Soil Investigation Report
Salt Flats Site Development
450 28 Road Property
Grand Junction, Colorado

Prepared for:

City of Grand Junction
244 North 7th Street
Grand Junction, Colorado

Attention: Ken Haley, PE
City of Grand Junction, Engineering Manager

Prepared by:

RockSol Consulting Group, Inc.
12076 Grant Street
Thornton, Colorado 80241

RockSol Project No. 803.08
April 26, 2024

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Ryan Lepro
Engineering Geologist

Reviewed by: Donald G. Hunt, P.E.
Senior Geotechnical Engineer

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ATTACHMENTS

1.0 PROJECT PURPOSE AND DESCRIPTION

This report documents the subsurface investigation performed by RockSol Consulting Group, Inc. (RockSol) to assist with design of the project for the proposed City of Grand Junction Salt Flats Development Project. The proposed Salt Flats Development Project will include new roadway infrastructure and proposed new mixed use site development on the property located at 450 28 Road. The City of Grand Junction is in the process of reviewing this property for consideration of purchase for new development in coordination with the Grand Junction Housing Authority.

Documents provided by the City of Grand Junction for consideration on this project include:

- Site Concept Plan of the proposed development (See Appendix A)
- Phase I Environmental Site Assessment Report, completed by Walter Environmental and Engineering Group, Walter Project No. 030-08-001, dated February 20, 2024
- Geotechnical Report Competed for the Site by Huddleston Berry (HBET), Dated March 9, 2023

The scope of work for this geotechnical investigation included:

- Preparing a drilling program to perform a subsurface investigation and implementing the program to collect soil samples for laboratory testing.
- Performing laboratory tests and analyzing the data.
- Preparing a subsurface exploration/soil investigation report presenting the field and laboratory data obtained and geological conditions.

Surface and groundwater hydrology, hydraulic engineering, and environmental evaluation of site soils and groundwater for possible contaminant characterization were not included in RockSol's geotechnical scope of work.

2.0 PROJECT LOCATION AND SITE CONDITIONS

The project site is located in the northwest corner of Section 18, Township 1 South, Range 1, east of the Ute Meridian in the City of Grand Junction, Colorado. The project site is bounded on the south by Grand Avenue and I-70 Business Route, on the west by 28 Road, on the east by the residential properties along 28 ½ Road, and on the north by residential and commercial. The project site is currently undeveloped. Topography generally consists of relatively flat slopes, decreasing in elevation from north to south towards the Colorado River located approximately 1.25 miles south of the project site.

Residential developments are noted to the west and north along with commercial business development to the north, south, and east. General site vicinity is shown in Images 1 and 2 and the proposed site concept plan can be found in Appendix A and Image 3.

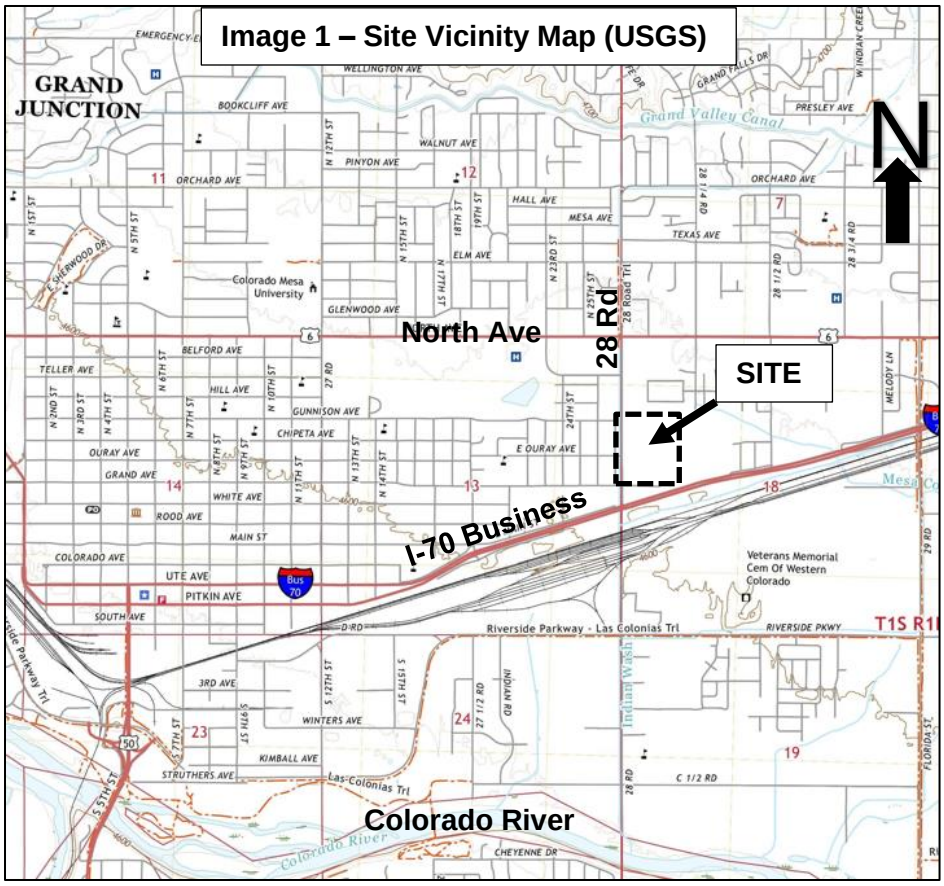


Image 1 – Site Vicinity Map (USGS)

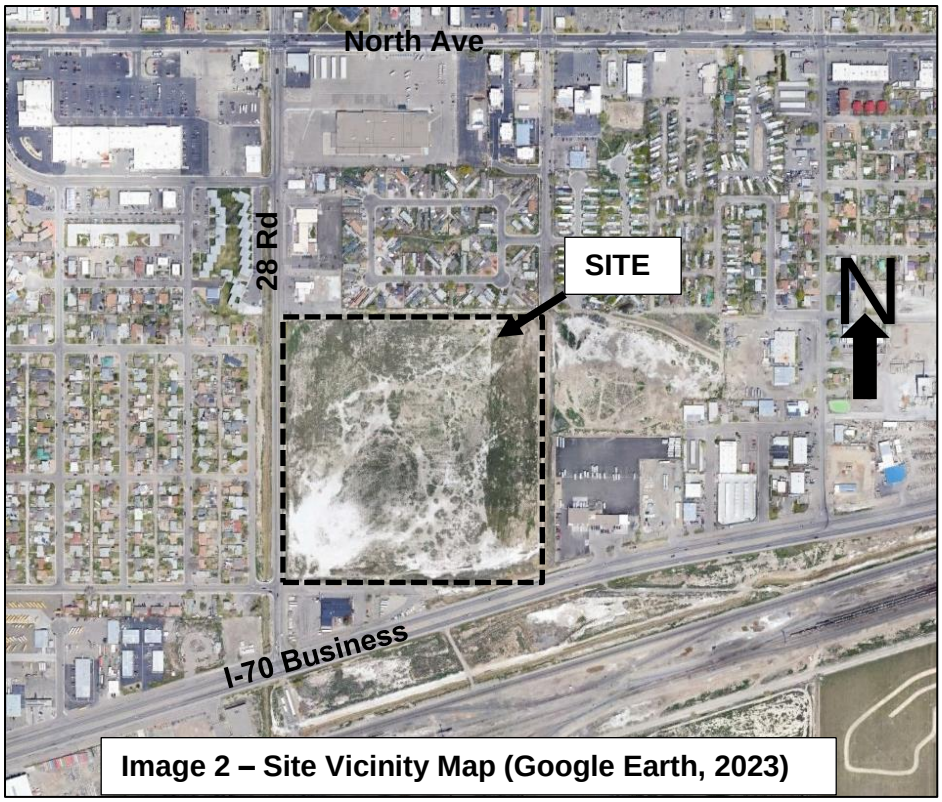


Image 2 – Site Vicinity Map (Google Earth, 2023)

3.0 SUBSURFACE EXPLORATION

RockSol completed three soil boreholes (BH-1 – BH-3) on March 21 and 22, 2024 to evaluate subsurface conditions at the project site based on the Site Concept Plan as shown on Image 3 and in Appendix A.

Image 3 – Proposed Salt Flats Development (Kaart Planning)

The boreholes were advanced using 9-inch outside diameter hollow stem augers to maximum depths ranging from approximately 33 feet to 35 feet below existing grades. A truck mounted Dietrich 90 drill rig was used for drilling and sampling of the boreholes. The boreholes were logged in the field by a representative of RockSol with the depth to groundwater, if encountered, noted at the time of drilling. Temporary piezometer pipes (2-inches in diameter) were installed within each borehole at the completion of drilling and sampling for subsequent water level monitoring.

Subsurface materials were sampled and resistance of the soil to penetration of the sampler was performed using modified California barrel and standard split spoon samplers. The modified California barrel sampler has an outside diameter of approximately 2.5 inches and an inside

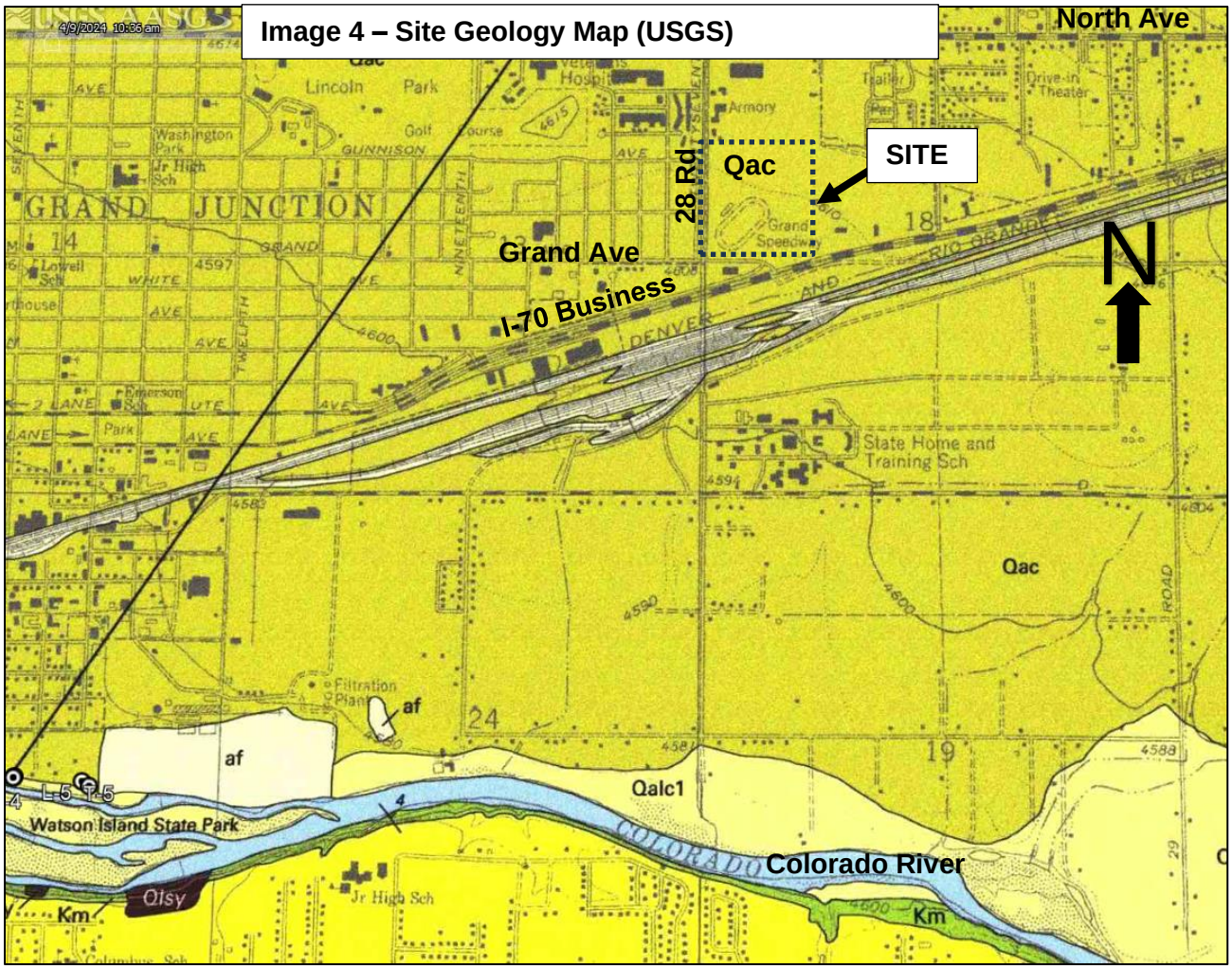
diameter of 2 inches. The standard split spoon sampler used had an outside diameter of 2 inches and an inside diameter of 1⅜-inches. Brass tube liners were used with the modified California barrel sampler. Brass tube liners are not used with the standard split spoon sampler. Soils were logged in the field per ASTM D2488.

Penetration Tests were performed at selected intervals using an automatic hammer lift system. The standard split spoon sampling method is the Standard Penetration Test (SPT) described by ASTM Method D-1586. Penetration Tests were also performed using the modified California barrel sampler with a standard hammer weighing 140 pounds falling 30 inches per ASTM D3550. The modified California Barrel sampling method is similar to the SPT test with the difference being the sampler dimensions and the number of 6-inch intervals driven with the hammer. It is RockSol's experience that blow counts obtained with the modified California sampler tend to be slightly greater than a standard split spoon sampler. Penetration resistance values (blow counts) were recorded for each sampling event. Blow counts, when properly evaluated, indicate the relative density or consistency of the soils.

Depths at which the samples were taken, the type of sampler used, and the blow counts that were obtained are shown on the Boring Logs for each borehole. Individual Borehole Logs are included in Appendix B.

4.0 GEOLOGICAL SETTING

Based on information presented in the United States Geological Survey (USGS) Geologic Map (See Image 4, *Site Geology Map*) *Geologic map of the Grand Junction quadrangle, Mesa County, Colorado, Scott, R.B., Carrara, P.E., Hood, W.C., and Murray, K.E., U.S. Geological Survey, Miscellaneous Field Studies Map MF-2363, dated 2002*, the project site is predominantly underlain by alluvium and colluvium (Holocene and late Pleistocene) (Qac). Alluvium generally consists of silt, sand, and gravel. The colluvium generally consists of sandy silt, silty to clayey sand, and sandy clay. Mancos Shale bedrock (Km) is mapped at or near the surface south of the project site near the Colorado River. The materials identified by the USGS mapping were consistent with native soils encountered during our subsurface investigation.



5.0 LABORATORY TESTING

Soil samples retrieved from the borehole locations were examined by the project geotechnical engineer in the RockSol laboratory. Selected samples were tested and classified according to the Unified Soil Classification System (USCS). The following laboratory tests were performed in accordance with the American Society for Testing and Materials (ASTM), American Association of State Highway and Transportation Officials (AASHTO), and current local practices:

- Natural Moisture Content (ASTM D-2216)
- Percent Passing No. 200 Sieve (ASTM D-1140)
- Liquid and Plastic Limits (ASTM D-4318)
- Dry Density (ASTM D-2937)
- Soil Classification (ASTM D-2487 and AASHTO M145)
- Gradation (ASTM D6913)
- Water Soluble Sulfate Content (CDOT CP-L 2103)
- Standard Test Method for pH of Soils (ASTM D4972-01)
- Soil Resistivity (ASTM G187 - Soil Box)

Laboratory test results were used to characterize the engineering properties of the subsurface material. For soil classification, RockSol conducted sieve analyses and Atterberg Limits tests. Lab testing was also performed on selected samples to determine the water-soluble sulfate content of subsurface materials to assist with cement type recommendations. Laboratory test results are presented in Appendix C and are also summarized on the Borehole Logs presented in Appendix B.

6.0 SUBGRADE CHARACTERIZATION

Subsurface conditions at the boreholes BH-1 through BH-3 generally consist of very soft to stiff native clay soils overlying dense to very dense silty to gravelly sand with cobbles. Groundwater was encountered at an approximate depth of 23 feet below existing grade during drilling operations in Borehole BH-3 and at depths ranging from approximately 13 feet to 17 feet below existing grades 4 and 5 days after drilling operations. See Table 1 for ground surface and groundwater elevations.

Table 1 – Groundwater Elevations

Borehole	Date of Measurement	Top of Well Cover / Ground Surface Elevation (ft)	Groundwater Elevation (ft)	Depth (ft) to Groundwater from Well Cover
BH-1	3/26/24	4608.7	4592.7	16
BH-2	3/26/24	4613.9	4596.5	17.4
BH-3	3/26/24	4604.9	4591.7	13.2
BH-1	4/25/24	4608.7	4592.7	16
BH-2	4/25/24	4613.9	4596.7	17
BH-3	4/25/24	4604.9	4591.8	13.1

6.1 Cement Type/Sulfate Resistance

Cementitious material requirements for concrete in contact with soils or groundwater are based on the percentage of water-soluble sulfate. Mix design requirements for concrete exposed to water-soluble sulfates in soils or water is considered by the Colorado Department of Transportation (CDOT) as shown in Table 2 and in the 2023 CDOT Standard Specifications for Road and Bridge Construction.

Table 2 – Requirements to Protect Against Damage to Concrete by Sulfate Attack from External Sources of Sulfate

Water-Soluble Sulfate (SO_4) in dry soil, percent	Water-Soluble Sulfate (SO_4) in water, ppm	Cementitious Material Requirements
0.00 to 0.10	0 to 150	Class 0
0.11 to 0.20	151 to 1,500	Class 1
0.21 to 2.0	1,501 to 10,000	Class 2
2.01 or greater	10,001 or greater	Class 3

The concentration of water-soluble sulfates measured in soil samples obtained from RockSol's exploratory boreholes ranged from 0.36 percent to 1.56 percent by weight (See Appendices B and C). Based on the results of the water-soluble sulfate testing, Exposure Class 2 cementitious material requirements are considered appropriate for concrete in contact with subgrade materials for this project. Refer to CDOT's current Specifications in Section 601 for concrete mixtures that satisfy appropriate sulfate exposure Class 2 requirements.

Electrical resistivity and pH tests were also performed on selected samples and are summarized in Appendix C – Summary of Physical & Chemical Test Results. The electrical resistivity analyses were performed in the RockSol laboratory using the soil box method. Additional testing at specific structure locations may be performed to provide structure specific corrosion resistance recommendations. Based on the result of the electrical resistivity test performed on a sample obtained at 9 feet below the existing grade at Borehole BH-2, the soils should be considered as "aggressive" to unprotected metals.

7.0 LIMITATIONS

This geotechnical investigation was conducted in general accordance with the scope of work. The geotechnical practices are similar to that used in Colorado with similar soil conditions and our understanding of the proposed work.

The subsurface investigation program was conducted to obtain information on the subsurface soil and groundwater conditions at the proposed Salt Flats Development site. RockSol is not providing geotechnical recommendations for site development, pavement thickness, or building foundations. Surface and groundwater hydrology, hydraulic engineering, and environmental studies including contaminant characterization were not included in RockSol's geotechnical scope of work.

This report has been prepared by RockSol for the City of Grand Junction exclusively for the project described in this report. The report is based on our exploratory boreholes and does not take into account variations in the subsurface conditions that may exist between boreholes. Additional investigation is required to address such variation. If during construction activities, materials or water conditions appear to be different from those described herein, RockSol should be advised at once so that a re-evaluation of the subsurface conditions presented in this report can be made. RockSol is not responsible for liability associated with interpretation of subsurface data by others.

APPENDIX A

SITE CONCEPT PLAN AND BOREHOLE LOCATION PLAN

MIXED USE

TOWNHOMES

TRI-PLEXES

APARTMENTS

APARTMENTS

(9) 24 PLEXES = 216 UNITS (3 STORIES)
(7) 12 PLEXES = 84 UNITS (3 STORIES)
PARKING SPACES REQUIRED = 300 * 0.75 = 225 SPACES
PARKING SPACES PROVIDED = 300 SPACES

TOWNHOMES & TRI-PLEXES

15 TRI-PLEXES
*2 BDR/2 BATH 1,167 SF PER UNIT
47 TOWNHOMES
*2 BDR/2.5 BATH & 1,509 SF PER UNIT
62 = TOTAL UNITS
* 1 GARAGE SPACE PER UNIT PROVIDED

MIXED-USE (2 BUILDINGS)

FIRST FLOOR = RETAIL
SECOND FLOOR = 4 UNITS*2 = 8 UNITS
THIRD FLOOR = 4 UNITS*2 = 8 UNITS
RESIDENTIAL PARKING SPACES REQUIRED = 16*0.75 = 12 SPACES
PARKING SPACES PROVIDED = 55 SPACES

TOTAL DENSITY

300 + 62 + 16 = 378
378/18.6 acres = 20.3 units/acre

SALT FLATS HOUSING

SITE CONCEPT

N
0 200 400

Kaart PLANNING & LANDSCAPE ARCHITECTURE

APPENDIX B

LEGEND AND INDIVIDUAL BOREHOLE LOGS

RockSol Consulting Group, Inc.

LEGEND

CLIENT City of Grand Junction **PROJECT NAME** Salt Flats Development Project

PROJECT NUMBER 803.08 **PROJECT LOCATION** Grand Junction, Colorado

LITHOLOGY

Native - CLAY

Native - SAND, with cobbles and gravel

SAMPLE TYPE

BULK SAMPLE (Auger Cuttings)

MODIFIED CALIFORNIA SAMPLER
2.5" O.D. AND 2" I.D.
WITH BRASS LINERS INCLUDED

SPLIT SPOON SAMPLER
2" O.D. AND 1 3/8" I.D.
NO LINERS

Fines Content indicates amount of material, by weight, passing the US No 200 Sieve (%)

15/12 Indicates 15 blows of a 140 pound hammer falling 30 inches was required to drive the sampler 12 inches.

50/11 Indicates 50 blows of a 140 pound hammer falling 30 inches was required to drive the sampler 11 inches.

5,5,5 Indicates 5 blows, 5 blows, 5 blows of a 140 pound hammer falling 30 inches was required to drive the sampler 18 inches.

GROUND WATER LEVEL AT TIME OF DRILLING

GROUND WATER LEVEL AT 2ND MEASUREMENT

RockSol Consulting Group, Inc.

BORING : BH-1

CLIENT City of Grand Junction
PROJECT NAME Salt Flats Development Project
PROJECT NUMBER 803.08
PROJECT LOCATION Grand Junction, Colorado
DATE STARTED 3/21/24 **COMPLETED** 3/22/24
GROUND ELEVATION _____ **STATION NO.** _____
DRILLING CONTRACTOR HRL
NORTH _____ **EAST** _____
DRILLING METHOD Hollow Stem Auger **HOLE SIZE** 9.0"
BORING LOCATION: 28 Rd and Gunnison Ave
LOGGED BY T. Woolley **HAMMER TYPE** Automatic
GROUND WATER LEVELS:
NOTES _____
WATER DEPTH None Encountered on 3/21/24

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS	SWELL POTENTIAL (%)	SULFATE (%)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
	0		(Native) CLAY, moist, gray, stiff										
	5			MC	9/12		0.36	107.2	18.8				
	10												
	15												
			(Native) CLAY, wet, gray, medium stiff to stiff										
	20			MC	5/12			101.5	25.9	41	20	21	95.9
	25			MC	12/12					52	25	27	99.3
	30												
			(Native) SAND, with cobbles, wet, tan, dense										
	35			SS	50/4								
			Bottom of hole at 35.3 feet.										

RockSol Consulting Group, Inc.

BORING : BH-2

CLIENT City of Grand Junction
PROJECT NAME Salt Flats Development Project
PROJECT NUMBER 803.08
PROJECT LOCATION Grand Junction, Colorado
DATE STARTED 3/22/24 **COMPLETED** 3/22/24
GROUND ELEVATION _____ **STATION NO.** _____
DRILLING CONTRACTOR HRL
NORTH _____ **EAST** _____
DRILLING METHOD Hollow Stem Auger **HOLE SIZE** 9.0"
BORING LOCATION: 28 1/4 Rd and Gunnison Ave
LOGGED BY T. Woolley **HAMMER TYPE** Automatic
GROUND WATER LEVELS:
NOTES _____
WATER DEPTH None Encountered on 3/22/24

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS	SWELL POTENTIAL (%)	SULFATE (%)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
	0		(Native) CLAY, sand in parts, moist to very moist, brown, very soft to stiff										
	5			B BULK									
	10			MC	2/12			88.8	28.5	25	16	9	98.8
	15												
	20												
	25			MC	2/12		1.56	88.7	25.8				
	30			MC	13/12			93.9	23.4	44	21	23	58.3
			(Native) SAND, with cobbles, wet										
			Bottom of hole at 34.0 feet.										

LOG - STANDARD 803.08_SALT FLATS DEVELOPMENT.GPJ 4/9/24

RockSol Consulting Group, Inc.

BORING : BH-3

CLIENT City of Grand Junction
PROJECT NAME Salt Flats Development Project
PROJECT NUMBER 803.08
PROJECT LOCATION Grand Junction, Colorado
DATE STARTED 3/21/24 **COMPLETED** 3/21/24
GROUND ELEVATION _____ **STATION NO.** _____
DRILLING CONTRACTOR HRL
NORTH _____ **EAST** _____
DRILLING METHOD Hollow Stem Auger **HOLE SIZE** 9.0"
BORING LOCATION: 28 Rd and Grand Ave
LOGGED BY T. Woolley **HAMMER TYPE** Automatic
GROUND WATER LEVELS: ▼ **1ST DEPTH** 23.0 ft on 3/21/24
NOTES _____
▼ **2ND DEPTH** 13.0 ft on 3/21/24

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	SWELL POTENTIAL (%)	SULFATE (%)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
	0		(Native) CLAY, moist, tan, stiff to medium stiff										
	5			MC	11/12		1.04	105.0	18.9				
	10												
	15												
	20			MC	6/12			96.4	25.9	34	18	16	99.4
	25		(Native) CLAY, wet, tan, medium stiff										
	30		(Native) SAND, with gravel and cobbles, wet, tan, medium dense to dense	SS	4/14/16					NP	NP	NP	7.1
			Bottom of hole at 33.0 feet.										

APPENDIX C

LABORATORY TEST RESULT SUMMARY

AND

TEST RESULT SHEETS

RockSol Consulting Group, Inc.

SUMMARY OF PHYSICAL & CHEMICAL TEST RESULTS

CLIENT City of Grand Junction

PROJECT NAME Salt Flats Development Project

PROJECT NUMBER 803.08

PROJECT LOCATION Grand Junction, Colorado

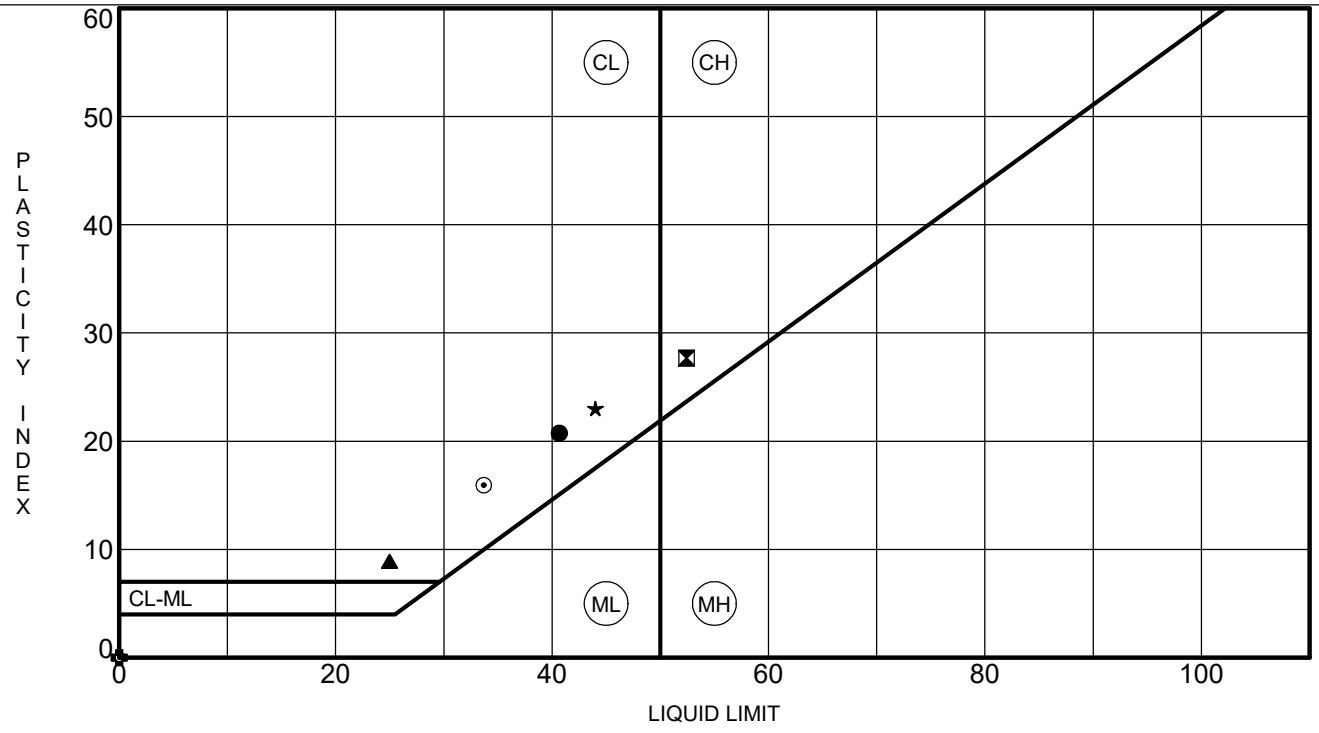
Borehole	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	Swell Potential (%)	%<#200 Sieve	Classification		Water Content (%)	Dry Density (pcf)	Unconfined Compressive Strength (psi)	Sulfate (%)	Resistivity (ohm-cm)	pH	Chlorides (%)	Proctor S=Standard M=Modified		
							USCS	AASHTO								MDD	OMC	S/M
BH-1	4								18.8	107.2		0.36						
BH-1	20	41	20	21		96	CL	A-7-6 (21)	25.9	101.5								
BH-1	26	52	25	27		99	CH	A-7-6 (31)										
BH-2	3-8												1000 @ 12.9%					
BH-2	9	25	16	9		99	CL	A-4 (7)	28.5	88.8								
BH-2	23								25.8	88.7		1.56		8.1				
BH-2	29	44	21	23		58	CL	A-7-6 (11)	23.4	93.9								
BH-3	6								18.9	105.0		1.04		8.7				
BH-3	18	34	18	16		99	CL	A-6 (16)	25.9	96.4								
BH-3	29	NP	NP	NP		7	SP-SM	A-3 (0)										

RockSol Consulting Group, Inc.

ATTERBERG LIMITS RESULTS
AASHTO T89 Method A/T90

CLIENT City of Grand Junction **PROJECT NAME** Salt Flats Development Project

PROJECT NUMBER 803.08 **PROJECT LOCATION** Grand Junction, Colorado



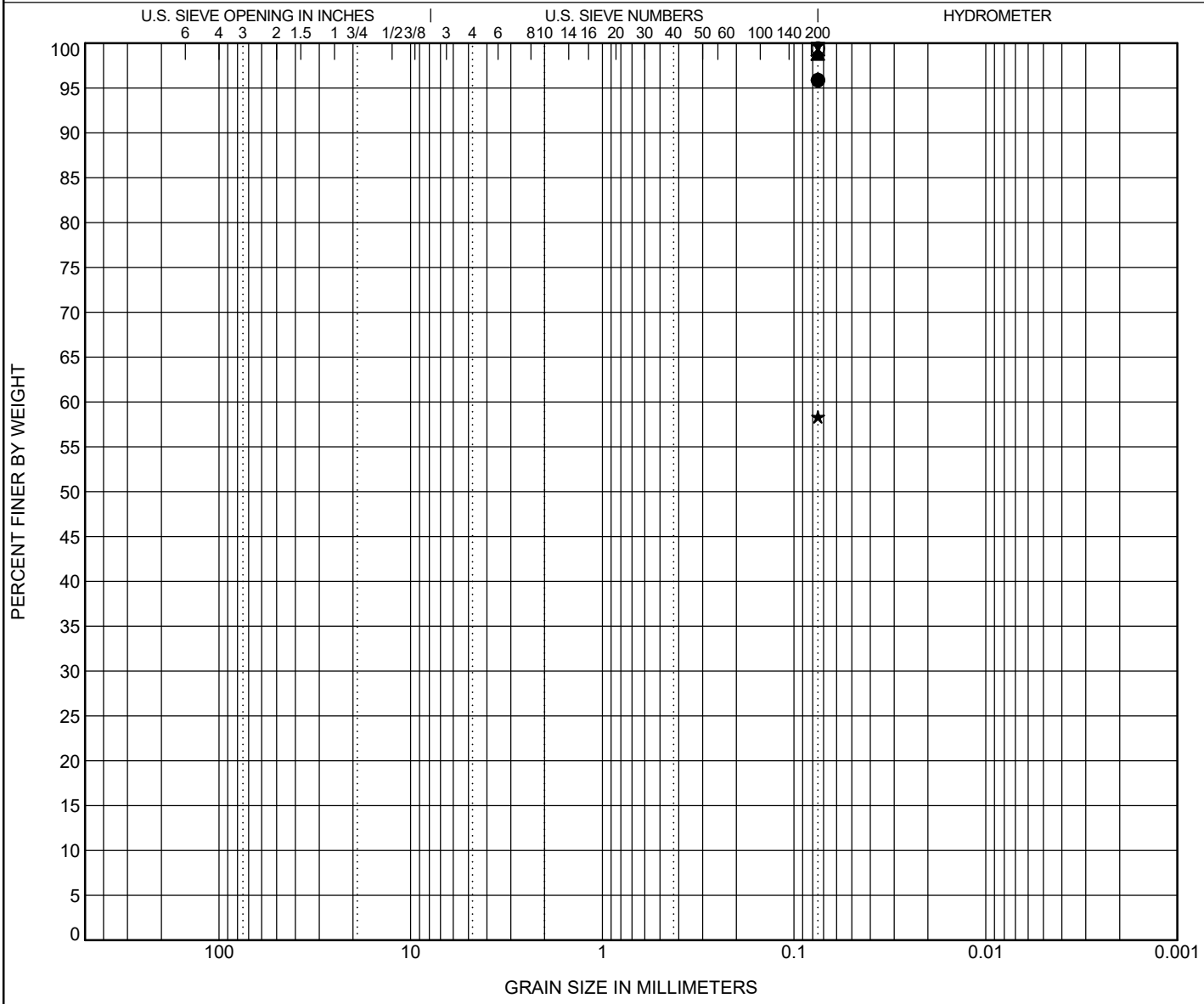
	Specimen Identification		LL	PL	PI	Fines	Classification
●	**BH-1**	**20.0**	**41**	**20**	**21**	**95.9**	**LEAN CLAY (CL) (A-7-6)**
⊠	**BH-1**	**26.0**	**52**	**25**	**27**	**99.3**	**FAT CLAY (CH) (A-7-6)**
▲	**BH-2**	**9.0**	**25**	**16**	**9**	**98.8**	**LEAN CLAY (CL) (A-4)**
★	**BH-2**	**29.0**	**44**	**21**	**23**	**58.3**	**SANDY LEAN CLAY (CL) (A-7-6)**
⊙	**BH-3**	**18.0**	**34**	**18**	**16**	**99.4**	**LEAN CLAY (CL) (A-6)**
✿	**BH-3**	**29.0**	**NP**	**NP**	**NP**	**7.1**	**POORLY GRADED SAND with SILT (SP-SM) (A-3)**

GRAIN SIZE DISTRIBUTION

RockSol

CLIENT City of Grand Junction **PROJECT NAME** Salt Flats Development Project

PROJECT NUMBER 803.08 **PROJECT LOCATION** Grand Junction, Colorado



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification			Classification	LL	PL	PI	Cc	Cu
●	BH-1	20.0	LEAN CLAY (CL) (A-7-6)	41	20	21		
⊠	BH-1	26.0	FAT CLAY (CH) (A-7-6)	52	25	27		
▲	BH-2	9.0	LEAN CLAY (CL) (A-4)	25	16	9		
★	BH-2	29.0	SANDY LEAN CLAY (CL) (A-7-6)	44	21	23		
⊙	BH-3	18.0	LEAN CLAY (CL) (A-6)	34	18	16		

Specimen Identification			D100	D60	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
●	BH-1	20.0	0.075							95.9	
⊠	BH-1	26.0	0.075							99.3	
▲	BH-2	9.0	0.075							98.8	
★	BH-2	29.0	0.075							58.3	
⊙	BH-3	18.0	0.075							99.4	

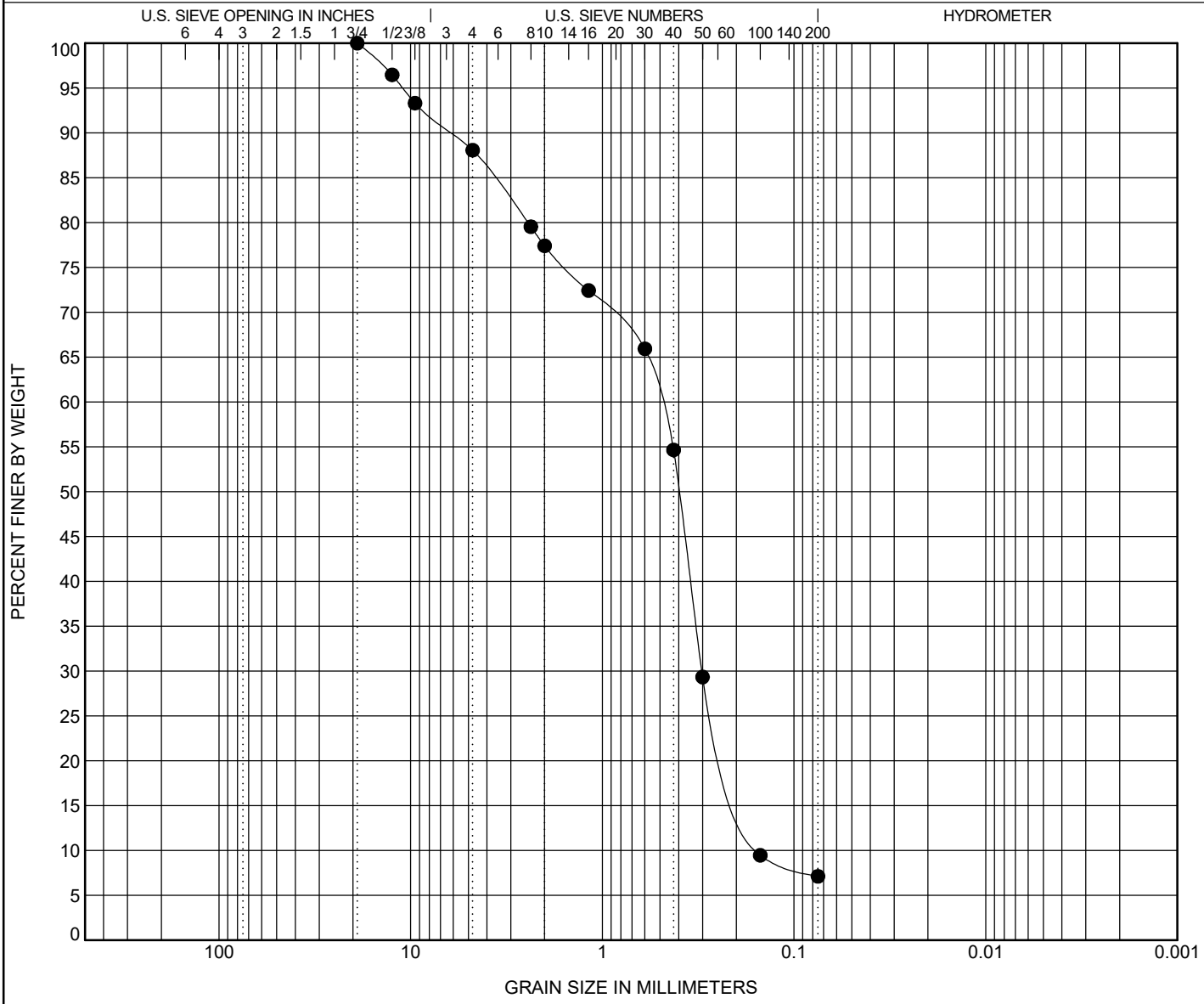
GRADATION - STANDARD 803.08_SALT FLATS DEVELOPMENT.GPJ ROCKSOL TEMPLATE.GDT 4/9/24

GRAIN SIZE DISTRIBUTION

RockSol

CLIENT City of Grand Junction **PROJECT NAME** Salt Flats Development Project

PROJECT NUMBER 803.08 **PROJECT LOCATION** Grand Junction, Colorado



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification		Classification	LL	PL	PI	Cc	Cu
● **BH-3**	**29.0**	**POORLY GRADED SAND with SILT (SP-SM) (A-3)**	**NP**	**NP**	**NP**	**1.20**	**3.27**

Specimen Identification		D100	D60	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
● **BH-3**	**29.0**	**19**	**0.501**	**0.303**	**0.153**	**22.6**	**22.8**	**47.5**	**7.1**	

GRADATION - STANDARD 803.08_SALT FLATS DEVELOPMENT.GPJ ROCKSOL TEMPLATE.GDT 4/9/24