# **GEOTECHNICAL REPORT**

## 50 - 62 INDIA STREET PORTLAND, MAINE

March 29, 2016

GSI Project No. 212234A

#### Prepared for:

Mr. Joe Dasco Atlas Investment Group, LLC. 35 Fay Street, Suite 107B Boston, Massachusetts 02118

#### Prepared by:

Harry K. Wetherbee, P.E. Geotechnical Services, Inc. 55 North Stark Highway Weare, NH 03281





🖊 Geotechnical Engineering 🔺 Environmental Studies 🔺 Materials Testing 🔺 Construction Monitoring 🚄

March 29, 2016

Mr. Joe Dasco Atlas Investment Group, LLC 35 Fay Street, Suite 107B Boston, Massachusetts 02118

#### RE: **Geotechnical Report Addendum Proposed Residential Development** 50-62 India Street Portland, ME

GSI Project No. 212234A

Dear Mr. Dasco:

Geotechnical Services, Inc. (GSI) is pleased to submit this report in connection with a geotechnical investigation for the above-referenced project. This study is an extension of our earlier preliminary geotechnical investigation and comprises supplemental investigations and analysis for foundation design. Our scope of service included subsurface explorations involving the retrieval of undisturbed clay samples, laboratory strength and consolidation testing, and data synthesis and evaluation. The work described herein has been conducted in accordance with our proposal of January 26, 2016.

#### **EXECUTIVE SUMMARY**

Our principal findings reveal the site to be underlain with loose, anthropogenic fills and very soft clay soils which will consolidate following the application of foundation loads. Consideration has been given to the support of the proposed structure on a spread footing foundation on undisturbed soil. However, it is estimated that as much as 5 inches of vertical soil compression due to consolidation will occur as a result of the applied foundation loads. This amount of settlement is considered excessive for the type of construction and we have reviewed several options as technically feasible for foundation support. At this time, GSI recommends that the subgrade be improved with a ground improvement technique involving the installation of drilled and pumped grout columns termed "Rigid Inclusion Columns" or "Controlled Modulus Columns". As with the grout columns installed for the Bay House I and II projects, the elements will terminate in a soil "Load Transfer Platform". However, unlike the installation of the grout columns which were installed using a vibratory mandrel, the application herewith involves installation by drilling and as such, there are minimal vibrations transmitted to the surrounding properties. Following subgrade improvement procedures, an allowable bearing pressure of 3,000 psf may be adopted for design of spread footings. The ground floor may be a concrete slab-on-grade.

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∠ 30 Newbury Street, Boston, MA ∠ 617/861/2617

#### 50-62 India Street March 29, 2016

#### **Purpose and Scope**

This report presents the results of a supplemental geotechnical investigation completed by Geotechnical Services, Inc. (GSI) for the proposed development at the corner of India and Newbury Streets in Portland, ME. The scope included the advancement of two additional soil borings and collection of undisturbed "Shelby tube" samples for laboratory testing. The laboratory tests included Atterberg Limits determinations, Unconfined Compression Tests, and One-Dimensional Consolidation Tests. These tests were performed to establish the soil index, strength, and compressibility properties. Such properties were used in an analysis of post-construction foundation settlement due to compression of the underlying clay deposit.

This report is subject to the Limitations outlined in Appendix A.

#### **Applicable Building Code**

International Building Code, IBC (2009) is the Code, which the State of Maine requires for compliance for the proposed building, including geotechnical-foundation engineering applications.

#### **Preliminary Findings**

As discussed in the preliminary geotechnical report, the site subsurface profile was determined to contain significant compressible silty clay. This silty clay presented geotechnical issues related to settlement and bearing capacity. GSI recommended additional exploration and testing with the following objectives:

- Determine the technical feasibility of a spread footing foundation;
- Define the subsurface soil properties as they relate to bearing capacity and settlement;
- Determine the compatibility of the subsurface conditions for ground improvement techniques, and;
- Consider other foundation options such as timber piles.

#### Site Description and Project Description

The project site comprises two separate lots at 50 and 62 India Street at the corner of India and Newbury Streets. The lot at 62 India Street is approximately 0.25 acres and is roughly square in shape. The topography ascends towards the north with the lowermost elevation around 31 feet and upper at 35 feet. At the time of our investigation the 62 India Street parcel was a vacant paved parking lot. The 50 India Street lot was occupied by the Portland Glass Company building which was razed and removed from the site during the course of this investigation. The Portland Glass Building was a single story, masonry structure resting on a spread footing foundation.

The project site is in an area surrounded with commercial and residential properties. The proposed structure will be a multi-story structure with ground-level parking in the west section. Construction will be wood framed residential and the area over the parking may be supported with steel columns. Column loads are expected to be no greater than 150 tons and exterior strip footing loads will be on the order of 3 to 5 tons per lineal foot.



#### SUBSURFACE EXPLORATION PROGRAM

#### **Supplemental Subsurface Explorations**

The subsurface exploration program for this project included the advancement of 2 test borings within the footprint of the proposed building. The explorations were advanced by wash and drive methods utilizing 4-inch casing to depths of 18 feet within the building areas. Soil samples were obtained continuously. Standard Penetration Tests (SPTs) were performed at the sampling intervals in general accordance with ASTM-D1586. The soils encountered during the preliminary exploration program were classified in the field by a representative from GSI. The samples obtained were furthered viewed in the laboratory and classified by a professional engineer. The soil classifications generally follow after the Burmister System. These soil descriptions, the observed depth to groundwater, and other pertinent data are contained in the test boring logs included in Appendix B.

During the supplemental exploration program two, 2.8-inch diameter undisturbed shelby tube samples were retrieved using a standard push sampler. The samples were retrieved within the cohesive silty clay deposit at varying depths. The shelby tube samples were sealed within the tube with wax upon removal from the ground to protect against moisture loss. All samples were transported in an upright position such that minimal disturbance was imparted to the tube. The exploration locations were determined in the field by taping from existing site features. The test boring locations are illustrated on Figure 2.

#### Soil Laboratory Testing

The soil laboratory tests were performed to estimate the engineering properties of the existing soils and to evaluate the suitability of the surface soils for use as structural fill and the impact the underlying silty clay layer would impart on foundation recommendations. The laboratory testing program for the supplemental exploration program included the completion of the following tests:

Four Atterberg limit tests per ASTM-D 4318 were performed in order to determine the liquid limit (LL), plastic limit (PL) and natural moisture content (Wn) of the sample tested. From these values the plasticity index (PI) can be determined and this value is used to infer soil properties, particularly as they relate to published values for the Presumptscott Formation. In addition, moisture content determinations were performed to compare the insitu conditions to the Atterberg Limits particularly with respect to the liquid limit.

Two unconfined compressive strength tests per ASTM-D 2166 were performed in order to determine the compressive strength of the material. This value is used to determine the undrained-unconfined shear strength of the clay. The shear strength of the clay is used in determining bearing capacity and to make an assessment of seismic parameters in accordance with IBC 2009.

Two consolidation tests per ASTM-D 2435 were performed in order to define the stress history of the silty clay soils and develop a stress-strain hysteresis. These properties are used in calculations to estimate settlement and the time required for settlement to occur based on theory developed by Terzarghi and others.

The soil samples chosen for testing were from varied representative depths. Our aim was to evaluate the degree of uniformity of the compressible strata and to determine which portions of the soil were the most susceptible to consolidation due to loading from either building foundation loads or earth fill.

The laboratory results are included in Appendix C.



#### STRATIGRAPHIC DEVELOPMENT

The subsurface explorations performed for this investigation are described in descending order as follows:

#### Urban Fill

A fill unit composed of black to dark brown, SAND and Gravel with Silty Clay, ash, porcelain, and brick fragments, was encountered beneath the pavement. The thickness of this unit ranges from 6 to 8 feet.

#### Silty Clay

The next unit the borings encountered was a very soft to soft grey silty clay. The SPT procedure indicated a soft consistency as sampling resistance was on the order of 2 blows per foot (bpf) to where the clay yielded to the weight of the drill rods. The blow counts are based on a 140 lb. hammer dropping 30 inch to drive the split spoon sampler. The clay exhibits poor shear strength with unconfined compression results ranging from nil to .25 tsf.

#### Sand and Gravel

Sand and Gravel soil was encountered underlying the silty clay materials at 14 to 16 feet. It is believed that this soil may originate as an ablation till. Glacial till is a non-sorted, non-stratified natural deposit of sand, silt, gravel, and boulders, mixed in various proportions and deposited directly by the glaciers in a non-aqueous depositional environment. SPT procedures indicated very dense conditions as sampling resistance was on the order of 17 to 11 bpf.

#### Groundwater

Groundwater was encountered at depths varying from 5 to 6 feet below existing surface elevation. The groundwater depths were measured immediately upon completion of the borings. The drilling was accomplished by wash-casing methods and water was introduced into the borehole. Groundwater readings at these locations would be expected to be shallower than at borings advanced by hollow-stem augers. All the groundwater levels should be anticipated to fluctuate from those measured during drilling operations in response to differences in equilibration time, rainfall, snowmelt, and seasonal fluctuations.

#### FOUNDATION DESIGN CONSIDERATIONS

The subsurface conditions encountered beneath the footprint of the proposed building are not considered suitable for support of a spread footing foundation. It is apparent that the fill soils have been placed in an uncontrolled manner as the relative density is highly variable. Moreover, the underlying clay is soft and weak and is prone to compression when subject to loading.

The behavior of the clay was mimicked in laboratory consolidation tests performed on undisturbed shelby tube samples obtained during the supplemental boring operation using a loading frame and precision measurement devices. From this testing, compressibility characteristics were derived for various portions of the underlying silty clay. Those characteristics of primary interest are overconsolidation ratio (OCR), compression index ( $C_c$ ) and rebound coefficient ( $C_r$ ).



OCR is the ratio of the preconsolidation stress to the existing vertical effective overburden stress. Soils become overconsolidated due to the following: a change in the total stress (removal of overburden), change in pore water pressure or desiccation of the upper layers due to surface drying. The rebound coefficient,  $C_r$ , also known as recompression index, is the slope of either the recompression curve or the unload rebound curve. This value is used during calculation of the primary consolidation settlement that occurs until such time that the applied load exceeds the past preconsolidation pressure. The compression index,  $C_c$ , is the slope of the virgin curve. This value is used during calculation of the primary consolidation settlement that occurs after the past preconsolidation pressure has been exceeded.

#### SPREAD FOOTING FOUNDATION SETTLEMENTS

GSI modeled and analyzed the anticipated foundation settlements based on loading from the foundation loads based on an 8 foot square footing with an allowable bearing pressure of 3000 pounds per square foot. The calculated primary consolidation settlement for the model is estimated to be 5 to 8 inches. Secondary compression is based on a 100 year design life and the resulting settlement from secondary compression is calculated to be 0.2 inches. This estimate was determined by obtaining the coefficient of secondary compression from the time versus deformation graphs created during the consolidation tests. The coefficient of secondary compression appeared comparable to published values for coefficient of secondary compression versus natural water content (Mesri, 1971).

#### FOUNDATION RECOMMENDATIONS

#### **Spread Footings on Improved Subgrade**

It is GSI's recommendation that the proposed structure be supported on an improved subgrade consisting of vertical grout elements comprising "Rigid Inclusion Columns" or "Controlled Modulus Columns" which would be constructed through the FILL and soft clay soils with termination in the underlying sand and gravel. The foundation elements installed for the Bay House I and II projects, "Vibrated Grout Columns", would also be acceptable but are not recommended at this time because of concerns with respect to the effect vibrations would have on the surrounding properties. However, if the vibrations can be run at high frequency, the attendant effects may be kept with innocuous levels.

We anticipate that the vertical grout elements, as proposed, would be a cost saver as compared to using end-bearing or friction piles. It is also expected that for a foundation system supported on such an improved subgrade, the maximum post-construction settlement at a column location would not exceed one inch, and the maximum differential settlement between adjacent columns (assumed at a nominal distance of 30 ft) would not exceed <sup>3</sup>/<sub>4</sub> inch. The allowable bearing pressure with ground improvement would be 3,000 psf.

The vertical grout elements should terminate in a 2 foot thick layer of structural fill which acts as a "load transfer platform". The structural fill should be placed in compacted lifts as specified hereinbelow.

For rigid inclusion columns contact:

David P. Mazzei, P.E. | Project ManagerHayward Baker Inc. | www.HaywardBaker.com9 Whipple Street | Unit 1 | Cumberland, RI 02864-53992: (401)334-2565 | ♣: (401)334-3337 | Cell: (401)500-0535⊠: DPMazzei@HaywardBaker.com



#### For controlled modulus columns contact:

#### MENARD USA

150 East Main Street, Suite 500 Carnegie, PA 15106 <u>412-620-6000</u> Email: <u>info@menardusa.com</u>

#### **OTHER FOUNDATION OPTIONS**

#### **Timber Piles**

The proposed building may also be supported upon a timber pile foundation. The timber piles would derive their support from a combination of tip bearing and friction resistance along the shaft in the competent sand and gravel bearing strata. The piles may be 8-inch tip units with natural taper in general accordance with ASTM D 25. The piles are to be southern yellow pine with a minimum compressive strength parallel to the grain of 1200 psi in accordance with ASTM D 2899. These units will derive their capacity through a combination of tip bearing and friction resistance. Assuming that the critical section occurs at the pile mid-depth, the piles are rated for an allowable capacity of **35 tons**.

Concerns with respect to timber pile foundations are the vibrations that would be generated during impact driving and the need for a structural slab and grade beams. It is our opinion therefore that timber piles, or other deep foundation systems, are not as cost-effective for this project as the afore-mentioned ground improvement procedures.

#### Removal of Anthropogenic Fill and Replacement with Lightweight Fill

The removal of the anthropogenic fill and replacement with lightweight material such as "Solite" (expanded vermiculite) or "Elastizell" material would relieve the subsurface of its present stae of effective vertical stress such that the imposition of building loads would have a neutral effect. However, this is not considered practical for this project because the anthropogenic fill may contain environmental contaminants which would require management at considerable cost. Also, the cost for lightweight fill is on the order of \$90/cy delivered thus it is not a cost-effective option for this project.

#### **Seismic Design Parameters**

In accordance with IBC2009, we have evaluated susceptibility of the project site to earthquake-induced liquefaction and have determined that the site would is susceptible to earthquake induced liquefaction. According to the criteria set in IBC2009, and based on the results of unconfined compressive strength testing by GSI, the project site has been evaluated to belong to Site Class E. However, with the subgrade improvement procedures imparted by the ground improvements, the site stiffness will be upgraded to Site Class D. Other seismic design parameters are attached in Appendix



#### Slab-On-Grade

GSI recommends that a concrete slab-on-grade be constructed following subgrade improvement of the underlying clay soils. Structural fill should be placed in 8 inch lifts and compacted to at least 95 percent relative compaction as determined by the Modified Proctor Test (ASTM-D1557) until floor slab base course subgrade is achieved. The concrete floor slabs should rest on a minimum 8-inch layer of floor slab base course soil meeting the gradation requirements for Structural Fill. The floor slab base course material should be compacted to at least 95 percent relative compaction as determined by the Modified Proctor Test (ASTM-D1557). Based upon the foregoing slab base preparation a modulus of subgrade reaction (Ks) of 250 pci may be used for design.

#### **Protection of Foundation Subgrades**

The contractor should maintain stable-dewatered subgrades for foundations, pavement areas, utility trenches and other concerned areas during construction. Subgrade disturbance may be influenced by excavation methods, moisture, precipitation, groundwater control, and construction activities. The silty soils overlying the clay are inherently vulnerable to disturbance when exposed to wet conditions. The moisture sensitivity of these soils is related to their high composition of fine-grained constituent (silt-clay) which acts to retain water.

The contractor should be aware of the sensitivity of the silty soils and take precautions to reduce subgrade disturbance. Such precautions may include diverting storm run-off away from construction areas, reducing traffic in sensitive areas, and maintaining an effective de-watering program.

Soils exhibiting weaving or instability should be over-excavated to more competent bearing soil and replaced with structural fill. It may be desirable for the contractor to place a lean concrete mud mat or a lift of free-draining gravel atop the prepared silty soil subgrade for protection against weakening/softening as construction progresses. A qualified engineer should inspect bearing subgrades throughout construction.

#### **Temporary Excavations**

For slope layback design, the on-site soils should be considered Type C soils in accordance with Occupational Safety and Health Administration (OSHA) regulations (29 CFR Part 1926). The maximum temporary slope for Soil Type C soils is 1.5H:1V provided the groundwater is lowered below the bottom of the excavation. The foregoing slope geometry precludes surcharge loads at the crest of the slope. It should be noted that these slope requirements are minimums required by OSHA regulations.

#### CONSTRUCTION SPECIFICATIONS

**Structural Fill (Compacted Granular Fill) -** Structural Fill should consist of clean sand and gravel free of organic material, snow, ice, or other objectionable materials and should be well-graded within the following limits:

Sieve Size	Percent Finer by Weight
6 in.	100
No. 4	30-70
No. 40	10-50
No. 200	0-10



#### 50-62 India Street March 29, 2016

Structural Fill should be placed in lift thickness not exceeding 12 in. loose measure. Cobbles and boulders having a size exceeding 2/3 of the loose lift thickness should be removed prior to compaction. Compaction in open areas should consist of self-propelled vibratory rollers such as a BoMag BW-60S or equivalent. In confined areas, hand guided equipment such as a large vibratory plate compactor, should be used and the loose lift thickness should not exceed 6 in. A minimum of four systematic passes of the compaction equipment should be used to compact each lift. Compaction effort should be verified by field density testing.

**Common Fill -** Common fill may be used to raise grades in paved and landscaped areas, subject to pavement design criteria and landscape planting or drainage requirements. Common fill should be granular mineral soil free from organic materials, loam, wood, trash, snow, ice, frozen soil, and other compressible materials. Common fill should not contain stones larger than 2/3 of the placement lift thickness, and have a maximum 80 percent passing the No. 40 sieve, and a maximum of 30 percent passing the No. 200 sieve. These soils typically would require moisture control during placement and compaction. The on-site FILL soils are anticipated to meet the Common Fill requirements.

**Backfilling** - We recommend that Structural Fill be used as backfill around and beneath the caps to receive the and beneath the slab (pavement)-on-grade. Backfill outside the building footprint may generally consist of Common Fill with the exception of special filling requirements for pavements or other site structures. Recommended compaction requirements are as follows:

Location	Minimum Compaction Recommendation
Beneath and around caps,	
grade beams, under slabs	95 %
Parking, roadways, and sidewalks	92 % up to 3 ft below finished grade;
	95% in the upper 3 ft
Landscaped areas	90 %

Minimum compaction requirements refer to percentages of the maximum dry density determined in accordance with ASTM D1557.

**Construction Dewatering** - It is anticipated that groundwater control during foundation excavation will not be a serious concern as long as the surface runoff is controlled in an effective way.

**Construction Monitoring -** It is recommended that a geotechnical engineer or experienced technical personnel be present during foundation construction to:

- 1. Monitor the foundation excavation and removal of the existing foundations, and preparation of subgrade to receive the ground improvements elements;
- 2. Monitor the construction of the ground improvement elements;
- 3. Confirm that backfill materials meet the requirements of the project plans and specifications, and make judgments regarding the suitability of excavated soils for reuse as Structural Fill or Common Fill;
- 4. Observe placement and test Structural Fill (as required by the Building Code) to meet asplaced density requirements.

It is recommended that GSI be retained to provide the recommended monitoring services. This will enable us to observe compliance with the project specific design requirements.



#### 50-62 India Street March 29, 2016

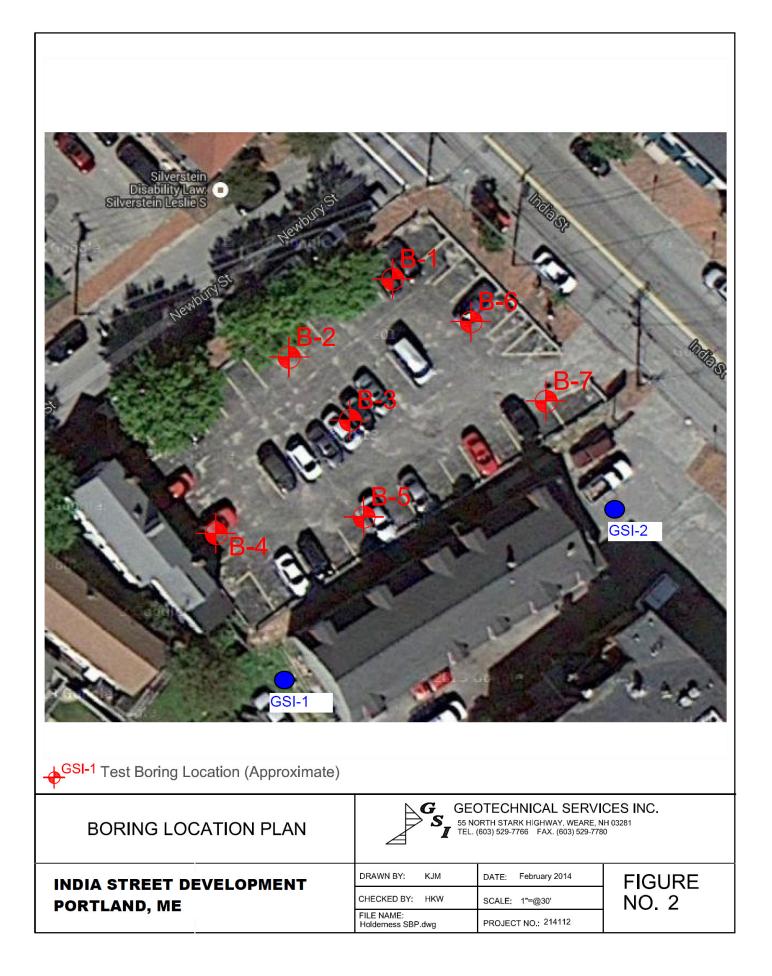
It has been a pleasure to serve you during the design phase of this project, and we look forward to its successful completion. If you have any questions on the content of this report, please do not hesitate to contact us.

#### **GEOTECHNICAL SERVICES INC.**

Harry K. Wetherbee, P.E. *Principal Engineer* 

Figures Appendix A - Limitations Appendix B – Exploration Logs Appendix C – Laboratory Test Results Appendix D – Seismic Design Parameters Appendix E – Preliminary Geotechnical Report (March 2014)





## **APPENDIX A**

**LIMITATIONS** 



#### LIMITATIONS

#### **Explorations**

- 1. The analyzes, recommendations and designs submitted in this report are based in part upon the data obtained from preliminary subsurface explorations. The nature and extent of variations between these explorations may not become evident until construction. If variations then appear evident, it will be necessary to re-evaluate the recommendations of this report.
- 2. The generalized soil profile described in the text is intended to convey trends in subsurface conditions. The boundaries between strata are approximate and idealized and have been developed by interpretation of widely spaced explorations and samples; actual soil transitions are probably more gradual. For specific information, refer to the individual test pit and/or boring logs.
- 3. Water level readings have been made in the test pits and/or test borings under conditions stated on the logs. These data have been reviewed and interpretations have been made in the text of this report. However, it must be noted that fluctuations in the level of the groundwater may occur due to variations in rainfall, temperature, and other factors differing from the time the measurements were made.

#### <u>Review</u>

- 4. It is recommended that this firm be given the opportunity to review final design drawings and specifications associated with development of this site to evaluate the appropriate implementation of the recommendations provided herein.
- 5. In the event that any changes in the nature, design, or location of the proposed areas are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and conclusions of the report modified or verified in writing by Geotechnical Services, Inc.

#### **Construction**

6. It is recommended that this firm be retained to provide geotechnical engineering services during the earthwork phases of the work. This is to observe compliance with the design concepts, specifications, and recommendations and to allow design changes in the event that subsurface conditions differ from those anticipated prior to the start of construction.

#### Use of Report

- 7. This report has been prepared for the exclusive use of Atlas Development and the design team in accordance with generally accepted soil and foundation engineering practices. No other warranty, expressed or implied, is made.
- 8. This report has been prepared for this project by Geotechnical Services, Inc. This report was completed for preliminary design purposes and may be limited in its scope to complete an accurate bid. Contractors wishing a copy of the report may secure it with the understanding that its scope is limited to evaluation considerations only.





**EXPLORATION LOGS** 



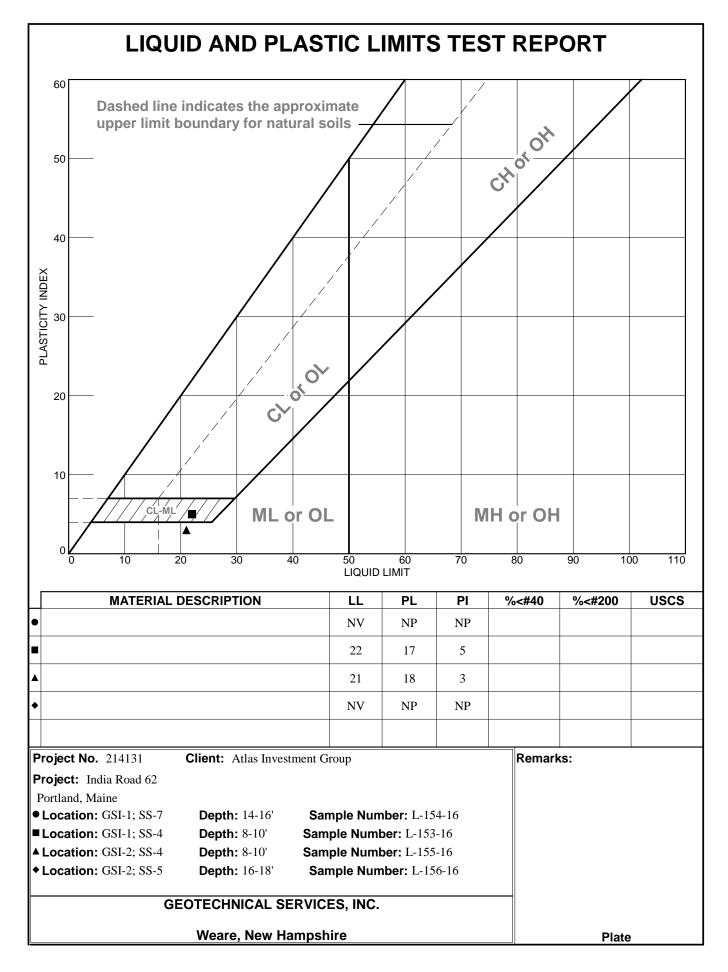
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/45	Iter	n:			Auger	Casin	g S	ample	r Core E	arrel	🗹 Tru	ick		Skid		<u> </u>	Hami	mer Ty	oe:
617	Тур	be				4"		SS			Tra					~		ety Ha	
ne	-		neter (in.)	/			-	1-3/8"			Bor	-		Geoprot	be			ughnut	
Pho			eight (lb)	)		300		140	_	-		ipod		Other				omatic	
16	Hai	nmer Fa	all (in.)			30"		30"			🔽 Wii	nch	Cat	Head	$\checkmark$	Roller Bit	t 🛄	Cutting	g Head
021	(Ħ)	g (ft)		1	1	Sample [	Data	I		_	Sc	oil-Roc	k Visı	ual Class	ificati	on and	Desc	riptior	1
Boston, MA 02116 Phone	Depth (ft)	Casing (Blows/ft)	No.	Depth (ft)	Rec (in.)	SPT (Bl./ 6-in.)	"N" Value	PII Rdg (ppr	g. Chang			(Roc	•	oils - Burn S. Corps		• /		- m)	
Bo	- 0 -								ASPHAL	T 3 Inc	ches of	Aspha	t.						
Phone 603/529-7766 Fax 603/5297080 - 30 Newbury St. 3rd Floor,	• 1 -		SS - 1 SS - 2	1 - 3 3 - 5	15/3 24/15	4 18 100/<3 3 4	118 8		URBAI FILL	tr J Wet,	ace silf	t. Piece gray-b	of roo	t, fine to c ck in tip o fine to coa	f SS. arse, S	Anthropo	ogeni	c Fill.	
Newbu	- 5 -		SS - 3A	5 - 7	04/44	4 3 68				Ũ			•				ne fir	ne to co	arse sanc
7080 - 30	 		SS - 3B		24/14	31 12 7	43		CLAYE SILT	Botto	ilt, red om 3 in	brick pi iches. V	eces. Vet, g	Anthropo ray, CLA	genic YEY S	Fill. SILT, little	e sma	all grav	el.
x 603/529	· -		SS - 4	8 - 10	24/16	WH WH WH WH	0			Wet,	, very lo	oose, g	ray SI	LT.					
766 Fa	- 10 -		US - 1	10 -12	2				SILT					Shelby T	ube T	aken.			
03/529-7			SS - 5	12 - 1	<sup>1</sup> 24/24	WR WR WH	0			Wet,	, very lo	oose, g	ray SI	LT.					
hone 6	- 15 -		SS - 6	14 - 1	<sup>3</sup> 24/14	WH 7 8 5	13			Wet,	, mediu	ım dens	se, gra	ay fine SA	AND, li	ttle smal	ll gra	vel, tra	ce silt.
			SS - 7	16 - 1	3 24/24	3 3 3 8	11		SAND	Wet,	, mediu	ım dens	se, gra	ay fine SA	ND, li	ttle smal	ll gra	vel, tra	ce silt.
Weare, N	· ·					6					Borir	ng termi	nated	at 18 fee	et and	backfille	d wit	h cuttir	ıgs.
55 North Stark Highway, Weare, NH 03281	20 -																		
С			N	Nater L	evel Data				Sample I					Soils N-V					- Value
Geotechnical Services, Inc.	Dat 3/8		Time EOD	Bott Cas	of E ng	oth (ft) to: Bott. of Hole 18'	Wate		O = Ope U = Unc S = Spli C = Roc G = Geo	isturbed Spoon k Core probe	ł	4 t 1	2 to to 8: N 8 to 5 to 3 Over	Very Soft 4: Soft Medium S 15: Stiff 0 Very St 30: Hard	itiff	11 to 3	4 to 1 30: N 31 to 3	Very Lo 10: Loo Medium 50: De : Very I	se 1 Dense nse
3chr					(0 to 5%		e (10 to :		, Some (2			And (3	5 to 50	0%)					
eote	1. EOD = End of drilling, WR = Weight of Rods, WH = Weight of Hammer.         2. Due to rotary wash method of drilling, water level data may not not reflect actual water table level.         GSI-2																		
Ğ	Note	es: 2. 1	Due to ro	otary wa	sh metho	d ot drilli	ng, wate	r leve	i data may n	ot not re	etlect a	ctual w	ater ta	adie level.				G	SI-2

## **APPENDIX C**

LABORATORY RESULTS







**REMARKS:** 

## **GEOTECHNICAL SERVICES, INC.**

Geotechnical Engineering

Material Testing Environmental Studies

**UNCONFINED COMPRESSIVE STRENGTH** 

PROJECT:	India Street	SAMPLED BY:	Others
PROJECT No .:	214131	DATE SAMPLED:	N/A
SAMPLE No.:	L-146-16	TESTED BY:	A.Osborne
DEPTH:	10'-12'	DATE TESTED:	3/23/2016
LOCATION:	GSI-2/U-2	PLOTTED BY:	A.Osborne
SOURCE:	On-Site	DATE PLOTTED:	3/28/2016
DESCRIPTION:			

#### ASTM D 2166

SAMPLE DATA

DI
M
A

DIAMETER (in)= 2.88 OISTURE (%)= 30.3 AREA,  $A_0$  (in<sup>2</sup>) = 6.51

3.8

Construction Monitoring

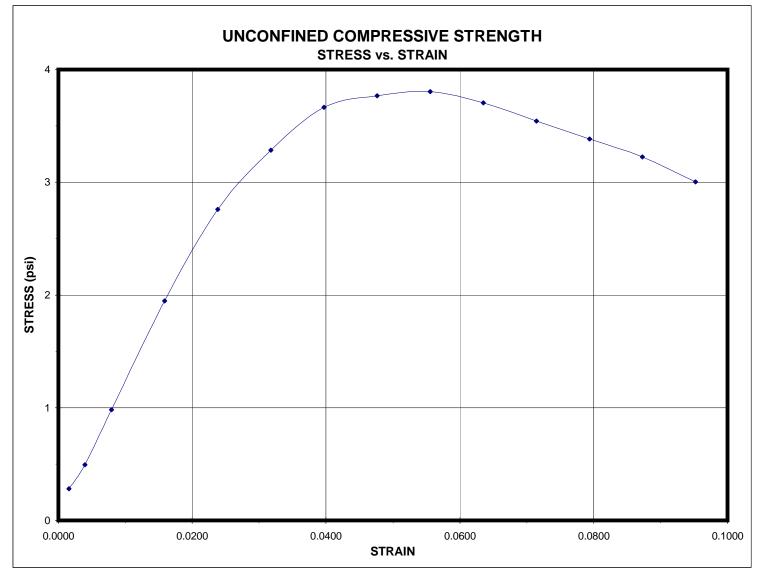
Unconfined Compressive Strength (psi) / (psf)=

Specimen Deformation	Vertical Strain	Proving Ring Dial Reading	Load	Corrected Area	Stress
(ΔL)	ε <b>= (ΔL / L)</b>	(# of small divisions)	Col. (3) * Cal. Factor	$A_{c} = A_{0} / (1 - \varepsilon)$	Col 4 / Col5
(1/1000 in) (1)	(2)	(3)	(lb) (4)	(in²) (5)	(lb/in <sup>2</sup> ) (6)
10	0.0016	4	1.8	6.52	0.28
25	0.0040	7	3.2	6.54	0.49
50	0.0079	14	6.4	6.56	0.98
100	0.0159	28	12.9	6.62	1.95
150	0.0238	40	18.4	6.67	2.76
200	0.0317	48	22.1	6.72	3.28
250	0.0397	54	24.8	6.78	3.66
300	0.0476	56	25.8	6.84	3.77
350	0.0556	57	26.2	6.89	3.80
400	0.0635	56	25.8	6.95	3.71
450	0.0714	54	24.8	7.01	3.54
500	0.0794	52	23.9	7.07	3.38
550	0.0873	50	23.0	7.13	3.22
600	0.0952	47	21.6	7.20	3.00

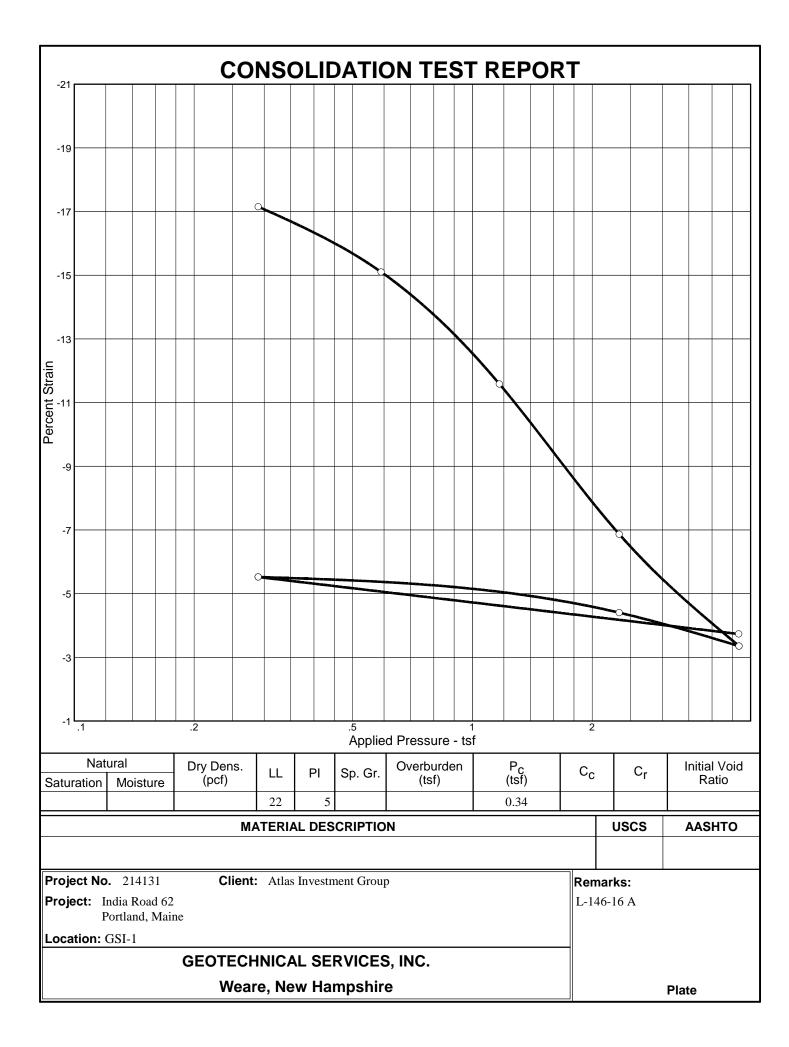


## **GEOTECHNICAL SERVICES, INC.**

Material Testing Geotechnical Engineering Environmental Studies Construction Monitoring **UNCONFINED COMPRESSIVE STRENGTH PROJECT:** India Street SAMPLED BY: Others **PROJECT No.:** DATE SAMPLED: 214131 N/A SAMPLE No.: L-146-16 **TESTED BY:** A.Osborne **ELEVATION:** 10'-12' DATE TESTED: 3/23/2016 GSI-2/U-2 LOCATION: PLOTTED BY: A.Osborne DATE PLOTTED: SOURCE: **On-Site** 3/28/2016 **DESCRIPTION: REMARKS:** 

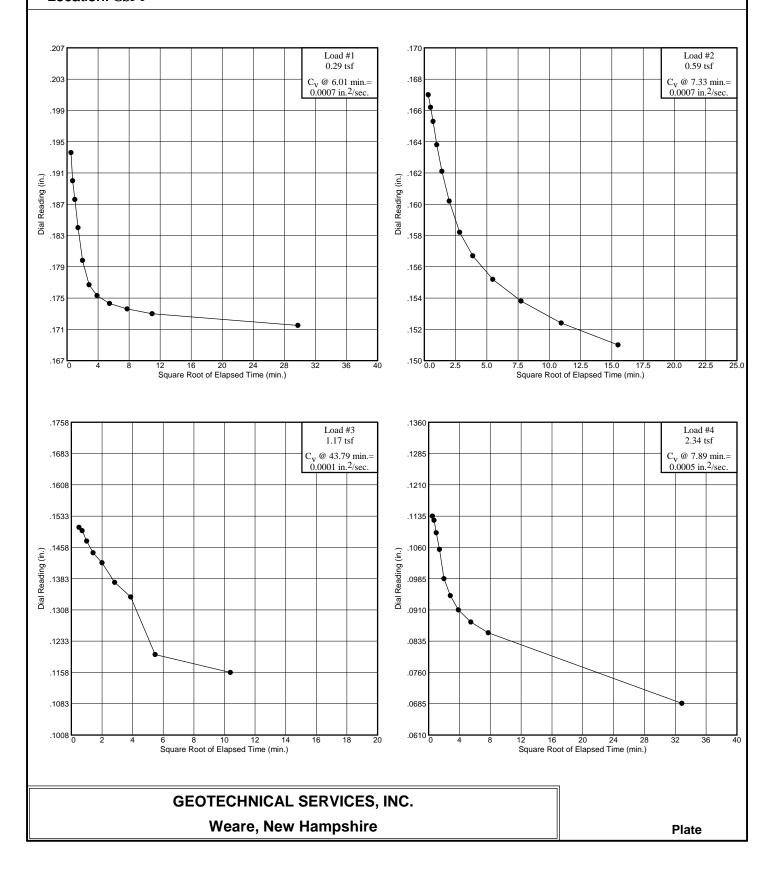


Unconfined Compressive Strength (psi) / (psf)= 3.8

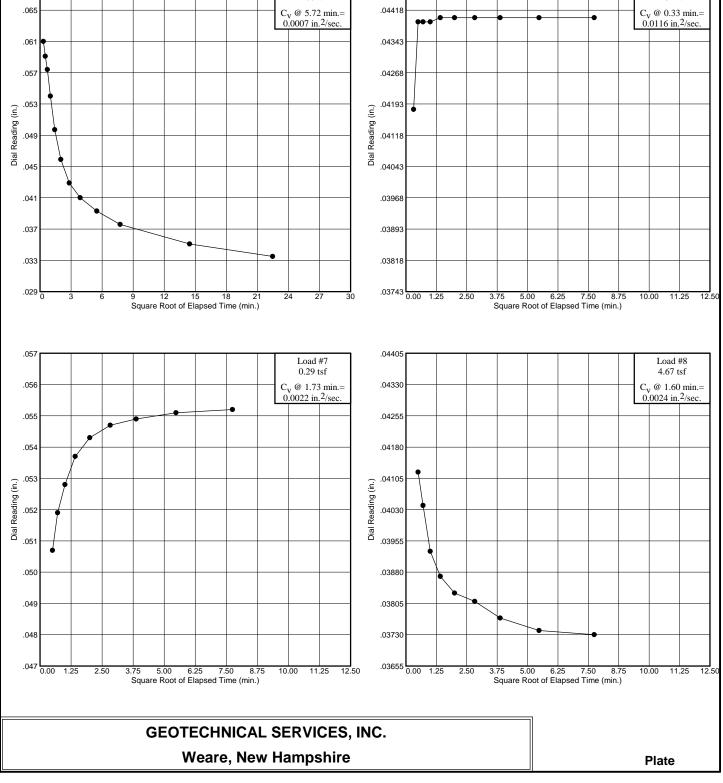


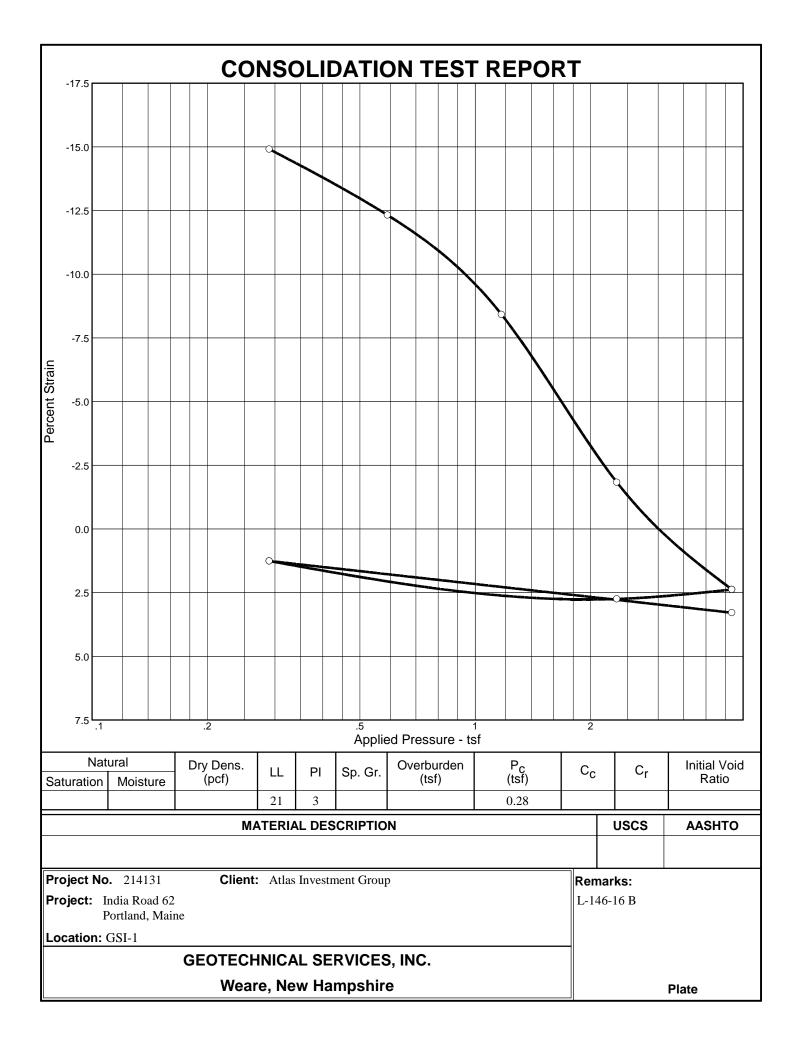
## **Dial Reading vs. Time**

Project No.: 214131 Project: India Road 62 Portland, Maine Location: GSI-1



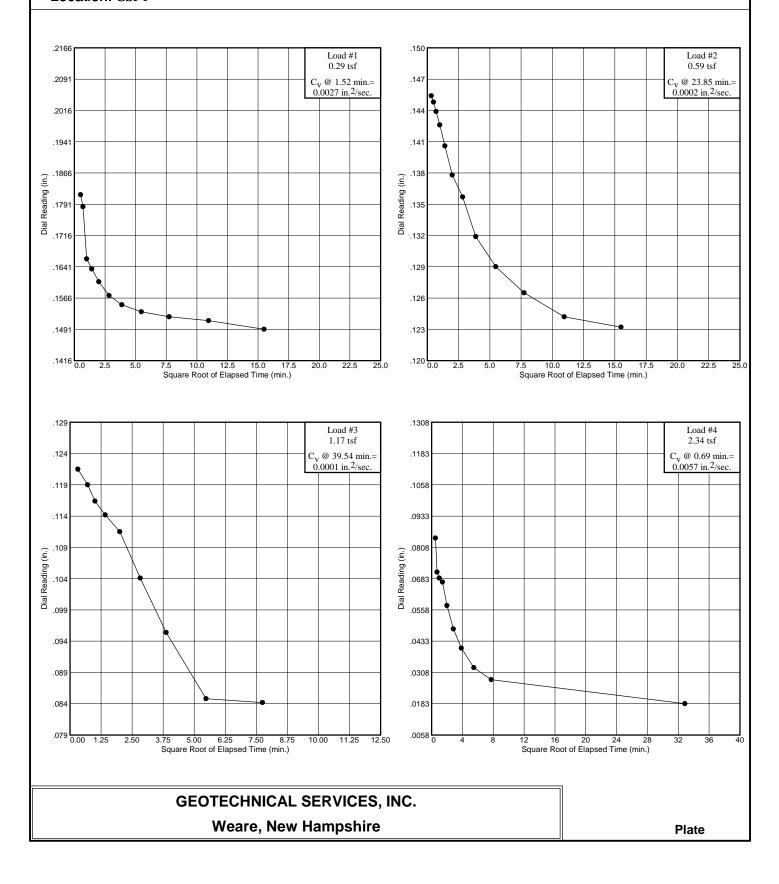
#### **Dial Reading vs. Time** Project No.: 214131 Project: India Road 62 Portland, Maine Location: GSI-1 .04493 .069 Load #6 Load #5 4.68 tsf 2.34 tsf .04418 C<sub>v</sub> @ 5.72 min.= C<sub>v</sub> @ 0.33 min.= • 0.0007 in.2/sec. 0.0116 in.2/sec. .04343 .04268





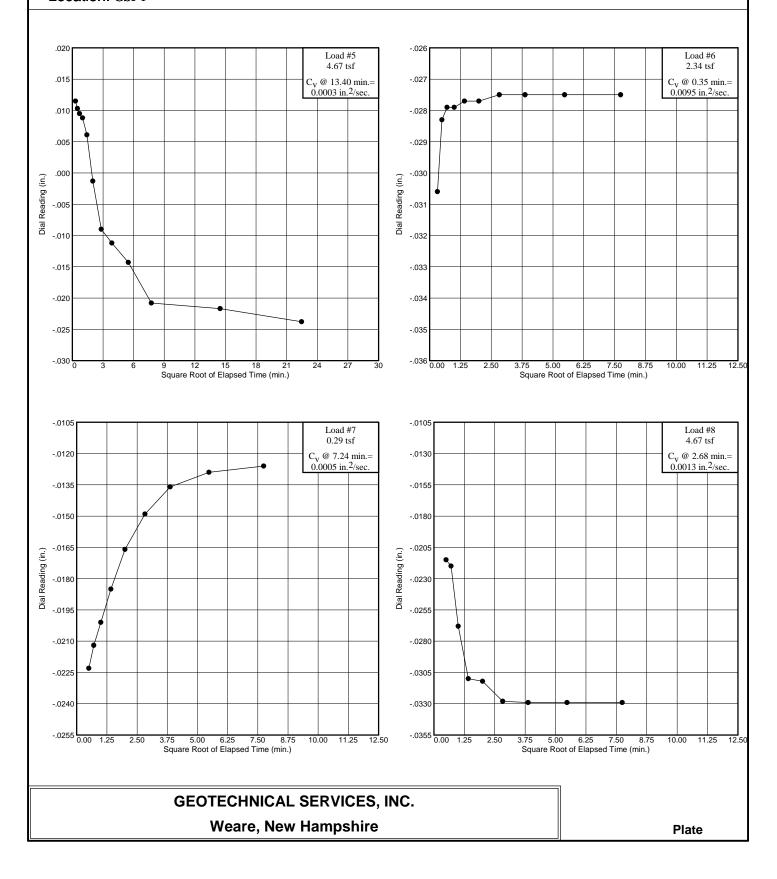
## **Dial Reading vs. Time**

Project No.: 214131 Project: India Road 62 Portland, Maine Location: GSI-1



## **Dial Reading vs. Time**

Project No.: 214131 Project: India Road 62 Portland, Maine Location: GSI-1





### **SEISMIC DESIGN**



### **EUSGS** Design Maps Detailed Report

2006/2009 International Building Code (43.66063°N, 70.25039°W)

Site Class D – "Stiff Soil", Occupancy Category I/II/III

#### Section 1613.5.1 — Mapped acceleration parameters

Note: Maps in the 2006 and 2009 International Building Code are provided for Site Class B. Adjustments for other Site Classes are made, as needed, in Section 1613.5.3.

From <u>Figure 1613.5(1)</u> <sup>[1]</sup>	S <sub>s</sub> = 0.314 g

#### From Figure 1613.5(2) [2]

 $S_1 = 0.077 g$ 

#### Section 1613.5.2 — Site class definitions

AHard rock $\overline{v_s} > 5,000$ N/AN/ABRock $2,500 < \overline{v_s} \le 5,000$ N/AN/ACVery dense $1,200 < \overline{v_s} \le 2,500$ $\overline{N} > 50$ >2,000 psfsoil and softrockDStiff soil $600 \le \overline{v_s} < 1,200$ $15 \le \overline{N} \le 50$ $1,000$ to 2,000 psfprofile </th <th>SITE CLASS</th> <th>SOIL PROFILE NAME</th> <th>Soil shear wave velocity, <math>\overline{v}_{s}</math>, (ft/s)</th> <th>Standard penetration resistance, <del>N</del></th> <th>Soil undrained shear strength, <math>\overline{s}_{_{\mathrm{u}}\prime}</math> (psf)</th>	SITE CLASS	SOIL PROFILE NAME	Soil shear wave velocity, $\overline{v}_{s}$ , (ft/s)	Standard penetration resistance, <del>N</del>	Soil undrained shear strength, $\overline{s}_{_{\mathrm{u}}\prime}$ (psf)		
CVery dense soil and soft rock $1,200 < \overline{v}_s \le 2,500$ $\overline{N} > 50$ >2,000 psfDStiff soil profile $600 \le \overline{v}_s < 1,200$ $15 \le \overline{N} \le 50$ $1,000$ to 2,000 psfEStiff soil profile $\overline{v}_s < 600$ $\overline{N} < 15$ $<1,000$ psfE—Any profile with more than 10 ft of soil having the characteristics:1. Plasticity index $PI > 20$ , 2. Moisture content $w \ge 40\%$ , and 3. Undrained shear strength $\overline{s}_u < 500$ psfF—Any profile containing soils having one or more of the following characteristics:1. Soils vulnerable to potential failure or collapse under seismic loading such a liquefiable soils, quick and highly sensitive clays, collapsible weakly cement soils.2. Peats and/or highly organic clays ( $H > 10$ feet of peat and/or highly organic clay where $H =$ thickness of soil)3. Very high plasticity clays ( $H > 25$ feet with plasticity index $PI > 75$ )	А	Hard rock	$\overline{v}_{s} > 5,000$	N/A	N/A		
soil and soft rockDStiff soil $600 \le \overline{v}_{s} < 1,200$ $15 \le \overline{N} \le 50$ $1,000$ to $2,000$ psfprofileEStiff soil $\overline{v}_{s} < 600$ $\overline{N} < 15$ $<1,000$ psfProfileE-Any profile with more than 10 ft of soil having the characteristics:1. Plasticity index $PI > 20$ , 2. Moisture content $w \ge 40\%$ , and 3. Undrained shear strength $\overline{s}_{u} < 500$ psfF-Any profile containing soils having one or more of the following characteristics:1. Soils vulnerable to potential failure or collapse under seismic loading such a liquefiable soils, quick and highly sensitive clays, collapsible weakly cement soils.2. Peats and/or highly organic clays ( $H > 10$ feet of peat and/or highly organic clay where $H =$ thickness of soil)3. Very high plasticity clays ( $H > 25$ feet with plasticity index $PI > 75$ )	В	Rock	$2,500 < \overline{v}_{\rm S} \le 5,000$	N/A	N/A		
profileEStiff soil $\overline{v}_s < 600$ $\overline{N} < 15$ <1,000 psf	С	soil and soft	$1,200 < \overline{v}_{s} \le 2,500$	$\overline{N} > 50$	>2,000 psf		
profileE—Any profile with more than 10 ft of soil having the characteristics:1. Plasticity index $PI > 20$ , 2. Moisture content $w \ge 40\%$ , and 3. Undrained shear strength $\overline{s}_u < 500$ psfF—Any profile containing soils having one or more of the following characteristics: 1. Soils vulnerable to potential failure or collapse under seismic loading such a liquefiable soils, quick and highly sensitive clays, collapsible weakly cement soils.2. Peats and/or highly organic clays ( $H > 10$ feet of peat and/or highly organic clay where $H =$ thickness of soil) 3. Very high plasticity clays ( $H > 25$ feet with plasticity index $PI > 75$ )	D		$600 \le \overline{v}_{s} < 1,200$	$15 \le \overline{N} \le 50$	1,000 to 2,000 psf		
<ul> <li>1. Plasticity index PI &gt; 20,</li> <li>2. Moisture content w ≥ 40%, and</li> <li>3. Undrained shear strength s<sub>u</sub> &lt; 500 psf</li> <li>F — Any profile containing soils having one or more of the following characteristics:</li> <li>1. Soils vulnerable to potential failure or collapse under seismic loading such a liquefiable soils, quick and highly sensitive clays, collapsible weakly cement soils.</li> <li>2. Peats and/or highly organic clays (H &gt; 10 feet of peat and/or highly organic clay where H = thickness of soil)</li> <li>3. Very high plasticity clays (H &gt; 25 feet with plasticity index PI &gt; 75)</li> </ul>	E		$\overline{v}_{s} < 600$	$\overline{N}$ < 15	<1,000 psf		
<ol> <li>Soils vulnerable to potential failure or collapse under seismic loading such a liquefiable soils, quick and highly sensitive clays, collapsible weakly cement soils.</li> <li>Peats and/or highly organic clays (<i>H</i> &gt; 10 feet of peat and/or highly organic clay where <i>H</i> = thickness of soil)</li> <li>Very high plasticity clays (<i>H</i> &gt; 25 feet with plasticity index <i>PI</i> &gt; 75)</li> </ol>	1. Plasticity index $PI > 20$ , 2. Moisture content $w \ge 40\%$ , and						
For SI: 1ft/s = 0.3048 m/s 1lb/ft <sup>2</sup> = 0.0479 kN/m <sup>2</sup>							

Section 1613.5.3 — Site coefficients and adjusted maximum considered earthquake spectral response acceleration parameters

Site Class	Мар	Mapped Spectral Response Acceleration at Short Period							
	S <sub>s</sub> ≤ 0.25	$S_{s} \le 0.25$ $S_{s} = 0.50$ $S_{s} = 0.75$ $S_{s} = 1.00$ $S_{s} \ge 1.25$							
A	0.8	0.8	0.8	0.8	0.8				
В	1.0	1.0	1.0	1.0	1.0				
С	1.2	1.2	1.1	1.0	1.0				
D	1.6	1.4	1.2	1.1	1.0				
E	2.5	2.5 1.7 1.2 0.9 0.9							
F	See Section 11.4.7 of ASCE 7								

TABLE 1613.5.3(1) VALUES OF SITE COEFFICIENT  $F_a$ 

Note: Use straight–line interpolation for intermediate values of  $S_s$ 

For Site Class = D and  $S_s = 0.314 \text{ g}$ ,  $F_a = 1.549$ 

TABLE 1613.5.3(2) VALUES OF SITE COEFFICIENT  $F_v$ 

Site Class	Ма	Mapped Spectral Response Acceleration at 1-s Period				
	S <sub>1</sub> ≤ 0.10	S <sub>1</sub> = 0.20	$S_1 = 0.30$	S <sub>1</sub> = 0.40	$S_1 \ge 0.50$	
A	0.8	0.8	0.8	0.8	0.8	
В	1.0	1.0	1.0	1.0	1.0	
С	1.7	1.6	1.5	1.4	1.3	
D	2.4	2.0	1.8	1.6	1.5	
E	3.5	3.2	2.8	2.4	2.4	
F	See Section 11.4.7 of ASCE 7					

Note: Use straight–line interpolation for intermediate values of  ${\rm S}_{\rm 1}$ 

For Site Class = D and S<sub>1</sub> = 0.077 g,  $F_v$  = 2.400

#### Design Maps Detailed Report

In the equations below, the equation number corresponding to the 2006 edition is listed first, and that corresponding to the 2009 edition is listed second.

Equation (16-37; 16-36):	$S_{MS} = F_a S_S = 1.549 \times 0.314 = 0.486 g$
Equation (16-38; 16-37):	$S_{M1} = F_v S_1 = 2.400 \times 0.077 = 0.184 g$
Section 1613.5.4 — Design spectral respon	se acceleration parameters
Equation (16-39; 16-38):	$S_{DS} = \frac{2}{3} S_{MS} = \frac{2}{3} \times 0.486 = 0.324 \text{ g}$
Equation (16-40; 16-39):	$S_{D1} = \frac{2}{3} S_{M1} = \frac{2}{3} \times 0.184 = 0.123 g$

#### Section 1613.5.6 — Determination of seismic design category

TABLE 1613.5.6(1)
SEISMIC DESIGN CATEGORY BASED ON SHORT-PERIOD RESPONSE ACCELERATION

VALUE OF S <sub>DS</sub>	OCCUPANCY CATEGORY			
VALUE OF S <sub>DS</sub>	I or II	III	IV	
S <sub>DS</sub> < 0.167g	А	А	А	
0.167g ≤ S <sub>DS</sub> < 0.33g	В	В	С	
0.33g ≤ S <sub>DS</sub> < 0.50g	С	С	D	
0.50g ≤ S <sub>DS</sub>	D	D	D	

For Occupancy Category = I and  $S_{DS}$  = 0.324 g, Seismic Design Category = B

#### TABLE 1613.5.6(2)

SEISMIC DESIGN CATEGORY BASED ON 1-SECOND PERIOD RESPONSE ACCELERATION

VALUE OF S <sub>D1</sub>	OCCUPANCY CATEGORY		
VALUE OF S <sub>D1</sub>	I or II	III	IV
S <sub>D1</sub> < 0.067g	А	А	А
$0.067g \le S_{D1} < 0.133g$	В	В	С
$0.133g \le S_{D1} < 0.20g$	С	С	D
0.20g ≤ S <sub>D1</sub>	D	D	D

For Occupancy Category = I and  $S_{D1}$  = 0.123 g, Seismic Design Category = B

Note: When  $S_1$  is greater than or equal to 0.75g, the Seismic Design Category is **E** for buildings in Occupancy Categories I, II, and III, and **F** for those in Occupancy Category IV, irrespective of the above.

Seismic Design Category  $\equiv$  "the more severe design category in accordance with Table 1613.5.6(1) or 1613.5.6(2)" = B

Note: See Section 1613.5.6.1 for alternative approaches to calculating Seismic Design Category.

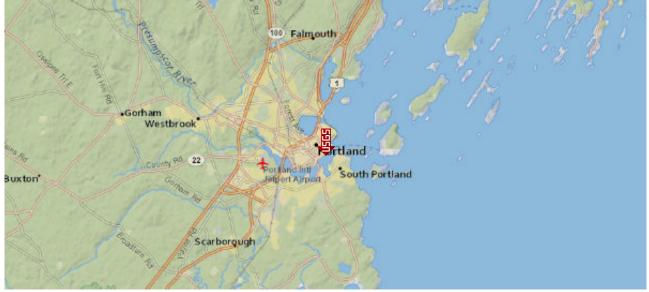
#### References

- 1. *Figure 1613.5(1)*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/IBC-2006-Figure1613\_5(01).pdf
- 2. *Figure 1613.5(2)*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/IBC-2006-Figure1613\_5(02).pdf

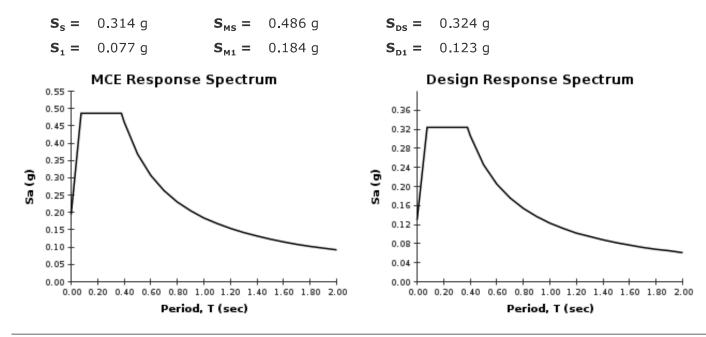
## **WUSGS** Design Maps Summary Report

#### **User-Specified Input**

Report Title	50 - 62 India Street Tue March 29, 2016 15:42:50 UTC
Building Code Reference Document	2006/2009 International Building Code (which utilizes USGS hazard data available in 2002)
Site Coordinates	43.66063°N, 70.25039°W
Site Soil Classification	Site Class D – "Stiff Soil"
Occupancy Category	I/II/III



#### **USGS-Provided Output**



Although this information is a product of the U.S. Geological Survey, we provide no warranty, expressed or implied, as to the accuracy of the data contained therein. This tool is not a substitute for technical subject-matter knowledge.



**PRELIMINARY REPORT OF MARCH 2014** 

# **GEOTECHNICAL REPORT**

## 62 INDIA STREET PORTLAND, MAINE

March 31, 2014

GSI Project No. 212234A

#### Prepared for:

Mr. Demetri Dasco Atlas Investment Group, LLC. 35 Fay Street, Suite 107B Boston, Massachusetts 02118

#### Prepared by:

Harry K. Wetherbee, P.E. Geotechnical Services, Inc. 55 North Stark Highway Weare, NH 03281





🔺 Geotechnical Engineering 🔺 Environmental Studies 🔺 Materials Testing 🔺 Construction Monitoring 🔺

March 31, 2014

Mr. Demetri Dasco Atlas Investment Group, LLC. 35 Fay Street, Suite 107B Boston, Massachusetts 02118

#### RE: Geotechnical Investigation Report New Residential Construction 62 India Street Portland, Maine

GSI Project No. 212234

Dear Mr. Dasco:

Geotechnical Services, Inc. (GSI) presents the following geotechnical report for the above referenced project. The contents of this report are subject to the Limitations outlined in Appendix A.

#### **PROJECT OVERVIEW AND SITE CONDITIONS**

The following narrative summarizes the geotechnical recommendations pertaining to the proposed project. The project consists of the construction of a multi-story residential structure on India Street in Portland, Maine. At the time of this writing, the presence of below grade space within the proposed structure has not been confirmed.

#### PURPOSE AND SCOPE

The scope of services performed by GSI to meet the above-stated objectives for geotechnical engineering services included the following:

- 1. Review of available project plans and documents.
- 2. Coordination and observation of test borings at the locations illustrated on Figure 2. The soil exploration program was observed by a field representative from GSI.
- 3. Preparation of recommendations for foundation support of the proposed structure, including estimated bearing capacity and settlement values.
- 4. Preparation of recommendations regarding seismic considerations for the site and the proposed development.

#### SUBSURFACE INVESTIGATIONS

A series of seven (7) test borings designated B-1 through B-7, were advanced on February 27 and 28, 2014 for the purpose of evaluating the geotechnical properties of the existing soils and developing a subsurface profile which could assist in the design of the proposed improvements. These explorations classified the on-site soils according to their color, grain size, and other material properties.

🥖 55 North Stark Highway, Weare, NH 03281	🥖 603/529/7766	-	FAX 603/529/7080	4
30 Newbury Street, Boston, MA 02116	<mark>∕</mark> 617/455/4248		FAX 617/745/4308	

The test boring program was conducted by New Hampshire Boring, Inc. of Derry, New Hampshire, utilizing a track mounted drill rig turning 2.25 inch inside diameter augers. Test borings were advanced to refusal depths of 13 to approximately 21 feet below existing surface grades. Soil explorations were performed in accordance with methods prescribed by ASTM D1586.

Soil samples were obtained at the surface and at five-foot intervals with a  $1\frac{3}{8}$  inch diameter split-spoon sampler. Standard Penetration Tests (SPTs) were performed at the sampling intervals in accordance with ASTM D1586. Field descriptions and penetration resistance of the soils encountered, observed depth to groundwater while drilling when observed, and other pertinent observations are contained in the attached test boring logs. The test boring locations are illustrated on Figure 2 of this report. Soil samples recovered were preserved in marked glass jars and transported to the GSI Soils Laboratory for temporary storage. Test boring logs are presented in Appendix B.

#### SUBSURFACE CONDITIONS

Based on the results of the subsurface investigations, the following generalized soil strata underlie the site:

#### **Structural Test Borings**

A series of seven structural test borings were advanced within an existing paved parking area. Soil conditions were extremely variable across the set of borings completed. At grade, 2 to 2.5 inches of asphalt overlay over 20 inches of frozen ground. Fill soils extended to a depth of at least 5 to 8 feet below existing ground surface. At test boring B-1, very loose coarse to fine Sand, little to some Gravel, little Silt, trace ash was present to a depth of 6 feet. Ash was also present at B-5, indicating that fill soils are present at a depth of 10 feet. At the remaining test boring locations, loose brown coarse to fine Sand, trace to little Gravel, trace Silt was observed to a depth of up to 10 feet below grade.

The soils below the fill material varied considerably between test borings. At test boring B-1, a medium dense coarse to fine Sand, trace to some Gravel, little Silt was present to a depth of 14 feet. At 8 feet, a 6 inch stratum of very stiff Silty Clay was observed. At 14 feet, dense gray coarse to fine Sand, little Gravel, trace Silt was encountered, suggesting the presence of a glacial till soil. At test boring B-2, vey soft to stiff Silty Clay was present to a depth of 12 feet, transitioning into a medium stiff gray Silt and gray Silty Clay at 14 feet. At test boring B-3, loose coarse to fine Sand at 6 to 8 feet overlay soft to stiff brown/gray Silty Clay to a depth of 20 feet. Two Shelby tubes were retrieved, the first at 11 feet, and the second at 15 feet. Loose gray coarse to fine Sand, trace Gravel, trace Silt was encountered at a depth of 20 feet.

Test boring B-4 encountered fill soils to a depth of at least 9 feet below grade. An obstruction was struck at 10 feet below grade and consisted of a large wood fragment. The nature of this wood obstruction and its origin is unknown. At a depth of 13 to 20 feet, very loose gray fine Sand, little Silt was observed, which transitioned into hard gray Clayey Silt, trace Sand. At test boring location B-5, fill soils containing ash were present to a depth of 9 feet. The fill soils overlay medium stiff to stiff brown Silt, trace to little fine Sand which continued to a depth of 14 feet. From 14 to 20 feet below grade, very soft gray Clayey Silt, trace Gravel was observed. A Shelby tube was attempted at a depth of 16 feet, but there was no recovery. At a depth of 21 feet, hard gray Silt, trace coarse Sand, trace Gravel was encountered.



At test boring B-6, fill soils consisting of loose black coarse to fine Sand, little Silt, trace ash were observed to a depth of 5 feet below grade, transitioning into medium dense brown coarse to fine Sand, trace to little Silt. The medium dense sands continued to a depth of 12 feet below grade. Very loose fine Sand, overlay stiff gray Silt, little fine Sand, trace Gravel at a depth of 14 to 16 feet. At test boring B-7, loose to medium dense coarse to fine Sand, trace Gravel, trace Silt was present to a depth of 10 feet below grade. At 10 feet very loose black fine Sand, trace Silt was observed to a depth of 12 feet. Loose sands continued to a depth of 20 feet below grade, transitioning to a very dense gray fine Sand, little Silt, trace Gravel.

#### Refusal

Refusal was encountered at all test boring locations between a depth of 18 to 23 feet below grade, with a majority of the test borings refusing over 20 feet in depth. Refusal was encountered almost immediately upon entering a dense glacial till material. The nature of the refusals are unknown.

#### **Groundwater Conditions**

Groundwater encountered consistently at a depth of 6 to 8 feet below grade. Test boring B-7 indicated a ground water depth of 16.5 feet, but levels at this location may not have stabilized prior to the reading. Due to the scope of the project and the expected depth to subgrade of the proposed structure, groundwater could be a factor during the excavation of footing subgrades dependent upon the final depth of excavation and the actual groundwater conditions for that time of year. It should be noted that groundwater conditions may vary depending upon factors such as temperature, season, precipitation, and other unknowns that may be different from those at the time these explorations were made. Groundwater levels at other times, therefore, may differ from those observed and described in this report.

### PRELIMINARY FOUNDATION DESIGN RECOMMENDATIONS

#### Foundation Design

The zone of soft, compressible soils encountered beneath the footprint of the proposed building present geotechnical issues related to settlement and bearing capacity. The potential settlement of these soils will vastly influence the technical feasibility of a spread footing foundation for the building. Although the medium dense sands encountered during the test boring program are considered a competent bearing stratum for spread footing support, the soft materials in the area of test borings B-3 through B-5 at depths of 15 to 20 feet below grade may be prone to compression when subject to loading. The degree of compression is related to the stress history of the material, the consolidation properties of the soil, and the magnitude and manner of the surface loading. In order to determine the geotechnical characteristics of the material, GSI recommends a series of further tests at the GSI laboratory to determine potential settlement. Shelby tubes were obtained during the test boring process.

In order to proceed further with the establishment of foundation design parameters, GSI requests that preliminary building layout and grading plans be provided. If the site is to be excavated, there may be a net stress relief that will obviate the potential for future settlements. In such case, a conventional spread footing foundation with slab on grade may be suitable.



### CLOSURE

We appreciate the opportunity to perform this investigation and look forward to working with you on the design and construction phases of this project. If you have any questions as to the contents of this report, please do not hesitate to contact us.

Very truly yours,

**GEOTECHNICAL SERVICES, INC.** 

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Harry K. Wetherbee, P.E. *Principal Engineer* 

Figure 1: Locus Map Figure 2: Boring Location Plan

Appendix A: Limitations Appendix B: Exploration Logs





LIMITATIONS



### LIMITATIONS

#### **Explorations**

- 1. The analyses, recommendations, and designs submitted in this report are based in part upon the data obtained from preliminary subsurface explorations. The nature and extent of variations between these explorations may not become evident until construction. If variations then appear evident, it will be necessary to re-evaluate the recommendations of this report.
- 2. The generalized soil profile described in the text is intended to convey trends in subsurface conditions. The boundaries between strata are approximate and idealized and have been developed by interpretation of widely spaced explorations and samples; actual soil transitions are probably more gradual. For specific information, refer to the individual test pit and/or boring logs.
- 3. Water level readings have been made in the test pits and/or test borings under conditions stated on the logs. These data have been reviewed and interpretations have been made in the text of this report. However, it must be noted that fluctuations in the level of the groundwater may occur due to variations in rainfall, temperature, and other factors differing from the time the measurements were made.

#### Review

- 4. It is recommended that this firm be given the opportunity to review final design drawings and specifications to evaluate the appropriate implementation of the recommendations provided herein.
- 5. In the event that any changes in the nature, design, or location of the proposed areas are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and conclusions of the report modified or verified in writing by Geotechnical Services, Inc.

#### Construction

6. It is recommended that this firm be retained to provide geotechnical engineering services during the earthwork phases of the work. This is to observe compliance with the design concepts, specifications, and recommendations and to allow design changes in the event that subsurface conditions differ from those anticipated prior to the start of construction.

#### Use of Report

- 7. This report has been prepared for the exclusive use of Atlas Development and their assigns, in accordance with generally accepted soil and foundation engineering practices. No other warranty, expressed or implied, is made.
- 8. This report has been prepared for this project by Geotechnical Services, Inc. This report was completed for preliminary design purposes and may be limited in its scope to complete an accurate bid. Contractors wishing a copy of the report may secure it with the understanding that its scope is limited to evaluation considerations only.





**EXPLORATION LOGS** 





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55 North Stark Highway	20 -		S-8	20-22	11	3		1					Hard o	rav wot ol	avev eilt	trace silt san	Ч			
NI NI			0-0	20-22		11	48	1					naiu y	-			u			
E١						37 100		1						Auger re Boring ter	efusal at					
2	-					100		1						boring ter	minated	ai 21.3				
ខ្ល	_							1												
•								1												
uc.	1							1												
°,=	25 -							<u> </u>							- 1		the NL M L			
Services,			V	Vater Le					<u>s</u>	ample Ide		_	Cohesive		alue	-	<u>bils N- Value</u>			
Ž	Dat		Time	Bott.		th (ft) to: ott. of				O = Ope U = Und			0 to 2: 2 to 4: 9	/ery Soft		0 to 4: Ve 4 to 10: L				
ň	Da		i iiiie	Casin		Hole	Wat	er		S = Split				Medium St	tiff		Medium Dense			
g	27-F		4:20	20		21.5	7			C = Roc			8 to 15:			31 to 50:				
Ë			5:45							G = Geo	probe			Very Stif	f	Over 50:	Very Dense			
				T	Trace (0 to 5%), Little (10 to 20%)						Over 30: Hard           Some (20 to 35%),         And (35 to 50%)									
Geotecnnical	Note	<u>ve</u> .		Irace	U to 5%	), Little	e (10 to	20%)	),	Some (2	20 to 35	o%),	And (35	10 50%)			B-4			
	INUL																<u> </u>			



Boring N	lo.
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B-5

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	Project	India St	-						SI Projec		212234			Elevation Existing Grade					
	ocation			ortland,		_			oject Mg	ır.	HKW			tum	N/A				
	lient				estment C				spector		CMP			te Started	2/27/2014				
	ontract	or			st Explor	ation, In	с.		necked E	Зу	HKW			te Finished	2/28/2014				
Dostoni, we use to react of random reaction reaction reaction         T T T T T T T T T T T T T T T T T T T	riller		C	hris Pov		-			g Make		CME		Rię	g Model	550				
te lte	em:			Auger	Casin	ig S	ample	er	Core Ba	ırrel	Truck	Skid		<u>Ham</u>	<u>mer Type:</u>				
L Ty	ype		F	S Aug			SS				Track	🗹 ATV		✓ Saf	ety Hammer				
1 In	side Di	ameter (in.	)	2.25"			ST				Bomb.	🗌 Geopr	obe		ughnut				
d Ha	ammer	Weight (lb	)		1		140				Tripod	Other			comatic				
ť Ha		Fall (in.)	<u> </u>		i		30"				Winch	Cat Head		oller Bit	Cutting Head				
	T			S	ample Da	ata		- 1				Cut licuu			j catting nead				
Œ,	bu d				SPT		Ro	ck	PID	Soil-R	ock Visual	Classificat	ion and C	escription (S	Soils - Burmister				
Depth (	Depth (ft) Casing (Blows/ft) .0V		Depth	Rec	(BI./	"N"	RG		Rdg.	Syster	, , , , , , , , , , , , , , , , , , , ,								
	O Q	<u>ן</u>	(ft)	(in.)	6-in.)	Value	(%		(ppm)			Engir	neers Sys	tem)					
	-					l	È	<i>.</i>	,	0" 4	- 14								
Š										2" Asph 48" Fros	all St								
5	1																		
S-	-	S-1					Medium	Dense darl	dium to fir	ne sand little s	silt								
<u> </u>	1	17 21								Medium Dense dark brown medium to fine sand little silt									
20					4 5														
5	1	S-2	4-6	9.5	5 2 2	_				Loose b	orown orang	trace gravel t	race silt						
- 5	-				2 3	5					-								
					3														
		S-3	6-8	17.5	4						4.5" Medium dense brown orange coarse to fine sand trace gravel trace silt 6" Medium dense brown coarse to fine sand trace gravel trace silt								
3	4				7	19													
•					12 7					7" Medium dense black coarse sand trace silt trace ash									
	1	S-4	8-10	24	5 4	-				2" Loos	Loose black coarse sand little silt trace ash " Medium stiff black silt little fine sand trace ash								
8 -	-				4	7				22" Mec	aum stiff bla	ICK SIIT IITTIE	iine sand	trace ash					
- 10	1		10.15		3 5						um stiff brov								
10 10 10 10		S-5	10-12	20	1	6				2" Loos 7" Medi	e coarse to um stiff brov	medium sai vn silt little f	nd little sil ine sand	t					
ŝ	1				2 4	5				1" Verv	loose brown	n coarse to I	medium s	um sand little silt					
	-	S-6	12-14	19	6 3					5" Medi 7 5" Stif	um stiff brov f brown clay	vn silt little f	ine sand	4					
1 15		0-0	12 14	13	10	15				11.5" St	tiff gray clay	ey silt trace	fine sand						
8					5 3														
	1	S-7	14-16	7.5	1	_				7.5" Vei	ry soft gray o	clayey silt tr	ace grave	el l					
<b>n</b> - 15	4				WOH WOH	0						-	-						
ŝ					1														
		S-8										Shelby t	ube - no r	ecovery					
- 1	1																		
vay	4																		
A I I																			
	1																		
- 20	-																		
ō _	1		01.00								40"	d							
		S-9	21-23	22	6 18	39				4	18" Hard Hard orav	a gray silt trace or	ace coars	e sand trace of trace of trace	gravel trace clav				
	1				21	00					i laid gidy			- addo graver					
3 -	-		18				Auco	r refusal a	at 23'										
•						Boring	terminated	d at 23'											
25 L												2							
<b>-</b> 25	-	<u> </u>	Nater Le			1	<u> </u>		molo Ide	antificatio	on Cohoo		Value	Granular Sa	ile N- Volue				
			valer Le		oth (ft) to:					dentification         Cohesive Soils N-Value         Granular Soils N- Value           open Ended         0 to 2: Very Soft         0 to 4: Very Loose									
Da	ate	Time	Bott.		Bott. of					listurbed		4: Soft	•	4 to 10: L					
		-	Casir		Hole	Wate	ər		S = Split	t Spoon	4 to	8: Medium	Stiff	11 to 30:	Medium Dense				
28-	Feb	8:20	20		23	8			C = Roc			15: Stiff		31 to 50:					
5		10:35							G = Geo	probe		o 30 Very S	titf	Over 50:	Very Dense				
			Trace	Trace (0 to 5%), Little (10 to 20%					Some (?	20 to 35%		r 30: Hard 35 to 50%)			_				
Casing         Hole           28-Feb         8:20         20         23         8           10:35									2) 91110	-0 10 307	oj, Aliu (	00 10 00 /0)			B-5				
															l				



Boring	No.
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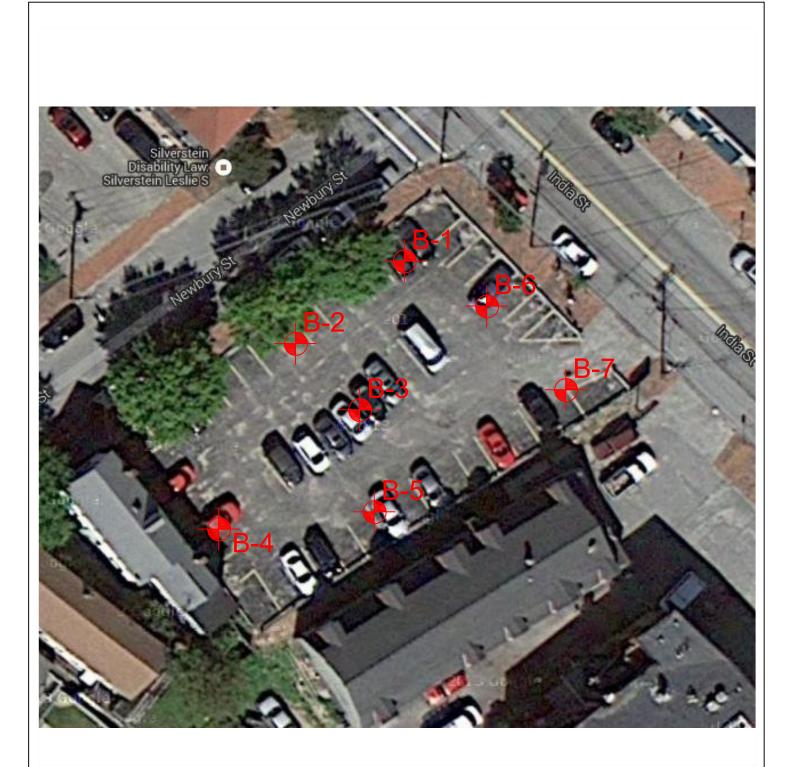
									1										•		
8	Proj	ject	India St	reet			Ģ	SSI Projec	t No.	212	234				Elevation Existing Grade						
54.	Loca	tion		P	ortland,	Maine			P	Project Mg	ır.	H	IKW			I	Datum N/A				
- 10 10	Clien	nt		A	tlas Inve	estment (	Group,	LLC.	lr	nspector		0	MP			I	Date Started 2/27/2014				
2	Conti	ractor		E	ast Coa	st Explor	ation, I	nc.	C	Checked E	βv	F	IKW				Date	Finished	2/28/2014		
017.455.4248 FaX. 617.745.4308	Drille	er			hris Pov					Rig Make									550		
ă.	tem:				Auger	Casin	na	Sampl		, Č									mer Type:		
<u>_</u>	_				S Aug	Outil	'9	SS	01	0010 20		Trac									
	Гуре		- <b>1</b>		U							Bom		È	1	- h -			fety Hammer		
<u>.</u>			eter (in.	/	2.25"			ST							Geopr	bbe			ughnut tomatic		
¥	Hammer Weight (Ib)							140				Trip			Other			Au			
	Hammer Fall (in.)							30"				Win	ch 🗌	Cat	Head	$\checkmark$	Roll	ler Bit	Cutting Head		
ei.	-	- <del>(</del>			S	ample D	ata			•	0.11							<b>-</b>			
<b>0</b> 4		Casing (Blows/ft)		Depth	Rec	SPT	"N"	Ro	ock	PID			visual C	Jas	sincati	on and	Des		Soils - Burmister - U.S. Corps of		
Denth (ft)	<u>, </u>	Slov	No.	(ft)	(in.)	(Bl./	Value	RC		Rdg.	System) Engineer						vetor	· · ·	- 0.3. Colps of		
	, c	ЭЩ		(11)	(111.)	6-in.)	value	<b>(</b> %	6)	(ppm)					Lingin	6613 0	ysiei	···· <i>)</i>			
	) -										2.5" As	nhali									
É,											20" Fro										
	-		S-1	2-4	9	2					3" Loos	se bla	ack medi	um	to fine s	and lit	tle si	ilt trace ash	I		
Ĕ.	4					2	4											gravel trace			
Street,						2222															
	1		S-2	4-6	4-6 7 1						Loose b	Loose black coarse to fine sand little silt trace gravel									
	5 -					1 3	4														
e -						5															
								5" Dense dark brown coarse to fine sand some silt trace gravel 5.5" Hard brown silt some coarse to fine sand													
	-					30	00				0.0 110										
•						12															
зĽ			S-4	8-10	19	9					9.5" Me	ediun	n dense o	dark	brown	coarse	e to fi	ine sand lit	le silt trace		
ĩ						6	12				gravel										
29.	_					6 8					9.5" Me	ediun	i dense o	dark	brown	coarse	e to fi	ine sand tra	ace silt		
11	0 -		S-5	10-12 24 4						17.5" N	lediu	m dense	bla	ck coar	se to fi	ine și	and trace s	ilt trace gravel			
<u> </u>	-					6 5	11				6.5" Sti	ff gra	ay silt trad	ce c	oarse t	o fine s	sand	trace grave	el		
гах.						3															
0			S-6	12.5 -	24	1					16" Medium dense black coarse to fine sand trace silt trace gravel trace organics 8" Very loose gray fine sand trace coarse sand trace silt										
Š-	_			14.5		1	2														
00//.62C.500											-		0,					anu trace :	SIIL		
C.5	1		S-7	14-16	10	2	10				Stiff gra	ay sil	t little fine	e sa	nd trac	e grave	əl				
	5 -					5 7	12														
e.	_					6															
2																					
55 NORIN STARK HIGHWAY	1																				
	-														Διιαοι	refusa	al at 1	18'			
Ĭ	]													E	Boring t	ermina	ted a	at 18'			
otal	]														-						
2 - 2	0 -																				
	4																				
≤ 0																					
• •	1																				
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	5																				
ses			V	Vater Le					<u>S</u>	ample Ide			Cohesiv				(		oils N- Value		
ž .				<b>D</b>		oth (ft) to:				O = Ope					ery Soft				ery Loose		
8   <sup> </sup>	Date		Гime	Bott.		Bott. of	Wa	ter		U = Und		1	2 to 4		oft edium S	2+;ff		4 to 10: L	.oose Medium Dense		
	8-Feb	h 1	1:20	Casir 18	ıy	Hole 18	6	3		S = Split C = Roc			4 to 8 8 to 1			ווו		31 to 50:			
<u>ة</u> الم			1:15	10		10		,		G = Gec					Very St	iff			Very Dense		
eci									Over 30: Hard												
				Trace	(0 to 5%	), Littl	e (10 t	o 20%	),	Some (2	20 to 35°	%),	And (3	85 to	50%)				B-6		
5 N	lotes	:																			



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project         India street         CSI / Pipet Mar.         Class / Pipet Mar.         NA           International Contractor         East Exponence         Contractor         East Pipet Mar.         Na         Na         Na           International Contractor         East Pipet Mar.         Na         Na         Na         Na           International Contractor         East Pipet Mar.         Na         Na         Na         Na           International Contractor         East Pipet Mar.         Na         Na         Safety Hammer Vigot Mar.         Anotactor         Robert Mar.		P	oject	India St	reet					G	SI Projec	t No.	212234			Ele	vation	Existing Grade
No.         Luger         Casing         Sampler         Core Barrel         Truck         Skid         Hammer Tupe:           Type         H3 Aug         S8         Incide Diameter (in.)         2.57         ST         Issee Diameter (in.)         Sold         Attornatic           Hammer Weight (ib)         Sold         Incide Diameter (in.)         Sold         Coughnut         Cutting Hammer           Hammer Weight (ib)         Sold         Sold         Coughnut         Cutting Hammer         Cutting Hammer           Hammer Staff         Sond Deck Visual Classification and Description (Solls - Burniste (Fock - U.S. Corps o         Engineers System)         Engineers System)         Engineers System)           0         Sold         Sold         Sold Hock Visual Classification and Description (Solls - Burniste (Fock - U.S. Corps o           5         Sold         Sold         Sold         Sold         Sold Hock Visual Classification and trace gravel trace silt           6         Sold         Sold         Sold         Medium dense brown coarse to fine sand trace gravel trace silt           10         Sold         Sold         Sold         Sold         Sold         Sold           6         Sold         Sold         Sold         Sold         Sold         Sold	430		,		-	ortland,	Maine											0
No.         Luger         Casing         Sampler         Core Barrel         Truck         Skid         Hammer Tupe:           Type         H3 Aug         S8         Incide Diameter (in.)         2.57         ST         Issee Diameter (in.)         Sold         Attornatic           Hammer Weight (ib)         Sold         Incide Diameter (in.)         Sold         Coughnut         Cutting Hammer           Hammer Weight (ib)         Sold         Sold         Coughnut         Cutting Hammer         Cutting Hammer           Hammer Staff         Sond Deck Visual Classification and Description (Solls - Burniste (Fock - U.S. Corps o         Engineers System)         Engineers System)         Engineers System)           0         Sold         Sold         Sold Hock Visual Classification and Description (Solls - Burniste (Fock - U.S. Corps o           5         Sold         Sold         Sold         Sold         Sold Hock Visual Classification and trace gravel trace silt           6         Sold         Sold         Sold         Medium dense brown coarse to fine sand trace gravel trace silt           10         Sold         Sold         Sold         Sold         Sold         Sold           6         Sold         Sold         Sold         Sold         Sold         Sold	45.	Clie	ent		A	tlas Inve	estment C	Group, Ll	LC.	In	spector		CMP			Da	te Started	2/27/2014
Auger         Casing         Sampler         Core Barrel         Truck         Skid         Hammer Tupe:           Type         H3 Aug         88         Truck         ZYV         Attammer Tupe:         ZYV         Stafety Hammer Tupe:         ZYV         ZYV         Stafety Hammer Tupe:         ZYV         ZYV         Stafety Hammer Tupe:         ZYV         ZYVV         ZYV         ZYVV         ZY	7.7	Co	ntractor		E	ast Coas	st Explora	ation, Ind	с.	Cł	necked E	By	HKW			Da	te Finished	2/28/2014
gr         Type         HS Aug         SS         Image of the stand limits of the stand trace sit         Stafety Hammer           Image of the stand limits of the stand trace sit         140         Image of the stand trace sit           Image of the stand trace sit         140         Image of the stand trace sit           Image of the stand trace sit         12         Image of the stand trace sit           Image of the stand trace sit         12         12         Image of the stand trace sit         Image of the stand trace sit         Image of the stand trace sit           Image of the stand trace sit         12         12         Image of the stand trace sit         Image of the stand trace sit         Image of the stand trace sit           Image of the stand trace sit         12         12         Image of the stand trace sit         Image of the stand trace sit           Image of the stand trace sit         13         12         Image of the stand trace sit         Image of the stand trace sit           Image of the stand trace sit         13         12         Image of the stand trace	6	Dri	ler		C	hris Pow	vell			Ri	g Make		CME			Rig	Model	550
gr         Type         HS Aug         SS         Image of the stand limits of the stand trace sit         Stafety Hammer           Image of the stand limits of the stand trace sit         140         Image of the stand trace sit           Image of the stand trace sit         140         Image of the stand trace sit           Image of the stand trace sit         12         Image of the stand trace sit           Image of the stand trace sit         12         12         Image of the stand trace sit         Image of the stand trace sit         Image of the stand trace sit           Image of the stand trace sit         12         12         Image of the stand trace sit         Image of the stand trace sit         Image of the stand trace sit           Image of the stand trace sit         12         12         Image of the stand trace sit         Image of the stand trace sit           Image of the stand trace sit         13         12         Image of the stand trace sit         Image of the stand trace sit           Image of the stand trace sit         13         12         Image of the stand trace	Fax	lter	n:			-	Casin	g Sa	ampl	er	Core Ba	rrel	Truck		Skid		Ham	mer Type:
Note         S-2         4-6         3         6         Medium dense brown coarse to fine sand trace gravel trace silt           6         S-3         6-8         16         5         12         Medium dense brown coarse to fine sand trace gravel trace silt           7         S-3         6-8         16         5         12         Medium dense brown coarse to fine sand trace gravel trace silt           10         S-5         10-12         20         5         1         2           11         2         1         2         1         1         1           10         S-5         10-12         20         5         1         2         1           10         S-5         10-12         20         5         2         1         2           11         2         1         2         1         2         1         3           10         S-6         12-14         24         2         11         1         2         1           11         2         1         3         6         9         1         1         100         1         100         10         10         10         10         10         10         10	48	Тур	e										Track	✓	1		🗹 Saf	ety Hammer
Note         S-2         4-6         3         6         Medium dense brown coarse to fine sand trace gravel trace silt           6         S-3         6-8         16         5         12         Medium dense brown coarse to fine sand trace gravel trace silt           7         S-3         6-8         16         5         12         Medium dense brown coarse to fine sand trace gravel trace silt           10         S-5         10-12         20         5         1         2           11         2         1         2         1         1         1           10         S-5         10-12         20         5         1         2         1           10         S-5         10-12         20         5         2         1         2           11         2         1         2         1         2         1         3           10         S-6         12-14         24         2         11         1         2         1           11         2         1         3         6         9         1         1         100         1         100         10         10         10         10         10         10         10	5.42	Ins	de Dian	neter (in.	) :	2.25"			ST							be		-
Note         S-2         4-6         3         6         Medium dense brown coarse to fine sand trace gravel trace silt           6         S-3         6-8         16         5         12         Medium dense brown coarse to fine sand trace gravel trace silt           7         S-3         6-8         16         5         12         Medium dense brown coarse to fine sand trace gravel trace silt           10         S-5         10-12         20         5         1         2           11         2         1         2         1         1         1           10         S-5         10-12         20         5         1         2         1           10         S-5         10-12         20         5         2         1         2           11         2         1         2         1         2         1         3           10         S-6         12-14         24         2         11         1         2         1           11         2         1         3         6         9         1         1         100         1         100         10         10         10         10         10         10         10	.45			0 (	)				140				Tripod				Aut	omatic
Note         S-2         4-6         3         6         Medium dense brown coarse to fine sand trace gravel trace silt           6         S-3         6-8         16         5         12         Medium dense brown coarse to fine sand trace gravel trace silt           7         S-3         6-8         16         5         12         Medium dense brown coarse to fine sand trace gravel trace silt           10         S-5         10-12         20         5         1         2           11         2         1         2         1         1         1           10         S-5         10-12         20         5         1         2         1           10         S-5         10-12         20         5         2         1         2           11         2         1         2         1         2         1         3           10         S-6         12-14         24         2         11         1         2         1           11         2         1         3         6         9         1         1         100         1         100         10         10         10         10         10         10         10	617	Ha	nmer Fa	all (in.)					30"				Winch	Cat	Head	⊡ R	oller Bit	Cutting Head
Note         S-2         4-6         3         6         Medium dense brown coarse to fine sand trace gravel trace silt           6         S-3         6-8         16         5         12         Medium dense brown coarse to fine sand trace gravel trace silt           7         S-3         6-8         16         5         12         Medium dense brown coarse to fine sand trace gravel trace silt           10         S-5         10-12         20         5         1         2           11         2         1         2         1         1         1           10         S-5         10-12         20         5         1         2         1           10         S-5         10-12         20         5         2         1         2           11         2         1         2         1         2         1         3           10         S-6         12-14         24         2         11         1         2         1           11         2         1         3         6         9         1         1         100         1         100         10         10         10         10         10         10         10	<u>e</u>	(H	g (tt)							<u> </u>		Soil-B	-Rock Visual Classification and Description (Soils - Rurmiete					Soils - Burmister
Note         S-2         4-6         3         6         Medium dense brown coarse to fine sand trace gravel trace silt           6         S-3         6-8         16         5         12         Medium dense brown coarse to fine sand trace gravel trace silt           7         S-3         6-8         16         5         12         Medium dense brown coarse to fine sand trace gravel trace silt           10         S-5         10-12         20         5         1         2           11         2         1         2         1         1         1           10         S-5         10-12         20         5         1         2         1           10         S-5         10-12         20         5         2         1         2           11         2         1         2         1         2         1         3           10         S-6         12-14         24         2         11         1         2         1           11         2         1         3         6         9         1         1         100         1         100         10         10         10         10         10         10         10	116 1	epth (	Casin Iows/	No.													(Rock	
Note         S-2         4-6         3         6         Medium dense brown coarse to fine sand trace gravel trace silt           6         S-3         6-8         16         5         12         Medium dense brown coarse to fine sand trace gravel trace silt           7         S-3         6-8         16         5         12         Medium dense brown coarse to fine sand trace gravel trace silt           10         S-5         10-12         20         5         1         2           11         2         1         2         1         1         1           10         S-5         10-12         20         5         1         2         1           10         S-5         10-12         20         5         2         1         2           11         2         1         2         1         2         1         3           10         S-6         12-14         24         2         11         1         2         1           11         2         1         3         6         9         1         1         100         1         100         10         10         10         10         10         10         10	02	ă	(B O		(π)	(in.)	6-in.)	value	(%	6)	(ppm)				Engine	ers Sysi	.em)	
Note         S-2         4-6         3         6         Medium dense brown coarse to fine sand trace gravel trace silt           6         S-3         6-8         16         5         12         Medium dense brown coarse to fine sand trace gravel trace silt           7         S-3         6-8         16         5         12         Medium dense brown coarse to fine sand trace gravel trace silt           10         S-5         10-12         20         5         1         2           11         2         1         2         1         1         1           10         S-5         10-12         20         5         1         2         1           10         S-5         10-12         20         5         2         1         2           11         2         1         2         1         2         1         3           10         S-6         12-14         24         2         11         1         2         1           11         2         1         3         6         9         1         1         100         1         100         10         10         10         10         10         10         10	MM	0										2.5" As	ohalt					
Note         S-2         4-6         3         6         Medium dense brown coarse to fine sand trace gravel trace silt           6         S-3         6-8         16         5         12         Medium dense brown coarse to fine sand trace gravel trace silt           7         S-3         6-8         16         5         12         Medium dense brown coarse to fine sand trace gravel trace silt           10         S-5         10-12         20         5         1         2           11         2         1         2         1         1         1           10         S-5         10-12         20         5         1         2         1           10         S-5         10-12         20         5         2         1         2           11         2         1         2         1         2         1         3           10         S-6         12-14         24         2         11         1         2         1           11         2         1         3         6         9         1         1         100         1         100         10         10         10         10         10         10         10	ÖŊ,											20" Fro:	st					
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Borner         S-4         8-10         19         6         16         B" Medium dense coarse to fine sand trace gravel trace silt           10         S-5         10-12         20         2         2         1         2           10         S-5         10-12         20         2         2         1         2           11         Black fine sand trace silt         11" Black fine sand trace silt         11" Black fine sand trace silt           13" Very loose black fine sand trace gravel         S-6         12-14         24         2           15         S-7         14-16         7         3         9         Loose gray fine sand trace silt           15         S-7         14-16         7         4         9         16" very dense moist gray fine sand little silt trace gravel           20         S-8         20-22         21         13         69         16" very dense moist gray fine sand little silt trace gravel           50         100         S         Sample Identification         Cohesive Soils N-Value         0 to 2: Very Soit         2 to 4: Soit         4 to 10: Loose           28         Time         Depth (ft) to:         Depth (ft) to:         Depth (ft) to:         0 = 0 pen Ended         2 to 4: Soit         4 to 10: Loose <th>ж,</th> <td></td> <td></td> <td>3-1</td> <td>2-4</td> <td>5</td> <td>3</td> <td>6</td> <td></td> <td></td> <td></td> <td>LUUSEL</td> <td></td> <td>arse to r</td> <td>ine sanu</td> <td>liace si</td> <td>t trace graver</td> <td></td>	ж,			3-1	2-4	5	3	6				LUUSEL		arse to r	ine sanu	liace si	t trace graver	
Borner         S-4         8-10         19         6         16         B" Medium dense coarse to fine sand trace gravel trace silt           10         S-5         10-12         20         2         2         1         2           10         S-5         10-12         20         2         2         1         2           11         Black fine sand trace silt         11" Black fine sand trace silt         11" Black fine sand trace silt           13" Very loose black fine sand trace gravel         S-6         12-14         24         2           15         S-7         14-16         7         3         9         Loose gray fine sand trace silt           15         S-7         14-16         7         4         9         16" very dense moist gray fine sand little silt trace gravel           20         S-8         20-22         21         13         69         16" very dense moist gray fine sand little silt trace gravel           50         100         S         Sample Identification         Cohesive Soils N-Value         0 to 2: Very Soit         2 to 4: Soit         4 to 10: Loose           28         Time         Depth (ft) to:         Depth (ft) to:         Depth (ft) to:         0 = 0 pen Ended         2 to 4: Soit         4 to 10: Loose <th>itre</th> <th></th>	itre																	
Borner         S-4         8-10         19         6         16         B" Medium dense coarse to fine sand trace gravel trace silt           10         S-5         10-12         20         2         2         1         2           10         S-5         10-12         20         2         2         1         2           11         Black fine sand trace silt         11" Black fine sand trace silt         11" Black fine sand trace silt           13" Very loose black fine sand trace gravel         S-6         12-14         24         2           15         S-7         14-16         7         3         9         Loose gray fine sand trace silt           15         S-7         14-16         7         4         9         16" very dense moist gray fine sand little silt trace gravel           20         S-8         20-22         21         13         69         16" very dense moist gray fine sand little silt trace gravel           50         100         S         Sample Identification         Cohesive Soils N-Value         0 to 2: Very Soit         2 to 4: Soit         4 to 10: Loose           28         Time         Depth (ft) to:         Depth (ft) to:         Depth (ft) to:         0 = 0 pen Ended         2 to 4: Soit         4 to 10: Loose <th>S ∑</th> <td></td> <td></td> <td>S-2</td> <td>4-6</td> <td>3</td> <td>4</td> <td>10</td> <td></td> <td></td> <td></td> <td colspan="5">Medium dense brown coarse to fine sand trace gravel trace silt</td>	S ∑			S-2	4-6	3	4	10				Medium dense brown coarse to fine sand trace gravel trace silt						
Borner         S-4         8-10         19         6         16         B" Medium dense coarse to fine sand trace gravel trace silt           10         S-5         10-12         20         2         2         1         2           10         S-5         10-12         20         2         2         1         2           11         Black fine sand trace silt         11" Black fine sand trace silt         11" Black fine sand trace silt           13" Very loose black fine sand trace gravel         S-6         12-14         24         2           15         S-7         14-16         7         3         9         Loose gray fine sand trace silt           15         S-7         14-16         7         4         9         16" very dense moist gray fine sand little silt trace gravel           20         S-8         20-22         21         13         69         16" very dense moist gray fine sand little silt trace gravel           50         100         S         Sample Identification         Cohesive Soils N-Value         0 to 2: Very Soit         2 to 4: Soit         4 to 10: Loose           28         Time         Depth (ft) to:         Depth (ft) to:         Depth (ft) to:         0 = 0 pen Ended         2 to 4: Soit         4 to 10: Loose <th>inq/</th> <td>- 5 -</td> <td colspan="2" rowspan="2">S-3</td> <td></td> <td></td> <td>7</td> <td>12</td> <td></td> <td></td> <td></td> <td></td> <td colspan="2" rowspan="2">ledium dense brown coarse to fine sand trac</td> <td></td> <td colspan="2"></td>	inq/	- 5 -	S-3				7	12					ledium dense brown coarse to fine sand trac					
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Xiff       S-6       12-14       24       2       11       Stiff moist gray silt trace fine sand trace gravel         15       S-7       14-16       7       3       9       10       Loose gray fine sand trace silt         15       S-7       14-16       7       3       9       16" very dense moist gray fine sand little silt trace gravel         20       S-8       20-22       21       13       69       16" very dense moist gray fine sand little silt trace gravel         20       S-8       20-22       21       13       69       16" very dense moist gray fine sand little silt trace gravel         20       S-8       20-22       21       13       69       16" very dense moist gray fine sand little silt trace gravel         20       S-8       20-22       21       13       69       16" very dense moist gray fine sand little silt trace gravel         4       100       9       0       0       0       Quer refusal at 21.5"         25       Water       Depth (ft) to:       0       0       0       0       0 to 2: Very Soft       0 to 4: Very Loose         28       155       20       21.5       16.5       0       2 to 4: Soft       8 to 15: Stiff       8 to 15: Stiff       1 to 30:	0		S-4 8		8-10	19		16				8" Medi 11" Bla	um denso ck fine sa	e coarse and trace	e to fine s e silt	sand trad	ce gravel trac	e silt
Xiff       S-6       12-14       24       2       11       Stiff moist gray silt trace fine sand trace gravel         15       S-7       14-16       7       3       9       10       Loose gray fine sand trace silt         15       S-7       14-16       7       3       9       16" very dense moist gray fine sand little silt trace gravel         20       S-8       20-22       21       13       69       16" very dense moist gray fine sand little silt trace gravel         20       S-8       20-22       21       13       69       16" very dense moist gray fine sand little silt trace gravel         20       S-8       20-22       21       13       69       16" very dense moist gray fine sand little silt trace gravel         20       S-8       20-22       21       13       69       16" very dense moist gray fine sand little silt trace gravel         4       100       9       0       0       0       Quer refusal at 21.5"         25       Water       Depth (ft) to:       0       0       0       0       0 to 2: Very Soft       0 to 4: Very Loose         28       155       20       21.5       16.5       0       2 to 4: Soft       8 to 15: Stiff       8 to 15: Stiff       1 to 30:	708						10											
Xiff       S-6       12-14       24       2       11       Stiff moist gray silt trace fine sand trace gravel         15       S-7       14-16       7       3       9       10       Loose gray fine sand trace silt         15       S-7       14-16       7       3       9       16" very dense moist gray fine sand little silt trace gravel         20       S-8       20-22       21       13       69       16" very dense moist gray fine sand little silt trace gravel         20       S-8       20-22       21       13       69       16" very dense moist gray fine sand little silt trace gravel         20       S-8       20-22       21       13       69       16" very dense moist gray fine sand little silt trace gravel         20       S-8       20-22       21       13       69       16" very dense moist gray fine sand little silt trace gravel         4       100       9       0       0       0       Quer refusal at 21.5"         25       Water       Depth (ft) to:       0       0       0       0       0 to 2: Very Soft       0 to 4: Very Loose         28       155       20       21.5       16.5       0       2 to 4: Soft       8 to 15: Stiff       8 to 15: Stiff       1 to 30:	29.	• 10 -		S-5	10-12	20	2					7" Very	loose bla	ack fine	sand trac	e silt		
Vite       S-6       12-14       24       2       11       Stiff moist gray silt trace fine sand trace gravel         15       S-7       14-16       7       3       9       10       Loose gray fine sand trace silt         15       S-7       14-16       7       3       9       16" very dense moist gray fine sand little silt trace gravel         20       S-8       20-22       21       13       69       16" very dense moist gray fine sand little silt trace gravel         20       S-8       20-22       21       13       69       16" very dense moist gray fine sand little silt trace gravel         50       100       9       50       100       0       0       Auger refusal at 21.5"         8       Very dense dry gray fine sand little silt trace gravel       0 to 2: Very Soft       0 to 4: Very Loose       0 to 4: Very Loose         25       Very dense dry gray fine       Sample Identification       Cohesive Soils N-Value       0 to 4: Very Loose         100       9       0 = Open Ended       0 to 2: Very Soft       2 to 4: Soft       0 to 4: Very Loose         28-Feb       1:55       20       21.5       16.5       6       11 to 30: Medium Dense         29       3:50       -       -       16.5<	03.5		S-6 12-14					2				13" Very loose moist gray fine sand little silt						
Time       S-8       20-22       21       13       69       16" very dense moist gray fine sand little silt trace gravel 5" Very dense dry gray fine sand little silt trace gravel Auger refusal at 21.5' Boring terminated at 21.5'         Water       Level Data       Sample Identification 0 = Open Ended U = Undisturbed S = Split Spoon G = Geoprobe       Cohesive Soils N-Value 0 to 2: Very Soft 2 to 4: Soft 4 to 8: Medium Stiff 8 to 15: Stiff 10 to 20: Very Soils       Granular Soils N- Value 0 to 4: Very Loose 4 to 10: Loose 11 to 30: Medium Dense 31 to 50: Dense Over 30: Hard         Trace (0 to 5%),       Little (10 to 20%),       Some (20 to 35%),       And (35 to 50%)       B-7	й. Х.				12-14	24		11				Stiff moist grav silt trace fine sand trace gravel						
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Time       S-8       20-22       21       13       69       16" very dense moist gray fine sand little silt trace gravel 5" Very dense dry gray fine sand little silt trace gravel Auger refusal at 21.5' Boring terminated at 21.5' Boring terminated at 21.5'         Water       Level Data       O = Open Ended U = Undisturbed S = Split Spoon G = Geoprobe       Cohesive Soils N-Value 0 to 2: Very Soft 2 to 4: Soft 4 to 8: Medium Stiff 8 to 15: Stiff 10: Dense 0 to 4: Very Loose 11 to 30: Medium Dense 3: 50       Granular Soils N- Value 0 to 4: Very Loose 4 to 8: Medium Stiff 8 to 15: Stiff 15 to 30 Very Stiff Over 30: Hard       Granular Soils N- Value 0 to 4: Very Loose 11 to 30: Medium Dense 3: 10: 50: Dense Over 30: Hard	3.5	- 15 -					5	Ŧ										
Water       Sample       Sample       Cohesive Soils N-Value Boring terminated at 21.5' Boring terminated at 21.5'       Granular Soils N-Value 0 to 2: Very Soft 25       Granular Soils N-Value 0 to 2: Very Soft 2 to 4: Soft 3:50       Granular Soils N-Value 0 to 2: Very Soft 2 to 4: Soft 4 to 8: Medium Stiff 8 to 15: Stiff 15 to 30 Very Stiff Over 30: Hard       Granular Soils N-Value 0 to 4: Very Loose 4 to 10: Loose 11 to 30: Medium Dense 31 to 50: Dense Over 30: Hard         Mater       Sample Identification 0 = Open Ended U = Undisturbed S = Split Spoon C = Rock Core D = Created Core 30: Hard       Granular Soils N-Value 0 to 4: Very Loose 4 to 10: Loose 11 to 30: Medium Dense 31 to 50: Dense Over 30: Hard	. 60	• -					0											
• or       Sample Identification       Cohesive Soils N-Value       Granular Soils N- Value         25       0	⊢ r	• -																
• or       Sample Identification       Cohesive Soils N-Value       Granular Soils N- Value         25       0	vay																	
• or       Sample Identification       Cohesive Soils N-Value       Granular Soils N- Value         25       0	ghv																	
• or       Sample Identification       Cohesive Soils N-Value       Granular Soils N- Value         25       0	Ī																	
• of 25       Water Level Data       Sample Identification O = Open Ended U = Undisturbed S = Split Spoon C = Rock Core 3:50       Cohesive Soils N-Value 0 to 2: Very Soft 2 to 4: Soft 4 to 8: Medium Stiff 8 to 15: Stiff 15 to 30 Very Stiff Over 30: Hard       Granular Soils N- Value 0 to 4: Very Loose 4 to 10: Loose 11 to 30: Medium Dense 31 to 50: Dense Over 50: Very Dense         0	star	20-		S-8	20-22	21	13	60										
• of 25       Water Level Data       Sample Identification O = Open Ended U = Undisturbed S = Split Spoon C = Rock Core 3:50       Cohesive Soils N-Value 0 to 2: Very Soft 2 to 4: Soft 4 to 8: Medium Stiff 8 to 15: Stiff 15 to 30 Very Stiff Over 30: Hard       Granular Soils N- Value 0 to 4: Very Loose 4 to 10: Loose 11 to 30: Medium Dense 31 to 50: Dense Over 50: Very Dense         0	th	• -					50	09					5 very	001158				e glavel
• of 25       Water Level Data       Sample Identification O = Open Ended U = Undisturbed S = Split Spoon C = Rock Core 3:50       Cohesive Soils N-Value 0 to 2: Very Soft 2 to 4: Soft 4 to 8: Medium Stiff 8 to 15: Stiff 15 to 30 Very Stiff Over 30: Hard       Granular Soils N- Value 0 to 4: Very Loose 4 to 10: Loose 11 to 30: Medium Dense 31 to 50: Dense Over 50: Very Dense         0	Nor	• -					100							B				
Stample       Mater Level Data       Sample Identification       Cohesive Soils N-Value       Granular Soils N- Value         Date       Time       Depth (ft) to:       O = Open Ended       0 to 2: Very Soft       0 to 4: Very Loose         28-Feb       1:55       20       21.5       16.5       C = Rock Core       8 to 15: Stiff       1 to 30: Medium Dense         3:50       Trace (0 to 5%), Little (10 to 20%), Some (20 to 35%), And (35 to 50%)       And (35 to 50%)       B-7	ŝ													2			= 2	
Signation       Water Level Data       Sample Identification       Cohesive Soils N-Value       Granular Soils N- Value         Date       Time       Depth (ft) to:       0 = Open Ended       0 to 2: Very Soft       0 to 4: Very Loose         28-Feb       1:55       20       21.5       16.5       C = Rock Core       8 to 15: Stiff       1 to 30: Medium Dense         3:50       Trace (0 to 5%), Little (10 to 20%), Some (20 to 35%), And (35 to 50%)       And (35 to 50%)       B-7	٠																	
Sample Identification       Cohesive Soils N-Value       Granular Soils N- Value         Date       Depth (ff) to:       0 = Open Ended       0 to 2: Very Soft       0 to 4: Very Loose         Date       Time       Bott. of Casing       Water       Sample Identification       0 to 2: Very Soft       0 to 4: Very Loose         28-Feb       1:55       20       21.5       16.5       C = Rock Core       8 to 15: Stiff       31 to 50: Dense         0ver 30: Hard       Trace (0 to 5%), Little (10 to 20%), Some (20 to 35%), And (35 to 50%)       And (35 to 50%)       B-7	nc.	25																
DateDepth (ft) to:O = Open Ended0 to 2: Very Soft0 to 4: Very LooseDateTimeBott. of CasingHoleWaterU = Undisturbed2 to 4: Soft4 to 10: Loose28-Feb1:552021.516.5C = Rock Core8 to 15: Stiff31 to 50: Dense3:50Trace (0 to 5%),Little (10 to 20%),Some (20 to 35%),And (35 to 50%)B-7	es,	20-		l V	Vater Le	vel Data	ta			<u>S</u> a	Sample Ident		on <u>Co</u> h	<u>nesive S</u>	<u>oils N-V</u> a	lue	<u>Granular So</u>	ils N- Value
DateLimeBott. of CasingBott. of HoleWaterU = Undisturbed S = Split Spoon C = Rock Core G = Geoprobe2 to 4: Soft 4 to 8: Medium Stiff 8 to 15: Stiff 15 to 30 Very Stiff Over 30: Hard4 to 10: Loose 11 to 30: Medium Dense 31 to 50: Dense Over 50: Very Dense0Trace (0 to 5%), Notes:Little (10 to 20%), Notes:Some (20 to 35%), Some (20 to 35%),And (35 to 50%)4 to 10: Loose 4 to 8: Medium Stiff 31 to 50: Dense Over 50: Very Dense	ž	-				Dep				O = Oper		n Endeo	0 k					
28-Feb         1:55         20         21.5         16.5         C = Rock Core         8 to 15: Stiff         31 to 50: Dense           3:50         G = Geoprobe         15 to 30 Very Stiff         Over 30: Hard         Over 50: Very Dense           Trace (0 to 5%),         Little (10 to 20%),         Some (20 to 35%),         And (35 to 50%)         B-7	Se	Dat	e					Wate	er									
3:50         G = Geoprobe         15 to 30 Very Stiff Over 30: Hard         Over 50: Very Dense           Trace (0 to 5%),         Little (10 to 20%),         Some (20 to 35%),         And (35 to 50%)         B-7	g	28-F	eb					16.5	5					8 to 15: Stiff 31 to 50: Dense				
B         I         I         I         Over 30: Hard           Image: Second state of the second sta	ų,			3:50							G = Geo	probe				•	Over 50:	Very Dense
B-7	otec				Trace	(0 to 5%)	).   ittl	e (10 to	20%	).	Some (2	20 to 35°					1	
	e e	Note	es:		.1400	, 2 . 0 0 /0	,, <b>_</b>			<i>,</i> ,	20110 (2		-/, /1					B-7





GSI-1 Test Boring Location (Approximate)

BORING LOCATION PLAN	GEOTECHNICAL SERVICES INC. 55 NORTH STARK HIGHWAY, WEARE, NH 03281 TEL. (603) 529-7766 FAX. (603) 529-7780						
INDIA STREET DEVELOPMENT	DRAWN BY: KJM	DATE: February 2014	FIGURE				
PORTLAND, ME	CHECKED BY: HKW	SCALE: 1"=@30'	NO. 2				
	FILE NAME: Holderness SBP.dwg	PROJECT NO.: 214112					