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GEOTECHNICAL INVESTIGATION

WATER LINE REPLACEMENT IN ANTOINE FOREST AREA
WBS NO. S-000035-0196-3
HOUSTON, TEXAS

Reported to:
Texas American Engineering, LLC
Houston, Texas

by

Aviles Engineering Corporation
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REPORT NO. G167-14

January 2016

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January 27, 2016

Mr. Jawed A. Moheet, P.E.
President
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521 North Sam Houston Parkway East, Suite 550
Houston, Texas 77060-4058

Reference: **Geotechnical Investigation**
Water Line Replacement in Antoine Forest Area
Houston, Texas
WBS No.: S-000035-196-3
AEC Report No. G167-14

Dear Mr. Moheet,

Aviles Engineering Corporation (AEC) is pleased to present this final report of the results of our geotechnical investigation for the above referenced project. Notice to proceed for the geotechnical investigation was provided by Mr. Jawed Mcheet, P.E., President of Texas American Engineering, LLC (TAE) on October 16, 2014, based on AECs proposal G2014-09-06R2, dated October 8, 2014.

AEC appreciates the opportunity to be of service to you. Please call us if you have any questions or comments concerning this report or when we can be of further assistance.

Respectfully submitted,
Aviles Engineering Corporation
(TBPE Firm Registration No. F-42)

1/27/16
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EXECUTIVE SUMMARY

The report submitted herein presents the results of Aviles Engineering Corporation's (AEC) geotechnical investigation for the proposed Water Line Replacement in Antoine Forest Area in Houston, Texas. Based on the most updated drawings provided by Texas American Engineering, LLC (TAE), the project includes design and construction of 8-inch diameter water line replacements in three areas (designated in this report as Areas 1 through 3 as shown on Plates A-1 and A-2, in Appendix A): (i) Area 1 is the west portion of the project that is bounded by Antoine Drive on the west, Winding Way Drive on the north, De Soto Street on the south, and White Oak Bayou on the east; (ii) Area 2 is the east portion of the project that is bounded by Areba Street on the north, Goldspier Street on the east, Garapan Street on the south, and White Oak Bayou on the west), and (iii) Area 3 is a section that is on the southwest corner of the project area along Homer Drive and Easter Street (or Roland Street) to the intersection of De Soto Street). AEC understands that the proposed water lines will be primarily installed using auger method.

1. Subsurface Soil Conditions: Generalized subsurface profiles along the alignments are presented on Plates B-1 through B-6, in Appendix B. Granular soils encountered at our borings are presented in Table 3.

   Area 1: Based on Borings B-1 through B-32, subsurface conditions in the Area 1 alignments generally consist of firm to hard lean clay/silty clay/fat clay (CL/CL-ML/CH) to the boring termination depths of 12 to 21 feet below existing grade. Approximately 1 to 11 feet of silt/silty sand/poorly graded sand with silt/silty clayey sand/clayey sand (ML/SM/SP-SM/SC-SM/SC) were encountered in Borings B-3, B-5, B-6, B-8, B-10, B-12, B-13, B-14, B-16, B-17, B-23, and B-30 at a depth ranging from 8 to 19 feet.

   Area 2: Based on Borings B-33 through B-60, subsurface conditions in the Area 2 alignments generally consist of firm to hard lean clay/silty clay/fat clay (CL/CL-ML/CH) to the boring termination depths of 14 to 22 feet below existing grade. Approximately 2 to 6 feet of silt/silty sand/poorly graded sand with silt/silty clayey sand/clayey sand (ML/SM/SP-SM/SC-SM/SC) were encountered in Borings B-34 to B-36, B-42, B-46, B-51, B-55 to B-57, and B-60 below pavement and/or at a depth ranging from 6 to 12 feet. Approximately 2 to 4 feet of fill, including stiff to hard lean clay or silt (CL/ML), were encountered at the ground surface in Borings B-33, B-39, B-48, B-53, B-56, B-58, and B-59.

   Area 3: Based on Borings B-61 and B-62, subsurface conditions in the Area 3 alignments generally consist of 2 feet of silty sand (SM), underlain by approximately 4 to 6 feet of very stiff to hard lean clay (CL), then by approximately 6 to 8 feet of loose to medium dense silty sand/clayey sand (SM/SC) to the boring termination depths of 12 to 15.5 feet below grade.

2. Subsurface Soil Properties: The subsurface clayey soils encountered in the borings have slight to very high plasticity, with liquid limits (LL) ranging from 22 to 70, and plasticity indices (PI) ranging from 5 to 47. The cohesive soils encountered are classified as "CL", "CL-ML", and "CH" type soils and granular soils encountered are classified as "ML", "SC", "SM", "SP-SM", and "SC-SM" type soils in accordance with ASTM D 2487.

2. Groundwater Conditions: Groundwater encountered at depths ranging from 10.5 to 18 feet in Borings B-8, B-13, B-21, B-30, B-42, B-46, and B-59 through B-62 during drilling and measured at depths ranging from 9.7 to 19.4 feet after drilling was completed. Groundwater in Borings B-13, B-14, B-42, and B-62 indicates that the ground water is pressurized. Groundwater encountered in our borings during drilling and after completion of drilling is summarized in Table 4.

EXECUTIVE SUMMARY (CONT.)

3. Hazardous Materials: Gasoline odor was encountered at the last sample depths of 14 to 15 feet in Boring B-26 during processing of the soil sample in the laboratory.

4. Geologic Hazards: Limited field observations were made in the project area by AEC Senior Geologist for evidences of faulting. No evidences of faulting were observed in the project area. AEC does not recommend any further fault studies for the project area.

5. Design parameters for installation of underground utilities by auger method are presented in Section 5.1 of this report.

6. Recommendations for installation of underground utilities by auger method are presented in Section 5.2 of this report.

This Executive Summary is intended as a summary of the investigation and should not be used without the full text of this report.

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GEOTECHNICAL INVESTIGATION

WATER LINE REPLACEMENT IN ANTOINE FOREST AREA
WBS NO. S-000035-0196-3
HOUSTON, TEXAS

1.0 INTRODUCTION

1.1 General

The report submitted herein presents the results of Aviles Engineering Corporation's (AEC) geotechnical investigation for the proposed Water Line Replacement in Antoine Forest Area in Houston, Texas (Houston/Harris County Key Map Nos.: 411Y&Z, 412W, 451C&D, and 452A). A vicinity map is presented on Plate A-1, in Appendix A. AEC performed this investigation based on the 100 percent submittal drawings (dated January 27, 2016) provided by Texas American Engineering, LLC (TAE), which have no change of waterline invert depths from the 60 percent submittal drawings (dated September 2014) according to TAE. This project includes design and construction of 8-inch diameter water line replacements in three areas (designated in this report as Areas 1 through 3 as shown on Plates A-1 and A-2, in Appendix A): (i) Area 1 is the west portion of the project that is bounded by Antoine Drive on the west, Winding Way Drive on the north, De Soto Street on the south, and White Oak Bayou on the east; (ii) Area 2 is the east portion of the project that is bounded by Areba Street on the north, Goldspier Street on the east, Garapan Street on the south, and White Oak Bayou on the west), and (iii) Area 3 is a section that is on the southwest corner of the project area along Homer Drive and Easter Street (or Roland Street) to the intersection of De Soto Street). AEC understands that the proposed water lines will be primarily installed using auger method.

1.2 Purpose and Scope

The purpose of this geotechnical investigation is to evaluate the subsurface soil and ground water conditions along the alignments and develop geotechnical engineering recommendations for design and construction of the water line by auger method. The scope of this geotechnical investigation is summarized below:

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1. Drilling and sampling 60 geotechnical borings to a depth ranging 12 to 21 feet below existing grade;
2. Soil laboratory testing on selected soil samples;
3. Engineering analyses and recommendations for the installation of underground water line by auger method, including loadings on pipes, bedding, lateral earth pressure parameters, auger pit stability, and backfill requirements;
4. Construction recommendations for installation of underground utilities by auger method.

2.0 SUBSURFACE EXPLORATION

2.1 Soil Borings

Boring spacing and depth were selected in accordance with Chapter 11 of the latest edition of the COH Engineering Design Manual and latest maximum invert depths provided prior to the drilling. In general, borings are spaced at an interval of approximately 500 feet along the alignment.

Based on the latest submittal drawings provided by TAE to AEC, the invert depth of the proposed water line range from 7 to 15 feet deep. In accordance with the COH Engineering Design Manual guidelines, piezometer is not required along the alignments since the proposed invert depths of the utility do not exceed 15 feet. Subsurface exploration consisted of drilling and sampling a total of 60 borings ranging from 12 to 21 feet below existing grade. In addition, two previous borings (designated as Borings B-42 and B-46 in this report) in AEC Report G195-09 (dated March 14, 2011) will be used in this investigation. The boring locations are shown on the Boring Location Plan on Plate A-2, in Appendix A. After completion of drilling, the borings were surveyed by others and boring designations and depths, coordinates, station and offset, and elevations are presented in Table 1.

Table 1. Boring Number, Locations, Survey Data, and Depths

Boring No.	Street	Northing[(1)]	Easting[(1)]	Elev.[(1)] (feet)	Station & Offset[(1)]	Invert Depth[(2)] (feet)	Boring Depth (feet)
B-1	Sheraton Oaks	13878713.42	3086659.48	76.7	2+39.25 22.63L	9	15
B-2	Winding Way	13878879.70	3087009.31	75.7	2+89.79 8.27L	9	14
B-3	Winding Way	13878913.58	3087341.60	73.8	6+26.37 8.65L	7	12
B-4	Winding Way	13878957.74	3087750.11	72.1	10+37.02 8.57L	7	12
B-5	Winding Way	13878981.49	3088297.27	70.9	15+84.69 8.12L	8	13

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Boring No.	Street	Northing[(1)]	Easting[(1)]	Elev.[(1)] (feet)	Station & Offset[(1)]	Invert Depth[(2)] (feet)	Boring Depth (feet)
B-6	Winding Way	13878599.11	3087217.54	73.4	8+93.38 8.83L	12	17
B-7	Sheraton Oaks	13878873.08	3088742.36	69.2	20+69.92 8.49L	8	13
B-8	Sheraton Oaks	13878635.47	3087713.95	71.9	13+91.39 8.22L	10	15
B-9	Sheraton Oaks	13878659.37	3088256.22	70.7	19+34.19 8.13L	7	13
B-10	Sheraton Oaks	13878679.50	3088688.83	69.8	23+67.97 8.42L	9	15
B-11	Holly View	13878136.80	3086693.71	75.8	2+47.70 13.87R	7	12
B-12	Holly View	13878154.91	3087174.13	74.2	7+28.47 14.52R	9	14
B-13	Statler	13878284.71	3087620.88	73.1	3+01.36 13.73L	13	19
B-14	Holly View	13878063.12	3087639.39	73.3	12+14.28 13.71R	11	17
B-15	Holly View	13877951.27	3088148.56	72.7	17+40.81 6.90L	13	18
B-16	Ash Oak	13878388.87	3088442.41	71.0	5+30.78 8.03R	12	17
B-17	Holly View	13877974.26	3088636.74	70.4	22+29.49 8.06L	12	18
B-18	Francis Marion	13878376.66	3088711.01	70.6	5+08.43 6.07L	12	18
B-19	Holly View	13877995.07	3089112.62	70.0	27+05.83 8.02L	13	19
B-20	Winding Way	13878495.86	3089038.90	69.6	25+70.02 8.33L	8	13
B-21	Holly View	13877969.62	3089696.57	70.5	32+93.37 8.80L	15	21
B-22	Oak Cove	13877661.87	3088359.69	70.7	1+87.75 8.11L	8	13
B-23	Oak Cove	13877679.57	3088758.84	69.7	5+87.29 8.33L	8	13
B-24	Oak Cove	13877703.33	3089308.23	68.5	11+37.19 8.03L	7	13
B-25	Oak Cove	13878162.48	3089895.05	69.3	19+84.03 8.27L	7	13
B-26	DeSoto	13876870.02	3086784.64	75.8	2+81.52 21.08R	10	15
B-27	DeSoto	13876921.16	3087168.59	75.1	6+67.19 14.79L	10	15
B-28	DeSoto	13876941.19	3087673.23	73.6	11+72.23 14.79L	8	13
B-29	DeSoto	13876957.74	3088085.17	72.1	15+84.51 14.99L	8	13
B-30	Oak Bay	13877285.02	3088273.42	72.4	4+34.61 14.93L	10	15
B-31	DeSoto	13876972.53	3088467.44	71.3	19+67.06 14.61L	8	14
B-32	DeSoto	13877037.95	3089010.01	69.7	25+00.85 66.44L	7	13
B-33	Areba	13879281.08	3090286.47	74.8	1+70.79 7.56R	9	14
B-34	Areba	13879301.33	3090826.55	77.3	7+11.24 8.24R	10	15
B-35	Areba	13879327.15	3091386.94	80.6	12+72.21 4.14R	12	18
B-36	Areba	13879342.21	3091802.68	81.9	16+88.22 5.19R	10	15
B-37	Areba	13879362.06	3092324.18	81.5	22+10.10 5.54R	9	15
B-38	Areba	13879383.69	3092877.39	82.0	27+63.74 5.34R	10	15
B-39	Areba	13879399.08	3093271.65	82.6	31+58.29 5.23R	9	15
B-40	Areba	13879417.94	3093755.38	82.7	36+42.39 5.12R	9	14

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Boring No.	Street	Northing[1]	Easting[1]	Elev.[1] (feet)	Station & Offset[1]	Invert Depth[2] (feet)	Boring Depth (feet)
B-41	Cliffdale	13878725.80	3091693.87	80.7	3+22.69 3.08L	8	14
B-42[3]	Yorkdale	13879046.92	3092178.54	80.1	13+76.35 209.53R	12	22
B-43	Cliffdale	13878745.35	3092168.41	81.8	7+97.63 4.25L	12	18
B-44	Cliffdale	13878766.82	3092722.61	82.2	13+52.25 4.24L	9	14
B-45	Cliffdale	13878789.27	3093257.39	81.8	18+87.50 5.96L	13	18
B-46[3]	Cliffdale	13878825.52	3093734.22	82.8	23+75.11 3.85L	9	22
B-47	Dalview	13878413.58	3091646.76	81.3	2+65.63 2.93L	9	14
B-48	Yorkdale	13878542.77	3091984.29	81.5	8+80.10 4.10L	13	18
B-49	Dalview	13878436.92	3092460.92	81.9	10+80.07 5.28R	9	14
B-50	Dalview	13878457.88	3093024.69	81.1	16+44.23 6.17R	13	18
B-51	Dalview	13878487.78	3093513.20	81.6	21+33.54 4.80L	9	14
B-52	Druid	13878104.99	3091656.15	80.7	2+60.41 4.20L	9	15
B-53	Yorkdale	13878028.82	3092004.17	82.2	3+65.76 4.13L	13	18
B-54	Druid	13878125.97	3092233.25	81.4	8+37.89 2.82L	13	18
B-55	Druid	13878149.22	3092836.67	81.6	14+41.75 2.68L	9	14
B-56	Druid	13878164.34	3093337.93	82.4	19+43.22 1.62R	13	18
B-57	Druid	13878243.08	3093775.69	82.5	24+15.86 4.36R	10	15
B-58	Garapan	13877707.22	3090168.33	70.6	1+41.84 35.66R	11	3 [5]
B-59	Garapan	13877753.77	3090663.09	71.2	6+38.03 8.30R	9	15
B-60	Garapan	13877770.49	3091087.95	77.0	10+63.21 8.05R	14	20
B-61	Homer	13877247.95	3094708.63	82.8	2+18.74 2.35R	9	12[4]
B-62	Roland	13877482.35	3094627.36	82.2	3+15.03 7.01L	9	15

Note: (1) Survey data were provided by TAE based on Texas State Plane Coordination System (TSPC);
(2) Invert depth were measured based on the 60 percent submittal drawings provided;
(3) Borings B-42 and B-46 are previous borings in AEC Report No. G195-09
(4) Boring B-61 was performed within the Phase II Environmental Site. Boring encountered water at a depth of 10.5 feet during drilling (see Table 4 also), therefore, boring terminated 2 feet above the proposed termination depth of 14 feet.
(5) Boring B-58 was proposed to drill to a depth of 16 feet below grade; however, drilling encountered underground utility and terminated at 3 feet deep.

Existing pavement at the borings was first cut with a core barrel prior to field drilling. The field drilling was performed with a truck-mounted drilling rig primarily using dry auger method. Undisturbed samples of cohesive soils were obtained from the borings by pushing 3-inch diameter thin-wall, seamless steel Shelby tube samplers in general accordance with ASTM D 1587. Granular soils were sampled with a 2-inch split-barrel sampler in accordance with ASTM D 1586. Standard Penetration Test resistance (N) values were recorded for the granular soils as "Blows per Foot" and are shown on the boring logs. Strength of the

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cohesive soils was estimated in the field using a hand penetrometer. The undisturbed samples of cohesive soils were extruded mechanically from the core barrels in the field and wrapped in aluminum foil; all samples were sealed in plastic bags to reduce moisture loss and disturbance. The samples were then placed in core boxes and transported to the AEC laboratory for testing and further study. Borings were grouted with cement-bentonite grout, and the pavements were patched with non-shrink grout or asphalt depending on existing pavement type.

3.0 LABORATORY TESTING PROGRAM

Soil laboratory testing was performed by AEC personnel. Samples from the borings were examined and classified in the laboratory by a technician under the supervision of a geotechnical engineer. Laboratory tests were performed on selected soil samples in order to evaluate the engineering properties of the foundation soils in accordance with applicable ASTM Standards. Atterberg limits, moisture contents, percent passing a No. 200 sieve, and dry unit weight tests were performed on typical samples to establish the index properties and confirm field classification of the subsurface soils. Strength properties of cohesive soils were determined by means of unconfined compression (UC) and undrained-unconsolidated (UU) triaxial tests performed on undisturbed samples. The test results are presented on the boring logs. Details of the soils encountered in the borings are presented on Plates A-3 through A-64, in Appendix A. A key to the boring logs, classification of soils for engineering purposes, terms used on boring logs, and reference ASTM Standards for laboratory testing are presented on Plates A-65 through A-68, in Appendix A. Summary of the laboratory test results is presented on Plates A-69 and A-83, in Appendix A.

4.0 SITE CONDITIONS

A summary of pavement types encountered in our borings is presented on Table 2. In general, existing pavements in Area 1 is concrete pavement, whereas existing pavements in Area 2 and Area 3 is asphalt pavement except at the locations of Garapan Street (Borings B-58 through B-60).

Table 2. Existing Pavement Encountered at Borings

Boring No.	Street	Pavement Section
B-1	Sheraton Oaks	5" concrete; 3" sand
B-2	Winding Way	6" concrete

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Boring No.	Street	Pavement Section
B-3	Winding Way	5.5" concrete
B-4	Winding Way	6" concrete
B-5	Winding Way	5.5" concrete
B-6	Winding Way	5" concrete
B-7	Sheraton Oaks	6.5" concrete
B-8	Sheraton Oaks	5.5" concrete
B-9	Sheraton Oaks	5.5" concrete
B-10	Sheraton Oaks	5.75" concrete
B-11	Holly View	7.5" concrete
B-12	Holly View	7.75" concrete
B-13	Statler	7" concrete
B-14	Holly View	7" concrete
B-15	Holly View	5.5" concrete
B-16	Ash Oak	6" concrete
B-17	Holly View	6.25" concrete
B-18	Francis Marion	6" concrete
B-19	Holly View	6" concrete
B-20	Winding Way	5.5" concrete
B-21	Holly View	6.5" concrete
B-22	Oak Cove	7" concrete
B-23	Oak Cove	8" concrete
B-24	Oak Cove	5.5" concrete
B-25	Oak Cove	6" concrete
B-26	DeSoto	7.5" concrete
B-27	DeSoto	7" concrete
B-28	DeSoto	7" concrete
B-29	DeSoto	7.5" concrete
B-30	Oak Bay	7.25" concrete
B-31	DeSoto	6" concrete
B-32	DeSoto	7" concrete
B-33	Areba	N/A
B-34	Areba	6" concrete
B-35	Areba	6.5" asphalt; 3" clayey sand and gravel
B-36	Areba	6" asphalt; 3" silty sand with gravel
B-37	Areba	8" asphalt; 3" sand and gravel
B-38	Areba	6" asphalt; 4" sand and gravel
B-39	Areba	8" asphalt; 5" stabilized sand and gravel

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Boring No.	Street	Pavement Section
B-40	Areba	4" asphalt; 7" sand and shell
B-41	Cliffdale	5" asphalt; 3" sand, shell, and gravel
B-42	Yorkdale	6" asphalt; 2" sand and shell
B-43	Cliffdale	6" asphalt; 2" sand and gravel
B-44	Cliffdale	5" asphalt; 2" sand and gravel
B-45	Cliffdale	5" asphalt; 5" sand and shell
B-46	Cliffdale	6.5" asphalt; 8.5" sand and shell
B-47	Dalview	5" asphalt; 2.5" sand and shell
B-48	Yorkdale	8" asphalt; 6" sand and gravel
B-49	Dalview	6" asphalt; 4" sand and gravel
B-50	Dalview	6" asphalt; 3" sand and gravel
B-51	Dalview	6" asphalt; 6" sand and gravel
B-52	Druid	5.5" asphalt; 4" sand and gravel
B-53	Yorkdale	7" asphalt; 4" sand and gravel
B-54	Druid	6" asphalt; 3" shell, sand, and gravel
B-55	Druid	6" asphalt; 3" sand and shell
B-56	Druid	6" asphalt; 9" sand and shell
B-57	Druid	5.5" asphalt; 6.5" sand and shell
B-58	Garapan	6.5" concrete
B-59	Garapan	8" concrete; 1" sand
B-60	Garapan	6.5" concrete; 3.5" sand
B-61	Homer	4" asphalt; 5" sand and crushed shell
B-62	Roland	8" asphalt; 4" sand and shell

4.1 Subsurface Conditions

Area 1: Based on Borings B-1 through B-32, subsurface conditions in the Area 1 alignments generally consist of firm to hard lean clay/silty clay/fat clay (CL/CL-ML/CH) to the boring termination depths of 12 to 21 feet below existing grade. Approximately 1 to 11 feet of silt/silty sand/poorly graded sand with silt/silty clayey sand/clayey sand (ML/SM/SP-SM/SC-SM/SC) were encountered in Borings B-3, B-5, B-6, B-8, B-10, B-12, B-13, B-14, B-16, B-17, B-23, and B-30 at a depth ranging from 8 to 19 feet as shown in Table 3.

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Area 2: Based on Borings B-33 through B-60, subsurface conditions in the Area 2 alignments generally consist of firm to hard lean clay/silty clay/fat clay (CL/CL-ML/CH) to the boring termination depths of 14 to 22 feet below existing grade. Approximately 2 to 6 feet of silt/silty sand/poorly graded sand with silt/silty clayey sand/clayey sand (ML/SM/SP-SM/SC-SM/SC) were encountered in Borings B-34 to B-36, B-42, B-46, B-51, B-55 to B-57, and B-60 below existing pavement and/or at a depth ranging from 6 to 20 feet as shown in Table 3. Approximately 2 to 4 feet of fill, including stiff to hard lean clay or silt (CL/ML), were encountered at the ground surface in Borings B-33, B-39, B-48, B-53, B-56, B-58, and B-59.

Area 3: Based on Borings B-61 and B-62, subsurface conditions in the Area 3 alignments generally consist of 2 feet of silty sand (SM), underlain by approximately 4 to 6 feet of very stiff to hard lean clay (CL), then by approximately 6 to 8 feet of loose to medium dense silty sand/clayey sand (SM/SC) to the boring termination depths of 12 to 15.5 feet below grade.

Generalized subsurface profiles along the alignments are presented on Plates B-1 through B-6, in Appendix B. Granular soils encountered at our borings are presented in Table 3.

Table 3. Granular Soil Encountered at Borings

Boring No.	Depth (feet)	Soil Type[(1)]
B-3	10-12	ML, with large calcareous pockets
B-5	12-13	SM
B-6	8-12	Dense SM
B-8	8-15	Medium dense SM/SP-SM
B-10	10-12	SM
B-12	8-14	Medium dense SC-SM
B-13	8-19	Medium dense SC/SP-SM
B-14	12-17	Medium dense SM
B-16	8-14	SC
B-17	8-13	SC-SM
B-23	8-13	SM
B-30	14-15	SM
B-34	0-3	SC-SM
B-35	0-2	SM
	12-14	SC
B-36	0-2	ML
B-42	0-2	SM

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Boring No.	Depth (feet)	Soil Type[(1)]
B-46	8-13	SC
B-51	0-4	ML
	10-14	SC-SM
B-55	0-6	ML
B-56	0-4	ML
	12-16	SP-SM/SC
B-57	0-2	SM
	8-12	SC, with silt partings
B-60	14-20	ML, with siltstone fragments
B-61	0-2	SM
	6-12	Medium dense SC/SM
B-62	0-2	SM
	8-15.5	Loose to medium dense SC

Note: (1) ML = Silt, SM = Silty Sand, SP-SM = Poorly Graded Sand w/Silt, SC-SM = Silty Clayey Sand, SC = Clayey Sand.

Subsurface Soil Properties: The subsurface clayey soils encountered in the borings have slight to very high plasticity, with liquid limits (LL) ranging from 22 to 70, and plasticity indices (PI) ranging from 5 to 47. The cohesive soils encountered are classified as "CL", "CL-ML", and "CH" type soils and granular soils encountered are classified as "ML", "SC", "SM", "SP-SM", and "SC-SM" type soils in accordance with ASTM D 2487. High plasticity clays can undergo significant volume changes due to seasonal changes in moisture contents. "CH" soils undergo significant volume changes due to seasonal changes in soil moisture contents. "CL" type soils with lower LL (less than 40) and PI (less than 20) generally do not undergo significant volume changes with changes in moisture content. However, "CL" soils with LL approaching 50 and PI greater than 20 essentially behave as "CH" soils and could undergo significant volume changes. Slickensides were encountered in the clayey soils.

Groundwater Conditions: Groundwater encountered at depths ranging from 10.5 to 18 feet in Borings B-8, B-13, B-21, B-30, B-42, B-46, and B-59 through B-62 during drilling and measured at depths ranging from 9.7 to 19.4 feet after drilling was completed. Groundwater in Borings B-13, B-14, B-42, and B-62 locations may be pressurized. Groundwater encountered in our borings during drilling and after completion of drilling is summarized in Table 4. The information in this report summarizes conditions found on the date the borings were drilled. It should be noted that our groundwater observations are short-term; groundwater

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depths and subsurface soil moisture contents will vary with environmental variations such as frequency and magnitude of rainfall and the time of year when construction is in progress.

Table 4. Groundwater Depths below Existing Ground Surface

Boring No.	Date of Drilling	Boring Depth (feet)	Groundwater Depth Encountered during Drilling (feet)	Groundwater Depth after Drilling was Completed (feet)
B-1	11/4/2014	15	N/A	N/A
B-2	11/5/2014	14	N/A	N/A
B-3	11/5/2014	12	N/A	N/A
B-4	11/5/2014	12	N/A	N/A
B-5	11/5/2014	13	N/A	N/A
B-6	11/5/2014	17	N/A	N/A
B-7	11/6/2014	13	N/A	N/A
B-8	11/6/2014	15	14	14
B-9	11/6/2014	13	N/A	N/A
B-10	11/6/2014	15	N/A	N/A
B-11	11/6/2014	12	N/A	N/A
B-12	11/6/2014	14	N/A	N/A
B-13	11/6/2014	19	14	11.8 (Cave in)
B-14	11/6/2014	17	N/A	14 (Cave in)
B-15	11/6/2014	18	N/A	N/A
B-16	11/6/2014	17	N/A	N/A
B-17	11/10/2014	18	N/A	N/A
B-18	11/10/2014	18	N/A	N/A
B-19	11/10/2014	19	N/A	N/A
B-20	11/19/2014	13	N/A	N/A
B-21	11/9/2014	21	16	19.4
B-22	11/9/2014	13	N/A	N/A
B-23	11/9/2014	13	N/A	N/A
B-24	11/9/2014	13	N/A	N/A
B-25	11/9/2014	13	N/A	N/A
B-26	11/11/2014	15	N/A	N/A
B-27	11/11/2014	15	N/A	N/A
B-28	11/11/2014	13	N/A	N/A
B-29	11/11/2014	13	N/A	N/A
B-30	11/11/2014	15	14	13.4 (Cave in)
B-31	11/11/2014	14	N/A	N/A

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Boring No.	Date of Drilling	Boring Depth (feet)	Groundwater Depth Encountered during Drilling (feet)	Groundwater Depth after Drilling was Completed (feet)
B-32	11/11/2014	13	N/A	N/A
B-33	10/28/2014	14	N/A	N/A
B-34	10/28/2014	15	N/A	N/A
B-35	10/28/2014	18	N/A	N/A
B-36	10/28/2014	15	N/A	N/A
B-37	10/28/2014	15	N/A	N/A
B-38	10/29/2014	15	N/A	N/A
B-39	10/29/2014	15	N/A	N/A
B-40	10/29/2014	14	N/A	N/A
B-41	10/29/2014	14	N/A	N/A
B-42	1/29/2010	22	18	14
B-43	10/29/2014	18	N/A	N/A
B-44	10/29/2014	14	N/A	N/A
B-45	10/29/2014	18	N/A	N/A
B-46	1/29/2010	22	12	14
B-47	10/29/2014	14	N/A	N/A
B-48	10/29/2014	18	N/A	N/A
B-49	10/30/2014	14	N/A	N/A
B-50	10/30/2014	18	N/A	N/A
B-51	10/30/2014	14	N/A	N/A
B-52	10/30/2014	15	N/A	N/A
B-53	10/30/2014	18	N/A	N/A
B-54	10/30/2014	18	N/A	N/A
B-55	10/30/2014	14	N/A	N/A
B-56	10/30/2014	18	N/A	N/A
B-57	10/30/2014	15	N/A	N/A
B-58	11/4/2014	16	N/A	N/A
B-59	11/4/2014	15	12	11 (Cave in)
B-60	11/4/2014	20	18	N/A
B-61	11/11/2014	14	10.5	9.7 (Cave in)
B-62	10/30/2014	15	12	9.7 (Cave in)

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4.2 Hazardous Materials

Gasoline odor was encountered at the last sample depths of 14 to 15 feet in Boring B-26 during processing of the soil sample in the laboratory.

Boring B-26 was drilled in between environmental Borings B-1 and B-2, which were drilled on October 20, 2014 during Phase II Environmental Site Assessment. Gasoline odor was not detected from soil samples recovered from environmental borings. In addition, volatile organic vapors were not detected by a PID meter in the soil samples from Borings B-1 and B-2. Laboratory analysis of a soil sample from each boring was below laboratory detection limits. The gasoline odor in Boring B-26 may be due to a small amount of contamination in the soil between environmental Borings B-1 and B-2. AEC will propose additional environmental assessment to investigate the gasoline odor detected in the vicinity of Boring B-26.

4.3 Geologic Conditions

AEC performed a preliminary fault investigation, which included a review of available literature, aerial photographs, public maps and limited field observations. According to the published maps "*Principal Active Faults of the Houston Area (after O'Neill and Van Siclen, May 1984)*", and "*Principal Surface Faults in the Central Houston Metropolitan Area (after O' Neill, Van Siclen, with additions by C. Norman, May 13, 2004)"*, no documented faults are located in the project area. The closest fault to the project area is the White Oak Fault. The fault is located approximately 1.9 miles northwest of the northwestern corner of the project area.

Limited field observations were made in the project area by AEC Senior Geologist for evidences of faulting. No evidences of faulting were observed in the project area. AEC does not recommend any further fault studies for the project area.

Limitations: The preliminary fault investigation provided in this report is limited to a review of literature, aerial photographs and maps and our limited field observations, and distances are scaled from maps. Faults may exist in, cross, or adjoin the project alignment which were not identified in this report due to the following reasons: not observed during the reconnaissance due to limitations of the scope of work and cost; the presence of obscuring vegetation and environmental features; modification of the land surface by human

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activities; and lack of documentation in the literature. Faults may also be present below ground but do not currently have surface expressions. Identification of these faults is beyond the scope of work for this project.

4.4 Subsurface Variations

It should be emphasized that: (i) at any given time, groundwater depths can vary from location to location, and (ii) at any given location, groundwater depths can change with time. Groundwater depths will vary with seasonal rainfall and other climatic/environmental events. Subsurface conditions may vary away from and in between the boring locations.

Clay soils in the Houston area typically have secondary features such as slickensides and contain sand/silt seams/lenses/layers/pockets. It should be noted that the information in the boring logs is based on 3-inch diameter soil samples which were obtained continuously at intervals of 2 feet in the top 10 to 20 feet of the borings, then at intervals of 5 feet thereafter to the boring termination depths of 12 to 22 feet below grade. A detailed description of the soil secondary features may not have been obtained due to the small sample size and sampling interval between the samples. Therefore, while a boring log shows some soil secondary features, it should not be assumed that the features are absent where not indicated on the boring logs.

5.0 GEOTECHNICAL ENGINEERING RECOMMENDATIONS

Based on the latest Plan and Profile drawings provided by TAE, the project includes design and construction of 8-inch diameter water line replacements in three areas (designated in this report as Areas 1 through 3 as shown on Plates A-1 and A-2, in Appendix A): (i) Area 1 is the west portion of the project that is bounded by Antoine Drive on the west, Winding Way Drive on the north, De Soto Street on the south, and White Oak Bayou on the east; (ii) Area 2 is the east portion of the project that is bounded by Areba Street on the north, Goldspier Street on the east, Garapan Street on the south, and White Oak Bayou on the west), and (iii) Area 3 is a section that is on the southwest corner of the project area along Homer Drive and Easter Street (or Roland Street) to the intersection of De Soto Street). AEC understands that the proposed water lines will be primarily installed using auger method.

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5.1 Geotechnical Parameters for Underground Utilities

Recommended geotechnical parameters for the subsurface soils along the alignments to be used for design of underground utilities are presented on Plates C-1 through C-6, in Appendix C. The design values are based on the results of field and laboratory test data on individual boring logs as well as our experience. It should be noted that because of the variable nature of soil stratigraphy, soil types and properties along the alignment or at locations away from a particular boring may vary substantially.

5.2 Installation of Underground Utilities by Auger Method

Underground utilities installed by auger methods should be designed and installed in accordance with Section 02447 of the latest edition of the City of Houston Standard Construction Specifications (COHSCS).

The Contractor is responsible for selecting, designing, installing, maintaining and monitoring safe augering systems and retaining professionals who are qualified and experienced to perform the tasks and who are capable of modifying the system, as required. The following discussion provides general guidelines to the Contractor for augering methods. The information in this report should be reviewed so that appropriate augering equipment and techniques can be planned and factored into the construction plan and cost estimate.

5.2.1 Loadings on Pipes

Underground utilities support the weight of the soil and water above the crown, as well as roadway traffic and any structures that exist above the utilities.

Earth Loads: The vertical soil load W_e can be calculated as the larger of the two values from Equations (1) and (3):

$$W_e = C_d \gamma B_d^2 \quad \text{.....Equation (1)}$$

$$C_d = [1- e^{-2K\mu'(H/B_d)}]/(2K\mu') \quad \text{.....Equation (2)}$$

$$W_e = \gamma B_c H \quad \text{.....Equation (3)}$$

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where: W_e = trench fill load, in pounds per linear foot (lb/ft);
C_d = trench load coefficient, see Plate C-7, in Appendix C;
γ = effective unit weight of soil over the conduit, in pounds per cubic foot (pcf);
B_d = trench width at top of the conduit < 1.5 B_c (ft);
B_c = outside diameter of the conduit (ft);
H = variable height of fill (ft);
when the height of fill above the top of the conduit H_c >2 B_d, H = H_h (height of fill above the middle of the conduit). When H_c < 2 B_d, H varies over the height of the conduit; and
$K\mu'$ = 0.1650 maximum for sand and gravel,
0.1500 maximum for saturated top soil,
0.1300 maximum for ordinary clay,
0.1100 maximum for saturated clay.

When underground conduits are located below groundwater, the total vertical dead loads should include the weight of the projected volume of water above the conduits.

Traffic Loads: The vertical stress on top of an underground conduit, p_L (psf), resulting from traffic loads (from a H-20 or HS-20 truck) can be obtained from Plate C-8, in Appendix C. The live load on top of the underground conduit can be calculated from Equation (4):

$$W_L = p_L B_c \quad \text{.....Equation (4)}$$

where: W_L = live load on the top of the conduit (lb/ft);
p_L = vertical stress (on the top of the conduit) resulting from traffic loads (psf);
B_c = outside diameter of the conduit, (ft);

Lateral Loads: The lateral soil pressure p_l can be calculated from Equation (5); hydrostatic pressure should be added, if applicable.

$$p_l = 0.5 (\gamma H_h + p_s) \quad \text{.....Equation (5)}$$

where: H_h = height of fill above the center of the conduit (ft);
γ = effective unit weight of soil over the conduit (pcf);
p_s = vertical pressure on conduit resulting from traffic and/or construction equipment (psf).

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5.2.2 Deflections of Flexible Pipes

Deflection is one of the controlling factors in the design of buried flexible or semi-rigid pipes, such as PVC and ductile iron pipes. These pipes deflect under soil and surcharge loads; the amount of deflection is a function of the service load on the pipe, the stiffness of the pipe, and the surrounding soil.

The deflection can be calculated using the Modified Iowa Formula, expressed as Equation (6), and the effective stiffness, E' of the surrounding soil. The E' is a combination of the stiffness of the pipe bedding material, E'_B and the stiffness of the native soil, E'_N. Long-term deflection values are typically used for flexible/semi-rigid pipe design; these values may be obtained by applying an appropriate deflection lag factor, D_L, to the short-term deflection values used in the Modified Iowa Formula.

$$\Delta x = \frac{D_L K W}{\frac{EI}{R^3} + 0.061 E'} \qquad \text{.....Equation (6)}$$

where: Δx = pipe deflection (in);
D_L = deflection lag factor,
(a) use minimum 1.0 for granular backfill and the full prism load is assumed to act on the pipe, (b) use minimum 1.5 for granular backfill and assumed trench loadings, (c) use minimum 2.5 for sandy lean clay (CL) where the backfill can become saturated
K = bedding constant, typically 0.11,
W = [W_e (from Eq. 3) + W_L (from Eq. 4) +W_w], total service load on the crown of the pipe, (lb/in); W_w = weight of water prism (if any) above the crown of the pipe
E = initial modulus (Young's modulus) of the pipe material (psi);
I = pipe wall moment of inertia ($in.^4/in$);
R = mean pipe radius (in);
E' = effective modulus of soil reaction (psi)

The effective modulus of soil reaction, E', may be obtained from the equations presented below:

$$E' = \text{zeta} * E'_B \qquad \text{.....Equation (7)}$$

$$\text{zeta} = \frac{1.44}{f + (1.44 - f) * E_B' / E_N'} \qquad \text{.....Equation (8)}$$

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where: $f = \frac{B_d / B_c - 1}{1.154 + 0.444(B_d / B_c - 1)}$ .....Equation (9)

and: B_d = trench width at the top of the pipe (ft);
B_c = outside diameter of the pipe (ft).

For the stiffness of the pipe bedding material E'_B, 2,000 psi can be used for granular materials such as clayey sand, silty sand, silty gravel or clayey gravel (containing less than 12 percent fines) with a minimum 95 percent ASTM D-698 (Standard Proctor) compaction. Effective Modulus of Soil Reaction for natural soil, E'_N is presented on Plates C-1 through C-6, in Appendix C.

5.2.3 Auger Pits

Auger pits are required for starting and ending pipes. They should be designed and constructed in accordance with Section 02447, Subsection 3.04 of the latest edition of the COHSCS. Auger pits that are constructed in conjunction with open cut methods should be in accordance with Section 02317 of the latest edition of the COHSCS.

Reaction Walls: For the braced pit walls to be used to provide passive reaction for pipe jacking, passive earth pressure can be calculated using Equation (10); we recommend that a factor of safety of 2.0 be used for passive earth pressure. The design soil parameters for reaction wall design are presented on Plates C-1 through C-6, in Appendix C.

$$p_p = \gamma z K_p + 2c(K_p)^{1/2}$$ .....Equation (10)

where, p_p = passive earth pressure (psf);
γ = wet unit weight of soil (pcf);
z = depth below ground surface for the point under consideration (ft);
K_p = coefficient of passive earth pressure;
c = cohesion of clayey soils (psf).

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5.2.4 Auger Pit Excavation

Based on our borings, granular soils could be encountered within the auger pit excavation depth in the vicinity of boring locations and depths presented in Table 3 of this report. Groundwater encountered at depths ranging from 10.5 to 18 feet in Borings B-8, B-13, B-21, B-30, B-42, B-46, and B-59 through B-62 during drilling and measured at depths ranging from 9.7 to 14 feet after drilling was completed. Groundwater encountered in Borings B-13, B-14, B-42, and B-62 indicates that the ground water is pressurized. If groundwater or saturated sands are encountered during auger pit excavation, groundwater control could be required. Groundwater control recommendations are presented in Section 6.2 of this report.

Cohesive soils in the Houston area contain many secondary features which affect trench stability, including sand seams and slickensides. Slickensides are shiny weak failure planes which are commonly present in fat clays; such clays often fail along these weak planes when they are not laterally supported, such as in an open excavation. The Contractor should not assume that slickensides and sand seams/layers/pockets are absent where not indicated on the logs.

The Contractor should be responsible for designing, constructing and maintaining safe excavations. The excavations should be performed in a manner so that they do not cause any distress to existing structures.

Trenches 20 feet and Deeper: OSHA requires that shoring or bracing for trenches 20 feet and deeper be specifically designed by a licensed professional engineer.

Trenches Less than 20 Feet Deep: Trench excavations that are less than 20 feet deep may be shored, sheeted and braced, or laid back to a stable slope for the safety of workers, the general public, and adjacent structures, except for excavations which are less than 5 feet deep and verified by a competent person to have no cave-in potential. The excavation and trenching should be in accordance with Occupational Safety and Health Administration (OSHA), Safety and Health Regulations, 29 CFR, Part 1926. Recommended OSHA soil types for trench design for existing soils can be found on Plates C-1 through C-6, in Appendix C. Fill soils are considered OSHA Class ‘C’; submerged cohesive soils should also be considered OSHA Class ‘C’, unless they are dewatered first.

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Critical Height is defined as the height a slope will stand unsupported for a short time; in cohesive soils, it is used to estimate the maximum depth of open-cuts at given side slopes. Critical Height may be calculated based on the soil cohesion. Values for various slopes and cohesion are shown on Plate D-1, in Appendix D. Cautions listed below should be exercised in use of Critical Height applications:

1. No more than 50 percent of the Critical Height computed should be used for vertical slopes. Unsupported vertical slopes are not recommended where granular soils or soils that will slough when not laterally supported are encountered within the excavation depth.

2. If the soil at the surface is dry to the point where tension cracks occur, any water in the crack will increase the lateral pressure considerably. In addition, if tension cracks occur, no cohesion should be assumed for the soils within the depth of the crack. The depth of the first waler should not exceed the depth of the potential tension crack. Struts should be installed before lateral displacement occurs.

3. Shoring should be provided for excavations where limited space precludes adequate side slopes, e.g., where granular soils will not stand on stable slopes and/or for deep open cuts.

4. All excavation, trenching and shoring should be designed and constructed by qualified professionals in accordance with OSHA requirements.

The maximum (steepest) allowable slopes for OSHA Soil Types for excavations less than 20 feet are presented on Plate D-2, in Appendix D.

If limited space is available for the required open trench side slopes, the space required for the slope can be reduced by using a combination of bracing and open cut as illustrated on Plate D-3, in Appendix D. Guidelines for bracing and calculating bracing stress are presented below.

Computation of Bracing Pressures: The following method can be used for calculating earth pressure against bracing for open cuts. Lateral pressure resulting from construction equipment, traffic loads, or other surcharge should be taken into account by adding the equivalent uniformly distributed surcharge to the design lateral pressure. Hydrostatic pressure, if any, should also be considered. The active earth pressure at depth z can be determined by Equation (11). The design soil parameters for trench bracing design are presented on Plates C-1 through C-6, in Appendix C.

$$p_a = (q_s + \gamma h_1 + \gamma' h_2) K_a - 2c\sqrt{K_a} + \gamma_w h_2 \quad \text{.....Equation (11)}$$

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where: p_a = active earth pressure (psf);
q_s = uniform surcharge pressure (psf);
γ, γ' = wet unit weight and buoyant unit weight of soil (pcf);
h_1 = depth from ground surface to groundwater table (ft);
h_2 = $z-h_1$, depth from groundwater table to the point under consideration (ft);
z = depth below ground surface for the point under consideration (ft);
K_a = coefficient of active earth pressure;
c = cohesion of clayey soils (psf); c can be omitted conservatively;
γ_w = unit weight of water, 62.4 pcf.

Pressure distribution for the practical design of struts in open cuts for clays and sands are illustrated on Plates D-4 through D-6, in Appendix D.

Bottom Stability: In open-cuts, it is necessary to consider the possibility of the bottom failing by heaving, due to the removal of the weight of excavated soil. Heaving typically occurs in soft plastic clays when the excavation depth is sufficiently deep enough to cause the surrounding soil to displace vertically due to bearing capacity failure of the soil beneath the excavation bottom, with a corresponding upward movement of the soils in the bottom of the excavation. In fat and lean clays, heave normally does not occur unless the ratio of Critical Height to Depth of Cut approaches one. In very sandy and silty lean clays and granular soils, heave can occur if an artificially large head of water is created due to installation of impervious sheeting while bracing the cut. This can be mitigated if groundwater is lowered below the excavation by dewatering the area. Granular soils encountered in our borings can refer to the boring logs and in Table 3 of this report. Guidelines for evaluating bottom stability in clay soils are presented on Plate D-7, in Appendix D.

If the excavation extends below groundwater and the soils at or near the bottom of the excavation are mainly sands or silts, the bottom can fail by blow-out (boiling) when a sufficient hydraulic head exists. The potential for boiling or in-flow of granular soils increases where the groundwater is pressurized. To reduce the potential for boiling of excavations terminating in granular soils below pressurized groundwater, the groundwater table should be lowered at least 5 feet below the excavation in accordance with Section 01578 of the latest edition of the City of Houston Standard General Requirements (COHSGR).

Calcareous nodules, silt/sand seams, and fat clays with slickensides were encountered in some of the borings. These secondary structures may become sources of localized instability when they are exposed

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during excavation, especially when they become saturated. Such soils have a tendency to slough or cave in when not laterally confined, such as in trench excavations. The Contractor should be aware of the potential for cave-in of the soils. Low plasticity soils (silts and clayey silts) will lose strength and may behave like granular soils when saturated.

5.2.5 Thrust Force Design Recommendations

Thrust forces are generated in pressure pipes, typically as a result of changes in pipe diameter, pipe direction or at the termination point of the pipes. The pipes could disengage at the joints if the forces are not balanced and if the pipe restraint is not adequate. Various methods of thrust restraint are used including thrust blocks, restrained joints, encasement, and tie-rods.

Thrust restraint design procedure based on the 2008 American Water Works Association (AWWA) Manual "Concrete Pressure Pipe (M9)" is discussed below. Plate D-8, in Appendix D shows the force diagram generated by flow in a bend in a pipe and also gives the equation for computing the thrust force. An example computation of a thrust force for a given surge pressure and a bend angle is presented on Plate D-9, in Appendix D.

Frictional Resistance: The unbalanced force due to changes in grade and alignment can be resisted by frictional force F_R, between the pipe and the surrounding soil. The resisting frictional force per linear foot of pipe against soil can be calculated from Equation (12):

$$F_R = f\,(2W_e + W_w + W_p) \qquad \text{.....Equation (12)}$$

where: f = Coefficient of friction between pipe and soil;
W_e = Weight of soil over pipe (lb/ft);
W_w = Weight of water inside the pipe (lb/ft);
W_p = Weight of pipe (lb/ft).

The value of the frictional resistance depends on the material in contact with the backfill and the soil used in the backfill. For a ductile iron pipe or PVC pipe with crushed stone or compacted sand backfill, an allowable coefficient of friction of 0.3 can be used. To account for submerged conditions, a soil unit weight of 60 pcf should be used to compute the weight of compacted backfill on the pipe.

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Thrust Blocks: Thrust blocks utilize passive earth pressures to resist forces generated by changes in direction or diameter of pressurized pipes. Passive earth pressure can be calculated using Equation (10); we recommend that a factor safety of 2.0 be used when using passive earth pressure for design of thrust blocks. The design soil parameters for thrust block design are presented on Plates C-1 through C-6, in Appendix C. Design parameters for bearing thrust blocks are presented on Plate D-10, in Appendix D.

5.2.6 Auger Face Stability During Construction

A Stability Factor, $N_t = (P_z - P_a)/C_u$ may be used to evaluate the stability of an unsupported bore face in cohesive soils (N_t is not applicable to granular soils), where P_z is the overburden pressure to the bore centerline; P_a is the equivalent uniform interior pressure applied to the face; and C_u is the soil undrained shear strength. For augering operations, no interior pressure is applied. Generally, N_t values of 4 or less are desirable as it represents a practical limit below which augering may be accomplished without significant difficulty. Higher N_t values usually lead to large deformations of the soil around the bore and problems associated with increased subsidence. It should be noted that the exposure time of the face is most important; with time, creep of the soil will occur, resulting in a reduction of shear strength. The N_t values will therefore increase when construction is slow.

An N_t value of about 0.01 to 3.8 was estimated for the cohesive soils encountered within the auger zone for our borings. N_t was not able to be determined if the granular soil strata is presence within the auger zone that is shown in Table 3. Note that the cohesive soils have secondary structures such as fissures, sand seams, and sand lenses which can cause the bore face to become unstable. **Since granular soils (and possibly water-bearing sand) will be encountered, the Contractor should make necessary provisions (such as casing or pressurized slurry auger machine) to stabilize the auger holes.** The Contractor should not base their bid on the above information alone, since granular soils will encountered between boring locations; the Contractor should verify the subsurface conditions between boring locations or add a contingency.

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5.2.7 Backfill for Auger Pits

Backfill for auger pits should be in accordance with Section 02317 of the latest edition of the COHSCS. Embedment material and backfill should be placed in loose lifts not exceeding 8 inches and compacted in accordance with Section 02317 of the latest edition of the COHSCS.

5.2.8 Influence of Augering on Adjacent Structures

Ground Subsidence: Augering in soft ground often induces some degree of settlement (ground subsidence) of the overlying ground surface. If such settlement is excessive, it may cause damage to existing structures and services located above and/or near the auger zone.

Predicting the amount of loss of ground (or ground subsidence) due to augering is very difficult, primarily because of the uncertainty involved in the analysis: such as heterogeneous soil properties, subsurface variability, or lack of information about proposed construction equipment and techniques.

Loss of Soil Support for Adjoining Structures: Augering operations, when located close to existing structures, will relieve the vertical and lateral soil support that these structures rely upon for their foundation bearing capacity and lateral soil support. This can result in distress to the existing structures if appropriate precautions are not taken.

Measures to Reduce Distress from Augering: Impact to existing foundations and structures can be mitigated by following proper augering procedures. Some methods to mitigate movement and/or distress to existing structures include:

- Supporting the augering excavation with steel or rigid concrete casing or the pipe material itself, as soon as the excavation is advanced and at short intervals; and
- proper grouting of the annular spaces; the type of equipment and method chosen will require the services of a specialty contractor.

To reduce the potential for the augering to influence the existing foundations or structures, we recommend that the outer edge of the influence zone of the auger tunnel be a minimum of 5 feet from the outer edge of the bearing (stress) zone of existing foundations. The bearing (stress) zone is defined by a line drawn

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downward from the outer edge of an existing foundation and inclined at an angle of 45 degrees to the vertical.

The auger influence zone is assumed to extend a distance of about 2.5i from the center of the auger tunnel, as shown on Plate D-11, in Appendix D. We estimated the resulting influence zones (extending from the centerline of the auger tunnel) to be approximately 2.5 to 7.5 feet based on the invert depths ranging from 7 to 15 feet below grade. We emphasize that the size of the influence zone of an auger tunnel is difficult to determine because several factors influence the response of the soil to augering operations including type of soil, ground water level, type of augering equipment, method of augering, experience of operator and other construction in the vicinity. The values of auger tunnel influence zone presented herein are therefore rough estimates.

We recommend that the following situations be evaluated on a case by case basis, where:

- augering cannot be located farther than the minimum distance recommended above;
- augering cannot be located outside the stress zone of the foundations for existing structures;
- unstable soils are encountered near existing structures;
- heavily loaded or critical structures are located close to the influence zone of the auger tunnels;

As an option, existing structure foundations should be protected by adequate shoring or strengthened by underpinning or other techniques, provided that augering cannot be located outside the stress zone of the existing foundations.

Disturbance and loss of ground from the augering operation may create surface soil disturbance and subsidence which in turn may cause distress to existing structures (including pavements) located in the zone of soil disturbance. Any open-cut excavation in the proposed augering areas should be adequately shored.

6.0 CONSTRUCTION CONSIDERATIONS

6.1 Site Preparation

To mitigate site problems that may develop following prolonged periods of rainfall, it is essential to have adequate drainage to maintain a relatively dry and firm surface prior to starting any work at the site.

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Adequate drainage should be maintained throughout the construction period. Methods for controlling surface runoff and ponding include proper site grading, berm construction around exposed areas, and installation of sump pits with pumps.

6.2 Groundwater Control

The need for groundwater control will depend on the depth of excavation relative to the groundwater depth at the time of construction. In the event that there is heavy rain prior to or during construction, the groundwater table may be higher than indicated in this report; higher seepage is also likely and may require a more extensive groundwater control program. In addition, groundwater may be pressurized in certain areas of the alignments, requiring further evaluation and consideration of the excess hydrostatic pressures. Groundwater control should be in general accordance with Section 01578 of the latest edition of the COHSGR.

The Contractor should be responsible for selecting, designing, constructing, maintaining, and monitoring a groundwater control system and adapt his operations to ensure the stability of the excavations. Groundwater information presented in Section 4.1 and elsewhere in this report, along with consideration for potential environmental and site variation between the time of our field exploration and construction, should be incorporated in evaluating groundwater depths. The following recommendations are intended to guide the Contractor during design and construction of the dewatering system.

In cohesive soils seepage rates are lower than in granular soils and groundwater is usually collected in sumps and channeled by gravity flow to storm sewers. If cohesive soils contain significant secondary features, seepage rates will be higher. This may require larger sumps and drainage channels, or if significant granular layers are interbedded within the cohesive soils, methods used for granular soils may be required. Where it is present, pressurized groundwater will also yield higher seepage rates.

Groundwater for excavations within saturated sands can be controlled by the installation of wellpoints. The practical maximum dewatering depth for well points is about 15 feet. When groundwater control is required below 15 feet, possible ground water control measures include: (i) deep wells with turbine or submersible pumps; (ii) multi-staged well points; or (iii) water-tight sheet pile cut-off walls. Generally, the groundwater depth should be lowered at least 5 feet below the excavation bottom (in accordance with

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Section 01578 of the latest edition of the COHSGR) to be able to work on a firm surface when water-bearing granular soils are encountered.

Extended and/or excessive dewatering can result in settlement of existing structures in the vicinity; the Contractor should take the necessary precautions to minimize the effect on existing structures in the vicinity of the dewatering operation. We recommend that the Contractor verify the groundwater depths and seepage rates prior to and during construction and retain the services of a dewatering expert (if necessary) to assist him in identifying, implementing, and monitoring the most suitable and cost-effective method of controlling groundwater.

For open cut construction in cohesive soils, the possibility of bottom heave must be considered due to the removal of the weight of excavated soil. In lean and fat clays, heave normally does not occur unless the ratio of Critical Height to Depth of Cut approaches one. In silty clays, heave does not typically occur unless an artificially large head of water is created through the use of impervious sheeting in bracing the cut. Guidelines for evaluating bottom stability are presented in Section 5.2.4 of this report.

6.3 Construction Monitoring

Pavement construction and subgrade preparation, as well as excavation, bedding, and backfilling of underground utilities should be monitored by qualified geotechnical professionals to check for compliance with project documents and changed conditions, if encountered. AEC should be allowed to review the design and construction plans and specifications prior to release to check that the geotechnical recommendations and design criteria presented herein are properly interpreted.

6.4 Monitoring of Existing Structures

Existing structures in the vicinity of the proposed alignments should be closely monitored prior to, during, and for a period after excavation. Several factors (including soil type and stratification, construction methods, weather conditions, other construction in the vicinity, construction personnel experience and supervision) may impact ground movement in the vicinity of the alignments. We therefore recommend that the Contractor be required to survey and adequately document the condition of existing structures in the vicinity of the proposed alignments.

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7.0 LIMITATIONS

The information contained in this report summarizes conditions found on the dates the borings were drilled. The attached boring logs are true representations of the soils encountered at the specific boring locations on the dates of drilling. Reasonable variations from the subsurface information presented in this report should be anticipated. If conditions encountered during construction are significantly different from those presented in this report; AEC should be notified immediately.

This investigation was performed using the standard level of care and diligence normally practiced by recognized geotechnical engineering firms in this area, presently performing similar services under similar circumstances. This report is intended to be used in its entirety. The report has been prepared exclusively for the project and location described in this report. If pertinent project details change or otherwise differ from those described herein, AEC should be notified immediately and retained to evaluate the effect of the changes on the recommendations presented in this report, and revise the recommendations if necessary. The recommendations presented in this report should not be used for other structures located along these alignments or similar structures located elsewhere, without additional evaluation and/or investigation.

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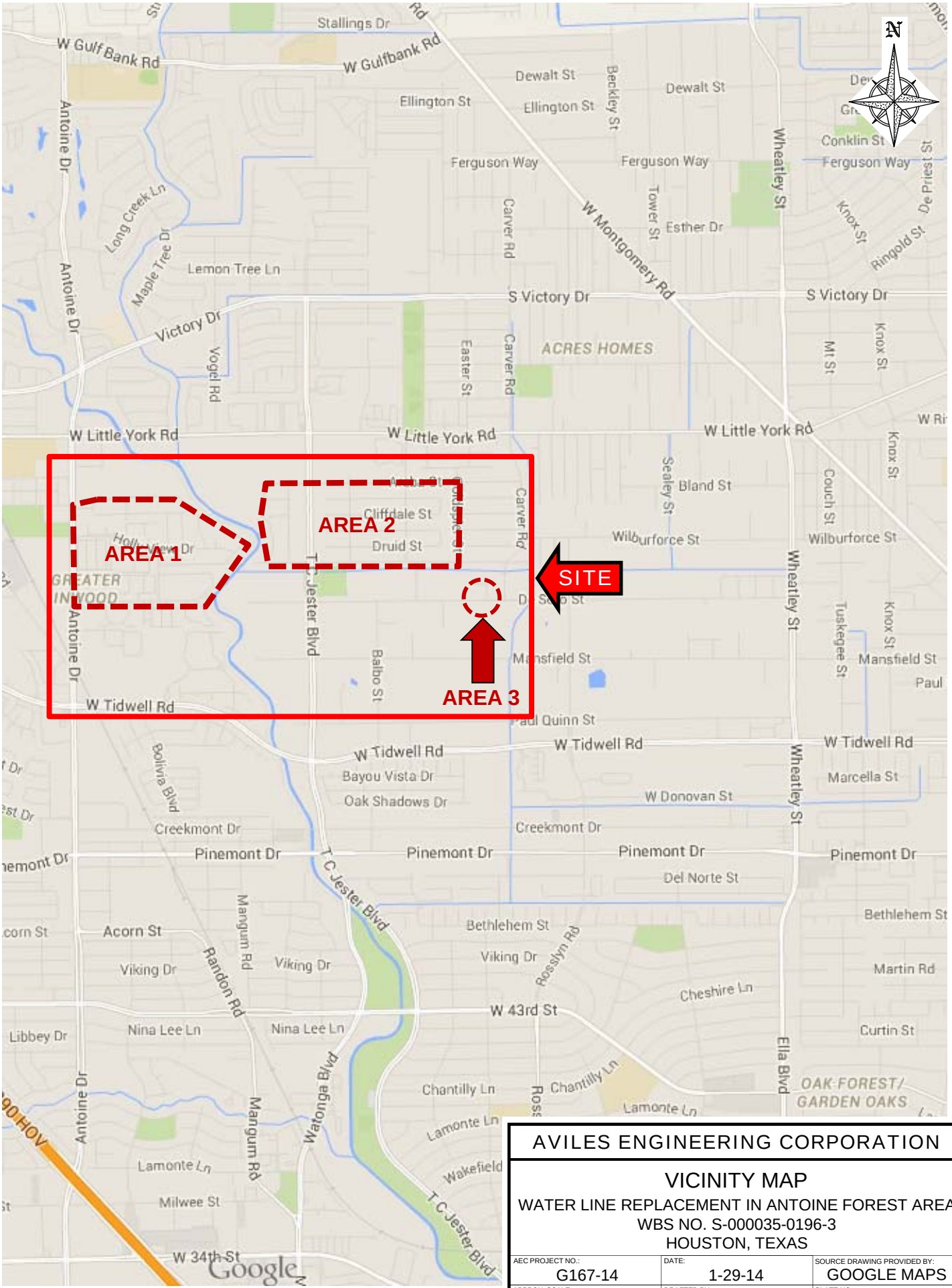
APPENDIX A



AVILES ENGINEERING CORPORATION

VICINITY MAP

WATER LINE REPLACEMENT IN ANTOINE FOREST AREA
WBS NO. S-000035-0196-3
HOUSTON, TEXAS

AEC PROJECT NO.:	DATE:	SOURCE DRAWING PROVIDED BY:
G167-14	1-29-14	GOOGLE MAPS
APPROX. SCALE:	DRAFTED BY:	PLATE NO.:
N.T.S.	CHL	PLATE A-1

N

0 300 600
GRAPHIC SCALE, FT

AREA 1

AREA 2

AREA 3

B-1 (15')
B-2 (14')
B-3 (12')
B-4 (12')
B-5 (13')
B-6 (17')
B-7 (13')
B-8 (15')
B-9 (13')
B-10 (15')
B-11 (12')
B-12 (14')
B-13 (19')
B-14 (17')
B-15 (18')
B-16 (17')
B-17 (18')
B-18 (18')
B-19 (19')
B-20 (13')
B-21 (21')
B-22 (13')
B-23 (13')
B-24 (13')
B-25 (13')
B-26 (15')
B-27 (15')
B-28 (13')
B-29 (13')
B-30 (15')
B-31 (14')
B-32 (13')
B-33 (14')
B-34 (15')
B-35 (18')
B-36 (15')
B-37 (15')
B-38 (15')
B-39 (15')
B-40 (14')
B-41 (14')
B-42 (22')
B-43 (18')
B-44 (14')
B-45 (18')
B-46 (22')
B-47 (14')
B-48 (18')
B-49 (14')
B-50 (18')
B-51 (14')
B-52 (15')
B-53 (18')
B-54 (18')
B-55 (14')
B-56 (18')
B-57 (15')
B-58 (16')
B-59 (15')
B-60 (20')
B-61 (14')
B-62 (15')

W. Little York
Winding Way
Sheraton Oaks
Holly View
Oak Cove
Oak Pass
Bayou View
Ashton
Areba
Carmel
Cliffdale
Dalview
Druid
Garapan
Homer
De Soto
Armada Dr
Mansfield St
Goldspier
Rollins St
Easter
Bolivia Blvd
Antoine Dr
T C Jester Blvd
Balbo St
Luther Ln
Preus Dr

© 2014 Google

LEGEND:

B-# (X') — Approximate Boring Location (Depth in feet)

B-# (X') — Previous AEC Borings from AEC Report G195-09

AVILES ENGINEERING CORPORATION

BORING LOCATION PLAN

WATER LINE REPLACEMENT IN ANTOINE FOREST AREA
CITY OF HOUSTON WBS NO. S-000035-0196-3
HOUSTON, TEXAS

AEC PROPOSAL NO.:	DATE:	SOURCE DRAWING PROVIDED BY:
G167-14	01-28-14	GOOGLE EARTH PRO
APPROX. SCALE:	DRAFTED BY:	PLATE NO.:
1" = 600'	CHL	PLATE A-2

PROJECT: **Waterline Replacement in Antoine Forest Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-1**

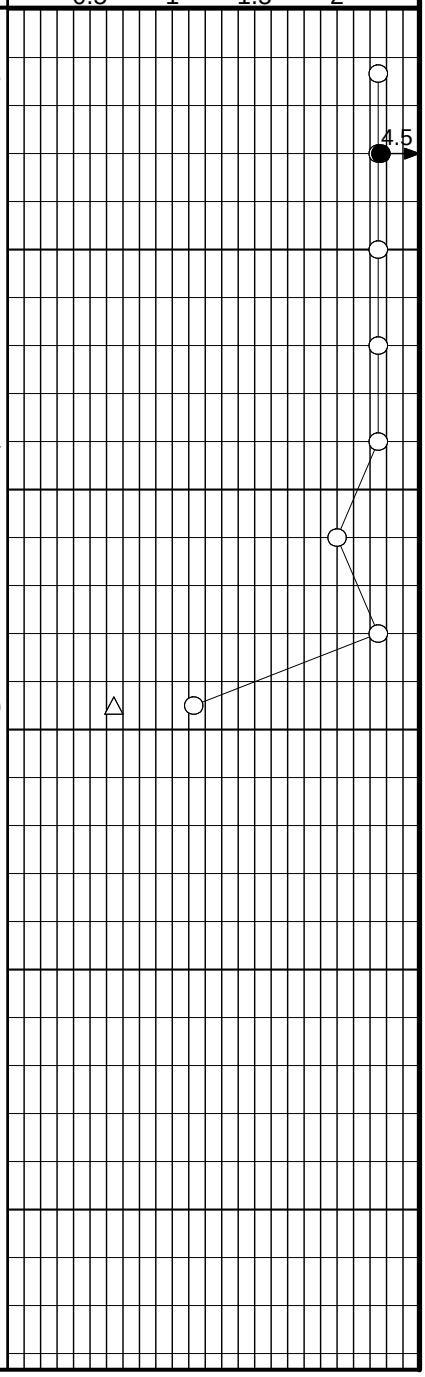
COH WBS No. **S-000035-0196-3** TYPE 4" Dry Auger DATE **11/4/2014**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
				Survey Coordinates (TSPC, Surface): *Easting: 3086659.48* *Northing: 13878713.42* *Elevation: 76.7*							
76	0			Pavement: 5" concrete							
				Base: 3" sand		76		11	50	17	33
				Hard, brown Fat Clay w/Sand (CH), with sand and sandy lean clay pockets -gray and tan, with ferrous stains 2'-6' -with silty sand pockets 2'-4'			121	12			
72	4							12			
				Very stiff to hard, tan, gray, and red Fat Clay (CH), with slickensides				17			
68	8					94		23	57	23	34
				-with ferrous stains 10'-14'				20			
64	12							23			
				Stiff to very stiff, gray and reddish tan Lean Clay (CL), with silty sand and fat clay pockets		91	106	22	37	17	20
60	16			Termination Depth = 15 feet.							
56	20										
52	24										
	28										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **15** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETED** ▼
DRILLED BY **J. H. Drilling** DRAFTED BY **MRB** LOGGED BY **MRB**

PROJECT NO. G167-14

PLATE A-3

PROJECT: **Waterline Replacement in Antoine Forest Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-2**

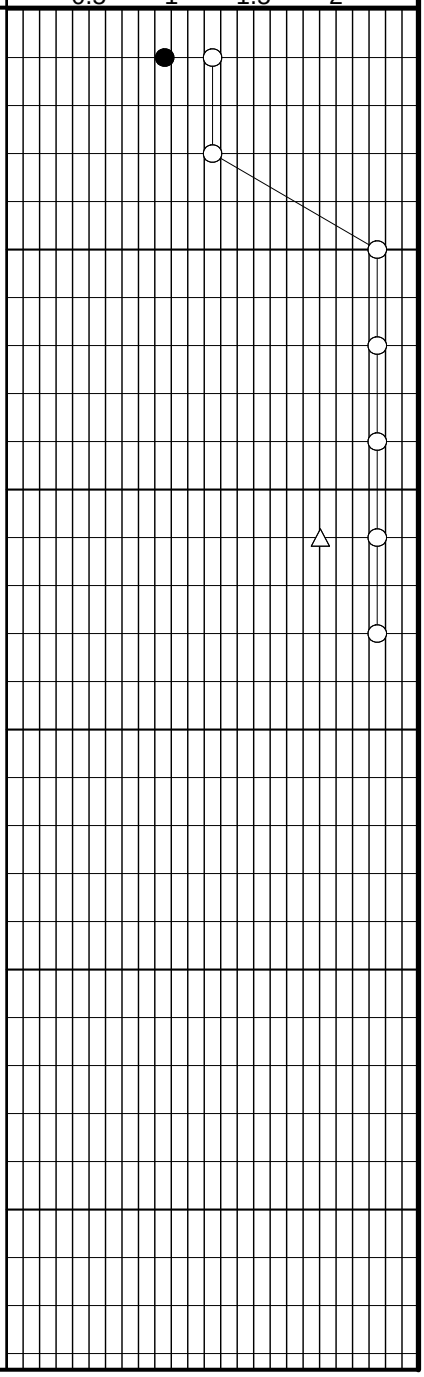
COH WBS No. **S-000035-0196-3** TYPE 4" Dry Auger DATE **11/5/2014**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
				Survey Coordinates (TSPC, Surface):							
				Easting: 3087009.31							
				Northing: 13878879.70							
				Elevation: 75.7							
	0			Pavement: 6" concrete							
				Stiff to very stiff, gray Fat Clay w/Sand (CH), with silt and sand pockets		78	102	22	53	19	34
72	4			Hard, tan and gray Sandy Lean Clay (CL), with silt partings				20			
								14			
68	8			Very stiff to hard, light gray and tan Fat Clay (CH), with slickensides and ferrous nodules				14			
								21			
64	12					95	107	21	51	20	31
								25			
				Termination depth = 14 feet.							
60	16										
56	20										
52	24										
48	28										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **14** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▼
DRILLED BY **J. H. Drilling** DRAFTED BY **RJM** LOGGED BY **MRB**

PROJECT NO. G167-14

PLATE A-4

PROJECT: **Waterline Replacement in Antoine Forest Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-3**

COH WBS No. **S-000035-0196-3** TYPE 4" Dry Auger DATE **11/5/2014**

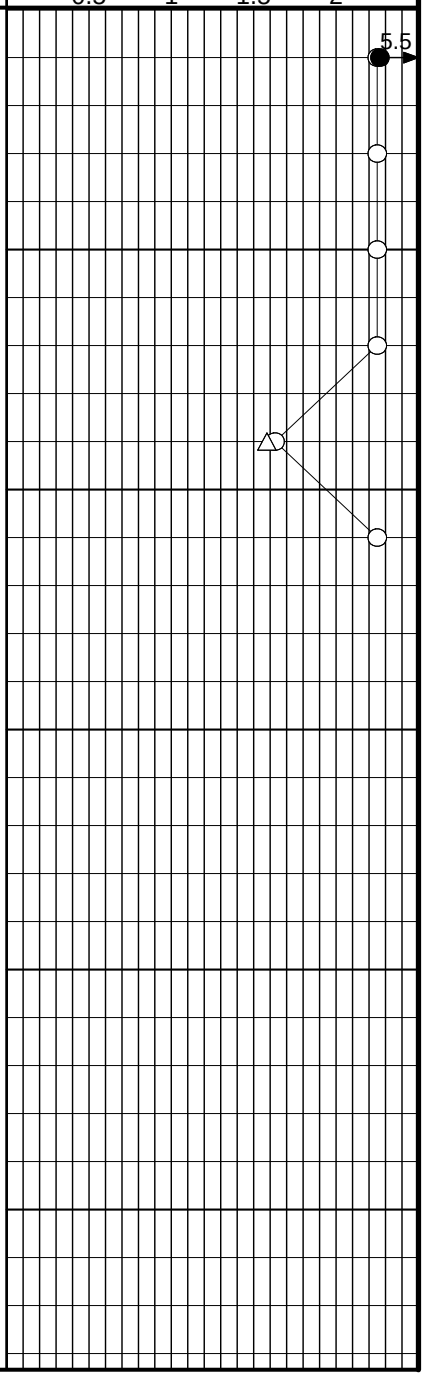
ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
	0			Pavement: 5.5" concrete							
72				Hard, gray and tan Lean Clay w/Sand (CL), with ferrous nodules -with roots 0'-2'		76	117	15	46	16	30
	4			Very stiff to hard, gray and tan Fat Clay (CH), with slickensides and ferrous nodules -with calcareous nodules 4'-10'				11 12 15			
68	8			-gray, red, and tan, with silty sand seams 8'-10'		92	107	21	52	19	33
64	12			Gray and red Silt (ML), with fat clay seams and large calcareous pockets				10			
60				Termination depth = 12 feet							
56	16										
52	20										
48	24										
	28										

Survey Coordinates (TSPC, Surface):
Easting: 3087341.60
Northing: 13878913.58
Elevation: 73.8

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **12** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE**
DRILLED BY **J. H. Drilling** DRAFTED BY **RJM** LOGGED BY **MRB**

PROJECT NO. G167-14

PLATE A-5

PROJECT: **Waterline Replacement in Antoine Forest Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-4**

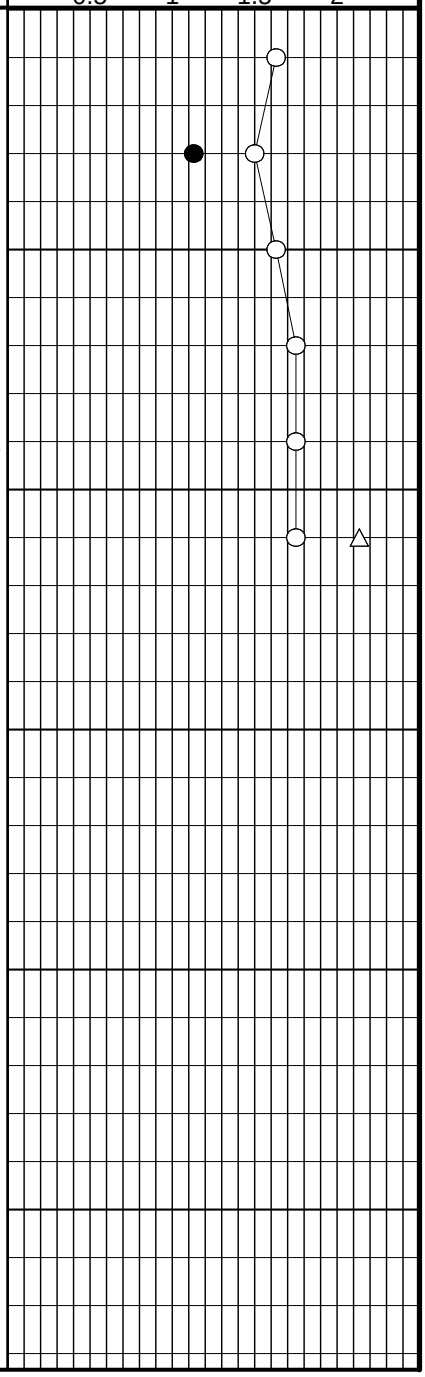
COH WBS No. **S-000035-0196-3** TYPE 4" Dry Auger DATE **11/5/2014**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
72	0			Pavement: 6" concrete							
				Very stiff, gray and tan Lean Clay w/Sand (CL), with abundant silt seams and pockets -with ferrous nodules 0'-2'		70		14	24	16	8
							111	17			
68	4							16			
								16			
64	8			Very stiff to hard, light gray and tan Fat Clay (CH), with slickensides and ferrous nodules -red, brown, and light gray 10'-12'		94		23	52	20	32
							102	25			
60	12			Termination depth = 12 feet.							
56	16										
52	20										
48	24										
44	28										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



Survey Coordinates (TSPC, Surface):
Easting: 3087750.11
Northing: 13878957.74
Elevation: 72.1

BORING DRILLED TO **12** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▼
DRILLED BY **J. H. Drilling** DRAFTED BY **RJM** LOGGED BY **MRB**

PROJECT NO. G167-14

PLATE A-6

PROJECT: **Waterline Replacement in Antoine Forest Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-5**

COH WBS No. **S-000035-0196-3** TYPE 4" Dry Auger DATE **11/5/2014**

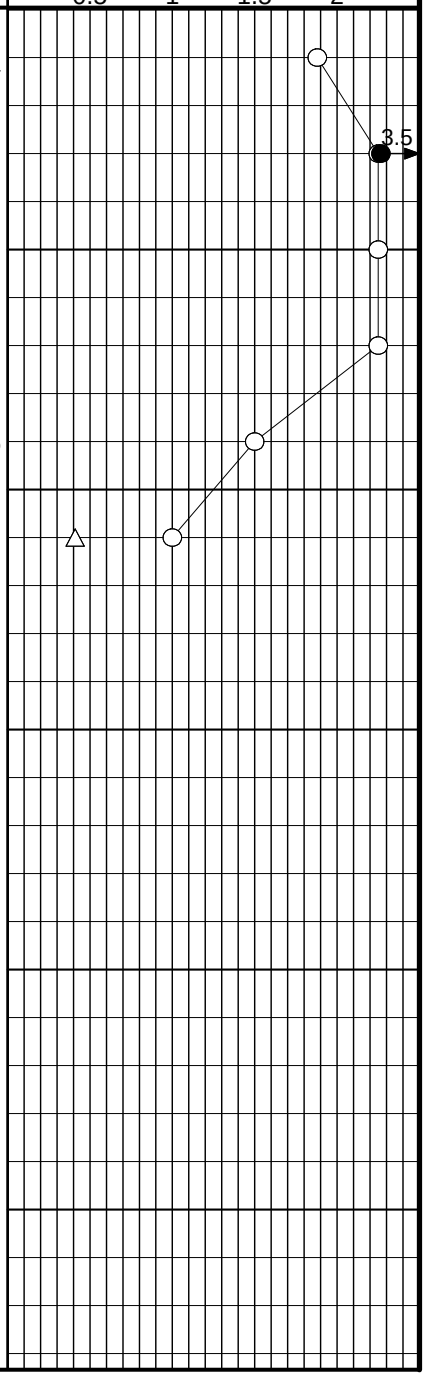
ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
	0			Pavement: 5.5" concrete							
				Firm to hard, light gray and tan Sandy Lean Clay (CL), with silt partings		64		9	29	15	14
68				-with siltstone fragments 0'-2'							
				-with ferrous nodules 2'-4'			120	10			
	4										
								9			
				-with ferrous nodules 6'-8'							
64								11			
	8			-with abundant silt seams 8'-12'							
						67		15	30	14	16
60							115	14			
	12			Light gray Silty Sand (SM)				8			
				Termination depth = 13 feet.							
56											
	16										
52											
	20										
48											
	24										
44											
	28										

Survey Coordinates (TSPC, Surface):
Easting: 3088297.27
Northing: 13878981.49
Elevation: 70.9

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **13** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▼
DRILLED BY **J. H. Drilling** DRAFTED BY **RJM** LOGGED BY **MRB**

PROJECT NO. G167-14

PLATE A-7

PROJECT: **Waterline Replacement in Antoine Forest Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-6**

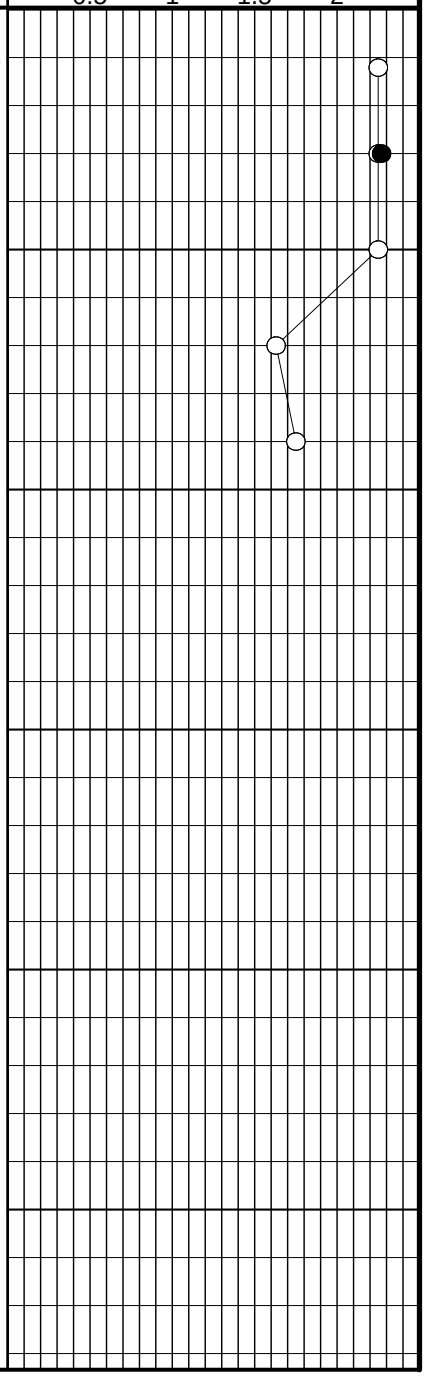
COH WBS No. **S-000035-0196-3** TYPE 4" Dry Auger DATE **11/5/2014**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
				Survey Coordinates (TSPC, Surface):							
				Easting: 3088742.36							
				Northing: 13878873.08							
				Elevation: 69.2							
68	0			Pavement: 5" concrete							
				Very stiff to hard, light gray and tan Sandy Lean Clay (CL), with ferrous nodules		59		9	31	14	17
				-with calcareous nodules 0'-2'			120	11			
64	4							12			
								14			
60	8			Dense, light gray Silty Sand (SM), with ferrous nodules and clay pockets		47	116	7	21	18	3
				-tan and light gray 10'-12'	41	48		7			
56	12			Reddish brown and light gray Fat Clay (CH)				19			
				-with large calcareous rocks 12'-16'				18			
52	16			-reddish brown, with lean clay pockets and silt partings				20			
				Termination Depth = 17 feet.							
48	20										
44	24										
	28										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **17** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▼
DRILLED BY **J. H. Drilling** DRAFTED BY **RJM** LOGGED BY **MRB**

PROJECT NO. G167-14

PLATE A-8

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

PROJECT: **Waterline Replacement in Antoine Forest Area** BORING **B-7**

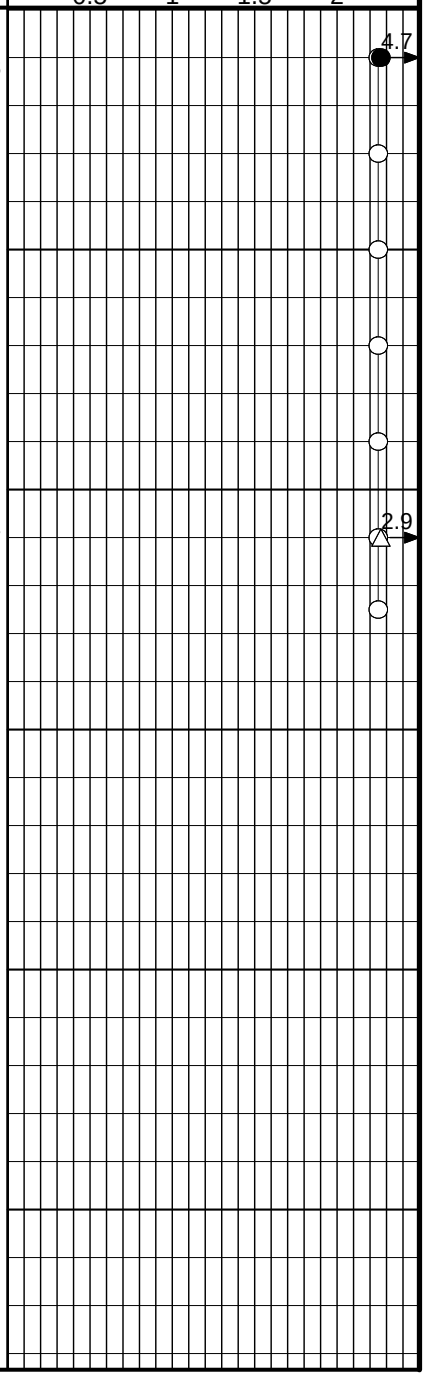
COH WBS No. **S-000035-0196-3** TYPE 4" Dry Auger DATE **11/6/2014**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
				Survey Coordinates (TSPC, Surface):							
				Easting: 3087217.54							
				Northing: 13878599.11							
				Elevation: 73.4							
72	0			Pavement: 6.5" concrete							
				Hard, dark gray, tan, and red Lean Clay w/ Sand (CL), with ferrous nodules		73	113	16	43	15	28
	4			-tan and gray, with silt pockets 2'-8'				12			
68								10			
								12			
	8			Hard, light gray and tan Fat Clay (CH), with slickensides				21			
64				-with silt pockets 8'-10'							
				-light gray, red, and brown 10'-13'		95	108	21	70	23	47
	12							22			
60				Termination depth = 13 feet.							
	16										
56											
	20										
52											
	24										
48											
	28										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **13** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▼
DRILLED BY **J. H. Drilling** DRAFTED BY **RJM** LOGGED BY **MRB**

PROJECT NO. G167-14

PLATE A-9

PROJECT: **Waterline Replacement in Antoine Forest Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-8**

COH WBS No. **S-000035-0196-3** TYPE 4" Dry Auger DATE **11/6/2014**

ELEVATION IN FEET	DEPTH IN FEET	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
		Survey Coordinates (TSPC, Surface):							
		Easting: 3087713.95							
		Northing: 13878635.47							
		Elevation: 71.9							
	0	Pavement: 5.5" concrete							
		Hard, gray Sandy Lean Clay (CL), with ferrous nodules and silt partings		55		8	31	13	18
		-with roots 0'-2'							
		-with slickensides 2'-4'			112	9			
68	4	-light gray and tan 4'-8', with silt seams 4'-6'				11			
						12			
64	8	Medium dense, light gray Silty Sand (SM)							
		-with clay partings 8'-10'		23	111	10	23	20	3
			16			9			
60	12	Medium dense, light gray Poorly Graded Sand w/Silt (SP-SM)	21			19			
		-wet at 14'	16	8		22			
		Termination depth = 15 feet.							
56	16								
52	20								
48	24								
44	28								

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2

3.5

BORING DRILLED TO **15** FEET WITHOUT DRILLING FLUID

WATER ENCOUNTERED AT **14** FEET WHILE DRILLING ▽

WATER LEVEL AT **14** FEET AFTER **COMPLETE** ▽

DRILLED BY **J. H. Drilling** DRAFTED BY **RJM** LOGGED BY **MRB**

PROJECT NO. G167-14

PLATE A-10

PROJECT: **Waterline Replacement in Antoine Forest Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-9**

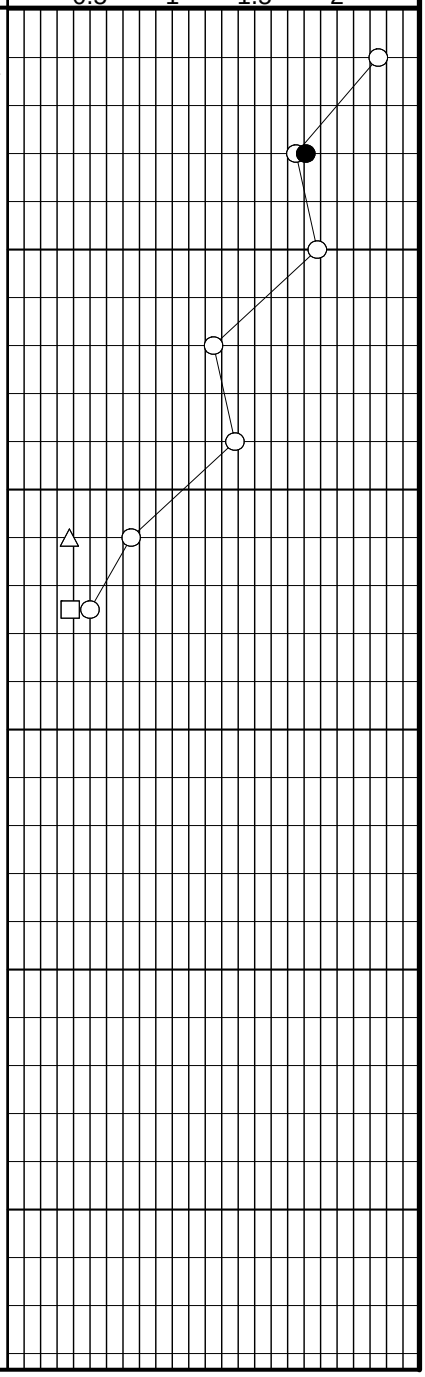
COH WBS No. **S-000035-0196-3** TYPE 4" Dry Auger DATE **11/6/2014**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
68	0			Pavement: 5.5" concrete							
				Very stiff to hard, light gray and tan Lean Clay w/Sand (CL), with ferrous nodules -with siltstone fragments 0'-4' and calcareous nodules 0'-2'		77		12	36	14	22
	4						116	17			
								14			
64				Firm to very stiff, light gray and tan Sandy Silty Clay (CL-ML)				13			
	8			-with silt seams 8'-10'							
								14			
60				-light gray 10'-13'			116	14			
	12					57		17	22	16	6
				Termination depth = 13 feet.							
56	16										
52											
	20										
48											
	24										
44											
	28										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **13** FEET WITHOUT DRILLING FLUID

WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽

WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▼

DRILLED BY **J. H. Drilling** DRAFTED BY **RJM** LOGGED BY **MRB**

PROJECT NO. G167-14

PLATE A-11

PROJECT: **Waterline Replacement in Antoine Forest Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-10**

COH WBS No. **S-000035-0196-3** TYPE 4" Dry Auger DATE **11/6/2014**

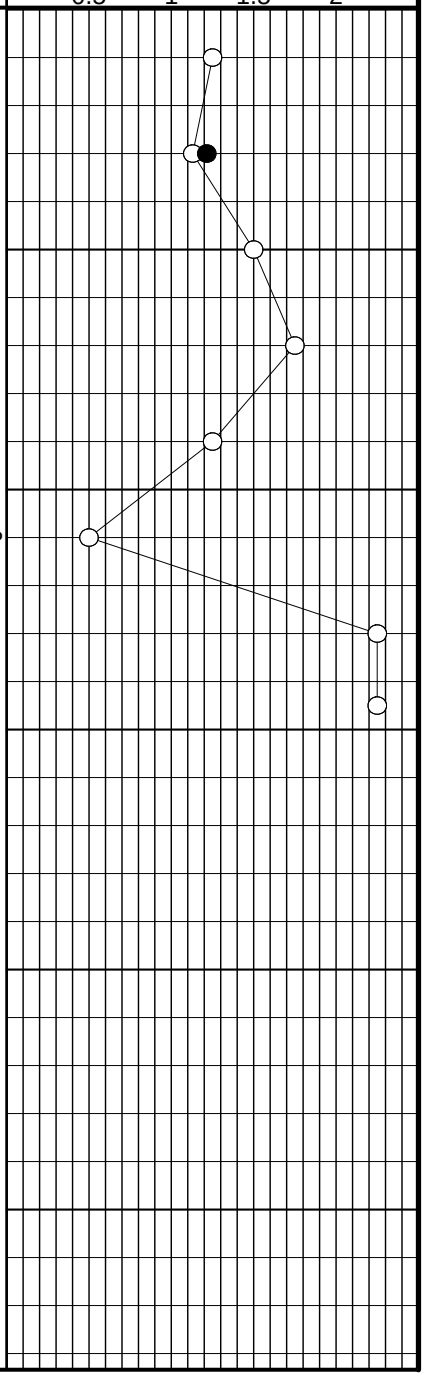
ELEVATION IN FEET	DEPTH IN FEET	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
	0	Pavement: 5.75" concrete							
68		Very stiff, light gray Sandy Lean Clay (CL), with silt partings		52		13	33	15	18
		-with abundant siltstone fragments and calcareous and ferrous nodules 0'-4'			109	18			
	4								
64						16			
		-with siltstone fragments 6'-8'				14			
	8	-with abundant silt seams 8'-10'				16			
60		Light gray Silty Sand (SM), with clay pockets		26	111	17	NP	NP	NP
	12	Hard, red, brown, and light gray Fat Clay (CH), with slickensides, calcareous nodules, and siltstone fragments				20			
56						21			
		Termination depth = 15 feet.							
	16								
52									
	20								
48									
	24								
44									
	28								

Survey Coordinates (TSPC, Surface):
Easting: 3088688.83
Northing: 13878679.50
Elevation: 69.8

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **15** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▼
DRILLED BY **J. H. Drilling** DRAFTED BY **RJM** LOGGED BY **MRB**

PROJECT NO. G167-14

PLATE A-12

PROJECT: **Waterline Replacement in Antoine Forest Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-11**

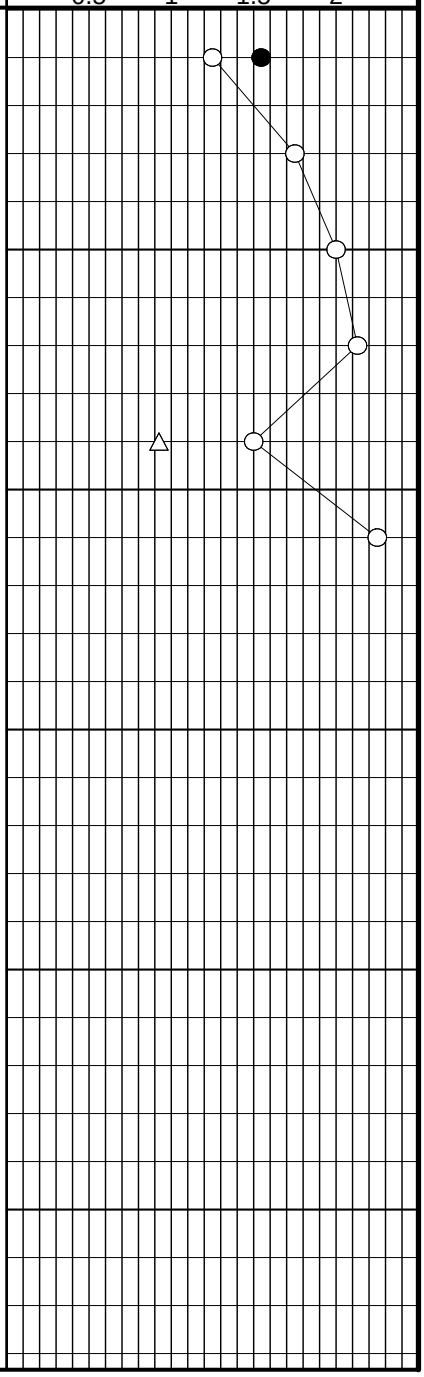
COH WBS No. **S-000035-0196-3** TYPE 4" Dry Auger DATE **11/6/2014**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
	0			*Survey Coordinates (TSPC, Surface):* *Easting: 3086693.71* *Northing: 13878136.80* *Elevation: 75.8*							
	0			Pavement: 7.5 concrete							
				Very stiff to hard, dark gray Lean Clay w/ Sand (CL)		80	111	18	35	13	22
				-with silt partings 0'-2' and ferrous nodules 0'-6'				17			
72	4			-light gray and tan 4'-8'				17			
				-with silt pockets and fat clay seams 6'-8'				17			
68	8			Stiff to hard, red, brown, and light gray Fat Clay (CH), with slickensides			104	27			
				-with silt pockets and seams 8'-10'							
				-with siltstone fragments, calcareous and ferrous nodules 10'-12'		99		28	68	28	40
64	12			Termination depth = 12 feet.							
60	16										
56	20										
52	24										
48	28										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **12** FEET WITHOUT DRILLING FLUID

WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽

WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▼

DRILLED BY **J. H. Drilling** DRAFTED BY **RJM** LOGGED BY **MRB**

PROJECT NO. G167-14

PLATE A-13

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

PROJECT: **Waterline Replacement in Antoine Forest Area** BORING **B-12**

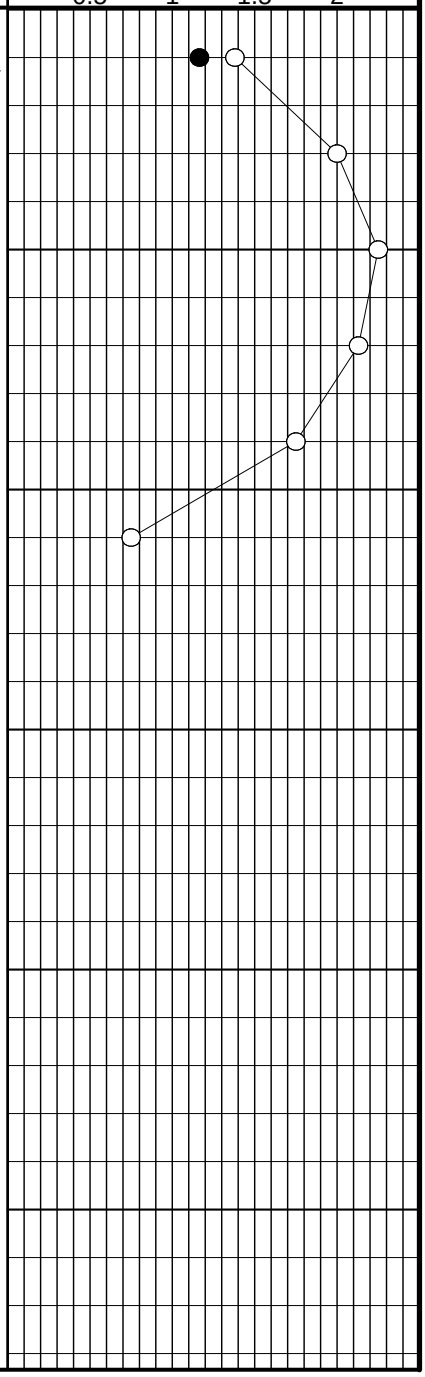
COH WBS No. **S-000035-0196-3** TYPE 4" Dry Auger DATE **11/6/2014**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
				Survey Coordinates (TSPC, Surface): *Easting: 3087174.13* *Northing: 13878154.91* *Elevation: 74.2*							
	0			Pavement: 7.75" concrete							
72				Very stiff to hard, dark gray Sandy Fat Clay (CH), with silt partings		65	98	27	65	21	44
	4			-tan and light gray, with ferrous nodules 2'-8'				15			
				-with silt seams 4'-6'				16			
68								15			
	8			Medium dense, light gray Silty Clayey Sand (SC-SM)		31		15	28	21	7
64							113	12			
	12				16	14		8			
60				Termination depth = 14 feet.							
	16										
56											
	20										
52											
	24										
48											
	28										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **14** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▼
DRILLED BY **J. H. Drilling** DRAFTED BY **RJM** LOGGED BY **MRB**

PROJECT NO. G167-14 **PLATE A-14**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

PROJECT: **Waterline Replacement in Antoine Forest Area** BORING **B-13**

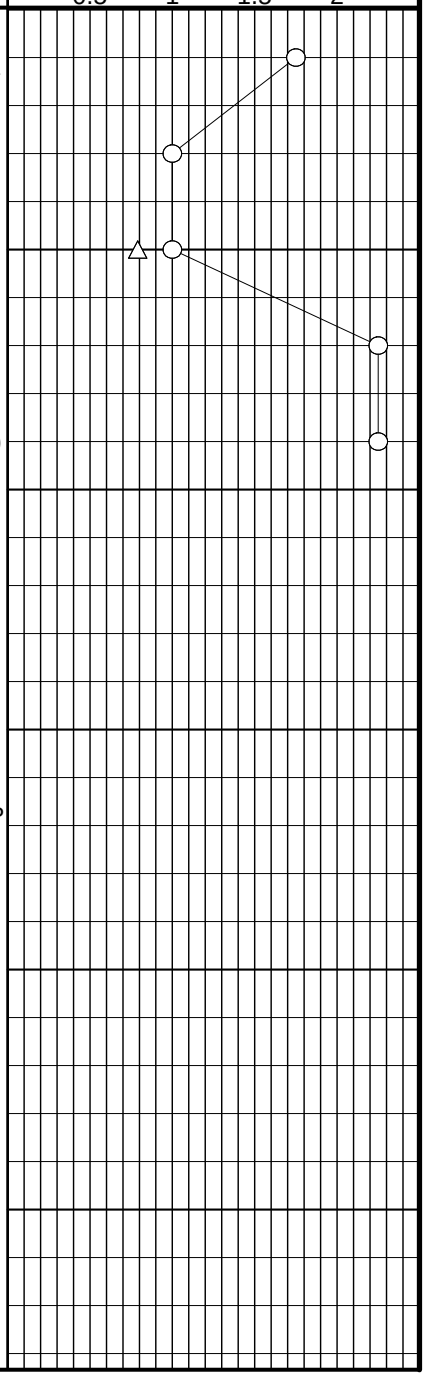
COH WBS No. **S-000035-0196-3** TYPE 4" Dry Auger DATE **11/6/2014**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
				Survey Coordinates (TSPC, Surface): *Easting: 3087620.88* *Northing: 13878284.71* *Elevation: 73.1*							
72	0			Pavement: 7" concrete							
				Stiff to hard, dark gray and light gray Sandy Lean Clay (CL), with silt seams and silt pockets		58		14	25	14	11
	4							14			
68							106	19			
								14			
	8			Tan and light gray Clayey Sand (SC)							
64						28		13	28	18	10
				Medium dense, light gray and tan Poorly Graded Sand w/Silt (SP-SM)	15			15			
	12			-boring cave in at 11.8' after drilling was completed							
60					16			7			
				-wet at 14'							
					23			22			
	16				17	8		23	NP	NP	NP
56				-with clay pockets 17'-19'							
					18			25			
				Termination depth = 19 feet.							
	20										
52											
	24										
48											
	28										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **19** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **14** FEET WHILE DRILLING ▽
WATER LEVEL AT **11.8** FEET AFTER **COMPLETE** ▼
DRILLED BY **J. H. Drilling** DRAFTED BY **RJM** LOGGED BY **MRB**

PROJECT NO. G167-14

PLATE A-15

PROJECT: **Waterline Replacement in Antoine Forest Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-14**

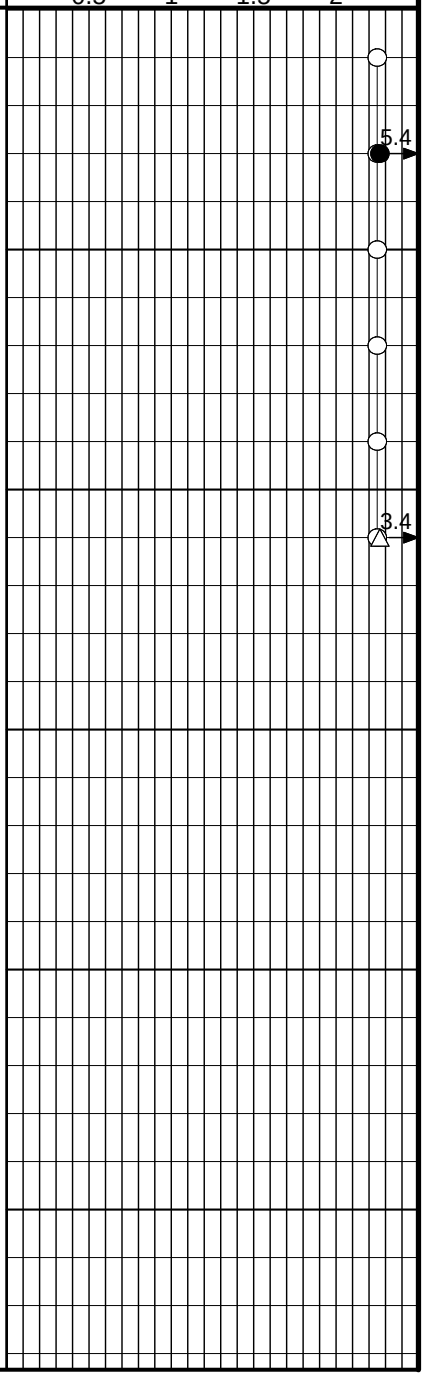
COH WBS No. **S-000035-0196-3** TYPE 4" Dry Auger DATE **11/6/2014**

ELEVATION IN FEET	DEPTH IN FEET	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
	0	Pavement: 7" concrete							
72		Hard, gray and tan Sandy Lean Clay (CL), with silt seams		61		11	38	13	25
		-with vertical silt seams 0'-4'			123	12			
	4	-light gray and tan, with ferrous nodules 4'-12'							
68						10			
						9			
	8	-with silt partings 8'-12'							
64						9			
				56	111	16			
	12	Medium dense, light gray Silty Sand (SM)	19			9			
60		-wet and boring cave in at 14' after drilling was completed	14			18			
	16		15			20			
56		Termination depth = 17 feet.							
	20								
52									
	24								
48									
	28								

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **17** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **14** FEET AFTER **COMPLETE** ▽
DRILLED BY **J. H. Drilling** DRAFTED BY **RJM** LOGGED BY **MRB**

PROJECT NO. G167-14

PLATE A-16

PROJECT: **Waterline Replacement in Antoine Forest Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-15**

COH WBS No. **S-000035-0196-3** TYPE 4" Dry Auger DATE **11/6/2014**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
72	0			Pavement: 5.5" concrete							
				Stiff to hard, gray and tan Lean Clay w/ Sand (CL), with silt partings and siltstone fragments -with ferrous nodules 0'-2' -with calcareous nodules 2'-4'		75	118	14	38	15	23
								13			
68	4							14			
								17			
64	8					78	109	20	47	15	32
								18			
60	12			Very stiff to hard, red, brown, light gray Fat Clay (CH), with slickensides -with silt pockets 12'-14' -with silt seams, siltstone fragments, and calcareous nodules 14'-16'				19			
								15			
56	16					98	98	26	58	24	34
				Termination depth = 18 feet.							
52	20										
48	24										
	28										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2

BORING DRILLED TO **18** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▼
DRILLED BY **J. H. Drilling** DRAFTED BY **RJM** LOGGED BY **MRB**

PROJECT NO. G167-14

PLATE A-17

PROJECT: **Waterline Replacement in Antoine Forest Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-16**

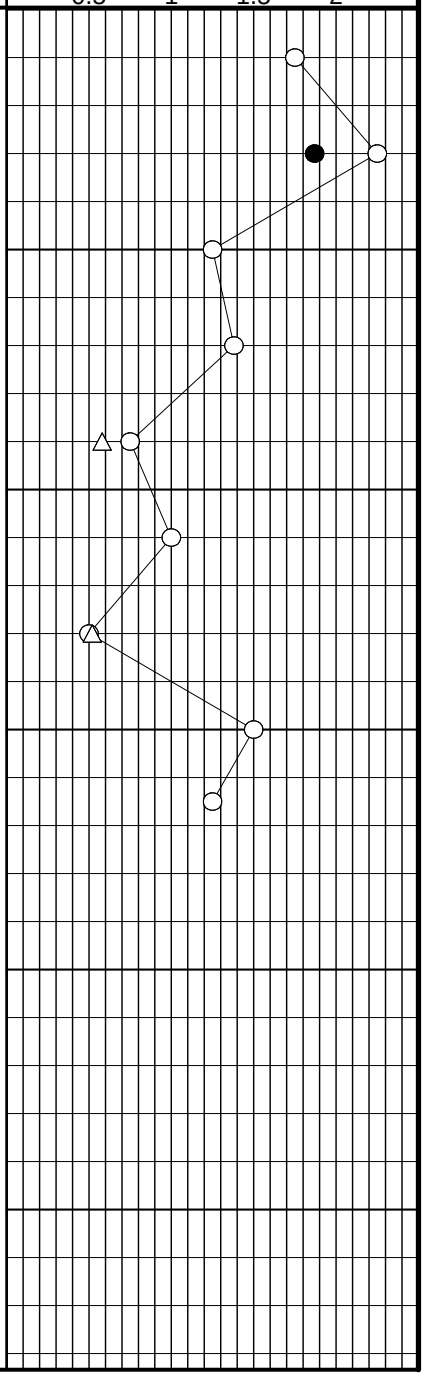
COH WBS No. **S-000035-0196-3** TYPE 4" Dry Auger DATE **11/6/2014**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
	0			Pavement: 6" concrete							
				Very stiff to hard, gray Sandy Lean Clay (CL)		62		14	36	15	21
68				-with siltstone fragments 0'-6'							
				-with calcareous nodules 2'-6'			123	12			
	4			-tan and light gray 4'-6', with ferrous nodules 4'-8'				15			
64								17			
	8			Light gray and tan Clayey Sand (SC)		39	116	13	26	13	13
60								14			
	12						120	14			
				Very stiff, red, brown, and light gray Lean Clay (CL), with slickensides, fat clay seams, siltstone fragments, and calcareous nodules				25			
56	16					93		23	36	18	18
				Termination depth = 17 feet.							
52											
	20										
48											
	24										
44											
	28										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **17** FEET WITHOUT DRILLING FLUID

WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽

WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▼

DRILLED BY **J. H. Drilling** DRAFTED BY **RJM** LOGGED BY **MRB**

PROJECT NO. G167-14

PLATE A-18

PROJECT: **Waterline Replacement in Antoine Forest Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-17**

COH WBS No. **S-000035-0196-3** TYPE 4" Dry Auger DATE **11/10/2014**

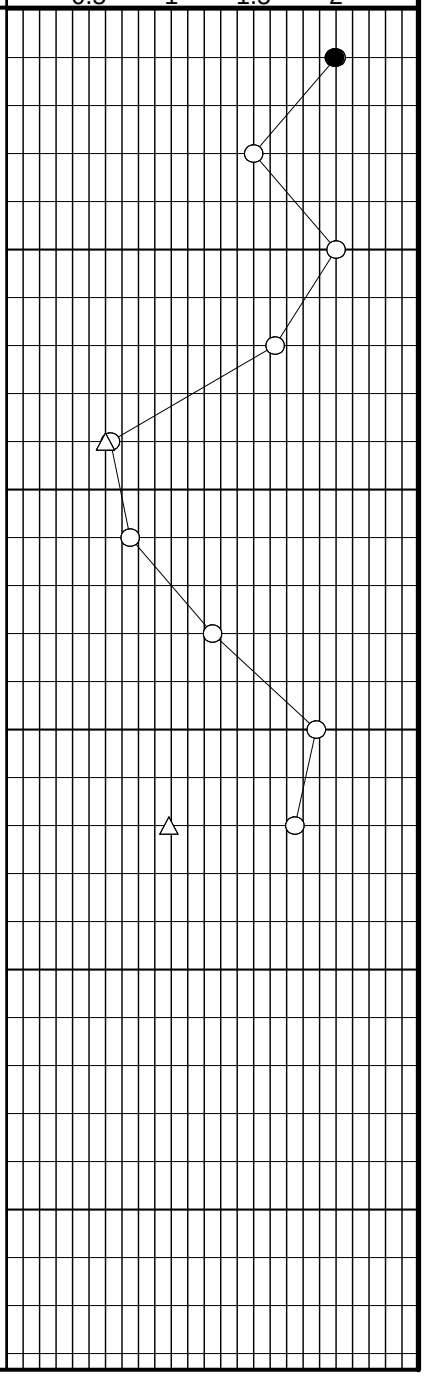
ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
	0			Pavement: 6.25" concrete							
68				Very stiff to hard, dark gray Sandy Lean Clay (CL), with ferrous nodules and abundant silt partings		66	120	13	31	15	16
	4			-light gray and tan 4'-8'				15			
64								14			
	8			Light gray Silty Clayey Sand (SC-SM)				15			
60				-with abundant silt seams 10'-12'			117	15			
	12					31		18	22	17	5
56				Stiff to very stiff, red, brown, light gray Fat Clay (CH), with slickensides -with silt pockets 14'-16'				23			
	16			-with siltstone fragments 16'-18'				25			
52							98	27			
				Termination depth = 18 feet.							
48	20										
	24										
44											
	28										

Survey Coordinates (TSPC, Surface):
Easting: 3088636.74
Northing: 13877974.26
Elevation: 70.35

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **18** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▼
DRILLED BY **J. H. Drilling** DRAFTED BY **RJM** LOGGED BY **MRB**

PROJECT NO. G167-14

PLATE A-19

PROJECT: **Waterline Replacement in Antoine Forest Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-18**

COH WBS No. **S-000035-0196-3** TYPE 4" Dry Auger DATE **11/10/2014**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
	0			Pavement: 6" concrete							
68	4			Stiff to very stiff, gray Lean Clay w/Sand (CL) -with siltstone fragments 0'-4' -gray and tan 2'-12, with calcareous nodules 2'-4'		74	115	16	37	14	23
								16			
64	8							16			
								16			
							109	18			
60	12			Very stiff to hard, red, brown, light gray Fat Clay (CH), with slickensides, siltstone fragments, and calcareous nodules -with silty clay pockets 14'-16'		81		19	30	13	17
								43			
56	16							25			
						93	105	23	62	23	39
52	20			Termination depth = 18 feet.							
48	24										
44	28										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2

BORING DRILLED TO **18** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▼
DRILLED BY **J. H. Drilling** DRAFTED BY **RJM** LOGGED BY **MRB**

PROJECT NO. G167-14

PLATE A-20

PROJECT: **Waterline Replacement in Antoine Forest Area** BORING **B-19**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

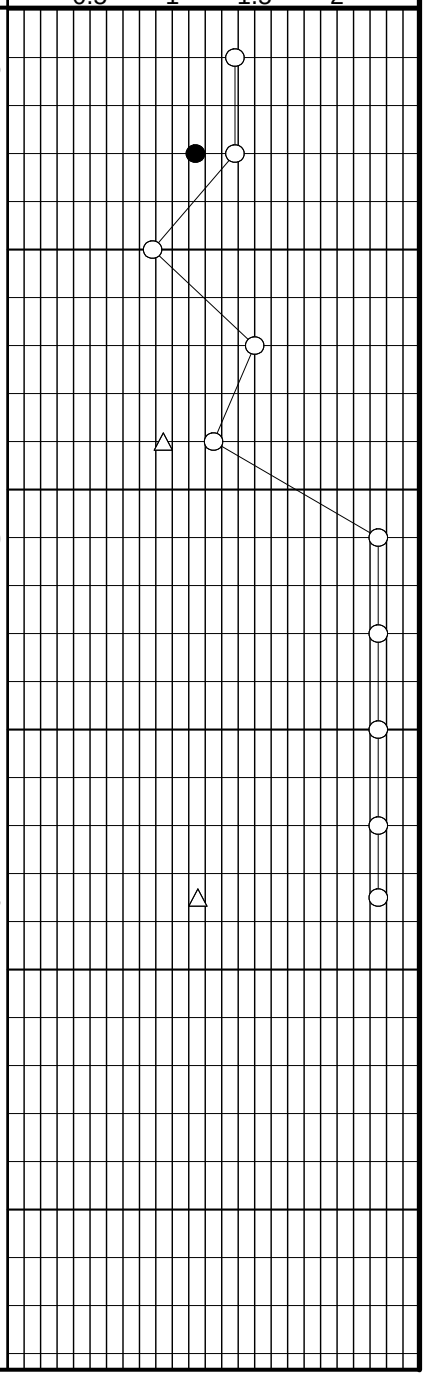
COH WBS No. **S-000035-0196-3** TYPE 4" Dry Auger DATE **11/10/2014**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
				Survey Coordinates (TSPC, Surface):							
				Easting: 3089112.62							
				Northing: 13877995.07							
				Elevation: 70.0							
72	0			Pavement: 6" concrete							
				Stiff to very stiff, dark gray Fat Clay w/Sand (CH), with ferrous nodules		78		18	51	15	36
68				-tan and light gray, with silt partings 2'-10'			113	18			
	4							21			
64								19			
	8						112	20			
60				Very stiff to hard, light gray, red, and brown Fat Clay (CH), with slickensides		99		28	62	23	39
	12			-with silt partings and siltstone fragments 10'-12'				24			
56								22			
	16			-with siltstone fragments and calcareous nodules 16'-19'				22			
52						88	105	23	53	20	33
				Termination depth = 19 feet.							
	20										
48											
	24										
44											
	28										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **18** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▼
DRILLED BY **J. H. Drilling** DRAFTED BY **RJM** LOGGED BY **MRB**

PROJECT NO. G167-14

PLATE A-21

PROJECT: **Waterline Replacement in Antoine Forest Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-20**

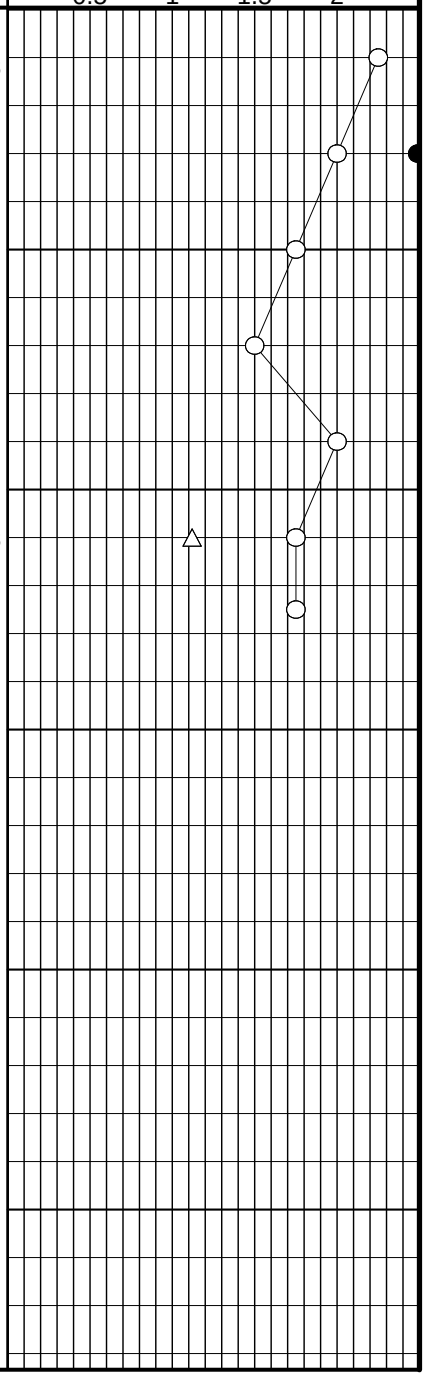
COH WBS No. **S-000035-0196-3** TYPE 4" Dry Auger DATE **11/19/2014**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
				Survey Coordinates (TSPC, Surface): *Easting: 3089038.90* *Northing: 13878495.86* *Elevation: 69.6*							
68	0			Pavement: 5.5" concrete							
				Base: 2" sand		59		10	32	14	18
				Very stiff to hard, dark gray Sandy Lean Clay (CL), with silt partings and ferrous nodules -tan and gray 2'-8'			119	14			
64	4							14			
								18			
	8			Very stiff, red, brown, and light gray Lean Clay w/Sand (CL), with slickensides and fat clay seams -with silt pockets and ferrous nodules 8'-10' -with calcareous nodules and siltstone fragments 10'-13'				26			
60						84	100	26	44	16	28
	12							31			
56				Termination depth = 13 feet.							
	16										
52											
	20										
48											
	24										
44											
	28										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **13** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▼
DRILLED BY **J. H. Drilling** DRAFTED BY **RJM** LOGGED BY **MRB**

PROJECT NO. G167-14

PLATE A-22

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

PROJECT: **Waterline Replacement in Antoine Forest Area** BORING **B-21**

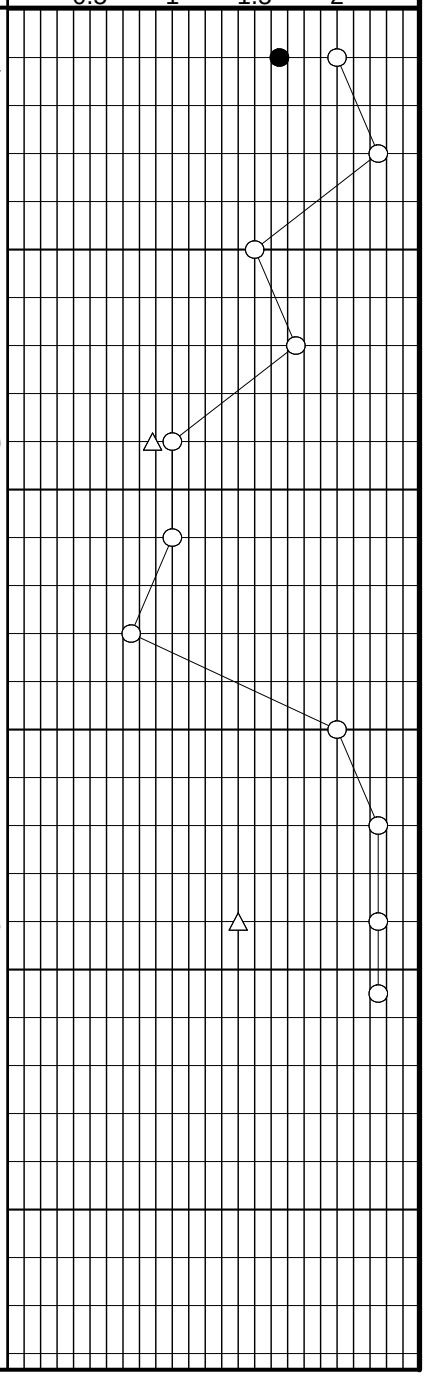
COH WBS No. **S-000035-0196-3** TYPE 4" Dry Auger DATE **11/9/2014**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
				Survey Coordinates (TSPC, Surface):							
				Easting: 3089696.57							
				Northing: 13877969.62							
				Elevation: 70.5							
72	0			Pavement: 6.5" concrete							
				Stiff to hard, brown Lean Clay w/Sand (CL), with ferrous nodules		80	113	16	39	15	24
68				-gray, with calcareous nodules 2'-12'				15			
	4							16			
64				-with silt partings 6'-10'				15			
	8					74	113	17	33	13	20
60				-with fat clay pockets 10'-12'				21			
	12			Stiff to hard, red and gray Fat Clay (CH), with slickensides				20			
				-with sand seams 12'-14'				27			
56	16			-with calcareous nodules 16'-21'				24			
52						98	102	24	62	24	38
	20							21			
				Termination depth = 21 feet.							
48											
	24										
44											
	28										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **21** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **16** FEET WHILE DRILLING ▽
WATER LEVEL AT **19.4** FEET AFTER **COMPLETE** ▽
DRILLED BY **J. H. Drilling** DRAFTED BY **RJM** LOGGED BY **MRB**

PROJECT NO. G167-14

PLATE A-23

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

PROJECT: **Waterline Replacement in Antoine Forest Area** BORING **B-22**

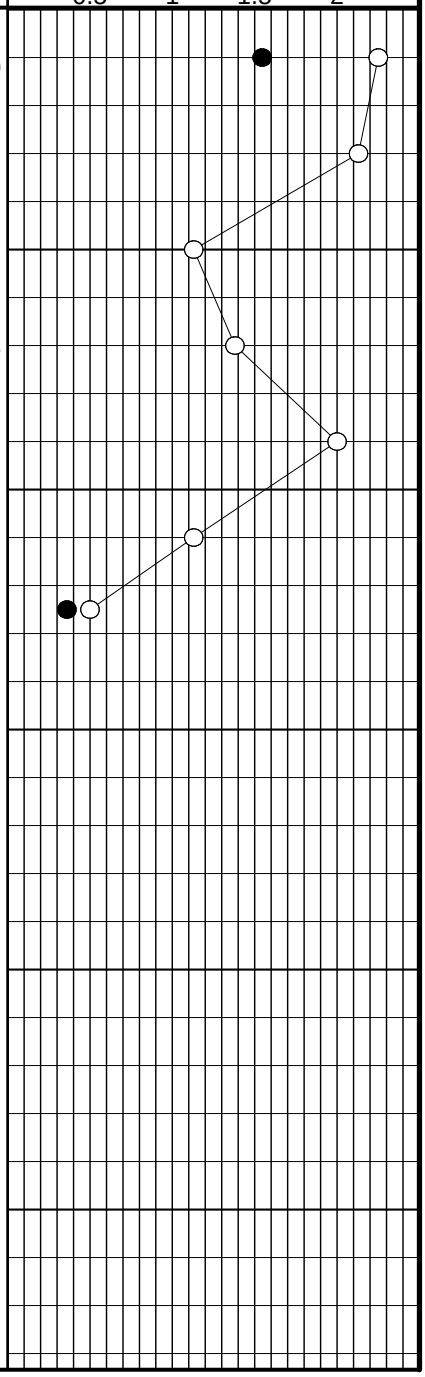
COH WBS No. **S-000035-0196-3** TYPE 4" Dry Auger DATE **11/9/2014**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
				Survey Coordinates (TSPC, Surface):							
				Easting: 3088359.69							
				Northing: 13877661.87							
				Elevation: 70.7							
70	0			Pavement: 7" concrete							
				Very stiff to hard, gray and tan Lean Clay w/Sand (CL), with ferrous nodules		70	119	14	35	15	20
68				-with calcareous nodules 0'-4'				16			
	4			-with silt partings 4'-6'				18			
64						85		18	49	16	33
	8							17			
60				Firm to very stiff, gray and tan Sandy Silty Clay (CL-ML), with abundant sand pockets				19			
	12					75	104	23	27	22	5
				Termination depth = 13 feet.							
56											
	16										
52											
	20										
48											
	24										
44											
	28										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **13** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▽
DRILLED BY **J. H. Drilling** DRAFTED BY **RJM** LOGGED BY **MRB**

PROJECT NO. G167-14

PLATE A-24

PROJECT: **Waterline Replacement in Antoine Forest Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-23**

COH WBS No. **S-000035-0196-3** TYPE 4" Dry Auger DATE **11/9/2014**

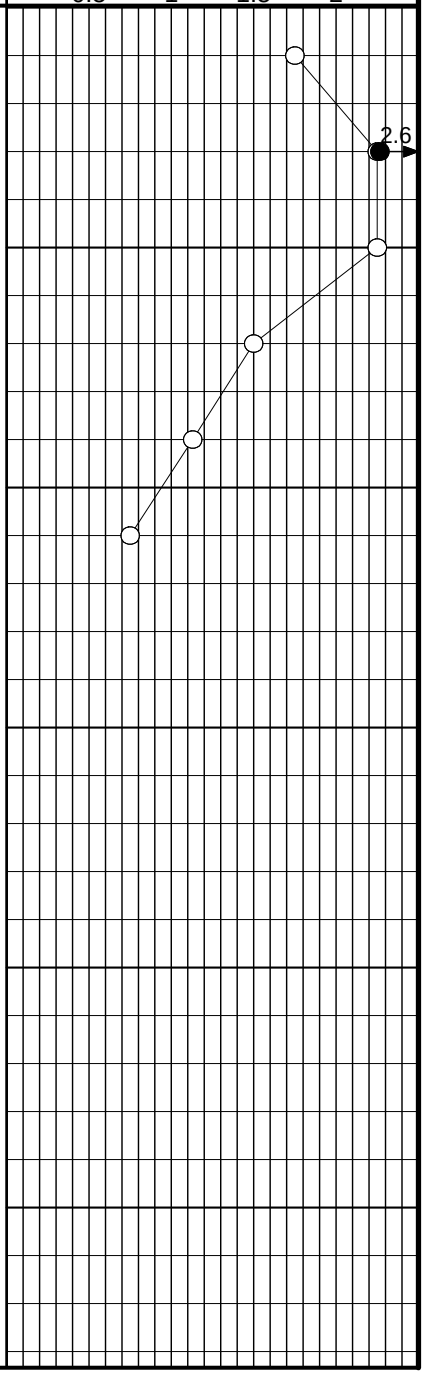
ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
	0			Pavement: 8" concrete							
68				Very stiff to hard, gray and dark brown Sandy Lean Clay (CL)		64		14	32	13	19
				-with silty sand pockets 0'-2'							
				-gray and tan 2'-8', with ferrous nodules 2'-6'			119	11			
	4										
64								11			
				-with abundant silty sand seams 6'-8'							
								13			
	8			Gray and tan Silty Sand (SM), with abundant clay pockets							
60								14			
						23	119	16	19	18	1
	12							18			
56				Termination depth = 13 feet.							
	16										
52											
	20										
48											
	24										
44											
	28										

Survey Coordinates (TSPC, Surface):
Easting: 3088758.84
Northing: 13877679.57
Elevation: 69.7

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **13** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▽
DRILLED BY **J. H. Drilling** DRAFTED BY **RJM** LOGGED BY **MRB**

PROJECT NO. G167-14

PLATE A-25

PROJECT: **Waterline Replacement in Antoine Forest Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-24**

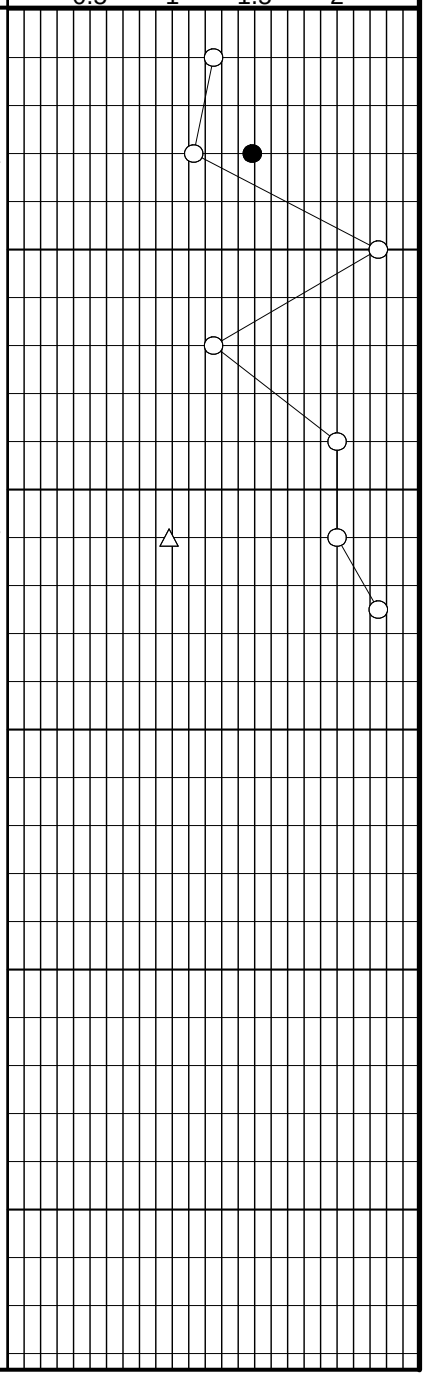
COH WBS No. **S-000035-0196-3** TYPE 4" Dry Auger DATE **11/9/2014**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
68	0			Pavement: 5.5" concrete							
				Very stiff to hard, dark gray and gray Sandy Lean Clay (CL)				18			
				-with silty sand pockets 0'-2'							
				-with ferrous nodules 2'-6', and calcareous nodules 2'-4'		68	118	16	35	14	21
64	4							12			
				Stiff to hard, light gray, red, and tan Fat Clay (CH), with slickensides and calcareous nodules				22			
				-with ferrous nodules 6'-8'							
60	8							26			
				-with silt pockets 10'-12'							
						99	103	23	58	21	37
56	12							19			
				Termination depth = 13 feet.							
52	16										
48	20										
44	24										
	28										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **13** FEET WITHOUT DRILLING FLUID

WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽

WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▼

DRILLED BY **J. H. Drilling** DRAFTED BY **RJM** LOGGED BY **MRB**

PROJECT NO. G167-14

PLATE A-26

PROJECT: **Waterline Replacement in Antoine Forest Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-25**

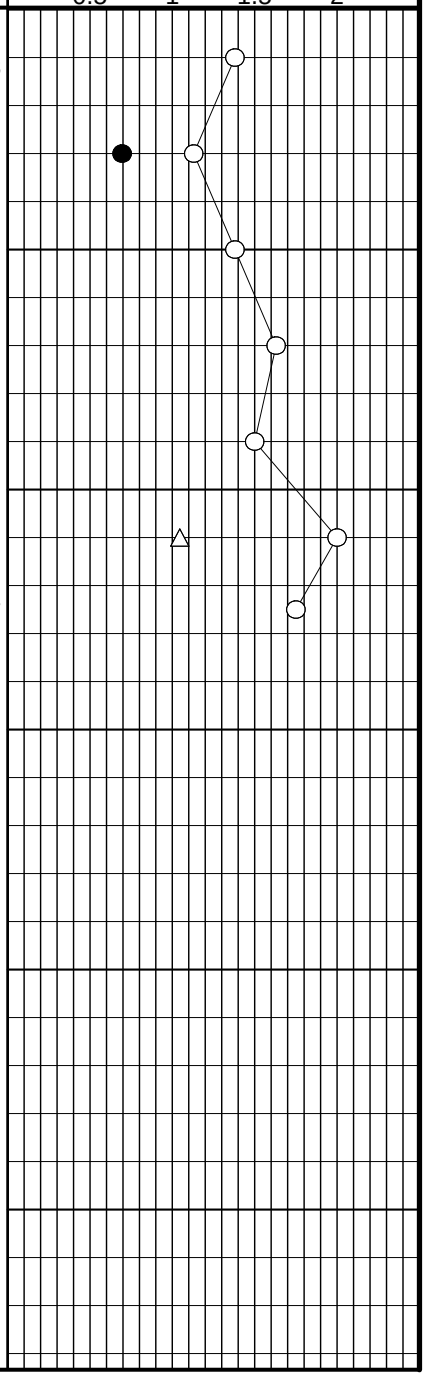
COH WBS No. **S-000035-0196-3** TYPE 4" Dry Auger DATE **11/9/2014**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
				Survey Coordinates (TSPC, Surface):							
				Easting: 3089895.05							
				Northing: 13878162.48							
				Elevation: 69.3							
68	0			Pavement: 6" concrete							
				Stiff to very stiff, gray Fat Clay w/Sand (CH), with abundant calcareous nodules -gray and tan 2'-6', with silt partings 2'-4'		79		19	51	18	33
							115	17			
64	4							13			
				Very stiff, red, brown, and gray Fat Clay (CH), with slickensides -with abundant calcareous nodules 6'-10' -with chalk pockets 8'-10'				27			
60	8							29			
							99	27			
	12					100		21	62	25	37
56				Termination depth = 13 feet.							
	16										
52											
	20										
48											
	24										
44											
	28										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **13** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▼
DRILLED BY **J. H. Drilling** DRAFTED BY **RJM** LOGGED BY **MRB**

PROJECT NO. G167-14

PLATE A-27

PROJECT: **Waterline Replacement in Antoine Forest Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-26**

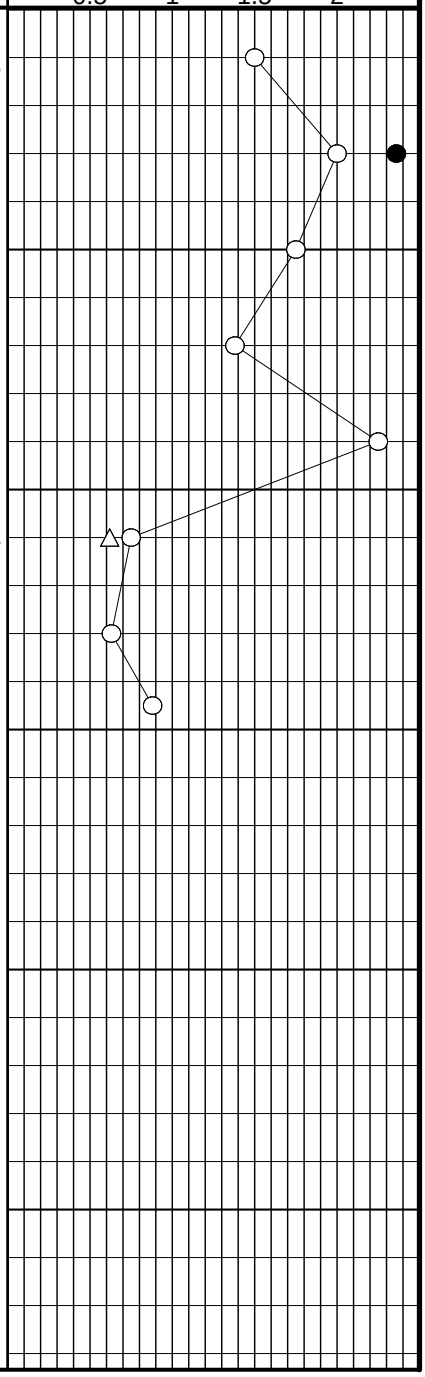
COH WBS No. **S-000035-0196-3** TYPE 4" Dry Auger DATE **11/11/2014**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
				Survey Coordinates (TSPC, Surface):							
				Easting: 3086784.64							
				Northing: 13876870.02							
				Elevation: 75.8							
	0			Pavement: 7.5" concrete							
				Very stiff to hard, gray and tan Fat Clay w/ Sand (CH)		72		18	50	15	35
				-with silty sand pockets							
				-gray and red 2'-6'			117	15			
72	4			-with silt partings and ferrous stains 4'-6'				17			
				Stiff to hard, gray and red Lean Clay w/ Sand (CL)				18			
68	8			-with ferrous nodules							
				-with silty sand pockets 8'-12'				16			
						73	107	21	32	18	14
64	12										
								23			
				-with fat clay pockets, calcareous nodules, and gasoline odor 14'-15'				20			
				Termination depth = 15 feet.							
60	16										
56	20										
52	24										
48	28										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **15** FEET WITHOUT DRILLING FLUID

WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽

WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▼

DRILLED BY **J. H. Drilling** DRAFTED BY **RJM** LOGGED BY **MRB**

PROJECT NO. G167-14

PLATE A-28

PROJECT: **Waterline Replacement in Antoine Forest Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-27**

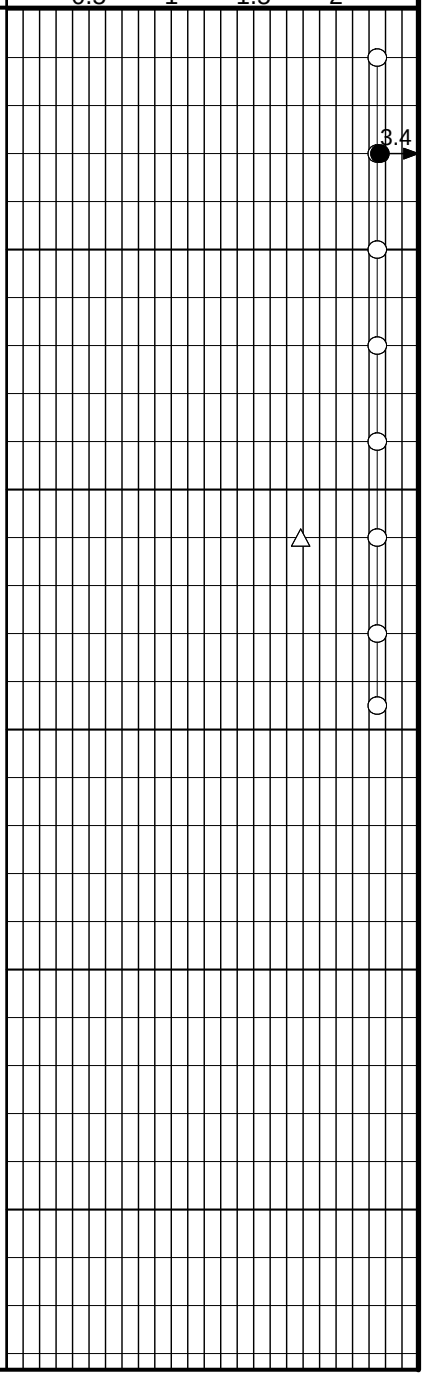
COH WBS No. **S-000035-0196-3** TYPE 4" Dry Auger DATE **11/11/2014**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
				Survey Coordinates (TSPC, Surface): *Easting: 3087168.59* *Northing: 13876921.16* *Elevation: 75.1*							
76	0			Pavement: 7" concrete							
				Hard, brown and gray Fat Clay w/Sand (CH)		79		14	55	16	39
				-gray and tan 2'-6'							
72	4						117	12			
				-with ferrous nodules 4'-6'							
								11			
68	8			Very stiff to hard, red, tan, and gray Fat Clay (CH), with slickensides				23			
				-with ferrous nodules and silty sand 6'-8'							
				-red and light gray 8'-15', with calcareous nodules 8'-10'				25			
64	12						100	26			
				-with calcareous nodules 12'-15'							
						97		23	57	24	33
								23			
60	16			Termination depth = 15 feet.							
56	20										
52	24										
48	28										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **15** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE**
DRILLED BY **J. H. Drilling** DRAFTED BY **RJM** LOGGED BY **MRB**

PROJECT NO. G167-14

PLATE A-29

PROJECT: **Waterline Replacement in Antoine Forest Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-28**

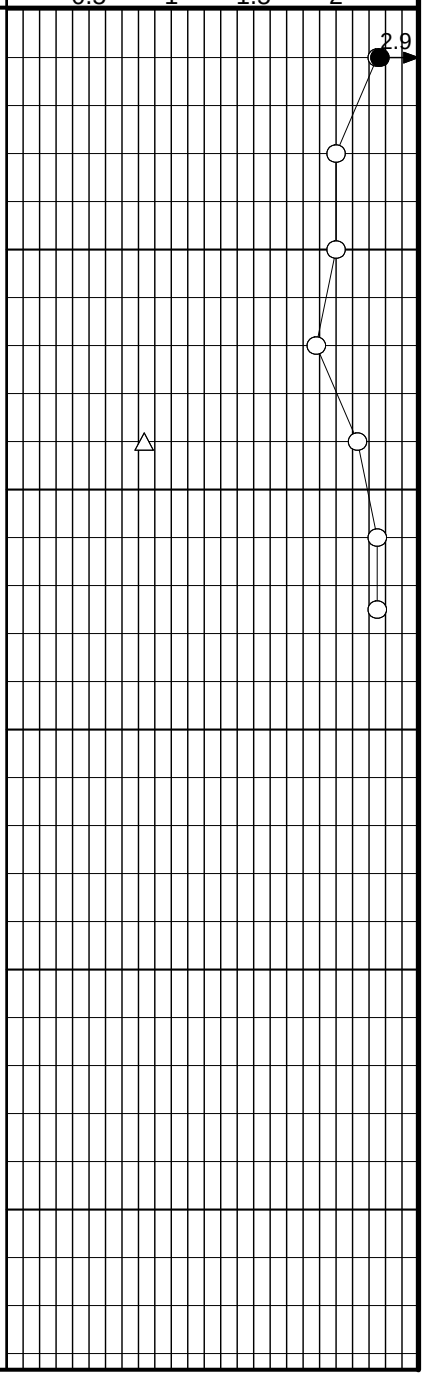
COH WBS No. **S-000035-0196-3** TYPE 4" Dry Auger DATE **11/11/2014**

ELEVATION IN FEET	DEPTH IN FEET	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
	0	Pavement: 7" concrete							
72		Very stiff to hard, gray Lean Clay w/Sand (CL), with ferrous nodules and silt partings		75	119	12	39	14	25
		-with silt seams 0'-2'							
	4					17			
		-with sand seams 4'-6'							
68						16			
		-with vertical silty clay seams 6'-8'							
	8					17			
		Stiff to hard, red, brown, and light gray Fat Clay (CH), with slickensides			106	23			
64		-with silt pockets 8'-12'							
		-with siltstone fragments 10'-12'		91		19	55	22	33
	12					22			
		-with ferrous nodules 12'-13'							
60		Termination depth = 13 feet.							
	16								
56									
	20								
52									
	24								
48									
	28								

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **13** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE**
DRILLED BY **J. H. Drilling** DRAFTED BY **RJM** LOGGED BY **MRB**

PROJECT NO. G167-14

PLATE A-30

PROJECT: **Waterline Replacement in Antoine Forest Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-29**

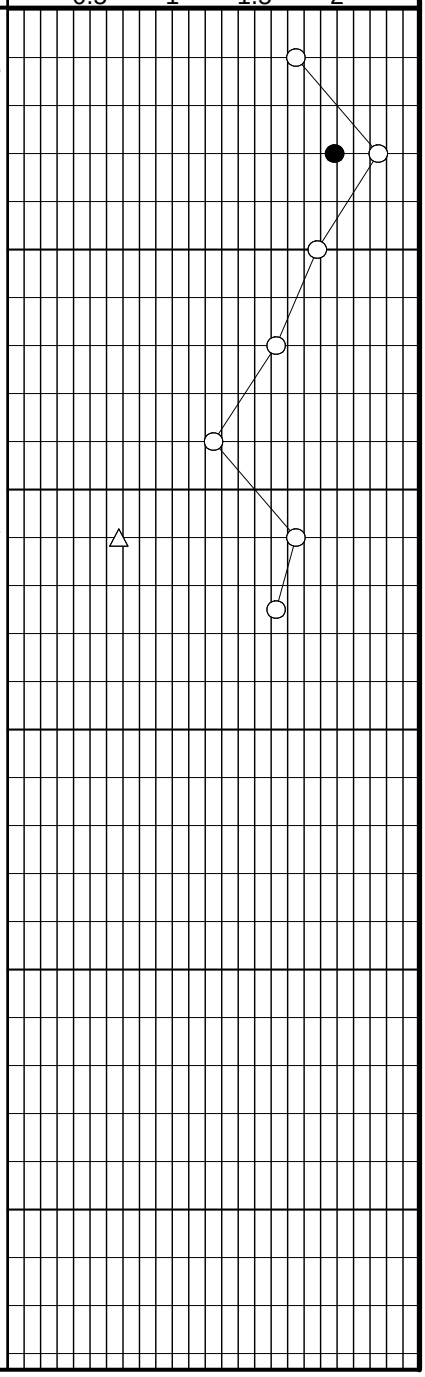
COH WBS No. **S-000035-0196-3** TYPE 4" Dry Auger DATE **11/11/2014**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
72	0			Pavement: 7.5" concrete							
				Very stiff to hard, gray and tan Lean Clay w/Sand (CL), with silt partings and ferrous nodules		77		16	43	15	28
				-with calcareous nodules and siltstone fragments 2'-6'			118	14			
68	4							15			
				Stiff to very stiff, red, brown, and light gray Lean Clay (CL), with slickensides and fat clay pockets				22			
64	8			-with silty clay seams 8'-12				31			
						93	95	31	34	17	17
60	12							26			
				Termination depth = 13 feet.							
56	16										
52	20										
48	24										
44	28										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



Survey Coordinates (TSPC, Surface):
Easting: 3088085.17
Northing: 13876957.74
Elevation: 72.1

BORING DRILLED TO **13** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▼
DRILLED BY **J. H. Drilling** DRAFTED BY **RJM** LOGGED BY **MRB**

PROJECT NO. G167-14

PLATE A-31

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

PROJECT: **Waterline Replacement in Antoine Forest Area** BORING **B-30**

COH WBS No. **S-000035-0196-3** TYPE 4" Dry Auger DATE **11/11/2014**

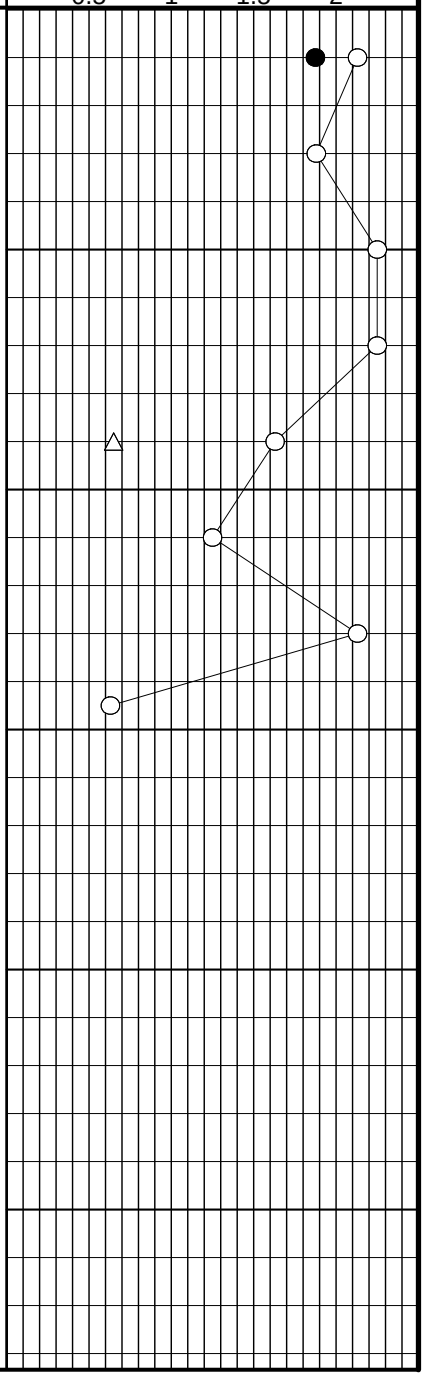
ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
72	0			Pavement: 7.25" concrete							
				Very stiff to hard, gray Lean Clay w/Sand (CL), with ferrous nodules and silt partings		78	115	16	36	15	21
				-gray and tan 2'-8', with calcareous nodules 2'-6'				14			
68	4							14			
								19			
64	8			Stiff to hard, light gray and tan Lean Clay (CL), with siltstone fragments and silt partings		89	102	26	44	15	29
				-with calcareous nodules 8'-10'							
				-gray, red, and brown 10'-14'				23			
60	12			-with abundant calcareous nodules and silty clay seams 12'-14'				27			
				-boring cave in at 13.4' after drilling was completed							
				Red, brown, and light gray Silty Sand (SM), with clay partings and siltstone fragments, wet				24			
56	16			Termination depth = 15 feet.							
52	20										
48	24										
44	28										

Survey Coordinates (TSPC, Surface):
Easting: 3088273.42
Northing: 13877285.02
Elevation: 72.1

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **15** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **14** FEET WHILE DRILLING ▽
WATER LEVEL AT **13.4** FEET AFTER **COMPLETE** ▽
DRILLED BY **J. H. Drilling** DRAFTED BY **RJM** LOGGED BY **MRB**

PROJECT NO. G167-14

PLATE A-32

PROJECT: **Waterline Replacement in Antoine Forest Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-31**

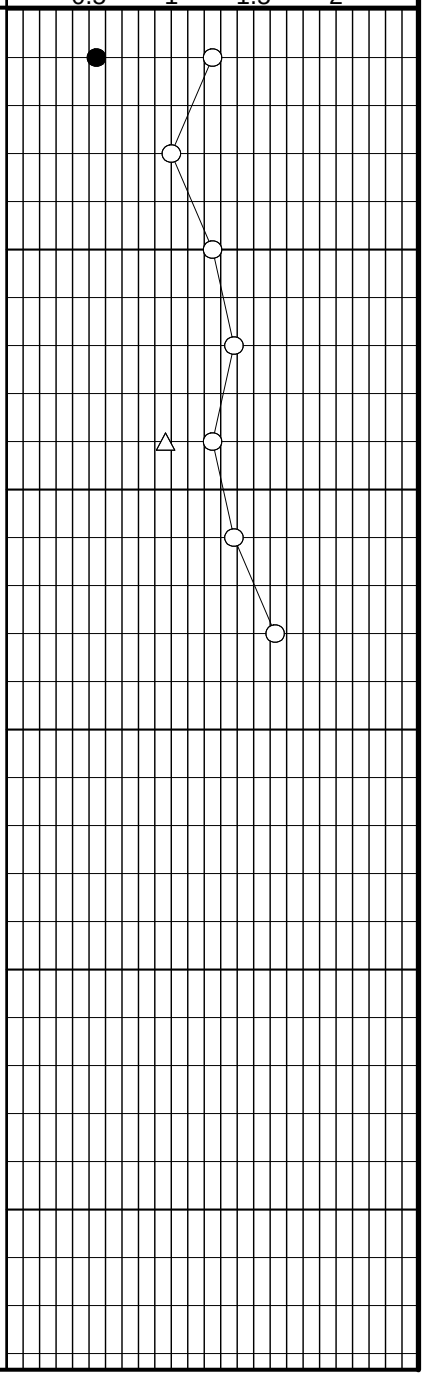
COH WBS No. **S-000035-0196-3** TYPE 4" Dry Auger DATE **11/11/2014**

ELEVATION IN FEET	DEPTH IN FEET	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
	0	Pavement: 6" concrete							
		Stiff to very stiff, gray and tan Lean Clay w/ Sand (CL), with silt partings and ferrous nodules		79	112	15	38	15	23
68	4	-with siltstone fragments and calcareous nodules 0'-8'				21			
						21			
64	8					21			
		Stiff to very stiff, red, brown, and light gray Lean Clay (CL)			102	25			
		-with ferrous nodules 8'-10'							
60	12	-with abundant siltstone fragments and calcareous nodules 10'-14'		89		26	36	19	17
						28			
		Termination depth = 14 feet.							
56	16								
52	20								
48	24								
44	28								

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **14** FEET WITHOUT DRILLING FLUID

WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽

WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▽

DRILLED BY **J. H. Drilling** DRAFTED BY **RJM** LOGGED BY **MRB**

PROJECT NO. G167-14

PLATE A-33

PROJECT: **Waterline Replacement in Antoine Forest Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-32**

COH WBS No. **S-000035-0196-3** TYPE 4" Dry Auger DATE **11/11/2014**

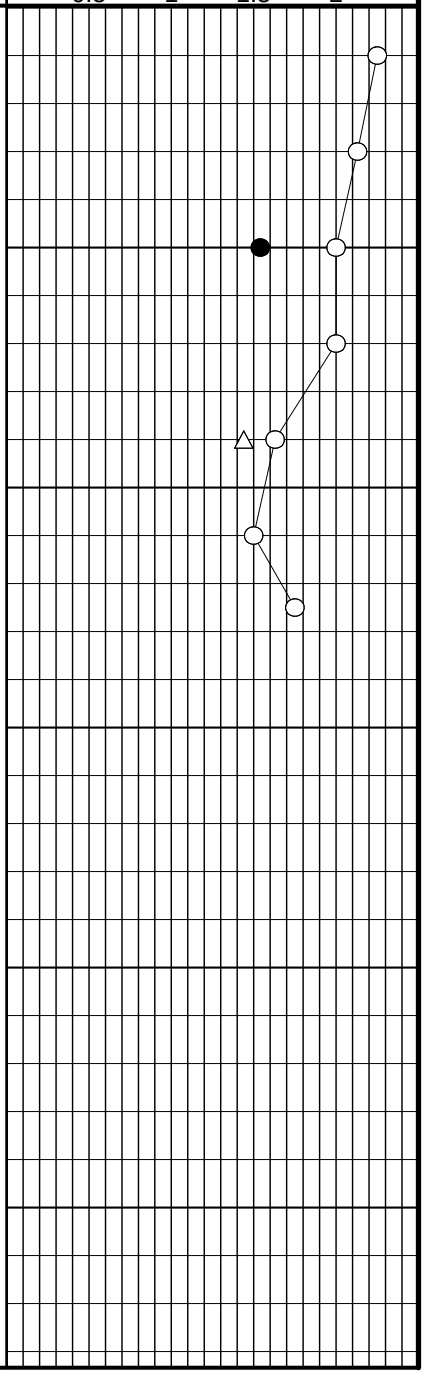
ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
	0			Pavement: 7" concrete							
68				Very stiff to hard, gray and tan Sandy Lean Clay (CL), with ferrous nodules and silt partings		62		11	36	14	22
	4			-with siltstone fragments and calcareous nodules 0'-8'				13			
64							116	16			
	8							15			
60							114	16			
	12			Very stiff, light gray Fat Clay w/Sand (CH), with silt partings		78		30	58	22	36
				-red, brown, and light gray 12'-13'				28			
56				Termination depth = 13 feet.							
	16										
52											
	20										
48											
	24										
44											
	28										

Survey Coordinates (TSPC, Surface):
Easting: 3089010.01
Northing: 13877037.95
Elevation: 69.7

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **13** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▼
DRILLED BY **J. H. Drilling** DRAFTED BY **RJM** LOGGED BY **MRB**

PROJECT NO. G167-14

PLATE A-34

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

PROJECT: **Waterline Replacement in Antoine Forest Area** BORING **B-33**

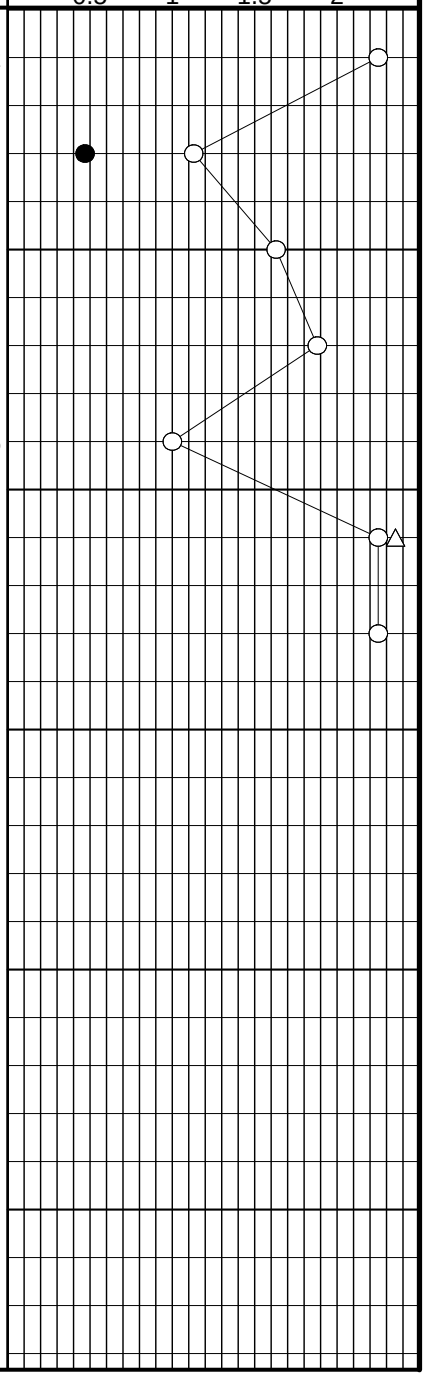
COH WBS No. **S-000035-0196-3** TYPE 4" Dry Auger DATE **10/28/2014**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
	0			*Survey Coordinates (TSPC, Surface):*							
				Easting: 3090286.47							
				Northing: 13879281.08							
				Elevation: 74.8							
72				Fill: Hard, brown Sandy Lean Clay (CL), with lean clay pockets, shells, and roots		52		14	29	17	12
	4			Stiff to very stiff, light gray Lean Clay w/ Sand (CL), with ferrous and calcareous nodules -with silt partings 2'-4' -with abundant calcareous nodules 4'-6'			114	17			
								13			
68				-gray and tan, with abundant ferrous nodules, ferrous stains, and chalk pockets 6'-10'				21			
	8					76		17	31	15	16
64				Hard, reddish tan and gray Fat Clay (CH), with calcareous nodules			115	17			
	12							18			
60				Termination Depth = 14 feet							
	16										
56											
	20										
52											
	24										
48											
	28										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **14** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▼
DRILLED BY **J. H. Drilling** DRAFTED BY **RJM** LOGGED BY **MRB**

PROJECT NO. G167-14

PLATE A-35

PROJECT: **Waterline Replacement in Antoine Forest Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-34**

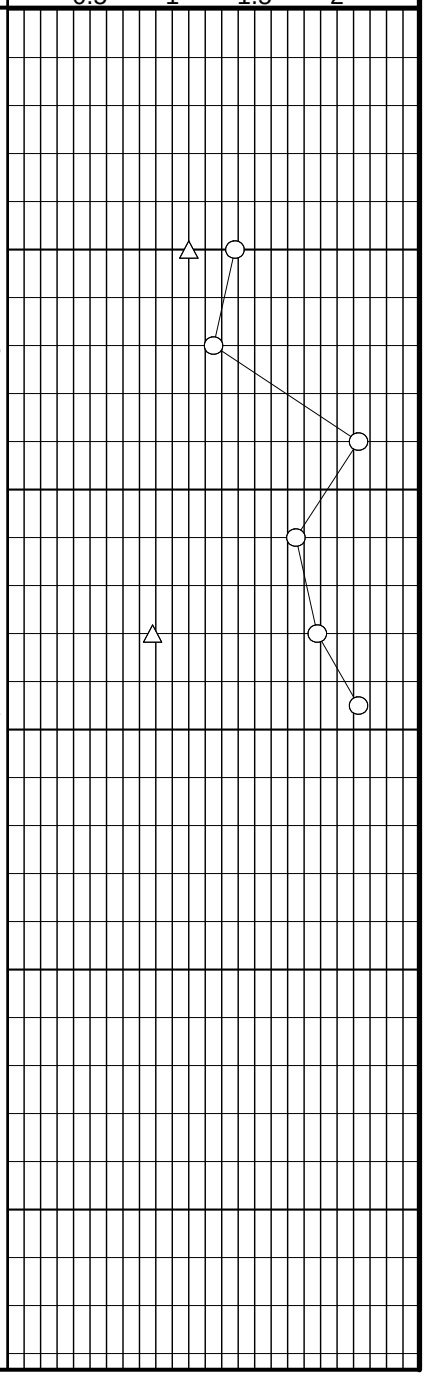
COH WBS No. **S-000035-0196-3** TYPE 4" Dry Auger DATE **10/28/2014**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
				Survey Coordinates (TSPC, Surface): *Easting: 3090826.55* *Northing: 13879301.33* *Elevation: 77.3*							
76	0			Pavement: 6" asphalt							
				Base: 42" lime-stabilized silty clayey sand with gravel		31		25	39	34	5
	4			Very stiff, gray Lean Clay w/Sand (CL), with fat clay pockets and ferrous stains -with silty sand partings 3'-6'			112	19			
72				-with silt partings 6'-8'		76		18	47	14	33
	8			Very stiff to hard, light gray Fat Clay (CH), with slickensides and ferrous stains -light gray, with sandy lean clay pockets and ferrous nodules 8'-10' -light gray and red, with fat clay and silty sand pockets 10'-14'				16			
68								20			
	12						106	26			
64						98		21	71	29	42
	16			Termination Depth = 15 feet							
60											
	20										
56											
	24										
52											
	28										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **15** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▼
DRILLED BY **J. H. Drilling** DRAFTED BY **RJM** LOGGED BY **MRB**

PROJECT NO. G167-14

PLATE A-36

PROJECT: **Waterline Replacement in Antoine Forest Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-35**

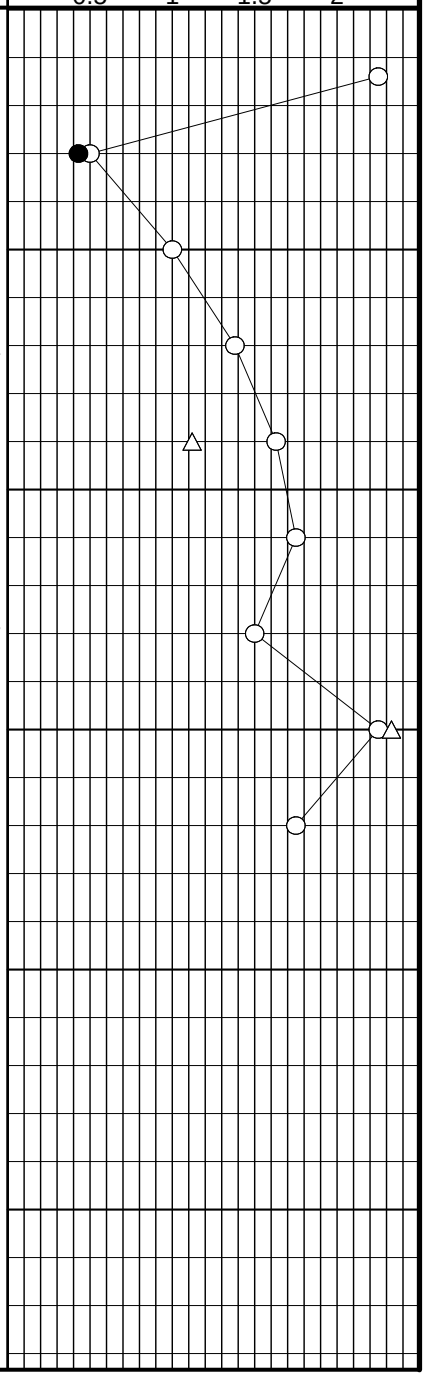
COH WBS No. **S-000035-0196-3** TYPE 4" Dry Auger DATE **10/28/2014**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
80	0			Pavement: 6.5" asphalt							
				Base: 3" clayey sand, with clay pockets and gravel		69		14	16	15	1
				Light gray and dark brown Sandy Silt (SM)							
				Stiff to very stiff, grayish brown Lean Clay w/Sand (CL), with fat clay pockets			101	23			
76	4			-with silt seams 2'-4'							
				-grayish brown and dark brown, with ferrous stains 4'-6'				21			
				-with silt partings 6'-8'							
				-with abundant ferrous nodules 6'-10'		74		17	45	14	31
72	8						117	17			
				-with silty sand pockets 10'-12'							
								17			
68	12			Gray and reddish tan Clayey Sand (SC), with fat clay seams and ferrous stains		48		16	32	15	17
				Very stiff to hard, red and gray Fat Clay (CH)			112	19			
64	16							22			
				Termination Depth = 18 feet							
60	20										
56	24										
	28										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **18** FEET WITHOUT DRILLING FLUID

WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽

WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▼

DRILLED BY **J. H. Drilling** DRAFTED BY **RJM** LOGGED BY **MRB**

PROJECT NO. G167-14

PLATE A-37

PROJECT: **Waterline Replacement in Antoine Forest Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-36**

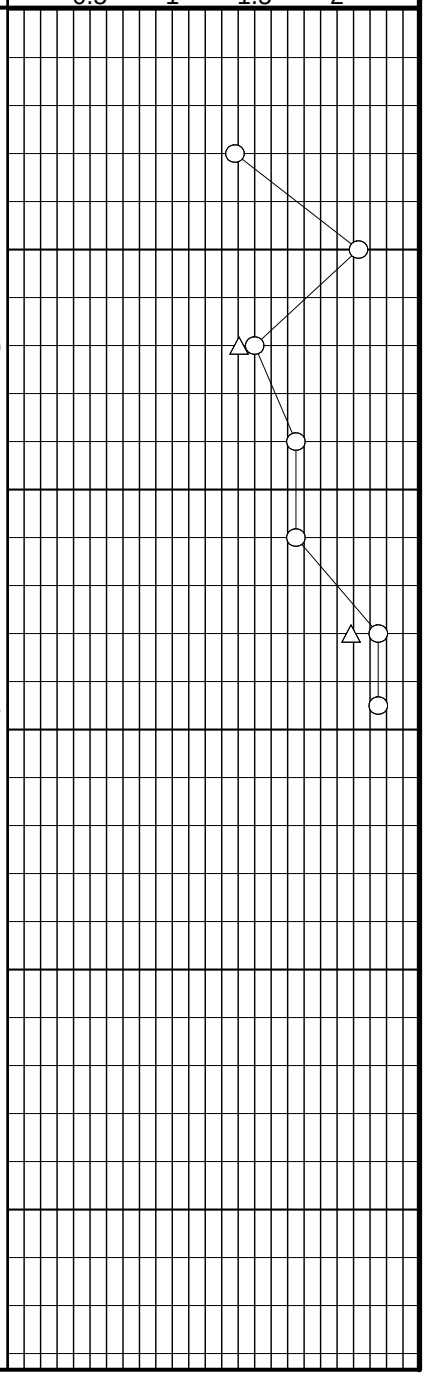
COH WBS No. **S-000035-0196-3** TYPE 4" Dry Auger DATE **10/28/2014**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
	0			*Survey Coordinates (TSPC, Surface):*							
				Easting: 3091802.68							
				Northing: 13879342.21							
				Elevation: 81.9							
				Pavement: 6" asphalt							
				Base: 3" silty sand with small gravel							
				Brown Sandy Silt (ML)		64		11	18	17	1
80				Very stiff to hard, gray Lean Clay w/Sand (CL), with calcareous nodules				16			
	4			-with vertical silt and sand seams 4'-6'				13			
76				-gray and tan 6'-10'							
				-with ferrous stains and calcareous nodules 6'-8'		77	119	15	34	14	20
	8			-with silt partings and ferrous nodules 8'-10'				19			
72				Very stiff to hard, gray and tan Fat Clay (CH)				17			
	12			-with ferrous stains 10'-14'							
							115	15			
68				-gray and reddish tan 14'-15				20	60	22	38
				Termination Depth = 15 feet							
	16										
64											
	20										
60											
	24										
56											
	28										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **15** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▼
DRILLED BY **J. H. Drilling** DRAFTED BY **RJM** LOGGED BY **MRB**

PROJECT NO. G167-14

PLATE A-38

PROJECT: **Waterline Replacement in Antoine Forest Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-37**

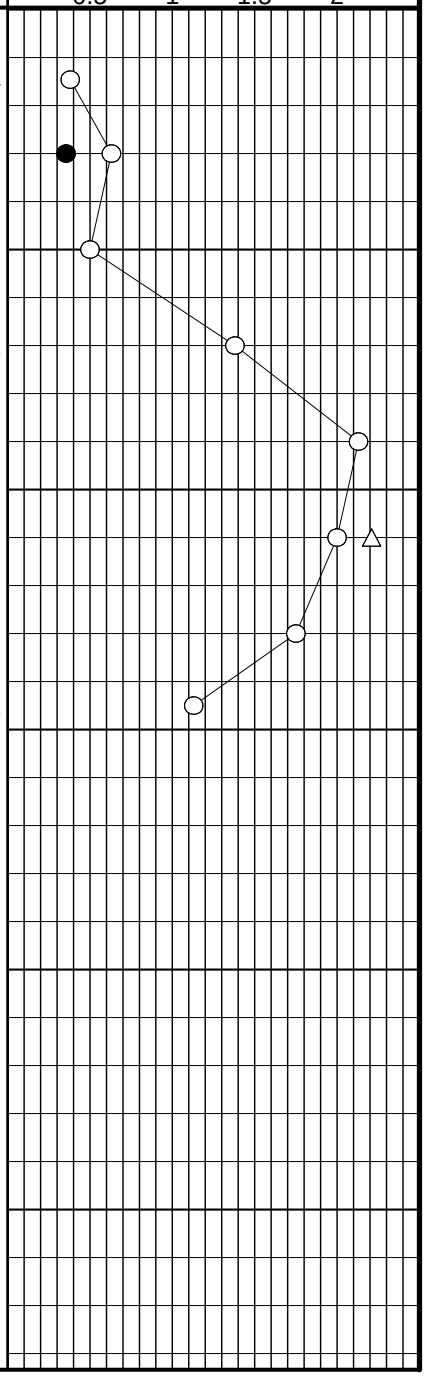
COH WBS No. **S-000035-0196-3** TYPE 4" Dry Auger DATE **10/28/2014**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
				Survey Coordinates (TSPC, Surface):							
				Easting: 3092324.18							
				Northing: 13879362.06							
				Elevation: 81.5							
80	0			Pavement: 8" asphalt							
				Base: 3" sand and gravel							
				Firm to very stiff, brown Lean Clay w/Sand (CL), with ferrous nodules		72		25	29	15	14
				-with silty sand pockets 0'-4'			106	20			
	4			-with silty sand seams 2'-4'							
76								21			
						80		21	45	14	31
	8										
72								15			
				Very stiff to hard, gray, red and tan Fat Clay (CH), with slickensides and ferrous nodules			113	18			
	12			-with silt partings 12'-15'							
68								23			
						95		33	66	25	41
	16			Termination depth = 15 feet.							
64											
	20										
60											
	24										
56											
	28										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **15** FEET WITHOUT DRILLING FLUID

WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽

WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▼

DRILLED BY **J. H. Drilling** DRAFTED BY **RJM** LOGGED BY **MRB**

PROJECT NO. G167-14

PLATE A-39

PROJECT: **Waterline Replacement in Antoine Forest Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-38**

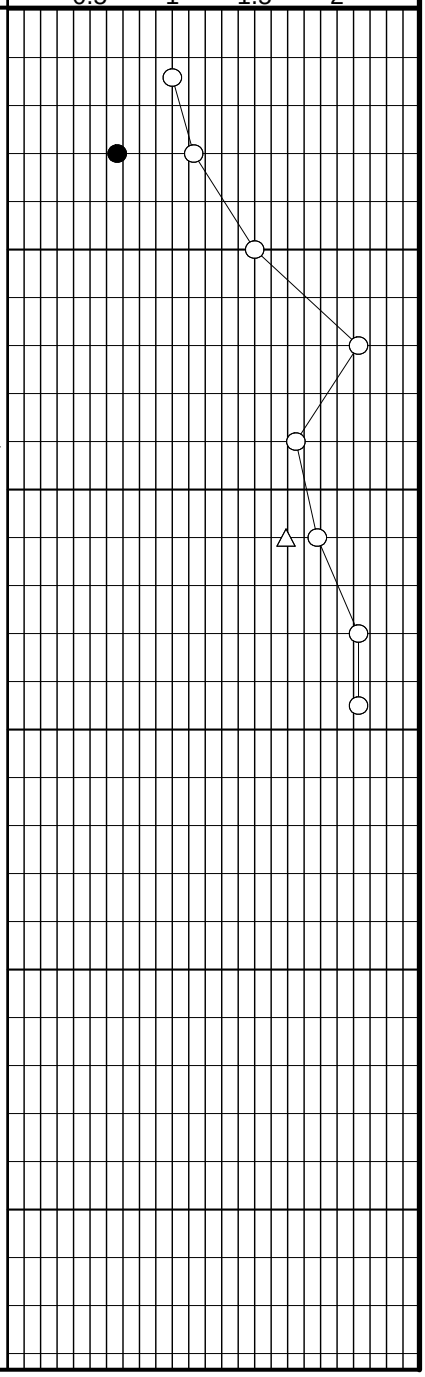
COH WBS No. **S-000035-0196-3** TYPE 4" Dry Auger DATE **10/29/2014**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
	0			Survey Coordinates (TSPC, Surface):							
				Easting: 3092877.39							
				Northing: 13879383.69							
				Elevation: 82.0							
				Pavement: 6" asphalt							
				Base: 4" sand and gravel							
80				Stiff to hard, gray and tan Lean Clay w/ Sand (CL), with sand partings and silt pockets		73		16	25	16	9
	4						114	17			
								16			
76				-with ferrous nodules 6'-15'							
	8							16			
						80		17	47	13	34
72											
	12						113	21			
								20			
68								21			
	16			Termination Depth = 15 feet							
64											
	20										
60											
	24										
56											
	28										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **15** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▼
DRILLED BY **J. H. Drilling** DRAFTED BY **RJM** LOGGED BY **MRB**

PROJECT NO. G167-14

PLATE A-40

PROJECT: **Waterline Replacement in Antoine Forest Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-39**

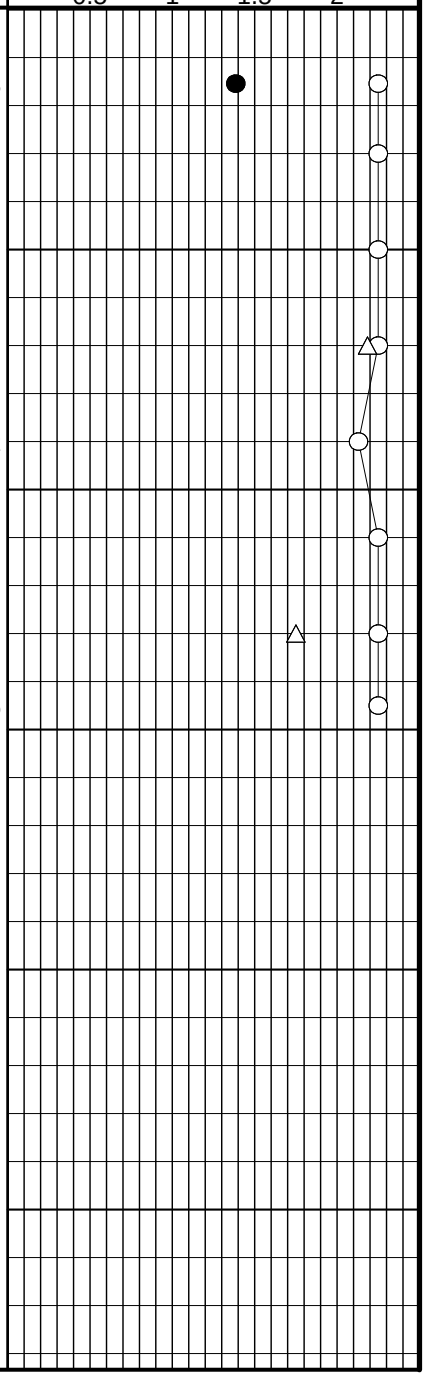
COH WBS No. **S-000035-0196-3** TYPE 4" Dry Auger DATE **10/29/2014**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
				Survey Coordinates (TSPC, Surface): *Easting: 3093271.65* *Northing: 13879399.08* *Elevation: 82.6*							
80	0			Pavement: 8" asphalt							
				Base: 5" stabilized sand and gravel							
				Fill: very stiff to hard, tan and gray Sandy Lean Clay (CL)		64	116	9	25	15	13
	4			Hard, tan and light gray Lean Clay w/Sand (CL)				11			
				-with ferrous nodules 2'-4'				11			
76				-with silt pockets 6'-8'			120	12			
	8					77		13	46	14	32
72								14			
	12			Very stiff to hard, light gray and tan Lean Clay (CL), with ferrous nodules			116	16			
68				-with silt pockets 12'-14'		88		16	42	16	26
	16			Termination depth = 15 feet.							
64											
	20										
60											
	24										
56											
	28										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **15** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▼
DRILLED BY **J. H. Drilling** DRAFTED BY **RJM** LOGGED BY **MRB**

PROJECT NO. G167-14

PLATE A-41

PROJECT: **Waterline Replacement in Antoine Forest Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-40**

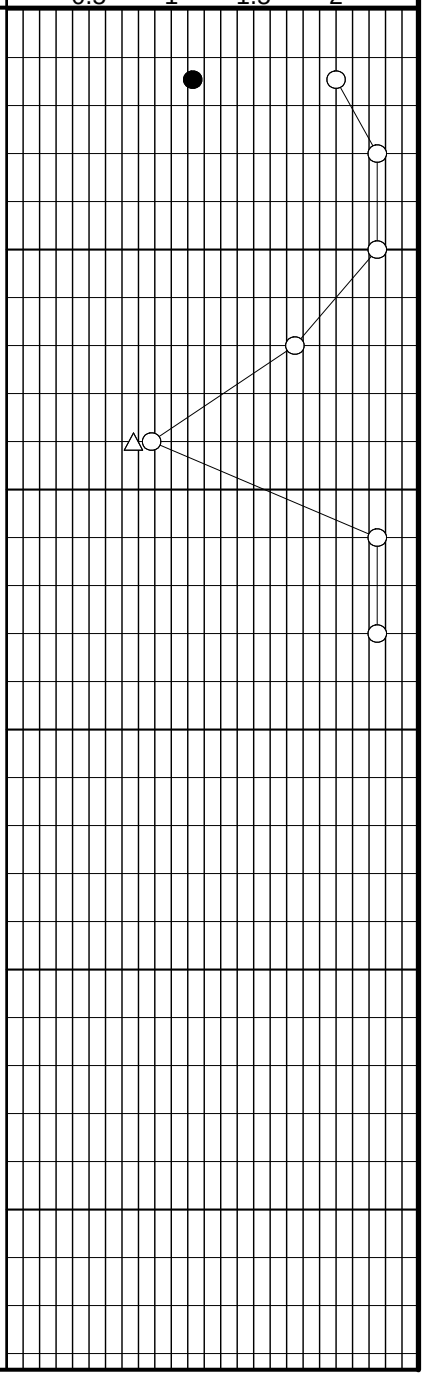
COH WBS No. **S-000035-0196-3** TYPE 4" Dry Auger DATE **10/29/2014**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
	0			Pavement: 4" asphalt							
				Base: 7" sand and shell							
80	4			Very stiff to hard, gray Sandy Lean Clay (CL), with silt partings -light gray and tan, with siltstone fragments, calcareous and ferrous nodules 2'-8'		69	113	11 12 13 14	29	15	14
76	8			Stiff to hard, light gray and tan Lean Clay w/ Sand (CL), with silt partings and ferrous nodules		76	110	18	38	13	25
72	12							15 17			
68	16			Termination depth = 14 feet.							
64	20										
60	24										
56	28										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **14** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▼
DRILLED BY **J. H. Drilling** DRAFTED BY **RJM** LOGGED BY **MRB**

PROJECT NO. G167-14

PLATE A-42

PROJECT: **Waterline Replacement in Antoine Forest Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-41**

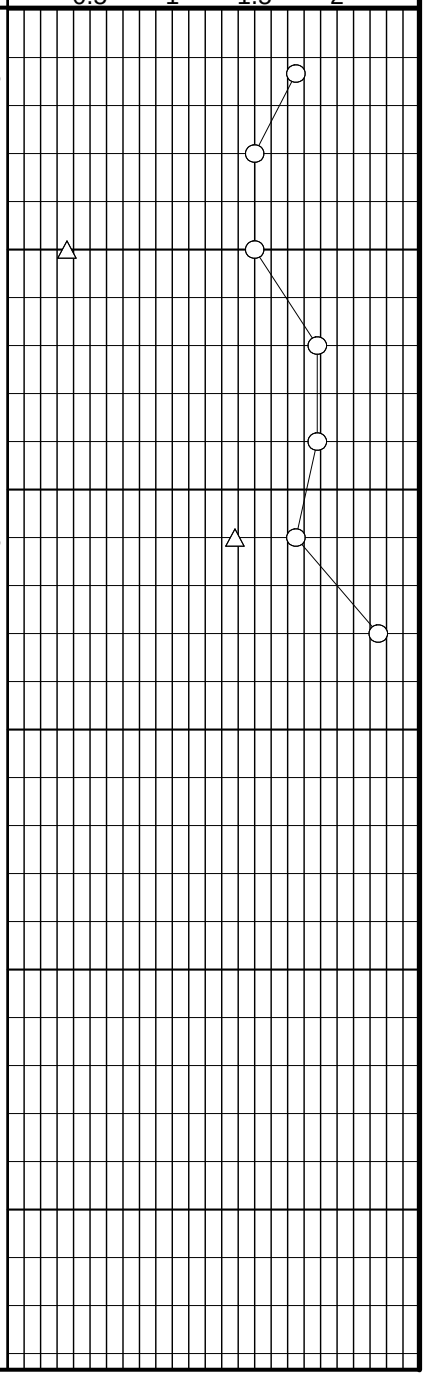
COH WBS No. **S-000035-0196-3** TYPE 4" Dry Auger DATE **10/29/2014**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
80	0			Pavement: 5" asphalt							
				Base: 3" sand, shell, and gravel							
				Firm to hard, dark gray Lean Clay w/Sand (CL)		77		12	32	14	18
				-with silt pockets 0'-6'				16			
				-gray and tan 2'-12'							
76	4			-with siltstone fragments 4'-10', and ferrous nodules 4'-12'			114	15			
				-with calcareous nodules 6'-10'							
								14			
72	8										
								17			
						78	112	19	42	14	28
68	12			-tan, light gray, red, and brown, with fat clay partings 12'-14'				19			
				Termination depth = 14 feet.							
64	16										
60	20										
56	24										
	28										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **14** FEET WITHOUT DRILLING FLUID

WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽

WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▽

DRILLED BY **J. H. Drilling** DRAFTED BY **RJM** LOGGED BY **MRB**

PROJECT NO. G167-14

PLATE A-43

PROJECT: **Waterline Replacement in Antoine Forest Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-42**

COH WBS No. **S-000035-0196-3** TYPE 4" Dry Auger DATE **1/29/2010**

ELEVATION IN FEET	DEPTH IN FEET	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
80	0	Pavement: 6" asphalt							
		Base: 2" sand and shell							
		Gray and tan Silty Sand (SM)							
		Very stiff, tan Sandy Lean Clay (CL), with slickensides and ferrous nodules				10			
		-with sand seams 2'-4', and siltstone fragments 2'-10'				14	28	14	14
76	4	-tan and light gray 4'-15', with sand pockets 4'-8', and calcareous nodules 4'-10'				15			
					109	17			
72	8								
						16	44	13	21
68	12								
						20			
64	16								
		Firm to stiff, tan and light gray Lean Clay w/ Sand (CL), with silt partings		80	99	23	32	16	16
60	20	-with calcareous nodules and siltstone fragments 20'-22'				26			
		Termination depth = 22 feet. *Previous Boring B-30 in AEC Report G195-09							
56	24								
52	28								

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2

BORING DRILLED TO **22** FEET WITHOUT DRILLING FLUID

WATER ENCOUNTERED AT **18** FEET WHILE DRILLING ▽

WATER LEVEL AT **14** FEET AFTER **COMPLETE** ▽

DRILLED BY **J. H. Drilling** DRAFTED BY **CHL** LOGGED BY **CHL**

PROJECT NO. G167-14

PLATE A-44

PROJECT: **Waterline Replacement in Antoine Forest Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-43**

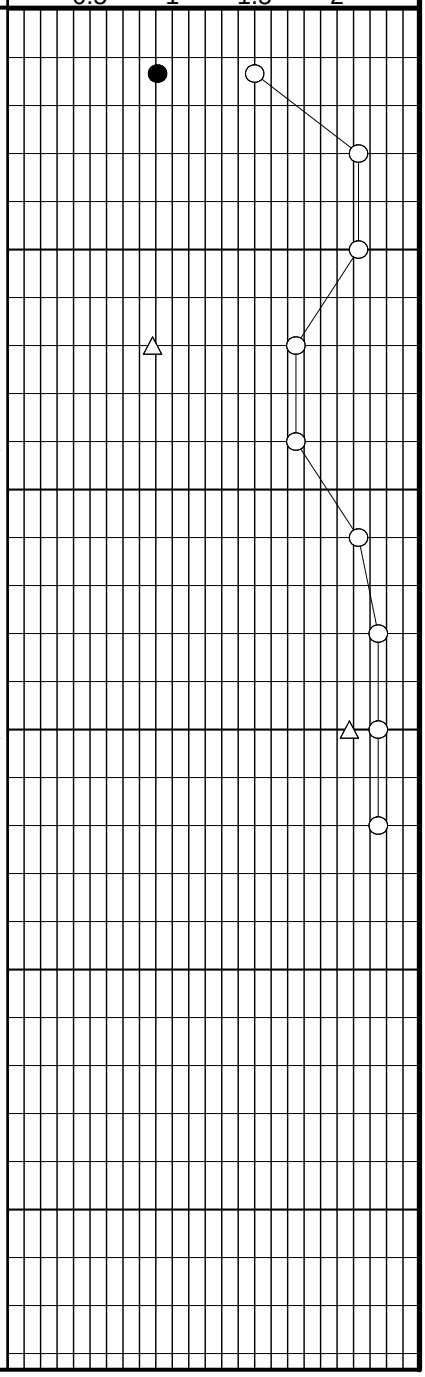
COH WBS No. **S-000035-0196-3** TYPE 4" Dry Auger DATE **10/29/2014**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
	0			Pavement: 6" asphalt							
				Base: 2" sand and gravel							
80				Stiff to hard, gray and light gray Sandy Silty Clay (CL-ML)		66	117	12	25	19	6
				-light gray and tan 2'-6', with ferrous nodules 2'-4'				14			
	4			-with abundant calcareous nodules and siltstone fragments 4'-6'				14			
76				Stiff to hard, light gray and tan Lean Clay w/ Sand (CL)			123	11			
				-with abundant calcareous nodules and siltstone fragments 6'-10'							
	8			-with ferrous nodules 8'-12'		83		15	46	14	32
72				-with fat clay pockets 10'-12'							
								16			
	12			Hard, light gray, tan, and red Lean Clay (CL) , with calcareous nodules and siltstone fragments				18			
68						87	110	20	48	17	31
	16										
								17			
64				Termination depth = 18 feet.							
	20										
60											
	24										
56											
	28										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **18** FEET WITHOUT DRILLING FLUID

WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽

WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▼

DRILLED BY **J. H. Drilling** DRAFTED BY **RJM** LOGGED BY **MRB**

PROJECT NO. G167-14

PLATE A-45

PROJECT: **Waterline Replacement in Antoine Forest Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-44**

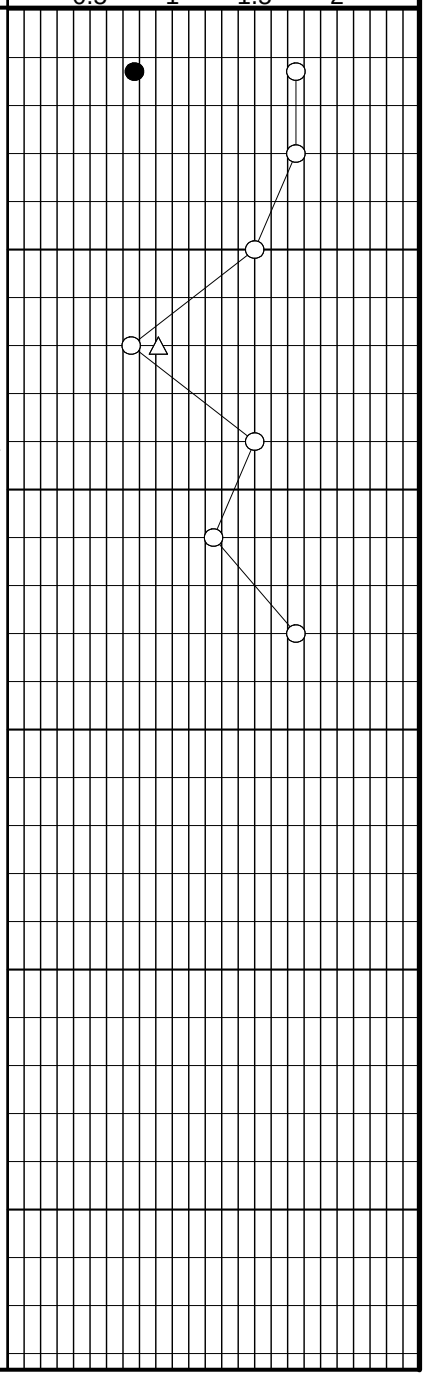
COH WBS No. **S-000035-0196-3** TYPE 4" Dry Auger DATE **10/29/2014**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
				Survey Coordinates (TSPC, Surface): *Easting: 3092722.61* *Northing: 13878766.82* *Elevation: 82.2*							
	0			Pavement: 5" asphalt							
				Base: 2" sand and gravel							
80				Stiff to very stiff, dark gray Sandy Silt Clay (CL-ML)		68	112	13	23	17	6
				-tan and gray, with ferrous nodules 2'-10'				14			
	4			-with abundant calcareous nodules and siltstone fragments 4'-6'				13			
76				Stiff to very stiff, light gray and tan Lean Clay w/Sand (CL), with ferrous nodules and silt partings			117	16			
	8					81		16	45	14	31
72								19			
	12			-with fat clay partings 12'-14'				20			
68				Termination depth = 14 feet.							
	16										
64											
	20										
60											
	24										
56											
	28										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **14** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▼
DRILLED BY **J. H. Drilling** DRAFTED BY **RJM** LOGGED BY **MRB**

PROJECT NO. G167-14

PLATE A-46

PROJECT: **Waterline Replacement in Antoine Forest Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-45**

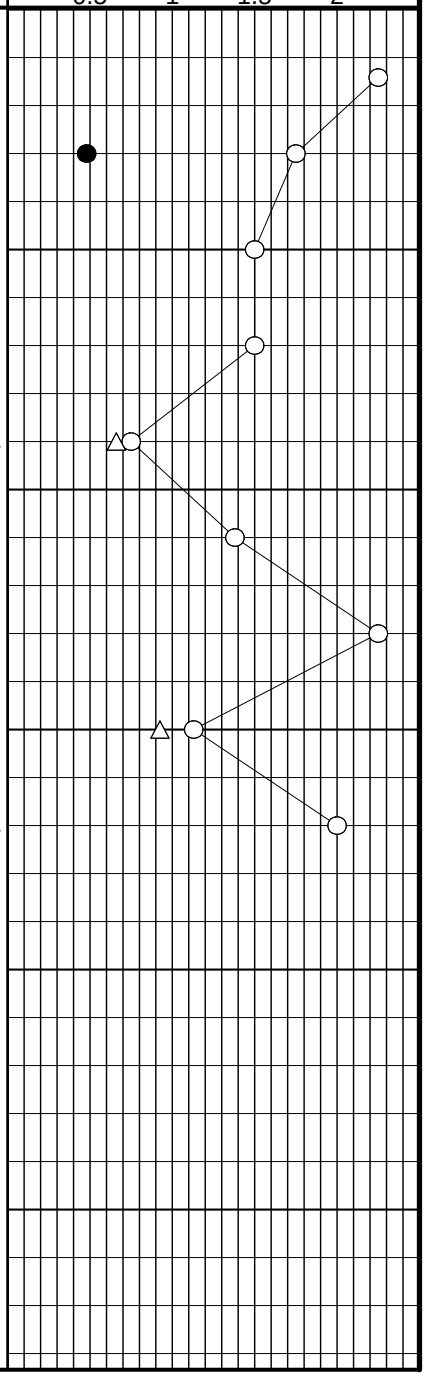
COH WBS No. **S-000035-0196-3** TYPE 4" Dry Auger DATE **10/29/2014**

ELEVATION IN FEET	DEPTH IN FEET	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
	0	*Survey Coordinates (TSPC, Surface):* *Easting: 3093257.39* *Northing: 13878789.27* *Elevation: 81.8*							
	0	Pavement: 5" asphalt							
		Base: 5" sand and shell		67		11	22	17	5
80		Firm to hard, dark gray Sandy Silty Clay (CL-ML) -gray and tan 2'-8'			111	16			
	4					16			
76						16			
	8	Stiff to very stiff, light gray and tan Sandy Lean Clay (CL), with silt pockets and seams and ferrous nodules		67	109	21	37	13	24
72						18			
	12	Stiff to hard, light gray and tan Lean Clay w/ Sand (CL), with ferrous nodules -with silt partings 14'-18'				14			
68					111	20			
	16			81		23	42	18	24
64		Termination depth = 18 feet.							
	20								
60									
	24								
56									
	28								

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **18** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▼
DRILLED BY **J. H. Drilling** DRAFTED BY **RJM** LOGGED BY **MRB**

PROJECT NO. G167-14

PLATE A-47

PROJECT: **Waterline Replacement in Antoine Forest Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-46**

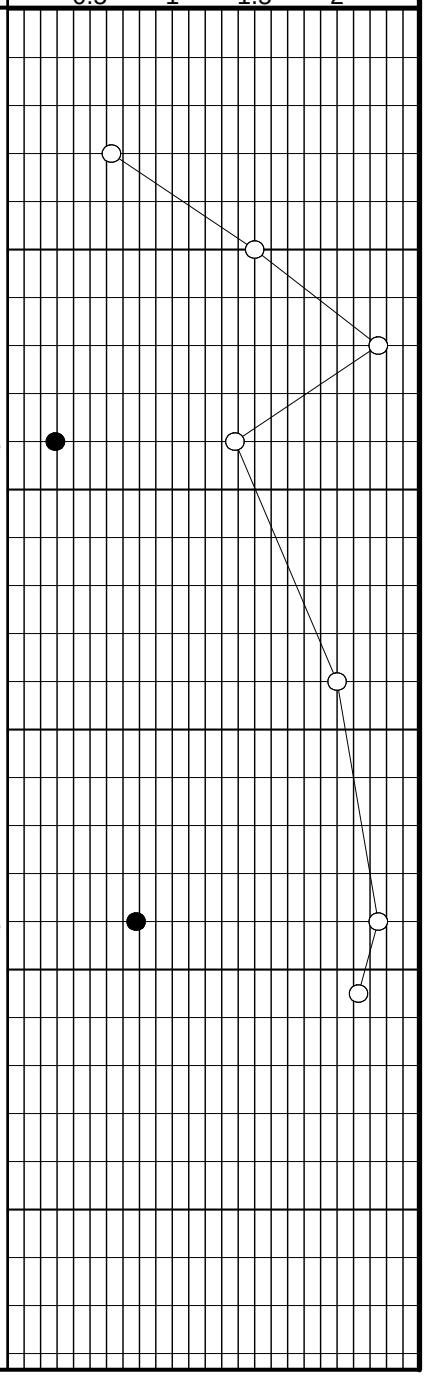
COH WBS No. **S-000035-0196-3** TYPE 4" Dry Auger DATE **1/29/2010**

ELEVATION IN FEET	DEPTH IN FEET	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
	0	*Survey Coordinates (TSPC, Surface):* *Easting: 3093734.22* *Northing: 13878825.52* *Elevation: 82.8* Pavement: 6.5" asphalt Base: 8.5" sand and shell							
80	4	Stiff, light gray Sandy Silty Clay (CL-ML), with sand seams and roots				11	22	15	7
		Very stiff to hard, light gray and tan Sandy Lean Clay (CL), with sand seams -with roots and ferrous stains 4'-6' -with sand pockets 6'-8'				16			
76	8					14			
		Light gray and tan Clayey Sand (SC), with sand pockets 8'-10'		35	111	16	26	13	13
72	12	-with sand layers 11'-12', wet ▽							
		Very stiff, light gray and tan Lean Clay (CL), with ferrous nodules ▼		94		20			
68	16								
		Stiff to hard, reddish brown and light gray Fat Clay (CH), with slickensides, abundant siltstone fragments, and calcareous nodules			106	23	53	20	33
64	20					22			
		Termination depth = 21 feet. *Previous Boring B-26 in AEC Report G195-09							
60	24								
56	28								

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **21** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **12** FEET WHILE DRILLING ▽
WATER LEVEL AT **14** FEET AFTER **COMPLETE** ▼
DRILLED BY **JH** DRAFTED BY **CHL** LOGGED BY **CHL**

PROJECT NO. G167-14

PLATE A-48

PROJECT: **Waterline Replacement in Antoine Forest Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-47**

COH WBS No. **S-000035-0196-3** TYPE 4" Dry Auger DATE **10/29/2014**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
				Survey Coordinates (TSPC, Surface): *Easting: 3091646.76* *Northing: 13878413.58* *Elevation: 81.3*							
80	0			Pavement: 5" asphalt							
				Base: 2.5" sand and gravel							
				Stiff to hard, gray and brown Lean Clay w/ Sand (CL)		71		13	28	15	13
				-with silty sand seams 0'-2'			114	17			
76	4			-with calcareous nodules 2'-8', and silt partings 2'-6'				16			
								15			
72	8						114	17			
				-with fat clay pockets 10'-14'		78		20	39	13	26
68	12			-with silty sand pockets 12'-14'				21			
				Termination depth = 14 feet.							
64	16										
60	20										
56	24										
	28										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2

BORING DRILLED TO **14** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▼
DRILLED BY **J. H. Drilling** DRAFTED BY **RJM** LOGGED BY **MRB**

PROJECT NO. G167-14

PLATE A-49

PROJECT: **Waterline Replacement in Antoine Forest Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-48**

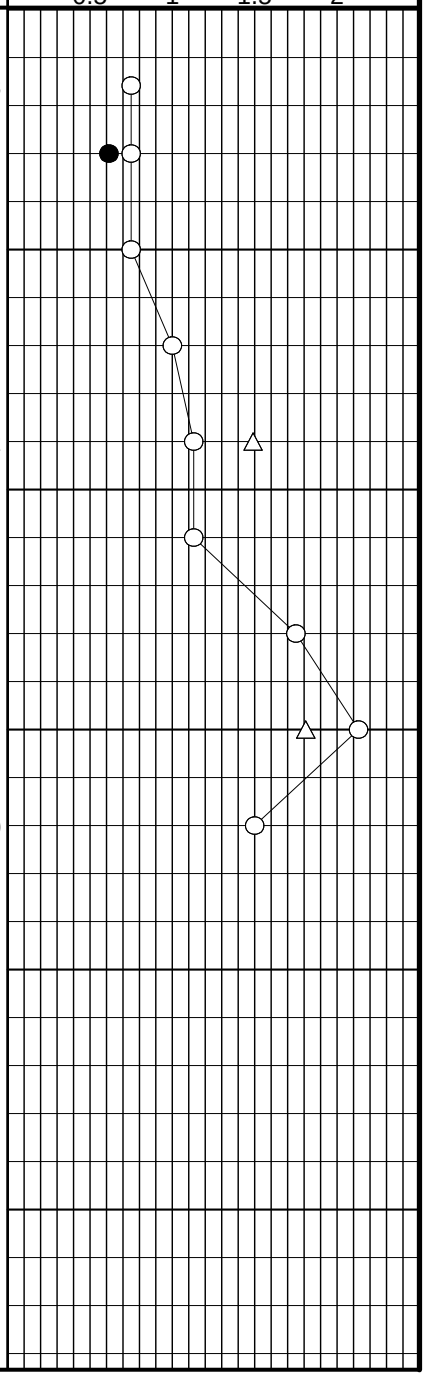
COH WBS No. **S-000035-0196-3** TYPE 4" Dry Auger DATE **10/29/2014**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
				Survey Coordinates (TSPC, Surface): *Easting: 3091984.29* *Northing: 13878542.77* *Elevation: 81.5*							
	0			Pavement: 8" asphalt							
				Base: 6" sand and gravel							
80				Fill: stiff, dark gray and brown Lean Clay w/ Sand (CL), with fat clay and silty sand pockets		74		20	29	16	13
							105	21			
	4			Stiff to very stiff, gray and brown Lean Clay w/Sand (CL) -with silty sand pockets 2'-4'				20			
76				-with fat clay seams 6'-12'				23			
	8			-with ferrous nodules 8'-12'							
						80	114	17	46	14	32
72								16			
	12			Very stiff to hard, gray and red Lean Clay (CL), with slickensides and fat clay seams				17			
68							108	20			
	16					96		21	49	19	30
64				Termination depth = 18 feet.							
	20										
60											
	24										
56											
	28										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **18** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▼
DRILLED BY **J. H. Drilling** DRAFTED BY **RJM** LOGGED BY **MRB**

PROJECT NO. G167-14

PLATE A-50

PROJECT: **Waterline Replacement in Antoine Forest Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-49**

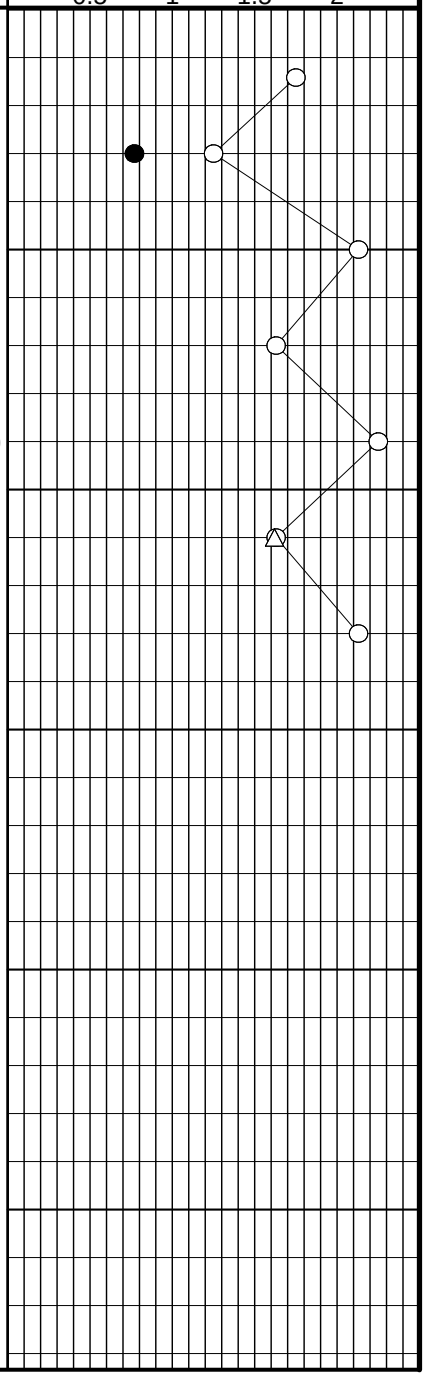
COH WBS No. **S-000035-0196-3** TYPE 4" Dry Auger DATE **10/30/2014**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
				Survey Coordinates (TSPC, Surface): *Easting: 3092460.92* *Northing: 13878436.92* *Elevation: 81.9*							
80	0			Pavement: 6" asphalt							
				Base: 4" sand and gravel							
				Stiff to hard, gray and brown Sandy Lean Clay (CL), with abundant silt and sand partings		69		14	25	17	8
	4			-with ferrous nodules 2'-6'			116	13			
				-with calcareous nodules 4'-6'				13			
76				Very stiff to hard, gray and tan Lean Clay w/Sand (CL), with ferrous nodules				15			
	8			-with silt partings 6'-10'		79		15	42	13	29
72							117	16			
	12			-with calcareous nodules 12'-14'				16			
68				Termination depth = 14 feet.							
	16										
64											
	20										
60											
	24										
56											
	28										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **14** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▼
DRILLED BY **J. H. Drilling** DRAFTED BY **RJM** LOGGED BY **MRB**

PROJECT NO. G167-14

PLATE A-51

PROJECT: **Waterline Replacement in Antoine Forest Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-50**

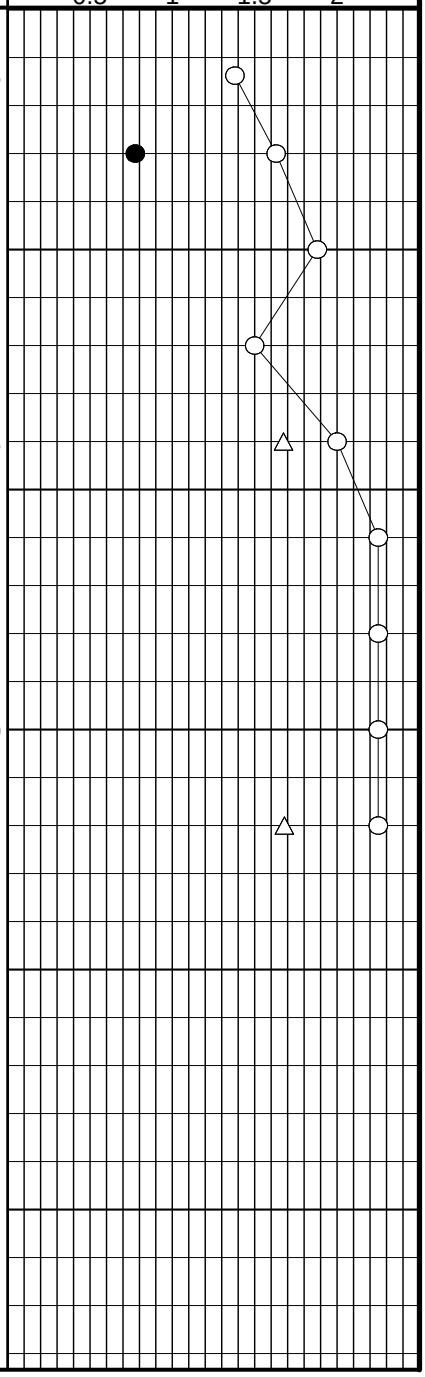
COH WBS No. **S-000035-0196-3** TYPE 4" Dry Auger DATE **10/30/2014**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
				Survey Coordinates (TSPC, Surface): *Easting: 3093024.69* *Northing: 13878457.88* *Elevation: 81.1*							
80	0			Pavement: 6" asphalt Base: 3" sand and gravel		66		15	29	14	15
	4			Stiff to very stiff, gray and brown Sandy Lean Clay (CL), with abundant silt and sand partings and calcareous nodules -with ferrous nodules 2'-6'			117	14			
76								14			
	8			Very stiff to hard, gray Lean Clay w/Sand (CL), with sand seams and ferrous nodules -lihgt gray and tan 8'-10'				15			
72						78	118	15	41	13	28
				-with calcareous nodules 10'-12'				15			
	12			Very stiff to hard, gray and tan Lean Clay (CL), with slickensides and calcareous nodules				17			
68				-gray, red, and tan 14'-18', with sand pockets 14'-16'		92		19	47	17	30
	16						106	23			
64				Termination depth = 18 feet.							
	20										
60											
	24										
56											
	28										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **18** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▼
DRILLED BY **J. H. Drilling** DRAFTED BY **RJM** LOGGED BY **MRB**

PROJECT NO. G167-14

PLATE A-52

PROJECT: **Waterline Replacement in Antoine Forest Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-51**

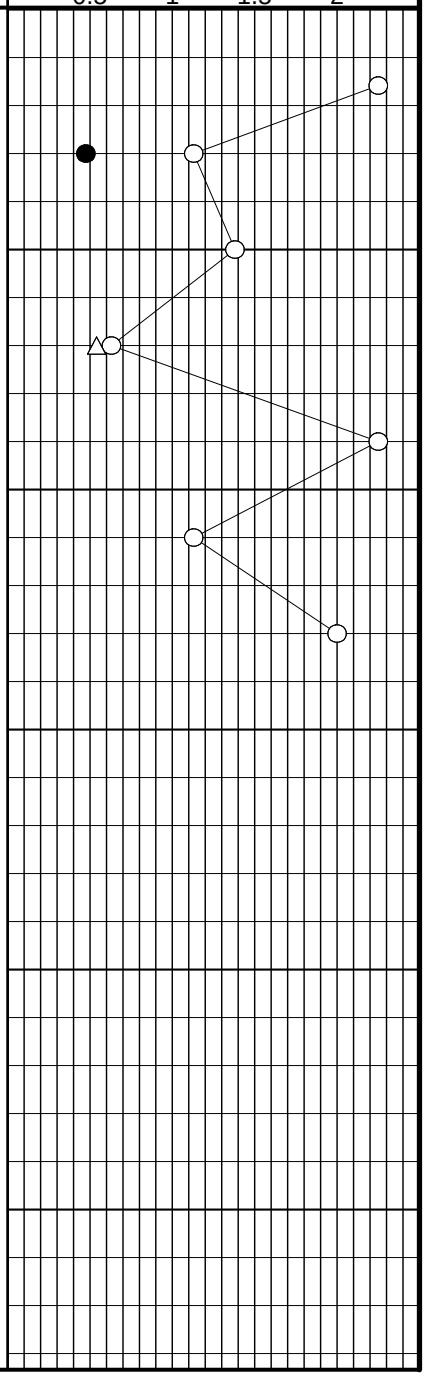
COH WBS No. **S-000035-0196-3** TYPE 4" Dry Auger DATE **10/30/2014**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
				Survey Coordinates (TSPC, Surface):							
				Easting: 3093513.20							
				Northing: 13878487.78							
				Elevation: 81.6							
80	0			Pavement: 6" asphalt							
				Base: 6" sand and gravel							
				Gray and dark gray Sandy Silt (ML) -with roots 1'-2' -with abundant clay pockets 2'-4'		51	117	12	18	16	2
	4							13			
76				Stiff to hard, gray and tan Sandy Lean Clay (CL), with abundant sand pockets				14			
							117	15			
	8										
72								15			
				Light tan Silty Clayey Sand (SC-SM), with clay pockets		19	113	16	28	21	7
	12										
68								14			
				Termination depth = 14 feet.							
	16										
64											
	20										
60											
	24										
56											
	28										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **14** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▼
DRILLED BY **J. H. Drilling** DRAFTED BY **RJM** LOGGED BY **MRB**

PROJECT NO. G167-14

PLATE A-53

PROJECT: **Waterline Replacement in Antoine Forest Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-52**

COH WBS No. **S-000035-0196-3** TYPE 4" Dry Auger DATE **10/30/2014**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
80	0			*Survey Coordinates (TSPC, Surface):* *Easting: 3091656.15* *Northing: 13878104.99* *Elevation: 80.7* . Pavement: 5.5" asphalt							
				Base: 4" sand and gravel							
				Stiff to very stiff, brown Sandy Silty Clay (CL-ML), with fat clay seams		68	119	9	23	18	5
				Very stiff to hard, dark brown Lean Clay w/ Sand (CL), with slickensides and fat clay seams				15			
76	4			-gray and brown 4'-6', with silty sand pockets 4'-8'				13			
				-gray and tan 6'-10'				14			
72	8							14			
				-gray, red, and tan 10'-15', with silt pockets 10'-12'		80	111	17	45	15	30
68	12							21			
								25			
	16			Termination depth = 15 feet.							
64											
	20										
60											
	24										
56											
	28										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2

BORING DRILLED TO **15** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▼
DRILLED BY **J. H. Drilling** DRAFTED BY **RJM** LOGGED BY **MRB**

PROJECT NO. G167-14

PLATE A-54

PROJECT: **Waterline Replacement in Antoine Forest Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-53**

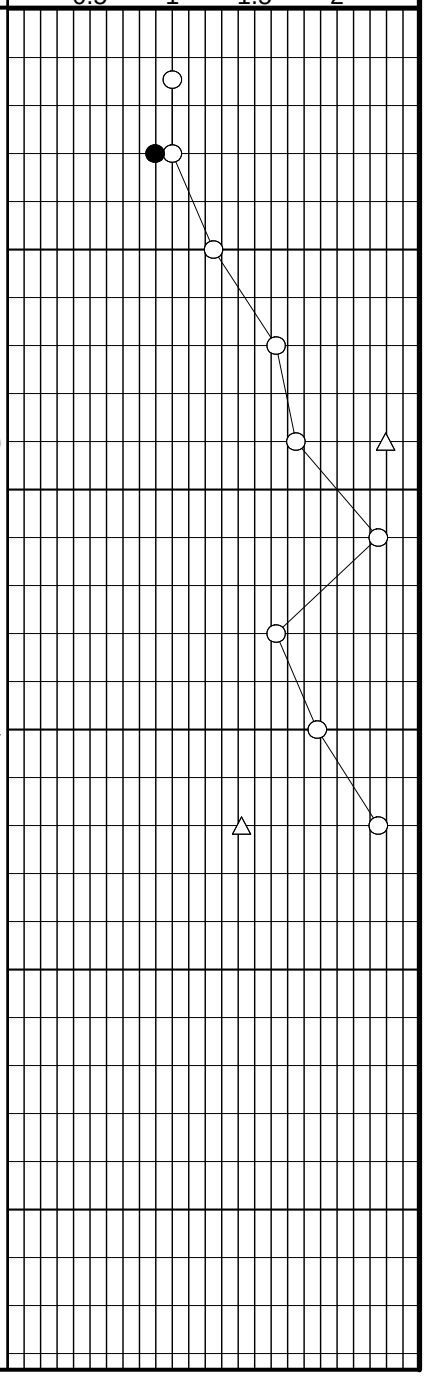
COH WBS No. **S-000035-0196-3** TYPE 4" Dry Auger DATE **10/30/2014**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
				Survey Coordinates (TSPC, Surface): *Easting: 3092004.17* *Northing: 13878028.82* *Elevation: 82.2*							
	0			Pavement: 7" asphalt							
				Base: 4" sand and gravel							
				Fill: stiff to very stiff, dark gray Sandy Lean Clay (CL), with wood pieces		65		15	23	15	8
80				Stiff to hard, dark gray Lean Clay w/Sand (CL), with ferrous nodules and silt partings			110	17			
	4			-with siltstone fragments 4'-6'							
								16			
76				-gray and tan 6'-10'							
								18			
	8			-with silt pockets 8'-10'							
						82	116	17	45	15	30
72				Very stiff to hard, tan, brown, and light gray Fat Clay (CH), with slickensides, ferrous and calcareous nodules, and siltstone fragments				20			
	12										
								23			
68											
						88		23	55	21	34
	16										
							104	23			
64				Termination depth = 18 feet.							
	20										
60											
	24										
56											
	28										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **18** FEET WITHOUT DRILLING FLUID

WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽

WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▼

DRILLED BY **J. H. Drilling** DRAFTED BY **RJM** LOGGED BY **MRB**

PROJECT NO. G167-14

PLATE A-55

PROJECT: **Waterline Replacement in Antoine Forest Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-54**

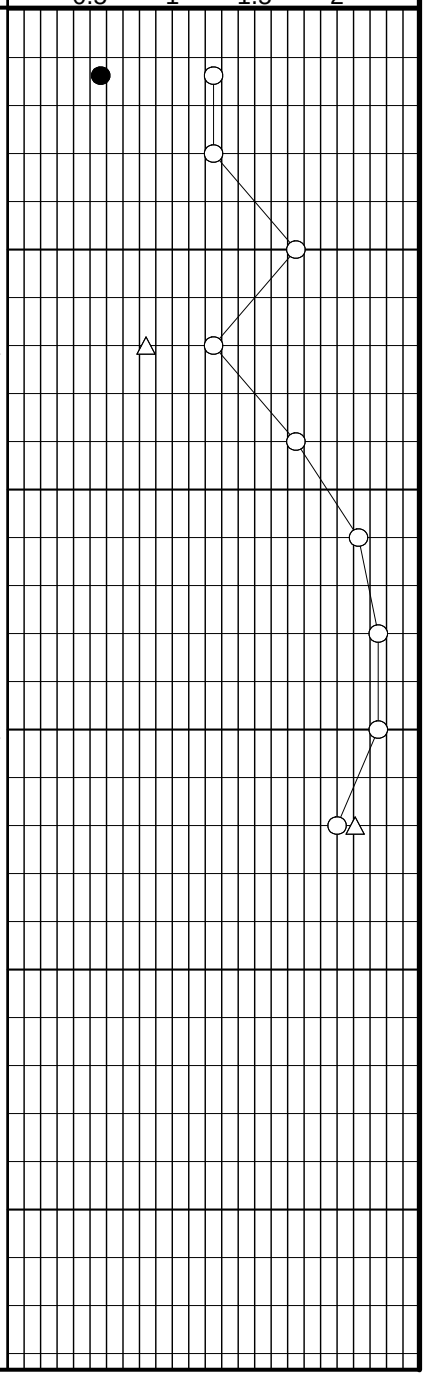
COH WBS No. **S-000035-0196-3** TYPE 4" Dry Auger DATE **10/30/2014**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
				Survey Coordinates (TSPC, Surface): *Easting: 3092233.25* *Northing: 13878125.97* *Elevation: 81.4*							
80	0			Pavement: 6" asphalt							
				Base: 3" shell, sand, and gravel							
				Stiff to very stiff, tan and gray Sandy Silty Clay (CL-ML)		69	111	14	22	17	5
								19			
	4			Stiff to very stiff, tan and light gray Lean Clay w/Sand (CL), with silt partings and ferrous nodules				17			
76						76	111	18	34	13	21
	8			-with silt pockets 8'-10'							
72								15			
				Very stiff to hard, light gray, tan, and red Fat Clay (CH)				15			
	12			-with silt pockets and ferrous nodules 10'-14'							
68								19			
						89		18	50	18	32
	16			-with silt partings 16'-18'							
64							111	20			
				Termination depth = 18 feet.							
	20										
60											
	24										
56											
	28										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **18** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▼
DRILLED BY **J. H. Drilling** DRAFTED BY **RJM** LOGGED BY **MRB**

PROJECT NO. G167-14

PLATE A-56

PROJECT: **Waterline Replacement in Antoine Forest Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-55**

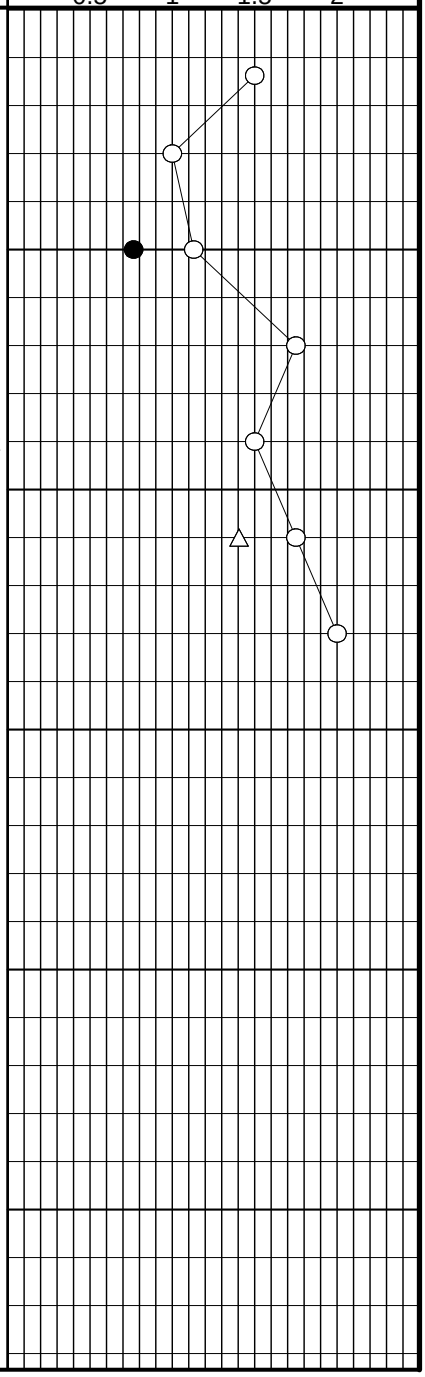
COH WBS No. **S-000035-0196-3** TYPE 4" Dry Auger DATE **10/30/2014**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
				Survey Coordinates (TSPC, Surface): *Easting: 3092836.67* *Northing: 13878149.22* *Elevation: 81.6*							
80	0			Pavement: 6" asphalt							
				Base: 3" sand and shell		67		13	19	16	3
				Gray Sandy Silt (ML), with clay partings -with silt seams 2'-4'				16			
	4			-with vertical silt seams and ferrous nodules 4'-6'			112	16			
76				Very stiff, tan, red, and light gray Lean Clay w/Sand (CL), with silt pockets and ferrous nodules				16			
	8					76		17	46	14	32
72							115	16			
	12			-with silty clay seams 12'-14'				20			
68				Termination depth = 14 feet.							
	16										
64											
	20										
60											
	24										
56											
	28										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **14** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▼
DRILLED BY **J. H. Drilling** DRAFTED BY **RJM** LOGGED BY **MRB**

PROJECT NO. G167-14

PLATE A-57

PROJECT: **Waterline Replacement in Antoine Forest Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-56**

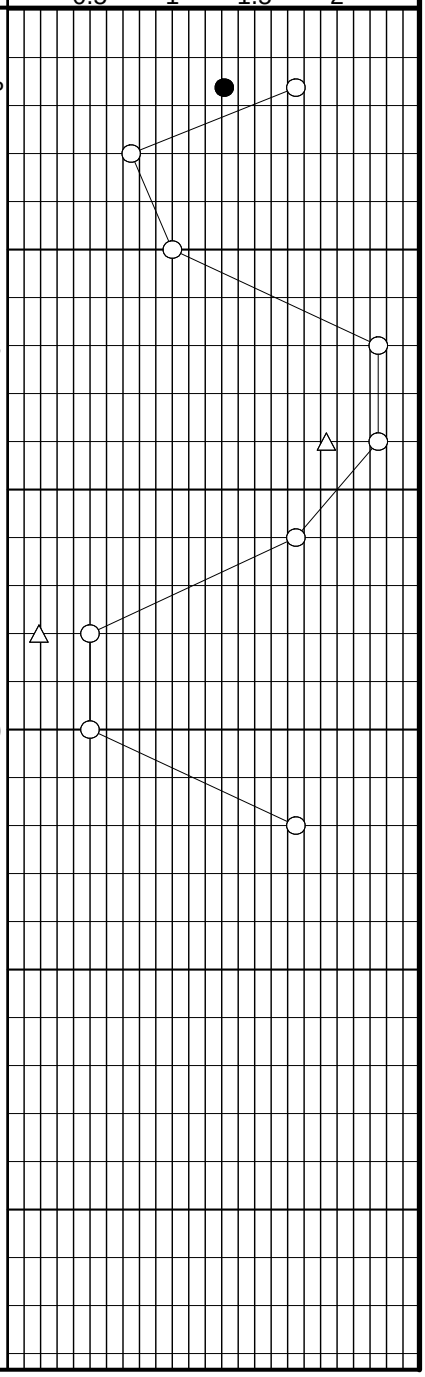
COH WBS No. **S-000035-0196-3** TYPE 4" Dry Auger DATE **10/30/2014**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
				Survey Coordinates (TSPC, Surface): *Easting: 3093337.93* *Northing: 13878164.34* *Elevation: 82.4*							
	0			Pavement: 6" asphalt							
				Base: 9" sand and shell							
80				Fill: dark gray Sandy Silt (ML), with clay partings and wood pieces		50	111	16	NP	NP	NP
	4			Very stiff to hard, dark gray Sandy Lean Clay (CL), with ferrous nodules and silt partings -light gray and tan 6'-12'				18			
								17			
76						56		16	36	13	23
	8						121	14			
72								15			
	12			Light gray and tan Poorly Graded Sand w/ Silt (SP-SM), with clay seams		8	109	19			
68				Light gray and tan Clayey Sand (SC), with vertical silt seams		26		17	33	13	20
	16			Very stiff, light gray and tan Lean Clay (CL), with ferrous nodules and silty clay seams				23			
64				Termination depth = 18 feet.							
	20										
60											
	24										
56											
	28										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **18** FEET WITHOUT DRILLING FLUID

WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽

WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▼

DRILLED BY **J. H. Drilling** DRAFTED BY **RJM** LOGGED BY **MRB**

PROJECT NO. G167-14

PLATE A-58

PROJECT: **Waterline Replacement in Antoine Forest Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-57**

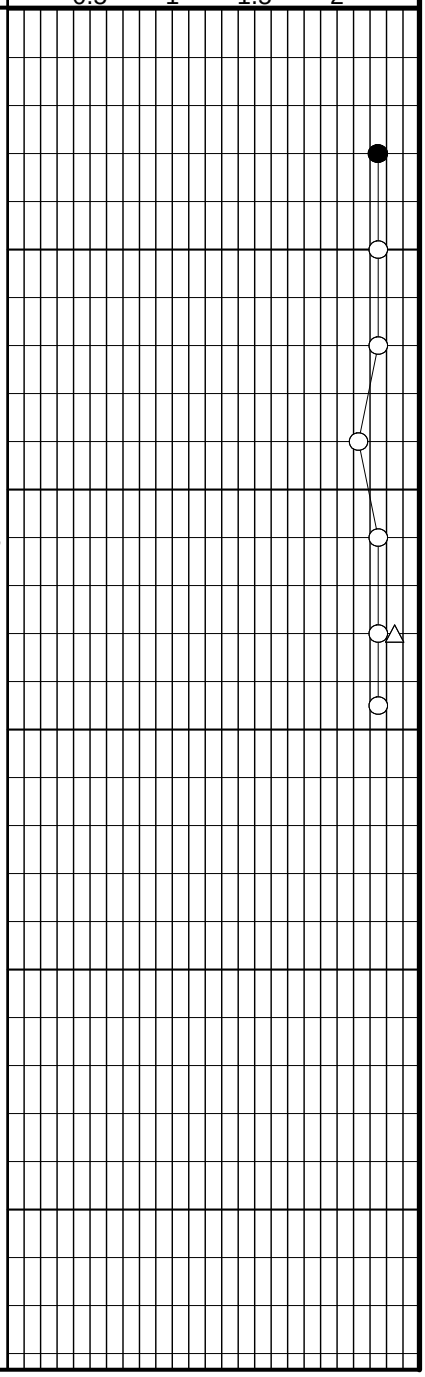
COH WBS No. **S-000035-0196-3** TYPE 4" Dry Auger DATE **10/30/2014**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
				Survey Coordinates (TSPC, Surface):							
				Easting: 3093775.69							
				Northing: 13878243.08							
				Elevation: 82.5							
80	0			Pavement: 5.5" asphalt							
				Base: 6.5" sand and shell							
				Tan Silty Sand (SM)		37		7			
				Hard, tan Sandy Lean Clay (CL), with silt partings and ferrous nodules			122	7	25	15	9
76	4							7			
								8			
72	8			Tan and light gray Clayey Sand (SC), with silt partings -with vertical silt seams 8'-10'				11			
						29		12	31	18	13
68	12			Hard, light gray and tan Fat Clay (CH), with silt pockets and ferrous nodules			122	14			
								14			
	16			Termination depth = 15 feet.							
64											
	20										
60											
	24										
56											
	28										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **15** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▼
DRILLED BY **J. H. Drilling** DRAFTED BY **RJM** LOGGED BY **MRB**

PROJECT NO. G167-14

PLATE A-59

PROJECT: **Waterline Replacement in Antoine Forest Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-58**

COH WBS No. **S-000035-0196-3** TYPE 4" Dry Auger DATE **11/4/2014**

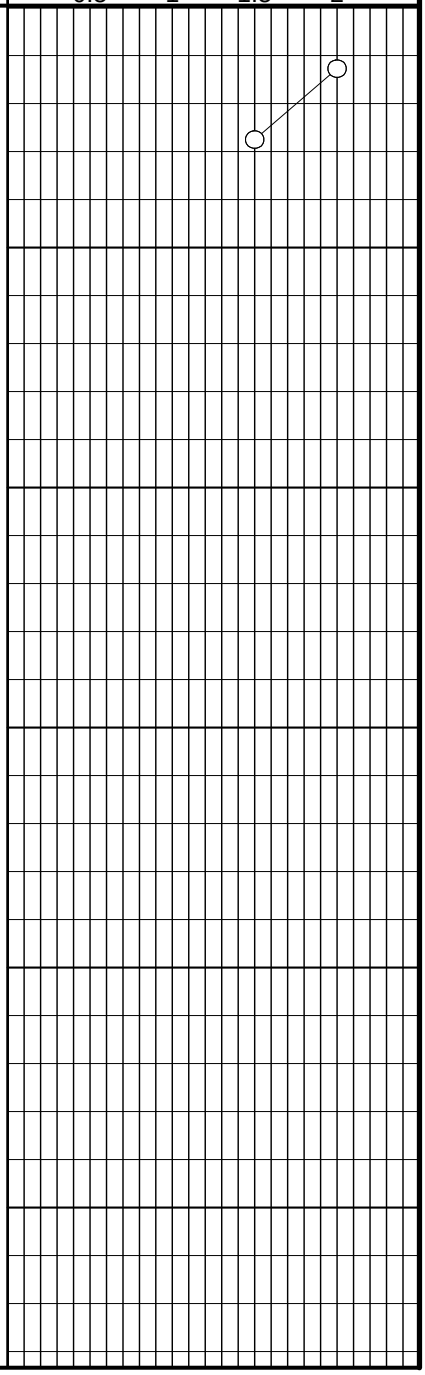
ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
68	0			Pavement: 6.5" concrete							
				Fill: very stiff, gray Sandy Lean Clay (CL), with ferrous nodules							
	4			Drilling Encountered Underground Utility; Termination depth = 3.5 feet.							
64	8										
60	12										
56	16										
52	20										
48	24										
44	28										

Survey Coordinates (TSPC, Surface):
Easting: 3090168.33
Northing: 13877707.22
Elevation: 70.6

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **3.5** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **N/A** FEET WHILE DRILLING ▽
WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▽
DRILLED BY **J. H. Drilling** DRAFTED BY **RJM** LOGGED BY **MRB**

PROJECT NO. G167-14

PLATE A-60

PROJECT: **Waterline Replacement in Antoine Forest Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-59**

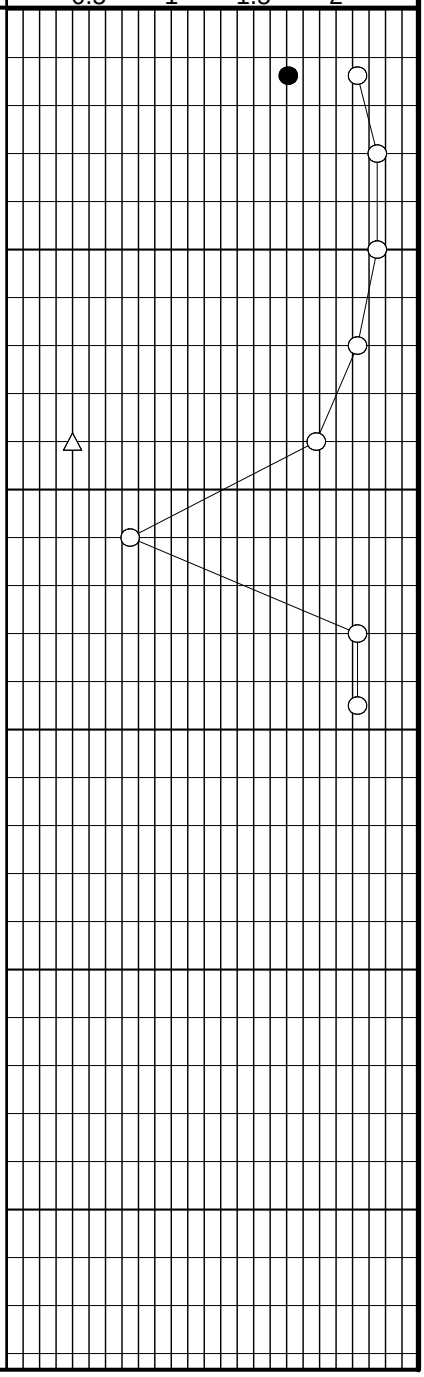
COH WBS No. **S-000035-0196-3** TYPE 4" Dry Auger DATE **11/4/2014**

ELEVATION IN FEET	DEPTH IN FEET	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
	0	Pavement: 8" concrete							
		Base: 1" sand			114	16			
		Fill: very stiff to hard, dark gray Lean Clay w/Sand (CL), with silt partings and ferrous nodules		72		13	36	15	21
68	4	-with wood pieces 0'-2'							
		-light gray and tan, with abundant calcareous nodules and siltstone fragments 2'-4'				13			
		Firm to hard, light gray and tan Silty Clay (CL-ML)				18			
64	8	-with abundant siltstone fragments and calcareous and ferrous nodules 4'-6'							
		-red, brown, and light gray 6'-12'			108	18			
60	12	-boring cave in at 11' after drilling was completed		87		21	27	22	5
		Hard, red, brown, and light gray Fat Clay (CH), wet				17			
		-with abundant siltstone fragments and calcareous nodules 12'-14'				23			
56	16	Termination depth = 15 feet.							
52	20								
48	24								
44	28								

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **15** FEET WITHOUT DRILLING FLUID

WATER ENCOUNTERED AT **12** FEET WHILE DRILLING ▽

WATER LEVEL AT **11** FEET AFTER **COMPLETE** ▽

DRILLED BY **J. H. Drilling** DRAFTED BY **RJM** LOGGED BY **MRB**

PROJECT NO. G167-14

PLATE A-61

PROJECT: **Waterline Replacement in Antoine Forest Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-60**

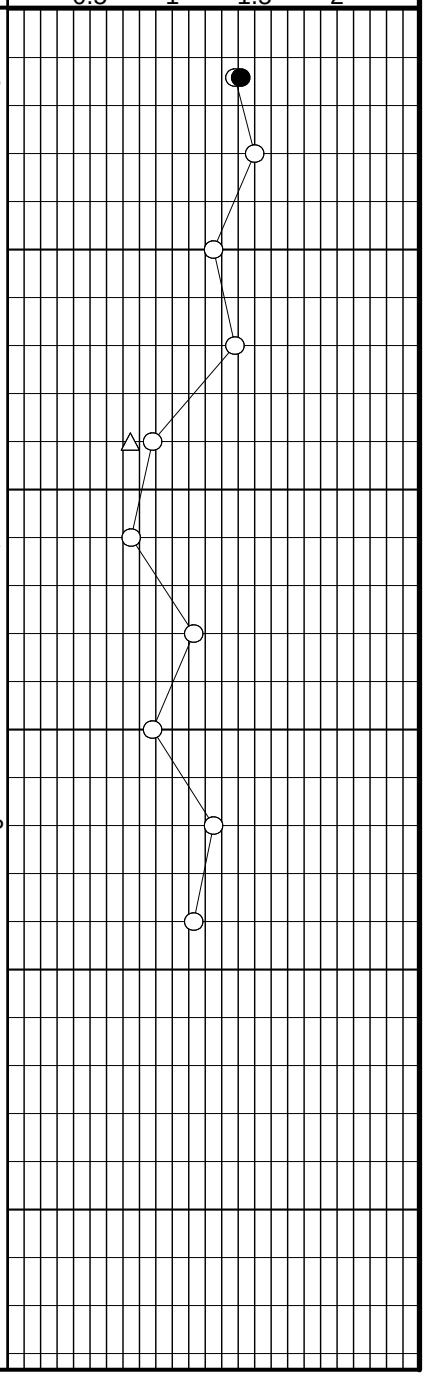
COH WBS No. **S-000035-0196-3** TYPE 4" Dry Auger DATE **11/4/2014**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
				Survey Coordinates (TSPC, Surface): *Easting: 3091087.95* *Northing: 13877770.49* *Elevation: 77.0*							
76	0			Pavement: 6.5" concrete							
				Base: 3.5" sand							
				Very stiff, tan and light gray Lean Clay w/ Sand (CL), with ferrous nodules and silt partings		77	112	17	46	18	28
								16			
72	4							18			
								17			
68	8			Stiff to very stiff, light gray, tan, and red Lean Clay (CL), with silt partings, calcareous nodules, and siltstone fragments			104	23			
						92		23	40	18	22
64	12							22			
				Red, brown, and light gray Silt w/Sand (ML), with clay partings and siltstone fragments			109	21			
	16			-with calcareous nodules 16'-18'							
60						75		22	NP	NP	NP
				-wet at 18' ▽							
								23			
	20			Termination depth = 20 feet.							
56											
	24										
52											
	28										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **20** FEET WITHOUT DRILLING FLUID

WATER ENCOUNTERED AT **18** FEET WHILE DRILLING ▽

WATER LEVEL AT **N/A** FEET AFTER **COMPLETE** ▽

DRILLED BY **J. H. Drilling** DRAFTED BY **RJM** LOGGED BY **MRB**

PROJECT NO. G167-14

PLATE A-62

PROJECT: **Waterline Replacement in Antoine Forest Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-61**

COH WBS No. **S-000035-0196-3** TYPE 4" Dry Auger DATE **11/11/2014**

ELEVATION IN FEET	DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
				Survey Coordinates (TSPC, Surface): *Easting: 3094708.63* *Northing: 13877247.95* *Elevation: 82.80*							
82	0			Pavement: 4" asphalt							
				Base: 5" sand and shell		49		7			
				Dark gray Silty Sand (SM)							
80				Very stiff to hard, dark gray Lean Clay (CL), with silt partings and pockets			125	7			
	4							7			
76				Gray and light gray Clayey Sand (SC), with vertical silt seams and roots		41		13	27	13	14
	8						113	16			
72				Medium dense, light gray Silty Sand (SM) -boring cave in at 9.7' after drilling was completed	12	20		16			
	12			-wet at 10.5' Termination depth = 12 feet.							
68	16										
64	20										
60	24										
56	28										

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2

BORING DRILLED TO **12** FEET WITHOUT DRILLING FLUID
WATER ENCOUNTERED AT **10.5** FEET WHILE DRILLING
WATER LEVEL AT **9.7** FEET AFTER **COMPLETE**
DRILLED BY **J. H. Drilling** DRAFTED BY **RJM** LOGGED BY **MRB**

PROJECT NO. G167-14

PLATE A-63

PROJECT: **Waterline Replacement in Antoine Forest Area**

AVLES ENGINEERING CORP. GEOTECHNICAL ENGINEERS

BORING **B-62**

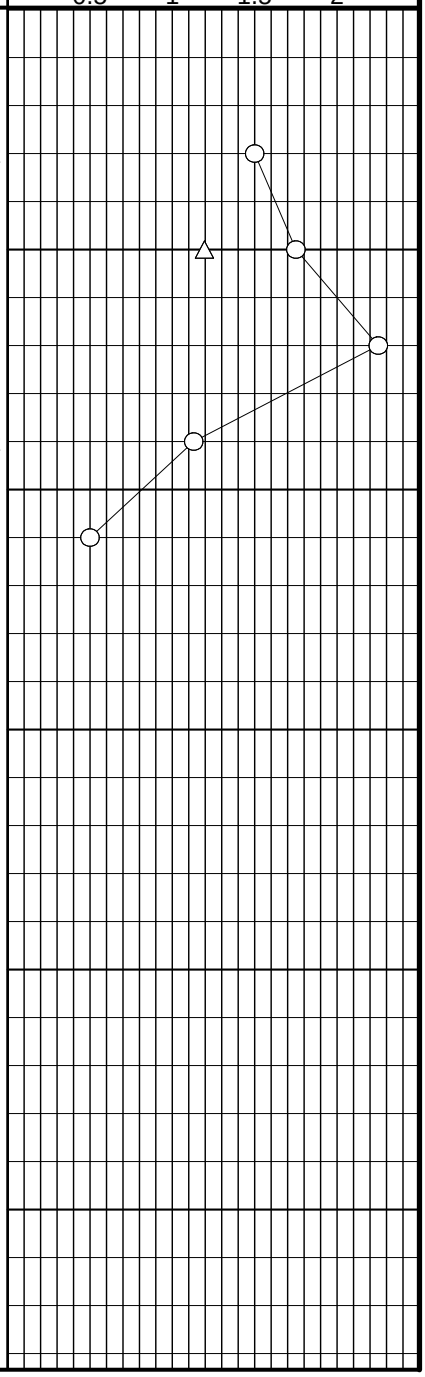
COH WBS No. **S-000035-0196-3** TYPE 4" Dry Auger DATE **10/30/2014**

ELEVATION IN FEET	DEPTH IN FEET	DESCRIPTION	S.P.T. BLOWS / FT.	-200 MESH	DRY DENSITY, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
	0	Pavement: 8" asphalt							
		Base: 4" sand and shell							
		Light gray and tan Silty Sand (SM)		39		10			
80		Very stiff to hard, tan and light gray Lean Clay (CL), with silt partings and ferrous nodules				14	26	14	12
	4				120	13			
76						12			
	8	Loose to medium dense, light gray and tan Clayey Sand (SC)		42		17	27	15	12
72		-with vertical silt seams 8'-12'							
					114	17			
	12	-boring cave in at 9.7' after drilling was completed							
		-with abundant silt partings 12'-14', wet at 12'	24			20			
68			8	22		21			
	16	Termination depth = 15.5 feet.							
64									
	20								
60									
	24								
56									
	28								

SHEAR STRENGTH, TSF

△ Confined Compression
● Unconfined Compression
○ Pocket Penetrometer
□ Torvane

0.5 1 1.5 2



BORING DRILLED TO **15.5** FEET WITHOUT DRILLING FLUID

WATER ENCOUNTERED AT **12** FEET WHILE DRILLING ▽

WATER LEVEL AT **9.7** FEET AFTER **COMPLETE** ▽

DRILLED BY **J. H. Drilling** DRAFTED BY **RJM** LOGGED BY **MRB**

PROJECT NO. G167-14

PLATE A-64

KEY TO SYMBOLS

Symbol	Description
Strata symbols	
	Paving
	Fill
	High plasticity clay
	Low plasticity clay
	Silt
	Silty sand
	Poorly graded sand with silt
	Silty low plasticity clay
	Poorly graded clayey silty sand
	Clayey sand
Misc. Symbols	
○	Pocket Penetrometer
●	Unconfined Compression
△	Confined Compression
	Water table depth during drilling
	Subsequent water table depth

Symbol	Description
□	Torvane
Soil Samplers	
	Rock core
	Auger
	Undisturbed thin wall Shelby tube
	Standard penetration test

AYLES ENGINEERING CORP.

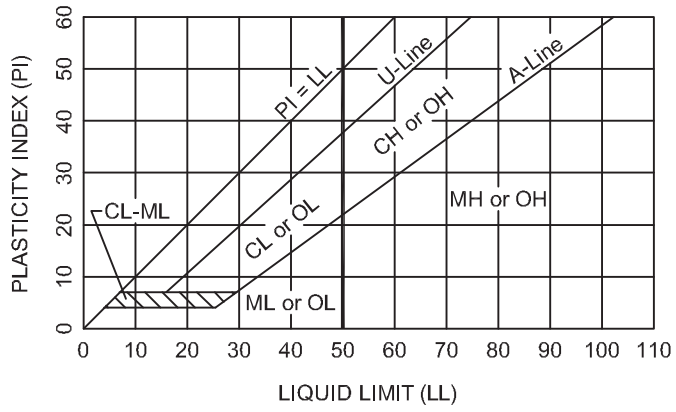
CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES

ASTM Designation D-2487

MAJOR DIVISIONS				GROUP SYMBOL	TYPICAL NAMES
COARSE-GRAINED SOILS (Less than 50% passes No. 200 sieve)	GRAVELS (Less than 50% of coarse fraction passes No. 4 sieve)	CLEAN GRAVELS (Less than 5% passes No. 200 sieve)		GW	Well-graded gravel, well-graded gravel with sand
				GP	Poorly-graded gravel, poorly-graded gravel with sand
		GRAVELS WITH FINES (More than 12% passes No. 200 sieve)	Limits plot below "A" line & hatched zone on plasticity chart	GM	Silty gravel, silty gravel with sand
			Limits plot above "A" line & hatched zone on plasticity chart	GC	Clayey gravel, clayey gravel with sand
	SANDS (50% or more of coarse fraction passes No. 4 sieve)	CLEAN SANDS (Less than 5% passes No. 200 sieve)		SW	Well-graded sand, well-graded sand with gravel
				SP	Poorly-graded sand, poorly-graded sand with gravel
		SANDS WITH FINES (More than 12% passes No. 200 sieve)	Limits plot below "A" line & hatched zone on plasticity chart	SM	Silty sand, silty sand with gravel
			Limits plot above "A" line & hatched zone on plasticity chart	SC	Clayey sand, clayey sand with gravel
FINE-GRAINED SOILS (50% or more passes No. 200 sieve)		SILTS AND CLAYS (Liquid Limit Less Than 50%)		ML	Silt, silt with sand, silt with gravel, sandy silt, gravelly silt
				CL	Lean clay, lean clay with sand, lean clay with gravel, sandy lean clay, gravelly lean clay
				OL	Organic clay, organic clay with sand, sandy organic clay, organic silt, sandy organic silt
		SILTS AND CLAYS (Liquid Limit 50% or More)		MH	Elastic silt, elastic silt with sand, sandy elastic silt, gravelly elastic silt
				CH	Fat clay, fat clay with sand, fat clay with gravel, sandy fat clay, gravelly fat clay
				OH	Organic clay, organic clay with sand, sandy organic clay, organic silt, sandy organic silt

NOTE: Coarse soils between 5% and 12% passing the No. 200 sieve and fine-grained soils with limits plotting in the hatched zone of the plasticity chart are to have dual symbols.

PLASTICITY CHART



Equation of A-Line: Horizontal at PI=4 to LL=25.5, then PI=0.73(LL-20)

Equation of U-Line: Vertical at LL=16 to PI=7, then PI=0.9(LL-8)

DEGREE OF PLASTICITY OF COHESIVE SOILS

Degree of Plasticity	Plasticity Index
None	0 - 4
Slight	5 - 10
Medium	11 - 20
High	21 - 40
Very High	>40

SOIL SYMBOLS

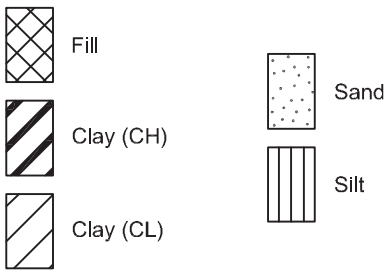


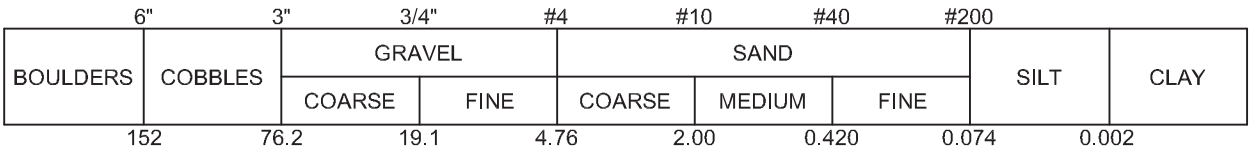
PLATE A-66

AYLES ENGINEERING CORP.

TERMS USED ON BORING LOGS

SOIL GRAIN SIZE

U.S. STANDARD SIEVE



SOIL GRAIN SIZE IN MILLIMETERS

STRENGTH OF COHESIVE SOILS

Consistency	Undrained Shear Strength, Kips per Sq. ft.
Very Soft	less than 0.25
Soft	0.25 to 0.50
Firm	0.50 to 1.00
Stiff	1.00 to 2.00
Very Stiff	2.00 to 4.00
Hard	greater than 4.00

RELATIVE DENSITY OF COHESIONLESS SOILS FROM STANDARD PENETRATION TEST

Very Loose	<4 bpf
Loose	5-10 bpf
Medium Dense	11-30 bpf
Dense	31-50 bpf
Very Dense	>50 bpf

SPLIT-BARREL SAMPLER DRIVING RECORD

Blows per Foot	Description
25	25 blows driving sampler 12 inches, after initial 6 inches of seating.
50/7"	50 blows driving sampler 7 inches, after initial 6 inches of seating.
Ref/3"	50 blows driving sampler 3 inches, during initial 6-inches seating interval.

NOTE: To avoid change to sampling tools, driving is limited to 50 blows during or after seating interval.

DRY STRENGTH ASTM D2488

None	Dry specimen crumbles into powder with mere pressure of handling
Low	Dry specimen crumbles into powder with some finger pressure
Medium	Dry specimen breaks into pieces or crumbles with considerable pressure
High	Dry specimen cannot be broken with finger pressure, it can be broken between thumb and hard surface
Very High	Dry specimen cannot be broken between thumb and hard surface

MOISTURE CONDITION ASTM D2488

Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water

SOIL STRUCTURE

Slickensided	Having planes of weakness that appear slick and glossy. The degree of slickensidedness depends upon the spacing of slickensides and the easiness of breaking along these planes.
Fissured	Containing shrinkage or relief cracks, often filled with fine sand or silt; usually more or less vertical.
Pocket	Inclusion of material of different texture that is smaller than the diameter of the sample.
Parting	Inclusion less than 1/8 inch thick extending through the sample.
Seam	Inclusion 1/8 inch to 3 inches thick extending through the sample.
Layer	Inclusion greater than 3 inches thick extending through the sample.
Laminated	Soil sample composed of alternating partings or seams of different soil types.
Interlayered	Soil sample composed of alternating layers of different soil types.
Intermixed	Soil sample composed of pockets of different soil types and layered or laminated structure is not evident.
Calcareous	Having appreciable quantities of calcium material.

AVILES
ENGINEERING CORP.

ASTM & TXDOT DESIGNATION FOR SOIL LABORATORY TESTS

NAME OF TEST	ASTM TEST DESIGNATION	TXDOT TEST DESIGNATION
Moisture Content	D 2216	Tex-103-E
Specific Gravity	D 854	Tex-108-E
Sieve Analysis	D 421 D 422	Tex-110-E (Part 1)
Hydrometer Analysis	D 422	Tex-110-E (Part 2)
Minus No. 200 Sieve	D 1140	Tex-111-E
Liquid Limit	D 4318	Tex-104-E
Plastic Limit	D 4318	Tex-105-E
Shrinkage Limit	D 427	Tex-107-E
Standard Proctor Compaction	D 698	Tex-114-E
Modified Proctor Compaction	D 1557	Tex-113-E
Permeability (constant head)	D 2434	-
Consolidation	D 2435	-
Direct Shear	D 3080	-
Unconfined Compression	D 2166	-
Unconsolidated-Undrained Triaxial	D 2850	Tex-118-E
Consolidated-Undrained Triaxial	D 4767	Tex-131-E
Pinhole Test	D 4647	-
California Bearing Ratio	D 1883	-
Unified Soil Classification System	D 2487	Tex-142-E

SUMMARY OF TEST RESULTS	Project Name: Water Line Replacement in Antoine Forest Area															
	WBS Number: S-000035-0916-3															
Aviles Engineering Corporation	AEC Project Number: G167-14															
Boring No.	Sample				SPT (blows/ ft)	Water Content (%)	Dry Density (pcf)	Atterberg Limits			Percent Passing Sieve #200 (%)	Shear Strength (tsf)				Type of Material
	No.	Depth (ft)		Type				LL (%)	PL (%)	PI (%)		Unconfined Compression	UU (confining pressure, psi)	Torvane	Pocket Penetrometer	
		Top	Bottom													
B-1	1	0	0.417	R												Pavement: 5" concrete
	2	0.417	0.667	AG												Base: 3" sand
	3	0.667	2	UD		11		50	17	33	76				2.25	Fat Clay w/Sand (CH)
	4	2	4	UD		12	121					4.50			2.25	Fat Clay w/Sand (CH)
	5	4	6	UD		12									2.25	Fat Clay w/Sand (CH)
	6	6	8	UD		17									2.25	Fat Clay (CH)
	7	8	10	UD		23		57	23	34	94				2.25	Fat Clay (CH)
	8	10	12	UD		20									2.00	Fat Clay (CH)
	9	12	14	UD		23									2.25	Fat Clay (CH)
	10	14	15	UD		22	106	37	17	20	91		0.65 (10)		1.13	Lean Clay (CL)
B-2	1	0	0.5	R												Pavement: 6" concrete
	2	0.5	1	UD												Fat Clay w/Sand (CH)
	3	1	2	UD		22	102	53	19	34	78	0.96			1.25	Fat Clay w/Sand (CH)
	4	2	4	UD		20									1.25	Fat Clay w/Sand (CH)
	5	4	6	UD		14									2.25	Sandy Lean Clay (CL)
	6	6	8	UD		14									2.25	Sandy Lean Clay (CL)
	7	8	10	UD		21									2.25	Fat Clay (CH)
	8	10	12	UD		21	107	51	20	31	95		1.91 (7)		2.25	Fat Clay (CH)
	9	12	14	UD		25									2.25	Fat Clay (CH)
B-3	1	0	0.458	R												Pavement: 5.5" concrete
	2	0.458	2	UD		15	117	46	16	30	76	5.50			2.25	Lean Clay w/Sand (CL)
	3	2	4	UD		11									2.25	Lean Clay w/Sand (CL)
	4	4	6	UD		12									2.25	Fat Clay (CH)
	5	6	8	UD		15									2.25	Fat Clay (CH)
	6	8	10	UD		21	107	52	19	33	92		1.58 (6)		1.63	Fat Clay (CH)
	7	10	12	UD		10									2.25	Silt (ML)
B-4	1	0	0.5	R												Pavement: 6" concrete
	2	0.5	2	UD		14		24	16	8	70				1.63	Lean Clay w/Sand (CL)
	3	2	4	UD		17	111					1.13			1.50	Lean Clay w/Sand (CL)
	4	4	6	UD		16									1.63	Lean Clay w/Sand (CL)
	5	6	8	UD		16									1.75	Lean Clay w/Sand (CL)
	6	8	10	UD		23		52	20	32	94				1.75	Fat Clay (CH)
	7	10	12	UD		25	102						2.14 (7)		1.75	Fat Clay (CH)
B-5	1	0	0.458	R												Pavement: 5.5" concrete
	2	0.458	2	UD		9		29	15	14	64				1.88	Sandy Lean Clay (CL)
	3	2	4	UD		10	120					3.50			2.25	Sandy Lean Clay (CL)
	4	4	6	UD		9									2.25	Sandy Lean Clay (CL)
	5	6	8	UD		11									2.25	Sandy Lean Clay (CL)
	6	8	10	UD		15		30	14	16	67				1.50	Sandy Lean Clay (CL)

PLATE A-69

SUMMARY OF TEST RESULTS	Project Name: Water Line Replacement in Antoine Forest Area															
	WBS Number: S-000035-0916-3															
Aviles Engineering Corporation	AEC Project Number: G167-14															
Boring No.	Sample				SPT (blows/ ft)	Water Content (%)	Dry Density (pcf)	Atterberg Limits			Percent Passing Sieve #200 (%)	Shear Strength (tsf)				Type of Material
	No.	Depth (ft)		Type				LL (%)	PL (%)	PI (%)		Unconfined Compression	UU (confining pressure, psi)	Torvane	Pocket Penetrometer	
		Top	Bottom													
	7	10	12	UD		14	115						0.41 (7)		1.00	Sandy Lean Clay (CL)
	8	12	13	UD		8										Light gray Silty Sand (SM)
B-6	1	0	0.417	R												Pavement: 5" concrete
	2	0.417	2	UD		9		31	14	17	59				2.25	Sandy Lean Clay (CL)
	3	2	4	UD		11	120					2.27			2.25	Sandy Lean Clay (CL)
	4	4	6	UD		12									2.25	Sandy Lean Clay (CL)
	5	6	8	UD		14									1.63	Sandy Lean Clay (CL)
	6	8	10	UD		7	116	21	18	3	47		0.94 (6)		1.75	Silty Sand (SM)
	7	10.5	12	SS	41	7					48					Silty Sand (SM)
	8	12	14	AG												Fat Clay (CH)
	9	14	16	AG		18										Fat Clay (CH)
	10	16	17	AG		20										Fat Clay (CH)
B-7	1	0	0.542	R												Pavement: 6.5" concrete
	2	0.542	2	UD		16	113	43	15	28	73	4.70			2.25	Lean Clay w/Sand (CL)
	3	2	4	UD		12									2.25	Lean Clay w/Sand (CL)
	4	4	6	UD		10									2.25	Lean Clay w/Sand (CL)
	5	6	8	UD		12									2.25	Lean Clay w/Sand (CL)
	6	8	10	UD		21									2.25	Fat Clay (CH)
	7	10	12	UD		21	108	70	23	47	95		2.90 (7)		2.25	Fat Clay (CH)
	8	12	13	UD		22									2.25	Fat Clay (CH)
B-8	1	0	0.458	R												Pavement: 5.5" concrete
	2	0.458	2	UD		8		33	13	18	55				2.25	Sandy Lean Clay (CL)
	3	2	4	UD		9	112					3.50			2.25	Sandy Lean Clay (CL)
	4	4	6	UD		11									2.25	Sandy Lean Clay (CL)
	5	6	8	UD		12									2.25	Sandy Lean Clay (CL)
	6	8	10	UD		10	111	23	20	3	23		0.51 (6)		1.13	Silty Sand (SM)
	7	10.5	12	SS	16	9										Silty Sand (SM)
	8	12	13.5	SS	21	19										Poorly Graded Sand w/Silt (SP-SM)
	9	13.5	15	SS	16	22					8					Poorly Graded Sand w/Silt (SP-SM)
B-9	1	0	0.458	R												Pavement: 5.5" concrete
	2	0.458	2	UD		12		36	14	22	77				2.25	Lean Clay w/Sand (CL)
	3	2	4	UD		17	116					1.81			1.75	Lean Clay w/Sand (CL)
	4	4	6	UD		14									1.88	Lean Clay w/Sand (CL)
	5	6	8	UD		13									1.25	Sandy Silty Clay (CL-ML)
	6	8	10	UD		14									1.38	Sandy Silty Clay (CL-ML)
	7	10	12	UD		14	116						0.38 (7)		0.75	Sandy Silty Clay (CL-ML)
	8	12	13	UD		17		22	16	6	57			0.38	0.50	Sandy Silty Clay (CL-ML)
B-10	1	0	0.479	R												Pavement: 5.75" concrete
	2	0.479	2	UD		13		33	15	18	52				1.25	Sandy Lean Clay (CL)

SUMMARY OF TEST RESULTS	Project Name: Water Line Replacement in Antoine Forest Area														
	WBS Number: S-000035-0916-3														
Aviles Engineering Corporation	AEC Project Number: G167-14														
Boring No.	Sample				SPT (blows/ ft)	Water Content (%)	Dry Density (pcf)	Atterberg Limits			Percent Passing Sieve #200 (%)	Shear Strength (tsf)				Type of Material
	No.	Depth (ft)		Type				LL (%)	PL (%)	PI (%)		Unconfined Compression	UU (confining pressure, psi)	Torvane	Pocket Penetrometer	
		Top	Bottom													
	3	2	4	UD		18	109					1.22			1.13	Sandy Lean Clay (CL)
	4	4	6	UD		16									1.50	Sandy Lean Clay (CL)
	5	6	8	UD		14									1.75	Sandy Lean Clay (CL)
	6	8	10	UD		16									1.25	Sandy Lean Clay (CL)
	7	10	12	UD		17	111	NP	NP	NP	26		0.40 (7)		0.50	Silty Sand (SM)
	8	12	14	UD		20									2.25	Fat Clay (CH)
	9	14	15	UD		21									2.25	Fat Clay (CH)
B-11	1	0	0.625	R												Pavement: 7.5 concrete
	2	0.625	2	UD		18	111	35	13	22	80	1.55			1.25	Lean Clay w/Sand (CL)
	3	2	4	UD		17									1.75	Lean Clay w/Sand (CL)
	4	4	6	UD		17									2.00	Lean Clay w/Sand (CL)
	5	6	8	UD		17									2.13	Lean Clay w/Sand (CL)
	6	8	10	UD		27	104						0.98 (6)			Fat Clay (CH)
	7	10	12	UD		28		68	28	40	99				2.25	Fat Clay (CH)
B-12	1	0	0.646	R												Pavement: 7.75" concrete
	2	0.646	2	UD		27	98	65	21	44	98	1.17			1.38	Sandy Fat Clay (CH)
	3	2	4	UD		15									2.00	Sandy Fat Clay (CH)
	4	4	6	UD		16									2.25	Sandy Fat Clay (CH)
	5	6	8	UD		15									2.13	Sandy Fat Clay (CH)
	6	8	10	UD		15		28	21	7	31				1.75	Silty Clayey Sand (SC-SM)
	7	10	12	UD		12	113						0.50 (7)		0.75	Silty Clayey Sand (SC-SM)
	8	12.5	SS	UD	16	8					14					Silty Clayey Sand (SC-SM)
B-13	1	0	0.583	R												Pavement: 7" concrete
	2	0.583	2	UD		14		25	14	11	58				1.75	Sandy Lean Clay (CL)
	3	2	4	UD		14									1.00	Sandy Lean Clay (CL)
	4	4	6	UD		19	106						0.79 (3)		1.00	Sandy Lean Clay (CL)
	5	6	8	UD		14									2.25	Sandy Lean Clay (CL)
	6	8	10	UD		13		28	18	10	28				2.25	Clayey Sand (SC)
	7	10.5	12	SS	15	15										Poorly Graded Sand w/Silt (SP-SM)
	8	12.5	14	SS	16	7										Poorly Graded Sand w/Silt (SP-SM)
	9	14.5	16	SS	23	22										Poorly Graded Sand w/Silt (SP-SM)
	10	16	17.5	SS	17	23		NP	NP	NP	8					Poorly Graded Sand w/Silt (SP-SM)
	11	17.5	19	SS	18	25										Poorly Graded Sand w/Silt (SP-SM)
B-14	1	0	0.583	R												Pavement: 7" concrete
	2	0.583	2	UD		11		38	12	25	61				2.25	Sandy Lean Clay (CL)
	3	2	4	UD		12	123					5.40			2.25	Sandy Lean Clay (CL)
	4	4	6	UD		10									2.25	Sandy Lean Clay (CL)
	5	6	8	UD		9									2.25	Sandy Lean Clay (CL)
	6	8	10	UD		9									2.25	Sandy Lean Clay (CL)

PLATE A-71

SUMMARY OF TEST RESULTS	Project Name: Water Line Replacement in Antoine Forest Area															
	WBS Number: S-000035-0916-3															
Aviles Engineering Corporation	AEC Project Number: G167-14															
Boring No.	Sample				SPT (blows/ ft)	Water Content (%)	Dry Density (pcf)	Atterberg Limits			Percent Passing Sieve #200 (%)	Shear Strength (tsf)				Type of Material
	No.	Depth (ft)		Type				LL (%)	PL (%)	PI (%)		Unconfined Compression	UU (confining pressure, psi)	Torvane	Pocket Penetrometer	
		Top	Bottom													
	7	10	12	UD		16	111				56		3.40 (7)		2.25	Sandy Lean Clay (CL)
	8	12.5	14	SS	19	9										Silty Sand (SM)
	9	14	15.5	SS	14	18										Silty Sand (SM)
	10	15.5	17	SS	15	20										Silty Sand (SM)
B-15	1	0	0.458	R												Pavement: 5.5" concrete
	2	0.458	2	UD		14	118	38	15	23	75	2.31			2.00	Lean Clay w/Sand (CL)
	3	2	4	UD		13									2.25	Lean Clay w/Sand (CL)
	4	4	6	UD		14									1.88	Lean Clay w/Sand (CL)
	5	6	8	UD		17									1.50	Lean Clay w/Sand (CL)
	6	8	10	UD		20	109	47	15	32	78		1.42 (6)		1.38	Lean Clay w/Sand (CL)
	7	10	12	UD		18									1.00	Lean Clay w/Sand (CL)
	8	12	14	UD		19									1.75	Fat Clay (CH)
	9	14	16	UD		15									2.25	Fat Clay (CH)
	10	16	18	UD		26	98	58	24	34	98		1.16 (11)		2.00	Fat Clay (CH)
B-16	1	0	0.5	R												Pavement: 6" concrete
	2	0.5	2	UD		14		36	15	21	62				1.75	Sandy Lean Clay (CL)
	3	2	4	UD		12	123					1.87			2.25	Sandy Lean Clay (CL)
	4	4	6	UD		15									1.25	Sandy Lean Clay (CL)
	5	6	8	UD		17									1.38	Sandy Lean Clay (CL)
	6	8	10	UD		13	116	26	13	13	39		0.58 (6)		0.75	Clayey Sand (SC)
	7	10	12	UD		14									1.00	Clayey Sand (SC)
	8	12	14	UD		14	120						0.52 (7)		0.50	Clayey Sand (SC)
	9	14	16	UD		25									1.50	Lean Clay (CL)
	10	16	17	UD		23		36	18	18	93				1.25	Lean Clay (CL)
B-17	1	0	0.521	R												Pavement: 6.25" concrete
	2	0.521	2	UD		13	120	31	15	16	66	1.99			2.00	Sandy Lean Clay (CL)
	3	2	4	UD		15									1.50	Sandy Lean Clay (CL)
	4	4	6	UD		14									2.00	Sandy Lean Clay (CL)
	5	6	8	UD		15									1.63	Sandy Lean Clay (CL)
	6	8	10	UD		15	117						0.60 (6)		0.63	Silty Clayey Sand (SC-SM)
	7	10	12	UD		18		22	17	5	31				0.75	Silty Clayey Sand (SC-SM)
	8	12	14	UD		23									1.25	Silty Clayey Sand (SC-SM)/Fat Clay (CH)
	9	14	16	UD		25									1.88	Fat Clay (CH)
	10	16	18	UD		27	98						0.99 (11)		1.75	Fat Clay (CH)
B-18	1	0	0.5	R												Pavement: 6" concrete
	2	0.5	2	UD		16	115	37	14	23	74	2.21			1.13	Lean Clay w/Sand (CL)
	3	2	4	UD		16									1.50	Lean Clay w/Sand (CL)
	4	4	6	UD		16									1.38	Lean Clay w/Sand (CL)
	5	6	8	UD		16									1.25	Lean Clay w/Sand (CL)

SUMMARY OF TEST RESULTS	Project Name: Water Line Replacement in Antoine Forest Area															
	WBS Number: S-000035-0916-3															
Aviles Engineering Corporation	AEC Project Number: G167-14															
Boring No.	Sample				SPT (blows/ ft)	Water Content (%)	Dry Density (pcf)	Atterberg Limits			Percent Passing Sieve #200 (%)	Shear Strength (tsf)				Type of Material
	No.	Depth (ft)		Type				LL (%)	PL (%)	PI (%)		Unconfined Compression	UU (confining pressure, psi)	Torvane	Pocket Penetrometer	
		Top	Bottom													
	6	8	10	UD		18	109						0.62 (6)		1.13	Lean Clay w/Sand (CL)
	7	10	12	UD		19		30	13	17	81				1.25	Lean Clay w/Sand (CL)
	8	12	14	UD		43									2.25	Fat Clay (CH)
	9	14	16	UD		25									2.00	Fat Clay (CH)
	10	16	18	UD		23	105	62	23	39	93		1.32 (11)		2.13	Fat Clay (CH)
B-19	1	0	0.5	R												Pavement: 6" concrete
	2	0.5	2	UD		18		51	15	36	78				1.38	Fat Clay w/Sand (CH)
	3	2	4	UD		18	113					1.14			1.38	Fat Clay w/Sand (CH)
	4	4	6	UD		21									0.88	Fat Clay w/Sand (CH)
	5	6	8	UD		19									1.50	Fat Clay w/Sand (CH)
	6	8	10	UD		20	112						0.95 (6)		1.25	Fat Clay w/Sand (CH)
	7	10	12	UD		28		62	23	39	99				2.25	Fat Clay (CH)
	8	12	14	UD		24									2.25	Fat Clay (CH)
	9	14	16	UD		22									2.25	Fat Clay (CH)
	10	16	18	UD		22									2.25	Fat Clay (CH)
	11	18	19	UD		23	105	53	20	33	88		1.16 (12)		2.25	Fat Clay (CH)
B-20	1	0	0.458	R												Pavement: 5.5" concrete
	2	0.458	0.625	AG												Base: 2" sand
	3	0.625	2	UD		10		32	14	18	59				2.25	Sandy Lean Clay (CL)
	4	2	4	UD		14	119					2.49			2.00	Sandy Lean Clay (CL)
	5	4	6	UD		14									1.75	Sandy Lean Clay (CL)
	6	6	8	UD		18									1.50	Sandy Lean Clay (CL)
	7	8	10	UD		26									2.00	Lean Clay w/Sand (CL)
	8	10	12	UD		26	100	44	16	28	84		1.12 (7)		1.75	Lean Clay w/Sand (CL)
	9	12	13	UD		31									1.75	Lean Clay w/Sand (CL)
B-21	1	0	0.542	R												Pavement: 6.5" concrete
	2	0.542	2	UD		16	113	39	15	24	80	1.65			2.00	Lean Clay w/Sand (CL)
	3	2	4	UD		15									2.25	Lean Clay w/Sand (CL)
	4	4	6	UD		16									1.50	Lean Clay w/Sand (CL)
	5	6	8	UD		15									1.75	Lean Clay w/Sand (CL)
	6	8	10	UD		17	113	33	13	20	74		0.88 (6)		1.00	Lean Clay w/Sand (CL)
	7	10	12	UD		21									1.00	Lean Clay w/Sand (CL)
	8	12	14	UD		20									0.75	Fat Clay (CH)
	9	14	16	UD		27									2.00	Fat Clay (CH)
	10	16	18	UD		24									2.25	Fat Clay (CH)
	11	18	20	UD		24	102	62	24	38	98		1.40 (13)		2.25	Fat Clay (CH)
	12	20	21	UD		21									2.25	Fat Clay (CH)
B-22	1	0	0.583	R												Pavement: 7" concrete
	2	0.583	2	UD		14	119	35	15	20	70	1.65			2.25	Lean Clay w/Sand (CL)

SUMMARY OF TEST RESULTS	Project Name: Water Line Replacement in Antoine Forest Area															
	WBS Number: S-000035-0916-3															
Aviles Engineering Corporation	AEC Project Number: G167-14															
Boring No.	Sample				SPT (blows/ ft)	Water Content (%)	Dry Density (pcf)	Atterberg Limits			Percent Passing Sieve #200 (%)	Shear Strength (tsf)				Type of Material
	No.	Depth (ft)		Type				LL (%)	PL (%)	PI (%)		Unconfined Compression	UU (confining pressure, psi)	Torvane	Pocket Penetrometer	
		Top	Bottom													
	3	2	4	UD		16									2.13	Lean Clay w/Sand (CL)
	4	4	6	UD		18									1.13	Lean Clay w/Sand (CL)
	5	6	8	UD		18		49	16	33	85				1.38	Lean Clay w/Sand (CL)
	6	8	10	UD		17									2.00	Lean Clay w/Sand (CL)
	7	10	12	UD		19									1.13	Sandy Silty Clay (CL-ML)
	8	12	13	UD		23	104	27	22	5	75	0.36			0.50	Sandy Silty Clay (CL-ML)
B-23	1	0	0.667	R												Pavement: 8" concrete
	2	0.667	2	UD		14		32	13	19	64				1.75	Sandy Lean Clay (CL)
	3	2	4	UD		11	119					2.60			2.25	Sandy Lean Clay (CL)
	4	4	6	UD		11									2.25	Sandy Lean Clay (CL)
	5	6	8	UD		13									1.50	Sandy Lean Clay (CL)
	6	8	10	UD		14									1.13	Silty Sand (SM)
	7	10	12	UD		16	119	19	18	1	23	0.30			0.75	Silty Sand (SM)
	8	12	13	UD		18										Silty Sand (SM)
B-24	1	0	0.458	R												Pavement: 5.5" concrete
	2	0.458	2	UD		18									1.25	Sandy Lean Clay (CL)
	3	2	4	UD		16	118	35	14	21	68	1.49			1.13	Sandy Lean Clay (CL)
	4	4	6	UD		12									2.25	Sandy Lean Clay (CL)
	5	6	8	UD		22									1.25	Fat Clay (CH)
	6	8	10	UD		26									2.00	Fat Clay (CH)
	7	10	12	UD		23	103	58	21	37	99		0.98 (7)		2.00	Fat Clay (CH)
	8	12	13	UD		19									2.25	Fat Clay (CH)
B-25	1	0	0.5	R												Pavement: 6" concrete
	2	0.5	2	UD		19		51	18	33	79				1.38	Fat Clay w/Sand (CH)
	3	2	4	UD		17	115					0.70			1.13	Fat Clay w/Sand (CH)
	4	4	6	UD		13									1.38	Fat Clay w/Sand (CH)
	5	6	8	UD		27									1.63	Fat Clay (CH)
	6	8	10	UD		29									1.50	Fat Clay (CH)
	7	10	12	UD		27	99						1.05 (7)		2.00	Fat Clay (CH)
	8	12	13	UD		21		62	25	37	100				1.75	Fat Clay (CH)
B-26	1	0	0.604	R												Pavement: 7.5" concrete
	2	0.604	2	UD		18		50	15	35	72				1.50	Fat Clay w/ Sand (CH)
	3	2	4	UD		15	117					2.36			2.00	Fat Clay w/ Sand (CH)
	4	4	6	UD		17									1.75	Fat Clay w/ Sand (CH)
	5	6	8	UD		18									1.38	Lean Clay w/Sand (CL)
	6	8	10	UD		16									2.25	Lean Clay w/Sand (CL)
	7	10	12	UD		21	107	32	18	14	73		0.62 (7)		0.75	Lean Clay w/Sand (CL)
	8	12	14	UD		23									0.63	Lean Clay w/Sand (CL)
	9	14	15	UD		20									0.88	Lean Clay w/Sand (CL)

SUMMARY OF TEST RESULTS	Project Name: Water Line Replacement in Antoine Forest Area															
	WBS Number: S-000035-0916-3															
Aviles Engineering Corporation	AEC Project Number: G167-14															
Boring No.	Sample				SPT (blows/ ft)	Water Content (%)	Dry Density (pcf)	Atterberg Limits			Percent Passing Sieve #200 (%)	Shear Strength (tsf)				Type of Material
	No.	Depth (ft)		Type				LL (%)	PL (%)	PI (%)		Unconfined Compression	UU (confining pressure, psi)	Torvane	Pocket Penetrometer	
		Top	Bottom													
B-27	1	0	0.583	R												Pavement: 7" concrete
	2	0.583	2	UD		14		55	16	39	79				2.25	Fat Clay w/Sand (CH)
	3	2	4	UD		12	117					3.40			2.25	Fat Clay w/Sand (CH)
	4	4	6	UD		11									2.25	Fat Clay w/Sand (CH)
	5	6	8	UD		23									2.25	Fat Clay (CH)
	6	8	10	UD		25									2.25	Fat Clay (CH)
	7	10	12	UD		26	100						1.79 (7)		2.25	Fat Clay (CH)
	8	12	14	UD		23		57	24	33	97				2.25	Fat Clay (CH)
	9	14	15	UD		23									2.25	Fat Clay (CH)
B-28	1	0	0.583	R												Pavement: 7" concrete
	2	0.583	2	UD		12		39	14	25	75				2.25	Lean Clay w/Sand (CL)
	3	2	4	UD		17									2.00	Lean Clay w/Sand (CL)
	4	4	6	UD		16									2.00	Lean Clay w/Sand (CL)
	5	6	8	UD		17									1.88	Lean Clay w/Sand (CL)
	6	8	10	UD		23	106						0.84 (6)		2.13	Fat Clay (CH)
	7	10	12	UD		19		55	22	33	91				2.25	Fat Clay (CH)
	8	12	13	UD		22									2.25	Fat Clay (CH)
B-29	1	0	0.625	R												Pavement: 7.5" concrete
	2	0.625	2	UD		16		43	15	28	77				1.75	Lean Clay w/Sand (CL)
	3	2	4	UD		14	118					1.99			2.25	Lean Clay w/Sand (CL)
	4	4	6	UD		15									1.88	Lean Clay w/Sand (CL)
	5	6	8	UD		22									1.63	Lean Clay (CL)
	6	8	10	UD		31									1.25	Lean Clay (CL)
	7	10	12	UD		31	95	34	17	17	93		0.68 (7)		1.75	Lean Clay (CL)
	8	12	13	UD		26									1.63	Lean Clay (CL)
B-30	1	0	0.604	R												Pavement: 7.25" concrete
	2	0.604	2	UD		16	115	36	15	21	78	1.88			2.13	Lean Clay w/Sand (CL)
	3	2	4	UD		14									1.88	Lean Clay w/Sand (CL)
	4	4	6	UD		14									2.25	Lean Clay w/Sand (CL)
	5	6	8	UD		19									2.25	Lean Clay w/Sand (CL)
	6	8	10	UD		26	102	44	15	29	89		0.65 (6)		1.63	Lean Clay (CL)
	7	10	12	UD		23									1.25	Lean Clay (CL)
	8	12	14	UD		27									2.13	Lean Clay (CL)
	9	14	15	UD		24								0.21	0.63	Silty Sand (SM)
B-31	1	0	0.5	R												Pavement: 6" concrete
	2	0.5	2	UD		15	112	38	15	23	79	0.55			1.25	Lean Clay w/Sand (CL)
	3	2	4	UD		21									1.00	Lean Clay w/Sand (CL)
	4	4	6	UD		21									1.25	Lean Clay w/Sand (CL)
	5	6	8	UD		21									1.38	Lean Clay w/Sand (CL)

SUMMARY OF TEST RESULTS	Project Name: Water Line Replacement in Antoine Forest Area															
	WBS Number: S-000035-0916-3															
Aviles Engineering Corporation	AEC Project Number: G167-14															
Boring No.	Sample				SPT (blows/ ft)	Water Content (%)	Dry Density (pcf)	Atterberg Limits			Percent Passing Sieve #200 (%)	Shear Strength (tsf)				Type of Material
	No.	Depth (ft)		Type				LL (%)	PL (%)	PI (%)		Unconfined Compression	UU (confining pressure, psi)	Torvane	Pocket Penetrometer	
		Top	Bottom													
	6	8	10	UD		25	102						0.97 (6)		1.25	Lean Clay (CL)
	7	10	12	UD		26		36	19	17	89				1.38	Lean Clay (CL)
	8	12	14	UD		28									1.63	Lean Clay (CL)
B-32	1	0	0.583	R												Pavement: 7" concrete
	2	0.583	2	UD		11		36	14	22	62				2.25	Sandy Lean Clay (CL)
	3	2	4	UD		13									2.13	Sandy Lean Clay (CL)
	4	4	6	UD		16	116					1.54			2.00	Sandy Lean Clay (CL)
	5	6	8	UD		15									2.00	Sandy Lean Clay (CL)
	6	8	10	UD		16	114						1.44 (6)		1.63	Sandy Lean Clay (CL)
	7	10	12	UD		30		58	22	36	78				1.50	Fat Clay w/Sand (CH)
	8	12	13	UD		28									1.75	Fat Clay w/Sand (CH)
B-33	1	0	2	UD		14		29	17	12	52				2.25	Fill: Sandy Lean Clay (CL)
	2	2	4	UD		17	114					0.47			1.13	Lean Clay w/ Sand (CL)
	3	4	6	UD		13									1.63	Lean Clay w/ Sand (CL)
	4	6	8	UD		21									1.88	Lean Clay w/ Sand (CL)
	5	8	10	UD		17		31	15	16	76				1.00	Lean Clay w/ Sand (CL)
	6	10	12	UD		17	115						2.36 (7)		2.25	Fat Clay (CH)
	7	12	14	UD		18									2.25	Fat Clay (CH)
B-34	1	0	0.5	R												Pavement: 6" asphalt
	2	0.5	2	AG		25		39	34	5	31				2.25	Base: 42" lime-stabilized silty clayey sand
	3	2	4	AG												Base to 3'/Lean Clay w/Sand (CL)
	4	4	6	UD		19	112						1.10 (5)		1.38	Lean Clay w/Sand (CL)
	5	6	8	UD		18		47	14	33	76				1.25	Lean Clay w/Sand (CL)
	6	8	10	UD		16									2.13	Fat Clay (CH)
	7	10	12	UD		20									1.75	Fat Clay (CH)
	8	12	14	UD		26	106						0.88 (7)		1.88	Fat Clay (CH)
	9	14	15	UD		21		71	29	42	98				2.13	Fat Clay (CH)
B-35	1	0	0.542	AG												Pavement: 6.5" asphalt
	2	0.542	0.792	AG												Base: 3" clayey sand
	3	0.792	2	UD		14		16	15	1	69				2.25	Sandy Silt (SM)
	4	2	4	UD		23	101					0.43			0.50	Lean Clay w/Sand (CL)
	5	4	6	UD		21									1.00	Lean Clay w/Sand (CL)
	6	6	8	UD		17		45	14	31	74				1.38	Lean Clay w/Sand (CL)
	7	8	10	UD		17	117						1.12 (6)		1.63	Lean Clay w/Sand (CL)
	8	10	12	UD		17									1.75	Lean Clay w/Sand (CL)
	9	12	14	UD		16		32	15	17	48				1.50	Clayey Sand (SC)
	10	14	16	UD		19	112						2.33 (11)		2.25	Fat Clay (CH)
	11	16	18	UD		22									1.75	Fat Clay (CH)
B-36	1	0	0.5	AG												Pavement: 6" asphalt

SUMMARY OF TEST RESULTS	Project Name: Water Line Replacement in Antoine Forest Area															
	WBS Number: S-000035-0916-3															
Aviles Engineering Corporation	AEC Project Number: G167-14															
Boring No.	Sample				SPT (blows/ ft)	Water Content (%)	Dry Density (pcf)	Atterberg Limits			Percent Passing Sieve #200 (%)	Shear Strength (tsf)				Type of Material
	No.	Depth (ft)		Type				LL (%)	PL (%)	PI (%)		Unconfined Compression	UU (confining pressure, psi)	Torvane	Pocket Penetrometer	
		Top	Bottom													
	2	0.5	0.75	AG												Base: 3" silty sand with small gravel
	3	0.75	2	AG		11		18	17	1	64					Sandy Silt (ML)
	4	2	4	UD		16									1.38	Lean Clay w/Sand (CL)
	5	4	6	UD		13									2.13	Lean Clay w/Sand (CL)
	6	6	8	UD		15	119	34	14	20	77		1.41 (3)		1.50	Lean Clay w/Sand (CL)
	7	8	10	UD		19									1.75	Lean Clay w/Sand (CL)
	8	10	12	UD		17									1.75	Fat Clay (CH)
	9	12	14	UD		15	115						2.09 (9)		2.25	Fat Clay (CH)
	10	14	15	UD		20		60	22	38					2.25	Fat Clay (CH)
B-37	1	0	0.667	AG												Pavement: 8" asphalt
	2	0.667	0.917	AG												Base: 3" sand and gravel
	3	0.917	2	UD		25		29	15	14	72				0.38	Lean Clay w/Sand (CL)
	4	2	4	UD		20	106					0.36			0.63	Lean Clay w/Sand (CL)
	5	4	6	UD		21									0.50	Lean Clay w/Sand (CL)
	6	6	8	UD		21		45	14	31	80				1.38	Lean Clay w/Sand (CL)
	7	8	10	UD		15									2.13	Lean Clay w/Sand (CL)
	8	10	12	UD		18	113						2.21 (7)		2.00	Fat Clay (CH)
	9	12	14	UD		23									1.75	Fat Clay (CH)
	10	14	15	UD		33		66	25	41	95				1.13	Fat Clay (CH)
B-38	1	0	0.5	AG												Pavement: 6" asphalt
	2	0.5	0.833	AG												Base: 4" sand and gravel
	3	0.833	2	UD		16		25	16	9	73				1.00	Lean Clay w/ Sand (CL)
	4	2	4	UD		17	114					0.67			1.13	Lean Clay w/ Sand (CL)
	5	4	6	UD		16									1.50	Lean Clay w/ Sand (CL)
	6	6	8	UD		16									2.13	Lean Clay w/ Sand (CL)
	7	8	10	UD		17		47	13	34	80				1.75	Lean Clay w/ Sand (CL)
	8	10	12	UD		21	113						1.69 (7)		1.88	Lean Clay w/ Sand (CL)
	9	12	14	UD		20									2.13	Lean Clay w/ Sand (CL)
	10	14	15	UD		21									2.13	Lean Clay w/ Sand (CL)
B-39	1	0	0.667	AG												Pavement: 8" asphalt
	2	0.667	1.083	AG												Base: 5" stabilized sand and gravel
	3	1.083	2	UD		9	116	25	15	13	64	1.39			2.25	Fill: Sandy Lean Clay (CL)
	4	2	4	UD		11									2.25	Lean Clay w/Sand (CL)
	5	4	6	UD		11									2.25	Lean Clay w/Sand (CL)
	6	6	8	UD		12	120						2.19 (5)		2.25	Lean Clay w/Sand (CL)
	7	8	10	UD		13		46	14	32	77				2.13	Lean Clay w/Sand (CL)
	8	10	12	UD		14									2.25	Lean Clay w/Sand (CL)
	9	12	14	UD		16	116						1.75 (9)		2.25	Lean Clay (CL)
	10	14	15	UD		16		42	16	26	88				2.25	Lean Clay (CL)

PLATE A-77

SUMMARY OF TEST RESULTS	Project Name: Water Line Replacement in Antoine Forest Area															
	WBS Number: S-000035-0916-3															
Aviles Engineering Corporation	AEC Project Number: G167-14															
Boring No.	Sample				SPT (blows/ ft)	Water Content (%)	Dry Density (pcf)	Atterberg Limits			Percent Passing Sieve #200 (%)	Shear Strength (tsf)				Type of Material
	No.	Depth (ft)		Type				LL (%)	PL (%)	PI (%)		Unconfined Compression	UU (confining pressure, psi)	Torvane	Pocket Penetrometer	
		Top	Bottom													
B-40	1	0	0.333	AG												Pavement: 4" asphalt
	2	0.333	0.917	AG												Base: 7" sand and crushed shell
	3	0.917	2	UD		11	113	29	15	14	69	1.13			2.00	Sandy Lean Clay (CL)
	4	2	4	UD		12									2.25	Sandy Lean Clay (CL)
	5	4	6	UD		13									2.25	Sandy Lean Clay (CL)
	6	6	8	UD		14									1.75	Sandy Lean Clay (CL)
	7	8	10	UD		18	110	38	13	25	76		0.77 (6)		0.88	Lean Clay w/Sand (CL)
	8	10	12	UD		15									2.25	Lean Clay w/Sand (CL)
	9	12	14	UD		17									2.25	Lean Clay w/Sand (CL)
B-41	1	0	0.417	AG												Pavement: 5" asphalt
	2	0.417	0.667	AG												Base: 3" sand, shell, and gravel
	3	0.667	2	UD		12		32	14	18	77				1.75	Lean Clay w/Sand (CL)
	4	2	4	UD		16									1.50	Lean Clay w/Sand (CL)
	5	4	6	UD		15	114						0.36 (3)		1.50	Lean Clay w/Sand (CL)
	6	6	8	UD		14									1.88	Lean Clay w/Sand (CL)
	7	8	10	UD		17									1.88	Lean Clay w/Sand (CL)
	8	10	12	UD		19	112	42	14	28	78		1.38 (7)		1.75	Lean Clay w/Sand (CL)
	9	12	14	UD		19									2.25	Lean Clay w/Sand (CL)
B-42	1	0	0.5	AG												Pavement: 6" asphalt
	2	0.5	0.667	AG												Base: 2" sand and shell
	3	0.667	2	UD		10										Silty Sand (SM)
	4	2	4	UD		14		28	14	14					1.63	Sandy Lean Clay (CL)
	5	4	6	UD		15									1.38	Sandy Lean Clay (CL)
	6	6	8	UD		17	109					1.16			1.38	Sandy Lean Clay (CL)
	7	8	13	UD		16		44	13	21					1.25	Sandy Lean Clay (CL)
	8	13	18	UD		20									1.88	Sandy Lean Clay (CL)
	9	18	20	UD		23	99	32	16	16	80	0.32			0.38	Lean Clay w/Sand (CL)
	10	20	22	UD		26									0.50	Lean Clay w/Sand (CL)
B-43	1	0	0.5	AG												Pavement: 6" asphalt
	2	0.5	0.667	AG												Base: 2" sand and gravel
	3	0.667	2	UD		12	117	25	19	6	66	0.91			1.50	Sandy Silty Clay (CL-ML)
	4	2	4	UD		14									2.13	Sandy Silty Clay (CL-ML)
	5	4	6	UD		14									2.13	Sandy Silty Clay (CL-ML)
	6	6	8	UD		11	123						0.88 (5)		1.75	Lean Clay w/Sand (CL)
	7	8	10	UD		15		46	14	32	83				1.75	Lean Clay w/Sand (CL)
	8	10	12	UD		16									2.13	Lean Clay w/Sand (CL)
	9	12	14	UD		18									2.25	Lean Clay (CL)
	10	14	16	UD		20	110	48	17	31	87		2.08 (10)		2.25	Lean Clay (CL)
	11	16	18	UD		17									2.25	Lean Clay (CL)

PLATE A-78

SUMMARY OF TEST RESULTS	Project Name: Water Line Replacement in Antoine Forest Area															
	WBS Number: S-000035-0916-3															
Aviles Engineering Corporation	AEC Project Number: G167-14															
Boring No.	Sample				SPT (blows/ ft)	Water Content (%)	Dry Density (pcf)	Atterberg Limits			Percent Passing Sieve #200 (%)	Shear Strength (tsf)				Type of Material
	No.	Depth (ft)		Type				LL (%)	PL (%)	PI (%)		Unconfined Compression	UU (confining pressure, psi)	Torvane	Pocket Penetrometer	
		Top	Bottom													
B-44	1	0	0.417	AG												Pavement: 5" asphalt
	2	0.417	0.583	AG												Base: 2" sand and gravel
	3	0.583	2	UD		13	112	23	17	6	68	0.77			1.75	Sandy Silt Clay (CL-ML)
	4	2	4	UD		14									1.75	Sandy Silt Clay (CL-ML)
	5	4	6	UD		13									1.50	Sandy Silt Clay (CL-ML)
	6	6	8	UD		16	117						0.92 (5)		0.75	Lean Clay w/Sand (CL)
	7	8	10	UD		16		45	14	31	81				1.50	Lean Clay w/Sand (CL)
	8	10	12	UD		19									1.25	Lean Clay w/Sand (CL)
	9	12	14	UD		20									1.75	Lean Clay w/Sand (CL)
B-45	1	0	0.417	AG												Pavement: 5" asphalt
	2	0.417	0.833	AG												Base: 5" sand and shell
	3	0.833	2	UD		11		22	17	5	67				2.25	Sandy Silty Clay (CL-ML)
	4	2	4	UD		16	111					0.48			1.75	Sandy Silty Clay (CL-ML)
	5	4	6	UD		16									1.50	Sandy Silty Clay (CL-ML)
	6	6	8	UD		16									1.50	Sandy Silty Clay (CL-ML)
	7	8	10	UD		21	109	37	13	24	67		0.66 (6)		0.75	Sandy Lean Clay (CL)
	8	10	12	UD		18									1.38	Sandy Lean Clay (CL)
	9	12	14	UD		14									2.25	Lean Clay w/Sand (CL)
	10	14	16	UD		20	111						0.93 (10)		1.13	Lean Clay w/Sand (CL)
	11	16	18	UD		23		42	18	24	81				2.00	Lean Clay w/Sand (CL)
B-46	1	0	0.542	AG												Pavement: 6.5" asphalt
	2	0.542	1.25	AG												Base: 8.5" sand and shell
	3	1.25	2	UD												Sandy Silty Clay (CL-ML)
	4	2	4	UD		11		22	15	7					0.63	Sandy Silty Clay (CL-ML)
	5	4	6	UD		16									1.50	Sandy Lean Clay (CL)
	6	6	8	UD		14									2.25	Sandy Lean Clay (CL)
	7	8	10	UD		16	111	26	13	13	35	0.29			1.38	Clayey Sand (SC)
	8	13	15	UD		20					94				2.00	Lean Clay (CL)
	9	18	20	UD		23	106	53	20	33		0.78			2.25	Fat Clay (CH)
	10	20	21	UD		22									2.13	Fat Clay (CH)
B-47	1	0	0.417	AG												Pavement: 5" asphalt
	2	0.417	0.625	AG												Base: 2.5" sand and gravel
	3	0.625	2	UD		13		28	15	13	71				2.25	Lean Clay w/Sand (CL)
	4	2	4	UD		17	114					0.62			1.13	Lean Clay w/Sand (CL)
	5	4	6	UD		16									1.50	Lean Clay w/Sand (CL)
	6	6	8	UD		15									1.50	Lean Clay w/Sand (CL)
	7	8	10	UD		17	114						1.36 (6)		1.63	Lean Clay w/Sand (CL)
	8	10	12	UD		20		39	13	26	78				1.00	Lean Clay w/Sand (CL)
	9	12	14	UD		21									1.88	Lean Clay w/Sand (CL)

PLATE A-79

SUMMARY OF TEST RESULTS	Project Name: Water Line Replacement in Antoine Forest Area															
	WBS Number: S-000035-0916-3															
Aviles Engineering Corporation	AEC Project Number: G167-14															
Boring No.	Sample				SPT (blows/ ft)	Water Content (%)	Dry Density (pcf)	Atterberg Limits			Percent Passing Sieve #200 (%)	Shear Strength (tsf)				Type of Material
	No.	Depth (ft)		Type				LL (%)	PL (%)	PI (%)		Unconfined Compression	UU (confining pressure, psi)	Torvane	Pocket Penetrometer	
		Top	Bottom													
B-48	1	0	0.667	AG												Pavement: 8" asphalt
	2	0.667	1.167	AG												Base: 6" sand and gravel
	3	1.167	2	UD		20		29	16	13	74				0.75	Fill: Lean Clay w/Sand (CL)
	4	2	4	UD		21	105					0.62			0.75	Lean Clay w/Sand (CL)
	5	4	6	UD		20									0.75	Lean Clay w/Sand (CL)
	6	6	8	UD		23									1.00	Lean Clay w/Sand (CL)
	7	8	10	UD		17	114	46	14	32	80		1.49 (6)		1.13	Lean Clay w/Sand (CL)
	8	10	12	UD		16									1.13	Lean Clay w/Sand (CL)
	9	12	14	UD		17									1.75	Lean Clay (CL)
	10	14	16	UD		20	108						1.81 (10)		2.13	Lean Clay (CL)
	11	16	18	UD		21		49	19	30	96				1.50	Lean Clay (CL)
B-49	1	0	0.5	AG												Pavement: 6" asphalt
	2	0.5	0.833	AG												Base: 4" sand and gravel
	3	0.833	2	UD		14		25	17	8	69				1.75	Sandy Lean Clay (CL)
	4	2	4	UD		13	116					0.77			1.25	Sandy Lean Clay (CL)
	5	4	6	UD		13									2.13	Sandy Lean Clay (CL)
	6	6	8	UD		15									1.63	Lean Clay w/Sand (CL)
	7	8	10	UD		15		42	13	29	79				2.25	Lean Clay w/Sand (CL)
	8	10	12	UD		16	117						1.62 (7)		1.63	Lean Clay w/Sand (CL)
	9	12	14	UD		16									2.13	Lean Clay w/Sand (CL)
B-50	1	0	0.5	AG												Pavement: 6" asphalt
	2	0.5	0.75	AG												Base: 3" sand and gravel
	3	0.75	2	UD		15		29	14	15	66				1.38	Sandy Lean Clay (CL)
	4	2	4	UD		14	117					0.78			1.63	Sandy Lean Clay (CL)
	5	4	6	UD		14									1.88	Sandy Lean Clay (CL)
	6	6	8	UD		15									1.50	Lean Clay w/Sand (CL)
	7	8	10	UD		15	118	41	13	28	78		1.68 (6)		2.00	Lean Clay w/Sand (CL)
	8	10	12	UD		15									2.25	Lean Clay w/Sand (CL)
	9	12	14	UD		17									2.25	Lean Clay (CL)
	10	14	16	UD		19		47	17	30	92				2.25	Lean Clay (CL)
	11	16	18	UD		23	106						1.68 (11)		2.25	Lean Clay (CL)
B-51	1	0	0.5	AG												Pavement: 6" asphalt
	2	0.5	1	AG												Base: 6" sand and gravel
	3	1	2	UD		12		18	16	2	51				2.25	Sandy Silt (ML)
	4	2	4	UD		13	117					0.48			1.13	Sandy Silt (ML)
	5	4	6	UD		14									1.38	Sandy Lean Clay (CL)
	6	6	8	UD		15	117						0.54 (5)		0.63	Sandy Lean Clay (CL)
	7	8	10	UD		15									2.25	Sandy Lean Clay (CL)
	8	10	12	UD		16	113	28	21	7	19		0.53 (7)		1.13	Silty Clayey Sand (SC-SM)

PLATE A-80

SUMMARY OF TEST RESULTS	Project Name: Water Line Replacement in Antoine Forest Area															
	WBS Number: S-000035-0916-3															
Aviles Engineering Corporation	AEC Project Number: G167-14															
Boring No.	Sample				SPT (blows/ ft)	Water Content (%)	Dry Density (pcf)	Atterberg Limits			Percent Passing Sieve #200 (%)	Shear Strength (tsf)				Type of Material
	No.	Depth (ft)		Type				LL (%)	PL (%)	PI (%)		Unconfined Compression	UU (confining pressure, psi)	Torvane	Pocket Penetrometer	
		Top	Bottom													
	9	12	14	UD		14									2.00	Silty Clayey Sand (SC-SM)
B-52	1	0	0.458	AG												Pavement: 5.5" asphalt
	2	0.458	0.792	AG												Base: 4" sand and gravel
	3	0.792	2	UD		9	119	23	18	5	68	1.26			1.00	Sandy Silty Clay (CL-ML)
	4	2	4	UD		15									2.25	Lean Clay w/Sand (CL)
	5	4	6	UD		13									2.25	Lean Clay w/Sand (CL)
	6	6	8	UD		14									2.25	Lean Clay w/Sand (CL)
	7	8	10	UD		14									2.25	Lean Clay w/Sand (CL)
	8	10	12	UD		17	111	45	15	30	80		1.43 (7)		2.25	Lean Clay w/Sand (CL)
	9	12	14	UD		21									1.75	Lean Clay w/Sand (CL)
	10	14	15	UD		25									0.88	Lean Clay w/Sand (CL)
B-53	1	0	0.583	AG												Pavement: 7" asphalt
	2	0.583	0.917	AG												Base: 4" sand and gravel
	3	0.917	2	UD		15		23	15	8	65				1.00	Fill: Sandy Lean Clay (CL)
	4	2	4	UD		17	110					0.90			1.00	Lean Clay w/Sand (CL)
	5	4	6	UD		16									1.25	Lean Clay w/Sand (CL)
	6	6	8	UD		18									1.63	Lean Clay w/Sand (CL)
	7	8	10	UD		17	116	45	15	30	82		2.30 (6)		1.75	Lean Clay w/Sand (CL)
	8	10	12	UD		20									2.25	Fat Clay (CH)
	9	12	14	UD		23									1.63	Fat Clay (CH)
	10	14	16	UD		23		55	21	34	88				1.88	Fat Clay (CH)
	11	16	18	UD		23	104						1.42 (11)		2.25	Fat Clay (CH)
B-54	1	0	0.5	AG												Pavement: 6" asphalt
	2	0.5	0.75	AG												Base: 3" shell, sand, and gravel
	3	0.75	2	UD		14	111	22	17	5	69	0.57			1.25	Sandy Silty Clay (CL-ML)
	4	2	4	UD		19									1.25	Sandy Silty Clay (CL-ML)
	5	4	6	UD		17									1.75	Lean Clay w/Sand (CL)
	6	6	8	UD		18	111	34	13	21	76		0.84 (5)		1.25	Lean Clay w/Sand (CL)
	7	8	10	UD		15									1.75	Lean Clay w/Sand (CL)
	8	10	12	UD		15									2.13	Fat Clay (CH)
	9	12	14	UD		19									2.25	Fat Clay (CH)
	10	14	16	UD		18		50	18	32	89				2.25	Fat Clay (CH)
	11	16	18	UD		20	111						2.11 (11)		2.00	Fat Clay (CH)
B-55	1	0	0.5	AG												Pavement: 6" asphalt
	2	0.5	0.75	AG												Base: 3" sand and shell
	3	0.75	2	UD		13		19	16	3	67				1.50	Sandy Silt (ML)
	4	2	4	UD		16									1.00	Sandy Silt (ML)
	5	4	6	UD		16	112					0.77			1.13	Sandy Silt (ML)
	6	6	8	UD		16									1.75	Lean Clay w/Sand (CL)

PLATE A-81

SUMMARY OF TEST RESULTS	Project Name: Water Line Replacement in Antoine Forest Area															
	WBS Number: S-000035-0916-3															
Aviles Engineering Corporation	AEC Project Number: G167-14															
Boring No.	Sample				SPT (blows/ ft)	Water Content (%)	Dry Density (pcf)	Atterberg Limits			Percent Passing Sieve #200 (%)	Shear Strength (tsf)				Type of Material
	No.	Depth (ft)		Type				LL (%)	PL (%)	PI (%)		Unconfined Compression	UU (confining pressure, psi)	Torvane	Pocket Penetrometer	
		Top	Bottom													
	7	8	10	UD		17		46	14	32	76				1.50	Lean Clay w/Sand (CL)
	8	10	12	UD		16	115						1.41 (7)		1.75	Lean Clay w/Sand (CL)
	9	12	14	UD		20									2.00	Lean Clay w/Sand (CL)
B-56	1	0	0.5	AG												Pavement: 6" asphalt
	2	0.5	1.25	AG												Base: 9" sand and shell
	3	1.25	2	UD		16	111	NP	NP	NP	50	1.32			1.75	Sandy Silt (ML)
	4	2	4	UD		18									0.75	Sandy Silt (ML)
	5	4	6	UD		17									1.00	Sandy Lean Clay (CL)
	6	6	8	UD		16		36	13	23	56				2.25	Sandy Lean Clay (CL)
	7	8	10	UD		14	121						1.94 (6)		2.25	Sandy Lean Clay (CL)
	8	10	12	UD		15									1.75	Sandy Lean Clay (CL)
	9	12	14	UD		19	109				8		0.19 (9)		0.50	Poorly Graded Sand w/Silt (SP-SM)
	10	14	16	UD		17		33	13	20	26				0.50	Clayey Sand (SC)
	11	16	18	UD		23									1.75	Lean Clay (CL)
B-57	1	0	0.458	AG												Pavement: 5.5" asphalt
	2	0.458	1	AG												Base: 6.5" sand and shell
	3	1	2	AG		7					37					Silty Sand (SM)
	4	2	4	UD		7	122	25	15	9		2.25			2.25	Sandy Lean Clay (CL)
	5	4	6	UD		7									2.25	Sandy Lean Clay (CL)
	6	6	8	UD		8									2.25	Sandy Lean Clay (CL)
	7	8	10	UD		11									2.13	Clayey Sand (SC)
	8	10	12	UD		12		31	18	13	29				2.25	Clayey Sand (SC)
	9	12	14	UD		14	122						2.35 (9)		2.25	Fat Clay (CH)
	10	14	15	UD		14									2.25	Fat Clay (CH)
B-58	1	0	0.542	R												Pavement: 6.5" concrete
	2	0.542	2	UD											2.00	Fill: Sandy Lean Clay (CL)
	3	2	3.5	UD											1.50	Fill: Sandy Lean Clay (CL)
B-59	1	0	0.667	R												Pavement: 8" concrete
	2	0.667	0.75	R												Base: 1" sand
	3	0.75	2	UD		16	114					1.71			2.13	Fill: Lean Clay w/Sand (CL)
	4	2	4	UD		13		36	15	21	72				2.25	Fill: Lean Clay w/Sand (CL)
	5	4	6	UD		13									2.25	Silty Clay (CL-ML)
	6	6	8	UD		18									2.13	Silty Clay (CL-ML)
	7	8	10	UD		18	108						0.40 (6)		1.88	Silty Clay (CL-ML)
	8	10	12	UD		21		27	22	5	87				0.75	Silty Clay (CL-ML)
	9	12	14	UD		17									2.13	Fat Clay (CH)
	10	14	15	UD		23									2.13	Fat Clay (CH)
B-60	1	0	0.542	R												Pavement: 6.5" concrete
	2	0.542	0.833	R												Base: 3.5" sand

PLATE A-82

SUMMARY OF TEST RESULTS	Project Name: Water Line Replacement in Antoine Forest Area														
	WBS Number: S-000035-0916-3														
Aviles Engineering Corporation	AEC Project Number: G167-14														
Boring No.	Sample				SPT (blows/ ft)	Water Content (%)	Dry Density (pcf)	Atterberg Limits			Percent Passing Sieve #200 (%)	Shear Strength (tsf)				Type of Material
	No.	Depth (ft)		Type				LL (%)	PL (%)	PI (%)		Unconfined Compression	UU (confining pressure, psi)	Torvane	Pocket Penetrometer	
		Top	Bottom													
	3	0.833	2	UD		17	112	46	18	28	77	1.42			1.38	Lean Clay w/Sand (CL)
	4	2	4	UD		16									1.50	Lean Clay w/Sand (CL)
	5	4	6	UD		18									1.25	Lean Clay w/Sand (CL)
	6	6	8	UD		17									1.38	Lean Clay w/Sand (CL)
	7	8	10	UD		23	104						0.75 (6)		0.88	Lean Clay (CL)
	8	10	12	UD		23		40	18	22	92				0.75	Lean Clay (CL)
	9	12	14	UD		22									1.13	Lean Clay (CL)
	10	14	16	UD		21	109						0.59 (10)		0.88	Silt w/Sand (ML)
	11	16	18	UD		22		NP	NP	NP	75				1.25	Silt w/Sand (ML)
	12	18	20	UD		23									1.13	Silt w/Sand (ML)
B-61	1	0	0.333	AG												Pavement: 4" asphalt
	2	0.333	0.75	AG												Base: 5" sand and shell
	3	0.75	2	UD		7					49					Silty Sand (SM)
	4	2	4	UD		7	125					1.57			2.25	Lean Clay (CL)
	5	4	6	UD		7									2.25	Lean Clay (CL)
	6	6	8	UD		13		27	13	14	41				1.38	Clayey Sand (SC)
	7	8	10	UD		16	113						0.34 (6)		1.00	Clayey Sand (SC)
	8	10	12	SS	12	16					20					Silty Sand (SM)
B-62	1	0	0.667	AG												Pavement: 8" asphalt
	2	0.667	1	AG												Base: 4" sand and shell
	3	1	2	AG		10					39					Silty Sand (SM)
	4	2	4	UD		14		26	14	12					1.50	Lean Clay (CL)
	5	4	6	UD		13	120						1.20 (3)		1.75	Lean Clay (CL)
	6	6	8	UD		12									2.25	Lean Clay (CL)
	7	8	10	UD		17		27	15	12	42				1.13	Clayey Sand (SC)
	8	10	12.5	UD		17	114						0.24 (6)		0.50	Clayey Sand (SC)
	9	12.5	14	SS	24	20										Clayey Sand (SC)
	10	14	15.5	SS	8	21					22					Clayey Sand (SC)

Legend			
	UD = UnDisturbed sample, extruded in field	LL = Liquid Limit	Notes: Borings B-42 and B-46 are previous borings in AEC Report G195-09.
	SS = Split Spoon sample	PL = Plastic Limit	
	AG = Auger Cuttings	PI = Plasticity Index	
	R = Concrete Coring	UU = Triaxial Compression	
	SPT = Standard Penetration Test		

AVLES
ENGINEERING CORP.

APPENDIX B

Plates B-1 to B-6 Generalized Soil Profiles

GENERALIZED SUBSURFACE SOIL PROFILE

ALONG WINDING WAY

WEST

EAST

BASELINE STATIONS

2+00 4+00 6+00 8+00 10+00 12+00 14+00 16+00 18+00 20+00 22+00 24+00 26+00 28+00 30+00

ELEVATION IN FEET

80 76 72 68 64 60 56 52 48 44

B-2

Pavement: 6" concrete

Stiff to very stiff, gray Fat Clay w/ Sand (CH), with silt and sand pockets

Hard, tan and gray Sandy Lean Clay (CL), with silt partings

Very stiff to hard, light gray and tan Fat Clay (CH), with slickensides and ferrous nodules

Termination depth = 14 feet.

B-3

Pavement: 5.5" concrete

Hard, gray and tan Lean Clay w/ Sand (CL), with ferrous nodules
-with roots 0'-2'

Very stiff to hard, gray and tan Fat Clay (CH), with slickensides and ferrous nodules
-with calcareous nodules 4'-10'

-gray, red, and tan, with silty sand seams 8'-10'

Gray and red Silt (ML), with fat clay seams and large calcareous pockets

Termination depth = 12 feet

B-4

Pavement: 6" concrete

Very stiff, gray and tan Lean Clay w/Sand (CL), with abundant silt seams and pockets
-with ferrous nodules 0'-2'

Very stiff to hard, light gray and tan Fat Clay (CH), with slickensides and ferrous nodules

-red, brown, and light gray 10'-12'

Termination depth = 12 feet.

B-5

Pavement: 5.5" concrete

Firm to hard, light gray and tan Sandy Lean Clay (CL), with silt partings
-with siltstone fragments 0'-2'
-with ferrous nodules 2'-4'

-with ferrous nodules 6'-8'

-with abundant silt seams 8'-12'

Light gray Silty Sand (SM)

Termination depth = 13 feet.

B-6

Pavement: 5" concrete

Very stiff to hard, light gray and tan Sandy Lean Clay (CL), with ferrous nodules
-with calcareous nodules 0'-2'

Dense, light gray Silty Sand (SM), with ferrous nodules and clay pockets

-tan and light gray 10'-12'

Reddish brown and light gray Fat Clay (CH)
-with large calcareous rocks 12'-16'

-reddish brown, with lean clay pockets and silt partings

Termination Depth = 17 feet.

B-20

Pavement: 5.5" concrete

Base: 2" sand

Very stiff to hard, dark gray Sandy Lean Clay (CL), with silt partings and ferrous nodules
-tan and gray 2'-8'

Very stiff to hard, red, brown, and light gray Lean Clay w/Sand (CL), with slickensides and fat clay seams
-with silt pockets and ferrous nodules 8'-10'
-with calcareous nodules and siltstone fragments 10'-13'

Termination depth = 13 feet.

LEGEND:

- Paving
- Fill
- Low plasticity clay
- Clayey sand
- Poorly graded silty clayey sand
- High plasticity clay
- Silty low plasticity clay
- Silt
- Silty sand
- Poorly graded sand with silt
- Depth of water during drilling
- Depth of water after completion of drilling

NOTE:

1. *SOIL STRATIGRAPHY AND SECONDARY SOIL STRUCTURE (SUCH AS SEAMS, LAYERS, OR POCKETS OF SANDS, SILTS, SLICKENSIDES, AND FISSURES) THAT ARE DIFFERENT FROM WHAT WERE IDENTIFIED IN THE ACTUAL BORINGS MAY EXIST AWAY FROM THESE BORINGS.*

AVILES ENGINEERING CORPORATION

GENERALIZED SOIL PROFILE

WATER LINE REPLACEMENT IN ANTOINE FOREST AREA

WBS NO. S-000035-0196-4

HOUSTON, TEXAS

AEC PROJECT NO.:	DATE:	SOURCE DRAWING PROVIDED BY:
G167-14	01-29-15	AVILES ENGINEERING CORP.
VERTICAL SCALE: 1" = 4' HORIZONTAL SCALE: 1" = 200'	DRAFTED BY: BpJ	PLATE NO.: PLATE B-1

GENERALIZED SUBSURFACE SOIL PROFILE

ALONG HOLLY VIEW

WEST

EAST

BASELINE STATIONS

2+00 4+00 6+00 8+00 10+00 12+00 14+00 16+00 18+00 20+00

MATCH LINE STA. 20+00

ELEVATION IN FEET

80 76 72 68 64 60 56 52 48 44

B-11

Pavement: 7.5 concrete

Very stiff to hard, dark gray Lean Clay w/Sand (CL)
-with silt partings 0'-2' and ferrous nodules 0'-6'

-light gray and tan 4'-8'

-with silt pockets and fat clay seams 6'-8'

Stiff to hard, red, brown, and light gray Fat Clay (CH), with slickensides
-with silt pockets and seams 8'-10'
-with siltstone fragments, calcareous and ferrous nodules 10'-12'

Termination depth = 12 feet.

B-12

Pavement: 7.75" concrete

Very stiff to hard, dark gray Sandy Fat Clay (CH), with silt partings
-tan and light gray, with ferrous nodules 2'-8'

-with silt seams 4'-6'

Medium dense, light gray Silty Clayey Sand (SC-SM)

Termination depth = 14 feet.

B-14

Pavement: 7" concrete

Hard, gray and tan Sandy Lean Clay (CL), with silt seams
-with vertical silt seams 0'-4'

-light gray and tan, with ferrous nodules 4'-12'

-with silt partings 8'-12'

Medium dense, light gray Silty Sand (SM)

-wet and boring cave in at 14' after drilling was completed

Termination depth = 17 feet.

B-15

Pavement: 5.5" concrete

Stiff to hard, gray and tan Lean Clay w/Sand (CL), with silt partings and siltstone fragments
-with ferrous nodules 0'-2'
-with calcareous nodules 2'-4'

Very stiff to hard, red, brown, light gray Fat Clay (CH), with slickensides
-with silt pockets 12'-14'
-with silt seams, siltstone fragments, and calcareous nodules 14'-16'

Termination depth = 18 feet.

LEGEND:

- Paving
- Fill
- Low plasticity clay
- Clayey sand
- Poorly graded silty clayey sand
- High plasticity clay
- Silty low plasticity clay
- Silt
- Silty sand
- Poorly graded sand with silt
- Depth of water during drilling
- Depth of water after completion of drilling

NOTE:

1. *SOIL STRATIGRAPHY AND SECONDARY SOIL STRUCTURE (SUCH AS SEAMS, LAYERS, OR POCKETS OF SANDS, SILTS, SLICKENSIDES, AND FISSURES) THAT ARE DIFFERENT FROM WHAT WERE IDENTIFIED IN THE ACTUAL BORINGS MAY EXIST AWAY FROM THESE BORINGS.*

AVILES ENGINEERING CORPORATION

GENERALIZED SOIL PROFILE

WATER LINE REPLACEMENT IN ANTOINE FOREST AREA
WBS NO. S-000035-0196-4
HOUSTON, TEXAS

AEC PROJECT NO.:	DATE:	SOURCE DRAWING PROVIDED BY:
G167-14	01-29-15	AVILES ENGINEERING CORP.
VERTICAL SCALE: 1" = 4' / HORIZONTAL SCALE: 1" = 200'	DRAFTED BY: BpJ	PLATE NO.: PLATE B-2a

GENERALIZED SUBSURFACE SOIL PROFILE

CONTINUED ALONG HOLLY VIEW

WEST

EAST

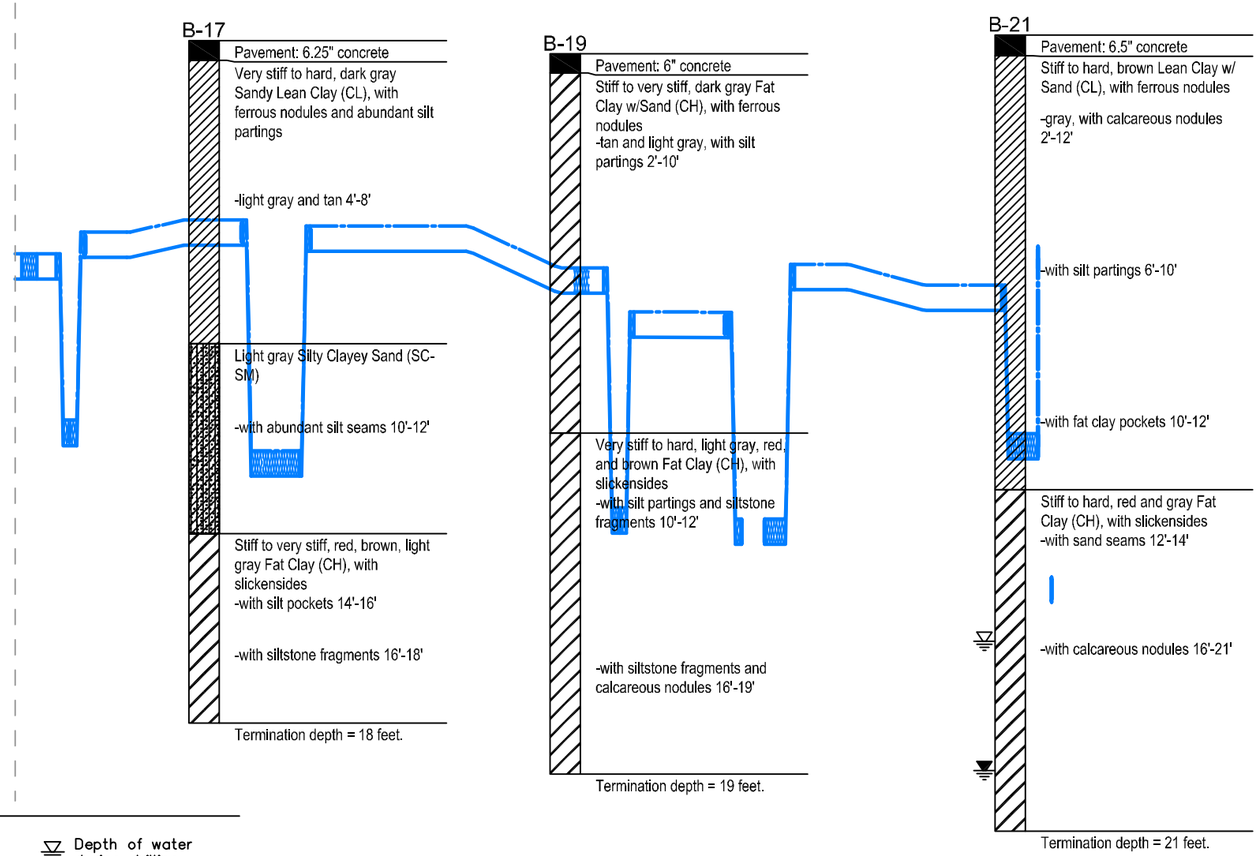
BASELINE STATIONS

20+00 22+00 24+00 26+00 28+00 30+00 32+00 34+00 36+00

MATCH LINE STA. 20+00

ELEVATION IN FEET

80 76 72 68 64 60 56 52 48 44



LEGEND:

- Paving
- Fill
- Low plasticity clay
- Clayey sand
- Poorly graded silty clayey sand
- High plasticity clay
- Silty low plasticity clay
- Silt
- Silty sand
- Poorly graded sand with silt
- Depth of water during drilling
- Depth of water after completion of drilling

NOTE:

1. *SOIL STRATIGRAPHY AND SECONDARY SOIL STRUCTURE (SUCH AS SEAMS, LAYERS, OR POCKETS OF SANDS, SILTS, SLICKENSIDES, AND FISSURES) THAT ARE DIFFERENT FROM WHAT WERE IDENTIFIED IN THE ACTUAL BORINGS MAY EXIST AWAY FROM THESE BORINGS.*

AVILES ENGINEERING CORPORATION

GENERALIZED SOIL PROFILE

WATER LINE REPLACEMENT IN ANTOINE FOREST AREA

WBS NO. S-000035-0196-4

HOUSTON, TEXAS

AEC PROJECT NO.:	DATE:	SOURCE DRAWING PROVIDED BY:
G167-14	01-29-15	AVILES ENGINEERING CORP.
VERTICAL SCALE: 1" = 4' HORIZONTAL SCALE: 1" = 200'	DRAFTED BY: BpJ	PLATE NO.: PLATE B-2b

GENERALIZED SUBSURFACE SOIL PROFILE

ALONG DE SOTO

WEST

EAST

BASELINE STATIONS

2+00 4+00 6+00 8+00 10+00 12+00 14+00 16+00 18+00 20+00 22+00 24+00 26+00 28+00

ELEVATION IN FEET

80 76 72 68 64 60 56 52 48 44

B-26

Pavement: 7.5" concrete

Very stiff to hard, gray and tan Fat Clay w/ Sand (CH)
-with silty sand pockets
-gray and red 2'-6'

-with silt partings and ferrous stains 4'-6'

Stiff to hard, gray and red Lean Clay w/Sand (CL)
-with ferrous nodules

-with silty sand pockets 8'-12'

-with fat clay pockets, calcareous nodules, and gasoline odor 14'-15'

Termination depth = 15 feet.

B-27

Pavement: 7" concrete

Hard, brown and gray Fat Clay w/Sand (CH)

-gray and tan 2'-6'

-with ferrous nodules 4'-6'

Very stiff to hard, red, tan, and gray Fat Clay (CH), with slickensides
-with ferrous nodules and silty sand 6'-8'
-red and light gray 8'-15', with calcareous nodules 8'-10'

-with calcareous nodules 12'-15'

Termination depth = 15 feet.

B-28

Pavement: 7" concrete

Very stiff to hard, gray Lean Clay w/Sand (CL), with ferrous nodules and silt partings
-with silt seams 0'-2'

-with sand seams 4'-6'

-with vertical silty clay seams 6'-8'

Stiff to hard, red, brown, and light gray Fat Clay (CH), with slickensides
-with silt pockets 8'-12'
-with siltstone fragments 10'-12'

-with ferrous nodules 12'-13'

Termination depth = 13 feet.

B-29

Pavement: 7.5" concrete

Very stiff to hard, gray and tan Lean Clay w/Sand (CL), with silt partings and ferrous nodules
-with calcareous nodules and siltstone fragments 2'-6'

Stiff to very stiff, red, brown, and light gray Lean Clay (CL), with slickensides and fat clay pockets

-with silty clay seams 8'-12

Termination depth = 13 feet.

B-31

Pavement: 6" concrete

Stiff to very stiff, gray and tan Lean Clay w/Sand (CL), with silt partings and ferrous nodules
-with siltstone fragments and calcareous nodules 0'-8'

Stiff to very stiff, red, brown, and light gray Lean Clay (CL)
-with ferrous nodules 8'-10'

-with abundant siltstone fragments and calcareous nodules 10'-14'

Termination depth = 14 feet.

B-32

Pavement: 7" concrete

Very stiff to hard, gray and tan Sandy Lean Clay (CL), with ferrous nodules and silt partings
-with siltstone fragments and calcareous nodules 0'-8'

Very stiff, light gray Fat Clay w/ Sand (CH), with silt partings

-red, brown, and light gray 12'-13'

Termination depth = 13 feet.

LEGEND:

- Paving
- Fill
- Low plasticity clay
- Clayey sand
- Poorly graded silty clayey sand
- High plasticity clay
- Silty low plasticity clay
- Silt
- Silty sand
- Poorly graded sand with silt
- Depth of water during drilling
- Depth of water after completion of drilling

NOTE:

1. *SOIL STRATIGRAPHY AND SECONDARY SOIL STRUCTURE (SUCH AS SEAMS, LAYERS, OR POCKETS OF SANDS, SILTS, SLICKENSIDES, AND FISSURES) THAT ARE DIFFERENT FROM WHAT WERE IDENTIFIED IN THE ACTUAL BORINGS MAY EXIST AWAY FROM THESE BORINGS.*

AVILES ENGINEERING CORPORATION

GENERALIZED SOIL PROFILE
WATER LINE REPLACEMENT IN ANTOINE FOREST AREA
WBS NO. S-000035-0196-4
HOUSTON, TEXAS

AEC PROJECT NO.:	DATE:	SOURCE DRAWING PROVIDED BY:
G167-14	01-29-15	AVILES ENGINEERING CORP.
VERTICAL SCALE: 1" = 4' / HORIZONTAL SCALE: 1" = 200'	DRAFTED BY: BpJ	PLATE NO.: PLATE B-3

GENERALIZED SUBSURFACE SOIL PROFILE

ALONG AREBA

WEST

EAST

BASELINE STATIONS

0+00 2+00 4+00 6+00 8+00 10+00 12+00 14+00 16+00 18+00 20+00

MATCH LINE STA. 20+00

ELEVATION IN FEET

88 84 80 76 72 68 64 60 56 52

B-33

Fill: Hard, brown Sandy Lean Clay (CL), with lean clay pockets, shells, and roots

Stiff to very stiff, light gray Lean Clay w Sand (CL), with ferrous and calcareous nodules
-with silt partings 2'-4'
-with abundant calcareous nodules 4'-6'

-gray and tan, with abundant ferrous nodules, ferrous stains, and chalk pockets 6'-10'

Hard, reddish tan and gray Fat Clay (CH), with calcareous nodules

Termination Depth = 14 feet

B-34

Pavement: 6" concrete

Base: 42" lime-stabilized silty clayey sand with gravel

Very stiff, gray Lean Clay w/Sand (CL), with fat clay pockets and ferrous stains
-with silty sand partings 3'-6'

-with silt partings 6'-8'

Very stiff to hard, light gray Fat Clay (CH), with slickensides and ferrous stains
-light gray, with sandy lean clay pockets and ferrous nodules 8'-10'
-light gray and red, with fat clay and silty sand pockets 10'-14'

Termination Depth = 15 feet

B-35

Pavement: 6.5" asphalt

Base: 3" clayey sand, with clay pockets and gravel

Light gray and dark brown Sandy Silt (SM)

Stiff to very stiff, grayish brown Lean Clay w/Sand (CL), with fat clay pockets
-with silt seams 2'-4'
-grayish brown and dark brown, with ferrous stains 4'-6'

-with silt partings 6'-8'
-with abundant ferrous nodules 6'-10'

-with silty sand pockets 10'-12'

Gray and reddish tan Clayey Sand (SC), with fat clay seams and ferrous stains

Very stiff to hard, red and gray Fat Clay (CH)

Termination Depth = 18 feet

B-36

Pavement: 6" asphalt

Base: 3" silty sand with small gravel

Brown Sandy Silt (ML)

Very stiff to hard, gray Lean Clay w/Sand (CL), with calcareous nodules

-with vertical silt and sand seams 4'-6'

-gray and tan 6'-10'
-with ferrous stains and calcareous nodules 6'-8'

-with silt partings and ferrous nodules 8'-10'

Very stiff to hard, gray and tan Fat Clay (CH)
-with ferrous stains 10'-14'

-gray and reddish tan 14'-15

Termination Depth = 15 feet

LEGEND:

- Paving
- Fill
- Low plasticity clay
- Clayey sand
- Poorly graded silty clayey sand
- High plasticity clay
- Silty low plasticity clay
- Silt
- Silty sand
- Poorly graded sand with silt
- Depth of water during drilling
- Depth of water after completion of drilling

NOTE:

1. *SOIL STRATIGRAPHY AND SECONDARY SOIL STRUCTURE (SUCH AS SEAMS, LAYERS, OR POCKETS OF SANDS, SILTS, SLICKENSIDES, AND FISSURES) THAT ARE DIFFERENT FROM WHAT WERE IDENTIFIED IN THE ACTUAL BORINGS MAY EXIST AWAY FROM THESE BORINGS.*

AVILES ENGINEERING CORPORATION

GENERALIZED SOIL PROFILE

WATER LINE REPLACEMENT IN ANTOINE FOREST AREA

WBS NO. S-000035-0196-4

HOUSTON, TEXAS

AEC PROJECT NO.:	DATE:	SOURCE DRAWING PROVIDED BY:
G167-14	01-29-15	AVILES ENGINEERING CORP.
VERTICAL SCALE: 1" = 4' HORIZONTAL SCALE: 1" = 200'	DRAFTED BY: BpJ	PLATE NO.: PLATE B-4a

GENERALIZED SUBSURFACE SOIL PROFILE

CONTINUED ALONG AREBA

WEST

EAST

BASELINE STATIONS

20+00 22+00 24+00 26+00 28+00 30+00 32+00 34+00 36+00 38+00 40+00

MATCH LINE STA. 20+00

ELEVATION IN FEET

88 84 80 76 72 68 64 60 56 52

B-37

Pavement: 8" asphalt

Base: 3" sand and gravel

Firm to very stiff, brown Lean Clay w/Sand (CL), with ferrous nodules

-with silty sand pockets 0'-4'

-with silty sand seams 2'-4'

Very stiff to hard, gray, red and tan Fat Clay (CH), with slickensides and ferrous nodules

-with silt partings 12'-15'

Termination depth = 15 feet.

B-38

Pavement: 6" asphalt

Base: 4" sand and gravel

Stiff to hard, gray and tan Lean Clay w/ Sand (CL), with sand partings and silt pockets

-with ferrous nodules 6'-15'

Termination Depth = 15 feet

B-39

Pavement: 8" asphalt

Base: 5" stabilized sand and gravel

Fill: very stiff to hard, tan and gray Sandy Lean Clay (CL)

Hard, tan and light gray Lean Clay w/Sand (CL)

-with ferrous nodules 2'-4'

-with silt pockets 6'-8'

Very stiff to hard, light gray and tan Lean Clay (CL), with ferrous nodules

-with silt pockets 12'-14'

Termination depth = 15 feet.

B-40

Pavement: 4" asphalt

Base: 7" sand and crushed shell

Very stiff to hard, gray Sandy Lean Clay (CL), with silt partings -light gray and tan, with siltstone fragments, calcareous and ferrous nodules 2'-8'

Stiff to hard, light gray and tan Lean Clay w/Sand (CL), with silt partings and ferrous nodules

Termination depth = 14 feet.

LEGEND:

- Paving
- Fill
- Low plasticity clay
- Clayey sand
- Poorly graded silty clayey sand
- High plasticity clay
- Silty low plasticity clay
- Silt
- Silty sand
- Poorly graded sand with silt
- Depth of water during drilling
- Depth of water after completion of drilling

NOTE:

1. *SOIL STRATIGRAPHY AND SECONDARY SOIL STRUCTURE (SUCH AS SEAMS, LAYERS, OR POCKETS OF SANDS, SILTS, SLICKENSIDES, AND FISSURES) THAT ARE DIFFERENT FROM WHAT WERE IDENTIFIED IN THE ACTUAL BORINGS MAY EXIST AWAY FROM THESE BORINGS.*

AVILES ENGINEERING CORPORATION

GENERALIZED SOIL PROFILE

WATER LINE REPLACEMENT IN ANTOINE FOREST AREA

WBS NO. S-000035-0196-4

HOUSTON, TEXAS

AEC PROJECT NO.:	DATE:	SOURCE DRAWING PROVIDED BY:
G167-14	01-29-15	AVILES ENGINEERING CORP.
VERTICAL SCALE: 1" = 4' / HORIZONTAL SCALE: 1" = 200'	DRAFTED BY: BpJ	PLATE NO.: PLATE B-4b

GENERALIZED SUBSURFACE SOIL PROFILE

ALONG CLIFFDALE

WEST

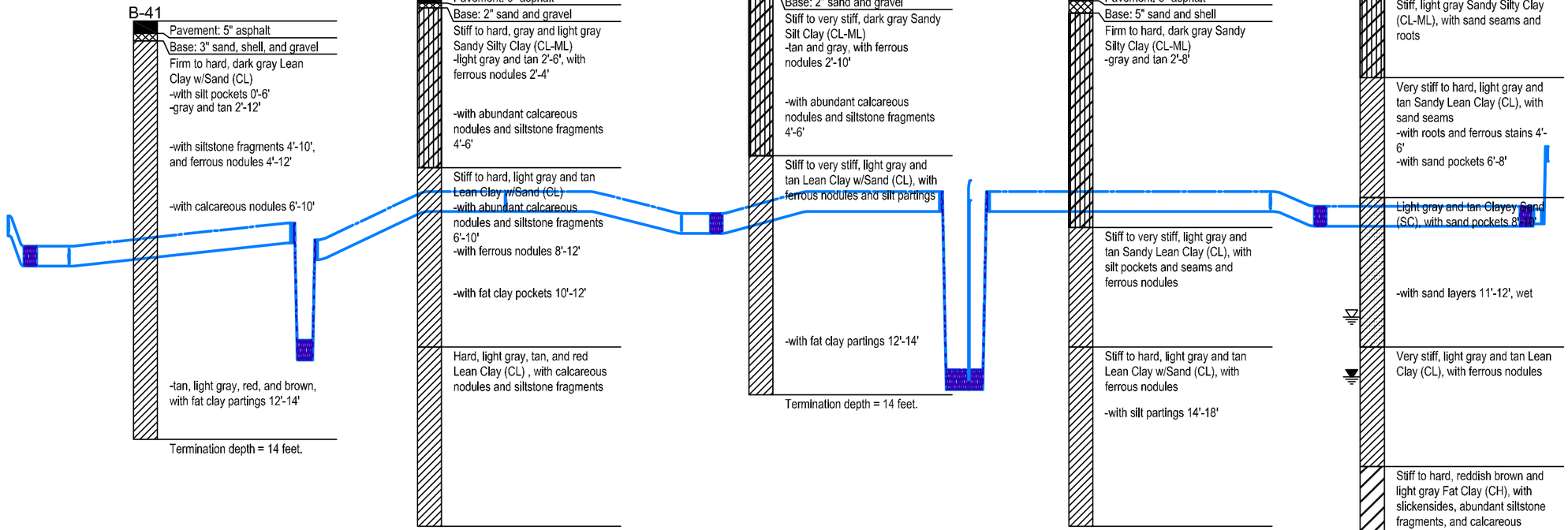
EAST

BASELINE STATIONS

2+00 4+00 6+00 8+00 10+00 12+00 14+00 16+00 18+00 20+00 22+00 24+00 26+00 28+00

ELEVATION IN FEET

88 84 80 76 72 68 64 60 56 52



LEGEND:

- Paving
- Fill
- Low plasticity clay
- Clayey sand
- Poorly graded silty clayey sand
- High plasticity clay
- Silty low plasticity clay
- Silt
- Silty sand
- Poorly graded sand with silt
- Depth of water during drilling
- Depth of water after completion of drilling

NOTE:

1. *SOIL STRATIGRAPHY AND SECONDARY SOIL STRUCTURE (SUCH AS SEAMS, LAYERS, OR POCKETS OF SANDS, SILTS, SLICKENSIDES, AND FISSURES) THAT ARE DIFFERENT FROM WHAT WERE IDENTIFIED IN THE ACTUAL BORINGS MAY EXIST AWAY FROM THESE BORINGS.*

AVILES ENGINEERING CORPORATION

GENERALIZED SOIL PROFILE

WATER LINE REPLACEMENT IN ANTOINE FOREST AREA

WBS NO. S-000035-0196-4

HOUSTON, TEXAS

AEC PROJECT NO.:	DATE:	SOURCE DRAWING PROVIDED BY:
G167-14	01-29-15	AVILES ENGINEERING CORP.
VERTICAL SCALE: 1" = 4' HORIZONTAL SCALE: 1" = 200'	DRAFTED BY: BpJ	PLATE NO.: PLATE B-5

GENERALIZED SUBSURFACE SOIL PROFILE

ALONG DRUID

BASELINE STATIONS

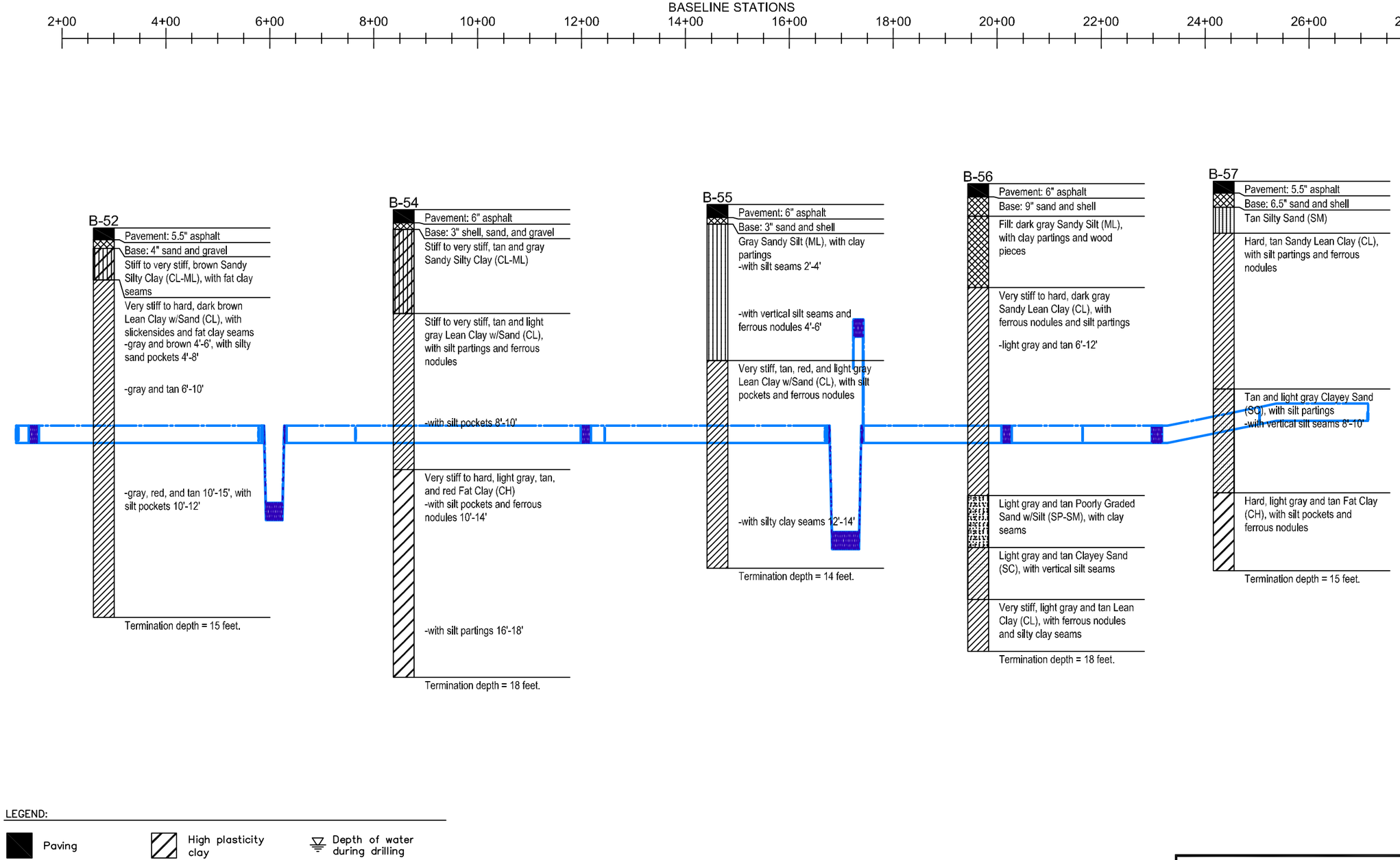
WEST

EAST

2+00 4+00 6+00 8+00 10+00 12+00 14+00 16+00 18+00 20+00 22+00 24+00 26+00 28+00

ELEVATION IN FEET

88 84 80 76 72 68 64 60 56 52



LEGEND:

- Paving
- Fill
- Low plasticity clay
- Clayey sand
- Poorly graded silty clayey sand
- High plasticity clay
- Silty low plasticity clay
- Silt
- Silty sand
- Poorly graded sand with silt
- Depth of water during drilling
- Depth of water after completion of drilling

NOTE:

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AVILES ENGINEERING CORPORATION

GENERALIZED SOIL PROFILE

WATER LINE REPLACEMENT IN ANTOINE FOREST AREA

WBS NO. S-000035-0196-4

HOUSTON, TEXAS

AEC PROJECT NO.: G167-14	DATE: 01-29-15	SOURCE DRAWING PROVIDED BY: AVILES ENGINEERING CORP.
VERTICAL SCALE: 1" = 4' HORIZONTAL SCALE: 1" = 200'	DRAFTED BY: BpJ	PLATE NO.: PLATE B-6

AVLES
ENGINEERING CORP.

APPENDIX C

Plates C-1 and C-6	Recommended Geotechnical Design Parameters
Plate C-7	Load Coefficients for Pipe Loading
Plate C-8	Live Loads on Pipe Crossing Under Roadway

SOIL PARAMETERS FOR UNDERGROUND UTILITIES

Boring	Depth (ft)	Soil Type	γ (pcf)	γ' (pcf)	OSHA Type	E'n (psi)	Short-Term					Long-Term				
							C (psf)	φ (deg)	K_a	K_0	K_p	C' (psf)	φ' (deg)	K_a	K_0	K_p
B-1	0-5	Very stiff to hard CH	136	74	B	600	2000	0	1.00	1.00	1.00	200	16	0.57	0.72	1.76
	5-14	Very stiff to hard CH	136	74	B	1000	3600	0	1.00	1.00	1.00	300	16	0.57	0.72	1.76
	14-15	Stiff to very stiff CL	129	67	B	600	1200	0	1.00	1.00	1.00	100	18	0.53	0.69	1.89
B-2	0-4	Stiff to very stiff CH	124	62	B	600	1800	0	1.00	1.00	1.00	175	16	0.57	0.72	1.76
	4-14	Very stiff to hard CL/CH	129	67	B	1000	3600	0	1.00	1.00	1.00	300	16	0.57	0.72	1.76
B-3	0-4	Very stiff to hard CL	135	73	B	600	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	4-10	Very stiff CH	129	67	B	1000	3200	0	1.00	1.00	1.00	300	16	0.57	0.72	1.76
	10-12	ML	120	58	C	300	0	26	0.39	0.56	2.56	0	26	0.39	0.56	2.56
B-4	0-8	Very stiff CL	130	68	B	600	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	8-12	Very stiff to hard CH	128	66	B	600	2000	0	1.00	1.00	1.00	200	16	0.57	0.72	1.76
B-5	0-5	Very stiff CL	132	70	B	600	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	5-8	Very stiff to hard CL	132	70	B	1000	3600	0	1.00	1.00	1.00	300	18	0.53	0.69	1.89
	8-12	Firm CL	131	69	B	300	800	0	1.00	1.00	1.00	75	18	0.53	0.69	1.89
	12-13	SM	120	58	C	300	0	26	0.39	0.56	2.56	0	26	0.39	0.56	2.56
B-6	0-8	Very stiff to hard CL	133	71	B	600	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	8-12	Dense SM	124	62	C	2000	0	32	0.31	0.47	3.25	0	32	0.31	0.47	3.25
	12-17	CH	120	58	B	300	1000	0	1.00	1.00	1.00	100	16	0.57	0.72	1.76
B-7	0-5	Hard CL	131	69	B	600	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	5-13	Hard CL/CH	131	69	B	1000	3600	0	1.00	1.00	1.00	300	18	0.53	0.69	1.89
B-8	0-8	Very stiff CL	122	60	B	600	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	8-15	Medium dense SM/SP-SM	122	60	C	1000	0	30	0.33	0.50	3.00	0	30	0.33	0.50	3.00
B-9	0-6	Very stiff to hard CL	136	74	B	600	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	6-10	Very stiff CL-ML	132	70	B	600	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	10-13	Firm CL-ML	132	70	B	300	750	0	1.00	1.00	1.00	75	18	0.53	0.69	1.89
B-10	0-10	Very stiff CL	129	67	B	1000	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	10-12	SM	130	68	C	300	0	26	0.39	0.56	2.56	0	26	0.39	0.56	2.56
	12-15	Very stiff CH	130	68	B	1000	2500	0	1.00	1.00	1.00	250	16	0.57	0.72	1.76
B-11	0-5	Very stiff to hard CL	131	69	B	600	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	5-12	Stiff to hard CH/CL	132	70	B	600	1800	0	1.00	1.00	1.00	175	16	0.57	0.72	1.76
B-12	0-8	Very stiff to hard CH	124	62	B	600	2000	0	1.00	1.00	1.00	200	16	0.57	0.72	1.76
	8-14	Medium dense SC-SM	127	65	C	600	0	30	0.33	0.50	3.00	0	30	0.33	0.50	3.00

SOIL PARAMETERS FOR UNDERGROUND UTILITIES

Boring	Depth (ft)	Soil Type	γ (pcf)	γ' (pcf)	OSHA Type	E'n (psi)	Short-Term					Long-Term				
							C (psf)	φ (deg)	K_a	K_0	K_p	C' (psf)	φ' (deg)	K_a	K_0	K_p
B-13	0-8	Stiff to hard CL	126	64	B	600	1600	0	1.00	1.00	1.00	150	18	0.53	0.69	1.89
	8-19	Medium dense SC/SP-SM	120	58	C	600	0	30	0.33	0.50	3.00	0	30	0.33	0.50	3.00
B-14	0-5	Very stiff CL	138	76	B	600	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	5-12	Hard CL	138	76	B	1000	3600	0	1.00	1.00	1.00	300	18	0.53	0.69	1.89
	12-17	Medium dense SM	120	58	C	600	0	30	0.33	0.50	3.00	0	30	0.33	0.50	3.00
B-15	0-4	Very stiff CL	135	73	B	600	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	4-10	Very stiff CL	131	69	B	1000	2800	0	1.00	1.00	1.00	275	18	0.53	0.69	1.89
	10-18	Very stiff to hard CL/CH	123	61	B	1000	2200	0	1.00	1.00	1.00	200	16	0.57	0.72	1.76
B-16	0-8	Very stiff to hard CL	138	76	B	600	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	8-14	SC	137	75	C	300	0	28	0.36	0.53	2.77	0	28	0.36	0.53	2.77
	14-17	Very stiff CL	130	68	B	600	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
B-17	0-8	Very stiff to hard CL	136	74	B	600	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	8-13	SC-SM	135	73	C	300	0	28	0.36	0.53	2.77	0	28	0.36	0.53	2.77
	13-18	Stiff to very stiff CH	124	62	B	600	2000	0	1.00	1.00	1.00	200	16	0.57	0.72	1.76
B-18	0-8	Very stiff CL	133	71	B	600	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	8-12	Stiff to very stiff CL	129	67	B	600	1200	0	1.00	1.00	1.00	100	18	0.53	0.69	1.89
	12-18	Very stiff to hard CH	129	67	B	1000	2600	0	1.00	1.00	1.00	250	16	0.57	0.72	1.76
B-19	0-4	Very stiff CH	133	71	B	600	2000	0	1.00	1.00	1.00	200	16	0.57	0.72	1.76
	4-10	Stiff to very stiff CH	134	72	B	600	1800	0	1.00	1.00	1.00	175	16	0.57	0.72	1.76
	10-19	Very stiff to hard CH	129	67	B	1000	2200	0	1.00	1.00	1.00	200	16	0.57	0.72	1.76
B-20	0-4	Very stiff to hard CL	136	74	B	600	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	4-13	Very stiff CL	126	64	B	1000	2200	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
B-21	0-8	Very stiff to hard CL	131	69	B	600	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	8-14	Stiff to very stiff CL/CH	132	70	B	600	1500	0	1.00	1.00	1.00	150	18	0.53	0.69	1.89
	14-21	Very stiff to hard CH	126	64	B (14-20)	1000	2800	0	1.00	1.00	1.00	275	16	0.57	0.72	1.76
B-22	0-10	Very stiff CL	136	74	B	600	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	10-13	Firm to very stiff CL-ML	128	66	B	300	700	0	1.00	1.00	1.00	50	18	0.53	0.69	1.89
B-23	0-8	Very stiff to hard CL	132	70	B	600	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	8-13	SM	138	76	C	300	0	26	0.39	0.56	2.56	0	26	0.39	0.56	2.56
B-24	0-13	Stiff to hard CH	137	75	B	600	2000	0	1.00	1.00	1.00	200	16	0.57	0.72	1.76

SOIL PARAMETERS FOR UNDERGROUND UTILITIES

Boring	Depth (ft)	Soil Type	γ (pcf)	γ' (pcf)	OSHA Type	E'n (psi)	Short-Term					Long-Term				
							C (psf)	φ (deg)	K_a	K_0	K_p	C' (psf)	φ' (deg)	K_a	K_0	K_p
B-25	0-6	Stiff to very stiff CH	135	73	B	600	1400	0	1.00	1.00	1.00	125	16	0.57	0.72	1.76
	6-13	Very stiff CH	126	64	B	600	2000	0	1.00	1.00	1.00	200	16	0.57	0.72	1.76
B-26	0-10	Very stiff to hard CH/CL	135	73	B	600	2000	0	1.00	1.00	1.00	200	16	0.57	0.72	1.76
	10-15	Stiff CL	129	67	B	600	1200	0	1.00	1.00	1.00	100	18	0.53	0.69	1.89
B-27	0-5	Hard CH	131	69	B	600	2000	0	1.00	1.00	1.00	200	16	0.57	0.72	1.76
	5-15	Very stiff to hard CH	126	64	B	1000	3600	0	1.00	1.00	1.00	300	16	0.57	0.72	1.76
B-28	0-8	Very stiff to hard CL	133	71	B	600	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	8-12	Stiff to hard CH	130	68	B	600	1600	0	1.00	1.00	1.00	150	16	0.57	0.72	1.76
B-29	0-6	Very stiff to hard CL	135	73	B	600	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	6-13	Stiff to very stiff CL	124	62	B	600	1400	0	1.00	1.00	1.00	125	18	0.53	0.69	1.89
B-30	0-8	Very stiff to hard CL	133	71	B	600	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	8-14	Stiff to hard CL	129	67	B	600	1300	0	1.00	1.00	1.00	125	18	0.53	0.69	1.89
	14-15	SM	120	58	C	300	0	26	0.39	0.56	2.56	0	26	0.39	0.56	2.56
B-31	0-8	Stiff to very stiff CL	129	67	B	300	1000	0	1.00	1.00	1.00	100	18	0.53	0.69	1.89
	8-14	Stiff to very stiff CL	128	66	B	600	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
B-32	0-5	Very stiff to hard CL	135	73	B	600	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	0-13	Very stiff to hard CL/CH	135	73	B	1000	2800	0	1.00	1.00	1.00	275	18	0.53	0.69	1.89
B-33	0-2	Fill: hard CL	120	58	C	600	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	2-10	Stiff to very stiff CL	133	71	B	300	900	0	1.00	1.00	1.00	75	18	0.53	0.69	1.89
	10-14	Hard CH	135	73	B	1000	3600	0	1.00	1.00	1.00	300	16	0.57	0.72	1.76
B-34	0-3	Base: SC-SM	120	58	C	300	0	26	0.39	0.56	2.56	0	26	0.39	0.56	2.56
	3-8	Very stiff CL	133	71	B	600	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	8-15	Very stiff to hard CH	134	72	B	600	1800	0	1.00	1.00	1.00	175	16	0.57	0.72	1.76
B-35	0-2	SM	120	58	C	300	0	26	0.39	0.56	2.56	0	26	0.39	0.56	2.56
	2-6	Stiff to very stiff CL	124	62	B	300	800	0	1.00	1.00	1.00	75	18	0.53	0.69	1.89
	6-12	Very stiff CL	137	75	B	1000	2200	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	12-14	SC	120	58	C	600	0	28	0.36	0.53	2.77	0	28	0.36	0.53	2.77
	14-18	Very stiff to hard CH	133	71	B	1000	3500	0	1.00	1.00	1.00	300	16	0.57	0.72	1.76

SOIL PARAMETERS FOR UNDERGROUND UTILITIES

Boring	Depth (ft)	Soil Type	γ (pcf)	γ' (pcf)	OSHA Type	E'n (psi)	Short-Term					Long-Term				
							C (psf)	φ (deg)	K_a	K_0	K_p	C' (psf)	φ' (deg)	K_a	K_0	K_p
B-36	0-2	ML	120	58	C	300	0	26	0.39	0.56	2.56	0	26	0.39	0.56	2.56
	2-5	Very stiff to hard CL	120	58	B	600	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	5-12	Very stiff to hard CL/CH	137	75	B	1000	2800	0	1.00	1.00	1.00	275	18	0.53	0.69	1.89
	12-15	Hard CH	132	70	B	1000	3600	0	1.00	1.00	1.00	300	16	0.57	0.72	1.76
B-37	0-6	Firm CL	127	65	B	300	700	0	1.00	1.00	1.00	50	18	0.53	0.69	1.89
	6-8	Very stiff CL	127	65	B	600	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	8-12	Very stiff to hard CL/CH	133	71	B	1000	3600	0	1.00	1.00	1.00	300	16	0.57	0.72	1.76
	12-15	Very stiff CH	133	71	B	600	2000	0	1.00	1.00	1.00	200	16	0.57	0.72	1.76
B-38	0-6	Stiff to very stiff CL	133	71	B	600	1300	0	1.00	1.00	1.00	125	18	0.53	0.69	1.89
	6-15	Very stiff to hard CL	137	75	B	1000	3400	0	1.00	1.00	1.00	300	18	0.53	0.69	1.89
B-39	0-2	Fill: very stiff to hard CL	126	64	C	600	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	2-5	Very stiff to hard CL	134	72	B	600	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	5-15	Very stiff to hard CL	135	73	B	1000	3500	0	1.00	1.00	1.00	300	18	0.53	0.69	1.89
B-40	0-8	Very stiff to hard CL	125	63	B	1000	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	8-14	Stiff to hard CL	130	68	B	600	1500	0	1.00	1.00	1.00	150	18	0.53	0.69	1.89
B-41	0-10	Firm to very stiff CL	131	69	B	300	700	0	1.00	1.00	1.00	50	18	0.53	0.69	1.89
	10-14	Very stiff to hard CL	133	71	B	1000	2800	0	1.00	1.00	1.00	275	18	0.53	0.69	1.89
B-42	0-2	SM	120	58	C	300	0	26	0.39	0.56	2.56	0	26	0.39	0.56	2.56
	2-14	Very stiff CL	128	66	B	1000	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	14-22	Firm to very stiff CL	122	60	C* (14-20)	300	600	0	1.00	1.00	1.00	50	18	0.53	0.69	1.89
B-43	0-10	Stiff to hard CL-ML/CL	137	75	B	600	1800	0	1.00	1.00	1.00	175	18	0.53	0.69	1.89
	10-18	Hard CL	132	70	B	1000	3600	0	1.00	1.00	1.00	300	18	0.53	0.69	1.89
B-44	0-14	Stiff to very stiff CL/CL-ML	136	74	B	600	1500	0	1.00	1.00	1.00	150	18	0.53	0.69	1.89
B-45	0-12	Firm to hard CL-ML/CL	132	70	B	300	1000	0	1.00	1.00	1.00	100	18	0.53	0.69	1.89
	12-18	Stiff to hard CL	133	71	B	600	1800	0	1.00	1.00	1.00	175	18	0.53	0.69	1.89

SOIL PARAMETERS FOR UNDERGROUND UTILITIES

Boring	Depth (ft)	Soil Type	γ (pcf)	γ' (pcf)	OSHA Type	E'n (psi)	Short-Term					Long-Term				
							C (psf)	φ (deg)	K_a	K_0	K_p	C' (psf)	φ' (deg)	K_a	K_0	K_p
B-46	0-4	Stiff CL-ML	120	58	B	300	1000	0	1.00	1.00	1.00	100	18	0.53	0.69	1.89
	4-8	Very stiff to hard CL	120	58	B	600	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	8-13	SC	129	67	C	300	0	26	0.39	0.56	2.56	0	26	0.39	0.56	2.56
	13-21	Very stiff to hard CL/CH	130	68	C* (13-21)	600	1600	0	1.00	1.00	1.00	150	16	0.57	0.72	1.76
B-47	0-4	Stiff to hard CL	133	71	B	600	1200	0	1.00	1.00	1.00	100	18	0.53	0.69	1.89
	4-10	Very stiff CL	133	71	B	1000	2700	0	1.00	1.00	1.00	250	18	0.53	0.69	1.89
	10-14	Very stiff CL	133	71	B	600	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
B-48	0-2	Fill: stiff CL	120	58	C	600	1200	0	1.00	1.00	1.00	100	18	0.53	0.69	1.89
	2-6	Stiff to very stiff CL	127	65	B	600	1200	0	1.00	1.00	1.00	100	18	0.53	0.69	1.89
	6-12	Very stiff CL	133	71	B	600	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	12-18	Very stiff to hard CL	130	68	B	1000	3000	0	1.00	1.00	1.00	300	18	0.53	0.69	1.89
B-49	0-6	Stiff to hard CL	131	69	B	600	1500	0	1.00	1.00	1.00	150	18	0.53	0.69	1.89
	6-14	Very stiff to hard CL	136	74	B	1000	3200	0	1.00	1.00	1.00	300	18	0.53	0.69	1.89
B-50	0-8	Stiff to very stiff CL	133	71	B	600	1500	0	1.00	1.00	1.00	150	18	0.53	0.69	1.89
	8-18	Very stiff to hard CL	136	74	B	1000	3200	0	1.00	1.00	1.00	300	18	0.53	0.69	1.89
B-51	0-4	ML	132	70	C	300	0	28	0.36	0.53	2.77	0	28	0.36	0.53	2.77
	4-10	Stiff to hard CL	135	73	B	600	1000	0	1.00	1.00	1.00	100	18	0.53	0.69	1.89
	10-14	SC-SM	131	69	C	300	0	28	0.36	0.53	2.77	0	28	0.36	0.53	2.77
B-52	0-5	Stiff to very stiff CL-ML/CL	130	68	B	600	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	5-12	Very stiff to hard CL	130	68	B	1000	2800	0	1.00	1.00	1.00	275	18	0.53	0.69	1.89
	12-15	Stiff CL	130	68	B	600	1600	0	1.00	1.00	1.00	150	18	0.53	0.69	1.89
B-53	0-2	Fill: Stiff CL	120	58	C	600	1800	0	1.00	1.00	1.00	175	18	0.53	0.69	1.89
	2-8	Stiff to very stiff CL	129	67	B	600	1800	0	1.00	1.00	1.00	175	18	0.53	0.69	1.89
	8-10	Very stiff to hard CL	136	74	B	1000	3500	0	1.00	1.00	1.00	300	18	0.53	0.69	1.89
	10-18	Very stiff to hard CH	128	66	B	1000	2800	0	1.00	1.00	1.00	275	16	0.57	0.72	1.76
B-54	0-4	Stiff to very stiff CL-ML	127	65	B	600	1100	0	1.00	1.00	1.00	100	18	0.53	0.69	1.89
	4-10	Stiff to very stiff CL	131	69	B	600	1600	0	1.00	1.00	1.00	150	18	0.53	0.69	1.89
	10-18	Very stiff to hard CH	133	71	B	1000	3600	0	1.00	1.00	1.00	300	16	0.57	0.72	1.76
B-55	0-6	ML	130	68	C	600	0	28	0.36	0.53	2.77	0	28	0.36	0.53	2.77
	6-14	Very stiff CL	133	71	B	1000	2800	0	1.00	1.00	1.00	275	18	0.53	0.69	1.89

SOIL PARAMETERS FOR UNDERGROUND UTILITIES

Boring	Depth (ft)	Soil Type	γ (pcf)	γ' (pcf)	OSHA Type	E'n (psi)	Short-Term					Long-Term				
							C (psf)	φ (deg)	K_a	K_0	K_p	C' (psf)	φ' (deg)	K_a	K_0	K_p
B-56	0-4	Fill: ML	129	67	C	600	0	28	0.36	0.53	2.77	0	28	0.36	0.53	2.77
	4-6	Stiff to very stiff CL	138	76	B	600	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	6-12	Very stiff to hard CL	138	76	B	1000	3500	0	1.00	1.00	1.00	300	18	0.53	0.69	1.89
	12-16	SP-SM/SC	130	68	C	300	0	26	0.39	0.56	2.56	0	26	0.39	0.56	2.56
	16-18	Very stiff CL	120	58	B	600	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
B-57	0-2	SM	120	58	C	300	0	26	0.39	0.56	2.56	0	26	0.39	0.56	2.56
	2-8	Very stiff to hard CL	131	69	B	1000	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	8-12	SC	125	63	C	600	0	30	0.33	0.50	3.00	0	30	0.33	0.50	3.00
	12-16	Very stiff to hard CH	139	77	B	2000	3600	0	1.00	1.00	1.00	300	16	0.57	0.72	1.76
B-58	0-3	Fill: very stiff CL	120	58	C	600	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
B-59	0-4	Fill: very stiff to hard CL	132	70	C	600	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	4-11	Firm to hard CL-ML	127	65	B	300	800	0	1.00	1.00	1.00	75	18	0.53	0.69	1.89
	11-15	Stiff to hard CL-ML/CH	120	58	C*	600	1000	0	1.00	1.00	1.00	100	16	0.57	0.72	1.76
B-60	0-8	Very stiff CL	131	69	B	1000	2000	0	1.00	1.00	1.00	200	18	0.53	0.69	1.89
	8-14	Stiff to very stiff CL	128	66	B	600	1400	0	1.00	1.00	1.00	125	18	0.53	0.69	1.89
	14-20	ML	132	70	C	600	0	30	0.33	0.50	3.00	0	30	0.33	0.50	3.00
B-61	0-2	SM	120	58	C	300	0	26	0.39	0.56	2.56	0	26	0.39	0.56	2.56
	2-6	Very stiff to hard CL	134	72	B	1000	3000	0	1.00	1.00	1.00	300	18	0.53	0.69	1.89
	6-12	Medium dense SC/SM	131	69	C	600	0	28	0.36	0.53	2.77	0	28	0.36	0.53	2.77
B-62	0-2	SM	120	58	C	300	0	26	0.39	0.56	2.56	0	26	0.39	0.56	2.56
	2-8	Very stiff to hard CL	136	74	B	1000	2400	0	1.00	1.00	1.00	225	18	0.53	0.69	1.89
	8-16	Loose to medium dense SC	133	71	C	300	0	26	0.39	0.56	2.56	0	26	0.39	0.56	2.56

(1) γ = Unit weight for soil above water level, γ′ = Buoyant unit weight for soil below water level. E'n = Soil modulus for native soils;

(2) C = Soil ultimate cohesion for short term (upper limit of 3,600 psf for design purposes), φ = Soil friction angle for short term;

(3) C' = Soil ultimate cohesion for long term (upper limit of 300 psf for design purposes), φ' = Soil friction angle for long term;

(4) K_a = Coefficient of active earth pressure, K_0 = Coefficient of at-rest earth pressure, K_p = Coefficient of passive earth pressure;

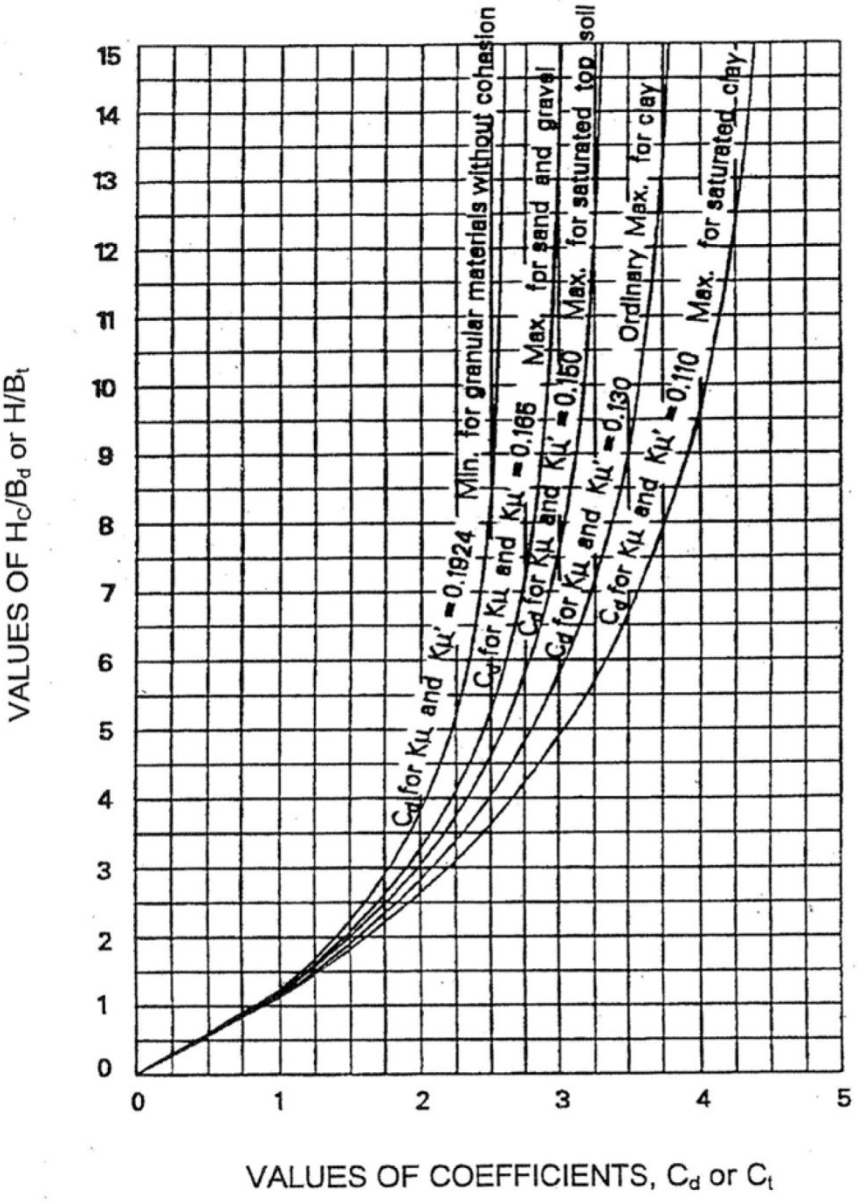
(5) CL= Lean Clay,CH= Fat Clay,ML= Silt,CL-ML= Silty Clay,SC-SM= Silty Clayey Sand,SC= Clayey Sand,SM= Silty Sand,SP-SM= Poorly Graded Sand w/Silt;

(6) OSHA Soil Types for soils in the top 20 feet below grade:

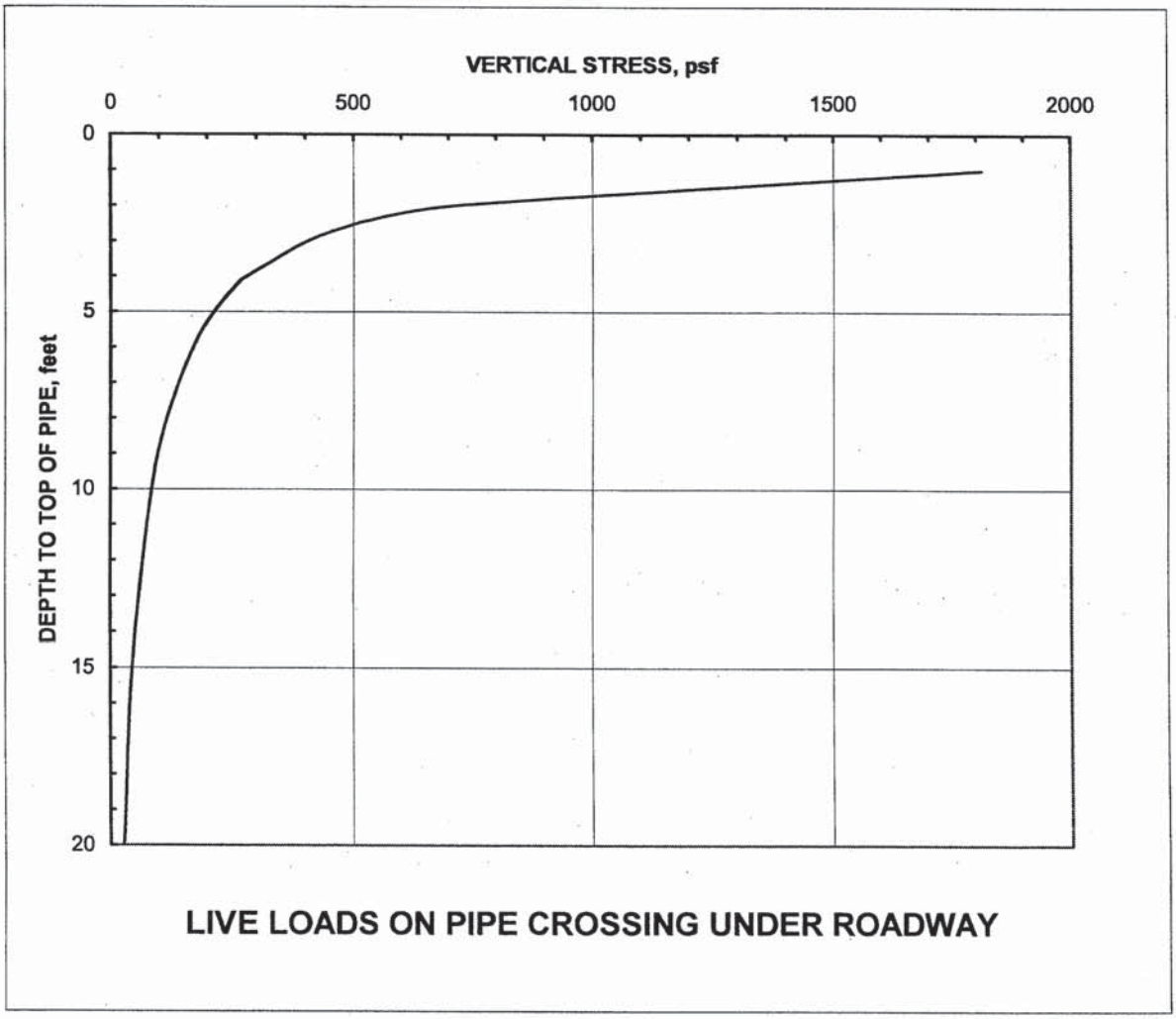
B: cohesive soils with qu = 0.5 tsf or greater

C: cohesive soils with qu = less than 0.5 tsf, fill materials, or granular soil

C*: submerged cohesive soils; dewatered cohesive soils can be considered OSHA Type C.



Reference: US Army Corps of Engineers Engineering Manual, EM 1110-2-2902, Oct. 31, 1997, Figure 2-5.



LIVE LOADS ON PIPE CROSSING UNDER ROADWAY

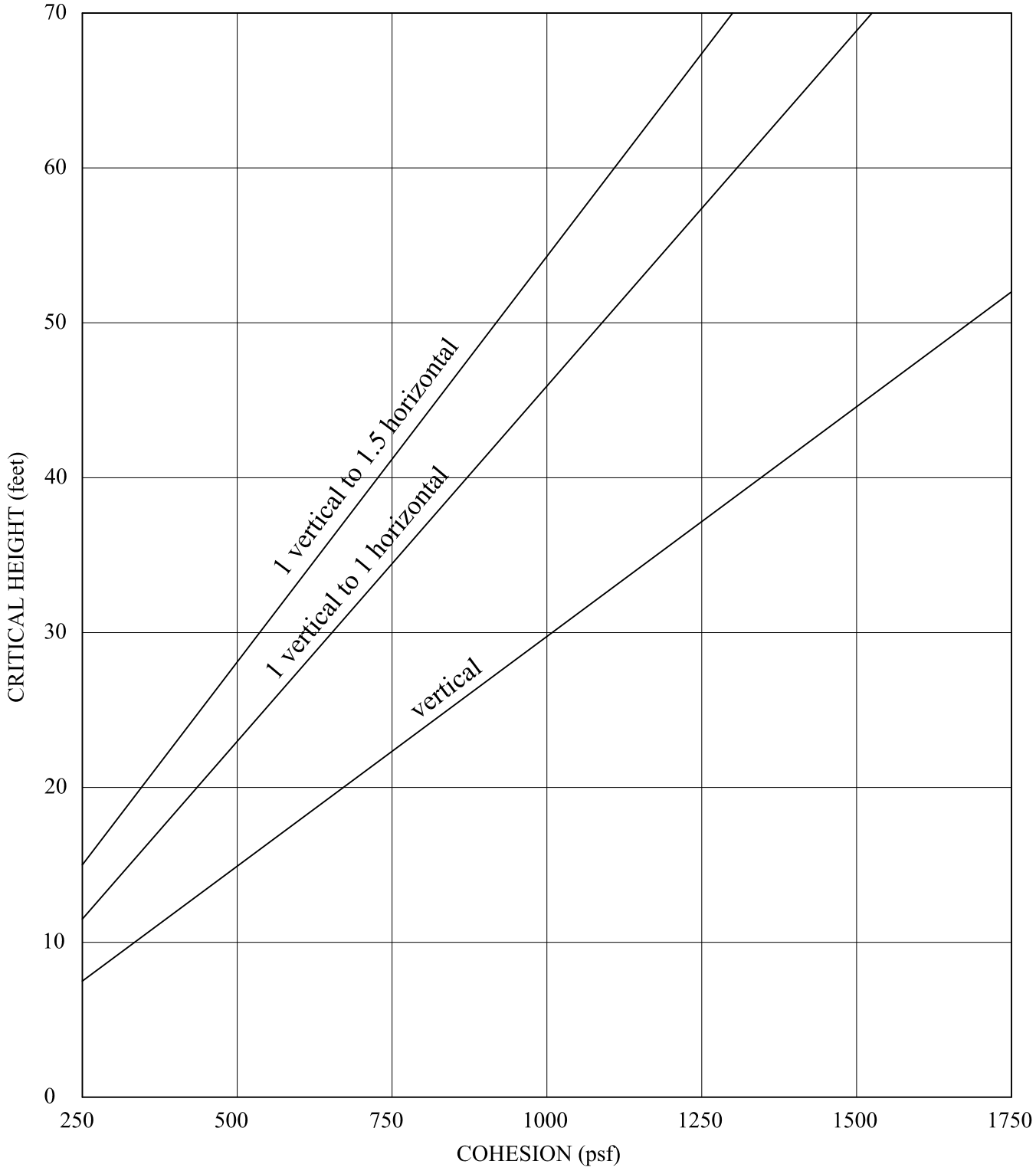
Note: 1. The vertical stress was estimated using AASHTO HS20 truck axle loadings on paved surfaces (Reference: ASCE 15-98, "Standard Practice for Direct Design of Buried Precast Concrete Pipe Using Standandard Installations").
2. Single truck passing.

AVLES
ENGINEERING CORP.

APPENDIX D

AYLES
ENGINEERING CORP.

Critical Heights of Cut Slopes in Nonfissured Clays

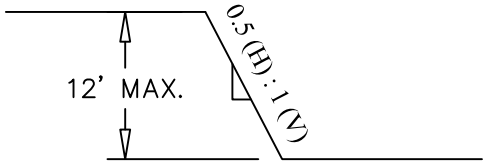
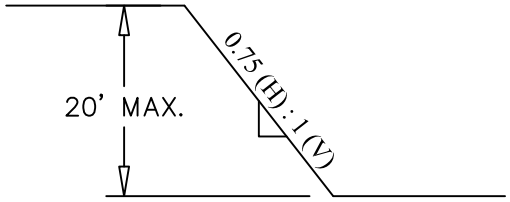
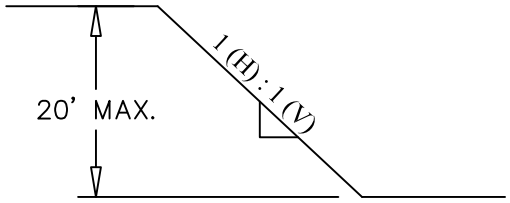
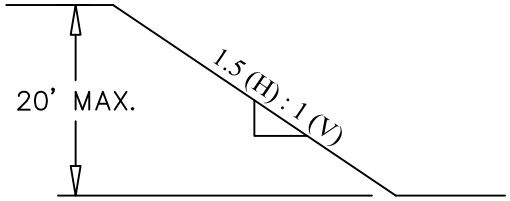


Note: The charts are calculated based on NAVFAC DM7.1, Page 7.1-319, assuming the critical circles are toe circles, and wet unit weight of soils = 125pcf.

PLATE D-1

AYLES ENGINEERING CORP.

MAXIMUM ALLOWABLE SLOPES

	SHORT TERM	LONG TERM
TYPE A SOILS		
TYPE B SOILS	N/A	
TYPE C SOILS	N/A	

NOTES:

(1) For Type A soils, a short term maximum allowable slope of 0.5 (H) : 1 (V) is allowed in excavations that are 12 feet or less in depth; short term (24 hours or less) maximum allowable slopes for excavations greater than 12 feet in depth shall be 0.75 (H) : 1 (V).

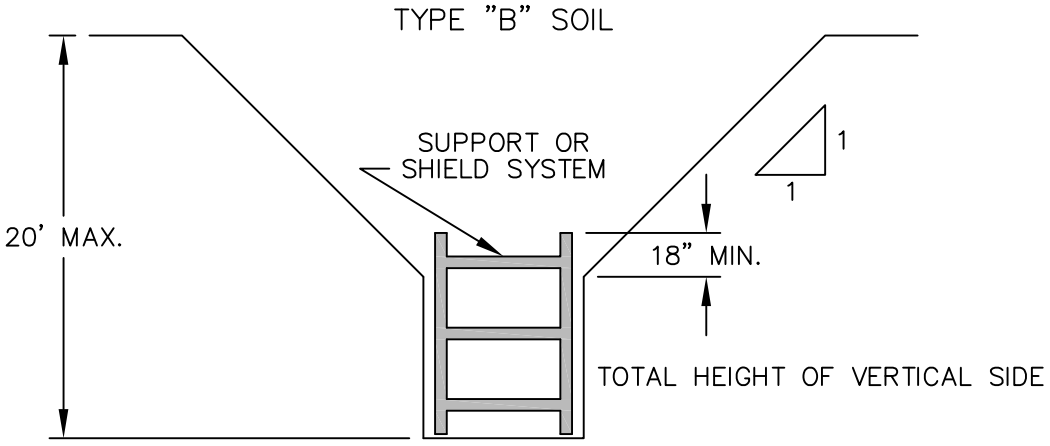
(2) Maximum depth for above slopes is 20 feet. For slopes deeper than 20 feet, trench protection should be designed by the Contractor's professional engineer.

PLATE D-2

Reference: OSHA, Safety and Health Regulations for Construction, 1926 Subpart P.

AYLES ENGINEERING CORP.

A COMBINATION OF BRACING AND OPEN CUTS



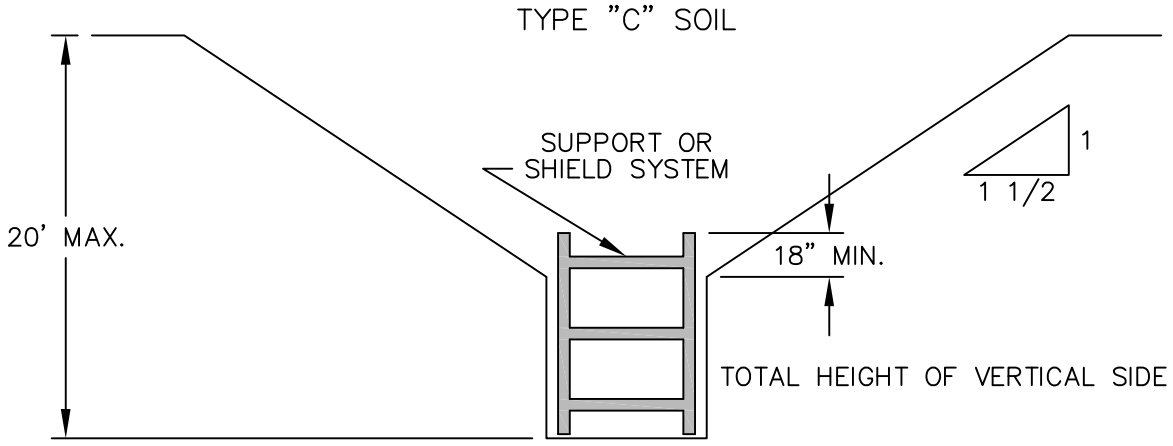
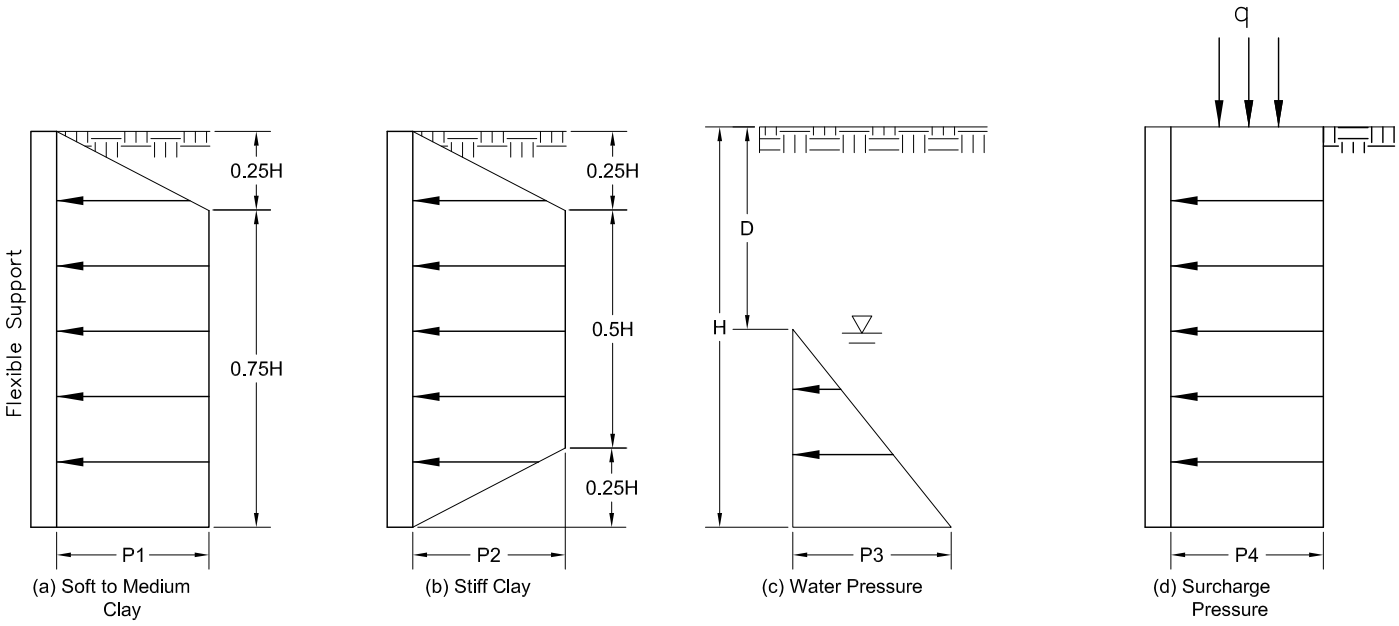


PLATE D-3

Reference: OSHA, Safety and Health Regulations for Construction, 1926 Subpart P.

LATERAL PRESSURE DIAGRAMS
FOR OPEN CUTS IN COHESIVE SOIL - SHORT TERM CONDITIONS



Empirical Pressure Distributions

Where:
H = Total excavation depth, feet
D = Depth to water table, feet
P1 = Lateral earth pressure = $\gamma H - 4S_u$, psf
P2 = Lateral earth pressure = $0.2\gamma H$, psf
P3 = Water pressure = γ_w (H-D), psf
P4 = Lateral earth pressure caused by surcharge = qK_a, psf
γ = Effective unit weight of soil, pcf
γ_w = Unit weight of water, pcf
S_u = Undrained shear strength = $q_u/2$, psf
q_u = Unconfined compressive strength, psf
K_a = Coefficient of active earth pressure

Notes:
1. All pressures are additive.
2. No safety factors are included.
3. For use only during short term construction.
4. If $\gamma H/S_u < 4$, use section (b),
   If $4 < \gamma H/S_u < 6$, use larger of section (a) or (b),
   If $\gamma H/S_u > 6$, use section (a).

Reference: Peck, R.B. (1969), "Deep Excavation and Tunneling in soft Ground", 7th ICSMFE, State of art volume, pp. 225-290.

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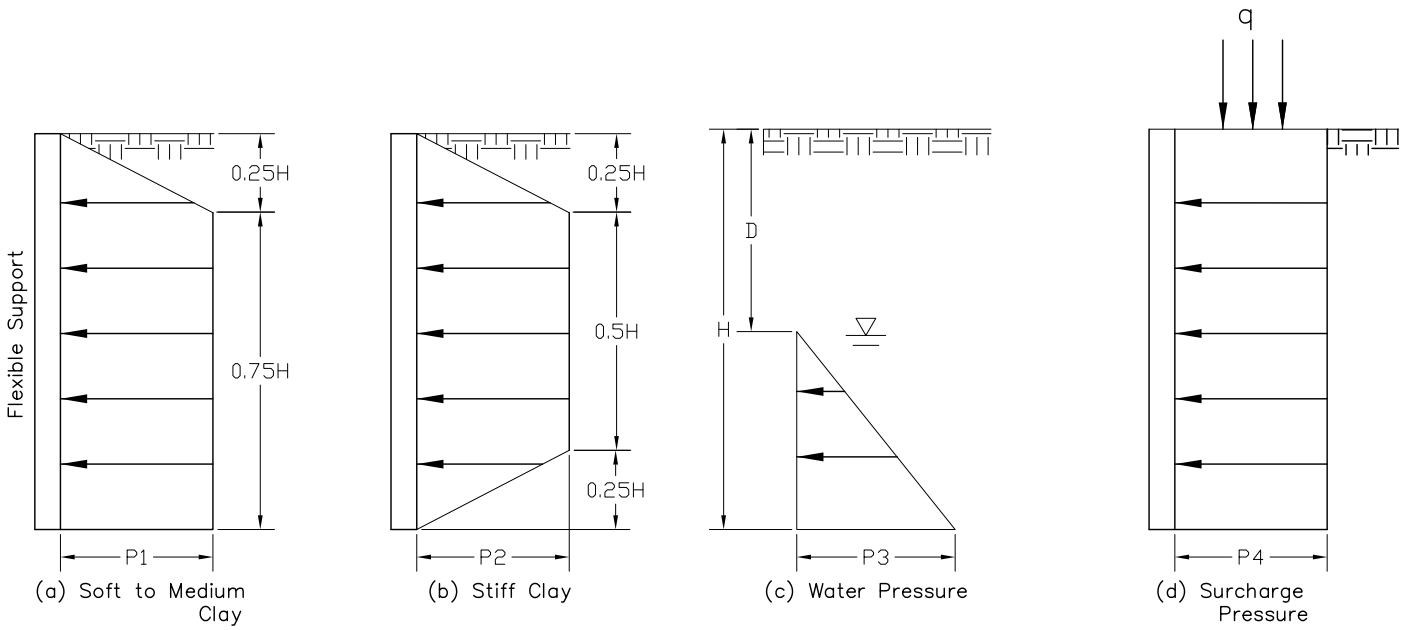
LATERAL PRESSURE DIAGRAMS
FOR OPEN CUTS IN COHESIVE SOIL - LONG TERM CONDITIONS



Empirical Pressure Distributions

Where:
H = Total excavation depth, feet
D = Depth to water table, feet
P1 = Lateral earth pressure = γH-4C, psf
P2 = Lateral earth pressure = 0.4γH, psf
P3 = Water pressure = γ_w (H-D), psf
P4 = Lateral earth pressure caused by surcharge = qK_a, psf
γ = Effective unit weight of soil, pcf
γ_w = Unit weight of water, pcf
C = Drained shear strength or cohesion, psf
K_a = Coefficient of active earth pressure

Notes:
1. All pressures are additive.
2. No safety factors are included.
3. For use only during long term construction.
4. If γH/C < 4, use section (b),
   If 4 < γH/C < 6, use larger of section (a) or (b),
   If γH/C > 6, use section (a).

Reference: Peck, R.B. (1969), "Deep Excavation and Tunneling in soft Ground", 7th ICSMFE, State of art volume, pp. 225-290.

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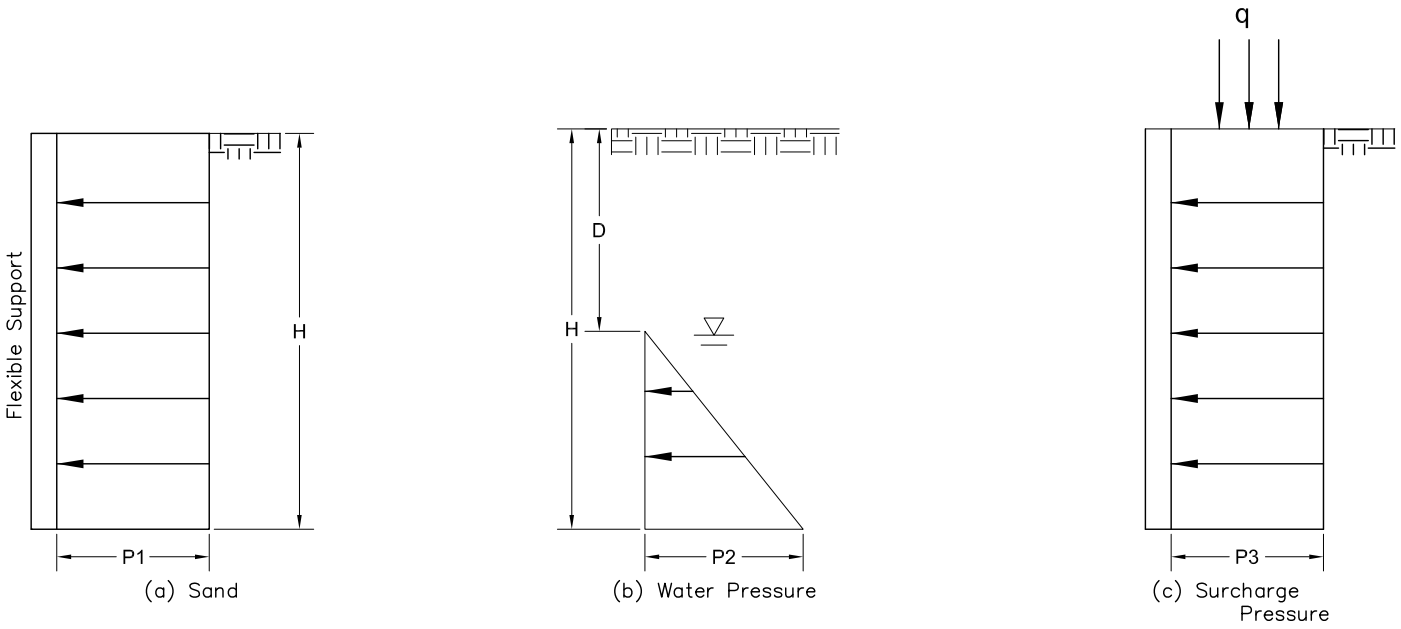
LATERAL PRESSURE DIAGRAMS
FOR OPEN CUTS IN SAND



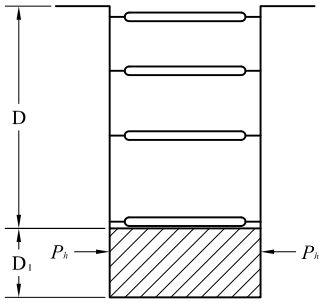
Empirical Pressure Distributions

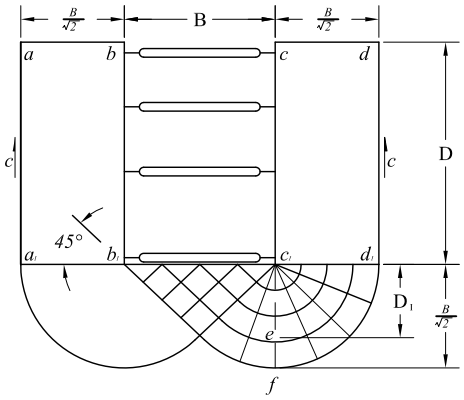
Where:
H = Total excavation depth, feet
D = Depth to water table, feet
P1 = Lateral earth pressure = $0.65*\gamma HK_a$, psf
P2 = Water pressure = γ_w (H-D), psf
P3 = Lateral earth pressure caused by surcharge = qK_a, psf
γ = Effective unit weight of soil, pcf
γ_w = Unit weight of water, pcf
K_a = Coefficient of active earth pressure = $(1-\sin\varphi)/(1+\sin\varphi)$
φ = Drained friction angle

Notes:
1. All pressures are additive.
2. No safety factors are included.

Reference: Peck, R.B. (1969), "Deep Excavation and Tunneling in soft Ground", 7th ICSMFE, State of art volume, pp. 225-290.

BOTTOM STABILITY FOR BRACED EXCAVATION IN CLAY





Factor of Safety against bottom of heave,

$$F.S = \frac{NcC}{(\gamma D+q)}$$

where, Nc = Coefficient depending on the dimension of the excavation (see Figure at the bottom)
C = Undrained shear strength of soil in zone immediately around the bottom of the excavation,
γ = Unit weight of soil,
D = Depth of excavation,
q = Surface surcharge.

If F.S < 1.5, sheeting should be extended further down to achieve stability

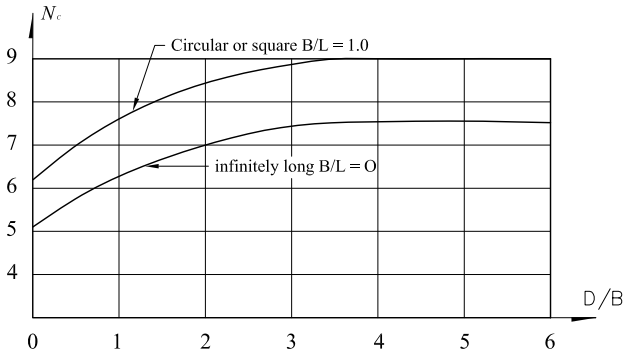
$$\text{Depth of Buried Length, } (D_1) = \frac{1.5(\gamma D+q)-NcC}{(C/B)-0.5\gamma} \; ; \; D_1 \geq 5 \text{ ft.}$$

Pressure on buried length, P_h:

For $D_1 < 0.47B$; $P_h = 1.5\, D_1(\gamma D - 1.4\, CD/B - 3.14C)$

For $D_1 > 0.47B$; $P_h = 0.7\, (\gamma DB - 1.4\, CD - 3.14CB)$

where; B = width of excavation



N_c rectangular = $(0.84 + 0.16B/L)N_c$ square

Reference: Bjerrum, L. and Eide, O., Stability of Strutted Excavations in Clay, Geotechnique, 6, 32-47 (1956).

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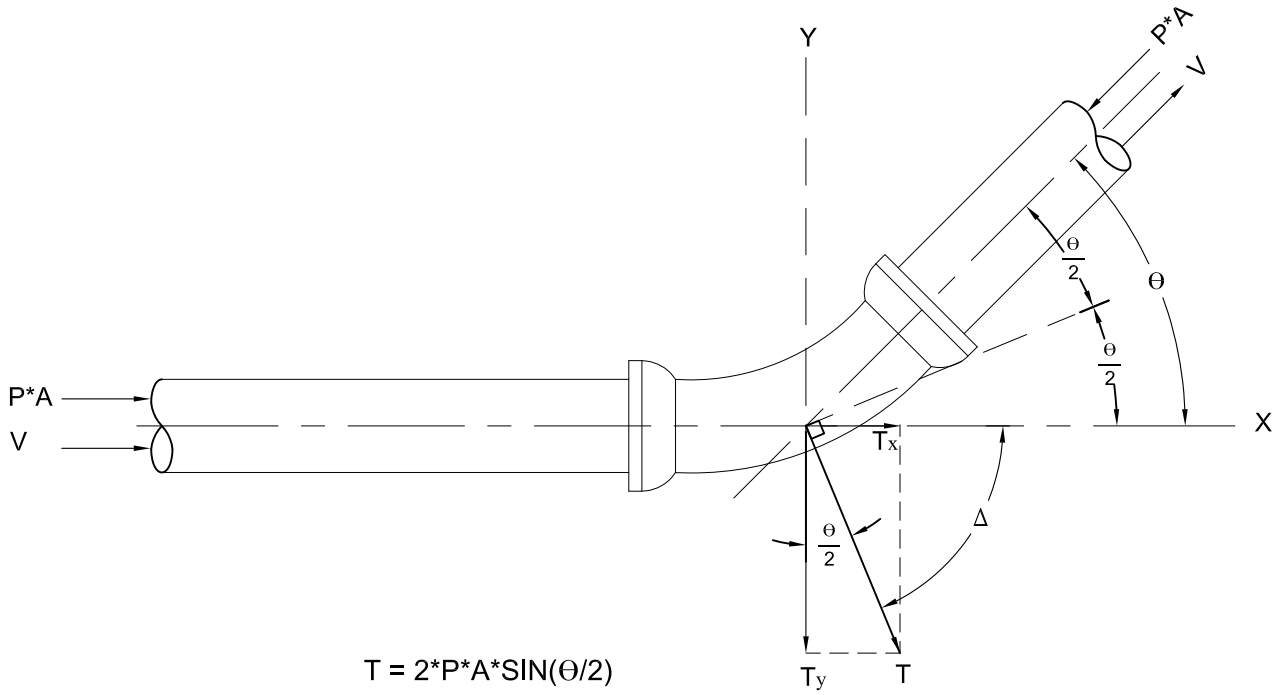
THRUST FORCE CALCULATION



$T = 2*P*A*SIN(\Theta/2)$

$T_x = P*A*(1-COS\Theta)$

$T_y = P*A*SIN\Theta$

$\Delta = (90-\Theta/2)$

Where:

T = resultant thrust force

T_x= thrust force component along the X axis

T_y= thrust force component along the Y axis

P = maximum sustained pressure

A = cross-sectional area of pipe = $(\pi/4)*(D)^2$

D = inside diameter conduit

Θ = angle of bend

Δ = angle between X axis and T

V = fluid velocity

PLATE D-8

Reference: American Water Works Association, Manual MA, "Concrete Pressure Pipe".

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THRUST FORCE EXAMPLE CALCULATION

Trust Force Example Calculation

$T = 2*P*A*SIN(\Theta/2)$

$T_x = P*A*SIN(1-COS\Theta)$

$T_y = P*A*SIN\ \Theta$

Where:

T = resultant thrust force

T_x = thrust force component along the X axis

T_y = thrust force component along the Y axis

P = maximum sustained pressure

A = cross-section area of pipe = $(\pi/4)*(D)^2$

D = inside diameter of conduit

U = angle of bend

Given: D = 24", P = 200 psi, $\Theta = 60°$

Find: T, T_x and T_y

$A = (\pi/4)*(24)^2 = 452.39\ in^2$

$T = 2*200*452.39*SIN(60/2) = 90,478\ lb$

$T_x = 200*452.39*(1-COS60) = 45,239\ lb$

$T_y = 200*452.39*SIN60 = 78,356\ lb$

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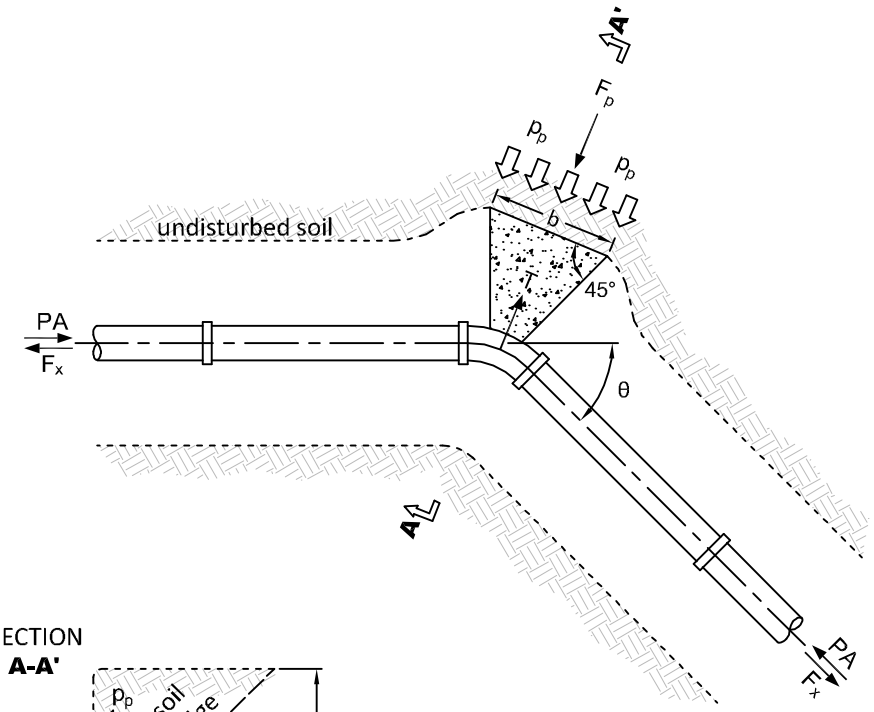
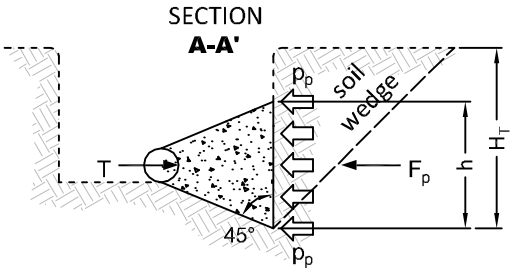
DESIGN PARAMETERS FOR BEARING THRUST BLOCK





Required Bearing Area:

$$A_b = hb = \frac{F_s\ 2PA\ \sin\frac{\theta}{2}}{p_p}$$

Required Block Width:

$$b = \frac{2F_s\ PA\ \sin\frac{\theta}{2}}{h\ p_p}$$

Where:

$p_p = \Upsilon H_c K_p + 2C\sqrt{K_p}$

$K_p = \tan^2\left(45° + \frac{\emptyset}{2}\right)$

Where:

T = resultant thrust force on the bend

F_p = resistance force developed by passive soil pressure

A_b = minimum bearing area of block base

h = height of thrust block

b = width of thrust block

A = pipe cross-sectional area

θ = bend deflection angle

p_p = passive soil pressure

H_T = depth to bottom of block

Υ = soil unit weight

K_p = coefficient of passive earth pressure

$\emptyset$ = soil internal friction angle

C = soil cohesion

F_s = factor of safety (usually 1.5)

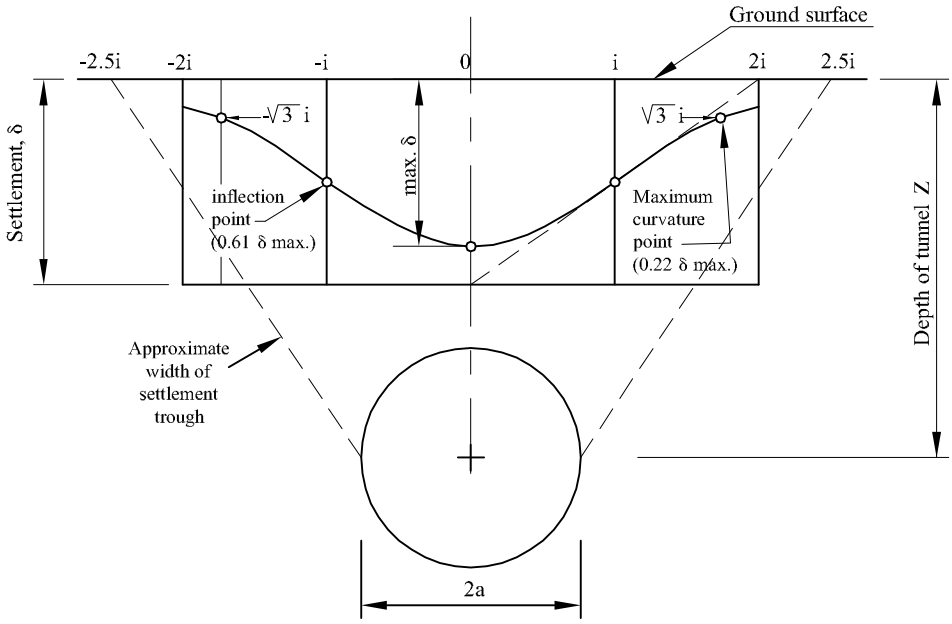
H_c = mean depth from ground surface to the plane of resistance (center of bearing area of a thrust block)

p = maximum sustained pressure

F_x = conduit frictional resistance per unit length

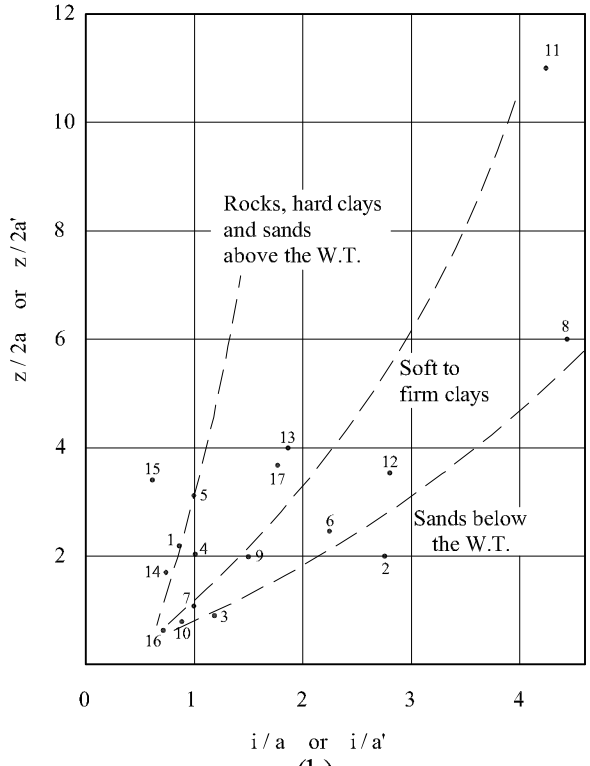
PLATE D-10

Relation between the Width of the Surface Depression (i/a) and the Depth of the Cavity (z/a) for Tunnels



Volume of depression = 2.5i δ max.

(a)



(b)

Reference: Peck, R. B. (1969) "Deep Excavations and Tunneling in Soft Ground," Proceedings, Seventh International Conference on Soil Mechanics and Foundation Engineering, Mexico City, State of the Art Volume, pp. 225-290.

PLATE D-11