Geotechnical Engineering Study

El Paso County ARPA 1010 Project – Panorama Village
El Paso, El Paso County, Texas
LOI File No. J23-1-1259

Prepared for:
Moreno Cardenas, Inc.
2505 E. Missouri Ave.
El Paso, Texas 79903

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

November 13, 2023

File No. J23-1-1259
November 13, 2023

Mr. Brian Klaes, P.E., LEED AP, PMP
Moreno Cardenas, Inc.
2505 E. Missouri Ave.
El Paso, Texas 79903

Re: Geotechnical Engineering Report
El Paso County ARPA 1010 Project – Panorama Village
El Paso, El Paso County, Texas

Dear Mr. Klaes:

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. P23-1-02026, dated October 5, 2023, and authorized on October 6, 2023. 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

Timothy J. Martin, E.I.T.
Project Professional

Bernardino Olague, P.E., PMP
Principal Engineer

STATE OF TEXAS
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11/13/23

PP
Danny R. Anderson, P.E.
Senior Geotechnical Engineer

Copies: Above (1) Via E-mail
File (1)

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1.0 INTRODUCTION

We have completed the geotechnical engineering study for the proposed Panorama Village sanitary sewer lines and lift station project, which will be located in Socorro, El Paso County, Texas. We were authorized to conduct this study by Mr. Brian Klaes, P.E., representing Moreno Cardenas, Inc (Client) on October 6, 2023, via Task Order No. 1.

2.0 PROJECT DESCRIPTION AND OBJECTIVE

The project consists of the design and construction of sanitary sewer lines accompanied by a lift station. The lift station is proposed to have an invert elevation of 3702 feet, and is to be located near soil boring B-3 (See Sheet A-1.2). The proposed project is primarily located within the Panorama Village subdivision, located in Socorro, El Paso County, Texas.

3.0 FIELD AND LABORATORY INVESTIGATION

3.1 Field Exploration

In our field exploration phase, we drilled one soil boring to a depth of 40 feet below ground surface (BGS), one soil boring to a depth of 25 feet BGS, six soil borings to a depth of 20 feet BGS, and one soil boring to a depth of 15 feet BGS. 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. Prior to and upon completion of our drilling operations, we cored through the flexible HMAC pavement and upon completion of the drilling operations, we patched the surface (with cold asphaltic concrete mix patch). 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-1.2. 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 the

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 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 two Moisture-Density Relationship tests in accordance with ASTM D-1557. The results of these tests can be found on Sheets A-8 and A-9, in Appendix A.

Table 1: Laboratory Testing Program

Type of Test	Number of Tests
Moisture Content (ASTM D-2216)	27
Grain Size Distribution Analysis (ASTM D-422)	10
Percent Passing No. 200 Sieve (ASTM D-1140)	21
Atterberg Limits (ASTM D-4318)	2

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 area is relatively level, and generally slopes gently downward in a southerly direction. The sanitary sewer line alignments are located primarily within Panorama Village, in Socorro, El Paso County, Texas. The sewer line alignments are located within the existing pavement areas, which are topped with HMAC pavement. The existing asphalt pavement thickness at the boring locations ranged from 1 inch to 2 inches in thickness. The existing pavement was underlain by base course material, which ranged in thickness from about 4 inches to 10 inches in thickness.

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 two generalized soil strata as follows:

Stratum A, consisting of brown-multicolor poorly graded sands, occasionally intermixed with various amounts of silt and gravel, was encountered from ground surface elevation and below pavement section in borings B-1 B-3, B-5, B-6, and B-8, interbedded in the Stratum B soils in borings B-2, B-4, and B-9, underlying the Stratum B soils in borings B-2, B-3, and B-9, and extended to depths ranging from 5 feet to 41½ feet BGS. These soils were encountered at a loose to dense relative density, with SPT values ranging from 5 to 41 blows per foot of penetration. These soils were encountered at a dry condition, with tested moisture content values ranging from 2 to 3 percent, and percent finer than the No. 200 sieve test results ranging from 4 to 12 percent. Soils in this stratum can be classified as SP or SP-SM in accordance with the USCS.

Stratum B, consisting of brown fine grained silty and clayey sands, occasionally intermixed with various amounts of gravel, was encountered from ground surface elevation and below pavement section in borings B-2, B-4, B-7, and B-9, interbedded in the Stratum A soils in borings B-2, B-3, and B-9, underlying the Stratum A soils in borings B-1, B-4, B-5, B-6, and B-8, and extended to depths ranging from 2½ feet to 21½ feet BGS. These soils were encountered at a very loose to medium dense relative density, with SPT values ranging from 4 to 23 blows per foot of penetration. These soils were encountered at a dry to moist condition, with tested moisture content values ranging from 2 to 10 percent, and percent finer than the No. 200 sieve test results ranging from 15 to 43 percent. These soils exhibited tested liquid limit value ranging from 20 to 28 and yielded tested plasticity index values ranging from 6 to 14. Soils in this stratum can be classified as SM, SC, or SC-SM 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 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 our borings exhibited relatively low plasticity characteristics. The calculated PVR of the existing soil conditions is ¼-inch.

5.2 Site Preparation

The existing flexible pavement and associated concrete flatwork in the subject area, as well as any foreign matter or debris, shall be removed and properly disposed of off-site per applicable local regulations prior to grading/excavation operations. The exposed subgrade shall be processed as per the select fill section of this report. Soils at their present condition may provide adequate support for concrete flatwork and/or pavement sections, when properly processed, moisture-conditioned, and compacted as indicated in this report.

5.3 Foundation Recommendations

The proposed manhole structures and lift station may be supported on shallow foundation systems. Allowable soil bearing capacities and design parameters for foundations are presented in the following table:

Table 2: Foundation Recommendations

Allowable Soil Bearing Capacity (lb/ft^2)	Minimum Footing Width (in.)	Minimum Footing Bearing Depth (ft.)	Minimum Select Fill Below Bottom of Footing Elevation (in.)
Manholes			
1,200	24	5	18
Lift Station			
1,500	24	16	8

The horizontal limits of over excavation shall extend 12 inches beyond the footing line.

Foundation systems designed and constructed based on the above data and parameters should experience total settlement of less than one inch. It is very important to provide adequate drainage to eliminate water accumulation or infiltration near the proposed building. Based on our settlement calculations using Schmertmann's method total settlements were estimated at 1-inch for a time equal to 1 year (T=1yr.).

Although differential settlement is typically estimated to be about one-half the total settlement (Ds=½-inch), differential movements across foundations may approach the total settlement if loose or soft soil deposits are left within the foundation footprints. The foundation system to be designed in accordance with the above criteria considers a safety factor of 3. Floor slabs should also be supported on select fill as recommended in Section 5.9 of this report

5.4 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 purposes, 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.

5.5 Lateral Earth Pressures

We recommend the values presented in the following table to be used in earth pressure computations, considering the Rankine method for lateral earth pressure computation having cohesionless or granular native materials.

Table 3: Lateral Earth Pressures

Boring No.	Depth BGS (ft.)	Estimated Angle of Internal Friction (°)	Estimated Unit Weight (lb/ft³)	Lateral Earth Pressure Coefficients		
				Active	Passive	At-Rest
B-1	0 – 5 5 –20+	30 28	120 115	0.33 0.36	3.00 2.77	0.50 0.53
B-2	0 – 2½ 2½ – 7½ 7½ – 20 20+	32 30 28 30	120 115 115 115	0.31 0.33 0.36 0.33	3.25 3.00 2.77 3.00	0.47 0.50 0.53 0.50
B-3	0 – 2½ 2½ – 20 20 – 40+	30 30 32	115 120 120	0.33 0.33 0.31	3.00 3.00 3.25	0.50 0.50 0.47
B-4	0 – 5 5 – 20+	30 28	120 115	0.33 0.36	3.00 2.77	0.50 0.53
B-5	0 – 25+	28	115	0.36	2.77	0.53
B-6	0 – 20+	28	115	0.36	2.77	0.53
B-7	0 – 15 15 – 20+	28 30	115 120	0.36 0.33	2.77 3.00	0.53 0.50
B-8	0 – 5 5 – 20+	30 28	115 115	0.33 0.36	3.00 2.77	0.50 0.53
B-9	0 – 15+	28	115	0.36	2.77	0.53

5.6 Seismic Considerations

The seismic site classification for the subject area was evaluated using the criteria given in the 2015 International Building Code (2015 IBC). Based on the project information and

soil test borings, we recommend the parameters shown in Table 3 be used for design purposes.

Table 4: Seismic Design Parameters (2015 International Building Code)

Parameter	Value
Site Class	D
Site Location (latitude, longitude)	31.65282934, -106.23965198
S_{MS} – Spectral Response Acceleration for Short Periods	0.481g
S_{M1} – Spectral Response Acceleration for a 1-Second Period	0.228g
S_{DS} – Design Spectral Response Acceleration for Short Periods	0.321g
S_{D1} – Design Spectral Response Acceleration for a 1-Second Period	0.152g

5.7 Flexible Pavement Recommendations

Flexible pavements will be used in the reconstruction of the roadway after the sewer lines installation. Therefore, we used the City of El Paso Design Standards for Construction a traffic loading of 269,000 equivalent single-axle load (ESAL) applications. This parameter is estimated based on the parking characteristics and estimated automobile traffic for a design period of 20 years. Additionally, based on our laboratory analysis we assigned a California Bearing Ratio (CBR) value of 10 for pavement design calculations.

We recommend that the flexible pavement consists of the following minimum thickness section for the traffic conditions:

Table 5: Flexible Pavement Recommendations

Pavement Component	Minimum Thickness (in.)
Hot-Mix Asphaltic Concrete	2
Crushed Stone Base Course	6
Compacted Subgrade	12

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.

5.8 Pipe Bedding and Trench Backfill

Pipe bedding and backfill material 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. Soil moisture content should be at ±3 percent of the optimum moisture content in accordance with the above standard. Refer to Appendix C for Lower Valley Water District Design Standards for bedding and backfill of water and sewer pipes. Use the following soil types for the design standards shown in Appendix C.

Table 6: Pipe Bedding Recommendations

Soil Class	Soil Type ASTM D-2487	Soil Description
Class I	None	Manufactured aggregates, angular, crushed rock, crushed gravel with maximum particle size of 1½ inches per ASTM D-2321
Class II	GW, GP, SW, SP	Coarse grained sands and gravels per ASTM D-2487 with maximum particle size of 1½ inches per ASTM D-2322
Class III	GM, GC, SM, SC	Coarse grained sands with fines per ASTM D-2487 with maximum particle size of 1½ inches per ASTM D-2323

5.9 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.

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 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:
    - Pipe area – A minimum of one (1) density test per lift (8-inch compacted) for every 200 linear feet for pipe bedding and backfill operations, or at least three (3) tests per lift, whichever is greater.
    - Pavement area – A minimum of one (1) density test per lift (8-inch compacted) for every 2,000 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).

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

- A minimum of one (1) hot-mix asphaltic concrete (HMAC) analysis, to include Marshall test, Rice test, asphalt content and gradation, and Marshall flow and stability, for every 500 tons of HMAC material.
- A minimum of one (1) nuclear density test in accordance with ASTM D-2950 for every 2,000 square feet.

6.2 Limitations

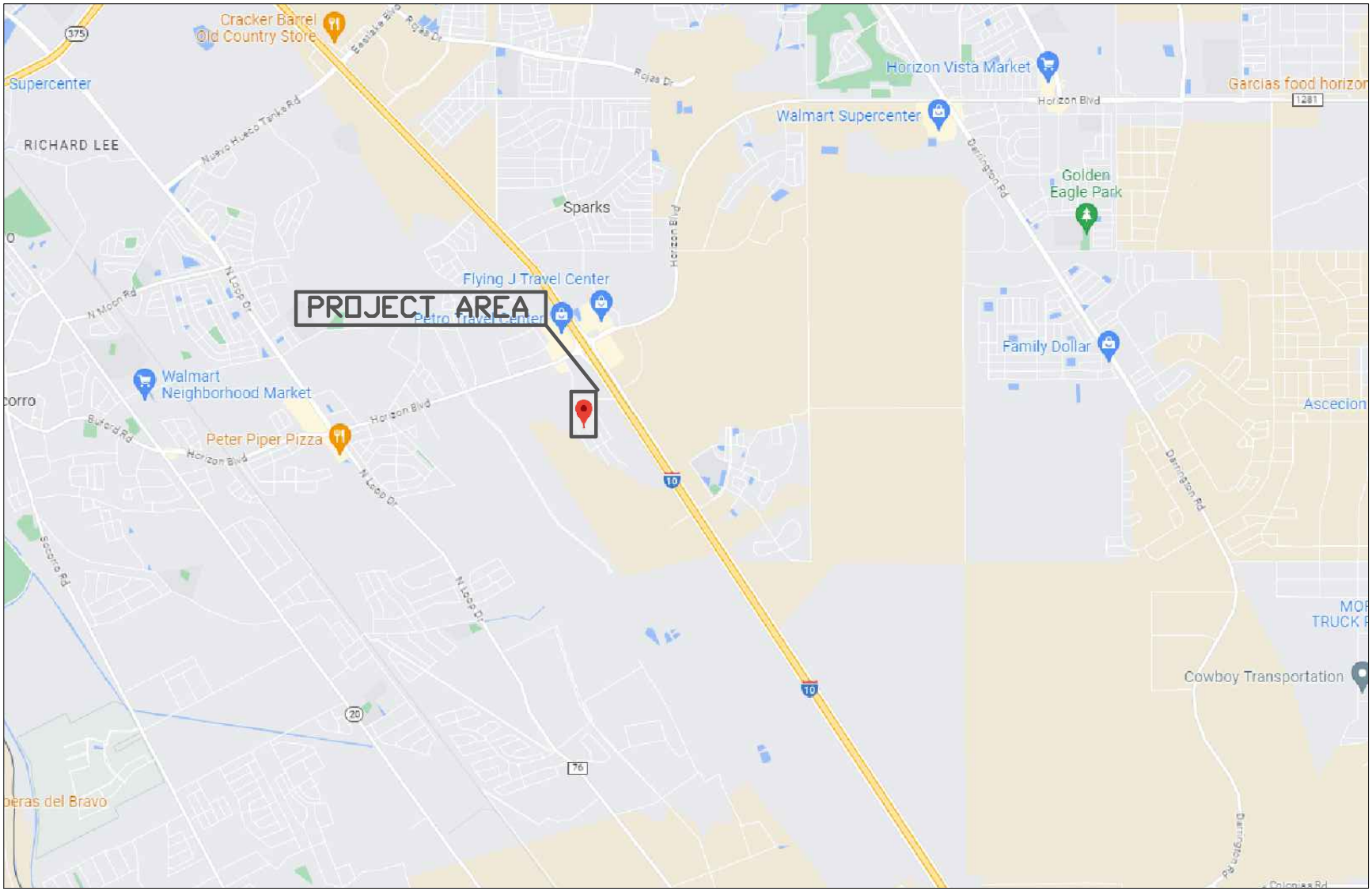
We have performed our professional services and have obtained the data presented in this report in accordance with generally accepted geotechnical engineering principles and practices. The information in this report is based on the data obtained from nine representative test borings and laboratory testing 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 proposed sanitary sewer lines and lift station project, which will be located within Panorama Village, in Socorro, El Paso County, Texas. Use of this information for projects other than the one described herein will not be adequate.

APPENDIX A



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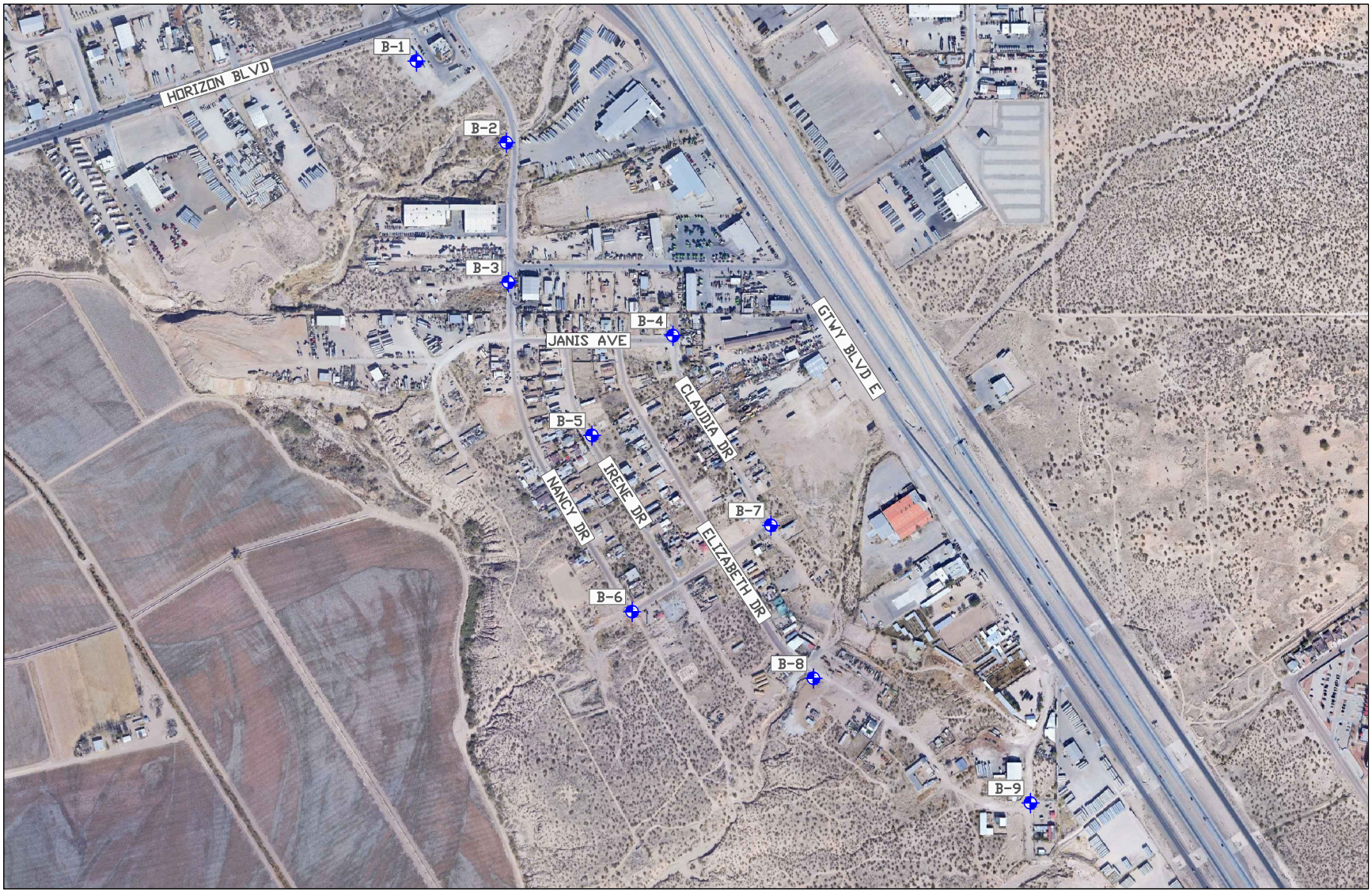
APPROXIMATE PROJECT LOCATION	LOI ENGINEERS 915-781-1532 2101 E. MISSOURI AVE SUITE B EL PASO, TEXAS 79903	MORENO CARDENAS, INC 2505 E. MISSOURI AVE. EL PASO, TEXAS 79903	PROJECT NAME: EL PASO COUNTY ARPA 1010 PROJECT – PANORAMA VILLAGE SOCORRO, EL PASO COUNTY, TEXAS

DRAWN BY	REVIEWED BY	APPROVED BY	SCALE
T.M.	G.M.	B.O.	N.T.S.
PROJECT No.	**FILE NAME**	**DATE**	**SHEET No.**
J23-1-1259	SITE PLAN	10/31/23	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	MORENO CARDENAS, INC 2505 E. MISSOURI AVE. EL PASO, TEXAS 79903	PROJECT NAME: EL PASO COUNTY ARPA 1010 PROJECT – PANORAMA VILLAGE SOCORRO, 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.**
J23-1-1259	SITE PLAN	10/31/23	A-1.2

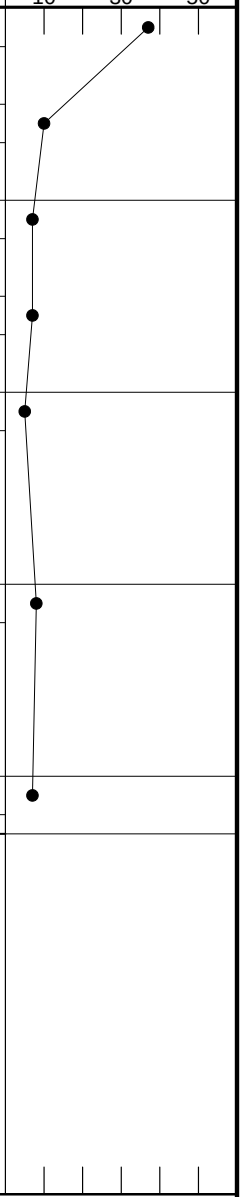
LOG OF TEST BORING No. B-1

Project name: EP County ARPA 1010 Panorama Village
File No.: J23-1-1259
Date Drilled: 10/31/23
Boring Location: See Sheet A-1.2
Elevation (ft): N/A North: N/A West: N/A

ENGINEERS

Elevation and Depth (ft.)	Samples	Soil symbols	Soil Description	USCS symbol	Moisture content,%	Minus #200 sieve, %	Liquid limit	Plastic limit	Plasticity index	Blows per foot (N)
0			SAND, poorly-graded, silty, brown-multicolor, dense, dry							37
			-medium dense at 2.5 feet							10
5			-loose at 5 feet	SP-SM	2	7				7
										7
10			SAND, poorly-graded, brown-multicolor, loose, dry	SP	3	4				5
15										8
20			SAND, fine grained, silty, brown, loose, dry to moist	SM	6					7
			Termination depth at 21.5 feet							
25										
30										

SPT N-Value CURVE



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: FM
Logger: GT
Sheet No.: **A-2**

LOG OF TEST BORING No. B-2

Project name: EP County ARPA 1010 Panorama Village
File No.: J23-1-1259
Date Drilled: 10/30/23
Boring Location: See Sheet A-1.2
Elevation (ft): N/A North: N/A West: N/A

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			SAND, fine grained, silty, brown, medium dense, dry to moist, with gravel, with traces of asphalt debris	SM						23	
			SAND, poorly-graded, brown-multicolor, loose, dry, with traces of asphalt debris	SP	3	4				8	
5			-medium dense, with gravel at 5 feet							15	
			SAND, fine grained, silty, brown, loose, dry to moist	SM	7	33				6	
10			SAND, fine grained, silty, clayey, brown, medium dense, dry to moist	SC-SM	8	26	20	14	6	11	
15			-loose at 15 feet							5	
20			SAND, poorly-graded, silty, brown-multicolor, medium dense, dry	SP-SM						16	
			Termination depth at 21.5 feet								
25											
30											

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: FM
Logger: GT
Sheet No.: **A-3**

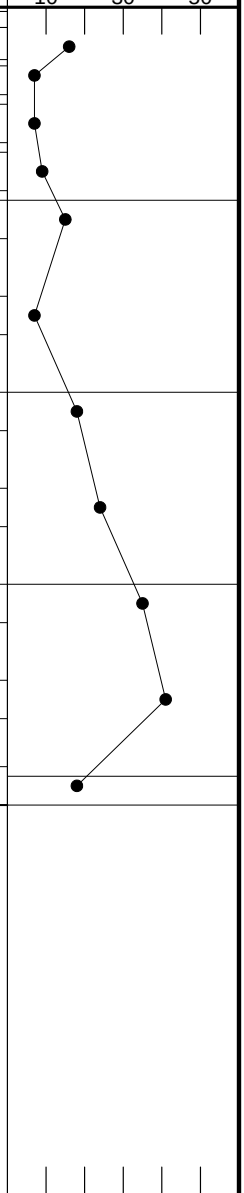
LOG OF TEST BORING No. B-3

Project name: EP County ARPA 1010 Panorama Village
File No.: J23-1-1259
Date Drilled: 10/30/23
Boring Location: See Sheet A-1.2
Elevation (ft): N/A North: N/A West: N/A

ENGINEERS

Elevation and Depth (ft.)	Samples	Soil symbols	Soil Description	USCS symbol	Moisture content,%	Minus #200 sieve, %	Liquid limit	Plastic limit	Plasticity index	Blows per foot (N)
0			Asphalt Thickness: 2 inches							
			Base Course Thickness: 10 inches	SP-SM						16
			SAND, poorly-graded, silty, brown-multicolor, medium dense, dry to moist							7
			-loose at 2.5 feet	SM	4	24				7
			SAND, fine grained, silty, brown, loose, dry							
			SAND, fine grained, clayey, brown, loose, dry to moist		10	43	28	14	14	9
10			-medium dense at 10 feet	SC						15
			SAND, fine grained, silty, brown, loose, dry to moist	SM						7
20			SAND, poorly-graded, silty, brown-multicolor, medium dense, dry		2	5				18
			-with gravel at 25 feet							24
30			-dense at 30 feet	SP-SM	3	7				35
										41
40			-medium dense at 40 feet							18
			Termination depth at 41.5 feet							
50										
60										

SPT N-Value CURVE



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: FM
Logger: GT
Sheet No.: **A-4**

LOG OF TEST BORING No. B-4

Project name: EP County ARPA 1010 Panorama Village
File No.: J23-1-1259
Date Drilled: 10/30/23
Boring Location: See Sheet A-1.2
Elevation (ft): N/A North: N/A West: N/A

ENGINEERS

Elevation and Depth (ft.)	Samples	Soil symbols	Soil Description	USCS symbol	Moisture content,%	Minus #200 sieve, %	Liquid limit	Plastic limit	Plasticity index	Blows per foot (N)
0			Asphalt Thickness: 1 inch							
			Base Course Thickness: 4 inches							22
			Asphalt Thickness: 1 inch							
			SAND, fine grained, silty, brown, medium dense, dry to moist	SM						8
			-loose at 2.5 feet							
5			SAND, poorly-graded, silty, brown-multicolor, loose, dry	SP-SM	2	9				5
										6
10			SAND, fine grained, silty, brown, very loose, dry	SM	3	17				4
15			-loose at 15 feet							5
20			-medium dense, dry to moist at 20 feet		5					13
			Termination depth at 21.5 feet							
25										
30										

SPT N-Value CURVE

10 30 50

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: FM
Logger: GT
Sheet No.: **A-5**

LOG OF TEST BORING No. B-5

Project name: EP County ARPA 1010 Panorama Village
File No.: J23-1-1259
Date Drilled: 10/30/23
Boring Location: See Sheet A-1.2
Elevation (ft): N/A North: N/A West: N/A

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			SAND, poorly-graded, silty, brown-multicolor, medium dense, dry							11	
			-loose at 2.5 feet	SP-SM	3	12				6	
5										6	
			SAND, fine grained, silty, brown, loose, dry		4	23				6	
10										6	
					5					7	
15				SM							
20										8	
25			-medium dense at 25 feet							11	
			Termination depth at 26.5 feet								
30											

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: FM
Logger: GT
Sheet No.: **A-6**

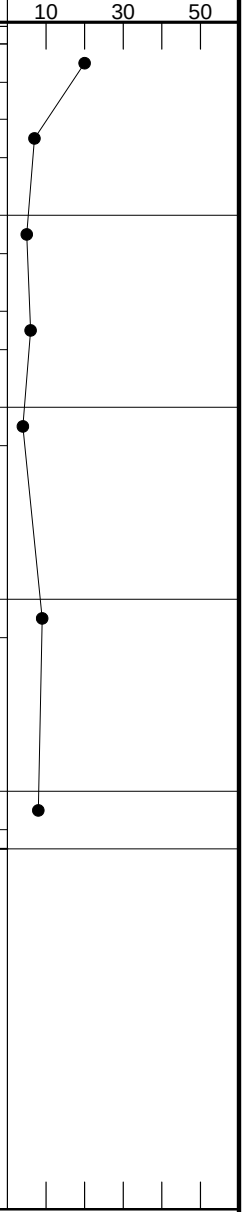
LOG OF TEST BORING No. B-6

Project name: EP County ARPA 1010 Panorama Village
File No.: J23-1-1259
Date Drilled: 10/31/23
Boring Location: See Sheet A-1.2
Elevation (ft): N/A North: N/A West: N/A

ENGINEERS

Elevation and Depth (ft.)	Samples	Soil symbols	Soil Description	USCS symbol	Moisture content,%	Minus #200 sieve, %	Liquid limit	Plastic limit	Plasticity index	Blows per foot (N)
0			Asphalt Thickness: 1 inch							
			Base Course Thickness: 5.5 inches							
			SAND, poorly-graded, silty, brown-multicolor, medium dense, dry	SP-SM	3	12				20
			-loose at 2.5 feet							7
5										5
			SAND, fine grained, silty, brown, loose, dry	SM	4	21				6
10			-very loose at 10 feet							4
15			-loose at 15 feet							9
20					3					8
			Termination depth at 21.5 feet							
25										
30										

SPT N-Value CURVE



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: FM
Logger: GT
Sheet No.: **A-7**

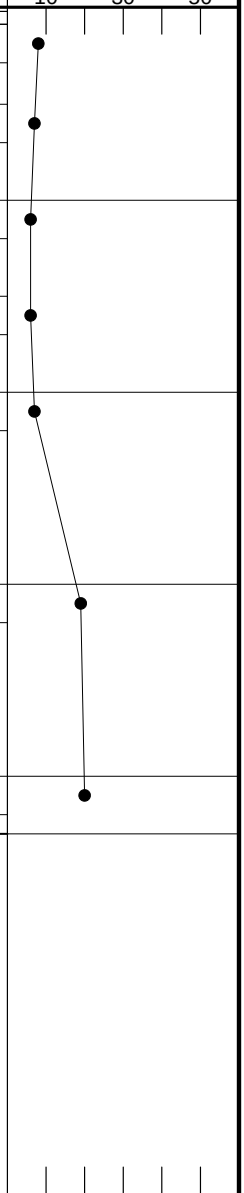
LOG OF TEST BORING No. B-7

Project name: EP County ARPA 1010 Panorama Village
File No.: J23-1-1259
Date Drilled: 10/31/23
Boring Location: See Sheet A-1.2
Elevation (ft): N/A North: N/A West: N/A

ENGINEERS

Elevation and Depth (ft.)	Samples	Soil symbols	Soil Description	USCS symbol	Moisture content,%	Minus #200 sieve, %	Liquid limit	Plastic limit	Plasticity index	Blows per foot (N)
0			Asphalt Thickness: 1 inch							
			Base Course Thickness: 4 inches							8
			SAND, fine grained, silty, brown, loose, dry							
					3	17				7
5										6
					2	15				6
10				SM						7
15			-medium dense at 15 feet		3					19
20										20
			Termination depth at 21.5 feet							
25										
30										

SPT N-Value CURVE



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: FM
Logger: GT
Sheet No.: **A-8**

LOG OF TEST BORING No. B-8

Project name: EP County ARPA 1010 Panorama Village
File No.: J23-1-1259
Date Drilled: 10/31/23
Boring Location: See Sheet A-1.2
Elevation (ft): N/A North: N/A West: N/A

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			SAND, poorly-graded, silty, brown-multicolor, dense, dry	SP-SM						33	
			-loose, with gravel at 2.5 feet							9	
5			SAND, fine grained, silty, brown, loose, dry to moist	SM	5	24				5	
			-dry at 7.5 feet		4	21				5	
10										8	
15					5					9	
20										8	
			Termination depth at 21.5 feet								
25											
30											

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: FM
Logger: GT
Sheet No.: **A-9**

LOG OF TEST BORING No. B-9

Project name: EP County ARPA 1010 Panorama Village
File No.: J23-1-1259
Date Drilled: 10/31/23
Boring Location: See Sheet A-1.2
Elevation (ft): N/A North: N/A West: N/A

ENGINEERS

Elevation and Depth (ft.)	Samples	Soil symbols	Soil Description	USCS symbol	Moisture content,%	Minus #200 sieve, %	Liquid limit	Plastic limit	Plasticity index	Blows per foot (N)	SPT N-Value CURVE
0			SAND, fine grained, silty, brown, medium dense, dry to moist	SM						17	
			SAND, poorly-graded, silty, brown-multicolor, loose, dry							6	
5			-very loose at 5 feet	SP-SM	3	8				4	
										4	
10			SAND, fine grained, silty, brown, loose, dry to moist	SM	6	20				7	
15			SAND, poorly-graded, silty, brown-multicolor, loose, dry to moist	SP-SM						6	
			Termination depth at 16.5 feet								
20											
25											
30											

SPT N-Value CURVE: 10 30 50

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: FM
Logger: GT
Sheet No.: **A-10**

SUMMARY OF RESULTS

Project: El Paso County ARPA 1010 Project - Panorama Village

LOI Project No.: J23-1-1259

Date: 11/03/23

Boring No.	Depth (ft.)	% Moisture Content	% Material passing # 4	% Material passing # 40	% Material minus # 200	LL	PL	PI	Soil Classification
1	5-6½	2	100	85	7				Poorly graded sand with silt (SP-SM)
1	10-11½	3	98	67	4				Poorly graded sand (SP)
1	20-21½	6							
2	2½-4	3	67	31	4				Poorly graded sand (SP)
2	7½-9	7			33				Silty sand (SM)
2	10-11½	8			26	20	14	6	Silty, clayey sand (SC-SM)
3	5-6½	4			24				Silty sand (SM)
3	7½-9	10			43	28	14	14	Clayey sand (SC)
3	20-21½	2	98	80	5				Poorly graded sand with silt (SP-SM)
3	30-31½	3	68	40	7				Poorly graded sand with silt (SP-SM)
4	5-6½	2			9				Poorly graded sand with silt (SP-SM)
4	10-11½	3			17				Silty sand (SM)
4	20-21½	5							
5	2½-4	3			12				Poorly graded sand with silt (SP-SM)
5	7½-9	4	100	88	23				Silty sand (SM)
5	15-16½	5							

SUMMARY OF RESULTS

Project: El Paso County ARPA 1010 Project - Panorama Village

LOI Project No.: J23-1-1259

Date: 11/03/23

Boring No.	Depth (ft.)	% Moisture Content	% Material passing # 4	% Material passing # 40	% Material minus # 200	LL	PL	PI	Soil Classification
6	0-1½	3			12				Poorly graded sand with silt (SP-SM)
6	7½-9	4	100	83	21				Silty sand (SM)
6	20-21½	3							
7	2½-4	3			17				Silty sand (SM)
7	7½-9	2	100	90	15				Silty sand (SM)
7	15-16½	3							
8	5-6½	5			24				Silty sand (SM)
8	7½-9	4	100	86	21				Silty sand (SM)
8	15-16½	5							
9	5-6½	3			8				Poorly graded sand with silt (SP-SM)
9	10-11½	6	100	88	20				Silty sand (SM)

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:

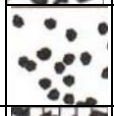
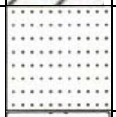
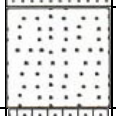
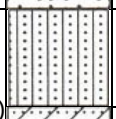
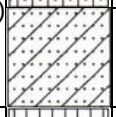
Compressive Strength* (Tons per Square Foot)	Descriptive Term	Penetration Resistance** (Blows per Foot)
Less than 0.25	Very Soft	Less than 2
0.25 - 0.50	Soft	2 - 4
0.50 - 1.00	Firm	5 - 8
1.00 - 2.00	Stiff	9 - 15
2.00 - 4.00	Very Stiff	16 - 50
4.00 and higher	Hard	50 and higher

* 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.

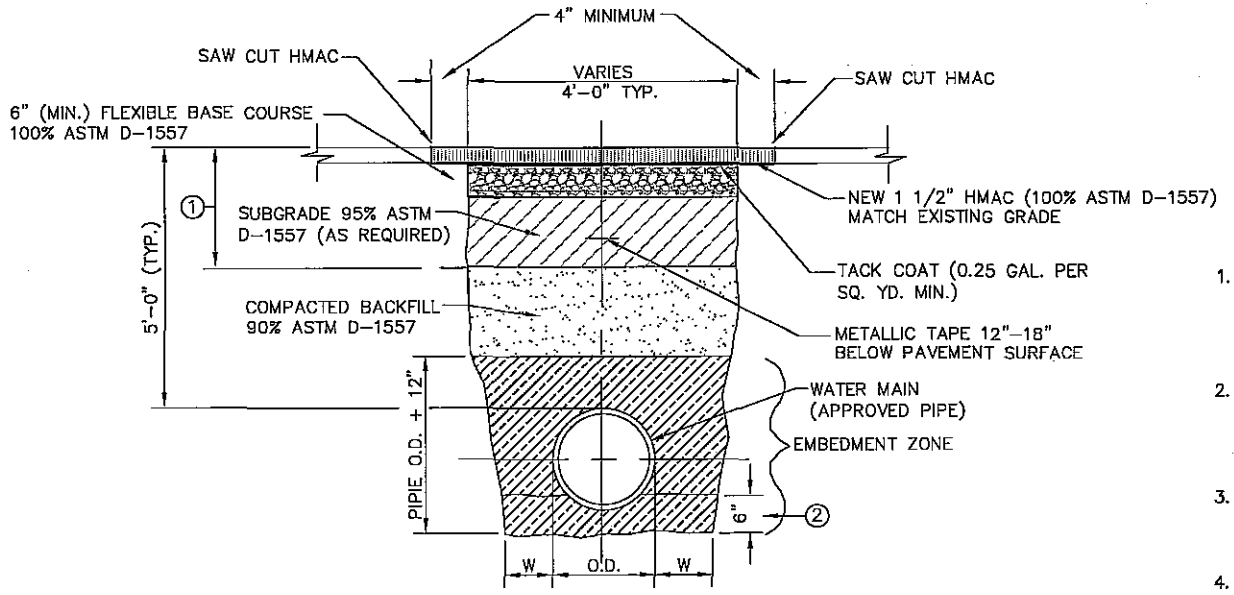
SOIL SYMBOLS

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)

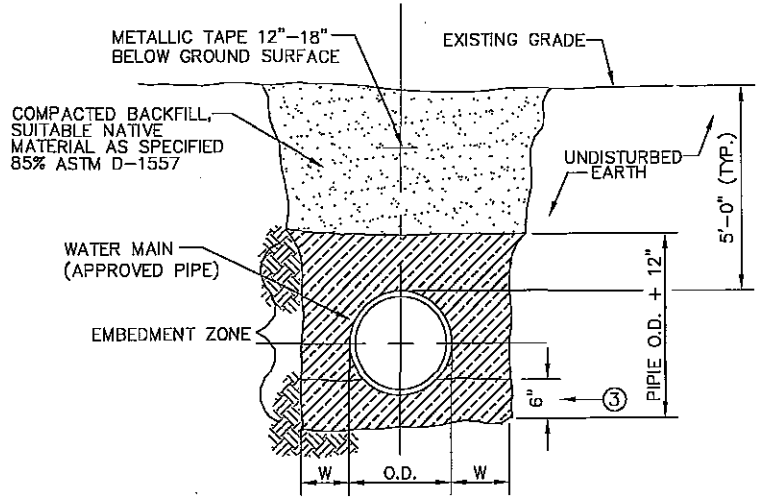
MAJOR SOIL DIVISIONS			SOIL SYMBOL	USCS SYMBOL	TYPICAL NAME
Coarse-Grained Soils (< 50% pass No. 200 sieve)	GRAVELS (<50% pass No. 4 sieve)	Clean Gravels (< 5% pass No. 200 sieve)		**GW**	Well-Graded Gravels
				**GP**	Poorly-Graded Gravels
		Gravels with fines (> 12% pass No. 200 sieve)		**GM**	Silty 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

APPENDIX C



PAVEMENT REPAIR AND BACKFILL DETAIL



PIPE TRENCH AND BACKFILL DETAIL

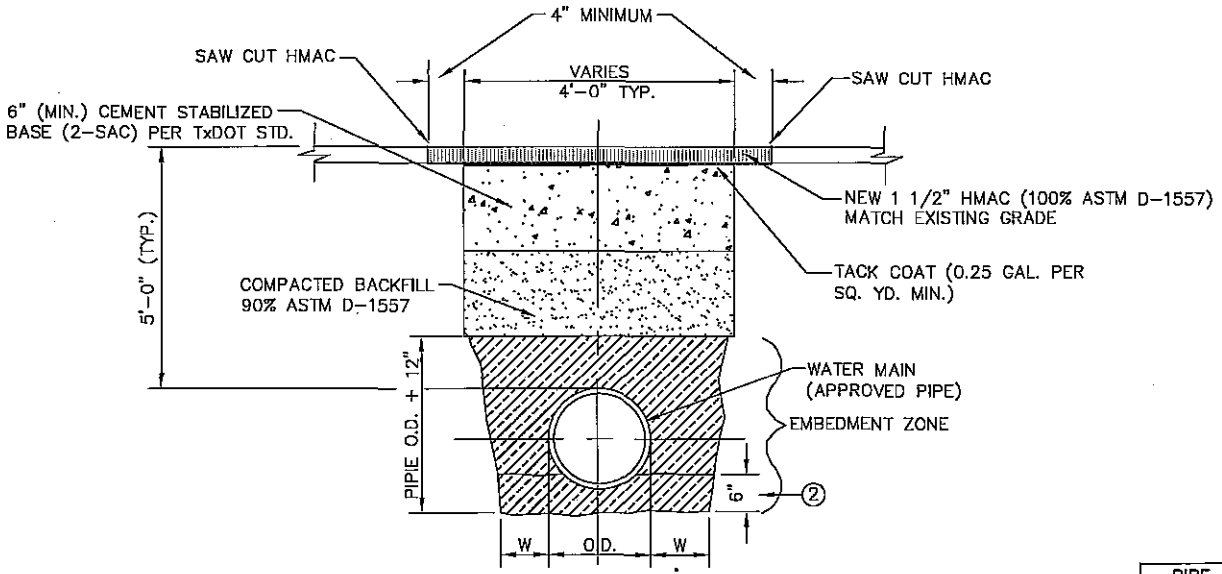
GENERAL NOTES:

1. THE PAVEMENT REPLACEMENT SYSTEM (HMAC, BASE, SUBGRADE) SHOWN ARE GENERAL REQUIREMENTS AND WILL WORK IN GOOD TO MODERATE SOIL CONDITIONS. REFER TO SITE SPECIFIC GEOTECHNICAL STUDY FOR PAVEMENT RECOMMENDATIONS IN AREAS OF BAD SOIL CONDITIONS AND FOR NEW SUBDIVISIONS.
2. UNIFORM TRENCH BOTTOM – PIPE SHALL GENERALLY BE LAID ON UNIFORM, EVENLY GRADED TRENCH BOTTOM. TRENCH BOTTOM SHALL BE SHAPED AT EVERY BELL TO PROVIDE UNIFORM BEARING OF PIPE BARREL.
3. NON-UNIFORM TRENCH BOTTOM – WHEN A UNIFORM TRENCH BOTTOM IS UNATTAINABLE (ie ROCKY OR UNEVENLY GRADED) A 6" SAND BEDDING SHALL BE REQUIRED.
4. EMBEDMENT BACKFILL – USE CLASS II COARSE GRAVELS PER ASTM D-2487 W/<12% FINES & MAX SIZE 1-1/2". NATIVE MATERIAL OR IMPORTED SELECT MATERIAL, MEETING OR EXCEEDING CLASS II REQUIREMENTS, MAY BE USED. CLASS I MATERIAL (MAXIMUM 1-1/2" SIZE) IS ACCEPTABLE AT THE DISCRETION OF THE CONTRACTOR.
5. FINAL BACKFILL – SUITABLE COMPACTED NATIVE MATERIAL, MINIMUM 3" SIZE IS ACCEPTABLE.
6. SHORING (TRENCH SAFETY) SHALL BE AS PER O.S.H.A. REQUIREMENTS. CONTRACTOR SHALL OBTAIN WRITTEN PERMISSION FROM R.O.W. OWNER TO PERFORM "ANGLE OF REPOSE" ON TRENCH WALLS.

NOMINAL PIPE DIAMETER	W	
	MIN.	MAX.
8"-18"	6"	12"
24" OR LARGER	12"	18"

PIPE MATERIAL	NOMINAL PIPE DIAMETER	EMBEDMENT MATERIAL
PVC	8"-18"	NATIVE MATERIAL W/ <12% PASSING NO. 200 @ 85% D-689 OR CRUSHED ROCK AS SPECIFIED
	24" OR LARGER	CRUSHED ROCK (PEA GRAVEL) AS SPECIFIED
D.I. C-303 STEEL	ALL DIA. ALL DIA. ALL DIA.	NATIVE MATERIAL W/ <12% PASSING NO. 200 @ 85% D-689 OR CRUSHED ROCK AS SPECIFIED

Lower Valley WATER DISTRICT	DESIGN STANDARDS	SECTION: WATER FACILITIES	DATE: APRIL 2005	No: 101
		DETAIL: TYPICAL PIPE TRENCH, EMBEDMENT AND BACKFILL		

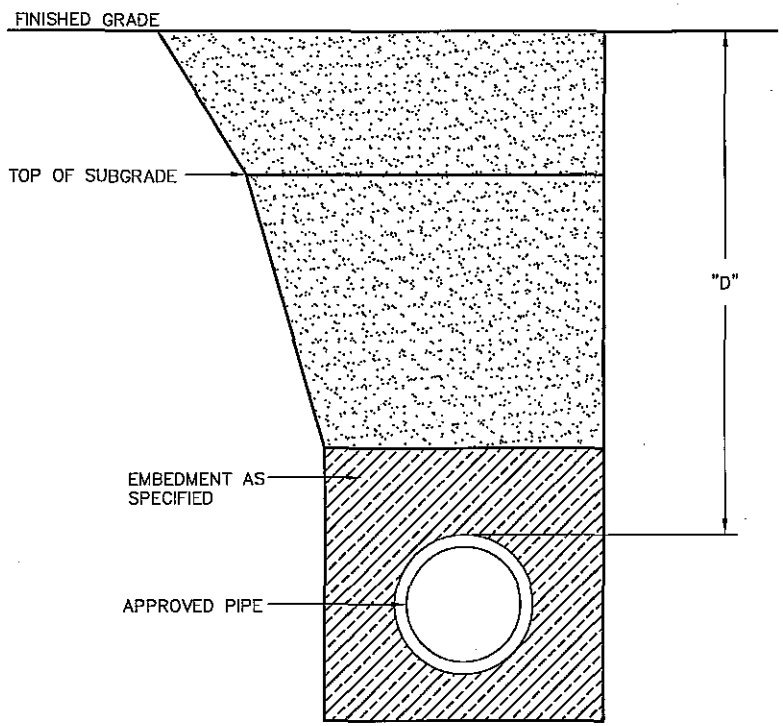


PIPE TRENCH AND BACKFILL DETAIL

NOMINAL PIPE DIAMETER	W	
	MIN.	MAX.
8"-18"	6"	12"
24" OR LARGER	12"	18"

PIPE MATERIAL	NOMINAL PIPE DIAMETER	EMBEDMENT MATERIAL
PVC	8"-18"	NATIVE MATERIAL W/ <12% PASSING NO. 200 @ 85% D-689 OR CRUSHED ROCK AS SPECIFIED
	24" OR LARGER	CRUSHED ROCK (PEA GRAVEL) AS SPECIFIED
D.I.	ALL DIA.	NATIVE MATERIAL W/ <12% PASSING NO. 200 @ 85% D-689 OR CRUSHED ROCK AS SPECIFIED
C-303	ALL DIA.	
STEEL	ALL DIA.	

Lower Valley WATER DISTRICT	DESIGN STANDARDS	SECTION: WATER FACILITIES	DATE: APRIL 2005	No: 102
		DETAIL: TYPICAL PIPE TRENCH IN TxDOT R.O.W.		



GENERAL NOTES:

1. REFER TO UTILITY STANDARD DETAIL FOR PAVEMENT REPLACEMENT AND BACKFILL REQUIREMENTS.
2. TRENCH SAFETY SYSTEMS SHALL BE USED WHEN TRENCH DEPTH EXCEEDS 5 FEET OR WHEN EXISTING SOIL CONDITIONS DICTATE.

CONSTRUCTION KEY NOTES:

A. STANDARD COVER FOR WATER MAINS SHALL DEPEND ON THE PIPE SIZE AND THE FOLLOWING INSTALLATION CONDITIONS,

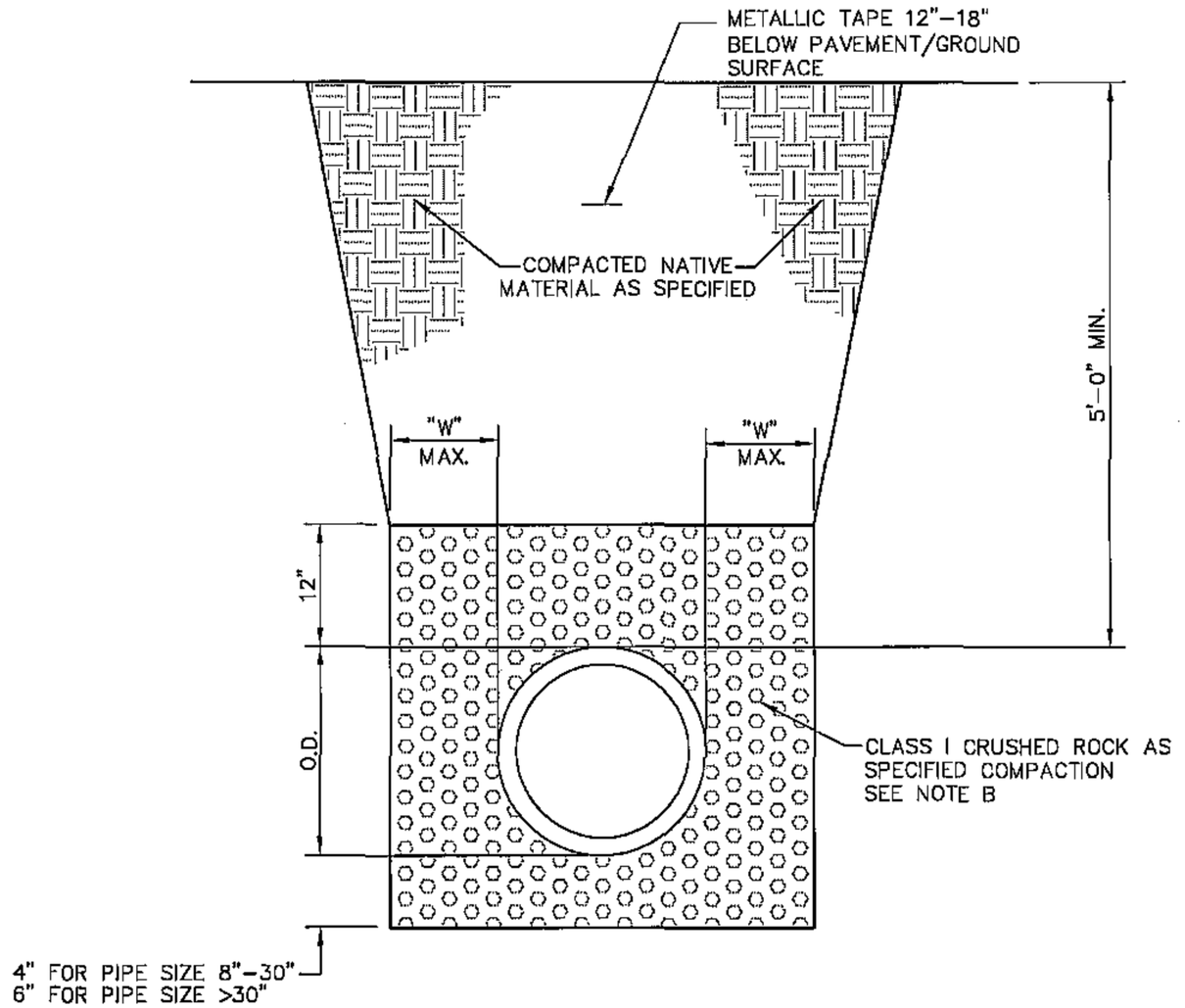
CONDITION A – WATERLINE RELOCATION

CONDITION B – NORMAL LINE INSTALLATION, STREET AND DRAINAGE PROJECTS, FOR NEW SUBDIVISIONS AND NON–PAVED AREA.

AND SHALL BE AS FOLLOWS.

PIPE SIZE	CONDITION	DIMENSION
6", 8"	A	"D" = 4'
6", 8"	B	"D" = 5'
12" & LARGER	A OR B	"D" = 5'

Lower Valley WATER DISTRICT	DESIGN STANDARDS	SECTION: WATER FACILITIES DETAIL: STANDARD COVER FOR WATER MAINS	DATE: APRIL 2005	No: 103



CONSTRUCTION KEY NOTES:

A. USE CLASS I CRUSHED ROCK MAXIMUM 1 1/2 INCH SIZE PER ASTM D–2321.

B. NO COMPACTION REQUIRED. USE MINIMAL TAMPING, RODDING OR HAUNCH SLICING CAREFULLY IN THE EMBEDMENT ZONE. IF REQUIRED BY THE ENGINEER, TEST PER ASTM D–4254 PERCENT OF RELATIVE DENSITY.

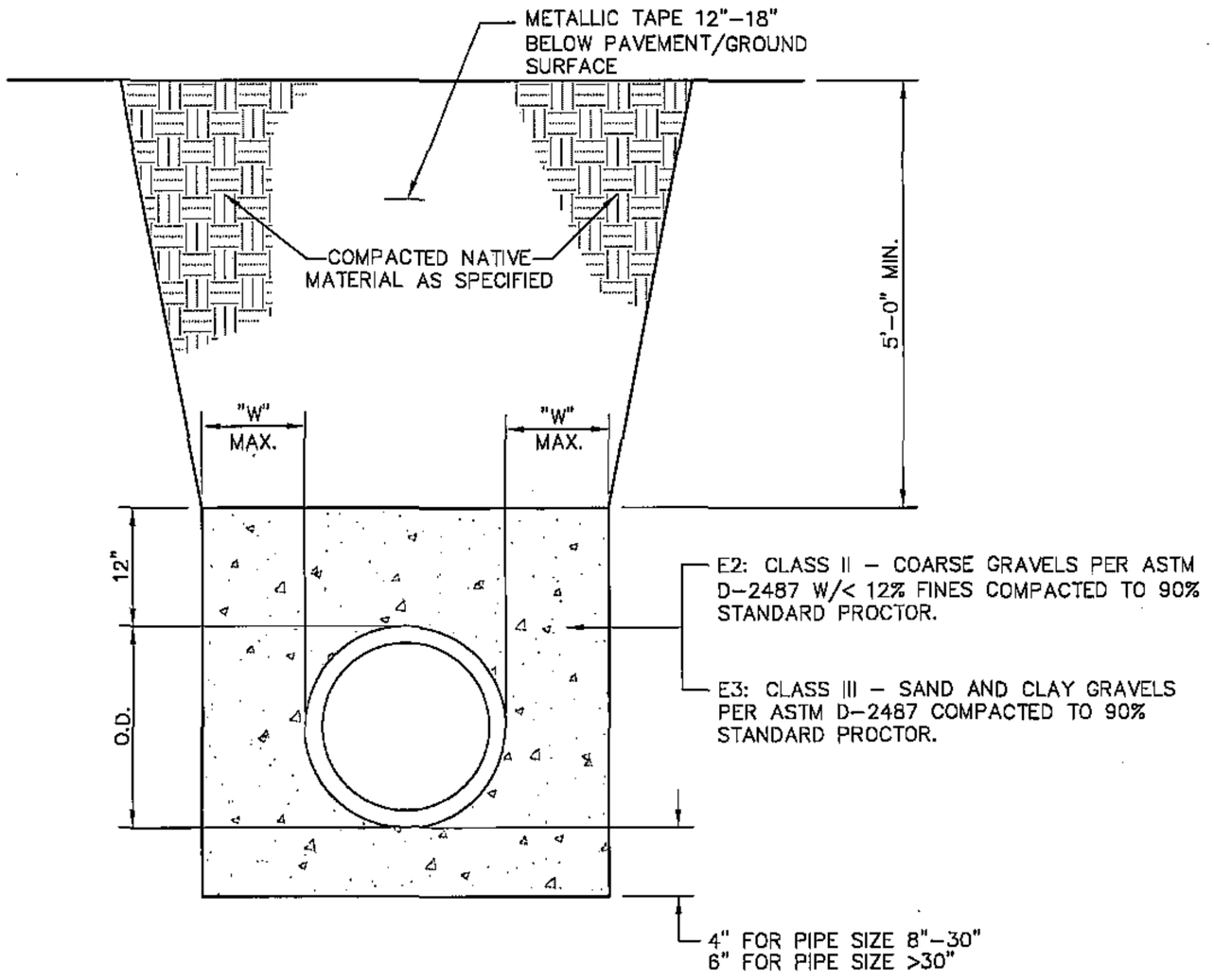
C. TRENCH DIMENSION "W" AS FOLLOWS FOR FLEXIBLE SEWER PIPE.

PIPE DIAMETER	"W" AS FOLLOWS
LESS THAN 24"	9"
24" – 48"	12"
GREATER THAN 48"	O.D./4

D. TRENCH DIMENSION "W" AS FOLLOWS FOR RIGID PIPE:

PIPE DIAMETER	"W" AS FOLLOWS
LESS THAN 18"	16"
18" – 24"	19"
27" – 39"	22"
42" & LARGER	1/2 PIPE O.D.

Lower Valley WATER DISTRICT	DESIGN STANDARDS	SECTION: WASTEWATER FACILITIES DETAIL: EMBEDMENT CLASS E1 FOR RIGID PIPE & FLEXIBLE SEWER PIPE	DATE: APRIL 2005	No: 213



GENERAL NOTES:

1. NATIVE MATERIAL MAY BE USED PROVIDED IT MEETS THE SPECIFICATIONS FOR CLASS II OR III MATERIALS.
2. EMBEDMENT CONDITIONS SHOWN FOR DRY TRENCH.

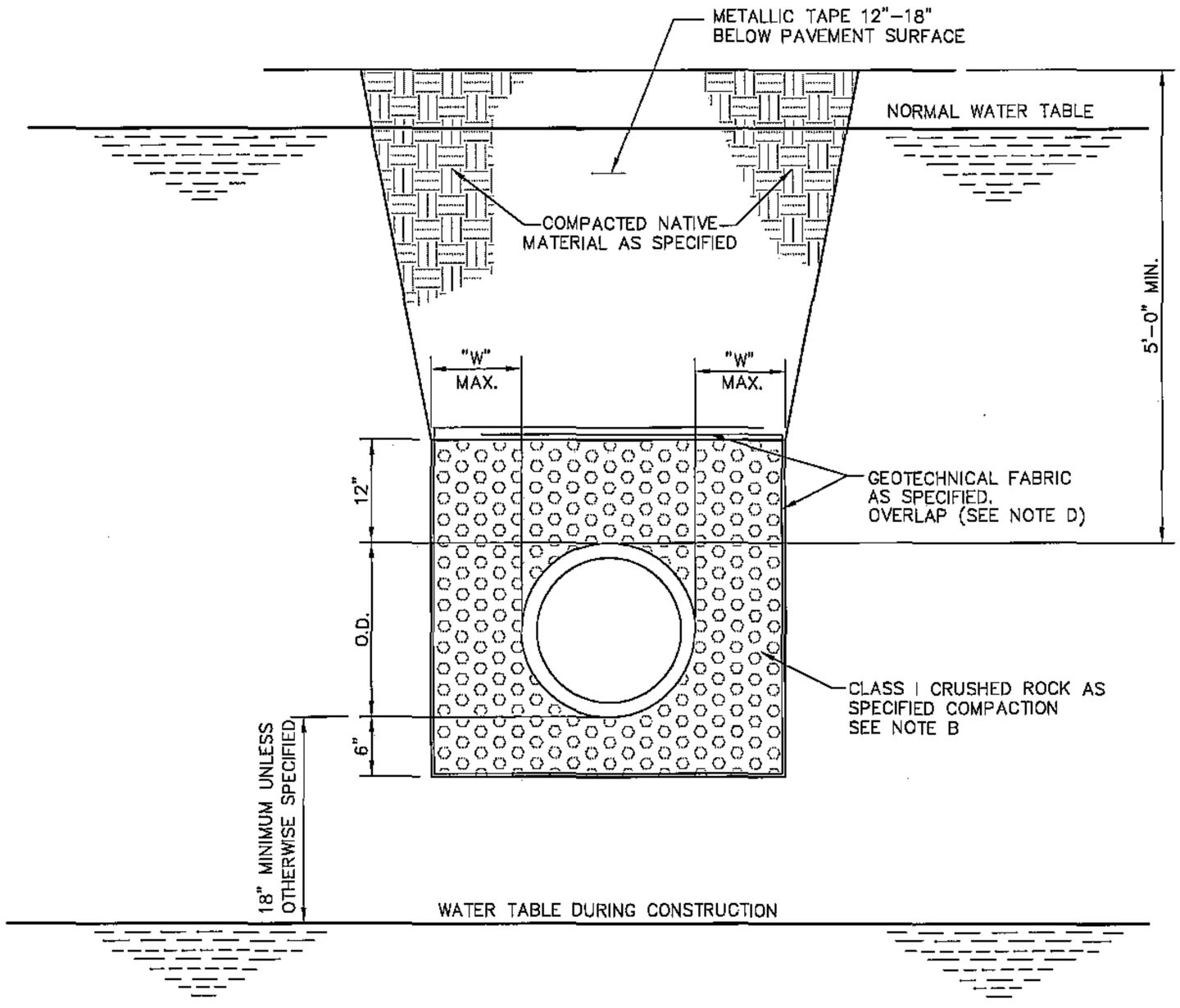
CONSTRUCTION KEY NOTES:

A. PLACE EMBEDMENT MATERIAL IN 8" LIFTS AND COMPACT AS SPECIFIED.

B. TRENCH DIMENSION "W" AS FOLLOWS:

PIPE DIAMETER	"W" AS FOLLOWS
LESS THAN 24"	9"
24" – 48"	12"
GREATER THAN 48"	O.D./4

Lower Valley WATER DISTRICT	DESIGN STANDARDS	SECTION: WASTEWATER FACILITIES	DATE: APRIL 2005	No: 214
		DETAIL: EMBEDMENT CLASS E2 & E3 FOR FLEXIBLE SEWER PIPE		



GENERAL NOTES:

1. EMBEDMENT CONDITION SHOWN FOR WET TRENCH.

CONSTRUCTION KEY NOTES:

A. USE CLASS I CRUSHED ROCK 1 1/2 INCH MAXIMUM SIZE PER ASTM D–2321.

B. NO COMPACTION REQUIRED. USE MINIMAL TAMPING, RODDING OR HAUNCH SLICING CAREFULLY IN THE EMBEDMENT ZONE. IF REQUIRED BY THE ENGINEER, TEST PER ASTM D–4254 PERCENT OF RELATIVE DENSITY.

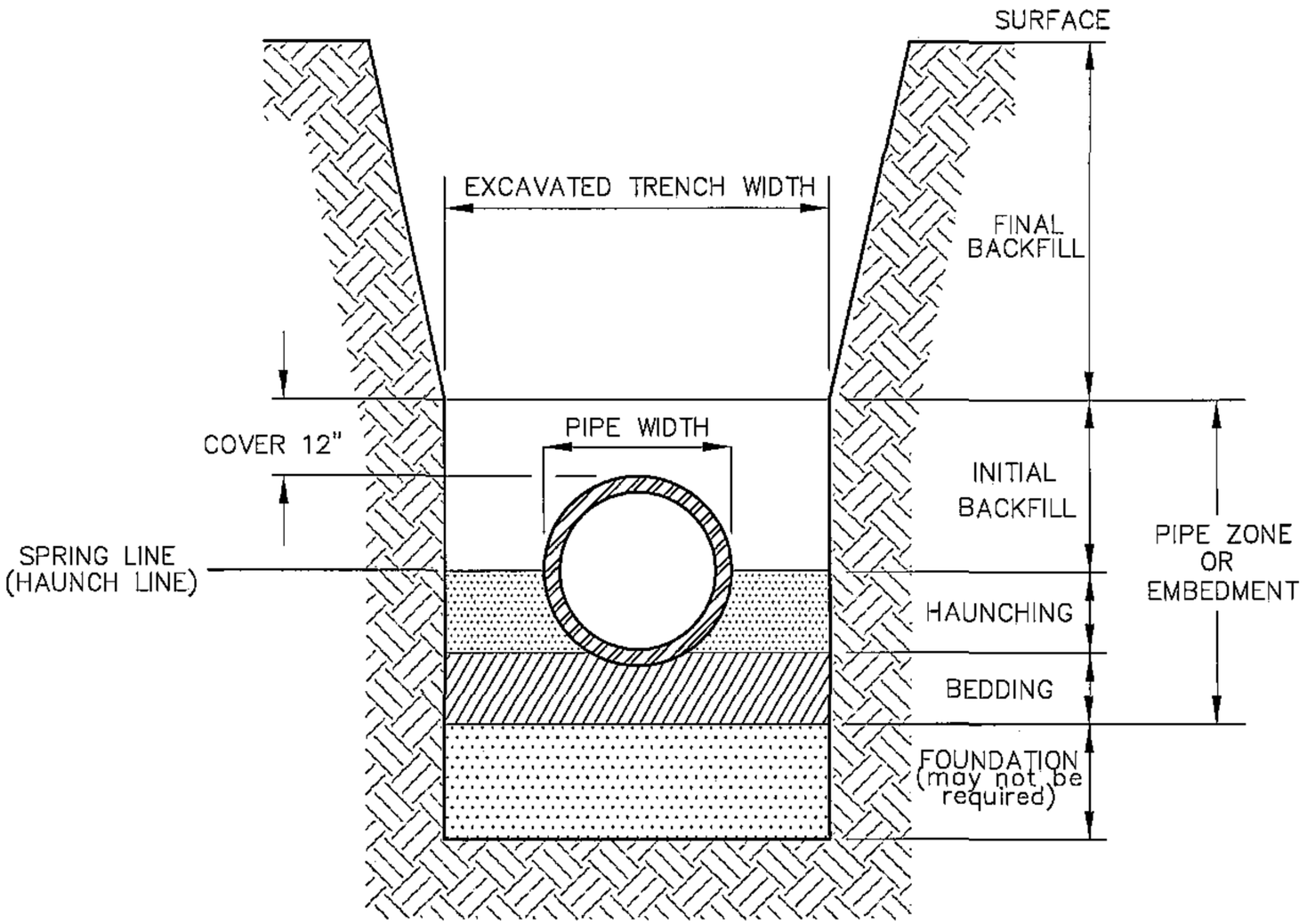
C. TRENCH DIMENSION "W" AS FOLLOWS:

PIPE DIAMETER	"W" AS FOLLOWS
LESS THAN 24"	9"
24" – 48"	12"
GREATER THAN 48"	O.D./4

D. STANDARD OVERLAP IS 2 FEET EXCEPT WHERE TRENCH WIDTH EXCEEDS 3 FEET THE OVERLAP AT TOP SHALL BE 3' FEET.

E. MAINTAIN A DRY TRENCH WHILE PLACING BEDDING AND FABRIC.

Lower Valley WATER DISTRICT	DESIGN STANDARDS	SECTION: WASTEWATER FACILITIES	DATE: APRIL 2005	No: 215
		DETAIL: EMBEDMENT CLASS F FOR FLEXIBLE SEWER PIPE		



GENERAL NOTES:

1. DETAIL DRAWING TERMINOLOGY IS IN ACCORDANCE WITH ASTM D-2321
2. UNLESS OTHERWISE PERMITTED BY THE ENGINEER. ALL MATERIAL IN THE EMBEDMENT ZONE SHALL BE HOMOGENEOUS.

Lower Valley WATER DISTRICT	DESIGN STANDARDS	SECTION: WATER AND SEWER DETAILS DETAIL: STANDARD TRENCH CROSS-SECTION TERMINOLOGY	DATE: APRIL 2005	No: 402