Geotechnical Engineering Report

Sanitary Sewer Interceptor 118 Upgrade
Various Locations
Carlsbad, New Mexico

August 11, 2015

Terracon Project No.68155081

Prepared for:

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Prepared by:

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Geotechnical ■ Environmental ■ Construction Materials ■ Facilities

EXECUTIVE SUMMARY

A geotechnical exploration has been performed for the proposed Sanitary Sewer Interceptor 118 Upgrade to be located along San Jose Boulevard, West Pecan Street and Ridgeway Street in Carlsbad, New Mexico. Terracon's geotechnical scope of work included the advancement of nine (9) test borings (4 borings for the San Jose Boulevard alignment, 3 borings for the West Pecan Street alignment, 2 borings for the Ridgeway Street alignment) to approximate depths of 2 to 11-1/2 feet below ground surface (bgs). Auger refusal was encountered due to very dense cemented soils in Borings B-2, B-3, and B-4 at the San Jose Boulevard alignment (4, 2 and 4 feet bgs respectively), Borings B-5, B-6 and B-7 at the West Pecan Street alignment (9 and 2 feet bgs), and Borings B-8 and B-9 at the Ridgeway Street alignment (7 and 6-1/2 feet bgs).

Based on the information obtained from our subsurface exploration, the site is suitable for development of the proposed project. The following geotechnical considerations were identified:

- The site soils in the sewer line installation areas generally consisted of silty gravel with sand, lean clay, silty clayey sand with gravel, clayey sand and sandy silt with varying degrees of carbonate cementation from the surface to the total explored depths. Groundwater was not encountered in the test borings at the time of drilling.

- **Design Pavement Sections**: San Jose Boulevard-5" AC over 11" ABC over 10" Compacted Subgrade. West Pecan Street-3" AC over 8" ABC over 10" Compacted Subgrade. Ridgeway Street-2" AC over 6" ABC over 10" Compacted Subgrade.

- The 2009 International Building Code, Table 1613.5.2 IBC seismic site classification is C.

- Close monitoring of the construction operations discussed herein will be critical in achieving the design subgrade support. We therefore recommend that Terracon be retained to monitor this portion of the work.

This geotechnical executive summary should be used in conjunction with the entire report for design and/or construction purposes. It should be recognized that specific details were not included or fully developed in this section, and the report must be read in its entirety for a comprehensive understanding of the items contained herein. The section titled **GENERAL COMMENTS** should be read for an understanding of the report limitations.

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Terracon

August 11, 2015

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Re: Geotechnical Engineering Report
Sanitary Sewer Interceptor 118 Upgrade
Various Locations
Carlsbad, New Mexico
Terracon Project No. 68155081

Terracon Consultants, Inc. (Terracon) has completed the geotechnical engineering services for the above referenced project. These services were performed in general accordance with our proposal number P6814-281G dated October 7, 2014. This geotechnical engineering report presents the results of the subsurface exploration and provides geotechnical recommendations concerning earthwork, utility installation and pavement sections for the proposed project.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.

JAMES D. COSPER, II
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REGISTERED PROFESSIONAL ENGINEER
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GEOTECHNICAL ENGINEERING REPORT
SANITARY SEWER INTERCEPTOR 118 UPGRADE
VARIOUS LOCATIONS
CARLSBAD, NEW MEXICO

Terracon Project No. 68155081
August 11, 2015

1.0 INTRODUCTION

This report presents the results of our geotechnical engineering services performed for the proposed Sanitary Sewer Interceptor 118 Upgrade to be located along San Jose Boulevard, West Pecan Street and Ridgeway Street in Carlsbad, New Mexico. Terracon's geotechnical scope of work included the advancement of nine (9) test borings (4 borings for the San Jose Boulevard alignment, 3 borings for the West Pecan Street alignment, 2 borings for the Ridgeway Street alignment) to approximate depths of 2 to 11-1/2 feet below ground surface (bgs). Auger refusal was encountered in Borings B-2, B-3, and B-4 at the San Jose Boulvard alignment (4, 2 and 4 feet bgs respectively), Borings B-5, B-6 and B-7 at the West Pecan Street alignment (9 and 2 feet bgs), and Borings B-8 and B-9 at the Ridgeway Street alignment (7 and 6-1/2 feet bgs) due to very dense cemented soils. Logs of the borings along with site location plan and boring location plan are included in Appendix A of this report.

The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- subsurface soil conditions
- earthwork
- trenching and soil slopes
- pavement sections

2.0 PROJECT INFORMATION

2.1 Project Description

Item	Description
Site layout	Refer to the Site Location Plan and Boring Location Plan (Exhibits A-1 and A-2)
Structures	The proposed project will include a new sanitary sewer line approximately 6,300 lineal feet.

Item	Description
Building construction	At the time of this proposal, the planned line size was unknown Construction activities will consist of trenching, excavation and backfilling. Re-paving of the streets will be associated with the project.
Finished elevation	Anticipated to match existing grades. The invert elevation of the utility is assumed to be on the order of 4 to 8 feet below existing grade.
Maximum loads	Unknown
Grading	Cuts and fills of about 5 to 10 feet are anticipated.
Cut and fill slopes	Permanent slopes are not anticipated for this project
Below Grade Areas	Sewer lines

2.2 Site Location and Description

Item	Description
Location	Project area referenced as: Sanitary Sewer Line (approx. 6,300 lineal ft.) from National Parks Highway(US62/180) to Kircher Street, the alignment will be adjacent to San Jose Blvd., Pecan St and Ridgeway Street. Project areas are all in Carlsbad, New Mexico
Existing site features	Roadways and undeveloped areas
Current ground cover	Asphalt surfacing and native soils
Existing topography	Relatively flat

3.0 SUBSURFACE CONDITIONS

3.1 Typical Subsurface Profile

Specific conditions encountered at the boring locations are indicated on the individual boring logs included in Appendix A of this report. Stratification boundaries on the boring logs represent the approximate location of changes in soil types; in-situ, the transition between materials may be gradual. Based on the results of the borings, subsurface conditions on the project site can be generalized as follows:

San Jose Boulevard Alignment

Description	Approximate Depth to Bottom of Stratum (feet)	Material Encountered*	Consistency/Density
Stratum 1	2 to 11-1/2 (auger refusal at 2 and 4 feet bgs in	Silty Gravel with Sand (Boring B-1 from surface to	Stiff to Very Stiff/Loose to Medium Dense

Description	Approximate Depth to Bottom of Stratum (feet)	Material Encountered*	Consistency/Density
	Borings B-2 thru B-4 due to very dense cemented soils)	depth of about 10 feet bgs, Borings B-3 and B-4 from surface to depths of 2 and 4 feet bgs) and Sandy Lean Clay (Boring B-1 from about 10 feet bgs to 11-1/2 feet bgs, Boring B-2 from surface to a depth of about 4 feet bgs).	

*All soils contained varying degrees of carbonate cementation

West Pecan Street Alignment

Description	Approximate Depth to Bottom of Stratum (feet)	Material Encountered*	Consistency/Density
Stratum 1	2 to 9 (auger refusal at 2 and 9 feet bgs in Borings B-5 thru B-7 due to very dense cemented soils)	Lean Clay (Boring B-5 from below the asphalt surface to depth of about 9 feet bgs), Silty Clayey Sand with Gravel (Boring B-6 from below asphalt surface to depth of about 2 feet bgs) and Clayey Sand (Boring B-7 from surface to depth of about 2 feet bgs).	Stiff to Hard

*All soils contained varying degrees of carbonate cementation

Ridgeway Street Alignment

Description	Approximate Depth to Bottom of Stratum (feet)	Material Encountered*	Consistency/Density
Stratum 1	6-1/2 to 7 (auger refusal at 6-1/2 and 7 feet bgs in Borings B-8 and B-9 due to very dense cemented soils)	Sandy Silt	Medium Stiff to Very Stiff

*All soils contained varying degrees of carbonate cementation

Laboratory tests were conducted on selected soil samples and the test results are presented in Appendix B.

3.3 Groundwater

The boreholes were observed while drilling and after completion for the presence and level of groundwater. Groundwater was not observed in the borings while drilling, or for the short duration that the borings were allowed to remain open. However, this does not necessarily mean the borings terminated above groundwater. Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the borings were performed.

4.0 RECOMMENDATIONS FOR DESIGN AND CONSTRUCTION

4.1 Geotechnical Considerations

Based on the geotechnical engineering analyses, subsurface exploration, and laboratory test results, it is our opinion that the each sewer utility alignment could be supported on prepared native subgrade or imported embedment materials (depending on the subgrade soil conditions explained later in this report). The over-excavated subgrade soil surface at each of the sewer utility alignment should be moisture conditioned and compacted or proof-rolled as recommended in this report prior to construction or placement of the imported embedment materials. Construction or placement of the imported embedment materials should commence before excessive moisture loss of the subgrade occurs.

Generally, the on-site gravel and sand soils appear suitable for use as embedment materials beneath the sewer utility alignments. Clay and silt soils (Class IV soils) are not suitable for use as embedment materials. Imported embedment materials should be tested prior to fill placement to verify if compliance with the recommended engineered fill specification provided in the Earthwork section of this report has been achieved.

Geotechnical factors impacting the San **San Jose Boulevard** sewer utility alignment are areas of hard cemented clay soils encountered in Boring B-2 below a depth of about 4 feet bgs and very dense cemented sand soils encountered in Borings B-3 and B-4 below depths of about 2 to 4 feet bgs. Difficult excavations that may require heavy duty of specialized equipment are anticipated to depths greater than about 2 and 4 feet bgs in the areas of Borings B-2 thru B-4. Shallow auger refusal was encountered in each of these borings. Subsurface soil verification may be required for the trench design in these areas.

Areas of concern for the **West Pecan Street** sewer utility alignment are hard cemented clay soils encountered in Boring B-5 at depths below about 7-1/2 feet bgs and very dense sand soils encountered in Borings B-6 and B-7 below a depth of about 2 feet bgs. Difficult excavations that may require heavy duty or specialized equipment are anticipated to depths greater than about 2 and 7-1/2 feet bgs in the areas of Borings B-5 thru B-7. Shallow auger refusal was

encountered in Borings B-6 and B-7 at a depth of 2 feet bgs. Subsurface soil verification may be required for the trench design in these areas.

Areas of concern for the **Ridgeway Street** sewer utility alignment are hard cemented silt soils encountered in Borings B-8 and B-9 below depths of about 6-1/2 to 7 feet bgs. Difficult excavations that may require heavy duty or specialized equipment are anticipated to depths greater than about 6-1/2 and 7 feet bgs in the areas of Borings B-8 and B-9.

Utility excavations should be observed by the geotechnical engineer. If the soil conditions encountered differ significantly from those presented in this report, supplemental recommendations will be required.

Design and construction recommendations and earth connected phases of the project are outlined below and, where appropriate, are generally based on the current issue of the New Mexico Standard Specifications for Public Works Construction (NMSSPWC).

Geotechnical engineering recommendations for utility installations, and other earth connected phases of the project are outlined below. The recommendations contained in this report are based upon the results of field and laboratory testing, engineering analyses, and our current understanding of the proposed project.

4.1.1 Lateral Earth Pressures (Pipeline)

Based on provided information, excavations of 5 to 10 feet bgs are expected. We understand that a system of trench boxes may be utilized below grade for aide in the installation of the sewer pipelines for each alignment with the exception of the shallow auger refusal areas. The following soil parameters, based on the test borings and laboratory results and engineering judgment, should be utilized in developing at-rest equivalent fluid pressures:

San Jose Boulevard Alignment

Depth Below Existing Grades, (feet)	Material Encountered in Soil Borings, (USCS)	Phi Angle, Ø (degrees)	Cohesion, c (psf)	Lateral Earth Pressure, At Rest	In-Situ Density, (pcf)
0 to 10 (Borings B-1), 0 to 2 (Boring B-3), 0 to 4 (Boring B-4)*	GM	32	--	55	115
10 to11-1/2 (Boring B-1) 0 to 4 (Boring B-2)*	CL	--	2,000	60	120

*Allowable bearing capacities of 3,000 psf can be used for design in auger refusal zones. An allowable bearing capacity of 1,000 psf can be used for design within the upper 10 feet of Boring B-1.

West Pecan Street Alignment

Depth Below Existing Grades, (feet)	Material Encountered in Soil Borings, (USCS)	Phi Angle, Ø (degrees)	Cohesion, c (psf)	Lateral Earth Pressure, At Rest	In-Situ Density, (pcf)
0 to 9 (Boring B-5)*	CL	--	1,750	66	115
0 to 2 (Borings B-6)*	SC-SM	34	--	52	115
0 to 2 (Borings B-7)*	SC	33	--	55	110

*Allowable bearing capacities of 3,000 psf can be used for design in auger refusal zones. An allowable bearing capacity of 1,500 psf can be used for design within the upper 9 feet of Boring B-5.

Ridgeway Street Alignment

Depth Below Existing Grades, (feet)	Material Encountered in Soil Borings, (USCS)	Phi Angle, Ø (degrees)	Cohesion, c (psf)	Lateral Earth Pressure, At Rest	In-Situ Density, (pcf)
0 to 6-1/2 and 7 (Borings B-8 and B-9)	ML	--	900	53	105

*Allowable bearing capacities of 3,000 psf can be used for design in auger refusal zones. An allowable bearing capacity of 1,000 psf can be used for design within the upper 6-1/2 to 7 feet of the Borings B-8 and B-9.

To limit lateral deflections, we recommended using at-rest pressure conditions.

4.1.2 Sewer Pipe Embedment Materials

We understand the proposed sewer lines are planned to bear at depths from about 4 to 8 feet below existing site grades for each alignment.

San Jose Boulevard Alignment

Based on the test borings, it appears the utilities will most likely bear on loose to medium dense silty gravel with sand (Boring B-1), very dense silty gravel with sand (Borings B-3 and B-4) or very stiff to hard sandy lean clay (Boring B-2).

West Pecan Street Alignment

Based on the test borings, it appears the utilities will most likely bear on stiff to hard lean clay (Boring B-5) or very dense clayey sand with varying amounts of silt and gravel (Borings B-6 and B-7).

Ridgeway Street Alignment

Based on the test borings, it appears the utilities will most likely bear on stiff to very stiff sandy silt (Borings B-8 and B-9).

Embedment materials shall consist of Class I, II, or III soils, or lean fill, as indicated in NMSSPWC Specifications Section 701, Subsection 701.13.3 (Flexible Pipe). Additionally, preparation, fill thickness and compaction of the embedment materials should follow Subsection 701.13, 701.14 and 701.15.

4.2 Earthwork

The following presents recommendations for site preparation, excavation, subgrade preparation and placement of engineered fills on the project. The recommendations presented for design and construction of earth supported elements are contingent upon following the recommendations outlined in this section.

Earthwork on the project should be observed and evaluated by Terracon. The evaluation of earthwork should include observation and testing of engineered fill, subgrade preparation, and other geotechnical conditions exposed during the construction of the project.

4.2.1 Site Preparation

Strip and remove existing vegetation, asphalt and other deleterious materials from proposed construction areas. Exposed surfaces should be free of mounds and depressions which could prevent uniform compaction.

Stripped materials consisting of vegetation and organic materials should be wasted from the site, or used to revegetate landscaped areas or exposed slopes after completion of grading operations.

The sites should be initially graded to create a relatively level surface to receive fill (if necessary), and to provide for a relatively uniform thickness of fill beneath utilities.

Although evidence of fills or underground facilities such as septic tanks, cesspools, utilities, and basements was not observed during the site reconnaissance, such features could be encountered during construction. If unexpected fills or underground facilities are encountered, such features should be removed and the excavation thoroughly cleaned prior to backfill placement and/or construction.

4.2.2 Excavation

It is anticipated that the majority of excavations for the proposed construction can be accomplished with conventional earthmoving equipment. However, hard/very dense cemented soils encountered at various depths in each of the alignments may require additional excavation effort and/or heavy duty/specialized excavation equipment. Therefore, a unit rate for difficult excavations should be included as a line item in the project bid documents.

On-site soils may pump or become unstable or unworkable at high water contents. Workability may be improved by scarifying and drying. Overexcavation of wet zones and replacement with

granular materials may be necessary. Lightweight excavation equipment may be required to reduce subgrade pumping.

Use of imported granular materials, lean concrete or geogrid could also be considered as a stabilization technique.

4.2.3 Subgrade Preparation

Exposed areas, which will receive fill or be constructed upon, once properly cleared and benched where necessary, should be scarified to a minimum depth of 10 inches, conditioned to near optimum moisture content, and compacted. If the exposed areas are terminated within the hard/very dense auger refusal layers, proof-rolling of subgrade soils surface may be performed as an alternative to the scarification method.

Areas of loose soils may be encountered at utility bearing depths after excavation is completed. When such conditions exist, the subgrade soils should be surficially compacted prior to placement of the utility or foundation. If sufficient compaction cannot be achieved in-place, the loose soils should be removed and replaced as engineered fill.

4.2.4 Fill Materials and Placement

All fill materials should be inorganic soils free of vegetation, debris, and fragments larger than six inches in size. Pea gravel or other similar non-cementitious, poorly-graded materials should not be used as fill or backfill without the prior approval of the geotechnical engineer. On-site gravel and sand soils may be used as **embedment** fill material.

On-site soils (gravel, sand, clay and silt) may be used as fill material for the following:

- foundation backfill
- utility backfill

Imported soils or on-site soils for use as **embedment** fill material should conform to low volume change materials as indicated in the following specifications:

Gradation	Percent Finer by Weight (ASTM C 136)
6"	100
3”	70-100
No. 4 Sieve	50-100
No. 200 Sieve	50 (max)

- Liquid Limit ..... 40 (max)
- Plasticity Index ..... 20 (max)

All fill should be placed and compacted in horizontal lifts, using equipment and procedures that will produce recommended moisture contents and densities throughout the lift. Fill lifts should not exceed ten inches loose thickness.

4.3 Utility Site Preparation

Site preparation is outlined in NMSSPWC Specification Section 200 and 300, Subsections 201 and 301, respectively.

Based upon the subsurface conditions determined from the geotechnical exploration, subgrade foundation soils for the sewer utility exposed during construction are anticipated to be relatively stable. However, the stability of the subgrade may be affected by precipitation, repetitive construction traffic or other factors. For stabilization techniques, NMSSPWC Specifications Section 304 should be consulted.

The individual contractor(s) is responsible for designing and constructing stable, temporary excavations as required to maintain stability of both the excavation sides and bottom. Excavations should be sloped or shored in the interest of safety following local and federal regulations, including current OSHA excavation and trench safety standards.

4.3.1 Utility Subgrade Preparation

Based on the NMSSPWC Specifications Section 700, and specifically subsection 701.3 and Table 701.3.A, it appears the utilities will bear on soils labeled as Class III soils (silty gravel with sand and clayey sand) or Class IV (lean clay and silt). However, the Class IV soils will have to be removed to a minimum depth of 12 inches below the flexible pipe utility and replaced with Class I, II, III soils or lean fill for proper embedment material. Depending on the condition of the Class III soils, stabilization of the subgrade may be necessary prior to utility construction. For stabilization techniques, NMSSPWC Specifications Section 304 should be consulted.

4.3.2 Utility Fill Materials Placement and Testing

NMSSPWC Specification Section 701, Subsections 701.13, 701.14 and 701.15 should be followed during the fill selection and method of compaction of the engineered soils. To comply with the NMSSPWC Specification 701.13, we anticipate that most of the on-site soils (Class III) will be sufficient. However, additional compensation should be allowed for the Class IV soils to be removed (as encountered in Borings B-2, B-5. B-8 and B-9) and replaced with Class I, II, and III imported soils or lean fill for a minimum thickness of 12 inches below the bottom of the flexible pipe elevation.

Based on the in-situ moisture contents of the laboratory tested soils, moisture conditioning will be necessary.

4.3.3 Excavation and Trench Construction

We understand excavations of 4 to 8 feet bgs are planned. Excavations into the on-site soils will encounter a variety of conditions and it is likely that caving soils could be encountered at some areas of the sewer utility alignments. The individual contractor(s) should be made responsible for designing and constructing stable, temporary excavations as required to maintain stability of both the excavation sides and bottom. All excavations should be sloped or shored in the interest of safety following local and federal regulations, including current OSHA excavation and trench safety standards.

For the sewer utility alignments, the overburden soils consisting of sandy lean clay and lean clay with sand (Borings B-2 and B-5) can be considered Type A soils when applying the OSHA regulations (OSHA 29 CFR Part 1926, Subpart P). For the sewer utility alignments, the sandy silt soils (Borings B-8 and B-9) can be considered Type B soils when applying the OSHA regulations (OSHA 29 CFR Part 1926, Subpart P). For the sewer utility alignments, the silty gravel with sand (Borings B-1, B-3 and B-4), silty clayey sand with gravel (Boring B-6) and clayey sand (Boring B-7) can be considered Type C soils when applying the OSHA regulations (OSHA 29 CFR Part 1926, Subpart P). OSHA recommends a maximum slope inclination of 0.75:1 (horizontal to vertical) for Type A soils, 1:1 for Type B soils and 1.5:1 for Type C soils in excavations of 20 feet or less. Flatter slopes may be required if caving soils or seepage is encountered in any excavation. If any excavation, including a utility trench, is extended to a depth of more than 20 feet, it will be necessary to have the side slopes designed by a professional engineer.

4.3.4 Compaction Requirements

Recommended compaction and moisture content criteria for engineered fill materials are as follows:

Material Type and Location	Per the Modified Proctor Test (ASTM D 1557)		
	Minimum Compaction Requirement (%)	Range of Moisture Contents for Compaction	
		Minimum	Maximum
Approved on-site or approved imported fill soils:			
Beneath foundations (if applicable):	95	-3%	+3%
Beneath utilities:	95	-3%	+3%
Utility and miscellaneous backfill	90	-3%	+3%

4.3.5 Grading and Drainage

Positive drainage should be provided during construction and maintained throughout the life of the proposed project. Infiltration of water into utility excavations or adjacent to foundations must

be prevented during construction. Backfill in utility line trenches should be well compacted and free of all construction debris to reduce moisture infiltration.

4.4 Seismic Considerations

Description	Value
2009 International Building Code Site Classification (IBC) [1]	C[2]
Site Latitude (midpoint of project site)	32.38366
Site Longitude (midpoint of project site)	-104.22938
Spectral Response Accelerations SMs and SM1 SMs = FaSs and SM1 = FvS1 Site Class C - Fa = 1.591, Fv = 2.4	
SM_S Spectral Acceleration for a Short Period (0.2 sec)	0.209g
SM1 Spectral Acceleration for a 1-Second Period	0.082g
SDs = 2/3 x SMs and SD1 = 2/3 x SM1	
SD_S Spectral Acceleration for a Short Period (0.2 sec)	0.139g
SD1 Spectral Acceleration for a 1-Second Period	0.054g

[1] Note: In general accordance with the *2009 International Building Code,* Table 1613.5.2.

[2] Note: The 2009 International Building Code (IBC) requires a site soil profile determination extending to a depth of 100 feet for seismic site classification. The current scope does not include the required 100 foot soil profile determination. The borings extending to a maximum depth of 11-1/2 feet, and this seismic site class definition considers that dense soil may be encountered below the maximum depth of the subsurface exploration. Additional exploration to deeper depths would be required to confirm the conditions below the current depth of exploration.

4.5 Corrosivity

Results of corrosivity testing are provided in Appendix B. The results of soluble sulfate testing indicate that ASTM Type I/II Portland cement should be suitable for concrete on and below grade for the length of the project.

Laboratory test results indicate that on-site soils have a pH values ranging from 8.7 to 8.8 and minimum resistivities ranging from 1,261 to 1,843 ohm-centimeters. The pH and minimum resistivity values should be used to determine potential corrosive characteristics of the on-site soils with respect to contact with the steel pipe materials that will be used for project construction. Values for pH and minimum resisitivity are commonly used to help evaluate the corrosion potential of the soil with respect to buried metal such as metal utility pipes and CMP culverts. This and other information is typically analyzed by a corrosion specialist to determine site specific recommendations. For specific recommendations regarding soil corrosivity, we recommend a corrosion specialist be consulted.

A number of methodologies have been developed by various agencies including American Water Works Association (AWWA) to determine the corrosion potential of soils with respect to buried metal. The AWWA scoring system is typically used to evaluate the corrosion potential of soil in relation to buried ductal iron pipe. Based on this scoring system, soils with a pH between 4 and 8.5 are considered to have a low impact on potential corrosion. Minimum resistivities above 2000 ohm-cm are also considered to have a low impact on potential corrosion. Minimum resistivities between 700 and 2000 ohm-cm are considered to have a significant corrosion potential, which increases with lower values. Values less than 700 ohm-cm are indicative of highly corrosive soils. Since the minimum resistivities range from 1,231 to 1,843 ohm-cm at this site, the soils are expected to have significant corrosion potential with respect to buried metal.

4.6 Topsoil Analysis

Three random topsoil samples were collected from different locations of the site (Borings B-1, B-4 and B-7). These samples were combined to achieve a composite representative sample of topsoil for laboratory/analytical testing for landscaping purposes. Laboratory tests included organic content, deleterious material, specific gravity and pH determination. Analytical testing was performed to determine mineral and herbicide contents. Organic content of the soils were determined to be 1.9% (Interlab test result presented in Appendix B of this report). The remaining results of these tests are included in Appendix B.

4.7 Pavement Recommendations

The following pavement section thicknesses have been performed to provide criteria for the construction of the proposed roadway.

4.7.1 Pavement Design and Construction

New pavement thicknesses developed for the project have been based on the procedures outlined in the Infrastructure Design Directive IDD-2008-05 by the New Mexico Department of Transportation (NMDOT). Estimated traffic criteria (based on traffic counts provided for San Jose Boulevard for a previously performed geotechnical study by Terracon) used for pavement thickness design includes single 18-kip equivalent standard axle loads (ESALs) of 1.3 million for San Jose boulevard. Estimated traffic criteria (based on previous experience with minor local traffic critera) used for pavement thickness design includes single 18-kip equivalent standard axle loads (ESALs) of 22,000 for West Pecan Street and Ridgeway Street. Based upon AASHTO criteria, New Mexico is located within Climatic Region V of the United States. This region is characterized as being dry, with freeze-thaw cycling. For design purposes, these conditions typically result in saturated or near-saturated subgrade soil moisture conditions for approximately 4 percent of the annual moisture variation cycle. For flexible pavement design of each roadway alignment, a terminal serviceability index of 2.0 was utilized along with an inherent reliability of 85 percent. Using the correlated design R-values (10 for San Jose Boulevard, 6 for West Pecan

Street, 46 for Ridgeway Street), appropriate EAL/day, environmental criteria and other factors, the structural numbers (SN) of the pavement sections were determined on the basis of the 1993 AASHTO design equation.

4.7.2 Recommended Pavement Sections

Recommended alternatives for flexible and rigid pavements are as follows:

PAVEMENT ALTERNATIVES

Traffic Area	Alternative	Recommended Pavement Section Thickness (inches)			
		Asphalt Concrete Surface	Aggregate Base Course	PCC Pavement	Total
San Jose Boulevard	A	5	11	---	16
	B	---	---	9	9
West Pecan Street	A	3	8	---	11
	B	---	---	6	6
Ridgeway Street	A	2	6	---	8
	B	---	---	5*	5*

*ACI minimum pavement thickness

Aggregate base course should consist of a blend of sand and gravel that meets strict specifications for quality and gradation. Use of materials meeting New Mexico Department of Transportation (NMDOT Section 304) specifications is recommended. Aggregate base course material should be tested to determine compliance with these specifications prior to importation to the site.

Aggregate base course materials should be placed in lifts not exceeding 6 inches and should be compacted to a minimum of 95% of the material's maximum modified Proctor density (ASTM D 1557) within a moisture content range of 2 percent below to 2 percent above optimum.

Asphalt concrete should be obtained from an approved mix design stating the optimum asphalt content, job mix formula, and recommended mixing and placing temperatures. The mix design should be submitted prior to construction to verify its adequacy. The asphalt materials should be placed in maximum 3.0-inch lifts.

4.7.3 Compliance

Recommendations for pavement construction presented depend upon compliance with recommended material specifications. To assess compliance, observation and testing should be performed under the direction of the geotechnical engineer.

4.7.4 Pavement Performance

Long term pavement performance will be dependent upon several factors, including maintaining subgrade moisture levels and providing for preventive maintenance. The following recommendations should be considered the minimum:

- Site grading at a minimum 2% grade away from the pavements;
- The subgrade and the pavement surface have a minimum ¼ inch per foot slope to promote proper surface drainage.
- Consider appropriate edge drainage and pavement under drain systems,
- Install pavement drainage surrounding areas anticipated for frequent wetting
- Install joint sealant and seal cracks immediately,
- Seal all landscaped areas in, or adjacent to pavements to minimize or prevent moisture migration to subgrade soils;
- Placing compacted, low permeability backfill against the exterior side of curb and gutter.

Preventive maintenance should be planned and provided for through an on-going pavement management program. Preventive maintenance activities are intended to slow the rate of pavement deterioration, and to preserve the pavement investment. Preventive maintenance consists of both localized maintenance (e.g. crack and joint sealing and patching) and global maintenance (e.g. surface sealing). Preventive maintenance is usually the first priority when implementing a planned pavement maintenance program and provides the highest return on investment for pavements. Prior to implementing any maintenance, additional engineering observation is recommended to determine the type and extent of preventive maintenance.

In new pavement areas, site grading is generally accomplished early in the construction phase. However as construction proceeds, the subgrade may be disturbed due to utility excavations, construction traffic, desiccation, or rainfall. As a result, the pavement subgrade may not be suitable for pavement construction and corrective action will be required. The subgrade should be carefully evaluated at the time of pavement construction for signs of disturbance or excessive rutting. If disturbance has occurred, pavement subgrade areas should be reworked, moisture conditioned, and properly compacted to the recommendations in this report immediately prior to paving.

In new pavement areas, we recommend the pavement areas be rough graded and then thoroughly proofrolled with a loaded tandem axle dump truck prior to final grading and paving. Particular attention should be paid to high traffic areas that were rutted and disturbed earlier and to areas where backfilled trenches are located. Areas where unsuitable conditions are located

should be repaired by removing and replacing the materials with properly compacted fills. All pavement areas should be moisture conditioned and properly compacted to the recommendations in this report immediately prior to paving.

5.0 GENERAL COMMENTS

Terracon should be retained to review the final design plans and specifications so comments can be made regarding interpretation and implementation of our geotechnical recommendations in the design and specifications. Terracon also should be retained to provide observation and testing services during grading, excavation, foundation construction and other earth-related construction phases of the project.

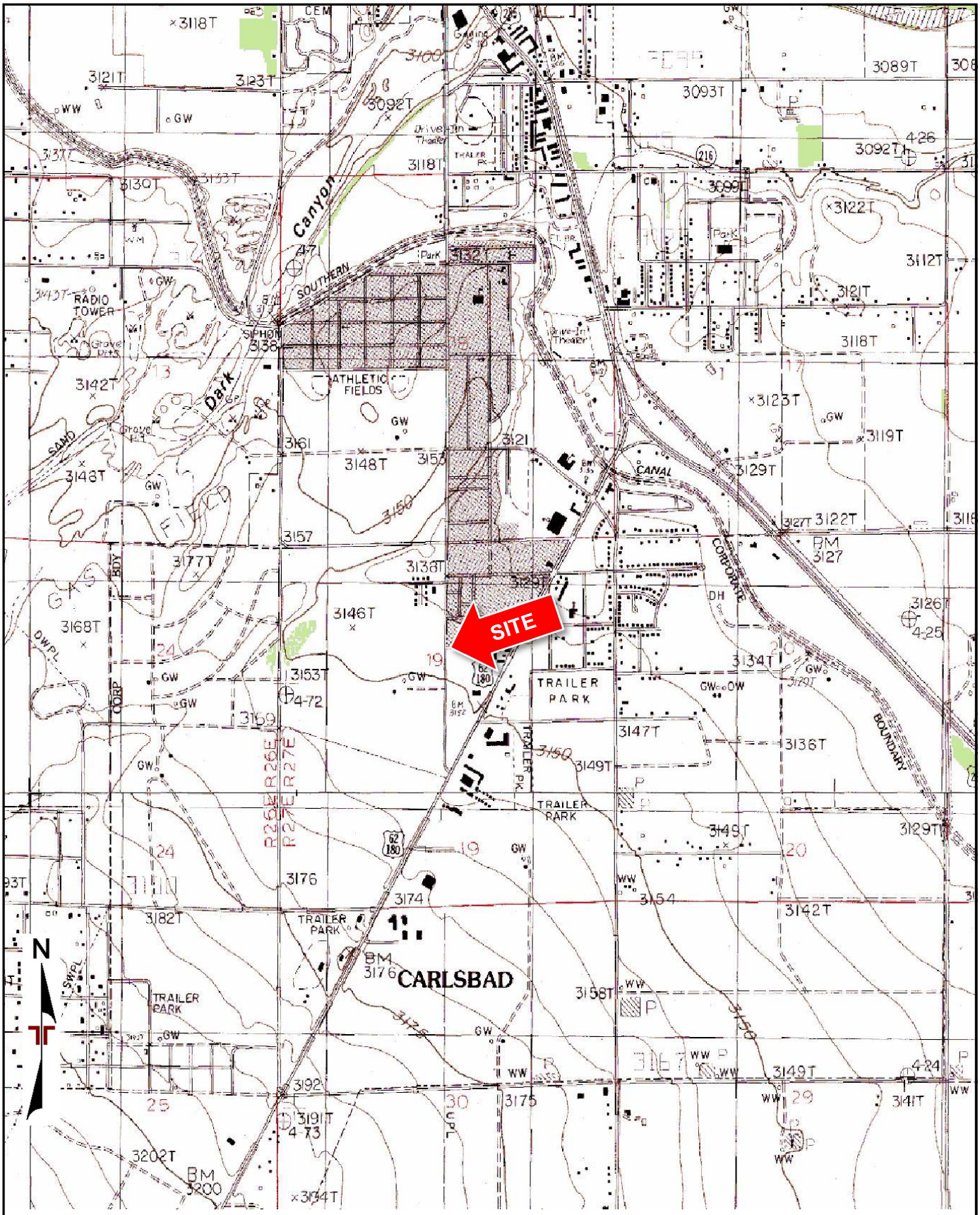
The analysis and recommendations presented in this report are based upon the data obtained from the borings performed at the indicated locations and from other information discussed in this report. This report does not reflect variations that may occur between borings, across the site, or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. If variations appear, we should be immediately notified so that further evaluation and supplemental recommendations can be provided.

The scope of services for this project does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either express or implied, are intended or made. Site safety, excavation support, and dewatering requirements are the responsibility of others. In the event that changes in the nature, design, or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless Terracon reviews the changes and either verifies or modifies the conclusions of this report in writing.

APPENDIX A

FIELD EXPLORATION



TOPOGRAPHIC MAP IMAGE COURTESY OF THE U.S. GEOLOGICAL SURVEY
QUADRANGLES INCLUDE: CARLSBAD WEST, NM (1/1/1985), CARLSBAD EAST, NM (1/1/1985), KITCHEN COVE, NM (1/1/1985) and OTIS, NM (1/1/1985).

Project Manager: DB	Project No. 68155081	Terracon 1640 Hickory Loop, Suite 105 Las Cruces, NM 88005	SITE LOCATION PLAN	Exhibit
Drawn by: RR	Scale: 1"=24,000 SF		Sanitary Sewer Interceptor 118 Upgrade **National Parks Hwy to Kircher Street running along San Jose Blvd., Pecan and Ridgeway Street** **Carlsbad, NM**	A-1
Checked by: DB	File Name: FIGURES			
Approved by: JDC	Date: 6/29/2015			

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

⊗ APPROXIMATE BORING LOCATION

AERIAL PHOTOGRAPHY PROVIDED BY MICROSOFT BING MAPS

Project Manager: DB	Project No. 68155081	Terracon 1640 Hickory Loop, Suite 105 Las Cruces, NM 88005	BORING LOCATION PLAN Sanitary Sewer Interceptor 118 Upgrade **National Parks Hwy to Kircher Street running along San Jose Blvd., Pecan and Ridgeway Street** **Carlsbad, NM**	Exhibit
Drawn by: RR	Scale: AS SHOWN			A-2
Checked by: DB	File Name: FIGURES			
Approved by: JDC	Date: 6/29/2015			

Field Exploration Description

A total of nine (9) test borings were drilled at the site on June 25, 2015. The borings were drilled to depths of about 2 to 11-1/2 feet below the ground surface at the approximate locations shown on the attached Boring Location Plan, Exhibit A-2. Auger refusal was encountered in Borings B-2 thru B-9 (2 to 9 feet bgs) due to very dense cemented soils.

The test borings were located as follows:

Borings	Location	Depth (feet)
B-1 thru B-4	San Jose Boulevard	2 to 11-1/2
B-5 thru B-7	West Pecan Street	2 to 9
B-8 and B-9	Ridgeway Street	6-1/2 to 7

The test borings were advanced with a truck-mounted CME-75 drill rig utilizing 8-inch diameter hollow-stem augers.

The borings were located in the field by using the proposed site plan and an aerial photograph of the site, and measuring from existing property lines. The accuracy of boring locations should only be assumed to the level implied by the method used.

Lithologic logs of each boring were recorded by the field engineer during the drilling operations. At selected intervals, samples of the subsurface materials were taken by driving split-spoon samplers. Bulk samples of subsurface materials were also obtained.

Penetration resistance measurements were obtained by driving the split-spoon samplers into the subsurface materials with a 140-pound automatic hammer falling 30 inches. The penetration resistance value is a useful index in estimating the consistency or relative density of materials encountered.

A CME automatic SPT hammer was used to advance the split-barrel sampler in the borings performed on this site. The effect of the automatic hammer's efficiency has been considered in the interpretation and analysis of the subsurface information for this report.

Groundwater conditions were evaluated in the borings at the time of site exploration.

BORING LOG NO. B-1

PROJECT: SANITARY SEWER INTERCEPTOR 118 UPGRADE

CLIENT: HDR ALBUQUERQUE, NM

SITE: SAN JOSE BLVD., W. PECAN ST. AND RIDGEWAY ST. CARLSBAD, NEW MEXICO

LOCATION San Jose Blvd.

Latitude: 32.37669° Longitude: -104.22919°

Approximate Surface Elev: 3162 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
SILTY GRAVEL WITH SAND (GM), light brown							
medium dense			8-6-10 N=16	3		NP	37
loose		5	4-3-4 N=7				
medium dense			4-5-6 N=11				
10.0	3152+/-	10					
SANDY LEAN CLAY (CL), stiff			4-5-5 N=10				
11.5	3150.5+/-						
Boring Terminated at 11.5 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Terracon
1640 Hickory Loop, Suite 105
Las Cruces, New Mexico

Boring Started: 6/24/2015 | Boring Completed: 6/24/2015
Drill Rig: CME 75 | Driller: R. Sosa
Project No.: 68155081 | Exhibit: A-4

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 68155081.GPJ

BORING LOG NO. B-2

PROJECT: SANITARY SEWER INTERCEPTOR 118 UPGRADE

CLIENT: HDR ALBUQUERQUE, NM

SITE: SAN JOSE BLVD., W. PECAN ST. AND RIDGEWAY ST. CARLSBAD, NEW MEXICO

LOCATION San Jose Blvd.

Latitude: 32.37939° Longitude: -104.22917°

Approximate Surface Elev: 3159 (Ft.) +/-

GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	SANDY LEAN CLAY (CL), trace gravel, light brown									
	very stiff					12-15-14 N=29	6		28-14-14	64
	4.0	3155+/-								
	Auger Refusal Due to Very Dense Cemented Soils at 4 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Terracon
1640 Hickory Loop, Suite 105
Las Cruces, New Mexico

Boring Started: 6/24/2015 | Boring Completed: 6/24/2015
Drill Rig: CME 75 | Driller: R. Sosa
Project No.: 68155081 | Exhibit: A-5

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 68155081.GPJ

BORING LOG NO. B-3

PROJECT: SANITARY SEWER INTERCEPTOR 118 UPGRADE

CLIENT: HDR ALBUQUERQUE, NM

SITE: SAN JOSE BLVD., W. PECAN ST. AND RIDGEWAY ST. CARLSBAD, NEW MEXICO

LOCATION San Jose Blvd.

Latitude: 32.38173° Longitude: -104.2291°

Approximate Surface Elev: 3151 (Ft.) +/-

GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	SILTY GRAVEL WITH SAND (GM), light brown						2		NP	39
	2.0	3149+/-								
	Auger Refusal Due to Very Dense Cemented Soils at 2 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Terracon
1640 Hickory Loop, Suite 105
Las Cruces, New Mexico

Boring Started: 6/24/2015 | Boring Completed: 6/24/2015
Drill Rig: CME 75 | Driller: R. Sosa
Project No.: 68155081 | Exhibit: A-6

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 68155081.GPJ

BORING LOG NO. B-4

PROJECT: SANITARY SEWER INTERCEPTOR 118 UPGRADE

CLIENT: HDR ALBUQUERQUE, NM

SITE: SAN JOSE BLVD., W. PECAN ST. AND RIDGEWAY ST. CARLSBAD, NEW MEXICO

LOCATION San Jose Blvd.

Latitude: 32.38366° Longitude: -104.22938°

Approximate Surface Elev: 3145 (Ft.) +/-

GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	SILTY GRAVEL WITH SAND (GM), light brown									
	medium dense					6-5-9 N=14	5		NP	29
	4.0	3141+/-								
	Auger Refusal Due to Very Dense Cemented Soils at 4 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Terracon
1640 Hickory Loop, Suite 105
Las Cruces, New Mexico

Boring Started: 6/24/2015 | Boring Completed: 6/24/2015
Drill Rig: CME 75 | Driller: R. Sosa
Project No.: 68155081 | Exhibit: A-7

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 68155081.GPJ

BORING LOG NO. B-5

PROJECT: SANITARY SEWER INTERCEPTOR 118 UPGRADE

CLIENT: HDR ALBUQUERQUE, NM

SITE: SAN JOSE BLVD., W. PECAN ST. AND RIDGEWAY ST. CARLSBAD, NEW MEXICO

LOCATION W. Pecan St.

Latitude: 32.38391° Longitude: -104.2272°

Approximate Surface Elev: 3155 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.3	3154.5+/-								
ASPHALT, 3 1/2" Asphalt thickness									
LEAN CLAY WITH SAND (CL), dark brown									
very stiff				X	7-7-13 N=20	14		41-20-21	83
		5							
stiff				X	4-5-9 N=14				
hard, gravel in shoe				X	3-31-50/5"				
9.0	3146+/-								
Auger Refusal Due to Very Dense Cemented Soils at 9 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Terracon
1640 Hickory Loop, Suite 105
Las Cruces, New Mexico

Boring Started: 6/25/2015 | Boring Completed: 6/25/2015
Drill Rig: CME 75 | Driller: R. Sosa
Project No.: 68155081 | Exhibit: A-8

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 68155081.GPJ

BORING LOG NO. B-6

PROJECT: SANITARY SEWER INTERCEPTOR 118 UPGRADE

CLIENT: HDR ALBUQUERQUE, NM

SITE: SAN JOSE BLVD., W. PECAN ST. AND RIDGEWAY ST. CARLSBAD, NEW MEXICO

LOCATION W. Pecan St.

Latitude: 32.38395° Longitude: -104.22572°

Approximate Surface Elev: 3142 (Ft.) +/-

GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	0.3 **ASPHALT**	3141.5+/-								
	SILTY CLAYEY SAND WITH GRAVEL (SC-SM), light brown						2		19-13-6	30
	2.0	3140+/-								
	Auger Refusal Due to Very Dense Cemented Soils at 2 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Terracon
1640 Hickory Loop, Suite 105
Las Cruces, New Mexico

Boring Started: 6/25/2015 | Boring Completed: 6/25/2015
Drill Rig: CME 75 | Driller: R. Sosa
Project No.: 68155081 | Exhibit: A-9

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 68155081.GPJ

BORING LOG NO. B-7

PROJECT: SANITARY SEWER INTERCEPTOR 118 UPGRADE

CLIENT: HDR ALBUQUERQUE, NM

SITE: SAN JOSE BLVD., W. PECAN ST. AND RIDGEWAY ST. CARLSBAD, NEW MEXICO

LOCATION W. Pecan St.

Latitude: 32.38414° Longitude: -104.22464°

Approximate Surface Elev: 3136 (Ft.) +/-

GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	CLAYEY SAND (SC), trace gravel, light brown						3		24-16-8	34
	2.0	3134+/-								
	Auger Refusal Due to Very Dense Cemented Soils at 2 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Terracon
1640 Hickory Loop, Suite 105
Las Cruces, New Mexico

Boring Started: 6/25/2015 | Boring Completed: 6/25/2015
Drill Rig: CME 75 | Driller: R. Sosa
Project No.: 68155081 | Exhibit: A-10

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 68155081.GPJ

BORING LOG NO. B-8

PROJECT: SANITARY SEWER INTERCEPTOR 118 UPGRADE

CLIENT: HDR ALBUQUERQUE, NM

SITE: SAN JOSE BLVD., W. PECAN ST. AND RIDGEWAY ST. CARLSBAD, NEW MEXICO

LOCATION Ridgeway St.

Latitude: 32.38567° Longitude: -104.22462°

Approximate Surface Elev: 3131 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
SANDY SILT (ML), light brown								
stiff			X	5-5-6 N=11	6		NP	67
very stiff		5	X	5-5-11 N=16				
7.0	3124+/-							
Auger Refusal Due to Very Dense Cemented Soils at 7 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Terracon
1640 Hickory Loop, Suite 105
Las Cruces, New Mexico

Boring Started: 6/25/2015 | Boring Completed: 6/25/2015
Drill Rig: CME 75 | Driller: R. Sosa
Project No.: 68155081 | Exhibit: A-11

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 68155081.GPJ

BORING LOG NO. B-9

PROJECT: SANITARY SEWER INTERCEPTOR 118 UPGRADE

CLIENT: HDR ALBUQUERQUE, NM

SITE: SAN JOSE BLVD., W. PECAN ST. AND RIDGEWAY ST. CARLSBAD, NEW MEXICO

LOCATION Ridgeway St.

Latitude: 32.38804° Longitude: -104.22459°

Approximate Surface Elev: 3130 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
SANDY SILT (ML), brown									
medium stiff to stiff				X	5-4-4 N=8	2		NP	70
		5		X	5-4-4 N=8				
6.5	3123.5+/-								
Auger Refusal Due to Very Dense Cemented Soils at 6.5 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Terracon
1640 Hickory Loop, Suite 105
Las Cruces, New Mexico

Boring Started: 6/25/2015 | Boring Completed: 6/25/2015
Drill Rig: CME 75 | Driller: R. Sosa
Project No.: 68155081 | Exhibit: A-12

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 68155081.GPJ

APPENDIX B

LABORATORY TESTING

Laboratory Testing

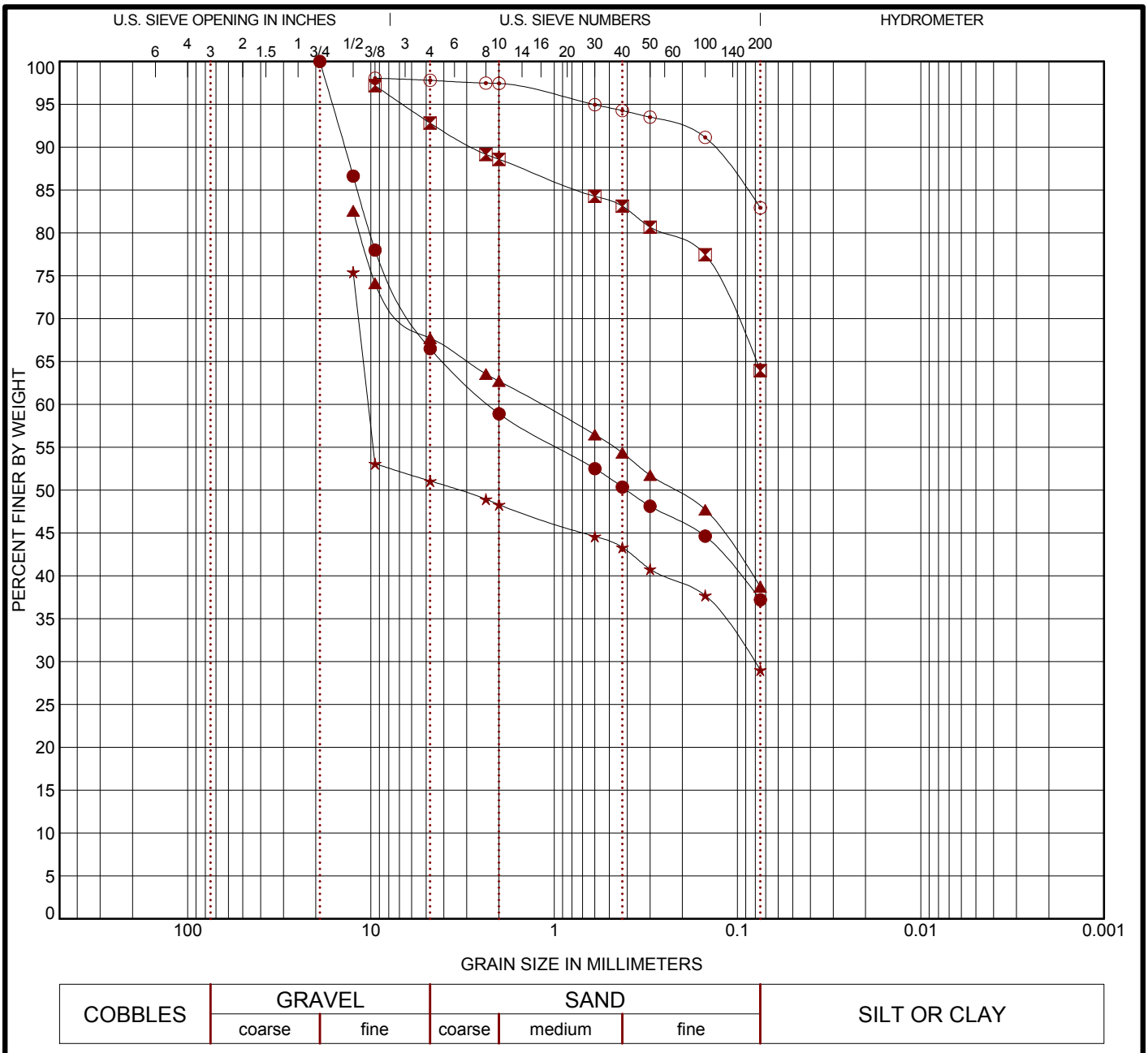
Soil samples were tested in the laboratory to measure their natural water content. Grain size and top soil analysis testing were also performed on selected samples. The test results are provided on the boring logs and presented in Appendix B.

Descriptive classifications of the soils indicated on the boring logs are in accordance with the enclosed General Notes and the Unified Soil Classification System. Also shown are estimated Unified Soil Classification Symbols. A brief description of this classification system is attached to this report in Appendix C. All classification was by visual/manual procedures, (ASTM D2487). Selected samples were further classified using the results of Atterberg limit testing, (ASTM D4318). The Atterberg limit test results are also provided on the boring logs.

Procedural standards noted above are for reference to methodology in general. In some cases, variations to methods are applied as a result of local practice or professional judgment.

GRAIN SIZE DISTRIBUTION

ASTM D422



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring ID	Depth	USCS Classification	LL	PL	PI	Cc	Cu
●	B-1	2.5 - 4	SILTY GRAVEL with SAND(GM)	NP	NP	NP		
⊠	B-2	2.5 - 4	SANDY LEAN CLAY(CL)	28	14	14		
▲	B-3	0 - 2	SILTY GRAVEL with SAND(GM)	NP	NP	NP		
★	B-4	2.5 - 4	SILTY GRAVEL with SAND(GM)	NP	NP	NP		
⊙	B-5	2.5 - 4	LEAN CLAY with SAND(CL)	41	20	21		

	Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Fines
●	B-1	2.5 - 4	19	2.267			33.5	29.3	37.2
⊠	B-2	2.5 - 4	9.5				4.4	28.9	64.0
▲	B-3	0 - 2	12.5	1.185			14.8	29.0	38.7
★	B-4	2.5 - 4	12.5	10.343	0.081		24.4	22.0	29.0
⊙	B-5	2.5 - 4	9.5				0.2	14.9	82.9

PROJECT: SANITARY SEWER INTERCEPTOR 118 UPGRADE

SITE: SAN JOSE BLVD., W. PECAN ST. AND RIDGEWAY ST. CARLSBAD, NEW MEXICO

Terracon
1640 Hickory Loop, Suite 105
Las Cruces, New Mexico

PROJECT NUMBER: 68155081

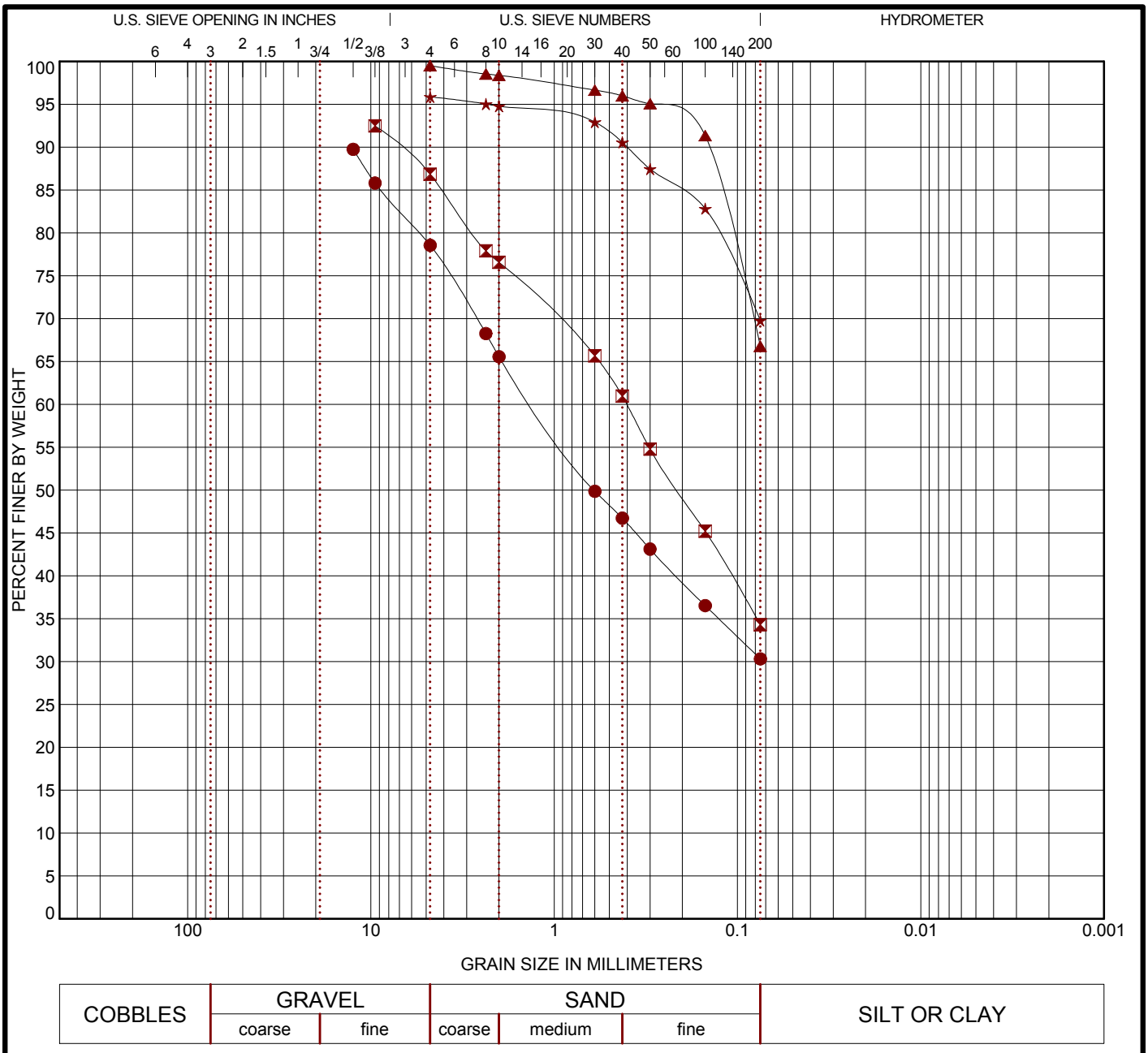
CLIENT: HDR ALBUQUERQUE, NM

EXHIBIT: B-2

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS-2 68155081.GPJ TERRACON2012.GDT 8/11/15

GRAIN SIZE DISTRIBUTION

ASTM D422



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring ID	Depth	USCS Classification	LL	PL	PI	Cc	Cu
●	B-6	0 - 2	SILTY, CLAYEY SAND with GRAVEL(SC-SM)	19	13	6		
⊠	B-7	0 - 2	CLAYEY SAND(SC)	24	16	8		
▲	B-8	2.5 - 4	SANDY SILT(ML)	NP	NP	NP		
★	B-9	2.5 - 4	SANDY SILT(ML)	NP	NP	NP		

	Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Fines
●	B-6	0 - 2	12.5	1.306			11.2	48.2	30.3
⊠	B-7	0 - 2	9.5	0.402			5.6	52.5	34.3
▲	B-8	2.5 - 4	4.75				0.0	32.7	66.8
★	B-9	2.5 - 4	4.75				0.0	26.1	69.8

PROJECT: SANITARY SEWER INTERCEPTOR 118 UPGRADE

SITE: SAN JOSE BLVD., W. PECAN ST. AND RIDGEWAY ST. CARLSBAD, NEW MEXICO

Terracon
1640 Hickory Loop, Suite 105
Las Cruces, New Mexico

PROJECT NUMBER: 68155081

CLIENT: HDR ALBUQUERQUE, NM

EXHIBIT: B-3

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS-2 68155081.GPJ TERRACON2012.GDT 8/11/15

CHEMICAL LABORATORY TEST REPORT

Project Number: 68155081
Service Date: 07/21/15
Report Date: 07/21/15
Task:

Terracon
750 Pilot Road, Suite F
Las Vegas, Nevada 89119
(702) 597-9393

Client

Project

Sanitary Sewer Interceptor 118 Upgrade

Sample Submitted By: Terracon (68) **Date Received:** 7/16/2015 **Lab No.: 15-0521**

Results of Resistivity Analysis

Sample Number			
Sample Location	B-1	B-5	B-9
Sample Depth (ft.)	5.0	5.0	5.0
pH Analysis, AWWA 4500 H	8.76	8.67	8.69
Water Soluble Sulfate (SO4), AWWA 4500 E (mg/kg)	94	96	102
Resistivity, ASTM G 57, (ohm-cm)	1795	1843	1261

Analyzed By: Kurt D. Ergun

Kurt D. Ergun
Chemist

The tests were performed in general accordance with applicable ASTM, AASHTO, or DOT test methods. This report is exclusively for the use of the client indicated above and shall not be reproduced except in full without the written consent of our company. Test results transmitted herein are only applicable to the actual samples tested at the location(s) referenced and are not necessarily indicative of the properties of other apparently similar or identical materials.

ANALYTICAL REPORT

450283

for

Project Manager: *Dan Cosper*

Project Name: Sanitary Sewer Interceptor 118 Upgrade

Friday, August 07, 2015

InterLab

151 S. Walnut St., #C-5 * Las Cruces, NM 88001

Phone (575) 527-9101 Fax (575) 527-9102

Interlab

Certificate of Analyses
No. 450283

Project Information

Client: Terracon

Project Manager: Dan Cosper

Project Name: Sanitary Sewer Interceptor 118 Upgrade

Project Location: Carlsbad, NM

Field Sample ID: San Jose Blv, Pecan St., & Ridgeway St. B-1,B-4,B-7 (combined) 0'-1'

Lab ID No.: 450283

Preservative: Ice

Date Sampled: Jul-28-15

Sample Depth: N/A

Sample Matrix: Soil

Date Received: Jul-28-15 4:20 PM

Test Description or Parameter	Test Method	Date Analyzed	LOQ	Final Results	Units*	Analyst
Sodium	SW846/6010	Aug-3-15	0.2	**1,990**	mg/kg	R.J.
Potassium	SW846/6010	Aug-3-15	0.2	**915**	mg/kg	R.J.
Calcium	SW846/6010	Aug-3-15	0.2	**11,519**	mg/kg	R.J.
Magnesium	SW846/6010	Aug-3-15	0.2	**10,799**	mg/kg	R.J.
SAR	EPA 200.7/Calculation	Aug-3-15	---	**3.19**	---	R.J.
pH	EPA 150.1	Jul-29-15	0-14	**8.74**	---	G.V.
Nitrate as (N)	SM 4500-NO3-Emod	Jul-30-15	0.1	**3.2**	mg/kg	G.V.
Organic Matter	Handbook 60	Aug-3-15	1	**1.9**	%	G.V.
Phosphorus	EPA 365.3	Jul-30-15	0.05	**35.73**	mg/kg	G.V.
Conductivity	EPA 120.1	Jul-29-15	1	**92**	u mhos/cm	G.V.
Texture by soil by feel	---	Jul-31-15	----	**Clay Loam**	---	G.V.

LOQ = Limit of Quantitation

*Units = Units for Measurement of Results and LOQ

ND = BQL = Below Quantitation Limit

Gracy K. Varughese

Gracy Varughese
Chief Analyst

Interlab

Herbicides Certificate of Analyses
No. 450283

Project Information

Client: Terracon

Project Manager: Dan Cosper

Project Name: Sanitary Sewer Interceptor 118 Upgrade

Project Location: Carlsbad, NM

Field Sample ID: San Jose Blv, Pecan St., & Ridgeway St. B-1,B-4,B-7 (combined) 0'-1'

Lab ID No.: 450283

Preservative: Ice

Date Sampled: Jul-28-15

Sample Depth: N/A

Sample Matrix: Soil

Date Received: Jul-28-15 16:20

Test Description or Parameter	Test Method	Date Analyzed	LOQ	Final Results	Units*	Analyst
2,4-D	SW846/-8151A	Aug-3-15	0.5	**<0.5**	µg/kg	R.J.
Silvex	SW846/-8151A	Aug-3-15	0.5	**<0.5**	µg/kg	R.J.

LOQ = Limit of Quantitation

*Units = Units for Measurement of Results and LOQ

ND = BQL = Below Quantitation Limit

Gracy K. Varughese

Gracy Varughese
Chief Analyst

APPENDIX C

SUPPORTING DOCUMENTS

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

SAMPLING

Auger	Split Spoon
Shelby Tube	Macro Core
Ring Sampler	Rock Core
Grab Sample	No Recovery

WATER LEVEL

- Water Initially Encountered
- Water Level After a Specified Period of Time
- Water Level After a Specified Period of Time

Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.

FIELD TESTS

(HP)	Hand Penetrometer
(T)	Torvane
(b/f)	Standard Penetration Test (blows per foot)
(PID)	Photo-Ionization Detector
(OVA)	Organic Vapor Analyzer

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance Includes gravels, sands and silts.			CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance			
Descriptive Term (Density)	Standard Penetration or N-Value Blows/Ft.	Ring Sampler Blows/Ft.	Descriptive Term (Consistency)	Unconfined Compressive Strength, Qu, psf	Standard Penetration or N-Value Blows/Ft.	Ring Sampler Blows/Ft.
Very Loose	0 - 3	0 - 6	Very Soft	less than 500	0 - 1	< 3
Loose	4 - 9	7 - 18	Soft	500 to 1,000	2 - 4	3 - 4
Medium Dense	10 - 29	19 - 58	Medium-Stiff	1,000 to 2,000	4 - 8	5 - 9
Dense	30 - 50	59 - 98	Stiff	2,000 to 4,000	8 - 15	10 - 18
Very Dense	> 50	≥ 99	Very Stiff	4,000 to 8,000	15 - 30	19 - 42
			Hard	> 8,000	> 30	> 42

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 15
With	15 - 29
Modifier	> 30

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300 mm)
Cobbles	12 in. to 3 in. (300mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm
Silt or Clay	Passing #200 sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 5
With	5 - 12
Modifier	> 12

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1 - 10
Medium	11 - 30
High	> 30

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UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]					Soil Classification	
					Group Symbol	Group Name [B]
Coarse Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$ [E]		GW	Well-graded gravel [F]
			$Cu < 4$ and/or $1 > Cc > 3$ [E]		GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH		GM	Silty gravel [F,G,H]
			Fines classify as CL or CH		GC	Clayey gravel [F,G,H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$ [E]		SW	Well-graded sand [I]
			$Cu < 6$ and/or $1 > Cc > 3$ [E]		SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH		SM	Silty sand [G,H,I]
			Fines classify as CL or CH		SC	Clayey sand [G,H,I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	$PI > 7$ and plots on or above "A" line [J]		CL	Lean clay [K,L,M]
			$PI < 4$ or plots below "A" line [J]		ML	Silt [K,L,M]
		Organic:	Liquid limit - oven dried / Liquid limit - not dried	< 0.75	OL	Organic clay [K,L,M,N]
						Organic silt [K,L,M,O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line		CH	Fat clay [K,L,M]
			PI plots below "A" line		MH	Elastic Silt [K,L,M]
		Organic:	Liquid limit - oven dried / Liquid limit - not dried	< 0.75	OH	Organic clay [K,L,M,P]
						Organic silt [K,L,M,Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor				PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve
[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.
[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.
[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add "with sand" to group name.
[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.
[H] If fines are organic, add "with organic fines" to group name.
[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.
[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.
[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.
[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.
[N] PI ≥ 4 and plots on or above "A" line.
[O] PI < 4 or plots below "A" line.
[P] PI plots on or above "A" line.
[Q] PI plots below "A" line.

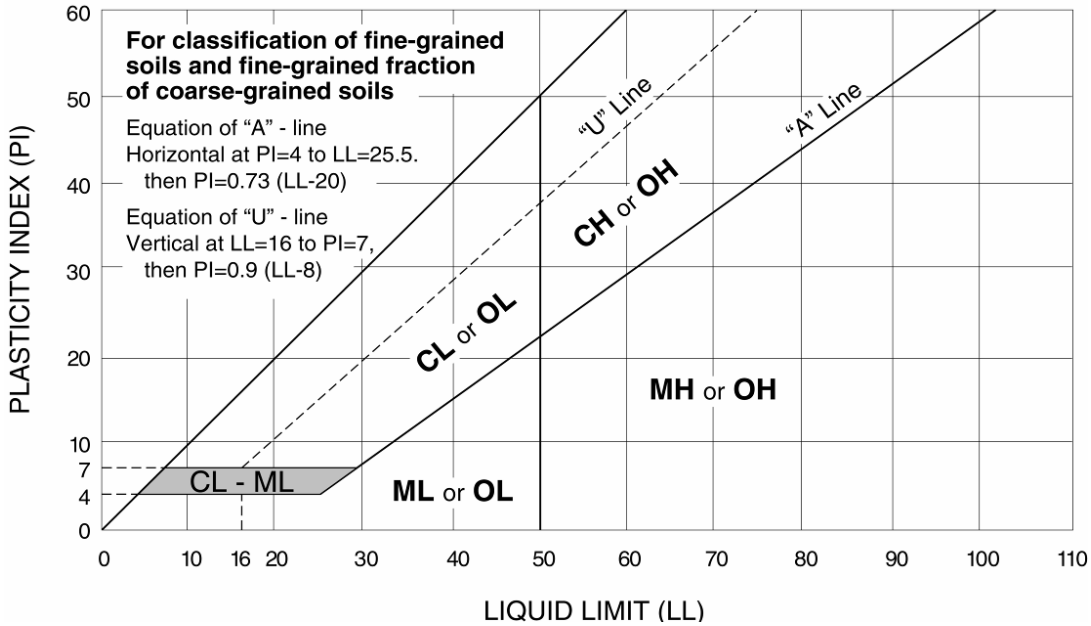

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Exhibit C-2