LGCI
Lahlaf Geotechnical Consulting, Inc.

March 11, 2023

Ms. Nichole Coscia
Burlington Public Schools
123 Cambridge Street
Burlington, MA 01803
Phone: 781-270-1800

Re: **Preliminary Geotechnical Report**
Proposed Fox Hill Elementary School
Burlington, Massachusetts
LGCI Project No. 2307

Dear Ms. Coscia:

Lahlaf Geotechnical Consulting, Inc. (LGCI) has completed a preliminary geotechnical study for the proposed Fox Hill Elementary School in Burlington, Massachusetts. We are submitting our preliminary geotechnical report electronically.

The soil and rock samples from our explorations are currently stored at LGCI for further analysis, if requested. Unless notified otherwise, we will dispose of the soil and rock samples after three (3) months.

Thank you for choosing LGCI as your geotechnical engineer.

Very truly yours,

Lahlaf Geotechnical Consulting, Inc.

Abdelmadjid M. Lahlaf, Ph.D., P.E.
Principal Engineer

LGCI
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PRELIMINARY GEOTECHNICAL REPORT
PROPOSED FOX HILL ELEMENTARY SCHOOL
BURLINGTON, MASSACHUSETTS

LGCI Project No. 2307
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Prepared for:

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Prepared for:

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123 Cambridge Street
Burlington, MA 01803
Phone: 781-270-1800

Prepared by:

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TABLE OF CONTENTS

List of Tables and Figures

List of Appendices

1. PROJECT INFORMATION

1.1 Project Authorization

This preliminary geotechnical report presents the results of the preliminary subsurface explorations and a preliminary geotechnical evaluation performed by Lahlaf Geotechnical Consulting, Inc. (LGCI) for the proposed Fox Hill Elementary School in Burlington, Massachusetts. We performed our services in general accordance with our proposal No. 22155-Rev. 1 dated December 19, 2022, revised on February 2, 2023. Ms. Nichole Coscia of the Burlington Public Schools authorized our services by signing our proposal on February 7, 2023, and by issuing a purchase order (PO) No. 23001804-00 on February 8, 2023.

1.2 Purpose and Scope of Services

The purpose of our geotechnical services was to perform preliminary subsurface explorations at the site for the proposed Fox Hill Elementary School, and to provide preliminary foundation design and construction recommendations. LGCI performed the following services:

- Coordinated our exploration locations with Dore and Whittier, the owner project manager (OPM) for this project.
- Marked the exploration locations at the site and notified Dig Safe Systems Inc. (Dig Safe) and the Town of Burlington for utility clearance.
- Engaged a drilling subcontractor for two (2) days to advance seven (7) soil borings at the site.
- Engaged an excavation subcontractor for one (1) day to excavate six (6) test pits at the site.
- Provided an LGCI geotechnical engineer at the site to coordinate and observe the borings and test pits, describe the soil samples and rock cores, and prepare field logs.
- Submitted two (2) soil samples from the borings and test pits for laboratory testing.
- Prepared this preliminary geotechnical report containing the results of our preliminary subsurface explorations and our preliminary recommendations for foundation design and construction.

Our scope does not include preparing specifications, reviewing contract documents, attending meetings, or providing construction services. LGCI would be pleased to perform these services when needed. Recommendations for unsupported slopes, stormwater management, erosion control, pavement design, slope stability analyses, liquefaction and/or site-specific seismic analysis, pile analysis and design, and cost or quantity estimates are not included in our scope of work.

LGCI's scope of services does not include an environmental assessment for the presence or absence of wetlands or analytical testing for hazardous or toxic materials in the soil, surface water, groundwater, or air, on or below or around this site, or mold in the soil or in any structure at the site. Any statements regarding odors, colors, or unusual or suspicious items or conditions are strictly for the information of the client.

1.3 Site Description

Our understanding of the site is based on our field observations, our discussions with Dore and Whittier, readily available aerial photographs of the site, and on the following documents:

- Drawing 1 titled: "Site Plan, Elementary School No. 5, Burlington, Massachusetts," (1965 Site Plan) prepared by J. Williams Beal, Sons, Granger & Postus, dated September 17, 1965, and provided to LGCI by Dore and Whittier via email on February 10, 2023.

- Drawing 3 titled: "Building Layout, Elementary School No. 5, Burlington, Massachusetts," (1965 Building Layout) prepared by J. Williams Beal, Sons, Granger & Postus, dated September 17, 1965, and provided to LGCI by Dore and Whittier via e-mail on February 10, 2023.

- Drawing 12 titled: "Elevations, Elementary School No. 5, Burlington, Massachusetts," (1965 Building Elevations) prepared by J. Williams Beal, Sons, Granger & Postus, dated September 17, 1965, and provided to LGCI by Dore and Whittier via e-mail on February 10, 2023.

The site is part of the existing Fox Hill Elementary School located on Fox Hill Road near the intersection with Westwood Street in Burlington, Massachusetts as shown in Figure 1. The site is bordered by wooded land on the northern, eastern, and southern sides, and by Fox Hill Road on the western side. The site is currently occupied by the existing Fox Hill Elementary School building and its associated parking lots and driveways. The site also includes a landscaped area, a paved playground area, and a baseball field and grass fields on the eastern side of the existing school building.

Based on the 1965 Site Plan, we understand that the existing elementary school building was constructed in the late 1960s. The formerly proposed grades for the current school ranged between El. 146 feet on the western side of the site and El. 186 feet near the eastern side of the site. The grades on the western side of the site, i.e., in the general vicinity of the existing elementary school building, ranged between El. 146 feet near the intersection of Fox Hill Road and Westwood Street and El. 158 feet near the existing school building. The grades on the eastern side of the site, i.e., in the general vicinity of the landscaped area, paved playground, and baseball and grass fields located on the eastern side of the existing elementary school building, range between El. 158 feet near the existing elementary school building and El. 186 feet near the eastern edge of the site. Please note that the existing grades at the site may have changed since the construction of the existing elementary school.

The existing Fox Hill Elementary School building consists of an irregularly-shaped, one-story building located on the western side of the site. Based on the 1965 Building Elevations, we

understand that the first finished floor elevation (FFE) of the existing elementary school is El. 158 feet.

1.4 Project Description

Our understanding of the proposed construction is based on our discussions with Dore and Whittier, the documents listed in Section 1.3, and the following document:

- Untitled boring location plan (Boring Location Plan) prepared by Dore and Whittier, undated, and provided to LGCI by Dore and Whittier via e-mail on February 2, 2023.

We understand that at the time of this preliminary geotechnical report, the size, layout, location, and grades of the proposed school building have not been established. Based on the Boring Location Plan, we understand that there two options are being considered at the current time for the proposed school as follows:

- Option 1 – This option consists of a somewhat rectangular-shaped building located near the paved parking lot located on the northern side of the existing school building.

- Option 2 – This option consists of an L-shaped building located within the landscaped area, paved playground, and baseball and grass fields located on the eastern side of the existing school building.

1.5 Elevation Datum

The 1965 Site Plan, the 1965 Building Layout, and the 1965 Building Elevations did not include a reference to a vertical elevation datum.

2. SITE AND SUBSURFACE CONDITIONS

2.1 Surficial Geology

LGCI reviewed a surficial geologic map titled: "Surficial Materials Map of the Wilmington Quadrangle, Massachusetts," prepared by Stone, B.D., Stone, J.R., and DiGiacomo-Cohen, M.L., Scientific Investigation Map 3402, Quadrangle 113 – Wilmington, 2018.

The Surficial Geologic Map of the site indicates that the natural soils in the general vicinity of the site consist of thin till and thick till.

The thin till is described as non-sorted, non-stratified matrix of sand, some silt, and little clay that contains scattered pebbles, cobbles, and boulders. The thin till is generally less than 10 to 15 feet thick. The thick till is similar in composition to the thin till but is more than 10 to 15 feet thick.

The Surficial Geologic Map indicates that abundant rock outcrops are present near the southeastern corner the eastern side of the site.

The Surficial Geologic Map is shown in Figure 2.

2.2 LGCI's Explorations

2.2.1 General

LGCI coordinated our exploration locations with Dore and Whittier and marked the exploration locations in the field. LGCI notified Dig Safe and the Town of Burlington for utility clearance prior to starting our explorations at the site.

Unless notified otherwise, we will dispose of the soil and rock samples obtained during our explorations after three (3) months.

2.2.2 LGCI's Soil Borings

LGCI engaged Northern Drilling Services, Inc. (NDS) of Northborough, Massachusetts to advance seven (7) soil borings (B-1 to B-7) at the site on February 20 and 21, 2023. The borings were advanced with a Mobile B-59 Truck-Mounted Drill Rig using drive and wash boring techniques with 4-inch casings. The borings extended to depths ranging between 12 and 21 feet beneath the ground surface. Upon completion, the boreholes were backfilled with soil cuttings and gravel. The ground surface was restored with asphalt cold patch in paved areas.

NDS performed Standard Penetration Tests (SPT) and obtained split spoon samples with an automatic hammer at typical depth intervals of 2 feet or 5 feet as noted on the boring logs in general accordance with ASTM D-1586.

An LGCI geotechnical engineer observed and logged the borings in the field.

2.2.3 LGCI's Test Pits

LGCI engaged Saunders Construction of Reading, Massachusetts to excavate six (6) test pits (TP-1 to TP-6) at the site on February 21, 2023. The test pits were excavated with a Takeuchi TB-175 excavator. The test pits extended to depths ranging between 7.4 feet and 10.5 feet beneath the ground surface.

Upon completion, the test pit excavations were backfilled with the excavated material in 12-inch to 18-inch lifts and tamped with the excavator bucket.

An LGCI geotechnical engineer observed and logged the test pits in the field.

2.2.4 Exploration Logs and Locations

The boring and test pit locations are shown in Figure 3. Appendix A contains LGCI's boring logs and Appendix B contains LGCI's test pit logs. Tables 1 and 2 include summaries of LGCI's borings and test pits, respectively.

2.3 Subsurface Conditions

The subsurface description in this report is based on a limited number of explorations and is intended to highlight the major soil strata encountered during our explorations. The subsurface conditions are known only at the actual exploration locations. Variations may occur and should be expected between exploration locations. The boring and test pit logs represent conditions that we observed at the time of our explorations and were edited, as appropriate, based on the results of the laboratory test data and inspection of the soil and rock samples in the laboratory. The strata boundaries shown in our boring and test pit logs are based on our interpretations and the actual transitions may be gradual. Graphic soil symbols are for illustration only.

The soil strata encountered in LGCI's borings and test pits were as follows, starting at the ground surface.

Topsoil – A layer of surficial organic topsoil was encountered at the ground surface in all borings and test pits except in boring B-3. The thickness of the topsoil ranged between 0.4 feet and 1 foot.

Asphalt – Asphalt was encountered at the ground surface in boring B-3. The thickness of the asphalt was 0.3 feet.

Fill – A layer of fill was encountered beneath the topsoil or asphalt in all borings and test pits. The fill extended to depths ranging between 1.4 feet and 6 feet beneath the ground surface. The samples within this layer were mostly described as silty sand. Two (2) samples were described as poorly graded sand and one (1) sample was described as well graded sand. The fines content in

the fill ranged between 5 and 35 percent, and the gravel content ranged between 0 and 25 percent. The fill contained traces of organic soil, roots, brick, and asphalt. The fill also contained cobbles and boulders ranging up to about 20 inches in size.

The SPT N-values in this layer ranged between 8 blows per foot (bpf) and 42 bpf, with most values lower than 18 bpf, indicating mostly loose to medium dense material. Please note that that high SPT N-values in the fill may be due to obstructions such as cobbles and boulders present in the fill and may not represent the true density of the fill. The excavation effort within the fill was described as easy to moderate.

Buried Organic Soil – A layer of buried organic soil was encountered beneath the fill in boring B-7 and in test pits TP-2 to TP-4. The buried organic soil extended to depths ranging between 4.5 feet and 8.5 feet beneath the ground surface. The samples in this layer were described as silty sand. The fines content in the buried organic soil ranged between 20 and 30 percent. The buried organic soil contained traces of organic soil, roots, and wood.

The SPT N-values in this layer were 5 bpf and 16 bpf, indicating very loose to medium dense material. The excavation effort within the buried organic soil was described as easy suggesting a loose material.

Sand and Gravel – A layer of sand and gravel was encountered beneath the layer of fill or buried organic soil in all borings and test pits. The sand and gravel extended to the termination depths in all borings and test pits except in boring B-6. In boring B-6, the sand and gravel extended to the top of rock at a depth of 9.4 feet beneath the ground surface. Split spoon refusal was encountered on rock at the bottom of borings B-3, B-5, and B-6 at depths of 20.3 feet, 20 feet, and 9.4 feet beneath the ground surface, respectively. Excavator refusal was encountered on apparent rock at the bottom of this layer in test pits TP-5 and T-6 at depths of 8 feet and 7.4 feet beneath the ground surface, respectively. The samples in this layer were mostly described as silty sand. Four (4) samples were described as poorly graded sand, and one (1) sample was described as well graded sand. The fines content in this layer ranged between 5 and 35 percent, and the gravel content ranged between 0 and 30 percent. A few samples within the sand and gravel contained traces of weathered rock. The sand and gravel also contained cobbles and boulders up to about 2 feet in size.

The SPT N-values in this layer ranged between 7 bpf and refusal, with most values higher than 20 bpf, indicating mostly medium dense to very dense material. Please note that the high SPT N-values in the sand and gravel may be due to obstructions such as cobbles and boulders in the sand and gravel and may not represent the true density of the sand and gravel. The excavation effort within the sand and gravel was described as easy to difficult.

Rock – Split spoon refusal and excavator refusal were encountered on rock in borings B-3, B-5, and B-6 and in test pits TP-5 and TP-6 at depths ranging between 7.4 feet and 20.3 feet beneath the ground surface.

To confirm and characterize the rock in boring B-6, the roller bit was advanced in apparent rock between the depths of 9.4 and 15 feet beneath the ground surface, and a 5-foot rock core was obtained between the depths of 15 and 20 feet beneath the ground surface. The cored rock consisted of hard to very hard, severely weathered to fresh, slightly fractured to sound, gray to brown, coarse-grained, Granite. The rock core recovery was 100 percent, and the Rock Quality Designation (RQD) was 68.3 percent. The coring rate ranged between 2.6 and 3.8 minutes per foot (min./ft.).

2.4 Groundwater

Groundwater was encountered in all borings and test pits except in test pit TP-6 at depths ranging between 2.0 and 8.3 feet beneath the ground surface, as shown in Tables 1 and 2 and in the boring and test pit logs.

The groundwater information reported herein is based on observations made during or shortly after the completion of drilling or excavation. In addition, the drilling procedure introduced water into the boreholes during drilling. Therefore, the reported groundwater levels may not represent the actual groundwater conditions, as additional time may be required for the groundwater levels to stabilize. The groundwater information presented in this report only represents the conditions encountered at the time and location of the explorations. Seasonal fluctuation should be anticipated.

2.5 Laboratory Test Data

LGCI submitted two (2) soil samples collected from the borings and test pits for grain-size analysis. The results of the grain-size analyses are provided in the test data sheets included in Appendix C and are summarized in the table below.

Grain-Size Analysis Test Results

Boring / Test Pit No.	Sample No.	Stratum	Sample Depth (ft.)	Percent Gravel	Percent Sand	Percent Fines
B-6	S2	Fill	2.0 – 4.0	20.4	47.6	32.0
TP-1	Grab	Sand and Gravel	1.4 – 10	10.9	57.9	31.2

3. EVALUATION AND RECOMMENDATIONS

3.1 General

Based on our understanding of the proposed construction, our observation of our borings and test pits, and the results of our laboratory testing, there are a few issues that we would like to highlight for consideration and discussion.

3.1.1 Asphalt, Surficial Topsoil, Existing Fill, and Buried Organic Soil

- Asphalt, topsoil, existing fill, and buried organic soil were encountered in the borings and test pits. These materials are not suitable to support foundations.

- The asphalt and topsoil should be removed from within the entire construction area, including the proposed building footprint, proposed driveways and parking lots, and site retaining walls and other structures.

- The existing fill was observed to be variable in composition and density. In addition, variable amounts of organic matter were noted in several of the fill samples. Existing fill that was not placed with strict moisture, density, and gradation control presents risk of unpredictable settlement that may result in poor performance of floor slabs and foundations. Due to these risks, the existing fill as well as the buried organic soil should be entirely removed from within the proposed building footprint and replaced with Structural Fill. Based on the limited explorations performed within the currently proposed building footprint, we anticipate that the removal will extend up to depths of about 4 feet, but may extend to depths of up to 8.5 feet beneath the ground surface based on borings and test pits conducted outside the currently proposed building footprints. The removal may extend to greater depths at locations not explored by LGCI. Laterally, the removal should extend beyond the proposed building footprint a distance equal to the distance between the bottom of the proposed footings and the top of the natural sand and gravel, or 5 feet, whichever is greater.

- LGCI considered the option of the leaving the existing fill and buried organic soil in placed and improving them by means of aggregate piers. However, we dismissed this option because the depth to the bottom of the existing fill and buried organic soil is not sufficient to warrant the use of aggregate piers. We will reconsider this option after additional explorations are performed at the site when the proposed building location, size, layout, and finished floor elevation are established.

- The subgrade of footings should be prepared in accordance with the recommendations in Section 4.1.

- Within paved areas, the existing fill and buried organic soil should be removed to the top of the natural sand and gravel or to a depth of 18 inches beneath the bottom of the

proposed pavement. Where organic soil is exposed, the organic soil should be removed. Where existing fill is exposed, the existing fill deeper than 18 inches beneath the bottom of the proposed pavement can remain in place provided these materials are firm and unyielding following proofrolling as described in Section 4.1.

3.1.2 Shallow Footings

Based on the results of the borings and test pits, the subsurface conditions are suitable to support shallow spread and continuous footings bearing on Structural Fill placed directly on top of the sand and gravel layer after entirely removing the asphalt, the topsoil, the existing fill, and the buried topsoil. Our recommendation for net allowable bearing capacity in the sand and gravel is presented in Section 3.2.1. Our estimates for settlement are presented in Section 3.2.2. Our concrete slab considerations are presented in Section 3.3. Section 4.1 provides recommendations for preparation of subgrades.

3.1.3 Reuse on Onsite Materials

Based on our field observations and the results of the grain-size analyses, the onsite soils are not suitable for reuse as Ordinary Fill or Structural Fill. Additional recommendations for reuse of onsite materials are presented in Section 4.4.

3.1.4 Additional Explorations

We recommend performing additional explorations at the site after the proposed building location, size, layout, and finished floor elevation are established. We recommend performing at least eight (8) borings and six (6) test pits, including installing a groundwater observation well.

3.2 Foundation Recommendations

3.2.1 Footing Design

- We recommend entirely removing the surficial asphalt, topsoil, s existing fill, and buried organic soil from within the proposed building footprint as described in Section 3.1.2.

- We recommend supporting the proposed building on spread footings bearing on Structural Fill placed directly on the natural sand and gravel.

- We recommend designing the proposed footings using a net allowable bearing pressure of 5 kips per square foot (ksf). We recommend that the footings bear on a minimum of 12 inches of Structural Fill placed directly on top of the natural sand and gravel or on rock. The Structural Fill should extend at least 1 foot laterally beyond the limits of the footings.

- Footing subgrades should be prepared in accordance with the recommendations in Section 4.1.

- Foundations should be designed in accordance with The Commonwealth of Massachusetts State Building Code 780 CMR, Ninth Edition (MSBC 9th Edition).

- Exterior footings and footings in unheated areas should be placed at a minimum depth of 4 feet below the final exterior grade 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.

- Wall footings should be designed and constructed with continuous, longitudinal steel reinforcement for greater bending strength to span across small areas of loose or soft soils that may go undetected during construction.

- A representative of LGCI should be engaged to observe that the subgrade has been prepared in accordance with our recommendations.

3.2.2 Settlement Estimates

Based on our experience with similar soils and designs using a net allowable bearing pressure of 5 ksf, we anticipate that the total settlement will be approximately 1 inch, and that the differential settlement of the footings will be 3/4 inch or less over a distance of 25 feet. We believe that total and differential settlements of this magnitude are tolerable for a similar structure. However, the tolerance of the proposed structure to the predicted total and differential settlements should be assessed by the structural engineer.

3.3 Concrete Slab Considerations

3.3.1 Slabs-on-Grade

- Floor slabs should be constructed as a slabs-on-grade bearing on a minimum of 12 inches of Structural Fill placed directly on top of the weathered rock. The subgrade of the slabs should be prepared as described in Section 4.1.

- To reduce the potential for dampness in the proposed floor slab, the project architect may consider placing a vapor barrier beneath the floor slab. The vapor barrier should be protected from puncture during the placement of the proposed slab reinforcement.

- For the design of the floor slab bearing on the materials described above, we recommend using a modulus of subgrade reaction, k_{s1}, of 100 tons per cubic foot (tcf). Please note that the values of k_{s1} are for a 1 x 1 square foot area. These values should be adjusted for larger areas using the following expression:

$$Modulus\ of\ Subgrade\ \mathrm{Re}action\ (k_s) = k_{s1} * \left(\frac{B+1}{2B}\right)^2$$

where:

k_s = Coefficient of vertical subgrade reaction for loaded area;
k_{s1} = Coefficient of vertical subgrade reaction for a 1 x 1 square foot area; and
B = Width of area loaded, in feet.

Please note that cracking of slabs-on-grade can occur 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 during the construction of all slabs-on-grade:

- Construction joints should be provided between the floor slab and the walls and columns in accordance with the American Concrete Institute (ACI) requirements, or other applicable code.

- The backfill in interior utility trenches should be properly compacted.

- In order for the movement of exterior slabs not to be transmitted to foundations or superstructures, exterior slabs, such as approach slabs and sidewalks, should be isolated from the superstructure.

3.3.2 Under-slab Drains and Waterproofing

Based on the groundwater level observed in the borings, we believe that an under-slab drainage system is not required.

If the proposed building includes an elevator pit or other structure that extends beneath the FFE, such elevator pit or other structure should be designed to be waterproof.

LGCI will revise this recommendation after we are engaged to perform additional explorations at the site.

3.4 Seismic Design

Based on the SPT N-values from the borings, we estimate that the seismic criteria for the site are as follows:

- Site Class: D
- Spectral Response Acceleration at short period (Ss): 0.227g

- Spectral Response Acceleration at 1 sec. (S_1): 0.072g
- Site Coefficient Fa (Table 1613.5.3(1)): 1.6
- Site Coefficient Fv (Table 1613.5.3(2): 2.4
- Adjusted spectral response S_{MS}: 0.363g
- Adjusted spectral response S_{M1}: 0.173g

LGCI will revise the site class to a Site Class C, if applicable, after additional explorations are performed, including rock cores.

Based on the SPT data from the borings, the site soils are not susceptible to liquefaction.

3.5 Lateral Pressures for Wall Design

3.5.1 Lateral Earth Pressures

Lateral earth pressures for the design of below-grade walls, if any, and site retaining walls are provided below.

Coefficient of Active Earth Pressure, K_A:	0.31
Coefficient of At-Rest Earth Pressure, K_o:	0.47
Coefficient of Passive Earth Pressure, K_p:	3.3
Total Unit Weight γ:	125 pcf

Note: The values in the table are based on a friction angle for the backfill of 32 degrees and neglecting friction between the backfill and the wall. The design active and passive coefficients are based on horizontal surfaces (non-sloping backfill) on both the active and passive sides, and on a vertical wall face.

- Exterior walls of below-ground spaces and other retaining walls braced at the top to restrain movement/rotation, should be designed using the "at-rest" pressure coefficient.

- We recommend placing free-draining material within the 3 feet immediately behind retaining walls.

- We recommend providing weep holes at the bottom of site retaining walls, including temporary SOE systems, to promote drainage where possible. Alternatively, a pipe should be placed at the base of the wall to collect the water. Groundwater collected by the wall drains should be discharged into a lower area if gravity flow is possible.

- Passive earth pressures should only be used at the toe of the wall where special measures or provisions are taken to prevent the disturbance or future removal of the soil on the passive side of the wall, or in areas where the wall design includes a key. In any case, the passive pressures should be neglected in the top 4 feet.

- Where a permanent vertical uniform load will be applied to the active side immediately adjacent to the wall, a horizontal surcharge load equal to half of the uniform vertical load should be applied over the height of the wall. At a minimum, a temporary lateral

construction surcharge load of 100 pounds per square foot (psf) should be applied uniformly over the height of the wall.

- We recommend using an ultimate friction factor of 0.5 between the weathered rock and the bottom of the wall. Below-grade walls should be designed for minimum factors of safety of 1.5 for sliding and 2.0 for overturning.

3.5.2 Seismic Pressures

In accordance with the Massachusetts State Building Code, 9th Edition (MSBC 9th Edition), Section 1610, a lateral earthquake force equal to $0.100*(S_s)*(F_a)*\gamma*H^2$ should be included in the design of the walls (for horizontal backfill), where S_s is the maximum considered earthquake spectral response acceleration (defined in Section 3.4), F_a is the site coefficient (defined in Section 3.4), γ is the total unit weight of the soil backfill, and H is the height of the wall.

The earthquake force should be distributed as an inverted triangle over the height of the wall. In accordance with MSBC 9th Edition, Section 1610.2, a load factor of 1.43 should be applied to the earthquake force for wall strength design.

Temporary surcharges should not be included when designing for earthquake loads. Surcharge loads applied for extended periods of time should be included in the total static lateral soil pressure, and their earthquake lateral force should be computed and added to the force determined above.

3.5.3 Perimeter Drains

- We recommend that free-draining material be placed within 3 feet of the exterior of walls of below-ground spaces, if any. To reduce the potential for dampness in below-ground spaces, proposed below-ground walls should be damp-proofed.

- We recommend that drains be provided behind the exterior of walls of below-ground spaces. The drains should consist of 4-inch perforated PVC pipes installed with the slots facing down. Perimeter drains should be installed at the bottom of the wall in 18 inches of crushed stone wrapped in a geotextile for separation and filtration.

To the extent possible, groundwater collected by the wall drains should be discharged in a lower area if gravity flow is possible. In any case, the groundwater collected by the wall drains should be discharged in accordance with municipal, state, and other applicable standards.

3.6 Parking Lots, Driveways, and Sidewalks

3.6.1 General

The subsurface conditions encountered at the site are generally suitable to support the proposed driveways, parking lots, and sidewalks after preparation of the subgrade as described in Section 4.1.

- We recommend entirely removing the existing asphalt and topsoil from within the footprint of the proposed driveways and parking lots.

- The existing fill should be improved in accordance with the recommendations in Section 4.1.

- Cobbles and boulders should be removed to at least 18 inches below the bottom of the pavement.

3.6.2 Sidewalks

- Sidewalks should be placed on a minimum of 12 inches of Structural Fill with less than 5 percent fines.

- To reduce the potential for heave caused by surface water penetrating under the sidewalk, the joints between sidewalk concrete sections should be sealed with a waterproof compound. The sidewalks should be sloped away from the building or other vertical surfaces to promote flow of water. To the extent possible, roof leaders should not discharge onto sidewalk surfaces.

3.6.3 Pavement Sections

A typical, minimum, standard-duty pavement section that could be used for parking areas is as follows:

1.5" Asphalt "Top Course"
2.0" Asphalt "Base Course"
8" Processed Gravel for Sub-Base (MassDOT M1.03.1)

A typical, minimum, heavy-duty pavement section that could be used for areas of heavy truck traffic is as follows:

2.0" Asphalt "Top Course"
2.5" Asphalt "Base Course"
12" Processed Gravel for Sub-Base (MassDOT M1.03.1)

The pavement sections shown above represent minimum thicknesses representative of typical local construction practices for similar use. Periodic maintenance should be anticipated.

Pavement material types and construction procedures should conform to specifications of the "Standard Specifications for Highways and Bridges," prepared by the Commonwealth of Massachusetts Department of Public Works and dated 1988 (with the latest Supplemental Specifications).

Areas to receive relatively highly concentrated, sustained loads such as dumpsters, loading areas, and storage bins are typically installed over a rigid pavement section to distribute concentrated loads and reduce the possibility of high stress concentrations on the subgrade. Typical rigid pavement sections consist of 6 inches of concrete placed over a minimum of 12 inches of subbase material.

3.7 Underground Utilities

Boulders at the bottom of utility trenches should be removed to at least 12 inches below the pipe invert and the resulting excavation should be backfilled with suitable backfill. Utilities should be placed on suitable bedding material in accordance with the manufacturer's recommendations. "Cushion" material should be placed, by hand, above the utility pipe in maximum 6-inch lifts. The lift should be compacted by hand to avoid damage to the utility. Where the bedding/cushion material consists of crushed stone, it should be wrapped in a geotextile fabric.

Compaction of fill in utility trenches should be in accordance with our recommendations in Section 4.3. To reduce the potential for damage to utilities, placement and compaction of fill immediately above the utilities should be performed in accordance with the manufacturer's recommendations.

4. CONSTRUCTION CONSIDERATIONS

4.1 Subgrade Preparation

- Asphalt, organic materials, existing fill, buried organic soil, buried subsoil, if any, abandoned utilities, buried foundations, and other below-ground structures should be entirely removed from within the footprint of the proposed building and site structures, including site retaining walls, and exterior stairs, if any, before the start of foundation work.

- Tree stumps, root balls, and roots larger than ½ inch in diameter should be removed and the cavities filled with suitable material and compacted per Section 4.3 of this report.

- Cobbles and boulders should be removed at least 6 inches from beneath footings and 18 inches beneath the bottom of slabs and paved areas. The resulting excavations should be backfilled with compacted Structural Fill under the building and with Ordinary Fill under the subbase of paved areas.

- The bottom of the excavation resulting from the removal of the existing fill or natural soil should be compacted with a dynamic vibratory compactor imparting a minimum of 40 kips of force to the subgrade.

- The base of the footing excavations in granular soil should be compacted with a dynamic vibratory compactor weighing at least 200 pounds and imparting a minimum of 4 kips of force to the subgrade.

- After the surficial materials are removed to a depth of 18 inches within the proposed paved areas in accordance with the recommendations in Section 3.1, the exposed existing fill and buried organic soil deeper than 18 inches beneath the bottom of the proposed pavement should be improved by proofrolled using a loaded rubber-tire truck. Where soft zones of soil are observed, the soft soil should be removed, and the grade should be restored using Ordinary Fill to the bottom of the proposed subbase layer. After proofrolling is completed, the subgrade should be compacted with at least six (6) passes of a vibratory roller compactor imparting a dynamic effort of at least 40 kips to a firm and unyielding condition. If pumping of the existing fill or buried organic soil deeper than 18 inches beneath the bottom of the proposed pavement is observed, the soft and/or pumping material should be removed and replaced.

- Fill placed within the footprint of the proposed building should meet the gradation and compaction requirements of Structural Fill, shown in Section 4.3.1.

- Fill placed under the subbase of paved areas should meet the gradation and compaction requirements of Ordinary Fill, shown in Section 4.3.2.

- Fill placed in the top 12 inches beneath sidewalks should consist of Structural Fill with less than 5 percent fines.

- Loose or soft soils identified during the compaction of the footing or floor slab subgrades should be excavated to a suitable bearing stratum, as determined by the representative of LGCI. Grades should be restored by backfilling with Structural Fill or crushed stone.

- When crushed stone is required in the drawings or is used for the convenience of the contractor, it should be wrapped in a geotextile fabric for separation except where introduction of the geotextile fabric promotes sliding. A geotextile fabric should not be placed between the bottoms of the footings and the crushed stone.

- An LGCI representative should observe the exposed subgrades prior to fill and concrete placement to verify that the exposed bearing materials are suitable for the design soil bearing pressure. If soft or loose pockets are encountered in the footing excavations, the soft or loose materials should be removed and the bottom of the footing should be placed at a lower elevation on firm soil, or the resulting excavation should be backfilled with Structural Fill, or crushed stone wrapped in a filter fabric.

4.2 Subgrade Protection

The onsite fill and natural soils are frost susceptible. If construction takes place during freezing weather, special measures should be taken to prevent the subgrade from freezing. Such measures should include the use of heat blankets or excavating the final six inches of soil just before pouring the concrete. Footings should be backfilled as soon as possible after footing construction. Soil used as backfill should be free of frozen material, as should the ground on which it is placed. Filling operations should be halted during freezing weather.

Materials with high fines contents are typically difficult to handle when wet, as they are sensitive to moisture content variations. Subgrade support capacities may deteriorate when such soils become wet and/or disturbed. The contractor should keep exposed subgrades properly drained and free of ponded water. Subgrades should be protected from machine and foot traffic to reduce disturbance.

4.3 Fill Materials

Structural Fill and Ordinary Fill should consist of inert, hard, durable sand and gravel free from organic matter, clay, surface coatings, and deleterious materials, and should conform to the gradation requirements shown below.

4.3.1 Structural Fill

The Structural Fill should have a plasticity index of less than 6 and should meet the gradation requirements shown below. Structural Fill should be compacted in maximum 9-inch loose lifts to at least 95 percent of the Modified Proctor maximum dry density (ASTM

D1557), with moisture contents within ±2 percentage points of the optimum moisture content.

Sieve Size Percent	Passing by Weight
3 inches	100
1 ½ inch	80-100
½ inch	50-100
No. 4	30-85
No. 20	15-60
No. 60	5-35
No. 200*	0-10

* 0 – 5 for the top 12 inches under sidewalks, exterior slabs, pads, and walkways

4.3.2 Ordinary Fill

Ordinary Fill should have a plasticity index of less than 6 and should meet the gradation requirements shown below. Ordinary Fill should be compacted in maximum 9-inch loose lifts to at least 95 percent of the Modified Proctor maximum dry density (ASTM D1557), with moisture contents within ±2 percentage points of the optimum moisture content.

Sieve Size Percent	Passing by Weight
6 inches	100
1 inch	50-100
No. 4	20-100
No. 20	10-70
No. 60	5-45
No. 200	0-20

4.4 Reuse of Onsite Materials

Based on our field observations and the results of the grain-size analyses, the onsite fill materials are not suitable for reuse as Ordinary Fill or Structural Fill. These materials can be used in landscaped areas.

The contractor should avoid mixing the reusable soils with fine-grained and/or organic soils. The soils to be reused should be excavated and stockpiled separately for compliance testing. Soils with 20 percent or greater fines contents are generally very sensitive to moisture content variations and are susceptible to frost. Such soils are very difficult to compact at moisture contents that are much higher or much lower than the optimum moisture content determined from the laboratory compaction test. Therefore, strict moisture control should be implemented during the compaction of onsite soils with fines contents of 20 percent or greater. The contractor should be prepared to remove and replace such soils if pumping occurs.

If needed, the onsite material could be blended with imported rock and processed in a crusher to produce fill meeting the gradation requirements of the materials in Section 4.3. Suitable imported material and amended/improved materials should be stockpiled separately from unimproved onsite soils.

Materials to be used as fill should first be tested for compliance with the applicable gradation specifications.

4.5 Groundwater Control Procedures

Based on the groundwater levels measured in our borings, we do not anticipate that major groundwater control procedures will be needed during construction. We anticipate that filtered sump pumps installed in a series of sump pump pits located at least 3 feet below the bottom of planned excavations may be sufficient to handle groundwater and surface runoff that may enter the excavation during wet weather. The contractor should be prepared to use multiple sump pumps to maintain a dry excavation during the removal of the existing fill.

The contractor should be permitted to employ whatever commonly accepted means and practices are necessary to maintain the groundwater level below the bottom of the excavation and to maintain a dry excavation during wet weather. Groundwater levels should be maintained at a minimum of 1 foot below the bottom of the excavations during construction. The placement of reinforcing steel or concrete in standing water should not be permitted.

To reduce the potential for sinkholes developing over sump pump pits after the sump pumps are removed, the crushed stone placed in the sump pump pits should be wrapped in a geotextile fabric. Alternatively, the crushed stone should be entirely removed after the sump pump is no longer in use, and the sump pump pit should be restored with suitable backfill.

4.6 Temporary Excavations

All excavations to receive human traffic should be constructed in accordance with OSHA guidelines.

The site soils should generally be considered Type “C” and should have a maximum allowable slope of 1.5 Horizontal to 1 Vertical (1.5H:1V) for excavations less than 20 feet deep. Deeper excavations, if needed, should have shoring designed by a professional engineer.

The contractor is solely responsible for designing and constructing stable, temporary excavations and should shore, slope, or bench the sides of the excavations as required to maintain the stability of the excavation sides and bottom.

5. RECOMMENDATIONS FOR FUTURE WORK

We recommend engaging LGCI to perform the following services:

- Perform additional explorations at the site after the proposed building location, size, layout, and finished floor elevation are established, and update our geotechnical report.

- Prepare Earth Moving Specifications and review the geotechnical aspect of contract drawings.

- Review contractor submittals and Request for Information (RFIs).

- Provide a field engineer during construction to observe the removal of the unsuitable soil, and to observe the subgrade of footings and slabs.

6. REPORT LIMITATIONS

Our analyses and recommendations are based on project information provided to us at the time of this report. If changes to the type, size, and location of the proposed structures or to the site grading are made, the recommendations contained in this report shall not be considered valid unless the changes are reviewed, and the conclusions and recommendations modified in writing by LGCI. LGCI cannot accept responsibility for designs based on our recommendations unless we are engaged to review the final plans and specifications to determine whether any changes in the project affect the validity of our recommendations, and whether our recommendations have been properly implemented in the design.

It is not part of our scope to perform a more detailed site history; therefore, we have not explored for or researched the locations of buried utilities or other structures in the area of the proposed construction. Our scope did not include environmental services or services related to moisture, mold, or other biological contaminants in or around the site.

The recommendations in this report are based in part on the data obtained from the subsurface explorations. The nature and extent of variations between explorations may not become evident until construction. If variations from anticipated conditions are encountered, it may be necessary to revise the recommendations in this report. We cannot accept responsibility for designs based on recommendations in this report unless we are engaged to 1) make site visits during construction to check that the subsurface conditions exposed during construction are in general conformance with our design assumptions and 2) ascertain that, in general, the work is being performed in compliance with the contract documents.

Our report has been prepared in accordance with generally accepted engineering practices and in accordance with the terms and conditions set forth in our agreement. No other warranty, expressed or implied, is made. This report has been prepared for the exclusive use of Burlington Public Schools for the Proposed Fox Hill Elementary School in Burlington, Massachusetts as conceived at this time.

7. REFERENCES

In addition to the references included in the text of the report, we used the following references:

American Society of Civil Engineers, "Minimum Design Loads and Associated Criteria for Buildings and Other Structures," ASCE/SEI 7-16, 2017.

The Commonwealth of Massachusetts (2017), "The Massachusetts State Building Code, Ninth (9^{th}) Edition."

The Department of Labor, Occupational Safety and Health Administration (1989), "Occupational Safety and Health Standards - Excavations; Final Rule," 20 CFR Part 1926, Subpart P.

USGS Burlington, MA topographic map from http://mapserver.mytopo.com.

Table 1 - Summary of LGCI's Borings
Proposed Fox Hill Elementary School
Burlington, Massachusetts
LGCI Project No. 2307

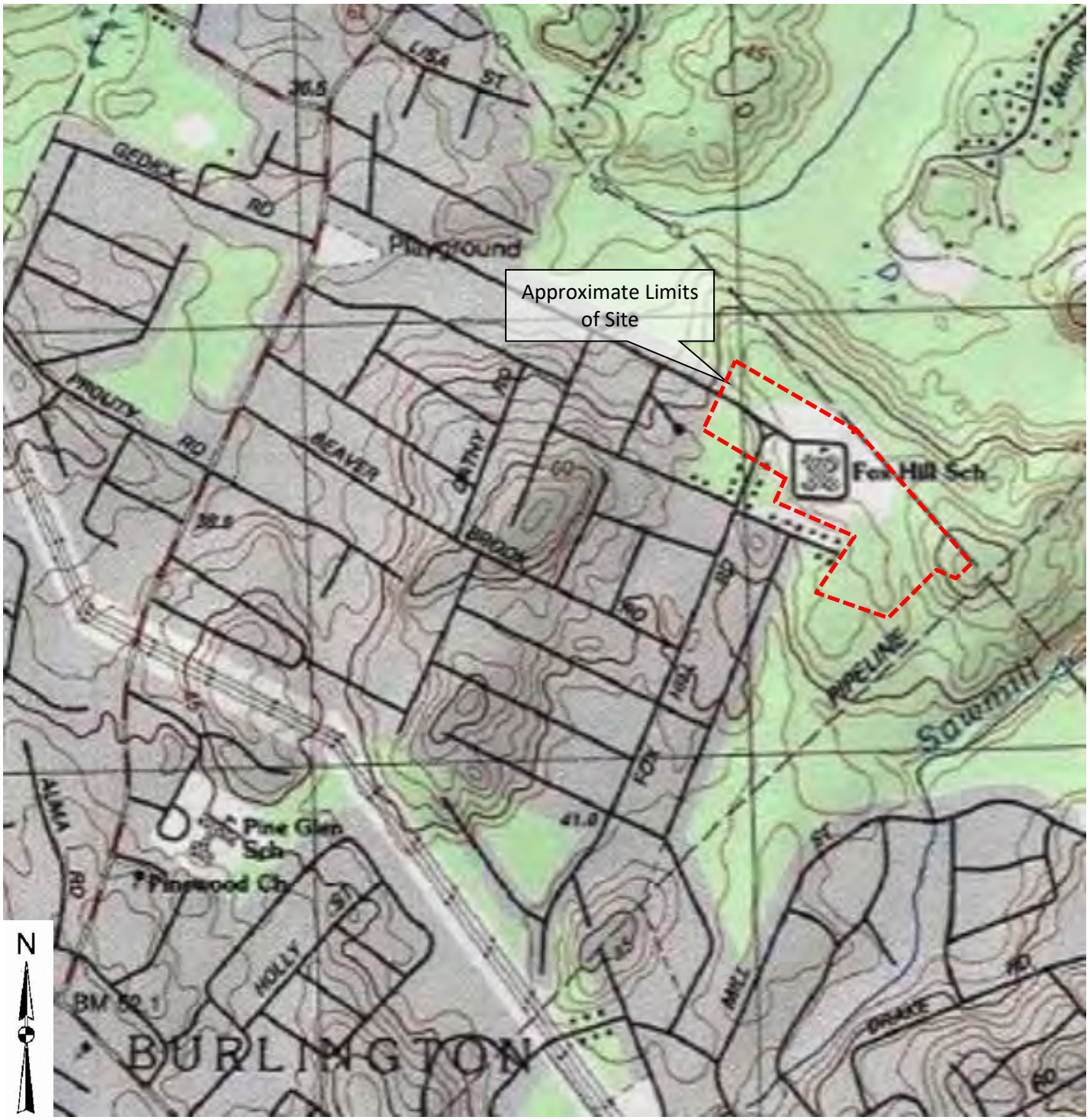
Boring No.	Ground Surface Elevation (ft.)[1]	Groundwater[2] Depth / El. (ft.)	Bottom of **Asphalt /** Topsoil Depth / El. (ft.)	Bottom of Fill Depth / El. (ft.)	Bottom of Buried Organic Soil Depth / El. (ft.)	Bottom of Sand Depth / El. (ft.)	Top of Possible rock Depth / El. (ft.)	Bottom of Boring Depth / El. (ft.)
B-1	170.0	4.0 / **166.0**	0.4 / **169.6**	2.0 / **168.0**	- / -	21.0 [3]/ **149.0**	- / -	21.0 [3]/ **149.0**
B-2	176.0	4.0 / **172.0**	1.0 / **175.0**	4.0 / **172.0**	- / -	21.0 [3]/ **155.0**	- / -	21.0 [3]/ **155.0**
B-3	174.0	3.8 / **170.2**	**0.3** / **173.7**	2.0 / **172.0**	- / -	20.3 [3]/ **153.7**	20.3 / **153.7**	20.3 [3]/ **153.7**
B-4	171.0	4.0 / **167.0**	0.4 / **170.6**	4.0 / **167.0**	- / -	21.0 [3]/ **150.0**	- / -	21.0 [3]/ **150.0**
B-5	174.0	4.3 / **169.7**	0.5 / **173.5**	6.0 / **168.0**	- / -	20.0 [3]/ **154.0**	20.0 / **154.0**	20.0 [3]/ **154.0**
B-6	175.0	2.0 / **173.0**	0.5 / **174.5**	4.0 / **171.0**	- / -	9.4 [3]/ **165.6**	9.4 / **165.6**	20.0 [4]/ **155.0**
B-7	173.0	2.0 / **171.0**	0.6 / **172.4**	4.0 / **169.0**	8.0 / **165.0**	12.0 [3]/ **161.0**	- / -	12.0 [3]/ **161.0**

1. The ground surface elevation was interpolated to the nearest 2 feet from drawing 9 titled: "Burlington Mass.," prepared by COL-EAST, Inc., dated March 24, 1976, and provided to LGCI by Dore and Whittier via e-mail on February 23, 2023.
2. Groundwater was measured during drilling, at the end of drilling, or based on sample moisture, whichever is shallower.
3. Boring terminated in the sand and gravel layer.
4. Boring terminated in rock.
5. "-" means layer was not encountered.

Table 1 - Summary of LGCI's Borings
Proposed Fox Hill Elementary School
Burlington, Massachusetts
LGCI Project No. 2307

Boring No.	Ground Surface Elevation (ft.)[1]	Groundwater[2] Depth / El. (ft.)	Bottom of Topsoil Depth / El. (ft.)	Bottom of Fill Depth / El. (ft.)	Bottom of Buried Organic Soil Depth / El. (ft.)	Bottom of Sand Depth / El. (ft.)	Top of Possible rock Depth / El. (ft.)	Bottom of Boring Depth / El. (ft.)
TP-1	175.0	7.0 / **168.0**	0.5 / **174.5**	1.4 / **173.6**	- / **-**	10.0 [3]/ **165.0**	- / **-**	10.0 / **165.0**
TP-2	172.0	8.3 / **163.7**	0.9 / **171.1**	5.5 / **166.5**	7.0 / **165.0**	10.5 [3]/ **161.5**	- / **-**	10.5 / **161.5**
TP-3	173.0	7.0 / **166.0**	**0.5** / **172.5**	6.0 / **167.0**	8.5 / **164.5**	10.0 [3]/ **163.0**	- / **-**	10.0 / **163.0**
TP-4	175.0	5.0 / **170.0**	0.6 / **174.4**	2.3 / **172.7**	4.5 / **170.5**	9.0 [3]/ **166.0**	- / **-**	9.0 / **166.0**
TP-5	180.0	2.0 / **178.0**	0.5 / **179.5**	1.5 / **178.5**	- / **-**	8.0 [3]/ **172.0**	8.0 / **172.0**	8.0 / **172.0**
TP-6	178.0	- / **-**	0.5 / **177.5**	2.2 / **175.8**	- / **-**	7.4 [3]/ **170.6**	7.4 / **170.6**	7.4 / **170.6**

1. The ground surface elevation was interpolated to the nearest 2 feet from drawing 9 titled: "Burlington Mass.," prepared by COL-EAST, Inc., dated March 24, 1976, and provided to LGCI by Dore and Whittier via e-mail on February 23, 2023.
2. Groundwater was measured during excavation, at the end of excavation, or based on sample moisture, whichever is shallower.
3. Test pit terminated in the sand and gravel layer.
4. "-" means groundwater or layer was not encountered.



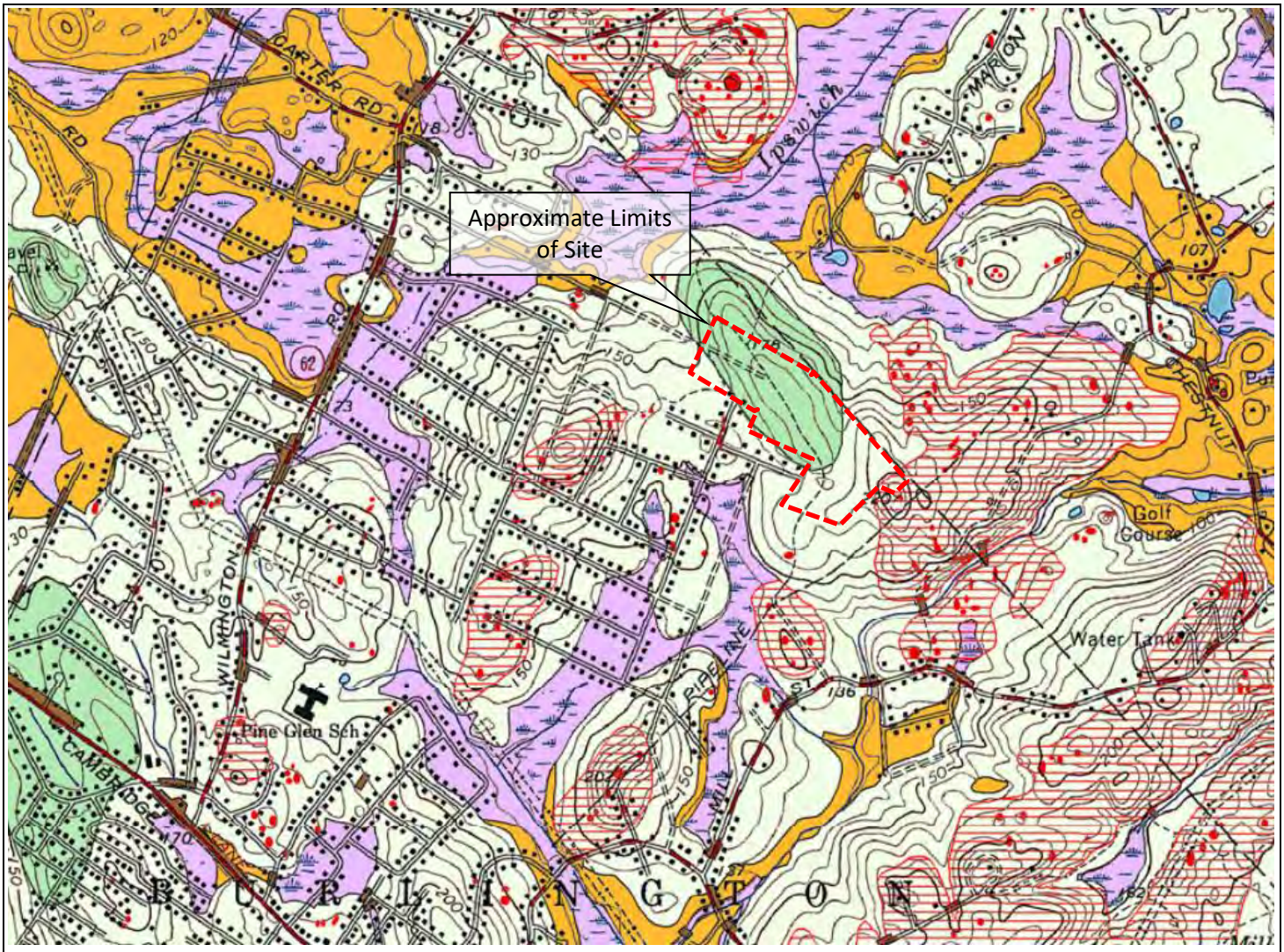
Contour Intervals: 10 feet

0.4 mi

Note: Figure based on USA Topo Maps of Burlington, MA obtained from https://viewer.nationalmap.gov/. Limits of site are based on sketch provided to LGCI by Dore and Whittier on February 2, 2023.

Client:	Project:	
Burlington Public Schools	Proposed Fox Hill Elementary School	Figure 1 – Site Location Map

LGCI Lahlaf Geotechnical Consulting, Inc.	Project Location: Burlington, MA	LGCI Project No.: 2307	Date: Mar. 2023



Thin till—Nonsorted, nonstratified matrix of sand, some silt, and little clay containing scattered pebble, cobble, and boulder clasts; large surface boulders are common; unit was mapped where till is generally less than 10 to 15 ft thick including areas of shallow bedrock. Predominantly consists of upper till of the last glaciation; loose to moderately compact, generally sandy, commonly stony. Two facies are present in some places: a looser, coarser grained ablation facies, melted out from supraglacial position; and an underlying more compact, finer grained lodgement facies deposited subglacially. In general, both ablation and lodgement facies of upper till derived from fine-grained bedrock are finer grained, more compact, less stony and have fewer surface boulders than upper till derived from coarse-grained crystalline rocks. Across Massachusetts, fine-grained bedrock sources include the red Mesozoic sedimentary rocks of the Connecticut Valley lowland, marble in the western river valleys, and fine-grained schists in upland areas

Thick till—Nonsorted, nonstratified matrix of sand, some silt, and little clay containing scattered pebbles, cobbles, and boulders in the shallow subsurface; at greater depths consists of compact, nonsorted matrix of silt, very fine sand, and some clay containing scattered small gravel clasts. Mapped in areas where till is greater than 10 to 15 ft thick, mostly in drumlin landforms in which till thickness commonly exceeds 100 ft (maximum recorded thickness is 230 ft). Although upper till of late Wisconsinan age is the surface deposit, lower till of probable Illinoian age constitutes the bulk of the material in thick-till areas. Lower till is moderately to very compact and is commonly finer grained and less stony than upper till. An oxidized zone, the lower part of a soil profile formed during a period of interglacial weathering, is generally present in the upper part of the lower till. This zone commonly shows closely spaced joints that are stained with iron and manganese oxides

Note: Figure based on map titled: "Surficial Materials Map of the Wilmington Quadrangle, Massachusetts," prepared by Stone, B.D., Stone J.R., and DiGiacomo-Cohen, M.L., Scientific Investigation Map 3402, Quadrangle 113 – Wilmington, 2018.
Limits of site are based on sketch provided to LGCI by Dore and Whittier on February 2, 2023.

Client:	Project	Figure 2 – Surficial Geologic Map	
Burlington Public Schools	Proposed Fox Hill Elementary School		
LGCI Lahlaf Geotechnical Consulting, Inc.	Project Location: Burlington, MA	LGCI Project No.: 2307	Date: Mar. 2023

Legend

Approximate location of borings advanced by Northern Drill Services, Inc. (NDS) of Northborough, MA on February 20 and 21, 2023, and observed by Lahlaf Geotechnical Consulting, Inc. (LGCI).

Approximate location of test pits excavated by Saunders Construction on February 21, 2023, and observed by LGCI.

N

Approximate Scale (ft.)

100 0 100 200

2' CONTOUR INTERVAL

Note

1. Figure based on aerial image from Google maps and overlayed on drawing 9 titled: "Burlington Mass.," prepared by COL-EAST, Inc., dated March 24, 1976, and provided to LGCI by Dore and Whittier via e-mail on February 23, 2023.
2. Limits of proposed/possible building footprint are based on sketch provided to LGCI by Dore and Whittier via e-mail on February 2, 2023.

Client:	Project:	Figure 3 – Exploration Location Plan	
Burlington Public Schools	Proposed Fox Hill Elementary School		
LGCI Lahlaf Geotechnical Consulting, Inc.	Project Location: Burlington, MA	LGCI Project No.: 2307	Date: Mar. 2023

Appendix A – LGCI's Boring Logs

LGCI
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BORING LOG

B-1
PAGE 1 OF 1

CLIENT: Burlington Public Schools
PROJECT NAME: Prop. Fox Hill Elementary School
LGCI PROJECT NUMBER: 2307
PROJECT LOCATION: Burlington, MA

DATE STARTED: 2/20/23 **DATE COMPLETED:** 2/20/23
BORING LOCATION: Near NW corner of site
COORDINATES: NA
SURFACE El.: 170 ft. (see note 1) **TOTAL DEPTH:** 21 ft.
WEATHER: 50's / Cloudy
GROUNDWATER LEVELS:
DURING DRILLING: 6.0 ft. / El. 164.0 ft. Based on sample moisture
AT END OF DRILLING: 4.0 ft. / El. 166.0 ft.
OTHER: -

DRILLING SUBCONTRACTOR: Northern Drill Service, Inc.
DRILLING FOREMAN: Tyler Kennedy
DRILLING METHOD: Drive and wash with 4-inch casing
DRILL RIG TYPE/MODEL: Mobile B-59 Truck mounted
HAMMER TYPE: Automatic
HAMMER WEIGHT: 140 lb. **HAMMER DROP:** 30 in.
SPLIT SPOON DIA.: 1.375 in. I.D., 2 in. O.D.
CORE BARREL SIZE: NA
LOGGED BY: TG **CHECKED BY:** NP

Depth (ft.)	El. (ft.)	Sample Interval (ft.)	Sample Number	Blow Counts (N Value)	Pen./Rec. (in.)	Remark	Strata	Depth El.(ft.)	Material Description
		0	S1	2-6-6-7 (12)	24/20		Topsoil	0.4	S1 - Top 5": Topsoil
							Fill	169.6	Bot. 15": Silty SAND (SM), fine to medium, trace coarse, 15-20% fines, 5-10% fine subangular gravel, trace of organic soil, trace of roots, brown, moist
		2	S2	7-13-14-16 (27)	24/22			2.0 168.0	S2 - Silty SAND (SM), fine to medium, trace coarse, ~15% fines, 0-5% fine subangular gravel, gray, moist
		4	S3	9-11-12-11 (23)	24/15				S3 - Similar to S2
5	165.0	6	S4	7-7-8-7 (15)	24/16				S4 - Silty SAND (SM), fine to medium, trace coarse, 15-20% fines, gray, wet
		8							
		9	S5	8-10-13-28 (23)	24/18				S5 - Similar to S4, 10-15% coarse subangular gravel
10	160.0	11					Sand and Gravel		
		14	S6	15-20-29-32 (49)	24/20				S6 - Similar to S4
15	155.0	16							
		19	S7	19-24-25-27 (49)	24/20				S7 - Similar to S4
20	150.0	21						21.0	Bottom of borehole at 21.0 feet. Borehole backfilled with drill cuttings.
25	145.0								

GENERAL NOTES:

1. The ground surface elevation was interpolated to the nearest 2 feet from drawing 9 titled: "Burlington Mass.," prepared by COL-EAST, Inc., dated March 24, 1976, and provided to LGCI by Dore and Whittier via e-mail on February 23, 2023.

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BORING LOG

B-2

CLIENT: Burlington Public Schools
PROJECT NAME: Prop. Fox Hill Elementary School
LGCI PROJECT NUMBER: 2307
PROJECT LOCATION: Burlington, MA

DATE STARTED: 2/20/23 **DATE COMPLETED:** 2/20/23
BORING LOCATION: Near northern portion of site
COORDINATES: NA
SURFACE El.: 176 ft. (see note 1) **TOTAL DEPTH:** 21 ft.
WEATHER: 50's / Cloudy
GROUNDWATER LEVELS:
DURING DRILLING: 4.0 ft. / El. 172.0 ft. Based on sample moisture
AT END OF DRILLING: 4.5 ft. / El. 171.5 ft.
OTHER: -

DRILLING SUBCONTRACTOR: Northern Drill Service, Inc.
DRILLING FOREMAN: Tyler Kennedy
DRILLING METHOD: Drive and wash with 4-inch casing
DRILL RIG TYPE/MODEL: Mobile B-59 Truck mounted
HAMMER TYPE: Automatic
HAMMER WEIGHT: 140 lb. **HAMMER DROP:** 30 in.
SPLIT SPOON DIA.: 1.375 in. I.D., 2 in. O.D.
CORE BARREL SIZE: NA
LOGGED BY: TG **CHECKED BY:** NP

Depth (ft.)	El. (ft.)	Sample Interval (ft.)	Sample Number	Blow Counts (N Value)	Pen./Rec. (in.)	Remark	Strata	Depth El.(ft.)	Material Description
	175.0	0	S1	3-9-13-15 (22)	24/12	1	Topsoil	1.0 175.0	S1 - Topsoil REMARK 1: Strata changed assumed based on drilling effort.
		2	S2	15-17-25-23 (42)	24/2		Fill		S2 - Poorly Graded SAND with Silt (SP-SM), fine to medium, trace coarse, 5-10% fines, 10-15% fine to coarse subangular gravel, trace of organic soil, trace of roots, light brown, moist
		4	S3	17-13-15-17 (28)	24/16			4.0 172.0	S3 - Silty SAND (SM), fine to coarse, 15-20% fines, 5-10% fine to coarse subrounded gravel, gray, wet
5	170.0	6	S4	17-26-42-44 (68)	24/20				S4 - Similar to S3
		8							
		9	S5	13-21-25-30 (46)	24/21				S5 - Silty SAND (SM), fine to medium, trace coarse, 20-25% fines, ~5% fine subangular gravel, gray, wet
10	165.0	11					Sand and Gravel		
		14	S6	14-20-25-40 (45)	24/23				S6 - Similar to S5
15	160.0	16							
		19	S7	25-33-49-53 (82)	24/18				S7 - Similar to S5, 5-10% fine angular gravel
20	155.0	21						21.0	Bottom of borehole at 21.0 feet. Borehole backfilled with drill cuttings.
25									

GENERAL NOTES:

1. The ground surface elevation was interpolated to the nearest 2 feet from drawing 9 titled: "Burlington Mass.," prepared by COL-EAST, Inc., dated March 24, 1976, and provided to LGCI by Dore and Whittier via e-mail on February 23, 2023.

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BORING LOG

B-3
PAGE 1 OF 1

CLIENT: Burlington Public Schools
PROJECT NAME: Prop. Fox Hill Elementary School
LGCI PROJECT NUMBER: 2307
PROJECT LOCATION: Burlington, MA

DATE STARTED: 2/20/23 **DATE COMPLETED:** 2/20/23
BORING LOCATION: Near northern portion of site
COORDINATES: NA
SURFACE El.: 174 ft. (see note 1) **TOTAL DEPTH:** 20.3 ft.
WEATHER: 50's / Sunny
GROUNDWATER LEVELS:
DURING DRILLING: 6.0 ft. / El. 168.0 ft. Based on sample moisture
AT END OF DRILLING: 3.8 ft. / El. 170.2 ft.
OTHER: -

DRILLING SUBCONTRACTOR: Northern Drill Service, Inc.
DRILLING FOREMAN: Tyler Kennedy
DRILLING METHOD: Drive and wash with 4-inch casing
DRILL RIG TYPE/MODEL: Mobile B-59 Truck mounted
HAMMER TYPE: Automatic
HAMMER WEIGHT: 140 lb. **HAMMER DROP:** 30 in.
SPLIT SPOON DIA.: 1.375 in. I.D., 2 in. O.D.
CORE BARREL SIZE: NA
LOGGED BY: TG **CHECKED BY:** NP

Depth (ft.)	El. (ft.)	Sample Interval (ft.)	Sample Number	Blow Counts (N Value)	Pen./Rec. (in.)	Remark	Strata	Depth El.(ft.)	Material Description
		0.5	S1	5-7-6 (13)	18/12		Asphalt	0.3 / 173.7	Top 2": Asphalt
							Fill		S1 - Well Graded SAND with Silt (SW-SM), fine to coarse, 5-10% fines, 10-15% fine to coarse subangular gravel, trace of asphalt, brown, moist
		2	S2	4-3-4-3 (7)	24/11			2.0 / 172.0	S2 - Silty SAND (SM), fine to medium, trace coarse, 15-20% fines, 0-5% fine subrounded gravel, light brown, moist
	170.0	4	S3	5-6-5-6 (11)	24/0				S3 - No recovery
5		6	S4	4-5-4-3 (9)	24/24				S4 - Silty SAND (SM), fine to medium, trace coarse, 15-20% fines, 0-5% fine subangular gravel, brown, wet
		8							
	165.0	9	S5	12-10-12-18 (22)	24/20				S5 - Similar to S4
10		11					Sand and Gravel		
	160.0	14	S6	11-19-22-32 (41)	24/20				S6 - Similar to S4, 20-25% fines
15		16							
	155.0	19	S7	15-50-50/3" (100/9")	15/14				S7 - Silty SAND with Gravel (SM), fine to coarse, 20-25% fines, 15-20% fine to coarse angular gravel, trace of weathered rock, gray, wet
20		20.3				1		20.3	REMARK 1: Split spoon refusal encountered at depth of 20.3 feet on possible boulder or rock.
									Bottom of borehole at 20.3 feet. Borehole backfilled with drill cuttings and 5 bags of gravel. Ground surface restored with asphalt cold patch.
	150.0								
25									

GENERAL NOTES:

1. The ground surface elevation was interpolated to the nearest 2 feet from drawing 9 titled: "Burlington Mass.," prepared by COL-EAST, Inc., dated March 24, 1976, and provided to LGCI by Dore and Whittier via e-mail on February 23, 2023.

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BORING LOG

B-4

CLIENT: Burlington Public Schools
PROJECT NAME: Prop. Fox Hill Elementary School
LGCI PROJECT NUMBER: 2307
PROJECT LOCATION: Burlington, MA

DATE STARTED: 2/20/23 **DATE COMPLETED:** 2/20/23
BORING LOCATION: Near NE portion of site
COORDINATES: NA
SURFACE El.: 171 ft. (see note 1) **TOTAL DEPTH:** 21 ft.
WEATHER: 50's / Cloudy
GROUNDWATER LEVELS:
DURING DRILLING: 4.0 ft. / El. 167.0 ft. Based on sample moisture
AT END OF DRILLING: 4.5 ft. / El. 166.5 ft.
OTHER: -

DRILLING SUBCONTRACTOR: Northern Drill Service, Inc.
DRILLING FOREMAN: Tyler Kennedy
DRILLING METHOD: Drive and wash with 4-inch casing
DRILL RIG TYPE/MODEL: Mobile B-59 Truck mounted
HAMMER TYPE: Automatic
HAMMER WEIGHT: 140 lb. **HAMMER DROP:** 30 in.
SPLIT SPOON DIA.: 1.375 in. I.D., 2 in. O.D.
CORE BARREL SIZE: NA
LOGGED BY: TG **CHECKED BY:** NP

Depth (ft.)	El. (ft.)	Sample Interval (ft.)	Sample Number	Blow Counts (N Value)	Pen./Rec. (in.)	Remark	Strata	Depth El.(ft.)	Material Description
	170.0	0	S1	2-7-10-10 (17)	24/15		Topsoil	0.4	S1 - Top 5": Topsoil
								170.6	Bot. 10": Silty SAND (SM), fine to medium, trace coarse, 15-20% fines, 0-5% fine subangular gravel, brown, moist
		2	S2	6-4-4-3 (8)	24/6		Fill		S2 - Similar to S1 Bot. 10" (appears reworked)
		4						4.0 ▽ 167.0 ▼	
5			S3	2-5-6-14 (11)	24/14				S3 - Silty SAND with Gravel (SM), fine to coarse, 15-20% fines, 15-20% fine to coarse subangular gravel, brown, wet
	165.0	6	S4	30-27-24-22 (51)	24/20				S4 - Well Graded SAND with Silt and Gravel (SW-SM), fine to coarse, 10-15% fines, 20-25% fine to coarse angular gravel, brown, wet
		8							
		9	S5	15-19-18-23 (37)	24/17				S5 - Poorly Graded SAND with Silt (SP-SM), fine to medium, 5-10% fines, light brown, wet
10									
	160.0	11					Sand and Gravel		
		14	S6	14-22-19-20 (41)	24/14				S6 - Silty SAND (SM), fine to medium, 15-20% fines, 10-15% fine to coarse angular gravel, brown, wet
15									
	155.0	16							
		19	S7	37-29-35-38 (64)	24/17				S7 - Silty SAND with Gravel (SM), fine to medium, trace coarse, 20-25% fines, 15-20% fine to coarse angular gravel, trace of weathered rock, gray, wet
20									
	150.0	21						21.0	Bottom of borehole at 21.0 feet. Borehole backfilled with drill cuttings.
25									

GENERAL NOTES:

1. The ground surface elevation was interpolated to the nearest 2 feet from drawing 9 titled: "Burlington Mass.," prepared by COL-EAST, Inc., dated March 24, 1976, and provided to LGCI by Dore and Whittier via e-mail on February 23, 2023.

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BORING LOG

B-5
PAGE 1 OF 1

CLIENT: Burlington Public Schools
PROJECT NAME: Prop. Fox Hill Elementary School
LGCI PROJECT NUMBER: 2307
PROJECT LOCATION: Burlington, MA

DATE STARTED: 2/21/23 **DATE COMPLETED:** 2/21/23
BORING LOCATION: Near eastern portion of site
COORDINATES: NA
SURFACE El.: 174 ft. (see note 1) **TOTAL DEPTH:** 20 ft.
WEATHER: 30's / Snow
GROUNDWATER LEVELS:
DURING DRILLING: 6.0 ft. / El. 168.0 ft. Based on sample moisture
AT END OF DRILLING: 4.3 ft. / El. 169.7 ft.
OTHER: -

DRILLING SUBCONTRACTOR: Northern Drill Service, Inc.
DRILLING FOREMAN: Tim Tucker
DRILLING METHOD: Drive and wash with 4-inch casing
DRILL RIG TYPE/MODEL: Mobile B-59 Truck mounted
HAMMER TYPE: Automatic
HAMMER WEIGHT: 140 lb. **HAMMER DROP:** 30 in.
SPLIT SPOON DIA.: 1.375 in. I.D., 2 in. O.D.
CORE BARREL SIZE: NA
LOGGED BY: TG **CHECKED BY:** NP

Depth (ft.)	El. (ft.)	Sample Interval (ft.)	Sample Number	Blow Counts (N Value)	Pen./Rec. (in.)	Remark	Strata	Depth El.(ft.)	Material Description
		0					Topsoil	0.5	S1 - Top 6": Topsoil
			S1	2-4-10-13 (14)	24/12			173.5	Bot. 6": Silty SAND (SM), fine to medium, trace coarse, 15-20% fines, 0-5% fine subangular gravel, trace of organic soil, trace of roots, brown, moist
		2	S2	8-10-5-5 (15)	24/16		Fill		S2 - Similar to S1 Bot. 6", 10-15% fine to coarse subangular gravel
	170.0	4	S3	2-5-8-12 (13)	24/16				S3 - Similar to S1 Bot. 6"
5		6	S4	13-13-8-11 (21)	24/18			6.0 168.0	S4 - Silty SAND (SM), fine to medium, trace coarse, 20-25% fines, 0-5% fine subangular gravel, brown, wet
		8							
	165.0	9	S5	8-7-9-10 (16)	24/17				S5 - Silty SAND (SM), fine to coarse, 15-20% fines, 5-10% fine to coarse subangular gravel, brown, wet
10		11					Sand and Gravel		
	160.0	14	S6	13-12-18-17 (30)	24/13				S6 - Poorly Graded SAND with Silt (SP-SM), fine to medium, trace coarse, 10-15% fines, 5-10% fine to coarse subangular gravel, brown, wet
15		16							
	155.0	19	S7	53-50	12/8				S7 - Silty SAND with Gravel (SM), fine to medium, trace coarse, ~20% fines, 25-30% fine to coarse angular gravel, trace of weathered rock, gray, wet
20		20				1		20.0	REMARK 1: Split spoon refusal encountered at depth of 20 feet on possible boulder or rock.
									Bottom of borehole at 20.0 feet. Borehole backfilled with drill cuttings and 3 bags of gravel.
	150.0								
25									

GENERAL NOTES:

1. The ground surface elevation was interpolated to the nearest 2 feet from drawing 9 titled: "Burlington Mass.," prepared by COL-EAST, Inc., dated March 24, 1976, and provided to LGCI by Dore and Whittier via e-mail on February 23, 2023.

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BORING LOG

B-6

CLIENT: Burlington Public Schools
PROJECT NAME: Prop. Fox Hill Elementary School
LGCI PROJECT NUMBER: 2307
PROJECT LOCATION: Burlington, MA

DATE STARTED: 2/21/23 **DATE COMPLETED:** 2/21/23
BORING LOCATION: Near SE portion of site
COORDINATES: NA
SURFACE El.: 175 ft. (see note 1) **TOTAL DEPTH:** 20 ft.
WEATHER: 30's / Snow
GROUNDWATER LEVELS:
DURING DRILLING: 4.0 ft. / El. 171.0 ft. Based on sample moisture
AT END OF DRILLING: 2.0 ft. / El. 173.0 ft.
OTHER: -

DRILLING SUBCONTRACTOR: Northern Drill Service, Inc.
DRILLING FOREMAN: Tim Tucker
DRILLING METHOD: Drive and wash with 4-inch casing
DRILL RIG TYPE/MODEL: Mobile B-59 Truck mounted
HAMMER TYPE: Automatic
HAMMER WEIGHT: 140 lb. **HAMMER DROP:** 30 in.
SPLIT SPOON DIA.: 1.375 in. I.D., 2 in. O.D.
CORE BARREL SIZE: NX
LOGGED BY: TG **CHECKED BY:** NP

Depth (ft.)	El. (ft.)	Sample Interval (ft.)	Sample Number	Blow Counts (N Value)	Pen./Rec. (in.)	Remark	Strata	Depth El.(ft.)	Material Description
		0	S1	1-8-8-11 (16)	24/14	1	Topsoil	0.5 / 174.5	S1 - Top 6": Topsoil REMARK 1: Puddle of water observed at ground surface.
		2	S2	61-23-14-11 (37)	24/17		Fill		Bot. 8": Poorly Graded SAND with Silt and Gravel (SP-SM), fine to medium, trace coarse, 10-15% fines, 20-25% fine to coarse subrounded gravel, brown, moist S2 - Silty SAND with Gravel (SM), mostly fine to medium, 30-35% fines, 20-25% fine to coarse subangular gravel, brown, moist
		4						4.0 / 171.0	
5	170.0		S3	11-21-7-9 (28)	24/7		Sand and Gravel		S3 - Silty SAND (SM), fine to medium, trace coarse, 15-20% fines, 0-5% fine subangular gravel, gray, wet
		6	S4	11-13-13-17 (26)	24/16				S4 - Similar to S3
		8							
		9							
		9.4	S5	100/5"	5/3	2		9.4 / 165.6	S5 - Similar to S3 REMARK 2: Split spoon refusal encountered at depth of 9.4 feet on possible boulder or rock. Advanced drill bit to depth of 14 into possible boulder or rock.
10	165.0								
		14							
		14.1	S6	100/1"	1/0	3	Rock		REMARK 3: Split spoon refusal encountered at depth of 14.1 feet on rock. Advanced drill bit to depth of 15 and started coring rock. S6 - No recovery
15	160.0	15							
			C1		60/60				C1 - Min./ft.: 2.6, 3.3, 2.9, 3.1, 3.8 REC. = 60"/60" = 100% RQD = 41"/60" = 68.33% Hard to very hard, severely weathered to fresh, slightly fractured to sound, gray to brown, coarse-grained, GRANITE
20	155.0	20						20.0	
									Bottom of borehole at 20.0 feet. Borehole backfilled with drill cuttings.
25	150.0								

GENERAL NOTES:

1. The ground surface elevation was interpolated to the nearest 2 feet from drawing 9 titled: "Burlington Mass.," prepared by COL-EAST, Inc., dated March 24, 1976, and provided to LGCI by Dore and Whittier via e-mail on February 23, 2023.

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BORING LOG

B-7

CLIENT: Burlington Public Schools
PROJECT NAME: Prop. Fox Hill Elementary School
LGCI PROJECT NUMBER: 2307
PROJECT LOCATION: Burlington, MA

DATE STARTED: 2/21/23 **DATE COMPLETED:** 2/21/23
BORING LOCATION: Near eastern portion of site
COORDINATES: NA
SURFACE El.: 173 ft. (see note 1) **TOTAL DEPTH:** 12 ft.
WEATHER: 30's / Snow
GROUNDWATER LEVELS:
DURING DRILLING: 6.0 ft. / El. 167.0 ft. Based on sample moisture
AT END OF DRILLING: 2.0 ft. / El. 171.0 ft.
OTHER: -

DRILLING SUBCONTRACTOR: Northern Drill Service, Inc.
DRILLING FOREMAN: Tim Tucker
DRILLING METHOD: Drive and wash with 4-inch casing
DRILL RIG TYPE/MODEL: Mobile B-59 Truck mounted
HAMMER TYPE: Automatic
HAMMER WEIGHT: 140 lb. **HAMMER DROP:** 30 in.
SPLIT SPOON DIA.: 1.375 in. I.D., 2 in. O.D.
CORE BARREL SIZE: NA
LOGGED BY: TG **CHECKED BY:** NP

Depth (ft.)	El. (ft.)	Sample Interval (ft.)	Sample Number	Blow Counts (N Value)	Pen./Rec. (in.)	Remark	Strata	Depth El.(ft.)	Material Description
		0					Topsoil	0.6	S1 - Top 7": Topsoil
			S1	1-5-9-10 (14)	24/16		Fill	172.4	Bot. 9": Silty SAND (SM), fine to medium, 15-20% fines, 5-10% fine to coarse subangular gravel, trace of organic soil, brown, moist
		2							S2 - No recovery
	170.0		S2	20-11-7-7 (18)	24/0			4.0	
		4						169.0	S3 - Piece of wood
5			S3	5-5-11-2 (16)	24/1		Buried Organic Soil		
		6							S4 - Silty SAND (SM), fine to medium, 25-30% fines, trace of organic soil, trace of roots, dark brown, wet
			S4	2-2-3-4 (5)	24/12				
	165.0	8						8.0	
			S5	10-16-20-17 (36)	24/12			165.0	S5 - Poorly Graded SAND with Silt (SP-SM), fine to medium, 5-10% fines, gray, wet
10		10					Sand and Gravel		
			S6	16-19-19-18 (38)	24/23				S6 - Similar to S5, 10-15% fines
		12						12.0	
	160.0								Bottom of borehole at 12.0 feet. Borehole backfilled with drill cuttings and 2 bags of gravel.
15									
	155.0								
20									
	150.0								
25									

GENERAL NOTES:

1. The ground surface elevation was interpolated to the nearest 2 feet from drawing 9 titled: "Burlington Mass.," prepared by COL-EAST, Inc., dated March 24, 1976, and provided to LGCI by Dore and Whittier via e-mail on February 23, 2023.

Appendix B – LGCI's Test Pit Logs

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TEST PIT LOG

TP-1

CLIENT: Burlington Public Schools
PROJECT NAME: Prop. Fox Hill Elementary School
LGCI PROJECT NUMBER: 2307
PROJECT LOCATION: Burlington, MA

DATE STARTED: 2/21/23 **DATE COMPLETED:** 2/21/23
TEST PIT LOCATION: Near northern portion of site
COORDINATES: NA
SURFACE EL.: 175 ft. (see note 1) **TOTAL DEPTH:** 10 ft.
GROUNDWATER LEVELS:
▽ **DURING EXCAVATION:** 7.0 ft. / El. 168.0 ft. Based on sample moisture
▼ **AT END OF EXCAVATION:** 7.0 ft. / El. 168.0 ft.

EXCAVATION SUBCONTRACTOR: Saunders Construction
EXCAVATION FOREMAN: Keith Webb
EXCAVATOR TYPE/MODEL: Takeuchi TB-175
WEATHER: 30's / Snow
TEST PIT DIMENSIONS: 10.0' x 3.0'
LOGGED BY: OL **CHECKED BY:** NP

Depth (ft)	El. (ft)	Excavation Effort	Remark	Strata	Depth El.(ft.)	Material Description
		E		Topsoil	0.5 / 174.5	0 ft. - 0.5 ft.: Topsoil
		M		Fill	1.4 / 173.6	0.5 ft. - 1.4 ft.: Silty SAND (SM), fine to medium, trace coarse, 20-25% fines, 0-5% fine subangular gravel, brown, moist
2.5	172.5	M		Sand and Gravel		1.4 ft. - 10 ft.: Silty SAND (SM), mostly fine to medium, 30-35% fines, 10-15% fine to coarse subrounded gravel, light brown, moist to wet
5.0	170.0					
7.5	167.5					▼
10.0	165.0		1		10.0	REMARK 1: Test pit terminated at depth of 10 feet due to sides of excavation collapsing. Bottom of test pit at 10.0 feet. Test pit backfilled with excavated material in 12-inch to 18-inch lifts and tamped with the excavator bucket.

GENERAL COMMENTS: **E = Easy, M - Moderate, D = Difficult, V = Very Difficult**

1. The ground surface elevation was interpolated to the nearest 2 feet from drawing 9 titled: "Burlington Mass.," prepared by COL-EAST, Inc., dated March 24, 1976, and provided to LGCI by Dore and Whittier via e-mail on February 23, 2023.

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TEST PIT LOG

TP-2

CLIENT: Burlington Public Schools
PROJECT NAME: Prop. Fox Hill Elementary School
LGCI PROJECT NUMBER: 2307
PROJECT LOCATION: Burlington, MA

DATE STARTED: 2/21/23 **DATE COMPLETED:** 2/21/23
TEST PIT LOCATION: Near NE portion of site
COORDINATES: NA
SURFACE EL.: 172 ft. (see note 1) **TOTAL DEPTH:** 10.5 ft.
GROUNDWATER LEVELS:
DURING EXCAVATION: 8.3 ft. / El. 163.7 ft. Based on sample moisture
AT END OF EXCAVATION: 8.3 ft. / El. 163.7 ft.

EXCAVATION SUBCONTRACTOR: Saunders Construction
EXCAVATION FOREMAN: Keith Webb
EXCAVATOR TYPE/MODEL: Takeuchi TB-175
WEATHER: 30's / Snow
TEST PIT DIMENSIONS: 9.0' x 3.5'
LOGGED BY: OL **CHECKED BY:** NP

Depth (ft)	El. (ft)	Excavation Effort	Remark	Strata	Depth El.(ft.)	Material Description
		E		Topsoil	0.9	0 ft. - 0.9 ft.: Topsoil
	170.0	E		Fill	171.1	0.9 ft. - 5.5 ft.: Silty SAND with Gravel (SM), fine to medium, 15-20% fines, 15-20% fine subrounded gravel, trace of organic soil, cobbles and boulders up to 16" in size, orange-brown, moist
2.5						
	167.5				5.5	
5.0		E		Buried Organic Soil	166.5	5.5 ft. - 7 ft.: Silty SAND (SM), fine to medium, 20-25% fines, trace of organic soil, trace of roots, black, moist
	165.0				7.0	
7.5		E		Sand and Gravel	165.0	7 ft. - 10.5 ft.: Silty SAND (SM), fine, 15-20% fines, 0-5% fine subrounded gravel, brown, moist to wet
	162.5					
10.0			1		10.5	REMARK 1: Test pit terminated at depth of 10.5 feet due to sides of excavation collapsing.
						Bottom of test pit at 10.5 feet. Test pit backfilled with excavated material in 12-inch to 18-inch lifts and tamped with the excavator bucket.

GENERAL COMMENTS: **E = Easy, M - Moderate, D = Difficult, V = Very Difficult**

1. The ground surface elevation was interpolated to the nearest 2 feet from drawing 9 titled: "Burlington Mass.," prepared by COL-EAST, Inc., dated March 24, 1976, and provided to LGCI by Dore and Whittier via e-mail on February 23, 2023.

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TEST PIT LOG

TP-3

CLIENT: Burlington Public Schools
PROJECT NAME: Prop. Fox Hill Elementary School
LGCI PROJECT NUMBER: 2307
PROJECT LOCATION: Burlington, MA

DATE STARTED: 2/21/23 **DATE COMPLETED:** 2/21/23
TEST PIT LOCATION: Near eastern portion of site
COORDINATES: NA
SURFACE EL.: 174 ft. (see note 1) **TOTAL DEPTH:** 10 ft.
GROUNDWATER LEVELS:
DURING EXCAVATION: 7.0 ft. / El. 167.0 ft. Based on sample moisture
AT END OF EXCAVATION: 7.0 ft. / El. 167.0 ft.

EXCAVATION SUBCONTRACTOR: Saunders Construction
EXCAVATION FOREMAN: Keith Webb
EXCAVATOR TYPE/MODEL: Takeuchi TB-175
WEATHER: 30's / Snow
TEST PIT DIMENSIONS: 18.0' x 5.0'
LOGGED BY: OL **CHECKED BY:** NP

Depth (ft)	El. (ft)	Excavation Effort	Remark	Strata	Depth / El. (ft.)	Material Description
		E		Topsoil	0.5 / 173.5	0 ft. - 0.5 ft.: Topsoil
	172.5	E		Fill		0.5 ft. - 6 ft.: Silty SAND with Gravel (SM), fine to coarse, 15-20% fines, 15-20% fine subrounded gravel, trace of organic soil, trace of brick, cobbles and boulders up to about 6' in size, light brown, moist
2.5		M				
	170.0					
5.0		E			6.0 / 168.0	
	167.5	E		Buried Organic Soil		6 ft. - 8.5 ft.: Silty SAND (SM), fine to medium, 25-30% fines, trace of organic soil, trace of roots, black, moist to wet
7.5					8.5 / 165.5	
	165.0	E		Sand and Gravel		8.5 ft. - 10 ft.: Silty SAND (SM), fine, 15-20% fines, 0-5% fine subrounded gravel, orange-brown, wet
10.0			1		10.0	REMARK 1: Test pit terminated at depth of 10 feet due to sides of excavation collapsing.
						Bottom of test pit at 10.0 feet. Test pit backfilled with excavated material in 12-inch to 18-inch lifts and tamped with the excavator bucket.

GENERAL COMMENTS: **E = Easy, M - Moderate, D = Difficult, V = Very Difficult**

1. The ground surface elevation was interpolated to the nearest 2 feet from drawing 9 titled: "Burlington Mass.," prepared by COL-EAST, Inc., dated March 24, 1976, and provided to LGCI by Dore and Whittier via e-mail on February 23, 2023.

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TEST PIT LOG

TP-4

CLIENT: Burlington Public Schools
PROJECT NAME: Prop. Fox Hill Elementary School
LGCI PROJECT NUMBER: 2307
PROJECT LOCATION: Burlington, MA

DATE STARTED: 2/21/23 **DATE COMPLETED:** 2/21/23
TEST PIT LOCATION: Near eastern portion of site
COORDINATES: NA
SURFACE EL.: 175 ft. (see note 1) **TOTAL DEPTH:** 9 ft.
GROUNDWATER LEVELS:
▽ **DURING EXCAVATION:** 5.0 ft. / El. 170.0 ft. Based on sample moisture
▼ **AT END OF EXCAVATION:** 5.0 ft. / El. 170.0 ft.

EXCAVATION SUBCONTRACTOR: Saunders Construction
EXCAVATION FOREMAN: Keith Webb
EXCAVATOR TYPE/MODEL: Takeuchi TB-175
WEATHER: 30's / Snow
TEST PIT DIMENSIONS: 12.0' x 5.0'
LOGGED BY: OL **CHECKED BY:** NP

Depth (ft)	El. (ft)	Excavation Effort	Remark	Strata	Depth El.(ft.)	Material Description
		E		Topsoil	0.6	0 ft. - 0.6 ft.: Topsoil
		E		Fill	174.4 2.3	0.6 ft. - 2.3 ft.: Silty SAND with Gravel (SM), fine to coarse, ~20% fines, 15-20% fine to coarse subrounded gravel, trace of organic soil, trace of roots, trace of brick, brown, moist
2.5	172.5	E		Buried Organic Soil	172.7 4.5	2.3 ft. - 4.5 ft.: Silty SAND (SM), fine to medium, 25-30% fines, trace of organic soil, trace of roots, trace of wood, black, moist
5.0	170.0	M		Sand and Gravel	170.5	4.5 ft. - 9 ft.: Silty SAND (SM), fine, 20-25% fines, 0-5% fine subrounded gravel, cobbles and boulders up to about 2' in size, light brown, moist to wet ▼
7.5	167.5		1		9.0	REMARK 1: Test pit terminated at depth of 9 feet due to sides of excavation collapsing.
						Bottom of test pit at 9.0 feet. Test pit backfilled with excavated material in 12-inch to 18-inch lifts and tamped with the excavator bucket.

GENERAL COMMENTS: **E = Easy, M - Moderate, D = Difficult, V = Very Difficult**

1. The ground surface elevation was interpolated to the nearest 2 feet from drawing 9 titled: "Burlington Mass.," prepared by COL-EAST, Inc., dated March 24, 1976, and provided to LGCI by Dore and Whittier via e-mail on February 23, 2023.

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TEST PIT LOG

TP-5

CLIENT: Burlington Public Schools
PROJECT NAME: Prop. Fox Hill Elementary School
LGCI PROJECT NUMBER: 2307
PROJECT LOCATION: Burlington, MA

DATE STARTED: 2/21/23 **DATE COMPLETED:** 2/21/23
TEST PIT LOCATION: Near SE portion of site
COORDINATES: NA
SURFACE EL.: 180 ft. (see note 1) **TOTAL DEPTH:** 8 ft.
GROUNDWATER LEVELS:
▽ **DURING EXCAVATION:** 2.0 ft. / El. 178.0 ft. Based on sample moisture
▼ **AT END OF EXCAVATION:** 2.0 ft. / El. 178.0 ft.

EXCAVATION SUBCONTRACTOR: Saunders Construction
EXCAVATION FOREMAN: Keith Webb
EXCAVATOR TYPE/MODEL: Takeuchi TB-175
WEATHER: 30's / Snow
TEST PIT DIMENSIONS: 10.0' x 4.0'
LOGGED BY: OL **CHECKED BY:** NP

Depth (ft)	El. (ft)	Excavation Effort	Remark	Strata	Depth El.(ft.)	Material Description
		E		Topsoil	0.5 / 179.5	0 ft. - 0.5 ft.: Topsoil
		E		Fill	1.5 / 178.5	0.5 ft. - 1.5 ft.: Silty SAND (SM), fine to coarse, 20-25% fines, 10-15% fine to coarse subrounded gravel, brown, moist
2.5	177.5	E		Sand and Gravel		1.5 ft. - 8 ft.: Silty SAND (SM), fine to medium, 15-20% fines, 25-30% fine to coarse subrounded gravel, cobbles up to 8" in size, brown, moist to wet ▼
5.0	175.0	M				
7.5	172.5	D	1		8.0	REMARK 1: Excavator refusal encountered at depth of 8 feet on possible boulder or rock. Test pit terminated.
						Bottom of test pit at 8.0 feet. Test pit backfilled with excavated material in 12-inch to 18-inch lifts and tamped with the excavator bucket.

GENERAL COMMENTS: **E = Easy, M - Moderate, D = Difficult, V = Very Difficult**

1. The ground surface elevation was interpolated to the nearest 2 feet from drawing 9 titled: "Burlington Mass.," prepared by COL-EAST, Inc., dated March 24, 1976, and provided to LGCI by Dore and Whittier via e-mail on February 23, 2023.

LGCI
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TEST PIT LOG

TP-6

CLIENT: Burlington Public Schools
PROJECT NAME: Prop. Fox Hill Elementary School
LGCI PROJECT NUMBER: 2307
PROJECT LOCATION: Burlington, MA

DATE STARTED: 2/21/23 **DATE COMPLETED:** 2/21/23
TEST PIT LOCATION: Near southern portion of site
COORDINATES: NA
SURFACE EL.: 179 ft. (see note 1) **TOTAL DEPTH:** 7.4 ft.
GROUNDWATER LEVELS:
DURING EXCAVATION: Not encountered
AT END OF EXCAVATION: Not encountered

EXCAVATION SUBCONTRACTOR: Saunders Construction
EXCAVATION FOREMAN: Keith Webb
EXCAVATOR TYPE/MODEL: Takeuchi TB-175
WEATHER: 30's / Snow
TEST PIT DIMENSIONS: 10.0' x 4.0'
LOGGED BY: OL **CHECKED BY:** NP

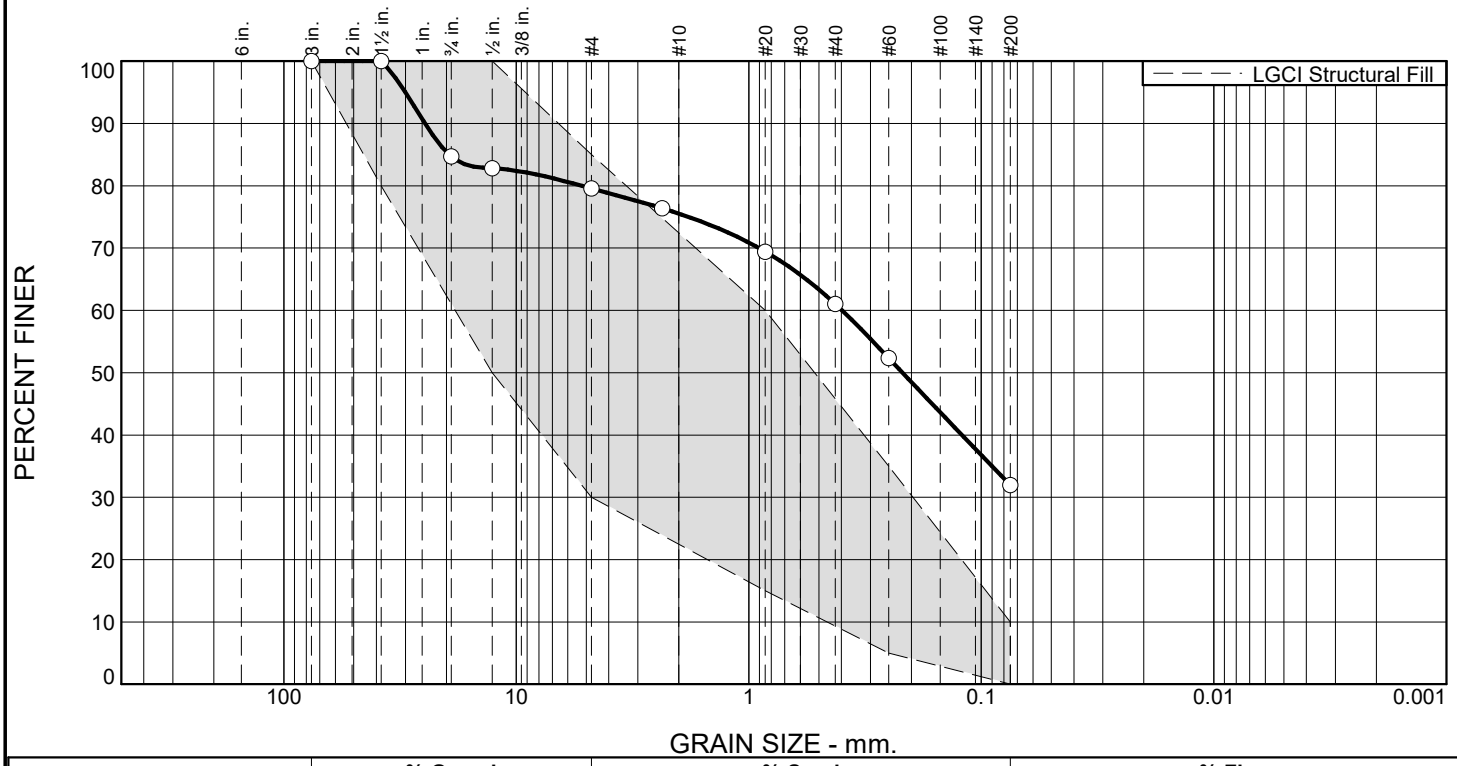
Depth (ft)	El. (ft)	Excavation Effort	Remark	Strata	Depth El.(ft.)	Material Description
		E		Topsoil	0.5 / 178.5	0 ft. - 0.5 ft.: Topsoil
	177.5	E		Fill	2.2 / 176.8	0.5 ft. - 2.2 ft.: Silty SAND with Gravel (SM), fine to coarse, 15-20% fines, 15-20% fine to coarse subrounded gravel, trace of organic soil, trace of roots, trace of brick, cobbles and boulders up to 20" in size, light brown, moist
2.5						
	175.0	M		Sand and Gravel		2.2 ft. - 7.4 ft.: Silty SAND with Gravel (SM), fine to medium, ~20% fines, 15-20% fine to coarse subrounded gravel, brown, moist
5.0						
	172.5	D	1		7.4	REMARK 1: Excavator refusal encountered at depth of 7.4 feet on possible boulder or rock.
						Bottom of test pit at 7.4 feet. Test pit backfilled with excavated material in 12-inch to 18-inch lifts and tamped with the excavator bucket.

GENERAL COMMENTS: **E = Easy, M - Moderate, D = Difficult, V = Very Difficult**

1. The ground surface elevation was interpolated to the nearest 2 feet from drawing 9 titled: "Burlington Mass.," prepared by COL-EAST, Inc., dated March 24, 1976, and provided to LGCI by Dore and Whittier via e-mail on February 23, 2023.

Appendix C – Laboratory Test Results

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	15.3	5.1	4.1	14.4	29.1	32.0	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3"	100.0	100.0	
1.5"	100.0	80.0 - 100.0	
0.75"	84.7		
0.5"	82.8	50.0 - 100.0	
#4	79.6	30.0 - 85.0	
#8	76.4		
#20	69.4	15.0 - 60.0	X
#40	61.1		
#60	52.3	5.0 - 35.0	X
#200	32.0	0.0 - 10.0	X

* LGCI Structural Fill

Material Description

ASTM (D 2488) Classification: Silty SAND with Gravel (SM), mostly fine to medium, 30-35% fines, 20-25% fine to coarse subangular gravel, brown

Atterberg Limits (ASTM D 4318)

PL= **LL=** **PI=**

Classification

USCS (D 2487)= **AASHTO (M 145)=**

Coefficients

D_{90}= 24.6925 D_{85}= 19.4344 D_{60}= 0.3964
D_{50}= 0.2182 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Fill sample.

Date Received: 2/21/23 **Date Tested:** 2/22/23

Tested By: NP

Checked By: SL

Location: Boring B-6
Sample Number: S2 **Depth:** 2.0'-4.0'

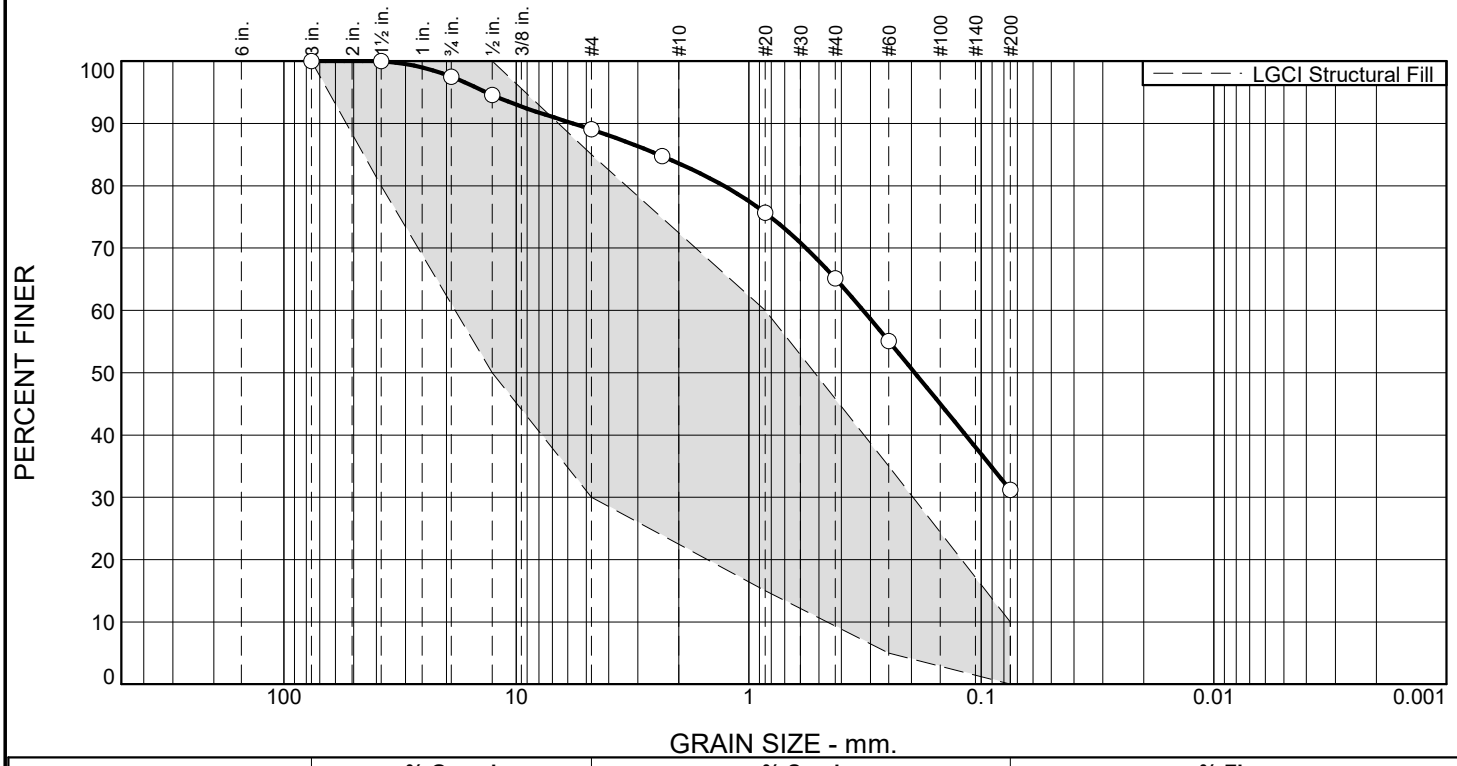
Date Sampled: 2/21/23

LGCI
Lahlaf Geotechnical Consulting, Inc.

Client: Burlington Public Schools
Project: Proposed Fox Hill Elementary School, Burlington, MA

Project No: 2307 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	2.5	8.4	5.5	18.5	33.9	31.2	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3"	100.0	100.0	
1.5"	100.0	80.0 - 100.0	
0.75"	97.5		
0.5"	94.6	50.0 - 100.0	
#4	89.1	30.0 - 85.0	X
#8	84.8		
#20	75.6	15.0 - 60.0	X
#40	65.1		
#60	55.1	5.0 - 35.0	X
#200	31.2	0.0 - 10.0	X

* LGCI Structural Fill

Material Description

ASTM (D 2488) Classification: Silty SAND (SM), mostly fine to medium, 30-35% fines, 10-15% fine to coarse subrounded gravel, light brown

Atterberg Limits (ASTM D 4318)

PL= **LL=** **PI=**

Classification

USCS (D 2487)= **AASHTO (M 145)=**

Coefficients

D_{90}= 5.6863 D_{85}= 2.4473 D_{60}= 0.3219
D_{50}= 0.1932 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Natural sand and gravel sample.

Date Received: 2/21/23 **Date Tested:** 2/22/23

Tested By: NP

Checked By: SL

Location: Test Pit TP-1
Sample Number: Grab **Depth:** 1.4'-10.0'

Date Sampled: 2/21/23

LGCI
Lahlaf Geotechnical Consulting, Inc.

Client: Burlington Public Schools
Project: Proposed Fox Hill Elementary School, Burlington, MA

Project No: 2307 **Figure**