REPORT ON

99 TREMONT STREET APARTMENTS
99 TREMONT STREET
BRIGHTON, MASSACHUSETTS

DELIVERED TO

ST. JOHN'S SEMINARY
BRIGHTON, MASSACHUSETTS

BY

Haley & Aldrich, Inc.
Boston, Massachusetts

FOR

Saracen Properties
Waltham, Massachusetts

File No. 41058-011
7 October 2014

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HALEY&
ALDRICH

7 October 2014
File No. 41058-011

Mr. Henry St. Hilaire
Saracen Properties
41 Seyon Street - Suite 200
Waltham, Massachusetts 02453

Subject: Effects of the Proposed Residential Development at 99 Tremont Street On
The St. John's Seminary Property Located at 676 and 680 Washington Street
Brighton, Massachusetts

Dear Mr. St. Hilaire:

In accordance with your request, Haley & Aldrich has performed an evaluation of selected geotechnical aspects of the subject development, in response to issues raised by St. John's Seminary in a letter dated 2 June 2014 (copy provided in Appendix A). The results of the evaluation are summarized herein.

SITE CONDITIONS

The 99 Tremont Street project site consists of an approximately 40,000 sq. ft parcel of land that was previously occupied by an apartment building that was destroyed by fire. To the west of the site, the seven-story Brighton Gardens apartment building occupies the property at 111 Tremont Street. An undeveloped wooded lot with mature trees is located to the east of the site, and the former Church of Our Lady of the Presentation (now St. John's Seminary Conference Center) is located on Washington Street to the north. The site and surrounding properties are shown on the aerial photograph in Exhibit A.

Topography rises quickly in the rear half of the 99 Tremont property, to an elevation approximately 46 feet above Tremont Street. The eastern side of the property abuts a 300-foot long stairway, which connects Tremont and Washington Streets. The site was significantly modified in the 1970s in connection with construction of the former residential structure. Remnant foundations and retaining walls remain visible in the rear half of the site.

PROPOSED CONSTRUCTION AT 99 TREMONT STREET

The proposed 99 Tremont Street development consists of the construction of a multi-level residential building having its ground floor near Tremont Street grade (El. 71, Boston City Base) and its rear wall in close proximity to the joint property line with St. John's. Due to the significant rise in topography toward St. John's, construction of the building will involve a two-tiered excavation, up to about 45 ft in total depth, near the property line. Temporary and permanent lateral support of the excavation will be required along the St. John's property line.

To create a stiff, permanent retaining wall system and limit ground movements, the wall along St. John's is planned to be constructed as a shotcrete-faced soil nail system. The soil-nail system is described in detail in a following section of this report. If permission is granted by St. John's, the soil nail anchorage elements would extend about 15 ft laterally into the St. John's Seminary's property, as illustrated on Exhibit B. Should St. John's deny permission to access their property, a soil modified nail system will still be installed; however, the nails would extend to, but not extend over, the property line. Although an easement from St. John's is not required, it would allow a lower cost solution to the developer as the longer soil nails would enable a less complicated project design.

SITE SUBSURFACE SOIL AND GROUNDWATER CONDITIONS

In connection with the previous land owner's proposed and permitted project, a subsurface investigation was performed at the site in 1999 consisting of 15 test borings and 5 test pits. Results of the investigation program indicated variable thicknesses of fill soil immediately below ground surface. Very dense naturally-deposited Glacial Till, consisting of silty fine sand with gravel and cobbles was encountered beneath the fill. Bedrock was not encountered in any of the explorations, which extended up to 20 ft below lowest site grades. Due to their high density and silty nature, the glacial till soils have relatively low permeability and are very stable, competent materials that resist movements due to excavations.

A supplemental subsurface investigation was performed in September 2014 to aid final design and construction of the 99 Tremont Street project. This investigation, which included one test boring on St. John's property, confirmed that subsurface soil conditions consist of miscellaneous fill overlying very dense glacial till. Data obtained in the recent supplemental the explorations are provided in Appendix B.

As part of the recent exploration program, two groundwater observation wells were installed to obtain site-specific information on groundwater levels. One well (HA14–B01OW) is located on St. John's property, and one (HA14–B07OW) is located in the lower portion of the 99 Tremont site, as shown on the Exploration Location Plan in Appendix B. As expected, water levels measured in the wells were relatively deep, and significantly below the St. John's Church structure basement. In HA14–B01OW on the St. John's property, water was detected at approximately El. 86, about 28 ft below the Church basement floor which is finished at about El. 114. In HA14–B07OW, the water level was measured approximately 20 ft below ground surface, at El. 52. The trend of declining water elevations in the direction from St. John's toward Tremont Street is consistent with the topography and soil conditions, and is illustrated on Exhibit B.

RESPONSE TO ISSUES RAISED BY ST. JOHN'S

The following sections of the report describe the results of our evaluations of potential impacts to:

- Groundwater levels, as affecting the St. John's Church or property
- Buildings on the St. John's property
- Future use of the St. John's property

Impacts to Off-Site Groundwater

Background

Based on discussions with St. John's representatives, we understand that the Seminary Church building has experienced water infiltration into its basement, possibly more frequently in the recent past. As noted above, normal groundwater is well below the Church basement floor elevation. Accordingly, the basement water infiltration is not a result of groundwater.

On 7 August 2014, Haley & Aldrich visited the site to observe the conditions around the Seminary building. Based on observations during the site visit and the known subsurface conditions, various factors contribute to the water infiltration including the following:

- The ground surface around the Church slopes severely downward toward the basement on the east and west sides of the structure. Paved steps and landing slabs also decline downward toward the building. Water from precipitation and snowmelt flow overland down the slopes, accumulates against the basement walls, infiltrates into the ground next to the basement, and leaks into the building.

- The Church basement is surrounded by backfill against the walls and then the natural glacial till soils. The low permeability of the glacial soils, in combination with the backfill which has much higher permeability, creates a condition where the water infiltrating from ground surface gets trapped against the basement walls, facilitating leakage into the basement ("bathtub effect"). Under these conditions, the infiltration and leakage is often related to rain storms and during freeze-thaw conditions in late winter/early spring.

- The Boston Water and Sewer Commission (BWSC) has recently directed that the Church roof leader pipes be disconnected from the City storm drain system. On an interim basis, the pipes now discharge the water onto the ground in the vicinity of the structure. This discharge contributes to the water infiltration immediately around the Church. St. John's is planning to re-direct the roof discharge to a drainage swale at the southwest corner of its property in the near future. Directing the roof runoff away from the building and into the drainage swale over 50 ft away from the Church could help reduce the basement infiltration.

Construction Effects on Off-Site Groundwater

The planned retaining wall near the common property line will be constructed with a permanent drainage system over the entire height of the wall. The drain will intercept any subsurface water immediately behind the wall and direct it to the 99 Tremont Street stormwater management system. The stormwater management system will include conventional subsurface infiltration chambers ("dry wells") located in the lower area of the 99 Tremont Street site, over 200 ft away from and 50 ft (in elevation) below the St. John's property.

By intercepting and draining any water that reaches the wall, the wall cannot cause any mounding or "damming" of water. It therefore cannot cause a rise in groundwater levels on the St. John's property. Rather, if it has any effect, the drained wall can only serve to lower the groundwater level at the property line. Such lowering of the groundwater could not adversely affect the Church water infiltration problem; if it has any effect, it would be to beneficially lower water levels on the St. John's property.

To demonstrate the effects described above, we have performed groundwater modeling of current and post-construction groundwater conditions. For analyses purposes, we conservatively assumed the groundwater elevation 4 ft above where we have observed in the recently installed observation wells, and then modeled the effect of installing the wall and its drainage system. The results of the modeling confirm that groundwater levels would be lowered as a result of the 99 Tremont Street wall construction. The results of the modeling are included in Appendix C.

Impacts to Buildings on St. John's Property

Planned Construction Methodology

The proposed construction will involve excavation into the existing slope and removal of the former building foundation system and retaining walls. A soil nail wall, described below, will be installed to support the soil as the excavation proceeds. A soil nail system was selected due to its stiffness and its ability to control movements of ground behind the wall and be protective of the Church property.

Soil Nail Wall System

Soil nail wall systems have been used successfully in the United States and throughout the world since the 1960s. Soil nailing involves reinforcement of the ground by installing closely spaced steel bars (i.e., nails) which are encased in cement grout. As excavation proceeds from top to bottom, soil nails are installed in rows about 5 ft apart (vertically and horizontally), steel mesh reinforcement is affixed to the excavation face, and then fluid concrete ("shotcrete") is spray-applied applied to the excavation face to provide face stability. Prior to application of the shotcrete, a drainage layer is installed against the excavated soil face. The drainage layer typically consists of a non-woven filter fabric wrapped around a solid formed polymeric core. The filter fabric is selected based on the soil conditions to retain soil particles while allowing water to freely enter the flow channel (polymeric core). This drainage layer removes any water that reaches the back of the wall and prevents the buildup of hydrostatic (groundwater) pressures behind the wall.

Soil nails are installed on a slight downward batter (on the order of 15 to 20 degrees) by drilling 4 to 8-in. diameter holes using one of several drilling methods, selected depending on the competency of the soil and sensitivity of adjacent structures. Once the drill hole is completed, a steel bar (the "nail") is inserted and the hole is filled with a cement grout.

Haley & Aldrich has been involved with the construction and design of many soil nail walls throughout New England. One example is the Everett High School in Everett, Massachusetts that was constructed to retain a deep excavation using permanent soil nails in glacial till soils similar to those present at the subject site. The permanent soil nail wall is 48 ft high with a shotcrete (spray-applied concrete) face. Haley & Aldrich designed the wall and monitored its performance during construction. Appendix D provides a plot of the horizontal movement of the soil behind the soil nail wall versus depth along with photos of the wall during various stages of construction. The maximum lateral movement of the soil nail system was approximately 0.3 inch, occurring at the very top of the wall in fill soils that overlie the glacial till. This magnitude of movement is typical and consistent with numerous case studies across the United States in dense glacial soil. Additional case study examples are provided in Appendix E for reference. Soil nail systems have proven to be very effective in limiting ground movements and protecting nearby facilities.

Anticipated Movement of the Soil Nail Wall and Church Structures

When an excavation is made, the soils behind it can move. Under otherwise similar conditions, the movements will be greater if the soils are weak (e.g., clay) and smaller if the soils are strong (such as the site glacial till). A steep excavation requires lateral support, for safety of workers and to prevent raveling or other movements of the soil. In some cases, steel sheeting or similar systems such as soldier piles are installed before making the excavation. At the subject site, the glacial till soils are too dense to drive sheeting or other systems, and their installation would cause very high vibrations which could be detrimental and disruptive.

A soil nail wall system can be installed in such conditions with essentially no vibrations, very low noise, and result in little or no movements of the ground and structures behind the wall (typically less than ½ inch). Ground movements are small with a soil nail system, in part, because the system actually further stiffens the existing soil behind the wall. Soil nailing in combination with the very dense glacial till results in wall systems with very favorable performance.

Experience and analyses on many soil nail excavation projects has shown that any ground movements behind the wall are usually greatest immediately behind the wall and in the zone of the soil nails, and quickly diminish with distance away from the soil nails. In stiff, granular soils such as glacial till, essentially all the movement occurs as the excavation is made.

In situations where the ground moves significantly, structures in close proximity behind the wall can settle. As described above, experience has proven that an excavation with a soil nail wall system results in very little movement of the ground and the wall itself, especially in favorable soil conditions such as exist at the subject site.

Three structures on the St. John's site exist in general proximity to the proposed soil nail-supported wall – a single-story garage at a distance of about 16 ft, the Church at a distance of about 70 ft, and the rectory building about 160 ft. As illustrated on Exhibit B, the proposed soil nails would extend slightly beneath the garage but their ends will be greater than 50 ft from the Church and even further from the rectory. To demonstrate the favorable anticipated performance, we have performed analyses to estimate movements of the soil nail wall and the St. John's structures, as described below.

Soil Nail Wall Movement

Based on extensive research, the Federal Highway Administration has developed a state-of-practice methodology for making a conservative estimate of soil nail wall deflections, using the following equation:

$$\delta_h = (\delta_h/H)_\iota \text{ x } H \quad \text{where:}$$

$(\delta_h/H)_\iota$ = ratio dependent on the soil conditions (for our site 1/1000 [1])
H = wall height or wall segment height (30 ft for the planned two-tiered soil nail wall system)

This equation yields a maximum wall movement of 0.36 in. at the top of the wall, and diminishing to essentially zero at the bottom. This is a conservative methodology and the resultant estimate of wall movement is very small because of the existing dense glacial soils. The size of the zone of influence where noticeable ground deformation may take place is defined by a horizontal distance behind the soil nail wall (D_{DEF}) and can be estimated with the following expression:

$$D_{DEF}/H = C\,(1 - \tan\alpha) \quad \text{where:}$$

α = the wall batter angle
C = a coefficient based on soil type (1.25 [2] for this site)

For the subject site, the wall will be essentially vertical, and the zone of potential ground deformations behind the wall is equal to 1.25 times the wall height. With the tiered wall system, this zone may extend approximately 38 ft behind the wall which corresponds to 28 ft beyond the property line onto St. John's property. The magnitude of vertical ground deformation immediately behind the wall is normally 50 to 100 percent of the horizontal wall movement. Accordingly, the analysis indicates that ground settlements could be up to about 0.36 in. immediately behind the wall and decrease to essentially zero at about 38 ft behind the wall.

Structure Movements

The Church and Rectory are located at least 70 ft from the soil nail wall, and significantly outside the zone of potential ground movements (zone within about 28 ft from the property line). Accordingly, the Church and Rectory are outside the zone where settlements or other adverse effects of the planned construction could occur.

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[1] Section 6.5 of the FHWA Soil Nail Design Manual provides ratios of δ_h/H for various soil conditions. For stiff soils this value is 1/1000

[2] Section 6.5 of the FHWA Soil Nail Design Manual provides ratios of C for various soil conditions. For stiff soils this value is 1.25

The analyses described above indicate that ground settlements on the order of ¼ in. could occur at the near wall of the garage, tapering to near zero at the far wall of the garage. The garage is likely to be supported on shallow spread footing foundations that would be subject to any ground settlements. Accordingly small calculated differential settlements, on the order of ¼ in., could be experienced by the garage. This magnitude of settlement should not have any structural or operational impact on the garage, but could cause some minor architectural cracking of the garage foundation wall.

Monitoring During Construction

It is common to install and monitor instrumentation on an earth retention wall and/or the soil behind the wall, as well as on any structures in the vicinity of an excavation, to confirm the performance of the excavation and enable adjustments to construction procedures if warranted. With the permission of St. John's, it is planned to install elevation reference point on each of the St. John's structures and monitor them frequently throughout the period of excavation and soil nail wall installation to detect any movements. In addition, an inclinometer (device to measure the lateral movement of soil) is planned to be installed behind the proposed soil nail wall next to the garage to detect and document any lateral movements of the soil on the St. John's property. This instrumentation program would provide very useful documentation on any movements, and facilitate decision making during construction in the event movements are detected.

IMPACTS TO FUTURE USE OF ST. JOHN'S PROPERTY

As noted above, soil nails required to support the wall would need to extend approximately 15 ft beyond the property line onto St. John's property as shown on Figure 1. The top row of nails at the property line would be approximately 8 to 9 feet below grade, and on the order of 15 feet below grade at their ends. The soil nails must continue to provide lateral support to the 99 Tremont Street retention system on a permanent basis, and would continue to do so as long as they are not physically damaged or the soil in their immediate vicinity is not disturbed.

Specifically, the nails must not be removed, severed, displaced or damaged by direct impact. Proposed excavation deeper than 2 ft below existing grades or within the zone of support behind the nails should be evaluated on case by case basis to confirm that the integrity of the soil nail system is maintained. The zone of support is defined by imaginary lines extending downward and outward (away from the soil nails) on a 1H:1V slope from points on the current ground surface above the ends of the nails (i.e., approximately 15 ft from the property line). Essentially, the nails and the soils around them must remain undisturbed by construction or other activity.

Subject to the above restrictions, buildings or other structures supported on spread footing or slab foundations could be positioned above the nails without compromising the soil nail system.

SUMMARY

The 99 Tremont Street project is being designed to be protective of the St. John's Seminary property and structures. State-of-practice methods are planned for making and supporting the required building excavation, to control ground movements and avoid adverse impacts. No impacts to the Church and Rectory are anticipated due to the proposed construction. Any impacts to the garage are expected to be very minor and architectural in nature. Groundwater levels on the St. John's property will not be raised due to construction of the soil nail wall or the proposed building. Existing infiltration into the Church basement will not be worsened, but rather might actually be improved. Soil nails must be maintained permanently but their presence would not prevent overlying building construction in the future.

CLOSURE

This report describes anticipated performance of the excavation at 99 Tremont Street and its potential impacts on the St. John's Seminary property and structures. Please do not hesitate to contact the undersigned if you wish to discuss the information provided herein or any aspect of the proposed construction.

Sincerely yours,
HALEY & ALDRICH, INC.

Damian R. Siebert

Damian R. Siebert, P.E.
Lead Underground Engineer

Steven R. Kraemer, P.E.
Senior Vice President

Enclosures:
- Exhibit A – Site Plan
- Exhibit B – Typical Soil Nail Wall Cross Section
- Appendix A – Monsignor Moroney 2 June 2014 Letter
- Appendix B – Recent Subsurface Explorations
- Appendix C – Groundwater Modeling Results
- Appendix D – Everett High School Soil Nail Wall
- Appendix E – Soil Nail Wall Case Study

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REFERENCES

1. Federal Highway Administration Engineering Circular No. 7, “Soil Nail Walls” dated March 2003.

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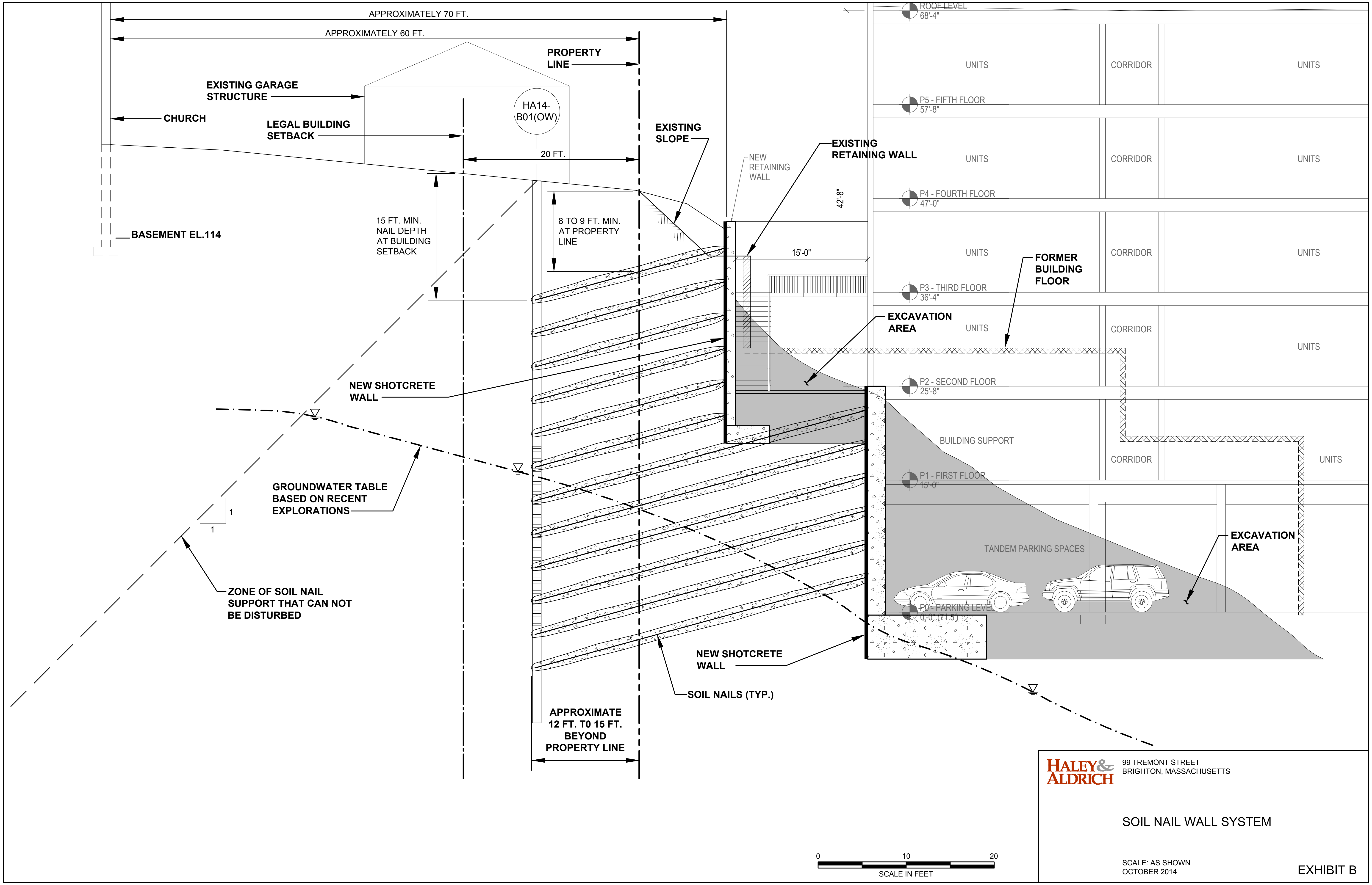
99 TREMONT STREET
BRIGHTON, MASSACHUSETTS

SITE PLAN

SCALE: AS SHOWN
OCTOBER 2014

EXHIBIT A



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99 TREMONT STREET
BRIGHTON, MASSACHUSETTS

SOIL NAIL WALL SYSTEM

SCALE: AS SHOWN
OCTOBER 2014

EXHIBIT B

APPENDIX A

Monsignor Moroney 2 June 2014 Letter

OFFICE OF THE RECTOR

2 June 2014

Henry St. Hilaire, Director of Construction
Saracen Properties
41 Seyon Street, Suite 200
Waltham, MA 02453

Re: 99 Tremont Street, Brighton, MA 02135

Dear Mr. St. Hilaire:

It was a pleasure meeting you several weeks ago at the community meeting regarding your firm's proposal to construct an apartment building at 99 Tremont Street, Brighton, MA ("hereinafter 99 Tremont Street"). I look forward to future meetings and discussions and collaborating with your firm on the matter.

Pursuant to my responsibilities and obligations as the Rector of Saint John's Seminary, however, I write to raise concerns regarding your development and construction of an apartment structure at 99 Tremont Street. Please be advised that my instant correspondence does not limit, under any circumstances, any of Saint John's Seminary's future legal causes of action, remedies, or rights in this matter. I write to raise present, known concerns about your proposed construction at a property directly abutting Seminary property.

I have become aware of a proposal pursuant to which your firm suggests that its construction of an apartment building at 99 Tremont Street potentially include soil nails extending between twelve and twenty-one feet underground across Saint John's Seminary's property line. As you know, Saint John's Seminary has not granted an easement for the installation of said underground "soil nails," which either your structural engineer and/or geotechnical engineer has proposed for the support of any structure or construction at 99 Tremont Street. Saint John's Seminary maintains its legal right to grant or deny said easement subject to reasons and/or conditions which it alone finds reasonable and acceptable.

ST. JOHN'S SEMINARY • 127 LAKE STREET • BRIGHTON • MASSACHUSETTS • 02135 • 617-746-5411 • rector@sjs.edu

Subject to its right to grant or deny an easement to Saracen Properties across property boundaries for the construction of an apartment building at 99 Tremont Street, Saint John's Seminary hereby requests the following from your firm:

First, Saint John's Seminary requests that Saracen Properties conduct a geotechnical investigation into any impact that construction of an apartment building at 99 Tremont Street will have on water levels and tables of the two abutting properties. I have reviewed your nine page agenda from a May 27, 2014 community meeting ("Oak Square Meeting"). Your firm states in said agenda that it has "not performed any recent geotechnical investigations." Despite the same, however, your firm alleges that its construction of a new building at 99 Tremont Street "will not exacerbate" any current water "problem." Your firm relies upon previous test pits and/or borings which it states McPhail Engineering conducted. Your firm has not provided Saint John's Seminary with the results of these tests, the conditions under which McPhail Engineering conducted the tests, or even when McPhail Engineering conducted them. Your agenda, however, indicates that they are not "recent." Saint John's Seminary is, therefore, not satisfied with your firm's conclusory statement that any construction will not exacerbate any water table issues on its property.

Second, Saint John's Seminary requests that Saracen Properties conduct an engineering investigation into any impact that construction of an apartment building at 99 Tremont Street will have on buildings, and the structural integrity of the same, on property which Saint John's Seminary owns. Saint John's Seminary raises herein the concern that construction of an apartment building at 99 Tremont Street will negatively impact the structural integrity of its buildings on its property, which directly abuts your proposed construction. Saint John's Seminary seeks assurances that construction of an apartment building at 99 Tremont Street will not impair the structural integrity of its property and buildings or prevent any future decision it may make to sell its land and structures or build upon the same. Without sufficient assurances, and supporting documentary, engineering proof thereof, Saint John's Seminary will not consider granting an easement to for the construction of an apartment building at 99 Tremont Street.

Third, at this current time, Saint John's Seminary questions your legal title to and ownership of a set of stairs adjacent to or built upon the lot directly abutting the lot located at 99 Tremont Street. Saint John's Seminary questions whether the Roman Catholic Archdiocese of Boston, Saint John's Seminary, or your client / firm owns said stairs. As a result, Saint John's Seminary requests that Saracen Properties conduct and provide proof of a complete title examination of the properties.

If either the Roman Catholic Archdiocese of Boston or Saint John's Seminary owns these stairs, Saint John's Seminary questions how construction of an apartment building at 99 Tremont Street, Brighton, MA will impact the structure and integrity of said stairs.

Further, if Saint John's Seminary owns the stairs, it raises the concern regarding use, liability for, and maintenance of said stairs if they remain part of your proposed apartment building property plans. The existence of stairs adjoining the two properties would invite trespassers onto Saint John's Seminary property and cause Saint John's Seminary insurance liability for any trespassers, invitees, or licensees on its property.

Again, Saint John's Seminary does not restrict any legal cause of action, remedy, or right it may have in raising the preliminary concerns, which I list above. Saint John's Seminary reserves the right to amend or supplement any of the issues it raises above in any future correspondence and/ or legal action. Saint John's Seminary, further, reserves the right to raise other issues, not addressed herein, in any future, potential legal matter regarding this issue.

I understand that there is another community meeting in June, 2014 regarding this matter. Please provide any and all requested documentation prior to the June, 2014 community meeting such that I may review and consider the same.

Please do not hesitate to contact me with any questions, comments, or concerns regarding this correspondence. Please, however, direct any and all questions, comments, or concerns to me in writing at the above address.

In the Lord,

M. James P. Moroney
Monsignor James P. Moroney
Saint John's Seminary, Rector

cc: Honorable Mayor Martin J. Walsh, City of Boston
Brian Golden, Director, Boston Redevelopment Authority
Zoning Board of Appeals, City of Boston
Brighton Allston Improvement Association
Attorney Joseph P. Hanley
Justin Pelland, LEED Green Association, Project Coordinator
Attorney Michael Ruane, Saint John's Seminary

APPENDIX B

Recent Subsurface Explorations

Exploration Location Plan
Boring Logs HA14-B01(OW) through HA14-B07(OW)

LEGEND:

⊕ HA14-BO1 (OW)

APPROXIMATE LOCATION AND DESIGNATION OF TEST BORINGS DRILLED BY NEW HAMPSHIRE BORING AND MONITORED BY HALEY & ALDRICH PERSONNEL IN SEPTEMBER 2014. (OW) INDICATES AN OBSERVATION WELL WAS INSTALLED IN THE COMPLETED BORING

99 Tremont Street
Brighton, Massachusetts

Exploration Location Plan

SCALE: AS SHOWN
October 2014

Appendix B

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TEST BORING REPORT

Boring No. HA14-B01 (OW)

Project 99 TREMONT STREET, BRIGHTON, MA
Client SARACEN PROPERTIES
Contractor NEW HAMPSHIRE BORING, INC.

File No. 41058-010
Sheet No. 1 of 3
Start 17 September 2014
Finish 18 September 2014
Driller Tom Schaefer
H&A Rep. A. Fleming

Elevation 118.0
Datum BCB

Location See Plan

	Casing	Sampler	Barrel
Type	HW	S	--
Inside Diameter (in.)	4.0	1 3/8	--
Hammer Weight (lb)	300	140	-
Hammer Fall (in.)	24	30	-

Drilling Equipment and Procedures

Rig Make & Model: CME75, truck, track
Bit Type: Roller Bit
Drill Mud: None
Casing: 4 in. driven 45 ft.
Hoist/Hammer: Cat-Head Safety Hammer
PID Make & Model: Thermo MiniRAE

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0							-FILL-										
	15 37 33 18	S1 16	2.0 4.0	SM			Very dense tan to light brown silty SAND with gravel (SM), mps 0.7 in., no structure, no odor, dry, trace roots PID = ND ppm	5	10	5	25	30	25				
							Note: Drill action indicates a cobble from 4.2 ft to 4.7 ft.										
5	5 5 8 10	S2 15	5.0 7.0	SM		113.0 5.0	Medium dense tan silty SAND (SM), mps 0.3 in., no structure, no odor, dry, trace roots PID = ND ppm		5	5	20	35	35				
							-LOESS-										
							Note: Former Loess horizon.										
						110.0 8.0											
10	28 38 50 22	S3 17	10.0 12.0	SM			Very dense tan to light brown silty SAND with gravel (SM), mps 1.0 in., slightly bonded, no odor, wet PID = 0.1 ppm	5	15	10	20	20	30				
							-GLACIAL TILL-										
15	70 50/1"	S4 5	15.0 15.6	SM			Similar to above PID = 0.4 ppm	5	15	10	15	25	30				
20																	

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Depth (ft) to: Bottom of Hole	Depth (ft) to: Water
9/18/14	0715	14	25	30	18.0
09/19/14	0900		--	50	26.8

See bottom of log for more Water Level Data

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

▥	Riser Pipe
▤	Screen
░	Filter Sand
▒	Cuttings
■	Grout
△	Concrete
▨	Bentonite Seal

Summary

Overburden (ft) 60.8
Rock Cored (ft) --
Samples S14

Boring No. HA14-B01 (OW)

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

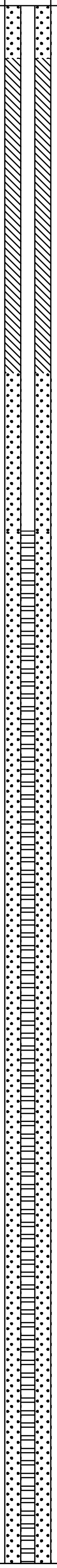
†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY& ALDRICH

TEST BORING REPORT

Boring No. HA14-B01 (OW)
File No. 41058-010
Sheet No. 2 of 3



Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel		Sand				Field Test			
								% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength
20							Note: Drill action indicates cobble at 20.0 ft.										
	62 50/2"	S5 7	20.5 21.2	SM			Very dense tan silty SAND with gravel (SM), mps 0.8 in., bonded, no odor, wet PID = ND ppm		15	10	20	25	30				
25	70 50/1"	S6 6	25.0 25.6	SM			Very dense tan silty SAND with gravel (SM), mps 0.9 in., bonded, no odor, wet, trace pocket of clay PID = 0.2 ppm		15	10	20	25	30				
	62 50/2"	S7 7	27.0 27.7	SM			Similar to above PID = 0.2 ppm										
	55 50/3"	S8	29.0 29.7				Note: Spoon tip fell off in hole; no recovery. Spoon tip retrieved with 3-in. casing driven past its depth. Sample from 3-in. casing . PID = ND ppm										
30							-GLACIAL TILL-										
35							Note: Drill action indicates cobble from 34.8 to 35.5 ft.										
	75/4.5"	S9 4	35.5 35.9				Very dense tan to light brown silty SAND with gravel (SM), mps 0.6 in., bonded, no odor, wet PID = 0.1 ppm	5	10	10	20	25	30				
40	62/5.5"	S10 5	40.0 40.5	SM			Similar to above PID = 0.2 ppm										
45	65/4"	S11 4	45.0 45.4	SM			Very dense tan to light brown silty SAND with gravel (SM), mps 0.8 in., bonded, no odor, wet PID = 0.2 ppm	5	10	10	15	25	35				

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

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TEST BORING REPORT

Boring No. HA14-B01 (OW)
File No. 41058-010
Sheet No. 3 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
50	30 45 50/3"	S12 13	50.0 51.3	SM			Very dense tan to gray brown silty SAND with gravel (SM), mps 0.8 in., bonded, no odor, wet, trace pockets of clay PID = 0.2 ppm	5	10	10	15	25	35				
							-GLACIAL TILL-										
55	50 50/3"	S13 7	55.0 55.8	SM			Very dense gray to olive brown silty SAND (SM), mps 0.5 in., bonded, no odor, wet, trace gravel, trace pockets of clay PID = ND ppm		5	10	15	30	35				
60	52 70/3"	S14 8	60.0 60.8			57.2 60.8	PID = ND ppm BOTTOM OF EXPLORATION 60.8 FT										

Note: Installed Groundwater Observation Well in completed borehole.

Water Level Data continued:

Date	Bottom of Hole	Water
9/22/2014	50 ft	31.9 ft
9/23/2014	50 ft	32.6 ft
9/24/2014	50 ft	32.9 ft
9/25/2014	50 ft	33.0 ft
9/26/2014	50 ft	33.2 ft

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

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TEST BORING REPORT

Boring No. HA14-B02

Project 99 TREMONT STREET, BRIGHTON, MA
Client SARACEN PROPERTIES
Contractor NEW HAMPSHIRE BORING, INC.

File No. 41058-010
Sheet No. 1 of 2
Start 23 September 2014
Finish 24 September 2014
Driller Mark D'Ambrosia
H&A Rep. A. Fleming

Elevation 102.0
Datum BCB
Location See Plan

	Casing	Sampler	Barrel
Type	NW	S	--
Inside Diameter (in.)	3.0	1 3/8	5
Hammer Weight (lb)	300	140	-
Hammer Fall (in.)	24	30	-

Drilling Equipment and Procedures

Rig Make & Model: CME75, Track
Bit Type: Roller Bit, Cutting Head
Drill Mud: Polymer
Casing: 3-in. driven 15 ft.
Hoist/Hammer: Cat-Head Safety Hammer
PID Make & Model: Thermo MiniRAE

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel		Sand				Field Test			
							% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength
0						-CONCRETE-										
					101.1 0.9											
	12 23 27 20	S1 16	1.5 3.5	SM		Dense tan silty SAND (SM), mps 0.8 in., no structure, no odor, moist, trace concrete fragments, trace wood, trace plastic bag material directly beneath concrete pad, appears disturbed PID = ND ppm Note: At 3.6 ft, cored through granite cobble to 3.8 ft.	5	5	5	45	25	15				
	21 18	S2 8	4.0 5.0	SM		Similar to above PID = ND ppm										
5	23 18 21 14	S3 10	5.0 7.0	SM		Dense tan to light brown silty SAND (SM), mps 0.4 in., no structure, no odor, moist, trace roots, trace wood PID = ND ppm	5	5	5	45	20	20				
	18 23 33 35	S4 13	7.0 9.0	SM		Very dense dark brown to tan silty SAND with gravel (SM), mps 0.6 in., slightly bonded, no odor, moist, trace pockets of clay PID = ND ppm	5	10	10	15	40	20				
10	17 15 9 8	S5 12	9.0 11.0	SM		Similar to above except medium dense PID = ND ppm -PROBABLE GLACIAL TILL FILL-										
	8 11 13 17	S6 16	11.0 13.0	SM		Similar to above PID = ND ppm										
	25 35 50 57	S7 14	13.0 15.0	SM	89.0 13.0	Very dense brown silty SAND with gravel (SM), mps 0.5 in., slightly bonded, no odor, moist to wet, 10% pockets of clay PID = ND ppm	5	10	5	15	40	25				
15	56 76 81 74	S8 20	15.0 17.0	SM		Very dense olive brown to tan silty SAND with gravel (SM), mps 0.8 in., bonded, no odor, wet, 10% pockets of clay PID = ND ppm -GLACIAL TILL-	10	10	10	15	25	30				
	100/4"	S9 3	17.0 17.3	SM		Similar to above PID = ND ppm										
	33 40	S10 19	19.0 21.0	SM		Very dense brown silty SAND (SM), mps 0.5 in., bonded, no odor, wet PID = ND ppm	5	5	10	15	35	30				
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to:		
			Bottom of Casing	Bottom of Hole	Water

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	35.0
Rock Cored (ft)	--
Samples	S17

Boring No. HA14-B02

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Plasticity**: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
20	50 63															
	36 100/5"	S11 11	21.0 21.9	SM		Very dense gray to olive brown silty SAND with gravel (SM), mps 0.7 in., well bonded, no odor, wet, trace pockets of clay PID = ND ppm	5	10	10	10	40	25				
	45 100/3"	S12 5	23.0 23.7	SM		Similar to above PID = 0.5 ppm -GLACIAL TILL-										
25	84 100/5"	S13 8	25.0 25.9	SM		Similar to above PID = ND ppm										
	49 54 51 64	S14 20	27.0 29.0	SM		Very dense tan to olive brown silty SAND with gravel (SM), mps 1.0 in., well bonded, no odor, wet, 10% pockets of clay PID = 0.2 ppm	5	10	10	10	30	35				
	55 100/4"	S15 18	29.0 29.8	SM		Similar to above PID = 0.1 ppm										
30																
	32 26 44 70	S16 20	31.0 33.0	SM		Similar to above PID = 0.4 ppm										
	34 45 51 60	S17 15	33.0 35.0	SM		Very dense tan silty SAND with gravel (SM), mps 0.8 in., well bonded, no odor, wet, 25% pockets of lean clay PID = 0.3 ppm	5	10	10	15	25	35				
35					67.0 35.0	BOTTOM OF EXPLORATION 35.0 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

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TEST BORING REPORT

Boring No. HA14-B03

Project	99 TREMONT STREET, BRIGHTON, MA
Client	SARACEN PROPERTIES
Contractor	NEW HAMPSHIRE BORING, INC.

File No.	41058-010
Sheet No.	1 of 2
Start	24 September 2014
Finish	25 September 2014
Driller	Mark D'Ambrosia
H&A Rep.	A. Fleming
Elevation	102.0
Datum	BCB
Location	See Plan

	Casing	Sampler	Barrel
Type	NW	S	--
Inside Diameter (in.)	3.0	1 3/8	--
Hammer Weight (lb)	300	140	-
Hammer Fall (in.)	24	30	-

Drilling Equipment and Procedures

Rig Make & Model: ATV, Track
Bit Type: Roller Bit, Cutting Head
Drill Mud: Polymer
Casing: NW driven 15 ft.
Hoist/Hammer: Cat-Head Safety Hammer
PID Make & Model: Thermo MiniRAE

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0					101.3 0.8	-CONCRETE-										
	5 8 6 9	S1 10	1.0 3.0	SP-SM SM	99.8 2.2	Note: Plastic matting under concrete, concrete contains rebar. S1: Medium dense brown to tan poorly graded SAND with silt (SP-SM), mps 0.7 in., no structure, no odor, dry, appears disturbed PID = ND ppm -FILL-	5 5	5 5	5 10	60 35	15 25	10 20				
	11 12 14 14	S2 12	3.0 5.0	SM		S1, Bottom: Medium dense tan silty SAND (SM), mps 0.5 in., no structure, no odor, moist, trace roots, trace brick S2: Similar to above PID = ND ppm										
5	18 13 14 10	S3 13	5.0 7.0	SM	97.0 5.0	Medium dense tan to olive brown silty SAND (SM), mps 0.7 in., no structure, no odor, moist, trace roots PID = ND ppm	5	5	10	30	25	25				
	25 25 19 17	S4 18	7.0 9.0	SM		Similar to above except dense PID = ND ppm										
10	18 16 14 16	S5 12	9.0 11.0	SM		Similar to above PID = ND ppm -PROBABLE GLACIAL TILL FILL-										
	16 19 21 22	S6 11	11.0 13.0	SM		Similar to above PID = ND ppm										
	14 16 17 16	S7 17	13.0 15.0	SM		Dense tan to olive brown silty SAND with gravel (SM), mps 0.7 in., well bonded, no odor, wet, 15% pockets of clay, appears disturbed PID = ND ppm	5	10	10	20	25	30				
15	35 100/4"	S8 7	15.0 15.8	SM	87.0 15.0	Similar to above, except very dense, not disturbed PID = ND ppm Note: Drill action indicates cobbles and boulders from 15.8 to 19.0 ft. -GLACIAL TILL-										
	32 50/5"	S9 8	19.0 19.9	SM		Similar to above, except very dense PID = ND ppm										
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Depth (ft) to: Bottom of Hole	Water

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

◫	Riser Pipe
☷	Screen
⁘	Filter Sand
⁂	Cuttings
■	Grout
△	Concrete
▨	Bentonite Seal

Summary

Overburden (ft)	34.7
Rock Cored (ft)	--
Samples	S16
Boring No.	**HA14-B03**

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Plasticity**: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

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TEST BORING REPORT

Boring No. HA14-B03
File No. 41058-010
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
20						Note: Drill action indicates boulders 19.9 to 20.9 ft.										
	49 100/4"	S10 7	21.0 21.8	SM		Very dense tan to olive brown silty SAND with gravel (SM), mps 1.0 in., well bonded, no odor, wet, 15% pockets of clay PID = 0.4 ppm Note: Drill action indicates cobble at 21.8 ft.	5	10	10	20	25	30				
	68 63 73 97	S11 12	23.0 25.0	SM		Very dense tan to olive brown silty SAND with gravel (SM), mps 0.8 in., well bonded, no odor, wet PID = 0.1 ppm	5	10	10	20	20	35				
25	37 100/5"	S12 8	25.0 25.9	SM		Similar to above PID = 0.2 ppm										
	17 33 62 63	S13 16	27.0 29.0			Very dense tan to olive brown silty SAND with gravel (SM), mps 0.6 in., well bonded, no odor, wet, trace pockets of silt, trace pockets of clay PID = ND ppm										
30	48 43 40 55	S14 17	29.0 31.0			Similar to above PID = 0.3 ppm -GLACIAL TILL-										
	16 28 39 73	S15 19	31.0 33.0	SM		Very dense tan to olive brown silty SAND with gravel (SM), mps 0.5 in., well bonded, no odor, wet, trace pockets of silt, 10% clay lenses PID = 1.1 ppm	5	10	10	20	20	35				
	22 27 38 100/2"	S16 13	33.0 34.7	CL		Hard gray lean CLAY with sand (CL), mps 0.4 in., well bonded, no odor, wet, 10% pockets of silt PID = 1.7 ppm		5		5	5	85				
					67.3 34.7	BOTTOM OF EXPLORATION 34.7 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. HA14-B03

HALEY& ALDRICH

TEST BORING REPORT

Boring No. HA14-B04

Project	99 TREMONT STREET, BRIGHTON, MA
Client	SARACEN PROPERTIES
Contractor	NEW HAMPSHIRE BORING, INC.

File No.	41058-010
Sheet No.	1 of 2
Start	22 September 2014
Finish	22 September 2014
Driller	Mark D'Ambrosia
H&A Rep.	A. Fleming
Elevation	92.0
Datum	BCB
Location	See Plan

	Casing	Sampler	Barrel
Type	NW	S	--
Inside Diameter (in.)	3.0	1 3/8	--
Hammer Weight (lb)	300	140	-
Hammer Fall (in.)	24	30	-

Drilling Equipment and Procedures

Rig Make & Model: ATV, Track
Bit Type: Roller Bit, Cutting Head
Drill Mud: None
Casing: 3 in. driven 25 ft.
Hoist/Hammer: Cat-Head Safety Hammer
PID Make & Model: Thermo MiniRAE

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0					91.2 0.8	-CONCRETE-										
	19 20 28 20	S1 12	1.5 3.5	SM		Dense gray to tan silty SAND (SM), mps 0.4 in., no structure, no odor, dry, trace concrete fragments PID = ND ppm		10	10	35	25	20				
5	19 20 18 20	S2 8	3.5 5.5			Similar to above, except no concrete PID = ND ppm -FILL-										
	17 32 30 14	S3 16	5.5 7.5	SP-SM SM	86.0 6.0	Dense tan to light brown poorly graded SAND with silt and gravel (SP-SM), mps 0.6 in., no structure, no odor, dry PID = 0.1 ppm S3, Bottom: Very dense tan silty SAND with gravel (SM), mps 1.0 in., slightly bonded, no odor, moist, trace pockets of dry fine to medium grained sand, trace pockets of clay	5 5	10 10	5 10	45 10	25 35	10 30				
	17 19 20 18	S4 13	7.5 9.5	SM		S4: Similar to above except dense PID = ND ppm										
10	17 18 50 40	S5 9	9.5 11.5	SM		Similar to above except very dense PID = ND ppm										
	10 11 23 26	S6 10	11.5 13.5	SM		Dense tan to olive brown silty SAND with gravel (SM), mps 0.8 in., no structure, no odor, wet, trace pockets of clay, 10% pockets of medium to fine grained sand PID = ND ppm	5	10	10	15	30	30				
15	14 9 10 9	S7 13	13.5 15.5	SM		Similar to above, except medium dense PID = ND ppm -PROBABLE GLACIAL TILL FILL-										
	11 12 15 12	S8 8	15.5 17.5	SM		Similar to above, except medium dense PID = ND ppm										
	9 7 9 11	S9 15	17.5 19.5	SM		Medium dense gray to tan silty SAND with gravel (SM), mps 0.9 in., slightly bonded, no odor, wet, 15% pockets of clay PID = ND ppm	5	10	10	30	15	30				
20	9	S10	19.5	SM		Similar to above										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Depth (ft) to: Bottom of Hole	Depth (ft) to: Water

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

◫ Riser Pipe
▤ Screen
▒ Filter Sand
▒ Cuttings
■ Grout
△ Concrete
▨ Bentonite Seal

Summary

Overburden (ft)	25.0
Rock Cored (ft)	--
Samples	S13

Boring No. HA14-B04

Field Tests:
Dilatancy: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

TEST BORING REPORT

Boring No. HA14-B04
File No. 41058-010
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	**VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION** (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
20	6 7 8 11	3 S11 10	20.0 20.0 22.0	SM		PID = ND ppm Similar to above PID = ND ppm -PROBABLE GLACIAL TILL FILL-										
	19 16 29 21	S12 8	22.0 24.0	CL	70.0 22.0	Hard gray sandy lean CLAY (CL), mps 0.4 in., no structure, no odor, wet PID = ND ppm -GLACIAL TILL-		5	5	5	5	80	N	M	M	M
25	22 18	S13	24.0 25.0	CL		Similar to above PID = ND ppm										
					67.0 25.0	BOTTOM OF EXPLORATION 25.0 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. HA14-B04

HALEY & ALDRICH

TEST BORING REPORT

Boring No. HA14-B05

Project	99 TREMONT STREET, BRIGHTON, MA	File No.	41058-010
Client	SARACEN PROPERTIES	Sheet No.	1 of 2
Contractor	NEW HAMPSHIRE BORING, INC.	Start	26 September 2014
		Finish	26 September 2014
		Driller	Mark D'Ambrosia
		H&A Rep.	A. Fleming
		Elevation	92.0
		Datum	BCB
		Location	See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HW	S	--	Rig Make & Model: ATV, Track
Inside Diameter (in.)	4.0	1 3/8	--	Bit Type: Roller Bit, Cutting Head Drill Mud: Polymer
Hammer Weight (lb)	300	140	-	Casing: HW Driven 9 ft.
Hammer Fall (in.)	30	30	-	Hoist/Hammer: Cat-Head, Winch Safety Hammer PID Make & Model: Thermo MiniRAE

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	**VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION** (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0						-CONCRETE-										
					91.2 0.8	Note: Plastic matting under concrete.										
	10 14 11	S1 16	1.5 3.0	SM		Medium dense olive brown silty SAND (SM), mps 0.4 in., no structure, no odor, moist PID = ND ppm	5	5	5	15	50	20				
	13 14 16 22	S2 13	3.0 5.0	SM		Similar to above PID = ND ppm -TILL FILL-										
5	19 19 17 19	S3 12	5.0 7.0	SM	87.0 5.0	Dense tan to olive brown silty SAND (SM), no structure, no odor, moist, trace roots, trace pockets of clay PID = ND ppm	5	5	5	15	45	25				
	20 22 15 17	S4 14	7.0 9.0	SM		Similar to above PID = ND ppm										
10	17 59 50/0"	S5 8	9.0 10.0	SM		Very dense tan to olive brown silty SAND with gravel (SM), mps 0.8 in., no structure, no odor, moist PID = ND ppm	5	10	10	15	40	25				
	14 12 13 11	S6 12	11.0 13.0	SM		Similar to above, except medium dense PID = ND ppm -PROBABLE GLACIAL TILL FILL-										
	12 15 15 14	S7 1	13.0 15.0	SM		Similar to above PID = ND ppm										
15	10 15 12 12	S8 6	15.0 17.0	SM		Medium dense olive brown silty SAND with gravel (SM), mps 1.0 in., slightly bonded, no odor, moist, trace pockets of clay, trace pockets of silt PID = 0.8 ppm	5	10	10	10	40	30				
	10 8 5 5	S9 2	17.0 19.0	SM		Similar to above PID = ND ppm										
	5 8	S10 20	19.0 21.0	SP		Medium dense tan to brown poorly graded SAND (SP), mps 0.3 in., no structure, no odor, wet, sample appears disturbed		5	15	25	50	5				
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Depth (ft) to: Bottom of Hole	Water

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

☐	Riser Pipe
▤	Screen
░	Filter Sand
▒	Cuttings
■	Grout
△	Concrete
▨	Bentonite Seal

Summary

Overburden (ft)	25.0
Rock Cored (ft)	--
Samples	S12

Boring No. HA14-B05

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Plasticity**: N - Nonplastic L - Low M - Medium H - High

Toughness: L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY & ALDRICH

TEST BORING REPORT

Boring No. HA14-B05
File No. 41058-010
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
20	11 11					PID = 0.2 ppm -PROBABLE GLACIAL TILL FILL-										
	9 9 10 22	S11 18	21.0 23.0	SP		Top 6 in.: Similar to above PID = 1.9 ppm										
				ML	70.0 22.0	S11, Bottom: Medium dense light tan sandy SILT (ML), mps 0.5 in., well bonded, no odor, wet, 10% pockets of clay	5	5	5	10	15	60				
	13 20 56 29	S12 20	23.0 25.0	ML		S12: Similar to above, except very dense PID = 0.8 ppm -GLACIAL TILL-										
25					67.0 25.0	BOTTOM OF EXPLORATION 25.0 FT										

H&A-TEST BORING-09 REV HA-LIB09-TAB.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT G:\41058\010 - EXPLORATIONS AND DESIGN\EXPLORATIONS\GINT\41058-010-TBOW.GPJ 3 Oct 14

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY & ALDRICH

TEST BORING REPORT

Boring No. HA14-B06

Project	99 TREMONT STREET, BRIGHTON, MA
Client	SARACEN PROPERTIES
Contractor	NEW HAMPSHIRE BORING, INC.

File No.	41058-010
Sheet No.	1 of 1
Start	19 September 2014
Finish	19 September 2014
Driller	Tom Schaefer
H&A Rep.	A. Fleming
Elevation	73.0
Datum	BCB
Location	See Plan

	Casing	Sampler	Barrel
Type	HW	S	--
Inside Diameter (in.)	4.0	1 3/8	--
Hammer Weight (lb)	300	140	-
Hammer Fall (in.)	24	30	-

Drilling Equipment and Procedures

Rig Make & Model: ATV, Track

Bit Type: Roller Bit

Drill Mud: None

Casing: HW Driven 16 ft.

Hoist/Hammer: Cat-Head, Winch Safety Hammer

PID Make & Model: Thermo MiniRAE

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0						-CONCRETE-										
	3 6 15 50/1"	S1 8	1.0 2.5	ML	72.0 1.0	Very stiff olive brown lean CLAY with sand (CL), mps 0.4 in., bonded, no odor, moist, trace pockets of silt, trace concrete PID = ND ppm -ABLATION TILL/ GLACIOLACUSTRINE DEPOSITS-			10	10	20	60	S	L	M	M
	6 7 9 11	S2 11	3.0 5.0	CL		Stiff olive brown lean CLAY (CL), mps 0.6 in., slightly bonded, moist, 10% pockets of silt PID = ND ppm						100	S	L	M	M
5	11 18 22 20	S3 16	5.0 7.0	ML	68.0 5.0	Dense olive brown sandy SILT (ML), mps 0.5 in., slightly bonded, no odor, moist, 10% pockets of silt PID = ND ppm					30	70				
						-GLACIOLACUSTRINE DEPOSITS-										
10	9 15 22 20	S4 18	10.0 12.0	ML/ CL	63.0 10.0	Dense to hard gray sandy SILT (ML) to sandy lean CLAY (CL), mps 0.3 in., bonded, no odor, moist, 15% pockets of silt PID = ND ppm		10		5	15	70	S	L	M	M
						-GLACIAL TILL-										
15	22 22 50/2"	S5 11	15.0 16.1	ML		Similar to above, except very dense, trace clay, with gravel PID = ND ppm	10	5		5	20	60				
					56.9 16.1	BOTTOM OF EXPLORATION 16.1 FT										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water

Sample ID

- O - Open End Rod
- T - Thin Wall Tube
- U - Undisturbed Sample
- S - Split Spoon Sample

Well Diagram

◫	Riser Pipe
▤	Screen
⁘	Filter Sand
⁂	Cuttings
■	Grout
△	Concrete
▨	Bentonite Seal

Summary

Overburden (ft)	16.1
Rock Cored (ft)	--
Samples	S5

Boring No. HA14-B06

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Plasticity**: N - Nonplastic L - Low M - Medium H - High

Toughness: L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

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TEST BORING REPORT

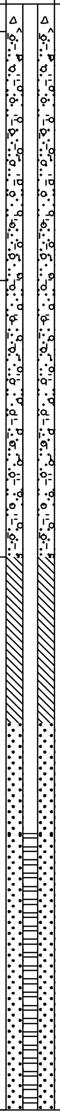
Boring No. HA14-B07 (OW)

Project 99 TREMONT STREET, BRIGHTON, MA
Client SARACEN PROPERTIES
Contractor NEW HAMPSHIRE BORING, INC.

File No. 41058-010
Sheet No. 1 of 2
Start 19 September 2014
Finish 19 September 2014
Driller Tom Schaefer
H&A Rep. A. Fleming

Elevation 72.0
Datum BCB
Location See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HW	S	--	Rig Make & Model: ATV, Track
Inside Diameter (in.)	4.0	1 3/8	--	Bit Type: Roller Bit Drill Mud: None
Hammer Weight (lb)	300	140	-	Casing: HW Driven 25 ft.
Hammer Fall (in.)	24	30	-	Hoist/Hammer: Cat-Head Safety Hammer PID Make & Model: Thermo MiniRAE



Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0						71.5 0.5	-ASPHALT-										
	14 11 15 21	S1 17	1.0 3.0	SP- SM			Medium dense brown to orange brown poorly graded SAND with silt and gravel (SP-SM), mps 0.8 in., no structure, no odor, moist, trace orange staining PID = ND ppm	5	10	5	60	10	10				
	12 22 50/3"	S2 10	3.0 4.3				-FILL- PID = ND ppm										
5	40 48 45 58	S3 16	5.0 7.0	SP- SM		67.0 5.0	Very dense tan to light brown poorly graded SAND with silt (SP-SM), mps 0.5 in., slightly bonded, no odor, moist, trace concrete PID = ND ppm -GLACIAL TILL-		5	10	65	10	10				
10	15 14 16 17	S4 14	10.0 12.0	SP- SM		62.0 10.0	Medium dense tan poorly graded SAND (SP), mps 0.2 in., no structure, no odor, moist PID = ND ppm -GLACIOLACUSTRINE DEPOSITS-			5	5	80	10				
15	14 20 20 22	S5 18	15.0 17.0	SP- SM			Dense tan poorly graded SAND with silt (SP-SM), mps 0.3 in., no structure, no odor, moist, pockets of pure silt PID = ND ppm				20	70	10				
20																	

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Depth (ft) to: Bottom of Hole	Depth (ft) to: Water
9/22/20154	0730	50+	--	25	20.34
9/23/2014	0715	75	--	25	20.72

See bottom of log for more Water Level Data

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
▥ Riser Pipe
▤ Screen
░ Filter Sand
▒ Cuttings
■ Grout
△ Concrete
▨ Bentonite Seal

Summary
Overburden (ft) 25.0
Rock Cored (ft) --
Samples S6

Boring No. HA14-B07 (OW)

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Plasticity**: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY & ALDRICH

TEST BORING REPORT

Boring No. HA14-B07 (OW)
File No. 41058-010
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
20	22 20 17 20	S6 14	20.0 22.0	SM		52.0 20.0	Dense tan silty SAND (SM), mps 0.5 in., moderately bonded, no odor, wet, trace gravel PID = 0.1 ppm -GLACIAL TILL-		5	5	20	50	20				
25						47.0 25.0	BOTTOM OF EXPLORATION 25.0 FT										

Note: Installed Groundwater Observation Well in completed borehole.

Water Level Data continued:

Date	Bottom of Hole	Water
9/24/2014	25 ft	20.8 ft
9/25/2014	25 ft	20.9 ft
9/26/2014	25 ft	20.9 ft

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. HA14-B07 (OW)

HALEY& ALDRICH

GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

Well No. HA14-B01 (OW)

Boring No. HA14-B01 (OW)

Project 99 TREMONT STREET

Location BRIGHTON, MA

Client SARACEN PROPERTIES

Contractor NEW HAMPSHIRE BORING, INC.

Driller Tom Schaefer

Initial Water Level (depth bgs) 18.0 ft

Well Diagram

- ◫ Riser Pipe
- ▤ Screen
- ░ Filter Sand
- ▓ Cuttings
- ■ Grout
- ▒ Concrete
- ▧ Bentonite Seal

File No. 41058-010

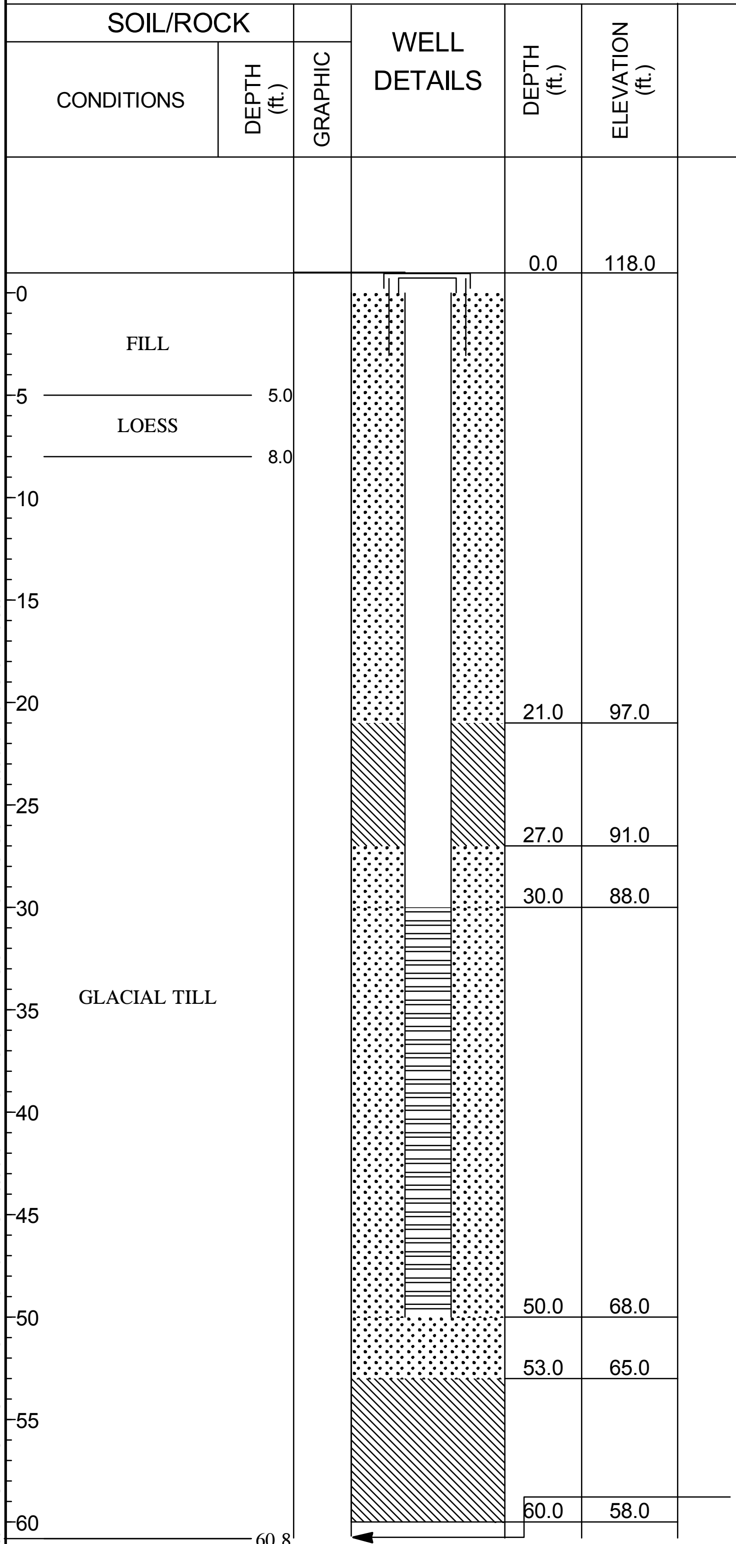
Date Installed 18 Sep 2014

H&A Rep. A. Fleming

Location See Plan

Ground El. 118.0

Datum BCB



WELL CONSTRUCTION DETAILS

Type of protective cover Roadway Box

Height of Roadway Box above ground surface 0.2 ft

Depth of top of riser below ground surface 3.0 ft

Type of protective casing Roadway Box

Length 0.8 ft

Inside diameter 6.0 in.

Depth of bottom of Roadway Box 0.6 ft

Type of riser pipe Schedule 40 PVC

Inside diameter of riser pipe 2.0 in.

Depth of bottom of riser pipe 30.0 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Concrete	0.0	0.5
Bentonite	21.0	6.0
Bentonite	53.0	7.0

Diameter of borehole 4.0 in.

Depth to top of well screen 30.0 ft

Type of screen Machine slotted Sch 40 PVC

Screen gauge or size of openings 0.010 in.

Diameter of screen 2.0 in.

Type of Backfill around Screen Filter Sand

Depth to bottom of well screen 50.0 ft

Bottom of silt trap

Depth of bottom of borehole 60.8 ft

COMMENTS:

HALEY& ALDRICH

GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

Well No. HA14-B07 (OW)
Boring No. HA14-B07 (OW)

Project 99 TREMONT STREET
Location BRIGHTON, MA
Client SARACEN PROPERTIES
Contractor NEW HAMPSHIRE BORING, INC.
Driller Tom Schaefer

Initial Water Level (depth bgs) 20.3 ft

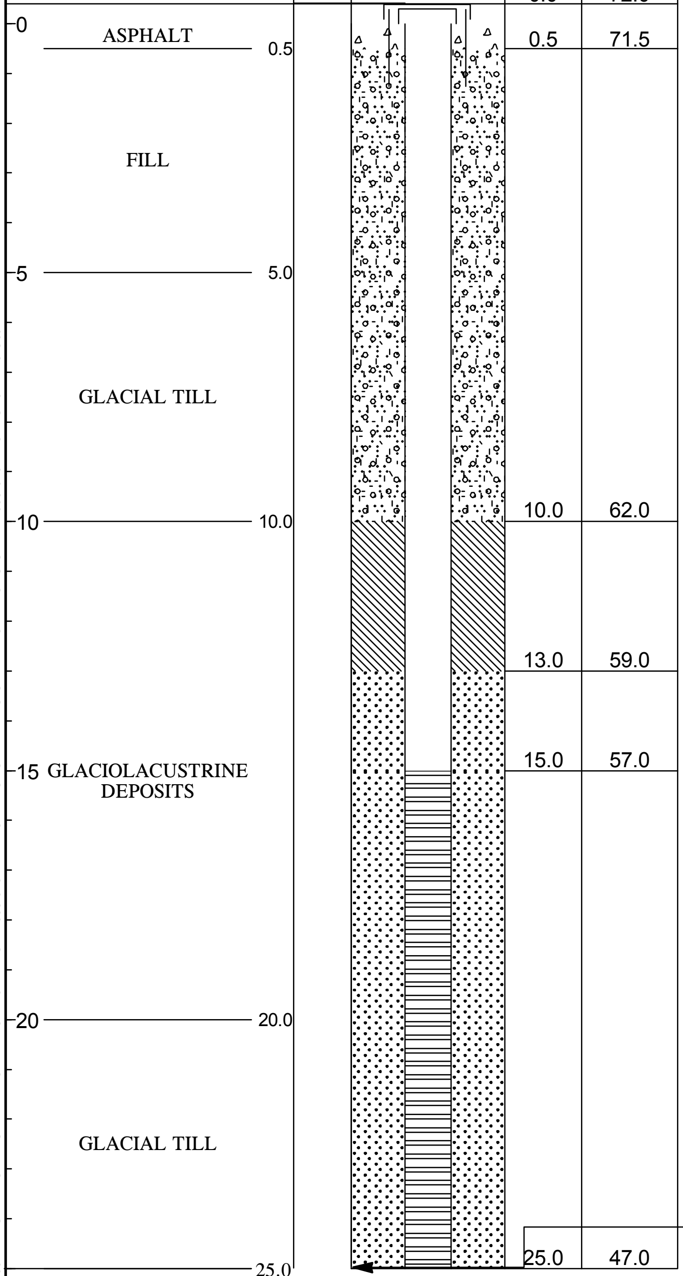
Well Diagram

- ◫ Riser Pipe
- ▤ Screen
- ░ Filter Sand
- ▒ Cuttings
- ■ Grout
- ⁖ Concrete
- ▨ Bentonite Seal

File No. 41058-010
Date Installed 19 Sep 2014
H&A Rep. A. Fleming
Location See Plan

Ground El. 72.0
Datum BCB

SOIL/ROCK CONDITIONS	DEPTH (ft.)
ASPHALT	0.5
FILL	5.0
GLACIAL TILL	10.0
GLACIOLACUSTRINE DEPOSITS	20.0
GLACIAL TILL	25.0



DEPTH (ft.)	ELEVATION (ft.)
0.0	72.0
0.5	71.5
10.0	62.0
13.0	59.0
15.0	57.0
25.0	47.0

WELL CONSTRUCTION DETAILS

Type of protective cover Roadway Box

Depth of Roadway Box below ground surface 0.0 ft

Depth of top of riser below ground surface 0.1 ft

Type of protective casing Roadway Box

Length 0.7 ft

Inside diameter 6.0 in.

Depth of bottom of Roadway Box 0.7 ft

Type of riser pipe Schedule 40 PVC

Inside diameter of riser pipe 2.0 in.

Depth of bottom of riser pipe 15.0 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Concrete	0.0	0.5
Bentonite	10.0	3.0
	-	-

Diameter of borehole 4.0 in.

Depth to top of well screen 15.0 ft

Type of screen Machine slotted Sch 40 PVC

Screen gauge or size of openings 0.010 in.

Diameter of screen 2.0 in.

Type of Backfill around Screen Filter Sand

Depth to bottom of well screen 25.0 ft

Bottom of silt trap

Depth of bottom of borehole 25.0 ft

COMMENTS:

APPENDIX C

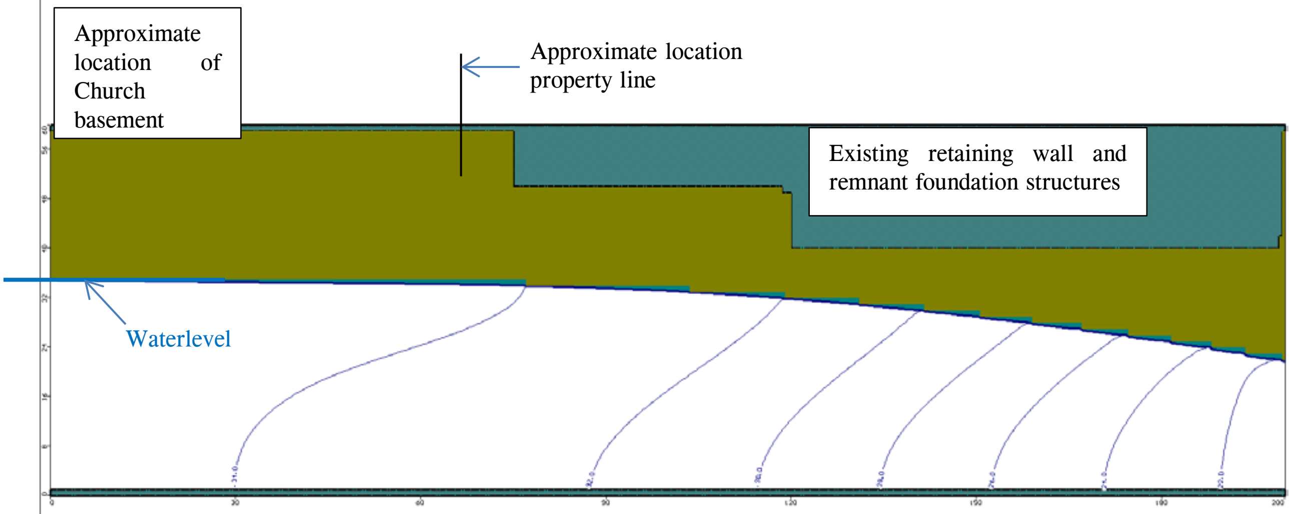
Groundwater Modeling Results

99 Tremont Street, Brighton, MA
File No. 41058-011
Groundwater Modeling using Modflow

Modflow was used to evaluate the effect on the groundwater from the installation of a permanently drained soil nail wall as part of the 99 Tremont Street construction. Modflow is a numerical modelling tool that evaluates groundwater flow in saturated media, and was used to produce flownets to assess the current and post construction water conditions at and around the site. The water table was modeled based on the water table observed in the recently installed observation wells HA14-B01(OW) and HA14-B07(OW). Recorded groundwater levels can be found in the boring logs in Appendix B.

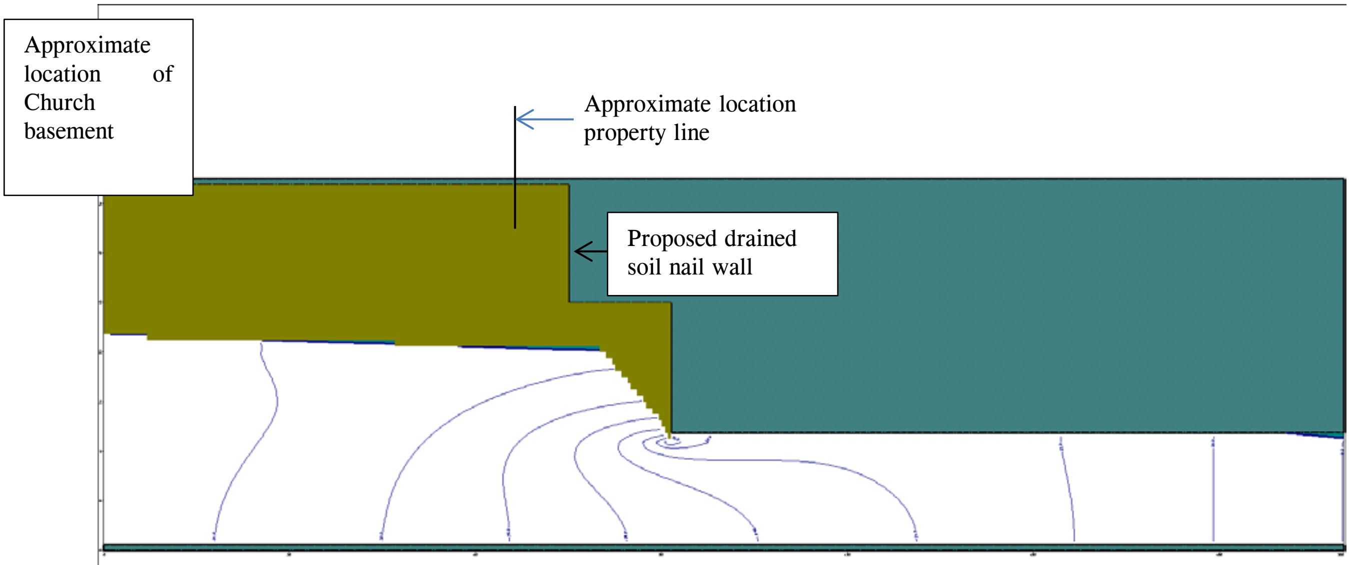
The following flownets were produced using Modflow. A two-dimensional grid was constructed with spacing of 1 ft horizontally and 1 ft vertically. It is assumed the current constructed basements are not equipped with underdrains, and the hydraulic conductivity of the glacial till is 1x10^{-4} cm/s. Type I or constant head boundaries were used on either side of the model to simulate a high water condition. The basements were modelled as impermeable structures. The model was run at a steady state condition.

Model: Existing site conditions with groundwater recorded in recent observation wells.



Flow is left to right. Equipotential head lines are shown

Model: Proposed drained soil nail wall



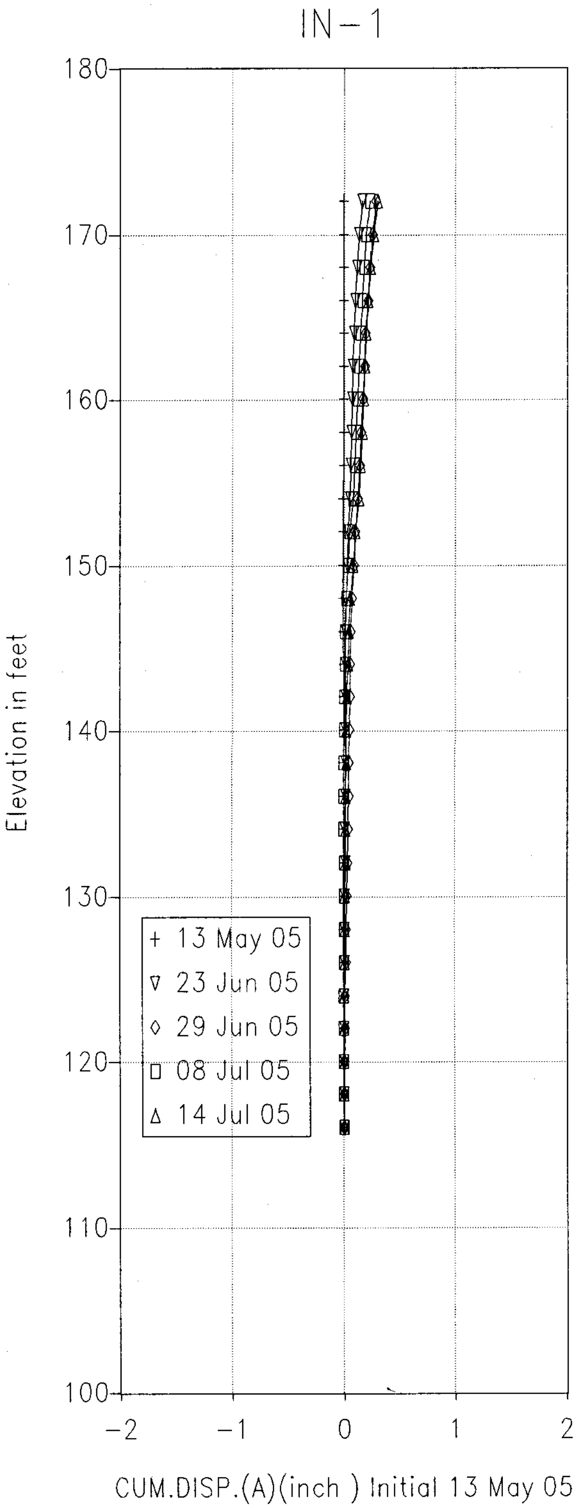
Flow is left to right. Equipotential head lines are shown

Decreasing the conductivity to 1x 10^{-6} cm/s did not change the theoretical long-term affect that the wall drains have on the groundwater. The range of conductivities tested was varied from $1\text{x}10^{-6}$ to $1\text{x}10^{-4}$ cm/s.

APPENDIX D

Everett High School Soil Nail Wall

Inclinometer Results (Lateral Wall Movement)
Photos of Soil Nail Wall Construction



NOTE: 1. ALL ELEVATIONS ARE IN FEET AND REFER TO EVERETT CITY BASE (ECB) DATUM.

2. POSITIVE DISPLACEMENT INDICATES MOVEMENT TOWARD THE EXCAVATION.

HALEY & ALDRICH

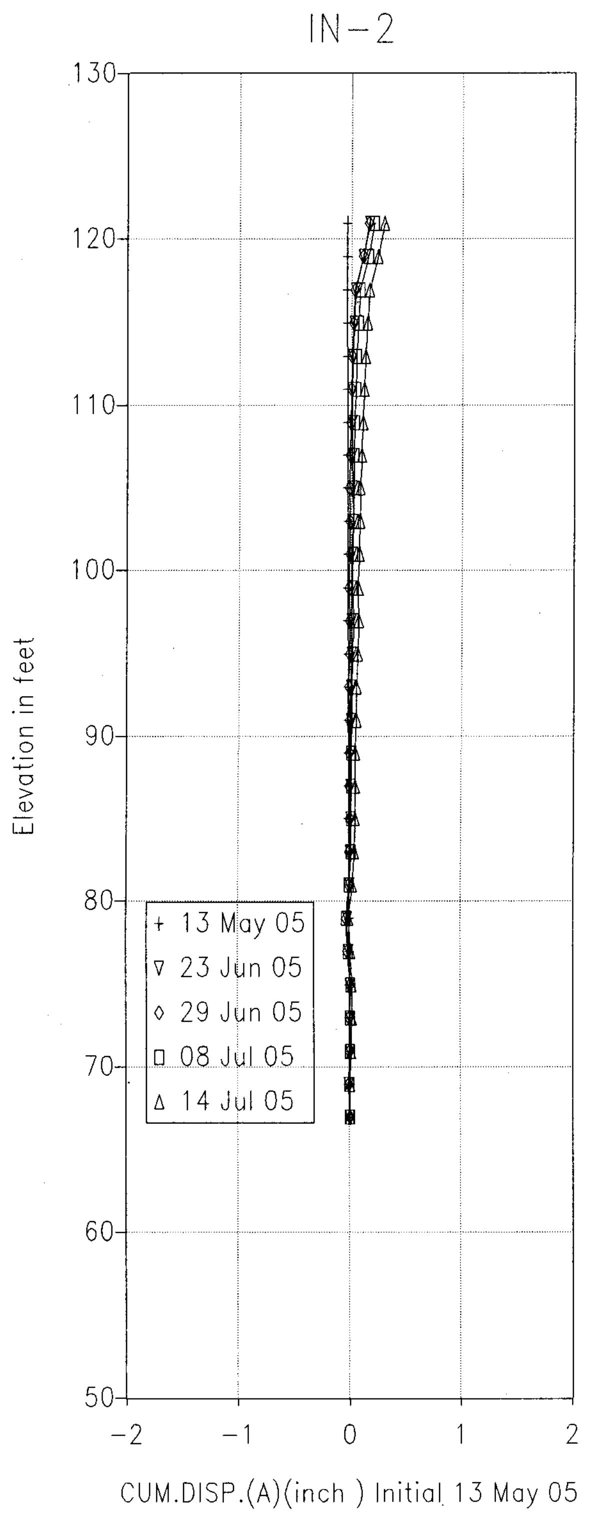
UNDERGROUND ENGINEERING & ENVIRONMENTAL SOLUTIONS

NEW EVERETT HIGH SCHOOL
EVERETT, MASSACHUSETTS

CUMULATIVE DISPLACEMENT
INCLINOMETER IN-1

FILE NO. 31118-030

DATE: AS SHOWN



NOTE: 1. ALL ELEVATIONS ARE IN FEET AND REFER TO EVERETT CITY BASE (ECB) DATUM.

2. POSITIVE DISPLACEMENT INDICATES MOVEMENT TOWARD THE EXCAVATION.

HALEY & ALDRICH **UNDERGROUND ENGINEERING & ENVIRONMENTAL SOLUTIONS**	NEW EVERETT HIGH SCHOOL EVERETT, MASSACHUSETTS CUMULATIVE DISPLACEMENT INCLINOMETER IN-2 FILE NO. 31118-030 DATE: AS SHOWN

Photo # 1: Site before construction

Photo #2: Site before construction

Photo #3: First layer of shotcrete and drainage strips

Photo #4: Reinforcement prior to shotcrete. Drainage strips in background

Photo #5: Prepping wall for shotcrete

Photo #6: Soil nails, shotcrete, reinforcement and drainage strips

Photo #**7**: Second layer of shotcrete

Photo #**8**: Drilling of soil nails

Photo #**9**. Four lifts of soil nails and shotcrete completed, prepping for fifth lift

Photo #**10**: Drilling of soil nails

Photo #**11**: Drilling final row of soil nails

Photo #**12**: Completed wall prior to final facing

Photo #*13**:*** Reinforcement prior to final wall facing application

Photo #*14**:*** Completed wall

Photo #*15**:*** Completed wall

Photo #*16**:*** Side view of wall (nearly vertical)

APPENDIX E

Soil Nail Wall Case Study

The Bravern Project, Bellevue, Washington

Temporary Soil Nail Walls

THE BRAVERN
BELLEVUE, WA

The Bravern - Phase I & II project, developed by Schnitzer Northwest was begun in 2005 and completed in 2009 and is a mixed-use commercial and residential development located in the heart of downtown Bellevue, Washington. The project encompasses 3 city blocks bounded by NE 8th Street to the north, 112th Ave NE along the east, NE 6th Street along the south, and 110th Ave NE to the west. The development includes several high-rise office and residential towers, and a 9-level below grade parking structure that required an excavation that reached up to 87 feet below the adjacent city streets.

Skanska USA was the Prime Contractor for the project and Malcolm Drilling provided the Design-Build shoring system with ourselves as designer. The parking garage excavation for both phases of the project required a total of roughly 155,000 SF of wall face that was temporarily shored with soil nailing. The existing Meydenbauer Center was located on the city block to the southeast of the site and required direct underpinning by the temporary shoring wall. The temporary soil nail wall at the north end of the site was up to 87 feet deep and is considered the deepest known temporary soil nail wall in the United States. The deflection of this wall was roughly 1-1/4" at the completion of construction, well within the expected performance.

Figure 1. View of Bravern Excavation toward Meydenbauer Convention Center.

Along the southeast wall, the existing Meydenbauer Center was directly under-pinned through the use of small diameter vertical elements that were drilled adjacent to the existing footing and connected via steel brackets attached to the beams (Figure 1). The soil nail wall in this area was 60-ft deep and was designed using an earth-pressure approach with a no-load zone and fully prestressed soil nails in the upper part of the wall, resulting in less than 1/4" of movement to the existing structure.