Tilton-Northfield Fire District
Design Build Phase I
Geotech & Site Evaluation

149 Park Street
Northfield, NH 03276
&
45 Sanborn Road
Tilton, NH 03276

September 8, 2023

Prepared for

Fire Chief
Michael W. Sitar Jr.

12 Center Street
Tilton, NH 03276

Loureiro
BUILDING CONSTRUCTION

Loureiro Building Construction, LLC.
100 Northwest Drive • Plainville, CT 06062 • 860.747.6181 • Fax 860.747.8822 • www.Loureiro.com
An Employee-Owned Company

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Comm. No. 222-0090

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1. BACKGROUND

Following a formal RFQ response format that included written proposals and interviews, Loureiro Building Construction was selected as the Design Build contractor for the Tilton Northfield Design Build Services project for the planning and construction of the Tilton-Northfield Fire District (TNFD) Fire Station to service the Town of Northfield and Town of Tilton.

Phase 1 of the Design Build Project was segregated into a five-step process including Program Evaluation, Geotech Survey and Site Evaluation, Space Needs Study, Schematic Design Plans, and Public Outreach. The Step 1 Program Evaluation report was completed on July 10, 2023 with a subsequent revision date of July 11, 2023. The Program Evaluation consisted of reviewing all the existing data, previous studies, existing Geotech reports and provided project program. The function of the program evaluation was to provide a full comprehensive review and understanding of the multitude of information that has been developed over the years. That report served as a brief summary of the review and high-level summary of the information contained therein.

The second and third steps, the Geotech Survey and Site Evaluation along with the Space needs study have been completed simultaneously. This report, Geotech Survey and Site Evaluation is step two of this five-step process.

Building systems recommendations and cost analysis are to be completed subsequently as part of steps three through five of this Design Build Phase 1.

2. SCOPE

This Geotech Survey and Site Evaluation consists of analysis and evaluation of each of the potential lots, 149 Park Street, Tilton, NH 03276 and 45 Sanborn Road, Tilton, NH 03276. Providing and analyzing geotechnical surveys on each site has been included within this report. The surveys included approximately 4 to 5 borings on each of the subject lots and provide formal analysis of the below grade conditions.

A visual site inspection of each potential lot was conducted. The photographic documentation is included in Appendix A Site Photographs. The visual inspection included review of existing grades, visible utilities, and other existing above ground site improvements. A formal site survey by a licensed surveyor has not be provided.

This report and subsequent site selection recommendation is based off the review and summation of the Existing Phase 1 Report, geotechnical surveys, visual site inspections, the previous Program Evaluation Report (including all referenced documents) and review of existing available site layout plans as well as the Site Concept plans provided by Loureiro. Site selection is a recommendation, and a formal site selection will be provided in conjunction with the TNFD, Commissioners and the Building Committee.

3. DOCUMENTS

The following documents were utilized in the preparation of this report:

- Geotechnical Engineering Report, Proposed Fire Station, 45 Sanborn Rd, Tilton, NH (August 30, 2023, Miller Engineering & Testing Inc.) 11 pages
- Geotechnical Engineering Report, Proposed Fire Station, 149 Park St, Northfield, NH (August 30, 2023, Miller Engineering & Testing Inc.) 11 pages
- Park Street Environmental Site Assessment (Sept. 17, 2019, Northpoint) 64 pages
- Existing Conditions Plan Sheet S1 (1 of 1) by Joseph M. Wichert LL, Appendix C from the Fire Station Committee Report. (See Appendix)
- Proposed Fire Station Sheet 1 (Sanborn Road) (Aug. 31, 2023, LEA)
- Proposed Fire Station Addition Sheet 1 (Park St.) (Sept. 1, 2023, LEA)

4. EXISTING DATA

4.1 Environmental Site Assesment Phase 1

In 2019 the TNFD retained Northpoint Engineering LLC to perform a Phase 1 Environmental Site Assessment (ESA) on the subject lot 149 Park Street, Northfield, NH. The study was completed following American Society for Testing and Materials (ASTM) Standard E-1527-13 - Standard Practice for Environmental Site Assessments: Phase I Site Assessment Processes. The report provided site specific background information including a Site description, Site history, Environmental setting, Records review and background information, Environmental impact assessment, Conclusions, Exceptions / Deviations, and Recommendations. While the report was comprehensive in nature, the following highlights shall be noted as potential impacts to the site.

- During the implementation of wetland flags it was observed that the existing adjacent landfill extends further onto the site than was previously known. The landfill/stump dump is on the western side of the site and extends onto the

western edge of the fires station site. A potential old underground storage tank exists on site. The possibility exists that the old tank is actually buried waste.

- Municipal water and sewer currently serve the Park Street Station. A former leach field exists to the south but is no longer in use. Natural gas serves the building and is used for heating.
- The adjacent Highway Garage Site has ground water monitoring related to petroleum releases from old underground storage tanks (UST's). A VOC (Volatile organic compounds) plume related to this former underground storage tank on the site is present to the west of the site. The landfill and the VOC plume are both active remediation sites.
- Multiple UST's existing and are known to have been removed. One UST is thought to still exist although it is understood that it was filled with soil when a horse put a foot through the top of the tank. This tank closure should be overseen by an ICC-certified individual who holds a U1 license for UST decommissioning. It is also recommended that someone from the Oil Remediation Section observe the excavation process as well.
- Two monitoring wells and one piezometer are located on the fire station site to monitor the impacts of the landfill/stump dump that extends onto the site.
- Floor drains that were previously connected to the abandoned-on site leach field were a possible pathway for solvents or petroleum's to impact the soil and groundwater. The Oil Remediation and Compliance Bureau should be notified if evidence of impacted soil is discovered during construction.
- As the adjacent landfill extends onto the site, any construction if performed over the existing landfill cap will require an application to modify the existing landfill permit.
- Asbestos-containing materials, lead based paint, mold, radon, or PCB-containing material assessment has not been conducted. Loureiro recommends a hazardous assessment be conducted for a full understanding of potential impact prior to design completion should Park Street be the selected site.

A phase 1 ESA for 45 Sanborn Road, Tilton, NH (Police Station Site) was not readily available for review. Prior to construction it is recommended that if a Phase 1 for the police station site was performed it be reviewed for any impact to the site. If a Phase 1 has not been performed it is recommended that a phase 1 ESA be performed prior to any construction activities.

5. SITE ANALYSIS

Two Geotechnical Engineering Report were conducted by Miller Engineering & Testing Inc. One for each of the perspective site locations, 45 Sanborn Rd, Tilton, NH and 149 Park Street, Northfield, NH.

While these reports may provide a representative analysis of the potential subsurface conditions at the location of the proposed TNFD Fire Station, it shall be understood that the analyses, recommendations, and designs within the geotechnical report are based on generalized soil profiles interpreted from the widely spaced boring samples. The nature and extent of variations between these explorations may not become evident until the exposure of such conditions during construction.

The following summations shall not be deemed to be a full representation of the subsurface conditions. A full review and compliance of each Geotechnical Engineering Report shall be provided within the final proposed design.

5.1 Geotechnical Engineering Report (45 Sanborn Rd., Tilton, NH)

Four test borings were performed on August 16, 2023, and performed utilizing equipment and methods as described in section 3.0 Subsurface Exploration Program. The subsurface geological conditions are described in detail in section 4.0 Subsurface Conditions and detailed soil conditions were provided within Table 1 and Appendix Boring Logs.

As described in the report the "site generally consisted of fill material and topsoil overlying naturally occurring sand and gravel soils. Ground water was encountered in the site test borings at depths between 14 and 19 feet below the existing grades. The fill materials were up to 4 feet thick in our site test borings."[1] The analysis indicated that "the subsurface conditions at the site are favorable for design and construction of a conventional, shallow, spread footing foundation system to support the proposed Fire Station, after removing and replacing any unsuitable soils and utilities below the proposed building footprint."[1]

The foundation system recommendations consist of providing a shallow foundation system including spread footings at columns and strip footings at load bearing walls. Removal of organic topsoil and fill material will be required at the foundation locations.

[1] Kenneth W. Milender, P.E. Miller Engineering & Testing Inc. Geotechnical Engineering Report 45 Sanborn Rd August 29, 2023.

The analysis indicates that the subsurface conditions should allow for a new bearing pressure of 3,000 psf and provide for minimal differential settlement of less than 0.5 inches between adjacent footings. Settlement typically occurs as loads are applied, therefore most of the settlement shall occur by the end of construction.

The slab on grade recommendations denotes that the subsurface conditions below the surficial organic layers are suitable for construction of the slab on grade. A 12" thick sub base course of fill shall be provided below the slab on grade meeting the gradation as denoted in the report.

A current site survey, proposed slab elevation and existing grade elevations at the street are not available. Existing grades appear to have a gradual slope with a differential elevation of approximately 3' across the site. The northern portion of the building footprint shall require topsoil removal. The Western portion of the building footprint will require topsoil and fill removal. Absent of a site survey, proposed slab elevation and existing grade elevations at the street, no topsoil or fill materials appear to extend to below the bottom of proposed footings and associated granular fill required below bearing locations based on the approximate elevation of suitable subgrades denoted in the chart within the report. Upon removal of the topsoil below the slab on grade area, a minimal amount of fill may be required on the north portion of the building footprint to allow for proper elevation of the required base course below the slab on grade.

Following removal of unsuitable soils four complete compaction passes shall be provided per the report. Saturate soils experiencing pump and weave during rolling shall be excavated and replaced. On site natural sand/gravel and existing fill material may be used as backfill as denoted in the report in select areas if compacted appropriately and performed during weather appropriate conditions.

5.2 Geotechnical Engineering Report (149 Park Street, Northfield, NH)

Five test borings were performed on August 15, 2023 and performed utilizing equipment and methods as described in section 3.0 Subsurface Exploration Program. The subsurface geological conditions are described in detail in section 4.0 Subsurface Conditions and detailed soil conditions were provided within Table 1 and Appendix Boring Logs.

As described in the report the "site generally consisted of fill materials and topsoil overlying naturally occurring sand soils and compressible lake bed silts and clays. Groundwater was encountered in the site test borings at depths between 6 and 9 feet

below the existing grades."[2] The analysis indicated that "the subsurface conditions at the site are favorable for design and construction of a conventional, shallow, spread footing foundation system to support the proposed Fire Station"[2] after removing and replacing any unsuitable soils and utilities below the proposed building footprint. A compressible, low plasticity and slightly over consolidated clayey silt formation were encountered and could consolidate and settle under the required fill needed to bring the site up to match the existing slab elevation however the analysis indicated the consolidation could be limited to approximately 0.25 inches with 2' of grade raise which should be tolerable by the structure.

The foundation system recommendations consist of providing a shallow foundation system including spread footings at columns and strip footings at load bearing walls. Removal of organic topsoil and fill material will be required at the foundation locations. The analysis indicates that the subsurface conditions should allow for a new bearing pressure of 3,000 psf and provide for minimal differential settlement of less than 0.5 inches between adjacent footings. Settlement typically occurs as loads are applied, as such most of the settlement shall occur by the end of construction.

The slab on grade recommendations denotes that the subsurface conditions below the surficial organic layers are suitable for construction of the slab on grade. A 12" thick sub base course of fill shall be provided below the slab on grade meeting the gradation as denoted in the report.

A current site survey, proposed slab elevation and existing grade elevations at the street are not available. Existing grades appear to have a gradual slope with a differential elevation of approximately 4' to 6'. The building's addition footprint shall require topsoil removal. The South and Southwest portion of the building footprint will require fill removal. Absent of a current site survey and existing/proposed slab elevation topsoil and fill materials appear to extend up to 8' below potential slab elevation based on the approximate elevation of suitable subgrades denoted in the chart within the report. Upon removal of the topsoil below the slab on grade, a varying amount of fill (depths of 8 to 10' possible) will be required to allow for proper elevation of the required base course below the slab on grade.

Following removal of unsuitable soils four complete compaction passes shall be provided per the report. Saturate soils experiencing pump and weave during rolling shall

[2] Kenneth W. Milender, P.E. Miller Engineering & Testing Inc. Geotechnical Engineering Report 45 Sanborn Rd August 29, 2023.

be excavated and replaced. On site natural sand/gravel and existing fill material may be used as backfill as denoted in the report in select areas if compacted appropriately and performed during weather appropriate conditions.

5.3 Visual Inspection

A visual site inspection was performed by Loureiro Building Construction on July 13, 2023. The photo documentation taken during the visual inspection has been included in Appendix A Site Photographs. During the visual inspection photographs were taken to exhibit any existing grade variations, site improvements, utilities or other above grade conditions that exist. Aerial photo documentation has been provided via Google Earth® imagery as documented in Appendix C Aerial Photography.

5.3.1 Park Street

The existing firehouse exists on the Northern portion of the site with a bituminous parking area on the Northeast and a bituminous parking area and drive on the Northwest. See aerial photo 1.1. The site contains an open grassy area to the South East of the existing building. The site has a gradual slope down in the Southeast direction of approximately 4' or more. A grouping of trees are evident on the South Western portion of the site. A flag pole and landscaped area exists along the Northeast property line adjacent to Park Street. There is a training structure along the Southwestern portion of site consisting of a multi store steel container structure. Not evident in the aerial photos but is documented in photograph 1.5 and 1.6 is an existing cell tower structure with fenced perimeter. This tower is accessible through a gravel drive along the back side of the existing firehouse and is situated South to Southeast of the training structure. A storage shed is positioned Southwest of the existing firehouse on the opposite side of the tower access drive.

There is evidence of an existing underground leaching field. A slight mound that is typical of leaching field construction exists slightly South to Southeast of the existing firehouse. Mound is slightly visible in left hand portion of photo 1.9. It is understood that this leaching field has been abandoned in place. Evidence of the leaching field also exists within the Geotech report boring B-4 sample S-2 labeled as "no recovery". The existing leaching field system will need to be remediated prior to construction.

There are existing buildings on adjacent sites that will require maintenance of access along the North of the Existing firehouse. Access to the communications tower must also be maintained (photo 1.7)

While a visual inspection of the Park Street facility existing building has not been performed as part of this report, it shall be understood that the existing building contains numerous structural deficiencies as noted in the Park Street Building Inspection Report dated May 1, 2019. The structural deficiencies will require to be repaired and/or upgraded to meet the structural requirements of todays building code as well as the potential additional loads transposed to the existing structure that will be applied to the existing building by the construction of a building addition. Due to the quantity of deficiencies at minimum a major renovation (possible complete removal and reconstruction) will be required to the existing Park Street station. This major renovation would require the displacement of the department from this station and introduce an encumbrance to the existing workflow and additional financial burden to the department. Additional structural analysis will be required prior to a determination of reconstruction versus demolition of the existing structure.

Phasing construction to allow for the construction of the new addition and then relocation of the department into the addition area before a subsequent renovation was discussed. Without disconnecting the addition from the existing building there would be additional loads applied to the existing structure (such as snow drift) that the structure was not designed to accommodate. Increasing the existing building loads to accommodate the addition prior to construction would require full displacement of the department from the existing facility.

5.3.2 **Sanborn Road**

Sanborn Road consists of a mostly open grassy area situated between an existing parking area at the North and the existing Police Station that was recently constructed (not evident in the aerial photo) at the south just north of the existing cemetery. See aerial photo 1.2. The site is bordered by Sanborn Road on the west and the Tanger Outlet buildings on the East. While the site appears to be mostly flat there is an apparent slight grade differential of approximately 3’ from the northern and southern portions of the site as denoted in the Geotech report.

Existing improvements consist of a Concession Stand (photo 2.5) and a small Storage Shed (photo 2.6) on the Western portion of the site adjacent to Sanborn Road. There are electrical utilities between the Concession Stand and Sanborn Road (photo 2.8) as well as utility stub up between the Concession Stand and the Storage Shed (photo 2.7). There is a treed area along Sanborn Road extending from the Concession stand area North toward the parking area. A chain link fence (photo 2.9 and 2.11) exists along the

Northern property line adjacent to the parking area. There is a powered field sign and electrical utility stub up in the Northeastern corner of the parcel (photo 2.11).

5.4 Site Constraint Analysis

Loureiro Engineering Associates performed a high-level preliminary analysis of each site and the potential constraints that exist. Each has been depicted in a proposed site layout plan attached. These proposed fire station site plans have been developed solely to understand the potential site constraints of each site and are not to depict the actual fire station layout plan for each site option. Each site plan was developed prior to the completion of the proposed programs for each site. Therefore, the building size, layouts, etc. are subject to change upon the completion of the schematic design plans. See the Space Needs Study for the program determination and recommendations.

5.4.1 Park Street

The proposed site plan Park Street option depicts a building addition and renovation option where the program functions of Center Street and Park Street are consolidated into one building on the Park Street Site. The existing park street facility would contain the renovation area converting the existing apparatus bay to interior program spaces with the proposed addition containing additional interior program space as well as the apparatus bay areas. The existing building contains existing structural deficiencies as well as size constraints that are not conductive to the apparatus bay function currently housed within.

Park Street zoning requirements include a 150’ minimum Frontage, 35’ Front Setback and a 20’ Rear and Side Setback.

Due to the maintenance requirements for the access drive servicing the tower and existing grade slope within the site, drive up access to both sides of the apparatus bay areas will not be achievable. Furthermore, a concept was discussed to locate a new building disconnected from the existing further southeast on site in an effort to obtain drive access to both sides of the apparatus bay area but again endured site constraints with the wetlands and the cell tower. Additionally, this segregation of the two structures on site concept provided logistical work flow discrepancies between the two structures.

Due to the existing grade differential across the site, the building foundations will require taller retaining walls to permit the new slab elevation to abut the existing elevation while maintaining the existing grades of the rear access drive and area around

the cell tower. In some instances, the retaining walls could reach a height of 10' (6' exposed and 4' below grade).

5.4.2 Sanborn Road

The proposed site plan for the Sanborn Road option depicts a new building option where the program functions of Center Street and Park Street are consolidated into a new building on Sanborn Road. While the Center Street station shall be closed, the Park Street station will remain and the existing spaces will be repurposed to accommodate the program needs as determined in the space needs study.

Sanborn Road zoning requirements include a 30' Front Setback, 20' Rear and 50' Side Setback. The maximum lot coverage is 75%.

The Sanborn Road site consist of mostly open space with an efficient length to width ratio allowing for a more proficient layout with drive up access to both sides of the apparatus bay area. While the existing Sanborn Road site includes minimal cross slope, the cross slope does not have any detrimental impacts to the site layout. This site also allows for the co-location concept and cross training between the Police Station and Fire Department. The existing sports field function will remain however will be consolidated to the rear (Eastern) portion of the site.

5.5 Utility Considerations

Minimal utilities exist at both the Park Street and Sanborn Road site. Sanborn Road utilities feed the existing concession stand and Park Street feed the existing building. Both sites existing utilities are deficient in size for the construction of the new Fire Station. New services will be required at both sites.

6. COST ANALYSIS

6.1 Building Site Concept

The buildings on both sites took into consideration the Geotech report and the space needs study for the analysis. A preliminary building and site layout of both locations with square footages to represent the required space relevant to the space needs study was used for comparison with similar design intent for both sites. Foundations are based on the requirements in the report along with the final grades as currently intended. The floor drains in the apparatus bays are not included in this analysis as they are needed in

both stations. The storm water drainage is included, Sanborn Street site has a much lower water table and will be a much easier installation.

6.2 Park Street Station

The front edge of the building would align with the existing station along Park St. The slab elevation would match the existing slab and be 8 inches thick with a double #5 rebar mat. Removal of topsoil from the building footprint and 6 feet beyond in all directions. The unsuitable soils inside the building area are 4-5 feet deep in areas. The grades at Park Street drop off significantly with the removal of the existing septic system requiring the removal of the system and any soils the system has leached into, we have considered the removal of this system to have a 6,000 sq foot footprint and removal of 4 feet deep in the area. The back of the station will require a foundation wall with the heights being 10 feet in sections. The existing wall that will abut the addition will need to have a single sided foundation placed to support the existing building and allow the new area to be properly supported without disturbing the existing building, we see no need for underpinning at this time. No cracks in the existing structure foundation were observed during our review of the site. There is a significant amount of structural fill required to be imported and compacted to bring the final floor elevation to grade level. The foundations will step from a 6-foot wall at the front of the station to 10 feet at the rear of the station. The runoff from the roof will be captured and will tie into the site storm water system to keep the water off Park Street. The front of the building will have 4 added bays which will need to have vehicles backing ion off Park Street, two vehicles deep. There will be no possible way to have vehicles access the building from the rear of the site. $914,000.00

Park St Sitework Costs			
Unsuitable Export		$	120,500.00
Import & compacted Gravel		$	348,000.00
Foundation Walls & Footing		$	149,300.00
Slab on Grade		$	212,300.00
Drainage		$	36,400.00
Paving & Curbing		$	47,500.00
	Total	**$**	**914,000.00**

6.3 Sanborn Road Station

Sanborn Road Station building would have the front align with the police station next door; the building would sit one hundred feet off the road. The building would have an access road to the rear of the building. The site is very level with a minor elevation drop to the rear of the site. The existing topsoil and unsuitable soils would be removed, and excess topsoil could be used at the rear of the site where the ball field is proposed to stay in place. The apparatus bay would have access at both ends and could be arranged as a drive-through station if desired or back in at both ends for quick exit by any vehicle without moving another out of the station. The foundations at this site would be rather simple 4-foot-high walls with the bottom of footings being a shallow cut. The apparatus bay would have an 8-inch slab and a 4-inch slab on the remainder of the building. Site drainage would be sloped to run off as the police station is and the roof drains would be captured by a storm water system. Granite curb at parking areas to match the aesthetics of the police station next door. The pavement numbers will more on this site as it is currently vacant with no improvements. Sidewalks are considered bituminous at this stage which matches what is at the police station. Granite curbs would abut the sidewalk areas, no curbing on other borders of the pavement. $669,000.00

Sanborn Road Sitework Costs		
Unsuitable Export		$ 38,800.00
Import & compacted Gravel		$ 173,200.00
Foundation Walls & Footing		$ 114,000.00
Slab on Grade		$ 178,600.00
Drainage		$ 15,000.00
Paving & Curbing		$ 149,400.00
	Total	**$ 669,000.00**

7. SITE RECOMMENDATION

This report, the Geotech Survey and Site Evaluation, consisted of a comprehensive analysis of the site conditions at both subject properties. Based on the following determining factors, Loureiro Building Construction recommends the 45 Sanborn Road, Tilton, NH site for the construction of the TNFD station.

- Site constraints at the Park Street site including the varying existing grade elevations, existing wetlands, 100 year flood plain, existing site improvement

and their spatial relationship to the new station and requirement to maintain vehicular access to adjacent structures.

- Lack of vehicular access to both sides of the apparatus bay at the Park Street Site.
- Consideration that utilities must be replaced at Park Street in the Park Street Addition option. There will be no utility infrastructure costs savings by construction on the Park Street site.
- Costs associated with the required Park Street upgrades to the existing structural deficiencies and subsequent department displacement costs including relocation and lease costs.
- Costs associated with the sitework and infrastructure required to implement a building addition to the Park Street site.
- The benefits associated with co-location and cross training with the Police Department and Fire Station located adjacent to each other.

8. NEXT STEPS

Upon acceptance of this Geotech Survey and Site Evaluation and the concurrent Space Needs Study, a formal site selection will be determined in conjunction with the TNFD, Commissioners and the Building Committee. Once a site has been selected the next step of the remaining two steps will commence. These steps shall be the Schematic Design Plans and Public Outreach.

8.1 Schematic Design Plans

Once program evaluation, Geotech reports, site selection, space needs study and building systems recommendations have been completed the schematic design step shall commence. The Schematic Design plans (SD) shall be provided based on the selected recommended building site and include new construction or new construction in conjunction with renovation pending the site selection. SD plans shall include:

- Preliminary Design & Floor Plans
- Structural Plans
- Elevations & Sections
- Exterior Elevation Rendering
- Mechanical System Recommendations
- Site Plan

A schematic design review and comment phase shall be provided with the TNFD and building committee. Comments, suggestions, thoughts, and ideas shall be discussed with the team and final revisions shall be implemented into the SD plan set.

8.2 Public Outreach

The public outreach shall be performed consecutively with the Schematic Design phase. Public information and outreach sessions shall be held with each towns community members. These shall function as an information gathering and sharing session to provide the communities with an opportunity to share their thoughts on this TNFD project. This will provide for a broader understanding of the community's thoughts on this project and what each community or demographic may want to include or exclude within the project as it may have a beneficial impact or hardship depending on their needs. Providing this outreach consecutively with the SD phase will allow for implementation of any knowledge gathered during these sessions during the early preliminary design stage and therefore reduce community concern prior to the finalization of the schematic design plans. Providing a schematic design that meets the TNFD needs as well as each community's feedback will allow for a successful project though all of its phases.

APPENDIX A

SITE PHOTOGRAPHS

1.0 Park Street

1.1 Park St. Station (Looking Northwest from Park St.)

1.2 Park St. Station (Looking Southeast from Park St.)

1.3 Rear of Park St. Station (Looking Northeast

1.4 Looking North at proposed addition location with training area to the left.

1.5 Looking Northwest at proposed addition location with cell tower and training area.

1.6 Looking South Southeast at existing Firehouse and existing communications tower.

1.7 Looking North at proposed addition location with existing shed area to the left.

1.8 Looking South at existing cell tower.

1.9 Looking West at proposed addition location with existing Fire Station and Flagpole.

1.10 Looking Southwest at existing adjacent structures and associated access drive.

2.0 Sanborn Road Site

2.1 Looking South from Tanger Outlet Mall parking lot, towards the Police Station.

2.2 Looking North from in front of Police Station.

2.3 Look East towards the Tanger Outlet Mall.

2.4 Looking Southwest towards Sanborn Rd. Police Station on the left.

2.5 Existing Concession Stand with temp power behind.

2.6 Existing Storage Building.

2.7 Existing buried utilities between two out-buildings.

2.8 Existing utility feeding Concession Stand.

2.9 Field sign.

2.10 Treed area adjacent to Concession and Storage shed.

2.11 Field sign utility and fencing.

2.12 Looking Southeast at the existing Concessions, adjacent Police Station and Police Station entry drive with gravel parking area.

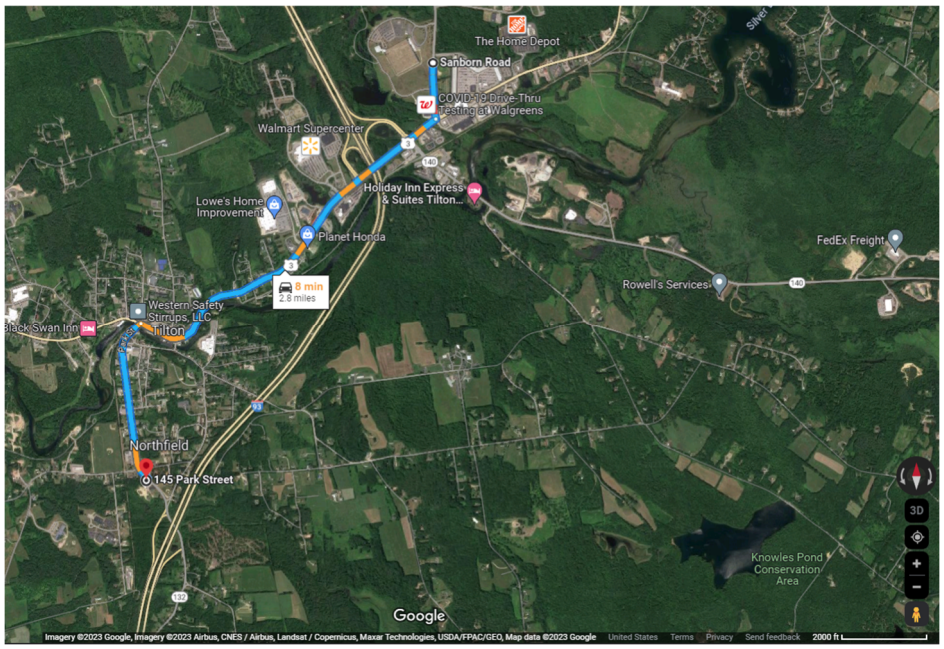
APPENDIX B

AERIAL MAPS

1.0 Aerial Maps

1.1 45 Sanborn Rd, Tilton NH and 145 Park Street, Northfield NH relative to town boundaries.

1.2 Distance between 45 Sanborn Rd and 145 Park Street: 2.8 miles or 8 minutes.



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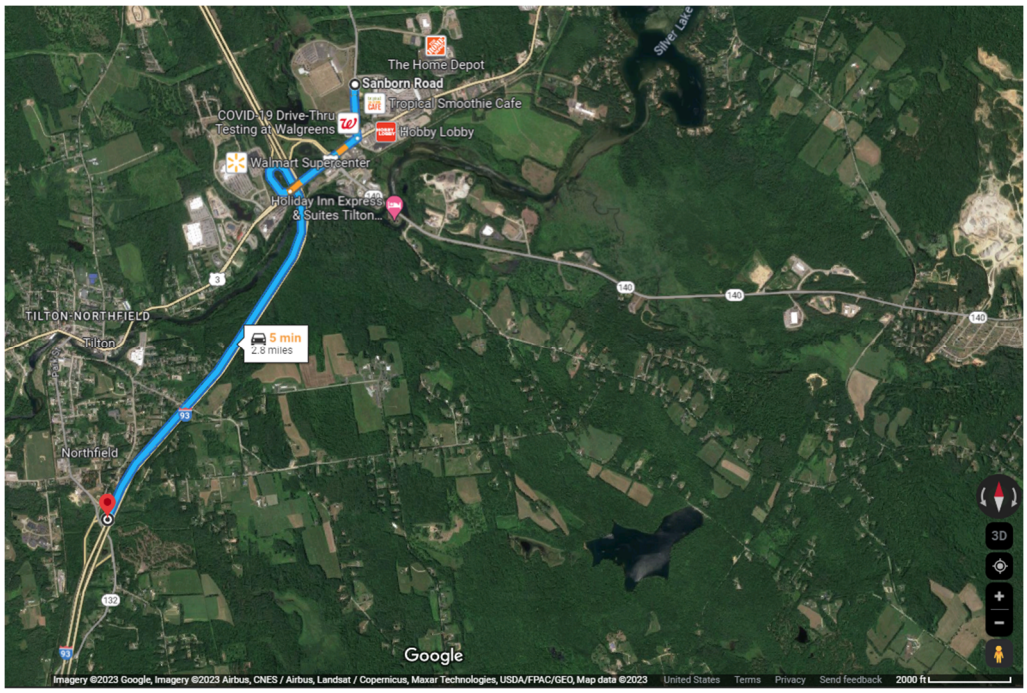
1.3 Distance between 45 Sanborn Rd and Northfield when traveled by highway 2.8 miles or 5 minutes.



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APPENDIX C

AERIAL PHOTOGRAPHY

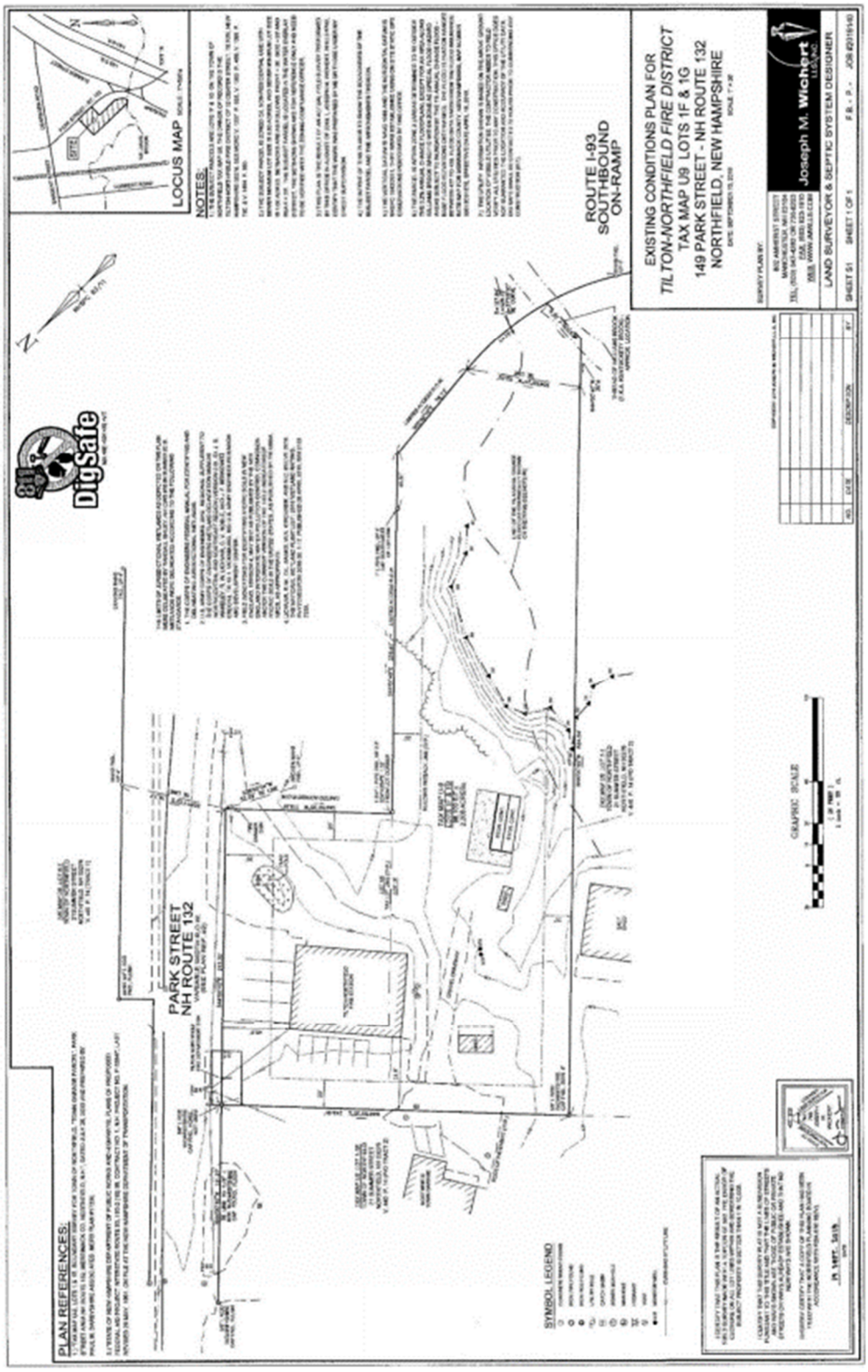
1.0 Aerial Maps

1.1 145 Park Street, Northfield NH.

1.2 45 Sanborn Rd, Tilton NH

APPENDIX D

PARK ST EXISTING CONDITIONS GRADES



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APPENDIX E

PRELIMINARY SITE PLANS

- Proposed Fire Station Sheet 1 (Sanborn Road) (Aug. 31, 2023, LEA)
- Proposed Fire Station Addition Sheet 1 (Park St.) (Sept. 1, 2023, LEA)

MAP REFERENCE:
1. "PROPOSED POLICE STATION TOWN OF TILTON, TILTON, NH". TITLE: FLOOR PLANS, PHASE: SCHEMATIC, SHEET NO. SITE, DRAWN BY: GLG, REV: 0/0/11, SCALE: 1" = 40', DATE: 1/10/11.
2. AERIAL IMAGE FROM NEARMAP, DATED APRIL 15, 2023.

MAP NOTE:
1. ALL SITE FEATURES ARE APPROXIMATE.
2. HORIZONTAL DATUM IS NEW HAMPSHIRE STATE PLANE, NORTH AMERICAN DATUM OF 1983 (NAD83).

REV.	DESCRIPTION OF REVISION	DATE	APPR.

STAMP

Loureiro Engineering Associates, Inc.
100 Northfield Street • Greenville, NH 03048
Phone: 866.747.4181 • Fax: 866.747.8822
An Employee Owned Company • www.Loureiro.com

SCALE: 1" = 20'
COMM. NO.: 051CP3.17
DRAWN BY: PJA — DATE: 08/31/2023
APPROVED BY: KAP — DATE: 08/31/2023

PROPOSED FIRE STATION

ROUTE 132 (SANBORN ROAD) TILTON, NEW HAMPSHIRE
PREPARED FOR:

TILTON NORTHFIELD FIRE DISTRICT

DRAWING 1
SHEET NO. — NO. OF SHEETS

V:\NH\TILTON\23-0005 TILTON FIRESTATION\LEAD\DWG\P-TILTON NORTHFIELD FIRE STATION.DWG Tab: ARCH Saved: 8/6/2023 3:32 PM Plotted: 8/6/2023 3:32 AM

MAP REFERENCES:
1. "EXISTING CONDITIONS PLAN FOR TILTON-NORTHFIELD FIRE DISTRICT, TAX MAP U9 LOTS 1F & 1G, 149 PARK STREET - NH ROUTE 132, NORTHFIELD, NEW HAMPSHIRE". SHEET S1, 1 OF 1, SCALE: 1" = 30', DATE: 9/10/2019. JOSEPH M. WICHERT LLS, INC. 802 AMHERST STREET, MANCHESTER, NH 03104. PH: 603-647-4282 OR 736-8233, WEB: WWW.JMWLLS.COM.
2. "BOUNDARY SURVEY PLAN FOR TILTON-NORTHFIELD FIRE DISTRICT, TAX MAP U9 LOTS 1F & 1G, 149 PARK STREET - NH ROUTE 132, NORTHFIELD, NH". SHEET S1, 1 OF 1, SCALE: 1" = 30', DATE: 1/27/2021. JOSEPH M. WICHERT LLS, INC. 802 AMHERST STREET, MANCHESTER, NH 03104. PH: 603-647-4282 OR 736-8203, WEB: WWW.JMWLLS.COM.
3. AERIAL IMAGE FRCM NEARMAP, DATED APRIL 15, 2023.

MAP NOTE:
1. ALL SITE FEATURES ARE APPROXIMATE.
2. HORIZONTAL DATUM IS NEW HAMPSHIRE STATE PLANE, NORTH AMERICAN DATUM OF 1983 (NAD83).

REV.	DESCRIPTION OF REVISION	DATE	APPR.

STAMP

Loureiro
Engineering • Construction • Risk • Energy
Boston, MA • Manchester, NH • Providence, RI • Hartford, CT
Loureiro Engineering Associates, Inc.
100 Northwest Drive • Plainville, Connecticut 06062
Phone: 860-747-6181 • Fax: 860-747-6852
An Employee-Owned Company • www.loureiro.com

SCALE: 1" = 20'
COMM. NO.: 051CP3.17
DRAWN BY: PJA
DATE: 09/01/2023
APPROVED BY: KAP
DATE: 09/01/2023

PROPOSED FIRE STATION ADDITION

149 PARK STREET, NORTHFIELD, NEW HAMPSHIRE
PREPARED FOR:
TILTON NORTHFIELD FIRE DISTRICT

DRAWING 1
SHEET NO.
NO. OF SHEETS

V:\MH\TILTON\2023-0050\ TILTON FIRESTATION\LEA\DWG\P-TILTON NORTHFIELD FIRE STATION ADDITION.DWG Tab: 1 Saved: 9/7/2023 3:56 PM Plotted: 9/8/2023 9:42 AM

APPENDIX F

GEOTECHNICAL ENGINEERING REPORTS

- Geotechnical Engineering Report, Proposed Fire Station, 45 Sanborn Rd, Tilton, NH (August 30, 2023, Miller Engineering & Testing Inc.) 11 pages
- Geotechnical Engineering Report, Proposed Fire Station, 149 Park St, Northfield, NH (August 30, 2023, Miller Engineering & Testing Inc.) 11 pages

GEOTECHNICAL ENGINEERING REPORT
PROPOSED FIRE STATION
45 Sanborn Road
Tilton, New Hampshire

August 29, 2023

Project No. 23.102.NH

PREPARED FOR:
Loureiro Building Construction, LLC
100 Northwest Drive
Plainville, Connecticut 06062

PREPARED BY:
Miller Engineering & Testing, Inc.
100 Sheffield Road, P.O. Box 4776
Manchester, New Hampshire 03108

MILLER ENGINEERING & TESTING INC.

GEOTECHNICAL / SOIL BORINGS / ENVIRONMENTAL / SOILS / CONCRETE / MASONRY / STEEL / ROOFING / ASPHALT INSPECTION
Mail all correspondence to: 100 SHEFFIELD ROAD · P.O. BOX 4776 · MANCHESTER, NH 03108-4776 · TELEPHONE (603) 668-6016

Via email: BAWorsham@loureiro.com; troy@loureiro.com; jjhardy@loureiro.com

August 29, 2023

Mr. Brian A. Worsham, Architect/Chief Estimator
LOUREIRO BUILDING CONSTRUCTION, LLC
100 Northwest Drive
Plainville, Connecticut 06062

RE: Geotechnical Engineering Report
Proposed Fire Station
45 Sanborn Road
Tilton, New Hampshire Project 23.102.NH

Dear Mr. Worsham:

This Geotechnical Engineering Report presents our findings and recommendations for the proposed Fire Station at 45 Sanborn Road in Tilton, New Hampshire. The subsurface conditions at the Site generally consisted of fill materials and topsoils overlying naturally occurring sand and gravel soils. Groundwater was encountered in the Site test borings at depths between 14 and 19 feet below the existing grades. The fill materials were up to 4 feet thick in our Site test borings.

The fill materials and topsoils will have to be stripped from the Fire Station footprint, and the underlying sand and gravel soils excavated to design grades. The sand and gravel formation should provide adequate support to a conventional shallow spread footing foundation and concrete slab-on-grade floor system for the proposed Fire Station.

We appreciate the opportunity to provide these geotechnical services to Loureiro. If you have any questions or require additional information, please contact us at (603) 668-6016 or kmilender@millerengandtesting.com.

Very truly yours,
MILLER ENGINEERING & TESTING, INC.

Kenneth W. Milender, P.G., P.E.
Senior Geotechnical Engineer

for

Frank K. Miller, P.E.
Executive Vice President

cc. (via email): 'T. Roy, J. Hardy [Loureiro]

TABLE OF CONTENTS

1.0 INTRODUCTION

Miller Engineering & Testing, Inc. has prepared this Geotechnical Engineering Report for the Fire Station being proposed for 45 Sanborn Road in Tilton, New Hampshire (referred to as the "Site" in this report). This evaluation was completed in general accordance with our proposal, dated August 2, 2023 (Ref. File 208-23R1), and consisted of the following work tasks:

1. Performing a site reconnaissance and subsurface exploration program with a series of test borings at the location of the proposed Fire Station and its ancillary facilities;
2. Evaluating the subsurface conditions and performing geotechnical engineering analyses to develop recommendations for the design and construction of the proposed project; and
3. Summarizing the exploration program and engineering evaluation in this Project Geotechnical Report.

Presented herein is a description of the proposed project and site, subsurface conditions, and the geotechnical implications on design and construction. The contents of this report are subject to the limitations in Appendix A.

2.0 SITE AND PROPOSED DEVELOPMENT

The Site consists of one parcel of land (Tilton Parcel ID R23-5-1) with a physical street address of 45 Sanborn Road (New Hampshire State Route 132) in Tilton, New Hampshire. Figure 1 of this report is a Site Location Map depicting the location of the Site on a 7.5-minute topographic quadrangle.

2.1 *Existing Conditions*

We have examined the civil engineering design sheet to provide information on the existing and historical conditions ("Proposed Fire Station, Route 132 (Sanborn Road), Tilton, NH" (dated July 25, 2023) prepared by Loureiro Engineering Associates, Inc. of Plainville, Connecticut).

The Site property is currently undeveloped within a neighborhood of commercial and institutional properties (Figure 1). Reference to Google Earth® indicates that the existing ground surface is at approximate elevation 497 feet above Mean Sea Level (MSL). Examination of historic aerial images indicates that the Site was formerly used as town-operated playing fields. The Tilton Police Station is adjacent to (south of) the Site. Access to the Site is from Sanborn Road (Figure 2).

2.2 *Proposed Development*

The project consists of constructing a 1-story fire station building in the center of the Site property, with a footprint area of approximately 20,000 square feet. We have assumed a floor slab at elevation 497 feet MSL to approximately match the existing grades and require minimal cutting and filling to prepare the building footprint and parking areas. The property has frontage on Sanborn Road and likely would share an access driveway with the neighboring police station. The building will likely be surrounded with stormwater management measures, surface parking lots, and driveways. Basement levels are not being planned. The Site design is currently in preparation by Loureiro Engineering Associates, Inc. (project civil engineer), and we have used their preliminary site plan as the base map for our Figure 2.

It is our understanding that structural engineering design of the Fire Station has not yet been completed; structural loads were not available at the time this report was prepared.

3.0 SUBSURFACE EXPLORATION PROGRAM

The subsurface conditions at the site were characterized by advancing a series of test borings through the overburden soil formations within the proposed Fire Station footprint. The locations and elevations of the test borings were estimated from Loureiro Engineering Associates, Inc. Fire Station Plan, dated July 25, 2023. The test borings were advanced in order to:

- Characterize the nature and consistency of the soil formations at the Site and provide samples for visual classification;
- Perform Standard Penetration Tests to estimate the relative density of the in-place soil units;
- Estimate the engineering properties of the subgrade soils and provide recommendations needed for designing the foundation elements; and
- Determine the depths to competent soil and/or bedrock, and the depth of the groundwater table.

The test borings (designated B-1 through B-4) were advanced on 16 August 2023 with a truck-mounted Diedrich model D-50 hydraulic rotary drill rig using a 2¼-inch inside-diameter hollow-stem auger to bore the holes. Soil samples were generally collected at 5-foot intervals from the ground surface to the bottoms of the borings. Soil samples were collected using 2-inch outside-diameter split-spoon samplers during Standard Penetration Tests; the tests were performed with a 140-pound hammer dropping 30 inches in general accordance with ASTM Standard D1586.

Our field engineer monitored the subsurface explorations, measured groundwater levels, and prepared test boring logs. Soil samples were placed in sealed, labeled containers and returned to our office for further evaluation. The test boring logs are included as Appendix B.

4.0 SUBSURFACE CONDITIONS

We reviewed the published geologic mapping to provide some basic information on the geologic conditions at the Site:

- The surficial geology of the Site and surrounding vicinity has been mapped as being underlain by thick lake bed deposits, consisting of sands and gravels deposited in Glacial Lake Tioga[1].

- The Bedrock Geology Map of New Hampshire indicates that the Site is underlain by rocks of the Rangeley Formation (a gray, thinly laminated metamorphosed turbidites and quartz conglomerates). No bedrock outcrops were observed on the Site.[2]

4.1 *Subsurface Soils*

Subsurface conditions at the Site were characterized by drilling into the unconsolidated overburden soil formations at selected locations within the proposed Fire Station footprint. Figure 2 illustrates the proposed site layout and the test boring locations.

The Site test borings were drilled to a maximum depth of 47 feet below the existing ground surface. Results from the test borings indicate that the subsurface conditions at the Site consist of surficial layers of topsoil overlying a naturally occurring sand and gravel deposit, clayey silt lakebed deposits, weathered rock, and bedrock (Appendix B). The general characteristics of the subsurface layers at the Site are described below in order of increasing depth below the ground surface; refer to the boring logs in Appendix B for more detailed soil descriptions at specific locations and depths; subsurface conditions are summarized in Table 1.

Surficial Layers

Our test borings B-1 and B-2 penetrated topsoil that ranged from approximately 12 inches to 18 inches thick (Appendix B). Topsoils could be encountered in localized areas during construction.

Fill Materials

Two of our Site test borings penetrated a layer of fill materials that ranged in thickness from 2 feet (in B-3) to 4 feet (in B-4). The fill materials consisted of silty sand and gravel with occasional rock fragments (Appendix B). Standard Penetration Tests indicated that the fill materials were generally in a medium dense relative density condition. The thickness and distribution of fill materials across the Site suggests that the thickest fills are probably within the building footprint on the south side of the Site. Laboratory testing indicated that the fill materials have a high fines content (silt and clay fractions combined): 24 percent.

[1] Tinkham, D.J. and Brooks, J.A., 2003, Surficial geologic map of the Northfield quadrangle, Belknap and Merrimack Counties, New Hampshire, New Hampshire Geological Survey.
[2] Lyons, J.B., Bothner, W.A., Moench, R.H., and Thompson, J.B. 1997. *Bedrock Geologic Map of New Hampshire*.

Test Boring	Approximate Ground Surface Elevation (ft MSL)	Depth to Suitable Bearing Soils (feet)	Elevation of Suitable Subgrade (ft MSL)	Depth to Groundwater (feet)	Groundwater Elevation (ft MSL)
B-1	497	1	496	14	483
B-2	497	1.5	495	14	483
B-3	499	2	497	19	480
B-4	500	4	496	19	481

Sand and Gravel Formation

The test borings encountered a naturally occurring deposit of sand and gravel that we interpret to be glacial outwash sediments (Appendix B). Laboratory testing (Appendix C) indicated that this soil formation consisted of fine to coarse grained sand and gravel with trace amounts of silt (USCS classifications: SW and GP) that was encountered directly below the fill materials and topsoils in all the Site test borings. Boring B-3 penetrated the full thickness of the glacial outwash deposit, which was 27 feet thick (Appendix B). This formation appeared to grade into a silty fine sand in deeper zones. Standard Penetration Tests indicated that this sand and gravel deposit was generally in a medium dense to very dense relative density condition.

Clay and Silt Lakebed Deposit

Below the sand and gravel formation, B-3 penetrated a layer of clayey silt between depths of 29 to 39 feet below grade (estimated elevations 460 to 470 feet MSL). These lakebed deposits consisted of interbedded clayey silt and fine sandy silt varves. Standard Penetration Tests indicated that these lakebed soils generally exhibited a medium stiff to stiff consistency.

Weathered Bedrock

B-3 penetrated a thin layer of weathered bedrock from depths of 39.5 feet to 47 feet below the surface grades (estimated elevations 460 to 452 feet MSL).

4.2 *Drilling Refusal/Presumed Bedrock Surface*

Drilling refusal, the depth below which the hollow-stem auger was not able to penetrate the deeper geologic formations, was encountered in the Site deep boring, at a depth below the existing grades of 47 feet (in B-3), which we estimate to be approximate elevation 452 feet MSL. It is our opinion that the refusal was on relatively unfractured bedrock. Rock coring, which was outside our scope of services, would be needed to confirm if the shallow drilling refusal was on bedrock.

4.3 *Groundwater*

Groundwater was encountered in all the Site test borings at depths below the existing ground surface of 14 feet to 19 feet below the proposed building footprint, which we estimate to be elevations 480 to 483 feet MSL.

It is our opinion that these groundwater depths do not represent stabilized water levels, and fluctuations in groundwater levels should be anticipated due to variations in precipitation, snowmelt, site development, and other environmental conditions. Groundwater levels at other times, therefore, could be different from those observed and recorded during this exploration program. Groundwater levels could fluctuate by several feet during the annual hydrologic cycle.

5.0 ENGINEERING EVALUATION

Our investigation and engineering analyses indicate that the subsurface conditions at the Site are favorable for design and construction of a conventional, shallow, spread footing foundation system to support the proposed Fire Station, after removing and replacing any unsuitable soils and utilities below the proposed building footprint. The foundation elements for the proposed Fire Station could be supported directly on the naturally occurring sand and gravel soils, following subgrade preparation made in accordance with this report.

6.0 DESIGN RECOMMENDATIONS

Based on the subsurface explorations and our geotechnical evaluations, we present the following recommendations for the design of the proposed Fire Station at 45 Sanborn Road in Tilton, New Hampshire.

6.1 *Foundation Systems*

The Site subsurface conditions are generally suitable for a shallow foundation system, consisting of isolated spread footings (under columns) and continuous, strip footings (below interior and exterior load-bearing walls) to support the proposed building. The Fire Station footprint area must be cleared and grubbed of unsuitable soils (such as organic topsoils and fill materials) to expose the undisturbed, naturally occurring sand and gravel soils, which are considered to be the uppermost suitable bearing stratum for the foundations and concrete slab-on-grade.

Engineering analyses indicate that the foundation elements constructed on these subsurface conditions should be designed using an allowable net bearing pressure of 3,000 pounds per square foot (1.5 tons per square foot).

Isolated and continuous spread footings supporting the building loads should be at least 3 feet wide. If smaller width footings are to be used, the allowable net bearing pressure should be reduced in direct proportion to the reduction in footing width. In no case should footing width be less than 2.0 feet.

An allowable net bearing pressure of 3,000 psf should limit total settlements below footings to less than 1 inch. Differential settlement between adjacent footings should be less than 0.5 inch. Angular distortion beneath continuous wall footings should be less than 0.002 feet/foot. Settlement would tend to occur as loads are applied, thus most of the dead-load related settlement will probably occur by the end of construction.

Foundation elements of the building that will be exposed to subfreezing temperatures should be constructed at a depth of 4 feet below the final exterior grades to provide frost protection.

Lateral forces can be resisted by the shear developed at the base of the footings. Base shear should be calculated using a coefficient of friction of 0.47 for concrete cast directly on the stable, compacted sand and gravel soils.

6.2 *Slabs-on-Grade*

The subsurface conditions beneath the surficial organic layers are suitable for constructing a reinforced concrete slab-on-grade for the Fire Station. The uppermost 12 inches of material beneath the building slab-on-grade should consist of Base Course Fill that conforms to the gradation specification in Table 1. This material should be placed in one loose lift and should be compacted to a minimum of 95 percent of its maximum dry density, as determined by ASTM D1557. A modulus of subgrade reaction (K_V) of 200 psi/inch should be used to proportion slabs-on-grade when constructed on properly placed and prepared Base Course Fill.

6.3 *Seismic Considerations*

The Fire Station will be founded within medium dense to dense sand and gravel soils. These soils are sufficiently dense and dry so as to theoretically preclude seismically induced liquefaction during the design regional seismic event. Accordingly, design provisions for liquefaction are not necessary at this Site.

The New Hampshire State Building Code (2018 International Building Code) requires that all structures be designed to withstand the forces generated by the maximum credible earthquake based on the soil and rock conditions. The soil profile beneath the proposed Fire Station constitutes a “stiff soil profile,” and we assign the Site a Seismic Site Class of D. The seismic site coefficients for computing the design spectral response acceleration parameters should be:

S_s	S_1	F_a	F_v
0.374	0.082	1.50	2.4

6.4 *Groundwater and Drainage Issues*

Groundwater was encountered in all the Site test borings at depths below the existing ground surface of 14 feet to 19 feet below the proposed building footprint, which we estimate to be elevations 480 to 483 feet MSL.

At this time, it is our opinion that the Fire Station does not need to be constructed with a perimeter foundation drainage system because of the permeable sand and gravel soils. It is also our opinion that a subslab drainage system is not necessary based on geotechnical considerations.

7.0 EARTHWORK AND CONSTRUCTION RECOMMENDATIONS

Based on the subsurface explorations and our geotechnical evaluations, we present the following recommendations for the construction of the proposed Fire Station at 45 Sanborn Road in Tilton, New Hampshire.

7.1 *Subgrade Preparations*

The undisturbed, naturally occurring sand and gravel soils are considered to be the uppermost suitable bearing stratum for this construction. Fill materials were encountered in the test borings at elevations above the likely design bottom-of-footing elevations, and these materials are considered to be unsuitable for supporting the proposed foundation elements. Excavation to remove the unsuitable soils should be continued to expose the undisturbed sand and gravel soils below the Fire Station footprint and all foundation elements.

All topsoil, subsoil, fill materials, debris, frozen soils, and loose or disturbed soils should be excavated and removed from all proposed foundation bearing zones and slab areas to the lateral limits defined by a one horizontal to one vertical (1H:1V) line sloped down and away from the bottom outside edges of foundation elements. If applicable, all subsurface utilities should be located and removed, and the removal should include the associated backfill materials.

Following stripping of unsuitable soils, the resulting subgrade should be compacted with at least four complete passes of a 10-ton vibratory drum roller in directions perpendicular to one another. Silty soil subgrades which are saturated (due to excessive precipitation during construction) or pump and weave during rolling should be excavated and replaced with Select Granular Fill material that is compacted to at least 95% of its maximum dry density as determined by ASTM Standard D1557, or compacted ¾-inch crushed stone. The depth of undercutting and type of backfill material should be selected with consideration of the proposed use (i.e., buildings or pavements) and the soil and weather conditions encountered during construction. Crushed stone should be placed in 12-inch maximum loose lifts, wrapped in a geotextile filter fabric (Mirafi 140N or approved equal), and compacted to ensure stability.

The contractor is responsible for construction means and methods and should anticipate the need for methods to prevent disturbance, softening, or rutting of subgrades, or damage to overlying soils resulting from construction traffic. Care must be taken to avoid disturbing subgrades by keeping construction traffic off of subgrades during wet conditions and/or inclement weather until a firm fill layer has been placed.

Final foundation and subgrade preparation should include re-compaction of bearing surfaces. Care should be taken to limit disturbance to bearing surfaces prior to placement of concrete. Any loose, softened, or disturbed material should be removed and replaced with compacted structural fill prior to placement of concrete. Excavated subgrades should not be left exposed overnight unless the weather forecast calls for above-freezing, clear conditions.

7.2 *Temporary Excavations*

Construction site safety, means and methods, and sequencing of construction activities is the sole responsibility of the contractor. Under no circumstances should the following information be interpreted to mean that Miller Engineering & Testing, Inc. is assuming responsibility for construction site safety, trench protection, or the contractor's responsibilities. Such responsibility is not being implied and should not be inferred.

All temporary excavations should be performed according to Occupational Safety and Health Administration (OSHA) Standards (29 CFR 1926 Subpart P). It is our opinion that the undisturbed sand and gravel soils are OSHA Type C soils, and temporary excavation side slopes should be 1½H:1V or flatter under dry or dewatered conditions.

7.3 *Dewatering and Runoff Control*

Groundwater was encountered in all the Site test borings at depths below the existing ground surface of 14 feet to 19 feet below the proposed building footprint, which we estimate to be elevations 480 to 483 feet MSL.

It is our opinion that groundwater will probably not be encountered during foundation construction. However, deeper excavations (for example, for underground utilities and stormwater facilities) could encounter groundwater that will require controls.

Should groundwater be encountered during construction, inflows should be controlled in order for earthwork to be completed "in the dry". The contractor should anticipate the need for controlling runoff during wet periods; pumping from open sumps will likely provide adequate control of water within excavations during construction.

Subgrade soils that become unstable should be undercut and replaced with structural fill or crushed stone, as necessary. Surface water runoff should be directed away from excavations to reduce dewatering efforts and to protect subgrades from becoming soft and unstable.

Temporary detention ponds, trenches, ditches, and dewatering sumps should not be made in areas to be filled.

7.4 *Placement of Granular Engineered Fills*

Engineered fills will be required to achieve the design grades in several areas of the proposed Site development. Table 1 is the gradation specifications for soils to be used in the engineered fills at the Site. The different granular fill types should be used as follows:

1. Select Granular Fill should be used for engineered fills below the Fire Station footprint areas, in foundation bearing zones, and as backfill around the foundation elements, and should have the gradation in Table 1. Acceptable alternatives are NHDOT Item 304.3 (Crushed Gravel) and 304.4 (Crushed Stone - Fine).

2. Clean Granular Fill should be used for engineered fills below roadway, parking, and other non-structural areas with the gradation shown in Table 1. An acceptable alternative is NHDOT Item 304.2 (Gravel).

3. Base Course should be used for the uppermost fill below the Fire Station slab-on-grade (Table 1). An acceptable alternative is NHDOT Item 304.33 (Crushed Aggregate for Shoulders).

All granular fills should be placed in 12-inch maximum loose lifts and should be compacted to a minimum of 95% of the material's maximum dry density, as determined by ASTM D1557 (modified Proctor test) and verified with field density testing (ASTM D6938 or equivalent method). Lift thickness should be a maximum of 6-inch (loose) when compacted with hand-guided equipment.

7.5 *Reuse of Site Materials*

A preliminary assessment of the suitability of using the unconsolidated soils as engineered fills in the proposed construction is based on the soil classifications, laboratory analyses, and observations at the Site. The suitability of these materials is summarized below.

1. Topsoils and subsoils (if encountered) are suitable for reuse on-site only within landscaped areas.

2. The natural sand and gravel soils might be suitable for use as structural fill beneath the building footprint provided the material can be compacted to a dry density at least 95 percent of the material's maximum dry density as determined by ASTM D1557. These materials could also potentially be reused in non-structural areas (outside the building footprint), below pavement subbase courses, and in landscaping areas, provided the contractor can place and compact these soils in accordance with this report.

3. The fill materials might be suitable for use as structural fill beneath the building footprint provided the material can be compacted to a dry density at least 95 percent of the material's maximum dry density as determined by ASTM D1557. Laboratory testing (Appendix C) indicates that the fill materials have a high fines content, which will make them sensitive to moisture and frost-susceptible. Therefore, the weather conditions during construction will directly impact whether these materials can be successfully reused as structural fill. These materials could also potentially be reused in non-structural areas (outside the building footprint), below pavement subbase courses, and in landscaping areas, provided the contractor can place and compact these soils in accordance with this report.

Materials to be used as the granular backfills and the base courses below the slab-on-grade and the pavements will need to be imported to the Site. Representative samples of all materials proposed for use as fills should be submitted for testing during construction to compare their gradation characteristics to the requirements of the project specifications, and to establish their optimum water contents and maximum dry densities (modified proctor testing, ASTM Standard D1557). The geotechnical engineer must approve use and reuse of on-site or borrow soils for use as engineered fills. Use of materials as engineered fills assumes that the moisture content of the material will be strictly controlled in order to allow for proper placement and compaction.

7.6 *Special Inspections*

In accordance with the State Building Code, special inspections are necessary during subgrade preparation and placement of fill within Fire Station footprint areas. The project geotechnical engineer should be engaged to make appropriate site visits during the excavation and subgrade preparations to confirm that our assumptions regarding subsurface conditions (which were based on a limited number of borings) were reasonably representative and that our recommendations are being properly interpreted and followed.

8.0 FINAL DESIGN AND CONSTRUCTION MONITORING

A qualified geotechnical engineer should be retained to provide engineering services during the excavation and construction phases of this project. This will become particularly important relative to the excavation of unsuitable materials, and the placement and compaction of engineered fills. This will also allow for design changes in the event that subsurface conditions differ from those anticipated prior to the start of construction. The adequacy of fill compaction should be determined by field density testing as the fill is placed and compacted.

Representative samples of all backfill materials should be submitted to Miller Engineering & Testing, Inc. for testing to establish their optimum water contents and maximum dry densities, and to compare their gradation characteristics with the project specifications. In this manner,

compaction criteria can be developed which will provide the materials with adequate strength and minimal distortion.

Lastly, we recommend that we be retained to assist in preparation of the project earthwork specifications and to review final design plans, specifications, and design submittals. In the event that any changes in the nature, design, or locations of the proposed project are planned, the conclusions and recommendations in this report will not be considered valid unless the changes are reviewed and conclusions of the report modified or verified in writing by Miller Engineering & Testing, Inc.

TABLES

GEOTECHNICAL ENGINEERING REPORT
Proposed Fire Station
45 Sanborn Road
Tilton, New Hampshire

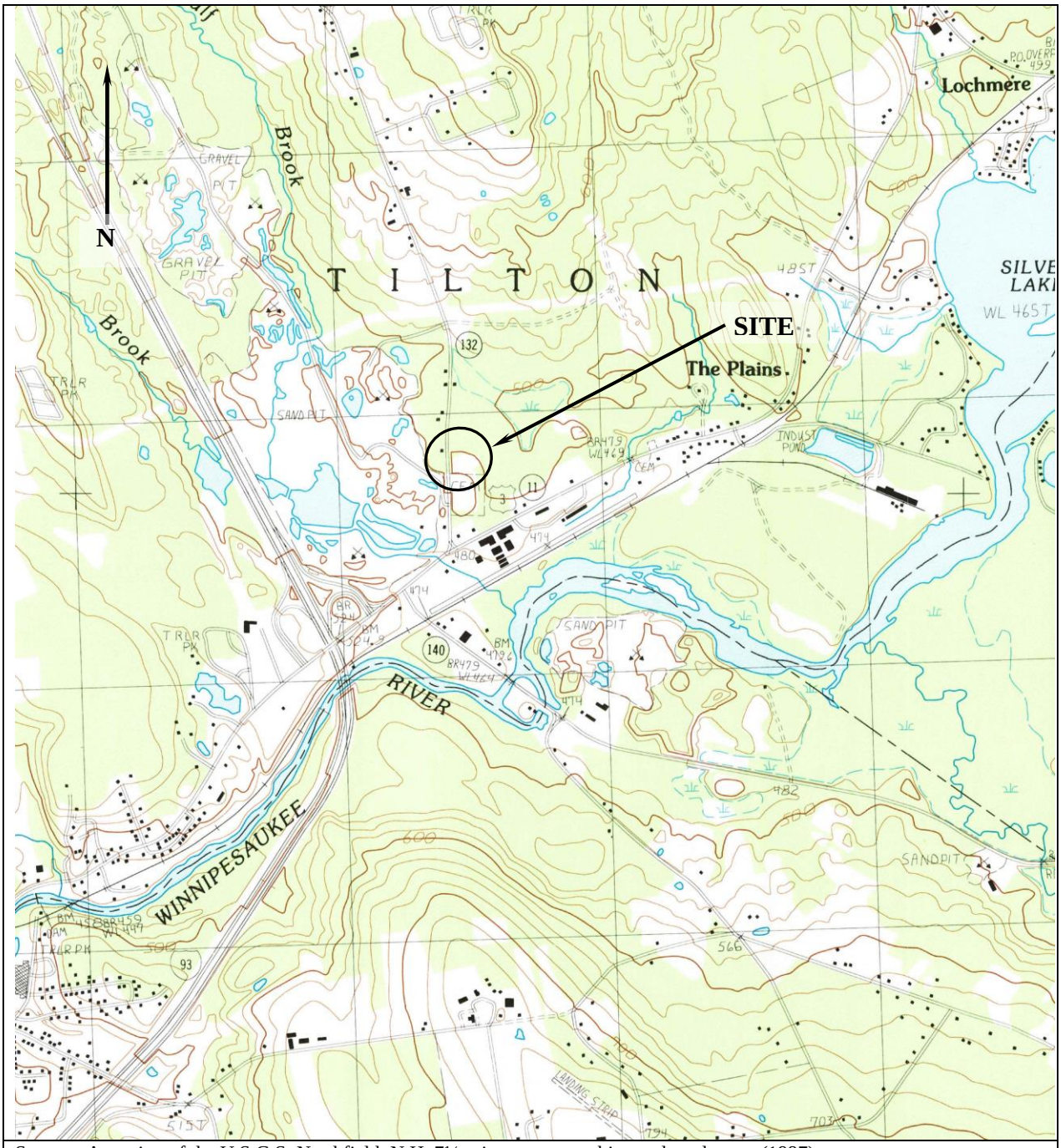
TABLE 1
GRADATION SPECIFICATIONS

GEOTECHNICAL ENGINEERING REPORT
Proposed Fire Station
45 Sanborn Road
Tilton, New Hampshire

SIEVE SIZE	PERCENT PASSING BY WEIGHT		
	CLEAN GRANULAR FILL	BASE COURSE	SELECT GRANULAR FILL
8”	100	100	100
3”	70 – 100	100	70 – 100
1½	-----	-----	-----
¾	-----	-----	-----
½”	40 – 100	40 – 80	40 – 90
No. 4	25 – 100	30 – 70	25 – 80
No. 10	15 – 95	20 – 60	15 – 70
No. 40	10 – 70	10 – 30	5 – 40
No. 50	-----	-----	-----
No. 200	0 – 15	3 - 10	0 – 12

FIGURES

GEOTECHNICAL ENGINEERING REPORT
Proposed Fire Station
45 Sanborn Road
Tilton, New Hampshire



Source: A portion of the U.S.G.S. Northfield, N.H. 7½-minute topographic quadrangle map (1987).

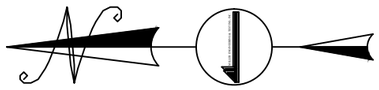
GEOTECHNICAL ENGINEERING REPORT	SITE LOCATION MAP
Proposed Fire Station Sanborn Road Site Tilton, NH August 2023 Miller Project No. 23.102.NH	FIGURE 1

NOTES

1. This plan is a reproduction of portions of "Proposed Fire Station Plan, Tilton, NH", (dated July 25, 2023) by Loureiro Engineering Associates, Inc. of Plainville, CT.
2. A geotechnical engineer from Miller Engineering & Testing, Inc. inspected the test borings.
3. Exploration locations were established by others and using the tape and pace method.

KEY

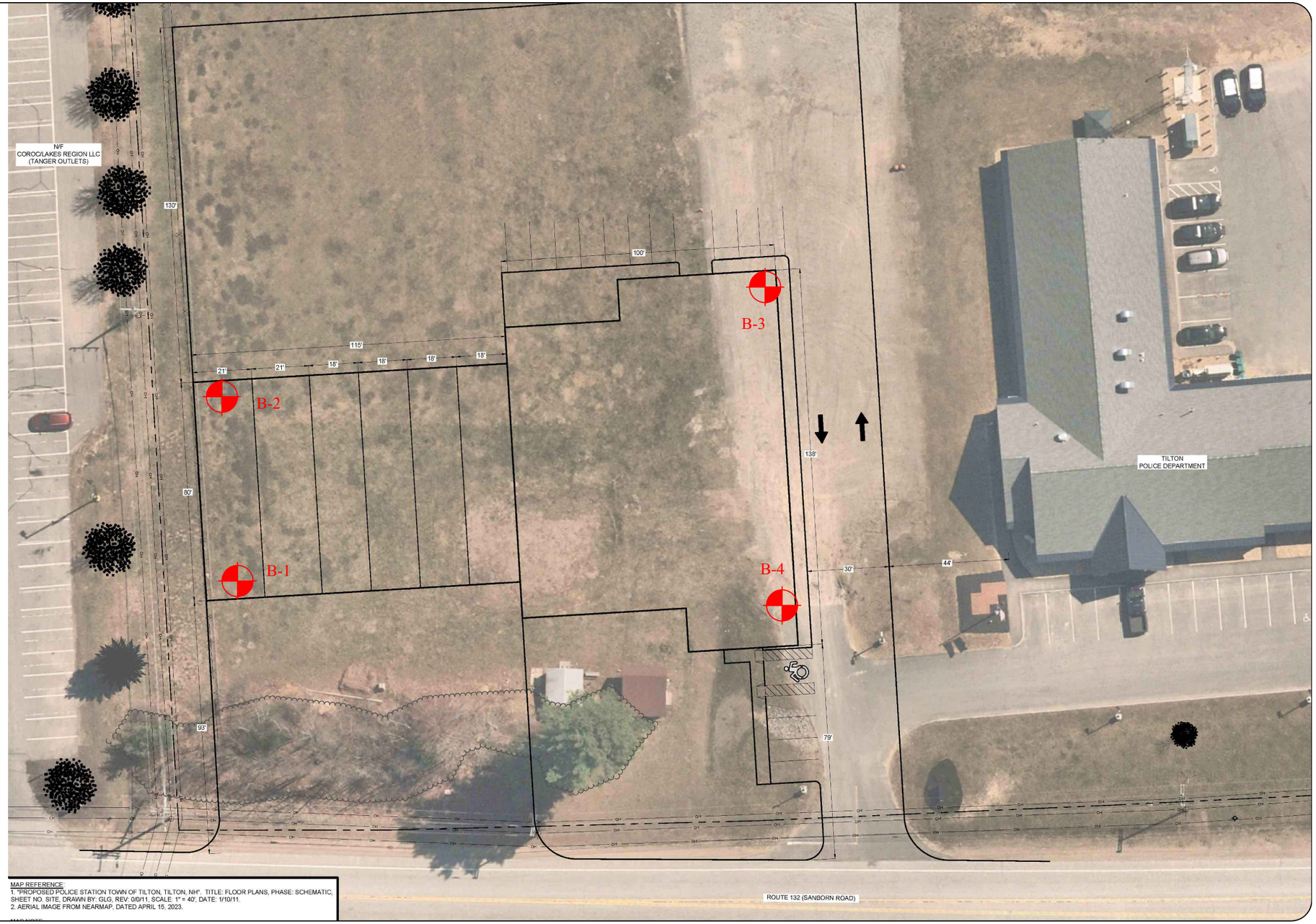
Approximate Boring Location



GRAPHIC SCALE

40 0 20 40 80

(IN FEET)



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Proposed Fire Station
Tilton, NH
August 2023
Project No. 23.102.NH

SUBSURFACE EXPLORATION LOCATION PLAN

FIGURE No. 2

APPENDICES

GEOTECHNICAL ENGINEERING REPORT
Proposed Fire Station
45 Sanborn Road
Tilton, New Hampshire

APPENDIX A

Limitations

GEOTECHNICAL ENGINEERING REPORT
Proposed Fire Station
45 Sanborn Road
Tilton, New Hampshire

LIMITATIONS

Explorations

1. The analyses, recommendations and designs submitted in this report are based in part upon the data obtained from subsurface explorations. The nature and extent of variations between these explorations may not become evident until construction. If variations then appear evident, it will be necessary to re-evaluate the recommendations of this report.

2. The generalized soil profile described in the text is intended to convey trends in subsurface conditions. The boundaries between strata are approximate and idealized and have been developed by interpretation of widely spaced explorations and samples; actual soil transitions are probably more gradual. For specific information, refer to the boring logs.

3. Water level readings have been made in the drill holes at times and under conditions stated on the boring logs. These data have been reviewed and interpretations have been made in the text of this report. However, it must be noted that fluctuations in the level of the groundwater may occur due to variations in rainfall, temperature, and other factors differing from the time measurements were made.

Review

4. It is recommended that this firm be retained to review final design plans and specifications. In the event that any changes in the nature, design, or location of the structures are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and conclusions of the report modified or verified in writing by Miller Engineering & Testing, Inc.

Construction

5. It is recommended that this firm be retained to provide soils engineering services during the excavations and foundation construction phases of the work. This is to observe compliance with the design concepts, specifications, or recommendations and to allow design changes in the event that subsurface conditions differ from those anticipated prior to the start of construction.

Use of Report

6. This report has been prepared for the exclusive use of **Loureiro Building Construction, LLC** for the **Proposed Fire Station** at **45 Sanborn Road** in **Tilton, New Hampshire** in accordance with generally accepted soil and foundation engineering practices. No other warranty, expressed or implied, is made.

7. This soil and foundation engineering report has been prepared for this project by Miller Engineering & Testing, Inc. This report was completed for design purposes and may be limited in its scope to prepare an accurate bid. Contractors wishing a copy of the report may secure it with the understanding that its scope is limited to design considerations only.

APPENDIX B

Test Boring Logs

GEOTECHNICAL ENGINEERING REPORT
Proposed Fire Station
45 Sanborn Road
Tilton, New Hampshire

TEST BORING LOG

MILLER ENGINEERING & TESTING, INC.
100 Sheffield Road - Manchester, NH 03103
Ph. (603) 668-6016 - Fax: (603) 668-8641

Project: Tilton Fire Dept.
Tilton, NH
Project No: 23.102.NH
Date Start: 08-16-23
Date End: 08-16-23

Sheet 1 **of** 1
Boring No: B-1
Location: See Plan
Approx. Surface Elev: 497

	CASING	SAMPLER	GROUNDWATER OBSERVATIONS Date	Depth	Casing At	Stabilization Period
Type	HSA	SS	08-16-23	14'	26'	Upon Completion
Size	2-1/4" ID	1-3/8" ID				
Hammer		140 lbs.				
Fall		30"				

Depth/ Elev.	Cas bl/ft	SAMPLE Sample No.	Depth Range	Pen.	Rec.	BLOWS 0-6"	6-12"	12-18"	18-24"	Strata Change	Sample Description	Notes
0 — 497		S-1	0.0-1.0	12	9	3	3				S-1: Topsoil	
		S-1A	1.0-2.0	12	3			21	44		S-1A: Brown, gravel, some fine to coarse sand, trace silt (rock fragments in tip of split-spoon)	
		S-2	2.0-4.0	24	13	12	33	31	33		S-2: Brown, fine to coarse sand, some gravel, trace silt	
5 — 492		S-3	4.0-6.0	24	11	9	26	13	10		S-3: Brown, fine to coarse sand, some gravel, trace silt	
10 — 487		S-4	9.0-11.0	24	13	38	19	11	9		S-4: Brown/Orange (mottled), fine sand, trace silt, trace gravel (fractured gravel at top of sample)	
15 — 482		S-5	14.0-16.0	24	18	4	7	8	9		S-5: Brown/Orange (mottled), fine sand, trace silt, trace gravel, wet	
20 — 477		S-6	19.0-21.0	24	15	5	6	9	11		S-6: Brown, fine sand, some silt, wet (blow- in, in split-spoon)	
25 — 472		S-7	24.0-26.0	24	14	4	8	8	9		S-7: Brown, silt, some fine sand, wet	
30 — 467											BORING TERMINATED AT 26 ft	

Driller: R. Marcoux
Helper: J. Donahue
Inspector: T. Young

COHESIVE CONSISTENCY (Blows/Foot)
0-2 VERY SOFT
2-4 SOFT
4-8 MEDIUM STIFF
8-15 STIFF
15-30 HARD

COHESIONLESS (Blows/Foot)
0-4 VERY LOOSE
4-10 LOOSE
10-30 MEDIUM DENSE
30-50 DENSE
50+ VERY DENSE

PROPORTIONS USED
TRACE: 0-10%
LITTLE: 10-20%
SOME: 20-35%
AND: 35-50%

NOTES:

REMARKS: THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITION MAY BE GRADUAL.
WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS.
FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

TEST BORING LOG

MILLER ENGINEERING & TESTING, INC.
100 Sheffield Road - Manchester, NH 03103
Ph. (603) 668-6016 - Fax: (603) 668-8641

Project: Tilton Fire Dept.
Tilton, NH
Project No: 23.102.NH
Date Start: 08-16-23
Date End: 08-16-23

Sheet 1 **of** 1
Boring No: B-2
Location: See Plan
Approx. Surface Elev: 497

	CASING	SAMPLER	GROUNDWATER OBSERVATIONS Date	Depth	Casing At	Stabilization Period
Type	HSA	SS	08-16-23	14'	26'	Upon Completion
Size	2-1/4" ID	1-3/8" ID				
Hammer		140 lbs.				
Fall		30"				

Depth/ Elev.	Cas bl/ft	SAMPLE Sample No.	Depth Range	Pen.	Rec.	BLOWS 0-6"	6-12"	12-18"	18-24"	Strata Change	Sample Description	Notes
0 — 497		S-1	0.0-1.5	18	16	2	4	7			S-1: Topsoil	
		S-1A	1.5-2.0	6	3	23	37	19	21		S-1A: Brown, fine to coarse sand, some gravel, trace silt	
		S-2	2.0-4.0	24	14				20		S-2: Brown, fine to coarse sand, some gravel, trace silt	
		S-3	4.0-6.0	24	11	7	10	10	11		S-3: Brown, fine to coarse sand, some gravel, trace silt	
5 — 492												
		S-4	9.0-11.0	24	18	10	9	9	10		S-4: Brown/Orange (mottled), fine sand, trace silt	
10 — 487												
		S-5	14.0-16.0	24	15	6	8	7	7		S-5: Brown/Orange (mottled), fine sand, trace silt, wet	
15 — 482												
		S-6	19.0-21.0	24	13	4	5	4	5		S-6: Brown to gray, silt, little fine sand, wet	
20 — 477												
		S-7	24.0-26.0	24	17	3	4	7	8		S-7: Gray/Brown, clayey silt, wet	
25 — 472												
											BORING TERMINATED AT 26 ft	
30 — 467												

Driller: R. Marcoux
Helper: J. Donahue
Inspector: T. Young

COHESIVE CONSISTENCY (Blows/Foot)
0-2 VERY SOFT
2-4 SOFT
4-8 MEDIUM STIFF
8-15 STIFF
15-30 HARD

COHESIONLESS (Blows/Foot)
0-4 VERY LOOSE
4-10 LOOSE
10-30 MEDIUM DENSE
30-50 DENSE
50+ VERY DENSE

PROPORTIONS USED
TRACE: 0-10%
LITTLE: 10-20%
SOME: 20-35%
AND: 35-50%

NOTES:

REMARKS: THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITION MAY BE GRADUAL.
WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS.
FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

TEST BORING LOG

MILLER ENGINEERING & TESTING, INC.
100 Sheffield Road - Manchester, NH 03103
Ph. (603) 668-6016 - Fax: (603) 668-8641

Project: Tilton Fire Dept.
Tilton, NH
Project No: 23.102.NH
Date Start: 08-16-23
Date End: 08-16-23

Sheet 1 **of** 2
Boring No: B-3
Location: See Plan
Approx. Surface Elev: 499

	CASING	SAMPLER	GROUNDWATER OBSERVATIONS Date	Depth	Casing At	Stabilization Period
Type	HSA	SS	08-16-23	19'	47'	Upon Completion
Size	2-1/4" ID	1-3/8" ID				
Hammer		140 lbs.				
Fall		30"				

Depth/ Elev.	Cas bl/ft	SAMPLE Sample No.	Depth Range	Pen.	Rec.	BLOWS 0-6"	6-12"	12-18"	18-24"	Strata Change	Sample Description	Notes
0 — 499		S-1	0.0-2.0	24	17	6	12	11	26		S-1: Brown, fine to coarse sand, some gravel, little silt (rock fragments in tip of split-spoon) (FILL)	
		S-2	2.0-4.0	24	11	27	23	14	16		S-2: Brown, fine to coarse sand and gravel, trace silt	
		S-3	4.0-6.0	24	14	8	22	23	19		S-3: Brown, fine to coarse sand, some gravel, trace silt	
5 — 494												
		S-4	9.0-11.0	24	6	3	4	7	7		S-4: Brown, fine to coarse sand, some gravel, trace silt (rock fragment in tip of split-spoon)	
10 — 489												
		S-5	14.0-16.0	24	14	8	7	6	7		S-5: Brown/Orange (mottled), fine sand, trace silt, trace gravel	
15 — 484												
		S-6	19.0-21.0	24	17	4	6	6	7		S-6: Brown to gray, fine sand, some silt, wet	
20 — 479												
		S-7	24.0-26.0	24	27	1	4	6	7		S-7: Brown/Orange (mottled), fine sand, little silt, wet	
25 — 474												
30 — 469		S-8	29.0-31.0	24	15	3	4	6	8		S-8: Brown to gray, clayey silt, trace fine sand, wet (1" layer of gray clay in sample)	

Driller: R. Marcoux
Helper: J. Donahue
Inspector: T. Young

COHESIVE CONSISTENCY (Blows/Foot)
0-2 VERY SOFT
2-4 SOFT
4-8 MEDIUM STIFF
8-15 STIFF
15-30 HARD

COHESIONLESS (Blows/Foot)
0-4 VERY LOOSE
4-10 LOOSE
10-30 MEDIUM DENSE
30-50 DENSE
50+ VERY DENSE

PROPORTIONS USED
TRACE: 0-10%
LITTLE: 10-20%
SOME: 20-35%
AND: 35-50%

NOTES:

REMARKS: THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITION MAY BE GRADUAL.
WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS.
FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

TEST BORING LOG

MILLER ENGINEERING & TESTING, INC.
100 Sheffield Road - Manchester, NH 03103
Ph. (603) 668-6016 - Fax: (603) 668-8641

Project:	Tilton Fire Dept.	**Sheet**	2 of 2
	Tilton, NH	**Boring No:**	B-3
Project No:	23.102.NH	**Location:**	See Plan
Date Start:	08-16-23		
Date End:	08-16-23	**Approx. Surface Elev:**	499

			GROUNDWATER OBSERVATIONS			
	CASING	**SAMPLER**	**Date**	**Depth**	**Casing At**	**Stabilization Period**
Type	HSA	SS	08-16-23	19'	47'	Upon Completion
Size	2-1/4" ID	1-3/8" ID				
Hammer		140 lbs.				
Fall		30"				

Depth/ Elev.	Cas bl/ft	SAMPLE Sample No.	Depth Range	Pen.	Rec.	BLOWS 0-6"	6-12"	12-18"	18-24"	Strata Change	Sample Description	Notes
35 — 464		S-9	34.0-36.0	24	16	1	2	3	5		S-9: Gray, clayey silt, trace fine sand, wet (1/4" gray clay varve)	
		S-10	39.0-39.5	6	5	9					S-10: Gray, clayey silt, trace fine sand, wet	
40 — 459		S-10A	39.5-41.0	18	9		17	18	19		S-10A: Very severely weathered rock	
45 — 454		S-11	44.0-45.3	16	9	1	13	50/4"			S-11: Very severely weathered rock Auger Refusal at 47'	
50 — 449											BORING TERMINATED AT 47 ft	
55 — 444												
60 — 439												

Driller: R. Marcoux
Helper: J. Donahue
Inspector: T. Young

COHESIVE CONSISTENCY (Blows/Foot)
0-2 VERY SOFT
2-4 SOFT
4-8 MEDIUM STIFF
8-15 STIFF
15-30 HARD

COHESIONLESS (Blows/Foot)
0-4 VERY LOOSE
4-10 LOOSE
10-30 MEDIUM DENSE
30-50 DENSE
50+ VERY DENSE

PROPORTIONS USED
TRACE: 0-10%
LITTLE: 10-20%
SOME: 20-35%
AND: 35-50%

NOTES:

REMARKS: THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITION MAY BE GRADUAL.
WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS.
FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

TEST BORING LOG

MILLER ENGINEERING & TESTING, INC.
100 Sheffield Road - Manchester, NH 03103
Ph. (603) 668-6016 - Fax: (603) 668-8641

Project: Tilton Fire Dept.
Tilton, NH
Project No: 23.102.NH
Date Start: 08-16-23
Date End: 08-16-23

Sheet 1 **of** 1
Boring No: B-4
Location: See Plan
Approx. Surface Elev: 500

	CASING	SAMPLER	GROUNDWATER OBSERVATIONS Date	Depth	Casing At	Stabilization Period
Type	HSA	SS	08-16-23	19'	26'	Upon Completion
Size	2-1/4" ID	1-3/8" ID				
Hammer		140 lbs.				
Fall		30"				

Depth/ Elev.	Cas bl/ft	SAMPLE Sample No.	Depth Range	Pen.	Rec.	BLOWS 0-6"	6-12"	12-18"	18-24"	Strata Change	Sample Description	Notes
0 — 500		S-1	0.0-2.0	24	5	6	9	15	13		S-1: Dark brown, fine to coarse sand, some gravel, little silt, trace fine roots (FILL)	
		S-2	2.0-4.0	24	6	10	8	17	22		S-2: Brown to dark brown, fine to coarse sand, some silt, little gravel (rock fragments in tip of split-spoon) (FILL)	
5 — 495		S-3	4.0-6.0	24	10	10	17	15	37		S-3: Brown, fine to coarse sand and gravel, trace silt (rock fragment in tip of split-spoon)	
10 — 490		S-4	9.0-11.0	24	2	11	14	14	13		S-4: Brown, fine sand, trace silt	
15 — 485		S-5	14.0-16.0	24	19	7	8	9	8		S-5: Brown/Orange (mottled), fine sand, trace silt	
20 — 480		S-6	19.0-21.0	24	16	3	6	6	7		S-6: Brown/Orange (mottled), fine sand, some silt, wet	
25 — 475		S-7	24.0-26.0	24	14	1	3	5	5		S-7: Brown/Orange (mottled), fine sand, some silt, wet	
30 — 470											BORING TERMINATED AT 26 ft	

Driller: R. Marcoux
Helper: J. Donahue
Inspector: T. Young

COHESIVE CONSISTENCY (Blows/Foot)
0-2 VERY SOFT
2-4 SOFT
4-8 MEDIUM STIFF
8-15 STIFF
15-30 HARD

COHESIONLESS (Blows/Foot)
0-4 VERY LOOSE
4-10 LOOSE
10-30 MEDIUM DENSE
30-50 DENSE
50+ VERY DENSE

PROPORTIONS USED
TRACE: 0-10%
LITTLE: 10-20%
SOME: 20-35%
AND: 35-50%

NOTES:

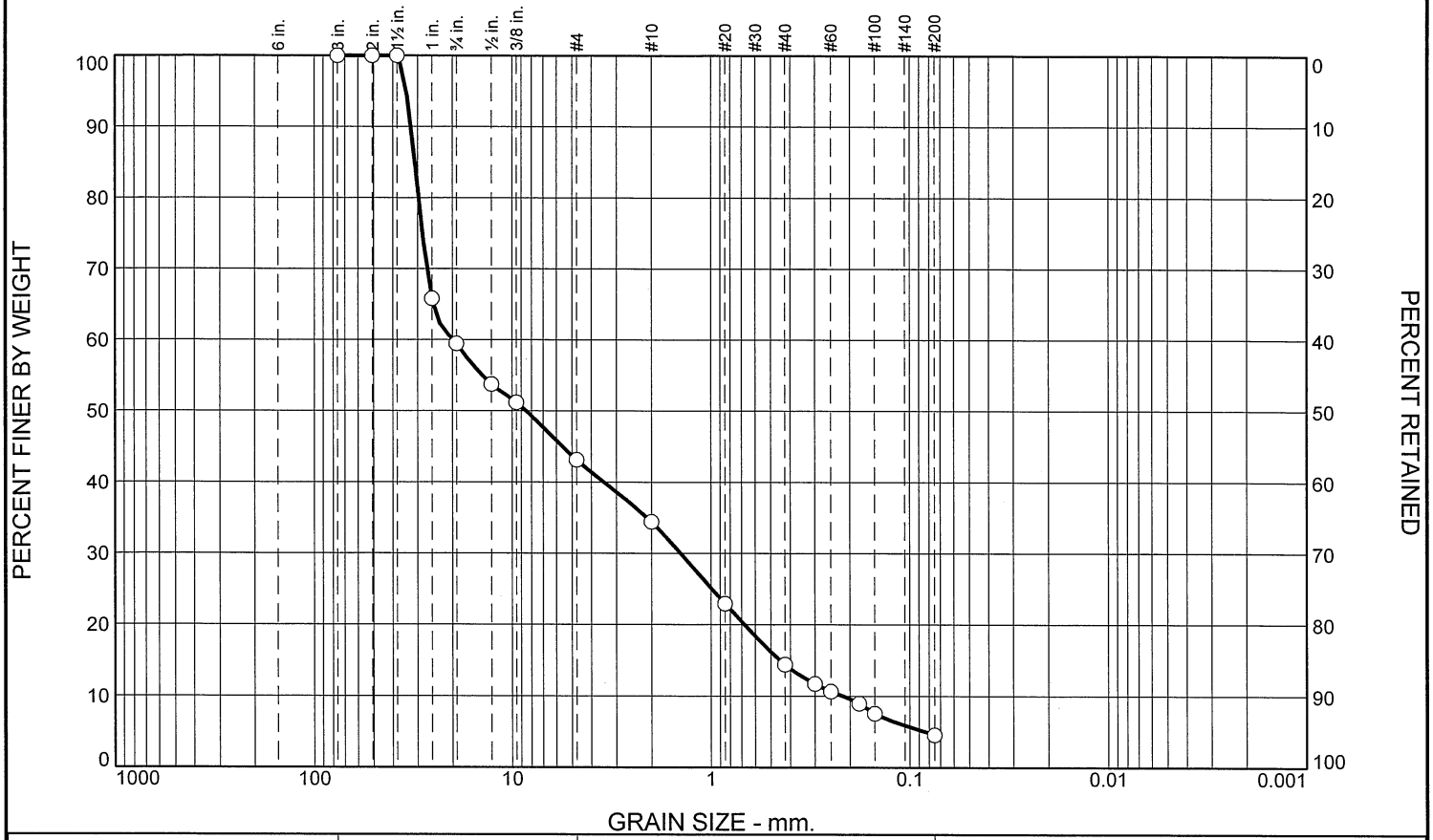
REMARKS: THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITION MAY BE GRADUAL.
WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS.
FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

APPENDIX C

Geotechnical Laboratory Report

GEOTECHNICAL ENGINEERING REPORT
Proposed Fire Station
45 Sanborn Road
Tilton, New Hampshire

GRAINSIZE DISTRIBUTION REPORT - AGGREGATE GRADING



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	41	16	9	20	9	5	

SIEVE SIZE OR DIAMETER	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3"	100		
2"	100		
1.5"	100		
1"	66		
3/4"	59		
1/2"	54		
3/8	51		
#4	43		
#10	34		
#20	23		
#40	14		
#50	12		
#60	11		
#80	9		
#100	8		
#200	4.5		

* (no specification provided)

Soil Description

Brown, fine to coarse sand, some gravel, trace silt

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 32.3873 D_{85}= 30.9475 D_{60}= 19.7141
D_{50}= 8.5373 D_{30}= 1.4233 D_{15}= 0.4504
D_{10}= 0.2198 C_u= 89.71 C_c= 0.47

Classification

USCS= GP AASHTO=

Remarks

Source of Sample: B-1 **Depth:** 2' - 4'
Sample Number: S-2

Date: 8-23-23

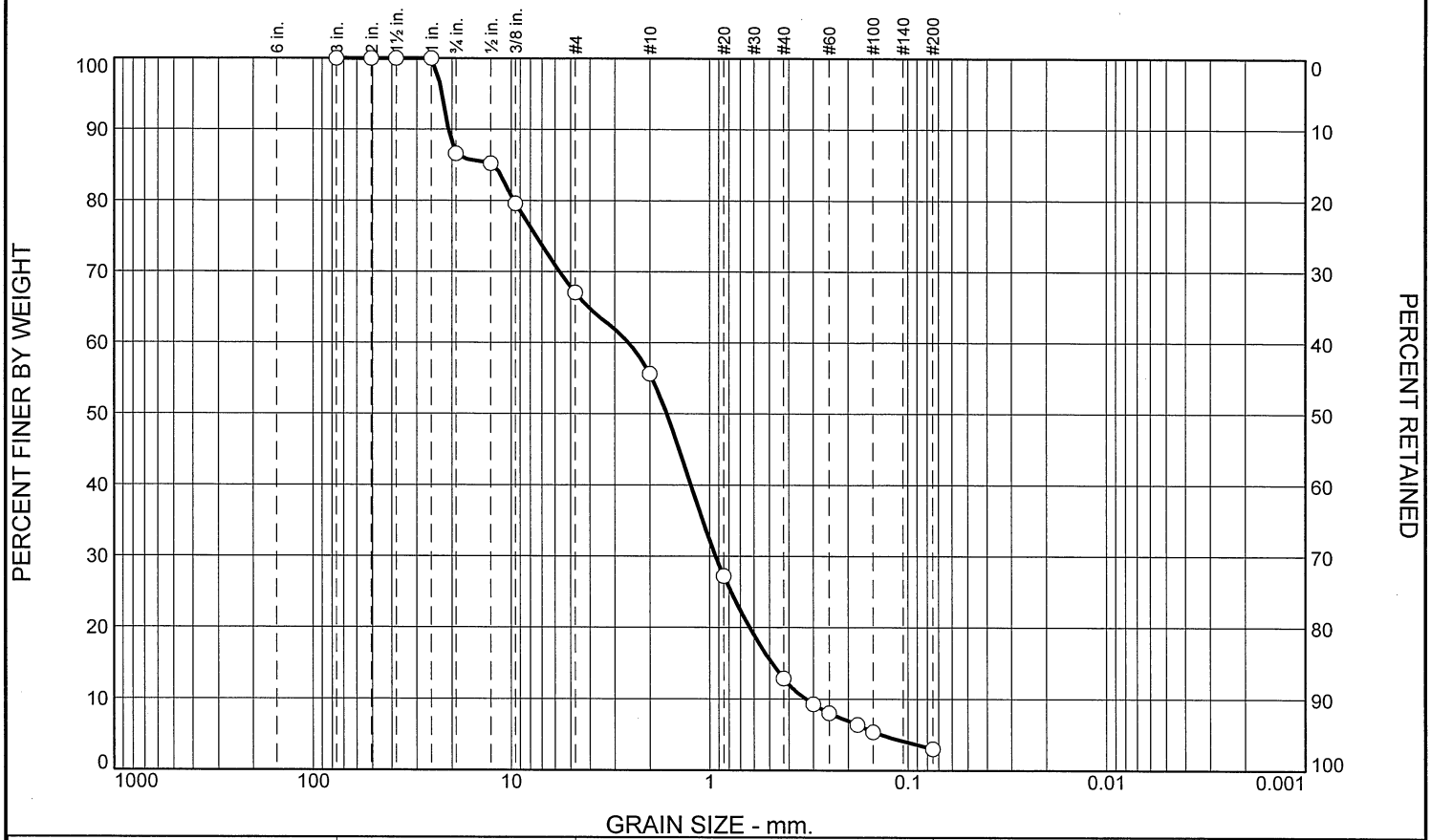
MILLER ENGINEERING & TESTING, INC.

Client: Loueiro Bldg. Const. LLC
Project: Tilton Fire Dept.

Project No: 23.102.NH **Figure** L23276A

Tested By: NL

GRAINSIZE DISTRIBUTION REPORT - AGGREGATE GRADING



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	13	20	11	43	10	3	

SIEVE SIZE OR DIAMETER	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3"	100		
2"	100		
1.5"	100		
1"	100		
3/4"	87		
1/2"	85		
3/8	80		
#4	67		
#10	56		
#20	27		
#40	13		
#50	9		
#60	8		
#80	6		
#100	5		
#200	3.0		

* (no specification provided)

Soil Description

Brown, fine to coarse sand, some gravel, trace silt

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 20.8033 D_{85}= 12.3370 D_{60}= 2.5546
D_{50}= 1.6397 D_{30}= 0.9343 D_{15}= 0.4851
D_{10}= 0.3280 C_u= 7.79 C_c= 1.04

Classification

USCS= SW AASHTO=

Remarks

Source of Sample: B-2 **Depth:** 2' - 4'
Sample Number: S-2

Date: 8-23-23

MILLER ENGINEERING & TESTING, INC.

Client: Loueiro Bldg. Const. LLC
Project: Tilton Fire Dept.

Project No: 23.102.NH **Figure** L23276B

Tested By: NL

GRAINSIZE DISTRIBUTION REPORT - AGGREGATE GRADING

% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	18	7	4	17	30	24	

SIEVE SIZE OR DIAMETER	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3"	100		
2"	100		
1.5"	100		
1"	88		
3/4"	82		
1/2"	80		
3/8	78		
#4	75		
#10	71		
#20	62		
#40	54		
#50	45		
#60	43		
#80	38		
#100	35		
#200	24		

* (no specification provided)

Soil Description

Brown to dark brown, fine to coarse sand, some silt, little gravel (rock fragments in tip of split-spoon) (FILL)

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 27.1084 D_{85}= 22.5514 D_{60}= 0.6741
D_{50}= 0.3586 D_{30}= 0.1127 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Source of Sample: B-4 **Depth:** 2' - 4'
Sample Number: S-2

Date: 8-23-23

MILLER ENGINEERING & TESTING, INC.

Client: Loueiro Bldg. Const. LLC
Project: Tilton Fire Dept.

Project No: 23.102.NH **Figure** L23276C

Tested By: NL

GEOTECHNICAL ENGINEERING REPORT
PROPOSED FIRE STATION
149 Park Street
Northfield, New Hampshire

August 30, 2023

Project No. 23.105.NH

PREPARED FOR:
Loureiro Building Construction, LLC
100 Northwest Drive
Plainville, Connecticut 06062

PREPARED BY:
Miller Engineering & Testing, Inc.
100 Sheffield Road, P.O. Box 4776
Manchester, New Hampshire 03108

MILLER ENGINEERING & TESTING INC.

GEOTECHNICAL / SOIL BORINGS / ENVIRONMENTAL / SOILS / CONCRETE / MASONRY / STEEL / ROOFING / ASPHALT INSPECTION
Mail all correspondence to: 100 SHEFFIELD ROAD · P.O. BOX 4776 · MANCHESTER, NH 03108-4776 · TELEPHONE (603) 668-6016

Via email: BAWorsham@loureiro.com; troy@loureiro.com; jjhardy@loureiro.com

August 30, 2023

Mr. Brian A. Worsham, Architect/Chief Estimator
LOUREIRO BUILDING CONSTRUCTION, LLC
100 Northwest Drive
Plainville, Connecticut 06062

RE: Geotechnical Engineering Report
Proposed Fire Station
149 Park Street
Northfield, New Hampshire Project 23.105.NH

Dear Mr. Worsham:

This Geotechnical Engineering Report presents our findings and recommendations for the proposed Fire Station at 149 Park Street in Northfield, New Hampshire. The subsurface conditions at the Site generally consisted of fill materials and topsoils overlying naturally occurring sand soils and compressible lake bed silts and clays. Groundwater was encountered in the Site test borings at depths between 6 and 9 feet below the existing grades. The fill materials were up to 6 feet thick in our Site test borings.

The clayey silt soils are slightly overconsolidated and compressible. Preliminary settlement analyses indicate that the total compression due to primary consolidation could be on the order of 0.25 inch when coupled with an average of 2 feet of new raise-in-grade fills to match the existing grades (without considering new foundation and ground floor stresses). This amount of settlement should be tolerable for the proposed Fire Station. With the estimated amount of potential deep-seated settlement, the Fire Station could be supported by a conventional shallow spread footing foundation and concrete slab-on-grade floor system, following stripping of the topsoils and excavating and replacing the existing fill materials.

We appreciate the opportunity to provide these geotechnical services to Loureiro. If you have any questions or require additional information, please contact us at kmilender@millerengandtesting.com or (603) 668-6016.

Very truly yours,
MILLER ENGINEERING & TESTING, INC.

Kenneth W. Milender, P.G., P.E.
Senior Geotechnical Engineer

for

Frank K. Miller, P.E.
Executive Vice President

cc. (via email): 'T. Roy, J. Hardy [Loureiro]

TABLE OF CONTENTS

1.0 INTRODUCTION

Miller Engineering & Testing, Inc. has prepared this Geotechnical Engineering Report for the Fire Station being proposed for 149 Park Street in Northfield, New Hampshire (referred to as the "Site" in this report). This evaluation was completed in general accordance with our proposal, dated August 2, 2023 (Ref. File 208-23R1), and consisted of the following work tasks:

1. Performing a site reconnaissance and subsurface exploration program with a series of test borings at the location of the proposed Fire Station and its ancillary facilities;
2. Evaluating the subsurface conditions and performing geotechnical engineering analyses to develop recommendations for the design and construction of the proposed project; and
3. Summarizing the exploration program and engineering evaluation in this Project Geotechnical Report.

Presented herein is a description of the proposed project and site, subsurface conditions, and the geotechnical implications on design and construction. The contents of this report are subject to the limitations in Appendix A.

2.0 SITE AND PROPOSED DEVELOPMENT

The Site consists of one parcel of land (Northfield Parcel ID U09-001G) with a physical street address of 149 Park Street (New Hampshire State Route 132) in Northfield, New Hampshire. Figure 1 of this report is a Site Location Map depicting the location of the Site on a 7.5-minute topographic quadrangle.

2.1 *Existing Conditions*

We have examined one civil engineering design sheet to provide information on the existing and historical conditions ("Existing Conditions Plan for Tilton-Northfield Fire District, Tax Map U9 Lots 1F & 1G, 149 Park Street – NH Route 132, Northfield, New Hampshire" (dated September 10, 2019), prepared by Joseph M. Wichert LLS, Inc. of Manchester, New Hampshire.

The Site property is currently undeveloped within a neighborhood of commercial and institutional properties (Figure 1). Examination of historic aerial images indicates that the Site has been a grassed lawn and landscaped area since at least the 1990s. The Northfield Fire Station is adjacent to (northwest of) the Site; facilities of the Northfield Highway Department are located to the west. Access to the Site is from Park Street (Figure 2).

2.2 *Proposed Development*

The project consists of constructing a 1-story fire station building in the center of the Site property, with a footprint area of approximately 20,000 square feet. We have assumed a floor slab at elevation 442 feet MSL to approximately match the existing grades and require minimal filling to prepare the building footprint and parking areas. The property has frontage on Park Street and likely would share an access driveway with the neighboring highway department and existing fire station. The building will likely be surrounded with stormwater management measures, surface parking lots, and driveways. Basement levels are not being planned. The Site design is currently in preparation by Loureiro Engineering Associates, Inc. (project civil engineer), and we have used their preliminary site plan as the base map for our Figure 2.

It is our understanding that structural engineering design of the Fire Station has not yet been completed; structural loads were not available at the time this report was prepared.

3.0 SUBSURFACE EXPLORATION PROGRAM

The subsurface conditions at the site were characterized by advancing a series of test borings through the overburden soil formations within the proposed Fire Station footprint. The locations and elevations of the test borings were estimated from "Existing Conditions Plan for Tilton-Northfield Fire District" (dated September 10, 2019), as provided in digital form by Loureiro Building Construction, LLC. Our test borings were advanced in order to:

- Characterize the nature and consistency of the soil formations at the Site and provide samples for visual classification;
- Perform Standard Penetration Tests to estimate the relative density of the in-place soil units;
- Estimate the engineering properties of the subgrade soils and provide recommendations needed for designing the foundation elements; and
- Determine the depths to competent soil and/or bedrock, and the depth of the groundwater table.

The test borings (designated B-1 through B-5) were advanced on 15 August 2023 with a truck-mounted Diedrich model D-50 hydraulic rotary drill rig using a 2¼-inch inside-diameter hollow-stem auger to bore the holes. Soil samples were generally collected at 5-foot intervals from the ground surface to the bottoms of the borings. Soil samples were collected using 2-inch outside-diameter split-spoon samplers during Standard Penetration Tests; the tests were performed with a 140-pound hammer dropping 30 inches in general accordance with ASTM Standard D1586.

Our field engineer monitored the subsurface explorations, measured groundwater levels, and prepared test boring logs. Soil samples were placed in sealed, labeled containers and returned to our office for further evaluation. The test boring logs are included as Appendix B.

4.0 SUBSURFACE CONDITIONS

We reviewed the published geologic mapping to provide some basic information on the geologic conditions at the Site:

- The surficial geology of the Site and surrounding vicinity has been mapped as being underlain by thick lake bed deposits, consisting of sands and gravels deposited in Glacial Lake Northfield[1].

- The Bedrock Geology Map of New Hampshire indicates that the Site is underlain by rocks of the Rangeley Formation (a gray, thinly laminated metamorphosed turbidites and quartz conglomerates). No bedrock outcrops were observed on the Site.[2]

4.1 *Subsurface Soils*

Subsurface conditions at the Site were characterized by drilling into the unconsolidated overburden soil formations at selected locations within the proposed Fire Station footprint. Figure 2 illustrates the proposed site layout and the test boring locations.

The Site test borings were drilled to a maximum depth of 26 feet below the existing ground surface. Results from the test borings indicate that the subsurface conditions at the Site generally consist of surficial layers of topsoil and/or fill materials overlying a naturally occurring sand deposit, and clayey silt lakebed deposits (Appendix B). The general characteristics of the subsurface layers at the Site are described below in order of increasing depth below the ground surface; refer to the boring logs in Appendix B for more detailed soil descriptions at specific locations and depths; subsurface conditions are summarized in Table 1.

Surficial Layers

Our test borings B-1, B-2, and B-3 penetrated topsoil that ranged from approximately 18 inches to 24 inches thick (Appendix B). Thicker topsoils could be encountered in localized areas during construction.

Fill Materials

Three of our Site test borings penetrated a layer of fill materials that ranged in thickness from 2 feet (in B-3) to 6 feet (in B-5). The fill materials consisted of silty sand with occasional brick fragments (Appendix B). Standard Penetration Tests indicated that the fill materials were generally in a loose to medium dense relative density condition. The thickness and distribution of fill materials across the Site suggests that the thickest fills are probably adjacent to the existing fire station building on the west side of the Site.

[1] Tinkham, D.J. and Brooks, J.A., 2003, Surficial geologic map of the Northfield quadrangle, Belknap and Merrimack Counties, New Hampshire, New Hampshire Geological Survey.
[2] Lyons, J.B., Bothner, W.A., Moench, R.H., and Thompson, J.B. 1997. *Bedrock Geologic Map of New Hampshire*.

Test Boring	Approximate Ground Surface Elevation (ft MSL)	Depth to Suitable Bearing Soils (feet)	Elevation of Suitable Subgrade (ft MSL)	Depth to Groundwater (feet)	Groundwater Elevation (ft MSL)
B-1	438	1	437	6	432
B-2	442	2	440	9	433
B-3	438	4	434	6	432
B-4	438	4	434	9	429
B-5	441	6	435	9	432

Sand Deposit

The test borings encountered a naturally occurring deposit of silty sand that we interpret to be glacial lake sediments (USCS classification: SM) that was encountered directly below the fill materials and topsoils in all the Site test borings (Appendix B). Our borings penetrated the full thickness of the sand deposit, which was 9 feet thick in B-5 and 15 feet thick in B-3 (Appendix B). This formation appeared to grade into a fine sandy silt in deeper zones. Standard Penetration Tests indicated that this sand deposit was generally in a medium dense relative density condition.

Clayey Silt Lakebed Deposit

The sand formation graded downward into a layer of fine sandy silt between 14 and 19 feet, and to clayey silt between depths of 19 and 26 feet below grade. The deeper clayey silt lakebed deposits consisted of interbedded clayey silt and fine sandy silt varves that we interpret to be glaciolacustrine lake bed deposits (USCS designations: ML and CL). Our test borings did not penetrate the full thickness of these lake bed deposits. Laboratory testing (Appendix C) indicates that the clayey silt soils were low plasticity and had:

- Natural water contents of about 34%.
- A liquid limit of 23 and the sample was non-plastic.

Standard Penetration Tests indicated that these lakebed soils generally exhibited a soft to medium stiff consistency. We estimated the shear strength of the silty clay formation by pocket penetrometer testing on samples from the test borings. This testing indicated that the shear strength of the overall silt and clay formation ranged from 1.0 to 3.0 tons per square foot (tsf), with an average of approximately 2.5 tsf. Penetrometer testing indicated that the lake bed deposits are slightly overconsolidated.

4.2 *Drilling Refusal/Presumed Bedrock Surface*

Drilling refusal, the depth below which the hollow-stem auger was not able to penetrate the deeper geologic formations, was not encountered in the Site test borings, to depths of 26 feet below the existing grades. Deeper test borings would be needed to confirm the depth to bedrock.

4.3 *Groundwater*

Groundwater was encountered in all the Site test borings at depths below the existing ground surface of 6 feet to 9 feet below the proposed building footprint, which we estimate to be elevations 429 to 433 feet MSL.

It is our opinion that these groundwater depths do not represent stabilized water levels, and fluctuations in groundwater levels should be anticipated due to variations in precipitation, snowmelt, site development, and other environmental conditions. Groundwater levels at other times, therefore, could be different from those observed and recorded during this exploration program. Groundwater levels could fluctuate by several feet during the annual hydrologic cycle.

5.0 ENGINEERING EVALUATION

Our test borings did encounter a compressible, low plasticity, slightly overconsolidated clayey silt formation at depths between approximately 19 and 26 feet below the ground surface; our test borings did not penetrate the full thickness of this formation. Because these soils could consolidate and settle under the loads that would be imposed by engineered fills needed to raise the Site grades to match the existing fire station slab elevation, we performed additional engineering analyses that indicated the total compression due to primary consolidation could be on the order of 0.25 inch with 2 feet of new raise-in-grade fills (average fill thickness over the area of the building footprint). This amount of deep-seated compression should be tolerable by the structure. Accordingly, it is our opinion that the subsurface conditions at the Site are favorable for design and construction of a conventional, shallow, spread footing foundation system to support the proposed Fire Station.

In addition, our test borings also encountered unsuitable topsoils and fill materials at shallow levels. These soils should be removed and replaced with compacted structural fill. Following these improvements, the foundation elements for the proposed Fire Station could be supported directly on the sand deposit soils or on compacted structural fill, following subgrade preparations made in accordance with this report.

6.0 DESIGN RECOMMENDATIONS

Based on the subsurface explorations and our geotechnical evaluations, we present the following recommendations for the design of the proposed Fire Station at 149 Park Street in Northfield, New Hampshire.

6.1 *Foundation Systems*

The Site subsurface conditions are generally suitable for a shallow foundation system, consisting of isolated spread footings (under columns) and continuous, strip footings (below interior and exterior load-bearing walls) to support the proposed building. The Fire Station footprint area must be cleared and grubbed of unsuitable soils (such as organic topsoils and fill materials) to expose the undisturbed, naturally occurring sand soils, which are considered to be the uppermost suitable bearing stratum for the engineered fills, foundations, and concrete slab-on-grade.

Engineering analyses indicate that the foundation elements constructed on these subsurface conditions should be designed using an allowable net bearing pressure of 3,000 pounds per square foot (1.5 tons per square foot).

Isolated and continuous spread footings supporting the building loads should be at least 3 feet wide. If smaller width footings are to be used, the allowable net bearing pressure should be reduced in direct proportion to the reduction in footing width. In no case should footing width be less than 2.0 feet.

An allowable net bearing pressure of 3,000 psf should limit total settlements below footings to less than 1 inch. Differential settlement between adjacent footings should be less than 0.5 inch. Angular distortion beneath continuous wall footings should be less than 0.002 feet/foot. Settlement would tend to occur as loads are applied, thus most of the dead-load related settlement will probably occur by the end of construction.

Foundation elements of the building that will be exposed to subfreezing temperatures should be constructed at a depth of 4 feet below the final exterior grades to provide frost protection.

Lateral forces can be resisted by the shear developed at the base of the footings. Base shear should be calculated using a coefficient of friction of 0.47 for concrete cast directly on stable, compacted Select Granular Fill.

6.2 *Slabs-on-Grade*

The subsurface conditions beneath the surficial organic layers are suitable for constructing a reinforced concrete slab-on-grade for the Fire Station. The uppermost 12 inches of material beneath the building slab-on-grade should consist of Base Course Fill that conforms to the gradation specification in Table 1. This material should be placed in one loose lift and should be compacted to a minimum of 95 percent of its maximum dry density, as determined by ASTM

D1557. A modulus of subgrade reaction (K_V) of 200 psi/inch should be used to proportion slabs-on-grade when constructed on properly placed and prepared Base Course Fill.

6.3 *Seismic Considerations*

The Fire Station will be founded within loose to medium dense sand soils. These soils are sufficiently dense and dry so as to theoretically preclude seismically induced liquefaction during the design regional seismic event. Accordingly, design provisions for liquefaction are not necessary at this Site.

The New Hampshire State Building Code (2018 International Building Code) requires that all structures be designed to withstand the forces generated by the maximum credible earthquake based on the soil and rock conditions. The soil profile beneath the proposed Fire Station constitutes a "stiff soil profile," and we assign the Site a Seismic Site Class of D. The seismic site coefficients for computing the design spectral response acceleration parameters should be:

S_s	S_1	F_a	F_v
0.378	0.082	1.5	2.4

6.4 *Groundwater and Drainage Issues*

Groundwater was encountered in all the Site test borings at depths below the existing ground surface of 6 feet to 9 feet below the proposed building footprint, which we estimate to be elevations 429 to 433 feet MSL.

At this time, it is our opinion that the Fire Station does not need to be constructed with a perimeter foundation drainage system because of the permeable sand and gravel soils. It is also our opinion that a subslab drainage system is not necessary based on geotechnical considerations.

7.0 EARTHWORK AND CONSTRUCTION RECOMMENDATIONS

Based on the subsurface explorations and our geotechnical evaluations, we present the following recommendations for the construction of the proposed Fire Station at 149 Park Street in Northfield, New Hampshire.

7.1 *Subgrade Preparations*

The Fire Station footprint area must be cleared and grubbed of unsuitable soils (such as organic topsoils and fill materials) to expose the undisturbed, naturally occurring sand soils, which are considered to be the uppermost suitable bearing stratum for the development of this Site.

Following stripping of unsuitable soils, the resulting subgrade should be compacted with at least four complete passes of a 10-ton vibratory drum roller in directions perpendicular to one another.

Silty soil subgrades which are saturated (due to excessive precipitation during construction) or pump and weave during rolling should be excavated and replaced with Select Granular Fill material that is compacted to at least 95% of its maximum dry density as determined by ASTM Standard D1557, or compacted ¾-inch crushed stone. The depth of undercutting and type of backfill material should be selected with consideration of the proposed use (i.e., buildings or pavements) and the soil and weather conditions encountered during construction. Crushed stone should be placed in 12-inch maximum loose lifts, wrapped in a geotextile filter fabric (Mirafi 140N or approved equal), and compacted to ensure stability.

The contractor is responsible for construction means and methods and should anticipate the need for methods to prevent disturbance, softening, or rutting of subgrades, or damage to overlying soils resulting from construction traffic. Care must be taken to avoid disturbing subgrades by keeping construction traffic off of subgrades during wet conditions and/or inclement weather until a firm fill layer has been placed.

Final foundation and subgrade preparation should include re-compaction of bearing surfaces. Care should be taken to limit disturbance to bearing surfaces prior to placement of concrete. Any loose, softened, or disturbed material should be removed and replaced with compacted structural fill prior to placement of concrete. Excavated subgrades should not be left exposed overnight unless the weather forecast calls for above-freezing, clear conditions.

7.2 *Temporary Excavations*

Construction site safety, means and methods, and sequencing of construction activities is the sole responsibility of the contractor. Under no circumstances should the following information be interpreted to mean that Miller Engineering & Testing, Inc. is assuming responsibility for construction site safety, trench protection, or the contractor's responsibilities. Such responsibility is not being implied and should not be inferred.

All temporary excavations should be performed according to Occupational Safety and Health Administration (OSHA) Standards (29 CFR 1926 Subpart P). It is our opinion that the undisturbed sand soils are OSHA Type C soils, and temporary excavation side slopes should be 1½H:1V or flatter under dry or dewatered conditions.

7.3 *Dewatering and Runoff Control*

Groundwater was encountered in all the Site test borings at depths below the existing ground surface of 6 feet to 9 feet below the proposed building footprint, which we estimate to be elevations 429 to 433 feet MSL.

It is our opinion that groundwater will probably not be encountered during foundation construction. However, deeper excavations (for example, for underground utilities and stormwater facilities) could encounter groundwater that will require controls.

Should groundwater be encountered during construction, inflows should be controlled in order for earthwork to be completed "in the dry". The contractor should anticipate the need for controlling runoff during wet periods; pumping from open sumps will likely provide adequate control of water within excavations during construction.

Subgrade soils that become unstable should be undercut and replaced with structural fill or crushed stone, as necessary. Surface water runoff should be directed away from excavations to reduce dewatering efforts and to protect subgrades from becoming soft and unstable.

Temporary detention ponds, trenches, ditches, and dewatering sumps should not be made in areas to be filled.

7.4 *Placement of Granular Engineered Fills*

Engineered fills will be required to achieve the design grades in several areas of the proposed Site development. Table 1 is the gradation specifications for soils to be used in the engineered fills at the Site. The different granular fill types should be used as follows:

1. Select Granular Fill should be used for engineered fills below the Fire Station footprint areas, in foundation bearing zones, and as backfill around the foundation elements, and should have the gradation in Table 1. Acceptable alternatives are NHDOT Item 304.3 (Crushed Gravel) and 304.4 (Crushed Stone - Fine).

2. Clean Granular Fill should be used for engineered fills below roadway, parking, and other non-structural areas with the gradation shown in Table 1. An acceptable alternative is NHDOT Item 304.2 (Gravel).

3. Base Course should be used for the uppermost fill below the Fire Station slab-on-grade (Table 1). An acceptable alternative is NHDOT Item 304.33 (Crushed Aggregate for Shoulders).

All granular fills should be placed in 12-inch maximum loose lifts and should be compacted to a minimum of 95% of the material's maximum dry density, as determined by ASTM D1557 (modified Proctor test) and verified with field density testing (ASTM D6938 or equivalent method). Lift thickness should be a maximum of 6-inch (loose) when compacted with hand-guided equipment.

7.5 *Reuse of Site Materials*

A preliminary assessment of the suitability of using the unconsolidated soils as engineered fills in the proposed construction is based on the soil classifications, laboratory analyses, and observations at the Site. The suitability of these materials is summarized below.

1. Topsoils and subsoils (if encountered) are suitable for reuse on-site only within landscaped areas.

2. The fill materials and natural sand soils might be suitable for use as structural fill beneath the building footprint provided the material can be compacted to a dry density at least 95 percent of the material's maximum dry density as determined by ASTM Standard D1557. These materials could also potentially be reused in non-structural areas (outside the building footprint), below pavement subbase courses, and in landscaping areas, provided the contractor can place and compact these soils in accordance with this report.

Materials to be used as the granular backfills and the base courses below the slab-on-grade and the pavements will need to be imported to the Site. Representative samples of all materials proposed for use as fills should be submitted for testing during construction to compare their gradation characteristics to the requirements of the project specifications, and to establish their optimum water contents and maximum dry densities (modified proctor testing, ASTM Standard D1557). The geotechnical engineer must approve use and reuse of on-site or borrow soils for use as engineered fills. Use of materials as engineered fills assumes that the moisture content of the material will be strictly controlled in order to allow for proper placement and compaction.

7.6 *Special Inspections*

In accordance with the State Building Code, special inspections are necessary during subgrade preparation and placement of fill within Fire Station footprint areas. The project geotechnical engineer should be engaged to make appropriate site visits during the excavation and subgrade preparations to confirm that our assumptions regarding subsurface conditions (which were based on a limited number of borings) were reasonably representative and that our recommendations are being properly interpreted and followed.

8.0 FINAL DESIGN AND CONSTRUCTION MONITORING

A qualified geotechnical engineer should be retained to provide engineering services during the excavation and construction phases of this project. This will become particularly important relative to the excavation of unsuitable materials, and the placement and compaction of engineered fills. This will also allow for design changes in the event that subsurface conditions differ from those anticipated prior to the start of construction. The adequacy of fill compaction should be determined by field density testing as the fill is placed and compacted.

Representative samples of all backfill materials should be submitted to Miller Engineering & Testing, Inc. for testing to establish their optimum water contents and maximum dry densities, and to compare their gradation characteristics with the project specifications. In this manner,

compaction criteria can be developed which will provide the materials with adequate strength and minimal distortion.

Lastly, we recommend that we be retained to assist in preparation of the project earthwork specifications and to review final design plans, specifications, and design submittals. In the event that any changes in the nature, design, or locations of the proposed project are planned, the conclusions and recommendations in this report will not be considered valid unless the changes are reviewed and conclusions of the report modified or verified in writing by Miller Engineering & Testing, Inc.

TABLES

GEOTECHNICAL ENGINEERING REPORT
Proposed Fire Station
149 Park Street
Northfield, New Hampshire

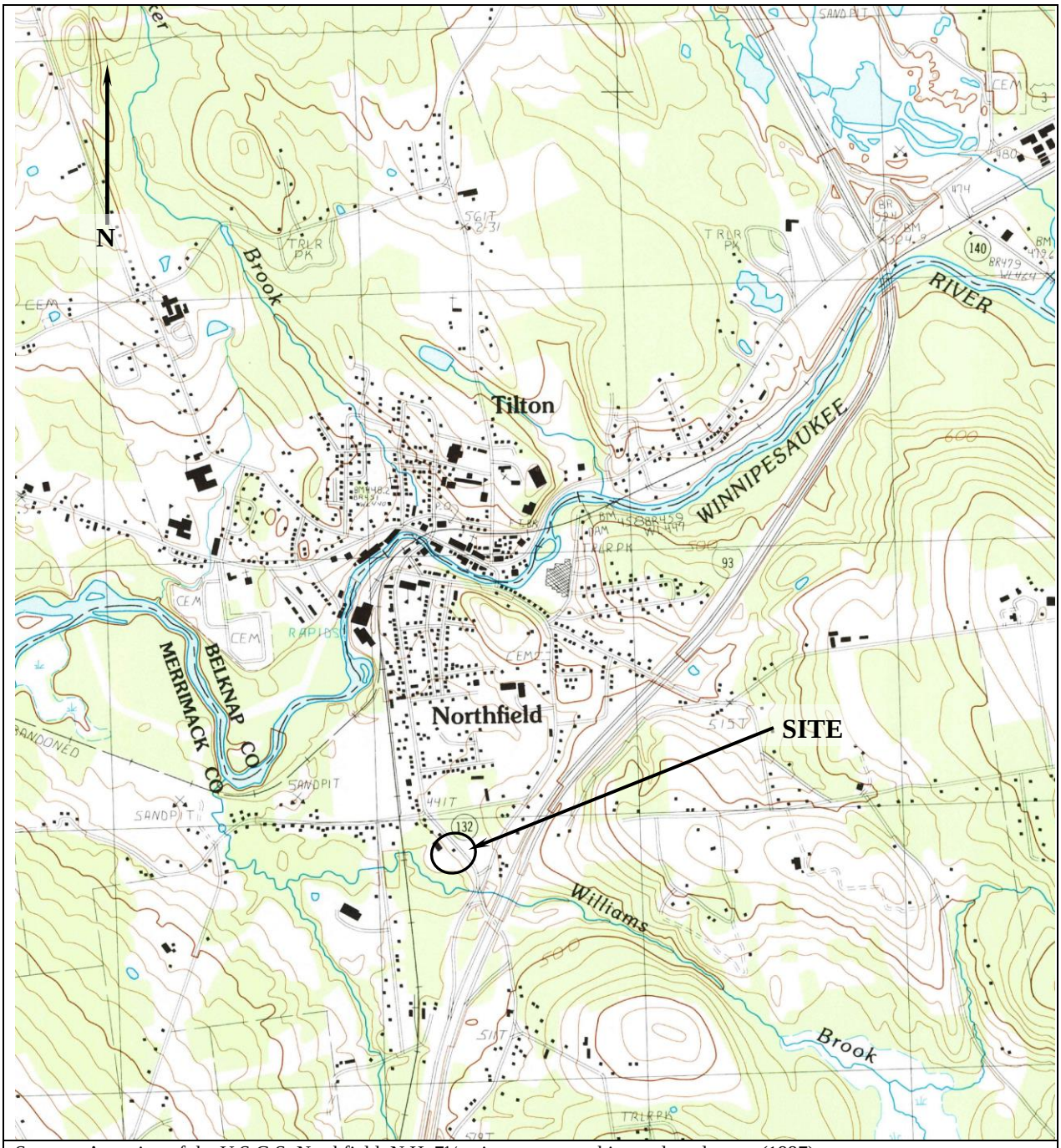
TABLE 1
GRADATION SPECIFICATIONS

GEOTECHNICAL ENGINEERING REPORT
Proposed Fire Station
149 Park Street
Northfield, New Hampshire

SIEVE SIZE	PERCENT PASSING BY WEIGHT		
	CLEAN GRANULAR FILL	BASE COURSE	SELECT GRANULAR FILL
8”	100	100	100
3”	70 – 100	100	70 – 100
1½	-----	-----	-----
¾	-----	-----	-----
½”	40 – 100	40 – 80	40 – 90
No. 4	25 – 100	30 – 70	25 – 80
No. 10	15 – 95	20 – 60	15 – 70
No. 40	10 – 70	10 – 30	5 – 40
No. 50	-----	-----	-----
No. 200	0 – 15	3 - 10	0 – 12

FIGURES

GEOTECHNICAL ENGINEERING REPORT
Proposed Fire Station
149 Park Street
Northfield, New Hampshire



Source: A portion of the U.S.G.S. Northfield, N.H. 7½-minute topographic quadrangle map (1987).

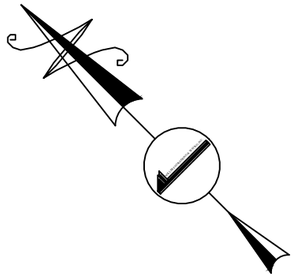
GEOTECHNICAL ENGINEERING REPORT	SITE LOCATION MAP
Proposed Fire Station Park Street Site Northfield, NH August 2023 Miller Project No. 23.105.NH	FIGURE 1

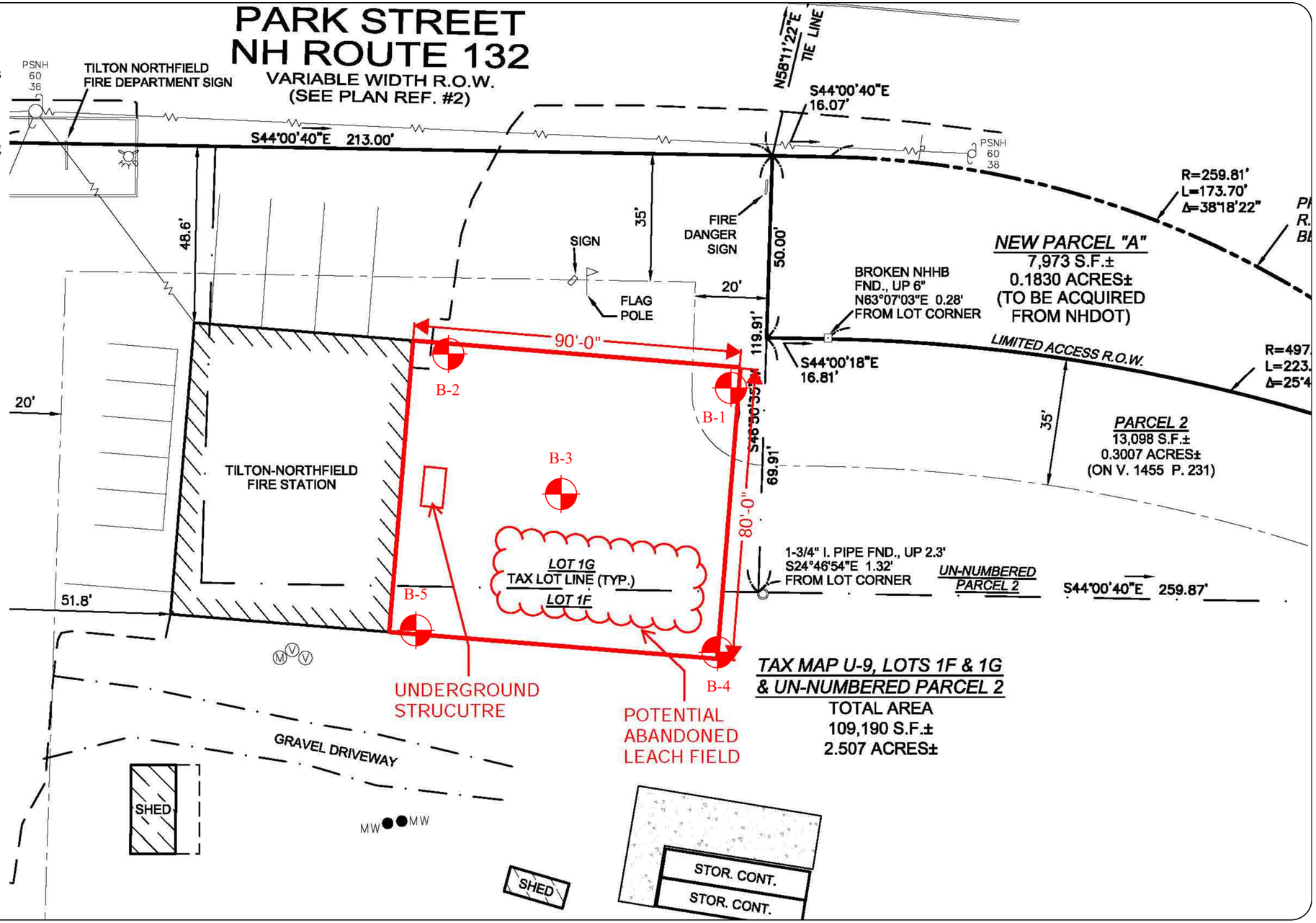
NOTES

1. This plan is a reproduction of portions of "Tilton-Northfield Fire District Tax Map U9 Lots 1F & 1G, Northfield, NH", (dated January 27, 2021) by Joseph M. Wichert LLS, Inc. of Manchester, NH.
2. A geotechnical engineer from Miller Engineering & Testing, Inc. inspected the test borings.
3. Exploration locations were established by others and using the tape and pace method.

KEY

Approximate Boring Location





MILLER ENGINEERING & TESTING, INC.

100 SHEFFIELD ROAD - PO BOX 4776
MANCHESTER, NEW HAMPSHIRE 03108
TEL (603) 668-6016 // FAX (603) 668-8641

Proposed Fire Station
Northfield, NH
August 2023
Project No. 23.105.NH

SUBSURFACE EXPLORATION LOCATION PLAN

FIGURE No. 2

APPENDICES

GEOTECHNICAL ENGINEERING REPORT
Proposed Fire Station
149 Park Street
Northfield, New Hampshire

APPENDIX A

Limitations

GEOTECHNICAL ENGINEERING REPORT
Proposed Fire Station
149 Park Street
Northfield, New Hampshire

LIMITATIONS

Explorations

1. The analyses, recommendations and designs submitted in this report are based in part upon the data obtained from subsurface explorations. The nature and extent of variations between these explorations may not become evident until construction. If variations then appear evident, it will be necessary to re-evaluate the recommendations of this report.

2. The generalized soil profile described in the text is intended to convey trends in subsurface conditions. The boundaries between strata are approximate and idealized and have been developed by interpretation of widely spaced explorations and samples; actual soil transitions are probably more gradual. For specific information, refer to the boring logs.

3. Water level readings have been made in the drill holes at times and under conditions stated on the boring logs. These data have been reviewed and interpretations have been made in the text of this report. However, it must be noted that fluctuations in the level of the groundwater may occur due to variations in rainfall, temperature, and other factors differing from the time measurements were made.

Review

4. It is recommended that this firm be retained to review final design plans and specifications. In the event that any changes in the nature, design, or location of the structures are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and conclusions of the report modified or verified in writing by Miller Engineering & Testing, Inc.

Construction

5. It is recommended that this firm be retained to provide soils engineering services during the excavations and foundation construction phases of the work. This is to observe compliance with the design concepts, specifications, or recommendations and to allow design changes in the event that subsurface conditions differ from those anticipated prior to the start of construction.

Use of Report

6. This report has been prepared for the exclusive use of **Loureiro Building Construction, LLC** for the **Proposed Fire Station** at **149 Park Street** in **Northfield, New Hampshire** in accordance with generally accepted soil and foundation engineering practices. No other warranty, expressed or implied, is made.

7. This soil and foundation engineering report has been prepared for this project by Miller Engineering & Testing, Inc. This report was completed for design purposes and may be limited in its scope to prepare an accurate bid. Contractors wishing a copy of the report may secure it with the understanding that its scope is limited to design considerations only.

APPENDIX B

Test Boring Logs

GEOTECHNICAL ENGINEERING REPORT
Proposed Fire Station
149 Park Street
Northfield, New Hampshire

TEST BORING LOG

MILLER ENGINEERING & TESTING, INC.
100 Sheffield Road - Manchester, NH 03103
Ph. (603) 668-6016 - Fax: (603) 668-8641

Project: Tilton Fire Dept.
Northfield, NH
Project No: 23.105.NH
Date Start: 08-15-23
Date End: 08-15-23

Sheet 1 **of** 1
Boring No: B-1
Location: See Plan
Approx. Surface Elev: 438'

	CASING	SAMPLER	GROUNDWATER OBSERVATIONS Date	Depth	Casing At	Stabilization Period
Type	HSA	SS	08-15-23	6'	26'	Upon Completion
Size	2-1/4" ID	1-3/8" ID				
Hammer		140 lbs.				
Fall		30"				

Depth/ Elev.	Cas bl/ft	SAMPLE Sample No.	Depth Range	Pen.	Rec.	BLOWS 0-6"	6-12"	12-18"	18-24"	Strata Change	Sample Description	Notes
0 438		S-1	0.0-1.5	18	12	1	1	2			S-1: Topsoil	
		S-1A	1.5-2.0	6	6				3		S-1A: Brown/Orange, fine sand, trace silt	
		S-2	2.0-4.0	24	17	4	4	4	4		S-2: Brown, fine sand, trace gravel, trace silt, wet	
		S-3	4.0-6.0	24	12	3	7	10	9		S-3: Brown, fine sand, trace gravel, trace silt, wet	
5 433												
		S-4	9.0-11.0	24	24	2	4	4	6		S-4: Brown, fine sand, little silt, trace gravel, wet	
10 428												
		S-5	14.0-16.0	24	15	3	9	12	14		S-5: Brown, silt, little fine sand, wet	
15 423												
		S-6	19.0-21.0	24	14	2	3	4	4		S-6: Brown, clayey silt, wet (1 - 1/8" clay varve)	
20 418												
		S-7	24.0-26.0	24	14	1	2	3	6		S-7: Brown, clayey silt, trace fine sand, wet	
25 413												
											BORING TERMINATED AT 26 ft	
30 408												

Driller: R. Marcoux
Helper: J. Donahue
Inspector: T. Young

COHESIVE CONSISTENCY (Blows/Foot)
0-2 VERY SOFT
2-4 SOFT
4-8 MEDIUM STIFF
8-15 STIFF
15-30 HARD

COHESIONLESS (Blows/Foot)
0-4 VERY LOOSE
4-10 LOOSE
10-30 MEDIUM DENSE
30-50 DENSE
50+ VERY DENSE

PROPORTIONS USED
TRACE: 0-10%
LITTLE: 10-20%
SOME: 20-35%
AND: 35-50%

NOTES:

REMARKS: THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITION MAY BE GRADUAL.
WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS.
FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

TEST BORING LOG

MILLER ENGINEERING & TESTING, INC.
100 Sheffield Road - Manchester, NH 03103
Ph. (603) 668-6016 - Fax: (603) 668-8641

Project: Tilton Fire Dept.
Northfield, NH
Project No: 23.105.NH
Date Start: 08-15-23
Date End: 08-15-23

Sheet 1 **of** 1
Boring No: B-2
Location: See Plan
Approx. Surface Elev: 442'

	CASING	SAMPLER	GROUNDWATER OBSERVATIONS Date	Depth	Casing At	Stabilization Period
Type	HSA	SS	08-15-23	9'	26'	Upon Completion
Size	2-1/4" ID	1-3/8" ID				
Hammer		140 lbs.				
Fall		30"				

Depth/ Elev.	Cas bl/ft	SAMPLE Sample No.	Depth Range	Pen.	Rec.	BLOWS 0-6"	6-12"	12-18"	18-24"	Strata Change	Sample Description	Notes
0 442		S-1	0.0-2.0	24	19	1	2	4	3		S-1: Topsoil (coal in sample)	
		S-2	2.0-4.0	24	16	4	4	4	6		S-2: Light brown, fine sand, trace silt	
		S-3	4.0-6.0	24	18	4	5	7	7		S-3: Light brown, fine sand, trace silt	
5 437												
		S-4	9.0-11.0	24	15	4	8	8	9		S-4: Brown, fine sand, trace gravel, trace silt, wet	
10 432												
		S-5	14.0-15.3	16	16	3	4	5			S-5: Brown, fine sand, trace gravel, trace silt, wet	
15 427												
		S-5A	15.3-16.0	8	8				7		S-5A: Brown, fine sand, some silt, wet	
		S-6	19.0-21.0	24	3	5	8	7	8		S-6: Gray, fine sand, some silt, wet	
20 422												
25 417		S-7	24.0-26.0	24	16	WOR	1	2	1		S-7: Gray, clayey silt, wet	
											BORING TERMINATED AT 26 ft	
30 412												

Driller: R. Marcoux
Helper: J. Donahue
Inspector: T. Young

COHESIVE CONSISTENCY (Blows/Foot)
0-2 VERY SOFT
2-4 SOFT
4-8 MEDIUM STIFF
8-15 STIFF
15-30 HARD

COHESIONLESS (Blows/Foot)
0-4 VERY LOOSE
4-10 LOOSE
10-30 MEDIUM DENSE
30-50 DENSE
50+ VERY DENSE

PROPORTIONS USED
TRACE: 0-10%
LITTLE: 10-20%
SOME: 20-35%
AND: 35-50%

NOTES:

REMARKS: THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITION MAY BE GRADUAL.
WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS.
FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

TEST BORING LOG

MILLER ENGINEERING & TESTING, INC.
100 Sheffield Road - Manchester, NH 03103
Ph. (603) 668-6016 - Fax: (603) 668-8641

Project: Tilton Fire Dept.
Northfield, NH
Project No: 23.105.NH
Date Start: 08-15-23
Date End: 08-15-23

Sheet 1 **of** 1
Boring No: B-3
Location: See Plan
Approx. Surface Elev: 438'

	CASING	SAMPLER	GROUNDWATER OBSERVATIONS Date	Depth	Casing At	Stabilization Period
Type	HSA	SS	08-15-23	6'	26'	Upon Completion
Size	2-1/4" ID	1-3/8" ID				
Hammer		140 lbs.				
Fall		30"				

Depth/ Elev.	Cas bl/ft	SAMPLE Sample No.	Depth Range	Pen.	Rec.	BLOWS 0-6"	6-12"	12-18"	18-24"	Strata Change	Sample Description	Notes
0 438		S-1	0.0-2.0	24	15	1	1	1	1		S-1: Topsoil	
		S-2	2.0-4.0	24	7	4	3	3	4		S-2: Brown/Orange to brown, fine sand, trace silt (FILL)	
5 433		S-3	4.0-6.0	24	14	3	9	11	16		S-3: Brown, fine sand, trace gravel, trace silt, wet (2" layer of brown, silt, near bottom of sample)	
10 428		S-4	9.0-11.0	24	13	4	7	10	13		S-4: Brown, fine sand, trace silt, wet (blow- in, in split-spoon)	
15 423		S-5	14.0-16.0	24	14	10	18	16	18		S-5: Brown, fine sand, some silt, wet	
20 418		S-6	19.0-21.0	24	18	WOR	WOH	2	3		S-6: Gray, clayey silt, wet (1 - 1/2" varve of gray clay)	
25 413		S-7	24.0-26.0	24	17	WOR	WOR	2	2		S-7: Gray, clayey silt, wet	
30 408											BORING TERMINATED AT 26 ft	

Driller: R. Marcoux
Helper: J. Donahue
Inspector: T. Young

COHESIVE CONSISTENCY (Blows/Foot)
0-2 VERY SOFT
2-4 SOFT
4-8 MEDIUM STIFF
8-15 STIFF
15-30 HARD

COHESIONLESS (Blows/Foot)
0-4 VERY LOOSE
4-10 LOOSE
10-30 MEDIUM DENSE
30-50 DENSE
50+ VERY DENSE

PROPORTIONS USED
TRACE: 0-10%
LITTLE: 10-20%
SOME: 20-35%
AND: 35-50%

NOTES:

REMARKS: THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITION MAY BE GRADUAL.
WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS.
FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

TEST BORING LOG

MILLER ENGINEERING & TESTING, INC.
100 Sheffield Road - Manchester, NH 03103
Ph. (603) 668-6016 - Fax: (603) 668-8641

Project: Tilton Fire Dept.
Northfield, NH
Project No: 23.105.NH
Date Start: 08-15-23
Date End: 08-15-23

Sheet 1 **of** 1
Boring No: B-4
Location: See Plan
Approx. Surface Elev: 438'

	CASING	SAMPLER	GROUNDWATER OBSERVATIONS Date	Depth	Casing At	Stabilization Period
Type	HSA	SS	08-15-23	9'	26'	Upon Completion
Size	2-1/4" ID	1-3/8" ID				
Hammer		140 lbs.				
Fall		30"				

Depth/ Elev.	Cas bl/ft	SAMPLE Sample No.	Depth Range	Pen.	Rec.	BLOWS 0-6"	6-12"	12-18"	18-24"	Strata Change	Sample Description	Notes
0 — 438		S-1	0.0-2.0	24	10	3	3	5	4		S-1: Brown, fine to coarse sand, some gravel, trace silt (FILL)	
		S-2	2.0-4.0	24	0	9	11	14	9		S-2: No recovery	
5 — 433		S-3	4.0-6.0	24	12	5	6	7	6		S-3: Brown/Orange, fine sand, trace silt	
10 — 428		S-4	9.0-11.0	24	13	7	10	12	13		S-4: Brown, fine sand, trace silt, wet	
15 — 423		S-5	14.0-16.0	24	14	3	1	2	4		S-5: Brown, silt, trace fine sand, wet	
20 — 418		S-6	19.0-21.0	24	2	1	2	2	1		S-6: Gray, clayey silt, wet	
25 — 413		S-7	24.0-26.0	24	18	WOR	1	3	4		S-7: Brown, clayey silt, wet	
30 — 408											BORING TERMINATED AT 26 ft	

Driller: R. Marcoux
Helper: J. Donahue
Inspector: T. Young

COHESIVE CONSISTENCY (Blows/Foot)
0-2 VERY SOFT
2-4 SOFT
4-8 MEDIUM STIFF
8-15 STIFF
15-30 HARD

COHESIONLESS (Blows/Foot)
0-4 VERY LOOSE
4-10 LOOSE
10-30 MEDIUM DENSE
30-50 DENSE
50+ VERY DENSE

PROPORTIONS USED
TRACE: 0-10%
LITTLE: 10-20%
SOME: 20-35%
AND: 35-50%

NOTES:

REMARKS: THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITION MAY BE GRADUAL.
WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS.
FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

TEST BORING LOG

MILLER ENGINEERING & TESTING, INC.
100 Sheffield Road - Manchester, NH 03103
Ph. (603) 668-6016 - Fax: (603) 668-8641

Project: Tilton Fire Dept.
Northfield, NH
Project No: 23.105.NH
Date Start: 08-15-23
Date End: 08-15-23

Sheet 1 **of** 1
Boring No: B-5
Location: See Plan
Approx. Surface Elev: 441'

	CASING	SAMPLER	GROUNDWATER OBSERVATIONS Date	Depth	Casing At	Stabilization Period
Type	HSA	SS	08-15-23	9'	26'	Upon Completion
Size	2-1/4" ID	1-3/8" ID				
Hammer		140 lbs.				
Fall		30"				

Depth/ Elev.	Cas bl/ft	SAMPLE Sample No.	Depth Range	Pen.	Rec.	BLOWS 0-6"	6-12"	12-18"	18-24"	Strata Change	Sample Description	Notes
0 441		S-1	0.0-2.0	24	16	1	1	1	1		S-1: Dark brown, fine sand, little silt, trace roots (FILL)	
		S-2	2.0-4.0	24	13	1	1	2	2		S-2: Brown, fine sand, trace gravel, trace silt (FILL)	
5 436		S-3	4.0-6.0	24	12	5	6	6	17		S-3: Dark brown, fine sand, little silt (brick in bottom of sample) (FILL)	
		S-4	6.0-8.0	24	5	22	25	27	19		S-4: Brown/orange (mottled), fine sand, trace silt (brick pieces in top of sample)	
10 431		S-5	9.0-11.0	24	13	6	13	14	15		S-5: Brown, fine sand, trace gravel, trace silt, wet	
15 426		S-6	14.0-16.0	24	24	7	9	12	13		S-6: Brown, fine sand, trace gravel, trace silt, wet	
20 421		S-7	19.0-21.0	24	14	3	9	15	12		S-7: Brown, silt, some fine sand, wet	
25 416		S-8	24.0-26.0	24	22	1	2	2	2		S-8: Gray, clayey silt, wet	
30 411											BORING TERMINATED AT 26 ft	

Driller: R. Marcoux
Helper: J. Donahue
Inspector: T. Young

COHESIVE CONSISTENCY (Blows/Foot)
0-2 VERY SOFT
2-4 SOFT
4-8 MEDIUM STIFF
8-15 STIFF
15-30 HARD

COHESIONLESS (Blows/Foot)
0-4 VERY LOOSE
4-10 LOOSE
10-30 MEDIUM DENSE
30-50 DENSE
50+ VERY DENSE

PROPORTIONS USED
TRACE: 0-10%
LITTLE: 10-20%
SOME: 20-35%
AND: 35-50%

NOTES:

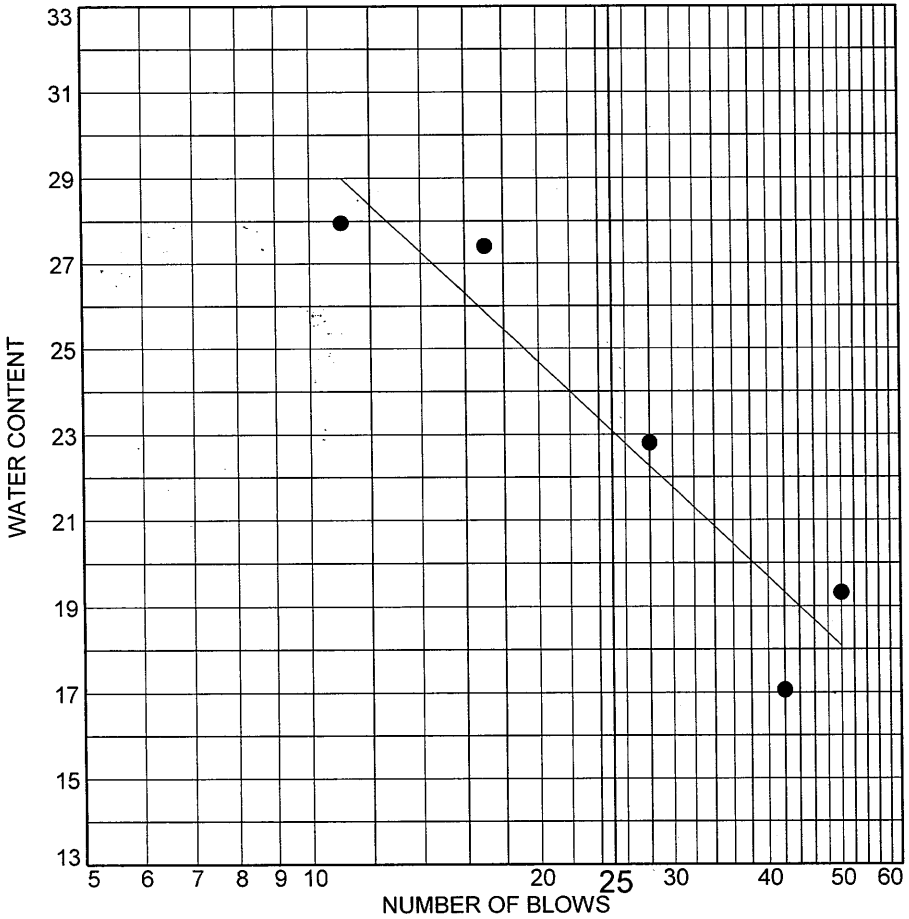
REMARKS: THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITION MAY BE GRADUAL.
WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS.
FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

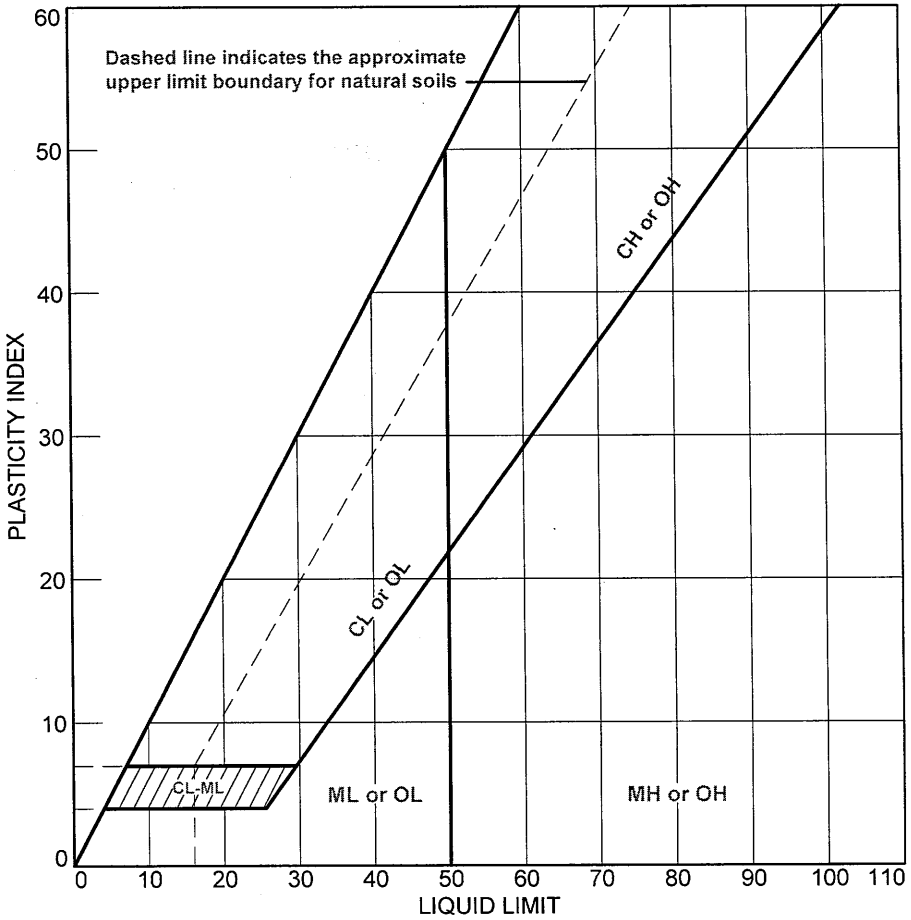
APPENDIX C

Geotechnical Laboratory Report

GEOTECHNICAL ENGINEERING REPORT
Proposed Fire Station
149 Park Street
Northfield, New Hampshire

LIQUID AND PLASTIC LIMITS TEST REPORT





	SOURCE	SAMPLE #	DEPTH/ELEV.	DATE SAMPLED	USCS	MATERIAL DESCRIPTION	NM %	LL	PI
●	B-4	S-7	24	8-30-23		Brown, clayey silt, wet		23	NP

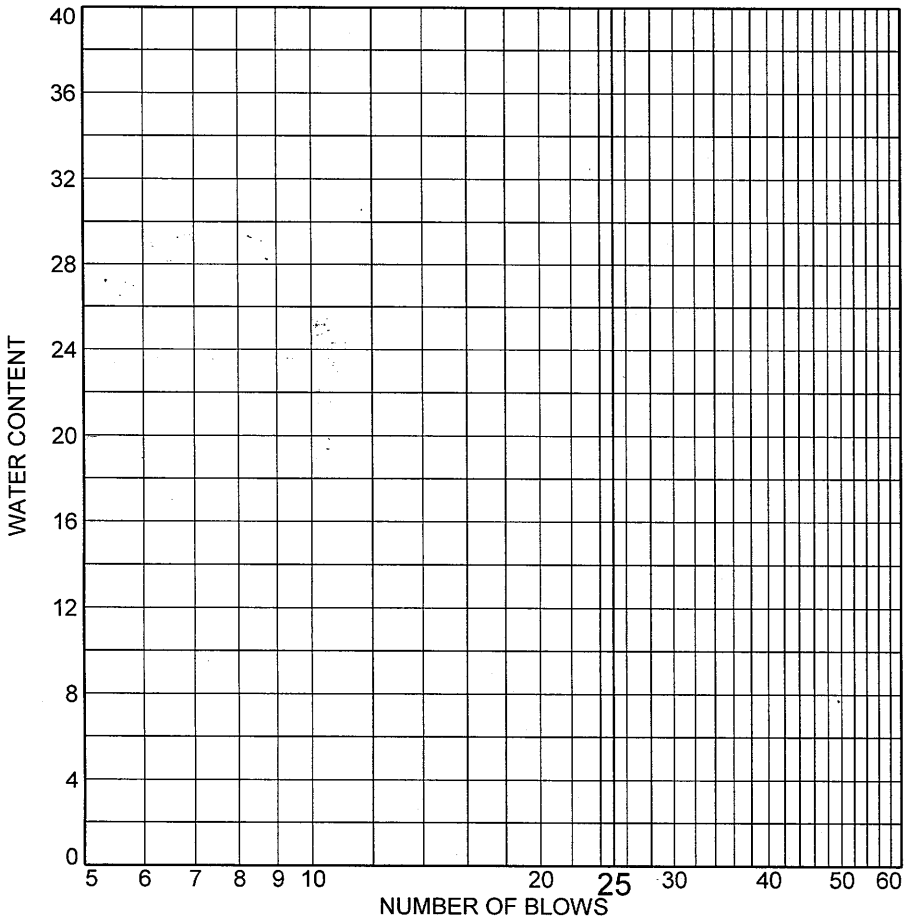
Client Loureiro Bldg Const. LLC

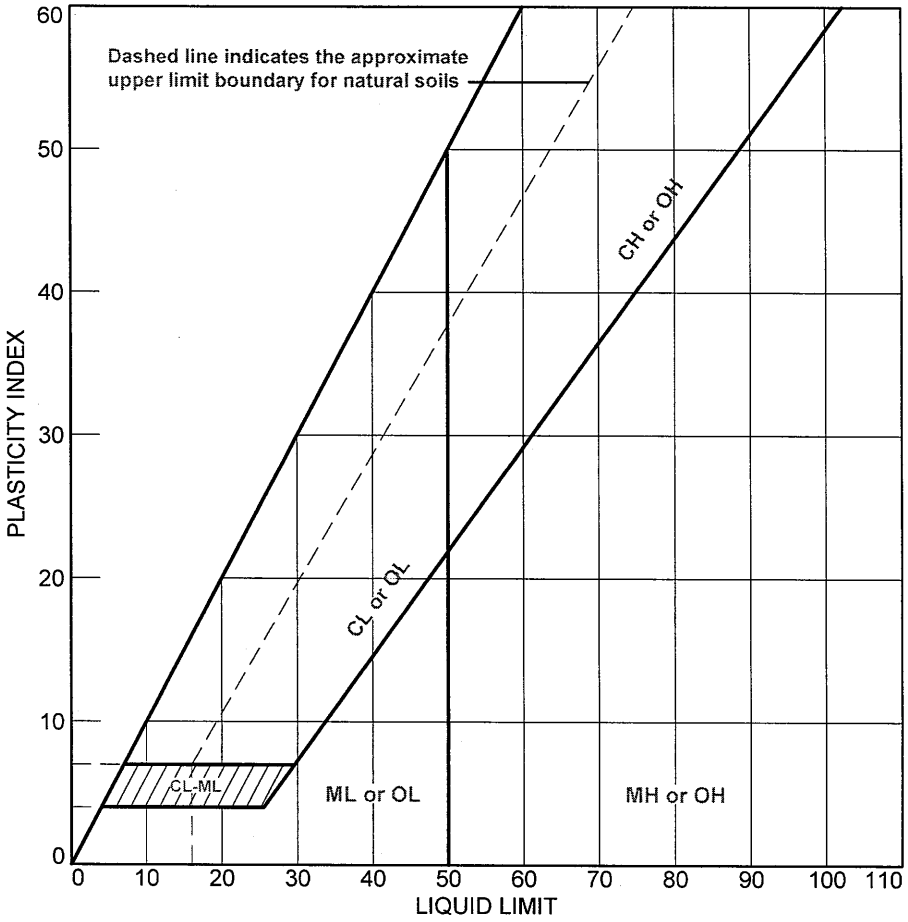
Project Tilton Fire Dept.

Project No. 23.105.NH Figure L23275B

MILLER ENGINEERING & TESTING, INC.

LIQUID AND PLASTIC LIMITS TEST REPORT





	SOURCE	SAMPLE #	DEPTH/ELEV.	DATE SAMPLED	USCS	MATERIAL DESCRIPTION	NM %	LL	PI
●	B-1	S-6	19	8-30-23		Brown, clayey silt, wet (1 - 1/8" clay varve)	34.2		

Client Loureiro Bldg Const. LLC

Project Tilton Fire Dept.

Project No. 23.105.NH | Figure

MILLER ENGINEERING & TESTING, INC.