Geotechnical Engineering Study

El Paso Water (EPW) – Decommissioning/Demolition
Mesa Del Castillo Lift Station Improvements
Task Order 6
LOI File No. 21-211

Prepared for:
El Paso Water
1154 Hawkins Boulevard
El Paso, Texas 79925

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

Initial Draft issued October 28, 2021
Final Report issued November 4, 2021

ENGINEERS

File No. LOI21-211
October 28, 2021 (Final 11/4/2021)

ENGINEERS

Mr. Francisco J. Martinez, P.E.
El Paso Water
1154 Hawkins Boulevard
El Paso, Texas 79925

Re: Geotechnical Engineering Report
El Paso Water (EPW) – Decommissioning/Demolition
Mesa Del Castillo Lift Station Improvements
Task Order 6

Dear Mr. Martinez:

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. LOIP21-317, dated June 4, 2021, and authorized on July 13, 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
11/4/21

Geoffrey A. Madrazo, P.E.
Project Professional

Bernardino Olague, P.E., PMP
Principal Engineer

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

STATE OF TEXAS
DANNY R. ANDERSON
32062
11-4-21
LICENSED
PROFESSIONAL ENGINEER

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

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ENGINEERS

1.0 INTRODUCTION

We have completed the geotechnical engineering study for the El Paso Water (EPW) Decommissioning/Demolition of the Mesa Del Castillo Lift Station Improvements project. We were authorized to conduct this study via Task Order 6, which was executed on July 13, 2021.

2.0 PROJECT DESCRIPTION AND OBJECTIVE

The project consists of the design and construction of a new 8-inch diameter gravity sewer system to bypass the existing Mesa Del Castillo lift station, which will be decommissioned and demolished. The new gravity sewer system will include about 1,100 linear feet (LF) of 8-inch diameter PVC sewer pipe, and four (4) manhole structures. The project will also include the replacement of demolished sections of flexible pavement, curb and gutter, and sidewalks. The pipeline will have invert elevations ranging from 3806.50 feet to 3834.22 feet above MSL. The proposed sewer line will tie into an existing manhole structure adjacent to the existing Mesa Del Castillo lift station on Le Conte Drive, generally traversing south through the existing Highway Diversion Channel drainage area, and will tie into an existing manhole on the east side of North Desert Boulevard about 800 feet north of North Mesa Street, in west El Paso, El Paso County, Texas, as shown on the General Location Map in Appendix A as Sheet A-1.1.

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 and sampled two (2) soil borings to depths of 25 feet and 26½ feet below ground surface (BGS), respectively, one (1) soil boring to drilling and sampling depths of 35 feet and 36½ feet BGS, respectively, and two (2) soil borings

to drilling and sampling depths of 45 feet and 46½ feet BGS, respectively, at representative locations along the proposed 8-inch sewer line. 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-5) are included in Appendix A of this report as Sheets A-2 through A-6. 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 distribution, 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 five (5) Moisture-Density Relationship tests in accordance with ASTM D-1557. The results of these tests can be found on Sheets A-10 and A-14, respectively.

Table 1: Laboratory Testing Program

Type of Test	Number of Tests
Moisture Content (ASTM D-2216)	39
Percent Passing No. 200 Sieve (ASTM D-1140)	39
Grain Size Distribution Analysis (ASTM D-6913)	28
Atterberg Limits (ASTM D-4318)	12
Moisture-Density Relationship Curve (ASTM D-1557)	5

4.0 GENERAL SITE CONDITIONS

4.1 Site Geology

The project site is located mainly on and near foot slopes of the Franklin Mountains. According to the Soil Conservation Service of El Paso County, the soils in this area correspond to the Delnorte-Canutillo association, which is described as nearly level to steep soils that are shallow or very shallow over caliche or that are deep and gravely throughout.

4.2 Site Topography and Site Conditions

The overall project site generally drains in a southwesterly direction. However, the northern and southern portions of the site are set at a higher elevation than the central

portion of the site located from about station 6+00 to station 10+00. Steep slopes lead down to the low elevation drainage area. Based on the preliminary drawings, the site has a maximum relief of about 31 feet. The proposed manhole structure rim elevations correspond with the existing grade elevations and are shown in the following table:

Table 2: Proposed Manhole Structure Rim Elevations

Boring No.	General Location	Manhole No.	Station (ft.)	Rim Elevation (ft. above MSL)
B-1	Le Conte Drive	SS-4	11+71.71	3842.08
B-2	Highway Diversion Channel	SS-3	9+66.71	3814.65
B-3	Highway Diversion Channel	SS-2	6+23.03	3813.00
B-4	Private Parking Lot near North Desert Boulevard	SS-1	3+81.97	3834.88
B-5	North Desert Boulevard	Existing manhole tie-in	1+00.00	3825.40

The northern and southern portions of the site are topped with hot-mix asphaltic concrete (flexible) pavement, ranging in thickness from 1½ inches to 3 inches. The existing pavement was underlain by base course material, ranging in thickness from 6 inches to 7 inches. The areas with existing pavement include associated curb and gutter, sidewalks, and landscape areas.

4.3 Site Vegetation

At the time of our field phase, the northern and southern portions of the site exhibited minimal native vegetation, but exhibited landscape vegetation such as shrubs and trees. The central portion of the site exhibited moderate native vegetation consisting of weeds, shrubs, trees, and perennial grasses.

4.4 Soil Stratigraphy

The soils we encountered in each individual soil boring location throughout the site can generally be divided into the generalized soil strata as described in Table 3. Detailed descriptions can be found on the boring logs in Appendix A of this report.

Table 3: Soil Stratigraphy

Soil Stratum	Approximate Depth to Bottom of Stratum (ft.)	Soil Description
Boring Location B-1		
A	2½	Brown poorly-graded sands with silt • USCS symbol – SP-SM • Relative density – dense • SPT values – 34 blows per foot • Moisture content – 5% • Material finer than #200 sieve – 9%
B	10	Brown silty sands occasionally mixed with gravel • USCS symbol – SM • Relative density – loose to medium dense • SPT values – 9 to 14 blows per foot • Moisture content – 3 to 13% • Material finer than #200 sieve – 27 to 47% • Liquid limit (LL) – No value • Plasticity index (PI) – Non-plastic
C	18	Brown poorly-graded sands occasionally mixed with silt • USCS symbol – SP, SP-SM • Relative density – medium dense to dense • SPT values – 17 to 38 blows per foot • Moisture content – 2 to 3% • Material finer than #200 sieve – 3 to 5%
Boring Location B-2		
A	2½	Brown silty sands with gravel • USCS symbol – SM • Relative density – dense • SPT values – 35 blows per foot • Moisture content – 2% • Material finer than #200 sieve – 15% • Liquid limit (LL) – No value • Plasticity index (PI) – Non-plastic
B	26½	Brown/multicolor poorly-graded and well-graded sands occasionally mixed with silt • USCS symbol – SP, SP-SM, SW-SM • Relative density – medium dense to very dense • SPT values – 12 to over 50 blows per foot • Moisture content – 1 to 3% • Material finer than #200 sieve – 2 to 12% • Liquid limit (LL) – No value • Plasticity index (PI) – Non-plastic

Table 3: Soil Stratigraphy

Soil Stratum	Approximate Depth to Bottom of Stratum (ft.)	Soil Description
Boring Location B-3		
A	7½	Brown silty sands with gravel • USCS symbol – SM • Relative density – medium dense to very dense • SPT values – 13 to over 50 blows per foot • Moisture content – 2 to 6% • Material finer than #200 sieve – 14 to 21% • Liquid limit (LL) – No value • Plasticity index (PI) – Non-plastic
B	26½	Brown/multicolor poorly-graded sands with silt • USCS symbol – SP-SM • Relative density – medium dense to dense • SPT values – 16 to 44 blows per foot • Moisture content – 3 to 6% • Material finer than #200 sieve – 6 to 10%
Boring Location B-4		
A	12	Brown/multicolor poorly-graded sands occasionally mixed with silt and gravel • USCS symbol – SP, SP-SM • Relative density – medium dense to very dense • SPT values – 15 to over 50 blows per foot • Moisture content – 2% • Material finer than #200 sieve – 9 to 11% • Liquid limit (LL) – No value • Plasticity index (PI) – Non-plastic
Boring Location B-5		
A	30	Brown poorly-graded and silty sands with gravel and occasionally mixed with clay • USCS symbol – SP-SM, SM, SC-SM • Relative density – medium dense to very dense • SPT values – 12 to over 50 blows per foot • Moisture content – 3 to 12% • Material finer than #200 sieve – 10 to 19% • Liquid limit (LL) – No value to 17 • Plasticity index (PI) – Non-plastic to 5
B	35	Multicolor poorly-graded gravels with clay, silt, and sand • USCS symbol – GP-GC • Moisture content – 3% • Material finer than #200 sieve – 6% • Liquid limit (LL) – 17 • Plasticity index (PI) – Non-plastic to 5
C	40	Brown silty sands • USCS symbol – SM • Relative density – medium dense • SPT values – 17 blows per foot • Moisture content – 8% • Material finer than #200 sieve – 20% • Liquid limit (LL) – No value • Plasticity index (PI) – Non-plastic

Table 3: Soil Stratigraphy

Soil Stratum	Approximate Depth to Bottom of Stratum (ft.)	Soil Description
D	44	Multicolor poorly-graded sands occasionally with silt and gravel • USCS symbol – SP, SP-SM • Relative density – very dense • SPT values – over 50 blows per foot • Moisture content – 3% • Material finer than #200 sieve – 3 to 6%

Due to the relatively small diameter of the drilling and sampling tools utilized in our drilling program, we could not establish the maximum size of cobbles in the above strata pertaining to soil borings B-1, B-4, and B-5. However, based on the degree of difficulty in our drilling program at the site, we anticipate that the size of cobbles will exceed 6 inches in diameter. During our drilling operations, auger refusal occurred at a depth of 18 feet below existing ground surface (BGS) in soil boring B-1, 12 feet BGS in soil boring B-4, and 44 feet BGS in soil boring B-5. Based on the natural stratigraphy in the vicinity of the project site, large boulders and rock formations may be encountered at depths of about 15 feet in certain locations. However, due to our drilling methodology and localized sampling, we could not verify the type, the presence or the extent of these possible formations.

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 Structural Information

Based on our experience with similar projects, we have assumed the total load of the manhole structures will be on the order of 10 tons or less, and the structures will be precast and/or supported on rigid mat foundations. If the final loads 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.

5.2 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 less than ¼-inch.

5.3 Site Preparation

The existing flexible pavement, curb and gutter, sidewalks, and vegetation, shall be removed and properly disposed of off-site per applicable local regulations prior to earthwork operations.

Furthermore, soils at their present condition may provide adequate support for foundations, flatwork, and/or pavement sections when properly processed, moisture conditioned, and compacted as indicated in this report. For structural elements and sewer pipes, the upper 24 inches of existing subgrade and/or select fill shall be moisture conditioned to within ±3% of its optimum moisture content and compacted to at least 95% of its maximum dry density, as determined by ASTM 1557.

5.4 Foundation Recommendations

The proposed manhole structures may be supported on individual spread/rigid mat foundation systems. These foundation systems should be dimensioned using the parameters shown in the following table:

Table 4: Individual Spread/Rigid Mat Foundation Recommendations

Manhole Structure Number [Boring Number]	Approximate Proposed Footing Bearing Depth Below Ground Surface (ft.)	Allowable Soil Bearing Capacity (lb/ft^2)	Minimum Select Fill Below Bottom of Footing Elevation (in.)
SS-1 [B-4]	29	2,500	8
SS-2 [B-3]	6	2,300	24
SS-3 [B-2]	7	2,300	24
SS-4 [B-1]	17	2,500	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. Flatwork should also be supported on select fill as recommended in Section 5.6 of this report.

5.5 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 pipeline installation contractor/subcontractor 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.

5.6 Concrete Flatwork

Flatwork (i.e. individual spread footings or rigid mat foundations) for the proposed manhole structures shall be built on compacted select fill material or suitable subgrade soils as outlined in Table 4. Sidewalks and curb and gutter replacement shall be building on a minimum of 8 inches of select fill material or suitable subgrade soils. Select fill placement can be substituted with controlled density fill material (minimum 2-sack mix). A modulus of subgrade reaction of 200 pounds per cubic inch may be used for backfill materials in the design of flatwork.

5.7 Lateral Earth Pressures

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

$$\Phi = 32^{\circ}$$

$$\gamma_w = 125 \text{ lb/ft}^3$$

Additionally, the equivalent fluid density, considering the equivalent fluid method with the appropriate k value, may be computed as follows:

$$G_h = k^*\gamma_w$$

For concrete or masonry walls, the wall-soil interface friction angle may be computed as follows:

$$\Phi_w = 0.67\Phi$$

Coefficients of active and passive earth pressure are given below, along with the coefficient for the possible at-rest condition:

$$k_A = 0.31$$

$$k_P = 3.25$$

$$k_O = 0.47$$

5.8 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 manhole structures for a minimum distance of 5 feet. Irrigated planters should not be allowed adjacent to the structures.

5.9 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 5 be used for design purposes:

Table 5: Seismic Design Parameters (2015 International Building Code)

Parameter	Value
Site Class	D
Site Location (latitude, longitude)	31.842875, -106.569559
S_{MS} – Spectral Response Acceleration for Short Periods	0.476g
S_{M1} – Spectral Response Acceleration for a 1-Second Period	0.227g
S_{DS} – Design Spectral Response Acceleration for Short Periods	0.317g
S_{D1} – Design Spectral Response Acceleration for a 1-Second Period	0.151g

5.10 Flexible Pavement Recommendations

Flexible pavements will be used in the reconstruction of the residential street and parking lot areas after the sewer line installation. Therefore, we used a traffic loading of 45,000 equivalent single-axle load (ESAL) applications and 269,000 ESAL's for areas that will be subjected to light and heavy traffic loads, respectively. This parameter is estimated based on the intended usage 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 light duty and heavy duty traffic conditions:

Table 6: Flexible Pavement Recommendations

Pavement Component	Light Duty Traffic Minimum Thickness (in.)	Heavy Duty Traffic Minimum Thickness (in.)
Hot-Mix Asphaltic Concrete	1½	3
Crushed Stone Base Course	6	8
Compacted Subgrade	8	8

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.

5.11 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. Cobbles are not permitted to be used as part of any 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.

5.12 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 dry density in accordance with ASTM D-1557 (modified Proctor) procedures. Soil moisture content should be at plus or minus 3 percent of the optimum moisture content in accordance with the above standard. Refer to Appendix C for El Paso Water Standard Details for bedding and backfill of pressure pipe and gravity pipe in dry and wet conditions. Use the following soil types for the standard details in Appendix C.

Table 7: 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

5.13 New Construction near Existing Structures and Utilities

Contractor shall exercise extreme care during footing excavation and site preparation near existing manhole structures, utility poles, trees, and residential structures, to avoid encroaching into the existing foundation systems, hence preventing adversely affecting or undermining the performance and structural integrity. We also recommend that before any excavation or earthwork takes place, all underground utilities be located to prevent damages to the existing infrastructure. We also recommend that any underground utilities that may encroach the proposed foundations system be decommissioned, removed and/or relocated, and the voids need to be filled with select fill as recommended in Section 5.11 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 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:
    - Manhole pad – A minimum of one (1) density test per lift (8-inch compacted) for every 1,000 square feet.
    - 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 1,000 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 1,000 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 five (5)

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.

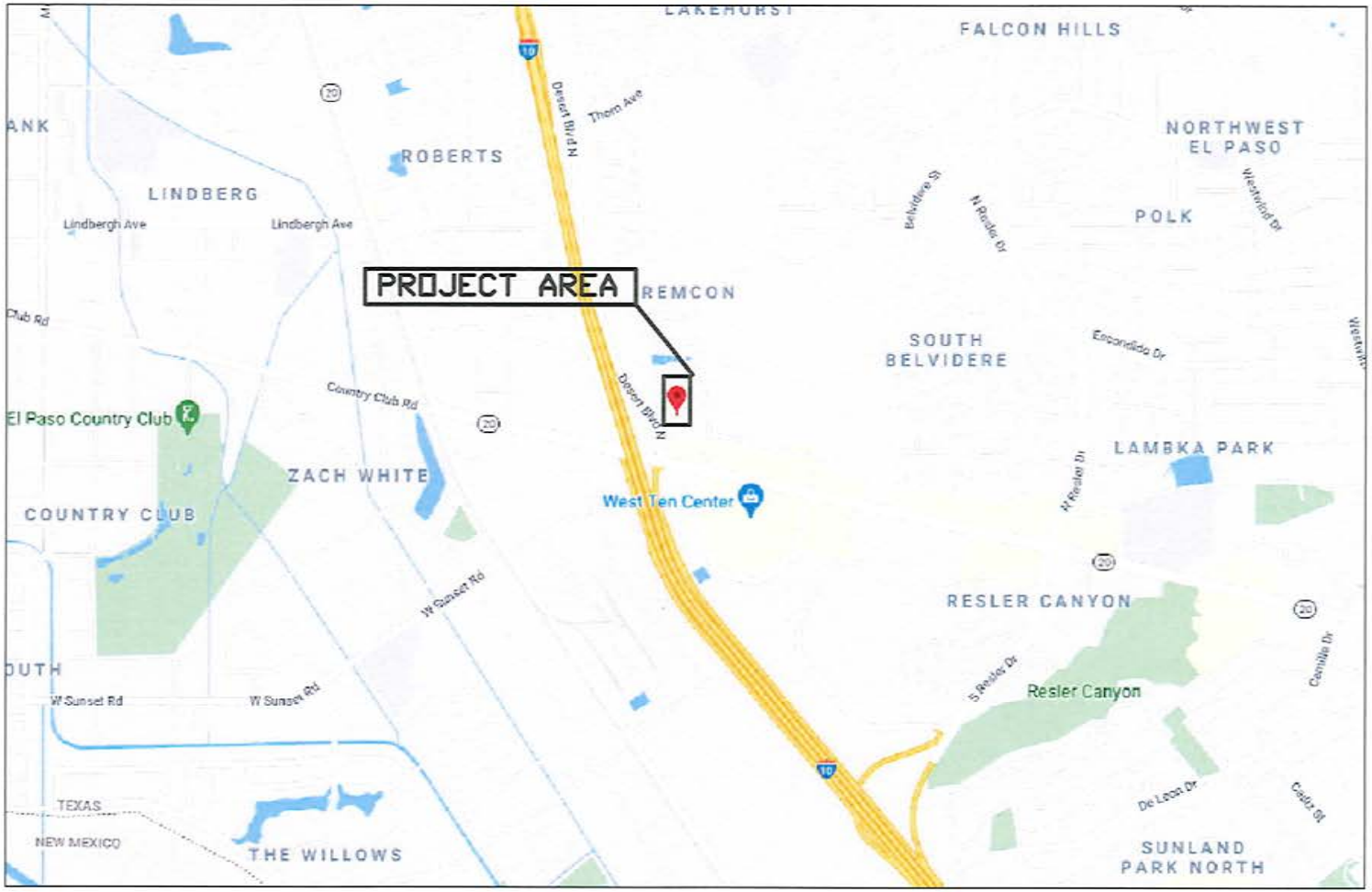
The data in this report reflects subsurface soil conditions only at the specific sampling location, time of sampling, and to the depths indicated in our report. This report is not intended to identify or address any potential environmental concerns associated with the project site.

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 EPW – Decommissioning/Demolition – Mesa Del Castillo and Electric Plant Lift Station Improvements project in El Paso, Texas. Use of this information for projects other than the one described herein will not be adequate.

ENGINEERS

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	EL PASO WATER 1154 HAWKINS BOULEVARD EL PASO, TEXAS 79925	PROJECT NAME: EPW – DECOMMISSIONING/DEMOLITION MESA DEL CASTILLO LIFT STATION IMPROVEMENTS EL PASO, TEXAS

DRAWN BY	REVIEWED BY	APPROVED BY	SCALE
A.G.	G.M.	B.O.	N.T.S.
PROJECT No. LOI21-211	FILE NAME SITE PLAN	DATE 07/29/21	SHEET No. 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	EL PASO WATER 1154 HAWKINS BOULEVARD EL PASO, TEXAS 79925	PROJECT NAME: EPW – DECOMMISSIONING/DEMOLITION MESA DEL CASTILLO LIFT STATION IMPROVEMENTS EL PASO, TEXAS

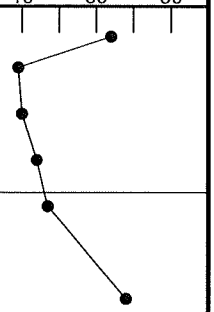
DRAWN BY	REVIEWED BY	APPROVED BY	SCALE
A.G.	G.M.	B.O.	N.T.S.
PROJECT No.	FILE NAME	DATE	SHEET No.
LOI21-211	SITE PLAN	07/29/21	A-1.2

LOG OF TEST BORING No. B-1

Project name: EPW Mesa Del Castillo Lift Station Improvements
File No.: LOI21-211
Date drilled: 10/12/21
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	Blows per foot (N)
0			3" ASPHALT PAVEMENT							
			7" BASE COURSE	SP-SM	5	9				34
			SAND, poorly-graded sand, silty, brown, dense, dry to moist		9	27	NV	NV	NP	9
			SAND, fine grained, silty, brown, loose, dry to moist	SM	13	47	NV	NV	NP	10
			-medium dense, moist at 5 feet							
			-multicolor, dry at 7.5 feet		3	35				14
10			SAND, poorly-graded, silty, multicolor, medium dense, dry, with gravel	SP-SM	3	5				17
			SAND, poorly-graded, multicolor, dense, dry	SP	2	3				38
20			Termination depth at 18 feet AUGER REFUSAL AT 18 FEET DUE TO HARD ROCK/COBBLES							
30										
40										
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

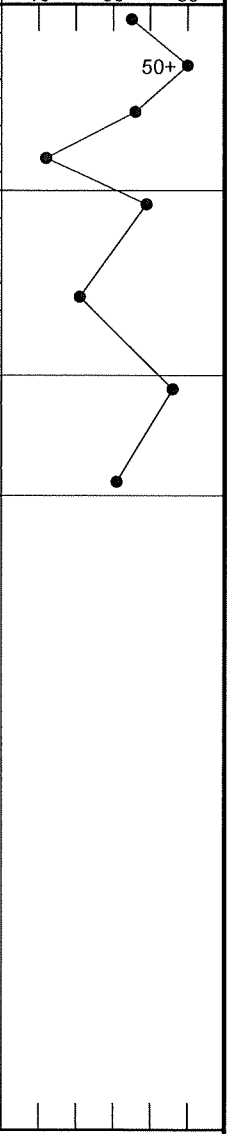
Rig type: CME-75
Boring type: HSA
Drilled by: JS
Logger: AG
Sheet No.: **A-2**

LOG OF TEST BORING No. B-2

Project name: EPW Mesa Del Castillo Lift Station Improvements
File No.: LOI21-211
Date drilled: 09/29/21
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	Blows per foot (N)
0			SAND, fine grained, silty, brown, dense, dry, with gravel	SM	2	15	NV	NV	NP	35
			-very dense at 2.5 feet		2	12				50+
			-dense at 5 feet		1	12	NV	NV	NP	36
			SAND, well-graded, silty, multicolor, medium dense, dry	SW-SM	3	10				12
10			SAND, poorly-graded, silty, multicolor, dense, dry, with gravel	SP-SM	2	7				39
			SAND, poorly-graded sand, multicolor, medium dense, dry	SP	1	2				21
20			SAND, poorly-graded, silty, multicolor, dense, dry, with gravel	SP-SM	1	5				46
			SAND, poorly-graded, multicolor, dense, dry	SP	1	3				31
			Termination depth at 26.5 feet							
30										
40										
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: JS
Logger: AG
Sheet No.: **A-3**

LOG OF TEST BORING No. B-3

Project name: EPW Mesa Del Castillo Lift Station Improvements
File No.: LOI21-211
Date drilled: 09/29/21
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, silty, brown, very dense, dry, with gravel	SM	2	21	NV	NV	NP	50+	10 30 50 50+
			-medium dense, dry to moist at 2.5 feet		6	21	NV	NV	NP	13	
			-dry at 5 feet		4	14				24	
			SAND, poorly-graded, silty, brown, dense, dry	SP-SM	3	8				32	
10			-medium dense at 10 feet		4	6				17	
			-dry to moist at 15 feet		6	10				16	
20					5	7				16	
			-dense, multicolor, dry to moist at 25 feet		6	6				44	
			Termination depth at 26.5 feet								
30											
40											
50											
60											

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: JS
Logger: AG
Sheet No.: **A-4**

LOG OF TEST BORING No. B-4

Project name: EPW Mesa Del Castillo Lift Station Improvements
File No.: LOI21-211
Date drilled: 7/27/21
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 (10 30 50)
0			2" ASPHALT PAVEMENT								
			6" BASE COURSE	SP-SM	2	6	NV	NV	NP	27	
			SAND, poorly-graded, silty, tan, medium dense, dry		2	3				16	
			SAND, poorly-graded, tan/multicolor, medium dense, dry	SP	2	4				15	
			SAND, poorly-graded, silty, multicolor, very dense, dry, with gravel		2	5				50+	50+
10				SP-SM	2	7				50+	50+
			Termination depth at 12 feet AUGER REFUSAL AT 12 FEET DUE TO HARD ROCK/COBBLES								
20											
30											
40											
50											
60											

Groundwater Table Data

Depth	Date	Time
N/A	N/A	N/A

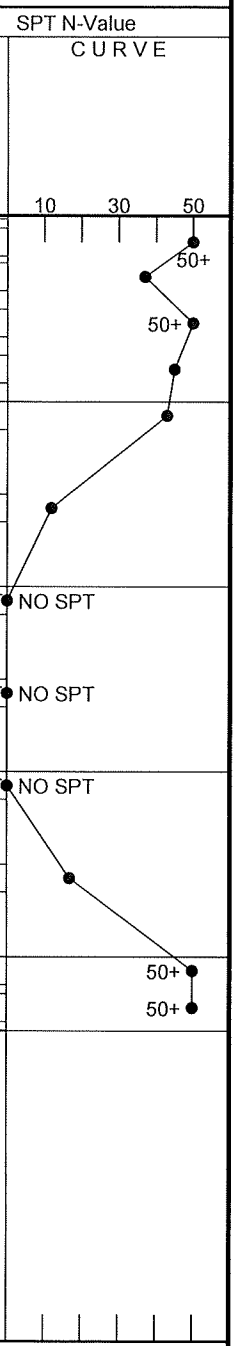
Sample Type
- Auger cutting
- 2" O.D. split spoon
- 3" O.D. split tube
- Thin-walled Shelby tube

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

LOG OF TEST BORING No. B-5

Project name: EPW Mesa Del Castillo Lift Station Improvements
File No.: LOI21-211
Date drilled: 7/27/21
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	Blows per foot (N)
0			1-1/2" ASPHALT PAVEMENT							
			6" BASE COURSE	SM	3	14	NV	NV	NP	50+
			SAND, fine grained, silty, brown, very dense, dry, with gravel	SP-SM	3	11				37
			SAND, poorly-graded, silty, brown, dense, dry, with gravel	SM	4	15				50+
			SAND, fine grained, silty, brown, very dense, dry, with gravel	SP-SM	4	12	NV	NV	NP	45
10			SAND, poorly-graded, silty, brown, dense, dry, with gravel	SM	8	14				43
			SAND, fine grained, silty, brown, dense, dry to moist, with gravel	SP-SM	3	10				12
			SAND, poorly-graded, silty, brown, medium dense, dry, with gravel							
20			SAND, fine grained, clayey, silty, brown, moist, with gravel	SC-SM	12	19	17	12	5	NO SPT
			SAND, fine grained, silty, brown, dry to moist, with gravel	SM	9	15				NO SPT
30			GRAVEL, poorly-graded, clayey, silty, sandy, dry	GP-GC	3	6	17	12	5	NO SPT
			SAND, fine grained, silty, brown, medium dense, dry to moist, with gravel	SM	8	20	NV	NV	NP	17
40			SAND, poorly-graded, silty, multicolor, very dense, dry	SP-SM	3	6				50+
			SAND, poorly-graded, multicolor, very dense, dry, with gravel	SP	3	3				50+
			Termination depth at 44 feet AUGER REFUSAL AT 44 FEET DUE TO HARD ROCK/COBBLES							
50										
60										



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/SSA
Drilled by: JS
Logger: AG
Sheet No.: **A-6**

SUMMARY OF RESULTS

Project: EPW - Decommissioning/Demolition
Mesa Del Castillo Lift Station Improvements

LOI Project No.: LOI21-211

Date: 10/18/21

Boring No.	Depth (ft.)	% Moisture Content	% Material passing # 4	% Material passing # 40	% Material minus # 200	LL	PL	PI	Soil Classification
1	0-1½	5			9				Poorly-graded sand (SP-SM) with silt
1	2½-4	9			27	NV	NV	NP	Silty sand (SM)
1	5-6½	13			47	NV	NV	NP	Silty sand (SM)
1	7½-9	3	100	80	35				Silty sand (SM)
1	10-11½	3			5				Poorly-graded sand (SP-SM) with silt
1	15-16½	2			3				Poorly-graded sand (SP)
2	0-1½	2	70	53	15	NV	NV	NP	Silty sand (SM) with gravel
2	2½-4	2	58	38	12				Silty sand (SM) with gravel
2	5-6½	1	54	32	12	NV	NV	NP	Silty sand (SM) with gravel
2	7½-9	3	86	55	10				Well-graded sand (SW-SM) with silt
2	10-11½	2	71	37	7				Poorly-graded sand (SP-SM) with silt and gravel
2	15-16½	1			2				Poorly-graded sand (SP)
2	20-21½	1	75	45	5				Poorly-graded sand (SP-SM) with silt and gravel
2	25-26½	1			3				Poorly-graded sand (SP)
3	0-1½	2	75	70	21	NV	NV	NP	Silty sand (SM) with gravel
3	2½-4	6	75	64	21	NV	NV	NP	Silty sand (SM) with gravel
3	5-6½	4			14				Silty sand (SM)
3	7½-9	3			8				Poorly-graded sand (SP-SM) with silt

SUMMARY OF RESULTS

Project: EPW - Decommissioning/Demolition
Mesa Del Castillo Lift Station Improvements

LOI Project No.: LOI21-211

Date: 10/18/21

Boring No.	Depth (ft.)	% Moisture Content	% Material passing # 4	% Material passing # 40	% Material minus # 200	LL	PL	PI	Soil Classification
3	10-11½	4	98	86	6				Poorly-graded sand (SP-SM) with silt
3	15-16½	6			10				Poorly-graded sand (SP-SM) with silt
3	20-21½	5			7				Poorly-graded sand (SP-SM) with silt
3	25-26½	6	99	83	6				Poorly-graded sand (SP-SM) with silt
4	0-1½	2	97	90	6	NV	NV	NP	Poorly-graded sand (SP-SM) with silt
4	2½-4	2	93	85	3				Poorly-graded sand (SP)
4	5-6½	2	97	83	4				Poorly-graded sand (SP)
4	7½-9	2	51	20	5				Poorly-graded sand (SP-SM) with silt and gravel
4	10-11½	2	61	40	7				Poorly-graded sand (SP-SM) with silt and gravel
5	0-1½	3	60	40	14	NV	NV	NP	Silty sand (SM) with gravel
5	2½-4	3	69	42	11				Poorly-graded sand (SP-SM) with silt and gravel
5	5-6½	4	68	48	15				Silty sand (SM) with gravel
5	7½-9	4	53	35	12	NV	NV	NP	Poorly-graded sand (SP-SM) with silt and gravel
5	10-11½	8	64	43	14				Silty sand (SM) with gravel
5	15-16½	3	51	31	10				Poorly-graded sand (SP-SM) with silt and gravel
5	20-21½	12	76	49	19	17	12	5	Clayey, silty sand (SC-SM) with gravel
5	25-26½	9	58	39	15				Silty sand (SM) with gravel
5	30-31½	3	21	15	6	17	12	5	Poorly-graded gravel (GP-GC) with clay, silt, and sand

SUMMARY OF RESULTS

Project: EPW - Decommissioning/Demolition
Mesa Del Castillo Lift Station Improvements

LOI Project No.: LOI21-211

Date: 10/18/21

Boring No.	Depth (ft.)	% Moisture Content	% Material passing # 4	% Material passing # 40	% Material minus # 200	LL	PL	PI	Soil Classification
5B	35-36½	8	99	95	20	NV	NV	NP	Silty sand (SM)
5B	40-41½	3	89	70	6				Poorly-graded sand (SP-SM) with silt
5B	42½-44	3	58	18	3				Poorly-graded sand (SP) with gravel

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

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

Project Name: EPW - Decommissioning/Demolition
Mesa Del Castillo Lift Station Improvements
El Paso, Texas

Project Number: LOI21-211

Client: El Paso Water
1154 Hawkins Boulevard
El Paso, Texas 79925

Sample date: 10/12/21

Sample Location: Existing material; Sample collected at Soil Boring B-1; 0'-18' in depth.

Sampler: MN

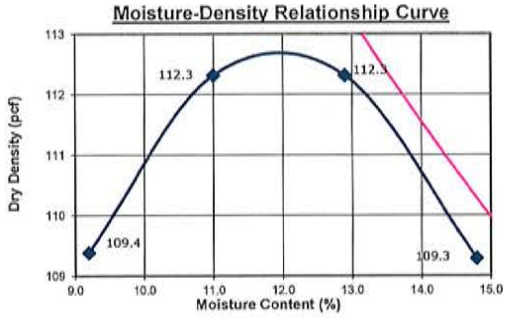
Soil Classification: Poorly graded sand with silt (SP-SM)

Sample Number: 101221-B1

Method Used: B
Preparation: Dry
Rammer: Mechanical
Specific Gravity: 2.58 (estimated)
As Received Water Content: 2 %

Corrected Maximum Dry Unit Weight: 112.7 pcf
Corrected Optimum Water Content: 12.0 %

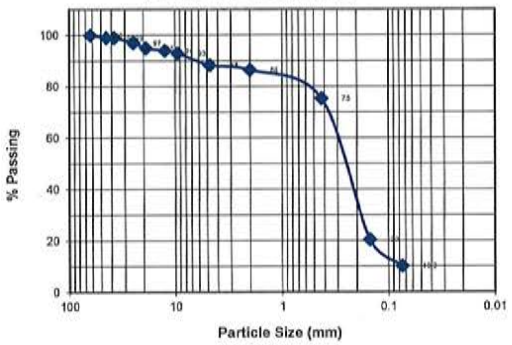
Moisture-Density Relationship Curve



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	1	-	99	-
1-1/2"	37.50	1	-	99	-
1"	25.00	3	-	97	-
3/4"	19.00	5	-	95	-
1/2"	12.50	6	-	94	-
3/8"	9.50	7	-	93	-
#4	4.75	12	-	88	-
#10	2.00	14	-	86	-
#40	0.425	25	-	75	-
#100	0.150	80	-	20	-
#200	0.075	89.8	-	10.2	-

Grain-Size Distribution



Gradation Parameters

D_{10}=	0.07	C_c=	1.53
D_{30}=	0.20	C_u=	4.75
D_{60}=	0.35	-	-

Plasticity Index

Process: Air-dry

Actual	**LL=**	NV	**PL=**	NV	**PI=**	NP
Typical	**LL=**	-	**PL=**	-	**PI=**	-

Sheet No. A-10

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

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

Project Name: EPW - Decommissioning/Demolition
Mesa Del Castillo Lift Station Improvements
El Paso, Texas

Project Number: LOI21-211

Client: El Paso Water
1154 Hawkins Boulevard
El Paso, Texas 79925

Sample date: 9/29/21

Sample Location: Existing material; Sample collected at Soil Boring B-2; 0' to 25' in depth.

Sampled by: MN

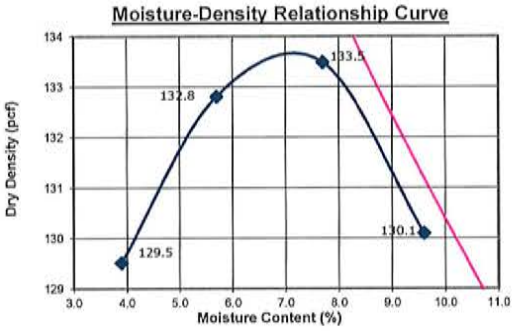
Soil Classification: Silty sand with gravel (SM)

Sample Number: 092921-B2

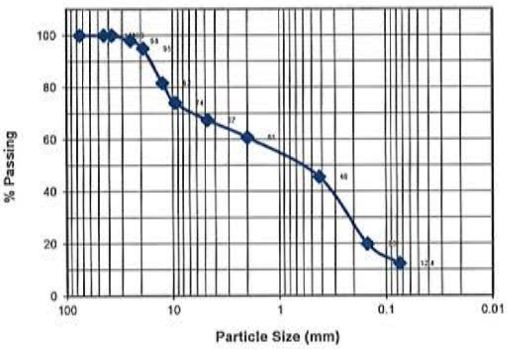
Method Used: C
Preparation: Dry
Rammer: Mechanical
Specific Gravity: 2.62 (estimated)
As Received Water Content: 2 %

Corrected Maximum Dry Unit Weight: 133.7 pcf
Corrected Optimum Water Content: 7.2 %

Moisture-Density Relationship Curve



Grain-Size Distribution



Sieve Analysis

Sieve Opening Size		Retained (%)		Passing (%)	
Std.	mm	Actual	Specs.	Actual	Typical
3"	75.00	0	-	100	-
1-3/4"	44.50	0	-	100	-
1-1/2"	37.50	0	-	100	-
1"	25.00	2	-	98	-
3/4"	19.00	5	-	95	-
1/2"	12.50	18	-	82	-
3/8"	9.50	26	-	74	-
#4	4.75	33	-	67	-
#10	2.00	39	-	61	-
#40	0.425	54	-	46	-
#100	0.150	80	-	20	-
#200	0.075	87.7	-	12.4	-

Gradation Parameters

D_{10}=	0.06	C_c=	0.57
D_{30}=	0.26	C_u=	31.57
D_{60}=	1.92	-	-

Plasticity Index

Process: Air-dry

Actual:	**LL=**	NV	**PL=**	NV	**PI=**	NP
Typical:	**LL=**	-	**PL=**	-	**PI=**	-

Sheet No. A-11

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

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

Project Name: EPW - Decommissioning/Demolition
Mesa Del Castillo Lift Station Improvements
El Paso, Texas

Project Number: LOI21-211

Client: El Paso Water
1154 Hawkins Boulevard
El Paso, Texas 79925

Sample date: 9/29/21

Sample Location: Existing material; Sample collected at Soil Boring B-3; 0' to 25' in depth.

Sampled by: MN

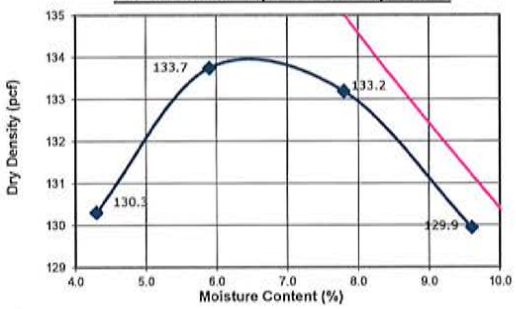
Soil Classification: Poorly graded gravel with silt and sand (GP-GM)

Sample Number: 092921-B3

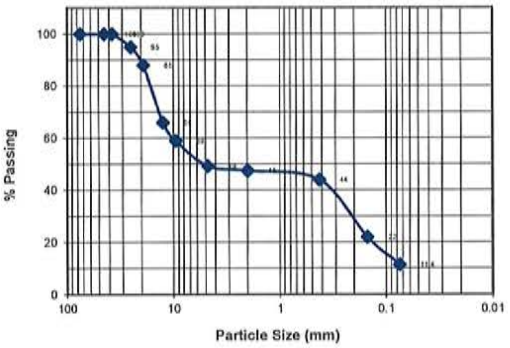
Method Used: C
Preparation: Dry
Rammer: Mechanical
Specific Gravity: 2.61 (estimated)
As Received Water Content: 2 %

Corrected Maximum Dry Unit Weight: 133.9 pcf
Corrected Optimum Water Content: 6.5 %

Moisture-Density Relationship Curve



Grain-Size Distribution



Sieve Analysis

Sieve Opening Size		Retained (%)		Passing (%)	
Std.	mm	Actual	Specs.	Actual	Typical
3"	75.00	0	-	100	-
1-3/4"	44.50	0	-	100	-
1-1/2"	37.50	0	-	100	-
1"	25.00	5	-	95	-
3/4"	19.00	12	-	88	-
1/2"	12.50	34	-	66	-
3/8"	9.50	41	-	59	-
#4	4.75	51	-	49	-
#10	2.00	52	-	48	-
#40	0.425	56	-	44	-
#100	0.150	78	-	22	-
#200	0.075	88.6	-	11.4	-

Gradation Parameters

D_{10}=	0.07	C_c=	0.10
D_{30}=	0.25	C_u=	151.67
D_{60}=	9.94	-	-

Plasticity Index

Process: Air-dry

Actual:	**LL=**	NV	**PL=**	NV	**PI=**	NP
Typical:	**LL=**	-	**PL=**	-	**PI=**	-

Sheet No. A-12

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

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

ENGINEERS

Project Name: EPW - Decommissioning/Demolition
Mesa Del Castillo Lift Station Improvements
El Paso, Texas

Project Number: LOI21-211

Client: El Paso Water
1154 Hawkins Boulevard
El Paso, Texas 79925

Sample date: 7/27/21

Sample Location: Existing material; Sample collected at Soil Boring B-4; 0'-12' in depth.

Sampler: EH

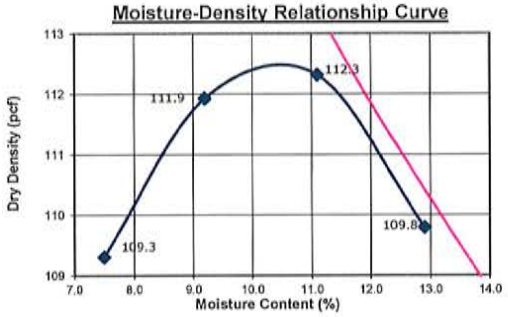
Soil Classification: Poorly graded sand with silt (SP-SM)

Sample Number: 072721-B4

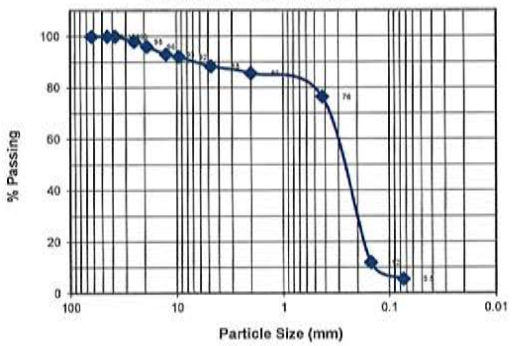
Method Used: B
Preparation: Dry
Rammer: Mechanical
Specific Gravity: 2.64 (estimated)
As Received Water Content: 2 %

Corrected Maximum Dry Unit Weight: 112.5 pcf
Corrected Optimum Water Content: 10.4 %

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	2	-	98	-
3/4"	19.00	4	-	96	-
1/2"	12.50	7	-	93	-
3/8"	9.50	8	-	92	-
#4	4.75	12	-	88	-
#10	2.00	14	-	86	-
#40	0.425	24	-	76	-
#100	0.150	88	-	12	-
#200	0.075	94.5	-	5.5	-

Gradation Parameters

D_{10}=	0.13	C_c=	1.14
D_{30}=	0.23	C_u=	2.79
D_{60}=	0.36	-	-

Plasticity Index

Process: Air-dry

Actual	**LL=**	NV	**PL=**	NV	**PI=**	NP
Typical	**LL=**	-	**PL=**	-	**PI=**	-

Sheet No. A-13

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

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

Project Name: EPW - Decommissioning/Demolition
Mesa Del Castillo Lift Station Improvements
El Paso, Texas

Project Number: LOI21-211

Client: El Paso Water
1154 Hawkins Boulevard
El Paso, Texas 79925

Sample date: 7/27/21

Sample Location: Existing material; Sample collected at Soil Boring B-5; 0' to 44' in depth.

Sampled by: EH

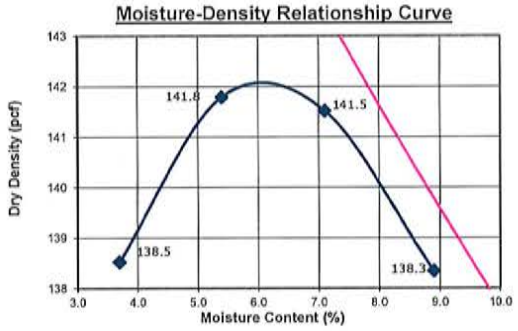
Soil Classification: Silty sand with gravel (SM)

Sample Number: 072721-B5

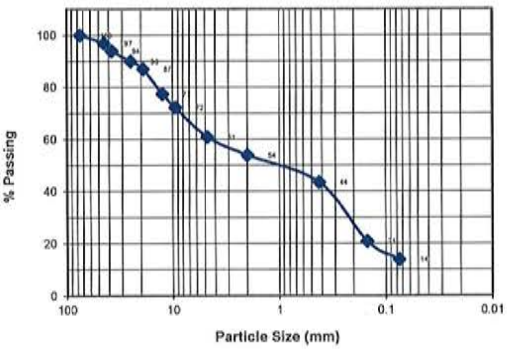
Method Used: C
Preparation: Dry
Rammer: Mechanical
Specific Gravity: 2.65 (estimated)
As Received Water Content: 3 %

Corrected Maximum Dry Unit Weight: 142.1 pcf
Corrected Optimum Water Content: 6.1 %

Moisture-Density Relationship Curve



Grain-Size Distribution



Sieve Analysis

Sieve Opening Size		Retained (%)		Passing (%)	
Std.	mm	Actual	Specs.	Actual	Typical
3"	75.00	0	-	100	-
1-3/4"	44.50	3	-	97	-
1-1/2"	37.50	6	-	94	-
1"	25.00	10	-	90	-
3/4"	19.00	13	-	87	-
1/2"	12.50	23	-	77	-
3/8"	9.50	28	-	72	-
#4	4.75	39	-	61	-
#10	2.00	46	-	54	-
#40	0.425	57	-	44	-
#100	0.150	79	-	21	-
#200	0.075	86	-	14	-

Gradation Parameters

D_{10}=	0.05	C_c=	0.29
D_{30}=	0.26	C_u=	81.56
D_{60}=	4.39	-	-

Plasticity Index

Process: Air-dry

Actual:	**LL=**	NV	**PL=**	NV	**PI=**	NP
Typical:	**LL=**	-	**PL=**	-	**PI=**	-

Sheet No. A-14

ENGINEERS

APPENDIX B

2101 E. Missouri Ave., Suite B
El Paso, TX 79903

www.loi-engineers.com

(915) TEL. 781-1532 •FAX. (915) 781-1190
TOLL FREE. 1.844.LOI.TEST

SOIL TERMINOLOGY

ENGINEERS

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.

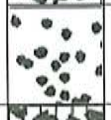
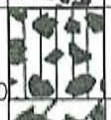
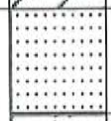
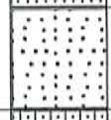
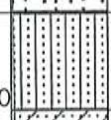
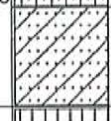
Slickensided: With inclined planes of weakness of slick and glassy appearance.
Fissured: With shrinkage cracks that are frequently filled with fine sand.
Laminated: With thin layers of varying colors and texture.
Interbedded: With alternate layers of different soil types.
Calcareous: With noticeable 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.

Sheet No. B-1

SOIL SYMBOLS

ENGINEERS

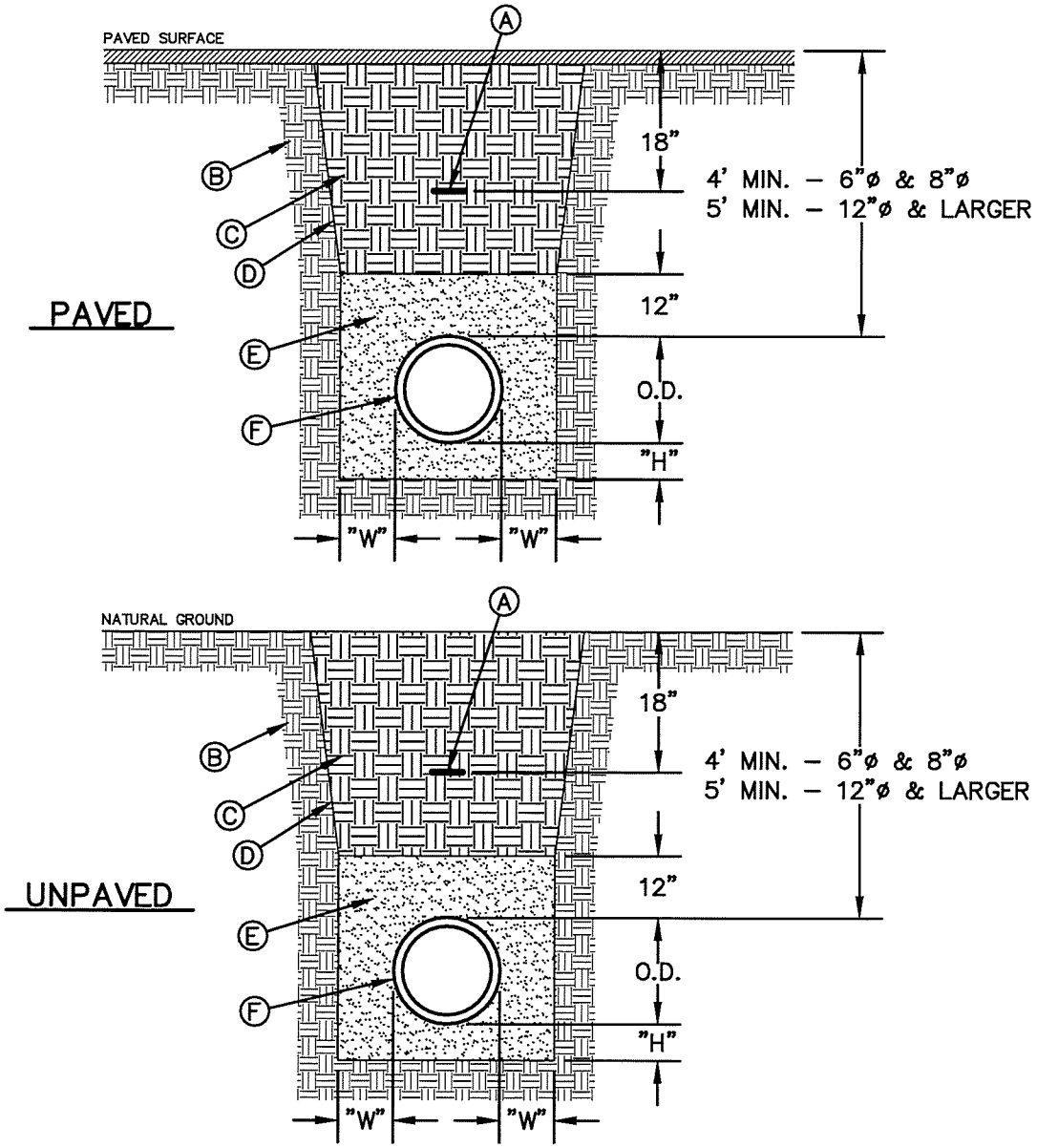
Identification of the major soil divisions used to distinguish the change of a different stratum. For their combinations and a more detailed description, see UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D 2487-00)

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

Sheet No. B-2

APPENDIX C



GENERAL NOTES:

1. BEDDING FOR PRESSURE AND GRAVITY PIPE IN DRY CONDITIONS.
2. PROVIDE TRENCH SAFETY SYSTEM FOR TRENCH DEPTHS GREATER THAN 5 FEET.
3. IF THE NATIVE MATERIAL EXCAVATED FROM THE TRENCH IS UNSUITABLE AS BACKFILL MATERIAL, OR THE REQUIRED COMPACTION IS UNATTAINABLE, THE CONTRACTOR SHALL, AT HIS EXPENSE, IMPORT SELECT MATERIAL TO BE MIXED WITH OR USED IN PLACE OF THE NATIVE MATERIAL. SELECT MATERIAL MUST BE APPROVED BY EPWU. SUBSTITUTE SOIL CEMENT SLURRY (1–SACK) IF REQUIRED IN SPECS.

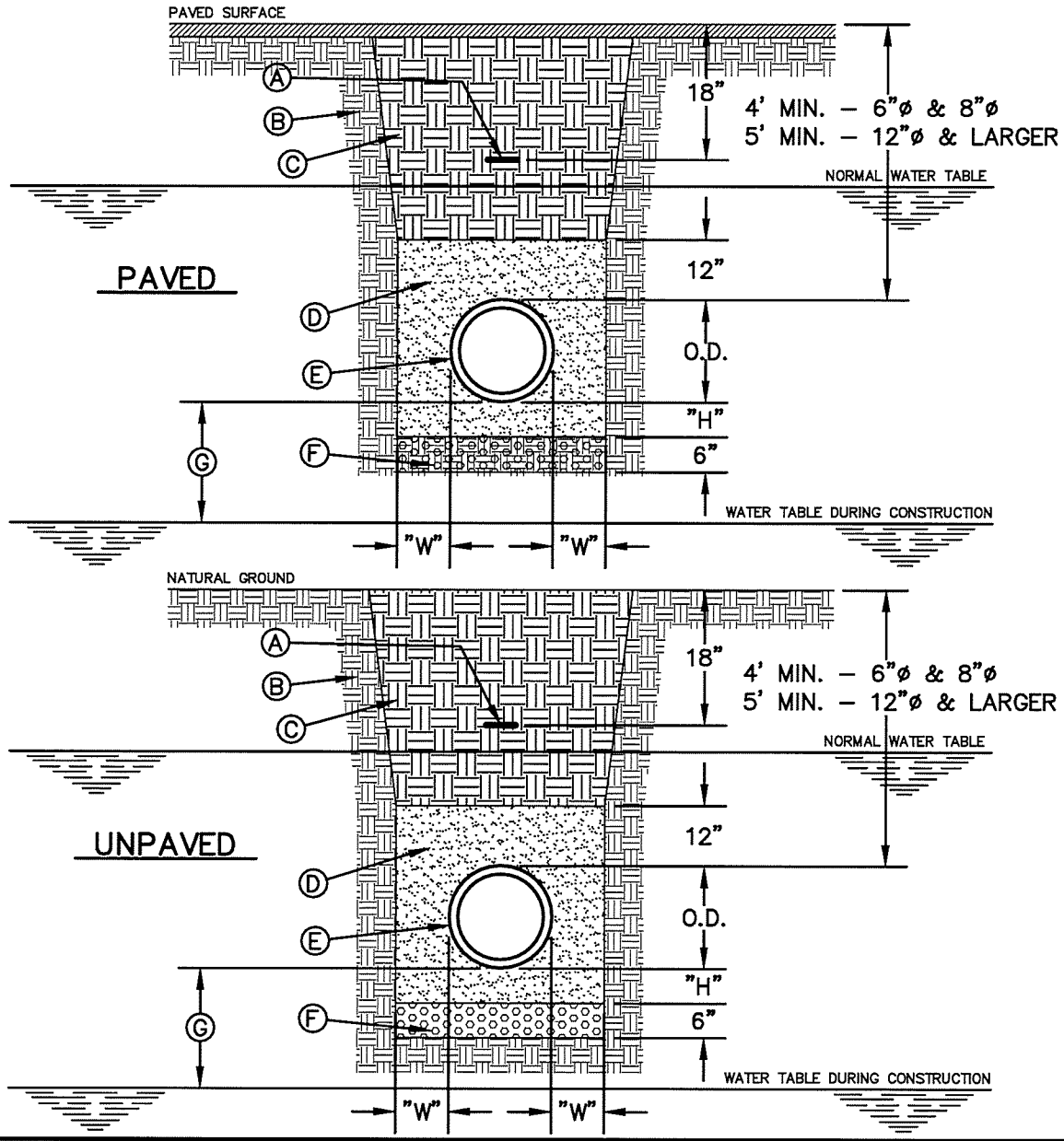
CONSTRUCTION KEY NOTES:

A. APPROVED MARKING TAPE.
B. UNDISTURBED STABLE MATERIAL.
C. NATIVE MATERIAL BACKFILL.
   PAVED CONDITION: COMPACT TO 90% DENSITY PER ASTM D–1557 MODIFIED PROCTOR.
   UNPAVED CONDITION: COMPACT TO 85% DENSITY PER ASTM D–1557 MODIFIED PROCTOR.
   (*SEE NOTE #3 IF THESE PREVIOUS CONDITIONS CANNOT BE MET.)
D. SLOPE TRENCH IN SANDY SOIL CONDITIONS.
E. USE CLASS II OR CLASS III SAND PER ASTM D–2487. NATIVE MATERIAL OR IMPORTED SELECT MATERIAL MEETING OR EXCEEDING THIS REQUIREMENT MAY BE USED. COMPACT TO 85% DENSITY PER ASTM D–1557 MODIFIED PROCTOR (OR 90% D–698 STANDARD PROCTOR).
F. APPROVED PIPE.
G. TRENCH DIMENSIONS AS FOLLOWS:

PIPE DIAMETER	"H"
6" – 30"	4"
GREATER THAN 30"	6"

PIPE DIAMETER	"W"
6" – 30"	8"
GREATER THAN 30"	12"

STANDARD DETAIL	DATE: 4/24/2007 REV: 2/21/2011	EMBEDMENT CLASS "A" FOR PRESSURE PIPE AND GRAVITY PIPE DRY CONDITIONS	N.T.S.	el paso WATER	DETAIL No. 171



GENERAL NOTES:

1. BEDDING FOR PRESSURE PIPE IN WET CONDITIONS.
2. PROVIDE TRENCH SAFETY SYSTEM FOR TRENCH DEPTHS GREATER THAN 5 FEET.
3. A DRY TRENCH MUST BE MAINTAINED WHILE PLACING BEDDING.
4. IF THE NATIVE MATERIAL EXCAVATED FROM THE TRENCH IS UNSUITABLE AS BACKFILL MATERIAL, OR THE REQUIRED COMPACTION IS UNATTAINABLE, THE CONTRACTOR SHALL, AT HIS EXPENSE, IMPORT SELECT MATERIAL TO BE MIXED WITH OR USED IN PLACE OF THE NATIVE MATERIAL. SELECT MATERIAL MUST BE APPROVED BY EPWU. SUBSTITUTE SOIL CEMENT SLURRY (1–SACK) IF REQUIRED IN SPECS.

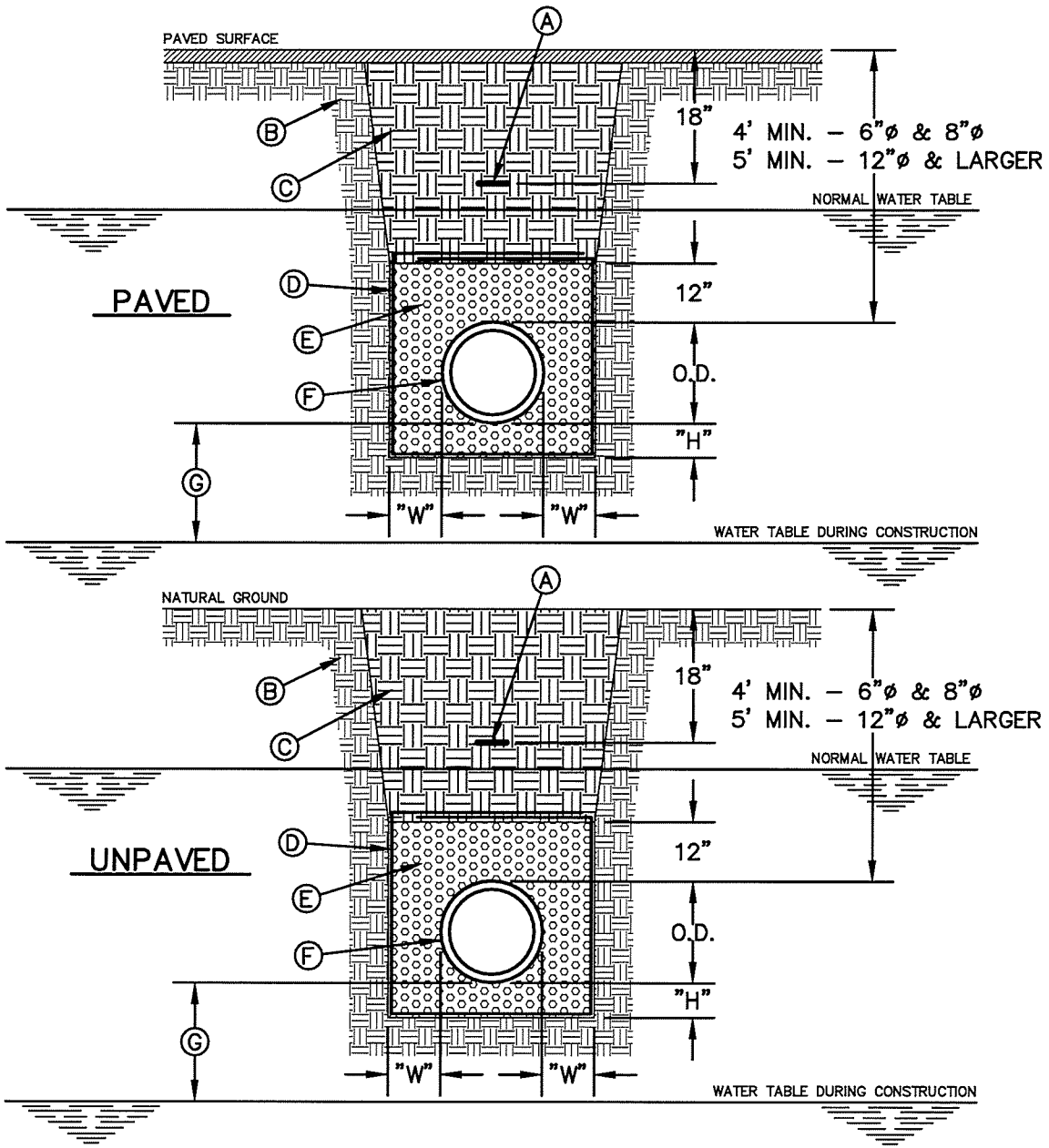
CONSTRUCTION KEY NOTES:

A. APPROVED MARKING TAPE.
B. UNDISTURBED STABLE MATERIAL.
C. NATIVE MATERIAL BACKFILL.
PAVED CONDITION: COMPACT TO 90% DENSITY PER ASTM D–1557 MODIFIED PROCTOR.
UNPAVED CONDITION: COMPACT TO 85% DENSITY PER ASTM D–1557 MODIFIED PROCTOR.
(*SEE NOTE #4 IF THESE PREVIOUS CONDITIONS CANNOT BE MET.)
D. USE CLASS II OR CLASS III SAND PER ASTM D–2487. NATIVE MATERIAL OR IMPORTED SELECT MATERIAL MEETING OR EXCEEDING THIS REQUIREMENT MAY BE USED. COMPACT TO 85% DENSITY PER ASTM D–1557 MODIFIED PROCTOR (OR 90% D–698 STANDARD PROCTOR).
E. APPROVED PIPE (WRAP DUCTILE IRON OR STEEL PIPE IN APPROVED POLYETHYLENE SHEETING, MINIMUM 6 MIL THICKNESS).
F. USE CLASS I GRAVEL PER ASTM D–2321 AND D–2487. NO COMPACTION REQUIRED. USE MINIMAL TAMPING, RODDING OR HAUNCH SLICING CAREFULLY IN THE EMEBEDMENT ZONE. IF REQUIRED BY THE ENGINEER, TEST PER ASTM D–4254 PERCENT OF RELATIVE DENSITY.
G. 18" MINIMUM UNLESS OTHERWISE SPECIFIED.
H. TRENCH DIMENSIONS AS FOLLOWS:

PIPE DIAMETER	"H"
6" – 30"	4"
GREATER THAN 30"	6"

PIPE DIAMETER	"W"
6" – 30"	8"
GREATER THAN 30"	12"

STANDARD DETAIL	DATE: 5/7/2007 REV: 7/6/2020	EMBEDMENT CLASS "B" FOR PRESSURE PIPE WET CONDITIONS	N.T.S.	el paso WATER	DETAIL No. 172



GENERAL NOTES:

1. BEDDING FOR GRAVITY PIPE IN WET CONDITIONS.
2. PROVIDE TRENCH SAFETY SYSTEM FOR TRENCH DEPTHS GREATER THAN 5 FEET.
3. A DRY TRENCH MUST BE MAINTAINED WHILE PLACING BEDDING AND GEOTECHNICAL FABRIC.
4. IF THE NATIVE MATERIAL EXCAVATED FROM THE TRENCH IS UNSUITABLE AS BACKFILL MATERIAL, OR THE REQUIRED COMPACTION IS UNATTAINABLE, THE CONTRACTOR SHALL, AT HIS EXPENSE, IMPORT SELECT MATERIAL TO BE MIXED WITH OR USED IN PLACE OF THE NATIVE MATERIAL. SELECT MATERIAL MUST BE APPROVED BY EPWU. SUBSTITUTE SOIL CEMENT SLURRY (1–SACK) IF REQUIRED IN SPECS.

CONSTRUCTION KEY NOTES:

A. APPROVED MARKING TAPE.
B. UNDISTURBED STABLE MATERIAL.
C. NATIVE MATERIAL BACKFILL.
   PAVED CONDITION: COMPACT TO 90% DENSITY PER ASTM D–1557 MODIFIED PROCTOR.
   UNPAVED CONDITION: COMPACT TO 85% DENSITY PER ASTM D–1557 MODIFIED PROCTOR. (*SEE NOTE #4 IF THESE PREVIOUS CONDITIONS CANNOT BE MET.)
D. APPROVED GEOTECHNICAL FABRIC WITH A STANDARD OVERLAP THAT IS 2 FEET EXCEPT WHERE TRENCH WIDTH EXCEEDS 3 FEET, THE OVERLAP AT TOP SHALL BE 3 FEET.
E. USE CLASS I GRAVEL PER ASTM D–2321 AND D–2487. 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.
F. APPROVED PIPE.
G. 18" MINIMUM UNLESS OTHERWISE SPECIFIED.
H. TRENCH DIMENSIONS AS FOLLOWS:

PIPE DIAMETER	"H"
6" – 30"	4"
GREATER THAN 30"	6"

PIPE DIAMETER	"W"
6" – 30"	8"
GREATER THAN 30"	12"

STANDARD DETAIL	DATE: 5/7/2007 REV: 7/6/2020	EMBEDMENT CLASS "C" FOR GRAVITY PIPE WET CONDITIONS	N.T.S.	el paso WATER	DETAIL No. 173