GEOTECHNICAL EVALUATION REPORT

TOWN OF UPLAND WASTEWATER IMPROVEMENTS
WASTEWATER TREATMENT PLANT
UPLAND, GRANT COUNTY, INDIANA

SME Project No. 087061.00
July 29, 2021

SME

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Fort Wayne, IN 46825

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July 29, 2021

Mr. Jeremy Hardy, PE
Commonwealth Engineers, Inc.
9604 Coldwater Road, Suite 203
Fort Wayne, Indiana 46825

Via E-mail: jhardy@contactcei.com (PDF file)

RE: Geotechnical Evaluation Report
Town of Upland Wastewater Improvements
Wastewater Treatment Plant
Upland, Grant County, Indiana
SME Project No. 087061.00

Dear Mr. Hardy:

We have completed our geotechnical evaluation for the subject project. This report presents the results of our observations and analyses, and our geotechnical recommendations based on the information disclosed by the borings.

We appreciate the opportunity to be of service. If you have questions or require additional information, please contact me.

Sincerely,

SME

Bradford L. Ewart II, PE
Project Manager / Regional Office Manager

TABLE OF CONTENTS

1. INTRODUCTION

This report presents the results of the geotechnical evaluation performed by SME for the wastewater treatment plant (WWTP) improvements in Upland, Grant County, Indiana. This evaluation was conducted in general accordance with the scope of services outlined in SME Proposal No. P01206.21, dated April 15, 2021. Commonwealth Engineers, Inc. (Commonwealth) authorized SME's services for this evaluation.

To assist with our evaluation and the preparation of this report, SME reviewed the following:

- A set of preliminary drawings titled "Town of Upland – Grant County, Indiana – WWTP Rehabilitation – September 2021", undated and prepared by Commonwealth;
- A drawing titled "Town of Upland – Flow Schematic Aerial (Figure 1-3)" undated and prepared by Commonwealth, which included a layout of the existing Town of Upland Wastewater Treatment Plant features and labels of existing structures;
- A set of drawings titled "Town of Upland – Grant County, Indiana – New Screen, Grit Removal, Pump Station, and Existing Pump Station Retrofit – Option 3 (Figure Nos. ES-3 and ES-4)", undated and prepared by Commonwealth; and
- A drawing titled "Town of Upland, Ind. – Water Quality Control Project – E.P.A. Grant No. C I80761 02 – Div. I Wastewater Treatment Plant Imp. – Aerated Grit and Pump Station Plan", dated August 1984 and prepared by Bonar & Associates, Inc.

1.1 PROJECT DESCRIPTION AND SITE CONDITIONS

The project site is at the existing Town of Upland WWTP located at the east end of East Bragg Avenue in Upland, Indiana. The project location is depicted on the Location Map inset included on the Boring Location Diagram (Figure No. 1) included in Appendix A. The Upland WWTP currently consists of existing structures associated with the WWTP process along with grass covered areas, paved and gravel covered access drives. A chain-linked fence and dense wooded areas surround the facility.

SME was not provided a topographic survey of the WWTP. However, based on our review via Google Earth Pro imagery and ground surface measurements obtained by SME during our field exploration, as further discussed in Section 2.1, the ground surface is generally rolling downward from the east to the west side of the site and elevations range from about 903 to 917 feet.

We understand the project includes the construction of a new pump station, headworks building, and associated site piping at the existing Town of Upland WWTP. The approximate locations of the planned structures are depicted on Figure No. 1. We understand the replacement pump station will have a bearing depth of about 30 feet below the ground surface, corresponding to approximately elevation 876 feet. We anticipate the structure will be supported on a 2-feet-thick pre-cast or cast-in-place, reinforced concrete mat foundation. We also understand the headworks building is planned to be constructed at grade and will either include a mat foundation and/or conventional spread foundations and slab-on-grade.

Based on the referenced plans, we understand the site piping will include pipes ranging from 10- to 24-inches in diameter. The anticipated invert depth of the site piping ranges from about 5 to 6 feet below existing ground surface. We anticipate the piping will be installed by open-cut construction. Additional project information, including pipe materials and invert elevations were not provided to SME for the site piping upgrades.

Please contact SME so we can reevaluate our recommendations if the information discussed above varies from the planned construction.

2. EVALUATION PROCEDURES

2.1 FIELD EXPLORATION

SME completed four borings (B10 through B13) at the site on June 28 and 29, 2021. The approximate as-drilled locations of the borings are depicted on Figure No. 1.

Commonwealth and SME jointly determined the planned number, locations, and depths of the borings. SME staked/marked the boring locations in the field by referencing existing site features and using a GPS unit. We obtained the existing ground surface elevations at the boring locations using our Trimble GPS unit.

The borings were drilled using a rotary-type drill rig and were advanced using continuous-flight augers. The borings included soil sampling based upon the Split-Barrel Sampling procedure. Recovered split-barrel samples were sealed in glass jars by the driller.

Groundwater level measurements were recorded during and immediately after completion of each boring. The boreholes were backfilled with auger cuttings after completion. Long-term groundwater levels were not obtained from the borings.

Soil samples recovered from the field exploration were sent to the SME laboratory for further observation and testing.

2.2 LABORATORY TESTING

The laboratory testing program consisted of visual soil classification on recovered samples in general accordance with ASTM D-2488. Moisture content and hand penetrometer tests were performed on portions of cohesive samples obtained. The Laboratory Testing Procedures in Appendix B provide descriptions of the laboratory tests. Based on the laboratory testing, we described the soils and assigned a Unified Soil Classification System (USCS) group symbol to each of the soil strata encountered.

Upon completion of the laboratory testing, boring logs were prepared including information on materials encountered, penetration resistances, pertinent field observations during the drilling operations, and the results of the laboratory tests. Explanations of symbols and terms used on the boring logs are provided on the Boring Log Terminology sheet included in Appendix A. The boring logs are included in Appendix A.

Soil samples are normally retained in our laboratory for 60 days and then disposed, unless instructed otherwise.

3. SUBSURFACE CONDITIONS

3.1 SOIL CONDITIONS

The subsurface conditions encountered at the borings generally consist of surficial topsoil, underlain by clay and/or sand fill, and then natural clay extending to the explored depths of the borings.

The soil profile described above and included on the boring logs is a generalized description of the conditions encountered. The stratification depths shown on the boring logs are intended to indicate a zone of transition from one soil type to another. They are not intended to show exact depths of change from one soil type to another. The soil descriptions are based on visual classification of the soils encountered. Soil conditions may vary between or away from the boring locations. Please refer to the boring logs for the soil conditions at the specific boring locations.

It is sometimes difficult to distinguish between fill and natural soils based on samples and cuttings from small-diameter boreholes, especially when portions of the fill do not contain man-made materials, debris, topsoil or organic layers, and when the fill appears similar in composition to the local natural soils. Therefore, the delineation of fill described on the boring logs should be considered approximate only.

Thickness measurements of surficial materials reported on the boring logs should be considered approximate since mixing of these materials can occur in small diameter boreholes. Therefore, if accurate thickness measurements are required for inclusion in bid documents or for quantity estimates, additional evaluations, such as shallow test pits or pavement cores, should be performed.

3.2 GROUNDWATER CONDITIONS

Groundwater was not encountered during or upon completion of drilling at borings B10 through B13.

In cohesive soils (clays), a long time may be required for the groundwater level in the borehole to reach an equilibrium position. Therefore, the use of groundwater observation wells (piezometers) is necessary to accurately determine the hydrostatic groundwater level within cohesive soils. However, a change in color from brown to gray is oftentimes an indicator of the long-term groundwater level, and can sometimes be used to estimate the site groundwater levels. This color change was observed in boring B10 about 13.5 feet below the ground surface, corresponding to about elevation 892.5 feet.

Expect hydrostatic groundwater levels, perched groundwater conditions, and the potential rate of infiltration into excavations to fluctuate throughout the year, based on variations in precipitation, evaporation, run-off, and other factors. The groundwater levels indicated by the borings represent conditions at the time the readings were taken. The actual groundwater levels at the time of construction may vary.

4. ANALYSIS AND RECOMMENDATIONS

4.1 SITE PREPARATION AND EARTHWORK

4.1.1 EXISTING FILL CONSIDERATIONS

Existing fill was encountered at three of the four boring locations and extended about 6 to 8.5 feet below the existing ground surface. The existing fill is likely associated with previous site grading for the development of the WWTP facility. While we do not have specific information to indicate the existing fill was placed as engineered fill, the soil borings suggest that the existing fill is relatively uniform in strength and overall condition. In the absence of site-specific information that documents the fill soils were placed and compacted as engineered fill, we will need to consider the existing fill as undocumented fill material.

Given the limited fill depths, the results from the soil borings, and the similarities to the natural soil at similar depths, the existing fill can be considered for support of slabs-on-grade if the subgrade is properly evaluated and prepared as described below. In general, the existing fill will need to be of sufficient strength and free of unsuitable materials such as excessive debris, chemically active materials, and significant organics, and provided the Owner accepts the associated risk of greater than typical post-construction settlement of structures supported on existing fill materials. Based on the borings, this risk appears to be relatively low, and can be reduced assuming the subgrade is properly prepared during construction.

Proper subgrade preparation typically includes removing unsuitable fill, debris laden fill, organic soils, and other unsuitable materials, uniformly compacting suitable existing fill with appropriate compaction equipment, performing proofroll tests on the compacted subgrade, undercutting overly soft/loose subgrade, and replacing undercuts with suitable engineered fill.

We recommend SME further evaluate (in the field and during construction) the existing fill that will remain below proposed structures. As is typical for conventional site earthwork projects, the further evaluation(s) can be performed using construction equipment (e.g., backhoes for test pits, dump trucks for proofrolls, etc.) and would occur on a case-by-case basis to address the specific needs of each situation where existing fill is to remain in-place. We recommend the contractor remove (and properly dispose of) any unsuitable existing fill and replace it with an appropriate engineered fill material. To address budgetary concerns, we recommend including a contingency for additional earthwork (e.g., undercutting, in-place compaction, removal of unsuitable fill, importing suitable fill, etc.) that may be required to improve subsurface conditions.

Regarding shallow foundation construction on the existing fill, refer to the “Foundation Recommendations” section (Section 4.2.2.1) of this report.

4.1.2 GENERAL SITE SUBGRADE PREPARATION

Remove topsoil, unsuitable fill, organic soils, tree root masses, chemically active materials, expansive materials, and other unsuitable materials from the planned structures areas and areas to receive engineered fill to expose the underlying inorganic subgrade. We recommend the clearing and stripping extend a minimum of 5 feet beyond the proposed structure footprints. Re-route existing utilities (if any) within the proposed structure footprints and abandoned utilities (if any) should be removed and the excavations backfilled with granular engineered fill to establish the design subgrade level.

The subgrade soils are sensitive to disturbance when exposed to water. If the subgrade is exposed to water, it may be necessary to improve the disturbed subgrade or remove and replace the soils with engineered fill, crushed aggregate or crushed concrete. Placement of crushed aggregate or crushed concrete, possibly with a geotextile for separation, is a traditional treatment to protect soft or easily disturbed subgrades.

After stripping and removal of deleterious materials and after cuts are made to achieve subgrade elevations, but prior to placing fill, if any, we recommend the exposed subgrade soils be subjected to a comprehensive proofrolling program. The purpose of proofrolling is to locate areas of unsuitably loose or soft subgrade. Proofrolling should be performed with a fully-loaded, tandem-axle truck or other similar pneumatic-tire construction equipment. Areas of unsuitable (i.e., wet, loose or soft) subgrade revealed during proofrolling should be mechanically improved (compacted) in-place. If it is not possible to compact the unsuitable subgrade, it may be necessary to remove the unsuitable soils and replace them with engineered fill.

After the exposed subgrade is evaluation as outlined above and improved as necessary, engineered fill may be placed on the exposed subgrade to establish final subgrade levels. Section 4.1.4 of this report presents materials and compaction requirements for engineered fill.

4.1.3 SUBGRADE PREPARATION FOR FLOOR SLABS

We anticipate the final subgrade for the headworks building will consist of suitable existing fill overlying natural soils, or engineered fill overlying natural soils or suitable existing fill. These soils are considered suitable for support of floor slabs, provided the subgrade is prepared as described in Sections 4.1.1 and 4.1.2, the Owner is willing to accept the stated risks of leaving the existing fill in-place for support of floor slabs, and engineered fill is placed and compacted per Section 4.1.4.

Prior to concrete placement for floor slabs, SME will need to observe and test the building pad subgrade to identify any areas that were disturbed during construction activities and to verify subgrade conditions are suitable for floor slab support. Unsuitable subgrade identified by SME will need to be recompacted or removed and replaced with engineered fill.

We recommend providing a minimum 4-inch thick slab subbase consisting of an approved granular material. The purposes of this is to provide a leveling surface for construction of the slab and a moisture capillary break between the slab and the underlying soils. We recommend INDOT No. 53 crushed aggregate be used for this purpose, and be compacted per Section 4.1.4. We do not recommend relying on the leveling course to protect the underlying subgrade from disturbances. Therefore, place the concrete slab soon after placing the leveling course to minimize subgrade disturbance.

We recommend a vapor retarder be provided below the floor slab if the slab is to receive an impermeable floor finish/seal or a floor covering which would retard vapor transmission. The location of the vapor retarder (relative to the subbase) will need to be determined by the design Architect/Engineer based on the intended floor usage, planned finishes, and ACI recommendations.

We recommend separating slabs by isolation joints from structural walls and columns to permit relative movement. A minimum of 6 inches of engineered fill is recommended between the bottom of the slab and the top of the shallow foundations below, to allow for relative settlements.

Protect the slab-on-grade subgrade soils from frost action during winter construction. Any frozen soils have to be thawed and compacted, or removed and replaced prior to slab-on-grade construction.

4.1.4 ENGINEERED FILL REQUIREMENTS

Engineered fill placed within the construction area, including utility trench backfill, should be an approved material, free of frozen soil, organics, particle sizes that will hinder compaction, or other deleterious materials. Fill placed in structural areas should be compacted to a minimum of 95 percent of the maximum dry density as determined in accordance with the Modified Proctor test and fills placed in non-structural green areas should be compacted to at least 92 percent. The fill should be spread in level layers with a loose thickness appropriate for the type of equipment used to obtain compaction and no greater than 9 inches. Sand fill should be compacted with a smooth drum vibratory roller or vibratory plate compactors including either walk-behind types, or plate compactors mounted on a backhoe or excavator (hoe-pacs), while clay fill should be compacted with a sheepsfoot roller at a moisture content between the optimum and 2 percent below the optimum.

Based on the information from the borings, the site clays (with a USCS group symbol of “CL”) are expected to be the predominant soil excavated during installation of the structures. The site clays are generally suitable for use as engineering fill provided these soils meet the requirements listed in the previous paragraph. However, based on our experience, clays are difficult to compact in confined areas where compaction by hand-operated equipment is required and should not be used where drainage is required (e.g., behind below-grade walls). We recommend the clays excavated from trenches not be reused as engineered trench backfill beneath pavements except as a cap in the upper 2 feet immediately below the pavement section where similar clays are present (to provide a uniform subgrade). The clays can be reused in open areas where large compaction equipment can operate.

The successful reuse of the on-site soils for engineered fill will depend on the time of year and the care the earthwork contractor uses in selecting and separating the fine-grained soils (i.e., clays) from the more granular and “cleaner” soils, e.g., soils with a USCS Group Symbol of “SP”. During cold and wet periods of the year, clay subgrade become saturated and disturbed and clays are difficult to dry. If such conditions occur, the contractor will have to use more of the on-site granular and “cleaner” soils and/or import sand to the site. We recommend imported fill should consist of INDOT B Borrow material, with less than 7 percent passing the No. 200 sieve.

If required to stabilize loose sand subgrades, we recommend using an approved coarse crushed aggregate or crushed concrete, consisting of nominal 1- to 2-inch diameter material with a maximum of 7 percent passing the No. 200 sieve, such as INDOT No. 2 specifications. The recommended crushed aggregate should be compacted using a steel-drum vibratory roller, a static roller (in the case of disturbed subgrades), vibratory plate compactor mounted on an excavator or backhoe (hoe-pac), or by tamping the aggregate layers using a backhoe or excavator bucket, if the material is placed in deep trenches or other confined areas. The crushed aggregate should be compacted until it is stable.

Once a stable base has been prepared, the pipe should be bedded with an approved granular material meeting the requirements of the governing agency. The placement and compaction of the bedding material should also confirm to the requirements of the appropriate municipal agency and acceptable buried pipe design practices.

4.2 FOUNDATIONS

4.2.1 PUMP STATION

As outlined previously in Section 1.1, we understand the pump station structure will bear about 30 feet below existing ground surface (about elevation 876 feet). Based on boring B10, a mat foundation bearing on a lean concrete mud mat overlying suitably prepared stiff to very stiff clay at about elevation 876 feet, we recommend a maximum net allowable soil bearing pressure of 2,500 pounds per square-foot (psf) (global safety factor of 3 or more) be used for design. In general, design of mats is not controlled by the maximum net allowable soil bearing pressure for static conditions since net contact pressure below the mats are usually less than the allowable bearing pressure. If subgrade reaction theory is used in the design and to model deflections across the mat and for foundation subgrade soils prepared and verified as discussed herein, we recommend a vertical modulus of subgrade reaction of 100 kips per cubic foot (kcf) for design. This recommended subgrade modulus is based on empirical relationships between soil type and plate load tests for a 12-inch square bearing plate at the ground surface.

4.2.2 HEADWORKS BUILDING

As outlined previously in Section 1.1, we understand the headworks building will either include mat foundation and/or conventional spread foundations. We recommend shallow mat or spread foundations, bearing on suitable natural soils or engineered fill placed directly over suitable natural soils for support of the headworks building. In addition, shallow footings may be supported on suitable existing fill soils directly above suitable natural soils, provided the existing fill is thoroughly probed and tested (during foundation construction) to verify it is suitable for foundation support. An SME representative will need to be onsite during foundation construction to test and evaluate the existing fill during foundation construction. We can then provide additional recommendations for shallow foundation construction based on the results of the field testing.

We recommend a maximum net allowable soil bearing pressure of 3,000 pounds per square-foot (psf) (global safety factor of 3 or more) be used for design of shallow mat or spread foundations. In general, design of mats is not controlled by the maximum net allowable soil bearing pressure for static conditions since net contact pressure below the mats are usually much smaller than the allowable bearing pressure. If subgrade reaction theory is used in the design and to model deflections across the mat and for foundation subgrade soils prepared and verified as discussed herein, we recommend a vertical modulus of subgrade reaction of 100 kips per cubic foot (kcf) for design. This recommended subgrade modulus is based on empirical relationships between soil type and plate load tests for a 12-inch square bearing plate at the ground surface.

4.2.3 GENERAL CONSIDERATIONS

Provided the foundations are designed and constructed in accordance with this report, it is anticipated that the total settlement will be less than about 1 inch and differential settlements for foundations supporting similar loads are estimated to be about one-half of the total settlement estimate, or less.

As indicted in the 2014 Indiana Building Code (Table 1608.2) for sites located in Grant County, shallow foundations must be situated a minimum of 30 inches below final site grade in any unheated areas for protection against frost action during normal winters. The contractor must protect the foundations and bearing soils from freezing during construction if work occurs in the winter months.

The conditions at the bottom of the foundation excavations should be evaluated to verify the presence of inorganic natural soil. Where undercutting of existing fill or soft clay is required near the edges of the foundations, the zone of over-excavation and backfill should extend laterally on 1H:1V slope extending from the outside bottom edge of the foundation to the base of the undercuts.

We recommend the mat foundations be supported on an aggregate subbase to facilitate localized dewatering and to limit disturbance to the subgrade during construction. We recommend the subbase consist of a total of 12 inches of crushed material, composed of 9-inches of coarse, crushed aggregate or crushed concrete capped with 3 inches of dense-graded crushed aggregate (such as INDOT No. 53 crushed aggregate). The coarse, crushed aggregate or crushed concrete should range in nominal size from 1- to 2- inches and contain no more than 7 percent passing the No. 200 sieve (such as INDOT No. 2). The depth of the excavation for the foundations should account for the recommended thickness of aggregate subbase. The aggregate subbase should extend laterally at least 1 foot beyond the outside edges of the foundations. The aggregate subbase should be compacted by tamping the material with a backhoe bucket or if conditions permit, using vibratory equipment.

New foundations should bear at the same level as any existing adjacent structure. If new foundations are proposed at shallow (or deeper) elevations than the existing, adjacent foundations, the new foundations should “step” up or down to match the existing foundation bearing levels where the foundations abut. As a guideline, and for reasons of constructability, we recommend limiting vertical “steps” to 1 foot for every 3 horizontal feet.

The clay subgrade supporting the pump station, should be protected once the exposed bearing surface has been approved with a thin (roughly 2 to 3 inches thick) layer of lean concrete.

Once each foundation area is exposed, foundation subgrade conditions should be observed and tested by SME to verify suitable soils are encountered. Any soft, loose, or other deleterious soils encountered should be undercut from below the foundations and the undercuts backfilled with crushed aggregate.

We anticipate most of the settlement described above could occur elastically as the structures are initially filled and dead loads are applied. If the structures are emptied, some portion of the settlement will rebound, and when the structures are re-filled, settlement will reoccur, although anticipated to match the initial settlement (provided similar water levels are achieved). We recommend connections to the structures be designed to accommodate the anticipated settlement. The above settlements are based on the boring information, our experience with similar structures and soil conditions, and field verification of suitable bearing soils by SME.

4.3 BELOW-GRADE WALLS AND DRAINAGE

4.3.1 PUMP STATION

The walls for the proposed pump station structure will extend approximately 30 feet below the existing ground surface. The below-grade walls should be backfilled with granular soils meeting the requirements outlined in Section 4.1.4. Based upon boring B10, the soils consist of clays and groundwater is generally not expected. Therefore, based on the recent conditions observed at boring B10, we do not anticipate hydrostatic uplift from groundwater would adversely affect the lift station structure. However, there is the potential for perched groundwater to accumulate within sand layers and seams and/or within the granular wall. Also, the risk of flooding or if design information changes (including, but not limited to invert depth and/or structure location), or if excessive groundwater is encountered during construction, SME should be contacted to amend our recommendations regarding potential hydrostatic pressure as necessary and/or provide additional guidance during construction. We recommend, as a minimum, that pressure relief valves be installed in the mat foundation of this structure to counteract the potential of hydrostatic uplift.

For a drained granular backfill above the design groundwater level, and a level finish surface behind the wall, we recommend an active equivalent fluid pressure of 40 pounds per cubic foot (pcf) for design. This earth pressure is based on the wall being flexible enough to permit the active earth pressure condition to be reached. An outward movement away from the backfill equal to approximately 0.001 times the height of the wall is generally required to achieve the active earth pressure condition for granular backfill. If the wall is restrained or is rigid enough so that it does not rotate sufficiently to reach the active earth condition, a higher lateral earth pressure (at-rest condition) should be used for design. For rigid walls backfilled with a free-draining granular material above the design groundwater level, and a level finish surface behind the wall, we recommend an at-rest fluid pressure of 55 pcf for design.

The above lateral pressures for flexible and rigid wall conditions assume the use of a drained granular wall backfill. If adequate drainage is not provided, the hydrostatic water pressure should be added to the earth pressure computed using the submerged unit weight of the backfill. For flexible walls, the combined earth and hydrostatic (water) pressure would be 85 psf per foot of wall height and 100 psf per foot of wall height for rigid walls. Also, any additional lateral wall loads resulting from surcharge loading, and stockpiled materials, should also be added to the above earth pressures.

4.4 OPEN CUT CONSTRUCTION

4.4.1 OPEN-CUT EXCAVATIONS

As outlined in Section 1.1, we anticipate the site piping will extend about 5 to 6 feet below the existing ground surface.

Variable fills and natural soils were encountered in the borings. Therefore, the proper OSHA classification for safe excavation slopes should be determined by the contractor based on the soil and groundwater conditions encountered in the open cut excavations at specific locations. At locations where multiple soil types or layers are present, it may be necessary to use the flattest slope associated with the varying soils present. The effect of perched groundwater must also be considered per OSHA requirements.

The contactor must provide a safely sloped excavation or an adequately constructed and braced shoring system in accordance with federal, state, and local safety regulations for individuals working in an excavation that may expose them to the danger of moving ground. If material is stored or heavy equipment is operated near an excavation, appropriate shoring must be used to resist the extra pressure due to the superimposed loads.

4.4.2 SHEETING AND SHORING

Due to the anticipated lateral constraints of at least some portions of the sites (i.e., existing underground utilities, WWTP structures, and roadways), utilization of open-cut, sloped, and/or benched excavations may not be feasible at all locations. At locations where adequate excavation slopes cannot be maintained during construction, a temporary earth retention system (TERS) comprised of steel sheeting or appropriately sized steel trench boxes will be necessary to support the excavation. Based on the borings, a significant amount of groundwater is not anticipated to be encountered within the excavations, however, the contractor should be prepared to handle perched groundwater conditions within granular layers which may be water bearing or ponded water from precipitation events.

Steel sheet piles or other approved earth retention methods should be used where excavations are close to critical or sensitive structures or utilities. The design of the sheeting and any required bracing is typically performed by the contractor’s engineer and will be based on economy as well as geometric and ground conditions. Temporary earth retention must be designed by a licensed professional engineer. In some cases, additional geotechnical information could be required. Consideration should be given to how installation and extraction of sheeting will affect nearby structures and underground utilities. Trench boxes can be used to support excavation sidewalls, but only in areas where soil movements of the magnitude that is common to the use of trench boxes would not adversely impact nearby structures.

Pre-existing and post-construction condition surveys could be considered to document conditions of adjacent structures, roadways, and utilities prior to and after performing the work, particularly if there are nearby structures that are more susceptible to damage from vibrations due to their age or the materials used in their construction. Vibration monitoring should also be considered if the work will be performed near sensitive structures or if large magnitude vibrations are noted during construction.

Please contact SME for more information regarding TERS design services, condition surveys, or vibration monitoring during construction.

4.4.3 PIPE SUPPORT

We anticipate generally suitable conditions consisting of very stiff to hard clay or medium dense sands will be encountered at the anticipated pipe invert depths for pipe support conditions. However, conditions may vary significantly away from boring locations. Undercutting of low strength clays could be necessary if those soils are encountered, and stabilization of the bottom of excavations could be necessary at locations where wet sands are encountered or locations that become disturbed due to seepage or for other reasons. Undercuts should be backfilled with engineered fill or crushed aggregate. Refer to Section 4.1.4 for pipe bedding and undercutting recommendations.

4.5 CONSTRUCTION CONSIDERATIONS AND COMMENTS

Based upon the results of the borings for this evaluation, groundwater was typically not encountered. However, considering the significant distance between boring locations, it is likely that some temporary groundwater control will be required in areas at the project site. For excavations encountering perched groundwater (e.g., minor groundwater seepage that is temporarily trapped within granular soils above a less permeable clay stratum), we anticipate that conventional sump pits and pumps will be adequate to control groundwater accumulations on a local basis.

The contractor(s) should be provided the locations and depths of existing utilities in the project areas before beginning construction. Care must be exercised during the excavating and compacting operations so that excessive vibrations do not cause settlement of existing structures, pavements, and utilities and to avoid undermining existing foundations, slabs, pavements, or utilities when excavating for the proposed construction. In areas where there is insufficient space to temporarily slope back excavations in accordance with applicable regulations, temporary earth retention systems will be required during construction. Underpinning, shoring and earth retention systems should be designed by a qualified professional engineer, and installed by a contractor experienced with construction of these systems.

The contractor should remove ponded surface water and prevent run-off from reaching utility trench or open foundation excavations and areas of prepared subgrade. We recommend the contractor establish positive surface drainage at the onset of construction to reduce the potential for subgrade disturbance. If subgrade disturbance is observed, then construction traffic should be restricted to dedicated areas that are stabilized, as needed, using crushed aggregate.

The contractor must provide a safely sloped excavation or an adequately constructed and braced shoring system in accordance with federal, state and local safety regulations for individuals working in an excavation that may expose them to the danger of moving ground. If material is stored or heavy equipment is operated near an excavation, use appropriate shoring to resist the extra pressure due to the superimposed loads.

Handling, transportation and disposal of excavated materials and groundwater should be performed in accordance with applicable regulations.

5. SIGNATURES

We appreciate the opportunity to team with you on this project. Please let us know if you have questions and if we can assist you further with this project.

Report Prepared By:

Jami M. Bate

Jamie M. Bates, PE
Project Engineer

Report Reviewed By:

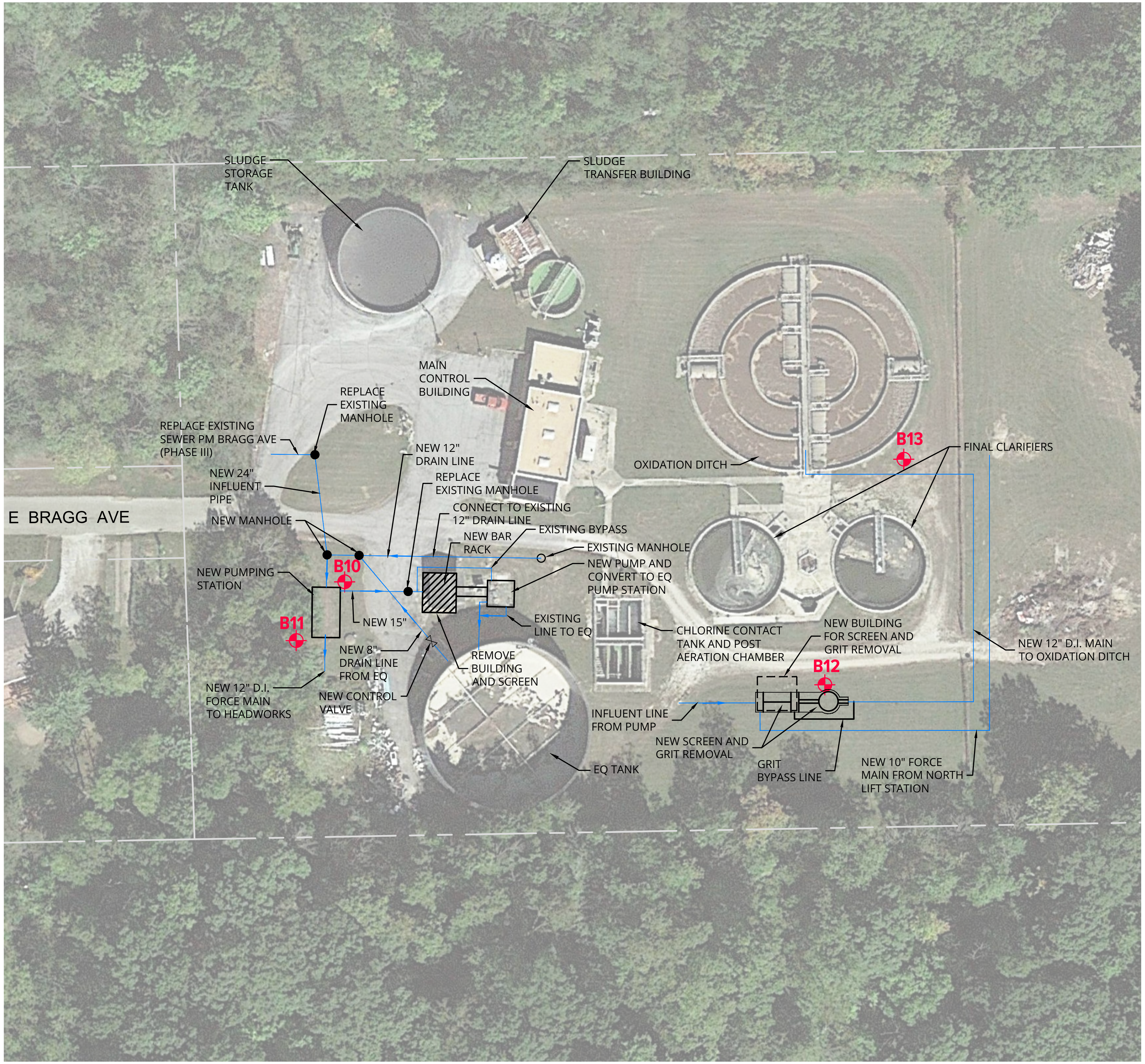
Larry P. Jedele, PE, D.GE (ret.)
Geotechnical Consultant

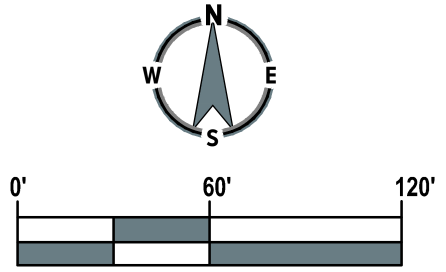
APPENDIX A

BORING LOCATION DIAGRAM (FIGURE NO. 1)
BORING LOG TERMINOLOGY
BORING LOGS (B10 THROUGH B13)

\\Sme-inc\pz\WIP\087061.00\CAD\Design Files\BLD\Rev1\087061.00-BLD-WWTP.dwg

PLOT DATE: Jul 26, 2021 - 4:14pm - julie.blake





GRAPHIC SCALE: 1" = 60'

LEGEND

⌖ BORING LOCATION

LOCATION MAP

NOT TO SCALE

NOTE:
BASE DRAWING INFORMATION TAKEN FROM GOOGLE EARTH PRO WITH IMAGE DATE 9-25-2019 AND A BASE CAD FILE DRAWING LABELED "xref-S20138-Contract A Base-Standard" PROVIDED BY COMMON WEALTH.

SME
www.sme-usa.com

Project

TOWN OF UPLAND WASTEWATER IMPROVEMENTS

Project Location

UPLAND,
GRANT COUNTY,
INDIANA

Sheet Name

BORING LOCATION DIAGRAM - WASTEWATER TREATMENT PLANT

No.	Revision Date

Date 7/26/2021

CADD JAB

Designer ARC/JMB

Scale AS NOTED

Project 087061.00

Figure No. 1

DRAWING NOTE: SCALE DEPICTED IS MEANT FOR 11" X 17" AND WILL SCALE INCORRECTLY IF PRINTED ON ANY OTHER SIZE MEDIA

BORING LOG TERMINOLOGY

UNIFIED SOIL CLASSIFICATION AND SYMBOL CHART

COARSE-GRAINED SOIL
(more than 50% of material is larger than No. 200 sieve size.)

GRAVEL More than 50% of coarse fraction larger than No. 4 sieve size	Clean Gravel (Less than 5% fines)		
	▨	GW	Well-graded gravel; gravel-sand mixtures, little or no fines
	▨	GP	Poorly-graded gravel; gravel-sand mixtures, little or no fines
	Gravel with fines (More than 12% fines)		
	▨	GM	Silty gravel; gravel-sand-silt mixtures
	▨	GC	Clayey gravel; gravel-sand-clay mixtures
SAND 50% or more of coarse fraction smaller than No. 4 sieve size	Clean Sand (Less than 5% fines)		
	▨	SW	Well-graded sand; sand-gravel mixtures, little or no fines
	▨	SP	Poorly graded sand; sand-gravel mixtures, little or no fines
	Sand with fines (More than 12% fines)		
	▨	SM	Silty sand; sand-silt-gravel mixtures
	▨	SC	Clayey sand; sand–clay-gravel mixtures

FINE-GRAINED SOIL
(50% or more of material is smaller than No. 200 sieve size)

SILT AND CLAY Liquid limit less than 50%	▨	ML	Inorganic silt; sandy silt or gravelly silt with slight plasticity
	▨	CL	Inorganic clay of low plasticity; lean clay, sandy clay, gravelly clay
	▨	OL	Organic silt and organic clay of low plasticity
SILT AND CLAY Liquid limit 50% or greater	▨	MH	Inorganic silt of high plasticity, elastic silt
	▨	CH	Inorganic clay of high plasticity, fat clay
	▨	OH	Organic silt and organic clay of high plasticity
HIGHLY ORGANIC SOIL	▨	PT	Peat and other highly organic soil

OTHER MATERIAL SYMBOLS

■	Topsoil	□	Void	▨	Sandstone
▨	Asphalt Concrete	▨	Glacial Till	▨	Siltstone
▨	Aggregate Base	▨	Coal	▨	Limestone
▨	Portland Cement Concrete	▨	Shale	▨	Fill

LABORATORY CLASSIFICATION CRITERIA

GW	$C_U = \frac{D_{60}}{D_{10}}$ greater than 4; $C_C = \frac{D_{30}^{\ 2}}{D_{10} \times D_{60}}$ between 1 and 3	
GP	Not meeting all gradation requirements for GW	
GM	Atterberg limits below “A” line or PI less than 4	Above “A” line with PI between 4 and 7 are borderline cases requiring use of dual symbols
GC	Atterberg limits above “A” line with PI greater than 7	
SW	$C_U = \frac{D_{60}}{D_{10}}$ greater than 6; $C_C = \frac{D_{30}^{\ 2}}{D_{10} \times D_{60}}$ between 1 and 3	
SP	Not meeting all gradation requirements for SW	
SM	Atterberg limits below “A” line or PI less than 4	Above “A” line with PI between 4 and 7 are borderline cases requiring use of dual symbols
SC	Atterberg limits above “A” line with PI 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…………….....……..Cases requiring dual symbols

- SP-SM or SW-SM (SAND with Silt or SAND with Silt and Gravel)
- SP-SC or SW-SC (SAND with Clay or SAND with Clay and Gravel)
- GP-GM or GW-GM (GRAVEL with Silt or GRAVEL with Silt and Sand)
- GP-GC or GW-GC (GRAVEL with Clay or GRAVEL with Clay and Sand)

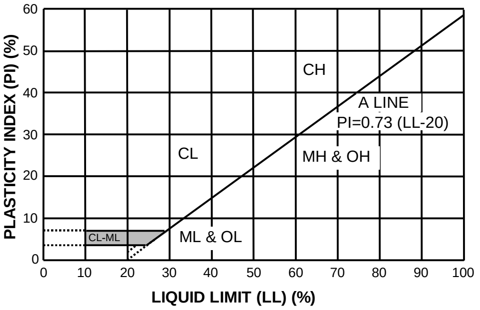
If the fines are CL-ML:

- SC-SM (SILTY CLAYEY SAND or SILTY CLAYEY SAND with Gravel)
- SM-SC (CLAYEY SILTY SAND or CLAYEY SILTY SAND with Gravel)
- GC-GM (SILTY CLAYEY GRAVEL or SILTY CLAYEY GRAVEL with Sand)

PARTICLE SIZES

Boulders - Greater than 12 inches
Cobbles - 3 inches to 12 inches
Gravel- Coarse - 3/4 inches to 3 inches
Fine - No. 4 to 3/4 inches
Sand- Coarse - No. 10 to No. 4
Medium - No. 40 to No. 10
Fine - No. 200 to No. 40
Silt and Clay - Less than (0.074 mm)

PLASTICITY CHART



VISUAL MANUAL PROCEDURE

When laboratory tests are not performed to confirm the classification of soils exhibiting borderline classifications, the two possible classifications would be separated with a slash, as follows:

For soils where it is difficult to distinguish if it is a coarse or fine-grained soil:

- SC/CL (CLAYEY SAND to Sandy LEAN CLAY)
- SM/ML (SILTY SAND to SANDY SILT)
- GC/CL (CLAYEY GRAVEL to Gravelly LEAN CLAY)
- GM/ML (SILTY GRAVEL to Gravelly SILT)

For soils where it is difficult to distinguish if it is sand or gravel, poorly or well-graded sand or gravel; silt or clay; or plastic or non-plastic silt or clay:

- SP/GP or SW/GW (SAND with Gravel to GRAVEL with Sand)
- SC/GC (CLAYEY SAND with Gravel to CLAYEY GRAVEL with Sand)
- SM/GM (SILTY SAND with Gravel to SILTY GRAVEL with Sand)
- SW/SP (SAND or SAND with Gravel)
- GP/GW (GRAVEL or GRAVEL with Sand)
- SC/SM (CLAYEY to SILTY SAND)
- GM/GC (SILTY to CLAYEY GRAVEL)
- CL/ML (SILTY CLAY)
- ML/CL (CLAYEY SILT)
- CH/MH (FAT CLAY to ELASTIC SILT)
- CL/CH (LEAN to FAT CLAY)
- MH/ML (ELASTIC SILT to SILT)

DRILLING AND SAMPLING ABBREVIATIONS

2ST – Shelby Tube – 2” O.D.
3ST – Shelby Tube – 3” O.D.
AS – Auger Sample
GS – Grab Sample
LS – Liner Sample
NR – No Recovery
PM – Pressuremeter
RC – Rock Core diamond bit. NX size, except where noted
SB – Split Barrel Sample 1-3/8” I.D., 2” O.D., except where noted
VS – Vane Shear
WS – Wash Sample

OTHER ABBREVIATIONS

WOH – Weight of Hammer
WOR – Weight of Rods
SP – Soil Probe
PID – Photo Ionization Device
FID – Flame Ionization Device

DEPOSITIONAL FEATURES

Parting – as much as 1/16 inch thick
Seam – 1/16 inch to 1/2 inch thick
Layer – 1/2 inch to 12 inches thick
Stratum – greater than 12 inches thick
Pocket – deposit of limited lateral extent
Lens – lenticular deposit
Hardpan/Till – an unstratified, consolidated or cemented mixture of clay, silt, sand and/or gravel, the size/shape of the constituents vary widely
Lacustrine – soil deposited by lake water
Mottled – soil irregularly marked with spots of different colors that vary in number and size
Varved – alternating partings or seams of silt and/or clay
Occasional – one or less per foot of thickness
Frequent – more than one per foot of thickness
Interbedded – strata of soil or beds of rock lying between or alternating with other strata of a different nature

DESCRIPTION OF RELATIVE QUANTITIES

The visual-manual procedure uses the following terms to describe the relative quantities of notable foreign materials, gravel, sand or fines:

Trace – particles are present but estimated to be less than 5%
Few – 5 to 10%
Little – 15 to 25%
Some – 30 to 45%
Mostly – 50 to 100%

CLASSIFICATION TERMINOLOGY AND CORRELATIONS

Cohesionless Soils

Relative Density	**N_{60} (N-Value) (Blows per foot)**
Very Loose	0 to 4
Loose	5 to 10
Medium Dense	11 to 30
Dense	31 to 50
Very Dense	51 to 80
Extremely Dense	Over 81

Cohesive Soils

Consistency	**N_{60} (N-Value) (Blows per foot)**	**Undrained Shear Strength (kips/ft^2)**
Very Soft	<2	0.25 or less
Soft	2 - 4	> 0.25 to 0.50
Medium	5 - 8	> 0.50 to 1.0
Stiff	9 - 15	> 1.0 to 2.0
Very Stiff	16 - 30	> 2.0 to 4.0
Hard	> 30	> 4.0 or greater

Standard Penetration ‘N-Value’ = Blows per foot of a 140-pound hammer falling 30 inches on a 2-inch O.D. split barrel sampler, except where noted. N60 values as reported on boring logs represent raw N-values corrected for hammer efficiency only.

Revised 10/06/20

SME

BORING B10

PAGE 1 OF 1

BORING DEPTH: 35 FEET

PROJECT NAME: Town of Upland Wastewater Improvements

PROJECT NUMBER: 087061.00

CLIENT: Commonwealth Engineers, Inc.

PROJECT LOCATION: Upland, Grant County, Indiana

DATE STARTED: 6/29/21 **COMPLETED:** 6/29/21 **BORING METHOD:** Hollow-stem Augers

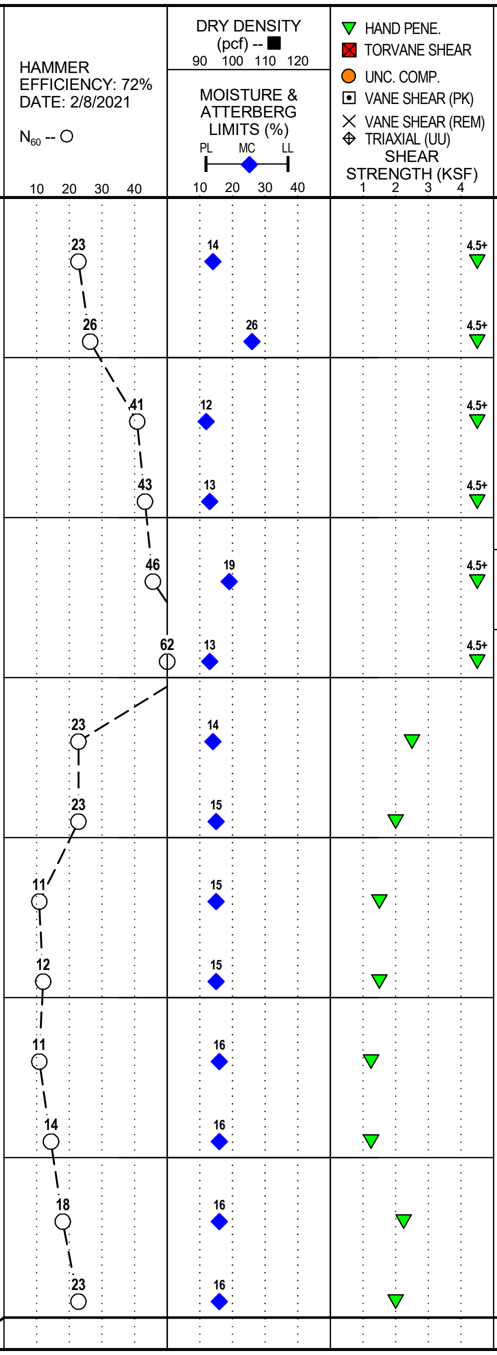
DRILLER: ELT/DLT **RIG NO.:** 558 (B-29) Truck **LOGGED BY:** JWJ **CHECKED BY:** AEB

ELEVATION: 906± FT

HAMMER EFFICIENCY: 72%
DATE: 2/8/2021

DEPTH (FEET)	ELEVATION (FEET)	PROFILE DESCRIPTION
0.6	905.4	7 inches of TOPSOIL
6.0	900.0	FILL- LEAN CLAY with Sand- Frequent Crushed Stone Fragments- Brown- Hard (CL)
13.5	892.5	LEAN CLAY with Sand- Brown- Hard (CL)
21.0	885.0	LEAN CLAY with Sand- Gray- Hard to Very Stiff (CL)
35.0	871.0	LEAN CLAY with Sand- Gray- Stiff to Very Stiff (CL)

END OF BORING AT 35.0 FEET.



▼ HAND PENE.
☒ TORVANE SHEAR
● UNC. COMP.
⊡ VANE SHEAR (PK)
× VANE SHEAR (REM)
⊕ TRIAXIAL (UU)

SAMPLE TYPE/NO. INTERVAL	RECOVERY LENGTH (INCHES)	SPT BLOWS PER SIX INCHES	N_{60}	MOISTURE (%)	HAND PENE. (KSF)	REMARKS
SB1	18	8 9 10	23	14	4.5+	
SB2	18	9 9 13	26	26	4.5+	
SB3	16	12 15 19	41	12	4.5+	
SB4	16	12 16 20	43	13	4.5+	
SB5	16	12 18 20	46	19	4.5+	Driller reported driving a stone.
SB6	16	17 22 30	62	13	4.5+	Driller reported driving a stone.
SB7	18	8 9 10	23	14		
SB8	18	8 8 11	23	15		
SB9	18	3 4 5	11	15		
SB10	18	3 5 5	12	15		
SB11	18	4 4 5	11	16		
SB12	18	4 5 7	14	16		
SB13	18	4 6 9	18	16		
SB14	18	4 6 13	23	16		

GROUNDWATER & BACKFILL INFORMATION

GROUNDWATER WAS NOT ENCOUNTERED

BACKFILL METHOD: Auger Cuttings

NOTES:
1. The indicated stratification lines are approximate. The in-situ transitions between materials may be gradual.
2. The colors depicted on the symbolic profile are solely for visualization purposes and do not necessarily represent the in-situ colors encountered.

7/29/21 9:43:23 AM

BORING B11

PAGE 1 OF 1

BORING DEPTH: 10 FEET

PROJECT NAME: Town of Upland Wastewater Improvements

PROJECT NUMBER: 087061.00

CLIENT: Commonwealth Engineers, Inc.

PROJECT LOCATION: Upland, Grant County, Indiana

DATE STARTED: 6/28/21

COMPLETED: 6/28/21

BORING METHOD: Hollow-stem Augers

DRILLER: ELT/DLT

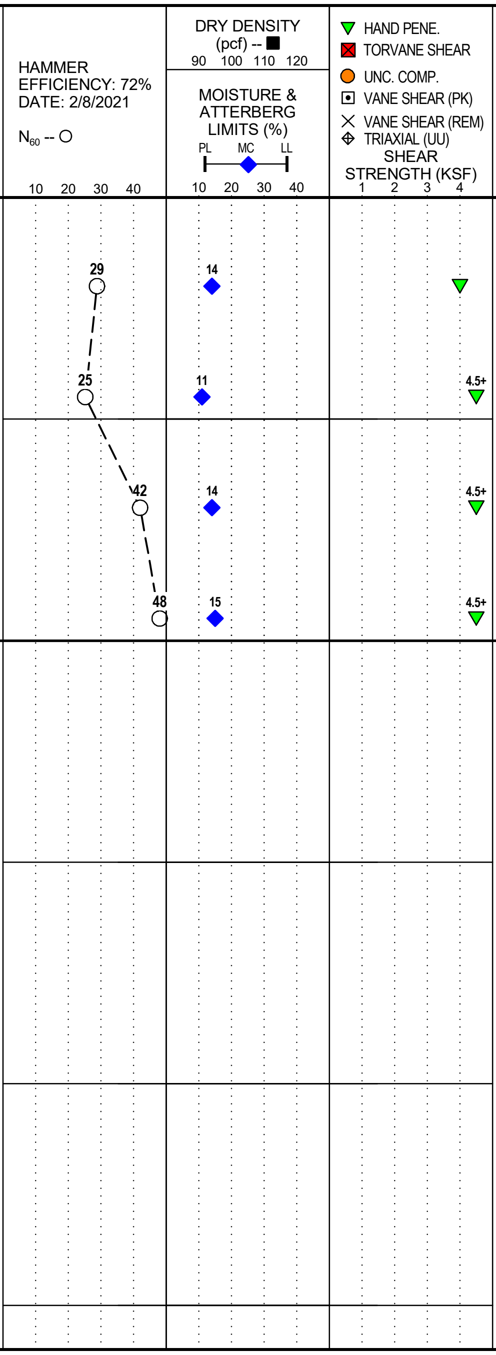
RIG NO.: 558 (B-29) Truck

LOGGED BY: JWJ

CHECKED BY: AEB

ELEVATION: 911± FT

ELEVATION (FEET)	DEPTH (FEET)	PROFILE DESCRIPTION	SAMPLE TYPE/NO. INTERVAL	RECOVERY LENGTH (INCHES)	SPT BLOWS PER SIX INCHES	REMARKS
910.4	0.6	7 inches of TOPSOIL				
905.0	6.0	LEAN CLAY with Sand- Brown- Very Stiff to Hard (CL)	SB1	18	8 10 14	
			SB2	18	9 10 11	
901.0	10.0	LEAN CLAY with Sand- Brown- Hard (CL)	SB3	16	12 14 21	
			SB4	16	12 17 23	
		END OF BORING AT 10.0 FEET.				



GROUNDWATER & BACKFILL INFORMATION

GROUNDWATER WAS NOT ENCOUNTERED

BACKFILL METHOD: Auger Cuttings

NOTES:
1. The indicated stratification lines are approximate. The in-situ transitions between materials may be gradual.
2. The colors depicted on the symbolic profile are solely for visualization purposes and do not necessarily represent the in-situ colors encountered.

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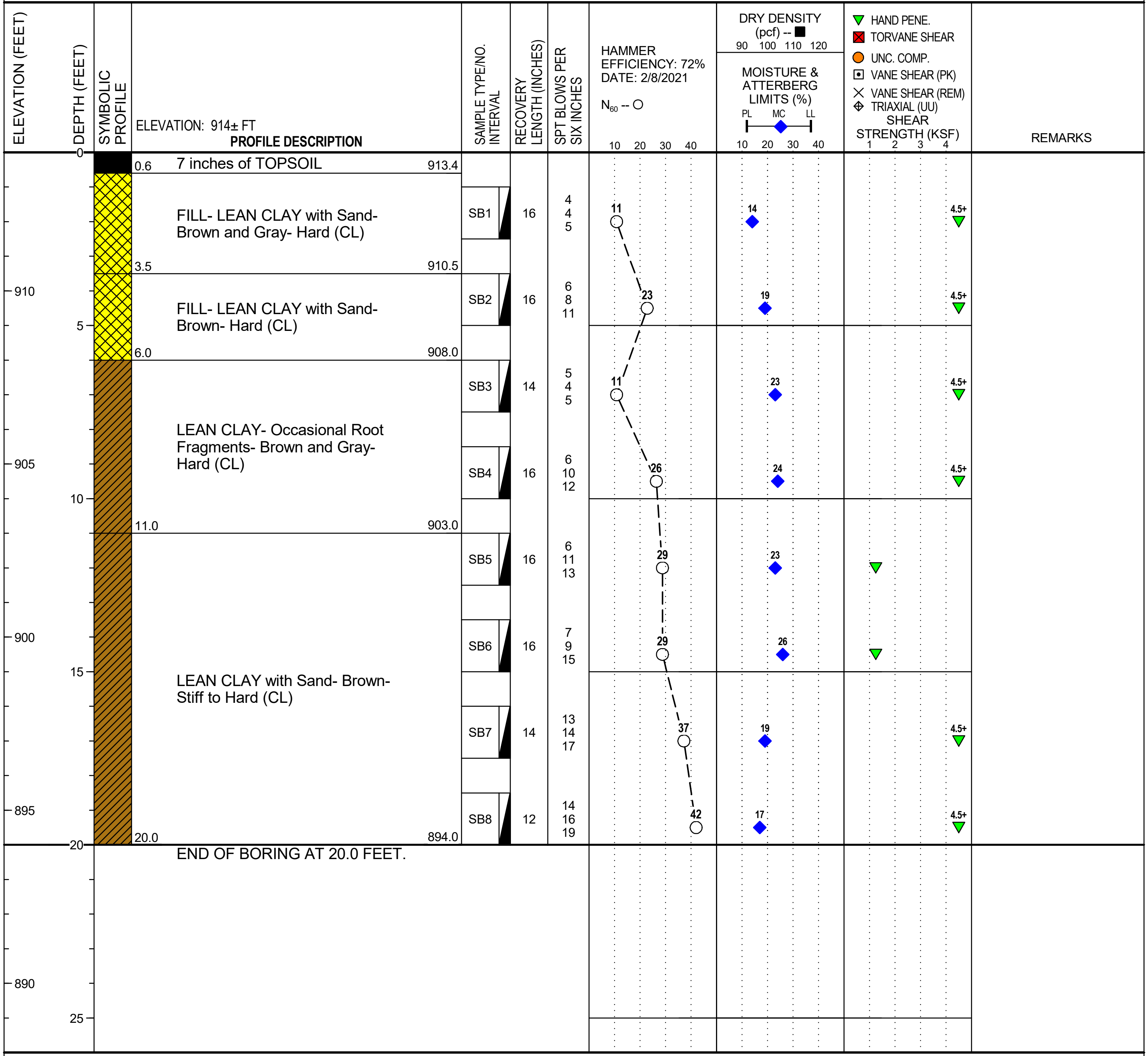
BORING B12

PAGE 1 OF 1

BORING DEPTH: 20 FEET

PROJECT NAME: Town of Upland Wastewater Improvements
PROJECT NUMBER: 087061.00
CLIENT: Commonwealth Engineers, Inc.
PROJECT LOCATION: Upland, Grant County, Indiana
DATE STARTED: 6/28/21
COMPLETED: 6/28/21
BORING METHOD: Hollow-stem Augers
DRILLER: ELT/DLT
RIG NO.: 558 (B-29) Truck
LOGGED BY: JWJ
CHECKED BY: AEB



Depth (ft)	Elevation (ft)	Profile Description	Sample	Recovery (in)	SPT Blows per Six Inches	N_{60}	MC (%)	Hand Pene. (ksf)
0.6	913.4	7 inches of TOPSOIL						
3.5	910.5	FILL- LEAN CLAY with Sand- Brown and Gray- Hard (CL)	SB1	16	4 4 5	11	14	4.5+
6.0	908.0	FILL- LEAN CLAY with Sand- Brown- Hard (CL)	SB2	16	6 8 11	23	19	4.5+
11.0	903.0	LEAN CLAY- Occasional Root Fragments- Brown and Gray- Hard (CL)	SB3	14	5 4 5	11	23	4.5+
			SB4	16	6 10 12	26	24	4.5+
20.0	894.0	LEAN CLAY with Sand- Brown- Stiff to Hard (CL)	SB5	16	6 11 13	29	23	▼
			SB6	16	7 9 15	29	26	▼
			SB7	14	13 14 17	37	19	4.5+
			SB8	12	14 16 19	42	17	4.5+

END OF BORING AT 20.0 FEET.

GROUNDWATER & BACKFILL INFORMATION

GROUNDWATER WAS NOT ENCOUNTERED

BACKFILL METHOD: Auger Cuttings

NOTES:
1. The indicated stratification lines are approximate. The in-situ transitions between materials may be gradual.
2. The colors depicted on the symbolic profile are solely for visualization purposes and do not necessarily represent the in-situ colors encountered.

7/29/21 9:43:24 AM

SME

BORING B13

PAGE 1 OF 1

BORING DEPTH: 10 FEET

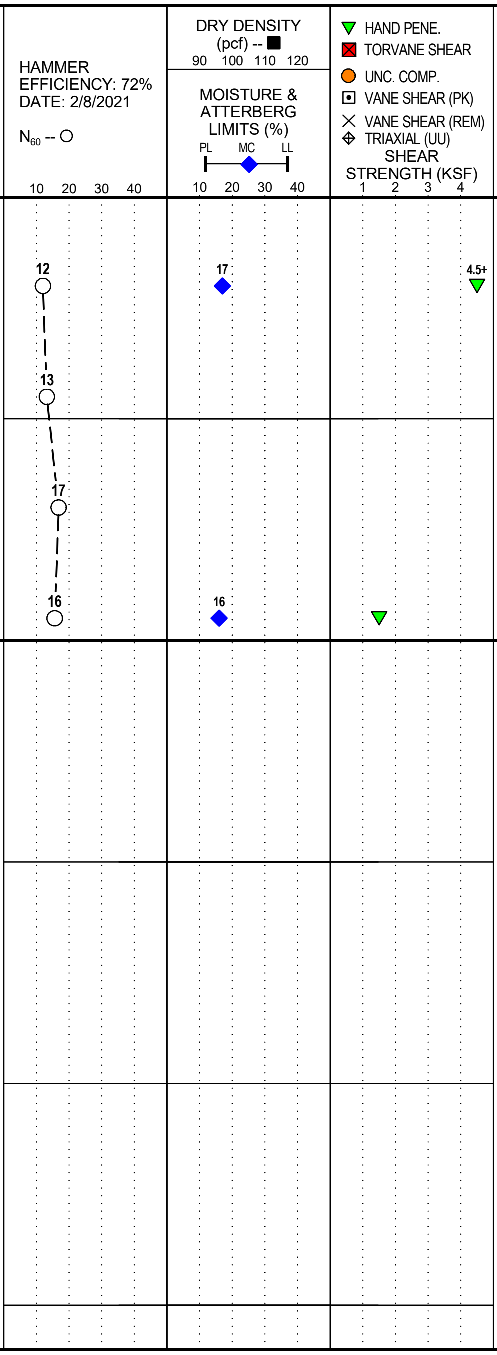
PROJECT NAME: Town of Upland Wastewater Improvements
PROJECT NUMBER: 087061.00
CLIENT: Commonwealth Engineers, Inc.
PROJECT LOCATION: Upland, Grant County, Indiana
DATE STARTED: 6/28/21
COMPLETED: 6/28/21
BORING METHOD: Hollow-stem Augers
DRILLER: ELT/DLT
RIG NO.: 558 (B-29) Truck
LOGGED BY: JWJ
CHECKED BY: AEB

ELEVATION: 916± FT

HAMMER EFFICIENCY: 72%
DATE: 2/8/2021

DEPTH (FEET)	ELEVATION (FEET)	PROFILE DESCRIPTION	SAMPLE TYPE/NO. INTERVAL	RECOVERY LENGTH (INCHES)	SPT BLOWS PER SIX INCHES	N_{60}	MOISTURE (%) MC	SHEAR STRENGTH (KSF) HAND PENE.	REMARKS
0.5	915.5	6 inches of TOPSOIL							
3.5	912.5	FILL- LEAN CLAY with Sand- Occasional Crushed Stone Fragments- Brown- Hard (CL)	SB1	10	8 5 5	12	17	4.5+	
8.5	907.5	FILL- Fine to Coarse SAND- Brown- Moist- Medium Dense (SP)	SB2	12	4 5 6	13			
			SB3	16	4 7 7	17			
10.0	906.0	LEAN CLAY with Sand- Brown- Stiff (CL)	SB4	16	4 5 8	16	16		

END OF BORING AT 10.0 FEET.



GROUNDWATER & BACKFILL INFORMATION

GROUNDWATER WAS NOT ENCOUNTERED

BACKFILL METHOD: Auger Cuttings

NOTES:
1. The indicated stratification lines are approximate. The in-situ transitions between materials may be gradual.
2. The colors depicted on the symbolic profile are solely for visualization purposes and do not necessarily represent the in-situ colors encountered.

APPENDIX B

IMPORTANT INFORMATION ABOUT THIS GEOTECHNICAL-ENGINEERING REPORT

GENERAL COMMENTS

LABORATORY TESTING PROCEDURES

Important Information about This

Geotechnical-Engineering Report

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

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

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

Understand the Geotechnical-Engineering Services Provided for this Report

Geotechnical-engineering services typically include the planning, collection, interpretation, and analysis of exploratory data from widely spaced borings and/or test pits. Field data are combined with results from laboratory tests of soil and rock samples obtained from field exploration (if applicable), observations made during site reconnaissance, and historical information to form one or more models of the expected subsurface conditions beneath the site. Local geology and alterations of the site surface and subsurface by previous and proposed construction are also important considerations. Geotechnical engineers apply their engineering training, experience, and judgment to adapt the requirements of the prospective project to the subsurface model(s). Estimates are made of the subsurface conditions that will likely be exposed during construction as well as the expected performance of foundations and other structures being planned and/or affected by construction activities.

The culmination of these geotechnical-engineering services is typically a geotechnical-engineering report providing the data obtained, a discussion of the subsurface model(s), the engineering and geologic engineering assessments and analyses made, and the recommendations developed to satisfy the given requirements of the project. These reports may be titled investigations, explorations, studies, assessments, or evaluations. Regardless of the title used, the geotechnical-engineering report is an engineering interpretation of the subsurface conditions within the context of the project and does not represent a close examination, systematic inquiry, or thorough investigation of all site and subsurface conditions.

Geotechnical-Engineering Services are Performed for Specific Purposes, Persons, and Projects, and At Specific Times

Geotechnical engineers structure their services to meet the specific needs, goals, and risk management preferences of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client.

Likewise, geotechnical-engineering services are performed for a specific project and purpose. For example, it is unlikely that a geotechnical-engineering study for a refrigerated warehouse will be the same as one prepared for a parking garage; and a few borings drilled during a preliminary study to evaluate site feasibility will not be adequate to develop geotechnical design recommendations for the project.

Do not rely on this report if your geotechnical engineer prepared it:
- for a different client;
- for a different project or purpose;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, the reliability of a geotechnical-engineering report can be affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying the recommendations in it. A minor amount of additional testing or analysis after the passage of time – if any is required at all – could prevent major problems.

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read the report in its entirety. Do not rely on an executive summary. Do not read selective elements only. *Read and refer to the report in full.*

You Need to Inform Your Geotechnical Engineer About Change

Your geotechnical engineer considered unique, project-specific factors when developing the scope of study behind this report and developing the confirmation-dependent recommendations the report conveys. Typical changes that could erode the reliability of this report include those that affect:
- the site's size or shape;
- the elevation, configuration, location, orientation, function or weight of the proposed structure and the desired performance criteria;
- the composition of the design team; or
- project ownership.

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

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

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

This Report's Recommendations Are Confirmation-Dependent

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

This Report Could Be Misinterpreted

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

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

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

Give Constructors a Complete Report and Guidance

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

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. This happens in part because soil and rock on project sites are typically heterogeneous and not manufactured materials with well-defined engineering properties like steel and concrete. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually provide environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures.* If you have not obtained your own environmental information about the project site, ask your geotechnical consultant for a recommendation on how to find environmental risk-management guidance.

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, the engineer's services were not designed, conducted, or intended to prevent migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration. Confront the risk of moisture infiltration*** by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***

GEOPROFESSIONAL
BUSINESS
ASSOCIATION

Telephone: 301/565-2733
e-mail: info@geoprofessional.org www.geoprofessional.org

GENERAL COMMENTS

BASIS OF GEOTECHNICAL REPORT

This report has been prepared in accordance with generally accepted geotechnical engineering practices to assist in the design and/or evaluation of this project. If the project plans, design criteria, and other project information referenced in this report and utilized by SME to prepare our recommendations are changed, the conclusions and recommendations contained in this report are not considered valid unless the changes are reviewed, and the conclusions and recommendations of this report are modified or approved in writing by our office.

The discussions and recommendations submitted in this report are based on the available project information, described in this report, and the geotechnical data obtained from the field exploration at the locations indicated in the report. Variations in the soil and groundwater conditions commonly occur between or away from sampling locations. The nature and extent of the variations may not become evident until the time of construction. If significant variations are observed during construction, SME should be contacted to reevaluate the recommendations of this report. SME should be retained to continue our services through construction to observe and evaluate the actual subsurface conditions relative to the recommendations made in this report.

In the process of obtaining and testing samples and preparing this report, procedures are followed that represent reasonable and accepted practice in the field of soil and foundation engineering. Specifically, field logs are prepared during the field exploration that describe field occurrences, sampling locations, and other information. Samples obtained in the field are frequently subjected to additional testing and reclassification in the laboratory and differences may exist between the field logs and the report logs. The engineer preparing the report reviews the field logs, laboratory classifications, and test data and then prepares the report logs. Our recommendations are based on the contents of the report logs and the information contained therein.

REVIEW OF DESIGN DETAILS, PLANS, AND SPECIFICATIONS

SME should be retained to review the design details, project plans, and specifications to verify those documents are consistent with the recommendations contained in this report.

REVIEW OF REPORT INFORMATION WITH PROJECT TEAM

Implementation of our recommendations may affect the design, construction, and performance of the proposed improvements, along with the potential inherent risks involved with the proposed construction. The client and key members of the design team, including SME, should discuss the issues covered in this report so that the issues are understood and applied in a manner consistent with the owner’s budget, tolerance of risk, and expectations for performance and maintenance.

FIELD VERIFICATION OF GEOTECHNICAL CONDITIONS

SME should be retained to verify the recommendations of this report are properly implemented during construction. This may avoid misinterpretation of our recommendations by other parties and will allow us to review and modify our recommendations if variations in the site subsurface conditions are encountered.

PROJECT INFORMATION FOR CONTRACTOR

This report and any future addenda or other reports regarding this site should be made available to prospective contractors prior to submitting their proposals for their information only and to supply them with facts relative to the subsurface evaluation and laboratory test results. If the selected contractor encounters subsurface conditions during construction, which differ from those presented in this report, the contractor should promptly describe the nature and extent of the differing conditions in writing and SME should be notified so that we can verify those conditions. The construction contract should include provisions for dealing with differing conditions and contingency funds should be reserved for potential problems during earthwork and foundation construction. We would be pleased to assist you in developing the contract provisions based on our experience.

The contractor should be prepared to handle environmental conditions encountered at this site, which may affect the excavation, removal, or disposal of soil; dewatering of excavations; and health and safety of workers. Any Environmental Assessment reports prepared for this site should be made available for review by bidders and the successful contractor.

THIRD PARTY RELIANCE/REUSE OF THIS REPORT

This report has been prepared solely for the use of our Client for the project specifically described in this report. This report cannot be relied upon by other parties not involved in the project, unless specifically allowed by SME in writing. SME also is not responsible for the interpretation by other parties of the geotechnical data and the recommendations provided herein.

LABORATORY TESTING PROCEDURES

VISUAL ENGINEERING CLASSIFICATION

Visual classification was performed on recovered samples. The appended General Notes and Unified Soil Classification System (USCS) sheets include a brief summary of the general method used visually classify the soil and assign an appropriate USCS group symbol. The estimated group symbol, according to the USCS, is shown in parentheses following the textural description of the various strata on the boring logs appended to this report. The soil descriptions developed from visual classifications are sometimes modified to reflect the results of laboratory testing.

MOISTURE CONTENT

Moisture content tests were performed by weighing samples from the field at their in-situ moisture condition. These samples were then dried at a constant temperature (approximately 110º C) overnight in an oven. After drying, the samples were weighed to determine the dry weight of the sample and the weight of the water that was expelled during drying. The moisture content of the specimen is expressed as a percent and is the weight of the water compared to the dry weight of the specimen.

HAND PENETROMETER TESTS

In the hand penetrometer test, the unconfined compressive strength of a cohesive soil sample is estimated by measuring the resistance of the sample to the penetration of a small calibrated, spring-loaded cylinder. The maximum capacity of the penetrometer is 4.5 tons per square-foot (tsf). Theoretically, the undrained shear strength of the cohesive sample is one-half the unconfined compressive strength. The undrained shear strength (based on the hand penetrometer test) presented on the boring logs is reported in units of kips per square-foot (ksf).

TORVANE SHEAR TESTS

In the Torvane test, the shear strength of a low strength, cohesive soil sample is estimated by measuring the resistance of the sample to a torque applied through vanes inserted into the sample. The undrained shear strength of the samples is measured from the maximum torque required to shear the sample and is reported in units of kips per square-foot (ksf).

LOSS-ON-IGNITION (ORGANIC CONTENT) TESTS

Loss-on-ignition (LOI) tests are conducted by first weighing the sample and then heating the sample to dry the moisture from the sample (in the same manner as determining the moisture content of the soil). The sample is then re-weighed to determine the dry weight and then heated for 4 hours in a muffle furnace at a high temperature (approximately 440º C). After cooling, the sample is re-weighed to calculate the amount of ash remaining, which in turn is used to determine the amount of organic matter burned from the original dry sample. The organic matter content of the specimen is expressed as a percent compared to the dry weight of the sample.

ATTERBERG LIMITS TESTS

Atterberg limits tests consist of two components. The plastic limit of a cohesive sample is determined by rolling the sample into a thread and the plastic limit is the moisture content where a 1/8-inch thread begins to crumble. The liquid limit is determined by placing a ½-inch thick soil pat into the liquid limits cup and using a grooving tool to divide the soil pat in half. The cup is then tapped on the base of the liquid limits device using a crank handle. The number of drops of the cup to close the gap formed by the grooving tool ½ inch is recorded along with the corresponding moisture content of the sample. This procedure is repeated several times at different moisture contents and a graph of moisture content and the corresponding number of blows is plotted. The liquid limit is defined as the moisture content at a nominal 25 drops of the cup. From this test, the plasticity index can be determined by subtracting the plastic limit from the liquid limit.

Passionate People Building
and Revitalizing our World

SME