Environmental Safety Health Geotechnical

O'Reilly, Talbot & Okun
[A S S O C I A T E S]
ENGINEERING

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J1753-02-01
March 20, 2009

Town of Greenfield
Department of Planning and Development
Town Hall - 14 Court Street
Greenfield, Massachusetts 01301
Attention: Mr. Eric Twarog

Re: Preliminary Geotechnical Engineering Recommendations
Proposed Parking Garage
Olive Street, Greenfield, Massachusetts

Dear Mr. Twarog:

In accordance with our proposal dated December 9, 2008, O'Reilly, Talbot & Okun Associates, Inc. (OTO) submits the results of our geotechnical investigations and provides preliminary recommendations for the proposed Olive Street parking garage in Greenfield, Massachusetts. This report is subject to the attached limitations.

BACKGROUND INFORMATION

This report provides the results of our preliminary geotechnical engineering study for the proposed parking garage to be located on Olive Street in Greenfield, Massachusetts. The work was performed under contract with the Town of Greenfield. This report is subject to the attached limitations.

Project Information

Preliminary design consists of a 40,000 square foot (footprint) precast concrete parking garage. We understand that two conceptual plans are being considered at this time. They consist of the following:

- A two level, rectangular structure consisting of one level of parking at grade and one level of parking above.
- A three level, rectangular structure consisting of one level of parking at grade, a second level of parking above, and a third level of retail and/or business offices.

The actual layout and design elevation are unknown at this time. For purposes of preliminary design, we have made the following assumptions. These assumptions may change during the final design stages.

We have assumed that the bottom level of the parking garage will be located approximately level with existing grade at 11 Olive Street (HAPCO building), or near 215 feet, and that the

second level will be located approximately level with existing grade just north of 39 Bank Row, near 225 feet. We have assumed that the lower levels of the structure will be unheated and mostly open, with the exception of a concrete retaining wall along the northern side of the structure.

We have assumed that the structural frame will consist of precast concrete columns with interior shear walls, vehicle ramp, and precast concrete decks. Exterior columns and selected interior columns will bear on isolated column footings. The interior walls associated with ramps and shear resisting elements will bear on continuous strip footings. For preliminary design, we have assumed that the column loads on exterior and interior columns will be up to approximately 1,200 kips, dead plus live loads. Loadings on continuous strip footings will be on the order of 10 to 15 kips per linear foot.

Site Description

The Site is located at the corner of Bank Row and Olive Street. A Site Locus is provided as Figure 1. A Site Plan is provided as Figure 2.

The northern and eastern portions of the Site are presently used as a paved surface parking lot. Buildings are located in the western and southern portions of the Site. The ground surface within the Site limits slopes generally downward from the north to the southeast, between elevations of 229 feet at the northwest corner and 205 feet at the southeast corner.

SUBSURFACE INVESTIGATIONS

Subsurface investigations performed for this study consisted of six borings (OSP-1 though OSP-6). Soil boring locations are shown on Figure 2. The borings were performed on February 18, 19 and 23, 2009 by Seaboard Drilling, Inc. of Chicopee, Massachusetts. These borings were observed by an OTO engineer, who collected and classified samples and developed the boring logs. The boring logs are attached.

The borings were drilled using a truck mounted, Mobile B-53 drill rig equipped with 2-1/4 inch inside diameter hollow stem augers. The borings were performed to a depth of between 32 and 58 feet below ground surface.

In general, soil samples were collected at the ground surface and every five feet thereafter, using the Standard Penetration Test (SPT). The SPT is performed by driving a 2-inch outside diameter split-spoon sampler 24 inches into the soil using a 140 pound hammer free falling 30 inches (American Society for Testing and Materials Test Method D1586-99 "Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils"). The number of blows required to advance the split-spoon each 6-inch interval is recorded. The total blows required to drive the sampler the middle 12 inches of the 24-inch drive is the standard penetration resistance or N value. After drilling, each borehole was backfilled with soil cuttings or imported Ottawa sand. The depth to the groundwater table was measured in the field during drilling and presented on the boring logs.

Field strength testing was performed on selected samples using a torvane (E-285 Pocket Vane Shear Tester) and/or pocket penetrometer devices. The pocket penetrometer provides a measure of the unconfined compressive strength of fine grained silt and clay by failing the clay under normal conditions by "punching". The torvane device provides an estimate of the undrained shear strength of a fine grained soil by failing the silt and/or clay in a rotational "shearing" mode. Theoretically, the unconfined compressive strength is twice the undrained shear strength. A total of 29 torvane and 25 pocket penetrometer tests were completed in the field. These field measurements are intended to provide a rough measure of the unconfined compressive strength of the fine grained soils encountered. Pocket vane shear and pocket penetrometer test results are presented in the boring logs.

Selected soil samples were submitted to the University of Massachusetts Soil and Plant Nutrient Testing Lab of Amherst, Massachusetts for laboratory analyses to evaluate soil moisture content of the varved clay soils that underlie the Site. The laboratory data sheet is attached.

SUBSURFACE CONDITIONS

The general subsurface profile for the Site consists of a surface layer of bituminous pavement and gravel base, underlain by an imported fill, followed by natural deposits of varved fine grained soils upon glacial till. Each of these units is described in detail below.

Geologic cross sections showing the lateral and vertical distribution of each of these soil layers are provided on Figures 3 and 4. Figure 3 provides a west to east section along the northern edge of the site. Figures 4 provides a north to south section along the eastern edge of the Site.

Surface Layer

In general, the surface layer consists of bituminous pavement. Where present, pavement is underlain by approximately 8 to 20 inches of imported sand and crushed gravel, which serves a base course for the pavement. This layer appears to be dense to very dense. Boring OSP-5 was performed within a grassy area located near the center of the site. At this location, a thin layer of silty topsoil was encountered at the ground surface.

Fill

Granular fill was encountered immediately below the surface layer in each boring. It consists of a brown and light brown, loose to dense, fine to coarse sand, with varying amounts of silt and gravel and little to trace amounts of debris (brick, metal, glass, plastic, concrete, coal ash, and wood). The density of the fill unit is highly variable, varying between being loose to very dense. The fill layer ranged in thickness from 2 feet, in boring OSP-6, to between 8 and 15 feet thick, in borings OSP-1 through OSP-5. The distribution of fill materials is summarized in Table 1.

Table 1
Boring Information

Boring	Approximate Ground Surface Elevation	Depth to Bottom of Fill (Approximate Elevation)	Depth to Glacial Till (Approximate Elevation)	Depth to Groundwater (Approximate Elevation)
	Feet (Feet MSL)			
OSP-1	225	8 (217)	54 (171)	10 (215)
OSP-2	221	10 (211)	>32 (<189)	10 (211)
OSP-3	218	12 (206)	50 (168)	20 (198)
OSP-4	217	10 (207)	34 (183)	10 (207)
OSP-5	217	15 (202)	>32 (<185)	10 (207)
OSP-6	216	2 (214)	>42 (<174)	10 (206)

Silty Fine to Medium Sand: This subsurface unit was observed directly below the surface fill layer in the northeastern part of the Site (OSP-2, OSP-3, and OSP-6). It consists of a loose to medium dense, fine sand and silt. Trace organics were observed within this layer in borings OSP-2 and OSP-3. This unit was between 5 and 12 feet thick and extended to a depth between 15 and 20 feet below ground surface.

Varved Silt and Clay: The entire Site is underlain by the varved silt and clay unit. This unit is the significant geotechnical issue at the Site, since it is potentially compressible under building loads. This deposit consists of fine grained, post-glacial lake deposits that were deposited within ancestral Lake Hitchcock (which filled much of the Connecticut River Valley from the retreat of the last continental glacier until approximately 15,000 years ago). These fine grained soils are characterized by alternating layers (or varves) of silt and clay. They are typically soft and compressible under larger building or fill loads. Published geologic maps indicate that, in the Site vicinity, the silty clay deposit is between 0 and 50 feet thick. A copy of this map showing the Site vicinity is attached as Figure 5. As can be seen on the published map, the Site lies near the eastern shore of the former Lake Hitchcock.

Unconfined compressive strength within the clay stratum was estimated in the field using torvane and/or pocket penetrometer devices. These field measurements are intended to provide a rough measure of the unconfined compressive strength of the fine-grained soils at the Site. Across the northern portion of the Site (OSP-1 through OSP-3), vane shear measurements of shear strength in the varved silt and clay ranged from 260 pounds per square foot (psf) to 560 psf, and pocket penetrometer measurements of compressive strength ranged from 2000 to 4500 psf. Across the western portion of the Site (OSP-4 through OSP-6), vane shear measurements of shear strength of the varved clay soils ranged from 100 psf to 460 psf, and pocket penetrometer measurements of compressive strength ranged from 1000 psf to 3000 psf. These measurements indicate that the average compressive strength of the clay is less where the clay unit is thickest (in the northern portion of the Site).

Eight samples were submitted for moisture content analysis. The moisture content (mass of water/mass of solids) ranged from 38 to 55 percent. The moisture contents were compared to published correlations between moisture content and consolidation properties of varved silt and clays[1]. The moisture content data are provided in Table 2.

Table 2
Moisture Content Measurements

Sample Location	Depth (feet)	Moisture Content (Percent)
OSP-1	15-17	46.6
	30-32	49.3
OSP-2	15-17	42.8
	20-22	46.4
	30-32	54.6
OSP-3	20-22	38.1
	30-32	46.4
	40-42	47.5

Glacial Till: Glacial till was encountered in three of the project borings. The glacial till was present directly below the varved clay unit at a depth of between 34 and 54 feet (corresponding to elevations between 171 and 183 feet). Glacial till consists of a very dense, heterogeneous mixture of sand, silt, clay and gravel. These soils were laid down at the base of the continental glaciers, which once covered all of New England. We anticipate that the glacial till unit would be no more than 10 feet thick and would directly overlay bedrock. Refusal was encountered in boring OSP-1 at a depth of 55 feet below ground surface on what appeared to be bedrock.

Groundwater

Based upon observations made during the soil borings, it appears that groundwater is present at between 10 and 20 feet below ground surface (between approximately elevation 198 and 215 feet). Since the planned parking structure will have a bottom level elevation near 215 feet, it is likely that groundwater will be encountered during construction and will be encountered during the service life of the structure. Once final design elevations are determined, groundwater control recommendations can be provided. However, given regional surface topography, it should be possible to drain subsurface groundwater via gravity.

[1]"Foundation Design of Embankments Constructed on Connecticut River Valley Varved Clays", Ladd, Massachusetts Institute of Technology.

GEOTECHNICAL ISSUES

The primary geotechnical issue at this Site is the presence of between two and eight feet of "urban fill," underlain by up to 40 feet of a soft and compressible varved silt and clay. These materials are unsuitable for supporting the structure, due to settlement concerns.

PRELIMINARY DESIGN RECOMMENDATIONS

The following preliminary design recommendations are provided for the proposed parking garage construction. These recommendations are provided for conceptual and preliminary design purposes. As is discussed below, an additional phase of subsurface explorations and testing will be required once the location of the proposed building is finalized and design parameters have been better established.

Engineering Implications of Subsurface Conditions

Two subsurface conditions identified in the soil borings will affect the selection of the type of foundation selected for the proposed structure.

The debris ("urban") fill identified in each of the borings is unsuitable for supporting the structure on normal spread footings or a structural mat foundation. Normally, this material would be removed from beneath the proposed building and the resulting excavation backfilled with sand and gravel. The fill is highly variable in density and compression of this material under the building loads could vary significantly between columns.

In addition, the varved silt and clay unit is of concern at the Site, since it is compressible under the building loads, which would likely occur under the anticipated construction. Because of the resulting settlement issue, it does not appear feasible to support the building on normal spread footings.

Foundations

Based upon these considerations, we do not recommend that the structure be supported on conventional spread footings without soil improvement. The following two foundation alternatives are available:

- Supporting the structure on a deep foundation system, such as a driven steel piles or drilled concrete shafts; or
- Transmitting the structural loads to the underlying natural soils and stiffening the near surface fill and varved silt and clay layers using rammed aggregate piers (geopiers).

Option 1: Deep Foundation Alternative

A deep foundation would transmit structural loads to a relatively incompressible soil layer at depth below the Site. Based upon the above information, we recommend that the proposed structure be founded on deep foundations (piles), deriving their load carrying capacity from end bearing in the glacial till layer or on bedrock. A variety of deep foundation types are possible for use at the Site: steel pipe or steel H piles; precast concrete piles; and drilled concrete piers. Based upon the anticipated depth to the glacial till bearing layer (approximately 95 feet below ground surface), we expect that driven precast concrete piles, steel pipe or steel H piles will be the most cost effective solution.

We recommend that piles be designed for a capacity of 50 tons or less to avoid the premium cost associated with a static load test (discussed below). Load testing is required in Section 1808.2.8 of the Massachusetts State Building Code (MSBC) for piles with capacities greater than 50 tons. In selecting pile type and design capacity, the cost of this load test should be considered. Given the anticipated structural loads, it appears unlikely that pile loads greater than 50 tons will be required to support the parking garage/commercial building. For a 50 ton pile, we recommend that the piles be driven at least five feet into the glacial till layer (approximate depth of 50 feet). Full time observation should be provided by the geotechnical engineer to monitor installation and to verify the location of the glacial till layer at each pile location.

Pile caps for the driven piles should be based on a minimum pile spacing of 2.5 pile diameters. We recommend that the structural engineer select the pile locations.

Steel piles are installed by a number of contractors throughout New England. A wide variety of structural steel sections are commonly used to carry structural loads to the bearing layer. The selection of a specific type of steel pile will depend on transportation, installation and upon pricing considerations. The selection should be left to the discretion of the structural engineer and contractor.

The MSBC contains requirements regarding the interconnection of pile caps. It is required in section 1808.3.4 that pile caps be tied together to carry 10 percent of the product of the larger pile cap load times the seismic coefficient, S_{DS}, unless it can be demonstrated that equal restraint can be provided by other means. Such other means can include the lateral earth pressure on the sides of pile caps and the lateral resistance of individual piles. For this construction project, cost savings may be realized by using the lateral resistance of individual piles to omit grade beams. Recommendations regarding the lateral resistance of driven piles can be provided during final design.

Option 2: Rammed Aggregate Pier Alternative

Rammed aggregate piers, or geopiers, are a proprietary foundation technique that uses drilled and compacted stone columns to stiffen the soil mass and/or transmit loads vertically to

suitable soil mass. Structures founded on stone columns can be in turn supported on normal spread footings. This reduces the complexity, cost and time required to construct the overlying structure.

Rammed aggregate piers are vertical columns of aggregate that are placed and mechanically tamped in thin lifts within an augered drill hole. A significant advantage of rammed aggregate piers is that they allow the structure to be founded on normal spread footing foundations. In New England, these piers are installed by Helical Drilling of Braintree, Massachusetts (781-848-2110). The installation process introduces lateral stresses into the surrounding soil mass to stiffen and reinforce the surrounding soil matrix. Rammed aggregate piers are typically designed by the contractor's engineer, who determines the number, size, depth and location of piers for a given project. Geopiers are typically installed in a relatively tight spacing beneath structural elements such as footings, shear walls and load bearing slabs. For this project, we anticipate that geopiers would be installed beneath footings and shear walls. Bearing capacity of footings supported on piers is generally near 5000 psf.

We recommend that the bottom of exterior footings be embedded a minimum of 48 inches below the lowest adjacent exterior grade for frost protection. The bottom of interior footings should be embedded a minimum of 24 inches below the slab. Footings shall be at least 24 inches wide for continuous footings and at least 30 inches wide for isolated footings. All other applicable requirements of the Massachusetts State Building Code (MSBC) should be followed.

Footings should not be placed on frozen soils. Footing excavations should be free of loose or disturbed materials. Footing excavations should be proof compacted by at least three passes with a hand operated vibrating plate compactor, prior to concrete placement.

SEISMIC CONSIDERATIONS

Earthquake loadings must be considered under requirements in Section 1615 and 1804 of the 7th Edition (September 2008) Massachusetts State Building Code (MSBC). Note that Section 1615.0 includes Sections with a prefix of "9," which refer to the applicable section of ASCE 7.

Section 1615 covers lateral forces imposed on structures from earthquake shaking. Per Table 1604.10, the maximum considered earthquake spectral response acceleration at short periods (S_s) and at 1-sec (S_1) were determined to be 0.23 and 0.069, respectively for Greenfield, Massachusetts. In addition, the Site Class was conservatively determined to be Class E in accordance with Section 9.4.1.2.1 and based upon a weighted average N value of less than 15 blows/foot and the varved clay having the following characteristics: Plasticity Index (PI) greater than 20; moisture content greater than 40 percent; and undrained shear strength of less than 500 psf. However, additional laboratory testing of the varved clay soils may indicate that the Site soils may be improved to Site Class D. Therefore, we recommend that additional soil testing be performed during final design to further define the

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characteristics of the varved clay soil. In addition, if the rammed aggregate pier alternative is chosen, an improved Site Class can be determined based upon the final design.

Furthermore, the Site coefficients F_a and F_v were determined according to Tables 9.4.1.2.4a and 9.4.1.2.4b, using both the S_s and S_v values and Site Class E. For preliminary design, F_a and F_v were determined to be 2.5 and 3.5, respectively.

Section 1804.6 relates to the liquefaction potential of the underlying soils. The liquefaction potential was evaluated for the Site soils encountered below the water table. The saturated soils at the Site would not be considered liquefiable based upon their fine grained nature.

If the final design contains below grade wells, the walls should be designed to resist dynamic lateral earth forces, in accordance with Section 9.5.2.9 of the MSBC. The seismic earth forces should be applied as an inverted triangle over the height of the wall and added to the static lateral pressures. The seismic pressures should be modeled as an inverted triangle with a maximum value of 11xH at the top of the wall (where H is the vertical height of the wall).

ADDITIONAL INVESTIGATIONS AND FINAL DESIGN

As was stated above, additional investigations, engineering design and further foundation support recommendations will be required once the final building configuration is known and additional design parameters are set.

Additional investigations at the Site should include the drilling of borings in locations not accessible at the time of this report. The borings should be performed to define the thickness of the varved silt and clay layer. Specifically, borings should be performed within the footprints of the existing buildings to the extent feasible (possibly after demolition), in the southwest corner of the Site, and where significant foundations walls will be placed. We estimate approximately three additional days of drilling at the site. However, this estimate may change based upon foundation alternative and the required information needed for design.

Furthermore, we recommend the collection and analysis of soil samples from the varved clay unit to determine the engineering properties of these soils. We recommend the collection of one to two undisturbed Shelby Tube samples to be submitted for consolidation testing and the collection of grab samples for Atterburg limits and moisture content testing. The results of these tests, along with the moisture content samples collected during this study, will allow the estimation of expected settlement.

Based upon the supplemental investigations and final design parameters, additional engineering design and geotechnical recommendations can be provided. These will include foundation requirements for the selected alternative, retaining wall considerations, groundwater control recommendations, shoring requirements, foundation recommendations and earthwork considerations.

If you have any questions, please do not hesitate to contact the undersigned.

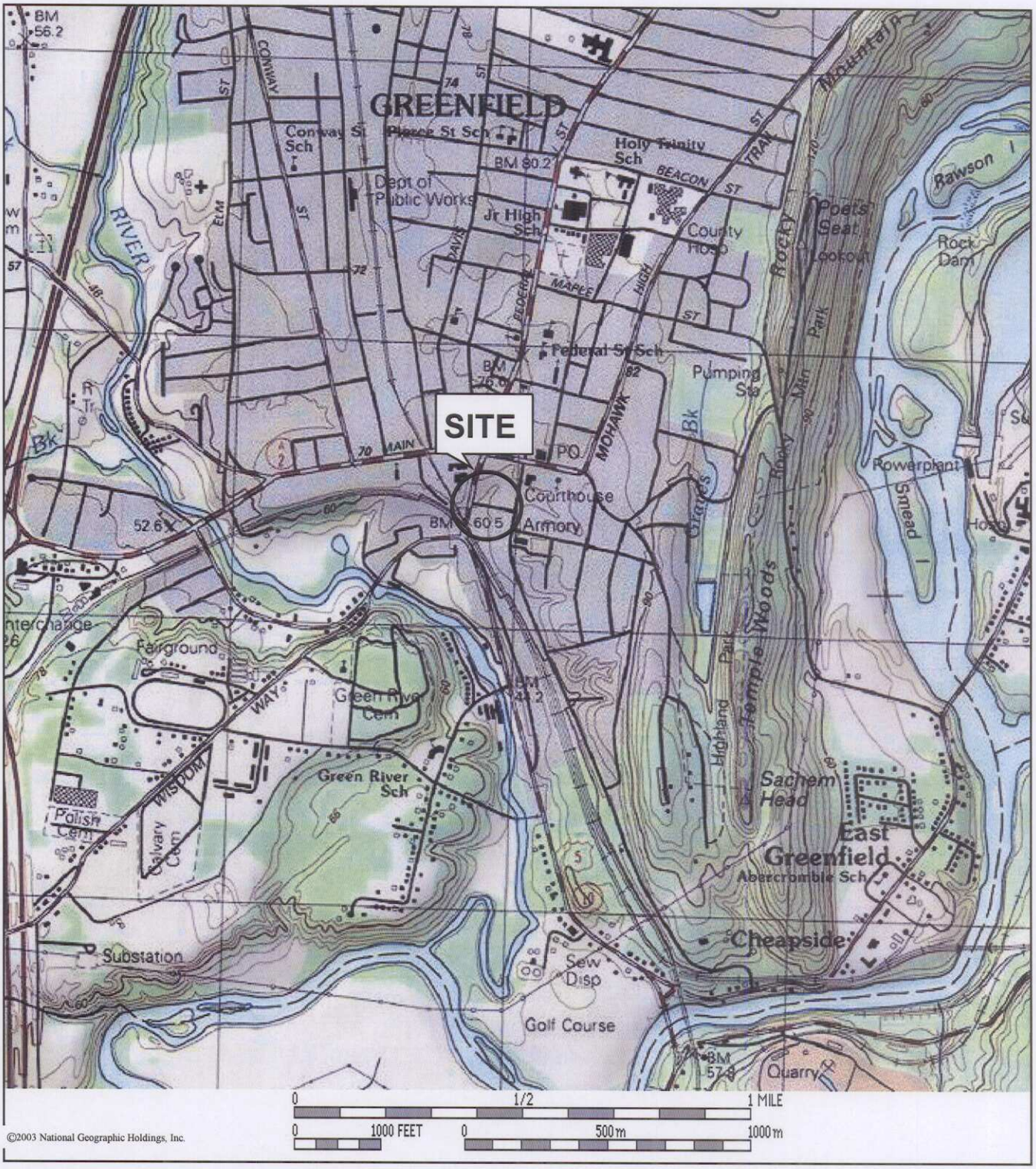
Sincerely,
O'Reilly, Talbot & Okun Associates, Inc.

Ashley Mickiewicz
Project Manager

Michael J. Talbot, P. E.
Principal

Attachments: Figures, Limitations, Boring Logs, Laboratory Data Sheet

F:\J1700\1753 Greenfield Planning\02 Olive Street Parking Site\Geotechnical Report.doc



O'Reilly, Talbot & Okun

[A S S O C I A T E S]

ENGINEERING

39 & 45 Bank Row Street
Greenfield, Massachusetts

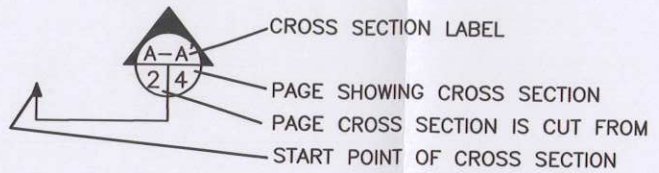
SITE LOCUS

March, 2009 Figure 1

LEGEND:

- PROPOSED GARAGE PROPERTY BOUNDARY
- TOWN AND/OR BUSINESS PROPERTY BOUNDARIES
- OTO SOIL BORING LOCATION

CROSS SECTIONAL CUT:



NOTES:

1. THIS PLAN WAS DEVELOPED BY REFERRING TO FIELD OBSERVATIONS AND TO TAPED MEASUREMENTS.
2. ALL DATA IS TO BE CONSIDERED ACCURATE ONLY TO THE DEGREE IMPLIED BY THE METHOD(S) USED.

DESIGNED BY: ALM
CHECKED BY: MJT
DRAWN BY: ARS
DATE: MARCH 11, 2009

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SCALE IN FEET
1"=30'
0' 15' 30' 60'

OLIVE STREET PARKING
GREENFIELD, MASSACHUSETTS

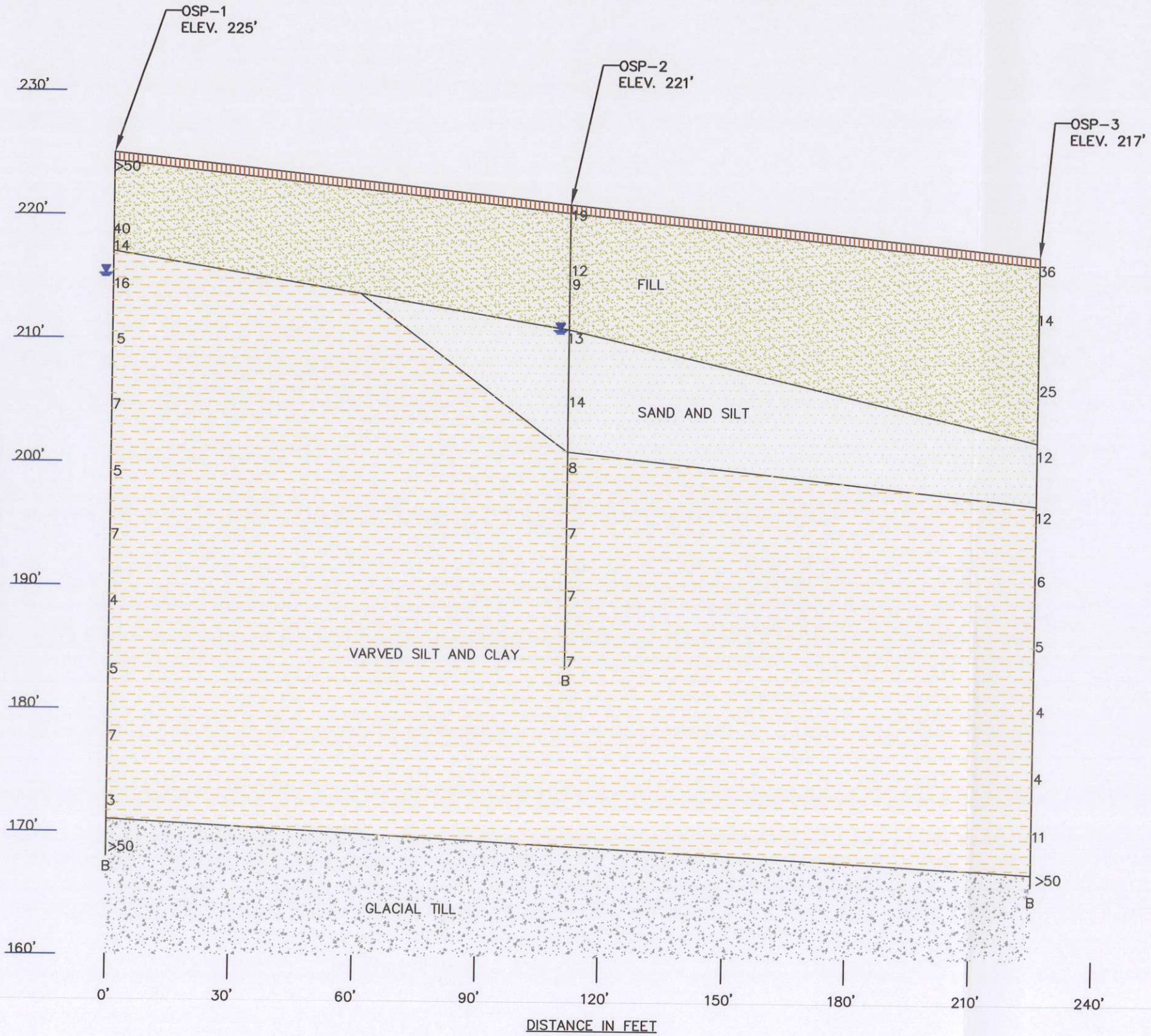
CROSS SECTIONAL CUTS

PROJECT No.
J1753-02-01

FIGURE No.
2

F:\J1700\1753 Greenfield Planning\02 Olive Street Parking Site\CAD FILES\1753-02-01_OLIVE STREET PARKING_SITE PLAN.dwg

SECTION: A–A' (2|3)



VERTICAL SCALE:
1"=10'
0' 5' 10' 20'

HORIZONTAL SCALE:
1"=30'
0' 15' 30' 60'

LEGEND:

B-13
204.3' <- BORING LOCATION AND NUMBER WITH GROUND SURFACE ELEVATION (FEET).

6 <- STANDARD PENETRATION RESISTANCE BLOW COUNT (BLOWS PER FOOT).

23

41 <- INDICATES GROUNDWATER LEVEL.

14

B <- BOTTOM OF BORING.

CROSS SECTIONAL CUT:

– TOPSOIL OR ASPHALT:	THREE TO FOUR INCHES ASPHALT PAVEMENT OR SIX TO EIGHT INCHES SILTY TOPSOIL.
– FILL:	BROWN AND LIGHT BROWN, LOOSE TO DENSE SAND WITH VARYING AMOUNTS OF SILT AND GRAVEL WITH TRACE AMOUNTS FO DEBRIS.
– SILT AND SAND:	LOOSE TO MEDIUM DESNS, BROWN OR GRAY, FINE SAND AND SILT
– VARVED SILT AND CLAY	SOFT TO STIFF, GRAY VARVED SILT, SAND, AND CLAY.
– GLACIAL TILL:	MEDIUM DENSE TO HARD, REDDISH BROWN SILT, WITH WOME FINE TO COARSE SAND WITH GRAVEL AND TRACE CLAY.

1. STRATIFICATION LINES ARE APPROXIMATE AND BASED UPON DATA OBTAINED IN WIDELY SPACED BORINGS, AND THUS REPRESENT APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES. ACTUAL TRANSITIONS MAY VARY FROM THOSE SHOWN.

2. WATER LEVER READINGS WERE MADE IN THE DRILL HOLES AT THE TIMES AND UNDER CONDITIONS STATED IN THE LOGS. INTERPRETATIONS OF THE INFORMATION HAVE BEEN MADE IN THE TEXT OF THIS REPORT. FLUCTUATIONS IN THESE WATER LEVELS MAY OCCUR DUE TO VARIATIONS IN PRECIPITATION, RUN OFF, AND OTHER FACTORS.

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SCALE NOTED

OLIVE STREET PARKING
GREENFIELD, MASSACHUSETTS

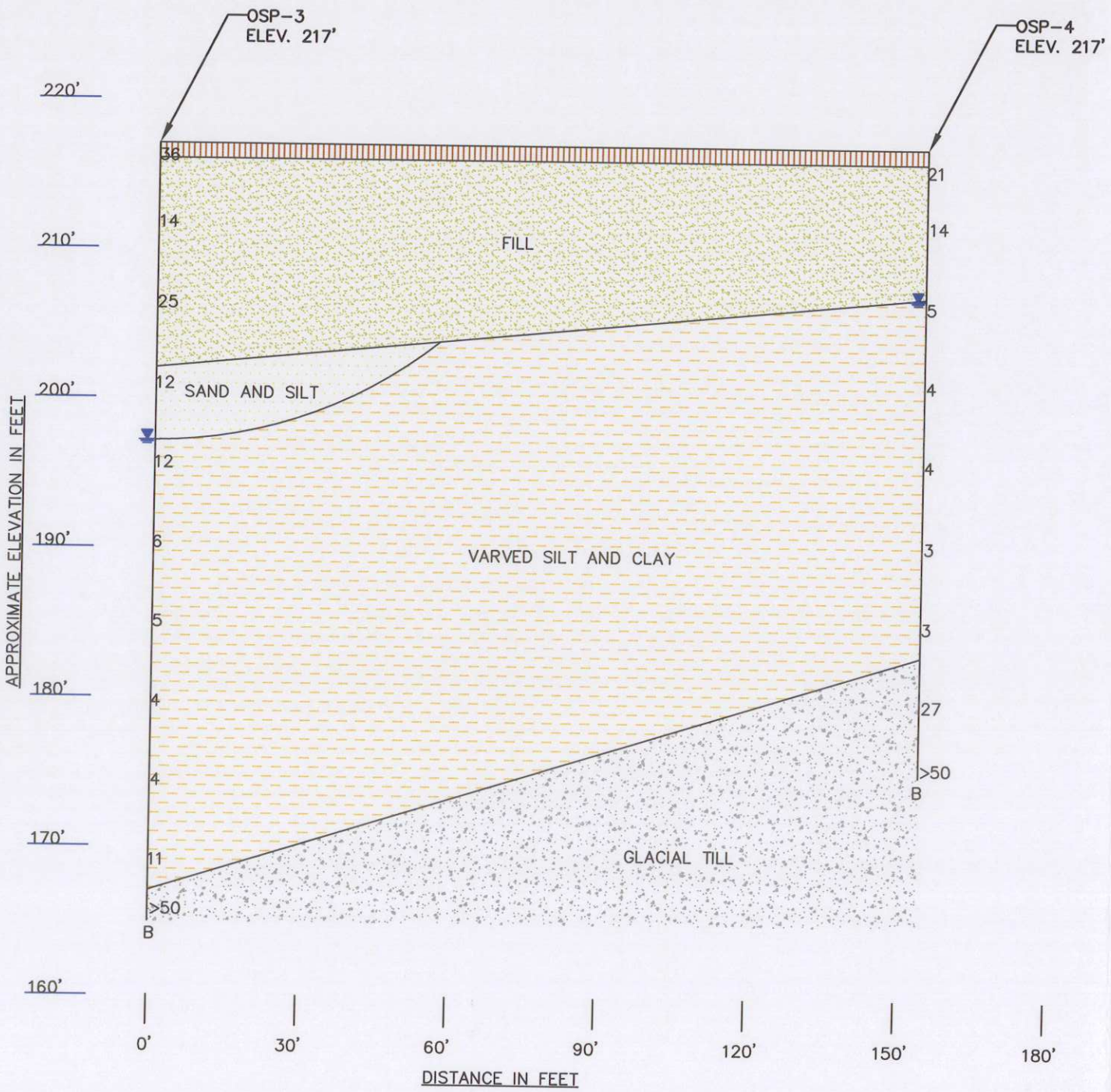
CROSS SECTION PLAN

PROJECT No.
J1753-02-01

FIGURE No.
3

F:\J1700\1753 Greenfield Planning\02 Olive Street Parking Site\CAD FILES\1753-02-01_CROSS SECTIONS.dwg

SECTION: B–B' (2 | 4)



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LEGEND:

B–13
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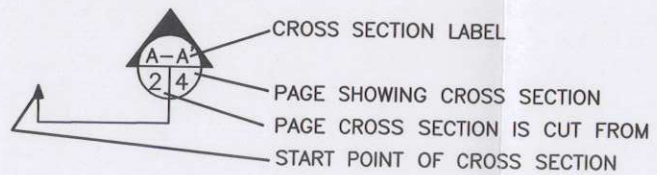
41 <– INDICATES GROUNDWATER LEVEL.

14

B <– BOTTOM OF BORING.

CROSS SECTIONAL CUT:



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SCALE NOTED

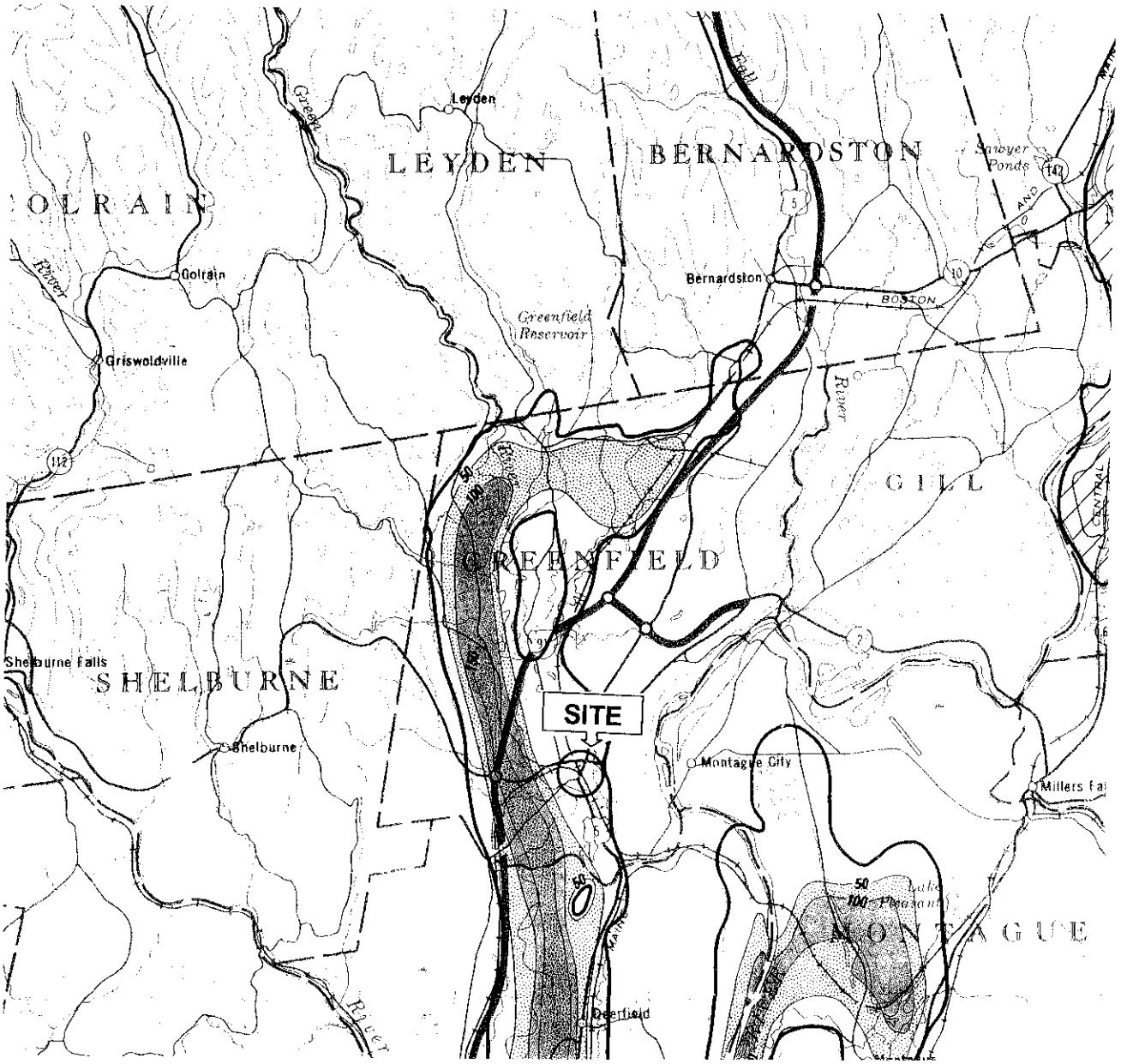
OLIVE STREET PARKING
GREENFIELD, MASSACHUSETTS

CROSS SECTION PLAN

PROJECT No.
J1753–02–01

FIGURE No.
4

BASED ON MAP SHOWING DISTRIBUTION AND THICKNESS OF THE PRINCIPAL FINE-GRAINED DEPOSITS, CONNECTICUT VALLEY URBAN AREA, CENTRAL NEW ENGLAND
By William H. Langer - 1979



O'Reilly, Talbot & Okun Associates, Inc.	**Thickness of Fine Grained Soils**
Bank Row and Olive Street Greenfield, Massachusetts	March 2009 — Figure 5

LIMITATIONS

1. The observations presented in this report were made under the conditions described herein. The conclusions presented in this report were based solely upon the services described in the report and not on scientific tasks or procedures beyond the scope of the project or the time and budgetary constraints imposed by the client. The work described in this report was carried out in accordance with the Statement of Terms and Conditions attached to our proposal.

2. The analysis and recommendations submitted in this report are based in part upon the data obtained from widely spaced subsurface explorations. The nature and extent of variations between these explorations may not become evident until construction. If variations then appear evident, it may be necessary to reevaluate the recommendations of this report.

3. 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 interpretations of widely spaced explorations and samples; actual soil transitions are probably more erratic. For specific information, refer to the boring logs.

4. In the event that any changes in the nature, design or location of the proposed structures are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and conclusions of this report modified or verified in writing by O'Reilly, Talbot & Okun Associates Inc. It is recommended that we be retained to provide a general review of final plans and specifications.

5. Our report was prepared for the exclusive benefit of our client. Reliance upon the report and its conclusions is not made to third parties or future property owners.

O'REILLY, TALBOT & OKUN ASSOCIATES, INC.

ENVIRONMENTAL AND GEOTECHNICAL ENGINEERING CONSULTANTS

LOG OF BORING OSP-1

PROJECT : Olive Street Parking Site		LOCATION: Greenfield, MA	PROJECT NO. : 1753-02-01
DRILLING CONTRACTOR Seabord Environmental Drilling	FOREMAN Rob HELPER John	DATE STARTED 02/18/2009	DATE FINISHED 02/18/2009
DRILLING EQUIPMENT B-53 Truck Mounted Rig		COMPLETION DEPTH 58'	GROUND SURFACE ELEV. DATUM: 225 (approximately), NGVD29
TYPE BIT Hollow Stem Auger	SIZE &TYPE OF CORE BARREL	No. Samples 13	UNDIST.
CASING		TIME	FIRST / COMPL. / HR.
CASING HAMM. WEIGHT	DROP	WATER LEVEL (FT.)	10'
SAMPLER: 2" O.D. Split Spoon	Rod A 1 5/8" O.D.	BORING LOCATION	Western portion of parking lot
SAMPLER HAMMER Safety	WEIGHT 140 lbs. / DROP 30" (Wire Line)	ENGINEER/GEOLOGIST	Brin Thompson

SAMPLES	DEPTH FT.	SAMPLES: PENETR. RESIST. BL/6 IN.	SAMPLES: REC. IN.	SAMPLES: TYPE/ NO.	DESCRIPTION	FIELD MEASUREMENTS 1, 2	SOIL DESCRIPTION	REMARKS
X		28/ 50 for 3"	6/24	S-1 (1'-3')	4": ASPHALT 8": Brown, fine to medium SAND and GRAVEL, frozen Very dense, brown, medium to coarse SAND, some sub-angular gravel, dry	--	ASPHALT FILL	
	5	17/21/19/18	NR	S-2 (5'-7')	No Recovery	--		
X		5/8/6/7	21/24	S-3 (7'-9')	Top 5": Medium dense, brown-gray, medium SAND and sub-angular GRAVEL, trace concrete, dry Bottom 16": Medium dense, gray, fine SAND and SILT, little clay, moist	--	8' VARVED SILT CLAY & SAND	
	10							
X		11/7/9/10	16/24	S-4 (10'-12')	Medium dense, gray, fine SAND and SILT, little clay, wet	0.17(vs)		
	15							
X		3/3/2/3	14/24	S-5 (15'-17')	Loose, gray, fine SAND and SILT, little clay, wet	0.14(vs)		
	20							
X		3/2/5/3	18/24	S-6 (20'-22')	Loose, gray, fine SAND and SILT, little clay, wet	0.11, 1 (vs)(pp)		
	25							
X		4/3/2/2	20/24	S-7 (25'-27')	Medium, gray, fine SAND and SILT, some clay, wet	0.23 (vs)		

Remarks:

1. Undrained sheer strength estimated in field using E285 Picket Vane Shear (vs). Values in tons/ft2
2. Unconfined compressive strength estimated in field using pocket penetrometer (pp). Values in tons/ft^2

LOG OF BORING OSP-1

Project No. 1753-02-01

SAMPLES	DEPTH FT.	SAMPLES: PENETR. RESIST. BL/6IN.	SAMPLES: REC. IN.	SAMPLES: TYPE/ NO.	DESCRIPTION	FIELD MEASUREMENTS	SOIL DESCRIPTION	REMARKS
							VARVED SILT CLAY & SAND	
X	30	4/3/3/4	22/24	S-8 (30'-32')	Medium, gray, CLAY, trace fine sand and silt, wet	0.13(vs)		
X	35	2/2/2/3	24/24	S-9 (35'-37')	Medium, gray, CLAY, trace fine sand and silt, wet	0.047, 1.5 (vs)(pp)		
X	40	2/2/3/4	24/24	S-10 (40'-42')	Medium, gray, CLAY, little fine sand and silt, wet	0.11(vs)		
X	45	2/3/4/3	24/24	S-11 (45'-47')	Stiff, gray, CLAY, little fine sand and silt, wet	0.14, 1 (vs)(pp)		
X	50	1/1/2/3	24/24	S-12 (50'-52')	Stiff, gray, CLAY, some fine sand and silt, wet	0.14,1.25 (vs)(pp)	54'	
X	55			S-13 (55'-57')	No Recovery	--	TILL 55' BEDROCK	1.
	60				End of exploration at 58'			

Remarks:

1. Change in material at 54', sample from 55'-57' had fill material from wash. Refusal most likely bedrock.

O'REILLY, TALBOT & OKUN ASSOCIATES, INC.

ENVIRONMENTAL AND GEOTECHNICAL ENGINEERING CONSULTANTS

LOG OF BORING OSP-2

PROJECT : Olive Street Parking Site		LOCATION: Greenfield, MA	PROJECT NO. : 1753-02-01
DRILLING CONTRACTOR Seabord Environmental Drilling	FOREMAN Rob HELPER John	DATE STARTED 02/18/2009	DATE FINISHED 02/18/2009
DRILLING EQUIPMENT B-53 Truck Mounted Rig		COMPLETION DEPTH 32'	GROUND SURFACE ELEV. DATUM: 221 (approximately), NGVD29
TYPE BIT Hollow Stem Auger	SIZE &TYPE OF CORE BARREL	No. Samples 9	UNDIST.
CASING		TIME	FIRST / COMPL. / HR.
CASING HAMM. WEIGHT	DROP	WATER LEVEL (FT.)	10'
SAMPLER: 2" O.D. Split Spoon	Rod A 1 5/8" O.D.	BORING LOCATION	Northwest portion of parking lot, center of drive
SAMPLER HAMMER Safety	WEIGHT 140 lbs. / DROP 30" (Wire Line)	ENGINEER/GEOLOGIST	Brin Thompson

SAMPLES	DEPTH FT.	SAMPLES: PENETR. RESIST. BL/6 IN.	SAMPLES: REC. IN.	SAMPLES: TYPE/ NO.	DESCRIPTION	FIELD MEASUREMENTS 1,2	SOIL DESCRIPTION	REMARKS
					4": ASPHALT 8": Brown, medium to coarse SAND and GRAVEL		ASPHALT FILL	
X		16/9/10/9	16/24	S-1 (1'-3')	Medium dense, brown, fine to medium SAND, some silt, trace sub-angular gravel, dry	--		
	5							
X		16/7/5/5	1/24	S-2 (5'-7')	Medium dense, dark brown, medium to coarse SAND, little sub-angular gravel, trace(-) brick, trace(-) metal, trace(-) glass, moist	--		
X		4/5/4/6	10/24	S-3 (7'-9')	Top 6": Loose, dark brown, medium to coarse SAND, some coal ash, little metal, moist Bottom 4": Loose, brown, fine SAND and SILT, moist	--		
	10						10'	
X		7/5/8/9	5/24	S-4 (10'-12')	Medium dense, brown, fine SAND and SILT, trace debris (brick, ash, ceramic), wet	--	SAND & SILT	
	15							
X		7/7/7/10	2/24	S-5 (15'-17')	Medium dense, brown, fine SAND and SILT, some clay, wet	--		
X		2/3/5/7	NR	S-6 (17'-19')	No Recovery	--		
	20						20'	
X		3/3/4/5	18/24	S-7 (20'-22')	Medium, gray, CLAY, trace fine sand, trace silt, wet	0.13, 1.25 (vs)(pp)	VARVED CLAY	1.
	25							
X		3/3/4/4	8/24	S-8 (25'-27')	Medium, gray, CLAY, trace fine sand, trace silt, wet	0.016, 0.5 (vs)(pp)		

Remarks:

1. Undrained sheer strength estimated in field using E285 Picket Vane Shear (vs). Values in tons/ft2
2. Unconfined compressive strength estimated in field using pocket penetrometer (pp). Values in tons/ft^2
3. Varves are 1/8" to 1/4" thick.

LOG OF BORING OSP-2

Project No. 1753-02-01

SAMPLES	DEPTH FT.	SAMPLES: PENETR. RESIST. BL/6IN.	SAMPLES: REC. IN.	SAMPLES: TYPE/ NO.	DESCRIPTION	FIELD MEASUREMENTS	SOIL DESCRIPTION	REMARKS
							VARVED CLAY	
X	30	3/4/3/5	20/24	S-9 (30'-32')	Medium, gray, CLAY, trace fine sand, trace silt, wet	0.047, 1 (vs)(pp)	↓	
					End of exploration at 32'			
	35							
	40							
	45							
	50							
	55							
	60							

Remarks:

O'REILLY, TALBOT & OKUN ASSOCIATES, INC.

ENVIRONMENTAL AND GEOTECHNICAL ENGINEERING CONSULTANTS

LOG OF BORING OSP-3

PROJECT : Olive Street Parking Site		LOCATION: Greenfield, MA	PROJECT NO. : 1753-02-01
DRILLING CONTRACTOR Seabord Environmental Drilling	FOREMAN Rob HELPER John	DATE STARTED 02/19/2009	DATE FINISHED 02/19/2009
DRILLING EQUIPMENT B-53 Truck Mounted Rig		COMPLETION DEPTH 52'	GROUND SURFACE ELEV. DATUM: 218 (approximately), NGVD29
TYPE BIT Hollow Stem Auger	SIZE &TYPE OF CORE BARREL	No. Samples 11	UNDIST.
CASING		TIME	FIRST 20' / COMPL. / HR.
CASING HAMM. WEIGHT	DROP	WATER LEVEL (FT.)	
SAMPLER: 2" O.D. Split Spoon	Rod A 1 5/8" O.D.	BORING LOCATION Northwest corner of site	
SAMPLER HAMMER Safety	WEIGHT 140 lbs. / DROP 30" (Wire Line)	ENGINEER/GEOLOGIST Brin Thompson	

SAMPLES	DEPTH FT.	SAMPLES: PENETR. RESIST. BL/6 IN.	SAMPLES: REC. IN.	SAMPLES: TYPE/ NO.	DESCRIPTION	FIELD MEASUREMENTS 1,2	SOIL DESCRIPTION	REMARKS
					Top 4": ASPHALT		ASPHALT	
					Bottom 20": Brown, fine to medium SAND, some fine gravel, little coarse sand	--	FILL	3.
X		49/16/20/23	15/24	S-1 (2'-4')	Top 8": Dense, brown, fine to medium SAND, some silt, trace coarse sand, trace coarse gravel, dry	--		
					Bottom 7": Dense, black, fine to medium sand, some silt, trace debris (brick, coal ash, metal), dry			
	5							
X		6/6/8/10	19/24	S-2 (5'-7')	Top 12": Medium dense, brown, fine to medium SAND, some silt, little debris (brick, coal ash, metal, plastic) dry	--		
					Bottom 7": Medium dense, brown, fine SAND and SILT, moist			
	10							
X		3/6/19/9	18/24	S-3 (10'-12')	Top 17": Medium dense, brown-gray, fine SAND and SILT, little debris (coal ash, glass), trace clay, moist	--		
					Bottom 7": Medium dense, brown, fine SAND and SILT, moist			
	15						15'	
X		6/5/7/14	16/24	S-4 (15'-17')	Medium dense, gray, fine SAND and SILT, trace organics, moist	--	SAND & SILT	
	20							
X		3/5/7/8	20/24	S-5 (20'-22')	Top 5": Medium dense, gray, fine SAND and SILT, little medium sand, moist	0.19, 1 (vs)(pp)	21'	
					Bottom 15": Very stiff, gray, CLAY, little fine sand and silt, wet		VARVED CLAY	
	25							
X		3/2/4/4	23/24	S-6 (25'-27')	Medium, gray, CLAY, little fine sand and silt, wet	0.13, 1 (vs)(pp)		

Remarks:

1. Undrained sheer strength estimated in field using E285 Picket Vane Shear (vs). Values in tons/ft2
2. Unconfined compressive strength estimated in field using pocket penetrometer (pp). Values in tons/ft^2
3. Augered through frost layer 0-2'.

LOG OF BORING OSP-3

Project No. 1753-02-01

SAMPLES	DEPTH FT.	SAMPLES: PENETR. RESIST. BL/6IN.	SAMPLES: REC. IN.	SAMPLES: TYPE/ NO.	DESCRIPTION	FIELD MEASUREMENTS	SOIL DESCRIPTION	REMARKS
							VARVED CLAY	
	30	3/2/3/3	20/24	S-7 (30'-32')	Medium, gray, CLAY, little fine sand and silt, wet	0.16, 1 (vs)(pp)		
	35	3/2/2/3	24/24	S-8 (35'-37')	Soft, gray, CLAY, little fine sand and silt, wet	0.16, 1.5 (vs)(pp)		
	40	2/2/2/3	24/24	S-9 (40'-42')	Soft, gray, CLAY, trace fine sand and silt, wet	0.094, 1.5 (vs)(pp)		
	45	3/4/7/11	24/24	S-10 (45'-47')	Stiff, gray, CLAY, trace fine sand and silt, wet	0.14, 1.25 (vs)(pp)		3.
	50	30/ 50 for 4"	7/24	S-11 (50'-52')	Very dense, gray-red, coarse SAND and GRAVEL, little red rock, wet	--	50' TILL	
					End of exploration at 52'			
	55							
	60							

Remarks:

2. Varves are 1/4" to 1/2" thick.
3. Change in material at 48' below ground surface.

O'REILLY, TALBOT & OKUN ASSOCIATES, INC.

ENVIRONMENTAL AND GEOTECHNICAL ENGINEERING CONSULTANTS

LOG OF BORING OSP-4

PROJECT : Olive Street Parking Site		LOCATION: Greenfield, MA	PROJECT NO. : 1753-02-01
DRILLING CONTRACTOR Seabord Environmental Drilling	FOREMAN Rob HELPER John	DATE STARTED 02/19/2009	DATE FINISHED 02/19/2009
DRILLING EQUIPMENT B-53 Truck Mounted Rig		COMPLETION DEPTH 42'	GROUND SURFACE ELEV. DATUM: 217 (approximately), NGVD29
TYPE BIT Hollow Stem Auger	SIZE &TYPE OF CORE BARREL	No. Samples 9	UNDIST.
CASING		TIME	FIRST / COMPL. / HR.
CASING HAMM. WEIGHT	DROP	WATER LEVEL (FT.)	10'
SAMPLER: 2" O.D. Split Spoon	Rod A 1 5/8" O.D.	BORING LOCATION	Southeast corner of site
SAMPLER HAMMER Safety	WEIGHT 140 lbs. / DROP 30" (Wire Line)	ENGINEER/GEOLOGIST	Brin Thompson

SAMPLES	DEPTH FT.	SAMPLES: PENETR. RESIST. BL/6 IN.	SAMPLES: REC. IN.	SAMPLES: TYPE/ NO.	DESCRIPTION	FIELD MEASUREMENTS 1,2	SOIL DESCRIPTION	REMARKS
					4": ASPHALT		ASPHALT	
					20": Brown, fine to medium SAND, some fine gravel, little silt, dry	--	FILL	3.
X		9/6/6/5	3/24	S-1 (2'-4')	Medium dense, brown, fine to medium SAND, little coal ash, little silt, dry	--		
	5							
X		5/7/7/7	20/24	S-2 (5'-7')	Top 4": Medium dense, brown, fine to medium SAND, some silt, dry Bottom 16": Medium dense, brown-gray, fine SAND and SILT, trace clay, moist	--		
	10						10'	
X		2/2/3/4	23/24	S-3 (10'-12')	Medium, brown-gray, fine SAND and SILT, some clay, wet	0.27, 2.25 (vs)(pp)	VARVED SAND SILT & CLAY	
	15							
X		3/1/3/2	24/24	S-4 (15'-17')	Soft, gray, fine SAND and SILT, some clay, wet	0.22, 1.5 (vs)(pp)		4.
	20							
X		2/2/2/3	24/24	S-5 (20'-22')	Soft, gray, fine SAND and SILT, some clay, wet	0.23, 2.0 (vs)(pp)		
	25							
X		2/1/2/3	24/24	S-6 (25'-27')	Top 14": Soft, gray, fine SAND and SILT, some clay, wet Bottom 10": Soft, gray, CLAY, little fine sand, and silt, wet	0.13, 1.0 (vs)(pp)	26' VARVED CLAY	

Remarks:

1. Undrained sheer strength estimated in field using E285 Picket Vane Shear (vs). Values in tons/ft2
2. Unconfined compressive strength estimated in field using pocket penetrometer (pp). Values in tons/ft^2
3. Augered to 2' below ground surface due to frost layer.
4. Varves between 1/8" and 1/4" thick.

LOG OF BORING OSP-4

Project No. 1753-02-01

SAMPLES	DEPTH FT.	SAMPLES: PENETR. RESIST. BL/6IN.	SAMPLES: REC. IN.	SAMPLES: TYPE/ NO.	DESCRIPTION	FIELD MEASUREMENTS	SOIL DESCRIPTION	REMARKS
							VARVED CLAY	
X	30	2/1/2/3	24/24	S-7 (30'-32')	Soft, gray, CLAY, little fine sand and silt, wet	0.16, 1.5 (vs)(pp)		3.
							34' TILL	
X	35	24/15/12/11	6/24	S-8 (35'-37')	Medium dense, brown-red, coarse SAND and fine GRAVEL, wet	--		
X	40	9/13/ 50 for 3"	10/24	S-9 (40'-42')	Very dense, brown-red, coarse SAND and fine GRAVEL, trace fine to medium sand, trace coarse gravel, wet	--		
					End of exploration at 42'			
	45							
	50							
	55							
	60							

Remarks:

O'REILLY, TALBOT & OKUN ASSOCIATES, INC.

ENVIRONMENTAL AND GEOTECHNICAL ENGINEERING CONSULTANTS

LOG OF BORING OSP-5

PROJECT : Olive Street Parking Site		LOCATION: Greenfield, MA	PROJECT NO. : 1753-02-01
DRILLING CONTRACTOR Seabord Environmental Drilling	FOREMAN Rob HELPER John	DATE STARTED 02/23/2009	DATE FINISHED 02/23/2009
DRILLING EQUIPMENT B-53 Truck Mounted Rig		COMPLETION DEPTH 32'	GROUND SURFACE ELEV. DATUM: 218 (approximately), NGVD29
TYPE BIT Hollow Stem Auger	SIZE &TYPE OF CORE BARREL	No. Samples 7	UNDIST.
CASING		TIME	FIRST / COMPL. / HR.
CASING HAMM. WEIGHT	DROP	WATER LEVEL (FT.)	10'
SAMPLER: 2" O.D. Split Spoon	Rod A 1 5/8" O.D.	BORING LOCATION	North of building on grass area
SAMPLER HAMMER Safety	WEIGHT 140 lbs. / DROP 30" (Wire Line)	ENGINEER/GEOLOGIST	Brin Thompson

SAMPLES	DEPTH FT.	SAMPLES: PENETR. RESIST. BL/6 IN.	SAMPLES: REC. IN.	SAMPLES: TYPE/ NO.	DESCRIPTION	FIELD MEASUREMENTS 1,2	SOIL DESCRIPTION	REMARKS
							FILL	
X		7/13/8/5	12/24	S-1 (2'-4')	Medium dense, brown, fine to medium SAND, little silt, trace debris (concrete, coal ash), dry	--		
	5							
X		7/5/18/20	13/24	S-2 (5'-7')	Top 6": Medium dense, brown, fine to medium SAND, some silt, trace debris (glass, brick) Bottom 7": Medium dense, brown-gray, fine to medium SAND and SILT, trace wood, moist	--		
	10							
X		5/7/6/6	5/24	S-3 (10'-12')	Medium dense, brown-gray, fine to medium SAND, some silt, trace(-) wood, trace(-) coal ash, wet	--		
	15						15'	
X		1/3/3/3	18/24	S-4 (15'-17')	Top 10": Medium, gray, silty CLAY, some fine sand, wet Bottom 8": Medium, gray, fine sand and silt, wet	--	VARVED SAND SILT & CLAY	
	20							
X		4/8/7/8	16/24	S-5 (20'-22')	Medium dense, gray, fine to medium SAND, some silt, little clay, trace organics, trace fine sub-rounded gravel, wet	--		3.
	25						25'	
X		5/4/3/4	21/24	S-6 (25'-27')	Medium gray, CLAY, little silt, wet	0.19, 1.5 (vs)(pp)	VARVED CLAY	

Remarks:

1. Undrained sheer strength estimated in field using E285 Picket Vane Shear (vs). Values in tons/ft2
2. Unconfined compressive strength estimated in field using pocket penetrometer (pp). Values in tons/ft^2
3. Varves approximately 1/4" to 1/2" thick.

LOG OF BORING OSP-5

Project No. 1753-02-01

SAMPLES	DEPTH FT.	SAMPLES: PENETR. RESIST. BL/6IN.	SAMPLES: REC. IN.	SAMPLES: TYPE/ NO.	DESCRIPTION	FIELD MEASUREMENTS	SOIL DESCRIPTION	REMARKS
	30	3/3/5/4	24/24	S-7 (30'-32')	Stiff, gray, CLAY, little silt, wet	0.22, 2.25 (vs)(pp)	VARVED CLAY ↓	2.
					End of exploration at 32'			
	35							
	40							
	45							
	50							
	55							
	60							

Remarks:
2. Varves approximately 1/2" thick.

O'REILLY, TALBOT & OKUN ASSOCIATES, INC.

ENVIRONMENTAL AND GEOTECHNICAL ENGINEERING CONSULTANTS

LOG OF BORING OSP-6

PROJECT : Olive Street Parking Site		LOCATION: Greenfield, MA	PROJECT NO. : 1753-02-01
DRILLING CONTRACTOR Seabord Environmental Drilling	FOREMAN Rob HELPER John	DATE STARTED 02/23/2009	DATE FINISHED 02/23/2009
DRILLING EQUIPMENT B-53 Truck Mounted Rig		COMPLETION DEPTH 32'	GROUND SURFACE ELEV. DATUM: 216 (approximately), NGVD29
TYPE BIT Hollow Stem Auger	SIZE &TYPE OF CORE BARREL	No. Samples 9	UNDIST.
CASING		TIME	FIRST / COMPL. / HR.
CASING HAMM. WEIGHT	DROP	WATER LEVEL (FT.)	10'
SAMPLER: 2" O.D. Split Spoon	Rod A 1 5/8" O.D.	BORING LOCATION	Northeast corner at building, on pavement
SAMPLER HAMMER Safety	WEIGHT 140 lbs. / DROP 30" (Wire Line)	ENGINEER/GEOLOGIST	Brin Thompson

SAMPLES	DEPTH FT.	SAMPLES: PENETR. RESIST. BL/6 IN.	SAMPLES: REC. IN.	SAMPLES: TYPE/ NO.	DESCRIPTION	FIELD MEASUREMENTS 1,2	SOIL DESCRIPTION	REMARKS
					Top 4": ASPHALT Bottom 20": Brown, fine to medium SAND, some gravel	--	ASPHALT FILL	
X		11/11/18/10	4/24	S-1 (2'-4')	Medium dense, brown-gray, fine SAND and SILT, moist	--	2' SAND & SILT	
X	5	3/2/3/2	14/24	S-2 (5'-7')	Loose, brown-gray, fine SAND and SILT, moist	--		
X	10	1/3/5/10	19/24	S-3 (10'-12')	Loose, brown, fine SAND and SILT, wet	--		
X	15	2/3/4/5	24/24	S-4 (15'-17')	Loose, brown-gray, fine SAND and SILT, little clay, wet	--	15' VARVED SAND SILT & CLAY	
X	20	1/1/2/2	24/24	S-5 (20'-22')	Soft, gray, CLAY, some fine SAND and SILT, wet	0.17, 2.0 (vs)(pp)		3.
X	25	1/2/2/3	24/24	S-6 (25'-27')	Soft, gray, CLAY, some fine SAND and SILT, wet	0.22, 1.0 (vs)(pp)		

Remarks:

1. Undrained sheer strength estimated in field using E285 Picket Vane Shear (vs). Values in tons/ft2
2. Unconfined compressive strength estimated in field using pocket penetrometer (pp). Values in tons/ft^2
3. Varves approximately 1/8" to 1/4" thick.

LOG OF BORING OSP-6

Project No. 1753-02-01

SAMPLES	DEPTH FT.	SAMPLES: PENETR. RESIST. BL/6IN.	SAMPLES: REC. IN.	SAMPLES: TYPE/ NO.	DESCRIPTION	FIELD MEASUREMENTS	SOIL DESCRIPTION	REMARKS
							VARVED SAND SILT & CLAY	
X	30	2/2/3/3	24/24	S-7 (30'-32')	Medium, gray, clayey SILT, little fine sand, wet	0.28, 1.5 (vs)(pp)		
X	35	2/2/3/4	24/24	S-8 (35'-37')	Medium, gray, clayey SILT, some fine sand, wet	0.25, 1.0 (vs)(pp)		
X	40	3/4/5/6	24/24	S-9 (40'-42')	Stiff, gray, clayey SILT, some fine sand, wet	0.16, 1.0 (vs)(pp)		
					End of exploration at 42'			
	45							
	50							
	55							
	60							

Remarks:

J1753-02-01

UNIVERSITY OF
MASSACHUSETTS

UMass Extension

Agriculture & Landscape Program
Soil and Plant Nutrient Testing Lab
West Experiment Station
University of Massachusetts
Amherst, MA 01003
413.545.2311
413.545.1931 fax
http://www.umass.edu/plsoils/soiltest

February 23, 2009

O'Reilly, Talbot, & Okun
c/o Ashley Mickiewicz
293 Bridge Street
Springfield, MA 01030

RE: Soil Moisture Percentages

	$\frac{\text{Mass water}}{\text{Mass sample}}$	$\frac{\text{Mass water}}{\text{Mass solids}}$
OSP-1 (15-17) = 31.8%		46.6
OSP-1 (30-32) = 33.0%		49.3
OSP-2 (15-17) = 30.0%		42.8
OSP-2 (20-22) = 31.7%		46.4
OSP-2 (30-32) = 35.3%		54.6
OSP-3 (20-22) = 27.6%		38.1
OSP-3 (30-32) = 31.7%		46.4
OSP-3 (40-42) = 32.2%		47.5