



GEOTECHNICAL AND
WATER RESOURCES ENGINEERING

FACILITIES DATA REPORT ADDENDUM NO. 3

THORNTON JUSTICE CENTER FACILITIES ADAMS COUNTY, COLORADO

Submitted to

City of Thornton

12450 Washington Street, Suite 100
Thornton, Colorado 80241

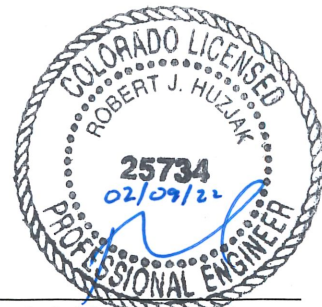
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Project 21129



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SECTION 1 – INTRODUCTION

1.1 Purpose and Objective

The purpose of this *Thornton Justice Center Facilities Data Report Addendum No. 3* (Addendum) is to present site and geotechnical data collected subsequent to completion of the Phase II remediation work. Information presented in this Addendum supplements data presented in the preceding RJH Consultants, Inc. (RJH) data reports (2015, 2016, 2018), and was collected to support concept-level and final design of expansive subgrade mitigation measures associated with Phase III.

Information regarding evaluation of mitigation concepts are presented in the *Draft Phase III Concept Memorandum* (RJH, 2022).

1.2 Background

The City of Thornton (Thornton) retained RJH to provide engineering services to evaluate expansive soil and bedrock conditions, and to assist in implementing mitigation measures to reduce the impact of expansive materials. The Thornton Justice Center (Justice Center) is located at 9551 Civic Center Drive in Thornton, Colorado and is comprised of a police building, courts building, bi-level parking structure, parking areas, and landscape areas. The Justice Center is located east of Interstate 25, west of Civic Center Drive, north of Thornton Parkway, and south of Croke Lake as shown on Figure 1.1.

The overall project was divided into three primary phases. Phase I mitigation was generally around the courts building located at the southern extent of the Justice Center. Phase II mitigation was located around the west side of the police building and lower parking lot. Phase III mitigation will address areas east of the police building, Memorial Plaza, and the upper parking area. The data collected during Phase I was provided in the *Thornton Justice Center Facilities Data Report* (RJH, 2015) and *Thornton Justice Center Facilities Data Report, Addendum No. 1* (RJH, 2016). Phase I construction was completed in fall 2017.

The data collected during Phase II was provided in *Thornton Justice Center Facilities Data Report Addendum No. 2* (RJH, 2018). Phase II construction was completed in October 2020.

This Phase III investigation provides additional subsurface data needed to support project design of the deep foundation required at the mechanically stabilized earth retaining wall at the north side of the upper parking area (MSEW-2), the collection trench at the east side of the upper parking area and Memorial Plaza, and the upper parking area (Project).

1.3 Scope of Services

RJH performed the following services as a part of the data collection task for Phase III:

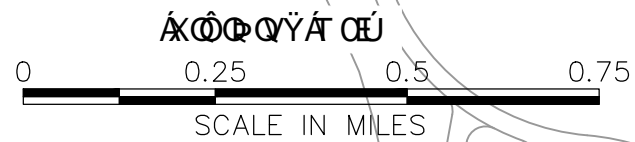
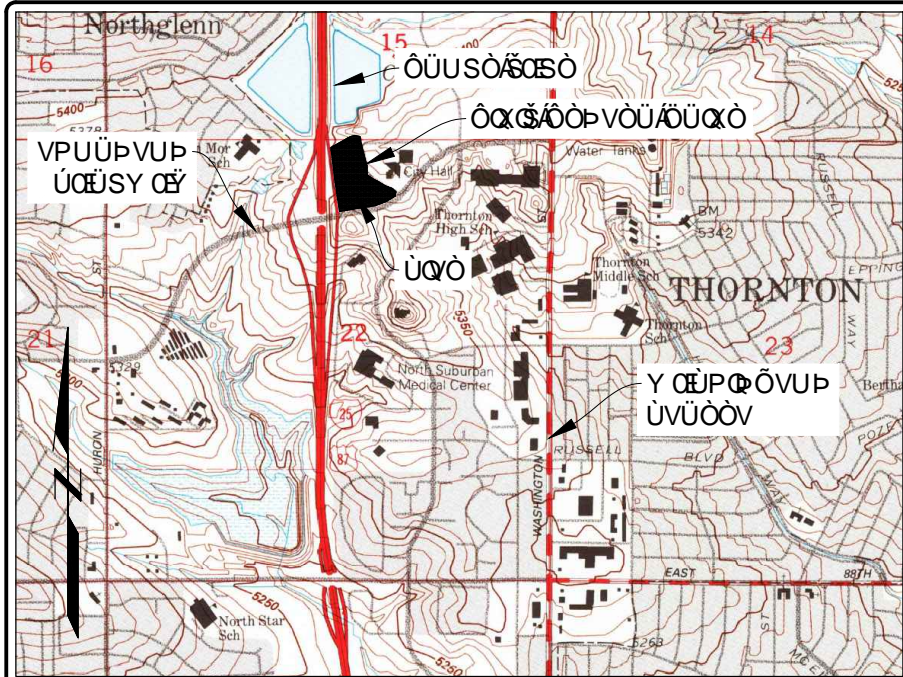
- Prepared for field work, which included creating a Project-specific Health and Safety Plan, developing an exploration plan, and coordinating underground utility locates.
- Performed a subsurface exploration, and provided a field engineer to observe and document site conditions and subsurface conditions.
- Performed quality assurance of collected samples and draft boring logs.
- Performed laboratory testing on select soil and bedrock materials.
- Prepared final boring logs based on field logs, quality assurance, and laboratory test results.
- Prepared this Addendum.

1.4 Authorization and Project Personnel

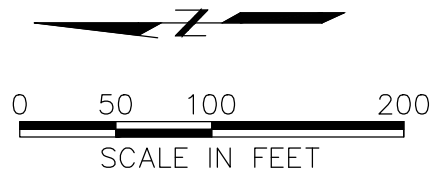
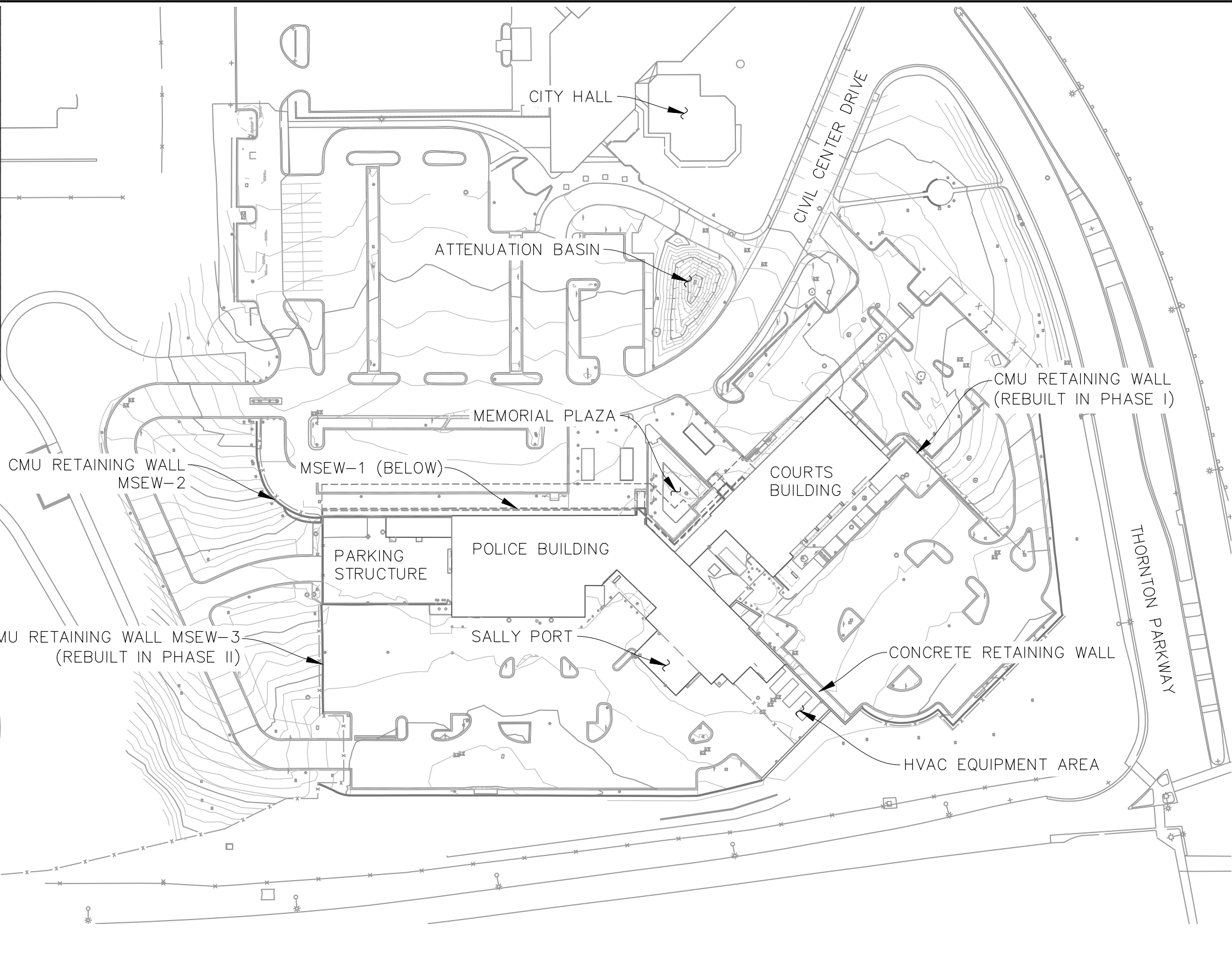
This work was performed in general accordance with the terms and conditions of Purchase Order Number 2101396 between Thornton and RJH dated August 27, 2021.

The following personnel from RJH are responsible for the work contained in this Addendum:

Project Manager, Geotechnical Engineer:	Robert Huzjak, P.E.
Project Engineer, Civil Engineer:	Nicole Alizadeh, P.E.
Staff Geological or Geotechnical Engineers:	Claire Stewart, E.I. Jake Weems, E.I.



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Figure 1.1

SECTION 2 – SITE INVESTIGATIONS AND EXPLORATIONS

2.1 General

The first stage of field work for the site investigation began on November 15, 2021 and concluded on November 20, 2021. The site investigation work consisted of:

- Drilling, sampling, and logging eight boreholes around the eastern perimeter of the Justice Center, in parking lots, sidewalks, and landscaped areas near MSEW-2.

The second stage of field work occurred on January 3, 2022 and consisted of drilling, sampling, and logging two boreholes in Memorial Plaza.

2.2 Subsurface Exploration

RJH retained Elite Drilling Services, LLC (Elite) of Denver, Colorado to provide drilling equipment and services. An RJH geotechnical engineer was on-site during drilling. Ten borings were drilled for the Project. B-601 through B-607B were performed during the first stage of field work, and B-608 and B-609 were performed during the second stage of field work. B-607A was abandoned after drilling approximately 46.0 feet below the ground surface (bgs) because coring equipment could not be retrieved from the bottom of the boring. B-607B was drilled approximately 5.0 feet north of B-607A to complete sampling to a depth of approximately 50.0 feet. Groundwater was not encountered in the borings. The horizontal coordinates and ground surface elevations at the boring locations are provided in Table 2.1 and the approximate boring locations are shown on Figure 2.1. Logs of each boring are provided in Appendix B.2.

**TABLE 2.1
SUMMARY OF BORINGS**

Boring ID ⁽¹⁾	Northing (ft) ⁽²⁾	Easting (ft) ⁽²⁾	Ground Surface Elevation (ft) ⁽³⁾	Estimated Top of Bedrock (ft)	Total Boring Depth (ft)
B-601	1196459.73	3145241.9	5438.68	Not Encountered	10.0
B-602	1196406.83	3145245.7	5437.27	6.0	10.0
B-603	1196332.23	3145248.1	5436.29	3.5	10.0
B-604	1196222.91	3145246.4	5436.54	2.2	10.0
B-605	1196158.09	3145238.2	5437.67	6.0	10.0
B-606	1196496.12	3145233.1	5435.02	18.8	53.0
B-607A	1196447.31	3145146.8	5424.48	8.9	46.0
B-607B	1196454.78	3145146.8	5425.00	8.9	49.0
B-608	1196140.49	3145254.52	5437.67	5.7	8.5
B-609	1196096.80	3145266.18	5437.67	7.1	10.0

Notes:

1. Boring locations are approximate and were located using a handheld GPS.
2. Modified Colorado State Plane NAD83, North Zone. Conversion factor is 0.999721940.
3. Vertical Datum is North American Vertical Datum of 1988.
4. Ground surface elevations are approximate and based on survey data collected as part of the Phase I investigation.

Elite used a track-mounted Mobile B48X drill rig to advance B-601 through B-607B. In addition, a CME-550X rubber tire all-terrain vehicle mounted rig was used to advance B-607B from 41.0 to 49.0 feet bgs after the track-mounted drill rig became inoperable. Elite used a Geoprobe 6620DT tracked drill rig to advance B-608 and B-609. Borings were advanced through soil and bedrock using 5.75-inch outside diameter (O.D.) (3.0-inch inside diameter [I.D.]), 6-inch O.D. (3.25-inch I.D.) or 7.625-inch O.D. (3.75-inch I.D.) hollow-stem augers (HSA). HSA samples were generally obtained at 2.5- or 5.0-foot intervals using the following methods:

- 1.375-inch I.D. (2.0-inch O.D.) standard split-spoon sampler (American Society for Testing and Materials International [ASTM] D1586). These samples are denoted with the prefix “S” on the boring logs.
- 2.5-inch I.D. (3.0-inch O.D.) ring-lined split barrel (Modified California) sampler (ASTM D3550). These samples are denoted with the prefix “MC” on the boring logs.

B-606 and B-607A were advanced through bedrock using 3-inch O.D. (1.875-inch I.D.) NQ wireline coring. B-607B was advanced through bedrock using HSA because coring equipment was abandoned in B-607A.

A Standard Penetration Test (SPT) was performed in general accordance with ASTM D1586 at the location of each split-spoon sample. At each SPT location, RJH recorded a “standard penetration resistance” or SPT N-value. The SPT N-value equals the number of blows that are required from a 140-pound hammer dropped 30 inches to drive a standard split-spoon sampler from 6 to 18 inches into the native soil or bedrock. The SPT N-values presented in this Addendum have not been adjusted to account for overburden pressures, hammer energy, etc. Sampler refusal was defined as 50 blows for less than 6 inches of penetration prior to advancing 18 inches. Some sample locations encountered refusal prior to advancing 18 inches. A summary of SPT N-values is presented in Table 2.2

**TABLE 2.2
SUMMARY OF SPT N-VALUES**

Geologic Unit	Number of Tests	Number of Tests Reporting Refusal	Minimum N-Value	Maximum N-Value	Average N-Value
Fill	21	0	4	20	11
Denver Formation	19	2	11	43	24

Notes:

1. The presented N-values are field measurements and were not adjusted to account for overburden pressures, hammer energy, etc.
2. Blow counts obtained while advancing Modified California samplers (10 samples) are not included in the tabulated data.
3. Tests that reported N-value as refusal (2 samples) were omitted while identifying the maximum and calculating the average.

Hammer blow counts were recorded for each 6-inch interval of penetration while advancing Modified California samplers. These blow counts differ from SPT data; however, blow counts can be used to monitor the relative consistency (i.e., soil stiffness or density) of the sampled materials. Hammer blow counts measured when advancing Modified California samplers are presented on the boring logs and figures but do not appear in the text or tables of this Addendum.

Bedrock was sampled continuously in B-606 and B-607A using NQ-size (1.875-inch core diameter, 3-inch hole diameter) wireline rock coring techniques in general accordance with ASTM D2113. Bedrock core runs ranged in length from 0.5 to 5.0 feet and were generally 5 feet.

Sampling in B-607B began at a depth of 20.0 feet bgs. This depth was selected to correlate bedrock material properties obtained from Modified California samplers, and standard split-spoon samplers in B-607B to coring information obtained in B-607A.

Borings were backfilled with cement-bentonite grout. Borings advanced through landscaped areas were capped with soil cuttings and borings advanced through pavements were capped with ready-mix concrete or asphalt.

2.3 Logging and Sample Package Procedures

RJH observed drilling procedures, recorded relevant drilling information, photographed and visually classified the soil and bedrock samples, and prepared a field log of each boring. Photographs of selected site and boring activities are presented in Appendix A.

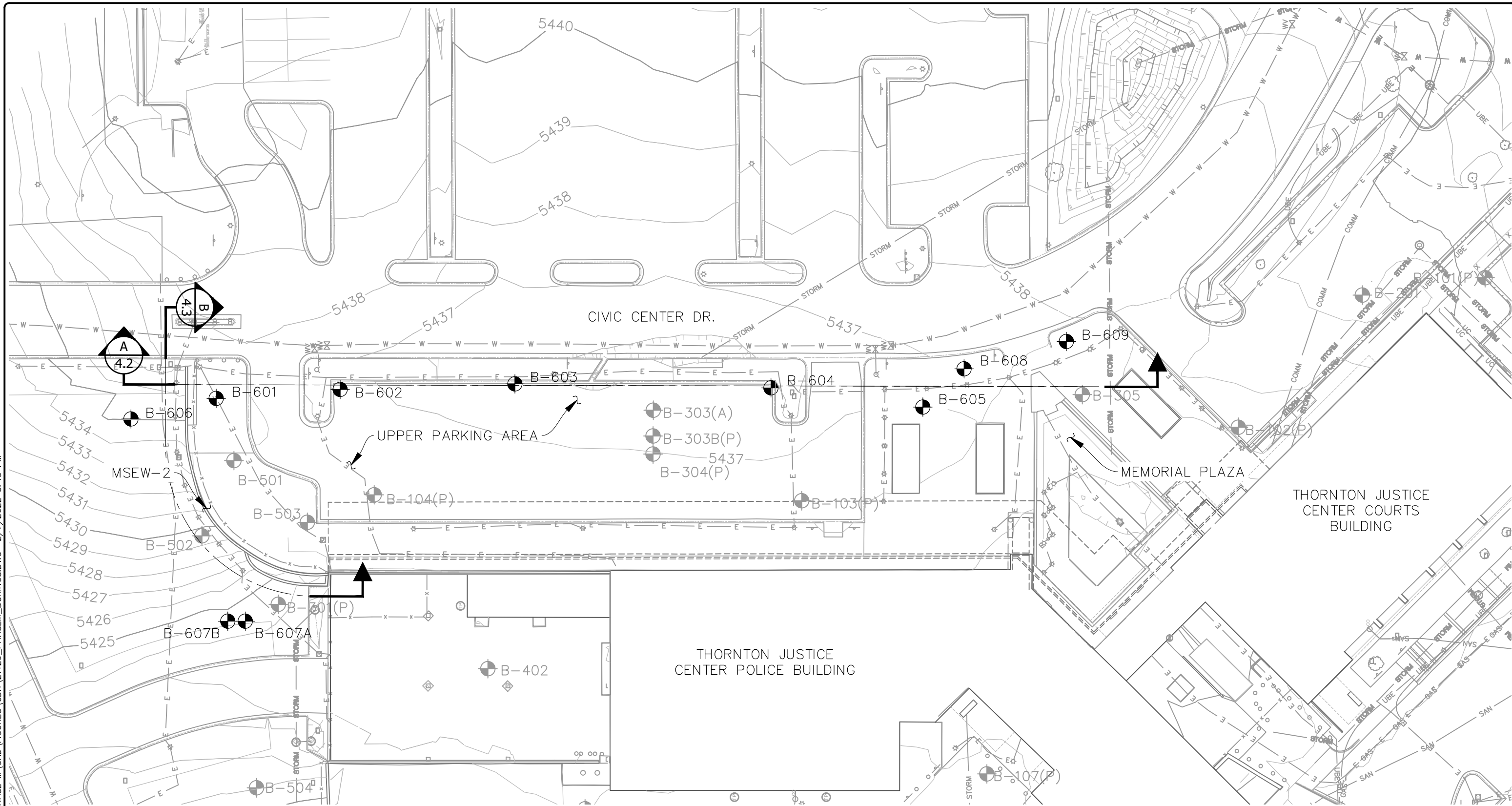
In the field, soil samples were classified in general accordance with ASTM D2488 (visual-manual method) and rock samples were classified in general accordance with the U.S. Bureau of Reclamation (USBR) Engineering Geology Field Manual (USBR, 2001).

Collected soil samples were packaged and transported in general accordance with ASTM D4220. Recovered split-spoon samples were placed in sealed plastic bags to help preserve the natural moisture content of the material. Samples recovered from Modified California samplers were kept in brass liners that were capped and sealed with vinyl tape.

Bedrock core samples were photographed, logged, and placed in wooden core boxes. Core samples were wrapped in plastic to help preserve the natural moisture content, and some core samples were also wrapped with tape to maintain the samples in compression for possible laboratory testing.

RJH prepared final boring logs based on field and laboratory classifications, quality assurance review of samples, and indirect observations (i.e., drill chatter, drill resistance, etc.) as appropriate. Between recovered samples, the lithology presented on the boring logs is interpreted. Explanations of the soil and rock descriptors used on the boring logs are presented in Appendix B.1. Boring logs are provided in Appendix B.2.

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Figure 2.1

SECTION 3 – LABORATORY TESTING

Laboratory tests were performed on select samples of soil and bedrock collected during the subsurface exploration. RJH retained Advanced Terra Testing of Lakewood, Colorado to perform the laboratory tests. The tests consisted of:

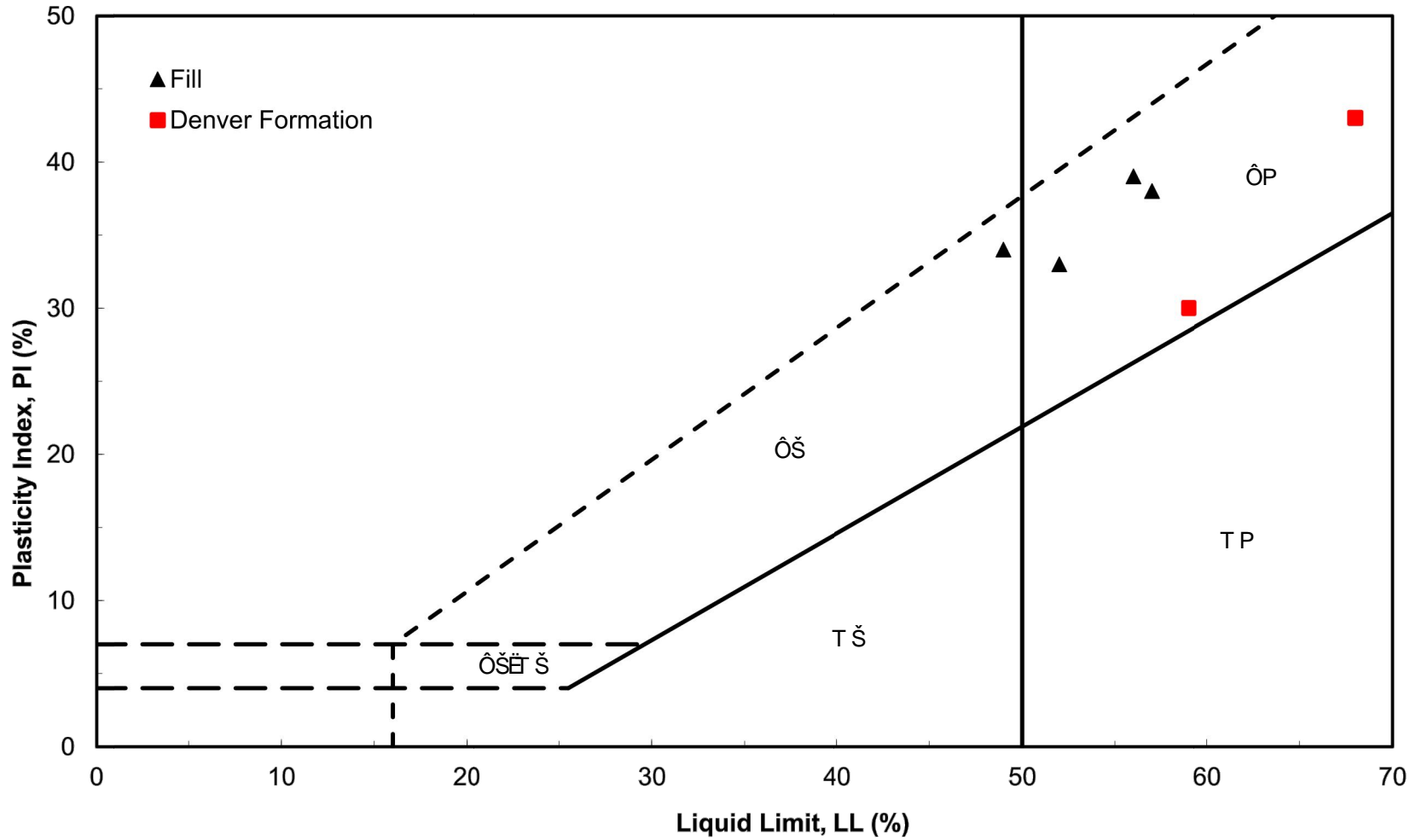
- Ten natural moisture content and density tests (ASTM D2216 and ASTM D7263).
- Six Atterberg limits tests (ASTM D4318).
- Two grain-size analyses (ASTM D6913).
- Two grain-size analyses with hydrometer (ASTM D7928 and ASTM D6913).
- Three minus No. 200 sieve analyses (ASTM D1140).
- Five swell-consolidation tests (ASTM D4546 Denver Method Pre-2008).
- Four unconfined compressive strength (UCS) tests (ASTM D7012).

Laboratory test results are provided in Appendix C and are summarized in Table 3.1. Atterberg limits and grain-size analysis test results are presented graphically on Figures 3.1 and 3.2, respectively.

**TABLE 3.1
SUMMARY OF LABORATORY TEST RESULTS**

Boring ID	Sample ID	Top Depth (ft)	Bottom Depth (ft)	USCS Classification (Group Symbol) or Bedrock Description ⁽¹⁾	Moisture Content (%)	Dry Unit Weight (pcf)	Atterberg Limits		Gradation				Swell / Consolidation ⁽²⁾		Unconfined Compression Strength (psf)
							Liquid Limit (%)	Plasticity Index, PI (%)	Gravel (<3" to >#4) (%)	Sand (<#4 to >#200) (%)	Fines (<#200) (%)		Inundation Pressure (pcf)	Swell / Consolidation (%) ⁽³⁾	
											Silt (<#200 to >0.002 mm) (%)	Clay (<0.002 mm) (%)			
Fill															
B-602	S-1	1.0	2.5	Clayey Sand (SC)					0	53					
B-603	S-1	1.0	2.5	Fat Clay (CH)			52	33	1	7					
B-607A	S-1	1.0	2.5	Fat Clay with Sand (CH)					2	14					
B-605	S-2	3.5	5.0	Sandy Fat Clay (CH)			57	38	6	28					
B-607A	MC-3	6.5	7.0	Fat Clay with Sand (CH)	23.4	96.6	56	39					2700	-0.53	
B-607A	MC-3	7.0	7.5	Fat Clay with Sand (CH)	23.1	102.0									3435
B-606	MC-4	9.5	10.0	Lean Clay with Sand (CL)	22	103.5	49	34					210	0.70	
Denver Formation															
B-604	S-3	6.0	7.5	Claystone					0	3	97				
B-606	MC-7	21.0	21.5	Claystone	20.4	104.7									5379
B-607A	NQ-2	22.6	23.1	Claystone	18.9	108.1	68	43							
B-607A	NQ-6	35.0	35.6	Clayey Sandstone	19	110.3			0	55	45		5989	-0.14	
B-606	NQ-5	42.0	42.4	Claystone	15.7	117.0									20541
B-606	NQ-5	42.4	42.8	Claystone	16.2	111.7	59	30	0	15	85		3578	1.44	
B-606	NQ-7	50.7	51.2	Claystone	18.2	111.4							4600	0.41	
B-606	NQ-7	50.7	51.2	Claystone	16.1	113.7									8971

1. Based on visual/manual classification and laboratory test results.
2. Tests performed using ASTM D4546 Pre-2008 Denver Method.
3. Positive values indicate swell and negative values indicate consolidation.



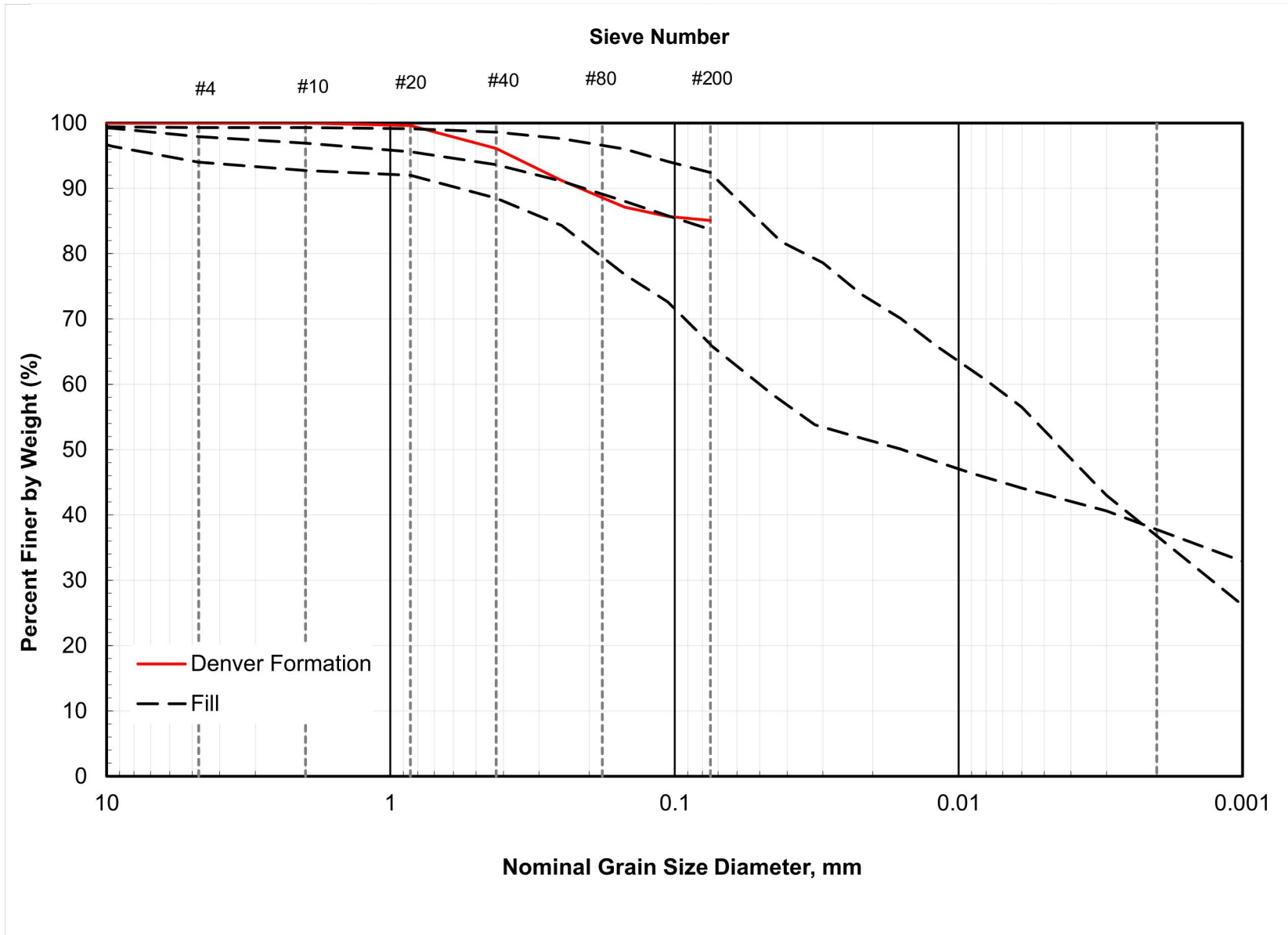
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Figure 3.1



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Figure 3.2

SECTION 4 – SUBSURFACE CONDITIONS

4.1 General

Ten geotechnical borings were drilled for this phase of work and encountered materials similar to those identified in borings from previous phases. Boring locations are presented on Figure 2.1, and boring logs are in Appendix B. Subsurface Sections A and B are presented on Figures 4.2 and 4.3 respectively, and an explanation of the subsurface sections is provided on Figure 4.1. Subsurface materials encountered in the borings consisted of pavement, fill, and bedrock. Bedrock was encountered in all borings except for B-601, which was located in MSEW-2 fill. Descriptions of the materials encountered near the collection trench, the upper parking area, and MSEW-2 are provided in the following sections.

Groundwater was not encountered in the borings drilled for Phase III. A water level measurement was recorded at 10.1 feet bgs in B-606, but is considered to represent the level of drilling fluids within the borehole.

4.2 Collection Trench

B-601 through B-605, B-608, and B-609 are considered collection trench borings. These borings were selected based on the general location near the concept-level alignment for a collection trench in the east side of the upper parking area.

4.2.1 Fill

Fill was encountered in all of the collection trench borings during Phase III. The top of fill ranged from 0.5 to 0.9 feet bgs, and the bottom of fill ranged from 2.2 to 10.0 feet bgs. Fill near the collection trench primarily consisted of medium to high plasticity clay with various amounts of sand and gravel sized particles. Visual classification included fat clay with sand, fat clay, sandy fat clay, sandy lean clay, and lean clay. Sand content typically ranged from 5- to 45-percent, and gravel content was typically less than 10-percent with a maximum particle size of 0.75-inch. The stiffness of the fill ranged from soft to hard and was typically medium stiff to stiff.

Coarse-grained fill was encountered in B-602 at a depth from 0.9 to 4.3 feet and in B-609 at a depth from 0.5 to 2.5 feet and consisted of clayey sand. The coarse-grained fill was medium dense and the maximum particle size was about 1.25-inches.

Unconfined compression strength from pocket penetrometer ranged from 0.75 to 4.25 tons per square foot (tsf) and was typically 2.0 tsf. The apparent moisture content of fill was generally dry to moist. Reaction with hydrochloric acid was typically weak to strong.

Index testing was performed on three samples of fill near the collection trench, and the results included:

- Liquid limit ranging from 52 to 57 percent with an average of 55 percent.
- Plasticity index ranging from 33 to 38 percent with an average of 36 percent.
- Fines content ranging from 47 to 92 percent with an average of 69 percent.
- Sand content ranging from 7 to 53 percent with an average of 29 percent.
- Gravel content ranging from 0 to 6 percent with an average of 2 percent.

4.2.2 Denver Formation Bedrock

Denver Formation bedrock was encountered in all of the collection trench except in B-601 which was located in MSEW-2 fill. The top of bedrock ranged from 2.2 to 7.1 feet bgs. The bottom of bedrock extended to the bottom of each boring except in B-601. Denver Formation near the collection trench was classified as medium to high plasticity claystone. Sand content was typically less than 10-percent with no gravel. Weathering ranged from moderately weathered to decomposed and was typically very intensely weathered. Fracturing could not be identified in the bedrock samples near the collection trench because samples were obtained using split-spoon or Modified California samplers and were disturbed. Unconfined compression strength from pocket penetrometer ranged from 2.0 to greater than 4.5 tsf and were typically 3.0 to 4.0 tsf. The apparent moisture content was generally dry to moist. Occasional iron staining and calcium seams and nodules were present in bedrock. The Denver Formation was typically light brown to light gray to gray, and the bedrock hardness was very soft.

One grain-size analysis test was performed on a sample of the Denver Formation near the collection trench, and resulted in 97 percent fines content and 3 percent sand content.

4.2.3 Previous Investigations

Phase III geotechnical data near the collection trench is generally in agreement with geotechnical data near the collection trench from Phase II. Phase II geotechnical data generally classified fill with lower plasticity and bedrock as less weathered than Phase III. Figure 2.1 presents the location of previously drilled borings near the proposed

collection trench which include B-303A and B-305. The subsurface conditions in B-303A consisted of asphalt pavement from 0.0 to 0.4 feet, fill from 0.4 to 2.6 feet, and bedrock extending from 2.6 feet to the bottom of the boring at 20.5 feet. The subsurface conditions in B-305 consisted of concrete pavement from 0.0 to 0.5 feet, fill from 0.5 to 12.0 feet, and bedrock extending from 12.0 feet to the bottom of the boring at 19.7 feet.

Fill near the collection trench from Phase II primarily consisted of low to medium plasticity fine-grained material with soil classifications of sandy lean clay, lean clay with gravel, and lean clay. One medium to high plasticity fine-grained material classified as fat clay with sand. Fine-grained material ranged from very soft to stiff and was typically medium stiff to stiff. Fine-grained fill generally consisted of 25 to 35 percent sand and less than 10 percent gravel. Some of the fill consisted of coarse-grained material with the classification of clayey sand. Coarse-grained material was medium dense. Fill was moist to very moist with some claystone fragments in the soil matrix. Unconfined compression strength from pocket penetrometer ranged from 1.0 to 1.5 tsf.

Denver Formation bedrock near the collection trench from Phase II was classified as low to high plasticity claystone. Sand content was typically less than 10 percent with no gravel content. Weathering ranged from fresh to intensely weathered and was typically classified as moderately to intensely weathered. Rock hardness classified as very soft rock. Occasional iron staining and calcium seams and nodules were present in bedrock. Groundwater was not encountered in the borings.

4.3 Upper Parking Area

No borings drilled for this phase of work were considered within the area identified as the upper parking area; however, a discussion of data from previous investigations for the upper parking area is provided below.

4.3.1 Previous Investigations

Figure 2.1 presents the location of previously drilled borings near the upper parking area, which include B-303B(P), B-304(P), B-103(P), and B-104(P). The subsurface conditions typically consisted of pavement from 0.0 to 0.5 feet over fill that extended from 10.5 to 32.8 feet, and bedrock below the fill to the bottom of each boring, which ranged from 15.0 to 50.0 feet. Generally, the top of rock elevation decreased from east to west.

Fill beneath the upper parking area was primarily classified as medium to high plasticity fine-grained material with soil classifications of fat clay with sand, sandy fat clay, and fat

clay, with some low to medium plasticity fine-grained material that classified as lean clay, sandy lean clay, and lean clay with sand. Fine-grained material ranged from soft to very stiff and was typically medium stiff to stiff. Fine-grained fill generally consisted of 20 to 30 percent sand and less than 5 percent gravel. Some of the fill was classified as coarse-grained material with the soil classifications of poorly graded sand with clay and gravel, clayey sand with gravel, well graded sand with silt and gravel, clayey sand, silty sand with gravel, and well graded sand with clay and gravel. Coarse-grained material was medium dense to very dense and was typically medium dense. Fill was typically slightly moist to moist with some claystone fragments in the soil matrix. Unconfined compression strength from pocket penetrometer ranged from 1.5 to 3.2 tsf and were typically 2.0 tsf.

Denver Formation bedrock beneath the upper parking area was primarily classified as low to high plasticity claystone with some classifications of low to medium plasticity silty claystone. Plasticity of claystone beneath the upper parking area from previous investigations was based on laboratory test results and visual classification. Sand content was typically less than 10 percent with no gravel content. Weathering ranged from fresh to intensely weathered and was typically moderately weathered. Bedrock hardness was very soft. Unconfined compression strength from pocket penetrometer was greater than 4.5 tsf. Occasional iron staining on fracture surfaces and calcium seams and nodules were present in bedrock. Groundwater was not encountered in the borings.

4.4 MSEW-2

B-606, B-607A, and B607B are considered MSEW-2 borings. The locations of these borings were generally in the vicinity of existing MSEW-2 and were selected to evaluate the subsurface conditions in the vicinity of the wall. The subsurface conditions in B-607B from 0.0 to 20.0 feet are considered to be the same as the subsurface conditions encountered in B-607A because B-607B was located about five feet north of B-607A.

4.4.1 Fill

Fill was encountered in all of the MSEW-2 borings, which were drilled on the downslope (north) side of the MSEW-2 within a sloped, landscaped area. Fill was encountered at the ground surface, and the bottom of fill ranged from 8.9 to 18.8 feet bgs. Fill near MSEW-2 primarily consisted of medium to high plasticity fine-grained clay with soil classifications of lean clay with sand, fat clay with sand, sandy lean clay, and sandy fat clay. Stiffness ranged from medium stiff to hard and was typically stiff to very stiff. Sand content typically ranged from 10 to 35 percent, and gravel content was typically

less than 10 percent with a maximum particle size of about 1.25-inches. Unconfined compression strength from pocket penetrometer ranged from 2.0 to 4.5 tsf and was typically 3.0 tsf. The apparent moisture content of fill was generally dry to moist. Reaction with hydrochloric acid was typically weak to strong.

Laboratory testing was performed on four samples of fill near MSEW-2, and the results included:

- Moisture content ranging from 22.0 to 23.4 percent with an average of 22.8 percent.
- Dry unit weight ranging from 97 to 104 pounds per cubic foot (pcf) with an average of 101 pcf.
- Liquid limit ranging from 49 to 56 percent with an average of 53 percent.
- Plasticity index ranging from 34 to 39 percent with an average of 37 percent.
- Fine content of 84 percent, sand content of 14 percent, and gravel content of 2 percent.
- Consolidation of -0.53 percent with inundation pressure of 2,700 pounds per square foot (psf) and swell of 0.70 percent with inundation pressure of 210 psf.
- Unconfined compression strength of 3,435 psf.

4.4.2 Denver Formation Bedrock

Denver Formation bedrock was encountered in all of the MSEW-2 borings. The top of bedrock ranged from 8.9 to 18.8 feet bgs, and bedrock extended to the bottom of each boring. Denver Formation near MSEW-2 primarily consisted of medium to high plasticity claystone. Sand content was typically less than 10 percent with no gravel content. A thin layer of clayey sandstone was encountered at B-606 from elevation (El.) 5390.1 to El. 5388.9 (44.9 to 46.1 feet bgs) and El 5389.9 to El. 5387.7 (34.6 to 36.8 feet bgs) at B-607A. The fines content of clayey sandstone ranged from 25- to 50-percent and consisted of low to medium plasticity fines. A layer of sandstone was encountered in B-607B from El. 5382.5 to El. 5376.3 (42.5 to 48.7 feet bgs). The fines content of sandstone ranged from 5- to 15-percent and consisted of low to medium plasticity fines. Gravel was not present in bedrock. Weathering ranged from fresh to decomposed with claystone typically ranging from moderately to intensely weathered, and coarse-grained bedrock typically ranging from slightly to intensely weathered. Reduction of weathering intensity was not apparent with depth. Fracturing density ranged from unfractured to very intensely fractured. Claystone was typically slightly to moderately fractured, and

coarse-grained bedrock was typically slightly fractured. Pattern of fracturing density was not apparent with depth. Randomly oriented fractures were noted throughout the claystone bedrock. Bedrock hardness ranged from soft to very soft. Unconfined compression strength from pocket penetrometer ranged from 3.0 to 4.0 tsf. The apparent moisture content of the bedrock was generally dry to moist. Occasional iron staining and calcium seams and nodules were present in bedrock with trace manganese staining. The bedrock was typically light brown to light gray to gray.

Laboratory testing was performed on seven samples of the Denver Formation near MSEW-2, and the results included:

- Moisture content ranging from 15.7 to 20.4 percent with an average of 17.8 percent.
- Dry unit weight ranging from 105 pcf to 117 pcf with an average of 111 pcf.
- Liquid limit ranging from 59 to 68 percent with an average of 64 percent.
- Plasticity index ranging from 30 to 43 percent with an average of 37 percent.
- Clayey sandstone fines content of 45 percent, sand content of 55 percent, and no gravel content.
- Claystone fines content of 85 percent, sand content of 15 percent, and no gravel content.
- Consolidation of -0.14 percent with inundation pressure of 5,989 psf, swell of 1.44 percent with inundation pressure of 3,578 psf, and swell of 0.41 percent with inundation pressure of 4,600 psf.
- Unconfined compression strength of claystone specimens ranging from 5,379 psf to 20,541 psf with an average of 11,630 psf.

4.4.3 Previous Investigations

Phase III geotechnical data near MSEW-2 is generally in agreement with geotechnical data near the MSEW-2 from Phase II. Phase II geotechnical data generally classified fill with less sand content and softer stiffness and bedrock as slightly less weathered than Phase III. Figure 2.1 presents the location of previously drilled borings near MSEW-2 which include B-301(P), B-501, B-502, and B-503. B-501 and B-503 were drilled on the upslope (south) side of MSEW-2 within the upper parking area while B-301(P) and B-502 were drilled on the downslope (north) side of the MSEW-2 within a sloped, landscaped area. Depth of fill is greater at B-501 and B-503 than at B-301(P) and B-502

because the borings on the upslope side of the wall advanced through MSEW-2 backfill, and foundation fill and borings on the downslope side of the wall advanced through foundation fill only. However, geotechnical data of the MSEW-2 backfill was similar to the foundation fill, and the soils were grouped together as one unit. The subsurface conditions of the Phase II borings typically consisted of asphalt pavement from 0.0 to 0.7 feet (for B-501 and B-503) over fill that extended to bottom depth ranging from 9.5 to 32.0 feet, and bedrock below the fill to the bottom of each boring which ranged from 29.0 to 51.0 feet.

Fill near MSEW-2 from Phase II primarily consisted of medium to high plasticity fine-grained material with soil classifications of fat clay, fat clay with sand, and sandy fat clay with one soil classification of lean clay. Fine-grained material ranged from very soft to very stiff and was typically medium stiff. Fine-grained fill generally consisted of 15 to 25 percent sand and less than 10 percent gravel. Coarse-grained fill was encountered in B-503 from 29.5 to 32.0 feet and consisted of clayey sand. Coarse-grained material was medium dense. Fill was typically moist to very moist with some claystone fragments in the soil matrix. Reaction to hydrochloric acid was typically weak to strong. Unconfined compression strength from pocket penetrometer ranged from less than 0.5 to 3.0 tsf and was typically 1.5 tsf.

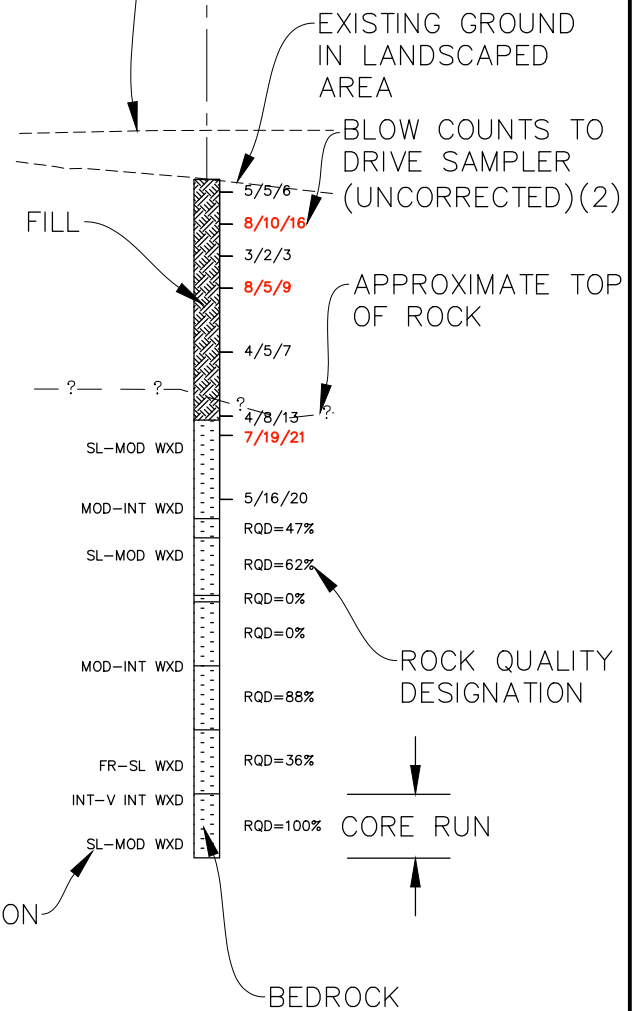
Denver Formation bedrock near MSEW-2 from Phase II was classified as medium to high plasticity claystone. Sand content was typically less than 10 percent with no gravel content. Weathering ranged from slightly to very intensely weathered and was typically classified as moderately weathered. Rock hardness classified as very soft rock. Unconfined compression strength from pocket penetrometer ranged from 2.5 to greater than 4.5 tsf and was typically 4.0 tsf. Iron and manganese staining was common on discontinuity surfaces. Groundwater was not encountered in the borings during Phase II.

BORING DESIGNATION
 LOCATION RELATION TO SECTION(5)
 B-606
 OFFSET 15

EXISTING SIDEWALK ABOVE MSEW-2

NOTES:

1. BORING COLUMNS ARE GENERALIZED AND DO NOT INCLUDE ALL INFORMATION PRESENTED ON THE BORING LOGS. REFER TO BORING LOGS IN APPENDIX B.
2. TEXT COLOR REFLECTS THE TYPE OF SAMPLER DRIVEN AND INCLUDES THE FOLLOWING:
 BLACK TEXT = SPLIT-SPOON SAMPLER
 RED TEXT = MODIFIED CALIFORNIA SAMPLER
 BLUE TEXT = DAMES & MOORE SAMPLER
3. BLOW COUNTS ARE SHOWN AT THE THE TOP OF THE SAMPLER.
4. WEATHERING DESCRIPTIONS ARE INCLUDED FOR BEDROCK WITH THE FOLLOWING ABBREVIATIONS:
 FR = FRESH
 SL WXD = SLIGHTLY WEATHERED
 MOD WXD = MODERATELY WEATHERED
 INT WXD = INTENSELY WEATHERED
 V INT = VERY INTENSELY WEATHERED
 DECOM = DECOMPOSED
5. OFFSET VALUE MEASURED IN FEET. POSITIVE OFFSET OF BORING IS NORTH OR WEST OF SECTION. NEGATIVE OFFSET OF BORING IS SOUTH OR EAST OF BORING.



WEATHERING DESCRIPTION

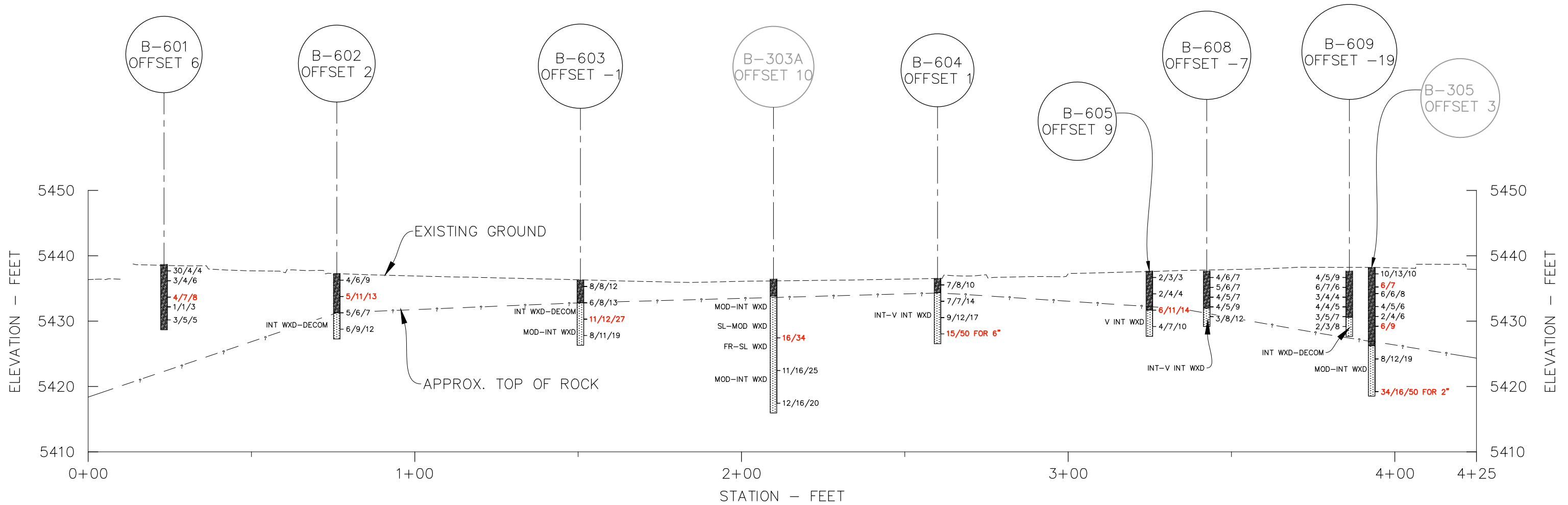
PRELIMINARY
 NOT FOR CONSTRUCTION

ÜÖÜÜÜÖWÖÖÄÖÜŠÜ



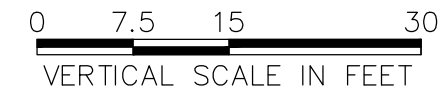
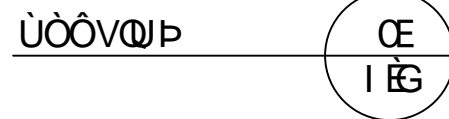
VPUÜBVUPÄMÜVÖÖÖPVOÜ
 ÜPÖÜÖÖ
 ÜÜURÖÖVÄÜÖFFGJ

ÜWÖÜWÜÖÖÖÜÖÖVÖPÄPÜVÖÜ
 ÖPÖÖÜÜÖÖPÖVÖP
 ÖÜÜÜÜÖÜÜ
 Figure 4.1



NOTES:

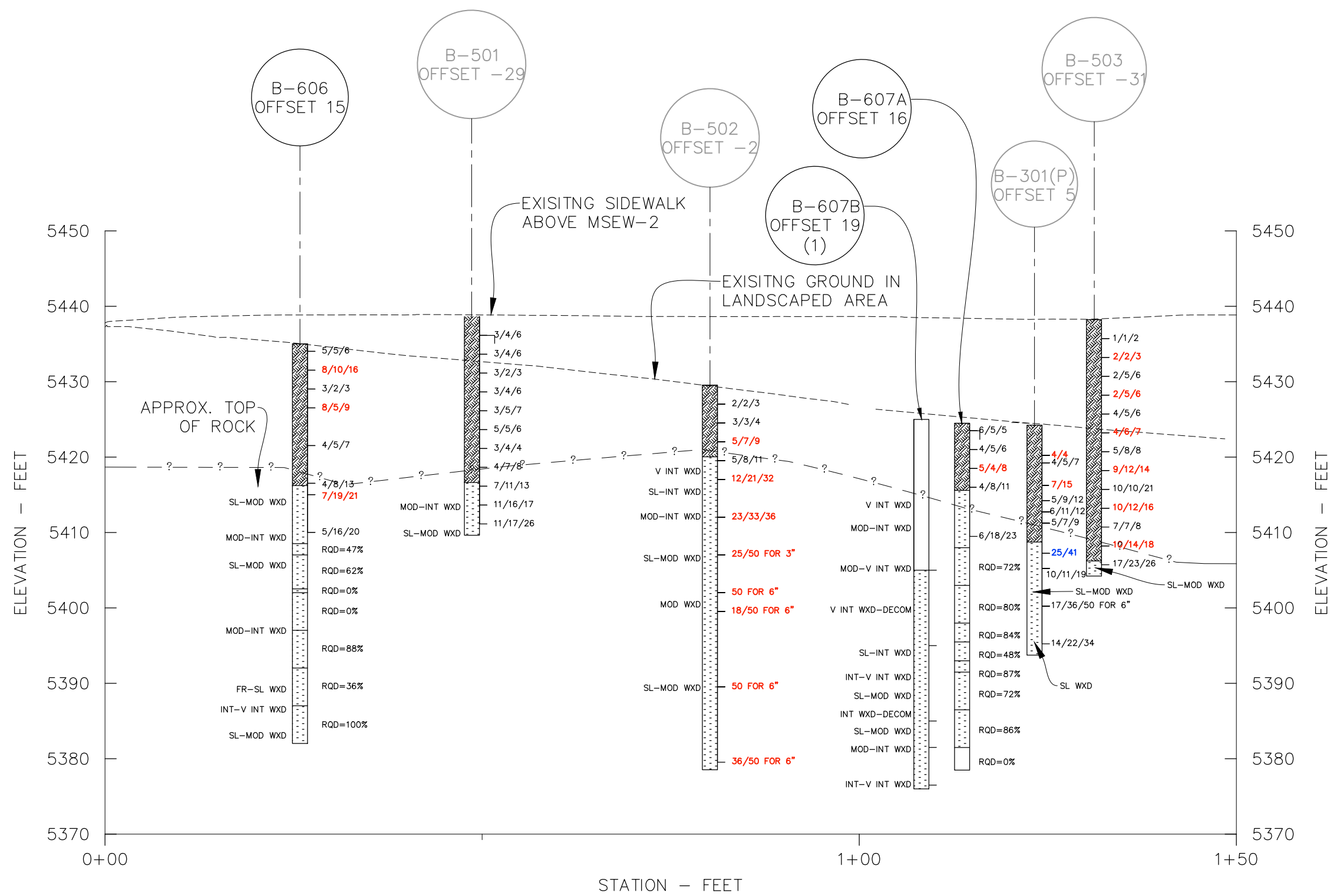
1. SUBSURFACE INFORMATION IS ONLY KNOWN AT THE BORING LOCATIONS. SUBSURFACE CONDITIONS BETWEEN BORINGS ARE INTERPOLATED.
2. SUBSURFACE STRATIGRAPHY IS BASED ON THE BORINGS WHICH ARE PROJECTED OR BEYOND THE SECTION. STRATIGRAPHY MAY NOT REPRESENT CONDITIONS ALONG THE SECTION ALIGNMENT.
3. PHASE I AND II BORING LABELS ARE SHOWN IN GRAY.



PRELIMINARY
 NOT FOR CONSTRUCTION

		VPUÜP VUP ARWÜVÖÖP VÖÜ ÜPÜÖÄM	ÜWÖÜWÜZÖÖÄÜÖÖNÜPÄE
	ÜÜURÖÖVÄUEFGJ	Øäi* æ* ÅEGG	Figure 4.2



P:\21129 - JUSTICE CENTER PHASE III\CAD\FIGURES\GDR\21129_PHASEIII_BORINGS.DWG 2/7/2022 3:44 PM



- NOTES:**
- REFER TO BORING LOGS IN APPENDIX B FOR B-607B BLOW COUNTS. WEATHERING DESCRIPTORS SHOWN AT B-607B INCLUDE OBSERVATIONS FROM ADJACENT B-607A.
 - SUBSURFACE INFORMATION IS ONLY KNOWN AT THE BORING LOCATIONS. SUBSURFACE CONDITIONS BETWEEN BORINGS ARE INTERPOLATED.
 - SUBSURFACE STRATIGRAPHY IS BASED ON THE BORINGS WHICH ARE PROJECTED OR BEYOND THE SECTION. STRATIGRAPHY MAY NOT REPRESENT CONDITIONS ALONG THE SECTION ALIGNMENT.
 - PHASE I AND II BORING LABELS ARE SHOWN IN GRAY.



PRELIMINARY
 NOT FOR CONSTRUCTION

		VPUÜPVUP ARWÜVÖÖVÖÜ ÜPÜÜÖÜ	ÜWÖÜWÜÖÜÖÜÜÖÜVÜPÜÖ
		ÜÜURÖÜVÜPÜÜFGJ	Øàì æ' ÜÜÜÜÜÜ Figure 4.3

SECTION 5 – LIMITATIONS

This Addendum has been prepared for the exclusive use of RJH and Thornton to support mitigation work around the east side of the police building, Memorial Plaza, and the upper parking area. RJH is not responsible for technical interpretations of this data by others. RJH has endeavored to conduct our professional services for this Project in a manner consistent with a level of care and skill ordinarily exercised by members of the engineering profession currently practicing in Colorado under similar conditions as this Project. RJH makes no other warranty, expressed or implied.

The methods used in this investigation indicate subsurface conditions only at the specific locations, where samples were obtained, only at the time they were obtained, and only to the depths penetrated. Samples cannot be relied on to accurately reflect variations in subsurface conditions that may exist between sampling locations.

The nature and extent of variations between borings may not become evident until construction. Timely and comprehensive observation and evaluation of actual subsurface conditions, supported by appropriate field and laboratory testing, will be critical during construction as variations from anticipated subsurface conditions may be encountered.

SECTION 6 – REFERENCES

RJH Consultants, Inc. (2015). *Thornton Justice Center Facilities Data Report – Justice Center Expansive Soils Project*, January.

RJH Consultants, Inc. (2016). *Thornton Justice Center Facilities Data Report Addendum No.1 – Justice Center Expansive Soils Project*, May.

RJH Consultants, Inc. (2018). *Thornton Justice Center Facilities Data Report Addendum No.2 – Justice Center Expansive Soils Project*, December.

RJH Consultants, Inc. (2022). *Draft Phase III Concept Memorandum - Thornton Justice Center Expansive Soil Mitigation Project*, January.

U.S. Bureau of Reclamation (USBR) (2001). *Engineering Geology Field Manual*.

APPENDIX A

PHOTOGRAPHS



Photograph 1: B-601 S-1 from 1.0 to 2.5 feet below ground surface (bgs). Typical split spoon sample of asphalt pavement.



Photograph 2: B-602 S-1 from 1.0 to 2.5 feet bgs. Typical split spoon sample of fill classified as sandy fat clay.



Photograph 3: B-606 S-5 from 13.5 to 15.0 feet bgs. Typical split spoon sample of fill classified as fat clay with sand.



Photograph 4: B-605 S-2 from 3.5 to 5.0 feet bgs. Typical split spoon sample of fill classified as fat clay.



Photograph 5: B-603 S-1 from 1.0 to 2.5 feet bgs. Typical split spoon sample of fill classified as lean clay.



Photograph 6: B-604 S-3 from 6.0 to 7.5 feet bgs. Typical split spoon of Denver Formation classified as intensely to very intensely weathered claystone.



Photograph 7: B-607A S-5 from 13.5 to 15.0 feet bgs. Typical split spoon sample of Denver Formation classified as moderately to intensely weathered claystone.



Photograph 8: B-606 NQ-2 from 28.0 to 32.5 feet bgs. Typical NQ core run of Denver Formation classified as slightly to intensely weathered claystone.



Photograph 9: B-607A NQ-3 from 26.8 to 29.0 feet bgs. Typical NQ core run of Denver Formation classified as moderately weathered to decomposed claystone.



Photograph 10: B-606 NQ-6 from 43.0 to 48.0 feet bgs. Typical NQ core run of Denver Formation classified as moderately to very intensely weathered claystone from 43.0 to 44.9 feet and 46.1 to 48.0 feet and fresh to slightly weathered clayey sandstone from 44.9 to 46.1 feet.



Photograph 11: B-607A NQ-1 through NQ-6 from 16.5 to 38.0 feet bgs. B-607A Core Box 1 of 2 of Denver Formation typically classified as moderately to very intensely weathered claystone.



Photograph 12: B-607B S-5 from 48.5 to 49.0 feet bgs. Typical split spoon of Denver Formation classified as moderately to intensely weathered sandstone.

APPENDIX B

BORING LOGS

B.1 RJH SOIL AND ROCK DESCRIPTORS

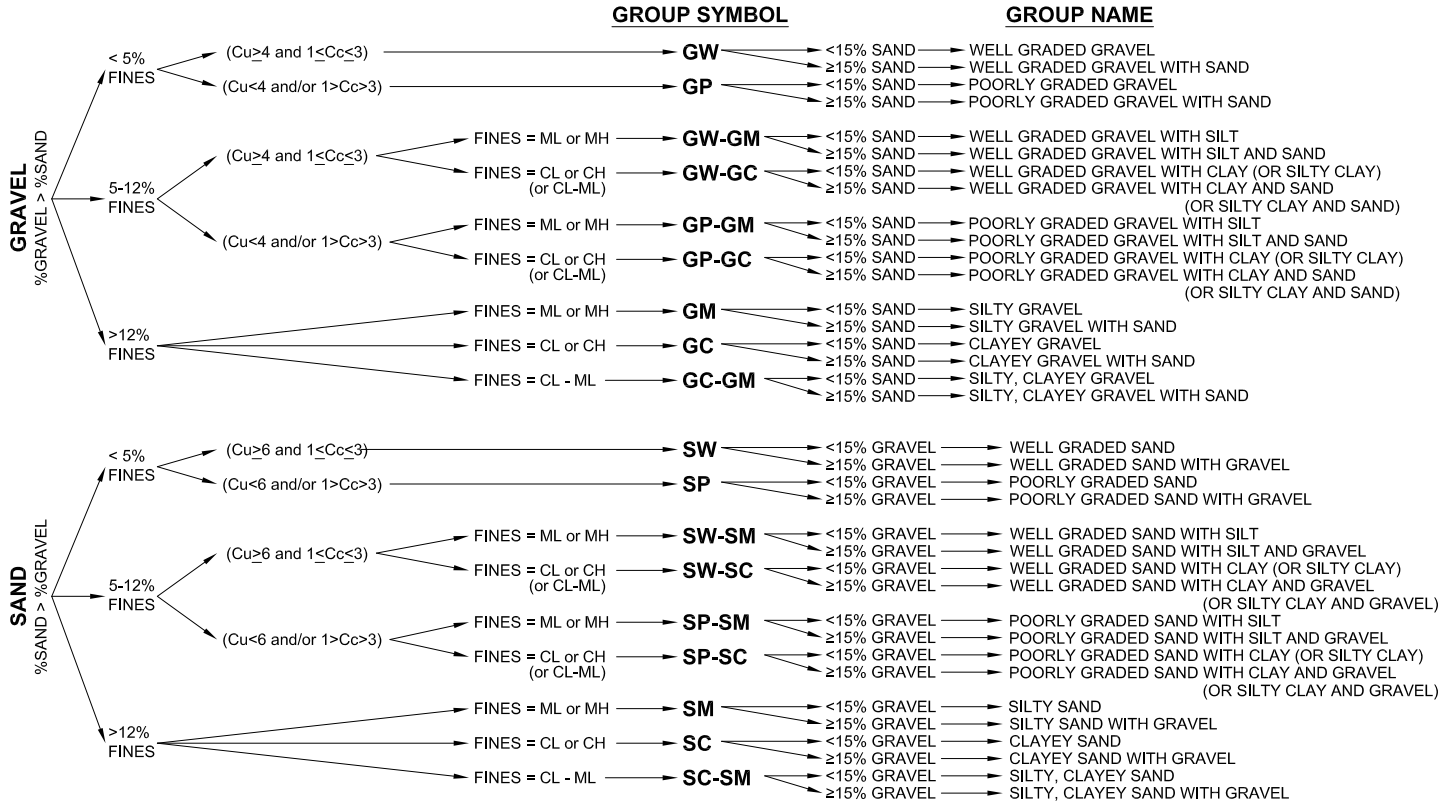
B.2 BORING LOGS

RJH ROCK AND SOIL DESCRIPTORS

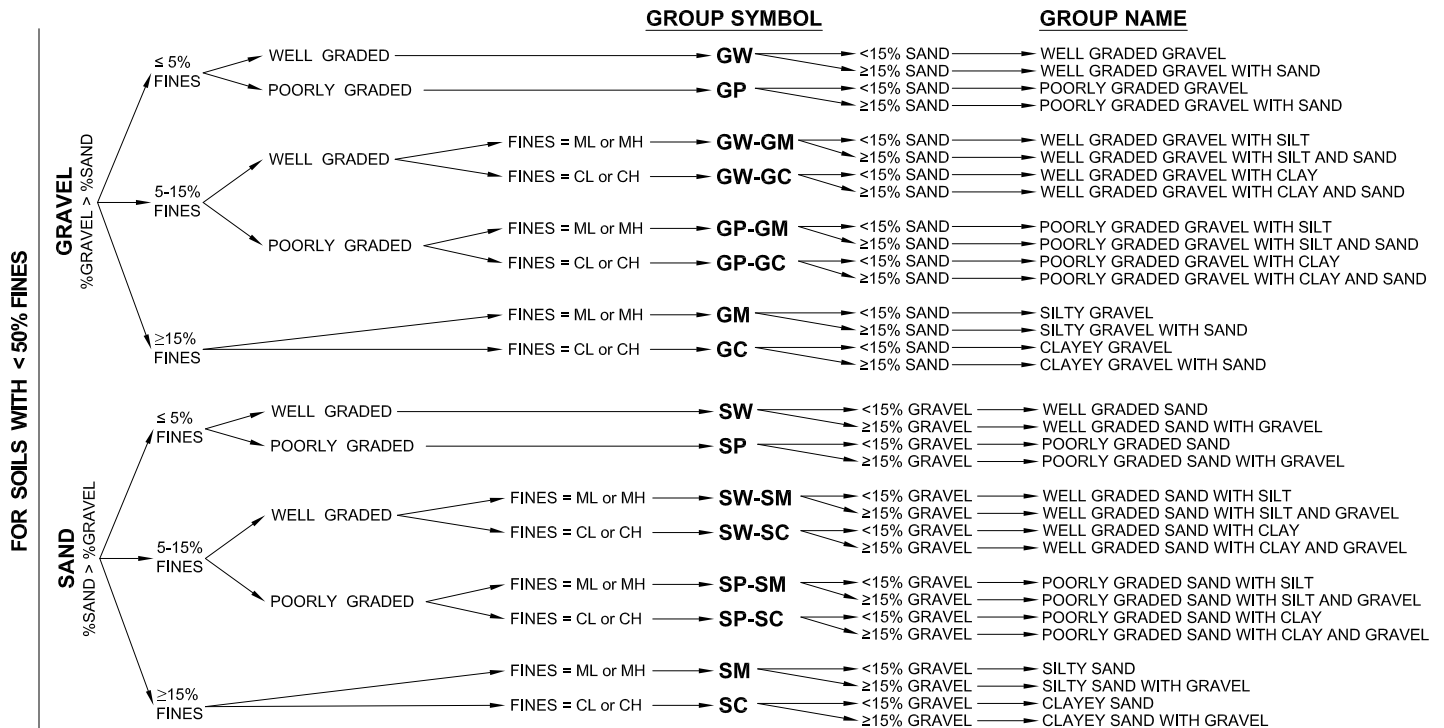
SOIL CLASSIFICATION FLOWCHARTS AND DESCRIPTION CRITERIA

COARSE GRAINED SOILS (< 50% FINES)

A) FLOWCHART APPLIED TO LABORATORY TESTED SOIL SAMPLES. ADAPTED FROM ASTM D 2487 CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES (USCS).

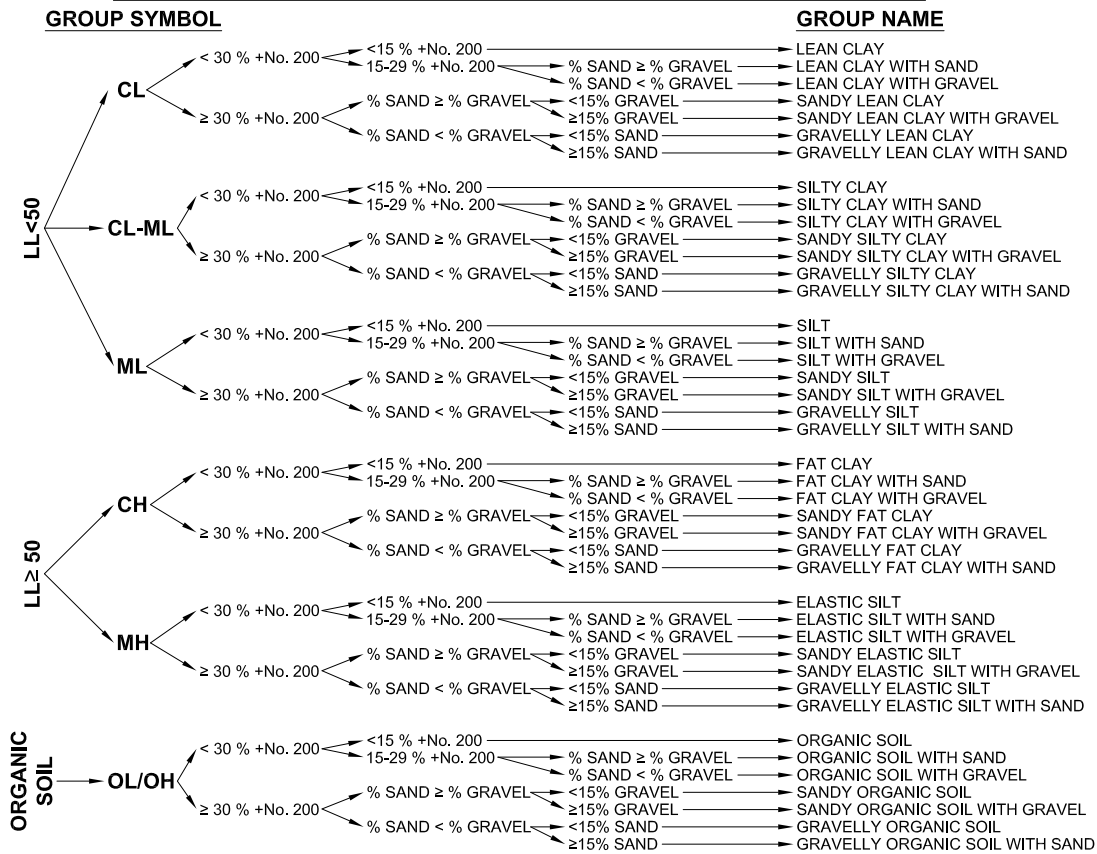


B) FLOWCHART APPLIED TO FIELD CLASSIFIED SOIL SAMPLES. ADAPTED FROM ASTM D 2488 DESCRIPTION AND IDENTIFICATION OF SOILS (VISUAL-MANUAL PROCEDURE).

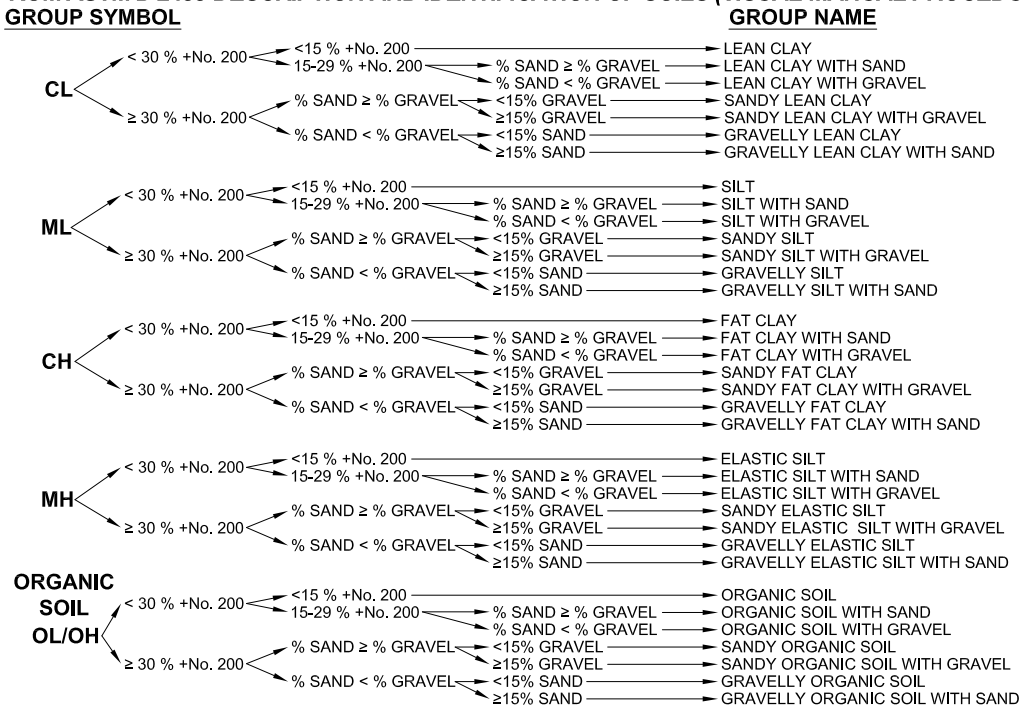


FINE GRAINED SOILS (≥ 50% FINES)

A) FLOWCHART APPLIED TO LABORATORY TESTED SOIL SAMPLES.
ADAPTED FROM ASTM D 2487 CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES (USCS).



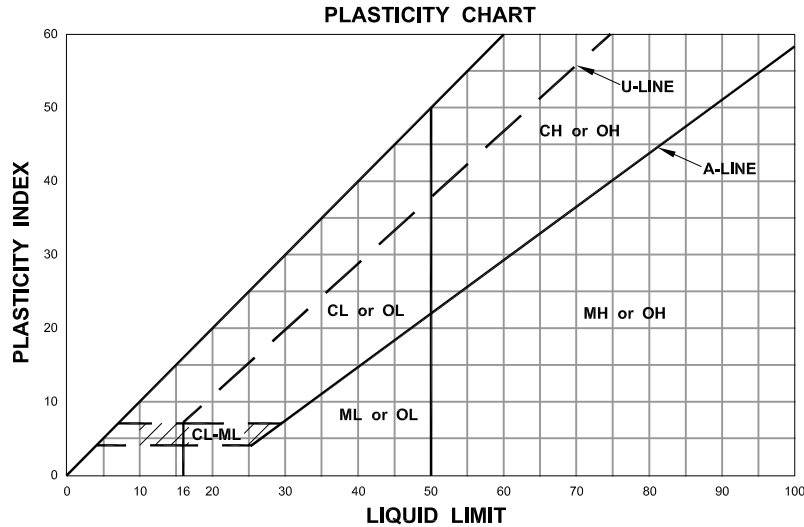
B) FLOWCHART APPLIED TO FIELD CLASSIFIED SOIL SAMPLES.
ADAPTED FROM ASTM D 2488 DESCRIPTION AND IDENTIFICATION OF SOILS (VISUAL-MANUAL PROCEDURE).



NOTE:

1. THE PLASTICITY CHART ON THE FOLLOWING PAGE WAS USED TO IDENTIFY THE GROUP SYMBOL FOR FLOWCHART A.
A COMBINATION OF THE VISUAL MANUAL CRITERIA ON THE FOLLOWING PAGE WERE USED TO IDENTIFY THE GROUP SYMBOL FOR FLOWCHART B.

SOIL PLASTICITY CHARACTERISTICS



A) IDENTIFICATION OF FINES GROUP SYMBOL FROM LABORATORY TESTS.
 REPRODUCED FROM ASTM D 2487 CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES (USCS).

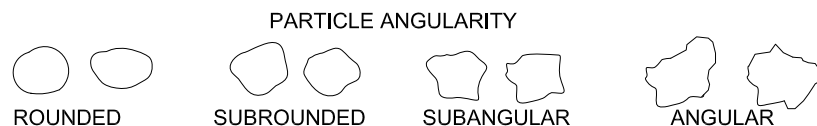
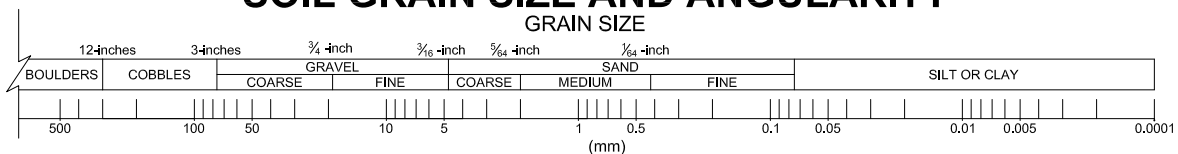
B) IDENTIFICATION OF FINES GROUP SYMBOL FROM VISUAL-MANUAL CRITERIA.
 REPRODUCED FROM ASTM D 2488 DESCRIPTION AND IDENTIFICATION OF SOILS (VISUAL-MANUAL PROCEDURE).

DRY STRENGTH	
DESCRIPTION	CRITERIA
NONE	CRUMBLES TO POWDER WHILE HANDLING.
LOW	CRUMBLES TO POWDER WITH SOME FINGER PRESSURE.
MEDIUM	BREAKS INTO PIECES OR CRUMBLES WITH CONSIDERABLE FINGER PRESSURE.
HIGH	CANNOT BE BROKEN WITH FINGER PRESSURE. BREAKS INTO PIECES BETWEEN THUMB AND HARD SURFACE.
VERY HIGH	CANNOT BE BROKEN BETWEEN THUMB AND HARD SURFACE.
DILATANCY (RESISTANCE TO SHAKING)	
DESCRIPTION	CRITERIA
NONE	NO VISIBLE CHANGE IN SPECIMEN.
SLOW	WATER APPEARS SLOWLY ON THE SURFACE OF THE SPECIMEN DURING SHAKING AND DOES NOT DISAPPEAR OR DISAPPEARS SLOWLY UPON SQUEEZING.
RAPID	WATER APPEARS QUICKLY ON THE SURFACE OF THE SPECIMEN DURING SHAKING AND DISAPPEARS QUICKLY UPON SQUEEZING.

TOUGHNESS (CONSISTENCY NEAR PLASTIC LIMIT)	
DESCRIPTION	CRITERIA
LOW	ONLY SLIGHT PRESSURE IS REQUIRED TO ROLL THE THREAD. THREAD AND LUMP ARE WEAK AND SOFT.
MEDIUM	MEDIUM PRESSURE IS REQUIRED TO ROLL THE THREAD. THREAD AND LUMP HAVE MEDIUM STIFFNESS.
HIGH	CONSIDERABLE EFFORT IS REQUIRED TO ROLL THE THREAD. THREAD AND LUMP HAVE HIGH STIFFNESS.
PLASTICITY	
CRITERIA FOR A 1/8-INCH (3 mm) THREAD.	
NON-PLASTIC	THREAD CANNOT BE ROLLED.
LOW	THREAD CAN BARELY BE ROLLED AND THE LUMP CANNOT BE FORMED WHEN DRIER THAN THE PLASTIC LIMIT.
MEDIUM	THREAD IS EASY TO ROLL AND NOT MUCH TIME IS REQUIRED TO REACH THE PLASTIC LIMIT. THE THREAD CANNOT BE RE-ROLLED SEVERAL TIMES AFTER REACHING THE PLASTIC LIMIT. THE LUMP CRUMBLES WHEN DRIER THAN THE PLASTIC LIMIT.
HIGH	IT TAKES CONSIDERABLE TIME ROLLING AND KNEADING TO REACH THE PLASTIC LIMIT. THE THREAD CAN BE RE-ROLLED SEVERAL TIMES AFTER REACHING THE PLASTIC LIMIT. THE LUMP CAN BE FORMED WITHOUT CRUMBLING WHEN DRIER THAN THE PLASTIC LIMIT.

SYMBOL	DRY STRENGTH	DILATANCY	TOUGHNESS AND PLASTICITY	PLASTICITY
ML	NONE - LOW	SLOW - RAPID	LOW	LOW TO NON-PLASTIC
CL	MEDIUM - HIGH	NONE - SLOW	MEDIUM	LOW TO MEDIUM
MH	LOW - MEDIUM	NONE - SLOW	LOW TO MEDIUM	LOW TO MEDIUM
CH	HIGH - VERY HIGH	NONE	HIGH	HIGH

SOIL GRAIN SIZE AND ANGULARITY



**TABLE 1.1
CRITERIA FOR DESCRIBING SOIL STRUCTURE⁽¹⁾**

Description	Criteria
Ud	...
S	...
O	...
P	...

(1) Description and Identification of Soils (Visual-Manual Procedure) ...
 Engineering Geology Field Manual ...

**TABLE 1.2
RELATIVE DENSITY OF SANDS ACCORDING TO RESULTS OF
STANDARD PENETRATION TEST⁽¹⁾**

Number of Blows N	Relative Density
0	0%
10	40%
30	60%
50	70%
100	100%

(1) ...

**TABLE 1.3
GUIDE FOR STIFFNESS OF FINE-GRAINED SOILS⁽¹⁾**

Description	Criteria	Estimated Unconfined Compressive Strength (TSF)
...
...
...
...
...
...

(1) ...

**TABLE 1.4
CRITERIA FOR DESCRIBING SOIL MOISTURE CONDITION⁽¹⁾**

Description	Criteria
Öi^Á	Öä•^} &^Á-Á [ä c ^Ä• c Äi^ Á Á@Á } &@
T ä c Á	Öä } Ä } c Ä ä ^Á ä^Á
Y ^ c Á	X ä ä ^Á ^Á } ä^Ä • ä ^Á [ä ^Á , Á@Á ä^Á ä ^Á

Þ [c • Ä
FÄ Ü^ | | ä • & ä Ä | { Ä UVT Ä | | Ä Description and Identification of Soils (Visual-Manual Procedure) ÄÄ

**TABLE 1.5
CRITERIA FOR DESCRIBING SOIL CEMENTATION⁽¹⁾⁽²⁾**

Description	Criteria
Y ^ ä Á	Öi^ { ä ^Á Ä ^ ä • Ä ä c ä ä * Ä Ä ^ Ä * ^ Ä ^ • • ^ Á
T ä ä^ Á	Öi^ { ä ^Á Ä ^ ä • Ä ä c } • ä ä ^ Ä * ^ Ä ^ • • ^ Á
Ud } * Á	Y ä Ä c { ä ^Á Ä ^ ä • Ä ä c * ^ Ä ^ • • ^ Á

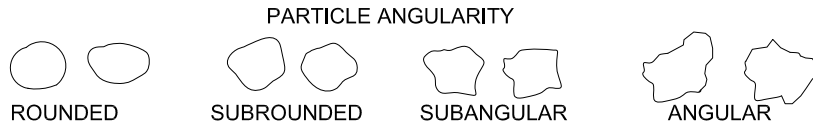
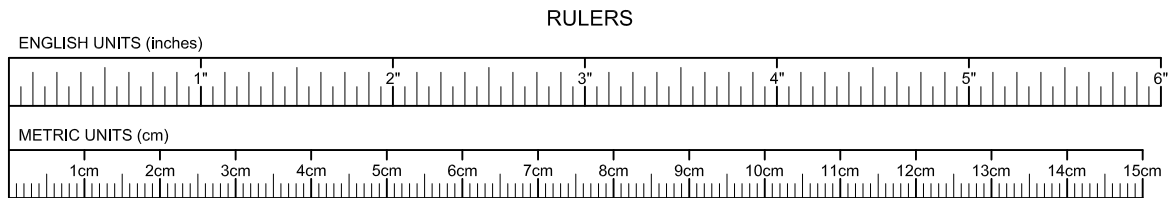
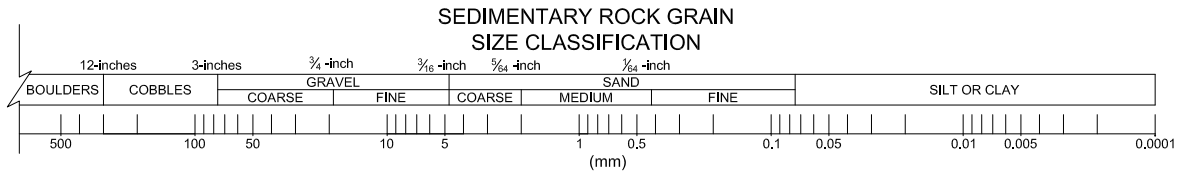
Þ [c • Ä
FÄ Ü^ | | ä • & ä Ä | { Ä UVT Ä | | Ä Description and Identification of Soils (Visual-Manual Procedure) ÄÄ
GÄ V @ Ä • ^ } & Ä - Ä | ^ } ä } Ä ä Ä | c | ä | ä | ^ ä } Ä | ä * Ä | * • Ä

**TABLE 1.6
CRITERIA FOR DESCRIBING SOIL REACTION WITH HCL⁽¹⁾**

Description	Criteria
Þ [} ^ c Á	Þ Ä ä ä ^ Á ä c } Ä
Y ^ ä Á	Ü { ^ Á ä c } Ä ä c ä ä ^ Á { ä * Ä , ^ Á
Üd } * Á	X ä ^ } c ä c } Ä ä c ä ä ^ Á { ä * Ä { ^ ä ä ^ Á

Þ [c • Ä
FÄ Ü^ | | ä • & ä Ä | { Ä UVT Ä | | Ä Ä • & ä c | } ä ä | ^ } ä ä c | } Ä Ü | ä • Ä ä ä | ^ ä | ^ • • | ^ Ä ÄÄ
GÄ V @ Ä • ^ } & Ä - Ä | ^ ä c | } Ä ä Ä | c | ä | ä | ^ ä } Ä | ä * Ä | * • Ä

SEDIMENTARY ROCK CLASSIFICATION AND CRITERIA FOR DESCRIPTIONS



PLASTICITY	
DESCRIPTION	CRITERIA
NON-PLASTIC	A 1/8 in. (3mm) THREAD CANNOT BE ROLLED AT ANY WATER CONTENT.
LOW	THE THREAD CAN BARELY BE ROLLED AND THE LUMP CANNOT BE FORMED WHEN DRIER THAN THE PLASTIC LIMIT.
MEDIUM	THE THREAD IS EASY TO ROLL AND NOT MUCH TIME IS REQUIRED TO REACH THE PLASTIC LIMIT. THE THREAD CANNOT BE RE-ROLLED AFTER REACHING THE PLASTIC LIMIT. THE LUMP CRUMBLES WHEN DRIER THAN THE PLASTIC LIMIT.
HIGH	IT TAKES CONSIDERABLE TIME ROLLING AND KNEADING TO REACH THE PLASTIC LIMIT. THE THREAD CAN BE RE-ROLLED SEVERAL TIMES AFTER REACHING THE PLASTIC LIMIT. THE LUMP CAN BE FORMED WITHOUT CRUMBLING WHEN DRIER THAN THE PLASTIC LIMIT.

NOTES:

1. SOURCE: ASTM D2488.
2. ONLY APPLIES TO FINE-GRAINED ROCKS SUCH AS CLAYSTONE.

**TABLE 2.3
WEATHERING DESCRIPTORS**

Weathering Descriptor	Diagnostic Features				
	Chemical Weathering – Discoloration and/or Oxidation		Mechanical Weathering (Grain boundary conditions-use with granitics and coarse grained sediments)	Texture	Solutioning
	Body of Rock	Fracture Surfaces ⁽²⁾			
0	Fracture surfaces show no weathering	Fracture surfaces show no weathering	Grain boundaries are sharp	Grain boundaries are sharp	Grain boundaries are sharp
Slightly weathered to fresh ⁽¹⁾					
1	Fracture surfaces show slight weathering	Fracture surfaces show slight weathering	Grain boundaries are slightly blurred	Grain boundaries are slightly blurred	Grain boundaries are slightly blurred
Moderately to slightly weathered ⁽¹⁾					
2	Fracture surfaces show moderate weathering	Fracture surfaces show moderate weathering	Grain boundaries are moderately blurred	Grain boundaries are moderately blurred	Grain boundaries are moderately blurred
Intensely to moderately weathered ⁽¹⁾					
3	Fracture surfaces show intense weathering	Fracture surfaces show intense weathering	Grain boundaries are intensely blurred	Grain boundaries are intensely blurred	Grain boundaries are intensely blurred
Very intensely weathered ⁽¹⁾					
4	Fracture surfaces show very intense weathering	Fracture surfaces show very intense weathering	Grain boundaries are very intensely blurred	Grain boundaries are very intensely blurred	Grain boundaries are very intensely blurred

P[...]
 V[...]
 ^[...]
 @[...]
 FE[...]
 CE[...]
 HE[...]
 Engineering Geology Field Manual

**TABLE 2.6
FRACTURE OPENNESS DESCRIPTORS⁽¹⁾**

Alphanumeric Descriptor	Descriptor	Openness
U€Á	Vã @Á	P[Áã ä Á^] æææ } Á
UFÁ	U ã @^ ÁJ ^} Á	S•• Á@ ÁEEH ÁOYFDGÁ áQ ÁÁ { DÁ
UGÁ	T[á^!æ^ ÁJ ^}	EEH Á ÁEEH ÁOYFDGÁ ÁD Á áQÁ ÁÁ { DÁ
UHÁ	U ^} Á	EEH Á ÁEEH ÁOYFD Á ÁD Á áQÁ ÁEÁ { DÁ
UI Á	T[á^!æ^ Á^ ä^Á	EEH Á ÁEEH ÁOYFD Á ÁEÁ áQÁ ÁEÁ { DÁ
UI Á	Y ä^Á	Ö!^æ^! Á@ ÁEEH ÁOYFD Á áQÁ ÁEÁ { DÁ

P[cKÁ
FÁ Ü^]!| á^ &áÁ[{ ÁNÜÖÖ!^æ Á-Ü^&æ ææ } , Engineering Geology Field Manual CEEFDÁ

**TABLE 2.7
FRACTURE ROUGHNESS DESCRIPTORS⁽¹⁾**

Alphanumeric Descriptor	Roughness Descriptor	Criteria
ÜFÁ	Uc] ^áÁ	P^æE [{ æÁ c^ • Á äÁä^* ^ Á &&^ Á } Á@ Á^æc ^ Á^ -æ& Á
ÜGÁ	Ü ^* @Á	Sæ^ Áæ^ * æÁæ ^! ä^ • Áæ Á^ Á^ Á^ } Á
ÜHÁ	T[á^!æ^ Á Ü ^* @Á	C] ^! ä^ • Áæ Á^ Á^ æ^ Áã ä Á^ äÁ^æc ^ Á^ -æ& Á^ Á^ Áæ! æ æ^ Á
ÜI Á	U ã @^ ÁJ ^* @Á	U æÁæ ^! ä^ • Á } Á@ Á^æc ^ Á^ -æ& Áæ^ Áã ä Á^ äÁæ Á^ Á^ cÁ
ÜI Á	U [[c@Á	P[Áæ ^! ä^ • Á { [[c@Á Á@ Á^ ^ &@Á
ÜI Á	U ã @áÁ U ä^ Á^ • ä^ áÁ	Ocd^ { ^ Á { [[c@Á äÁ @^ EÁEÁ [ã @áÁæ cÁ^ -æ& Á -c } Á ä@ æÁ^ áææ } Á ææ^ Á Á@ Áä } æ { ^ } cÁá^ &c } Á

P[cKÁ
FÁ Ü^]!| á^ &áÁ[{ ÁNÜÖÖ!^æ Á-Ü^&æ ææ } , Engineering Geology Field Manual CEEFDÁ

**TABLE 2.8
FRACTURE FILLING THICKNESS DESCRIPTORS⁽¹⁾**

Alphanumeric Descriptor	Fracture Filling Descriptor	Thickness
V€Á	Ö!^æ Á	P[Áá Á!Á ææ * Á
VFÁ	X^!^ Á@ Á	S•• Á@ ÁEEH ÁOYFDGÁ áQ ÁÁ { DÁ
VGÁ	T[á^!æ^ Á^ @ Á	EEH Á ÁEEH ÁOYFDGÁ ÁD Á áQÁ ÁÁ { D
VHÁ	V@ Á	EEH Á ÁEEH ÁOYFD Á ÁD Á áQÁ ÁEÁ { DÁ
VI Á	T[á^!æ^ Á^ @ Á	EEH ÁD Á á ÁEEH ÁOYFD Á ÁEÁ { DÁ
VI Á	V@ Á	Ö!^æ^! Á@ ÁEEH ÁOYFD Á ÁEÁ { DÁ

P[cKÁ
FÁ Ü^]!| á^ &áÁ[{ ÁNÜÖÖ!^æ Á-Ü^&æ ææ } , Engineering Geology Field Manual CEEFDÁ

DEFINITIONS

Aphanitic: Aphanitic is a term used in geology to describe a type of igneous rock. It is characterized by a fine-grained texture where the individual mineral grains are too small to be easily visible to the naked eye. This texture is typically formed when magma cools rapidly, preventing the growth of large crystals.

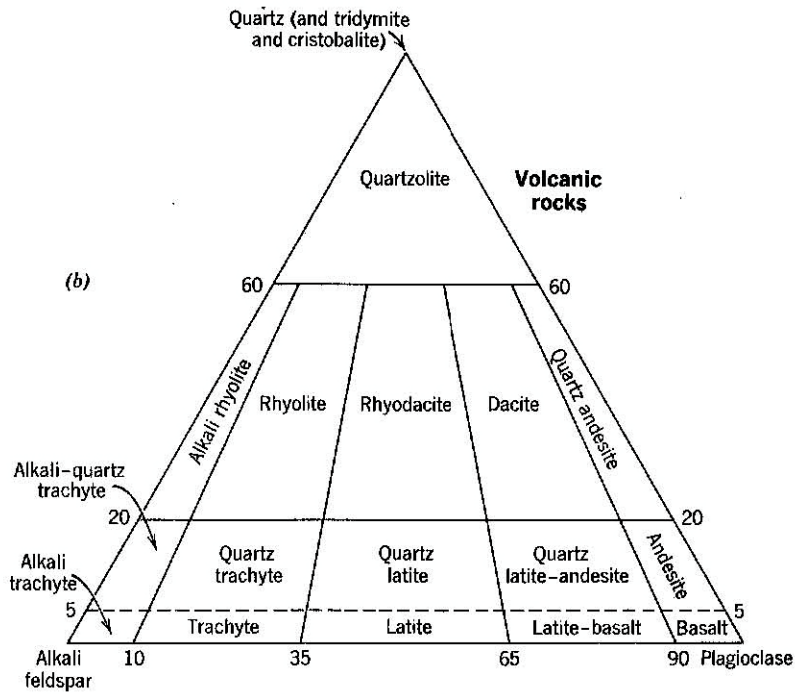
Pegmatite: Pegmatite is a type of igneous rock characterized by extremely large, well-crystallized mineral grains. These grains can range from centimeters to several meters in size. Pegmatites are formed from a residual melt that is enriched in silica and other minerals, which allows for the growth of large crystals over long periods of time.

Phaneritic: Phaneritic is a term used in geology to describe a type of igneous rock with a coarse-grained texture. The individual mineral grains are large enough to be easily visible to the naked eye. This texture is typically formed when magma cools slowly, allowing for the growth of large crystals.

Phenocryst: A phenocryst is a large, well-crystallized mineral grain that is embedded in a finer-grained matrix. Phenocrysts are typically formed when a magma cools slowly, allowing for the growth of large crystals. They are often used as indicators of the temperature and pressure conditions under which the rock formed.

Porphyry: Porphyry is a term used in geology to describe a type of igneous rock with a coarse-grained texture. The individual mineral grains are large enough to be easily visible to the naked eye. This texture is typically formed when magma cools slowly, allowing for the growth of large crystals.

VOLCANIC ROCK CLASSIFICATION



General classification and nomenclature of some common plutonic rock types (a) and some common volcanic rock types (b). This classification is based on the relative percentages of quartz, alkali feldspar, and plagioclase, measured in volume percent. (Adapted from Subcommittee on the Systematics of Igneous Rocks, *Geotimes*, 1973, v. 18, no. 10, pp. 26-30, and Hyndman, D. W., 1972, *Petrology of Igneous and Metamorphic Rocks*. McGraw-Hill Book Co., New York, p. 35.)

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APPENDIX B.2





BORING LOGS

LOG OF SOIL BORING

Start Date: 11-15-2021 End Date: 11-15-2021
 Driller: Elite-Lenny Logged By: CLS
 Bedrock Depth: Not encountered Checked By: JRW
 Drilling Rig: Track Mounted Mobile B48X
 Equipment: Hollow Stem Auger 3.25" I.D. 6.0" O.D.

Borehole ID:
B-601
 Sheet 1 of 2

Project name: Thornton Justice Center Phase III
 Project No: 21129
 Boring Location: N 1196459.7, E 3145241.9 ft
 Ground El: 5438.7 ft Total Depth: 10.0 ft
 Groundwater El: Not Encountered On Date:

Elevation	Depth (ft)	Type - No	Blows per 6 inch	Penetration (ft)	Recovery (ft)	Remarks	Graphic Lithology	Description and Classification of Materials
						Concrete slab approximately 6 inches thick.		
5437.0	1	S - 1	30/4/4	1.5	0.7			S-1: Reclaimed Asphalt Fill; [Fill]
	2							S-1, S-2: Sandy Lean Clay Mostly fines, medium plasticity; 35-45% sand, fine to coarse grained, subangular to subrounded; less than 5% gravel, fine grained, subangular to subrounded; maximum particle size = 0.75 inches; medium stiff; moist; light brown; PP = 0.75 tsf; weak to strong reaction with HCl; (CL); [Fill]
	3	S - 2	3/4/6	1.5	0.9			
5434.2	4							
	5	MC - 3	4/7/8	1.5	1.0			MC-3, S-4, S-5: Fat Clay with Sand Mostly fines, high plasticity; 15-25% sand, fine to coarse grained, subangular to subrounded; less than 5% gravel, fine grained, subangular to subrounded; maximum particle size = 0.5 inches; stiff to very stiff; moist; light brown; strong reaction with HCl; (CH); [Fill]
	6							
	7	S - 4	1/1/3	1.5	1.0			6.5 to 8.0 ft: Fines are medium to high plasticity; less than 10% gravel, fine to coarse grained; maximum particle size = 1 inch; medium stiff; white to light brown; (CH);
	8							
	9	S - 5	3/5/5	1.5	1.1			8.9 to 9.7 ft: PP = 2 tsf; (CH);
5429.0								
5428.7	10					Bottom of boring at 10.0 feet.		S-5: Lean Clay Mostly fines, medium plasticity; 5-15% sand, fine to medium

Continued on next sheet

Notes Lithology between recovered samples is interpreted. Contacts are approximate. Boring was backfilled with grout. Horizontal coordinate system is modified from the Colorado State Plane NAD1983 North Zone with conversion factor = 0.999721940.



LOG OF SOIL BORING

Start Date: 11-15-2021

End Date: 11-15-2021

Borehole ID:

Driller: Elite-Lenny

Logged By: CLS

B-601

Bedrock Depth: Not encountered

Checked By: JRW

Sheet 2 of 2

Project name: Thornton Justice Center Phase III

Project No: 21129

Boring Location: N 1196459.7, E 3145241.9 ft

Ground El: 5438.7 ft Total Depth: 10.0 ft

Groundwater El: Not Encountered On Date:

Drilling Rig: Track Mounted Mobile B48X

Equipment: Hollow Stem Auger 3.25" I.D. 6.0" O.D.

Elevation	Depth (ft)	Type - No	Blows per 6 inch	Penetration (ft)	Recovery (ft)	Remarks	Graphic Lithology	Description and Classification of Materials
	11							grained, subangular to subrounded; medium stiff; moist; dark brown; no to weak reaction with HCl; (CL); [Fill] ----- End of boring log at 10.00 ft
	12							
	13							
	14							
	15							
	16							
	17							
	18							
	19							
	20							

Notes Lithology between recovered samples is interpreted. Contacts are approximate. Boring was backfilled with grout. Horizontal coordinate system is modified from the Colorado State Plane NAD1983 North Zone with conversion factor = 0.999721940.



LOG OF SOIL BORING

Start Date: 11-15-2021 End Date: 11-15-2021
 Driller: Elite-Lenny Logged By: CLS
 Bedrock Depth: 6.0 ft Checked By: JRW
 Drilling Rig: Track Mounted Mobile B48X
 Equipment: Hollow Stem Auger 3.25" I.D. 6.0" O.D.

Borehole ID:
B-602
 Sheet 1 of 1

Project name: Thornton Justice Center Phase III
 Project No: 21129
 Boring Location: N 1196406.8, E 3145245.7 ft
 Ground El: 5437.3 ft Total Depth: 10.0 ft
 Groundwater El: Not Encountered On Date:

Elevation	Depth (ft)	Type - No	Blows per 6 inch	Penetration (ft)	Recovery (ft)	Remarks	Graphic Lithology	Description and Classification of Materials
						Asphalt and subgrade approximately 11 inches thick.		
	1							S-1, MC-2: Clayey Sand Mostly sand, fine to coarse grained, angular to subrounded; 40-50% fines, high plasticity; medium dense; dry to moist; dark brown to brown; PP = 4 tsf; iron staining common; strong reaction with HCl; (SC); [Fill]
	2	S - 1	4/6/9	1.5	1.0			
	3							
	4							3.5 to 4.3 ft: 15-25% fines, medium plasticity; 5-15% gravel, fine to coarse grained, angular to subrounded; maximum particle size = 1 inch; light brown; (SC);
5433.0	4	MC - 2	5/11/13	1.5	0.8			MC-2: Lean Clay Mostly fines, medium plasticity; 5-15% sand, fine grained; medium dense; dry; light brown to white; weak to strong reaction with HCl; (CL); [Fill]
	5							
5431.3	6					Top of rock at 6.0 feet.		
	6							S-3, S-4: Claystone Massive; Mostly fines, medium plasticity; 5-15% sand, fine grained; intensely weathered to decomposed; fracturing not apparent; dry to moist; light brown to gray; PP = 2.5 to 3.0 tsf; H7; behaves as a very stiff fat clay; no to weak reaction with HCl; occasional iron staining; [Denver Formation]
	7	S - 3	5/6/7	1.5	1.3			
	8							
	9							8.5 to 10.0 ft: less than 10% sand;
	9	S - 4	6/9/12	1.5	1.2			
5427.3	10					Bottom of boring at 10.0 feet.		End of boring log at 10.00 ft

Notes Lithology between recovered samples is interpreted. Contacts are approximate. Boring was backfilled with grout. Horizontal coordinate system is modified from the Colorado State Plane NAD1983 North Zone with conversion factor = 0.999721940.



LOG OF SOIL BORING

Start Date: 11-15-2021 End Date: 11-15-2021
 Driller: Elite-Lenny Logged By: CLS
 Bedrock Depth: 3.5 ft Checked By: JRW
 Drilling Rig: Track Mounted Mobile B48X
 Equipment: Hollow Stem Auger 3.25" I.D. 6.0" O.D.

Borehole ID:
B-603
 Sheet 1 of 1

Project name: Thornton Justice Center Phase III
 Project No: 21129
 Boring Location: N 1196332.2, E 3145248.1 ft
 Ground El: 5436.3 ft Total Depth: 10.0 ft
 Groundwater El: Not Encountered On Date:

Elevation	Depth (ft)	Type - No	Blows per 6 inch	Penetration (ft)	Recovery (ft)	Remarks	Graphic Lithology	Description and Classification of Materials
5432.8 5426.3	1					Asphalt and subgrade approximately 11 inches thick.		
		S - 1	8/8/12	1.5	1.1			S-1: Fat Clay Mostly fines, medium to high plasticity; less than 10% sand, fine to medium grained; very stiff to hard; dry; light gray; PP = 4.25 tsf; occasional calcium seams and nodules; occasional iron staining; (CH); [Fill]
	2							
	3							
	4					Top of rock at 3.5 feet.		
		S - 2	6/8/13	1.5	1.4		S-2, MC-3, S-4: Claystone Massive; mostly fines, medium to high plasticity; 5-15% sand, fine to medium grained; intensely weathered to decomposed; fracturing not apparent; dry; light brown; PP = 3 tsf; H7; behaves as a very stiff to hard fat clay; iron staining throughout; calcium seams and nodules common; weak to strong reaction with HCl; [Denver Formation]	
	5							
	6							6.0 to 7.5 ft: less than 10% sand; moderately to intensely weathered; dark brown to gray; occasional iron staining; no calcium nodules and seams;
	7							
		MC - 3	11/12/27	1.5	1.2			
8								
9								
	S - 4	8/11/19	1.5	1.4			8.7 to 10.0 ft: less than 10% sand; moderately to intensely weathered; dark brown to gray; PP = >4.5 tsf; no iron staining;	
10						Bottom of boring at 10.0 feet.		End of boring log at 10.00 ft

Notes Lithology between recovered samples is interpreted. Contacts are approximate. Boring was backfilled with grout. Horizontal coordinate system is modified from the Colorado State Plane NAD1983 North Zone with conversion factor = 0.999721940.


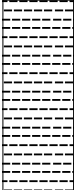
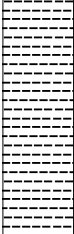
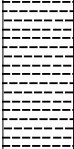
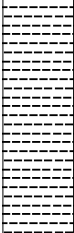
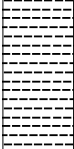
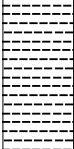




LOG OF SOIL BORING

Start Date: 11-15-2021 End Date: 11-15-2021
 Driller: Elite-Lenny Logged By: CLS
 Bedrock Depth: 2.2 ft Checked By: JRW
 Drilling Rig: Track Mounted Mobile B48X
 Equipment: Hollow Stem Auger 3.25" I.D. 6.0" O.D.

Borehole ID:
B-604
 Sheet 1 of 1

Project name: Thornton Justice Center Phase III
 Project No: 21129
 Boring Location: N 1196222.9, E 3145246.4 ft
 Ground El: 5436.5 ft Total Depth: 10.0 ft
 Groundwater El: Not Encountered On Date:

Elevation	Depth (ft)	Type - No	Blows per 6 inch	Penetration (ft)	Recovery (ft)	Remarks	Graphic Lithology	Description and Classification of Materials
5434.3	1					Asphalt and subgrade approximately 11 inches thick.		
	2	S - 1	7/8/10	1.5	1.4			S-1: Fat Clay Mostly fines, medium to high plasticity; 5-15% sand, fine to medium grained; stiff to very stiff; dry; light gray to light brown; PP = 2 tsf; calcium seams and nodules common; iron staining and veins common; (CH); [Fill]
	3					Top of rock at 2.2 feet.		S-1, S-2, S-3, MC-4: Claystone Massive; Mostly fines, medium to high plasticity; less than 10% sand, fine to medium grained; intensely to very intensely weathered; fracturing not apparent; dry; light gray to light brown; H7; iron veins common; occasional calcium seams and nodules; [Denver Formation]
	4	S - 2	7/7/14	1.5	1.2			3.5 to 5.0 ft: PP = 4 tsf; black speckles common;
	5							
	6	S - 3	9/12/17	1.5	1.6			6.0 to 7.5 ft: PP = 4.5 tsf; trace black speckles; strong reaction with HCl;
	7							
	8							
	9	MC - 4	15/50 for 6"	1.0	0.8			8.5 to 10.0 ft: PP = >4.5 tsf; trace iron staining;
	5426.5	10					Bottom of boring at 10.0 feet.	

Notes Lithology between recovered samples is interpreted. Contacts are approximate. Boring was backfilled with grout. Horizontal coordinate system is modified from the Colorado State Plane NAD1983 North Zone with conversion factor = 0.999721940.



LOG OF SOIL BORING

Start Date: 11-15-2021 End Date: 11-15-2021
 Driller: Elite-Lenny Logged By: CLS
 Bedrock Depth: 6.0 ft Checked By: JRW
 Drilling Rig: Track Mounted Mobile B48X
 Equipment: Hollow Stem Auger 3.25" I.D. 6.0" O.D.

Borehole ID:
B-605
 Sheet 1 of 1

Project name: Thornton Justice Center Phase III
 Project No: 21129
 Boring Location: N 1196158.1, E 3145238.2 ft
 Ground El: 5437.7 ft Total Depth: 10.0 ft
 Groundwater El: Not Encountered On Date:

Elevation	Depth (ft)	Type - No	Blows per 6 inch	Penetration (ft)	Recovery (ft)	Remarks	Graphic Lithology	Description and Classification of Materials
						Concrete slab approximately 6 inches thick.		
	1							S-1, S-2: Sandy Fat Clay Mostly fines, high plasticity; 25-35% sand, fine to coarse grained, subangular to subrounded; 5-15% gravel, fine grained, subangular to subrounded; maximum particle size = 0.5 inches; medium stiff to stiff; dry to moist; light brown; PP = 1 tsf; occasional calcium nodules; strong reaction with HCl; (CH); [Fill]
	2	S - 1	2/3/3	1.5	1.5			2.2 to 2.5 ft: dark brown; (CH);
	3							
	4	S - 2	2/4/4	1.5	1.5			3.5 to 5.0 ft: 20-30% sand; dark brown to brown; PP = 1.75 tsf; trace organics; trace calcium nodules; no to strong reaction; (CH);
	5							
5431.7	6					Top of rock at 6.0 feet.		
	7	MC - 3	6/11/14	1.5	1.0			MC-3, S-4: Claystone Massive; Mostly fines, medium to high plasticity; less than 10% sand, fine grained; very intensely weathered; fracturing not apparent; dry to moist; light gray to light brown; PP = 4.5 tsf; H7; calcium nodules throughout; trace iron veins; weak to strong reaction with HCl; [Denver Formation]
	8							
	9	S - 4	4/7/10	1.5	1.6			8.5 to 10.0 ft: PP = 2.5 tsf; occasional calcium veins; iron veins and staining common;
5427.7	10					Bottom of boring at 10.0 feet.		End of boring log at 10.00 ft

Notes Lithology between recovered samples is interpreted. Contacts are approximate. Boring was backfilled with grout. Horizontal coordinate system is modified from the Colorado State Plane NAD1983 North Zone with conversion factor = 0.999721940.



LOG OF SOIL BORING

Start Date: 11-16-2021 End Date: 11-16-2021
 Driller: Elite-Lenny Logged By: CLS
 Bedrock Depth: 18.8 ft Checked By: JRW
 Drilling Rig: Track Mounted Mobile B48X
 Equipment: Hollow Stem Auger 3.75" I.D. 7-5/8" O.D.; NQ Wireline Coring 1-7/8" I.D. 3" O.D.

Borehole ID:
B-606
 Sheet 1 of 7

Project name: Thornton Justice Center Phase III
 Project No: 21129
 Boring Location: N 1196496.1, E 3145233.1 ft
 Ground El: 5435.0 ft Total Depth: 53.0 ft
 Groundwater El: Not Encountered On Date:

Elevation	Depth (ft)	Type - No	Blows per 6 inch	Penetration (ft)	Recovery (ft)	Remarks	Graphic Lithology	Description and Classification of Materials	
5429.5	1							S-1, MC-2: Sandy Lean Clay Mostly fines, medium plasticity; 20-30% sand, fine to coarse grained, angular to subrounded; 10-20% gravel, fine to coarse grained, angular to subrounded; maximum particle size = 1 inch; stiff to very stiff; dry; brown; strong reaction with HCl; (CL); [Fill]	
								1.0 to 2.5 ft: organics and geotextile throughout; (CL);	
	2	S - 1	5/5/6	1.5	0.7				
	3								
	4	MC - 2	8/10/16	1.5	0.7				3.5 to 5.0 ft: 25-35% sand; maximum particle size = 1.25 inches; very stiff to hard; (CL);
	5								
	6	S - 3	3/2/3	1.5	0.9				S-3, MC-4, S-5, S-6: Lean Clay with Sand Mostly fines, medium plasticity; 10-20% sand, fine to coarse grained, subangular to subrounded; less than 10% gravel, fine to coarse grained, angular to subrounded; maximum particle size = 1 inch; medium stiff; dry to moist; brown to reddish brown; occasional calcium nodules; (CL); [Fill]
	7								
	8								
	9	MC - 4	8/5/9	1.5	0.8				8.5 to 10.0 ft: 15-25% sand, fine to medium grained; stiff; PP = 2 tsf; no calcium nodules; (CL);
10									


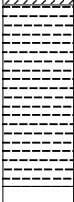
Continued on next sheet

Notes Lithology between recovered samples is interpreted. Contacts are approximate. Boring was backfilled with grout. Horizontal coordinate system is modified from the Colorado State Plane NAD1983 North Zone with conversion factor = 0.999721940.



LOG OF SOIL BORING

Start Date: 11-16-2021 End Date: 11-16-2021
 Driller: Elite-Lenny Logged By: CLS
 Bedrock Depth: 18.8 ft Checked By: JRW
 Borehole ID: **B-606**
 Sheet 2 of 7
 Project name: Thornton Justice Center Phase III
 Project No: 21129
 Boring Location: N 1196496.1, E 3145233.1 ft
 Ground El: 5435.0 ft Total Depth: 53.0 ft
 Groundwater El: Not Encountered On Date:
 Drilling Rig: Track Mounted Mobile B48X
 Equipment: Hollow Stem Auger 3.75" I.D. 7-5/8" O.D.; NQ Wireline Coring 1-7/8" I.D. 3" O.D.

Elevation	Depth (ft)	Type - No	Blows per 6 inch	Penetration (ft)	Recovery (ft)	Remarks	Graphic Lithology	Description and Classification of Materials
	11					Water level measured at 10.1 feet after drilling and coring.		
	12							
	13							
	14	S - 5	4/5/7	1.5	1.4			13.5 to 15.0 ft: 5-15% sand, fine to medium grained; less than 5% gravel, fine grained; maximum particle size = 0.5 inches; very stiff; PP = 3.5 tsf; strong reaction with HCl; (CL);
	15							
	16							
	17							
	18							
5416.2	19	S - 6	4/8/13	1.5	1.6	Top of rock at 18.8 feet.		18.5 to 18.8 ft: 15-25% sand; Gravel is fine grained, subangular to subrounded; maximum particle size = 0.5 inches; very stiff; strong reaction with HCl; (CL); S-6, MC-7, S-8: Claystone Massive; Mostly fines, high plasticity; less than 5% sand, fine grained; slightly to moderately weathered; randomly oriented fractures throughout; dry to moist; light gray to gray; H7; occasional calcium seams; occasional iron staining; weak to strong reaction with HCl; [Denver Formation]
	20							

Notes Lithology between recovered samples is interpreted. Contacts are approximate. Boring was backfilled with grout. Horizontal coordinate system is modified from the Colorado State Plane NAD1983 North Zone with conversion factor = 0.999721940.



LOG OF SOIL BORING

Start Date: 11-16-2021 End Date: 11-16-2021
 Driller: Elite-Lenny Logged By: CLS
 Bedrock Depth: 18.8 ft Checked By: JRW

Borehole ID:
B-606
 Sheet 3 of 7

Project name: Thornton Justice Center Phase III
 Project No: 21129
 Boring Location: N 1196496.1, E 3145233.1 ft
 Ground El: 5435.0 ft Total Depth: 53.0 ft
 Groundwater El: Not Encountered On Date:

Drilling Rig: Track Mounted Mobile B48X
 Equipment: Hollow Stem Auger 3.75" I.D. 7-5/8" O.D.; NQ Wireline Coring 1-7/8" I.D. 3" O.D.

Elevation	Depth (ft)	Type - No	Blows per 6 inch	Penetration (ft)	Recovery (ft)	Remarks	Graphic Lithology	Description and Classification of Materials
5408.5	21	MC - 7	7/19/21	1.5	0.9			
	22							
	23							
	24							
	25							
	26	S - 8	5/16/20	1.5	1.6			25.0 to 26.5 ft: Fines are medium plasticity; moderately to intensely weathered; light gray to light brown; H6 to H7; iron staining increases with depth; calcium seams and nodules common;
	27					Stop hollow stem augering at 26.5 feet. Start NQ coring.		
	28							
	29							
	30							

Notes Lithology between recovered samples is interpreted. Contacts are approximate. Boring was backfilled with grout. Horizontal coordinate system is modified from the Colorado State Plane NAD1983 North Zone with conversion factor = 0.999721940.



LOG OF ROCK CORE

Start Date: 11-16-2021
 Driller: Elite-Lenny
 Bedrock Depth: 18.8 ft
 Plunge: 90.0

End Date: 11-16-2021
 Logged By: CLS
 Checked By: JRW
 Bearing: N/A

Borehole ID:
B-606
 Sheet 4 of 7

Project name: Thornton Justice Center Phase III
 Project No: 21129
 Boring Location: N 1196496.1, E 3145233.1 ft
 Ground El: 5435.0 ft Total Depth: 53.0 ft
 Groundwater El: ^{Not} Encountered On Date:

Drilling Rig: Track Mounted Mobile B48X
 Equipment: Hollow Stem Auger 3.75" I.D. 7-5/8" O.D.; NQ Wireline Coring 1-7/8" I.D. 3" O.D.

Elevation	Depth (ft)	Notes: Groundwater, Drilling, Conditions, Circulation etc	Interval (ft)	Penetration (ft)	Recovery ft. (%)	RQD, ft (%)	Coring Time (min)	No. of Pieces	Longest (ft)	Shortest (ft)	Hardness	In Situ Testing	Joint Description	Joint Symbol	Lithology	Description and Classification of Materials
5408.5	21															
	22															
	23															
	24															
	25															
	26															
	27	Stop hollow stem augering at 26.5 feet. Start NQ coring.	26.5 to 28.0	1.5	0.7 (47)	0.7 (47)	1	2	0.4	0.3	H7	No Recovery			26.5 to 44.9 feet: Claystone Massive; mostly fines, medium to high plasticity; 5-15% sand, fine grained; moderately to intensely weathered; slightly fractured, randomly oriented fractures throughout; dry to moist; light brown; iron staining common; occasional calcium seams; weak reaction with HCl; [Denver Formation]	
	28											Mechanical Break				
	28											Mechanical Break				
	28											Mechanical Break				
	28											No Recovery				
	28											Rubble			28.4 to 30.3 ft: Thinly bedded; slightly to moderately weathered; moderately to very intensely fractured; gray;	
	29											Slightly to moderately open, stepped to rough, clean				
	29	Good circulation.										Slightly open, stepped to rough, clean				
	29											Rubble				
	30															

Continued on next sheet

Notes Lithology between recovered samples is interpreted. Contacts are approximate. Boring was backfilled with grout. Horizontal coordinate system is modified from the Colorado State Plane NAD1983 North Zone with conversion factor = 0.999721940.



LOG OF ROCK CORE

Start Date: 11-16-2021 End Date: 11-16-2021
 Driller: Elite-Lenny Logged By: CLS
 Bedrock Depth: 18.8 ft Checked By: JRW
 Plunge: 90.0 Bearing: N/A
 Drilling Rig: Track Mounted Mobile B48X
 Equipment: Hollow Stem Auger 3.75" I.D. 7-5/8" O.D.; NQ Wireline Coring 1-7/8" I.D. 3" O.D.

Project name: Thornton Justice Center Phase III
 Project No: 21129
 Boring Location: N 1196496.1, E 3145233.1 ft
 Ground El: 5435.0 ft Total Depth: 53.0 ft
 Groundwater El: ^{Not} Encountered On Date:

Borehole ID:
B-606
 Sheet 5 of 7

Elevation	Depth (ft)	Notes: Groundwater, Drilling, Conditions, Circulation etc	Interval (ft)	Penetration (ft)	Recovery ft. (%)	RQD, ft. (%)	Coring Time (min)	No. of Pieces	Longest (ft)	Shortest (ft)	Hardness	In Situ Testing	Joint Description	Joint Symbol	Lithology	Description and Classification of Materials
31	31	Water leaking from drill steel attachment.	28.0 to 32.5	4.5	4.1 (91)	2.8 (62)	15	>10	1.7	<0.1	H7		Rubble			
32	32	Slower coring than typical for the last 1.0 foot.											Mechanical Break			30.3 to 38.0 ft: trace calcium seams;
33	33		32.5 to 33.0	0.5	0.0 (0)	0.0 (0)	5	0	0	0			No Recovery			
34	34	Intentional slow coring.														
35	35	Shoe was at the wrong end of sampler. No recovery of NQ-4 because sleeve was incorrectly assembled.	33.0 to 38.0	5.0	0.0 (0)	0.0 (0)	30	0	0	0			No Recovery			
36	36															
37	37															
38	38															38.0 to 44.9 ft: light brown to light gray; iron staining throughout; no calcium seams;
39	39												Slightly to moderately open, rough to moderately rough, clean, Fe staining			
40	40															

Notes Lithology between recovered samples is interpreted. Contacts are approximate. Boring was backfilled with grout. Horizontal coordinate system is modified from the Colorado State Plane NAD1983 North Zone with conversion factor = 0.999721940.



LOG OF ROCK CORE

Start Date: 11-16-2021
 Driller: Elite-Lenny
 Bedrock Depth: 18.8 ft
 Plunge: 90.0

End Date: 11-16-2021
 Logged By: CLS
 Checked By: JRW
 Bearing: N/A

Borehole ID:
B-606
 Sheet 6 of 7

Project name: Thornton Justice Center Phase III
 Project No: 21129
 Boring Location: N 1196496.1, E 3145233.1 ft
 Ground El: 5435.0 ft Total Depth: 53.0 ft
 Groundwater El: ^{Not} Encountered On Date:

Drilling Rig: Track Mounted Mobile B48X
 Equipment: Hollow Stem Auger 3.75" I.D. 7-5/8" O.D.; NQ Wireline Coring 1-7/8" I.D. 3" O.D.

Elevation	Depth (ft)	Notes: Groundwater, Drilling, Conditions, Circulation etc	Interval (ft)	Penetration (ft)	Recovery ft. (%)	RQD, ft. (%)	Coring Time (min)	No. of Pieces	Longest (ft)	Shortest (ft)	Hardness	In Situ Testing	Joint Description	Joint Symbol	Lithology	Description and Classification of Materials
	41		38.0 to 43.0	5.0	5.0 (100)	4.4 (88)	23	6	2.9	0.2	H7		60 degrees, Slightly to moderately open, moderately to slightly rough, clean, Mn staining Moderately open, rough, clean			
	42												Moderately open, rough, clean			
	43												15 degrees, Slightly open, stepped to rough, clean 15 degrees, Slightly open, stepped to rough, clean			
	44	Poor circulation.											No Recovery			
5390.1	45	Approximately 100 gallons of water lost after 2 to 5 minutes.	43.0 to 48.0	5.0	3.1 (62)	1.8 (36)	11	>10	1.3	<0.1	H7 to H6					44.9 to 46.1 feet: Clayey Sandstone Massive; mostly sand, fine grained; 25-35% fines, low to medium plasticity; fresh to slightly weathered; unfractured; moist; light brown; weakly cemented; increase in grain size with depth; [Denver Formation]
5388.9	46															
	47												30 degrees, Tight, stepped, clean Slightly open, stepped to slightly rough, clean, Rubble			46.1 to 53.0 feet: Claystone Massive; mostly fines, medium plasticity; less than 5% sand, fine grained; intensely to very intensely weathered; moderately to very intensely fractured, randomly oriented fractures throughout; dry; gray; [Denver Formation] 46.1 to 47.0 ft: iron staining throughout; slickensides common;
	48												Mechanical Break Mechanical Break			47.8 to 53.0 ft: slightly to moderately weathered; very slightly to moderately fractured; dark gray to gray to brown;
	49												Moderately open, stepped, clean			
	50															

Continued on next sheet

Notes Lithology between recovered samples is interpreted. Contacts are approximate. Boring was backfilled with grout. Horizontal coordinate system is modified from the Colorado State Plane NAD1983 North Zone with conversion factor = 0.999721940.



LOG OF ROCK CORE

Start Date: 11-16-2021 End Date: 11-16-2021
 Driller: Elite-Lenny Logged By: CLS
 Bedrock Depth: 18.8 ft Checked By: JRW
 Plunge: 90.0 Bearing: N/A

Borehole ID:
B-606
 Sheet 7 of 7

Project name: Thornton Justice Center Phase III
 Project No: 21129
 Boring Location: N 1196496.1, E 3145233.1 ft
 Ground El: 5435.0 ft Total Depth: 53.0 ft
 Groundwater El: ^{Not} Encountered On Date:

Drilling Rig: Track Mounted Mobile B48X
 Equipment: Hollow Stem Auger 3.75" I.D. 7-5/8" O.D.; NQ Wireline Coring 1-7/8" I.D. 3" O.D.

Elevation	Depth (ft)	Notes: Groundwater, Drilling, Conditions, Circulation etc	Interval (ft)	Penetration (ft)	Recovery ft. (%)	RQD, ft (%)	Coring Time (min)	No. of Pieces	Longest (ft)	Shortest (ft)	Hardness	In Situ Testing	Joint Description	Joint Symbol	Lithology	Description and Classification of Materials
51			48.0 to 53.0	5.0	5.0 (100)	5.0 (100)	15	3	3.8	0.3	H7 to H6					
52													Moderately open, rough to slightly rough, clean			
53		Bottom of boring at 53.0 feet.														End of rock core log at 53.00 ft
54																
55																
56																
57																
58																
59																
60																

Notes Lithology between recovered samples is interpreted. Contacts are approximate. Boring was backfilled with grout. Horizontal coordinate system is modified from the Colorado State Plane NAD1983 North Zone with conversion factor = 0.999721940.



LOG OF SOIL BORING

Start Date: 11-17-2021 End Date: 11-19-2021
 Driller: Elite-Lenny Logged By: CLS
 Bedrock Depth: 8.9 ft Checked By: JRW
 Drilling Rig: Track Mounted Mobile B48X
 Equipment: Hollow Stem Auger 3.75" I.D. 7-5/8" O.D.; NQ Wireline Coring 1-7/8" I.D. 3" O.D.

Borehole ID:
B-607A
 Sheet 1 of 6

Project name: Thornton Justice Center Phase III
 Project No: 21129
 Boring Location: N 1196447.3, E 3145146.8 ft
 Ground El: 5424.5 ft Total Depth: 46.0 ft
 Groundwater El: Not Encountered On Date:

Elevation	Depth (ft)	Type - No	Blows per 6 inch	Penetration (ft)	Recovery (ft)	Remarks	Graphic Lithology	Description and Classification of Materials
	1							S-1, S-2, MC-3: Fat Clay with Sand Mostly fines, high plasticity; 10-20% sand, fine to coarse grained, subangular to subrounded; less than 5% gravel; very stiff to hard; dry; light brown to brown; PP = 4.5 tsf; occasional organics; iron staining throughout; weak to strong reaction with HCl; (CH); [Fill]
	2	S - 1	6/5/5	1.5	1.0			
	3							
	4	S - 2	4/5/6	1.5	0.3			
	5							
	6							
	7	MC - 3	5/4/8	1.5	1.5			6.0 to 7.5 ft: 15-25% sand; Gravel is fine grained, subangular to subrounded; maximum particle size = 0.5 inches; dry to moist; PP = 3 tsf; no to weak reaction with HCl; (CH);
5416.5	8							S-4: Sandy Fat Clay Mostly fines, high plasticity; 35-45% sand, fine to coarse grained, subangular to subrounded; less than 5% gravel, fine grained, subangular to subrounded; maximum particle size = 0.5 inches; stiff; dry to moist; brown; no to weak reaction with HCl; (CH); [Fill]
5415.6	9	S - 4	4/8/11	1.5	1.7	Top of rock at 8.9 feet.		S-4, S-5: Claystone Massive; mostly fines, medium to high plasticity; less than 10% sand, fine grained; very intensely weathered; randomly oriented fractures throughout; dry to moist; gray to orangish brown; H7; iron staining and veins throughout; trace calcium nodules; [Denver Formation]
	10							

Continued on next sheet

Notes Lithology between recovered samples is interpreted. Contacts are approximate. Boring was backfilled with grout. Horizontal coordinate system is modified from the Colorado State Plane NAD1983 North Zone with conversion factor = 0.999721940.



LOG OF SOIL BORING

Start Date: 11-17-2021 End Date: 11-19-2021
 Driller: Elite-Lenny Logged By: CLS
 Bedrock Depth: 8.9 ft Checked By: JRW

Borehole ID:
B-607A
 Sheet 2 of 6

Project name: Thornton Justice Center Phase III
 Project No: 21129
 Boring Location: N 1196447.3, E 3145146.8 ft
 Ground El: 5424.5 ft Total Depth: 46.0 ft
 Groundwater El: Not Encountered On Date:

Drilling Rig: Track Mounted Mobile B48X
 Equipment: Hollow Stem Auger 3.75" I.D. 7-5/8" O.D.; NQ Wireline Coring 1-7/8" I.D. 3" O.D.

Elevation	Depth (ft)	Type - No	Blows per 6 inch	Penetration (ft)	Recovery (ft)	Remarks	Graphic Lithology	Description and Classification of Materials
5408.0	11							
	12							
	13							
	14							
	15							
	16	S - 5	6/18/23	1.5	1.6			15.0 to 16.5 ft: moderately to intensely weathered; gray to dark gray; H6 to H7; iron staining and veins common; no calcium nodules;
	17					Stop hollow stem augering at 16.5 feet. Start NQ coring.		End of boring log at 16.50 ft
	18							
	19							
	20							

Notes Lithology between recovered samples is interpreted. Contacts are approximate. Boring was backfilled with grout. Horizontal coordinate system is modified from the Colorado State Plane NAD1983 North Zone with conversion factor = 0.999721940.



LOG OF ROCK CORE

Start Date: 11-17-2021 End Date: 11-19-2021
 Driller: Elite-Lenny Logged By: CLS
 Bedrock Depth: 8.9 ft Checked By: JRW
 Plunge: 90.0 Bearing: N/A

Borehole ID:
B-607A
 Sheet 3 of 6

Project name: Thornton Justice Center Phase III
 Project No: 21129
 Boring Location: N 1196447.3, E 3145146.8 ft
 Ground El: 5424.5 ft Total Depth: 46.0 ft
 Groundwater El: ^{Not} Encountered On Date:

Drilling Rig: Track Mounted Mobile B48X
 Equipment: Hollow Stem Auger 3.75" I.D. 7-5/8" O.D.; NQ Wireline Coring 1-7/8" I.D. 3" O.D.

Elevation	Depth (ft)	Notes: Groundwater, Drilling, Conditions, Circulation etc	Interval (ft)	Penetration (ft)	Recovery ft. (%)	RQD, ft (%)	Coring Time (min)	No. of Pieces	Longest (ft)	Shortest (ft)	Hardness	In Situ Testing	Joint Description	Joint Symbol	Lithology	Description and Classification of Materials
5408.0	11															
	12															
	13															
	14															
	15															
	16															
	17	Stop hollow stem augering at 16.5 feet. Start NQ coring.											No Recovery			
	18	Slow coring.	16.5 to 21.5	5.0	4.3 (86)	3.6 (72)	21	8	2	<0.1	H7 to H6		Mechanical Break 25 degrees. Moderately open, moderately to slightly rough, clean Mechanical Break Rubble			16.5 to 34.6 feet: Claystone Massive; mostly fines, medium to high plasticity; less than 5% sand, fine grained; moderately to very intensely weathered; slightly to moderately fractured, randomly oriented fractures throughout; dry to moist; gray; iron staining and veins throughout; [Denver Formation]
	19	Water flowing up boring on outside of hollow stem augers and exiting on ground surface.														
	20															

Continued on next sheet

Notes Lithology between recovered samples is interpreted. Contacts are approximate. Boring was backfilled with grout. Horizontal coordinate system is modified from the Colorado State Plane NAD1983 North Zone with conversion factor = 0.999721940.



LOG OF ROCK CORE

Start Date: 11-17-2021
 Driller: Elite-Lenny
 Bedrock Depth: 8.9 ft
 Plunge: 90.0

End Date: 11-19-2021
 Logged By: CLS
 Checked By: JRW
 Bearing: N/A

Borehole ID:
B-607A
 Sheet 4 of 6

Project name: Thornton Justice Center Phase III
 Project No: 21129
 Boring Location: N 1196447.3, E 3145146.8 ft
 Ground El: 5424.5 ft Total Depth: 46.0 ft
 Groundwater El: ^{Not} Encountered On Date:

Drilling Rig: Track Mounted Mobile B48X
 Equipment: Hollow Stem Auger 3.75" I.D. 7-5/8" O.D.; NQ Wireline Coring 1-7/8" I.D. 3" O.D.

Elevation	Depth (ft)	Notes: Groundwater, Drilling, Conditions, Circulation etc	Interval (ft)	Penetration (ft)	Recovery ft. (%)	RQD, ft (%)	Coring Time (min)	No. of Pieces	Longest (ft)	Shortest (ft)	Hardness	In Situ Testing	Joint Description	Joint Symbol	Lithology	Description and Classification of Materials
	21												Slightly to moderately open, rough to moderately rough, clean			
													Mechanical Break			
	22												No Recovery			
													Moderately open, rough, clean			
	23	Good circulation.														
	24		21.5 to 26.5	5.0	4.5 (90)	4.0 (80)	14	4	4	<0.1	H7					23.5 to 25.8 ft: very intensely weathered to decomposed, behaves as a very stiff to hard fat clay; light brown; occasional reddish brown staining;
	25															
	26												15 degrees, Slightly to moderately open, rough, clean			25.8 to 27.8 ft: very intensely weathered to decomposed, behaves as a very stiff to hard fat clay; light brown; occasional reddish brown staining; iron staining common;
													Mechanical Break			
	27												Moderately open, rough to slightly rough, clean			
													60 degrees, Slightly to moderately open, rough to moderately rough, clean			
	28		26.5 to 29.0	2.5	2.5 (100)	2.1 (84)	10	4	1.6	0.2	H7 to H6		Mechanical Break			
	29	Water flowing up boring after equipment turned off. Pressurized coring fluid.											No Recovery			29.0 to 31.0 ft: slightly to intensely weathered; occasional manganese staining on fracture surface increases with depth;
													Mechanical Break			
													Moderately open, stepped to rough, clean, Fe and Mn staining			
	30															

Continued on next sheet

Notes Lithology between recovered samples is interpreted. Contacts are approximate. Boring was backfilled with grout. Horizontal coordinate system is modified from the Colorado State Plane NAD1983 North Zone with conversion factor = 0.999721940.



LOG OF ROCK CORE

Start Date: 11-17-2021 End Date: 11-19-2021
 Driller: Elite-Lenny Logged By: CLS
 Bedrock Depth: 8.9 ft Checked By: JRW
 Plunge: 90.0 Bearing: N/A
 Borehole ID: **B-607A**
 Sheet 5 of 6

Project name: Thornton Justice Center Phase III
 Project No: 21129
 Boring Location: N 1196447.3, E 3145146.8 ft
 Ground El: 5424.5 ft Total Depth: 46.0 ft
 Groundwater El: ^{Not} Encountered On Date:

Drilling Rig: Track Mounted Mobile B48X
 Equipment: Hollow Stem Auger 3.75" I.D. 7-5/8" O.D.; NQ Wireline Coring 1-7/8" I.D. 3" O.D.

Elevation	Depth (ft)	Notes: Groundwater, Drilling, Conditions, Circulation etc	Interval (ft)	Penetration (ft)	Recovery ft. (%)	RQD, ft. (%)	Coring Time (min)	No. of Pieces	Longest (ft)	Shortest (ft)	Hardness	In Situ Testing	Joint Description	Joint Symbol	Lithology	Description and Classification of Materials	
5389.9	31	Stop coring at 30.0 feet on 11/17/21. Start coring at 30.0 feet on 11/18/21.	29.0 to 31.5	2.5	2.3 (92)	1.2 (48)	14	8	0.9	0.1	H7 to H5		Moderately open to open, stepped to rough, clean, Fe and Mn staining				
	32		31.5 to 33.0	1.5	1.5 (100)	1.3 (87)	4	2	1.3	0.2	H7		Slightly open, moderately to slightly rough, clean Moderately open to open, stepped to rough, clean Moderately open to open, stepped to rough, clean Mechanical Break			31.0 to 32.2 ft: 5-15% sand; light brown; occasional reddish brown staining; occasional manganese staining on fracture surface;	
	33												Slightly open, moderately rough, clean				32.2 to 34.6 ft: intensely to very intensely weathered; light brown;
	34												No Recovery				
5387.7	35		33.0 to 38.0	5.0	4.1 (82)	3.6 (72)	13	6	1.9	0.1	H7 to H6		20 degrees, Moderately open, stepped to rough, clean			34.6 to 36.8 feet: Clayey Sandstone Massive; mostly sand, fine grained; 40-50% fines, low to medium plasticity; slightly to moderately weathered; slightly fractured; dry to moist; iron staining common; occasional manganese staining; poorly cemented; [Denver Formation]	
	36											Moderately open, stepped to rough, clean, Fe and Mn staining					
	37											Slightly open, stepped to rough, clean, Fe and Mn staining				36.8 to 42.7 feet: Claystone Massive; mostly fines, medium to high plasticity; less than 5% sand, fine grained; intensely weathered to decomposed; slightly to moderately fractured, randomly oriented fractures throughout; dry to moist; light brown to gray; iron staining and veins common; manganese staining common; [Denver Formation]	
	38											Moderately open, stepped to rough, clean, Fe and Mn staining				38.0 to 38.7 ft: iron staining and manganese staining throughout;	
	39											15 degrees, Moderately open to open, stepped to rough, clean, Fe and Mn staining				39.5 to 41.0 ft: slightly to moderately weathered; no manganese staining;	
	40																

Notes Lithology between recovered samples is interpreted. Contacts are approximate. Boring was backfilled with grout. Horizontal coordinate system is modified from the Colorado State Plane NAD1983 North Zone with conversion factor = 0.999721940.



LOG OF ROCK CORE

Start Date: 11-17-2021
 Driller: Elite-Lenny
 Bedrock Depth: 8.9 ft
 Plunge: 90.0

End Date: 11-19-2021
 Logged By: CLS
 Checked By: JRW
 Bearing: N/A

Borehole ID:
B-607A
 Sheet 6 of 6

Project name: Thornton Justice Center Phase III
 Project No: 21129
 Boring Location: N 1196447.3, E 3145146.8 ft
 Ground El: 5424.5 ft Total Depth: 46.0 ft
 Groundwater El: ^{Not} Encountered On Date:

Drilling Rig: Track Mounted Mobile B48X
 Equipment: Hollow Stem Auger 3.75" I.D. 7-5/8" O.D.; NQ Wireline Coring 1-7/8" I.D. 3" O.D.

Elevation	Depth (ft)	Notes: Groundwater, Drilling, Conditions, Circulation etc	Interval (ft)	Penetration (ft)	Recovery ft. (%)	RQD, ft (%)	Coring Time (min)	No. of Pieces	Longest (ft)	Shortest (ft)	Hardness	In Situ Testing	Joint Description	Joint Symbol	Lithology	Description and Classification of Materials
5381.8	41		38.0 to 43.0	5.0	5.0 (100)	4.3 (86)	13	6	4	0.1	H7 to H6					41.1 to 42.7 ft: light brown; occasional calcium nodules;
	42											Mechanical Break Mechanical Break				
	43											Moderately open, stepped to rough, clean 20 degrees, Slightly to moderately open, stepped to moderately rough, clean				42.7 to 43.0 feet: Clayey Sandstone Similar to 34.6 to 36.8 ft Except: moderately to intensely weathered; intensely fractured; occasional calcium seams; [Denver Formation]
	44		43.0 to 46.0	3.0	0.0 (0)	0.0 (0)	12	0	0	0		No Recovery				
	45	Drillers dropped core barrel down the borehole and could not retrieve sample or equipment.														
	46	Stop coring at 46.0 feet on 11/18/21. Bottom of boring at 46.0 feet. Moved drill rig approximately 5.0 feet north of B-607A to complete drilling.														
	47															End of rock core log at 46.00 ft
	48															
	49															
	50															

Notes Lithology between recovered samples is interpreted. Contacts are approximate. Boring was backfilled with grout. Horizontal coordinate system is modified from the Colorado State Plane NAD1983 North Zone with conversion factor = 0.999721940.



LOG OF SOIL BORING

Start Date: 11-19-2021	End Date: 11-20-2021	Borehole ID: B-607B
Driller: Elite-Lenny	Logged By: LEA/JEL	Sheet 1 of 5
Bedrock Depth: 8.9 ft	Checked By: JRW	
Drilling Rig: Track Mounted Mobile B48X/CME-550X Rubber Tire ATV Mounted Rig Equipment: Hollow Stem Auger 3.75" I.D. 7-5/8" O.D.; NQ Wireline Coring 1-7/8" I.D. 3" O.D.		

Project name: Thornton Justice Center Phase III
 Project No: 21129
 Boring Location: N 1196454.8, E 3145146.8 ft
 Ground El: 5425.0 ft Total Depth: 49.0 ft
 Groundwater El: Not Encountered On Date:

Elevation	Depth (ft)	Type - No	Blows per 6 inch	Penetration (ft)	Recovery (ft)	Remarks	Graphic Lithology	Description and Classification of Materials
	1					B-607B was performed to complete drilling and sampling to about 50.0 feet after B-607A was abandoned because equipment at the bottom of borehole could not be recovered. B-607B is approximately 5.0 feet north of B-607A. Smooth drilling. Dry, brown cuttings. Dry to moist, brown cuttings.		0.0 to 20.0 ft: See B-607A log for description of materials.
	2							
	3							
	4							
	5							
	6							
	7							
	8							
	9							
	10							

Continued on next sheet

Notes Lithology between recovered samples is interpreted. Contacts are approximate. Boring was backfilled with grout. Horizontal coordinate system is modified from the Colorado State Plane NAD1983 North Zone with conversion factor = 0.999721940.



LOG OF SOIL BORING

Start Date: 11-19-2021	End Date: 11-20-2021	Borehole ID: B-607B
Driller: Elite-Lenny	Logged By: LEA/JEL	Sheet 2 of 5
Bedrock Depth: 8.9 ft	Checked By: JRW	
Drilling Rig: Track Mounted Mobile B48X/CME-550X Rubber Tire ATV Mounted Rig		
Equipment: Hollow Stem Auger 3.75" I.D. 7-5/8" O.D.; NQ Wireline Coring 1-7/8" I.D. 3" O.D.		

Project name: Thornton Justice Center Phase III
 Project No: 21129
 Boring Location: N 1196454.8, E 3145146.8 ft
 Ground El: 5425.0 ft Total Depth: 49.0 ft
 Groundwater El: Not Encountered On Date:

Elevation	Depth (ft)	Type - No	Blows per 6 inch	Penetration (ft)	Recovery (ft)	Remarks	Graphic Lithology	Description and Classification of Materials
	11							
	12							
	13							
	14							
	15					Drillers report water level at about 15.0 feet after auger removal. Water level was not measured.		
	16							
	17							
	18					Brown to gray cuttings.		
	19							
	20							

Continued on next sheet

Notes Lithology between recovered samples is interpreted. Contacts are approximate. Boring was backfilled with grout. Horizontal coordinate system is modified from the Colorado State Plane NAD1983 North Zone with conversion factor = 0.999721940.



LOG OF SOIL BORING

Start Date: 11-19-2021 End Date: 11-20-2021
 Driller: Elite-Lenny Logged By: LEA/JEL
 Bedrock Depth: 8.9 ft Checked By: JRW
 Borehole ID: **B-607B**
 Sheet 3 of 5
 Project name: Thornton Justice Center Phase III
 Project No: 21129
 Boring Location: N 1196454.8, E 3145146.8 ft
 Ground El: 5425.0 ft Total Depth: 49.0 ft
 Groundwater El: Not Encountered On Date:

Drilling Rig: Track Mounted Mobile B48X/CME-550X Rubber Tire ATV Mounted Rig
 Equipment: Hollow Stem Auger 3.75" I.D. 7-5/8" O.D.; NQ Wireline Coring 1-7/8" I.D. 3" O.D.

Elevation	Depth (ft)	Type - No	Blows per 6 inch	Penetration (ft)	Recovery (ft)	Remarks	Graphic Lithology	Description and Classification of Materials
	21	MC - 1	15/35/50 for 5"	1.4	1.0	Augered without sampling to the approximate start of coring of B-607A at 20.0 feet bgs. Sampling began at 20.0 feet to correlate material properties to B-607A data.		MC-1, S-2, S-3: Claystone Massive; mostly fines, medium to high plasticity; less than 5% sand, fine grained; intensely to very intensely weathered; fracturing not apparent; dry to moist; brown; PP = 4 tsf; H6 to H7; iron staining and veins common; [Denver Formation]
	22							
	23							
	24							
	25					Smooth drilling.		
	26							
	27							
	28					Dry to moist, gray cuttings.		
	29							
	30							

Continued on next sheet

Notes Lithology between recovered samples is interpreted. Contacts are approximate. Boring was backfilled with grout. Horizontal coordinate system is modified from the Colorado State Plane NAD1983 North Zone with conversion factor = 0.999721940.



LOG OF SOIL BORING

Start Date: 11-19-2021 End Date: 11-20-2021
 Driller: Elite-Lenny Logged By: LEA/JEL
 Bedrock Depth: 8.9 ft Checked By: JRW
 Borehole ID: **B-607B**
 Sheet 4 of 5
 Project name: Thornton Justice Center Phase III
 Project No: 21129
 Boring Location: N 1196454.8, E 3145146.8 ft
 Ground El: 5425.0 ft Total Depth: 49.0 ft
 Groundwater El: Not Encountered On Date:

Drilling Rig: Track Mounted Mobile B48X/CME-550X Rubber Tire ATV Mounted Rig
 Equipment: Hollow Stem Auger 3.75" I.D. 7-5/8" O.D.; NQ Wireline Coring 1-7/8" I.D. 3" O.D.

Elevation	Depth (ft)	Type - No	Blows per 6 inch	Penetration (ft)	Recovery (ft)	Remarks	Graphic Lithology	Description and Classification of Materials
	31	S - 2	9/15/28	1.5	1.6			30.0 to 31.5 ft: 5-15% sand; mottled orange brown; PP = 3 tsf;
	32					Smooth drilling.		
	33							
	34							
	35							
	36					Brown to gray cuttings.		
	37							
	38							
	39							
	40							

Continued on next sheet

Notes Lithology between recovered samples is interpreted. Contacts are approximate. Boring was backfilled with grout. Horizontal coordinate system is modified from the Colorado State Plane NAD1983 North Zone with conversion factor = 0.999721940.



LOG OF SOIL BORING

Start Date: 11-19-2021 End Date: 11-20-2021 Borehole ID: **B-607B**
 Driller: Elite-Lenny Logged By: LEA/JEL
 Bedrock Depth: 8.9 ft Checked By: JRW Sheet 5 of 5
 Drilling Rig: Track Mounted Mobile B48X/CME-550X Rubber Tire ATV Mounted Rig
 Equipment: Hollow Stem Auger 3.75" I.D. 7-5/8" O.D.; NQ Wireline Coring 1-7/8" I.D. 3" O.D.

Project name: Thornton Justice Center Phase III
 Project No: 21129
 Boring Location: N 1196454.8, E 3145146.8 ft
 Ground El: 5425.0 ft Total Depth: 49.0 ft
 Groundwater El: Not Encountered On Date:

Elevation	Depth (ft)	Type - No	Blows per 6 inch	Penetration (ft)	Recovery (ft)	Remarks	Graphic Lithology	Description and Classification of Materials
5382.5	41	S - 3	7/12/19	1.5	1.7	Stop drilling at 41.0 feet on 11/19/21. Start drilling at 41.0 feet on 11/21/21. Additional recovery possibly from slough or material swelling.		40.0 to 41.5 ft: light brown mottled with orange; PP = 3.5 tsf; manganese staining common;
	42							
	43							S-4, S-5: Sandstone Massive; mostly sand, fine grained, angular to subrounded; 5-15% fines, low to medium plasticity; moderately to intensely weathered; fracturing not apparent; moist; brown; H7; weakly cemented; [Denver Formation]
	44	S - 4	50 for 3"	0.3	0.2			
	45							
5376.3	49	S - 5	50 for 6"	0.5	1.2	Bottom of boring at 49.0 feet.	S-5: Sandy Claystone Massive; mostly fines, medium to high plasticity; 20-30% sand, fine grained, angular to subrounded; intensely to very intensely weathered; moist; light brown; H7; occasional iron staining on contact with sandstone; [Denver Formation]	
5376.0	49						End of boring log at 49.00 ft	
	50							

Notes Lithology between recovered samples is interpreted. Contacts are approximate. Boring was backfilled with grout. Horizontal coordinate system is modified from the Colorado State Plane NAD1983 North Zone with conversion factor = 0.999721940.



LOG OF SOIL BORING

Start Date: 01-03-2022 End Date: 01-03-2022
 Driller: Elite-Lenny Logged By: CLS
 Bedrock Depth: 5.7 ft Checked By: JRW
 Drilling Rig: Track Geoprobe 6620DT
 Equipment: Hollow Stem Auger 3.0" I.D. 5.75" O.D.

Borehole ID:
B-608
 Sheet 1 of 1

Project name: Thornton Justice Center Phase III
 Project No: 21129
 Boring Location: N 1196140.5, E 3145254.5 ft
 Ground El: 5437.7 ft Total Depth: 8.5 ft
 Groundwater El: Not Encountered On Date:

Elevation	Depth (ft)	Type - No	Blows per 6 inch	Penetration (ft)	Recovery (ft)	Remarks	Graphic Lithology	Description and Classification of Materials
						Concrete slab approximately 6 inches thick.		
	1							S-1, S-2: Fat Clay with Sand Mostly fines, medium to high plasticity; 15-25% sand, fine to coarse grained, subangular to subrounded; less than 10% gravel, fine to coarse grained, angular to subrounded; maximum particle size = 1 inch; stiff to very stiff; moist; brown to dark brown; roots common; weak to strong reaction with HCl; (CH); [Fill]
	2	S - 1	4/6/7	1.5	1.3			
	3							2.5 to 4.0 ft: medium stiff to stiff; no gravel; no roots;
	4	S - 2	5/6/7	1.5	0.3			
5433.7	5							S-3: Fat Clay Mostly fines, medium to high plasticity; 10-15% sand, fine to medium grained; medium stiff; moist; dark brown; weak to strong reaction with HCl; (CH); [Fill]
	6	S - 3	4/5/7	1.5	0.3			
5432.2	7					Top of rock at 5.7 feet.		S-4: Fat Clay with Sand Similar to 0.9 to 4.0 ft Except: less than 5% gravel, fine grained, subangular to subrounded; maximum particle size = 0.5 inches; medium stiff; no gravel; no roots; (CH); [Fill]
5432.0	8	S - 4	4/5/9	1.5	1.1			S-4, S-5: Claystone Massive; mostly fines, medium plasticity; less than 10% sand, fine to medium grained; intensely to very intensely weathered; fracturing not apparent; moist; gray; PP = 2.5 to 3.5 tsf; H7; occasional iron staining and veins; calcium seams common; weak to strong reaction with HCl; [Denver Formation]
	9	S - 5	3/8/12	1.5	1.3			
5429.2	10					Bottom of boring at 8.5 feet.		End of boring log at 8.50 ft

Notes Lithology between recovered samples is interpreted. Contacts are approximate. Boring was backfilled with grout. Horizontal coordinate system is modified from the Colorado State Plane NAD1983 North Zone with conversion factor = 0.999721940.





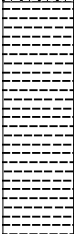



LOG OF SOIL BORING

Start Date: 01-03-2022 End Date: 01-03-2022
 Driller: Elite-Lenny Logged By: CLS
 Bedrock Depth: 7.1 ft Checked By: JRW
 Drilling Rig: Track Geoprobe 6620DT
 Equipment: Hollow Stem Auger 3.0" I.D. 5.75" O.D.

Borehole ID:
B-609
 Sheet 1 of 1

Project name: Thornton Justice Center Phase III
 Project No: 21129
 Boring Location: N 1196096.8, E 3145266.2 ft
 Ground El: 5437.7 ft Total Depth: 10.0 ft
 Groundwater El: Not Encountered On Date:

Elevation	Depth (ft)	Type - No	Blows per 6 inch	Penetration (ft)	Recovery (ft)	Remarks	Graphic Lithology	Description and Classification of Materials
						Concrete slab approximately 6 inches thick.		
5435.2	1	S - 1	4/5/9	1.5	1.3			S-1: Clayey Sand Mostly sand, fine to coarse grained, subangular to subrounded; 25-35% fines, medium plasticity; 5-15% gravel, fine to coarse grained, angular to subrounded; maximum particle size = 1.25 inches; medium dense; moist; brown; weak to strong reaction with HCl; (SC); [Fill]
	2							
	3	S - 2	6/7/6	1.5	1.2			S-2, S-3: Sandy Lean Clay Mostly fines, low to medium plasticity; 30-40% sand, fine to coarse grained, subangular to subrounded; less than 5% gravel, fine grained, subangular to rounded; maximum particle size = 0.5 inches; stiff to very stiff; moist; light brown to brown; weak to strong reaction with HCl; (CL); [Fill]
	4							4.0 to 5.5 ft: less than 10% gravel, fine to coarse grained; maximum particle size = 0.75 inches; (CH);
	5	S - 3	3/4/4	1.5	0.9			
5432.2	6	S - 4	4/4/5	1.5	0.4			S-4, S-5: Fat Clay with Sand Mostly fines, high plasticity; 15-25% sand, fine to coarse grained, subangular to subrounded; soft to medium stiff; moist; brown; weak to strong reaction with HCl; (CH); [Fill]
	7					Top of rock at 7.1 feet.		7.0 to 7.1 ft: stiff; (CH);
5430.6	8	S - 5	3/5/7	1.5	1.5			S-5, S-6: Claystone Massive; mostly fines, high plasticity; less than 5% sand, fine to medium grained; very intensely weathered to decomposed; fracturing not apparent; moist; gray; PP = 2.0 to 2.5 tsf; H7; calcium veins and seams common; occasional iron veins; strong reaction with HCl; [Denver Formation]
	9							8.5 to 10.0 ft: trace manganese staining; trace iron staining; weak to strong reaction with HCl;
	10	S - 6	2/3/8	1.5	1.1			
5427.7						Bottom of boring at 10.0 feet.		End of boring log at 10.00 ft

Notes Lithology between recovered samples is interpreted. Contacts are approximate. Boring was backfilled with grout. Horizontal coordinate system is modified from the Colorado State Plane NAD1983 North Zone with conversion factor = 0.999721940.



APPENDIX C

LABORATORY TEST RESULTS



ADVANCED TERRA TESTING
833 PARFET ST UNIT A
LAKEWOOD, CO
303-232-8308 www.terratesting.com

Thursday, December 30, 2021

Project Number: 2679-166
Company: RJH Consultants
Address:
City:
State:

RE: Soil Testing
TJC Phase III
21129

Dear Claire Stewart,

With this letter you will find a report on Soil samples assigned on 12/3/2021.

Testing was performed in accordance with standardized test methods, accepted industry practices as well as specific instructions received from you, our client. Advanced Terra Testing accepts no responsibility and makes no claims to the use or purpose of the material being tested. Furthermore, the results herein are based solely on the material received and tested. Please note that all material will be disposed of after thirty days unless other arrangements are made.

We respectfully request that sample reports be considered proprietary information and are not to be reproduced, except in full and only with prior written approval of Advanced Terra Testing. We are pleased to have been given the opportunity to perform high quality laboratory testing for your project. We sincerely hope the results herein provide you with all the information required. If you have questions or need anything further, please reach out and we will be happy to assist you.

Respectfully,
Kerry Repola



Percent Minus #200
ASTM D 1140

ADVANCED TERRA TESTING

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USCS Classification ASTM D 2487

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Unconfined Compressive Strength

ASTM D2166

ADVANCED TERRA TESTING

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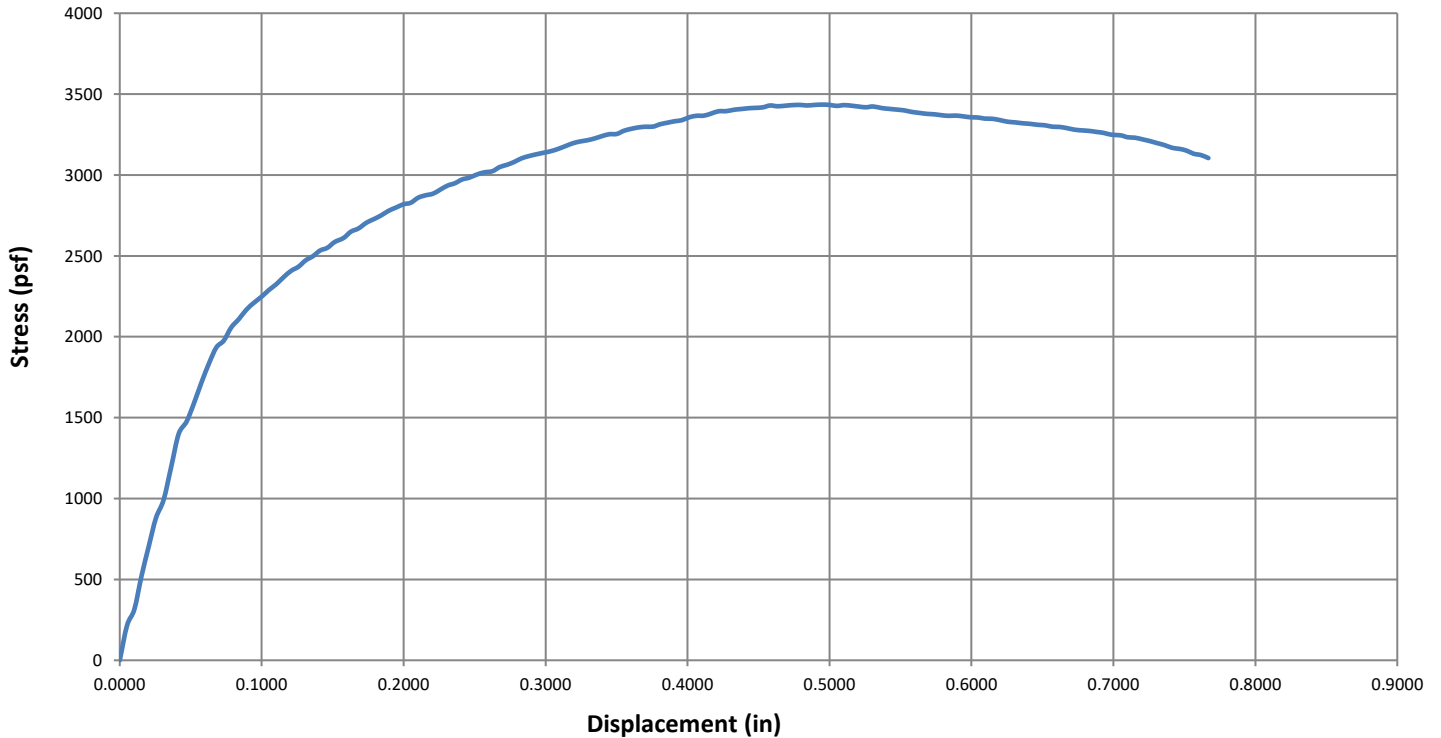
Moisture & Density Data

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Displacement vs. Stress



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**Unconfined Compressive Strength
ASTM D2166**

CLIENT	RJH Consultants	BORING NO.	B-607 A
JOB NO.	2679-166	DEPTH	7.0-7.5'
PROJECT	TJC Phase III	SAMPLE NO.	MC-3
PROJECT NO.	21129	DATE SAMPLED	11/17/2021
LOCATION	--	DESCRIPTION	liner
DATE TESTED	12/16/21		
TECHNICIAN	CAL		

Displacement (in)	Displacement (cm)	Strain (%)	Average Cross Sectional Area (in ²)	Load (lbs)	Load (N)	Stress (psf)	Stress (kPa)
0.6725	1.708	13.30	5.19	118	526	3280	157
0.6778	1.722	13.41	5.19	118	526	3276	157
0.6829	1.735	13.51	5.20	118	526	3272	157
0.6880	1.748	13.61	5.21	118	525	3266	156
0.6932	1.761	13.71	5.21	118	525	3260	156
0.6984	1.774	13.81	5.22	118	524	3249	156
0.7051	1.791	13.95	5.23	118	524	3245	155
0.7101	1.804	14.04	5.23	117	523	3233	155
0.7152	1.817	14.15	5.24	118	523	3230	155
0.7205	1.830	14.25	5.24	117	522	3220	154
0.7256	1.843	14.35	5.25	117	521	3210	154
0.7307	1.856	14.45	5.26	117	519	3197	153
0.7358	1.869	14.55	5.26	116	518	3185	153
0.7415	1.883	14.67	5.27	116	516	3168	152
0.7465	1.896	14.76	5.28	116	515	3162	151
0.7516	1.909	14.87	5.28	116	514	3150	151
0.7566	1.922	14.96	5.29	115	512	3131	150
0.7618	1.935	15.07	5.30	115	511	3123	150
0.7669	1.948	15.17	5.30	114	508	3105	149