Water Services Building Project

ADDENDUM NO. 2

Date: May 9, 2023

RE: Water Services Building Project Bid

BID DATE AND TIME:
Thursday, May 11, 2023 at 2:00 p.m. CST

Location for the bid opening remains the Shelby County Manager's Office, located at 200 West College Street, Room 123, Columbiana, Alabama, 35051

* * * * * * * * * * * * * * * * *

Project Manual, Plans and Specifications:

- See attached geotechnical report

Substitution Request:

- 23 5000 Heat Pump Indoor & Outdoor Units – 2.1, 2.2 - Manufacturers – Daikin Applied – APPROVED

Questions and Clarifications:

Q1. - There is currently no fire alarm system shown on the plans, but it is mentioned in the specs regarding connecting different systems to the fire alarm system. But, there is no fire alarm spec section. Please advise if there will be a required fire alarm system to be included in the bid. –
A1. - Fire Alarm is not required.

Q2. - I know it was discussed briefly in the Pre-Con, but please confirm that the access control system equipment (cameras, racks, monitors, etc.) will be furnished and installed by the county. Please confirm all that needs to be included in the bid is the conduit rough-in for these items. Also, are the card readers furnished and installed by the county as well?
A2. - The County will supply the cameras, racks and monitors. The contractor is responsible for the data conduits, cabling, and terminations on both ends. Access control system – card reader and associated access control door- contractor shall supply ¾" conduit from card reader, door frame and electric lock to above ceiling. – See detail "E-AC" on sheet E-3

Q3. - The ceramic tile specs call for Daltile Parkway Series tile in 9x12 and 6x6 sizes. This style of tile is only available in 12x12 and 12x24. Are we to price the available sizes in Daltile, or another similar tile from one of the listed manufacturers?
A3. - Price the available sizes from Daltile.

Q4. - Addendum No. 1 Pre-Bid Meeting Notes/Required Bid Proposal Contents reads that Proof of Competency of Bidders is required to be included in the bid envelope. Our understanding from the meeting is that we do not need to include this. Is it required?

A4. – This is NOT required.

Q5. - P1.0 Plumbing Floor Plan Non-pressure shows the sanitary line leaving the building at 112 Lobby. Utility Plan sheet 1 of 2 shows the sanitary leaving at 106 Office 6. Which is correct?
A5.- The correct location is 106 Office 6.

Q6. - P2.0 Plumbing Floor Plan Pressure shows the water line coming in at 124 Warehouse. Utility Plan sheet 1 of 2 shows the water coming in at 106 Office 6. Which is correct?
A6. – The correct location is 106 Office 6.

Q7. - Does the steel mezzanine structure at 125 Fenced Area need to be painted?
A7. – Yes painting will be required. (Sherwin Williams Pro Industrial Waterbased Alkyd Urethane Enamel)

Q8. - Does the gyp board above the plywood on the demising wall in 124 Warehouse need to be painted?
A8. – Yes

Q9. - Do 124 Warehouse floors need to be striped with hashed areas as shown on LF Life Safety FloorPlan? If so, please provide product specification.
A9. – No, the dashed line work in the plans represent the shelving by others.

Q10. - A8 Window, Door & Finish Schedules shows the reception window, but does not label the glass type. Spec Section 08 8000 Glazing Part 2.4.E. Bullet-Resisting Glass calls for it at Customer Service desks, but it was mentioned at the pre- bid meeting that bullet-resistant glass is not required. What glass type is needed at this location?
A10. – Bullet proof glass is not required this will need to be 1/4” thick tempered glass

Q11. - A8 Window, Door & Finish Schedules shows the reception window, but does not label the transaction surface. Is a counter required? If so, what material and dimensions are required?
A11. – A counter is required. This will need to be solid surface. Dimensions per detail on Sheet A8, reception window detail.

Q12. - Spec Section 10 2813 Part 3.2 lists Robe Hooks, but none are shown on the plans. Which doors need robe hooks?
A12. – No robe hooks are required.

Q13. - A9 shows shower rod and curtain, shower grab bars, and a shower seat. Spec Section 10 2813 Part 3.2 does not list any shower accessories. Are these accessories by owner or general contractor? If contractor, please provide spec section or product information.
A13. – The grab bars will need to be installed per building code and plans with blocking installed in the framing. The shower curtain rod, curtain and shower seat will be provided and installed by owner.

Q14. Note #1 on the Foundation Notes on sheet S1 references a Geotech report from Terracon ‘E1235030’ and states we are to follow the requirements within the recommendations section of the report. Will you send us a copy of this report?
A14. Please see attached geotechnical report. Note the owner performed grading work will address all fill and all footing excavation is expected to not extend below the required compacted fill material. The excavated soils required for footing installation shall be disposed of onsite on the south side of the property.

End of Addendum

Shelby County Water Services Building

Geotechnical Engineering Report

February 7, 2023 | Terracon Project No. E1235030

Prepared for:

Shelby County Development Services
1123 County Services Drive
County Services Building
Pelham, AL 35124

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February 7, 2023

Shelby County Development Services
1123 County Services Drive
County Services Building
Pelham, AL 35124

Attn: Trey Gauntt
Manager, Facilities and General Services
E: tgauntt@shelbyal.com

Re: Geotechnical Engineering Report
Shelby County Water Services Building
Westover, Shelby County, Alabama
Terracon Project No. E1235030

Dear Mr. Gauntt:

We have completed the scope of Geotechnical Engineering services for the above referenced project in general accordance with Terracon Proposal No. PE1235030 dated February 09, 2023. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design and construction of foundations, floor slabs and pavements for the proposed project.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report or if we may be of further service, please contact us.

Sincerely,

Terracon

Bryan C. Ritenour, P.E.	Sam Brancheau, P.E.
Senior Engineer	Project Engineer

Table of Contents

Figures

Attachments

Exploration and Testing Procedures
Site Location and Exploration Plans
Exploration and Laboratory Results
Supporting Information

Note: This report was originally delivered in a web-based format. **Blue Bold** text in the report indicates a referenced section heading. The PDF version also includes hyperlinks which direct the reader to that section and clicking on the Terracon logo will bring you back to this page. For more interactive features, please view your project online at **client.terracon.com**.

Refer to each individual Attachment for a listing of contents.

Introduction

This report presents the results of our subsurface exploration and Geotechnical Engineering services performed for the proposed Shelby Water Services Building to be located at 10927 US Hwy 280 in Westover, Shelby County, Alabama. The purpose of these services was to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil conditions
- Groundwater conditions
- Seismic site classification per IBC
- Site preparation and earthwork
- Foundation design and construction
- Floor slab design and construction
- Permanent Slopes
- Pavement design and construction

The geotechnical engineering Scope of Services for this project included the advancement of 5 test pits, laboratory testing, engineering analysis, and preparation of this report.

Drawings showing the site and test pit locations are shown on the **Site Location** and **Exploration Plan**, respectively. The results of the laboratory testing performed on soil samples obtained from the site during our field exploration are included on the test pit logs in the **Exploration Results** section.

Project Description

Our initial understanding of the project was provided in our proposal and was discussed during project planning. A period of collaboration has transpired since the project was initiated, and our final understanding of the project conditions is as follows:

Item	Description
Information Provided	The site location and layout were provided by Mr. Trey Guantt via email.
Project Description	The project will consist of a new office/warehouse facility for Shelby County Water Services. The new building will be one-story and have a footprint measuring 180' x 75'. New paved parking is planned along the east side of the new building.

Item	Description
Building Construction	Pre-engineered metal building, concrete slab on grade, some brick veneer
Finished Floor Elevation	El. 475.75
Maximum Loads	▪ Walls: 2 to 3 kips per linear foot (klf) ▪ Columns: 50 kips
Grading	A furnished topographic map and finished floor elevation indicates that up to about 8 feet of fill will be required to raise the existing grades to the final site grades.
Below-Grade Structures	None
Free-Standing Retaining Walls	None
Slopes	Based on the existing site grades and the new finished floor elevation, permanent slope up to about 7 feet in height will be required.
Pavements	New asphalt paved parking and drive

Terracon should be notified if any of the above information is inconsistent with the planned construction, especially the grading limits, as modifications to our recommendations may be necessary.

Site Conditions

The following description of site conditions is derived from our site visit in association with the field exploration and our review of publicly available geologic and topographic maps.

Item	Description
Parcel Information	The project site is located at the existing Shelby County Water Services facility at 10927 US Hwy 280 in Westover, AL. Latitude/Longitude (approximate) 33.3508° N, 86.5309° W (See **Site Location**)
Existing Improvements	The site of the new building is currently grassed covered with sparse trees. A portion of the new entrance drive alignment is currently the existing asphalt paved entrance drive.

Item	Description
Current Ground Cover	Grass and asphalt pavement
Existing Topography	Gently sloping from about El 475 to El 468
Local Geology	Published maps indicate the site is underlain by the Parkwood and Floyd Shale undifferentiated, which consists of shale with thin beds of sandstone and limestone.

Geotechnical Characterization

We have developed a general characterization of the subsurface conditions based upon our review of the subsurface exploration, laboratory data, geologic setting and our understanding of the project. This characterization, termed GeoModel, forms the basis of our geotechnical calculations and evaluation of the site. Conditions observed at each exploration point are indicated on the individual logs. The individual logs can be found in the **Exploration Results** and the GeoModel can be found in the **Figures** attachment of this report.

As part of our analyses, we identified the following model layers within the subsurface profile. For a more detailed view of the model layer depths at each test pit location, refer to the GeoModel.

Model Layer	Layer Name	General Description
1	**Surface Layer**	Topsoil: 8 to 12 inches at the test pit locations
2	**Native Soft Lean Clay (CL)**	Typically, brown to yellowish brown, very soft to soft
3	**Native Medium Stiff To Hard Lean Clay (CL) to at Clay (CH)**	Typically, yellowish brown or brown, appears medium stiff to hard
4	**Weathered Shale**	Brown and gray, thinly bedded

Short term groundwater observations were made during and shortly after the excavation process. The following table shows the groundwater conditions at each test pit during field exploration.

Test Pit No.	Groundwater During Excavation	Groundwater After Specified Time
1	None Observed	Seepage At 3' After 1 Hour
2	None Observed	Seepage at 3' After 1 hour
3	None Observed	Seepage at 3' After 40 Minutes
4	None Observed	Seepage at 4' After 15 Minutes
5	Seepage at 3' During Excavation	Test Pit Backfilled Upon Completion

Groundwater conditions may be different at the time of construction. Groundwater conditions may change because of seasonal variations in rainfall, runoff, and other conditions not apparent at the time of excavation. Long-term groundwater monitoring was outside the scope of services for this project. However, contractors should be prepared to dewater undercut excavations during fill placement.

Seismic Site Class

The seismic design requirements for buildings and other structures are based on Seismic Design Category. Site Classification is required to determine the Seismic Design Category for a structure. The Site Classification is based on the upper 100 feet of the site profile defined by a weighted average value of either shear wave velocity, standard penetration resistance, or undrained shear strength in accordance with Section 20.4 of ASCE 7 and the International Building Code (IBC). Based on the soil/bedrock properties observed at the site and as described on the exploration logs and results, our professional opinion is for that a **Seismic Site Classification of C** be considered for the project. Subsurface explorations at this site were extended to a maximum depth of about 9 feet. The site properties below the test pit depth to 100 feet were estimated based on our experience and knowledge of geologic conditions of the general area. Additional deeper borings or geophysical testing could be performed to confirm the conditions below the current test pit depth.

Geotechnical Overview

The site can be made suitable for the proposed construction based upon geotechnical conditions encountered in the test pits, provided that the undercutting and replacement of the soft soils is performed in accordance with the recommendations provided in this report.

Beneath topsoil, which measured from about 8 to 12 thick, native soils consisting of lean-to fat clay were encountered by the test pits. The native soils at test pits TP-1 and TP-2 were medium stiff to stiff to a depth of about 2 feet, and then they became stiff to hard. The native soils at test pits TP-3, TP-4, and TP-5 were very soft to soft to a depth of about 3 feet, and then they became medium stiff to hard.

Weathered shale was encountered at all of the test pit locations beneath the native soils at depths ranging from about 5 to 9 feet below the surface. The shale became less weathered and harder with depth.

Due to the very soft to soft nature of upper 2 to 3 feet of native soil encountered in test pits TP-5, TP-4, and TP-5, we recommend that the very soft to soft native soils be removed and replaced with new engineered fill beneath the proposed building and permanent fill slopes. The undercut should extend to at least 10 feet beyond the limits of the building and 5 feet beyond the toe of the fill slopes. The low plasticity lean clay (CL) undercut material that is free of organics and debris may reused as engineered fill. However, significant moisture conditioning (i.e., drying) will likely be required for proper compaction. The fat clay (CH) should not be reused as engineered fill.

Due to the potential for encountering shallow perched water or the groundwater table, and the depth required to undercut the soft soils, contractors should be prepared to dewater the undercut excavations prior to placing new engineered fill. Dewatering will likely require pumping from one or more temporary sumps within the bottom of the excavation. Temporary or permanent underdrains and/or blanket drains could also be required. An initial lift of crushed aggregate (e.g. ALDOT No. 2 stone and/or ALDOT No. 57 stone) and separation geotextile may be required to provide a stable platform above the encountered water levels for engineered fill placement. Temporary or permanent underdrains may be required to control groundwater during the undercut and fill placement operations. Temporary undercut excavations will need to be sloped and/or benched to meet OSHA requirements. Depending upon site and weather conditions at the time of earthwork operations, we caution that significant construction delays could be incurred during undercutting and replacement. The soft soils undercut will likely be saturated and would not be suitable for proper compaction without significant drying.

The new building may be supported on a conventional shallow foundation system bearing in new engineered fill, or suitable native soils following the complete undercutting and replacement of all very soft to soft native soils. Undercut depths of up to 4 feet should be anticipated based on the results of our test pits. Shallow foundation design and construction recommendations are presented in Shallow Foundations.

The near surface soils could become unstable with typical earthwork and construction traffic, especially after precipitation events. The effective drainage should be completed early in the construction sequence and maintained after construction to avoid potential issues. If possible, the grading should be performed during the warmer and drier times of the year. If grading is performed during the winter months, an increased risk for possible undercutting and replacement of unstable subgrade will persist. Additional site preparation recommendations, including subgrade improvement and fill placement, are provided in the **Earthwork** section.

Our opinion of pavement section thickness design has been developed based on our understanding of the intended use, provided traffic, and subgrade preparation recommended herein with consideration to local practice. The **Pavements** section includes minimum pavement component thickness.

The recommendations contained in this report are based upon the results of field and laboratory testing (presented in the **Exploration Results**), engineering analyses, and our current understanding of the proposed project. The **General Comments** section provides an understanding of the report limitations.

Earthwork

Earthwork is anticipated to include clearing and grubbing, excavations, and engineered fill placement. The following sections provide recommendations for use in the preparation of specifications for the work. Recommendations include critical quality criteria, as necessary, to render the site in the state considered in our geotechnical engineering evaluation for foundations, floor slabs, and pavements.

Site Preparation

After removal of the vegetation from the area of the proposed building and new fill slope areas , we recommend that the very soft to soft native soils be removed and replaced with new engineered fill. The undercut should extend to at least 10 feet beyond the limits of the building and 5 feet beyond the toe of the fill slopes. Following the undercutting, the newly exposed subgrade should be evaluated by the Geotechnical Engineer. Evaluations could include proofrolling with a loaded dump truck, if possible, or probing with a steel rod. Areas excessively deflecting under the proofroll should be delineated and subsequently addressed by the Geotechnical Engineer. Such areas should either be removed, further densified in place, or stabilized by other methods discussed in the following sections, depending on site and weather conditions. Excessively wet or dry material should either be removed or moisture conditioned and recompacted. Compacted structural fill soils should then be placed to the proposed design grade and the moisture content and compaction of subgrade soils should be maintained until foundation or pavement construction.

The proposed parking and drive areas appear to overlap the areas of the existing entrance drive. The existing entrance drive appears in good condition and stable. However, where proposed pavements are underlain by the soft native soils, undercutting and/or stabilization of the subgrade will be required prior to fill placement. In paved areas, the exposed subgrade after stripping should be evaluated by proof-rolling under the direction of the Geotechnical Engineer. Due to the presence of soft native soils, stabilization measures will likely be required prior to fill placement. If the County wishes to limit the undercutting, stabilization could consist of a layer of biaxial geogrid (such as Tensar BX 1200, or approved equivalent). A minimum 12-inch layer of crushed aggregate (open-graded crushed stone, dense-graded aggregate base, or concrete crushed to a similar gradation) should be placed and compacted above the geogrid. Depending on the final grades, some undercutting will likely be required prior to placement of the geogrid to achieve the minimum cover of crushed aggregate. The actual extent of any undercut and stabilization should be determined based on the Geotechnical Engineer's evaluation (i.e., proof-rolling) at the time of construction.

Based upon the subsurface conditions determined from the geotechnical exploration, the workability of the subgrade soils may be affected by groundwater seepage, precipitation, repetitive construction traffic or other factors. If unworkable conditions develop, workability may be improved by scarifying and drying.

Excavation

We anticipate that excavations into the soft to hard native soils can be accomplished with conventional earthmoving equipment. However, excavations into the underlying weathered to sound shale bedrock would require hammering devices attached to large excavators. The bottom of excavations should be thoroughly cleaned of loose soils and disturbed materials prior to backfill placement and/or construction.

Fill Material Types

Fill required to achieve design grade should be classified as structural fill. Structural fill is material used below, or within 10 feet of structures, pavements or constructed slopes.

Reuse of On-Site Soil: Excavated on-site soil may be selectively reused as fill. Material property requirements for on-site soil for use as structural fill are noted in the table below:

Property	Structural Fill
Composition	Free of deleterious material
Maximum particle size	4 inches
Fines content	Not limited
Plasticity	Liquid Limit less than 50 Plasticity index less than 25

Property	Structural Fill
GeoModel Layer Expected to be Suitable[1]	Lean clays (CL) in model layer 2 and 3

1. Lean clays undercut from Geomodel Layer 2 may be reused if free from organics. However, significant drying would be required to achieve a proper moisture content for compaction.

Imported Fill Materials: Imported fill materials should meet the following material property requirements. Regardless of its source, compacted fill should consist of approved materials that are free of organic matter and debris. Frozen material should not be used, and fill should not be placed on a frozen subgrade.

Soil Type [1]	USCS Classification	Acceptable Parameters (for Structural Fill)
Low Plasticity Cohesive	CL, CL-ML ML, SM, SC	Liquid Limit less than 50 Plasticity index less than 25
Granular	GW, GP, GM, GC, SW, SP, SM, SC	Less than 50% passing No. 200 sieve

1. Structural fill should consist of approved materials free of organic matter and debris. Frozen material should not be used, and fill should not be placed on a frozen subgrade. A sample of each material type should be submitted to the Geotechnical Engineer for evaluation prior to use on this site. Additional geotechnical consultation should be provided prior to use of uniformly graded gravel on the site.

Fill Placement and Compaction Requirements

Structural fill should meet the following compaction requirements.

Item	Structural Fill
Maximum Lift Thickness	8 inches or less in loose thickness when heavy, self-propelled compaction equipment is used 4 to 6 inches in loose thickness when hand-guided equipment (i.e. jumping jack or plate compactor) is used
Minimum Compaction Requirements [1]	98% of max.
Water Content Range [1]	Low plasticity cohesive: -2% to +2% of optimum Granular: -3% to +3% of optimum

Item	Structural Fill

1. Maximum density and optimum water content as determined by the standard Proctor test (ASTM D 698).

Utility Trench Backfill

Any soft or unsuitable materials encountered at the bottom of utility trench excavations should be removed and replaced with structural fill or bedding material in accordance with public works specifications for the utilities. This recommendation is particularly applicable to utility work requiring grade control and/or in areas where subsequent grade raising could cause settlement in the subgrade supporting the utility. Trench excavation should not be conducted below a downward 1:1 projection from existing foundations without engineering review of shoring requirements and geotechnical observation during construction.

On-site materials are considered suitable for backfill of utility and pipe trenches, provided the material is free of organic matter and deleterious substances. However, material used as trench backfill should comply with the pipe manufacturer or governing municipality's requirements.

Trench backfill should be mechanically placed and compacted as discussed earlier in this report. Compaction of initial lifts should be accomplished with hand-operated tampers or other lightweight compactors. Where trenches are placed beneath slabs, footings, or pavements, the backfill should satisfy the gradation requirements of engineered fill discussed in this report. Flooding or jetting for placement and compaction of backfill is not recommended.

Grading and Drainage

All grades must provide effective drainage away from the building during and after construction and should be maintained throughout the life of the structure. Water retained next to the building can result in soil movements greater than those discussed in this report. Greater movements can result in unacceptable differential floor slab and/or foundation movements, cracked slabs and walls, and roof leaks. In areas where hardscapes and/or paving do not abut against the structure, the roof should have gutters/drains with downspouts that discharge onto splash blocks at a distance of at least 10 feet from the building.

Exposed ground should be sloped and maintained at a minimum 5% away from the building for at least 10 feet beyond the perimeter of the building. Locally, flatter grades may be necessary to transition ADA access requirements for flatwork. After building construction and landscaping have been completed, final grades should be verified to document effective drainage has been achieved. Grades around the structure should also be periodically inspected and adjusted, as necessary, as part of the structure's maintenance program. Where paving or flatwork abuts the structure, a maintenance program should be established to effectively seal and maintain joints and prevent surface water infiltration.

Earthwork Construction Considerations

Shallow excavations for the proposed structure are anticipated to be accomplished with conventional construction equipment. Upon completion of filling and grading, care should be taken to maintain the subgrade water content prior to construction of grade-supported improvements such as floor slabs and pavements. Construction traffic over the completed subgrades should be avoided. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. Water collecting over or adjacent to construction areas should be removed. If the subgrade freezes, desiccates, saturates, or is disturbed, the affected material should be removed, or the materials should be scarified, moisture conditioned, and recompacted prior to floor slab construction.

As a minimum, excavations should be performed in accordance with OSHA 29 CFR, Part 1926, Subpart P, "Excavations" and its appendices, and in accordance with any applicable local and/or state regulations.

Construction site safety is the sole responsibility of the contractor who controls the means, methods, and sequencing of construction operations. Under no circumstances shall the information provided herein be interpreted to mean Terracon is assuming responsibility for construction site safety or the contractor's activities; such responsibility shall neither be implied nor inferred.

Construction Observation and Testing

The earthwork efforts should be observed by the Geotechnical Engineer (or others under their direction). Observation should include documentation of adequate removal of surficial materials (vegetation, topsoil, and pavements), evaluation of undercutting, as well as proofrolling and mitigation of unsuitable areas delineated by the proofroll.

Each lift of compacted fill should be tested, evaluated, and reworked, as necessary, as recommended by the Geotechnical Engineer prior to placement of additional lifts. Each lift of fill should be tested for density and water content at a frequency of at least one test for every 2,500 square feet of compacted fill in the building areas and 5,000 square feet in pavement areas. Where not specified by local ordinance, one density and water content test should be performed for every 50 linear feet of compacted utility trench backfill and a minimum of one test performed for every 12 vertical inches of compacted backfill.

In areas of foundation excavations, the bearing subgrade should be evaluated by the Geotechnical Engineer. If unanticipated conditions are observed, the Geotechnical Engineer should prescribe mitigation options.

In addition to the documentation of the essential parameters necessary for construction, the continuation of the Geotechnical Engineer into the construction phase of the project provides the continuity to maintain the Geotechnical Engineer's evaluation of subsurface conditions, including assessing variations and associated design changes.

Shallow Foundations

If the site has been prepared in accordance with the requirements noted in **Earthwork**, the following design parameters are applicable for shallow foundations.

Design Parameters – Compressive Loads

Item	Description
Maximum Net Allowable Bearing Pressure [1, 2]	2,500 psf - foundations bearing upon new structural fill after removal of the soft native soils or medium stiff to hard low plasticity native soils.
Required Bearing Stratum [3]	GeoModel Layer 3 or new structural fill installed after undercutting of soft soils
Minimum Foundation Dimensions	Per IBC 1809.7
Ultimate Passive Resistance[4] **(Equivalent fluid pressures)**	330 pcf (cohesive backfill) 460 pcf (crushed stone)
Sliding Resistance [5]	0.30 ultimate coefficient of friction – onsite soil or structural fill 0.35 ultimate coefficient of friction - granular material
Minimum Embedment below Finished Grade [6]	18 inches
Estimated Total Settlement from Structural Loads [2]	Less than about 1 inch
Estimated Differential Settlement [2, 7]	About 1/2 of total settlement

1. The maximum net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. Values assume that exterior grades are no steeper than 20% within 10 feet of structure.

2. Values provided are for maximum loads noted in **Project Description**. Additional geotechnical consultation will be necessary if higher loads are anticipated.
3. Unsuitable or soft soils should be overexcavated and replaced per the recommendations presented in **Earthwork**.
4. Use of passive earth pressures require the sides of the excavation for the spread footing foundation to be nearly vertical and the concrete placed neat against these vertical faces or that the footing forms be removed and compacted structural fill be placed against the vertical footing face. Assumes no hydrostatic pressure. Apply a factor of safety of at least 1.5 when designing for lateral force resistance.
5. Can be used to compute sliding resistance where foundations are placed on suitable soil/materials. Frictional resistance for granular materials is dependent on the bearing pressure which may vary due to load combinations.
6. Embedment necessary to minimize the effects of frost and/or seasonal water content variations. For sloping ground, maintain depth below the lowest adjacent exterior grade within 5 horizontal feet of the structure.
7. Differential settlements are noted for equivalent-loaded foundations and bearing elevation as measured over a span of 50 feet.

Design Parameters – Overturning and Uplift Loads

Shallow foundations subjected to overturning loads should be proportioned such that the resultant eccentricity is maintained in the center-third of the foundation (e.g., $e < b/6$, where b is the foundation width). This requirement is intended to keep the entire foundation area in compression during the extreme lateral/overturning load event. Foundation oversizing may be required to satisfy this condition.

Uplift resistance of spread footings can be developed from the effective weight of the footing and the overlying soils with consideration to the IBC basic load combinations.

Item	Description
Soil Moist Unit Weight	120 pcf
Soil Effective Unit Weight[1]	58 pcf
Soil weight included in uplift resistance	Soil included within the prism extending up from the top perimeter of the footing at an angle of 20 degrees from vertical to ground surface

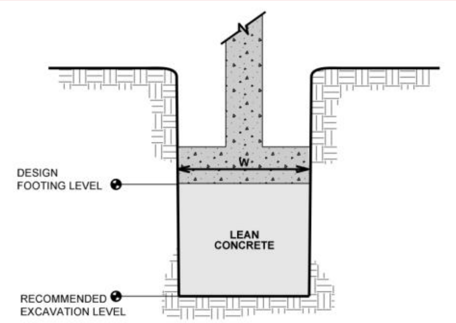
1. Effective (or buoyant) unit weight should be used for soil above the foundation level and below a water level. The high groundwater level should be used in uplift design as applicable.

Foundation Construction Considerations

As noted in **Earthwork**, the footing excavations should be evaluated under the observation of the Geotechnical Engineer. The base of all foundation excavations should be free of water and loose soil, prior to placing concrete. Concrete should be placed soon after excavating to reduce bearing soil disturbance. Care should be taken to prevent wetting or drying of the bearing materials during construction. Excessively wet or dry material or any loose/disturbed material in the bottom of the footing excavations should be removed/reconditioned before foundation concrete is placed.

Sensitive soils exposed at the surface of footing excavations may require surficial compaction with hand-held dynamic compaction equipment prior to placing structural fill, steel, and/or concrete. Should surficial compaction not be adequate, construction of a working surface consisting of either crushed stone or a lean concrete mud mat may be required prior to the placement of reinforcing steel and construction of foundations.

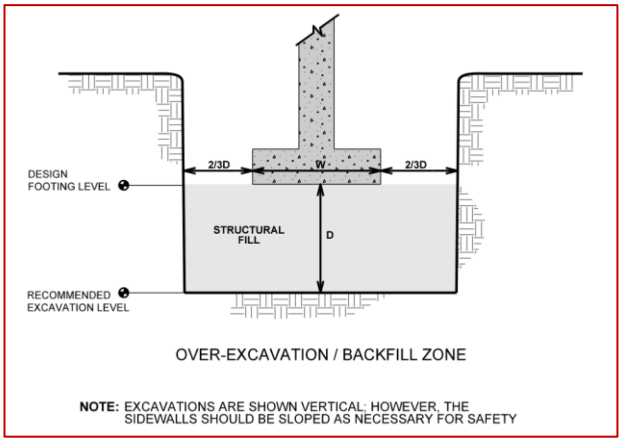
If unsuitable bearing soils are observed at the base of the planned footing excavation, the excavation should be extended deeper to suitable soils, and the footings could bear directly on these soils at the lower level or on lean concrete backfill placed in the excavations. The lean concrete replacement zone is illustrated on the sketch below.



LEAN CONCRETE BACKFILL

NOTE: EXCAVATIONS ARE SHOWN VERTICAL; HOWEVER, THE SIDEWALLS SHOULD BE SLOPED AS NECESSARY FOR SAFETY

Overexcavation for structural fill placement below footings should be conducted as shown below. The overexcavation should be backfilled up to the footing base elevation, with structural fill placed, as recommended in the **Earthwork** section.



Floor Slabs

Design parameters for floor slabs assume the requirements for **Earthwork** have been followed. Specific attention should be given to positive drainage away from the structure and positive drainage of the aggregate base beneath the floor slab.

The soft native soils should be undercut and replaced with structural fill.

Floor Slab Design Parameters

Item	Description
Floor Slab Support[1]	Minimum 4 inches base course meeting material specifications of ACI 302 Subgrade compacted to recommendations in **Earthwork**
Estimated Modulus of Subgrade Reaction [2]	100 pounds per square inch per inch (psi/in) for point loads

1. Floor slabs should be structurally independent of building footings or walls to reduce the possibility of floor slab cracking caused by differential movements between the slab and foundation.
2. Modulus of subgrade reaction is an estimated value based upon our experience with the subgrade condition, the requirements noted in **Earthwork**, and the floor slab support as noted in this table. It is provided for point loads. For large area loads the modulus of subgrade reaction would be lower.

The use of a vapor retarder should be considered beneath concrete slabs on grade covered with wood, tile, carpet, or other moisture sensitive or impervious coverings, when the project includes humidity-controlled areas, or when the slab will support equipment sensitive to moisture. When conditions warrant the use of a vapor retarder, the slab designer should refer to ACI 302 and/or ACI 360 for procedures and cautions regarding the use and placement of a vapor retarder.

Saw-cut contraction joints should be placed in the slab to help control the location and extent of cracking. For additional recommendations, refer to the ACI Design Manual. Joints or cracks should be sealed with a waterproof, non-extruding compressible compound specifically recommended for heavy duty concrete pavement and wet environments.

Where floor slabs are tied to perimeter walls or turn-down slabs to meet structural or other construction objectives, our experience indicates differential movement between the walls and slabs will likely be observed in adjacent slab expansion joints or floor slab cracks beyond the length of the structural dowels. The Structural Engineer should account for potential differential settlement through use of sufficient control joints, appropriate reinforcing or other means.

Floor Slab Construction Considerations

Finished subgrade, within and for at least 10 feet beyond the floor slab, should be protected from traffic, rutting, or other disturbance and maintained in a relatively moist condition until floor slabs are constructed. If the subgrade should become damaged or desiccated prior to construction of floor slabs, the affected material should be removed, and structural fill should be added to replace the resulting excavation. Final conditioning of the finished subgrade should be performed immediately prior to placement of the floor slab support course.

The Geotechnical Engineer should observe the condition of the floor slab subgrades immediately prior to placement of the floor slab support course, reinforcing steel, and concrete. Attention should be paid to high traffic areas that were rutted and disturbed earlier, and to areas where backfilled trenches are located.

Permanent Slopes

Based on the site topography and finished floor elevation, we anticipate fill slopes to be 7 feet or less in height. We recommend that slopes composed of engineered fill soils be graded at a maximum steepness of 2.5(H):1.0(V). Flatter slopes may be required for maintenance equipment such as tractors and mowers. Buildings should be at least 10 feet from the crest of the slope, and pavements or curbs should be at least 3 feet from the crest of the slopes.

Regular maintenance should be anticipated to identify and address changes in natural drainage creating potential for soil creep or erosion near improvements. The maintenance program should include replacing or replanting trees and grasses, as necessary, and grading the slope to reduce soil creep and erosion. If future surficial slope erosion occurs near the crest of slopes, we recommend the slope face be restored as soon as practical. Positive drainage should be maintained at the top and bottom of all slopes.

Fill slopes should be re-vegetated as soon as possible after grading and protected from erosion until vegetation is established. Slope planting should consist of ground cover, shrubs, and trees possessing deep, dense root structures that require minimum irrigation. It is the responsibility of the owner to maintain such planting.

Pavements

General Pavement Comments

Pavement designs are provided for the traffic conditions and pavement life conditions as noted in **Project Description** and in the following sections of this report. A critical aspect of pavement performance is site preparation. Pavement designs noted in this section must be applied to the site which has been prepared as recommended in the **Earthwork** section.

Pavement Design Parameters

The pavement design parameters were empirically derived based upon our experience with similar subgrade soils and our expectation of the quality of the subgrade as prescribed by the **Site Preparation** conditions as outlined in **Earthwork**. A modulus of rupture of 580 psi was used in design for the concrete (based on correlations with a minimum 28-day compressive strength of 4,000 psi).

Pavement Section Thicknesses

The following table provides our opinion of minimum thickness for AC sections:

Asphaltic Concrete Design

Layer	Thickness (inches)	
	Light Duty [1]	Heavy Duty [1]
AC Wearing Surface [2, 3]	1.0	1.5
AC Binder [2]	2.0	2.5

Asphaltic Concrete Design

Layer	Thickness (inches)	
	Light Duty [1]	Heavy Duty [1]
Aggregate Base [2]	6.0	8.0

1. Minimum thicknesses provided by Shelby County Development Services.
2. All materials should meet the current Alabama Department of Transportation (ALDOT) Standard Specifications for Highway Construction.
   - Asphaltic Surface - ALDOT 424A Superpave Bituminous Concrete Wearing Surface Layer, 3/8 inch maximum aggregate size mix
   - Asphaltic Base - ALDOT 424B Superpave Bituminous Concrete Upper Binder Layer, ¾ inch maximum aggregate size mix
   - Aggregate Base – ALDOT 825B Dense Graded Aggregate Base, compacted to 100% of the modified Proctor
3. A minimum 1.0-inch surface course should be used on ACC pavements.

The following table provides our estimated minimum thickness of PCC pavements.

Portland Cement Concrete Design

Layer	Thickness (inches)	
	Light Duty [1]	Heavy Duty [1] And Dumpster Pad
PCC	5.0	6.0
Aggregate Base	4.0	4.0

1. All materials should meet Section 450 of the Alabama Department of Transportation (ALDOT) Standard Specifications for Highway Construction.

Areas for parking of heavy vehicles, concentrated turn areas, and start/stop maneuvers could require thicker pavement sections. Edge restraints (i.e. concrete curbs or aggregate shoulders) should be planned along curves and areas of maneuvering vehicles.

Although not required for structural support, a minimum 4-inch thick base course layer is recommended to help reduce potential for slab curl, shrinkage cracking, and subgrade pumping through joints. Proper joint spacing will also be required to prevent excessive slab curling and shrinkage cracking. Joints should be sealed to prevent entry of foreign material and doweled where necessary for load transfer. PCC pavement details for joint spacing, joint reinforcement, and joint sealing should be prepared in accordance with ACI 330 and ACI 325.

Where practical, we recommend early-entry cutting of crack-control joints in PCC pavements. Cutting of the concrete in its "green" state typically reduces the potential for micro-cracking of the pavements prior to the crack control joints being formed, compared to cutting the joints after the concrete has fully set. Micro-cracking of pavements may lead to crack formation in locations other than the sawed joints, and/or reduction of fatigue life of the pavement.

Openings in pavements, such as decorative landscaped areas, are sources for water infiltration into surrounding pavement systems. Water can collect in the islands and migrate into the surrounding subgrade soils thereby degrading support of the pavement. Islands with raised concrete curbs, irrigated foliage, and low permeability near-surface soils are particular areas of concern. To reduce the risk of excess water migrating into the surrounding subgrade, the curb and gutter could be placed directly on the cohesive soil subgrade rather than on the unbound granular base course.

Pavement Drainage

Pavements should be sloped to provide rapid drainage of surface water. Water allowed to pond on or adjacent to the pavements could saturate the subgrade and contribute to premature pavement deterioration. In addition, the pavement subgrade should be graded to provide positive drainage within the granular base section.

Pavement Maintenance

The pavement sections represent minimum recommended thicknesses and, as such, periodic upkeep should be anticipated. Preventive maintenance should be planned and provided for through an on-going pavement management program. Maintenance activities are intended to slow the rate of pavement deterioration and to preserve the pavement investment. Pavement care consists of both localized (e.g., crack and joint sealing and patching) and global maintenance (e.g., surface sealing). Additional engineering consultation is recommended to determine the type and extent of a cost-effective program. Even with periodic maintenance, some movements and related cracking may still occur, and repairs may be required.

Pavement performance is affected by its surroundings. In addition to providing preventive maintenance, the civil engineer should consider the following recommendations in the design and layout of pavements:

- Final grade adjacent to paved areas should slope down from the edges at a minimum 2%.

- Subgrade and pavement surfaces should have a minimum 2% slope to promote proper surface drainage, unless flatter slopes are required for ADA compliance.
- Install joint sealant and seal cracks immediately.
- Seal all landscaped areas in or adjacent to pavements to reduce moisture migration to subgrade soils.
- Place compacted, low permeability backfill against the exterior side of curb and gutter.

Place curb, gutter and/or sidewalk directly on cohesive subgrade soils rather than on unbound granular base course materials.

General Comments

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Variations will occur between exploration point locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer, where noted in this report, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our Scope of Services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

Our services and any correspondence are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third-party beneficiaries intended. Any third-party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

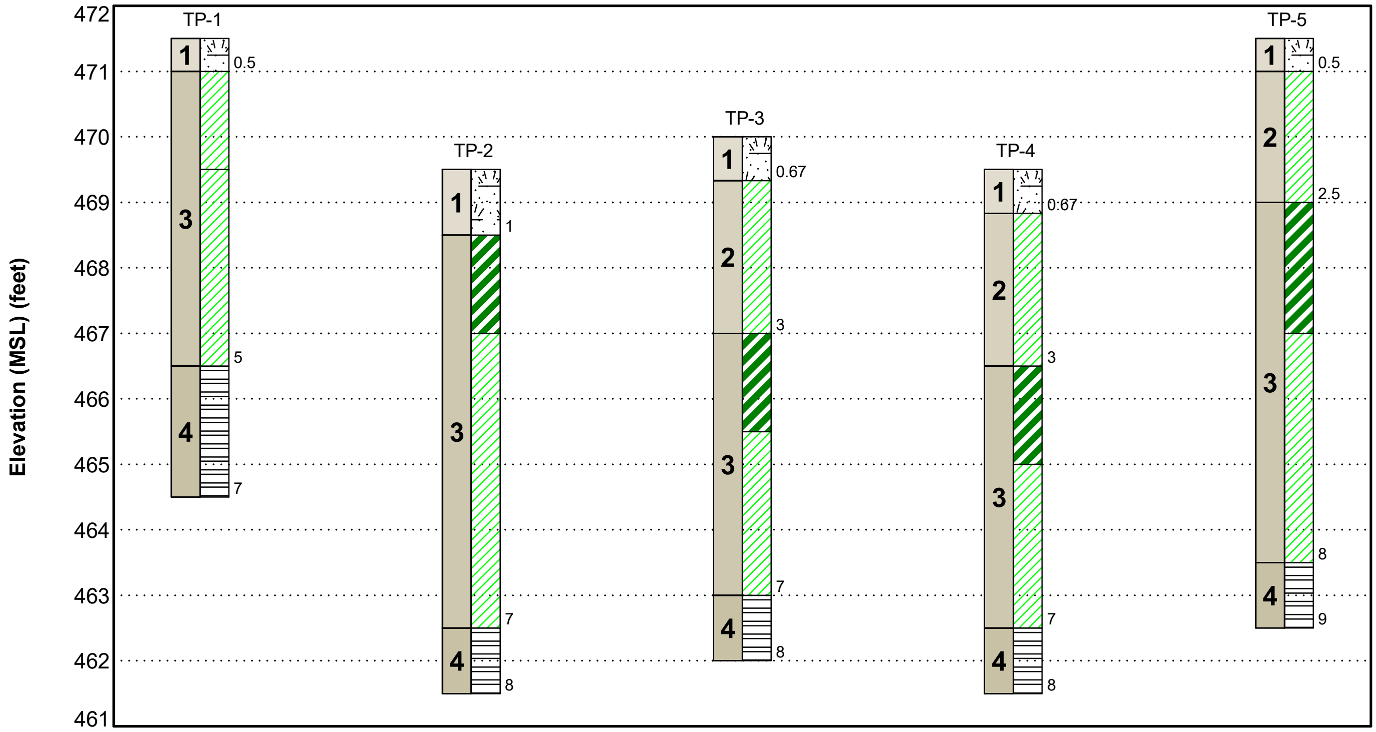
Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly effect excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety and cost estimating including excavation support and dewatering requirements/design are the responsibility of others. Construction and site development have the potential to affect adjacent properties. Such impacts can include damages due to vibration, modification of groundwater/surface water flow during construction, foundation movement due to undermining or subsidence from excavation, as well as noise or air quality concerns. Evaluation of these items on nearby properties are commonly associated with contractor means and methods and are not addressed in this report. The owner and contractor should consider a preconstruction/precondition survey of surrounding development. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

Figures

Contents:

2147 Riverchase Office Rd
Birmingham, AL

GeoModel



This is not a cross section. This is intended to display the Geotechnical Model only. See individual logs for more detailed conditions.

Model Layer	Layer Name	General Description
1	**Surface Layer**	Topsoil (8 inches to 12 inches)
2	**Native Soft Lean Clay**	Typically, brown to yellowish brown, very soft to soft
3	**Native Medium Stiff to Hard Lean Clay (CL) to Fat Clay (CH)**	Typically, yellowish brown or brown, appears medium stiff to hard
4	**Weathered Shale**	Typically, brown with gray and thinly bedded

LEGEND

- Topsoil
- Fat Clay
- Lean Clay
- Shale

NOTES:
Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project.
Numbers adjacent to soil column indicate depth below ground surface.

Attachments

Exploration and Testing Procedures

Field Exploration

Number of Test pits	Approximate Test pit Depth (feet)	Location
5	7 to 9	building

Test pit Layout and Elevations: Terracon personnel provided the test pit layout using measurements from existing site features. If a more precise test pit layout and elevations are desired, we recommend test pits be surveyed.

Subsurface Exploration Procedures: The test pits were advanced by Shelby County using a large track mounted excavator. For safety purposes, all test pits were backfilled with excavated material after their completion.

We also observed the test pits while excavating and at the completion of excavation for the presence of groundwater. The groundwater levels are shown on the attached test pit logs.

The sampling depths, penetration distances, and other sampling information was recorded on the field test pit logs. The samples were placed in appropriate containers and taken to our soil laboratory for testing and classification by a Geotechnical Engineer. Our exploration team prepared field test pit logs as part of the excavation operations. These field logs included visual classifications of the materials observed during excavation and our interpretation of the subsurface conditions between samples. Final test pit logs were prepared from the field logs. The final test pit logs represent the Geotechnical Engineer's interpretation of the field logs and include modifications based on observations and tests of the samples in our laboratory.

Laboratory Testing

The project engineer reviewed the field data and assigned laboratory tests. The laboratory testing program included the following types of tests:

- Moisture Content
- Atterberg Limits

The laboratory testing program often included examination of soil samples by an engineer. Based on the results of our field and laboratory programs, we described and classified the soil samples in accordance with the Unified Soil Classification System.

Site Location and Exploration Plans

Contents:

Site Location Plan
Exploration Plan

Note: All attachments are one page unless noted above.

Site Location

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES MAP PROVIDED BY MICROSOFT BING MAPS

Exploration Plan

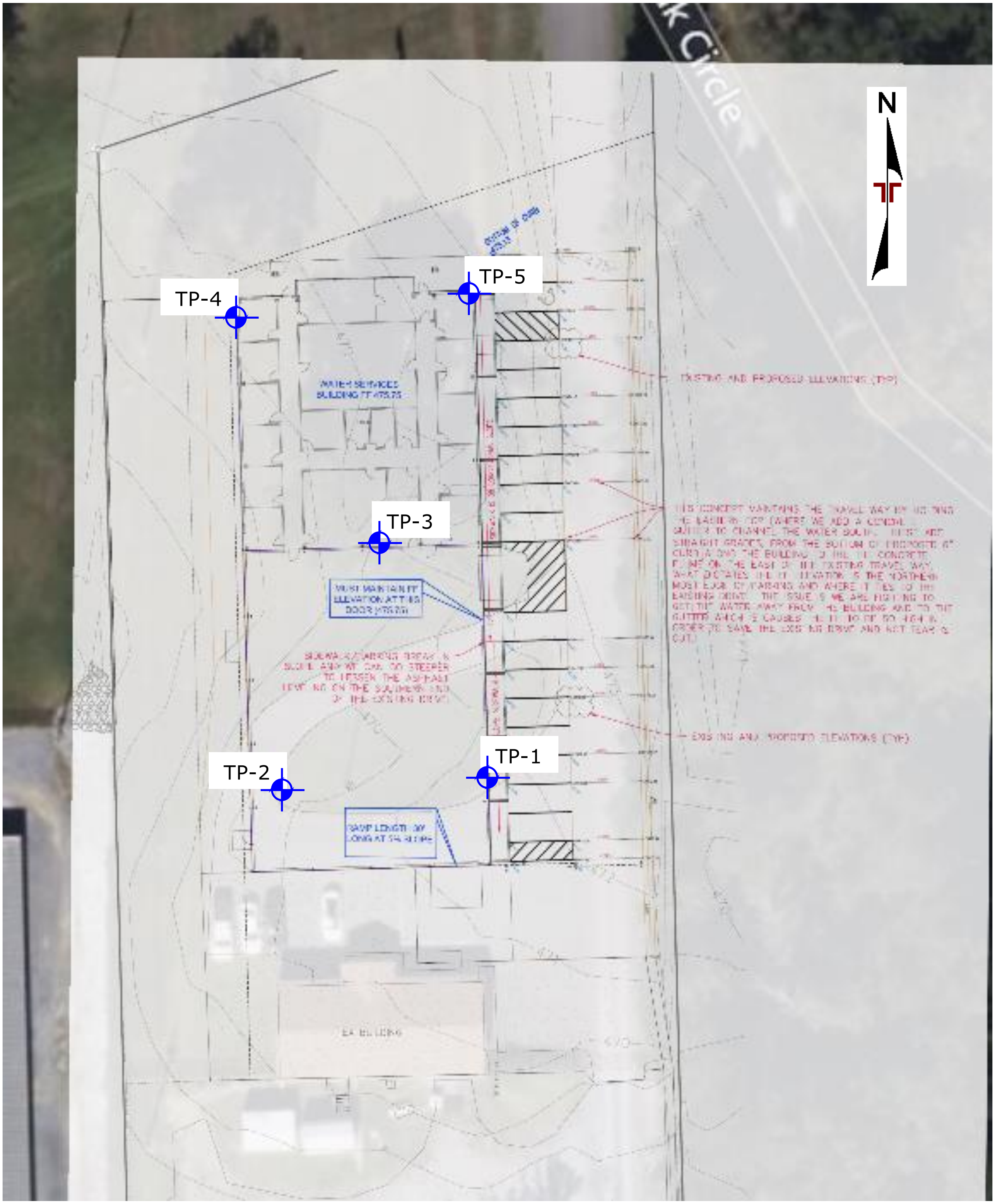


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES MAP PROVIDED BY SHELBY COUNTY

Exploration and Laboratory Results

Contents:

Note: All attachments are one page unless noted above.

Terracon
2147 Riverchase Office Rd
Birmingham, AL

Test Pit Log No. TP-1

Location: See Exploration Plan

Elevation.: 471.5 (Ft.)

Model Layer	Depth (Ft.)	Material Description	Elevation (Ft.)	Sample Type	Water Content (%)	Atterberg Limits LL-PL-PI
1	0.5	**TOPSOIL (6")**	471			
3	2.0	**LEAN CLAY (CL)**, yellowish brown with gray, stiff	469.5			
3	5.0	**LEAN CLAY (CL)**, brown, very stiff to hard, with relict shale	466.5	Grab (4–5 ft)	10.7	
4	7.0	**WEATHERED SHALE**, brown, thinly bedded	464.5			

Test Pit Terminated at 7 Feet

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Water Level Observations
Water not observed at time of excavation
Water seepage at 3' after 1 hour

Notes

Advancement Method
Trackhoe

Abandonment Method
Test pit backfilled with excavated material

Operator
Shelby County

Logged by
BCR

Test Pit Started
02-17-2023

Test Pit Completed
02-17-2023

Terracon
2147 Riverchase Office Rd
Birmingham, AL

Test Pit Log No. TP-2

Location: See Exploration Plan

Model Layer	Depth (Ft.)	Description	Elevation.: 469.5 (Ft.)	Sample Type	Field Test Results	Water Content (%)	Atterberg Limits LL-PL-PI
1		**TOPSOIL (12")**					
	1.0		468.5				
3		**FAT CLAY (CH)**, yellowish brown with gray, medium stiff to stiff		Grab (hand) at ~1.5–2.5 ft		32.2	65-27-38
	2.5		467				
3		**LEAN CLAY (CL)**, with weathered shale, brown and gray, very stiff to hard					
	7.0		462.5				
4		**WEATHERED SHALE**, brown with gray					
	8.0		461.5				
		Test Pit Terminated at 8 Feet					

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Water Level Observations
Water not observed at time of excavation
Water seepage at 3' after 1 hour

Notes

Advancement Method
Trackhoe

Abandonment Method
Test pit backfilled with excavated material

Operator
Shelby County

Logged by
BCR

Test Pit Started
02-17-2023

Test Pit Completed
02-17-2023

2147 Riverchase Office Rd
Birmingham, AL

Test Pit Log No. TP-3

Location: See Exploration Plan

Model Layer	Graphic Log	Depth (Ft.) / Description / Elevation.: 470 (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Water Content (%)	Atterberg Limits LL-PL-PI
1		**TOPSOIL (8")** — 0.7 / 469.33						
2		**LEAN CLAY (CL)**, light brown, soft — 3.0 / 467	1, 2, 3					
3		**FAT CLAY (CH)**, yellowish brown, medium stiff to stiff — 4.5 / 465.5	4		Grab		24.8	
3		**LEAN CLAY (CL)**, with weathered shale, brown, very stiff to hard — 7.0 / 463	5, 6, 7					
4		**WEATHERED SHALE**, brown with gray — 8.0 / 462	8					
		Test Pit Terminated at 8 Feet						

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Water Level Observations
Water not observed at time of excavation
Water seepage at 3' after 40 minutes

Notes

Advancement Method
Trackhoe

Abandonment Method
Test pit backfilled with excavated material

Operator
Shelby County

Logged by
BCR

Test Pit Started
02-17-2023

Test Pit Completed
02-17-2023

Terracon
2147 Riverchase Office Rd
Birmingham, AL

Test Pit Log No. TP-4

Location: See Exploration Plan

Model Layer	Graphic Log	Depth (Ft.)	Material Description	Elevation.: 469.5 (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Water Content (%)	Atterberg Limits LL-PL-PI
1		0.7	**TOPSOIL (8")**	468.83						
2		3.0	**LEAN CLAY (CL)**, brown, very soft, very moist	466.5	1, 2, 3					
3		4.5	**FAT CLAY (CH)**, yellowish brown with light gray, stiff	465	4					
3		7.0	**LEAN CLAY (CL)**, with weathered shale, brown, hard	462.5	5, 6, 7					
4		8.0	**WEATHERED SHALE**, brown, thinly bedded	461.5	8					

Test Pit Terminated at 8 Feet

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes

Water Level Observations
Water not observed at time of excavation
Water seepage at 4' after 15 minutes

Advancement Method
Trackhoe

Abandonment Method
Test pit backfilled with excavated material

Operator
Shelby County

Logged by
BCR

Test Pit Started
02-17-2023

Test Pit Completed
02-17-2023

Terracon
2147 Riverchase Office Rd
Birmingham, AL

Test Pit Log No. TP-5

Location: See Exploration Plan

Elevation.: 471.5 (Ft.)

Model Layer	Depth (Ft.)	Material Description	Elevation (Ft.)	Water Level Observations	Sample Type	Field Test Results	Water Content (%)	Atterberg Limits LL-PL-PI
1	0.5	**TOPSOIL (6")**	471					
2	2.5	**LEAN CLAY (CL)**, brown to yellowish brown, soft	469					
3	4.5	**FAT CLAY (CH)**, yellowish brown with gray, stiff to very stiff	467					
3	8.0	**LEAN CLAY (CL)**, with weathered shale, brown, very stiff to hard	463.5					
4	9.0	**WEATHERED SHALE**, brown and gray, thinly bedded	462.5					

Test Pit Terminated at 9 Feet

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes

Water Level Observations
Water seepage at 3' at time of excavation

Advancement Method
Trackhoe

Abandonment Method
Test pit backfilled with excavated material

Operator
Shelby County

Logged by
BCR

Test Pit Started
02-17-2023

Test Pit Completed
02-17-2023

Supporting Information

Contents:

Note: All attachments are one page unless noted above.

Terracon
2147 Riverchase Office Rd
Birmingham, AL

General Notes

Sampling

Grab Sample

Water Level

- Water Initially Encountered
- Water Level After a Specified Period of Time
- Water Level After a Specified Period of Time
- Cave In Encountered

Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.

Field Tests

N	Standard Penetration Test Resistance (Blows/Ft.)
(HP)	Hand Penetrometer
(T)	Torvane
(DCP)	Dynamic Cone Penetrometer
UC	Unconfined Compressive Strength
(PID)	Photo-Ionization Detector
(OVA)	Organic Vapor Analyzer

Descriptive Soil Classification

Soil classification as noted on the soil boring logs is based Unified Soil Classification System. Where sufficient laboratory data exist to classify the soils consistent with ASTM D2487 "Classification of Soils for Engineering Purposes" this procedure is used. ASTM D2488 "Description and Identification of Soils (Visual-Manual Procedure)" is also used to classify the soils, particularly where insufficient laboratory data exist to classify the soils in accordance with ASTM D2487. In addition to USCS classification, coarse grained soils are classified on the basis of their in-place relative density, and fine-grained soils are classified on the basis of their consistency. See "Strength Terms" table below for details. The ASTM standards noted above are for reference to methodology in general. In some cases, variations to methods are applied as a result of local practice or professional judgment.

Location And Elevation Notes

Exploration point locations as shown on the Exploration Plan and as noted on the soil boring logs in the form of Latitude and Longitude are approximate. See Exploration and Testing Procedures in the report for the methods used to locate the exploration points for this project. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

Strength Terms

Relative Density of Coarse-Grained Soils (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance		**Consistency of Fine-Grained Soils** (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance		
Relative Density	**Standard Penetration or N-Value (Blows/Ft.)**	**Consistency**	**Unconfined Compressive Strength Qu (tsf)**	**Standard Penetration or N-Value (Blows/Ft.)**
Very Loose	0 - 3	Very Soft	less than 0.25	0 - 1
Loose	4 - 9	Soft	0.25 to 0.50	2 - 4
Medium Dense	10 - 29	Medium Stiff	0.50 to 1.00	4 - 8
Dense	30 - 50	Stiff	1.00 to 2.00	8 - 15
Very Dense	> 50	Very Stiff	2.00 to 4.00	15 - 30
		Hard	> 4.00	> 30

Relevance of Exploration and Laboratory Test Results

Exploration/field results and/or laboratory test data contained within this document are intended for application to the project as described in this document. Use of such exploration/field results and/or laboratory test data should not be used independently of this document.

Unified Soil Classification System

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]				Soil Classification	
				Group Symbol	**Group Name** [B]
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	Cu≥4 and 1≤Cc≤3 [E]	GW	Well-graded gravel [F]
			Cu<4 and/or [Cc<1 or Cc>3.0] [E]	GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH	GM	Silty gravel [F, G, H]
			Fines classify as CL or CH	GC	Clayey gravel [F, G, H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	Cu≥6 and 1≤Cc≤3 [E]	SW	Well-graded sand [I]
			Cu<6 and/or [Cc<1 or Cc>3.0] [E]	SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH	SM	Silty sand [G, H, I]
			Fines classify as CL or CH	SC	Clayey sand [G, H, I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots above "A" line [J]	CL	Lean clay [K, L, M]
			PI < 4 or plots below "A" line [J]	ML	Silt [K, L, M]
		Organic:	$\frac{LL\ oven\ dried}{LL\ not\ dried} < 0.75$	OL	Organic clay [K, L, M, N]
					Organic silt [K, L, M, O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line	CH	Fat clay [K, L, M]
			PI plots below "A" line	MH	Elastic silt [K, L, M]
		Organic:	$\frac{LL\ oven\ dried}{LL\ not\ dried} < 0.75$	OH	Organic clay [K, L, M, P]
					Organic silt [K, L, M, Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor			PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve.
[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.
[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.
[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay.
[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$
[F] If soil contains ≥ 15% sand, add "with sand" to group name.
[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.
[H] If fines are organic, add "with organic fines" to group name.
[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.
[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.
[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.
[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.
[N] PI ≥ 4 and plots on or above "A" line.
[O] PI < 4 or plots below "A" line.
[P] PI plots on or above "A" line.
[Q] PI plots below "A" line.