GEOTECHNICAL REPORT

TUCKER FREE LIBRARY
31 WESTERN AVENUE
HENNIKER, NEW HAMPSHIRE

October 2, 2019

GSI Project No. 219247

Prepared for:

Tucker Free Library
Director, Lynn M. Piotrowicz
31 Western Avenue
PO Box 688
Henniker, NH 03242

Prepared by:

Harry K. Wetherbee, P.E.
Geotechnical Services, Inc.
55 North Stark Highway
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Geotechnical Services Inc.
Geotechnical Engineering ◣ Environmental Studies ◣ Materials Testing ◣ Construction Monitoring

GEOTECHNICAL SERVICES INC.
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Tucker Free Library
Director, Lynn M. Piotrowicz
31 Western Avenue
PO Box 688
Henniker, NH 03242

RE: Geotechnical Report
Tucker Free Library
31 Western Avenue
Henniker, New Hampshire **GSI Project No. 219247**

This report presents the results of a geotechnical investigation completed by Geotechnical Services, Inc. (GSI) for the construction of the proposed addition to the Tucker Free Library in Henniker, New Hampshire. 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 included the following:

1. Coordination and observation of three (3) test borings 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 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 site is located at 31 Western Avenue in Henniker, New Hampshire. The property is abutted by Western Avenue to the north, Henniker Community School to the west, Henniker Pharmacy to the east, and the wooded Azalea Park to the south. The property is currently occupied by the existing two-story Tucker Free Library, a historical structure opened in 1904.

The project development includes the construction of a new addition to the existing library structure, which will adjoin to the southwest corner of the building. The addition will incorporate a new entrance to the library as well as an elevator. The new addition is expected to be founded upon conventional concrete spread footings with a concrete slab-on-grade. Partial below grade space will be incorporated into the structural design as the addition will be constructed into an existing slope. Limited site and structural details were obtained from a series of sketches provided by SMP Architecture.

SUBSURFACE INVESTIGATION

Three test borings designated GSI-1 through GSI-3 were advanced for the purpose of evaluating the geotechnical properties of the existing soils. The test borings were advanced within the proposed building footprint to depths of 15 to 20 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 New England Boring Contractors, Inc. of Derry, New Hampshire utilizing a truck 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.

SUBSURFACE CONDITIONS

Topsoil

The test borings were advanced within an existing lawn area and topsoil was observed at ground surface, which will be removed prior to construction.

Sand and Gravel

Loose to dense, light brown/brown, coarse to fine Sand, little to some Gravel, trace to little Silt was encountered underlaying the topsoil and loam. SPT “N” values within the sand and gravel varied from 3 to 60 blows per foot. Sampling at test boring locations GSI-2 resulted in SPT “N” values of 3 and 5 at depths of 0 to 2 and 4 to 6 feet respectively indicating loose soil in that vicinity. SPT blow counts at test boring GSI-1 were higher in comparison with an SPT “N” value of 60 at 4 to 6 feet below grade.

Glacial Till

Glacial till was encountered at test borings GSI-1 and GSI-2 at depths of 9 to 14 feet below existing ground surface. The till consisted of dense to very dense, brown, fine to coarse Sand, little to some Gravel, little to some Silt. SPT "N" values within the glacial till varied from 34 to over 100 blows per foot. Glacial till is a non-sorted, non-stratified natural deposit of sand, silt, gravel, and boulders, mixed in various proportions and deposited directly by the glaciers in a non-aqueous depositional environment. The glacial till was present to test boring termination at depths of 15 to 20 feet below existing ground surface.

Refusal/Possible Bedrock

Test boring refusal was encountered at 2 of the 3 test borings at a depth of 15 feet below grade. Refusal is defined as the inability of the augers to advance despite increasing torque and downward pressure applied by the drill rig. 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. Refusal may be caused by nested cobbles, very dense soils, boulders, obstructions, or bedrock. The density of the glacial till observed during the subsurface investigation may also cause test boring refusal.

GROUNDWATER

Groundwater was observed at a depths of 9 to 15 feet below existing grades during following the completion of the test borings. Groundwater levels can be measured within the observation wells at a later date for additional documentation. 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 sand and gravel described above. An allowable bearing pressure of 1.5 tons per square foot (3,000psf) may be assumed for design. Topsoil, loam, and any loose fill placed during the construction of the original library which may be encountered will be removed to competent native soils per the Footing Zone of Influence detail provided as Figure 3.

With regards to footing geometry, the minimum footing width of column and strip footings should be 4 feet and 2 feet, respectively. 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. The spread footings should be founded at least 5 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.

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)
Sand and Gravel	30-32	0	120	0.35

LATERAL EARTH PRESSURE

The lowest level of the addition will be set into an existing slope, therefore below grade space will be incorporated into the structural 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 $P = \frac{1}{2}K\gamma H^2$.

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 Kγ. 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

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 3-ft or deeper below adjacent exterior finished grade. Such systems should be provided at exterior walls and walls between differing floor levels beneath the buildings.

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 a 6-in. of peastone 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.

SEISMIC DESIGN PARAMETERS

The seismic design parameters have been reviewed with respect to the 2012 Edition of the International Building Code. Upon review of the subsurface soils data, 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 are 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 on subbase = 150 pci.

Slabs should be designed to act independent 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.

EARTHWORK RECOMMENDATIONS

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 is recommended 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.

Temporary Earth Support

It is assumed that the subgrade excavation may be accomplished via an open cut excavation. Care must be taken to may be required to maintain excavation safety, as well as the integrity of the adjacent roadway, sidewalks, and properties. The on-site soils are considered as Type “C” soils based on OSHA Standard 29 CFR 1926. Excavation sloping and support implementation must meet OSHA excavation safety requirement and trench box certifications must be on site at the time of excavation in order to maintain OSHA compliance. The existing building has a basement level, therefore, underpinning of the existing library is not anticipated.

Construction Dewatering

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 not be conducted 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
Pavements below 18 inches of Subgrade	95%	92%	5,000 ft^2
Trenches	95%	92%	150 lineal feet
Lawns and Unimproved Areas	92%	90%	20,000 ft^2
Building and Pavement 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	0-12

Structural Fill should be placed in lift thickness not exceeding 12 in. loose measure. Cobbles and boulders having a size exceeding 2/3 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 2/3 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
4 in.	100
No. 4	40-70
No. 40	25-45
No. 200	0-12

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.

Slab Base Course should be placed in lift thicknesses 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 6 inches. A minimum of four systematic passes of the compaction equipment should be used to compact each lift.

CONSTRUCTION MONITORING

It is recommended that a qualified geotechnical engineer be retained to observe foundation construction, subgrade preparation, backfilling, and compaction in conformance with the requirements of local building codes. GSI has the geotechnical personnel trained and experienced in monitoring earthwork excavation and testing, as well as a full-service Soils and Materials laboratory.

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.

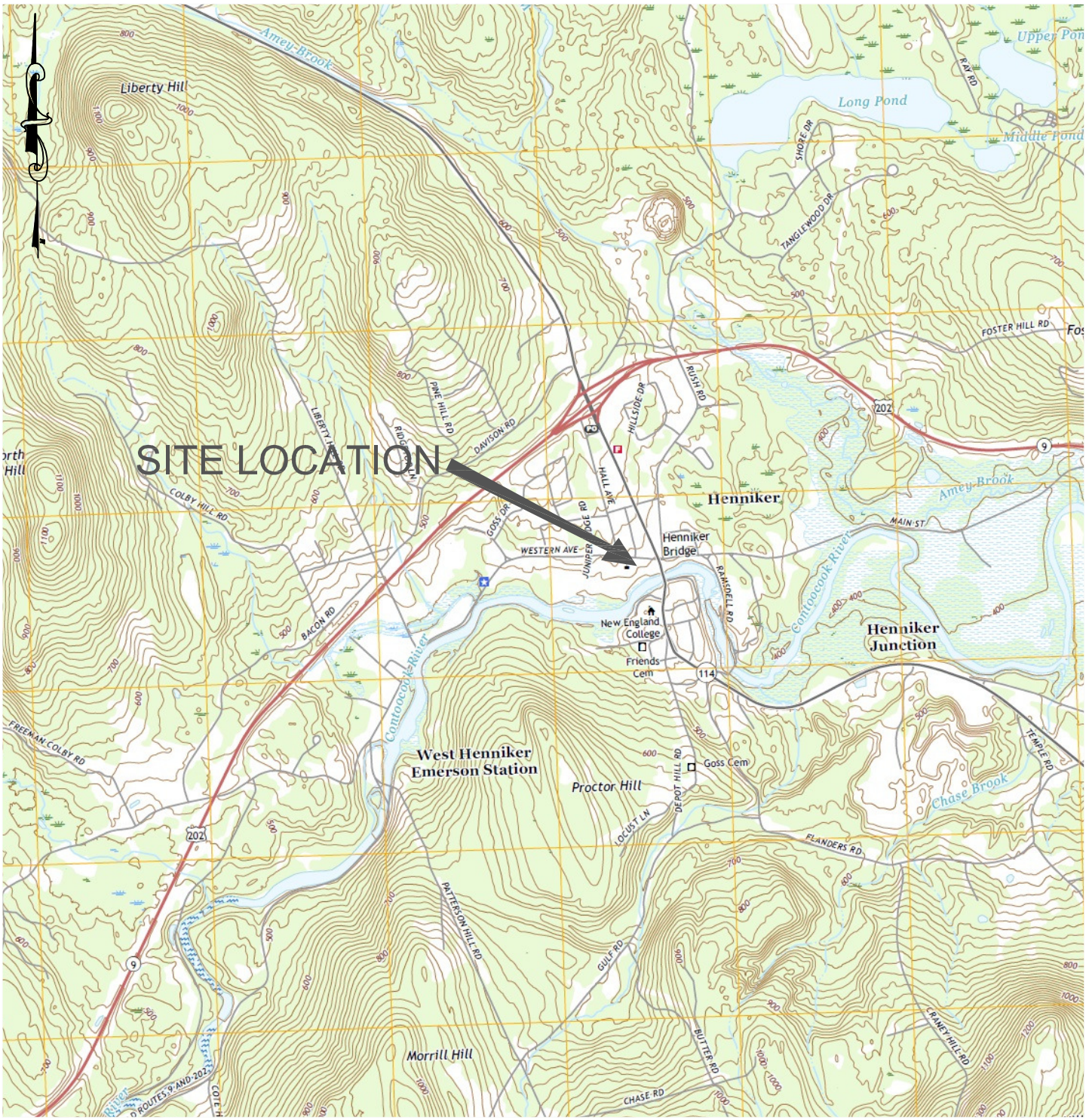
Very truly yours,

GEOTECHNICAL SERVICES, INC.

Harry K. Wetherbee, P.E.
Principal Engineer

Attachments:
Figure 1: Locus Plan
Figure 2: Boring Location Plan
Figure 3: Foundation Zone of Influence
Figure 4: Diagram of Lateral Earth Pressures

Appendix A: Limitations
Appendix B: Exploration Logs
Appendix C: Subsurface Exploration Key
Appendix D: USGS Seismic Design Maps
Appendix E: Draft Earthwork Specification



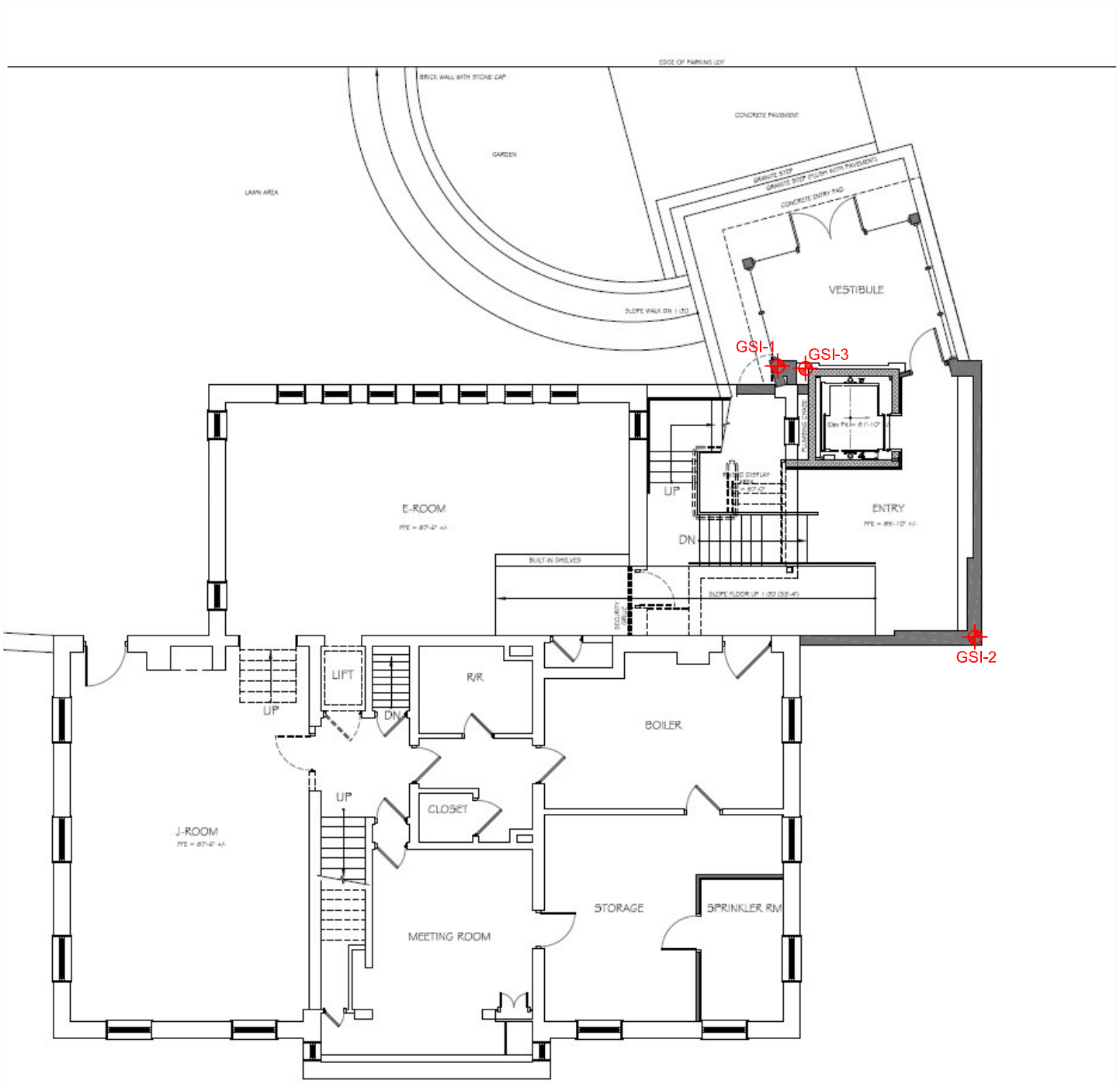
LOCUS MAP

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

Tucker Free Library
Henniker, New Hampshire

DRAWN BY: KJM	DATE: October 2019
CHECKED BY: HKW	SCALE: 1" = @1500'
FILE NAME: Tucker Free Library.dwg	PROJECT NO.: 219247

FIGURE NO. 1



GSI-1 Test Boring Location (Approximate)

EXPLORATION LOCATION PLAN

GEOTECHNICAL SERVICES INC.
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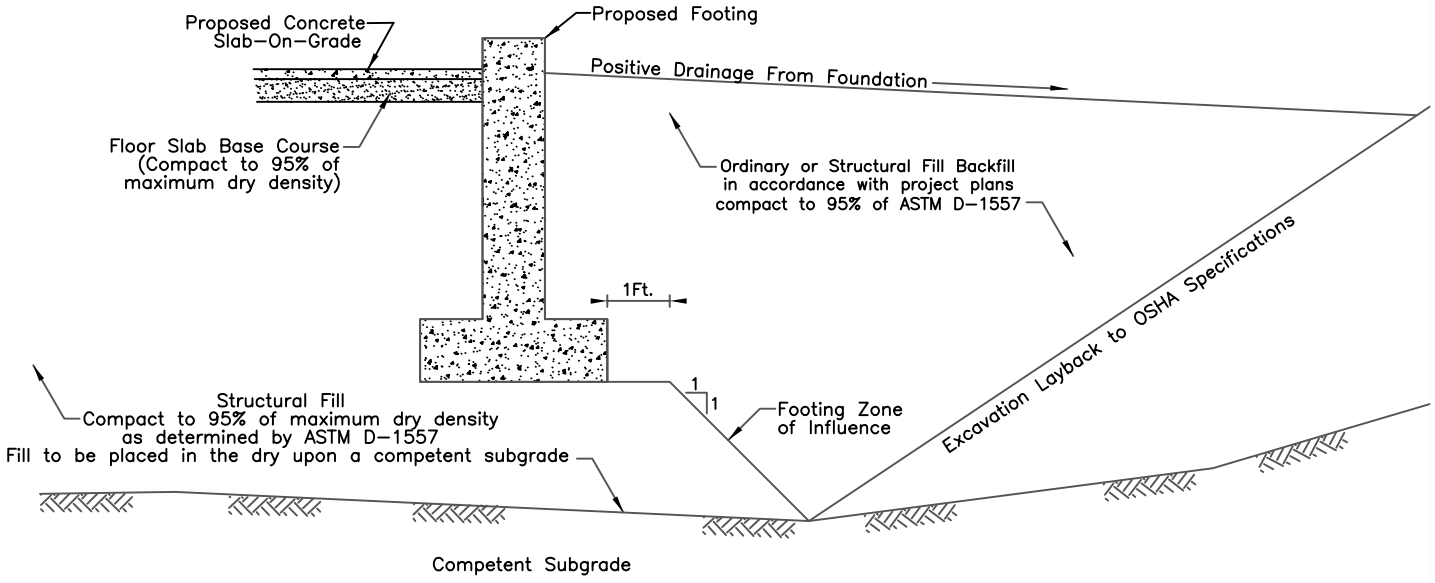
Tucker Free Library
Henniker, New Hampshire

DRAWN BY: KJM	DATE: October 2019
CHECKED BY: HKW	SCALE: NTS
FILE NAME: Tucker Free Library.dwg	PROJECT NO.: 219247

FIGURE NO. 2



FOUNDATION ZONE OF INFLUENCE

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Tucker Free Library
Henniker, New Hampshire

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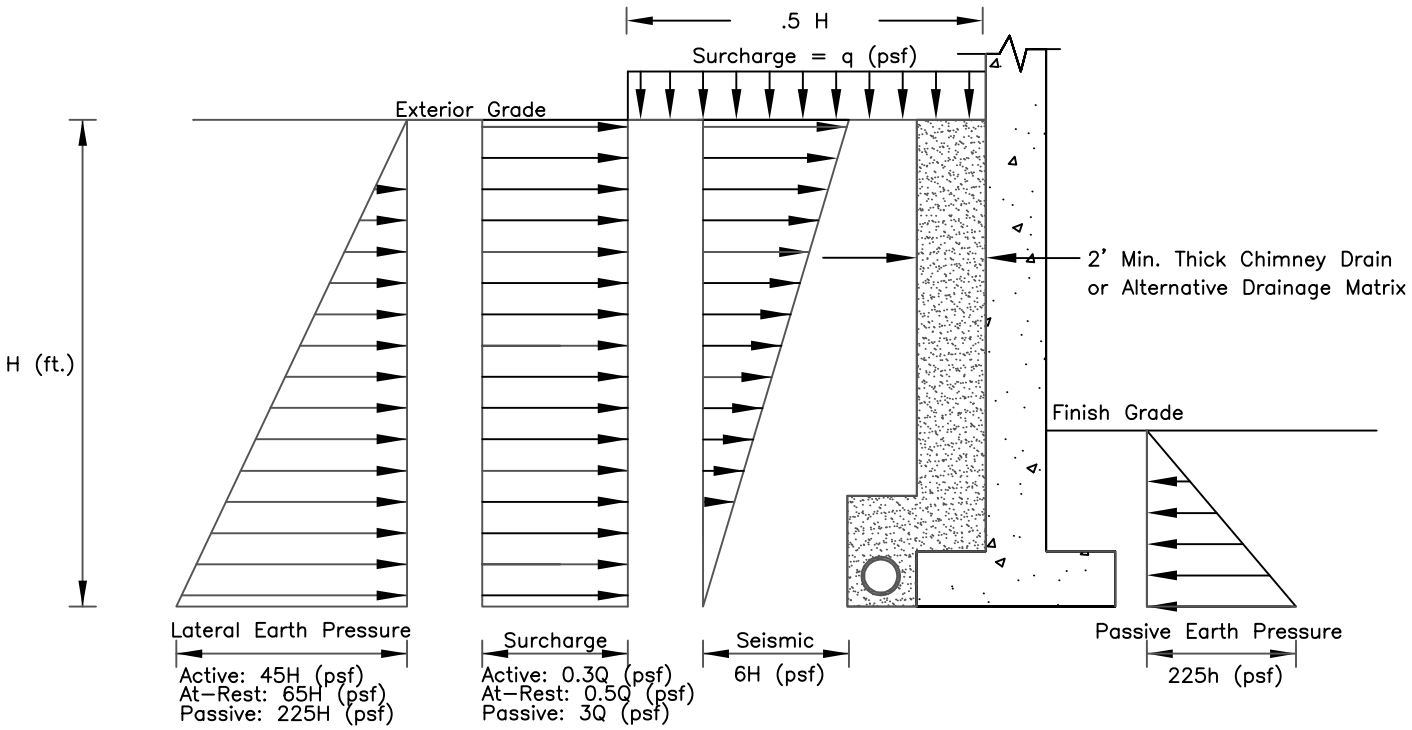
FIGURE NO. 3



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

Tucker Free Library
Henniker, New Hampshire

DRAWN BY: KJM	DATE: October 2019
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FILE NAME: Tucker Free Library.dwg	PROJECT NO.: 219247

FIGURE NO. 4

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

TEST BORING LOG

Boring No. GSI-1

Page 1 of 1

Project	Tucker Free Library	GSI Project No.	219247	Elevation	Existing Grade
Location	Henniker, New Hampshire	Project Mgr.	H. Wetherbee	Datum	-
Client	Tucker Free Library	Inspector	K. Maynard	Date Started	9/27/2019
Contractor	New England Boring Cont.	Checked By	H. Wetherbee	Date Finished	9/27/2019
Driller	Pat Schofield	Rig Make & Model	Mobile	Rig Model	B-48

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

☑ Truck ☐ Skid
☐ Track ☐ ATV
☐ Bomb. ☐ Geoprobe
☐ Tripod ☐ Other
☐ Winch ☐ Cat Head

Hammer Type:
☐ Safety Hammer
☐ Doughnut
☑ Automatic

☐ Roller Bit ☑ Cutting Head

Depth (ft)	Casing (Blows/ft)	Sample No.	Sample 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	18	3 4 3 4	7			Loose, brown, coarse to fine Sand, little to some Gravel, trace to little Silt
		S-2	4-6	16	7 27	60			Very dense, light brown, coarse to fine Sand and Gravel, trace Silt
5					33 25				
		S-3	9-11	14	12 17	34			Dense, brown, fine to coarse Sand, little Gravel, trace to little Silt
10					17 16				
		S-4	14-16	12	37 62	100+			Very dense, brown, coarse to fine Sand, some Gravel, trace to little Silt
15					100/2"				Test boring terminated at 15'-1"
20									

Water Level Data

Date	Time	Depth (ft) to: Bott. of Casing	Bott. of Hole	Water
9/27	EOD	-	15'-1"	9'-6"

Sample Identification
O = Open Ended Rod
U = Undisturbed
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 5%), Little (10 to 20%), Some (20 to 35%), And (35 to 50%)

Notes:

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

Page 1 of 1

Project	Tucker Free Library	GSI Project No.	219247	Elevation	Existing Grade
Location	Henniker, New Hampshire	Project Mgr.	H. Wetherbee	Datum	-
Client	Tucker Free Library	Inspector	K. Maynard	Date Started	9/27/2019
Contractor	New England Boring Cont.	Checked By	H. Wetherbee	Date Finished	9/27/2019
Driller	Pat Schofield	Rig Make & Model	Mobile	Rig Model	B-48

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

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

☐ Winch ☐ Cat Head ☐ Roller Bit ☑ Cutting Head

Hammer Type: ☐ Safety Hammer ☐ 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	12	1 2 1 1	3			Very loose, brown, coarse to fine Sand, little Gravel, trace to little Silt
		S-2	4-6	16	1 1	5			Loose, coarse to fine Sand, little Gravel, trace Silt trace Silt
5		S-3	9-11	20	4 7 11 14	31			Dense, light brown, fine to coarse Sand, little Gravel, trace to little Silt
10		S-4	14-16	20	17 16 19 24	48			Dense, light brown/brown, fine to coarse Sand, little to some Gravel, little to some Silt
15		S-5	18-20	22	24 20 22 33	77			Very dense, light brown/brown, fine to coarse Sand, little to some Silt, little to some Gravel
20					44 32				Test boring terminated at 20'

Water Level Data

Date	Time	Depth (ft) to: Bott. of Casing	Bott. of Hole	Water
9/27	EOD	-	20'	14'

Sample Identification
O = Open Ended Rod
U = Undisturbed
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 5%), Little (10 to 20%), Some (20 to 35%), And (35 to 50%)

Notes:

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

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TEST BORING LOG

Boring No. GSI-3

Project	Tucker Free Library	GSI Project No.	219247	Elevation	Existing Grade
Location	Henniker, New Hampshire	Project Mgr.	H. Wetherbee	Datum	-
Client	Tucker Free Library	Inspector	K. Maynard	Date Started	9/27/2019
Contractor	New England Boring Cont.	Checked By	H. Wetherbee	Date Finished	9/27/2019
Driller	Pat Schofield	Rig Make & Model	Mobile	Rig Model	B-48

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

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

☐ Winch ☐ Cat Head ☐ Roller Bit ☑ Cutting Head

Hammer Type:
☐ Safety Hammer
☐ 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)
0								
5								
10								
15								
20								

Soil-Rock Visual Classification and Description
(Soils - Burmister System)
(Rock - U.S. Corps of Engineers System)

Auger refusal at 15'
Test boring terminated at 15'

Water Level Data

Date	Time	Depth (ft) to: Bott. of Casing	Bott. of Hole	Water
9/27	EOD	-	15'	9'-6"

Sample Identification
O = Open Ended Rod
U = Undisturbed
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 5%), Little (10 to 20%), Some (20 to 35%), And (35 to 50%)

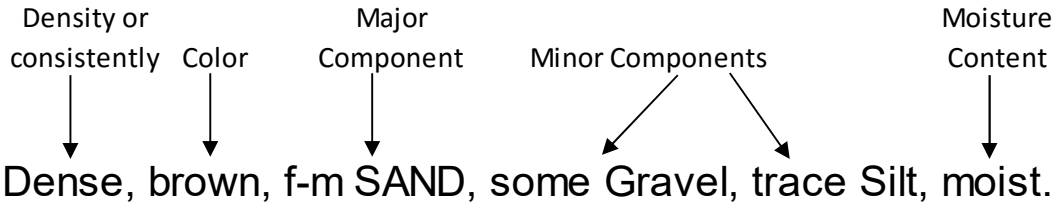
Notes:

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:



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	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

Tucker Free Library Addition

31 Western Ave, Henniker, NH 03242, USA

Latitude, Longitude: 43.1794649, -71.82354670000001

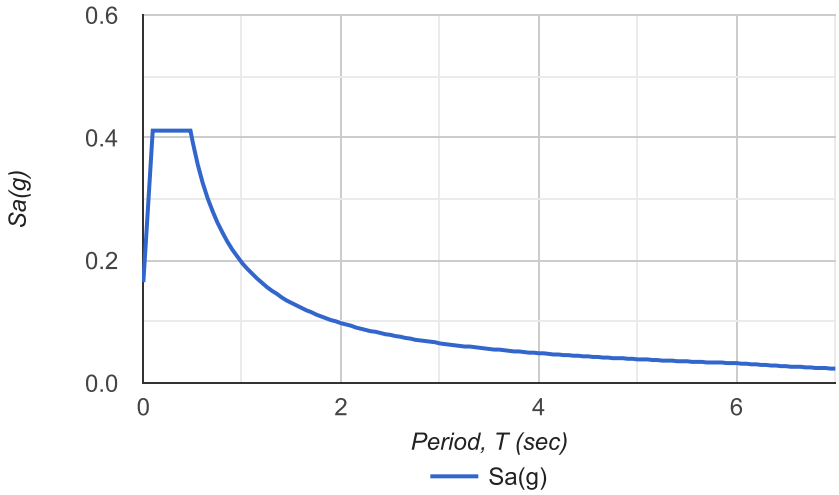
Date	10/2/2019, 10:04:56 AM
Design Code Reference Document	IBC-2012
Risk Category	II
Site Class	D - Stiff Soil

Type	Value	Description
S_S	0.259	MCE_R ground motion. (for 0.2 second period)
S_1	0.082	MCE_R ground motion. (for 1.0s period)
S_{MS}	0.412	Site-modified spectral acceleration value
S_{M1}	0.196	Site-modified spectral acceleration value
S_{DS}	0.275	Numeric seismic design value at 0.2 second SA
S_{D1}	0.131	Numeric seismic design value at 1.0 second SA

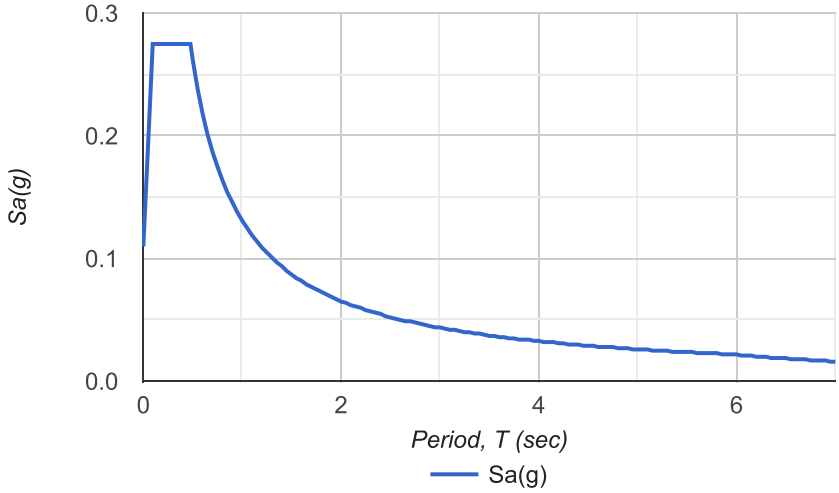
Type	Value	Description
SDC	B	Seismic design category
F_a	1.593	Site amplification factor at 0.2 second
F_v	2.4	Site amplification factor at 1.0 second
PGA	0.142	MCE_G peak ground acceleration
F_{PGA}	1.516	Site amplification factor at PGA
PGA_M	0.215	Site modified peak ground acceleration
T_L	6	Long-period transition period in seconds
SsRT	0.259	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	0.29	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	1.5	Factored deterministic acceleration value. (0.2 second)
S1RT	0.082	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.091	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.6	Factored deterministic acceleration value. (1.0 second)
PGAd	0.6	Factored deterministic acceleration value. (Peak Ground Acceleration)
C_{RS}	0.893	Mapped value of the risk coefficient at short periods

Type	Value	Description
C_{R1}	0.902	Mapped value of the risk coefficient at a period of 1 s

MCER Response Spectrum



Design Response Spectrum



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APPENDIX E

DRAFT EARTHWORK SPECIFICATIONS

TUCKER FREE LIBRARY
31 WESTERN AVENUE
HENNIKER, NEW HAMPSHIRE

SECTION 02200
EARTHWORK

PART I- GENERAL

1.01 GENERAL REQUIREMENTS

1. Include GENERAL CONDITIONS and SUPPLEMENTARY CONDITIONS as part of this Section.

2. Examine all other Sections of the Specifications for requirements, which affect work of this Section whether or not such work is specifically mentioned in this Section.

3. Coordinate work with trades affecting, or affected by, work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.

1.02 WORK INCLUDED

1. Perform all work required to complete the work of the Section, as indicated. Such work includes, but is not limited to, the following:

    1. Excavation, filling, grading and compaction
    2. Supplying of fill materials
    3. Construction Dewatering
    4. Sheeting, shoring and bracing
    5. Rock excavation/blasting

1.03 RELATED WORK UNDER OTHER SECTIONS

1. Erosion And Sediment Control
2. Site Preparation
3. Bituminous Concrete Paving
4. Site Water Lines
5. Storm Drainage System
6. Sanitary Sewer System
7. Site Furnishings
8. Site Irrigation
9. Lawns
10. Planting

1.04 SUBMITTALS

1. Issue submittals in accordance with Division 1. Submittals under this Section shall include manufacturer's specifications and installation instructions.

1.05 SAMPLES AND TESTING

1. A 50 lb. sample of each off-site material proposed for use, and of any on-site material when so requested by the Architect or Geotechnical Engineer, shall be submitted for approval.

    1. Samples shall be delivered to office of the Geotechnical Engineer, as directed.
    2. Samples required in connection with compaction tests will be taken and transported by the Geotechnical Engineer.

3. Product Data: Submit location of pits for all borrow material.

1.06 COORDINATION

1. The work of this Section shall be coordinated with that of other trades affecting, or affected by, this work, as necessary to assure the steady progress of all work of the Contract.

2. Prior to the start of earthwork, the Contractor shall arrange an on-site meeting with the Architect and Geotechnical Engineer for the purpose of establishing Contractor's schedule of operations and scheduling inspection procedures and requirements.

3. As construction proceeds, the Contractor shall be responsible for notifying the Architect prior to start of earthwork operations requiring inspection and/or testing.

1.09 INFORMATION

1. It is hereby understood that the Contractor has carefully examined the site and all conditions affecting work under this Section. No claim for additional costs will be allowed because of lack of full knowledge of existing conditions.

2. Plans, surveys, measurements and dimensions, under which the work is to be performed, are believed to be correct to the best of the Architect's knowledge, but the Contractor shall have examined them for himself during the bidding period, as no allowance will be made for any errors or inaccuracies that may be found herein.

3. Information on the Drawings, Reference Drawings, and in the Specifications relating to subsurface conditions, natural phenomena, and existing utilities and structures is from the best sources presently available. Such information is furnished only for the information and convenience of the Contractor, and the accuracy or completeness of this information is not guaranteed.

1.10 EXISTING CONDITIONS

1. The Contractor shall become thoroughly familiar with the site, consult records and drawings of adjacent structures and of existing utilities, and note all conditions, which may influence the work of this Section.

2. By submitting a bid, the Contractor affirms that he has carefully examined the site and all conditions affecting work under this Section. No claim for additional costs will be allowed because of lack of full knowledge of existing conditions.

3. The Contractor may, at his own expense, conduct additional subsurface testing as required for his own information after approval by the Owner.

1.11 SUBSURFACE CONDITIONS AND SPECIAL SITE CONSIDERATIONS

1. Soil borings have been made by a qualified Contractor prior to this Contract. This information shall be made available to bidders as specified under other Sections. The final results of these subsurface explorations were prepared by Geotechnical Services, Inc., consulting geotechnical engineers, and are hereby attached to this specification for information only. Procedures for dewatering, areas to receive special fill and other methods and procedures specified herein shall be supplemented by this information. For purposes of this specification, this information will be referred to as the report. Where procedures within the report vary from procedures as specified herein, this specification shall override. The results and recommendations are available in the geotechnical report prepared by Geotechnical Services. Copies of this report are available from the Architect. Soil samples may be examined at the office of the Geotechnical Engineer.

2. It is the responsibility of the Contractor under this Contract to do the excavation, filling, grading

and rough grading to bring the existing grades to subgrade and parallel to finished grades as specified herein and as shown on the Drawings for this Work. The Contractor shall visit the site prior to submitting a bid to become familiar with the extent of the work to be done under this Contract. The Contractor shall be responsible for determining the quantities of earth materials necessary to complete the work under this Section. All earth materials shall be included in the Contractor's base bid.

3. Site Information - data on indicated subsurface conditions are not representations or warrants of continuity of such conditions between subsurface explorations. It is expressly understood that the Owner will not be responsible for interpretations or conclusions drawn there from by the Contractor. Data are made available for the convenience of the Contractor. Neither the Owner nor the Geotechnical Engineer assumes responsibility for accuracy of the data other than at the particular locations and at the time the explorations were made.

4. The subsurface data was gathered and report prepared by Geotechnical Services, Inc. The elevations indicated on the drill holes, borings and test pits refer to existing conditions. A copy of this report may be seen at the office of the Architect during normal working hours.

1.12 QUALITY ASSURANCE

1. The Owner will retain a Geotechnical Engineer to perform on-site observations and testing during the following phases of the construction operations. The services of the Geotechnical Engineer may include, but not be limited to the following:

    1. Observation during excavation and dewatering of building areas, parking areas and controlled fill areas.
    2. Observation and testing during placement and compaction of fills within the building area, parking area, and controlled fill areas.
    3. Laboratory testing and analysis of fill and bedding materials specified, as required.
    4. Observation, construction and performance of water content, gradation, and compaction tests at a frequency and at locations to assure conformance of this Specification. The results of these tests will be submitted to the Architect; copy to the Contractor, on a timely basis so that the Contractor can take such action as is required to remedy indicated deficiencies. During the course of construction, the Geotechnical Engineer will advise the Architect, in writing, with copy to Contractor if, at any time, in his opinion, the work is not in substantial conformity with the Contract Documents.

2. The Geotechnical Engineer's presence does not include supervision or direction of the actual work by the Contractor, his employees or agents. Neither the presence of the Geotechnical Engineer, nor any observations and testing performed by him, nor any notice or failure to give notice shall excuse the Contractor from defects discovered in his work.

3. The Owner reserves the right to modify or waive Geotechnical Engineer services.

1.13 PERMITS, CODES AND SAFETY REQUIREMENTS

1. All work shall conform to the Drawings and Specifications and shall comply with applicable codes and regulations.

2. Comply with the rules, regulations, laws and ordinances of the Town of Henniker, New Hampshire appropriate agencies of the State of New Hampshire and all other authorities having jurisdiction. Coordinate all work done within town and State rights of way with the appropriate agencies. Provide all required traffic control and safety measures, including uniformed police officers per town and State requirements. All labor, materials, equipment and services necessary to make the work comply with such requirements shall be provided without additional cost to the Owner.

3. Comply with the provisions of the Manual of Accident Prevention in Construction of the Associated General Contractors of America, Inc. and the requirements of the Occupational

Safety and Health Administration (OSHA), United States Department of Labor.

4. The Contractor shall procure and pay for all permits and licenses required for the complete work specified herein and shown on the Drawings.

5. The Contractor shall not close or obstruct any street, sidewalk, or passageway unless authorized in writing by the Architect. The Contractor shall so conduct his operations as to interfere as little as possible with the use ordinarily made of roads, driveways, sidewalks or other facilities near enough to the work to be affected hereby. The Contractor shall comply with the time limits established by the terms for trucking onto and off of the site.

6. Any apparent conflict between the Drawings and Specifications and the applicable codes and regulations shall be referred to the Architect in writing, for resolution before the work is started.

1.14 LAYOUTS AND GRADES

1. All line and grade work not presently established at the site shall be laid out by a survey team under the supervision of a Registered Land Surveyor or Professional Engineer employed by the Contractor in accordance with Drawings and Specifications. The Contractor shall establish permanent benchmarks and replace as directed any which are destroyed or disturbed.

2. The words "finished grades" as used herein shall mean final grade elevations indicated on the Drawings. Spot elevations shall govern over proposed contours. Where not otherwise indicated, project site areas outside of the building shall be given uniform slopes between points for which finished grades are indicated or between such points and existing grades.

3. The word "subgrade" as used herein, means the required surface of excavated area, subsoil, borrow fill or compacted fill. This surface is immediately beneath the site improvements; fill materials as dimensioned on the Drawings, or other proposed surface material.

1.15 DISPOSITION OF EXISTING UTILITIES

1. Active utilities existing on the site and work areas shall be carefully protected from damage and relocated or removed as required by the work. When an active utility line is exposed during construction, its location and elevation shall be plotted on the record drawings as described in this Section and both Architect and Utility Owner notified in writing.

2. Inactive or abandoned utilities encountered during construction shall be removed if within the building area or grouted, plugged or capped. The location of such utilities shall be noted on the record drawings and reported in writing to the Architect.

3. The Contractor shall notify "Dig Safe" and local utility companies prior to the start of construction. The "Dig Safe" number shall be submitted by the Contractor in writing to the Architect prior to construction.

1.16 SHORING, SHEETING, AND BRACING

1. Provide shoring, sheeting, and/or bracing at excavations, as required, to ensure complete safety against collapse of earth at sides of excavations.

2. If, at any place, sufficient or proper supports have not been provided, additional supports shall be placed at the expense of the Contractor. Care shall be taken to prevent voids outside of the sheeting, but if voids are formed, they shall be immediately filled and compacted.

3. All sheeting and bracing not ordered left in place shall be carefully removed in such a manner as not to endanger the construction of other structures, utilities or property whether public or private. All voids left after withdrawal of sheeting shall be immediately refilled with sand and rammed with tools especially adapted to that purpose or otherwise compacted as directed to achieve the

required density.

4. Shoring or sheeting shall not constitute a condition for which an increase may be made in the contract price with the exception that if the Architect directs in writing that certain shoring or sheeting shall be left in place, the contract price will be adjusted in accordance with General Conditions.

5. Excavation support systems shall be designed to support the earth pressures, hydrostatic pressures, surcharge loads and other forces from existing site conditions, stored material and construction equipment.

6. Shoring and bracing of trenches and other excavations shall, at a minimum, be in accordance with the latest requirements of the Department of Labor and Industries Bulletin No. 12, Section 10, and all subsequent amendments.

7. Shoring and sheeting shall be designed by a Registered Professional Engineer in the State of New Hampshire and paid for by the Contractor. The contractor shall submit an earth shoring and bracing plan to the Architect for review by the Geotechnical Engineer at least 2 weeks prior to installation. The submittal shall include calculations and plans drawn to scale.

1.17 DRAINAGE

1. The Contractor shall control the grading in areas under construction on the site so that the surface of the ground will properly slope to prevent accumulation of water in excavated areas and adjacent properties.

2. The Contractor shall excavate interceptor swales and ditches where shown on the Drawings and as otherwise necessary prior to the start of major earthmoving operations to insure minimal erosion and to keep areas as free from surface water as possible.

3. Should surface, rain or ground water be encountered during the operations, the Contractor shall furnish and operate pumps or other equipment, and provide all necessary piping to keep all excavations clear of water at all times and shall be responsible for any damage to work or adjacent properties for such water. All piping exposed above surface for this use, shall be properly covered to allow foot traffic and vehicles to pass without obstruction.

4. Presence of ground water in soil will not constitute a condition for which an increase in the contract price may be made. Under no circumstances place concrete fill, soil fill, lay piping or install appurtenances in excavation containing free water. Keep utility trenches free of water until pipe joint material has hardened and backfilled to prevent flotation.

1.18 FROST PROTECTION

1. Do not excavate to full-indicated depth when freezing temperatures may be expected, unless work can be completed to subgrade or piping can be installed and backfilled the same day. Protect the excavation from frost if placing of concrete or piping is delayed.

2. The Contractor shall keep the operations under this Contract clear and free of accumulation of snow within the limits of Contract Lines as required to carry out the work.

3. No work shall be installed on frozen ground.

4. Provide heat and/or insulation to slab, footings, foundation walls, and other elements during freezing conditions to prevent damage from frost heaving.

1.19 DISTURBANCE OF EXCAVATED AND FILLED AREAS DURING CONSTRUCTION

1. The Contractor shall take the necessary steps to avoid disturbance of subgrade and underlying natural soils/compacted fill during excavation and filling operations. Methods of excavation and filling operations shall be revised as necessary to avoid disturbance of the subgrade and underlying natural soils/compacted fill, including restricting the use of certain types of construction equipment and their movement over sensitive or unstable materials. The Contractor shall coordinate with the Architect or Geotechnical Engineer to modify his operations as necessary to minimize disturbance and protect bearing soils.

2. All excavated or filled areas disturbed during construction, all loose or saturated soil, and other areas that will not meet compaction requirements as specified herein shall be removed and replaced with compacted structural fill or crushed stone. Fill that cannot be compacted within 48 hours because of excess moisture shall be removed and replaced with compacted structural fill or crushed stone. Costs of removal of disturbed material and replacement with gravel fill or crushed stone shall be borne by the Contractor.

3. If requested by the Architect, the Contractor shall place a six-inch layer of crushed stone or 4-inch concrete mudmat over natural underlying soil to stabilize areas disturbed during construction. The placement of crushed stone layer or mudmat as well as material costs shall be borne by the Contractor.

4. Material that is not within +\- 3% optimum moisture for compaction as determined by the Modified Proctor Test of the particular material in place as determined by the Architect or the Geotechnical Engineer, and is disturbed by the Contractor during construction operations so that proper compaction cannot be reached, shall be construed as unsuitable bearing materials. This material shall be removed and replaced with crushed stone or structural fill as directed by the Architect or Geotechnical Engineer at no additional cost to the Owner.

1.20 PROTECTION OF BEARING SUBGRADES

1. The Contractor shall be required to maintain stable, dewatered, and frost fee subgrades for foundations, pavement areas, utility trenches, and other areas as directed by the Architect or Geotechnical Engineer.

2. The Contractor shall take precautions to reduce subgrade disturbance. Such precautions may include diverting storm water runoff away from construction areas, reducing traffic in sensitive areas, thermal protection during cold weather periods, and maintaining an effective dewatering operation.

3. Soils exhibiting weaving/instability or which become frozen, as determined by the Geotechnical Engineer, shall be over-excavated (removed) to competent bearing material and replaced with compacted gravel fill or lean concrete at no additional cost to the Owner.

1.21 DEWATERING

1. Based on subsurface investigations conducted prior to this Contract, it is anticipated that excavation will be carried out below existing groundwater levels. The Contractor shall be required to implement ground water control measures to maintain the ground water level a minimum of one foot below all final excavation levels or to propose alternative methods for placement of fill over existing undisturbed material with ground water at or near the surface in such a manner that the existing materials will not be disturbed. The Contractor will be required to implement ground water control measures adequate to maintain the excavation sufficiently dry to allow efficient use of normal excavation equipment and to provide a borrow material suitable for placement and compaction as specified or as directed by the Geotechnical Engineer. The moisture content shall not exceed 3% above the optimum moisture content as determined by modified Proctor test (ASTM DI557). The Contractor shall furnish all labor, equipment and materials in connection with handling ground water and surface water encountered during construction and placement of compacted granular fill or other material as specified.

2. Not less than 14 days prior to the scheduled start of work, the Contractor shall submit his proposed method of dewatering and maintaining dry conditions, to the Geotechnical Engineer for review. The submittal shall include calculations, plans, sketches, pump curves, method of sediment control, and disposal. The dewatering plan shall be prepared by a licensed Civil Engineer registered in the State of New Hampshire. Review by the Architect of the Contractor's proposed method of dewatering shall not relieve the Contractor of responsibility for the satisfactory performance of the dewatering system. The Contractor is responsible for correcting any disturbance of natural bearing soils or damage to structures caused by an inadequate dewatering system or by interruption of the continuous operation of the system as specified.

3. The Contractor shall make the entire excavation for this work in the dry. The water level is to be maintained continuously one foot below bottom of excavation for the length of time to complete the work. The Contractor shall place all fill materials and proposed improvements in the dry.

4. The Contractor shall, at all times during construction, provide and maintain proper equipment and facilities to remove promptly and dispose of properly, all water entering excavations and keep such excavations dry so as to obtain a satisfactory undisturbed bottom of excavation or subgrade condition. Dewatering shall be in operation until the fill or the proposed surface condition has been completed to such extent that it will not be floated or otherwise damaged by allowing water levels to return to natural elevations.

5. In excavations below the ground water level, it is expected that dewatering trenches or deep sumps will be required for predrainage of the soils prior to final excavation, and for maintaining the lowered groundwater level until construction has been completed to such an extent that floating, slumping or damage to excavations or materials placed does not occur. Monitoring of adjacent ground water levels by observation wells or other satisfactory means may be required.

6. The Contractor shall discharge all pumped water away from the work area, and in accordance with all applicable local codes and laws. Requirements specified herein for Erosion and Siltation Control shall be met during this process.

7. All fill material shall be placed and compacted in the dry. The Contractor shall dewater excavated areas as required to perform the work and in such a manner as to preserve the undisturbed state of the natural inorganic or other subgrade soils.

8. The Contractor shall verify that the construction and/or operation of his dewatering system will not adversely affect any well, pond, stream structure, utility, etc., on or adjacent to the area being dewatered.

1.22 RESTORATION OF DRAINAGE SWALES, DETENTION BASINS AND WATER BODIES

1. In addition to other work specified and prior to substantial completion, the Contractor shall repair all erosion in all areas and excavate and remove accumulations of silt, debris or other material occurring from work under this Contract in the water bodies, detention areas and in all drainage swales to remain and as shown on Drawings. Water bodies and detention areas will be drained or pumped, if necessary, to properly remove all accumulations of silt and debris and to achieve a smooth bottom. If it is necessary to drain or pump water bodies and detention areas, the Contractor shall be required to implement ground water control measures to maintain the ground water level at a level to eliminate floating or slumping materials. The water level is to be maintained continuously at or below this level for the length of time that the pond water level is lowered. During filling of the water bodies to achieve previous or proposed water levels, the water level should be at or above the water level in the adjacent ground. Water bodies shall be filled with fresh water prior to securing the dewatering system. For further- information on dewatering, refer to DEWATERING as specified herein.

PART 2 - PRODUCTS

2.01 MATERIALS

1. Fill material shall be obtained from required on-site cut to the extent suitable material is available and off-site to the extent suitable material is not available from on-site cuts.

2. On-site material for use in compacted fill shall be natural inorganic granular soil taken from areas of cut after removal of pavement, topsoil, or other unsuitable materials.

3. Fill materials shall be well-graded within specified gradation limits. Gradation of backfill materials shall be determined in accordance with ASTM D-422.

4. Crushed Stone: Crushed stone processed from a stone quarry, washed, graded, free of organic materials. Gradation is as follows:

1. 1/2" Crushed Stone

U. S. SIEVE NO.	% PASSING BY WEIGHT
2"	100
1/2"	85-100
3/8"	15-45
#4	0-15
#8	0-5

2. 3/4" Crushed Stone

U.S. SIEVE NO.	% PASSING BY WEIGHT
1"	100
3/4"	90-100
1/2"	10-50
3/8"	0-20
# 4	0-5

3. 1-1/2" Crushed Stone

U.S. SIEVE NO.	% PASSING BY WEIGHT
2"	100
1-1/2"	95-100
l”	35-70
3/4"	0-25

4. Modified Rockfill

U.S. SIEVE NO.	% PASSING BY WEIGHT
8"	100
4"	0-25
2-1/2"	0-5

5. Structural Fill: Well-graded, hard, durable, natural sand and gravel, free from ice and snow, roots, sod, rubbish, and other deleterious or organic matter. Material shall conform to the following gradation requirements:

U.S. SIEVE NO.	% PASSING BY WEIGHT
4"*	100
#4	40-70
#200	0-12

- Four inches where placed as base below concrete floor slab and pavement or within 12 inches of walls; elsewhere 2/3 the lift thickness.

6. Ordinary Fill: Well-graded, natural, inorganic soil approved by the Architect and meeting the following requirements:

1. It shall have less than 3% organic matter, free from weak, compressible, or frozen materials, and of stones larger than eight inches in dimension. It shall not contain granite block, concrete, masonry rubble, roots, stumps or other similar materials.

2. It shall be of such nature and character that it can be compacted to the specified densities.

3. Topsoil and the zone directly below the topsoil indicated on the borings as "subsoil" shall not be considered Ordinary Fill nor shall topsoil or subsoil stockpiled on the site. Where subsoil is encountered, it shall be stripped separately from the topsoil and the granular material directly beneath the subsoil. This excavated material shall only be utilized in lawn areas, playfield areas or other non-structural areas, and shall be placed in these areas at distances away from adjacent site improvements as specified herein or as directed by the Architect.

4. It shall have a minimum dry density of not less than 100 pounds per cubic foot.

5. Material from excavations on the site may be used as Ordinary Fill if it is deemed acceptable by the Geotechnical Engineer.

7. Unsuitable material which is classified as "unsuitable" shall be material having at least one of the following properties:

1. Material with a maximum unit dry weight per cubic foot less than 90 lbs., as determined by ASTM D1557.
2. Material containing greater than 5% organic matter by weight, organic silt, peat, construction debris, roots and stumps.
3. Material deemed unsuitable by the Geotechnical Engineer based on its inherent inability to perform satisfactorily as a bearing stratum.
4. Soil, which is allowed to become frozen, saturated, or unstable because of the contractor's failure to employ appropriate dewatering, excavation methods, or weather protection is not deemed unsuitable soil but rather represents a condition in which the subgrade was not adequately prepared and/or protected.

8. Blast Rock Fill: Shall be broadly graded blasted rock with a maximum size of 12 inches, 25% smaller than six inches and 10% finer than 3/4 inch. Occasional boulders up to 18 inches will be permitted near the base of the fill.

1. General site rock fill (outside the building area) may be placed up to within 42 inches of finish grade in pavement areas and to within 18 inches of inverts of utility lines. First lift over the top of rock fill shall be a choke stone layer 18 inches thick. Compaction shall be by minimum of four coverages of a self-propelled vibratory drum roller in each direction (i.e. north-south and east-west). The minimum weight of the drum shall be 10,000 lbs. Compaction may also be by four coverages of heavy track equipment such as a CAT D8 Bulldozer or other heavy track equipment approved by the Geotechnical Engineer.
2. Rock shall not be placed within a five-foot horizontal distance on either side of any proposed utility line. The intent is to leave a zone of granular fill that can later be excavated for installation of utilities. Also, large rock fragments shall be kept away from utility pipes.

9. Choke Stone: Shall have a maximum rock size of nine inches and shall have 50% finer than 1-1/2 inch and 25% finer than 3/4 inch.

10. Sand Fill: Shall consist of well-graded natural sand, free from organic, other weak or compressible materials, or frozen materials, Conforming to the following gradation:

U.S. SIEVE NO.	% PASSING BY WEIGHT

#8	100
#50	15-40
#100	2-10
#200	0-5

11. Slab Base Course : Shall be hard, durable, natural sand and gravel, free from ice and snow, roots, sod, rubbish, or organic matter. Material shall conform to the following gradation requirements:

U.S. SIEVE NO.	% PASSING BY WEIGHT
2"	100
3/4"	20-90
#4	15-70
#40	10-50
#200	0-8

PART 3 - EXECUTION

3.01 GENERAL EXCAVATION

1. Excavate all materials encountered to allow construction of the proposed building and structures, utilities and site work as shown on the Drawings and as hereinafter specified.

2. Excavate to levels shown for footings and structures, as required to provide working clearance and to allow adequate inspection and to subgrades outside of buildings and structures as specified herein and as shown on Drawings.

3. In planted areas, remove ledge, boulders and other obstructions to a depth of at least two feet below finished grade.

4. Remove from the site and legally dispose of all debris and other excavated material not needed for, or suitable for, fill except as otherwise specified herein. Remove all materials subject to rot or attack by termites.

5. In general, the Contractor will be permitted to use machine excavation to the bottom of fill under concrete slabs on grade. The final three inches under footings and foundations shall be excavated using a straight blade bucket. If the final three inches cannot be satisfactorily excavated using a straight blade bucket without disturbing subgrades, the Contractor shall use alternative methods, including hand excavations. Alternative methods shall be subject to approval by the Architect or Geotechnical Engineer.

6. Unsuitable Soil Conditions:

   a. If unsuitable bearing materials are encountered at the specified subgrade depths, the Contractor shall notify the Architect. The Contractor shall carry excavation deeper and replace the excavated material with compacted fill or concrete as directed by the Architect or Geotechnical Engineer. Soil subgrades, which are unstable due to inadequate construction dewatering or excessive subgrade disturbance, are not deemed unsuitable soils.
   b. Removal of such material and its replacement as directed will be paid for as extra compensation in quantity approved by the Architect. Only changes in the work authorized in advance by the Architect in writing shall constitute an adjustment in the Contract Price.

c. Material that is not within +\- 3% optimum moisture for compaction of the particular material in place as determined by the Architect or the Geotechnical Engineer and is disturbed by the Contractor during construction operations so that proper compaction cannot be reached shall not be construed as unsuitable bearing materials. This material shall be removed and replaced with lean concrete or structural fill as directed by the Architect or Geotechnical Engineer at no additional cost to the Owner.

d. The Contractor shall follow a construction procedure, which permits visual identification of firm natural ground.

e. The volume of unsuitable material shall be measured by profiling the in-place topography and calculation by the average-end-area method or other method deemed acceptable by the Geotechnical Engineer. The contractor's Licensed Surveyor or Professional Engineer shall prepare the calculations. Payment limits shall be as for rock excavation.

7. Excessive Excavation: If any part of the general or trench excavation is carried, through error, beyond the depth and the dimensions indicated on the Drawings or called for in the Specifications, the Contractor at his own expense, shall furnish and install compacted gravel fill, concrete, or take other remedial measures as directed by the Architect to bring fill material up to the required level.

3.02 TRENCH EXCAVATION

1. Excavate as necessary for all footings, structures, pipes, storm and sanitary drainage, electrical, gas, water, related structures and appurtenances, and for any other trenching necessary to complete the work. Unless otherwise indicated, provide separate trench for each utility.

2. Definitions:

   1. "Trench excavation" shall be defined as an excavation in which the bottom width does not exceed seven feet and the top width does not exceed twice the depth or where footings are excavated by backhoe. Refer to Drawings for any special trenching conditions for utilities, structures, etc.

   2. The words "invert" or "invert elevation" as used herein mean the elevation at the inside bottom of pipe or channel.
   3. The words "bottom of the pipe" as used herein means the elevation at the base of the pipe at its outer surface.

3. In general, machine excavation of trenches will be permitted with the exception of preparation of pipe beds, which will be handwork. Excavate by hand or machine methods at least six inches below the bottom of all utilities.

4. Trench excavation shall include the removal of all materials encountered. During excavation, materials determined to be suitable for backfilling shall be piled in an orderly manner a sufficient distance from the banks of the trench to avoid overloading and to prevent slides or cave-ins. All excavated materials not required or unsuitable for backfill shall be removed and legally disposed off the site. The banks of trenches shall be cut as near vertical as practicable to the extent allowed by OSHA.

5. The Contractor shall provide, at his own expense, suitable bridges over trenches where required for accommodation and safety of the traveling public and as necessary to satisfy the required permits and codes.

6. Trenches shall be excavated to the necessary width and depth for proper laying of pipe or other utility and shall have vertical sides or slopes as required by codes. Minimum width of trenches shall provide clearance between the sides of the trench and the outside face of the utility. Maximum trench sizes are as shown on the Drawings or as specified herein. The depth of the trench shall be six inches below the bottom of the pipe barrel or respective utility. If the existing

soil is found not suitable, the Architect or Geotechnical Engineer may approve removal and replacement of material. Costs for removal and replacement materials will be based on Unit Prices.

7. Coordinate all utility and trench backfilling with the trades involved.

3.03 ROCK EXCAVATION

1. Definitions and Classifications: The following classifications of excavation will be made only when rock excavation is required.

    1. "Earth Excavation" consists of removal and disposal of pavement and other obstructions visible on ground surface; underground structures and utilities indicated to be demolished and removed; material of any classification indicated in data on subsurface conditions; and other materials encountered that are not classified as rock excavation.
    2. "Rock Excavation" consists of removal and disposal of materials encountered that cannot be excavated without continuous and systematic drilling and blasting or continuous use of a ripper or other special equipment, except such materials that are classed as earth excavation. Typical of materials classified as rock excavation are as follows:

        1. Consolidated Bedrock.
        2. Boulders on site, outside trench limits, exceeding two cubic yards in volume.
        3. Boulders within trench limits, exceeding one cubic yard in volume.

    3. Should highly fractured or weathered bedrock be encountered during excavation, the following shall apply:

        1. When the material is encountered in trenching operations or under footings, it shall be excavated or ripped with a hydraulic backhoe equal to or larger than a Caterpillar 235 excavator, and will be classified as Earth Excavation. When it is demonstrated to the satisfaction of the Architect and the Geotechnical Engineer that this material can no longer be removed with a hydraulic backhoe and requires drilling and blasting, this material shall be classified as Rock Excavation. - For excavation procedures when this material is encountered under footings, refer to paragraph below.

    4. Intermittent drilling and ripping performed to increase production and not necessary to permit excavation of material encountered will be classified as Earth Excavation.

    5. Allowance for Rock Excavation: The Contractor shall carry in the Base Bid an allowance for xxx cubic yards of rock encountered in trench excavation removed from the site. The Contractor shall also carry in the Base Bid an allowance of xxx cubic yards of open rock excavation removed from the site. The Base Bid shall cover all costs relating to such rock excavation, including blasting, removal and placement of the excavated material, overhead and profit. The Owner for excavation herein defined will pay no amount other than that herein specified.

        1. If the total quantity of Rock Excavation, open and/or trench, exceeds the amount of Rock Excavation included in the Contract as listed above, the Owner shall pay the excess excavation at the unit prices as indicated in the contract.
        2. If the total quantity of Rock Excavation, open and/or trench, is less than the amount of Rock Excavation included in the Contract as listed above, the Contract sum will be decreased by the difference in Rock Excavation multiplied by the unit prices as listed in the contract.

2. Measurements:

    1. When, during the process of excavation, rock is encountered, such material shall be uncovered and exposed in such a manner that the unbroken ledge surface is clearly

visible, and the Contractor shall notify the Architect, before proceeding further. The areas in question shall then be cross-sectioned as hereinafter specified.

2. Failure on the part of the Contractor to uncover such material and to notify the Architect and proceeding by the Contractor with the rock excavation before cross-sections are taken, will forfeit the Contractor's right of claim towards the stated allowance or additional payment over and above the stated allowance at the quoted unit price.
3. The Contractor shall employ and pay for a licensed Registered Civil Engineer or Land Surveyor to take cross-sections of rock before removal and to make computations of volume of rock encountered within the Payment Lines. Cross-sections shall be taken in the presence of the Geotechnical Engineer and the computations approved by the Architect. The volume calculations shall be by the average end area method. The Owner has the option to perform independent cross-sections and computations of rock quantities.
4. Where removal of boulder or ledge is required outside the established payment lines, the Architect shall determine the extent of this removal and basis of payment.

3. Blasting: Obtain written permission and approval of method from local authorities before proceeding with rock excavation. Explosives shall be stored, handled, and employed in accordance with state and local regulations or, in the absence of such, in accordance with the provisions of the "Manual of Accident Prevention of Construction" of the Associated General Contractors of America, Inc.

    1. Notify the Architect at least 48 hours before any intended blasting and do no blasting without his specific approval of each blasting operation.
    2. Contractor shall present evidence that his insurance includes coverage for blasting operations before doing any blasting work. A preblast survey shall be performed for all buildings and utilities within a radius of 150 feet from the blasting zone or conforming to the ordinance governing blasting and the Fire Department regulations.
    3. All rock blasting shall be well covered with heavy mats or timbers chained together and the Contractor shall take great care to do no damage to existing structures, utility lines and trees to remain.
    4. Any damage caused by the work of this Contractor shall be repaired to the full satisfaction of the Architect at no additional cost to the Owner.
    5. Any rock fragments or loose material from blasting operations shall be removed. All voids shall be filled with a leveling mat of structural fill or lean concrete as directed by the Geotechnical Engineer.
    6. At least 2 weeks prior to blasting the contractor shall submit a blasting plan indicating blasting agents to be used, drill hole depths and spacing, powder factors, personnel, vibration limits and method of measurement, for review by the Geotechnical Engineer.

4. Complaints:

    1. Report all blasting complaints to the Architect within 24 hours of receipt thereof. Include the name, address, date, time received, date and time of blast complained about, and a brief description of the alleged damages or other circumstances upon which the complaint is predicated. Assign each complaint a number, and number all complaints consecutively in order of receipt.
    2. Submit a summary report to the Architect each month which indicates the date, time and name of person investigating the complaint, and the amount of settlement, if any.
    3. When settlement of a claim is made, furnish the Architect with a copy of the release of claim by the claimant.
    4. Immediately notify the Architect, throughout the statutory period of liability, of any formal claim or demands made by attorneys on behalf of claimants, or of serving of any notice, summons, subpoena, or other legal documents incidental to litigation, and of any out-of-court settlement or court verdict resulting from litigation.
    5. Immediately notify the Architect of any investigations, hearings, or orders received from any governmental agency, board or body claiming to have authority to regulate blasting operations.

5. If ledge is encountered within the limits of the Proposed Building Area, the Contractor shall excavate this material 18 inches below subgrade of footings and 12 inches below subgrade of slabs unless otherwise directed by the Architect or Geotechnical Engineer. All loose or shaken rock shall be removed and replaced with compacted gravel fill or lean concrete as specified herein.

6. Rock excavation for foundations outside of the Building Area: Remove rock to foundation or footing subgrade. All rock bottoms for foundations shall be carefully examined. Loose or shaken rock shall be removed to solid bearing, and the rock surface leveled, or shelved to a slope not exceeding one inch per two feet, or as directed.

7. Excavate rock encountered in grading under paved areas, lawns and plant beds to subgrade as specified herein and shown on the Drawings. All boulders or protruding rock outcrops shall remain undisturbed at lawns and plant beds when so directed by the Architect. Rock shall be fractured six inches below subgrade of paved areas but this six-inch layer shall remain in place.

8. If any part of the rock excavation at footings be carried beyond the depth and the dimensions indicated on the Drawings or called for in the Specifications, the Contractor shall, at his own expense, furnish and install concrete of same strength as footings to the required subgrade level of the footings as shown on the Drawings. Doweling or other corrective structural measures as directed by the Architect may also be required to properly anchor or reinforce the concrete. If rock excavation is carried beyond the depth and dimensions to subgrade in other areas, the Contractor shall, at his own expense, furnish and install compacted gravel fill to subgrade as directed by the Architect.

9. Basis of Payment: The total amount of rock excavation will be based upon the volume of rock excavated within and/or above the lines referred to in the next paragraph as "Payment Lines". The payment lines are only to be used as a basis of payment, and are not to be used as limits of excavation. Limits of excavation area as shown on the Drawings and as specified herein.

10. Payment Lines for Rock Excavation:

    1. Payment lines for columns and footings within the building shall be a vertical line one foot from the toe of the footings; the depth shall be measured at 24 inches below the bottom elevations shown on the Drawings. If rock is to remain directly below the bottom of the footings within the Building Area, payment lines shall be six inches below the bottom elevation of the footing as shown on the Drawings. Payment lines for walls to be damp-proofed shall be a vertical line two feet outside the walls. Payment lines for footings outside of the building shall be six inches below the bottom of footings. Vertical payment lines shall be as specified hereinafter.
    2. Payment lines for manholes and catch basins shall be one foot outside of the outer wall and six inches below subgrade beneath the structure.
    3. Payment lines for rock excavation under slabs on grade shall be six inches below the bottom elevation of the specified gravel base course outside of the building and 12 inches below subgrade for slabs within the building.
    4. Payment lines for rock excavation at paved areas and lawns shall be six inches below respective subgrades.
    5. Payment lines for rock excavation under pipes within the building and for utility trenches outside the building lines shall in no case be calculated as greater in width than the outside diameter of the pipe plus two feet for pipes up to 18 inches. For pipes 18 inches and larger payment lines shall in no case be calculated as greater in width than the outside diameter of the pipe plus three feet. Payment lines at bottom of all pipe and utility trenches shall be six inches below subgrade.

3.04 PROOF-ROLLING

1. Contractor shall be required to proofroll foundation and pavement subgrades prior to foundation construction or the placement and compaction of fill materials.

2. Proofrolling of foundation subgrades shall include at least ten passes of a small vibratory plate compactor for trench excavations or six passes of a heavy vibratory roller for open areas.

3. Proofrolling of pavement subgrades shall include four passes of a heavy vibratory roller.

4. If groundwater is located within one foot of foundation or pavement subgrade, proofrolling may be eliminated. However, the Contractor shall demonstrate care during excavation so as to minimize subgrade disturbance.

5. The Geotechnical Engineer shall visually observe Proofrolling. Foundation construction or replacement of fill materials shall not commence until the Geotechnical Engineer has witnessed subgrade conditions and proofrolling operations.

6. Soils which exhibit weaving or instability during the proofrolling operations as determined by the Geotechnical Engineer shall be removed and replaced with compacted Structural Fill or Crushed Stone at no additional cost to the Owner.

3.05 FILLING AND GRADING

1. Samples and Testing:

    1. All fill materials, and their placement shall be subject to quality control testing. The Owner shall pay for all testing except that the Contractor will bear cost of testing materials, which fail to conform to Specifications. Test results and laboratory recommendations will be available to Contractor. All sieve analyses for conformance of on-site and off-site fill materials to be used in the work shall be done by means of a mechanical wet sieve analysis and in accordance with ASTM D-422.
    2. The Owner will retain a Geotechnical Engineer to provide personnel, qualified by training and experience, to be at the site to observe preparation for the placement of compacted fills, to observe excavation and dewatering required for the work, and to observe earthwork operations and report on the conformity of operations with these Specifications. All service and approvals given by the Geotechnical Engineer shall not relieve the Contractor of his responsibility for performing the work in accordance with these Specifications. The Contractor agrees to accept as final the results of field and laboratory tests performed by the above representatives. As stated hereinbefore, the Owner reserves the right to modify or waive Geotechnical Engineer's services.
    3. Excavated material taken directly from on-site cuts that will meet these Specifications may be used as Ordinary Fill or Structural Fill provided the Contractor obtains written approval from the Architect. No such fill material shall be put in place until approved for use by the Architect in writing.
    4. Field density tests will be made by the Geotechnical Engineer in accordance with the Method of Test for ASTM Designation D1556 or D2944, to determine the adequacy of compaction; the location and frequency of such field tests shall be at the Geotechnical Engineer's discretion.
    5. The Contractor shall notify the Architect or the Geotechnical Engineer when an area is ready for compaction testing. This notification shall be 48 hours in advance of placing or final compaction so that the Geotechnical Engineer has adequate time to take compaction tests.
    6. The Architect or his designated representative shall have the right to observe the installation of all controlled compacted fills.
    7. Testing of materials as delivered may be made from time to time. Materials in question may not be used, pending test results. Tests of compacted materials will be made regularly. Remove rejected materials and replace with new, whether in stockpiles or in place.
    8. Cooperate with the Geotechnical Engineer in obtaining field samples of in-place materials after compaction. Furnish incidental field labor in connection with these tests. The Contractor will be informed by the Geotechnical Engineer of areas of unsatisfactory density which may require improvement by removal and replacement, or by scarifying, aerating, sprinkling (as needed), and re-compaction prior to the placement of the new lift.

No additional compensation shall be paid for work required to achieve proper compaction.

9. The Geotechnical Engineer's presence does not include supervision or direction of the actual work by the Contractor, his employees, or agents. Neither the presence of the Geotechnical Engineer nor any observations and testing performed by him shall excuse the Contractor from defects discovered in his work.
10. In no case will frozen material be allowed for use in fill, backfill, or rough grading material.
11. Stones or rock fragments larger than four inches in their greatest dimension shall not be permitted within the top six inches of subgrade of any fills or embankments.

2. Placing, Spreading and Compacting Fill Material:

1. Fill materials are to be placed as designated herein and as indicated on the Contract Drawings.

1. Crushed Stone shall be placed as follows and compacted as specified herein:

1.) Under and around utility structures and around foundation drains and underdrains, (use 1/2" stone).
2.) Behind retaining walls, and under rip rap.
3.) Where otherwise shown on Drawings or as directed by the Architect.

2. Structural Fill shall be placed as follows and compacted in lifts to a minimum of 95% maximum dry density per the Modified Proctor Test (ASTM D 1557) as specified herein: (Refer to table specified herein for compaction methods and lift requirements.)

1.) Within building pad areas.
2.) As a subgrade fill for all material to be placed in controlled compacted fills under exterior concrete slabs, foundations, on grade stairs, and other soil bearing situations.
3.) Wherever a structural fill is called for or shown on the Drawings.

3. Ordinary Fill shall be placed as follows and compacted as specified herein:

1.) In general fill areas such as lawn or in parking islands except where Structural Fill is shown.
2.) Wherever Ordinary Fill is called for and as specified hereinbefore.
3.) Wherever Structural Fill, Crushed Stone, Sand Fill or Topsoil is not required herein or on the Drawings.

4. Blast Rock Fill may be placed up to within three feet of finish grade in pavement areas and within two feet of finish grade in lawns, and to within 30 inches of inverts of utility lines and proposed utility routes. First lift over the top of rock fill shall be choked stone layer 18 inches thick which shall be a well-graded mixture of sand, gravel, and blasted rock with maximum stone size less than nine inches. Compaction shall be by minimum of six coverages of a self-propelled vibratory drum roller in each direction (i.e. north-south and east-west). The minimum weight of the drum shall be 1 0,000 lbs. Compaction may also be by four coverages of heavy track machinery such as a Caterpillar D8 or other track machinery approved by the Geotechnical Engineer.

1.) Blast Rock Fill shall not be placed within 30 inches vertically of exterior concrete slabs (i.e. sidewalks, loading docks, etc..
2.) Rock shall not be placed within a five-foot horizontal distance on either side of any proposed utility line. The intent is to leave a zone of granular fill that can later be excavated for installation of utilities. Also keep large rock fragments away from any utility lines.

3.) Place woven filter fabric (Mirafi 500X or equivalent) over Blast Rock Fill.

5. Sand Fill shall be placed as follows and compacted as specified for the particular item:

1.) As a bedding material for PVC electrical conduit where concrete is not required, telephone-cable, primary electric service and gas pipe.
2.) Where otherwise specified or shown on the Drawings.

6. Slab Base Fill shall be placed in minimum 6-inch lift under concrete floor slabs.

7. Subsoil shall be used only under lawn areas and athletic fields. This material shall not be placed closer to areas being otherwise prepared than a 1:1 angle of repose x depth of fill for the particular area. For instance, if a fill is four feet deep, subsoil may not be placed closer than four feet to the area being otherwise prepared.

1.) Unsuitable Earth Materials shall be removed from the site.
2.) The fill material shall be placed in uniform horizontal layers and compacted as specified herein.

8. Each layer shall be spread evenly and shall be thoroughly mixed during the spreading to obtain uniformity of material in each layer. So far as practicable, each layer of material shall extend the entire length and width of the area being filled plus two additional feet horizontally along each side for every one foot of fill required.

3. All fill material shall be placed and compacted in the dry. The Contractor shall dewater excavated areas as required to perform the work, and in such a manner as to preserve the undisturbed bearing capaTown of the subgrade soils. In freezing weather, a layer of fill shall not be left in an uncompacted state at the close of a day's operation. Prior to terminating operations for the day, the final layer of fill, after compaction, shall be rolled with a smooth-wheeled roller to eliminate ridges of soil left by tractors, trucks and compaction equipment.
4. The Contractor shall not place a layer of compacted fill on soil that was permitted to freeze prior to compaction or on snow or ice. Removal of these unsatisfactory materials will be required as directed by the Owner.
5. When the moisture content of the fill material is below optimal moisture necessary for compaction as specified herein, water shall be added until the moisture content is as specified.
6. When the moisture content of the fill material is above the optimal moisture necessary for compaction as specified herein, the fill material shall be aerated by blending, mixing, or other satisfactory methods until the moisture content is as specified.
7. After each layer has been placed, mixed and spread evenly, it shall be thoroughly compacted to the specified density. Compaction shall be continuous over the entire area and the equipment shall make sufficient passes to ensure that the desired density is obtained. A minimum of four coverages with acceptable compaction equipment described hereinafter is a requirement. These coverages are to be provided as systematic compactive effort; incidental coverages due to construction vehicle traffic through the area will not be included.

3. Structural Fill: All fills within the building area shall be made with Structural Fill as defined herein and shown on the Footing Zone of Influence detail included herein. No excavated on-site material will be acceptable as Structural Fill unless specifically approved by testing as specified herein.

4. Allowance for Unsuitable Materials and replacement with Structural Fill: The Contractor shall

account for in his base bid for the removal of Unsuitable Materials and Structural Fill in place and graded as specified herein to be used as directed by the Architect or the Geotechnical Engineer. This quantity of Structural Fill is in addition to the requirements for Structural Fill in areas as specified herein, and as shown on the Contract Documents and is to be used at the discretion of the Architect or the Geotechnical Engineer.

5. Backfilling of Trenches, Structures and Foundations:

    1. Areas to be backfilled shall be free of construction debris, refuse, compressible or decayable materials and standing water. Do not place fill when temperature is below 30 degrees F and when fill materials or layers below it are frozen unless specifically approved by the Geotechnical Engineer.
    2. Requirement of description, placement, compaction and spreading of fill materials as specified herein shall be applicable to backfilling operations.
    3. Structural Fill shall be used as Backfill around manholes and other structures. Excavated material may be used if approved by the Architect or Geotechnical Engineer.
    4. Backfilling of foundations, structures and retaining walls shall not commence until construction finish grade has been approved, forms removed, and the excavation cleaned of trash and debris. Backfill shall not be placed against walls until they are braced or have cured sufficiently to develop the strength necessary to withstand, without damage, the pressure that will result from backfilling and compacting operations. If fill is required on both sides of a wall, it shall be brought up simultaneously and evenly on both sides. Avoid damage to the walls and to damp-proofing and waterproofing and other work in place. Allow seven days from the date of application of waterproofing before backfilling. Stones larger than four inches maximum dimension shall not be permitted in the upper six inches of fill or horizontally within 12 inches of walls.
    5. Do not commence backfilling operations of utility trenches until all piping, conduits, etc. have been installed, tested and approved and the locations of all pipe and appurtenances have been recorded. Backfill carefully by hand around pipe to depth of one foot above top of pipe using material specified herein, and tamping firmly in layers not exceeding six inch layers, compacting by hand rammers or mechanical tampers. When a manufacturer of utility line materials suggests backfill materials and methods other than those specified herein, such requirements shall govern providing the finished work equals or exceeds the result obtained by the materials and methods specified herein. Water mains shall be hand backfilled to a minimum cover of 18 inches before mechanical equipment can be used to backfill trench.
    6. Sand Bedding will be required below all pipe unless otherwise shown on the Drawings or specified herein. Crushed Stone is required under utility structures where shown on the Drawings. Gravel Bedding, Sand Bedding or Crushed Stone shall be placed to the full width of the trench and under utility structure foundations as indicated on the Drawings. After a pipe is bedded, the trench shall be filled to the centerline of the pipe with Gravel Fill or Sand Bedding except at the joint. After the joint is inspected, that portion shall be filled in with Sand Bedding. Material under and around the pipe shall be carefully and thoroughly tamped.
    7. From the centerline of the pipe to a point 12 inches above the top of the pipe the backfill shall be Structural Fill or Sand Fill placed by hand and hand tamped. Above this point, backfill shall be placed in layers six inches deep and each layer shall be compacted with mechanical tampers to not less than 95% of maximum density at optimum moisture of the material. This backfill shall be carried up to the bottom of materials specified to be placed for surfacing requirements.
    8. Utilities shall not be laid directly on ledge, boulders or other hard material. This material shall be removed as specified herein within trench limits, and within vertical planes one foot outside of structure walls. Backfill will be placed in eight-inch lifts and thoroughly compacted. If hand guided compaction equipment is used, fill shall be placed in six-inch lifts. All rock excavation shall be considered unsuitable for backfill around utilities. Ordinary fill may be used as backfill in areas as specified herein.
    9. Coordinate all utility and trench backfilling with the trades involved.

6. Compaction Equipment:

1. Compaction shall be accomplished by vibratory rollers, multiple wheel pneumatic tired rollers or other types of approved compacting equipment. Loaded trucks, low beds, water wagons and the like shall not be considered as acceptable compaction equipment unless specifically approved by the Architect or Geotechnical Engineer for a particular location. Equipment shall be of any such design that it will be able to compact the fill to the specified density in a reasonable length of time. All compaction equipment shall be subject to the approval of the Geotechnical Engineer.

7. Compaction Requirements:

    1. The following table lists minimum compactive efforts and lift weights which are required for all fill materials. Compaction of each lift shall be completed before compaction of the next lift is started. The compaction equipment shall make an equal number of transverse and longitudinal coverages of each lift. Allow the Geotechnical Engineer sufficient time to make necessary observations and tests. The degree of compaction for fill placed in various areas shall be as follows:

        Relative Compaction

        1. Within buildings and structures:
            -Under footings 95%
            -under slab 95%

        2. Outside building areas:
            -within paved areas 95%
            -within lawn areas and playing fields 85%

        - Percent of maximum dry density of the material at optimum moisture content as determined by methods or tests for ASTM designation D 1557.

8. Methods: The compaction alternatives given below are stated to provide minimum compaction standards only and in no way relieves the Contractor of his obligation to achieve the specified degree of compaction by whatever additional effort is necessary.

    1. All fill to be placed "in-the-dry" with the exception specified hereinafter. If, in the opinion of the Architect or the Geotechnical Engineer, the Contractor has followed a logical sequence of construction procedures, has employed the proper and necessary equipment, and has otherwise conducted himself in a workmanlike manner, but still cannot effectively dewater the excavation, the Architect or the Geotechnical Engineer may permit the Contractor to place a first lift of Gravel or Crushed Stone fill "in-the-wet". Fill placed in-the-wet must meet the gradation and placement requirements specified herein. The quantity of fill placed in-the-wet must be no greater than deemed necessary by the Architect and must be limited to the lowermost lift.

9. Moisture Control:

    1. Variation of moisture content in fill and backfill materials shall be limited to Optimum Moisture (-l% to +2%). Moisture content shall be as uniformly distributed as practicable within each lift, and shall be adjusted as necessary to obtain the specified compaction.
    2. Material which does not contain sufficient moisture to be compacted to the specified densities shall be moisture conditioned by sprinkling, discing, windrowing, or other method approved by the Geotechnical Engineer.

        1. Material conditioned by sprinkling shall have water added before compaction.

Uniformly apply water to surface of subgrade or layer of soil material to obtain sufficient moisture content. The Contractor shall maintain sufficient hoses and/or water distributing equipment at the site for this purpose.

3. Material containing excess moisture shall be dried to required Optimum Moisture before it is placed and compacted. Excessively moist soils shall be removed and replaced and shall be scarified by use of plows, discs, or other approved methods, and air-dried to meet the above requirements.
4. Materials, which are within the moisture requirements specified above, but which display pronounced elastiTown or deformation under the action of earthmoving and compaction equipment, shall be reduced to Optimum Moisture Content, or below, to secure stability.
5. In the event of sudden downpours or other inclement weather, exposed subgrades and fills which, in the opinion of the Geotechnical Engineer become inundated or excessively moistened shall have excess water removed and soil dried as specified above.

3.06 ROUGH GRADING

1. Rough grading shall include the shaping, trimming, rolling and finishing the surface of the sub-base, shoulders, and earth slopes, and the preparation of the sub-base for loam, seeding and paved surfaces. The grading of shoulders and sloped areas may be done by machine methods. Up to two inches in 100" tolerance will be permitted on slopes and one inch in 100" on lawn areas provided the slopes are uniform in appearance and without abrupt changes. All ruts shall be eliminated. Grading of subgrades for paved areas shall be finished at the required depth below and parallel to the proposed surface within 3/8 inch in 100" tolerance.

2. If, during the progress of rough grading work, water pipe, sewer conduit, drain, or other construction is damaged due to operations under this Contract, the Contractor shall repair all such damage at no additional cost to the Owner and restore damaged areas to their original condition.

3. Do all other cutting, filling and rough grading to the lines and grades indicated on the Drawings. Grade evenly to within the dimensions required for finished grades shown on the Drawings. No stone larger than three inches in largest dimension shall be placed in upper 12 inches of fill.

4. Grades shall be brought below finished grades in accordance with the various depths specified below:

    1. Under slabs-on-grade, as specified herein and as shown on the Drawings.
    2. Under paved areas, bottom of base course as shown on Drawings.
    3. Under seeded areas, six inches.
    4. Under cattail marsh area and pond bottom, 12 inches.

5. No rubbish of any description shall be allowed to enter fill material. Such material shall be removed from the site.

6. Complete the grading operations after the building has been finished, the utilities installed, site improvements constructed, and all materials, rubbish and debris removed from the site. Leave subgrade for lawns clean at required grades. There must be sufficient grade staking to provide correct lines and grades.

3.07 DEFICIENCY OF FILL MATERIAL

1. Provide required additional fill material from offsite sources to complete the work if a sufficient quantity of suitable material is not available from the required excavation on the project site.

3.08 SURPLUS OF FILL MATERIAL

1. Surplus fill which is not required to fulfill the requirements of the Contract shall be removed from the site and legally disposed of.

3.09 DUST AND EROSION CONTROL

1. The Contractor shall take all necessary measures and provide equipment and/or materials to minimize dust from rising and blowing across the site and also to control surface water throughout the operation so that it does not run onto paved ways without being filtered. In addition, the Contractor shall control all dust created by construction operations and movement of construction vehicles, both on the site and on paved ways. Provide additional crushed stone where necessary to provide traps or pads for construction vehicles carrying sediment. Provide temporary swales and interceptor ditches to control surface runoff water where necessary.

2. If dust control is required off-site due to work under this Contract, in addition to watering, sweeping and other methods, the Contractor shall apply calcium chloride in the required amounts to properly control dust. These amounts shall be approved by the Town Engineer prior to application.

3.10 RESTORATION OF SITE ITEMS

1. Wherever streets, lawns or other items within the Contract Limit Lines have been excavated in fulfilling the work required under the Contract, the Contractor shall furnish and install all material at no cost to the Owner to bring finish surface level with the existing adjacent conditions. All work shall be installed to match the existing conditions.

END OF SECTION 02200