2135 South 116th Street
West Allis, WI 53227

March 3, 2025

Curt Wiebelhaus
Bridge Church
1314 S. Grand Avenue
Waukesha, Wisconsin

Subject: Geotechnical Consulting Services
Bridge Church Addition
1314 S. Grand Avenue, Waukesha, Wisconsin

Dear Mr. Wiebelhaus:

GeoTest, Inc. (GeoTest) has prepared this geotechnical engineering report related to the above-referenced project. This report describes the subsurface exploration and laboratory testing programs and presents recommendations regarding civil and structural engineering design aspects of the project, as well as other construction considerations.

Project Description

Bridge Church is preparing to construct an addition to the main building on the campus located at 1314 S. Grand Avenue in Waukesha, Wisconsin. The location of the project is illustrated on Figure 1 in Appendix A.

The area of the addition is currently occupied with an existing bi-level residence that will be demolished, pavements, and landscaping. Based on historic aerial photographs, the western edge of the proposed addition will likely extend into the boundaries of a former gravel pit.

The project will include a 23,500-sf single-story, slab-on-grade addition, as well as exterior concrete walkways and asphalt pavement parking and drive areas. The proposed development is illustrated on Figure 2 in Appendix A.

Structural loads have not been provided. However, we anticipate that column and wall loads will not exceed 500 kips and 8 kips per linear foot, respectively. The finished floor elevation for the new addition will match the existing building's floor elevation (estimated to be at 856 feet), which will require minimal grade changes.

Scope of Work

Geotechnical Subsurface Exploration

The geotechnical exploration program consisted of seven borings drilled to depths of 30 feet (B-1 through B-4) and 20 feet (B-5 through B-7) below the existing ground surface. The boring locations are identified on the Boring Location Diagram (Figure 2) in Appendix A.

The borings were drilled using conventional hollow-stem augers. Soil samples were obtained at 2.5-foot intervals to a depth of 10 feet and 5-foot intervals thereafter. The soil samples were obtained by split-barrel sampling procedures, in general accordance with ASTM D1586. Representative portions of the samples were sealed in glass jars and returned to GeoTest for laboratory testing and classification.

Descriptive logs for each boring, which describe the method of borehole advancement, sample types, sample depths, and observations regarding soil and groundwater conditions, were prepared at the time of drilling. These logs were utilized by a GeoTest geotechnical engineer as an aid to prepare the final boring logs and cross-section included in Appendix B.

The ground surface elevations at the boring locations were drawn from the USGS map viewer website. The elevations are considered accurate to the nearest 1 foot. Water level information, if encountered, was noted during drilling.

All drilling and sampling procedures are described in Appendix C.

Laboratory Testing

A GeoTest geotechnical engineer examined and visually classified each sample, based on texture and plasticity, in accordance with the Unified Soil Classification System (USCS). The engineer grouped like soil samples into strata that are illustrated on the soil boring logs and cross-section. The notes included on the boring logs and chart describing this system of classification is included in Appendix B.

The laboratory testing program consisted of the following:

- Water content testing on all samples.
- Calibrated hand penetrometer testing (Q_p) on all fine-grained (clay) samples.

The laboratory test results are presented on the final boring logs included in Appendix B. The four Q_u reports are included in Appendix B. All laboratory procedures are described in Appendix C.

The recovered soil samples will be retained for 60 days after the date of this report. Unless other instructions as to their disposition are received, they will be discarded at that point.

Soil and Groundwater Conditions

The following narrative is a generalization of the subsurface conditions encountered at the borings. Soil conditions can vary in areas between the boring locations. This potential variability warrants considering all soil conditions when designing the various structural and civil elements of the development. For a more-detailed description of the subsurface conditions encountered at each boring location, please refer to the attached boring logs and cross-section in Appendix B.

General Soil Conditions

The general soil profile (beneath the surface materials) consisted of mostly sand fill to depths up to 17 feet overlying stratified layers of mostly native sand to depths of about 22 to 23 where limestone bedrock was present. Intermixed topsoil was noted in several fill samples. Clay fill was encountered at one boring (B-6) to a depth of about 6 feet. No fill was encountered at B-6. Native clay was encountered at two borings: B-4 at a depth of 14 to 17 feet (below the fill), and B-6 to a depth of about 6 feet. The native sand soils varied in their clay and silt content and contained occasional cobbles.

Fill Materials - The relative density of the fifteen coarse-grained (sand) fill samples was loose to dense, with N-values that ranged from 8 to sampler refusal (more than 50 blows for less than 6 inches of penetration). Six samples (40%) were below 10 (loose). Five samples (33%) experienced sampler refusal.

The two clay fill samples exhibited very stiff to hard consistencies, with Q_p values of 7,000 pounds per square foot (psf) to greater than 9,000 psf.

Typically, moisture contents are considered high if they are above 15% in coarse-grained (sand and gravel) soils and above 20% in fine-grained soils. The moisture content in the sand fill samples ranged from 5.3% to 27.2%. Four samples (27%) exceeded 15%.

The moisture content in the clay fill samples were 13.4% and 13.6%.

Native Soils - The three native clay samples exhibited stiff to very stiff consistencies, with Q_p values of 2,000 psf, 3,500 psf, and 4,000 psf.

The relative density of the twenty-two native sand samples was loose to dense, with N-values ranging from 8 to sampler refusal. The average was 37. Two samples (9%) were less than 10 (loose). Fifteen samples (68%) exceeded 30 (dense).

The moisture content in the native sand samples ranged from 3.2% to 18.8%. Four samples (18%) exceeded 15%.

The moisture content in the native clay samples were 20.0%, 25.2%, and 28.9%.

Groundwater Conditions

Free groundwater was encountered at depths that ranged from about 6 to 14 feet (elevations of 841 to 849 feet) at the borings during drilling. Fluctuations in the groundwater table elevation should be expected with variations in precipitation, evapotranspiration, surface runoff, etc. Also, shallow perched groundwater conditions should be expected where relatively permeable granular soils are underlain by relatively impermeable cohesive soils, especially following precipitation events.

Analysis and Recommendations

There are nine primary issues that should be considered when planning this project.

- Undocumented, variable fill materials (including intermixed topsoil) exist within the proposed addition footprint. These fills are a concern for structural support because they could have been placed inconsistently, not sufficiently compacted, and contain intermixed topsoil, potentially causing excessive total and/or differential settlements for foundations and floor slabs. The field data indicates the fills are variable in their strength characteristics, indicating they are not considered suitable for support of structural elements.
- Either variable bearing soils or variable foundation elements will be necessary. Therefore, additional structural design considerations will be required to manage differential settlements.
- Clayey soils were present on the property, which are sensitive to construction activity, and actions to stabilize the subgrade during construction should be planned.
- Some shallow soils exhibited high moisture, which can cause earthwork challenges.
- Shallow groundwater was encountered, which would impact foundation and utility excavations.
- Clean coarse-grained (small quantities of fines) soils were encountered that will pose excavating challenges, especially related to trench stability.
- Cobbles exist within the coarse-grained soils, which could impact excavations.
- Because the property has a development history, care should be taken to identify any existing buried structural elements and utilities that may impact new elements. The removal of structural elements can also cause ground disturbance that will require restoration.
- Care must be taken to ensure the integrity of the foundations of the existing adjacent building are maintained.

Foundation Support

Within most of the building addition, the unsuitable fills extend up to depths of about 6 feet (elevations of 848 to 850 feet). Along the western edge, the unsuitable fills extend up to depths of about 17 feet (838 feet). Based on the subsurface conditions encountered at the borings, the proposed addition should not be supported by conventional, shallow foundations without substantial subgrade improvement.

Given the size of the addition, the following options were evaluated:

- Remove the unsuitable fills and replace them with engineered (compacted) fills. This could be difficult along the western area due to the presence of shallow groundwater.
- Utilize a rigid foundation and floor-slab system (mat). This option would manage differential settlements.
- Utilize medium-depth foundation elements, such as resistance or helical piers, in the deeper fill area. This option would need unique structural design considerations because the addition would be supported by different foundation elements, potentially resulting in differential settlements.

With the estimated interior footing pad elevation of 854 feet and exterior footing pad elevation of 852 feet, the most viable option would be over-excavation and replacement. Within most of the addition footprint, it is estimated that the footing excavations would need to extend an average of about 3.4 feet. The over-excavation would need to extend to an average depth of about 13.5 feet along the western edge.

Because of the presence of shallow groundwater (elevation of 842 to 851 feet), complete removal of the undocumented fills would likely not be possible with substantial efforts to dewater and support the excavation walls. Therefore, an option to consider would be a hybrid: remove the undocumented fills that are accessible and use an alternative design for the footings in any area where full removal was not accomplished. If about half of the undocumented fills are removed along the western edge, the potential differential settlement could be managed by reducing the allowable bearing capacity by half and installing additional reinforcing at the transitions. Additional soil evaluations during construction should be planned in case unexpected conditions are encountered.

On a conservative basis, the foundation can be designed using an allowable bearing capacity value of 4,000 psf and using a reduced value of 2,000 psf where any unsuitable fills are left in-place. The goal of the hybrid design is to minimize differential settlements. Based on the subsurface conditions, properly designed and constructed footings should experience total and differential settlements of less than 1 inch and ¾ inch, respectively.

Traditionally, perimeter footings and interior footings in unheated areas should bear at a depth of at least 48 inches below the final exterior grade to provide adequate frost protection. If desired, exterior footings can bear at shallower depths by following ASCE 32-01 (American Society of Civil Engineers, Design and Construction of Frost-Protected Shallow Foundations, 2001). Interior footings not subject to frost can bear directly beneath the floor slab.

Seismic Design

The soil conditions present at a site are utilized in determining the Seismic Design Category (SDC) for structures. Part of selecting the SDC is determining the Site Class for the soils, which categorizes common soil conditions into broad classes, where typical ground motion attenuation and amplification effects are assigned. Site Class is determined based on the average properties of the soil within 100 feet of the ground surface. Geotechnical engineers use a variety of parameters to characterize the engineering properties of these soils, including general soil classifications (e.g., hard rock, soft clay, etc.), N-values, and laboratory testing.

Site Class A includes hard rock that is typically found only in the eastern United States. The types of rock typically found in the western states include various volcanic deposits, sandstones, shales, and granites that commonly have the characteristic appropriate to either Site Class B or C. Sites with very dense sands and gravels or very stiff to hard clay deposits also may qualify as Site Class C. Sites with relatively stiff cohesive or medium dense non-cohesive soils, including mixtures of clays, silts, and sands, are categorized as Site Class D. Site Class D is the most common site class throughout the United States. Sites along rivers or other waterways underlain by deep soft clay deposits are categorized as Site Class E. Sites where soils are subject to liquefaction or other ground instabilities are categorized as Site Class F and site-specific analyses are required.

Based on the types of soils present at the boring locations at this property, and their apparent engineering properties, Site Class D is assigned to the site, as defined in the International Building Code (2015) Section 1613.

Floor Slab Support

The existing soils are mostly suitable for support of the concrete floor slab. However, due to the presence of undocumented fills, the floor slab area should be proof-rolled and unsuitable areas removed or improved prior to the placement of base course materials. An average subgrade modulus value of 125 pounds per cubic inch (pci) is appropriate with this option. Additional rigidity in the design should be considered along the western edge where all unsuitable fill are not removed.

Engineered Fill, Wall, and Utility Trench Backfill

All engineered fill, wall, and utility trench backfill should consist of inorganic materials, free of debris, not exceed 3 inches in size, and should be placed in 8 to 10-inch loose lifts compacted to a minimum of 95 percent of the maximum dry density (Modified Proctor). The fill should be moisture conditioned to be within 3± percent of the optimum moisture content.

The on-site soils can be reused as engineered fill, assuming they do not include deleterious materials (organic soils, wet soils, etc.). However, due to the moisture sensitive nature of clay and silt, their use could pose construction challenges regarding achieving the required compaction requirements. The grading contractor may choose to use a granular soil that can be more easily compacted and would be less sensitive to moisture levels.

Pavement Design
The subgrade soil conditions on the property consist of variable fills and clay soils, which restrict water infiltration. Therefore, greater than normal distress, faster deterioration, overall reduced service life, and increased maintenance is anticipated. To reduce the potential for localized settlements and provide more consistent subgrade support, a geotextile fabric (e.g., Geotex 315ST) should be placed below all base course materials.

The Wisconsin Asphalt Pavement Association (WAPA) Design Guide should be utilized to design the new asphalt surface parking areas. It has been assumed that Traffic Class I is suitable for parking areas that are mainly used by light passenger vehicles and Traffic Class II for medium-loaded drive areas.

Based on the soil conditions encountered at the boring locations, the minimum pavement section should consist of the following:

Material	**Traffic Class I**	**Traffic Class II**	**WisDOT Specification**
Asphalt Surface Course	2 inches	2 inches	Section 460
Asphalt Binder Course	2 inches	2.5 inches	Section 460
Dense Graded Base Course	8 inches	10 inches	Section 305

The pavement sections above are not intended to support on-going construction traffic. Also, the pavement sections presented above should not be used for areas that experience heavy truck traffic, equipment or truck parking areas, entrances and exit aprons, or trash-dumpster loading zones. In these areas, a Portland Cement Concrete (PCC) pavement should be used. The PCC layer thickness is recommended to be at least 7 inches with a minimum of 6-inch-thick crushed stone base course. The reinforcement details for PCC layers and final pavement sections should be designed by the project design engineer.

These recommendations assume the subgrade is prepared as described in this report. Additional corrective action may be warranted at the time of construction, depending on the site conditions.

Hot Mix Asphalt (HMA) and base course materials should be placed and compacted following the project requirements and guidelines of WisDOT Standard Specifications for Highway and Structure Construction, section 460.3.

Construction Considerations
All loose, wet, disturbed, or otherwise unsuitable surface soils should be stripped from structural and engineered fill areas prior to any construction activities. The exposed subgrade soils and all engineered fills should be observed, tested, and documented by a representative of the geotechnical engineer. Large structural areas, such as building,

engineered fill, and pavement areas, should be proof-rolled to identify low-strength or disturbed areas that need to be removed or improved.

Footing excavations and all structural subgrade soils should be evaluated to confirm the bearing materials are consistent with those identified in this report and anticipated by the structural engineer. If unanticipated conditions are encountered, the geotechnical and structural engineers should be notified immediately. All footing pads must bear upon suitable native soils or engineered fill soils that have been confirmed in the field by a representative of the geotechnical engineer. Where unsuitable bearing soils, such as fill, organic, disturbed, wet, frozen, or low-strength (less than the design bearing capacity) soils are encountered, the excavation should be extended to competent bearing soil. If extended, the footing pads can be constructed at the base of the excavations, or the excavations can be backfilled with clean, crushed stone or lean concrete.

The structural design should consider the proximity of new footings in relation to existing footings. Imparting new loads to existing footings could induce additional settlement and new footing excavations could affect the structural integrity of existing footings.

Because the property has a development history, efforts should be taken during site grading to identify any structural elements. Buried structural elements from existing and former buildings, associated backfill materials, and utilities are present on the property. Therefore, efforts should be taken during site grading to identify any existing elements and undocumented fills. Existing foundations should be removed to a depth of at least 4 feet below proposed foundations. Existing concrete slabs below a depth of 4 feet should be removed or broken into minimum 1-foot pieces to avoid water pooling. Utilities exist that will also require abandonment. Care should also be taken to minimize disturbance of existing native soils that would require additional subgrade restoration.

The clay soils on-site will be sensitive to disturbances from construction activity and increases in moisture content. Increases in the moisture content of these soils can cause significant reduction in soil strength and support capabilities. In addition, moisture sensitive soils that become wet will likely impact grading and compaction schedules. Care should be taken during construction to protect these soils from moisture or disturbance from equipment. Placing a working subbase layer of 3-inch crushed stone or utilizing a cement stabilization program in areas subjected to construction traffic could be beneficial and reduce the potential need to strip disturbed soils.

It is possible that excavations could encounter shallow groundwater. Filtered sump pumps and drawing water from sump pits should be adequate to remove water that collects in excavations. Sump pits should be lined with a geotextile and filled with open-graded, free- draining aggregate.

Surface water should not be allowed to collect in excavations or on prepared subgrades during or after construction. Areas should be sloped to facilitate removal of collected

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surface runoff. Positive site drainage should be provided to reduce infiltration of surface water around the perimeter of structures and within pavement areas.

Excavation walls may need to be sloped or braced for stability and safety reasons. The Owner and Contractor should be aware of, and become familiar with, applicable local, state, and federal safety regulations, including current OSHA Excavation and Trench Safety Standards. Construction-site safety generally is the responsibility of the Contractor, who should also be responsible for the means, methods, and sequencing of construction operations.

The Contractor should be aware that slope height, slope inclination, or excavation depths should in no case exceed those specified in local, state, or federal safety regulations, (e.g., OSHA Health and Safety Standards for Excavations, 29 CFR Part 1926), or successor regulations. The soils encountered in the borings are predominantly Type C when applying the OSHA regulations. Such regulations are strictly enforced, and if they are not followed, the Owner, Contractor, and/or earthwork Subcontractor(s) could be liable for substantial penalties.

General Qualifications

The services provided by GeoTest on this project were performed with the degree of skill and care typically performed by other members of the geotechnical engineering profession, practicing in this locale, at this time. No other warranty, expressed or implied, is given.

We appreciate the opportunity to provide geotechnical engineering services. If you have any questions, or require any further assistance, please feel free to contact us.

Sincerely,

Michael D. Frede, P.E.
Technical Director/Senior Engineer