0	4.0	11.0	24.50	13.5

DESIGN/BUILD GEOTECHNICAL

Representing *Geopier* Foundation Company - GNE

GEOPIER®

GEOPIER SCHEDULE

Project Number: GNE-01207
Project Name: Mixed Use Development
Project Location: Portland, ME
Date: 3/4/2016

FF Elev, Structural
FF Elev. Civil VARIES

RETAIL BUILDING

Pier		Design	Footing Design Data, ft			Design Installation Data, ft				Proposed Geopier Geometry		
No.	Type	Capacity kg, kips	Type	Depth Below FFE	Bottom Elev.	Surface Elev.	Est. Drill Depth	Calc. Top Depth	Top Depth	Bottom El, ft	Top El, ft.	Shaft Length, ft
51	RAP	70	F7	5.58	24.50	29.5	19	4.0	4.0	11.0	24.50	13.5
52	RAP	70	Strip	4.74	25.34	29.5	19	3.2	3.2	11.0	25.34	14.3
53	RAP	70	F6	5.24	24.84	29.5	19	3.7	3.7	11.0	24.84	13.8
54	RAP	70	F6	5.24	24.84	29.5	19	3.7	3.7	11.0	24.84	13.8
55	RAP	70	Strip	4.74	25.34	29.5	19	3.2	3.2	11.0	25.34	14.3
56	RAP	70	F7	5.58	24.50	29.5	19	4.0	4.0	11.0	24.50	13.5
57	RAP	70	F7	5.58	24.50	29.5	19	4.0	4.0	11.0	24.50	13.5
58	RAP	70	F7	5.58	24.50	29.5	19	4.0	4.0	11.0	24.50	13.5
59	RAP	70	Strip	4.74	25.34	29.5	19	3.2	3.2	11.0	25.34	14.3
60	RAP	70	F4	4.25	25.83	29.5	19	2.7	2.7	11.0	25.83	14.8
61	RAP	70	Strip	4.08	26.00	29.5	19	2.5	2.5	11.0	26.00	15.0
62	RAP	70	Strip	4.08	26.00	29.5	19	2.5	2.5	11.0	26.00	15.0
63	RAP	70	F9	5.25	24.83	29.5	19	3.7	3.7	11.0	24.83	13.8
64	RAP	70	F9	5.25	24.83	29.5	19	3.7	3.7	11.0	24.83	13.8
65	RAP	70	F9	5.25	24.83	29.5	19	3.7	3.7	11.0	24.83	13.8
66	RAP	70	F9	5.25	24.83	29.5	19	3.7	3.7	11.0	24.83	13.8
67	RAP	70	Strip	4.67	26.00	29.5	19	2.5	2.5	11.0	26.00	15.0
68	RAP	70	F6	5.17	25.50	29.5	19	3.0	3.0	11.0	25.50	14.5
69	RAP	70	F6	5.17	25.50	29.5	19	3.0	3.0	11.0	25.50	14.5
70	RAP	70	Strip	4.67	26.00	29.5	19	2.5	2.5	11.0	26.00	15.0
71	RAP	70	Strip	4.67	26.00	29.5	19	2.5	2.5	11.0	26.00	15.0
72	RAP	70	F4	4.84	25.83	29.5	19	2.7	2.7	11.0	25.83	14.8
73	RAP	70	Strip	4.67	26.00	29.5	19	2.5	2.5	11.0	26.00	15.0
74	RAP	70	Strip	4.67	26.00	29.5	19	2.5	2.5	11.0	26.00	15.0
75	RAP	70	F6	5.24	24.83	29.5	19	3.7	3.7	11.0	24.83	13.8
76	RAP	70	F6	5.24	24.83	29.5	19	3.7	3.7	11.0	24.83	13.8
77	RAP	70	Strip	2.67	28.00	29.5	19	0.5	0.5	11.0	28.00	17.0
78	RAP	70	Strip	2.67	28.00	29.5	19	0.5	0.5	11.0	28.00	17.0
79	RAP	70	F8	2.84	27.83	29.5	19	0.7	0.7	11.0	27.83	16.8
80	RAP	70	F8	2.84	27.83	29.5	19	0.7	0.7	11.0	27.83	16.8
81	RAP	70	F8	2.84	27.83	29.5	19	0.7	0.7	11.0	27.83	16.8
82	RAP	70	F8	2.84	27.83	29.5	19	0.7	0.7	11.0	27.83	16.8
83	RAP	70	RW	2.34	28.33	29.5	19	0.2	0.2	11.0	28.33	17.3
84	RAP	70	RW	2.34	28.33	29.5	19	0.2	0.2	11.0	28.33	17.3
85	RAP	70	RW	2.34	28.33	29.5	19	0.2	0.2	11.0	28.33	17.3
86	RAP	70	RW	2.34	28.33	29.5	19	0.2	0.2	11.0	28.33	17.3
87	RAP	70	RW	2.34	28.33	29.5	19	0.2	0.2	11.0	28.33	17.3
88	RAP	70	RW	2.34	28.33	29.5	19	0.2	0.2	11.0	28.33	17.3
89	RAP	70	RW	2.34	28.33	29.5	17	0.2	0.2	13.0	28.33	15.3
90	RAP	70	RW	2.34	28.33	29.5	17	0.2	0.2	13.0	28.33	15.3
91	RAP	70	RW	2.34	28.33	29.5	17	0.2	0.2	13.0	28.33	15.3
92	RAP	70	RW	2.34	28.33	29.5	17	0.2	0.2	13.0	28.33	15.3
93	RAP	70	RW	2.34	28.33	29.5	15	0.2	0.2	15.0	28.33	13.3
94	RAP	70	RW	2.34	28.33	29.5	15	0.2	0.2	15.0	28.33	13.3
95	RAP	70	RW	2.34	28.33	29.5	13	0.2	0.2	17.0	28.33	11.3
96	RAP	70	RW	2.34	28.33	29.5	13	0.2	0.2	17.0	28.33	11.3
97	RAP	70	RW	2.34	28.33	29.5	13	0.2	0.2	17.0	28.33	11.3
98	RAP	70	RW	2.34	28.33	29.5	13	0.2	0.2	17.0	28.33	11.3
99	RAP	70	RW	2.34	28.33	29.5	11	0.2	0.2	19.0	28.33	9.3
100	RAP	70	RW	2.34	28.33	29.5	11	0.2	0.2	19.0	28.33	9.3

DESIGN/BUILD GEOTECHNICAL

Representing *Geopier* Foundation Company - GNE

GEOPIER®

GEOPIER SCHEDULE

Project Number: GNE-01207
Project Name: Mixed Use Development
Project Location: Portland, ME
Date: 3/4/2016

FF Elev, Structural
FF Elev. Civil VARIES

RETAIL BUILDING

Pier		Design	Footing Design Data, ft			Design Installation Data, ft				Proposed Geopier Geometry		
No.	Type	Capacity kg, kips	Type	Depth Below FFE	Bottom Elev.	Surface Elev.	Est. Drill Depth	Calc. Top Depth	Top Depth	Bottom El, ft	Top El, ft.	Shaft Length, ft
101	RAP	70	RW	2.34	28.33	29.5	11	0.2	0.2	19.0	28.33	9.3
102	RAP	70	RW	2.34	28.33	29.5	11	0.2	0.2	19.0	28.33	9.3
103	RAP	70	RW	2.34	28.33	29.5	11	0.2	0.2	19.0	28.33	9.3
104	RAP	70	RW	2.34	28.33	29.5	11	0.2	0.2	19.0	28.33	9.3
105	RAP	70	RW	2.34	28.33	29.5	11	0.2	0.2	19.0	28.33	9.3
106	RAP	70	RW	2.34	28.33	29.5	11	0.2	0.2	19.0	28.33	9.3
107	RAP	70	RW	2.84	27.83	29.5	11	0.7	0.7	19.0	27.83	8.8
108	RAP	70	RW	2.84	27.83	29.5	11	0.7	0.7	19.0	27.83	8.8
109	RAP	70	RW	2.84	27.83	29.5	11	0.7	0.7	19.0	27.83	8.8
110	RAP	70	RW	2.84	27.83	29.5	11	0.7	0.7	19.0	27.83	8.8
111	RAP	70	RW	2.84	27.83	29.5	11	0.7	0.7	19.0	27.83	8.8
112	RAP	70	RW	2.84	27.83	29.5	11	0.7	0.7	19.0	27.83	8.8
113	RAP	70	RW	2.34	28.33	29.5	11	0.2	0.2	19.0	28.33	9.3
114	RAP	70	RW	2.34	28.33	29.5	11	0.2	0.2	19.0	28.33	9.3
115	RAP	70	RW	2.34	28.33	29.5	11	0.2	0.2	19.0	28.33	9.3
116	RAP	70	RW	2.34	28.33	29.5	11	0.2	0.2	19.0	28.33	9.3
117	RAP	70	RW	2.84	27.83	29.5	11	0.7	0.7	19.0	27.83	8.8
118	RAP	70	RW	2.84	27.83	29.5	11	0.7	0.7	19.0	27.83	8.8
119	RAP	70	RW	2.84	27.83	29.5	11	0.7	0.7	19.0	27.83	8.8
120	RAP	70	RW	2.84	27.83	29.5	11	0.7	0.7	19.0	27.83	8.8
121	RAP	70	RW	2.84	27.83	29.5	11	0.7	0.7	19.0	27.83	8.8
122	RAP	70	RW	2.84	27.83	29.5	11	0.7	0.7	19.0	27.83	8.8
123	RAP	70	RW	2.34	28.33	29.5	11	0.2	0.2	19.0	28.33	9.3
124	RAP	70	RW	2.34	28.33	29.5	11	0.2	0.2	19.0	28.33	9.3
125	RAP	70	RW	2.34	28.33	29.5	11	0.2	0.2	19.0	28.33	9.3
126	RAP	70	RW	2.34	28.33	29.5	11	0.2	0.2	19.0	28.33	9.3
127	RAP	70	RW	2.67	26.83	29.5	11	1.7	1.7	19.0	26.83	7.8
128	RAP	70	RW	2.67	26.83	29.5	11	1.7	1.7	19.0	26.83	7.8
129	RAP	70	RW	2.67	26.83	29.5	11	1.7	1.7	19.0	26.83	7.8
130	RAP	70	RW	2.67	26.83	29.5	11	1.7	1.7	19.0	26.83	7.8
131	RAP	70	RW	2.67	26.83	29.5	11	1.7	1.7	19.0	26.83	7.8
132	RAP	70	RW	2.67	26.83	29.5	11	1.7	1.7	19.0	26.83	7.8
133	RAP	70	RW	2.17	27.33	29.5	11	1.2	1.2	19.0	27.33	8.3
134	RAP	70	RW	2.17	27.33	29.5	11	1.2	1.2	19.0	27.33	8.3
135	RAP	70	RW	2.17	27.33	29.5	11	1.2	1.2	19.0	27.33	8.3
136	RAP	70	RW	2.17	27.33	29.5	11	1.2	1.2	19.0	27.33	8.3
137	RAP	70	RW	2.67	26.83	29.5	11	1.7	1.7	19.0	26.83	7.8
138	RAP	70	RW	2.67	26.83	29.5	11	1.7	1.7	19.0	26.83	7.8
139	RAP	70	RW	2.67	26.83	29.5	11	1.7	1.7	19.0	26.83	7.8
140	RAP	70	RW	2.67	26.83	29.5	11	1.7	1.7	19.0	26.83	7.8
141	RAP	70	RW	2.67	26.83	29.5	11	1.7	1.7	19.0	26.83	7.8
142	RAP	70	RW	2.67	26.83	29.5	11	1.7	1.7	19.0	26.83	7.8
143	RAP	70	RW	2.17	27.33	29.5	11	1.2	1.2	19.0	27.33	8.3
144	RAP	70	RW	2.17	27.33	29.5	11	1.2	1.2	19.0	27.33	8.3
145	RAP	70	RW	2.17	27.33	29.5	11	1.2	1.2	19.0	27.33	8.3
146	RAP	70	RW	2.17	27.33	29.5	11	1.2	1.2	19.0	27.33	8.3
147	RAP	70	RW	2.67	26.83	29.5	11	1.7	1.7	19.0	26.83	7.8
148	RAP	70	RW	2.67	26.83	29.5	11	1.7	1.7	19.0	26.83	7.8
149	RAP	70	RW	2.67	26.83	29.5	11	1.7	1.7	19.0	26.83	7.8
150	RAP	70	RW	2.67	26.83	29.5	11	1.7	1.7	19.0	26.83	7.8

GEOPIER SCHEDULE

Project Number: GNE-01207
Project Name: Mixed Use Development
Project Location: Portland, ME
Date: 3/4/2016

FF Elev, Structural
FF Elev. Civil VARIES

RETAIL BUILDING

Pier		Design	Footing Design Data, ft			Design Installation Data, ft				Proposed Geopier Geometry		
No.	Type	Capacity kg, kips	Type	Depth Below FFE	Bottom Elev.	Surface Elev.	Est. Drill Depth	Calc. Top Depth	Top Depth	Bottom El, ft	Top El, ft.	Shaft Length, ft
151	RAP	70	RW	2.67	26.83	29.5	11	1.7	1.7	19.0	26.83	7.8
152	RAP	70	RW	2.67	26.83	29.5	11	1.7	1.7	19.0	26.83	7.8
153	RAP	70	RW	2.17	27.33	29.5	11	1.2	1.2	19.0	27.33	8.3
154	RAP	70	RW	2.17	27.33	29.5	11	1.2	1.2	19.0	27.33	8.3
155	RAP	70	RW	2.17	27.33	29.5	11	1.2	1.2	19.0	27.33	8.3
156	RAP	70	RW	2.17	27.33	29.5	11	1.2	1.2	19.0	27.33	8.3
157	RAP	70	RW	2.17	27.33	29.5	11	1.2	1.2	19.0	27.33	8.3
158	RAP	70	RW	2.17	27.33	29.5	11	1.2	1.2	19.0	27.33	8.3
159	RAP	70	F10	2.84	26.66	29.5	11	1.8	1.8	19.0	26.66	7.7
160	RAP	70	F10	2.84	26.66	29.5	11	1.8	1.8	19.0	26.66	7.7
161	RAP	70	F10	2.84	26.66	29.5	11	1.8	1.8	19.0	26.66	7.7
162	RAP	70	F10	2.84	26.66	29.5	11	1.8	1.8	19.0	26.66	7.7
163	RAP	70	RW	2.75	27.25	29.5	11	1.3	1.3	19.0	27.25	8.3
164	RAP	70	F9	3.50	26.50	29.5	11	2.0	2.0	19.0	26.50	7.5
165	RAP	70	F9	3.50	26.50	29.5	11	2.0	2.0	19.0	26.50	7.5
166	RAP	70	F9	3.50	26.50	29.5	11	2.0	2.0	19.0	26.50	7.5
167	RAP	70	F9	3.50	26.50	29.5	11	2.0	2.0	19.0	26.50	7.5
168	RAP	70	RW	2.75	27.25	29.5	11	1.3	1.3	19.0	27.25	8.3
169	RAP	70	RW	2.75	27.25	29.5	11	1.3	1.3	19.0	27.25	8.3
170	RAP	70	RW	2.75	27.25	29.5	11	1.3	1.3	19.0	27.25	8.3
171	RAP	70	F9	3.50	26.50	29.5	13	2.0	2.0	17.0	26.50	9.5
172	RAP	70	F9	3.50	26.50	29.5	13	2.0	2.0	17.0	26.50	9.5
173	RAP	70	F9	3.50	26.50	29.5	13	2.0	2.0	17.0	26.50	9.5
174	RAP	70	F9	3.50	26.50	29.5	13	2.0	2.0	17.0	26.50	9.5
175	RAP	70	RW	2.75	27.25	29.5	13	1.3	1.3	17.0	27.25	10.3
176	RAP	70	RW	2.75	27.25	29.5	13	1.3	1.3	17.0	27.25	10.3
177	RAP	70	RW	2.75	27.25	29.5	13	1.3	1.3	17.0	27.25	10.3
178	RAP	70	F4	2.25	28.42	29.5	11	0.1	0.1	19.0	28.42	9.4
179	RAP	70	F4	2.25	28.42	29.5	11	0.1	0.1	19.0	28.42	9.4
180	RAP	70	F10	4.17	25.91	29.5	15	2.6	2.6	15.0	25.91	10.9
181	RAP	70	F10	4.17	25.91	29.5	15	2.6	2.6	15.0	25.91	10.9
182	RAP	70	F10	4.17	25.91	29.5	15	2.6	2.6	15.0	25.91	10.9
183	RAP	70	F10	4.17	25.91	29.5	15	2.6	2.6	15.0	25.91	10.9
184	RAP	70	F10	4.17	25.91	29.5	15	2.6	2.6	15.0	25.91	10.9
185	RAP	70	F10	4.17	25.91	29.5	15	2.6	2.6	15.0	25.91	10.9
186	RAP	70	F6	1.99	28.09	29.5	15	0.4	0.4	15.0	28.09	13.1
187	RAP	70	F6	1.99	28.09	29.5	15	0.4	0.4	15.0	28.09	13.1
188	RAP	70	F6	1.99	28.09	29.5	15	0.4	0.4	15.0	28.09	13.1
189	RAP	70	F8	2.66	27.42	29.5	17	1.1	1.1	13.0	27.42	14.4
190	RAP	70	F8	2.66	27.42	29.5	17	1.1	1.1	13.0	27.42	14.4
191	RAP	70	F8	2.66	27.42	29.5	17	1.1	1.1	13.0	27.42	14.4
192	RAP	70	F8	2.66	27.42	29.5	17	1.1	1.1	13.0	27.42	14.4
193	RAP	70	F4	5.00	25.67	29.5	13	2.8	2.8	17.0	25.67	8.7
194	RAP	70	F4	7.50	23.17	29.5	13	5.3	5.3	17.0	23.17	6.2
195	RAP	70	Elevator	5.00	25.67	29.5	13	2.8	2.8	17.0	25.67	8.7
196	RAP	70	Elevator	7.50	23.17	29.5	13	5.3	5.3	17.0	23.17	6.2
197	RAP	70	F4	4.41	25.67	29.5	15	2.8	2.8	15.0	25.67	10.7
198	RAP	70	F4	6.91	23.17	29.5	15	5.3	5.3	15.0	23.17	8.2
199	RAP	70	F6	4.74	25.34	29.5	15	3.2	3.2	15.0	25.34	10.3
200	RAP	70	F6	4.74	25.34	29.5	15	3.2	3.2	15.0	25.34	10.3

DESIGN/BUILD GEOTECHNICAL

Representing *Geopier* Foundation Company - GNE

GEOPIER®

GEOPIER SCHEDULE

Project Number: GNE-01207
Project Name: Mixed Use Development
Project Location: Portland, ME
Date: 3/4/2016

FF Elev, Structural
FF Elev. Civil VARIES

RETAIL BUILDING

Pier		Design	Footing Design Data, ft			Design Installation Data, ft				Proposed Geopier Geometry		
No.	Type	Capacity kg, kips	Type	Depth Below FFE	Bottom Elev.	Surface Elev.	Est. Drill Depth	Calc. Top Depth	Top Depth	Bottom El, ft	Top El, ft.	Shaft Length, ft
201	RAP	70	F7	2.33	27.75	29.5	17	0.8	0.8	13.0	27.75	14.8
202	RAP	70	F7	2.33	27.75	29.5	17	0.8	0.8	13.0	27.75	14.8
203	RAP	70	F7	2.33	27.75	29.5	17	0.8	0.8	13.0	27.75	14.8
204	RAP	70	F8	2.66	27.42	29.5	13	1.1	1.1	17.0	27.42	10.4
205	RAP	70	F8	2.66	27.42	29.5	13	1.1	1.1	17.0	27.42	10.4
206	RAP	70	F8	2.66	27.42	29.5	13	1.1	1.1	17.0	27.42	10.4
207	RAP	70	F8	2.66	27.42	29.5	13	1.1	1.1	17.0	27.42	10.4
208	RAP	70	F8	2.66	27.42	29.5	17	1.1	1.1	13.0	27.42	14.4
209	RAP	70	F8	2.66	27.42	29.5	17	1.1	1.1	13.0	27.42	14.4
210	RAP	70	F8	2.66	27.42	29.5	17	1.1	1.1	13.0	27.42	14.4
211	RAP	70	F8	2.66	27.42	29.5	17	1.1	1.1	13.0	27.42	14.4
212	RAP	70	F11	3.33	26.17	29.5	11	2.3	2.3	19.0	26.17	7.2
213	RAP	70	F11	3.33	26.17	29.5	11	2.3	2.3	19.0	26.17	7.2
214	RAP	70	F11	3.33	26.17	29.5	11	2.3	2.3	19.0	26.17	7.2
215	RAP	70	F11	3.33	26.17	29.5	11	2.3	2.3	19.0	26.17	7.2
216	RAP	70	F11	3.33	26.17	29.5	11	2.3	2.3	19.0	26.17	7.2
217	RAP	70	F11	3.33	26.17	29.5	11	2.3	2.3	19.0	26.17	7.2
218	RAP	70	F9	4.00	25.50	29.5	13	3.0	3.0	17.0	25.50	8.5
219	RAP	70	F9	4.00	25.50	29.5	13	3.0	3.0	17.0	25.50	8.5
220	RAP	70	F9	4.00	25.50	29.5	13	3.0	3.0	17.0	25.50	8.5
221	RAP	70	F9	4.00	25.50	29.5	13	3.0	3.0	17.0	25.50	8.5
222	RAP	70	F9	4.00	25.50	29.5	13	3.0	3.0	17.0	25.50	8.5
223	RAP	70	F11	3.33	26.17	29.5	11	2.3	2.3	19.0	26.17	7.2
224	RAP	70	F11	3.33	26.17	29.5	11	2.3	2.3	19.0	26.17	7.2
225	RAP	70	F11	3.33	26.17	29.5	11	2.3	2.3	19.0	26.17	7.2
226	RAP	70	F11	3.33	26.17	29.5	11	2.3	2.3	19.0	26.17	7.2
227	RAP	70	F11	3.33	26.17	29.5	11	2.3	2.3	19.0	26.17	7.2
228	RAP	70	F11	3.33	26.17	29.5	11	2.3	2.3	19.0	26.17	7.2
229	RAP	70	F10	3.00	26.50	29.5	13	2.0	2.0	17.0	26.50	9.5
230	RAP	70	F10	3.00	26.50	29.5	13	2.0	2.0	17.0	26.50	9.5
231	RAP	70	F10	3.00	26.50	29.5	13	2.0	2.0	17.0	26.50	9.5
232	RAP	70	F10	3.00	26.50	29.5	13	2.0	2.0	17.0	26.50	9.5
233	RAP	70	F10	3.00	26.50	29.5	13	2.0	2.0	17.0	26.50	9.5
234	RAP	70	F11	3.33	26.17	29.5	11	2.3	2.3	19.0	26.17	7.2
235	RAP	70	F11	3.33	26.17	29.5	11	2.3	2.3	19.0	26.17	7.2
236	RAP	70	F11	3.33	26.17	29.5	11	2.3	2.3	19.0	26.17	7.2
237	RAP	70	F11	3.33	26.17	29.5	11	2.3	2.3	19.0	26.17	7.2
238	RAP	70	F11	3.33	26.17	29.5	11	2.3	2.3	19.0	26.17	7.2
239	RAP	70	F11	3.33	26.17	29.5	11	2.3	2.3	19.0	26.17	7.2
240	RAP	70	F10	4.17	25.33	29.5	15	3.2	3.2	15.0	25.33	10.3
241	RAP	70	F10	4.17	25.33	29.5	15	3.2	3.2	15.0	25.33	10.3
242	RAP	70	F10	4.17	25.33	29.5	15	3.2	3.2	15.0	25.33	10.3
243	RAP	70	F10	4.17	25.33	29.5	15	3.2	3.2	15.0	25.33	10.3
244	RAP	70	F10	4.17	25.33	29.5	15	3.2	3.2	15.0	25.33	10.3
245	RAP	70	F11	5.83	23.67	29.5	13	4.8	4.8	17.0	23.67	6.7
246	RAP	70	F11	5.83	23.67	29.5	13	4.8	4.8	17.0	23.67	6.7
247	RAP	70	F11	5.83	23.67	29.5	13	4.8	4.8	17.0	23.67	6.7
248	RAP	70	F11	5.83	23.67	29.5	13	4.8	4.8	17.0	23.67	6.7
249	RAP	70	F11	5.83	23.67	29.5	13	4.8	4.8	17.0	23.67	6.7
250	RAP	70	F11	5.83	23.67	29.5	13	4.8	4.8	17.0	23.67	6.7
251	RAP	70	Strip	4.66	25.34	29.5	11	3.2	3.2	19.0	25.34	6.3
252	RAP	70	F6.5	5.50	24.50	29.5	13	4.0	4.0	17.0	24.50	7.5
253	RAP	70	F6.5	5.50	24.50	29.5	13	4.0	4.0	17.0	24.50	7.5

DESIGN/BUILD GEOTECHNICAL

Representing *Geopier* Foundation Company - GNE

GEOPIER®

GEOPIER SCHEDULE

Project Number: GNE-01207
Project Name: Mixed Use Development
Project Location: Portland, ME
Date: 3/4/2016

FF Elev, Structural
FF Elev. Civil VARIES

RETAIL BUILDING

Pier		Design	Footing Design Data, ft			Design Installation Data, ft				Proposed Geopier Geometry		
No.	Type	Capacity kg, kips	Type	Depth Below FFE	Bottom Elev.	Surface Elev.	Est. Drill Depth	Calc. Top Depth	Top Depth	Bottom El, ft	Top El, ft.	Shaft Length, ft
254	RAP	70	F6.5	5.50	24.50	29.5	13	4.0	4.0	17.0	24.50	7.5
255	RAP	70	Strip	4.16	25.34	29.5	13	3.2	3.2	17.0	25.34	8.3
256	RAP	70	Strip	4.16	25.34	29.5	15	3.2	3.2	15.0	25.34	10.3
257	RAP	70	F10	6.84	22.66	29.5	15	5.8	5.8	15.0	22.66	7.7
258	RAP	70	F10	6.84	22.66	29.5	15	5.8	5.8	15.0	22.66	7.7
259	RAP	70	F10	6.84	22.66	29.5	15	5.8	5.8	15.0	22.66	7.7
260	RAP	70	F10	6.84	22.66	29.5	15	5.8	5.8	15.0	22.66	7.7
261	RAP	70	F10	6.84	22.66	29.5	15	5.8	5.8	15.0	22.66	7.7
262	RAP	70	F10	6.84	22.66	29.5	15	5.8	5.8	15.0	22.66	7.7
263	RAP	70	Strip	5.50	24.00	29.5	17	4.5	4.5	13.0	24.00	11.0
264	RAP	70	Strip	5.50	24.00	29.5	17	4.5	4.5	13.0	24.00	11.0
265	RAP	70	Strip	4.66	25.34	29.5	15	3.2	3.2	15.0	25.34	10.3
266	RAP	70	Strip	4.66	25.34	29.5	15	3.2	3.2	15.0	25.34	10.3
267	RAP	70	Strip	6.00	24.00	29.5	15	4.5	4.5	15.0	24.00	9.0
268	RAP	70	F9	6.67	22.83	29.5	17	5.7	5.7	13.0	22.83	9.8
269	RAP	70	F9	6.67	22.83	29.5	17	5.7	5.7	13.0	22.83	9.8
270	RAP	70	F9	6.67	22.83	29.5	17	5.7	5.7	13.0	22.83	9.8
271	RAP	70	F9	6.67	22.83	29.5	17	5.7	5.7	13.0	22.83	9.8
272	RAP	70	F9	6.67	22.83	29.5	17	5.7	5.7	13.0	22.83	9.8
273	RAP	70	Strip	5.50	24.00	29.5	17	4.5	4.5	13.0	24.00	11.0

DESIGN/BUILD GEOTECHNICAL

Representing *Geopier* Foundation Company - GNE

GEOPIER®

GEOPIER SCHEDULE

Project Number: GNE-01207
Project Name: Mixed Use Development
Project Location: Portland, ME
Date: 3/4/2016

FF Elev, Structural
FF Elev. Civil VARIES

PARKING GARAGE

Pier		Design	Footing Design Data, ft			Design Installation Data, ft			Proposed Geopier Geometry		
No.	Type	Capacity kg, kips	Type	Depth Below FFE	Bottom Elev.	Surface Elev.	Est. Drill Depth	Top Depth	Bottom El, ft	Top El, ft.	Shaft Length, ft
274	RAP	70	RW	4.25	32.75	37.0	10	3.3	27.0	32.75	5.8
275	RAP	70	RW	4.75	32.75	37.0	10	3.3	27.0	32.75	5.8
276	RAP	70	RW	4.75	32.75	37.0	10	3.3	27.0	32.75	5.8
277	RAP	70	RW	3.25	34.75	37.0	10	1.3	27.0	34.75	7.8
278	RAP	70	RW	3.25	34.75	37.0	10	1.3	27.0	34.75	7.8
279	RAP	70	RW	3.25	34.75	37.0	10	1.3	27.0	34.75	7.8
280	RAP	70	RW	2.75	34.75	37.0	10	1.3	27.0	34.75	7.8
281	RAP	70	RW	2.75	34.75	37.0	10	1.3	27.0	34.75	7.8
282	RAP	70	RW	2.75	34.75	37.0	13	1.3	24.0	34.75	10.8
283	RAP	70	RW	2.75	34.75	37.0	13	1.3	24.0	34.75	10.8
284	RAP	70	RW	2.75	34.75	37.0	13	1.3	24.0	34.75	10.8
285	RAP	70	RW	2.75	34.75	37.0	13	1.3	24.0	34.75	10.8
286	RAP	70	F-8A	3.25	34.25	37.0	16	1.8	21.0	34.25	13.3
287	RAP	70	F-8A	3.25	34.25	37.0	16	1.8	21.0	34.25	13.3
288	RAP	70	F-8A	3.25	34.25	37.0	16	1.8	21.0	34.25	13.3
289	RAP	70	F-8A	3.25	34.25	37.0	16	1.8	21.0	34.25	13.3
290	RAP	70	F-8A	3.25	34.25	37.0	16	1.8	21.0	34.25	13.3
291	RAP	70	Mat	2.75	35.75	37.0	16	0.3	21.0	35.75	14.8
292	RAP	70	Mat	2.75	35.75	37.0	16	0.3	21.0	35.75	14.8
293	RAP	70	Mat	2.75	35.75	37.0	16	0.3	21.0	35.75	14.8
294	RAP	70	Mat	2.75	35.75	37.0	16	0.3	21.0	35.75	14.8
295	RAP	70	Mat	2.75	35.75	37.0	16	0.3	21.0	35.75	14.8
296	RAP	70	Mat	2.75	35.75	37.0	16	0.3	21.0	35.75	14.8
297	RAP	70	Mat	2.75	35.75	37.0	16	0.3	21.0	35.75	14.8
298	RAP	70	Mat	2.75	35.75	37.0	16	0.3	21.0	35.75	14.8
299	RAP	70	Mat	2.75	35.75	37.0	16	0.3	21.0	35.75	14.8
300	RAP	70	Mat	2.75	35.75	37.0	16	0.3	21.0	35.75	14.8
301	RAP	70	Mat	2.75	35.75	37.0	16	0.3	21.0	35.75	14.8
302	RAP	70	Mat	2.75	35.75	37.0	16	0.3	21.0	35.75	14.8
303	RAP	70	Mat	2.75	35.75	37.0	16	0.3	21.0	35.75	14.8
304	RAP	70	Mat	2.75	35.75	37.0	16	0.3	21.0	35.75	14.8
305	RAP	70	Mat	2.75	35.75	37.0	16	0.3	21.0	35.75	14.8
306	RAP	70	Mat	3.75	34.75	37.0	16	1.3	21.0	34.75	13.8
307	RAP	70	Mat	3.75	34.75	37.0	16	1.3	21.0	34.75	13.8
308	RAP	70	Mat	3.75	34.75	37.0	16	1.3	21.0	34.75	13.8
309	RAP	70	Mat	3.75	34.75	37.0	16	1.3	21.0	34.75	13.8
310	RAP	70	Mat	3.75	34.75	37.0	16	1.3	21.0	34.75	13.8
311	RAP	70	RW	2.92	35.75	37.0	16	0.3	21.0	35.75	14.8
312	RAP	70	RW	2.92	35.75	37.0	16	0.3	21.0	35.75	14.8
313	RAP	70	RW	2.92	35.75	37.0	16	0.3	21.0	35.75	14.8
314	RAP	70	F10	3.84	34.83	37.0	16	1.2	21.0	34.83	13.8
315	RAP	70	F10	3.84	34.83	37.0	16	1.2	21.0	34.83	13.8
316	RAP	70	F10	3.84	34.83	37.0	16	1.2	21.0	34.83	13.8
317	RAP	70	F10	3.84	34.83	37.0	16	1.2	21.0	34.83	13.8
318	RAP	70	F10	3.84	34.83	37.0	16	1.2	21.0	34.83	13.8
319	RAP	70	RW	2.92	35.75	37.0	16	0.3	21.0	35.75	14.8
320	RAP	70	RW	2.92	35.75	37.0	16	0.3	21.0	35.75	14.8
321	RAP	70	RW	2.92	35.75	37.0	16	0.3	21.0	35.75	14.8
322	RAP	70	F10	3.84	34.83	37.0	16	1.2	21.0	34.83	13.8
323	RAP	70	F10	3.84	34.83	37.0	16	1.2	21.0	34.83	13.8

DESIGN/BUILD GEOTECHNICAL

Representing *Geopier* Foundation Company - GNE

GEOPIER®

GEOPIER SCHEDULE

Project Number: GNE-01207
Project Name: Mixed Use Development
Project Location: Portland, ME
Date: 3/4/2016

FF Elev, Structural
FF Elev. Civil VARIES

PARKING GARAGE

Pier		Design	Footing Design Data, ft			Design Installation Data, ft			Proposed Geopier Geometry		
No.	Type	Capacity kg, kips	Type	Depth Below FFE	Bottom Elev.	Surface Elev.	Est. Drill Depth	Top Depth	Bottom El, ft	Top El, ft.	Shaft Length, ft
324	RAP	70	F10	3.84	34.83	37.0	16	1.2	21.0	34.83	13.8
325	RAP	70	F10	3.84	34.83	37.0	16	1.2	21.0	34.83	13.8
326	RAP	70	F10	3.84	34.83	37.0	16	1.2	21.0	34.83	13.8
327	RAP	70	F10	3.84	34.83	37.0	16	1.2	21.0	34.83	13.8
328	RAP	70	RW	2.92	35.75	37.0	19	0.3	18.0	35.75	17.8
329	RAP	70	RW	2.92	35.75	37.0	19	0.3	18.0	35.75	17.8
330	RAP	70	RW	2.92	35.75	37.0	19	0.3	18.0	35.75	17.8
331	RAP	70	RW	2.92	35.75	37.0	19	0.3	18.0	35.75	17.8
332	RAP	70	RW	2.92	35.75	37.0	19	0.3	18.0	35.75	17.8
333	RAP	70	RW	2.92	35.75	37.0	19	0.3	18.0	35.75	17.8
334	RAP	70	RW	2.92	35.75	37.0	19	0.3	18.0	35.75	17.8
335	RAP	70	RW	2.92	35.75	37.0	19	0.3	18.0	35.75	17.8
336	RAP	70	RW	2.25	35.75	37.0	19	0.3	18.0	35.75	17.8
337	RAP	70	RW	3.25	34.75	37.0	19	1.3	18.0	34.75	16.8
338	RAP	70	RW	2.75	34.75	37.0	19	1.3	18.0	34.75	16.8
339	RAP	70	RW	3.25	33.75	37.0	19	2.3	18.0	33.75	15.8
340	RAP	70	RW	2.75	33.75	37.0	19	2.3	18.0	33.75	15.8
341	RAP	70	RW	3.25	32.75	37.0	19	3.3	18.0	32.75	14.8
342	RAP	70	RW	3.25	30.75	29.5	7	0.0	23.0	29.50	6.5
343	RAP	70	RW	2.75	30.75	29.5	7	0.0	23.0	29.50	6.5
344	RAP	70	RW	3.25	29.75	29.5	7	0.0	23.0	29.50	6.5
345	RAP	70	RW	2.75	29.75	29.5	7	0.0	23.0	29.50	6.5
346	RAP	70	RW	2.25	29.75	29.5	7	0.0	23.0	29.50	6.5
347	RAP	70	RW	2.95	28.75	29.5	8	0.0	22.0	28.75	6.8
348	RAP	70	RW	2.55	28.75	29.5	8	0.0	22.0	28.75	6.8
349	RAP	70	RW	3.75	27.25	29.5	9	1.3	21.0	27.25	6.3
350	RAP	70	RW	3.55	27.25	29.5	9	1.3	21.0	27.25	6.3
351	RAP	70	RW	3.35	27.25	29.5	11	1.3	19.0	27.25	8.3
352	RAP	70	RW	3.15	27.25	29.5	11	1.3	19.0	27.25	8.3
353	RAP	70	RW	2.95	27.25	29.5	13	1.3	17.0	27.25	10.3
354	RAP	70	RW	2.75	27.25	29.5	13	1.3	17.0	27.25	10.3
355	RAP	70	RW	2.75	27.25	29.5	11	1.3	19.0	27.25	8.3
356	RAP	70	RW	2.75	27.25	29.5	11	1.3	19.0	27.25	8.3
357	RAP	70	RW	2.75	27.25	29.5	11	1.3	19.0	27.25	8.3
358	RAP	70	RW	2.75	27.25	29.5	11	1.3	19.0	27.25	8.3
359	RAP	70	RW	2.75	27.25	29.5	11	1.3	19.0	27.25	8.3
360	RAP	70	F8	3.25	26.75	29.5	11	1.8	19.0	26.75	7.8
361	RAP	70	F8	3.25	26.75	29.5	11	1.8	19.0	26.75	7.8
362	RAP	70	F8	3.25	26.75	29.5	11	1.8	19.0	26.75	7.8
363	RAP	70	F8	3.25	26.75	29.5	11	1.8	19.0	26.75	7.8
364	RAP	70	RW	2.75	27.25	29.5	11	1.3	19.0	27.25	8.3
365	RAP	70	RW	2.75	27.25	29.5	11	1.3	19.0	27.25	8.3
366	RAP	70	RW	2.75	27.25	29.5	11	1.3	19.0	27.25	8.3
367	RAP	70	F13	5.00	32.50	29.5	9	0.0	21.0	29.50	8.5
368	RAP	70	F13	5.00	32.50	29.5	9	0.0	21.0	29.50	8.5
369	RAP	70	F13	5.00	32.50	29.5	9	0.0	21.0	29.50	8.5
370	RAP	70	F13	5.00	32.50	29.5	9	0.0	21.0	29.50	8.5
371	RAP	70	F13	5.00	32.50	29.5	9	0.0	21.0	29.50	8.5
372	RAP	70	F13	5.00	32.50	29.5	9	0.0	21.0	29.50	8.5
373	RAP	70	F13	5.00	32.50	29.5	9	0.0	21.0	29.50	8.5

DESIGN/BUILD GEOTECHNICAL

Representing *Geopier* Foundation Company - GNE

GEOPIER®

GEOPIER SCHEDULE

Project Number: GNE-01207
Project Name: Mixed Use Development
Project Location: Portland, ME
Date: 3/4/2016

FF Elev, Structural
FF Elev. Civil VARIES

PARKING GARAGE

Pier		Design	Footing Design Data, ft			Design Installation Data, ft			Proposed Geopier Geometry		
No.	Type	Capacity kg, kips	Type	Depth Below FFE	Bottom Elev.	Surface Elev.	Est. Drill Depth	Top Depth	Bottom El, ft	Top El, ft.	Shaft Length, ft
374	RAP	70	F13	5.00	32.50	29.5	9	0.0	21.0	29.50	8.5
375	RAP	70	F13	5.00	32.50	29.5	9	0.0	21.0	29.50	8.5
376	RAP	70	F13	5.00	32.50	29.5	9	0.0	21.0	29.50	8.5
377	RAP	70	F13	5.00	32.50	29.5	9	0.0	21.0	29.50	8.5
378	RAP	70	F13	5.00	32.50	29.5	9	0.0	21.0	29.50	8.5
379	RAP	70	F13	5.00	32.50	29.5	9	0.0	21.0	29.50	8.5
380	RAP	70	F13	5.00	32.50	29.5	9	0.0	21.0	29.50	8.5

DESIGN/BUILD GEOTECHNICAL

GEOPIER®
Delivering the Geopier Foundation System

QUALITY CONTROL PACKAGE FOR GEOPIER FOUNDATIONS

Date:	March 4, 2016
Project Number:	GNE-01207
Project:	Mixed Use Development Portland, ME
Geopier Designer:	James R. Wheeler, PE, Design/Build Geotechnical, LLC
Phone:	508-481-3849
Mobile:	978-618-0811
Fax:	508-460-1114
Geotechnical Engineer:	S. W. Cole Engineering, Inc.
Contact:	Timothy J. Boyce, PE
Phone:	207-657-2866
Structural Engineer:	Becker Structural Engineers
Referenced Drawings:	S1.01 “Foundation Plan”
Referenced Drawings:	GS1.01 “Parking Garage Fnd. Plan”
Date of Drawings:	February 29, 2016

Anticipated Geotechnical Conditions:
Subsurface soils consist of up to 9 feet of loose to medium dense silty sand Fill over up to 16 feet of loose to medium dense sand or silty sand. Beneath the sand or silty sand, very dense Glacial Till or Bedrock was noted at depths ranging from 4 to 28 feet below ground surface where the borings were terminated at auger or probe refusal. Ground water was encountered 7 to 14 feet below ground surface at the time the borings/probes were completed.

Potential Anomalies:
Depths of fill and the depth to till or bedrock may be irregular across to work area.

Pier Construction and Termination Requirements:
Working from a temporary grade at approximately El. 29.5 to El. 37, piers shall completely penetrate the Fill and underlying sand or silty sand and terminate at refusal in the Glacial Till or on Bedrock resulting in drill depths between approximately 7 and 19 feet. Effort should be made to construct piers with a minimum shaft length of 6 feet. In the event that refusal, defined as a mandrel penetration rate of less than 3 inches in 30 seconds under full hammer energy and crowd, is encountered significantly above the scheduled drill depth, the Geopier Designer should be contacted.

Refer to the Geopier Schedule for estimated drill depths and other pier construction geometry. If unanticipated ground conditions are encountered, call Jim Wheeler.

ATTACHMENT 1 – DAILY QUALITY CONTROL FORM
ATTACHMENT 2 – GEOTECHNICAL INFORMATION

DESIGN/BUILD GEOTECHNICAL

GEOPIER IMPACT® RAMMED AGGREGATE PIER QUALITY CONTROL SUMMARY

GEOPIER®

Project Name: Danforth - York Street Parking Garage
Location: Portland, ME
Date: 3/7/2001

Hammer: ____________
Rig Type: ____________

GFC # 01207

Stone Gradation ____________
Grout Mix: ____________

Hopper Volume ______ cf
Mandrel Diameter ______ in

Volume of bucket ______ cf
Est. Grout Req'd. ______ cf/ft

Top Grout El.: Varies, see below

Pier No.	Pier Type	Des. Cap. kips	Bottom Footing El, ft	Ground Surface Elevation, ft Planned	Ground Surface Elevation, ft Actual	Mandrel Penetration Data Bottom Depth,ft Planned	Mandrel Penetration Data Bottom Depth,ft Actual	Mandrel Penetration Data Top Depth, ft Planned	Mandrel Penetration Data Top Depth, ft Actual	Impact Bottom El, ft	Impact Top El, ft.	Impact Shaft Length,ft	Top of Grout El, ft	Design Shaft Length	Estimated Grout Volume cf	Estimated Grout Volume gal	Actual Grout Vol. cf.	Install Date	Mandrel Stroke, ft Up Stroke	Mandrel Stroke, ft Down Stroke	No. Buckets	Install Time (min)	Rock Spoil Cone Bottom Dia., in.	Rock Spoil Cone Height in.	Top Cone Dia.	Spoil Volume, cf Below Grade	Spoil Volume, cf Above Grade	Pier Volume, cf	Nominal Pier Dia., in	Remarks

Planned Grouted Shaft Length

GNE Quality Control Representative
__________ **(HDI)**

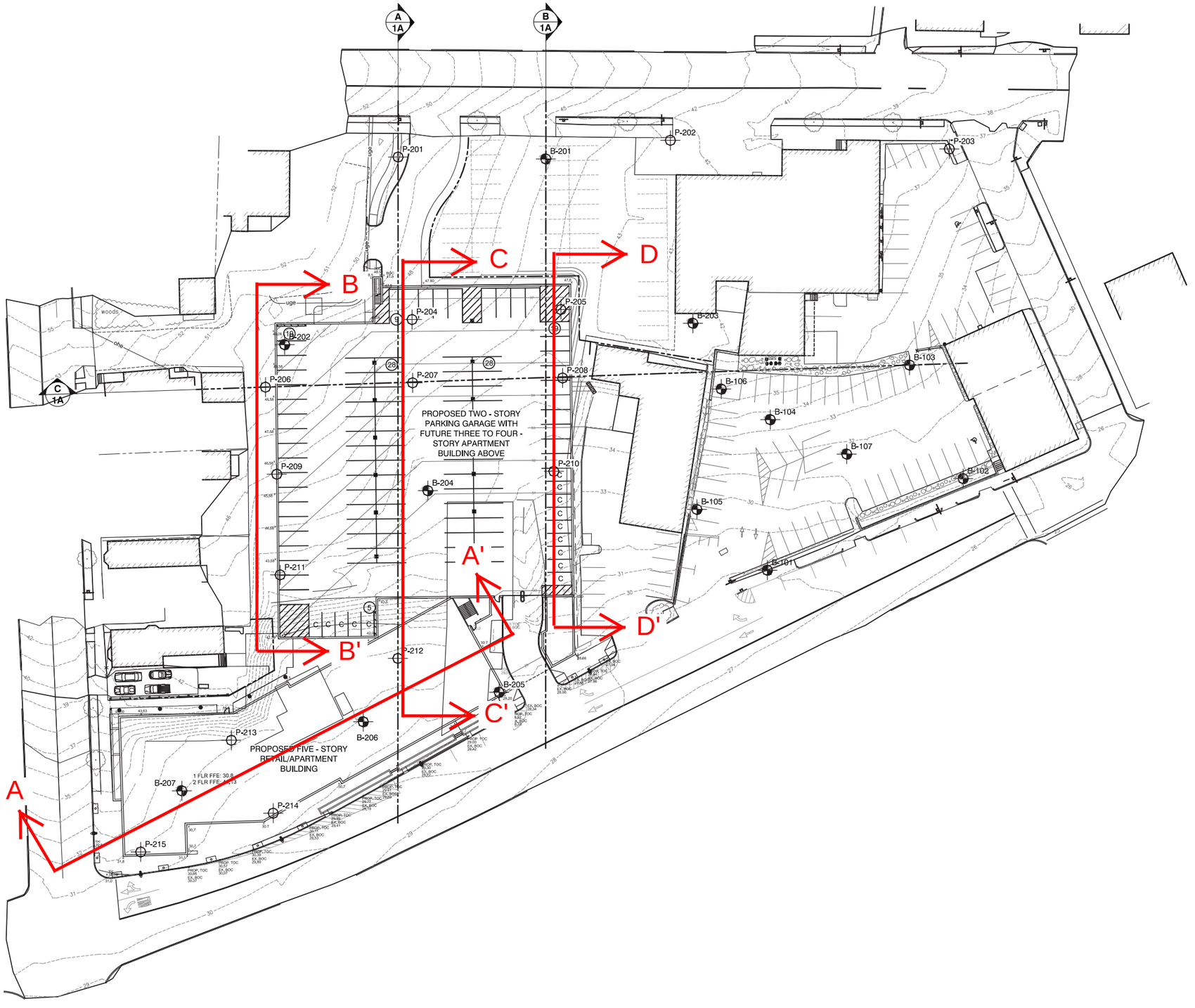
Owner's Quality Assurance Representative
____

DESIGN/BUILD GEOTECHNICAL

GEOPIER®

Delivering the Geopier Foundation System

GEOTECHNICAL INFORMATION



LEGEND:

APPROXIMATE BORING LOCATION

APPROXIMATE PROBE LOCATION

NOTES:

1. EXPLORATION LOCATION PLAN WAS PREPARED FROM A SCALE PRELIMINARY CONCEPT PLAN OF THE SITE PREPARED BY OPECHEE CONSTRUCTION CORPORATION, RECEIVED VIA E-MAIL JULY 20, 2015 IN AUTOCAD DWG FILE FORMAT.
2. BORINGS B-202 THROUGH B-207 AND PROBES P-202, P-203, P-206, P-209 THROUGH P-215 WERE LOCATED IN THE FIELD BY SURVEY BY OWEN HASKELL, INC. AND PROVIDED ON THE ABOVE REFERENCED PLAN. BORING B-201 AND PROBES P-201, P-204, P-205, P-207 AND P-208 WERE LOCATED IN THE FIELD BY TAPED MEASUREMENTS FROM EXISTING SITE FEATURES.
3. BORINGS B-101 THROUGH B-107 WERE PERFORMED BY SEBAGO TECHNICS, INC. THE LOCATIONS WERE PROVIDED ON A PLAN ENTITLED "BORING LOCATION PLAN," PROVIDED BY J.B.BROWN & SOND, DATED 5/10/2010.
4. THIS PLAN SHOULD BE USED IN CONJUNCTION WITH THE ASSOCIATED S.W. COLE ENGINEERING, INC. GEOTECHNICAL REPORT.
5. THE PURPOSE OF THIS PLAN IS ONLY TO DEPICT THE LOCATION OF THE EXPLORATIONS IN RELATION TO THE EXISTING CONDITIONS AND PROPOSED CONSTRUCTION AND IS NOT TO BE USED FOR CONSTRUCTION.

NO.	DATE	DESCRIPTION	BY
2	08/03/2015	FINAL REPORT SUBMISSION	CEM
1	02/28/2014	REVISED BASE PLAN, ADDED SECTION LINES, PRELIMINARY REPORT SUBMISSION	CEM
--	11/20/2013	DRAFT SUBMISSION	CEM

S.W.COLE ENGINEERING, INC.

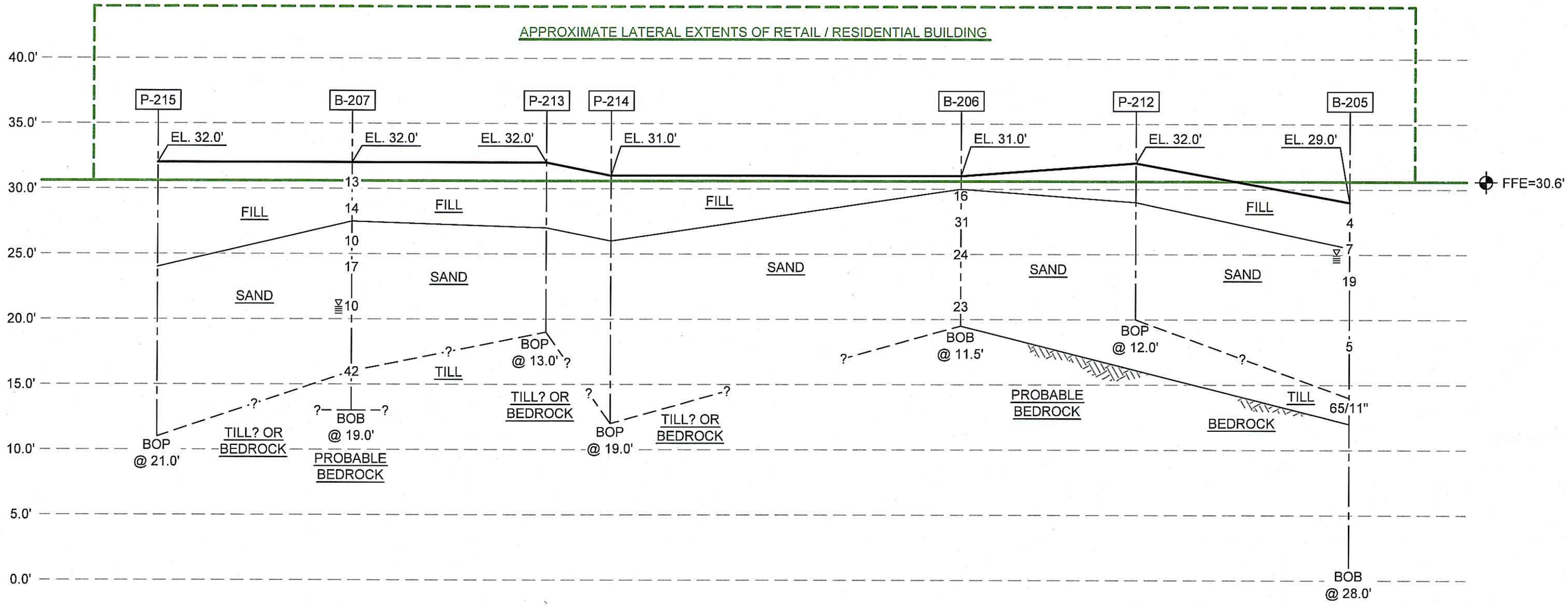
OPECHEE CONSTRUCTION CORPORATION

EXPLORATION LOCATION PLAN

PROPOSED MIXED USE DEVELOPMENT
YORK AND HIGH STREETS
PORTLAND, MAINE

Job No.: 13-0545.1 Scale: 1" = 30'
Date : 01/07/2014 Sheet: 1

(GEOPIER ELEMENT SUPPORT REQUIRED BELOW ENTIRE BUILDING)



SUB SURFACE PROFILE A-A'
SCALE: N.T.S.

INSTALLER:
Helical Drilling
Geotechnical Design/Builders

HELICAL DRILLING, INC.
639 GRANITE STREET
BRAINTREE, MA 02184
TEL. (781) 848-2110

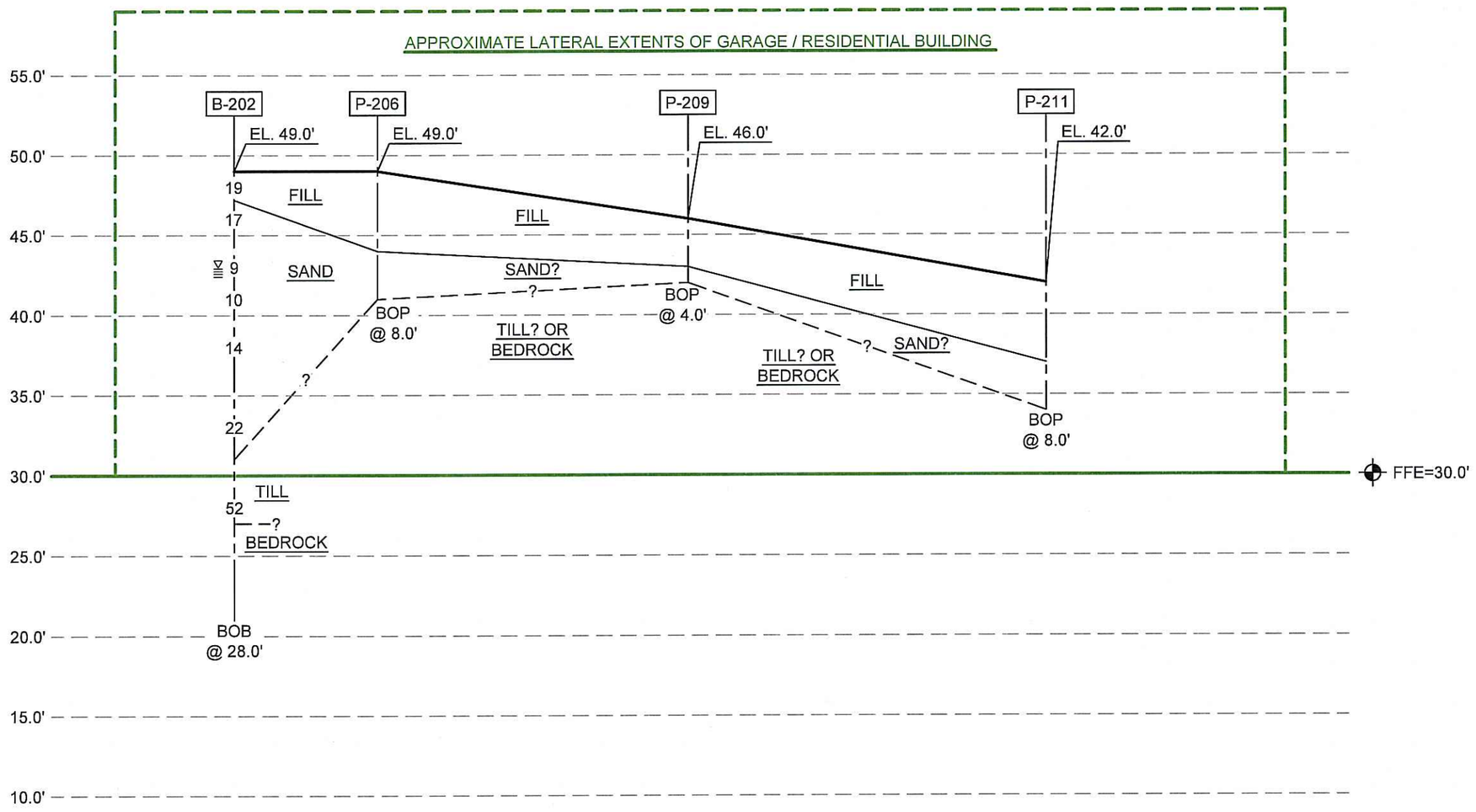
SCALE	DATE	SHEET	PLAN #
N.T.S.	10/1/15	1 of 4	
DRAWN BY	CHKD BY	APPD BY	DISK REF #
MJP	DS	JW	

SUB SURFACE PROFILE A-A'

Danforth Parking Garage
York Street
Portland, ME

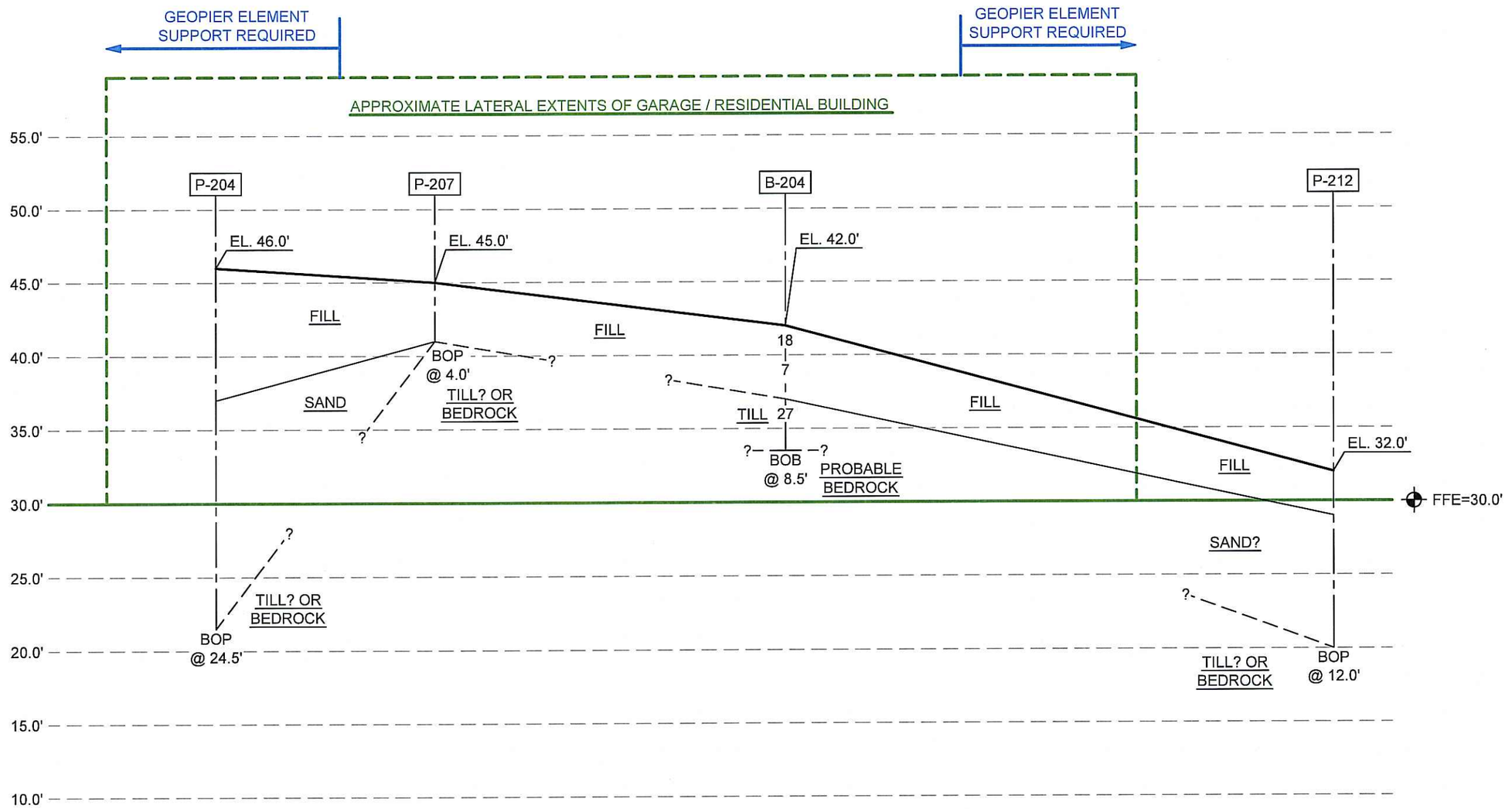
SHEET NO.
GNE-01207
SSP-1.1

(GEOPIER ELEMENT SUPPORT NOT REQUIRED THROUGH THIS SECTION)



SUB SURFACE PROFILE B-B'
SCALE: N.T.S.

INSTALLER: Helical Drilling Geotechnical Design/Builders HELICAL DRILLING, INC. 639 GRANITE STREET BRAINTREE, MA 02184 TEL. (781) 848-2110	SCALE N.T.S.	DATE 10/1/15	SHEET 2 of 4	PLAN #	SUB SURFACE PROFILE B-B' Danforth Parking Garage York Street Portland, ME	SHEET NO. GNE-01207 SSP-1.2
	DRAWN BY MJP	CHKD BY DS	APPD BY JW	DISK REF #		



SUB SURFACE PROFILE C-C'
SCALE: N.T.S.

INSTALLER:
Helical Drilling
Geotechnical Design/Builders

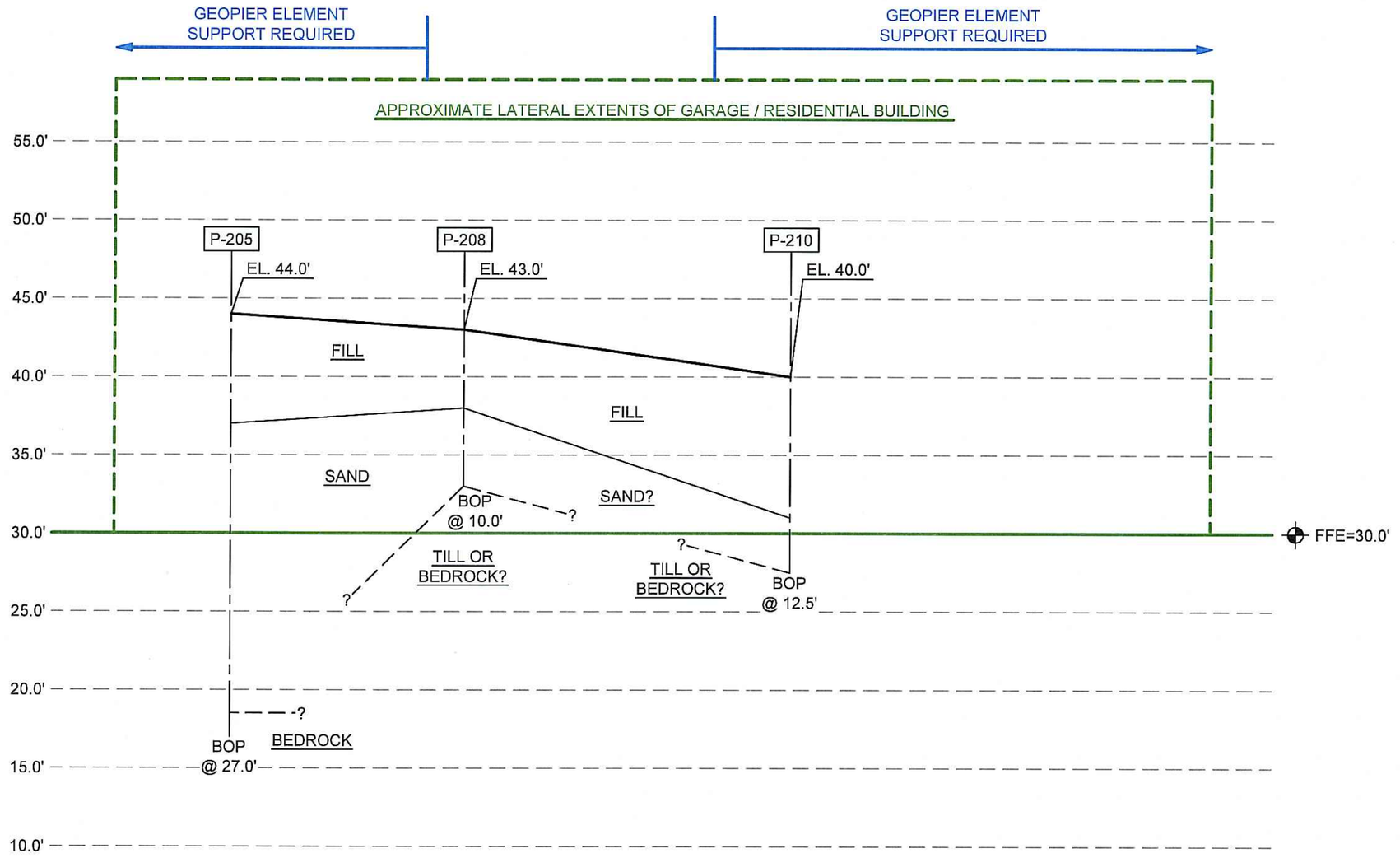
HELICAL DRILLING, INC.
639 GRANITE STREET
BRAINTREE, MA 02184
TEL. (781) 848-2110

SCALE	DATE	SHEET	PLAN #
N.T.S.	10/1/15	3 of 4	
DRAWN BY	CHKD BY	APPD BY	DISK REF #
MJP	DS	JW	

SUB SURFACE PROFILE C-C'

Danforth Parking Garage
York Street
Portland, ME

SHEET NO.
GNE-01207
SSP-1.3



SUB SURFACE PROFILE D-D'
SCALE: N.T.S.

INSTALLER:
Helical Drilling
Geotechnical Design/Builders

HELICAL DRILLING, INC.
639 GRANITE STREET
BRAINTREE, MA 02184
TEL. (781) 848-2110

SCALE	DATE	SHEET	PLAN #
N.T.S.	10/1/15	4 of 4	
DRAWN BY	CHKD BY	APPD BY	DISK REF #
MJP	DS	JW	

SUB SURFACE PROFILE D-D'

Danforth Parking Garage
York Street
Portland, ME

SHEET NO.
GNE-01207
SSP-1.4

S.W.COLE ENGINEERING, INC.

BORING LOG

BORING NO.: **B-201**
SHEET: 1 OF 1
PROJECT NO.: 13-0545

PROJECT: PROPOSED MIXED USE DEVELOPMENT
CLIENT : J.B. BROWN & SONS
LOCATION: YORK STREET AND DANFORTH STREET PORTLAND, MAINE
DRILLING FIRM: GREAT WORKS TEST BORING INC DRILLER: PETER MICHAUD

DATE START: 11/13/2013
DATE FINISH: 11/13/2013
ELEVATION: 45'
SWC REP.: K. GIMPEL

	TYPE	SIZE	HAMMER WT.	HAMMER FALL
CASING:	HW	4"		
SAMPLER:	SS	1 3/8" I.D.	140-LB	30"
CORE BARREL:	NQ 2"			

WATER LEVEL INFORMATION
SOILS APPEARED SATURATED BELOW 6' +/-

CASING BLOWS PER FOOT	SAMPLE NO.	PEN.	REC.	DEPTH @ BOT	SAMPLER BLOWS PER 6" 0-6	6-12	12-18	18-24	DEPTH	STRATA & TEST DATA
SSA										
	1D	24"	12"	2.0'	15	21	17	9		BROWN GRAVELLY SILTY SAND
										WITH BRICKS (FILL)
	2D	18"	6"	3.5'	12	25	30			[PROBABLE RELIC FOUNDATION WALL AT 3.5' - OFFSET 3' AND RESUMED DRILLING]
									5.5'	
	3D	24"	19"	7.0'	2	8	8	11		BROWNISH GRAY SANDY SILT WITH SILTY SAND SEAMS
									8.0'	~MEDIUM DENSE~
	4D	24"	24"	9.0'	7	7	15	15		GRAY SILTY SAND SOME GRAVEL
									10.0'	~MEDIUM DENSE~
HW										
CASING	5D	24"	3"	12.0'	3	3	3	2		GRAY SILTY SAND
										~LOOSE~
	6D	24"	4"	17.0'	8	7	5	3		~MEDIUM DENSE~
									19.5'	
	7D	12"	0"	21.0'	50	50				PROBABLE GLACIAL TILL SOILS
									23.5'	
									24.5'	PROBABLE WEATHERED ROCK [ADVANCE BY ROLLER CONE]
										REFUSAL AT 24.5'
										(PROBABLE BEDROCK)

SAMPLES:
D = SPLIT SPOON
C = 3" SHELBY TUBE
U = 3.5" SHELBY TUBE

SOIL CLASSIFIED BY:
[ ] DRILLER - VISUALLY
[X] SOIL TECH. - VISUALLY
[ ] LABORATORY TEST

REMARKS:
STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.

BORING NO.: **B-201**

S.W.COLE ENGINEERING, INC.

BORING LOG

BORING NO.: **B-202**
SHEET: 1 OF 1
PROJECT NO.: 13-0545

PROJECT: PROPOSED MIXED USE DEVELOPMENT
CLIENT : J.B. BROWN & SONS
LOCATION: YORK STREET AND DANFORTH STREET PORTLAND, MAINE
DRILLING FIRM: GREAT WORKS TEST BORING INC DRILLER: PETER MICHAUD

DATE START: 11/13/2013
DATE FINISH: 11/13/2013
ELEVATION: 49'
SWC REP.: K. GIMPEL

	TYPE	SIZE	HAMMER WT.	HAMMER FALL
CASING:	HW	4" O.D.		
SAMPLER:	SS	1 3/8" I.D.	140-LB	30"
CORE BARREL:	NQ 2"			

WATER LEVEL INFORMATION
SOILS APPEARED SATURATED BELOW 6' +/-

CASING BLOWS PER FOOT	SAMPLE NO.	PEN.	REC.	DEPTH @ BOT	SAMPLER BLOWS PER 6" 0-6	6-12	12-18	18-24	DEPTH	STRATA & TEST DATA
SSA									1.0'	BROWN GRAVELLY SILTY SAND (FILL)
	1D	24"	15"	2.0'	11	12	7	9	1.8'	BROWN SILTY SAND SOME GRAVEL WITH BRICK (FILL)
									3.0'	~MEDIUM DENSE~ BROWN SAND AND SILT SOME GRAVEL
	2D	24"	16"	4.0'	6	8	9	8	4.0'	~MEDIUM DENSE~ BROWN SILTY SAND AND GRAVEL
										BROWN SILTY SAND
										WITH OCCASIONAL SAND SEAMS
	3D	24"	20"	7.0'	3	4	5	6		~MEDIUM DENSE~
	4D	24"	22"	9.0'	5	5	5	10		…WITH TRACE CLAY
									9.5'	
HW										GRAY SILTY SAND SOME GRAVEL
CASING	5D	24"	14"	12.0'	4	7	7	8	12.0'	~MEDIUM DENSE~
										BROWN SAND TRACE SILT
										~MEDIUM DENSE~
	6D	24"	17"	17.0'	11	11	11	16		
									18.0'	
										GRAY GRAVEL AND SILTY SAND (TILL)
										~DENSE~
	7D	24"	10"	22.0'	23	19	33	35	22.0'	
									24.0'	WEATHERED ROCK
										[ADVANCE BY ROLLER CONE]
										GRAY METAVOLCANIC ROCK, HARD, SLIGHTLY WEATHERED
										FINE-MEDIUM GRAINED, IRON OXIDE STAINING ON FRACTURES
										FRACTURES AT 65 TO 75 DEGREES
	R1	48"	36"	28.0'					28.0'	RQD = 21%
										BOTTOM OF EXPLORATION AT 28.0'
										(BEDROCK)

SAMPLES:
D = SPLIT SPOON
C = 3" SHELBY TUBE
U = 3.5" SHELBY TUBE

SOIL CLASSIFIED BY:
[ ] DRILLER - VISUALLY
[X] SOIL TECH. - VISUALLY
[ ] LABORATORY TEST

REMARKS:
STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.

BORING NO.: **B-202**

S.W.COLE ENGINEERING, INC.

BORING LOG

BORING NO.: **B-204**
SHEET: 1 OF 1
PROJECT NO.: 13-0545

PROJECT: PROPOSED MIXED USE DEVELOPMENT
CLIENT : J.B. BROWN & SONS
LOCATION: YORK STREET AND DANFORTH STREET PORTLAND, MAINE
DRILLING FIRM: GREAT WORKS TEST BORING INC DRILLER: JEFF LEE

DATE START: 11/12/2013
DATE FINISH: 11/12/2013
ELEVATION: 42'
SWC REP.: E. WALKER

	TYPE	SIZE	HAMMER WT.	HAMMER FALL
CASING:	SSA	4.5" O.D.		
SAMPLER:	SS	1 3/8" I.D.	140-LB	30"
CORE BARREL:	N/A			

WATER LEVEL INFORMATION

CASING BLOWS PER FOOT	SAMPLE NO.	SAMPLE PEN.	SAMPLE REC.	SAMPLE DEPTH @ BOT	SAMPLER BLOWS PER 6" 0-6	6-12	12-18	18-24	DEPTH	STRATA & TEST DATA
SSA										BROWN GRAVELLY SAND SOME SILT (FILL) TRACE ORGANICS TOP 6"
	1D	24"	16"	2.0'	5	9	9	8	2.0'	~ MEDIUM DENSE ~
	2D	24"	14"	4.0'	5	4	3	2		DARK BROWN SILT AND SAND SOME GRAVEL (FILL)
									5.0'	~ LOOSE ~
	3D	24"	18"	7.0'	6	14	13	17		BROWN WITH ORANGE AND DARK BROWN STAINING
										SILTY SAND SOME GRAVEL WITH WEATHERED BEDROCK FRAGMENTS
									8.5'	(GLACIAL TILL) ~ MEDIUM DENSE ~
										REFUSAL AT 8.5'
										(PROBABLE BEDROCK)

SAMPLES:
D = SPLIT SPOON
C = 3" SHELBY TUBE
U = 3.5" SHELBY TUBE

SOIL CLASSIFIED BY:
[ ] DRILLER - VISUALLY
[X] SOIL TECH. - VISUALLY
[ ] LABORATORY TEST

REMARKS:
STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.

BORING NO.: **B-204**

S.W.COLE ENGINEERING, INC.

BORING LOG

BORING NO.: **B-205**
SHEET: 1 OF 1
PROJECT NO.: 13-0545

PROJECT: PROPOSED MIXED USE DEVELOPMENT
CLIENT : J.B. BROWN & SONS
LOCATION: YORK STREET AND DANFORTH STREET PORTLAND, MAINE
DRILLING FIRM: GREAT WORKS TEST BORING INC DRILLER: JEFF LEE

DATE START: 11/12/2013
DATE FINISH: 11/12/2013
ELEVATION: 29'
SWC REP.: K. GIMPEL

	TYPE	SIZE	HAMMER WT.	HAMMER FALL
CASING:	HW	4" O.D.		
SAMPLER:	SS	1 3/8" I.D.	140-LB	30"
CORE BARREL:	NQ 2"			

WATER LEVEL INFORMATION
SOILS APPEARED SATURATED BELOW 4' +/-

CASING BLOWS PER FOOT	SAMPLE NO.	PEN.	REC.	DEPTH @ BOT	SAMPLER BLOWS PER 6" 0-6	6-12	12-18	18-24	DEPTH	STRATA & TEST DATA
SSA									0.1'	2-INCHES ASPHALT PAVEMENT
	1D	24"	16"	2.5'	4	2	2	2	3.0'	BROWN SILTY SAND SOME GRAVEL WITH BRICKS (FILL)
									3.5'	BROWN SILTY SAND (FILL)
	2D	24"	21"	4.5'	2	2	5	5		GRAY SILTY SAND [PETROLEUM ODOR] ~MEDIUM DENSE BECOMING…
	3D	24"	15"	7.0'	5	8	11	11		
	4D	24"	17"	12.0'	3	2	3	2		…LOOSE~
									15.0'	
HW									16.4'	~DENSE~ BROWN GRAVELLY SILTY SAND (TILL)
CASING	5D	17"	16"	16.4'	13	15	50/5"		17.0'	WEATHERED ROCK
TO 16'										GRAY SCHIST, HARD, SLIGHTLY WEATHERED, MEDIUM GRAINED FRACTURES AT 35 TO 75 DEGREES
	R1	60"	39"	23.0'						RQD = 65%
	R2	60"	50"	28.0'					28.0'	RQD = 63%
										BOTTOM OF EXPLORATION AT 28.0' (BEDROCK)

SAMPLES:
D = SPLIT SPOON
C = 3" SHELBY TUBE
U = 3.5" SHELBY TUBE

SOIL CLASSIFIED BY:
[ ] DRILLER - VISUALLY
[X] SOIL TECH. - VISUALLY
[ ] LABORATORY TEST

REMARKS:
STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.

BORING NO.: **B-205**

S.W.COLE ENGINEERING, INC.

BORING LOG

BORING NO.: **B-206**
SHEET: 1 OF 1
PROJECT NO.: 13-0545

PROJECT: PROPOSED MIXED USE DEVELOPMENT
CLIENT : J.B. BROWN & SONS
LOCATION: YORK STREET AND DANFORTH STREET PORTLAND, MAINE
DRILLING FIRM: GREAT WORKS TEST BORING INC DRILLER: JEFF LEE

DATE START: 11/12/2013
DATE FINISH: 11/12/2013
ELEVATION: 31'
SWC REP.: K. GIMPEL

	TYPE	SIZE	HAMMER WT.	HAMMER FALL
CASING:	SSA	4.5" O.D.		
SAMPLER:	SS	1 3/8" I.D.	140-LB	30"
CORE BARREL:	N/A			

WATER LEVEL INFORMATION
NO FREE WATER OBSERVED

CASING BLOWS PER FOOT	SAMPLE NO.	SAMPLE PEN.	SAMPLE REC.	SAMPLE DEPTH @ BOT	SAMPLER BLOWS PER 6" 0-6	6-12	12-18	18-24	DEPTH	STRATA & TEST DATA
SSA									0.2'	2.5-INCHES ASPHALT PAVEMENT
									1.0'	BROWN GRAVELLY SAND TRACE SILT (FILL)
	1D	24"	17"	2.5'	6	8	8	12		
										BROWN GRAVELLY SILTY SAND
	2D	24"	20"	4.5'	9	15	16	16		~MEDIUM DENSE~
	3D	24"	22"	7.0'	12	15	9	12		
	4D	18"	18"	11.5'	12	11	12	25/0"	11.5'	
										REFUSAL AT 11.5'
										(PROBABLE BEDROCK)

SAMPLES:
D = SPLIT SPOON
C = 3" SHELBY TUBE
U = 3.5" SHELBY TUBE

SOIL CLASSIFIED BY:
[ ] DRILLER - VISUALLY
[X] SOIL TECH. - VISUALLY
[ ] LABORATORY TEST

REMARKS:
STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.

BORING NO.: **B-206**

S.W.COLE ENGINEERING, INC.

BORING LOG

BORING NO.: **B-207**
SHEET: 1 OF 1
PROJECT NO.: 13-0545

PROJECT: PROPOSED MIXED USE DEVELOPMENT
CLIENT : J.B. BROWN & SONS
LOCATION: YORK STREET AND DANFORTH STREET PORTLAND, MAINE
DRILLING FIRM: GREAT WORKS TEST BORING INC DRILLER: JEFF LEE

DATE START: 11/12/2013
DATE FINISH: 11/12/2013
ELEVATION: 32'
SWC REP.: K. GIMPEL

	TYPE	SIZE	HAMMER WT.	HAMMER FALL
CASING:	SSA	4.5" O.D.		
SAMPLER:	SS	1 3/8" I.D.	140-LB	30"
CORE BARREL:	N/A			

WATER LEVEL INFORMATION
SOILS APPEARED SATURATED BELOW 11'+/-

CASING BLOWS PER FOOT	SAMPLE NO.	SAMPLE PEN.	SAMPLE REC.	SAMPLE DEPTH @ BOT	SAMPLER BLOWS PER 6" 0-6	6-12	12-18	18-24	DEPTH	STRATA & TEST DATA
SSA									0.3'	4-INCHES ASPHALT PAVEMENT
									1.0'	BROWN GRAVELLY SAND TRACE SILT (FILL)
	1D	24"	18"	2.5'	6	6	7	8		BROWN SILTY SAND SOME GRAVEL TRACE ASH (FILL)
	2D	24"	17"	4.5'	7	5	9	8	4.5'	
									5.5'	~MEDIUM DENSE~ BROWN SILTY SAND SOME GRAVEL
	3D	24"	24"	7.0'	5	4	6	7	6.5'	~MEDIUM DENSE~ GRAY SILTY SAND TRACE GRAVEL
									8.0'	~MEDIUM DENSE~ BROWN SAND TRACE SILT
	4D	24"	15"	9.0'	7	8	9	7	8.5'	~MEDIUM DENSE~ BROWN GRAVELLY SAND SOME SILT
										~MEDIUM DENSE~ BROWN GRAVELLY SILTY SAND
									11.0'	WITH WEATHERED ROCK FRAGMENTS
	5D	24"	8"	12.0'	7	6	4	3		GRAY SILTY SAND TRACE CLAY ~MEDIUM DENSE~
									16.0'	
	6D	24"	16"	17.0'	5	10	32	32		BROWN GRAVELLY SILTY SAND (TILL) ~DENSE~
									19.0'	
										REFUSAL AT 19.0' PROBABLE BEDROCK

SAMPLES:
D = SPLIT SPOON
C = 3" SHELBY TUBE
U = 3.5" SHELBY TUBE

SOIL CLASSIFIED BY:
[ ] DRILLER - VISUALLY
[X] SOIL TECH. - VISUALLY
[ ] LABORATORY TEST

REMARKS:
STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.

BORING NO.: **B-207**

S.W.COLE ENGINEERING, INC.

PROBE DATA

PROJECT: PROPOSED MIXED-USE DEVELOPMENT
CLIENT: J.B.BROWN & SONS
LOCATION: DANFORTH AND YORK STREETS, PORTLAND, MAINE

PROBE NUMBER	GROUND SURFACE ELEVATION (FT)	DEPTH TO REFUSAL (FT)	ESTIMATED THICKNESS OF FILL SOILS (FT)
P-201	50	30 NR	8
P-202	43	30 NR	9
P-203	37	28.5	9
P-204	46	24.5	9
P-205	44	27	7
P-206	49	8	5
P-207	45	4	4
P-208	43	10	5
P-209	46	4	3
P-210	40	12.5	9
P-211	42	8	5
P-212	32	12	3
P-213	32	13	5
P-214	31	19	5
P-215	32	21	8

NOTES: P-201: 30-foot depth was not refusal, but probable dense till or bedrock
P-202: 30-foot depth was not refusal, but probable dense till or bedrock
P-205: Bedrock at 25.5'
P-207: Refusal at 4-feet below ground surface, offset and had refusal at 6.5'