Geotechnical Engineering Report

Ft. Sam National Cemetery Phase 3 Expansion & Improvements
San Antonio, TX
May 5, 2020
Terracon Project No. 90195179

Prepared for:
Anderson Engineering of Minnesota, LLC
Plymouth, Minnesota

Prepared by:
Terracon Consultants, Inc.
San Antonio, Texas

May 5, 2020

Terracon GeoReport

Anderson Engineering of Minnesota, LLC
13605 1st Avenue N, Suite 100
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Attn: Mr. Eric Sautbine, PE
P: (763) 412 4062
E: ESautbine@AE-MN.COM

Re: Geotechnical Engineering Report
Ft. Sam National Cemetery Phase 3 Expansion & Improvements
1520 Harry Wurzbach Road
San Antonio, TX
Terracon Project No. 90195179

Dear Mr. Sautbine:

We have completed the Geotechnical Engineering services for the above referenced project. This study was performed in general accordance with Task Order No. 36C10F19N0033 dated May 31, 2019. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design and construction of foundations, pavements and graveyard expansion area for the proposed project.

We appreciate the opportunity to work with you on this project and look forward to contributing to the ongoing success of this project by providing Materials Testing services during construction. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,

Terracon Consultants, Inc.
(Firm Registration No. F3272)

Shasanka Dutta, P.E.
Project Engineer

STATE OF TEXAS
SHASANKA DUTTA
132647
LICENSED
PROFESSIONAL ENGINEER

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REPORT TOPICS

INTRODUCTION 1
SITE CONDITIONS 1
PROJECT DESCRIPTION 2
GEOTECHNICAL CHARACTERIZATION 3
GEOTECHNICAL OVERVIEW 7
EARTHWORK 9
SHALLOW FOUNDATIONS 18
DEEP FOUNDATIONS 21
SEISMIC CONSIDERATIONS 26
FLOOR SLABS 26
PAVEMENTS 28
GENERAL COMMENTS 36
ATTACHMENTS 37

ATTACHMENTS

EXPLORATION AND TESTING PROCEDURES
SITE LOCATION AND EXPLORATION PLANS
PHOTOGRAPHY LOG
EXPLORATION RESULTS (Boring Logs)
FIGURES (GeoModel)
SUPPORTING INFORMATION (General Notes and Unified Soil Classification System)

Geotechnical Engineering Report

Ft. Sam National Cemetery Phase 3 Expansion & Improvements
1520 Harry Wurzbach Road
San Antonio, TX

Terracon Project No. 90195179
May 5, 2020

INTRODUCTION

This report presents the results of our subsurface exploration and Geotechnical Engineering services performed for the proposed cemetery expansion to be located at 1520 Harry Wurzbach Road in San Antonio, TX. The purposes of these services are to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil conditions
- Groundwater conditions
- Seismic site classification per IBC
- Pavement design and construction
- Foundation design and construction
- Site preparation and earthwork
- Excavation considerations

The Geotechnical Engineering Scope of Services for this project included the advancement of fifty-five (55) test borings to depths ranging from about 8 to 40 feet below existing site grades.

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

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 is located at 1520 Harry Wurzbach Road in San Antonio, Texas. GPS coordinates of the site are: 29.47676° and -98.43270° See **Site Location**
Existing Improvements	Existing buildings, asphalt pavements and cemetery
Current Ground Cover	Asphalt, landscape, grass and bare soil.

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 are as follows:

Item	Description
Information Provided	The project information was provided by Mr. Eric Sautbine with Anderson Engineering of Minnesota, LLC.
Proposed Structures	The development will include: ■ New honor guard building; ■ Expansion to the existing administration building; ■ New equipment storage and material storage building; ■ Associated parking/driveway areas; ■ Repair of existing pavement sections on the west side of the property as well as a construction of a new access road in the east side of the property; ■ Expansion of graveyard area. Footprint area of the buildings are: ■ Approximately 1,200 square feet for the honor guard building; ■ Approximately 800 square feet for the material storage building; ■ Approximately 2,300 square feet for the equipment storage building. ■ Approximately 2,500 square feet for the addition to the existing administration building. ■ New columbaria (maximum of 10,784 niches)
Existing Topography	Based on grading plan provided by Mr. Eric Sautbine, P.E., with Anderson Engineering of Minnesota, LLC., existing grades at the building locations are: ■ Existing grade at the honor guard building is about EL. 720.0 feet; ■ Existing grade at the equipment storage and material storage building is about EL. 676.0 feet; ■ Existing grade at the addition to the existing administration building is about EL. 677.0 feet. ■ Existing grade at columbaria location is about EL. 672.0 feet.

Item	Description
Finished Floor Elevation	Based on grading plan provided by Mr. Eric Sautbine, P.E., with Anderson Engineering of Minnesota, LLC., finished floor elevations the building locations are: ■ Finished floor elevation (FFE) at the honor guard building is set at EL. 722.0 feet; ■ Finished floor elevation (FFE) at the equipment storage building is set at EL. 675.6 feet; ■ Finished floor elevation (FFE) at the material storage building is set at EL. 676.6 feet; ■ Finished floor elevation (FFE) at the addition to the existing administration building is set at EL. 677.3 feet.

GEOTECHNICAL CHARACTERIZATION

Site Geology

The San Antonio Sheet (1983) of the Geologic Atlas of Texas published by the Bureau of Economic Geology at the University of Texas at Austin has mapped **Fluviatile Terrace Deposits (Qt)** underlain by the **Navarro Group and Marlbrook Marl - Undivided (Kknm)** at the project site.

The **Fluviatile Terrace Deposits** are of the Pleistocene period and consist of gravel, sand, silt and clay. These deposits are found along the banks of streams, creeks and rivers and are the result of water born deposition and generally consist of the weathered products of rock located at higher elevations.

The **Fluviatile Terrace Deposits** are likely underlain by the **Navarro Group and Marlbrook Marl - Undivided** formation. The upper part of this geologic unit typically consists of marl, clay, sandstone, and siltstone. The lower part of this geologic unit typically consists of montmorillonitic, unctuous, greenish gray to brownish gray clay which weathers to a very thick, black, clayey soil.

Subsurface Conditions

We have developed a general characterization of the subsurface conditions at the building locations based upon our review of the subsurface exploration, laboratory data, geologic setting and our understanding of the project. As part of our analyses, we identified the following model layers within the subsurface profile in the areas of the building pads.

Honor Guard Building		
Model Layer #	**Description**	**General Description**
1	Fat Clay[1]	Dark Brown, Yellowish Brown and Brown; Medium Stiff to Hard

1/ The FAT CLAY materials could undergo high volumetric changes (shrink/swell) should they experience changes in their in-place moisture content.

Equipment and Material Storage Building		
Model Layer #	**Description**	**General Description**
1	Clayey Gravel[1] (Fill)	Light Brown, Brown, Yellowish Brown; Medium Dense to Dense
2	Clayey Gravel[2]	Light Brown; Dense to Very Dense
3	Fat Clay[3]	Dark Brown, Light Brown and Brown; Stiff to Hard
4	Lean Clay[4]	Light Brown, Brown and Light Gray; Stiff to Hard
5	Shale[5]	Gray; Hard

1/The FILL CLAYEY GRAVEL materials are primarily granular in nature and are expected to possess a negligible potential for volumetric changes due to moisture fluctuations. However, uncontrolled fill material may be subject to excessive settlement if not properly compacted. Also, uncontrolled fills may contain debris and other unsuitable material not detected by our widely spaced borings.

2/The CLAYEY GRAVEL materials are primarily granular in nature and are expected to possess a negligible potential for volumetric changes due to moisture fluctuations.

3/ The FAT CLAY materials could undergo high volumetric changes (shrink/swell) should they experience changes in their in-place moisture content.

4/ The LEAN CLAY materials could undergo moderate volumetric changes (shrink/swell) should they experience changes in their in-place moisture content.

5/ The CLAY-SHALE materials are volumetrically stable when considered for expansive soil-related movements.

Administration Building Expansion		
Model Layer #	**Description**	**General Description**
1	Clayey Gravel[1] (Fill)	Yellowish Brown
2	Clayey Gravel[2]	Light Brown; Dense
3	Fat Clay[3]	Brown; Stiff
4	Lean Clay[4]	Light Brown, Brown; Stiff to Hard
5	Shale[5]	Light Gray, Gray; Hard

1/The FILL CLAYEY GRAVEL materials are primarily granular in nature and are expected to possess a negligible potential for volumetric changes due to moisture fluctuations. However, uncontrolled fill material may be subject to excessive settlement if not properly compacted. Also, uncontrolled fills may contain debris and other unsuitable material not detected by our widely spaced borings.

2/The CLAYEY GRAVEL materials are primarily granular in nature and are expected to possess a negligible potential for volumetric changes due to moisture fluctuations.

3/ The FAT CLAY materials could undergo high volumetric changes (shrink/swell) should they experience changes in their in-place moisture content.

4/ The LEAN CLAY materials could undergo moderate volumetric changes (shrink/swell) should they experience changes in their in-place moisture content.

5/ The CLAY-SHALE materials are volumetrically stable when considered for expansive soil-related movements.

This characterization, termed GeoModel, forms the basis of our geotechnical calculations and evaluation of site preparation and foundation options. Conditions encountered at each exploration point are indicated on the individual logs. The individual logs and GeoModel can be found in the **Exploration Results** section and **Figures** section of this report respectively. It can be emphasized that the stratification boundaries on the boring logs represent the approximate location of changes in native soil types; in situ, the transition between materials may be gradual.

Groundwater Conditions

Groundwater generally appears as either a permanent or temporary water source. Permanent groundwater is generally present year-round, which may or may not be influenced by seasonal and climatic changes. Temporary groundwater water is also referred to as a “perched” water source, which generally develops because of seasonal and climatic conditions.

The borings were advanced to the required depths using dry drilling techniques to evaluate groundwater conditions at the time of our field program. The boreholes were observed for the presence of groundwater during and after completion of drilling. The water levels observed in the borings can be found on the boring logs in the **Exploration Results** section of this report and are summarized in the table below.

Boring #	Approximate Depth to Water from Existing Grade while Drilling (feet)
B-21	11
B-26	11
B-27	8
B-28	9
B-53	28
B-54	31
B-57	34
Note: No free water was observed during drilling of the borings not listed here	

Seasonal variations such as amount of rainfall and runoff, climatic conditions and other factors generally result in fluctuations of the groundwater level over time. The granular strata can easily transmit water. Therefore, groundwater levels during construction or at other times in the life of the structure may be higher or lower than the levels indicated on the boring logs. The foundation contractor should check the groundwater conditions just before foundation excavation activities.

In addition to observations for water made during the drilling, five 20-foot deep piezometers were installed at the site. Piezometer locations are provided in the table below and illustrated on the exploration plan.

Piezometer	Latitude	Latitude	Ground Surface Elevation above MSL
P-1	29.47825°	-98.41792°	677 feet
P-2	29.47430°	-98.41890°	669 feet
P-3	29.47180°	-98.41878°	671 feet
P-4	29.47283°	-98.41444°	667 feet
P-5	29.47780°	-98.41457°	662 feet

Water readings at the piezometers to date are provided below. Two more sets of water readings will be taken at about two week intervals in January 2020. The wells then be will be abandoned

by pulling the PVC pipe and backfilling the holes. The results of subsequent readings will be transmitted via email.

Date of Reading	Depth of Water (feet)				
	P-1	P-2	P-3	P-4	P-5
December 13, 2019	No water observed	No water observed	No water observed	No water observed	11

GEOTECHNICAL OVERVIEW

The buildings may be supported by

- Shallow grade supported slab with grade beams (Stiffened), or
- Structurally suspended slab supported on drilled shafts.

The foundations being considered must satisfy two independent engineering criteria with respect to the subsurface conditions encountered at this site. One criterion is the foundation system must be designed with an appropriate factor of safety to reduce the possibility of a bearing capacity failure of the soils underlying the foundation when subjected to axial and lateral load conditions. The other criterion is that the movement of the foundation system due to compression (consolidation or shrinkage) or expansion (swell) of the underlying soils must be within tolerable limits.

Expansion Potential

Expansive soils are present at this site. The near surface, high plasticity fat clay could become unstable with typical earthwork and construction traffic, especially after precipitation events. 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.

Based on our findings, the subsurface soils at this site generally exhibit moderate to high shrink/swell potential in their current condition. Estimated Potential Vertical Rise (PVR) values at the project site are summarized in the table below.

Building	Boring #	Approximate Potential Vertical Rise (inches)
Honor Guard Building	B-3 and B-4	5.5
Equipment Storage Building	B-53 and B-54	4.5
Material Storage Building	B-55 and B-56	4.5
Administration Building Expansion	B-57 and B-58	4.0

We estimated the potential shrink/swell at the site using the information from our field and laboratory programs and based on method TEX-124-E of the Texas Department of Transportation (TxDOT) Manual of Testing Procedures. It can be emphasized that the actual movements could be greater than the values presented in this report because of inadequate drainage, ponded water and moisture infiltration beneath the structures after construction.

This report provides recommendations to help mitigate the effects of soil shrinkage and expansion. However, even if these procedures are followed, some movement and (at least minor) cracking in the structure should be anticipated. The severity of cracking and other damage such as uneven floor slabs will probably increase if modification of the site results in excessive wetting or drying of the expansive soils. **Eliminating the risk of movement and distress may not be feasible unless the floor slab is suspended and supported by drilled pier foundations. Therefore, we strongly recommend the floor slabs at the buildings be structurally suspended and supported by drilled pier foundations.**

Demolition Considerations

If any existing buildings and sidewalks at this site will be demolished prior to construction work, abandoned (or to be abandoned) underground utilities may be present within the footprint area of the planned structures. Utilities and associated backfill and granular bedding material can provide avenues for subsurface water to enter under the structure subgrade. We recommend that all abandoned utility lines be completely removed from the proposed structure areas. Abandoned pipes which remain underground should be grouted.

Removal of any below-grade foundation or structures will likely create large subsurface voids. It is very important that all subsurface voids formed from the removal of the foundation system be backfill completely with moisture conditioned, compacted, engineered fill as described **Earthwork** section of this report. It is our experience that improperly backfilled excavations can cause significant settlement under and around the proposed structures.

As an alternative to compacted soil backfill, a flowable fill material may be considered. Flowable fill, or slurry, when properly designed provides a competent subgrade and can still be readily excavated if the utilities require repair or maintenance. In addition, flowable fill does not need to be placed in lifts, compacted, or tested.

Interaction with Existing Structures

We understand the Administration Building expansion will be connected to the existing building. The construction of additions to an existing structure can often create a situation that leads to the formation of distress in both structures if both structures are connected to each other. Typically, such distress occurs due to the use of different foundations and different framing stiffness of the structures. These differences often lead to dissimilar performances between the additions and existing structure. Such performance dissimilarities typically manifest themselves as differential movements and can cause significant amount of distress. The risks associated with dissimilar performances between the additions and existing structure may be reduced by adopting the following ways:

- Designing the foundation of the addition using the type and geometry similar to the existing foundation system (when appropriate);
- Dowel the addition and existing foundations/floor slabs together to prevent differential vertical movements across the joint; and
- Constructing an expansion joint between the new and existing structure to allow for differential horizontal movement between the addition and existing structure.
- Installing new piers at least 2 pier diameters away from the closest existing piers.

Excavating adjacent to the existing foundation should be performed with care. Excavations adjacent to the existing structure could cause the foundation to become undermined and as a result the foundation or structure could suffer damages. We recommended that the contractor monitor the existing foundation carefully during construction and be prepared to brace the existing foundation if necessary.

EARTHWORK

Earthwork will include clearing and grubbing, excavations, and 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.

General Site Preparation

Construction operations may encounter difficulties due to the wet or soft surface soils becoming a general hindrance to equipment due to rutting and pumping of the soil surface, especially during and soon after periods of wet weather. If the subgrade cannot be adequately compacted to

minimum densities as described in the **Fill Compaction Requirements** section of this report, one of the following measures may be required:

- removal and replacement with select fill;
- chemical treatment of the soil to dry and increase the stability of the subgrade; or
- drying by natural means if the schedule allows.

Prior to construction, all vegetation, pavements, loose topsoil and any otherwise unsuitable materials should be removed from the construction area. The stripped materials consisting of vegetation and organic materials should be wasted from the site or used to revegetate landscaped areas or exposed slopes after completion of grading operations. Wet or dry material should either be removed, or moisture conditioned and recompacted. After stripping and grubbing, the subgrade should be proof-rolled where possible to aid in locating loose or soft areas. Proof-rolling can be performed with a fully loaded dump truck or comparable pneumatic tired vehicle. Soils that are observed to rut or deflect excessively (typically greater than 1-inch) under the moving load should be undercut and replaced with properly compacted on-site soils. The proof-rolling and undercutting activities should be witnessed by a representative of the Geotechnical Engineer and should be performed during a period of dry weather.

Building Pad Preparation

Average existing grades and planned Finished Floor Elevations (FFEs) within the Honor Guard Building, Equipment Storage Building, Material Storage Building and Administration Building Expansion are given in the table below.

Structure	Approximate Existing Grade (feet)	Planned Finished Floor Elevations (feet)	Finished Building Pad Elevation [1] (feet)
Honor Guard Building	EL. 720.0 feet	EL 722.0 feet	EL 721.5 feet
Equipment Storage Building	EL. 676.0 feet	EL 675.6 feet	EL 675.1 feet
Material Storage Building	EL. 676.0 feet	EL 676.6 feet	EL 676.1 feet
Administration Building Expansion	EL. 677.0 feet	EL 677.3 feet	EL 676.8 feet
Columbaria[2]	EL. 672.0 feet	EL 672.0 feet	EL 671.5 feet

1/ Assuming a slab thickness of about 6 inches.
2/ FFE of the columbaria is assumed to be at or near existing grades

As previously mentioned, the Potential Vertical Rise (PVR) is about 4 to 5½ inches for the current conditions at the site. Therefore, use of a grade supported slab will entail proper subgrade preparation to reduce expansive soil related movements. These recommendations may change if the FFE changes.

For a structurally suspended slab carried on drilled shafts (with void boxes and/ or crawl space), building pad preparation will not be necessary.

Honor Guard Building Pad (Borings B-3 and B-4)

- After completing stripping operations as discussed in the **General Site Preparation** section, excavate all subgrade in the building area to an elevation of EL. 710.0 feet (about 10 feet excavation). The building pad area is defined as the area that extends at least 5 feet (horizontal) beyond the perimeter of the proposed building or to the outside edge of any movement sensitive flatwork.

- After excavating to the depth specified above, the exposed subgrade should be proof rolled with a fully loaded dump truck or comparable pneumatic tired vehicle to evidence any weak yielding zones. A Terracon geotechnical engineer or their representative should be present to observe proof rolling operations.

- Over-excavate any confirmed weak yielding zones, both vertically and horizontally, to expose competent soil. The exposed subgrade should be moisture conditioned between +2 and +6 percentage points of the optimum moisture content and compacted to at least 95 percent of the maximum dry density determined in accordance with ASTM D 698.

- Place 11 feet of imported cohesive select fill soil in loose lifts of about 8 inches to achieve an elevation of about EL. 721.0 feet. Each lift should be moisture conditioned between -2 and +3 percentage points of the optimum moisture content and compacted to at least 95 percent of the maximum dry density determined in accordance with ASTM D 698.

- Place ½ foot (6 inches) of Granular Select Fill to achieve the proposed FBPE (EL. 721.5 feet). The material should be moisture conditioned between -2 and +3 percentage points of the optimum moisture content, and then compacted to at least 100 percent of the maximum dry density determined in accordance with ASTM D 698. The layer of Granular Select Fill will help to serve as an all weathering working surface.

- If grades are to be raised further, then Granular Select Fill should be used to achieve finished building pad elevation (FBPE).

Equipment Storage Building Pad (Borings B-53 and B-54)

- After completing stripping operations as discussed in the **General Site Preparation** section, excavate all subgrade in the building area to an elevation of EL. 667.0 feet (about 9 feet excavation). The building pad area is defined as the area that extends at least 5 feet (horizontal) beyond the perimeter of the proposed building or to the outside edge of any movement sensitive flatwork.

- After excavating to the depth specified above, the exposed subgrade should be proof rolled with a fully loaded dump truck or comparable pneumatic tired vehicle to evidence any weak yielding zones. A Terracon geotechnical engineer or their representative should be present to observe proof rolling operations.

- Over-excavate any confirmed weak yielding zones, both vertically and horizontally, to expose competent soil. The exposed subgrade should be moisture conditioned between +2 and +6 percentage points of the optimum moisture content and compacted to at least 95 percent of the maximum dry density determined in accordance with ASTM D 698.

- Place 7 feet of imported cohesive select fill soil in loose lifts of about 8 inches to achieve an elevation of about EL. 674.0 feet. Each lift should be moisture conditioned between -2 and +3 percentage points of the optimum moisture content and compacted to at least 95 percent of the maximum dry density determined in accordance with ASTM D 698.

- Place a minimum of 1 feet of Granular Select Fill to achieve proposed FBPE (EL. 675.1 feet). The material should be moisture conditioned between -2 and +3 percentage points of the optimum moisture content, and then compacted to at least 100 percent of the maximum dry density determined in accordance with ASTM D 698. The layer of Granular Select Fill will help to serve as an all weathering working surface and will also improve the modulus of subgrade reaction that in turn will provide slab support for floor loads.

- If grades are to be raised further, then Granular Select Fill should be used to achieve finished building pad elevation (FBPE).

- Please refer to the **Floor Slabs** Section of this report for options on K values for slab support.

Material Storage Building Pad (Borings B-55 and B-56)

- After completing stripping operations as discussed in the **General Site Preparation** section, excavate all subgrade in the building area to an elevation of EL. 667.0 feet (about 9 feet excavation). The building pad area is defined as the area that extends at least 5

feet (horizontal) beyond the perimeter of the proposed building or to the outside edge of any movement sensitive flatwork.

- After excavating to the depth specified above, the exposed subgrade should be proof rolled with a fully loaded dump truck or comparable pneumatic tired vehicle to evidence any weak yielding zones. A Terracon geotechnical engineer or their representative should be present to observe proof rolling operations.

- Over-excavate any confirmed weak yielding zones, both vertically and horizontally, to expose competent soil. The exposed subgrade should be moisture conditioned between +2 and +6 percentage points of the optimum moisture content and compacted to at least 95 percent of the maximum dry density determined in accordance with ASTM D 698.

- Place 8 feet of imported cohesive select fill soil in loose lifts of about 8 inches to achieve an elevation of about EL. 675.0 feet. Each lift should be moisture conditioned between -2 and +3 percentage points of the optimum moisture content and compacted to at least 95 percent of the maximum dry density determined in accordance with ASTM D 698.

- Place a minimum of 1 feet of Granular Select Fill to achieve proposed FBPE (EL. 676.1 feet). The material should be moisture conditioned between -2 and +3 percentage points of the optimum moisture content, and then compacted to at least 100 percent of the maximum dry density determined in accordance with ASTM D 698. The layer of Granular Select Fill will help to serve as an all weathering working surface and will also improve the modulus of subgrade reaction that in turn will provide slab support for floor loads.

- If grades are to be raised further, then Granular Select Fill should be used to achieve finished building pad elevation (FBPE).

- Please refer to the **Floor Slabs** Section of this report for options on K values for slab support.

Building Pad for Administration Building Expansion (Borings B-57 and B-58)

- After completing stripping operations as discussed in the **General Site Preparation** section, excavate all subgrade in the building area to an elevation of EL. 668.0 feet (about 9 feet excavation). The building pad area is defined as the area that extends at least 5 feet (horizontal) beyond the perimeter of the proposed building or to the outside edge of any movement sensitive flatwork.

- After excavating to the depth specified above, the exposed subgrade should be proof rolled with a fully loaded dump truck or comparable pneumatic tired vehicle to evidence

any weak yielding zones. A Terracon geotechnical engineer or their representative should be present to observe proof rolling operations.

- Over-excavate any confirmed weak yielding zones, both vertically and horizontally, to expose competent soil. The exposed subgrade should be moisture conditioned between +2 and +6 percentage points of the optimum moisture content and compacted to at least 95 percent of the maximum dry density determined in accordance with ASTM D 698.

- Place 8 feet of imported cohesive select fill soil in loose lifts of about 8 inches to achieve an elevation of about EL. 676.0 feet. Each lift should be moisture conditioned between -2 and +3 percentage points of the optimum moisture content and compacted to at least 95 percent of the maximum dry density determined in accordance with ASTM D 698.

- Place a minimum of ½ foot (6 inches) of Granular Select Fill to achieve proposed FBPE (EL. 676.8 feet). The material should be moisture conditioned between -2 and +3 percentage points of the optimum moisture content, and then compacted to at least 100 percent of the maximum dry density determined in accordance with ASTM D 698. The layer of Granular Select Fill will help to serve as an all weathering working surface.

- If grades are to be raised further, then Granular Select Fill should be used to achieve finished building pad elevation (FBPE).

- Please refer to the **Floor Slabs** Section of this report for options on K values for slab support.

Columbaria (Borings B-44 through B-47)

- After completing stripping operations as discussed in the **General Site Preparation** section, excavate all subgrade in the columbaria area to an elevation of EL. 664.0 feet (about 8 feet excavation). The pad area is defined as the area that extends at least 5 feet (horizontal) beyond the perimeter of the proposed columbaria or to the outside edge of any movement sensitive flatwork.

- After excavating to the depth specified above, the exposed subgrade should be proof rolled with a fully loaded dump truck or comparable pneumatic tired vehicle to evidence any weak yielding zones. A Terracon geotechnical engineer or their representative should be present to observe proof rolling operations.

- Over-excavate any confirmed weak yielding zones, both vertically and horizontally, to expose competent soil. The exposed subgrade should be moisture conditioned between +2 and +6 percentage points of the optimum moisture content and compacted to at least 95 percent of the maximum dry density determined in accordance with ASTM D 698.

- Place 7 feet of imported cohesive select fill soil in loose lifts of about 8 inches to achieve an elevation of about EL. 671.0 feet. Each lift should be moisture conditioned between -2 and +3 percentage points of the optimum moisture content and compacted to at least 95 percent of the maximum dry density determined in accordance with ASTM D 698.

- Place a minimum of ½ foot (6 inches) of Granular Select Fill to achieve proposed FPE (EL. 671.5 feet). The material should be moisture conditioned between -2 and +3 percentage points of the optimum moisture content, and then compacted to at least 100 percent of the maximum dry density determined in accordance with ASTM D 698. The layer of Granular Select Fill will help to serve as an all weathering working surface.

- If grades are to be raised further, then Granular Select Fill should be used to achieve finished pad elevation (FPE).

It can be emphasized that the recommendations are based on the current moisture conditions at the site. To maintain the moisture and to protect the soils from further moisture fluctuations, construction should proceed fairly rapidly, and the subgrade soils should not be exposed to the elements for a long period of time.

Details regarding fill materials, placement and compaction are presented in **Fill Material Types** and **Fill Compaction Requirements** sections.

Clay Cap- If not covered with concrete flatwork or pavements, the upper 2 feet (clay “cap”) of the 5-foot (horizontal) overbuild should consist of a cohesive clay with a plasticity index greater than 25. The purpose of the clay cap is to reduce the potential for water to infiltrate the building pad causing the subgrade soils to swell. The clay "cap" material should have at least 70 percent by weight passing the No. 200 Sieve and no more that 15 percent by weight retained in the No. 4 Sieve. The clay “cap” may be replaced with concrete flatwork or pavement extending to the edge of the foundation. Properly compacted, this clay layer should help to reduce migration of moisture into the select fill below.

Flatwork

As previously stated, the subgrade soils exhibit Potential Vertical Rise (PVR) that ranges from about 4 inch to 5½ inches for the current conditions at the site. It will be necessary to perform modifications beneath the movement sensitive flatwork to reduce the PVR to a desirable level. The pad beneath the movement sensitive flatwork should be prepared as described under **Building Pad Preparation** section of this report to reduce soil movement. The pad should extend only to the edge of the movement sensitive flatwork. If the flatwork is not prepared as recommended under the **Building Pad Preparation** section, then movement and cracking should be expected that may result in uneven flatwork which in turn may cause trip hazards, reverse

surface flow or doors which drag on the flatwork when opened. Consider including the door stoops as part of the building pad to prevent interference with door operations.

Fill Material Types

Earthen materials used for structural and general fill should meet the following material property requirements:

Fill Type [1]	USCS Classification	Comments
Select fill	CL (LL≤40) and (7≤PI≤20)	Can be placed at all locations and elevations.
On-Site Soil	CH, GC, CL	Not to be used as Select Fill.
Granular Select Fill[2]	See Note 2	-----

1/ Prior to any filling operations, samples of the proposed borrow and on-site materials should be obtained for laboratory moisture-density testing. The tests will provide a basis for evaluation of fill compaction by in-place density testing. A qualified soil technician should perform sufficient in-place density tests during the filling operations to evaluate that proper levels of compaction, including dry unit weight and moisture content, are being attained.

2/ Granular select fill should consist of 2014 TxDOT Item 247, Type A, Grade 1-2 crushed limestone base material. Plasticity Index (PI) should range from 5 to 15.

Fill Compaction Requirements

Select and general fill should meet the following compaction requirements.

Item	Description
Fill Lift Thickness	All fill should be placed in thin, loose lifts of about 8 inches, with compacted thickness not exceeding 6 inches.
Compaction of On-Site Soil and Select Fill	At least 95 percent of the material's Standard Proctor maximum dry density (ASTM D 698).
Compaction of Granular Select Fill	At least 100 percent of the material's Standard Proctor maximum dry density (ASTM D 698).
Moisture Content of On-Site Soil	Between +2 and +6 percentage points of the optimum moisture content.
Moisture Content of Select Fill and Granular Select Fill	Between -2 and +3 percentage points of the optimum moisture content.

Grading and Drainage

Effective drainage should be provided during construction and maintained throughout the life of the new improvements. After pad construction, we recommend verifying final grades to document that 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.

Proper site drainage should be maintained during the entire construction phase so that ponding of surface runoff does not occur and cause construction delays and/or inhibit site access, particularly in cut areas. During construction, it is possible that the surficial soils may become excessively wet as a result of inclement weather conditions. When the moisture content of these clay soils elevates above what is considered to be the optimum range of moisture for compaction operations, they can become difficult to handle and compact. If such conditions create a hindrance to compaction operations or site access, lime or cement may be mixed with these soils to improve their workability. The additive can be mixed as per 2014 TxDOT Item 275 (cement) or 2014 TxDOT Item 260 (lime). The subgrade should be tested for sulfates prior to the use of lime. The purpose of the additive is to dry out the subgrade and improve sire access. The strict requirements for curing and actual quantity of additive can be at the discretion of the contractor. The subgrade, however, should be compacted to at least 95 percent of the maximum dry density as per ASTM D 698 at moisture contents ranging from +2 to +6 percentage points of the optimum moisture content.

Flatwork and pavements will be subjected to post-construction movement. Maximum grades that are feasible should be used for paving and flatwork to prevent water from ponding. Allowances in final grades should also consider post-construction movement of flatwork, particularly if such movements are deemed critical. Where paving or flatwork abuts the structure, joints should be effectively sealed and maintained to prevent surface water infiltration. In areas where sidewalks or paving do not immediately adjoin the structure, we recommend that protective slopes be provided with a grade of at least five percent for at least 10 feet from perimeter walls (except in areas where ADA ramps are required; these should comply with state and local regulations). Backfill against grade beams, exterior walls, and in utility and sprinkler line trenches should be well compacted and free of construction debris to reduce the possibility of moisture infiltration.

Planters and other surface features which could retain water in areas adjacent to the structures should be properly drained, designed, sealed or eliminated. Landscaped irrigation adjacent to the foundation systems should be properly designed and controlled to help maintain a relatively constant moisture content within 5 feet of the structure.

Utility trenches are a common source of water infiltration and migration. Infiltration of water into utility trenches or foundation excavations should be prevented during construction. Utility trenches that penetrate beneath the structure should be effectively sealed to restrict water intrusion and flow through the trenches that could migrate below the pad. We recommend constructing an

effective clay "trench plug" that extends at least 5 feet out from the face of the building exterior. The plug material should consist of clay compacted at a water content at or above the soil's optimum water content. The clay fill should be placed to completely surround the utility line and be compacted in accordance with recommendations in this report. The combination of 10 mil poly and flowable fill backfill can be used in place of a clay plug.

Consideration should be given to the use of utility trenches outside of the building area as interceptor drains. For instance, these excavations can be backfilled near full depth with granular material and sloped to drain into storm sewers or similar outflow areas. In addition, 20 mil PVC vapor barrier (ASTM E 1745 Class A) may be placed on the downhill side (building pad side of the trench). In order to separate granular backfill materials within drainage system and trench backfill materials, geotextiles should be placed or wrapped around drainage system. As a result, some additional "protection" from the negative effects of subsurface water flow may be gained with little extra cost.

Earthwork Construction Considerations

It is anticipated that excavations for the proposed construction can be accomplished with conventional earthmoving equipment. Upon completion of filling and grading, care should be taken to maintain the subgrade water content prior to construction of floor slabs. 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.

SHALLOW FOUNDATIONS

A stiffened slab on grade foundation may be considered to support the structures at the project site provided the building pad is prepared as per the Building Pad Preparation section. A strip footing may be used to support the columbaria.

Design Parameters – Slab on Grade Foundation

Parameters commonly used to design this type of foundation are provided on the table below. The slab foundation design parameters presented in the table are based on the criteria published by the Wire Reinforcement Institute (WRI). These are essentially empirical design methods and the recommended design parameters are based on our understanding of the proposed project, our interpretation of the information and data collected as a part of this study, our area experience, and the criteria published in the WRI design manual.

Conventional Method Parameters	Value
Net Allowable Bearing Pressures [1]	2,000 psf
Subgrade Modulus (k)	80 pci
Potential Vertical Rise (PVR)	1 to 1½ inches
WRI Method Parameters	
Design Plasticity Index (PI) [2]	26
Climatic Rating (C_w)	17
Soil – Climate Support Index (1-C)	0.11

We recommend that exterior grade beams be at least 30 inches below the finished exterior grade. Interior grade beams (if any) should be at least 24 inches below the Finished Floor Elevation (FFE). These recommendations are for a proper development of bearing capacity for the continuous beam sections of the foundation system and to reduce the potential for water to migrate beneath the slab foundation. These recommendations are not based on structural considerations. Grade beam depths may need to be greater than recommended herein for structural considerations and should be properly evaluated and designed by the Structural Engineer. The grade beams or slab portions may be thickened and widened to serve as spread footings at concentrated load areas.

For a slab foundation system designed and constructed as recommended in this report, post construction settlements should be less than 1 inch. Settlement response of a select fill supported slab is influenced more by the quality of construction than by soil-structure interaction. Therefore, it is essential that the recommendations for foundation construction be strictly followed during the construction phases of the pad and foundation.

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

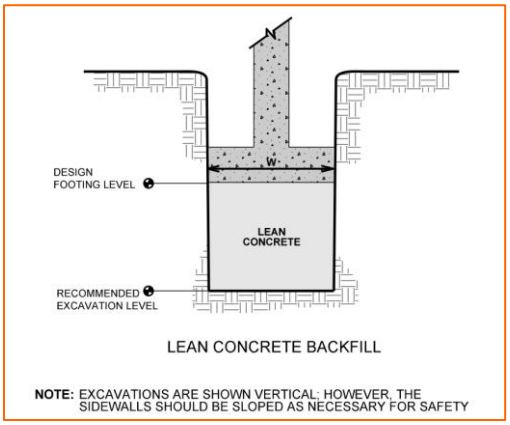
Design Parameters – Strip Footing

Allowable bearing pressure along the base of the wall should be 2,000 psf. This bearing pressure includes a factor of safety against a bearing capacity failure of at least 3. Allowable bearing pressures are also based on the bearing surface being comprised of compacted soil that is free and clean of all debris and loose material. To calculate the resistance to sliding, a value of 0.4 should be used as the ultimate coefficient of friction between the footing and the underlying soil or select fill.

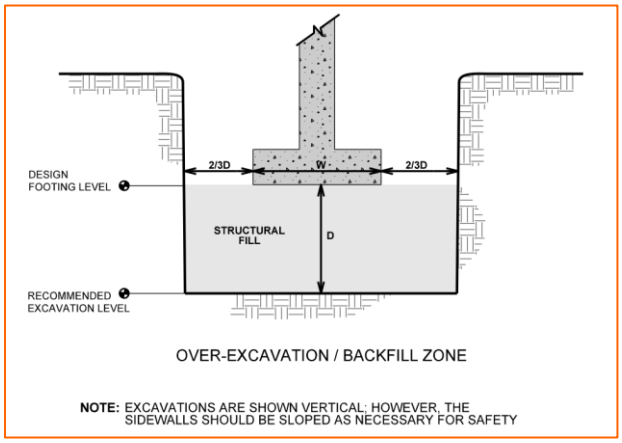
Foundation Construction Considerations

As noted in **Earthwork**, the footing excavations should be evaluated under the direction 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.

If unsuitable bearing soils are encountered 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. This is illustrated on the sketch below.



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



DEEP FOUNDATIONS

Drilled Shaft Design Parameters

The structures may be supported on straight-sided (non-underreamed) drilled piers. Soil design parameters for the design of drilled shaft foundations are provided in the table below. Due to the presence of gravel zones, underreamed piers are not deemed a viable option at the project site.

The drilled shafts for the Honor Guard Building should be installed to a minimum depth of 25 feet below existing site grades.

Drilled Shaft Design Summary (Honor Guard Building)		
Approximate Elevation (feet)	**Allowable Skin Friction[1,3] (psf)**	**Allowable End Bearing Pressure[2] (psf)**
EL. 720 – EL. 715	---	---
EL. 715 – EL. 705	500	---
EL. 705 – EL. 695	600	---
EL. 695 – EL. 680	750	10,000

1/ The allowable skin friction values include a factor of safety of 2.

2/ The bearing pressure includes a factor of safety of 3.

3/ Top 5 feet of the soil are considered not to contribute towards side friction due potential separation of the surficial soil due to desiccation and construction disturbance.

The drilled shafts for the Equipment Storage and Material Storage Buildings should be socketed at least 5 feet into the underlying shale.

Drilled Shaft Design Summary (Equipment Storage and Material Storage Building)		
Approximate Elevation (feet)	**Allowable Skin Friction[1,3] (psf)**	**Allowable End Bearing Pressure[2] (psf)**
EL. 676 – EL. 671	---	---
EL. 671 – EL. 661	650	---
EL. 661 – EL. 640	500	---
EL. 640 – EL. 636	950	18,000

1/ The allowable skin friction values include a factor of safety of 2.

2/ The bearing pressure includes a factor of safety of 3.

3/ Top 5 feet of the soil are considered not to contribute towards side friction due potential separation of the surficial soil due to desiccation and construction disturbance.

The drilled shafts for the Administration Building Expansion should be socketed at least 5 feet into the underlying shale.

Drilled Shaft Design Summary (Administration Building Expansion)		
Approximate Elevation (feet)	**Allowable Skin Friction[1,3] (psf)**	**Allowable End Bearing Pressure[2] (psf)**
EL. 677 – EL. 672	---	---
EL. 672 – EL. 662	350	---
EL. 662 – EL. 642	500	---
EL. 642 – EL. 637	1,000	20,000

1/ The allowable skin friction values include a factor of safety of 2.

2/ The bearing pressure includes a factor of safety of 3.

3/ Top 5 feet of the soil are considered not to contribute towards side friction due potential separation of the surficial soil due to desiccation and construction disturbance.

The bearing pressures presented in the table assume that the bearing surface will be free and clean of soft or moist material and loose debris. The allowable end bearing and skin friction values presented in this report are based on center-to-center spacing of at least three shaft diameters. A closer spacing may be considered but it may reduce the axial capacity of the foundation depending on the spacing pattern of the foundations. If a clearance of three diameters cannot be maintained in every case, the above bearing capacities should be reduced by 20 percent. **Drilled piers installed at a center-to-center clearance of two diameters or less are not recommended.**

In addition to the axial compressive loads on the piers, these piers will also be subjected to axial tension loads due to the expansive soil conditions and possibly due to other induced structural loading conditions. To compute the axial tension force due to the swelling soils along the pier shaft, the following equation may be used.

$$Q_u = 65 \cdot d$$

Where: Q_u = Uplift force due to expansive soil conditions in kips (k)

d = Diameter of pier shaft in feet (ft)

This calculated force may be used to compute the longitudinal reinforcing steel required in the pier to resist the uplift force induced by the swelling clays. However, the cross-sectional area of the reinforcing steel should not be less than 1 percent of the gross cross-sectional area of the drilled pier shaft. The reinforcing steel should extend from the top to the bottom of the shaft to resist this potential uplift force.

For the straight-sided drilled piers, the uplift force due to swelling soils and any other axial tension forces due to structural loading conditions can be resisted by the allowable side-shear of the drilled pier. The allowable uplift resistance of the straight sided drilled piers can be evaluated using the following equation:

$$Q_{ar} = 2.6 \cdot d \cdot D_p + 0.9W_p + P_{DL}$$

Where: Q_{ar} = Allowable uplift resistance of pier in kips (k)

d = Diameter of pier shaft in feet (ft)

D_p = Anchorage length which is the pier length minus the upper 15 feet of shaft in contact with the soil in feet (ft)

W_p = Weight of the drilled pier in kips (k)

P_{DL} = Permanent sustained dead Load acting on the drilled pier in kips (k)

Total settlements, based on the indicated bearing pressures, should be approximately ¾ inch or less for properly designed and constructed drilled piers. Differential settlement may also occur between adjacent piers. The amount of differential settlement could approach 50 to 75 percent of the total pier settlement. For properly designed and constructed piers, differential settlement between adjacent piers is estimated to be less than ½ of an inch. Settlement response of drilled piers is impacted more by the quality of construction than by soil-structure interaction.

Improper pier installation could result in differential settlements significantly greater than we have estimated. In addition, larger magnitudes of settlement should be expected if the soil is subjected to bearing pressures higher than the allowable values presented in this report.

Drilled Shaft Construction Considerations

The pier excavations should be augered and constructed in a continuous manner. Steel and concrete should be placed in the pier excavation immediately following drilling and evaluation for proper bearing stratum, embedment, and cleanliness. In no circumstances should the pier excavation remain open overnight. **Due to the presence of dense Gravel and strong Shale zones, high powered, high torque rock excavation equipment will be necessary.**

Due to the presence of subsurface water and some gravel layers, we recommend that the foundation contractor be prepared to control sloughing of the excavation sidewalls or control water seepage into the pier excavations should they occur. Prior to any excavation, the foundation contractor should verify the subsurface water levels.

Two (2) methods to control sloughing and water seepage include the use of casing and slurry displacement. The casing and slurry methods are discussed in the following paragraphs.

Casing Method - Casing will provide stability of the excavation walls and will reduce water influx; however, casing may not completely eliminate subsurface water influx potential. In order for the casing to be effective, a “water tight” seal must be achieved between the casing and surrounding soils. The drilling subcontractor should determine casing depths and casing procedures. Water that accumulates in excess of six (6) inches in the bottom of the pier excavation should be pumped out prior to steel and concrete placement. If the water is not pumped out, a closed-end tremie should be used to place the concrete completely to the bottom of the pier excavation in a controlled manner to effectively displace the water during concrete placement. If water is not a factor, concrete should be placed with a short tremie so the concrete is directed to the bottom of the pier excavation. The concrete should not be allowed to ricochet off the walls of the pier excavation nor off the reinforcing steel.

If this operation is not successful or to the satisfaction of the Geotechnical Engineer, the pier excavation should be flooded with fresh water to offset the differential water pressure caused by the unbalanced water levels inside and outside of the casing. When the pier excavation depth is achieved and the bearing area has been cleaned, steel and concrete should then be placed immediately in the excavation. The concrete should be tremied completely to the bottom of the excavation with a closed-end tremie.

Removal of casing should be performed with extreme care and under proper supervision to minimize mixing of the surrounding soil and water with the fresh concrete. Rapid withdrawal of casing or the auger may develop suction that could

cause the soil to intrude into the excavation. An insufficient head of concrete in the casing during its withdrawal could also allow the soils to intrude into the wet concrete. Both of these conditions may induce "necking", a section of reduced diameter, in the pier.

Slurry Method - As an alternate to the use of casing to install the pier foundations, water or a weighted drilling fluid may be considered. Slurry displacement drilling can only prevent sloughing and water influx but cannot control sloughing once it has occurred. Therefore, slurry displacement drilling techniques must begin at the ground surface, not after sloughing materials are encountered.

Typical drilling fluids include those which contain polymers or bentonite. If a polymer is used with "hard" mixing water, a water softening agent may be required to achieve intimate mixing and the appropriate viscosity. The polymer manufacturer should be consulted concerning proper use of the polymer. If bentonite slurry is used, the bentonite should be mixed with water several hours before placing in the pier excavation. Prior mixing gives the bentonite sufficient time to hydrate properly. The drilling fluid should only be of sufficient viscosity to control sloughing of the excavation walls and subsurface water flow into the excavation. Care should be exercised while extracting the auger so that suction does not develop and cause disturbance or create "necking" in the excavation walls as described above. Casing should not be employed in conjunction with the slurry drilling technique due to possible trapping of loose soils and slurry between the concrete and natural soil.

The use of weighted drilling fluid when installing drilled pier foundations requires extra effort to ensure an adequate bearing surface is obtained. A clean-out bucket should be used just prior to pier completion in order to remove any cuttings and loose soils which may have accumulated in the bottom of the excavation. Steel and concrete should be placed in the excavation immediately after pier completion. A closed-end tremie should be used to place the concrete completely to the bottom of the excavation in a controlled manner to effectively displace the slurry during concrete placement. The concrete should be placed completely to the bottom of the excavation with a closed-end tremie in the pier excavation if more than six (6) inches of water is ponded on the bearing surface or the water should be pumped from the excavation. A short tremie may be used if the excavation has less than 6 inches of ponded water. The fluid concrete should not be allowed to strike the pier reinforcement, temporary casing (if required) or excavation sidewalls during concrete placement.

All aspects of concrete design and placement should comply with the American Concrete Institute (ACI) 318 Code Building Code Requirements for Structural Concrete, ACI 336.1 Standard Specification for the Construction of Drilled Piers, and ACI 336.3R entitled Suggested Design and Construction Procedures for Pier Foundations.

Foundation Construction Monitoring

The performance of the foundation system for the proposed structure will be highly dependent upon the quality of construction. Thus, we recommend that fill pad compaction and foundation installation be monitored full time by an experienced Terracon soil technician under the direction of our Geotechnical Engineer. During foundation installation, the base should be monitored to evaluate the condition of the subgrade. We would be pleased to develop a plan for compaction and foundation installation monitoring to be incorporated in the overall quality control program.

SEISMIC CONSIDERATIONS

Description	Value
2018 International Building Code Site Classification (IBC) [1]	D [2]
1/ The site class definition was determined using SPT N-values in conjunction with section 1613.3.2 in the 2018 IBC and Table 20.3-1 in the 2016 ASCE-7.	
2/ Borings extended to a maximum depth of 40 feet, and this seismic site class definition considers that similar conditions continue below the maximum depth of the subsurface exploration.	

FLOOR SLABS

Based on the subsurface conditions at this site, both structurally suspended floor slab and grade supported floor slab systems may be considered.

Suspended Floor Slab System

For a structurally suspended floor slab system at this site, Terracon recommends a void space of at least 12-inches beneath the floor slabs, structural beams and subfloor plumbing systems. In many cases, the thickness of the void space is several feet in order to facilitate maintenance activities in the crawl space. **With the structurally suspended floor slab system, the Building Pad Preparation measures presented in this report will not be necessary other than establishing crawlspace grades to ensure drainage.**

Drainage beneath the structure must be designed to remove and/or reduce the possibility of water accumulation in these areas. The subgrade below the floor slab should be sloped to appropriate drainage outlets. Surface and subsurface drainage of water away from the building will enhance the performance of the foundation.

In addition, proper ventilation should be provided to reduce the possibility that a high humidity environment could develop in the void space areas. Measures should be taken to maintain voids beneath the perimeter beams.

Ground-Supported Slab System

For a ground-supported floor slab, subgrade soil within slab area should be prepared as described in the **Building Pad Preparation** section of this report. A PVR of 1 inch has been presented for a ground-supported slab. Several design methods use the modulus of subgrade reaction, k, to account for soil properties in design of flat, floor slabs. The modulus of subgrade reaction is a spring constant that depends on the kind of soil, the degree of compaction, and the moisture content. Depending on the thickness of the granular select fill cap, below are the different k values.

Select Fill Type	Granular Select Fill Thickness	k-value
Granular Select Fill Material	6 inches	100 pci
	12 inches	125 pci
	24 inches	240 pci
	48 inches	375 pci

Fork Lift: We have assumed that portions of the floor slab in the storage buildings may be subjected to forklift traffic. ACI 360 Design of Slabs on Grade discusses slab foundations and forklift type traffic in more detail. Modulus of Subgrade Reaction values for the granular select fill placed immediately beneath the floor slab as given in the table above can be used to analyze/design the floor slab for forklift traffic.

The abrasion resistance to forklift traffic should also be considered for the floor slab. The required abrasion resistance will be in part due to the frequency of the forklift traffic loading, but also on the weight, wheel configuration, and wheel type of forklifts. Some techniques used to increase the floor slab abrasion resistance include:

- Increasing the compressive strength of the concrete;
- Using a more durable aggregate in the concrete mix design (such as, a traprock or chert aggregate versus a limestone aggregate);
- Specifying a surface treatment and finish (such as, using a traprock or metallic aggregate treatment or topping with a hard steel trowel finish); and
- A combination of these techniques.

Forklift traffic can create significant distress in the floor slab if the slab is not properly designed for the loading conditions.

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

PAVEMENTS

Visual Observation Survey

Terracon conducted a visual observation survey to assess the physical condition of the existing pavements. The types of distress that were identified and their severity are furnished in the table below. Photos taken during our survey are provided in the **Attachments**.

Distress Type	Severity
Alligator Cracking	Low to High
Block Cracking	Medium
Patching	Medium
Pot holes	Medium

Approximate thicknesses of existing asphalt and base material at the pavement boring locations are provided below.

Boring Location	Asphalt thickness (inches)	Base Material Thickness (inches)
B-5	1.5	5
B-6	3.0	10.0
B-7	2.0	22.0
B-8	2.0	11.0
B-9	3.0	12.0
B-10	3.0	12.0

Boring Location	Asphalt thickness (inches)	Base Material Thickness (inches)
B-11	2.0	12.0
B-12	2.0	12.0
B-13	2.0	5.0
B-14	2.0	12.0
B-15	2.5	12.0

The recommendations in this report are based upon the data obtained from our field and laboratory programs, project information provided to us and on our experience with similar subsurface and site conditions.

We understand the existing pavement sections on the west side of the property will be repaired and new access road in the east side of the property will be constructed. Based on the pavement condition and our experience in similar projects, we recommend the following two options as discussed below to repair the pavements on the west side of the property.

Option 1 - Seal Coat

- Asphalt emulsion sealer must meet all applicable EPA requirements.
- Clean parking area of loose debris.
- Pre-treat oil spots.
- Apply first coat squeezed, and then apply second coat sprayed.

Option 2 - Mill and Overlay

- Mill 2 inches of the existing surface.
- Proofroll and observe the pavement for any cracks, weak and soft zones.
- If any cracks and joints are present, clean them aggressively. Seal cracks and joints. The sealer should meet TxDOT Item 712.
- After the crack sealing operation is completed, the area should be cleaned of loose debris.

- Tack coat should be sprayed to the sealed and repaired surface, and then place the Type C (PG 70-22 or higher) HMAC meeting TxDOT Item 340, to achieve the required elevations.

Areas with minor distress levels can be remediated with Seal Coating Option. Areas with high distress levels should be repaired with the Mill and Overlay option or undergo a complete rebuild. Determination of the appropriate option should be made by the project Civil Engineer on a case-by-case basis.

Construction of a New Pavement Section

Both flexible and rigid pavement systems may be considered for the project. Based on our knowledge of the project, we anticipate that traffic loads will be produced primarily by automobile traffic, delivery and trash removal trucks.

Subgrade Preparation

Prior to construction, any vegetation, loose topsoil and any otherwise unsuitable materials should be removed from the new pavement areas. After stripping, the subgrade should be proof-rolled where possible to aid in locating loose or soft areas. Proof-rolling can be performed with a 15-ton roller or fully loaded dump truck. Wet, soft, low-density or dry material should either be removed or moisture conditioned and recompacted to the moisture contents and densities described in section **Fill Compaction Requirements** prior to placing fill.

Due to the presence of the expansive clay soil at the site, some movement of the pavements should be expected. If the movement of the pavement is not acceptable, then the pavement subgrade should be prepared similar to the building pad provided in the **Building Pad Preparation** section of this report.

Design Recommendations

For this project Light and Heavy pavement section alternatives have been provided. Light is for areas expected to receive only passenger vehicles. Heavy assumes areas with heavy traffic, such as trash pickup areas, delivery areas and main access drive areas.

The flexible pavement section was designed in general accordance with the National Asphalt Pavement Association (NAPA) Information Series (IS-109) method (Class 1 for Light and Class 2 for Heavy). The rigid pavement section was designed using the American Concrete Institute (ACI 330R-01) method (Traffic Category A (ADTT=0) for Light and A-1 (ADTT=10) for Heavy). If heavier traffic loading is expected, Terracon should be provided with the information and allowed to review these pavement sections.

Layer	FLEXIBLE PAVEMENT SYSTEM (inches)			
	Raw Subgrade		Modified Subgrade	
	Light Duty	Heavy Duty	Light Duty	Heavy Duty
Hot Mix Asphaltic Concrete	5.0	5.5	5.0	5.5
Granular Base Material [1]	8.0	13.0	7.0	10.0
Modified Subgrade (hydrated lime) [2,3]	----	----	6.0	6.0
Moisture Conditioned Subgrade	6.0	6.0	----	----

1/ Asphaltic base material may be used in place of crushed limestone base material. Every 2.5 inches of crushed limestone base material may be replaced with 1 inch of asphaltic base material. However, the minimum thickness of the asphaltic base material is 4 inches.

2/ Tensar TX 130 geogrid may be used in lieu of modified subgrade. The geogrid should be placed at the bottom of the base course, and on top of the pavement subgrade.

3/ The subgrade should be tested for sulfates prior to the use of lime.

Layer	RIGID PAVEMENT SYSTEM (inches)			
	Raw Subgrade		Modified Subgrade	
	Light Duty	Heavy Duty	Light Duty	Heavy Duty
Concrete	8.0	9.0	8.0	9.0
Granular Base Material [1]	8.0	9.0	7.0	8.0
Geogrid	Tensar TX-5	Tensar TX-5	Tensar TX-5	Tensar TX-5
Modified Subgrade (hydrated lime) [2]	----	----	8.0	8.0
Moisture Conditioned Subgrade	8.0	8.0	----	----

. 1/ Asphaltic base material (Type A or B) may be used in place of crushed limestone base material. Every 2½ inches of crushed limestone base material may be replaced with 1 inch of asphaltic base material. However, the minimum thickness of the asphaltic base material is 4 inches.

2/ The subgrade should be tested for sulfates prior to the use of lime

Pavement areas that will be subjected to heavy wheel and traffic volumes, such as waste bin or "dumpster" areas, entrance/exit ramps, and delivery areas, should be a heavy duty rigid pavement section constructed of reinforced concrete. The concrete pavement areas should be large enough to properly accommodate the vehicular traffic and loads. For example:

- The dumpster pad should be large enough so that the wheels of the collection truck are entirely supported on the concrete pavement during lifting of the waste bin; and

- The concrete pavement should extend beyond any areas that require extensive turning, stopping, and maneuvering.

The pavement section has been designed using generally recognized structural coefficients for the pavement materials. These structural coefficients reflect the relative strength of the pavement materials and their contribution to the structural integrity of the pavement. If the pavement does not drain properly, it is likely that ponded water will infiltrate the pavement materials resulting in a weakening of the materials. As a result, the structural coefficients of the pavement materials will be reduced and the life and performance of the pavement will be shortened. The Asphalt Institute recommends a minimum of 2 percent slope for asphalt pavements. The importance of proper drainage cannot be overemphasized and should be thoroughly considered by the project team.

Pavement Section Materials

Presented below are selection and preparation guidelines for various materials that may be used to construct the pavement sections. Submittals should be made for each pavement material. The submittals should be reviewed by the Geotechnical Engineer and appropriate members of the design team and should provide test information necessary to verify full compliance with the recommended or specified material properties.

- **Hot Mix Asphaltic Concrete Surface Course** - The asphaltic concrete surface course should be plant mixed, hot laid Type C or D Surface. Each mix should meet the master specifications requirements of 2014 TXDOT Standard Specifications Item 341, Item SS 3224 (2011) and specific criteria for the job mix formula. The mix should be compacted between 91 and 95 percent of the maximum theoretical density as measured by TEX-227-F. The asphalt cement content by percent of total mixture weight should fall within a tolerance of ±0.3 percent asphalt cement from the specific mix. In addition, the mix should be designed so 75 to 85 percent of the voids in the mineral aggregate (VMA) are filled with asphalt cement. The grade of the asphalt cement should be PG 70-22 or higher performance grade. Aggregates known to be prone to stripping should not be used in the hot mix. If such aggregates are used measures should be taken to mitigate this concern. The mix should have at least 70 percent strength retention when tested in accordance with TEX-531-C.

  Pavement specimens, which shall be either cores or sections of asphaltic pavement, will be tested according to Test Method TEX-207-F. The nuclear-density gauge or other methods which correlate satisfactorily with results obtained from project pavement specimens may be used when approved by the Engineer. Unless otherwise shown on the plans, the Contractor shall be responsible for obtaining the required pavement specimens at their expense and in a manner and at locations selected by the Engineer.

- **Concrete** - Concrete should have a minimum 28-day design compressive strength of 4,000 psi.

- **Granular Base Material** - Base material may be composed of crushed limestone base meeting all of the requirements of 2014 TxDOT Item 247, Type A, Grade 1-2; including triaxial strength. The material should be compacted to at least 95 percent of the maximum dry density as determined in accordance with ASTM D 1557 at moisture contents ranging from -2 and +3 percentage points of the optimum moisture content.

- **Modified Subgrade** - Due to the presence of clay at this site, the subgrade may be modified with hydrated lime in accordance with TxDOT Item 260 in order to improve its strength and improve its load carrying capacity. We anticipate that approximately 6 percent hydrated lime will be required. This is equivalent to about 30 pounds of hydrated lime per square yard for a 6-inch treatment depth. However, the actual percentage should be determined by laboratory tests on samples of the clayey subgrade prior to construction. Additionally, the subgrade should be tested for sulfates prior to the use of lime. The optimum lime content should result in a soil-lime mixture with a pH of at least 12.4 when tested in accordance with ASTM C 977, Appendix XI and should reduce the Plasticity Index to 20 or less.

  The lime should be initially blended with a mixing device such as a Pulvermixer, sufficient water added, and be allowed to cure for at least 48 hours. After curing, the lime-soil should be remixed to meet the in-place gradation requirements of Item 260 and compacted to at least 95 percent of the maximum dry density determined in accordance with ASTM D 698 at moisture contents ranging from optimum and 4 percentage points above the optimum moisture content.

- **Moisture Conditioned Subgrade** - The subgrade should be scarified to a depth of 6 inches and then moisture conditioned and compacted as recommended in the Compaction Requirements section of this report.

Details regarding subgrade preparation, fill materials, placement and compaction are presented in **Earthwork** section under subsections **Fill Material Types** and **Fill Compaction Requirements**.

Pavement Joints and Reinforcement

The following is recommended for all concrete pavement sections in this report. Refer to ACI 330 “Guide for Design and Construction of Concrete Parking Lots” for additional information.

Item	Description
Distributed Reinforcing Steel	No. 3 reinforcing steel bars at 18 inches on-center-each-way, Grade 60. It is imperative that the distributed steel be positioned accurately in the pavement cross section, namely 2 inches from the top of the pavement.
Contraction Joint Spacing	12.5 feet each way for pavement thickness of 5 to 5.5 inches. 15 feet each way for pavement thickness of 6 inches or greater. Saw cut control joints should be cut within 6 to 12 hours of concrete placement.
Contraction Joint Depth	At least ¼ of pavement thickness.
Contraction Joint Width	One-fourth inch or as required by joint sealant manufacturer.
Construction Joint Spacing	To attempt to limit the quantity of joints in the pavement, consideration can be given to installing construction joints at contraction joint locations, where it is applicable.
Construction Joint Depth/Width	Full depth of pavement thickness. Construct sealant reservoir along one edge of the joint. Width of reservoir to be ¼ inch or as required by joint sealant manufacturer. Depth of reservoir to be at least ¼ of pavement thickness.
Isolation Joint Spacing	As required to isolate pavement from structures, etc.
Isolation Joint Depth	Full depth of pavement thickness.
Isolation Joint Width	½ to 1 inch or as required by the joint sealant manufacturer.
Expansion Joint	In this locale, drying shrinkage of concrete typically significantly exceeds anticipated expansion due to thermal affects. As a result, the need for expansion joints is eliminated provided all joints (including saw cuts) are sealed. Construction of an unnecessary joint may be also become a maintenance problem. All joints should be sealed. If all joints, including sawcuts, are not sealed then expansion joints should be installed.

All construction joints have dowels. Dowel information varies with pavement thickness as presented as follows:

Parameter	8 inches thick slab	9 inches thick slab
Dowel Diameter	1 inch	1-⅛ inch
Dowel Spacing	12 inches on center	12 inches on center
Dowel Length	14 inches	16 inches
Dowel Embedment	6 inches	7 inches

Pavement Drainage and Maintenance

Long-term pavement performance will be dependent upon several factors, including maintaining subgrade moisture levels and providing for preventative maintenance. Water allowed to pond on or adjacent to the pavements could saturate the subgrade and contribute to premature pavement deterioration. Proper perimeter drainage is very important and should be provided so infiltration of surface water from unpaved areas surrounding the pavement is minimized. We do not recommend installation of landscape beds or islands in the pavement areas. Such features provide an avenue for water to enter the pavement section and underlying soil subgrade.

The following recommendations should be implemented to help promote long-term pavement performance:

- The subgrade and the pavement surface should be designed to promote proper surface drainage, preferably at a minimum grade of 2 percent.
- Install joint sealant and seal cracks immediately.
- Extend curbs into the treated subgrade for a depth of at least 3 inches to help reduce moisture migration into the subgrade soils beneath the pavement section.
- Place compacted, low permeability clayey backfill against the exterior side of the curb and gutter.
- Slope subgrade in landscape islands to low points should drain to an appropriate outlet.
- Edge drains are recommended along pavement/ landscape borders.
- Strip (wick) drains installed behind the curbs will also help protect the pavements from water which ponds behind the curbs.

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. Natural 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 or collaboration through this system 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 impact 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. 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.

ATTACHMENTS

EXPLORATION AND TESTING PROCEDURES

Field Exploration

Boring Layout and Elevations: We used handheld GPS equipment to locate borings with an estimated horizontal accuracy of +/-20 feet.

Subsurface Exploration Procedures: We advanced the soil borings with a truck-mounted drill rig using continuous flight augers (solid stem and/or hollow stem, as necessary, depending on soil conditions). Five samples were obtained in the upper 10 feet of each boring and at intervals of 5 feet thereafter. Soil sampling was performed using thin-wall tube and/or split-barrel sampling procedures. In the thin-walled tube sampling procedure, a thin-walled, seamless steel tube with a sharp cutting edge was pushed hydraulically into the soil to obtain a relatively undisturbed sample. In the split barrel sampling procedure, a standard 2-inch outer diameter split barrel sampling spoon was driven into the ground by a 140-pound automatic hammer falling a distance of 30 inches. The number of blows required to advance the sampling spoon the last 12 inches of a normal 18-inch penetration was recorded as the Standard Penetration Test (SPT) resistance value. The SPT resistance values, also referred to as N-values, are indicated on the boring logs at the test depths. We observed and recorded groundwater levels during drilling and sampling. For safety purposes, all borings were backfilled with auger cuttings after their completion. Pavements were patched with cold-mix asphalt and/or pre-mixed concrete, as appropriate.

The sampling depths, penetration distances, and other sampling information were recorded on the field boring 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 boring logs as part of the drilling operations. These field logs included visual classification of the materials encountered during drilling and our interpretation of the subsurface conditions between samples.

Laboratory Testing

Samples retrieved during the field exploration were taken to the laboratory for further observation by the project geotechnical engineer and were classified in accordance with the Unified Soil Classification System (USCS) described in this Appendix. At that time, the field descriptions were confirmed or modified as necessary and an applicable laboratory testing program was formulated to determine engineering properties of the subsurface materials.

Laboratory tests were conducted on selected soil samples and the test results are presented in this appendix. The laboratory test results were used for the development of foundation and earthwork recommendations. Laboratory tests were performed in general accordance with the applicable ASTM, local or other accepted standards.

Selected soil samples obtained from the site were tested for the following engineering properties:

- Moisture Content
- Atterberg Limits
- Soil Finer than No. 200 Mesh Sieve

Final boring logs that were prepared represented the Geotechnical Engineer's interpretation of the field logs and include modifications based on observations and tests of the samples in our laboratory.

SITE LOCATION AND EXPLORATION PLAN

SITE LOCATION

Ft. Sam National Cemetery Phase 3 Expansion & Improvements ■ San Antonio, TX
May 5, 2020 ■ Terracon Project No. 90195179

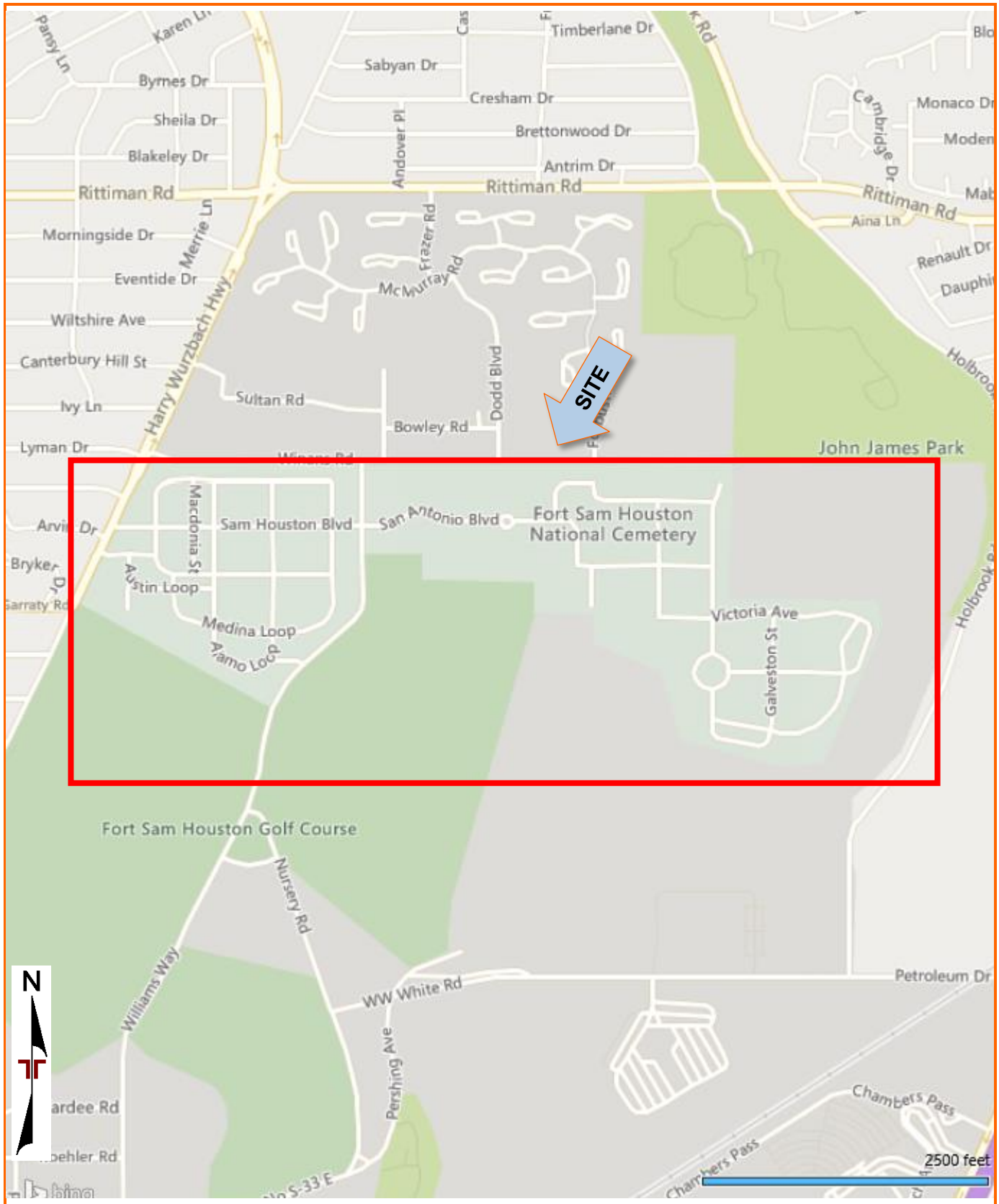


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

EXPLORATION PLAN (ALL BORINGS)

Ft. Sam National Cemetery Phase 3 Expansion and Improvements ■ San Antonio, Texas

May 5, 2020 ■ Terracon Project No. 90195179

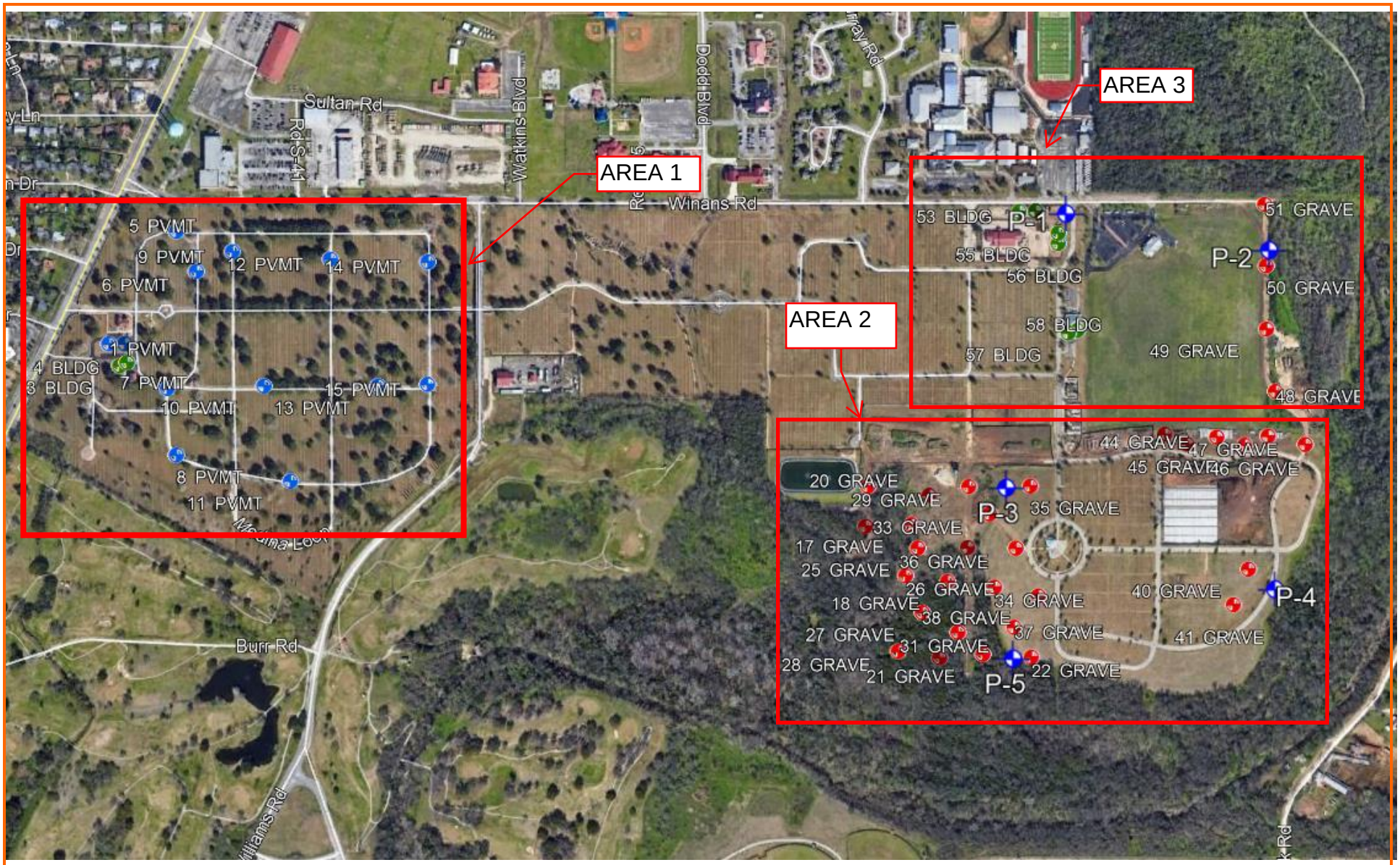


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY GOOGLE EARTH

EXPLORATION PLAN (AREA 1)

Ft. Sam National Cemetery Phase 3 Expansion and Improvements ■ San Antonio, Texas

May 5, 2020 ■ Terracon Project No. 90195179

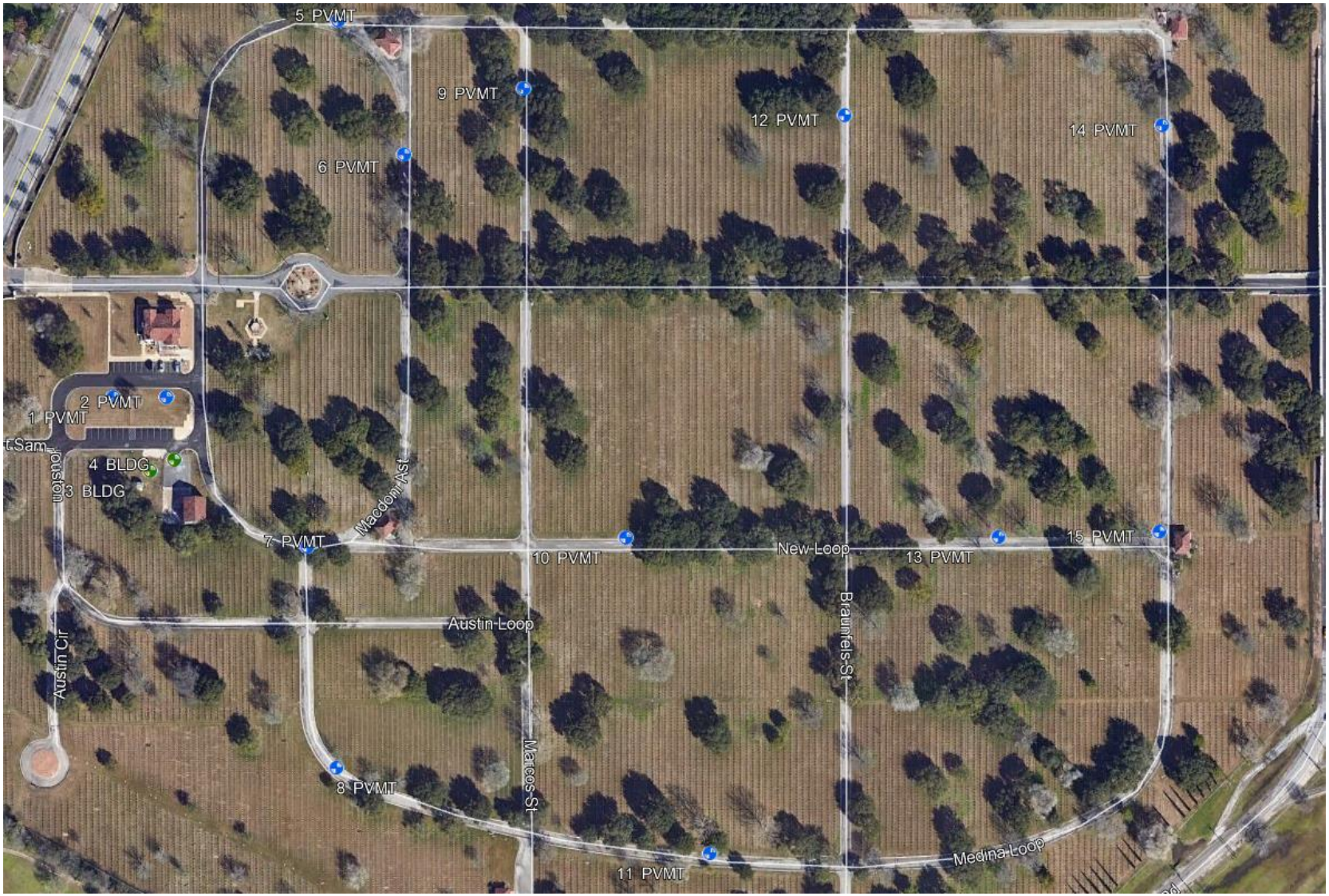


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY GOOGLE EARTH

EXPLORATION PLAN (AREA 2)

Ft. Sam National Cemetery Phase 3 Expansion and Improvements ■ San Antonio, Texas
May 5, 2020 ■ Terracon Project No. 90195179

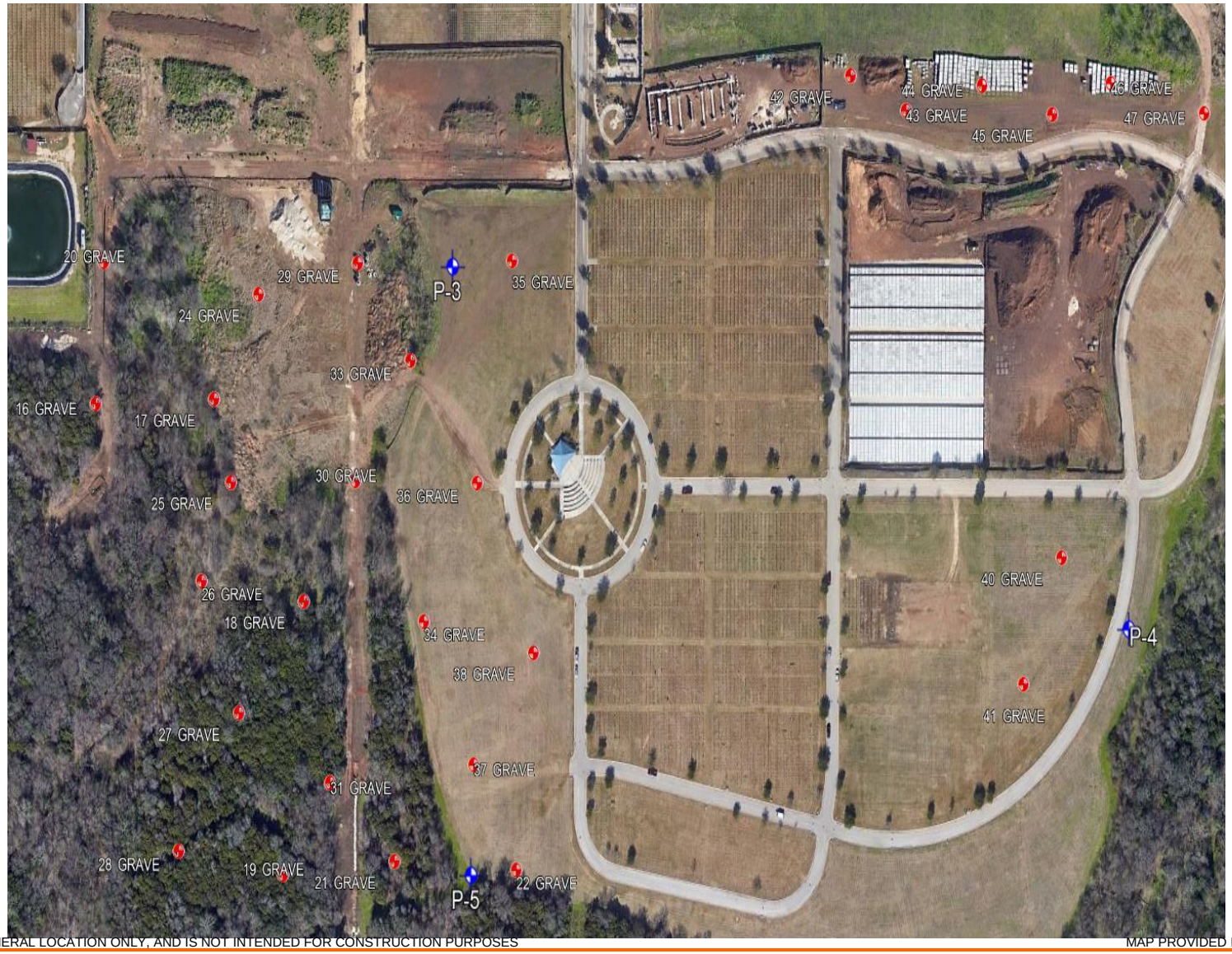


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY GOOGLE EARTH

EXPLORATION PLAN (AREA 3)

Ft. Sam National Cemetery Phase 3 Expansion and Improvements ■ San Antonio, Texas
May 5, 2020 ■ Terracon Project No. 90195179

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY GOOGLE EARTH

PHOTOGRAPHY LOG

EXPLORATION RESULTS

BORING LOG NO. B-1

PROJECT: Ft. Sam Houston National Cemetery Phase 3 Expansion & Improvements

CLIENT: Anderson Engineering of Minnesota, LLC Plymouth, MN

SITE: 1520 Harry Wurzbach Rd San Antonio, TX

LOCATION See Exploration Plan

Latitude: 29.4763° Longitude: -98.4337°

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
LEAN CLAY (CL), dark brown, very stiff, with sand and trace gravel					6-8-10 N=18	16	33-10-23	
4.0					11-11-8 N=19	15		70
FAT CLAY (CH), dark brown, stiff to very stiff		5			3-3-6 N=9	26		
- yellowish brown below 6 feet					6-8-10 N=18	25		
10.0		10			4-8-9 N=17	24		
Boring Terminated at 10 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Flight Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

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:
Pavement Boring

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 09-10-2019 | Boring Completed: 09-10-2019

Drill Rig: CME 75 | Driller: Ramco

Project No.: 90195179

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 90195179.GPJ TERRACON_DATATEMPLATE.GDT 12/20/19

BORING LOG NO. B-2

PROJECT: Ft. Sam Houston National Cemetery Phase 3 Expansion & Improvements

CLIENT: Anderson Engineering of Minnesota, LLC Plymouth, MN

SITE: 1520 Harry Wurzbach Rd San Antonio, TX

LOCATION See Exploration Plan

Latitude: 29.4763° Longitude: -98.4334°

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
FILL - CLAYEY GRAVEL (GC), brown to yellowish brown, dense					8-11-19 N=30	11		
2.0 **LEAN CLAY (CL)**, dark brown, very stiff, with sand and trace gravel					13-8-14 N=22	19	28-19-9	
4.0 **FAT CLAY (CH)**, dark brown, stiff to very stiff		5			3-4-6 N=10	29		
- yellowish brown below 6 feet					4-8-12 N=20	26		
10.0		10			4-8-11 N=19	17		
Boring Terminated at 10 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Flight Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

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:
Pavement Boring

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 09-10-2019 | Boring Completed: 09-10-2019

Drill Rig: CME 75 | Driller: Ramco

Project No.: 90195179

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 90195179.GPJ TERRACON_DATATEMPLATE.GDT 12/20/19

BORING LOG NO. B-3

PROJECT: Ft. Sam Houston National Cemetery Phase 3 Expansion & Improvements

CLIENT: Anderson Engineering of Minnesota, LLC Plymouth, MN

SITE: 1520 Harry Wurzbach Rd San Antonio, TX

LOCATION See Exploration Plan

Latitude: 29.476° Longitude: -98.4335°

Surface Elev.: 720 (Ft.)

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
1		**FAT CLAY (CH)**, dark brown, medium stiff to very stiff, with sand and trace gravel					3-3-3 N=6	14	61-21-40	
							5-3-4 N=7	15	61-23-38	
				5			5-6-6 N=12	18	75-17-58	
		- brown below 6 feet					7-10-12 N=22	34	70-21-49	
							6-8-12 N=20	27	73-19-54	
				10						
							5-9-10 N=19	23		97
				15						
		- gypsum deposits between 18 and 20 feet					8-10-12 N=22	20		
				20						
							13-8-9 N=17	20	57-17-40	
				25						
							10-12-16 N=28	19		
				30						
		- gypsum deposits below 33 feet					9-12-17 N=29	22		
				35						
		40.0	680	40			11-10-11 N=21	22		
		Boring Terminated at 40 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Flight Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

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:
Honor Guard Building Boring

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 09-04-2019 | Boring Completed: 09-04-2019

Drill Rig: CME 75 | Driller: Ramco

Project No.: 90195179

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL HONOR GUARD.GPJ TERRACON_DATATEMPLATE.GDT 12/20/19

BORING LOG NO. B-4

PROJECT: Ft. Sam Houston National Cemetery Phase 3 Expansion & Improvements

CLIENT: Anderson Engineering of Minnesota, LLC Plymouth, MN

SITE: 1520 Harry Wurzbach Rd San Antonio, TX

LOCATION See Exploration Plan

Latitude: 29.4761° Longitude: -98.4334°

Surface Elev.: 720 (Ft.)

MODEL LAYER	DEPTH	ELEVATION (Ft.)	Description
	0.2	720	**Asphalt 2 inches thick**
	1.3	719	**Base Material 13 inches thick**
1			**FAT CLAY (CH)**, dark brown, medium stiff to hard
			- yellowish brown and light gray below 6 feet
			- gypsum deposits below 18 feet
	40.0	680	***Boring Terminated at 40 Feet***

DEPTH (Ft.)	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		9-3-3 N=6	25		
		3-5-6 N=11	25	73-19-54	
5		2-4-6 N=10	25		
		8-8-13 N=21	24		98
10		4.5+ (HP)	25	71-19-52	
15		7-11-17 N=28	24		
20		6-10-12 N=22	26		
25		9-11-16 N=27	24		
30		9-12-17 N=29	20		
35		14-16-17 N=33	22		
40		14-18-21 N=39	22		

WATER LEVEL OBSERVATIONS

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Flight Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite
Surface Capped with Asphalt

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:
Honor Guard Building Boring

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 09-10-2019 | Boring Completed: 09-10-2019

Drill Rig: CME 75 | Driller: Ramco

Project No.: 90195179

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL HONOR GUARD.GPJ TERRACON_DATATEMPLATE.GDT 12/20/19

BORING LOG NO. B-5

PROJECT: Ft. Sam Houston National Cemetery Phase 3 Expansion & Improvements

CLIENT: Anderson Engineering of Minnesota, LLC Plymouth, MN

SITE: 1520 Harry Wurzbach Rd San Antonio, TX

LOCATION See Exploration Plan

Latitude: 29.478° Longitude: -98.4326°

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.1	**Asphalt 1.5 inches thick**							
0.5	**Base Material 5 inches thick**							
2.0	**FAT CLAY (CH)**, dark brown, stiff				4-6-7 N=13	20	61-17-44	
	LEAN CLAY (CL), dark brown, very stiff to hard				7-9-11 N=20	15		
		5			5-6-10 N=16	14		
					7-15-20 N=35	13	40-15-25	
10.0		10			7-15-23 N=38	15		

Boring Terminated at 10 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Flight Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite
Surface Capped with Asphalt

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:
Pavement Boring

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 09-06-2019 | Boring Completed: 09-06-2019

Drill Rig: CME 75 | Driller: Ramco

Project No.: 90195179

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 90195179.GPJ TERRACON_DATATEMPLATE.GDT 12/20/19

BORING LOG NO. B-6

PROJECT: Ft. Sam Houston National Cemetery Phase 3 Expansion & Improvements

CLIENT: Anderson Engineering of Minnesota, LLC Plymouth, MN

SITE: 1520 Harry Wurzbach Rd San Antonio, TX

LOCATION See Exploration Plan

Latitude: 29.4774° Longitude: -98.4323°

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.3	**Asphalt 3 inches thick**							
1.1	**Base Material 10 inches thick**							
	FAT CLAY (CH), brown, medium stiff to very stiff				4-3-4 N=7	24		
					5-6-11 N=17	22	60-17-43	
	- yellowish brown below 4 feet - gypsum deposits between 4 and 8 feet	5			4-5-7 N=12	17		
					8-11-14 N=25	14		
10.0		10			8-9-15 N=24	20		
	Boring Terminated at 10 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Flight Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite
Surface Capped with Asphalt

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:
Pavement Boring

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 09-10-2019 | Boring Completed: 09-10-2019

Drill Rig: CME 75 | Driller: Ramco

Project No.: 90195179

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 90195179.GPJ TERRACON_DATATEMPLATE.GDT 12/20/19

BORING LOG NO. B-7

PROJECT: Ft. Sam Houston National Cemetery Phase 3 Expansion & Improvements

CLIENT: Anderson Engineering of Minnesota, LLC Plymouth, MN

SITE: 1520 Harry Wurzbach Rd San Antonio, TX

LOCATION See Exploration Plan

Latitude: 29.4757° Longitude: -98.4327°

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.2	**Asphalt 2 inches thick**							
2.0	**Base Material 22 inches thick**							
	FAT CLAY (CH), yellowish brown, very stiff to hard				7-8-9 N=17	2		
					5-5-9 N=14	18		
		5			8-11-16 N=27	19	68-21-47	
					6-11-13 N=24	19		99
10.0					10-14-19 N=33	21		
	Boring Terminated at 10 Feet	10						

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Flight Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite
Surface Capped with Asphalt

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:
Pavement Boring

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 09-10-2019 | Boring Completed: 09-10-2019

Drill Rig: CME 75 | Driller: Ramco

Project No.: 90195179

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 90195179.GPJ TERRACON_DATATEMPLATE.GDT 12/20/19

BORING LOG NO. B-8

PROJECT: Ft. Sam Houston National Cemetery Phase 3 Expansion & Improvements

CLIENT: Anderson Engineering of Minnesota, LLC Plymouth, MN

SITE: 1520 Harry Wurzbach Rd San Antonio, TX

LOCATION See Exploration Plan

Latitude: 29.4747° Longitude: -98.4326°

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.2	**Asphalt 2 inches thick**							
1.1	**Base Material 11 inches thick**							
	FAT CLAY (CH), dark brown, stiff to very stiff				12-4-4 N=8	24	65-16-49	
					7-9-11 N=20	29		
	- yellowish brown below 4 feet	5			3-5-5 N=10	28		
					7-8-13 N=21	24		
10.0		10			7-8-12 N=20	25		
	Boring Terminated at 10 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Flight Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite
Surface Capped with Asphalt

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:
Pavement Boring

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 09-10-2019 | Boring Completed: 09-10-2019

Drill Rig: CME 75 | Driller: Ramco

Project No.: 90195179

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 90195179.GPJ TERRACON_DATATEMPLATE.GDT 12/20/19

BORING LOG NO. B-9

PROJECT: Ft. Sam Houston National Cemetery Phase 3 Expansion & Improvements

CLIENT: Anderson Engineering of Minnesota, LLC Plymouth, MN

SITE: 1520 Harry Wurzbach Rd San Antonio, TX

LOCATION See Exploration Plan

Latitude: 29.4777° Longitude: -98.4317°

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.3 **Asphalt 3 inches thick**								
1.3 **Base Material 12 inches thick**								
FAT CLAY (CH), dark brown, stiff to hard					2-3-6 N=9	22		
					6-8-11 N=19	17		
- yellowish brown below 4 feet		5			4-6-8 N=14	23		
					6-8-9 N=17	14	61-15-46	
10.0		10			9-15-21 N=36	16		
Boring Terminated at 10 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Flight Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite
Surface Capped with Asphalt

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:
Pavement Boring

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 09-10-2019 | Boring Completed: 09-10-2019

Drill Rig: CME 75 | Driller: Ramco

Project No.: 90195179

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 90195179.GPJ TERRACON_DATATEMPLATE.GDT 12/20/19

BORING LOG NO. B-10

PROJECT: Ft. Sam Houston National Cemetery Phase 3 Expansion & Improvements

CLIENT: Anderson Engineering of Minnesota, LLC Plymouth, MN

SITE: 1520 Harry Wurzbach Rd San Antonio, TX

LOCATION See Exploration Plan

Latitude: 29.4757° Longitude: -98.4312°

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.3 **Asphalt 3 inches thick**								
1.3 **Base Material 12 inches thick**								
FAT CLAY (CH), dark brown, stiff to very stiff					3-5-6 N=11	24		
					6-6-10 N=16	25		
- yellowish brown below 4 feet		5			4-5-7 N=12	26		
					5-6-10 N=16	23	64-15-49	
10.0		10			4-6-8 N=14	26		
Boring Terminated at 10 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Flight Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite
Surface Capped with Asphalt

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:
Pavement Boring

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 09-10-2019 | Boring Completed: 09-10-2019

Drill Rig: CME 75 | Driller: Ramco

Project No.: 90195179

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 90195179.GPJ TERRACON_DATATEMPLATE.GDT 12/20/19

BORING LOG NO. B-11

PROJECT: Ft. Sam Houston National Cemetery Phase 3 Expansion & Improvements

CLIENT: Anderson Engineering of Minnesota, LLC Plymouth, MN

SITE: 1520 Harry Wurzbach Rd San Antonio, TX

LOCATION See Exploration Plan

Latitude: 29.4743° Longitude: -98.4307°

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.2 **Asphalt 2 inches thick**								
1.2 **Base Material 12 inches thick**								
FAT CLAY (CH), dark brown, medium stiff to very stiff					4-2-2 N=4	27		
					7-5-9 N=14	33	75-21-54	
		5			2-3-5 N=8	25		
- yellowish brown below 6 feet					5-7-9 N=16	26		
10.0		10			4-6-7 N=13	23		
Boring Terminated at 10 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Flight Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite
Surface Capped with Asphalt

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:
Pavement Boring

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 09-10-2019 | Boring Completed: 09-10-2019

Drill Rig: CME 75 | Driller: Ramco

Project No.: 90195179

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 90195179.GPJ TERRACON_DATATEMPLATE.GDT 12/20/19

BORING LOG NO. B-12

PROJECT: Ft. Sam Houston National Cemetery Phase 3 Expansion & Improvements

CLIENT: Anderson Engineering of Minnesota, LLC Plymouth, MN

SITE: 1520 Harry Wurzbach Rd San Antonio, TX

LOCATION See Exploration Plan

Latitude: 29.4776° Longitude: -98.4301°

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.2 **Asphalt 2 inches thick**								
1.2 **Base Material 12 inches thick**								
FAT CLAY (CH), dark brown, stiff to very stiff					5-6-7 N=13	5		
					6-9-13 N=22	19	73-18-55	
		5			6-9-11 N=20	18		
- brown between 6 and 8 feet					4-7-12 N=19	18	68-16-52	
- light brown with gypsum deposits below 8 feet					4-6-9 N=15	16		93
10.0		10						
Boring Terminated at 10 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Flight Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite
Surface Capped with Asphalt

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:
Pavement Boring

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 09-06-2019 | Boring Completed: 09-06-2019

Drill Rig: CME 75 | Driller: Ramco

Project No.: 90195179

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 90195179.GPJ TERRACON_DATATEMPLATE.GDT 12/20/19

BORING LOG NO. B-13

PROJECT: Ft. Sam Houston National Cemetery Phase 3 Expansion & Improvements

CLIENT: Anderson Engineering of Minnesota, LLC Plymouth, MN

SITE: 1520 Harry Wurzbach Rd San Antonio, TX

LOCATION See Exploration Plan

Latitude: 29.4757° Longitude: -98.4293°

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.2	**Asphalt 2 inches thick**							
0.6	**Base Material 5 inches thick**							
	FAT CLAY (CH), dark brown, stiff to very stiff				4-4-5 N=9	20	71-20-51	
					6-7-10 N=17	20		94
		5			4-7-9 N=16	20		
					9-10-14 N=24	19	69-18-51	
	- light brown below 8 feet				5-7-10 N=17	24		
10.0		10						
	Boring Terminated at 10 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Flight Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite
Surface Capped with Asphalt

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:
Pavement Boring

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 09-06-2019 | Boring Completed: 09-06-2019

Drill Rig: CME 75 | Driller: Ramco

Project No.: 90195179

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 90195179.GPJ TERRACON_DATATEMPLATE.GDT 12/20/19

BORING LOG NO. B-14

PROJECT: Ft. Sam Houston National Cemetery Phase 3 Expansion & Improvements

CLIENT: Anderson Engineering of Minnesota, LLC Plymouth, MN

SITE: 1520 Harry Wurzbach Rd San Antonio, TX

LOCATION See Exploration Plan

Latitude: 29.4775° Longitude: -98.4285°

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.2	**Asphalt 2 inches thick**							
1.2	**Base Material 12 inches thick**							
	FAT CLAY (CH), dark brown, stiff to very stiff				7-5-7 N=12	20		
					3-7-10 N=17	14	73-11-62	
		5			6-9-12 N=21	18		
	- light brown with gypsum seams below 6 feet				10-16-20 N=36	18		87
10.0		10			6-7-11 N=18	21	62-16-46	
	Boring Terminated at 10 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Flight Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite
Surface Capped with Asphalt

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:
Pavement Boring

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 09-03-2019 | Boring Completed: 09-03-2019

Drill Rig: CME 75 | Driller: Ramco

Project No.: 90195179

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 90195179.GPJ TERRACON_DATATEMPLATE.GDT 12/20/19

BORING LOG NO. B-15

PROJECT: Ft. Sam Houston National Cemetery Phase 3 Expansion & Improvements

CLIENT: Anderson Engineering of Minnesota, LLC Plymouth, MN

SITE: 1520 Harry Wurzbach Rd San Antonio, TX

LOCATION See Exploration Plan

Latitude: 29.4758° Longitude: -98.4285°

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.2 **Asphalt 2.5 inches thick**								
1.2 **Base Material 12 inches thick**								
FAT CLAY (CH), dark brown, stiff to very stiff					3-4-5 N=9	20		
					3-4-5 N=9	20	55-17-38	
- brown between 4 and 6 feet		5			4-4-6 N=10	20		
- light brown below 6 feet					4-5-4 N=9	19	60-16-44	
- gypsum deposits below 8 feet					4-7-9 N=16	24		
10.0 ***Boring Terminated at 10 Feet***		10						

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Flight Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite
Surface Capped with Asphalt

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:
Pavement Boring

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 09-03-2019 | Boring Completed: 09-03-2019

Drill Rig: CME 75 | Driller: Ramco

Project No.: 90195179

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 90195179.GPJ TERRACON_DATATEMPLATE.GDT 12/20/19

BORING LOG NO. B-16

PROJECT: Ft. Sam Houston National Cemetery Phase 3 Expansion & Improvements

CLIENT: Anderson Engineering of Minnesota, LLC Plymouth, MN

SITE: 1520 Harry Wurzbach Rd San Antonio, TX

LOCATION See Exploration Plan

Latitude: 29.4737° Longitude: -98.4212°

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	FAT CLAY (CH), dark brown, stiff to very stiff				2-3-7 N=10	25	54-18-36	
					8-12-13 N=25	18		
4.0	**CLAYEY GRAVEL WITH SAND (GC)**, tan, medium dense	5			6-7-12 N=19	6	42-16-26	
	- tan below 6 feet				16-10-17 N=27	10		11
8.0	**FAT CLAY (CH)**, tan, stiff to very stiff				4-5-7 N=12	21		
		10			3-9-15 N=24	17		
12.0	***Boring Terminated at 12 Feet***							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Flight Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

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:
Grave Boring

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 11-21-2019 | Boring Completed: 11-21-2019

Drill Rig: CME 75 | Driller: Ramco

Project No.: 90195179

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 90195179.GPJ TERRACON_DATATEMPLATE.GDT 12/20/19

BORING LOG NO. B-17

PROJECT: Ft. Sam Houston National Cemetery Phase 3 Expansion & Improvements

CLIENT: Anderson Engineering of Minnesota, LLC Plymouth, MN

SITE: 1520 Harry Wurzbach Rd San Antonio, TX

LOCATION See Exploration Plan

Latitude: 29.4737° Longitude: -98.4205°

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
LEAN CLAY (CL), dark brown, medium stiff to stiff					2-3-3 N=6	12		
					3-4-5 N=9	15		
4.0 **FAT CLAY (CH)**, dark brown, medium stiff to stiff		5			2-2-3 N=5	27	51-19-32	
					4-4-6 N=10	28		
		10			3-7-8 N=15	21	55-21-34	
- brown below 10 feet					3-4-5 N=9	20		
12.0 ***Boring Terminated at 12 Feet***								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Flight Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

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:
Grave Boring

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 11-21-2019 | Boring Completed: 11-21-2019

Drill Rig: CME 75 | Driller: Ramco

Project No.: 90195179

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 90195179.GPJ TERRACON_DATATEMPLATE.GDT 12/20/19

BORING LOG NO. B-18

PROJECT: Ft. Sam Houston National Cemetery Phase 3 Expansion & Improvements

CLIENT: Anderson Engineering of Minnesota, LLC Plymouth, MN

SITE: 1520 Harry Wurzbach Rd San Antonio, TX

LOCATION See Exploration Plan

Latitude: 29.4729° Longitude: -98.4199°

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
FAT CLAY (CH), dark brown, medium stiff to very stiff					2-3-3 N=6	26		
					3-5-7 N=12	25	54-23-31	
		5			2-3-5 N=8	24		
					3-7-6 N=13	24		
					8-8-10 N=18	18	50-20-30	
- brown below 10 feet		10			11-14-14 N=28	20		
12.0								
Boring Terminated at 12 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Flight Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

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:
Grave Boring

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 11-21-2019 | Boring Completed: 11-21-2019

Drill Rig: CME 75 | Driller: Ramco

Project No.: 90195179

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 90195179.GPJ TERRACON_DATATEMPLATE.GDT 12/20/19

BORING LOG NO. B-19

PROJECT: Ft. Sam Houston National Cemetery Phase 3 Expansion & Improvements

CLIENT: Anderson Engineering of Minnesota, LLC Plymouth, MN

SITE: 1520 Harry Wurzbach Rd San Antonio, TX

LOCATION See Exploration Plan

Latitude: 29.4718° Longitude: -98.42°

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
FAT CLAY (CH), dark brown, stiff					3-4-5 N=9	21		
2.0 **LEAN CLAY (CL)**, gray, stiff to hard					5-6-8 N=14	18	47-19-28	
		5			8-15-10 N=25	12	38-22-16	
- tan below 6 feet					8-11-19 N=30	13		
		10			6-8-10 N=18	16	45-16-29	
12.0					15-25-20 N=45	8		
Boring Terminated at 12 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Flight Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

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:
Grave Boring

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 11-20-2019 | Boring Completed: 11-20-2019

Drill Rig: CME 75 | Driller: Ramco

Project No.: 90195179

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 90195179.GPJ TERRACON_DATATEMPLATE.GDT 12/20/19

BORING LOG NO. B-20

PROJECT: Ft. Sam Houston National Cemetery Phase 3 Expansion & Improvements

CLIENT: Anderson Engineering of Minnesota, LLC Plymouth, MN

SITE: 1520 Harry Wurzbach Rd San Antonio, TX

LOCATION See Exploration Plan

Latitude: 29.4743° Longitude: -98.4212°

DEPTH	ELEVATION (Ft.)	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		LEAN CLAY (CL), gray, stiff to hard				4-6-8 N=14	11	42-16-26	
						10-9-12 N=21	13		
		- light brown below 4 feet	5			8-14-16 N=30	10		
8.0						16-17-20 N=37	10	39-13-26	
		CLAYEY GRAVEL (GC), tan, very dense				15-27-43 N=70	5		46
			10			30-26-50/4"	9		
12.0		***Boring Terminated at 12 Feet***							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Flight Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

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:
Grave Boring

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 11-21-2019 | Boring Completed: 11-21-2019

Drill Rig: CME 75 | Driller: Ramco

Project No.: 90195179

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 90195179.GPJ TERRACON_DATATEMPLATE.GDT 12/20/19

BORING LOG NO. B-21

PROJECT: Ft. Sam Houston National Cemetery Phase 3 Expansion & Improvements

CLIENT: Anderson Engineering of Minnesota, LLC Plymouth, MN

SITE: 1520 Harry Wurzbach Rd San Antonio, TX

LOCATION See Exploration Plan

Latitude: 29.4718° Longitude: -98.4193°

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
FAT CLAY (CH), dark brown, stiff					3-5-4 N=9	22		
2.0 **LEAN CLAY (CL)**, gray, very stiff to hard					6-13-10 N=23	14		
		5			7-9-12 N=21	11	41-15-26	
					11-19-21 N=40	11		
8.0 **CLAYEY GRAVEL (GC)**, tan, dense					15-24-20 N=44	8	34-15-19	
		10	▽		20-21-20 N=41	7		11
12.0 ***Boring Terminated at 12 Feet***								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Flight Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

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:
Grave Boring

WATER LEVEL OBSERVATIONS

▽ *While sampling*

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 11-20-2019 | Boring Completed: 11-20-2019

Drill Rig: CME 75 | Driller: Ramco

Project No.: 90195179

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 90195179.GPJ TERRACON_DATATEMPLATE.GDT 12/20/19

BORING LOG NO. B-22

PROJECT: Ft. Sam Houston National Cemetery Phase 3 Expansion & Improvements

CLIENT: Anderson Engineering of Minnesota, LLC Plymouth, MN

SITE: 1520 Harry Wurzbach Rd San Antonio, TX

LOCATION See Exploration Plan

Latitude: 29.4718° Longitude: -98.4185°

DEPTH	ELEVATION (Ft.)	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		FAT CLAY (CH), dark brown, stiff to very stiff				2-3-5 N=8	25		
4.0		**LEAN CLAY (CL)**, brown, stiff to very stiff				4-8-9 N=17	20	54-19-35	
			5			4-6-8 N=14	14		
						7-11-10 N=21	12		
			10			5-4-6 N=10	15		
12.0						5-10-12 N=22	13	43-17-26	
		Boring Terminated at 12 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Flight Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

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:
Grave Boring

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 11-20-2019 | Boring Completed: 11-20-2019

Drill Rig: CME 75 | Driller: Ramco

Project No.: 90195179

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 90195179.GPJ TERRACON_DATATEMPLATE.GDT 12/20/19

BORING LOG NO. B-24

PROJECT: Ft. Sam Houston National Cemetery Phase 3 Expansion & Improvements

CLIENT: Anderson Engineering of Minnesota, LLC Plymouth, MN

SITE: 1520 Harry Wurzbach Rd San Antonio, TX

LOCATION See Exploration Plan

Latitude: 29.4741° Longitude: -98.4202°

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
FAT CLAY (CH), dark brown, medium stiff					3-3-3 N=6	22	59-24-35	
2.0 **LEAN CLAY (CL)**, tan, stiff to very stiff					4-4-4 N=8	18		
		5			3-7-9 N=16	13		
- gray below 6 feet					7-10-12 N=22	13	49-21-28	
		10			5-10-12 N=22	18	49-19-30	
12.0					13-12-15 N=27	20		
Boring Terminated at 12 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Flight Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

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:
Grave Boring

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 11-21-2019 | Boring Completed: 11-21-2019

Drill Rig: CME 75 | Driller: Ramco

Project No.: 90195179

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 90195179.GPJ TERRACON_DATATEMPLATE.GDT 12/20/19

BORING LOG NO. B-25

PROJECT: Ft. Sam Houston National Cemetery Phase 3 Expansion & Improvements

CLIENT: Anderson Engineering of Minnesota, LLC Plymouth, MN

SITE: 1520 Harry Wurzbach Rd San Antonio, TX

LOCATION See Exploration Plan

Latitude: 29.4734° Longitude: -98.4204°

DEPTH	ELEVATION (Ft.)	DESCRIPTION	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		FAT CLAY (CH), dark brown, stiff to hard	2-5-6 N=11	21		
			6-6-8 N=14	13	60-19-41	
5			9-13-19 N=32	16		
			17-25-20 N=45	15		
8.0		**CLAYEY GRAVEL (GC)**, tan, very dense	13-30-50/5"	6		15
10			50/5"	4		
12.0		***Boring Terminated at 12 Feet***				

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Flight Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

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:
Grave Boring

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 11-21-2019 | Boring Completed: 11-21-2019

Drill Rig: CME 75 | Driller: Ramco

Project No.: 90195179

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 90195179.GPJ TERRACON_DATATEMPLATE.GDT 12/20/19

BORING LOG NO. B-26

PROJECT: Ft. Sam Houston National Cemetery Phase 3 Expansion & Improvements

CLIENT: Anderson Engineering of Minnesota, LLC Plymouth, MN

SITE: 1520 Harry Wurzbach Rd San Antonio, TX

LOCATION See Exploration Plan

Latitude: 29.473° Longitude: -98.4206°

DEPTH	ELEVATION (Ft.)	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		FAT CLAY (CH), dark brown, medium stiff to very stiff				3-3-4 N=7	12	61-19-42	
						4-7-9 N=16	20		
		- gray below 4 feet	5			5-10-14 N=24	17	58-20-38	
						6-2-18 N=20	18		
8.0		**CLAYEY GRAVEL (GC)**, tan, medium dense to dense				11-25-17 N=42	4		
			10	▽		12-13-7 N=20	18		14
12.0		***Boring Terminated at 12 Feet***							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Flight Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

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:
Grave Boring

WATER LEVEL OBSERVATIONS

▽ *While sampling*

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 11-21-2019 | Boring Completed: 11-21-2019

Drill Rig: CME 75 | Driller: Ramco

Project No.: 90195179

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 90195179.GPJ TERRACON_DATATEMPLATE.GDT 12/20/19

BORING LOG NO. B-27

PROJECT: Ft. Sam Houston National Cemetery Phase 3 Expansion & Improvements

CLIENT: Anderson Engineering of Minnesota, LLC Plymouth, MN

SITE: 1520 Harry Wurzbach Rd San Antonio, TX

LOCATION See Exploration Plan

Latitude: 29.4724° Longitude: -98.4203°

DEPTH	ELEVATION (Ft.)	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		LEAN CLAY (CL), dark brown, medium stiff to very stiff				2-2-2 N=4	14		
		- gray below 2 feet				4-6-10 N=16	19	49-18-31	
			5			6-13-10 N=23	16		
8.0				▽		6-9-9 N=18	20	24-14-10	
		CLAYEY GRAVEL (GC), tan, medium dense				6-7-17 N=24	12		18
			10			8-6-5 N=11	18		
12.0		***Boring Terminated at 12 Feet***							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Flight Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

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:
Grave Boring

WATER LEVEL OBSERVATIONS

▽ *While drilling*

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 11-21-2019 | Boring Completed: 11-21-2019

Drill Rig: CME 75 | Driller: Ramco

Project No.: 90195179

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 90195179.GPJ TERRACON_DATATEMPLATE.GDT 12/20/19

BORING LOG NO. B-28

PROJECT: Ft. Sam Houston National Cemetery Phase 3 Expansion & Improvements

CLIENT: Anderson Engineering of Minnesota, LLC Plymouth, MN

SITE: 1520 Harry Wurzbach Rd San Antonio, TX

LOCATION See Exploration Plan

Latitude: 29.4719° Longitude: -98.4207°

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
LEAN CLAY (CL), dark brown, stiff to very stiff					3-8-9 N=17	15		
- gray below 2 feet					3-10-10 N=20	13	38-18-20	
		5			3-5-6 N=11	18		
8.0					5-7-9 N=16	18	48-17-31	
CLAYEY GRAVEL (GC), tan, dense			▽		16-1-41 N=42	4		
		10			26-22-24 N=46	11		
12.0								
Boring Terminated at 12 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Flight Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

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:
Grave Boring

WATER LEVEL OBSERVATIONS

▽ *While sampling*

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 11-20-2019 | Boring Completed: 11-20-2019

Drill Rig: CME 75 | Driller: Ramco

Project No.: 90195179

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 90195179.GPJ TERRACON_DATATEMPLATE.GDT 12/20/19

BORING LOG NO. B-29

PROJECT: Ft. Sam Houston National Cemetery Phase 3 Expansion & Improvements

CLIENT: Anderson Engineering of Minnesota, LLC Plymouth, MN

SITE: 1520 Harry Wurzbach Rd San Antonio, TX

LOCATION See Exploration Plan

Latitude: 29.4743° Longitude: -98.4195°

DEPTH	ELEVATION (Ft.)	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		LEAN CLAY (CL), dark brown, medium stiff to very stiff, with sand				8-8-10 N=18	7		
						10-10-13 N=23	6		
		- brown below 4 feet	5			2-2-3 N=5	22	44-15-29	
8.0						5-6-11 N=17	15		75
		Boring Terminated at 8 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Flight Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

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:
Grave Boring

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 09-06-2019 | Boring Completed: 09-06-2019

Drill Rig: CME 75 | Driller: Ramco

Project No.: 90195179

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 90195179.GPJ TERRACON_DATATEMPLATE.GDT 12/20/19

BORING LOG NO. B-30

PROJECT: Ft. Sam Houston National Cemetery Phase 3 Expansion & Improvements

CLIENT: Anderson Engineering of Minnesota, LLC Plymouth, MN

SITE: 1520 Harry Wurzbach Rd San Antonio, TX

LOCATION See Exploration Plan

Latitude: 29.4734° Longitude: -98.4195°

GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	FAT CLAY (CH), dark brown and gray, stiff to hard					3-6-6 N=12	14		
						3-12-10 N=22	18		
			5			6-10-12 N=22	16	56-21-35	
						10-14-18 N=32	16		
	- tan below 8 feet					5-6-9 N=15	19	59-22-37	
			10			8-13-16 N=29	20		
	12.0								
	Boring Terminated at 12 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Flight Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

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:
Grave Boring

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 11-20-2019 | Boring Completed: 11-20-2019

Drill Rig: CME 75 | Driller: Ramco

Project No.: 90195179

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 90195179.GPJ TERRACON_DATATEMPLATE.GDT 12/20/19

BORING LOG NO. B-31

PROJECT: Ft. Sam Houston National Cemetery Phase 3 Expansion & Improvements

CLIENT: Anderson Engineering of Minnesota, LLC Plymouth, MN

SITE: 1520 Harry Wurzbach Rd San Antonio, TX

LOCATION See Exploration Plan

Latitude: 29.4722° Longitude: -98.4197°

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
FAT CLAY (CH), dark brown, stiff					2-3-9 N=12	20		
2.0 **LEAN CLAY (CL)**, gray, stiff to very stiff					10-10-9 N=19	12	49-24-25	
		5			3-4-8 N=12	11		
					10-12-18 N=30	10		
		10			11-9-6 N=15	13	37-14-23	
12.0					6-8-20 N=28	15		
Boring Terminated at 12 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Flight Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

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:
Grave Boring

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 11-20-2019 | Boring Completed: 11-20-2019

Drill Rig: CME 75 | Driller: Ramco

Project No.: 90195179

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 90195179.GPJ TERRACON_DATATEMPLATE.GDT 12/20/19

BORING LOG NO. B-33

PROJECT: Ft. Sam Houston National Cemetery Phase 3 Expansion & Improvements

CLIENT: Anderson Engineering of Minnesota, LLC Plymouth, MN

SITE: 1520 Harry Wurzbach Rd San Antonio, TX

LOCATION See Exploration Plan

Latitude: 29.4739° Longitude: -98.4192°

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
LEAN CLAY (CL), brown, very stiff to hard, with sand					18-18-18 N=36	6	42-27-15	
					19-18-14 N=32	7		
- gypsum deposits below 4 feet		5			7-8-15 N=23	8	46-45-1	
8.0					18-23-28 N=51	9		79
Boring Terminated at 8 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Flight Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

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:
Grave Boring

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 09-06-2019 | Boring Completed: 09-06-2019

Drill Rig: CME 75 | Driller: Ramco

Project No.: 90195179

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 90195179.GPJ TERRACON_DATATEMPLATE.GDT 12/20/19

BORING LOG NO. B-34

PROJECT: Ft. Sam Houston National Cemetery Phase 3 Expansion & Improvements

CLIENT: Anderson Engineering of Minnesota, LLC Plymouth, MN

SITE: 1520 Harry Wurzbach Rd San Antonio, TX

LOCATION See Exploration Plan

Latitude: 29.4728° Longitude: -98.4191°

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
FAT CLAY (CH), dark brown, medium stiff to hard			2-3-4 N=7	24	61-23-38	
			4-7-11 N=18	19		
- gray below 4 feet		5	8-15-15 N=30	16	56-18-38	
8.0			8-18-23 N=41	16		
LEAN CLAY (CL), gray, stiff to very stiff			4-7-9 N=16	18		
12.0		10	3-5-8 N=13	17		
Boring Terminated at 12 Feet						

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Flight Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

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:
Grave Boring

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 11-20-2019 | Boring Completed: 11-20-2019

Drill Rig: CME 75 | Driller: Ramco

Project No.: 90195179

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 90195179.GPJ TERRACON_DATATEMPLATE.GDT 12/20/19

BORING LOG NO. B-35

PROJECT: Ft. Sam Houston National Cemetery Phase 3 Expansion & Improvements

CLIENT: Anderson Engineering of Minnesota, LLC Plymouth, MN

SITE: 1520 Harry Wurzbach Rd San Antonio, TX

LOCATION See Exploration Plan

Latitude: 29.4743° Longitude: -98.4185°

DEPTH	ELEVATION (Ft.)	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		LEAN CLAY (CL), dark brown, very stiff				6-10-8 N=18	8		
2.0		**FAT CLAY (CH)**, dark brown, very stiff to hard				12-11-14 N=25	13	65-17-48	
		- brown, with gypsum deposits below 4 feet	5			17-18-16 N=34	13		
8.0						14-21-30 N=51	14	50-14-36	
		Boring Terminated at 8 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Flight Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

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:
Grave Boring

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 09-06-2019 | Boring Completed: 09-06-2019

Drill Rig: CME 75 | Driller: Ramco

Project No.: 90195179

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 90195179.GPJ TERRACON_DATATEMPLATE.GDT 12/20/19

BORING LOG NO. B-36

PROJECT: Ft. Sam Houston National Cemetery Phase 3 Expansion & Improvements

CLIENT: Anderson Engineering of Minnesota, LLC Plymouth, MN

SITE: 1520 Harry Wurzbach Rd San Antonio, TX

LOCATION See Exploration Plan

Latitude: 29.4734° Longitude: -98.4187°

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
FAT CLAY (CH), dark brown, very stiff					3-5-11 N=16	17	58-22-36	
					8-9-10 N=19	14		
		5			5-9-9 N=18	16		
- gray below 6 feet					6-8-14 N=22	16		
		10			5-9-9 N=18	20	53-20-33	
12.0					8-14-15 N=29	20		
Boring Terminated at 12 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Flight Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

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:
Grave Boring

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 11-20-2019 | Boring Completed: 11-20-2019

Drill Rig: CME 75 | Driller: Ramco

Project No.: 90195179

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 90195179.GPJ TERRACON_DATATEMPLATE.GDT 12/20/19

BORING LOG NO. B-37

PROJECT: Ft. Sam Houston National Cemetery Phase 3 Expansion & Improvements

CLIENT: Anderson Engineering of Minnesota, LLC Plymouth, MN

SITE: 1520 Harry Wurzbach Rd San Antonio, TX

LOCATION See Exploration Plan

Latitude: 29.4722° Longitude: -98.4188°

DEPTH	ELEVATION (Ft.)	DESCRIPTION	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		FAT CLAY (CH), dark brown, stiff	2-3-6 N=9	20		
2.0		**LEAN CLAY (CL)**, gray, stiff to very stiff	4-8-12 N=20	15	45-23-22	
			7-7-10 N=17	10		
			9-3-11 N=14	11		
			3-7-5 N=12	20	40-16-24	
12.0			3-6-10 N=16	15		
		Boring Terminated at 12 Feet				

DEPTH (Ft.): 5, 10

WATER LEVEL OBSERVATIONS / SAMPLE TYPE

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Flight Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

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:
Grave Boring

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 11-20-2019 | Boring Completed: 11-20-2019

Drill Rig: CME 75 | Driller: Ramco

Project No.: 90195179

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 90195179.GPJ TERRACON_DATATEMPLATE.GDT 12/20/19

BORING LOG NO. B-38

PROJECT: Ft. Sam Houston National Cemetery Phase 3 Expansion & Improvements

CLIENT: Anderson Engineering of Minnesota, LLC Plymouth, MN

SITE: 1520 Harry Wurzbach Rd San Antonio, TX

LOCATION See Exploration Plan

Latitude: 29.4727° Longitude: -98.4184°

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
FAT CLAY (CH), dark brown, very stiff					2-3-5 N=8	20		
					3-3-11 N=14	18	51-17-34	
		5			6-7-10 N=17	16		
- gray below 6 feet					7-13-15 N=28	16	52-16-36	
		10			8-12-10 N=22	20		
12.0					9-13-15 N=28	18		
Boring Terminated at 12 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Flight Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

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:
Grave Boring

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 11-20-2019 | Boring Completed: 11-20-2019

Drill Rig: CME 75 | Driller: Ramco

Project No.: 90195179

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 90195179.GPJ TERRACON_DATATEMPLATE.GDT 12/20/19

BORING LOG NO. B-39

PROJECT: Ft. Sam Houston National Cemetery Phase 3 Expansion & Improvements

CLIENT: Anderson Engineering of Minnesota, LLC Plymouth, MN

SITE: 1520 Harry Wurzbach Rd San Antonio, TX

LOCATION See Exploration Plan

Latitude: 29.4717° Longitude: -98.4182°

DEPTH	ELEVATION (Ft.)	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		LEAN CLAY (CL), dark brown, very stiff, with sand and trace gravel				8-9-10 N=19	8		
		- brown below 2 feet				8-9-16 N=25	11		69
4.0		**FAT CLAY (CH)**, brown, very stiff	5			5-8-13 N=21	15	50-17-33	
8.0						12-12-18 N=30	11		
		Boring Terminated at 8 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Flight Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

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:
Grave Boring

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 09-06-2019 | Boring Completed: 09-06-2019

Drill Rig: CME 75 | Driller: Ramco

Project No.: 90195179

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 90195179.GPJ TERRACON_DATATEMPLATE.GDT 12/20/19

BORING LOG NO. B-40

PROJECT: Ft. Sam Houston National Cemetery Phase 3 Expansion & Improvements

CLIENT: Anderson Engineering of Minnesota, LLC Plymouth, MN

SITE: 1520 Harry Wurzbach Rd San Antonio, TX

LOCATION See Exploration Plan

Latitude: 29.4731° Longitude: -98.4149°

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
FAT CLAY (CH), dark brown, stiff to hard					3-5-7 N=12	16	51-17-34	
- brown between 2 and 4 feet					3-4-9 N=13	20		
- light brown below 4 feet		5			4.5+ (HP)	14		
8.0					5-5-6 N=11	15		80
Boring Terminated at 8 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Flight Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

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:
Grave Boring

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 09-10-2019 | Boring Completed: 09-10-2019

Drill Rig: CME 75 | Driller: Ramco

Project No.: 90195179

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 90195179.GPJ TERRACON_DATATEMPLATE.GDT 12/20/19

BORING LOG NO. B-41

PROJECT: Ft. Sam Houston National Cemetery Phase 3 Expansion & Improvements

CLIENT: Anderson Engineering of Minnesota, LLC Plymouth, MN

SITE: 1520 Harry Wurzbach Rd San Antonio, TX

LOCATION See Exploration Plan

Latitude: 29.4726° Longitude: -98.4151°

DEPTH	ELEVATION (Ft.)	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		LEAN CLAY (CL), dark brown, medium stiff to very stiff, with sand				1-3-3 N=6	20		
		- brown between 2 and 4 feet				3-6-7 N=13	19	41-16-25	
		- light brown below 4 feet	5			3-5-7 N=12	16		81
8.0						9-10-15 N=25	16		
		Boring Terminated at 8 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Flight Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

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:
Grave Boring

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 09-10-2019 | Boring Completed: 09-10-2019

Drill Rig: CME 75 | Driller: Ramco

Project No.: 90195179

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 90195179.GPJ TERRACON_DATATEMPLATE.GDT 12/20/19

BORING LOG NO. B-42

PROJECT: Ft. Sam Houston National Cemetery Phase 3 Expansion & Improvements

CLIENT: Anderson Engineering of Minnesota, LLC Plymouth, MN

SITE: 1520 Harry Wurzbach Rd San Antonio, TX

LOCATION See Exploration Plan

Latitude: 29.475° Longitude: -98.4163°

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
LEAN CLAY (CL), dark brown, stiff to very stiff, with sand					4-7-5 N=12	9		
					9-8-11 N=19	13		
- light brown below 4 feet		5			5-6-7 N=13	16		82
8.0					9-11-16 N=27	15	32-12-20	
Boring Terminated at 8 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Flight Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

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:
Grave Boring

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 09-04-2019 | Boring Completed: 09-04-2019

Drill Rig: CME 75 | Driller: Ramco

Project No.: 90195179

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 90195179.GPJ TERRACON_DATATEMPLATE.GDT 12/20/19

BORING LOG NO. B-43

PROJECT: Ft. Sam Houston National Cemetery Phase 3 Expansion & Improvements

CLIENT: Anderson Engineering of Minnesota, LLC Plymouth, MN

SITE: 1520 Harry Wurzbach Rd San Antonio, TX

LOCATION See Exploration Plan

Latitude: 29.4749° Longitude: -98.4159°

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
LEAN CLAY (CL), dark brown, stiff to hard, with gypsum deposits					9-6-5 N=11	9	50-18-32	
					5-4-6 N=10	8		
		5			11-7-10 N=17	8		
8.0					15-17-28 N=45	10		
Boring Terminated at 8 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Flight Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

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:
Grave Boring

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 09-04-2019 | Boring Completed: 09-04-2019

Drill Rig: CME 75 | Driller: Ramco

Project No.: 90195179

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 90195179.GPJ TERRACON_DATATEMPLATE.GDT 12/20/19

BORING LOG NO. B-44

PROJECT: Ft. Sam Houston National Cemetery Phase 3 Expansion & Improvements

CLIENT: Anderson Engineering of Minnesota, LLC Plymouth, MN

SITE: 1520 Harry Wurzbach Rd San Antonio, TX

LOCATION See Exploration Plan

Latitude: 29.475° Longitude: -98.4154°

GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	FAT CLAY (CH), dark brown, stiff to very stiff, with sand					2-4-6 N=10	19		69
						4-4-9 N=13	21		
	- brown between 4 and 6 feet		5			4-6-9 N=15	18	55-14-41	
	- light brown and with gypsum deposits below 6 feet					9-7-16 N=23	18		
	8.0								
	Boring Terminated at 8 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Flight Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

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:
Grave Boring

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 09-04-2019 | Boring Completed: 09-04-2019

Drill Rig: CME 75 | Driller: Ramco

Project No.: 90195179

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 90195179.GPJ TERRACON_DATATEMPLATE.GDT 12/20/19

BORING LOG NO. B-45

PROJECT: Ft. Sam Houston National Cemetery Phase 3 Expansion & Improvements

CLIENT: Anderson Engineering of Minnesota, LLC Plymouth, MN

SITE: 1520 Harry Wurzbach Rd San Antonio, TX

LOCATION See Exploration Plan

Latitude: 29.4749° Longitude: -98.415°

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
FAT CLAY (CH), dark brown, hard					7-12-18 N=30	6	53-19-34	
2.0 **CLAYEY GRAVEL (GC)**, light brown, dense to very dense					6-11-22 N=33	4		
		5			5-21-17 N=38	5		15
8.0					19-22-31 N=53	5		
Boring Terminated at 8 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Flight Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

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:
Grave Boring

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 09-04-2019 | Boring Completed: 09-04-2019

Drill Rig: CME 75 | Driller: Ramco

Project No.: 90195179

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 90195179.GPJ TERRACON_DATATEMPLATE.GDT 12/20/19

BORING LOG NO. B-46

PROJECT: Ft. Sam Houston National Cemetery Phase 3 Expansion & Improvements

CLIENT: Anderson Engineering of Minnesota, LLC Plymouth, MN

SITE: 1520 Harry Wurzbach Rd San Antonio, TX

LOCATION See Exploration Plan

Latitude: 29.475° Longitude: -98.4146°

GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	CLAYEY GRAVEL (GC), dark brown, medium dense to dense					21-19-25 N=44	5		
	- light brown below 2 feet					16-11-22 N=33	4	29-16-13	
			5			5-10-9 N=19	4		
	8.0					12-13-15 N=28	4		
	Boring Terminated at 8 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Flight Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

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:
Grave Boring

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 09-04-2019 | Boring Completed: 09-04-2019

Drill Rig: CME 75 | Driller: Ramco

Project No.: 90195179

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 90195179.GPJ TERRACON_DATATEMPLATE.GDT 12/20/19

BORING LOG NO. B-47

PROJECT: Ft. Sam Houston National Cemetery Phase 3 Expansion & Improvements

CLIENT: Anderson Engineering of Minnesota, LLC Plymouth, MN

SITE: 1520 Harry Wurzbach Rd San Antonio, TX

LOCATION See Exploration Plan

Latitude: 29.4749° Longitude: -98.414°

DEPTH	ELEVATION (Ft.)	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		FILL - CLAYEY GRAVEL (GC), dark brown, medium dense				23-16-11 N=27	6		
						9-11-11 N=22	8		
4.0		**FAT CLAY (CH)**, brown, very stiff to hard	5			8-13-15 N=28	8	54-18-36	
						16-20-30 N=50	8		
8.0		***Boring Terminated at 8 Feet***							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Flight Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

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:
Grave Boring

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 09-04-2019 | Boring Completed: 09-04-2019

Drill Rig: CME 75 | Driller: Ramco

Project No.: 90195179

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 90195179.GPJ TERRACON_DATATEMPLATE.GDT 12/20/19

BORING LOG NO. B-48

PROJECT: Ft. Sam Houston National Cemetery Phase 3 Expansion & Improvements

CLIENT: Anderson Engineering of Minnesota, LLC Plymouth, MN

SITE: 1520 Harry Wurzbach Rd San Antonio, TX

LOCATION See Exploration Plan

Latitude: 29.4757° Longitude: -98.4144°

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
LEAN CLAY (CL), brown, stiff to hard, with sand					3-5-6 N=11	3		
					6-7-10 N=17	10	49-15-34	
		5			8-10-12 N=22	7		
8.0					16-20-26 N=46	5		
Boring Terminated at 8 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Flight Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

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:
Grave Boring

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 09-04-2019 | Boring Completed: 09-04-2019

Drill Rig: CME 75 | Driller: Ramco

Project No.: 90195179

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 90195179.GPJ TERRACON_DATATEMPLATE.GDT 12/20/19

BORING LOG NO. B-49

PROJECT: Ft. Sam Houston National Cemetery Phase 3 Expansion & Improvements

CLIENT: Anderson Engineering of Minnesota, LLC Plymouth, MN

SITE: 1520 Harry Wurzbach Rd San Antonio, TX

LOCATION See Exploration Plan

Latitude: 29.4766° Longitude: -98.4146°

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
LEAN CLAY (CL), brown, stiff to hard					7-6-8 N=14	6		
					8-7-10 N=17	10		
- with gypsum deposits below 4 feet		5			5-6-7 N=13	11	35-15-20	
8.0					12-16-18 N=34	7		
Boring Terminated at 8 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Flight Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

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:
Grave Boring

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 09-06-2019 | Boring Completed: 09-06-2019

Drill Rig: CME 75 | Driller: Ramco

Project No.: 90195179

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 90195179.GPJ TERRACON_DATATEMPLATE.GDT 12/20/19

BORING LOG NO. B-50

PROJECT: Ft. Sam Houston National Cemetery Phase 3 Expansion & Improvements

CLIENT: Anderson Engineering of Minnesota, LLC Plymouth, MN

SITE: 1520 Harry Wurzbach Rd San Antonio, TX

LOCATION See Exploration Plan

Latitude: 29.4775° Longitude: -98.4146°

DEPTH	ELEVATION (Ft.)	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		LEAN CLAY (CL), brown, very stiff to hard, with sand and gravel				8-11-14 N=25	7		
						20-15-22 N=37	6	46-18-28	
		- light brown between 4 and 6 feet	5			21-25-22 N=47	9		
8.0						7-9-14 N=23	9		
		Boring Terminated at 8 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Flight Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

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:
Grave Boring

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 09-06-2019 | Boring Completed: 09-06-2019

Drill Rig: CME 75 | Driller: Ramco

Project No.: 90195179

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 90195179.GPJ TERRACON_DATATEMPLATE.GDT 12/20/19

BORING LOG NO. B-51

PROJECT: Ft. Sam Houston National Cemetery Phase 3 Expansion & Improvements

CLIENT: Anderson Engineering of Minnesota, LLC Plymouth, MN

SITE: 1520 Harry Wurzbach Rd San Antonio, TX

LOCATION See Exploration Plan

Latitude: 29.4784° Longitude: -98.4146°

DEPTH	ELEVATION (Ft.)	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		FILL - CLAYEY GRAVEL (GC), light brown, dense to very dense				26-36-26 N=62	2		
						12-14-16 N=30	3		
4.0		**FAT CLAY (CH)**, dark brown, stiff to hard	5			6-7-7 N=14	18	55-15-40	
						10-12-20 N=32	15		
8.0		***Boring Terminated at 8 Feet***							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Flight Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

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:
Grave Boring

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 09-06-2019 | Boring Completed: 09-06-2019

Drill Rig: CME 75 | Driller: Ramco

Project No.: 90195179

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 90195179.GPJ TERRACON_DATATEMPLATE.GDT 12/20/19

BORING LOG NO. B-53

PROJECT: Ft. Sam Houston National Cemetery Phase 3 Expansion & Improvements

CLIENT: Anderson Engineering of Minnesota, LLC Plymouth, MN

SITE: 1520 Harry Wurzbach Rd San Antonio, TX

LOCATION See Exploration Plan

Latitude: 29.4783° Longitude: -98.4187°

Surface Elev.: 676 (Ft.)

MODEL LAYER	DEPTH	ELEVATION (Ft.)	Description
1	1.0	675	**FILL - CLAYEY GRAVEL (GC)**, light brown, medium dense
3			**FAT CLAY (CH)**, dark brown, stiff to hard - brown between 4 and 6 feet - gypsum deposits below 8 feet
4	10.0	666	**LEAN CLAY (CL)**, light brown, stiff
2	15.0	661	**CLAYEY GRAVEL (GC)**, light brown, dense to very dense
5	25.0	651	**CLAY SHALE**, gray, hard
	40.0	636	***Boring Terminated at 40 Feet***

DEPTH (Ft.)	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
	11-7-17 N=24	16	
	5-6-9 N=15	16	62-15-47
5	6-9-15 N=24	15	
	11-15-18 N=33	14	
	4-5-5 N=10	16	
10			
	5-7-7 N=14	12	33-13-20
15			
	12-15-19 N=34	6	
20			
	10-21-30 N=51	11	
25			
	4-10-23 N=33	23	
30			
	21-37-50 N=87	16	
35			
	40-50/4"	16	
40			

WATER LEVEL OBSERVATIONS: ▽ While sampling

SAMPLE TYPE: ☒

PERCENT FINES:

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method: Flight Auger

Abandonment Method: Boring backfilled with auger cuttings upon completion.

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: Equipment Storage Building Boring

WATER LEVEL OBSERVATIONS

▽ *While sampling*

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 09-03-2019 | Boring Completed: 09-03-2019

Drill Rig: CME 75 | Driller: Ramco

Project No.: 90195179

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL EQUIPMENT STORAGE.GPJ TERRACON_DATATEMPLATE.GDT 12/20/19

BORING LOG NO. B-54

PROJECT: Ft. Sam Houston National Cemetery Phase 3 Expansion & Improvements

CLIENT: Anderson Engineering of Minnesota, LLC Plymouth, MN

SITE: 1520 Harry Wurzbach Rd San Antonio, TX

LOCATION See Exploration Plan

Latitude: 29.4783° Longitude: -98.4184°

Surface Elev.: 676 (Ft.)

MODEL LAYER	DEPTH	ELEVATION (Ft.)	Description
1	0.0	676	**FILL - CLAYEY GRAVEL (GC)**, brown, medium dense to dense
3	4.0	672	**FAT CLAY (CH)**, brown, very stiff - trace gravel between 6 and 8 feet - light brown between 8 and 18 feet
4	22.0	654	**LEAN CLAY (CL)**, brown, stiff to very stiff
5	30.0	646	**CLAY SHALE**, gray, hard
	40.0	636	***Boring Terminated at 40 Feet***

DEPTH (Ft.)	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
	9-7-12 N=19	15	
	9-11-19 N=30	2	
5	8-6-9 N=15	18	58-15-43
	10-14-15 N=29	18	
10	6-9-12 N=21	16	
15	7-10-11 N=21	17	
20	5-7-8 N=15	22	
25	9-5-9 N=14	12	31-14-17
30	12-12-12 N=24	25	
35	31-39-48 N=87	9	
40	36-41-40 N=81	16	

WATER LEVEL OBSERVATIONS: ▽ While sampling

SAMPLE TYPE: ☒

PERCENT FINES:

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Flight Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

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:
Equipment Storage Building Boring

WATER LEVEL OBSERVATIONS

▽ *While sampling*

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 09-03-2019 | Boring Completed: 09-03-2019

Drill Rig: CME 75 | Driller: Ramco

Project No.: 90195179

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL EQUIPMENT STORAGE.GPJ TERRACON_DATATEMPLATE.GDT 12/20/19

BORING LOG NO. B-55

PROJECT: Ft. Sam Houston National Cemetery Phase 3 Expansion & Improvements

CLIENT: Anderson Engineering of Minnesota, LLC Plymouth, MN

SITE: 1520 Harry Wurzbach Rd San Antonio, TX

LOCATION See Exploration Plan

Latitude: 29.4779° Longitude: -98.418°

Surface Elev.: 676 (Ft.)

MODEL LAYER	DEPTH	ELEVATION (Ft.)	Description
	0.7	675.5	**Concrete 8 inches thick**
	1.1	675	**Base Material 5 inches thick**
3			**FAT CLAY (CH)**, dark brown, stiff to very stiff
	6.0	670	
4			**LEAN CLAY (CL)**, brown, stiff to hard
			- light gray below 18 feet
			- gravelly below 24 feet
	30.0	646	
5			**CLAY SHALE**, gray, hard
	40.0	636	
			Boring Terminated at 40 Feet

DEPTH (Ft.)	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		5-6-7 N=13	21	59-17-42	
		5-7-8 N=15	22		84
5		5-8-11 N=19	20		
		11-18-26 N=44	18	48-15-33	
10		6-7-11 N=18	18		
15		5-8-10 N=18	19		
20		4-9-9 N=18	21		
25		13-9-4 N=13	6		55
30		6-7-11 N=18	16		
35		26-43-50/5"	15		
40		40-50/3"	14		

WATER LEVEL OBSERVATIONS

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Flight Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

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:
Material Storage Building Boring

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 09-03-2019 | Boring Completed: 09-03-2019

Drill Rig: CME 75 | Driller: Ramco

Project No.: 90195179

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL MAT STORAGE.GPJ TERRACON_DATATEMPLATE.GDT 12/20/19

BORING LOG NO. B-56

PROJECT: Ft. Sam Houston National Cemetery Phase 3 Expansion & Improvements

CLIENT: Anderson Engineering of Minnesota, LLC Plymouth, MN

SITE: 1520 Harry Wurzbach Rd San Antonio, TX

LOCATION See Exploration Plan

Latitude: 29.4778° Longitude: -98.4181°

Surface Elev.: 676 (Ft.)

MODEL LAYER	DEPTH	ELEVATION (Ft.)	Description
1	4.0	672	**FILL - CLAYEY GRAVEL (GC)**, yellowish brown, medium dense to dense
3	13.0	663	**FAT CLAY (CH)**, brown, very stiff, with sand
4	18.0	658	**LEAN CLAY (CL)**, light brown, very stiff
2	27.0	649	**CLAYEY GRAVEL (GC)**, light brown, dense to very dense
4	30.0	646	**LEAN CLAY (CL)**, light brown, hard
5	40.0	636	**CLAY SHALE**, gray, hard
			Boring Terminated at 40 Feet

DEPTH (Ft.)	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	16-16-18 N=34	15		
	16-19-8 N=27	2		
5	7-6-10 N=16	18	61-16-45	
	7-9-15 N=24	18		55
10	6-8-9 N=17	16		
15	6-8-12 N=20	15	36-14-22	
20	24-18-19 N=37	8		
25	12-31-40 N=71	4		
30	11-10-35 N=45	19		
35	11-21-50/4"	17	47-15-32	
40	38-50/4"	13		

WATER LEVEL OBSERVATIONS

SAMPLE TYPE

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Flight Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

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:
Material Storage Building Boring

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 09-04-2019 | Boring Completed: 09-06-2019

Drill Rig: CME 75 | Driller: Ramco

Project No.: 90195179

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL MAT STORAGE.GPJ TERRACON_DATATEMPLATE.GDT 12/20/19

BORING LOG NO. B-57

PROJECT: Ft. Sam Houston National Cemetery Phase 3 Expansion & Improvements

CLIENT: Anderson Engineering of Minnesota, LLC Plymouth, MN

SITE: 1520 Harry Wurzbach Rd San Antonio, TX

LOCATION See Exploration Plan

Latitude: 29.4765° Longitude: -98.4179°

Surface Elev.: 677 (Ft.)

MODEL LAYER	DEPTH	ELEVATION (Ft.)	Description
	0.3	676.5	**Asphalt 3.5 inches thick**
	0.6	676.5	**Base Material 4 inches thick**, medium dense
3			**FAT CLAY (CH)**, brown, stiff
	6.0	671	
4			**LEAN CLAY (CL)**, light brown, stiff to hard, with sand
			- gravelly below 28 feet
	30.0	647	
5			**CLAY SHALE**, light gray, hard
	40.0	637	
			Boring Terminated at 40 Feet

DEPTH (Ft.)	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		3-4-4 N=8	21	51-17-34	
		4-4-10 N=14	22		
5		5-5-5 N=10	17		
		6-7-8 N=15		46-15-31	70
		5-4-4 N=8	12		
10					
		4-4-5 N=9	18	40-13-27	
15					
		17-7-7 N=14	17		
20					
		5-4-8 N=12			79
25					
		29-25-14 N=39	6		
30					
		18-23-38 N=61	18		
35					
		22-25-36 N=61	17		
40					

WATER LEVEL OBSERVATIONS: ▽ While sampling

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Flight Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

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:
Administration Building Expansion Boring

WATER LEVEL OBSERVATIONS

While sampling

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 09-03-2019 | Boring Completed: 09-03-2019

Drill Rig: CME 75 | Driller: Ramco

Project No.: 90195179

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL ADMIN.GPJ TERRACON_DATATEMPLATE.GDT 12/20/19

BORING LOG NO. B-58

PROJECT: Ft. Sam Houston National Cemetery Phase 3 Expansion & Improvements

CLIENT: Anderson Engineering of Minnesota, LLC Plymouth, MN

SITE: 1520 Harry Wurzbach Rd San Antonio, TX

LOCATION See Exploration Plan

Latitude: 29.4765° Longitude: -98.4177°

Surface Elev.: 677 (Ft.)

MODEL LAYER	DEPTH	ELEVATION (Ft.)	Description
1	3.0	674	**FILL - CLAYEY GRAVEL (GC)**, yellowish brown
4	23.0	654	**LEAN CLAY (CL)**, brown, stiff to hard, with sand - light brown below 6 feet
2	30.0	647	**CLAYEY GRAVEL (GC)**, light brown, dense
5	40.0	637	**CLAY SHALE**, gray, hard
			Boring Terminated at 40 Feet

DEPTH (Ft.)	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		1.0 (HP)	12		
		9-11-10 N=21	14		
5		4.0 (HP)	21	49-17-32	
		4-4-6 N=10	17		
10		8-9-12 N=21			66
15		3-4-7 N=11	9		
20		4-6-8 N=14	20	44-14-30	
25		22-23-9 N=32			13
30		8-13-21 N=34	15		
35		20-30-33 N=63	16		
40		29-50/4"	12		

WATER LEVEL OBSERVATIONS

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Flight Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

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:
Administration Building Expansion Boring

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 09-03-2019 | Boring Completed: 09-03-2019

Drill Rig: CME 75 | Driller: Ramco

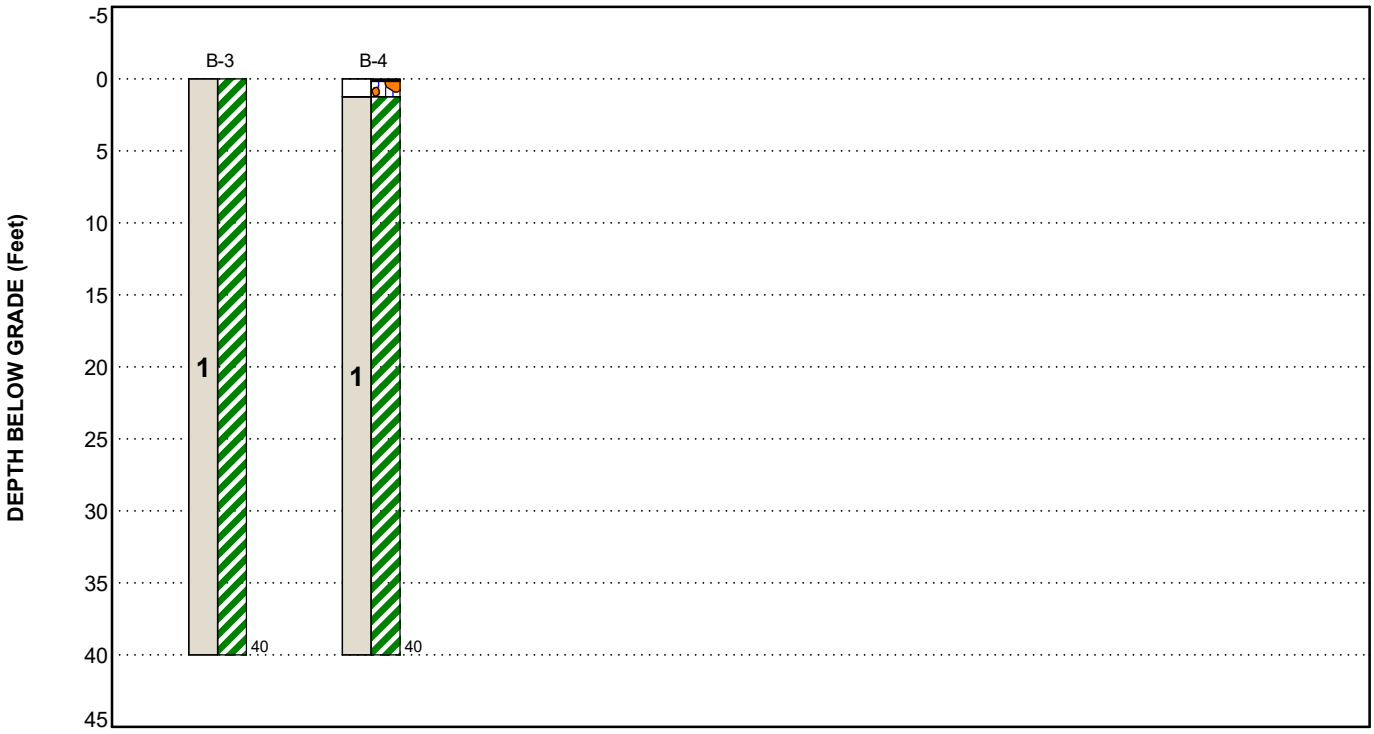
Project No.: 90195179

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL ADMIN.GPJ TERRACON_DATATEMPLATE.GDT 12/20/19

FIGURES

GEOMODEL (HONOR GUARD BUILDING)

Ft. Sam Houston National Cemetery Phase 3 Expansion & Improvements ■ San Antonio, TX
Terracon Project No. 90195179



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	Fat Clay	Dark Brown, Yellowish Brown and Brown; Medium Stiff to Hard

LEGEND

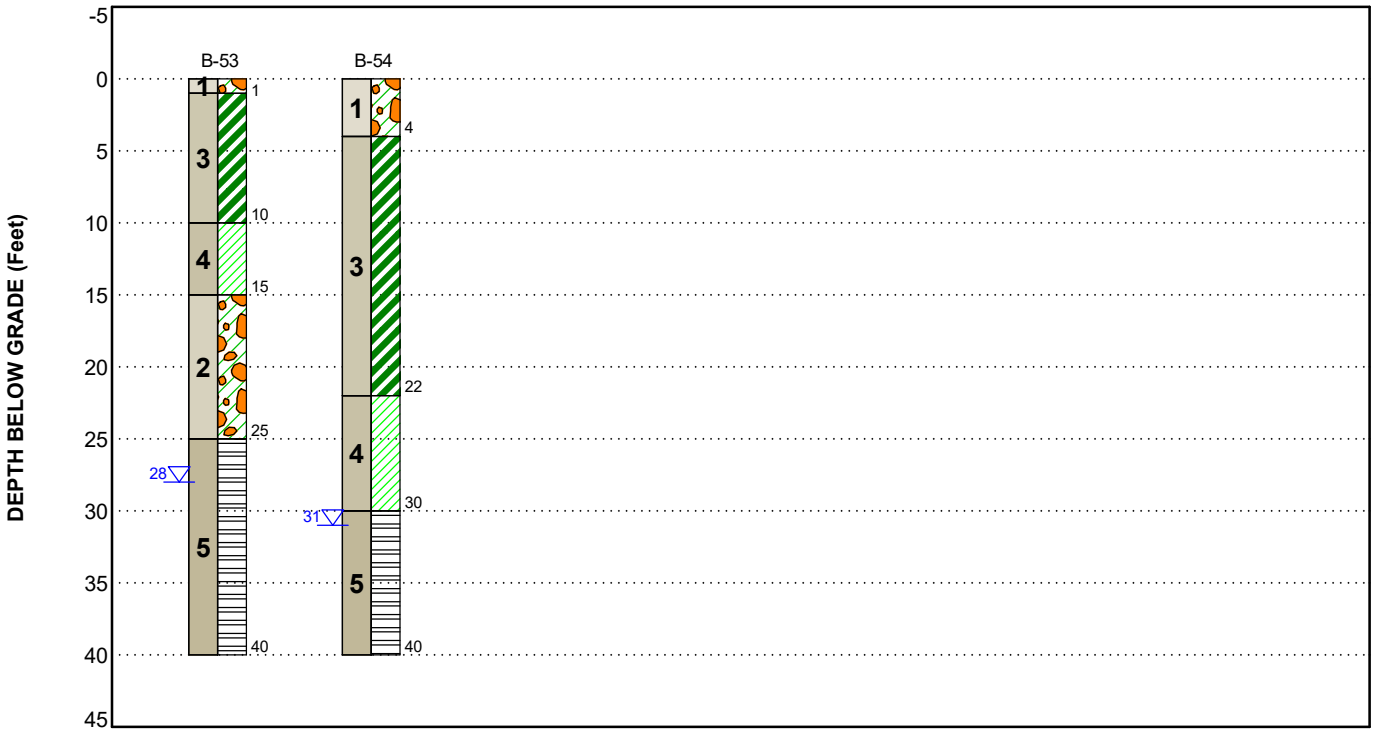
- Fat Clay
- Asphalt
- Silty Gravel

First Water Observation

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.

GEOMODEL (EQUIPMENT STORAGE BUILDING)

Ft. Sam Houston National Cemetery Phase 3 Expansion & Improvements ■ San Antonio, TX
Terracon Project No. 90195179



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	Clayey Gravel (Fill)	Light Brown, Brown, Yellowish Brown; Medium Dense to Dense
2	Clayey Gravel	Light Brown; Dense to Very Dense
3	Fat Clay	Dark Brown, Light Brown and Brown; Stiff to Hard
4	Lean Clay	Light Brown, Brown and Light Gray; Stiff to Hard
5	Clay Shale	Gray; Hard

LEGEND

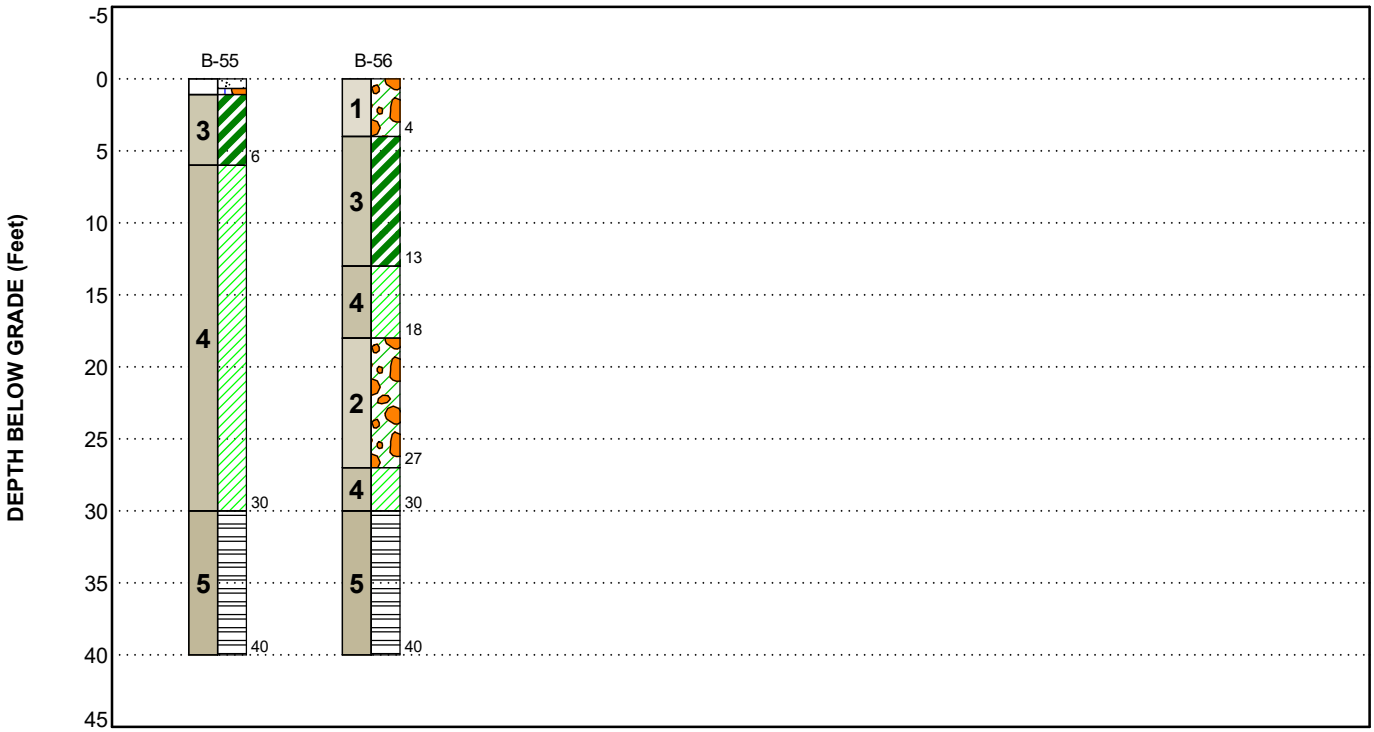
- Clayey Gravel
- Shale
- Fat Clay
- Lean Clay

First Water Observation

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.

GEOMODEL (MATERIAL STORAGE BUILDING)

Ft. Sam Houston National Cemetery Phase 3 Expansion & Improvements ■ San Antonio, TX
Terracon Project No. 90195179



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	Clayey Gravel (Fill)	Light Brown, Brown, Yellowish Brown; Medium Dense to Dense
2	Clayey Gravel	Light Brown; Dense to Very Dense
3	Fat Clay	Dark Brown, Light Brown and Brown; Stiff to Hard
4	Lean Clay	Light Brown, Brown and Light Gray; Stiff to Hard
5	Clay Shale	Gray; Hard

LEGEND

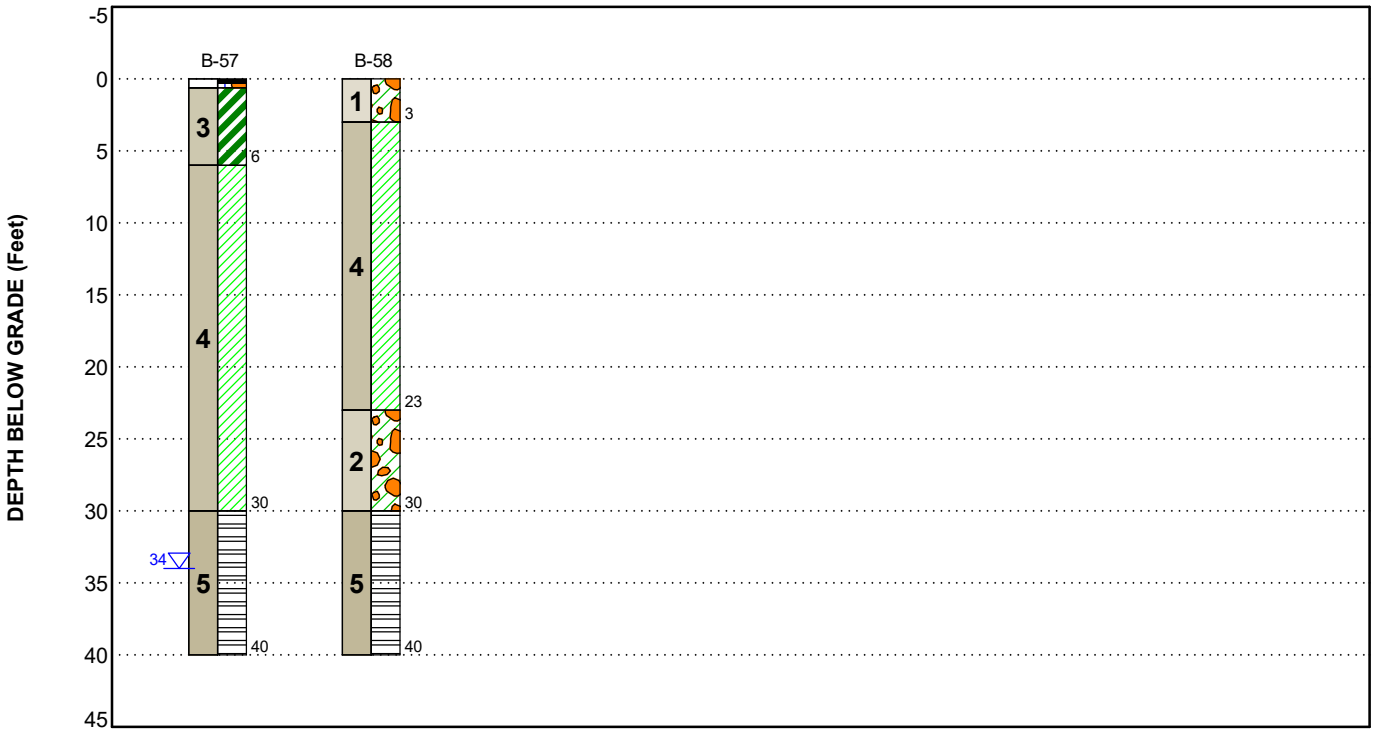
- Concrete
- Lean Clay
- Silty Gravel
- Shale
- Fat Clay
- Clayey Gravel

First Water Observation

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.

GEOMODEL (ADMINISTRATION BUILDING EXPANSION)

Ft. Sam Houston National Cemetery Phase 3 Expansion & Improvements ■ San Antonio, TX
Terracon Project No. 90195179



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	Clayey Gravel (Fill)	Yellowish Brown
2	Clayey Gravel	Light Brown; Dense
3	Fat Clay	Brown; Stiff
4	Lean Clay	Light Brown, Brown; Stiff to Hard
5	Clay Shale	Light Gray, Gray; Hard

LEGEND

- Asphalt
- Silty Gravel
- Fat Clay
- Lean Clay
- Shale
- Clayey Gravel

First Water Observation

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.

SUPPORTING INFORMATION

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

Ft. Sam Houston National Cemetery Phase 3 Expansion & Improvements ■ San Antonio, TX

Terracon Project No. 90195179

SAMPLING	WATER LEVEL	FIELD TESTS
Shelby Tube Split Spoon	**Water Initially Encountered** **Water Level After a Specified Period of Time** **Water Level After a Specified Period of Time** 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.	**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 is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. 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		
Descriptive Term (Density)	**Standard Penetration or N-Value Blows/Ft.**	**Descriptive Term (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

RELATIVE PROPORTIONS OF SAND AND GRAVEL		RELATIVE PROPORTIONS OF FINES	
Descriptive Term(s) of other constituents	Percent of Dry Weight	**Descriptive Term(s) of other constituents**	**Percent of Dry Weight**
Trace	<15	Trace	<5
With	15-29	With	5-12
Modifier	>30	Modifier	>12

GRAIN SIZE TERMINOLOGY		PLASTICITY DESCRIPTION	
Major Component of Sample	**Particle Size**	**Term**	**Plasticity Index**
Boulders	Over 12 in. (300 mm)	Non-plastic	0
Cobbles	12 in. to 3 in. (300mm to 75mm)	Low	1 - 10
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)	Medium	11 - 30
Sand	#4 to #200 sieve (4.75mm to 0.075mm	High	> 30
Silt or Clay	Passing #200 sieve (0.075mm)		

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 on or above "A"		CL	Lean clay [K, L, M]
			PI < 4 or plots below "A" line [J]		ML	Silt [K, L, M]
		Organic:	Liquid limit - oven dried / Liquid limit - 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:	Liquid limit - oven dried / Liquid limit - 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] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[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.

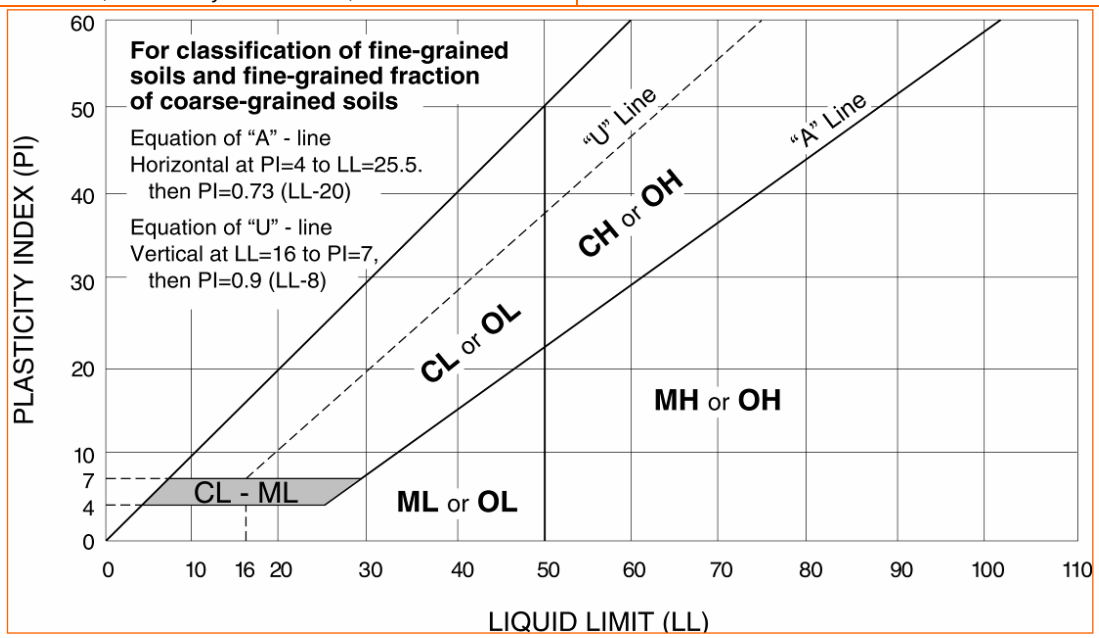
[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[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.