GEOTECHNICAL AND GEOLOGIC HAZARDS INVESTIGATION
WOODBRIDGE PROPERTY SUBDIVISION
GRAND JUNCTION, COLORADO
PROJECT#02566-0001

GREENLINE VENTURES
1555 BLAKE STREET, SUITE 210
DENVER, COLORADO 80202

NOVEMBER 7, 2022

Huddleston-Berry Engineering and Testing, LLC
2789 Riverside Parkway
Grand Junction, Colorado 81501

SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

A geologic hazards and geotechnical investigation was conducted for the proposed Woodbridge Property Subdivision in Grand Junction, Colorado. The project location is shown on Figure 1 – Site Location Map. The purpose of the investigation was to evaluate the surface and subsurface conditions at the site with respect to geologic hazards, foundation design, pavement design, and earthwork for the proposed construction. This summary has been prepared to include the information required by civil engineers, structural engineers, and contractors involved in the project.

Subsurface Conditions (p. 2)

The subsurface investigation consisted of nine borings, drilled on October 6th, 2022. The location of the borings are shown on Figure 2 – Site Plan. The borings encountered native clay soils above gravel and cobble soils. Groundwater was encountered in the borings at depths of between 7.0 and 10.0 feet at the time of the investigation. The native clay soils were indicated to be slightly plastic and are anticipated to be slightly collapsible at their current density. However, the clay soils and were indicated to be slightly expansive when saturated and compacted.

Geologic Hazards and Constraints (p. 3)

The primary geologic hazard and constraint at the site is the presence of moisture sensitive soils. In addition, shallow groundwater may also impact the proposed development.

Summary of Foundation Recommendations

- *Shallow Foundations*
  - *Foundation* Type - Spread Footings or Monolithic Structural Slabs (p. 4)
  - *Structural Fill* – Minimum of 24-inches below foundations. The native soils, exclusive of topsoil, are suitable for reuse as structural fill. Imported structural fill should consist of granular material approved by HBET.(p. 4)
  - *Maximum Allowable Bearing Capacity* – 1,500 psf. (p. 5)
  - *Subgrade Modulus* – 150 pci for native soils. 200 pci for approved imported materials. (p. 5)
- *Deep Foundations*
  - *Foundation Type* - Helical Piles (p. 5)
  - *Anticipated Length* – 20 to 45 feet. (p. 5)
  - *Axial Capacity* – Dependent upon pile load testing; however, 40 to 60 tons anticipated. (p. 5)
- *General*
  - *Seismic Design* – Site Class D (p. 5)
  - *Lateral Earth Pressure* – 55 pcf active. 75 pcf at-rest. (p. 6)

Summary of Pavement Recommendations (p. 7)

Automobile Parking Areas
ESAL's = 50,000; Structural Number = 2.75

ALTERNATIVE	PAVEMENT SECTION (Inches)				
	Hot-Mix Asphalt Pavement	CDOT Class 6 Base Course	CDOT Class 3 Subbase Course	Concrete Pavement	TOTAL
A	3.0	10.0			13.0
B	4.0	7.0			11.0
C	3.0	6.0	6.0		15.0
Rigid Pavement		6.0		6.0	12.0

Internal Subdivision Roadways

ESAL's = 200,000; Structural Number = 3.50

ALTERNATIVE	PAVEMENT SECTION (Inches)				
	Hot-Mix Asphalt Pavement	CDOT Class 6 Base Course	CDOT Class 3 Subbase Course	Concrete Pavement	TOTAL
A	3.0	15.0			18.0
B	4.0	12.0			16.0
C	3.0	6.0	13.0		22.0
Rigid Pavement		6.0		8.0	14.0

F¾ Road and 23¾ Road

ESAL's = 500,000; Structural Number = 3.91

ALTERNATIVE	PAVEMENT SECTION (Inches)				
	Hot-Mix Asphalt Pavement	CDOT Class 6 Base Course	CDOT Class 3 Subbase Course	Rigid Pavement	TOTAL
A	4.0	16.0			20.0
B	5.0	13.0			18.0
C	4.0	6.0	14.0		24.0
Full Depth RP		6.0		8.0	14.0

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1.0 INTRODUCTION

As part of the continued development in Western Colorado, the Woodbridge Property Subdivision is proposed Grand Junction. As part of the development process, Huddleston-Berry Engineering and Testing, LLC (HBET) was retained by Geenline Ventures to conduct a geologic hazards and geotechnical investigation at the site.

1.1 Scope

As discussed above, a geologic hazards and geotechnical investigation was conducted for the proposed Woodbridge Property Subdivision in Grand Junction, Colorado. The scope of the investigation included the following components:

- Conducting a subsurface investigation to evaluate the subsurface conditions at the site.
- Collecting soil samples and conducting laboratory testing to determine the engineering properties of the soils at the site.
- Providing recommendations for foundation type and subgrade preparation.
- Providing recommendations for bearing capacity.
- Providing recommendations for lateral earth pressure.
- Providing recommendations for drainage, grading, and general earthwork.
- Providing recommendations for pavements.
- Evaluating potential geologic hazards at the site.

The investigation and report were completed by a Colorado registered professional engineer in accordance with generally accepted geotechnical and geological engineering practices. This report has been prepared for the exclusive use of the Greenline Ventures.

1.2 Site Location and Description

The site is located west of 24 Road and approximately 1,300-feet south of G Road in Grand Junction, Colorado. The project location is shown on Figure 1 – Site Location Map.

At the time of the investigation, the site was open with a general slight slope down towards the southwest. Vegetation consisted primarily of weeds, grasses, and sparse bushes. The site was bordered to the north, south, and east by vacant lots, and to the west by an unlined irrigation ditch and a vacant lot.

1.3 Proposed Construction

The proposed construction is anticipated to include new multi-family multi-story buildings, utility installation, and pavements. The proposed structures may be wood framed, steel framed, or masonry.

2.0 GEOLOGIC SETTING

2.1 Soils

Soils data was obtained from the USDA Natural Resource Conservation Service Web Soil Survey. The data indicates that the soils at the site consist of Sagers silty clay loam, saline, 0 to 2 percent slopes. Soil survey data, including descriptions of the soil units, is included in Appendix A.

Structure construction in the site soils is described as being somewhat limited due to shrink-swell. The site soils are indicated to have a moderate potential for frost action, high risk of corrosion of uncoated steel, and high risk of corrosion of concrete.

2.2 Geology

According to the *Geologic Map of the Grand Junction Quadrangle* (2002), the site is underlain alluvium and colluvium deposits.

2.3 Groundwater

Groundwater was encountered at depths of 17.0 and 18.0 feet at the time of the investigation.

3.0 FIELD INVESTIGATION

3.1 Subsurface Investigation

The subsurface investigation was conducted on October 6th, 2022 and consisted of nine borings as shown on Figure 2 – Site Plan. The borings were drilled to depths ranging from 22.0 to 33.0 feet below the existing ground surface. Typed boring logs are included in Appendix B. Samples of the native soils were collected using driven sample tubes and/or bulk sampling methods at the locations shown on the logs.

As indicated on the logs, the subsurface conditions at the site were fairly consistent. The borings generally encountered 1.0 foot of topsoil above brown, moist to wet, stiff to very soft silty clay to silty clay with sand to lean clay soils to depths of between 17.0 and 30.0 feet. The clay soils were underlain by brown, wet, dense gravel and cobble soils in a silty sand matrix to the bottoms of the borings. As discussed previously, groundwater was encountered in the subsurface at depths of between 7.0 and 10.0 feet at the time of the investigation.

3.2 Field Reconnaissance

The field reconnaissance included walking the site during the subsurface investigation. In general, the site was fairly level and no evidence of active landslides, debris flows, rockfalls, etc. was observed.

4.0 LABORATORY TESTING

Selected native soil samples collected from the borings were tested in the Huddleston-Berry Engineering and Testing LLC geotechnical laboratory for natural moisture content determination, grain size analysis, maximum dry density and optimum moisture content (Proctor) determination, California Bearing Ratio (CBR) determination, and Atterberg limits determination. The laboratory testing results are included in Appendix C.

The laboratory testing results indicate that the native clay soils are slightly plastic. Based upon the Atterberg limits of the material and upon our experience with similar soils in the vicinity of the subject site, the native clay soils are anticipated to be slightly collapsible at their current density. However, CBR results indicate that the clay soils may expand as much as 0.7% when compacted and introduced to excess moisture.

5.0 GEOLOGIC INTERPRETATION

5.1 Geologic Hazards

The primary geologic hazard at the site is the presence of moisture sensitive soils.

5.2 Geologic Constraints

The primary geologic constraint to construction at the site is the presence of moisture sensitive soils. However, shallow groundwater may also impact the design and construction.

5.3 Water Resources

No water supply wells were observed on the property. As discussed previously, shallow groundwater was encountered at the site. However, with proper design and construction, the proposed construction is not anticipated to adversely impact surface water or groundwater.

5.4 Mineral Resources

Potential mineral resources in the Grand Valley generally include gravel, uranium ore, and commercial rock products such as flagstone. As discussed previously, gravel and cobble soils were encountered at the time of the subsurface investigation. However, the gravels were fairly deep. In general, HBET does not believe that any gravels at the site represent an economically recoverable resource.

6.0 CONCLUSIONS

Based upon the available data sources, field investigation, and nature of the proposed construction, HBET does not believe that there are any geologic conditions which should preclude construction at the site. However, the presence of moisture sensitive soils may impact the design and construction. In addition, shallow groundwater may impact the design and/or construction.

7.0 RECOMMENDATIONS

7.1 Foundations

Based upon the results of the subsurface investigation both shallow and deep foundations may be considered. Shallow foundation alternatives including spread footings and monolithic (turndown) structural slab foundations are appropriate. However, the bearing capacity of the native soils will be limited. As an alternative to shallow foundations, deep foundations such as helical piles are also appropriate. The alternatives are discussed below.

Spread Footings and Monolithic Structural Slabs

As discussed previously, the shallow native clay soils are anticipated to be slightly collapsible at their existing density. Therefore, in order to provide a uniform bearing stratum and reduce the risk of excessive differential movements, it is recommended that the foundations be constructed above a minimum of 24-inches of structural fill.

The native clay soils were indicated to be slightly expansive when compacted; however, the magnitude of expansion measured in the laboratory was small. Therefore, the native clay soils, exclusive of topsoil, are suitable for reuse as structural fill. Imported structural fill should consist of a granular, non-expansive, non-free draining material approved by HBET.

For spread footing foundations, the footing areas may be trenched. However, for monolithic slab foundations, the structural fill should extend across the entire building pad area to a depth of 24-inches below the turndown edges. Structural fill should extend laterally beyond the edges of the foundations a distance equal to the thickness of structural fill for both foundation types.

Prior to placement of structural fill, it is recommended that the bottoms of the foundation excavations be scarified to a depth of 6 to 9-inches, moisture conditioned, and re-compacted to a minimum of 95% of the standard Proctor maximum dry density, within ±2% of the optimum moisture content as determined in accordance with ASTM D698. However, as discussed previously, very soft soil conditions were encountered in some areas of the site and this may make compaction of the subgrade difficult. It may be necessary to utilize geotextile and/or geogrid in conjunction with up to 30-inches of additional granular fill to stabilize the subgrade. HBET should be contacted to provide specific recommendations for subgrade stabilization based upon the actual conditions encountered during construction.

Structural fill should be moisture conditioned, placed in maximum 8-inch loose lifts, and compacted to a minimum of 95% of the standard Proctor maximum dry density for fine grained soils and 90% of the modified Proctor maximum dry density for coarse grained soils, within ±2% of the optimum moisture content as determined in accordance with ASTM D698 and D1557, respectively. Structural fill should be extended to within 0.1-feet of the bottom of the foundation. No more than 0.1-feet of gravel should be placed below the footings or turndown edge as a leveling course.

For structural fill consisting of the native soils or imported granular materials, and foundation building pad preparation as recommended, a maximum allowable bearing capacity of 1,500 psf may be used. In addition, a modulus of subgrade reaction of 150 pci may be used for structural fill consisting of the native soils and a modulus of subgrade reaction of 200 pci may be used for structural fill consisting of approved imported materials. Foundations subject to frost should be at least 24 inches below the finished grade.

Helical Piles

Helical piles consist of circular or square steel shafts with load carrying helices attached to them. Some of these types of piers are proprietary. In general, the precise type, size, and quantity of piles should be established by the contractor in conjunction with the structural engineer. However, HBET provides the following design comments.

In general, helical piles should be designed to penetrate the upper clay soils and bear into the dense gravel and cobble soils. To eliminate reductions in capacity from group effects, the piles should be spaced a distance equal to three times the diameter of the largest helix. It is anticipated that the helical piles will reach refusal within 3 to 15 feet of the top of the gravel and cobble soils. Therefore, pile lengths of up to approximately 45 feet may be possible.

Based upon our experience with other projects utilizing helical piles, allowable axial capacities of between approximately 40 and 60 tons are anticipated for piles with a minimum shaft diameter of 4-inches. However, higher capacities are possible depending on the specific pile type/size proposed. The actual allowable capacity should be determined based upon the results of pile load testing conducted on the project site prior to final design. Where necessary, piles battered up to 15° should be utilized to carry lateral loads.

7.2 Seismic Design Criteria

In general, based upon the result of the subsurface investigation, the site classifies as Site Class D in accordance with the International Building Code (IBC).

7.3 Lateral Resistance for Seismic and Wind Loads

As discussed above, the native clay soils are soft through most of the profile and are anticipated to provide limited lateral capacity for deep foundations. Based upon the results of the subsurface investigation, the following soil parameters are recommended for use in lateral pile capacity analyses:

Depth from Grade (in).	0 to 84	84+
Soil Type	Soft Clay	Soft Clay
Density (pci)	0.0637	0.0318
Cohesion (psi)	3	3
Friction Angle (ϕ)	0	0
ε_{50} (in/in)	0.02	0.02
K (pci)	30	30

In addition to lateral resistance of the piles, lateral resistance can be developed from sliding friction between the floor slab and the ground. In general, for the native soils, a sliding friction angle of 18° is recommended. This corresponds to a friction factor of 0.32.

7.4 Corrosion of Concrete and Steel

As discussed previously, the USDA Soil Survey Data indicates that the site soils have a high potential for corrosion of concrete. Therefore, at a minimum, Type I-II sulfate resistant cement is recommended for construction at this site.

The Soil Survey Data also indicates that the site soils have a high potential for corrosion of uncoated steel. Based upon our experience with similar soils in the vicinity of the subject site, HBET believes that the native soils have a resistivity of less than 1,000 ohm-cm. Pile design should consider corrosion in their design based upon these resistivity values either through galvanization or accounting for section loss.

7.5 Non-Structural Floor Slabs and Exterior Flatwork

To help limit the potential for excessive movement of non-structural floor slabs, it is recommended that non-structural floor slabs be constructed above a minimum of 24-inches of structural fill with subgrade preparation and fill placement in accordance with the *Shallow Foundations* section of this report. It is recommended that exterior flatwork be constructed above a minimum of 12-inches of structural fill.

7.6 Lateral Earth Pressures

Stemwalls and/or retaining walls should be designed to resist lateral earth pressures. For backfill consisting of the native soils or imported granular, non-free draining, non-expansive material, we recommend that the walls be designed for an active equivalent fluid unit weight of 45 pcf in areas where no surcharge loads are present. An at-rest equivalent fluid unit weight of 65 pcf is recommended for braced walls. Lateral earth pressures should be increased as necessary to reflect any surcharge loading behind the walls.

7.7 Drainage

Due to the presence of moisture sensitive soils at the site, proper site grading is critical to the performance of the structures. In order to improve the long-term performance of the foundations and slabs-on-grade, grading around the structures should be designed to carry precipitation and runoff away from the structures. It is recommended that the finished ground surface drop at least twelve inches within the first ten feet away from the structures. However, where impermeable surfaces (i.e. pavements, sidewalks, etc.) are adjacent to the structures, the grade can be reduced to approximately 2.5-inches (ADA grade) within the first ten feet away from the structures.

HBET recommends that downspout extensions be used which discharge a minimum of 15 feet from the structure or beyond the backfill zone, whichever is greater. However, if subsurface downspout drains are utilized, they should be carefully constructed of solid-wall PVC and should daylight a minimum of 15 feet from the structures. In addition, an impermeable membrane is recommended below subsurface downspout drains. Dry wells should not be used.

As discussed previously, shallow groundwater was encountered at the time of the subsurface investigation. Therefore, if below grade construction is proposed, perimeter foundation drains are recommended. In general, the perimeter foundation drains should consist of prefabricated drain materials or a perforated pipe and gravel system with the flowlines of the drains at the bottoms of the foundations (at the highest point). The prefabricated drain materials or gravel should extend along basement walls to within 36-inches of the finished grade. The perimeter drains should slope at a minimum of 1.0% to sumps with pumps.

7.8 Excavations

Excavations in the soils at the site may stand for short periods of time but should not be considered to be stable. Trenching and excavations should be sloped back, shored, or shielded for worker protection in accordance with applicable OSHA standards. The soils generally classify as Type C soil with regard to OSHA's *Construction Standards for Excavations*. For Type C soils, the maximum allowable slope in temporary cuts is 1.5H:1V.

7.9 Pavements

The proposed construction may include paved automobile parking areas and truck traffic areas on the site. In addition, the development will likely include improvements to F¾ Road and 23¾ Road. As discussed previously, the pavement subgrade materials consist primarily of clay soils. The design California Bearing Ratio (CBR) of the site soils was determined in the laboratory to be less than 2.0. Therefore, the minimum recommended Resilient Modulus of 3,000 psi was used for the pavement design.

Based upon the subgrade conditions and anticipated traffic loading, flexible and rigid pavement section alternatives were developed in accordance with AASHTO design methodologies. The following minimum pavement section alternatives are recommended:

Automobile Parking Areas
EDLA = 5, Structural Number = 2.75

ALTERNATIVE	PAVEMENT SECTION (Inches)				
	Hot-Mix Asphalt Pavement	CDOT Class 6 Base Course	CDOT Class 3 Subbase Course	Concrete Pavement	TOTAL
A	3.0	10.0			13.0
B	4.0	7.0			11.0
C	3.0	6.0	6.0		15.0
Rigid Pavement		6.0		6.0	12.0

Internal Subdivision Roadways
EDLA = 20, Structural Number = 3.50

ALTERNATIVE	PAVEMENT SECTION (Inches)				
	Hot-Mix Asphalt Pavement	CDOT Class 6 Base Course	CDOT Class 3 Subbase Course	Concrete Pavement	TOTAL
A	3.0	15.0			18.0
B	4.0	12.0			16.0
C	3.0	6.0	13.0		22.0
Rigid Pavement		6.0		8.0	14.0

F¾ Road and 23¾ Road
ESAL's = 500,000, Structural Number = 3.91

ALTERNATIVE	PAVEMENT SECTION (Inches)				
	Hot-Mix Asphalt Pavement	CDOT Class 6 Base Course	CDOT Class 3 Subbase Course	Rigid Pavement	TOTAL
A	4.0	16.0			20.0
B	5.0	13.0			18.0
C	4.0	6.0	14.0		24.0
Full Depth RP		6.0		8.0	14.0

Prior to pavement placement, areas to be paved should be stripped of all topsoil, fill, or other unsuitable materials. It is recommended that the subgrade soils be scarified to a depth of 12-inches; moisture conditioned, and recompacted to a minimum of 95% of the standard Proctor maximum dry density, within ±2% of optimum moisture content as determined by AASHTO T-99. However, as discussed previously, very soft soil conditions were encountered in some areas of the site and this may make compaction of the subgrade difficult. It may be necessary to utilize geotextile and/or geogrid in conjunction with up to 30-inches of additional granular fill to stabilize the subgrade. HBET should be contacted to provide specific recommendations for subgrade stabilization based upon the actual conditions encountered during construction.

Aggregate base course and subbase course should be placed in maximum 9-inch loose lifts, moisture conditioned, and compacted to a minimum of 95% and 93% of the maximum dry density, respectively, at -2% to +3% of optimum moisture content as determined by AASHTO T-180. In addition to density testing, base course should be proofrolled to verify subgrade stability.

It is recommended that Hot-Mix Asphaltic (HMA) pavement conform to CDOT grading SX or S specifications and consist of an approved 75 gyration Superpave method mix design. HMA pavement should be compacted to between 92% and 96% of the maximum theoretical density. An end point stress of 50 psi should be used. It is recommended that rigid pavements consist of CDOT Class P concrete or alternative approved by the Engineer. In addition, pavements should conform to local specifications.

The long-term performance of the pavements is dependent on positive drainage away from the pavements. Ditches, culverts, and inlet structures in the vicinity of paved areas must be maintained to prevent ponding of water on the pavement.

8.0 GENERAL

The recommendations included above are based upon the results of the subsurface investigation and on our local experience. These conclusions and recommendations are valid only for the proposed construction.

As discussed previously, the subsurface conditions at the site were fairly consistent. However, the precise nature and extent of any subsurface variability may not become evident until construction. As a result, it is recommended that HBET provide construction materials testing and engineering oversight during the entire construction process.

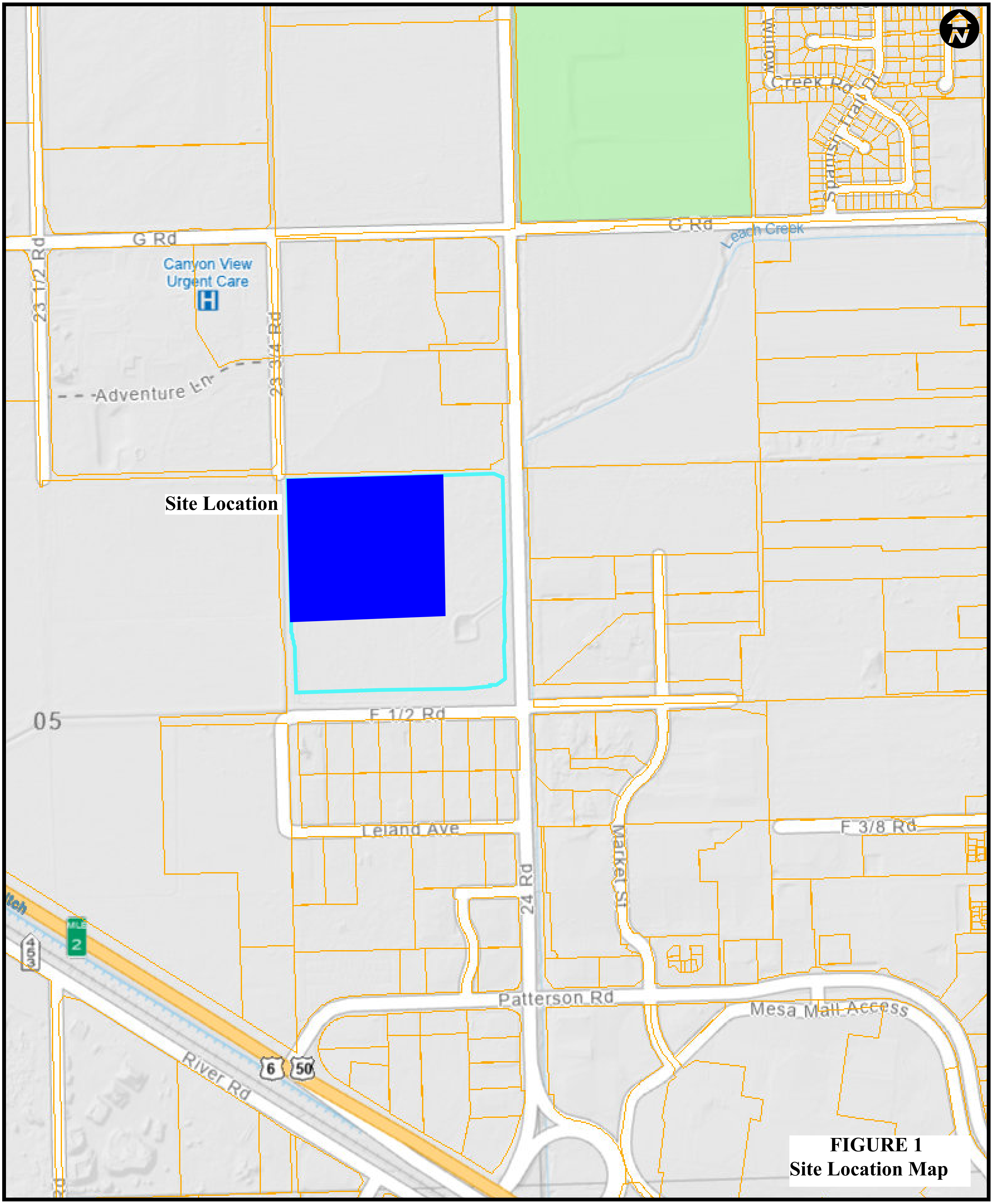
It is important to note that the recommendations herein are intended to reduce the risk of structural movement and/or damage, to varying degrees, associated with volume change of the native soils. However, HBET cannot predict long-term changes in subsurface moisture conditions and/or the precise magnitude or extent of volume change. Where significant increases in shallow subsurface moisture occur due to poor grading, improper stormwater management, utility line failure, excess irrigation, or other cause, either during construction or the result of actions of the property owner, several inches of movement are possible. In addition, any failure to comply with the recommendations in this report releases Huddleston-Berry Engineering & Testing, LLC of any liability with regard to the structure performance.

Huddleston-Berry Engineering and Testing, LLC is pleased to be of service to your project. Please contact us if you have any questions or comments regarding the contents of this report.

Respectfully Submitted:
Huddleston-Berry Engineering and Testing, LLC

Michael A. Berry, P.E.
Vice President of Engineering

FIGURES



Mesa County Map

The Geographic Information System (GIS) and its components are designed as a source of reference for answering inquiries, for planning and for modeling. GIS is not intended or does not replace legal description information in the chain of title and other information contained in official government records such as the County Clerk and Recorders office or the courts. In addition, the representations of location in this GIS cannot be substitute for actual legal surveys.
The information contained herein is believed accurate and suitable for the limited uses, and subject to the limitations, set forth above. Mesa County makes no warranty as to the accuracy or suitability of any information contained herein. Users assume all risk and responsibility for any and all damages, including consequential damages, which may flow from the user's use of this information.

0 0.05 0.1 0.2 mi

0 0.075 0.15 0.3 km

Print Date: October 27, 2022

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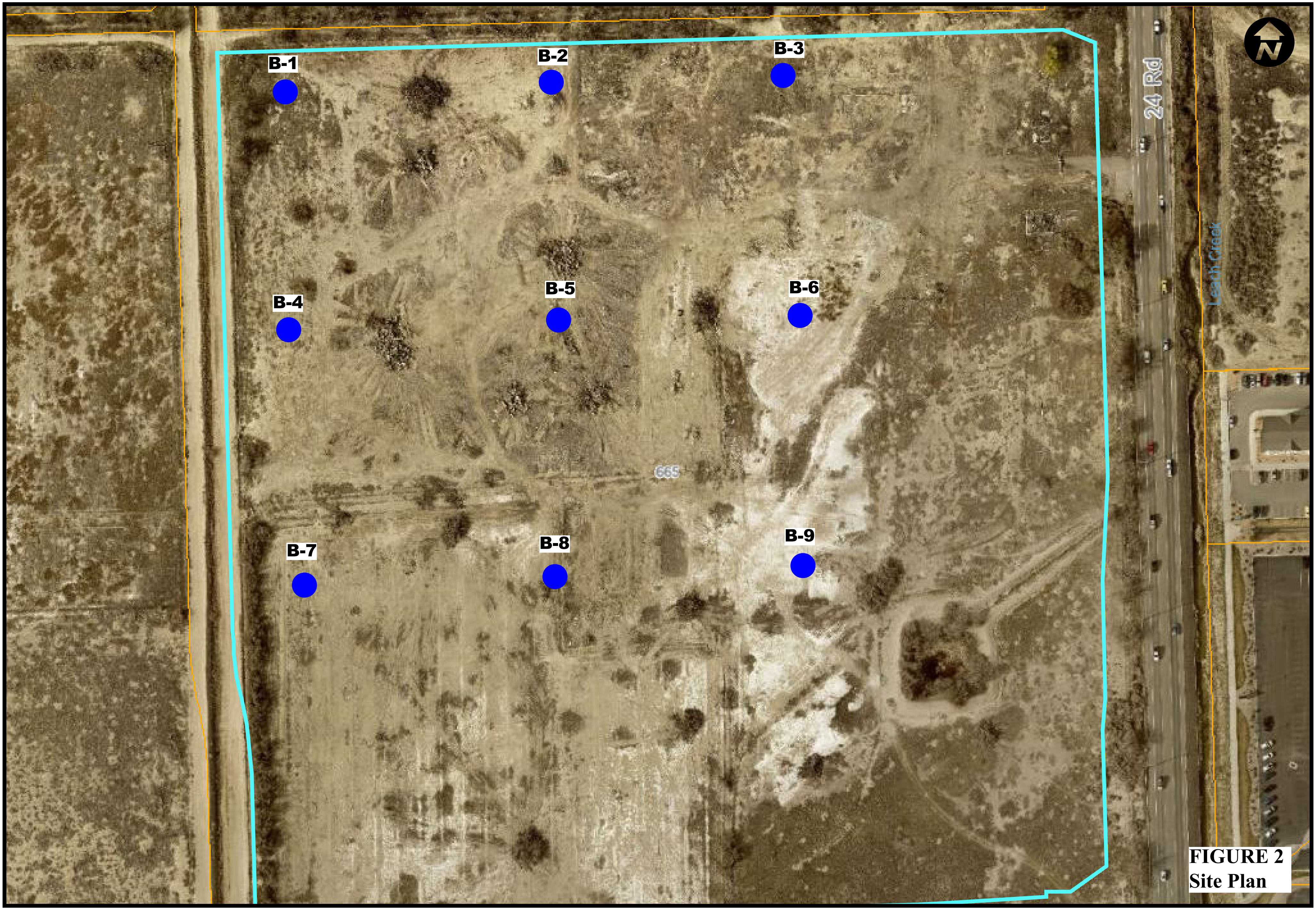
GIS/IT Department
gis.mesacounty.us



Mesa County Map

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0 0.015 0.03 0.06 mi
0 0.0175 0.035 0.07 km

Print Date: October 27, 2022

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APPENDIX A
Soil Survey Data

Map Scale: 1:2,620 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0, 35, 70, 140, 210

Feet: 0, 100, 200, 400, 600

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 12N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Mesa County Area, Colorado
Survey Area Data: Version 13, Sep 6, 2022

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jun 24, 2020—Jul 8, 2020

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
BcS	Sagers silty clay loam, saline, 0 to 2 percent slopes	23.3	100.0%
Totals for Area of Interest		**23.3**	**100.0%**

Map Unit Description

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions in this report, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named, soils that are similar to the named components, and some minor components that differ in use and management from the major soils.

Most of the soils similar to the major components have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Some minor components, however, have properties and behavior characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. All the soils of a series have major horizons that are similar in composition, thickness, and arrangement. Soils of a given series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Additional information about the map units described in this report is available in other soil reports, which give properties of the soils and the limitations, capabilities, and potentials for many uses. Also, the narratives that accompany the soil reports define some of the properties included in the map unit descriptions.

Report—Map Unit Description

Mesa County Area, Colorado

BcS—Sagers silty clay loam, saline, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: k0bs
Elevation: 4,490 to 4,920 feet

Mean annual precipitation: 6 to 9 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 140 to 180 days
Farmland classification: Not prime farmland

Map Unit Composition

Sagers, saline, and similar soils: 90 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Sagers, Saline

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear, concave
Across-slope shape: Linear
Parent material: Cretaceous source alluvium derived from sandstone and shale

Typical profile

Ap - 0 to 12 inches: silty clay loam
C - 12 to 25 inches: silty clay loam
Cy - 25 to 60 inches: silty clay loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.21 to 0.71 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Gypsum, maximum content: 5 percent
Maximum salinity: Strongly saline (16.0 to 32.0 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 4.9 inches)

Interpretive groups

Land capability classification (irrigated): 7s
Land capability classification (nonirrigated): 7c
Hydrologic Soil Group: C
Ecological site: R034BY106UT - Desert Loam (Shadscale)
Hydric soil rating: No

Data Source Information

Soil Survey Area: Mesa County Area, Colorado
Survey Area Data: Version 13, Sep 6, 2022

Dwellings and Small Commercial Buildings

Soil properties influence the development of building sites, including the selection of the site, the design of the structure, construction, performance after construction, and maintenance. This table shows the degree and kind of soil limitations that affect dwellings and small commercial buildings.

The ratings in the table are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect building site development. *Not limited* indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected. *Somewhat limited* indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. *Very limited* indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

Numerical ratings in the table indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

Dwellings are single-family houses of three stories or less. For dwellings without basements, the foundation is assumed to consist of spread footings of reinforced concrete built on undisturbed soil at a depth of 2 feet or at the depth of maximum frost penetration, whichever is deeper. For dwellings with basements, the foundation is assumed to consist of spread footings of reinforced concrete built on undisturbed soil at a depth of about 7 feet. The ratings for dwellings are based on the soil properties that affect the capacity of the soil to support a load without movement and on the properties that affect excavation and construction costs. The properties that affect the load-supporting capacity include depth to a water table, ponding, flooding, subsidence, linear extensibility (shrink-swell potential), and compressibility. Compressibility is inferred from the Unified classification. The properties that affect the ease and amount of excavation include depth to a water table, ponding, flooding, slope, depth to bedrock or a cemented pan, hardness of bedrock or a cemented pan, and the amount and size of rock fragments.

Small commercial buildings are structures that are less than three stories high and do not have basements. The foundation is assumed to consist of spread footings of reinforced concrete built on undisturbed soil at a depth of 2 feet or at the depth of maximum frost penetration, whichever is deeper. The ratings are based on the soil properties that affect the capacity of the soil to support a load without movement and on the properties that affect excavation and construction costs. The properties that affect the load-supporting capacity include depth to a water table, ponding, flooding, subsidence, linear extensibility (shrink-swell potential), and compressibility (which is inferred from the Unified classification). The properties that affect the ease and amount of excavation include flooding, depth to a water table, ponding, slope, depth to bedrock or a cemented pan, hardness of bedrock or a cemented pan, and the amount and size of rock fragments.

Information in this table is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil between the surface and a depth of 5 to 7 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this table. Local ordinances and regulations should be considered in planning, in site selection, and in design.

Report—Dwellings and Small Commercial Buildings

[Onsite investigation may be needed to validate the interpretations in this table and to confirm the identity of the soil on a given site. The numbers in the value columns range from 0.01 to 1.00. The larger the value, the greater the potential limitation. The table shows only the top five limitations for any given soil. The soil may have additional limitations]

Dwellings and Small Commercial Buildings–Mesa County Area, Colorado							
Map symbol and soil name	Pct. of map unit	Dwellings without basements		Dwellings with basements		Small commercial buildings	
		Rating class and limiting features	Value	Rating class and limiting features	Value	Rating class and limiting features	Value
BcS—Sagers silty clay loam, saline, 0 to 2 percent slopes							
Sagers, saline	90	Somewhat limited		Somewhat limited		Somewhat limited	
		Shrink-swell	0.03	Shrink-swell	0.03	Shrink-swell	0.03

Data Source Information

Soil Survey Area: Mesa County Area, Colorado
Survey Area Data: Version 13, Sep 6, 2022

Soil Features

This table gives estimates of various soil features. The estimates are used in land use planning that involves engineering considerations.

A *restrictive layer* is a nearly continuous layer that has one or more physical, chemical, or thermal properties that significantly impede the movement of water and air through the soil or that restrict roots or otherwise provide an unfavorable root environment. Examples are bedrock, cemented layers, dense layers, and frozen layers. The table indicates the hardness and thickness of the restrictive layer, both of which significantly affect the ease of excavation. *Depth to top* is the vertical distance from the soil surface to the upper boundary of the restrictive layer.

Subsidence is the settlement of organic soils or of saturated mineral soils of very low density. Subsidence generally results from either desiccation and shrinkage, or oxidation of organic material, or both, following drainage. Subsidence takes place gradually, usually over a period of several years. The table shows the expected initial subsidence, which usually is a result of drainage, and total subsidence, which results from a combination of factors.

Potential for frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, saturated hydraulic conductivity (Ksat), content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured, clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that corrodes or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors results in a severe hazard of corrosion. The steel or concrete in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than the steel or concrete in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion also is expressed as *low*, *moderate*, or *high.* It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Report—Soil Features

Soil Features–Mesa County Area, Colorado									
Map symbol and soil name	Restrictive Layer				Subsidence		Potential for frost action	Risk of corrosion	
	Kind	Depth to top	Thickness	Hardness	Initial	Total		Uncoated steel	Concrete
		Low-RV-High	*Range*		*Low-High*	*Low-High*			
		In	*In*		*In*	*In*			
BcS—Sagers silty clay loam, saline, 0 to 2 percent slopes									
Sagers, saline		—	—		0	0	Moderate	High	High

Data Source Information

Soil Survey Area: Mesa County Area, Colorado
Survey Area Data: Version 13, Sep 6, 2022

APPENDIX B
Typed Boring Logs

Huddleston-Berry Engineering & Testing, LLC
2789 Riverside Parkway
Grand Junction, CO 81501
970-255-8005

BORING NUMBER B-1

CLIENT Greenline Ventures
PROJECT NAME Woodbridge Subdivision
PROJECT NUMBER 02566-0001
PROJECT LOCATION Grand Junction, CO
DATE STARTED 10/6/22 **COMPLETED** 10/6/22
GROUND ELEVATION **HOLE SIZE** 4
DRILLING CONTRACTOR S. McKracken
GROUND WATER LEVELS:
DRILLING METHOD Simco 3000 Truck
AT TIME OF DRILLING 9.5 ft
LOGGED BY TC **CHECKED BY** MAB
AT END OF DRILLING 9.5 ft
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTIC LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	FINES CONTENT (%)
0		Sandy Clay with Organics (TOPSOIL)										
		Silty CLAY to Silty CLAY with Sand (CL-ML) to Lean CLAY (cl), brown, moist to wet, medium stiff to soft SS-1: Lab Classified										
			SS 1	83	3-3-3 (6)			14	25	18	7	83
5												
			SS 2	72	2-1-2 (3)							
10												
			SS 3	100	4-3-3 (6)							
15												
			SS 4	100	1-1-2 (3)							
20												
		GRAVELS and COBBLES in a Silty SAND matrix, brown, wet, dense										
		Bottom of hole at 24.0 feet.										

Huddleston-Berry Engineering & Testing, LLC
2789 Riverside Parkway
Grand Junction, CO 81501
970-255-8005

BORING NUMBER B-2

CLIENT Greenline Ventures
PROJECT NAME Woodbridge Subdivision
PROJECT NUMBER 02566-0001
PROJECT LOCATION Grand Junction, CO
DATE STARTED 10/6/22 **COMPLETED** 10/6/22
GROUND ELEVATION **HOLE SIZE** 4
DRILLING CONTRACTOR S. McKracken
GROUND WATER LEVELS:
DRILLING METHOD Simco 3000 Truck
AT TIME OF DRILLING 10.0 ft
LOGGED BY TC **CHECKED BY** MAB
AT END OF DRILLING 10.0 ft
NOTES
AFTER DRILLING ---

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	FINES CONTENT (%)
0	Sandy Clay with Organics (TOPSOIL)										
	Silty CLAY to Silty CLAY with Sand (cl-ml) to Lean CLAY (cl), brown, moist to wet, medium stiff to very soft										
		SS 1	72	4-4-3 (7)							
5											
		SS 2	50	2-3-3 (6)							
10											
		SS 3	100	1-1-0 (1)							
15											
		SS 4	100	1-1-1 (2)							
20											
25											
30	GRAVELS and COBBLES in a Silty SAND matrix, brown, wet, dense										
	Bottom of hole at 33.0 feet.										

Huddleston-Berry Engineering & Testing, LLC
2789 Riverside Parkway
Grand Junction, CO 81501
970-255-8005

BORING NUMBER B-3

CLIENT Greenline Ventures
PROJECT NAME Woodbridge Subdivision
PROJECT NUMBER 02566-0001
PROJECT LOCATION Grand Junction, CO
DATE STARTED 10/6/22 **COMPLETED** 10/6/22
GROUND ELEVATION **HOLE SIZE** 4
DRILLING CONTRACTOR S. McKracken
GROUND WATER LEVELS:
DRILLING METHOD Simco 3000 Truck
AT TIME OF DRILLING 9.5 ft
LOGGED BY TC **CHECKED BY** MAB
AT END OF DRILLING 9.5 ft
NOTES
AFTER DRILLING ---

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	FINES CONTENT (%)
0	Sandy Clay with Organics (TOPSOIL)										
	Silty CLAY to Silty CLAY with Sand (cl-ml) to Lean CLAY (cl), brown, moist to wet, stiff to soft										
		SS 1	67	4-5-7 (12)							
5											
		SS 2	28	2-2-3 (5)							
10											
		SS 3	100	0-2-1 (3)							
15											
		SS 4	100	2-1-2 (3)							
20											
25											
	GRAVELS and COBBLES in a Silty SAND matrix, brown, wet, dense										
30											
	Bottom of hole at 32.0 feet.										

Huddleston-Berry Engineering & Testing, LLC
2789 Riverside Parkway
Grand Junction, CO 81501
970-255-8005

BORING NUMBER B-4

CLIENT Greenline Ventures
PROJECT NAME Woodbridge Subdivision
PROJECT NUMBER 02566-0001
PROJECT LOCATION Grand Junction, CO
DATE STARTED 10/6/22 **COMPLETED** 10/6/22
GROUND ELEVATION **HOLE SIZE** 4
DRILLING CONTRACTOR S. McKracken
GROUND WATER LEVELS:
DRILLING METHOD Simco 3000 Truck
▽ **AT TIME OF DRILLING** 8.0 ft
LOGGED BY TC **CHECKED BY** MAB
▼ **AT END OF DRILLING** 8.0 ft
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		Sandy Clay with Organics (TOPSOIL)										
		Silty CLAY to Silty CLAY with Sand (cl-ml) to Lean CLAY (cl), brown, moist to wet, medium stiff to soft										
			SS 1	100	2-3-3 (6)							
5												
	▼		SS 2	22	1-1-2 (3)							
10												
			SS 3	100	1-1-1 (2)							
15												
			SS 4	100	4-6-6 (12)							
20		GRAVELS and COBBLES in a Silty SAND matrix, brown, wet, dense										
		Bottom of hole at 22.0 feet.										

Huddleston-Berry Engineering & Testing, LLC
2789 Riverside Parkway
Grand Junction, CO 81501
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BORING NUMBER B-5

CLIENT Greenline Ventures
PROJECT NAME Woodbridge Subdivision
PROJECT NUMBER 02566-0001
PROJECT LOCATION Grand Junction, CO
DATE STARTED 10/6/22 **COMPLETED** 10/6/22
GROUND ELEVATION **HOLE SIZE** 4
DRILLING CONTRACTOR S. McKracken
GROUND WATER LEVELS:
DRILLING METHOD Simco 3000 Truck
AT TIME OF DRILLING 7.0 ft
LOGGED BY TC **CHECKED BY** MAB
AT END OF DRILLING 7.0 ft
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	FINES CONTENT (%)
0		Sandy Clay with Organics (TOPSOIL)										
		Silty CLAY to Silty CLAY with Sand (CL-ML) to Lean CLAY (cl), brown, moist to wet, medium stiff to very soft SS-1: Lab Classified										
			SS 1	56	2-3-4 (7)			17	22	17	5	88
5												
			SS 2	44	1-1-0 (1)							
10												
			SS 3	100	1-1-2 (3)							
15												
			SS 4	100	3-3-4 (7)							
20												
25												
		GRAVELS and COBBLES in a Silty SAND matrix, brown, wet, dense										
		Bottom of hole at 28.0 feet.										

Huddleston-Berry Engineering & Testing, LLC
2789 Riverside Parkway
Grand Junction, CO 81501
970-255-8005

BORING NUMBER B-6

CLIENT Greenline Ventures
PROJECT NAME Woodbridge Subdivision
PROJECT NUMBER 02566-0001
PROJECT LOCATION Grand Junction, CO
DATE STARTED 10/6/22 **COMPLETED** 10/6/22
GROUND ELEVATION **HOLE SIZE** 4
DRILLING CONTRACTOR S. McKracken
GROUND WATER LEVELS:
DRILLING METHOD Simco 3000 Truck
∇ **AT TIME OF DRILLING** 7.0 ft
LOGGED BY TC **CHECKED BY** MAB
▼ **AT END OF DRILLING** 7.0 ft
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		Sandy Clay with Organics (TOPSOIL)										
		Silty CLAY to Silty CLAY with Sand (cl-ml) to Lean CLAY (cl), brown, moist to wet, medium stiff to very soft										
			SS 1	39	2-2-3 (5)							
5												
	▼		SS 2	83	0-0-1 (1)							
10												
			SS 3	72	1-2-1 (3)							
15												
			SS 4	100	2-2-3 (5)							
20												
25		GRAVELS and COBBLES in a Silty SAND matrix, brown, wet, dense										
		Bottom of hole at 28.0 feet.										

Huddleston-Berry Engineering & Testing, LLC
2789 Riverside Parkway
Grand Junction, CO 81501
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BORING NUMBER B-7

CLIENT Greenline Ventures
PROJECT NAME Woodbridge Subdivision
PROJECT NUMBER 02566-0001
PROJECT LOCATION Grand Junction, CO
DATE STARTED 10/6/22 **COMPLETED** 10/6/22
GROUND ELEVATION **HOLE SIZE** 4
DRILLING CONTRACTOR S. McKracken
GROUND WATER LEVELS:
DRILLING METHOD Simco 3000 Truck
AT TIME OF DRILLING 8.5 ft
LOGGED BY TC **CHECKED BY** MAB
AT END OF DRILLING 8.5 ft
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		Sandy Clay with Organics (TOPSOIL)										
		Silty CLAY to Silty CLAY with Sand (cl-ml) to Lean CLAY (cl), brown, moist to wet, soft										
			SS 1	83	2-1-2 (3)							
5												
			SS 2	44	1-1-1 (2)							
10												
			SS 3	100	0-1-1 (2)							
15												
		GRAVELS and COBBLES in a Silty SAND matrix, brown, wet, dense										
20		Bottom of hole at 20.0 feet.										

Huddleston-Berry Engineering & Testing, LLC
2789 Riverside Parkway
Grand Junction, CO 81501
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BORING NUMBER B-8

CLIENT Greenline Ventures
PROJECT NAME Woodbridge Subdivision
PROJECT NUMBER 02566-0001
PROJECT LOCATION Grand Junction, CO
DATE STARTED 10/6/22 **COMPLETED** 10/6/22
GROUND ELEVATION **HOLE SIZE** 4
DRILLING CONTRACTOR S. McKracken
GROUND WATER LEVELS:
DRILLING METHOD Simco 3000 Truck
▽ **AT TIME OF DRILLING** 9.0 ft
LOGGED BY TC **CHECKED BY** MAB
▼ **AT END OF DRILLING** 9.0 ft
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		Sandy Clay with Organics (TOPSOIL)										
		Silty CLAY to Silty CLAY with Sand (cl-ml) to Lean CLAY (cl), brown, moist to wet, medium stiff to soft										
			SS 1	100	2-2-3 (5)							
5												
			SS 2	83	1-1-1 (2)							
	▼											
10												
			SS 3	100	0-1-2 (3)							
15												
			SS 4	83	4-4-7 (11)							
20												
25												
		GRAVELS and COBBLES in a Silty SAND matrix, brown, wet, dense										
30												
		Bottom of hole at 31.0 feet.										

Huddleston-Berry Engineering & Testing, LLC
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Grand Junction, CO 81501
970-255-8005

BORING NUMBER B-9

CLIENT Greenline Ventures
PROJECT NAME Woodbridge Subdivision
PROJECT NUMBER 02566-0001
PROJECT LOCATION Grand Junction, CO
DATE STARTED 10/6/22 **COMPLETED** 10/6/22
GROUND ELEVATION **HOLE SIZE** 4
DRILLING CONTRACTOR S. McKracken
GROUND WATER LEVELS:
DRILLING METHOD Simco 3000 Truck
▽ **AT TIME OF DRILLING** 7.0 ft
LOGGED BY TC **CHECKED BY** MAB
▼ **AT END OF DRILLING** 7.0 ft
NOTES
AFTER DRILLING ---

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	FINES CONTENT (%)
0	Sandy Clay with Organics (TOPSOIL)										
	Silty CLAY to Silty CLAY with Sand (cl-ml) to Lean CLAY (CL), brown, moist to wet, medium stiff to soft										
		SS 1	33	2-2-3 (5)							
5											
	▼ SS-2: Lab Classified	SS 2	83	1-1-1 (2)			28	28	18	10	96
10											
		SS 3	78	4-3-3 (6)							
15											
		SS 4	78	3-3-4 (7)							
20											
	GRAVELS and COBBLES in a Silty SAND matrix, brown, wet, dense										
25	Bottom of hole at 25.0 feet.										

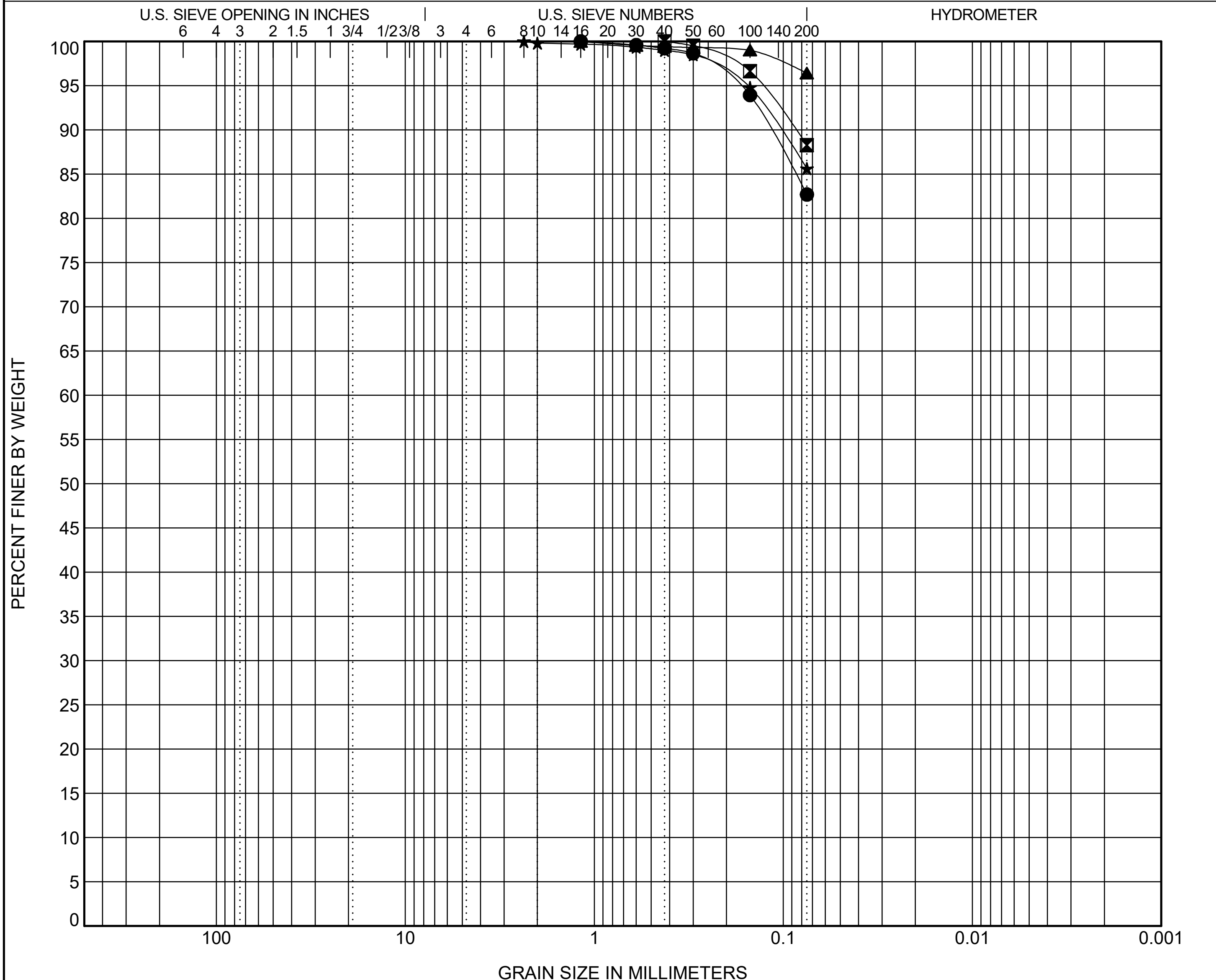
APPENDIX C
Laboratory Testing Results

Huddleston-Berry Engineering & Testing, LLC
2789 Riverside Parkway
Grand Junction, CO 81501
970-255-8005

GRAIN SIZE DISTRIBUTION

CLIENT Greenline Ventures **PROJECT NAME** Woodbridge Subdivision

PROJECT NUMBER 02566-0001 **PROJECT LOCATION** Grand Junction, CO



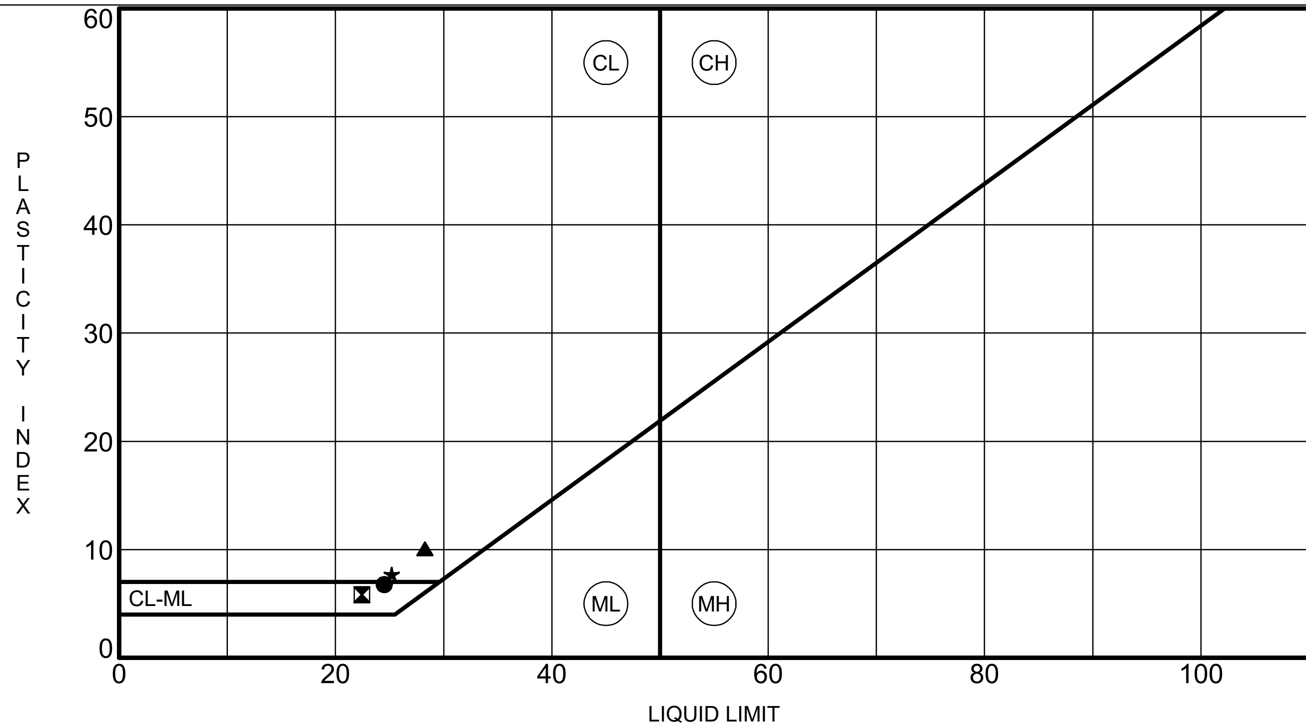
Specimen Identification		Classification	LL	PL	PI	Cc	Cu
● B-1, SS-1	10/6	SILTY CLAY with SAND(CL-ML)	25	18	7		
⊠ B-5, SS-1	10/6	SILTY CLAY(CL-ML)	22	17	5		
▲ B-9, SS-2	10/6	LEAN CLAY(CL)	28	18	10		
★ COMPOSITE	10/6	LEAN CLAY(CL)	25	17	8		

Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● B-1, SS-1	10/6	1.18				0.0	17.3	82.7	
⊠ B-5, SS-1	10/6	0.425				0.0	11.7	88.3	
▲ B-9, SS-2	10/6	1.18				0.0	3.6	96.4	
★ COMPOSITE	10/6	2.36				0.0	14.4	85.6	

Huddleston-Berry Engineering & Testing, LLC
2789 Riverside Parkway
Grand Junction, CO 81501
970-255-8005

ATTERBERG LIMITS' RESULTS

CLIENT Greenline Ventures
PROJECT NAME Woodbridge Subdivision
PROJECT NUMBER 02566-0001
PROJECT LOCATION Grand Junction, CO



	Specimen Identification		LL	PL	PI	#200	Classification
●	**B-1, SS-1**	**10/6**	**25**	**18**	**7**	**83**	**SILTY CLAY with SAND(CL-ML)**
⧗	**B-5, SS-1**	**10/6**	**22**	**17**	**5**	**88**	**SILTY CLAY(CL-ML)**
▲	**B-9, SS-2**	**10/6**	**28**	**18**	**10**	**96**	**LEAN CLAY(CL)**
★	**COMPOSITE**	**10/6**	**25**	**17**	**8**	**86**	**LEAN CLAY(CL)**

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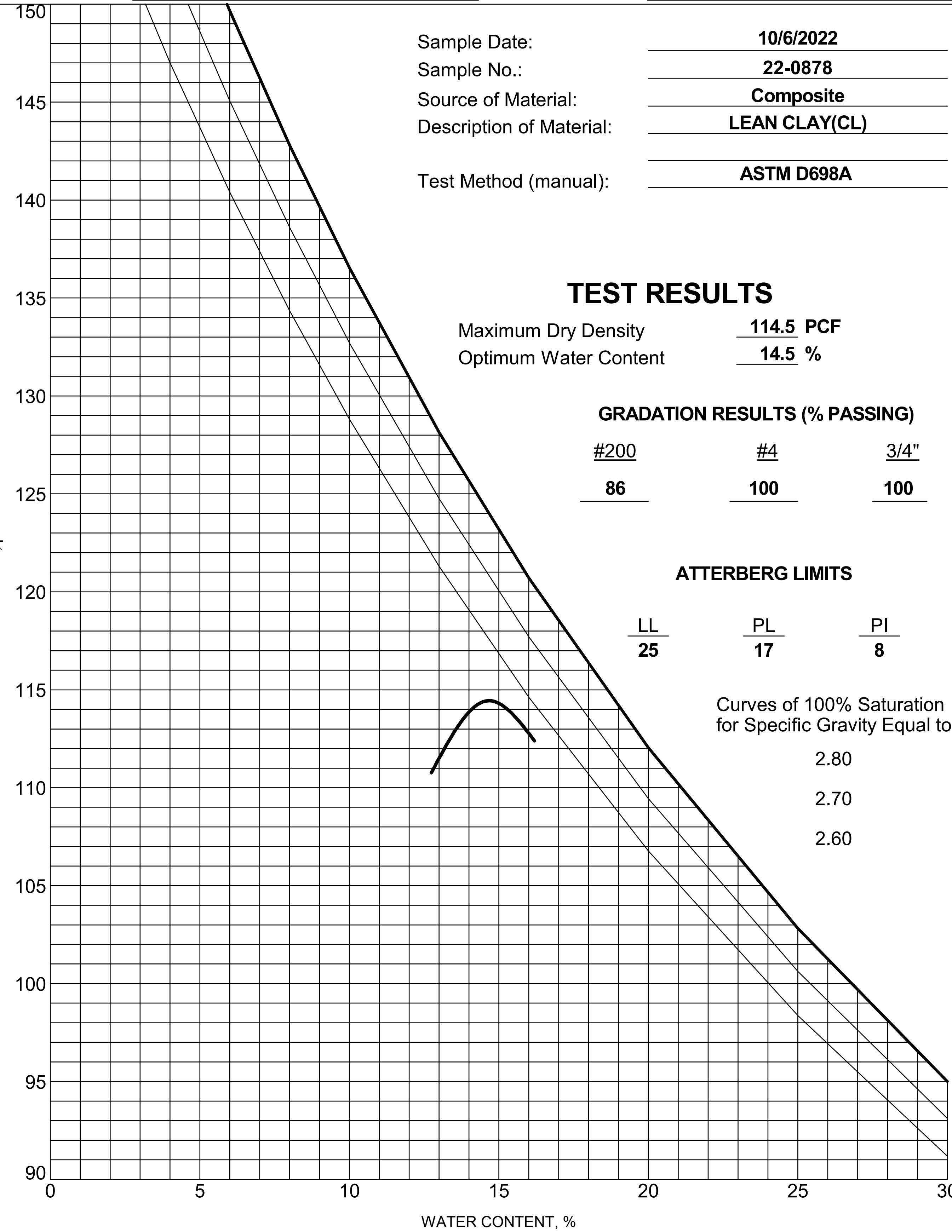
MOISTURE-DENSITY RELATIONSHIP

CLIENT Greenline Ventures

PROJECT NAME Woodbridge Subdivision

PROJECT NUMBER 02566-0001

PROJECT LOCATION Grand Junction, CO



Sample Date: **10/6/2022**

Sample No.: **22-0878**

Source of Material: **Composite**

Description of Material: **LEAN CLAY(CL)**

Test Method (manual): **ASTM D698A**

TEST RESULTS

Maximum Dry Density **114.5 PCF**

Optimum Water Content **14.5 %**

GRADATION RESULTS (% PASSING)

#200	#4	3/4"
86	100	100

ATTERBERG LIMITS

LL	PL	PI
25	17	8

Curves of 100% Saturation
for Specific Gravity Equal to:

2.80

2.70

2.60

Huddleston-Berry
Engineering & Testing, LLC

CALIFORNIA BEARING RATIO
ASTM D1883

Project No.:	02566-0001	**Authorized By:**	Client	**Date:**	10/06/22
Project Name:	Woodbridge Subdivision	**Sampled By:**	TC	**Date:**	10/06/22
Client Name:	Greenline Ventures	**Submitted By:**	WDA	**Date:**	10/31/22
Sample Number:	22-0878 **Location:** COMPOSITE	**Reviewed By:**	MAB	**Date:**	11/07/22

Compaction Method ASTM D698, Method A

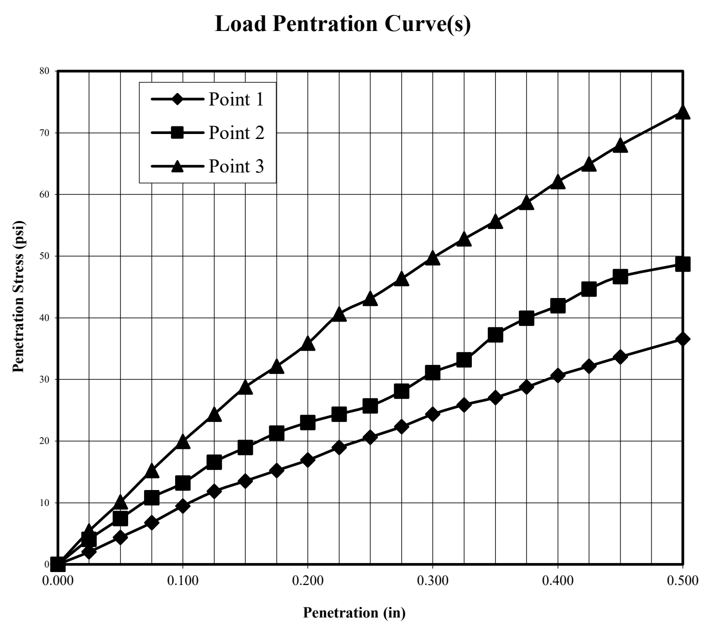
Maximum Dry Density (pcf): 114.5

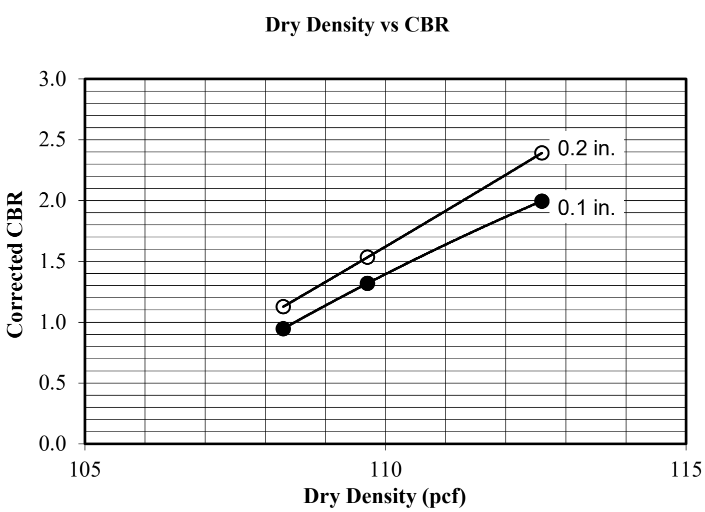
Opt. Moisture Content (%): 14.5

Sample Condition: Soaked

Remarks:

Sample Data		Point 1	Point 2	Point 3
Blows per Compacted Lift:		15	25	56
Surcharge Weight (lbs):		10.0	10.0	10.0
Dry Density Before Soak (pcf):		108.3	109.7	112.6
Dry Density After Soak (pcf):		107.5	109.2	112.2
Moisture Content (%)	Bottom Pre-Test	13.8	14.4	13.7
	Top Pre-Test	13.9	14.7	14.7
	Top 1" After Test	21.1	20.4	18.1
	Average After Soak:	17.9	17.3	15.7
Percent Swell After Soak:		0.7	0.5	0.4





Penetration Data

Point 1 Dist. (in)	Point 1 Load (lbs)	Point 1 Stress (psi)	Point 2 Dist. (in)	Point 2 Load (lbs)	Point 2 Stress (psi)	Point 3 Dist. (in)	Point 3 Load (lbs)	Point 3 Stress (psi)
0.000	0	0	0.000	0	0	0.000	0	0
0.025	6	2	0.025	12	4	0.025	16	5
0.050	13	4	0.050	22	7	0.050	30	10
0.075	20	7	0.075	32	11	0.075	45	15
0.100	28	9	0.100	39	13	0.100	59	20
0.125	35	12	0.125	49	17	0.125	72	24
0.150	40	14	0.150	56	19	0.150	85	29
0.175	45	15	0.175	63	21	0.175	95	32
0.200	50	17	0.200	68	23	0.200	106	36
0.225	56	19	0.225	72	24	0.225	120	41
0.250	61	21	0.250	76	26	0.250	128	43
0.275	66	22	0.275	83	28	0.275	137	46
0.300	72	24	0.300	92	31	0.300	147	50
0.325	77	26	0.325	98	33	0.325	156	53
0.350	80	27	0.350	110	37	0.350	165	56
0.375	85	29	0.375	118	40	0.375	174	59
0.400	91	31	0.400	124	42	0.400	184	62
0.425	95	32	0.425	132	45	0.425	192	65
0.450	100	34	0.450	138	47	0.450	201	68
0.500	108	37	0.500	144	49	0.500	217	73

Corrected CBR @ 0.1"		
0.9	1.3	2.0
Corrected CBR @ 0.2"		
1.1	1.5	2.4

Penetration Distance Correction (in)		
0.000	0.000	0.000

Figure: _____