ADDENDUM NO**. 1**
ISSUE DATE: **May 20, 2025**

RE: **GRAINGER HALL DINING EXPANSION AND RENOVATION**
UNIVERSITIES OF WISCONSIN - MADISON
MADISON, WISCONSIN
UW-Madison Project No. 9950-2307 / UWSA Project No. A-24-004

BID OPENING: **MEP Bid – 2:00 P.M., June 10, 2025.**
GPC Bid – 2:00 P.M., June 24, 2025.

FROM: **Workshop Architects**
201 E. Pittsburgh Ave. Suite 301
Milwaukee WI 53204

TO: Prospective Bidders

This addendum forms a part of the Contract Documents and modifies the original Contract Documents dated **April 14, 2025** as noted below. Acknowledge receipt of this Addendum by inserting the number and issue date of this addendum in the blank space provided on the Bid Form. Failure to do so may subject the Bidder to disqualification.

This Addendum consists of **1 page** and the attached documents:

CHANGES TO THE SPECIFICATION (DIVISIONS 2 THRU 33):

Division 2 – Existing Conditions:
- 02 32 00 - GEOTECHNICAL INVESTIGATION
  - a. Geotechnical Report has been added to the specification.

END OF ADDENDUM

The Board Of Regents Of The Universities of Wisconsin System
C/O UWSA - Capital Planning And Budget,
780 Regent Street, Suite 239
Madison, Wisconsin 53715

SECTION 02 32 00
GEOTECHNICAL INVESTIGATION
BASED ON DFD MASTER SPECIFICATION DATED 11/21/13

PART 1 - GENERAL

SCOPE

This section provides information resulting from subsurface investigations completed at the site as part of this project. The information provided is for design and construction purposes. The project specifications and plans shall supersede any information or recommendations provided in the subsurface investigations if there are any conflicts. This section may contain information applicable to ALL sitework, and other technical specification sections, as well. All Contractors are expected to review this information as part of their duties to familiarize themselves with the site.

A Geotechnical Investigation Report was completed by CGC, Inc. on November 22, 2024. Results of the geotechnical investigation apply only to the locations at which data was collected, at the specific time it was collected. Geotechnical conditions may differ elsewhere on the site. Refer to the Geotechnical Investigation Report following this section.

Prior to making additional investigations of his own using test pits, borings, or other methods; Bidder shall first gain permission from property owner and UW-Madison Project Manager. Geotechnical investigations completed by Bidder shall comply with all applicable requirements of Division 01 through Division 33 of this project.

RELATED WORK

Applicable provisions of Division 01 govern work under this Section.

Section 02 05 00 – Common Work Results for Existing Conditions
Section 03 30 00 – Cast-In-Place Concrete
Section 30 05 00 – Common Work Results for all Exterior Work
Section 31 20 00 – Earthmoving
Section 31 22 16.15 – Roadway Subgrade Preparation
Section 31 23 16.13 - Trenching
Section 31 23 19 – Dewatering
Section 31 25 00 – Erosion Control
Section 31 41 16 – Sheet Piling
Section 32 11 23.33 – Dense Graded Base
Section 32 91 13 – Soil Preparation
Section 33 40 00 – Storm Drainage Utilities

PART 2 - MATERIALS

Not used.

PART 3 - EXECUTION

Not used.

END OF SECTION

CGC, Inc.
Construction • Geotechnical
Consulting Engineering/Testing

November 22, 2024
C24476

Ash Lettow, AIA, NCARB
Workshop Architects, Inc.
201 E Pittsburgh Ave Suite 301
Milwaukee, WI 53204

Re: Geotechnical Exploration Report
Proposed Building Addition
UW Madison Grainger Hall
Madison, WI

Dear Mr. Lettow:

Construction • Geotechnical Consultants, Inc. (CGC) has completed the subsurface exploration program for the above-referenced project. The purpose of this program was to evaluate the subsurface conditions within the proposed construction area and to provide geotechnical recommendations regarding excavation, foundation, floor slab, below-grade wall and pavement design/construction. A determination of the site class for seismic design is also included. We are sending you an electronic copy of this report, and we can provide a paper copy upon request.

PROJECT DESCRIPTION AND SITE CONDITIONS

We understand that a two-story building addition is planned within the current Grainger Hall courtyard off West Johnson Street, which currently contains landscaping and concrete pavement with benches and picnic tables. It is understood that about the western two-thirds of the addition will be supported on the existing below-grade levels that are present below a portion of the courtyard. Furthermore, an approximately 1,000-SF below-grade expansion is planned adjacent to the existing parking structure. The ground surface within the courtyard is fairly flat and near finished first floor elevation of Grainger Hall (100’-0” which appears to correspond to EL 875.6 ft based on provided building drawings).

Two levels of below-grade parking are present below approximately the western two-thirds of the courtyard, with the lower parking level P2 having a finished floor elevation of 73’-7” (or approximately EL 849.2 ft). The existing building wing on the east side of the courtyard generally does not include a lower level. As an exception, a concrete box conduit is present below the east wing near the north end of the courtyard. The box conduit is located within a vault with the bottom at approximately 81’-3” (approximately EL 856.9 ft). The east wing is a building addition that was completed in 2006.

The new below-grade portion of the building is planned to include mechanical equipment and will be located along the east wall of the existing parking levels with a plan footprint of about 40 ft by 25 ft. The bottom of the underground mechanical room is proposed to be established at 82’-7” (approximately EL 858.2 ft), matching the finished P1 floor elevation. New duct banks are planned to the east and south adjacent to the new mech room, with a small area bounded by the new northern and southern duct banks, the new mech room and the existing east wing of the building remaining unexcavated. The duct banks are expected to be 6 ft deep below finished first floor elevation.

In order to not impose additional loads on the exterior walls of the below-grade parking levels, the mech room and new above-grade construction beyond the limits of the parking structure are planned to be supported on micropiles. The tops of pile caps are planned at depths between 1'-6" and 3'-0" below finished first floor elevation outside the footprint of the mech room, and at 18'-11" below the mech room. The micropiles will have a required service capacity of 40 tons.

SUBSURFACE CONDITIONS

Subsurface conditions for this study were explored by drilling three Standard Penetration Test (SPT) soil borings (labeled B-1 through B-3) to planned depths of 35 ft. The general boring locations were selected by Thornton Tomasetti and marked in the field by CGC under consideration of existing site features. The borings were drilled by America's Drilling Company (ADC; under subcontract to CGC) on October 7, 2024 using a track-mounted Geoprobe 7822DT rotary drill rig equipped with hollow stem augers and an automatic SPT hammer. Note that auger refusal occurred in B-2 at a depth of about 5.5 ft on an unknown obstruction (possible concrete and/or brick rubble), and three offset borings (labeled B-2A, B-2B and B-2C) were subsequently drilled in an attempt to bypass the obstruction. B-2A and B-2B terminated at about 5.5 ft below the ground surface with the same result as B-2, while B-2C was able to reach the planned boring depth. Ground surface elevations at the boring locations were estimated by CGC based on the provided building drawings and 1-ft contour lines shown within DCiMap, and the elevations should therefore be considered approximate.

In addition to the recently completed soil borings, we have also considered the findings of four SPT soil borings (labeled B-1 [2004] through B-4 [2004]) in this evaluation, which were completed in 2004 in the area of the eastern building wing addition. The borings from 2004 were extended to 50 ft below the (then) ground surface. We assume the ground surface elevations indicated on the boring logs from 2004 refer to finished first floor elevation of Grainger Hall (100'-0"), which we have estimated at about EL 875.6 ft based on provided building drawings.

The specific procedures used for drilling and sampling are described in Appendix A, and the boring locations are shown in plan on the Soil Boring Location Exhibit presented in Appendix B. The subsurface profiles at the boring locations varied somewhat near the ground surface but were fairly consistent with depth, and can be described, in general terms, by the following strata (in descending order):

- About 5 to 6 in. of ***concrete pavement*** on top of about 5 to 10 in. of base course at B-1, B-2, B-2A, B-2B and B-3; or
- About 2.5 in. of ***topsoil fill*** at B-2C; underlain by

- Roughly 4 to 13 ft of ***fill*** in B-1, B-2, B-3 and B-1 [2004], comprised of loose to very dense *sand* soils with typically significant amounts of silt and gravel that were intermixed with *rubble/debris* (brick, concrete, wood, etc.); and/or
- Approximately 4 to 22 ft of loose to dense ***sand*** strata in B-1, B-2C, B-3, B-2 [2004] and B-4 [2004], containing somewhat variable amounts of silt and gravel as well as scattered silt seams and cobbles/boulders; followed by
- On the order of 8 to 28 ft of stiff to hard ***lean to silty clay*** in B-2C, B-3 and B-1 [2004] through B-4 [2004]; over
- Medium dense to very dense ***sand*** strata with somewhat varying amounts of silt and gravel, as well as scattered cobbles/boulders, to the maximum depths explored.

As noted, B-2, B-2A and B-2B terminated at depths of about 5.5 ft below current courtyard grades as a result of auger refusal. Per information provided by Thornton Tomasetti, a “garden wall” was present in this area prior to construction of the east wing building addition. Refusal in the borings may have occurred on remnants of the old wall, or other coarse rubble/debris contained within the fill soils. Some of the sand soils directly underlying or being present instead of the apparent fill materials were classified as *possible fill* due to their depth/position in the profile and/or somewhat inconsistent composition or coloration.

Groundwater was encountered in the majority of the recent and previous borings during and shortly after the completion of drilling at about 19 to 34 ft below the ground surface, corresponding to approximately EL 837 to 856 ft. It must be noted, however, that some of the encountered soils are fairly to very fine-grained, typically correlated to a fairly to very low hydraulic conductivity, which can be expected to delay groundwater infiltration into and subsequent stabilization of the groundwater table in the boreholes. The groundwater level observations during the fairly short period of drilling (and shortly thereafter) should therefore be considered approximate. In light of this, groundwater levels were checked in B-1 [2004], B-2 [2004] and B-4 [2004] about one to two days after the completion of drilling, at which time the groundwater table was at about 18 to 28.5 ft below (then) site grades, or approximately EL 843 to 857 ft. Note that the shallower water observed in B-1 [2004] at a depth of about 18 ft (or EL 857 ft) on the day after drilling was completed may have been accumulation of seepage from perched water circulating within a sand layer interbedded within otherwise relatively impermeable clay soils. A similar perched condition may have been observed in B-2 [2004] where water was documented at a depth of about 24 ft (or EL 850 ft) at roughly two days after the completion of drilling. The water level observed in B-4 [2004] at a depth of about 28.5 ft (or EL 843 ft) within the fairly permeable sand deposits underlying the clay layers may be most representative of the static groundwater table (at that time). Shallower perched zones of water may also be encountered within existing sand fill materials that are underlain by less permeable clay or very dense granular soils.

Grainger Hall is located about 1,600 ft south of Lake Mendota and 3,300 ft northwest of Monona Bay/Lake Monona. As such, the natural (undisturbed) groundwater level is generally expected to be between the water levels in the two lakes. For reference, on the day the recent soil borings were conducted (October 7, 2024), water levels in Lakes Mendota and Monona were recorded at about EL 850.1 and 845.0 ft, respectively, according to the Dane County Land & Water Resources Department *Lake Levels & Information* online platform. Typical summer maximum water levels in Lakes Mendota and Monona are EL 850.1 and 845.2 ft, and a 1% flood event is defined by water levels of EL 852.8 and 847.7 ft, respectively. It must be noted that permanent dewatering efforts below the P2 parking level of Grainger Hall and lower levels of existing buildings in the vicinity of Grainger Hall may effectively result in a groundwater drawdown over a larger area, which may result in an apparent groundwater level below the assumed undisturbed groundwater table based on interpolation of lake levels. Groundwater levels are expected to fluctuate with pumping rates in nearby wells, dewatering below nearby buildings, water levels in Lakes Mendota and Monona and seasonal variations in precipitation, infiltration, evapotranspiration, as well as other factors.

A more detailed description of the site's soil and groundwater conditions is presented on the individual boring logs attached in Appendix B.

DISCUSSION AND RECOMMENDATIONS

Subject to the limitations discussed below and based on the subsurface exploration, it is our opinion that the site is generally suitable for the planned improvements, and that the additions outside of the footprint of the existing parking levels can be supported on micropiles or potentially conventional shallow spread footing foundations. If shallow foundations are chosen, undercutting and replacement of unsuitable existing fill and/or loose native soils will likely be required below the bottom of some footings. Our recommendations for excavation, foundation, floor slab, below-grade wall and pavement design/construction, along with a discussion of the seismic site class, are presented in the following subsections. Additional information regarding the conclusions and recommendations presented in this report is discussed in Appendix C.

1. Excavation

Based on spatial constraints on the site and with the building wing east of the planned mechanical room and duct banks not containing a lower level, it is our opinion that temporary shoring/earth retention will generally be required to secure the excavation. The provided plans show a proposed permanent earth retention system on the north, east and south sides of the planned excavation, consisting of apparent sheet piling. The west side of the excavation is expected to be secured by the eastern exterior wall of the existing P1 parking level. The earth retention system should be designed by an adequately qualified professional engineer.

Based on provided/assumed building grades, water level observations in the soil borings and typical lake levels, we do not anticipate the need for full-scale dewatering of the mech room/duct bank excavation. The anticipated sheet piling may be sufficient to shut off lateral seepage from perched layers. However, seepage from perched layers or precipitation accumulating at the bottom of the excavation should be quickly removed, using pumps that operate from filter sump pits or similar. *Dewatering means and methods are the contractor's responsibility.*

Note that the presence of rubble/debris or remnants of former structures may hinder sheet pile driving. Since the excavation is not expected to extend below the groundwater table, a different earth retention system (e.g., drilled soldier piles with wood lagging or potentially shotcrete with soil nails) may be better suited for the site.

Where remnants of former structures are encountered below planned building grades, we recommend these elements be completely removed. Subsequently, the soils exposed below the removed elements should be carefully evaluated for their foundation, floor slab and duct bank support suitability, as applicable, followed by restoring design grades with granular backfill compacted to at least 95% compaction based on modified Proctor methods (ASTM D1557) in accordance with our Recommended Compacted Fill Specifications presented in Appendix D. Alternatively, 3-in. dense graded base (DGB) that is placed in loose 10-in. lifts and compacted until deflection ceases can also be used to restore grades in undercut or low areas. Unsuitable soils present at the bottom of former/removed structures should be undercut prior to backfill placement.

Sloped excavations, if any, are expected to be controlled by sand soils with low to moderate amounts of fines (denoted SP and/or SP-SM on the boring logs). Based on OSHA guidelines, these soils are typically classified as "Type C" soil, and slopes of 1.5H:1.0V are expected to be at least temporarily stable. Note that flatter side slopes may be required where perched or seeping water is present that destabilizes the side slopes. *The appropriate excavation side slopes should be determined by a competent person completing the earthwork in accordance with OSHA slope guidelines.*

2. <u>Foundation Design</u>

A. Micropiles

The bottom of the new mechanical room is expected to match the finished floor elevation of the adjacent P1 level (82'-7" or approximately EL 858.2 ft), and the tops of pile caps below the mech room are planned at 18'-11" below finished first floor grade, or approximately EL 856.7 ft. In addition, isolated shallower pile caps are planned outside the footprint of the mech room and duct bank excavation to support the new above-grade construction, with the tops of pile caps ranging between 1'-6" and 3'-0" below finished first floor elevation (approximately EL 872.6 to 874.1 ft). In order to not impose additional loads on the P1 and P2 exterior walls, it is our opinion that the use of deep foundations is likely warranted. However, if the P1 and P2 walls can accommodate the additional lateral pressures from new shallow foundations and the duct banks, *which should be evaluated by a structural engineer,* deep foundation may not be necessary. Shallow foundations are further discussed in the following subsection.

Based on the spatial constraints of the site, with the lid on top of the parking level immediately west of the planned mech room presumably not designed to accommodate loads from heavy construction machinery, it is our opinion that micropiles are the best deep foundation alternative for this project. Micropiles can be installed using fairly light and compact drilling equipment, somewhat comparable to the rig used do drill the recent soil borings. Micropile diameters typically range from about 5 to 9 in., and the upper part of the borehole is usually cased, with the bottom part of the hole not cased. After (or during) drilling, a high-strength threaded steel bar is placed in the borehole and grouted in-place. Soil parameters for micropile design, including *ultimate (i.e., unfactored)* grout-to-ground bond strengths are summarized in Table 1.

TABLE 1 – Estimated Soil Parameters(1) for Deep Foundation Design

Parameter	**Loose to Dense Sand**	**Stiff to Hard Clay**	**Medium Dense to Very Dense Sand**
Boring No.	***Approximate Bottom Elevation of Layer (ft)***		
B-1	848±	Not encountered	<840±(2)
B-2/2C	856±	848±	<840±(2)
B-3	863±	848±	<840±(2)
B-1 [2004]	Not encountered	848±	<825±(2)
B-4 [2004]	855±	844±	<821±(2)
Angle of Internal Friction (deg)	30	0(3) / 25(4)	36
Cohesion (psf)	0	4,000(3) / 400(4)	0
Active Lateral Earth Pressure Coefficient	0.3	1.0(3) / 0.4(4)	0.3
Passive Lateral Earth Pressure Coefficient	3.0	1.0(3) / 2.5(4)	3.9
Moist Unit Weight (pcf)	120	120	130
Saturated Unit Weight (pcf)	130	125	140
L-Pile Soil Type Code(4)	4 – Sand (Reese)	3 – Stiff Clay without Free Water	4 – Sand (Reese)
L-Pile Constant of Subgrade Reaction, n_h (pci)	90	1,000(6) / 400(7)	125
Estimated Ultimate Bond Strength for Micropiles (psi)			
Gravity-Grouting	15	10	25
Pressure-Grouting	25	20	40

Notes: (1) Parameters do not include a factor of safety (i.e., FS = 1)

[2] Soil boring termination depth.
[3] For undrained/short-term loading conditions.
[4] For drained/long-term loading conditions.
[5] Per L-Pile Plus 5.0 for Windows User's Manual.
[6] For static loading.
[7] For cyclic loading.

We recommend applying a factor of safety of 3.0 to the ultimate bond strengths summarized in Table 1 when calculating allowable micropile capacities. Accordingly, for a service capacity of 40 tons as specified for this project, an ultimate capacity of 120 tons would be required per micropile. It is our opinion that these capacities can be achieved with micropiles that are grouted within the medium dense to very dense sand strata that were generally encountered below about EL 844 to 848 ft. Several combinations of pile diameter, bond length and grouting technique would be possible to achieve the required capacities. For example, a micropile with a diameter of 6 in. that is pressure-grouted over a length of at least 14 ft within the target strata would likely be able to develop an ultimate capacity greater than 120 tons. *End-bearing of micropiles should be neglected.*

The factor of safety can be reduced to 2.0 if at least one static load test is performed to document the bond strength. If the controlling load direction is tension (uplift), a pullout load test should be performed to evaluate pullout capacity.

Micropile design should be completed by the specialty contractor installing the micropiles, or their design engineer. Other items that should be considered in the micropile design include:

- The micropile contractor should also be aware of the presence of larger cobbles and boulders or possible very gravelly zones within the native sand soils that could slow micropile installation.

- The clay soils may be slightly corrosive, and appropriate corrosion protection should be provided where micropiles are in contact with these soils, since this application is considered a permanent installation.

- Pile caps/grade beams should be located a minimum of 4 ft below finish grade for frost protection, and these excavations should be sloped in accordance with OSHA slope guidelines if they need to be entered by workers.

- The minimum spacing between micropiles should be the larger of 30 in. or three micropile diameters.

B. Conventional Shallow Spread Footings

As noted, if the existing exterior parking level walls can accommodate the additional loads imposed by new shallow spread footings and the base slabs of the duct banks, *which should be evaluated by a structural engineer*, deep foundations may not be necessary. Shallow footings outside the footprint of the mech room excavation are generally expected to bear within existing sandy fill soils or the underlying, loose to medium dense native sands. The duct banks are expected to be supported on newly-placed backfill outside of the mech room. Footings below the mech room are expected to bear within loose to dense sand or very stiff to hard clay soils. *The suitability of the existing fill soils for foundation support should be carefully evaluated at the time of construction, and soils deemed unsuitable for foundation support should be undercut and replaced.* We recommend the following parameters be used for spread foundation design, if deemed feasible:

- Maximum net allowable bearing pressure:
    - Shallow footings outside of mech room excavation: 2,000 psf
    - Duct banks and footings supported on new backfill within mech room excavation: 3,000 psf
    - Footings below mech room: 5,000 psf

- Modulus of subgrade reaction for duct bank slabs[1]: 150 pci

- Friction[2] factors:
    - Mass concrete on clay soils: 0.4
    - Mass concrete on sand soils: 0.5

- Nominal lateral earth pressure[3] coefficients:
    - Active earth pressure coefficient, K_a: 0.31
    - Passive earth pressure coefficient, K_p: 3.25
    - At-rest earth pressure coefficient, K_0: 0.47

- Minimum foundation widths:
    - Continuous wall footings: 18 in.
    - Column pad footings: 30 in.

- Minimum footing depths below finish site grades:
    - Exterior/perimeter footings: 4 ft
    - Interior footings: no minimum requirement

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[1] Assuming the inclusion of a minimum 6 in. of well-compacted 1¼-in. DGB over firm, recompacted soil subgrade below the slab.

[2] *Unfactored values – appropriate factor of safety needs to be applied*.

[3] *Unfactored values – appropriate factors of safety need to be applied*; assuming granular foundation backfill with less than 20% by weight passing the No. 200 U.S. standard sieve (including some of the native sands), compacted to a minimum 95% compaction based on modified Proctor methods (ASTM D1557). Unit weight of 120 pcf can be assumed for adequately compacted granular backfill.

Where new footings are planned adjacent to existing building foundations, the effects of overlapping soil stresses must be considered, and the recommended maximum net allowable bearing pressure must not be exceeded. If the existing building footings are designed for a lower allowable bearing pressure, the lower bearing pressure will control the maximum allowable overlapping soil stress. Care must also be exercised not to undermine the existing building foundations during new footing and possible undercut excavations.

As a variety of subsurface conditions may be encountered across the improvement area, foundation subgrades should be evaluated during construction by a CGC field representative to document that the subgrade soils are suitable for footing support or otherwise advise on corrective measures, such as undercutting. We recommend using a smooth-edged backhoe bucket for footing/undercut excavations. Granular soils exposed at footing grade or at the bottom of undercut excavations should be thoroughly recompacted with a large vibratory plate compactor or an excavator-mounted hoe-pack prior to backfilling or formwork/concrete placement to densify soils loosened during the excavation process. Soils potentially susceptible to disturbance from vibratory compaction (e.g., cohesive/fine-grained soils or sands with elevated moisture contents) should be hand-trimmed. OSHA slope guidelines should be followed if workers need to enter the excavations.

As noted, undercutting will be required where unsuitable existing fill materials are present at or below footing grades. In addition, native clays with pocket penetrometer readings (q_p-values; an estimate of the unconfined compressive strength of cohesive soils) of less than 1.0, 1.5 and 2.5 tsf, should also be undercut at or slightly below the bottom of footings proportioned for an allowable bearing pressure of 2,000, 3,000 and 5,000 psf, respectively. Further, loose or disturbed native sands that cannot be adequately recompacted or stabilized in-place should also be undercut and replaced slightly below the bottom of conventional shallow spread footings. *The base of undercut excavations should be widened beyond the footing edges at least 0.5 ft in each direction for each foot of undercut depth for stress distribution purposes.* In order to re-establish footing grades in undercut areas, we recommend using granular backfill (including native sand soils excavated on-site) compacted to at least 95% based on modified Proctor methods (ASTM D1557), in accordance with the Recommended Compacted Fill Specifications presented in Appendix D. Alternatively, 3-in. DGB that is placed in loose 10-in. lifts and compacted until deflection ceases can also be used to restore foundation grades.

Provided the foundation design/construction recommendations discussed above are followed, we estimate that total and differential settlements should be on the order of 1.0 and 0.5 in., respectively.

3. **Floor Slab**

The floor slab of the new mechanical room is generally expected to be supported on loose to dense sand or very stiff to hard clay soils. Prior to slab construction, granular subgrade soils should be thoroughly recompacted with a vibratory smooth-drum roller to densify soils that may become disturbed or loosened during construction activities. Cohesive or fine-grained subgrades should be statically recompacted and subsequently proof-rolled to check for soft/yielding areas. Areas of disturbed soil or where soils remain loose after recompaction should be undercut and replaced with compacted 3-in. DGB or granular fill.

To act as a capillary break below the slab, we recommend including a minimum 6-in. thick layer of well-graded sand/gravel with less than 5% by weight passing the No. 200 U.S. standard sieve. Note, however, that some structural engineers require a layer of dense graded base, such as 1¼-in. DGB, rather than sand/gravel below floor slabs to increase the subgrade modulus immediately below the slab. To further reduce the potential for moisture migration through the slab, a vapor barrier can also be utilized. Fill and base layer material below the floor slab should be placed as described in the Site Preparation section of this report. Slabs constructed on a minimum 6-in. thick dense graded base layer may be designed utilizing a subgrade modulus of 150 pci, and a subgrade modulus of 100 pci should be used for the design of slabs that are constructed on a sand/gravel layer. The design subgrade moduli are based on a firm or adequately stabilized, recompacted subgrade such that non-yielding conditions are developed. If a higher subgrade modulus is required due to heavier slab loads, a thicker aggregate section may be required below the slabs, which should be evaluated by the structural engineer. The slab should be structurally separated from the footings or pile caps/grade beams with a compressible filler and have construction joints and reinforcement for crack control.

4. Below-Grade Walls

We anticipate that the exterior walls of the new mech room and duct banks will be laterally supported and restrained against rotating by structural means. Therefore, *at-rest* lateral earth pressures should be used during the design of these walls. To reduce the buildup of such pressures, high-quality backfill should be placed within 4 to 6 ft of the walls. We recommend that a perimeter drainage system be installed to intercept potential surface water infiltration, and that the granular backfill be continuously connected to the drainage system, which discharges water by means of one or more sump pumps. The granular backfill should be well-graded sand or gravel having no more than 12% by weight passing the No. 200 U.S. standard sieve (i.e., USCS designations SP, SP-SM, GP or GP-GM). Sands with higher amounts of fines (denoted as SM on the boring logs) may potentially also be used as wall backfill if a three-dimensional drainage board is included in the wall design. Soils containing cobbles/boulders should not be used in direct contact with below-grade walls. To impede the inflow of surface water, the final 2 ft of backfill in unpaved areas should consist of a clayey fill cap. The clayey cap (or pavement) should be graded to promote positive drainage away from the walls.

Before placing the wall backfill, the exterior walls should be damp-proofed with spray-applied or mopped-on rubber or bituminous sealer. Compaction of the backfill within 3 to 5 ft of the walls should be performed with lightweight equipment to avoid the development of excessive lateral earth pressures. The backfill should generally be compacted to a minimum compaction level of 93% modified Proctor following Appendix D guidelines. *Note, however, that we recommend a minimum 95% compaction where shallow exterior footings, stoops or pavement will be supported on the wall backfill.* Lower-level walls constructed in accordance with the above recommendations may be designed for an equivalent fluid pressure of 55 psf per foot of depth (*drained*, *at-rest* conditions). Additionally, the wall design should also account for surcharge effects that could be applied during or after construction.

5. Seismic Site Class

In our opinion, the average soil properties in the upper 100 ft of the site [based on SPT blow counts (N-values) projected to range between 15 and 50 blows/ft, on average, in the granular soils underlying the site] may be characterized as a stiff soil profile. This characterization would place the site in Site Class D for seismic design according to the International Building Code and ASCE 7.

6. Pavement Design

We anticipate that minimal exterior pavement areas are planned as part of the improvements. We generally anticipate that concrete will be used for these applications. We recommend that concrete pavement be at least 6 in. thick and contain adequate reinforcement for crack control. Concrete slabs underlain by a minimum 6-in. thick dense graded base layer over a firm or stabilized subgrade can be designed utilizing a subgrade modulus of 150 pci. Note that if only foot/bicycle traffic is expected on new pavement areas, the concrete thickness may be reduced to 4 in. If needed, we can provide additional recommendations for design and construction of flexible pavement upon request.

CONSTRUCTION CONSIDERATIONS

Due to variations in weather, construction methods and other factors, specific construction problems are difficult to predict. Soil related difficulties which could be encountered on the site are discussed below:

- Due to the potentially sensitive nature of some of the on-site soils, we recommend that final site grading activities be completed during dry weather, if possible. Construction traffic should be avoided on prepared subgrades to minimize potential disturbance.

- Earthwork construction during the late fall through early spring could be complicated as a result of wet weather and freezing temperatures. During cold weather, exposed subgrades should be protected from freezing before and after footing construction. *Fill should never be placed while frozen or on frozen ground.*

- Excavations extending greater than 4 ft in depth below the existing ground surface should be sloped or braced in accordance with current OSHA standards. Earth retention systems should be designed by an adequately qualified professional engineer. *Care must be exercised not to undermine the footings of the existing building and other nearby improvements during construction, and the need for underpinning should be evaluated by the contractor.*

- Based on the observations made during our field exploration, we generally do not anticipate groundwater to be encountered during footing, undercut or pile cap/grade beam excavations. However, water accumulating at the bottom of excavations as a result of precipitation or seepage from perched layers should be quickly removed, with dewatering means and methods being the contractor's responsibility.

RECOMMENDED CONSTRUCTION MONITORING

The quality of the foundation, floor slab and pavement subgrades will be largely determined by the level of care exercised during site development. To check that earthwork and foundation construction proceed in accordance with our recommendations, the following operations should be monitored by a CGC:

- Topsoil stripping and subgrade proof-rolling/compaction;
- Fill/backfill placement and compaction;
- Deep foundation installation;
- Foundation excavation/subgrade preparation; and
- Concrete placement.

* * * * *

It has been a pleasure to serve you on this project. If you have any questions or need additional consultation, please contact us.

Sincerely,

CGC, Inc.

Tim F. Gassenheimer, PE
Senior Staff Engineer

Ryan J. Portman

Ryan J. Portman, PE
Senior Consulting Professional/Field Supervisor

Encl: Appendix A - Field Exploration
Appendix B - Soil Boring Location Exhibit
Logs of Test Borings (7)
Log of Test Boring-General Notes
Unified Soil Classification System
Appendix C - Document Qualifications
Appendix D - Recommended Compacted Fill Specifications

APPENDIX A

FIELD EXPLORATION

APPENDIX A

FIELD EXPLORATION

Subsurface conditions for this study were explored by drilling three Standard Penetration Test (SPT) soil borings to 35 ft below current site grades, and we have also included the results of four SPT borings that were previously completed to depths of 50 ft on the site. The borings were sampled at 2.5-ft intervals to a depth of 10 ft, and at 5-ft intervals thereafter. The soil samples were obtained in general accordance with specifications for standard penetration testing, ASTM D1586, and the specific procedures used for drilling and sampling are described below.

1. Boring Procedures between Samples

   The boring is extended downward, between samples, by a hollow-stem auger.

2. Standard Penetration Test and Split-Barrel Sampling of Soils
   (ASTM Designation: D1586)

   This method consists of driving a 2-in. outside diameter split-barrel sampler using a 140-lb weight falling freely through a distance of 30 in. The sampler is first seated 6 in. into the material to be sampled and then driven 12 in. The number of blows required to drive the sampler the final 12 in. is recorded on the log of borings and is known as the Standard Penetration Resistance.

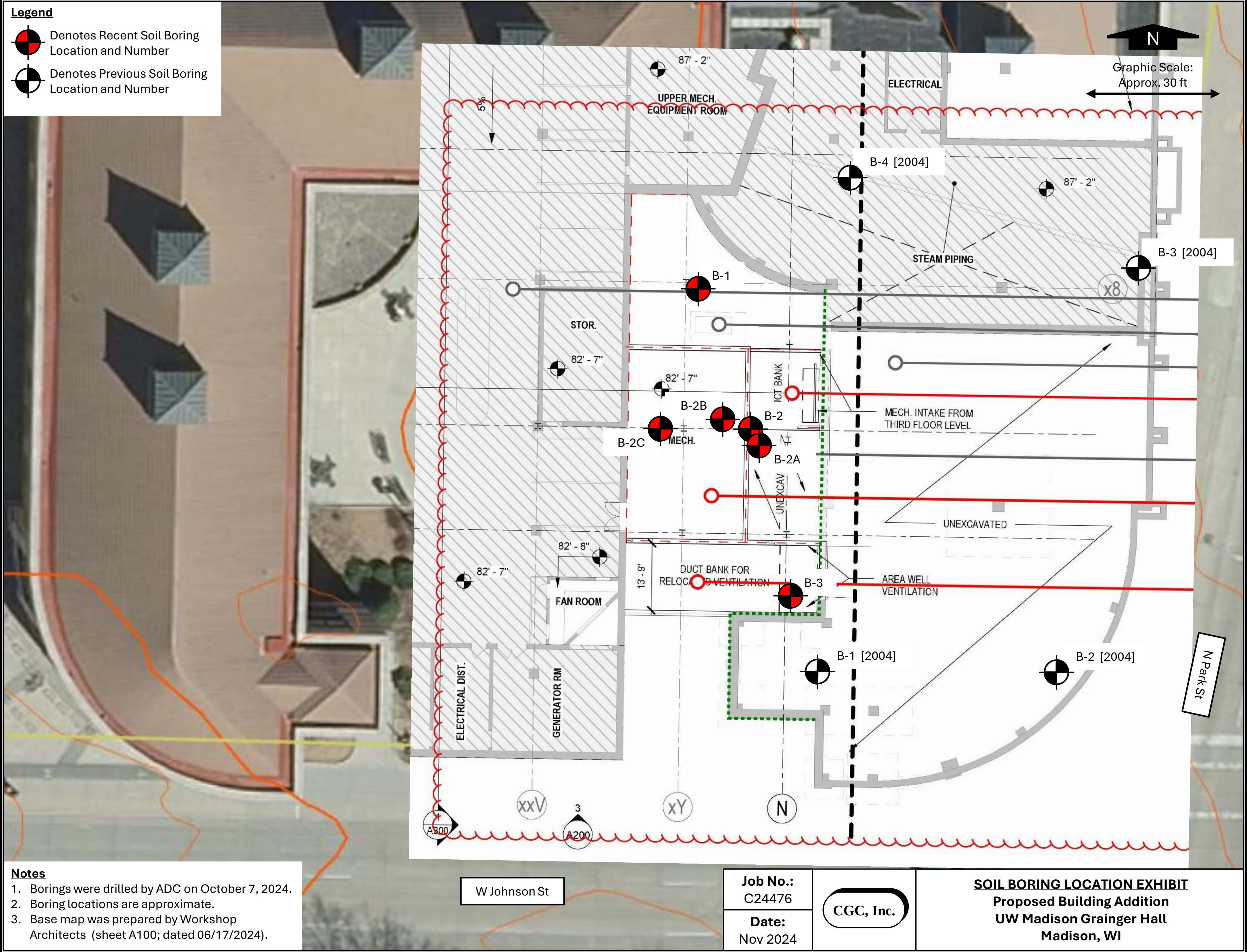
During the field exploration, the driller visually classified the soil and prepared a field log. *Field screening of the soil samples for possible environmental contaminants was not conducted by the driller as these services were not part of CGC's work scope*. Water level observations were made in each boring during and after drilling and are shown at the bottom of each boring log. Upon completion of drilling, the borings were backfilled with bentonite to satisfy WDNR regulations, and the soil samples were delivered to our laboratory for visual classification. The soils were visually classified by a geotechnical engineer using the Unified Soil Classification System. The final logs prepared by the engineer, along with a Soil Boring Location Exhibit and a description of the Unified Soil Classification System are presented in Appendix B.

APPENDIX B

SOIL BORING LOCATION EXHIBIT
LOGS OF TEST BORINGS (7)
LOG OF TEST BORING-GENERAL NOTES
UNIFIED SOIL CLASSIFICATION SYSTEM

Legend

- ⊕ Denotes Recent Soil Boring Location and Number
- ⊕ Denotes Previous Soil Boring Location and Number



Notes

1. Borings were drilled by ADC on October 7, 2024.
2. Boring locations are approximate.
3. Base map was prepared by Workshop Architects (sheet A100; dated 06/17/2024).

Job No.:	C24476
Date:	Nov 2024

CGC, Inc.

SOIL BORING LOCATION EXHIBIT
Proposed Building Addition
UW Madison Grainger Hall
Madison, WI

CGC Inc.

LOG OF TEST BORING

Project: **Proposed Building Addition**
UW Madison Grainger Hall
Location: **Madison, WI**

Boring No. **1**
Surface Elevation (ft) **875±**
Job No. **C24476**
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N	Depth (ft)		qu (qa) (tsf)	W	LL	PL	LI
						6± in. Concrete Pavement / 10± in. Base Course					
1	■	13	M	10		FILL: Loose, Brownish Gray Fine to Coarse Sand, Some Gravel, Little to Some Silt					
2	■	0	M/W	8		No Recovery in SPT Sample 2; Sample Obtained from Auger Cuttings Contained Concrete Fragments					
					5						
3	■	14	M/W	7		Loose, Grayish Brown Fine to Coarse SAND, Some Silt, Little Gravel (SM; Possible Fill)					
4	■	13	M/W	6							
					10						
5	■	14	M/W	15		Loose to Medium Dense, Brownish Gray Fine to Coarse SAND, Little to Some Silt and Gravel, Scattered Silt Seams (SP-SM/SM)					
					15						
6	■	11	M/W	16							
					20						
7	■	8	M/W	7							
					25						
					∇						
					▼	Dense, Tan Fine SAND, Trace to Little Silt, Scattered Silt Seams (SP/SP-SM)					
8	■	16	W	34							
					30						
9	■	15	W	56		Very Dense, Light Brown Fine to Medium SAND, Some Silt and Gravel, Scattered Cobbles/Boulders (SM)					
					35	End of Boring at 35 ft Borehole Backfilled with Bentonite-Grout Mixture and Concrete Patch					
					40						

WATER LEVEL OBSERVATIONS

While Drilling	∇ 27.0'	Upon Completion of Drilling			
Time After Drilling				15 mins.	
Depth to Water				28.4'	▼
Depth to Cave in				28.4'	

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **10/7/24** End **10/7/24**
Driller **ADC** Chief **CJ** Rig **Geoprobe**
Logger **BU** Editor **TFG** **7822DT**
Drill Method **2.25" HSA; Autohammer**

CGC Inc.

LOG OF TEST BORING

Project **Proposed Building Addition**
UW Madison Grainger Hall
Location **Madison, WI**

Boring No. **2**
Surface Elevation (ft) **875±**
Job No. **C24476**
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N	Depth (ft)		qu (qa) (tsf)	W	LL	PL	LI
						5.5± in. Concrete Pavement / 6.5± in. Base Course					
1	■	14	M	11		FILL: Medium Dense to Very Dense, Light Brown Fine to Medium Sand, Some Silt and Gravel, Scattered Wood, Concrete and Brick Fragments					
2	■	8	M	78/8"							
					5	End of Boring/Auger Refusal on Unknown Obstruction at 5.5 ft Borehole Backfilled with Bentonite-Grout Mixture and Concrete Patch					
					10						
					15						
					20						
					25						
					30						
					35						
					40						

WATER LEVEL OBSERVATIONS

While Drilling ∇ NW Upon Completion of Drilling NW
Time After Drilling
Depth to Water ▼
Depth to Cave in

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **10/7/24** End **10/7/24**
Driller **ADC** Chief **CJ** Rig **Geoprobe 7822DT**
Logger **BU** Editor **TFG**
Drill Method **2.25" HSA; Autohammer**

CGC Inc.

LOG OF TEST BORING

Project **Proposed Building Addition**
UW Madison Grainger Hall
Location **Madison, WI**

Boring No. **2C**
Surface Elevation (ft) **875±**
Job No. **C24476**
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE

No.	TYPE	Rec (in.)	Moist	N	qu (qa) (tsf)	W	LL	PL	LI
1	■	7	M	5					
2	■	15	M	4					
3	■	15	M	6					
4	■	16	M	11	(4.5+)				
5	■	17	M	20	(4.5+)				
6	■	14	M/W	51					
7	■	15	W	63					

Depth (ft): 5, 10, 15, 20, 25, 30, 35, 40

VISUAL CLASSIFICATION and Remarks

2.5± in. TOPSOIL FILL

Blind-Drilled B-2A about 5 ft SSE and B-2B about 7 ft WNW of B-2 with Same Result (Auger Refusal at 5.5 ft in B-2A and 5.0 ft in B-2B);
Offset about 25 ft W of B-2 for B-2C, Blind-Drilled to 6 ft, then Resumed Sampling; See B-2 for Soil Description to 5.5 ft

Loose, Grayish Brown Gravelly Fine to Coarse SAND, Little to Some Silt (SP-SM/SM; Possible Fill)

Loose, Tan Fine to Medium SAND, Little to Some Silt, Trace Gravel, Scattered Silt Seams (SP-SM/SM)

Hard, Brown Lean CLAY, Trace Sand, Interbedded Medium Dense, Gray/Brown (Mottled) SILT, Trace Sand (CL/ML)

Hard, Light Brown Lean CLAY, Trace Sand (CL)

Very Dense, Tan Fine to Medium SAND, Some Silt and Gravel, Scattered Cobbles/Boulders (SM)

End of Boring at 35 ft

Borehole Backfilled with Bentonite-Grout Mixture

SOIL PROPERTIES

WATER LEVEL OBSERVATIONS

While Drilling ▽ 32.0' Upon Completion of Drilling

Time After Drilling				15 mins.
Depth to Water				29.6' ▼
Depth to Cave in				29.6'

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **10/7/24** End **10/7/24**
Driller **ADC** Chief **CJ** Rig **Geoprobe**
Logger **BU** Editor **TFG** **7822DT**
Drill Method **2.25" HSA; Autohammer**

CGC Inc.

LOG OF TEST BORING

Project **Proposed Building Addition**
UW Madison Grainger Hall
Location **Madison, WI**

Boring No. **3**
Surface Elevation (ft) **875±**
Job No. **C24476**
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE

No.	TYPE	Rec (in.)	Moist	N	qu (qa) (tsf)	W	LL	PL	LI
1	■	14	M	33					
2	■	13	M/W	9					
3	■	11	M/W	12					
4	■	14	M	15					
5	■	16	M	5	(3.5-4.0)				
6	■	15	M	18	(4.5+)				
7	■	6	M	28	(-)*				
8	■	15	M	55					
9	■	12	M	63					

Depth (ft): 5, 10, 15, 20, 25, 30, 35, 40

VISUAL CLASSIFICATION and Remarks

5± in. Concrete Pavement / 5± in. Base Course

FILL: Loose to Dense, Light Brown Fine to Coarse Sand, Some Gravel, Little to Some Silt, Scattered Silt/Clay Seams and Concrete Fragments

Medium Dense, Grayish Brown Fine to Coarse SAND, Little to Some Silt and Gravel (SP-SM/SM; Possible Fill)

Very Stiff to Hard, Light Brown Lean to Silty CLAY, Trace Sand (CL/CL-ML)

*Pushed Stone near 23.5 ft; no Reading Possible on Disturbed Clay Sample

Very Dense, Tan Fine to Medium SAND, Some Gravel, Little Silt (SP-SM)

Very Dense, Tan Fine SAND, Trace to Little Silt and Gravel (SP/SP-SM)

End of Boring at 35 ft

Borehole Backfilled with Bentonite-Grout Mixture and Concrete Patch

SOIL PROPERTIES

WATER LEVEL OBSERVATIONS

While Drilling ▽ NW Upon Completion of Drilling
Time After Drilling 15 mins.
Depth to Water NW ▼
Depth to Cave in 24.5'

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **10/7/24** End **10/7/24**
Driller **ADC** Chief **CJ** Rig **Geoprobe**
Logger **BU** Editor **TFG** **7822DT**
Drill Method **2.25" HSA; Autohammer**

CGC Inc.

LOG OF TEST BORING

Project Grainger Hall Addition
Park Street and University Avenue
Location Madison, WI

Boring No. 1
Surface Elevation (ft) 99.0
Job No. C04153
Sheet 1 of 2

3011 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N	Depth (ft)		qu (qa) (tsf)	W	LL	PL	LI
						6 in. TOPSOIL					
1	▮	12	M	4		FILL: Loose to Very Dense, Light Brown Fine SAND, Some Silt, Little Gravel (SM)					
2	▮	18	M	11		More gravel near 9 ft					
					5						
3	▮	18	M	29							
4	▮	11	M	50/4"							
					10						
5	▮	18	M	12		Very Stiff, Light Brown Lean CLAY, Trace Sand (CL)					
					15		(2.5-3.0)				
						Dense, Light Brown Fine SAND, Little Silt (SP-SM)					
6	▮	18	W	58	⊻	Hard, Light Brown to Brown Lean CLAY (CL)	(4.5+)				
					20						
						Hard, Gray/Brown Lean CLAY (CL)					
7	▮	18	W	105			(4.5+)				
					25						
						Very Dense, Brown Fine to Medium SAND, Some and Gravel, Occasional Cobbles and Boulders (SM)					
8	▮	14	M	178 /8"	30						
9	▮	12	W	50/4"							
					35						
10	▮	12	W	50/3"							
					40						

WATER LEVEL OBSERVATIONS

While Drilling ⊻ 19.0'   Upon Completion of Drilling ______

Time After Drilling			24 hr	1/4 hr
Depth to Water			18'	19.3' ▼
Depth to Cave in			24'	40.1'

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start 6/15/04 End 6/15/04
Driller Badger Chief JHR Rig B-59
Logger JHR Editor WWW
Drill Method 4 1/4 in. HSA

CGC Inc.

LOG OF TEST BORING

Project Grainger Hall Addition
Park Street and University Avenue
Location Madison, WI

Boring No. 1
Surface Elevation 99.0
Job No. C04153
Sheet 2 of 2

3011 PERRY STREET, MADISON, WIS. 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N	Depth (ft)		qu (qa) (tsf)	W	LL	PL	LI
						Very Dense, Brown Fine SAND, Little Silt (SP-SM)					
11	■	14	W	85/9"							
					45						
12	■	4	W	50/4"							
					50	End Boring at 50 ft Borehole backfilled with bentonite chips					
					55						
					60						
					65						
					70						
					75						
					80						
					85						

CGC Inc.

LOG OF TEST BORING

Project Grainger Hall Addition
Park Street and University Avenue
Location Madison, WI

Boring No. 2
Surface Elevation (ft) 98.0
Job No. C04153
Sheet 1 of 2

3011 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N	Depth (ft)		qu (qa) (tsf)	W	LL	PL	LI
						8 in. TOPSOIL					
1	▮	18	M	15		Medium Dense to Dense, Brown Silty Fine SAND, Little Clay (SM)					
2	▮	17	M	35							
					5						
3	▮	16	M	17		Medium Dense, Brown Silty Fine to Medium SAND, Some Gravel, Occasional Cobbles and Boulders (SM)					
4	▮	15	M	30							
					10						
5	▮	18	M	26							
					15						
						Hard, Light Brown to Brown Lean CLAY (CL)					
6	▮	18	M	57			(4.5+)				
					20						
7	▮	18	M	111	▼		(4.5+)				
					25						
						Hard, Gray/Brown Lean CLAY (CL)					
8	▮	18	M	98			(4.5+)				
					30						
						Medium Dense to Dense, Brown Fine to Medium SAND, Some Silt, Little Gravel, Occasional Cobbles and Boulders (SM)					
9	▮	15	W	41	∇						
					35						
10	▮	18	W	30							
					40						

WATER LEVEL OBSERVATIONS

While Drilling ∇ 34.0' Upon Completion of Drilling ______

Time After Drilling			2 days	1 day
Depth to Water			24'	▼
Depth to Cave in			28'	29'

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start 6/14/04 End 6/14/04
Driller Badger Chief JHR Rig B-59
Logger JHR Editor WWW
Drill Method 4 1/4 in. HSA

CGC Inc.

LOG OF TEST BORING

Project Grainger Hall Addition
Park Street and University Avenue
Location Madison, WI

Boring No. 2
Surface Elevation 98.0
Job No. C04153
Sheet 2 of 2

3011 PERRY STREET, MADISON, WIS. 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N	Depth (ft)		qu (qa) (tsf)	W	LL	PL	LI
						Medium Dense to Dense, Brown Fine to Medium SAND, Some Silt, Little Gravel, Occasional Cobbles and Boulders (SM)					
11	■	12	W	23	45						
						Medium Dense, Brown Fine to Medium SAND, Little Silt and Gravel (SP-SM)					
12	■	12	W	20	50	End Boring at 50 ft Borehole backfilled with bentonite chips					
					55						
					60						
					65						
					70						
					75						
					80						
					85						

CGC Inc.

LOG OF TEST BORING

Project Grainger Hall Addition
Park Street and University Avenue
Location Madison, WI

Boring No. 3
Surface Elevation (ft) 95.8
Job No. C04153
Sheet 1 of 2

3011 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N	Depth (ft)		qu (qa) (tsf)	W	LL	PL	LI
						3 in. Asphalt/8 in. Crushed Stone Base Course					
1	■	13	M	9		Stiff to Hard, Light Brown to Brown Lean CLAY (CL)	(3.0)				
2	■	14	M	5	5	Occasional thin sand lenses in upper 10 ft.	(1.3-2.0)				
3	■	14	M	11			(2.1-2.3)				
4	■	17	M	10	10		(2.4-3.3)				
5	■	18	M	59	15		(4.5+)				
6	■	18	M	59	20		(4.5+)				
7	■	3	M	50/4"	25	Hard, Gray/Brown Lean CLAY (CL)	(4.5+)				
8	■	14	W	26	▼ 30	Medium to Very Dense, Brown Fine to Medium SAND, Little to Some Silt, Little Gravel (SP-SM/SM)					
9	■	15	W	62	35						
10	■	18	W	79	40						

WATER LEVEL OBSERVATIONS

While Drilling ▽ 29.0' Upon Completion of Drilling

Time After Drilling				1/4 hr
Depth to Water				29' ▼
Depth to Cave in				31'

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start 6/15/04 End 6/15/04
Driller Badger Chief JHR Rig B-59
Logger JHR Editor WWW
Drill Method 4 1/4 in. HSA

CGC Inc.

LOG OF TEST BORING

Project Grainger Hall Addition
Park Street and University Avenue
Location Madison, WI

Boring No. 3
Surface Elevation 95.8
Job No. C04153
Sheet 2 of 2

3011 PERRY STREET, MADISON, WIS. 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N	Depth (ft)		qu (qa) (tsf)	W	LL	PL	LI
						Medium to Very Dense, Brown Fine to Medium SAND, Little to Some Silt, Little Gravel (SP-SM/SM)					
11	■	13	W	63	45						
12	■	1	W	50/4"	50						
						End Boring at 50 ft Borehole backfilled with bentonite chips					
					55						
					60						
					65						
					70						
					75						
					80						
					85						

CGC Inc.

LOG OF TEST BORING

Project: Grainger Hall Addition
Park Street and University Avenue
Location: Madison, WI

Boring No. 4
Surface Elevation (ft) 95.8
Job No. C04153
Sheet 1 of 2

3011 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE

No.	TYPE	Rec (in.)	Moist	N	qu (qa) (tsf)	W	LL	PL	LI
1	■	15	M	17					
2	■	15	M	36					
3	■	15	M	39					
4	■	16	M	33					
5	■	16	M	7					
6	■	18	M	83	(4.5+)				
7	■	18	M	59	(4.5+)				
8	■	18	M	75					
9	■	18	W	75					
10	■	18	W	69					

Depth (ft): 5, 10, 15, 20, 25, 30, 35, 40

VISUAL CLASSIFICATION and Remarks

6 in. Concrete/8 in. Crushed Stone Base Course

Medium Dense to Dense, Brown Fine SAND, Little to Some Silt, Little Gravel (SP-SM/SM - Possible Fill)

Loose, Brown Silty Fine SAND, Little Clay (SM)

Occasional Seams of Gray Lean Clay, 2 to 6 in. thick

Hard, Gray/Brown Lean CLAY (CL)

Medium to Very Dense, Brown Fine to Medium SAND, Little Gravel, Trace Silt (SP)

SOIL PROPERTIES

WATER LEVEL OBSERVATIONS

While Drilling ▽ 34.0' Upon Completion of Drilling ______

Time After Drilling			2 days	1 day
Depth to Water			28.5'	28.5' ▼
Depth to Cave in			29'	29'

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start 6/14/04 End 6/14/04
Driller Badger Chief JHR Rig B-59
Logger JHR Editor WWW
Drill Method 4 1/4 in. HSA

CGC Inc.

LOG OF TEST BORING

Project Grainger Hall Addition
Park Street and University Avenue
Location Madison, WI

Boring No. 4
Surface Elevation 95.8
Job No. C04153
Sheet 2 of 2

3011 PERRY STREET, MADISON, WIS. 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N	Depth (ft)		qu (qa) (tsf)	W	LL	PL	LI
						Medium to Very Dense, Brown Fine to Medium SAND, Little Gravel, Trace Silt (SP)					
11	■	13	W	25							
					45						
12	■	10	W	23							
					50	End Boring at 50 ft Borehole backfilled with bentonite chips					
					55						
					60						
					65						
					70						
					75						
					80						
					85						

CGC, Inc.

LOG OF TEST BORING

General Notes

DESCRIPTIVE SOIL CLASSIFICATION

Grain Size Terminology

Soil Fraction		Particle Size	U.S. Standard Sieve Size
Boulders		Larger than 12”	Larger than 12”
Cobbles		3” to 12”	3” to 12”
Gravel:	Coarse	¾” to 3”	¾” to 3”
	Fine	4.76 mm to ¾”	#4 to ¾”
Sand:	Coarse	2.00 mm to 4.76 mm	#10 to #4
	Medium	0.42 to mm to 2.00 mm	#40 to #10
	Fine	0.074 mm to 0.42 mm	#200 to #40
Silt		0.005 mm to 0.074 mm	Smaller than #200
Clay		Smaller than 0.005 mm	Smaller than #200

Plasticity characteristics differentiate between silt and clay.

General Terminology

Physical Characteristics
  Color, moisture, grain shape, fineness, etc.
Major Constituents
  Clay, silt, sand, gravel
Structure
  Laminated, varved, fibrous, stratified, cemented, fissured, etc.
Geologic Origin
  Glacial, alluvial, eolian, residual, etc.

Relative Density

Term	“N” Value
Very Loose	0 - 4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	Over 50

Relative Proportions Of Cohesionless Soils

Proportional Term	Defining Range by Percentage of Weight
Trace	0% - 5%
Little	5% - 12%
Some	12% - 35%
And	35% - 50%

Consistency

Term	q_u-tons/sq. ft
Very Soft	0.0 to 0.25
Soft	0.25 to 0.50
Medium	0.50 to 1.0
Stiff	1.0 to 2.0
Very Stiff	2.0 to 4.0
Hard	Over 4.0

Organic Content by Combustion Method

Soil Description	Loss on Ignition
Non Organic	Less than 4%
Organic Silt/Clay	4 – 12%
Sedimentary Peat	12% - 50%
Fibrous and Woody Peat	More than 50%

Plasticity

Term	Plastic Index
None to Slight	0 - 4
Slight	5 - 7
Medium	8 - 22
High to Very High	Over 22

The penetration resistance, N, is the summation of the number of blows required to effect two successive 6” penetrations of the 2” split-barrel sampler. The sampler is driven with a 140 lb. weight falling 30” and is seated to a depth of 6” before commencing the standard penetration test.

SYMBOLS

Drilling and Sampling

CS – Continuous Sampling
RC – Rock Coring: Size AW, BW, NW, 2”W
RQD – Rock Quality Designation
RB – Rock Bit/Roller Bit
FT – Fish Tail
DC – Drove Casing
C – Casing: Size 2 ½”, NW, 4”, HW
CW – Clear Water
DM – Drilling Mud
HSA – Hollow Stem Auger
FA – Flight Auger
HA – Hand Auger
COA – Clean-Out Auger
SS - 2” Dia. Split-Barrel Sample
2ST – 2” Dia. Thin-Walled Tube Sample
3ST – 3” Dia. Thin-Walled Tube Sample
PT – 3” Dia. Piston Tube Sample
AS – Auger Sample
WS – Wash Sample
PTS – Peat Sample
PS – Pitcher Sample
NR – No Recovery
S – Sounding
PMT – Borehole Pressuremeter Test
VS – Vane Shear Test
WPT – Water Pressure Test

Laboratory Tests

q_a – Penetrometer Reading, tons/sq ft
q_a – Unconfined Strength, tons/sq ft
W – Moisture Content, %
LL – Liquid Limit, %
PL – Plastic Limit, %
SL – Shrinkage Limit, %
LI – Loss on Ignition
D – Dry Unit Weight, lbs/cu ft
pH – Measure of Soil Alkalinity or Acidity
FS – Free Swell, %

Water Level Measurement

▽- Water Level at Time Shown
NW – No Water Encountered
WD – While Drilling
BCR – Before Casing Removal
ACR – After Casing Removal
CW – Cave and Wet
CM – Caved and Moist

Note: Water level measurements shown on the boring logs represent conditions at the time indicated and may not reflect static levels, especially in cohesive soils.

CGC, Inc.

Madison - Milwaukee

Unified Soil Classification System

UNIFIED SOIL CLASSIFICATION AND SYMBOL CHART

COARSE-GRAINED SOILS (more than 50% of material is larger than No. 200 sieve size)			
GRAVELS More than 50% of coarse fraction larger than No. 4 sieve size	Clean Gravels (Less than 5% fines)		
	▨	GW	Well-graded gravels, gravel-sand mixtures, little or no fines
	▨	GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines
	Gravels with fines (More than 12% fines)		
	▨	GM	Silty gravels, gravel-sand-silt mixtures
	▨	GC	Clayey gravels, gravel-sand-clay mixtures
SANDS 50% or more of coarse fraction smaller than No. 4 sieve size	Clean Sands (Less than 5% fines)		
	▨	SW	Well-graded sands, gravelly sands, little or no fines
	▨	SP	Poorly graded sands, gravelly sands, little or no fines
	Sands with fines (More than 12% fines)		
	▨	SM	Silty sands, sand-silt mixtures
	▨	SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS (50% or more of material is smaller than No. 200 sieve size.)			
SILTS AND CLAYS Liquid limit less than 50%	▨	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity
	▨	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
	▨	OL	Organic silts and organic silty clays of low plasticity
SILTS AND CLAYS Liquid limit 50% or greater	▨	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
	▨	CH	Inorganic clays of high plasticity, fat clays
	▨	OH	Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS	▨	PT	Peat and other highly organic soils

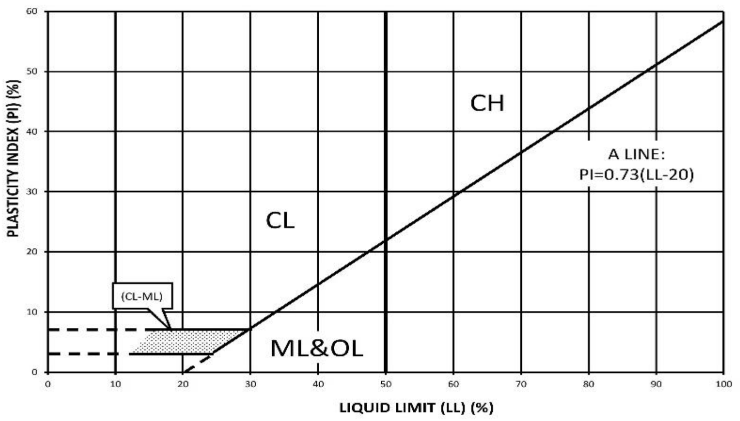
LABORATORY CLASSIFICATION CRITERIA

GW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_C = \frac{D_{30}}{D_{10} \times D_{60}}$ between 1 and 3	
GP	Not meeting all gradation requirements for GW	
GM	Atterberg limts below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols
GC	Atterberg limts above "A" line or P.I. greater than 7	
SW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_C = \frac{D_{30}}{D_{10} \times D_{60}}$ between 1 and 3	
SP	Not meeting all gradation requirements for GW	
SM	Atterberg limits below "A" line or P.I. less than 4	Limits plotting in shaded zone with P.I. between 4 and 7 are borderline cases requiring use of dual symbols
SC	Atterberg limits above "A" line with P.I. greater than 7	

Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows:

Less than 5 percent ………………………………………….. GW, GP, SW, SP
More than 12 percent ……………………….……………… GM, GC, SM, SC
5 to 12 percent ……………………..….. Borderline cases requiring dual symbols

PLASTICITY CHART



APPENDIX C

DOCUMENT QUALIFICATIONS

APPENDIX C
DOCUMENT QUALIFICATIONS

I. GENERAL RECOMMENDATIONS/LIMITATIONS

CGC, Inc. should be provided the opportunity for a general review of the final design and specifications to confirm that earthwork and foundation requirements have been properly interpreted in the design and specifications. CGC should be retained to provide soil engineering services during excavation and subgrade preparation. This will allow us to observe that construction proceeds in compliance with the design concepts, specifications and recommendations, and also will allow design changes to be made in the event that subsurface conditions differ from those anticipated prior to the start of construction. CGC does not assume responsibility for compliance with the recommendations in this report unless we are retained to provide construction testing and observation services.

This report has been prepared in accordance with generally accepted soil and foundation engineering practices and no other warranties are expressed or implied. The opinions and recommendations submitted in this report are based on interpretation of the subsurface information revealed by the test borings indicated on the location plan. The report does not reflect potential variations in subsurface conditions between or beyond these borings. Therefore, variations in soil conditions can be expected between the boring locations and fluctuations of groundwater levels may occur with time. The nature and extent of the variations may not become evident until construction.

II. IMPORTANT INFORMATION
ABOUT YOUR
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.

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. *No one except you* should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one - not even you* - should apply the report for any purpose or project except the one originally contemplated.

READ THE FULL REPORT

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A GEOTECHNICAL ENGINEERING REPORT IS BASED ON A UNIQUE SET OF PROJECT-SPECIFIC FACTORS

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, *do not rely on a geotechnical engineering report* that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical report include those that affect:

- 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,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- 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. *CGC cannot accept responsibility or liability for problems that occur because our reports do not consider developments of which we were not informed.*

SUBSURFACE CONDITIONS CAN CHANGE

A geotechnical engineering report is based on conditions that existed at the time the geotechnical engineer performed the study. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

MOST GEOTECHNICAL FINDINGS ARE PROFESSIONAL OPINION

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgement to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ - sometimes significantly - from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A REPORT'S RECOMMENDATIONS ARE NOT FINAL

Do not over-rely on the confirmation-dependent recommendations included in your report. *Those confirmation-dependent recommendations are not final*, because geotechnical engineers develop them principally from judgement and opinion. Geotechnical engineers can finalize their recommendations *only* by observing actual subsurface conditions revealed during construction. *CGC cannot assume responsibility or liability for the report's confirmation-dependent recommendations if we do not perform the geotechnical-construction observation required to confirm the recommendations' applicability.*

A GEOTECHNICAL ENGINEERING REPORT IS SUBJECT TO MISINTERPRETATION

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Constructors can also misinterpret a geotechnical engineering report. Confront that risk by having CGC participate in prebid and preconstruction conferences, and by providing geotechnical construction observation.

DO NOT REDRAW THE ENGINEER'S LOGS

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

GIVE CONSTRUCTORS A COMPLETE REPORT AND GUIDANCE

Some owners and design professionals mistakenly believe they can make constructors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give constructors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise constructors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure constructors have sufficient time* to perform additional study. Only then might you be in a position to give constructors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

READ RESPONSIBILITY PROVISIONS CLOSELY

Some clients, design professionals, and constructors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineer's 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.

ENVIRONMENTAL CONCERNS ARE NOT COVERED

The equipment, techniques, and personnel used to perform an *environmental* study differ significantly from those used to perform a *geotechnical* 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 environmental problems have led to numerous project failures.* If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

OBTAIN PROFESSIONAL ASSISTANCE TO DEAL WITH MOLD

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, many mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; ***none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.***

RELY ON YOUR GEOTECHNICAL ENGINEER FOR ADDITIONAL ASSISTANCE

Membership in the Geotechnical Business Council (GBC) of 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. Confer with CGC, a member of GBC, for more information.

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Geotechnical Business Council
of the Geoprofessional Business Association
8811 Colesville Road, Suite G 106
Silver Spring, MD 20910

APPENDIX D

RECOMMENDED COMPACTED FILL SPECIFICATIONS

APPENDIX D

CGC, INC.

RECOMMENDED COMPACTED FILL SPECIFICATIONS

General Fill Materials

Proposed fill shall contain no vegetation, roots, topsoil, peat, ash, wood or any other non-soil material which by decomposition might cause settlement. Also, fill shall never be placed while frozen or on frozen surfaces. Rock, stone or broken concrete greater than 6 in. in the largest dimension shall not be placed within 10 ft of the building area. Fill used greater than 10 ft beyond the building limits shall not contain rock, boulders or concrete pieces greater than a 2 sq ft area and shall not be placed within the final 2 ft of finish subgrade or in designated utility construction areas. Fill containing rock, boulders or concrete pieces should include sufficient finer material to fill voids among the larger fragments.

Special Fill Materials

In certain cases, special fill materials may be required for specific purposes, such as stabilizing subgrades, backfilling undercut excavations or filling behind retaining walls. For reference, WisDOT gradation specifications for various types of granular fill are attached in Table 1.

Placement Method

The approved fill shall be placed, spread and leveled in layers generally not exceeding 10 in. in thickness before compaction. The fill shall be placed at moisture content capable of achieving the desired compaction level. For clay soils or granular soils containing an appreciable amount of cohesive fines, moisture conditioning will likely be required.

It is the Contractor's responsibility to provide all necessary compaction equipment and other grading equipment that may be required to attain the specified compaction. Hand-guided vibratory or tamping compactors will be required whenever fill is placed adjacent to walls, footings, columns or in confined areas.

Compaction Specifications

Maximum dry density and optimum moisture content of the fill soil shall be determined in accordance with modified Proctor methods (ASTM D1557). The recommended field compaction as a percentage of the maximum dry density is shown in Table 2. Note that these compaction guidelines would generally not apply to coarse gravel/stone fill. Instead, a method specification would apply (e.g., compact in thin lifts with a vibratory compactor until no further consolidation is evident).

Testing Procedures

Representative samples of proposed fill shall be submitted to CGC, Inc. for optimum moisture-maximum density determination (ASTM D1557) prior to the start of fill placement. The sample size should be approximately 50 lb.

CGC, Inc. shall be retained to perform field density tests to determine the level of compaction being achieved in the fill. The tests shall generally be conducted on each lift at the beginning of fill placement and at a frequency mutually agreed upon by the project team for the remainder of the project.

Table 1
Gradation of Special Fill Materials

Material	WisDOT Section 311	WisDOT Section 312	WisDOT Section 305			WisDOT Section 209		WisDOT Section 210
	Breaker Run	Select Crushed Material	3-in. Dense Graded Base	1 1/4-in. Dense Graded Base	3/4-in. Dense Graded Base	Grade 1 Granular Backfill	Grade 2 Granular Backfill	Structure Backfill
Sieve Size	Percent Passing by Weight							
6 in.	100							
5 in.		90-100						
3 in.			90-100					100
1 1/2 in.		20-50	60-85					
1 1/4 in.				95-100				
1 in.					100			
3/4 in.			40-65	70-93	95-100			
3/8 in.				42-80	50-90			
No. 4			15-40	25-63	35-70	100 (2)	100 (2)	25-100
No. 10		0-10	10-30	16-48	15-55			
No. 40			5-20	8-28	10-35	75 (2)		
No. 100						15 (2)	30 (2)	
No. 200			2-12	2-12	5-15	8 (2)	15 (2)	15 (2)

Notes:

1. Reference: Wisconsin Department of Transportation *Standard Specifications for Highway and Structure Construction.*
2. Percentage applies to the material passing the No. 4 sieve, not the entire sample.
3. Per WisDOT specifications, both breaker run and select crushed material can include concrete that is 'substantially free of steel, building materials and other deleterious material'.

Table 2
Compaction Guidelines

Area	Percent Compaction (1)	
	Clay/Silt	Sand/Gravel
Within 10 ft of building lines		
Footing bearing soils	93 - 95	95
Under floors, steps and walks		
- Lightly loaded floor slab	90	90
- Heavily loaded floor slab and thicker fill zones	92	95
Beyond 10 ft of building lines		
Under walks and pavements		
- Less than 2 ft below subgrade	92	95
- Greater than 2 ft below subgrade	90	90
Landscaping	85	90

Notes:

1. Based on Modified Proctor Dry Density (ASTM D 1557)