ECS Southwest, LLP

Geotechnical Engineering Report

REDI East Texas Logistics Center

I-30 and Spur 86
Texarkana, Texas

ECS Project Number 19:8111

January 7, 2021

ECS SOUTHWEST, LLP
"Setting the Standard for Service"
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January 7, 2021

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ECS Project No. 19:8111

Reference: Preliminary Geotechnical Engineering Report
REDI East Texas Logistics Center
I-30 and Spur 86
Texarkana, Texas

Dear Mr. Sitterley:

ECS Southwest (ECS) has completed the subsurface exploration, laboratory testing, and preliminary geotechnical engineering analyses for the referenced project. Our services were performed in general accordance with our Proposal No. 19:10322-GP, dated August 28, 2020. This report presents our understanding of the preliminary geotechnical aspects of the project along with the results of the field exploration and laboratory testing conducted. The report also contains our findings and preliminary recommendations for design and construction.

It has been our pleasure to be of service to you during preliminary design phase of this project. We would appreciate the opportunity to remain involved during the continuation of the design phase, and we would like to provide our services during construction phase operations as well to verify the assumptions of subsurface conditions made for this report. Should you have any questions concerning the information contained in this report, or if we can be of further assistance to you, please contact us.

Respectfully,

ECS SOUTHWEST, LLP

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EXECUTIVE SUMMARY

The following summarizes the main findings of the preliminary exploration, particularly those that may have a cost impact on the planned development. Further, our principal foundation recommendations are summarized. Information gleaned from the executive summary should not be utilized in lieu of reading the entire geotechnical report.

- The preliminary geotechnical exploration performed for this study consisted of a total of 10 borings drilled to a depth of approximately 25 feet below the existing site grades.

- The borings encountered sandy fat clay (CH), fat clay with sand (CH). Lean clay with sand (CL) was encountered in boring B-10.

- Groundwater seepage was not encountered in the borings.

- The planned structures at this site can be supported on underreamed drilled shaft (belled) foundations bearing in fat clay. Groundwater may be encountered in the drilled shafts. Alternatively, they can be supported by shallow footings if some movement can be tolerated in the foundation.

- The clay soils encountered at the site are considered highly expansive. The Potential Vertical Movement (PVM) of the soils encountered is estimated to be on the order of 3 to 6 inches. Subgrade treatment of these expansive clay soils is necessary to reduce the potential for vertical movement in the building pad area. Specific details on addressing these expansive clay soils are presented in the body of the report.

1.0 INTRODUCTION

1.1 GENERAL

The purpose of this study was to provide preliminary geotechnical information for the design and construction of the proposed warehouse type facility.

The recommendations developed for this report are preliminary and are based on project information provided by the client. This report contains the results of our subsurface explorations and geotechnical laboratory testing programs, site characterization, engineering analyses, and preliminary recommendations for the design and construction of the planned structures.

1.2 SCOPE OF SERVICES

To obtain the necessary geotechnical information, the preliminary study consisted of 10 soil test borings that were drilled to a depth of approximately 25 feet below the existing site grades. The borings were drilled at locations selected and located in the field by representatives of ECS. A laboratory-testing program was also implemented to characterize the physical and geotechnical engineering properties of the subsurface soils.

This report discusses our preliminary exploratory and testing procedures, presents our findings and evaluations and includes the following:

- A brief review and description of our field and laboratory test procedures and the results of testing conducted.
- A review of surface topographical features and site conditions.
- A review of area and site geologic conditions.
- A review of subsurface soil stratigraphy with pertinent available physical properties.
- A final copy of our soil test borings.
- Preliminary recommendations for site preparation and construction of compacted fills, including an evaluation of on-site soils for use as compacted fills.
- Preliminary recommended foundation types.
- Preliminary floor slab recommendations
- Preliminary retaining wall and below grade recommendations

1.3 AUTHORIZATION

Our services were provided in accordance with our Proposal No. 19:10322-GP, dated August 28, 2020 and authorized by the client on October 20, 2020.

2.0 PROJECT INFORMATION

2.1 PROJECT LOCATION

The project is located on the north and south sides of IH-30, near the intersection with Spur 86 Texarkana, Texas. The location is depicted in Figure 2.1.1 as shown below.

Figure 2.1.1 Site Location

2.2 CURRENT SITE CONDITIONS

The site for the proposed development is an undeveloped vacant land with tree, shrubs, and grass cover. Based on the ground surface elevations obtained from Google Earth, the north site slopes down from the south to the north with maximum and minimum elevations of approximately 379 feet and 367 feet, respectively. The south site slopes down from the south to the north with maximum and minimum elevations of approximately 398 feet and 379 feet, respectively.

2.3 PROPOSED CONSTRUCTION

We understand that this proposed project will include future construction of a warehouse type facility on an 850-acre site in Texarkana, Texas.

3.0 FIELD EXPLORATION

3.1 FIELD EXPLORATION PROGRAM

The field exploration was planned with the objective of characterizing the project site in general geotechnical and geological terms and to evaluate subsequent field and laboratory data to assist in the determination of preliminary geotechnical recommendations.

The preliminary subsurface explorations consisted of 10 borings drilled to a depth of approximately 25 feet below the existing site grades. A truck-mounted drill rig with hollow stem augers and ATV drill rig were utilized to drill the borings.

The boring locations were determined by and identified in the field by ECS personnel using the supplied diagram. The approximate as-drilled boring locations are shown on the Boring Location Diagram in Appendix A. The ground surface elevations noted in this report were obtained from Google Earth.

Representative soil samples were obtained by means of the split-barrel and Shelby tube sampling procedures in accordance with ASTM Specifications D-1586 and D-1587, respectively. In the split-barrel sampling procedure, a 2-inch O.D., split-barrel sampler is driven into the soil a distance of 18 inches by means of a 140-pound hammer falling 30 inches. The number of blows required to drive the sampler through a 12-inch interval is termed the Standard Penetration Test (SPT) value and is indicated for each sample on the boring logs. In the Shelby tube sampling procedure, a thin walled, steel, seamless tube with sharp cutting edges is pushed hydraulically into the soil, and a relatively undisturbed sample is obtained.

Field logs of the soils encountered in the borings were maintained by the drill crew. After recovery, each geotechnical soil sample was removed from the sampler and visually classified. Representative portions of each soil sample were then wrapped in plastic and transported to our laboratory for further visual examination and laboratory testing. After completion of the drilling operations, the boreholes were backfilled with auger cuttings to the existing ground surface. The surface was patched with concrete in the borings that were drilled through pavements.

3.2 REGIONAL GEOLOGY

The regional parent geologic mapping indicates that the site is underlain by the Undivided Midway Group. The Midway Group typically consists of silty or sandy clay that grades up to mudstone and sand of the Wilcox Group.

The location of the site on the geologic map is provided below on Figure 3.2.1.

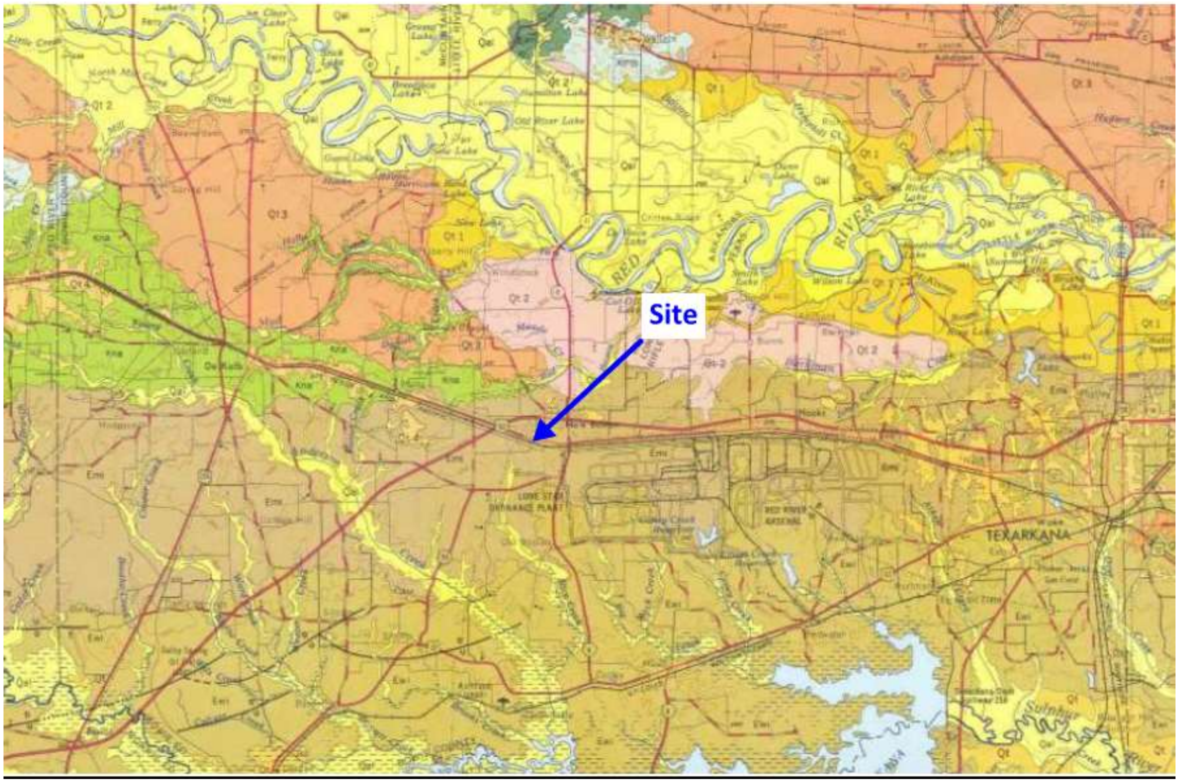


Figure 3.2.1

Geologic map for Figure 3.2.1 obtained from the Geologic Atlas of Texas, Texarkana Sheet, 1987

3.3 SUBSURFACE CHARACTERIZATION

The subsurface conditions encountered were generally consistent with published geological mapping. The following sections provide generalized characterizations of the soil and rock strata encountered during our subsurface exploration. For subsurface information specific information refer to the Boring Logs in Appendix B.

Table 3.3.1 Subsurface Stratigraphy

Approximate Depth to Bottom of Strata Below Grade (feet)	Material Description	Consistency
2 to 4	SANDY FAT CLAY (CH), brown	Very soft to very stiff
6 to 12	FAT CLAY WITH SAND (CH), red, light brown	Stiff to hard
15[1]	LEAN CLAY WITH SAND (CL), red, light brown	Hard
18 to 25*	FAT CLAY (CH), light brown, grey	Hard

Note:

1. Encountered in boring B-10

**Boring termination depth*

Please refer to the attached boring logs and laboratory data summary for this field exploration for a more detailed description of the subsurface conditions encountered in the borings as the stratification descriptions above are generalized for presentation purposes.

3.4 GROUNDWATER OBSERVATIONS

Groundwater was not encountered in the borings. Groundwater level observations were made in the borings during drilling operations. In auger drilling operations, water is not introduced into the borehole and the groundwater position can often be determined by observing water flowing into and out of the excavation. Furthermore, visual observation of soil samples retrieved can often be used in evaluating the groundwater conditions.

Any water encountered in borings within this geologic setting is generally referred to as a partially perched condition. Specifically, rainfall that enters the site, either directly from overland flow or from adjacent properties, begins to percolate through surficial soils and within clay seams and fissures, between natural soils and fill, as well as on the top of the underlying rock. This ground water flow continues downhill with the water table occasionally surfacing to form wet springs and intermittent streams. Only in the lowest lying areas and adjacent to existing creeks is a shallow groundwater table in a continuous condition.

The highest groundwater observations are normally encountered in the late winter and early spring. Fluctuations in the location of the long-term water table may occur as a result of changes in precipitation, evaporation, surface water runoff and other factors not immediately apparent at the time of this investigation. Therefore, the groundwater conditions could be different at the time of construction. The possibility of groundwater level fluctuation should be considered when developing the design and construction plans for the project.

4.0 LABORATORY TESTING

The laboratory testing was performed by ECS on selected samples obtained during our field exploration operations. Classification and index property tests were performed on representative soil samples obtained from the test borings in order to aid in classifying soils according to the Unified Soil Classification System and to quantify and correlate engineering properties. The soil samples were tested for moisture content and density, Atterberg Limits, unconfined compression, and passing No. 200.

An experienced geotechnical engineer visually classified each soil sample from the test borings on the basis of texture and plasticity in accordance with the Unified Soil Classification System (USCS) and ASTM D-2488 (Description and Identification of Soils-Visual/Manual Procedures). After classification, the geotechnical engineer grouped the various soil types into the major zones noted on the boring logs in Appendix B. The group symbols for each soil type are indicated in parentheses following the soil descriptions on the boring logs. The stratification lines designating the interfaces between earth materials on the boring logs are approximate; in situ, the transitions may be gradual.

The soil samples will be retained in our laboratory for a period of 60 days, after which, they will be discarded unless other instructions are received as to their disposition.

5.0 PRELIMINARY DESIGN RECOMMENDATIONS

The following recommendations are preliminary and additional borings will be required prior to finalizing the provided design recommendations. The preliminary design recommendations are on the basis of the previously described project characteristics and subsurface conditions. If there are any changes to the project characteristics or if different subsurface conditions are encountered during construction, ECS should be consulted so that the recommendations of this report can be reviewed.

The planned structures at this site can be supported on underreamed drilled shaft (belled) foundations or shallow footings bearing in fat clay. The recommendations of this report must be reviewed once the finished grades for the buildings are established.

Preliminary geotechnical recommendations for foundations, floor slabs, retaining walls, pavements and earthwork are presented in the following report sections

5.1 POTENTIAL VERTICAL MOVEMENTS

The surface soils encountered at this site are highly expansive. The expansive soils are susceptible to shrink and swell tendencies with the changes in moisture content, occurring seasonally. Based on test method TEX-124-E in the Texas Department of Transportation (TxDOT) Manual of Testing Procedures, swell test results and our experience with similar soils, we estimate potential vertical soil movements (PVM) of about 3 to 6 inches for floor slabs and flatwork placed near existing grades. The actual movements could be greater if poor drainage, ponded water, and/or other unusual sources of moisture are allowed to saturate the soils beneath the structure after construction.

Subgrade modification is recommended to reduce potential movements of slab-on-grade/ flatwork placed on expansive clays. The depth of moisture conditioning required will depend the allowable movement of floor slabs/ flatwork and the finished elevation of the slab-on-grade/ flatwork. The movement can be reduced to about 1 inch by moisture conditioning the on-site soils and capping it with select fill. We recommend the following building pad subgrade improvement options to achieve a uniform movement across the building pads, reduce the movements to about 1 inch, and minimize the risk associated with future movements.

Table 5.1.1 Subgrade Improvements to Achieve Movements of 1 inch

Location See Plan	Depth of Non-Expansive Fill (feet)	Depth of Moisture Conditioning (feet)	Total Depth of Improved Zone (feet)	PVM (in)
At Grade Structures	2	8	10	1.0

The subgrade improvements should extend beyond the building lines to include building entrances, abutting sidewalks, flatwork areas sensitive movement and 5 feet beyond those elements. Select fill or flexible base should not be used in exposed areas outside the building. Exterior grade beam backfill should consist of on-site moisture conditioned clay. Properties of moisture conditioned soil, select fill, flexible base and lime stabilized soil are provided in ***Section 6.3 Material Specifications***.

5.2 FOUNDATIONS

Based on the conditions encountered in the borings, the planned structures at this site can be supported on underreamed drilled (belled) shaft foundations bearing in fat clay. Design parameters for these foundation systems are presented below.

5.2.1 DRILLED UNDERREAMED (BELLED) SHAFTS – AXIAL DESIGN PARAMETERS

Axial design parameters for drilled and underreamed shafts are presented in the following table.

Table 5.2.1.1 Axial Design Parameters for Underreamed Drilled Shafts

Parameter	Recommendations
Bearing stratum	Fat Clay
Bearing depth	15 feet
Net allowable end bearing capacity[1]	5,000 psf
Factor of safety	3
Minimum shaft diameter	18 inches
Minimum bell diameter	30 inches larger than straight portion
Minimum bell to shaft diameter ratio	2 to 1
Maximum bell to shaft diameter ratio	3 to 1
Minimum bell edge to bell edge spacing	One bell diameter, based on the larger of the two bells
Soil induced uplift[2]	1,800 psf for soils without moisture conditioning and 750 psf for soils with moisture conditioning acting over a total depth of 8 feet.
Total Settlement	½ to 1 percent of the bell diameter. About 75 percent of the total settlement is expected to occur as the shafts are loaded.
Differential settlement	50 to 75 percent of the total settlement

Notes:

1. *The net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation.*
2. *The drilled shafts will be subject to uplift due to swelling of the expansive clays in contact with the drilled shafts. The drilled shafts should be reinforced with sufficient, full-depth, vertical reinforcing steel to resist uplift forces.*

5.2.2 DRILLED UNDERREAMED (BELLED) SHAFTS – LATERAL DESIGN PARAMETERS (PRELIMINARY)

Drilled shafts may be subject to lateral loads. Lateral design parameters for underreamed drilled shafts (belled) are presented in the following tables for use in LPILE 2016 computer program, developed by Ensoft, Inc.

Table 5.2.2.1 LPILE Design Parameters for Soil

Soil Description	LPile Material Type	Unit Weight, (pcf)	Undrained Shear Strength, (psf)	Friction Angle, (degrees)	E_{50}
0' – 3'	Ignore				
Natural Clay	Stiff Clay without Free Water	120	2,000	-	0.007

5.2.3 DRILLED UNDERREAMED (BELLED) SHAFTS – CONSTRUCTION CONSIDERATIONS

The drilled shafts should be installed in accordance with American Concrete Institute's "Standard Specification for the Construction of Drilled Piers" (ACI 336). Recommendations provided in this report are based on proper construction procedures including maintaining a dry shaft excavation. We recommend that all drilled shafts be observed by qualified geotechnical personnel, to verify proper shaft installation. Observations should include:

1. identification of the bearing stratum;
2. minimum penetration depth;
3. removal of all smear zones and cuttings;
4. correct handling of groundwater seepage;
5. shafts are within acceptable vertical tolerance; and
6. other related items

Groundwater was not encountered in the borings and may be encountered during installation of underreamed drilled shafts (belled). Temporary casing terminated in overburden soils will not control the groundwater, requiring underwater placement of concrete by a sealed tremie or a concrete pump. In addition, sandy soils are subject to caving, and it will be necessary to process the shaft excavation. Mineral or polymer slurry can be used to process shaft excavation in sand.

In underwater placement of concrete, the water level should be stabilized before beginning the concreting operations. Reinforcing steel and concrete should be placed immediately after the excavation has been completed. The pipe or tremie should be plugged after the discharge pipe is lowered until it rests on the bottom of the hole. It should be filled with concrete and then lifted off the bottom about 1 foot. Concreting operations using a tremie or concrete pump should take place as continuously as possible until the concrete placement is complete. The bottom of the discharge pipe should always be kept least 5 feet below the surface of the concrete. A properly designed concrete mix should be used for drilled shafts.

If casing is used control groundwater, it must be installed to a sufficient depth to ensure that an adequate seal is obtained. After the satisfactory installation of the temporary casing, the required penetration into the bearing material may be excavated through the casing. Water and loose materials in the cased hole should be removed prior to the concrete placement. Dewatering could consist of using a bailing bucket, pumping, mixing the water with dry soil, etc.

Reinforcing steel and concrete should be placed immediately after the excavation has been completed, dewatered, cleaned, and observed. The concrete placed in dry excavations should have a slump between 5 and 7 inches and should be placed in a manner that prevents it from striking the reinforcing steel and sides of the excavation. Concrete placed in an excavation in excess of 10 feet should be placed in such a manner (using a tremie, centralizing chute, or by similar means) to prevent segregation of aggregates or to prevent concrete from striking the reinforcing steel. The concrete in the upper five feet of the shaft should be mechanically consolidated.

Underreamed drilled shafts (belled) should be completed in one day. Care should be taken to avoid creating an oversized cap ("mushroom") near the ground surface. A "mushroom" at the top of the drilled shaft could be lifted by uplift loads of soils.

5.2.4 GRADE BEAMS/ PIER CAPS

All grade beams/ pier caps should be supported by the drilled shafts. The grade beams situated in the overburden soils should be formed with a nominal 8 to 12-inch void beneath the beam. This void is provided to isolate the grade beams from the underlying active clays. Cardboard carton forms can be used to create this void. A soil retainer should be provided to help prevent “in fill” of this void.

Cardboard void forms must have sufficient strength to support the weight of the grade beam during construction. The excavation in which the void box lays must remain dry. Care must be exercised during construction to prevent collapse of these cartons. Backfill material must not be allowed to enter the void carton area below the grade beams, since this reduces the void space in which the underlying soils need to swell.

Soils placed along the exterior of the grade beams should be on-site clay soils placed and compacted to at least 93% of the Maximum Dry Density at a minimum of 5 percentage points above optimum moisture content as obtained using the Standard Proctor Method (ASTM D-698). The purpose of this clay backfill is to reduce the opportunity for surface or subsurface water infiltration beneath the structure.

A void space is not required for grade beams situated in the tan or gray limestone (if any).

5.2.5 SHALLOW FOOTINGS – DESIGN PARAMETERS

As an alternate to drilled and underreamed shafts, the structures at this site can be supported by shallow footings bearing on clay soils if some movement can be tolerated in the foundation. In order to use footing foundations, the building subgrade should be prepared to reduce movements to about 1 inch as discussed in in ***Section 5.1 Potential Vertical Movements***. The design parameters for shallow footings are presented in the following table.

Table 5.2.5.1: Shallow Footing Design Parameters

Parameter	Recommendation
Bearing stratum[1]	On site clay or properly placed and compacted fill
Net allowable bearing capacity[1]	2,500 psf
Minimum embedment	2 feet below lowest adjacent final grade
Minimum dimension – continuous footings	18 inches
Minimum dimension – individual footings	36 inches
Ultimate Passive pressure (triangular distribution)[2, 3]	245 psf/ ft
Ultimate coefficient of sliding[3]	0.36
Foundation settlement	1 inch
Approximate differential settlement	½ to ¾ inches

Notes:

1. *The net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. No footing should be founded within a 45 degree plane from the base of the adjacent footing or excavation.*
2. *The side of the excavation for footings must be nearly vertical and concrete should be placed against these vertical faces. The passive earth pressure in clay soils should be neglected. In addition, the passive pressure should be ignored if the material in front of the wall will be excavated at any time in the future.*
3. *A minimum factor of safety of 1.5 is recommended against sliding.*

5.2.6 SHALLOW FOOTINGS - CONSTRUCTION CONSIDERATIONS

Footing excavations should be protected from standing water or desiccation. The base of all foundation excavations should be free of water and loose soil and rock prior to placing concrete. Complete construction of a spread footing or a section of wall footing, including excavation, placement of steel and concrete, and backfilling should be completed in a reasonably continuous manner, preferably within 72 hours of excavation to reduce the disturbance to foundation bearing material. A seal slab of footing strength concrete should be provided at the bottom of any footing which will remain open for more than 72 hours or if rain events are expected before footings are constructed.

Backfilling of footings should be accomplished using excavated material for footings and as soon as possible to reduce disturbance of foundation soils. Backfill should be placed at a minimum of 5 percentage points above optimum moisture content and compacted to at least 92% of the Maximum Dry Density as obtained using the Standard Proctor Method (ASTM D-698). Construction of footings should be inspected by a qualified geotechnical engineer to verify the bearing materials and to perform related observations and testing.

5.3 FLOOR SYSTEMS

The potential movements of floor slabs placed near existing grade are estimated to be about 4 to 6 inches. A structural floor slab system in conjunction with drilled shafts are recommended for the portions of the building that cannot tolerate movements. Floor slabs in areas that can tolerate movements of about 1 inch can be supported on grade provided the subgrade is prepared as discussed in ***Section 5.1 Potential Vertical Movements***. In addition, flatwork adjacent to the building can be supported on a prepared subgrade.

5.3.1 SLABS-ON-GRADE/ FLATWORK ON PREPARED SUBGRADE

The structures with floor slabs situated in overburden soils that can tolerate movements of about 1 inch can be supported on a prepared subgrade. To reduce the movements to about 1 inch, we recommend preparing the building subgrade as discussed in ***Section 5.1 Potential Vertical Movements***. We recommend that a modulus of subgrade reaction (ks) of 125 pci be used for the design of the slab-on-grade on natural or moisture conditioned soils.

If a slab on grade is used, we recommend it be isolated from the foundations so differential movements of the structure will not induce shear stresses on the floor slab or pour strips may be considered. For maximum effectiveness, temperature, and shrinkage reinforcements in slabs on ground should be positioned in the upper third of the slab thickness. The Wire Reinforcement Institute recommends the mesh reinforcement be placed 2 inches below the slab surface or upper one-third of slab thickness, whichever is closer to the surface. Adequate construction joints, contraction joints and isolation joints should also be provided in the slab to reduce the impacts of cracking and shrinkage. Please refer to ACI 302.1R96 Guide for Concrete Floor and Slab Construction for additional information regarding concrete slab joint design.

If floor treatments that are sensitive to moisture will be used, a vapor retarder of polyethylene sheeting or similar material should be placed beneath the slab to minimize moisture migration through the slab. If a vapor retarder is considered to provide moisture protection, special attention should be given to the surface curing of the slabs to minimize uneven drying of the slabs and associated cracking and/or slab curling. Please refer to ACI 302.1R96 Guide for Concrete Floor and Slab Construction and ASTM E 1643 Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs for additional guidance on this issue. A sub-floor drainage system is recommended for below grade slabs.

5.4 SEISMIC DESIGN CONSIDERATIONS

Seismic Site Classification: The International Building Code (IBC) 2015 requires site classification for seismic design based on the upper 100 feet of a soil profile. The methods are utilized in classifying sites, namely the shear wave velocity (v_s) method; the unconfined compressive strength (s_u) method; and the Standard Penetration Resistance (N-value) method. The unconfined compressive strength (s_u) method was used in classifying this site.

The seismic site class definitions for the weighted average of shear wave velocity, SPT N-value or unconfined compressive strength (s_u) in the upper 100 feet of the soil profile are shown in the following table:

Table 5.4.1: Seismic Site Classification

Site Class	Soil Profile Name	Shear Wave Velocity, V_s, (ft./s)	Standard Penetration Resistance, N	Soil Undrained Shear Strength, s_u (psf)
A	Hard Rock	Vs > 5,000 fps	N/A	N/A
B	Rock	2,500 < Vs ≤ 5,000	N/A	N/A
C	Very dense soil and soft rock	1,200 < Vs ≤ 2,500	N >50	$s_u \geq$ 2,000
D	Stiff Soil Profile	600 ≤ Vs ≤ 1,200	15 ≤ N ≤ 50	1,000 ≤ s_u ≤ 2000
E	Soft Soil Profile	Vs < 600	N <15	s_u < 1000

Based on the 2015 International Building Code (IBC) Site Class Definitions, in our opinion the site soil and rock can be characterized as Site Class C. Site Class C is described as Very Dense Soil and Soft Rock for the top 100 feet of the site soil profile. If a higher site classification is beneficial to the project, ECS would be pleased to discuss additional testing capabilities in this regard.

The Mapped Spectral Response Acceleration at Short Periods and 1-Second Periods, S_s and S_1, respectively, are as follows for the project site. The approximate S_s and S_1 values, as shown below, are calculated through the United States Geological Survey's (USGS) Seismic Hazard Curves and Uniform Hazard Response Spectra program according to the 2015 IBC.

S_s = 0.123 g S_1 = 0.075 g

The Site Class definition should not be confused with the Seismic Design Category designation, which the Structural Engineer typically assesses.

5.5 SITE RETAINING WALLS

Site retaining walls may be required. Retaining walls associated with the structure should be supported on underreamed drilled shafts (belled) or footings as discussed in ***Section 5.2 Foundations*** of this report. Cast-in-place concrete cantilever retaining walls supported on shallow footings in clay soils can be used for site retaining walls. Recommendations for site retaining walls are provided below.

5.5.1 LATERAL EARTH PRESSURE

The lateral pressure acting on the walls will depend on the backfill material type, the amount of wall movement and drainage conditions behind the walls. Recommended lateral design parameters are provided in Table 5.6.3.1 below. The values in the table that follows under "Active Conditions" pertain to retaining walls free to tilt outward as a result of lateral earth pressures. For rigid, non-yielding walls (such as below grade walls) which are not allowed to rotate, the values under "At-Rest Conditions" should be used.

Table 5.5.1.1 Lateral Earth Pressure Design Values

Backfill Type (Level Backfill)	Total Unit Weight (pcf)	Active Condition		At Rest Condition	
		Earth Pressure Coefficient, k_a	Equivalent Fluid Pressure (psf/ ft)	Earth Pressure Coefficient, k_o	Equivalent Fluid Pressure (psf/ft)
On Site Clay/ Imported Clay Fill	125	0.45	56	0.62	78
Select Fill	125	0.36	45	0.53	67
Granular Fill	125	0.26	33	0.41	51

Properties of backfill materials are provided in Section ***6.3 Material Specifications***. The Select fill or granular backfill limits should extend outward at least 2 feet from the base of the wall footing and then upward on a 1H:1V slope. For narrower backfill widths of select or granular fill, the equivalent fluid pressures for on-site soils should be used.

The values presented above assume the surface of the backfill materials to be level. Sloping the surface of the backfill materials will increase the earth pressures acting on the retaining wall and can be evaluated if required. The above values also do not include the effect of surcharge loads such as construction equipment, vehicular loads, or future buildings or paving near the walls. Surcharge loads should be considered if they apply at the surface above the wall within an angle of 45° extending up from the base of the wall.

5.5.2 WALL DRAINAGE

The lateral pressure design values presented above assume a drained condition behind the wall. Hydrostatic pressures resulting from groundwater seepage entering and ponding within the backfill materials should be considered in the design if proper drainage is not provided.

For walls with a height of 4 feet or less, weep holes can be used for drainage. For walls with a height greater than 4 feet, vertical wall drains consisting of a composite geosynthetic drainage medium is recommended if select fill or on-site soil is chosen as backfill. The vertical drain should be located immediately behind the wall system and extend from the level of longitudinal drains, upward to not higher than 2 feet below the top of the wall. The vertical drains should transport water to the longitudinal drains and then to a storm water line. Composite geosynthetic drainage systems are typically proprietary systems. They are available in different sizes and with different flow rates. The manufacturer should be consulted for installation and spacing guidelines.

If free-draining granular backfill is used, a vertical wall drain would not be necessary. The granular backfill should transport water to longitudinal drains and then to a storm water line. However, in this case, we recommend that a 2-foot thickness of well-compacted, impervious clay cover be placed over the backfill surface to reduce infiltration in areas that are not covered by pavement. A geotextile filter fabric should be placed between the aggregate backfill and the clay cover materials and between the aggregate backfill and the backslope of the native material to minimize infiltration of fines into the backfill.

5.5.3 BACKFILL SETTLEMENT

Backfill placed behind the walls should be well compacted. Special care must be exercised to “tie in” the backfill with adjacent undisturbed, firm, natural soils by providing deep benches into the firm natural soil during placement of each fill lift. All loose materials and “slope wash” that may accumulate in the wall excavation during construction should be completely removed prior to placement of the backfill materials.

Some post-construction settlement of the backfill surface should be anticipated. This is typically on the order of one percent of the backfill height, even if satisfactory compaction of the backfill materials is achieved. This will lead to potential differential settlement. Therefore, it is recommended that special consideration be given to the design of any foundation elements, floor slabs, and pavements that may extend over this backfill as a result of the potential for differential settlements introduced by this condition.

6.0 PRELIMINARY SITE CONSTRUCTION RECOMMENDATIONS

6.1 SUBGRADE PREPARATION

In a dry and undisturbed state, the upper 1-foot of the majority of the soil at the site will provide good subgrade support for fill placement and construction operations. However, these soils contain fines which are considered moderately erodible and are moisture and disturbance sensitive. Therefore, good site drainage should be maintained during earthwork operations, which would help maintain the integrity of the soil. We recommend that an attempt be made to enhance the natural drainage without interrupting its pattern. All erosion and sedimentation should be controlled in accordance with sound engineering practice and current jurisdictional requirements.

All the existing structures and features at the site, including pavement sections should be removed. Remnants of any existing or previously demolished structures, foundations, debris, and similar unsuitable materials should also be removed. Existing underground utility lines should be completely removed or fully grouted to prevent moisture intrusion. All trees present at the site should be removed. Tree removal should include root bulbs.

Where excavations are not performed, the site should then be stripped. After removing all unsuitable surface materials, stripping, cutting to the proposed grade, and prior to the placement of any structural fill, the exposed subgrade should be examined by the Geotechnical Engineer or authorized representative. The exposed soil subgrade should be thoroughly proofrolled with previously approved construction equipment having a minimum axle load of 10 tons (e.g. fully loaded tandem-axle dump truck). The areas subject to proofrolling should be traversed by the equipment in two perpendicular (orthogonal) directions with overlapping passes of the vehicle under the observation of the Geotechnical Engineer or authorized representative. This procedure is intended to assist in identifying any localized yielding materials.

In the event that unstable or “pumping” subgrade is identified by the proofrolling, those areas should be marked for repair prior to the placement of any subsequent structural fill or other construction materials. Methods of repair of unstable subgrade, such as undercutting or moisture conditioning or chemical stabilization, should be discussed with the Geotechnical Engineer to determine the appropriate procedure with regard to the existing conditions causing the instability.

6.2 EARTHWORK OPERATIONS

Prior to placement of any new fill, all subgrades should be scarified to a minimum depth of 6 inches, compacted to at least 95% of Maximum Dry Density as obtained by the Standard Proctor Method (ASTM D-698) and moisture conditioned above the optimum value. All fills should be benched into the existing soils.

Imported soil used for general fill should not have a Plasticity Index (PI) of greater than the material encountered onsite. All general fill material, outside of the building subgrade improvements, should be moisture conditioned at or above optimum moisture content and compacted to at least 95% of the Maximum Dry Density as obtained by the Standard Proctor Method (ASTM D-698). All fill soils should be placed in 8 inch loose lifts for mass grading operations and 4 inches for trench type excavations where walk behind or “jumping jack” compaction equipment is used.

Upon completion of the filling operations, care should be taken to maintain the soil moisture content prior to construction of floor slabs and pavements. Soil moisture levels can be preserved by various methods that can include covering with plastic, watering, etc. If the soil becomes desiccated, the affected material should be removed and replaced, or these materials should be scarified, moisture conditioned and recompacted.

Utility cuts should not be left open for extended periods of time and should be properly backfilled. Backfilling should be accomplished with properly compacted on-site soils, rather than granular materials. If granular materials are used, a utility trench cut-off at the building line is recommended to help prevent water from migrating through the utility trench backfill to beneath the proposed structure.

Field density and moisture tests should be performed on each lift as necessary to verify that adequate compaction is achieved. As a guide, one test per 2,500 square feet per lift is recommended in the building and paving areas (two tests minimum per lift). Utility trench backfill should be tested at a rate of one test per lift per each 150 linear feet of trench (two tests minimum per lift). Certain jurisdictional requirements may require testing in addition to that noted previously. Therefore, these specifications should be reviewed, and the more stringent specifications should be followed.

6.3 MATERIAL SPECIFICATIONS

Material specifications recommended for this project are provided below.

6.3.1 MOISTURE CONDITIONED CLAY FILL

Moisture conditioning may be performed within any structures and flatwork areas sensitive to movements. Moisture conditioning of the existing clays, and all new clayey fill is performed to increase the moisture of the clays to a level that reduces their ability to absorb additional water that could result in post-construction heave in these soils.

The moisture conditioning should consist of undercutting, scarifying and/or reworking, as required to achieve the required subgrade improvement. During this process, the clay should receive adequate amounts of water to ensure a uniform moisture content of at least 5 percentage or higher above the optimum moisture content. During the addition of water, the soils should be adequately mixed, and re-mixed, to ensure a uniform distribution of the moisture throughout the soil mass. Once appropriately mixed, the material should be compacted to at least 93% of the Maximum Dry Density as obtained using the Standard Proctor Method (ASTM D-698).

Outside of the moisture conditioned zone and where clay is used to establish site grades, we recommend that the clay material be placed and compacted to at least 95% of the Maximum Dry Density at or above the optimum moisture content as obtained using the Standard Proctor Method (ASTM D-698). These soils should be free of deleterious materials and be reworked to ensure a uniform distribution of water in order to achieve a uniform moisture content above the optimum moisture content.

Care should be taken to verify and preserve the specified moisture levels in the reworked clays prior to placement of floor slabs and pavements.

6.3.2 SELECT FILL

For the purposes of this report, Select Fill may consist of onsite or imported material that is free of debris and organic matter and have a Plasticity Index (PI) of 5 to 15, and contain 40 to 70 percent passing the No. 200 sieve. The select fill can be used as protective cap over moisture conditioned clays within building pads or use as backfill materials behind retaining walls and below grade walls.

Crushed limestone may also be used as protective cap over moisture conditioned clays within building pads. The crushed limestone used for this process should have a minimum Dry Density of 115 pcf. The crushed limestone should have a maximum dimension of 1 inch.

This material should be placed and compacted at workable moisture contents at or above the optimum moisture content and compacted to at least 95% of the Maximum Dry Density as obtained using the Standard Proctor Method (ASTM D-698).

6.3.3 FLEXIBLE BASE

Flexible base material can also be used in lieu of as select fill or lime stabilized clay for the protective cap over moisture conditioned clays within building pads or beneath pavements.

Flexible base should meet the requirements of TxDOT Item 247, Type D, Grade 1 or 2. Recycled concrete meeting the gradation requirements of flexible base is also acceptable for use. The flexible base and recycled concrete should be compacted to 95% of maximum dry density at or above the optimum moisture content as obtained using the Standard Proctor Method (ASTM D-698).

6.3.4 GRANULAR FILL

The granular fill can be used as backfill materials behind retaining walls and below grade walls. Granular fill should consist of crushed limestone with less than 3% passing N0.200 Sieve and less than 30% passing No.40 sieve. The fine materials in the granular fill should be non-plastic. The granular fill should be compacted to 95% of maximum dry density at or above the optimum moisture content as obtained using the Standard Proctor Method (ASTM D-698).

7.0 CLOSING

ECS has prepared this report of findings, evaluations, and recommendations to guide geotechnical-related preliminary design and construction aspects of the project. This report is preliminary and a final subsurface investigation and geotechnical engineering must be performed at a future date.

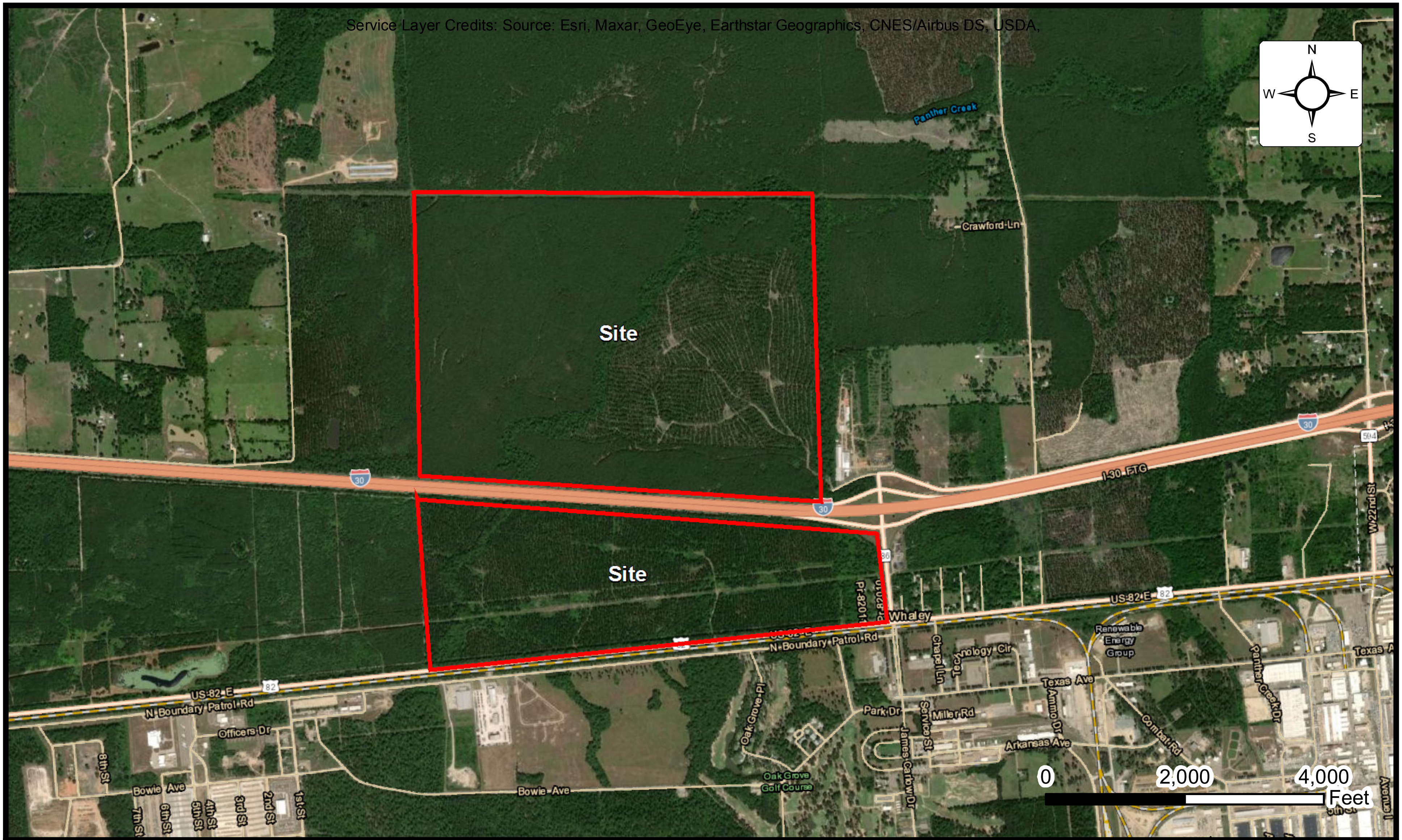
The description of the proposed project is based on information provided to ECS by the design team. If any of this information is inaccurate, either due to our interpretation of the documents provided or site or design changes that may occur later, ECS should be contacted immediately in order that we can review the report in light of the changes and provide additional or alternate recommendations as may be required to reflect the proposed construction.

We recommend that ECS be allowed to review the project's plans and specifications pertaining to our work so that we may ascertain consistency of those plans/specifications with the intent of the geotechnical report.

The analysis and recommendations submitted in this report are preliminary and are based upon the data obtained from the borings and tests performed at the locations as indicated on the Boring Location Diagram and other information referenced in this report. This report does not reflect any variations, which may occur between the borings. In the performance of the subsurface exploration, specific information is obtained at specific locations at specific times. However, it is a well-known fact that variations in subsurface conditions exist on most sites between boring locations and also such situations as groundwater levels vary from time to time. The nature and extent of variations may not become evident until the course of construction. If variations then appear evident, after performing on-site observations during the construction period and noting characteristics and variations, a reevaluation of the recommendations for this report will be necessary. The assessment of site environmental conditions for the presence of pollutants in the soil and groundwater of the site was beyond the scope of this report.

APPENDIX A – Figures

Site Location Map
Boring Location Diagram
Regional Geology



Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA,

Site Location Diagram

REDI EAST TEXAS LOGISTICS CENTER (TEXARKANA, TX)

SPUR 86 AND I-30 WEST, TEXARKANA, TEXAS

AR-TX REDI

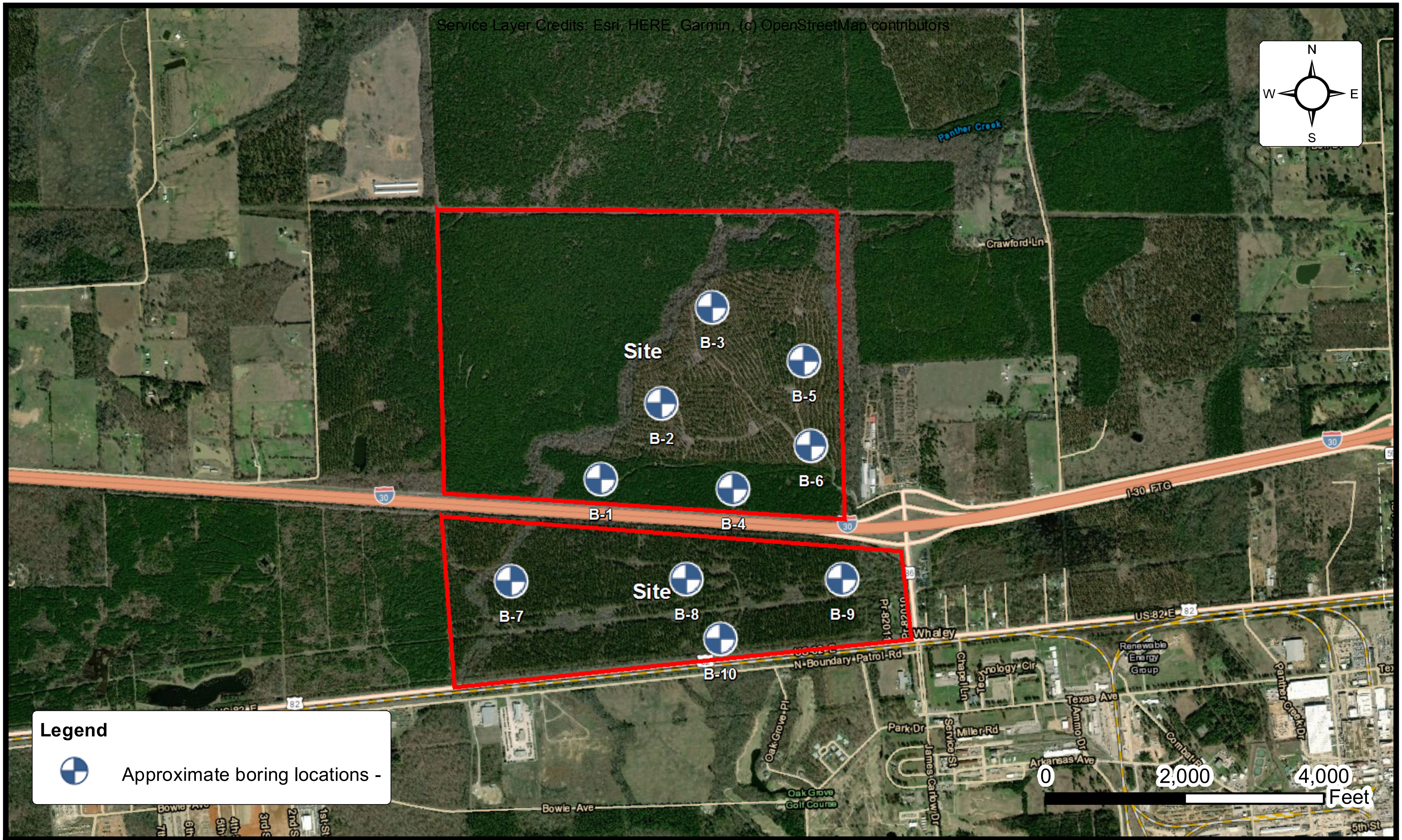
ENGINEER
JNH

SCALE
AS NOTED

PROJECT NO.
19:8111

SHEET
1 OF 1

DATE
1/5/2021



Boring Location Diagram

REDI EAST TEXAS LOGISTICS CENTER (TEXARKANA, TX)

SPUR 86 AND I-30 WEST, TEXARKANA, TEXAS

AR-TX REDI

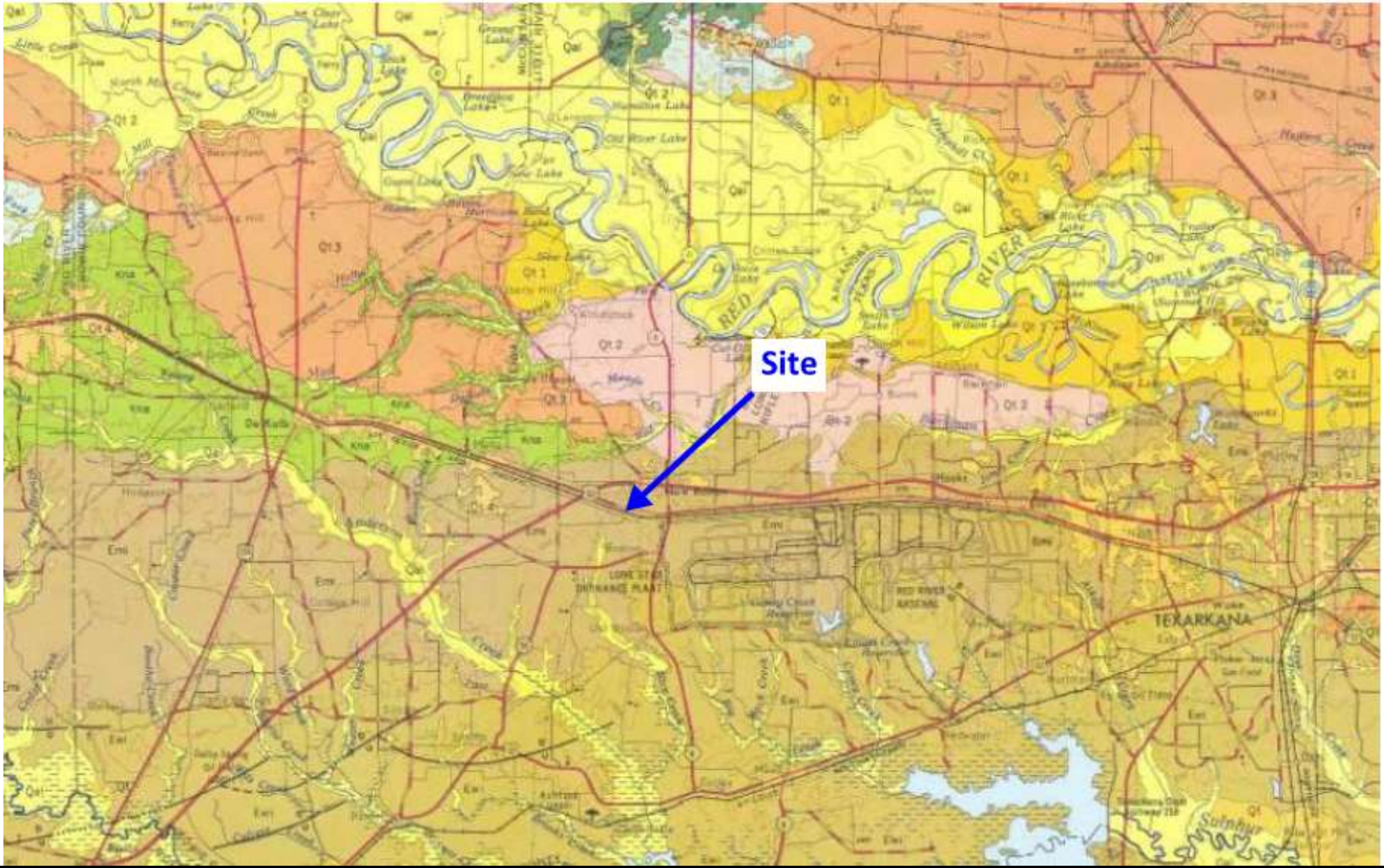
ENGINEER
JNH

SCALE
AS NOTED

PROJECT NO.
19:8111

SHEET
1 OF 1

DATE
12/14/2020



REGIONAL GEOLOGY
REDI EAST TEXAS LOGISTICS CENTER (TEXARKANA, TX)

IH-30 AND SPUR 86, TEXARKANA, TEXAS

AR-TX REDI

ENGINEER	JNH
SCALE	NOT TO SCALE
PROJECT NO.	19:8111
SHEET	1 OF 1
DATE	1/04/2020

APPENDIX B – Field Operations

Reference Notes for Boring Logs
Boring Logs B-1 and B-10

REFERENCE NOTES FOR BORING LOGS

MATERIAL[1,2]

■	**ASPHALT**	
▨	**CONCRETE**	
▨	**GRAVEL**	
▨	**TOPSOIL**	
□	**VOID**	
▨	**BRICK**	
▨	**AGGREGATE BASE COURSE**	
▨	**FILL[3]**	**MAN-PLACED SOILS**
▨	**GW**	**WELL-GRADED GRAVEL** **gravel-sand mixtures, little or no fines**
▨	**GP**	**POORLY-GRADED GRAVEL** **gravel-sand mixtures, little or no fines**
▨	**GM**	**SILTY GRAVEL** **gravel-sand-silt mixtures**
▨	**GC**	**CLAYEY GRAVEL** **gravel-sand-clay mixtures**
▨	**SW**	**WELL-GRADED SAND** **gravelly sand, little or no fines**
▨	**SP**	**POORLY-GRADED SAND** **gravelly sand, little or no fines**
▨	**SM**	**SM SILTY SAND** **sand-silt mixtures**
▨	**SC**	**CLAYEY SAND** **sand-clay mixtures**
▨	**ML**	**SILT** **non-plastic to medium plasticity**
▨	**MH**	**ELASTIC SILT** **high plasticity**
▨	**CL**	**LEAN CLAY** **low to medium plasticity**
▨	**CH**	**FAT CLAY** **high plasticity**
▨	**OL**	**ORGANIC SILT or CLAY** **non-plastic to low plasticity**
▨	**OH**	**ORGANIC SILT or CLAY** **high plasticity**
▨	**PT**	**PEAT** **highly organic soils**

DRILLING SAMPLING SYMBOLS & ABBREVIATIONS

SS	Split Spoon Sampler	PM	Pressuremeter Test
ST	Shelby Tube Sampler	RD	Rock Bit Drilling
WS	Wash Sample	RC	Rock Core, NX, BX, AX
BS	Bulk Sample of Cuttings	REC	Rock Sample Recovery %
PA	Power Auger (no sample)	RQD	Rock Quality Designation %
HSA	Hollow Stem Auger		

PARTICLE SIZE IDENTIFICATION

DESIGNATION		PARTICLE SIZES
Boulders		12 inches (300 mm) or larger
Cobbles		3 inches to 12 inches (75 mm to 300 mm)
Gravel:	Coarse	¾ inch to 3 inches (19 mm to 75 mm)
	Fine	4.75 mm to 19 mm (No. 4 sieve to ¾ inch)
Sand:	Coarse	2.00 mm to 4.75 mm (No. 10 to No. 4 sieve)
	Medium	0.425 mm to 2.00 mm (No. 40 to No. 10 sieve)
	Fine	0.074 mm to 0.425 mm (No. 200 to No. 40 sieve)
Silt & Clay ("Fines")		<0.074 mm (smaller than a No. 200 sieve)

COHESIVE SILTS & CLAYS

UNCONFINED COMPRESSIVE STRENGTH, QP[4]	SPT[5] (BPF)	CONSISTENCY[7] (COHESIVE)
<0.25	<3	Very Soft
0.25 - <0.50	3 - 4	Soft
0.50 - <1.00	5 - 8	Firm
1.00 - <2.00	9 - 15	Stiff
2.00 - <4.00	16 - 30	Very Stiff
4.00 - 8.00	31 - 50	Hard
>8.00	>50	Very Hard

RELATIVE AMOUNT[7]	COARSE GRAINED (%)[8]	FINE GRAINED (%)[8]
Trace	≤5	≤5
Dual Symbol (ex: SW-SM)	10	10
With	15 - 20	15 - 25
Adjective (ex: "Silty")	≥25	≥30

GRAVELS, SANDS & NON-COHESIVE SILTS

SPT[5]	DENSITY
<5	Very Loose
5 - 10	Loose
11 - 30	Medium Dense
31 - 50	Dense
>50	Very Dense

WATER LEVELS[6]

▽	WL	Water Level (WS)(WD) (WS) While Sampling (WD) While Drilling
▽	SHW	Seasonal High WT
▼	ACR	After Casing Removal
▽	SWT	Stabilized Water Table
	DCI	Dry Cave-In
	WCI	Wet Cave-In

---

[1] Classifications and symbols per ASTM D 2488-09 (Visual-Manual Procedure) unless noted otherwise.

[2] To be consistent with general practice, "POORLY GRADED" has been removed from GP, GP-GM, GP-GC, SP, SP-SM, SP-SC soil types on the boring logs.

[3] Non-ASTM designations are included in soil descriptions and symbols along with ASTM symbol [Ex: (SM-FILL)].

[4] Typically estimated via pocket penetrometer or Torvane shear test and expressed in tons per square foot (tsf).

[5] Standard Penetration Test (SPT) refers to the number of hammer blows (blow count) of a 140 lb. hammer falling 30 inches on a 2 inch OD split spoon sampler required to drive the sampler 12 inches (ASTM D 1586). "N-value" is another term for "blow count" and is expressed in blows per foot (bpf). SPT correlations per 7.4.2 Method B and need to be corrected if using an auto hammer.

[6] The water levels are those levels actually measured in the borehole at the times indicated by the symbol. The measurements are relatively reliable when augering, without adding fluids, in granular soils. In clay and cohesive silts, the determination of water levels may require several days for the water level to stabilize. In such cases, additional methods of measurement are generally employed.

[7] Minor deviation from ASTM D 2488-09 Note 16.

[8] Percentages are estimated to the nearest 5% per ASTM D 2488-09.

CLIENT: **AR-TX REDI**	PROJECT NO.: **19:8111**	BORING NO.: **B-1**	SHEET: **1 of 1**	ECS
PROJECT NAME: **REDI East Texas Logistics Center (Texarkana, TX)**	DRILLER/CONTRACTOR: **Total Depth**			
SITE LOCATION: **Spur 86 and I-30 West, Texarkana, Texas 75503**				
NORTHING: **3166862.4**	EASTING: **2835831.3**	STATION:	SURFACE ELEVATION: **372.0**	

LOSS OF CIRCULATION 100%

BOTTOM OF CASING ➤

Plastic Limit Water Content Liquid Limit
X———●———△

⊗ **STANDARD PENETRATION BLOWS/FT**

ROCK QUALITY DESIGNATION & RECOVERY

🟥 **RQD**

— **REC**

○ **CALIBRATED PENETROMETER TON/SF**

[FINES CONTENT] %

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
	S-1	ST	24	24	(CH) FAT CLAY WITH SAND, brown, moist, stiff			
	S-2	ST	24	24	(CH) FAT CLAY WITH SAND, red, light brown, moist, very stiff to hard			
5	S-3	ST	24	24			367	
	S-4	ST	12	12				
	S-5	SS	18	18				8-8-11 (19)
10	S-6	ST	12	12			362	
	S-7	ST	24	24	(CH) FAT CLAY, light brown, gray, moist, hard			
15							357	
	S-8	ST	24	24				
20							352	
	S-9	ST	24	24				
25					**END OF DRILLING AT 25.0 FT**		347	
30							342	

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

▽ WL (First Encountered)	**Dry**	BORING STARTED:	**Dec 17 2020**	CAVE IN DEPTH:
▼ WL (Completion)	**Dry**	BORING COMPLETED:	**Dec 17 2020**	HAMMER TYPE: **Auto**
▽ WL (Seasonal High Water)	**N/A**	EQUIPMENT: **ATV**	LOGGED BY: **JNH**	DRILLING METHOD: **CFA**
▽ WL (Stabilized)	**N/A**			

GEOTECHNICAL BOREHOLE LOG

CLIENT:
AR-TX REDI

PROJECT NO.:
19:8111

BORING NO.:
B-2

SHEET:
1 of 1

PROJECT NAME:
REDI East Texas Logistics Center (Texarkana, TX)

DRILLER/CONTRACTOR:
Total Depth

SITE LOCATION:
Spur 86 and I-30 West, Texarkana, Texas 75503

LOSS OF CIRCULATION 〉100%〉

BOTTOM OF CASING ➡

NORTHING:
3168191.1

EASTING:
2836814.0

STATION:

SURFACE ELEVATION:
362.0

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0–2	S-1	ST	24	24	(CH) FAT CLAY WITH SAND, red, light brown, moist, firm to hard			
2–4	S-2	ST	24	24				
4–6	S-3	ST	24	24				
6–8	S-4	ST	24	24				
8–10	S-5	ST	24	24				
13–15	S-6	ST	24	24	(CH) FAT CLAY, light brown, gray, moist, hard			
18–20	S-7	ST	24	24				
23–25	S-8	ST	24	24				
25					**END OF DRILLING AT 25.0 FT**			

DEPTH (FT)	ELEVATION (FT)
5	357
10	352
15	347
20	342
25	337
30	332

Plastic Limit Water Content Liquid Limit
X——●——△

⊗ STANDARD PENETRATION BLOWS/FT

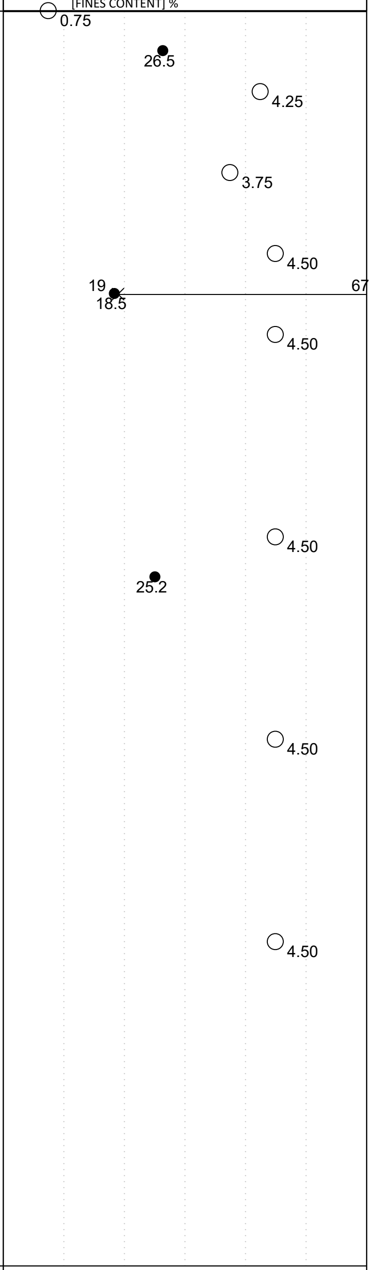
ROCK QUALITY DESIGNATION & RECOVERY

🟥 RQD

— REC

○ CALIBRATED PENETROMETER TON/SF

[FINES CONTENT] %



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

▽ WL (First Encountered)	**Dry**
▼ WL (Completion)	**Dry**
▼ WL (Seasonal High Water)	**N/A**
▽ WL (Stabilized)	**N/A**

BORING STARTED: **Dec 17 2020**

CAVE IN DEPTH:

BORING COMPLETED: **Dec 17 2020**

HAMMER TYPE: **Auto**

EQUIPMENT:
ATV

LOGGED BY:
JNH

DRILLING METHOD: **CFA**

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
AR-TX REDI	**19:8111**	**B-3**	**1 of 1**

PROJECT NAME: **REDI East Texas Logistics Center (Texarkana, TX)**

DRILLER/CONTRACTOR: **Total Depth**

SITE LOCATION: **Spur 86 and I-30 West, Texarkana, Texas 75503**

NORTHING:	EASTING:	STATION:	SURFACE ELEVATION:
3168344.9	**2837828.4**		**375.0**

LOSS OF CIRCULATION 100%

BOTTOM OF CASING

Plastic Limit Water Content Liquid Limit

X———●———△

⊗ STANDARD PENETRATION BLOWS/FT

ROCK QUALITY DESIGNATION & RECOVERY

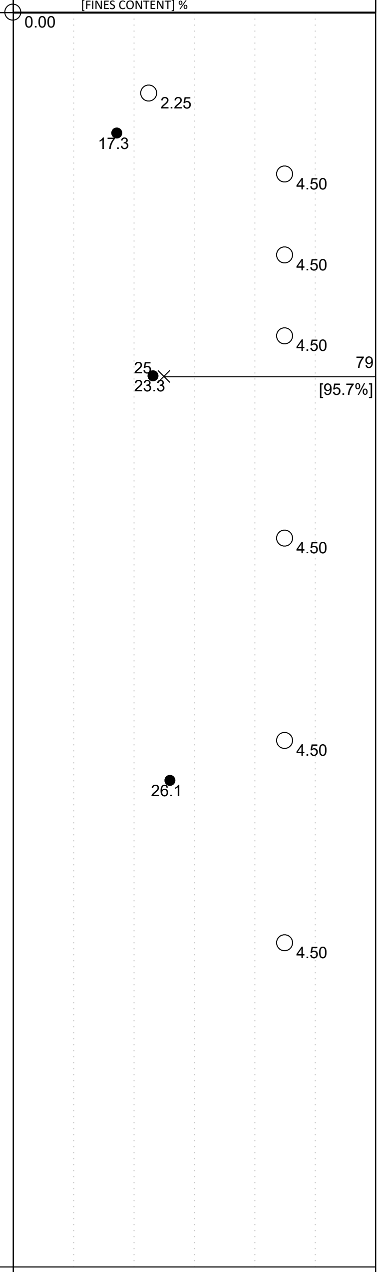
🟥 RQD

— REC

○ CALIBRATED PENETROMETER TON/SF

[FINES CONTENT] %

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
	S-1	ST	24	24	(CH) FAT CLAY WITH SAND, brown, moist, very soft to very stiff			
	S-2	ST	24	24				
5	S-3	ST	24	24	(CH) FAT CLAY WITH SAND, red, light brown, moist, hard		370	
	S-4	ST	24	24				
	S-5	ST	24	24	(CH) FAT CLAY, light brown, gray, moist, hard			
10							365	
	S-6	ST	24	24				
15							360	
	S-7	ST	24	24				
20							355	
	S-8	ST	24	24				
25					**END OF DRILLING AT 25.0 FT**		350	
30							345	



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

▽ WL (First Encountered)	**Dry**	BORING STARTED: **Dec 17 2020**
▼ WL (Completion)	**Dry**	BORING COMPLETED: **Dec 17 2020**
▽ WL (Seasonal High Water)	**N/A**	EQUIPMENT: **ATV**
▽ WL (Stabilized)	**N/A**	LOGGED BY: **JNH**

CAVE IN DEPTH:

HAMMER TYPE: **Auto**

DRILLING METHOD: **CFA**

GEOTECHNICAL BOREHOLE LOG

CLIENT: **AR-TX REDI**	PROJECT NO.: **19:8111**	BORING NO.: **B-4**	SHEET: **1 of 1**
PROJECT NAME: **REDI East Texas Logistics Center (Texarkana, TX)**	DRILLER/CONTRACTOR: **Total Depth**		
SITE LOCATION: **Spur 86 and I-30 West, Texarkana, Texas 75503**		LOSS OF CIRCULATION	100%
NORTHING: **3167093.0**	EASTING: **2837746.6**	STATION:	SURFACE ELEVATION: **375.0**
BOTTOM OF CASING			

Plastic Limit Water Content Liquid Limit
X——●——△

⊗ STANDARD PENETRATION BLOWS/FT

ROCK QUALITY DESIGNATION & RECOVERY

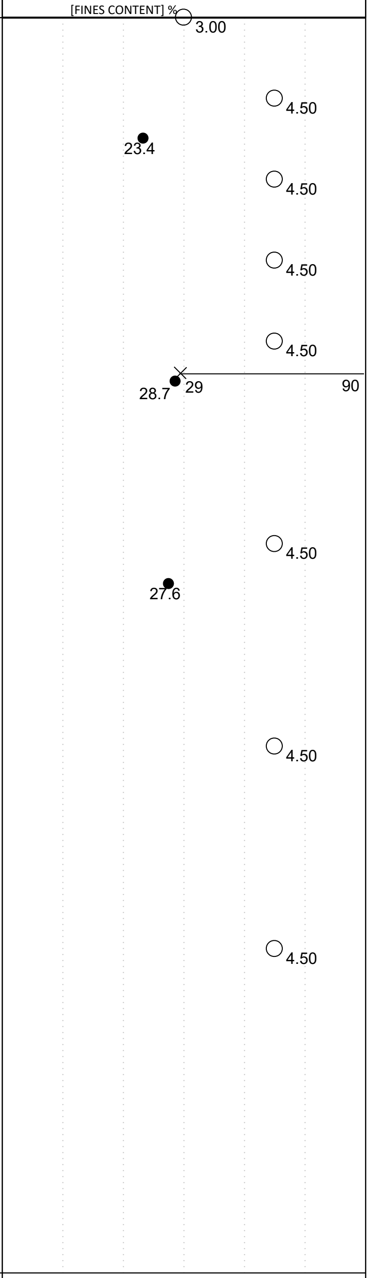
🟥 RQD

— REC

○ CALIBRATED PENETROMETER TON/SF

[FINES CONTENT] %

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
	S-1	ST	24	24	(CH) FAT CLAY WITH SAND, brown, moist, very stiff			
	S-2	ST	24	24	(CH) FAT CLAY WITH SAND, red, light brown, moist, hard			
5	S-3	ST	24	24			370	
	S-4	ST	24	24				
	S-5	ST	24	24				
10							365	
	S-6	ST	24	24	(CH) FAT CLAY, light brown, gray, moist, hard			
15							360	
	S-7	ST	24	24				
20							355	
	S-8	ST	24	24				
25					**END OF DRILLING AT 25.0 FT**		350	
30							345	



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

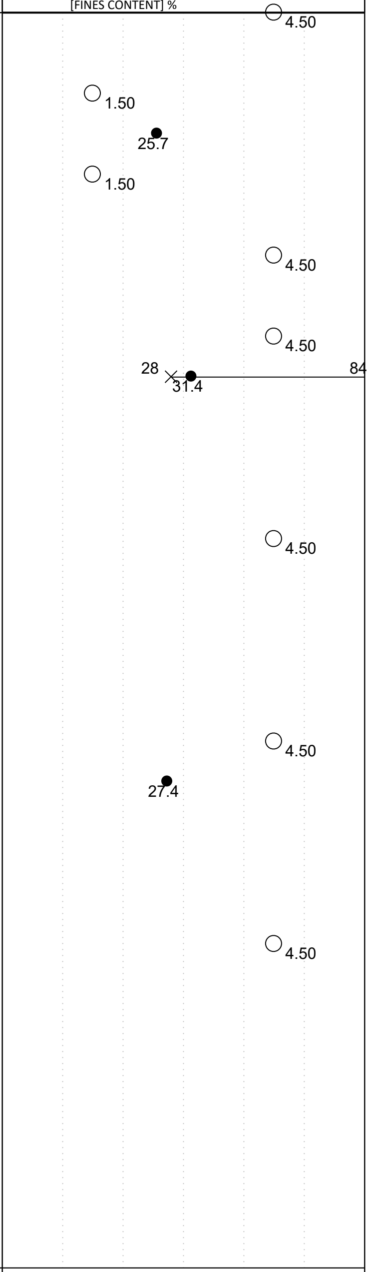
▽ WL (First Encountered)	**Dry**	BORING STARTED: **Dec 17 2020**	CAVE IN DEPTH:
▼ WL (Completion)	**Dry**	BORING COMPLETED: **Dec 17 2020**	HAMMER TYPE: **Auto**
▼ WL (Seasonal High Water)	**N/A**	EQUIPMENT: **ATV** LOGGED BY: **JNH**	DRILLING METHOD: **CFA**
▽ WL (Stabilized)	**N/A**		

GEOTECHNICAL BOREHOLE LOG

CLIENT: **AR-TX REDI**	PROJECT NO.: **19:8111**	BORING NO.: **B-5**	SHEET: **1 of 1**
PROJECT NAME: **REDI East Texas Logistics Center (Texarkana, TX)**	DRILLER/CONTRACTOR: **Total Depth**		
SITE LOCATION: **Spur 86 and I-30 West, Texarkana, Texas 75503**		LOSS OF CIRCULATION	⟩100%⟩
NORTHING: **3168874.7**	EASTING: **2838511.3**	STATION:	SURFACE ELEVATION: **371.0**
		BOTTOM OF CASING	▶

Plastic Limit Water Content Liquid Limit
X——●——△
⊗ STANDARD PENETRATION BLOWS/FT
ROCK QUALITY DESIGNATION & RECOVERY
RQD
REC
○ CALIBRATED PENETROMETER TON/SF
[FINES CONTENT] %

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
	S-1	ST	24	24	(CH) FAT CLAY WITH SAND, brown, moist, hard			
	S-2	ST	24	24	(CH) FAT CLAY WITH SAND, red, light brown, moist, stiff to hard			
5	S-3	ST	24	24			366	
	S-4	ST	24	24				
	S-5	ST	24	24				
10							361	
					(CH) FAT CLAY, light brown, gray, moist, hard			
	S-6	ST	24	24				
15							356	
	S-7	ST	24	24				
20							351	
	S-8	ST	24	24				
25					**END OF DRILLING AT 25.0 FT**		346	
30							341	



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

▽ WL (First Encountered)	**Dry**	BORING STARTED:	**Dec 17 2020**	CAVE IN DEPTH:
▼ WL (Completion)	**Dry**	BORING COMPLETED:	**Dec 17 2020**	HAMMER TYPE: **Auto**
▼ WL (Seasonal High Water)	**N/A**	EQUIPMENT: **ATV**	LOGGED BY: **JNH**	DRILLING METHOD: **CFA**
▽ WL (Stabilized)	**N/A**			

GEOTECHNICAL BOREHOLE LOG

CLIENT: **AR-TX REDI**	PROJECT NO.: **19:8111**	BORING NO.: **B-6**	SHEET: **1 of 1**
PROJECT NAME: **REDI East Texas Logistics Center (Texarkana, TX)**	DRILLER/CONTRACTOR: **Total Depth**		
SITE LOCATION: **Spur 86 and I-30 West, Texarkana, Texas 75503**		LOSS OF CIRCULATION	
NORTHING: **3167492.5**	EASTING: **2838834.8**	STATION:	SURFACE ELEVATION: **369.0**
		BOTTOM OF CASING	

Plastic Limit Water Content Liquid Limit
X———●———△

⊗ STANDARD PENETRATION BLOWS/FT

ROCK QUALITY DESIGNATION & RECOVERY

RQD

REC

○ CALIBRATED PENETROMETER TON/SF

[FINES CONTENT] %

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
	S-1	ST	24	24	(CH) FAT CLAY WITH SAND, brown, moist, stiff to hard			
	S-2	ST	24	24				
5	S-3	ST	24	24	(CH) FAT CLAY WITH SAND, red, light brown, moist, stiff		364	
	S-4	ST	24	24				
	S-5	ST	24	24	(CH) FAT CLAY, light brown, gray, moist, very stiff to hard			
10							359	
	S-6	ST	24	24				
15							354	
	S-7	ST	24	24				
20							349	
	S-8	ST	24	24				
25					**END OF DRILLING AT 25.0 FT**		344	
30							339	

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

▽ WL (First Encountered)	**Dry**	BORING STARTED: **Nov 24 2020**	CAVE IN DEPTH:
▼ WL (Completion)	**Dry**	BORING COMPLETED: **Nov 24 2020**	HAMMER TYPE: **Auto**
▽ WL (Seasonal High Water)	**N/A**	EQUIPMENT: **Truck**	LOGGED BY: **JNH**
▽ WL (Stabilized)	**N/A**		DRILLING METHOD: **CFA**

GEOTECHNICAL BOREHOLE LOG

CLIENT:
AR-TX REDI

PROJECT NO.:
19:8111

BORING NO.:
B-7

SHEET:
1 of 1

PROJECT NAME:
REDI East Texas Logistics Center (Texarkana, TX)

DRILLER/CONTRACTOR:
Total Depth

SITE LOCATION:
Spur 86 and I-30 West, Texarkana, Texas 75503

LOSS OF CIRCULATION 100%

BOTTOM OF CASING

NORTHING:
3165782.7

EASTING:
2835926.0

STATION:

SURFACE ELEVATION:
380.0

Plastic Limit X—— Water Content ● ——△ Liquid Limit

⊗ **STANDARD PENETRATION BLOWS/FT**

ROCK QUALITY DESIGNATION & RECOVERY

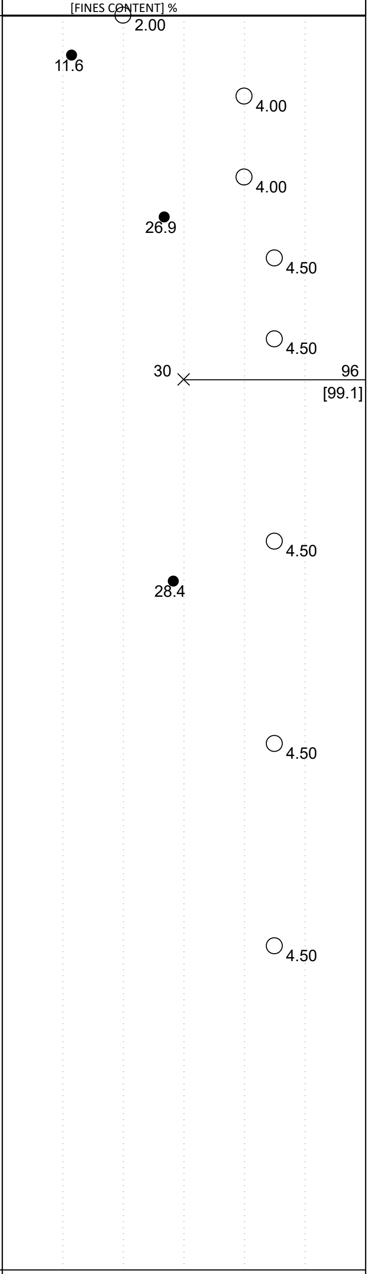
🟥 **RQD**

— **REC**

○ **CALIBRATED PENETROMETER TON/SF**

[FINES CONTENT] %

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
	S-1	ST	24	24	(CH) FAT CLAY WITH SAND, brown, moist, very stiff			
	S-2	ST	24	24	(CH) FAT CLAY WITH SAND, red, light brown, moist, hard			
5	S-3	ST	24	24			375	
	S-4	ST	24	24	(CH) FAT CLAY, light brown, gray, moist, hard			
	S-5	ST	24	24				
10							370	
	S-6	ST	24	24				
15							365	
	S-7	ST	24	24				
20							360	
	S-8	ST	24	24				
25					**END OF DRILLING AT 25.0 FT**		355	
30							350	



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

▽	WL (First Encountered)	**Dry**
▼	WL (Completion)	**Dry**
▼	WL (Seasonal High Water)	**N/A**
▽	WL (Stabilized)	**N/A**

BORING STARTED: **Nov 24 2020**

CAVE IN DEPTH:

BORING COMPLETED: **Nov 24 2020**

HAMMER TYPE: **Auto**

EQUIPMENT:
Truck

LOGGED BY:
JNH

DRILLING METHOD: **CFA**

GEOTECHNICAL BOREHOLE LOG

CLIENT:
AR-TX REDI

PROJECT NO.:
19:8111

BORING NO.:
B-8

SHEET:
1 of 1

PROJECT NAME:
REDI East Texas Logistics Center (Texarkana, TX)

DRILLER/CONTRACTOR:
Total Depth

SITE LOCATION:
Spur 86 and I-30 West, Texarkana, Texas 75503

LOSS OF CIRCULATION 100%

BOTTOM OF CASING

NORTHING:
3165784.8

EASTING:
2836885.5

STATION:

SURFACE ELEVATION:
391.0

Plastic Limit X Water Content ● Liquid Limit △

⊗ STANDARD PENETRATION BLOWS/FT

ROCK QUALITY DESIGNATION & RECOVERY

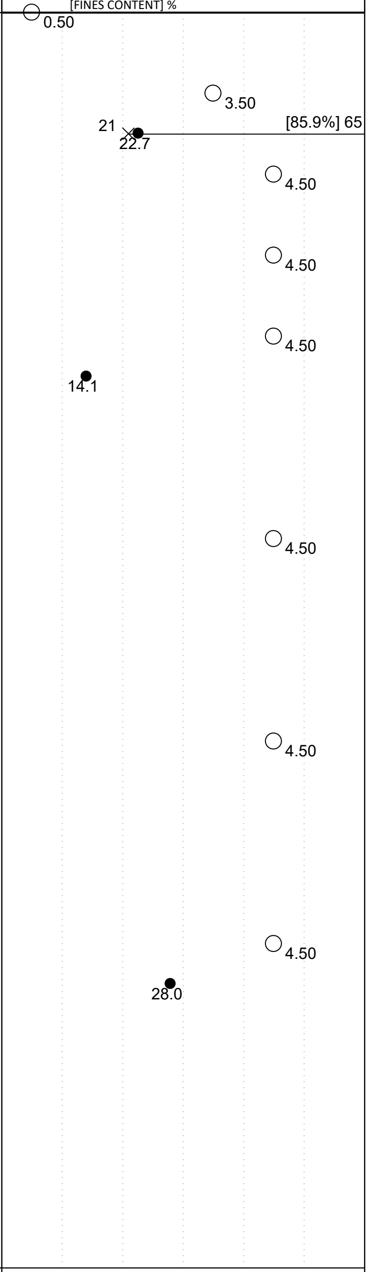
RQD

REC

○ CALIBRATED PENETROMETER TON/SF

[FINES CONTENT] %

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
	S-1	ST	24	24	(CH) FAT CLAY WITH SAND, brown, moist, firm to very stiff			
	S-2	ST	24	24				
5	S-3	ST	24	24	(CH) FAT CLAY WITH SAND, red, light brown, moist, hard		386	
	S-4	ST	24	24				
	S-5	ST	24	24				
10							381	
					(CH) FAT CLAY WITH SAND, light brown, gray, moist, hard			
	S-6	ST	24	24				
15							376	
	S-7	ST	24	24				
20							371	
	S-8	ST	24	24				
25					**END OF DRILLING AT 25.0 FT**		366	
30							361	



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

▽	WL (First Encountered)	**Dry**
▼	WL (Completion)	**Dry**
▼	WL (Seasonal High Water)	**N/A**
▽	WL (Stabilized)	**N/A**

BORING STARTED: **Nov 24 2020**

BORING COMPLETED: **Nov 24 2020**

EQUIPMENT: **Truck**

LOGGED BY: **JNH**

CAVE IN DEPTH:

HAMMER TYPE: **Auto**

DRILLING METHOD: **CFA**

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
AR-TX REDI	**19:8111**	**B-9**	**1 of 1**

PROJECT NAME: **REDI East Texas Logistics Center (Texarkana, TX)**

DRILLER/CONTRACTOR: **Total Depth**

SITE LOCATION: **Spur 86 and I-30 West, Texarkana, Texas 75503**

NORTHING:	EASTING:	STATION:	SURFACE ELEVATION:
3165829.5	**2837778.1**		**392.0**

LOSS OF CIRCULATION 100%

BOTTOM OF CASING

Plastic Limit Water Content Liquid Limit
X———●———△

⊗ STANDARD PENETRATION BLOWS/FT

ROCK QUALITY DESIGNATION & RECOVERY

RQD

REC

○ CALIBRATED PENETROMETER TON/SF

[FINES CONTENT] %

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
	S-1	ST	24	24	(CH) FAT CLAY WITH SAND, brown, moist, stiff			
	S-2	ST	24	24				
5	S-3	ST	24	24	(CH) FAT CLAY WITH SAND, red, light brown, moist, hard		387	
	S-4	ST	24	24				
	S-5	ST	24	24				
10							382	
					(CH) FAT CLAY, light brown, gray, moist, hard			
	S-6	ST	24	24				
15							377	
	S-7	ST	24	24				
20							372	
	S-8	ST	24	24				
25					**END OF DRILLING AT 25.0 FT**		367	
30							362	

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

▽	WL (First Encountered)	**Dry**
▼	WL (Completion)	**Dry**
▽	WL (Seasonal High Water)	**N/A**
▽	WL (Stabilized)	**N/A**

BORING STARTED: **Nov 24 2020**

BORING COMPLETED: **Nov 24 2020**

EQUIPMENT: **Truck**

LOGGED BY: **JNH**

CAVE IN DEPTH:

HAMMER TYPE: **Auto**

DRILLING METHOD: **CFA**

GEOTECHNICAL BOREHOLE LOG

CLIENT: **AR-TX REDI**

PROJECT NO.: **19:8111**

BORING NO.: **B-10**

SHEET: **1 of 1**

PROJECT NAME: **REDI East Texas Logistics Center (Texarkana, TX)**

DRILLER/CONTRACTOR: **Total Depth**

SITE LOCATION: **Spur 86 and I-30 West, Texarkana, Texas 75503**

NORTHING: **3165023.5**

EASTING: **2837800.9**

STATION:

SURFACE ELEVATION: **391.0**

LOSS OF CIRCULATION 100%

BOTTOM OF CASING

Plastic Limit Water Content Liquid Limit
X———●———△

⊗ STANDARD PENETRATION BLOWS/FT

ROCK QUALITY DESIGNATION & RECOVERY

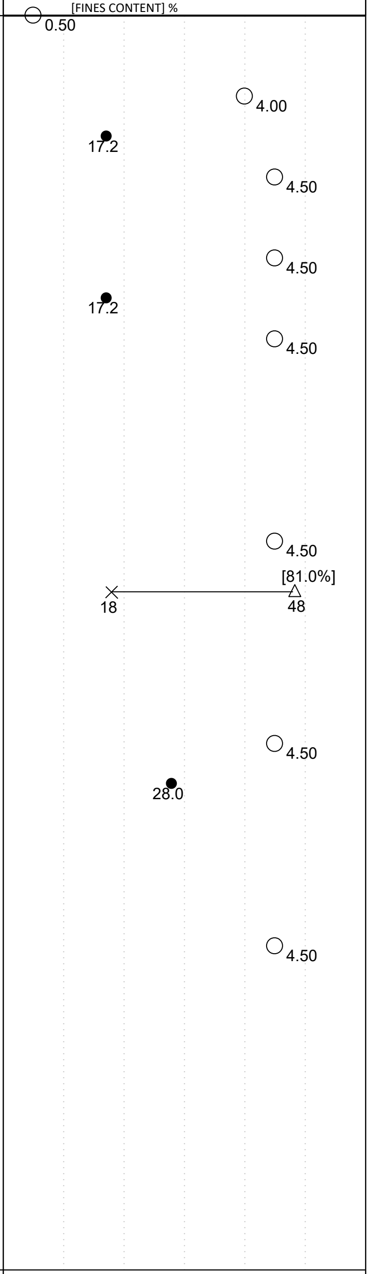
🟥 RQD

— REC

○ CALIBRATED PENETROMETER TON/SF

[FINES CONTENT] %

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
	S-1	ST	24	24	(CH) FAT CLAY WITH SAND, brown, moist, firm to hard			
	S-2	ST	24	24				
5	S-3	ST	24	24	(CH) FAT CLAY WITH SAND, light brown, red, moist, hard		386	
	S-4	ST	24	24				
	S-5	ST	24	24				
10							381	
					(CL) LEAN CLAY WITH SAND, light brown, red, moist, hard			
	S-6	ST	24	24				
15					(CH) FAT CLAY, light brown, gray, moist, hard		376	
	S-7	ST	24	24				
20							371	
	S-8	ST	24	24				
25					**END OF DRILLING AT 25.0 FT**		366	
30							361	



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

▽	WL (First Encountered)	**Dry**
▼	WL (Completion)	**Dry**
▼	WL (Seasonal High Water)	**N/A**
▽	WL (Stabilized)	**N/A**

BORING STARTED: **Nov 24 2020**

CAVE IN DEPTH:

BORING COMPLETED: **Nov 24 2020**

HAMMER TYPE: **Auto**

EQUIPMENT: **Truck**

LOGGED BY: **JNH**

DRILLING METHOD: **CFA**

GEOTECHNICAL BOREHOLE LOG

APPENDIX C – Laboratory Testing

Laboratory Testing Summary

ECS Southwest, LLP
Carrollton, Texas
Laboratory Testing Summary

Date: 1/5/2021

Project Number: 19:8111 **Project Name:** REDI East Texas Logistics Center

Project Engineer: JNH **Principal Engineer:** MPB **Summary By:** JNH

Boring Number	Sample Number	Depth (feet)	MC[1] (%)	Soil Type[2]	Atterberg Limits[3]			Dry Unit Weight[4] (pcf)	Percent Passing No. 200 Sieve[5]	One-Dimensional Swell[6]			Unconfined Compressive Strength[7] (tsf)
					LL	PL	PI			Final Moisture (%)	Overburden (psf)	Swell (%)	
B-1													
	S-2	2 - 4	24.1	**CH**	57	23	34		64				
	S-6	13 - 15	29.1										
	S-8	23-25	25.8										
B-2													
	S-1	0 - 2	26.5										
	S-4	6 - 8	18.5	**CH**	67	19	48						
	S-6	13 - 15	25.2					97.8					2.7
B-3													
	S-2	2 - 4	17.3										
	S-5	8 - 10	23.3	**CH**	79	25	54		96				
	S-7	18 - 20	26.1					96.3					4.1
B-4													
	S-2	2 - 4	23.4										
	S-5	8 - 10	28.7	**CH**	90	29	61						
	S-6	13 - 15	27.6										
B-5													
	S-2	2 - 4	25.7										
	S-5	8 - 10	31.4	**CH**	84	28	56						
	S-7	18 - 20	27.4										

Notes: 1. ASTM D 2216, 2. ASTM D 2487, 3. ASTM D 4318, 4. ASTM D 7260, 5. ASTM D 1140, 6. ASTM D 4546, 7 ASTM D 2166

Definitions: MC: Moisture Content, Soil Type: USCS (Unified Soil Classification System), LL: Liquid Limit, PL: Plastic Limit, PI: Plasticity Index, NP: Non Plastic

ECS Southwest, LLP

Carrollton, Texas

Laboratory Testing Summary

Date: 1/5/2021

Project Number: 19:8111 **Project Name:** REDI East Texas Logistics Center

Project Engineer: JNH **Principal Engineer:** MPB **Summary By:** JNH

Boring Number	Sample Number	Depth (feet)	MC[1] (%)	Soil Type[2]	Atterberg Limits[3]			Dry Unit Weight[4] (pcf)	Percent Passing No. 200 Sieve[5]	One-Dimensional Swell[6]			Unconfined Compressive Strength[7] (tsf)
					LL	PL	PI			Final Moisture (%)	Overburden (psf)	Swell (%)	
B-6													
	S-1	0 - 2	13.3										
	S-3	4 - 6	32.3	**CH**	71	24	47	97.5	83				1.4
	S-6	13 - 15	30.9										
B-7													
	S-1	0 - 2	11.6										
	S-3	4 - 6	26.9										
	S-5	8 - 10		**CH**	96	30	66		99				
	S-6	13 - 15	28.4										
B-8													
	S-2	2 - 4	22.7	**CH**	65	21	44		86				
	S-5	8 - 10	14.1										
	S-8	23-25	28.0										
B-9													
	S-2	2 - 4	22.8										
	S-3	4 - 6	25.4					100.4					1.9
	S-5	8 - 10	22.4	**CH**	76	23	53						
	S-7	18 - 20	27.8										

Notes: 1. ASTM D 2216, 2. ASTM D 2487, 3. ASTM D 4318, 4. ASTM D 7260, 5. ASTM D 1140, 6. ASTM D 4546

Definitions: MC: Moisture Content, Soil Type: USCS (Unified Soil Classification System), LL: Liquid Limit, PL: Plastic Limit, PI: Plasticity Index, NP: Non Plastic

Laboratory Testing Summary

Carrollton, Texas

Laboratory Testing Summary

Date: 1/5/2021

Project Number: 19:8111 **Project Name:** REDI East Texas Logistics Center

Project Engineer: JNH **Principal Engineer:** MPB **Summary By:** JNH

Boring Number	Sample Number	Depth (feet)	MC[1] (%)	Soil Type[2]	Atterberg Limits[3]			Dry Unit Weight[4] (pcf)	Percent Passing No. 200 Sieve[5]	One-Dimensional Swell[6]			Unconfined Compressive Strength[7] (tsf)
					LL	PL	PI			Final Moisture (%)	Overburden (psf)	Swell (%)	
B-10													
	S-2	2 - 4	17.2										
	S-4	6 - 8	17.2										
	S-6	13 - 15		**CL**	48	18	30		81				
	S-7	18 - 20	28.0										