Best Engineering Solutions and Technologies

PAVEMENT DESIGN STUDY
GRANDWOOD RANCH
FAIRPLAY DRIVE AND HIGBY ROAD
MONUMENT, COLORADO
80132

PROJECT NUMBER 21-1238
JULY 26, 2021

PREPARED FOR
ELITE SURFACE INFRASTRUCTURE, INC.
REISE PROKOP
1199 ATCHISON COURT
CASTLE ROCK, COLORADO
80109

Prepared By:

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Reviewed By:

COLORADO LICENSED MATTHEW ALAN BEST 0051186 7/26/2021 PROFESSIONAL ENGINEER

Matthew A. Best, P.E.
Project Engineer

Matt Best

Digitally signed by Matt Best
Date: 2021.07.26 11:01:58 -06'00'

Please add "PCD File No. SF-20-026".

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Locations: Summit County & Lakewood, Colorado ▪ Psalm 20 ▪ Phone: 970.409.9670 ▪ Matt@BestEngineeringUSA.com
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EXECUTIVE SUMMARY

Best Engineering Solutions and Technologies, LLC (BEST) completed a pavement design study for the proposed roadways in the Grandview Ranch Development located at Fairplay Drive and Higby Road in Monument, Colorado. Design parameters and a discussion of geotechnical engineering considerations related to construction of the proposed roadways are included in this report. A summary of our conclusions and recommendations is presented below, with more detailed criteria and recommendations contained in the report.

1. Subsurface explorations encountered man-placed fill consisting of clayey sand over native clayey sand to clayey sandstone to the maximum depth explored. Groundwater was not encountered during excavation of the test borings. Fluctuations of the groundwater may occur seasonally or with precipitation events.

   Using the design resilient modulus (M_R) and the assumed ESALs identified in the report, flexible pavements section recommendations for streets classified as "Rural Local" should be constructed with a minimum composite section of 4.0 inches of asphalt over 6.0 inches of aggregate base course. For streets classified as "Rural Major Collector" should be constructed with a minimum composite section of 4.0 inches of asphalt over 12.0 inches of aggregate base course. For streets classified as "Rural Minor Arterial" should be constructed with a minimum composite section of 5.0 inches of asphalt over 12.0 inches of aggregate base course. Areas requiring Portland Cement Concrete should be constructed with a minimum of 5.0 inches of concrete for "Rural Local" and 6.0 inches for "Rural Major Collector" and "Rural Minor Arterial".

2. A representative of our office should observe the construction operations discussed in this report.

3. Keep any exposed soils from excessive drying or wetting during the construction process.

4. More detailed recommendations are made throughout this report. These must be reviewed to assure proper consideration in the design.

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PURPOSE AND SCOPE OF WORK

This report presents the results of a pavement design study for the proposed roadways in the Grandview Ranch Development located at Fairplay Drive and Higby Road in Monument, Colorado. The project site is shown on Figure 1. The project will include the construction of Copper Valley Court, Furrow Road, Sunnyvale Trail, Pasture Trail, and Grandwood Drive. The study was conducted to determine the type of subgrade soils present at the site, evaluation of pavement support characteristics, and provide pavement design recommendations.

A field exploration study consisting of seventeen exploratory borings was conducted to collect information on the subsurface conditions. Samples of the subsoils collected during the field exploration were tested in the laboratory to determine their classification and engineering characteristics. The results of the field exploration and laboratory testing were analyzed to develop recommendations for alternative pavement sections, construction, materials and maintenance recommendations.

This report has been prepared to summarize the data obtained during this study and to present our conclusions and recommendations based on AASHTO design criteria and method and our experience. If plans change significantly, we should be contacted to review our recommendations.

SITE CONDITIONS

At the time of our field exploration, the property consisted of a vacant lot. The site is bounded by undeveloped lots and single-family homes. The lot is relatively flat and is at an approximate elevation ranging of 7,180 to 7,320 feet MSL. At the time of our investigation, grading had been performed and underground utilities, including storm sewer, had been installed. BEST performed construction materials testing, including laboratory testing and nuclear density testing, on the site grading for the proposed roadways and storm sewer installation.

FIELD EXPLORATION

The exploratory borings were drilled on May 8, 2021, approximately at the location shown on Figure 2 to evaluate the subsurface conditions. The borings were drilled using a truck-mounted rig and was logged by a representative of BEST. Samples of the soils were taken with undisturbed sampling methods and the depth of the borings and samples are shown on the Boring Logs, Figure 3 and Legend and Notes, Figure 4.

SUBSURFACE CONDITIONS

Boring B-1 encountered man-placed fill consisting of clayey sand with trace gravel to a depth of approximately 9.5 feet Below Existing Grade (BEG). Native clayey sandstone was encountered to the maximum depth explored of 10 feet BEG. **Boring B-2** encountered man-placed fill consisting of clayey sand with trace gravel to a depth of approximately 4 feet BEG. Native clayey sand with trace gravel was encountered to the maximum depth explored of 5 feet BEG. **Boring B-3** encountered man-placed fill consisting of clayey sand with trace gravel to a depth of approximately 1 foot BEG. Native clayey sandstone was encountered to the maximum depth explored of 10 feet BEG. **Boring B-4** encountered man-placed fill consisting of clayey sand with trace gravel to the maximum depth explored of 5 feet BEG. **Boring B-5** encountered man-placed fill consisting of clayey sand with trace gravel to a depth of approximately 4 feet BEG. Native clayey sand with trace gravel was encountered to the maximum depth explored of 5 feet BEG. **Boring B-6** encountered man-placed fill consisting of clayey sand with trace gravel to the maximum depth explored of 10 feet BEG. **Boring B-7** encountered man-placed fill consisting of clayey sand with trace gravel to the maximum depth explored of 5 feet BEG. **Boring B-8** encountered man-placed fill consisting of clayey sand with trace gravel to the maximum depth explored of 5 feet BEG. **Boring B-9** encountered man-placed fill consisting of clayey sand with trace gravel to the maximum depth explored of 5 feet BEG. **Boring B-10** encountered native clayey sand with trace gravel to the maximum depth

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explored of 5 feet BEG. **Boring B-11** encountered native clayey sandstone to the maximum depth explored of 10 feet BEG. **Boring B-12** encountered native clayey sandstone to the maximum depth explored of 5 feet BEG. **Boring B-13** encountered native clayey sandstone to the maximum depth explored of 10 feet BEG. **Boring B-14** encountered man-placed fill consisting of clayey sand with trace gravel to the maximum depth explored of 5 feet BEG. **Boring B-15** encountered native clayey sand with trace gravel to the maximum depth explored of 5 feet BEG. **Boring B-16** encountered man-placed fill consisting of clayey sand with trace gravel to the maximum depth explored of 10 feet BEG. **Boring B-17** encountered native clayey sand with trace gravel to the maximum depth explored of 5 feet BEG. Groundwater was not encountered at the time of the borings. Fluctuations in the groundwater levels may occur seasonally or with precipitation events.

Samples taken from the exploratory borings were obtained for laboratory testing and inspected by the project engineer. The results of the tests performed on the samples obtained from the test borings are shown on Table 1. Laboratory testing included index property tests, such as moisture content and density, swell/consolidation testing and gradation analysis. The testing was performed on relatively undisturbed drive samples and were in general conformance with recognized test procedures, primarily, ASTM and Colorado Department of Transportation (CDOT).

PAVEMENT THICKNESS DESIGN

The following pavement design criteria meets the El Paso County pavement design guidelines. The pavement design provided here is based on the minimum required pavement thicknesses as shown on Table D-2, Minimum Pavement Sections, for streets classified as "Rural Local", "Rural Major Collector", and "Rural Minor Arterial", for private street or drive and fire lanes.

If the recommendations provided below are followed, the proposed pavement sections should provide acceptable performance for the property.

A pavement section is a layered system designed to distribute concentrated traffic loads to the subgrade. Performance of the pavement structure is directly related to the physical properties of the subgrade soils and traffic loadings. Soils are represented for pavement design purposes by means of a resilient modulus (MR) for flexible pavements and a modulus of subgrade reaction (k) for rigid pavements. Both values are empirically related to strength.

HOT MIX ASPHALT (HMA)

1. Subgrade Materials – Based on the results of the field exploration and laboratory test data, the pavement subgrade materials at the site classify as A-3, in accordance with the American Association of State Highway and Transportation Officials (AASHTO) classification system. Soils classifying as A-3 would generally be considered to provide very good subgrade support.

   The CBR value of the onsite material, 7.1, was converted to resilient modulus (MR) value of 8,958 psi, using CDOT and AASHTO methods for conversion. Based on this, we have selected an MR of 8,958 psi for pavement thickness design calculations.

2. Design Traffic – It appears that daily traffic at the site will be generally limited to automobiles that will utilize the facility along with delivery and trash trucks on a routine basis. At the time of the report, traffic data was not available. Therefore, we have estimated traffic usage based on similar facilities. We have assumed an

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18-kip equivalent single axle loading (ESAL) of 36,500 for “Rural Local” streets, 273,750 ESAL value for “Rural Major Collector” streets and 689,850 ESAL value for “Minor Arterial” streets.

If the assumptions indicated above appear to be different than actual traffic values for the site, we should be notified to reevaluate the pavement thickness requirements.

3. Pavement Sections – The pavement sections were calculated using the 1993 AASHTO pavement design procedures. For flexible pavement design, an initial serviceability of 4.5 and 2.0, were selected with a reliability of 75 percent. If other design parameters are preferred, we should be contacted in order to reevaluate the recommendations presented in this report.

   The pavement section recommendations for streets classified as “Ru ... ith a minimum composite section of 4.0 inches of asphalt over 6.0 inches

   Please review ECM table D-1 for reliability percentages for each road classification and include requirements.

   The pavement section recommendations for streets classified as ... d be constructed with a minimum composite section of 4.0 inches of asphalt over 12.0 inches of aggregate base course.

   The pavement section recommendations for streets classified as “Minor Arterial” (Furrow Road) should be constructed with a minimum composite section of 5.0 inches of asphalt over 12.0 inches of aggregate base course.

   Per Grandwood Ranch TIS (PCD File Nos. P191 and SP195) Furrow Rd is a two lane rural major collector. Please update to match report.

   Truck loading areas, dumpster p ... centrated should be paved with a minimum of 5 inches of Portland cement concrete on “Rural Local” streets, and 6 inches for “Rural Major Collector” and “Rural Minor Arterial” streets. All concrete pavement areas on the site should contain sawed or formed joints to ¼ of the depth of the slab at a maximum distance of 12 feet on center.

4. Pavement Material Recommendations – The asphalt mix should meet the latest requirements of the CDOT Standard Specifications for Road and Bridge Construction. The asphalt placed for the project should be designed in accordance with the SuperPave gyratory mix design method. The mix should meet Grading S or SX requirements. A SuperPave gyratory design revolution (NDES) of 75 should be used in the design process. A PG 64-22 asphalt binder should be used for the mix.

5. Subgrade Preparation – The pavement subgrade should be scarified to a depth of 12 inches, adjusted to a moisture content within 2 percentage points of the optimum moisture content and recompacted to at least 95% of the standard Proctor maximum dry density (ASTM D 698). Subgrade should not contain organic matter or other deleterious substances.

   The pavement subgrade should be proof-rolled with a heavily loaded pneumatic-tired vehicle of a heavy, smooth drum compactor. Pavement design procedures assume a stable subgrade. Areas that deform excessively under a heavy wheel load are not stable and should be removed and replaced to achieve a stable subgrade prior to paving. The contractor should be aware that the clay soils, including onsite and imported materials, may become somewhat unstable and deform under wheel loads if placed near the upper end of the moisture range.

6. Paving should only be performed when subgrade temperatures are above 40° F and air temperature is at least 40° F and rising.

Please provide pavement design calculations that include structural numbers and strength coefficients used for asphalt and subgrade.

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7. HMA should not be placed at a temperature lower than 245° F for mixes containing PG 64-22 asphalt, and 290° F for mixes containing polymer modified asphalt. The breakdown compaction should be completed before the mixture temperature drops 20° F.

8. The maximum compacted lift should be 3.0 inches and joints should be staggered. No joints should be placed within wheel paths.

9. HMA should be compacted to between 92 and 96 percent of Maximum theoretical Density, The surface shall be sealed with a finish roller prior to the mix cooling to 185° F.

10. Placement and compaction of HMA should be observed and tested by a representative of our firm. Placement should not commence until the subgrade is properly prepare, tested and proof rolled.

11. Drainage – The collection and diversion of surface drainage away from paved areas is extremely important to the satisfactory performance of the pavement structure. Drainage design should provide for the removal of water from paved areas and prevent the wetting of the subgrade soils.

PORTLAND CEMENT CONCRETE (PCC)

1. Portland cement concrete should have a minimum compressive strength of 4,500 psi at 28 days and a minimum modulus of rupture (flexural strength) of 650 psi. A CDOT approved Class P mix design is also acceptable. A job mix design is recommended and periodic checks on the job site should be made to verify compliance with specifications.

2. Portland cement should be Type II "low alkali" and should conform to ASTM C 150. Portland cement should conform to ASTM C 150.

3. Portland cement concrete should not be placed when the subgrade or air temperature is below 40° F.

4. Free water should not be finished into the concrete surface and finishers should not use a steel trowel on the surface. Atomizing nozzle pressure sprayers for applying finishing compounds are recommended whenever the concrete surface becomes difficult to finish.

5. Curing of the portland cement concrete should be accomplished by the use of a curing compound. The curing compound should be applied in accordance with manufacturer recommendations.

6. Curing procedures should be implemented, as necessary, to protect the pavement against moisture loss, rapid temperature change, freezing, and mechanical injury.

7. Construction joints, including longitudinal joints and transverse joints, should be formed during construction or sawed after the concrete has begun to set, but prior to uncontrolled cracking.

8. All joints should be properly sealed using a rod back-up and approved epoxy sealant.

9. Traffic should not be allowed on the pavement until it has properly cured and achieved at least 80 percent of the design strength, with saw joints already cut.

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10. Placement of portland cement concrete should be observed and tested by a representative of our firm. Placement should not commence until the subgrade is properly prepared and tested.

CONSTRUCTION DETAILS

The design of a pavement system is as much a function of the quality of the paving materials and construction as the support characteristics of the subgrade. The construction materials are assumed to possess sufficient quality as reflected by the strength coefficients used in the flexible pavement design calculations. These strength coefficients were developed through research and experience to simulate expected material of good quality, as explained herein. During construction careful attention should be paid to the following details:

- Placement and compaction of trench backfill.
- Compaction at curblines and around manholes and water valves.
- Excavation of completed pavements for utility construction and repair.
- Moisture treating or stabilization of the subgrade to reduce swell potential.

Design slopes of the adjacent ground and pavement to rapidly remove water from the pavement surface.

MAINTENANCE

Routine maintenance, such as sealing and repair of cracks, is necessary to achieve the long-term life of a pavement system. We recommend a preventive maintenance program be developed and followed for all pavement systems to assure the design life can be realized. Choosing to defer maintenance usually results in accelerated deterioration leading to higher future maintenance costs, and/or repair.

LIMITATIONS

This study has been conducted in accordance with generally accepted geotechnical engineering practices in this area for exclusive use by the client for design purposes. Copying of this report or portions of this report without the express written permission of Best Engineering Solutions and Technologies, LLC (BEST), is specifically prohibited. We make no warranty either express or implied. The conclusions and recommendations submitted in this report are based upon data obtained from the exploratory test borings at the locations indicated on Fig. 1, and the proposed construction. This report may not reflect subsurface variations that occur between the explorations. The nature and extent of variations across the site may not become evident until site grading and excavations are performed. If fill, soil, rock or water conditions appear to be different from those described herein, BEST should be advised at once so that a re-evaluation of the recommendations presented in this report can be made. BEST is not responsible for liability associated with interpretation of subsurface data by others.

The scope of services for this project does not include any environmental assessment of the site or identification of contaminated or hazardous materials or conditions. In addition, this study does not include determination of the presence, prevention, or possibility of mold or other biological contaminants developing in the future. If the owner is concerned about the potential for such contamination, other studies should be undertaken.

Matthew A. Best, P.E.
Project Engineer

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TABLE 1
SUMMARY OF LABORATORY TEST RESULTS

PROJECT: Grandwood Ranch Pavement Design **PROJECT NO:** 21-1238 **DATE:** July 26, 2021
LOCATION: Monument, CO **SOURCE:** Field Test Boring / Lab Testing

Boring No.	Depth	Sample Type (Note 1)	Nat. Dry Density (PCF)	Natural Moist. (%)	ATTERBERG LIMITS		GRADATION			% Swell and Consolidation	Additional Test Results (Note 3)	Soil Description
					LL	PI	% Gravel +No. 4	% Sand -No. 4 +No. 200	% Fines -No. 200			
1	1	CA	115.7	9.4			13	69	17			Clayey sand, little gravel (Fill)
1	4	CA	129.2	5.7			12	73	15			Clayey sand, little gravel (Fill)
1	9	CA	127.3	7.6			6	74	19			Clayey sand, trace gravel (Fill)
2	1	CA	109.5	5.5			3	87	10			Clayey sand, trace gravel (Fill)
2	4	CA	112.3	4.1			2	76	21			Clayey sand, trace gravel
3	1	CA	115.6	10.6			2	81	17			Clayey sandstone
3	4	CA	122.3	8.9			5	69	26			Clayey sandstone
4	1	CA	119.8	8.9			2	71	27			Clayey sand, trace gravel (Fill)
4	4	CA	132.0	8.2			5	72	23			Clayey sand, trace gravel (Fill)
5	1	CA	93.0	9.4			6	78	15			Clayey sand, trace gravel (Fill)
5	4	CA	115.0	8.5					32	SW= 0.9		Clayey sand
6	1	CA	113.7	8.9			5	57	37			Clayey sand, trace gravel (Fill)

NOTE 1- Sample Type
BS=Bag Sample
AS=Auger Sample
ST=Shelby Tube
CA=California Sample
RM=Remolded Sample
HD=Hand Drive
AD=Air Dried
SS=Split Spoon Sample

NOTE 2-Shear Strength Tests
C1= Unconfined Compression
C2=Miniature Compression
C3=Pocket Penetrometer
C4=Pocket Value

NOTE 3- Additional Test Results
TT=Triaxial Test
PT=Proctor
CT=Consolidation Test
RA=Radon Testing (pCi/L)
pH = pH of soil
OR = Organic content of soil
WSS=Water Soluble Sulfates

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TABLE 2
SUMMARY OF LABORATORY TEST RESULTS

PROJECT: Grandwood Ranch Pavement Design **PROJECT NO:** 21-1238 **DATE:** July 19, 2021
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					LL	PI	% Gravel +No. 4	% Sand -No. 4 +No. 200	% Fines -No. 200			
6	4	CA	120.6	6.4			10	74	15			Clayey sand, little gravel (Fill)
6	9	CA	134.6	6.0			6	66	28			Clayey sand, trace gravel (Fill)
7	1	CA	118.3	8.1			9	73	18			Clayey sand, trace gravel (Fill)
7	4	CA	129.6	6.5			8	72	20			Clayey sand, trace gravel (Fill)
8	1	CA	124.1	7.0			4	69	28			Clayey sand, trace gravel (Fill)
8	4	CA	127.1	7.8			12	70	17			Clayey sand, little gravel (Fill)
9	1	CA	112.9	7.7			9	66	25			Clayey sand, trace gravel (Fill)
9	4	CA	126.7	7.4			9	72	19			Clayey sand, trace gravel (Fill)
10	1	CA	100.1	3.0			1	94	5			Clayey sand, trace gravel
10	4	CA	107.0	2.7			7	87	6			Clayey sand, trace gravel
11	1	CA	106.5	7.8			12	79	8			Clayey sandstone
11	4	CA	107.9	10.7					33			Clayey sandstone

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					LL	PI	% Gravel +No. 4	% Sand -No. 4 +No. 200	% Fines -No. 200			
11	9	CA	122.3	7.3					42			Clayey sandstone
12	1	CA	91.0	11.3			9	79	11			Clayey sandstone
12	4	CA	106.4	10.0			2	82	16			Clayey sandstone
13	1	CA	107.5	7.0			20	70	10			Clayey sandstone
13	4	CA	103.2	10.4			9	82	9			Clayey sandstone
14	1	CA	129.4	6.9			14	63	22			Clayey sand, little gravel (Fill)
14	4	CA	103.1	6.8			7	72	22			Clayey sand, trace gravel (Fill)
15	1	CA	113.9	4.1			7	79	15			Clayey sand, trace gravel
15	4	CA	110.7	6.5			9	72	19			Clayey sand, trace gravel
16	1	CA	85.6	28.7			8	78	13			Clayey sand, trace gravel (Fill)
16	4	CA	98.7	5.9			10	76	15			Clayey sand, trace gravel (Fill)
17	1	CA	65.1	7.9			9	75	15			Clayey sand, trace gravel

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TABLE 4
SUMMARY OF LABORATORY TEST RESULTS

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LOCATION: Monument, CO **SOURCE:** Field Test Boring / Lab Testing

Boring No.	Depth	Sample Type (Note 1)	Nat. Dry Density (PCF)	Natural Moist. (%)	ATTERBERG LIMITS		GRADATION			% Swell and Consolidation	Additional Test Results (Note 3)	Soil Description
					LL	PI	% Gravel +No. 4	% Sand -No. 4 +No. 200	% Fines -No. 200			
17	4	CA	111.4	2.3			4	84	11			Clayey sand, trace gravel
17	9	CA	99.3	7.9			22	62	16			Gravelly sand, little clay

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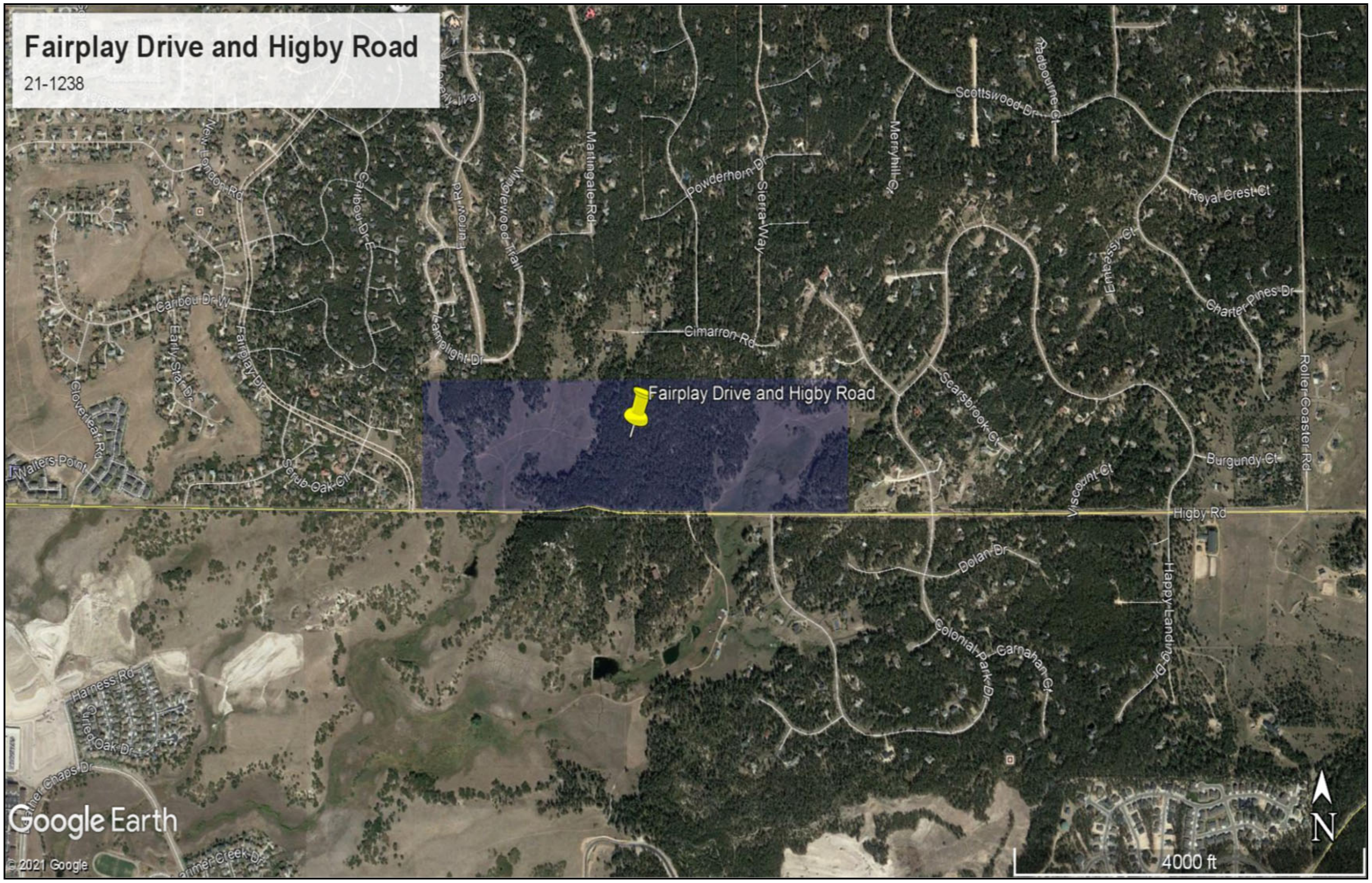
SITE MAP



N

Not to Scale

Project Number 21-1238

Figure 1

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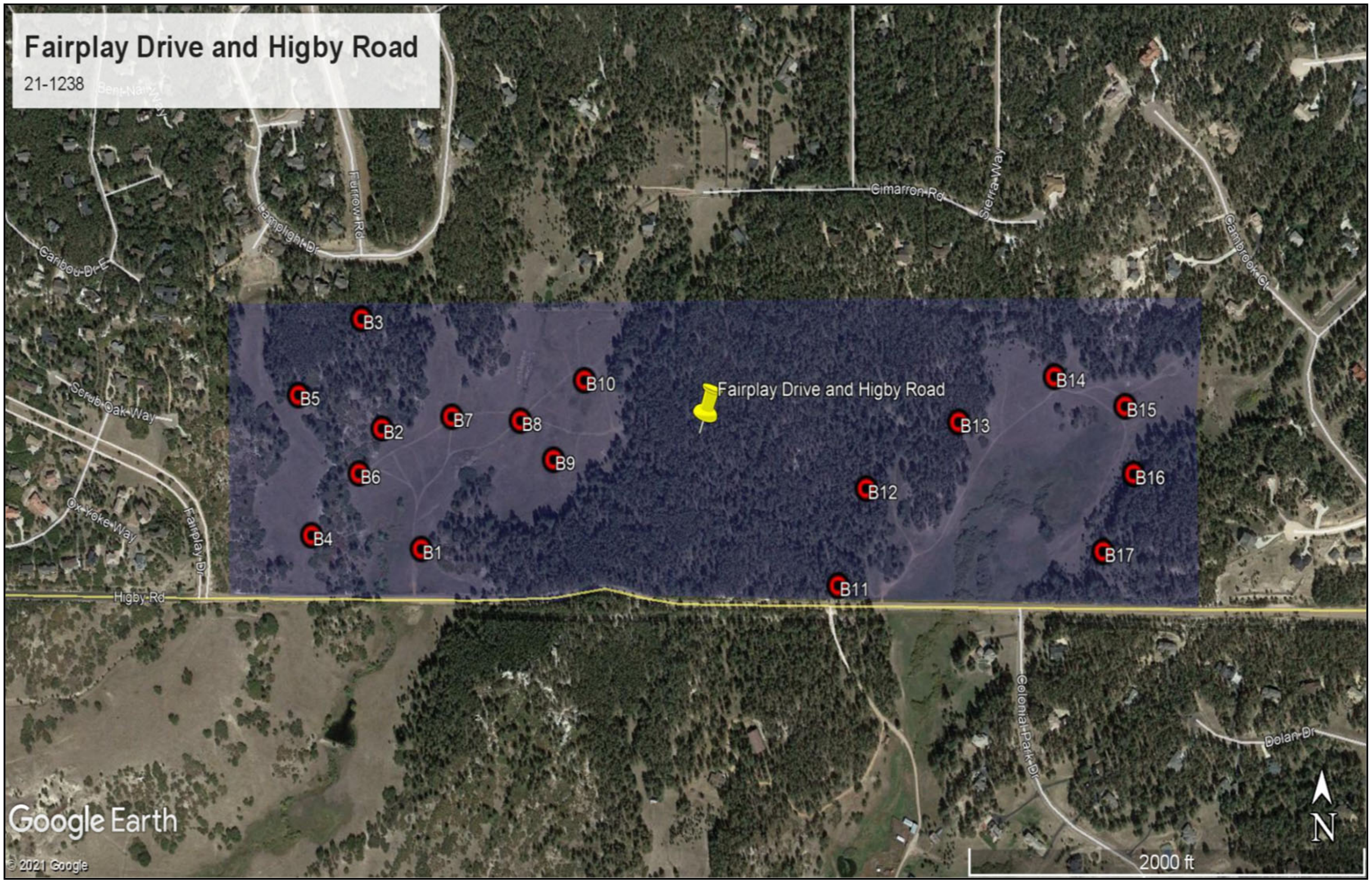
BORING LOCATION



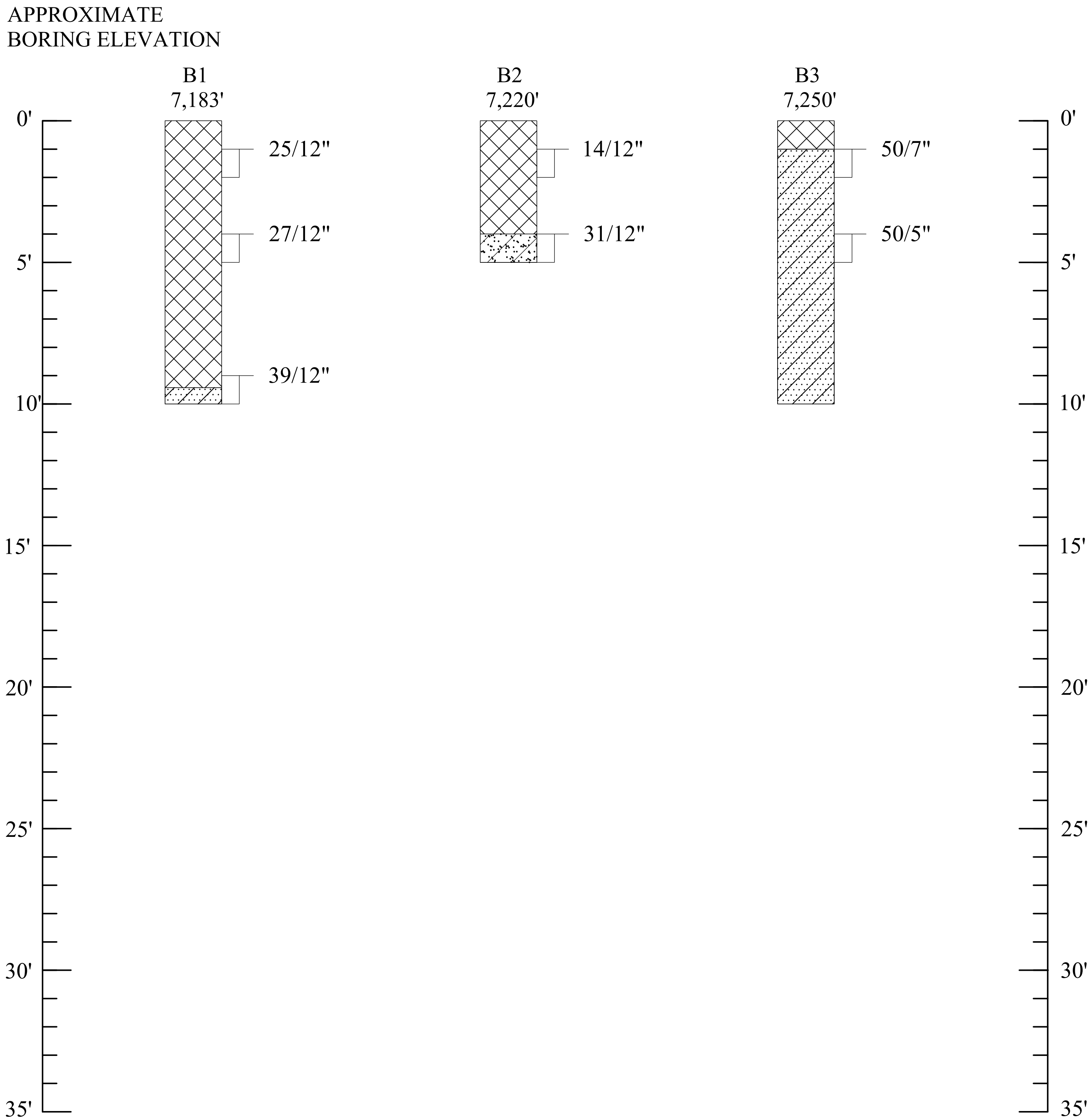
N

Not to Scale

Please provide a scale. Note that per ECM D.2.1 field investigations should consist of borings that are not more than 500 feet apart from each other.

LEGEND: B-1 – Indicates approximate location of exploratory boring

Project Number 21-1238 **Figure 2**



BORING LOG

Lakewood Office:
747 Sheridan Blvd, Unit 2A
Lakewood, CO 80214

Project Location:
Fairplay Drive and Higby Road
Montument, Colorado

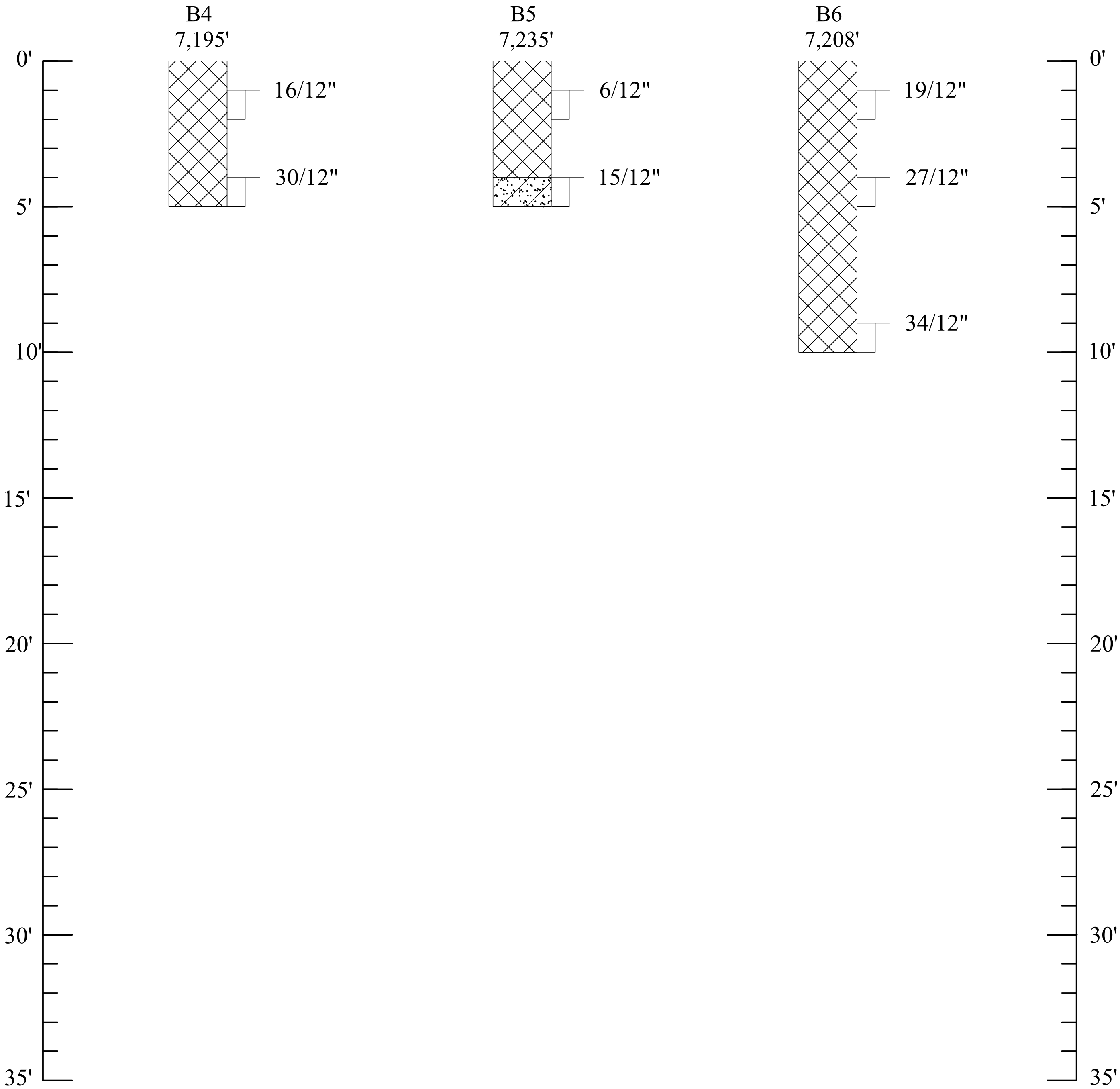
DRAWN BY: KMH
REVIEWED BY: MAB
DATE: July 26, 2021

SCALE:
Vertical: N/A
Horizontal: N/A

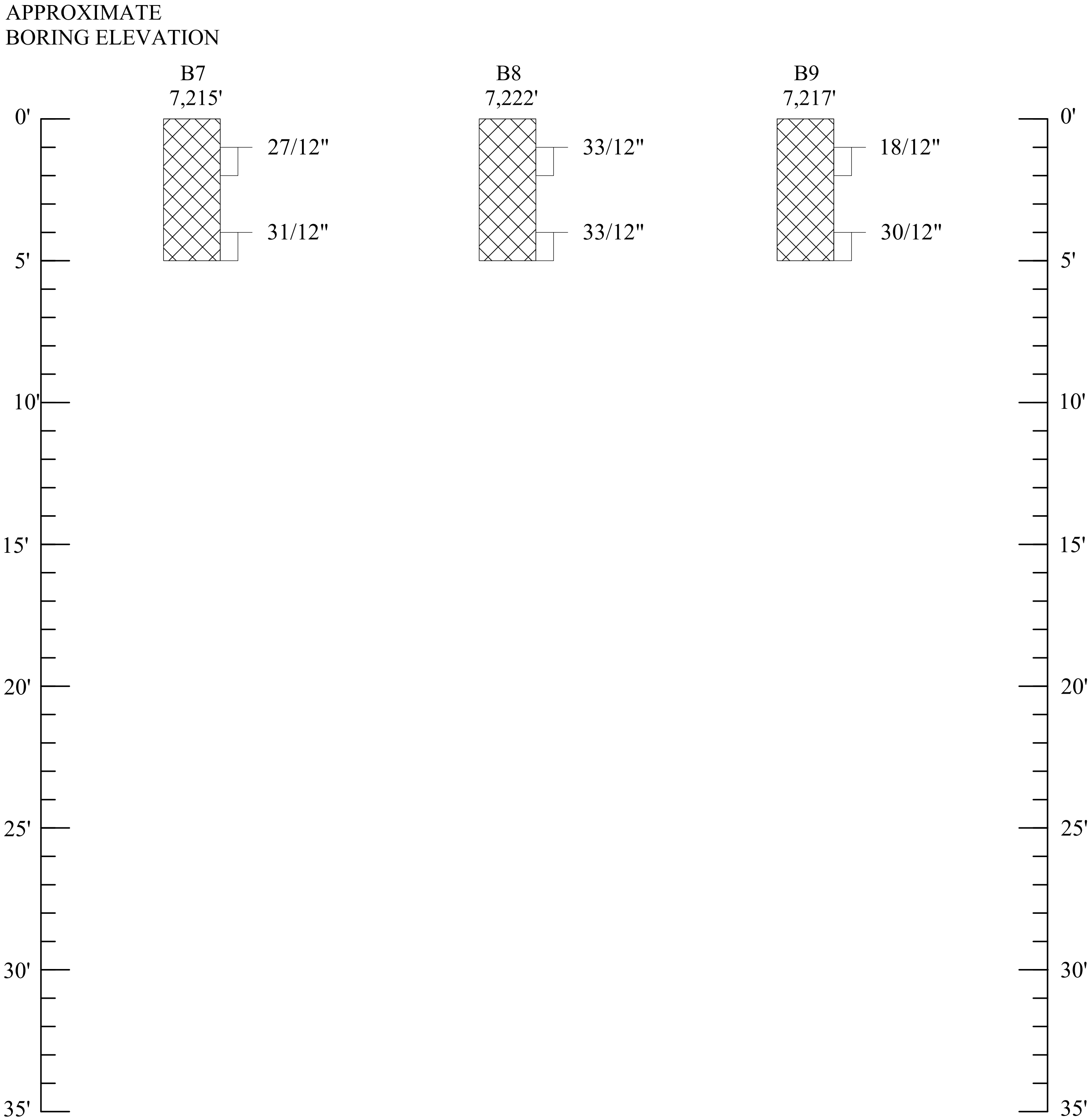
PROJECT NO: 21-1238

FIGURE: 3 A

APPROXIMATE
BORING ELEVATION



BORING LOG		*Lakewood Office:* *747 Sheridan Blvd, Unit 2A* *Lakewood, CO 80214*
Project Location: Fairplay Drive and Higby Road Montument, Colorado	**DRAWN BY:** KMH **REVIEWED BY:** MAB **DATE:** July 26, 2021	**SCALE:** Vertical: N/A Horizontal: N/A
	PROJECT NO: 21-1238	**FIGURE: 3 B**



BORING LOG

Lakewood Office:
747 Sheridan Blvd, Unit 2A
Lakewood, CO 80214

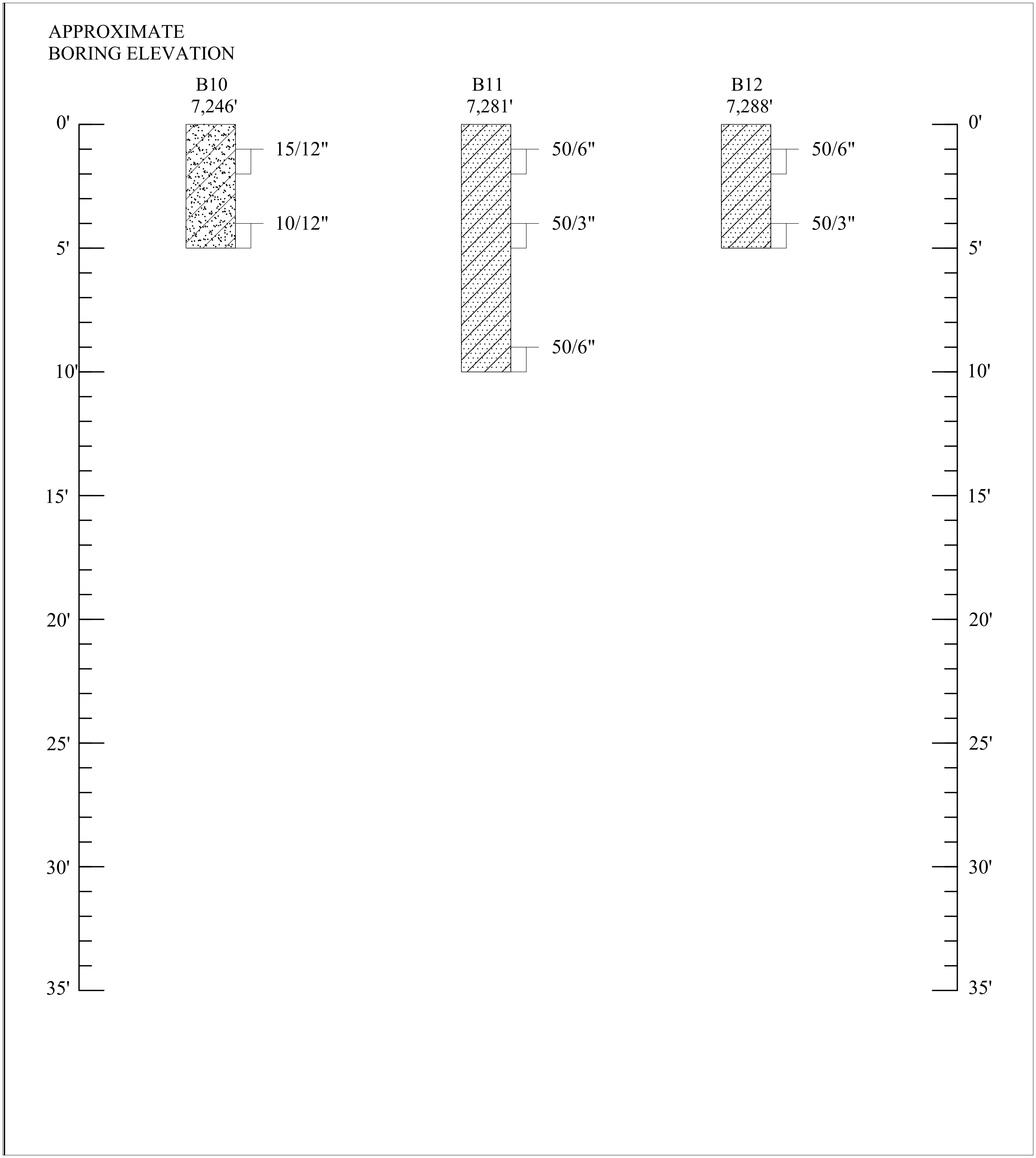
Project Location:
Fairplay Drive and Higby Road
Montument, Colorado

DRAWN BY: KMH
REVIEWED BY: MAB
DATE: July 26, 2021

SCALE:
Vertical: N/A
Horizontal: N/A

PROJECT NO: 21-1238

FIGURE: 3 C



BORING LOG

Lakewood Office:
747 Sheridan Blvd, Unit 2A
Lakewood, CO 80214

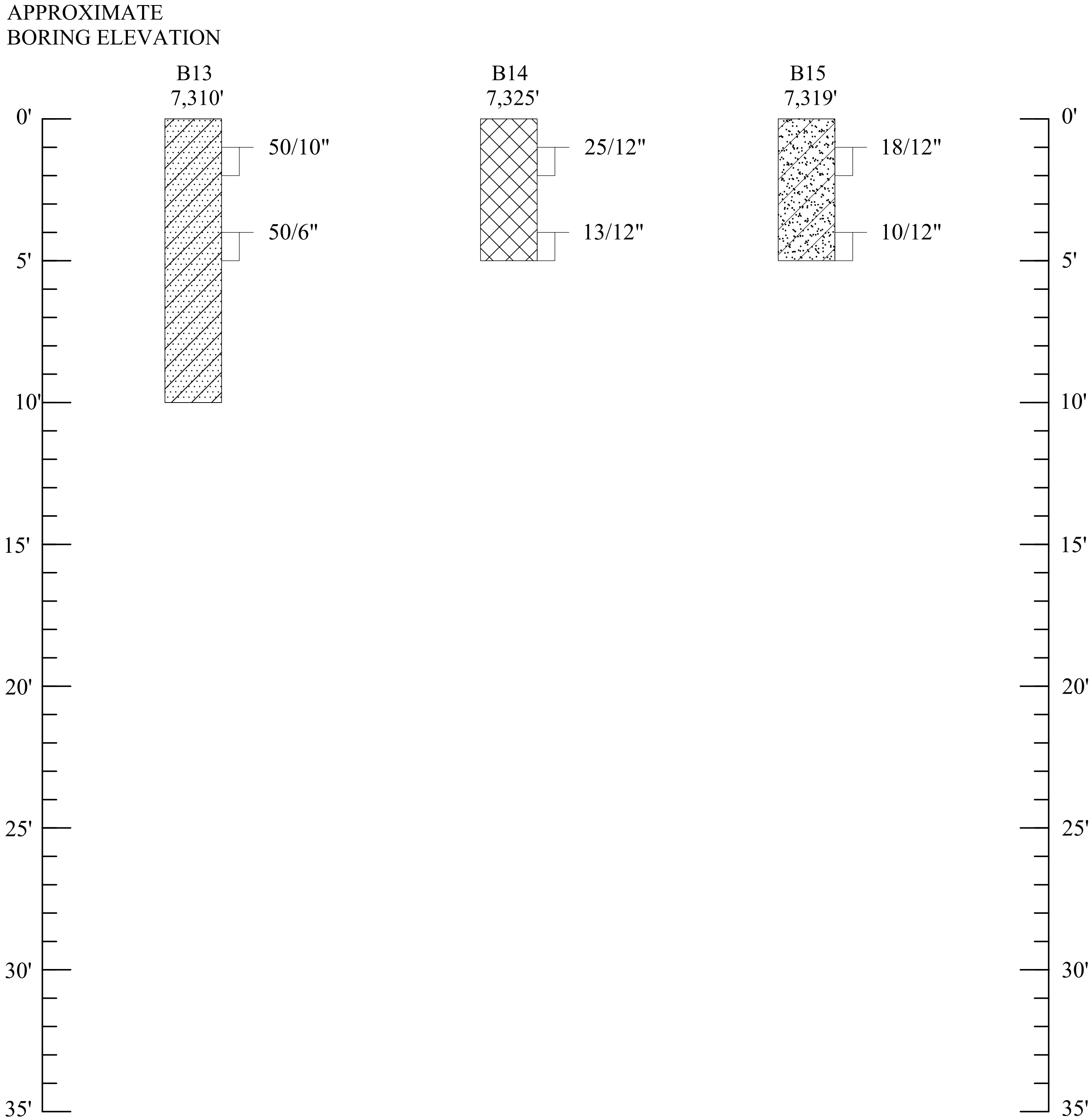
Project Location:
Fairplay Drive and Higby Road
Montument, Colorado

DRAWN BY: KMH
REVIEWED BY: MAB
DATE: July 26, 2021

SCALE:
Vertical: N/A
Horizontal: N/A

PROJECT NO: 21-1238

FIGURE: 3 D



BORING LOG

Lakewood Office:
747 Sheridan Blvd, Unit 2A
Lakewood, CO 80214

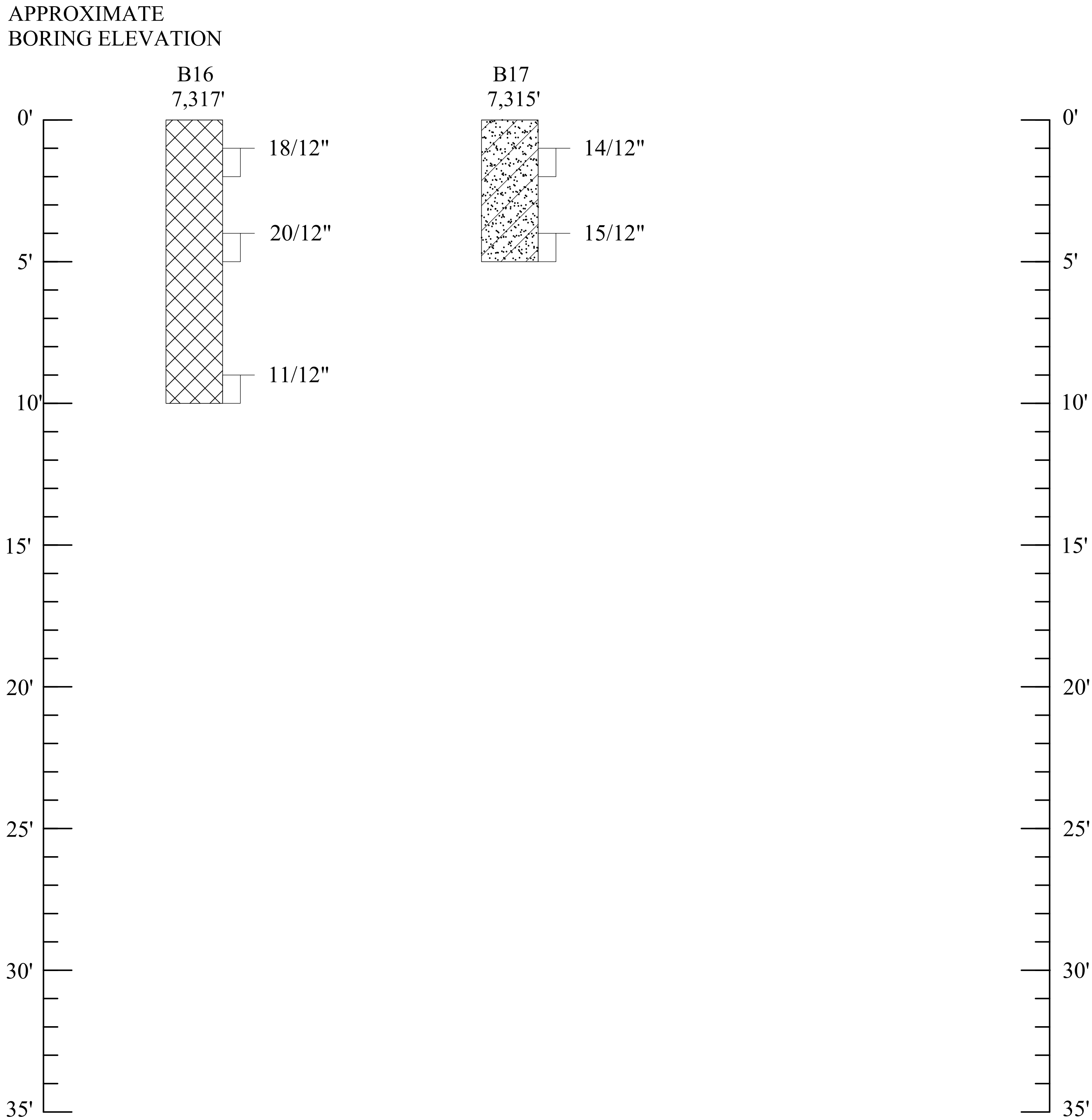
Project Location:
Fairplay Drive and Higby Road
Montument, Colorado

DRAWN BY: KMH
REVIEWED BY: MAB
DATE: July 26, 2021

SCALE:
Vertical: N/A
Horizontal: N/A

PROJECT NO: 21-1238

FIGURE: 3 E



BORING LOG

Lakewood Office:
747 Sheridan Blvd, Unit 2A
Lakewood, CO 80214

Project Location:
Fairplay Drive and Higby Road
Montument, Colorado

DRAWN BY: KMH
REVIEWED BY: MAB
DATE: July 26, 2021

SCALE:
Vertical: N/A
Horizontal: N/A

PROJECT NO: 21-1238

FIGURE: 3 F

Man-placed fill, clayey sand with trace to little clay

Clayey sand with trace gravel, medium dense, brown, moist

Clayey to silty sandstone, hard to very hard, olive to brown, moist

(0)

Water Level, Time After Drilling (0 = At Time of Drilling)

Disturbed Sample Collected

Undisturbed Sample Collected

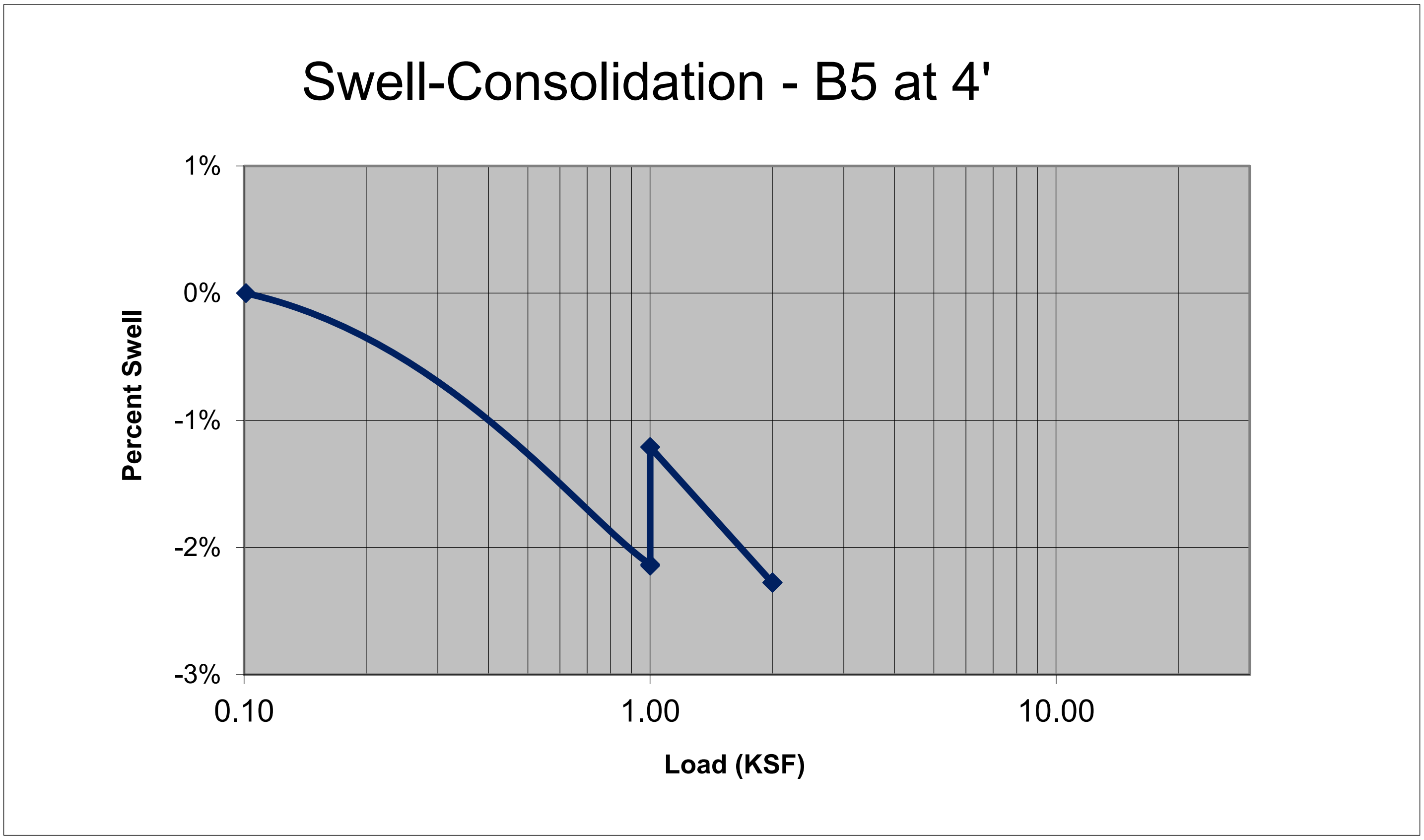
X/12"	Blow Counts; Number of Blows to Drive the Sampler 12-Inches (ASTM D-1586)
((X))	Depth of Caving Soils

Practical Auger Refusal

NOTES:

1. The samples were collected on May 8, 2021 with a truck mounted drill rig and 4" solid flight auger.
2. The stratification lines represent the approximate boundary between soil types and the transition may be gradual.
3. The boring log(s) show subsurface conditions at the dates and locations indicated, and it is not warranted that they are representative of subsurface conditions at other locations or times.
4. Elevations are provided by Google Earth© and are considered approximate.

BORING LOG	Best Engineering Solutions and Technologies	*Lakewood Office:* *747 Sheridan Blvd, Unit 2A* *Lakewood, CO 80214*
Project Location: Fairplay Drive and Higby Road Montument, Colorado	**DRAWN BY:** KMH **REVIEWED BY:** MAB **DATE:** July 26, 2021	**SCALE:** Vertical: N/A Horizontal: N/A
	PROJECT NO: 21-1238	**FIGURE: 4**

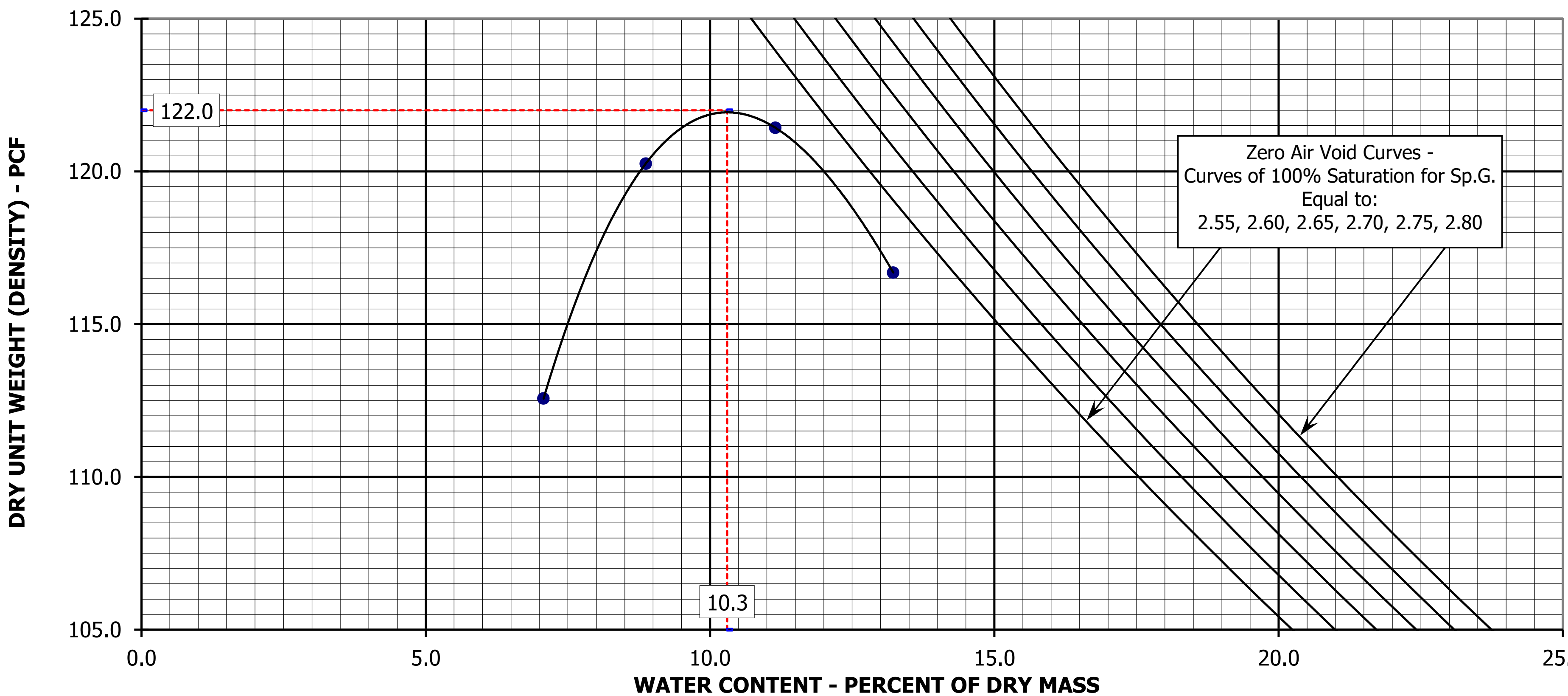


Swell-Consolidation Tests	Best Engineering Solutions and Technologies	*Lakewood Office:* *747 Sheridan Blvd, Unit 2A* *Lakewood, CO 80214*
Project Location: Grandwood Ranch Pavement Design Monument, CO	**DRAWN BY:** KMH **CHECKED BY:** MAB **DATE:** July 26, 2021	**SCALE:** Vertical NA Horizontal
	PROJECT NO: 21-1238	FIGURE: 5

CESARE, INC.
Geotechnical Engineers & Construction Materials Consultants

ASTM/AASHTO Compaction
Test Procedure Designation: ASTM D 698 (Standard)
Method: A

Laboratory Maximum Dry Unit Weight (Density): 122.0 pcf
Laboratory Optimum Moisture Content (OMC): 10.3 %



Sample Location	Elev. or Depth, ft	**LL**	PL	**PI**	**-#200, %**	Soil Description & Classification
Bulk sample						Visual: SAND, clayey, brown AASHTO: USCS:

Moisture/Density Relationship (Proctor) Test

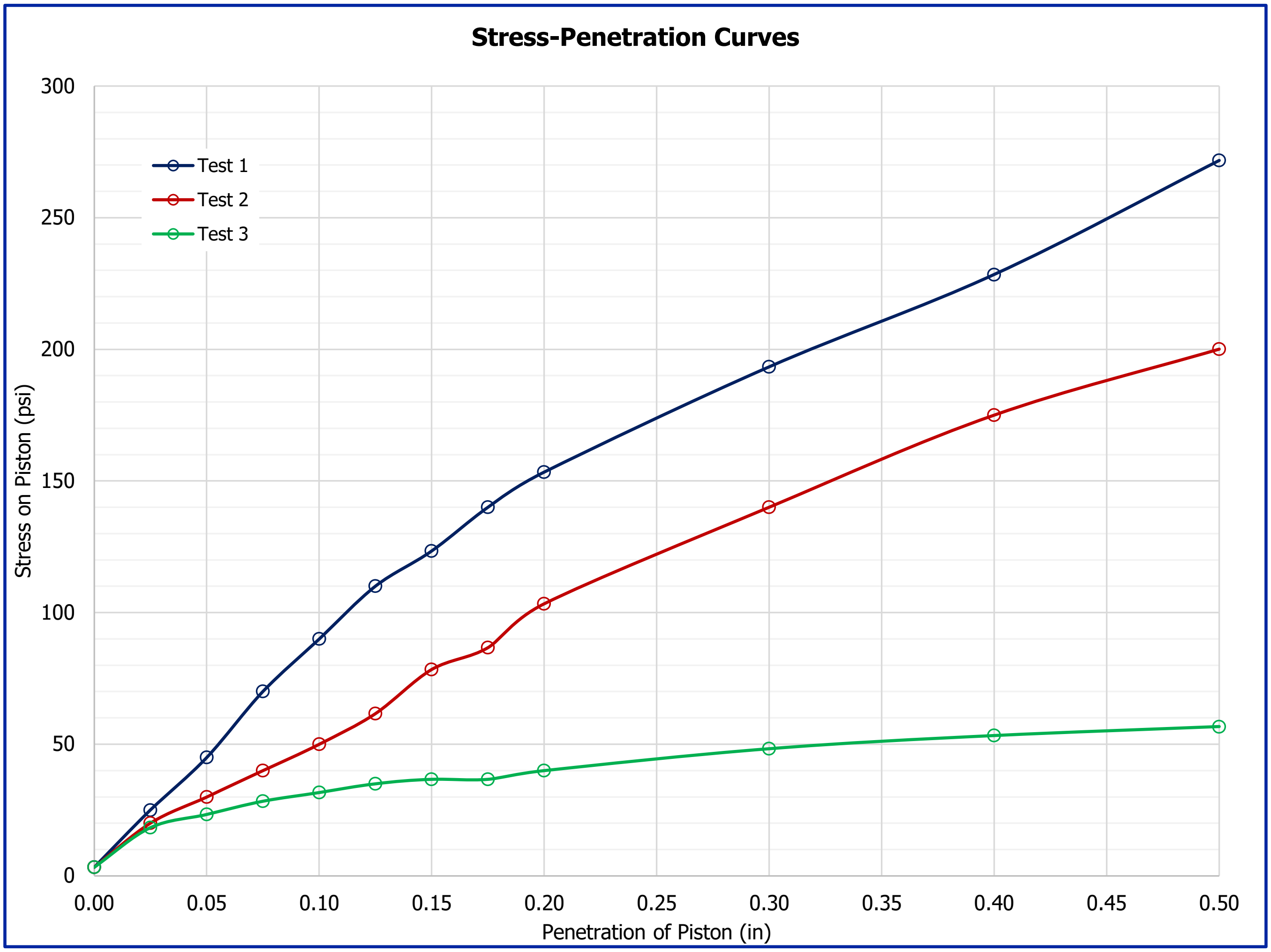
Project Number:	21.028, Best Engineering		
Project Name:	General Lab Testing 2021		
Drawn By:	G. Hoyos	Tested by:	S. Welsh
Checked By:	G. Hoyos	Date:	2-Jun-21
Date:	2-Jun-21	Lab ID Number:	212698

Corporate: 7108 South Alton Way, Building B • Centennial, Colorado 80112
Phone 303-220-0300 • www.cesareinc.com

CESARE, INC.
Geotechnical Engineers & Construction Materials Consultants

CALIFORNIA BEARING RATIO ASTM D1883

Project number	21.028, Best Engineering	Date	June 3, 2021
Project name	General Lab Testing 2021	Technician	G. Hoyos/J. Holiman
Lab ID number	212698	Reviewer	G. Hoyos
Sample location	Bulk sample		
Visual description	SAND, clayey, brown		



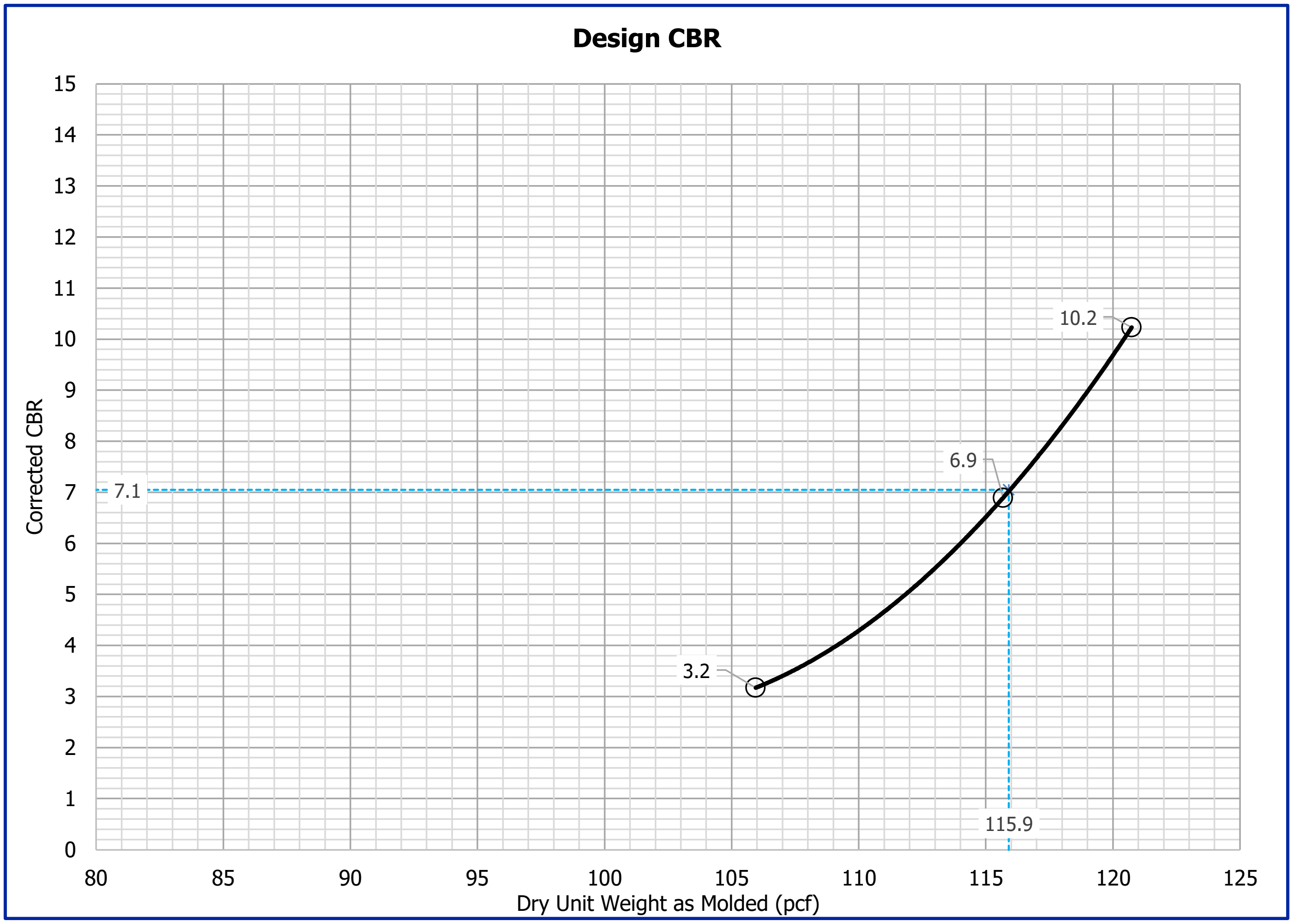
Sample Information			
LL	--	Proctor test method	ASTM D698 - Method A
PI	--	Maximum dry density (pcf)	122.0
USCS symbol	--	Optimum moisture content (%)	10.3
AASHTO class	--	Surcharge load (lbs)	10

	As Molded				After Soaking			
Test Number	Dry Density (pcf)	Moisture Content (%)	Relative Compaction (%)	Deviation from OMC (%)	Soaking Time (hrs)	Swell (%)	Moisture Content at top 1 inch of specimen (%)	Corrected CBR Value
1	120.7	10.9	99.0	0.6	96	0.4	13.9	10.2
2	115.7	10.6	94.8	0.3	96	0.3	14.2	6.9
3	105.9	10.9	86.8	0.6	96	0.2	15.9	3.2

CESARE, INC.
Geotechnical Engineers & Construction Materials Consultants

CALIFORNIA BEARING RATIO ASTM D1883

Project number	21.028, Best Engineering	Date	June 3, 2021
Project name	General Lab Testing 2021	Technician	G. Hoyos/J. Holiman
Lab ID number	212698	Reviewer	G. Hoyos
Sample location	Bulk sample		
Visual description	SAND, clayey, brown		



Sample Information			
LL	--	Proctor test method	ASTM D698 - Method A
PI	--	Maximum dry density (pcf)	122.0
USCS symbol	--	Optimum moisture content (%)	10.3
AASHTO class	--	Surcharge load (lbs)	10

	As Molded				After Soaking			
Test Number	Dry Density (pcf)	Moisture Content (%)	Relative Compaction (%)	Deviation from OMC (%)	Soaking Time (hrs)	Swell (%)	Moisture Content at top 1 inch of Specimen (%)	CBR Value
1	120.7	10.9	99.0	0.6	96	0.4	13.9	10.2
2	115.7	10.6	94.8	0.3	96	0.3	14.2	6.9
3	105.9	10.9	86.8	0.6	96	0.2	15.9	3.2
Corrected Design CBR Value								7.1
Dry Unit Weight (pcf)								115.9
Relative Compaction (%)								95.0