Geotechnical Engineering Study

Fenter Road Reconstruction
Town of Clint, El Paso County, Texas
LOI File No. 21-061

Prepared for:
Huitt-Zollars
5822 Cromo Drive, Suite 210
El Paso, Texas 79912

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

April 5, 2021

ENGINEERS

File No. LOI21-061
April 5, 2021

Ms. Alejandra Gallegos, P.E., PTOE
Huitt-Zollars
5822 Cromo Drive, Suite 210
El Paso, Texas 79912

Re: Geotechnical Engineering Report
Fenter Road Reconstruction
Town of Clint, El Paso County, Texas

Dear Ms. Gallegos:

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. LOIP21-021, dated January 19, 2021, and authorized on March 10, 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

Diana S. Guerrero, E.I.T.
Project Professional

Bernardino Olague, P.E., PMP
Principal Engineer

STATE OF TEXAS
Bernardino Olague
81628
LICENSED
PROFESSIONAL ENGINEER
4/5/21

Copies: Above (2)
Email (1)
File (1)

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1.0 INTRODUCTION

We have completed the geotechnical engineering study for the proposed Fenter Road Reconstruction project, in Client, Texas. We were authorized to conduct this study by Ms. Isabel Vazquez, P.E., Vice President of Huitt-Zollars (Client) on March 10, 2021.

2.0 PROJECT DESCRIPTION AND OBJECTIVE

The project consists of the design and reconstruction Fenter Road, extending from Clint Cut-Off Road to North Loop Drive, in the Town of Clint, El Paso County, Texas. The proposed street reconstruction will span a length of about 3,045 linear feet. The existing roadway width is approximately 25 feet. The roadway width will remain the same.

We conducted our study in general accordance with the "Recommended Practice for the Design of Foundations" manual published by the American Society of Civil Engineers.

3.0 FIELD AND LABORATORY INVESTIGATION

3.1 Field Exploration

In our field exploration phase, we drilled four (4) soil borings to a depth of 6½-feet each below ground surface at representative locations within the proposed roadway improvements. 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 Plan included in the Appendix A of this report in Sheet A-1. 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-4) are included in the Appendix A of this report as Sheets A-2 through A-5. A key to the soil terminology used in the logs is included in the 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 one (1) Moisture-Density Relationship test and one (1) California Bearing Ratio (CBR) test, in accordance with ASTM D-1557 and D-1883, respectively. The results of these tests can be found on Sheets A-7 and A-8, respectively.

Type of Test	Number of Tests
Moisture Content (ASTM D-2216)	13
Grain Size Distribution Analysis (ASTM D-422)	2
Percent Passing No. 200 Sieve (ASTM D-6913)	11
Atterberg Limits (ASTM D-4318)	5
California Bearing Ratio Test (ASTM D-1883)	1
Moisture-Density Relationship Curve (ASTM D-1557)	1

4.0 GENERAL SITE CONDITIONS

4.1 Site Geology

The project site is located on the Rio Grande flood plain. According to the Soil Conservation Service of El Paso County, the soils in this area correspond to the Harkey-Glendale association, which is described as nearly level soils that have loamy very fine sand to silty clay loam underlying material.

4.2 Site Topography and Site Conditions

The project site is relatively level. The proposed site is a street currently in use. The site is topped with a hot-mix asphaltic concrete (flexible) pavement. The thicknesses of asphalt and base course layers encountered are shown in boring log sheets A-2 through A-5. We also observed manholes and other appurtenances within the road alignment and along the shoulders of Fenter Road. Several underground lines traverse the roadway at different locations.

4.3 Site Vegetation

At the time of our field phase, the site was relatively free of vegetation.

4.4 Soil Stratigraphy

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

Stratum A, consisting of fine grained brown clayey sands, occasionally intermixed with gravel and calcareous material, was encountered underlying the asphalt and base

course layer, and extended to depths ranging from 2½ feet below ground surface (bgs) in soil borings B-1 and B-3, and also underlying the Stratum C soils in soil borings B-2 and B-3. These soils were encountered at a loose to medium dense relative density, with SPT values results ranging from 6 to 21 blows per foot of penetration. These soils were encountered at a dry to moist condition, with tested moisture content values ranging from 5 to 12 percent, and percent finer than the No. 200 sieve test results ranging from 20 to 48 percent. These soils exhibited a maximum tested liquid limit of 27 which yielded a plasticity index of 12. Soils in this stratum can be classified as SC in accordance with the USCS.

Stratum B, consisting of brown sandy lean clays, was encountered underlying the Stratum A soils from a depth of 2½ feet BGS in soil boring B-1 and B-3, and also underlying the asphalt and base course layer and extended to depths ranging from 5 feet to 5¾ feet in soil borings B-2 and B-4. These soils were encountered at soft to stiff consistency, with SPT values ranging from 3 to 13 blows per foot of penetration. These soils were encountered at a moist to very moist condition, with tested moisture content values ranging from 13 to 25 percent, and percent finer than the No. 200 sieve test results ranging from 55 to 89 percent. These soils exhibited a maximum tested liquid limit of 40 which yielded a plasticity index of 22. Soils in this stratum can be classified as CL in accordance with the USCS.

Stratum C, consisting of tan-multicolored poorly graded sands, was encountered underlying the Stratum B soils, and extended to the total explored depth of 6½ feet bgs in the soil borings. These soils were encountered at loose relative density, with an SPT value of 7 blows per foot of penetration. These soils were encountered at a dry condition, with a tested moisture content value of 3 percent, and a percent finer than the No. 200 sieve test result of 4 percent. Soils in this stratum can be classified as SP 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.

It is our opinion that the depth to groundwater at the site may vary considerably after periods of significant rainfall or during irrigation seasons. Fluctuations in groundwater may also occur as a function of temperature, groundwater withdrawal and future construction activities that may alter the surface drainage and sub-drainage characteristics of this site.

5.0 ENGINEERING EVALUATION

5.1 Vertical Movements

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

5.2 Site Preparation

Based on the SPTs performed at the site, the majority of soils in the upper 5 feet below ground surface were encountered at a dry to very moist condition, and at a loose to medium dense relative density and soft to stiff consistency. Soils at their present condition may not provide adequate support for a replacement pavement structure, unless properly processed as indicated below.

All existing pavements shall be completely removed and disposed off-site. Demolition debris shall be removed and disposed off-site as per local regulations.

ENGINEERS

5.3 Trench Guidelines

We recommend adequate protection on the faces of the excavations to prevent hazards from falling material. Adequate sloping on the faces of the excavations should also be implemented to avoid possible soil sloughing.

The Occupational Safety and Health Administration (OSHA) classifies soils for the purpose of defining stable slopes to be used in trenching applications.

The soils found during our field exploration, are considered Type C materials. For temporary slopes in soil trenching for this project, Type C soils can have a maximum slope of 1½:1 (H:V).

The contractor may be required to utilize shielded trench systems during the construction phase whenever excavations deeper than 5 feet are required taking into consideration site constraints such as vehicular traffic, existing underground lines (fuel, natural gas, telecommunication, and water), overhead lines, and existing structures.

We should note that the information included in this report is for design of sewer pipeline facilities and lift station structures only, and is not intended to provide a trench safety plan. The contractor should develop a trench safety plan in accordance with the requirements of OSHA and specifications in the project plans. If trench shields will be used, these should be selected appropriately to retain the lateral loads from the native coarse grained soils.

5.4 Flexible Pavement Recommendations

Flexible pavements will be used in the reconstruction of Fenter Road. In our analysis, we assigned a road function classification of "Residential Collector", utilizing a traffic loading of 269,000 equivalent single-axle loads (ESAL's) and assuming a 54-foot right-of-way. This parameter is estimated based on the pavement usage characteristics for a design period of 20 years.

Based on our laboratory analysis, we calculated a California Bearing Ratio (CBR) of 6, and follow the Pavement Thickness Design Procedure as specified in the "Design Standards for Construction" document published by the City of El Paso. The resulting pavement design criteria is shown in the following table, and the corresponding pavement calculations are included in Appendix A as Sheet A-9.

Pavement Component	Minimum Thickness
Hot-Mix Asphaltic Concrete	2 inches
Crushed Stone Base Course	6 inches
Select Fill (95% compaction)	18 inches[1]
Compacted Subgrade (per Section 5.6)	8 inches

[1] Recommended thickness to reduce PVR to acceptable limits.

As a minimum, the HMAC material should conform to Type C, in accordance with the City of El Paso standards. The HMAC mix should have a minimum 1,500 pounds of Marshall Stability when compacted at 75 blows in accordance with ASTM D-1559, and should have a flow between 8 and 16. The HMAC course should be placed at a target density of at least 98 percent.

The Crushed Stone Base Course (CSBC) should be 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. CSBC materials should be placed in loose lifts not exceeding 6 inches in compacted thickness, and compacted to a minimum 95 percent of maximum dry density and a moisture content within plus or minus 2 percent, in accordance with ASTM D-1557.

5.5 Existing Flexible Pavement Condition

During our subsurface exploration and field activities, we observed multiple signs of pavement distress throughout the project site. We noted reflective and alligator-type cracking along Fenter Road.

The above described signs of distress are normally associated with a reduction in the pavement support, which may be attributed to water infiltration, poor drainage and exceedance of traffic volumes over the street's life cycle.

5.6 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 Stratum A and Stratum C soils in our borings are suitable for use as select fill, provided they meet the above criteria for acceptable fill materials. The Stratum B soils in our borings are NOT suitable for use as select fill.

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.

5.7 New Construction near Existing Structures and Utilities

Contractor shall exercise extreme care during subgrade excavation and site preparation near the existing utility lines to avoid encroaching into the existing sidewalks, underground utility lines, manholes, or any foundation system, hence preventing adversely affecting or undermining the performance and structural integrity of the existing utility lines and associated appurtenances. We recommend that before any excavation or earthwork takes place, all underground utilities be located to prevent damages to the existing infrastructure.

We recommend that ten (10) days prior to commencing any excavation within the site, 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 in the event that site conditions vary from those described in this report.

The geotechnical engineer should also conduct testing of fill materials used for site grading at the rate of three field densities per each lift of fill or one per 1,000 square feet of fill, whichever yields the larger number of tests, in accordance with ASTM D-6938 or D-

1556. Additionally, one moisture-density curve should be obtained for each type of material used in accordance with ASTM D-1557, and one sieve analysis and one plasticity index for each type of material used, according to ASTM C-136, and D-4318.

6.2 Limitations

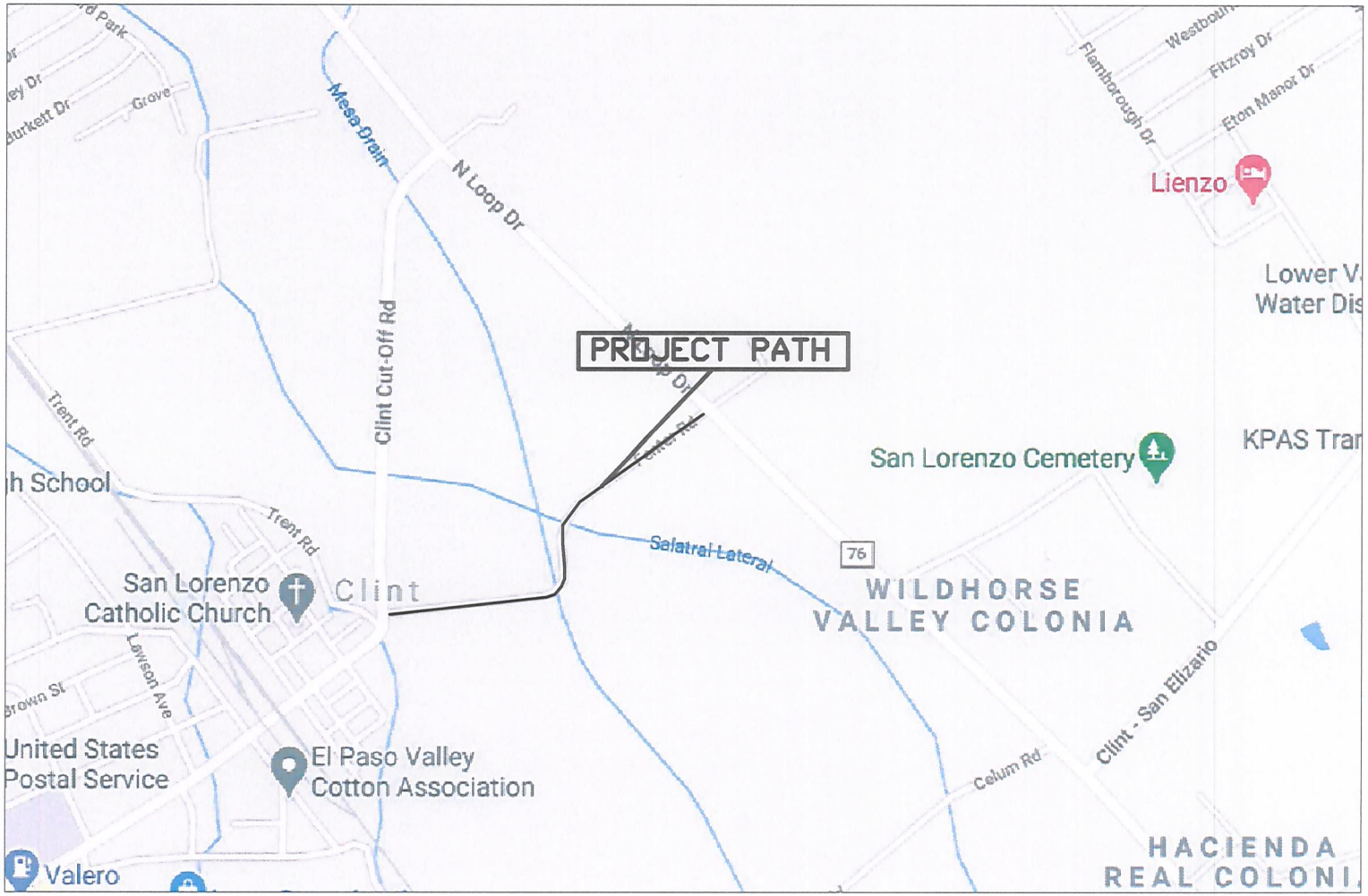
We have performed our professional services and have obtained the data presented in this report in accordance with generally accepted geotechnical engineering principles and practices. The information in this report is based on the data obtained from four (4) representative test borings and laboratory 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 Fenter Road Reconstruction project, in the Town of Clint, El Paso County, Texas. Use of this information for projects other than the one described herein will not be adequate.

APPENDIX A



LEGEND	GEOTECHNICAL CONSULTANT	PROJECT CONSULTANT	DRAWING TITLE: GENERAL LOCATION MAP
APPROXIMATE PROJECT LOCATION	LOI ENGINEERS 915-781-1532 2101 E. MISSOURI AVE SUITE B EL PASO, TEXAS 79903	HUITT-ZOLLARS, INC. 5822 CROMO DR., SUITE 210 EL PASO, TEXAS 79912	PROJECT NAME: FENTER ROAD RECONSTRUCTION CLINT, EL PASO COUNTY, TEXAS

DRAWN BY	REVIEWED BY	APPROVED BY	SCALE
F.R.	D.G.	B.O.	N.T.S.

PROJECT No.	FILE NAME	DATE	SHEET No.
LOI21-061	SITE PLAN	03/16/21	A-1.1

LEGEND	GEOTECHNICAL CONSULTANT	PROJECT CONSULTANT	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	HUITT-ZOLLARS, INC. 5822 CROMO DR., SUITE 210 EL PASO, TEXAS 79912	PROJECT NAME: FENTER ROAD RECONSTRUCTION CLINT, EL PASO COUNTY, TEXAS

DRAWN BY	REVIEWED BY	APPROVED BY	SCALE
F.R.	D.G.	B.O.	N.T.S.
PROJECT No.	**FILE NAME**	**DATE**	**SHEET No.**
LOI21-061	SITE PLAN	03/16/21	A-1.2

LOG OF TEST BORING No. B-1

Project name: Fenter Road Reconstruction, Clint, Texas
File No.: LOI21-061
Date drilled: 03/22/21
Boring Location: See Sheet A-1.2
Elevation (ft.): N/A North: N/A West: N/A

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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			1-5/8" ASPHALT								
			SAND, fine grained, clayey, brown, loose, moist with gravel and calcareous material	SC	12	33				6	
2			CLAY, lean, brown, firm, moist	CL						6	
4											
			CLAY, sandy lean, brown, firm, moist		19	65				5	
6			Termination depth at 6.5 feet								
8											
10											
12											

Groundwater Table Data

Depth	Date	Time
N/A	N/A	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: EAH
Logger: AG
Sheet No.: **A-2**

LOG OF TEST BORING No. B-2

Project name: Fenter Road Reconstruction, Clint, Texas
File No.: LOI21-061
Date drilled: 03/22/21
Boring Location: See Sheet A-1.2
Elevation (ft.): N/A North: N/A West: N/A

LOI ENGINEERS

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			2-3/4" ASPHALT								
			6" BASE COURSE								
			CLAY, sandy lean, brown, stiff, moist		13	61	34	16	18	13	
2			CLAY, lean, brown, soft, very moist	CL	25	89	37	21	16	3	
4			- firm at 5 feet							6	
6			SAND, fine grained, clayey, brown, loose, dry to moist	SC	9	23					
			Termination depth at 6.5 feet								
8											
10											
12											

Groundwater Table Data

Depth	Date	Time
N/A	N/A	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: EAH
Logger: AG
Sheet No.: **A-3**

LOG OF TEST BORING No. B-3

Project name: Fenter Road Reconstruction, Clint, Texas
File No.: LOI21-061
Date drilled: 03/22/21
Boring Location: See Sheet A-1.2
Elevation (ft.): N/A North: N/A West: N/A

LOI ENGINEERS

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			2-7/8" ASPHALT								
			6" BASE COURSE								
			SAND, fine grained, clayey, brown, medium dense, dry to moist with traces of gravel	SC	5	20	27	15	12	21	
2											
			CLAY, lean, brown, firm, dry to moist	CL						8	
4			-with sand and moist at 5 feet		19	76	38	19	19	5	
6			SAND, fine grained, clayey, brown, loose, dry to moist	SC	10	48					
			Termination depth at 6.5 feet								
8											
10											
12											

Groundwater Table Data

Depth	Date	Time
N/A	N/A	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: EAH
Logger: AG
Sheet No.: **A-4**

LOG OF TEST BORING No. B-4

Project name: Fenter Road Reconstruction, Clint, Texas
File No.: LOI21-061
Date drilled: 03/22/21
Boring Location: See Sheet A-1.2
Elevation (ft.): N/A North: N/A West: N/A

LOI ENGINEERS

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			3-7/8" ASPHALT								
			6" BASE COURSE								
			CLAY, sandy lean, brown, firm, moist		14	55				5	
2			CLAY, lean with sand, brown, firm, moist	CL	19	72	40	18	22	5	
4			SAND, fine grained, poorly-graded, tan, loose, dry	SP	3	4				7	
6			Termination depth at 6.5 feet								
8											
10											
12											

Groundwater Table Data

Depth	Date	Time
N/A	N/A	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: EAH
Logger: AG
Sheet No.: **A-5**

SUMMARY OF RESULTS

Project: Fenter Road Reconstruction
Town of Clint, El Paso County, Texas

LOI Project No.: LOI21-061

Date: 03/26/21

Boring No.	Depth (ft.)	% Moisture Content	% Material passing # 4	% Material passing # 40	% Material minus # 200	LL	PL	PI	Soil Classification
1	0-1½	12	80	58	33				Clayey sand with gravel (SC)
1	5-6½	19			65				Sandy lean clay (CL)
2	0-1½	13			61	34	16	18	Sandy lean clay (CL)
2	2½-4	25			89	37	21	16	Lean clay (CL)
2	5-6½ LOWER	9			23				Clayey sand (SC)
3	0-1½	5	56	36	20	27	15	12	Clayey sand with gravel (SC)
3	5-6½ UPPER	19			76	38	19	19	Lean clay with sand (CL)
3	5-6½ LOWER	10			48				Clayey sand (SC)
4	0-1½	14			55				Sandy lean clay (CL)
4	2½-4	19			72	40	18	22	Lean clay with sand (CL)
4	5-6½	3			4				Poorly-graded sand (SP)

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

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

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Project Name: Fenter Road Reconstruction
Town of Clint, Texas

Project Number: LOI21-061

Client: Huitt-Zollars
5822 Cromo Drive, Suite 210
El Paso, Texas 79912

Sample date: 3/22/21

Sample Location: Existing material; Sample collected at soil boring B-4; 0'-3' in depth.

Sampler: EH

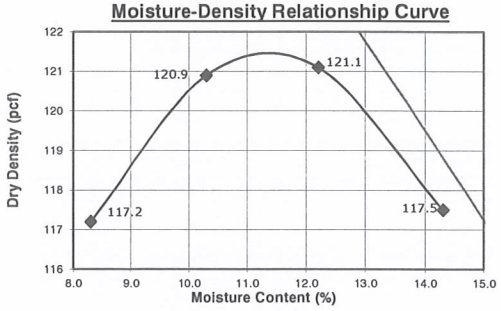
Soil Classification: Sandy lean clay (CL)

Sample Number: 032221-B4

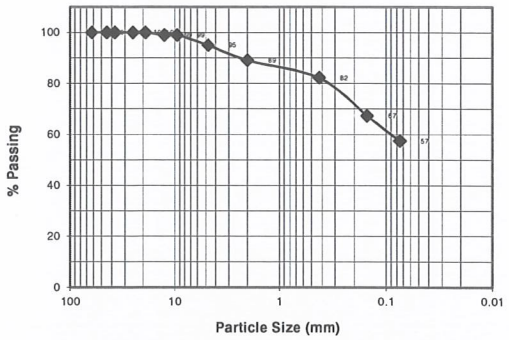
Method Used: B
Preparation: Dry
Rammer: Mechanical
Specific Gravity: 2.63 (estimated)
As Received Water Content: 5 %

Corrected Maximum Dry Unit Weight: 121.5 pcf
Corrected Optimum Water Content: 11.4 %

Moisture-Density Relationship Curve



Grain-Size Distribution



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	5	-	95	-
#10	2.00	11	-	89	-
#40	0.425	18	-	82	-
#100	0.150	33	-	67	-
#200	0.075	43	-	57	-

Gradation Parameters

D_{10}=	0.01	C_c=	1.24
D_{30}=	0.04	C_u=	7.24
D_{60}=	0.09	-	-

Plasticity Index

Process: Air-dry

Actual	**LL=**	34	**PL=**	16	**PI=**	18
Typical	**LL=**	-	**PL=**	-	**PI=**	-

Sheet A-7

REPORT OF CALIFORNIA BEARING RATIO (CBR) TEST

ASTM D-1883

Project Name: Fenter Road Reconstruction
Town of Clint, Texas

Project Number: LOI21-061

Client: Huitt-Zollars
5822 Cromo Drive, Suite 210
El Paso, Texas 79912

Sample date: 3/22/21

Sample Location: Existing material; Sample collected at soil boring B-4; 0' to 3' in depth.

Sampler by: EH

USCS Classification: Sandy lean clay (CL)

Sample Number: 032221-B4

MOISTURE-DENSITY DATA:

Compaction Method:	ASTM D-1557 *(Modified Proctor Test)*		
Maximum dry unit weight:	121.5 pcf	**Optimum moisture content:**	11.4 %
		Prescribed relative compaction:	95.0 %

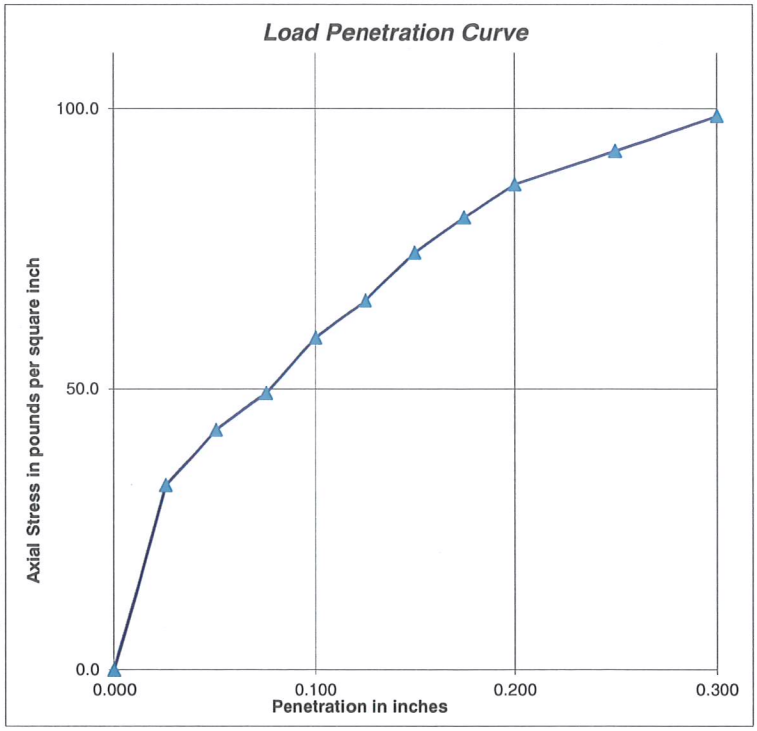
SOAKING PERIOD OUTPUT PARAMETERS:

Initial dry unit weight:	114.9 pcf	**Initial moisture content:**	11.4 %
Final dry unit weight:	111.5 pcf	**Final water content, top 1-inch layer:**	22.9 %
Swell index:	4.0%	**Final water content, middle layer:**	15.7 %

BEARING TEST DATA:

Penetration *(inch.)*	Load *(lbs.)*	Axial Stress *(psi)*
0.000	0	0.0
0.025	100	32.9
0.050	130	42.8
0.075	150	49.3
0.100	180	59.2
0.125	200	65.8
0.150	226	74.3
0.175	245	80.6
0.200	**263**	**86.5**
0.250	281	92.4
0.300	300	98.7

Corrected 0.1 inch penetration:	6%
Corrected 0.2 inch penetration:	**6%**



Sheet No. A-8

PAVEMENT CALCULATION SHEET

Project: Fenter Road Reconstruction
File No.: LOI21-061
Date: April 5, 2021
By: Geoffrey Madrazo

Road Name: **Fenter Road**
Pavement Section: Residential Connector, 54 ft. ROW

Estimated E.A.L assuming average daily traffic over a period of 20 years:

∴ E.A.L. = 269,000

CBR Value: 6
S - Soil support value = 5.00
SN – Weighted structural number = 2.40

A_1 = 0.44 (for High-stability roadmix)
D_1 = 2.0 (min. HMAC thickness)
A_2 = 0.14 (for crushed stone base)
D_2 = 6.0 (min. CSBC thickness)
A_3 = 0.11 (for subgrade material)
D_3 = x

$SN = A_1 D_1 + A_2 D_2 + A_3 D_3$ ∴ $2.40 = (0.44)(2.0) + (0.14)(6.0) + (0.11)(x)$

$x = (2.40 - 0.88 - 0.84) / 0.11$

$x = (0.68) / 0.11 = 6.18$ inches ∴ use minimum D_3 = 8 inches

Minimum recommended pavement section:

HMAC	=	2 inches
CSBC	=	6 inches
Compacted fill material	=	8 inches

Sheet No. A-9

APPENDIX B

loi ENGINEERS

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 - 10	Loose	15 – 35
11 - 30	Medium Dense	35 – 65
31 - 50	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:

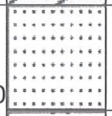
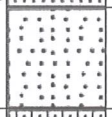
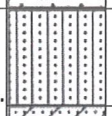
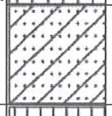
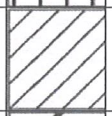
Compressive Strength* (Tons per Square Foot)	Descriptive Term	Penetration Resistance** (Blows per Foot)
Less than 0.25	Very Soft	Less than 2
0.25 - 0.50	Soft	3 - 4
0.50 - 1.00	Firm	5 - 8
1.00 - 2.00	Stiff	9 - 15
2.00 - 4.00	Very Stiff	16 - 50
4.00 and higher	Hard	50 and higher

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

Slickensided: 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