



Construction • Geotechnical
Consulting Engineering/Testing

June 8, 2020
CM20074

Mr. Bryan Lindgren
Neumann Companies, Inc.
N27 W24075 Paul Court, Suite 200
Pewaukee, Wisconsin

Re: Preliminary Subsurface Investigation
Proposed East 50 Acre Development
Campus Drive
Hartland, Wisconsin

Dear Mr. Lindgren:

Construction • Geotechnical Consultants, Inc. (CGC) has completed the subsurface exploration for the proposed East 50 Acre residential development at the above referenced project site, in the Village of Hartland, Wisconsin. The purpose of this exploration was to preliminarily evaluate the subsurface conditions across the site and to provide preliminary geotechnical-related recommendations regarding general site development, foundation, floor slab, below-grade wall and roadway design/construction. In addition, the site's soils were reviewed to provide an indication as to the infiltration properties of the soils within the planned stormwater management basins. An electronic copy of this report is provided for your use. A hard copy can be provided if requested. An additional electronic copy has also been forwarded to Mr. Terry Foster with Trio Engineering (Trio).

PROJECT DESCRIPTION

Development of the "East 50 Acre" residential development is being considered on the vacant parcel located east of Campus Drive and north of STH 16 in the Village of Hartland, Wisconsin. The project area is located east of the Lake Country Lutheran Campus, which is located west of Campus Drive. The project will consist of developing the northern portion of the site with 47 single-family standalone condominium structures and the southern portion with 6 multi-family townhome structures, with separate garage buildings. It is anticipated that the condominium and townhome structures will generally consist of one- to two-story wood-framed buildings with either slab-on-grade floors or full basements, supported by conventional spread footings. The garages are anticipated to consist of one-story structures with slab-on-grade floors. Structural loads are generally expected to be light to moderate in magnitude. A public roadway will extend from east to west through the central portion of the site, in the area of an existing asphaltic concrete walk/bike path and private roadways and surface parking areas will also be constructed. In addition, up to eight separate stormwater management areas are planned. Details regarding stormwater management areas were not known at the time of this report. In addition, proposed site grades were not known at the time of this report; however, considering the elevation



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differences across the site and the generally rolling to hilly terrain, substantial cut and/or fill is anticipated to be necessary to establish site grades.

EXPLORATION PROGRAM

Thirteen (13) Standard Penetration Test (SPT) soil borings (Borings B3, B6, B7, B9, B11, B12, B13, and B16 in proposed roadway and building areas and Borings B1, B2, B5, B17 and B18 in stormwater management areas) were drilled for this exploration to depths ranging from about 10 to 20 ft below existing site grades. In addition, five (5) shallow hand auger borings (Borings B4, B8, B10, B14 and B15) were performed within proposed stormwater management areas that were inaccessible with ATV mounted drilling equipment. Due to the densely wooded and hilly terrain over the site, access to the SPT boring locations was gained with clearing of trees and/or brush by the client's subcontractor. The borings were located and staked in the field by Trio Engineering (Trio) personnel. The SPT borings were drilled on May 18 and 19, 2020 by GeoServe, Inc. (under subcontract to CGC, Inc.) using an all-terrain vehicle (ATV) mounted Geoprobe drill rig equipped with hollow-stem augers and an automatic SPT hammer. The shallow hand auger borings were performed by CGC personnel on May 29. The ground surface elevations were provided by Trio. Specific procedures used for drilling and sampling during the field exploration are described in Appendix A. The approximate boring locations are shown in plan on the Soil Boring Location Maps enclosed in Appendix B.

Representative samples of the subsoils were collected during the field exploration for classification and laboratory testing. The soils were classified by a geotechnical engineer using the Unified Soil Classification System (USCS), and the samples collected from the stormwater-related soil borings (Borings B1, B2, B4, B5, B8, B10, B14, B15, B17 and B18) were also classified in accordance with the descriptive procedures, terminology and interpretations presented by the *USDA - NRCS Field Book for Describing and Sampling Soils* (version 2.0, dated September 2002). Pocket penetrometer readings were obtained on intact cohesive samples recovered during the exploration, where appropriate, to aid in the evaluation of their shear strength properties. Natural moisture content determination testing was completed on representative samples of the clayey soils. Laboratory test results are presented on the individual logs. The final logs and Soil and Site Evaluation-Storm form prepared by the engineer per the USCS and USDA procedures are presented in Appendices B and C, respectively.

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SITE CONDITIONS

A. Surface Conditions

The proposed development areas are depicted on the Soil Boring Location Maps attached in Appendix B. Overall, the site consists of vacant, undeveloped land that is partially to heavily wooded and/or covered with brush. An existing asphaltic concrete walk/bike path extends east to west through the central portion of the site and numerous walk paths extend through the wooded areas. An existing stormwater management basin is located in the northwest corner of the site. Existing wetlands are located throughout the eastern portion of the site. Based on review of existing site grades, included on the *Overall Proposed Site Plan* (Sheet C1.0, dated March 6, 2020) prepared and provided by Trio, existing site grades are somewhat variable across the site. The site grades in the northern planned single-family condominium development areas currently range between about EL 970 to 990 ft on the east side and EL 990 to 1010 ft on the west side. The site grades in the southern planned multi-family townhome development area currently range between about EL 1000 to 1019 ft. Although planned grades were not known at the time of this report, we anticipate a mass-grading operation may be required for cutting and filling on the site.

B. Regional Geology

Surficial soil deposits in the project area are generally described as loamy soils with gravelly loam or sand and gravel outwash as the substrata. The predominant series for the surface soils across the site are mapped in the Soil Survey for Milwaukee and Waukesha Counties as the Casco-Rodman Complex and Hochheim. Inclusions of the Dodge and Juneau series are also mapped on the site. The soil series on the site are generally described as being moderately well to excessively drained. The following Table 1 presents a summary of the engineering properties of the prevalent soil series present across the site. Pedological mapping of the site is shown in the Soil Survey Map enclosed in Appendix B.

Table 1
Summary of Soil Series ⁽¹⁾

Soil Name	Characteristics	Description	Depth to Seasonal High-Water Table (ft)	Degree/Kind of Limitations Affecting --	
				Road Subgrade	Foundations
Casco-Rodman Complex (CrD, CrE & CrF)	• Well to excessively drained • Low shrink-swell potential • Good shear strength	Clay and gravelly loam over sand and gravel outwash	5+	Slight to Good	Slight
Dodge Silt Loam (DdB)	• Well drained • Low to moderate shrink-swell potential • Low bearing capacity when wet	Silt and silty clay loam	5+	Severe	Slight
Hochheim Loam (HmB2, HmC2, HmD2 & HoD3)	• Well drained • Low to moderate shrink-swell potential • Low bearing capacity	Clay loam over gravelly loam	5+	Very Severe to Slight ⁽²⁾	Slight
Juneau Silt Loam (JuA)	• Well to moderately well drained • Low to moderate shrink-swell potential • Fair shear strength	Silt and silty clay loam	5+	Severe	Slight to Moderate

Notes: ⁽¹⁾ Reference - USDA Soil Conservation Service Soil Survey of Milwaukee and Waukesha Counties.
⁽²⁾ Slight limitations refer to the HoD3 mapping at the southwest corner of the parcel.

C. Subsurface Conditions

The borings indicate a somewhat variable soil profile beneath the project site in the planned building versus the planned stormwater management borings. A summary of the conditions within the building/roadway areas and the planned stormwater management areas is included as follows:

1. Building/Roadway Borings (B3, B6, B7, B9, B11, B12, B13, and B16)

- Surface materials consist of about 2 to 12 in. of dark brown *silty clay topsoil*; underlain by,

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- Natural brown to brown mottled **silty/lean clay**, with variable sand and gravel content extending to depths of about 4 to 6.5 ft; underlain by,
- Brown fine to coarse **sand and gravel** with variable percentages of silt, gravel and cobbles extending to the maximum depths explored, 10 to 20 ft.

Exceptions to the above-described generalized soil conditions were encountered as follows:

- Natural brown **clayey sand** layers were encountered at Borings B7 (2.5 to 4 ft), B12 (4 to 5.5 ft) and B13 (4 to 5.5 ft).
- A **silty fine to medium sand** layer was encountered at Boring B9 (6 to 8 ft).

The encountered cohesive **natural lean silty/clay** soils generally exhibited unconfined compressive strengths (as measured with a hand penetrometer) ranging from 1.0 to 2.25 tons per square foot (tsf), which corresponds to a medium stiff to very stiff consistency. However, *an exception was encountered at Boring B7 (northern single-family condominium area) where the lean clay soil between depths of about 4 to 6.5 ft exhibited an unconfined compressive strength of 0.25 tsf, corresponding to a very soft to soft consistency.* Natural moisture testing performed on representative samples of the natural clayey soils indicated the natural moisture contents range between about 9.3 to 24.7 percent. The natural **sand and gravel, clayey sand and silty sand** soils generally exhibited SPT N-values ranging from 15 to 100 blows per foot (bpf), which corresponds to a medium dense to very dense density. However, the clayey sand encountered at Boring B7 (2.5 to 4 ft) exhibited an SPT N-value of 2 bpf, corresponding to very loose characteristics. The underlying granular soils encountered across the site contain possible cobbles and/or boulders and the higher SPT N-values may not be representative of the actual density of the soils.

2. Stormwater Borings (B1, B2, B4, B5, B8, B10, B14, B15, B17 and B18)

- Surface materials consist of about 2 to 12 in. of dark brown/black **silty clay to sandy loam topsoil**; underlain by,
- Natural brown, brown mottled to brown and gray mottled **silty/lean clay**, with variable sand and gravel content generally extending to the maximum depths explored of 2 to 15 ft.

Exceptions to the above-described generalized soil conditions were encountered as follows:

- Brown gray **silty sand**, some gravel was encountered at Boring B1 at a depth of about 14 ft, extending to at least 15 ft, the maximum depth explored.
- Brown **silty sand and gravel** was encountered at Boring B5 at a depth of about 7 ft, extending to at least 10 ft, the maximum depth explored.
- A 4-in thick brown **sand and gravel** layer classified as **possible fill** was encountered at



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Boring B15, below the 4 in thick surface topsoil. In addition, a brown **sandy silt/sandy clay** layer was encountered at Boring B15 at a depth of about 2.5 ft extending to at least 3.3 ft, the maximum depth explored.

The encountered prevalent cohesive **silty clay/lean clay** soils encountered in the stormwater borings generally exhibited unconfined compressive strengths ranging from 0.5 to 2.5 tsf, which corresponds to a soft to very stiff consistency. Natural moisture testing performed on representative samples of the natural clayey soils indicated the natural moisture contents range between about 22.2 to 34.5 percent. The natural granular soils exhibited SPT N-values ranging from 13 to 19 bpf, which corresponds to medium dense characteristics.

D. Groundwater Conditions

Groundwater was encountered within the building/roadway Borings B3, B7 and B12 at a depth of 4 ft, corresponding to between EL 989 to 1015± ft. However, no groundwater was encountered within the remaining building/roadway borings during or upon completion of drilling. Based on the observed water conditions and soil coloration, we anticipate the long-term water table within the building/roadway borings was below the maximum depths explored. The shallow water encountered at Borings B3, B7 and B12 is considered to represent perched water.

Groundwater was encountered within the stormwater SPT Borings B1, B2, B5, B17 and B18 at depths ranging between 7 to 14 ft. However, no groundwater was encountered within the shallow hand auger storm water borings. Based on the observed water conditions, relative moisture contents of the collected soil samples and soil coloration, we anticipate the long-term water table within the deeper stormwater borings to have been at 7 to 14 ft, corresponding to between EL 954 to 982± ft.

Groundwater levels can be expected to fluctuate based on seasonal variations in precipitation, infiltration, evapotranspiration, and other factors. More detailed information regarding the subsurface and groundwater conditions is presented on the boring logs contained in Appendix B.

DISCUSSION AND PRELIMINARY RECOMMENDATIONS

It is our opinion that the site appears suitable for the proposed development and that planned structures may be supported by conventional spread footings. However, considering the presence of occasional lower strength lean clay and sand soil layers, such as in the area of Boring B7, some undercutting and replacement of unsuitable soils during site preparation and/or footing excavations or stabilization during site preparation activities may be necessary. Preliminary recommendations for site preparation, as well as foundation, floor slab, below-grade walls and roadway construction, are presented in the following subsections. In addition, a discussion of



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stormwater management considerations is also provided. Additional information regarding the conclusions and recommendations presented in this report is discussed in Appendix D.

A. Site Preparation

To prepare the site for construction, we recommend that the surface vegetation, trees, brush and topsoil be stripped to a minimum of 5 ft beyond proposed building and pavement limits. Topsoil depths at the boring locations ranged between about 2 to 12 in. However, considering the heavy woods throughout the majority of the site, substantially greater removal depths may be required between and beyond the boring locations to remove organic materials such as root systems, trees etc. The topsoil is not suitable for re-use as engineered fill and should be stockpiled outside the construction limits, removed from the site, or utilized in landscape areas.

While site development plans are in the preliminary stage at this time, we anticipated that both site filling and cutting will be required throughout the development limits to establish building pad grades. Following the removal of vegetation/topsoil, including tree stumps/grubbing, the exposed subgrades are expected to consist primarily of natural silty/lean clays, silts, and/or granular soils. The silty/lean clays and silts generally exhibited relatively high natural moisture contents and are susceptible to disturbance especially when wet, and when subjected to repeated trafficking by wheeled or tracked construction equipment in wet weather.

Prior to fill placement, we recommend the exposed subgrades be proof-rolled with a heavy piece of construction equipment such as a haul truck or a loaded scraper. The purpose of proof-rolling is to check for soft or yielding areas that may require undercutting prior to fill placement. If unstable areas are detected, an initial attempt should be made to aerate and densify the subgrade by recompaction where natural moisture contents are at appropriate levels (i.e., on the dry side of optimum moisture content). If this procedure is ineffective, the disturbed soils should be undercut and replaced with compacted fill and/or stabilizing materials such as an imported 3-in. breaker rock, etc. Alternately, unstable subgrades within non-building areas may be stabilized by “bridging over” these soils with a maximum 2 ft thick stabilization/bridging layer consisting of the on-site non-organic soils. A relatively firm, non-yielding subgrade should be established prior to proceeding with fill placement. *The extent of undercutting required and/or instability observed in the stripped subgrade will be highly dependent on the time of year in which site grading proceeds.* Due to the susceptibility of the native soils to disturbance, especially if wet, measures should be taken to provide positive drainage of surface runoff away from the fill areas and roadway embankments, and to minimize trafficking across exposed subgrades.

After the subgrade is prepared as described above, we recommend that fill placement proceed as necessary to establish planned subgrade elevations. Where possible, we recommend filling proceed with any substantial fill zones as early as possible during the mass grading operation.



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Selection, placement and compaction of engineered fill should be in accordance with our Recommended Compacted Fill Specifications in Appendix E. It is our opinion that the non-organic native soils present across the site may be used to develop building pads and roadway embankments. However, use of the cohesive clay soils in structural areas will require close observation on a regular basis during fill placement including the monitoring of moisture contents, compaction levels, and the overall stability of the prepared fill subgrade. Based on moisture levels observed, some moisture conditioning of these soils will be required to aid in compactive efforts. In general, we recommend that fills placed in developing building pads be placed and compacted to a minimum of 95 percent of modified Proctor. Fills placed in pavement areas should be placed and compacted to levels in the range of 90 to 92 percent of modified Proctor. Other details regarding proper placement, selection and compaction of engineered fills are presented in our Recommended Compacted Fill Specifications in Appendix E.

B. Building Foundations, Floor Slabs and Below-Grade Walls

Based on the existing variable site grades and terrain, bearing conditions are expected to be somewhat variable across the site. Foundations for future structures will bear within the natural soils or engineered fill consisting of fine to coarse sands with varying percentages of gravel and silt, silty/lean clays or silt. It is our opinion that the anticipated lightly to moderately loaded buildings can be supported on conventional spread footings bearing within these strata. For preliminary planning purposes, allowable soil pressures in the range of 1,500 to 3,000 psf can be used to size footings in the shallow soil deposits. While the relatively dense granular strata encountered at various locations across the site could support higher design pressures for sizing footings, values in excess of 3,000 psf do not appear warranted for the type of development currently being considered for this site. It is anticipated that localized areas of very loose to loose clayey sand to very soft to soft clayey soils may be encountered while developing site grades, or during future footing construction. Where these conditions exist, such as noted at Boring B7, special subgrade preparation measures or use of reduced design pressures (i.e., 1500 psf) may be required.

After preparing the building sites as described in the subsection entitled "Site Preparation", soils present at these elevations should be suitable for slab-on-grade construction. Subgrade soils beneath the floor slabs will consist of either the natural soils or engineered fill soils comprised of lean clays, silts or fine to coarse sands.

If structures are to contain basement levels as currently anticipated, installation of a perimeter drain tile system connected to a sump crock should be installed to minimize hydrostatic pressures and maintain dry conditions. Recommended perimeter drain tile recommendations are attached to this report in Appendix F. Basement walls should be damp-proofed with a spray-applied or

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mopped-on rubber or bituminous sealer. CGC can provide additional design details for below-grade walls once site development details become further established.

C. Utility Construction

Based on the available soil and groundwater information, it appears that the natural cohesive and granular soils throughout the site are generally expected to provide adequate support for pipeline installation and that utility construction can proceed using traditional open cut methods (i.e., utilizing a trench shield, etc.). Although not anticipated for the entire site, areas of shallow groundwater may require pumping to control and lower groundwater levels to accommodate utility construction. It is anticipated that removal of infiltrating water from within the open excavations can generally be accomplished with conventional filtered sump pumps placed within the excavations.

D. Roadway Construction

It is anticipated that for most of the project site, roadway subgrades will consist of either the surficial silty/lean clays or the prevailing natural granular soils or engineered fills comprised of materials of similar texture. These strata are considered a fair to good subgrade material based on Unified Soil Classifications of CL-ML, CL, SP-SM and SM. A firm non-yielding subgrade is required for proper performance of a flexible pavement structure. It is, therefore, recommended that the natural strata or compacted fill to be used to develop the subbase be properly compacted before construction of the flexible pavement structure. The performance of these soils as subbase materials within pavement areas can be improved by preparing exposed subgrades in the manner described in the "Site Preparation" section of this report. Prior to placement of base course materials, prepared roadway subgrades should be evaluated for stability by proof-rolling. This is particularly important where the roadway has been established in "cut/fill" transitional areas.

Unstable areas should be undercut and replaced with compacted granular fill. Alternately, a geotextile fabric and/or biaxial geogrid could be used below the base course section. The geotextile fabric would maintain separation between the silty/clay soils of the site and the base course, and would assist in providing "bridging action" between the dissimilar roadway subgrade materials. A minimum of 10- to 12-in. thick base course layer would be required where either a fabric or geogrid is utilized for stabilization purposes.

The prevailing weather conditions, the construction methods employed, as well as the selected placement of the roadway grade lines within the subsoil profile, will be significant factors in determining if, or to what degree, subgrade stabilization measures will be required within roadway areas.



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For preliminary purposes, the following typical range of pavement design parameters were developed for consideration in the design of flexible pavements:

AASHTO Classification	A-1 to A-3 (granular soils) A-6 (clays)
Design Group Index	5 to 10
Frost Index	F-2 to F-3
Soil Support Value	3.8 to 5.0

The above parameters are based on the following assumptions:

- a. The subgrade has been closely monitored.
- b. The subgrade has been thoroughly and adequately compacted.
- c. Wet zones have been dried, drained, or removed.
- d. Pockets of dissimilar material have been removed, replaced or mixed to achieve a homogeneous subgrade.
- e. Adequate subgrade drainage has been achieved.

Minimum pavement sections may be required by the Village of Hartland, dependent on the anticipated roadway usage.

F. Stormwater Design Considerations

1. Infiltration Considerations

As discussed earlier in this report, it is our understanding that current plans call for eight separate stormwater management areas throughout the site. Details regarding stormwater management areas were not known at the time of this report. In general, the prevalent soils encountered in Borings B1, B2, B4, B5, B8, B10, B14, B15, B17 and B18, within the planned stormwater basin areas, consist of silty clay loam and silty clay, with isolated layers of gravelly loamy sand and sandy loam. Groundwater was encountered at depths ranging from about 7 to 14 ft, corresponding to between EL 954 to 982± ft. In addition, soils exhibiting redoximorphic (i.e., low chroma, high value mottling) features were encountered at several of the borings at a depth of about 1 ft below grade, indicating a shallow seasonal high-water table.

Based on the subsurface conditions revealed by the borings, it is our opinion that the prevalent on-site silty clay loam and silty clay soils encountered in the planned stormwater management areas are considered to have a very limited capacity for infiltration of stormwater through the use

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of infiltration devices. Therefore, based on the soil classifications at Borings B1, B2, B4, B5, B8, B10, B14, B15, B17 and B18 and guidelines in the current Wisconsin DNR *Technical Standard* 1002, the site should be eligible for *exemption* under Chapter NR 151 Wis. Adm. Code guidelines, in our opinion. However, gravelly sand to loamy sand soils were generally encountered at depths ranging from about 4 to 6.5 ft in the building and roadway borings. The gravelly sand to loamy sand is considered to have a higher potential for infiltration. Therefore, if infiltration is required, relocation of at least some of the planned stormwater management ponds may be required.

Should infiltration be performed at the site, the following parameters should be considered for design of infiltration features, considering the soils encountered across the site:

Infiltration Potential: The following infiltration parameters were estimated using Table 2 of the WDNR Conservation Practice Standard 1002, *Site Evaluation for Storm Water Infiltration*. The estimated infiltration rates are as follows:

- | | |
|------------------------------|-------------|
| • Silty clay loam (SICL) | 0.04 in/hr. |
| • Silty clay (SIC) | 0.07 in/hr. |
| • Sandy clay loam (SCL) | 0.11 in/hr. |
| • Sandy loam (SL) | 0.50 in/hr. |
| • Gravelly loamy sand (GRLS) | 1.63 in/hr. |
| • Gravelly sand (GRS) | 3.60 in/hr. |

Note that the infiltration rates should be considered 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.

Groundwater: The long-term groundwater table, based on soil colorations, was estimated to be at depths ranging from about 7 to 14 ft, corresponding to between EL 954 to 982± ft, in the planned stormwater areas. Groundwater levels should be expected to fluctuate, as previously discussed.

Bedrock: No bedrock was encountered at the boring locations.

During construction of the proposed buildings and related site work, appropriate erosion control measures should be provided to prevent eroded soil from contaminating potential infiltration areas. Where appropriate, basin design should include pretreatment to remove fine-grained soils (silt/clay) from stormwater prior to entering the infiltration area(s). Additionally, a regular maintenance plan should be developed to remove silt/clay soils that may accumulate in the bottom of the basins over time. Failure to adequately control fine-grained soils from entering the



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infiltration area(s) or failure to regularly remove fine-grained soils that accumulate at the base of the basins will likely cause the basin to fail. Refer to WDNR Conservation Practice Standard 1002 and NR 151 for additional information.

The Soil and Site Evaluation-Storm form prepared by the Certified Soil Tester per USDA procedures is presented in Appendix C.

2. Detention Pond Considerations

Based on the borings performed, we anticipate that lean clay/silty clay soils will typically be present within the currently planned stormwater management basins. Our experience has shown that a 2 ft thick clay liner is typically sufficient for lining detention ponds. However, a "sacrificial" layer of clayey fill may be required to be placed along the sidewalls and/or base where silt and/or granular soils are encountered prior to commencing with actual liner placement/construction to aid in attaining a satisfactorily compacted liner section. The placement of a "sacrificial" layer is particularly beneficial in creating a stable subbase in the event dewatering measures taken are not totally effective and slight groundwater seepage occurs and/or due to the sensitivity of the exposed subgrade to disturbance due to construction traffic.

The clay liner materials are recommended to be compacted to a minimum of 90 percent of the maximum dry density as determined by modified Proctor (ASTM D1557). The on-site lean clay/silty clay soils (classified as "CL") appear suitable for re-use as liner quality material during liner construction, although additional soil laboratory testing (P200 and Atterberg Limits testing) would be necessary to confirm their suitability for use as a pond liner. The moisture content of the cohesive soils at the time of compaction should be within about 3 percent of the wet side of the optimum moisture content. In general, fill placement/compaction should proceed in general accordance with our Recommended Compacted Fill Specifications presented in Appendix E.

CONSTRUCTION CONSIDERATIONS

Due to the 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:

1. Due to the potential sensitive nature of the surficial clays and silts at the site, we recommend that general site grading activities be completed during dry weather, if possible. Earthwork construction during the early spring or late fall could be complicated as a result of wet weather and freezing temperatures.
2. During cold weather, exposed subgrades should be protected from freezing before and after footing construction. Fill should never be placed while frozen.
3. Based on observations made during the field exploration, groundwater infiltration into open and/or stripped excavations is not generally expected to be a problem. However, water accumulating at the base of excavations as a result of precipitation or seepage from “perched” water within the interspersed sand seams could be removed satisfactorily using pumps operating from filtered sump pits and/or drainage ditches.
4. Since foundation materials generally tend to loosen and soften when exposed to free water, every effort should be made to keep the construction excavations dry and the site graded in a manner to prevent water accumulation.

RECOMMENDED CONSTRUCTION MONITORING

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

1. Subgrade proof-rolling and undercutting;
2. Fill placement and compaction;
3. Foundation excavation; and
4. Concrete placement.



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It has been a pleasure to serve you on this project. Upon finalization of site development, we advise that the preliminary subsurface information be reviewed to evaluate the need for a supplemental exploration program. If you have any questions or require further consultation, please contact us.

Sincerely,

CGC, INC.

A handwritten signature in blue ink, reading "Paul J. Giese".

Paul J. Giese, P.E., CST
Senior Consulting Professional

A handwritten signature in blue ink, reading "Nathan I. Springstead".

Nathan I. Springstead, P.E., CST
Senior Staff Engineer

Encl: Appendix A - Field Exploration
Appendix B - Soil Survey Map
Soil Boring Location Maps
Log of Test Borings (18)
Log of Test Boring - General Notes
Unified Soil Classification System
Appendix C - Soil and Site Evaluation Storm Form
Appendix D - Document Qualifications
Appendix E - Recommended Compacted Fill Specifications

APPENDIX A

FIELD EXPLORATION

APPENDIX A

FIELD EXPLORATION

Thirteen (13) Standard Penetration Test (SPT) soil borings (Borings B3, B6, B7, B9, B11, B12, B13, and B16 in proposed roadway and building areas and Borings B1, B2, B5, B17 and B18 in stormwater management areas) were drilled for this exploration to depths ranging from about 10 to 20 ft below existing site grades. In addition, five (5) shallow hand auger borings (Borings B4, B8, B10, B14 and B15) were performed within proposed stormwater management areas that were inaccessible with ATV mounted drilling equipment. Prior to drilling the SPT borings, land/tree clearing was performed by the client's subcontractor. The borings were located and staked in the field by Trio Engineering (Trio) personnel. The SPT borings were drilled on May 18 and 19, 2020 by GeoServe, Inc. (under subcontract to CGC, Inc.) using an all-terrain vehicle (ATV) mounted Geoprobe drill rig equipped with hollow-stem augers and an automatic SPT hammer. The shallow hand auger borings were performed by CGC personnel on May 29. The ground surface elevations were provided by Trio. The approximate boring locations are shown in plan on the Soil Boring Location Maps enclosed in Appendix B.

Soil samples in the SPT roadway/building borings were obtained at 2.5-foot intervals to a depth of about 10 ft and at 5 ft intervals thereafter to the boring termination depths. Soil samples in the SPT stormwater area borings were obtained at 2.5-foot intervals to the depths explored of about 10 to 15 ft. The soil samples were obtained in general accordance with specifications for standard penetration testing, ASTM D 1586. Samples from the hand auger borings were obtained at approximate 0.5 to 1 ft intervals to the shallow depths explored. The specific procedures used for SPT 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 drillers as environmental site assessment activities 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 (where required) to satisfy WDNR regulations. The soil samples were delivered to our laboratory for visual classification and laboratory testing. The soil samples were visually classified by a geotechnical engineer/certified soil tester (CST) using the Unified Soil Classification System (USCS) and the stormwater boring samples were also classified using the United States Department of Agriculture (USDA) classification system. The final logs prepared by the engineer/CST and a description of the Unified Soil Classification System are presented in Appendix B and the Soil and Site Evaluation – Storm Form is enclosed in Appendix C.

APPENDIX B

SOIL SURVEY MAP

SOIL BORING LOCATION MAPS

LOG OF TEST BORINGS (18)

LOG OF TEST BORING - GENERAL NOTES

UNIFIED SOIL CLASSIFICATION SYSTEM



Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
CrD	Casco-Rodman complex, 12-20 percent slopes	11.3	24.4%
CrE	Casco-Rodman complex, 20 to 30 percent slopes	1.1	2.4%
DdB	Dodge silt loam, 2 to 6 percent slopes	0.3	0.6%
HmB2	Hochheim loam, 2 to 6 percent slopes, eroded	7.6	16.2%
HmC2	Hochheim loam, 6 to 12 percent slopes, eroded	17.0	36.5%
HmD2	Hochheim loam, 12 to 20 percent slopes, eroded	8.8	18.8%
JuA	Juneau silt loam, 1 to 3 percent slopes	0.5	1.0%
Totals for Area of Interest		46.5	100.0%

Notes

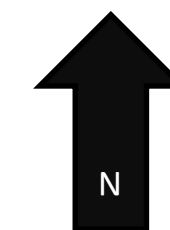
- Exhibit is an excerpt from the NRCS Soil Survey Website

Job No.
CM20074

Date:
June, 2020

CGC, Inc.

SOIL SURVEY MAP
Proposed East 50 Acres Development
Campus Drive
Hartland, Wisconsin



Scale: Reduced

Legend



Denotes boring location and number. Borings staked in the field by Trio Engineering.

Notes

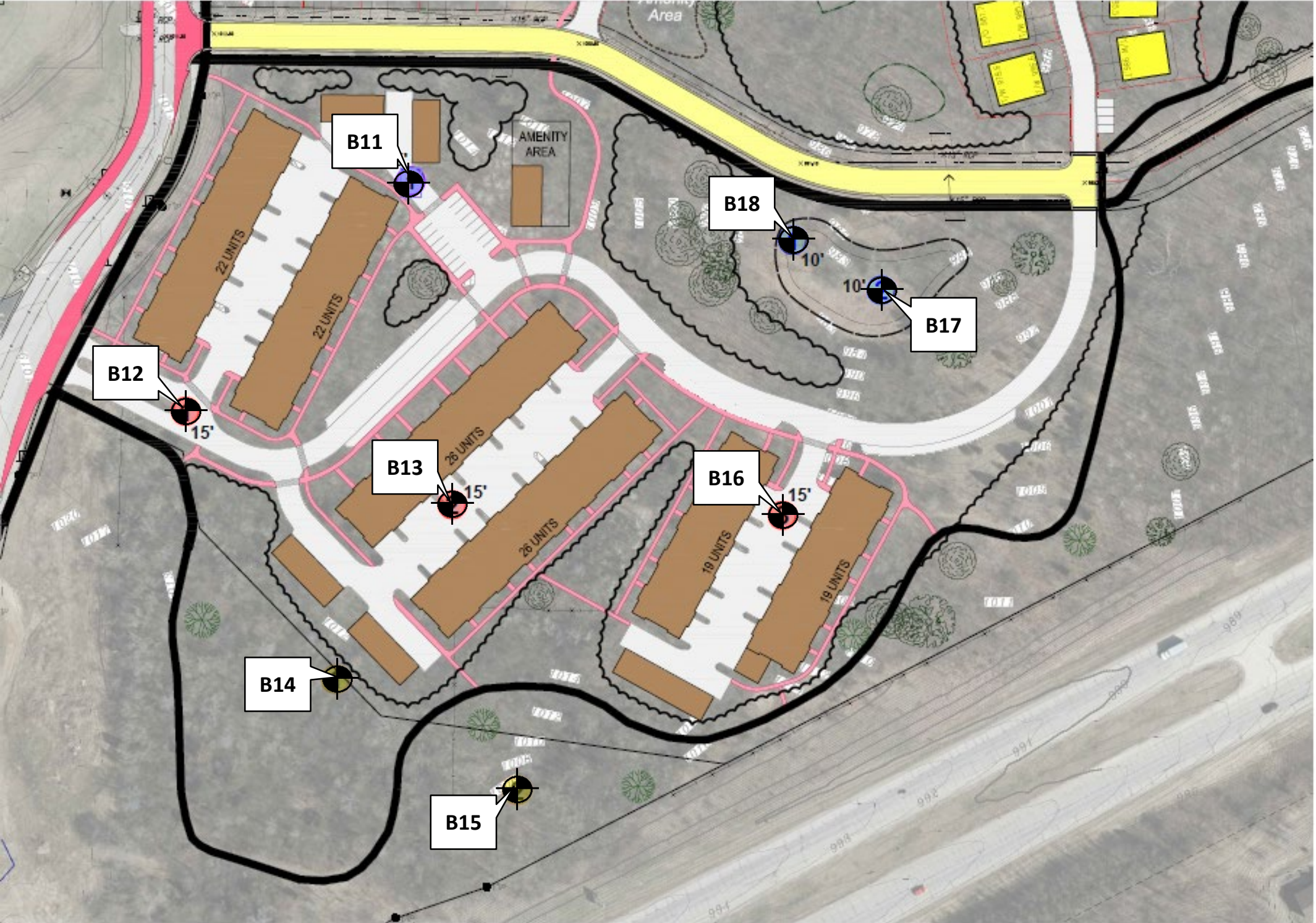
1. Developed from *Soil Test – Single Family Condominium.pdf* drawing provided by Trio Engineering.
2. Borings B1, B2, B3, B5, B6, B7 and B9 drilled by GeoServe, Inc. on May 18 and 19, 2020.
3. Borings B4, B8 and B10 performed using hand methods by CGC.

Date:
May, 2020

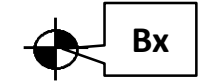
Job No.
CM20074

CGC, Inc.

SOIL BORING LOCATION MAP
SINGLE FAMILY CONDOMINIUMS
Proposed East 50 Acres Development
Campus Drive
Hartland, Wisconsin



Legend

 **Bx** Denotes boring location and number. Borings staked in the field by Trio Engineering.

Notes

- 1. Developed from *Soil Test – Townhome Residential.pdf* drawing provided by Trio Engineering.
- 2. Borings B11, B12, B13, B16, B17 and B18 drilled by GeoServe, Inc. on May 18 and 19, 2020.
- 3. Borings B14 and B15 performed using hand methods by CGC.

Date:
May, 2020

Job No.
CM20074

CGC, Inc.

SOIL BORING LOCATION MAP
TOWNHOME RESIDENTIAL
Proposed East 50 Acres Development
Campus Drive
Hartland, Wisconsin



LOG OF TEST BORING

Project **Proposed East 50 Acres Development**
Campus Drive
Location **Hartland, Wisconsin**

Boring No. **B1**
Surface Elevation (ft) **995.9**
Job No. **CM20074**
Sheet **1** of **1**

336 S. Curtis Rd, West Allis, WI 53214 (414) 443-2000, FAX (414) 443-2099

SAMPLE					VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	Excavation (in.)	Rec (in.)	Moist	N		qu (qa) (tsf)	W	LL	PL	LOI
					12" TOPSOIL					
1		18	M	5	Medium Stiff to Stiff, Brown and Gray Mottled Lean CLAY; Trace Sand and Gravel (CL)	(1.5)	30.0			
2		18	M	4		(0.75)	34.5			
3		18	M	5		(1.5)	27.3			
4		18	M	4		(1.0)				
5		18	M	3		(0.5)				
6		16	W	19	Medium Dense, Brown Gray Silty Fine to Coarse SAND; Some Fine to Coarse Gravel (SM)					
					End of Boring at 15 ft Backfilled with Bentonite Chips					

WATER LEVEL OBSERVATIONS

GENERAL NOTES

While Drilling ☒ 14.0' Upon Completion of Drilling **NW**
Time After Drilling _____
Depth to Water _____
Depth to Cave in _____

Start **5/18/20** End **5/18/20**
Driller **GeoServe Chief** **Eddie** Rig **Geoprobe**
Logger **Matt** Editor **PJG** **ATV**
Drill Method **2.25" HSA**

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



LOG OF TEST BORING

Project **Proposed East 50 Acres Development**
Campus Drive
Location **Hartland, Wisconsin**

Boring No. **B2**
Surface Elevation (ft) **995.0**
Job No. **CM20074**
Sheet **1** of **1**

336 S. Curtis Rd, West Allis, WI 53214 (414) 443-2000, FAX (414) 443-2099

SAMPLE					VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	Excavation (in.)	Rec (in.)	Moist	N		qu (qa) (tsf)	W	LL	PL	LOI
					12" TOPSOIL					
1		18	W/M	3	Soft to Stiff, Brown and Gray Mottled Lean CLAY; Trace Sand and Gravel (CL)	(1.0)	23.0			
2		18	M	6		(2.0)	28.3			
3		18	M	4		(1.5)	30.9			
4		18	M	3		(1.5)				
5		18	VM	2		(0.5)				
6		18	M/W	3		(0.5)				
					End of Boring at 15 ft Backfilled with Bentonite Chips					

WATER LEVEL OBSERVATIONS

GENERAL NOTES

While Drilling ☒ 14.0' Upon Completion of Drilling **NW**
Time After Drilling _____
Depth to Water _____
Depth to Cave in _____

Start **5/18/20** End **5/18/20**
Driller **GeoServe Chief** **Eddie** Rig **Geoprobe**
Logger **Matt** Editor **PJG** **ATV**
Drill Method **2.25" HSA**

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



LOG OF TEST BORING

Project **Proposed East 50 Acres Development**
Campus Drive
Location **Hartland, Wisconsin**

Boring No. **B3**
Surface Elevation (ft) **993.1**
Job No. **CM20074**
Sheet **1** of **1**

336 S. Curtis Rd, West Allis, WI 53214 (414) 443-2000, FAX (414) 443-2099

SAMPLE					VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	Excavation (in.)	Rec (in.)	Moist	N		qu (qa) (tsf)	W	LL	PL	LOI
					2" TOPSOIL					
1		10	M	6	Medium Stiff to Stiff, Brown Mottled Lean CLAY; Little to Some Sand and Gravel (CL)	(1.0)	14.0			
2		16	M	15	Medium Dense to Dense, Brown Fine to Coarse SAND & GRAVEL; Trace to Little Silt, Few Cobbles (SW-GW)	(1.5)				
3		12	M	28						
4		16	M	31						
					End of Boring at 10 ft Backfilled with Bentonite Chips					

WATER LEVEL OBSERVATIONS

GENERAL NOTES

While Drilling ☒ 4.0' Upon Completion of Drilling **NW**
Time After Drilling _____
Depth to Water _____
Depth to Cave in _____

Start **5/18/20** End **5/18/20**
Driller **GeoServe Chief** **Eddie** Rig **Geoprobe**
Logger **Matt** Editor **PJG** **ATV**
Drill Method **2.25" HSA**

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

[illegible]



LOG OF TEST BORING

Project **Proposed East 50 Acres Development**
Campus Drive
 Location **Hartland, Wisconsin**

Boring No. **B6**
 Surface Elevation (ft) **996.2**
 Job No. **CM20074**
 Sheet **1** of **1**

336 S. Curtis Rd, West Allis, WI 53214 (414) 443-2000, FAX (414) 443-2099

SAMPLE					VISUAL CLASSIFICATION and Remarks		SOIL PROPERTIES					
No.	Excavation (in.)	Rec (in.)	Moist	N			Depth (ft)	qu (qa) (tsf)	W	LL	PL	LOI
							12" TOPSOIL					
1		18	M	5			Stiff to Very Stiff, Brown Mottled Lean CLAY; Trace Sand and Gravel (CL)	(2.0)	24.4			
2		16	M	7				(1.25)				
					5		Medium Dense to Very Dense, Brown Fine to Coarse SAND & GRAVEL; Trace Silt, Few Cobbles (SW-GW)					
3		16	M	13								
4		16	M	19								
					10							
5		12	M	58								
					15		End of Boring at 15 ft Backfilled with Bentonite Chips					
					20							
					25							

WATER LEVEL OBSERVATIONS

GENERAL NOTES

While Drilling ☒ NW Upon Completion of Drilling ☒ NW
 Time After Drilling _____
 Depth to Water _____
 Depth to Cave in _____

Start **5/19/20** End **5/19/20**
 Driller **GeoServe Chief** **Eddie** Rig **Geoprobe**
 Logger **Matt** Editor **PJG** **ATV**
 Drill Method **2.25" HSA**

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



LOG OF TEST BORING

Project **Proposed East 50 Acres Development**
Campus Drive
 Location **Hartland, Wisconsin**

Boring No. **B7**
 Surface Elevation (ft) **1003.3**
 Job No. **CM20074**
 Sheet **1** of **1**

336 S. Curtis Rd, West Allis, WI 53214 (414) 443-2000, FAX (414) 443-2099

SAMPLE					VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	Rec (in.)	Moist	N	Depth (ft)		qu (qa) (tsf)	W	LL	PL	LOI
					12" TOPSOIL					
1	16	M	5		Stiff, Brown Mottled Lean CLAY; Trace Sand and Gravel (CL)	(1.5)	24.7			
					Very Loose, Clayey Fine to Medium SAND; Trace to Little Gravel (SC)					
2	18	M/W	2	5	Very Soft, Brown Lean CLAY; Some Sand and Gravel (CL)	(0.25)	9.3			
					Medium Dense to Dense, Brown Fine to Coarse SAND & GRAVEL; Trace Silt, Few Cobbles (SW-GW)					
3	12	M	15							
4	16	M	33	10						
5	18	M	34	15						
					End of Boring at 15 ft Backfilled with Bentonite Chips					
				20						
				25						

WATER LEVEL OBSERVATIONS

GENERAL NOTES

While Drilling ∇ **4.0'** Upon Completion of Drilling **NW**
 Time After Drilling _____
 Depth to Water _____
 Depth to Cave in _____

Start **5/19/20** End **5/19/20**
 Driller **GeoServe Chief** **Eddie** Rig **Geoprobe**
 Logger **Matt** Editor **PJG** **ATV**
 Drill Method **2.25" HSA**

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

WATER LEVEL OBSERVATIONS					GENERAL NOTES			
While Excavating	∇	NW	Upon Completion of Excavating	NW	Start	5/29/20	End	5/29/20
Time After Excavating					Driller		Chief	
Depth to Water					Logger	NIS	Editor	NIS
Depth to Cave in					Equip. Used:			
The stratification lines represent the approximate boundary between soil types and the transition may be gradual.								



LOG OF TEST BORING

Project **Proposed East 50 Acres Development**
Campus Drive
 Location **Hartland, Wisconsin**

Boring No. **B9**
 Surface Elevation (ft) **984.1**
 Job No. **CM20074**
 Sheet **1** of **1**

336 S. Curtis Rd, West Allis, WI 53214 (414) 443-2000, FAX (414) 443-2099

SAMPLE					VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	Excavation (in.)	Rec (in.)	Moist	N	Depth (ft)	qu (qa) (tsf)	W	LL	PL	LOI
					8" TOPSOIL					
1		12	M	4	Stiff, Brown Mottled Lean CLAY; Trace to Some Sand and Gravel (CL)	(1.5)	21.3			
2		12	M	6		(1.25)				
3		16	M	15	Medium Dense, Brown Silty Fine to Medium SAND; Little Gravel, Trace Clay (SM)					
4		4	M	100	Medium Dense to Very Dense, Brown Fine to Coarse SAND & GRAVEL; Trace Silt, Few Cobbles and/or Boulders (SW-GW)					
5		18	M	26						
6		12	M	37						
					End of Boring at 20 ft Backfilled with Bentonite Chips					

WATER LEVEL OBSERVATIONS

GENERAL NOTES

While Drilling ☒ NW Upon Completion of Drilling ☒ NW
 Time After Drilling _____
 Depth to Water _____
 Depth to Cave in _____

Start **5/19/20** End **5/19/20**
 Driller **GeoServe Chief** **Eddie** Rig **Geoprobe**
 Logger **Matt** Editor **PJG** **ATV**
 Drill Method **2.25" HSA**

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



LOG OF AUGER BORING

Project Proposed East 50 Acres Development
Campus Drive
Location Hartland, Wisconsin

Boring No. **B10**
Surface Elevation (ft) **971.4**
Job No. **CM20074**
Sheet **1** of **1**

336 S. Curtis Rd., West Allis, WI 53214 (414) 443-2000, FAX (414) 443-2099

SAMPLE					VISUAL CLASSIFICATION and Remarks		SOIL PROPERTIES					
No.	TYPE	Rec (in.)	Moist	N			Depth (ft)	qu (qa) (tsf)	W	LL	PL	P200
1			M				3" Brown to Dark Brown Sandy Loamy TOPSOIL with Heavy Root Mass (OL)					
							Brown to Brown Mottled Silty CLAY; Little Fine Sand, Trace Gravel (CL)					
2			M									
3			M									

WATER LEVEL OBSERVATIONS

GENERAL NOTES

While Excavating ☒ NW Upon Completion of Excavating ☐ NW
Time After Excavating _____
Depth to Water _____
Depth to Cave in _____

Start 5/29/20 End 5/29/20
Driller _____ Chief _____
Logger NIS Editor NIS
Equip. Used: _____

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



LOG OF TEST BORING

Project **Proposed East 50 Acres Development**
Campus Drive
Location **Hartland, Wisconsin**

Boring No. **B11**
Surface Elevation (ft) **1013.0**
Job No. **CM20074**
Sheet **1** of **1**

336 S. Curtis Rd, West Allis, WI 53214 (414) 443-2000, FAX (414) 443-2099

SAMPLE					VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	Excavation (in.)	Rec (in.)	Moist	N		qu (qa) (tsf)	W	LL	PL	LOI
					12" TOPSOIL					
1		12	M	5	Stiff to Very Stiff, Brown Mottled Lean CLAY; Trace Sand and Gravel (CL)	(2.25)	24.3			
2		8	M	34	Dense to Very Dense, Brown Fine to Coarse SAND & GRAVEL; Trace Silt, Few Cobbles (SW-GW)	(2.0)				
3		16	M	33						
4		16	M	31						
5		12	M	59						
					End of Boring at 15 ft Backfilled with Bentonite Chips					

WATER LEVEL OBSERVATIONS

GENERAL NOTES

While Drilling ☒ NW Upon Completion of Drilling ☒ NW
Time After Drilling _____
Depth to Water _____
Depth to Cave in _____

Start **5/18/20** End **5/18/20**
Driller **GeoServe Chief** **Eddie** Rig **Geoprobe**
Logger **Matt** Editor **PJG** **ATV**
Drill Method **2.25" HSA**

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



LOG OF TEST BORING

Project **Proposed East 50 Acres Development**
Campus Drive
Location **Hartland, Wisconsin**

Boring No. **B12**
Surface Elevation (ft) **1018.8**
Job No. **CM20074**
Sheet **1** of **1**

336 S. Curtis Rd, West Allis, WI 53214 (414) 443-2000, FAX (414) 443-2099

SAMPLE					VISUAL CLASSIFICATION and Remarks		SOIL PROPERTIES					
No.	Excavation (in.)	Rec (in.)	Moist	N			Depth (ft)	qu (qa) (tsf)	W	LL	PL	LOI
							12" TOPSOIL					
1		12	M	4			Stiff, Brown Mottled Lean CLAY; Trace Sand and Gravel (CL)	(1.75)	24.6			
2		18	W	11	▽		Medium Dense, Brown Clayey Fine to Coarse SAND & GRAVEL (SC-GC)		12.9			
					5							
3		18	M	25			Medium Dense to Very Dense, Brown Fine to Coarse SAND & GRAVEL; Trace Silt, Few Cobbles (SW-GW)					
4		0	M	64								
					10							
5		12	M	49								
					15							
End of Boring at 15 ft Backfilled with Bentonite Chips												
					20							
					25							

WATER LEVEL OBSERVATIONS

GENERAL NOTES

While Drilling ☒ 4.0' Upon Completion of Drilling **NW**
Time After Drilling **(perched)**
Depth to Water _____
Depth to Cave in _____

Start **5/18/20** End **5/18/20**
Driller **GeoServe Chief** **Eddie** Rig **Geoprobe**
Logger **Matt** Editor **PJG** **ATV**
Drill Method **2.25" HSA**

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



LOG OF TEST BORING

Project **Proposed East 50 Acres Development**
Campus Drive
 Location **Hartland, Wisconsin**

Boring No. **B13**
 Surface Elevation (ft) **1017.6**
 Job No. **CM20074**
 Sheet **1** of **1**

336 S. Curtis Rd, West Allis, WI 53214 (414) 443-2000, FAX (414) 443-2099

SAMPLE					VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	Excavation (in.)	Rec (in.)	Moist	N	Depth (ft)	qu (qa) (tsf)	W	LL	PL	LOI
						12" TOPSOIL				
1		10	M	6		Stiff, Brown Mottled Lean CLAY; Trace Sand and Gravel (CL)	(1.5)	20.7		
2		13	VM	18		Medium Dense, Brown Clayey Fine to Coarse SAND & GRAVEL (SC-GC)				
3		16	M	39		Dense to Very Dense, Brown Fine to Coarse SAND & GRAVEL; Trace Silt, Few Cobbles (SW-GW)				
4		18	M	47						
5		18	M	67						
End of Boring at 15 ft Backfilled with Bentonite Chips										

WATER LEVEL OBSERVATIONS					GENERAL NOTES				
While Drilling	∇	NW	Upon Completion of Drilling	NW	Start	5/19/20	End	5/19/20	
Time After Drilling					Driller	GeoServe Chief	Eddie	Rig	Geoprobe
Depth to Water					Logger	Matt	Editor	PJG	ATV
Depth to Cave in					Drill Method	2.25" HSA			

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



LOG OF AUGER BORING

Project Proposed East 50 Acres Development
Campus Drive
Location Hartland, Wisconsin

Boring No. **B14**
Surface Elevation (ft) **1011.8**
Job No. **CM20074**
Sheet **1** of **1**

336 S. Curtis Rd., West Allis, WI 53214 (414) 443-2000, FAX (414) 443-2099

SAMPLE					VISUAL CLASSIFICATION and Remarks		SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N			Depth (ft)	qu (qa) (tsf)	W	LL	PL
1			W			 6" Brown to Dark Brown Sandy Loamy TOPSOIL with Heavy Root Mass (OL)					
2						 Brown to Brown Mottled Silty CLAY; Little Fine Sand, Trace Gravel (CL)					
3			M								
4			M								
			M								
5						 End of Auger Boring at 3.4 ft on Cobble					

WATER LEVEL OBSERVATIONS

GENERAL NOTES

While Excavating ☒ NW Upon Completion of Excavating NW
Time After Excavating _____
Depth to Water _____
Depth to Cave in _____

Start 5/29/20 End 5/29/20
Driller _____ Chief _____
Logger NIS Editor NIS
Equip. Used: _____

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



LOG OF AUGER BORING

Project Proposed East 50 Acres Development
 Campus Drive
 Location Hartland, Wisconsin

Boring No. **B15**
 Surface Elevation (ft) **1005.3**
 Job No. **CM20074**
 Sheet **1** of **1**

336 S. Curtis Rd., West Allis, WI 53214 (414) 443-2000, FAX (414) 443-2099

SAMPLE					VISUAL CLASSIFICATION and Remarks		SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N			Depth (ft)	qu (qa) (tsf)	W	LL	PL
1			M			 4" Black Sandy TOPSOIL (OL)					
2						 4" - 8" Brown Fine to Coarse SAND & GRAVEL (SP/GP) (POSSIBLE FILL)					
3			W			 Brown to Brown Mottled Silty CLAY; Little Fine Sand, Trace Gravel (CL)					
			M								
4			M			 Brown Sandy SILT/CLAY; Trace Gravel (ML/CL-ML)					
									</		

WATER LEVEL OBSERVATIONS

GENERAL NOTES

While Excavating ☒ NW Upon Completion of Excavating NW
 Time After Excavating _____
 Depth to Water _____
 Depth to Cave in _____

Start 5/29/20 End 5/29/20
 Driller _____ Chief _____
 Logger NIS Editor NIS
 Equip. Used: _____

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



LOG OF TEST BORING

Project **Proposed East 50 Acres Development**
Campus Drive
 Location **Hartland, Wisconsin**

Boring No. **B16**
 Surface Elevation (ft) **1012.3**
 Job No. **CM20074**
 Sheet **1** of **1**

336 S. Curtis Rd, West Allis, WI 53214 (414) 443-2000, FAX (414) 443-2099

SAMPLE					VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	Excavation (in.)	Rec (in.)	Moist	N	Depth (ft)	qu (qa) (tsf)	W	LL	PL	LOI
					12" TOPSOIL					
1		12	M	4	Stiff, Brown Mottled Lean CLAY; Trace Sand and Gravel (CL)	(1.5)				
2		10	M	7		(1.25)	12.4			
3		16	M	15	Medium Dense to Dense, Gray Brown to Light Brown Fine to Coarse SAND & GRAVEL; Trace Silt, Few Cobbles (SW-GW)					
4		12	M	22						
5		12	M	36						
					End of Boring at 15 ft Backfilled with Bentonite Chips					

WATER LEVEL OBSERVATIONS

GENERAL NOTES

While Drilling ☒ NW Upon Completion of Drilling ☒ NW
 Time After Drilling _____
 Depth to Water _____
 Depth to Cave in _____

Start **5/19/20** End **5/19/20**
 Driller **GeoServe Chief** **Eddie** Rig **Geoprobe**
 Logger **Matt** Editor **PJG** **ATV**
 Drill Method **2.25" HSA**

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



LOG OF TEST BORING

Project **Proposed East 50 Acres Development**
Campus Drive
Location **Hartland, Wisconsin**

Boring No. **B17**
Surface Elevation (ft) **982.2**
Job No. **CM20074**
Sheet **1** of **1**

336 S. Curtis Rd, West Allis, WI 53214 (414) 443-2000, FAX (414) 443-2099

SAMPLE					VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	Field Rec (in.)	Moist	N	Depth (ft)		qu (qa) (tsf)	W	LL	PL	LOI
					12" TOPSOIL					
1	16	M	4		Stiff, Dark Brown Mottled Lean CLAY; Trace Sand and Gravel (CL)	(1.5)	29.2			
2	18	M	3			(1.25)	25.2			
3	18	M	5		Medium Stiff to Very Stiff, Brown Mottled Lean CLAY; Trace Sand and Gravel (CL)	(2.5)				
4	18	M/W	7		Some fine to medium sand at 8.5± ft	(1.0)				
					End of Boring at 10 ft Backfilled with Bentonite Chips					

WATER LEVEL OBSERVATIONS					GENERAL NOTES				
While Drilling	9.0'	Upon Completion of Drilling	NW		Start	5/18/20	End	5/18/20	
Time After Drilling					Driller	GeoServe Chief	Eddie	Rig	Geoprobe
Depth to Water					Logger	Matt	Editor	PJG	ATV
Depth to Cave in					Drill Method	2.25" HSA			
The stratification lines represent the approximate boundary between soil types and the transition may be gradual.									



LOG OF TEST BORING

Project **Proposed East 50 Acres Development**
Campus Drive
 Location **Hartland, Wisconsin**

Boring No. **B18**
 Surface Elevation (ft) **982.7**
 Job No. **CM20074**
 Sheet **1** of **1**

336 S. Curtis Rd, West Allis, WI 53214 (414) 443-2000, FAX (414) 443-2099

SAMPLE					VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	Excavation (in.)	Rec (in.)	Moist	N	Depth (ft)	qu (qa) (tsf)	W	LL	PL	LOI
						12" TOPSOIL				
1		18	M	3		Medium Stiff to Stiff, Dark Brown and Gray Mottled Lean CLAY; Trace Sand and Gravel (CL)	(1.0)	28.9		
2		18	M	2			(1.0)	22.2		
3		12	W/M	4			(0.75)			
4		16	M	12		Stiff, Brown Mottled Lean CLAY; Trace Sand and Gravel (CL)	(1.5)			
End of Boring at 10 ft Backfilled with Bentonite Chips										

WATER LEVEL OBSERVATIONS					GENERAL NOTES				
While Drilling	7.0'	Upon Completion of Drilling	NW		Start	5/18/20	End	5/18/20	
Time After Drilling					Driller	GeoServe Chief	Eddie	Rig	Geoprobe
Depth to Water					Logger	Matt	Editor	PJG	ATV
Depth to Cave in					Drill Method	2.25" HSA			

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

LOG OF TEST BORING

General Notes

DESCRIPTIVE SOIL CLASSIFICATION

Grain Size Terminology

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

Plasticity characteristics differentiate between silt and clay.

General Terminology

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

Relative Density

Term	"N" Value
Very Loose.....	0 - 4
Loose.....	4 - 10
Medium Dense.....	10 - 30
Dense.....	30 - 50
Very Dense.....	Over 50

Relative Proportions Of Cohesionless Soils

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

Consistency

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

Organic Content by Combustion Method

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

Plasticity

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

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

SYMBOLS

Drilling and Sampling

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

Laboratory Tests

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

Water Level Measurement

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

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

CGC, Inc.

Madison - Milwaukee

UNIFIED SOIL CLASSIFICATION SYSTEM

UNIFIED SOIL CLASSIFICATION AND SYMBOL CHART

COARSE-GRAINED SOILS (more than 50% of material is larger than No. 200 sieve size.)		
GRAVELS More than 50% of coarse fraction larger than No. 4 sieve size	Clean Gravels (Less than 5% fines)	
	 GW	Well-graded gravels, gravel-sand mixtures, little or no fines
	 GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines
	Gravels with fines (More than 12% fines)	
	 GM	Silty gravels, gravel-sand-silt mixtures
	 GC	Clayey gravels, gravel-sand-clay mixtures
SANDS 50% or more of coarse fraction smaller than No. 4 sieve size	Clean Sands (Less than 5% fines)	
	 SW	Well-graded sands, gravelly sands, little or no fines
	 SP	Poorly graded sands, gravelly sands, little or no fines
	Sands with fines (More than 12% fines)	
	 SM	Silty sands, sand-silt mixtures
	 SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS (50% or more of material is smaller than No. 200 sieve size.)		
SILTS AND CLAYS Liquid limit less than 50%	 ML	Inorganic silts and very fine sands, rock flour, silty of 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

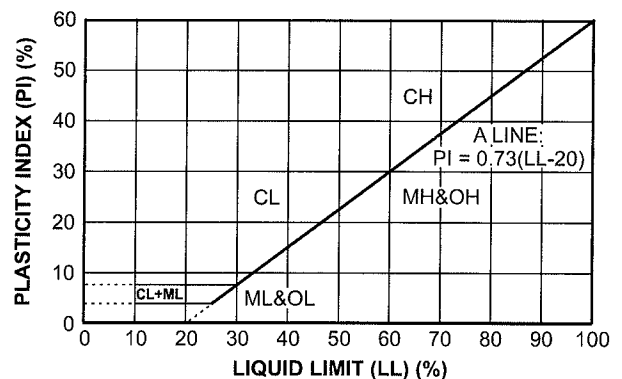
LABORATORY CLASSIFICATION CRITERIA

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 limits 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 limits above "A" line with 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

SOIL AND SITE EVALUATION STORM FORM

SOIL AND SITE EVALUATION - STORM

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

Page 1 of 4

Attach complete site plan on paper not less than 8 1/2 x 11 inches in size. Plan must include, but not limited to: vertical and horizontal reference point (BM), direction and percent slope, scale or dimensions, north arrow, and BM referenced to nearest road.

Please print all information.

Personal information you provide may be used for secondary purposes (Privacy Law, s.15.04 (1) (m)).

Property Owner Lutheran High School Association of Greater Milwaukee				Property Location Campus Drive			
Property Owner's Mailing Address 10427 W. Lincoln Avenue, Suite 1300				Govt. Lot SW 1/4 SE 1/4 S 34 T 8 N R 18 E			
City Milwaukee				State WI		Zip Code 53227-1263	
Phone Number				Lot # 2		Block #	
City Milwaukee				State WI		Zip Code 53227-1263	
Phone Number				City Hartland		Block #	
Phone Number				Village Hartland		Town	
Phone Number				Nearest Road Hill Street		Subd. Name or CSM#	

Drainage area: 53.3 sq. ft. ☒ acres				Hydraulic Application Test Method				Soil Moisture			
Test Site Suitable for (check all that apply)				☒ Morphological Evaluation				Date of soil borings: 5/18/20 & 5/19/20			
☐ Bioretention				☐ Double-Ring Infiltrometer				USDA-NRCS WETS Value:			
☐ Subsurface Dispersal System				☐ Other (Specify) _____				☐ Dry = 1			
☐ Reuse								☒ Normal = 2			
☐ Irrigation								☐ Wet = 3			
☐ Other _____											

B1	Obs. #	☒ Boring
		☐ Pit
Ground Surface Elev. 995.9 ft		Elevation of limiting factor 994.9 ft

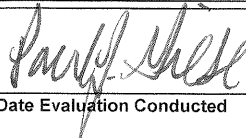
Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frag.	% Fines	Hydraulic App. Rate Inches/Hr
1	0-12	TOPSOIL (Not Sampled)								
2	12-168	10YR5/4	m2d 10YR5/8 & 10YR6/2	SIC	2mabk	mfi	g	<5	>60	0.07
3	168-180	10YR5/4	None	GRLS	0fcgr	mfr	-	-	-	1.63

Comments: Groundwater encountered at 14 ft while drilling.

B2	Obs. #	☒ Boring
		☐ Pit
Ground Surface Elev. 995.0 ft		Elevation of limiting factor 994.0 ft

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frag.	% Fines	Hydraulic App. Rate Inches/Hr
1	0-12	TOPSOIL (Not Sampled)								
2	12-180	10YR6/2	c2d 10YR5/8	SIC	2mabk	mfi	-	<5	>60	0.07

Comments: Groundwater encountered at 14 ft while drilling

CST/PSS Name (Please Print) Paul J. Giese, CST		Signature 		CST Number SP-030800004	
Address 336 S. Curtis Road, West Allis, WI 53214		Date Evaluation Conducted 5/29/20		Telephone Number (414) 443-2000	

SBD-10793 (R.01/17)

Property Owner Lutheran High School Association of Greater Milwaukee Parcel ID# HAV 0423981 Page 2 of 4

B4 Obs. # ☒ Boring
☐ Pit Ground Surface Elev. 943.3 ft Elevation of limiting factor <941.3 ft

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frag.	% Fines	Hydraulic App. Rate Inches/Hr
1	0-4	10YR2/2	None	SCL	1fsbk	mfr	cw	<5	>50	0.11
2	4-24	10YR4/4	c1f 10YR6/2	SIC	2msbk	mvfi	-	<5	>60	0.07

Comments: Advanced using hand auger methods. No groundwater encountered while drilling.

B5 Obs. # ☒ Boring
☐ Pit Ground Surface Elev. 961.5 ft Elevation of limiting factor 954.5 ft

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frag.	% Fines	Hydraulic App. Rate Inches/Hr
1	0-12	TOPSOIL (Not Sampled)								
2	12-84	10YR4/4	c1f 10YR3/4	SIC	2mabk	mfi	-	<5	>60	0.07
3	84-120	10YR6/4		GRLS	0f-cgr	mfr	-	-	-	1.63

Comments: Groundwater encountered at 7 ft while drilling.

B8 Obs. # ☒ Boring
☐ Pit Ground Surface Elev. 966.2 ft Elevation of limiting factor <962.9 ft

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frag.	% Fines	Hydraulic App. Rate Inches/Hr
1	0-2	10YR2/2	None	SCL	1fsbk	mfr	cw	<5	>50	0.11
2	2-40	10YR4/4	c1f 10YR6/2 & 6/4	SIC	2msbk	mvfi	-	<5	>60	0.07

Comments: Advanced using hand auger methods. No groundwater encountered while drilling.

B10 Obs. # ☒ Boring
☐ Pit Ground Surface Elev. 971.4 ft Elevation of limiting factor <968.1 ft

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frag.	% Fines	Hydraulic App. Rate Inches/Hr
1	0-3	10YR2/2	None	SCL	1fsbk	mfr	cw	<5	>60	0.11
2	3-41	10YR4/4	c2f 10YR7/9 & 6/8	SIC	2msbk	mvfi	-	<5	>60	0.07

Comments: Advanced using hand auger methods. No groundwater encountered while drilling.

B14 Obs. # ☒ Boring
☐ Pit Ground Surface Elev. 1011.8 ft Elevation of limiting factor <1008.4 ft

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frag.	% Fines	Hydraulic App. Rate Inches/Hr
1	0-6	10YR2/2	None	SL	1fsbk	mfr	cw	<5	>50	0.50
2	6-41	10YR4/4	c2f 10YR7/1 & 6/8	SIC	2msbk	mvfi	-	<5	>60	0.07

Comments: Advanced using hand auger methods. No groundwater encountered while drilling.

B15 Obs. # ☒ Boring
☐ Pit Ground Surface Elev. 1005.3 ft Elevation of limiting factor <1002.0 ft

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frag.	% Fines	Hydraulic App. Rate Inches/Hr
1	0-4	10YR2/2	None	SL	1fsbk	mfr	cw	<10	>50	0.50
2	4-8	10YR6/8	None	VGRS	0sg	mlo	cw	35-<60	<10	3.60
3	8-30	10YR4/4	c2f 10Y7/1 & 6/4	SIC	2msbk	mvfi	cw	<5	>60	0.07
4	30-40	10YR4/4	None	SICL	2msbk	mvfi	-	<5	>70	0.04

Comments: Advanced using hand auger methods. No groundwater encountered while drilling.

Property Owner Lutheran High School Association of Greater Milwaukee Parcel ID# HAV 0423981 Page 4 of 4

B17 Obs. # ☒ Boring ☐ Pit Ground Surface Elev. 982.2 ft Elevation of limiting factor 973.2 ft

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frag.	% Fines	Hydraulic App. Rate Inches/Hr
1	0-12	TOPSOIL (Not Sampled)								
2	12-66	10YR4/3	f2d 10YR3/2	SIC	2mabk	mfr	g	<5	>60	0.07
3	66-120	10YR5/4	f2f 10YR4/3	SIC	2mabk	mfi	-	<5	>60	0.07

Comments: Groundwater encountered at 9 ft while drilling.

B18 Obs. # ☒ Boring ☐ Pit Ground Surface Elev. 982.7 ft Elevation of limiting factor 981.7 ft

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frag.	% Fines	Hydraulic App. Rate Inches/Hr
1	0-12	TOPSOIL (Not Sampled)								
2	12-90	10YR5/3	f1f 10YR3/4	SIC	2mabk	mfi	g	<5	>60	0.07
3	90-120	10YR4/4	f1d 10YR3/3	SIC	2mabk	mfi	-	<5	>60	0.07

Comments: Groundwater encountered at 7 ft while drilling.

Obs. # ☐ Boring ☐ Pit Ground Surface Elev. ft Elevation of limiting factor ft

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frag.	% Fines	Hydraulic App. Rate Inches/Hr

Comments:

APPENDIX D

DOCUMENT QUALIFICATIONS

APPENDIX D

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 E

RECOMMENDED COMPACTED FILL SPECIFICATIONS

APPENDIX E

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 a moisture content capable of achieving the desired compaction level. For clay soils or granular soils containing an appreciable amount of cohesive fines, moisture conditioning will likely be required.

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

Compaction Specifications

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

Testing Procedures

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

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

Table 1
Gradation of Special Fill Materials

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

Notes:

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

Table 2
Compaction Guidelines

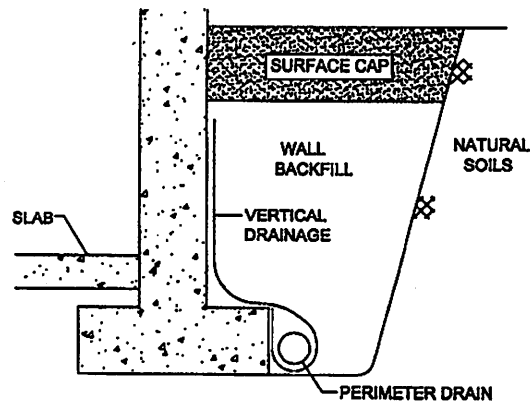
Area	Percent Compaction (1)	
	Clay/Silt	Sand/Gravel
<u>Within 10 ft of building lines</u>		
Footing bearing soils	93 - 95	95
Under floors, steps and walks		
- Lightly loaded floor slab	90	90
- Heavily loaded floor slab and thicker fill zones	92	95
<u>Beyond 10 ft of building lines</u>		
Under walks and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

Notes:

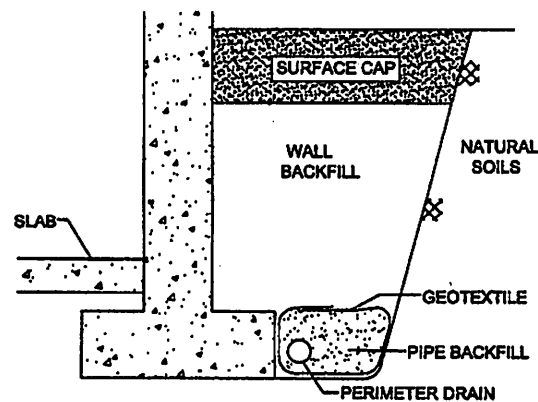
1. Based on Modified Proctor Dry Density (ASTM D 1557)

APPENDIX F

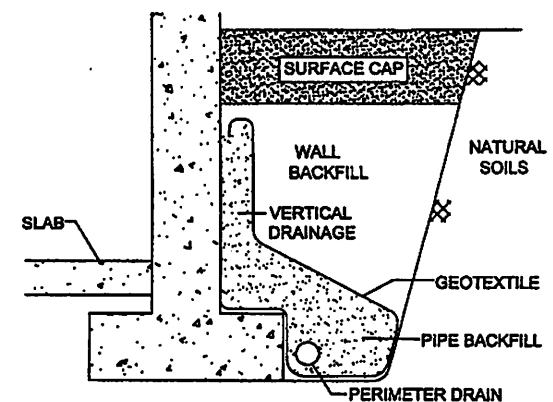
PERIMETER DRAIN DETAILS



ALTERNATE NO. 1



ALTERNATE NO. 2



ALTERNATE NO. 3

DRAINAGE SYSTEM COMPONENTS

Component	Alternate No. 1	Alternate No. 2	Alternate No. 3
Surface Cap	1 to 2 ft of clayey soils. Minimum 1 ft thick if overlain by pavement	Refer to Alternate No. 1	Refer to Alternate No. 1
Vertical Drainage	3-dimensional drainage geocomposite hydraulically connected to perimeter drain.	Relatively free-draining granular soils with $P_{200} (\% \text{ fines}) \leq 12\%$.	Minimum 6-in. wide zone of free-draining granular soils with $P_{200} \leq 5\%$ hydraulically connected to perimeter drain. Provide geotextile as required (see note 10).
Perimeter Drain	Perforated pipe encapsulated in geocomposite.	Perforated pipe surrounded by free-draining granular pipe backfill with $P_{200} \leq 5\%$. Provide geotextile as required (See Note 10).	Refer to Alternate No. 2
Wall Backfill	Excavation spoils or imported materials (granular soils preferred).	Relatively free-draining granular soils with $P_{200} \leq 12\%$.	Refer to Alternate No. 1

CGC, Inc.

Typical Perimeter Drain Detail

General Notes

1. This system's primary function is to intercept infiltrating surface water. These alternates are not appropriate for use in situations of high groundwater (i.e., cases where the water table approaches floor slab elevation).
2. Grade surface cap to slope away from structure.
3. Exterior surface of walls below grade should be damp-proofed.
4. A plastic vapor barrier should be installed below the slab.
5. Recommended types of drain pipes:

<u>Specification</u>	<u>Description</u>
ASTM D2729	Polyvinyl Chloride (PVC) Drain Pipe
ASTM F405	Corrugated Polyethylene Drain Pipe
ASTM D2852	Styrene-Rubber Plastic Drain Pipe
AASHTO M1366	Corrugated Metal Underdrain Pipe
6. Minimum slope of drain pipes should be 2 in. per 100 lin ft.
7. Place drain pipe below basement floor level and orient the perforations toward the bottom.
8. Clean-outs should be provided to service the pipe.
9. Collected field water should be discharged to a sump, storm sewer or drainage field.
10. The geotextile for Alternative Nos. 2 and 3 may be eliminated if filter requirements are satisfied between the wall and pipe backfill, as well as between backfill materials and natural soils.
11. Pipe backfill materials should satisfy filter requirements for the slot width or hole diameter of the perforated pipe.
12. Care should be taken during backfilling not to damage the integrity of the system. For compaction requirements, refer to geotechnical report.
13. Pipe, geotextile, and geocomposite should be installed according to manufacturer specifications.