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Subsurface Exploration
Foundation Specialty Systems

Laboratory Soil Testing
Ground Improvement

Geothermal Testing
Earthwork Testing

27 November 2024
File No. 2436

Town of Reading
c/o Bargmann Hendrie Archetype
9 Channel Center Street – Suite 300
Boston, MA 02210

Attention: Mason Brunnick - COO

Subject: ***Geotechnical Data Summary Report***
Proposed Community Center
Range Road
Reading, Massachusetts 01867

Dear Mason:

This geotechnical data summary report gives our site background data review, subsurface explorations (soil, groundwater), field soil testing, engineering data summary, analyses and calculations for the proposed new construction on Range Road in Reading, Massachusetts (*Figure 1A*).

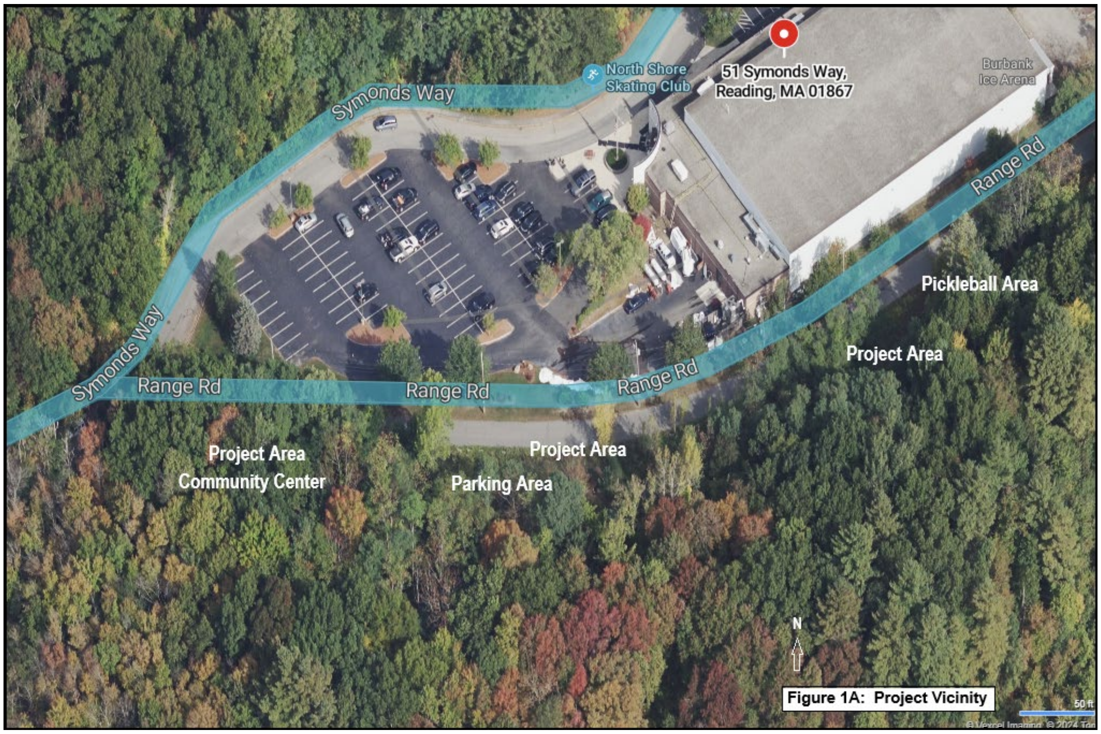


Figure 1A: Project Vicinity

45 New Ocean Street – Suite A
Swampscott, MA 01907
Tel. 781/646-6982

354 Ashburnham Street
Fitchburg, MA 01420
Tel. 617/201-0914

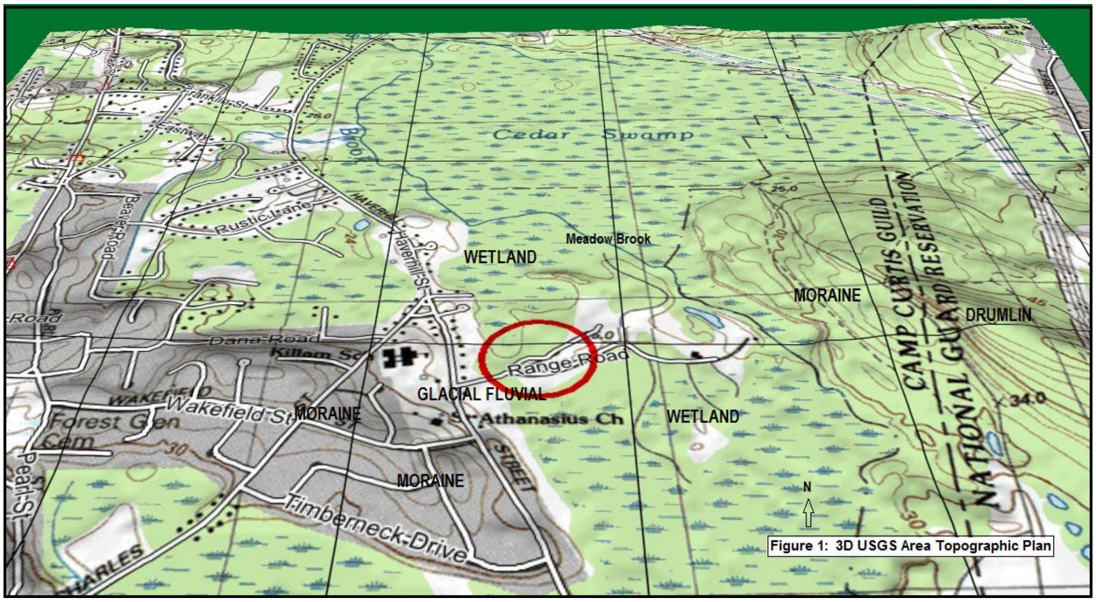


Figure 1: 3D USGS Area Topographic Plan

I. Proposed Construction:

Existing Conditions:

- <u>Plan reference</u>:
  - *Approval Not Required Plan of Land – Haverhill Street Lot 133 Map 35 Town of Reading, Middlesex County, Commonwealth of Massachusetts*; prepared by Control Point Associates, Inc. of South Marlborough, MA; dated 22 June 2022.
  - No site utilities survey was required as the property is raw woodland.

- <u>Direction, Datum, Elevation and Coordinates</u>:
  - Direction:
    - Plan north: *Figure 1A, Figure 1*
    - Called north for this review: in the general direction of Symonds Way.
  - Elevation and datum:
    - Vertical elevations:
      - Site topographic elevations were provided on the site survey plan.
      - The proposed new community center building footprint is relatively level with site elevations ranging from El. 86 ft.+/- to El. 88 ft.+/-.
    - Elevation datum: NAV88.
  - Site coordinates:
    - Latitude: 42.5412° N
    - Longitude: -71.0850° W

- <u>Existing Site Conditions</u>:
  - No attempt has been made to undertake a detailed history of this site. Historic review is included in research for Phase I environmental site assessments.
    - No useful site area mapping was found except an undated map which showed three structures directly across Range Road (*Figure 1B*). The subject site was undeveloped.
    - During the 1950s a missile launch site was created directly across the street on Range Road. This launch site was decommissioned in 1963. A 1977 aerial map seems to show remnants of the launch site. The subject site remained undeveloped.
    - By 1994 the launch site had been redeveloped as the Burbank Ice Arena and parking area, which remain today. The subject site remained undeveloped (*Figure 1A*).

- Immediate site area topography is slightly to moderately sloping (*Figure 1*).
- Site underground utilities (water, sewer) are not relevant as this is a raw woodland property. Even so, an area utilities list is held by us.

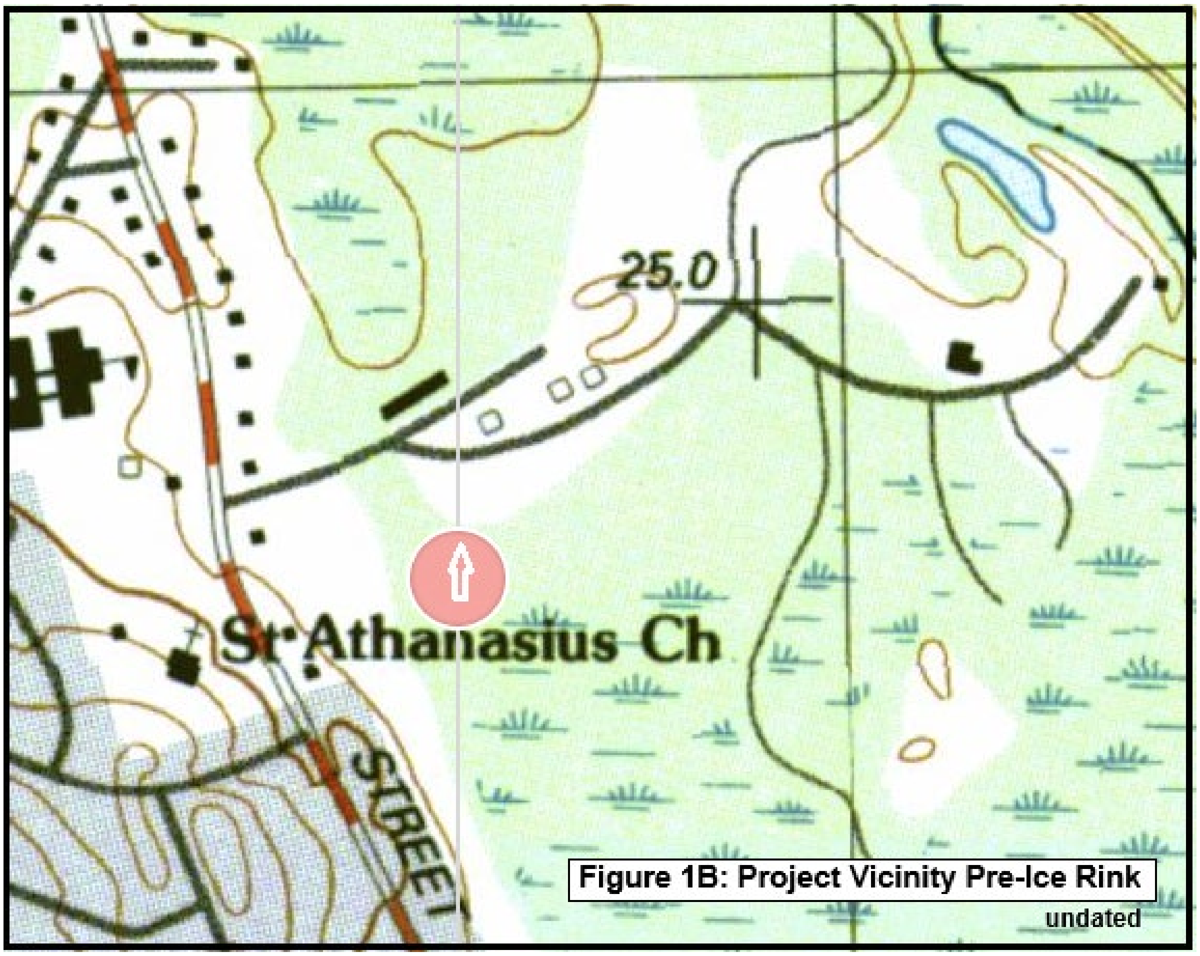


Figure 1B: Project Vicinity Pre-Ice Rink

undated

Anticipated New Construction:

- <u>Plan Reference</u>:
  - *Reading CAL – Town of Reading*; prepared by Bargmann Hendrie & Archetype of Boston, MA, dated 1 November 2024.

- <u>New Building Structural Information</u>: *Figure 1C*
  - New construction:
    - Above-grade floor levels: two (2)
    - Below-grade floor level: none currently planned
    - Elevator included in design: one (1) conventional
  - Footings:
    - Applied loads: assumed maximum
      - Columns: 100 K
      - Exterior walls: 4 KLF
    - Bottom of footing (BOF):
      - Exterior: at minimum at recommended frost depth
      - Interior: 2 feet below first floor finish floor slab
  - Ground floor elevation: assumed 1st floor FFE at El. 88 ft.+/- (NAV88).

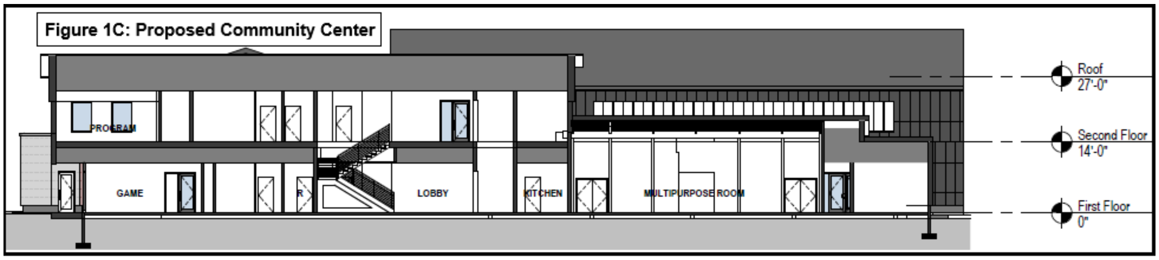


Figure 1C: Proposed Community Center

- Ground floor loads (assumed):
  - Mechanical and storage areas: 150 PSF applied total load
  - Public use areas: 150 PSF applied total load
  - Interior equipment parking area: 450 PSF, if any are planned.
- Elevator pit: pit base at 5 ft. below 1st floor FFE; El. 83 ft.+/- (NAV88)

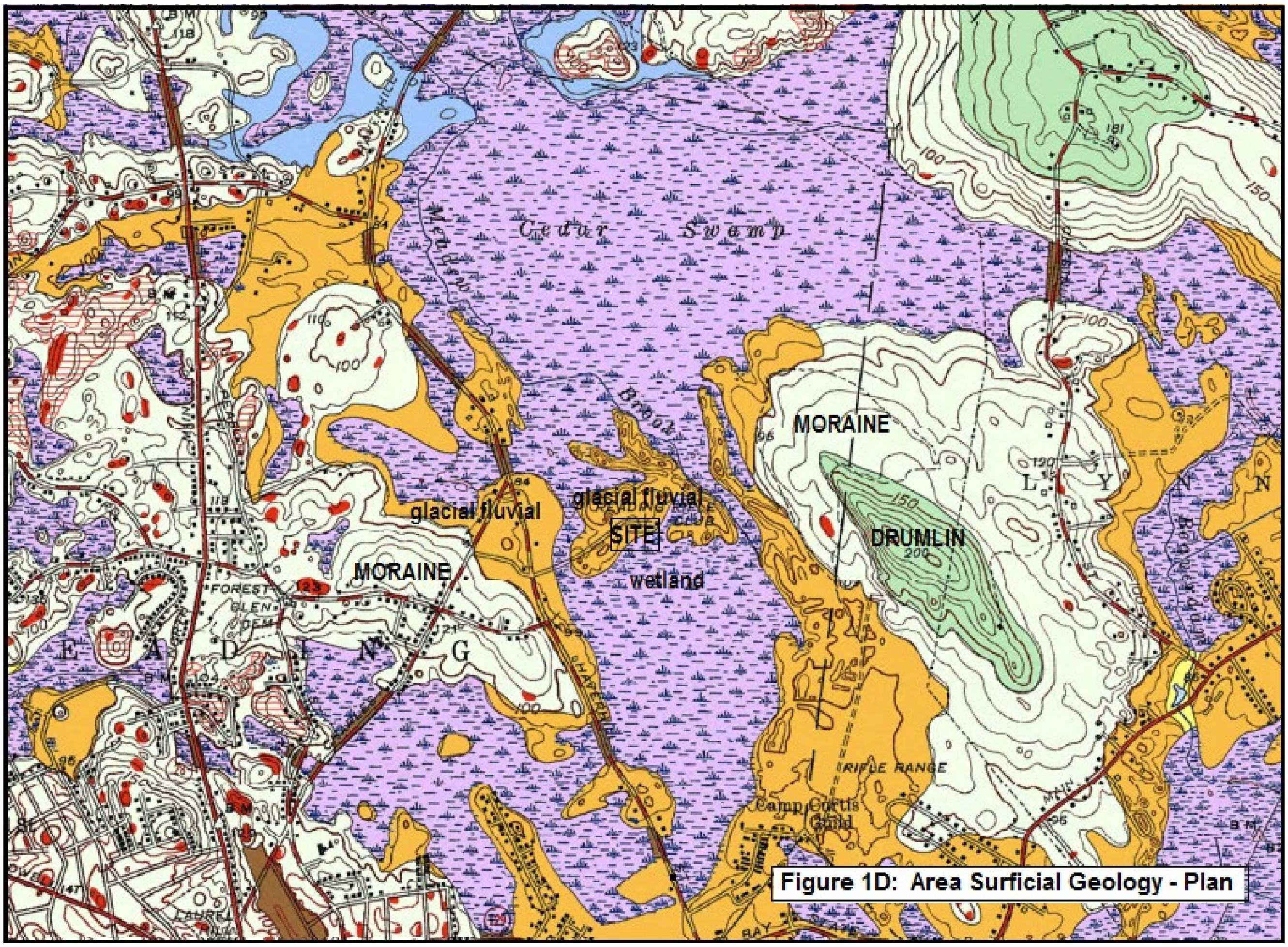


Figure 1D: Area Surficial Geology - Plan

II. Subsurface Conditions:

Topographic Data:

- Elevation Range: the immediate site area is slightly to moderately sloping (*Figure 1D-1, Figure 1*).

- Area Surficial Geology:
  - Area surficial geology is the result of a series of glacial advances and retreats with possible occasional intrusive marine action.
    - The result in the general area was land dotted with glacial moraines and glacial drumlins with adjacent extensive low-lying glacial outwash (glacial fluvial) plains *Figure 1D*). In this area the outwash is overshadowed by extensive wetland.
    - Glacial drumlin and moraine formations were left behind by glacial scour and melt.
    - Areas near rivers also had alluvial (river flood) sediment contributions within their lowland formation (alluvial land; Bear Meadow Brook, northeast) as contrasted with sedimentation within glacial outwash plains (*Figure 1D-1*).
    - Glacial upland formations (drumlins, moraines) can contain extensive mapped adjacent glacial outwash soil deposits as shown in this area in *Figure 1D*.
      - Glacial moraines are an accumulation by deposition of glacial drift (silt, sand and gravel) within a glaciated region. Thrust of glacial ice (bulldozed material) occurred frequently. Exposed bedrock is common.
      - Glacial drumlins are oval hills of clay, silt, sand and gravel compacted under pressure at the base of hundreds of vertical feet of glacial ice. A drumlin's axis indicates the direction of ice movement (compacted material).
      - An alluvial plain is formed by granular soil left behind by repeated river flooding providing silt, sand and gravel commonly found in the relatively level areas beyond the river. Outwash plain soils are similarly formed within glacial meltwater.
    - According to *Figure 1D*, the site lies within mapped glacial outwash. Subsoils associated with this formation would largely include a mix of gravel, sand and silt.
  - According to area surficial geologic mapping utilizing the site latitude and longitude coordinates [*Massachusetts GIS, Surficial Geology;* Commonwealth of Massachusetts Office of Geographic Information; September 2012; updated 2018] the site was predicted to be situated upon on one or more of the following surficial native soil units:
    - Glacial outwash (water placed silt, sand and gravel); glacial fluvial
    - Glacial till

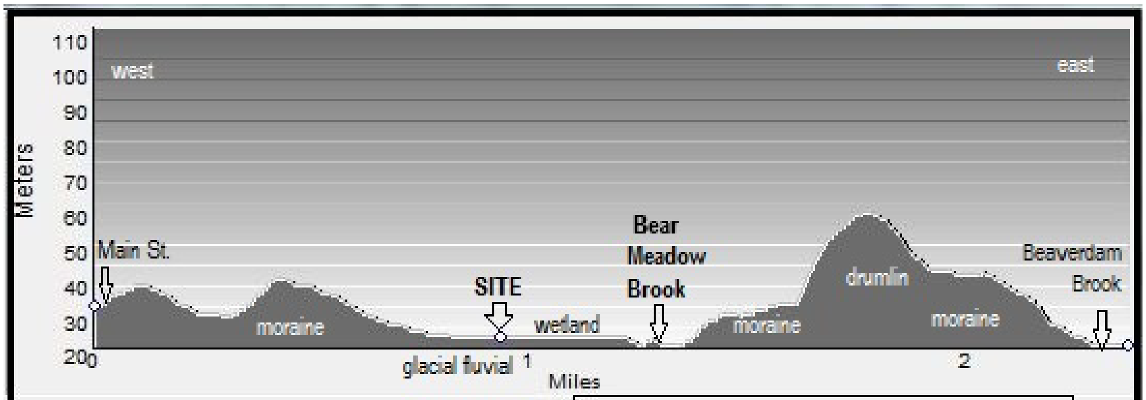


Figure 1D-1: Area Surficial Geology - Profile

- Water Bodies:
  - The following mapped water bodies are closest to the subject site:
    - Pond: 1760 ft. northeast.
    - Bear Brook: 1860 ft. northeast
    - No other significant project area water bodies (ponds, lakes, rivers, streams) are mapped on *Figure 1* within a 1-mile radius of the subject site.
  - Wetlands
    - South Cedar Swamp: adjacent south, east
    - Cedar Swamp: 500 ft. north

- Anticipated Site Substrata: Based upon the collected geologic and topographic data, anticipated native site substrata were considered to potentially include:
    - Man-placed fill
    - Organic soil (peat, organic silt)
    - Glacial outwash (water sorted silt, sand and gravel)
    - Glacial till (ablation till, basal till)
    - Bedrock

- Area Bedrock Geology: [US Department of the Interior; US Geological Survey, *Massachusetts State Geologic Map*; 1998; updated 2018; see *Figure 1E*]
    - Primary rock: volcanic
        - Hardness: a medium hard rock; igneous
        - Structure: fine grained
        - Mineralogy: felsic with rhyolite
    - Primary rock: gabbro
        - Hardness: a dark hard rock; igneous
        - Structure: medium to coarse grained equigranular
        - Mineralogy: feldspar with ferromagnesian minerals; no quartz
    - Primary rock: diorite
        - Hardness: a hard rock; intrusive igneous
        - Structure: medium to coarse grained granular
        - Mineralogy: feldspar; no quartz
    - Depth to bedrock data was not available from MA GIS (2018 database).

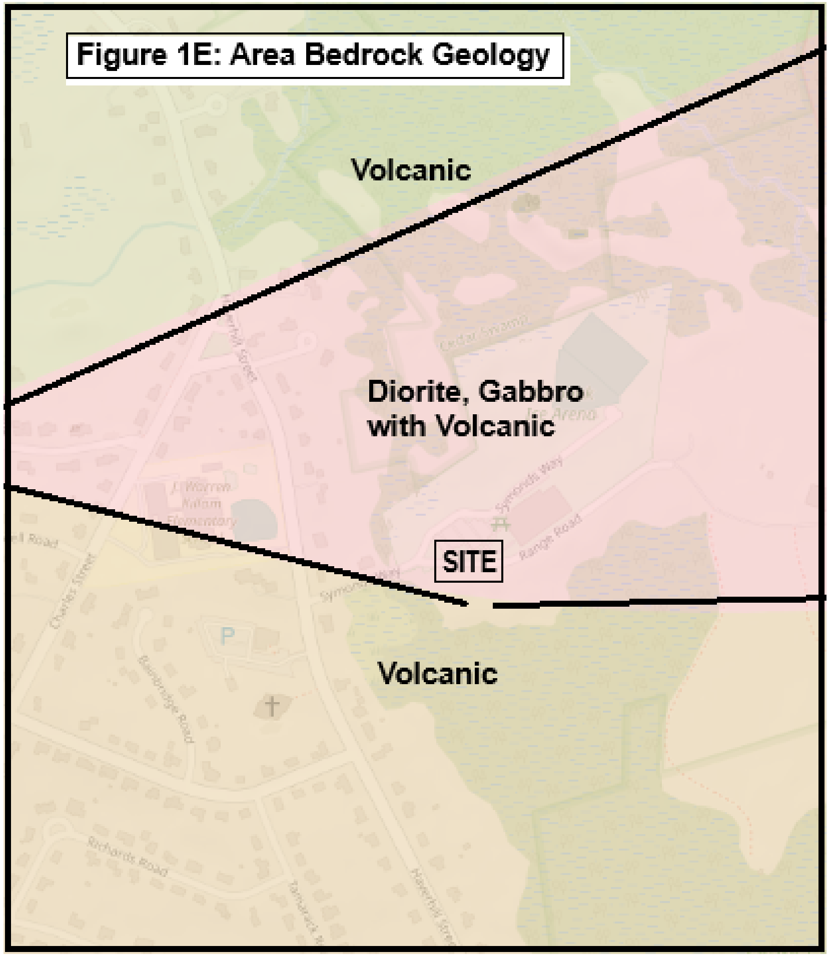


Figure 1E: Area Bedrock Geology

Previous Test Borings and Monitoring Wells

- On-Site Borings: no previous on-site boring records were found

- Previous Area Borings: no previous boring records were found

- Existing Groundwater Monitoring Wells:
    - Three remnant groundwater monitoring wells were found on this site (designated Well A, B, and C; *Figure 2*).
    - No wells were noted on adjacent properties.

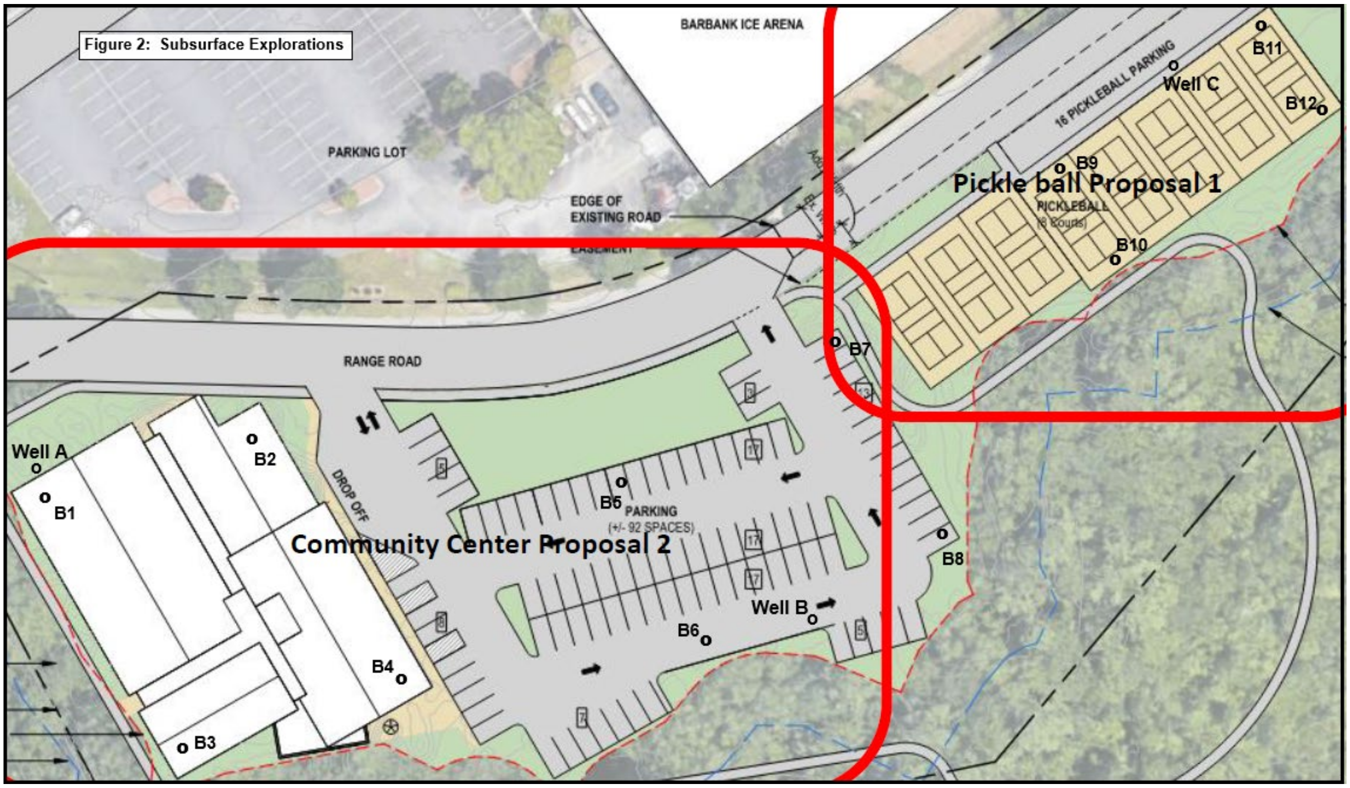


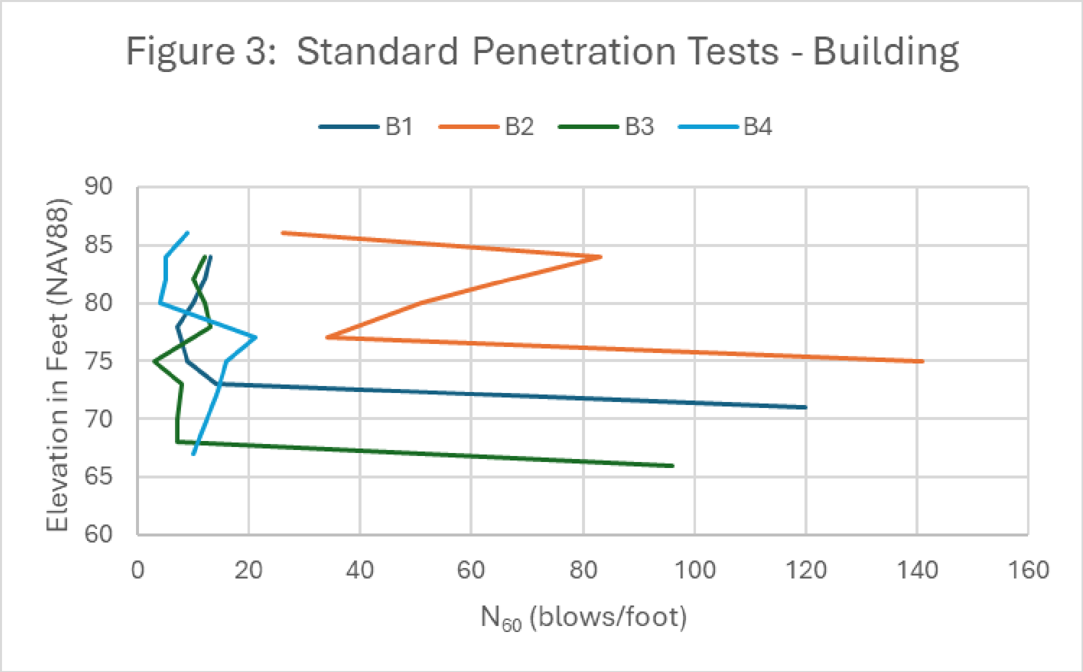
Figure 2: Subsurface Explorations

Test Borings Undertaken for this Study

- <u>Dig Safe</u>: was performed by us

- <u>Test Borings</u>:
  - Drilling was performed by Cosmo Drilling of Ocean Bluffs, MA:
    - Twelve (12) structural test borings (designated B1 through B12) were drilled on-site during November 2024 (*Figure 2*). Drilling dates for the individual borings are provided on the boring logs in *Appendix A*.
    - Refer to *Figure 2: Subsurface Explorations* for approximate as-drilled test boring locations.
  - A tripod mounted (portable) drill-rig equipped with a drop hammer drilled and sampled soils in the borings below grade.
    - 3-in. dia. BW cased drive and wash borings were advanced
    - Community center borings B1 to B4 were terminated either to top of possible bedrock or 22 ft. below existing site grade (*Table I, Figure 5A, Figure 5B*).
    - Paved area and pickleball court borings (B5 to B12; *Figure 2*) to shallow depths, typically to either possible top of bedrock or dense glacial soil.
  - Soil samples were generally taken in 2-foot increments continuously from ground surface to up to 12 ft. depth and at 5-foot intervals thereafter (*Appendix A*).

- <u>Digital Boring Logs</u>:
  - Recovered test boring soil samples were digitally logged by the geotechnical engineer in accordance with *ASTM D-5434-97: Standard Guide for Logging of Subsurface Explorations of Soil and Rock*.
  - Boring logs prepared by the engineer are presented in soil boring log sheets in *Appendix A.* Log details soil type, boundary elevation or depth, density, consistency, thickness, coloration, moisture and composition.



III. Geotechnical Testing:

Field Testing Performed:

- Standard Penetration Tests (SPT) (N_{60} in blows/foot)
- Field Gradation Tests

Standard Penetration Testing (SPT):

- SPT Presentation and Definition:
  - A standard penetration test is defined as the number of blows of a 140 lb. hammer falling 30 inches to drive a standard soil split spoon sampler 12 vertical inches. The number of blows is designated as "N"
  - Standard penetration tests (SPT) N are summarized for the four building borings with depth on the boring logs in *Appendix A* and for the borings in *Figure 5A, Figure 5B.*
  - Field SPT N (blows/foot) is taken from blow count graphs provided on the boring logs.
  - Standard penetration test N is plotted for the four building borings in *Figure 3.*

- SPT Type:
  - The borings drilled (see *Appendix A*) used a drop hammer sampler drive system.
  - Borings were advanced using drive and wash methodology. This drilling technique is known to yield more accurate N values than either auger or percussion drilling.

- SPT N Data Analysis of this Site: see also *Appendix A*
  - Note that in the plot of N with depth in *Figure 3:*
    - Boring N values are variable within the near surface existing fill soil.
    - Boring N values are also variable with depth within the sandy glacial fluvial soils and then generally increase with additional depth.
    - No casing or split spoon refusal was found in any of the four borings, which could have indicated the top of possible bedrock.
  - See also the N pattern variation with respect to soil type in *Figure 5A, Figure 5B* as well as in the blow count graphs on individual boring logs in *Appendix A.*

- SPT N Engineering Uses: SPT data can be useful in determination of values of soil bearing capacity, Young's Modulus for footing settlement evaluation, as well as input to footing base soil friction angle, seismic site class and slab subgrade modulus determination.

Field Gradation Tests:

- Test Use:
  - Limited field gradation tests were performed to better determine the relative percents of coarse gravel, fine gravel, coarse sand, and medium sand and fines (silt and fine sand) in recovered site granular fill and sandy glacial fluvial subsoil samples.

- Limitations:
  - Field tests are limited to recovered dry or field air dried soil samples.
  - 4-sieve method does not allow for separation of silt from fine sand.

Laboratory Soil Tests:

- Test Boring Sampling:
  - No laboratory soil particle gradation testing was undertaken for this review.
  - Test boring samples are typically too small in recovered volume for accurate lab testing.

- Quality of Sampled Soils for Re-use: refer to the final section of this report.

IV. Soil Strata:

Data Summaries:

- Subsoil Profile Data Summary: general summaries of soil substrata found in the subsurface explorations are provided in:
  - *Table I: Exploration Summary*.
  - The subsoil profile drawings (*Figure 5A, Figure 5B*); and
  - The test boring logs (*Appendix A*).
  - Report section: Site Subsoil Descriptions

- Exploration Summary Table: refer to *Table I*

Table I: Exploration Summary – Community Center Building

Location	***Surface El. (ft.) (NAV88)***	***Depth Drilled (ft.)***	***AR Existing Fill (ft.)***	***All SP & SP-GP Glacial Fluvial (medium dense to dense) (ft.)***	***All SP Glacial Fluvial (low medium dense) (ft.)***	***All SP Glacial Fluvial (very loose to loose) (ft.)***	***Depth to Possible Gabbro Bedrock (ft.)***
B1	86+/-	15.4R	1	---	5	9.4	15.4
B2	88+/-	13.2R	5	8.2	---	---	13.2
B3	86+/-	21R	1	---	8	11	20
B4	88+/-	22	9.5	4	3	>5.5	>22

- Subsurface Profile Drawings:
  - Refer to the subsoil profiles sketched in *Figure 5A, Figure 5B* to gain an initial overview of site subsurface soil conditions at the locations drilled (*Figure 2*).
  - Subsoil profiles' orientations are parallel to Range Road (*Figure 2)* and are at the perimeter of the proposed new site building.

- Subsoil Profile Field Log Descriptions: Detailed field subsoil descriptions are given in the logs of the borings presented in *Appendix A*.

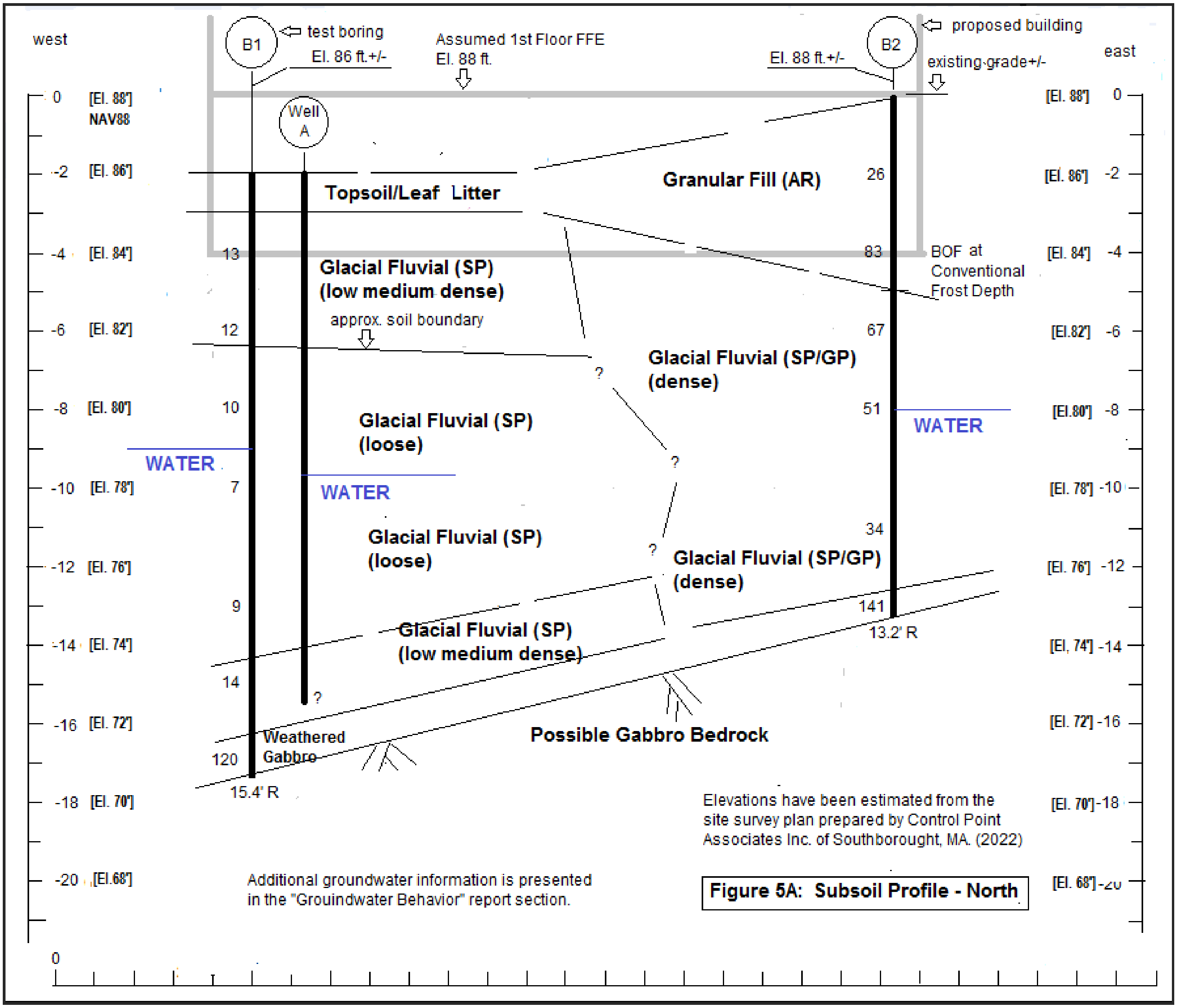
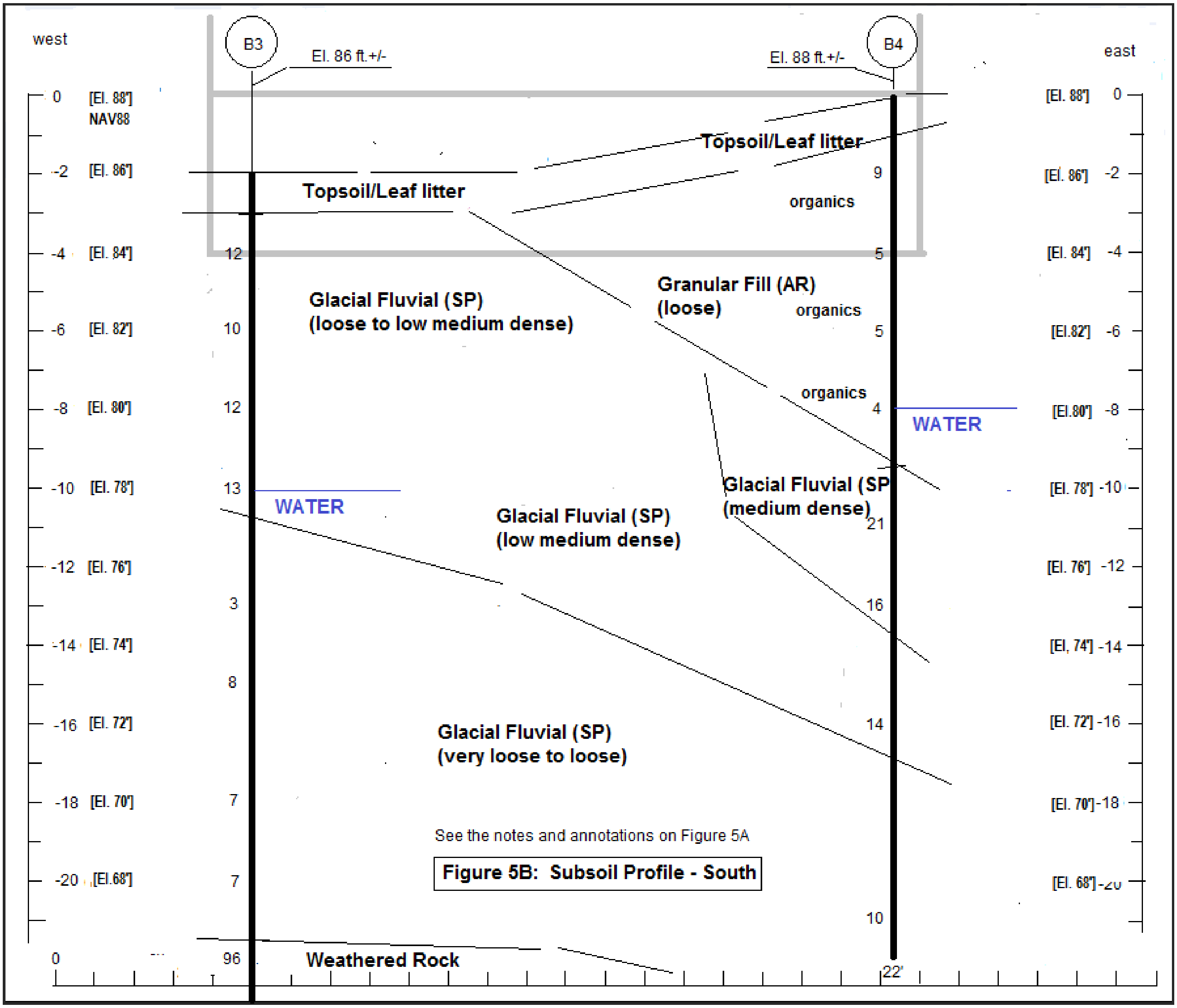


Figure 5A: Subsoil Profile - North



See the notes and annotations on Figure 5A

Figure 5B: Subsoil Profile - South

Soil Classification System Used for this Site Investigation:

- <u>Soil Classification System</u>: Project soils have been classified in accordance with the Unified Soil Classification System (USCS; MIT System). This is reflected in the test boring logs in *Appendix A*.

- <u>Soil Descriptions</u>: Soils are described in terms of color, grain size, moisture content, density (coarse grained soils), consistency (fine grained soils), plasticity and cementation, as appropriate.

Grain	Size Boundaries (dia.)	Common Size Example
Boulder	>12 in.	>Basketball
Cobble	3-in. to 12-in.	Grapefruit size

Coarse Gravel	¾-in. to 3-in.	Lemon size
Fine Gravel	#4 Sieve (4.75mm) to ¾-in.	Pea to grape size
Coarse Sand	#10 Sieve (2 mm) to #4 Sieve	Peppercorn size
Medium Sand	# 40 Sieve (.425 mm) to #10 Sieve	Sugar to table salt size
Fine Sand	#200 Sieve (.075 mm) to #40 Sieve	Powdered sugar size
Silt/Clay	<#200 Sieve (.075 mm)	Flour particle or finer

- Soil Moisture Content:
  - Dry: no moisture noted
  - Moist: some moisture observed
  - Very moist: very moist, but not saturated (possible vadose zone)
  - Wet: saturated above the liquid limit (likely groundwater zone)

- Soil Density and Consistency:
  - Density of coarse grained soils (non-plastic silts, sands, gravels): defined in terms of standard penetration test blowcount N values (refer to the summary table at the bottom of any boring log)
  - Consistency (plastic silts, clay, and organics): defined secondarily in terms of blowcount N values and primarily with respect to field unconfined compressive strength in TSF (refer to the summary table at the bottom of any boring log).

- Soil Particle Percentage Field Designation: Relative soil particle size percentages (trace, few, little, some, mostly [capitalized soil unit]): refer to summary table at bottom of any boring log. These are more accurately tallied by laboratory soil particle gradation tests.

- Subsoil Classes on this Site: USCS soil type designations utilized in this report:
  - AR = man placed fill, artificial soil stratum
  - SP = glacial fluvial sand; uniform
  - GP = glacial fluvial gravel
  - GT = glacial till; ablation till

Site Subsoil Descriptions: community center building

- Existing Fill (AR):
  - Fill types: two (2) general types of fill were found on-site: *Figure 5A, Figure 5B*
    - Granular fill: cohesionless soil with a lesser silt content (≤ 15%)
    - Common fill/urban fill: cohesionless soil with included unsuitable material (organics).
  - Coloration:
    - Granular fill: black, dark-brown, brown, tan
    - Common fill/urban fill: dark-brown, brown, light gray
  - Existing Fill thickness (t) at the borings drilled: 1 ft. ≤ t ≤ 9.5 ft.
  - Density:
    - Granular fill: medium dense to dense
    - Common fill/urban fill: very loose to loose
  - Fill source:
    - Granular fill: likely imported neighborhood glacial fluvial sand (SP)
    - Common fill/urban fill: mix of organics (topsoil, peat, organic silt) and granular fill (likely imported neighborhood glacial fluvial sand (SP)).
  - Competence:
    - Granular fill:
      - Could be re-used as earthwork phase engineered fill from >1 ft. depth below a floor slab pending the results of earthwork phase laboratory soil gradation tests and removal of any included unsuitable organic material.
      - Some of the granular fill has inadequate (low) gravel content (*Appendix A*).

        - Common fill/urban fill:
            - No common fill or urban fill observed should be allowed to remain in-place below conventional structural units (footings, grade slabs).
            - Re-use of common fill would be limited as backfill in planted areas
            - Re-use of urban fill could have environmental engineering limitations with associated off-site disposal restrictions.

- Organics:
    - Although mapped adjacent, no woodland wetland organic soils (peat, organic silt) were found in the on-site borings drilled
    - Organic soil was found mixed with the existing fill in boring B4 (*Figure 5B*).

Photo 1: SP Glacial Fluvial in B3 at 1 ft; sand .

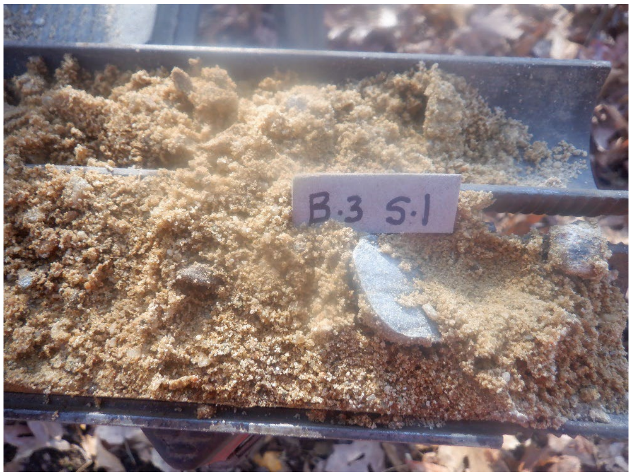
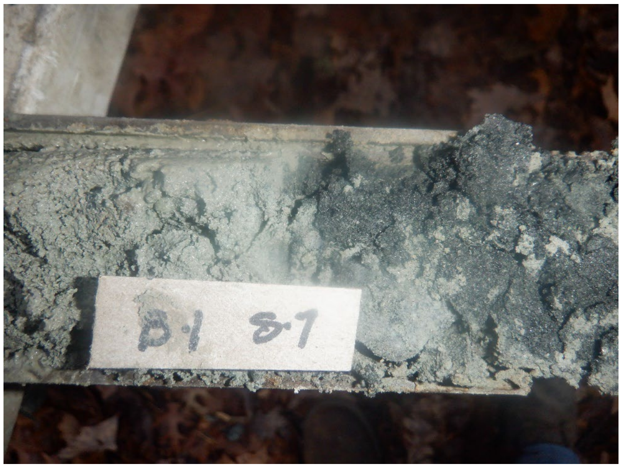


Photo 2: SP Glacial Fluvial in B3 at 5 ft; sand

- Glacial Fluvial Soil (Glacial Outwash; Alluvial): glacial fluvial soil was mapped for this site (*Figure 1D*), and glacial outwash was found in the borings (*Photo 1, Photo 2, Photo 3*).
    - Definition and source:
        - Glacial fluvial (outwash) soils were deposited during glacial melt cycles within meltwater. Soil particles (silt, sand, gravel) were water sorted. Formation of glacial outwash lowland occurs within topographic lowlands adjacent to moraines and drumlins (*Figure 1D*, *Figure 1D-1*).
        - Alluvial soils are deposited during repeated river flood events (Bear Meadow Brook).

Photo 3: SP in B3 at 10 ft.; fine sand, wet

Photo 4: Weathered gabbro rock (rt.) in B1 at 14 ft.



- Description: soil types found:
    - SP: medium to fine sand (*Photo 1, Photo 2*) or fine sand (*Photo 3*) with a low non-plastic silt content; and absent to low gravel content; has a poorly graded, fairly uniform sand particle size (*Appendix A*); soil particles are water sorted; loose to dense found in-situ density.
    - GP: gravel with sand and minor (non-plastic) silt content. Found primarily in boring B2.
- Thickness (t): refer to *Table I*
- Coloration: dark-brown, rust brown, brown, light brown, tan, light gray, gray
- Competency: highly variable; very loose to dense
- Re-use:
    - SP soil could, dependent upon found gravel content, possibly be re-used as engineered fill per earthwork phase soil particle gradation test results.
    - GP soil likely can be re-used as engineered fill.

- Glacial Till:
    - Types: two varieties of glacial till are typically found
        - Ablation till: a cohesionless, sandy granular till
        - Basal till: a cohesive and/or strongly cemented granular till
    - One or both, of the two glacial till types were expected to be found at depth. However, neither was found to the depths drilled.

- Bedrock:
    - Rock outcropping was not noted on-site or in the immediate site area.
    - Weathered gabbro bedrock was encountered in some of the borings (*Photo 4; Appendix A*).
    - Rock type expected is either gabbro, diorite or volcanic (see “Area Bedrock Geology” report section and *Figure 1E*).

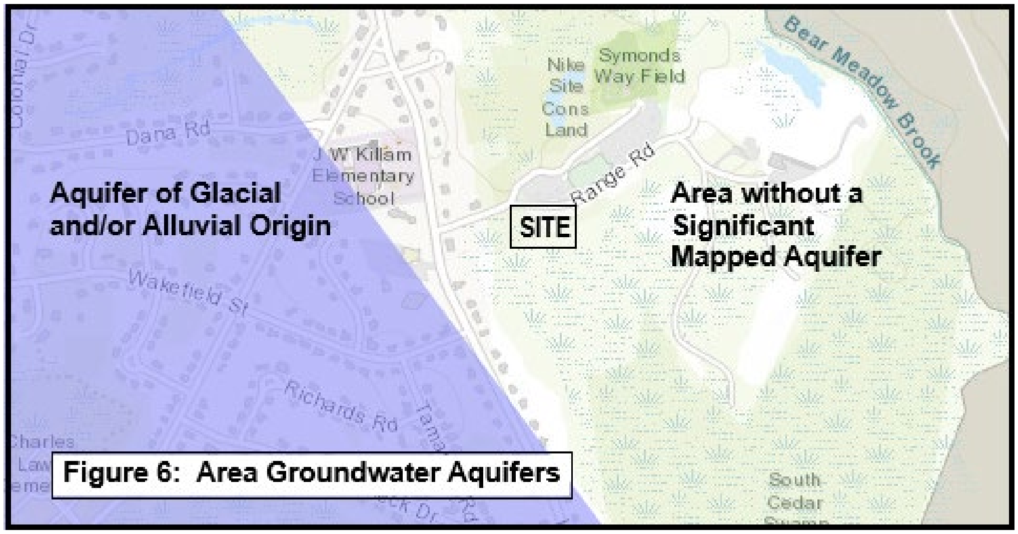


Figure 6: Area Groundwater Aquifers

V. *Groundwater Behavior – Community Building*

- Free Water:
    - Wet (saturated) soil zones were encountered in all borings drilled (*Figure 5A, Figure 5B, Appendix A, Table II*).
    - The borings continued to remain wet at depth within the sandy (SP) glacial fluvial soil zone (*Appendix A*).
    - No groundwater monitoring well was installed in a completed borehole as the likely excavation depths should not encounter groundwater and Well A exists here (*Table II*).

Table II: Groundwater Data – Community Building

Loc.	Elevation	Date	Observation	Groundwater Depth	Groundwater El.
B1	86'+/-	11/23/24	Wet SP sand	7.0 ft.	79 ft.+/-
B2	88'+/-	11/23/24	Wet SP sand	8.0 ft.	80 ft.+/-
B3	86'+/-	11/24/24	Wet SP sand	8.0 ft.	78 ft.+/-
B4	88'+/-	11/24/24	Wet SP sand	8.0 ft.	80 ft.+/-
Well A	86'+/-	11/27/24	Well Reading	7.7 ft.	78.3 ft.+/-
Other wells elsewhere on-site (see *Figure 2* for approximate well locations):					
Well B		11/27/24	Well Reading	4.6 ft.	
Well C		11/27/24	Well Reading	8.2 ft.	

- Groundwater Level Variation:
  - This site does not contain a significant mapped groundwater aquifer *(Figure 6)*
  - Clear soil mottling (color variation, typically splotches, due to past or current water presence), and/or rust staining was not seen in site soil borings.
    - Rust staining and mottling give an indication of a past higher water level possibly indicative of seasonal high groundwater level.
    - Wet soils were found in all borings (*Figure 5A, Figure 5B, Table II, Appendix A*) but no useful soil mottling or rust staining was seen above the wet soils.
    - Note also that mottling and staining, if found, is considered unreliable in fill soils.
  - Localized temporary and long-term changes to groundwater level can be natural or man-made. These include:
    - Alternating dry and wet precipitation periods now seem to be the norm, such as:
      - The 2016 extreme drought condition, the relatively dry summer of 2017, and the recent 2020, early 2021 and 2022 and 2024 drought periods.
      - A notably wetter 2018, parts of 2019 and summer 2021 and 2023 with included near record high water levels in eastern Massachusetts.
    - Winter drier season water levels.
    - Heavy rainstorms or lengthy precipitation periods
    - Leaky underground structures (pipes, tunnels)
    - Underground flow retarders (buried structures, walls, rock outcrops)
    - Percent of land surface covered by pavement and buildings without ability to recharge.
    - Nearby construction dewatering.
    - Changes to the existing surface drainage pattern due to new site topography, trenches, infiltrators, bio-retention basins and subgrade structures.
  - Groundwater impact based upon the data collected to date (*Table II, Appendix A*):
    - Based on the data collected Seasonal High Groundwater is estimated at El. 81.5 ft. (NAV88)
    - Groundwater (seasonal or found, *Table II*) would not impact expected conventional depth building excavations (≤ 4 ft. depth (El. 84 ft).
    - Underground utilities on some sites are designed to be installed deeper than foundations, however such data has not been provided us to-date for this project.

Hydraulic Conductivity (K in GPD/ft.^{2}):

- Scope: Laboratory soil gradation testing was not undertaken for this study and associated calculations and estimations of soil hydraulic conductivity (K) were not undertaken for any site subsoil unit.

- K Determination:
    - Many input factors go into determination of K. K is a function of particle grain sizes, soil density, soil particle uniformity, gravel content, soil cementation and soil layering.
    - Granular fill and SP sandy glacial fluvial soil are expected to be of moderate soil permeability (*Figure 5A, Figure 5B*).
    - GP glacial fluvial soil is expected to be of higher soil permeability.
    - K determination is the domain of the site civil engineer.

Site Civil and Environmental Site Investigation and Remediation Structural Unit Impact:

- Intrusive Site Civil and Environmental Testing and Remediation:
    - Site civil and environmental exploration (test pits and test trenches) can damage anticipated building structural unit bearing soils by lowering native bearing capacity.
    - Site remediation work including underground tank removal and soil replacement can remove significant volumes of contaminated soil materials from within proposed new construction footprints and inadvertently cause structural unit bearing soil degradation at the excavation base.
    - Any new site soil remediation work should be reviewed by the design team for quality of soil material placed to replace removed soils and/or tanks, as well as documentation that replacement soils were placed in compacted lifts.

- Protection of Structural Unit Bearing Subgrade: to protect structural bearing areas, project specifications should require:
    - Test pit and test trench areas avoid proposed project footing and slab bearing zones.
    - Test pit and test trench depths be limited to structural bearing depths minus one foot.
    - Where contaminated soil removal is required, replacement soil should be structural fill placed in compacted lifts, verified by field soil density testing to a laboratory Proctor standard for the placed soil.

VI. Foundation Review and Recommendations: Community Building

Foundation System:

- Groundwater impact: no groundwater impact on normal frost depth foundation excavation is anticipated *Figure 5A, Figure 5B*). This is also true for seasonal high groundwater estimated at El. 81.5 ft. (NAV88; page 15).

- Subsoil impact: weak soil bearing zones as well as a thin deep bearing layer were found throughout the site which limits the type of foundation that can be economically utilized here *(Figure 5A, Figure 5B*).

- Subsoil and groundwater impact to support of walls, columns and lowest level floor slab:
    - Foundation and slab type: primarily impacted by existing fill currently in place
        - ***Conventional shallow foundations****:* spread and continuous wall footings with a 1st floor slab on grade.
            - ***Deep Bulk excavation and replacement*** of existing fill and weak glacial fluvial soil would be required within the building limits.
                - Excavation to near top of bedrock would be required in most site areas which is well below groundwater and thus not practicable without massive site dewatering (well points).
                - See *Table I, Figure 5A, Figure 5B, Appendix A*.
                - This approach is not economically feasible for site development with conventional structural units (footings, slab).

- Alternative foundation support methods (piles, ground improvement):
    - ***Helical piles***: not practicable on this site as there is inadequate thickness of competent bearing soil for pile plate bearing in many parts of the site. These piles are not expected to be end bearing.
    - ***Drilled concrete micropiles***: piles drilled and grouted into bedrock; cost prohibitive
    - ***Ground improvement with aggregate piers***: there is usually not enough base soil thickness to properly seat the piers; not readily practicable. The size of project is likely too small for area contractors to consider in any case.
    - ***Driven timber piles***:
        - This approach is practicable but possibly not cost effective. Piles would be driven to tip bearing in dense glacial fluvial sand or weathered rock.
        - Due to small diameter pile tips, the pile capacity could be as low as 20 K/pile.
        - Pile breakage during driving could occur in the vicinity of boring B2.
    - ***Drilled concrete shafts***: this method is likely practicable with shaft end bearing on weathered rock or dense glacial fluvial sand (*Figure 5A, Figure 5B*).
        - Net allowable bearing pressure on weathered rock is on the order of 16 KSF.
        - Shallower shaft bearing take up in the vicinity of boring B2 should be expected (*Figure 5A*) in dense sand with net allowable bearing on the order of 12 KSF.
    - ***Ductile iron piles***: piles pushed to bear on weathered rock or dense glacial fluvial sand and gravel (*Figure 5A, Figure 5B*). Pile capacity should be provided by the installer's engineer and could be at least 30 K/pile dependent upon pile sizing.

- Existing uncontrolled on-site fill (*Figure 5A, Figure 5B, Table I, Appendix AI*):
    - The quality of some portion of the existing granular fill soil as seen in the borings may meet classification for engineered fill (see later report section: "Engineered Fills and their Uses". If so, it could be placed and compacted in lifts.
    - Excavated granular fill soil would need to be reviewed during earthwork with laboratory soil particle gradation testing of collected samples.
    - However, any large diameter solid waste debris (wood, asphalt, brick) and cobbles and boulders would have to be culled from the granular fill soil (*Appendix A*). Included topsoil and organics would have to be removed as well.

Seismic Recommendations:

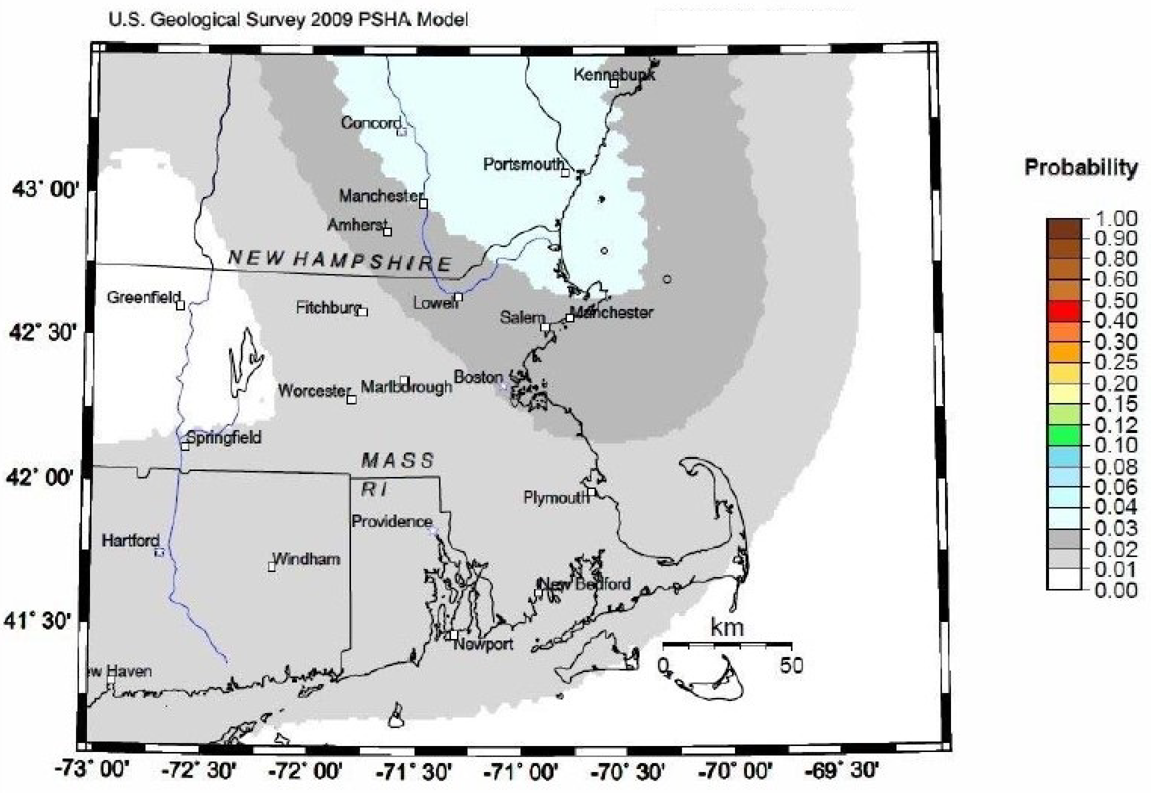
- Seismic Site Hazard Review:
    - Probabilistic Site Hard Analysis [*PSHA Interactive Deagregation*; Geologic Hazards Science Center, US Geologic Survey; 2008 v.2]
        - Decimal site latitude and longitude utilized in this review: (42.5412° N, -71.0850° W)
        - Probability of magnitude 5 (M5.0) or greater earthquake occurrence within 50 miles of the subject site within a 50-year building design life is considered relatively low (< 2.5%+/-) according to *Figure 7*.
    - Area earthquake history:
        - Typical measured earthquakes within the past 40 years have magnitude ≤ 3.5+/-
        - Past significant earthquakes with area impact recreated from the geologic record:

Year	Magnitude	Location	Intensity in Boston
1638	6.5	Central New Hampshire	MMI: V-VII
1663	7.0	Charlevoix, Quebec	MMI: V-VI
1727	5.6	Newbury, MA	MMI: V-VI
1755	5.9	Scituate, MA	MMI: IX

MMI: Modified Mercalli Scale (subjective; observed damage and effects)

- Seismic Site Class: The collected site subsoil data has been applied to the Massachusetts adopted *International Building Code (2015)*. According to the *Building Code*
  - Analytic depth:
    - The upper 100 feet of soil and bedrock are subject to analysis.
    - Soil data on-site has generally been collected to likely top of bedrock (*Table I, Figure 5A, Figure 5B*).
    - Native soils tested indicated variable density glacial fluvial soil over likely bedrock (*Table I, Figure 5A, Figure 5B*).
  - Bedrock:
    - Bedrock expected is gabbro (see *Appendix A* and "Area Bedrock Geology" report section).
    - The depth to bedrock ranged from about 13 ft. to 25 ft. depth from existing ground surface.
    - Based upon the data collected this site is classified as seismic Site Class D.

Figure 7: Probability of earthquake with M > 5.0 within 50 years & 50 km



- Seismic Design Factors: Preliminary estimated Earthquake Design Factors for Reading, Massachusetts (*Massachusetts Amendments to the International Building Code (2017; 9th Edition))* and *IBC (2015)*:
    - S_s = 0.234g (short interval)
    - S_1 = 0.072g (1-second interval)
    - F_a = 1.6 (site coefficient, classification as Site Class D)
    - F_v = 2.4 (site coefficient, classification as Site Class D)

Liquefaction:

- <u>Liquefaction Factors</u>:
    - Earthquake magnitude
    - Earthquake amplitude (duration)
    - Subsoil types and condition

- <u>Earthquake Magnitude</u>:
    - Collected data indicates that the probability of occurrence of an earthquake of magnitude 5 or higher is low probable during a 50-year building design life.
    - However, with a time period measured in centuries instead of decades, earthquakes of magnitude 5 or greater can be expected to occur as the earthquakes listed above indicate.

- <u>Earthquake Duration</u>: This topic is beyond the scope of this review.

- <u>Subsoil Data Input</u>: Review of the site subsoil profile was necessary for soil liquefaction determination below structural units:
    - Relevant test boring information: no significant thickness (> 10 ft.; *Table I*) of post compaction, loose to very loose saturated native silty to clean sands and non-plastic silts (SM, SP, SW, ML) would be found below structural units.
    - Drill rig, site groundwater level and measured soil strength data with depth:
        - Drill rig hammer type: drop hammer
        - Groundwater level: El. 81.5 ft. (NAV88), seasonal high (page 15).
        - Plotted field N_{60}-values from the borings with depth (*Figure 3*).

- <u>Site Liquefaction Determination</u>:
    - Review of field auto hammer N_{60} from the borings with depth with respect to *Figure 1806.a* of the *Massachusetts Amendments (2017; 9th Edition)* for preliminary liquefaction exclusion review compared to a range of (seasonal high) groundwater levels.
    - Assumption that site subgrade preparation will be performed as described in the "Excavated Base and Working Base" report section.
    - Result: liquefaction settlement is not of concern for this site were a 5M or greater earthquake to occur here.

Structural Unit Frost Protection Depth:

- <u>Definition</u>:
    - Frost depth, freezing depth or frost line is the depth to which moisture in subsoil is expected to freeze.
    - Frost line varies in position (elevation) during seasonal freeze and thaw.

- <u>*Massachusetts State Building Code* Mandated Frost Protection Depth Changes</u>:
    - 7th Edition: "All foundations for buildings and structures shall extend to a minimum of 4 ft. below (exterior) finished grades…"
    - 8th Edition: Foundations and permanent building supports should be protected by "extending below the frost line of the locality…" **This suggests a 4 ft. frost depth is too deep for coastal and southern areas and too shallow for northern or topographically elevated locales.**

- <u>Site Structural Unit Frost Protection Depth</u>:
    - Frost line:
        - Average area frost line value: 0.9 m = 35.5 in. [J.E. *Bowles; Foundation Analysis and Design 5th Ed.*; 1997; Figure 7-1].

    - Extreme frost line based upon state average: 53 in. [NAVFAC DM-7.1; *Soil Mechanics Design Manual 7.1*; Figure 7; 1982].
    - Deepest frost observed by us in test borings in eastern Massachusetts: 28 in. (40-year period) coupled with the comment above about coastal area frost depth the recommended minimum site structural unit frost protection depth in soil bearing for this property as measured from exterior grade: = **<u>36 in. (3 ft.)</u>**

- <u>Cold Weather Work Soil Protection</u>:
  - During construction earthwork the contractor must be prepared to provide protection and/or thawing of foundation bearing soils against freezing.
    - Footings: insulation blankets and/or ground heating hoses should be utilized if footing subgrade is exposed to freezing during cold weather periods.
    - Lowest Level Slabs:
      - Typically slab subgrade areas are thawed once basic framing is up by providing heaters after enclosing the lowest level in plastic sheeting.
      - Then any remaining required grade raise fill, treatment and placement of the slab base pad can be properly performed.

Foundation Wall Design (Restrained Walls): no below grade foundation walls in design

Cantilever Earth Retaining Wall Design:

- <u>Retaining Wall Construction</u>:
  - It is not known if a cantilever wall will be required in site design.
  - Clean, free-draining granular backfill should be placed behind a new wall.
  - Weep holes should be provided in the wall to prevent hydrostatic pressure build up behind the wall.
  - Wall should be founded upon compacted structural fill placed upon an undisturbed glacial till subgrade or native conglomerate rock.

- <u>Retaining Wall Design</u>:
  - Backfill design factors: soil at 120 PCF; $\Phi=30°$; $k_a = 0.33$; triangular soil load distribution
  - Equivalent fluid pressure behind the wall: 40 PCF; level backfill, no surcharge loads; resultant (P), located at P = 1/3 H above base of wall.
  - Surcharge load (Q): an additional, uniform load on the wall = $k_a \times Q$ (resultant at 0.5 H)

Drainage and Waterproofing:

- <u>General Comments/Good Practice</u>:
  - Exterior grading at the building should be designed to carry surface water runoff away from the structure.
  - Planted areas or pavements should enhance the exterior grading performed to ensure surface water runoff beyond building limits.
  - Roof downspout water or other water should not be allowed to pool near the building.

- <u>Review Summary of Groundwater and Structural Unit Elevation Data</u>:
  - Building structural unit elevations are estimated as shown on *Figure 5A, Figure 5B*:
  - Groundwater elevation*:* all borings encountered groundwater
    - Found high groundwater elevation in the borings: about El. 80 ft. (NAV88) *(Table II)*
    - Seasonal high groundwater level: estimated at El. 81.5 ft. (NAV88; page 15).
    - Likely deepest bulk excavation point: El. 64 ft.+/- (NAV88; *Table I*)
  - Site flooding: not reviewed by us; review flood potential with project site civil engineer.

- <u>Building Foundation Wall Drainage and Waterproofing</u>:
  - Based upon the data collected, 1st floor frost wall foundation drains are unnecessary.
  - As there is no basement planned, basement level wall drains are irrelevant.

- <u>Lowest Level Floor Slab Drainage and Waterproofing</u>: normally two options exist for the lowest level;
  - Waterproofing Option 1: ground floor slab underdrains: unnecessary
  - Waterproofing Option 2: ground floor level membrane waterproofing such as Preprufe from WR Grace with hydrostatic slab: unnecessary
  - Damp proofing: only normal damp proofing need be provided:
    - Loose laid plastic sheeting; or
    - An under-slab membrane such as Florprufe by WR Grace.

Lowest Level Floor Slabs:

- <u>Floor Slab Type</u>:
  - Lowest level floor as a <u>grade slab</u> would only be expected if the **full** bulk excavation and replacement option is selected which is not practicable on this site.
  - The lowest level slab is a <u>structural slab</u> with any of the other alternative foundation approaches (pages 16-17).

- <u>Groundwater Levels and Lowest Level Slab</u>:
  - The lowest level floor slab itself is not expected to be impacted by groundwater (see Review on page 20; *Figure 5A, Figure 5B*).
  - Refer to the groundwater information provided in the “Groundwater Behavior” report section on pages 14-15.

- <u>Subgrade Modulus</u>: no 1st floor slab or elevator pit slab modulus of subgrade reaction is needed as no grade slabs can safely be installed on this site.

- <u>Under Slab Pads and Slab Control Joints</u>:
  - Lowest level slab base pads will be provided as either compacted ¾ inch crushed stone or compacted structural fill.
  - Slab control joints are usually unnecessary with a 1st floor structural slab.

Excavation and Bracing:

- <u>Excavation Depth ≤ 4 ft.+/- in Soil</u>:
  - Common practice is to maintain a 1H:1V temporary side slope for shallow excavation (≤ 4 ft.+/-) during construction. Benched steps can also be executed.
  - Note that the sidewall stability will be undermined by:
    - Minor sloughing when sidewall bleeding occurs either from release of trapped water in soil or drainage following storm events; and
    - Surficial exposed granular sidewall soil drying and subsequent caving or sloughing.

  - <u>Excavation > 4 ft. in Soil</u>:
    - Excavation here is not expected to exceed 4 ft. depth (*Figure 5A, Figure 5B*) in general and slightly deeper at the elevator pit.
    - Any excavation > 4 ft. depth would take place within site granular soils which can be classified as **OSHA Type C** subsoils (*Appendix A*).
      - Excavate with a 1.5 H:1 V sidewall layback. A braced excavation is required where adequate lateral space does not exist for a temporary sloped excavation (**layback**).
      - Since layback space is adequate on this site, support of excavation is unlikely to be required.

Elevator:

- Elevator Pit Support:
  - The elevator pit base is assumed to bear at about 5 feet below lowest level slab.
    - Elevator system will likely be supported upon perimeter piles or a pile supported structural mat.

- Elevator Pit Uplift, Drainage and Waterproofing:
  - Groundwater will not impact either elevator pit installation or the pit base by uplift.
  - Pit waterproofing is typically provided as the pit is the lowest elevation excavation point in the structure. Here it is above groundwater.
    - Pit waterproofing should consist of installation of a positive side membrane system such as PrePrufe or equivalent.
    - Elevator pit construction should require properly tied continuous water stops in construction joints.

Construction Dewatering:

- Groundwater Impact:
  - Based upon the data collected to-date, groundwater seepage into recommended depth excavations for foundations and floor slab is unlikely (*Table II, Figure 5A, Figure 5B*).
  - Rain and melt seepage water into excavations should be expected.
  - Refer also to the "Groundwater Behavior" report section on pages 14-15, and the foundation preparation sections on pages 16-17.

- Dewatering Required:
  - Intruding water into normal level site excavation would be from rain and melt events.
  - Water at this level can be controlled by ditching to filtered sumps.

- Pumped Discharge:
  - Discharge of any pumped water should be performed in accord with all City, Commonwealth and Federal regulations. Filtering of pumped water prior to discharge should be expected.
  - Permitting required by the USEPA, MWRA, or the City should be reviewed. Assessment by the Project Civil Engineer should be sought.
  - The contractor would be responsible for obtaining all permits and any associated laboratory testing required for construction dewatering.
  - Based upon City requirements the contractor may be required to use frac tanks to temporarily store pumped water at the work site. This possibility should be reviewed in conjunction with the Project Civil Engineer.

Paved Area and Pickleball Court Borings:

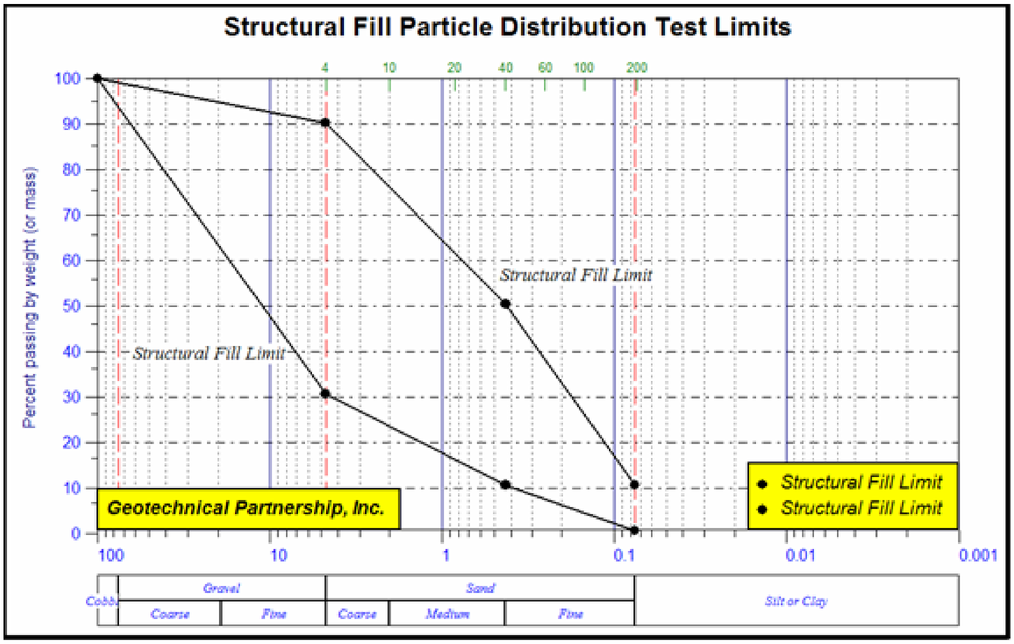
- Structural borings B5 through B12 (*Appendix A*) were drilled in the proposed paved parking and pickleball court areas (see *Figure 2*).
- The same mix of soils (fill, glacial fluvial) were found in these borings (*Appendix A)* at variable density as has been reported for the Community Building.
- Remnant groundwater monitoring wells designated B and C also exist in these areas (see *Figure 2*). Water level depths from ground surface were found to be 4.6 ft. and 8.2 ft., respectively.
- Ground surface elevations at the borings can be determined by others from the existing site survey plan.
- The logs of the borings should be shared with the site civil engineer as well as the landscape architect to help them with their design of pavement sections and consideration of the need of excavation and replacement and/or deep compaction base preparation in these areas.

Engineered Fills and their Uses:

- Crushed stone: ¾ in. clean, hard, durable crushed stone; uses:
  - As a construction working pad
  - As a surface protection below footings
  - As drainage media in wall and under slab drainage systems.

- Gravel: sandy gravel, bank run gravel; max. 3-in. gravel; limit No. 200 sieve content to about 6%; uses:
  - As base in a pavement section

- Structural fill: hard, durable sand and gravel.
  - Common gradation limits for structural fill are given in the plot shown below.
  - Gradation adjustments: gradations often specify
    - Minimum of 2% passing No. 200 to aid compaction
    - Maximum of 15% passing No. 200 with the assumption that work may not proceed during wet conditions using this material (Dense Grade can be substituted)
  - Structural Fill Uses (in lieu of crushed stone):
    - To form a protective base directly below footings or pile caps
    - As a slab base pad
    - As a replacement fill below structural units (over-excavated soft areas)
    - As sub base in a pavement section



- Dense Grade Structural Fill/2-in. Crushed Stone: Structural fill/crushed stone meeting the following minimum requirements

Sieve Size	Percent Finer by Weight
2 in.	100
1.5 in.	70 – 100
¾ in.	50 – 85
No. 4	30 – 55
No. 50	8 – 24
No. 200	3 – 10

- Dense grade structural fill uses:
  - As a readily workable replacement for conventional or recycled concrete type structural fill when work must proceed during cold and/or wet conditions.
  - As a base pad for lowest level floor slabs, footings or pile caps

- Granular Fill: minor gravel; primarily medium to fine sand and silt meeting the following

Sieve Size	Percent Finer by Weight
4 in.	100
No. 10	30 – 95
No. 40	10 – 70
No. 200	0 – 15*

** May be as high as 20% if field compaction can be verified in **dry** conditions*

- Granular Fill Uses:
  - As under slab fill below 12 in. depth as measured from the slab base.
  - As densified trench backfill

Re-use of Existing Site Subsoils as Engineered Fill:

- Existing Granular Fill:
  - Granular fill has been found from 1 ft. to 9.5 ft. depth within the community building area (*Figure 5A, Figure 5B, Appendix A*).
    - It tends to be a coarse to fine sand with zones of siltier sand and those of more predominant gravel (*Appendix A*).
    - It can contain scant gravel (*Appendix A*).
    - It can contain included organics and topsoil (*Appendix A*).
  - If the sandy granular fill has adequate gravel content and can be separated from the undesirable included material, it may be re-used as engineered fill (see previous section: “Engineered Fills and their Uses”) pending results of construction phase soil particle gradation test results.
  - Any found excavated granular fill soil should be considered non-engineered:
    - Thus, undertaking laboratory Proctor and associated field compaction tests is not useful as the silt-sand-gravel ratios will vary.
    - Re-use of these soils on-site would require experienced third-party field observation of compaction equipment behavior, supported by consideration of addition of water to dry soil or drying of saturated soils (harrowing, land spreading) as needed.

- Existing SP Sandy Glacial Fluvial Soil: this native soil material where excavated can be treated as described above for granular fill (*Figure 5A, Figure 5B, Appendix A*).

Thank you for inviting us to perform this site study. Please contact us with any questions.

Sincerely yours,
Geotechnical Partnership, Inc.

Lisa R. Casselli, PE
Principal

Attachments: *Appendix A*: *Logs of Test Borings B1 to B12*

APPENDIX A: Logs of Structural Test Borings B1 through B12

51 Symonds Way
Reading, Massachusetts

Geotechnical Partnership, Inc.
Fitchburg, MA
File No. 2436

Geotechnical Partnership, Inc.
Fitchburg, MA
Geotechnical Services

PROJECT: New Construction
New Commuinity Center - Range Rd.
Reading, Massachusetts

CLIENT: Bargmann Hendrie & Archtype, Inc.

File No. 2436

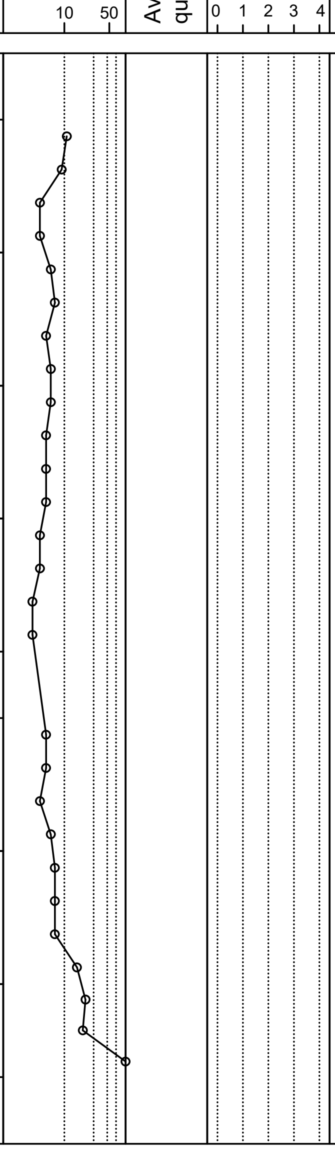
Date Drilled : 23 November 2024
Boring Location : Refer to Report Figure 2
Drilling Contractor : Cosmo Drilling
: Ocean Bluff, MA
Driller : E. Sviokla
Rock Core : ---
GPI Field Engineer : F. Sviokla
Elevation and Datum : El. 86 ft. (NAV88)
Drilling Mud Utilized : Not necessary
Constant Water Head : Drive & Wash

Test Boring No. B-1

(1 of 1)

Drill Rig Type : Tripod Mounted
Hammer Type : Drop
Cat-Head or Winch : Cat-Head
Soil Casing Type : 3 in. BW
Sampler Type : SS - 1.375 in. I.D.; unlined
Sampler Hammer Fall : 140 lbs. / 30 in.

Depth in Feet	Elev. in Feet 86	DESCRIPTIONS	USCS	Water Level	Sample No.	Blow Count	REMARKS
0	86	LEAF LITTER, DUFF & FIBROUS TOPSOIL	AR				Groundwater=7.0' Well Set: no
1	85	Brown, fine SAND, few silt, trace fine gravel (sub-angular), (loose to medium dense, dry to moist)	SP		1	11 9 4 4	SS-1: 1' - 3' R=9 N=13
3	83	Brown, coarse to fine SAND, trace fine gravel (sub-rounded), and silt, (loose to medium dense, dry)			2	6 7 5 6	SS-2: 3' - 5' R=14 N=12
5	81	Brown, coarse to fine SAND, trace fine gravel (sub-rounded), and silt, (loose, very moist) 6.0 ft. -GLACIAL FLUVIAL-			3	6 5 5 5	SS-3: 5' - 7' R=13 N=10
7	79	Light brown, fine SAND (uniform), trace silt, (loose, wet)		▼	4	4 4 3 3	SS-4: 7' - 9' R=12 N=7
10	76	Light gray, fine SAND (uniform), trace silt, (loose, wet)	SP		5	5 5 4 6	SS-5: 10' - 12' R=18 N=9
12	74	Light brown, fine SAND (uniform), trace silt, (medium dense, wet) 14.0 ft. -GLACIAL FLUVIAL-			6	7 7 7 16	SS-6: 12' - 14' R=19 N=14
14	72	Light gray, coarse to fine SAND, few silt, (dense, wet), over black weathered gabbro fragments 15.4 ft. -GLACIAL FLUVIAL-	SP		7	22 20 100	SS-7: 14' - 15.4' R=13 N=120
15.4		END OF BORING @ 15.4 FT DEPTH POSSIBLE BEDROCK					P=Penetrometer
17	69	Particle Size: trace: <5%; few: 5-10%; little: 15-20%; some 30-45%; mostly: 50-100%					
18							



COHESIONLESS SOILS: 0-6 Very Loose 0-8
(DENSITY) 6-10 Loose 8-15
L: Sands; R: Gravels 11-30 Med-Dense 16-40
>30 Dense 41-50
Very Dense >50

COHESIVE SOILS: 0-2 Very Soft (<0.25 TSF)
(CONSISTENCY) 2-4 Soft (0.25-0.5 TSF)
4-8 Med. Stiff (0.5-1.0 TSF)
9-20 Stiff (1.0-4.0 TSF)
>20 Hard (>4.0 TSF)

Test Boring No. B-1

(1 of 1)

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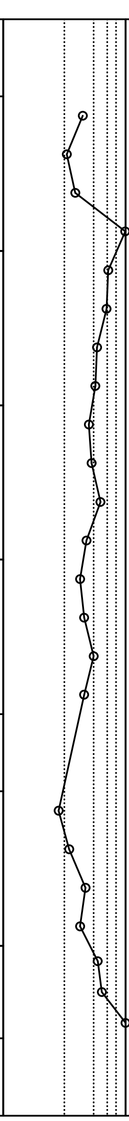
Date Drilled : 23 November 2024
Boring Location : Refer to Report Figure 2
Drilling Contractor : Cosmo Drilling
: Ocean Bluff, MA
Driller : E. Sviokla
Rock Core : ---
GPI Field Engineer : F. Sviokla
Elevation and Datum : El. 88 ft.+/- (NAV88)
Drilling Mud Utilized : Not necessary
Constant Water Head : Drive & Wash

Test Boring No. B-2

(1 of 1)

Drill Rig Type : Tripod Mounted
Hammer Type : Drop
Cat-Head or Winch : Cat-Head
Soil Casing Type : 3 in. BW
Sampler Type : SS - 1.375 in. I.D.; unlined
Sampler Hammer Fall : 140 lbs. / 30 in.

Depth in Feet	Elev. in Feet 88	DESCRIPTIONS	USCS	GRAPHIC	Water Level	Sample No.	Blow Count	Blow Count Graph 10 50	Average qu-Field	Average qu-Field (TSF) 0 1 2 3 4	REMARKS
0	88	MOSS & CRUSHED STONE OVER GRANULAR FILL	AR								Groundwater=8.0' Well Set: no
1 2	87 86	Dark brown, coarse to fine SAND, little coarse to fine gravel (angular to sub-angular), few silt, (medium dense, moist)	AR			1	20 11 15 99				SS-1: 1' - 3' R=16 N=26
3 4	85 84	Brown, coarse to fine GRAVEL (angular to sub-rounded), some coarse to fine sand, few silt, (dense, moist) 5.0 ft. -GRANULAR FILL-				2	52 49 34 32				SS-2: 3' - 5' R=14 N=83
5 6	83 82	Light brown/tan, fine SAND (uniform), little fine gravel (sub-angular), few silt, (dense, moist)	SP/GP			3	25 28 39 23				SS-3: 5' - 7' R=20 N=67
7 8	81 80	Brown, coarse to fine SAND, some coarse to fine gravel (angular to sub-angular), few silt, (dense, wet)			▼	4	18 21 30 21				SS-4: 7' - 9' R=16 N=51
9	79										
10 11	78 77	Brown, fine GRAVEL (angular to sub-rounded), few coarse to fine sand, and silt, (dense, wet)				5	8 12 22 18				SS-5: 10' - 12' R=15 N=34
12 13	76 75	Black & brown, coarse GRAVEL (angular), little coarse to fine sand, trace silt, (dense, wet) 13.2 ft. -GLACIAL FLUVIAL-				6	35 41 100				SS-6: 12' - 13.2' R=11 N=141 P=Penetrometer
14	74	END OF BORING @ 13.2 FT DEPTH POSSIBLE GABBRO BEDROCK									
15		Particle Size: trace: <5%; few: 5-10%; little: 15-20%; some 30-45%; mostly: 50-100%									



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L: Sands; R: Gravels 11-30 Med-Dense 16-40
>30 Dense 41-50
Very Dense >50

COHESIVE SOILS: 0-2 Very Soft (<0.25 TSF)
(CONSISTENCY) 2-4 Soft (0.25-0.5 TSF)
4-8 Med. Stiff (0.5-1.0 TSF)
9-20 Stiff (1.0-4.0 TSF)
>20 Hard (>4.0 TSF)

Test Boring No. B-2

(1 of 1)

12-02-2024 C:\Users\User\Documents\M-Tech 4\samples\2436 B2-22.bor

Geotechnical Partnership, Inc.
Fitchburg, MA
Geotechnical Services

PROJECT: New Construction
New Commuinity Center - Range Rd.
Reading, Massachusetts

CLIENT: Bargmann Hendrie & Archtype, Inc.

File No. 2436

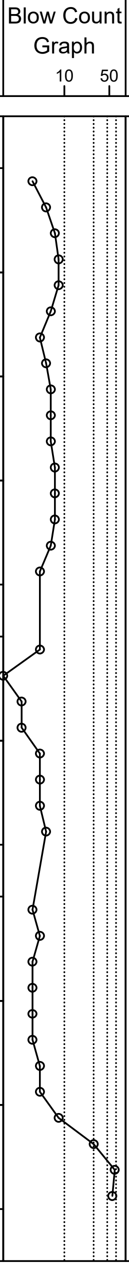
Date Drilled : 24 November 2024
Boring Location : Refer to Report Figure 2
Drilling Contractor : Cosmo Drilling
: Ocean Bluff, MA
Driller : E. Sviokla
Rock Core : ---
GPI Field Engineer : F. Sviokla
Elevation and Datum : El. 86 ft.+/- (NAV88)
Drilling Mud Utilized : Not necessary
Constant Water Head : Drive & Wash

Test Boring No. B-3

(1 of 1)

Drill Rig Type : Tripod Mounted
Hammer Type : Drop
Cat-Head or Winch : Cat-Head
Soil Casing Type : 3 in. BW
Sampler Type : SS - 1.375 in. I.D.; unlined
Sampler Hammer Fall : 140 lbs. / 30 in.

Depth in Feet	Elev. in Feet 86	DESCRIPTIONS	USCS	Water Level	Sample No.	Blow Count	Average qu-Field	Average qu-Field (TSF)	REMARKS
0	86	LEAF LITTER, DUFF & TOPSOIL	AR						Groundwater=8 ft. Well Set: no
1	85	Light brown, coarse to fine SAND, little coarse to fine gravel (sub-rounded), trace silt, (medium dense, moist)			1	3 5 7 8			SS-1: 1' - 3' R=14 N=12
2	84								
3	83	Brown & rust-brown, coarse to fine SAND, few fine gravel (sub-rounded), trace silt, (loose, moist)			2	8 6 4 5			SS-2: 3' - 5' R=11 N=10
4	82								
5	81	Light brown, coarse to fine SAND, little fine gravel (sub-rounded), trace silt, (medium dense, moist)	SP		3	6 6 6 7			SS-3: 5' - 7' R=9 N=12
6	80								
7	79	Tan & rust-brown, coarse to fine SAND, few fine gravel (sub-rounded), (loose to medium dense, moist to wet)			4	7 7 6 4			SS-4: 7' - 9' R=16 N=13
8	78			▼					
9	77	9.0 ft. -GLACIAL FLUVIAL-							
10	76	Gray-brown, fine SAND (uniform), trace silt, (very loose, wet)			5	4 1 2 2			SS-5: 10' - 12' R=17 N=3
11	75								
12	74	Gray, fine SAND (uniform), trace silt, (loose, wet)			6	4 4 4 5			SS-6: 12' - 14' R=19 N=8
13	73								
14	72		SP						
15	71	Gray, fine SAND (uniform), trace silt, (loose, wet)			7	3 4 3 3			SS-7: 15' - 17' R=19 N=7
16	70								
17	69	Gray, fine SAND (uniform), trace silt, (loose, wet)			8	3 3 4 4			SS-7: 17 - 19' R=20 N=7
18	68								
19	67	19.5 ft. -GLACIAL FLUVIAL-			9	8 30 66 61			SS-7: 19' - 21' R=14 N=96
20	66	Black & gray, coarse gravel (rock fragments), few silt, (very dense, wet) 21.0 ft. -WEATHERED/BROKEN /ROCK-	GR						P=Penetrometer
21	65	END OF BORING @ 21 FT DEPTH POSSIBLE GABBRO BEDROCK							
22	64	Particle Size: trace: <5%; few: 5-10%; little: 15-20%; some 30-45%; mostly: 50-100%							
23									



COHESIONLESS SOILS: (DENSITY) L: Sands; R: Gravels	L		R	COHESIVE SOILS: (CONSISTENCY)	
	0-6	Very Loose	0-8	0-2	Very Soft (<0.25 TSF)
	6-10	Loose	8-15	2-4	Soft (0.25-0.5 TSF)
	11-30	Med-Dense	16-40	4-8	Med. Stiff (0.5-1.0 TSF)
	>30	Dense	41-50	9-20	Stiff (1.0-4.0 TSF)
		Very Dense	>50	>20	Hard (>4.0 TSF)

Test Boring No. B-3

(1 of 1)

Geotechnical Partnership, Inc.
Fitchburg, MA
Geotechnical Services

PROJECT: New Construction
New Commuinity Center - Range Rd.
Reading, Massachusetts

CLIENT: Bargmann Hendrie & Archtype, Inc.

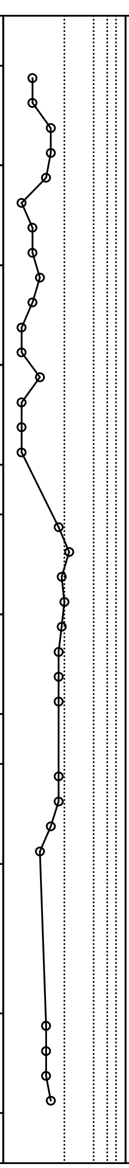
File No. 2436

Date Drilled : 24 November 2024
Boring Location : Refer to Report Figure 2
Drilling Contractor : Cosmo Drilling
: Ocean Bluff, MA
Driller : E. Sviokla
Rock Core : ---
GPI Field Engineer : F. Sviokla
Elevation and Datum : El. 88 ft.+/- (NAV88)
Drilling Mud Utilized : Not necessary
Constant Water Head : Drive & Wash

Test Boring No. B-4.

(1 of 1)

Drill Rig Type : Tripod Mounted
Hammer Type : Drop
Cat-Head or Winch : Cat-Head
Soil Casing Type : 3 in. BW
Sampler Type : SS - 1.375 in. I.D.; unlined
Sampler Hammer Fall : 140 lbs. / 30 in.



Depth in Feet	Elev. in Feet 88	DESCRIPTIONS	USCS	GRAPHIC	Water Level	Sample No.	Blow Count	Blow Count Graph 10 50	Average qu-Field	Average qu-Field (TSF) 0 1 2 3 4	REMARKS
0	88	LEAF LITTER & DUFF	AR								Groundwater=8 ft. Well Set: no
1 2	87 86	Dark brown, coarse to fine SAND, some coarse gravel (angular to sub-rounded), (loose, moist), infillings of dark-brown fibrous topsoil & leaves				1	3 3 6 6				SS-1: 1' - 3' R=14 N=9
3 4	85 84	Brown, coarse to fine SAND, few silt & organic silt, (very loose, moist)				2	5 2 3 3				SS-2: 3' - 5' R=9 N=5
5 6	83 82	Dark brown, SILT LOAM TOPSOIL/PEAT (remolded, filled), little coarse gravel (sub-angular), (very loose, very moist)	AR			3	4 3 2 2				SS-3: 5' - 7' R=11 N=5
7 8 9	81 80 79	Light gray, coarse to fine SAND, few coarse gravel (angular to sub-rounded) and organic silt, (very loose, wet) 9.5 ft. -FILL WITH ORGANICS-			▼	4	4 2 2 2				SS-4: 7' - 9' R=9 N=4
10 11	78 77	Light brown/tan, coarse to fine SAND, little coarse gravel (angular), trace silt, (medium dense, wet)				5	8 12 9 10				SS-5: 10' - 12' R=12 N=21
12 13 14	76 75 74	Light brown, coarse to fine SAND, few coarse to fine gravel (angular), trace silt, (medium dense, wet)	SP			6	9 8 8 8				SS-6: 12' - 14' R=14 N=16
15 16 17	73 72 71	Brown, coarse to fine SAND, trace fine gravel (sub-angular to sub-rounded) and silt, (medium dense, wet) 17.5 ft. -GLACIAL FLUVIAL-				7	8 8 6 4				SS-7: 15' - 17' R=16 N=14
18 19 20 21	70 69 68 67	Brown/tan, coarse to fine SAND, trace fine gravel (sub-rounded) and silt, (loose, wet) 22.0 ft. -GLACIAL FLUVIAL-	SP			8	5 5 5 6				SS-8: 20' - 22' R=18 N=10 P=Penetrometer
22	66	END OF BORING @ 22 FT DEPTH									
23 24	65	Particle Size: trace: <5%; few: 5-10%; little: 15-20%; some 30-45%; mostly: 50-100%									

COHESIONLESS SOILS: 0-6 Very Loose 0-8
(DENSITY) 6-10 Loose 8-15
L: Sands; R: Gravels 11-30 Med-Dense 16-40
>30 Dense 41-50
Very Dense >50

COHESIVE SOILS: 0-2 Very Soft (<0.25 TSF)
(CONSISTENCY) 2-4 Soft (0.25-0.5 TSF)
4-8 Med. Stiff (0.5-1.0 TSF)
9-20 Stiff (1.0-4.0 TSF)
>20 Hard (>4.0 TSF)

Test Boring No. B-4.

(1 of 1)

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Geotechnical Partnership, Inc.
Fitchburg, MA
Geotechnical Services

PROJECT: New Construction
New Commuinity Center - Range Rd.
Reading, Massachusetts

CLIENT: Bargmann Hendrie & Archtype, Inc.

File No. 2436

Date Drilled : 27 November 2024
Boring Location : Refer to Report Figure 2
Drilling Contractor : Cosmo Drilling
: Ocean Bluff, MA
Driller : E. Sviokla
Rock Core : ---
GPI Field Engineer : F. Sviokla
Elevation and Datum :
Drilling Mud Utilized : Not necessary
Constant Water Head : Drive & Wash

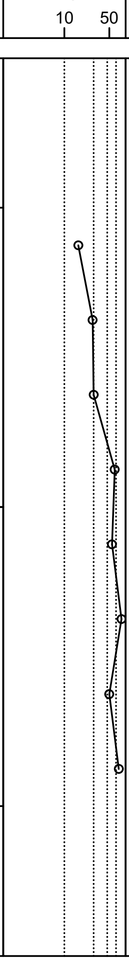
Test Boring No. B-5

(1 of 1)

Drill Rig Type : Tripod Mounted
Hammer Type : Drop
Cat-Head or Winch : Cat-Head
Soil Casing Type : 3 in. BW
Sampler Type : SS - 1.375 in. I.D.; unlined
Sampler Hammer Fall : 140 lbs. / 30 in.

Depth in Feet	Elev. in Feet	DESCRIPTIONS	USCS	GRAPHIC	Water Level	Sample No.	Blow Count	Average qu-Field	Average qu-Field (TSF) 0 1 2 3 4	REMARKS
0		LEAF LITTER OVER GRANULAR FILL	AR	▨						Groundwater=not encountered Well Set: no
1		Brown & gray, coarse to fine SAND, little silt, few fine gravel (angular), (dense, moist) 2.0 ft. -COMMON FILL-	AR	▨		1	17 29			SS-1: 1' - 3' R=14 N=59
2		Brown, coarse to fine SAND, little silt, and coarse to fine gravel (angular to sub-angular), (dense, moist) 5.0 ft. -GLACIAL FLUVIAL-	SP	■		1 2	30 66 60 86 54 77			SS-2: 3' - 5' R=13 N=140 P=Penetrometer
5		REFUSAL @ 5 FT DEPTH IN GLACIAL TILL OR ROCK								
6		Particle Size: trace: <5%; few: 5-10%; little: 15-20%; some 30-45%; mostly: 50-100%								
7										
8										

Blow Count Graph



COHESIONLESS SOILS: 0-6 Very Loose 0-8
(DENSITY) 6-10 Loose 8-15
L: Sands; R: Gravels 11-30 Med-Dense 16-40
>30 Dense 41-50
Very Dense >50

COHESIVE SOILS: 0-2 Very Soft (<0.25 TSF)
(CONSISTENCY) 2-4 Soft (0.25-0.5 TSF)
4-8 Med. Stiff (0.5-1.0 TSF)
9-20 Stiff (1.0-4.0 TSF)
>20 Hard (>4.0 TSF)

Test Boring No. B-5

(1 of 1)

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Geotechnical Partnership, Inc.
Fitchburg, MA
Geotechnical Services

PROJECT: New Construction
New Commuinity Center - Range Rd.
Reading, Massachusetts

CLIENT: Bargmann Hendrie & Archtype, Inc.

File No. 2436

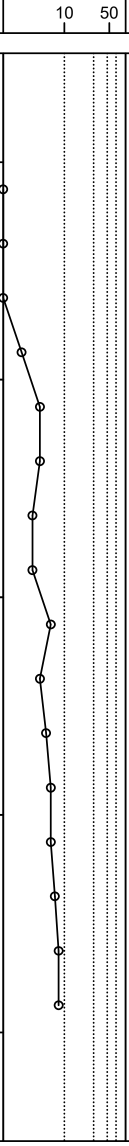
Date Drilled : 25 November 2024
Boring Location : Refer to Report Figure 2
Drilling Contractor : Cosmo Drilling
: Ocean Bluff, MA
Driller : E. Sviokla
Rock Core : ---
GPI Field Engineer : F. Sviokla
Elevation and Datum :
Drilling Mud Utilized : Not necessary
Constant Water Head : Drive & Wash

Test Boring No. B-6

(1 of 1)

Drill Rig Type : Tripod Mounted
Hammer Type : Drop
Cat-Head or Winch : Cat-Head
Soil Casing Type : 3 in. BW
Sampler Type : SS - 1.375 in. I.D.; unlined
Sampler Hammer Fall : 140 lbs. / 30 in.

Depth in Feet	Elev. in Feet	DESCRIPTIONS	USCS	GRAPHIC	Water Level	Sample No.	Blow Count	Blow Count Graph	Average qu-Field	Average qu-Field (TSF)	REMARKS
0 - 1		LEAF LITTER & DUFF	AR	▨							Groundwater=7' Well Set: no
1 - 3		TOPSOIL, LEAVES, VINES & ROOTS	AR	▨		1	1 1 1 2				SS-1: 1' - 3' R=7 N=2
3 - 5		Black & dark brown, fine SAND, trace fine gravel (sub-angular), and organic silt, (loose, moist), frequent infillings of remolded topsoil	AR	▨		2	4 4 3 3				SS-2: 3' - 5' R=10 N=7
5 - 7		Dark brown, fine SAND, (loose, moist), frequent root clusters 6.5 ft. -FILL WITH ORGANICS-	AR	▨	▼ 7	3	6 4 5 6				SS-3: 5' - 7' R=14 N=9
7 - 9		Dark brown to brown, medium to fine SAND, trace fine gravel (rounded), (medium dense, very moist) 9.0 ft. -GLACIAL FLUVIAL-	SP	■		4	6 7 8 8				SS-4: 7' - 9' R=15 N=15 P=Penetrometer
9 - 10		END OF BORING @ 9 FT DEPTH									
10 - 11		Particle Size: trace: <5%; few: 5-10%; little: 15-20%; some 30-45%; mostly: 50-100%									



Average qu-Field (TSF): 0 1 2 3 4

COHESIONLESS SOILS: (DENSITY) L: Sands; R: Gravels			COHESIVE SOILS: (CONSISTENCY)	
0-6	Very Loose	0-8	0-2	Very Soft (<0.25 TSF)
6-10	Loose	8-15	2-4	Soft (0.25-0.5 TSF)
11-30	Med-Dense	16-40	4-8	Med. Stiff (0.5-1.0 TSF)
>30	Dense	41-50	9-20	Stiff (1.0-4.0 TSF)
	Very Dense	>50	>20	Hard (>4.0 TSF)

Test Boring No. B-6

(1 of 1)

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Geotechnical Partnership, Inc.
Fitchburg, MA

Geotechnical Services

PROJECT: New Construction
New Commuinity Center - Range Rd.
Reading, Massachusetts

CLIENT: Bargmann Hendrie & Archtype, Inc.

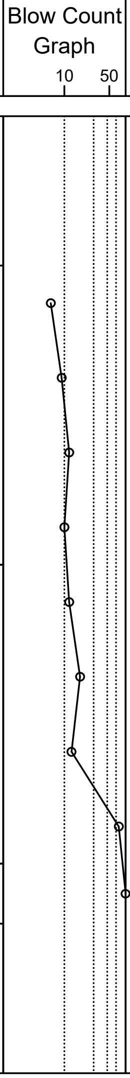
File No. 2436

Date Drilled : 25 November 2024
Boring Location : Refer to Report Figure 2
Drilling Contractor : Cosmo Drilling
: Ocean Bluff, MA
Driller : E. Sviokla
Rock Core : ---
GPI Field Engineer : F. Sviokla
Elevation and Datum :
Drilling Mud Utilized : Not necessary
Constant Water Head : Drive & Wash

Test Boring No. B-7
(1 of 1)

Drill Rig Type : Tripod Mounted
Hammer Type : Drop
Cat-Head or Winch : Cat-Head
Soil Casing Type : 3 in. BW
Sampler Type : SS - 1.375 in. I.D.; unlined
Sampler Hammer Fall : 140 lbs. / 30 in.

Depth in Feet	Elev. in Feet	DESCRIPTIONS	USCS	GRAPHIC	Water Level	Sample No.	Blow Count	Average qu-Field	Average qu-Field (TSF) 0 1 2 3 4	REMARKS
0		LEAF LITTER OVER TOPSOIL	AR	▨						Groundwater=not encountered Well Set: no
1		Brown, coarse to fine SAND, some coarse to fine gravel (angular to sub-rounded), few silt, (medium dense, moist)	SP			1	6 9 12 10			SS-1: 1' - 3' R=12 N=21
3		Brown/tan, fine SAND, few silt, trace fine gravel (sub-rounded to rounded), (dense, moist) 4.5 ft. -GLACIAL FLUVIAL-				2	12 18 13 77			SS-2: 3' - 5' R=16 N=31
4.5		Brown, coarse GRAVEL (angular), little coarse to fine sand, few silt, (dense, moist) 5.4 ft. -GLACIAL FLUVIAL-	GP			3	100			SS-3: 5' - 5.4' R=4 N=100 P=Penetrometer
5.4		REFUSAL @ 5.4 FT DEPTH								



Particle Size: trace: <5%; few: 5-10%; little: 15-20%; some 30-45%; mostly: 50-100%

COHESIONLESS SOILS: (DENSITY) L: Sands; R: Gravels

0-6	Very Loose	0-8
6-10	Loose	8-15
11-30	Med-Dense	16-40
>30	Dense	41-50
	Very Dense	>50

COHESIVE SOILS: (CONSISTENCY)

0-2	Very Soft (<0.25 TSF)
2-4	Soft (0.25-0.5 TSF)
4-8	Med. Stiff (0.5-1.0 TSF)
9-20	Stiff (1.0-4.0 TSF)
>20	Hard (>4.0 TSF)

Test Boring No. B-7
(1 of 1)

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Geotechnical Partnership, Inc.
Fitchburg, MA
Geotechnical Services

PROJECT: New Construction
New Commuinity Center - Range Rd.
Reading, Massachusetts

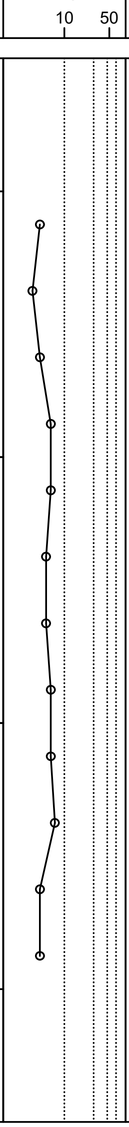
CLIENT: Bargmann Hendrie & Archtype, Inc.
File No. 2436

Date Drilled	: 25 November 2024
Boring Location	: Refer to Report Figure 2
Drilling Contractor	: Cosmo Drilling : Ocean Bluff, MA
Driller	: E. Sviokla
Rock Core	: ---
GPI Field Engineer	: F. Sviokla
Elevation and Datum	:
Drilling Mud Utilized	: Not necessary
Constant Water Head	: Drive & Wash

Test Boring No. B-8
(1 of 1)

Drill Rig Type	: Tripod Mounted
Hammer Type	: Drop
Cat-Head or Winch	: Cat-Head
Soil Casing Type	: 3 in. BW
Sampler Type	: SS - 1.375 in. I.D.; unlined
Sampler Hammer Fall	: 140 lbs. / 30 in.

Depth in Feet	Elev. in Feet	DESCRIPTIONS	USCS	GRAPHIC	Water Level	Sample No.	Blow Count	Blow Count Graph	Average qu-Field	Average qu-Field (TSF)	REMARKS
0 - 1		LEAF LITTLER OVER TOPSOIL	AR								Groundwater=not encountered Well Set: no
1 - 3		Tan, fine SAND (uniform), few silt, trace fine gravel (rounded), (loose, moist)	SP			1	4 3 4 6				SS-1: 1' - 3' R=13 N=7
3 - 5		Light gray, fine SAND (uniform), trace silt, (loose, moist)				2	6 5 5 6				SS-2: 3' - 5' R=15 N=10
5 - 7		Light gray, coarse to fine SAND, little coarse to fine gravel (angular to sub-rounded), trace silt, (loose to medium dense, moist) 7.0 ft. -GLACIAL FLUVIAL-				3	6 7 4 4				SS-3: 5' - 7' R=12 N=11 P=Penetrometer
7 - 8		Bottom of Exploration at 7 feet Depth									



Particle Size: trace: <5%; few: 5-10%; little: 15-20%; some 30-45%; mostly: 50-100%

COHESIONLESS SOILS: (DENSITY) L: Sands; R: Gravels	L		R	COHESIVE SOILS: (CONSISTENCY)	
	0-6	Very Loose	0-8	0-2	Very Soft (<0.25 TSF)
	6-10	Loose	8-15	2-4	Soft (0.25-0.5 TSF)
	11-30	Med-Dense	16-40	4-8	Med. Stiff (0.5-1.0 TSF)
	>30	Dense	41-50	9-20	Stiff (1.0-4.0 TSF)
		Very Dense	>50	>20	Hard (>4.0 TSF)

Test Boring No. B-8
(1 of 1)

Geotechnical Partnership, Inc.
Fitchburg, MA
Geotechnical Services

PROJECT: New Construction
New Commuinity Center - Range Rd.
Reading, Massachusetts

CLIENT: Bargmann Hendrie & Archtype, Inc.

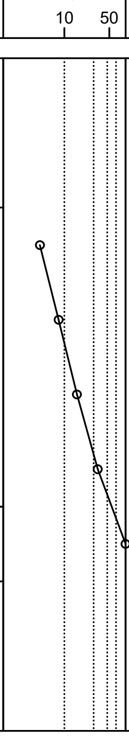
File No. 2436

Date Drilled : 25 November 2024
Boring Location : Refer to Report Figure 2
Drilling Contractor : Cosmo Drilling
: Ocean Bluff, MA
Driller : E. Sviokla
Rock Core : ---
GPI Field Engineer : F. Sviokla
Elevation and Datum :
Drilling Mud Utilized : Not necessary
Constant Water Head : Drive & Wash

Test Boring No. B-9
(1 of 1)

Drill Rig Type : Tripod Mounted
Hammer Type : Drop
Cat-Head or Winch : Cat-Head
Soil Casing Type : 3 in. BW
Sampler Type : SS - 1.375 in. I.D.; unlined
Sampler Hammer Fall : 140 lbs. / 30 in.

Depth in Feet	Elev. in Feet	DESCRIPTIONS	USCS	GRAPHIC	Water Level	Sample No.	Blow Count	Blow Count Graph 10 50	Average qu-Field	Average qu-Field (TSF) 0 1 2 3 4	REMARKS
0		LEAF LITTER OVER FIBROUS TOPSOIL	AR	▨							Groundwater=not encountered Well Set: no
1		Brown, coarse to fine SAND, little coarse to fine gravel (angular), trace silt, (medium dense, moist) 2.0 ft. -GLACIAL FLUVIAL-	SP	■			4 8				SS-1: 1' - 3' R=16 N=24
2			SP	■		1	16 35				
3		Gray, coarse to fine SAND, some coarse to fine gravel (sub-angular), few silt, (dense, moist) 3.5 ft. -GLACIAL FLUVIAL-				2	100				SS-2: 3' - 3.5' R=4 N=100 P=Penetrometer
4		END OF BORING @ 3.5 FT DEPTH REFUSAL IN NESTED BOULDERS									
5		Particle Size: trace: <5%; few: 5-10%; little: 15-20%; some 30-45%; mostly: 50-100%									
6											
7											
8											



COHESIONLESS SOILS: 0-6 Very Loose 0-8
(DENSITY) 6-10 Loose 8-15
L: Sands; R: Gravels 11-30 Med-Dense 16-40
>30 Dense 41-50
Very Dense >50

COHESIVE SOILS: 0-2 Very Soft (<0.25 TSF)
(CONSISTENCY) 2-4 Soft (0.25-0.5 TSF)
4-8 Med. Stiff (0.5-1.0 TSF)
9-20 Stiff (1.0-4.0 TSF)
>20 Hard (>4.0 TSF)

Test Boring No. B-9
(1 of 1)

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Geotechnical Partnership, Inc.
Fitchburg, MA
Geotechnical Services

PROJECT: New Construction
New Commuinity Center - Range Rd.
Reading, Massachusetts

CLIENT: Bargmann Hendrie & Archtype, Inc.

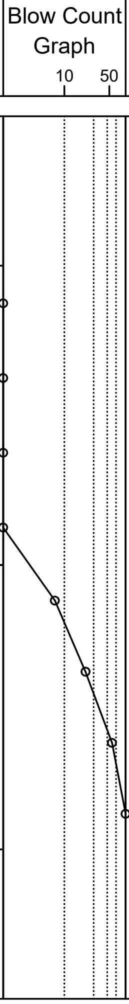
File No. 2436

Date Drilled : 26 November 2024
Boring Location : Refer to Report Figure 2
Drilling Contractor : Cosmo Drilling
: Ocean Bluff, MA
Driller : E. Sviokla
Rock Core : ---
GPI Field Engineer : F. Sviokla
Elevation and Datum :
Drilling Mud Utilized : Not necessary
Constant Water Head : Drive & Wash

Test Boring No. B-10

(1 of 1)

Drill Rig Type : Tripod Mounted
Hammer Type : Drop
Cat-Head or Winch : Cat-Head
Soil Casing Type : 3 in. BW
Sampler Type : SS - 1.375 in. I.D.; unlined
Sampler Hammer Fall : 140 lbs. / 30 in.



Depth in Feet	Elev. in Feet	DESCRIPTIONS	USCS	GRAPHIC	Water Level	Sample No.	Blow Count	Average qu-Field	Average qu-Field (TSF) 0 1 2 3 4	REMARKS
0		LEAF LITTER & DUFF	AR							Groundwater=not encountered Well Set: no
1		Light brown, fine SAND, little fine gravel (rounded), trace silt and organic silt, (very loose, moist), frequent infillings of decomposed vegetation	AR			1	1 1 1 0			SS-1: 1' - 3' R=7 N=2
3		3.5 -FILL WITH ORGANICS-				2	7			SS-2: 3' - 4.9' R=15 N=88 P=Penetrometer
4		Brown, coarse to fine SAND, some coarse gravel (angular) and rock fragments, few silt, (dense, moist) 4.9 ft. -GLACIAL FLUVIAL-	SP				22 60 100			
5		REFUSAL @ 4.9 FT DEPTH POSSIBLE BEDROCK								
6		Particle Size: trace: <5%; few: 5-10%; little: 15-20%; some 30-45%; mostly: 50-100%								
7										
8										

COHESIONLESS SOILS: 0-6 Very Loose 0-8
(DENSITY) 6-10 Loose 8-15
L: Sands; R: Gravels 11-30 Med-Dense 16-40
>30 Dense 41-50
Very Dense >50

COHESIVE SOILS: 0-2 Very Soft (<0.25 TSF)
(CONSISTENCY) 2-4 Soft (0.25-0.5 TSF)
4-8 Med. Stiff (0.5-1.0 TSF)
9-20 Stiff (1.0-4.0 TSF)
>20 Hard (>4.0 TSF)

Test Boring No. B-10

(1 of 1)

Geotechnical Partnership, Inc.
Fitchburg, MA

Geotechnical Services

PROJECT: New Construction
New Commuinity Center - Range Rd.
Reading, Massachusetts

CLIENT: Bargmann Hendrie & Archtype, Inc.

File No. 2436

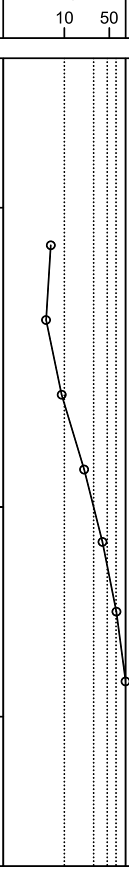
Date Drilled : 27 November 2024
Boring Location : Refer to Report Figure 2
Drilling Contractor : Cosmo Drilling
: Ocean Bluff, MA
Driller : E. Sviokla
Rock Core : ---
GPI Field Engineer : F. Sviokla
Elevation and Datum :
Drilling Mud Utilized : Not necessary
Constant Water Head : Drive & Wash

Test Boring No. B-11

(1 of 1)

Drill Rig Type : Tripod Mounted
Hammer Type : Drop
Cat-Head or Winch : Cat-Head
Soil Casing Type : 3 in. BW
Sampler Type : SS - 1.375 in. I.D.; unlined
Sampler Hammer Fall : 140 lbs. / 30 in.

Depth in Feet	Elev. in Feet	DESCRIPTIONS	USCS	GRAPHIC	Water Level	Sample No.	Blow Count	Blow Count Graph 10 50	Average qu-Field	Average qu-Field (TSF) 0 1 2 3 4	REMARKS
0		LEAF LITTER & TOPSOIL	AR	▨							Groundwater=not encountered Well Set: no
1 2		Light brown, coarse to fine SAND, trace fine gravel (sub-angular to sub-rounded) and silt, (medium dense, moist) 2.5 ft. -GLACIAL FLUVIAL-	SP	▨		1	6 5 9				SS-1: 1' - 3' R=14 N=14
3 4		Brown, coarse to fine SAND, some coarse to fine gravel (angular to sub-angular), few silt, (dense, moist) 4 ft. -GLACIAL FLUVIAL-	SP	▨		2	21 42 71 100				SS-2: 3' - 4.4' R=12 N=171 P=Penetrometer
5		END OF BORING @ 4.9 FT DEPTH REFUSAL IN POSSIBLE GLACIAL TILL OR ROCK									
6 7 8		Particle Size: trace: <5%; few: 5-10%; little: 15-20%; some 30-45%; mostly: 50-100%									



COHESIONLESS SOILS:	0-6	Very Loose	0-8	COHESIVE SOILS:	0-2	Very Soft (<0.25 TSF)
(DENSITY)	6-10	Loose	8-15	(CONSISTENCY)	2-4	Soft (0.25-0.5 TSF)
L: Sands; R: Gravels	11-30	Med-Dense	16-40		4-8	Med. Stiff (0.5-1.0 TSF)
	>30	Dense	41-50		9-20	Stiff (1.0-4.0 TSF)
		Very Dense	>50		>20	Hard (>4.0 TSF)

Test Boring No. B-11

(1 of 1)

Geotechnical Partnership, Inc.
Fitchburg, MA
Geotechnical Services

PROJECT: New Construction
New Commuinity Center - Range Rd.
Reading, Massachusetts

CLIENT: Bargmann Hendrie & Archtype, Inc.

File No. 2436

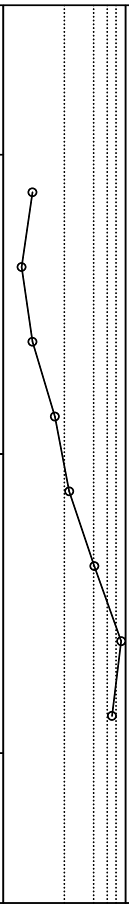
Date Drilled	: 26 November 2024
Boring Location	: Refer to Report Figure 2
Drilling Contractor	: Cosmo Drilling : Ocean Bluff, MA
Driller	: E. Sviokla
Rock Core	: ---
GPI Field Engineer	: F. Sviokla
Elevation and Datum	:
Drilling Mud Utilized	: Not necessary
Constant Water Head	: Drive & Wash

Test Boring No. B-12

(1 of 1)

Drill Rig Type	: Tripod Mounted
Hammer Type	: Drop
Cat-Head or Winch	: Cat-Head
Soil Casing Type	: 3 in. BW
Sampler Type	: SS - 1.375 in. I.D.; unlined
Sampler Hammer Fall	: 140 lbs. / 30 in.

Depth in Feet	Elev. in Feet	DESCRIPTIONS	USCS	GRAPHIC	Water Level	Sample No.	Blow Count	Blow Count Graph 10 50	Average qu-Field	Average qu-Field (TSF) 0 1 2 3 4	REMARKS
0		LEAF LITTER & TOPSOIL	AR	▩							Groundwater=not encountered Well Set: no
1		Rust-brown, coarse to fine SAND, little coarse to fine gravel (sub-angular to sub-rounded), few silt, (loose, moist) 3.5 ft. -GLACIAL FLUVIAL-	SP	■		1	3 2 3 7				SS-1: 1' - 3' R=15 N=5
3						2	12				SS-2: 3' - 5' R=16 N=116 P=Penetrometer
3.5		Brown, coarse to fine SAND, some coarse gravel (sub-angular to sub-rounded), few silt, (dense, moist) 5.0 ft. -GLACIAL FLUVIAL-	SP	■			31 85 60				
5		END OF BORING @ 5.0 FT DEPTH REFUSAL IN GLACIAL TILL oR ROCK									
6											
7											
8											



Particle Size: trace: <5%; few: 5-10%; little: 15-20%; some 30-45%; mostly: 50-100%

COHESIONLESS SOILS: (DENSITY) L: Sands; R: Gravels			COHESIVE SOILS: (CONSISTENCY)	
0-6	Very Loose	0-8	0-2	Very Soft (<0.25 TSF)
6-10	Loose	8-15	2-4	Soft (0.25-0.5 TSF)
11-30	Med-Dense	16-40	4-8	Med. Stiff (0.5-1.0 TSF)
>30	Dense	41-50	9-20	Stiff (1.0-4.0 TSF)
	Very Dense	>50	>20	Hard (>4.0 TSF)

Test Boring No. B-12

(1 of 1)