Emerson Park Geotechnical and Parking Lot Pavement Design
City of Grand Junction, Colorado
Professional Geotechnical Services On-Call RFP-4739-20-DH
Contract Renewal Option #4887-23-DH

RockSol Project No. 599.77
July 14, 2023

Prepared for:

City of Grand Junction, Public Works
333 West Avenue, Bldg. C
Grand Junction, Colorado, 81501

Attention: Kirsten Armbruster, PE

Prepared by:

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566 W Crete Circle #2
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ATTACHMENTS

1.0 PROJECT PURPOSE AND DESCRIPTION

This report documents the geotechnical engineering investigation performed by RockSol Consulting Group, Inc. (RockSol) to assist the City of Grand Junction (City) with the design of a proposed parking lot and skate park improvements project at Emerson Park in Grand Junction, Colorado. The scope of work for this geotechnical investigation was presented in our proposal, dated April 5, 2023, and included preparing a subsurface investigation to collect subsurface soil samples for laboratory testing and evaluation.

The proposed Park improvements include a new paved parking area (approximately 10-12 parking stalls) with access from 10th Street, potential pedestrian pathway improvements, and a concrete-surfaced skate park with depressed bowls. The majority of parking improvements will be located on the east end of the park, with skate park improvements towards the center of the park. Improvements will be designed to minimize disturbance to the existing trees. A specialty design consultant will be assisting the City with design of the Skate Park amenities.

The subsurface investigation program was conducted to obtain geotechnical information on the subsurface soil, groundwater, and bedrock conditions at the Emerson Skate Park Project site. Surface and groundwater hydrology, hydraulic engineering, and environmental studies including contaminant characterization were not included in RockSol's geotechnical scope of work.

2.0 PROJECT LOCATION AND SITE CONDITIONS

The Emerson Skate Park Project area is located between south 9th Street and South 10th Street and between Ute Avenue and Pitkin Avenue (see Figure 1). Developments near or adjacent to the site include commercial and residential properties. Topography at the site generally consists of flat to mild slopes with decreasing elevation to the south.

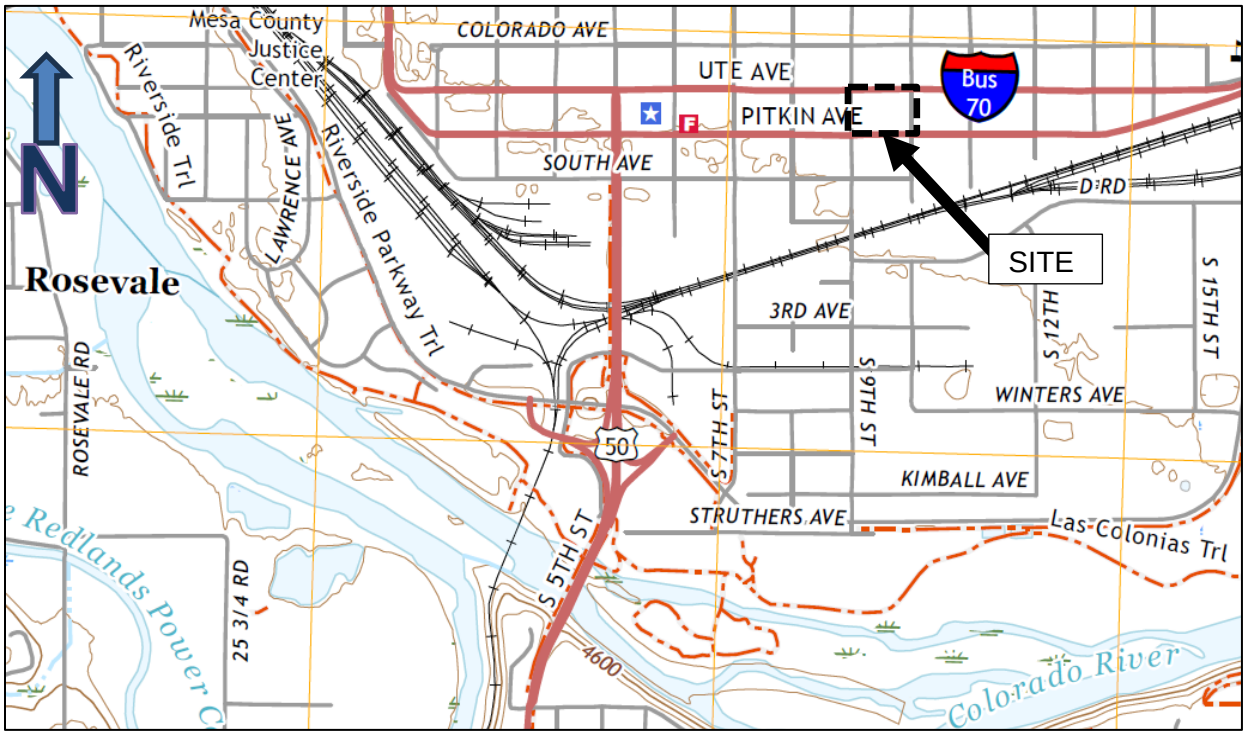


Figure 1 – Site Vicinity Map (USGS Topoview, 2022)

3.0 SUBSURFACE EXPLORATION

On May 30, 2023, RockSol advanced three vertically oriented boreholes to evaluate subsurface conditions at the project site. The borehole locations are identified as B-1 through B-3 as shown in Figure 2, Borehole Location Plan. A truck mounted Simco 2800 drill rig was used for drilling and sampling. The boreholes were advanced using 4-inch outside diameter solid stem auger to a maximum depth of 10 feet (Borehole B-1) and 15 feet (Boreholes B-2 and B-3) below existing grades. The boreholes were logged in the field by a representative of RockSol. Two boreholes (B-1 and B-3) were backfilled with auger cuttings and pea gravel material at the completion of drilling and groundwater level checks. A temporary piezometer was installed at Borehole B-2 and was left open temporarily to monitor groundwater elevation after completion of the borehole.

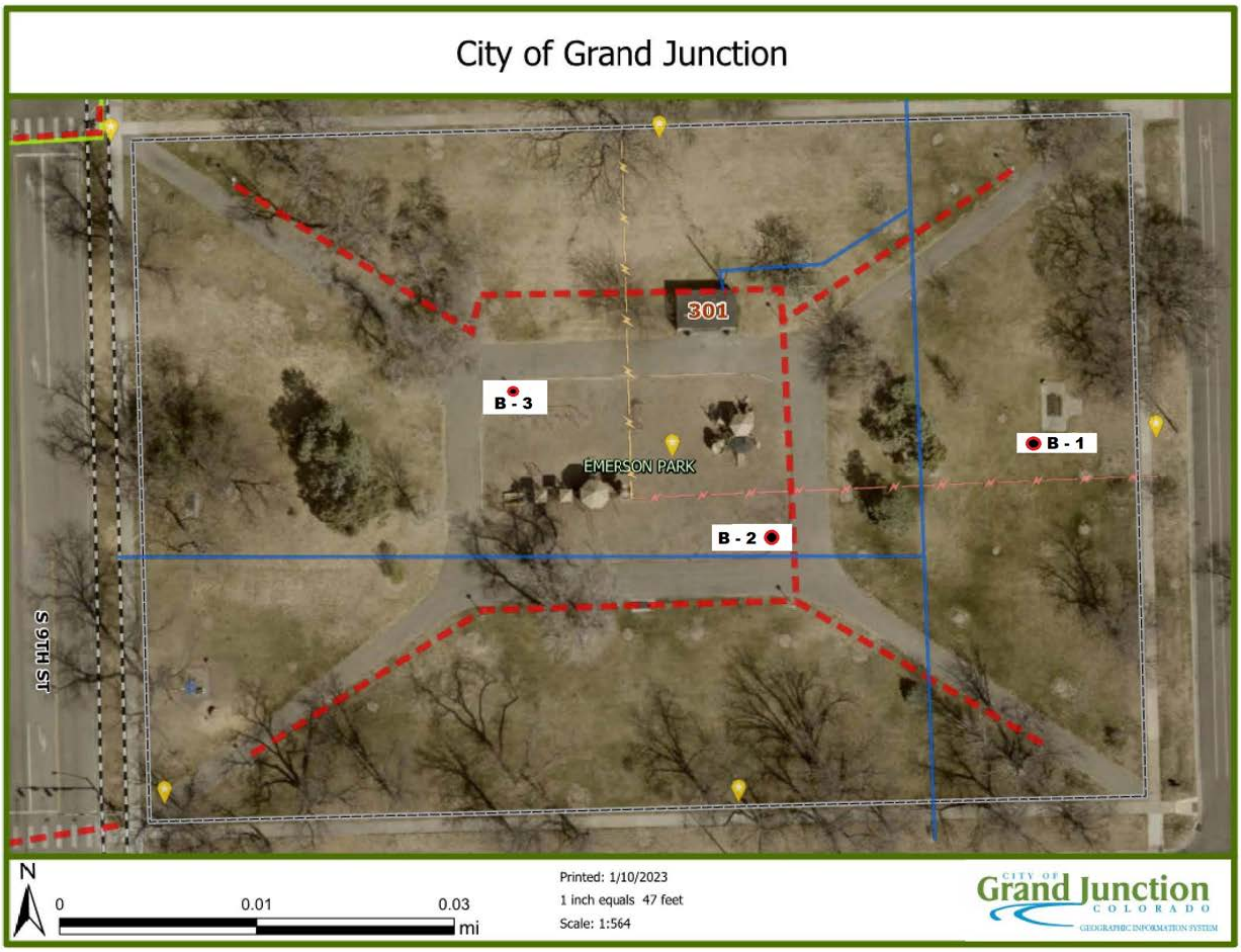


Figure 2 – Borehole Location Plan

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.

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 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. The borehole were logged in general accordance of ASTM D2488.

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 A.

Following borehole drilling and sampling operations, a piezometer pipe consisting of 1-inch-diameter Schedule 40 PVC slotted casing was installed in Borehole B-2 to the maximum depth drilled. Sand filter material for the piezometer was placed from the bottom of the borehole to approximately 1 foot below the ground surface on the outside of the pipe. Native clay soil was placed around the piezometer within the upper 1 foot of the ground surface to reduce the infiltration potential of precipitation. After subsequent groundwater depths were measured, the piezometer pipe was removed, and the borehole backfilled.

4.0 LABORATORY TESTING

Soil samples retrieved from the boreholes were reviewed by the project geotechnical engineer and selected samples were tested and classified according to the Unified Soil Classification System (USCS) and American Association of State Highway and Transportation Officials (AASHTO) classification systems . The following laboratory tests were performed in accordance with the American Society for Testing and Materials (ASTM), 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)
- Gradation (ASTM D 6913)
- Water-Soluble Sulfates (CDOT CP-L 2103)
- Soil Resistivity (ASTM G187 - Soil Box)
- Soil Classification (ASTM D-2487 and AASHTO M145)
- Swell Test (Denver Swell Test, modified from ASTM D-4546)
- Resistance Value (R-Value, AASHTO T190)

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. All laboratory tests were performed by RockSol. Laboratory test results are presented in Appendix B and are also summarized on the Borehole Logs presented in Appendix A.

5.0 SURFACE AND SUBSURFACE CHARACTERIZATION

Surface conditions generally consist of 3 inches of sandy clay topsoil (Borehole B-1) and 3 inches of playground wood chip bedding (Boreholes B-2 and B-3) overlying native soils.

At Borehole B-1, stiff to very stiff and moist to very moist clay was encountered below the topsoil and extended to the maximum depth explored of 10 feet. At Borehole B-2, stiff clay that was moist to wet was encountered below the playground chips to a depth of 12 feet where wet, medium stiff, sandy to silty clay was encountered to the maximum depth explored, 15 feet. At Borehole B-3, stiff to medium stiff clay that was moist to very moist was encountered below the playground chips to a depth of 12 feet where wet, soft, sandy to silty clay was encountered to the maximum depth explored, 15.5 feet.

RockSol did not encounter cobble or boulder size material to the maximum depths explored, approximately 10 feet to 15.5 feet below existing grades. Bedrock was not encountered to the maximum depths drilled, approximately 10 feet to 15 feet below existing grades. Based on the materials encountered and the geologic setting described in Section 6.0, cobble or boulder-sized material is not anticipated to be encountered within 15 feet of the ground surface at this site.

Groundwater was noted at approximate depths of 9.3 to 9.5 feet below existing grades at Boreholes B-2 and B-3 during drilling operations. When checked one day after completion of the borehole, groundwater was observed at a depth of 10.5 feet in Borehole B-3. A temporary piezometer pipe was placed at Borehole B-2 to obtain subsequent groundwater measurements at that location. The piezometer was removed/abandoned on June 26, 2023. A summary of short-term groundwater levels can be found in Table 1.

Table 1: Approximate Ground Surface and Groundwater Elevations

Borehole	Ground Surface Elevation (ft)	Depth To Groundwater (ft)	Groundwater Elevation (ft)	Maximum Depth Drilled
B-1	4586.7	Not Observed	----	10.0
B-2	4584.8	10.9 (Note 1)	4573.9	15.0
B-3	4584.5	10.5 (Note 2)	4574.0	15.5

Note 1: Measured on June 26, 2023
Note 2: Measured on May 31, 2023

Descriptions of the surface and subsurface conditions encountered in the boreholes are summarized on the Borehole Logs presented in Appendix A. A summary of laboratory test results, with soil classifications, is presented in Appendix B.

Swell/Consolidation Potential of Subgrade Soils

Based on swell test results, subgrade soils with low to moderate expansive potential have been identified within the project limits. Swell tests were performed on selected samples obtained from the boreholes at approximate depths of 2 feet to 9 feet below existing grades. The swell/consolidation tests indicated a swell/collapse potential ranging from -0.1 percent (consolidation) to 4.8 percent (swell), when tested with 200 pound per square foot (psf) and 500-psf surcharge pressures. Swell mitigation is not deemed necessary provided subgrade preparation recommendations presented Section 9.2 of this report are properly followed during construction.

Sulfate Resistance Discussion

Cementitious material requirements for concrete in contact with site soils or groundwater are based on the percentage of water-soluble sulfate in either soil or groundwater that will be in

contact with concrete constructed for this project. Mix design requirements for concrete exposed to water soluble sulfates in soils or water is shown in Table 2: Concrete Sulfate, and in the Standard Specifications for Road and Bridge Construction, dated 2022 (from CDOT Table 601-2).

Table 2: Concrete Sulfate Exposure Class

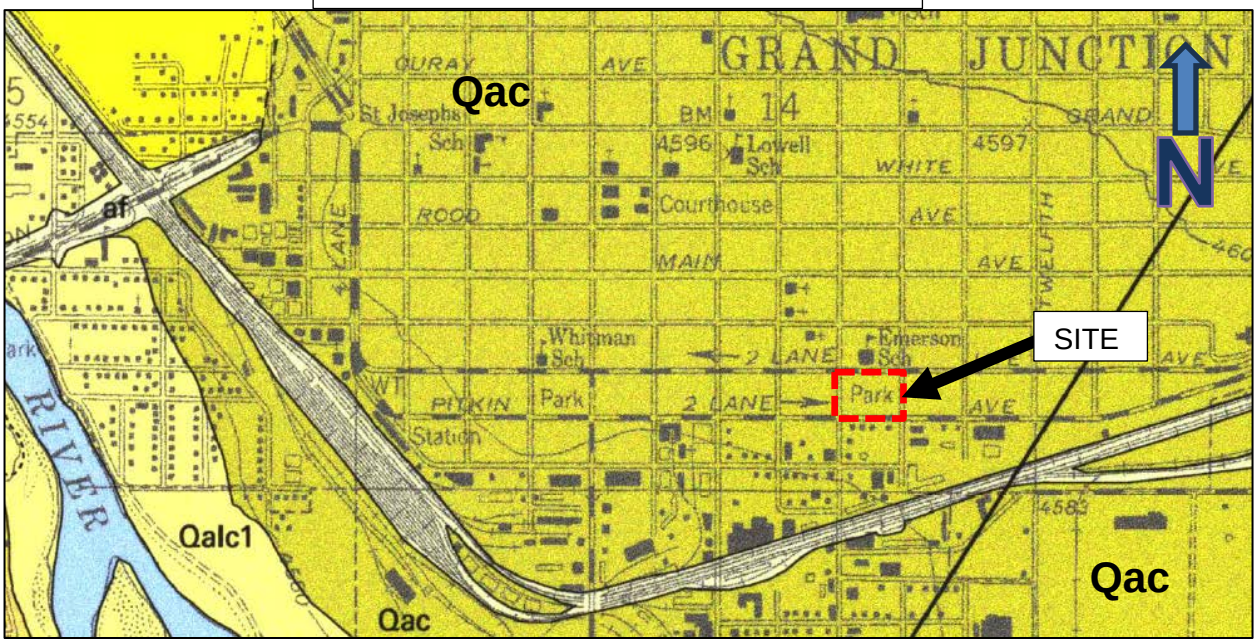
Water-Soluble Sulfate (SO_4) in Dry Soil, (%)	Sulfate (SO_4) In Water, ppm	Cementitious Material Requirements
0.00 to 0.10	0 to 150	Class 0
0.11 to 0.20	151 to 1,500	Class 1
0.21 to 2.0	1,500 to 10,000	Class 2
2.01 or greater	10,001 or greater	Class 3

The concentration of water-soluble sulfates (percent by weight) measured in soil samples obtained in the upper 4 to 15 feet from RockSol's exploratory boreholes ranged from 0.27 to 1.53 percent. Based on the results of the water-soluble sulfate testing, **Class 2** cementitious material mix design requirements for concrete exposed to water soluble sulfates in soils is recommended. Refer to CDOT's current *Standard Specifications for Road and Bridge Construction Section 601* for concrete mixtures that satisfy appropriate sulfate exposure *Class* requirements.

6.0 GEOLOGICAL SETTING

Based on information presented in the *Geologic map of the Grand Junction quadrangle, Mesa County, Colorado by Scott, R.B., Carrara, P.E., Hood, W.C., and Murray, K.E., U.S. Geological Survey, Miscellaneous Field Studies Map MF-2363, Publication Date: 2002,* (See Figure 3 – Site Geology Map), the project site is underlain by Alluvium and colluvium (Qac), undivided (Holocene and late Pleistocene) which is generally made up of a mix of alluvium, sheetwash, and debris flow deposits consisting of sandy silt and clayey silt with shale and sandstone pebbles derived from the Mancos Shale (Km). Mancos Shale is identified at or near the surface approximately 1 mile south of the project site on the southern bank of the Colorado River. Mancos Shale was not encountered to the depths explored for this investigation.

Figure 3 – Site Geology Map (USGS, 2002)



7.0 PAVEMENT DESIGN RECOMMENDATIONS

Park improvements will include the construction of a new paved parking lot on the east side of the Park. CDOT Mechanistic- Empirical (M-E) Pavement Design Methodology is not applicable to parking lot pavement design, so RockSol has prepared pavement design recommendations using the Colorado Asphalt Pavement Association's manual entitled "A Guideline for the Design and Construction of Asphalt Parking Lots in Colorado" dated January 2006, which recommends the use of PAVEXpress software that uses AASHTO 1993 methodology, and the output result can be found in Appendix C.

7.1 Traffic Loading (Parking Lot)

Primary vehicle usage of the proposed parking lot will be passenger cars with infrequent light-duty trucks. For pavement design purposes, RockSol recommends the use of 18,000-pound Equivalent Axle Loads (18-kip ESALs) of 20,000 for a 30-year design life in accordance with Subsection 29.32.030 of the City of Grand Junction Transportation Engineering Design Standards (TEDS) for the approximate 10 space parking facility.

7.2 Pavement Subgrade Characterization

To assist with pavement design recommendations, RockSol obtained bulk samples of on-site soils within 8-feet of the existing ground surface at the borehole locations. Classification testing indicates that the subgrade soils generally consist of a plastic, CLAY soil with an AASHTO soil classification of A-6 with Group Indices ranging from 14 to 21.

To test the subgrade support characteristics, one R-Value laboratory test was performed on in accordance with American Association of State Highway Transportation Officials (AASHTO) T-190 on a combined sample of material obtained within the top 4 feet of the surface from Borehole B-1. An R-Value of 8 was obtained from the sample and is attached to this report in Appendix B. Based on R-Value testing, a conservative R-Value of 5 will be used for new pavement constructed on the existing site soils. In accordance with the Guideline for Design and Use of Asphalt Pavements for Colorado Roadways, published by the Colorado Asphalt Pavement Association dated January 2006, the R-Value of 5 converts to a resilient modulus of 3,035 psi and will be used for the HMA design procedures mentioned in Subsections 29.32.040 (a) of the City of Grand Junction Transportation Engineering Design Standards (TEDS).

7.3 Pavement Design Parameter Summary

A summary of the pavement design input parameters used to evaluate the pavement thickness requirements for the proposed parking lot are presented below.

Table 3: Pavement Design Parameters

Pavement Design Parameter	Value
30-Year Design Life ESAL's	20,000
Subgrade Resilient Modulus, M_R	3,035 psi
Serviceability Loss, (ΔPSI)	2.5
Overall Standard Deviation, S_O	0.44
Reliability, (R)	80%
Structural Coefficient of HMA	0.44
Structural Coefficient of ABC	0.12

7.4 Flexible Pavement Section Thickness Evaluation

A summary of the pavement section thickness obtained from PAVExpress and recommended by RockSol is presented in Table 4. A pavement design calculation sheet is presented in Appendix C for the parking lot area and entrance drive.

Table 4: Pavement Section Thickness Evaluation

Using On-Site Soils (R-Value of 5 used as Design Basis)		
Roadway	**Design ESALs (30 year)**	**Recommended Section (inches)**
Parking Lot (Stall Area)	20,000	4.0 (Asphalt Section) over 6.0 (Aggregate Base Course)
Parking Lot (Entrance Drive)		4.0 (Asphalt Section) over 6.0 (Aggregate Base Course)

The recommended pavement section is two two-inch thick lifts of CDOT's Grading SX mix with 75 design gyrations using a PG 64-22 performance graded binder. The aggregate base course (ABC) layer should be a minimum of six inches of CDOT Class 6 material.

7.5 Other Park Hard Surfacing Recommendations

Interior Park hard surfacing improvements will be included for pedestrian walkways, maintenance vehicles and small trucks associated with Park events. The number of maintenance vehicles and event trucks is anticipated to be very low when considered on a daily average basis.

All pavement (rigid and flexible pavement/flat-work materials) subgrade shall be properly compacted prior to placement of pavement sections. See Section 9.0 for compaction requirements.

Concrete paving for pedestrian-only use should be a minimum of 6-inches thick and should be constructed with a CDOT Class B concrete mix as modified by Section 601 of the current City Grand Junction Standard Specification for Road and Bridge Construction.

Concrete unit pavers are suitable for this site provided they are set on bedding sand with underlying aggregate base course and a geotextile separator fabric for the interface between the aggregate base course and the subgrade soils.

8.0 SKATE PARK EARTHWORK DISCUSSION

The City will be working with a specialty consultant for design of the Skate Park components such as the ramps, bowls, concrete surfacing.

Construction and materials for the proposed skate park amenities shall follow the designer guidelines and recommendations. At a minimum, the compaction and subgrade preparation recommendations presented in Sections 9.1 and 9.2 of this report should be considered.

Groundwater was encountered at an approximate depth of 10.9 feet at this site. The subsurface soils encountered in our boreholes are primarily CLAY and based on the in-situ moisture contents the CLAY appears to be moist to very moist due to capillary rise of the underlying groundwater. The moisture contents measured suggest that the in-situ moisture content is at, or slightly above optimum moisture content compared to the standard proctor performed for this project. Percent saturation values of 90% to 98% were measured in the existing soils.

The in-situ density of the samples suggests that the "state of compaction" is generally at or above 95 percent of maximum dry density compared to the standard proctor value obtained and performed for this investigation.

The CLAY encountered at this site will deflect under the wheels/tires of heavy equipment or vehicles and repeated loading will result in significant deformation of the working surface of the soil. Lightweight equipment and methods are recommended for excavating and reworking the CLAY soils at this site.

9.0 GENERAL EARTHWORK

All earthwork shall be performed in accordance with Section 203 of the current City of Grand Junction Standard Specification for Road and Bridge Construction.

9.1 Compaction Specifications

A representative of the geotechnical engineer should observe and test fill placement operations. The minimum compaction recommendations are presented in Table 5 and are based on AASHTO soil classifications. The majority of the existing site soil falls into the A-6 group shown in Table 5.

Table 5: Compaction Specifications

AASHTO Classification (AASHTO M 145)	AASHTO T 99 (Standard Proctor) Relative Compaction (Minimum Percent)	AASHTO T180 (Modified Proctor) Relative Compaction (Minimum Percent)
A-1	100	95
A-3	100	95
A-2-4	100	95
A-2-5	100	95
A-2-6, A-3, A-4, A-6, A-7-5, and A-7-6	95	Not Applicable

9.2 Subgrade Preparation

Prior to embankment-related and parking lot construction, the underlying subgrade should be properly prepared by removal of all organic matter (topsoil), debris, loose material, and any deleterious material identified by the Project Engineer followed by scarification, moisture conditioning and recompaction. Unless otherwise required, the minimum depth of scarification, moisture conditioning and re-compaction shall be 6 inches and compacting to a minimum of 95 percent of maximum dry density (MDD) as determined by AASHTO T99 (standard proctor) and moisture conditioned to a range from 2 percent below optimum moisture content to 2 percent above optimum moisture content (OMC).

10.0 OTHER DESIGN AND CONSTRUCTION CONSIDERATIONS

Proper construction practices, in accordance with City of Grand Junction Transportation Engineering Design Standards, should be followed during site preparation, structure and earthwork excavations for the suitable long-term performance of the proposed improvements. Excavation support should be provided to maintain onsite safety and the stability of excavations and slopes. Excavations shall be constructed in accordance with local, state and federal regulations including OSHA guidelines. The contractor must provide a competent person to determine compliance with OSHA excavation requirements. For preliminary planning, existing fill material and native soils may be considered as OSHA Type C soils.

Surface drainage patterns may be altered during construction and local landscape irrigation (if any) must be controlled to prevent excessive moisture infiltration into the subgrade soils during and after construction.

Environmentally contaminated material, if encountered, should be characterized and removed under the direction of the project environmental consultant. Design and construction plans should be reviewed, and onsite construction should be observed by the professional engineers.

11.0 LIMITATIONS

This geotechnical investigation was conducted in general accordance with the scope of work. RockSol's geotechnical practices are similar to those used in Colorado with similar soil conditions and based on our understanding of the proposed work. This report has been prepared for use by the City of Grand Junction for the project described in this report. The report is based on our exploratory boreholes and does not consider 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 recommendations presented in this report can be made. RockSol is not responsible for liability associated with interpretation of subsurface data by others.

APPENDIX A

LEGEND AND INDIVIDUAL SOIL BOREHOLE LOGS

RockSol Consulting Group, Inc.

LEGEND

CLIENT City of Grand Junction
PROJECT NAME Emerson Park Geotechnical Investigation
PROJECT NUMBER 599.77
PROJECT LOCATION Grand Junction, Colorado

LITHOLOGY

- TOPSOIL
- Native - CLAY, sandy to silty
- Native - CLAY
- Playground Chips

SAMPLE TYPE

- 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.

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 1ST DEPTH
- GROUND WATER LEVEL 2ND DEPTH

RockSol Consulting Group, Inc.

BORING : B-1

CLIENT City of Grand Junction
PROJECT NAME Emerson Park Geotechnical Investigation
PROJECT NUMBER 599.77
PROJECT LOCATION Grand Junction, Colorado
DATE STARTED 5/30/23 **COMPLETED** 5/30/23
EXISTING ELEVATION 4586.7 ft **STATION NO.**
DRILLING CONTRACTOR Colorado Drilling and Sampling
NORTH **EAST**
DRILLING METHOD Solid Stem Auger **HOLE SIZE** 4.25"
BORING LOCATION: East/middle area of park
LOGGED BY R. Lepro **HAMMER TYPE** Automatic
GROUND WATER LEVELS: **1ST DEPTH** None Encountered on 5/30/23
NOTES
2ND DEPTH N. E. on 5/31/23 **3RD DEPTH** N. E. on 6/1/23

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 (%)
4586.7	0.0		(Topsoil) CLAY, sandy, moist, brown, grass cover, approximately 3 inches thick										
			(Native) CLAY, moist, brown, stiff to very stiff, slightly calcareous										
			Approximate Bulk Depth 0.25-4 Liquid Limit= 39 Plastic Limit= 19 Plasticity Index= 20 Fines Content= 97.8 Sulfate= 0.70	B BULK									
4584.2	2.5			MC	8/12	0.1	0.70	104.2	20.2	39	19	20	97.8
4581.7	5.0			MC	11/12			106.5	19.3				
4579.2	7.5												
4576.7	10.0			MC	18/12	4.8		104.6	19.9				
			Bottom of hole at 10.0 feet.										

RockSol Consulting Group, Inc.

BORING : B-2

CLIENT City of Grand Junction
PROJECT NAME Emerson Park Geotechnical Investigation
PROJECT NUMBER 599.77
PROJECT LOCATION Grand Junction, Colorado
DATE STARTED 5/30/23 **COMPLETED** 5/30/23
EXISTING ELEVATION 4584.8 ft **STATION NO.**
DRILLING CONTRACTOR Colorado Drilling and Sampling
NORTH **EAST**
DRILLING METHOD Solid Stem Auger **HOLE SIZE** 4.25"
BORING LOCATION: SE corner of playground area
LOGGED BY R. Lepro **HAMMER TYPE** Automatic
GROUND WATER LEVELS: ▼ **1ST DEPTH** 9.5 ft on 5/30/23
NOTES Temporary piezometer installed
▼ **2ND DEPTH** 10.8 ft on 5/31/23 ▼ **3RD DEPTH** 10.9 ft on 6/26/23

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 (%)
4584.8	0.0		Playground Chips, approximately 3 inches thick										
			(Native) CLAY, moist to wet, brown, stiff, slightly calcareous										
4582.3	2.5			MC	9/12	2.6		100.1	23.4				
			Approximate Bulk Depth 0.25-8 Liquid Limit= 30 Plastic Limit= 15 Plasticity Index= 15 Fines Content= 98.6 Sulfate= 0.27	B BULK			0.27			30	15	15	98.6
4579.8	5.0			MC	9/12	1.3		97.9	25.2				
4577.3	7.5												
4574.8	10.0			MC	13/12	1.4	0.94	102.7	22.3				
4572.3	12.5		(Native) CLAY, sandy to silty, wet, brown, medium stiff	B BULK			0.88			29	14	15	93.1
			Approximate Bulk Depth 9-15 Liquid Limit= 29 Plastic Limit= 14 Plasticity Index= 15 Fines Content= 93.1 Sulfate= 0.88										
4569.8	15.0			MC	6/12								
			Bottom of hole at 15.0 feet.										

LOG - STANDARD - 2 H20 599.77_EMERSON PARK GJ.GPJ 6/29/23

RockSol Consulting Group, Inc.

BORING : B-3

CLIENT City of Grand Junction
PROJECT NAME Emerson Park Geotechnical Investigation
PROJECT NUMBER 599.77
PROJECT LOCATION Grand Junction, Colorado
DATE STARTED 5/30/23 **COMPLETED** 5/30/23
EXISTING ELEVATION 4584.6 ft **STATION NO.**
DRILLING CONTRACTOR Colorado Drilling and Sampling
NORTH **EAST**
DRILLING METHOD Solid Stem Auger **HOLE SIZE** 4.25"
BORING LOCATION: NW corner of playground area
LOGGED BY R. Lepro **HAMMER TYPE** Automatic
GROUND WATER LEVELS: ▼ **1ST DEPTH** 9.3 ft on 5/30/23
▼ **2ND DEPTH** 10.5 ft on 5/31/23
NOTES

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 (%)
4584.6	0.0		Playground Chips, approximately 3 inches thick										
			(Native) CLAY, slightly silty, moist to very moist, brown, stiff to medium stiff, slightly calcareous										
4582.1	2.5		**Approximate Bulk Depth 0.25-6** Liquid Limit= 38 Plastic Limit= 19 Plasticity Index= 19 Fines Content= 97.3	MC	12/12	1.3		108.7	18.8				
				B BULK						38	19	19	97.3
4579.6	5.0			MC	8/12	-0.1		102.8	22.0				
4577.1	7.5												
4574.6	10.0			MC	12/12	0.9	1.53	106.3	20.6				
				B BULK			1.04			28	16	12	75.8
4572.1	12.5		(Native) CLAY, sandy to silty, wet, brown, soft **Approximate Bulk Depth 9-15** Liquid Limit= 28 Plastic Limit= 16 Plasticity Index= 12 Fines Content= 75.8										
4569.6	15.0			SS	1/1/2					18	14	4	61.5
			Bottom of hole at 15.5 feet.										

LOG - STANDARD - 2 H20 599.77_EMERSON PARK GJ.GPJ 6/29/23

APPENDIX B

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 Emerson Park Geotechnical Investigation

PROJECT NUMBER 599.77

PROJECT LOCATION Grand Junction, Colorado

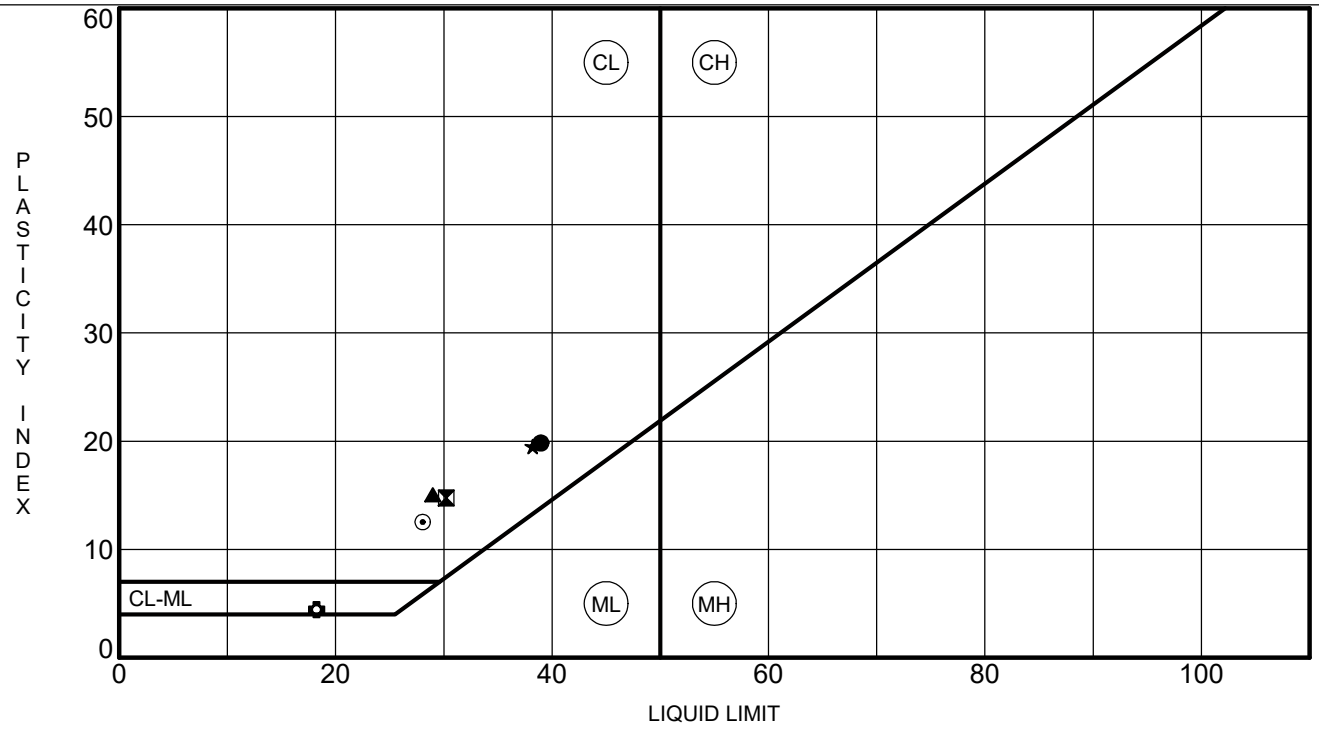
Borehole	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	Swell Potential (%)	%<#200 Sieve	Classification		Water Content (%)	Dry Density (pcf)	Unconfined Compressive Strength (psi)	Sulfate (%)	Resistivity (ohm-cm)	pH	Chlorides (%)	Proctor S=Standard M=Modified		
							USCS	AASHTO								MDD	OMC	S/M
B-1	0.25-4	39	19	20		98	CL	A-6 (21)				0.70						
B-1	2				0.1				20.2	104.2								
B-1	4								19.3	106.5								
B-1	9				4.8				19.9	104.6								
B-2	0.25-8	30	15	15		99	CL	A-6 (14)				0.27				106.2	19.0	S
B-2	2				2.6				23.4	100.1								
B-2	4				1.3				25.2	97.9								
B-2	9-15	29	14	15		93	CL	A-6 (12)				0.88						
B-2	9.01				1.4				22.3	102.7		0.94						
B-3	0.25-6	38	19	19		97	CL	A-6 (19)										
B-3	2				1.3				18.8	108.7								
B-3	4				-0.1				22.0	102.8								
B-3	9-15	28	16	12		76	CL	A-6 (7)				1.04						
B-3	9.01				0.9				20.6	106.3		1.53						
B-3	14	18	14	4		62	CL-ML	A-4 (0)										

RockSol Consulting Group, Inc.

ATTERBERG LIMITS RESULTS
AASHTO T89 Method A/T90

CLIENT City of Grand Junction **PROJECT NAME** Emerson Park Geotechnical Investigation

PROJECT NUMBER 599.77 **PROJECT LOCATION** Grand Junction, Colorado



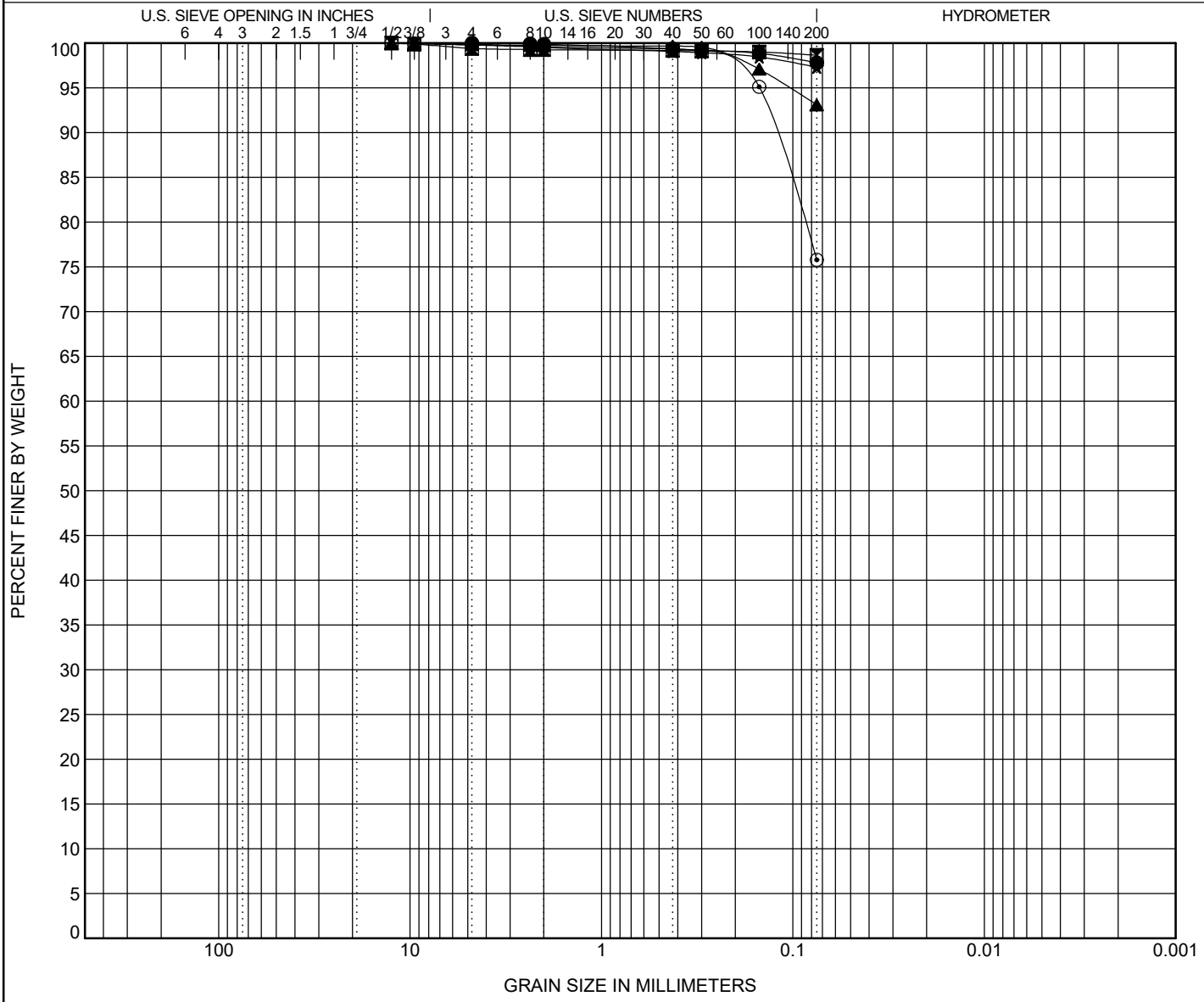
	Specimen Identification		LL	PL	PI	Fines	Classification
●	B-1	0.3-4.0	39	19	20	97.8	LEAN CLAY (CL) (A-6)
⊠	B-2	0.3-8.0	30	15	15	98.6	LEAN CLAY (CL) (A-6)
▲	B-2	9.0-15.0	29	14	15	93.1	LEAN CLAY (CL) (A-6)
★	B-3	0.3-6.0	38	19	19	97.3	LEAN CLAY (CL) (A-6)
⊙	B-3	9.0-15.0	28	16	12	75.8	LEAN CLAY with SAND (CL) (A-6)
✿	B-3	14.0	18	14	4	61.5	SANDY SILTY CLAY (CL-ML) (A-4)

GRAIN SIZE DISTRIBUTION

RockSol
Consulting Group, Inc.

RockSol

CLIENT City of Grand Junction
PROJECT NAME Emerson Park Geotechnical Investigation
PROJECT NUMBER 599.77
PROJECT LOCATION Grand Junction, Colorado



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification			Classification	LL	PL	PI	Cc	Cu
●	B-1	0.3-4.0	LEAN CLAY (CL) (A-6)	39	19	20		
⊠	B-2	0.3-8.0	LEAN CLAY (CL) (A-6)	30	15	15		
▲	B-2	9.0-15.0	LEAN CLAY (CL) (A-6)	29	14	15		
★	B-3	0.3-6.0	LEAN CLAY (CL) (A-6)	38	19	19		
⊙	B-3	9.0-15.0	LEAN CLAY with SAND (CL) (A-6)	28	16	12		

Specimen Identification			D100	D60	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
●	B-1	0.3-4.0	4.75				0.1	0.5	1.6	97.8	
⊠	B-2	0.3-8.0	12.5				0.7	0.1	0.5	98.6	
▲	B-2	9.0-15.0	12.5				0.3	0.1	6.6	93.1	
★	B-3	0.3-6.0	9.5				0.5	0.5	1.8	97.3	
⊙	B-3	9.0-15.0	12.5				0.5	0.2	23.6	75.8	

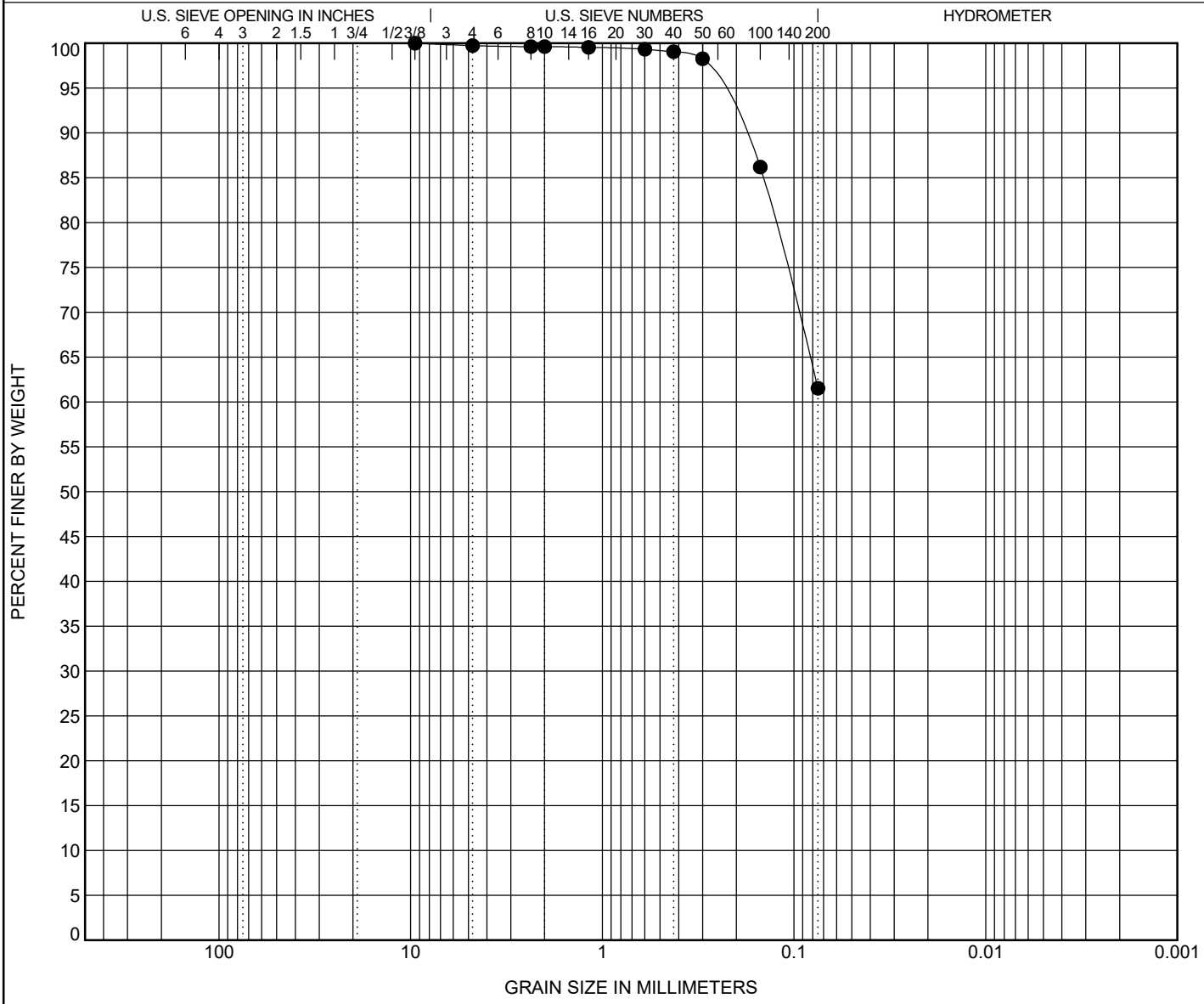
GRADATION - STANDARD 599.77_EMERSON PARK GJ.GPJ ROCKSOL TEMPLATE.GDT 6/20/23

GRAIN SIZE DISTRIBUTION

RockSol

CLIENT City of Grand Junction **PROJECT NAME** Emerson Park Geotechnical Investigation

PROJECT NUMBER 599.77 **PROJECT LOCATION** Grand Junction, Colorado



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	**B-3**	**14.0**	**SANDY SILTY CLAY (CL-ML) (A-4)**	**18**	**14**	**4**		

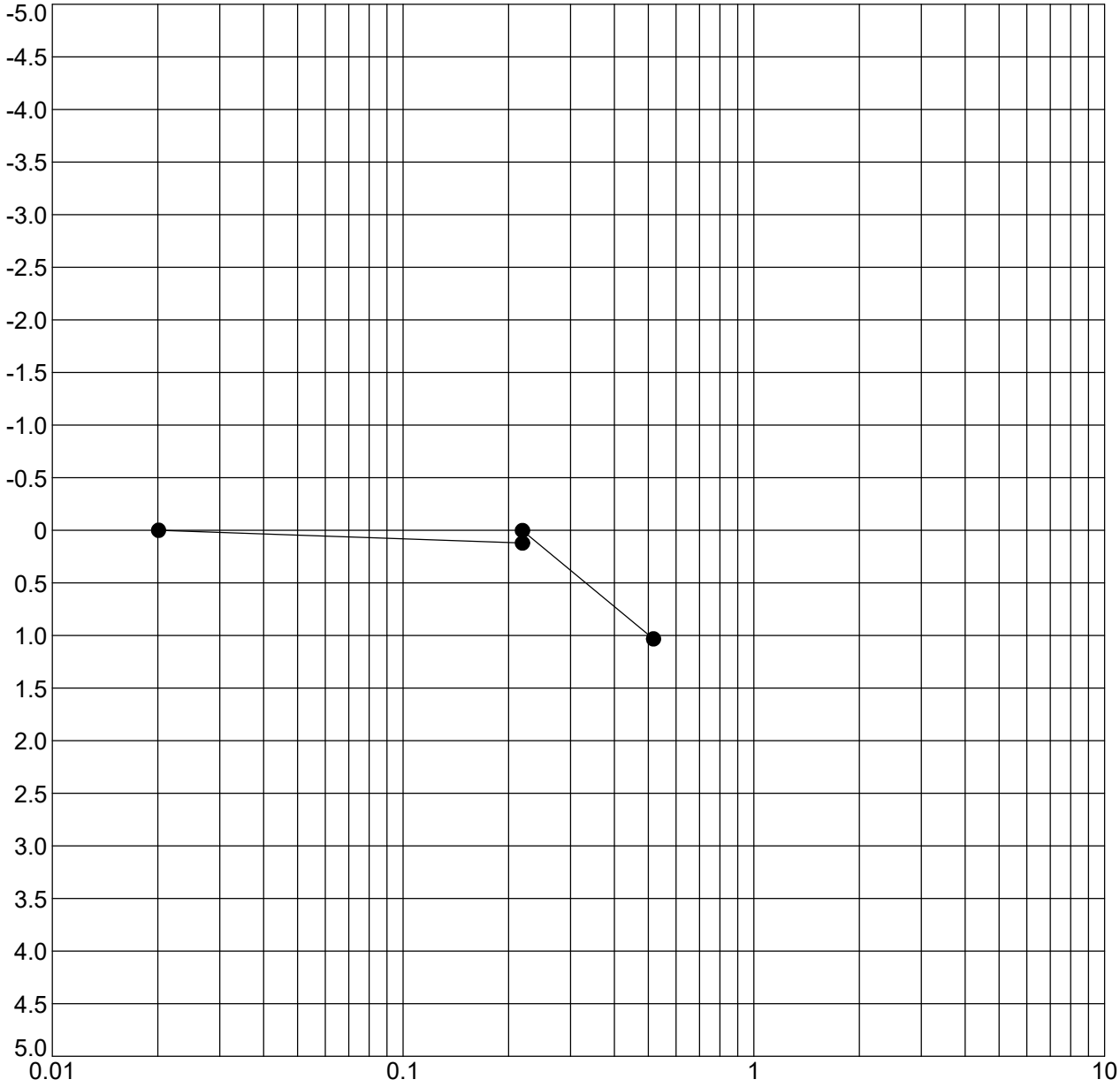
	Specimen Identification		D100	D60	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
●	**B-3**	**14.0**	**9.5**				**0.4**	**0.6**	**37.5**	**61.5**	

SWELL - CONSOLIDATION TEST

RockSol Consulting Group, Inc.

CLIENT City of Grand Junction **PROJECT NAME** Emerson Park Geotechnical Investigation

ROCKSOL PROJECT NUMBER 599.77 **CLIENT PROJECT NUMBER** Grand Junction, Colorado



Specimen Identification	Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **B-1 2**	**CLAY**	**0.1**	**104.2**	**20.2**

SWELL - CLIENT STANDARD 599.77_EMERSON PARK GJ.GPJ ROCKSOL TEMPLATE.GDT 6/29/23

SWELL - CONSOLIDATION TEST

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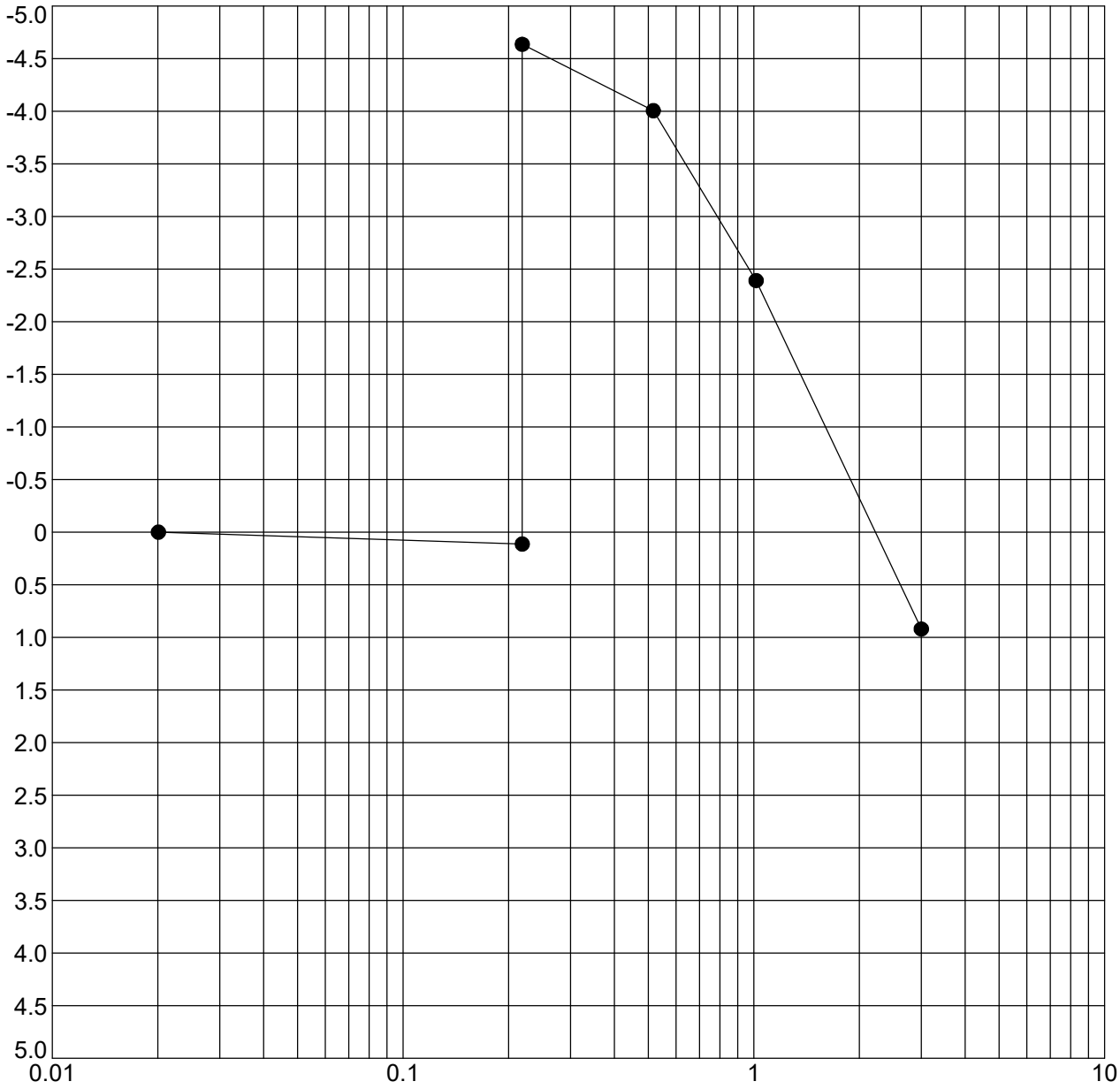
CLIENT City of Grand Junction **PROJECT NAME** Emerson Park Geotechnical Investigation

ROCKSOL PROJECT NUMBER 599.77 **CLIENT PROJECT NUMBER** Grand Junction, Colorado



Specimen Identification	Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **B-1** **9**	**CLAY**	**4.8**	**104.6**	**19.9**

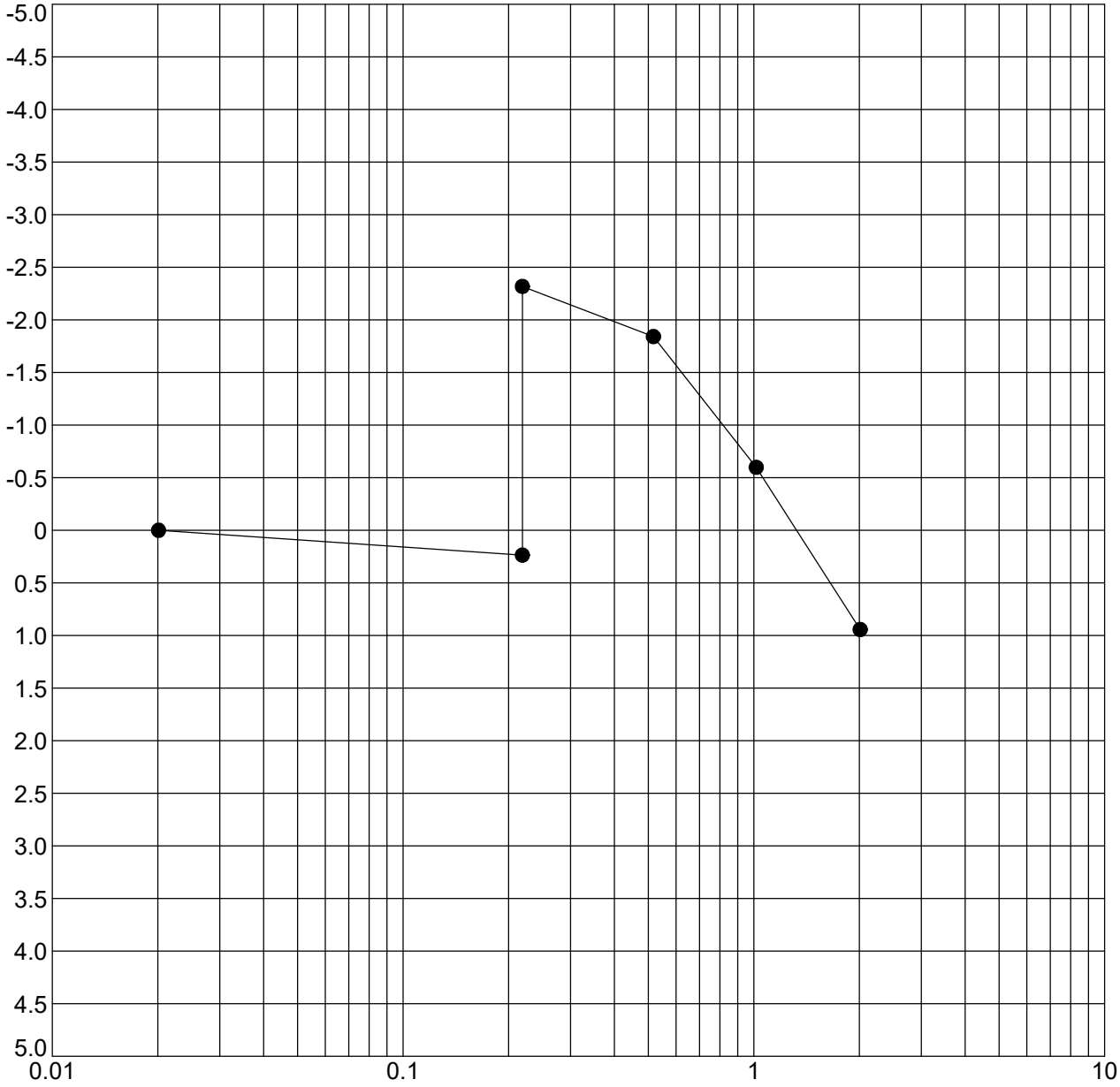
SWELL - CLIENT STANDARD 599.77_EMERSON PARK GJ.GPJ ROCKSOL TEMPLATE.GDT 6/29/23

SWELL - CONSOLIDATION TEST

RockSol Consulting Group, Inc.

CLIENT City of Grand Junction **PROJECT NAME** Emerson Park Geotechnical Investigation

ROCKSOL PROJECT NUMBER 599.77 **CLIENT PROJECT NUMBER** Grand Junction, Colorado



Specimen Identification	Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **B-2 2**	**CLAY**	**2.6**	**100.1**	**23.4**

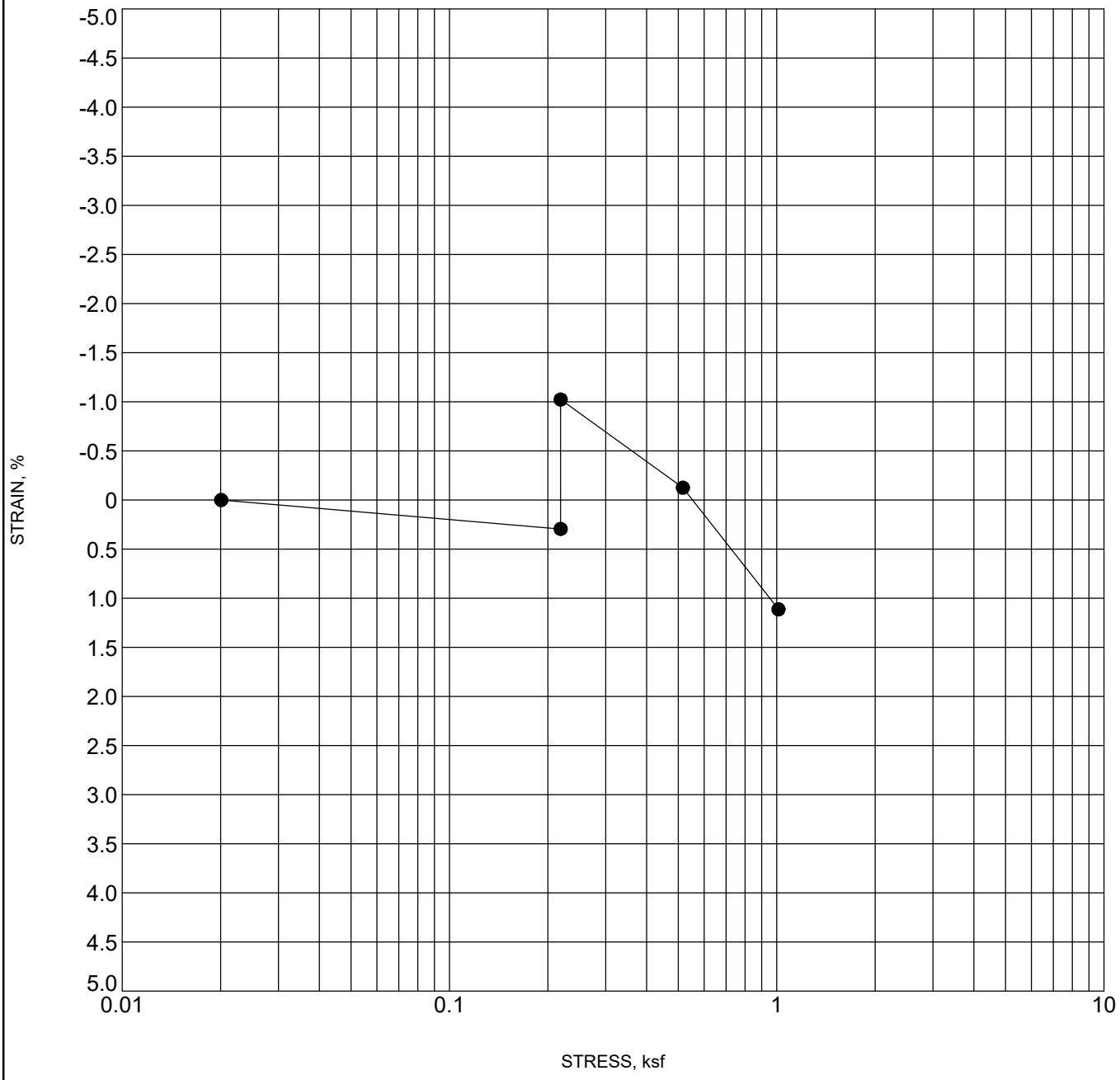
SWELL - CLIENT STANDARD 599.77_EMERSON PARK GJ.GPJ ROCKSOL TEMPLATE.GDT 6/29/23

SWELL - CONSOLIDATION TEST

RockSol Consulting Group, Inc.

CLIENT City of Grand Junction **PROJECT NAME** Emerson Park Geotechnical Investigation

ROCKSOL PROJECT NUMBER 599.77 **CLIENT PROJECT NUMBER** Grand Junction, Colorado



Specimen Identification	Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **B-2** **4**	**CLAY**	**1.3**	**97.9**	**25.2**

SWELL - CLIENT STANDARD 599.77_EMERSON PARK GJ.GPJ ROCKSOL TEMPLATE.GDT 6/29/23

SWELL - CONSOLIDATION TEST

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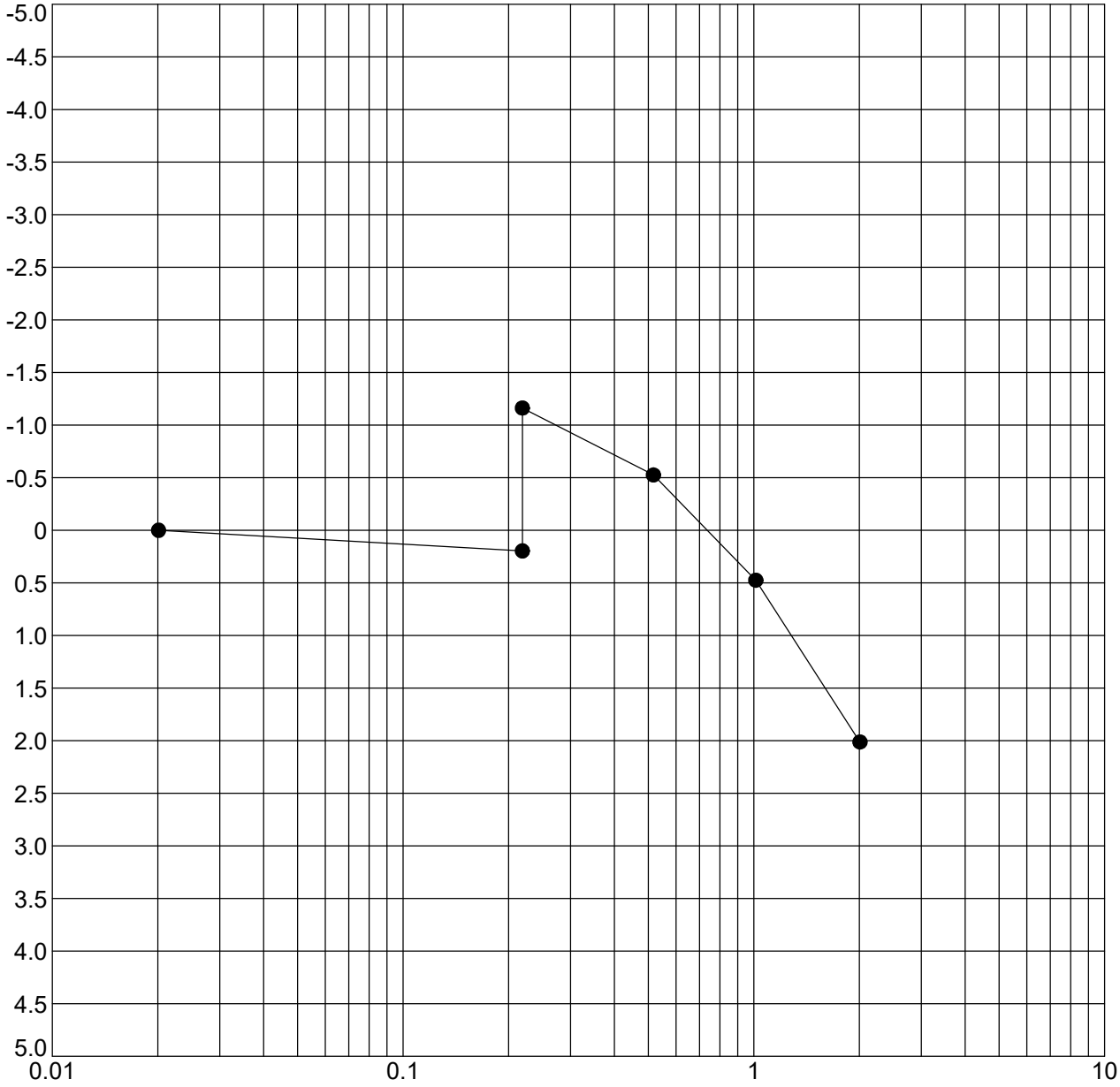
CLIENT City of Grand Junction **PROJECT NAME** Emerson Park Geotechnical Investigation

ROCKSOL PROJECT NUMBER 599.77 **CLIENT PROJECT NUMBER** Grand Junction, Colorado



Specimen Identification	Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **B-2 9**	**CLAY**	**1.4**	**102.7**	**22.3**

SWELL - CLIENT STANDARD 599.77_EMERSON PARK GJ.GPJ ROCKSOL TEMPLATE.GDT 6/29/23

SWELL - CONSOLIDATION TEST

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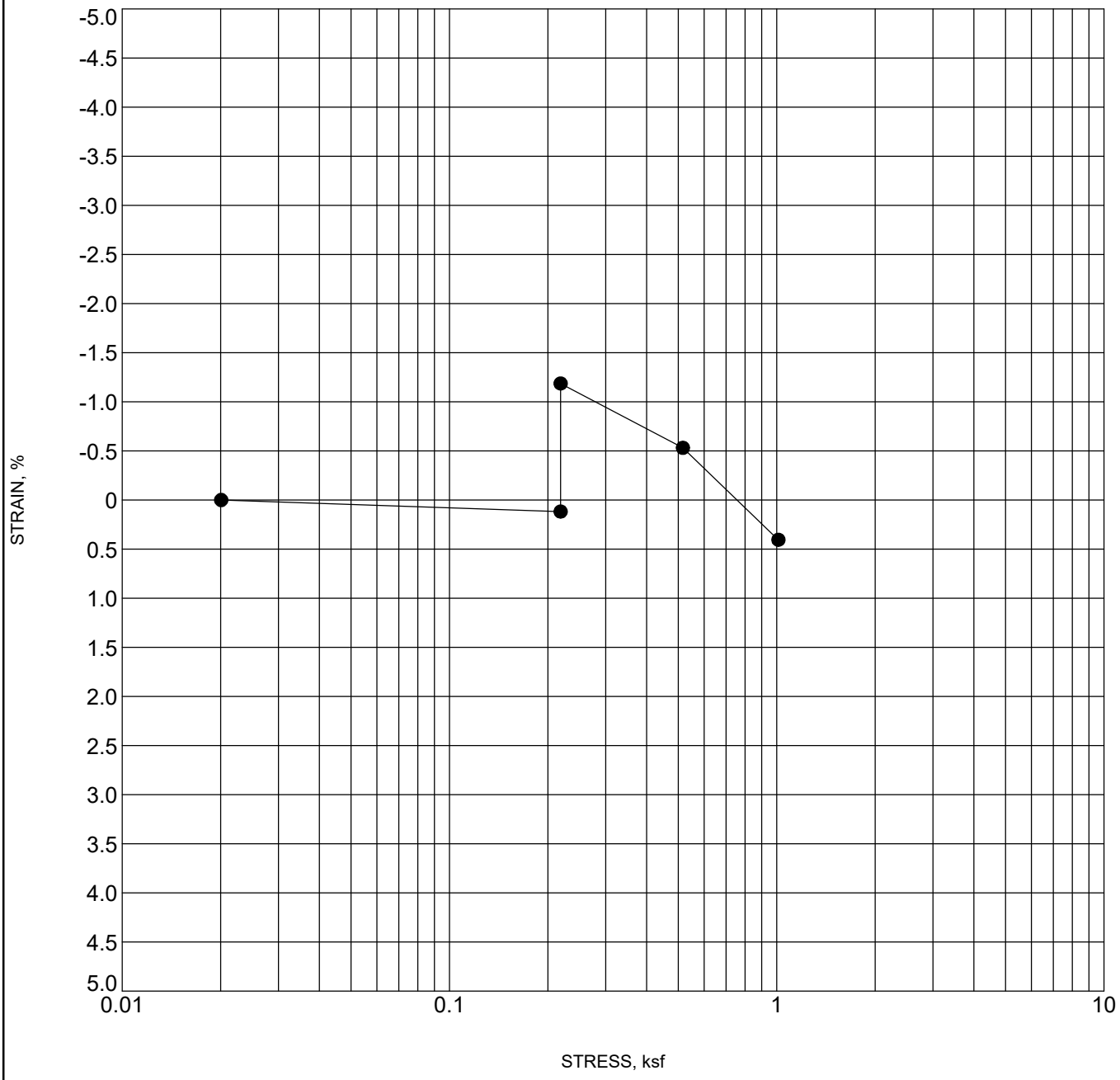

Specimen Identification	Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **B-3 2**	**CLAY**	**1.3**	**108.7**	**18.8**

SWELL - CLIENT STANDARD 599.77_EMERSON PARK GJ.GPJ ROCKSOL TEMPLATE.GDT 6/29/23

SWELL - CONSOLIDATION TEST

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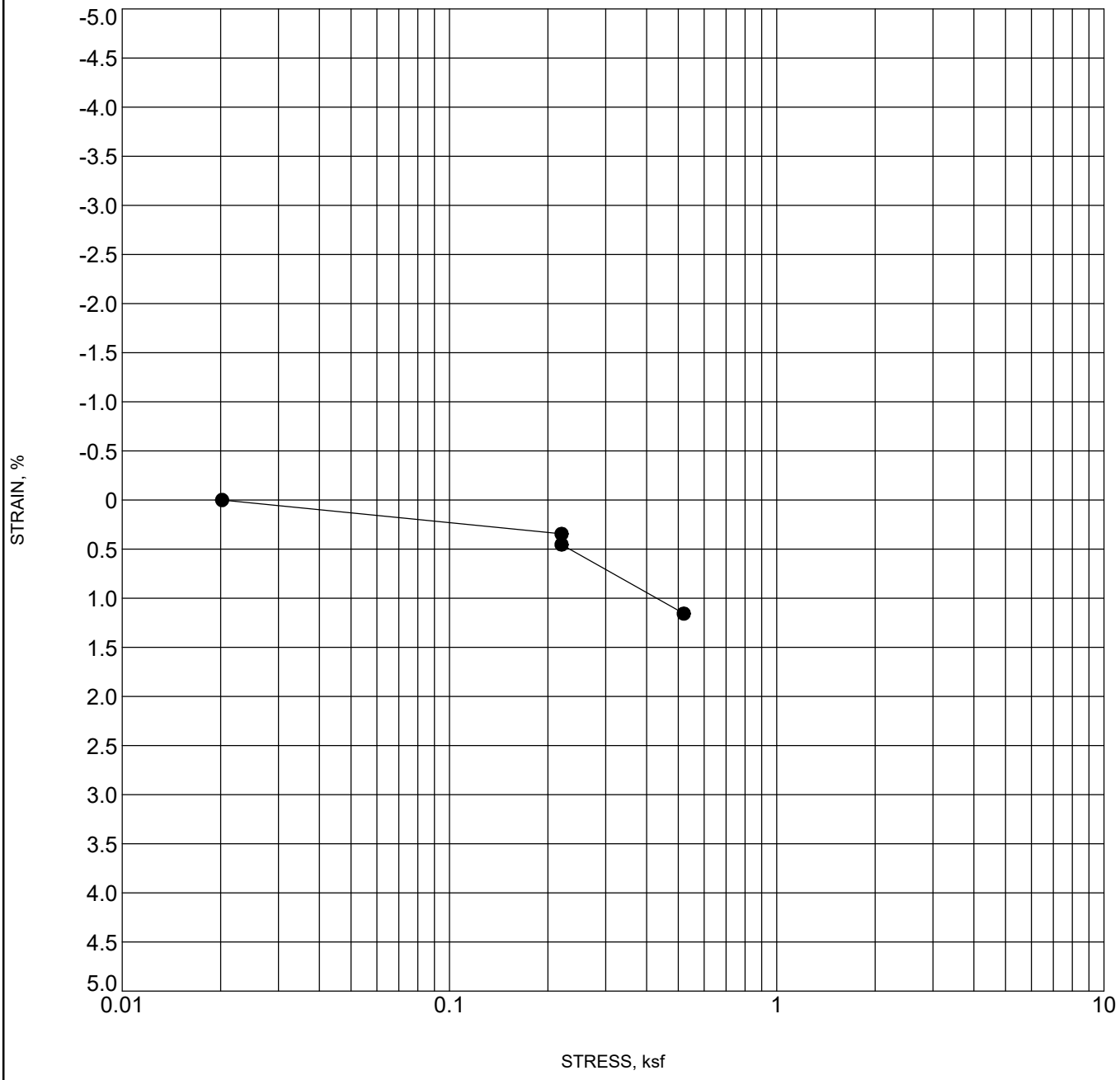
CLIENT City of Grand Junction **PROJECT NAME** Emerson Park Geotechnical Investigation

ROCKSOL PROJECT NUMBER 599.77 **CLIENT PROJECT NUMBER** Grand Junction, Colorado



Specimen Identification	Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **B-3 4**	**CLAY**	**-0.1**	**102.8**	**22.0**

SWELL - CLIENT STANDARD 599.77_EMERSON PARK GJ.GPJ ROCKSOL TEMPLATE.GDT 6/29/23

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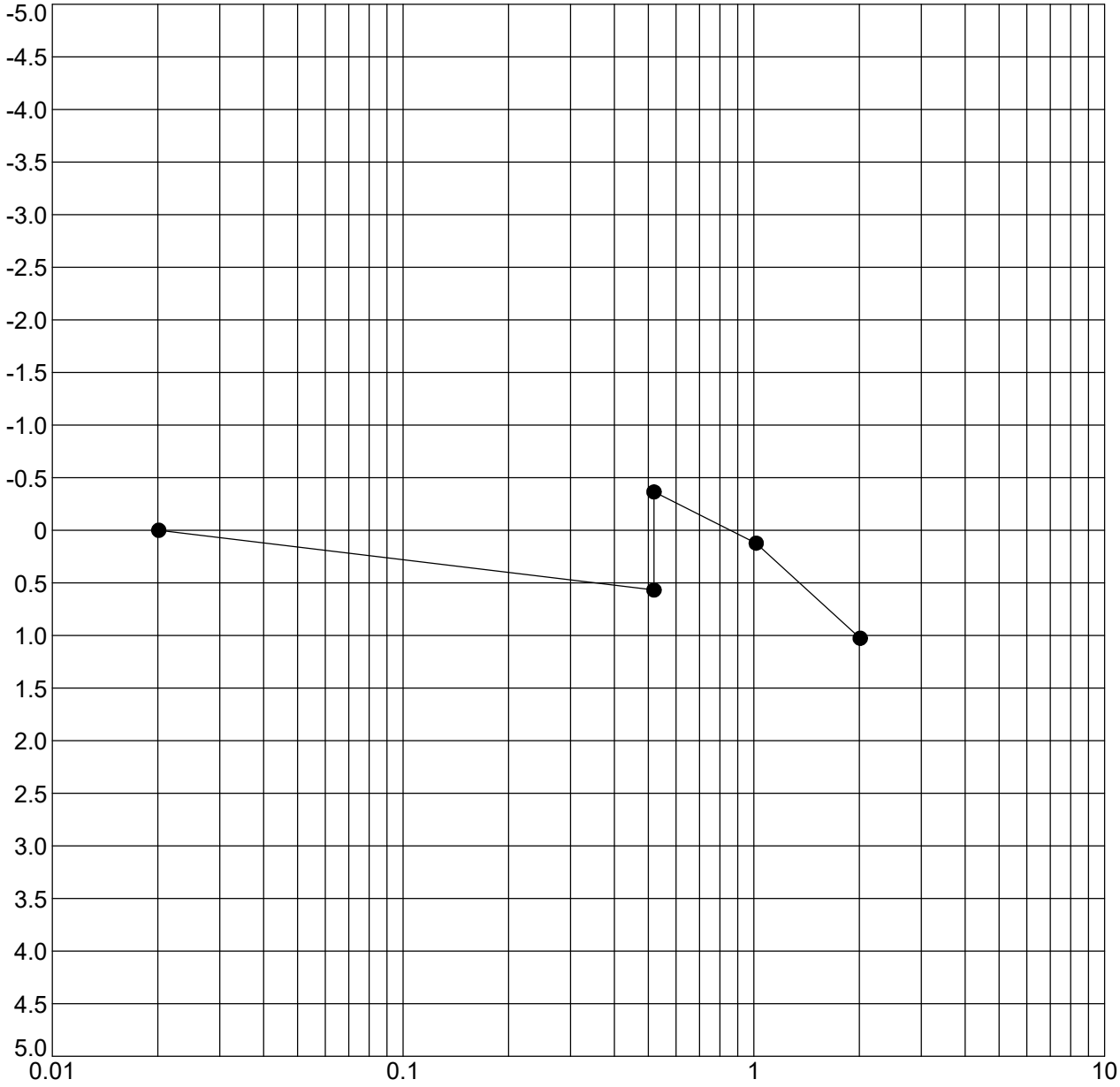


Specimen Identification	Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● B-3 9	**CLAY**	**0.9**	**106.3**	**20.6**

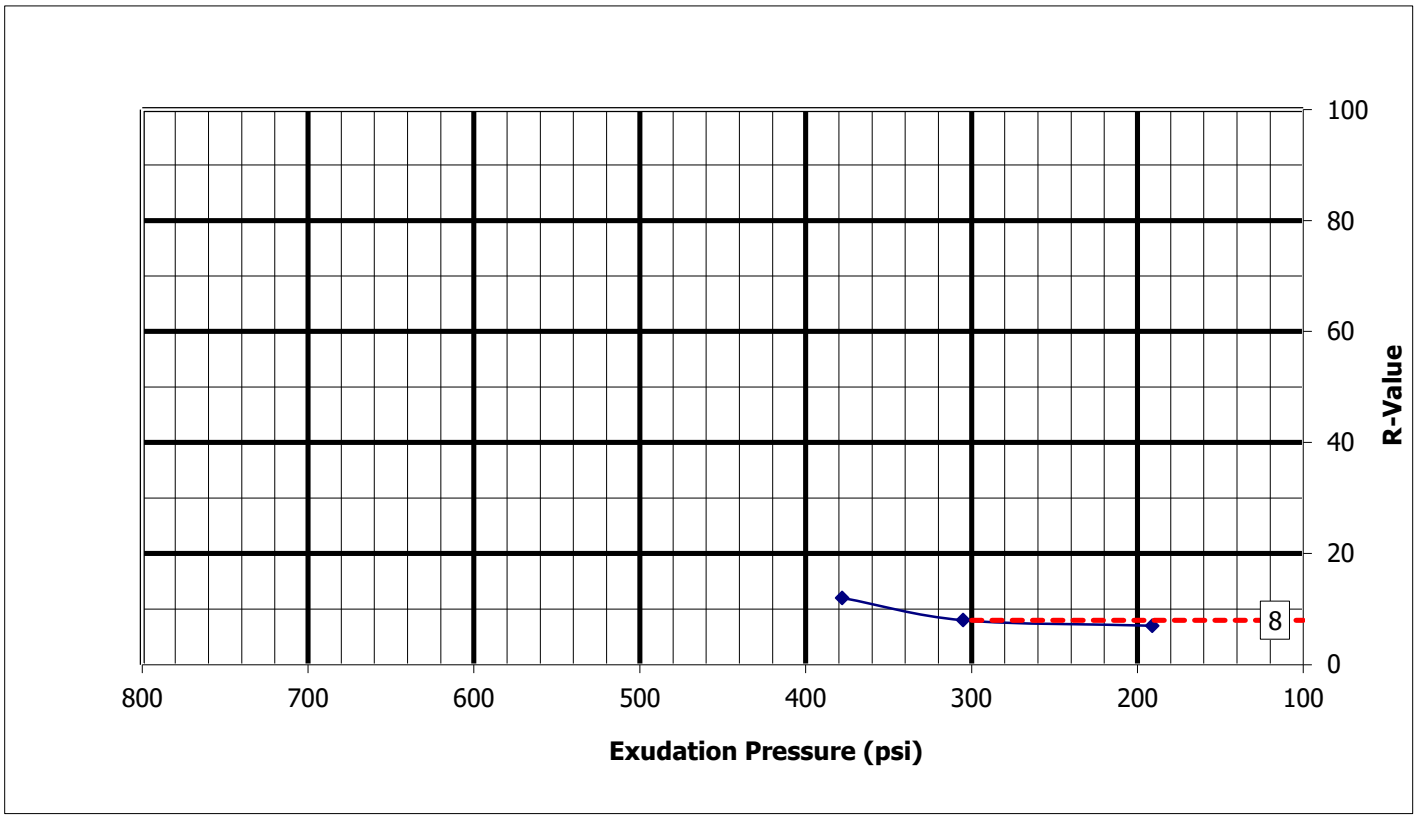
SWELL - CLIENT STANDARD 599.77_EMERSON PARK GJ.GPJ ROCKSOL TEMPLATE.GDT 6/29/23

CMT TECHNICAL SERVICES

AASHTO ACCREDITED

R-VALUE TEST GRAPH (AASHTO T190)

Project Number:	23.022, RockSol Consulting	Date:	06/08/23
Project Name:	City of GJ Emerson Park (RockSol Project No. 599.77)	Technician:	J. De Los Santos
Lab ID Number:	232491	Reviewer:	G. Hoyos
Sample Location:	East Middle Park / Roadway and Parking Area (BH-1 at 3 inches to 4 feet)		
Visual Description:	CLAY, sandy, brown		



R-Value @ Exudation Pressure 300 psi: 8

Specification:

CDOT Pavement Design Manual, 2011.
Eq. 2.1 & 2.2, page 2-3.

$S_1 = [(R-5)/11.29]+3$ **S_1= 3.27**

$M_R = 10^{[(S_1+18.72)/6.24]}$ **M_R= 3,337**

M_R = Resilient Modulus, psi

S_1 = the Soil Support Value

R = the R-Value obtained

Test Specimen:	1	2	3
Moisture Content, %:	17.0	19.6	21.4
Expansion Pressure, psi:	0.85	0.49	0.12
Dry Density, pcf:	114.5	108.1	104.7
R-Value:	12	8	7
Exudation Pressure, psi:	378	305	191

Note: The R-Value is measured; the M_R is an approximation from correlation formulas.

APPENDIX C

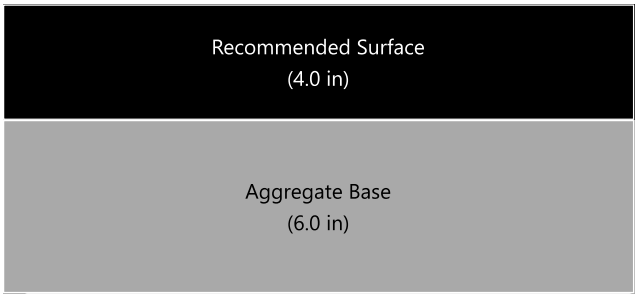
PAVEXPRESS PAVEMENT DESIGN OUTPUT SHEET

Project: Emerson Park

New Asphalt Pavement Design

AASHTO '93/'98: Flexible Pavement Design

Pavement Diagram



Required minimum design SN: 2.40

Layer Thicknesses (in)
Recommended Surface: 4.0 in
Aggregate Base: 6.0 in

Total SN: 2.41

Print

Details

Scenario: New Asphalt Pavement Design

Created By: Jay Goldbaum, Goldbaum@RockSol.com

Last Modified: June 28, 2023 5:57:19 pm

Design Parameters

Design Period: 30 years

Reliability Level (R): 80%

Combined Standard Error (S_0): 0.44

Initial Servicability Index (p_i): 4.5

Terminal Servicability Index (p_t): 2

Delta Servicability Index (ΔPSI): 2.5

Total Design ESALs (W_{18}): 20000

Layers

Recommended Surface - Asphalt

Thickness: 4 in

Aggregate Base - Base

Thickness: 6 in

Structural Coefficient: 0.12

Drainage Coefficient: 0.9