Geotechnical Engineering Study

Fred Hervey Water Reclamation Plant (WRP) Access Road
El Paso, El Paso County, Texas
LOI File No. 20-245

Prepared for:
Brown and Caldwell
1200 Golden Key Circle, Suite 430
El Paso, Texas 79925

Prepared by:
LOI ENGINEERS
2101 E. Missouri Avenue, Suite B
El Paso, Texas 79903

Initial Report issued February 24, 2022
Revised Report issued May 26, 2022

File No. LOI20-245
February 24, 2022 (Revised 5/26/22)

Mr. Fernie Silva, P.E.
Brown and Caldwell
1200 Golden Key Circle, Suite 430
El Paso, Texas 79925

Re: Geotechnical Engineering Report
Fred Hervey Water Reclamation Plant (WRP) Access Road
El Paso, El Paso County, Texas

Dear Mr. Silva:

We thank you for the opportunity to present the enclosed geotechnical engineering report for the above referenced project. This engineering report was prepared in accordance with the scope of services as presented in our proposal No. LEIP15-240, dated September 10, 2015, revised on February 5, 2020, and authorized on January 7, 2021. The information we are presenting herein describes the procedures utilized for field and laboratory investigation, along with the results of our study.

It was a pleasure to work with you on this phase of your project, and we look forward to assist you further during the subsequent construction activities. If you have any questions regarding the information we present herein, please call us.

Respectfully submitted,
LOI ENGINEERS

STATE OF TEXAS
GEOFFREY A. MADRAZO
141284
LICENSED
PROFESSIONAL ENGINEER
5/26/22

Geoffrey A. Madrazo, P.E.
Project Professional

Bernardino Olague, P.E., PMP
Principal Engineer

Copies: Above (1) via Email
File (1)

Table of Contents

1.0 INTRODUCTION

We have completed the geotechnical engineering study for the proposed Fred Hervey Water Reclamation Plant (WRP) Access Road project, which will be located at 11700 Railroad Drive, in El Paso, Texas. We were authorized to conduct this study by Mr. Carlos Torres, P.E., representing Brown and Caldwell (Client) on January 7, 2021.

2.0 PROJECT DESCRIPTION AND OBJECTIVE

The project consists of the design and construction of a new aggregate surface access road for the Fred Hervey WRP. A polymeric treatment will be applied to the driving surface of the aggregate surface access road. The new access road will have a pavement width of 30 feet and a total easement width of 80 feet. The new access road will extend from Roy Johnson Lane to the existing Fred Hervey WRP entrance road, to the east and parallel to the Union Pacific Railroad line, in northeast El Paso, El Paso County, Texas, as shown on the General Location Map in Appendix A as Sheet A-1.1.

3.0 FIELD AND LABORATORY INVESTIGATION

3.1 Field Exploration

In our field exploration phase, we drilled and sampled nine (9) pavement soil borings to depths of 5 feet and 6½ feet, respectively, below ground surface at representative locations within the proposed access road. We drilled and sampled the soil borings in general accordance with ASTM D-6151 and D-1586 procedures with a truck-mounted CME-75 drill rig. We located the borings in the field using property corners and street references included in the project plans provided by Client.

The soil boring locations are shown in the Boring Location Plan included in Appendix A of this report in Sheet A-1.2. We also prepared a log of each soil boring to delineate the soil strata studied at the site. The soil boring logs (B-1 through B-9) are included in Appendix

A of this report as Sheets A-2 through A-10. A key to the soil terminology used in the logs is included in Appendix B of this report as Sheets B-1 and B-2.

We conducted Standard Penetration Tests (SPT) at each representative soil strata in the soil borings to determine the relative density or consistency of the resident soils. The SPT is a widely recognized procedure that provides a numerical value of the soil strata being tested, indicating the number of blows that it takes for a standard 140-pound weight hammer with a standard 30-inch free fall drop to penetrate 12 inches into the soil. The SPT values for the soil strata in the soil borings are included in the soil boring logs.

As part of our field exploration, we collected representative soil samples from the soil borings at regular depth intervals using a standard 2-inch diameter split spoon sampler. We identified and labeled the samples according to boring number and depth, visually classified them according to ASTM D-2488, and placed them in moisture-proof containers for transportation to the laboratory for further evaluation and testing.

Unless we receive prompt notification from Client, we will store the samples collected from the field investigation in our laboratory for a period of 90 days from the date of this report, after which time we will discard the samples.

3.2 Geotechnical Laboratory Testing

In the laboratory, we determined the moisture content, particle size analysis, percent passing the No. 200 sieve, and Atterberg Limits of selected samples. We conducted these tests to determine the physical and engineering properties of representative soils at the site. These tests also allowed us to properly classify the resident soils in accordance with the Unified Soil Classification System (USCS). The results of our tests are included in the soil boring logs, adjacent to the depth at which the sample was recovered.

In addition, we conducted three (3) Moisture-Density Relationship tests and three (3) California Bearing Ratio (CBR) tests, in accordance with ASTM D-1557 and D-1883, respectively. The results of these tests can be found on Sheets A-13 through A-18.

Table 1: Laboratory Testing Program

Type of Test	Number of Tests
Moisture Content (ASTM D-2216)	27
Percent Passing No. 200 Sieve (ASTM D-1140)	18
Grain Size Distribution Analysis (ASTM D-6913)	1
Atterberg Limits (ASTM D-4318)	9
California Bearing Ratio Test (ASTM D-1883)	3
Moisture-Density Relationship Curve (ASTM D-1557)	3

4.0 GENERAL SITE CONDITIONS

4.1 Site Geology

According to the Natural Resources Conservation Service of the United States Department of Agriculture, the project area is located at the transition of the Turney-Berino association, which is described as nearly level and gently sloping soils that have a clay loam subsoil and are moderately deep over soft caliche, and the Hueco-Wink association, which is described as nearly level and gently sloping soils that have a fine, sandy loam subsoil and are moderately deep over caliche.

4.2 Site Topography and Site Conditions

The project site is relatively level, and slopes gently downward in a southwesterly direction. The proposed roadway area is a dirt road currently used as a military vehicle trail. Several underground utility lines (i.e. gas, communications, overhead electric, water) parallel the roadway. Several underground gas lines and overhead electrical lines cross the roadway at the north end near the existing Fred Hervey WRP entrance road.

4.3 Site Vegetation

At the time of our field phase, the existing roadway was relatively free of vegetation, and exhibited dense native vegetation, consisting of weeds, shrubs, mesquite plants, and perennial grasses, outside of the existing roadway.

4.4 Soil Stratigraphy

The soils we encountered in the borings can be grouped into three (3) generalized soil strata as follows:

Stratum A, consisting of brown fine grained clayey sands occasionally intermixed with calcareous material, was encountered from ground surface elevation, and extended to depths ranging from 5 feet below ground surface (BGS) to the total explored depth of 6½ feet BGS in the soil borings at the site. These soils were encountered at a loose to very dense relative density, with SPT values ranging from 8 to over 50 blows per foot of penetration. These soils were encountered at a dry to moist condition, with tested moisture content values ranging from 5 to 15 percent, and percent finer than the No. 200 sieve test results ranging from 24 to 42 percent. These soils exhibited a maximum tested liquid limit of 35 and yielded a maximum plasticity index of 19. Soils in this stratum can be classified as SC in accordance with the USCS.

Stratum B, consisting of multicolor poorly-graded sands intermixed with gravel, was encountered underlying the Stratum A soils in boring B-5, and extended to the total explored depth of 6½ feet BGS. These soils were encountered at a medium dense relative density, with an SPT value of 17 blows per foot of penetration. These soils were encountered at a dry condition, with a tested moisture content value of 4 percent, and a percent finer than the No. 200 sieve test result of 9 percent. Soils in this stratum can be classified as SP-SM in accordance with the USCS.

Stratum C, consisting of brown lean clays intermixed with various amounts of fine grained sand, was encountered underlying the Stratum A soils in boring B-7, and extended to the total explored depth of 6½ feet BGS. These soils were encountered at a very stiff consistency, with an SPT value of 26 blows per foot of penetration. These soils were encountered at a moist condition, with a tested moisture content value of 14 percent, and a percent finer than the No. 200 sieve test result of 52 percent. Soils in this stratum can be classified as CL in accordance with the USCS.

4.5 Groundwater

Groundwater was not present in the borings drilled during the time of our field exploration. The groundwater table at the site is anticipated to be at depths well below the planned depth of the foundation system and related excavations at the site.

5.0 ENGINEERING EVALUATION

5.1 Traffic Loads

Based on the proposed roadway width, the intended usage, and our experience with similar projects, we have assigned a traffic loading of 630,000 equivalent single-axle loads (ESAL's) as discussed in Section 5.5 of this report. If the final traffic volumes differ significantly from the assumed values presented herein, LOI ENGINEERS should be notified immediately so that we may conduct further analysis to determine whether our recommendations need to be revised, as appropriate.

The recommendations presented herein are predicated on the assumption that finished subgrade elevations will be within ±3 feet from existing elevations.

5.2 Vertical Movements

We calculated the Potential Vertical Rise (PVR) of the existing soil profile, in accordance with Texas Department of Transportation (TxDOT) method Tex 124-E. The calculated PVR value of the soil profile is ¾-inch for soils and conditions encountered in samples obtained from the soil borings.

5.3 Site Preparation

Any vegetation in the project area shall be removed (completely uprooted) and properly disposed of off-site prior to grading operations. We recommend the upper 8 inches of the existing subgrade soils be scarified, moisture-conditioned to within ±3 percent of its optimum moisture, and compacted to a minimum of 95% of its maximum dry density in accordance with ASTM D-1557.

5.4 Site Drainage

Positive surface drainage should be provided during and after construction by sloping the ground surface a minimum of two percent graded away from the pavement area for a minimum distance of 5 feet. If relevant, underground water and sewer lines should be properly installed underneath the pavement section to reduce the possibility of moisture infiltration in the event of plumbing leaks.

5.5 Aggregate Surface Access Road

Aggregates will be used in the construction of the proposed access road. Therefore, we used a traffic loading of 630,000 equivalent single-axle load (ESAL) applications for roadway that will be subjected heavy traffic loads. This parameter is estimated based on the estimated heavy automobile traffic for a design period of 20 years. Additionally, based on our laboratory analysis, we calculated a California Bearing Ratio (CBR) value of 9 for pavement design calculations. The thickness of aggregate surface course required for the roadway was calculated to be 18 inches.

As a minimum, the aggregates that will be used to construct the access road should meet the requirements of Item 247, Type A, Grade 3, in accordance with the Texas Department of Transportation (TxDOT) Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges. Aggregate materials should be placed in loose lifts not exceeding 6 inches in compacted thickness, moisture-conditioned to within ±2 percent of its optimum moisture content, and compacted to a minimum of 95 percent of its maximum dry density, in accordance with ASTM D-1557.

5.6 Rigid Pavement Recommendations

Rigid pavement sections may be required for frequent vehicle turning areas and other installations at the project site. Based on our rigid pavement design calculations and the traffic loading conditions described in Section 5.5, we recommend a jointed-reinforced concrete slab with a minimum thickness section for heavy duty traffic conditions:

Table 2: Rigid Pavement Recommendations

Traffic Conditions (E.S.A.L's)	Jointly-Reinforced Slab Minimum Thickness (in.)	Select Fill Support (in.)
Heavy-Duty (630,000)	7	18

The above recommendations were generated considering concrete with a minimum 28-day compressive strength of 3,500 psi.

Rigid pavement design should follow guidelines in accordance with ACI 330R-08.

5.7 Select Fill

Select fill material used for site grading should be granular, cohesionless, and free of deleterious material and particles over 4 inches in greatest dimension. Soils proposed for use as fill materials should be classified in accordance with ASTM D-2487. The following soils classified in accordance with the Unified Soil Classification System (USCS) can be considered satisfactory for use as select fill.

> GM, GC, GW-GM, GW-GC, GP, GP-GM and GP-GC, SM, SC, SW-SM, SW-SC, SP-SM, SW-SC and SC-SM.

The following USCS-classified soils are not considered satisfactory for use as select fill.

> CH, CL, MH, ML, OH, OL and PT, or soils that exceed a liquid limit of 40 and a plasticity index of 15.

The soils in our borings are suitable for use as select fill, provided they meet the above criteria for acceptable fill materials.

Select fill should be placed in uniform layers not exceeding 8 inches in compacted thickness, moisture-conditioned to add the amount of moisture required for optimum compaction and compacted to a minimum of 95 percent of maximum density in accordance with ASTM D-1557 (modified Proctor) procedures. The moisture content should be at plus or minus 3 percent of optimum moisture content in accordance with ASTM D-1557.

This compaction requirement also applies to the subgrade soils that will receive select fill. However, if the subgrade soils consist of cohesive soils such as CL or CH, or if the plasticity index exceeds 18, the subgrade soils should be compacted to a minimum of 90 percent of the above standard.

Compaction of the fill material and subgrade soils should be conducted with approved types of pneumatic, power or tamping equipment. Determination of density in the field should be conducted in accordance with ASTM D-2922 or D-1556.

5.8 New Construction near Existing Structures and Utilities

Contractor shall exercise extreme care during footing excavation and site preparation near the existing underground utilities and ancillary equipment to avoid encroaching into the existing pipelines and/or foundation systems, hence preventing adversely affecting or undermining the performance and structural integrity of the existing utilities. We recommend that before any excavation or earthwork takes place, all underground utilities be located to prevent damages to the existing infrastructure. If any of the underground utilities are scheduled to be decommissioned, removed and/or relocated, the resulting voids need to be filled with select fill as recommended in Section 5.7 of this report.

We recommend that ten (10) days prior to commencing any excavation near the existing building, the contractor shall submit a plan describing how they will protect the existing structures during construction activities. Protective measures may include, but may not be limited to temporary shoring and/or phased excavation.

6.0 ADDITIONAL CONSIDERATIONS

6.1 Construction Monitoring

We recommend that Client retain LOI ENGINEERS during the construction phase of this project to verify the findings of our study, and to provide supplemental data to this study

The geotechnical engineer should also conduct testing of fill materials used for earthwork operations at the following frequencies:

- At least one (1) moisture-density relationship (ASTM D-1557) and soil classification tests (ASTM D-6913 and ASTM D-4318) for each type of material encountered, or imported material to be used.
- Soil density (compaction) testing in accordance with ASTM D-6938 or D-1556 using the following testing frequencies:
    - Pavement area – A minimum of one (1) density test per lift (8-inch compacted) for every 5,000 square feet.

Sampling and testing for quality assurance of concrete materials should be performed at the following frequency:

- A minimum of one (1) set of four specimens should be collected for every 50 cubic yards of concrete placed, or fraction thereof. Concrete field testing shall include temperature, slump, and air content (if applicable).

6.2 Limitations

We have performed our professional services and have obtained the data presented in this report in accordance with generally accepted geotechnical engineering principles and practices. The information in this report is based on the data obtained from nine (9) representative test borings and laboratory testing conducted on representative samples, and on our knowledge of the project conditions at the time of our subsurface soil study.

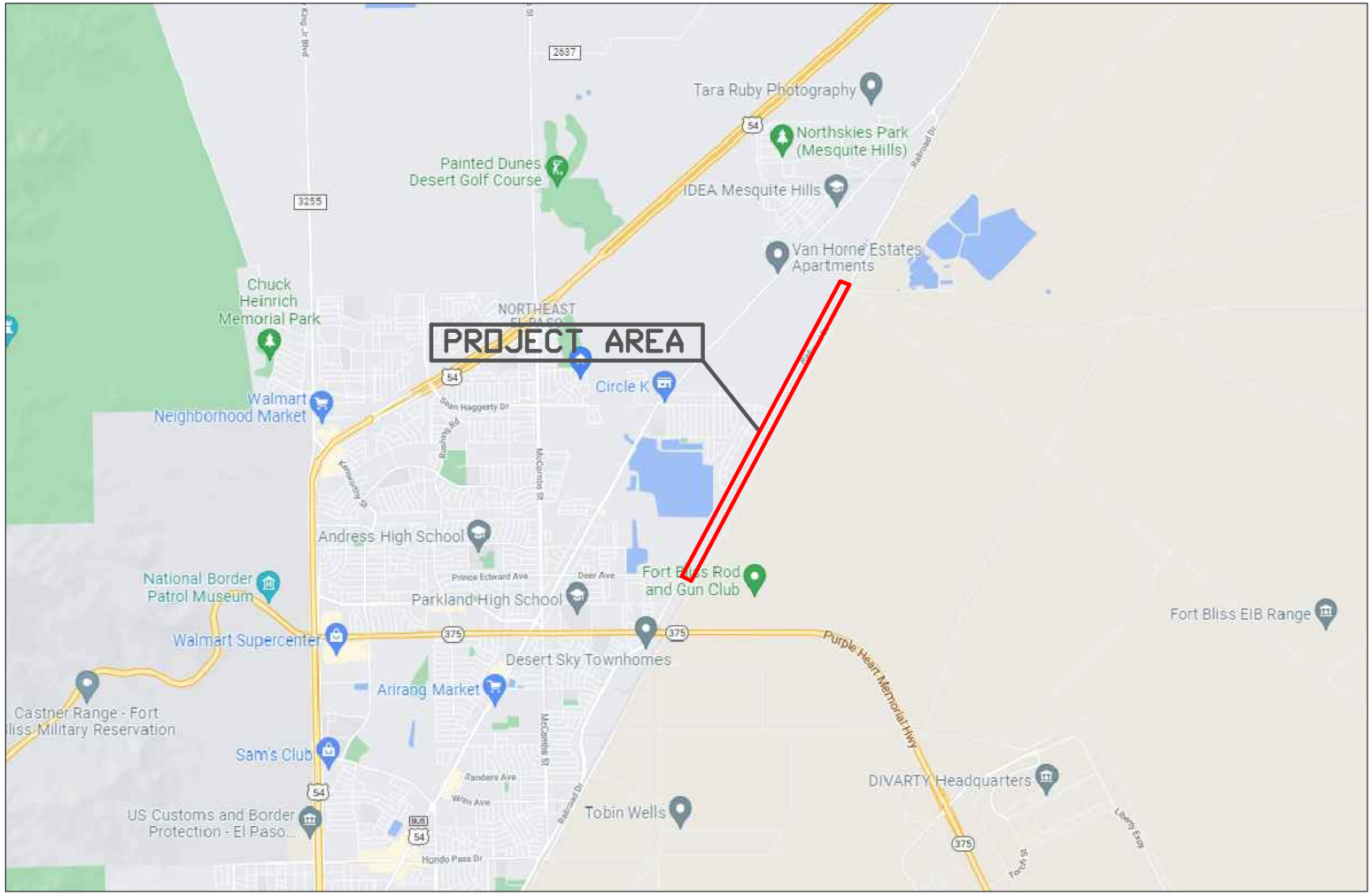
The data in this report reflects subsurface soil conditions only at the specific sampling location, time of sampling, and to the depths indicated in our report. This report is not intended to identify or address any potential environmental concerns associated with the project site.

We recommend that Client notify LOI ENGINEERS of any changes to the project conditions considered in this report, so that we may provide pertinent modifications to

our recommendations if deemed necessary. Additionally, once construction commences, we should be notified of any unusual site conditions that appear to vary from those reported herein, so that we may conduct further investigations and prepare supplemental recommendations if deemed necessary.

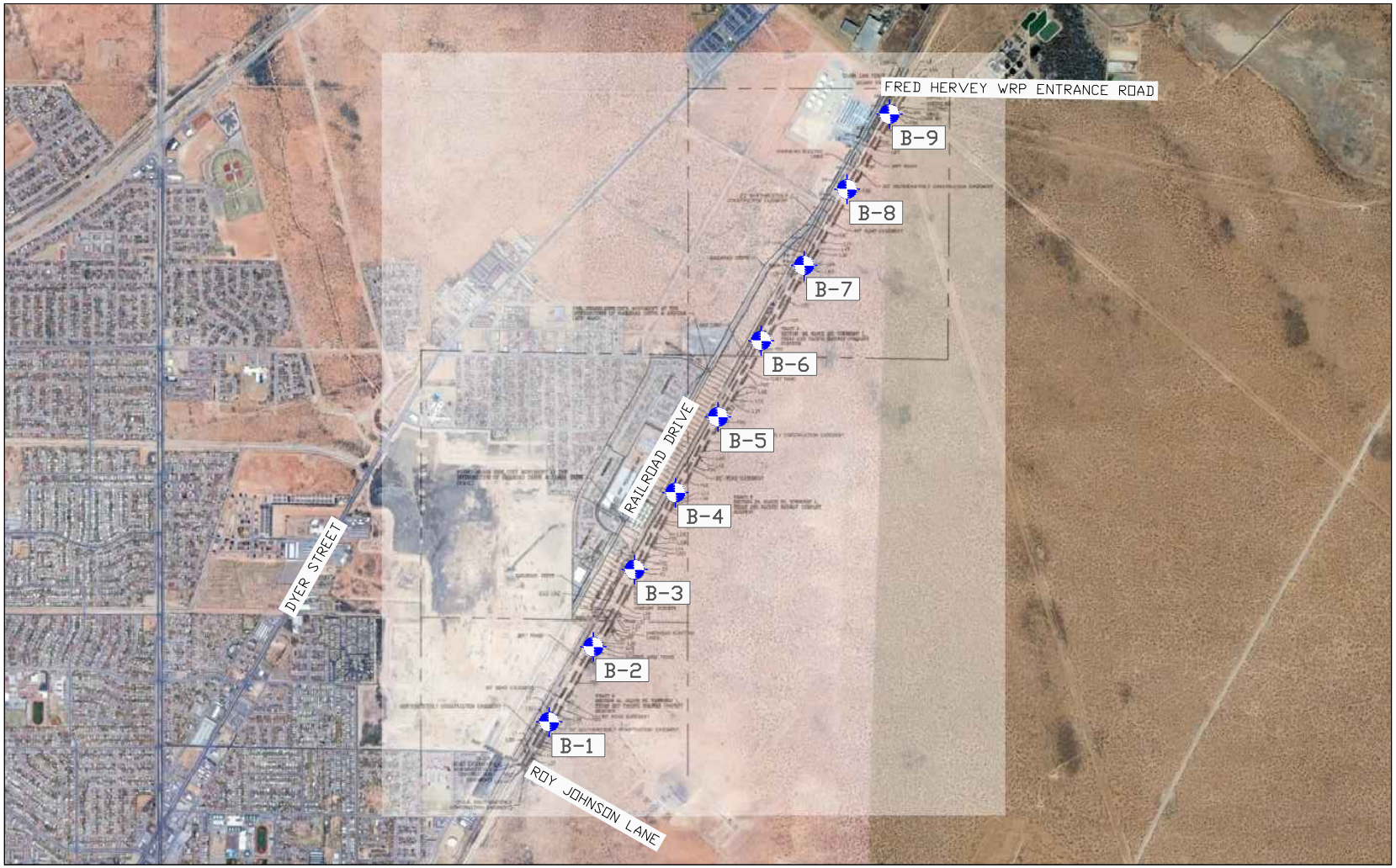
We conducted this investigation for the purpose of defining the subsurface soil conditions for the Fred Hervey WRP Access Road project in El Paso, Texas. Use of this information for projects other than the one described herein will not be adequate.

APPENDIX A



LEGEND	GEOTECHNICAL CONSULTANT	PROJECT CLIENT	DRAWING TITLE: GENERAL LOCATION MAP
APPROXIMATE PROJECT LOCATION	LOI ENGINEERS 915-781-1532 2101 E. MISSOURI AVE SUITE B EL PASO, TEXAS 79903	BROWN AND CALDWELL 1200 GOLDEN KEY CIRCLE SUITE 430 EL PASO, TEXAS 79925	PROJECT NAME: FRED HERVEY WRP ACCESS ROAD EL PASO, EL PASO, COUNTY, TEXAS

DRAWN BY	REVIEWED BY	APPROVED BY	SCALE
T.M.	G.M.	B.O.	N.T.S.
PROJECT No.	**FILE NAME**	**DATE**	**SHEET No.**
LOI20-245	SITE PLAN	2/8/22	A-1.1



LEGEND	GEOTECHNICAL CONSULTANT	PROJECT CLIENT	DRAWING TITLE: BORING LOCATION PLAN
B-1 APPROXIMATE BORING LOCATION AND NUMBER	LOI ENGINEERS 915-781-1532 2101 E. MISSOURI AVE SUITE B EL PASO, TEXAS 79903	BROWN AND CALDWELL 1200 GOLDEN KEY CIRCLE SUITE 430 EL PASO, TEXAS 79925	PROJECT NAME: FRED HERVEY WRP ACCESS ROAD EL PASO, EL PASO, COUNTY, TEXAS

DRAWN BY	REVIEWED BY	APPROVED BY	SCALE
T.M.	G.M.	B.O.	N.T.S.
PROJECT No.	**FILE NAME**	**DATE**	**SHEET No.**
LOI20-245	SITE PLAN	2/8/22	A-1.2

LOG OF TEST BORING No. B-1

Project name: Fred Hervey WRP Access Road
File No.: LOI20-245
Date drilled: 2/2/22
Boring Location: See Sheet A-1.2
Elevation (ft.): N/A North: N/A West: N/A

Elevation and Depth (Ft.)	Samples	Soil symbols	Soil Description	USCS symbol	Moisture content,%	Minus #200 sieve, %	Liquid limit	Plastic limit	Plasticity index	SPT N-Value: Blows per foot (N)	SPT N-Value CURVE
0			SAND, fine grained, clayey, brown, loose, dry to moist		6	26				8	
2			-medium dense, moist at 2.5 feet	SC	13	39	35	16	19	18	
4					15					24	
6			Termination depth at 6.5 feet								
8											
10											
12											

SPT N-Value CURVE: 10 30 50

Groundwater Table Data

Depth	Date	Time
NGWE	2/2/22	N/A

Sample Type
- Auger cutting
- 2" O.D. split spoon
- 3" O.D. split tube
- Thin-walled Shelby tube

Rig type: CME-75
Boring type: HSA
Drilled by: JFL
Logger: TM
Sheet No.: **A-2**

LOG OF TEST BORING No. B-2

Project name: Fred Hervey WRP Access Road
File No.: LOI20-245
Date drilled: 2/2/22
Boring Location: See Sheet A-1.2
Elevation (ft.): N/A North: N/A West: N/A

Elevation and Depth (Ft.)	Samples	Soil symbols	Soil Description	USCS symbol	Moisture content,%	Minus #200 sieve, %	Liquid limit	Plastic limit	Plasticity index	SPT N-Value: Blows per foot (N)	SPT N-Value: CURVE
0			SAND, fine grained, clayey, brown, medium dense, dry to moist	SC	7	32	20	11	9	12	
2			-dense at 2.5 feet		5					31	
4			-very dense at 5 feet		7	42				50+	50+
6			Termination depth at 6.5 feet								
8											
10											
12											

SPT N-Value CURVE: 10 30 50

Groundwater Table Data

Depth	Date	Time
NGWE	2/2/22	N/A

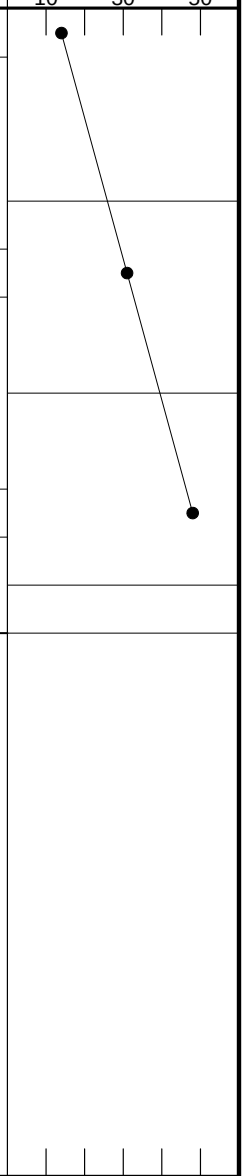
Sample Type
- Auger cutting
- 2" O.D. split spoon
- 3" O.D. split tube
- Thin-walled Shelby tube

Rig type: CME-75
Boring type: HSA
Drilled by: JFL
Logger: TM
Sheet No.: **A-3**

LOG OF TEST BORING No. B-3

Project name: Fred Hervey WRP Access Road
File No.: LOI20-245
Date drilled: 2/2/22
Boring Location: See Sheet A-1.2
Elevation (ft.): N/A North: N/A West: N/A

Elevation and Depth (Ft.)	Samples	Soil symbols	Soil Description	USCS symbol	Moisture content,%	Minus #200 sieve, %	Liquid limit	Plastic limit	Plasticity index	SPT N-Value: Blows per foot (N)	SPT N-Value: CURVE (10 30 50)
0			SAND, fine grained, clayey, brown, medium dense, dry to moist	SC	7	40	26	13	13	14	
2			-dense at 2.5 feet		6					31	
4					7	33				48	
6			Termination depth at 6.5 feet								
8											
10											
12											



Groundwater Table Data

Depth	Date	Time
NGWE	2/2/22	N/A

Sample Type
- Auger cutting
- 2" O.D. split spoon
- 3" O.D. split tube
- Thin-walled Shelby tube

Rig type: CME-75
Boring type: HSA
Drilled by: JFL
Logger: TM
Sheet No.: **A-4**

LOG OF TEST BORING No. B-4

Project name: Fred Hervey WRP Access Road
File No.: LOI20-245
Date drilled: 2/2/22
Boring Location: See Sheet A-1.2
Elevation (ft.): N/A North: N/A West: N/A

Elevation and Depth (Ft.)	Samples	Soil symbols	Soil Description	USCS symbol	Moisture content,%	Minus #200 sieve, %	Liquid limit	Plastic limit	Plasticity index	SPT N-Value: Blows per foot (N)	SPT N-Value: CURVE (10 30 50)
0			SAND, fine grained, clayey, brown, loose, dry to moist		9	39	26	13	13	9	
2			-medium dense at 2.5 feet		9					15	
4				SC							
6			-moist at 5 feet		10	36				10	
			Termination depth at 6.5 feet								
8											
10											
12											

Groundwater Table Data

Depth	Date	Time
NGWE	2/2/22	N/A

Sample Type
- Auger cutting
- 2" O.D. split spoon
- 3" O.D. split tube
- Thin-walled Shelby tube

Rig type: CME-75
Boring type: HSA
Drilled by: JFL
Logger: TM
Sheet No.: **A-5**

LOG OF TEST BORING No. B-5

Project name: Fred Hervey WRP Access Road
File No.: LOI20-245
Date drilled: 2/2/22
Boring Location: See Sheet A-1.2
Elevation (ft.): N/A North: N/A West: N/A

Elevation and Depth (Ft.)	Samples	Soil symbols	Soil Description	USCS symbol	Moisture content,%	Minus #200 sieve, %	Liquid limit	Plastic limit	Plasticity index	SPT N-Value: Blows per foot (N)	SPT N-Value: CURVE (10 30 50)
0			SAND, fine grained, clayey, brown, medium dense, dry to moist	SC	7	41	28	5	23	19	
2					9					27	
4											
6			SAND, poorly-graded, silty, multicolor, medium dense, dry, with gravel	SP-SM	4	9				17	
			Termination depth at 6.5 feet								
8											
10											
12											

Groundwater Table Data

Depth	Date	Time
NGWE	2/2/22	N/A

Sample Type
- Auger cutting
- 2" O.D. split spoon
- 3" O.D. split tube
- Thin-walled Shelby tube

Rig type: CME-75
Boring type: HSA
Drilled by: JFL
Logger: TM
Sheet No.: **A-6**

LOG OF TEST BORING No. B-6

Project name: Fred Hervey WRP Access Road
File No.: LOI20-245
Date drilled: 2/2/22
Boring Location: See Sheet A-1.2
Elevation (ft.): N/A North: N/A West: N/A

Elevation and Depth (Ft.)	Samples	Soil symbols	Soil Description	USCS symbol	Moisture content,%	Minus #200 sieve, %	Liquid limit	Plastic limit	Plasticity index	SPT N-Value: Blows per foot (N)	SPT N-Value CURVE
0			SAND, fine grained, clayey, brown, medium dense, dry to moist	SC	8	40	26	13	13	15	
2			-dense at 2.5 feet		7					31	
4			-medium dense, with traces of calcareous material at 5 feet		8	24				15	
6			Termination depth at 6.5 feet								
8											
10											
12											

SPT N-Value CURVE: 10 30 50

Groundwater Table Data

Depth	Date	Time
NGWE	2/2/22	N/A

Sample Type
- Auger cutting
- 2" O.D. split spoon
- 3" O.D. split tube
- Thin-walled Shelby tube

Rig type: CME-75
Boring type: HSA
Drilled by: JFL
Logger: TM
Sheet No.: **A-7**

LOG OF TEST BORING No. B-7

Project name: Fred Hervey WRP Access Road
File No.: LOI20-245
Date drilled: 2/2/22
Boring Location: See Sheet A-1.2
Elevation (ft.): N/A North: N/A West: N/A

Elevation and Depth (Ft.)	Samples	Soil symbols	Soil Description	USCS symbol	Moisture content,%	Minus #200 sieve, %	Liquid limit	Plastic limit	Plasticity index	SPT N-Value: Blows per foot (N)	SPT N-Value CURVE (10 30 50)
0			SAND, fine grained, clayey, brown, medium dense, moist		10	35	28	13	15	10	
2			-dry to moist at 2.5 feet	SC	9					14	
4			CLAY, lean, sandy, brown, very stiff, moist, with traces of calcareous material	CL	14	52				26	
6			Termination depth at 6.5 feet								
8											
10											
12											

Groundwater Table Data

Depth	Date	Time
NGWE	2/2/22	N/A

Sample Type
- Auger cutting
- 2" O.D. split spoon
- 3" O.D. split tube
- Thin-walled Shelby tube

Rig type: CME-75
Boring type: HSA
Drilled by: JFL
Logger: TM
Sheet No.: **A-8**

LOG OF TEST BORING No. B-8

Project name: Fred Hervey WRP Access Road
File No.: LOI20-245
Date drilled: 2/2/22
Boring Location: See Sheet A-1.2
Elevation (ft.): N/A North: N/A West: N/A

Elevation and Depth (Ft.)	Samples	Soil symbols	Soil Description	USCS symbol	Moisture content,%	Minus #200 sieve, %	Liquid limit	Plastic limit	Plasticity index	SPT N-Value: Blows per foot (N)	SPT N-Value CURVE
0			SAND, fine grained, clayey, brown, medium dense, dry to moist	SC	7	34	25	12	13	11	
2			-dense at 2.5 feet		7					31	
4			-medium dense, with traces of calcareous material at 5 feet		8	39				23	
6			Termination depth at 6.5 feet								
8											
10											
12											

SPT N-Value CURVE: 10 30 50

Groundwater Table Data

Depth	Date	Time
NGWE	2/2/22	N/A

Sample Type
- Auger cutting
- 2" O.D. split spoon
- 3" O.D. split tube
- Thin-walled Shelby tube

Rig type: CME-75
Boring type: HSA
Drilled by: JFL
Logger: TM
Sheet No.: **A-9**

LOG OF TEST BORING No. B-9

Project name: Fred Hervey WRP Access Road
File No.: LOI20-245
Date drilled: 2/2/22
Boring Location: See Sheet A-1.2
Elevation (ft.): N/A North: N/A West: N/A

Elevation and Depth (Ft.)	Samples	Soil symbols	Soil Description	USCS symbol	Moisture content,%	Minus #200 sieve, %	Liquid limit	Plastic limit	Plasticity index	SPT N-Value: Blows per foot (N)	SPT N-Value: CURVE
0			SAND, fine grained, clayey, brown, medium dense, dry to moist, with traces of calcareous material	SC	5	37	30	13	17	27	
2			-very dense at 2.5 feet		6					50+	50+
4			-dense at 5 feet		6	36				36	
6			Termination depth at 6.5 feet								
8											
10											
12											

SPT N-Value CURVE: 10 30 50

Groundwater Table Data

Depth	Date	Time
NGWE	2/2/22	N/A

Sample Type
- Auger cutting
- 2" O.D. split spoon
- 3" O.D. split tube
- Thin-walled Shelby tube

Rig type: CME-75
Boring type: HSA
Drilled by: JFL
Logger: TM
Sheet No.: **A-10**

SUMMARY OF RESULTS

Project: Fred Hervey WRP Access Road
El Paso, El Paso County, Texas

LOI Project No.: LOI20-245

Date: 02/10/22

Boring No.	Depth (ft.)	% Moisture Content	% Material passing # 4	% Material passing # 40	% Material minus # 200	LL	PL	PI	Soil Classification
1	0-1½	6			26				Clayey sand (SC)
1	2½-4	13			39	35	16	19	Clayey sand (SC)
1	5-6½	15							
2	0-1½	7			32	20	11	9	Clayey sand (SC)
2	2½-4	5							
2	5-6½	7			42				Clayey sand (SC)
3	0-1½	7			40	26	13	13	Clayey sand (SC)
3	2½-4	6							
3	5-6½	7			33				Clayey sand (SC)
4	0-1½	9			39	26	13	13	Clayey sand (SC)
4	2½-4	9							
4	5-6½	10			36				Clayey sand (SC)
5	0-1½	7			41	28	5	23	Clayey sand (SC)
5	2½-4	9							
5	5-6½	4	65	31	9				Poorly-graded sand (SP-SM) with silt and gravel
6	0-1½	8			40	26	13	13	Clayey sand (SC)
6	2½-4	7							
6	5-6½	8			24				Clayey sand (SC)

SUMMARY OF RESULTS

Project: Fred Hervey WRP Access Road
El Paso, El Paso County, Texas

LOI Project No.: LOI20-245

Date: 02/10/22

Boring No.	Depth (ft.)	% Moisture Content	% Material passing # 4	% Material passing # 40	% Material minus # 200	LL	PL	PI	Soil Classification
7	0-1½	10			35	28	13	15	Clayey sand (SC)
7	2½-4	9							
7	5-6½	14			52				Lean clay (CL) with sand
8	0-1½	7			34	25	12	13	Clayey sand (SC)
8	2½-4	7							
8	5-6½	8			39				Clayey sand (SC)
9	0-1½	5			37	30	13	17	Clayey sand (SC)
9	2½-4	6							
9	5-6½	6			36				Clayey sand (SC)

REPORT OF MOISTURE-DENSITY RELATIONSHIP, SIEVE ANALYSIS, AND PLASTICITY INDEX

ASTM D-2487, C-136, D-4318, D-1557

Project Name: Fred Hervey WRP Access Road
El Paso, El Paso County, Texas

Project Number: LOI20-245

Client: Brown and Caldwell
1200 Golden Key Circle, Suite 430
El Paso, Texas 79925

Sample date: 2/2/22

Sample Location: Existing material; Sample collected at Soil Boring B-2; 0'-3' in depth.

Sampler: JFL

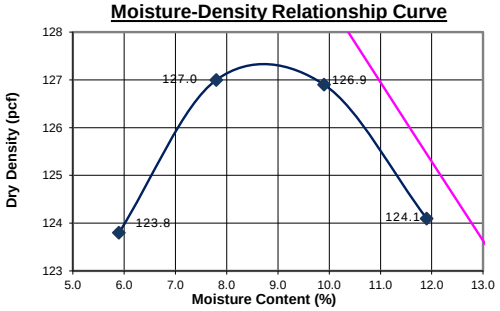
Soil Classification: Clayey sand (SC)

Sample Number: 020222-B2

Method Used: B
Preparation: Dry
Rammer: Mechanical
Specific Gravity: 2.63 (estimated)
As Received Water Content: 3 %

Modified Maximum Dry Unit Weight: 127.3 pcf
Modified Optimum Water Content: 8.7 %

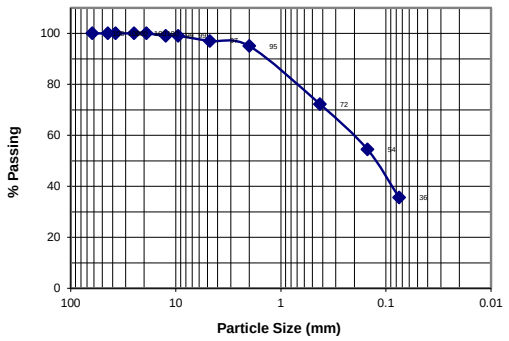
Moisture-Density Relationship Curve



Sieve Analysis

Sieve Opening Size		Retained (%)		Passing (%)	
Std.	mm	Actual	Specs.	Actual	Specs.
2-1/2"	62.50	0	-	100	-
1-3/4"	44.50	0	-	100	-
1-1/2"	37.50	0	-	100	-
1"	25.00	0	-	100	-
3/4"	19.00	0	-	100	-
1/2"	12.50	1	-	99	-
3/8"	9.50	1	-	99	-
#4	4.75	3	-	97	-
#10	2.00	5	-	95	-
#40	0.425	28	-	72	-
#100	0.150	46	-	54	-
#200	0.075	64	-	36	-

Grain-Size Distribution



Gradation Parameters

D_{10}=	0.02	C_c=	0.80
D_{30}=	0.06	C_u=	11.20
D_{60}=	0.24	-	-

Plasticity Index

Process: Air-dry

Actual	**LL=**	27	**PL=**	13	**PI=**	14
Typical	**LL=**	-	**PL=**	-	**PI=**	-

REPORT OF CALIFORNIA BEARING RATIO (CBR) TEST

ASTM D-1883

Project Name: Fred Hervey WRP Access Road
El Paso, El Paso County, Texas

Project Number: 20-245

Client: Brown and Caldwell
1200 Golden Key Circle, Suite 430
El Paso, Texas 79925

Sample date: 2/2/22

Sample Location: Existing material; Sample collected at Soil Boring B-2; 0' to 3' in depth.

Sampled by: JFL

USCS Classification: Clayey sand (SC)

Sample Number: 020222-B2

MOISTURE-DENSITY DATA:

Compaction Method: ASTM D-1557 *(Modified Proctor Test)*
Maximum dry unit weight: 127.3 pcf
Optimum moisture content: 8.7 %
Prescribed relative compaction: 95.0 %

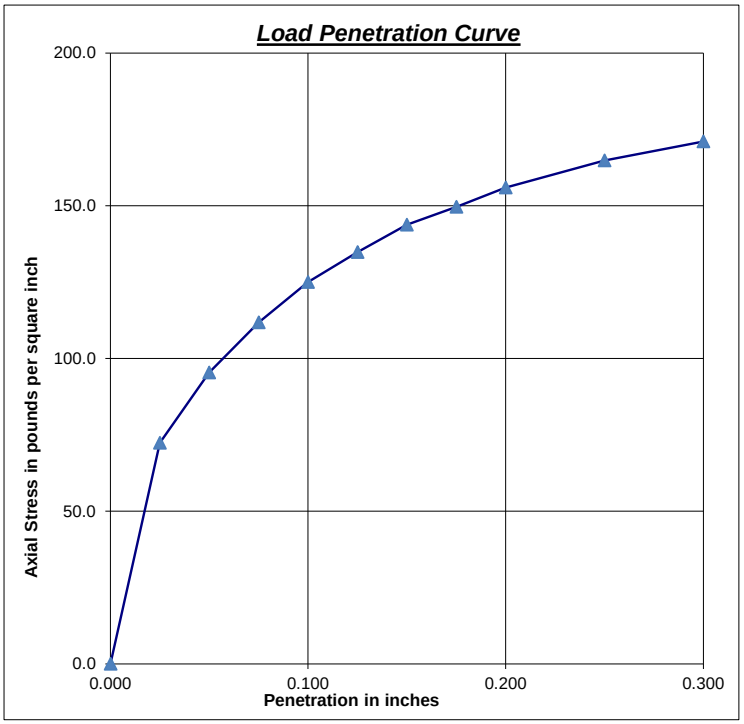
SOAKING PERIOD OUTPUT PARAMETERS:

Initial dry unit weight: 120.8 pcf
Final dry unit weight: 117.1 pcf
Swell index: 1.2%
Initial moisture content: 8.7 %
Final water content, top 1-inch layer: 16.2 %
Final water content, middle layer: 13.0 %

BEARING TEST DATA:

Penetration *(inch.)*	Load *(lbs.)*	Axial Stress *(psi)*
0.000	0	0.0
0.025	220	72.4
0.050	290	95.4
0.075	340	111.8
0.100	380	125.0
0.125	410	134.9
0.150	437	143.8
0.175	455	149.7
0.200	**474**	**155.9**
0.250	501	164.8
0.300	520	171.1

Corrected 0.1 inch penetration:	13%
Corrected 0.2 inch penetration:	**10%**



REPORT OF MOISTURE-DENSITY RELATIONSHIP, SIEVE ANALYSIS, AND PLASTICITY INDEX

ASTM D-2487, C-136, D-4318, D-1557

Project Name: Fred Hervey WRP Access Road
El Paso, El Paso County, Texas

Project Number: LOI20-245

Client: Brown and Caldwell
1200 Golden Key Circle, Suite 430
El Paso, Texas 79925

Sample date: 2/2/22

Sample Location: Existing material; Sample collected at Soil Boring B-5; 0'-3' in depth.

Sampler: JFL

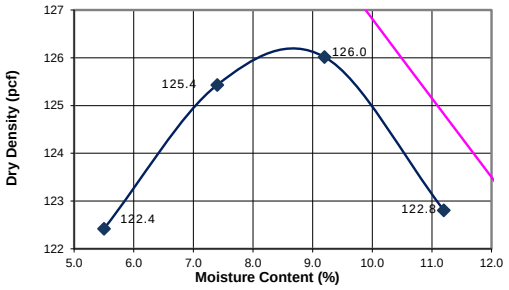
Soil Classification: Clayey sand (SC)

Sample Number: 020222-B5

Method Used: B
Preparation: Dry
Rammer: Mechanical
Specific Gravity: 2.63 (estimated)
As Received Water Content: 3 %

Corrected Maximum Dry Unit Weight: 126.2 pcf
Corrected Optimum Water Content: 8.7 %

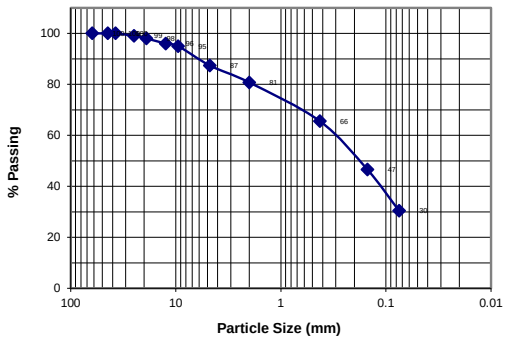
Moisture-Density Relationship Curve



Sieve Analysis

Sieve Opening Size		Retained (%)		Passing (%)	
Std.	mm	Actual	Specs.	Actual	Specs.
2-1/2"	62.50	0	-	100	-
1-3/4"	44.50	0	-	100	-
1-1/2"	37.50	0	-	100	-
1"	25.00	1	-	99	-
3/4"	19.00	2	-	98	-
1/2"	12.50	4	-	96	-
3/8"	9.50	5	-	95	-
#4	4.75	13	-	87	-
#10	2.00	19	-	81	-
#40	0.425	34	-	66	-
#100	0.150	53	-	47	-
#200	0.075	70	-	30	-

Grain-Size Distribution



Gradation Parameters

D_{10}=	0.02	C_c=	0.64
D_{30}=	0.07	C_u=	13.97
D_{60}=	0.34	-	-

Plasticity Index

Process: Air-dry

Actual	**LL=**	32	**PL=**	15	**PI=**	17
Typical	**LL=**	-	**PL=**	-	**PI=**	-

REPORT OF CALIFORNIA BEARING RATIO (CBR) TEST

ASTM D-1883

Project Name: Fred Hervey WRP Access Road
El Paso, El Paso County, Texas

Project Number: 20-245

Client: Brown and Caldwell
1200 Golden Key Circle, Suite 430
El Paso, Texas 79925

Sample date: 2/2/22

Sample Location: Existing material; Sample collected at Soil Boring B-5; 0' to 3' in depth.

Sampled by: JFL

USCS Classification: Clayey sand (SC)

Sample Number: 020222-B5

MOISTURE-DENSITY DATA:

Compaction Method: ASTM D-1557 *(Modified Proctor Test)*
Maximum dry unit weight: 126.2 pcf
Optimum moisture content: 8.7 %
Prescribed relative compaction: 95.0 %

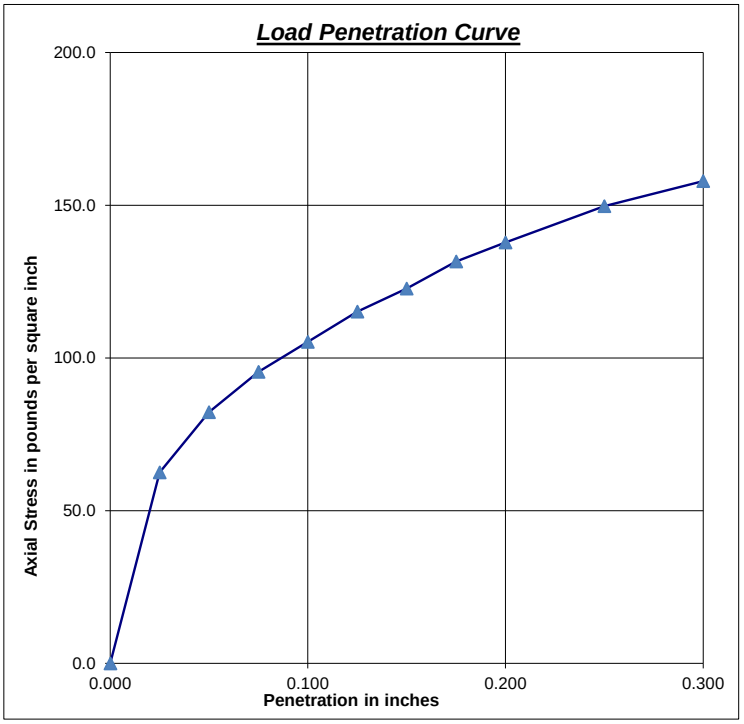
SOAKING PERIOD OUTPUT PARAMETERS:

Initial dry unit weight: 120.0 pcf
Initial moisture content: 8.7 %
Final dry unit weight: 114.5 pcf
Final water content, top 1-inch layer: 19.2 %
Swell index: 1.7%
Final water content, middle layer: 12.9 %

BEARING TEST DATA:

Penetration *(inch.)*	Load *(lbs.)*	Axial Stress *(psi)*
0.000	0	0.0
0.025	190	62.5
0.050	250	82.2
0.075	290	95.4
0.100	320	105.3
0.125	350	115.1
0.150	373	122.7
0.175	400	131.6
0.200	**419**	**137.8**
0.250	455	149.7
0.300	480	157.9

Corrected 0.1 inch penetration:	11%
Corrected 0.2 inch penetration:	**9%**



REPORT OF MOISTURE-DENSITY RELATIONSHIP, SIEVE ANALYSIS, AND PLASTICITY INDEX

ASTM D-2487, C-136, D-4318, D-1557

Project Name: Fred Hervey WRP Access Road
El Paso, El Paso County, Texas

Project Number: LOI20-245

Client: Brown and Caldwell
1200 Golden Key Circle, Suite 430
El Paso, Texas 79925

Sample date: 2/2/22

Sample Location: Existing material; Sample collected at Soil Boring B-8; 0'-3' in depth.

Sampler: JFL

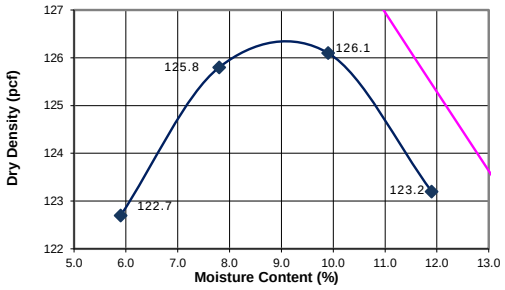
Soil Classification: Clayey sand (SC)

Sample Number: 020222-B8

Method Used: B
Preparation: Dry
Rammer: Mechanical
Specific Gravity: 2.63 (estimated)
As Received Water Content: 4 %

Modified Maximum Dry Unit Weight: 126.3 pcf
Modified Optimum Water Content: 9.0 %

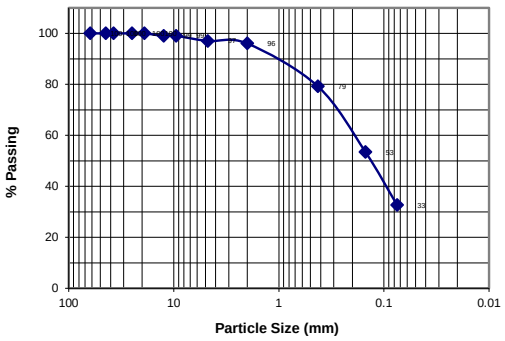
Moisture-Density Relationship Curve



Sieve Analysis

Sieve Opening Size		Retained (%)		Passing (%)	
Std.	mm	Actual	Specs.	Actual	Specs.
2-1/2"	62.50	0	-	100	-
1-3/4"	44.50	0	-	100	-
1-1/2"	37.50	0	-	100	-
1"	25.00	0	-	100	-
3/4"	19.00	0	-	100	-
1/2"	12.50	1	-	99	-
3/8"	9.50	1	-	99	-
#4	4.75	3	-	97	-
#10	2.00	4	-	96	-
#40	0.425	21	-	79	-
#100	0.150	47	-	53	-
#200	0.075	67	-	33	-

Grain-Size Distribution



Gradation Parameters

D_{10}=	0.02	C_c=	0.94
D_{30}=	0.07	C_u=	9.58
D_{60}=	0.22	-	-

Plasticity Index

Process: Air-dry

Actual	**LL=**	26	**PL=**	12	**PI=**	14
Typical	**LL=**	-	**PL=**	-	**PI=**	-

REPORT OF CALIFORNIA BEARING RATIO (CBR) TEST

ASTM D-1883

Project Name: Fred Hervey WRP Access Road
El Paso, El Paso County, Texas

Project Number: 20-245

Client: Brown and Caldwell
1200 Golden Key Circle, Suite 430
El Paso, Texas 79925

Sample date: 2/2/22

Sample Location: Existing material; Sample collected at Soil Boring B-8; 0' to 3' in depth.

Sampled by: JFL

USCS Classification: Clayey sand (SC)

Sample Number: 020222-B8

MOISTURE-DENSITY DATA:

Compaction Method: ASTM D-1557 *(Modified Proctor Test)*
Maximum dry unit weight: 126.3 pcf
Optimum moisture content: 9.0 %
Prescribed relative compaction: 95.0 %

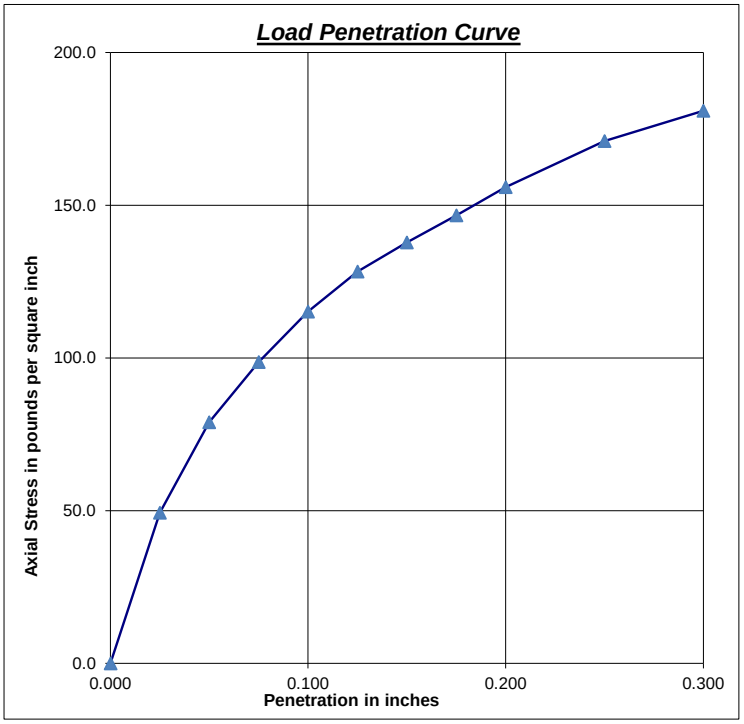
SOAKING PERIOD OUTPUT PARAMETERS:

Initial dry unit weight: 120.0 pcf
Initial moisture content: 9.0 %
Final dry unit weight: 116.6 pcf
Final water content, top 1-inch layer: 16.4 %
Swell index: 1.1%
Final water content, middle layer: 12.5 %

BEARING TEST DATA:

Penetration *(inch.)*	Load *(lbs.)*	Axial Stress *(psi)*
0.000	0	0.0
0.025	150	49.3
0.050	240	78.9
0.075	300	98.7
0.100	350	115.1
0.125	390	128.3
0.150	419	137.8
0.175	446	146.7
0.200	**474**	**155.9**
0.250	520	171.1
0.300	550	180.9

Corrected 0.1 inch penetration:	12%
Corrected 0.2 inch penetration:	**10%**



APPENDIX B

SOIL TERMINOLOGY

COARSE GRAINED SOILS: More than 50 percent retained on No. 200 sieve. Includes fine, medium, or coarse grained (depending on grain size) gravel and sand, and silty and/or clayey gravel and sand. Density is described according to relative density measured in the laboratory, or sampler resistance in the field as follows:

Penetration Resistance* (Blows per Foot)	Descriptive Term	Relative Density** (Percent)
0 – 4	Very Loose	0 - 15
5 - 9	Loose	15 – 35
10 - 29	Medium Dense	35 – 65
30 - 49	Dense	65 - 85
More than 50	Very Dense	85 - 100

* From Standard Penetration Test with 140-pound hammer, 30-inch drop.
** From relative density tests on undisturbed sand sample.

FINE GRAINED SOILS: More than 50 percent passing through the No. 200 sieve. Includes organic and inorganic silt and clay, gravelly and/or sandy silt and clay, silty clay, and clayey silt. Consistency is described according to shear strength, from unconfined compression tests in the laboratory, penetrometer tests in the field or laboratory, or sampler resistance in the field as follows:

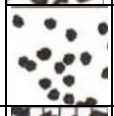
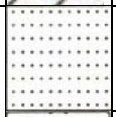
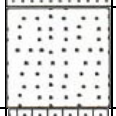
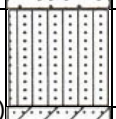
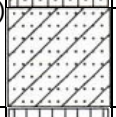
Compressive Strength* (Tons per Square Foot)	Descriptive Term	Penetration Resistance** (Blows per Foot)
Less than 0.25	Very Soft	Less than 2
0.25 - 0.50	Soft	2 - 4
0.50 - 1.00	Firm	5 - 8
1.00 - 2.00	Stiff	9 - 15
2.00 - 4.00	Very Stiff	16 - 50
4.00 and higher	Hard	50 and higher

* From unconfined compression strength test.
** From Standard Penetration Test with 140-pound hammer, 30 inch drop.

Slicken sided: With inclined planes of weakness of slick and glassy appearance.
Fissured: With shrinkage cracks that are frequently filled with fine sand.
Laminated: With thin layers of varying colors and texture.
Interbedded: With alternate layers of different soil types.
Calcareous: With noticeable quantities of calcium carbonate.
Sensitive: Applies to cohesive soils that are subject to loss of strength when remolded.
Well graded: With wide range in grain sizes and good distribution of intermediate particle sizes.
Poorly graded: With one predominant grain size, or a poor distribution with intermediate sizes missing.

SOIL SYMBOLS

Identification of the major soil divisions used to distinguish the change of a different stratum. For their combinations and a more detailed description, see UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D 2487-00)

MAJOR SOIL DIVISIONS			SOIL SYMBOL	USCS SYMBOL	TYPICAL NAME
Coarse-Grained Soils (< 50% pass No. 200 sieve)	GRAVELS (<50% pass No. 4 sieve)	Clean Gravels (< 5% pass No. 200 sieve)		**GW**	Well-Graded Gravels
				**GP**	Poorly-Graded Gravels
		Gravels with fines (> 12% pass No. 200 sieve)		**GM**	Silty Gravels
				**GC**	Clayey Gravels
	SANDS (> 50% pass No. 4 sieve)	Clean Sands (< 5% pass No. 200 sieve)		**SW**	Well-Graded Sands
				**SP**	Poorly-Graded Sands
		Sands with fines (> 12% pass No. 200 sieve)		**SM**	Silty Sands
				**SC**	Clayey Sands
Fine-Grained Soils (> 50% pass No. 200 sieve)	SILTS	Silts of Low Plasticity (*LL < 50)		**ML**	Inorganic Silts (slightly plastic)
		Silts of High Plasticity (*LL > 50)		**MH**	Inorganic Silts (elastic)
	CLAYS	Clays of Low Plasticity (*LL < 50)		**CL**	Inorganic Clays (lean clays)
		Clays of High Plasticity (*LL > 50)		**CH**	Inorganic Clays (Fat clays)

*Liquid Limit of the soil
NV: No value obtained; NP: Non-plastic