GEOTECHNICAL STUDY

Gunnison Rising Subdivision Phase I
Gunnison, Colorado

Report Prepared for:

Mr. Ron Welborn
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Project No. 20.6050
October 21, 2020

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CESARE, INC.
Geotechnical Engineers & Construction Materials Consultants

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Report Prepared by:

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COMMON ABBREVIATIONS

AASHTO .... **American Association of State Highway and Transportation Officials**
ABC .... **aggregate base course**
ACI .... **American Concrete Institute**
ADA .... **Americans with Disabilities Act**
ADSC .... **Association of Drilled Contractors**
AI .... **Asphalt Institute**
APM .... **asphalt paving material**
ASCE .... **American Society of Civil Engineers**
ASTM .... **American Society for Testing and Materials**
AWWA .... **American Water Works Association**
bgs .... **below ground surface**
CDOT .... **Colorado Department of Transportation**
CBR .... **California Bearing Ratio**
CFR .... **Code of Federal Regulations**
CGS .... **Colorado Geological Survey**
CKD .... **cement of kiln dust stabilized subgrade**
CMU .... **concrete masonry unit**
CTB .... **cement treated base course**
deg .... **degree**
EDLA .... **equivalent daily load application**
e_m .... **edge moisture variation distance**
EPS .... **expanded polystyrene**
ESAL .... **equivalent single axle loads**
f'c .... **specified compressive strength of concrete at the age of 28 days**
F_a .... **seismic site coefficient**
FHWA .... **Federal Highway Administration**
FS .... **factor of safety**
F_V .... **seismic site coefficient**
GSA .... **global stability analysis**
GVW .... **gross vehicle weight**
HMA .... **hot mix asphalt**
IBC .... **International Building Code**
ICC-ES .... **International Code Council Evaluation Services, Inc.**
IRC .... **International Residential Code**
kip .... **1,000 pounds-force**
km .... **kilometer**
LTS .... **lime treated subgrade**
MDD .... **maximum dry density**
mg/L .... **milligrams per liter**
MGPEC .... **Metropolitan Government Pavement Engineers Council**
mm .... **millimeter**
Mr .... **resilient modulus**
MSE .... **mechanically stabilized earth**
mV .... **millivolts**
NAPA .... **National Asphalt Pavement Association**
N_{DESIGN} .... **design gyrations**

OSHA .... **Occupational Safety and Health Administration**
OMC .... **optimum moisture content**
OWTS .... **onsite wastewater treatment system**
PCA .... **Portland Cement Association**
PCC .... **portland cement concrete**
pcf .... **pounds per cubic foot**
pci .... **pounds per cubic inch**
pH .... **power of hydrogen**
psf .... **pounds per square foot**
psi .... **pounds per square inch**
PT .... **post-tension**
S_s .... mapped spectral accelerations for short periods
UBC .... **Uniform Building Code**
USGS .... **United States Geological Survey**

1. PURPOSE

1.1 GENERAL

Cesare, Inc. (Cesare) performed a geotechnical study for the proposed subdivision development to be located in Gunnison, Colorado. The study was made to characterize existing subsurface conditions at the site and assist in determining design criteria for planning, site development, preliminary foundation and interior floor systems, exterior flatwork, surface and subsurface drainage adjacent to structures, pavement systems and to present other pertinent geotechnical issues. Information gathered during the field exploration and laboratory testing is summarized in Figures 1 and 2 and Appendices A and B. Cesare's opinions and recommendations presented in this report are based on data generated during this field exploration, laboratory testing, and its experience.

1.2 SCOPE OF SERVICES

The scope of services performed is detailed in Cesare's Proposal Agreement No. SC200604.A which was executed on July 1, 2020.

2. SUMMARY OF FINDINGS AND CONCLUSIONS

This section is intended as a summary only and does not include design details. The report should be read in its entirety and utilized for design.

- Clayey sands, silty sands, gravelly sands, and sandy gravels were encountered to the full depth explored of 15 to 25 feet north of US Highway 50 and sandy clay over sandy gravels were encountered to the full depth explored of 2.5 to 6.5 feet south of US Highway 50. Groundwater was encountered, especially during flood irrigating. No bedrock was encountered.
- A report by CTL/Thompson, Inc. (CTL), 2008, encountered similar soil conditions north of the Cemetery Ditch within the valleys. The hills and ridge encountered shallow bedrock consisting of West Elk Breccia.
- Both Cesare's study and the CTL study identified potentially collapsing soil in the overburden. This soil should be remediated when encountered beneath structures.
- Due to the presence of potentially collapsing soil, Cesare recommends that geotechnical studies be performed for individual structures north of the future East College Avenue.
- Good surface drainage should be established and positive drainage away from the structures, pavement, and other site improvements should be provided during construction and maintained throughout the life of the proposed structures. Below grade areas, such as basements, are discouraged. Crawlspaces and the lowest floor elevation should be established as high as possible due to high groundwater conditions.
- The subgrade beneath proposed roadways north of East College Avenue will be constructed on clayey sands which is considered poor for pavement support. As such, the recommended pavement section is 4 inches of APM over 9 inches of ABC. Three inches of APM over 6 inches of ABC will be adequate south of East College Avenue. Three inches of APM over 6 inches of ABC will be adequate on New York Avenue, as long as a minimum of 2 feet of material having an R-value of 45 or greater exists beneath the pavement section.

3. SITE CONDITIONS

The site is located in Gunnison, Colorado. Phase I of the development consists of about 65 acres. Phase I also includes construction of New York Avenue and sewer line south of US Highway 50. The site is currently undeveloped land. The site is bound by vacant land to the east, Western Colorado University to the west, US Highway 50 to the south, and the Cemetery Ditch to the north. New York Avenue exists south of US Highway 50. The topography of the site north of US Highway 50 is gently sloping with a grade change of about 60 feet to the south. The topography south of US Highway 50 is flat with a slope of about 0.5% to the west.

Vegetation onsite consists of cultivated grasses. The Cemetery Ditch borders the site to the north and was flowing water when onsite July 9 and 24, 2020. The Cemetery Ditch is above the site and is used to flood irrigate the site. As such, the site had flowing water on the surface through August 2020. Tomichi Creek exists about 600 feet south of the proposed New York Avenue alignment. No bedrock outcrops were observed onsite.

4. PROPOSED CONSTRUCTION

Phase I consists of about 16 city blocks of residential development, commercial development along US Highway 50, and typical infrastructure, including utilities and roadways. Phase I includes the construction of about 4,100 linear feet of New York Avenue with sanitary sewer south of US Highway 50.

5. PREVIOUS STUDIES

A report titled, "Preliminary Geotechnical Investigation, Gunnison Rising, Gunnison County, Colorado" was prepared by CTL, dated February 18, 2008. The CTL study completed seven borings on the property north of the Cemetery Ditch and one boring south of US Highway 50 on the far eastern edge of the overall property. The auger borings north of the Cemetery Ditch encountered 10 to about 20 feet of overburden over bedrock. The overburden consisted of clay and sand with some gravels. The soil, when tested in one of the borings, indicated a low to moderate potential to consolidate of 2.4% to 4.8%. CTL was unable to drill any borings south of the Cemetery Ditch due to flood irrigating. Bedrock consisted of the West Elk Breccia. No groundwater was encountered north of the Cemetery Ditch. The boring completed south of US Highway 50 encountered groundwater at 4 feet. The borings were completed in August 2007.

6. GEOLOGIC CONDITIONS

6.1 SURFICIAL DEPOSITS

The "Geologic Map of the Gunnison Quadrangle, Gunnison County, Colorado" prepared for the CGS by Stork, et al., dated 2006, indicates that surficial deposits onsite likely consist of:

- Alluvial fan deposits and earthflow deposits generally north of East College Avenue.
- Alluvium deposits south of the extension of East College Avenue.

6.2 BEDROCK

The "Geologic Map of the Gunnison Quadrangle, Gunnison County, Colorado" prepared for the CGS by Stork, et al., dated 2006, indicates that bedrock deposits onsite likely consist of:

- West Elk Breccia.

7. FIELD EXPLORATION

7.1 EXPLORATORY BORINGS

Subsurface conditions were explored on July 9, 2020 by drilling seven borings (B-1 to B-7) and September 15, 2020 by drilling eight borings (B-8 to B-15) at the locations indicated in Figure 1. The eight borings drilled on September 15, 2020 were in areas that could not be accessed on July 9, 2020 due to flood irrigation. Borings were drilled 15 to 25 feet deep. Graphical logs of the subsurface conditions observed, locations of sampling, and further explanation of the exploration performed are presented in the Boring Logs and accompanying Key to Symbols contained in Appendix A.

7.2 EXPLORATORY PITS

Subsurface conditions along the sanitary sewer alignment south of US Highway 50 were explored on July 24, 2020 by excavating eight exploratory pits at the locations indicated in Figure 2. Exploratory pits were excavated 2.5 to 6.5 feet deep. Graphical logs of the subsurface conditions observed, locations of sampling, and further explanation of the exploration performed are presented in Appendix A.

EXHIBIT 1. View of gravels encountered below the sandy clays in the exploratory pits.

8. LABORATORY TESTING

Cesare personnel returned samples obtained during field exploration to its laboratory where professional staff visually classified them and assigned testing to selected samples to evaluate pertinent engineering properties. Laboratory tests performed are listed in Table 8.1. Further discussion of laboratory testing and the laboratory test results are presented in Appendix B.

TABLE 8.1. Laboratory Testing Performed

Laboratory Test	To Evaluate
Grain size analysis	Grain size distribution for classification purposes.
Atterberg limits	Soil plasticity for classification purposes.
Swell/consolidation	Effect of wetting and loading on the soil.
Water soluble sulfate content	Potential corrosivity of the soil on cementitious material.
Natural moisture content and dry density	The potential collapse potential of the soil.

9. SUBSURFACE CONDITIONS

9.1 EXPLORATORY PITS

Cesare's exploratory borings encountered soil consisting of:

- Clayey, silty sands that were loose to medium dense, moist to wet, and light brown to brown in color. This soil was encountered below topsoil in Exploratory Borings B-1, B-2, B-4 to B-9, and B-15 to depths of 5 to 14 feet and between depths of 13 to 20 feet in B-3.
- Gravelly, silty sands that were very loose to medium dense, moist to wet, and light brown to brown in color. This soil was encountered below the clayey sand in Exploratory Borings B-1, B-4, B-5, and B-7 to depths of 9 to 14 feet, below the topsoil in B-10 to B-15 to depths of 9 to 12 feet, and between depths of 2 to 13 feet and 20 to 25 feet in B-3.
- Gravelly sand to sandy gravel that were poorly to well graded, very moist to wet, and light brown to brown in color. This soil was encountered below the clayey sands and silty sands in Exploratory Borings B-2, B-6, and B-8 to B-15 at depths of 6.5 to 13 feet.
- No bedrock was encountered to the full depth explored of 15 to 25 feet.
- Groundwater was measured at depths as indicated in Table 10.1.
- Exploratory Borings B-3, B-5, B-7, and B-10 to B-15 caved at depths of 5 to 22 feet at the time of drilling.

9.2 EXPLORATORY PITS

Cesare's exploratory pits encountered:

- Sandy clay that was soft to medium stiff, low plasticity, very moist to wet, and brown to dark brown in color. This soil was encountered below topsoil to depths of 2 to 5.5 feet.
- Sandy gravels that were medium dense, moist to wet, and light brown to brown in color. This soil was encountered below the sandy clay.
- No bedrock was encountered to the full depth explored of 2.5 to 6.5 feet.
- Groundwater was measured at various depths as indicated in Table 10.2.

The subsurface conditions encountered in Cesare's exploratory borings and pits are reasonably consistent with those described in Section **6. GEOLOGIC CONDITIONS**. These observations represent conditions at the time of field exploration and may not be indicative of other times or other locations.

10. GROUNDWATER

Groundwater was encountered as indicated in Tables 10.1A, 10.1.B, and 10.2. Temporary monitoring wells were installed in Exploratory Borings B-1, B-2, B-7, B-8, B-10, and B-14 and Exploratory Pits EP-2, EP-6, and EP-8 to monitor groundwater levels. The temporary monitoring wells consisted of PVC well screen or perforated PVC. Refer to Appendix A for details of well construction. A "Notice of Intent" (NOI) was submitted to the Colorado Department of Water Resources (DWR) at least 3 business days prior to installation of the wells. Also, a well construction report was submitted to DWR for each well installed within 60 days of drilling completion. All temporary monitoring wells must be abandoned within 18 months of installation in accordance with DWR abandonment requirements, unless the wells are permitted as permanent monitoring wells. When groundwater monitoring is completed, Cesare can abandon each of the monitoring wells, when directed by the Client. Fees for abandoning the wells are not included in this evaluation.

TABLE 10.1A. Groundwater Measurements Exploratory Borings (in feet)

Measurement Date	B-1	B-2	B-3	B-4	B-5	B-6	B-7	B-8
07/09/20	4	1.5	3	Dry	3	9	3	
07/28/20	5.4	3.8					0.6	
08/24/20	Dry	Dry					12.7	
09/15/20			21.5					4
10/20/20	Dry	Dry					Dry	5.9

TABLE 10.1B. Groundwater Measurements Exploratory Borings (in feet)

Measurement Date	B-9	B-10	B-11	B-12	B-13	B-14	B-15
07/09/20							
07/28/20							
08/24/20							
09/15/20	3	4.5	9	12	9	6	10.5
10/20/20		6.3				7.7	

TABLE 10.2. Groundwater Measurements Exploratory Pits (in feet)

Measurement Date	EP-1	EP-2	EP-3	EP-4	EP-5	EP-6	EP-7	EP-8
07/24/20	5.5	5	2.5	3	1.8	3	3.8	5
10/20/20		Dry				Dry		Dry

Groundwater can be expected to fluctuate and can be influenced by variations in seasons, weather, precipitation, drainage, vegetation, landscaping, irrigation, leakage of water and/or wastewater systems, etc., both onsite and offsite, and height of water in Tomichi Creek. Discontinuous zones of perched water may exist or develop within the overburden over ice lenses during spring snowmelt.

11. GEOLOGIC HAZARDS

The following subsections present a cursory review of geologic publications and data gathered during this study. A detailed geologic hazards assessment is not the focus of Cesare's scope of service.

11.1 COLLAPSIBLE SOIL

Alluvial fan and earthflow deposits that exist north of East College Avenue are deposited in a relatively rapid environment. As such, these deposits tend to be under consolidated and have an increased risk of containing collapsible soil. Testing conducted indicated that the clayey sands encountered have a low to moderate potential to collapse. This is described in greater detail in section **12.1 MOISTURE SENSITIVE SOIL**.

11.2 ABANDONED MINES

No abandoned mines are known to exist below or in the vicinity of the property. Risks associated with settlement due to abandoned mines is considered nil.

11.3 RADON

The U.S. Environmental Protection Agency map of radon zones indicates that virtually all of western Colorado, including Gunnison County, is in Zone 1 (www.epa.gov/radon/zonemap.html). Although there is no known safe level of radon, Zone 1 is the zone of highest risk for exposure to radon gas [i.e., greater than 4 picoCuries per Liter (pCi/L)]. The Colorado Geological Survey (CGS) participated in an EPA study in 1987 and 1988 to record indoor radon levels throughout Colorado residences and compiled its results in a report that related geologic setting and building construction with radon levels (CGS 1991 Open-File Report 91-4). Generally, residences with basements had higher levels of radon than residences built on grade on the same geologic material. Radon values in alluvial and glacial valley fill was highly variable. The CGS is careful to state that radon potential can vary considerably within the same geologic unit due to the non-uniform distribution of uranium, secondary leaching, and the accumulation of uranium and other radioactive elements into other strata.

Based on levels of radon recorded in existing residences in the region and the presence of rock types that are known to produce radon, it is reasonable to assume that radon emission into buildings is occurring in the Gunnison area. The EPA, the Colorado Department of Public Health and Environment (CDPHE) Radiation Management Division, and the National Association of Home Builders (NAHB) recommend that all new residences constructed in Zone 1 should include radon-resistant features. These organizations also recommend that after the building is constructed, radon should be measured and if the results are greater than 4 pCi/L, the system should be upgraded from passive to active (usually by installing a fan). In the EPA publication titled, Building Radon Out: A Step-by-Step Guide on How to Build Radon-Resistant Homes (USEPA Office of Air and Radiation EPA/402-K-01-002, April 2001), three practical and inexpensive alternatives for passive, sub-slab depressurization systems are presented: gravel with vents, perforated pipes, or soil gas collection mats. Recommendations for passive and active design and construction techniques for reducing radon gas can be found on the EPA radon website www.epa.gov/radon or the CDPHE radon website www.cdphe.state.co.us/hm/rad/radon.

11.4 EROSION

The clayey sands (north of US Highway 50) and sandy clays (south of US Highway 50) will have a moderate to high risk of erosion when exposed to sheet flow. Measures should be taken to protect these soils from erosion especially, on non-vegetated slopes in excess of 10 horizontal to 1 vertical (10:1).

12. GEOTECHNICAL CONSIDERATIONS

12.1 MOISTURE SENSITIVE SOIL

Results of swell/consolidation testing performed on samples obtained from the site is summarized in Table 11.1.

TABLE 11.1. Summary of Swell/Consolidation Laboratory Testing

Material Type	Compression (-) Upon Wetting (%)	Inundation Pressure (psf)	Generalized Volume Change Category
Clayey sand	0.0 to 1.4	500 to 1,000	Nil to moderate

The CTL report identified the soil as having a consolidation potential of 2.4% to 4.8% and were located north of the Cemetery Ditch and north of flood irrigation from the Cemetery Ditch. The routine flood irrigation has likely reduced the collapse potential but has not eliminated it. These soils were encountered in every exploratory boring except B-10 to B-14. North of future East College Avenue, the thickness of the clayey sand was generally greater than 6 feet and the settlement potential due to collapsing soil is greater than 1 inch. As such, structures north of East College Avenue should have geotechnical studies conducted to determine the risk associated with collapsing soil and provide recommendations to reduce this risk on the structures.

13. FOUNDATION RECOMMENDATIONS

13.1 SPREAD FOOTINGS

Spread footings will be adequate for structures founded on silty sands, gravelly sands, and sandy gravels. Spread footings can be used on the clayey sands if the collapse potential is reduced to provide a risk of movement of less than 1 inch. If the collapse potential cannot be reduced to less than 1 inch, deep foundations, such as drilled piers or micropiles, may be necessary. The structures should be founded entirely on native soil or entirely on structural fill but not a combination of the two. Cesare anticipates the following design criteria:

- A frost depth of 30 inches (City of Gunnison Building Permit Packet, April 2010).
- Maximum allowable soil bearing pressures of 3,000 psf based on dead load plus full live load for foundations on silty sands, gravelly sands, and sandy gravels and 2,500 psf for foundations founded on remediated (as necessary) clayey sands.

14. LATERAL EARTH PRESSURES

14.1 RETAINING WALLS

Lateral pressures on walls depend on the type of wall, hydrostatic pressure behind the wall, type of backfill material, and allowable wall movements. Cesare recommends drain systems be constructed behind walls to reduce the potential for hydrostatic pressures to develop. Where anticipated/permissible wall movements are greater than 0.5% of the wall height, lateral earth pressures can be estimated for an "active" condition. Where anticipated/permissible wall movement is less than approximately 0.5% of the wall height or wall movement is constrained, lateral earth pressures should be estimated for an "at rest" condition. Recommended lateral earth pressures for onsite material are provided in Table 14.1.

The recommended values for lateral earth pressures provided in Table 14.1 are given in terms of an equivalent unit weight. The equivalent unit weight multiplied by the depth below the top of the ground surface is the horizontal pressure against the wall at that depth. The resulting pressure distribution is a triangular shape. These soil pressures are for horizontal backfill with no surcharge loading and no hydrostatic pressures. If these criteria cannot be met, Cesare should be contacted for additional criteria.

The unfactored or ultimate coefficients of sliding resistance between concrete and bearing soil are provided in Table 14.1.

TABLE 14.1. Lateral Earth Pressures and Coefficients of Sliding Resistance for Onsite Material

Backfill Material Type	Equivalent Unit Weight (pcf)			Coefficient of Sliding Resistance
	Active	At Rest	Passive	
Clayey sands	60	40	280	0.6
Silty sands	55	40	250	0.7
Gravelly sands and sandy gravels	45	35	220	0.8

14.2 THRUST BLOCK LOADS

The subsurface conditions at the proposed sewer and water line locations consists of clayey sands, silty sands, gravelly sands, and sandy gravels. Thrust blocks placed within the clayey sand and silty sand should be designed for a maximum allowable lateral soil bearing pressure of 150 psf/feet of depth. For example, if the thrust block is placed 8 feet deep, then 150 (psf/feet) x 8 (feet) = 1,200 psf. Thrust blocks placed within the gravelly sand and sandy gravel should be designed for a maximum allowable lateral soil bearing pressure of 200 psf/feet of depth.

15. INTERIOR FLOORS

The natural soil exhibited zero swell potential; however, the clayey sands exhibited up to a moderate collapse potential. This soil should be remediated prior to placement of slab-on-grade floors. Concrete slabs placed on the silty sand, gravelly sand, or sandy gravel material or on properly placed structural fill comprised of this material do not require special considerations for accommodating movement as a result of collapsing soil.

15.1 SLAB-ON-GRADE CONSTRUCTION DETAILS

Cracking of slabs-on-grade can occur as a result of compressing of the supporting soil but also as a result of concrete curing stresses. If slab-on-grade floors are chosen, Cesare recommends that design and construction of all interior slab-on-grade floors incorporate the following considerations and precautions. These details will not reduce the amount of movement but are intended to reduce potential damage should some settlement of the supporting subgrade take place. The ACI Committee 302, “Guide for Concrete Floor and Slab Construction (ACI 302.R-96)” should be consulted regarding methods/techniques to reduce the occurrence of concrete shrinkage cracks and other potential issues associated with concrete finishing and curing.

a) A vapor barrier is recommended beneath concrete slabs-on-grade that will support equipment sensitive to moisture or will be covered with wood, tile, carpet, linoleum, or other moisture sensitive or impervious coverings. Location of the vapor barrier should be in accordance with recommendations provided by ACI 302.2R-06, "Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials."
b) Backfill in the utility trenches beneath slabs should be compacted as specified in Section **18. STRUCTURAL FILL/BACKFILL SOIL.**
c) Plumbing and utilities that pass through the slab should be isolated from the slabs.
d) Separate slabs from foundation walls, interior columns, and utilities with a joint which allows/provides free vertical movement of the slab (i.e., floating slab construction).
e) Provide frequent control joints in the slab. Refer to ACI 302.1R-15.
f) Use of load transfer devices at construction and contraction joints is recommended when positive load transfer is required (See ACI 302.1R).

15.2 STRUCTURALLY SUPPORTED FLOORS

A floor system that is supported by the foundation system and has an air or void space (typically a crawlspace) below the floor so that it is not in contact with the underlying soil/bedrock material is considered a structurally supported or structurally suspended floor. If potential movement of slab-on-grade floors and associated cracking/distress are not considered tolerable by the owner, developer, architect, or structural engineer for any reason, a structurally supported floor should be provided.

There are design and construction issues associated with structurally supported floors that must be considered, such as ventilation and lateral loads. Where structurally supported floors are installed, the minimum required air space depends on the material used to construct the floor. Building codes require a clearance space of at least 18 inches above exposed earth if untreated wood floor components are used. Where other support material is used, a minimum clearance space of 8 inches is recommended. This minimum clearance space should be maintained between any point on the underside of the floor system (including beams and plumbing) and the surface of the exposed earth. The minimum clearance between the crawlspace ground surface and the structural floor members and suspended plumbing should be constructed to meet minimum code or recommended clearances.

Where structurally supported floors are used, utility connections, including water, gas, air duct, and exhaust stack connections to floor supported appliances should be capable of absorbing some deflection of the floor. Plumbing that passes through the floor should ideally be hung from the underside of structural floor and not lay on the bottom of the excavation. This configuration may not be achievable for some parts of the installation. It is prudent to maintain the minimum clearance space below all plumbing lines. If trenching below the lines is necessary, Cesare recommends sloping these trenches so they discharge to the foundation drain. Penetrations through the foundation wall should allow for at least 1 inch of clearance and be provided with flexible connections. The ground surface below the structurally supported floor should be sloped to the perimeter drain.

Control of humidity in crawlspaces is important for indoor air quality and performance of wood floor systems. An engineering professional with expertise in the design and construction of crawlspace humidity control should be contacted.

16. EXTERIOR FLATWORK

Flatwork supported on foundation wall backfill may settle and crack if the backfill is not properly moisture conditioned and compacted.

Exterior flatwork should be isolated from the structures. Exterior flatwork should be expected to move, although measures can be incorporated into construction to limit the movement or effects of the movement. Cesare recommends flatwork not be doweled into structure foundations, but rather supported on a haunch to limit settlement. The haunch should extend the full length of the slab.

Exterior flatwork, such as driveways and sidewalks, are normally constructed as slabs-on-grade. Porches and patios are increasingly constructed as structurally supported slabs, which in Cesare's opinion, is the most positive means of keeping slabs from moving and adversely affecting the operation of doors or means of egress. Cesare recommends that landings and slabs at egress doors, as well as porches and patios, be constructed as structurally supported elements if potential movement cannot be tolerated.

Simple decks that are not integral to the structure and can tolerate foundation movement can be constructed with less substantial foundations. A short pier or footing bottomed below frost depth can be used if movement is acceptable and if acceptable by local building requirements. Use of deeper foundation elements can reduce potential movement. Footings or short piers should not be underlain by wall backfill, due to risk of settlement. Inner edges of decks may be constructed on haunches and detailed such that movement of the deck foundations will not cause distress to the structure.

16.1 OVERHANGING ROOFS

Porches, patios, or decks with overhanging roofs that are integral to the structure, such that foundation movement cannot be tolerated, should be constructed with the same foundation type as the structure.

17. EXCAVATIONS

Conventional earthmoving equipment should be adequate to excavate the onsite soil. Groundwater should be expected in all excavations, especially during irrigation season. The silty sands, gravelly sands, and sandy gravels will flow below the groundwater table. Below grade construction below the groundwater table will require temporary dewatering. All excavations should be properly sloped and/or braced, and local and federal safety codes should be observed. Slopes and other areas void of vegetation should be protected against erosion. If temporary shoring is required, a contractor specializing in design and construction of shoring should be contacted.

It is the contractor's responsibility to provide safe working conditions and comply with the regulations in OSHA Standards-Excavations, 29 CFR Part 1926. The following guidelines are provided for planning purposes. Sloping and shoring requirements must be evaluated at the time of construction by the contractor's competent person as defined by OSHA. OSHA classifications for various material types and the steepest allowable slope configuration corresponding to those classifications are shown in Table 17.1.

TABLE 17.1. Allowable Slope Configuration for Onsite Material

Material Type	OSHA Classification	Steepest Allowable Slope Configuration*
All overburden	Type C	1-1/2:1

* Units horizontal to units vertical. The values shown apply to excavation less than 20 feet in height. Conditions can change and evaluation is the contractor's responsibility.

The classifications and slope configurations in Table 17.1 assume that excavations are above the groundwater table, there is no standing water in the excavations, and there is no seepage from the slope into the excavations, unless otherwise specified. The above classifications and slope configurations assume that the material in the excavations is not fractured, adversely bedded, jointed, nor left open to desiccate, crack, or slough, and is protected from surface runoff. There are other considerations regarding allowable slope configurations that the contractor is responsible for, including proximity of equipment, stockpiles, and other surcharge loads to the excavation. The contractor's competent person is responsible for all decisions regarding slope configuration and safety conditions for excavations.

Excavations should not undermine existing foundation systems of structures or infrastructure unless they are adequately protected. At a minimum, new excavations should not intersect a line drawn on a 34 degree angle down and away from the bottom edge of the existing foundation systems or bottom edge of infrastructure. If this condition cannot be met, shoring or staged excavations may be required. If shoring is required, a condition survey of the adjacent structures is recommended before construction starts and upon completion of construction. In Cesare's experience, condition surveys include, but may not be limited to, photographs of any distress to adjacent structures.

Permanent slopes should be no steeper than 2:1 and should be revegetated or otherwise protected from erosion.

18. STRUCTURAL FILL/BACKFILL SOIL

Where fill/backfill soil is necessary, the suitable onsite inorganic soil may be used below, around, and above the structure. At this site, unsuitable material is defined as topsoil, organics, trash, ash, frozen material, hard lumps, and clods, and particles that are larger than 3 inches. Existing onsite fill material can be reused for structural fill/backfill, provided it is free of unsuitable material. If unsuitable material is encountered in the existing fill, it cannot be reused as fill/backfill. Recommendations for fill/backfill placement are:

a) Fill/backfill material should be placed in loose lifts and compacted in accordance with Table 18.1
b) Maximum loose lift thickness shall be 8 inches, depending on the type of equipment used to apply compactive effort, and shall be reduced if the specified compaction cannot be obtained with the equipment used.
c) Fill/backfill should not be placed if material is frozen or if the surface upon which fill/backfill

is to be placed is frozen.

d) Fill/backfill material should be placed and spread in horizontal lifts of uniform thickness in a manner that avoids segregation.

e) Placement surface should be kept free of standing water, debris, and unsuitable material during placement and compaction of fill/backfill material.

f) Fill/backfill maximum allowable particle size is 3 inches. Do not incorporate oversize material in the fill/backfill that is incapable of being broken down by the equipment and methods being employed to process and compact the fill/backfill. Process and compact material in the lift, as necessary, to produce the specified fill/backfill characteristics. If oversize particles remain in the lift after processing and compacting, remove oversize material to produce a fill/backfill within specified requirements.

g) Overlot fill placement beneath structures and pavements and compaction should be observed and tested on a full-time basis by a representative of Cesare. At a minimum, utility trench backfill should be tested in accordance with jurisdictional requirements.

TABLE 18.1 Compaction Specifications

Material Type (General)	AASHTO Classification	Material Thickness* (ft)	Moisture Content (%)	Relative Compaction (%)	Compaction Standard
Granular material that is clean to silty	A-1, A-2-4, A-2-5, A-3, A-4, A-5	<15	+ 2% of OMC	>95%	Standard Proctor (ASTM D698)
Fine grained material and granular material with plastic fines	A-2-6, A-2-7 A-6 A-7	<15	+ 2% of OMC	>95%	Standard Proctor (ASTM D698)

* If fill thickness greater than 15 feet is planned, additional requirements may apply.

18.1 IMPORT FILL

Material imported for structural fill should be tested and approved for use onsite by the project geotechnical engineer prior to hauling to the site. Proctor and classification tests should be conducted to determine if the fill meets required specifications. Fill material should be well graded meeting the specifications in Table 18.2.

TABLE 18.2. Import Fill Specifications

Soil Parameter	Specification
Maximum particle size	3 inch
Percent finer than No. 200 sieve	Maximum 20%
Liquid limit	Maximum 30%
Plasticity index	Maximum 15%

19. SUBSURFACE DRAINAGE

Due to the existence of high groundwater conditions when water is flowing in the Cemetery Ditch, Cesare recommends that no basements be planned. Crawlspaces and lowest floor elevations should be founded as high as reasonably possible.

Cesare recommends that crawlspaces be provided with an exterior perimeter subsurface drainage system. The system shall be sloped to drain to a suitable gravity outlet or a sump. A pump shall be installed if a sump is used. The drainage system shall consist of perforated, machine slotted, or equivalent rigid plastic pipe placed around the perimeter of the basement or crawlspace foundation. Pipes with a smooth interior are recommended. Pipes that are corrugated on the interior can become obstructed more easily than pipes with smooth interiors and may be more difficult to clean.

Cesare recommends exterior perimeter drains rather than interior perimeter drains for most conditions because for water to reach interior perimeter drains, it must first pass beneath the foundations. This increases the risk of wetting the soil beneath the foundations, which increases the risk for foundation movement. It is difficult to quantify the increase in risk associated with using interior rather than exterior perimeter drains, but foundation movement can cause distress to structures, such as cracking of walls, slabs, and finishes, and out-of-plumb doors and windows.

20. SURFACE DRAINAGE

Good drainage and surface water management is important. Performance of site improvements, such as foundations, floors, hardscape, and pavement are often adversely affected by failing to establish and/or maintain good site drainage. Grades must be adjusted to provide positive drainage away from the structure, pavement, and other site improvements during construction and maintained throughout the life of the proposed facility. The following drainage precautions are recommended:

a) The ground surface around the perimeter foundation walls should be sloped to drain away from the structure in all directions. Current building codes require a minimum slope of 6 inches in the first 10 feet of the structure (5%). At the completion of construction, Cesare recommends a continuous slope away from foundations of 12 inches in the first 10 feet (10%), where site constraints permit. Cesare recommends that concrete and pavement adjacent to structures slope at a rate of at least 2% away from the structure or as otherwise required by ADA criteria. Maximum grades practical should be used for paving and flatwork to prevent areas where water can pond.
b) Joints that occur at locations where paving or flatwork abuts the structure should be properly sealed with flexible sealants and maintained.
c) The ground surface should be sloped so that water will not pond between or adjacent to structures and other site improvements. Curbs, sidewalks, paths, plants, or other improvements should not block, impede, or otherwise disrupt surface runoff. Use of chases and weep holes to promote drainage is encouraged. Landscape edging should be perforated or otherwise constructed in a manner to prevent ponding of surface water, especially in the vicinity of the backfill soil.
d) Drainage swales should be located as far away from the foundation as practicable.
e) If site constraints do not allow for the recommended slopes, the project civil engineer shall provide a method for drainage that is equivalent to the recommendations herein. Water should not be allowed to pond adjacent to or near foundations, flatwork, or other improvements.
f) Roof downspouts and other water collection systems should discharge onto pavements or extend away from the structure well beyond the limits of the backfill zone using downspout extensions, appropriately sized splash blocks, or other means. Buried

downspout extensions are discouraged as they can be difficult to monitor and maintain.

g) Irrigation directly adjacent to the structure is discouraged and should be minimized. Sprinkler lines, zone control boxes, and sprinkler drains shall be located outside the limits of the foundation backfill. Sprinkler systems should be placed so that the spray from the heads, under full pressure, does not fall within 5 feet of the foundation walls.

h) Plants, vegetation, and trees that require moderate to high water usage are discouraged and should not be located within 3 feet of foundation walls.

i) Plantings that are desired within 5 feet of the foundation should be placed in watertight planters/containers.

j) The project civil engineer shall perform measurements to document that positive drainage, as described in this section or as otherwise designed by the project civil engineer is achieved. Maintenance of surface drainage is imperative subsequent to construction and is the responsibility of the owner and/or tenant.

21. PAVEMENT RECOMMENDATIONS

21.1 DESIGN CRITERIA

The pavement recommendations contained in this report are based on the Colorado Department of Transportation (CDOT) pavement Design Manual, 2012 and the design parameters indicated in Table 21.1.

TABLE 21.1. Pavement Design Parameters

Design Parameter	Value
Design period (years)	20
Initial serviceability (ρ_s)	4.5
Terminal serviceability (ρ_t) (Local/Collector)	2.0/2.5
Serviceability loss, (ρ_s-ρ_t) (Local/Collector)	2.5/2.0
Reliability, Z_r (%)	80
Overall standard deviation, S_o (APM)	0.44
Total 18 kip ESAL's • Local • Collector	 60,000 150,000
Subgrade strength • R-value (estimated clayey sand) • R-value (estimated silty sand) • R-value (estimated gravelly sand/sandy gravel)	 15 25 45

Deviation from the parameters shown in Table 21.1 will require a revision to the recommended pavement section thicknesses. If the subgrade becomes saturated, the pavement is not properly maintained, and/or the actual traffic is greater than the values used in the design, the design service life will be reduced.

21.2 SPECIAL CONCERNS

21.2.1 Frost Heave

The clayey soil encountered onsite has susceptibility to frost heave. The presence of water is required for frost heave to occur. Groundwater was encountered at depths as shallow as 1.5 feet during this study. According to "Fundamentals of Geotechnical Engineering" by Das, dated 2000, capillary rise of about 4 feet is possible which would provide a source of water at or near the typical frost depth. Cesare recommends a capillary break be installed to reduce the potential for ice lenses and frost heave to develop. The capillary break should be installed by placing granular material within the subgrade. As such, Cesare recommends the use of composite sections.

21.2.2 SANDY CLAYS NEW YORK AVENUE

The near surface sandy clays along the proposed alignment of New York Avenue are considered very poor for providing support of the pavement section. Cesare recommends that the upper 2 feet of subgrade consists of the gravelly sands/sandy gravels that exist below the sandy clays or import material with the same structural quality as the gravelly sands/sandy gravels (minimum R-value of 45). Sandy clays that remain below the 2 feet structural fill maybe unstable. Any unstable material should be stabilized prior to placement of fill.

21.3 PAVEMENT THICKNESSES

Most of the shallow subgrade soil north of College Avenue consists of the clayey sands. According to FHWA-RD-97-083 *Design Pamphlet for the Determination of Design Subgrade in Support of the 1993 AASHTO Guide for the Design of Pavement Structures*, dated September 1997, this material is considered poor for pavement subgrade. South of College Avenue they consist of the silty sands which is considered fair to good for pavement subgrade. The gravelly sands and sandy gravels are considered excellent for pavement subgrade. The recommended pavement sections are shown on Table 21.2.

TABLE 21.2. Recommended Pavement Section Thicknesses

Traffic Area	Alternate	APM (in)	ABC (in)	Total Thickness (in)
North of College Avenue (local)	APM	4.0	9.0	13.0
South of College Avenue (local)	APM	3.0	6.0	9.0
New York Avenue (collector)	APM	3.0	6.0	9.0

21.4 SUBGRADE PREPARATION AND PAVEMENT CONSTRUCTION

21.4.1 Pavement Subgrade

At least the top 12 inches of clayey subgrade should be uniformly moisture conditioned in accordance with Table 18.1. Blading, tilling, windrowing, watering, or drying shall be performed, as needed, to achieve the moisture/density specification to the required depth. It is Cesare’s experience that scarifying to a depth of 12 inches in-place and attempting to compact 12 inches of scarified material in one lift may not be successful in achieving a uniformly moisture conditioned and adequately compacted subgrade.

The entire subgrade should be proof rolled a maximum of 24 hours prior to placement of ABC with a heavy rubber tired vehicle (GVW of 50,000 pounds with 18 kip per axle at tire pressures of 90 psi) to detect any soft or loose areas. All areas exhibiting unstable subgrade conditions, such as rutting, pumping, or excessive movement should be overexcavated to a firm soil layer or to a maximum depth of 2 feet, whichever is shallowest, and replaced with suitable compacted fill. If unstable subgrade conditions persist, Cesare should be contacted for consultation. Soft spots should be stabilized prior to placement of pavement sections. Positive drainage off paved surfaces should be provided.

21.4.2 Subbase and Aggregate Base Course

Subbase and ABC should meet the following requirements:

- ABC material should be approved prior to construction and should subsequently be tested as the material is being placed.
- ABC should have a minimum R-value of 70.
- ABC material should be compacted to a minimum of 95% of the MDD as determined by the modified Proctor test, ASTM D1557.

21.4.3 Pavement

Pavement construction shall be in accordance with the following recommendations and criteria:

- APM shall meet the requirements in the latest edition of CDOT *Standard Specifications for Road and Bridge Construction*, Section 400.
- Asphalt binder grade shall be PG 58-28, N_{Design} of 50 (Local) or 75 (Collector).
- Approved APM material should be placed in the lifts indicated on Table 21.3.

TABLE 21.3. Pavement Section Lift Thickness Recommendations

Grade	Lift Thickness (in)
S	2 to 4-1/4
SX	1-1/2 to 2-1/2

Per MGPEC 2019.

- APM shall be compacted to 92% to 96% of the maximum theoretical density within 0.3% of the optimum asphalt content as determined by ASTM D2041.
- APM placement specifications should follow CDOT specifications and industry standards as recommended by the NAPA and the AI.
- Portland cement concrete should be obtained from an approved mixture design with minimum properties meeting a CDOT Class D mixture.
- Portland cement concrete placement specifications should follow industry standards as recommended by the ACI and the PCA.
- Positive drainage off paved surfaces should be provided.
- Construction material should be approved prior to use and should subsequently be tested as this material is being placed.

22. SOIL CHEMICAL TESTING

22.1 SULFATE EXPOSURE

Water soluble sulfate contents of 0.02% were measured on samples collected in Exploratory Boring B-5 at a depth of 5 feet. Results are summarized in Appendix B. The PCA publication titled *Design and Control of Concrete Mixtures* 2002 and the ACI publication titled *Building Code Requirements for Structural Concrete and Commentary* consider this range negligible for water soluble sulfate exposure.

23. GEOTECHNICAL RISK

The concept of risk is an important aspect of any geotechnical study. The primary reason for this is that the analytical methods used by geotechnical engineers are generally empirical and must be tempered by engineering judgment and experience, therefore, the solutions or recommendations presented in any geotechnical study should not be considered risk free, and more importantly, are not a guarantee that the interaction between the soil and the proposed construction will perform as predicted, desired, or intended. The engineering recommendations presented in the preceding sections constitute Cesare's best estimate of those measures that are necessary to help the structures/pavements perform in a satisfactory manner based on the information generated during this study, training, and experience in working with these conditions.

24. LIMITATIONS

This document has been prepared as an instrument of service for the exclusive use of Gunnison Valley Properties, LLC for the specific application to the project as discussed herein and has been prepared in accordance with geotechnical engineering practices generally accepted in the state of Colorado at the date of its preparation. No warranties, either expressed or implied, are intended or made. This document should not be assumed to contain information for other parties or other purposes.

The findings of this study are valid as of the date its preparation. Changes in the conditions of a property can occur with the passage of time, whether due to natural processes or the works of people on this or adjacent properties. Standards of practice evolve in engineering and changes in applicable or appropriate standards may occur, whether they result from legislation or the broadening of knowledge. Accordingly, the findings of this study may be invalidated wholly or partially by changes outside of Cesare's control, therefore, this study is subject to review and should not be relied upon without such review after a period of 3 years.

In the event that changes, including but not limited to, the nature, type, design, size, elevation, or location of the project or project elements as outlined in this report are made, the conclusions and recommendations contained in this report shall not be considered valid unless Cesare reviews the changes and either confirms or modifies the conclusions of this report in writing.

Cesare should be retained to review final plans and specifications that are developed for proposed construction to judge whether the recommendations presented in this report and any addenda have been appropriately interpreted and incorporated in the project plans and specifications as intended.

The exploration locations for this study were selected to obtain a reasonably accurate depiction of underground conditions for design purposes and these locations are often modified based on accessibility and the presence of underground or overhead utility conflicts. Variations from the soil conditions encountered are possible. These variations may necessitate modifications to Cesare's design recommendations, therefore, Cesare should be retained to observe subsurface conditions, once exposed, to evaluate whether they are consistent with the conditions encountered during Cesare's exploration and that the recommendations of this study remain valid. If parties other than Cesare perform these observations and judgements, they must accept responsibility to judge whether the recommendations in this report remain appropriate.

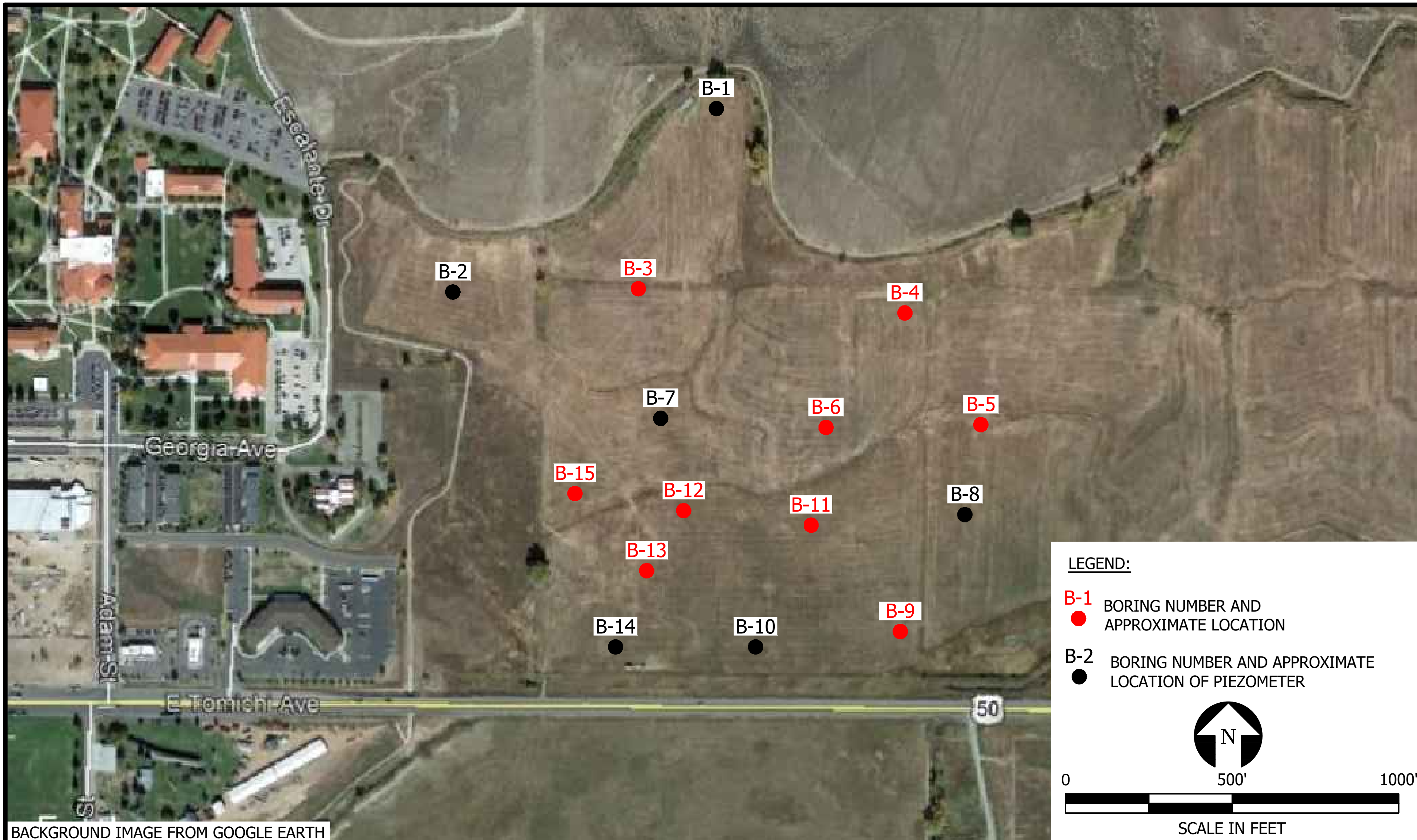
Cesare's scope of services for this report did not include either specifically, or by implication, any environmental assessment of the site or identification of contaminated or hazardous material or conditions. Additionally, none of the services performed in connection with this study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not, of itself, be enough to prevent mold from growing in or on the structures involved.

At a minimum, Cesare should be retained during construction to observe and/or test the following:

- completed excavations.
- placement and compaction of fill.
- proposed import or onsite fill material.
- placement and compaction of pavement subgrade, subbase, base course and asphalt.

Cesare offers many other construction observations, materials engineering, and testing services and can be contacted to discuss further.

W:\2020\SCB\20.6050.A Gunnison Rising Phase I\ACAD\Boring Location Map.dwg 10/21/2020 7:51 AM



PROJECT NO:	20.6050		
PROJECT NAME:	Gunnison Rising Phase 1		
DRAWN BY:	GPH	CHECKED BY:	DRD
DWG DATE:	10.20.20	REV. DATE:	--

FIGURE 1
Site Plan and Locations of Borings and Piezometers

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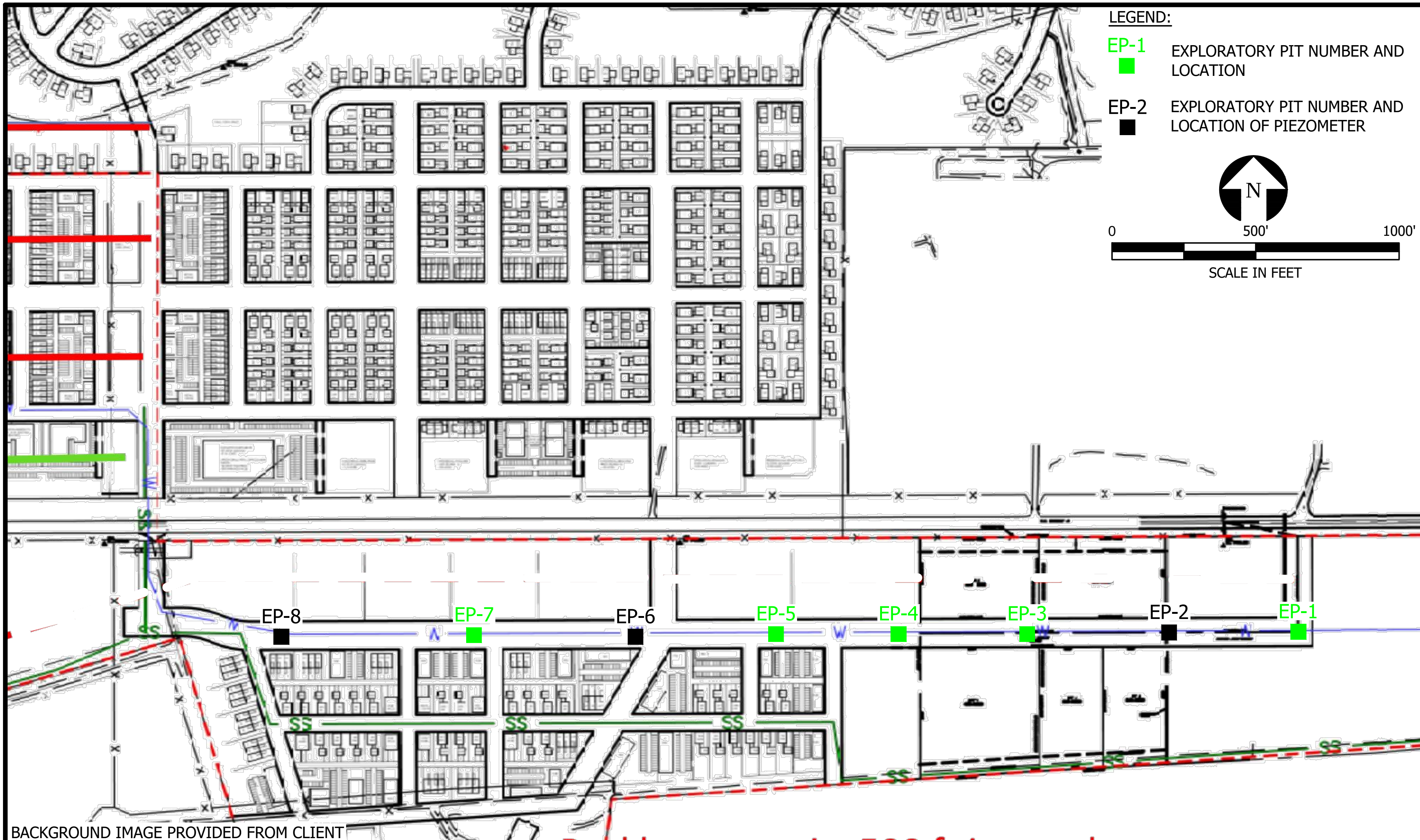

PROJECT NO:	20.6050		
PROJECT NAME:	Gunnison Rising Phase 1		
DRAWN BY:	GPH	CHECKED BY:	DRD
DWG DATE:	10.20.20	REV. DATE:	--

FIGURE 2
Site Plan and Location of Exploratory Pits and Piezometers

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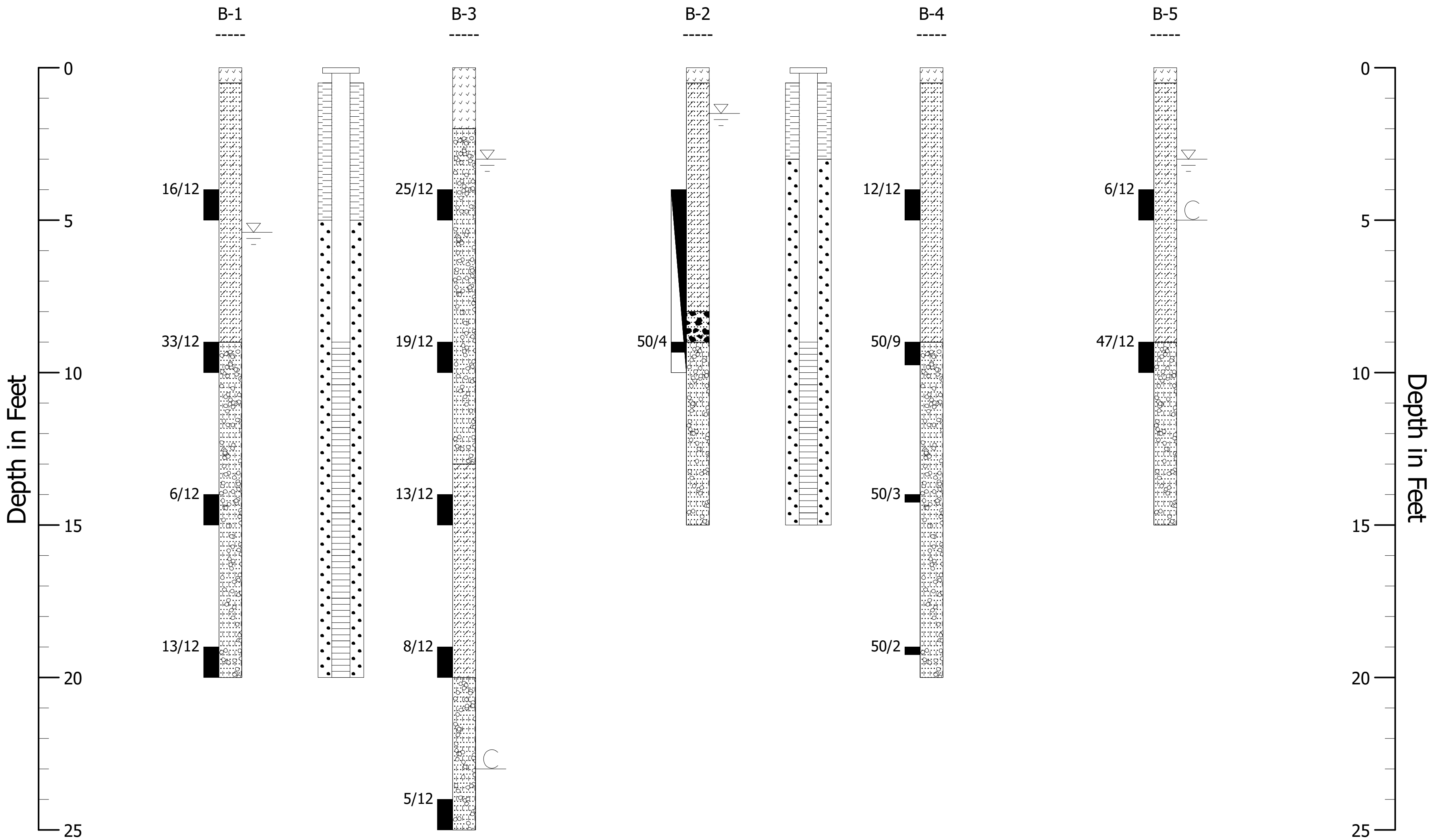
APPENDIX A

Field Exploration

FIELD EXPLORATION

Samples of the subsoil with exploratory borings were obtained at this site using a modified California sampler which was driven into the soil by dropping a 140 pound hammer through a free fall of 30 inches. The modified California sampler is a 2-1/2 inch outside diameter by 2 inch inside diameter device lined with brass tubes. The procedure to drive the modified California sampler into the soil and to record the number of blows required to drive the sampler into the soil is known as a penetration test. The number of blows required for the sampler to penetrate 12 inches gives an indication of the relative stiffness of cohesive soil, and relative density of non-cohesive soil encountered. Bulk samples were collected from cuttings generated during drilling and spoils from exploratory pits. Locations of sampling and penetration test results are presented on the boring logs and key to symbols/legend contained in this Appendix.



PROJECT NO:	20.6050	LOGS OF EXPLORATORY BORINGS
PROJECT NAME:	Gunnison Rising Phase I	
DATE:	10/18/2020	

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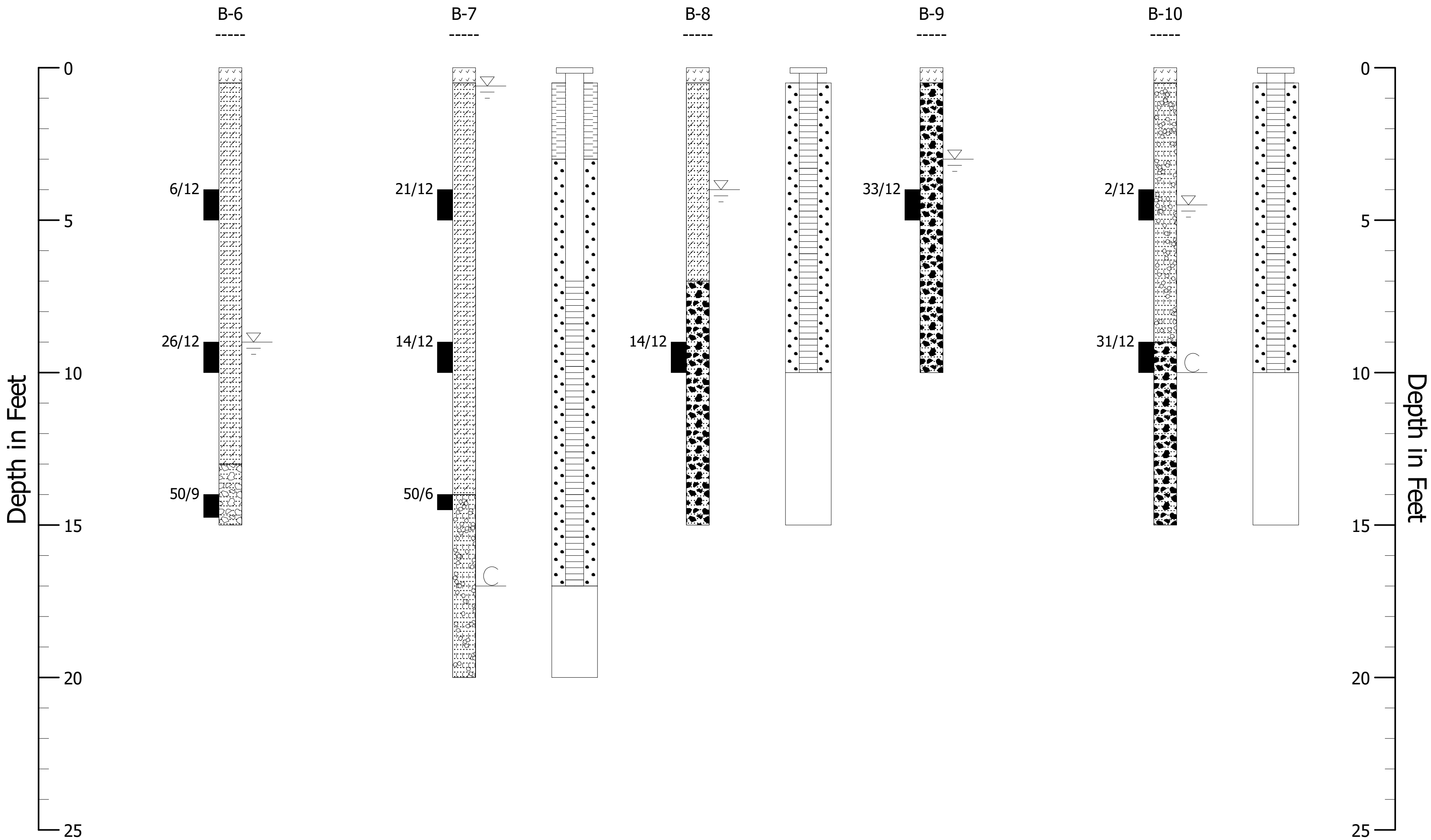

PROJECT NO:	20.6050
PROJECT NAME:	Gunnison Rising Phase I
DATE:	10/18/2020

LOGS OF EXPLORATORY BORINGS

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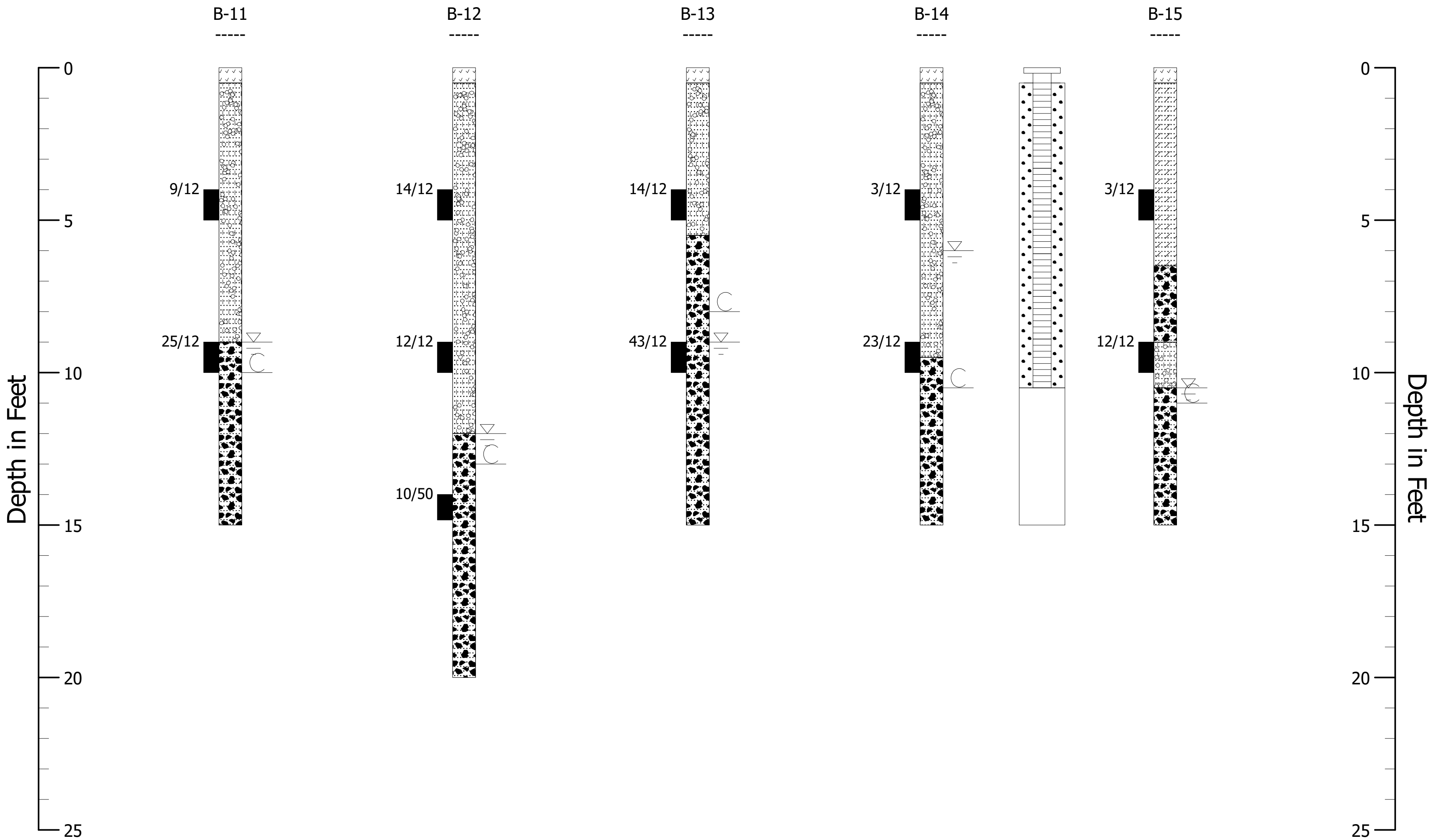
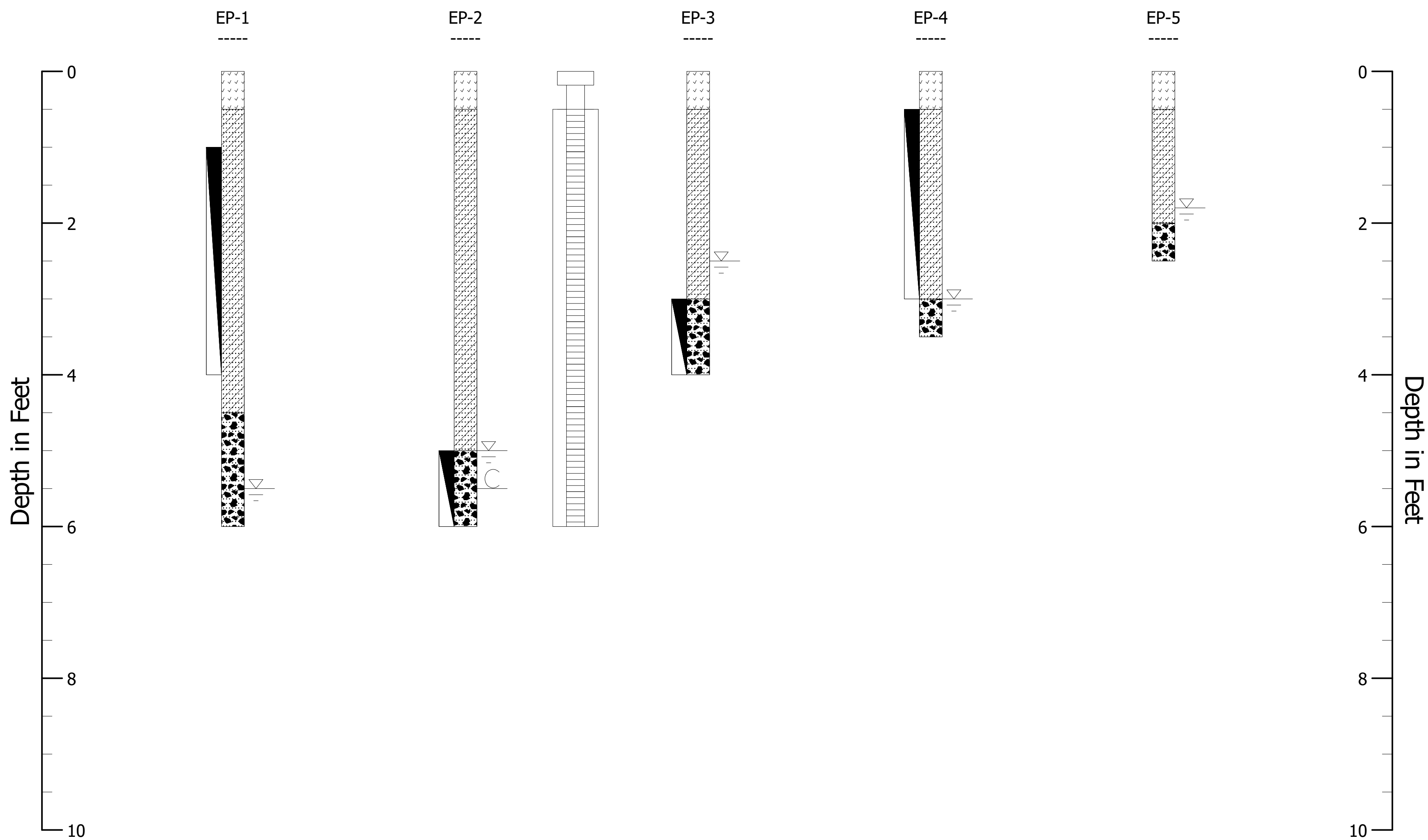


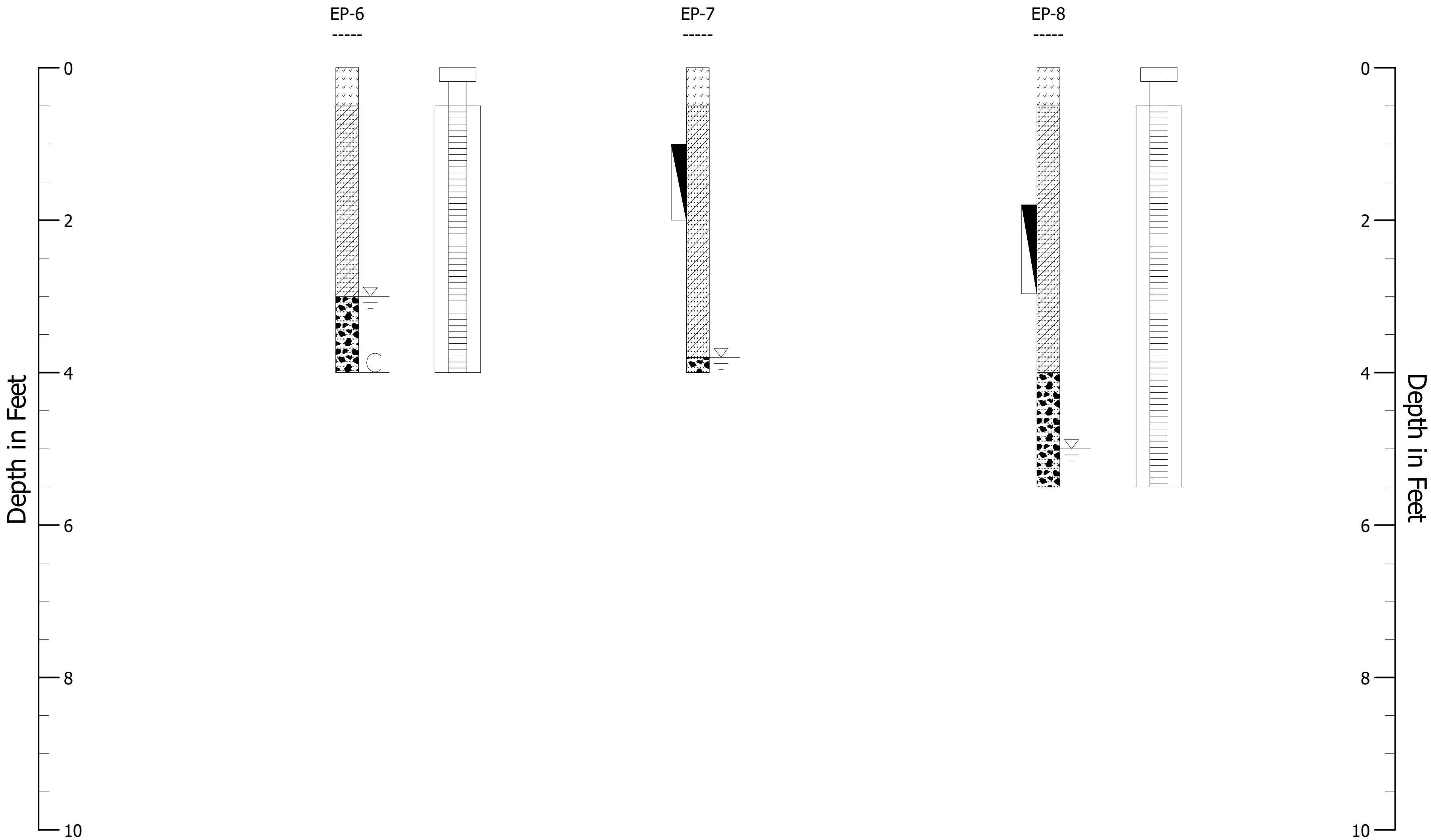
PROJECT NO:	20.6050
PROJECT NAME:	Gunnison Rising Phase I
DATE:	10/18/2020

LOGS OF EXPLORATORY BORINGS

CESARE, INC.
Geotechnical Engineers & Construction Materials Consultants



PROJECT NO:	20.6050	**LOGS OF EXPLORATORY PITS**	CESARE, INC. Geotechnical Engineers & Construction Materials Consultants
PROJECT NAME:	Gunnison Rising Phase I		
DATE:	10/18/2020		



PROJECT NO:	20.6050	**LOGS OF EXPLORATORY PITS**	CESARE, INC. *Geotechnical Engineers & Construction Materials Consultants*
PROJECT NAME:	Gunnison Rising Phase I		
DATE:	10/18/2020		

KEY TO SYMBOLS

Symbol	Description
Strata symbols	
	Topsoil
	SAND, clayey, silty, very loose to medium dense, moist to wet, light brown to brown (SC, SM; A-4 to A-2-6).
	SAND, gravelly, silty, very loose to medium dense, moist to wet, light brown to brown (SM; A-2-4).
	SAND, gravelly to GRAVEL, sandy, silty, clayey, poorly to well graded, very moist to wet, light brown to brown (SP, SM, GW, GC, GM; A-1-a to A-2-6).
	CLAY, sandy, silty, soft to medium stiff, low plasticity, very moist to wet, brown to dark brown (CL to CL-ML; A-4 to A- 6).
Misc. Symbols	
	Water level during drilling
	Depth to caving
Soil Samplers	
	Modified California sample

Symbol	Description
	Bulk/Grab sample
Monitor Well Details	
	Covered riser
	Bentonite pellets, blank PVC
	Silica sand, blank PVC
	Slotted pipe w/ sand
	End of well installation
	Perforatted pipe, soil backfill

Notes:

1. 16/12 indicates that 16 blows with a 140-pound hammer falling 30 inches were required to drive a modified California sampler 12 inches.

2. Exploratory borings B-1 through B-7 were drilled on July 9, 2020, and borings B-8 through B-15 were drilled on September 15, 2020 using a CME-55 track mounted drill rig equipped with a 4-inch continous flight solid stem auger.

3. Exploratory pits were excavated on July 24, 2020 using a CAT mini excavator.

4. Groundwater was encountered at various depths at the time of drilling and excavating. Monitoring wells were installed in exploratory borings B-1, B-2, B-7, B-8, B-10 and B-14 and exploratory pits EP-2, EP-6 and EP-8.

5. Contacts between soil units are approximate and may be gradational.

6. These logs are subject to the limitations, conclusions, and recommendations in this report.
Project No. 20.6050.

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APPENDIX B

Laboratory Testing

LABORATORY TESTING

Swell/consolidation testing was performed on samples collected using a modified California sampler to evaluate the effect of wetting and loading on the soil. The samples were loaded to 500 to 1,000 psf and then inundated with water.

SUMMARY OF LABORATORY TEST RESULTS
Gunnison Rising Phase I
Project No. 20.6050

Sample Location		Natural Dry Density	Natural Moisture Content	Water Soluble Sulfates	Gradation			Atterberg Limits		Swell/Consolidation			Material Type
Boring/ Pit	Depth (feet)	(pcf)	(%)	(%)	Gravel (%)	Sand (%)	Silt/ Clay (%)	Liquid Limit (%)	Plasticity Index (%)	Inundation Pressure (psf)	Volume Change (%)	Swell Pressure (psf)	
B-1	9		17.4		18	55	27	NV	NP				(SM) Silty sand with gravel; A-2-4(0)
B-2	4 to 9		29.4		4	65	31	21	12				(SC) Clayey sand; A-2-6(0)
B-3	14	99.6	14.2							1,000	-1.3	NA	(SC) Clayey sand
B-4	4	98.8	17.6							500	-1.4	NA	(SC) Clayey sand
B-4	9		17.2		18	51	31	29	5				(SM) Silty sand with gravel; A-2-4(0)
B-5	4			0.02									
B-5	9		17.7		9	59	32	NV	NP				(SM) Silty sand; A-2-4(0)
B-7	0 to 4		18.2		0	51	49	19	7				(SC-SM) Silty, clayey sand; A-4(0)
B-7	14	117.8	13.6										(SM) Silty sand with gravel
B-8	1 to 7		24.6		1	64	35	22	3				(SM) Silty sand; A-4(0)
B-10	5	103.0	12.6										(SM) Silty sand
B-10/11*	9				49	47	4						(GP) Poorly graded gravel with sand; A-1-a
B-12	9	102.4	9.1										(SM) Silty sand
B-13	9				40	55	5						(SP-SM) Poorly graded sand with gravel and silt, A-1-a
B-15	4	102.1	17.8							500	0.0	NA	(SC) Clayey sand
B-15	9	101.7	9.3										(SM) Silty sand
EP-1	1 to 4				50	29	21	32	21				(GC) Clayey gravel with sand; A-2-6(0)
EP-3	3 to 4				48	49	3						(GW) Well graded gravel with sand; A-1-a
EP-7	1.5 to 2				0	22	78	32	11				(CL) Lean clay with sand; A-6(8)
EP-8	1.8 to 3				0	40	60	25	7				(CL-ML) Sandy silty clay; A-4(2)

* Combined
NP=non plastic
NV=no value

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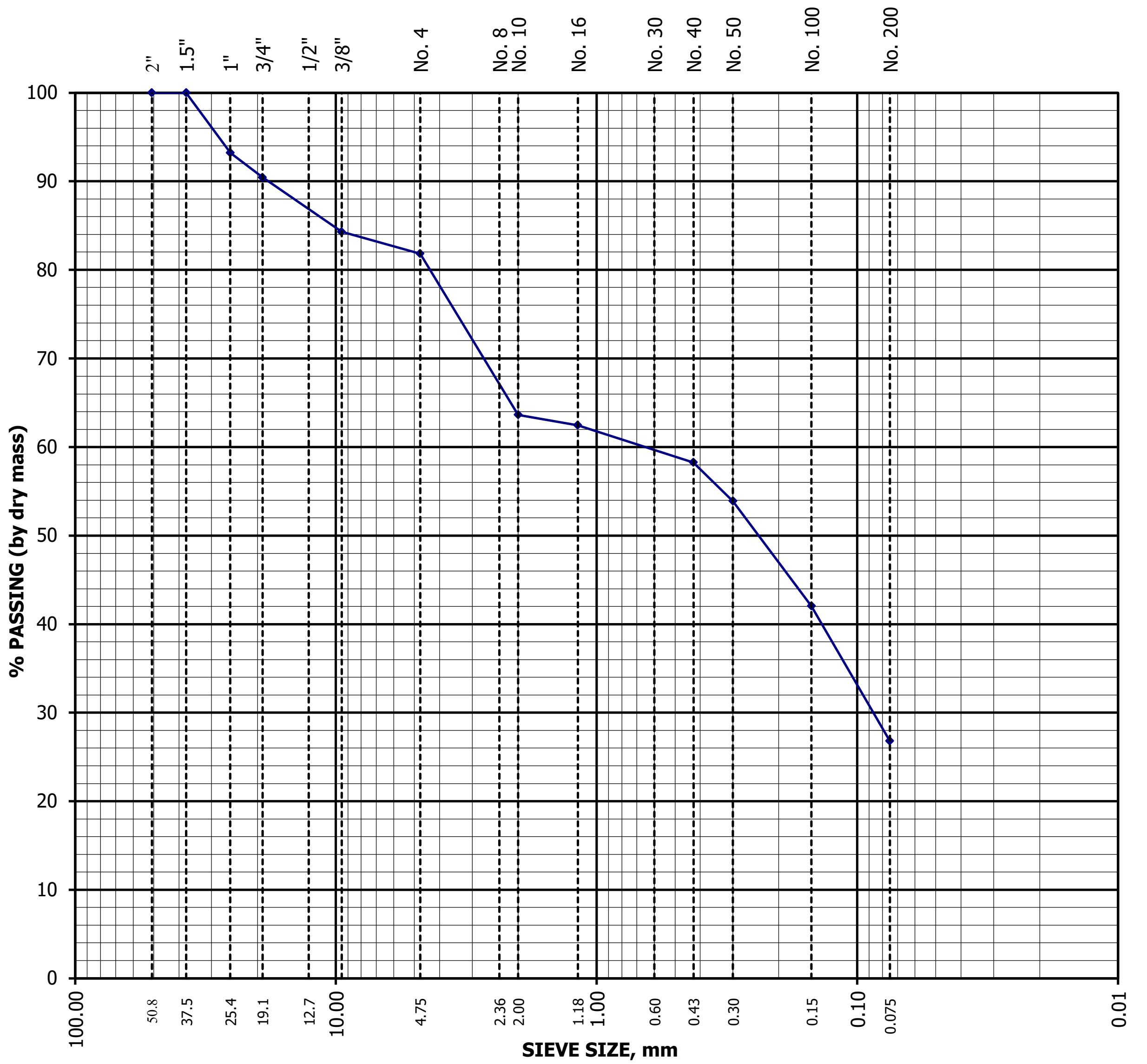
GRADATION PLOT - SOIL & AGGREGATE

Project Number:	20.6050, Gunnison Valley Properties, LLC	Date:	15-Jul-20
Project Name:	Gunnison Rising Phase 1	Technician:	K. Frazier
Lab ID Number:	SC202037	Reviewer:	D. Duran
Sample Location:	B-1 at 9 feet		
Visual Description:	SAND, silty with gravel, brown		

AASHTO M 145 Classification: **A-2-4** **Group Index:** **(0)**
Unified Soil Classification System (ASTM D 2487): **(SM)** **Silty sand with gravel**



Sieve Size	% Passing
2"	
1.5"	100
1"	93
3/4"	90
1/2"	
3/8"	84
#4	82
#8	
#10	64
#16	62
#30	
#40	58
#50	54
#100	42
#200	26.8

Moisture (M) & Density (D)	
M, %:	17.4
D, pcf:	

LL	17
PL	17
PI	0

D_{60}	
D_{30}	
D_{10}	
Cu	
Cc	

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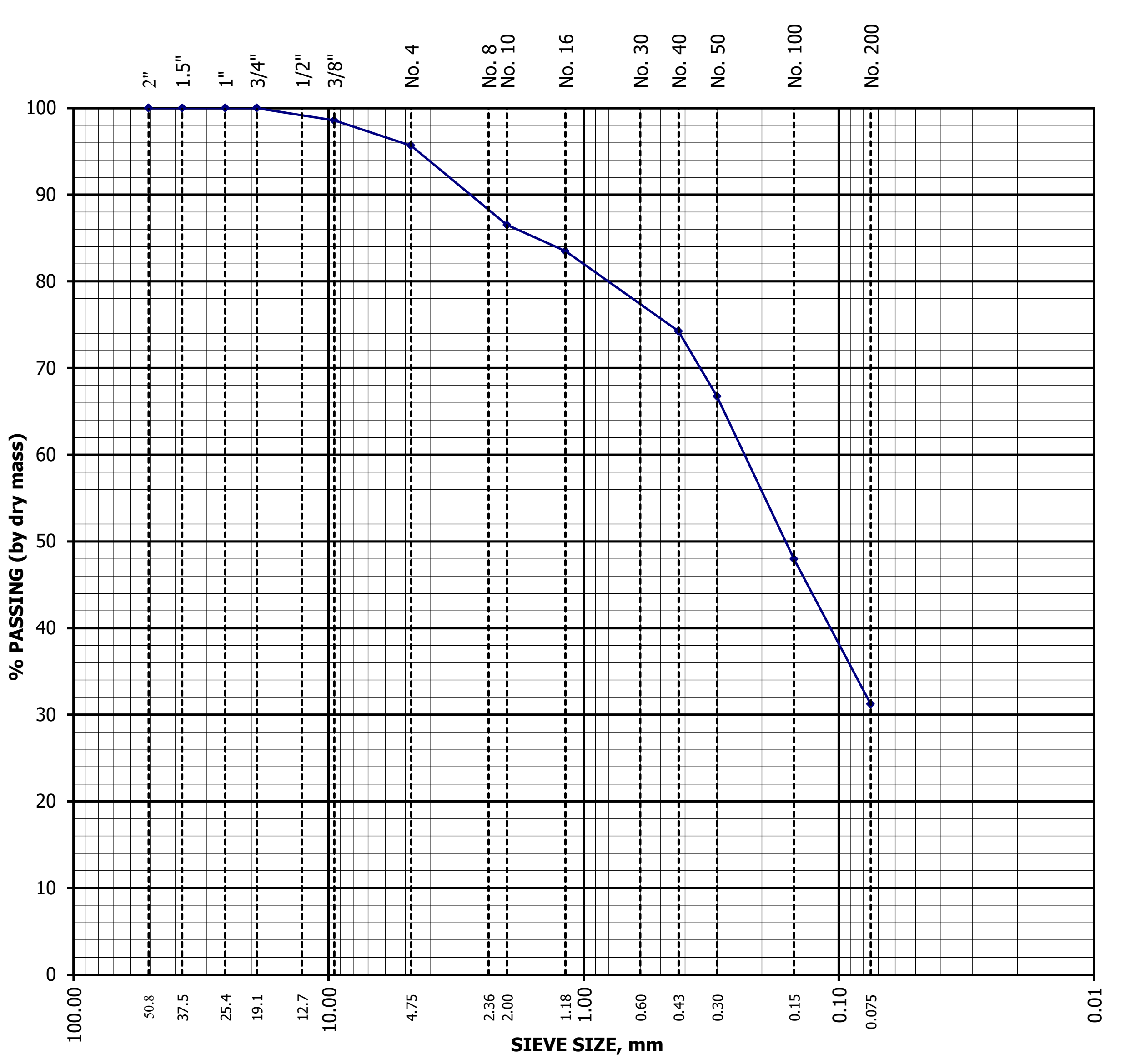
GRADATION PLOT - SOIL & AGGREGATE

Project Number:	20.6050, Gunnison Valley Properties, LLC	Date:	15-Jul-20
Project Name:	Gunnison Rising Phase 1	Technician:	K. Frazier
Lab ID Number:	SC202039	Reviewer:	D. Duran
Sample Location:	B-2 at 4 to 9 feet		
Visual Description:	SAND, clayey, silty, light brown		

AASHTO M 145 Classification: **A-2-6** **Group Index:** **(0)**
Unified Soil Classification System (ASTM D 2487): **(SC)** **Clayey sand**



Sieve Size	% Passing
2"	
1.5"	
1"	
3/4"	100
1/2"	
3/8"	99
#4	96
#8	
#10	87
#16	83
#30	
#40	74
#50	67
#100	48
#200	31.2

Moisture (M) & Density (D)	
M, %:	29.4
D, pcf:	

LL	21
PL	9
PI	12

D_{60}	
D_{30}	
D_{10}	
Cu	
Cc	

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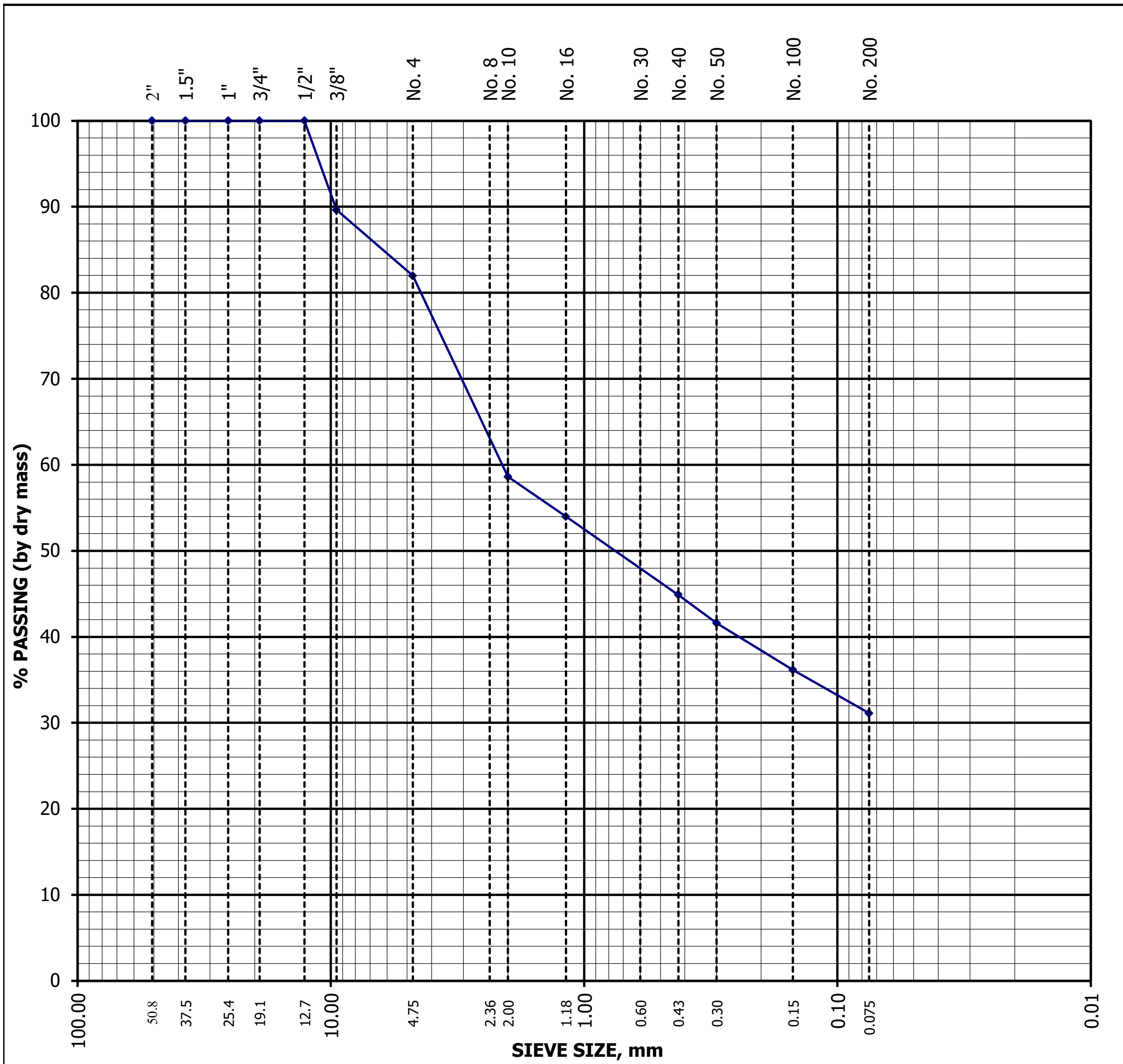
GRADATION PLOT - SOIL & AGGREGATE

Project Number:	20.6050, Gunnison Valley Properties, LLC	Date:	15-Jul-20
Project Name:	Gunnison Rising Phase 1	Technician:	K. Frazier
Lab ID Number:	SC202040	Reviewer:	D. Duran
Sample Location:	B-4 at 9 feet		
Visual Description:	SAND, silty with gravel, light brown		

AASHTO M 145 Classification: **A-2-4** **Group Index:** **(0)**
Unified Soil Classification System (ASTM D 2487): **(SM)** **Silty sand with gravel**



Sieve Size	% Passing
2"	
1.5"	
1"	
3/4"	100
1/2"	
3/8"	90
#4	82
#8	
#10	59
#16	54
#30	
#40	45
#50	42
#100	36
#200	31.1

Moisture (M) & Density (D)	
M, %:	17.2
D, pcf:	

LL	29
PL	24
PI	5

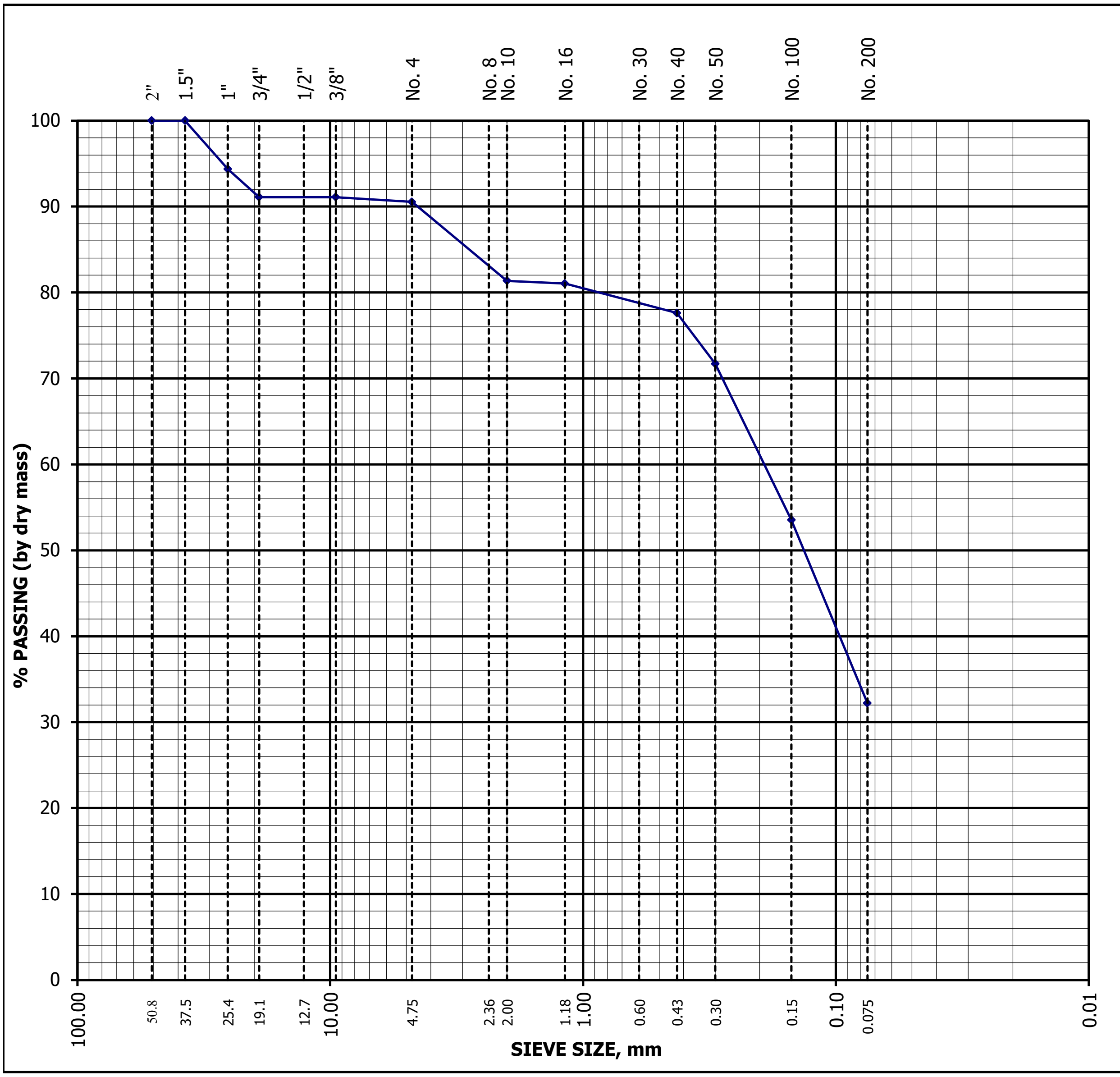
D_{60}	
D_{30}	
D_{10}	
Cu	
Cc	

GRADATION PLOT - SOIL & AGGREGATE

Project Number:	20.6050, Gunnison Valley Properties, LLC	Date:	15-Jul-20
Project Name:	Gunnison Rising Phase 1	Technician:	K. Frazier
Lab ID Number:	SC202041	Reviewer:	D. Duran
Sample Location:	B-5 at 9 Feet		
Visual Description:	SAND, silty, brown		

AASHTO M 145 Classification: **A-2-4** **Group Index:** **0**

Unified Soil Classification System (ASTM D 2487): **(SM) Silty sand**



Sieve Size	% Passing
2"	
1.5"	100
1"	94
3/4"	91
1/2"	
3/8"	91
#4	91
#8	
#10	81
#16	81
#30	
#40	78
#50	72
#100	54
#200	32.2

Moisture (M) & Density (D)	
M, %:	17.7
D, pcf:	

LL	NV
PL	NP
PI	NP

D_{60}	
D_{30}	
D_{10}	
Cu	
Cc	

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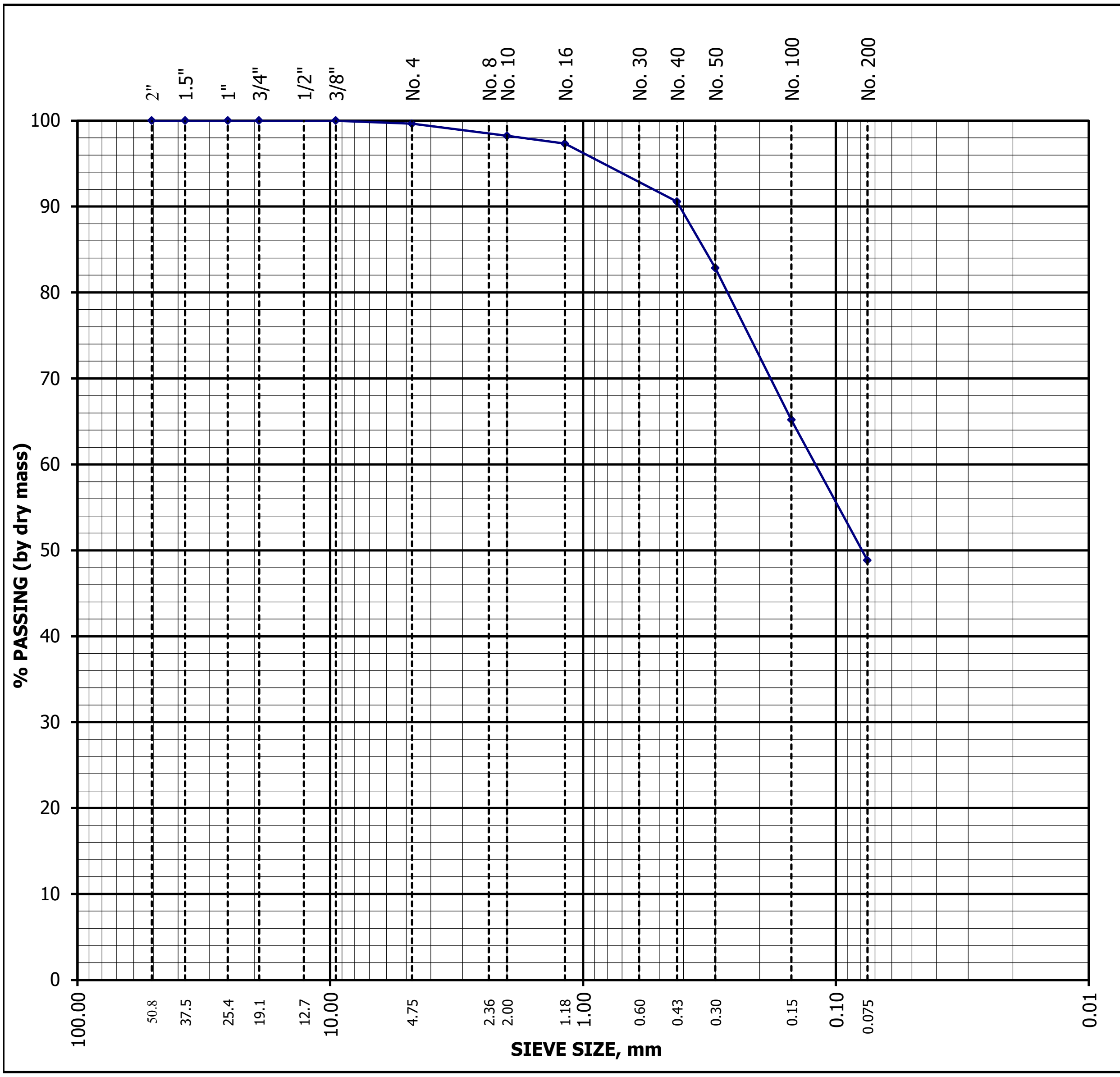
GRADATION PLOT - SOIL & AGGREGATE

Project Number:	20.6050, Gunnison Valley Properties, LLC	Date:	15-Jul-20
Project Name:	Gunnison Rising Phase 1	Technician:	K. Frazier
Lab ID Number:	SC202042	Reviewer:	D. Duran
Sample Location:	B-7 at 0 to 4 feet		
Visual Description:	SAND, silty, brown		

AASHTO M 145 Classification: **A-4** **Group Index:** **0**

Unified Soil Classification System (ASTM D 2487): **(SC-SM) Silty, clayey sand**



Sieve Size	% Passing
2"	
1.5"	
1"	
3/4"	
1/2"	
3/8"	100
#4	100
#8	
#10	98
#16	97
#30	
#40	91
#50	83
#100	65
#200	48.8

Moisture (M) & Density (D)	
M, %:	18.2
D, pcf:	

LL	19
PL	12
PI	7

D_{60}	
D_{30}	
D_{10}	
Cu	
Cc	

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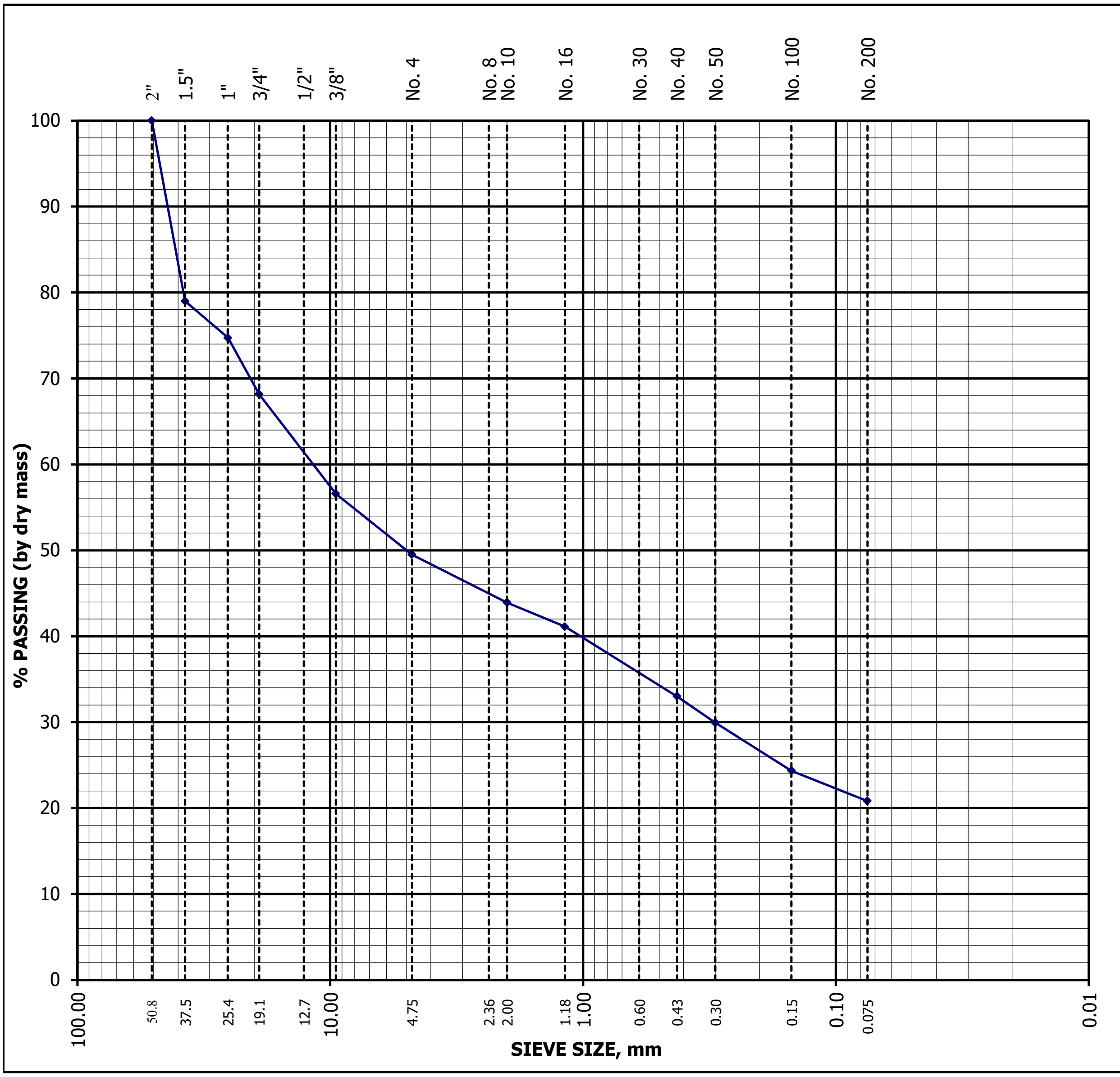
GRADATION PLOT - SOIL & AGGREGATE

Project Number:	20.6050, Gunnison Valley Properties, LLC	Date:	30-Jul-20
Project Name:	Gunnison Rising Phase 1	Technician:	K. Frazier
Lab ID Number:	SC202043	Reviewer:	D. Duran
Sample Location:	EP-1 at 1 to 4 feet		
Visual Description:	GRAVEL, clayey with sand, brown		

AASHTO M 145 Classification: **A-2-6** **Group Index:** **(0)**
Unified Soil Classification System (ASTM D 2487): **(GC)** **Clayey gravel with sand**



Sieve Size	% Passing
2"	100
1.5"	79
1"	75
3/4"	68
1/2"	
3/8"	57
#4	50
#8	
#10	44
#16	41
#30	
#40	33
#50	30
#100	24
#200	20.8

Moisture (M) & Density (D)	
M, %:	12.5
D, pcf:	

LL	32
PL	11
PI	21

D_{60}	
D_{30}	
D_{10}	
Cu	
Cc	

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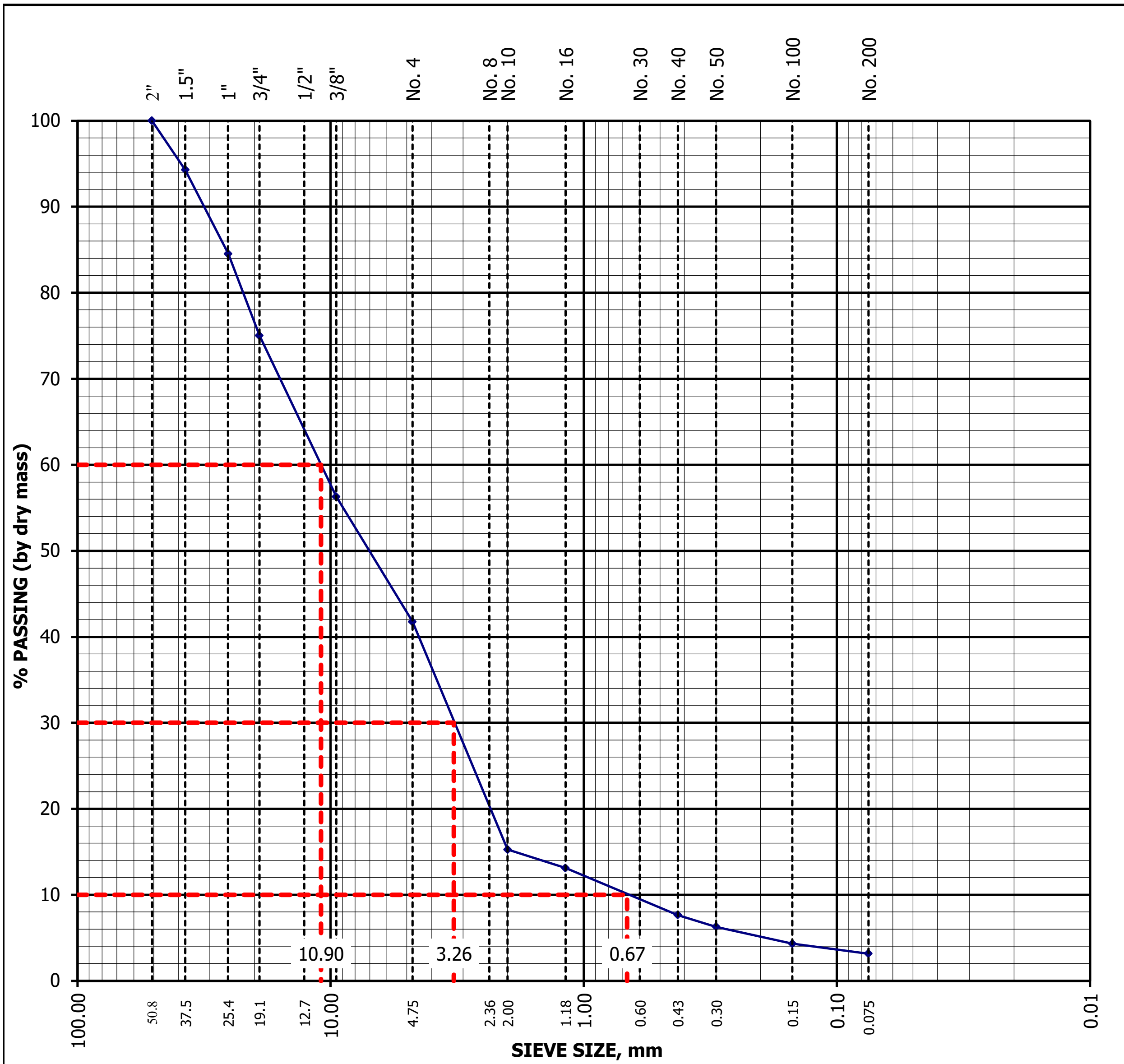
GRADATION PLOT - SOIL & AGGREGATE

Project Number:	20.6050, Gunnison Valley Properties, LLC	Date:	30-Jul-20
Project Name:	Gunnison Rising Phase 1	Technician:	K. Frazier
Lab ID Number:	SC202044	Reviewer:	D. Duran
Sample Location:	EP-3 at 3 to 4 feet		
Visual Description:	GRAVEL, sandy, brown		

AASHTO M 145 Classification: **A-1-a** **Group Index:** ____
Unified Soil Classification System (ASTM D 2487): **(GW)** **Well graded gravel with sand**



Sieve Size	% Passing
2"	100
1.5"	94
1"	85
3/4"	75
1/2"	
3/8"	56
#4	42
#8	
#10	15
#16	13
#30	
#40	8
#50	6
#100	4
#200	3.2

Moisture (M) & Density (D)	
M, %:	4.1
D, pcf:	

LL	
PL	
PI	

D_{60}	10.90
D_{30}	3.26
D_{10}	0.67
Cu	**16.17**
Cc	**1.44**

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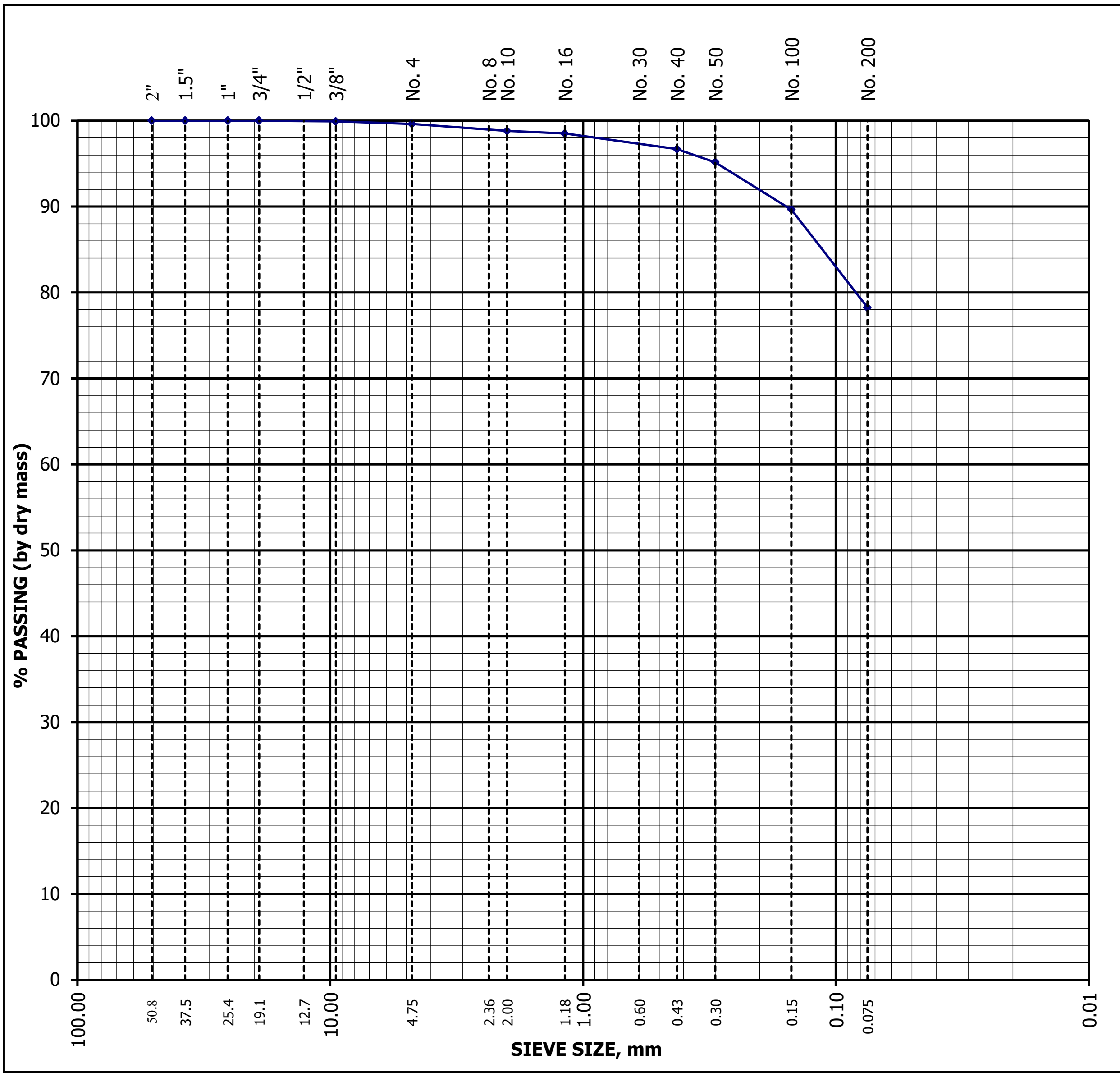
GRADATION PLOT - SOIL & AGGREGATE

Project Number:	20.6050, Gunnison Valley Properties, LLC	Date:	30-Jul-20
Project Name:	Gunnison Rising Phase 1	Technician:	K. Frazier
Lab ID Number:	SC202045	Reviewer:	D. Duran
Sample Location:	EP-7 at 1.5 to 2 feet		
Visual Description:	CLAY, sandy, brown		

AASHTO M 145 Classification: **A-6** **Group Index:** **8**

Unified Soil Classification System (ASTM D 2487): **(CL)** **Lean clay with sand**



Sieve Size	% Passing
2"	
1.5"	
1"	
3/4"	100
1/2"	
3/8"	100
#4	100
#8	
#10	99
#16	98
#30	
#40	97
#50	95
#100	90
#200	78.3

Moisture (M) & Density (D)	
M, %:	25.6
D, pcf:	

LL	32
PL	21
PI	11

D_{60}	
D_{30}	
D_{10}	
Cu	
Cc	

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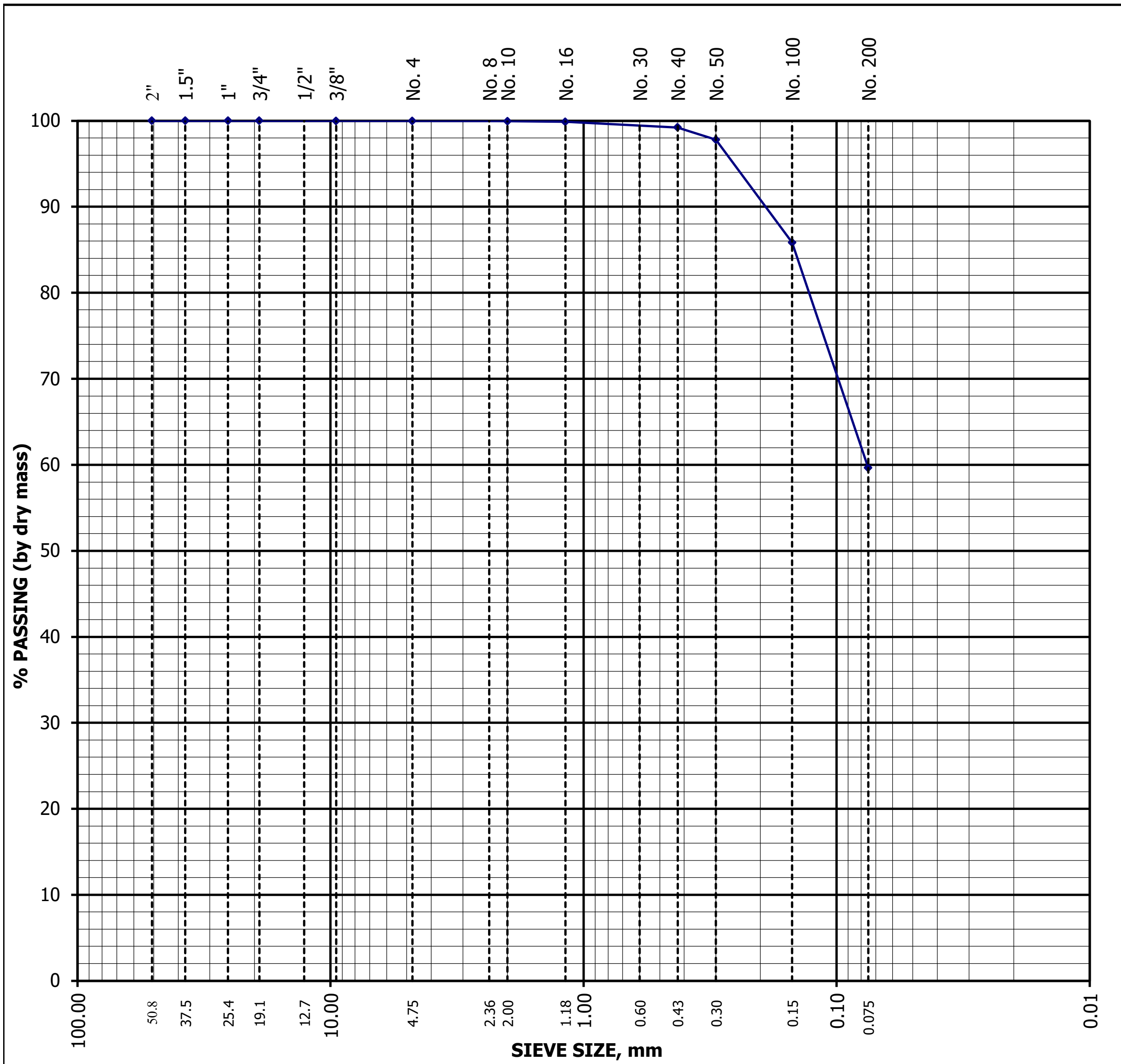
GRADATION PLOT - SOIL & AGGREGATE

Project Number:	20.6050, Gunnison Valley Properties, LLC	Date:	30-Jul-20
Project Name:	Gunnison Rising Phase 1	Technician:	K. Frazier
Lab ID Number:	SC202046	Reviewer:	D. Duran
Sample Location:	EP-8 at 1.8 to 3 feet		
Visual Description:	CLAY, with silt and sand, brown		

AASHTO M 145 Classification: **A-4** **Group Index:** **2**
Unified Soil Classification System (ASTM D 2487): **(CL-ML) Sandy silty clay**



Sieve Size	% Passing
2"	
1.5"	
1"	
3/4"	100
1/2"	
3/8"	100
#4	100
#8	
#10	100
#16	100
#30	
#40	99
#50	98
#100	86
#200	59.6

Moisture (M) & Density (D)	
M, %:	23.9
D, pcf:	

LL	25
PL	18
PI	7

D_{60}	
D_{30}	
D_{10}	
Cu	
Cc	

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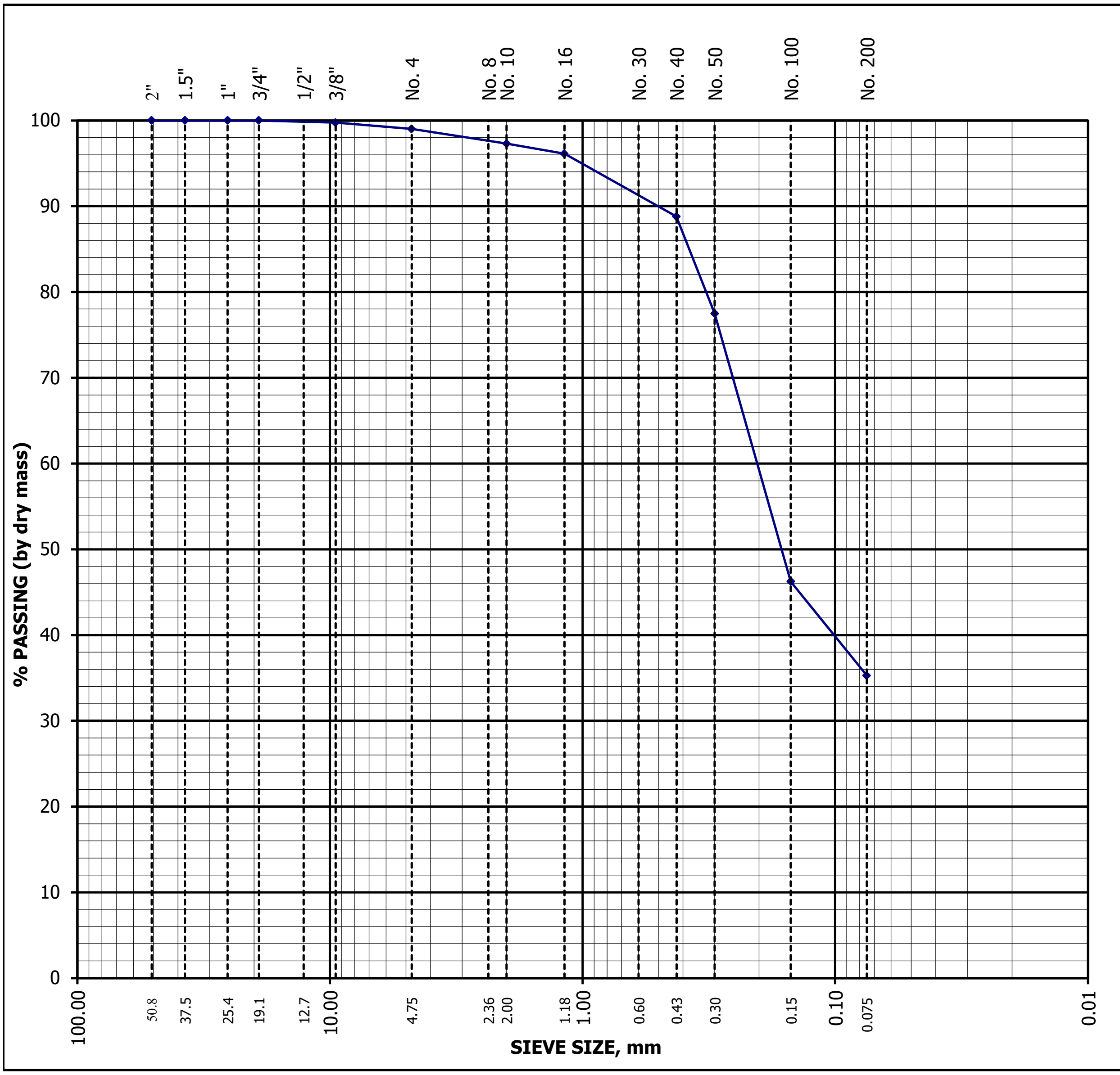
GRADATION PLOT - SOIL & AGGREGATE

Project Number:	20.6050, Gunnison Valley Properties, LLC	Date:	11-Oct-20
Project Name:	Gunnison Rising Phase 1	Technician:	K. Frazier
Lab ID Number:	SC202078	Reviewer:	D. Duran
Sample Location:	B-8 at 1 to 7 feet		
Visual Description:	SAND with silt and clay, brown		

AASHTO M 145 Classification: **A-4** **Group Index:** **(0)**
Unified Soil Classification System (ASTM D 2487): **(SM) Silty sand**



Sieve Size	% Passing
2"	
1.5"	
1"	
3/4"	100
1/2"	
3/8"	100
#4	99
#8	
#10	97
#16	96
#30	
#40	89
#50	77
#100	46
#200	35.3

Moisture (M) & Density (D)	
M, %:	24.6
D, pcf:	

LL	22
PL	19
PI	3

D_{60}	
D_{30}	
D_{10}	
Cu	
Cc	

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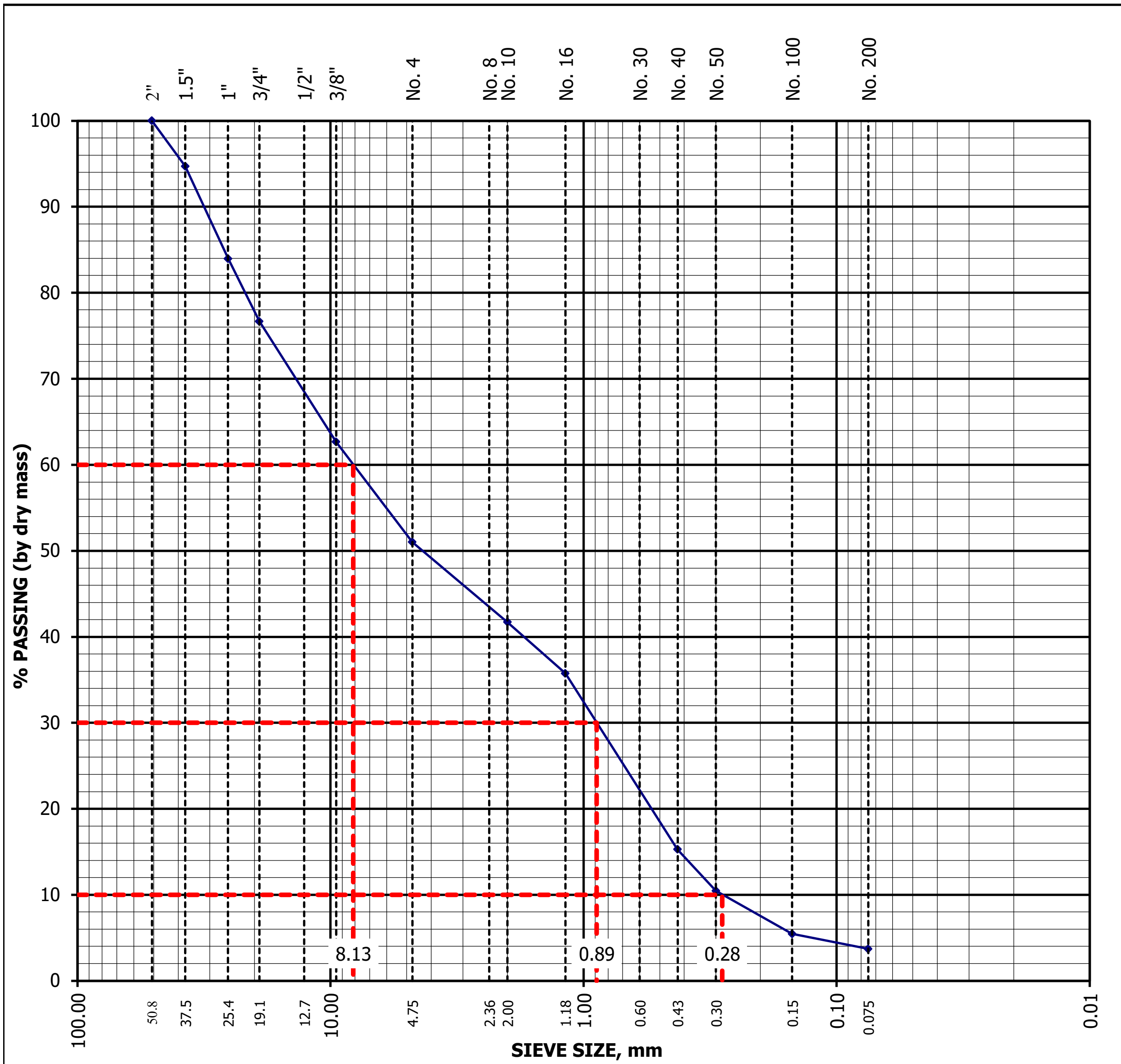
GRADATION PLOT - SOIL & AGGREGATE

Project Number:	20.6050, Gunnison Valley Properties, LLC	Date:	11-Oct-20
Project Name:	Gunnison Rising Phase 1	Technician:	K. Frazier
Lab ID Number:	SC202079	Reviewer:	D. Duran
Sample Location:	B-10/11 (combined) at 9 feet		
Visual Description:	GRAVEL with sand and silt, brown		

AASHTO M 145 Classification: **A-1-a** **Group Index:** **0**

Unified Soil Classification System (ASTM D 2487): **(GP)** **Poorly graded gravel with sand**



Sieve Size	% Passing
2"	100
1.5"	95
1"	84
3/4"	77
1/2"	
3/8"	63
#4	51
#8	
#10	42
#16	36
#30	
#40	15
#50	10
#100	5
#200	3.7

Moisture (M) & Density (D)	
M, %:	6.4
D, pcf:	

LL	
PL	
PI	

D_{60}	8.13
D_{30}	0.89
D_{10}	0.28
Cu	**28.73**
Cc	**0.34**

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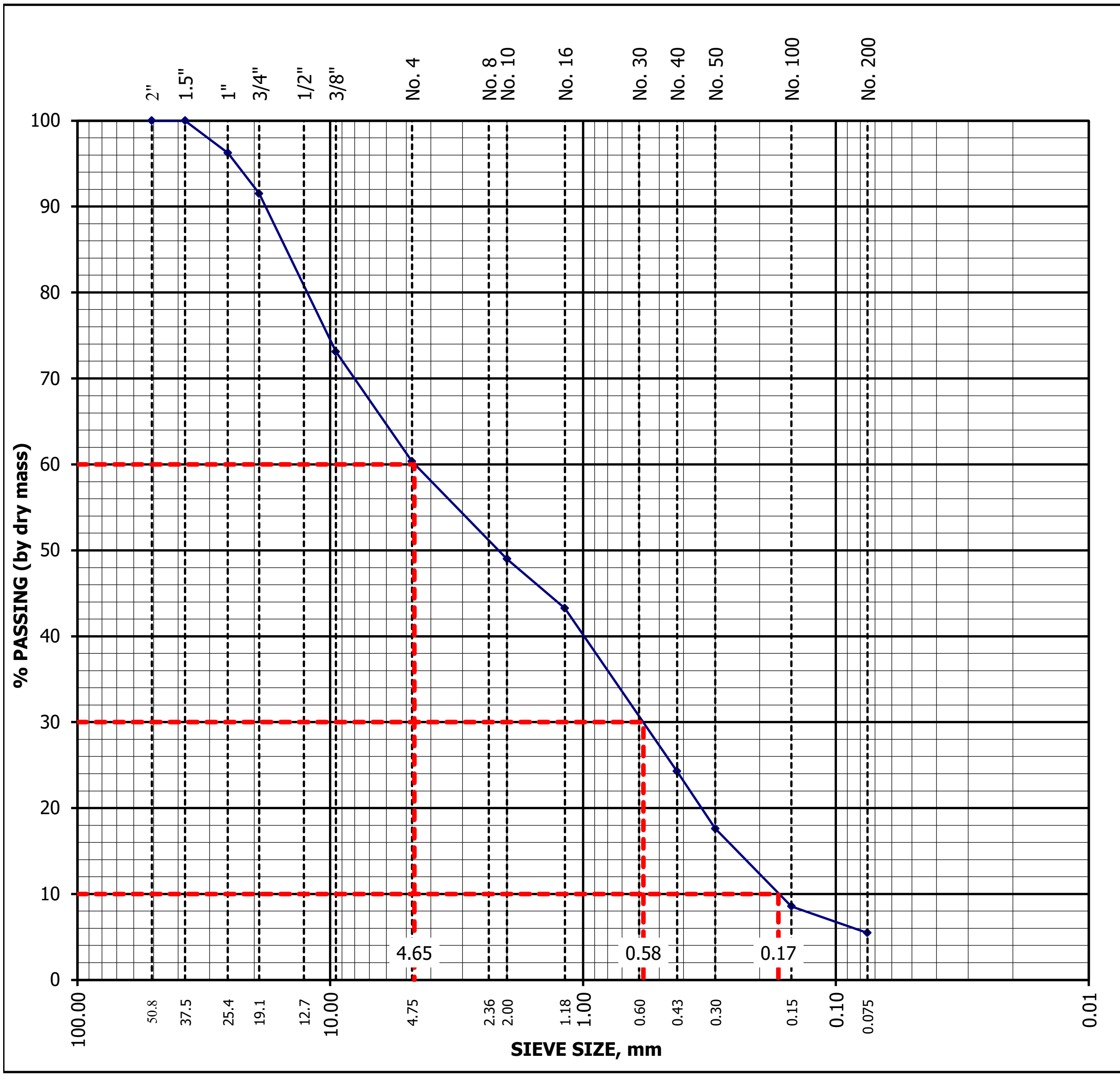
GRADATION PLOT - SOIL & AGGREGATE

Project Number:	20.6050, Gunnison Valley Properties, LLC	Date:	11-Oct-20
Project Name:	Gunnison Rising Phase 1	Technician:	K. Frazier
Lab ID Number:	SC202080	Reviewer:	D. Duran
Sample Location:	B-13 at 9 feet		
Visual Description:	SAND, gravelly with silt, brown		

AASHTO M 145 Classification: A-1-a Group Index: 0
Unified Soil Classification System (ASTM D 2487): (SP-SM) Poorly graded sand with gravel and silt



Sieve Size	% Passing
2"	
1.5"	100
1"	96
3/4"	92
1/2"	
3/8"	73
#4	60
#8	
#10	49
#16	43
#30	
#40	24
#50	18
#100	9
#200	5.5

Moisture (M) & Density (D)	
M, %:	7.1
D, pcf:	

LL	
PL	
PI	

D_{60}	4.65
D_{30}	0.58
D_{10}	0.17
Cu	**27.51**
Cc	**0.43**

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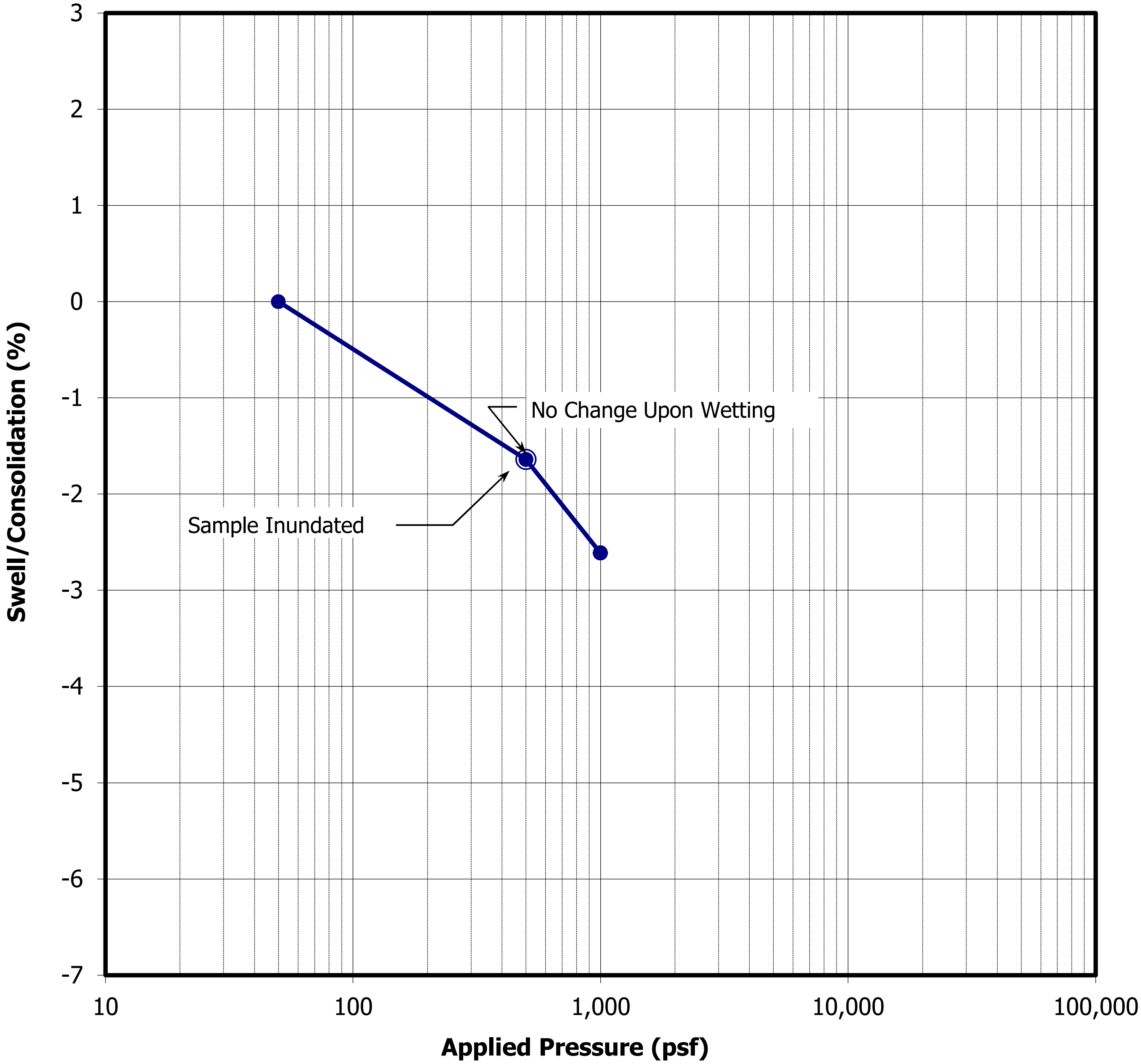
SWELL/CONSOLIDATION PLOT



Sample Location	Sample Depth (ft)	Visual Description of Sample	Dry Density (pcf)	Moisture Content (%)	Inundation Pressure (psf)	Volume Change (%)	Swell Pressure (psf)
B-15	4	SAND, clayey, brown	102.1	17.8	500	0.0	N/A

Project Number	Client	Project Name	Lab ID Number
20.6050	Gunnison Valley Properties, LLC.	Gunnison Rising Phase 1	2021098

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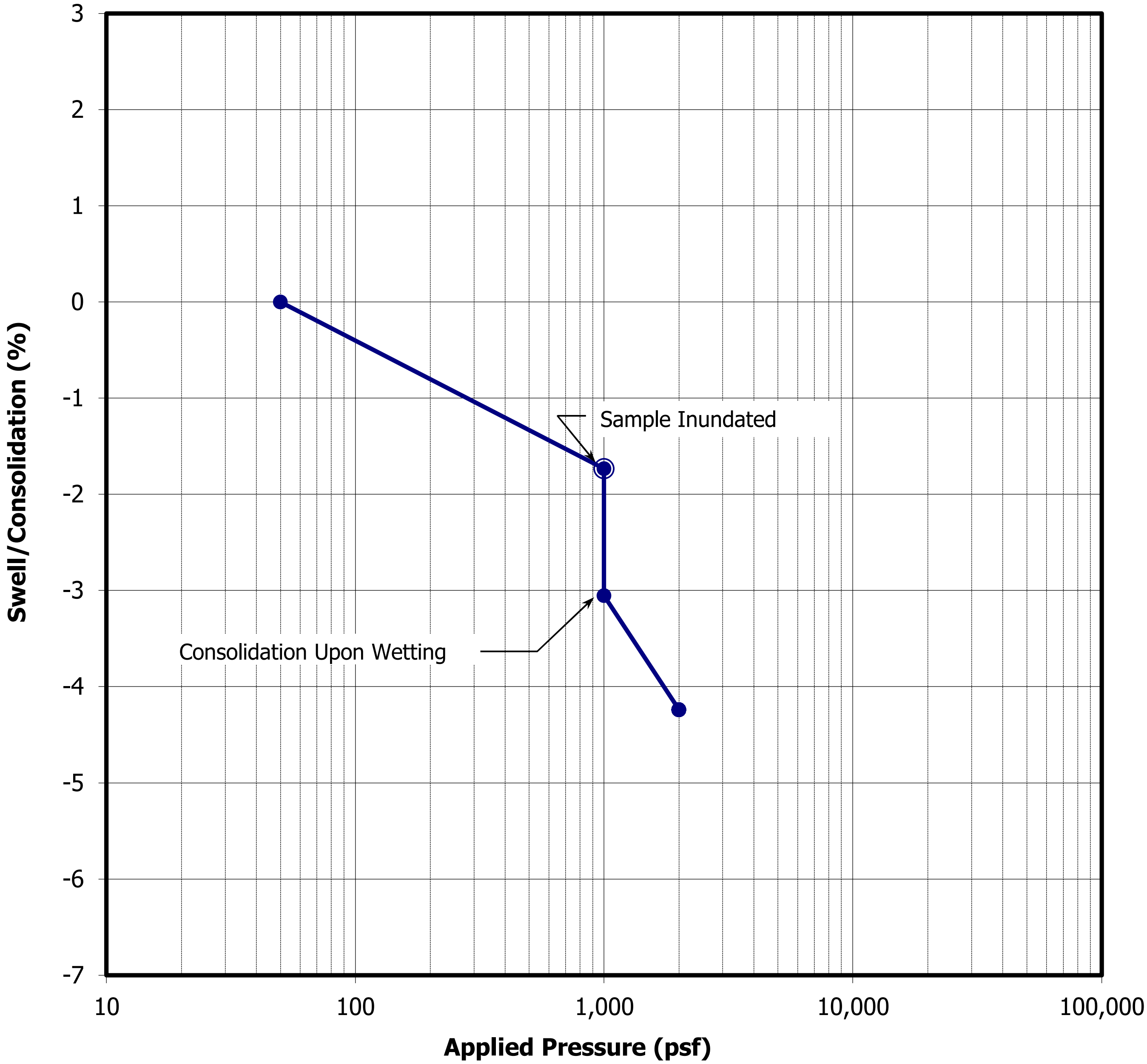
SWELL/CONSOLIDATION PLOT



Sample Location	Sample Depth (ft)	Visual Description of Sample	Dry Density (pcf)	Moisture Content (%)	Inundation Pressure (psf)	Volume Change (%)	Swell Pressure (psf)
B-3	14	SAND, clayey, brown	99.6	14.2	1,000	-1.3	N/A

Project Number	Client	Project Name	Lab ID Number
20.6050	Gunnison Valley Properties, LLC.	Gunnison Rising Phase 1	2021099

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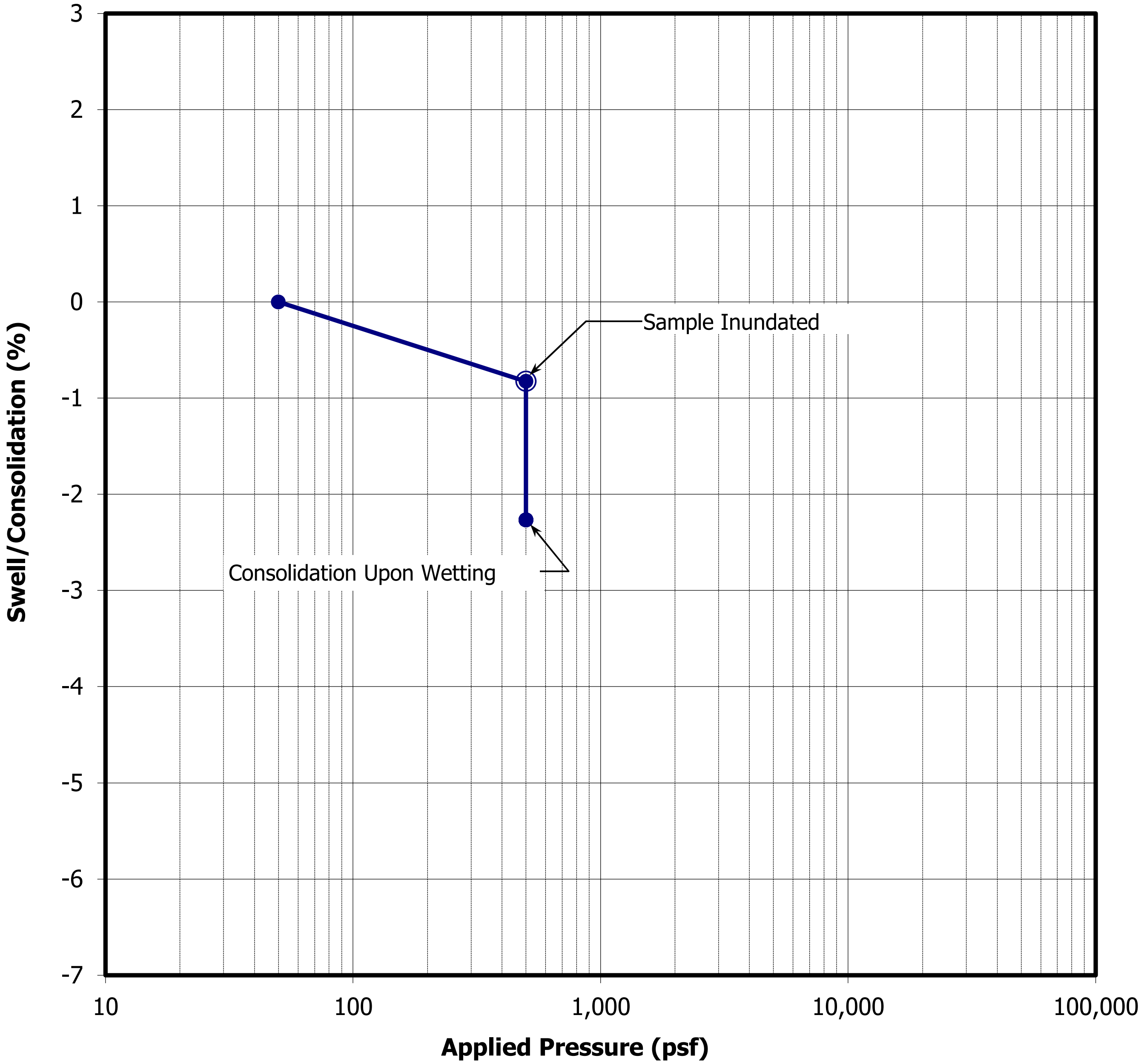
SWELL/CONSOLIDATION PLOT



Sample Location	Sample Depth (ft)	Visual Description of Sample	Dry Density (pcf)	Moisture Content (%)	Inundation Pressure (psf)	Volume Change (%)	Swell Pressure (psf)
B-4	4	SAND, clayey, brown	98.8	17.6	500	-1.4	N/A

Project Number	Client	Project Name	Lab ID Number
20.6050	Gunnison Valley Properties, LLC	Gunnison Rising Phase 1	202876