Weston & Sampson

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Town of Millbury
Weston & Sampson Project No. 2180403

January 14, 2019

Town of Millbury
C/o Michael Moonan, RLA
Weston & Sampson
427 Main Street, Suite 400
Worcester, MA 01608

RE: Geotechnical Engineering Report
Downtown Redevelopment
Millbury, MA

INTRODUCTION

Weston & Sampson is pleased to present this report of geotechnical engineering services for the proposed Millbury, MA Downtown Redevelopment project. Improvements associated with the project are proposed in the area of the intersection of North/South Main Streets with Elm Street.

Based on a draft Materials Plan prepared by Weston & Sampson, proposed improvements include two (2) new traffic signal mast arms, a new clock tower, new pavement in and around the intersection of North/South Main Street with Elm Street, new drainage, new decorative pedestrian signals and street lights, and various other physical improvements as shown in *Figure 1 – Site Plan*. Geotechnical recommendations contained in this report are limited to the proposed traffic signal mast arms and clock tower only.

PROJECT UNDERSTANDING

The new traffic signal mast arms are proposed in existing concrete sidewalk areas at the northwest and southeast corners of the intersection of North/South Main Street with Elm Street, close to the location of existing mast arms. The mast arm at the northeast corner of the intersection will be 40 ft. long and the mast arm at the southeast corner of the intersection will be 30 ft. long. Both mast arms will be 20 ft. tall and will support up to four signals. We understand that the mast arms will be supported on drilled pier foundations that are designed in accordance with the MassDOT Standard Drawings for Overhead Signal Structure & Foundation. Drilled pier foundation diameter(s) and depth(s) will be determined by others based on information contained in this report and in the MassDOT Standard Drawings.

The new clock is proposed in an existing brick paved area in the southwest corner of the intersection. We understand the clock will be approximately 15 ft. tall and the pedestal will have a diameter of approximately 1.5 ft. Foundation details were preliminary at the time of this report, but we understand the clock tower will likely be supported on an approximately 3 ft. square concrete footing embedded 4 ft. below surrounding surface grades. A foundation bearing stress will be less than 2,000 pounds per square foot is assumed. Proposed elevations around the clock will essentially match existing elevations.

Subsurface utilities in the proposed mast arm and clock tower areas include water, sewer, drainage, electric, gas, and telecommunications.

SUBSURFACE CONDITIONS

Geologic Setting

Surficial geology information available from the Massachusetts Office of Geographic Information (MassGIS) indicates the site is located in an area of glacial till above bedrock at depths less than 50 ft. Bedrock outcrops are mapped about 500 ft. west of the site. Bedrock geology is mapped as metamorphic rock of the Avalon Belt. Bedrock outcrops were not observed during the site reconnaissance.

Subsurface Explorations

Subsurface conditions at the site were explored on October 31, 2018 by completing two borings (B-1 and B-2). Boring B-1 was completed at the location of the mast arm proposed at the southeast corner of the intersection and B-2 was completed at the location of the proposed clock tower. A boring was not completed at the location of the mast arm proposed at the northwest corner of the intersection since subsurface utilities had not been marked in this area on the day of our explorations. Approximate boring locations relative to existing and proposed site conditions are shown in *Figure 1.*

The borings were completed by Technical Drilling Services of Sterling, MA using a Geoprobe® rig and 4-1/4-inch inside-diameter hollow-stem augers. Standard penetration tests (SPTs) were conducted in the borings by driving a 24 in. long by 1-3/8 in. inside diameter (2 in. outside diameter) split spoon sampler with blows from a 140 lb. automatic hammer falling 30 in. per blow. Sampling intervals were generally every 2 ft. in the upper 11 to 13 ft. and every 5 ft. thereafter.

Weston & Sampson geotechnical engineering staff monitored drilling activities in the field and prepared logs for each boring. Subsurface conditions encountered in our borings are described in the following sections.

Subsurface Conditions

Subsurface conditions below concrete and brick surfaces generally consisted of up to approximately 7 ft. of fill above native sand and glacial till to the depths explored. The subsurface conditions encountered in the borings were generally consistent with the mapped surficial geology.

Descriptions of the subsurface conditions encountered in the borings are described below and included in the borings logs in *Attachment A*. Variations may occur and should be expected outside and between boring locations.

The concrete sidewalk at B-1 was approximately 3-inches thick and was underlain by approximately 6-inches of grouted gravel. Below the brick pavement at B-2, approximately 6-inches of concrete with wire mesh was encountered. The loose to medium dense FILL below the grouted gravel or concrete generally consisted of fine to coarse sand with varying amounts of gravel (little to gravelly) and trace silt. An approximately 6-inch thick layer of SILT with some fine to medium sand was encountered below the fill in B-1 and between the approximate depths of 5 and 5.5 ft.

The very loose to medium dense, fine to coarse SAND below the fill or silt generally contained trace to some silt and trace to little gravel. The sand was encountered to approximately 21 ft. in B-1. Boring B-2 was terminated in the sand at 11 ft. The very dense GLACIAL TILL below the sand in B-1 consisted of gravelly, fine to medium sand with some silt. Boring B-1 was terminated in the glacial till at 23 ft.

Groundwater was encountered between the approximate depths of 8.5 and 9 ft. in the borings. We anticipate that groundwater levels will fluctuate with season, variations in precipitation, construction in the area, and other factors. Perched groundwater conditions could exist close to the ground surface, especially during and after extended periods of wet weather.

GEOTECHNICAL DESIGN RECOMMENDATIONS

General

Based on the results of our subsurface explorations and geotechnical analyses, the proposed traffic signal mast arm (at the southeast corner of the intersection) and the clock tower can be constructed as planned following the recommendations contained herein.

As previously discussed, a boring was not completed at the location of the mast arm proposed at the northwest corner of the intersection of North/South Main Streets with Elm Street. We recommend completion of a boring at this location so that we can evaluate subsurface conditions and provide geotechnical recommendations for design and construction of the mast arm foundation.

Approximately 7 ft. of loose to medium dense granular fill was encountered at the location of the proposed clock tower. Complete removal of the fill below the clock tower foundation is not considered necessary since stresses imposed on the subgrade soils by the foundation are anticipated to be light, as described previously in this report However, partial removal of the existing fill is recommended to reduce stresses imposed on the fill and to provide a firm and stable subgrade to construct and support the foundation. Foundation subgrade recommendations are included in the Subgrade Preparation and Protection section of this report.

Shallow Foundation

The proposed clock tower can be supported by a shallow concrete footing bearing on at least 12-inches of compacted 1-1/2-inch crushed stone fill placed on recompacted granular fill approved by the geotechnical engineer. The footing bearing on these materials can be designed using an allowable bearing pressure of 2,000 pounds per square foot (psf). The allowable bearing pressure can be increased to 3,000 psf to resist temporary wind and seismic loads provided load eccentricities are within the middle third of the footing. Resistance to lateral loads can be obtained by a passive equivalent fluid unit weight of 250 pcf, ignoring the top 12 inches of embedment, and by a footing base friction coefficient of 0.45.

The foundation should be designed in accordance with the provisions of the latest edition of the Massachusetts State Building Code. The footing should be embedded at least 4 ft. below the nearest proposed adjacent ground surface exposed to freezing. The shallow foundation constructed as recommend herein is anticipated to undergo less than 1-inch of total settlement.

Mast Arm Foundation Design and Construction Recommendations

The mast arm foundations should be designed and constructed in accordance with provisions in the MassDOT Standard Drawings for Overhead Signal Structure & Foundation and MassDOT Standard Specifications Item 945 – Drilled Shafts. The design and construction recommendations presented in this section apply for the mast arm proposed at the southeast corner of the intersection of North/South Main Streets with Elm Street only. Design and construction recommendations for the mast arm proposed at the northwest corner of the intersection can be provided after a boring is completed at the mast arm location.

Boring B-1 was completed in the area of the mast arm proposed at the southeast corner of the intersection. Subsurface conditions encountered in B-1 consisted of approximately 5 ft. of loose fill and approximately 6-inches of silt above very loose to loose sand to approximately 21 ft. Very dense glacial till was encountered below the sand to the depth explored (23 ft.). Based on the subsurface conditions encountered in B-1 and in accordance with the MassDOT Standard Drawings for Overhead Signal Structure & Foundation, the mast arm foundation at this location should be designed using the soil parameters of Loose Wet Sand.

The Contractor should be responsible for selecting appropriate construction methods to ensure the foundations are constructed in accordance with project contract documents and with MassDOT Standard Specifications Item 945 – Drilled Shafts. The presence of caving soils and/or groundwater infiltration into foundation excavations should be anticipated. These conditions could require the use of casing or drilling slurry to maintain excavation integrity. Cleanout buckets may be required to remove loose and unstable material from the shaft base. Tremie methods should be utilized to install concrete if water is present at the bottom of the excavations.

CONSTRUCTION RECOMMENDATIONS

Excavation Considerations

Surface water should be controlled during construction and prevented from eroding temporary slopes and disturbing excavation and subgrade materials. If excavations encounter groundwater, moderate to severe caving should be expected where seepage is present. Flowing conditions are likely where granular soils and groundwater seepage are present.

All excavations should be made in accordance with applicable OSHA safety regulations. Temporary excavation support may be required for the clock tower foundation depending on the depth of excavation and if the excavation needs to approach the zone-of-influence beneath existing structures, utilities, or other site features. An excavation support system, if necessary, should be the responsibility of the Contractor and designed by a Professional Engineer licensed in the Commonwealth of Massachusetts.

Depending on excavation depth and amount of groundwater seepage, dewatering may be necessary. Flow rates for dewatering are likely to vary depending on location, soil type, and the season during which the excavation occurs. The dewatering system should be capable of lowering the groundwater table at least 2 ft. below the anticipated excavation depths and be kept operational until fill placement and compaction and concrete installation have been completed to at least 2 ft. above the groundwater table elevation. The dewatering system should be capable of handling variable flow rates and should be the responsibility of the Contractor.

Subgrade Preparation and Protection

Existing granular fill is expected at the clock tower foundation subgrade. Existing fill should be removed at least 12-inches below the bottom of the foundation and at least 12-inches beyond the foundation edges. Additional fill removal could be necessary if debris and/or organic materials are present in the fill or the fill cannot be compacted as recommended herein. Excavation should be completed with an excavator equipped with a smooth-edged bucket to reduce disturbance. This approach required observation of subgrade preparation by a Weston & Sampson geotechnical engineer.

The granular fill subgrade should be proof compacted with at least four (4) complete passes of a 700-pound vibratory plate compactor, or equivalent effort. Weston & Sampson should be contacted to evaluate the exposed subgrades prior to placement of foundation forms, rebar, or overlying materials. Over-excavation could be required if soft or unstable areas are identified during the proof compaction or if the subgrade is disturbed.

Compacted 1-1/2-inch crushed stone should be used to backfill the excavation up to the bottom of the clock tower foundation. Depending on the condition of the subgrade, a geosynthetic separation layer between the subgrade and crushed stone backfill may be required. We recommend that a geosynthetic used for stabilization consist of a woven geosynthetic with an AOS of #70 to # 100 sieve, and a minimum puncture resistance of at least 120 pounds (such as Mirafi FW700 or equivalent).

Soils containing more than trace amounts of silt are highly susceptible to softening and disturbance by construction activity during wet or freezing weather. Subgrade protection is the responsibility of the contractor and special precautions and protective measures appropriate for the weather conditions during construction should be used during earthwork and foundation construction to preserve the integrity of subgrades.

If foundation construction occurs during freezing conditions, insulating blankets, heaters, or other suitable measured should be employed to prevent the foundation subgrade from freezing until the foundation is backfilled sufficiently to prevent frost from reaching the foundation subgrade. The Contractor should be responsible for subgrade protection.

Fill

Crushed stone fill below the foundation should meet the requirements MassDOT M2.01.1 (1-1/2-inch crushed stone). The crushed stone should be placed in 6-inch thick maximum loose lifts with each lift compacted until well keyed.

Fill above and around the foundation should meet the requirements of MassDOT M1.03.0 (Gravel Borrow, type b). Gravel Borrow should be placed in 6-inch thick loose lifts with each lift compacted to at least 95 percent of the materials maximum dry density as determined by ASTM D1557.

Granular soils derived from the foundation excavation can be used as Gravel Borrow provided the material meets the requirements of Gravel Borrow and provided they are free of organics, contamination (including metals, VOCs, SVOCs, etc.), and other deleterious materials.

LIMITATIONS

We have prepared this report for use by the Town of Millbury and the design and construction teams for this project and this site only. The information herein can be used for bidding or estimating purposes but should not be construed as a warranty of subsurface conditions. We have made observations only at the aforementioned locations and only to the stated depths. These observations do not reflect soil types, strata thicknesses, water levels or seepage that may exist between observations.

We should be retained to review final design and specifications in order to see that our recommendations are suitably followed. If any changes are made to the anticipated locations, loads, grading, configurations, or construction timing, our recommendations may not be applicable, and we should be consulted.

The preceding recommendations should be considered preliminary, as actual soil conditions may vary. In order for our recommendations to be final, we should be retained to observe actual subsurface conditions encountered, specifically subgrade preparation for the clock tower foundation. Our observations will allow us to interpret actual conditions and adapt our recommendations if needed. Additional information about interpretation and use of this report is included in *Appendix B*.

Within the limitations of scope, schedule and budget, our services have been executed in accordance with the generally accepted practices in this area at the time this report was prepared. No warranty, expressed or implied, is given.

It has been a pleasure assisting you with this project and we look forward to our continued involvement. Please call if you have any questions.

Sincerely,

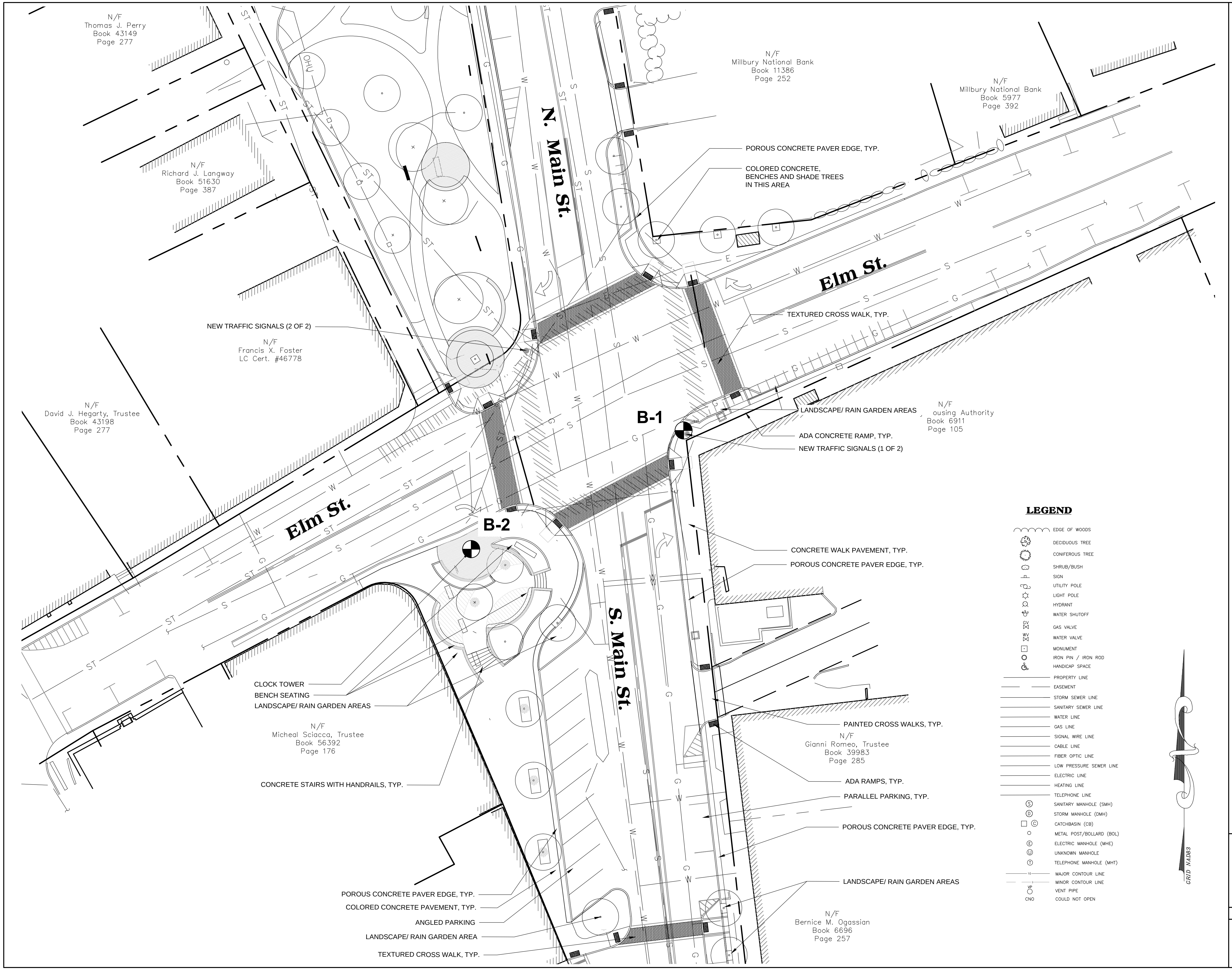
WESTON & SAMPSON ENGINEERS, INC.

Thomas J, Strike, PE
Senior Project Manager

Christopher J. Palmer, PE
Senior Technical Leader

Attachments:
Figure 1 – Site Plan (1 page)
Attachment A – Boring Logs (2 pages)
Attachment B – Important Information about This Geotechnical-Engineering Report (2 pages)

TJS:CJP



NOTES:

1. THIS DRAWING IS BASED ON A NOVEMBER 2018 DRAFT MATERIALS PLAN PREPARED BY WESTON & SAMPSON.
2. EXPLORATION LOCATIONS SHOWN ARE BASED ON FIELD MEASUREMENTS RELATIVE TO EXISTING SITE FEATURES.
3. BORINGS WERE COMPLETED BY TECHNICAL DRILLING SERVICES, INC. ON OCTOBER 31, 2018 AND OBSERVED BY A WESTON & SAMPSON REPRESENTATIVE.

LEGEND:

B-1 ◒	BORING DESIGNATION AND APPROXIMATE LOCATION.

40 20 0 40 80

SCALE: 1"=40'

FIGURE 1
SITE PLAN

MILLBURY, MA
DOWNTOWN REDEVELOPMENT

DESIGNED BY: RJV | CHECKED BY: TJS | DATE: NOVEMBER 2018

Weston & Sampson℠

ATTACHMENT A

Boring Logs

Weston & Sampson℠

BORING NUMBER: **B-1**

PAGE 1 OF 1

CLIENT: Town of Millbury
PROJECT NUMBER: 2180403
PROJECT NAME: Millbury Downtown Redevelopment
PROJECT LOCATION: Millbury, MA

DRILLER: Matt - Technical Drilling Services
LOGGED / CHECKED BY: R. van der Heijden / T. Strike
RIG TYPE / DRILLING METHODS: Geoprobe / hollow-stem auger (HSA)
CASING DIAMETER: 4.25" ID HSA
SAMPLING METHODS: Standard penetration test (SPT)
SAMPLER TYPE: Standard 24" long x 2" OD (1-3/8" ID) split-spoon
SAMPLER HAMMER: 140-lb. automatic hammer
OTHER:

BORING LOCATION: See site plan.
GROUND ELEVATION: 411 ft. +/-
DATUM: NAVD 88
DRILLING START DATE: 10/31/2018
END DATE: 10/31/2018

GROUNDWATER OBSERVATIONS

DATE	DEPTH	COMMENTS
10/31/2018	9 ft. +/-	Based on wet samples.

MATERIAL DESCRIPTION

(see guide below for soil classification based on constituent percentage)

Mineral Soil	Organic Soil
GRAVEL, SAND, SILT, CLAY: >50%	PEAT: 50-100%
gravelly, sandy, silty, clayey: 35-50%	organic (soil): 15-50%
some: 20-35%	with some organics: 5-15%
little: 10-20%	
trace: 0-10%	

DEPTH (ft.) *Elevation*	SAMPLE INFORMATION							GRAPHIC LOG	STRATA NAME	MATERIAL DESCRIPTION	COMMENTS
	TYPE - NO.	DEPTH (ft.)	REC./PEN. (in.)	SPT BLOWS/6"	SPT N-VALUE	% MOISTURE	% FINES (P200)				
0 *411*										Approximately 3 in. of concrete sidewalk over approximately 6 in. of grouted gravel.	
	S1	1.0	6/24	2 2 3 3	5				FILL	Loose, brown, fine to coarse SAND, some gravel, trace silt; moist. [FILL]	
	S1	3.0	0/24	7 6 1 1	7					No recovery - gravel stuck in tip of spoon.	
5 *406*	S3	5.0	22/24	2 1 1 1	2				SAND	Top 6": Dark brown, SILT, some fine to medium sand, trace organics (roots); moist. Bottom 16": Very loose, brown, fine to medium SAND, some silt; moist.	
	S4	7.0	0/24	2 1 1 2	2					No Recovery. ▼	
10 *401*	S5	9.0	14/24	3 4 5 6	9					Loose, gray-brown, fine to medium SAND, some silt, little gravel; wet.	
	S6	11.0	15/24	4 4 5 15	9					Loose, gray-brown, fine to medium SAND, some silt, trace gravel; wet.	
15 *396*											
	S7	16.0	0/24	10 10 9 9	19					No Recovery.	
20 *391*											
	S8	21.0	14/24	60 68 71 56	139				TILL	Very dense, gray-brown, gravelly fine to medium SAND, some silt; wet.	

End of boring at 23 ft.

SAMPLE		GRANULAR SOILS		COHESIVE SOILS	
SYMBOL	TYPE	N-Value	Density	N-VALUE	CONSISTENCY
S	Split spoon	0-4	Very Loose	< 2	Very Soft
ST	Shelby tube	4-10	Loose	2-4	Soft
AG	Auger grab	10-30	Med. Dense	4-8	Med. Stiff
NX	Rock core	30-50	Dense	8-15	Stiff
GP	Direct push	> 50	Very Dense	15-30	Very Stiff
				> 30	Hard

GENERAL NOTES:

1. The stratification lines represent the approximate boundary between soil types; actual transitions may be gradual.

2. Water level readings have been made in the drill holes at the times and conditions stated on the boring log. Fluctuations in the level of groundwater may occur due to other factors than those presented at the time measurements are made.

Weston & Sampson

BORING NUMBER: **B-2**

PAGE 1 OF 1

CLIENT: Town of Millbury
PROJECT NUMBER: 2180403
PROJECT NAME: Millbury Downtown Redevelopment
PROJECT LOCATION: Millbury, MA

DRILLER: Matt - Technical Drilling Services
LOGGED / CHECKED BY: R. van der Heijden / T. Strike
RIG TYPE / DRILLING METHODS: Geoprobe / hollow-stem auger (HSA)
CASING DIAMETER: 4.25" ID HSA
SAMPLING METHODS: Standard penetration test (SPT)
SAMPLER TYPE: Standard 24" long x 2" OD (1-3/8" ID) split-spoon
SAMPLER HAMMER: 140-lb. automatic hammer
OTHER:

BORING LOCATION: See site plan.
GROUND ELEVATION: 408 ft. +/-
DATUM: NAVD 88
DRILLING START DATE: 10/31/2018
END DATE: 10/31/2018

GROUNDWATER OBSERVATIONS

DATE	DEPTH	COMMENTS
10/31/2018	8.5 ft. +/-	Based on wet samples.

DEPTH (ft.) *Elevation*	SAMPLE INFORMATION							GRAPHIC LOG	STRATA NAME	MATERIAL DESCRIPTION (see guide below for soil classification based on constituent percentage) Mineral Soil: GRAVEL, SAND, SILT, CLAY: >50%; gravelly, sandy, silty, clayey: 35-50%; some: 20-35%; little: 10-20%; trace: 0-10% Organic Soil: PEAT: 50-100%; organic (soil): 15-50%; with some organics: 5-15%	COMMENTS
	TYPE - NO.	DEPTH (ft.)	REC./PEN. (in.)	SPT BLOWS/6"	SPT N-VALUE	% MOISTURE	% FINES (P200)				
0 *408*										Brick over approximately 6 in. of concrete with wire mesh.	
	S1	1.0	16/24	17 12 12 13	24				FILL	Medium dense, brown, gravelly fine to coarse SAND, trace silt; moist. [FILL]	
	S2	3.0	11/24	11 10 5 2	15					Medium dense, brown, fine to coarse SAND, some gravel. trace silt; moist. [FILL]	
5 *403*	S3	5.0	4/24	10 6 3 3	9					Loose, brown, fine to coarse SAND, little gravel, little silt; moist. [FILL]	Piece of gravel stuck in tip of spoon.
	S4	7.0	20/24	3 2 2 12	4				SAND	Loose, brown, fine to medium SAND, little silt, trace gravel; bottom 6 in. wet. ▼	
10 *398*	S5	9.0	19/24	4 13 14 16	27					Medium dense, gray-brown, fine to coarse SAND, little gravel, little silt; wet.	

End of boring at 11 ft.

SAMPLE		GRANULAR SOILS		COHESIVE SOILS	
SYMBOL	TYPE	N-Value	Density	N-VALUE	CONSISTENCY
S	Split spoon	0-4	Very Loose	< 2	Very Soft
ST	Shelby tube	4-10	Loose	2-4	Soft
AG	Auger grab	10-30	Med. Dense	4-8	Med. Stiff
NX	Rock core	30-50	Dense	8-15	Stiff
GP	Direct push	> 50	Very Dense	15-30	Very Stiff
				> 30	Hard

GENERAL NOTES:

1. The stratification lines represent the approximate boundary between soil types; actual transitions may be gradual.

2. Water level readings have been made in the drill holes at the times and conditions stated on the boring log. Fluctuations in the level of groundwater may occur due to other factors than those presented at the time measurements are made.

ATTACHMENT B

Important Information about This Geotechnical Engineering Report

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, clients can benefit from a lowered exposure to the subsurface problems that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed below, contact your GBA-member geotechnical engineer. Active involvement in the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Geotechnical-Engineering Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. *Those who rely on a geotechnical-engineering report prepared for a different client can be seriously misled.* No one except authorized client representatives should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one – not even you – should apply this report for any purpose or project except the one originally contemplated.*

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read it *in its entirety*. Do not rely on an executive summary. Do not read selected elements only. *Read this report in full.*

You Need to Inform Your Geotechnical Engineer about Change

Your geotechnical engineer considered unique, project-specific factors when designing the study behind this report and developing the confirmation-dependent recommendations the report conveys. A few typical factors include:

- the client's goals, objectives, budget, schedule, and risk-management preferences;
- the general nature of the structure involved, its size, configuration, and performance criteria;
- the structure's location and orientation on the site; and
- other planned or existing site improvements, such as retaining walls, access roads, parking lots, and underground utilities.

Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

This Report May Not Be Reliable

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, that it could be unwise to rely on a geotechnical-engineering report whose reliability may have been affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If your geotechnical engineer has not indicated an "apply-by" date on the report, ask what it should be*, and, in general, *if you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying it. A minor amount of additional testing or analysis – if any is required at all – could prevent major problems.

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface through various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing were performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgment to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team from project start to project finish, so the individual can provide informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, *they are not final*, because the geotechnical engineer who developed them relied heavily on judgment and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* revealed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a full-time member of the design team, to:

- confer with other design-team members,
- help develop specifications,
- review pertinent elements of other design professionals' plans and specifications, and
- be on hand quickly whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction observation.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for informational purposes only*. To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report, but they may rely on the factual data relative to the specific times, locations, and depths/elevations referenced. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely*. Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures*. If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. As a general rule, *do not rely on an environmental report prepared for a different client, site, or project, or that is more than six months old.*

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, none of the engineer's services were designed, conducted, or intended to prevent uncontrolled migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration.*** Confront the risk of moisture infiltration by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***

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