CGC, Inc.
Construction • Geotechnical
Consulting Engineering/Testing

December 11, 2020
C20051-31

Mr. Matt Gall, LEED AP
City of Madison Department of Public Works
Engineering Division – Facilities and Sustainability
City-County Building, Room 115
210 Martin Luther King, Jr. Blvd.
Madison, Wisconsin 53703

Re: Preliminary Geotechnical Exploration Report
Proposed 2021 Site Expansion
City of Madison DPW – 402 South Point Road
Madison, Wisconsin

Dear Mr. Gall:

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 preliminary geotechnical recommendations regarding site preparation, foundation, floor slab, site pavement, retaining wall, roadway and utility design/construction. A determination of the site class for seismic design is also included, along with a preliminary discussion of the on-site stormwater infiltration potential. We are sending you an electronic copy of this report, and we can provide a paper copy upon request.

PROJECT AND SITE DESCRIPTION

We understand that the existing City of Madison Department of Public Works facility at 402 South Point Road is proposed to be expanded in 2021. The project area, located north of the existing facility, is currently undeveloped/former farmland with variable topography. Based on a provided topographic site plan (Burse Surveying & Engineering; 1-ft contour lines), existing site grades range between about EL 1,066 and 1,081 ft throughout the project area. Site grades within the existing facility (near the warm storage building that is closest to the planned expansion) appear to be near EL 1,070 to 1,071 ft, and roadway grades at the current dead-end of Yard Drive are near EL 1,070 ft.

Planned improvements involve a new truck scale, fueling islands and site preparation for a future salt storage shed to the north/northeast of the existing facility. Possible additional improvements for 2021 include a stormwater management area to the east of the new fueling islands, an extension of Yard Drive northwest and north of the planned site expansion, and a possible retaining wall associated with the road extension.

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Note that when final building details and finished grades have been determined, CGC should be provided with the latest development details for review with relation to the recommendations provided herein.

SUBSURFACE CONDITIONS

Subsurface conditions for this study were explored by drilling nine Standard Penetration Test (SPT) soil borings at locations selected and field-staked by CGC: B-1 and B-2, planned depths of 25 ft below current site grades, in the area of the planned salt storage building; B-3 and B-4, planned depths of 15 ft below current site grades, in the area of the planned fueling islands; B-5, planned depth of 10 ft below the ground surface, along the planned Yard Drive alignment; B-6 and B-7, planned depths of 20 and 30 ft below current site grades, respectively, near the proposed retaining wall along Yard Drive; as well as B-8 and B-9, planned depths of 20 ft below current site grades, within the proposed stormwater management area. The borings were conducted by Badger State Drilling (under subcontract to CGC) on November 16, 2020 using a track-mounted CME-45 rotary drill rig equipped with hollow stem augers and an automatic SPT hammer. 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. Ground surface elevations at the boring locations were estimated by CGC based on the 1-ft contour lines shown on the provided topographic site plan (Burse), and the elevations should therefore be considered approximate.

The subsurface profiles at the boring locations varied to some degree, but the following strata were typically encountered (in descending order):

- About 8 to 20 in. of ***topsoil***; underlain by
- About 2 to 7 ft of medium stiff to hard ***lean clay*** to ***sandy lean clay*** layers; over
- Loose to dense ***sand*** strata, generally containing significant amounts of silt and gravel, as well as scattered cobbles/boulders, to the maximum depths explored.

As an exception to the above generalized subsurface profile, approximately 5 ft of very stiff *cohesive fill* were encountered below the topsoil in Boring 1. It must be noted that the existing fill soils were found to contain scattered *asphalt pieces* and/or *possible cinders*. In addition, a possible petroleum/chemical odor was noted in Sample 2 (lower sample of the fill soils) of Boring 1. Fill soils containing odors, cinders and other debris may be environmentally impacted and could potentially require landfill disposal if excavated and hauled off-site. We recommend that the City's environmental staff be consulted to provide further recommendations regarding these issues.

The native clay layers that were encountered near existing site grades within most of the soil borings were generally medium stiff to hard, as previously noted, but occasional softer zones should be expected near the bottom of the clay soils in isolated areas, at the transition from the clays to the underlying sand soils (see B-8 for example). Natural moisture contents in representative native clay samples were determined to range from 17.1% to 28.4%. Based on natural moisture contents, pocket penetrometer readings (q_p-values; an estimate of the unconfined compressive strength of cohesive soils) and SPT blow counts (N-values), the cohesive soils should be considered slightly to moderately compressible. Shallow clay soils were not encountered in Boring 3, where the topsoil was directly underlain by native granular soils.

As previously noted, the sand soils underlying this site were generally found to contain significant silt and gravel contents, as well as scattered cobbles/boulders. However, occasional silt horizons or sandy zones with lower fines-content were also encountered in the soil borings. Two representative samples obtained from the granular soils in Boring 8 were combined into a composite sample and analyzed for their particle size distribution (gradation) to aid in their classification. With a composite P200-content ("fines") of 20.8%, the samples classify as silty sand (SM) and gravelly sandy loam (GRSL) per the USCS and USDA classification systems, respectively.

Groundwater was generally not encountered in the borings during and/or upon the completion of drilling, with the exception of Boring 2. In this boring, apparent groundwater was first encountered at a depth of about 22 ft during drilling (corresponding to approximately EL 1,046 ft). Approximately 30 minutes after the completion of drilling, prior to backfilling the borehole, a second groundwater level reading showed an apparent water level at about 21 ft below the ground surface, corresponding to approximately EL 1,047 ft. Groundwater levels are expected to fluctuate with seasonal variations in precipitation, infiltration, evapotranspiration, the level in nearby waterbodies and other factors.

A more detailed description of the site soil and groundwater conditions is presented on the individual soil boring logs attached in Appendix B, which also contain the laboratory test results, as well as on the WDSPS *Soil and Site Evaluation – Storm* forms for the two Stormwater Borings (B-8 and B-9) contained in Appendix F. The particle size distribution test report is also 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 proposed DPW facility expansion and that the planned structures can be supported by conventional reinforced concrete spread footing foundation systems with the understanding that undercutting of existing fill and marginal native soils will likely be required below the bottom of footings on an isolated basis. Our preliminary recommendations for site preparation, foundation, floor slab, site pavement, retaining wall, roadway and utility design/construction, along with our assessment of the site class for seismic design and the stormwater infiltration potential, are presented in the following subsections. *As finish site and structure grades were not available to us at the time of this report, the recommendations contained herein should be considered preliminary, and CGC should be allowed to review these recommendations and adjust them, as needed, once the expansion plans have been finalized and provided to us.* Additional information regarding the conclusions and recommendations presented in this report is discussed in Appendix C.

1. Site Preparation

We recommend that topsoil and vegetation be stripped at least 10 ft beyond the proposed construction area, including areas requiring fill beyond the building footprint and pavement limits. The topsoil can be stockpiled on-site and later re-used as fill in landscaped areas. As mentioned earlier, topsoil was about 8 to 20 in. thick in the borings, but variable topsoil thicknesses may be encountered between and beyond boring locations due to previous agricultural and grading activities.

After topsoil stripping, subgrades are anticipated to largely consist of stiff to hard clay, but granular soils may also be encountered below the topsoil in isolated areas, or where grades need to be cut. In areas remaining at-grade or requiring fill, we recommend cohesive and fine-grained subgrades be statically recompacted (i.e., without vibration) and subsequently proof-rolled with a piece of heavy rubber-tire construction equipment, such as a loaded tri-axle dump truck, to check for soft/yielding areas. If soft/yielding areas are observed, these soils should be undercut and replaced 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 areas. Granular subgrades should be thoroughly recompacted with a vibratory smooth-drum roller, and zones that remain loose after recompaction should be undercut and replaced or stabilized as described above. Areas subsequently receiving fill should be checked for their pavement, floor slab and footing support suitability prior to fill placement, as applicable. *Due to the presence of clay (natural and fill) near existing site grades in isolated areas, some undercutting/stabilization should generally be expected to create firm and stable subgrades in new pavement and floor slab areas, and we recommend that the project budget contain a contingency for such operations.*

Following the development of a firm and stable subgrade, fill placement to establish site, pavement and building grades can proceed. To the extent possible, we recommend using granular soils (i.e., sands/gravels, including native granular soils if selectively excavated and stockpiled) as structural fill within the building envelope, along retaining wall alignments and upper 2 to 3 ft in pavement areas because these soils are relatively easy to place and compact in most weather conditions compared to clay/silt soils. Clay and silt soils excavated on-site are generally not recommended as structural fill because moisture conditioning by discing and drying (aeration) will likely be required to achieve desired compaction levels, which is highly weather-dependent (i.e., dry, warm and windy conditions) and could delay construction progress. In our opinion, clay/silt soils are best used as fill in landscaping or potentially as lower lifts in pavement areas provided the moisture contents can be sufficiently lowered from the natural states to facilitate compaction efforts. We recommend that structural fill be compacted to at least 95% compaction based on modified Proctor methods (ASTM D1557) following Appendix D guidelines. Periodic field density tests should be taken by CGC staff within the fill to document the adequacy of compactive efforts.

2. **Building Foundations**

Based on presumed finish site grades near EL 1,071 ft surrounding the planned salt storage building (similar to the existing site) and assuming that footings of the new building will bear at frost depth, a minimum of 4 ft below finish site grades, foundation subgrades are expected to consist of existing cohesive fill or medium stiff to very stiff native clay soils. We recommend that existing fill soils be undercut below the bottom of footings due to the potential for long-term settlement of the fill exceeding typically tolerable levels. Foundation grades should be restored with well-compacted structural fill, where necessary.

We recommend the following parameters be used for *preliminary* foundation design:

- Maximum net allowable bearing pressure: 2,000 psf

- 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

Recognizing that subsurface conditions will vary across the building footprint, footing subgrades should be checked 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 and undercut excavations. Where required, 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. 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 and 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 content) should be hand-trimmed. OSHA slope guidelines should be followed if workers need to enter footing excavations.

As previously discussed, we recommend that existing fill soils be undercut and replaced below the bottom of footings. Undercutting will also be required where natural clay soils with q_p-values of less than 1.0 tsf are present at and slightly below the bottom of footings designed for an allowable bearing pressure of 2,000 psf. Similarly, loose native granular and fine-grained soils that cannot be recompacted satisfactorily should also be undercut at and slightly below footing grades. In order to re-establish footing grade in undercut areas, we recommend using granular backfill compacted to at least 95% compaction 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 grades in undercut areas.

Provided the *preliminary* 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.

Final site and building grades should be provided to CGC once available, and CGC should be allowed to review the recommendations contained herein and adjust them, as needed, in light of the final expansion plans.

3. Seismic Site Class

In our opinion, the average soil properties in the upper 100 ft of the site (based on N-values projected to be between 15 and 50 blows/ft, on average, in the granular/fine-grained 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.

4. Floor Slabs

Based on presumed finish site and floor slab grades in the area of the planned salt storage building near EL 1,071 ft, we anticipate that the floor slab will be supported on existing, very stiff cohesive fill or on newly-placed structural fill over very stiff clay soils (fill or native). Contrary to footing subgrades, the existing fill soils may potentially remain in-place below the floor slab provided they are firm and stable at the time of construction, which should be evaluated by thoroughly proof-rolling the floor slab area and checking the composition of the existing fill exposed at the sidewalls of footing excavations. 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 and fine-grained subgrades will require static recompaction and subsequent proof-rolling. Areas of disturbed soil or soils that remain loose after recompaction, as well as soft/yielding zones observed during proof-rolling should be undercut and replaced with compacted 3-in. DGB or granular fill. *Some undercutting may be required where floor slab subgrades consist of existing fill or natural clay that are wet or have become unstable/disturbed by construction activities, and we recommend that the project budget include a contingency for floor slab subgrade improvement.*

To act as a capillary break below the slab, we recommend including a minimum 4 to 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 the floor slab to increase the subgrade modulus immediately below the slab. To further reduce the potential for moisture migration through the slab, a plastic 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. The slab should be structurally separated from the footings with a compressible filler and have construction joints and reinforcement for crack control.

5. <u>Site Pavement</u>

We anticipate that new pavement design will be controlled by the native clay and existing cohesive fill soils. Subgrades should be prepared as described in the Site Preparation section of this report, with recompaction/proof-rolling completed prior to base course and asphalt placement. *Based on the presence of fill near existing site grades in isolated areas, as well as natural clay soils that are considered moisture sensitive, we recommend that the budget include a contingency for subgrade undercutting/stabilization, which could potentially include about 12 in. of additional coarse aggregate (e.g., 3-in. DGB) over biaxial geogrid (e.g., Tensar BX Type 1 or equivalent).* The need for undercutting below the pavement section will likely be reduced where site grades are raised at least 2 ft above existing grade with high-quality granular fill.

We anticipate that some asphalt pavement on this site, such as smaller parking areas (i.e., less than 50 stalls) or low traffic volume-driveways, will be exposed to primarily automobile traffic with less than one 18-kip equivalent single axle load (ESAL) per day. In view of this, we have assumed Traffic Class I following Wisconsin Asphalt Pavement Association (WAPA) recommendations for smaller parking areas and driveways that are mainly used by light passenger vehicles. However, main sections of driveways are likely to experience heavier traffic loads from truck traffic. For pavement areas where trucks will routinely travel, as well as larger parking lots (i.e., 50 stalls or more, if any), we have assumed a traffic load of up to 10 ESALs per day and Traffic Class II according to WAPA. We have also included a heavy-duty pavement section where higher truck traffic loads (up to 50 ESALs per day, Traffic Class III) are expected. The pavement sections summarized in Table 1 below were selected assuming a Soil Support Value “SSV” of about 4.0 for a firm or adequately stabilized clay or fill subgrade and a design life of 20 years.

TABLE 1 – Recommended Pavement Sections

Material	Thicknesses (in.)			WDOT Specification [1]
	Traffic Class I (Light Duty)	Traffic Class II (Medium Duty)	Traffic Class III (Heavy Duty)	
Bituminous Upper Layer [2,3]	1.5	1.75	2.0	Section 460, Table 460-1, 9.5 mm (light duty), 12.5 mm (medium and heavy duty)
Bituminous Lower Layer [2,3]	2.0	2.25	3.0	Section 460, Table 460-1, 12.5 mm (light duty), 19 mm (medium and heavy duty)
Dense Graded Base Course [2,4]	8.0	10.0	12.0	Sections 301 and 305, 3 in. and 1¼ in.
Total Thickness	**11.5**	**14.0**	**17.0**	

Notes:

1) Wisconsin DOT *Standard Specifications for Highway and Structure Construction*, latest edition, including supplemental specifications, and Wisconsin Asphalt Pavement Association *2020 Asphalt Pavement Design Guide*.

2) Compaction requirements:
   - Bituminous concrete: Refer to Section 460-3.
   - Base course: Refer to Section 301.3.4.2, Standard Compaction

3) Mixture Type LT bituminous; refer to Section 460, Table 460-2 of the *Standard Specifications*. Mixture type MT is recommended in heavy duty traffic areas. Note that an "H Grade" asphalt surface layer is recommended where there will be slow moving heavy truck traffic making turning movements.

4) The upper 4 in. should consist of 1¼-in. DGB; the bottom part of the layer can consist of 3-in. DGB.

The recommended pavement sections assume that regular maintenance (crack sealing, etc.) will occur, as needed. Note that if traffic volumes are greater than those assumed, CGC should be allowed to review the recommended pavement sections and adjust them accordingly. Alternative pavement designs may prove acceptable and should be reviewed by CGC. If there is a delay between subgrade preparation and placing the base course, the subgrade should be recompacted.

Where concrete pavement may be used, such as in pavement areas subjected to concentrated wheel loads (e.g., dumpster pads, containment area around fueling islands, etc.), we recommend that the concrete pavement be at least 6-in. thick, be underlain by at least 6 in. of DGB 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 a thicker pavement section (more than 6 in. of concrete) may be required depending on pavement loads, which should be evaluated by a structural engineer.

6. <u>Yard Drive Retaining Wall</u>

It is understood that a retaining wall is planned on the north side of the planned Yard Drive extension, in an area where the road is expected to cut into an existing ridge (possible glacial feature). Considering the maximum existing ground surface elevation on the back side of the planned retaining wall of about EL 1,081 ft and a presumed finish roadway grade of about EL 1,071 ft, the maximum exposed retaining wall height is estimated to be approximately 10 ft.

We expect that retaining wall construction will involve backsloping of the retained soils, and the excavation to construct the new wall should be sloped according to OSHA requirements. The on-site sands with significant amounts of fines, typically classified as OSHA “Type B” soils, are anticipated to control excavation slopes, and slopes of 1H:1V are expected to be at least temporarily stable. Flatter excavation slopes may be required where perched or seeping water is present that may destabilize the slopes, or if cleaner sand soils are present within the limits of the excavation. *The appropriate excavation slopes should be determined by a competent person completing the earthwork in accordance with OSHA slope guidelines.*

Foundation subgrades for the new wall are expected to consist of stiff to hard clay or loose to medium dense sand and silt soils. Granular soils anticipated at foundation grade should be thoroughly recompacted with a large vibratory plate compactor or an excavator-mounted hoe-pack prior to placing the leveling pad (or footing) 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 content) should be hand-trimmed. Loose/disturbed soils that cannot recompacted satisfactorily will require undercutting (excavation below subgrade – EBS) and replacement below the bottom of the new retaining wall. Where required, the EBS zone should extend laterally in front of and behind the bottom of the retaining wall [and potentially behind the reinforced zone if a mechanically stabilized earth (MSE) wall will be constructed], a minimum of 0.5 ft for each foot of EBS depth. Following the recompaction of the EBS base, foundation subgrades should subsequently be restored with granular backfill (including native sand soils excavated on-site) that are compacted to at least 95% compaction 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 grades in undercut areas.

Based on the soil borings and assuming finish roadway grades near EL 1,071 ft, it is our opinion that an allowable bearing pressure of 2,500 psf may be used for *preliminary* retaining wall foundation design, which will be controlled by stiff clay and looser sand/silt soils anticipated at or slightly below foundation grades. If the design will be based on Load and Resistance Factor Design (LRFD) procedures, we recommend a *nominal (i.e., unfactored)* bearing resistance of 7.5 ksf[1] be used for *preliminary* foundation design. Furthermore, we recommend an *ultimate* friction factor/*nominal* sliding resistance at the base of the retaining wall of 0.3 be utilized for *preliminary* wall design, assuming a clay subgrade. Appropriate resistance factors need to be applied to the nominal bearing and sliding resistance values.

Once more details regarding the planned wall type and geometry become available, this information should be provided to CGC, and CGC should be allowed to review the preliminary foundation recommendations contained herein and adjust them, as needed.

After the new wall has been constructed, we recommend that the work space behind the wall be backfilled with *imported, free-draining granular material*, and the following soil parameters for structural backfill can be used for wall design:

[1] As details regarding the planned retaining wall type and foundation were not available at the time of this report, the *preliminary* nominal bearing resistance was calculated by multiplying the *preliminary* allowable bearing pressure [which, in turn, is based on SPT blow counts (N-values)] by the LRFD load factor (1.35) and dividing the product by the LRFD resistance factor (0.45).

TABLE 2 – Recommended Soil Parameters for Imported Wall Backfill

Parameter	**Design Value**
P200 Content (%)	<12 (USCS Classification SP, SP-SM, GP or GP-GM)
Minimum Compaction Level, based on Modified Proctor (%)	90
Moist Unit Weight (pcf)	120
Saturated Unit Weight (pcf)	130
Buoyant Unit Weight (pcf)	68
Angle of Internal Friction (degrees)	30
Active Lateral Earth Pressure Coefficient	0.3
Passive Lateral Earth Pressure Coefficient	3.0
At-Rest Lateral Earth Pressure Coefficient	0.5

7. Utilities

Based on the available soil and groundwater information, it appears that new utility construction can proceed using traditional open-cut methods. It is expected that excavation sidewalls will be sloped back for relatively shallow installations (i.e., less than 4 ft in depth) and that a trench shield and/or internal bracing will be used for deeper excavations. The following are our recommendations regarding trench excavation, dewatering, and backfilling:

- Excavation: Open cuts should be sloped and/or braced in accordance with OSHA guidelines. The sands with significant amounts of fines, generally classified as OSHA "Type B" soils, are expected to control the excavation slopes, and slopes of 1H:1V or flatter are expected to be at least temporarily stable. Note that flatter side slopes may also be required where groundwater or perched water is present that destabilizes the side slopes, or where cleaner sand layers are encountered. *The appropriate utility trench excavation side slopes should be determined by a competent person completing the earthwork in accordance with OSHA slope guidelines.*

- Dewatering: Based on the observations in the soil borings, groundwater infiltration into utility excavations is generally not expected. However, water accumulating at the base of utility excavations as a result of precipitation or seepage from perched layers should be quickly removed, with dewatering means and methods being the responsibility of the utility contractor.

- Rock Removal: We do not anticipate the need for rock removal during utility excavations.

- Backfilling: Excavation backfilling may proceed using the following guidelines:

  - Although clayey and silty excavation spoils may be used to backfill the utility trenches above the pipe and associated granular bedding material, to the extent possible, we recommend that granular soils be used as backfill below paved areas because sand/gravel soils are relatively easy to place and compact in most weather conditions compared to cohesive and fine-grained soils. Silt and clay soils will likely require moisture conditioning prior to placement and compaction, as previously discussed, which could delay construction progress. Granular soils containing cobbles and boulders should not be used in direct contact with utility lines.

  - Backfill material should be placed in accordance with Appendix D guidelines and/or applicable City of Madison requirements.

  - Compaction recommendations:
    - Within 10 ft of buildings or the planned retaining wall: 95% modified Proctor (ASTM D1557);
    - Depths greater than 3 ft below grade in pavement areas: 90% modified Proctor;
    - Final 3 ft in pavement areas: 95% modified Proctor; and
    - Landscape areas: 85% modified Proctor.

8. Yard Drive Extension

A. Soil Mapping

Using the United States Department of Agriculture – Natural Resources Conservation Service (USDA-NRCS) *Web Soil Survey* website, we identified an area approximately encompassing the proposed Yard Drive extension, extending from the current dead end of Yard Drive to South Point Road, just south of Fire Station 12. The soil mapping for the project area is shown on the Soil Map, generated through the USDA-NRCS *Web Soil Survey* website, which is attached in Appendix E. Several soil series are mapped within the area of interest, including (from west to east) Troxel silt loam (denoted TrB on the Soil Map), Plano silt loam (PoA and PoB), Griswold loam (GwC) and again Plano silt loam (PnC2). Table 3 includes key parameters for evaluating the soils' suitability for pavement support, which have been taken from published WisDOT references and are based on decades of WisDOT and AASTHO experience. Note that the parameters in the table are representative of the B horizon (e.g., the soil layer directly below the naturally occurring organic topsoil A horizon).

Table 3 – Summary of Soil Properties

Soil Series	Symbols	Design Group Index, DGI	Frost Index, FI	Modulus of Subgrade Reaction, K Factor (pci)
Griswold loam	GwC	14	F-3	100
Plano silt loam	PoA, PoB, PnC2	14	F-3	100
Troxel silt loam	TrB	16	F-4	75

The Griswold and Plano soils are described as well drained and derived from loamy till or loess over glacial loamy till on till plains or from loess over loamy, sandy and gravelly outwash on outwash plains. Typical Griswold and Plano profiles involve finer-grained clay loam, silty clay loam, silt loam and loam over coarser-grained sandy loam to gravelly sandy loam and stratified gravelly sand. The depth to the seasonal high-water table within Griswold and Plano soils is typically more than 6 ft below the ground surface, except in the area designated PnC2, where the seasonal high-water table may be within about 3 to 4 ft of the ground surface. Shallower seasonal high-water levels of about 3 to 6 ft below the ground surface may also be experienced within Troxel soils, which are described as moderately well drained soils that formed from silty colluvium on moraines and depressions. Troxel soils typically involve deeper deposits of fine-grained silt loam and silty clay loam. The soil mapping is in general agreement with the subsurface profiles encountered in the soil borings.

Based on the soil mapping and soil borings, it is our opinion that pavement design will be controlled by near-surface clay soils having characteristics similar to those described for the soils summarized in Table 3.

B. Pavement Subgrade Preparation

After utility installation, where required, and site grading to establish roadway subgrades, the exposed soils are generally expected to consist of native clay, silt and sand soils, as well as new fill to raise site grades (where required) and potentially granular utility trench backfill, which was discussed in the *Site Preparation* and *Utilities* sections of this report, respectively. The exposed soil subgrades should be thoroughly recompacted and proof-rolled as discussed in the *Site Preparation* section. *Proof-rolling should not be performed within 48 hours of a rainfall exceeding ¼-inch.*

If soft/yielding areas are encountered within the subgrade, these soils should be selectively undercut (e.g., excavation below subgrade, EBS) and replaced with coarse aggregate [e.g., 3-in. dense graded base (DGB) or select crushed material (SCM), WisDOT *Standard Specification for Highway and Structure Construction*, Sections 305 and 312, respectively] prior to base course placement. The thickness of the undercut/stabilization layer should be determined in the field during proof-rolling, and the required thickness of the layer will likely vary along the alignment. If long, continuous sections of soft/yielding soils are encountered, a geogrid [e.g., Tensar Type 1 or 2 (BX 1100 or 1200) or equivalents] could be considered to provide additional reinforcement, and potentially reduce the thickness of the aggregate stabilization layer.

Based on the soil mapping and subsurface profiles encountered in the soil borings, we expect that some soft/yielding areas may be encountered during proof-rolling. It has been our experience that clay soils with q_p-values of less than about 1.5 tsf, and/or moisture contents in excess of about 20%, will likely require some undercutting/stabilization if encountered at/near pavement subgrade elevations. We recommend that the project budget include a contingency to address weak/unstable subgrade conditions.

A "final" proof-roll should be performed on the base course prior to asphalt paving to check for soft/yielding conditions. Soft/yielding areas should be undercut/stabilized, as described above.

C. Pavement Design Parameters

The pavement design parameters contained herein assume a firm or stabilized clay subgrade is present or has been developed according to the recommendations and techniques discussed previously. The recommended design soil parameters outlined in Table 4, which are conservatively based on the Troxel soils, should be used in conjunction with anticipated traffic loads to develop the design pavement section. The following parameters are based on pavement design methods discussed in the WisDOT *Geotechnical Manual*:

TABLE 4 – Recommended Pavement Design Parameters

Soil Parameter	Recommended Design Values
USCS	CL/CL-ML/ML
AASHTO Classification	A-4/A-6
Frost Index, FI	F-4
Design Group Index, DGI	16
Soil Support Value, SSV	3.6
Subgrade Modulus, K (pci)	75

Note: These values are based on the following assumptions (based on WisDOT *Geotechnical Manual*):

1) The subgrade has been closely monitored.
2) The subgrade has been thoroughly and adequately compacted.
3) Wet zones have been dried, drained, or removed.
4) Pockets of dissimilar material have been removed, replaced or mixed to achieve a homogeneous subgrade.
5) Adequate subgrade drainage has been achieved.
6) Lower quality soils have been undercut, where encountered.

Note that although we anticipate selective undercutting (EBS) will be completed, where deemed necessary, the soil support value and subgrade modulus can potentially be increased if a systematic stabilization layer is included below *the entire* planned pavement section, as described in the WisDOT *Facilities Development Manual (FDM)* Section 14-5 incorporating *select materials in subgrade*. The ten alternatives for select materials are discussed in the FDM Section 11-5-15, Attachment 15.2. However, we do not recommend adjusting the recommended pavement design parameters if only isolated undercutting/stabilization will be completed. We can provide additional information upon request.

Assuming a firm/non-yielding subgrade is developed, including undercutting/stabilization of lower quality soils discussed previously, and assumed traffic loading conditions, consisting of a combination of light passenger vehicles and heavy truck traffic [e.g., less than 10 daily 18-kip Equivalent Single-Axle Loads (ESALs)], a typical flexible pavement design is 4.5 to 5.5 in. of asphalt pavement and 12 to 14 in. of dense graded base course. However, the pavement design should be based on traffic count data, past City of Madison projects and the provided soil parameters.

9. Stormwater Infiltration

We understand that a ¼-acre stormwater basin is envisioned to the east of the proposed fueling islands. The profiles in Borings B-8 and B-9, which were performed in the area of the planned stormwater basin, were fairly consistent and involved lower-permeability *silty clay loam* and *sandy clay loam* strata to depths between about 7 and 8 ft below current site grades, underlain by more permeable/granular *sandy loam*, *gravelly sandy loam*, *loamy fine sand* and *sand* layers to the maximum depths explored. Provided that the infiltration system extends through the shallow lower-permeability soils and into the granular layers (or lower-permeability soils are undercut below the bottom of the infiltration system and replaced with appropriate sandier soils), it is our opinion that some stormwater infiltration will likely be possible on this site.

However, it must be noted that lower-permeability seams of *clay loam* and relatively thin horizons of *silt loam* were observed within the granular soils, which will likely limit the infiltration rate. In an effort to improve the infiltration potential, we recommend that granular soils containing fairly thin lower-permeability seams/layers be excavated and blended (or deep tilling, ripping, etc.) to break up the lower-permeability seams. *Thicker silt and clay layers will require excavation and removal.* After removal of the overlying lower-permeability strata, we recommend that the deep-tilling process extend at least 5 ft (potentially deeper pending field observations) below the bottom of the infiltration system. Samples of the mixed soils should be collected during construction to document that the gradations of the mixed samples are consistent with the soil texture that the design infiltration rate is based upon (per Table 2 of WDNR Tech. Std. 1002). *Variability in the soil conditions should be expected across the site and within the stormwater basin that could result in a wide range of undercut depths to reach soil suitable for the design infiltration rate.*

Infiltration Potential: The following is a summary of the estimated infiltration rates for the soils encountered in Borings 8 and 9, per Table 2 of the WDNR Conservation Practice Standard 1002, *Site Evaluation for Storm Water Infiltration*. *Note that where lower-permeability soil (e.g., silt loam, clay loam, etc.) seams/layers exist within otherwise more permeable soils (e.g., granular, coarse-grained soils), the infiltration rate of the lower-permeability seams/layers will control the vertical infiltration rate, unless the lower-permeability seams are removed or the layer (with scattered seams) is excavated and blended (or deep tilling, ripping, etc.), as discussed previously.* The estimated infiltration rates are as follows:

- Clay loam (CL) 0.03 in./hr
- Silty clay loam (SiCL) 0.04 in./hr
- Sandy clay loam (SCL) 0.11 in./hr
- Silt loam (SiL) 0.13 in./hr
- Sandy loam (SL) 0.50 in./hr
- Gravelly sandy loam (GRSL) 0.50 in./hr
- Loamy fine sand (LFS) 0.50 in./hr
- Sand (S) 3.60 in./hr

Note that the infiltration rates should be considered very approximate since they are merely based on soil texture and do not account for in-place soil density and other factors, which will affect the infiltration rate. We recommend that the soils at and several feet below the bottom of stormwater management system be checked by a certified soil tester *in conjunction with the basin designer* to document that the soils are appropriate for the design infiltration rate or recommend remedial measures, if necessary. The Wisconsin Department of Safety & Professional Services *Soil and Site Evaluation – Storm* form for Borings 8 and 9 is contained in Appendix F.

It must be cautioned that the results of the soil borings have limitations with regard to the evaluation of the on-site stormwater infiltration potential, as actual soil horizon transitions may vary from those shown on the boring logs and infiltration forms. The reviewing agency may require test pits to be excavated at a later date prior to finalizing the stormwater design. *The results of the test pits may require revisions to the stormwater management design if the design has been based solely on the soil borings.*

Groundwater: Groundwater was not encountered in the Stormwater Borings B-8 and B-9, and the soil mapping (see Appendix E) indicates the seasonal high-water level in the approximate area of the planned stormwater basin (mapped as Plano/Griswold soils) to generally remain more than 6 ft below the ground surface. However, redoximorphic features (redox or mottling), partially in combination with low-chroma/high-value (gray) matrix color, in the native clay soils indicate the level of past saturation from perched water, periodically infiltrating surface water or seasonally elevated groundwater. Since groundwater was not encountered in the underlying granular soils and under consideration of the soil mapping, it is our opinion that the redox and gray matrix color can likely be attributed to perched conditions and/or surface water infiltration. Groundwater levels/seasonal high levels and groundwater mounding effects must be carefully considered during the design (i.e., establishing design bottom elevation) since it is a limiting factor for infiltration and may preclude the ability to infiltrate. Adequate separation distance must be maintained per WDNR requirements.

Bedrock: Bedrock was not encountered in the soil borings. The depth of bedrock should be expected to vary across the site.

During construction, appropriate erosion control should be provided to prevent eroded soil from contaminating the stormwater management area. Where appropriate, the stormwater system design should include pretreatment to remove fine-grained soils (silt/clay) and clogging materials (oils/greases) from stormwater prior to entering the infiltration area. Additionally, a regular maintenance plan should be developed to remove silt/clay soils and clogging materials that may accumulate in the bottom of the stormwater management area over time. Failure to adequately control fine-grained soils and clogging materials from entering the infiltration area or failure to regularly remove fine-grained soils and clogging materials that accumulate at the base of the stormwater infiltration system will likely cause the stormwater management system to fail. Additionally, it is important that the soils in the bottom of the infiltration system do not become compacted during construction or measures are taken to mitigate soils that are compacted during construction. Refer to WDNR Conservation Practice Standards 1002, 1003 and 1004, as well as NR151 for additional information.

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.

- Contingencies in the project budget for subgrade stabilization with coarse aggregate in pavement and floor slab areas should be increased if the project schedule requires that work proceed during adverse weather conditions.

- 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.

- Based on the observations made during our field exploration, we generally do not anticipate groundwater to be encountered during construction. However, water accumulating at the bottom of excavations as a result of precipitation or seepage should be quickly removed. Dewatering means and methods are 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 CGC:

- Topsoil stripping and subgrade proof-rolling/compaction;
- Fill/backfill placement and compaction;
- 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, EIT, CST
Staff Engineer

Ryan J. Portman, PE, CST
Senior Consulting Professional

Encl: Appendix A - Field Exploration
Appendix B - Soil Boring Location Exhibit
Logs of Test Borings (9)
Particle Size Distribution Test Report (1)
Log of Test Boring-General Notes
Unified Soil Classification System
Appendix C - Document Qualifications
Appendix D - Recommended Compacted Fill Specifications
Appendix E - USDA-NRCS *Web Soil Survey* Map and Legend
Appendix F - WDSPS *Soil and Site Evaluation – Storm* Form (2 Borings)

APPENDIX A

FIELD EXPLORATION

APPENDIX A

FIELD EXPLORATION

Subsurface conditions for this study were explored by drilling nine Standard Penetration Test (SPT) soil borings to planned depths between 10 and 30 ft below current site grades, which were generally sampled at 2.5-ft intervals to a depth of 10 ft and at 5-ft intervals thereafter. As an exception, the two borings performed within the planned stormwater management area, B-8 and B-9, were sampled at 2.5-ft intervals to the final depths at 20 ft below grade. The 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.

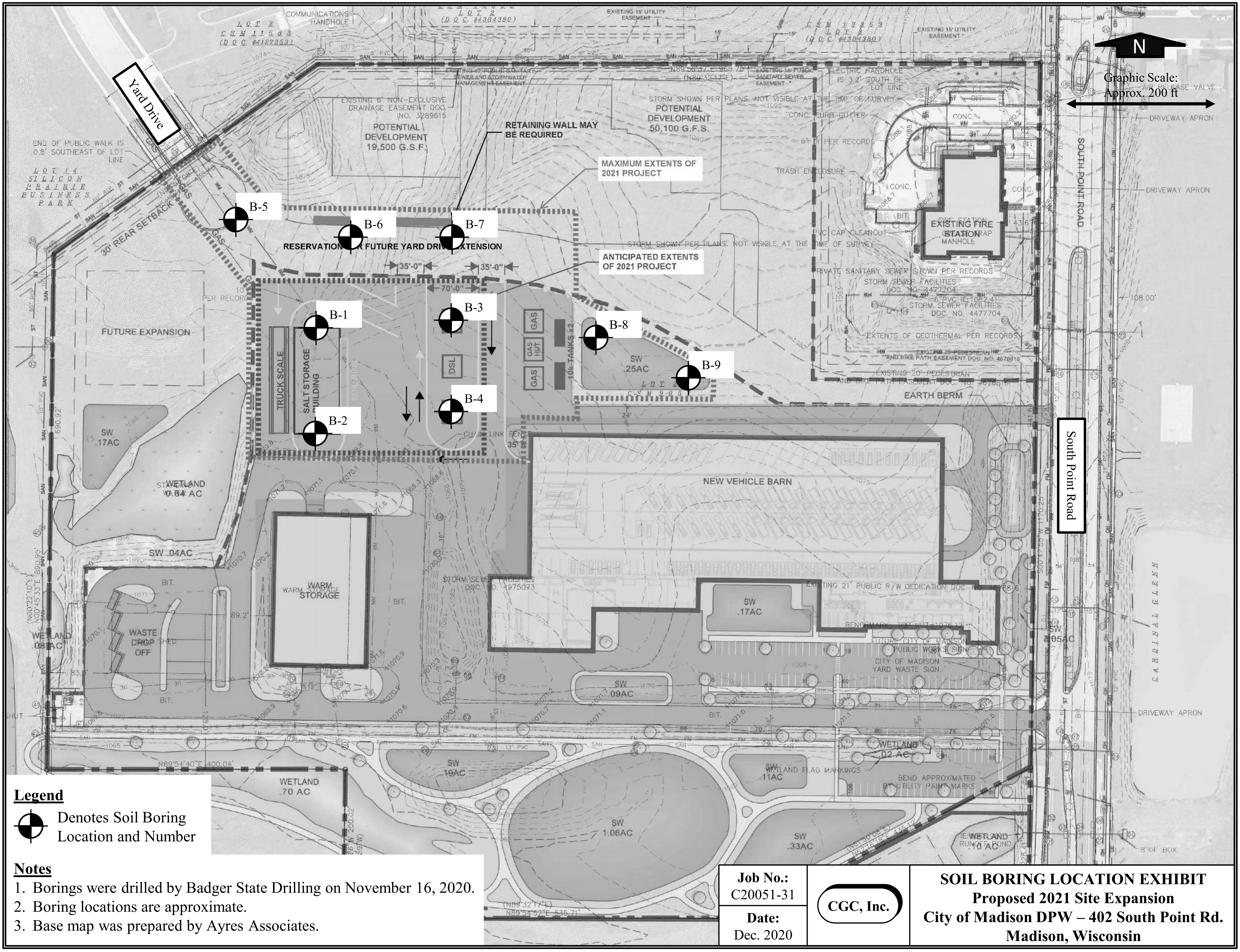
2. Standard Penetration Test and Split-Barrel Sampling of Soils
   (ASTM Designation: D 1586)

   This method consists of driving a 2-inch outside diameter split-barrel sampler using a 140-pound weight falling freely through a distance of 30 inches. The sampler is first seated 6 inches into the material to be sampled and then driven 12 inches. The number of blows required to drive the sampler the final 12 inches 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 and laboratory testing. The soils were visually classified by a geotechnical engineer using the Unified Soil Classification System (USCS). The samples from the two Stormwater Borings B-8 and B-9 were additionally classified using the USDA classification system. The final boring logs prepared by the engineer, including laboratory test results, 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 (9)
PARTICLE SIZE DISTRIBUTION TEST REPORT (1)
LOG OF TEST BORING-GENERAL NOTES
UNIFIED SOIL CLASSIFICATION SYSTEM



Legend

Denotes Soil Boring Location and Number

Notes

1. Borings were drilled by Badger State Drilling on November 16, 2020.
2. Boring locations are approximate.
3. Base map was prepared by Ayres Associates.

Job No.:	CGC, Inc.	SOIL BORING LOCATION EXHIBIT
C20051-31		Proposed 2021 Site Expansion
Date:		City of Madison DPW – 402 South Point Rd.
Dec. 2020		Madison, Wisconsin

LOG OF TEST BORING

CGC Inc.

Project: Proposed 2021 Site Expansion
City of Madison DPW - 402 South Point Rd.
Location: Madison, Wisconsin

Boring No. 1
Surface Elevation (ft) 1072±
Job No. C20051-31
Sheet 1 of 1

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

SAMPLE No.	TYPE	Rec (in.)	Moist	N	Depth (ft)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	W	LL	PL	LI
						8± in. TOPSOIL FILL					
1	■	18	M	9		FILL: Very Stiff, Brown/Dark Gray Lean Clay, Little Sand, Trace Gravel, Scattered Asphalt Pieces/Possible Cinders	(2.0-2.25)				
2	■	18	M	8	5	FILL: Very Stiff, Gray to Dark Gray Sandy Lean Clay, Trace to Little Gravel, Scattered Asphalt Pieces/Possible Cinders *Possible Petroleum/Chemical Odor is Sample 2*	(2.5-3.5)				
3	■	18	M	9		Medium Stiff to Very Stiff, Gray/Brown (Mottled) Lean CLAY, Trace to Little Sand, Trace Gravel (CL)	(1.75-2.25)	28.4			
4	■	18	M/W	6			(0.75-1.0)	22.3			
					10	Loose to Medium Dense, Light Brown Silty Fine SAND to Sandy SILT, Trace Gravel (SM/ML)					
5	■	18	M	17	15						
						Medium Dense, Light Brown Fine to Medium SAND, Some Silt, Little to Some Gravel, Scattered Cobbles/Boulders (SM)					
6	■	18	M/W	16	20						
7	■	18	M/W	13	25						
						End of Boring at 25 ft					
						Borehole Backfilled with Bentonite Chips					
					30						

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 11/16/20 End 11/16/20
Driller BSD Chief MC Rig CME-45
Logger GB Editor TFG
Drill Method 2.25" HSA; Autohammer

LOG OF TEST BORING

CGC Inc.

Project: Proposed 2021 Site Expansion
City of Madison DPW - 402 South Point Rd.
Location: Madison, Wisconsin

Boring No. 2
Surface Elevation (ft) 1068±
Job No. C20051-31
Sheet 1 of 1

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

SAMPLE No.	TYPE	Rec (in.)	Moist	N	Depth (ft)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	W	LL	PL	LI
					0–1.5	18± in. TOPSOIL					
1		18	M	9	1.5–4	Very Stiff, Brown Lean CLAY, Little Sand, Trace Gravel (CL)	(3.25-3.75)	19.3			
2		3	M	16							
3		18	M	4	4–8	Loose to Medium Dense, Brown Fine to Medium SAND, Some Silt, Trace Gravel (SM)					
4		18	M	8	8–12	Loose, Tan Fine SAND, Trace Silt and Gravel (SP)					
5		18	M/W	12	12–25	Medium Dense to Dense, Light Brown Fine to Medium SAND, Some Silt, Little to Some Gravel, Scattered Cobbles/Boulders (SM)					
6		18	M/W	25							
7		18	W	41							
					25	End of Boring at 25 ft Borehole Backfilled with Bentonite Chips					

WATER LEVEL OBSERVATIONS

While Drilling ∇ 22.0'   Upon Completion of Drilling ______
Time After Drilling: 30 mins.
Depth to Water: ▼
Depth to Cave in: 21.0'

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

GENERAL NOTES

Start 11/16/20 End 11/16/20
Driller BSD Chief MC Rig CME-45
Logger GB Editor TFG
Drill Method 2.25" HSA; Autohammer

LOG OF TEST BORING

CGC Inc.

Project: Proposed 2021 Site Expansion
City of Madison DPW - 402 South Point Rd.
Location: Madison, Wisconsin

Boring No. 3
Surface Elevation (ft) 1074±
Job No. C20051-31
Sheet 1 of 1

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

SAMPLE No.	TYPE	Rec (in.)	Moist	N	Depth (ft)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	W	LL	PL	LI
					0–1.5	18± in. TOPSOIL					
1		3	M	10	1.5–3.5	Loose to Medium Dense, Brown Fine to Medium SAND, Some Silt, Trace Gravel (SM)					
2		18	M	15	3.5–6	Medium Dense, Light Brown Fine to Medium SAND, Some Silt and Gravel, Scattered Cobbles/Boulders (SM)					
3		18	M	18	6–15	Medium Dense, Light Brown Fine SAND, Some Silt, Trace to Little Gravel (SM)					
4		18	M	21							
5		18	M	22							
					15	End of Boring at 15 ft Borehole Backfilled with Bentonite Chips					

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 11/16/20 End 11/16/20
Driller BSD Chief MC Rig CME-45
Logger GB Editor TFG
Drill Method 2.25" HSA; Autohammer

LOG OF TEST BORING

CGC Inc.

Project	Proposed 2021 Site Expansion
	City of Madison DPW - 402 South Point Rd.
Location	Madison, Wisconsin
Boring No.	4
Surface Elevation (ft)	1071±
Job No.	C20051-31
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
						8± in. TOPSOIL					
1		18	M	12		Very Stiff to Hard, Brown Lean CLAY, Little Sand, Trace Gravel (CL)	(3.25-4.5+)	17.1			
2		18	M	15		Medium Dense to Dense, Light Brown Fine to Medium SAND, Some Silt, Little to Some Gravel, Scattered Lean Clay Seams and Cobbles/Boulders (SM)					
					5						
3		18	M	17							
4		18	M	19							
					10						
5		18	M	42							
					15	End of Boring at 15 ft Borehole Backfilled with Bentonite Chips					
					20						
					25						
					30						

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 11/16/20 End 11/16/20

Driller BSD Chief MC Rig CME-45

Logger GB Editor TFG

Drill Method 2.25" HSA; Autohammer

LOG OF TEST BORING

CGC Inc.

Project: **Proposed 2021 Site Expansion**
City of Madison DPW - 402 South Point Rd.
Location: **Madison, Wisconsin**

Boring No. **5**
Surface Elevation (ft) **1069±**
Job No. **C20051-31**
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
						8± in. TOPSOIL					
1		8	M	5		Very Stiff, Brown Lean CLAY, Trace to Little Sand (CL)	(2.0-3.0)	26.2			
2		16	M	5	5	Stiff, Gray/Reddish Brown (Mottled) Lean CLAY, Trace to Little Sand (CL)	(1.0-1.5)				
3		18	M	17		Medium Dense, Light Brown Fine to Medium SAND, Little to Some Silt, Trace Gravel, Interbedded with Stiff, Gray Lean CLAY, Trace Sand (SP-SM/SM/CL)	(1.25-1.75)				
4		18	M	21	10	Medium Dense, Tan Fine to Coarse SAND, Trace to Little Silt, Trace Gravel, Scattered Silt Seams (SP/SP-SM)					
						End of Boring at 10 ft					
						Borehole Backfilled with Bentonite Chips					

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 **11/16/20** End **11/16/20**
Driller **BSD** Chief **MC** Rig **CME-45**
Logger **GB** Editor **TFG**
Drill Method **2.25" HSA; Autohammer**

LOG OF TEST BORING

CGC Inc.

Project: **Proposed 2021 Site Expansion**
City of Madison DPW - 402 South Point Rd.
Location: **Madison, Wisconsin**

Boring No. **6**
Surface Elevation (ft) **1071±**
Job No. **C20051-31**
Sheet **1** of **1**

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

SAMPLE No.	Rec (in.)	Moist	N	Depth (ft)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	W	LL	PL	LI
					12± in. TOPSOIL					
1	10	M	5		Stiff, Brown/Gray (Lightly Mottled) Lean CLAY, Trace Sand (CL)	(1.25-2.0)	28.2			
2	18	M	10	5	Loose to Medium Dense, Tan Fine to Medium SAND, Little to Some Silt, Trace Gravel (SP-SM/SM)					
3	18	M	16		Medium Dense, Tan Fine to Coarse SAND, Little Gravel, Trace Silt, Scattered Silt Seams (SP)					
4	18	M	17	10	Medium Dense, Light Brown Silty Fine SAND to Sandy SILT, Trace Gravel (SM/ML)					
5	18	M	19	15	Medium Dense, Light Brown Fine to Medium SAND, Some Silt and Gravel, Scattered Cobbles/Boulders (SM)					
6	18	M	24	20						
					End of Boring at 20 ft Borehole Backfilled with Bentonite Chips					

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 **11/16/20** End **11/16/20**
Driller **BSD** Chief **MC** Rig **CME-45**
Logger **GB** Editor **TFG**
Drill Method **2.25" HSA; Autohammer**

LOG OF TEST BORING

CGC Inc.

Project: Proposed 2021 Site Expansion
City of Madison DPW - 402 South Point Rd.
Location: Madison, Wisconsin

Boring No. 7
Surface Elevation (ft) 1080±
Job No. C20051-31
Sheet 1 of 1

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

SAMPLE No.	Type	Rec (in.)	Moist	N	Depth (ft)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	W	LL	PL	LI
						20± in. TOPSOIL					
1		18	M	10		Very Stiff to Hard, Brown Lean CLAY, Trace to Little Sand (CL)	(3.25)				
2		18	M	10			(3.5-4.5+)	23.0			
					5						
3		18	M	6		Very Stiff, Gray/Orange Brown (Mottled) Lean CLAY, Trace Sand (CL)	(2.25-2.5)	27.8			
4		18	M	8		Loose, Brown Silty Fine SAND to Sandy SILT, Trace Gravel (SM/ML)					
					10						
						Medium Dense, Light Brown SILT, Trace Sand (ML)					
5		18	M	23							
					15						
						Medium Dense to Dense, Light Brown Fine to Medium SAND, Some Silt, Little to Some Gravel, Scattered Cobbles/Boulders (SM)					
6		18	M	27							
					20						
7		18	M/W	31							
					25						
						Dense, Light Brown Gravelly Fine to Coarse SAND, Little to Some Silt (SP-SM/SM)					
8		18	M/W	33							
					30	End of Boring at 30 ft Borehole Backfilled with Bentonite Chips					

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 11/16/20 End 11/16/20
Driller BSD Chief MC Rig CME-45
Logger GB Editor TFG
Drill Method 2.25" HSA; Autohammer

LOG OF TEST BORING

CGC Inc.

Project: **Proposed 2021 Site Expansion**
City of Madison DPW - 402 South Point Rd.
Location: **Madison, Wisconsin**

Boring No. **8**
Surface Elevation (ft) **1078±**
Job No. **C20051-31**
Sheet **1** of **1**

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

Sample No.	Type	Rec (in.)	Moist	N	Depth (ft)	Visual Classification and Remarks	qu (qa) (tsf)	W	LL	PL	LI
						12± in. TOPSOIL					
1		14	M	6		Stiff, Brown/Gray (Lightly Mottled) Lean CLAY, Trace Sand (CL)	(1.75)				
						USDA: 10YR 5/3 (Redox: f1f 10YR 5/1) Silty Clay Loam					
2		18	M/W	3			(0.5-0.75)				
					5	Medium Stiff, Brown/Gray (Mottled) Lean CLAY, Trace to Little Sand, Trace Gravel (CL)					
3		18	M/W	3		*USDA: 10YR 5/3 (Redox: c2d 10YR 5/1) Silty Clay Loam*	(0.25-0.5)				
						Soft/Very Loose, Brown Sandy Lean CLAY to Clayey Fine SAND, Trace Gravel (CL/SC)					
4		18	M	12		*USDA: 10YR 5/3 Sandy Clay Loam*					
					10	Medium Dense, Dark Brown Fine to Coarse SAND, Some Silt, Little Gravel (SM)					
5		18	M	17		*USDA: 10YR 4/3 Sandy Loam*					
								5.8			
6		18	M	24		Medium Dense, Light Brown Fine to Medium SAND, Some Silt, Little to Some Gravel, Scattered Lean Clay Seams and Cobbles/Boulders (SM)					
					15	*USDA: 10YR 6/4 Gravelly Sandy Loam, Scattered Clay Loam Seams*					
7		18	M	26		Composite P200 - Samples 5 and 6: 20.8%					
8		18	M	30							
					20	End of Boring at 20 ft					
						Borehole Backfilled with Bentonite Chips					
					25						
					30						

WATER LEVEL OBSERVATIONS

While Drilling	∇ NW	Upon Completion of Drilling		NW
Time After Drilling				Next Day
Depth to Water				NW
Depth to Cave in				16.0'

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

GENERAL NOTES

Start **11/16/20** End **11/16/20**
Driller **BSD** Chief **MC** Rig **CME-45**
Logger **GB** Editor **TFG**
Drill Method **2.25" HSA; Autohammer**

CGC Inc.

LOG OF TEST BORING

Project: Proposed 2021 Site Expansion
City of Madison DPW - 402 South Point Rd.
Location: Madison, Wisconsin

Boring No. 9
Surface Elevation (ft) 1078±
Job No. C20051-31
Sheet 1 of 1

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

SAMPLE No.	Rec (in.)	Moist	N	Depth (ft)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	W	LL	PL	LI
					18± in. TOPSOIL					
1	18	M	16		Hard, Brown/Gray (Lightly Mottled) Lean CLAY, Trace Sand (CL) *USDA: 10YR 5/3 (Redox: f1f 10YR 5/1) Silty Clay Loam*	(4.25-4.5)				
2	18	M	8	5		(1.5-1.75)				
3	18	M	3		Stiff, Brown/Gray (Mottled) Lean CLAY, Trace to Little Sand, Trace Gravel (CL) *USDA: 10YR 5/3 (Redox: c2d 10YR 5/1) Silty Clay Loam*	(0.75)				
4	18	M	14	10	Medium Stiff, Gray/Reddish Brown (Mottled) Lean CLAY, Trace Sand (CL) *USDA: 2.5Y 6/1 (Redox: c3p 10YR 3/6) Silty Clay Loam*					
5	18	M	21		Very Loose to Medium Dense, Tan Fine SAND, Little to Some Silt, Trace Gravel (SP-SM/SM) *USDA: 10YR 7/4 Loamy Fine Sand*					
6	18	M	19	15	Medium Dense, Tan Fine to Coarse SAND, Trace Silt and Gravel (SP) *USDA: 10YR 7/3 Sand*					
7	18	M	29		Medium Dense, Light Brown SILT, Trace Sand (ML) *USDA: 10YR 6/3 Silt Loam*					
8	18	M	26	20	Medium Dense, Light Brown Fine to Medium SAND, Some Silt, Little to Some Gravel, Scattered Lean Clay Seams and Cobbles/Boulders (SM) *USDA: 10YR 6/4 Gravelly Sandy Loam, Scattered Clay Loam Seams*					

End of Boring at 20 ft

Borehole Backfilled with Bentonite Chips

WATER LEVEL OBSERVATIONS

While Drilling ▽ NW — Upon Completion of Drilling: NW

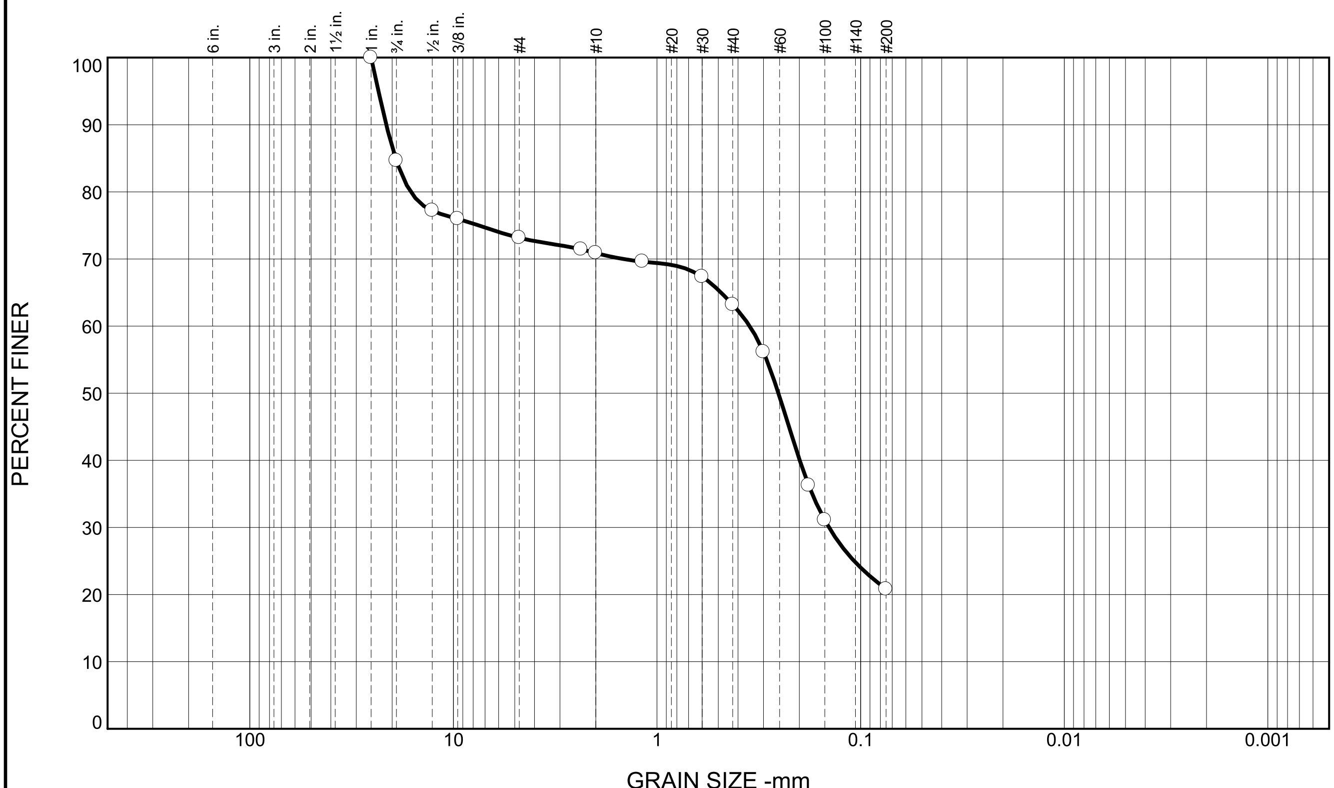
Time After Drilling				Next Day
Depth to Water				NW ▼
Depth to Cave in				16.5'

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

GENERAL NOTES

Start 11/16/20 End 11/16/20
Driller BSD Chief MC Rig CME-45
Logger GB Editor TFG
Drill Method 2.25" HSA; Autohammer

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	15.4	11.4	2.3	7.7	42.4	20.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
3/4	84.6		
1/2	77.2		
3/8	76.0		
#4	73.2		
#8	71.4		
#10	70.9		
#16	69.6		
#30	67.3		
#40	63.2		
#50	56.1		
#80	36.3		
#100	31.1		
#200	20.8		

* (no specification provided)

Material Description

Brown Fine to Medium Sand, Some Silt and Gravel

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 21.3687 D_{85}= 19.2213 D_{60}= 0.3506
D_{50}= 0.2533 D_{30}= 0.1429 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Natural Moisture = 5.8%

Sample Number: B-8 / S 5 & 6

Date: 11/30/20

CGC, Inc.

Client: City of Madison Engineering
Project: DPW 402 South Point Road

Project No: C20051-31 **Figure**

Tested By: DRW **Checked By:** KJS

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)		
	Clean Gravels (Less than 5% fines)	
GRAVELS More than 50% of coarse fraction larger than No. 4 sieve size	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
	Clean Sands (Less than 5% fines)	
SANDS 50% or more of coarse fraction smaller than No. 4 sieve size	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

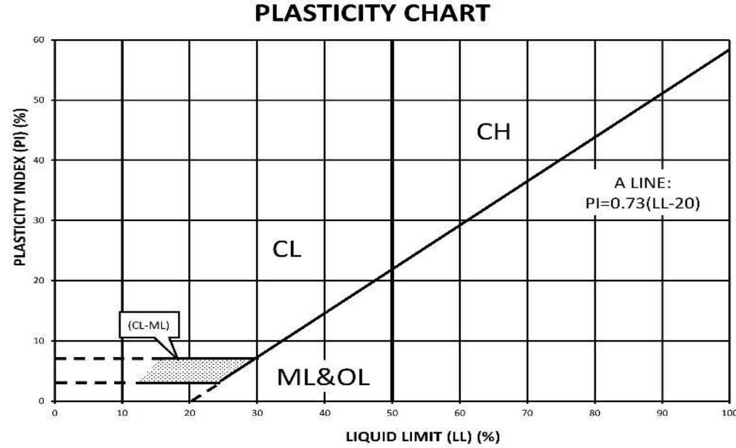
LABORATORY CLASSIFICATION CRITERIA

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.

Modified and reprinted with permission from:

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	Percent Compaction (1) 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)

APPENDIX E

UNITED STATES DEPARTMENT OF AGRICULTURE – NATURAL RESOURCES CONSERVATION SERVICE *WEB SOIL SURVEY* MAP AND LEGEND

Soil Map—Dane County, Wisconsin
(Yard Drive Extension, Madison)

Map Scale: 1:1,980 if printed on A landscape (11" x 8.5") sheet.

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 16N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Dane County, Wisconsin
Survey Area Data: Version 19, Jun 8, 2020

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Apr 29, 2011—Aug 29, 2013

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
GwC	Griswold loam, 6 to 12 percent slopes	4.0	38.1%
PnC2	Plano silt loam, till substratum, 6 to 12 percent slopes, eroded	1.1	10.3%
PoA	Plano silt loam, gravelly substratum, 0 to 2 percent slopes	1.4	13.5%
PoB	Plano silt loam, gravelly substratum, 2 to 6 percent slopes	2.3	22.1%
TrB	Troxel silt loam, 0 to 3 percent slopes	1.7	16.0%
Totals for Area of Interest		**10.5**	**100.0%**

APPENDIX F

WISCONSIN DEPARTMENT OF SAFETY & PROFESSIONAL SERVICES
SOIL AND SITE EVALUATION – STORM FORM (2 BORINGS)

Division of Industry Services
P.O. Box 2658
Madison, Wisconsin 53701

Attachment 2:

SOIL AND SITE EVALUATION - STORM

In accordance with SPS 382.365, 385, Wis. Adm. Code, and WDNR Standard 1002

Attach a complete site plan on paper not less than 8 ½ x 11 inches in size. Plan must include, but not limited to: vertical and horizontal reference point (BM), direction and percent of slope, scale or dimensions, north arrow, and BM referenced to nearest road	County Dane
	Parcel I.D. 251/0708-282-0103-1
Please print all information Personal information you provide may be used for secondary purposes [Privacy Law, s. 15.04(1)(m)]	Reviewed by: Date:

Property Owner: City of Madison Streets West Side Public Works	Property Location: Govt. Lot SE ¼ NW ¼ S 28 T 7 N R 8 E
Property Owner's Mail Address: 1501 West Badger Road	Lot # / Block# / Subd. Name or CSM #
City: Madison; State: WI; Zip Code: 53713-2307; Phone Number:	[X] City [ ] Village [ ] Town — Madison; Nearest Road: 402 South Point Road

Drainage area ________ [ ] sq ft [ ] acres

Test site suitable for (check all that apply): [ ] Site not suitable; [ ] Bioretention; [ ] Subsurface Disperal System; [ ] Reuse; [ ] Irrigation; [ ] Other ________

Hydraulic Application Test Method: [X] Morphological Evaluation [ ] Double Ring Infiltrometer [ ] Other: (specify) ________

Soil Moisture — Date of soil borings: ________ USDA-NRCS WETS Value: [ ] Dry = 1; [ ] Normal = 2; [ ] Wet = 3.

B-8 #OBS. [ ] Pit [X] Boring Ground surface elevation 1078± ft. Elevation of limiting factor 1077± ft. (Redox)

Horizon	Approx. Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frags.	% Fines (P200)	Hydraulic App Rate Inches/Hr
1	0-12	Topsoil (not sampled)								
2	12-36	10YR 5/3	f1f 10YR 5/1	SiCL	0m	mfi		<5		0.04
3	36-66	10YR 5/3	c2d 10YR 5/1	SiCL	0m	mfi		<10		0.04
4	66-96	10YR 5/3	none	SCL	0m	mfi		<10		0.11
5	96-126	10YR 4/3	none	SL	0sg	ml		5-15		0.50
6	126-240	10YR 6/4	none	GRSL, CL Seams	0sg	ml		29	21	0.03-0.50 (1)

Comments: Groundwater was not encountered during or upon the completion of drilling. However, redox in Horizons 2 and 3 indicates the level of past saturation from perched water, periodically infiltrating surface water or seasonally elevated groundwater.

(1) Vertical infiltration potential will be limited by clay loam seams and can potentially improved by excavating and turning over (i.e., deep-tilling) this layer to break up scattered lower-permeability seams; gradations should be collected during construction to document that the texture of the blended soil is consistent with the design infiltration rate.

Name (Please Print): Tim F. Gassenheimer	Signature: [signature]	Credential Number: SP-011900004
Address: 129 Milky Way, Madison, WI 53718	Date Evaluation Conducted: November 21, 2020	Telephone Number: (608) 288-4100

B-9 #OBS. ☐ Pit ☒ Boring Ground surface elevation 1078± ft. Elevation of limiting factor 1077± ft. (Redox)

Horizon	Approx. Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frags.	% Fines (P200)	Hydraulic App Rate Inches/Hr
1	0-18	Topsoil (not sampled)								
2	18-36	10YR 5/3	f1f 10YR 5/1	SiCL	0m	mfi		<5		0.04
3	36-66	10YR 5/3	c2d 10YR 5/1	SiCL	0m	mfi		<10		0.04
4	66-84	2.5Y 6/1	c3p 10YR 3/6	SiCL	0m	mfi		<5		0.04
5	84-126	10YR 7/4	none	LFS	0sg	ml		<10		0.50
6	126-168	10YR 7/3	none	S	0sg	ml		<10		3.60
7	168-192	10YR 6/3	none	SiL	2mabk	mfi		<5		0.13
8	192-240	10YR 6/4	none	GRSL, CL Seams	0sg	ml		15-25		0.03-0.50 (1)

Comments: Groundwater was not encountered during or upon the completion of drilling. However, low-chroma/high-value matrix color and/or redox in Horizons 2, 3 and 4 indicate the level of past saturation from perched water, periodically infiltrating surface water or seasonally elevated groundwater.

(1) Vertical infiltration potential will be limited by clay loam seams and can potentially improved by excavating and turning over (i.e., deep-tilling) this layer to break up scattered lower-permeability seams; gradations should be collected during construction to document that the texture of the blended soil is consistent with the design infiltration rate.

Overall Site Comments: See Comments above and Preliminary Stormwater Infiltration Potential section in Geotechnical Exploration Report.