GEOTECHNICAL REPORT

WHITINSVILLE SOCIAL LIBRARY

17 CHURCH STREET

NORTHBRIDGE, MASSACHUSETTS

November 19, 2025

GSI Project No. 225294

Prepared for:

Dave Hurley

Senior Project Manager

LeftField Project Management, Inc.

255 Park Avenue, Suite 1000

Worcester, MA 01609

Prepared by:

Harry K. Wetherbee, P.E.

Geotechnical Services, Inc.

55 North Stark Highway

Weare, NH 03281

November 19, 2025

Dave Hurley
Senior Project Manager
LeftField Project Management
255 Park Avenue, Suite 1000
Worcester, MA 01609

RE: Geotechnical Report
Whitinsville Social Library
17 Church Street
Northbridge, Massachusetts **GSI Project No. 225294**

Dear Mr. Hurley,

This report presents the results of a geotechnical investigation completed by Geotechnical Services, Inc. (GSI) for the construction of the proposed development in Northbridge, Massachusetts. The objective of the geotechnical investigation was to explore subsurface conditions within the proposed development area and formulate geotechnical engineering recommendations for the design and construction of foundations, and floor slabs. Included are the findings of our subsurface exploration program and an engineering evaluation of the subsurface conditions encountered. The contents of this report are subject to the **Limitations** included in Appendix A.

PURPOSE AND SCOPE

The scope of services performed by GSI to meet the above-stated objectives for geotechnical engineering services included the following:

1. Coordination and observation of five (5) test borings and three (3) test pits at the locations illustrated on the attached Figure 2.

2. Evaluation of appropriate foundation systems based on subsurface conditions encountered. Formulation of design parameters for spread footing foundation and slab-on-grade construction, including allowable bearing pressure and prediction of long-term settlement values.

3. Formulation of earthwork and foundation construction procedures to be followed during the construction phase of this project.

4. Establishment of seismic design parameters and liquefaction potential based on the subsurface profile and the proposed structure.

5. Preparation of this geotechnical engineering report which summarizes our findings and recommendations.

SITE AND PROJECT INFORMATION

The project involves the construction of the proposed library addition on Church Street in Northbridge, Massachusetts. The geotechnical RFP describes the property and existing conditions as follows: "The Whitinsville Social Library ("WSL"), located at 17 Church Street, is the public library for the Town of Northbridge. The building and grounds are owned by the Town of Northbridge. The library is one of the properties included in the Whitinsville Downtown Crossroads Historic District and the National Register of Historic Places.

The building was originally built in 1913 and contains 15,556 gross sq ft and 11,625 sq ft of living area. It consists of a ground floor, first floor, and second floor. Its construction includes granite masonry. The property contains 0.65 acres according to the Town's Assessors Property Record Cards, including a parking lot with eight parking spots. The Library Trustees Corporation also owns three (3) adjacent properties; 24, 28 and 30 Cottage Street. 24 Cottage Street is a vacant lot, and the site is 0.26 acres. 28 Cottage Street contains a single-family cape residence of 1,590 sq ft, built in 1949, and the site is 0.16 acres. 30 Cottage Street contains a single-family ranch residence of 912 sq ft, built in 1940, and the site is 0.15 acres. The three properties were purchased with the intent of accommodating a future Library expansion as needed.

The proposed development consists of the construction of an addition to the existing Whitinsville Social Library building, to be located north of the existing building. The 18,722 square foot addition will directly abut the library and is located within an area currently utilized as paved parking and green space. Expanded parking will also be constructed north and northwest of the existing library. The residences north of the library adjacent to Cottage Street will be demolished to allow for the new parking facilities.

SUBSURFACE INVESTIGATION

Five (5) test borings designated GSI-1 through GSI-5 were advanced for the purpose of evaluating the geotechnical properties of the existing soils. The test borings were advanced in the vicinity of the proposed structure to depths of 17 to 24 feet below existing grade. The subsurface explorations classified the on-site soils according to their color, grain size, and other material properties. The test boring program was conducted by Geosearch, Inc. utilizing a track mounted drill rig.

Soil explorations were performed in accordance with methods prescribed by ASTM D1586. Soil samples were obtained at the surface and at two to five-foot intervals with a 1⅜ inch diameter split-spoon sampler. Standard Penetration Tests (SPTs) were performed at the sampling intervals in accordance with ASTM D1586. Field descriptions of the soils encountered, observed depth to groundwater while drilling when observed, and other pertinent observations are contained in the attached test boring logs. The test boring locations are illustrated on Figure 2 of this report. GSI test boring logs are presented in Appendix B. In addition to the test borings, a series of three (3) test pits were advanced by the Northbridge DPW utilizing a CAT backhoe in the vicinity of the proposed addition to verify the soil information obtained via the test boring program.

SUBSURFACE CONDITIONS

Surficial Materials

The test borings and test pits were advanced within both paved and green areas. At ground surface, up to 10 inches of topsoil and subsoil was observed within green areas and 3 to 3.5 inches of asphalt pavement in paved areas.

Fill

Fill was encountered at test pits TP-1 and TP-3. At TP-1, the fill consisted of 4 feet of dark brown, fine to medium Sand, some Silt, little Gravel with metal and metal piping. It is assumed this fill was placed during the installation of a wooden library sign in the vicinity. At test pit TP-3, up to 6 feet of loamy soils classified as dark brown, fine to medium Sand, some Silt, little Gravel were observed and assumed to be fill as subsurface utilities were present near this location.

Sand and Gravel

Sand and Gravel soil was encountered at all test boring and test pit locations, and was visually classified as loose to dense, light brown to olive brown, fine to medium or fine to coarse Sand, some Gravel, trace to little Silt. SPT "N" values of 7 to 30 blows per foot were observed. The Silty Sand and Gravel was present to test boring refusal and termination.

Refusal/Bedrock

Auger and/or split-spoon refusal was encountered at depths of 17 to 24 feet at test borings GSI-1 through GSI-5. Refusal is defined as the inability of roller bit to advance despite increasing torque and downward pressure applied by the drill rig. Refusal may be caused by nested cobbles, very dense soils, boulders, obstructions, or bedrock. Split spoon refusal is defined as either 100 blows or more required to drive the split spoon sampler 12 inches with a 140 lb. hammer falling 30 inches; 50 blows for less than 6 inches of advancement; or 10 blows with no discernable, vertical movement of the split spoon sampler. Based on the conditions observed at the site the refusals are likely the result of bedrock

GROUNDWATER

Groundwater was observed at depths of 8 to 10 feet during the subsurface investigation. Groundwater observations should not be considered long-term, equilibrated groundwater levels, but rather an approximate indication of the likely groundwater elevation during construction. Groundwater levels should be anticipated to fluctuate from those measured during drilling operations in response to differences in equilibrated time, rainfall, snowmelt, and seasonal changes.

FOUNDATION DESIGN RECOMMENDATIONS

GSI recommends that building walls, columns and other structural elements be supported by reinforced concrete spread or strip footings bearing directly upon the native soils described above. An allowable bearing pressure of 2 tons per square foot (4,000psf) may be assumed for design. Any asphalt, fill, or organic (topsoil & forest mat) soils encountered during subgrade excavation shall be removed within the foundation zone of influence extending at a 1 horizontal to 1 vertical angle from the outside edge of the proposed footing.

With regards to footing geometry, the minimum footing width of column and strip footings should be 4 feet and 2 feet, respectively. The spread footings should be founded at least 4 feet below exterior grade to obviate frost action in the bearing strata. If the construction occurs during the winter months, it will be necessary to provide temporary insulation and/or heat application to the foundations.

At the recommended bearing pressures, we anticipate that the total settlement of individual footings under static loading conditions and constructed as recommended herein, will not exceed 1 in., with differential settlements between adjacent footings not exceeding ¾ in. Most of the settlement will likely occur elastically during construction as structure dead loads are placed on the foundations. The live load contribution to foundation settlement is expected to be less than 50% of the dead load thus post construction settlements are not expected to be problematic.

ENGINEERING PARAMETERS OF ON-SITE SOILS

Based on results of our subsurface exploration program, the following engineering properties of soils that will be supporting foundation elements are estimated as follows:

TABLE ONE
SOIL ENGINEERING DESIGN PARAMETERS

Soil Type	Friction Angle φ, (degrees)	Cohesion c, (psf)	Unit Weight γ, (pcf)	Coeff. of Sliding Friction Soil to Concrete (tan δ)	Coeff. of Active Soil Pressure (Ka)	Coeff. of Passive Soil Pressure (Kp)
Sand and Gravel Or Structural Fill	32	0	125	0.40	0.31	3.25

FLEXIBLE PAVEMENT DESIGN

Recommendations for bituminous pavement sections for auto traffic and truck traffic are provided below based upon Massachusetts Highway Department standards. Heavy duty pavement is not expected to be utilized, but recommendations have been provided for use.

Standard-Duty Flexible Pavement:

Pavement: 3 in. thickness (1.25 in. wear course, 1.25 in. binder) M3.11.03
Base: 6 in. compacted thickness Borrow Base Course M1.03.0
Subbase: 6 in. compacted thickness Gravel Borrow Subbase M1.03.1

Heavy-duty Flexible Pavement:

Pavement: 3.5 in. thickness (1.5 in. wear course, 2.0 in. binder) M3.11.03
Base: 6 in. compacted thickness Borrow Base Course M1.03.0
Subbase: 8 in. compacted thickness Gravel Borrow Subbase M1.03.1

The above recommendations assume that the standard-duty flexible pavement design will be constructed in automobile parking areas. It is expected that most or all of the proposed pavement areas will utilize standard duty pavement, but it is up to the discretion of the civil engineer to determine the appropriate pavement type for each use condition.

Bituminous pavement should conform to the requirements of state Standard Specifications. The minimum pavement sections presented are based on our experience with the types of materials encountered and typical roadway traffic loadings for this type of development, assuming a 10-year design life. We recommend that local requirements be confirmed by the Project Site/Civil Engineer. The pavement recommendations also assume that a stable, firm subgrade is achieved beneath the base and subbase courses, and that the subgrades are prepared as recommended in this report.

Base and subbase materials should be placed and compacted in separate lifts to at least 95 percent of the maximum dry density as determined by ASTM D698. Procedures and equipment for compaction should be as recommended in this report for Compacted Structural Fill.

SEISMIC DESIGN PARAMETERS

The seismic design parameters have been reviewed with respect to the 10th Edition of the Massachusetts State Building Code, which is based on the 2021 edition of the International Building Code (IBC). Upon review of the subsurface soils data and considering information gathered from projects with similar subsurface profiles, the site is to be associated with Site Class "C", and the design of structural elements should reflect this distinction. The subsurface conditions are also not deemed susceptible to earthquake induced "liquefaction." A Summary of USGS Design Maps is included as Appendix D.

CONCRETE FLOOR SLAB

We recommend that ground floor slabs be designed as slabs-on-grade designed in accordance with ACI 360R-10. The slab should bear directly upon a 6-inch (minimum) layer of compacted Base Course Soil. The subgrade will consist of compacted structural fill or proof-compacted undisturbed soil. The floor slab may thus be designed following the ACI "elastic support" approach, using a modulus of subgrade reaction value, k = 250 pci. Fill beneath the slab shall be removed and replaced with compacted lifts of structural fill.

Slabs should be designed to act independently of foundation walls and column footings with isolation joints. Shrinkage cracking may be controlled with welded wire fabric, reinforcing steel, or contraction joints. Contraction joints in plain concrete should not be spaced a distance greater than 30 times the slab thickness. Saw cuts should be made within 12 hours of slab finishing and penetrate at least ¼ the slab thickness or a minimum of 1 inch. Welded wire fabric or reinforcing steel may also be used to widen the control joint spacing.

For moisture sensitive environments, ACI indicates that a subslab vapor retarder may be used beneath the concrete slab. The vapor retarder should be at a minimum; 10-mil polyethylene with joints lapped a minimum of 12 inches. It is emphasized that these are recommendations and that the final decision on the use and location of the subslab vapor retarder whether in direct contact with the slab or beneath the layer of compacted Structural Fill should be made considering specific conditions for the project. Factors which may affect this decision include moisture sensitivity of the planned floor finishes, anticipated moisture conditions, including precipitation and exposure before the slab is constructed, and the potential effects of slab curling and cracking. Design guidance is provided in ACI 360R-10, *Design of Slabs on Grade,* Figure 3-7.

LATERAL EARTH PRESSURE

GSI has been advised that below grade space may be incorporated into the proposed design. Lateral earth pressure recommendations are provided for design and construction of the basement walls which will support lateral soil pressures. These walls should be designed to resist lateral earth loads resulting from earth pressures, as well as those imparted by any surcharge loadings adjacent to the wall. A diagram of the effects of lateral earth pressures is provided as Figure 4.

Lateral earth forces are computed by the general formula $P = ½K\gamma H^2$.

Where: P = lateral earth force (pounds per linear foot of wall)
K = lateral earth pressure coefficient
γ = unit weight of soil (pounds per cubic foot)
H = height of wall (feet)

The lateral earth pressure coefficient is based on Rankine lateral earth pressure theory for the active (K_A), passive (K_P), and at-rest (K_0) conditions. The active condition exists when the top of the wall is free to deflect, reducing the lateral earth pressure. The at-rest condition exists when the wall is restrained from deflecting by lateral bracing such as a basement wall. The passive condition exists when the wall deflects against a soil, and the soil mass resists wall deflection. It is recommended to compute lateral earth pressures based on an equivalent fluid weight equal to $K\gamma$. The following equivalent fluid weights should be utilized for design: 40 pounds per cubic foot (pcf) equivalent fluid weight (efw) (active), 375 pcf efw (passive), 60 pcf efw (at-rest). Lateral pressures exerted from surcharge pressures such as traffic, floor loads, etc. should be applied as a uniform pressure equal in magnitude to 0.3q and 0.5q for the active and at-rest conditions respectively. These equivalent fluid pressures do not include hydrostatic forces, as it is presumed that drainage will be provided behind the wall. Lateral loads imposed from seismic ground acceleration should be computed as $0.045\gamma H^2$. Assuming a unit weight of 125 pcf, this translates to $6H^2$ psf. The lateral seismic load should be applied as an inverted triangle over the height of the wall.

Foundation and Lower-Level Floor Drainage

If below grade space is included, we recommend that permanent foundation drainage be provided to collect and drain any infiltrating surface or seepage water which might otherwise become trapped against below-grade walls and seep into the building or exert hydro-static pressures on the walls. We recommend that drainage be provided at all below-grade foundation walls where the adjacent floor slab is 2-ft or deeper below adjacent exterior finished grade. Such systems should be provided at exterior walls.

The foundation drainage should consist of a free-draining soil and a footing drain at the wall base to collect and transmit the water. Alternatively, a prefabricated drainage board product, such as Amerdrain 200 by the American Wick Drain Company (AWDC), may be applied to the exterior walls. The drainage board should connect at its base to a “high-profile sheet drain section” (such as Amerdrain Total-Drain System by AWDC) or to a 6-in. diameter perforated PVC or corrugated HDPE foundation drain.

Foundation drains should be completely surrounded by 6-inches of pea-stone meeting ASTM C-33 #67, which in turn is completely surrounded by a non-woven filter fabric to avoid potential clogging due to migration of fine soils into the drainage system. The peastone should be placed in contact with the drainage board against the wall in accordance with manufacturer’s recommendations.

Underslab drains should also be considered to prevent buildup of groundwater beneath the floor slab. Underslab and site utilities may be soil-supported, bearing on undisturbed, naturally deposited soils or on compacted fill placed following the removal of any unsuitable bearing materials (including topsoil, fill, organics, etc.). The underslab drain system shall be designed and spaced using not less than 4-inch diameter perforated laterals and 4 or 6-inch perforated mains as required, with filter fabric and positive slope (typically 0.5%). A backflow preventer is recommended at the system discharge point.

Subsurface drainage will be improved by the placement of the slab base course beneath the concrete slab on grade. Underslab utilities should be located above foundation bearing levels or outside the zone of influence below footings. Along with the measures noted above, the ground surface immediately adjacent to the foundation should be sloped away from the building to allow for positive drainage. It is recommended that the surficial materials adjacent to the building be relatively impermeable to reduce the volume of precipitation infiltrating into the subsurface. Such impermeable materials may include Portland cement concrete, bituminous concrete or vegetated silty topsoil.

EARTHWORK RECOMMENDATIONS

Foundation Subgrade Preparation

Prior to foundation construction, any topsoil, subsoil, or loose soils encountered should be removed. Foundation and floor slab subgrades should be proof compacted using a heavy vibratory plate or drum roller, as described below, prior to foundation construction or placing additional fill to densify disturbed soils resulting from excavation and preload the subgrade.

Recommended proof compaction should include 4 coverages (2 in each orthogonal direction) with a minimum of a 10-ton vibratory roller. During the proof rolling process, the subgrade should be observed by a qualified Geotechnical Engineer to identify areas exhibiting weaving or excessive reaction. Any soils exhibiting excessive reaction should be locally excavated and replaced with free-draining structural fill or 1-1/2-inch crushed stone.

Protection of Foundation Subgrades

The contractor should be required to maintain stable, dewatered subgrades for foundations, pavement areas, and utility trenches. Subgrades may be disturbed by improper excavation methods, moisture, precipitation, groundwater control, and construction activities. The contractor should take precautions to protect the bearing subgrade against disturbance from construction traffic and weathering. If necessary, dewatering can be accomplished via open pumping utilizing submersible pumps and temporary stone lined sump pits.

A lift of compacted crushed stone may be utilized to protect the subgrade surface from wear and disturbance should water be present within the excavation. The subgrade must still be verified for competency prior to the placement of concrete or backfill materials within the building footprint. If construction activities are to take place during winter months, the contractor should protect the work area from freezing, which may necessitate the use of soil blankets or tents and heaters to protect the subgrade surface.

Construction Dewatering

Based on the subsurface investigation, extensive subsurface dewatering is not expected for the construction of foundations and slabs. The site contractor should be prepared to remove any standing water from foundation excavations. If the sumps are unable to control the development of groundwater within the excavation, supplemental dewatering in the form of deep wells or wellpoints may be required. Stormwater runoff developed from storm events should be diverted away from excavation areas to minimize any impoundment in the excavation or disturbance to the foundation subgrades. It is anticipated that groundwater and stormwater may be controlled by localized dewatering efforts employing sumps and pumps.

The groundwater elevation should be maintained at least 12 inches below the foundation grade until backfilling is complete. A lift of crushed stone or free draining structural fill at foundation grade may be utilized to facilitate dewatering and provide a dry and stable subgrade during construction.

Backfilling

Backfill in the building area should be placed and compacted in lifts immediately after final excavation to limit disturbance to the subgrade surface. Except for zones requiring special backfill such as directly beneath pavements or exterior slabs, the exterior of foundation walls and other site areas may be backfilled with Common Fill.

Placement of compacted fills should proceed with caution when air temperatures are low enough (approximately 30°F, or below) to cause freezing of the moisture in the fill during or before placement. Fill materials should not be placed on snow, ice or uncompacted frozen soil. Compacted fill should not be placed on frozen soil.

No fill should be allowed to freeze prior to compaction. At the end of each day's operations, the last lift of fill, after compaction, should be rolled by a smooth-wheeled roller to eliminate ridges of uncompacted soil.

Minimum compaction requirements for all fill materials are as follows:

TABLE TWO
MINIMUM COMPACTION REQUIREMENTS

Location or Area	Standard Proctor Density ASTM698	Modified Proctor Density ASTM D1557	Testing Frequency One Test Per Lift Per
Structures and Walkways	95%	92%	2,000 ft^2
Retaining Walls	95%	92%	1,000 ft^2
Trenches	95%	92%	150 lineal feet
Lawns and Unimproved Areas	92%	90%	20,000 ft^2
Pavement Areas	95%	92%	1,000 ft^2
Building Subgrades	100%	95%	1,000 ft^2

Structural Fill

Structural Fill should consist of clean sand and gravel free of organic material, snow, ice, or other objectionable materials and should be well-graded within the following limits:

Sieve Size	Percent Finer by Weight
6 in.	100
No. 4	30-70
No. 40	10-50
No. 200	0-10

Structural Fill should be placed in lift thickness not exceeding 12 in. loose measure. Cobbles and boulders having a size exceeding two-thirds of the loose lift thickness should be removed prior to compaction. Compaction in open areas should consist of self-propelled vibratory rollers such as a BoMag BW-60S or equivalent. In confined areas, hand guided equipment such as a large vibratory plate compactor should be used, and the loose lift thickness should not exceed 6 in. A minimum of four systematic passes of the compaction equipment should be used to compact each lift. Compaction effort should be verified by field density testing.

Common Fill

Common fill may be used to raise grades in paved and landscaped areas, subject to pavement design criteria and landscape planting or drainage requirements. Common fill should be granular mineral soil free from organic materials, loam, wood, trash, snow, ice, frozen soil, and other compressible materials. Common fill should not contain stones larger than two-thirds of the placement lift thickness, and have a maximum 80 percent passing the No. 40 sieve, and a maximum of 30 percent passing the No. 200 sieve. These soils typically would require moisture control during placement and compaction.

Slab Base Course

Slab Base Course beneath building slabs should consist of bank-run sand and gravel, free of organic material, snow, ice, or other unsuitable materials and should be well-graded within the following limits:

Sieve Size	Percent Finer by Weight
2 in.	100
No. 4	40-70
No. 40	25-45
No. 200	0-10

Other materials could be acceptable for compacted Slab Base Course and should be evaluated by the Geotechnical Engineer on a case-by-case basis if proposed by the Contractor.

The Slab Base Course should be placed in lift thickness not exceeding 8-inches loose measure. In confined areas, hand-guided equipment such as a vibratory plate compactor should be used, and the loose lift thickness should not exceed six inches. A minimum of four systematic passes of the compaction equipment should be used to compact each lift.

CONSTRUCTION MONITORING

It is strongly recommended that GSI be retained to provide construction monitoring and testing services in conformance with the requirements of the IBC. GSI has the Geotechnical Engineering staff and Technicians trained and experienced in all facets of monitoring earthwork excavation and construction materials testing, as well as a full-service soils and materials laboratory.

These services may include:

- Construction Materials Testing of Soils, Aggregates, Concrete, Steel, and Asphalt.
- Design Phase engineering services include preparation of final earthwork specifications, review of contractor submittals, and plan review.
- Construction Phase engineering services on Geotechnical issues and/or differing conditions encountered during construction.

CLOSURE

We trust that you find this report consistent with your needs. Should you have any questions with regard to this report, please do not hesitate to contact our office.

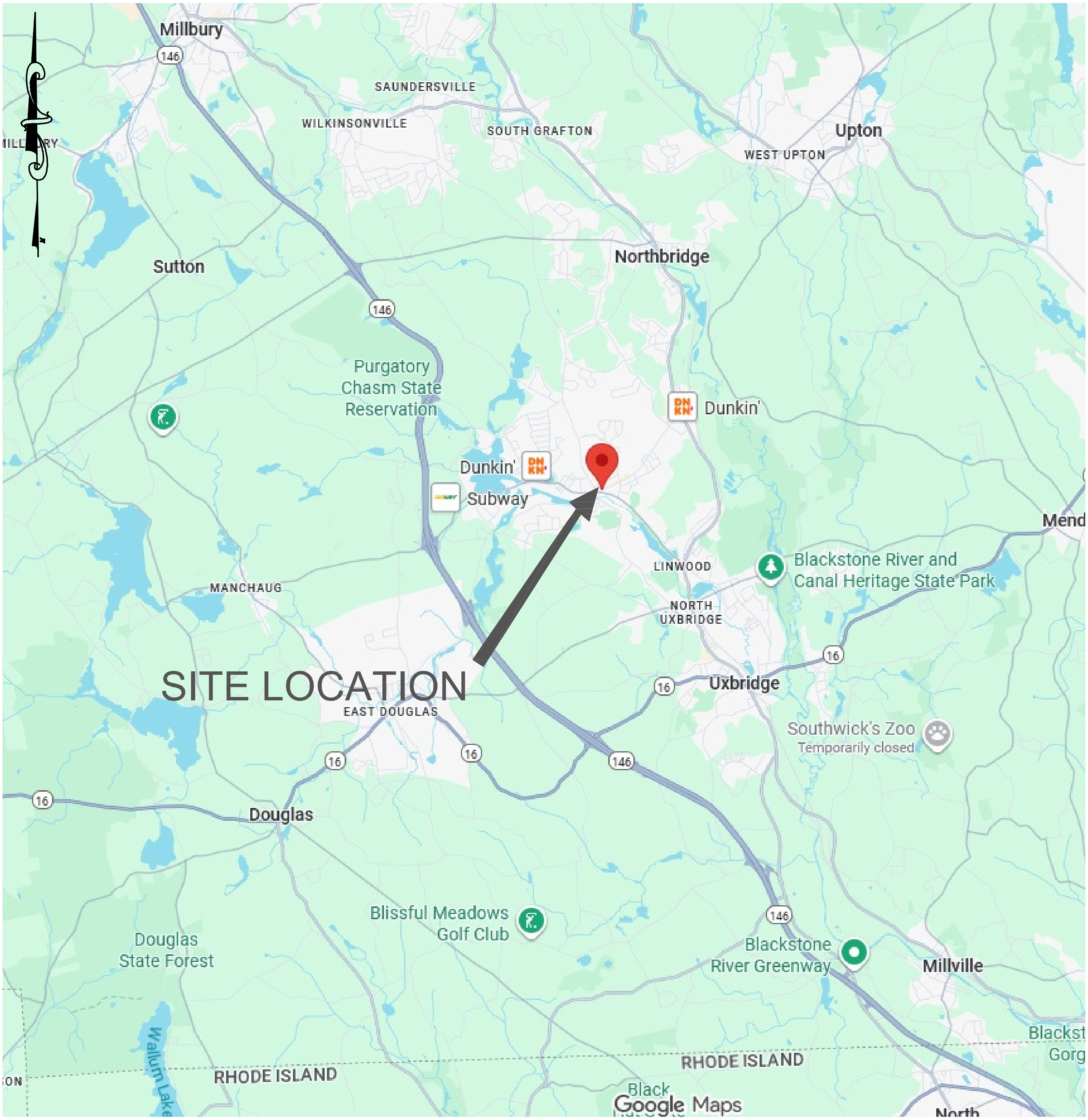
Very truly yours,

GEOTECHNICAL SERVICES, INC.

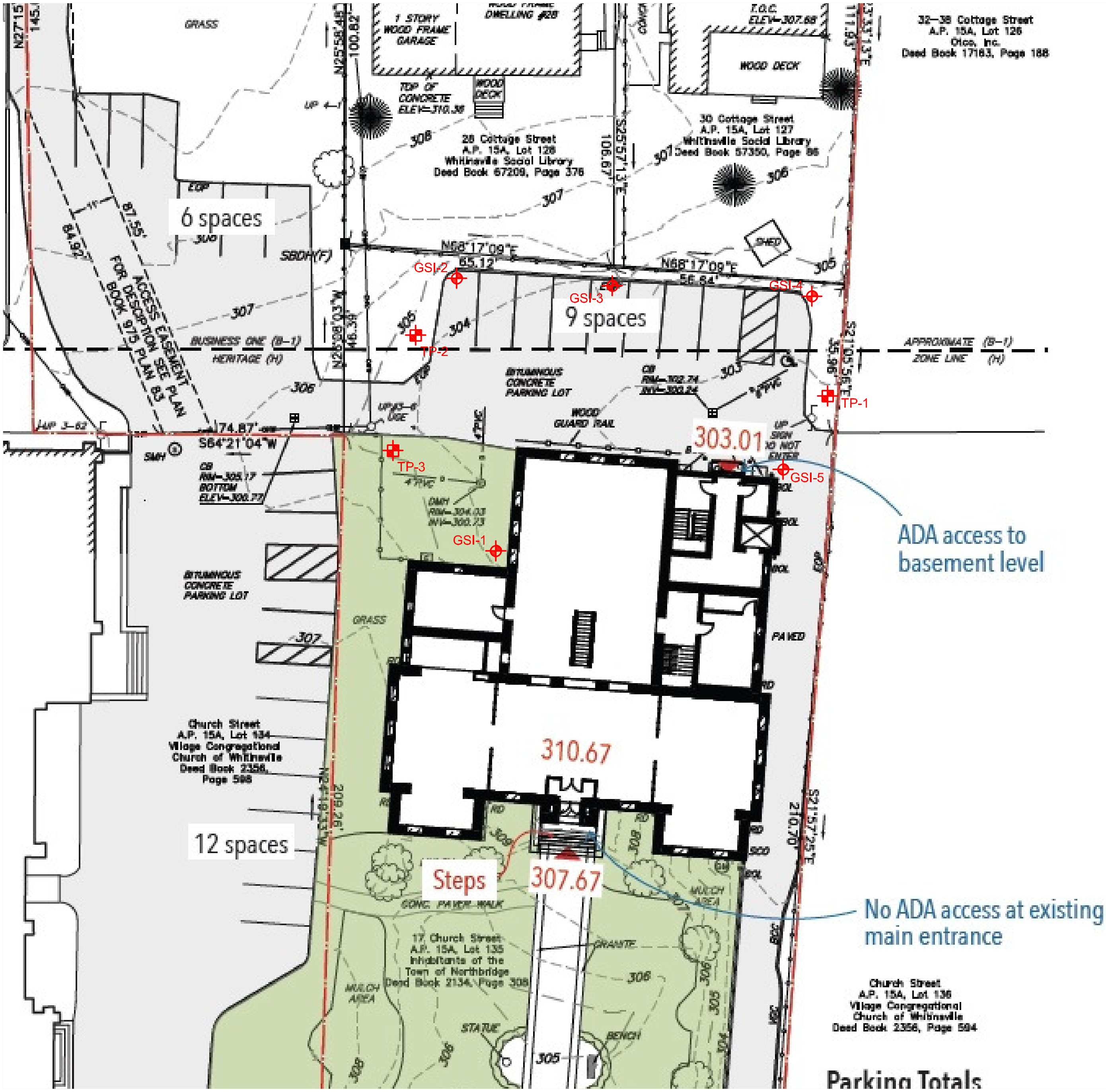
Harry K. Wetherbee, P.E.
Principal Engineer

Attachments:
Figure 1: Locus Plan
Figure 2: Exploration Location Plan
Figure 3: Foundation Zone of Influence

Appendix A: Limitations
Appendix B: Exploration Logs
Appendix C: Subsurface Exploration Key
Appendix D: USGS Seismic Design Maps



LOCUS MAP	GEOTECHNICAL SERVICES INC. 55 NORTH STARK HIGHWAY, WEARE, NH 03281 TEL. (603) 529-7766 FAX. (603) 529-7780		
Whitinsville Social Library Northbridge, Massachusetts	DRAWN BY: KJM	DATE: November 2025	FIGURE NO. 1
	CHECKED BY: HKW	SCALE: NTS	
	FILE NAME: Whitinsville Library.dwg	PROJECT NO.: 225294	



GSI-1 GSI Test Boring Location (Approximate)

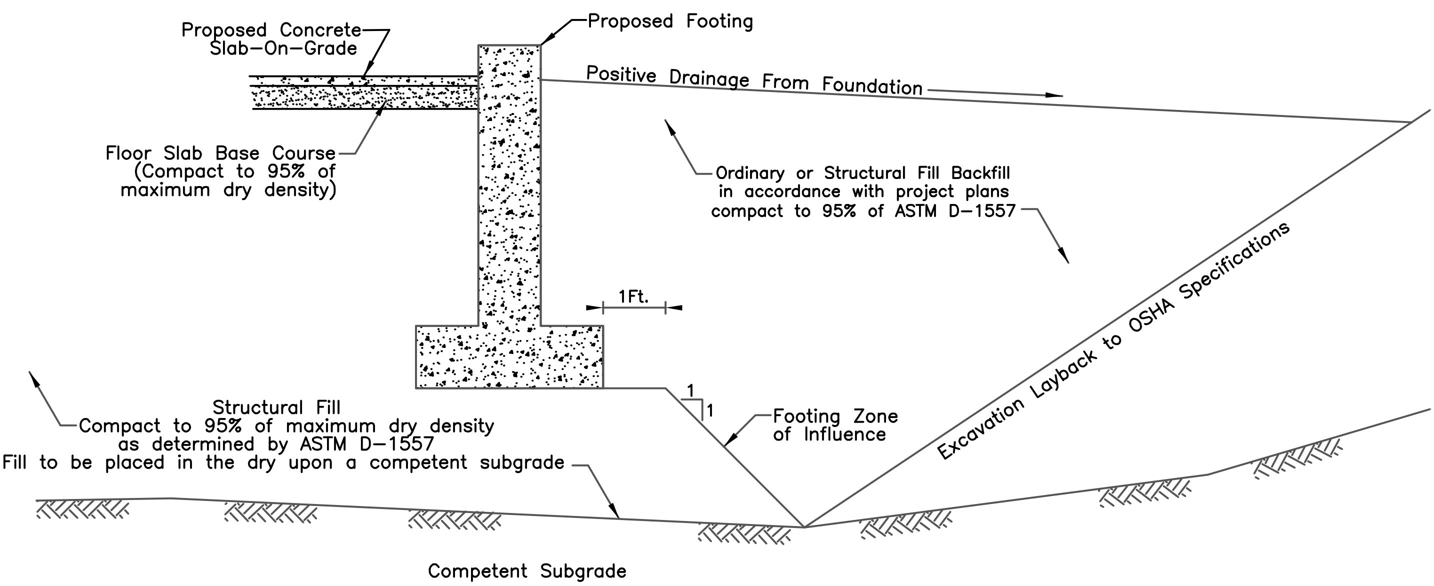
TP-1 Test Pit Location (Approximate)

EXPLORATION LOCATION PLAN

GEOTECHNICAL SERVICES INC.
55 NORTH STARK HIGHWAY, WEARE, NH 03281
TEL. (603) 529-7766 FAX. (603) 529-7780

Whitinsville Social Library
Northbridge, Massachusetts

DRAWN BY: KJM	DATE: November 2025	FIGURE NO. 2
CHECKED BY: HKW	SCALE: NTS	
FILE NAME: Whitinsville Library.dwg	PROJECT NO.: 225294	

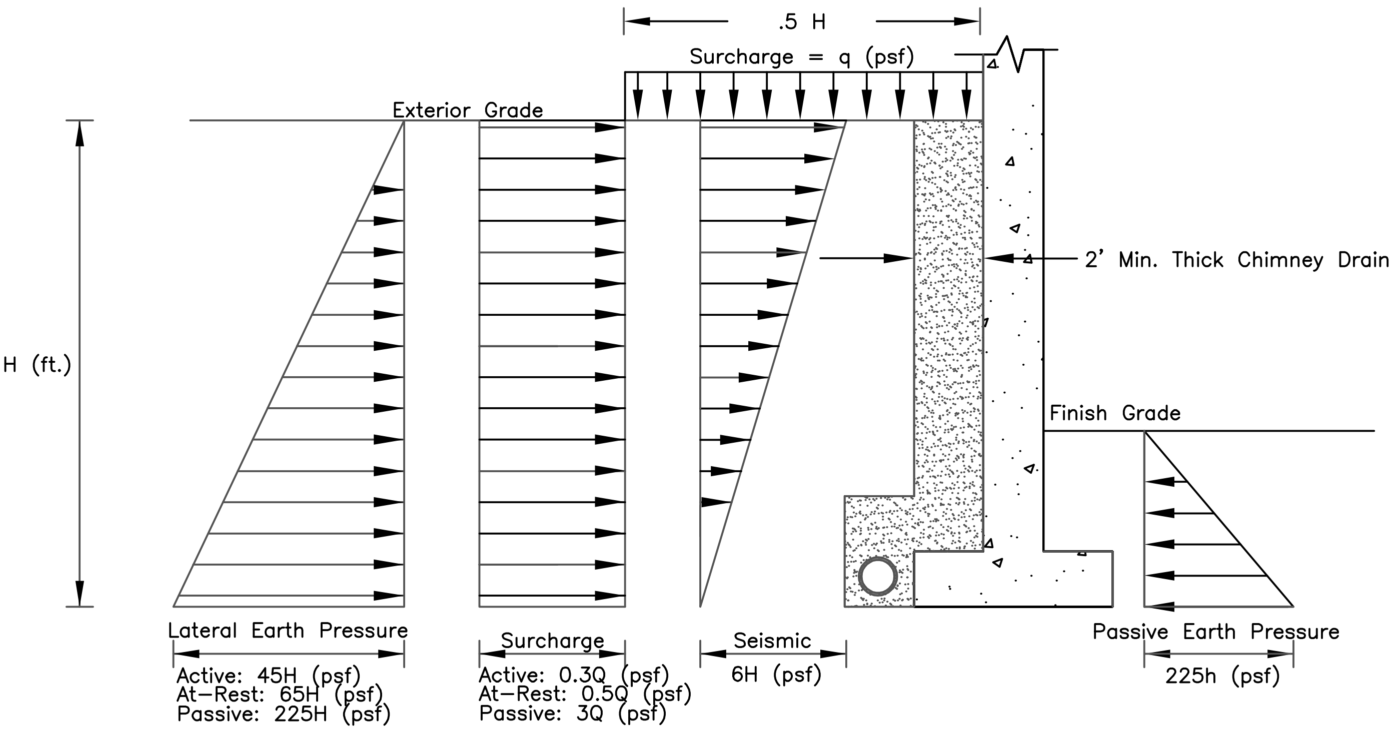


FOUNDATION ZONE OF INFLUENCE

GEOTECHNICAL SERVICES INC.
55 NORTH STARK HIGHWAY, WEARE, NH 03281
TEL. (603) 529-7766 FAX. (603) 529-7780

Whitinsville Social Library
Northbridge, Massachusetts

DRAWN BY: KJM	DATE: November 2025	FIGURE NO. 3
CHECKED BY: HKW	SCALE: NTS	
FILE NAME: Whitinsville Library.dwg	PROJECT NO.: 225294	



Note:

1. Lateral earth pressure diagram is based on no permanent hydrostatic pressures (i.e. groundwater) behind the wall and construction of a subdrainage system behind the wall, as shown hereon, to relieve hydrostatic pressures.

2. Refer to the project geotechnical report for additional information.

LATERAL EARTH PRESSURES

GEOTECHNICAL SERVICES INC.
55 NORTH STARK HIGHWAY, WEARE, NH 03281
TEL. (603) 529-7766 FAX. (603) 529-7780

Whitinsville Social Library
Northbridge, Massachusetts

DRAWN BY: KJM	DATE: November 2025	FIGURE NO. 4
CHECKED BY: HKW	SCALE: NTS	
FILE NAME: Whitinsville Library.dwg	PROJECT NO.: 225294	

APPENDIX A

LIMITATIONS

LIMITATIONS

Explorations

1. The analyses, recommendations, and designs submitted in this report are based in part upon the data obtained from preliminary 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 individual test pit and/or boring logs.

3. Water level readings have been made in the test pits and/or test borings under conditions stated on the 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 the measurements were made.

Review

4. It is recommended that this firm be given the opportunity to review final design drawings and specifications to evaluate the appropriate implementation of the recommendations provided herein.

5. In the event that any changes in the nature, design, or location of the proposed areas 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 Geotechnical Services, Inc.

Construction

6. It is recommended that this firm be retained to provide geotechnical engineering services during the earthwork phases of the work. This is to observe compliance with the design concepts, specifications, and 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

7. This report has been prepared for the exclusive use of the above and their assigns, in accordance with generally accepted soil and foundation engineering practices. No other warranty, expressed or implied, is made.

8. This report has been prepared for this project by Geotechnical Services, Inc. This report was completed for preliminary design purposes and may be limited in its scope to complete an accurate bid. Contractors wishing a copy of the report may secure it with the understanding that its scope is limited to evaluation considerations only.

APPENDIX B

EXPLORATION LOGS

Geotechnical Services, Inc. 55 North Stark Highway, Weare, NH 03281 Phone 603/529-7766 Fax 603/5297080 - 30 Newbury St. 3rd Floor, Boston, MA 02116 Phone 617/455-4248 Fax 617/745-4308

TEST BORING LOG

Boring No. GSI-1

Project	Whitinsville Social Library	GSI Project No.	225294	Elevation	304' +/-
Location	Northbridge, Massachusetts	Project Mgr.	HKW	Datum	-
Client	LeftField Project Management	Inspector	KJM	Date Started	11/10/2025
Contractor	Geosearch	Checked By	HKW	Date Finished	11/10/2025
Driller	Rodney Smith	Rig Make & Model	CME	Rig Model	53

Item:	Auger	Casing	Sampler	Core Barrel
Type	H.S.A.		SS	
Inside Diameter (in.)	4-1/4"		1-3/8"	
Hammer Weight (lb)			140	
Hammer Fall (in.)			30"	

☑ Truck ☐ Skid ☐ Track ☐ ATV ☐ Bomb. ☐ Geoprobe ☐ Tripod ☐ Other

Hammer Type: ☐ Safety Hammer ☑ Doughnut ☐ Automatic

☑ Winch ☐ Cat Head ☐ Roller Bit ☑ Cutting Head

Depth (ft)	Casing (Blows/ft)	No.	Depth (ft)	Rec (in.)	SPT (Bl./ 6-in.)	"N" Value	PID Rdg. (ppm)	Stratum Change (ft)	Soil-Rock Visual Classification and Description (Soils - Burmister System) (Rock - U.S. Corps of Engineers System)
0		S-1	0-2	12	2 2 3 3	5		3'	0-6" Topsoil/Subsoil 6"-2' Loose, dark brown, fine to medium Sand, some Silt, trace Gravel, roots
5		S-2	5-7	9	7 16 14 12	30			Dense, light brown, fine to medium Sand, some Gravel, trace to little Silt
10		S-3	10-12	11	16 12 11 10	22			Medium dense, light brown, fine to coarse Sand, and Gravel, trace to little Silt
15		S-4	15-17	16	5 6 9 8	15			Medium dense, light to olive brown, fine to medium Sand, little Silt, trace to little Gravel Auger refusal at 19'-2" Test boring terminated at 19'-2"
20									

Water Level Data

Date	Time	Depth (ft) to: Bott. of Casing	Bott. of Hole	Water
11/10	E.O.D	-	19'-2"	8'-4"

Sample Identification	Cohesive Soils N-Value	Granular Soils N- Value
O = Open Ended Rod	0 to 2: Very Soft	0 to 4: Very Loose
U = Undisturbed Sampl	2 to 4: Soft	4 to 10: Loose
S = Split Spoon	4 to 8: Medium Stiff	11 to 30: Medium Dense
C = Rock Core	8 to 15: Stiff	31 to 50: Dense
G = Geoprobe	15 to 30 Very Stiff	Over 50: Very Dense
	Over 30: Hard	

Trace (0 to 10%), Little (10 to 20%), Some (20 to 35%), And (35 to 50%)

Notes: Test boring elevation data was determined via online references

GSI-1

Geotechnical Services, Inc. 55 North Stark Highway, Weare, NH 03281 Phone 603/529-7766 Fax 603/5297080 - 30 Newbury St. 3rd Floor, Boston, MA 02116 Phone 617/455-4248 Fax 617/745-4308

TEST BORING LOG

Boring No. **GSI-2**

Project	Whitinsville Social Library	GSI Project No.	225294	Elevation	306' +/-
Location	Northbridge, Massachusetts	Project Mgr.	HKW	Datum	-
Client	LeftField Project Management	Inspector	KJM	Date Started	11/10/2025
Contractor	Geosearch	Checked By	HKW	Date Finished	11/10/2025
Driller	Rodney Smith	Rig Make & Model	CME	Rig Model	53

Item:	Auger	Casing	Sampler	Core Barrel
Type	H.S.A.		SS	
Inside Diameter (in.)	4-1/4"		1-3/8"	
Hammer Weight (lb)			140	
Hammer Fall (in.)			30"	

- [x] Truck
- [ ] Skid
- [ ] Track
- [ ] ATV
- [ ] Bomb.
- [ ] Geoprobe
- [ ] Tripod
- [ ] Other
- [x] Winch
- [ ] Cat Head
- [ ] Roller Bit
- [x] Cutting Head

Hammer Type:
- [ ] Safety Hammer
- [x] Doughnut
- [ ] Automatic

Depth (ft)	Casing (Blows/ft)	Sample Data: No.	Depth (ft)	Rec (in.)	SPT (Bl./ 6-in.)	"N" Value	PID Rdg. (ppm)	Stratum Change (ft)	Soil-Rock Visual Classification and Description (Soils - Burmister System) (Rock - U.S. Corps of Engineers System)
0		S-1	0-2	15	6 5 6 9	11		8"	0-8" Topsoil/Subsoil Medium dense, light brown, fine to medium Sand, some Gravel, trace Silt
5		S-2	5-7	17	7 11 8 8	19			Medium dense, light brown, fine to coarse Sand, some Gravel, trace Silt
10		S-3	10-12	15	10 14 15 11	29			Medium dense, light brown, fine to medium Sand, some Gravel, little Silt
15		S-4	15-17	12	6 6 15 54	21			Medium dense, olive brown, fine to medium Sand, little Silt, little Gravel Auger refusal at 17'-6" Test boring terminated at 17'-6"
20									

Water Level Data

Date	Time	Depth (ft) to: Bott. of Casing	Bott. of Hole	Water
11/10	E.O.D	-	17'-6"	8'-6"

Sample Identification
- O = Open Ended Rod
- U = Undisturbed Sampl
- S = Split Spoon
- C = Rock Core
- G = Geoprobe

Cohesive Soils N-Value
- 0 to 2: Very Soft
- 2 to 4: Soft
- 4 to 8: Medium Stiff
- 8 to 15: Stiff
- 15 to 30 Very Stiff
- Over 30: Hard

Granular Soils N- Value
- 0 to 4: Very Loose
- 4 to 10: Loose
- 11 to 30: Medium Dense
- 31 to 50: Dense
- Over 50: Very Dense

Trace (0 to 10%), Little (10 to 20%), Some (20 to 35%), And (35 to 50%)

Notes: Test boring elevation data was determined via online references

GSI-2

Geotechnical Services, Inc. 55 North Stark Highway, Weare, NH 03281 Phone 603/529-7766 Fax 603/5297080 - 30 Newbury St. 3rd Floor, Boston, MA 02116 Phone 617/455-4248 Fax 617/745-4308

GSI

TEST BORING LOG

Boring No. **GSI-3**

Project	Whitinsville Social Library	GSI Project No.	225294	Elevation	304' +/-
Location	Northbridge, Massachusetts	Project Mgr.	HKW	Datum	-
Client	LeftField Project Management	Inspector	KJM	Date Started	11/10/2025
Contractor	Geosearch	Checked By	HKW	Date Finished	11/10/2025
Driller	Rodney Smith	Rig Make & Model	CME	Rig Model	53

Item:	Auger	Casing	Sampler	Core Barrel
Type	H.S.A.		SS	
Inside Diameter (in.)	4-1/4"		1-3/8"	
Hammer Weight (lb)			140	
Hammer Fall (in.)			30"	

- [x] Truck
- [ ] Skid
- [ ] Track
- [ ] ATV
- [ ] Bomb.
- [ ] Geoprobe
- [ ] Tripod
- [ ] Other
- [x] Winch
- [ ] Cat Head
- [ ] Roller Bit
- [x] Cutting Head

Hammer Type:
- [ ] Safety Hammer
- [x] Doughnut
- [ ] Automatic

Depth (ft)	Casing (Blows/ft)	No.	Depth (ft)	Rec (in.)	SPT (Bl./ 6-in.)	"N" Value	PID Rdg. (ppm)	Stratum Change (ft)	Soil-Rock Visual Classification and Description (Soils - Burmister System) (Rock - U.S. Corps of Engineers System)
0		S-1	0-2	12	21 14 18 14	32			3" Asphalt pavement Dense, light brown, fine to medium Sand, some Gravel, little Silt
5		S-2	5-7	14	6 8 7 6	15			Medium dense, light brown, fine to medium Sand, and Gravel, trace Silt
10		S-3	10-12	10	4 4 4 3	8			Loose, light brown, fine to medium Sand, some Gravel, little Silt
15		S-4	15-17	12	6 12 14 25	26			Medium dense, light brown to olive brown, fine to medium Sand, some Gravel, little Silt Auger refusal at 18'-3" Test boring terminated at 18'-3"
20									

Water Level Data

Date	Time	Depth (ft) to: Bott. of Casing	Bott. of Hole	Water
11/10	E.O.D	-	18'-3"	9'-0"

Sample Identification
- O = Open Ended Rod
- U = Undisturbed Sampl
- S = Split Spoon
- C = Rock Core
- G = Geoprobe

Cohesive Soils N-Value
- 0 to 2: Very Soft
- 2 to 4: Soft
- 4 to 8: Medium Stiff
- 8 to 15: Stiff
- 15 to 30 Very Stiff
- Over 30: Hard

Granular Soils N- Value
- 0 to 4: Very Loose
- 4 to 10: Loose
- 11 to 30: Medium Dense
- 31 to 50: Dense
- Over 50: Very Dense

Trace (0 to 10%), Little (10 to 20%), Some (20 to 35%), And (35 to 50%)

Notes: Test boring elevation data was determined via online references

GSI-3

Geotechnical Services, Inc. 55 North Stark Highway, Weare, NH 03281 Phone 603/529-7766 Fax 603/5297080 - 30 Newbury St. 3rd Floor, Boston, MA 02116 Phone 617/455-4248 Fax 617/745-4308

TEST BORING LOG

Boring No. GSI-4

Project	Whitinsville Social Library	GSI Project No.	225294	Elevation	305' +/-
Location	Northbridge, Massachusetts	Project Mgr.	HKW	Datum	-
Client	LeftField Project Management	Inspector	KJM	Date Started	11/10/2025
Contractor	Geosearch	Checked By	HKW	Date Finished	11/10/2025
Driller	Rodney Smith	Rig Make & Model	CME	Rig Model	53

Item:	Auger	Casing	Sampler	Core Barrel
Type	H.S.A.		SS	
Inside Diameter (in.)	4-1/4"		1-3/8"	
Hammer Weight (lb)			140	
Hammer Fall (in.)			30"	

☑ Truck ☐ Skid ☐ Track ☐ ATV ☐ Bomb. ☐ Geoprobe ☐ Tripod ☐ Other

Hammer Type: ☐ Safety Hammer ☑ Doughnut ☐ Automatic

☑ Winch ☐ Cat Head ☐ Roller Bit ☑ Cutting Head

Depth (ft)	Casing (Blows/ft)	Sample No.	Depth (ft)	Rec (in.)	SPT (Bl./6-in.)	"N" Value	PID Rdg. (ppm)	Stratum Change (ft)	Soil-Rock Visual Classification and Description (Soils - Burmister System) (Rock - U.S. Corps of Engineers System)
0		S-1	0-2	8	22 11 7 4	18			3" Asphalt pavement Medium dense, light brown, fine to medium Sand, some Gravel, trace to little Silt
5		S-2	5-7	14	4 6 8 8	14			Medium dense, light brown, fine to medium Sand, and Gravel, little Silt
10		S-3	10-12	12	7 12 15 27	27			Medium dense, light brown, fine to medium Sand, and Gravel, trace to little Silt
15		S-4	15-17	10	8 9 10 10	19			Medium dense, light brown, fine to coarse Sand, and Gravel, trace to little Silt
20		S-5	20-22	9	11 12 18 28	30			Dense, light gray, fine to coarse Sand, and Gravel, trace to little Silt Auger refusal at 23'-6" Test boring terminated at 23'-6"

Water Level Data

Date	Time	Depth (ft) to: Bott. of Casing	Bott. of Hole	Water
11/10	E.O.D	-	23'-6"	9'-4"

Sample Identification
O = Open Ended Rod
U = Undisturbed Sampl
S = Split Spoon
C = Rock Core
G = Geoprobe

Cohesive Soils N-Value
0 to 2: Very Soft
2 to 4: Soft
4 to 8: Medium Stiff
8 to 15: Stiff
15 to 30 Very Stiff
Over 30: Hard

Granular Soils N- Value
0 to 4: Very Loose
4 to 10: Loose
11 to 30: Medium Dense
31 to 50: Dense
Over 50: Very Dense

Trace (0 to 10%), Little (10 to 20%), Some (20 to 35%), And (35 to 50%)

Notes: Test boring elevation data was determined via online references

GSI-4

TEST BORING LOG

Boring No. GSI-5

Page 1 of 1

Project	Whitinsville Social Library	GSI Project No.	225294	Elevation	302' +/-
Location	Northbridge, Massachusetts	Project Mgr.	HKW	Datum	-
Client	LeftField Project Management	Inspector	KJM	Date Started	11/10/2025
Contractor	Geosearch	Checked By	HKW	Date Finished	11/10/2025
Driller	Rodney Smith	Rig Make & Model	CME	Rig Model	53

Item:	Auger	Casing	Sampler	Core Barrel
Type	H.S.A.		SS	
Inside Diameter (in.)	4-1/4"		1-3/8"	
Hammer Weight (lb)			140	
Hammer Fall (in.)			30"	

☑ Truck ☐ Skid ☐ Track ☐ ATV ☐ Bomb. ☐ Geoprobe ☐ Tripod ☐ Other

Hammer Type: ☐ Safety Hammer ☑ Doughnut ☐ Automatic

☑ Winch ☐ Cat Head ☐ Roller Bit ☑ Cutting Head

Depth (ft)	Casing (Blows/ft)	No.	Depth (ft)	Rec (in.)	SPT (Bl./ 6-in.)	"N" Value	PID Rdg. (ppm)	Stratum Change (ft)	Soil-Rock Visual Classification and Description (Soils - Burmister System) (Rock - U.S. Corps of Engineers System)
0		S-1	0-2	10	34 8 5 5	13			3" Asphalt pavement Medium dense, light brown, fine to medium Sand, some Gravel, little Silt
5		S-2	5-7	20	2 2 5 4	7			Loose, light brown, fine to medium Sand, and Silt
10		S-3	10-12	12	9 12 14 15	26			Medium dense, light brown, fine to medium Sand, and Gravel, little Silt
15		S-4	15-17	9	9 10 10 12	20			Medium dense, light brown, fine to medium Sand, some Gravel, trace to little Silt
20		S-5	20-22	11	5 7 6 9	13			Medium dense, light brown, fine to medium Sand, and Gravel, trace to little Silt Auger refusal at 24'-2" Test boring terminated at 24'-2"

Water Level Data

Date	Time	Depth (ft) to: Bott. of Casing	Bott. of Hole	Water
11/10	E.O.D	-	24'-2"	9'-8"

Sample Identification
- O = Open Ended Rod
- U = Undisturbed Sampl
- S = Split Spoon
- C = Rock Core
- G = Geoprobe

Cohesive Soils N-Value
- 0 to 2: Very Soft
- 2 to 4: Soft
- 4 to 8: Medium Stiff
- 8 to 15: Stiff
- 15 to 30 Very Stiff
- Over 30: Hard

Granular Soils N- Value
- 0 to 4: Very Loose
- 4 to 10: Loose
- 11 to 30: Medium Dense
- 31 to 50: Dense
- Over 50: Very Dense

Trace (0 to 10%), Little (10 to 20%), Some (20 to 35%), And (35 to 50%)

Notes: Test boring elevation data was determined via online references

GSI-5

Geotechnical Services, Inc. 55 North Stark Highway, Weare, NH 03281 Phone 603/529-7766 Fax 603/5297080 - 30 Newbury St. 3rd Floor, Boston, MA 02116 Phone 617/455-4248 Fax 617/745-4308

TEST PIT FIELD LOG

Test Pit

TP-1

Project	Whitinsville S. Library	**GSI Project No.**	225294	**Date Started**	11/10/2025
Location	Northbridge, MA	**Project Mgr.**	HKW	**Time Started**	-
Client	LeftField	**Inspector**	KJM	**Time Finished**	-
Contractor	Northbridge DPW	**Checked By**	HKW	**Elevation**	305' +/-
Operator	Northbridge DPW	**Equipment Used**	CAT Backhoe	**Groundwater**	N/E
Test Pit Location	See Figure 2				
Approx. Dimensions:	Length: 6 ft.	Width: 4 ft.	Depth: 8 ft.		
GPS Coordinates:	Lat.	Long:			

Depth	Soil Description	Excav. Effort	Boulder Class
0-6"	Topsoil/subsoil	E	None
6"-4'	Dark brown, fine to medium Sand, some Silt, little Gravel, metal (fill)	M	A
4'-8'+	Light brown, fine to coarse Sand, some Gravel, trace to little Silt	M	A

Test Pit Photograph

Excavation Effort: E: Easy
M: Moderate
D: Difficult

Boulder Count: (Classification / Designation)
6"-18" - A
18"-36" - B
Larger than 36" - C

TP-1

Geotechnical Services, Inc. 55 North Stark Highway, Weare, NH Phone 603/529-7766 Fax 603/5297080 - 30 Newbury St. , Boston, MA Phone 617/455-4248 Fax 617/745-4308

Geotechnical Services, Inc. 55 North Stark Highway, Weare, NH Phone 603/529-7766 Fax 603/5297080 - 30 Newbury St. , Boston, MA Phone 617/455-4248 Fax 617/745-4308

TEST PIT FIELD LOG

Test Pit
TP-2

Project	Whitinsville S. Library	**GSI Project No.**	225294	**Date Started**	11/10/2025
Location	Northbridge, MA	**Project Mgr.**	HKW	**Time Started**	-
Client	LeftField	**Inspector**	KJM	**Time Finished**	-
Contractor	Northbridge DPW	**Checked By**	HKW	**Elevation**	303' +/-
Operator	Northbridge DPW	**Equipment Used**	CAT Backhoe	**Groundwater**	N/E

Test Pit Location: See Figure 2

Approx. Dimensions: Length: 6 ft. Width: 4 ft. Depth: 8 ft.

GPS Coordinates: Lat. Long:

Depth	Soil Description	Excav. Effort	Boulder Class
0-9"	Topsoil/subsoil	E	None
9'-8'+	Light brown, fine to coarse Sand, some Gravel, trace to little Silt	M	A

Test Pit Photograph

Excavation Effort: E: Easy
M: Moderate
D: Difficult

Boulder Count: (Classification / Designation)
6"-18" - A
18"-36" - B
Larger than 36" - C

TP-2

Geotechnical Services, Inc. 55 North Stark Highway, Weare, NH Phone 603/529-7766 Fax 603/5297080 - 30 Newbury St. , Boston, MA Phone 617/455-4248 Fax 617/745-4308

TEST PIT FIELD LOG

Test Pit **TP-3**

Project	Whitinsville S. Library	**GSI Project No.**	225294	**Date Started**	11/10/2025
Location	Northbridge, MA	**Project Mgr.**	HKW	**Time Started**	-
Client	LeftField	**Inspector**	KJM	**Time Finished**	-
Contractor	Northbridge DPW	**Checked By**	HKW	**Elevation**	305' +/-
Operator	Northbridge DPW	**Equipment Used**	CAT Backhoe	**Groundwater**	N/E
Test Pit Location	See Figure 2				
Approx. Dimensions:	Length: 6 ft.	Width: 4 ft.	Depth: 8 ft.		
GPS Coordinates:	Lat.	Long:			

Depth	Soil Description	Excav. Effort	Boulder Class
0-8"	Topsoil/subsoil	E	None
8"-6'	Dark brown, fine to medium Sand, some Silt, little Gravel	E	None
6'-8'+	Light brown, fine to coarse Sand, some Gravel, trace to little Silt	M	A

Test Pit Photograph

Excavation Effort: E: Easy
M: Moderate
D: Difficult

Boulder Count: (Classification / Designation)
6"-18" - A
18"-36" - B
Larger than 36" - C

TP-3

APPENDIX C

SUBSURFACE EXPLORATION KEY

FIELD DESCRIPTION AND CLASSIFICATION OF SOIL - Burmister System

Soil descriptions indicated on the test boring logs are based on Standard Penetration Test (SPT) results and observation of the soil samples obtained. Soil samples generally described and classified as illustrated in the following example:

Density or consistently | Color | Major Component | Minor Components | Moisture Content

Dense, brown, f-m SAND, some Gravel, trace Silt, moist.

1.0 DENSITY OR CONSISTENCY – The density or consistency is determined from the Standard Penetration Test (ASTM 1586), which corresponds to the number of blows required to drive a standard 2-inch outside diameter split-spoon sampler from the 6 to 18-inch depth of a 24-inch sample using a 140-pound weight falling freely for 30 inches.

Density of Granular Soil	Penetration Resistance (N-blows/ft)		Consistency of Composite Clay Soil
Very Loose	0 - 4	< 2	Very soft
Loose	4 - 10	2 - 4	Soft
Medium Dense	10 - 30	4 - 8	Medium soft
Dense	30 - 50	8 - 15	Stiff
Very Dense	> 50	15 - 30	Very stiff
		> 30	Hard

2.0 COLOR – Visual

3.0 SOIL COMPONENTS – The description and classification is based on the following criteria.

3.1 DESCRIPTION – The components of a soil sample are described by visually estimating the percentage of each component by weight of the total sample.

Major Component – The major component (>50%) is written with upper case letters for granular soil (SAND, GRAVEL), and a combination of upper and lower case letters for composite soil (Silty CLAY, Clayey SILT).

Minor Component – The minor soil components (≤50%) are written with the first letter of each material in upper case, and the remaining letters in lower case (Gravel, Silt). The minor components are identified and prefaced in the description based on the following percentages:

Description	Percentage
and	35 - 50%
some	20 - 35%
little	10 - 20%
trace	0 - 10%

Other Components – The other components within the soil which may be encountered include glass, bricks, trash, etc. The other components are identified and follow the major and minor soil components.

3.2 CLASSIFICATION

Granular Soil by Sieve Size – A granular soil sample is classified by visually estimating the particle size as referenced to a Standard Sieve.

Material*			Standard Sieve Limit Upper	Standard Sieve Limit Lower
GRAVEL	-	coarse	3-inch	3/4-inch
	-	fine	3/4-inch	No. 4
SAND	-	coarse	No. 4	No. 10
	-	medium	No. 10	No. 40
	-	fine	No. 40	No. 200
SILT			No. 200	

Granular Soil by Visual Identification

Material	Visual ID
Silts and Clays	Too small to see.
Fine Sand	Finest visible grain.
Medium Sand	1/64” to 1/16”
Coarse Sand	1/16” to 1/4”
Fine Gravel	1/4" to 3/4"
Coarse Gravel	3/4" to 3”
Cobbles	3” to 6”
Boulders	Greater than 6”

*The Gravel/Sand portions of a granular soil are further divided based on the following proportions:

Gravel/Sand	Proportion
fine to coarse	> 10% all factions
coarse	< 10% fine and medium
medium to coarse	< 10% fine
medium	< 10% fine and coarse
fine to medium	< 10% coarse
fine	< 10% medium and coarse

Composite Clay Soil – A composite clay soil sample is classified by determining the smallest diameter thread that can be rolled manually.

Material	Smallest Thread Diameter	Degree of Plasticity
SILT	None	Nonplastic
Clayey SILT	1/4-inch	Slight
SILT & CLAY	1/8-inch	Low
CLAY & SILT	1/16-inch	Medium
Silty CLAY	1/32-inch	High
CLAY	1/64-inch	Very High

Organic Soil – An organic soil sample is classified by observation of the sample structure.

Material		
Topsoil	-	surficial soils that support plant life and which contain a high percentage of organic matter.
Fibrous Peat	-	deposits of plant remains in which the original plant fibers are still visible.
Amorphous Peat	-	deposits of plant remains in which the original plant fibers have been destroyed. Usually found underlying fibrous peat.
Organic Silt	-	fine grained marine soils which have been transported due to erosion and deposited in still water below the zone of wave action. May contain shell fragments, organic odor, high sand content, nonplastic.
Clayey Organic Silt	-	similar to Organic Silt, low sand content, plastic.

4.0 ADDITIONAL DETAILS AND DISCRIPTIVE TERMS

SOIL STRUCTURE – produced by deposition of sediments.

Stratified	-	random soil deposits of varying components or color.
Varved	-	alternating soil deposits of varying thickness (i.e. clays or silts).
Stratum	-	soil deposit greater than 12 inches thick.
Layer	-	soil deposit 3 inches to 12 inches thick.
Seam	-	soil deposit 1/8 inch to 3 inches thick.
Parting/lens	-	soil deposit less than 1/8 inch thick.

MOISTURE CONTENT

Dry	-	moisture not apparent, dusty, dry to the touch.
Moist	-	damp, but no visible water.
Wet	-	visible free water.

5.0 UNIFIED SOIL CLASSIFICATION SYMBOL AND DISCRIPTION

CL	Lean Clay	GW	Well Graded Gravel
ML	Silt	GP	Poorly Graded Gravel
OL	Organic Silt/ Clay Low Plasticity	GM	Silty Gravel
CH	Fat Clay	GC	Clayey Gravel
MH	Plastic Silt	SW	Well Graded Sand
OH	Organic Silt/Clay High Plasticity	SP	Poorly Graded Sand
PT	Peat	SM	Silty Sand
		SC	Clayey Sand

GUIDELINES TO CLASSIFICATION AND IDENTIFICATION OF ROCK

A. WEATHERING

Fresh	Fresh rock, crystals bright, few joints, may show slight staining. Rock rings under hammer if crystalline.
Slightly Weathered	Rock generally fresh, joints stained and discoloration extends into rock up to 1 inch. Joints may contain clay or gouge. In granitoid rocks some occasional feldspar crystals are dull and discolored. Crystalline rocks ring under hammer.
Moderately Weathered	Significant portions of rock show discoloration and weathering effects. In granitoid rocks, most feldspars are dull and discolored; some look clayey. Rock has dull sound under hammer and shows significant loss of strength as compared with fresh rock.
Highly Weathered	All rock is discolored or stained. In granitoid rocks all feldspars are dull and discolored and majority shows kaolinization. Rock shows severe loss of strength and can be excavated with a geologists pick. A clunking sound when struck with a hammer.
Disintegrate Rock	Rock texture clear and evident, but reduced in strength to strong soil. Some fragments of strong rock usually left.

B. FRACTURING AND BEDDING

Spacing	Fracturing	Bedding and Foliation
More than 3 feet	Massive	Thick
1 foot – 3 feet	Slightly Fractured	Medium
2 inches – 1 foot	Moderately Fractured	Thin
Less than 2 inches	Highly fractured	Very Thin

C. GRAIN SIZE

Fine	Visible to naked eye to 1/16-inch diameter.
Medium	1/16-inch to 1/4-inch diameter.
Coarse	Greater than 1/4-inch diameter.

D. HARDNESS

Very Hard	Cannot be scratched with a knife or sharp pick. Breaking of hand specimens requires several hard blows with a geologists pick.
Hard	Can be scratched with a knife or pick only with difficulty. Hard blow of hammer required to detach hand specimen.
Moderately Hard	Can be scratched with a knife or pick. Gouges or grooves to ¼ inch deep can be excavated with hard blows of a geologists pick. Hand specimens can be detached by a moderate blow.
Medium	Can be grooved to a 1/16-inch deep by firm pressure on a knife or pick point. Can be excavated in small chips to pieces approximately 1-inch maximum size by hard blows of the point of a geologists pick.
Soft	Can be gouged or grooved easily with a knife or pick point. Can be excavated in chips to pieces several inches in size. Small thin pieces can be broken by finger pressure.
Very Soft	Can be carved with a knife. Can be excavated easily with the point of a pick. Pieces 1 inch or more in thickness can be broken with finger pressure.

E. ROCK QUALITY DESIGNATION (RQD)

RQD (Percent)	Diagnostic Description
Exceeding 90	Excellent
75 – 90	Good
50 – 75	Fair
25 – 50	Poor
0 – 25	Very Poor

Comments: RQD is applicable to NX core only. The diameter of an NX core is 2.16 inches. RQD is expressed as a percentage and is determined by dividing the length of the run by the total length of the recovered cores pieces measuring 4-inches or greater. Core recovery is reported as a percentage and is determined by dividing the length of the core recovered (all pieces) by the length of the run.

APPENDIX D

USGS SEISMIC DESIGN MAPS

Announcement
ASCE 7-22 is now available.

Whitinsville Social Library

17 Church St, Whitinsville, MA 01588, USA

Latitude, Longitude: 42.1112932, -71.6636109

Date	11/19/2025, 9:49:50 AM
Design Code Reference Document	IBC-2015
Risk Category	II
Site Class	A

Type	Value	Description
S_S	0.177	MCE_R ground motion. (for 0.2 second period)
S_1	0.064	MCE_R ground motion. (for 1.0s period)
S_{MS}	0.142	Site-modified spectral acceleration value
S_{M1}	0.051	Site-modified spectral acceleration value
S_{DS}	0.095	Numeric seismic design value at 0.2 second SA
S_{D1}	0.034	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	A	Seismic design category
F_a	0.8	Site amplification factor at 0.2 second
F_v	0.8	Site amplification factor at 1.0 second
PGA	0.088	MCE_G peak ground acceleration
F_{PGA}	0.8	Site amplification factor at PGA
PGA_M	0.071	Site modified peak ground acceleration
T_L	6	Long-period transition period in seconds
SsRT	0.177	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	0.198	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	1.5	Factored deterministic acceleration value. (0.2 second)
S1RT	0.064	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.072	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.6	Factored deterministic acceleration value. (1.0 second)

Type	Value	Description
PGAd	0.6	Factored deterministic acceleration value. (Peak Ground Acceleration)
PGA_{UH}	0.088	Uniform-hazard (2% probability of exceedance in 50 years) Peak Ground Acceleration
C_{RS}	0.897	Mapped value of the risk coefficient at short periods
C_{R1}	0.896	Mapped value of the risk coefficient at a period of 1 s
C_V		Vertical coefficient