PSI *Information To Build On*

Engineering • Consulting • Testing

March 16, 2009

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Reference: Geotechnical Engineering Report
Proposed Town Hall Addition
Westford, Massachusetts
PSI Project No. 444-95008

Dear Ms Kang:

We are pleased to submit this letter summarizing the results of the geotechnical engineering studies undertaken regarding the proposed building addition at the referenced site. This work was conducted in accordance with our proposal dated February 3, 2009 and signed by you on February 19, 2009. The objective of the work summarized herein was to provide geotechnical recommendations to members of the design team for use on this project.

Project Understanding and Site Description

We understand that the Town of Westford plans on expanding its existing Town Hall located at 55 Main Street in Westford, Massachusetts, as shown in Figure 1, Site Location Map. The site is generally occupied by the existing Town Hall and the Westford police department in an adjacent facility. A drain line, sewer line, and a light pole were present within or crossing the site of the proposed addition which required a modification of the drilling locations.

The addition will consist of a basement section for future expansion and 2 stories above the basement level for offices. The building expansion area which is located along the rear of the existing building is currently occupied by walkways, handicap ramp and landscaping. We have assumed that the proposed basement floor grade will match or be lower than the grade of the existing basement which is approximately 2 feet lower than the exterior grade at the site.

At the time that this report was prepared, structural loads were not available. Therefore, the recommendations presented herein are based upon typical foundation loading conditions for the type of structure proposed.

Surficial Geology

The project site is located within the USGS Surficial Geology Map of the Westford Quadrangle (1980-1982). The site is generally underlain by glacial stratified deposits and/or shallow bedrock. The samples of material retrieved in the explorations conducted at the site are consistent with this description.

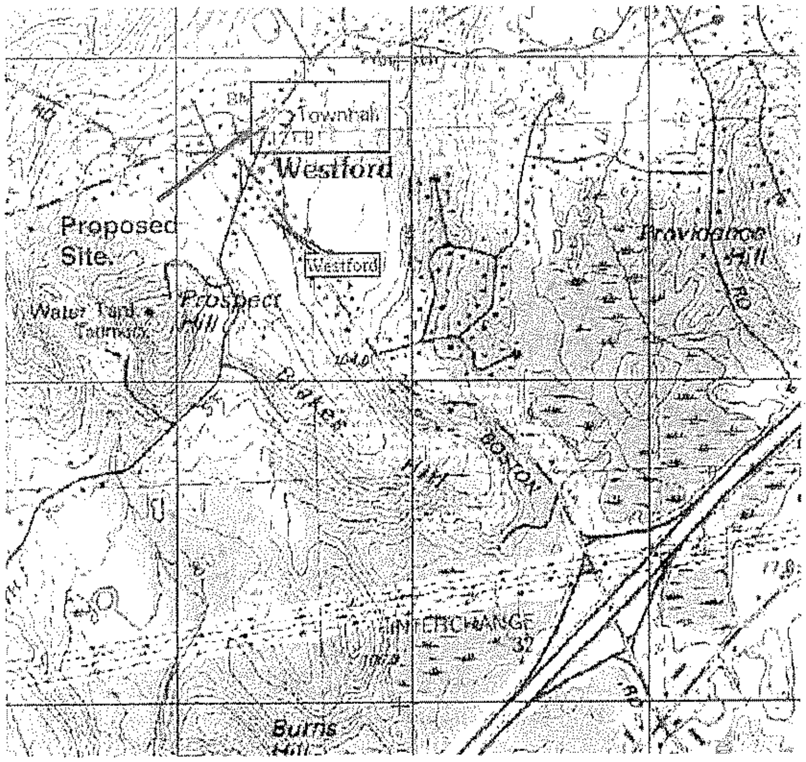

Figure 1 - Site Location Map

Subsurface Explorations

PSI engaged New Hampshire Boring of Londonderry, New Hampshire to advance 3 borings within the general vicinity of the proposed building addition on March 11, 2009 to assess general subsurface conditions within the proposed building footprint. The locations of the explorations are shown in Figure 2 - Exploration Location Plan which is based upon a plan provided to PSI by Kang Associates. All the borings extended to refusal within rock or weathered rock at depths ranging from 7 feet to 10 feet below ground surface (BGS).

Prior to undertaking the explorations PSI chose the four (4) corners of the proposed building addition and marked the proposed boring location. These locations were chosen based on the plan provided to us by Kang Associates. These locations were shifted and/or reduced, however, due to the underground site constraints mentioned above. Subsurface information from these locations will not vary significantly from the intended boring locations to the location effectively drilled. PSI's subcontractors notified Dig Safe, The Town's Water Department, and the Town of Westford for private utility clearance prior to undertaking the field work.

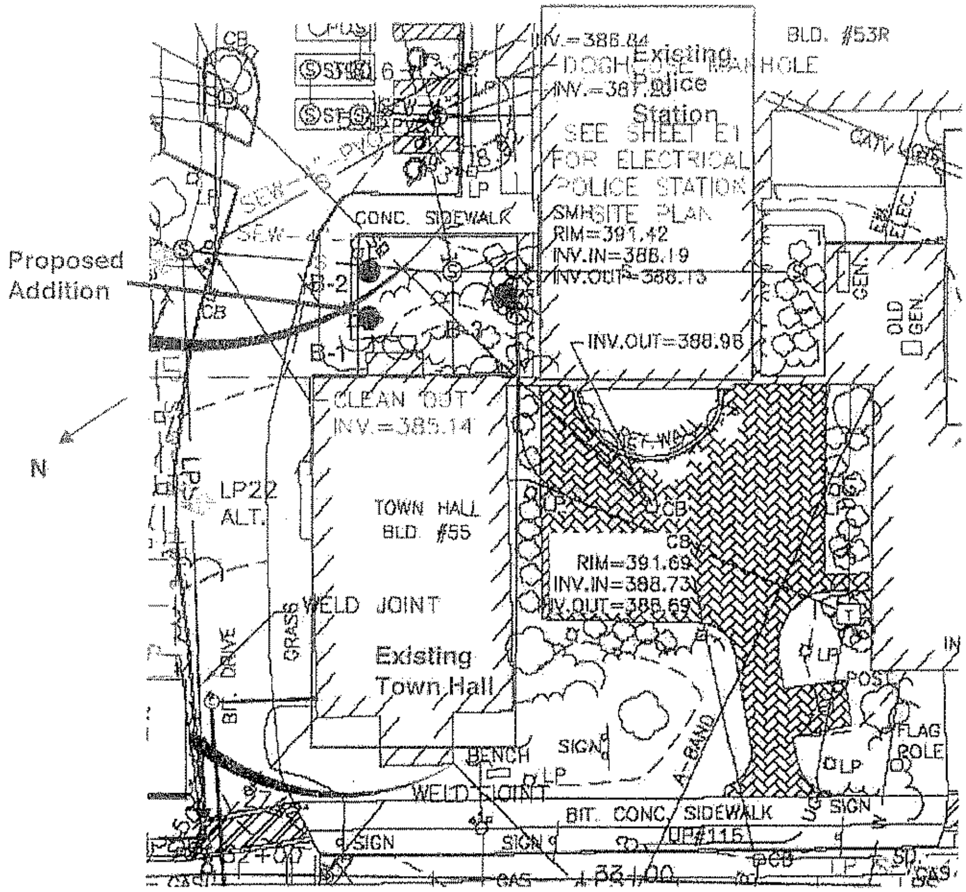

Figure 2 - Exploration Location Plan

Two borings (B-1 and B-2) were advanced using hollow flight augers while boring B-3 was advanced using a 3-inch-diameter casing so that a rock core could be taken. Samples of soil were retrieved at the ground surface and at generally 5-foot intervals to provide material for the visual classification as shown on the logs. The samples were retrieved using a standard split spoon sampler driven with a 140-pound safety hammer falling 30-inches at each sampling depth. The sampler was driven a distance of 24-inches or as otherwise shown on the logs. The number of hammer blows required to drive the sampler into the soil in 6-inch increments is recorded on the logs. The sum of the hammer blows for the second and third interval provides the Standard Penetration Resistance (N) and is a measure of soil density in granular soils.

The classification of soil strata shown on the logs is based upon our interpretation of the subsurface conditions. It is possible that there might be thin layers of material lying between the sampling intervals that are not described on the logs and which might not become known until construction. Likewise, the depth to each soil stratum is considered to be approximate and may be more gradual or different in the field. Logs of the borings were prepared by PSI and are attached to this report for reference.

Subsurface Conditions

The general subsurface conditions encountered during the exploration program are described herein. Refer to the logs for details.

Topsoil – At boring locations B-1 and B-2 an approximately 6-inch to 8-inch-thick layer of topsoil was encountered at the ground surface.

Fill – An approximately 2-foot to 3-foot thick layer of loose to medium dense fine to coarse sand, some organic silt, little gravel was encountered beneath the topsoil at boring locations B-2 and B-3.

Stratified Deposit – A natural deposit of medium dense soil consisting of layers of (1) fine sand and silt and (2) fine to medium sand, trace coarse sand, some silt was encountered beneath either the fill or the top soil.

Weathered Rock – Weathered rock was encountered beneath the natural deposit at all boring locations at depths ranging from approximately 4 feet to 5 feet BGS. At borings B-1 and B-2, the drillers advanced the 2 ¼ -inch-internal diameter hollow steam auger (HSA) to refusal within the weathered rock as shown in the boring logs attached to this report. Although the driller was able to drill into the weathered rock for several feet the material might be difficult to excavate without using mechanical methods to break the rock.

Rock – A 5-foot long rock core was obtained at boring B-3 from a depth of 5 feet to 10 feet BGS. The top 18 inches of the rock core consisted of reddish gray, fine-grained, highly weathered schist with closely spaced fractures. The RQD within this top 18 inches was approximately zero percent (0%). The bottom 42 inches of the rock core consisted of reddish gray, fine-grained, slightly weathered schist with few fractures. The RQD within this top 42 inches was approximately one hundred percent (100%). The overall RQD for the entire core was approximately sixty six percent (66%).

Groundwater – Although groundwater was not encountered in any of the boreholes to the depth explored, at boring B-1 sample S-2 was wet. It is likely that the groundwater will travel along the rock / soil interface especially during periods of heavy rainfall or snow melt. These conditions can lead to groundwater migrating into the below ground sections of the building..

The groundwater conditions stated on the logs are applicable to the time when the readings were made. The level of groundwater below the ground surface fluctuates based on conditions such as season, temperature and amount of precipitation that may be different from the time when the observations were made. Therefore, the groundwater levels may be higher or lower during construction and during the life of the structure. This fact should be taken into consideration when preparing foundation design and developing earthwork procedures.

Recommendations

We have assumed that the footings for the proposed addition will be located at the same depth as the bottom of the foundation wall for the existing structure or deeper. The existing basement slab is approximately 2 feet BGS within the area of proposed addition. If the addition foundations are deeper, then underpinning will be required to support the existing foundations.

The subsurface conditions encountered within the proposed building footprint consist of a relatively thin layer of topsoil underlying by either fill or natural stratified deposit of silty sand or sand and silt which are then underlain by weathered rock beginning at a depth of 4 feet to 5 feet BGS. Since the building will have a basement section it is our opinion that the topsoil, fill and the natural soil will be entirely removed during construction of the proposed addition depending upon the design grades of the structure. Excavation of weathered rock should also be expected to reach the footings grades and possibly to install utilities below the basement slab.

Foundations

Based on the existing subsurface conditions described previously, it is our opinion that the proposed building can be supported on shallow spread footings or continuous wall footings bearing on the existing natural soil or natural rock. The footings should not bear on the existing fill. We recommend using a net allowable bearing pressure of 4,000 pounds per square foot (psf) for footing design provided the footings are at least 2 feet wide.

Footings designed and constructed in accordance with these recommendations are expected to have a total settlement less than ¾ -inches. Differential settlement between adjacent footings is expected to be less. Since the foundation soil is granular, we expect that the settlement will occur during construction and shortly thereafter as load is applied to the foundation.

Exterior footings and footings in unheated areas must be placed a minimum depth of 4 feet below final exterior grades to provide adequate frost protection. Interior footings in heated areas may be designed and constructed at a minimum depth of 2 feet below finished floor grades.

We expect that the proposed building addition will encounter weathered rock or both soil and weathered rock at the slab and footing grade depending upon the depth of the structure. We recommend that the footing excavations extend to a depth of 12-inches below the footing grades and the resulting excavation backfilled with ¾-inch crushed stone to provide a firm working surface, cushion and drainage zone.

We recommend constructing a transition zone along wall (continuous) footings bearing on soil and rock. The transition zone should consist of a 12-inch thick layer of ¾-inch crushed stone that extends lengthwise along the wall footing 8 feet along the rock and 8 feet along the soil. The width of the zone should extend 12-inches from each edge of the footing. The contact surface below individual footings should be similar (i.e. entirely rock or entirely soil).

All foundations must be designed in accordance with applicable sections of the 7th Edition of the Massachusetts State Building Code.

Basement Slab

Subsurface soil conditions are suitable for supporting a slab on grade after removing the fill or other unsuitable material that is present from within the building addition footprint. We expect that the cut for the slab grade might also encounter bedrock depending upon the actual design grades. We recommend that rock be removed to a depth of 12-inches below the bottom of the slab to accommodate utilities and allow for an underslab drainage system.

The rock can be removed to a common depth below the entire slab to accommodate drainage, interior footings and utilities or individual trenches can be cut to accommodate utilities. The selected alternative should be shown on the drawing so that all work to excavate soil and remove rock is included in the contract lump sum bid price.

All slabs must be constructed using suitable vapor retarder to reduce the potential for moisture migrating into the enclosed space.

Cosmetic cracking of slabs-on-grade is normal and should be expected. Cracking can occur not only as a result of heaving or compression of the underlying soil, but also as a result of concrete curing stresses. To reduce the potential for cracking, the precautions listed below should be closely followed for construction of all slabs-on-grade:

Foundation and Under-Slab Drains

Although groundwater was not encountered to depth explored the soil from sample S-2 in boring B-1 was wet. We also understand that the existing basement has periodic wet conditons. For these reasons, it is our opinion that an underslab drainage system along with perimeter foundation drains be incorporated into the design.

The drainage system should:

- Be installed around the basement perimeter and below the slab;
- Perimeter drains should consist of ¾-inch crushed stone placed from the bearing elevation of the wall footing to a minimum of 12 inches above the top of the wall footing protected by geotextile fabric at the soil / stone interface;
- Include a 6-inch diameter slotted PVC pipe installed within the crushed stone at least 6 inches above the bearing elevation of the wall footing;
- Underslab drainage should consist of the 12-inch thick layer of crushed stone that is interconnected to the exterior perimeter drains;
- The perimeter drain should be channeled to flow by gravity to a suitable discharge area that will not become flooded or to the Town storm drainage system.

Moisture

The Massachusetts State Building Code (MBC) requires that below ground walls be dampproofed unless subject to groundwater in which case the walls must be waterproofed. As a practical minimum, we recommend that all walls and slab on grade be treated with a suitable vapor retarder to reduce the possibility of migration of moisture into the building, which could contribute to development of mold. You should also be aware that subsurface drains around and below the structure will not prevent moisture. This issue must also be coordinated with other design team professionals who can provide measures to handle moisture that might invade building space.

In order to reduce potential percolation of surface water around the below ground area, all drainage must be directed away from the structure as required in the MBC.

Lateral Earth Pressure

The basement walls must be designed using the "at rest "soil pressure conditions since the walls are restrained from lateral movement. The walls should be designed to resist both the superimposed effect of the total static lateral earth pressure and the earthquake force as required by the MBC. The recommended lateral earth pressure is shown below. Since the walls will be drained, there is no additional pressure due to groundwater.

Total Soil Unit Weight	$\gamma = 125$ pcf
At Rest Lateral Earth Pressure Coefficient [1, 3] assuming horizontal backfill surface	$K_0 = 0.5$
At Rest Equivalent Fluid Pressure	$K_0\gamma = 62.5$ pcf/ft depth
Water pressure	None – walls drained

Surcharge Pressure

If vehicles will be parked adjacent to the basement walls then we recommend including a surcharge pressure in addition to the static and seismic forces. The recommended lateral surcharge pressure is a uniform load of 0.5q psf applied uniformly to the backfilled side of the below ground wall. We recommend using a vertical surcharge pressure (q) of 100 psf.

Seismic Considerations

The project site is located in a municipality that employs the 7th Edition of the Massachusetts State Building Code (MBC) and the design of structures must consider dynamic forces resulting from seismic events. These forces are dependent upon the magnitude of the earthquake event as well as the properties of the soils that underlie the site.

Part of the procedure to assign seismic forces requires the evaluation of the Seismic Site Class, which categorizes the site based upon the characteristics of the subsurface profile within the upper 100 feet of the ground surface. Shallow bedrock was encountered at all boring locations and the rock was generally classified as schist. Based on a review of the available data, knowledge of regional geology and Standard Penetration Test (SPT) N Values, we have assigned a Site Class C to the area as stated in Section 9.4.1.2.2(d) of the MBC. The recommended seismic values are presented in the table below.

Table 2: seismic Values

Parameter	Reference - MBC 7th Ed.	Value
Site Class	Section 9.4.1.2.2(d)	C
Mapped spectral accelerations for short periods (S_S)	Table 1604.10	0.3 g
Mapped spectral accelerations for a 1-second period (S_1)	Table 1604.10	0.073 g
Site coefficient F_a	Table 9.4.1.2.4a	1.2
Site coefficient F_V	Table 9.4.1.2.4b	1.7
Maximum considered earthquake spectral response for short periods (S_{MS}) adjusted for site class effects	Equation 9.4.1.2.4-1	0.360 g
Maximum considered earthquake spectral response for 1-second period (S_{M1}), adjusted for site class effects	Equation 9.4.1.2.4-2	0.124 g
Design Spectral Response acceleration at short periods (S_{DS})	Equation 9.4.1.2.5-1	0.240 g
Design Spectral Response acceleration at 1-second periods (S_{D1})	Equation 9.4.1.2.5-2	0.083 g

Notes:

1. g is the acceleration of gravity

The site is not susceptible to liquefaction.

Earthwork

In the preceding sections we have outlined several recommendations for earthwork. Below, we provide additional recommendations, which should be incorporated into the structural design and Contract Documents.

1. Concrete, utilities and other features must be removed from within the proposed addition footprint. The resulting excavations to remove utilities or structures must be backfilled with compacted Structural Fill where they might extend below the basement grade.

2. All footing and slab subgrades in soil should be proofrolled using equipment such as a dynamic vibratory compactor weighing at least 200 pounds and imparting a minimum of 4 kips of force to the subgrade.

3. All loose rock should be removed before placing the crushed stone foundation preparation.

4. We expect that the on site soil (fill with organics or natural silty sand) cannot be reused as backfill within the building footprint, below pavements, and below sidewalks. If borrow material is required, then the borrow material should meet the requirements for the specific material as outlined below. Backfill adjacent to the below ground walls

should be freely draining.

5. All excavations shall be stabilized by cutting back the side slopes or using shoring and bracing as required by 29 CFR 1926 Subpart P, Excavations. Plans and specifications should make reference to this requirement so that Contractors are aware of their responsibility.

6. We do not anticipate that the groundwater will be encountered during construction. However, if wet conditions become apparent, we expect that the excavations can be dewatered by pumping from the bottom of the excavations especially through the crushed stone drainage layer.

Material

The on-site soil may be suitable for re-use as Ordinary Fill provided that it can be compacted to the required degree.

We recommend that the following material gradations and names be used be used for consistency on the drawings and in the earthwork specifications for borrow material imported on to the site. All material must be well graded between the limits shown herein and be capable of being compacted to the required degree of density. The material shall have sufficient fines so that it does not shove and remains stable. We also recommend that the specifications not allow the use of recycled material such as reprocessed building demolition material.

We recommend submitting bulk samples of fill for testing to determine if the material is suitable for reuse as backfill within the building footprint. Soils with high fine contents (higher than about 20 percent) are generally very sensitive to moisture content variations and are susceptible to frost. Such soils are very difficult to compact at moisture contents higher than the optimum moisture content as determined from the laboratory compaction test and require strict moisture control during stockpiling, placement, and compaction.

Structural Fill

- Borrow fill placed within the footprint of the proposed building below the base course layer or as backfill adjacent to the walls should consist of inert, hard, durable sand and gravel, free from organic matter, clay, surface coatings and deleterious materials, and should conform to the following gradation requirements:

Sieve Size	Percent Finer
3-inches	100
½-inches	50 - 100
No. 4	30 - 85
No. 10	20 - 75
No. 60	5 - 35
No. 200	0-10

- All fill placed within and below the structure must be compacted to at least 95 percent of the maximum dry density determined in accordance with ASTM D1557. Lifts must be controlled so that they do not exceed 6-inches in confined areas and 12-inches in open areas where larger compactors can be utilized. Use hand-operated equipment within 10-ft behind retaining walls and do not over-compact the backfill material.

- A PSI geotechnical engineer or their representative should observe the placement and compaction of any Structural Fill and should test the density of the Structural Fill to check that proper compaction is achieved.

Common Borrow

Fill placed outside the building footprint in landscaped or non-load bearing areas should consist of friable natural sand and gravel containing no gravel greater than 2/3 loose lift thickness and free of trash, snow, ice, organics, roots, tree stumps and no more than 35 percent passing the No. 200 sieve. Common borrow can be used as general backfill provided it can be compacted and stabilized for the intended purpose.

Common borrow should be compacted in maximum 8-inch loose lifts to at least 92 percent of the Modified Proctor maximum dry density (ASTM D1557), with moisture contents within ±2 percentage points of optimum moisture content.

Gravel Base

Gravel base placed below the concrete slab should meet the requirements for Dense Graded Crushed Stone, Massachusetts Standard Specifications for Highway and Bridges, Section M2.01.7 derived from a stone quarry and is hard, durable and free of deleterious materials, clay, loam or other plastic material. The gradation shall conform to MHD Specification Designation, M2.01.7, and the following:

U.S. Sieve No.	Percent Finer by Weight
2"	100
1-1/2"	70-100
3/4"	50-85
No. 4	30-55
No. 50	8-24
No. 200	3-10

The material should be compacted in maximum 12-inch loose lifts to at least 95 percent of the Modified Proctor maximum dry density (ASTM 1557), with moisture contents within ±2 percentage points of optimum moisture content.

Crushed Stone

Crushed stone for use below footings and slab or where otherwise required shall consist of inert angular material derived from a stone quarry that is hard, durable, washed stone, free of deleterious materials. Gradation shall conform to MHD Specification Designation, M2.01.4, and the following:

U.S. Sieve No.	Percent Finer by Weight
1"	100
3/4"	90-100
1/2"	10-50
3/8"	0-20
No. 4	0-5

Additional Services

We recommend that we be allowed the opportunity to review the plans and specifications for geotechnical issues prior to completing the Contract Documents. The purpose of this is to verify that the intent of our recommendations have been correctly interpreted and included.

We recommend that PSI be engaged to observe subsurface conditions at the bottom of the foundations prior to casting the footings. The purpose of this is to verify that the expected conditions are present and to provide recommendations should actual conditions differ. We also recommend that PSI be engaged to provide services to assess the degree of compaction attained when placing structural fill to support the building.

Limitations

This report is delivered subject to the following limitations:

- The recommendations presented herein reflect our opinions and are based upon engineering studies conducted using the available subsurface information as stated herein along with our understanding of the building configuration and grades. If other information becomes available or if conditions change we must be notified. The recommendations will be reviewed in context with the new information and we reserve the right to modify our recommendations as necessary.

- The studies and recommendations summarized herein are based upon generally accepted geotechnical engineering practices. No other warranty, expressed or implied is made. These recommendations apply specifically to this project since they are based on site specific conditions. Hence, they are not transferable.

- This report has been prepared solely for design purposes and shall not be incorporated by reference or other means into the Contract Documents. If this report is included in the Project Manual, it shall be for information only. Earthwork specification clauses shall take precedence.

- PSI did not provide any services to investigate or detect the presence of moisture, mold or other biological contaminates in or around any structure, or any service that was designed or intended to prevent or lower the risk of the occurrence or the amplification of the same. Client acknowledges that mold is ubiquitous to the environment with mold amplification occurring when building materials are impacted by moisture. Client further acknowledges that site conditions are outside of PSI's control, and that mold amplification will likely occur, or continue to occur, in the presence of moisture. As such, PSI cannot and shall not be held responsible for the occurrence or recurrence of mold amplification.

- PSI did not provide any services to investigate or detect the presence of contamination in the subsurface environment.

If you have any questions regarding this report, please do not hesitate to call.

Very truly yours,

PROFESSIONAL SERVICE INDUSTRIES, INC.

For/ Abner M Reis, E.I.T, MSc.
Project Engineer

Richard P. Weber, P.E.
Principal Consultant and Manager

COMMONWEALTH OF MASSACHUSETTS
RICHARD PAUL WEBER
No. 29804
REGISTERED PROFESSIONAL ENGINEER

Attachments:
Soil Test Boring Logs

BORING LOG

(Page 1 of 1) Boring No. B-1

Project:	Proposed Town Hall Addition, 55 Main Street, Westford, Massachusetts
Client:	Kang Associates — PSI Project No. 444-95008

Drilling Subcontractor:	New Hampshire Boring	Date Started:	3/11/09
Drilling Foreman:	Sam Cooley	Date Completed:	3/11/09
PSI Engineer:	Abner Reis	Location:	Near the northern corner of prop. addition.
Ground Surface Elev.	~390	Total Depth:	7 ft.
Ground Water Depth:	N.E.	Drill Rig Type:	Truck Rig
		Drilling Method:	2 1/4" - HSA
Hammer Weight:	140 lbs.	Split Spoon Diameter:	ID- 1.375", OD- 2"
Hammer Type:	Safety	Rock Core Barrel Size:	N/A
Drop:	30"		

Depth (ft)	SAMPLE No.	SAMPLE Depth (ft)	SAMPLE Pen./Rec. (in)	SAMPLE * Blows Per Six Inches/ RQD (%)	DESCRIPTION OF SAMPLES (Classification)	Remarks	Soil Strata	N VALUE (bpf) ▲	PID (ppm)
		0.0			S1 Top 8": Topsoil		Topsoil		
	S1		24/10	4-5-4-4	Bottom 2": Fine to medium SAND, trace coarse SAND, some Silt, little Gravel, light brown, moist.		Silty Sand	9	
2.0		2.0			S2 Similar to bottom of S1, except wet.				
	S2		24/14	4-8-10-20				18	
4.0		4.0				1			
		5.0							
	S3	5.8	9/6	50-50/3"	S3 Weathered ROCK.		Weathered Rock	50	
6.0									
					Bottom of boring at 7 feet. Backfilled with cuttings.	2			
8.0									
10.0									
12.0									
14.0									
16.0									
18.0									
20.0									
22.0									

N VALUE scale: 20 40 60 80

Remarks:
1 Advanced HSA through weathered rock from approximately 4' to 7' below ground surface.
2 HSA refusal.

*Number of blows required for a 140 lb hammer dropping 30" to drive 2" O.D., 1.375" I.D. sampler a total of 24 inches in four 6" increments. The sum of the middle two increments of penetration is termed the standard penetration resistance, N. RQD = Rock Quality Designation. WOH = Weight of Hammer. WOR = Weight of drilling Rods.

BORING LOG

(Page 1 of 1) Boring No. **B-2**

Project:	Proposed Town Hall Addition, 55 Main Street, Westford, Massachusetts		
Client:	Kang Associates	PSI Project No.:	444-95008
Drilling Subcontractor:	New Hampshire Boring	Date Started:	3/11/09
Drilling Foreman:	Sam Cooley	Date Completed:	3/11/09
PSI Engineer:	Abner Reis	Location:	Near the eastern corner of prop. addition.
Ground Surface Elev:	~390	Total Depth:	9.2 ft.
Ground Water Depth:	N.E.	Drill Rig Type:	Truck Rig
		Drilling Method:	2 1/4" - HSA
Hammer Weight:	140 lbs.	Split Spoon Diameter:	ID- 1.375", OD- 2"
Hammer Type:	Safety	Rock Core Barrel Size:	N/A
Drop:	30"		

Depth (ft)	SAMPLE No.	SAMPLE Depth (ft)	SAMPLE Pen./ Rec. (in)	SAMPLE * Blows Per Six Inches/ RQD (%)	DESCRIPTION OF SAMPLES (Classification)	Remarks	Soil Strata	N VALUE (bpf) ▲ (20 40 60 80)	PID (ppm)
		0.0			S1 Top 6": Topsoil		Topsoil		
	S1		24/11	5-4-4-10	Bottom 5": Fine to coarse SAND, some organic Silt, little Gravel, dark brown, moist.		Fill	8	
2.0		2.0				1			
4.0							Silty Sand		
		5.0				2			
	S2	5.8	9/7	12-70/3"	S2 Weathered ROCK.		Weathered Rock	70	
6.0									
8.0									
	S3	9.0 9.3	3/0	100/3"		3		100/3" 100	
10.0					S3 No Recovery Bottom of boring at 7 feet. Backfilled with cuttings.				
12.0									
14.0									
16.0									
18.0									
20.0									
22.0									

Remarks:
1. Assumed strata change based on drilling action. Layer of silty sand identified based on soil cuttings.
2. Advanced HSA through weathered rock from approximately 5' to 9' below ground surface.
3. HSA refusal.

*Number of blows required for a 140 lb hammer dropping 30" to drive 2" O.D., 1.375" I.D. sampler a total of 24 inches in four 6" increments. The sum of the middle two increments of penetration is termed the standard penetration resistance, N. RQD = Rock Quality Designation. WOH = Weight of Hammer WOR = Weight of drilling Rods.

BORING LOG

 Boring No. B-3

Project:	Proposed Town Hall Addition, 55 Main Street, Westford, Massachusetts
Client:	Kang Associates — PSI Project No: 444-95008

Drilling Subcontractor:	New Hampshire Boring	Date Started:	3/11/09
Drilling Foreman:	Sam Cooley	Date Completed:	3/11/09
PSI Engineer:	Abner Reis	Location:	Near the southwestern side of prop. addition.
Ground Surface Elev.:	~390	Total Depth:	10 ft.
Ground Water Depth:	N.E.	Drill Rig Type:	Truck Rig
		Drilling Method:	3-Inch Casing
Hammer Weight:	140 lbs.	Split Spoon Diameter:	ID- 1.375", OD- 2"
Hammer Type:	Safety	Rock Core Barrel Size:	N/A
Drop:	30"		

Depth (ft)	SAMPLE No.	SAMPLE Depth (ft)	Pen./Rec. (in)	* Blows Per Six Inches/ RQD (%)	DESCRIPTION OF SAMPLES (Classification)	Remarks	Soil Strata	N VALUE (bpf) ▲ (20 40 60 80)	PID (ppm)
0.0–2.0	S1	0.0	24/14	6-8-7-8	S1 Fine to coarse Sand, some organic Silt, little gravel, dark brown, moist.		Fill	15	
2.0–3.8	S2	2.0	21/19	6-7-8-50/3"	S2 Top 12": Fine to coarse SAND, little gravel, light brown, moist.		Fill	14	
					Bottom 7": Fine SAND and SILT, light brown, moist.	1	Sand and Silt		
3.8–5.0		3.8				2			
5.0–10.0	C1	5.0	60/60	RQD = 66 %	C1 Top 18": Reddish gray, soft, fine-grained, highly weathered, SCHIST with closely spaced fractures.	3	Weathered Rock		
					Bottom 42": Reddish gray, hard, fine-grained, slightly weathered, SCHIST with few fractures.		Rock		
10.0		10.0			Bottom of boring at 10 feet. Backfilled with cuttings.				

Remarks:
1 Strata change at approximately 3'.
2 Strata change at approximately 4'.
3 Cored rock from 5' to 10.

*Number of blows required for a 140 lb hammer dropping 30" to drive 2" O.D., 1.375" I.D. sampler a total of 24 inches in four 6" increments. The sum of the middle two increments of penetration is termed the standard penetration resistance, N. RQD = Rock Quality Designation. WOH = Weight of Hammer. WOR = Weight of drilling Rods.