Huddleston-Berry
Engineering & Testing, LLC

GEOLOGIC HAZARDS AND GEOTECHNICAL INVESTIGATION LAS COLONIAS AMPHITHEATER GRAND JUNCTION, COLORADO PROJECT#00208-0057

CITY OF GRAND JUNCTION
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1.0 INTRODUCTION

As part of continued development in Western Colorado, the City of Grand Junction proposes to construct an amphitheater at Las Colonias Park in Grand Junction. As part of the design development process, Huddleston-Berry Engineering and Testing, LLC (HBET) was retained by the City of Grand Junction 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 Las Colonias Park 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 types 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 City of Grand Junction.

1.2 Site Location and Description

The site is located between Struthers Avenue and the Colorado River in Grand Junction, Colorado. The project location is shown on Figure 1 – Site Location Map.

At the time of the investigation, the site was generally open with a slight slope down to the south. A concrete path ran through the site. Vegetation consisted primarily of scattered weeds. The site was bordered to the north by Struthers Avenue, to the south by the Colorado River, to the west by existing commercial property, and to the east by open land.

1.3 Proposed Construction

The proposed construction is anticipated to include a stage structure, concrete seating area, raised grass seating areas, parking lots, concrete paths, and utilities. A generalized site plan is included as Figure 2.

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 site is underlain by Massadona silty clay loam, 0 to 2 percent slopes, and Bebeevar and Green River soils, and Riverwash, 0 to 2 percent slopes. Soil survey data is included in Appendix A.

Structure construction in the Massadona soils is described as being somewhat limited due to shrink-swell. Construction in the Bebeevar and Green River soils is described as being very limited due to flooding. Excavation in the site soils is described as being somewhat limited to very limited due to unstable excavation walls, depth to saturated zone, clay content, and/or dust. The site soils are indicated to have a low to high potential for frost action, moderate to high risk of corrosion of steel, and low to high risk of corrosion of concrete.

2.2 Geology

According to the *Geologic Map of Colorado* by Ogden Tweto (1979), the site is underlain by Quaternary gravels. The gravels are underlain by Mancos shale bedrock. The Mancos shale unit is thick in the Grand Valley and has a low to moderate potential for expansion.

2.3 Groundwater

Groundwater was encountered in two of the test pits in the eastern portion of the site. Groundwater was encountered in TP-5 at a depth of 8.0 feet and in TP-6 at a depth of 9.0 feet.

3.0 FIELD INVESTIGATION

3.1 Subsurface Investigation

The subsurface investigation was conducted on December 19, 2014 and consisted of six test pits. The test pits were excavated to depths of between 9.5 and 11.0 feet below the existing ground surface. Test pit locations are shown on Figure 2 – Site Plan. Typed test pit logs are included in Appendix B. Samples of the native soils were collected using hand driven sample tubes and using bulk sampling methods at the locations shown on the logs.

As shown on the logs, the subsurface conditions were slightly variable. Test Pits TP-1 through TP-4, conducted in the western portion of the site, encountered 1.0 foot of lean clay topsoil above brown to black, dry to moist, stiff lean clay with sand to the bottoms of the excavations. Cobbles and boulders were observed in some of the clay soils. Groundwater was not encountered in TP-1 through TP-4 at the time of the investigation.

Test Pit TP-5, conducted in the southeastern portion of the site, encountered 6.0 feet of brown, dry to moist, stiff lean clay with sand above black, moist to wet, dense sandy gravel and cobbles to the bottom of the excavation. Groundwater was encountered in TP-5 at a depth of 8.0 feet at the time of the investigation.

Test Pit TP-6, conducted in the northeastern portion of the site, encountered 1.0 foot of lean clay topsoil above brown shale fill to a depth of 3.0 feet. The fill was underlain by brown to black, moist, stiff lean clay with sand to a depth of 5.0 feet. Below the clay, black, moist to wet, dense sandy gravel and cobbles extended to the bottom of the excavation. Groundwater was encountered in TP-6 at a depth of 9.0 feet at the time of the investigation.

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 and density, grain size analysis, Atterberg limits, maximum dry density and optimum moisture (Proctor), California Bearing Ratio (CBR), and water soluble sulfates content. The laboratory testing results are included in Appendix C.

The laboratory testing results indicate that the native clay soils are slightly plastic. In addition, the CBR results indicate that the native clay soils are slightly expansive with up to approximately 0.7% expansion measured in the laboratory. Water soluble sulfates were detected in the site soils in a concentration of 0.2%.

5.0 GEOLOGIC INTERPRETATION

5.1 Geologic Hazards

The most significant geologic hazard identified on the site is the potential impacts to the site of flooding of the Colorado River. However, moisture sensitive soils were also encountered at the site. In addition, shallow groundwater was encountered in portions of the site.

5.2 Geologic Constraints

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

5.3 Water Resources

No water supply wells were observed on the property. As discussed previously, the site lies adjacent to the Colorado River. In general, with proper design and construction, the development of the property is not anticipated to adversely impact surface water or groundwater.

5.4 Mineral Resources

Potential mineral resources in western Colorado generally include gravel, uranium ore, and commercial rock products such as flagstone. The site is mapped in the Mesa County GIS database as containing potential gravel resources. As indicate in the test pit logs, gravels were encountered during the subsurface investigation. However, due to the size and location of the property, the existing gravel resources likely do not reflect 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 this site. However, foundations, pavements, and earthwork may have to consider the impacts of moisture sensitive soils, potential flooding of the Colorado River, and/or shallow groundwater.

7.0 RECOMMENDATIONS

7.1 Foundations

As discussed previously, moisture sensitive soils were encountered at the site. However, based upon the nature of the proposed construction, shallow foundations are recommended. Spread footings and monolithic (turndown edge or mat) structural slabs are both appropriate foundation alternatives. However, to provide a uniform subgrade and limit the potential for excessive differential movements, it is recommended that the foundations be constructed above a minimum of 24-inches of structural fill.

As discussed previously, the native clay soils were shown to be slightly expansive. However, the magnitude of expansion measured in the laboratory was small. Therefore, with careful moisture control and proper compaction, the native clay soils, exclusive of topsoil, may be reused as structural fill, provided particles in excess of 6-inches in diameter are removed. Imported structural fill should consist of a granular, non-expansive, non-free draining material such as pit-run with high fines content, crusher fines, or CDOT Class 6 base course. However, if pit-run is used as structural fill, a minimum of 6-inches of base course, crusher fines, or other suitable fill material should be placed above the pit-run to prevent large point stresses on the bottoms of the foundations due to large particles in the pit-run.

Prior to placement of structural fill, it is recommended that the bottoms of the foundation excavations be scarified to a depth of 9 to 12-inches, moisture conditioned, and 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, depending upon the depth of excavation and time of year during construction, shallow groundwater and associated soft soil conditions may exist. It may be necessary to utilize geotextile and/or geogrid in conjunction with up to approximately 30-inches of granular fill to stabilize the subgrade.

Structural fill should extend laterally beyond the edges of the foundation a distance equal to the thickness of structural fill. 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 D1557C, respectively. Pit-run used as structural fill should be proofrolled to the Engineer's satisfaction.

For the foundation building pad prepared as recommended with structural fill consisting of the native soils or imported granular materials, 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 clay soils and a modulus of 250 pci may be used for structural fill consisting of crusher fines, pit-run, or base course. The bottoms of exterior foundations should extend a minimum of 24-inches below grade for frost protection.

7.2 Drainage

Based upon information provided to HBET, the proposed stage structure will be elevated above the existing grade between 4 and 6 feet. In addition, a basement is proposed below the stage. As indicated previously, groundwater was not encountered in the immediate vicinity of the stage structure. However, the subsurface investigation was conducted during the winter months where groundwater is typically lowest.

In order to evaluate the magnitude of potential groundwater fluctuations, HBET reviewed data from several monitoring wells at the site. The monitoring well data suggest that high groundwater is at approximately elevation 4568 feet. This is at a depth of approximately 8 feet in the vicinity of the stage at the location of Test Pit TP-1. However, during significant flood events, the groundwater elevation could rise even higher.

In most cases, a perimeter foundation drain system with sumps should be sufficient to limit the potential for groundwater to impact the basement. However, HBET understands that there are special Department of Energy (DOE) rules at the site due to the previous use of the site. As a result, a perimeter foundation drain may not be suitable.

As an alternative to the use of a perimeter foundation drain, it may be necessary to waterproof the basement. In this case, a slab foundation with special connections to the basement walls would likely be required. In addition, waterproofing concrete additives or finishes may be necessary. Also, it may be necessary to design the structure for buoyancy forces.

7.3 Seismic Design Criteria

In general based upon the results of the subsurface investigation, the site classifies as Site Class D for a stiff soil profile.

7.4 Corrosion of Concrete

As indicated previously, water soluble sulfates were encountered in the site soils in a concentration of 0.2%. This concentration represents a severe degree of potential sulfate attack on concrete. Therefore, Type V cement is recommended in accordance with the International Building Code. However, Type V cement can be difficult to obtain in Western Colorado. Where Type V cement is unavailable, Type I-II sulfate resistant cement is recommended.

7.5 Non-Structural Floor Slab and Concrete Seating Area

As mentioned above, expansive materials are present in the subsurface at the site. In general, slabs-on-grade cannot develop sufficient bearing pressures to resist swelling pressures. Therefore, some movement of slabs-on-grade should be expected. The only way to eliminate the potential for excessive differential movements would be to utilize structural slabs supported by deep foundations. However, where deep foundation supported slabs are not used, while the risk of movement cannot be eliminated, the risk can be reduced by constructing the floor slab and/or concrete seating area above a minimum of 18-inches of structural fill.

Floating slabs-on-grade should not be tied in or connected to the foundations in any manner. If a non-structurally supported floor slab is used, interior non-bearing partitions should include a slip-joint or framing void which permits a minimum of 2-inches of vertical movement.

7.6 Lateral Earth Pressures

Stemwalls and/or any 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 equivalent fluid unit weight of 55 pcf in areas where no surcharge loads are present. Lateral earth pressures should be increased as necessary to reflect any surcharge loading behind the walls.

7.7 Excavations

Excavations in the soils at the site may stand for short periods of time but should not be considered to be stable. The native 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.

7.8 Pavements

The proposed construction is anticipated to include new parking lots and concrete paths. As discussed previously, the pavement subgrade materials at the site consist primarily of lean clay soils. The design California Bearing Ratio (CBR) of the native clay soils was determined in the laboratory to be approximately 2.2. This corresponds to a Resilient Modulus of 3,300 psi.

Based upon the subgrade conditions and anticipated traffic loading, pavement section alternatives were developed in accordance with the *Guideline for the Design and Use of Asphalt Pavements for Colorado Roadways* by the Colorado Asphalt Pavement Association and CDOT *Pavement Design Manual.* The following pavement section alternatives are recommended:

Automobile Parking Areas (Limited Truck Traffic)
ESAL's = 100,000, Structural Number = 3.10

ALTERNATIVE	PAVEMENT SECTION (Inches)				
	Hot-Mix Asphalt Pavement	CDOT Class 6 Base Course	CDOT Class 3 Subbase Course	Concrete Pavement	TOTAL
Full Depth HMA	7.0				7.0
A	3.0	13.0			16.0
B	4.0	10.0			14.0
C	3.0	6.0	10.0		19.0
Rigid Pavement		6.0		6.0	12.0

Mixed Use Areas (Higher Truck Traffic)
ESAL's = 350,000; Structural Number = 3.50

ALTERNATIVE	PAVEMENT SECTION (Inches)				
	Hot-Mix Asphalt Pavement	CDOT Class 6 Base Course	CDOT Class 3 Subbase Course	Concrete	TOTAL
Full Depth HMA	9.0				9.0
A	4.0	14.0			18.0
B	5.0	11.0			16.0
C	4.0	6.0	11.0		21.0
Concrete Pavement		6.0		8.0	14.0

Concrete Paths

ALTERNATIVE	PAVEMENT SECTION (Inches)		
	CDOT Class 6 Base Course	Concrete	TOTAL
No Maintenance Traffic	6.0	5.0	11.0
Some Maintenance Traffic	6.0	6.0	12.0

Prior to new 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, soft soils may be encountered associated with shallow groundwater. It may be necessary to utilize geotextile and/or geogrid in conjunction with up to approximately 30-inches of granular fill to stabilize the subgrade.

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 slightly variable. However, the precise nature and extent of any subsurface variability may not become evident until construction. Therefore, it is recommended that a representative of HBET observe the foundation excavations prior to structural fill placement to verify that the subsurface conditions are consistent with those described herein. In addition, it is recommended that a representative of HBET test compaction of structural fill materials.

As discussed previously, moisture sensitive soils were encountered at the site. The recommendations contained herein are designed to reduce the potential for excessive differential movements; however, HBET cannot predict long-term changes in subsurface moisture conditions and/or the precise magnitude or extent of volume change. Where significant changes in subsurface moisture occur due to poor grading, improper stormwater management, utility line failure, excess irrigation, significant groundwater fluctuations, or other cause either during or after construction, significant movements are possible.

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

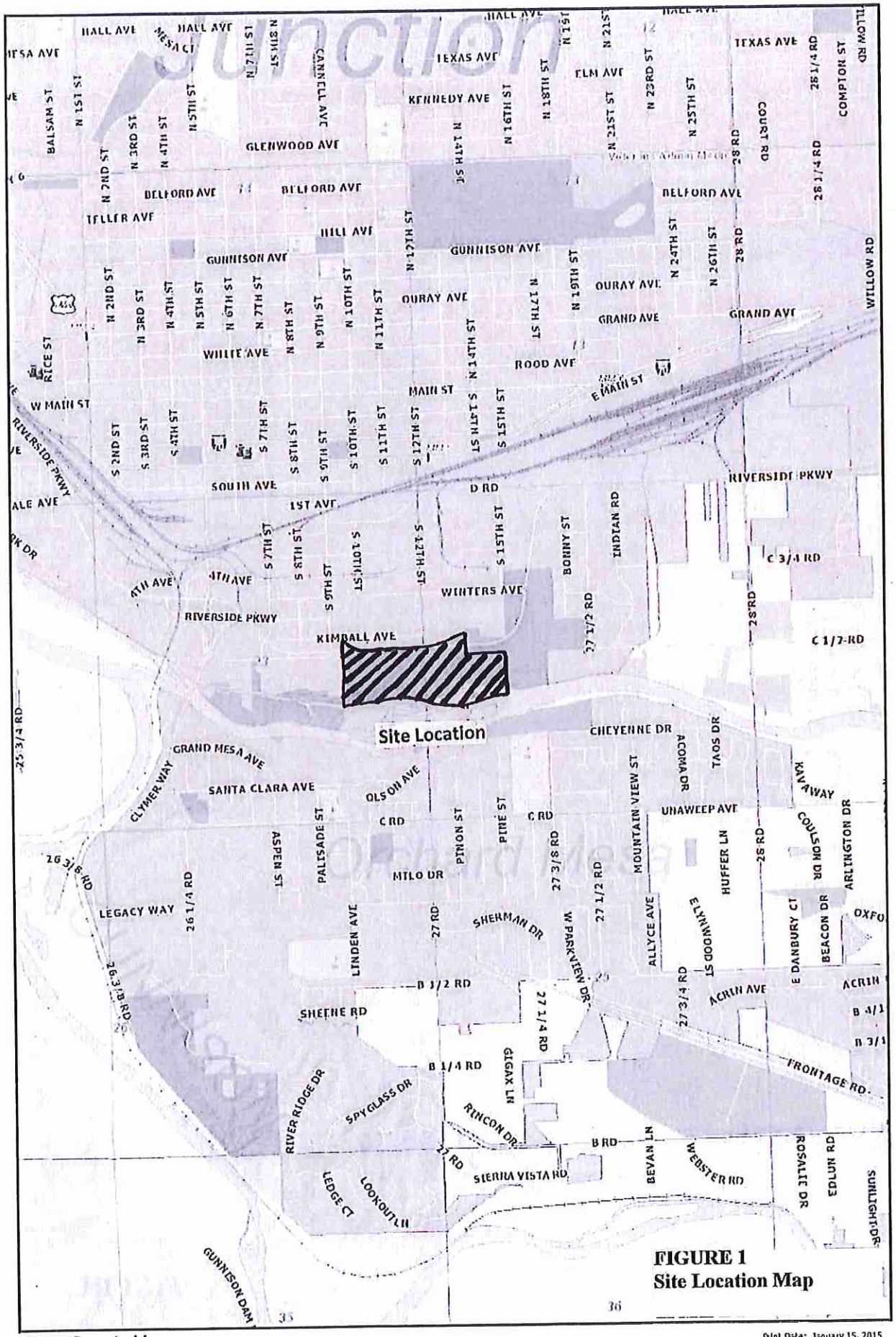


FIGURE 1
Site Location Map

Mesa County Map

0 0.125 0.25 0.5 mi
0 0.15 0.3 0.6 km

Print Date: January 15, 2015
Mesa County, Colorado
GIS/IT Department

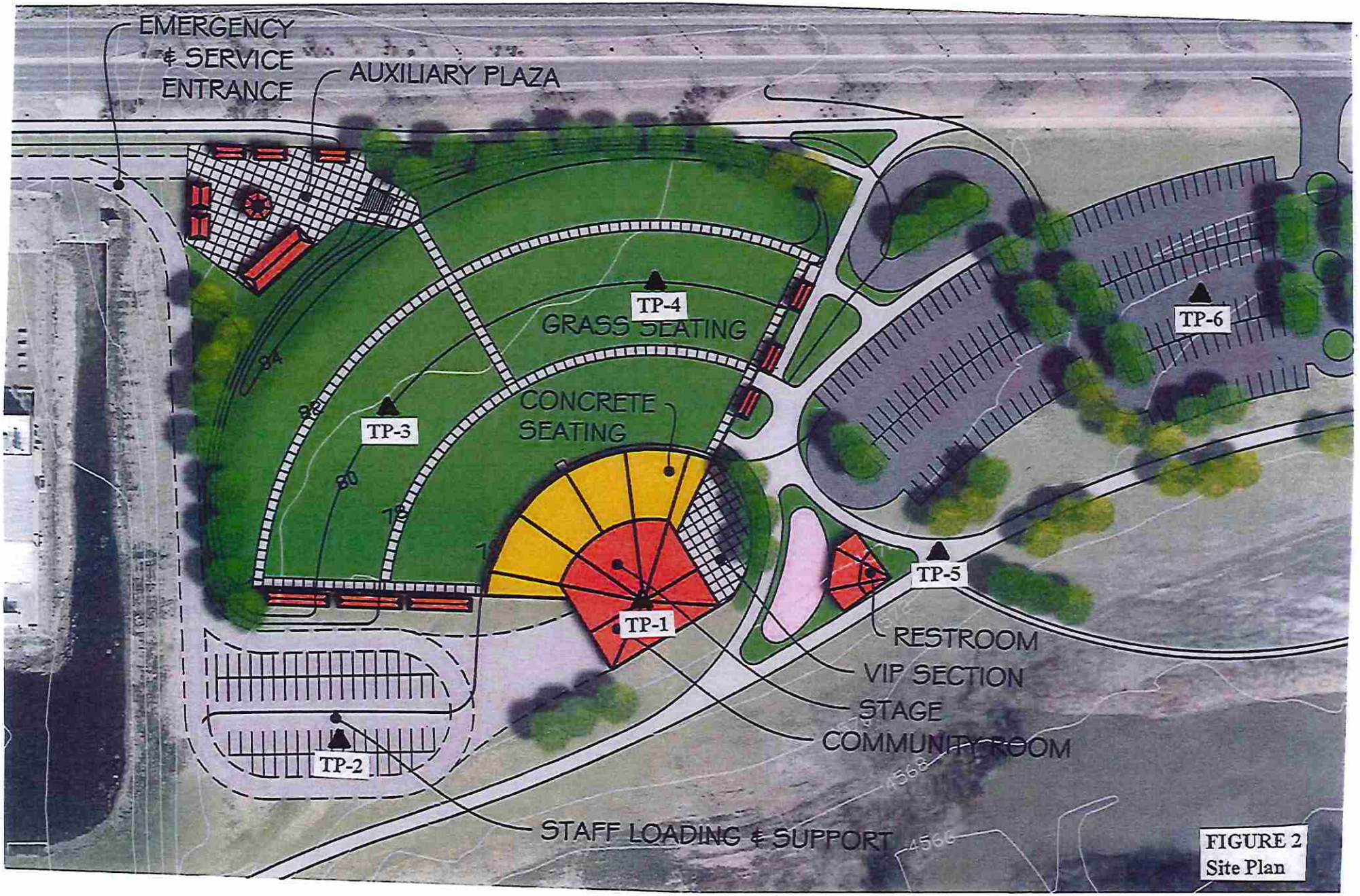
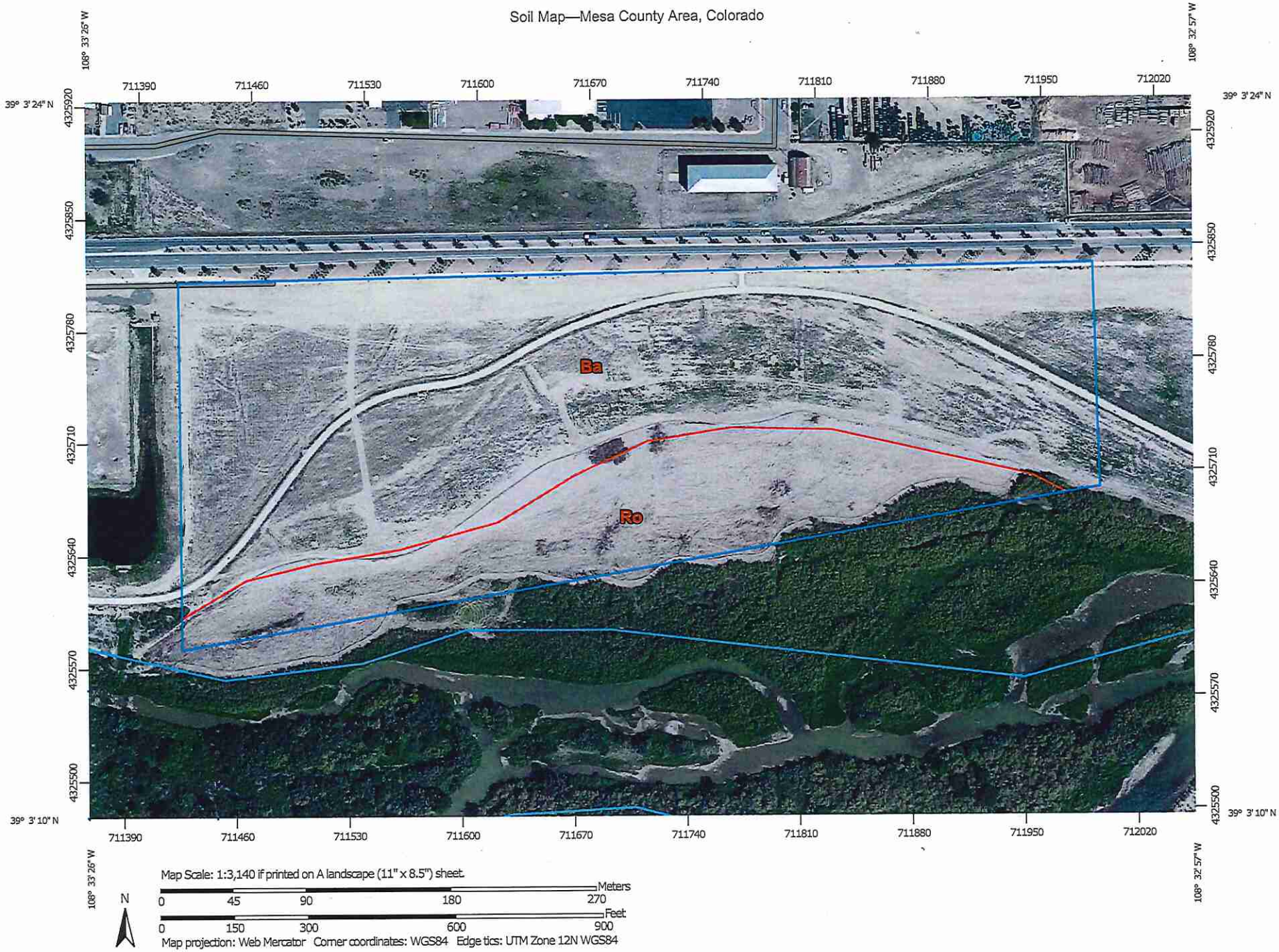


FIGURE 2
Site Plan

APPENDIX A
Soil Survey Data

Soil Map—Mesa County Area, Colorado



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: http://websoilsurvey.nrcs.usda.gov
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 5, Sep 22, 2014

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

Date(s) aerial images were photographed: Jun 22, 2010—Sep 2, 2010

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

Mesa County Area, Colorado (CO680)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
Ba	Massadona silty clay loam, 0 to 2 percent slopes	19.4	74.6%
Ro	Bebeevar and Green River soils, and Riverwash, 0 to 2 percent slopes	6.6	25.4%
Totals for Area of Interest		**26.0**	**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 and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils 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. Other minor components, however, have properties and behavioral 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

Ba—Massadona silty clay loam, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: k06n
Elevation: 4,500 to 4,900 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 150 to 190 days
Farmland classification: Not prime farmland

Map Unit Composition

Massadona and similar soils: 70 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Massadona

Setting

Landform: Fan remnants
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Alluvium derived from clayey shale

Typical profile

A - 0 to 2 inches: silty clay loam
Bw - 2 to 12 inches: silty clay
Bky - 12 to 24 inches: silty clay
BCky1 - 24 to 48 inches: stratified silty clay loam to fine sandy loam
BCky2 - 48 to 60 inches: stratified silty clay loam to fine sandy loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Gypsum, maximum in profile: 2 percent
Salinity, maximum in profile: Moderately saline to strongly saline (10.0 to 32.0 mmhos/cm)
Available water storage in profile: High (about 10.0 inches)

Interpretive groups

Land capability classification (irrigated): 3s
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: C

Ro—Bebeevar and Green River soils, and Riverwash, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: k0d4
Elevation: 4,430 to 4,820 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 135 to 190 days
Farmland classification: Not prime farmland

Map Unit Composition

Bebeevar and similar soils: 45 percent
Green river and similar soils: 35 percent
Riverwash: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Bebeevar

Setting

Landform: Flood plains
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium over sandy and gravelly alluvium derived from sandstone and shale

Typical profile

Ap - 0 to 9 inches: loam
C1 - 9 to 14 inches: loam
C2 - 14 to 18 inches: fine sandy loam
2C - 18 to 32 inches: sand
3C - 32 to 59 inches: very cobbly sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: About 24 to 48 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Salinity, maximum in profile: Nonsaline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Low (about 4.7 inches)

Interpretive groups

Land capability classification (irrigated): 3s
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: C

Description of Green River

Setting

Landform: Flood plains, terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Clayey alluvium over coarse-loamy alluvium derived from sandstone and shale

Typical profile

Ap - 0 to 10 inches: silty clay loam
C1 - 10 to 16 inches: fine sandy loam
C2 - 16 to 24 inches: fine sandy loam
C3 - 24 to 32 inches: fine sandy loam
C4 - 32 to 44 inches: fine sandy loam
C5 - 44 to 52 inches: fine sandy loam
2C - 52 to 60 inches: very cobbly sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: About 24 to 48 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Salinity, maximum in profile: Nonsaline to moderately saline (2.0 to 16.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 5.0
Available water storage in profile: Moderate (about 7.7 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 7c
Hydrologic Soil Group: C

Description of Riverwash

Setting

Landform: Flood plains
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy and gravelly alluvium

Typical profile

C1 - 0 to 6 inches: very gravelly sand
C2 - 6 to 60 inches: stratified extremely gravelly coarse sand to gravelly sand

Properties and qualities

Slope: 0 to 2 percent
Natural drainage class: Somewhat excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)
Depth to water table: About 0 to 24 inches
Frequency of flooding: Frequent
Available water storage in profile: Very low (about 1.8 inches)

Interpretive groups

Land capability classification (irrigated): 6w
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: A

Data Source Information

Soil Survey Area: Mesa County Area, Colorado
Survey Area Data: Version 5, Sep 22, 2014

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
Ba—Massadona silty clay loam, 0 to 2 percent slopes							
Massadona	70	Somewhat limited		Somewhat limited		Somewhat limited	
		Shrink-swell	0.99	Shrink-swell	0.96	Shrink-swell	0.99
Ro—Bebeevar and Green River soils, and Riverwash, 0 to 2 percent slopes							
Bebeevar	45	Very limited		Very limited		Very limited	
		Flooding	1.00	Flooding	1.00	Flooding	1.00
				Depth to saturated zone	0.96		
Green river	35	Very limited		Very limited		Very limited	
		Flooding	1.00	Flooding	1.00	Flooding	1.00
				Depth to saturated zone	0.96		
Riverwash	20	Not rated		Not rated		Not rated	

Data Source Information

Soil Survey Area: Mesa County Area, Colorado
Survey Area Data: Version 5, Sep 22, 2014

Roads and Streets, Shallow Excavations, and Lawns and Landscaping

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 local roads and streets, shallow excavations, and lawns and landscaping.

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).

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material; a base of gravel, crushed rock, or soil material stabilized by lime or cement; and a surface of flexible material (asphalt), rigid material (concrete), or gravel with a binder. The ratings are based on the soil properties that affect the ease of excavation and grading and the traffic-supporting capacity. The properties that affect the ease of excavation and grading are depth to bedrock or a cemented pan, hardness of bedrock or a cemented pan, depth to a water table, ponding, flooding, the amount of large stones, and slope. The properties that affect the traffic-supporting capacity are soil strength (as inferred from the AASHTO group index number), subsidence, linear extensibility (shrink-swell potential), the potential for frost action, depth to a water table, and ponding.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for graves, utility lines, open ditches, or other purposes. The ratings are based on the soil properties that influence the ease of digging and the resistance to sloughing. Depth to bedrock or a cemented pan, hardness of bedrock or a cemented pan, the amount of large stones, and dense layers influence the ease of digging, filling, and compacting. Depth to the seasonal high water table, flooding, and ponding may restrict the period when excavations can be made. Slope influences the ease of using machinery. Soil texture, depth to the water table, and linear extensibility (shrink-swell potential) influence the resistance to sloughing.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. Irrigation is not considered in the ratings. The ratings are based on the soil properties that affect plant growth and trafficability after vegetation is established. The properties that affect plant growth are reaction; depth to a water table; ponding; depth to bedrock or a cemented pan; the available water capacity in the upper 40 inches; the content of salts, sodium, or calcium carbonate; and sulfidic materials. The properties that affect trafficability are flooding, depth to a water table, ponding, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer.

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—Roads and Streets, Shallow Excavations, and Lawns and Landscaping

[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]

Roads and Streets, Shallow Excavations, and Lawns and Landscaping–Mesa County Area, Colorado							
Map symbol and soil name	Pct. of map unit	Local roads and streets		Shallow excavations		Lawns and landscaping	
		Rating class and limiting features	Value	Rating class and limiting features	Value	Rating class and limiting features	Value
Ba—Massadona silty clay loam, 0 to 2 percent slopes							
Massadona	70	Very limited		Somewhat limited		Somewhat limited	
		Frost action	1.00	Dusty	0.50	Dusty	0.50
		Low strength	1.00	Too clayey	0.02		
		Shrink-swell	0.99	Unstable excavation walls	0.01		

Roads and Streets, Shallow Excavations, and Lawns and Landscaping–Mesa County Area, Colorado							
Map symbol and soil name	Pct. of map unit	Local roads and streets		Shallow excavations		Lawns and landscaping	
		Rating class and limiting features	Value	Rating class and limiting features	Value	Rating class and limiting features	Value
Ro—Bebeevar and Green River soils, and Riverwash, 0 to 2 percent slopes							
Bebeevar	45	Somewhat limited		Very limited		Somewhat limited	
		Flooding	0.40	Unstable excavation walls	1.00	Dusty	0.19
				Depth to saturated zone	0.96		
				Dusty	0.19		
Green river	35	Somewhat limited		Somewhat limited		Somewhat limited	
		Flooding	0.40	Depth to saturated zone	0.96	Dusty	0.29
				Dusty	0.29	Salinity	0.13
				Unstable excavation walls	0.01		
Riverwash	20	Not rated		Not rated		Not rated	

Data Source Information

Soil Survey Area: Mesa County Area, Colorado
Survey Area Data: Version 5, Sep 22, 2014

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
		In	*In*		*In*	*In*			
Ba—Massadona silty clay loam, 0 to 2 percent slopes									
Massadona		—	—		0	—	High	High	High
Ro—Bebeevar and Green River soils, and Riverwash, 0 to 2 percent slopes									
Bebeevar		—	—		0	—	Low	Moderate	Low
Green river		—	—		0	—	Low	High	Moderate
Riverwash		—	—		0	—	Low	High	Low

Data Source Information

Soil Survey Area: Mesa County Area, Colorado
Survey Area Data: Version 5, Sep 22, 2014

APPENDIX B
Typed Test Pit Logs

Huddleston-Berry Engineering & Testing, LLC
640 White Avenue, Unit B
Grand Junction, CO 81501
970-255-8005
970-255-6818

TEST PIT NUMBER TP-1

CLIENT City of Grand Junction
PROJECT NAME Las Colonias Amiptheater
PROJECT NUMBER 00208-0057
PROJECT LOCATION Grand Junction, CO
DATE STARTED 12/19/14 COMPLETED 12/19/14
GROUND ELEVATION ___ TEST PIT SIZE ___
EXCAVATION CONTRACTOR Hi-River
GROUND WATER LEVELS:
EXCAVATION METHOD Mini-Excavator
AT TIME OF EXCAVATION dry
LOGGED BY NWB CHECKED BY MAB
AT END OF EXCAVATION dry
NOTES
AFTER EXCAVATION ---

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 (%)
0.0		Lean CLAY with Sand and Organics (TOPSOIL), brown, dry										
		Lean CLAY with Sand (cl), brown, dry, stiff	MC 1				134	8				
2.5			GB 1									
		Lean CLAY with Sand, Boulders, and Cobbles (cl), brown to black, moist, stiff										
5.0												
7.5												
10.0												
		Bottom of test pit at 11.0 feet.										

Huddleston-Berry Engineering & Testing, LLC
640 White Avenue, Unit B
Grand Junction, CO 81501
970-255-8005
970-255-6818

TEST PIT NUMBER TP-2

CLIENT City of Grand Junction
PROJECT NAME Las Colonias Amiptheater
PROJECT NUMBER 00208-0057
PROJECT LOCATION Grand Junction, CO
DATE STARTED 12/19/14 COMPLETED 12/19/14
GROUND ELEVATION ____ TEST PIT SIZE ____
EXCAVATION CONTRACTOR Hi-River
GROUND WATER LEVELS:
EXCAVATION METHOD Mini-Excavator
AT TIME OF EXCAVATION dry
LOGGED BY NWB CHECKED BY MAB
AT END OF EXCAVATION dry
NOTES ____
AFTER EXCAVATION ---

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 (%)
0.0		Lean CLAY with Sand and Organics (TOPSOIL), brown, dry										
		Lean CLAY with Sand (cl), brown, dry, stiff	GB 1									
2.5												
		Lean CLAY with Sand, Boulders, and Cobbles (cl), brown, moist, stiff										
5.0												
7.5												
10.0		Bottom of test pit at 10.5 feet.										

GEOTECH BH COLUMNS 00208-0057 LAS COLONIAS AMIPTHEATER.GPJ GINT US LAB.GDT 1/27/15

Huddleston-Berry Engineering & Testing, LLC
640 White Avenue, Unit B
Grand Junction, CO 81501
970-255-8005
970-255-6818

TEST PIT NUMBER TP-3

CLIENT City of Grand Junction
PROJECT NAME Las Colonias Amiptheater
PROJECT NUMBER 00208-0057
PROJECT LOCATION Grand Junction, CO
DATE STARTED 12/19/14 COMPLETED 12/19/14
GROUND ELEVATION ___ TEST PIT SIZE ___
EXCAVATION CONTRACTOR Hi-River
GROUND WATER LEVELS:
EXCAVATION METHOD Mini-Excavator
AT TIME OF EXCAVATION dry
LOGGED BY NWB CHECKED BY MAB
AT END OF EXCAVATION dry
NOTES ___
AFTER EXCAVATION ---

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 (%)
0.0		Lean CLAY with Sand and Organics (TOPSOIL), brown, dry										
		Lean CLAY with Sand (cl), brown, dry, stiff										
2.5												
		Lean CLAY with Sand, Boulders, and Cobbles (cl), brown, moist, stiff										
5.0												
7.5												
10.0												
		Bottom of test pit at 11.0 feet.										

Huddleston-Berry Engineering & Testing, LLC
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970-255-8005
970-255-6818

TEST PIT NUMBER TP-4

CLIENT City of Grand Junction
PROJECT NAME Las Colonias Amiptheater
PROJECT NUMBER 00208-0057
PROJECT LOCATION Grand Junction, CO
DATE STARTED 12/19/14 COMPLETED 12/19/14
GROUND ELEVATION ___ TEST PIT SIZE ___
EXCAVATION CONTRACTOR HI-River
GROUND WATER LEVELS:
EXCAVATION METHOD Mini-Excavator
AT TIME OF EXCAVATION dry
LOGGED BY NWB CHECKED BY MAB
AT END OF EXCAVATION dry
NOTES ___
AFTER EXCAVATION ---

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 (%)
0.0		Lean CLAY with Sand and Organics (TOPSOIL), brown, dry										
		Lean CLAY with Sand, Boulders, and Cobbles (cl), brown, dry to moist, stiff										
2.5												
5.0												
7.5												
10.0		Bottom of test pit at 10.0 feet.										

GEOTECH BH COLUMNS 00208-0057 LAS COLONIAS AMIPTHEATER.GPJ GINT US LAB.GDT 1/27/15

Huddleston-Berry Engineering & Testing, LLC
640 White Avenue, Unit B
Grand Junction, CO 81501
970-255-8005
970-255-6818

TEST PIT NUMBER TP-5

CLIENT City of Grand Junction
PROJECT NAME Las Colonias Amiptheater
PROJECT NUMBER 00208-0057
PROJECT LOCATION Grand Junction, CO
DATE STARTED 12/19/14 COMPLETED 12/19/14
GROUND ELEVATION ____ TEST PIT SIZE ____
EXCAVATION CONTRACTOR Hi-River
GROUND WATER LEVELS:
EXCAVATION METHOD Mini-Excavator
▽ AT TIME OF EXCAVATION 8.0 ft
LOGGED BY NWB CHECKED BY MAB
▼ AT END OF EXCAVATION 8.0 ft
NOTES
AFTER EXCAVATION ---

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 (%)
0.0		Lean CLAY with Sand (CL) and Boulders and Cobbles, brown, dry to moist, stiff										
			GB 1					7	27	13	14	71
2.5		*** Lab Classified GB1 ***										
5.0		Sandy GRAVEL and COBBLES (gw), trace boulders , black, moist to wet, dense										
7.5												
		Bottom of test pit at 9.5 feet.										

Huddleston-Berry Engineering & Testing, LLC
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970-255-6818

TEST PIT NUMBER TP-6

CLIENT City of Grand Junction
PROJECT NAME Las Colonias Amiptheater
PROJECT NUMBER 00208-0057
PROJECT LOCATION Grand Junction, CO
DATE STARTED 12/19/14 COMPLETED 12/19/14
GROUND ELEVATION ___ TEST PIT SIZE ___
EXCAVATION CONTRACTOR Hi-River
GROUND WATER LEVELS:
EXCAVATION METHOD Mini-Excavator
▽ AT TIME OF EXCAVATION 9.0 ft
LOGGED BY NWB CHECKED BY MAB
▼ AT END OF EXCAVATION 9.0 ft
NOTES ___
AFTER EXCAVATION ---

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 (%)
0.0		Lean CLAY with Sand and Organics (TOPSOIL), brown, dry										
		SHALE, brown, very soft, moderately weathered										
2.5		Lean CLAY with Sand (cl) and Boulders and Cobbles, brown to black, moist, stiff										
5.0		Sandy GRAVEL and COBBLES (gw), trace Boulders, black, moist to wet, dense										
7.5												
10.0		Bottom of test pit at 10.0 feet.										

APPENDIX C
Laboratory Testing Results

Huddleston-Berry Engineering & Testing, LLC
640 White Avenue, Unit B
Grand Junction, CO 81501
970-255-8005
970-255-6818

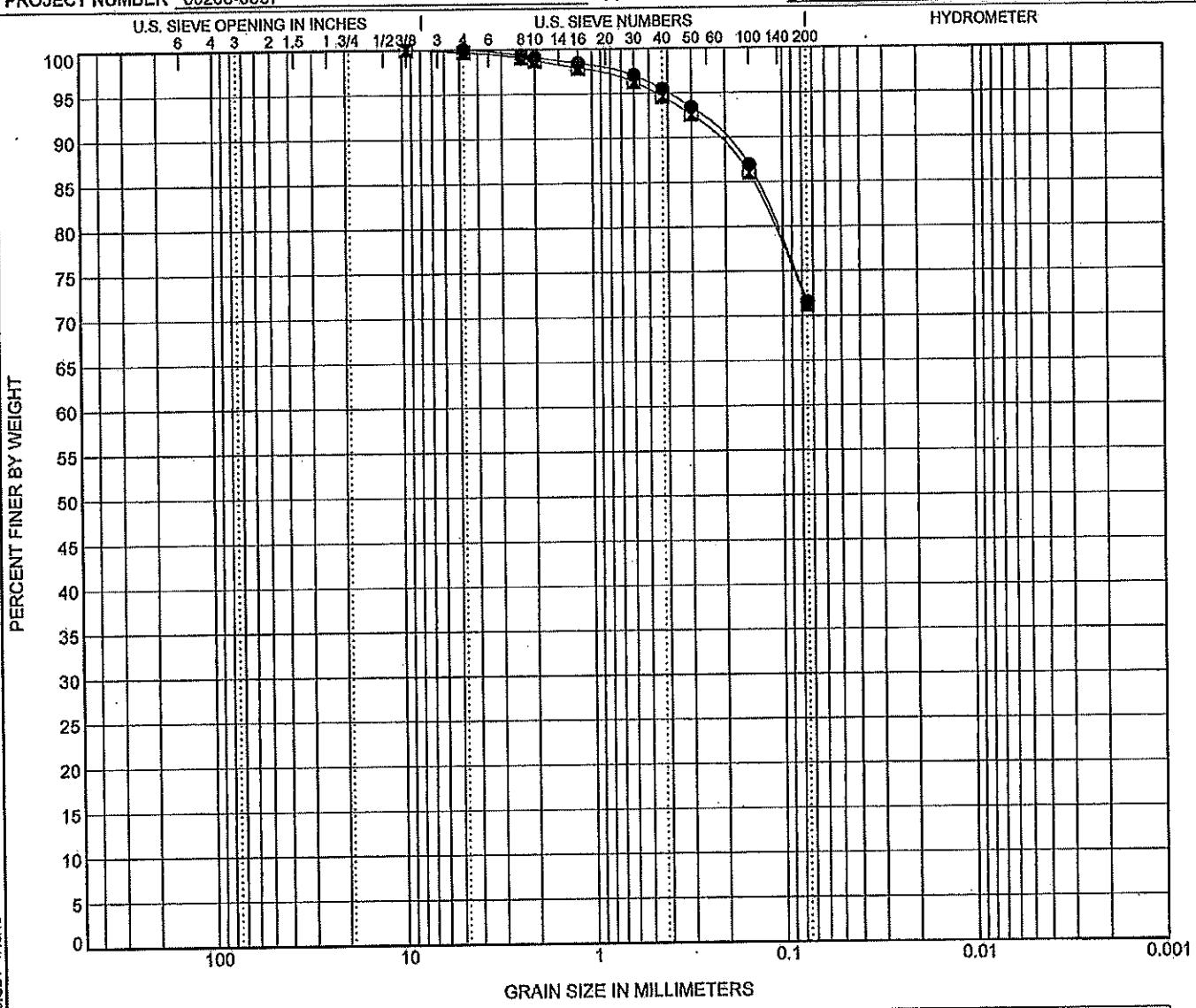
GRAIN SIZE DISTRIBUTION

CLIENT City of Grand Junction

PROJECT NAME Las Colonias Amiptheater

PROJECT NUMBER 00208-0057

PROJECT LOCATION Grand Junction, CO



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	LL	PL	PI	Cc	Cu
● Composite 12/2014	LEAN CLAY with SAND(CL)	25	14	11		
☒ TP-5, GB1 12/2014	LEAN CLAY with SAND(CL)	27	13	14		

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● Composite 12/2014	4.75				0.0	28.4	71.6	
☒ TP-5, GB1 12/2014	9.5				0.3	28.5	71.2	

Huddleston-Berry Engineering & Testing, LLC
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Grand Junction, CO 81501
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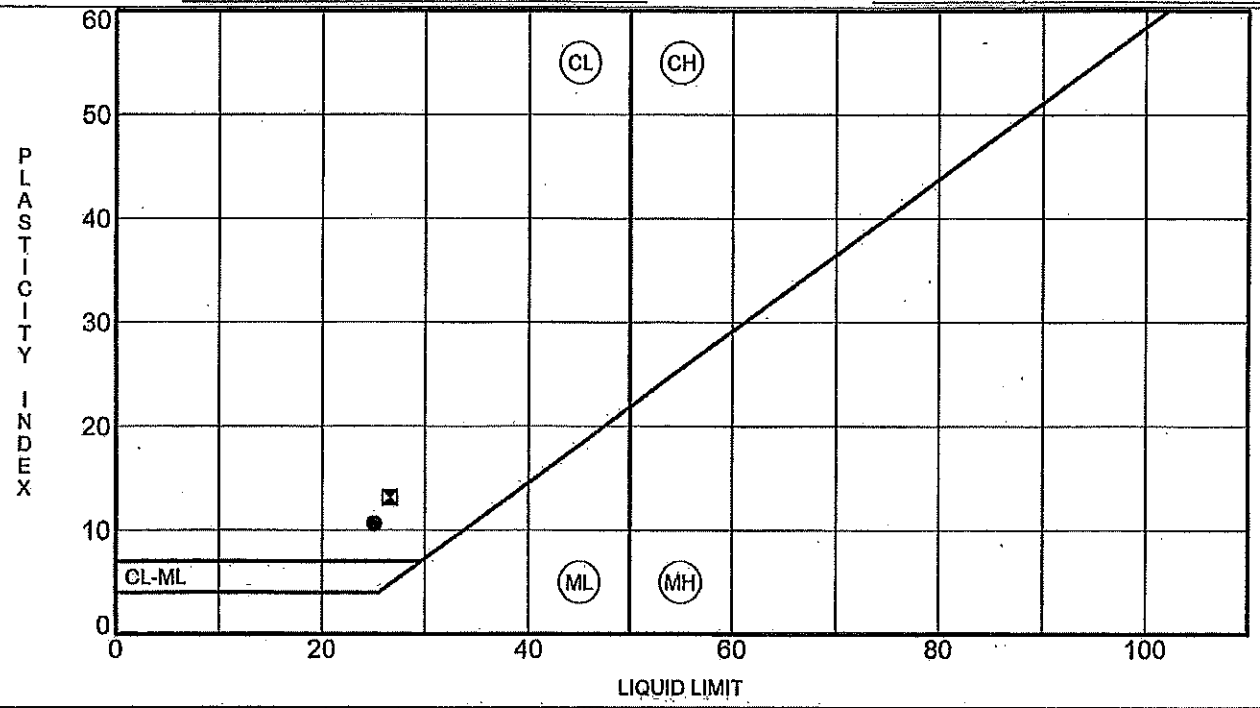
ATTERBERG LIMITS' RESULTS

CLIENT City of Grand Junction

PROJECT NAME Las Colonias Amiptheater

PROJECT NUMBER 00208-0057

PROJECT LOCATION Grand Junction, CO



	Specimen Identification		LL	PL	PI	#200	Classification
●	Composite	12/19/2014	25	14	11	72	LEAN CLAY with SAND(CL)
⊠	TP-5, GB1	12/19/2014	27	13	14	71	LEAN CLAY with SAND(CL)

Huddleston-Berry Engineering & Testing, LLC
640 White Avenue, Unit B
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970-255-8005
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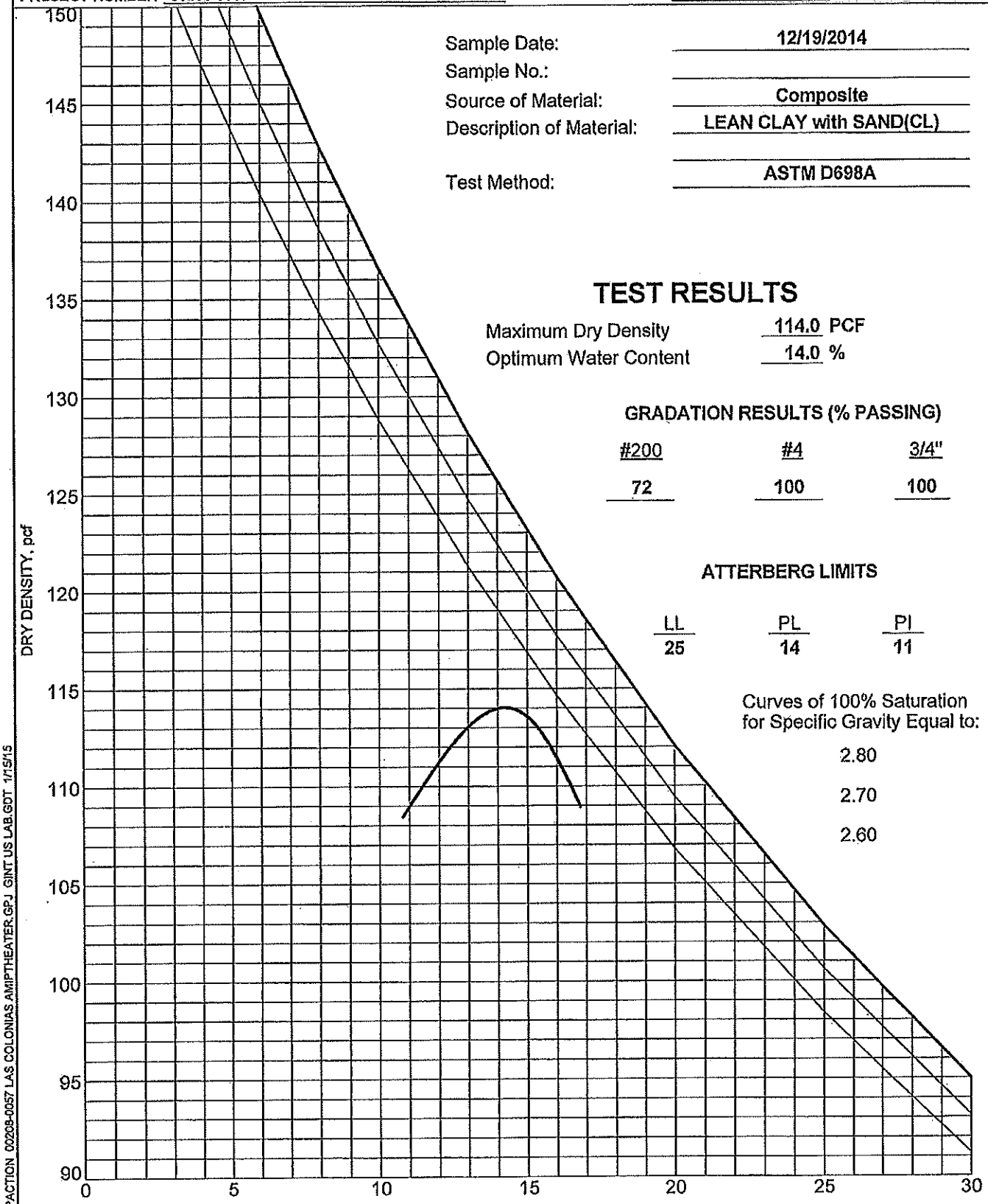
MOISTURE-DENSITY RELATIONSHIP

CLIENT City of Grand Junction

PROJECT NAME Las Colonias Amiptheater

PROJECT NUMBER 00208-0057

PROJECT LOCATION Grand Junction, CO



Sample Date: 12/19/2014

Sample No.:

Source of Material: Composite

Description of Material: LEAN CLAY with SAND(CL)

Test Method: ASTM D698A

TEST RESULTS

Maximum Dry Density 114.0 PCF

Optimum Water Content 14.0 %

GRADATION RESULTS (% PASSING)

#200	#4	3/4"
72	100	100

ATTERBERG LIMITS

LL	PL	PI
25	14	11

Curves of 100% Saturation for Specific Gravity Equal to:

2.80

2.70

2.60

COMPACTION 00208-0057 LAS COLONIAS AMIPTHEATER.GPJ GINT US LAB.GDT 1/7/15

Huddleston-Berry
Engineering & Testing, LLC

CALIFORNIA BEARING RATIO
ASTM D1883

Project No.:	00208-0057		**Authorized By:**	Client	**Date:** 12/19/14
Project Name:	Las Colonias Amiptheater		**Sampled By:**	NB	**Date:** 12/19/14
Client Name:	City of Grand Junction		**Submitted By:**	NB	**Date:** 01/15/15
Sample Number:	14-0788	**Location:** Composite	**Reviewed By:**	MAB	**Date:** 01/21/15

Compaction Method: ASTM D698, Method A

Maximum Dry Density (pcf): 114.0

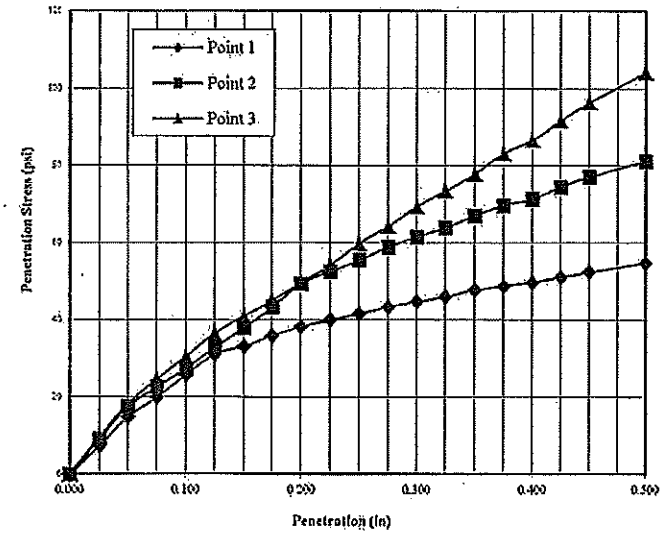
Opt. Moisture Content (%): 14.0

Sample Condition: Soaked

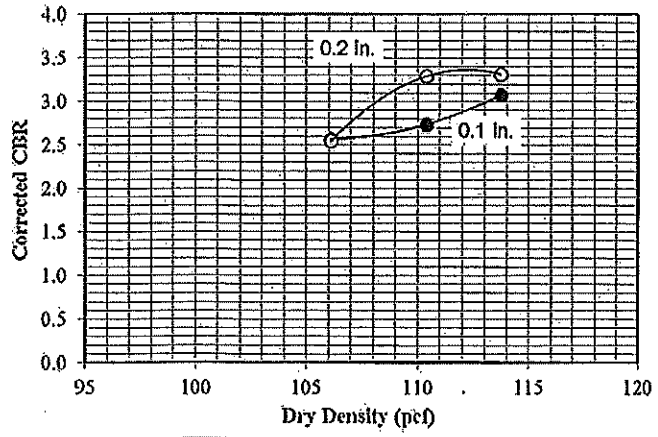
Remarks:

		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):		106.1	110.4	113.7
Dry Density After Soak (pcf):		105.5	109.6	112.9
Moisture Content (%)	Bottom Pre-Test	14.7	14.6	14.1
	Top Pre-Test	14.7	15.6	14.5
	Top 1" After Test	20.4	19.8	18.6
	Average After Soak:	19.4	17.9	16.4
Percent Swell After Soak:		0.6	0.7	0.7

Load Penetration Curve(s)



Dry Density vs CBR



Penetration Data								
Point 1			Point 2			Point 3		
Dist. (in)	Load (lbs)	Stress (psi)	Dist. (in)	Load (lbs)	Stress (psi)	Dist. (in)	Load (lbs)	Stress (psi)
0.000	0	0	0.000	0	0	0.000	0	0
0.025	22	7	0.025	27	9	0.025	29	10
0.050	44	15	0.050	52	18	0.050	54	18
0.075	59	20	0.075	67	23	0.075	73	25
0.100	76	26	0.100	81	27	0.100	90	30
0.125	92	31	0.125	97	33	0.125	108	37
0.150	98	33	0.150	112	38	0.150	121	41
0.175	106	36	0.175	128	43	0.175	133	45
0.200	113	38	0.200	146	49	0.200	147	50
0.225	118	40	0.225	155	52	0.225	160	54
0.250	123	42	0.250	164	55	0.250	177	60
0.275	128	43	0.275	174	59	0.275	190	64
0.300	132	45	0.300	182	62	0.300	205	69
0.325	136	46	0.325	189	64	0.325	217	73
0.350	141	48	0.350	198	67	0.350	230	78
0.375	144	49	0.375	206	70	0.375	246	83
0.400	147	50	0.400	211	71	0.400	256	87
0.425	151	51	0.425	220	74	0.425	271	92
0.450	155	52	0.450	228	77	0.450	285	96
0.500	162	55	0.500	240	81	0.500	308	104

Corrected CBR @ 0.1"		
2.6	2.7	3.1
Corrected CBR @ 0.2"		
2.5	3.3	3.3

Penetration Distance Correction (in)		
0.000	0.000	0.000

Figure: ____