LEC ENGINEERING INC.

LEADERSHIP EXCELLENCE COMMITMENT

Geotechnical Engineering Study

Mesa Street, Crestmont To Fiesta Reservoir, 24-Inch Water Transmission Line R302582.01
El Paso, Texas

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

September 2014

LEC ENGINEERING INC.

File No. LEI14-085
September 24, 2014

Ms. M. Isabel Vasquez, PE
Huitt-Zollars, Inc.
5822 Cromo Drive, Suite 210
El Paso, Texas 79912

Re: Geotechnical Engineering Study
Mesa Street, Crestmont To Fiesta Reservoir, 24-Inch Water Transmission Line R302582.01
El Paso, Texas

Dear Ms. Vasquez:

We thank you for the opportunity to present the enclosed geotechnical engineering report to Huitt-Zollars, Inc. (Client) for the above referenced project. This engineering report was prepared in accordance with the authorized scope of services as presented in our proposal No. LEIP14 - 021 dated January 9, 2014, executed on May 7, 2014 and with authorization to proceed on June 2, 2014. The information we are presenting herein, describes the procedures utilized for field and laboratory investigation, along with the results of our study. This report includes our evaluation of the data obtained and engineering recommendations for design and construction of the proposed 24-inch water line alignment.

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

Respectfully submitted,

LEC ENGINEERING, INC.

Bernardino Olague, P.E.

STATE OF TEXAS
BERNARDINO OLAGUE
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9/24/14

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1.0 INTRODUCTION

We have completed the geotechnical engineering study for the design and construction of the Mesa Street, Crestmont to Fiesta Reservoir, 24-inch Water Transmission Line project. The proposed water transmission line will start at Beaumont Place and will end at the Fiesta Reservoir. We were authorized to conduct this study on June 7, 2013 by Ms. M. Isabel Vasquez, P.E., representing Huitt-Zollars, Inc. (Client).

2.0 PROJECT DESCRIPTION

The project consists of the design and construction of the Mesa Street, Crestmont to Fiesta Reservoir, 24-inch Water Transmission Line project. The limits of the project will commence at Crestmont Drive (at its intersection with Beaumont Place), will continue southeast following a drainage easement (that runs between N. Mesa St. and Beaumont Place) toward Mesa Hills Drive, continuing along Mesa Hills Drive heading west-southwest, toward to Cabaret Drive, on to Confetti Drive, then to South Festival, and then along a driveway (that leads to a church), and finally up to the Fiesta Reservoir Site. The project is located in west El Paso, Texas.

3.0 ENGINEERING INVESTIGATION

3.1 Field Exploration

In our field exploration phase, we drilled eight (8) soil borings to depths ranging between 4 feet and 16-½ feet below ground surface elevation along

the proposed water transmission line alignment. During our field exploration we encountered auger refusal as follows:

Auger Refusal (AR)

Boring No.	Location	Depth to AR (Feet)
B-1	Beaumont Pl. (Sta. 3+50)	Reached target depth 16 ½ ft.
B-2	Drainage Easement (Sta. 12+00)	12½
B-3	Mesa Hills Dr. (Sta. 25+00)	8½
B-4	Cabaret Dr. (Sta. 36+50)	12
B-5	Cabaret Dr. (Sta. 42+00)	4
B-6	Cabaret Dr. (Sta. 55+00)	12½
B-7	Confetti Dr. (Sta. 58+00)	4
B-8	S. Festival Dr. (Sta. 58+20)	2

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 street references provided by Client. The soil boring locations are shown in the Boring Plan included in the Appendix of this report in Sheet A-1.

We also prepared a log of each soil boring to delineate the soil strata studied along the proposed water transmission line section. The soil boring logs (B-1 through B-8) are included in the Appendix as Sheets A-2 through A-9. A key to the soil terminology used in the borings is included as Sheets A-20 and A-21.

We conducted Standard Penetration Tests (SPT) at each representative soil strata in the soil borings to determine the relative density 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 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 the 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 native 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. The results of nine (9) particle size analyses are included in the

Appendix in Sheets A-10 through A-18. A summary of the test results is presented in Sheet A-19 of the Appendix.

4.0 GENERAL SITE CONDITIONS

4.1 Area Geology

The project site is located in the Delnorte-Canutio Association. This association is described as nearly level to steep soils that are shallow or very shallow over caliche or that are deep and gravelly throughout; mainly on and near foot slopes of the Franklin Mountains.

In this association are nearly level to steep soils that occur mainly on the foot slopes but also lie in or near arroyos and alluvial fans below the Franklin Mountains. The association has a total area of about 63,700 acres.

About 55 percent of the acreage is Delnorte soils, 18 percent is Canutio Soils, and 27 percent is minor soils. The Delnorte soils, which occupy most of the higher and steeper areas, typically have a surface layer of pinkish-gray, calcareous very gravelly loam about 6 inches thick. This is underlain by strongly cemented or indurated caliche about 24 inches thick. Below the caliche is gravelly fine sand.

The Canutio soils lie in arroyos and on alluvial fans between the hills. They are deep, nearly level to sloping soils that are calcareous very gravelly sandy loam throughout.

4.2 Site Topography

The project alignment traverses a relatively level topography, as observed at the time of our exploration, a change of several feet in elevation was observed throughout the alignment.

4.3 Site Vegetation

The majority of the proposed water transmission line alignment is relatively free of vegetation, with the exception of the drainage easement, where we observed perennial grasses and small weeds.

4.4 Soil Stratigraphy

The soils encountered along the proposed water transmission line alignment depths below the pavement structure can be divided into two generalized soil strata as follows:

Stratum A, consisting of fine to medium grained silty sands and poorly graded sands with traces to some clay, was encountered from surface elevation or underlying the pavement section, to depths ranging from 2 feet to 7½ feet, and throughout the soil profile in boring B-2. These soils were encountered at a dry to moist condition, with moisture contents ranging from 1 to 5 percent, and at a medium dense to very dense relative density with SPT values ranging from 19 to more than 50 blows per foot of penetration. A clayey sand lens was encountered in boring B-2, from 4 feet to 7 feet. The clayey sand has liquid limit of 37 and a plasticity index of 22. These soils have a percent passing the No. 200 sieve ranging from 10 to 21

percent. The soils in this stratum may be classified as SM, SC, and SP-SM in accordance with the USCS.

Stratum B, consisting of coarse gravels blended with various amounts of sand and silt and occasional cobbles, was encountered from depths of ½-foot to 2-½ feet below surface elevation, and extended to the total depth explored in all borings, except boring B-2. The soils were encountered at a moist condition, with tested moisture content ranging from 3 to 7 percent, and at a very dense relative density with SPT values ranging from 17 to more than 50 blows per foot of penetration. These soils have a percent passing the No. 200 sieve ranging from 7 to 24 percent. The soils in this stratum may be classified as GP, GM, or a combination of these in accordance with the USCS.

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 gravel and cobbles in the above strata. However, based on the degree of difficulty in our drilling program at the site, we anticipate that the size of cobbles will exceed 5 inches in diameter.

Based on the natural stratigraphy in the vicinity of the project site, igneous rock formations may be encountered within the project site. We noticed some large cobbles near the project site during our field exploration. However, due to our drilling methodology and sampling tools, we could not define the horizontal and vertical extent of these rock outcrops.

Furthermore, excavation in these soils will require the use of heavy-duty equipment.

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 believed to be at depths well below the depth of new flexible pavements and related excavations at the project site.

5.0 ENGINEERING EVALUATION

5.1 Subsurface Soil Conditions & Recommendations

The soils encountered in strata A and B are considered suitable for use as the bearing stratum for the planned installation of the water pipelines and related structures, provided that any particles greater than 3 inches are removed prior to their installation as trench backfill.

We recommend that these soils could be used as support directly beneath the planned pipelines and related structures provided. Depending on the bearing depth of the planned structures, these soils should be over-excavated and replaced with structural fill to a minimum depth of 8 inches. The horizontal limits of any excavation associated with a structural element shall extend 12 inches beyond the footing line.

We recommend that support structures be designed using an allowable soil bearing capacity of 2,500 pounds per square foot, with a minimum support width of 36 inches.

The foundation system designed and constructed in accordance with the above recommendations should experience a total settlement of less than one inch.

We have also classified the soils in Stratum A and Stratum B in accordance with ASTM Designation 2321, which allows the determination of a stable subsurface environment for underground pipe installation.

5.2 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 in Stratum A and Stratum B are considered Type C and B materials, respectively. For temporary slopes in soil trenching for this project, Type B soils can have a maximum slope of 1 horizontal to 1 vertical, and Type C soils can have a maximum slope of 1½ horizontal to 1 vertical.

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

Trenchless Pipeline Installation

In the event that trenchless methods are required, the use of jack-and-bore techniques may be implemented as part of this project. Considering the nature of the site soils, which include large gravels, cobbles and possibly boulders, the Contractor shall make provisions to account for site conditions. However, it is the responsibility of the Contractor to determine the right type of equipment. It is not unusual to install a steel casing that will house the 24-inch water line. It is the Contractor's responsibility to ensure that no differential movement and/or settlement may occur due to any space between the earth tunnel and the steel casing.

5.3 Subsurface Structures

We recommend the following values to be used in earth pressure computations for design of thrust blocks and other subsurface or below grade structures. These values consider the Rankine method for cohesionless pipe bedding and trench backfill materials, as follows:

- Angle of Internal Friction, $\Phi = 33°$
- Unit Weight of Soil, $\gamma_w = 125$ lbs./ft^3
- Passive Earth Resistance $= 145$ lbs./ft^3

The wall-soil interface friction angle may be computed as follows:

$$\Phi_w = 0.67\Phi$$

Coefficients of active and at-rest condition pressure are given below, along with the equivalent fluid pressures for generalized wall sections are presented in the table below. These lateral earth pressures vary depending on the backfill soil type at the proposed earth-retaining structures.

Bearing Depth	Estimated Angle of Internal Friction (degrees)	Estimated Unit Weight (lb/ft^3)	Lateral Earth Pressure Coefficient		Lateral Earth Pressure (lb/ft^2)	
			Active	At-rest	Active	At-rest
5 feet	31	115	0.29	0.51	33.4	58.7
5 to 10 feet	33	120	0.34	0.54	40.6	64.8
< 15 feet	34	125	0.39	0.56	48.8	70

The below grade structures may be designed using an allowable soil bearing capacity table included below.

Proposed Location	Allow. Bearing Capacity (psf)	Footing Width (in.)	Footing Depth (in.)	Compacted Subgrade [1] (in.)
5 feet	2,500	12	12	8
5 to 10 feet	2,800	12	18	8
< 15 feet	3,400	18	18	8

[1] Below Footing Elevation

Foundation system for the retaining structures designed using the above parameters may experience a total settlement of less than one inch. The foundation systems to be designed in accordance with the above criteria for the proposed retaining walls consider a safety factor of 3.0.

5.4 Pipe Bedding and Trench Backfill

The structural fill or resident subgrade soils used to support the waterline pipe should be granular, preferably cohesionless, and free of deleterious material and particles over 3 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 structural 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 fill material:

> CH, CL, MH, ML, OH, OL and PT, or soils that exceed a liquid limit of 40 and a plasticity index of 18.

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 should be at plus or minus 3 percentage points of optimum in accordance with the above standard.

The subgrade soils that will receive structural fill and consist of Stratum A or Stratum B should be compacted to a minimum of 95 percent of maximum density in accordance with ASTM D-1557 (modified Proctor) procedures.

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.

5.4 Flexible Pavement Recommendations

We understand that the flexible pavement sections will be used to reconstruct the affected street sections. Therefore, we used traffic loads of 630,000 equivalent single-axle load (ESAL) applications, which is the ESAL for non-residential collectors. Additionally, we assumed a California Bearing Ratio (CBR) value of 20 for pavement design calculations. Furthermore, the recommendations presented below take into consideration the existing pavement section thicknesses.

We recommend that the flexible pavement for the proposed street sections consists of the following thickness section:

Layer	Mesa Hills (in.)	Beaumont, Cabaret, Confetti and South Festival (in.)
Hot-Mix Asphaltic Concrete	3	2
Crushed Aggregate Base Course	6	4½
Compacted Subgrade or Structural Fill	8	8

Hot-mix asphaltic concrete surface course should comply with the requirements of Grade "C" mix paving mixture according to Item K3305 – Plant Mix Bituminous Pavements – of the City of El Paso Engineering Department Division II Paving Construction Details. The asphaltic concrete surface course shall be compacted to at least 98 percent as determined by the "Marshall Method". The Marshall stability of the mix shall be no less than

1,500 pounds when compacted to 75 blows and have a flow of between 8 and 16.

Crushed stone base course should comply with the requirements of Item 247 Type "A" Grade III Crushed Stone – of the Texas Department of Transportation Pavement Construction Details, as adopted by the City of El Paso Engineering Department Division II Paving Construction Details. The fine fraction passing the No. 40 sieve should have a tested liquid limit not greater than 40 and a plasticity index less than 12. The base course should be compacted to 100 percent of the maximum dry density as determined by ASTM D-1557 Modified Compaction Test and the moisture content maintained within plus or minus 2 percent of the optimum moisture content of the base material

6.0 ADDITIONAL CONSIDERATIONS

6.1 Construction Monitoring

We recommend that the client retain the geotechnical engineer (LEC Engineering Inc.) during the construction phase of this project to verify the findings of our study, and to provide supplemental recommendations 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 at the rate of one field densities per each lift of fill at a frequency of 250 linear feet of fill, in accordance with ASTM D-2922 or D-1556. Additionally, one moisture-density curve should be obtained for each type of material used in

accordance with ASTM D-1557, and one sieve analysis and one plasticity index for each type of imported material used, according to ASTM C-136, and D-4318. Concrete sampling and testing shall be carried out at a rate of one set of four cylinders per every 50 cubic yards or fraction thereof.

6.2 Limitations

We have performed our professional services, have obtained the data presented in this report, and have prepared our recommendations in accordance with generally accepted engineering principles and practices. Our conclusions and recommendations are based on the data obtained from eight (8) test borings and laboratory testing conducted on representative samples and on our knowledge of the project conditions at the time of our geotechnical engineering study.

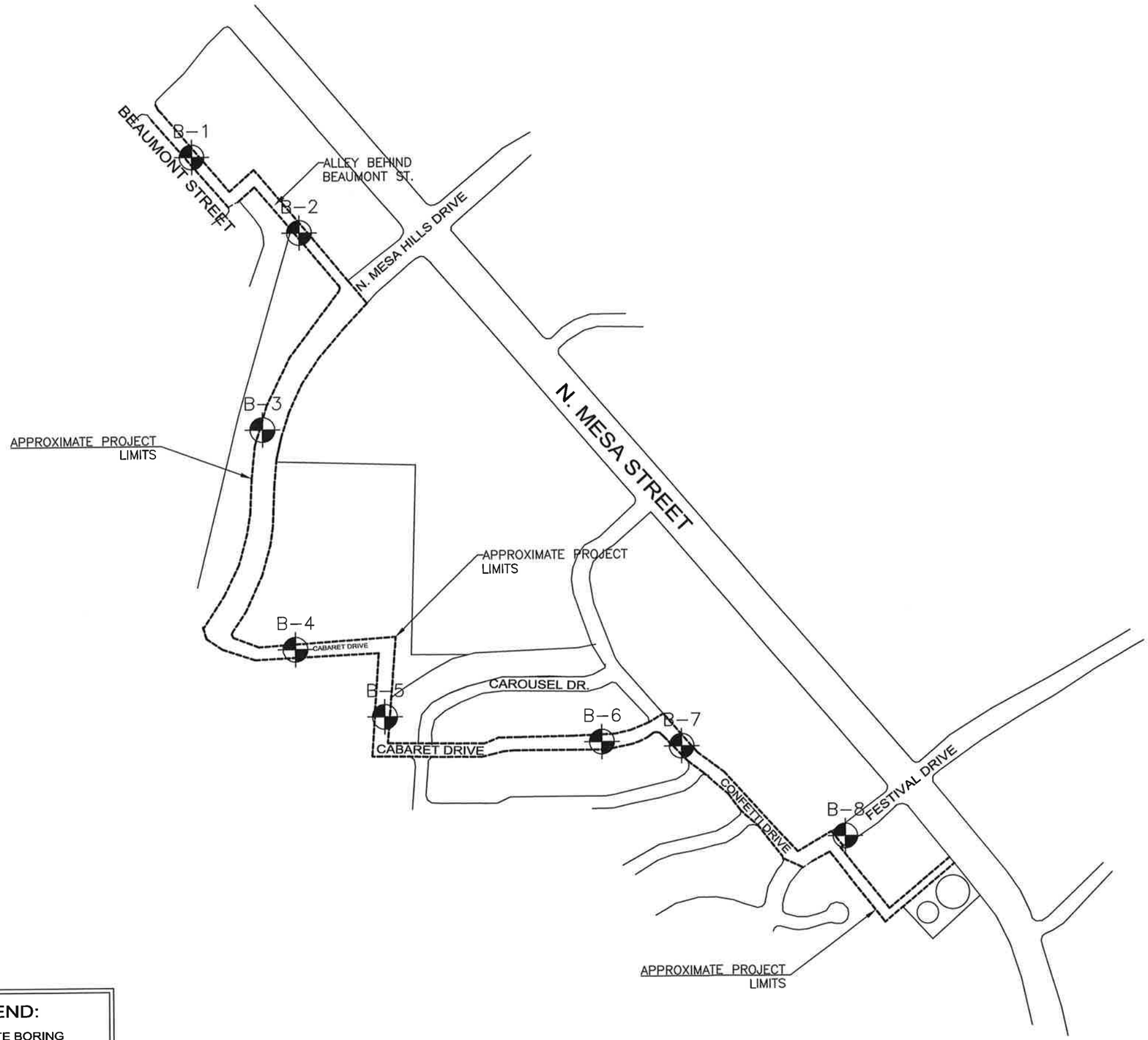
The data in this report reflects subsurface soil conditions only at the specific sampling location, time of sampling, and to the depths indicated in our report.

We recommend that the Client notify LEC Engineering Inc. 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 design of the Mesa, Crestmont to Fiesta Reservoir 24-inch Water Transmission Line. Use of this information for projects other than the one described herein will not be adequate.

Appendix



LEGEND:

B-1 APPROXIMATE BORING LOCATION AND NUMBER

LEC ENGINEERING INC.

DRAWING TITLE

BORING PLAN

PROJECT NAME

MESA ST., CRESTMONT TO FIESTA RESERVOIR
24-INCH WATER TRANSMISSION LINE PROJECT
EL PASO, TEXAS

DRAWN BY	REVIEWED BY	APPROVED BY	SCALE
I.O.	B.O.	B.O.	N.T.S
PROJECT No.	**FILE NAME**	**DATE**	**SHEET No.**
LEC14-085	SITE PLAN	9/8/14	A-1

LOG OF TEST BORING No. 1

Project name: Mesa St. to Crestmont to Fiesta Reservoir
File No.: LEI14-085
Boring location: See Sheet A-1
Surface elevation: Not Determined
Date drilled: June 9, 2014

LICON ENGINEERING CO.

Elevation and Depth (feet)	Samples	Soil symbols	Soil Description	USCS symbol	Moisture content, %	Minus #200 sieve, %	Liquid limit	Plastic limit	Plasticity index	SPT N-Value: Blows per foot (N)	SPT N-Value: CURVE (10 30 50)
0			3-in. Thick Hot Mix Asphaltic Concrete 6-in. Thick Base Course								
			SAND, fine grained, silty, light brown, dense, dry	SM	2.0	10.8	NV	NV	NP	44	
			GRAVEL, poorly graded, light gray, dense, dry, with silt	GP-GM							
3			-very dense at 2.5 feet		3.0					53	
			-very dense at 5 feet							53	
6											
			SAND, fine grained, silty, light brown, very dense, dry, with gravel		3.0	13.0	NV	NV	NP	61	61 →
9			-very dense at 10 feet							65	65 →
12				SM							
15			-medium dense AT 15 feet							15	
			Termination depth at 16.5 feet.								
18											

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: Hollow Stem Auger
Logger: A.E.

Sheet No. A-2

LOG OF TEST BORING No. 2

Project name: Mesa St. to Crestmont to Fiesta Reservoir
File No.: LEI14-085
Boring location: See Sheet A-1
Surface elevation: Not Determined
Date drilled: June 9, 2014

LICON ENGINEERING CO.

Elevation and Depth (feet)	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, light brown, very dense, dry, with gravel		1.0	21.2	NV	NV	NP	58	
3			-very dense, with gravel at 2.5 feet	SM						80	80 →
6			SAND, fine grained, clayey, light brown, dense, moist, with gravel	SC	6.0		37	15	22	44	
9			SAND, fine grained, silty, light brown, dry, with gravel -dense, dry, with gravel at 7.5 feet		2.0	16.3	NV	NV	NP	49	
12			-very dense, with gravel at 10 feet	SM						50	
15			Termination depth at 12.5 feet due to auger refusal								
18											

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: Hollow Stem Auger
Logger: A.E.

Sheet No. A-3

LOG OF TEST BORING No. 3

Project name: Mesa St. to Crestmont to Fiesta Reservoir
File No.: LEI14-085
Boring location: See Sheet A-1
Surface elevation: Not Determined
Date drilled: June 9, 2014

LICON ENGINEERING CO.

Elevation and Depth (feet)	Samples	Soil symbols	Soil Description	USCS symbol	Moisture content, %	Minus #200 sieve, %	Liquid limit	Plastic limit	Plasticity index	SPT N-Value: Blows per foot (N)	SPT N-Value: CURVE (10 30 50)
0			2-in. Thick Hot Mix Asphaltic Concrete 6-in. Thick Base Course								
			GRAVEL, light gray, dense, dry, with clay	GC						32	
3			-very dense, dry at 2.5 feet		4.0		32	15	17	73	73
			SAND, fine grained, silty, light brown, dense, dry								
6			-very dense at 5 feet	SM	1.0	10.0	NV	NV	NP	52	
			GRAVEL, poorly graded, gray, very dense, dry, with silt	GP-GM	1.0	9.4	NV	NV	NP	57	
9			Termination depth at 8.5 feet due to auger refusal								
12											
15											
18											

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: Hollow Stem Auger
Logger: A.E.

Sheet No. A-4

LOG OF TEST BORING No. 4

Project name: Mesa St. to Crestmont to Fiesta Reservoir
File No.: LEI14-085
Boring location: See Sheet A-1
Surface elevation: Not Determined
Date drilled: June 9, 2014

LICON ENGINEERING CO.

Elevation and Depth (feet)	Samples	Soil symbols	Soil Description	USCS symbol	Moisture content, %	Minus #200 sieve, %	Liquid limit	Plastic limit	Plasticity index	SPT N-Value: Blows per foot (N)	SPT N-Value: CURVE (10 30 50)
0			2-in. Thick Hot Mix Asphaltic Concrete 6-in. Thick Base Course								
			SAND, fine grained, clayey, light brown, medium dense, moist	SC						19	
3			GRAVEL, poorly graded, gray, very dense, moist, with clay	GP-GC	7.0		31	14	17	17	
			GRAVEL, poorly graded, gray, with silt and sand -medium dense at 5 feet	GP-GM	2.0	24.3				20	
6			-very dense at 7.5 feet							51	
9			GRAVEL, light gray, dense, dry, with silt	GM	2.0	12.9	NV	NV	NP	75	75 →
12			Termination depth at 12 feet due to auger refusal.								
15											
18											

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: Hollow Stem Auger
Logger: A.E.

Sheet No. A-5

LOG OF TEST BORING No. 5

Project name: Mesa St. to Crestmont to Fiesta Reservoir
File No.: LEI14-085
Boring location: See Sheet A-1
Surface elevation: Not Determined
Date drilled: June 16, 2014

LICON ENGINEERING CO.

Elevation and Depth (feet)	Samples	Soil symbols	Soil Description	USCS symbol	Moisture content, %	Minus #200 sieve, %	Liquid limit	Plastic limit	Plasticity index	SPT N-Value: Blows per foot (N)	SPT N-Value: CURVE (10 30 50)
0			2-in. Thick Hot Mix Asphaltic Concrete 6-in. Thick Base Course								
			SAND, fine grained, silty, light brown, dry, with gravel	SM	3.0	22.3	NV	NV	NP	54	
3			GRAVEL, poorly graded, gray, dry, with silt and sand	GP-GM	1.0					57	
			Termination depth at 4 feet due to auger refusal.								
6											
9											
12											
15											
18											

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: Hollow Stem Auger
Logger: A.E.

Sheet No. A-6

LOG OF TEST BORING No. 6

Project name: Mesa St. to Crestmont to Fiesta Reservoir
File No.: LEI14-085
Boring location: See Sheet A-1
Surface elevation: Not Determined
Date drilled: June 16, 2014

LICON ENGINEERING CO.

Elevation and Depth (feet)	Samples	Soil symbols	Soil Description	USCS symbol	Moisture content, %	Minus #200 sieve, %	Liquid limit	Plastic limit	Plasticity index	SPT N-Value: Blows per foot (N)	SPT N-Value: CURVE (10 30 50)
0			2-in. Thick Hot Mix Asphaltic Concrete 4-in. Thick Base Course								
			SAND, fine grained, clayey, light brown, medium dense, moist, with gravel	SC	5.0					19	
3			GRAVEL, poorly graded, gray, dry, with silt and sand	GP-GM						56	
			-very dense at 5 feet		1.0	8.9	NV	NV	NP	59	
6			-very dense at 7.5 feet		2.0	7.2	NV	NV	NP	54	
9			-very dense at 10 feet							57	
12			Termination depth at 12.5 feet due to auger refusal.								
15											
18											

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: Hollow Stem Auger
Logger: A.E.

Sheet No. A-7

LOG OF TEST BORING No. 7

Project name: Mesa St. to Crestmont to Fiesta Reservoir
File No.: LEI14-085
Boring location: See Sheet A-1
Surface elevation: Not Determined
Date drilled: June 16, 2014

LICON ENGINEERING CO.

Elevation and Depth (feet)	Samples	Soil symbols	Soil Description	USCS symbol	Moisture content, %	Minus #200 sieve, %	Liquid limit	Plastic limit	Plasticity index	SPT N-Value: Blows per foot (N)	SPT N-Value: CURVE (10 30 50)
0			3-in. Thick Hot Mix Asphaltic Concrete 6-in. Thick Base Course								
			SAND, fine grained, silty, light brown, very dense, dry, with gravel	SM	3.0	15.5	NV	NV	NP	50	
3			GRAVEL, light gray, very dense, dry, with clay	GC	2.0		24	17	7	57	
			Termination depth at 4 feet due to auger refusal.								
6											
9											
12											
15											
18											

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: Hollow Stem Auger
Logger: A.E.

Sheet No. A-8

LOG OF TEST BORING No. 8

Project name: Mesa St. to Crestmont to Fiesta Reservoir
File No.: LEI14-085
Boring location: See Sheet A-1
Surface elevation: Not Determined
Date drilled: June 16, 2014

LICON ENGINEERING CO.

Elevation and Depth (feet)	Samples	Soil symbols	Soil Description	USCS symbol	Moisture content, %	Minus #200 sieve, %	Liquid limit	Plastic limit	Plasticity index	SPT N-Value: Blows per foot (N)	SPT N-Value: CURVE (10 30 50)
0			3-in. Thick Hot Mix Asphaltic Concrete 3-in. Thick Base Course								
			GRAVEL, light gray, dense, dry, with silt	GM	3.0	13.7	NV	NV	NP	31	●
			Termination depth at 2 feet due to auger refusal.								
3											
6											
9											
12											
15											
18											

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: Hollow Stem Auger
Logger: A.E.

Sheet No. A-9

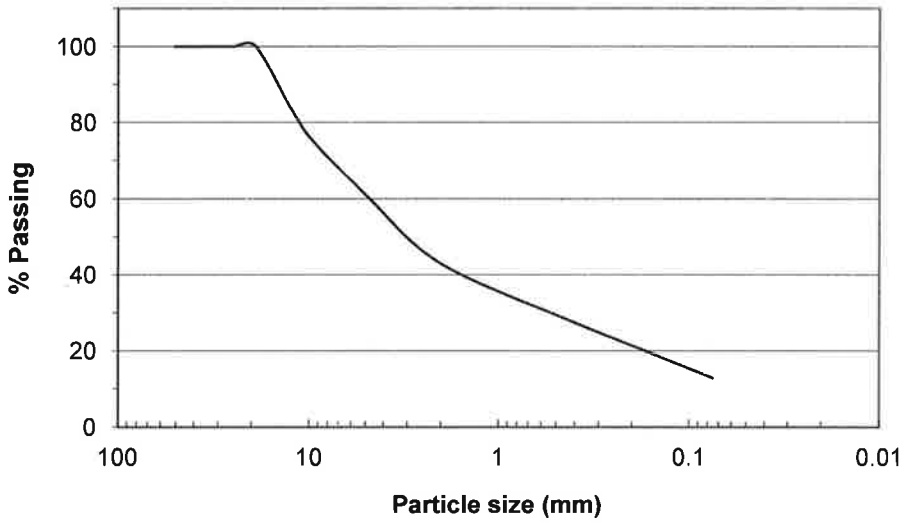
REPORT OF SIEVE ANALYSIS

Project Name:	Mesa St. to Crestmont to Fiesta Reservoir 24-inch Water Transmission Line	**Project Number:**	LEI14-085
Client:	Huitt-Zollars, Inc.	**Sample date:**	06/16/14

Sample Location: Boring 1 at 7 1/2 - 9 feet
Soil Classification (ASTM D2487): SM; Silty sand with gravel

Sieve Size	% Retained	% Passing
2" (50mm)	0	100
1-1/2" (37.5mm)	0	100
1" (25mm)	0	100
3/4" (19mm)	0	100
1/2" (12.5mm)	16	84
3/8" (9.5mm)	25	75
#4 (4.75mm)	40	60
#10 (2mm)	57	43
#40 (425 µm)	72	28
#100 (150 µm)	81	19
#200 (75 µm)	87.0	13.0

Grain Size Distribution



These tests were performed in general accordance with ASTM C 136 "Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates"

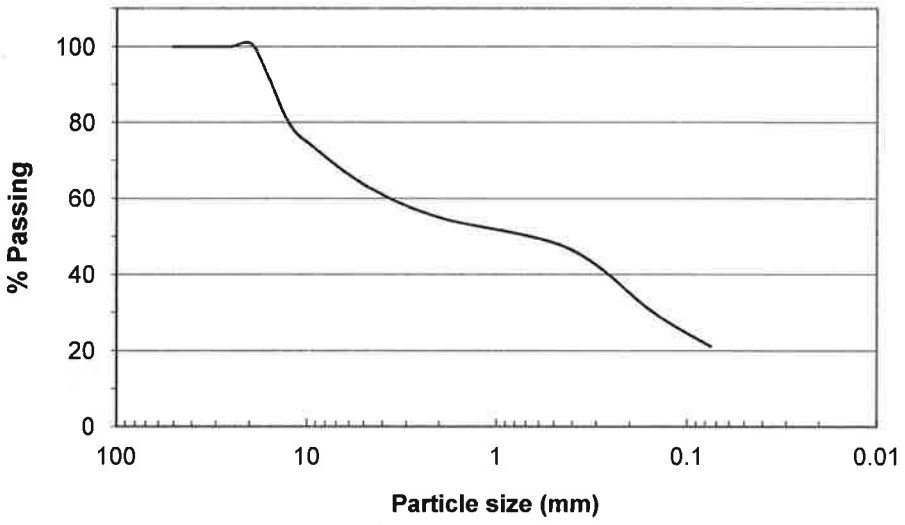
REPORT OF SIEVE ANALYSIS

Project Name:	Mesa St. to Crestmont to Fiesta Reservoir 24-inch Water Transmission Line	**Project Number:**	LEI14-085
Client:	Huitt-Zollars, Inc.	**Sample date:**	06/16/14

Sample Location: Boring 2 at 0 - 1 1/2 feet
Soil Classification (ASTM D2487): SM; Silty sand with gravel

Sieve Size	% Retained	% Passing
2" (50mm)	0	100
1-1/2" (37.5mm)	0	100
1" (25mm)	0	100
3/4" (19mm)	0	100
1/2" (12.5mm)	20	80
3/8" (9.5mm)	26	74
#4 (4.75mm)	37	63
#10 (2mm)	45	55
#40 (425 µm)	53	47
#100 (150 µm)	70	30
#200 (75 µm)	78.8	21.2

Grain Size Distribution



These tests were performed in general accordance with ASTM C 136 "Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates"

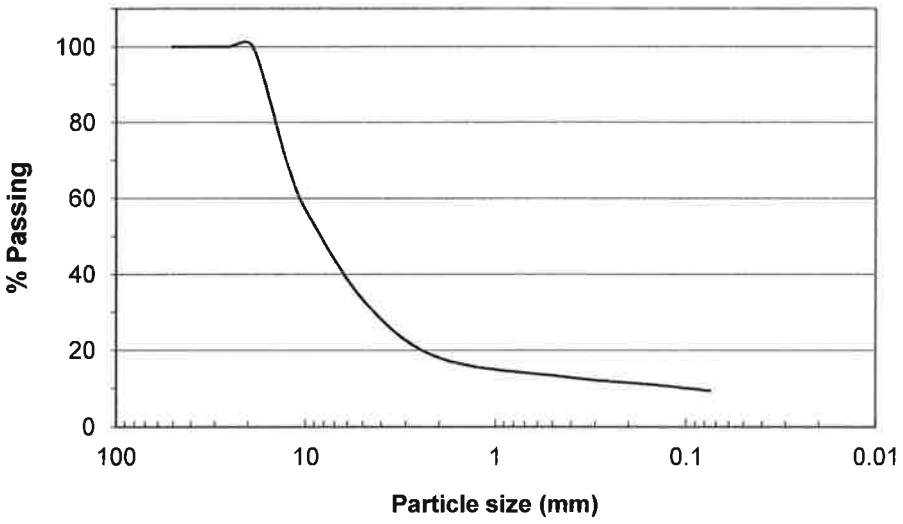
REPORT OF SIEVE ANALYSIS

Project Name:	Mesa St. to Crestmont to Fiesta Reservoir 24-inch Water Transmission Line	**Project Number:**	LEI14-085
Client:	Huitt-Zollars, Inc.	**Sample date:**	06/16/14

Sample Location: Boring 3 at 7 1/2 - 9 feet
Soil Classification (ASTM D2487): GP-GM; Poorly graded gravel with silt and sand

Sieve Size	% Retained	% Passing
2" (50mm)	0	100
1-1/2" (37.5mm)	0	100
1" (25mm)	0	100
3/4" (19mm)	0	100
1/2" (12.5mm)	31	69
3/8" (9.5mm)	45	55
#4 (4.75mm)	68	32
#10 (2mm)	82	18
#40 (425 µm)	87	13
#100 (150 µm)	89	11
#200 (75 µm)	90.6	9.4

Grain Size Distribution



These tests were performed in general accordance with ASTM C 136 "Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates"

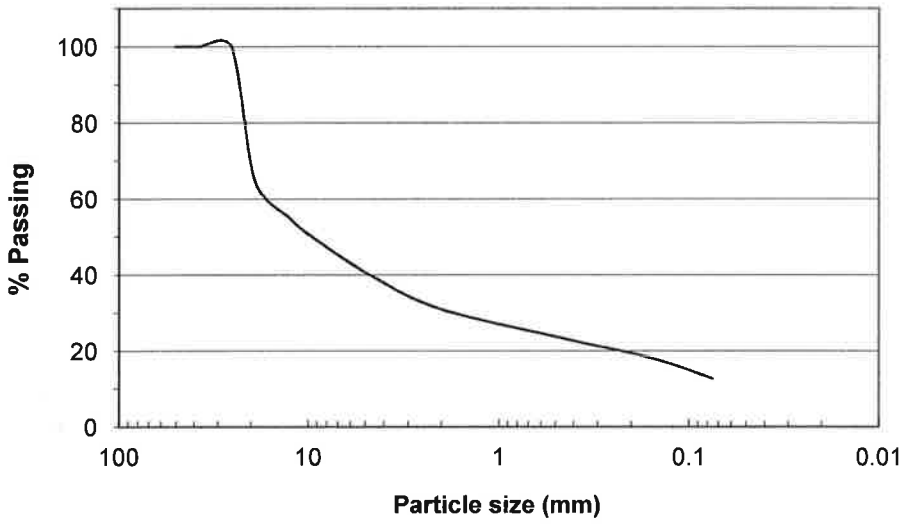
REPORT OF SIEVE ANALYSIS

Project Name:	Mesa St. to Crestmont to Fiesta Reservoir 24-inch Water Transmission Line	**Project Number:**	LEI14-085
Client:	Huitt-Zollars, Inc.	**Sample date:**	06/16/14

Sample Location: Boring 4 at 10 - 11 1/2 feet
Soil Classification (ASTM D2487): GM; Silty gravel with sand

Sieve Size	% Retained	% Passing
2" (50mm)	0	100
1-1/2" (37.5mm)	0	100
1" (25mm)	0	100
3/4" (19mm)	35	65
1/2" (12.5mm)	45	55
3/8" (9.5mm)	50	50
#4 (4.75mm)	60	40
#10 (2mm)	69	31
#40 (425 µm)	77	23
#100 (150 µm)	82	18
#200 (75 µm)	87.1	12.9

Grain Size Distribution



These tests were performed in general accordance with ASTM C 136 "Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates"

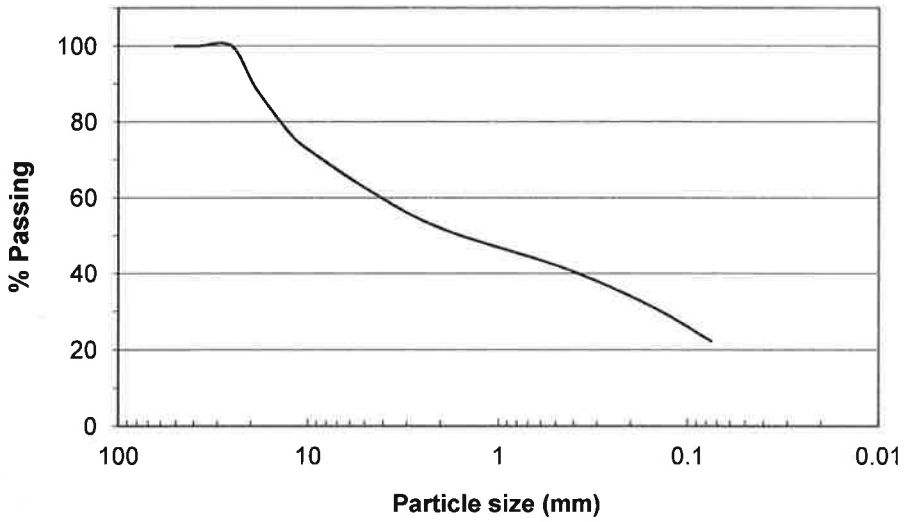
REPORT OF SIEVE ANALYSIS

Project Name:	Mesa St. to Crestmont to Fiesta Reservoir 24-inch Water Transmission Line	**Project Number:**	LEI14-085
Client:	Huitt-Zollars, Inc.	**Sample date:**	06/16/14

Sample Location: Boring 5 at 0 - 1 1/2 feet
Soil Classification (ASTM D2487): SM; Silty sand with gravel

Sieve Size	% Retained	% Passing
2" (50mm)	0	100
1-1/2" (37.5mm)	0	100
1" (25mm)	0	100
3/4" (19mm)	11	89
1/2" (12.5mm)	23	77
3/8" (9.5mm)	28	72
#4 (4.75mm)	38	62
#10 (2mm)	48	52
#40 (425 µm)	59	41
#100 (150 µm)	69	31
#200 (75 µm)	77.7	22.3

Grain Size Distribution



These tests were performed in general accordance with ASTM C 136 "Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates"

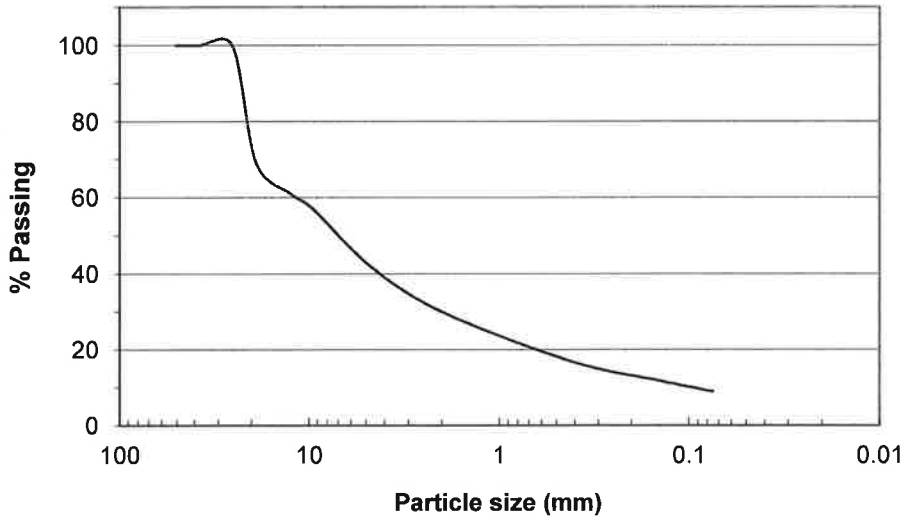
REPORT OF SIEVE ANALYSIS

Project Name:	Mesa St. to Crestmont to Fiesta Reservoir 24-inch Water Transmission Line	**Project Number:**	LEI14-085
Client:	Huitt-Zollars, Inc.	**Sample date:**	06/16/14

Sample Location: Boring 6 at 5 - 6 1/2 feet
Soil Classification (ASTM D2487): GP-GM; Poorly graded gravel with silt and sand

Sieve Size	% Retained	% Passing
2" (50mm)	0	100
1-1/2" (37.5mm)	0	100
1" (25mm)	0	100
3/4" (19mm)	31	69
1/2" (12.5mm)	39	61
3/8" (9.5mm)	43	57
#4 (4.75mm)	58	42
#10 (2mm)	70	30
#40 (425 µm)	83	17
#100 (150 µm)	88	12
#200 (75 µm)	91.1	8.9

Grain Size Distribution



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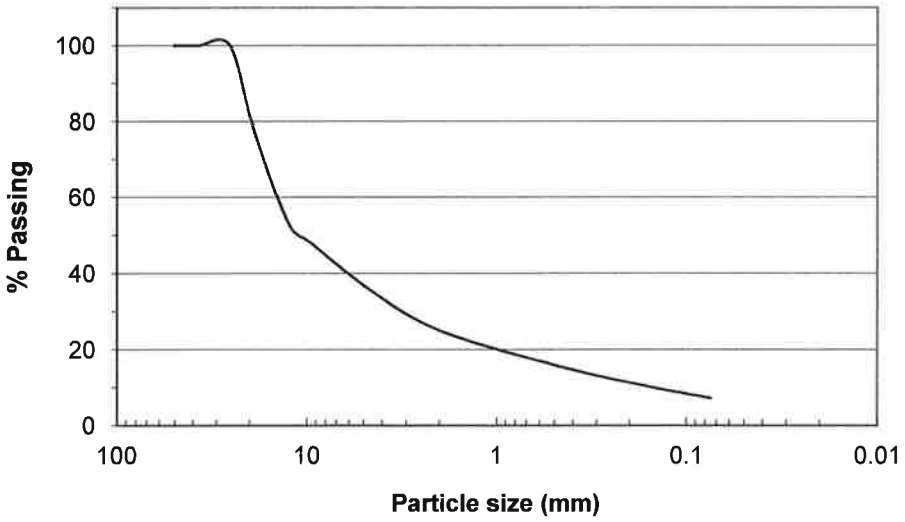
REPORT OF SIEVE ANALYSIS

Project Name:	Mesa St. to Crestmont to Fiesta Reservoir 24-inch Water Transmission Line	**Project Number:**	LEI14-085
Client:	Huitt-Zollars, Inc.	**Sample date:**	06/16/14

Sample Location: Boring 6 at 7 1/2 - 9 feet
Soil Classification (ASTM D2487): GP-GM; Poorly graded gravel with silt and sand

Sieve Size	% Retained	% Passing
2" (50mm)	0	100
1-1/2" (37.5mm)	0	100
1" (25mm)	0	100
3/4" (19mm)	22	78
1/2" (12.5mm)	47	53
3/8" (9.5mm)	52	48
#4 (4.75mm)	64	36
#10 (2mm)	75	25
#40 (425 µm)	85	15
#100 (150 µm)	90	10
#200 (75 µm)	92.8	7.2

Grain Size Distribution



These tests were performed in general accordance with ASTM C 136 "Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates"

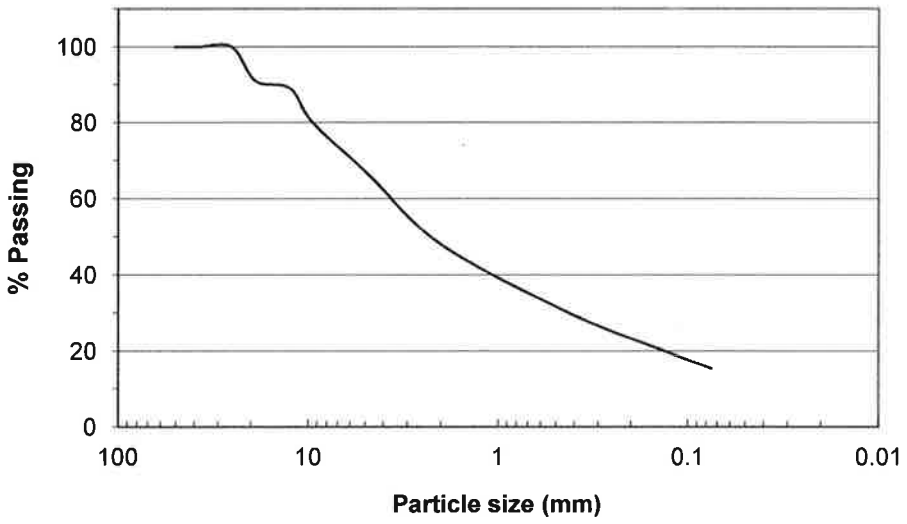
REPORT OF SIEVE ANALYSIS

Project Name:	Mesa St. to Crestmont to Fiesta Reservoir 24-inch Water Transmission Line	**Project Number:**	LEI14-085
Client:	Huitt-Zollars, Inc.	**Sample date:**	06/16/14

Sample Location: Boring 7 at 0 - 1 1/2 feet
Soil Classification (ASTM D2487): SM; Silty sand with gravel

Sieve Size	% Retained	% Passing
2" (50mm)	0	100
1-1/2" (37.5mm)	0	100
1" (25mm)	0	100
3/4" (19mm)	9	91
1/2" (12.5mm)	11	89
3/8" (9.5mm)	20	80
#4 (4.75mm)	34	66
#10 (2mm)	52	48
#40 (425 µm)	70	30
#100 (150 µm)	79	21
#200 (75 µm)	84.5	15.5

Grain Size Distribution



These tests were performed in general accordance with ASTM C 136 "Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates"

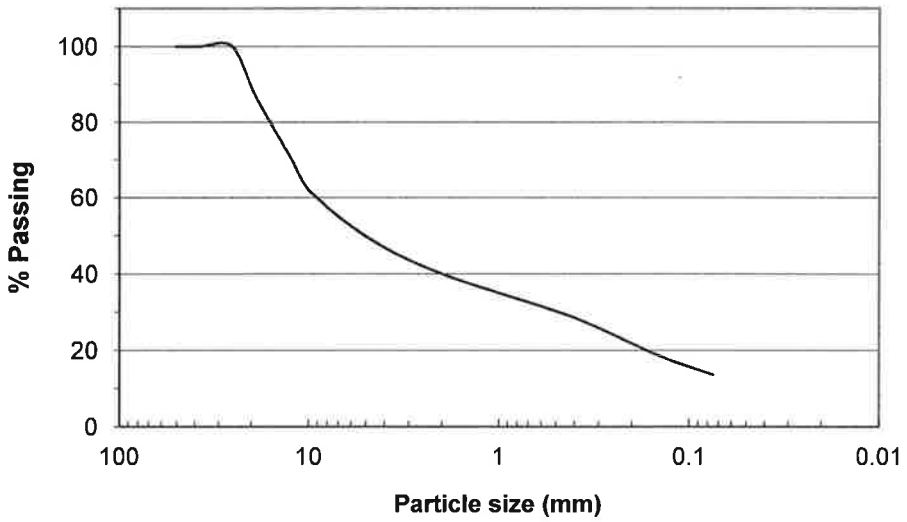
REPORT OF SIEVE ANALYSIS

Project Name:	Mesa St. to Crestmont to Fiesta Reservoir 24-inch Water Transmission Line	**Project Number:**	LEI14-085
Client:	Huitt-Zollars, Inc.	**Sample date:**	06/16/14

Sample Location: Boring 8 at 0 - 1 1/2 feet
Soil Classification (ASTM D2487): GM; Silty gravel with sand

Sieve Size	% Retained	% Passing
2" (50mm)	0	100
1-1/2" (37.5mm)	0	100
1" (25mm)	0	100
3/4" (19mm)	13	87
1/2" (12.5mm)	29	71
3/8" (9.5mm)	39	61
#4 (4.75mm)	51	49
#10 (2mm)	60	40
#40 (425 µm)	71	29
#100 (150 µm)	81	19
#200 (75 µm)	86.3	13.7

Grain Size Distribution



These tests were performed in general accordance with ASTM C 136 "Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates"

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 - 10	Loose	0 - 40
10 - 30	Medium Dense	40 - 70
30 - 50	Dense	70 - 90
More than 50	Very Dense	90 - 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:

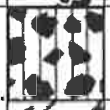
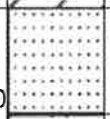
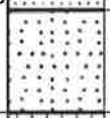
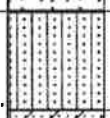
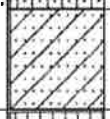
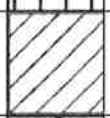
Compressive Strength* (Tons per Square Foot)	Descriptive Term	Penetration Resistance** (Blows per Foot)
Less than 0.25	Very Soft	Less than 2
0.25 - 0.50	Soft	2 - 4
0.50 - 1.00	Firm	5 - 8
1.00 - 2.00	Stiff	9 - 15
2.00 - 4.00	Very Stiff	16 - 50
4.00 and higher	Hard	50 and higher

* 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.

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

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