

November 18, 2016

Mr. Jake Upton
Upton + Partners, LLC
191 Lowder Street, 2nd Floor
Dedham, Massachusetts 02026

**RE: Preliminary Geotechnical Summary
Commercial Property
355-361 Belgrade Avenue
West Roxbury, Massachusetts
Lightship Project No. 854.2**

Dear Mr. Upton:

Consistent with Lightship Engineering LLC's ("Lightship Engineering's") scope of work dated September 29, 2016, Lightship Engineering subcontracted the completion of a Preliminary Geotechnical Summary at the commercial property located at 355-361 Belgrade Avenue in West Roxbury, Massachusetts (the "Site"). The Preliminary Geotechnical Summary included the advancement of five soil borings and the collection of Standard Penetration Tests at select locations at the site. A copy of the Preliminary Geotechnical Summary is attached.

If you have any questions or comments, please contact Bryan Massa or Timothy Condon at (508) 830-3344, extension 220 and 120, respectively.

Very truly yours,

Lightship Engineering, LLC

Bryan Massa
Project Manager

Timothy Condon, P.E., LSP
President

ATTACHMENT A

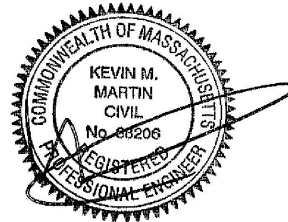
PRELIMINARY GEOTECHNICAL SUMMARY

KEVIN M. MARTIN, P.E.
KMM GEOTECHNICAL CONSULTANTS, LLC
7 Marshall Road
Hampstead, NH 03841
603-489-5556 (p)/ 603-489-5558 (f)/781-718-4084(m)
kevinmartinpe@aol.com

MEMORANDUM

TO: Lightship Engineering, LLC
39 Industrial Park Road, Unit C
Plymouth, Massachusetts 02360

FROM: Kevin M. Martin, P.E.
Geotechnical Engineer



DATE: November 9, 2016

**RE: PRELIMINARY GEOTECHNICAL SUMMARY
PROPOSED CHARTER SCHOOL
361 BELGRADE AVENUE
WEST ROXBURY, MASSACHUSETTS**

This memorandum serves as a preliminary geotechnical summary report for the referenced project. The contents of this memorandum are subject to the attached *Limitations*.

SITE & PROJECT DESCRIPTION

Present development includes a commercial building with pavement areas. A MBTA rail line borders the rear of the property. The project will include removal of the building and other construction to accommodate a new, 3-4 story charter school. Limited Plans were available at this time. The project is in the preliminary or conceptual stage at this time. Based on visual review, the site possesses a gradual downward slope. KMM has limited knowledge of prior construction, use and/or development of the property except what is visible.

The purpose of this study is to review the subgrade conditions and provide a preliminary geotechnical evaluation as it pertains to feasible means of foundation support. This report does not include an environmental assessment relative to oil, gasoline, solid waste and/or other hazardous materials. The environmental conditions of the property are being reviewed by Lightship Engineering. This study also does not include review of site design or construction issues such as infiltration systems, excavation support systems, underground utilities, protection of surrounding buildings/utilities, shoring, crane pads or other site and/or temporary design unless addressed herein.



SUBSURFACE EXPLORATION PROGRAM

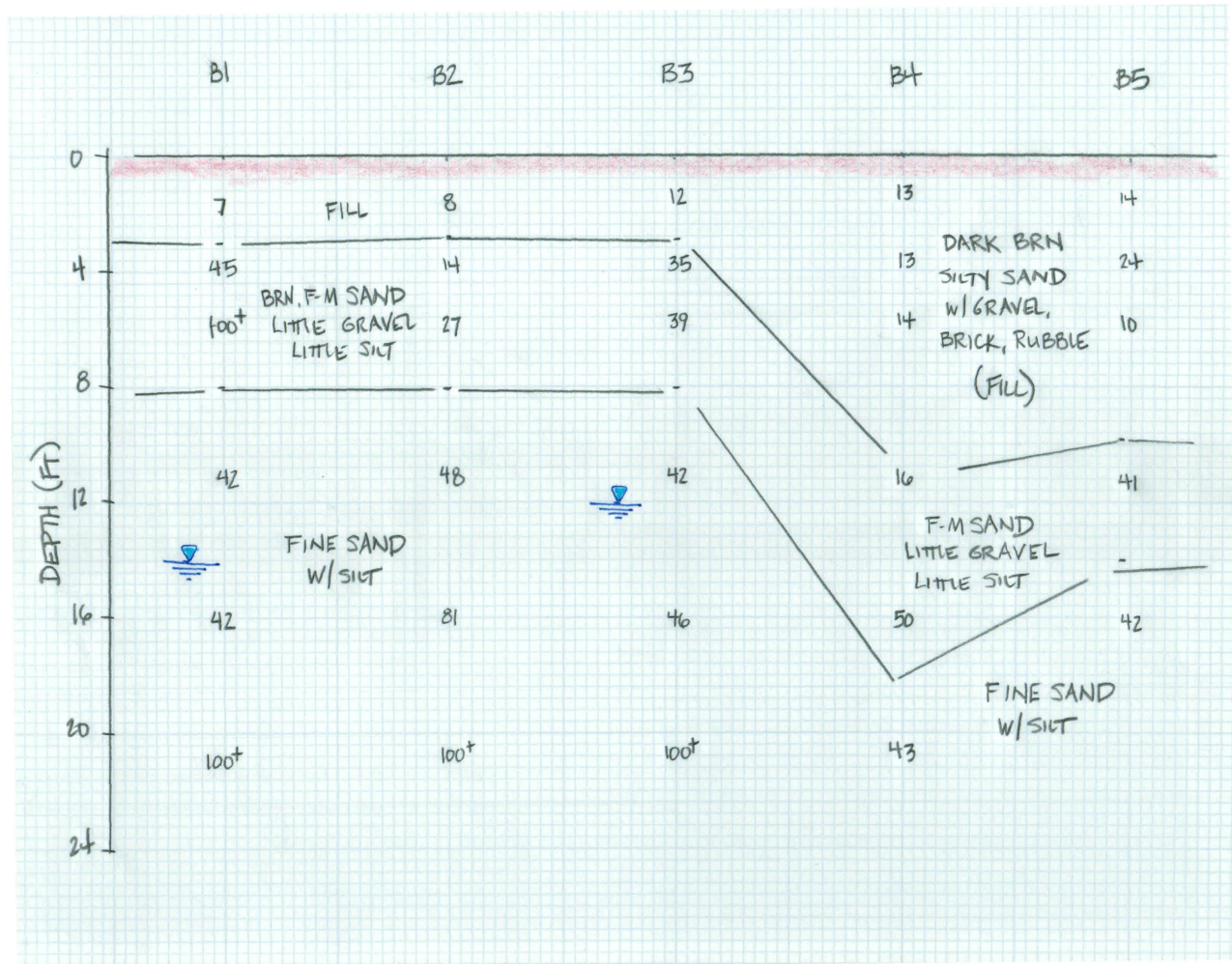
Test Borings

The exploration program for the project included five (5) test borings completed around the site. The test borings (B1 to B5) were advanced to depths of ≈ 17 -22 ft utilizing 4¼ inch hollow stem augers. Soil samples were typically retrieved at no greater than 5 ft intervals with a 2 inch diameter split-spoon sampler. Standard Penetration Tests (SPTs) were performed at the sampling intervals in general accordance with ASTM-D1586 (*Standard Method for Penetration Test and Split-Barrel Sampling of Soils*). Field descriptions and penetration resistance of the soils encountered, observed depth to groundwater and other pertinent data are contained on the attached *Test Boring Logs*.



SUBSURFACE CONDITIONS

The subsurface conditions include (1) undocumented Fill underlain by (2) Granular Glacial soils then (3) Fine Sand with variable Silt. A *Subsurface Profile* depicting the soil and groundwater conditions is attached for review.



Fill was encountered at all the test holes to depths of ≈ 3 -10 ft. Deeper Fill was encountered at B4 & B5. The Fill varies in composition but generally consists of a dark brown, Sand, little gravel, little silt.. Trace amounts of rubble, loam and other matter are embedded in the Fill. The Fill varies from loose to medium dense. Fill should also be expected around existing foundations and utilities.

The parent site soils include Granular soils underlain by fine-grained soils. The Granular soils include a brown, fine to medium Sand with little to some gravel and silt. These soils are generally Sandy in composition. At depth, the soils include a Fine Sand & Silt. These fine-grained soils are present at depths of ≈ 8 -18 ft. The fine-grained composition renders these soils moisture sensitive, poor-draining and frost susceptible. The overburden soils are stable, dense and compact.

Groundwater was encountered in the test holes at depths of ≈ 12 -15 ft below grade. Some of the shallower soils were mottled (re-dox staining) suggesting seasonal groundwater fluctuations. It should be noted that fluctuations in the level of the groundwater may occur due to variations in rainfall, temperature, flooding, utilities and other factors differing from the time of the measurements. This study was completed at a time of seasonally low groundwater.

PRELIMINARY GEOTECHNICAL EVALUATION

Based on our review, we provide the following preliminary geotechnical evaluation related to the proposed project.

- The Fill soils are **not** considered suitable for foundation bearing support due to their poor strength and compressibility characteristics. Relying on these soils for foundation bearing support will likely translate intolerable settlement to the proposed building. Removal & Replacement with Structural Fill (Table 1) is viable given the shallow depth of excavation. More specifically, the fill, intersecting utilities, abandoned foundations and other questionable materials shall be removed from the building pad including the *Footing Zone of Influence (FZOI)* to expose the Glacial soils. The *FZOI* is defined as that area extending laterally one foot from the edge of footing then outward and downward at a 1H:1V splay.
- The parent site soils compact and stable. The footings are expected to gain bearing support atop the parent site soils and/or compacted Structural Fill (Table 1). Preliminary review suggests footings may be designed using an allowable bearing capacity of at least 5 ksf with nominal settlement less than 1 inch with differential settlement less than ½ inch.
- The subsurface conditions were reviewed with respect to seismic criteria set forth in the *Massachusetts State Building Code (Eighth Edit)*. Based on the relative density of the soils and the depth to groundwater, the site is not susceptible to liquefaction in the event of an earthquake (*Section 1804.6*). Based on interpretation of the *Building Code*, the *Site Classification* (Section 9.4.1.2.1) is “D” (Stable Soil Profile).
- The subgrade should ultimately be stable, dewatered, compact and protected from frost throughout construction. Bearing subgrades that become weakened or disturbed due to wet conditions or other cause will be rendered unsuitable for structural support. The Contractor shall ultimately be responsible for the means and methods of temporary groundwater control, subgrade protection and site stability during construction.

CLOSING

This geotechnical review is considered preliminary at this time. It is recommended that additional test bores, laboratory testing and geotechnical review be completed as the project progresses and more definitive plans are available. This review should provide a basic assessment for moving forward with the project. The final foundation design shall be completed in accordance with the *Massachusetts State Building Code*.

We trust the contents of this memorandum report are responsive to your needs at this time. Should you have any questions or require additional assistance, please do not hesitate to contact our office.

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 KMM Geotechnical Consultants, LLC.

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 Lightship Engineering, LLC 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 KMM Geotechnical Consultants, LLC. 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 preliminary geotechnical design considerations only.

TABLE 1

*Proposed Charter School
361 Belgrade Avenue
West Roxbury, MA*

Recommended Soil Gradation & Compaction Specifications

Clean Granular Fill (Select Gravel Fill)

SIEVE SIZE	PERCENT PASSING BY WEIGHT
3 inch	100
3/4 inch	60-90
No. 4	20-70
No. 200	2-8

NOTE: For minimum 8-inch base below Concrete Floor Slabs (in heated areas)
For minimum 12-inch base for concrete slabs exposed to frost
For minimum 15-inch base below entrances, ramps, etc.
A ¾-inch crushed stone may be used in lieu of gravel

Structural Fill (Gravelly SAND, trace Silt)

SIEVE SIZE	PERCENT PASSING BY WEIGHT
5 inch	100
3/4 inch	60-100
No. 4	20-80
No. 200	0-10

NOTE: For use as structural load support below the foundations
For use as backfill behind unbalanced foundation/retaining walls
A ¾-inch crushed stone may be used in wet conditions

Structural Fill placed beneath the foundation should include the *Footing Zone of Influence* which is defined as that area extending laterally one foot from the edge of the footing then outward and downward at a 1H:1V splay. Structural Fill should be placed in loose lifts not exceeding 12 inches for heavy vibratory rollers and 8 inches for vibratory plate compactors. All Structural Fill should be compacted to at least 95 percent of maximum dry density as determined by the Modified Proctor Test (ASTM-D1557). The Structural Fill should be compacted within $\pm 3\%$ of optimum moisture content. The adequacy of the compaction efforts should be verified by field density testing which is also a requirement of the *Massachusetts State Building Code*.

TEST BORING LOG

SHEET 1

Soil Exploration Corp.
 Geotechnical Drilling
 Groundwater Monitor Well
 148 Pioneer Drive
 Leominster, MA 01453
 978 840-0391

Lightship Engineering, LLC
Site: 355-361 Belgrade Avenue
West Roxbury, MA

BORING B-1

PROJECT NO. 16-1039

DATE: November 3, 2016

Ground Elevation:
 Date Started: October 28, 2016
 Date Finished: October 28, 2016
 Driller: GG

GROUNDWATER OBSERVATIONS

DATE	DEPTH	CASING	STABILIZATION
10/28/1	14 ft	n/a	

Soil Engineer/Geologist:

Depth Ft.	Casing bl/ft	Sample				Strata	Visual Identification of Soil and / or Rock Sample
		No.	Pen/Rec	Depth	Blows/6"		
1		1	11"	6"-2'6"	3-3-4-10	4"	Pavement
		2	10"	2'6"-4'6"	11-21-24-27	2'6"	Dark Brown, loamy, silty Sand w/ gravel, dry (FILL)
5		3	2"	5'0"-5'9"	54-70/3"		Brown, fine to coarse Sand & Gravel, little silt, cobbles, dry
10		4	12"	10'0"-12'0"	21-21-21-22	8'	
15		5	21"	15'0"-17'0"	17-21-21-23		Brown, Fine Sand w/ Silt
20		6	11"	20'0"-22'0"	21-26-50/3"		
25							End of boring at 22 ft Water encountered at 14 ft
30							
35							

Notes: Hollow Stem Auger Size - 4 1/4"

Cohesionless: 0 - 4 V. Loose, 4 - 10 Loose, 10 -30 M Dense, 30 -50 Dense, 50+ V	Trace 0 to 10%	ID SIZE (IN)	CASING	SAMPLE	CORE TYPE
Cohesive: 0 -2 V Soft, 2 -4 Soft, 4 -8 M	Little 10 to 20%	HAMMER WGT (LB)		SS	
8 -15 Stiff. 15 -30 V. Stiff. 30 + Hard.	Some 20 to 35%	HAMMER FALL (IN)		140 lb.	
	And 35% to 50%			30"	

TEST BORING LOG

SHEET 2

Soil Exploration Corp.
 Geotechnical Drilling
 Groundwater Monitor Well
 148 Pioneer Drive
 Leominster, MA 01453
 978 840-0391

Lightship Engineering, LLC
Site: 355-361 Belgrade Avenue
West Roxbury, MA

BORING B-2

PROJECT NO. 16-1039

DATE: November 3, 2016

Ground Elevation:
 Date Started: October 28, 2016
 Date Finished: October 28, 2016
 Driller: GG

GROUNDWATER OBSERVATIONS

DATE	DEPTH	CASING	STABILIZATION
10/28/1	n/a		

Soil Engineer/Geologist:

Depth Ft.	Casing bl/ft	Sample				Strata	Visual Identification of Soil and / or Rock Sample
		No.	Pen/Rec	Depth	Blows/6"		
1		1	12"	6"-2'6"	3-4-4-5	4"	Pavement
		2	15"	2'6"-4'6"	5-7-7-12	2'6"	Dark Brown, fine to coarse Sand, some gravel, little silt, trace rubble, dry (FILL)
5		3	18"	5'0"-7'0"	11-13-14-14		Brown, mottled, fine to medium Sand, little silt, little gravel
						8'	Brown, mottled, fine to medium Sand, some silt, trace gravel, dry
10		4	17"	10'0"-12'0"	20-24-24-26		
15		5	14"	15'0"-17'0"	30-41-40-43		Brown, Fine Sand, some silt, dry
20		6	3"	20'0"-20'4"	70/4"	21'4"	
25							End of boring at 21'4" No water encountered
30							
35							

Notes: Hollow Stem Auger Size - 4 1/4"

Cohesionless: 0 - 4 V. Loose, 4 - 10 Loose, 10 -30 M Dense, 30 -50 Dense, 50+ V	Trace 0 to 10%	ID SIZE (IN)	CASING	SAMPLE	CORE TYPE
Cohesive: 0 -2 V Soft, 2 -4 Soft, 4 -8 M	Little 10 to 20%	HAMMER WGT (LB)		SS	
8 -15 Stiff. 15 -30 V. Stiff. 30 + Hard.	Some 20 to 35%	HAMMER FALL (IN)		140 lb.	
	And 35% to 50%			30"	

TEST BORING LOG

SHEET 3

Soil Exploration Corp.
 Geotechnical Drilling
 Groundwater Monitor Well
 148 Pioneer Drive
 Leominster, MA 01453
 978 840-0391

Lightship Engineering, LLC
Site: 355-361 Belgrade Avenue
West Roxbury, MA

BORING B-3

PROJECT NO. 16-1039

DATE: November 3, 2016

Ground Elevation:
 Date Started: October 28, 2016
 Date Finished: October 28, 2016
 Driller: GG

GROUNDWATER OBSERVATIONS

DATE	DEPTH	CASING	STABILIZATION
10/28/1	12 ft	n/a	Upon Completion

Soil Engineer/Geologist:

Depth Ft.	Casing bl/ft	Sample				Strata	Visual Identification of Soil and / or Rock Sample
		No.	Pen/Rec	Depth	Blows/6"		
1		1	15"	6"-2'6"	2-5-7-7	4"	Pavement
		2	10"	2'6"-4'6"	10-15-20-22	2'6"	Brown, fine to coarse Sand, some gravel, little silt dry (FILL)
5		3	12"	5'0"-7'0"	12-19-20-21	8'	Brown, fine to medium Sand, little gravel, little silt
		4	18"	10'0"-12'0"	10-21-21-24		Brown, Fine Sand w/ silt, wet
15		5	17"	15'0"-17'0"	18-22-24-37		Silt w/ Fine Sand
20		6	4"	20'0"-20'9"	24-50/3"	20'9"	Same
							End of boring at 20'9"
25							Water encountered at 12 ft
30							
35							

Notes: Hollow Stem Auger Size - 4 1/4"

Cohesionless: 0 - 4 V. Loose, 4 - 10 Loose, 10 -30 M Dense, 30 -50 Dense, 50+ V	Trace 0 to 10%	ID SIZE (IN)	CASING	SAMPLE	CORE TYPE
Cohesive: 0 -2 V Soft, 2 -4 Soft, 4 -8 M	Little 10 to 20%	HAMMER WGT (LB)		SS	
8 -15 Stiff. 15 -30 V. Stiff. 30 + Hard.	Some 20 to 35%	HAMMER FALL (IN)		140 lb.	
	And 35% to 50%			30"	

TEST BORING LOG

SHEET 4

Soil Exploration Corp.
 Geotechnical Drilling
 Groundwater Monitor Well
 148 Pioneer Drive
 Leominster, MA 01453
 978 840-0391

Lightship Engineering, LLC
Site: 355-361 Belgrade Avenue
West Roxbury, MA

BORING B-4

PROJECT NO. 16-1039

DATE: November 3, 2016

Ground Elevation:
 Date Started: October 28, 2016
 Date Finished: October 28, 2016
 Driller: GG

GROUNDWATER OBSERVATIONS

DATE	DEPTH	CASING	STABILIZATION
10/28/1	n/a		

Soil Engineer/Geologist:

Depth Ft.	Casing bl/ft	Sample				Strata	Visual Identification of Soil and / or Rock Sample	
		No.	Pen/Rec	Depth	Blows/6"			
1		1	12"	6"-2'6"	4-6-7-14	4"	Pavement	
		2	14"	2'6"-4'6"	7-7-6-8		Dark Brown, Sand & Gravel, little silt, trace rubble (FILL)	
5		3	10"	5'0"-7'0"	8-7-7-7		Dark Brown, Sand, little gravel, little silt	
							Same (FILL)	
10		4	14"	10'0"-12'0"	7-8-8-9		11'	Grey, Sand & Gravel, some silt, dry
15		5	13"	15'0"-17'0"	10-26-24-29			Brown, fine to medium Sand, little gravel, little silt
20		6	12"	20'0"-22'0"	10-17-26-31	18'	Brown, Fine Sand, some silt	
25							End of boring at 22 ft No water encountered	
30								
35								

Notes: Hollow Stem Auger Size - 4 1/4"

Cohesionless: 0 - 4 V. Loose, 4 - 10 Loose, 10 -30 M Dense, 30 -50 Dense, 50+ V	Trace 0 to 10%		CASING	SAMPLE	CORE TYPE
Cohesive: 0 -2 V Soft, 2 -4 Soft, 4 -8 M 8 -15 Stiff. 15 -30 V. Stiff. 30 + Hard.	Little 10 to 20%	ID SIZE (IN)		SS	
	Some 20 to 35%	HAMMER WGT (LB)		140 lb.	
	And 35% to 50%	HAMMER FALL (IN)		30"	

TEST BORING LOG

SHEET 5

Soil Exploration Corp.
 Geotechnical Drilling
 Groundwater Monitor Well
 148 Pioneer Drive
 Leominster, MA 01453
 978 840-0391

Lightship Engineering, LLC
Site: 355-361 Belgrade Avenue
West Roxbury, MA

BORING B-5

PROJECT NO. 16-1039

DATE: November 3, 2016

Ground Elevation:
 Date Started: October 28, 2016
 Date Finished: October 28, 2016
 Driller: GG

GROUNDWATER OBSERVATIONS

DATE	DEPTH	CASING	STABILIZATION
10/28/1	n/a		

Soil Engineer/Geologist:

Depth Ft.	Casing bl/ft	Sample				Strata	Visual Identification of Soil and / or Rock Sample
		No.	Pen/Rec	Depth	Blows/6"		
1		1	13"	6"-2'6"	5-7-7-8	4"	Pavement
		2	3"	2'6"-4'6"	7-12-12-15		Sand, Gravel, Brick
5		3	12"	5'0"-7'0"	3-5-5-5		Sand & Gravel, little silt (FILL)
							Brown, silty Sand, little gravel, trace organic, dry
10		4	8"	10'0"-12'0"	10-21-20-20	10'	Brown, fine to medium Sand, little gravel, little silt, dry
						13'	
15		5	15"	15'0"-17'0"	12-18-24-36		Brown, Fine Sand w/ Silt, trace gravel
20							End of boring at 17 ft No water encountered
25							
30							
35							

Notes: Hollow Stem Auger Size - 4 1/4"

Cohesionless: 0 - 4 V. Loose, 4 - 10 Loose, 10 -30 M Dense, 30 -50 Dense, 50+ V	Trace 0 to 10%		CASING	SAMPLE	CORE TYPE
Cohesive: 0 -2 V Soft, 2 -4 Soft, 4 -8 M	Little 10 to 20%	ID SIZE (IN)		SS	
8 -15 Stiff. 15 -30 V. Stiff. 30 + Hard.	Some 20 to 35%	HAMMER WGT (LB)		140 lb.	
	And 35% to 50%	HAMMER FALL (IN)		30"	