GEOTECHNICAL INVESTIGATION REPORT
BRIDGE STRUCTURES AND RETAINING WALLS

US6 BRIDGES DESIGN BUILD PROJECT
BR 0061-083 [18838 (CN)]

DENVER, COLORADO

Prepared for:

Hartwig and Associates, Inc.
188 Inverness Drive West, Suite 675
Englewood, CO 80112

Attention: Ms. Marvinetta Hartwig

October 15, 2012

RockSol Project No. 280.01

Prepared by:

RockSol
Consulting Group, Inc.

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TABLE OF CONTENTS

Pages

1.0 PURPOSE AND SCOPE OF STUDY

This report documents the geotechnical investigation performed by RockSol Consulting Group, Inc. (RockSol) within the Colorado Department of Transportation (CDOT) Right-of-Way (ROW) for preliminary design of the US6 Bridges Design Build Project from Knox Court to the Burlington Northern Santa Fe (BNSF) Railroad corridor in Denver, Colorado (see Figure 1, Site Vicinity Map).

The US6 Bridges project, originally from I-25 to Bryant Street, has evolved as a result of inclusion of the US6 over BNSF project and the inclusion of the Federal Boulevard Interchange Reconstruction project into the scope of the US6 Bridges Design/Build project. New bridge structures, which will carry East Bound (EB) and West Bound (WB) US6 traffic over Bryant Street, the South Platte River, and I-25, are proposed to replace the existing bridge structures and were investigated by RockSol.

This report also contains geotechnical recommendations to assist with preliminary design of the proposed braided ramp bridge structure from Federal Boulevard to east bound US 6; a proposed pedestrian bridge over US 6, just west of Federal Boulevard; retaining wall structures associated with the bridge replacements; and new ramp configurations for the subject interchanges.

Geotechnical investigations for the US 6 Bridge over the BNSF Railroad (RR) and the Federal Boulevard Bridge over US 6 were performed by others (Geocal, Inc. and CDOT, respectively) and RockSol understands the geotechnical reports for those projects will be included as reference documents for the US 6 Bridges Design Build project.

New pavement is anticipated for all roadways and ramps throughout the project limits, including a portion of I-25 under US6 and extending along I-25 for short distances north and south of US6, approximately from 8th Avenue to 5th Avenue. A pavement design report for new pavement construction was prepared by RockSol under a separate cover.

The RockSol geotechnical investigation was conducted to obtain information on the surface and subsurface soil conditions, depth to groundwater, and bedrock conditions at the location of the bridge and retaining wall structures. Summary borehole logs are presented in Appendix A. Samples of material obtained during the subsurface investigation were tested in the laboratory to provide data on the engineering characteristics and classification of the recovered soils and bedrock. The results of the laboratory testing are presented in Appendix C.

Surface and groundwater hydrology, hydraulic engineering, and environmental studies including contaminant characterization were not included in RockSol's scope of work.

2.0 PROPOSED CONSTRUCTION

Improvements to US6 between Knox Court and the BNSF Railroad corridor include construction of new bridge structures and retaining wall structures, reconfiguration of entrance and exit ramps at the Federal Boulevard, Bryant Street and I-25 interchanges, new embankment, grading and excavation. The profile of US6 is to be raised from Bryant Street to just east of the South Platte River. An increase of grade between 5 feet and 10 feet is anticipated as a result of the need to raise the new South Platte River Bridge sufficiently to prevent overtopping during

the 100-year storm event. As a result of the new bridge structures, interchange reconfiguration and profile changes, 15 retaining wall structures are proposed.

Bridge and Underpass Structures

Seven new bridge structures are proposed for this project. The new bridge structures include a ramp bridge structure (Braided Ramp) from Colorado Highway 88 (Federal Boulevard) to east bound US 6, a proposed pedestrian bridge over US 6, just west of Federal Boulevard, EB and WB US6 over Bryant Street, the South Platte River, I-25, and the BNSF Railroad corridor located east of I-25, and Federal Boulevard over US6. Descriptions of the proposed bridge structures are presented in Table 2.1. Preliminary foundation recommendations for the proposed bridge structures are presented in Section 8.0.

Table 2.1 – Proposed Bridge/Underpass Structure Summary

Structure	Number of Spans	Approximate Width (feet)	Approximate Length (feet)	Description	Corresponding RockSol Boreholes
US6 Bridge over Bryant Street (F-16-EN)	Single	250	100	Carries EB and WB US6 traffic over Bryant Street.	BR-1 through BR-6
US6 Bridge over South Platte River (F-16-EF)	Three	180	280	Carries EB and WB US6 traffic over the South Platte River.	BR-7 through BR-14
US6 Bridge over I-25 (F-16-DU)	Two	200	170	Carries EB and WB US6 traffic over I-25.	BR-15 through BR-22
US6/I-25 Underpass Structure	NA	50	170	Carries traffic under US6 from NB I-25 to WB US6.	BR-20 through BR-22
Pedestrian Bridge over US6	Two	12	190	Carries pedestrians over US6 from Barnum Park (south side) to the baseball fields (north side).	BR-23 through BR-25
Braided Ramp Bridge	Single	35	150	Carries traffic from Federal Boulevard to EB US6.	BR-26 and BR-27
Federal Boulevard Bridge over US6 (F-16-EK)	Two	140	210	Carries NB and SB Federal Boulevard traffic over US6.	Note 1
US6 Bridge over BNSF	Two	35	150	Carries EB and WB US6 traffic over the BNSF corridor.	Note 2

Note 1: See CDOT Geotechnical Report, *Geotechnical Recommendations for Replacement of Structure F-16-EK*, Project IM 088A-024, SA 16228, dated December 3, 2009.

Note 2: See Geocal, Inc. Geotechnical Report (*G10.1354.003*), *30% Design Soil and Foundation Investigation, Proposed 6th Avenue Freeway over BNSF Bridge Replacement, City and County of Denver, Colorado*, dated December 19, 2011.

Retaining Walls

New retaining wall structures associated with the bridge replacements and new ramp configurations for the subject interchanges are proposed along US6 from Federal Boulevard to I-25. Retaining walls will be required to retain fill material at embankment locations and native soil in cut areas. Mechanically stabilized earth (MSE) walls and cast-in-place (CIP) walls are being considered for the proposed retaining wall structures. Maximum retaining wall heights are anticipated between 15 and 34 feet for single tier retaining wall systems. Descriptions of the proposed retaining wall systems for this project are presented in Table 2.2. Estimated wall

heights and retaining wall categorization were provided by Hartwig and are based on plans titled *US 6 Bridges Design Build Project, 18838, dated 7/3/2012*.

Table 2.2 – Proposed Retaining Wall Summary

Wall Identification	Wall Type (cut or fill)	Associated Structure/Roadway	Approximate Wall Length (ft)	Approximate Wall Height (ft)	Corresponding RockSol Boreholes
A	Fill	South Side of Federal Blvd Ramp to WB US6.	300	7 to 15	Note 1
B	Cut	Bryant Street Ramp to Federal Blvd. Starts near Federal Blvd and ends at Wall C offset.	720	8 to 30	Note 1
C	Fill	North side of Bryant Street Ramp to Federal Blvd. Starts near Bryant Street and ends at Wall B offset.	811	7 to 28	RW1-1, RW1-2, BR-3 and Note 1
D	Fill	WB US 6 Ramp to Federal Blvd.	472	7 to 21	Note 1
E	Fill and Cut	North Side of Federal Blvd Ramp to Braided Ramp Bridge/EB US6 and I-25.	1074	6 to 34	BR-26 and BR-27 and Note 1
F	Fill and Cut	South Side of Federal Blvd Ramp to Braided Ramp Bridge/EB US6, I-25 and Bryant Street.	1397	7 to 29	BR-1, BR-26, BR-27,RW5-1, RW5-2 and Note 1
G	Fill	EB US6 Braided Ramp to EB US6 (north side of ramp/roadway)	988	7 to 34	BR-1, BR-2, BR-26, BR-27,RW5-1, RW5-2 and Note 1
H	Fill	EB US6 Braided Ramp to EB US6 (south side of ramp/roadway)	1012	7 to 30	BR-1, BR-2, BR-26, BR-27,RW5-1, RW5-2 and Note 1
I	Fill	North side of EB US6 CD Lane to I-25	600	14 to 23	BR-6, BR-7, and RW4-1 through RW4-3
J	Fill	South side of EB US6 CD Lane to I-25	665	8 to 20	BR-6, BR-7, and RW4-1 through RW4-3
K	Fill	North side of WB US 6 CD Lane	641	20 to 31	BR-4, BR-9, RW2-1 and RW2-2
L	Fill	North side of Federal Blvd Ramp to Bryant Street	783	6 to 34	BR-1, RW5-1, and RW5-2
M	Fill	North side of EB US6 Ramp to Federal Blvd.	158	6 to 12	Note 1
N	Fill	South side of Bryant Street Ramp to Federal Blvd.	567	7 to 32	BR-2, BR-3, RW1-1, and RW1-2
O	Fill	North Side of Federal Boulevard Ramp to WB US6.	575	8 to 16	Note 1
P	Cut	East side of NB I-25 Ramp to WB US6, South side of US6	75	12 to 32	BR-20
Q	Cut	East side of NB I-25 Ramp to WB US6, North side of US6	70	6 to 30	BR-22

Note 1: See CDOT Geotechnical Report, *Geotechnical Recommendations for Replacement of Structure F-16-EK*, Project IM 088A-024, SA 16228, dated December 3, 2009.

Note 2: See Geocal, Inc. Geotechnical Report (*G10.1354.003*), *30% Design Soil and Foundation Investigation, Proposed 6th Avenue Freeway over BNSF Bridge Replacement, City and County of Denver, Colorado*, dated December 19, 2011.

Preliminary foundation recommendations for the proposed retaining walls are presented in Section 9.0.

3.0 GEOLOGIC SETTING

The US6 Knox Court to BNSF Design Build project corridor lies within the Denver Basin, east of the Rocky Mountain foothills. Geologic conditions evaluated for this report are shown on the Geologic Map, Figure 2 which was obtained from the "Geologic Map of the Fort Logan Quadrangle, Jefferson, Denver and Arapahoe Counties, Colorado", by Robert M. Lindvall, USGS Map GQ-1427, 1978.

Based on the Geologic Map shown on Figure 2, overburden soils/materials mapped within the project area generally consist of sand, silt, clay and gravel alluvial deposits (Piney Creek [Qp] and Post Piney Creek [Qpp] Alluvium) associated with the South Platte River basin; sands and gravels of the Broadway Alluvium (Qb) and Lower Verdos (Qvl) terrace deposits; sandy silt and clay colluvium (Qco) deposits noted on the native slopes; and fill material (af) associated with development of the project area, especially roadway construction for US 6 and I-25, consisting clay, silt, sand, gravel, and a variety of concrete, brick, wood, metal, plastic, and glass debris. Sedimentary bedrock of the Denver and Arapahoe Formations is mapped at or close to the ground surface on the western portion of the project area.

These geologic formations are composed of interbedded claystone, sandstone, siltstone, shale, and conglomerate. The native soil and bedrock types and conditions observed by RockSol in boreholes drilled for this project generally appear to be consistent with the geological conditions mapped in Figure 2.

Based on the results of RockSol's geotechnical investigation, bedrock elevations within the project limits vary from 5,168 feet at the proposed structure for the Braided Ramp to 5,261 feet at the proposed pedestrian bridge location. Near the US 6 Bridge over I-25, bedrock elevations in the range of 5,182 feet to 5,187 feet are noted. At the South Platte River Bridge, bedrock elevations range from approximately 5,181 feet to 5,186 feet at the east side of the South Platte River bridge and approximate bedrock elevations of 5,179 feet to 5,182 feet at the west side of the South Platte River bridge. Bedrock elevations in the vicinity of the Bryant Street Bridge range from approximately 5,172 feet to 5,177 feet. Bedrock elevations in the vicinity of the braided ramp bridge are approximately 5,168 feet and 5,172 feet.

Based on information obtained from CDOT's Geotechnical Report, *Geotechnical Recommendations for Replacement of Structure F-16-EK*, Project IM 088A-024, SA 16228, dated December 3, 2009, bedrock elevations noted adjacent to and at the Federal Boulevard Bridge range from 5,171 feet to 5,173 feet.

Groundwater was noted in RockSol's boreholes at approximate elevations ranging from 5,190 feet to 5,252 feet (4 feet to 38 feet below existing grades). The majority of the groundwater noted appears to be at approximate elevations ranging from 5,190 feet to 5,197 feet within native slightly silty to gravelly sand soil, fairly consistent with the surface water elevation of the South Platte River. Groundwater was also noted at an approximate elevation of 5,252 feet in Borehole BR-25 at the proposed pedestrian bridge location, within a sandy layer confined in the claystone bedrock.

Topographic relief varies from low to moderate along most of the project alignment, with land surfaces generally sloping toward the South Platte River.

4.0 SUBSURFACE INVESTIGATION

A total of 42 boreholes were drilled by RockSol for the proposed bridge and retaining wall structures. The locations of 27 bridge boreholes (BR-1 through BR-27) and 15 retaining wall boreholes (RW1-1, RW1-2, RW2-1, RW2-2, RW3-1, RW3-2, RW4-1 through RW4-3, RW5-1, RW5-2, RW6-1 through RW6-3, and RW7-1) are shown on the Borehole Location Plans, Figures 3A through 3D and Figures 4A through 4F. Figures 3A through 3D present borehole locations on proposed ultimate lane configurations. Also shown as a shaded sub-layer are the locations of boreholes drilled by RockSol for the pavement design report. The locations of the pavement design report boreholes are presented for information only in this report. Boreholes drilled by RockSol are also presented on Figures 4A through 4F with the borehole locations presented on an aerial image of the existing conditions of the project. Horizontal locations and elevations at the top of boreholes were obtained by field survey performed by Lund Partnership. Borehole BR-24 was located in the field by Lund using an off-set location due to traffic safety concerns. The survey location is approximately 55 feet north of the actual location drilled. The actual drilled location is shown on the Borehole Location map.

The boreholes were advanced with truck and track mounted drill rigs (CME 45/50/55 or equivalent). The boreholes were advanced through the overburden soils and underlying bedrock with 4-inch outside diameter continuous flight augers or 3.25-inch inside diameter hollow stem augers. The auger type used is indicated on each boring log. The 4-inch solid stem auger produces a borehole diameter of approximately 4.25 inches and the hollow-stem auger produces a borehole diameter of approximately 7 inches.

The boreholes were logged in the field by a representative of RockSol with the depth to groundwater noted at the time of drilling. Hollow-stem augers were used when caving soil conditions, generally due to granular soils and groundwater, were either anticipated or encountered. The boreholes were backfilled at the completion of drilling or subsequent groundwater measurement readings, except for Boreholes RW1-2, RW2-1, RW3-2, RW5-1, RW6-1, and RW7-1, in which Olsson Associates installed six temporary groundwater monitoring wells.

Subsurface materials were sampled 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 are used with the modified California barrel sampler to retain samples for density, swell, and unconfined compressive strength testing. Sample retaining liners are not used with the standard split spoon sampler.

Penetration Tests were performed at selected intervals using both a standard rope-cathead lift system and an automatic lift system. Both hammer lift systems used a hammer weighing 140 pounds and falling 30 inches. 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. Correlation of blow counts obtained from a modified California sampler to blow counts obtained from a standard split spoon sampler is not available. However, 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 individual Borehole Logs in Appendix A and on the Engineering Geology Sheets, Figures B-1 through B-7, in Appendix B.

5.0 LABORATORY TESTING

Samples obtained from the boreholes were examined and visually classified in the RockSol laboratory by the RockSol project engineer. Laboratory testing was performed on selected samples to evaluate their classification, moisture content, dry density, swell/consolidation potential, moisture-density relationship, unconfined compression, water soluble sulfate content, chloride content, pH, and soil resistivity. Results of the laboratory testing are presented in Appendix C.

The testing was conducted in general accordance with recognized test procedures, primarily those of the American Society for Testing and Materials (ASTM) and American Association of State Highway and Transportation Officials (AASHTO).

- 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 Classification (ASTM D-2487, ASTM D-2488, and AASHTO M145)
- Swell Test (ASTM D-4546) (with 200 psf and 500 psf swell surcharge)
- Water Soluble Chloride Content (AASHTO T291-91)
- Standard Test Method for pH of Soils (AASHTO T289)
- Soil Resistivity (ASTM G187 - Soil Box)
- Moisture Density Relationship (Proctor Test) (AASHTO T99)
- Moisture Density Relationship (Proctor Test) (AASHTO T180)
- Unconfined Compression (ASTM D2166)

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.

Swell/Consolidation tests were used to determine the swell or consolidation characteristics of the subsurface materials. Moisture-density relationships (proctors) were performed on selected bulk samples to assist with evaluation of the compaction characteristics of the on-site soils.

Lab testing was also performed on selected samples to determine the water soluble sulfate content, soil resistivity, chloride content, and pH of subsurface materials to assist with evaluation of corrosion potential and cement type recommendations.

Laboratory test results are presented in Appendix C and are also summarized on the Borehole Logs presented in Appendix A.

6.0 SUBSURFACE CONDITIONS

A summary of subsurface conditions encountered in the boreholes drilled by RockSol is presented in this section. The summary is presented in four segments, each identified by structures at the segment limits, from west to east: 1) Proposed Pedestrian Bridge to Federal Boulevard Bridge; 2) Federal Boulevard Bridge to Bryant Street Bridge; 3) Bryant Street Bridge to South Platte River Bridge; 4) and South Platte River Bridge to US6 Bridge over I-25. Subsurface conditions between boreholes may vary from those described in this section. Copies of RockSol borehole logs are presented in Appendix B.

The existing pavement sections encountered during RockSol's investigation are discussed in the Pavement Design Report under a separate cover. Pavement sections encountered in the boreholes drilled within the existing roadways and shoulder areas generally consisted of hot mix asphalt and/or Portland cement concrete pavement ranging in thickness from 3 inches to 20 inches. Aggregate base course, where noted, ranged in thickness from 6 inches to 18 inches. Boreholes drilled outside of the existing pavement sections generally encountered 3 inches to 8 inches of silty to clayey sand and sandy clay topsoil with a light to moderate growth of vegetation.

6.1 Proposed Pedestrian Bridge to Federal Boulevard Bridge

This portion of the project includes the proposed pedestrian bridge, Federal Boulevard Bridge and Retaining Wall A, Wall M and Wall O. Three boreholes were completed by RockSol in this portion of the project. hese boreholes were identified as BR-23 through BR-25. In general, stiff to hard sandy clay native soil was encountered in Boreholes BR-23 through BR-25 below the existing pavement section overlying very stiff to hard clay (weathered claystone). The sandy clay soil exhibited low to high swell potential ranging from 0.2 percent to 5.2 percent.

Sedimentary bedrock consisting of claystone and silty sandstone was encountered at depths ranging from 14 feet to 22 feet (elevations ranging from 5,253 feet to 5,261) feet below the existing ground surface. The claystone bedrock was very hard and exhibited low to high swell potential ranging from 0.2 percent to 5.6 percent. The sandstone bedrock was very hard, silty to slightly clayey and generally non-expansive.

Groundwater was noted during drilling operations in Borehole BR-25 at an approximate depth of 23 feet (elevation of 5,252 feet) below the existing ground surface. Groundwater was not noted during drilling operations at the remaining borehole locations in this section to the maximum depth explored, approximately 40 feet below existing grades.

CDOT performed a geotechnical investigation for the Federal Boulevard and US6 interchange and the results of that investigation are presented in the CDOT geotechnical report titled *Geotechnical Recommendations for Replacement of Structure F-16-EK*, Project IM 088A-024, SA 16228, dated December 3, 2009. At the location of the Federal Boulevard and US6 interchange, CDOT reported soil conditions to generally consist of "…medium stiff to very stiff clay overlaying medium dense to very dense well graded sand overlaying very hard claystone bedrock. Bedrock was encountered between 5,171 feet above mean sea level (amsl) (83 feet below ground surface [bgs]) to the north and 5,173 feet amsl (84 feet bgs) to

the south. Groundwater was encountered in the borings during drilling between 5,194 feet amsl (28 feet bgs) to the east in TH14 and 5,224 feet amsl (32 feet bgs) to the west in TH3. Flowing sand conditions existed in areas where sand was present below the groundwater table."

6.2 Federal Boulevard Bridge to Bryant Street Bridge

This portion of the project includes proposed Retaining Walls B through H, L and N and the Braided Ramp Bridge. A total of 8 boreholes were completed by RockSol in this portion of the project. These boreholes were identified as BR-1, BR-3, BR-26, BR-27, RW1-1, RW1-2, RW5-1 and RW5-2.

In general, medium dense to dense slightly silty to gravelly sand and silty to clayey sand and stiff to hard sandy clay fill material were encountered below the pavement sections or topsoil material and extended to approximate depths ranging from 2 feet to 17 feet below existing grades. he sandy clay and clayey sand fill material exhibited low swell potential ranging from 0.1 percent to 2.3 percent and a low consolidation potential of 0.1 percent. The fill material encountered appears to be associated with the development (roadway, bridge, and embankment construction) of US6.

Native soils consisting of very stiff to hard sandy clay and medium dense to very dense silty to clayey sand and slightly silty to gravelly sand were encountered in the boreholes and extended to depths ranging from 20 feet to 84 feet below existing grades. The sandy clay soil exhibited low to high swell potential ranging from 0.5 percent to 6.1 percent.

Sedimentary bedrock consisting of very hard claystone and silty to clayey sandstone was encountered at depths ranging from 56½ feet and 84 feet (elevations of 5,168 feet and 5,171.5) feet below the existing ground surface at the proposed braided ramp bridge and at depths of 33 feet and 35 feet (elevations of 5,173 feet and 5,174 feet) below existing grades on the west side of the Bryant Street bridge. Bedrock was not noted in the retaining wall (RW) boreholes to the maximum depths explored, approximately 20 feet to 35 feet below existing grades.

Groundwater was noted during drilling operations at approximate depths ranging from 10 feet to 29½ feet (elevations ranging from 5,193 feet to 5,222.5 feet) below existing grades. Groundwater was not noted during drilling operations in Boreholes RW1-1 and RW5-2 to the maximum depths explored, approximately 20 feet to 30 feet below existing grades.

CDOT performed a geotechnical investigation for the Federal Boulevard and US6 interchange and the results of that investigation are presented in the CDOT geotechnical report titled *Geotechnical Recommendations for Replacement of Structure F-16-EK*, Project IM 088A-024, SA 16228, dated December 3, 2009. At the location of the Federal Boulevard and US6 interchange, CDOT reported soil conditions to generally consist of "…medium stiff to very stiff clay overlaying medium dense to very dense well graded sand overlaying very hard claystone bedrock. Bedrock was encountered between 5,171 feet above mean sea level (amsl) (83 feet below ground surface [bgs]) to the north and 5,173 feet amsl (84 feet bgs) to the south. Groundwater was encountered in the borings during drilling between 5,194 feet amsl (28 feet bgs) to the east in TH14 and 5,224 feet amsl (32 feet bgs) to the west in TH3. Flowing sand conditions existed in areas where sand was present below the groundwater table."

6.3 Bryant Street Bridge to South Platte River Bridge

This portion of the project includes the Bryant Street Bridge and Retaining Wall I, Wall J and Wall K. A total of 16 boreholes were completed by RockSol in this portion of the project. These boreholes were identified as BR-1 through BR-6, BR-7, BR-9, RW2-1, RW2-2, RW4-1 through RW4-3, and RW6-1 through RW6-3.

In general, medium dense to dense slightly silty to gravelly sand and silty to clayey sand and stiff to very stiff sandy clay fill material were encountered below the pavement sections or topsoil material and extended to approximate depths ranging from 1 foot to 22 feet below existing grades. Minor amounts of coal dust and brick debris were noted in Boreholes BR-7 and BR-9 at approximate depths ranging from 5 feet to 15 feet below existing grades. The sandy clay and clayey sand fill material exhibited low swell potentials of less than 1 percent and low consolidation potentials of less than 0.5 percent. The fill material encountered appears to be associated with the development (roadway, bridge, and embankment construction) of US6.

Native soils consisting of stiff to very stiff sandy clay, medium dense to very dense slightly silty to gravelly sand, medium dense silty to clayey sand with gravel in parts, and loose to very loose silty to clayey sand were encountered in the boreholes and extended to depths ranging from 20 feet to 55 feet below existing grades. The loose to very loose native soils noted were encountered in Borehole RW2-2 at approximate depths between 8 feet and 20 feet (between approximate elevations 5,191 feet and 5,203 feet) below existing grade.

Sedimentary bedrock consisting of very hard claystone and silty to clayey sandstone was encountered at approximate depths ranging from 30 feet to 55½ feet (approximate elevations of 5,172.5 feet to 5,177) feet below the existing ground surface at the Bryant Street bridge and at depths of 23 feet and 29 feet (approximate elevations of 5,179 feet and 5,182 feet) below existing grades on the west side of the South Platte River bridge. The very hard silty to clayey sandstone bedrock encountered in Borehole BR-7 and BR-9 was lightly to moderately cemented. Bedrock was not noted in the retaining wall (RW) boreholes to the maximum depths explored, approximately 20 feet to 32 feet below existing grades.

Groundwater was noted during drilling operations at approximate depths ranging from 10 feet to 32 feet (elevations ranging from 5,190.5 feet to 5,197 feet) below existing grades. Groundwater was not noted during drilling operations in Boreholes RW4-1 through RW4-3 to the maximum depth explored, approximately 20 feet below existing grades.

6.4 South Platte River Bridge to US6 Bridge over I-25

This portion of the project includes the South Platte River Bridge, I-25 Bridge and the northbound I-25 CD Lane underpass structure to westbound US6. A total of 19 boreholes were completed by RockSol in this portion of the project. These boreholes were identified as BR-7 through BR-22, RW3-1, RW3-2, and RW7-1.

In general, very loose to very dense slightly silty to gravelly sand with cobbles in parts, and silty to clayey sand and stiff to very hard sandy clay fill material were encountered below the pavement sections or topsoil material and extended to approximate depths ranging from 4 feet to 32 feet below existing grades. Minor amounts of coal dust and brick debris were noted in Boreholes BR-7 and BR-9 at approximate depths ranging from 5 feet to 15 feet below existing grades and trace amounts of concrete and brick debris were noted in Boreholes BR-16 and BR-21 within the fill material. The sandy clay and clayey sand fill material exhibited low to high

swell potentials ranging from 0.2 percent to 5.0 percent and low consolidation potentials of less than or equal to 1.0 percent. The fill material encountered appears to be associated with the development (roadway, bridge, and embankment construction) of US6.

Native soils consisting of very stiff sandy clay, loose sandy silt and silty sand, loose to very dense slightly silty to gravelly sand and silty to clayey sand with gravel in parts, and hard weathered claystone were encountered in the boreholes and extended to approximate depths ranging from 9 feet to 47 feet below existing grades. The loose to very loose fill material and native soils noted were encountered in Boreholes BR-7, BR-9, BR-16, RW3-2 and RW7-1 at approximate depths between 10 feet and 30 feet below existing grades.

Sedimentary bedrock consisting of very hard claystone and silty to clayey sandstone was encountered at approximate depths ranging from 9 feet to 29 feet (approximate elevations of 5,190 feet to 5,192) feet below the existing ground surface at the South Platte River bridge and at depths of 19 feet and 47 feet (approximate elevations of 5,191 feet and 5,194.5 feet) below existing grades at the I-25 bridge. The very hard silty to clayey sandstone bedrock encountered in Boreholes BR-7 through BR-14 was lightly to moderately cemented. Claystone bedrock was not noted in the boreholes drilled at the South Platte River bridge location to the maximum depths explored, approximately 17 feet to 50 feet below existing grades.

Groundwater was noted during drilling operations at approximate depths ranging from 4 feet to 39 feet (approximate elevations ranging from 5,190 feet to 5,195 feet) below existing grades.

6.5 Summary of Significant Subsurface Conditions

A transition from native sandy clay to slightly silty to gravelly sand soils was encountered in the boreholes along the US6 alignment from the western portion to the eastern portion of the project limits. In general, the upper 10 feet to 15 feet of clay soils encountered in the western portion (the proposed pedestrian bridge location to the proposed braided ramp structure) of the project limits can be characterized as possessing low to high swell potential. Low and high swell potential was noted in both the fill and native clay soils. In the eastern portion of the project (Bryant Street to I-25), the swell potential of the overburden clays generally decreases to nonexpansive to low. Soils with low consolidation potential (less than or equal to 1 percent consolidation) were encountered in some of the samples obtained. However, very loose to loose native soils and fill material were encountered in boreholes drilled between Bryant Street and I-25 along the US6 alignment. Fill material containing brick, coal dust, and concrete debris may be encountered during construction activities at the South Platte River bridge location and the US6 embankment material at I-25.

7.0 SEISMICITY

RockSol boreholes generally terminated at depths less than 100 feet below the ground surface and shear wave velocity testing was not performed. Borehole BR-26 was drilled an approximate depth of 95 feet below existing grade. Based on the subsurface conditions encountered, it is our opinion that a Seismic Site Class D is considered appropriate for preliminary design of the proposed pedestrian bridge, braided ramp, Bryant Street, South Platte River and I-25 bridge structures. Soil conditions necessary for Site Class E and F were not encountered in RockSol's boreholes. However, as discussed in CDOT's geotechnical report titled *Geotechnical Recommendations for Replacement of Structure F-16-EK*, Project IM 088A-024, SA 16228, dated December 3, 2009, CDOT classified the Federal Boulevard Bridge project site as Seismic Site Class E.

For final design, RockSol recommends performing shear wave velocity testing or performing penetration tests to a depth of 100 feet to confirm the appropriate site class for seismic design or use of Seismic Site Class D can be considered if accepted by CDOT and the City and County of Denver. Seismic design parameters for Seismic Site Class D are included in Appendix D. Seismic design parameters for Seismic Site Class D are discussed below.

Seismic Design Parameters

Seismic design parameters were obtained from the 2007 United States Geological Survey (USGS) Seismic Design Parameters CD (Version 2.10) using the AASHTO Earthquake Motion Parameters Program. The values provided are for a 7 percent probability of exceedance in 75 years. Interpolated values for Peak Ground Acceleration Coefficient (PGA), Spectral Acceleration Coefficient at Period 0.2 sec (S_s), and Spectral Acceleration Coefficient at Period 1.0 sec (S_1) were obtained using the latitude and longitude for the bridge structure. The seismic acceleration coefficients obtained (data based on 0.05 degree grid spacing) are presented in Table 7.1:

Table 7.1 – Seismic Acceleration Coefficients

Bridge Location (Latitude°/Longitude°)	Peak Ground Acceleration (PGA)	Spectral Acceleration Coefficient - S_s (Period 0.2 sec)	Spectral Acceleration Coefficient - S_1 (Period 1.0 sec)
Pedestrian Bridge (39.725511°/-105.029166°)	0.060	0.127	0.034
Braided Ramp Bridge (39.725258°/-105.023243°)	0.059	0.127	0.034
Bryant Street Bridge (39.725269°/-105.018659°)	0.059	0.127	0.034
South Platte River Bridge (39.725434°/-105.015802°)	0.059	0.126	0.034
I-25 Bridge (39.725581°/-105.013212°)	0.059	0.126	0.034

The acceleration coefficients are then used to obtain Site Factors F_{pga}, F_a, and F_v based on the defined Site Class as shown in Tables 3.10.3.2-1, 3.10.3.2-2, and 3.10.3.2-3 of the *AASHTO LRFD*. A summary of the Site Factor values obtained for each station are shown in Table 7.2.

Table 7.2 – Seismic Site Factor Values

Bridge Location	F_{pga} (at zero-period on acceleration spectrum)	F_a (for short period range of acceleration spectrum)	F_v (for long period range of acceleration spectrum)
Pedestrian Bridge	1.60	1.60	2.40
Braided Ramp Bridge	1.60	1.60	2.40
Bryant Street Bridge	1.60	1.60	2.40
South Platte River Bridge	1.60	1.60	2.40
I-25 Bridge	1.60	1.60	2.40

Seismic Performance Zone determination is based on the value of the Acceleration Coefficient, S_{D1}, as determined by *Eq. 3.10.4.2-6* of the *AASHTO LRFD* ($S_{D1} = F_v \times S_1$).

Table 7.3 outlines the Seismic Zone determination and Acceleration Coefficient obtained for the proposed bridge structure.

Table 7.3 – Seismic Performance Zone

Bridge Location	Acceleration Coefficient (S_{D1})	Seismic Zone (1)
Pedestrian Bridge	0.082	1
Braided Ramp Bridge	0.082	1
Bryant Street Bridge	0.081	1
South Platte River Bridge	0.081	1
I-25 Bridge	0.081	1

Note (1): Seismic Zone 1 is assigned when $S_{D1} \leq 0.15$.

8.0 BRIDGE STRUCTURE FOUNDATION RECOMMENDATIONS

Foundation recommendations are presented for viable foundation types based on the subsurface conditions encountered at the proposed pedestrian bridge, braided ramp bridge, Bryant Street Bridge, South Platte River Bridge and I-25 Bridge structures along the US6 Knox Court to BNSF Design Build project limits. Drilled shafts are considered the most viable structure foundation option for the proposed structures. Driven piles are considered a viable foundation alternative for the proposed structures.

The foundation design parameters are based on data obtained from the RockSol boreholes drilled for this evaluation and RockSol's review and interpretation of geotechnical information documented on project plans for the existing bridges at I-25, the South Platte River and Bryant Street and CDOT's geotechnical investigation for the replacement of the Colorado Highway 88 (Federal Boulevard) bridge structure (Structure F-16-EK) over US 6.

Bearing capacity of the bedrock was evaluated based on blow count data obtained during drilling and sampling from this evaluation and previous explorations. Plan sheets and reports reviewed included:

- CDOT Geotechnical Report, *Geotechnical Recommendations for Replacement of Structure F-16-EK*, Project IM 088A-024, SA 16228, dated December 3, 2009
- Bryant Street Bridge, *General Layout, Summary of Quantities and Notes*, Sheet No. 43, Project No. U012-2(3)
- South Platte River Bridge, *General Layout, Summary of Quantities, General Notes, Sheet No. 4,* Project U1002-2(30)
- US 6 Bridge Over I-25, *General Plan and Elevation*, Sheet No. 36, Project No. U012-2(13)
- *Ramp G Engineering Geology*, Sheet No. 85, Project IR 25-2(208)
- *Ramp H Engineering Geology,* Sheet No. 131, Project IR 25-2(191)

- *Ramp F Engineering Geology*, Sheet No. 97, Project IR 25-2(187)

A summary of geotechnical recommendations for the drilled shaft option is presented in Section 8.1 and driven piles are discussed in Section 8.2. In Section 8.3, lateral load parameters are presented.

8.1 Drilled Shafts

Drilled shafts will provide axial support by embedment into sedimentary bedrock. Based on our evaluation, suggested nominal (unfactored) base resistance and nominal (unfactored) side resistance values for the bedrock material are presented in Table 8.1 for use with Load and Resistance Factor Design (LRFD) methods and allowable bearing and side resistance capacities using Allowable Strength Design (ASD) methods.

Table 8.1 - Base and Side Resistance Values for Drilled Shafts

Bearing Material	Nominal Values (LRFD)		Allowable Capacity (ASD)	
	Base Resistance (ksf)	Side Resistance (ksf)	Bearing Resistance (ksf)	Side Resistance (ksf)
Claystone Bedrock and Sandstone Bedrock	135	13.5	45	4.5

Due to the depth to bedrock at the proposed bridge locations, the side resistance is applicable to the entire portion of the shaft embedded in competent bedrock. Side resistance in the soil zone above competent bedrock should be neglected. For LRFD strength limit state evaluation, a resistance factor of 0.55 is recommended for base/tip resistance and a resistance factor of 0.60 is recommended for side resistance evaluation for redundant single shafts. Per AASHTO LRFD (Section 10.5.5.2.4), the resistance factors for base/tip and side resistance should be reduced by 20 percent for non-redundant single shafts.

A minimum shaft penetration into competent bedrock of 10 feet is suggested for drilled shafts less than 5 feet in diameter. For drilled shafts 5 feet and greater in diameter, a minimum penetration into competent bedrock of 15 feet is recommended. If needed, the embedment length may be increased to provide additional resistance to lateral loads and to provide additional axial capacity. Groundwater will be encountered during construction of drilled shafts embedded into bedrock.

Drilled shaft diameters shall be sufficient to satisfy axial and lateral load resistance requirements. In addition, the shaft diameters shall be sufficient to allow for use of casing, if required, and placement of reinforcement with adequate concrete cover.

Additional design and construction considerations are listed below.

(a) The construction of the drilled shafts should follow the guidelines specified in the “CDOT Standard Specifications for Road and Bridge Construction (SSRBC), Section 503, 2011” and “Drilled Shafts: Construction Procedures and LRFD Design Methods, FHWA-NHI-10-016, May 2010”.

(b) During construction of the drilled shafts, casing or slurry will be required to support the excavation where groundwater exists and or where holes are unstable due to soil conditions.

(c) Prior to the placement of the concrete, the drilled shaft excavation, including the bottom should be cleaned of all loose material. Due to the presence of water, dewatering of the excavation may be required. For wet conditions (more than two inches of water), concrete placement by "tremie" methods should be used.

(d) Special provisions should be specified for drilling operations and equipment where hard bedrock and or difficult subsurface conditions exist.

(e) Lateral load capacity of the drilled shafts should be evaluated. Geotechnical parameters for evaluation of lateral load capacity are provided in Table 8.3.

(f) All piers should be reinforced full depth for the applied axial, lateral and uplift stresses imposed. The amount of reinforcing steel for extension should be determined by the tensile force created by the uplift force on each pier, with allowance for dead load.

(g) Drilled shafts should be constructed at least three shaft diameters center to center. For closely spaced drilled shafts, the axial and lateral capacities should be appropriately reduced. Group action of drilled shafts should be analyzed on an individual basis to assess the appropriate reduction.

8.2 Driven Piles

Driven Piles

Alternatively, driven piles (Grade 50 steel H-pile is assumed) may be considered for the proposed bridges, including the abutments. Evaluation of the effect of pile driving on existing foundations should be considered. RockSol recommends the piles be driven to refusal in the bedrock. Based on anticipated subsurface conditions, practical refusal is estimated to occur within approximately 5 feet of penetration into competent bedrock. Pile driving shall be monitored per CDOT requirements. Monitoring shall be conducted using a Pile Driving Analyzer (PDA) to determine the condition of the pile, the efficiency of the hammer and the static bearing capacity of the pile, and to establish the pile driving criteria. For the LRFD method, a nominal (ultimate) capacity of 37.5 ksi, based on the cross section area of the pile, can be used for Grade 50 steel. A resistance factor of 0.65 is recommended for LRFD strength limit state design for axial compression. Additional design and construction details of the driven piles are presented below:

(a) Steel piling, pile driving equipment, and installation of the driven steel H-piles should follow the guidelines specified in "CDOT Standard Specifications for Road and Bridge Construction (SSRBC), Section 502, 2011 Edition."

(b) Lateral load capacity of the driven piles should also be evaluated. As preliminary design efforts progress, RockSol will provide soil parameters appropriate for the conditions encountered in boreholes drilled for this project. Battered piles may be used to resist the lateral loads. The battered piles inclination should be within one (1) horizontal to four (4) vertical.

(c) RockSol anticipates that approximately 5 feet of pile penetration into bedrock will be required to achieve capacity. The actual length of the piles should be determined during installation.

(d) Center to center pile spacing should not be less than 30 inches or 2.5 pile diameters. For evaluation of horizontal pile foundation movement, the effects of group interaction shall be

evaluated in accordance with AASHTO LRFD Bridge Design Specifications, Section 10.7.2.4.

(e) Predrilling may be required for difficult subsurface conditions. Pile tips should be protected against damage using driving shoes for hard sedimentary bedrock.

(f) Potential damage to the property or adjacent structures during pile installation due to noise and vibrations should be evaluated.

8.3 Lateral Load Parameters

Recommended lateral load parameters for preliminary design of drilled shafts and driven piles constructed for the proposed bridge structures are presented in Table 8.3. The parameters listed are for use with LPILE® or equivalent COM624 software.

Table 8.3 - Lateral Load Parameters (Bridge Structures)

Material	Cohesion (psi)	Angle of Internal Friction (degrees)	Subgrade Reaction Coefficient, (pci)	Strain, E_{50} (%)	Unit Weight (pcf)
(Fill) SAND, silty to clayey Above water table (AWT)	0	30	90	--	125 (Total)
(Fill) CLAY, with sand to sandy, AWT	10	0	500	0.01	120 (Total)
(Native) SAND, silty to clayey, AWT	0	32	90		125 (Total)
(Native) SAND, silty to clayey, below water table (BWT)	0	32	60	--	60 (Submerged)
(Native) SAND, silty, with gravel to gravelly, AWT	0	36	90	--	120 (Total)
(Native) SAND, silty, with gravel to gravelly, BWT	0	36	60	--	60 (Submerged)
(Native) CLAY and SILT, with sand to sandy, AWT	10	0	500	0.01	120 (Total)
(Native) CLAY and SILT, with sand to sandy, BWT	10	0	500	0.01	60 (Submerged)
Claystone, Sandstone, and Siltstone Bedrock	40	0	1,500	0.006	125 (Total)

Total unit weight indicated in the table above includes soil plus moisture content and is intended for use with soil above the water table. Submerged unit weight accounts for the buoyant effect of water and is intended for use with soil below the water table. Depths at which groundwater was encountered are indicated on the attached boring logs.

8.4 Preliminary Structure Foundation Recommendations (Underpass Structure)

An underpass structure which will carry north bound I-25 traffic under US6 to west bound US6 with a lane separated from NB I-25 is being considered. Viable foundation types for the underpass structure include spread footings and drilled shafts. A pre-cast or cast-in-place three-sided box structure may be supported by the spread footings or drilled shafts.

Spread Footings

A spread footing foundation system is feasible for the NB I-25 to WB US6 underpass structure. Based on the subsurface conditions encountered in Boreholes BR-20 through BR-22, an

allowable bearing capacity of 5 ksf is considered appropriate for preliminary design of the spread footings bearing on native sand and gravel encountered at approximate elevations ranging from 5,198 feet to 5,201 feet.

Groundwater was noted in Boreholes BR-20 through BR-22 at elevations ranging from 5,194 feet to 5,220 feet. It appears the groundwater encountered in Borehole BR-22 at an approximate elevation of 5,220 feet is perched within the embankment material and may be due to accumulation of infiltrated surface drainage water. A permanent subsurface drainage system should be incorporated into the design of the underpass structure walls to prevent accumulation of surface water infiltration behind associated retaining walls.

Drilled Shafts

Drilled shafts are a feasible foundation type for the underpass structure. Drilled shafts will provide support by embedment into sedimentary bedrock. Based on our evaluation, the recommended nominal (unfactored) base resistance and nominal (unfactored) side resistance values for the bedrock material presented in Table 8.1 may be used for drilled shafts constructed for the underpass structure.

9.0 PRELIMINARY RETAINING WALL RECOMMENDATIONS

New retaining wall structures associated with the bridge replacements and new ramp configurations are proposed along US6 at the Federal Boulevard, Bryant Street and I-25 interchanges. Retaining walls will be required to retain fill material at embankment locations and native soil in cut areas. Mechanically stabilized earth (MSE) walls and cast-in-place (CIP) walls are being considered for the proposed retaining wall structures. Maximum retaining wall heights are anticipated between 15 to 34 feet for single retaining wall systems. Descriptions of the proposed retaining wall systems for this project are presented in Table 9.1. Estimated wall heights and retaining wall categorization were provided by Hartwig and are based on the plans titled *US 6 Bridges Design Build Project, 18838, dated 7/3/2012*.

Table 9.1 – Proposed Retaining Wall Summary

Wall Identification	Wall Type (cut or fill)	Associated Structure/Roadway	Approximate Wall Length (ft)	Approximate Wall Height (ft)	Corresponding RockSol Boreholes
A	Fill	South Side of Federal Blvd Ramp to WB US6.	300	7 to 15	Note 1
B	Cut	Bryant Street Ramp to Federal Blvd. Starts near Federal Blvd and ends at Wall C offset.	720	8 to 30	Note 1
C	Fill	North side of Bryant Street Ramp to Federal Blvd. Starts near Bryant Street and ends at Wall B offset.	811	7 to 28	RW1-1, RW1-2, BR-3 and Note 1
D	Fill	WB US 6 Ramp to Federal Blvd.	472	7 to 21	Note 1
E	Fill and Cut	North Side of Federal Blvd Ramp to Braided Ramp Bridge/EB US6 and I-25.	1,074	6 to 34	BR-26 and BR-27 and Note 1
F	Fill and Cut	South Side of Federal Blvd Ramp to Braided Ramp Bridge/EB US6, I-25 and Bryant Street.	1,397	7 to 29	BR-1, BR-26, BR-27,RW5-1, RW5-2 and Note 1
G	Fill	EB US6 Braided Ramp to EB US6 (north side of ramp/roadway)	988	7 to 34	BR-1, BR-2, BR-26, BR-27,RW5-1, RW5-2 and Note 1
H	Fill	EB US6 Braided Ramp to EB US6 (south side of ramp/roadway)	1,012	7 to 30	BR-1, BR-2, BR-26, BR-27,RW5-1, RW5-2 and Note 1
I	Fill	North side of EB US6 CD Lane to I-25	600	14 to 23	BR-6, BR-7, and RW4-1 through RW4-3
J	Fill	South side of EB US6 CD Lane to I-25	665	8 to 20	BR-6, BR-7, and RW4-1 through RW4-3
K	Fill	North side of WB US 6 CD Lane	641	20 to 31	BR-4, BR-9, RW2-1 and RW2-2
L	Fill	North side of Federal Blvd Ramp to Bryant Street	783	6 to 34	BR-1, RW5-1, and RW5-2
M	Fill	North side of EB US6 Ramp to Federal Blvd.	158	6 to 12	Note 1
N	Fill	South side of Bryant Street Ramp to Federal Blvd.	567	7 to 32	BR-2, BR-3, RW1-1, and RW1-2
O	Fill	North Side of Federal Boulevard Ramp to WB US6.	575	8 to 16	Note 1
P	Cut	East side of NB I-25 Ramp to WB US6, South side of US6	75	12 to 32	BR-20
Q	Cut	East side of NB I-25 Ramp to WB US6, North side of US6	70	6 to 30	BR-22

Note 1: See CDOT Geotechnical Report, *Geotechnical Recommendations for Replacement of Structure F-16-EK*, Project IM 088A-024, SA 16228, dated December 3, 2009.

Note 2: See Geocal, Inc. Geotechnical Report (*G10.1354.003*), *30% Design Soil and Foundation Investigation, Proposed 6th Avenue Freeway over BNSF Bridge Replacement, City and County of Denver, Colorado*, dated December 19, 2011.

Based on the subsurface conditions encountered in our boreholes and our geotechnical evaluation, very loose to loose soil conditions exist along the eastern portion of the proposed Retaining Wall K that may require special design and construction considerations.

9.1 Ground Improvement Discussion

Based on conditions encountered in Borehole RW2-2, very loose to loose soils may require ground improvement mitigation to reduce settlement potential at and in the vicinity of Retaining Wall K.

RockSol recommends overexcavating the existing soils to a minimum depth of 3 feet below, and 3 feet laterally away from, bottom elevation of the footing or leveling pad of the proposed retaining wall system. Prior to replacement of the overexcavated material, the underlying native soil surface shall be scarified to a depth of 6 inches and compacted to a minimum of 95 percent of maximum dry density (MDD) as determined by AASHTO T180 (modified proctor) and moisture conditioned to within 2 percent of Optimum Moisture Content (OMC). Once the underlying soil surface is scarified and compacted, on-site or imported soil meeting the requirements of structural backfill material should be moisture conditioned to within 2 percent of OMC and compacted to 95 percent of MDD as determined by AASHTO T180 (modified proctor) in maximum 8 inch lifts. Cobbles greater than 6 inches in diameter, if encountered, should be removed from the scarification and structural fill zone.

The overexcavation and replacement operations are recommended to provide a higher density and uniform bearing stratum for the proposed retaining wall system to reduce, but not eliminate, settlement potential in the existing subgrade soils. RockSol recommends the replacement material consist of either on-site material with all material greater than 6 inches in diameter removed, or non-expansive, imported soil with a maximum of 35 percent passing the US No. 200 sieve, no material in excess of 6-inches, and with a Liquid Limit less than 30.

9.2 Feasible Wall Type Discussion

Based on conditions encountered in our borings and on our geotechnical evaluation, CIP concrete walls or MSE walls are feasible for the proposed retaining wall systems. Table 9.2 presents recommended bearing resistances for preliminary design. The nominal (ultimate) bearing resistances presented are unfactored for Load and Resistance Factor Design (LRFD). The allowable bearing capacity based on Allowable Stress Design (ASD) includes an estimated Factor of Safety of 3 and an estimated settlement of about one inch.

Table 9.2 – Wall Bearing Resistance for Preliminary Design

US 6 Bridges Design Build Project Wall Locations	Nominal Resistance (LRFD) (ksf)	Allowable Bearing Capacity, (ASD) (ksf)
Walls A, B, D, E, F, M and O	5.5	1.8
Walls C, G, H, I, J, K, L, N, P, and Q	10.0	3.3

Note 1: Bearing resistance for Wall K is based on conditions anticipated after ground improvement is completed.

For preliminary design, internal reinforcement lengths for the MSE wall option of 0.7 times the wall height are suggested. Greater lengths should be considered if surcharge loads and non-

horizontal backslopes are planned. Positive internal and external surface drainage to eliminate hydrostatic pressure is also assumed for either wall type.

Lateral Earth Pressure Parameters

Lateral earth pressure parameters are presented in Table 9.3 for retaining walls based on retained soil type.

Table 9.3 – Lateral Earth Pressure Parameters – CIP Walls

Unified Soil Classification	AASHTO Classification	Unit Weight (pcf)	Active Earth Pressure (psf/ft)	At Rest Earth Pressure (psf/ft)	Passive Earth Pressure (psf/ft)	Coefficient of Friction
SW, GW SP, GP	A-1	125	35	60	150	0.50
SP-SM, SM GP-GM, GM	A-2, A-3	120	45	60	150	0.40
SC, CL, ML	A-4, A-6, A-7-5	120	not suitable unless evaluated by a qualified geotechnical engineer		125	0.35
CH, MH	A-7-6	120			100	0.30

Values presented are based on “equivalent fluid pressure” and assume horizontal slopes at toe and top of wall. Hydrostatic forces are not included. Drainage of retained soil behind all walls should be included in the design. Passive earth pressure values are presented to limit horizontal movement. The lateral earth pressure parameters in Table 9.3 do not include surcharge loadings such as traffic, construction equipment or fill stockpiles. The lateral earth pressure values provided in this report assume light weight hand operated compaction equipment will be used to compact backfill within 5 feet of the wall face. Cantilevered retaining structures can be expected to deflect sufficiently to mobilize the full active lateral earth pressure condition.

10.0 GEOCHEMISTRY

Water soluble sulfate content, water soluble chloride content, pH and electrical resistivity testing was performed on samples obtained from selected boreholes within the project limits to help evaluate sulfate resistance requirements and corrosion resistance levels as discussed in the following sections.

10.1 Sulfate Resistance Requirements (Cement Type)

Cementitious material requirements for concrete in contact with site soils or groundwater is 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 CDOT as shown in Table 10.1 and in the Standard Specifications for Road and Bridge Construction, dated 2011.

Table 10.1
Requirements to Protect Against Damage to Concrete
by Sulfate Attack from External Sources of Sulfate

Severity of sulfate exposure	Water-soluble sulfate (SO_4), in dry soil, percent	Sulfate (SO_4), in water, ppm	Water cementitious ratio, maximum	Cementitious material requirements
Class 0	0.00 to 0.10	0 to 150	0.45	Class 0
Class 1	0.11 to 0.20	151 to 1,500	0.45	Class 1
Class 2	0.21 to 2.0	1,500 to 10,000	0.45	Class 2
Class 3	2.01 or greater	10,001 or greater	0.40	Class 3

Water soluble sulfate content was tested in 63 samples obtained from RockSol's boreholes at various depths. Fifty-eight samples exhibited water soluble contents less than 0.10 percent by weight (Exposure Class 0). This represents approximately 92 percent of the total samples tested. Three samples exhibited water soluble sulfate contents between 0.1 and 0.2 percent (Exposure Class 1). This represents approximately 5 percent of the total samples tested. Two samples obtained from Borehole RW2-1 (proposed Retaining Wall K) exhibited water soluble sulfate contents between 0.2 and 2.0 percent (Exposure Class 2). This represents approximately 3 percent of the total samples tested.

Based on the results of the water soluble sulfate testing, concrete in contact with subgrade materials for most of the project may be constructed with cement meeting the requirements for Exposure Class 0. Exposure Class 1 and 2 conditions were also encountered. Therefore, cement requirements for Exposure Class 2 should be considered for this project.

10.2 Corrosion Resistance Levels

Water soluble chloride content, pH and electrical resistivity tests were performed on five bulk samples obtained from selected boreholes and are summarized below in Table 10.2. The electrical resistivity analyses were performed in the RockSol laboratory using the soil box method (ASTM G-187).

Table 10.2 – Corrosivity Test Results

Borehole Location	Sample Depth	Water Soluble Chloride (%)	Saturated Resistivity (ohm-cm) at Moisture content (%)	Water Soluble Sulfate (% by weight)	pH
B-8	9" – 5'	0.0313	470 @ 24.6	0.03	7.8
B-12	13" – 5'	0.03	200 @ 16.7	<0.01	7.8
B-21	7.5" – 5'	0.0871	320 @ 23.3	<0.01	7.7
RW2-1	0 – 5'	0.0433	420 @ 26.5	0.25	7.8
RW3-1	0 – 5'	0.00	1,800 @ 18.5-	<0.01	8.4

Comparison of the results of the chloride, sulfate and pH testing performed with *Table 1 - Guidelines for Selection of Corrosion Resistance Levels as presented in the CDOT Pipe Materials Selection Policy,* Page 6 of 11, dated May 27, 2010*,* suggests a corrosion resistance (CR) level of CR1 is appropriate for most of the project site, except in the vicinity of Boreholes RW2-1 and RW2-2. A corrosion resistance level of CR-3 is suggested in the vicinity of Boreholes RW2-1 and RW2-2. As stated in *CDOT Pipe Materials Selection Policy*, the

Guidelines for Selection of Corrosion Resistance Levels chart and "observations of field conditions of existing pipes are to be used as aids in the determination of a CR level".

Based on the laboratory electrical resistivity test results, an aggressive corrosion condition for steel pipe and piles and reinforcement bars is indicated at this site based on criteria presented in Table 3.9 of FHWA report FHWA0-IF-3-017, Geotechnical Engineering Circular No.7 – Soil Nail Walls.

Additional corrosion resistance testing was performed on bulk samples obtained from the pavement boreholes along the US6 Bridges Design Build Project limits. Those results are reported under a separate cover.

11.0 POTENTIAL DESIGN AND CONSTRUCTABLIITY ISSUES AND MITIGATION

Support for excavations should be designed in accordance with the local, state and federal regulations including OSHA guidelines based on site specific conditions. OSHA Type C soils are anticipated along most of the US6 Bridges Design Build Project alignment. The contractor shall be responsible for identification of soil types and implementation of appropriate excavation methods. Existing structures and underground utilities on the project must be protected when excavating below grade. The provisions to protect existing facilities will depend on the proximity of the adjacent excavations.

Based on conditions encountered in Borehole RW2-2, very loose to loose soils may require ground improvement mitigation to reduce settlement potential at and in the vicinity of Retaining Wall K.

Elevated levels of water soluble sulfates were encountered in two soil samples obtained from Borehole RW2-1. A corrosion resistance level of CR-3 is suggested in the vicinity of Boreholes RW2-1 and RW2-2. Based on the laboratory electrical resistivity test results, an aggressive corrosion condition for steel pipe and piles and reinforcement bars is indicated at this site.

Construction of embankments for US6 adjacent to the South Platte River should include an appropriate design to protect the embankment from potential scour and erosion from the South Platte River.

Expansive soil and bedrock were encountered in portions of the US6 Bridges Design Build project limits. Swell potentials ranging from less than 1 percent to 6.1 percent were encountered at the proposed structure locations. Forty-four samples were tested for swell/consolidation potential and test results indicate an average of 1.5 percent for swell potential and 0.2 percent for consolidation potential. In general, the expansive soil and bedrock was predominately located in the western portion of the US6 Bridges project, west of Federal Boulevard. Based on the laboratory test results and our understanding of the proposed type of construction, ground improvement is not deemed necessary to mitigate expansive soils (swell mitigation) for the proposed structures.

12.0 LIMITATIONS

This geotechnical investigation was conducted in general accordance with the scope of work. This report has been prepared for use by Hartwig and Associates, Inc. and the Colorado Department of Transportation (CDOT) exclusively for the project described in this report. The report is based on information provided by CDOT, RockSol's observations, and 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. The nature and extent of subsurface variations across the project site may not become evident until the construction phase of the project and when excavations are performed.

The conclusions and recommendations submitted in this report are based upon the data obtained from the boreholes drilled at the locations indicated on the boring location sheets and our understanding of the proposed type of construction. Additional field investigation is recommended and additional evaluation for development of final geotechnical recommendations for the final design phase is recommended. If the proposed construction is different than described in this report, RockSol should be notified to re-evaluate, or supplement, the recommendations contained in this report. RockSol is not responsible for liability associated with interpretation of subsurface data by others.

This report was prepared as a Reference Document for the Design/Build Project. Additional geotechnical investigations will be required by the Design/Build Contractor to prepare final design documents.

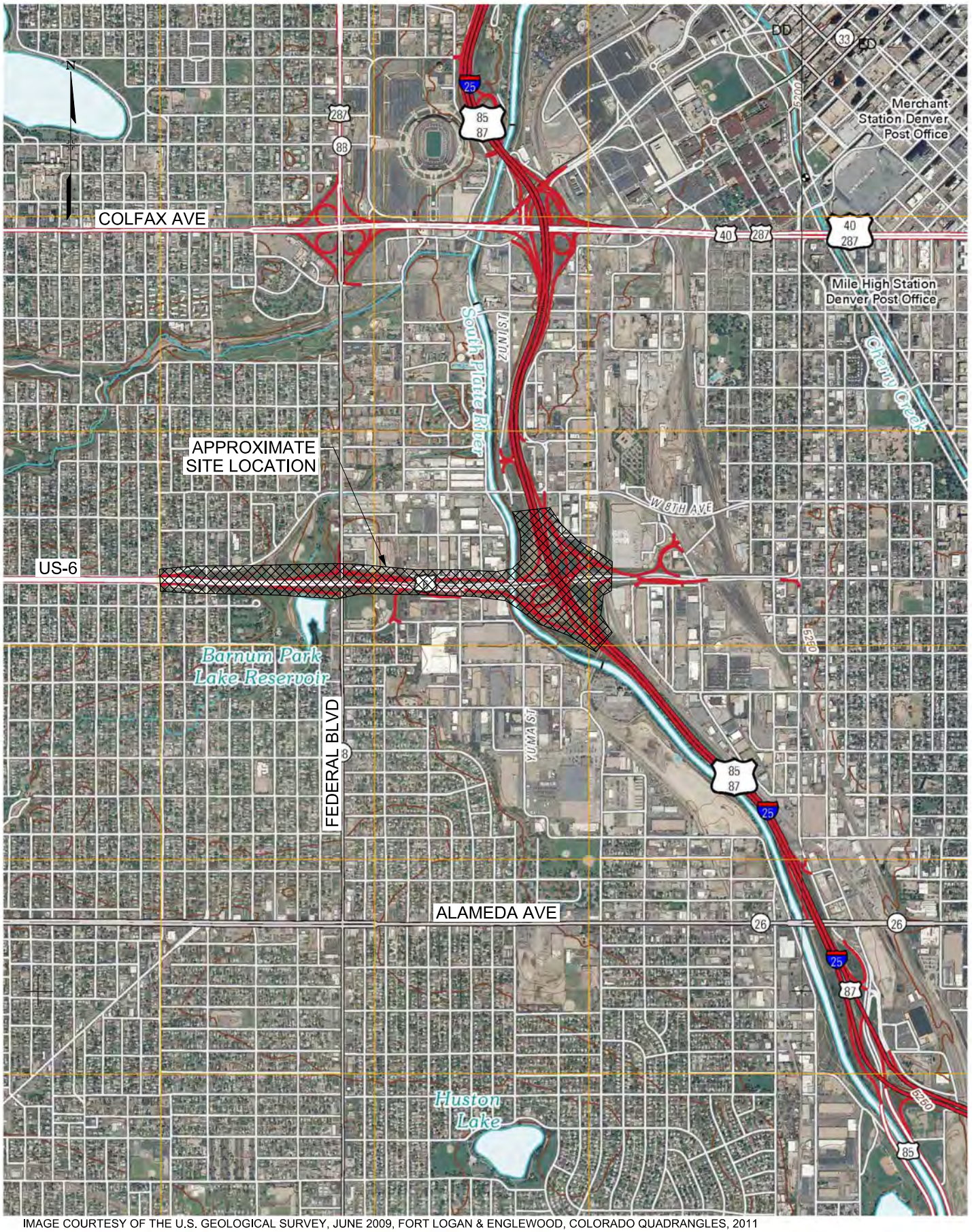


IMAGE COURTESY OF THE U.S. GEOLOGICAL SURVEY, JUNE 2009, FORT LOGAN & ENGLEWOOD, COLORADO QUADRANGLES, 2011

USER: dknight 7/6/2012 11:21:50 AM 18838 RS Site Vicinity Map.dgn

RockSol Consulting Group, Inc.
6510 W 91st Ave, Ste 130 Ph: 303-962-9300
Westminster, CO 80031 Fax: 303-962-9350

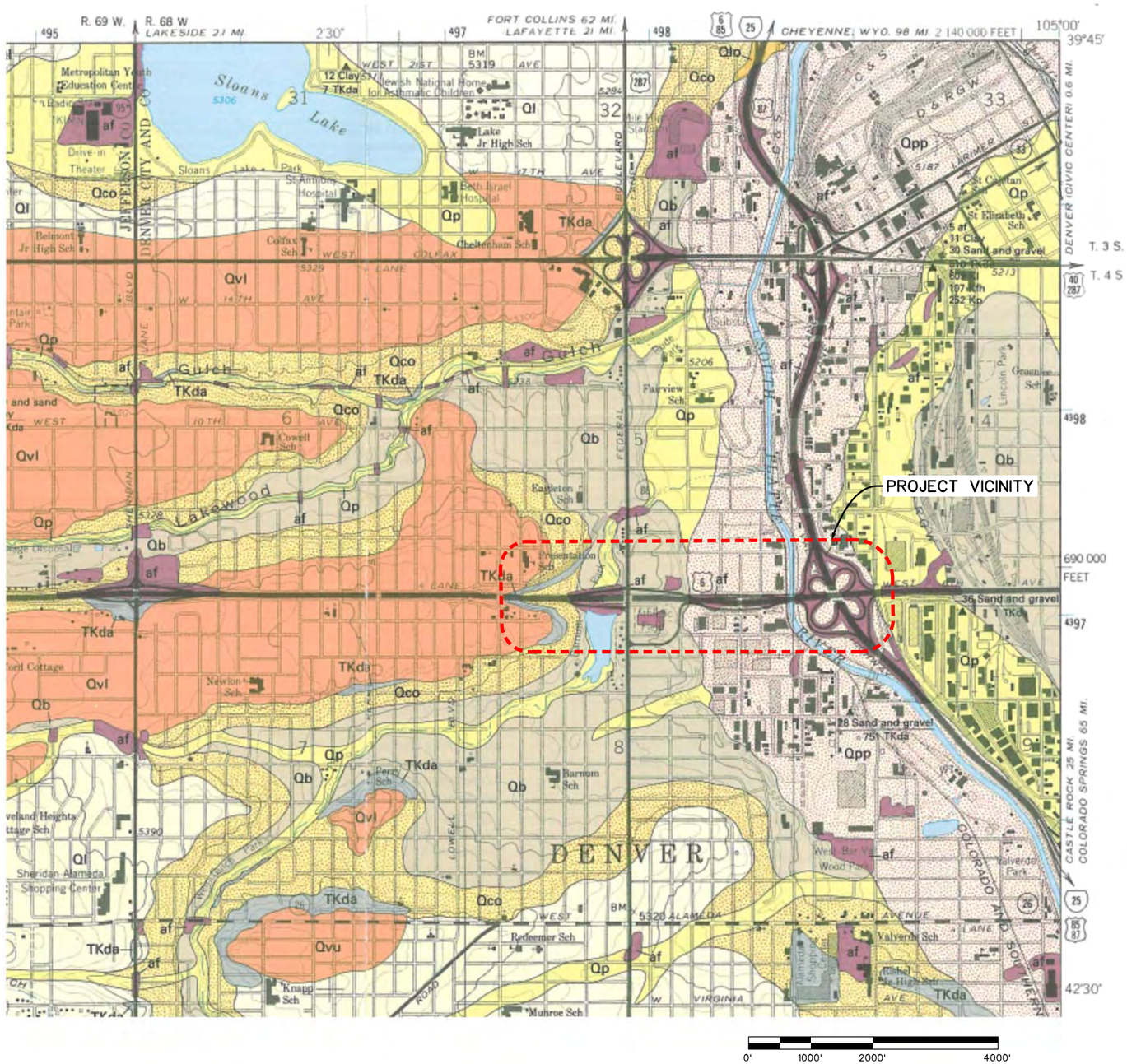
DESIGNED BY: R. LEPRO DATE: 7/6/12
DRAWN BY: D. KNIGHT DATE: 7/6/12

US-6 BRIDGES DESIGN BUILD PROJECT

SITE VICINITY MAP

0 1000 2000 3000
(FEET)

ROCKSOL NUMBER: 280.01
FIGURE 1



DESCRIPTION OF MAP UNITS

af — ARTIFICIAL FILL—Clay, silt, sand, gravel, and a variety of debris consisting of concrete, brick, wood, metal, plastic, glass, vegetation, and other trash. Includes engineered and compacted fill for highways, buildings, and bridge abutments; engineered and semi-engineered fill for dams, canal and railway embankments, stream-channelization dikes, and some sanitary landfills; and uncompacted materials in local rubbish dumps. Generally 5–15 feet (1.5–4.5 m) thick, but some dams and embankments are as much as 40 feet (12 m) thick

Qpp — POST-PINEY CREEK ALLUVIUM (HOLOCENE)—Light- to dark-grayish-brown clay, silt, sand, and small amounts of gravel. Dark-brown and dark-bluish-black humic bog clays, interbedded in places with sand and silt. Mapped chiefly in the South Platte River and Bear Creek valleys, but thin deposits are present in most minor tributary stream valleys. Deposits forming the flood plains of Bear Creek and South Platte River have a high proportion of silt. Thickness about 5–10 feet (1.5–3 m)

Qp — PINEY CREEK ALLUVIUM (HOLOCENE)—Brown, light-brown, light-gray to dark-gray interbedded sand, silt, and clay. Humic material is common in upper 1–2 feet (0.3–0.6 m); interbedded gravel in lower part. Generally well stratified; upper part of alluvium is generally finer grained than the lower part. Occupies the bottoms of almost every valley except Bear Creek and South Platte River. Commonly 5–10 feet (1.5–3 m) thick

Qco — COLLUVIUM (HOLOCENE TO PLEISTOCENE)—Gray, dark-gray, brown to light-brown sandy silt and clay. In places may contain pebbles and cobbles. Developed on steep to gentle slopes; generally transitional downslope into Piney Creek Alluvium. Commonly less than 5 feet (1.5 m) thick

Qb — BROADWAY ALLUVIUM (PLEISTOCENE)—Pink to light-brown, generally well-stratified sand and gravel, in well-formed terraces along South Platte River and Lakewood and McIntyre Gulches. Alluvium on west side of South Platte River and along the tributaries generally is fine sand and silt. Upper surfaces of terrace deposits are about 25–30 feet (7.6–9 m) above modern major streams. As much as 30 feet (9 m) thick

Qvl — Lower Verdos terrace or pediment deposit—Surface is generally about 180–200 feet (55–61 m) above modern major stream courses

TKda — DENVER (PALEOCENE AND UPPER CRETACEOUS) AND ARAPAHOE (UPPER CRETACEOUS) FORMATIONS—Brown, yellowish-brown, gray, and blue-gray interbedded sandstone, claystone, siltstone, shale, and conglomerate. Crossbedded and lenticular units are common throughout the formations. Shale and claystone generally exhibit marked swelling properties when wetted. Olive-brown andesitic sandstone beds are a diagnostic feature of the Denver Formation. The lower conglomerate member of the Arapahoe Formation is generally water bearing. Thickness of 810 feet (247 m) reported in well log from downtown Denver locality

TAKEN FROM THE "GEOLOGIC MAP OF THE FORT LOGAN QUADRANGLE, JEFFERSON, DENVER AND ARAPAHOE COUNTIES, COLORADO" BY ROBERT M. LINDVALL, USGS MAP GQ-1427, 1978

Print Date: 7/25/2012	Sheet Revisions	Colorado Department of Transportation	As Constructed
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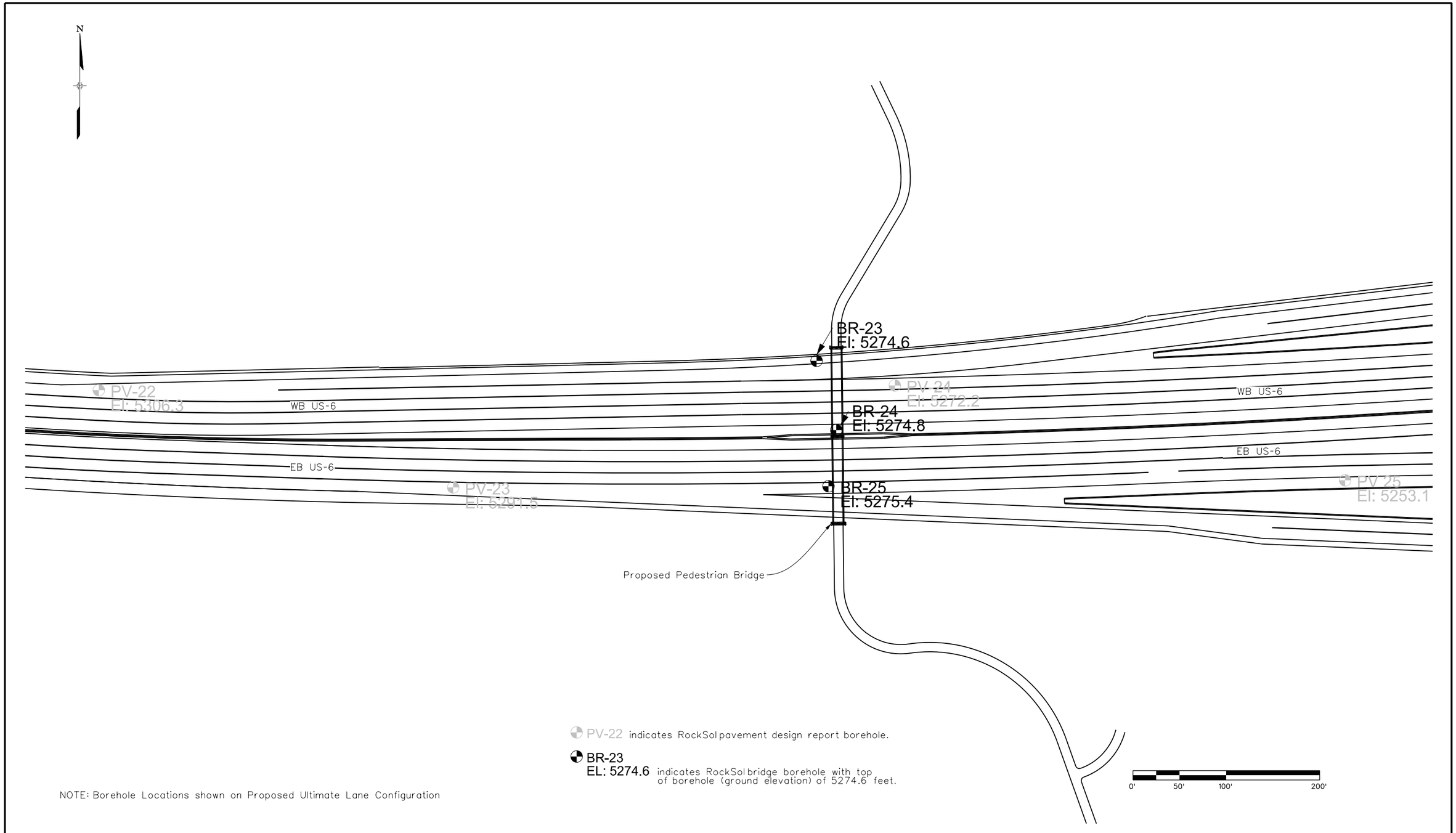
Horiz. Scale: 1:0.0833333 Vert. Scale: As Noted	R-X	Region 6 MDP	Revised:
Unit Information Unit Leader Initials			Void:
RockSol Consulting Group, Inc. 6510 W 91st Ave, Ste 130 Westminster, CO 80031 Ph: 303-962-9300 Fax: 303-962-9350			

GEOLOGIC MAP		Project No./Code	
Designer: R. Lepro	Structure Numbers	US 6 BRIDGES DESIGN BUILD PROJECT	
Detailer: S. McKanna-Koon		18838	
Sheet Subset:	Subset Sheets: 1 of 1	Figure	2



NOTE: Borehole Locations shown on Proposed Ultimate Lane Configuration

Print Date: 10/15/2012		Sheet Revisions			Colorado Department of Transportation	As Constructed	BOREHOLE LOCATION PLAN	Project No./Code
File Name: 18838-F-3A-Borehole Location Plan.dgn		Date:	Comments	Init.	8833 South Wadsworth Court Littleton, CO 80128 Phone: 303-972-9112 FAX: 303-972-9114	No Revisions:		US 6 BRIDGES DESIGN BUILD PROJECT
Horiz. Scale: 1:100 Vert. Scale: As Noted	R-X					Revised:	Designer: R. Lepro / Detailer: D. Knight / Structure Numbers	18838
Unit Information Unit Leader Initials					Region 6 MDP	Void:	Sheet Subset: / Subset Sheets: 1 of 6	Sheet Number 3A
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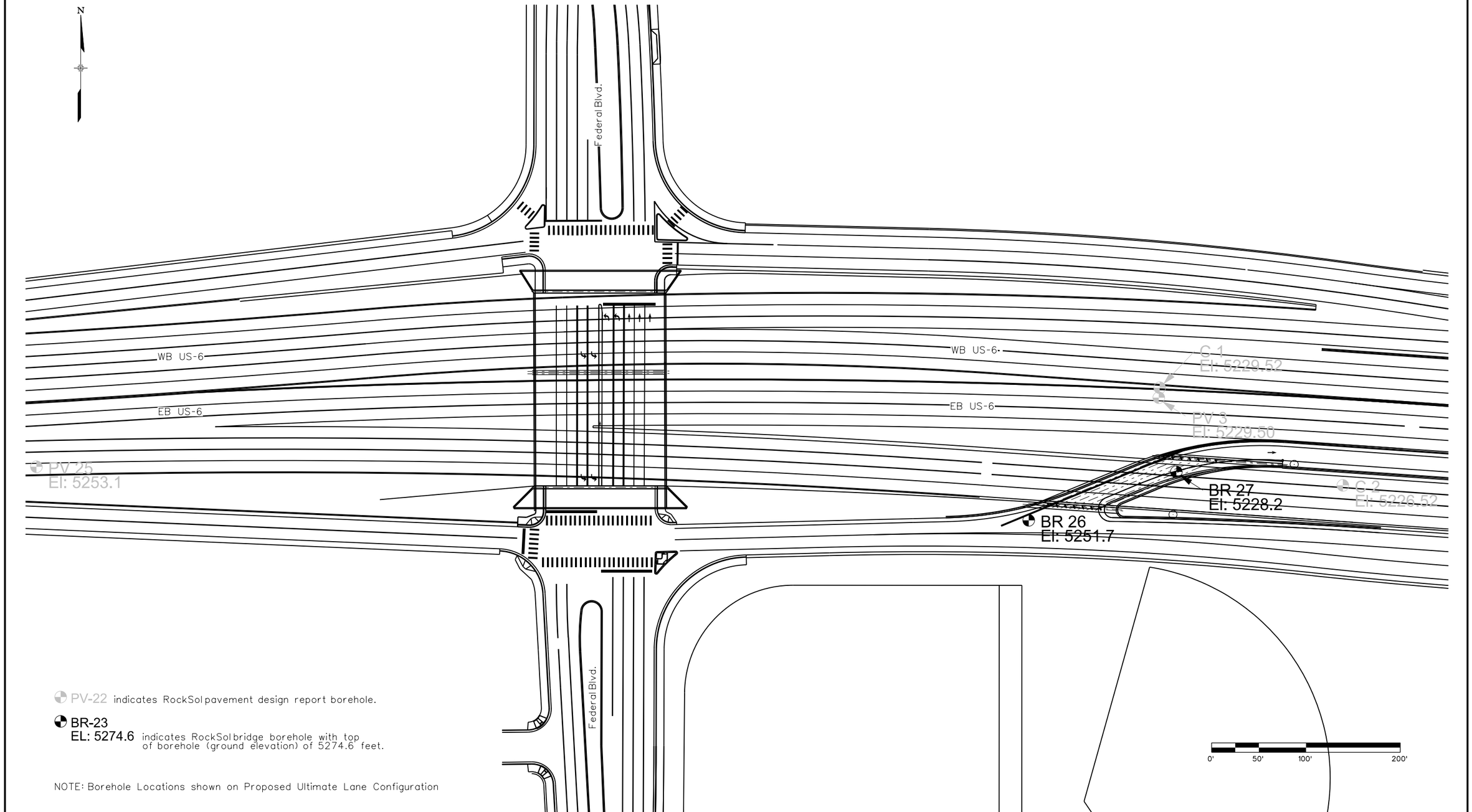

PV-22 indicates RockSol pavement design report borehole.

BR-23
EL: 5274.6 indicates RockSol bridge borehole with top of borehole (ground elevation) of 5274.6 feet.

NOTE: Borehole Locations shown on Proposed Ultimate Lane Configuration

Print Date: 10/15/2012			
File Name: 18838-F-3B-Structural Borehole Location Plan.dgn			
Horiz. Scale: 1:100	Vert. Scale: As Noted	R-X	
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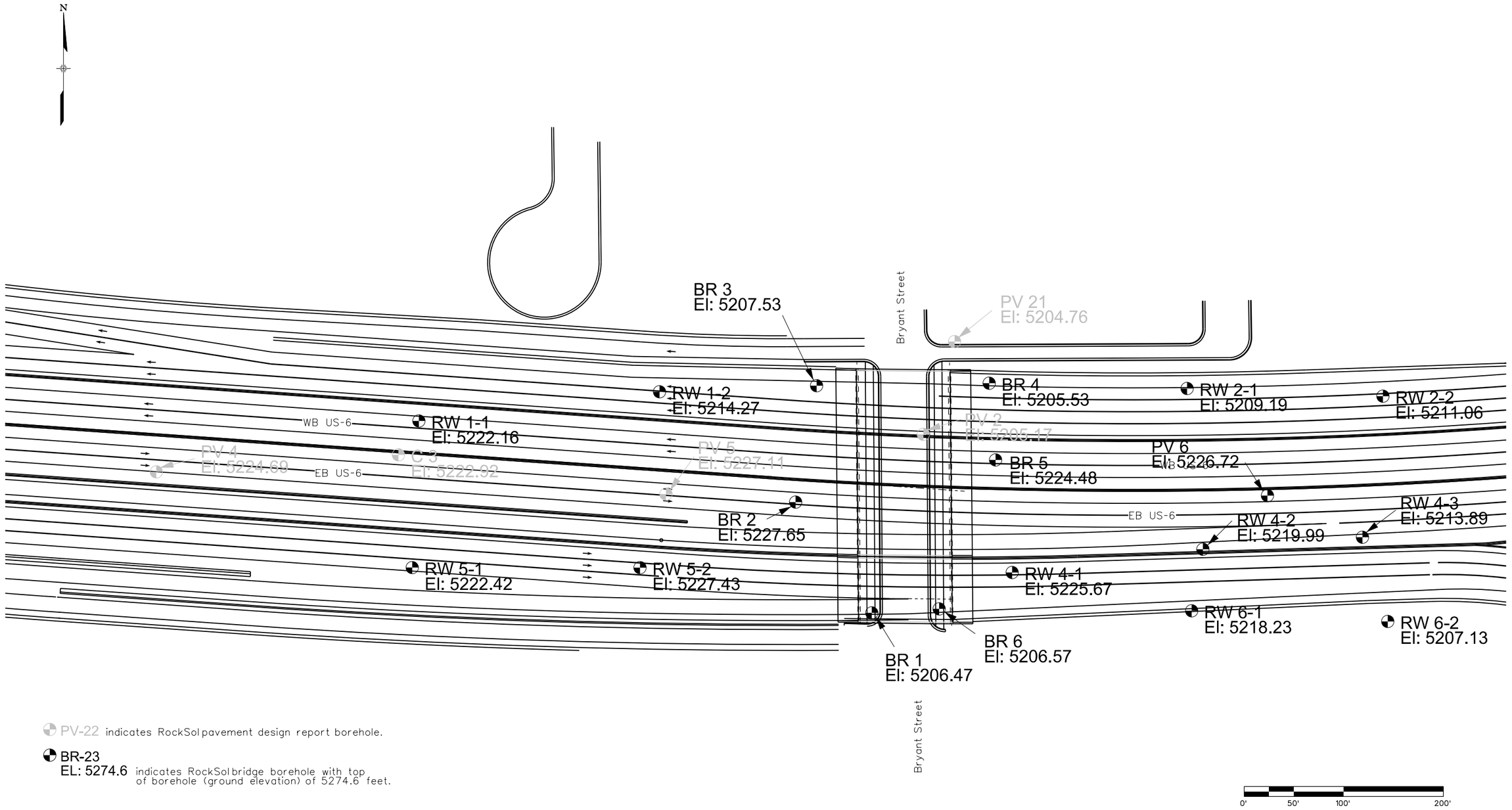
BOREHOLE LOCATION PLAN

Designer: R. Lepro
Detailer: D. Knight
Sheet Subset:
Structure Numbers:
Subset Sheets: 2 of 6

Project No./Code
US 6 BRIDGES
DESIGN BUILD PROJECT
18838
Figure 3B



PV-22 indicates RockSol pavement design report borehole.

BR-23
EL: 5274.6 indicates RockSol bridge borehole with top of borehole (ground elevation) of 5274.6 feet.

NOTE: Borehole Locations shown on Proposed Ultimate Lane Configuration

Print Date: 10/15/2012		Sheet Revisions			Colorado Department of Transportation
File Name: 18838-F-3C-Borehole Location Plan.dgn		Date:	Comments	Init.	8833 South Wadsworth Court Littleton, CO 80128 Phone: 303-972-9112 FAX: 303-972-9114
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Unit Information Unit Leader Initials					
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No Revisions:			US 6 BRIDGES DESIGN BUILD PROJECT
Revised:	Designer: R. Lepro	Structure Numbers	18838
Void:	Detailer: D. Knight		Figure 3C
	Sheet Subset:	Subset Sheets: 3 of 6	

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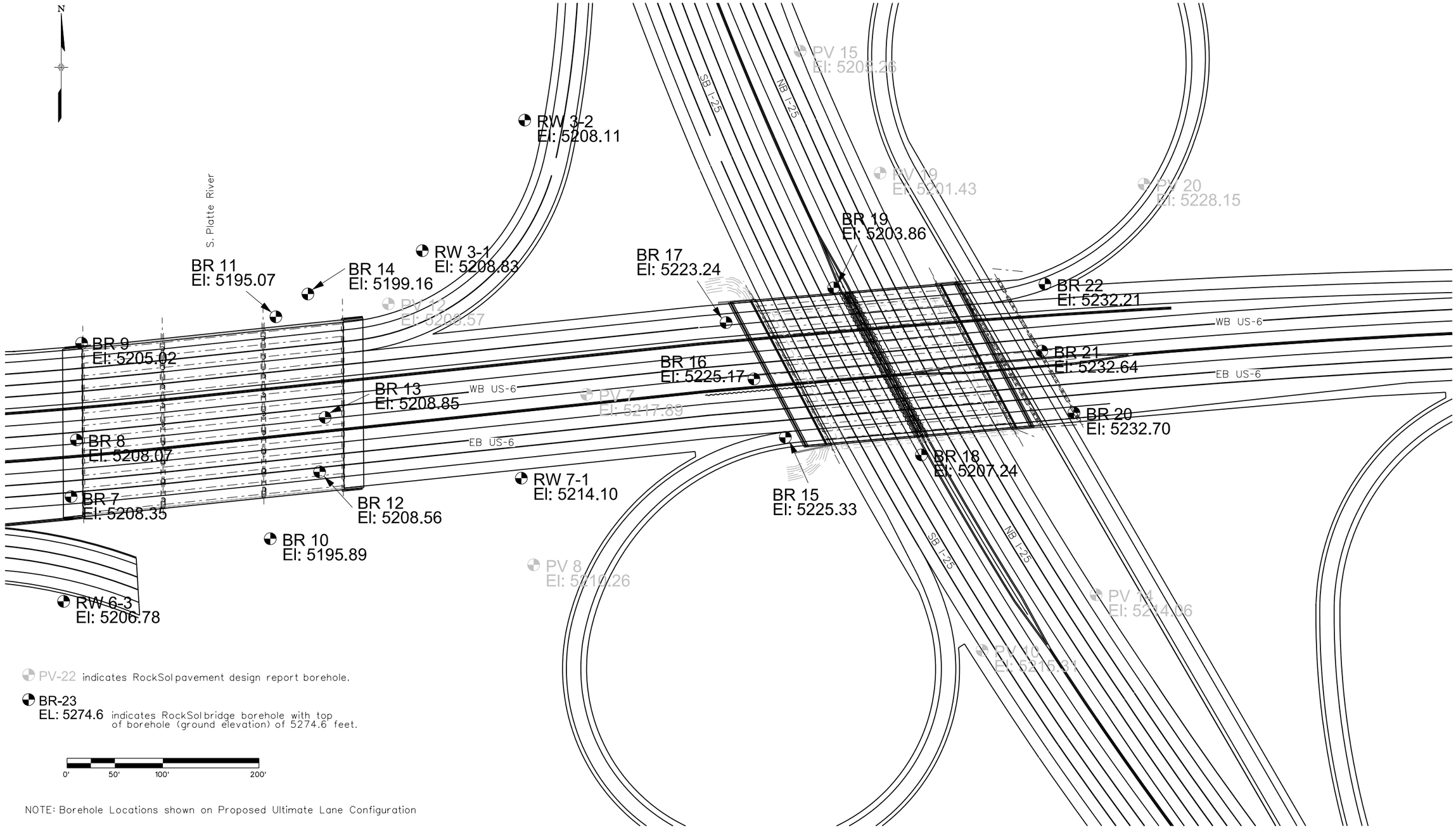

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Print Date: 10/15/2012
File Name: 18838-F-3D-Structural Borehole Location Plan.dgn
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BOREHOLE LOCATION PLAN

Designer: R. Lepro
Detailer: D. Knight
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Structure Numbers
Subset Sheets: 4 of 6

Project No./Code
US 6 BRIDGES
DESIGN BUILD PROJECT
18838
Figure 3D

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Print Date: 8/16/2012
File Name: 18838-F-4A-Borehole Location - Existing.dgn
Horiz. Scale: 1:100 Vert. Scale: As Noted
Unit Information Unit Leader Initials

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BOREHOLE LOCATION PLAN EXISTING CONDITIONS

Designer:	D. Hunt	Structure Numbers	
Detailer:	D. Knight		
Sheet Subset:	Geotech	Subset Sheets:	of

Project No./Code
US 6 BRIDGES DESIGN BUILD PROJECT
18838
Figure 4A

Print Date: 8/15/2012
File Name: 18838-F-4B-Borehole Location - Existing.dgn
Horiz. Scale: 1:100 Vert. Scale: As Noted
Unit Information Unit Leader Initials

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BOREHOLE LOCATION PLAN
EXISTING CONDITIONS

Designer:	D. Hunt	Structure Numbers	
Detailer:	D. Knight		
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Project No./Code
US 6 BRIDGES
DESIGN BUILD PROJECT
18838
Figure 4B

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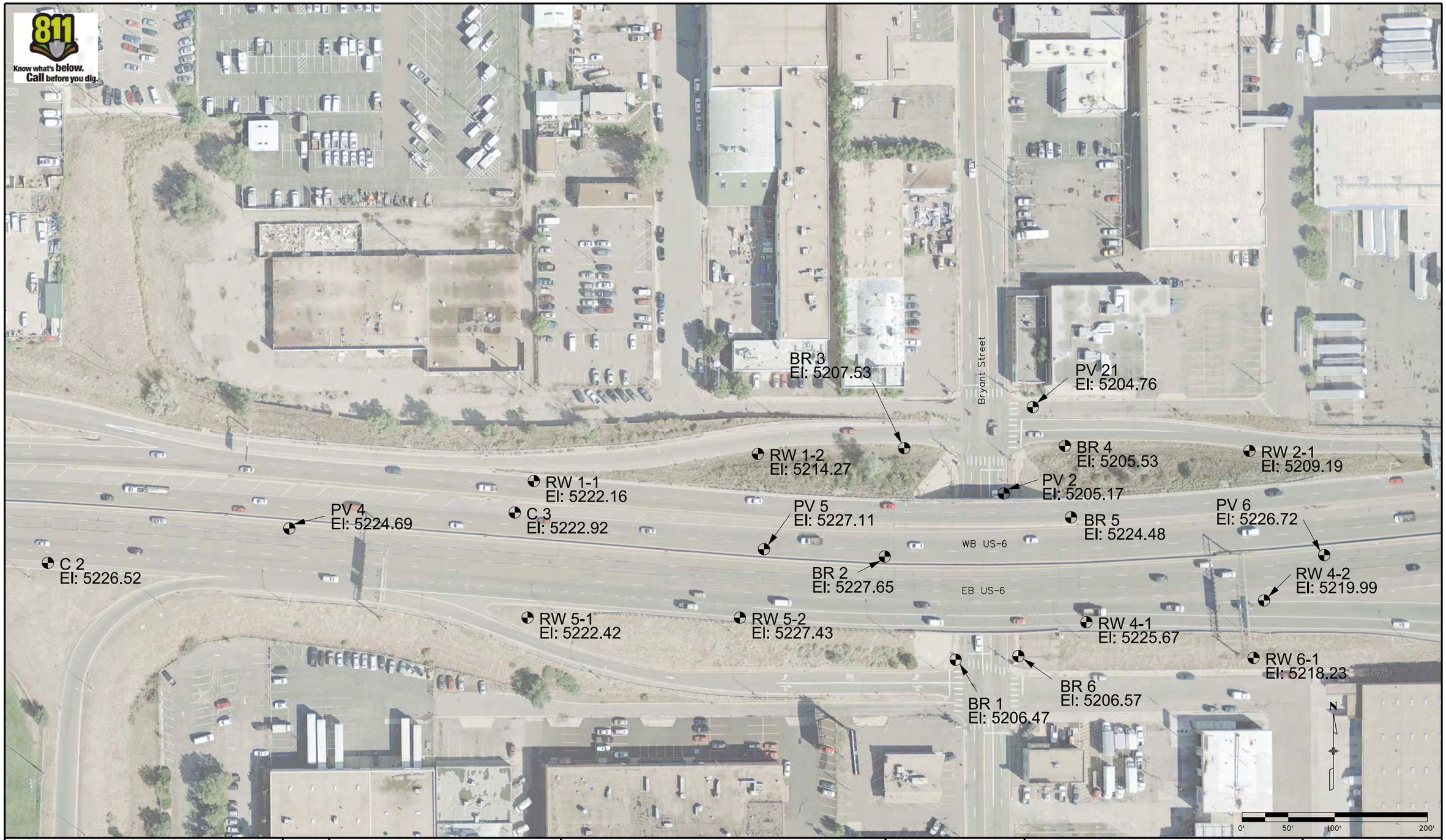

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Print Date: 8/16/2012
File Name: 18838-F-4C-Borehole Location - Existing.dgn
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R-X

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BOREHOLE LOCATION PLAN EXISTING CONDITIONS

Designer: D. Hunt
Detailer: D. Knight
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Structure Numbers:
Subset Sheets: of

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18838
Figure 4C

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BOREHOLE LOCATION PLAN EXISTING CONDITIONS

Designer: D. Hunt
Detailer: D. Knight
Sheet Subset: Geotech
Structure Numbers:
Subset Sheets: of

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US 6 BRIDGES DESIGN BUILD PROJECT
18838
Figure 4D

Print Date: 8/15/2012		Sheet Revisions	
File Name: 18838-F-4E-Borehole Location - Existing.dgn		Date:	Comments / Init.
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BOREHOLE LOCATION PLAN
EXISTING CONDITIONS

Designer:	D. Hunt	Structure Numbers	
Detailer:	D. Knight		
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US 6 BRIDGES
DESIGN BUILD PROJECT
18838
Figure 4E

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Print Date: 8/15/2012	
File Name: 18838-F-4F-Borehole Location - Existing.dgn	
Horiz. Scale: 1:100	Vert. Scale: As Noted
Unit Information	Unit Leader Initials

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R-X

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BOREHOLE LOCATION PLAN EXISTING CONDITIONS

Designer:	D. Hunt	Structure Numbers	
Detailer:	D. Knight		
Sheet Subset:	Geotech	Subset Sheets:	of

Project No./Code

US 6 BRIDGES
DESIGN BUILD PROJECT

18838

Figure 4F

APPENDIX A

LEGEND
AND
INDIVIDUAL BOREHOLE LOGS

BR-1 through BR-27
and
RW1-1, RW1-2, RW2-1, RW2-2, RW3-1, RW3-2,
RW4-1 through RW4-3, RW5-1, RW5-2,
RW6-1 through RW6-3 and RW7-1

LEGEND

RockSol Consulting Group, Inc.

CLIENT Hartwig and Associates **PROJECT NAME** US6 Bridges Design Build Project

PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado

LITHOLOGY

- Fill - Aggregate Base Course
- Bedrock - CLAYSTONE
- Native - CLAY, silty
- Concrete
- Fill - SAND
- Bedrock - SANDSTONE
- Bedrock - SILTSTONE
- Native - SAND
- TOPSOIL
- Asphalt Pavement
- Native - CLAY
- Native - CLAY, sandy
- Fill - CLAY
- Native - SILT
- Native - SAND, clayey
- Native - SAND, silty
- Native - SAND, gravelly

SAMPLE TYPE

GRAB SAMPLE
FROM 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

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 NOTED AT THE TIME OF DRILLING

RockSol Consulting Group, Inc.

BORING : BR- 1

CLIENT Hartwig and Associates
PROJECT NAME US6 Bridges Design Build Project
PROJECT NUMBER 280.01
PROJECT LOCATION Denver, Colorado
DATE STARTED 12/21/11 **COMPLETED** 12/21/11
GROUND ELEVATION 5206.5 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 687280.3 **EAST** 954457.3
DRILLING METHOD Hollow Stem **HOLE SIZE** 8"
BORING LOCATION: In sidewalk SW corner of Bryant St. and US6
LOGGED BY H. Ochoa
GROUND WATER LEVELS:
NOTES Manual Hammer/US 6 Bridge over Bryant St.
WATER DEPTH 10.0 ft on 12/21/11

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 (%)
5207	0		CONCRETE sidewalk approximately 4" thick										
			(Fill) CLAY, with sand to sandy, trace gravel, moist, dark brown to brown, medium stiff										
5202	5			MC	7/12	-0.4		88.2	35.5	28	17	11	92.1
			(Native) SAND, slightly silty, with gravel, moist or wet, reddish brown, medium dense to dense										
5197	10			MC	25/12				2.0				
5192	15			SS	8/13/17				10.8	NP	NP	NP	4.7
5187	20			SS	15/20/22				12.4				
5182	25			SS	8/14/14				12.4				
5177	30												
5172	35		(Bedrock) SANDSTONE, silty, moist, reddish brown, very hard	MC	50/6			109.0	18.3	34	28	6	48.5

LOG - STANDARD 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 10/15/12

RockSol Consulting Group, Inc.

CLIENT Hartwig and Associates **PROJECT NAME** US6 Bridges Design Build Project

PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado

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 (%)
5172	35		(Bedrock) SANDSTONE, silty, moist, reddish brown, very hard *(continued)*										
			(Bedrock) CLAYSTONE, slightly moist, to moist, grey, very hard										
5167	40			MC	50/3			104.8	19.6	44	18	26	84.5
			(Bedrock) SANDSTONE, silty to clayey, slightly moist, grey-brown, very hard										
			Bottom of hole at 43.3 feet.	SS	50/3				20.8				

RockSol Consulting Group, Inc.

BORING : BR- 2

CLIENT Hartwig and Associates
PROJECT NAME US6 Bridges Design Build Project
PROJECT NUMBER 280.01
PROJECT LOCATION Denver, Colorado
DATE STARTED 12/28/11 **COMPLETED** 12/28/11
GROUND ELEVATION 5227.7 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 687391.6 **EAST** 954380.9
DRILLING METHOD Hollow Stem **HOLE SIZE** 8"
BORING LOCATION: Lane 1 WB US6, West of Bryant St
LOGGED BY H. Ochoa
GROUND WATER LEVELS:
NOTES Manual Hammer/US 6 Bridge over Bryant St.
WATER DEPTH 32.0 ft on 12/28/11

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 (%)
5228	0		(Asphalt) PAVEMENT, approximately 10"										
			(Fill) SAND, silty, with gravel and traces of clay, moist, brown, dense	SS	15/20/21				6.4				
5223	5		(Fill) CLAY, sandy, moist, brown, stiff to very stiff (US6 Embankment Fill)	MC	8/12	0.0		100.2	21.0				
5218	10			MC	12/12	0.0	0.00	98.8	21.0				
5213	15			MC	9/12	-0.2		103.0	19.9				
5208	20			MC	18/12			103.3	20.9				
			(Native) CLAY, with sand to sandy, moist, brown, stiff										
5203	25			MC	14/12			95.0	26.7				
5198	30												
			(Native) SAND, slightly silty to silty, with gravel and clay in parts, moist to wet, reddish brown and grey, dense to very dense										
5193	35			SS	15/21/28				10.9	NP	NP	NP	6.1

LOG - STANDARD 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 9/21/12

RockSol Consulting Group, Inc.

BORING : BR- 2

CLIENT Hartwig and Associates **PROJECT NAME** US6 Bridges Design Build Project

PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado

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 (%)
5193	35		(Native) SAND, slightly silty to silty, with gravel and clay in parts, moist to wet, reddish brown and grey, dense to very dense *(continued)*										
5188	40												
5183	45			SS	12/30/36				13.5	NP	NP	NP	5.9
5178	50			SS	16/20/24				10.7				
5173	55			SS	70/10				13.9	30	18	12	22.2
			(Bedrock) CLAYSTONE, sandy in parts, slightly moist, brown to grey, very hard										
				SS	50/3		0.00		20.9				
			Bottom of hole at 59.5 feet.										

Bulk Sample 10"-5'
LL=27
PL=15
PI=12
-200=28%
WSS=0.00

LOG - STANDARD 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 9/21/12

RockSol Consulting Group, Inc.

BORING : BR- 3

CLIENT Hartwig and Associates
PROJECT NAME US6 Bridges Design Build Project
PROJECT NUMBER 280.01
PROJECT LOCATION Denver, Colorado
DATE STARTED 12/27/11 **COMPLETED** 12/27/11
GROUND ELEVATION 5207.5 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 687508.5 **EAST** 954401.9
DRILLING METHOD Hollow Stem **HOLE SIZE** 8"
BORING LOCATION: Shoulder, NW corner of Bryant St at US6
LOGGED BY H. Ochoa
GROUND WATER LEVELS:
NOTES Manual Hammer/ US 6 Bridge over Bryant St.
WATER DEPTH 15.0 ft on 12/27/11

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS	SWELL POTENTIAL (%)	SULFATE (%)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			FINES CONTENT (%)
										LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
5208	0		(Topsoil) SAND, silty with light cover of grass and weeds at surface, approximately 6" in thickness										
			(Fill) SAND, silty, moist, light brown to brown, medium dense										
5203	5			MC	21/12		0.00	102.9	15.2				
			(Native) SAND slightly silty to gravelly, moist to wet, reddish brown, medium dense to very dense										
5198	10			SS	21/19/21				3.8	NP	NP	NP	7.2
5193	15			SS	11/14/15				9.0				
5188	20			SS	9/12/19				12.4				
5183	25			SS	12/25/25				12.2	NP	NP	NP	7.2
5178	30												
5173	35			SS	50/4				12.3				

RockSol Consulting Group, Inc.

CLIENT Hartwig and Associates **PROJECT NAME** US6 Bridges Design Build Project

PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado

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 (%)
5173	35		(Bedrock) CLAYSTONE, moist, grey, very hard										
5168	40			MC	50/5		0.00	109.9	15.6				
5163	45												
				MC	50/4			120.7	14.7	41	23	18	92.1
			Bottom of hole at 49.5 feet.										

RockSol Consulting Group, Inc.

BORING : BR- 4

CLIENT Hartwig and Associates
PROJECT NAME US6 Bridges Design Build Project
PROJECT NUMBER 280.01
PROJECT LOCATION Denver, Colorado
DATE STARTED 12/19/11 **COMPLETED** 12/19/11
GROUND ELEVATION 5206.0 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 687511.0 **EAST** 954575.0
DRILLING METHOD Hollow Stem **HOLE SIZE** 8"
BORING LOCATION: Shoulder NE corner of Bryant St at US6
LOGGED BY J. Biller
GROUND WATER LEVELS:
NOTES Manual Hammer/US 6 Bridge over Bryant St.
WATER DEPTH 14.5 ft on 12/19/11

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 (%)
5206	0		(Topsoil) silty SAND,wet, dark brown, loose, Approximately 6"										
			(Fill) SAND, silty with gravel and trace clay, moist, light brown to brown, medium dense	MC	12/12			94.9	13.4				
5201	5			MC	13/12		0.00	125.0	9.7				
			(Native) SAND, slightly silty to gravelly, moist to wet, light brown, medium dense to very dense										
5196	10			SS	10/9/12				2.3	NP	NP	NP	5.2
5191	15			MC	32/12			125.4	11.8				
5186	20			SS	7/28/30				11.6	NP	NP	NP	6.8
5181	25			SS	19/12/14				14.1				
5176	30		(Bedrock) CLAYSTONE, sandy with interbedded silty sandstone lenses, moist, reddish brown to grey, very hard	SS	50/4				19.7	39	22	17	65.5
5171	35												

LOG - STANDARD 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 10/15/12

RockSol Consulting Group, Inc.

BORING : BR- 4

CLIENT Hartwig and Associates **PROJECT NAME** US6 Bridges Design Build Project

PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS	SWELL POTENTIAL (%)	SULFATE (%)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			FINES CONTENT (%)
										LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
5171	35		(Bedrock) CLAYSTONE, sandy with interbedded silty sandstone lenses, moist, reddish brown to grey, very hard *(continued)*	MC	50/6		0.02	108.8	19.1				
5166	40			SS	50/5				17.6	24	23	1	22.9
5161	45			MC	50/3			117.5	15.6				
5156	50			SS	50/6				22.8				
			Bottom of hole at 50.5 feet.										

RockSol Consulting Group, Inc.

BORING : BR- 5

CLIENT Hartwig and Associates
PROJECT NAME US6 Bridges Design Build Project
PROJECT NUMBER 280.01
PROJECT LOCATION Denver, Colorado
DATE STARTED 1/3/12 **COMPLETED** 1/3/12
GROUND ELEVATION 5224.0 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 687434.0 **EAST** 954582.0
DRILLING METHOD Hollow Stem **HOLE SIZE** 8"
BORING LOCATION: Lane 1 WB US 6 Entrance & Exit Lanes, East of Bryant
LOGGED BY J. Biller
GROUND WATER LEVELS:
NOTES Manual Hammer/ US 6 Bridge over Bryant St.
WATER DEPTH 32.0 ft on 1/3/12

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 (%)
5224	0		(Asphalt) PAVEMENT, approximately 7" in thickness										
			(Concrete) PAVEMENT, approximately 7" in thickness										
			(Fill) SAND, gravelly with trace of silt and clay, very moist, light brown, medium dense to dense	MC	31/12			122.9	4.7				
5219	5			SS	4/5/6				11.4				
			(Fill) CLAY, sandy, moist to very moist, brown, stiff to very stiff										
5214	10			SS	4/6/8				21.4	42	18	24	57.0
5209	15			MC	17/12			106.3	20.6				
5204	20			SS	6/6/5				18.4	32	20	12	54.6
			(Native) SAND, slightly silty to gravelly, moist to wet, light brown to light reddish brown, medium dense to dense										
5199	25			MC	25/12				2.1				
5194	30			SS	9/16/26				2.9				
5189	35												

LOG - STANDARD 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 9/21/12

RockSol Consulting Group, Inc.

BORING : BR- 5

CLIENT Hartwig and Associates **PROJECT NAME** US6 Bridges Design Build Project

PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado

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 (%)
5189	35		(Native) SAND, slightly silty to gravelly, moist to wet, light brown to light reddish brown, medium dense to dense *(continued)*	SS	15/10/12				11.8				
5184	40			SS	16/25/30				12.5	NP	NP	NP	4.4
5179	45			SS	50/6				22.4				
5174	50		(Bedrock) SANDSTONE, clayey, silty in parts, slightly moist, dark grey, very hard (lightly cemented)										
5169	55			SS	50/0.5				18.0				
5164	60			MC	50/1			112.0	18.4				
5159	65			MC	50/0								
5154	70		Bulk Sample 14"-5' LL=22 PL=22 PI=NP -200=12% WSS=0.00	SS	50/3				21.5				
			Bottom of hole at 70.5 feet.										

LOG - STANDARD 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 9/21/12

RockSol Consulting Group, Inc.

BORING : BR- 6

CLIENT Hartwig and Associates
PROJECT NAME US6 Bridges Design Build Project
PROJECT NUMBER 280.01
PROJECT LOCATION Denver, Colorado
DATE STARTED 12/13/11 **COMPLETED** 12/13/11
GROUND ELEVATION 5206.6 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 687284.3 **EAST** 954525.1
DRILLING METHOD Hollow Stem **HOLE SIZE** 7"
BORING LOCATION: In sidewalk SE corner of Bryant St. and US6
LOGGED BY J, Biller
GROUND WATER LEVELS:
NOTES Manual Hammer/ US 6 Bridge over Bryant St.
WATER DEPTH 15.5 ft on 12/13/11

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 (%)
5207	0		CONCRETE PAVEMENT, approximately 4" in thickness										
			(Fill) CLAY, sandy, moist, dark brown										
			(Native) SAND, slightly silty to gravelly, moist to wet, light brown, medium dense to very dense	MC	32/12			112.6	15.4				
5202	5			MC	35/12			113.0	2.3	NP	NP	NP	3.1
5197	10			SS	9/8/10				2.6				
5192	15			SS	7/11/12				12.1				
5187	20			SS	14/19/15		0.00		14.1				
5182	25			SS	4/39/50				11.0				
5177	30			SS	21/21/21				10.0				
5172	35		(Bedrock) SANDSTONE, clayey, moist, grey, very hard										

LOG - STANDARD 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 9/21/12

RockSol Consulting Group, Inc.

CLIENT Hartwig and Associates **PROJECT NAME** US6 Bridges Design Build Project

PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado

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 (%)
5172	35		(Bedrock) SANDSTONE, clayey, moist, grey, very hard *(continued)*	SS	75/10				16.6	36	21	15	42.7
			(Bedrock) SANDSTONE, silty, clayey in parts,moist, grey, very hard, lightly to moderately cemented in parts										
5167	40			SS	50/3				14.5	24	22	2	38.0
5162	45			MC	50/4		0.00	120.6	12.5				
5157	50			MC	50/3			105.2	19.5				
			(Bedrock) CLAYSTONE, moist, grey, very hard										
5152	55			MC	50/4			108.2	19.6				
			Bottom of hole at 55.5 feet.										

Bulk Sample 0"-5'
LL=20
PL=18
PI=2
-200=21%
WSS=0.00

RockSol Consulting Group, Inc.

BORING : BR- 7

CLIENT Hartwig and Associates
PROJECT NAME US6 Bridges Design Build Project
PROJECT NUMBER 280.01
PROJECT LOCATION Denver, Colorado
DATE STARTED 1/12/12 **COMPLETED** 1/13/12
GROUND ELEVATION 5208.0 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 687380.0 **EAST** 955153.0
DRILLING METHOD Solid Stem **HOLE SIZE** 4"
BORING LOCATION: Outside Shoulder EB US6, West of South Platte
LOGGED BY J. Biller
GROUND WATER LEVELS:
NOTES Manual Hammer/ US6 Bridge over S. Platte River
WATER DEPTH 17.5 ft on 1/12/12

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 (%)
5208	0		(Asphalt) PAVEMENT approximately 12" in thickness										
			(Fill) Aggregate Base Course approximatly 6" in thickness	SS	50/1								
			(Fill) SAND, silty with gravel, sandy clay in parts, slightly moist to moist, grey to black, very loose to very dense	MC	50/6			129.9	2.7				
5203	5		(coal cinders, brick fragments 10'-14')	MC	20/12				20.9				
5198	10			SS	2/1/1				36.1	47	43	4	23.2
5193	15		(Fill) SAND, gravelly with cobbles, slightly moist, light brown, dense	MC	46/12			117.1	2.0				
			(Native) SAND, slightly silty to gravelly, wet, light brown, medium dense to very dense										
5188	20			SS	9/14/14				13.7	NP	NP	NP	1.0
5183	25			MC	50/11				11.4				
5178	30		(Bedrock) SANDSTONE, silty, moist to wet, light brown, very hard, lightly cemented	SS	50/6				20.3	NP	NP	NP	19.8
5173	35												

LOG - STANDARD 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 10/15/12

RockSol Consulting Group, Inc.

CLIENT Hartwig and Associates **PROJECT NAME** US6 Bridges Design Build Project

PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado

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 (%)
5173	35		(Bedrock) SANDSTONE, silty, moist to wet, light brown, very hard, lightly cemented *(continued)*	MC	50/3								
5168	40												
5163	45												
5158	50												
			Bottom of hole at 50.0 feet.	SS	50/0								

RockSol Consulting Group, Inc.

BORING : BR- 8

CLIENT Hartwig and Associates
PROJECT NAME US6 Bridges Design Build Project
PROJECT NUMBER 280.01
PROJECT LOCATION Denver, Colorado
DATE STARTED 1/5/12 **COMPLETED** 1/5/12
GROUND ELEVATION 5208.0 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 687439.0 **EAST** 955159.0
DRILLING METHOD Solid Stem Auger **HOLE SIZE** 4"
BORING LOCATION: WB US 6 Lane 1 West Side of S. Platte River Bridge
LOGGED BY J. Biller
GROUND WATER LEVELS:
NOTES Manual Hammer/ US 6 Bridge over S. Platte River
WATER DEPTH 18.0 ft on 1/5/12

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 (%)
5208	0		(Asphalt) PAVEMENT, Approximately 9" in thickness										
			(Fill) CLAY, sandy with silt and gravel, slightly moist to moist, grey to black, stiff to hard										
			Chloride @ 9" - 5' = 0.03%	MC	17/12	-0.1	0.01	111.1	18.1	25	15	10	68.1
5203	5			MC	17/12	0.2		101.5	23.0				
5198	10			SS	5/6/4				4.3				
5193	15			MC	35/12			128.1	2.4				
			(Native) SAND, slightly silty to gravelly, wet, light brown, medium dense to very dense										
5188	20			SS	8/9/10				16.1				
5183	25			MC	50/12			130.4	10.5				
			(Bedrock) SANDSTONE, silty to clayey, slightly moist to moist, light brown to dark grey, very hard, lightly to moderately cemented										
5178	30			SS	50/5				22.2				
5173	35			SS	50/0								

LOG - STANDARD 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 9/21/12

RockSol Consulting Group, Inc.

BORING : BR- 8

CLIENT Hartwig and Associates **PROJECT NAME** US6 Bridges Design Build Project

PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado

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 (%)
5173	35		Electrical Resistivity=470 Ohm-cm @ 24.6% (Bedrock) SANDSTONE, silty to clayey, slightly moist to moist, light brown to dark grey, very hard, lightly to moderately cemented *(continued)*										
5168	40			SS	50/0								
			Bottom of hole at 44.1 feet.	SS	50/1				21.1				

Bulk Sample 9"-10'
LL=38
PL=15
PI=23
-200=53%
WSS=0.03
pH=7.8
Chloride Content=0.0313%

RockSol Consulting Group, Inc.

BORING : BR- 9

CLIENT Hartwig and Associates
PROJECT NAME US6 Bridges Design Build Project
PROJECT NUMBER 280.01
PROJECT LOCATION Denver, Colorado
DATE STARTED 11/30/11 **COMPLETED** 11/30/11
GROUND ELEVATION 5205.0 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 687540.0 **EAST** 955164.0
DRILLING METHOD Hollow Stem **HOLE SIZE** 7"
BORING LOCATION: Robinson Dairy parking lot, SE Corner
LOGGED BY J. Biller
GROUND WATER LEVELS:
NOTES Manual Hammer/ US 6 Bridge over S. Platte River
WATER DEPTH 14.5 ft on 11/30/11

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 (%)
5205	0		(Fill) SAND, silty to clayey, with gravel in parts, with debris and brick fragments, moist, grey to black, medium dense										
			(Coal dust debris noted in sample obtained at 5 feet)	MC	9/12			114.4	15.1				
5200	5			MC	9/12		0.00	66.1	33.3				
5195	10			SS	7/6/11				5.7	NP	NP	NP	10.4
			(Native) SAND, slightly silty to gravelly, wet, light brown, medium dense to dense										
5190	15			MC	40/12			122.4	12.4	NP	NP	NP	2.8
5185	20			SS	10/12/23				11.8	NP	NP	NP	3.6
			(Bedrock) SANDSTONE, silty, moist, reddish brown, very hard										
5180	25			SS	50/3				19.0	26	28	NP	31.5
			(Bedrock) SANDSTONE, silty, moist, grey to dark grey with white flecks, very hard, lightly to moderately cemented										
5175	30			MC	50/1		0.00	113.9	18.5	42	29	13	30.2
5170	35												

RockSol Consulting Group, Inc.

CLIENT Hartwig and Associates **PROJECT NAME** US6 Bridges Design Build Project

PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado

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 (%)
5170	35		(Bedrock) SANDSTONE, silty, moist, grey to dark grey with white flecks, very hard, lightly to moderately cemented *(continued)*	MC	50/2			111.9	14.8				
5165	40			MC	50/0 Sampler Bounce			117.5	13.3	NP	NP	NP	35.9
5160	45			MC	50/3			123.2	15.0				
5155	50		Bottom of hole at 50.0 feet.	MC	50/0 Sampler Bounce								

RockSol Consulting Group, Inc.

BORING : BR- 10

CLIENT Hartwig and Associates
PROJECT NAME US6 Bridges Design Build Project
PROJECT NUMBER 280.01
PROJECT LOCATION Denver, Colorado
DATE STARTED 12/14/11 **COMPLETED** 12/14/11
GROUND ELEVATION 5195.9 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 687336.1 **EAST** 955360.9
DRILLING METHOD Hollow Stem Auger **HOLE SIZE** 8"
BORING LOCATION: East river bank, South Side of S. Platte Bridge
LOGGED BY J. Biller
GROUND WATER LEVELS:
NOTES Manual Hammer/ Track Rig/ Aprrox. 80' W, from E. Bridge Abutment **WATER DEPTH** 5.5 ft on 12/14/11

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 (%)
5196	0		(Fill) SAND, clayey with silt, very moist, brown, loose (temporary construction road)										
5191	5		(Native) SAND, silty with gravel, wet, grey to light brown, medium dense	MC	14/12		0.00	110.8	12.3				
5186	10			SS	8/13/16				13.7	NP	NP	NP	2.9
5181	15		(Bedrock) SANDSTONE, silty, clayey in parts, moist, reddish brown and grey, very hard, lightly to moderately cemented	SS	73/11				18.8	NP	NP	NP	40.7
5176	20			MC	50/3			113.7	15.0				
5171	25			MC	50/5			116.9	15.1	NP	NP	NP	17.3
			Bottom of hole at 28.0 feet.	SS	50/1								

LOG - STANDARD 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 10/15/12

RockSol Consulting Group, Inc.

BORING : BR- 11

CLIENT Hartwig and Associates
PROJECT NAME US6 Bridges Design Build Project
PROJECT NUMBER 280.01
PROJECT LOCATION Denver, Colorado
DATE STARTED 12/14/11 **COMPLETED** 12/14/11
GROUND ELEVATION 5195.1 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 687567.3 **EAST** 955366.8
DRILLING METHOD Hollow Stem **HOLE SIZE** 8"
BORING LOCATION: East river bank, N. Side of S. Platte Bridge
LOGGED BY J, Biller
GROUND WATER LEVELS:
NOTES Manual Hammer/ Approx. 65' W. of E. Bridge Abutment
WATER DEPTH 4.0 ft on 12/14/11

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 (%)
5195	0		(Native) TOPSOIL SAND, silty, very moist, dark brown, loose, lightly to moderately vegetated										
			(Native) SAND, silty, very moist to wet, light brown to dark brown, loose to medium dense										
5190	5			MC	20/12			117.4	16.1	NP	NP	NP	3.1
5185	10		(Bedrock) SANDSTONE, silty to clayey in parts, slightly moist to very moist, light brown to grey, very hard, lightly to moderately cemented (12 ft. to 17.25 ft.)	SS	80/12		0.00		20.6	40	34	6	33.6
5180	15			MC	50/3		0.00	114.5	16.8				
				MC	50/3					40	28	12	42.1
			Bottom of hole at 17.3 feet.										

RockSol Consulting Group, Inc.

BORING : BR- 12

CLIENT Hartwig and Associates
PROJECT NAME US6 Bridges Design Build Project
PROJECT NUMBER 280.01
PROJECT LOCATION Denver, Colorado
DATE STARTED 1/12/12 **COMPLETED** 1/12/12
GROUND ELEVATION 5209.0 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 687406.0 **EAST** 955412.0
DRILLING METHOD Solid Stem **HOLE SIZE** 4.25"
BORING LOCATION: Outside Shoulder EB US6, East of South Platte
LOGGED BY H. Ochoa
GROUND WATER LEVELS:
NOTES Manual Hammer/ US 6 Bridge over S. Platte River
WATER DEPTH 18.0 ft on 1/12/12

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 (%)
5209	0		(Asphalt) PAVEMENT, approximately 13" in thickness										
			(Fill) SAND, with gravel, slightly moist, light brown to brown, medium dense	SS	19/12/9				6.8	NP	NP	NP	11.2
			Chloride @ 13"-5' = 0.0320%										
5204	5			MC	17/12			113.2	5.1				
5199	10			MC	13/12			127.9	3.4	NP	NP	NP	8.8
5194	15		(Native) SAND, slightly silty to gravelly, slightly moist to wet, brown, medium dense to very dense	SS	11/7/7				3.6				
5189	20			SS	12/12/16				11.7	NP	NP	NP	4.0
5184	25		Bulk Sample 13"-5' LL=NP PL=NP PI=NP -200=9% WSS=0.00 pH=7.8 Chloride Content=0.03% Electrical Resistivity=200 Ohm-cm @ 16.7%	SS	20/30/20				11.6				
5179	30		(Bedrock) SANDSTONE, clayey to silty, moist to wet, brown to grey, very hard, lightly to moderately cemented	MC	50/1				11.6				
			Bottom of hole at 34.1 feet.	SS	50/1				19.8				

RockSol Consulting Group, Inc.

BORING : BR- 13

CLIENT Hartwig and Associates
PROJECT NAME US6 Bridges Design Build Project
PROJECT NUMBER 280.01
PROJECT LOCATION Denver, Colorado
DATE STARTED 1/4/12 **COMPLETED** 1/4/12
GROUND ELEVATION 5209.0 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 687463.0 **EAST** 955418.0
DRILLING METHOD Solid Stem Auger **HOLE SIZE** 4"
BORING LOCATION: Lane 1 WB US6, East of South Platte
LOGGED BY J. Biller
GROUND WATER LEVELS:
NOTES Manual Hammer/ US 6 Bridge over S. Platte River
WATER DEPTH 17.0 ft on 1/4/12

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 (%)
5209	0		(Asphalt) PAVEMENT, approximately 8.5" in thickness										
			(Fill) SAND, silty with trace clay, moist to very moist, brown grey, medium dense	MC	23/12	-1.0		119.3	6.9				
5204	5			MC	13/12			117.4	12.0				
5199	10			SS	10/6/5				4.5	NP	NP	NP	10.6
			(Native) SAND, gravelly with silt, slightly moist to wet, light brown, medium dense to very dense										
5194	15			MC	24/12				3.0				
5189	20			SS	8/10/4				12.6	NP	NP	NP	5.3
5184	25			MC	50/7			133.9	9.1				
			(Bedrock) SANDSTONE, silty, clayey in parts, slightly moist to moist, grey, very hard, lightly to moderately cemented										
5179	30			SS	50/4				16.4	34	24	10	25.1
5174	35			SS	50/1								

LOG - STANDARD 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 10/15/12

RockSol Consulting Group, Inc.

CLIENT Hartwig and Associates **PROJECT NAME** US6 Bridges Design Build Project

PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado

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 (%)
5174	35		(Bedrock) SANDSTONE, silty, clayey in parts, slightly moist to moist, grey, very hard, lightly to moderately cemented *(continued)*										
5169	40			SS	50/0								
5164	45			SS	50/0								
			Bottom of hole at 49.0 feet.	SS	50/0								

RockSol Consulting Group, Inc.

BORING : BR- 14

CLIENT Hartwig and Associates
PROJECT NAME US6 Bridges Design Build Project
PROJECT NUMBER 280.01
PROJECT LOCATION Denver, Colorado
DATE STARTED 12/14/11 **COMPLETED** 12/14/11
GROUND ELEVATION 5199.2 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 687591.0 **EAST** 955400.2
DRILLING METHOD Hollow Stem **HOLE SIZE** 8"
BORING LOCATION: NE corner of US6 over the South Platte
LOGGED BY J. Biller
GROUND WATER LEVELS:
NOTES Manual Hammer/ Aprrox. 40' N. of E. Bridge Abutment
WATER DEPTH 8.5 ft on 12/14/11

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 (%)
5199	0		(Fill) TOPSOIL, SAND, silty, very moist, dark brown, loose										
			(Fill) CLAY, sandy with gravel, moist, brown, very hard										
5194	5			MC	50/7		0.00		12.6				
			(Native), SAND, slightly silty to gravelly, moist, grey brown, medium dense										
5189	10			SS	9/9/9				12.0	NP	NP	NP	4.2
			(Bedrock) SANDSTONE, silty, clayey in parts, slightly moist to moist, reddish brown to grey, very hard, lightly to moderately cemented (17 ft. to 22.25 ft.)										
5184	15			SS	50/9				20.9	39	33	6	25.7
5179	20			MC	50/3			109.5	18.4				
				SS	50/3				19.8	39	29	10	43.0
			Bottom of hole at 22.3 feet.										

RockSol Consulting Group, Inc.

BORING : BR- 15

CLIENT Hartwig and Associates
PROJECT NAME US6 Bridges Design Build Project
PROJECT NUMBER 280.01
PROJECT LOCATION Denver, Colorado
DATE STARTED 1/12/12 **COMPLETED** 1/12/12
GROUND ELEVATION 5225.0 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 687442.0 **EAST** 955898.0
DRILLING METHOD Hollow Stem **HOLE SIZE** 8"
BORING LOCATION: Outside Shoulder EB US6, West of I-25
LOGGED BY H. Ochoa
GROUND WATER LEVELS:
NOTES Manual Hammer/ US 6 Bridge over I-25, SW corner
▼ **WATER DEPTH** 32.0 ft on 1/12/12

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 (%)
5225	0		(Asphalt) PAVEMENT, approximately 8" in thickness										
			(Fill) SAND, gravelly, slightly moist, reddish brown, dense						8.1	NP	NP	NP	7.3
				SS	31/32/15								
			(Fill) CLAY, sandy with gravel, very sandy in parts, moist, brown, stiff to very stiff										
5220	5			MC	19/12	0.2		116.0	10.7				
			(US6 Embankment Fill)										
5215	10			SS	2/4/5				16.9				
5210	15			MC	26/12			114.6	16.4	30	14	16	49.0
5205	20			SS	6/4/12				13.8				
			(Native) SAND, with silt, trace gravel, moist to wet, light brown, medium dense to very dense										
5200	25			MC	24/12			88.7	1.5	NP	NP	NP	1.9
5195	30			SS	10/11/-				8.1				
			▼										
5190	35			SS	65/12				10.9	NP	NP	NP	4.8

LOG - STANDARD 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 9/21/12

RockSol Consulting Group, Inc.

BORING : BR- 15

CLIENT Hartwig and Associates **PROJECT NAME** US6 Bridges Design Build Project

PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado

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 (%)
5190	35		(Native) SAND, with silt, trace gravel, moist to wet, light brown, medium dense to very dense *(continued)*										
5185	40			SS	12/29/39				12.2				
			(Bedrock) CLAYSTONE, with sand, moist, very hard, brown and grey										
5180	45			MC	50/2			109.6	19.6				
5175	50			SS	50/3				19.0				
			Bottom of hole at 54.0 feet.	SS	50/1				21.7				

Bulk Sample 8.5"-5'
LL=NP
PL=NP
PI=NP
-200=17%
WSS=0.00

RockSol Consulting Group, Inc.

BORING : BR- 16

CLIENT Hartwig and Associates
PROJECT NAME US6 Bridges Design Build Project
PROJECT NUMBER 280.01
PROJECT LOCATION Denver, Colorado
DATE STARTED 1/9/12 **COMPLETED** 1/9/12
GROUND ELEVATION 5225.0 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 687502.0 **EAST** 955865.0
DRILLING METHOD Hollow Stem **HOLE SIZE** 8"
BORING LOCATION: Lane 1 WB US6, West of I-25
LOGGED BY J. Biller
GROUND WATER LEVELS:
NOTES Manual Hammer/ US 6 Bridge over I-25
WATER DEPTH 33.5 ft on 1/9/21

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 (%)
5225	0		(Asphalt) PAVEMENT, approximately 8" in thickness										
			(Fill) Aggregate Base Course (8"-2.5') SAND, gravelly, very moist, brown, medium dense to dense										
				MC	15/12	1.2		117.2	17.1				
			(Fill) CLAY, sandy, moist to very moist, brown to grey brown, stiff to very stiff, brick debris in parts										
5220	5		(US6 Embankment Fill)										
				MC	13/12	0.4		110.2	20.8				
5215	10												
				SS	5/6/10				16.3				
5210	15												
				MC	16/12			115.9	15.8				
5205	20		(Native) CLAY, sandy, moist, grey brown, stiff										
				SS	3/4/4				17.1				
			(Native) SAND, slightly silty to gravelly, moist to wet, light brown, loose to medium dense										
5200	25												
				MC	19/12			111.3	1.4	NP	NP	NP	0.1
5195	30												
				SS	3/2/3								
5190	35												

LOG - STANDARD 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 9/21/12

RockSol Consulting Group, Inc.

BORING : BR- 16

CLIENT Hartwig and Associates **PROJECT NAME** US6 Bridges Design Build Project

PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado

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 (%)
5190	35		(Native) SAND, slightly silty to gravelly, moist to wet, light brown, loose to medium dense *(continued)*	SS	14/12/11				15.0				
5185	40		(Bedrock) CLAYSTONE, slightly moist to moist, grey, hard to very hard	SS	10/17/41				22.0				
5180	45			MC	50/5			114.0	15.0				
5175	50			SS	50/5				19.4	41	20	21	79.0
5170	55			SS	50/5				21.4				

Bottom of hole at 57.0 feet.

Bulk Sample 8"-5'
LL=25
PL=16
PI=9
-200=14%
WSS=0.00

RockSol Consulting Group, Inc.

BORING : BR- 17

CLIENT Hartwig and Associates
PROJECT NAME US6 Bridges Design Build Project
PROJECT NUMBER 280.01
PROJECT LOCATION Denver, Colorado
DATE STARTED 1/10/12 **COMPLETED** 1/10/12
GROUND ELEVATION 5223.0 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 687561.0 **EAST** 955836.0
DRILLING METHOD Hollow Stem **HOLE SIZE** 8"
BORING LOCATION: Outside Shoulder WB US6, West of I-25
LOGGED BY J. Biller
GROUND WATER LEVELS:
NOTES Manual Hammer/ US 6 Bridge over I-25
WATER DEPTH 30.5 ft on 1/10/12

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 (%)
5223	0		(Asphalt) PAVEMENT, approximately 9"										
			(Fill) SAND, silty to gravelly, moist, brown, medium dense	MC	14/12				16.1				
5218	5		(Fill) CLAY, silty, with sand to sandy, clayey sand in parts, moist, grey brown, stiff to very stiff	SS	4/6/8				15.4	37	15	22	53.1
5213	10			MC	17/12			113.0	16.9				
5208	15			SS	6/6/8				13.3	27	15	12	42.9
5203	20			MC	20/12			102.9	20.8				
5198	25		(Native) SAND, slightly silty to gravelly, moist to wet, light brown with black streaks, medium dense to very dense	SS	5/8/14				1.3				
5193	30			SS	14/17/17				8.1	NP	NP	NP	3.3
5188	35												

LOG - STANDARD 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 9/21/12

RockSol Consulting Group, Inc.

CLIENT Hartwig and Associates **PROJECT NAME** US6 Bridges Design Build Project

PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado

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 (%)
5188	35		(Native) SAND, slightly silty to gravelly, moist to wet, light brown with black streaks, medium dense to very dense *(continued)*	SS	18/18/22				20.7				
5183	40			SS	50/10				17.7				
5178	45		(Bedrock) CLAYSTONE, moist, grey, very hard	MC	50/3		0.00	118.4	14.1				
5173	50			SS	50/6				18.4	39	21	18	91.9
5168	55			SS	50/5								
			Bottom of hole at 55.5 feet.										

Bulk Sample 9"-5'
LL=NP
PL=NP
PI=NP
-200=9%
WSS=0.00

RockSol Consulting Group, Inc.

BORING : BR- 18

CLIENT Hartwig and Associates
PROJECT NAME US6 Bridges Design Build Project
PROJECT NUMBER 280.01
PROJECT LOCATION Denver, Colorado
DATE STARTED 12/15/11 **COMPLETED** 12/15/11
GROUND ELEVATION 5207.2 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 687423.4 **EAST** 956039.4
DRILLING METHOD Solid Stem **HOLE SIZE** 4"
BORING LOCATION: Lane 1 SB I-25, South of US6
LOGGED BY J, Biller
GROUND WATER LEVELS:
NOTES Manual Hammer/US6 Bridge over I-25
WATER DEPTH 16.0 ft on 12/15/11

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 (%)
5207	0		(Asphalt) PAVEMENT, approximately 16" in thickness										
			(Fill) SAND, silty with traces of clay, slightly moist, light brown to grey brown, medium dense to dense	MC	44/12			123.3	12.3				
5202	5		(Native) SAND, silty in parts, moist to wet, light brown, medium dense to dense	MC	30/12				1.6				
5197	10			SS	7/5/5				1.0	NP	NP	NP	0.5
5192	15			MC	20/12			117.6	12.1				
5187	20			SS	7/10/20				12.1				
5182	25		(Bedrock) SANDSTONE, clayey, moist, dark grey, very hard, interbedded with claystone	MC	50/3			94.3	18.4				
5177	30			SS	50/5				15.4				
5172	35			SS	50/4		0.00		21.6	34	20	14	69.9

LOG - STANDARD 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 9/21/12

RockSol Consulting Group, Inc.

CLIENT Hartwig and Associates **PROJECT NAME** US6 Bridges Design Build Project

PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado

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 (%)
5172	35		(Bedrock) SANDSTONE, clayey, moist, dark grey, very hard, interbedded with claystone *(continued)*										
				SS	50/3				20.2				
5167	40												
				SS	50/4				20.7				
			Bottom of hole at 44.3 feet.										

Bulk Sample 16"-5'
LL=NP
PL=NP
PI=NP
-200=8%
WSS=0.00

RockSol Consulting Group, Inc.

BORING : BR- 19

CLIENT Hartwig and Associates
PROJECT NAME US6 Bridges Design Build Project
PROJECT NUMBER 280.01
PROJECT LOCATION Denver, Colorado
DATE STARTED 12/15/11 **COMPLETED** 12/16/11
GROUND ELEVATION 5203.9 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 687597.4 **EAST** 955947.9
DRILLING METHOD Solid Stem **HOLE SIZE** 4"
BORING LOCATION: Lane 1 SB I-25, North side of US 6 Bridge
LOGGED BY J. Biller
GROUND WATER LEVELS:
NOTES Manual Hammer/ US 6 Bridge over I-25
WATER DEPTH 9.5 ft on 12/15/11

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 (%)
5204	0		(Asphalt) PAVEMENT, approximately 16" in thickness										
			(Fill) SAND, silty with gravel, slightly moist to moist, light brown, medium dense	MC	29/12			117.6	15.1				
			(Native) SAND, slightly silty to gravelly, slightly moist to moist, light brown, medium dense										
5199	5			MC	25/12			98.1	1.5	NP	NP	NP	1.9
5194	10			SS	4/6/7				6.1				
5189	15			MC	23/12			114.2	15.3	NP	NP	NP	2.3
5184	20		(Bedrock) CLAYSTONE, sandy, interbedded with silty SANDSTONE, moist, reddish brown to dark grey, very hard	SS	50/5				23.1				
5179	25			MC	50/0								
5174	30			SS	50/4				17.5	41	19	22	62.7
5169	35		Bulk Sample 16"-5' LL=17 PL=18 PI=NP -200=9% WSS=0.00	SS	50/3				19.5				
			Bottom of hole at 39.3 feet.	SS	50/3				20.6				

LOG - STANDARD 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 9/21/12

RockSol Consulting Group, Inc.

BORING : BR- 20

CLIENT Hartwig and Associates
PROJECT NAME US6 Bridges Design Build Project
PROJECT NUMBER 280.01
PROJECT LOCATION Denver, Colorado
DATE STARTED 1/13/12 **COMPLETED** 1/13/12
GROUND ELEVATION 5233.0 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 687467.0 **EAST** 956198.0
DRILLING METHOD Hollow Stem **HOLE SIZE** 8"
BORING LOCATION: Lane 3 EB US6, East of I-25
LOGGED BY J. Biller
GROUND WATER LEVELS:
NOTES Manual Hammer/ US 6 Bridge over I-25
WATER DEPTH 39.0 ft on 1/13/12

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 (%)
5233	0		(Asphalt) PAVEMENT, approximately 8" in thickness										
			Aggregate Base Course, slightly moist, light brown, very dense, approximately 12" in thickness	MC	21/12			117.2	10.5				
			(Fill) SAND, with gravel and clay in parts, slightly moist, dark brown to black, medium dense										
5228	5		(Fill) CLAY, sandy, slightly moist to moist, grey with black to brown, stiff to very stiff	MC	9/12	0.4		106.8	19.1				
			(US 6 Embankment)										
5223	10			SS	9/11/11				14.9				
			(Fill) SAND, clayey, sandy clay, with gravel in parts, very stiff, brown, moist, (US 6 Embankment)										
5218	15			MC	21/12			113.3	16.2	29	13	16	46.0
5213	20			SS	8/10/12				18.2				
5208	25			MC	25/12			116.8	14.1	29	14	15	43.5
			(Native) SAND, with silt and trace gravel, slightly moist, light brown, medium dense										
5203	30			SS	8/12/15				2.2				
			(Native) SAND, slightly silty to gravelly, slightly moist to wet, light brown, medium dense to very dense										
5198	35			SS	25/17/12				3.1	NP	NP	NP	5.1
5193	40			SS	26/30/30				11.7				

LOG - STANDARD 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 9/21/12

RockSol Consulting Group, Inc.

BORING : BR- 20

CLIENT Hartwig and Associates **PROJECT NAME** US6 Bridges Design Build Project

PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado

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 (%)
			(Native) SAND, slightly silty to gravelly, slightly moist to wet, light brown, medium dense to very dense *(continued)*										
5188	45			MC	50/11								
			(Bedrock) CLAYSTONE, silty in parts, moist, grey, very hard										
5183	50			SS	50/6		0.00		21.6	50	22	28	92.9
5178	55			MC	50/3								
			Bottom of hole at 55.3 feet.										

Bulk Sample 8"-5'
LL=NP
PL=NP
PI=NP
-200=19%
WSS=0.00

BORING : BR- 21

RockSol Consulting Group, Inc.

CLIENT Hartwig and Associates
PROJECT NAME US6 Bridges Design Build Project
PROJECT NUMBER 280.01
PROJECT LOCATION Denver, Colorado
DATE STARTED 1/5/12 **COMPLETED** 1/6/12
GROUND ELEVATION 5233.0 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 687532.0 **EAST** 956165.0
DRILLING METHOD Hollow Stem **HOLE SIZE** 8"
BORING LOCATION: Lane 1 WB US6, East of I-25
LOGGED BY J. Biller
GROUND WATER LEVELS:
NOTES Manual Hammer/ US 6 Bridge over I-25
WATER DEPTH 38.5 ft on 1/6/12

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 (%)
5233	0		(Asphalt) PAVEMENT, approximately 7.5" in thickness										
			(Fill) CLAY, sandy, clayey sand in parts, moist, grey brown, very stiff, minor debris in parts										
				MC	15/12	0.2		104.3	20.3				
			(US 6 Embankment)										
5228	5		Chloride @ 7.5" - 5' = 0.09%										
				MC	18/12	-0.1		103.0	30.5				
5223	10												
				SS	5/9/12				13.8				
5218	15												
				MC	18/12			122.1	14.8				
5213	20												
				SS	7/8/11				16.4	42	15	27	58.6
5208	25												
				MC	18/12			113.8	16.2				
5203	30												
				SS	10/11/10				2.8				
5198	35		(Native) SAND, gravelly, moist to wet, grey brown to redish brown, dense										

LOG - STANDARD 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 9/21/12

RockSol Consulting Group, Inc.

CLIENT Hartwig and Associates **PROJECT NAME** US6 Bridges Design Build Project

PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado

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 (%)
5198	35		(Native) SAND, gravelly, moist to wet, grey brown to redish brown, dense *(continued)*	MC	40/12			129.4	4.2	NP	NP	NP	4.6
5193	40			SS	13/18/20				13.4				
5188	45		(Native) CLAY, trace sand, moist, brown, hard (weathered claystone)	SS	15/20/15				19.9				
5183	50		(Bedrock) CLAYSTONE, interbedded with siltstone, moist, grey, very hard	MC	50/5			120.7	15.0				
5178	55			SS	50/5				17.2	38	25	13	66.4
5173	60			SS	50/5				17.6				
			Bottom of hole at 60.5 feet.										

Bulk Sample 7"-5'
LL=30
PL=15
PI=15
-200=44%
WSS=0.00
pH=7.7
Chloride Content=0.0871%
Electrical Resistivity=320 Ohm-cm @ 23.3%

LOG - STANDARD 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 9/21/12

RockSol Consulting Group, Inc.

BORING : BR- 22

CLIENT Hartwig and Associates
PROJECT NAME US6 Bridges Design Build Project
PROJECT NUMBER 280.01
PROJECT LOCATION Denver, Colorado
DATE STARTED 1/15/12 **COMPLETED** 1/15/12
EXISTING ELEVATION 5232.2 ft **PROPOSED ELEVATION** ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 687601.4 **EAST** 956168.0
DRILLING METHOD Hollow Stem **HOLE SIZE** 8"
BORING LOCATION: Outside Shoulder WB US6, East of I-25
LOGGED BY H. Ochoa
GROUND WATER LEVELS: ▼ **1ST DEPTH** 12.0 ft on 1/15/12
NOTES Manual Hammer/ US 6 Bridge over I-25
▼ **2ND DEPTH** 38.0 ft on 1/15/12 **3RD DEPTH** --- on

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 (%)
5232	0		(Asphalt) PAVEMENT, approximately 8.5" in thickness										
			Aggregate Base Course, sand, gravel, approximately 15.5" in thickness						7.1				
			(Fill) CLAY, with sand to sandy, moist to very moist, medium stiff to very stiff, brown, minor debris in parts	SS	22/19/9								
5227	5		(US 6 Embankment)	MC	21/12	0.2		112.9	16.1				
5222	10			SS	7/10/11								
		▼	(Perched Water Layer)										
5217	15			SS	6/3/3		0.12		22.2	31	16	15	54.5
5212	20			SS	7/14/12				17.3				
5207	25		(Native) CLAY, sandy in parts, very moist to moist, light brown to brown, very stiff	SS	8/10/10				19.5				
5202	30			SS	6/10/12				19.3				
			(Native) SAND, slightly silty to gravelly, slightly moist, light reddish brown, medium dense	SS	10/19/30				15.5				
5197	35			SS	8/7/6				3.1	NP	NP	NP	3.7

LOG - STANDARD - 2 H20 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 9/21/12

RockSol Consulting Group, Inc.

BORING : BR- 22

CLIENT Hartwig and Associates **PROJECT NAME** US6 Bridges Design Build Project

PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado

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 (%)
5197	35		(Native) SAND, slightly silty to gravelly, slightly moist, light reddish brown, medium dense *(continued)*										
			(Native) SAND, gravelly, wet, light reddish brown, dense										
5192	40			SS	10/19/25				8.2	NP	NP	NP	4.8
5187	45			SS	9/12/38								
			(Bedrock) CLAYSTONE, moist, grey, very hard										
5182	50			MC	50/4		0.04	128.4	15.0				
5177	55			SS	50/4				19.6	40	22	18	68.8
5172	60			MC	50/2								
				SS	50/3								
			Bottom of hole at 60.3 feet.										

Bulk Sample 8.5"-5'
LL=NP
PL=NP
PI=NP
-200=42%
WSS=0.00

RockSol Consulting Group, Inc.

BORING : BR- 23

CLIENT Hartwig and Associates
PROJECT NAME US6 Bridges Design Build Project
PROJECT NUMBER 280.01
PROJECT LOCATION Denver, Colorado
DATE STARTED 6/22/12 **COMPLETED** 6/22/12
GROUND ELEVATION 5274.6 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 687532.6 **EAST** 951527.5
DRILLING METHOD Solid Stem **HOLE SIZE** 4.25"
BORING LOCATION: WB US6 W/sd Federal, N. Shoulder
LOGGED BY R. Lepro
GROUND WATER LEVELS:
NOTES Manul Hammer/Proposed Ped. Bridge, N. Abutment
WATER DEPTH None Encountered on 6/22/12

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 (%)
5275	0		Asphalt Pavement, approximately 3" in thickness										
			(Native) CLAY, sandy, mostly moist, brown, very stiff to hard										
5270	5			MC	25/12	5.2	0.00	115.2	14.0				
5265	10			MC	42/12			106.9	20.6				
5260	15			MC	34/12	2.9		98.2	25.6				
			(Native) CLAY, (weathered claystone) moist, grey, hard, slightly clayey in parts										
			(Bedrock) SANDSTONE, silty, slightly clayey in parts, slightly moist, brown, very hard										
5255	20			MC	50/5			106.7	18.0	36	21	15	31.1
			(Bedrock) CLAYSTONE, slightly silty to sandy, moist, brown grey to dark grey, very hard										
5250	25			MC	50/6			103.2	21.6				
5245	30			MC	50/9			106.2	19.7				
5240	35			SS	50/3		0.00		15.4	48	17	31	81.9
				MC	50/4	-0.4		98.9	14.3				
			Bottom of hole at 39.3 feet.										

LOG - STANDARD 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 10/15/12

RockSol Consulting Group, Inc.

BORING : BR- 24

CLIENT Hartwig and Associates
PROJECT NAME US6 Bridges Design Build Project
PROJECT NUMBER 280.01
PROJECT LOCATION Denver, Colorado
DATE STARTED 6/20/12 **COMPLETED** 6/20/12
GROUND ELEVATION 5274.8 ft
DRILLING CONTRACTOR Old Dirt Drilling
NORTH 687512.5 **EAST** 951548.6
DRILLING METHOD Hollow Stem **HOLE SIZE** 8"
BORING LOCATION: WB US6 W. of Federal, Lane 1
LOGGED BY J. Biller
GROUND WATER LEVELS:
NOTES Automatic Hammer/ Proposed pedestrian bridge
WATER DEPTH None Encountered on 12/20/12

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 (%)
5275	0		Asphalt Pavement, approximately 7" in thickness										
			(Fill) SAND, gravelly, moist, brown										
			(Native) CLAY, samdy to very sandy, silty, sand and gravel in parts, moist, brown, stiff										
5270	5			MC	9/12	1.9		98.8	22.0				
5265	10			MC	11/12			106.2	21.3				
5260	15			MC	14/12			99.9	25.6	48	11	37	74.6
			(Native) CLAY (weathered claystone), with sand to sandy, silty in parts, moist, brown, very stiff to medium hard										
5255	20			MC	32/12	0.2	0.00	94.2	30.5				
			(Bedrock) SANDSTONE, silty, slightly moist, reddish brown, very hard										
5250	25			MC	50/3			96.7	18.0				
			(Bedrock) CLAYSTONE, silty in parts, slightly moist, olive grey brown, very hard										
5245	30			MC	50/6	4.2		114.7	16.9				
5240	35			MC	75/11			111.1	17.4	49	23	26	98.8
			Bottom of hole at 39.3 feet.	MC	50/4	5.6		124.0	12.8				

RockSol Consulting Group, Inc.

BORING : BR- 25

CLIENT Hartwig and Associates
PROJECT NAME US6 Bridges Design Build Project
PROJECT NUMBER 280.01
PROJECT LOCATION Denver, Colorado
DATE STARTED 6/25/12 **COMPLETED** 6/25/12
GROUND ELEVATION 5275.4 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 687398.3 **EAST** 951540.3
DRILLING METHOD Solid Stem **HOLE SIZE** 4"
BORING LOCATION: EB US6 at Federal exit ramp
LOGGED BY J. Biller
GROUND WATER LEVELS:
NOTES Manual Hammer/Proposed Pedestrian Bridge, S. Abutment
WATER DEPTH 23.0 ft on 6/25/12

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 (%)
5275	0		Asphalt Pavement approximately 10" in thickness										
			Aggregate Base Course, gravel, moist, light brown, dense										
			(Native) CLAY, sandy, silty in parts, moist, brown, very stiff to hard	MC	24/12	2.9		105.7	21.3				
5270	5			MC	32/12			103.8	22.6	45	12	33	72.1
5265	10			MC	27/12			102.5	22.8				
5260	15		(Bedrock) CLAYSTONE, silty to sandy, slightly moist, olive brown, very hard	SS	69/12		0.00		20.6	40	23	17	54.3
5255	20			MC	50/5	0.2		115.0	15.9				
5250	25			SS	80/11				25.4				
5245	30			MC	50/4			114.3	15.8				
				MC	50/3								

Bottom of hole at 34.5 feet.

RockSol Consulting Group, Inc.

BORING : BR- 26

CLIENT Hartwig and Associates
PROJECT NAME US6 Bridges Design Build Project
PROJECT NUMBER 280.01
PROJECT LOCATION Denver, Colorado
DATE STARTED 7/10/12 **COMPLETED** 7/10/12
GROUND ELEVATION 5251.7 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 687347.8 **EAST** 953145.3
DRILLING METHOD Hollow Stem **HOLE SIZE** 7"
BORING LOCATION: Braided Ramp Structure, West Abutment
LOGGED BY J. Biller
GROUND WATER LEVELS:
NOTES Manual Hammer
WATER DEPTH 29.5 ft on 7/10/12

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 (%)
5252	0		Topsoil, sitly, sand, wet, brown, approximately 6"										
			(Fill) CLAY, sandy, moist, ddark brown, hard					110.5	9.6				
			(Native) SAND, clayey to silty, slightly moist, brown to light brown, dense, clay with sand in parts	MC	44/12								
5247	5			MC	39/12		0.01	107.4	15.8	53	18	35	87.6
			(Native) CLAY, sandy , silty in parts, moist, light brown, very hard										
5242	10			MC	65/12	6.1		103.0	16.1				
5237	15			MC	22/12			92.9	19.5				
			(Native) SAND, clayey with silt, moist, brown, medium dense, sandy clay in parts										
5232	20			MC	20/12		0.00	99.7	25.9	41	18	23	62.9
			(Native) CLAY, sandy, very moist to wet, brown with reddish brown, very stiff										
5227	25			MC	22/12			99.6	26.5				
5222	30		(Native) SAND, gravelly, wet, light brown, medium dense										
			(Native) CLAY, sandy, very moist to wet, brown and reddish brown, very stiff	MC	16/12			101.1	25.1				
5217	35												

RockSol Consulting Group, Inc.

BORING : BR- 26

CLIENT Hartwig and Associates **PROJECT NAME** US6 Bridges Design Build Project

PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado

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 (%)
5217	35		(Native) CLAY, sandy, very moist to wet, brown and reddish brown, very stiff *(continued)*	MC	21/12			99.9	28.6				
5212	40			MC	22/12		0.00	95.4	28.8	65	20	45	79.4
5207	45			MC	23/12			100.3	24.7				
5202	50			MC	17/12			95.7	30.1				
5197	55			MC	19/12			91.7	30.7				
5192	60		(Native) SAND, silty, wet, dark grey, medium dense to dense	MC	31/12			98.7	25.1				
5187	65		(Native) SAND, slightly silty to gravelly, wet, light brown, dense	MC	78/12			127.6	9.5				
5182	70			SS	34/12				9.8				
5177	75												

LOG - STANDARD 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 10/15/12

RockSol Consulting Group, Inc.

BORING : BR- 26

CLIENT Hartwig and Associates **PROJECT NAME** US6 Bridges Design Build Project

PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS	SWELL POTENTIAL (%)	SULFATE (%)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			FINES CONTENT (%)
										LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
5177	75		(Native) SAND, slightly silty to gravelly, wet, light brown, dense *(continued)*	SS	76/11		0.00		9.2	NP	NP	NP	7.8
5172	80			SS	23/24/28				7.4				
5167	85		(Bedrock) SANDSTONE, silty with clay, moist, light brown, very hard	SS	50/4				19.4				
5162	90		(Bedrock) CLAYSTONE, very moist, dark grey, very hard, with interbedded SILTSTONE	SS	50/4		0.00		19.7	52	29	23	90.7
5157	95			MC	50/3			116.9	13.5				
			Bottom of hole at 95.3 feet.										

RockSol Consulting Group, Inc.

BORING : BR- 27

CLIENT Hartwig and Associates
PROJECT NAME US6 Bridges Design Build Project
PROJECT NUMBER 280.01
PROJECT LOCATION Denver, Colorado
DATE STARTED 6/21/12 **COMPLETED** 6/21/12
GROUND ELEVATION 5228.2 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 687399.2 **EAST** 953301.7
DRILLING METHOD Hollow Stem **HOLE SIZE** 7"
BORING LOCATION: EB US 6 Outside Shoulder E. of Federal Blvd.
LOGGED BY J. Biller
GROUND WATER LEVELS:
NOTES Manual Hammer/Proposed Braided Ramp
WATER DEPTH 20.5 ft on 6/21/12

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 (%)
5228	0		Asphalt Pavement, approximately 7" in thickness										
			Aggregate Base Course, approximatly 17" in thickness										
			(Native) CLAY, with sand to sandy, moist to wet, brown, stiff to very stiff, silty in parts	MC	21/12	2.6		100.9	24.1				
5223	5												
			(Minor calcareous and iron oxide staining @ 15')	MC	16/12	0.5		89.4	39.6				
5218	10												
				MC	26/12			102.2	24.7				
5213	15												
				SS	6/10/11		0.00		32.3	69	20	49	94.5
5208	20												
		▼		MC	18/12			94.3	29.2				
5203	25												
				SS	4/5/6				35.4				
5198	30		(Native) SAND, slightly silty to gravelly, moist to wet, light brown, dense to very dense										
				MC	61/12			114.0	1.4	NP	NP	NP	2.3
5193	35												

LOG - STANDARD 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 10/15/12

RockSol Consulting Group, Inc.

BORING : BR- 27

CLIENT Hartwig and Associates **PROJECT NAME** US6 Bridges Design Build Project

PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado

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 (%)
5193	35		(Native) SAND, slightly silty to gravelly, moist to wet, light brown, dense to very dense *(continued)*	SS	28/22/33				9.6				
5188	40			SS	15/20/22				13.2				
5183	45			SS	16/24/26				10.7	NP	NP	NP	4.1
5178	50			SS	66/11				10.0				
5173	55			SS	16/43/36				10.1 21.7				
5168	60		(Bedrock) CLAYSTONE, (weathered), moist to very moist, brown with grey, hard (Bedrock) CLAYSTONE, slightly sandy in parts, moist, grey, very hard	MC	50/3		0.00	121.6	14.8				
5163	65												
5158	70			MC	50/5			107.5	19.1	48	27	21	97.3
5153	75			MC	50/5			112.1	18.1				

Bottom of hole at 75.0 feet.

RockSol Consulting Group, Inc.

BORING : RW 1-1

CLIENT Hartwig and Associates
PROJECT NAME US6 Bridges Design Build Project
PROJECT NUMBER 280.01
PROJECT LOCATION Denver, Colorado
DATE STARTED 1/4/12 **COMPLETED** 1/4/12
GROUND ELEVATION 5222.2 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 687473.1 **EAST** 954002.3
DRILLING METHOD Solid Stem **HOLE SIZE** 4"
BORING LOCATION: Median, Bryant St to Federal Blvd Ramp
LOGGED BY J. Biller
GROUND WATER LEVELS:
NOTES Manual Hammer/Approx. 400' W. of Bryant St., N. sd. of US 6
WATER DEPTH None Encountered on 1/4/12

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 (%)
5222	0		(Asphalt) Pavement, approximately 6" in thickness										
			(Fill) SAND, silty to clayey, moist, brown, medium dense										
			(Fill) CLAY, with sand to sandy, moist to very moist, brown, stiff	MC	21/12	0.6		97.1	24.6				
5217	5			MC	14/12	-0.1		99.5	24.2				
5212	10			SS	5/5/8				25.5	46	17	29	71.7
			(Native) SAND, clayey, moist, brown and grey, medium dense										
5207	15			MC	26/12			107.4	19.9				
			(Native) CLAY, with sand, moist, brown, very stiff										
5202	20		(Native) SAND, silty with gravel, moist, light brown, medium dense to dense	SS	7/14/43				15.7				
			Bottom of hole at 20.5 feet.										

Bulk Sample 6"-5"
LL=22
PL=17
PI=5
-200=29%
WSS=0.00

BORING : RW 1-2

RockSol Consulting Group, Inc.

CLIENT Hartwig and Associates
PROJECT NAME US6 Bridges Design Build Project
PROJECT NUMBER 280.01
PROJECT LOCATION Denver, Colorado
DATE STARTED 12/9/11 **COMPLETED** 12/9/11
EXISTING ELEVATION 5214.3 ft **PROPOSED ELEVATION** ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 687502.4 **EAST** 954244.1
DRILLING METHOD Hollow Stem **HOLE SIZE** 8"
BORING LOCATION: Median, Bryant St. to Federal Blvd. Ramp
LOGGED BY R. Lepro
GROUND WATER LEVELS: ▼ **1ST DEPTH** 19.0 ft on 12/9/11
NOTES Manual Hammer/Monitoring Well/Aprrox. 200' W. of Bryant St.
▼ **2ND DEPTH** 22.2 ft on 4/19/12 **3RD DEPTH** --- on

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 (%)
5214	0		(Topsoil) Approximately 6" in thickness (off shoulder landscape area)										
			(Fill) SAND, silty to clayey, moist, dark grey brown, medium dense to dense	MC	34/12	2.3		111.1	17.1				
			(Fill) CLAY, sandy with gravel in parts, moist to very moist, dark brown to grey, stiff to hard										
5209	5			MC	11/12		0.17	91.6	28.3	54	18	36	75.7
5204	10			MC	44/12			96.8	25.4				
			(Native) SAND, gravelly, slightly moist to wet, light brown, medium dense to very dense										
5199	15			SS	15/17/30				1.8	NP	NP	NP	5.3
				SS	9/22/25/25				4.8				
5194	20		▼	SS	18/21/22				5.6				
5189	25			SS	12/15/15				11.7				
			Bottom of hole at 25.5 feet.										

LOG - STANDARD - 2 H20 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 10/15/12

RockSol Consulting Group, Inc.

BORING : RW 2-1

CLIENT Hartwig and Associates
PROJECT NAME US6 Bridges Design Build Project
PROJECT NUMBER 280.01
PROJECT LOCATION Denver, Colorado
DATE STARTED 12/7/11 **COMPLETED** 12/7/11
EXISTING ELEVATION 5209.2 ft **PROPOSED ELEVATION** ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 687505.7 **EAST** 954774.2
DRILLING METHOD Hollow Stem **HOLE SIZE** 8"
BORING LOCATION: Median, US6 WB to Bryant St Ramp
LOGGED BY J. Biller
GROUND WATER LEVELS: ▼ **1ST DEPTH** 19.5 ft on 12/7/11
NOTES Manual Hammer/ Monitoring Well/Approx. 200' E. of Bryant St.
▼ **2ND DEPTH** 17.1 ft on 4/19/12 **3RD DEPTH** --- on

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 (%)
5209	0		(Fill) SAND, clayey, with debris/rubble, moist, dark brown to black, medium dense	MC	20/12	0.2		99.7	22.2				
5204	5		(Fill) SAND AND CLAY, with gravel and cobbles, silty and sandy, moist, light brown to dark brown with black, stiff to very dense	MC	50/11				3.6				
5199	10			SS	4/5/4		0.50		30.3	52	21	31	73.5
5194	15		(Native) SAND, slightly silty to gravelly, moist to wet, light brown, medium dense to very dense	MC	20/12				2.6				
5189	20			SS	30/36/30				8.9	NP	NP	NP	6.0
				SS	13/15/14				11.3				
5184	25		Bulk Sample 0-5' LL=35 PL=17 PI=18 -200=33% WSS=0.25 pH=7.8 Chloride Content=0.0433% Electrical Resistivity=420 Ohm-cm @ 26.5%	SS	12/14/14				13.7				
5179	30			SS	13/13/8				16.3				
			Bottom of hole at 31.5 feet.										

LOG - STANDARD - 2 H20 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 9/21/12

RockSol Consulting Group, Inc.

BORING : RW 2-2

CLIENT Hartwig and Associates
PROJECT NAME US6 Bridges Design Build Project
PROJECT NUMBER 280.01
PROJECT LOCATION Denver, Colorado
DATE STARTED 12/30/11 **COMPLETED** 12/30/11
GROUND ELEVATION 5211.0 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 687498.0 **EAST** 954971.0
DRILLING METHOD Solid Stem **HOLE SIZE** 4.25"
BORING LOCATION: Median, US6 WB to Bryant St Ramp
LOGGED BY J. Biller
GROUND WATER LEVELS:
NOTES Manual Hammer/Approx. 400E. of Bryant St.
WATER DEPTH 20.0 ft on 12/30/11

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 (%)
5211	0		(Topsoil) TOPSOIL, silt with sand, very moist, dark brown, loose to medium dense, approximately 6" in thickness										
			(Fill) SAND, clayey, moist, dark brown to black, medium dense	MC	18/12	-0.2		117.8	11.9				
5206	5			MC	20/12	-0.1		112.8	14.2				
			(Native) SAND, clayey, moist, brown, loose										
5201	10			SS	6/3/2				16.3				38.0
			(Native) SAND, trace silt and gravel, moist to wet, light brown, very loose										
5196	15			MC	4/12				2.6	NP	NP	NP	1.8
5191	20			SS	2/1/1				13.0				
			Bottom of hole at 20.5 feet.										

Bulk Sample 0"-5'
LL=35
PL=17
PI=18
-200=36%
WSS=0.00

LOG - STANDARD 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 9/21/12

BORING : RW 3-1

RockSol Consulting Group, Inc.

CLIENT Hartwig and Associates
PROJECT NAME US6 Bridges Design Build Project
PROJECT NUMBER 280.01
PROJECT LOCATION Denver, Colorado
DATE STARTED 12/7/11 **COMPLETED** 12/7/11
GROUND ELEVATION 5208.8 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 687636.2 **EAST** 955519.4
DRILLING METHOD Hollow Stem **HOLE SIZE** 4"
BORING LOCATION: I-25 SB to US6 WB Loop Ramp N. outside shoulder
LOGGED BY J. Biller
GROUND WATER LEVELS:
NOTES Manual Hammer/Approx. 200 E. of S. Platte River
WATER DEPTH 18.0 ft on 12/7/11

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 (%)
5209	0		(Topsoil) SAND, clayey, very moist, brown, loose to medium dense, approximately 6" in thickness										
			(Fill) SAND, clayey, moist to very moist, light brown to black, medium dense	MC	17/12			114.8	13.2	39	15	24	32.2
			Chloride @ 0-5' bulk=0.0016%										
5204	5			MC	20/12		0.00	108.8	9.6				
			(Native) SAND, gravelly with silt, moist to wet, light brown, medium dense to very dense										
5199	10			SS	4/7/8				3.1				
5194	15			MC	12/12			108.2	2.7				
5189	20			SS	4/6/9				6.6				1.5
5184	25			MC	50/6			129.2	8.8				
			Bottom of hole at 25.5 feet.										

Bulk Sample 0-5'
LL=25
PL=15
PI=10
-200=27%
WSS=0.00
pH=8.4
Chloride Content=0.00%
Electrical Resistivity=1800 Ohm-cm @ 18.5%

LOG - STANDARD 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 9/21/12

RockSol Consulting Group, Inc.

BORING : RW 3-2

CLIENT Hartwig and Associates
PROJECT NAME US6 Bridges Design Build Project
PROJECT NUMBER 280.01
PROJECT LOCATION Denver, Colorado
DATE STARTED 12/7/11 **COMPLETED** 12/7/11
EXISTING ELEVATION 5208.1 ft **PROPOSED ELEVATION** ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 687772.2 **EAST** 955626.0
DRILLING METHOD Hollow Stem **HOLE SIZE** 8"
BORING LOCATION: I-25 SB to US6 WB Loop Ramp, in outside shoulder
LOGGED BY J. Biller
GROUND WATER LEVELS: ▼ **1ST DEPTH** 15.0 ft on 12/7/11
NOTES Manual Hammer/Monitoring Well/Approx. 400 E. of S. Platte River
▼ **2ND DEPTH** 15.0 ft on 4/19/12 **3RD DEPTH** --- on

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 (%)
5208	0		(Topsoil) SAND and CLAY, with silt, very moist, dark brown, approximately 6" in thickness										
			(Fill) SAND, clayey, with cobbles in parts, very moist, light brown to brown, medium dense to very dense	MC	20/12	-0.1		118.0	15.0				
5203	5			GB	50/0 Sample Bounce on Cobble		0.14		4.2	25	16	9	14.2
5198	10		(Native) SAND, silty, slightly moist, light brown, loose	SS	3/3/3				6.5	NP	NP	NP	9.6
5193	15		(Native) SAND, slightly silty to gravelly, wet, brown to dark brown, medium dense	MC	27/12				2.1				
				SS	8/4/5/10				11.6	NP	NP	NP	5.0
5188	20			SS	6/4/9				16.7	NP	NP	NP	1.7
5183	25		(Bedrock) CLAYSTONE, sandy, moist, grey, hard	SS	50/12				21.3	51	25	26	74.1
			Bottom of hole at 25.0 feet.										

BORING : RW 4-1

RockSol Consulting Group, Inc.

CLIENT Hartwig and Associates
PROJECT NAME US6 Bridges Design Build Project
PROJECT NUMBER 280.01
PROJECT LOCATION Denver, Colorado
DATE STARTED 12/30/11 **COMPLETED** 12/30/11
GROUND ELEVATION 5226.0 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 687321.0 **EAST** 954598.0
DRILLING METHOD Solid Stem **HOLE SIZE** 4.25"
BORING LOCATION: Lane 5 EB US6 to SB I-25 Ramp
LOGGED BY J. Biller
GROUND WATER LEVELS:
NOTES Manual Hammer/East of Bryant St. approx. 70'
WATER DEPTH None Encountered on 12/30/11

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 (%)
5226	0		(Asphalt) PAVEMENT, approximately 8" in thickness										
			(Fill) SAND gravelly, silty, slightly moist, light brown, dense (aggregate base course)										
			(Fill) SAND, clayey, slightly moist, grey black, medium dense	MC	25/12	0.2		101.1	22.8				
5221	5			MC	12/12	-0.1		99.2	22.5				
			(Fill) CLAY, sandy, moist, brown to black, stiff to very stiff										
5216	10			SS	4/5/5				23.5	43	20	23	68.9
5211	15			MC	19/12			107.7	20.9				
5206	20			SS	10/12/7				16.6				
			(Native) SAND, silty, brown, medium dense, moist										
			Bottom of hole at 20.5 feet.										

Bulk Sample 8"-5'
LL=NP
PL=NP
PI=NP
-200=17%
WSS=0.00

LOG - STANDARD 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 9/21/12

RockSol Consulting Group, Inc.

BORING : RW 4-2

CLIENT Hartwig and Associates
PROJECT NAME US6 Bridges Design Build Project
PROJECT NUMBER 280.01
PROJECT LOCATION Denver, Colorado
DATE STARTED 12/30/11 **COMPLETED** 12/30/11
GROUND ELEVATION 5220.0 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 687344.0 **EAST** 954790.0
DRILLING METHOD Solid Stem **HOLE SIZE** 4.25"
BORING LOCATION: Median Shoulder between EB US6 and I-25 Exit ramps
LOGGED BY J. Biller
GROUND WATER LEVELS:
NOTES Manual Hammer/East of Bryant St./Approx. 250 ft.
WATER DEPTH None Encountered on 12/30/11

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 (%)
5220	0		(Asphalt) PAVEMENT, approximately 8" in thickness										
			(Fill) SAND, slightly moist, light brown (aggregate base course)										
			(Fill) CLAY, sandy with gravel and silt, moist, light brown to gray, stiff to very stiff	MC	14/12	0.6		98.8	26.5				
5215	5			MC	16/12	0.1		98.6	24.8				
5210	10			SS	4/9/15				22.8	40	18	22	57.3
			(Native) CLAY, sandy, moist, grey to black, very stiff										
5205	15			MC	22/12			83.4	26.9	59	23	36	77.7
			(Native) SAND, silty with gravel, slightly moist, light brown, medium dense										
5200	20			SS	17/10/11				2.3	NP	NP	NP	3.2
			Bottom of hole at 20.5 feet.										

Bulk Sample 8"-5'
LL=NP
PL=NP
PI=NP
-200=28%
WSS=0.00

BORING : RW 4-3

RockSol Consulting Group, Inc.

CLIENT Hartwig and Associates
PROJECT NAME US6 Bridges Design Build Project
PROJECT NUMBER 280.01
PROJECT LOCATION Denver, Colorado
DATE STARTED 12/30/11 **COMPLETED** 12/30/11
GROUND ELEVATION 5214.0 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 687356.0 **EAST** 954950.0
DRILLING METHOD Solid Stem **HOLE SIZE** 4.25"
BORING LOCATION: Outside Shoulder EB US6
LOGGED BY J. Biller
GROUND WATER LEVELS:
NOTES Manual Hammer/West of S. Platte River, Approx. 250 ft.
WATER DEPTH None Encountered on 12/30/11

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 (%)
5214	0		(Asphalt) PAVEMENT, Approximately 20" in thickness										
			(Fill) SAND, gravelly trace clay, slightly moist, light brown, medium dense to very dense	MC	50/7			132.5	3.7				
5209	5		(Fill) CLAY, sandy, moist, brown to grey, very stiff	MC	18/12	0.3		105.2	21.6				
5204	10			SS	5/8/8				22.5	45	18	27	60.8
5199	15		(Native) SAND, slightly silty, slightly moist, light brown, medium dense	MC	19/12				2.1	NP	NP	NP	3.6
5194	20			SS	14/14/14				1.7				
			Bottom of hole at 20.5 feet.										

Bulk Sample 20"-5'
LL=NP
PL=NP
PI=NP
-200=14%
WSS=0.00

LOG - STANDARD 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 9/21/12

BORING : RW 5-1

RockSol Consulting Group, Inc.

CLIENT Hartwig and Associates
PROJECT NAME US6 Bridges Design Build Project
PROJECT NUMBER 280.01
PROJECT LOCATION Denver, Colorado
DATE STARTED 12/9/12 **COMPLETED** 12/9/12
EXISTING ELEVATION 5222.4 ft **PROPOSED ELEVATION** ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 687325.8 **EAST** 953995.6
DRILLING METHOD Hollow Stem **HOLE SIZE** 8"
BORING LOCATION: Median Between EB US6 and Bryant St. Exit ramp
LOGGED BY R. Lepro
GROUND WATER LEVELS: ▼ **1ST DEPTH** 29.0 ft on 12/9/11
NOTES Manual Hammer/Monitoring Well/Approx. 400 ft. W. of Bryant St.
▼ **2ND DEPTH** 30.2 ft on 4/19/12 **3RD DEPTH** --- on

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 (%)
5222	0		(Topsoil) approximately 3" in thickness, sand, clayey, moist, brown										
			(Fill) SAND, slightly silty to gravelly, cobbles in parts, slightly moist, brown, dense	MC	50/6				2.7				
5217	5		(Fill) CLAY, sandy with clayey sand in parts, moist to very moist, brown to dark grey, stiff to very stiff	MC	18/12	0.4		108.7	20.4	34	17	17	48.9
5212	10			MC	18/12	0.1	0.00	109.5	19.5				
5207	15			SS	6/6/8				24.4	47	16	31	69.3
			(Native) SAND, slightly silty to gravelly, moist to wet, light brown to reddish brown, medium dense to dense										
5202	20			MC	16/12			93.9	8.4				
5197	25			SS	13/19/17/16				3.0				
5192	30		▼ ▼	SS	13/14/15				14.6				
5187	35			SS	8/13/15				12.2				

Bottom of hole at 35.5 feet.

LOG - STANDARD - 2 H20 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 10/15/12

RockSol Consulting Group, Inc.

BORING : RW 5-2

CLIENT Hartwig and Associates
PROJECT NAME US6 Bridges Design Build Project
PROJECT NUMBER 280.01
PROJECT LOCATION Denver, Colorado
DATE STARTED 12/29/11 **COMPLETED** 12/29/11
GROUND ELEVATION 5227.4 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 687325.7 **EAST** 954224.6
DRILLING METHOD Solid Stem **HOLE SIZE** 4.25"
BORING LOCATION: Median between EB US6 and Bryant St. exit ramp
LOGGED BY J. Biller
GROUND WATER LEVELS:
NOTES Manual Hammer/Approx. 200 ft. W. of Bryant St.
WATER DEPTH None Encountered on 12/29/11

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 (%)
5227	0		(Asphalt) PAVEMENT, approximately 12" in thickness										
			(Fill) SAND, silty with gravel, clayey in parts, slightly moist to moist, black to grey, medium dense to dense	MC	39/12		0.04	114.3	13.3				
5222	5			MC	16/12			116.3	16.1				
			(Fill) CLAY, sandy, slightly moist to moist, brown to grey, very stiff										
5217	10			SS	4/8/8				21.6	38	20	18	70.3
5212	15			MC	24/12	-0.1		107.6	18.7				
5207	20			SS	7/6/10				25.4	50	17	33	71.0
			(Native) CLAY, trace sand, moist, dark brown to grey, stiff Bulk Sample 1'-5' LL=20 PL=20										
5202	25		PI=NP -200=14% WSS=0.00	MC	14/12	-0.2	0.00	93.0	27.9				
			(Native) SAND, gravelly, slightly moist, light brown, very dense										
5197	30			SS	85/11				2.2	NP	NP	NP	6.6
			Bottom of hole at 30.5 feet.										

RockSol Consulting Group, Inc.

BORING : RW 6-1

CLIENT Hartwig and Associates
PROJECT NAME US6 Bridges Design Build Project
PROJECT NUMBER 280.01
PROJECT LOCATION Denver, Colorado
DATE STARTED 12/12/11 **COMPLETED** 12/12/11
EXISTING ELEVATION 5218.2 ft **PROPOSED ELEVATION** ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 687282.3 **EAST** 954778.7
DRILLING METHOD Hollow Stem **HOLE SIZE** 8"
BORING LOCATION: Shoulder EB US6 to SB I-25
LOGGED BY J. Biller
GROUND WATER LEVELS: ▼ **1ST DEPTH** 26.5 ft on 12/12/11
NOTES Manual Hammer/Monitoring Well/Approx. 300 ft. E. of Bryant St.
▼ **2ND DEPTH** 25.6 ft on 4/19/12 **3RD DEPTH** --- on

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 (%)
5218	0		(Topsoil) SAND. silty, moist, brown, loose, approximately 8" in thickness										
			(Fill) SAND, gravelly to silty with trace clay, moist, brown, dense to very dense	MC	50/12		0.05	121.5	3.8				
5213	5			MC	46/12			126.7	6.0	26	17	9	14.7
5208	10			SS	10/7/5								
5203	15		(Native) SAND, gravelly , moist to wet, light brown to reddish brown, medium dense to very dense	MC	50/11								
5198	20			SS	8/9/13					NP	NP	NP	2.3
5193	25			MC	31/12								
				SS	9/10/11								
5188	30			SS	19/21/19								
			Bottom of hole at 31.5 feet.										

LOG - STANDARD - 2 H20 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 10/15/12

RockSol Consulting Group, Inc.

BORING : RW 6-2

CLIENT Hartwig and Associates
PROJECT NAME US6 Bridges Design Build Project
PROJECT NUMBER 280.01
PROJECT LOCATION Denver, Colorado
DATE STARTED 12/12/11 **COMPLETED** 12/12/11
GROUND ELEVATION 5207.1 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 687271.6 **EAST** 954975.7
DRILLING METHOD Hollow Stem **HOLE SIZE** 8"
BORING LOCATION: off shoulder S. of EB US 6
LOGGED BY J. Biller
GROUND WATER LEVELS:
NOTES Manual Hammer/W. of South Platte River Approx. 250 Ft.
WATER DEPTH 13.0 ft on 12/12/11

ELEVATION (ft)	DEPTH (ft)	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 (%)
5207	0	(Topsoil) SAND, silty, moist, dark brown, loose, vegetation at ground surface, (grass and weeds), approximately 6" in thickness										
		(Fill) SAND, silty with trace clay, moist, light brown, medium dense										
5202	5		MC	17/12		0.00	109.9	4.0	NP	NP	NP	27.5
		(Native) SAND, gravelly with silt, moist to wet, light brown, medium dense to very dense										
5197	10		SS	9/13/13				1.8	NP	NP	NP	2.9
5192	15		SS	12/13/16				9.5	NP	NP	NP	8.7
5187	20		SS	23/30/21				16.3				
5182	25		SS	28/13/11				14.1				
		Bottom of hole at 26.5 feet.										

LOG - STANDARD 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 10/15/12

RockSol Consulting Group, Inc.

BORING : RW 6-3

CLIENT Hartwig and Associates
PROJECT NAME US6 Bridges Design Build Project
PROJECT NUMBER 280.01
PROJECT LOCATION Denver, Colorado
DATE STARTED 12/12/11 **COMPLETED** 12/12/11
GROUND ELEVATION 5206.8 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 687270.8 **EAST** 955145.7
DRILLING METHOD Hollow Stem **HOLE SIZE** 8"
BORING LOCATION: Off Shoulder S. of EB US6 to I-25 Ramp
LOGGED BY J. Biller
GROUND WATER LEVELS:
NOTES Manual Hammer/W. of South Platte Approx. 150 ft.
WATER DEPTH 13.0 ft on 12/12/11

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 (%)
5207	0		(Topsoil) SAND, silty, moist, dark brown, loose, approximately 6" in thickness										
			(Fill) SAND, silty with traces of clay and gravel, moist to very moist, dark brown to black, medium dense										
5202	5			MC	14/12		0.00	106.3	7.0	23	18	5	17.3
			(Native) SAND, with gravel, moist, dark brown, medium dense										
5197	10			SS	15/12/13				2.9	NP	NP	NP	4.4
			(Native) SAND, slightly silty to gravelly, slightly moist to wet, light brown, medium dense to dense										
5192	15			SS	6/10/10				7.5	NP	NP	NP	0.6
5187	20			SS	9/14/17				14.0				
5182	25			SS	3/20/27				15.7				
			Bottom of hole at 26.5 feet.										

BORING : RW 7-1

RockSol Consulting Group, Inc.

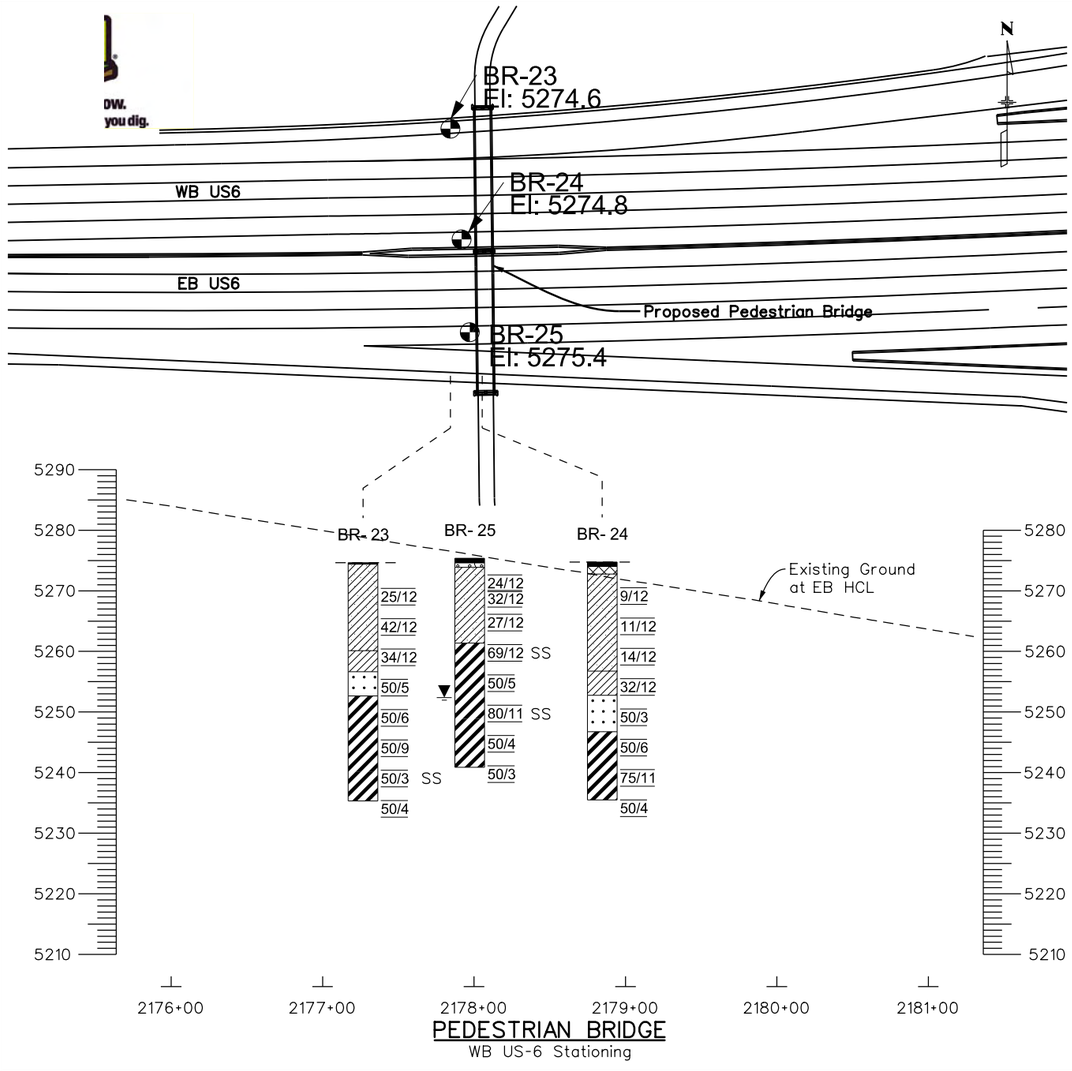
CLIENT Hartwig and Associates
PROJECT NAME US6 Bridges Design Build Project
PROJECT NUMBER 280.01
PROJECT LOCATION Denver, Colorado
DATE STARTED 12/20/11 **COMPLETED** 12/20/11
EXISTING ELEVATION 5214.1 ft **PROPOSED ELEVATION** ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 687399.1 **EAST** 955622.5
DRILLING METHOD Hollow Stem **HOLE SIZE** 8"
BORING LOCATION: Median EB US6 and SB I-25 ramp to EB US6
LOGGED BY H. Ochoa
GROUND WATER LEVELS: ▼ **1ST DEPTH** 21.2 ft on 12/20/11
NOTES Manual Hammer/East of South Platte Approx. 200 ft.
▼ **2ND DEPTH** 21.0 ft on 4/19/12 **3RD DEPTH** --- on

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 (%)
5214	0		(Fill) TOPSOIL, moist, grass and weeds at surface, approximately 6" in thickness										
			(Fill) SAND, clayey, slightly moist to moist, brown, medium dense to dense	MC	45/12	5.0		126.3	7.3				
5209	5			MC	15/12	1.3		105.7	14.3				
			(Native) SILT, sandy, slightly moist, light brown, loose										
5204	10			MC	9/12			98.8	14.2	23	25	NP	54.1
			(Native) SAND, slightly silty to gravelly, moist to wet, reddish brown, medium dense										
5199	15			MC	26/12								
5194	20			SS	5/5/8								
5189	25		Bulk Sample 6"-5' LL=35 PL=15 PI=20 -200=42% WSS=0.00	SS	6/8/13/18					NP	NP	NP	4.0
5184	30		(Bedrock) CLAYSTONE, moist, brown, very hard	SS	2/15/50								
			Bottom of hole at 30.5 feet.										

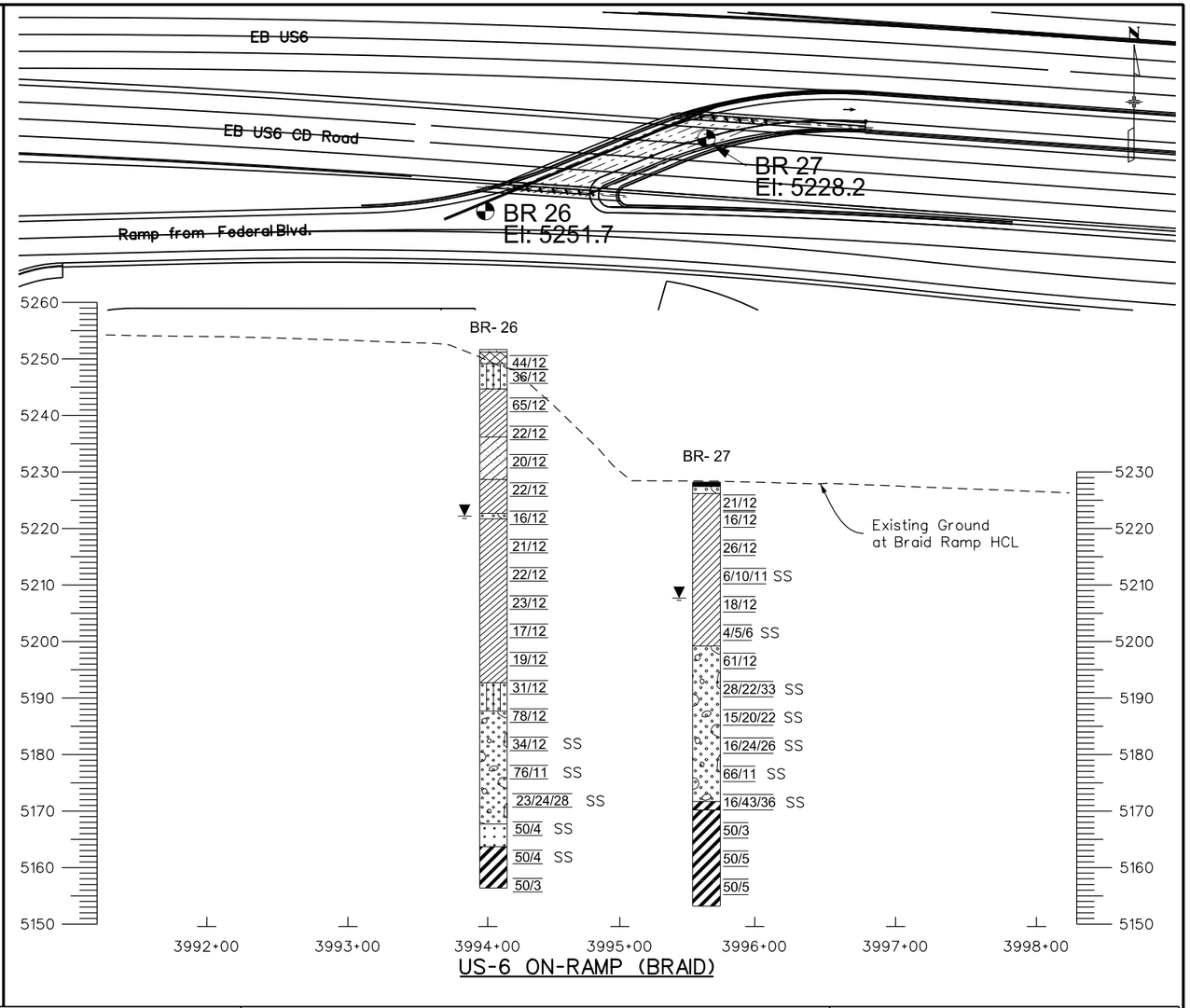
LOG - STANDARD - 2 H20 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 9/21/12

APPENDIX B

ENGINEERING GEOLOGY SHEETS
(Figures B-1 through B-7)



PEDESTRIAN BRIDGE
WB US-6 Stationing



US-6 ON-RAMP (BRAID)

SUMMARY OF TEST RESULTS

Sample ID	Depth (ft)	Liquid Limit	Plasticity Index	%< #200 Sieve	Classification USCS	Classification AASHTO	Water Content (%)	Dry Density (%)	Sulfate (%)
BR- 23	19	36	15	31.1	SC	A-2-6 (1)	18.0	106.7	
BR- 23	34	48	31	81.9	CL	A-7-6 (25)	15.4		0.00
BR- 24	14	48	37	74.6	CL	A-7-6 (26)	25.6	99.9	
BR- 24	34	49	26	98.8	CL	A-7-6 (29)	17.4	111.1	
BR- 25	4	45	33	72.1	CL	A-7-6 (21)	22.6	103.8	
BR- 25	15	40	17	54.3	CL	A-6 (7)	20.6		0.00
BR- 26	5	53	35	87.6	CH	A-7-6 (32)	15.8	107.4	0.01
BR- 26	20	41	23	62.9	CL	A-7-6 (12)	25.9	99.7	0.00
BR- 26	40	65	45	79.4	CH	A-7-6 (37)	28.8	95.4	0.00
BR- 26	75	NP	NP	7.8	SP-SM	A-1-b (0)	9.2		0.00
BR- 26	90	52	23	90.7	MH	A-7-6 (24)	19.7		0.00
BR- 27	15	69	49	94.5	CH	A-7-6 (51)	32.3		0.00
BR- 27	30	NP	NP	2.3	SP	A-1-a (0)	1.4	114.0	
BR- 27	45	NP	NP	4.1	SW	A-1-b (0)	10.7		
BR- 27	65	48	21	97.3	CL	A-7-6 (24)	19.1	107.5	

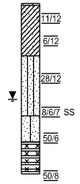
TYPE OF MATERIAL

- Fill - Aggregate Base Course
- Bedrock - CLAYSTONE
- Native - CLAY, silty
- Concrete
- Fill - SAND
- Bedrock - SANDSTONE
- USCS Clayey Sand
- Native - SAND, silty
- Native - SAND, gravelly
- Asphalt Pavement
- Native - CLAY
- Native - CLAY, sandy
- Fill - CLAY
- Native - SILT
- Native - SAND, clayey
- Bedrock - SILTSTONE
- Native - SAND
- Native - TOPSOIL

SEE INDIVIDUAL LOG SHEETS FOR ADDITIONAL DESCRIPTION OF MATERIAL ENCOUNTERED

LEGEND

TEST BORING



BR Bridge Borehole

Ground Water Level At Time of Drilling

3/12 9 Blows for 12 Inches

50/3 50 Blows for 3 Inches

8/6/7 SS Split Spoon Sampler
Required 8 Blows for 6 Inches
Required 6 Blows for 6 Inches
Required 7 Blows for 6 Inches

BORING ID NOTED AT THE TOP OF LOG
BLOW COUNTS OBTAINED WITH SPLIT SPOON SAMPLERS ARE NOTED WITH "SS". ALL OTHER BLOW COUNTS OBTAINED WITH A MODIFIED CALIFORNIA BARREL SAMPLER
SEE INDIVIDUAL LOG SHEETS FOR MORE DETAIL

Print Date: 8/30/2012
File Name: 18838-F-B-1-Engineering Geology.dgn
Horiz. Scale: 1:100 Vert. Scale: As Noted
Unit Information Unit Leader Initials

RockSol Consulting Group, Inc.
6510 W 91st Ave, Ste 130
Westminster, CO 80031
Ph: 303-962-9300
Fax: 303-962-9350

R-X

Sheet Revisions

Date:	Comments	Init.

Colorado Department of Transportation
8833 South Wadsworth Court
Littleton, CO 80128
Phone: 303-972-9112 FAX: 303-972-9114
Region 6 MDP

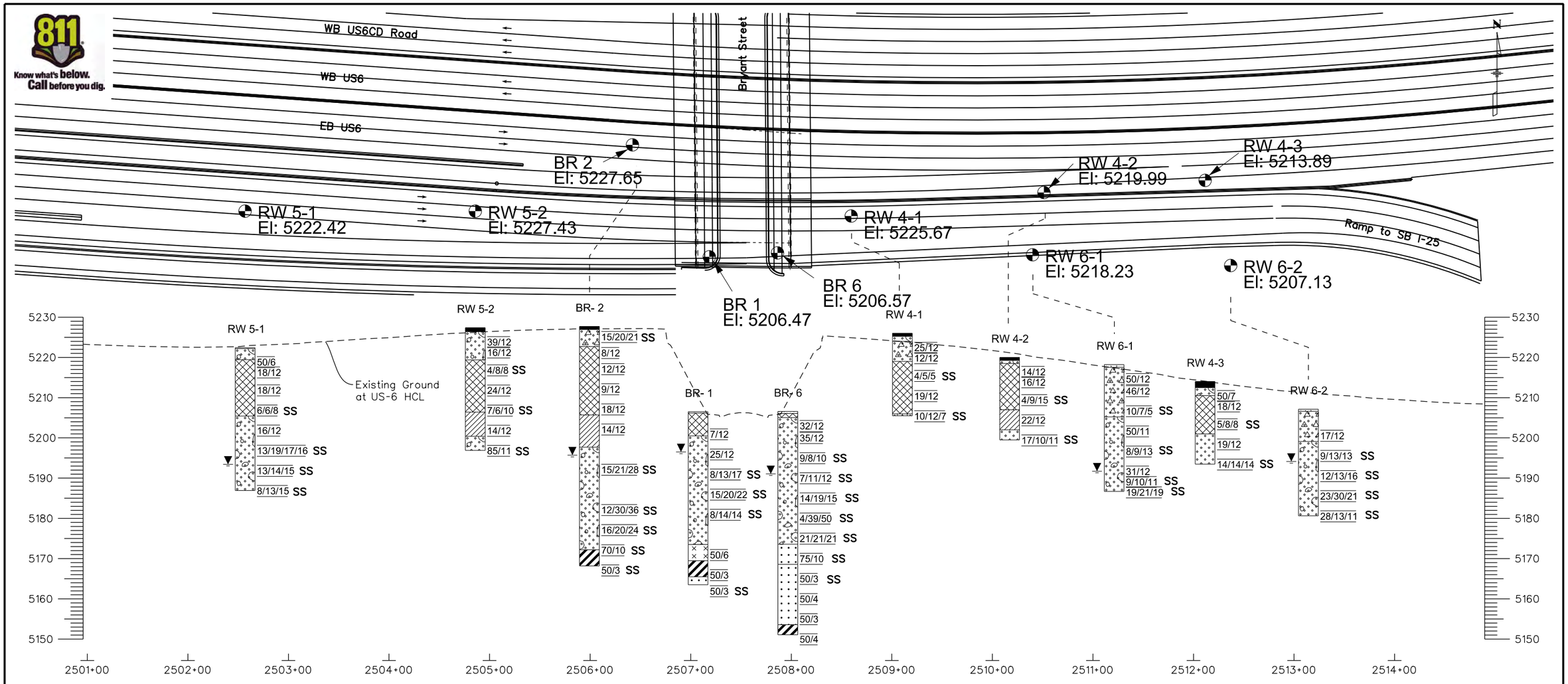
As Constructed
No Revisions:
Revised:
Void:

ENGINEERING GEOLOGY
Pedestrian Bridge and Braided Ramp

Designer: R. Lepro
Detailer: D. Knight
Sheet Subset:
Structure Numbers
Subset Sheets: 1 of 7

Project No./Code
US 6 BRIDGES
DESIGN BUILD PROJECT
18838
Figure B-1

dknight 1:57:40 PM M:\PROJECTS\280.01 US-6 Bridges (Knox Ct. to BNSF)\18838\Materials_Geotechnical\Drawings\Reference_Files\Engineering Geology\18838-F-B-1-Engineering Geology.dgn



BRYANT STREET STRUCTURE

Eastbound US-6

SUMMARY OF TEST RESULTS

Sample ID	Depth (ft)	Liquid Limit	Plasticity Index	%< #200 Sieve	Classification USCS	Classification AASHTO	Water Content (%)	Dry Density (%)	Sulfate (%)
BR- 1	4	28	11	92	CL	A-6 (9)	35,5	88,2	
BR- 1	14	NP	NP	5	SW	A-1-b (0)	10,8		
BR- 1	34	34	6	48	SM	A-4 (1)	18,3	109,0	
BR- 1	39	44	26	84	CL	A-7-6 (22)	19,6	104,8	
BR- 1	43						20,8		
BR- 2	0	27	12	28	SC	A-2-6 (0)			0,00
BR- 2	9						21,0	98,8	0,00
BR- 2	19						20,9	103,3	
BR- 2	34	NP	NP	6	SP-SM	A-1-b (0)	10,9		
BR- 2	44	NP	NP	6	SP-SM	A-1-b (0)	13,5		
BR- 2	54	30	12	22	SC	A-2-6 (0)	13,9		
BR- 2	59						20,9		0,00
BR- 6	0,5	20	2	21	SM	A-1-b (0)			0,00
BR- 6	2						15,4	112,6	
BR- 6	5	NP	NP	3	GW	A-1-a (0)	2,3	113,0	

Sample ID	Depth (ft)	Liquid Limit	Plasticity Index	%< #200 Sieve	Classification USCS	Classification AASHTO	Water Content (%)	Dry Density (%)	Sulfate (%)
BR- 6	20						14,1		0,00
BR- 6	35	36	15	43	SC	A-6 (3)	16,6		
BR- 6	40	24	2	38	SM	A-4 (0)	14,5		
BR- 6	45						12,5	120,6	0,00
BR- 6	55						19,6	108,2	
RW 4-1	0	NP	NP	17	SM	A-1-b (0)			0,00
RW 4-1	2						22,8	101,1	
RW 4-1	9	43	23	69	CL	A-7-6 (14)	23,5		
RW 4-1	14						20,9	107,7	
RW 4-2	0	NP	NP	28	SM	A-2-4 (0)			0,00
RW 4-2	2						26,5	98,8	
RW 4-2	9	40	22	57	CL	A-6 (9)	22,8		
RW 4-2	14	59	36	78	CH	A-7-6 (29)	26,9	83,4	
RW 4-2	19	NP	NP	3	SP	A-1-a (0)	2,3		
RW 4-3	0	NP	NP	14	SM	A-1-b (0)			0,00

Sample ID	Depth (ft)	Liquid Limit	Plasticity Index	%< #200 Sieve	Classification USCS	Classification AASHTO	Water Content (%)	Dry Density (%)	Sulfate (%)
RW 4-3	2						3,7	132,5	
RW 4-3	9	45	27	61	CL	A-7-6 (14)	22,5		
RW 4-3	14	NP	NP	4	SP	A-1-b (0)	2,1		
RW 5-1	4	34	17	49	SC	A-6 (5)	20,4	108,7	
RW 5-1	9						19,5	109,5	0,00
RW 5-1	14	47	31	69	CL	A-7-6 (19)	24,4		
RW 5-1	19						8,4	93,9	
RW 5-1	34						12,2		
RW 6-1	2						3,8	121,5	0,05
RW 6-1	5	26	9	15	SC	A-2-4 (0)	6,0	126,7	
RW 6-1	20	NP	NP	2	SW	A-1-a (0)			
RW 6-2	5	NP	NP	27	SM	A-2-4 (0)	4,0	109,9	0,00
RW 6-2	10	NP	NP	3	SW	A-1-a (0)	1,8		
RW 6-2	15	NP	NP	9	SW-SM	A-1-a (0)	9,5		
RW 6-2	25						14,1		

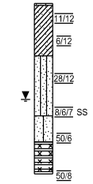
TYPE OF MATERIAL

- Fill - Aggregate Base Course
- Bedrock - CLAYSTONE
- Native - CLAY, silty
- Concrete
- Fill - SAND
- Bedrock - SANDSTONE
- USCS Clayey Sand
- Native - SAND, silty
- Native - SAND, gravelly
- Asphalt Pavement
- Native - CLAY
- Native - CLAY, sandy
- Fill - CLAY
- Native - SILT
- Native - SAND, clayey
- Bedrock - SILTSTONE
- Native - SAND
- Native - TOPSOIL

SEE INDIVIDUAL LOG SHEETS FOR ADDITIONAL DESCRIPTION OF MATERIAL ENCOUNTERED

LEGEND

TEST BORING



BR Bridge Borehole
RW Retaining Wall Borehole
Ground Water Level At Time of Drilling
9/12 9 Blows for 12 Inches
50/3 50 Blows for 3 Inches
8/6/7 SS Split Spoon Sampler
Required 8 Blows for 6 Inches
Required 6 Blows for 6 Inches
Required 7 Blows for 6 Inches

BORING ID NOTED AT THE TOP OF LOG
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SEE INDIVIDUAL LOG SHEETS FOR MORE DETAIL

Print Date: 8/17/2012
File Name: 18838-F-B-2-Engineering Geology.dgn
Horiz. Scale: 1:100 Vert. Scale: As Noted
Unit Information Unit Leader Initials

RockSol Consulting Group, Inc.
6510 W 91st Ave, Ste 130
Westminster, CO 80031
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Fax: 303-962-9350

R-X

Sheet Revisions

Date:	Comments	Init.

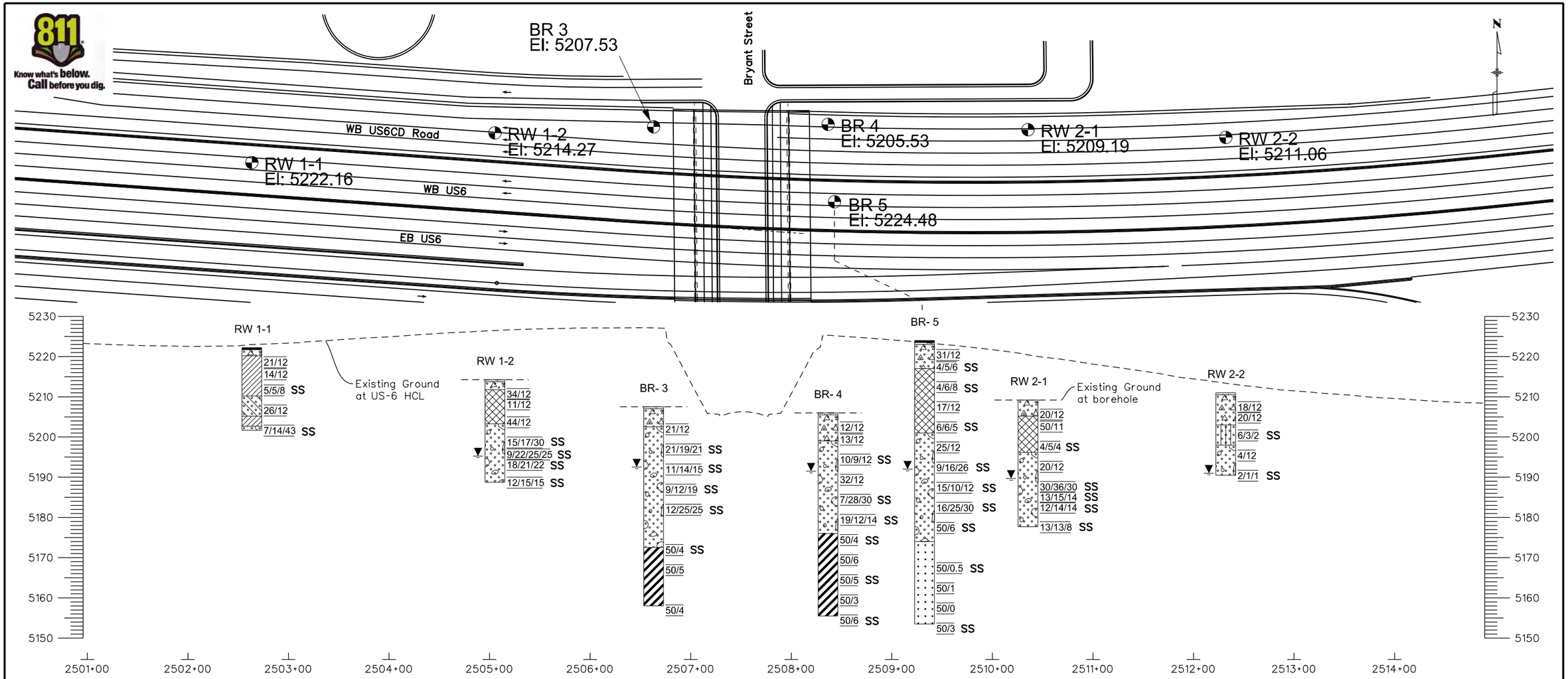
Colorado Department of Transportation
DEPARTMENT OF TRANSPORTATION
8833 South Wadsworth Court
Littleton, CO 80128
Phone: 303-972-9112 FAX: 303-972-9114
Region 6 MDP

As Constructed
No Revisions:
Revised:
Void:

ENGINEERING GEOLOGY
EB US6 at Bryant Street Structure

Designer: R. Lepro
Detailer: D. Knight
Sheet Subset:
Structure Numbers
Subset Sheets: 2 of 7

Project No./Code
US 6 BRIDGES
DESIGN BUILD PROJECT
18838
Figure B-2



BRYANT STREET STRUCTURE

Westbound US-6

SUMMARY OF TEST RESULTS

Sample ID	Depth (ft)	Liquid Limit	Plasticity Index	%< #200 Sieve	Classification USCS	Classification AASHTO	Water Content (%)	Dry Density (%)	Sulfate (%)
BR- 3	4						15.2	102.9	0.00
BR- 3	9	NP	NP	7	SW-SM	A-1-a (0)	3.8		
BR- 3	24	NP	NP	7	SP-SM	A-1-b (0)	12.2		
BR- 3	39						15.6	109.9	0.00
BR- 3	49	41	18	92	CL	A-7-6 (18)	14.7	120.7	
BR- 4	2						13.4	94.9	
BR- 4	5						9.7	125.0	0.00
BR- 4	10	NP	NP	5	SW-SM	A-1-a (0)	2.3		
BR- 4	15						11.8	125.4	
BR- 4	20	NP	NP	7	SP-SM	A-1-b (0)	11.6		
BR- 4	30	39	17	66	CL	A-6 (10)	19.7		
BR- 4	35						19.1	108.8	0.02
BR- 4	40	24	1	23	SM	A-2-4 (0)	17.6		
BR- 4	45						15.6	117.5	
BR- 4	50						22.8		
BR- 5	0	22	NP	12	GM	A-1-a (0)			0.00
BR- 5	2						4.7	122.9	
BR- 5	10	42	24	57	CL	A-7-6 (11)	21.4		
BR- 5	15						20.6	106.3	
BR- 5	20	32	12	55	CL	A-6 (4)	18.4		
BR- 5	35						11.8		
BR- 5	40	NP	NP	4	SW	A-1-b (0)	12.5		
BR- 5	60						18.4	112.0	
BR- 5	70						21.5		
RW 1-1	0	22	5	29	SC-SM	A-2-4 (0)			0.00
RW 1-1	2						24.6	97.1	
RW 1-1	9	46	29	72	CL	A-7-6 (19)	25.5		
RW 1-1	14						19.9	107.4	
RW 1-2	2						17.1	111.1	
RW 1-2	4	54	36	76	CH	A-7-6 (27)	28.3	91.6	0.17
RW 1-2	9								
RW 1-2	14	NP	NP	5	SW-SM	A-1-a (0)	1.8		
RW 1-2	19						5.6		
RW 1-2	24						11.7		
RW 2-1	0	35	18	33	SC	A-2-6 (1)			0.25
RW 2-1	2						22.2	99.7	
RW 2-1	5						3.6		
RW 2-1	10	52	31	73	CH	A-7-6 (22)	30.3		0.50
RW 2-1	20	NP	NP	6	SW-SM	A-1-a (0)	8.9		
RW 2-1	30						16.3		
RW 2-2	0	35	18	36	SC	A-6 (2)			0.00
RW 2-2	2						11.9	117.8	
RW 2-2	4						14.2	112.8	
RW 2-2	14	NP	NP	2	SP	A-1-b (0)	2.6		
RW 2-2	19						13.0		

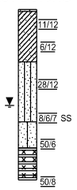
TYPE OF MATERIAL

- Fill - Aggregate Base Course
- Bedrock - CLAYSTONE
- Native - CLAY, silty
- Concrete
- Fill - SAND
- Bedrock - SANDSTONE
- USCS Clayey Sand
- Native - SAND, silty
- Native - SAND, gravelly
- Asphalt Pavement
- Native - CLAY
- Native - CLAY, sandy
- Fill - CLAY
- Native - SILT
- Native - SAND, clayey
- Bedrock - SILTSTONE
- Native - SAND
- Native - TOPSOIL

SEE INDIVIDUAL LOG SHEETS FOR ADDITIONAL DESCRIPTION OF MATERIAL ENCOUNTERED

LEGEND

TEST BORING



- BR Bridge Borehole
- RW Retaining Wall Borehole
- Ground Water Level At Time of Drilling
- 9/12 9 Blows for 12 Inches
- 50/3 50 Blows for 3 Inches
- 8/6/7 SS Split Spoon Sampler Required 8 Blows for 6 Inches Required 6 Blows for 6 Inches Required 7 Blows for 6 Inches

BORING ID NOTED AT THE TOP OF LOG
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SEE INDIVIDUAL LOG SHEETS FOR MORE DETAIL

Print Date: 8/17/2012
File Name: 18838-F-B-3-Engineering Geology.dgn
Horiz. Scale: 1:100 Vert. Scale: As Noted
Unit Information Unit Leader Initials

RockSol Consulting Group, Inc.
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R-X

Sheet Revisions		
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Colorado Department of Transportation
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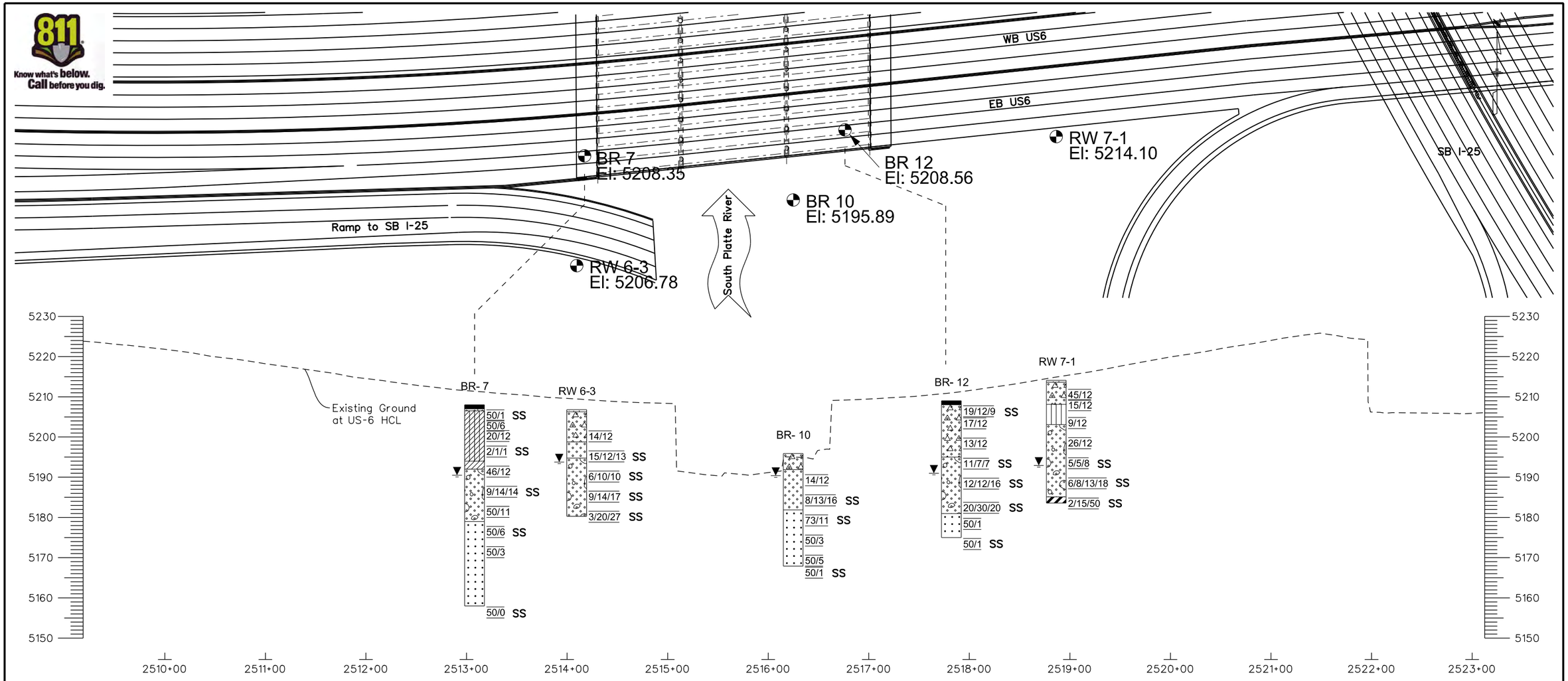
8833 South Wadsworth Court
Littleton, CO 80128
Phone: 303-972-9112 FAX: 303-972-9114
Region 6 MDP

As Constructed
No Revisions:
Revised:
Void:

ENGINEERING GEOLOGY
WB US6 at Bryant Street Structure

Designer: R. Lepro
Detailer: D. Knight
Sheet Subset:
Structure Numbers
Subset Sheets: 3 of 7

Project No./Code
US 6 BRIDGES
DESIGN BUILD PROJECT
18838
Figure B-3



SOUTH PLATTE RIVER STRUCTURE

Eastbound US-6

SUMMARY OF TEST RESULTS

Sample ID	Depth (ft)	Liquid Limit	Plasticity Index	%< #200 Sieve	Classification USCS	Classification AASHTO	Water Content (%)	Dry Density (%)	Sulfate (%)
BR- 7	2						2.7	129.9	
BR- 7	5						20.9		
BR- 7	10	47	4	23	SM	A-2-5 (0)	36.1		
BR- 7	15						2.0	117.1	
BR- 7	20	NP	NP	1	SP	A-1-b (0)	13.7		
BR- 7	25						11.4		
BR- 7	30	NP	NP	20	SM	A-2-4 (0)	20.3		
BR- 10	5						12.3	110.8	0.00
BR- 10	10	NP	NP	3	SW	A-1-b (0)	13.7		
BR- 10	15	NP	NP	41	SM	A-4 (0)	18.8		
BR- 10	20						15.0	113.7	
BR- 10	25	NP	NP	17	SM	A-2-4 (0)	15.1	116.9	
BR- 12	0	NP	NP	9	SW-SM	A-1-b (0)			0.00
BR- 12	1	NP	NP	11	SP-SM	A-1-b (0)	6.8		
BR- 12	4						5.1	113.2	

Sample ID	Depth (ft)	Liquid Limit	Plasticity Index	%< #200 Sieve	Classification USCS	Classification AASHTO	Water Content (%)	Dry Density (%)	Sulfate (%)
BR- 12	9	NP	NP	9	SW-SM	A-1-b (0)	3.4	127.9	
BR- 12	14						3.6		
BR- 12	19	NP	NP	4	SW	A-1-b (0)	11.7		
BR- 12	25						11.6		
BR- 12	29						11.6		
BR- 12	34						19.8		
RW 6-3	5	23	5	17	SC-SM	A-1-b (0)	7.0	106.3	0.00
RW 6-3	10	NP	NP	4	SW	A-1-a (0)	2.9		
RW 6-3	15	NP	NP	1	SP	A-1-a (0)	7.5		
RW 6-3	20						14.0		
RW 6-3	25						15.7		
RW 7-1	0	35	20	42	SC	A-6 (4)			0.00
RW 7-1	2						7.3	126.3	
RW 7-1	4						14.3	105.7	
RW 7-1	9	23	NP	54	ML	A-4 (0)	14.2	98.8	

Sample ID	Depth (ft)	Liquid Limit	Plasticity Index	%< #200 Sieve	Classification USCS	Classification AASHTO	Water Content (%)	Dry Density (%)	Sulfate (%)
RW 7-1	24	NP	NP	4	SW	A-1-b (0)			

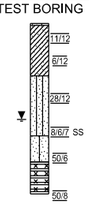
TYPE OF MATERIAL

- Fill - Aggregate Base Course
- Bedrock - CLAYSTONE
- Native - CLAY, silty
- Concrete
- Fill - SAND
- Bedrock - SANDSTONE
- USCS Clayey Sand
- Native - SAND, silty
- Native - SAND, gravelly
- Asphalt Pavement
- Native - CLAY
- Native - CLAY, sandy
- Fill - CLAY
- Native - SILT
- Native - SAND, clayey
- Bedrock - SILTSTONE
- Native - SAND
- Native - TOPSOIL

SEE INDIVIDUAL LOG SHEETS FOR ADDITIONAL DESCRIPTION OF MATERIAL ENCOUNTERED

LEGEND

TEST BORING



- BR Bridge Borehole
- RW Retaining Wall Borehole
- Ground Water Level At Time of Drilling
- 9/12 9 Blows for 12 Inches
- 50/3 50 Blows for 3 Inches
- 8/6/7 SS Split Spoon Sampler Required 8 Blows for 6 Inches Required 6 Blows for 6 Inches Required 7 Blows for 6 Inches

BORING ID NOTED AT THE TOP OF LOG
BLOW COUNTS OBTAINED WITH SPLIT SPOON SAMPLERS ARE NOTED WITH "SS". ALL OTHER BLOW COUNTS OBTAINED WITH A MODIFIED CALIFORNIA BARREL SAMPLER
SEE INDIVIDUAL LOG SHEETS FOR MORE DETAIL

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Sheet Revisions		
Date:	Comments	Init.

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Littleton, CO 80128
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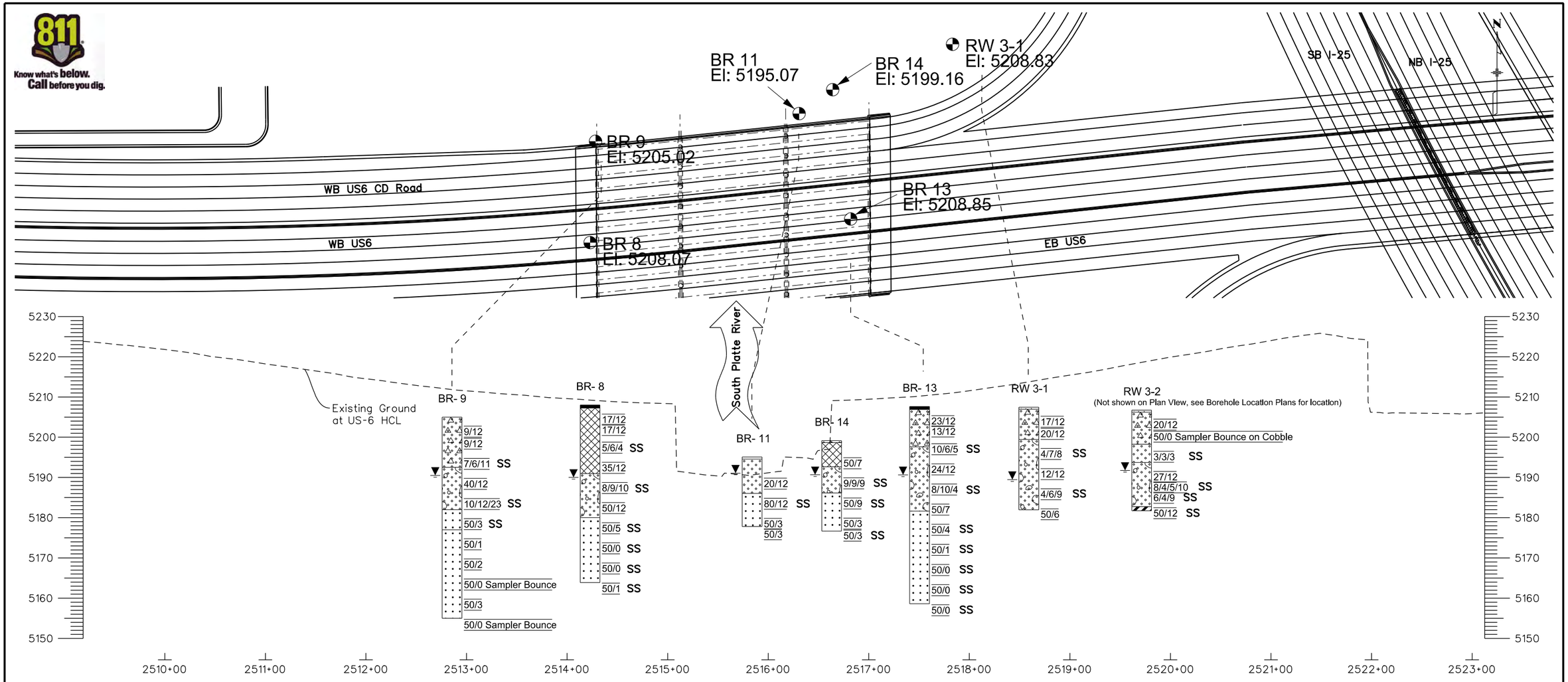
Region 6 MDP

As Constructed
No Revisions:
Revised:
Void:

ENGINEERING GEOLOGY
EB US6 at South Platte River

Designer: R. Lepro
Detailer: D. Knight
Sheet Subset:
Structure Numbers
Subset Sheets: 4 of 7

Project No./Code
US 6 BRIDGES
DESIGN BUILD PROJECT
18838
Figure B-4



SOUTH PLATTE RIVER STRUCTURE

Westbound US-6

SUMMARY OF TEST RESULTS

Sample ID	Depth (ft)	Liquid Limit	Plasticity Index	%< #200 Sieve	Classification USCS	Classification AASHTO	Water Content (%)	Dry Density (%)	Sulfate (%)
BR- 8	0	38	23	53	CL	A-6 (8)			0,03
BR- 8	2	25	10	68	CL	A-4 (4)	18,1	111,1	0,01
BR- 8	4						23,0	101,5	
BR- 8	14						2,4	128,1	
BR- 8	19						16,1		
BR- 8	24						10,5	130,4	
BR- 8	29						22,2		
BR- 9	2						15,1	114,4	
BR- 9	5						33,3	66,1	0,00
BR- 9	10	NP	NP	10	SP-SM	A-1-a (0)	5,7		
BR- 9	15	NP	NP	3	SW	A-1-b (0)	12,4	122,4	
BR- 9	20	NP	NP	4	SW	A-1-b (0)	11,8		
BR- 9	25	26	NP	32	SM	A-2-4 (0)	19,0		
BR- 9	30	42	13	30	SM	A-2-7 (0)	18,5	113,9	0,00
BR- 9	35						14,8	111,9	

Sample ID	Depth (ft)	Liquid Limit	Plasticity Index	%< #200 Sieve	Classification USCS	Classification AASHTO	Water Content (%)	Dry Density (%)	Sulfate (%)
BR- 9	40	NP	NP	36	SM	A-4 (0)	13,3	117,5	
BR- 9	45						15,0	123,2	
BR- 11	5	NP	NP	3	SW	A-1-b (0)	16,1	117,4	
BR- 11	10	40	6	34	SM	A-2-4 (0)	20,6		0,00
BR- 11	15						16,8	114,5	0,00
BR- 11	17	40	12	42	SM	A-6 (2)			
BR- 13	2						6,9	119,3	
BR- 13	4						12,0	117,4	
BR- 13	9	NP	NP	11	SW-SM	A-1-b (0)	4,5		
BR- 13	19	NP	NP	5	SW-SM	A-1-b (0)	12,6		
BR- 13	24						9,1	133,9	
BR- 13	29	34	10	25	SM	A-2-4 (0)	16,4		
BR- 14	4						12,6		0,00
BR- 14	9	NP	NP	4	SW	A-1-b (0)	12,0		
BR- 14	14	39	6	26	SM	A-2-4 (0)	20,9		

Sample ID	Depth (ft)	Liquid Limit	Plasticity Index	%< #200 Sieve	Classification USCS	Classification AASHTO	Water Content (%)	Dry Density (%)	Sulfate (%)
BR- 14	19						18,4	109,5	
BR- 14	22	39	10	43	SM	A-4 (2)	19,8		
RW 3-1	0	25	10	27	SC	A-2-4 (0)			0,00
RW 3-1	2	39	24	32	SC	A-2-6 (2)	13,2	114,8	
RW 3-1	5						9,6	108,8	0,00
RW 3-1	15						2,7	108,2	
RW 3-1	20			1	SP		6,6		
RW 3-1	25						8,8	129,2	
RW 3-2	2						15,0	118,0	
RW 3-2	5	25	9	14	SC	A-2-4 (0)	4,2		0,14
RW 3-2	10	NP	NP	10	SP-SM	A-3 (0)	6,5		
RW 3-2	15						2,1		
RW 3-2	16,5	NP	NP	5	SW	A-1-b (0)	11,6		
RW 3-2	20	NP	NP	2	SP	A-1-b (0)	16,7		
RW 3-2	25	51	26	74	CH	A-7-6 (19)	21,3		

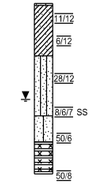
TYPE OF MATERIAL

- Fill - Aggregate Base Course
- Bedrock - CLAYSTONE
- Native - CLAY, silty
- Concrete
- Fill - SAND
- Bedrock - SANDSTONE
- USCS Clayey Sand
- Native - SAND, silty
- Native - SAND, gravelly
- Asphalt Pavement
- Native - CLAY
- Native - CLAY, sandy
- Fill - CLAY
- Native - SILT
- Native - SAND, clayey
- Bedrock - SILTSTONE
- Native - SAND
- Native - TOPSOIL

SEE INDIVIDUAL LOG SHEETS FOR ADDITIONAL DESCRIPTION OF MATERIAL ENCOUNTERED

LEGEND

TEST BORING



BR Bridge Borehole
RW Retaining Wall Borehole
Ground Water Level At Time of Drilling
9/12 9 Blows for 12 Inches
50/3 50 Blows for 3 Inches
8/6/7 SS Split Spoon Sampler
Required 8 Blows for 6 Inches
Required 6 Blows for 6 Inches
Required 7 Blows for 6 Inches

BORING ID NOTED AT THE TOP OF LOG
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SEE INDIVIDUAL LOG SHEETS FOR MORE DETAIL

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Date:	Comments	Init.

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Region 6 MDP

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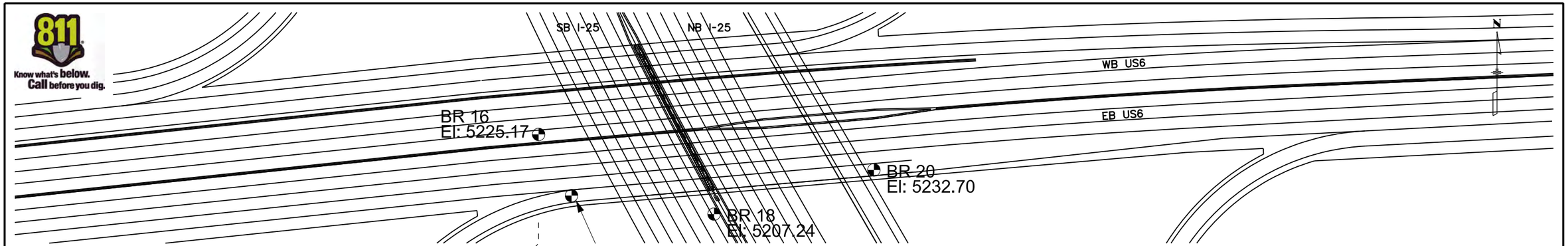
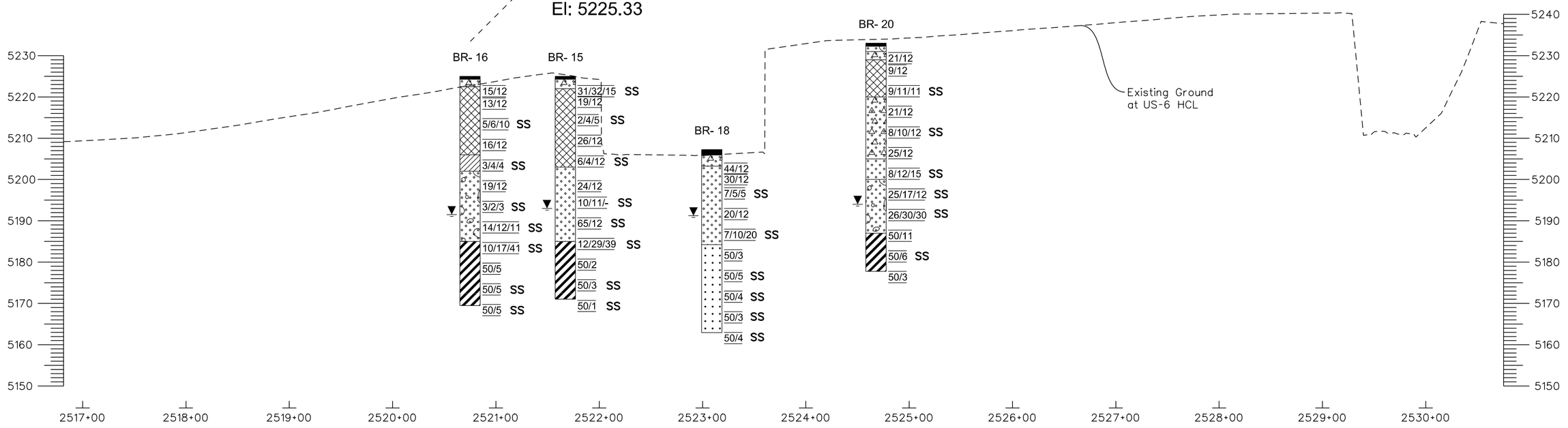
No Revisions:
Revised:
Void:

ENGINEERING GEOLOGY
WB US 6 at South Platte River

Designer: R. Lepro
Detailer: D. Knight
Sheet Subset:
Structure Numbers
Subset Sheets: 5 of 7

Project No./Code
US 6 BRIDGES
DESIGN BUILD PROJECT
18838
Figure B-5





I-25 STRUCTURE

Eastbound US-6

SUMMARY OF TEST RESULTS

Sample ID	Depth (ft)	Liquid Limit	Plasticity Index	%< #200 Sieve	Classification USCS	Classification AASHTO	Water Content (%)	Dry Density (%)	Sulfate (%)
BR- 15	0	NP	NP	17	SM	A-1-b (0)			0.00
BR- 15	1	NP	NP	7	GW-GM	A-1-a (0)	8.1		
BR- 15	4						10.7	116.0	
BR- 15	9						16.9		
BR- 15	14	30	16	49	SC	A-6 (4)	16.4	114.6	
BR- 15	19						13.8		
BR- 15	25	NP	NP	2	SP	A-1-b (0)	1.5	88.7	
BR- 15	29						8.1		
BR- 15	34	NP	NP	5	SW	A-1-b (0)	10.9		
BR- 15	39						12.2		
BR- 15	44						19.6	109.6	
BR- 15	49						19.0		
BR- 15	54						21.7		
BR- 16	0	25	9	14	SC	A-2-4 (0)			0.00
BR- 16	2						17.1	117.2	

Sample ID	Depth (ft)	Liquid Limit	Plasticity Index	%< #200 Sieve	Classification USCS	Classification AASHTO	Water Content (%)	Dry Density (%)	Sulfate (%)
BR- 16	5						20.8	110.2	
BR- 16	10						16.3		
BR- 16	15						15.8	115.9	
BR- 16	20						17.1		
BR- 16	25	NP	NP	0	SP	A-1-b (0)	1.4	111.3	
BR- 16	35						15.0		
BR- 16	40						22.0		
BR- 16	45						15.0	114.0	
BR- 16	50	41	21	79	CL	A-7-6 (16)	19.4		
BR- 16	55						21.4		
BR- 18	0	NP	NP	8	SW-SM	A-1-b (0)			0.00
BR- 18	2						12.3	123.3	
BR- 18	5						1.6		
BR- 18	9	NP	NP	1	SP	A-1-a (0)	1.0		
BR- 18	14						12.1	117.6	

Sample ID	Depth (ft)	Liquid Limit	Plasticity Index	%< #200 Sieve	Classification USCS	Classification AASHTO	Water Content (%)	Dry Density (%)	Sulfate (%)
BR- 18	24						18.4	94.3	
BR- 18	29						15.4		
BR- 18	34	34	14	70	CL	A-6 (8)	21.6		0.00
BR- 18	39						20.2		
BR- 18	44						20.7		
BR- 20	0	NP	NP	19	SM	A-1-b (0)			0.00
BR- 20	2						10.5	117.2	
BR- 20	5						19.1	106.8	
BR- 20	10						14.9		
BR- 20	15	29	16	46	SC	A-6 (3)	16.2	113.3	
BR- 20	20						18.2		
BR- 20	25	29	15	43	SC	A-6 (3)	14.1	116.8	
BR- 20	35	NP	NP	5	SW-SM	A-1-a (0)	3.1		
BR- 20	40						11.7		
BR- 20	50	50	28	93	CH	A-7-6 (29)	21.6		0.00

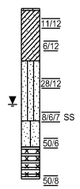
TYPE OF MATERIAL

- Fill - Aggregate Base Course
- Bedrock - CLAYSTONE
- Native - CLAY, silty
- Concrete
- Fill - SAND
- Bedrock - SANDSTONE
- USCS Clayey Sand
- Native - SAND, silty
- Native - SAND, gravelly
- Asphalt Pavement
- Native - CLAY
- Native - CLAY, sandy
- Fill - CLAY
- Native - SILT
- Native - SAND, clayey
- Bedrock - SILTSTONE
- Native - SAND
- Native - TOPSOIL

SEE INDIVIDUAL LOG SHEETS FOR ADDITIONAL DESCRIPTION OF MATERIAL ENCOUNTERED

LEGEND

TEST BORING



BR Bridge Borehole

Ground Water Level At Time of Drilling

9/12 9 Blows for 12 Inches

50/3 50 Blows for 3 Inches

8/6/7 SS Split Spoon Sampler
Required 8 Blows for 6 Inches
Required 6 Blows for 6 Inches
Required 7 Blows for 6 Inches

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6510 W 91st Ave, Ste 130
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Fax: 303-962-9350

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Date:	Comments	Init.

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8833 South Wadsworth Court
Littleton, CO 80128
Phone: 303-972-9112 FAX: 303-972-9114
Region 6 MDP

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Revised:
Void:

ENGINEERING GEOLOGY
EB US 6 at I-25

Designer: R. Lepro
Detailer: D. Knight
Sheet Subset:
Structure Numbers
Subset Sheets: 6 of 7

Project No./Code
US 6 BRIDGES DESIGN BUILD PROJECT
18838
Sheet Number B-6

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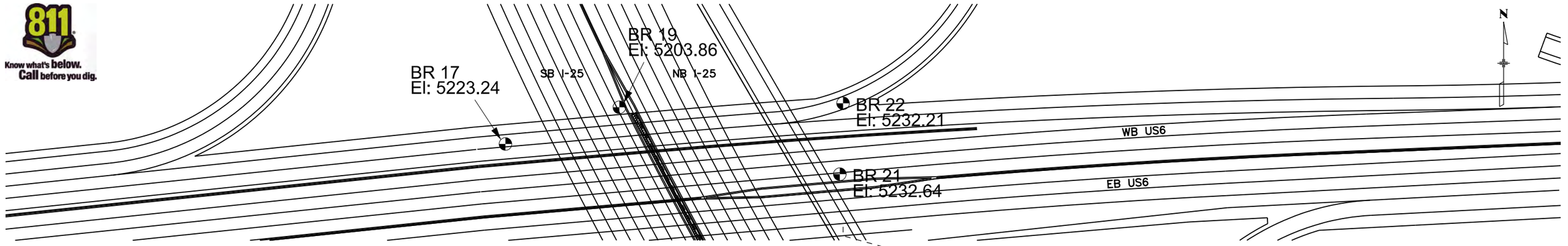
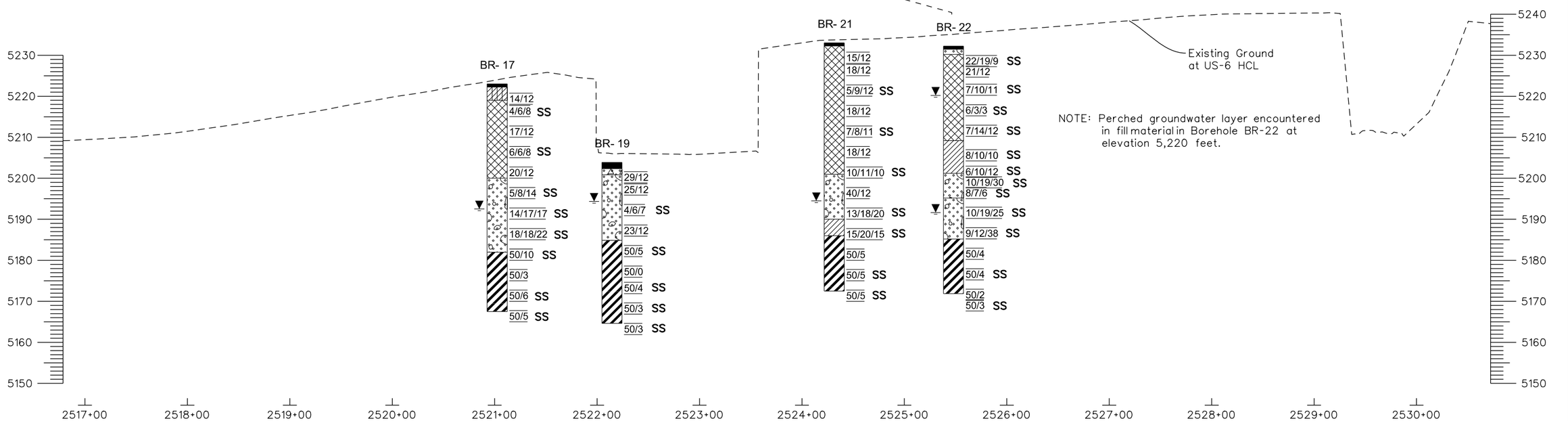




I-25 STRUCTURE
Westbound US-6

SUMMARY OF TEST RESULTS

Sample ID	Depth (ft)	Liquid Limit	Plasticity Index	%< #200 Sieve	Classification USCS	Classification AASHTO	Water Content (%)	Dry Density (%)	Sulfate (%)
BR- 17	0	NP	NP	9	GP-GM	A-1-a (0)			0.00
BR- 17	2						16.1		
BR- 17	5	37	22	53	CL	A-6 (8)	15.4		
BR- 17	10						16.9	113.0	
BR- 17	15	27	12	43	SC	A-6 (2)	13.3		
BR- 17	20						20.8	102.9	
BR- 17	30	NP	NP	3	SP	A-1-a (0)	8.1		
BR- 17	35						20.7		
BR- 17	40						17.7		
BR- 17	45						14.1	118.4	0.00
BR- 17	50	39	18	92	CL	A-6 (17)	18.4		
BR- 19	0	17	NP	9	SW-SM	A-1-a (0)			0.00
BR- 19	2						15.1	117.6	
BR- 19	5	NP	NP	2	SW	A-1-b (0)	1.5	98.1	
BR- 19	10						6.1		
BR- 19	15	NP	NP	2	SP	A-1-b (0)	15.3	114.2	
BR- 19	20						23.1		
BR- 19	29	41	22	63	CL	A-7-6 (12)	17.5		
BR- 19	34						19.5		
BR- 19	39						20.6		
BR- 21	0	30	15	44	SC	A-6 (3)			0.00
BR- 21	2						20.3	104.3	
BR- 21	5						30.5	103.0	
BR- 21	10						13.8		
BR- 21	15						14.8	122.1	
BR- 21	20	42	27	59	CL	A-7-6 (13)	16.4		
BR- 21	25						16.2	113.8	
BR- 21	30						2.8		
BR- 21	35	NP	NP	5	SP	A-1-a (0)	4.2	129.4	
BR- 21	45						19.9		
BR- 21	50						15.0	120.7	
BR- 21	55	38	13	66	ML	A-6 (7)	17.2		
BR- 21	60						17.6		
BR- 22	0	NP	NP	42	SM	A-4 (0)			0.00
BR- 22	1						7.1		
BR- 22	4						16.1	112.9	
BR- 22	14	31	15	54	CL	A-6 (5)	22.2		0.12
BR- 22	19						17.3		
BR- 22	25						19.5		
BR- 22	29						19.3		
BR- 22	30.5						15.5		
BR- 22	34	NP	NP	4	SP	A-1-b (0)	3.1		
BR- 22	39	NP	NP	5	SW	A-1-a (0)	8.2		
BR- 22	49						15.0	128.4	0.04
BR- 22	54	40	18	69	CL	A-6 (11)	19.6		

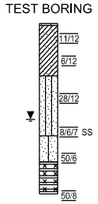
TYPE OF MATERIAL

- Fill - Aggregate Base Course
- Bedrock - CLAYSTONE
- Native - CLAY, silty
- Concrete
- Fill - SAND
- Bedrock - SANDSTONE
- USCS Clayey Sand
- Native - SAND, silty
- Native - SAND, gravelly
- Asphalt Pavement
- Native - CLAY
- Native - CLAY, sandy
- Fill - CLAY
- Native - SILT
- Native - SAND, clayey
- Bedrock - SILTSTONE
- Native - SAND
- Native - TOPSOIL

SEE INDIVIDUAL LOG SHEETS FOR ADDITIONAL DESCRIPTION OF MATERIAL ENCOUNTERED

LEGEND

TEST BORING



BR Bridge Borehole
Ground Water Level At Time of Drilling
9/12 9 Blows for 12 Inches
50/3 50 Blows for 3 Inches
8/6/7 SS Split Spoon Sampler
Required 8 Blows for 6 Inches
Required 6 Blows for 6 Inches
Required 7 Blows for 6 Inches

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Sheet Revisions		
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Region 6 MDP

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No Revisions:
Revised:
Void:

ENGINEERING GEOLOGY
WB US 6 at I-25

Designer: R. Lepro
Detailer: D. Knight
Sheet Subset:
Structure Numbers
Subset Sheets: 7 of 7

Project No./Code
US 6 BRIDGES DESIGN BUILD PROJECT
18838
Figure B-7

APPENDIX C

LABORATORY TEST RESULTS

RockSol Consulting Group, Inc.

SUMMARY OF PHYSICAL & CHEMICAL TEST RESULTS

CLIENT Hartwig and Associates

PROJECT NAME US6 Bridges Design Build Project

PROJECT NUMBER 280.01

PROJECT LOCATION Denver, 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
BR- 1	4	28	17	11	-0.4	92	CL	A-6 (9)	35.5	88.2								
BR- 1	9								2.0									
BR- 1	14	NP	NP	NP		5	SW	A-1-b (0)	10.8									
BR- 1	19								12.4									
BR- 1	24								12.4									
BR- 1	34	34	28	6		48	SM	A-4 (1)	18.3	109.0								
BR- 1	39	44	18	26		84	CL	A-7-6 (22)	19.6	104.8								
BR- 1	43								20.8									
BR- 2	10"-5'	27	15	12		28	SC	A-2-6 (0)				0.00						
BR- 2	1								6.4									
BR- 2	5				0.0				21.0	100.2								
BR- 2	9				0.0				21.0	98.8		0.00						
BR- 2	14				-0.2				19.9	103.0								
BR- 2	19								20.9	103.3								
BR- 2	24								26.7	95.0								
BR- 2	34	NP	NP	NP		6	SP-SM	A-1-b (0)	10.9									
BR- 2	44	NP	NP	NP		6	SP-SM	A-1-b (0)	13.5									
BR- 2	49								10.7									
BR- 2	54	30	18	12		22	SC	A-2-6 (0)	13.9									
BR- 2	59								20.9			0.00						
BR- 3	4								15.2	102.9		0.00						
BR- 3	9	NP	NP	NP		7	SW-SM	A-1-a (0)	3.8									
BR- 3	14								9.0									
BR- 3	19								12.4									
BR- 3	24	NP	NP	NP		7	SP-SM	A-1-b (0)	12.2									
BR- 3	34								12.3									
BR- 3	39								15.6	109.9		0.00						
BR- 3	49	41	23	18		92	CL	A-7-6 (18)	14.7	120.7								
BR- 4	2								13.4	94.9								
BR- 4	5								9.7	125.0		0.00						

RockSol Consulting Group, Inc.

SUMMARY OF PHYSICAL & CHEMICAL TEST RESULTS

CLIENT Hartwig and Associates

PROJECT NAME US6 Bridges Design Build Project

PROJECT NUMBER 280.01

PROJECT LOCATION Denver, 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
BR- 4	10	NP	NP	NP		5	SW-SM	A-1-a (0)	2.3									
BR- 4	15								11.8	125.4								
BR- 4	20	NP	NP	NP		7	SP-SM	A-1-b (0)	11.6									
BR- 4	25								14.1									
BR- 4	30	39	22	17		66	CL	A-6 (10)	19.7									
BR- 4	35								19.1	108.8		0.02						
BR- 4	40	24	23	1		23	SM	A-2-4 (0)	17.6									
BR- 4	45								15.6	117.5								
BR- 4	50								22.8									
BR- 5	14"-5'	22	22	NP		12	GM	A-1-a (0)				0.00						
BR- 5	2								4.7	122.9								
BR- 5	5								11.4									
BR- 5	10	42	18	24		57	CL	A-7-6 (11)	21.4									
BR- 5	15								20.6	106.3								
BR- 5	20	32	20	12		55	CL	A-6 (4)	18.4									
BR- 5	25								2.1									
BR- 5	30								2.9									
BR- 5	35								11.8									
BR- 5	40	NP	NP	NP		4	SW	A-1-b (0)	12.5									
BR- 5	45								22.4									
BR- 5	55								18.0									
BR- 5	60								18.4	112.0								
BR- 5	70								21.5									
BR- 6	0-5'	20	18	2		21	SM	A-1-b (0)				0.00						
BR- 6	2								15.4	112.6								
BR- 6	5	NP	NP	NP		3	GW	A-1-a (0)	2.3	113.0								
BR- 6	10								2.6									
BR- 6	15								12.1									
BR- 6	20								14.1			0.00						
BR- 6	25								11.0									

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							USCS	AASHTO								MDD	OMC	S/M
BR- 6	30								10.0									
BR- 6	35	36	21	15		43	SC	A-6 (3)	16.6									
BR- 6	40	24	22	2		38	SM	A-4 (0)	14.5									
BR- 6	45								12.5	120.6		0.00						
BR- 6	50								19.5	105.2								
BR- 6	55								19.6	108.2								
BR- 7	2								2.7	129.9								
BR- 7	5								20.9									
BR- 7	10	47	43	4		23	SM	A-2-5 (0)	36.1									
BR- 7	15								2.0	117.1								
BR- 7	20	NP	NP	NP		1	SP	A-1-b (0)	13.7									
BR- 7	25								11.4									
BR- 7	30	NP	NP	NP		20	SM	A-2-4 (0)	20.3									
BR- 8	9"-10'	38	15	23		53	CL	A-6 (8)				0.03	470 Omhs-cm @ 24.6 %	7.8	0.0313%	112.7	16.0	S
BR- 8	2	25	15	10	-0.1	68	CL	A-4 (4)	18.1	111.1		0.01						
BR- 8	4				0.2				23.0	101.5								
BR- 8	9								4.3									
BR- 8	14								2.4	128.1								
BR- 8	19								16.1									
BR- 8	24								10.5	130.4								
BR- 8	29								22.2									
BR- 8	44								21.1									
BR- 9	2								15.1	114.4								
BR- 9	5								33.3	66.1		0.00						
BR- 9	10	NP	NP	NP		10	SP-SM	A-1-a (0)	5.7									
BR- 9	15	NP	NP	NP		3	SW	A-1-b (0)	12.4	122.4								
BR- 9	20	NP	NP	NP		4	SW	A-1-b (0)	11.8									
BR- 9	25	26	28	NP		32	SM	A-2-4 (0)	19.0									
BR- 9	30	42	29	13		30	SM	A-2-7 (0)	18.5	113.9		0.00						
BR- 9	35								14.8	111.9								

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							USCS	AASHTO								MDD	OMC	S/M
BR- 9	40	NP	NP	NP		36	SM	A-4 (0)	13.3	117.5								
BR- 9	45								15.0	123.2								
BR- 10	5								12.3	110.8		0.00						
BR- 10	10	NP	NP	NP		3	SW	A-1-b (0)	13.7									
BR- 10	15	NP	NP	NP		41	SM	A-4 (0)	18.8									
BR- 10	20								15.0	113.7								
BR- 10	25	NP	NP	NP		17	SM	A-2-4 (0)	15.1	116.9								
BR- 11	5	NP	NP	NP		3	SW	A-1-b (0)	16.1	117.4								
BR- 11	10	40	34	6		34	SM	A-2-4 (0)	20.6			0.00						
BR- 11	15								16.8	114.5		0.00						
BR- 11	17	40	28	12		42	SM	A-6 (2)										
BR- 12	13"-5'	NP	NP	NP		9	SW-SM	A-1-b (0)				0.00	200 Ohms-cm @ 16.7	7.8	0.03			
BR- 12	1	NP	NP	NP		11	SP-SM	A-1-b (0)	6.8									
BR- 12	4								5.1	113.2								
BR- 12	9	NP	NP	NP		9	SW-SM	A-1-b (0)	3.4	127.9								
BR- 12	14								3.6									
BR- 12	19	NP	NP	NP		4	SW	A-1-b (0)	11.7									
BR- 12	25								11.6									
BR- 12	29								11.6									
BR- 12	34								19.8									
BR- 13	2				-1.0				6.9	119.3								
BR- 13	4								12.0	117.4								
BR- 13	9	NP	NP	NP		11	SW-SM	A-1-b (0)	4.5									
BR- 13	14								3.0									
BR- 13	19	NP	NP	NP		5	SW-SM	A-1-b (0)	12.6									
BR- 13	24								9.1	133.9								
BR- 13	29	34	24	10		25	SM	A-2-4 (0)	16.4									
BR- 14	4								12.6			0.00						
BR- 14	9	NP	NP	NP		4	SW	A-1-b (0)	12.0									
BR- 14	14	39	33	6		26	SM	A-2-4 (0)	20.9									

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SUMMARY OF PHYSICAL & CHEMICAL TEST RESULTS

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PROJECT LOCATION Denver, Colorado

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							USCS	AASHTO								MDD	OMC	S/M
BR- 14	19								18.4	109.5								
BR- 14	22	39	29	10		43	SM	A-4 (2)	19.8									
BR- 15	8.5"-5'	NP	NP	NP		17	SM	A-1-b (0)				0.00						
BR- 15	1	NP	NP	NP		7	GW-GM	A-1-a (0)	8.1									
BR- 15	4				0.2				10.7	116.0								
BR- 15	9								16.9									
BR- 15	14	30	14	16		49	SC	A-6 (4)	16.4	114.6								
BR- 15	19								13.8									
BR- 15	25	NP	NP	NP		2	SP	A-1-b (0)	1.5	88.7								
BR- 15	29								8.1									
BR- 15	34	NP	NP	NP		5	SW	A-1-b (0)	10.9									
BR- 15	39								12.2									
BR- 15	44								19.6	109.6								
BR- 15	49								19.0									
BR- 15	54								21.7									
BR- 16	8"-5'	25	16	9		14	SC	A-2-4 (0)				0.00						
BR- 16	2				1.2				17.1	117.2								
BR- 16	5				0.4				20.8	110.2								
BR- 16	10								16.3									
BR- 16	15								15.8	115.9								
BR- 16	20								17.1									
BR- 16	25	NP	NP	NP		0	SP	A-1-b (0)	1.4	111.3								
BR- 16	35								15.0									
BR- 16	40								22.0									
BR- 16	45								15.0	114.0	64.7							
BR- 16	50	41	20	21		79	CL	A-7-6 (16)	19.4									
BR- 16	55								21.4									
BR- 17	9"-5'	NP	NP	NP		9	GP-GM	A-1-a (0)				0.00						
BR- 17	2								16.1									
BR- 17	5	37	15	22		53	CL	A-6 (8)	15.4									

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							USCS	AASHTO								MDD	OMC	S/M
BR- 17	10								16.9	113.0								
BR- 17	15	27	15	12		43	SC	A-6 (2)	13.3									
BR- 17	20								20.8	102.9								
BR- 17	25								1.3									
BR- 17	30	NP	NP	NP		3	SP	A-1-a (0)	8.1									
BR- 17	35								20.7									
BR- 17	40								17.7									
BR- 17	45								14.1	118.4		0.00						
BR- 17	50	39	21	18		92	CL	A-6 (17)	18.4									
BR- 18	16"-5'	NP	NP	NP		8	SW-SM	A-1-b (0)				0.00						
BR- 18	2								12.3	123.3								
BR- 18	5								1.6									
BR- 18	9	NP	NP	NP		1	SP	A-1-a (0)	1.0									
BR- 18	14								12.1	117.6								
BR- 18	19								12.1									
BR- 18	24								18.4	94.3								
BR- 18	29								15.4									
BR- 18	34	34	20	14		70	CL	A-6 (8)	21.6			0.00						
BR- 18	39								20.2									
BR- 18	44								20.7									
BR- 19	16"-5'	17	18	NP		9	SW-SM	A-1-a (0)				0.00						
BR- 19	2								15.1	117.6								
BR- 19	5	NP	NP	NP		2	SW	A-1-b (0)	1.5	98.1								
BR- 19	10								6.1									
BR- 19	15	NP	NP	NP		2	SP	A-1-b (0)	15.3	114.2								
BR- 19	20								23.1									
BR- 19	29	41	19	22		63	CL	A-7-6 (12)	17.5									
BR- 19	34								19.5									
BR- 19	39								20.6									
BR- 20	0	NP	NP	NP		19	SM	A-1-b (0)				0.00						

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							USCS	AASHTO								MDD	OMC	S/M
BR- 20	2								10.5	117.2								
BR- 20	5				0.4				19.1	106.8								
BR- 20	10								14.9									
BR- 20	15	29	13	16		46	SC	A-6 (3)	16.2	113.3								
BR- 20	20								18.2									
BR- 20	25	29	14	15		43	SC	A-6 (3)	14.1	116.8								
BR- 20	30								2.2									
BR- 20	35	NP	NP	NP		5	SW-SM	A-1-a (0)	3.1									
BR- 20	40								11.7									
BR- 20	50	50	22	28		93	CH	A-7-6 (29)	21.6			0.00						
BR- 21	7"-5'	30	15	15		44	SC	A-6 (3)				0.00	320 ohms-cm @ 23.3	7.7	0.0871%			
BR- 21	2				0.2				20.3	104.3								
BR- 21	5				-0.1				30.5	103.0								
BR- 21	10								13.8									
BR- 21	15								14.8	122.1								
BR- 21	20	42	15	27		59	CL	A-7-6 (13)	16.4									
BR- 21	25								16.2	113.8								
BR- 21	30								2.8									
BR- 21	35	NP	NP	NP		5	SP	A-1-a (0)	4.2	129.4								
BR- 21	40								13.4									
BR- 21	45								19.9									
BR- 21	50								15.0	120.7	99.7							
BR- 21	55	38	25	13		66	ML	A-6 (7)	17.2									
BR- 21	60								17.6									
BR- 22	8.5"-5'	NP	NP	NP		42	SM	A-4 (0)				0.00				122.5	10.1	S
BR- 22	1								7.1									
BR- 22	4				0.2				16.1	112.9								
BR- 22	14	31	16	15		54	CL	A-6 (5)	22.2			0.12						
BR- 22	19								17.3									
BR- 22	25								19.5									

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							USCS	AASHTO								MDD	OMC	S/M
BR- 22	29								19.3									
BR- 22	30.5								15.5									
BR- 22	34	NP	NP	NP		4	SP	A-1-b (0)	3.1									
BR- 22	39	NP	NP	NP		5	SW	A-1-a (0)	8.2									
BR- 22	49								15.0	128.4	43.0	0.04						
BR- 22	54	40	22	18		69	CL	A-6 (11)	19.6									
BR- 23	4				5.2				14.0	115.2		0.00						
BR- 23	9								20.6	106.9								
BR- 23	14				2.9				25.6	98.2								
BR- 23	19	36	21	15		31	SC	A-2-6 (1)	18.0	106.7								
BR- 23	24								21.6	103.2								
BR- 23	29								19.7	106.2	111.8							
BR- 23	34	48	17	31		82	CL	A-7-6 (25)	15.4			0.00						
BR- 23	39				-0.4				14.3	98.9								
BR- 24	4				1.9				22.0	98.8								
BR- 24	9								21.3	106.2								
BR- 24	14	48	11	37		75	CL	A-7-6 (26)	25.6	99.9								
BR- 24	19				0.2				30.5	94.2		0.00						
BR- 24	24								18.0	96.7								
BR- 24	29				4.2				16.9	114.7								
BR- 24	34	49	23	26		99	CL	A-7-6 (29)	17.4	111.1	136.8							
BR- 24	39				5.6				12.8	124.0								
BR- 25	2				2.9				21.3	105.7								
BR- 25	4	45	12	33		72	CL	A-7-6 (21)	22.6	103.8								
BR- 25	9								22.8	102.5								
BR- 25	15	40	23	17		54	CL	A-6 (7)	20.6			0.00						
BR- 25	19				0.2				15.9	115.0								
BR- 25	24								25.4									
BR- 25	29								15.8	114.3	98.0							
BR- 26	2								9.6	110.5								

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							USCS	AASHTO								MDD	OMC	S/M
BR- 26	5	53	18	35		88	CH	A-7-6 (32)	15.8	107.4		0.01						
BR- 26	10				6.1				16.1	103.0								
BR- 26	15								19.5	92.9								
BR- 26	20	41	18	23		63	CL	A-7-6 (12)	25.9	99.7		0.00						
BR- 26	25								26.5	99.6								
BR- 26	30								25.1	101.1								
BR- 26	35								28.6	99.9								
BR- 26	40	65	20	45		79	CH	A-7-6 (37)	28.8	95.4		0.00						
BR- 26	45								24.7	100.3								
BR- 26	50								30.1	95.7								
BR- 26	55								30.7	91.7								
BR- 26	60								25.1	98.7								
BR- 26	65								9.5	127.6								
BR- 26	70								9.8									
BR- 26	75	NP	NP	NP		8	SP-SM	A-1-b (0)	9.2			0.00						
BR- 26	80								7.4									
BR- 26	85								19.4									
BR- 26	90	52	29	23		91	MH	A-7-6 (24)	19.7			0.00						
BR- 26	95								13.5	116.9	84.6							
BR- 27	2				2.6				24.1	100.9								
BR- 27	5				0.5				39.6	89.4								
BR- 27	10								24.7	102.2								
BR- 27	15	69	20	49		94	CH	A-7-6 (51)	32.3			0.00						
BR- 27	20								29.2	94.3								
BR- 27	25								35.4									
BR- 27	30	NP	NP	NP		2	SP	A-1-a (0)	1.4	114.0								
BR- 27	35								9.6									
BR- 27	40								13.2									
BR- 27	45	NP	NP	NP		4	SW	A-1-b (0)	10.7									
BR- 27	50								10.0									

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							USCS	AASHTO								MDD	OMC	S/M
BR- 27	55								21.7									
BR- 27	55.1								10.1									
BR- 27	60								14.8	121.6		0.00						
BR- 27	65	48	27	21		97	CL	A-7-6 (24)	19.1	107.5								
BR- 27	70								18.1	112.1								
RW 1-1	6"-5'	22	17	5		29	SC-SM	A-2-4 (0)				0.00						
RW 1-1	2				0.6				24.6	97.1								
RW 1-1	5				-0.1				24.2	99.5								
RW 1-1	9	46	17	29		72	CL	A-7-6 (19)	25.5									
RW 1-1	14								19.9	107.4								
RW 1-1	19								15.7									
RW 1-2	2				2.3				17.1	111.1								
RW 1-2	4	54	18	36		76	CH	A-7-6 (27)	28.3	91.6		0.17						
RW 1-2	9								25.4	96.8								
RW 1-2	14	NP	NP	NP		5	SW-SM	A-1-a (0)	1.8									
RW 1-2	17								4.8									
RW 1-2	19								5.6									
RW 1-2	24								11.7									
RW 2-1	0-5'	35	17	18		33	SC	A-2-6 (1)				0.25	420 Ohms-cm @ 26.5%	7.8	0.0433%			
RW 2-1	2				0.2				22.2	99.7								
RW 2-1	5								3.6									
RW 2-1	10	52	21	31		73	CH	A-7-6 (22)	30.3			0.50						
RW 2-1	15								2.6									
RW 2-1	20	NP	NP	NP		6	SW-SM	A-1-a (0)	8.9									
RW 2-1	21.5								11.3									
RW 2-1	25								13.7									
RW 2-1	30								16.3									
RW 2-2	0-5'	35	17	18		36	SC	A-6 (2)				0.00						
RW 2-2	2				-0.2				11.9	117.8								
RW 2-2	4				-0.1				14.2	112.8								

RockSol Consulting Group, Inc.

SUMMARY OF PHYSICAL & CHEMICAL TEST RESULTS

CLIENT Hartwig and Associates

PROJECT NAME US6 Bridges Design Build Project

PROJECT NUMBER 280.01

PROJECT LOCATION Denver, 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
RW 2-2	9					38			16.3									
RW 2-2	14	NP	NP	NP		2	SP	A-1-b (0)	2.6									
RW 2-2	19								13.0									
RW 3-1	0-5'	25	15	10		27	SC	A-2-4 (0)				0.00	1800 Ohms-cm @ 18.5%	8.4	0.00			
RW 3-1	2	39	15	24		32	SC	A-2-6 (2)	13.2	114.8								
RW 3-1	5								9.6	108.8		0.00		8.1				
RW 3-1	10								3.1									
RW 3-1	15								2.7	108.2								
RW 3-1	20					1	SP		6.6									
RW 3-1	25								8.8	129.2								
RW 3-2	2				-0.1				15.0	118.0								
RW 3-2	5	25	16	9		14	SC	A-2-4 (0)	4.2			0.14		7.4				
RW 3-2	10	NP	NP	NP		10	SP-SM	A-3 (0)	6.5									
RW 3-2	15								2.1									
RW 3-2	16.5	NP	NP	NP		5	SW	A-1-b (0)	11.6									
RW 3-2	20	NP	NP	NP		2	SP	A-1-b (0)	16.7									
RW 3-2	25	51	25	26		74	CH	A-7-6 (19)	21.3									
RW 4-1	8"-5'	NP	NP	NP		17	SM	A-1-b (0)				0.00						
RW 4-1	2				0.2				22.8	101.1								
RW 4-1	4				-0.1				22.5	99.2								
RW 4-1	9	43	20	23		69	CL	A-7-6 (14)	23.5									
RW 4-1	14								20.9	107.7								
RW 4-1	19								16.6									
RW 4-2	8"-5'	NP	NP	NP		28	SM	A-2-4 (0)				0.00						
RW 4-2	2				0.6				26.5	98.8								
RW 4-2	4				0.1				24.8	98.6								
RW 4-2	9	40	18	22		57	CL	A-6 (9)	22.8									
RW 4-2	14	59	23	36		78	CH	A-7-6 (29)	26.9	83.4								
RW 4-2	19	NP	NP	NP		3	SP	A-1-a (0)	2.3									
RW 4-3	20"-5'	NP	NP	NP		14	SM	A-1-b (0)				0.00						

RockSol Consulting Group, Inc.

SUMMARY OF PHYSICAL & CHEMICAL TEST RESULTS

CLIENT Hartwig and Associates

PROJECT NAME US6 Bridges Design Build Project

PROJECT NUMBER 280.01

PROJECT LOCATION Denver, 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
RW 4-3	2								3.7	132.5								
RW 4-3	4				0.3				21.6	105.2								
RW 4-3	9	45	18	27		61	CL	A-7-6 (14)	22.5									
RW 4-3	14	NP	NP	NP		4	SP	A-1-b (0)	2.1									
RW 4-3	19								1.7									
RW 5-1	2								2.7									
RW 5-1	4	34	17	17	0.4	49	SC	A-6 (5)	20.4	108.7								
RW 5-1	9				0.1				19.5	109.5		0.00						
RW 5-1	14	47	16	31		69	CL	A-7-6 (19)	24.4									
RW 5-1	19								8.4	93.9								
RW 5-1	24								3.0									
RW 5-1	29								14.6									
RW 5-1	34								12.2									
RW 5-2	1'-5'	20	20	NP		14	SM	A-1-b (0)				0.00						
RW 5-2	2								13.3	114.3		0.04						
RW 5-2	4								16.1	116.3								
RW 5-2	9	38	20	18		70	CL	A-6 (11)	21.6									
RW 5-2	14				-0.1				18.7	107.6								
RW 5-2	19	50	17	33		71	CH	A-7-6 (22)	25.4									
RW 5-2	24				-0.2				27.9	93.0		0.00						
RW 5-2	29	NP	NP	NP		7	SP-SM	A-1-a (0)	2.2									
RW 6-1	2								3.8	121.5		0.05						
RW 6-1	5	26	17	9		15	SC	A-2-4 (0)	6.0	126.7								
RW 6-1	20	NP	NP	NP		2	SW	A-1-a (0)										
RW 6-2	5	NP	NP	NP		27	SM	A-2-4 (0)	4.0	109.9		0.00						
RW 6-2	10	NP	NP	NP		3	SW	A-1-a (0)	1.8									
RW 6-2	15	NP	NP	NP		9	SW-SM	A-1-a (0)	9.5									
RW 6-2	20								16.3									
RW 6-2	25								14.1									
RW 6-3	5	23	18	5		17	SC-SM	A-1-b (0)	7.0	106.3		0.00						

RockSol Consulting Group, Inc.

SUMMARY OF PHYSICAL & CHEMICAL TEST RESULTS

CLIENT Hartwig and Associates

PROJECT NAME US6 Bridges Design Build Project

PROJECT NUMBER 280.01

PROJECT LOCATION Denver, Colorado

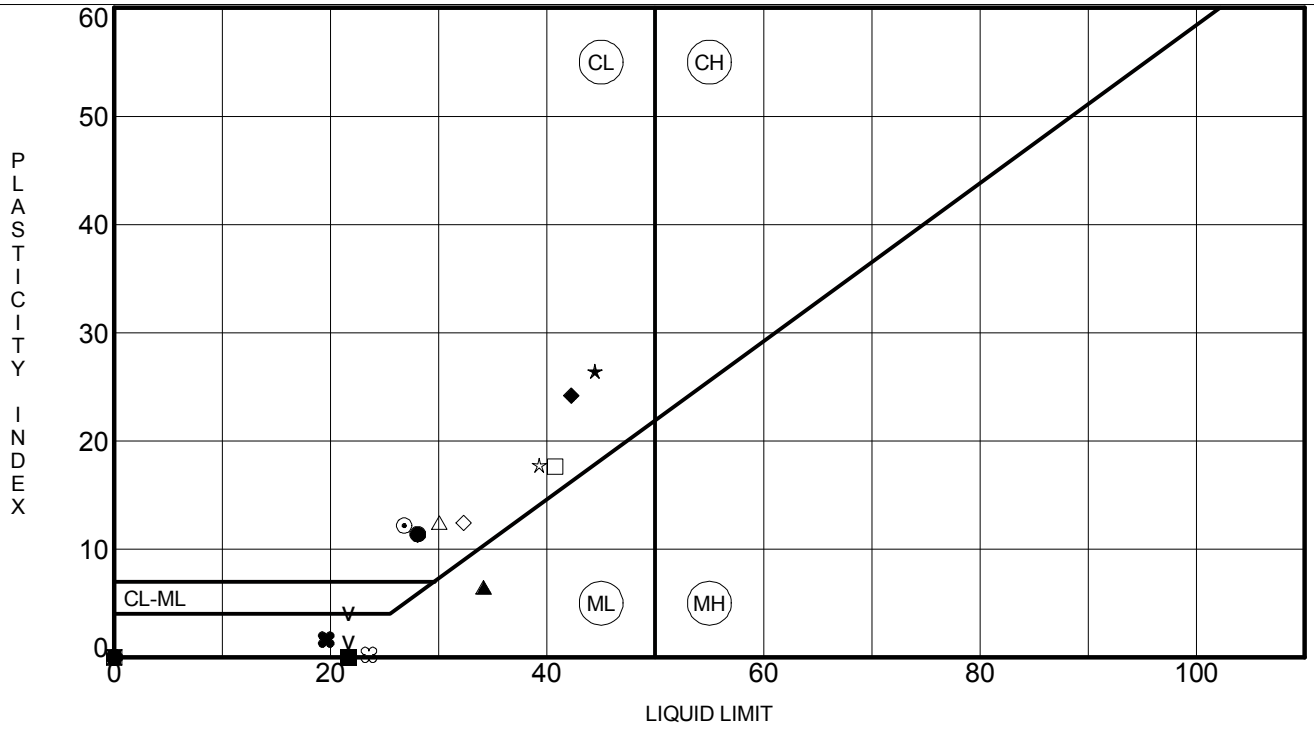
Borehole	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	Swell Potential (%)	%<#200 Sieve	Classification		Water Content (%)	Dry Density (pcf)	Unconfined Compressive Strength (psi)	Sulfate (%)	Resistivity (ohm-cm)	pH	Chlorides (%)	Proctor S=Standard M=Modified		
							USCS	AASHTO								MDD	OMC	S/M
RW 6-3	10	NP	NP	NP		4	SW	A-1-a (0)	2.9									
RW 6-3	15	NP	NP	NP		1	SP	A-1-a (0)	7.5									
RW 6-3	20								14.0									
RW 6-3	25								15.7									
RW 7-1	6"-5'	35	15	20		42	SC	A-6 (4)				0.00						
RW 7-1	2				5.0				7.3	126.3								
RW 7-1	4				1.3				14.3	105.7								
RW 7-1	9	23	25	NP		54	ML	A-4 (0)	14.2	98.8								
RW 7-1	24	NP	NP	NP		4	SW	A-1-b (0)										

ATTERBERG LIMITS RESULTS

RockSol Consulting Group, Inc.

CLIENT Hartwig and Associates **PROJECT NAME** US6 Bridges Design Build Project

PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado



	Specimen Identification		LL	PL	PI	Fines	Classification
●	BR- 1	4	28	17	11	92.1	LEAN CLAY (CL)
⊠	BR- 1	14	NP	NP	NP	4.7	WELL-GRADED SAND with GRAVEL (SW)
▲	BR- 1	34	34	28	6	48.5	(Bedrock) SANDSTONE, silty (SM)
★	BR- 1	39	44	18	26	84.5	(Bedrock) CLAYSTONE (CL)
⊙	BR- 2	10"-5'	27	15	12	28.1	CLAYEY SAND with GRAVEL (SC)
✿	BR- 2	34	NP	NP	NP	6.1	POORLY GRADED SAND with SILT and GRAVEL (SP-SM)
○	BR- 2	44	NP	NP	NP	5.9	POORLY GRADED SAND with SILT (SP-SM)
△	BR- 2	54	30	18	12	22.2	CLAYEY SAND (SC)
⊗	BR- 3	9	NP	NP	NP	7.2	WELL-GRADED SAND with SILT and GRAVEL (SW-SM)
⊕	BR- 3	24	NP	NP	NP	7.2	POORLY GRADED SAND with SILT and GRAVEL (SP-SM)
□	BR- 3	49	41	23	18	92.1	(Bedrock) CLAYSTONE (CL)
⊛	BR- 4	10	NP	NP	NP	5.2	WELL-GRADED SAND with SILT and GRAVEL (SW-SM)
◒	BR- 4	20	NP	NP	NP	6.8	POORLY GRADED SAND with SILT and GRAVEL (SP-SM)
☆	BR- 4	30	39	22	17	65.5	(Bedrock) CLAYSTONE (CL)
⊠	BR- 4	40	24	23	1	22.9	(Bedrock) SANDSTONE, silty (SM)
■	BR- 5	14"-5'	22	22	NP	12.4	SILTY GRAVEL with SAND (GM)
◆	BR- 5	10	42	18	24	57.0	SANDY LEAN CLAY (CL)
◇	BR- 5	20	32	20	12	54.6	SANDY LEAN CLAY (CL)
×	BR- 5	40	NP	NP	NP	4.4	WELL-GRADED SAND (SW)
✖	BR- 6	0-5'	20	18	2	21.4	SILTY SAND with GRAVEL (SM)

ATTERBERG LIMITS RESULTS

RockSol Consulting Group, Inc.

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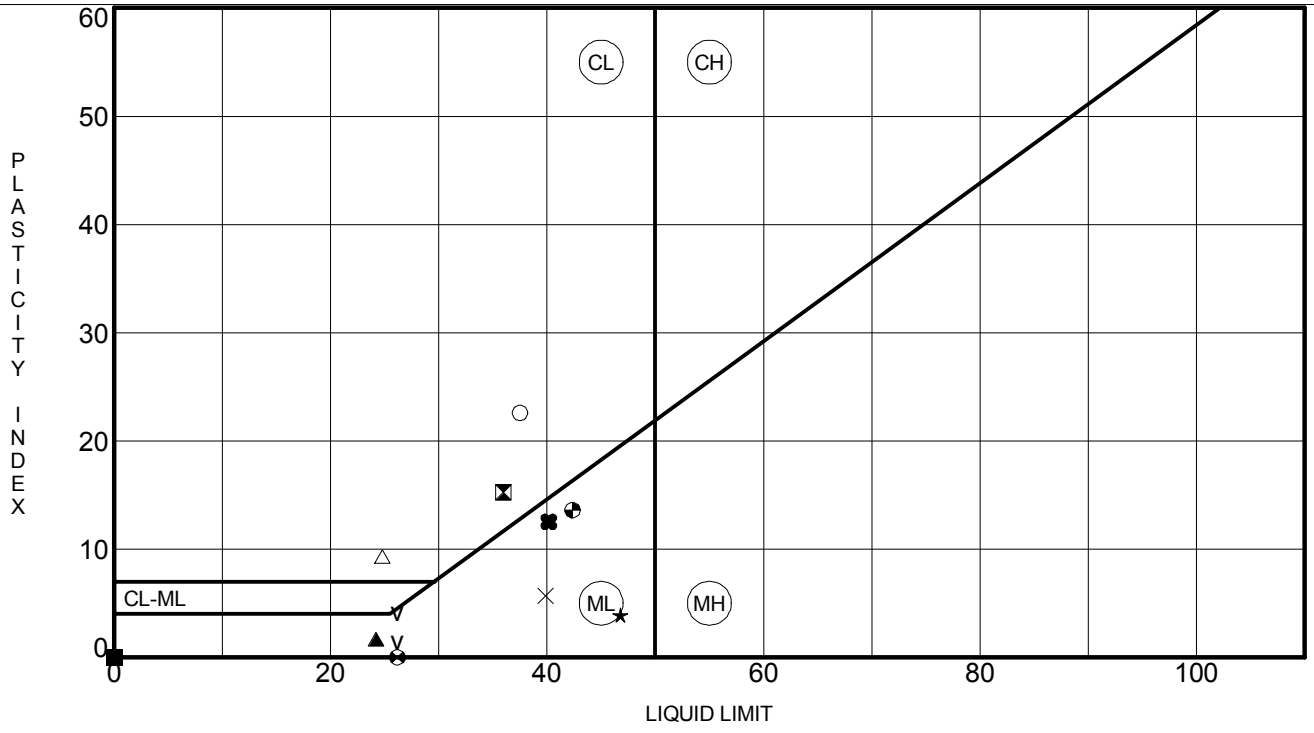
PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado



	Specimen Identification		LL	PL	PI	Fines	Classification
●	BR- 6	5	NP	NP	NP	3.1	WELL-GRADED GRAVEL with SAND (GW)
⊠	BR- 6	35	36	21	15	42.7	(Bedrock) SANSTONE, clayey (SC)
▲	BR- 6	40	24	22	2	38.0	(Bedrock) SANDSTONE, silty (SM)
★	BR- 7	10	47	43	4	23.2	SILTY SAND (SM)
⊙	BR- 7	20	NP	NP	NP	1.0	POORLY GRADED SAND with GRAVEL (SP)
✿	BR- 7	30	NP	NP	NP	19.8	(Bedrock) SILTY SANDSTONE (SM)
○	BR- 8	9"-10'	38	15	23	53.1	SANDY LEAN CLAY (CL)
△	BR- 8	2	25	15	10	68.1	(Fill) SANDY LEAN CLAY (CL)
⊗	BR- 9	10	NP	NP	NP	10.4	POORLY GRADED SAND with SILT and GRAVEL (SP-SM)
⊕	BR- 9	15	NP	NP	NP	2.8	WELL-GRADED SAND (SW)
□	BR- 9	20	NP	NP	NP	3.6	WELL-GRADED SAND (SW)
⊛	BR- 9	25	26	28	NP	31.5	(Bedrock) SILTY SANDSTONE (SM)
◕	BR- 9	30	42	29	13	30.2	(Bedrock) SILTY SANDSTONE (SM)
☆	BR- 9	40	NP	NP	NP	35.9	(Bedrock) SILTY SANDSTONE (SM)
⊠	BR- 10	10	NP	NP	NP	2.9	WELL-GRADED SAND (SW)
■	BR- 10	15	NP	NP	NP	40.7	(Bedrock) SILTY SANDSTONE (SM)
◆	BR- 10	25	NP	NP	NP	17.3	(Bedrock) SILTY SANDSTONE (SM)
◇	BR- 11	5	NP	NP	NP	3.1	WELL-GRADED SAND (SW)
×	BR- 11	10	40	34	6	33.6	(Bedrock) SILTY SANDSTONE (SM)
✖	BR- 11	17	40	28	12	42.1	(Bedrock) SILTY SANDSTONE (SM)

ATTERBERG LIMITS RESULTS

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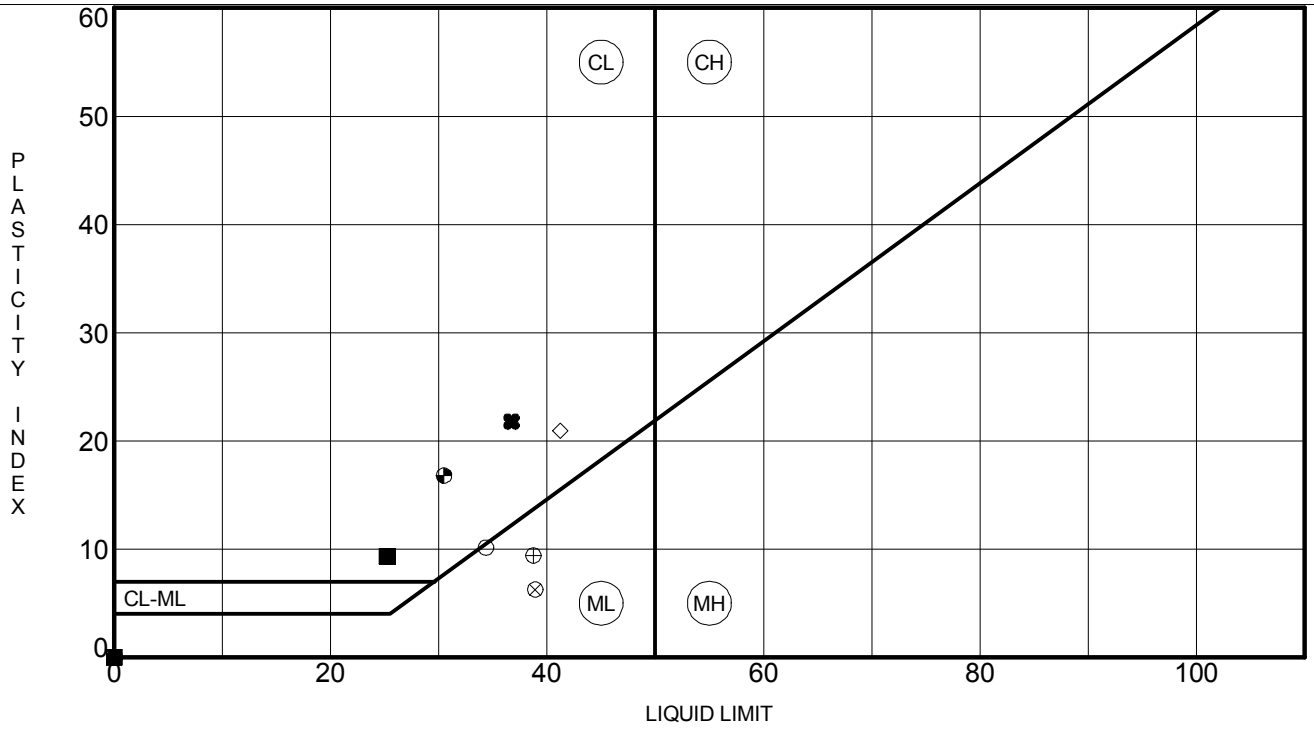
PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado



	Specimen Identification		LL	PL	PI	Fines	Classification
●	BR- 12	13"-5'	NP	NP	NP	9.4	WELL-GRADED SAND with SILT and GRAVEL (SW-SM)
⊠	BR- 12	1	NP	NP	NP	11.2	POORLY GRADED SAND with SILT and GRAVEL (SP-SM)
▲	BR- 12	9	NP	NP	NP	8.8	WELL-GRADED SAND with SILT and GRAVEL (SW-SM)
★	BR- 12	19	NP	NP	NP	4.0	WELL-GRADED SAND with GRAVEL (SW)
⊙	BR- 13	9	NP	NP	NP	10.6	WELL-GRADED SAND with SILT (SW-SM)
✿	BR- 13	19	NP	NP	NP	5.3	WELL-GRADED SAND with SILT (SW-SM)
○	BR- 13	29	34	24	10	25.1	(Bedrock) SILTY SANDSTONE (SM)
△	BR- 14	9	NP	NP	NP	4.2	WELL-GRADED SAND with GRAVEL (SW)
⊗	BR- 14	14	39	33	6	25.7	(Bedrock) SILTY SANDSTONE (SM)
⊕	BR- 14	22	39	29	10	43.0	(Bedrock) SILTY SANDSTONE (SM)
□	BR- 15	8.5"-5'	NP	NP	NP	17.1	SILTY SAND with GRAVEL (SM)
⊛	BR- 15	1	NP	NP	NP	7.3	WELL-GRADED GRAVEL with SILT and SAND (GW-GM)
◕	BR- 15	14	30	14	16	49.0	CLAYEY SAND (SC)
☆	BR- 15	25	NP	NP	NP	1.9	POORLY GRADED SAND (SP)
⊠	BR- 15	34	NP	NP	NP	4.8	WELL-GRADED SAND with GRAVEL (SW)
■	BR- 16	8"-5'	25	16	9	14.1	CLAYEY SAND with GRAVEL (SC)
◆	BR- 16	25	NP	NP	NP	0.1	POORLY GRADED SAND (SP)
◇	BR- 16	50	41	20	21	79.0	(Bedrock) CLAYSTONE (CL)
×	BR- 17	9"-5'	NP	NP	NP	8.8	POORLY GRADED GRAVEL with SILT and SAND (GP-GM)
✖	BR- 17	5	37	15	22	53.1	SANDY LEAN CLAY (CL)

ATTERBERG LIMITS RESULTS

RockSol Consulting Group, Inc.

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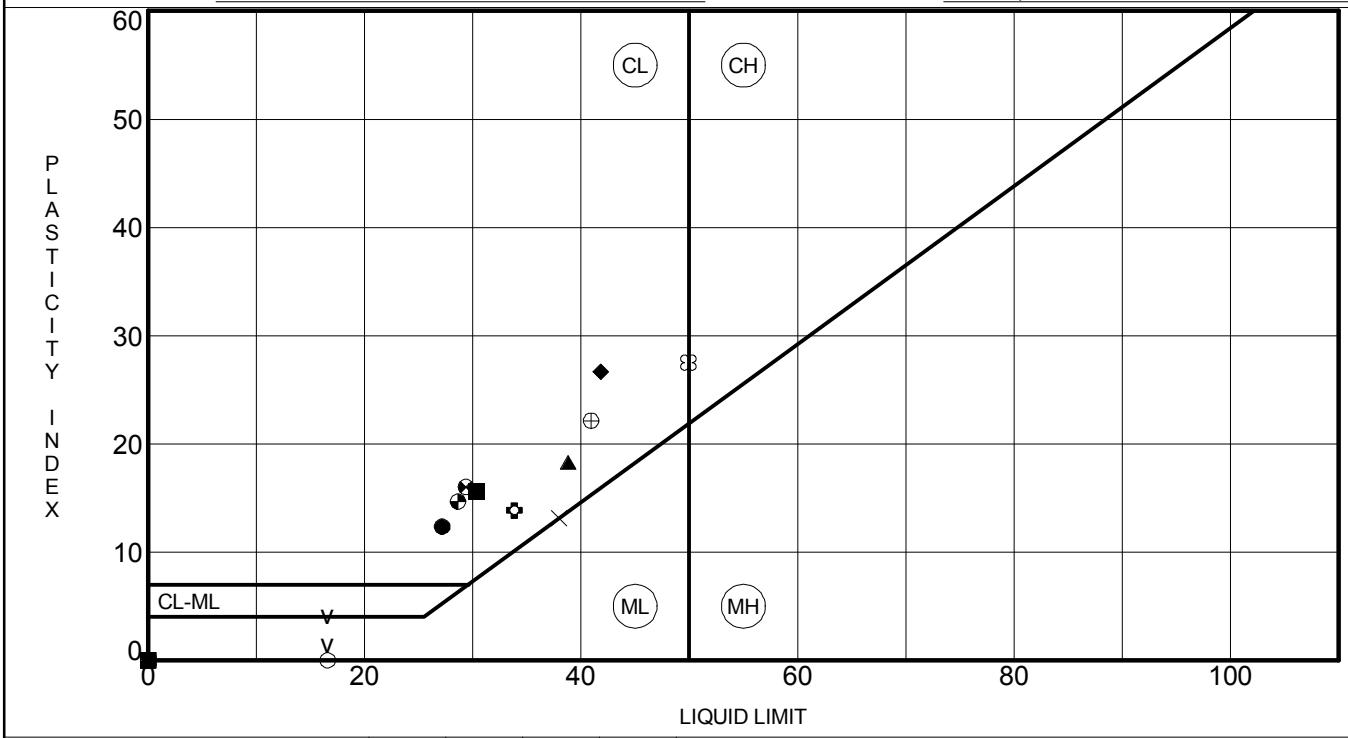
PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado



	Specimen Identification		LL	PL	PI	Fines	Classification
●	BR- 17	15	27	15	12	42.9	CLAYEY SAND (SC)
⊠	BR- 17	30	NP	NP	NP	3.3	POORLY GRADED SAND with GRAVEL (SP)
▲	BR- 17	50	39	21	18	91.9	(Bedrock) CLAYSTONE (CL)
★	BR- 18	16"-5'	NP	NP	NP	8.4	WELL-GRADED SAND with SILT and GRAVEL (SW-SM)
⊙	BR- 18	9	NP	NP	NP	0.5	POORLY GRADED SAND with GRAVEL (SP)
✿	BR- 18	34	34	20	14	69.9	(Bedrock) CLAYSTONE (CL)
○	BR- 19	16"-5'	17	18	NP	8.6	WELL-GRADED SAND with SILT and GRAVEL (SW-SM)
△	BR- 19	5	NP	NP	NP	1.9	WELL-GRADED SAND (SW)
⊗	BR- 19	15	NP	NP	NP	2.3	POORLY GRADED SAND (SP)
⊕	BR- 19	29	41	19	22	62.7	(Bedrock) CLAYSTONE (CL)
□	BR- 20	8"-5'	NP	NP	NP	18.9	SILTY SAND with GRAVEL (SM)
⊛	BR- 20	15	29	13	16	46.0	CLAYEY SAND (SC)
◒	BR- 20	25	29	14	15	43.5	CLAYEY SAND (SC)
☆	BR- 20	35	NP	NP	NP	5.1	WELL-GRADED SAND with SILT and GRAVEL (SW-SM)
⊠	BR- 20	50	50	22	28	92.9	(Bedrock) CLAYSTONE (CH)
■	BR- 21	7"-5'	30	15	15	43.7	CLAYEY SAND with GRAVEL (SC)
◆	BR- 21	20	42	15	27	58.6	SANDY LEAN CLAY (CL)
◇	BR- 21	35	NP	NP	NP	4.6	POORLY GRADED SAND with GRAVEL (SP)
×	BR- 21	55	38	25	13	66.4	(Bedrock) SILTSTONE (ML)
✖	BR- 22	8.5"-5'	NP	NP	NP	41.6	SILTY SAND with GRAVEL (SM)

ATTERBERG LIMITS RESULTS

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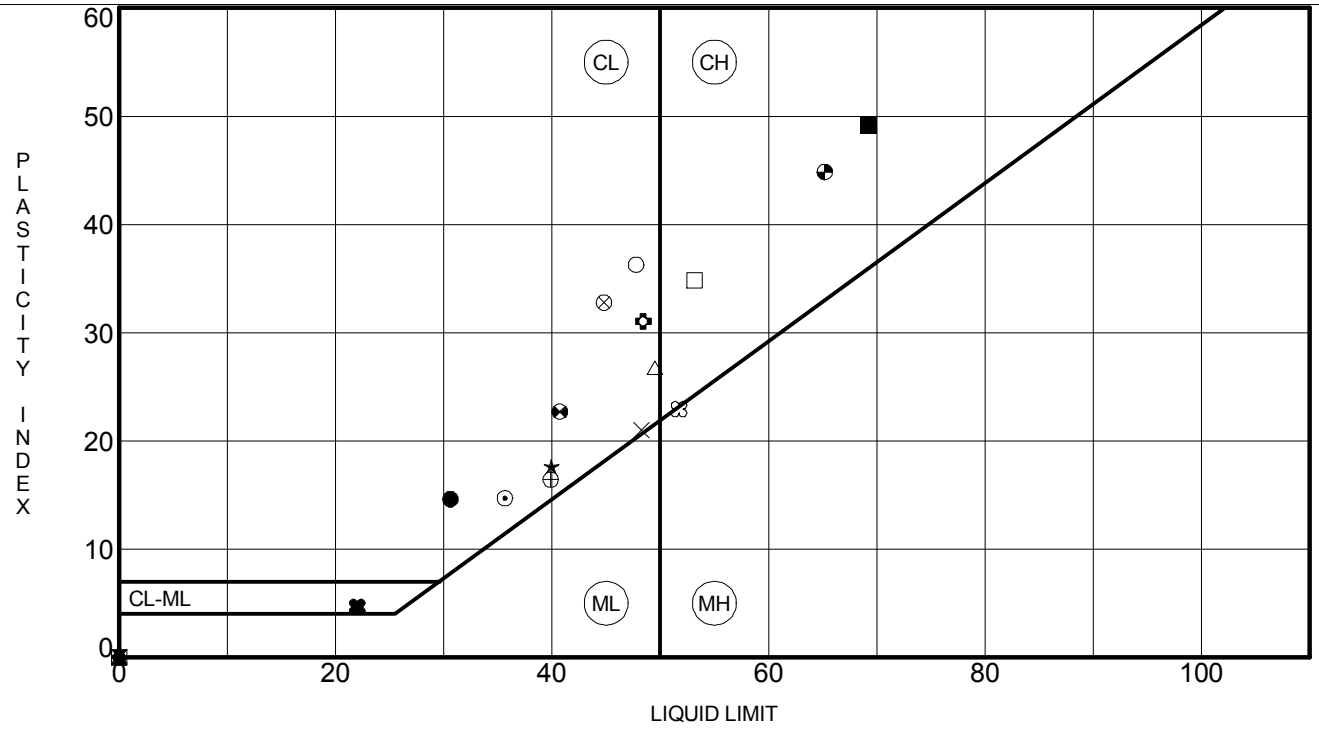

	Specimen Identification		LL	PL	PI	Fines	Classification
●	BR- 22	14	31	16	15	54.5	SANDY LEAN CLAY (CL)
⊠	BR- 22	34	NP	NP	NP	3.7	POORLY GRADED SAND (SP)
▲	BR- 22	39	NP	NP	NP	4.8	WELL-GRADED SAND with GRAVEL (SW)
★	BR- 22	54	40	22	18	68.8	SANDY LEAN CLAY (CL)
⊙	BR- 23	19	36	21	15	31.1	(Bedrock) SANDSTONE
✿	BR- 23	34	48	17	31	81.9	(Bedrock) CLAYSTONE
○	BR- 24	14	48	11	37	74.6	LEAN CLAY with SAND (CL)
△	BR- 24	34	49	23	26	98.8	(Bedrock) CLAYSTONE
⊗	BR- 25	4	45	12	33	72.1	LEAN CLAY with SAND (CL)
⊕	BR- 25	15	40	23	17	54.3	(Bedrock) CLAYSTONE
□	BR- 26	5	53	18	35	87.6	FAT CLAY (CH)
⊛	BR- 26	20	41	18	23	62.9	SANDY LEAN CLAY (CL)
◕	BR- 26	40	65	20	45	79.4	FAT CLAY with SAND (CH)
☆	BR- 26	75	NP	NP	NP	7.8	POORLY GRADED SAND with SILT and GRAVEL (SP-SM)
⊠	BR- 26	90	52	29	23	90.7	(Bedrock) SILTSTONE
■	BR- 27	15	69	20	49	94.5	FAT CLAY (CH)
◆	BR- 27	30	NP	NP	NP	2.3	POORLY GRADED SAND with GRAVEL (SP)
◇	BR- 27	45	NP	NP	NP	4.1	WELL-GRADED SAND with GRAVEL (SW)
×	BR- 27	65	48	27	21	97.3	(Bedrock) CLAYSTONE
✖	RW 1-1	6"-5'	22	17	5	29.4	SILTY, CLAYEY SAND with GRAVEL (SC-SM)

ATTERBERG LIMITS RESULTS

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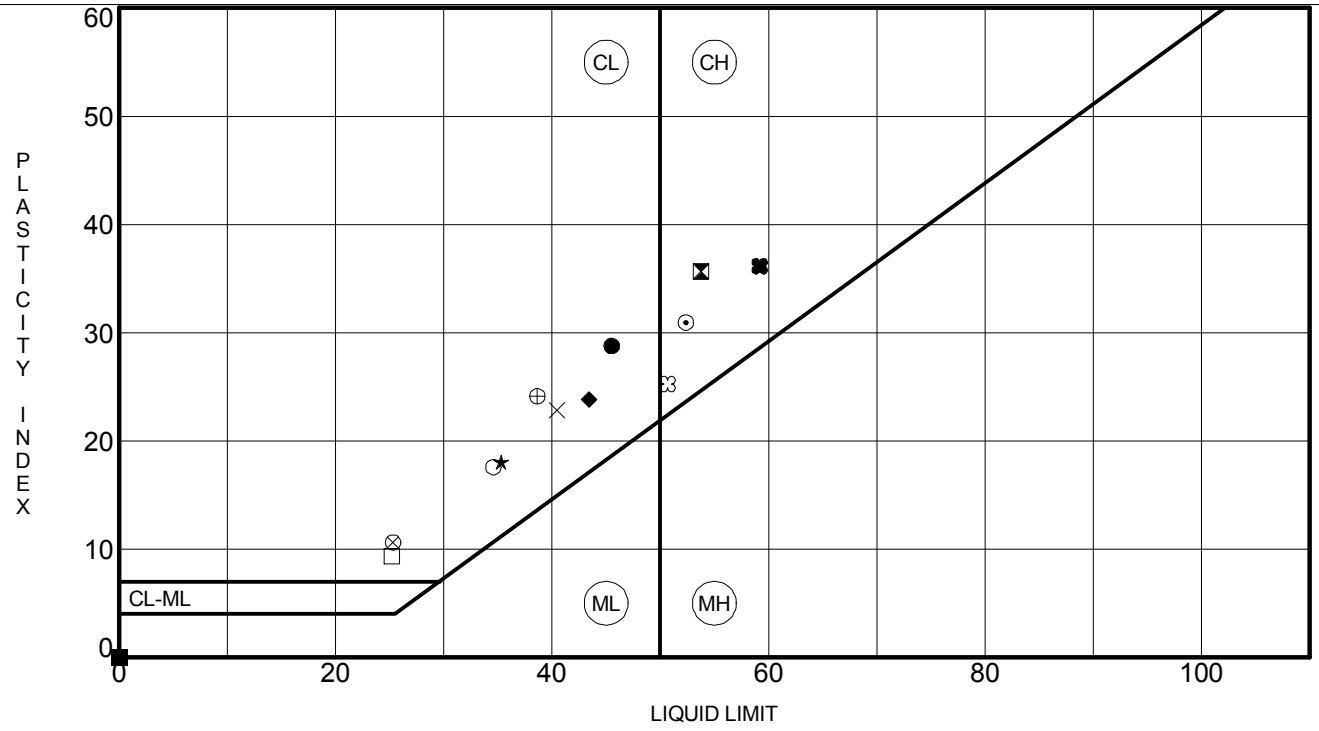


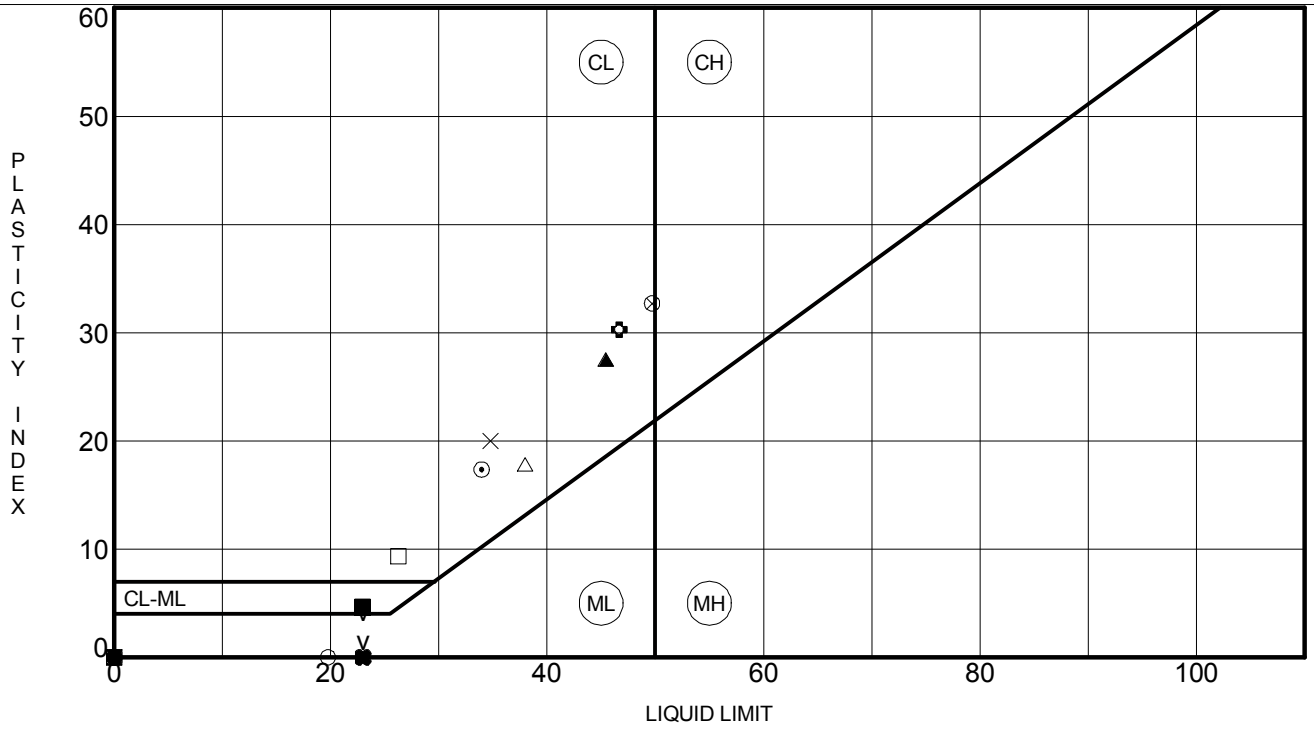
	Specimen Identification		LL	PL	PI	Fines	Classification
●	RW 1-1	9	46	17	29	71.7	LEAN CLAY with SAND (CL)
⊠	RW 1-2	4	54	18	36	75.7	FAT CLAY with SAND (CH)
▲	RW 1-2	14	NP	NP	NP	5.3	WELL-GRADED SAND with SILT and GRAVEL (SW-SM)
★	RW 2-1	0	35	17	18	33.2	CLAYEY SAND with GRAVEL (SC)
⊙	RW 2-1	10	52	21	31	73.5	FAT CLAY with SAND (CH)
✿	RW 2-1	20	NP	NP	NP	6.0	WELL-GRADED SAND with SILT and GRAVEL (SW-SM)
○	RW 2-2	0-5'	35	17	18	36.4	CLAYEY SAND (SC)
△	RW 2-2	14	NP	NP	NP	1.8	POORLY GRADED SAND with GRAVEL (SP)
⊗	RW 3-1	0-5'	25	15	10	26.6	CLAYEY SAND with GRAVEL (SC)
⊕	RW 3-1	2	39	15	24	32.2	CLAYEY SAND (SC)
□	RW 3-2	5	25	16	9	14.2	CLAYEY SAND with GRAVEL (SC)
⊛	RW 3-2	10	NP	NP	NP	9.6	POORLY GRADED SAND with SILT (SP-SM)
◒	RW 3-2	17	NP	NP	NP	5.0	WELL-GRADED SAND with GRAVEL (SW)
☆	RW 3-2	20	NP	NP	NP	1.7	POORLY GRADED SAND (SP)
⊠	RW 3-2	25	51	25	26	74.1	(Bedrock) CLAYSTONE (CH)
■	RW 4-1	8"-5'	NP	NP	NP	17.3	SILTY SAND with GRAVEL (SM)
◆	RW 4-1	9	43	20	23	68.9	SANDY LEAN CLAY (CL)
◇	RW 4-2	8"-5'	NP	NP	NP	27.6	SILTY SAND with GRAVEL (SM)
×	RW 4-2	9	40	18	22	57.3	SANDY LEAN CLAY (CL)
✖	RW 4-2	14	59	23	36	77.7	FAT CLAY with SAND (CH)

ATTERBERG LIMITS RESULTS

RockSol Consulting Group, Inc.

CLIENT Hartwig and Associates **PROJECT NAME** US6 Bridges Design Build Project

PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado



	Specimen Identification		LL	PL	PI	Fines	Classification
●	RW 4-2	19	NP	NP	NP	3.2	POORLY GRADED SAND with GRAVEL (SP)
⊠	RW 4-3	20"-5'	NP	NP	NP	14.3	SILTY SAND with GRAVEL (SM)
▲	RW 4-3	9	45	18	27	60.8	SANDY LEAN CLAY (CL)
★	RW 4-3	14	NP	NP	NP	3.6	POORLY GRADED SAND with GRAVEL (SP)
⊙	RW 5-1	4	34	17	17	48.9	(Fill) CLAYEY SAND (SC)
✿	RW 5-1	14	47	16	31	69.3	SANDY LEAN CLAY (CL)
○	RW 5-2	1'-5'	20	20	NP	14.3	SILTY SAND with GRAVEL (SM)
△	RW 5-2	9	38	20	18	70.3	LEAN CLAY with SAND (CL)
⊗	RW 5-2	19	50	17	33	71.0	FAT CLAY with SAND (CH)
⊕	RW 5-2	29	NP	NP	NP	6.6	POORLY GRADED SAND with SILT and GRAVEL (SP-SM)
□	RW 6-1	5	26	17	9	14.7	CLAYEY SAND with GRAVEL (SC)
⊛	RW 6-1	20	NP	NP	NP	2.3	WELL-GRADED SAND with GRAVEL (SW)
◒	RW 6-2	5	NP	NP	NP	27.5	SILTY SAND (SM)
☆	RW 6-2	10	NP	NP	NP	2.9	WELL-GRADED SAND with GRAVEL (SW)
⊠	RW 6-2	15	NP	NP	NP	8.7	WELL-GRADED SAND with SILT and GRAVEL (SW-SM)
■	RW 6-3	5	23	18	5	17.3	SILTY, CLAYEY SAND with GRAVEL (SC-SM)
◆	RW 6-3	10	NP	NP	NP	4.4	WELL-GRADED SAND with GRAVEL (SW)
◇	RW 6-3	15	NP	NP	NP	0.6	POORLY GRADED SAND with GRAVEL (SP)
×	RW 7-1	6"-5'	35	15	20	42.0	CLAYEY SAND (SC)
✖	RW 7-1	9	23	25	NP	54.1	SANDY SILT (ML)

ATTERBERG LIMITS RESULTS

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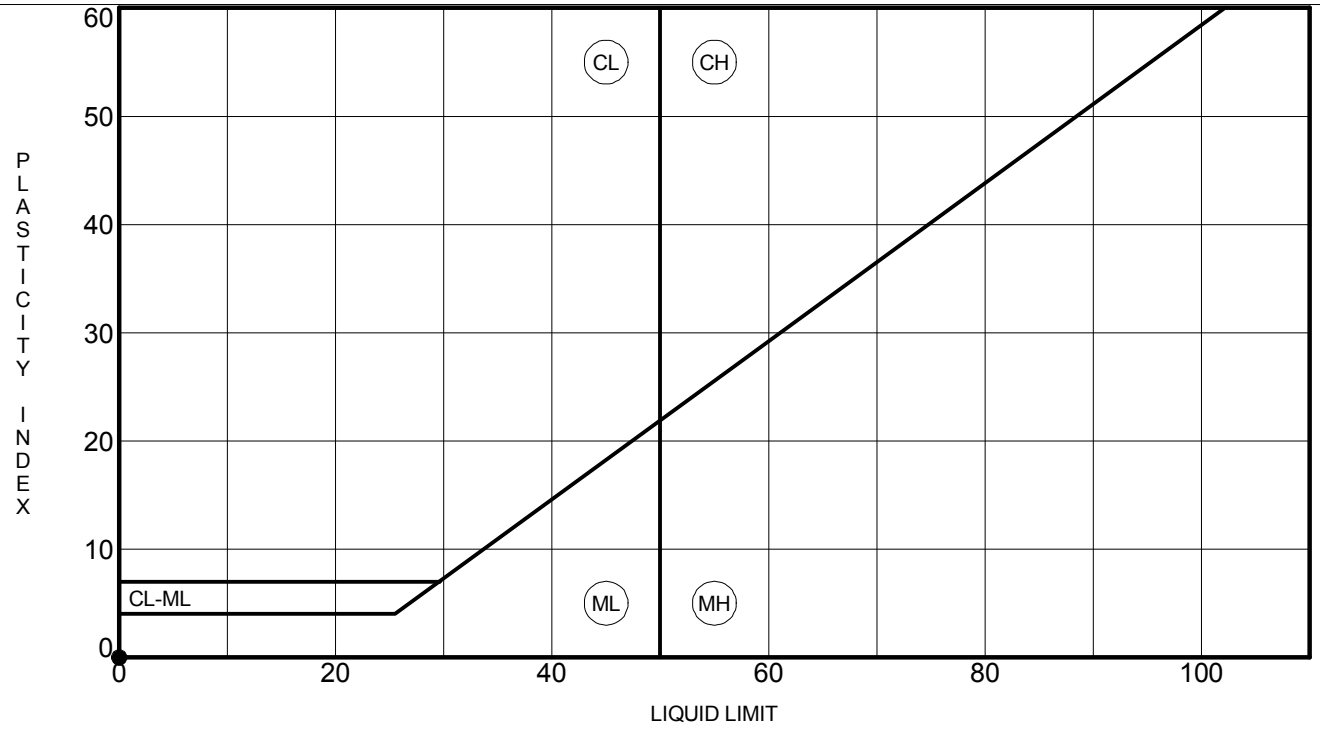

	Specimen Identification		LL	PL	PI	Fines	Classification
●	**RW 7-1**	**24**	**NP**	**NP**	**NP**	**4.0**	**WELL-GRADED SAND (SW)**

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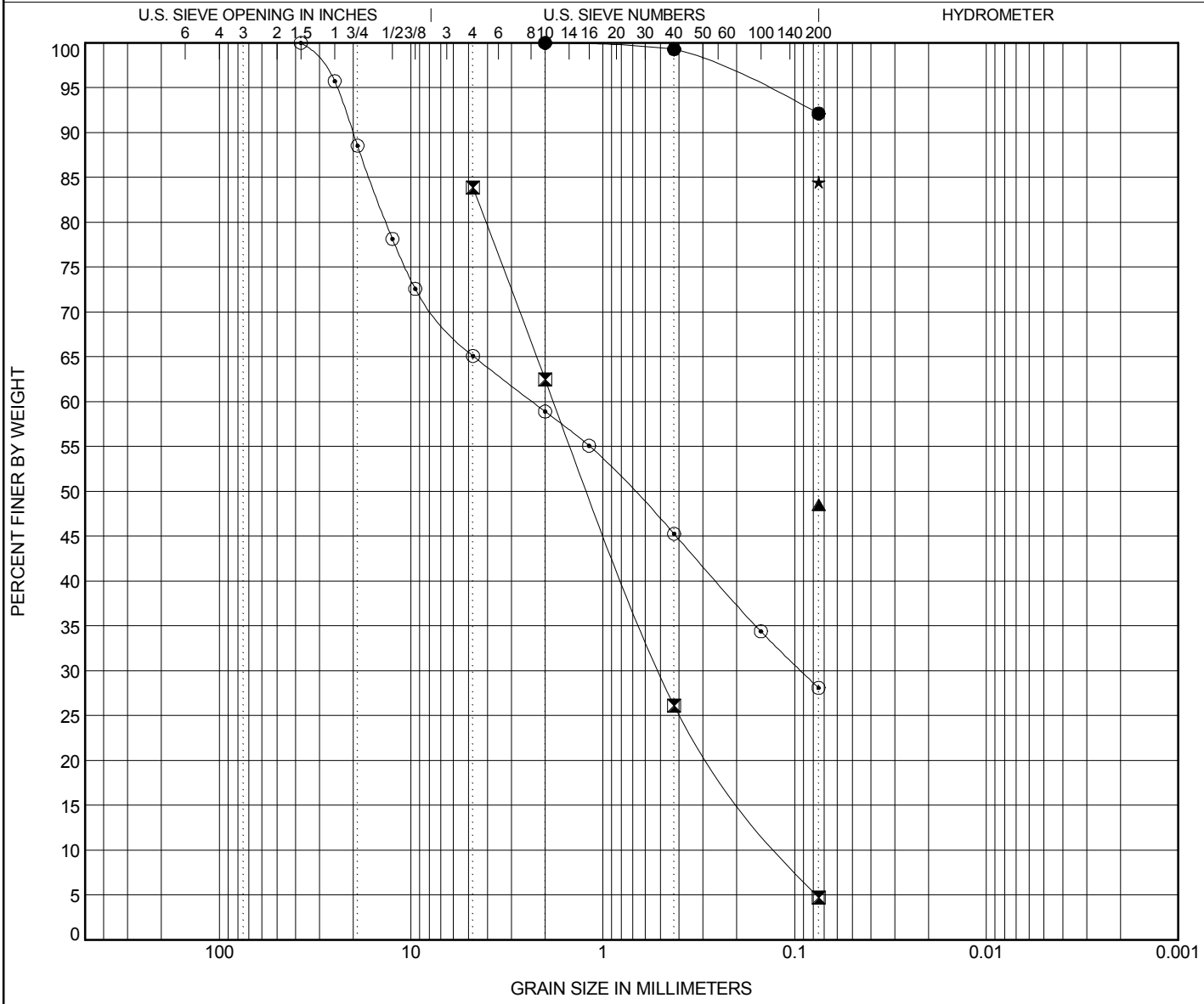

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification			Classification	LL	PL	PI	Cc	Cu
●	BR- 1	4	LEAN CLAY (CL)	28	17	11		
⧓	BR- 1	14	WELL-GRADED SAND with GRAVEL (SW)	NP	NP	NP	1.21	15.67
▲	BR- 1	34	(Bedrock) SANDSTONE, silty (SM)	34	28	6		
★	BR- 1	39	(Bedrock) CLAYSTONE (CL)	44	18	26		
⊙	BR- 2	10"-5'	CLAYEY SAND with GRAVEL (SC)	27	15	12		

Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	BR- 1	4	2				0.0	7.9	92.1	
⧓	BR- 1	14	4.75	1.801	0.501	0.115		79.2	4.7	
▲	BR- 1	34	0.075						48.5	
★	BR- 1	39	0.075						84.5	
⊙	BR- 2	10"-5'	37.5	2.331	0.092		34.9	37.0	28.1	

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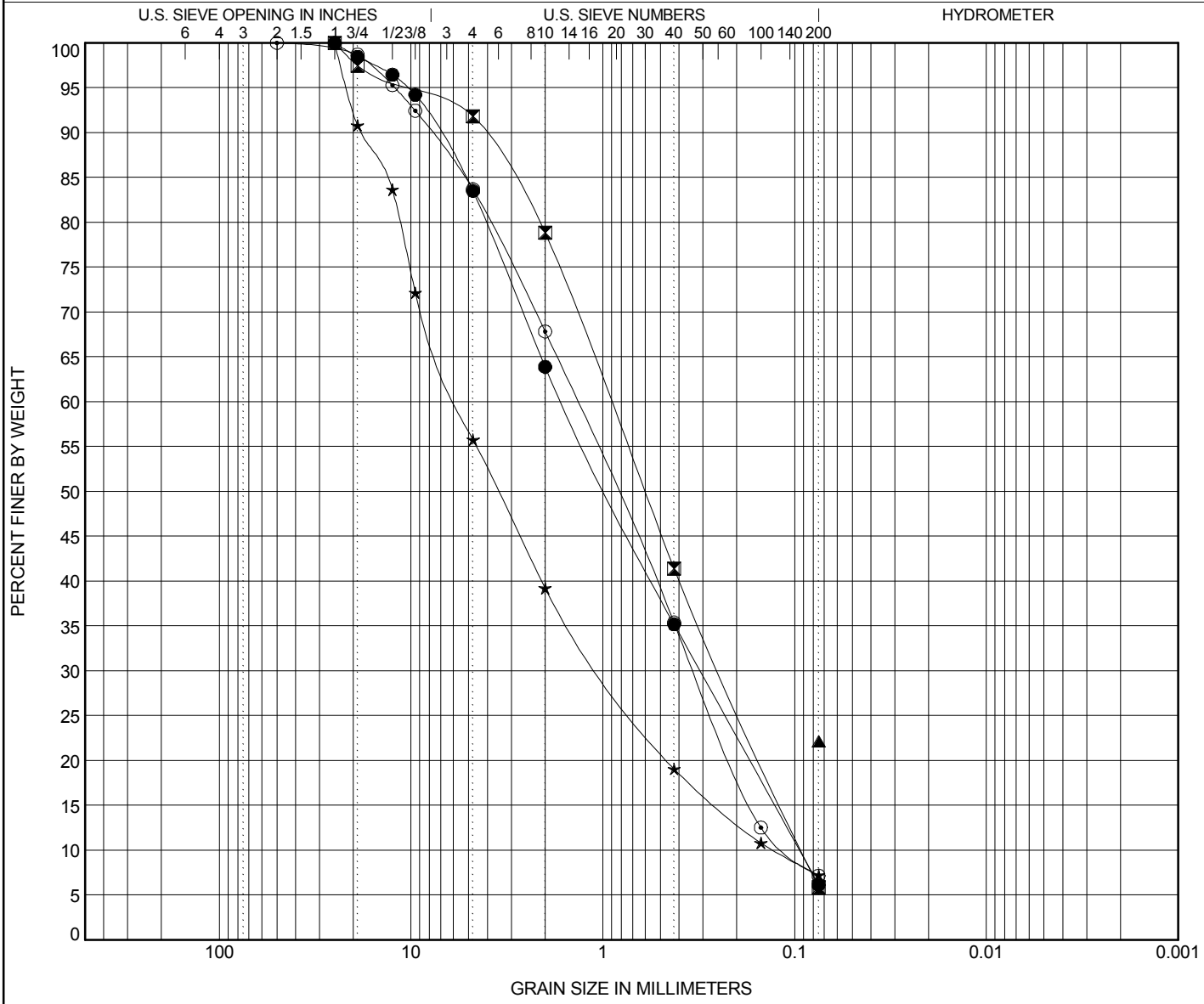

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification			Classification	LL	PL	PI	Cc	Cu
●	BR- 2	34	POORLY GRADED SAND with SILT and GRAVEL (SP-SM)	NP	NP	NP	0.63	17.17
⊠	BR- 2	44	POORLY GRADED SAND with SILT (SP-SM)	NP	NP	NP	0.70	9.99
▲	BR- 2	54	CLAYEY SAND (SC)	30	18	12		
★	BR- 3	9	WELL-GRADED SAND with SILT and GRAVEL (SW-SM)	NP	NP	NP	1.33	44.34
⊙	BR- 3	24	POORLY GRADED SAND with SILT and GRAVEL (SP-SM)	NP	NP	NP	0.74	12.71

Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	BR- 2	34	25	1.622	0.312	0.094	16.5	77.4	6.1	
⊠	BR- 2	44	25	0.917	0.244	0.092	8.2	86.0	5.9	
▲	BR- 2	54	0.075						22.2	
★	BR- 3	9	25	5.68	0.985	0.128	44.2	48.5	7.2	
⊙	BR- 3	24	50	1.376	0.332	0.108	16.3	76.5	7.2	

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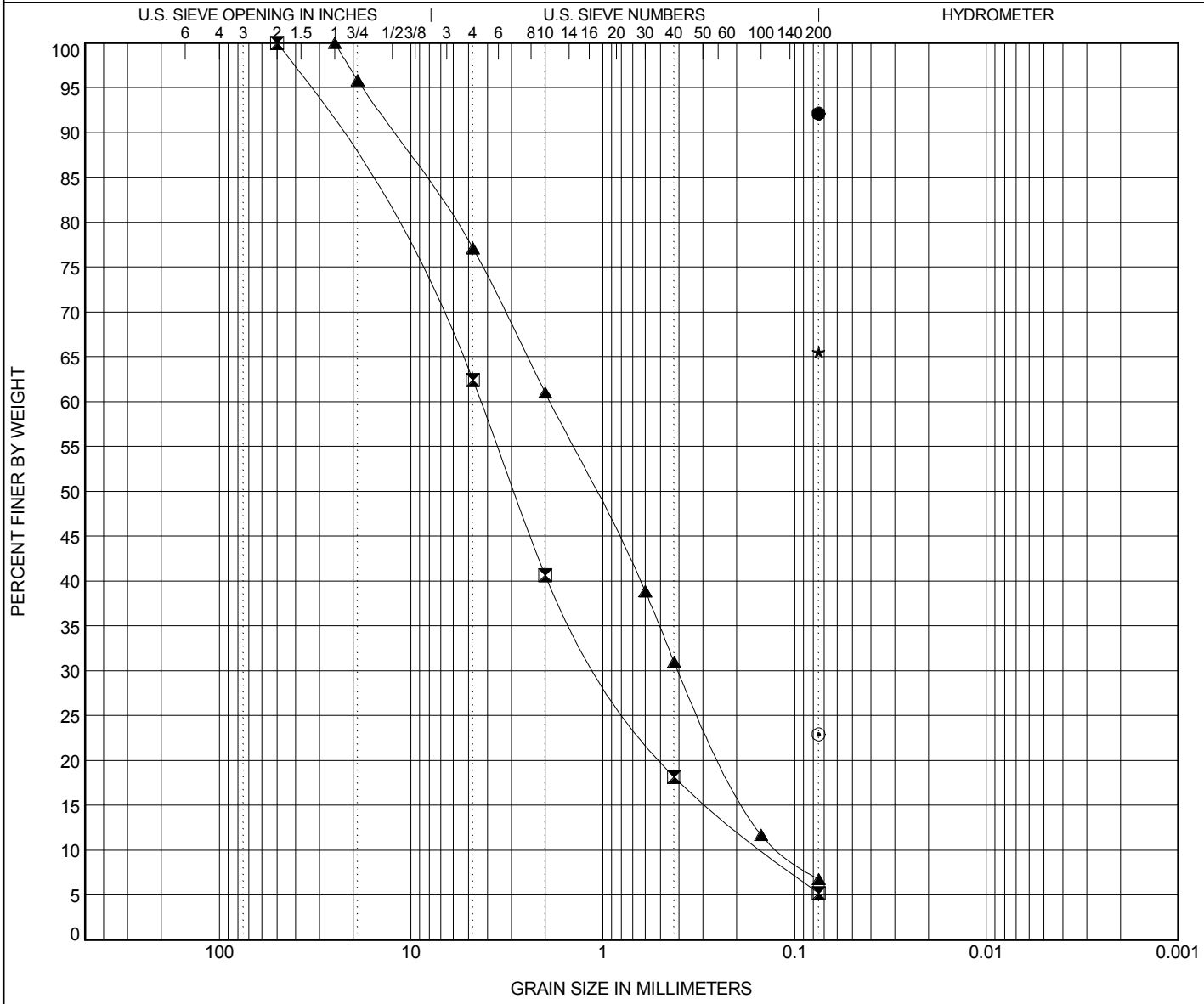

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification			Classification	LL	PL	PI	Cc	Cu
●	BR- 3	49	(Bedrock) CLAYSTONE (CL)	41	23	18		
⧓	BR- 4	10	WELL-GRADED SAND with SILT and GRAVEL (SW-SM)	NP	NP	NP	1.50	30.29
▲	BR- 4	20	POORLY GRADED SAND with SILT and GRAVEL (SP-SM)	NP	NP	NP	0.73	16.08
★	BR- 4	30	(Bedrock) CLAYSTONE (CL)	39	22	17		
⊙	BR- 4	40	(Bedrock) SANDSTONE, silty (SM)	24	23	1		

Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	BR- 3	49	0.075						92.1	
⧓	BR- 4	10	50	4.31	0.959	0.142	37.6	57.2	5.2	
▲	BR- 4	20	25	1.891	0.403	0.118	22.9	70.4	6.8	
★	BR- 4	30	0.075						65.5	
⊙	BR- 4	40	0.075						22.9	

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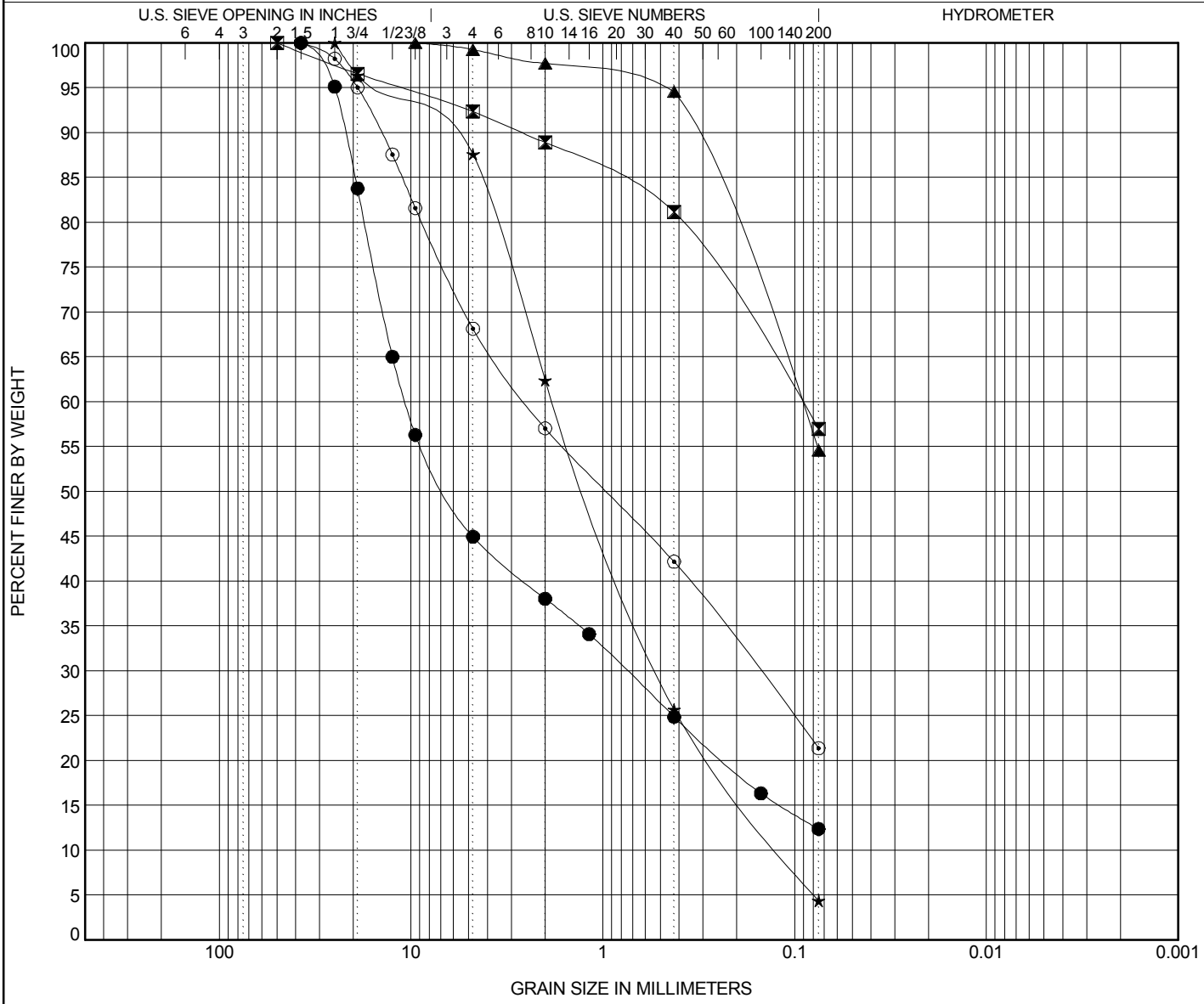

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification			Classification	LL	PL	PI	Cc	Cu
●	BR- 5	14"-5'	SILTY GRAVEL with SAND (GM)	22	22	NP	1.06	215.45
⊠	BR- 5	10	SANDY LEAN CLAY (CL)	42	18	24		
▲	BR- 5	20	SANDY LEAN CLAY (CL)	32	20	12		
★	BR- 5	40	WELL-GRADED SAND (SW)	NP	NP	NP	1.21	15.23
⊙	BR- 6	0-5'	SILTY SAND with GRAVEL (SM)	20	18	2		

Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	BR- 5	14"-5'	37.5	10.675	0.75		55.0	32.6	12.4	
⊠	BR- 5	10	50	0.093			7.6	35.4	57.0	
▲	BR- 5	20	9.5	0.095			0.7	44.7	54.6	
★	BR- 5	40	25	1.807	0.51	0.119	12.4	83.2	4.4	
⊙	BR- 6	0-5'	37.5	2.521	0.154		31.9	46.8	21.4	

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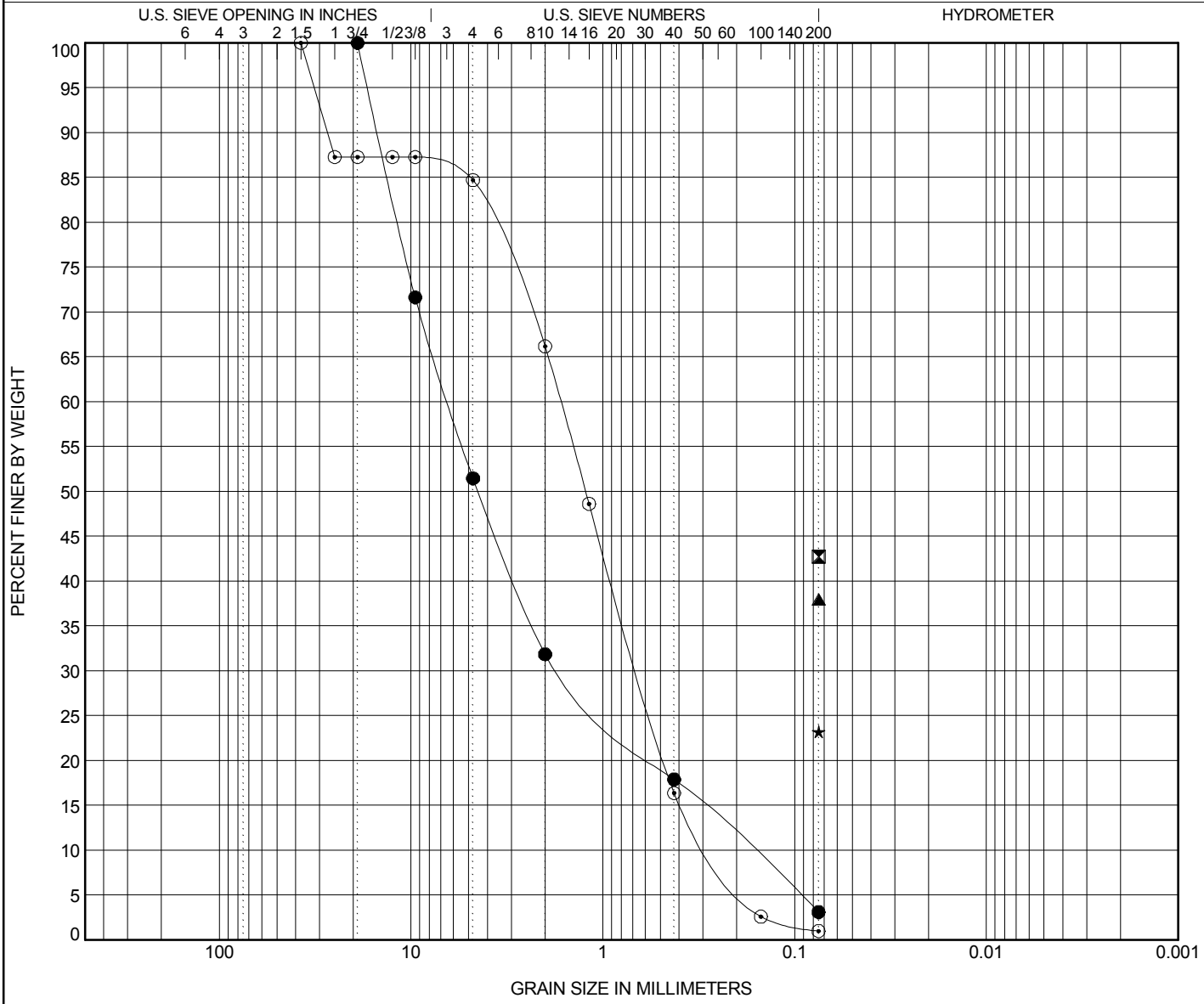

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification			Classification	LL	PL	PI	Cc	Cu
●	BR- 6	5	WELL-GRADED GRAVEL with SAND (GW)	NP	NP	NP	2.48	37.83
⊠	BR- 6	35	(Bedrock) SANSTONE, clayey (SC)	36	21	15		
▲	BR- 6	40	(Bedrock) SANDSTONE, silty (SM)	24	22	2		
★	BR- 7	10	SILTY SAND (SM)	47	43	4		
⊙	BR- 7	20	POORLY GRADED SAND with GRAVEL (SP)	NP	NP	NP	0.98	6.33

Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	BR- 6	5	19	6.369	1.629	0.168	48.5	48.4	3.1	
⊠	BR- 6	35	0.075						42.7	
▲	BR- 6	40	0.075						38.0	
★	BR- 7	10	0.075						23.2	
⊙	BR- 7	20	37.5	1.662	0.654	0.263	15.3	83.7	1.0	

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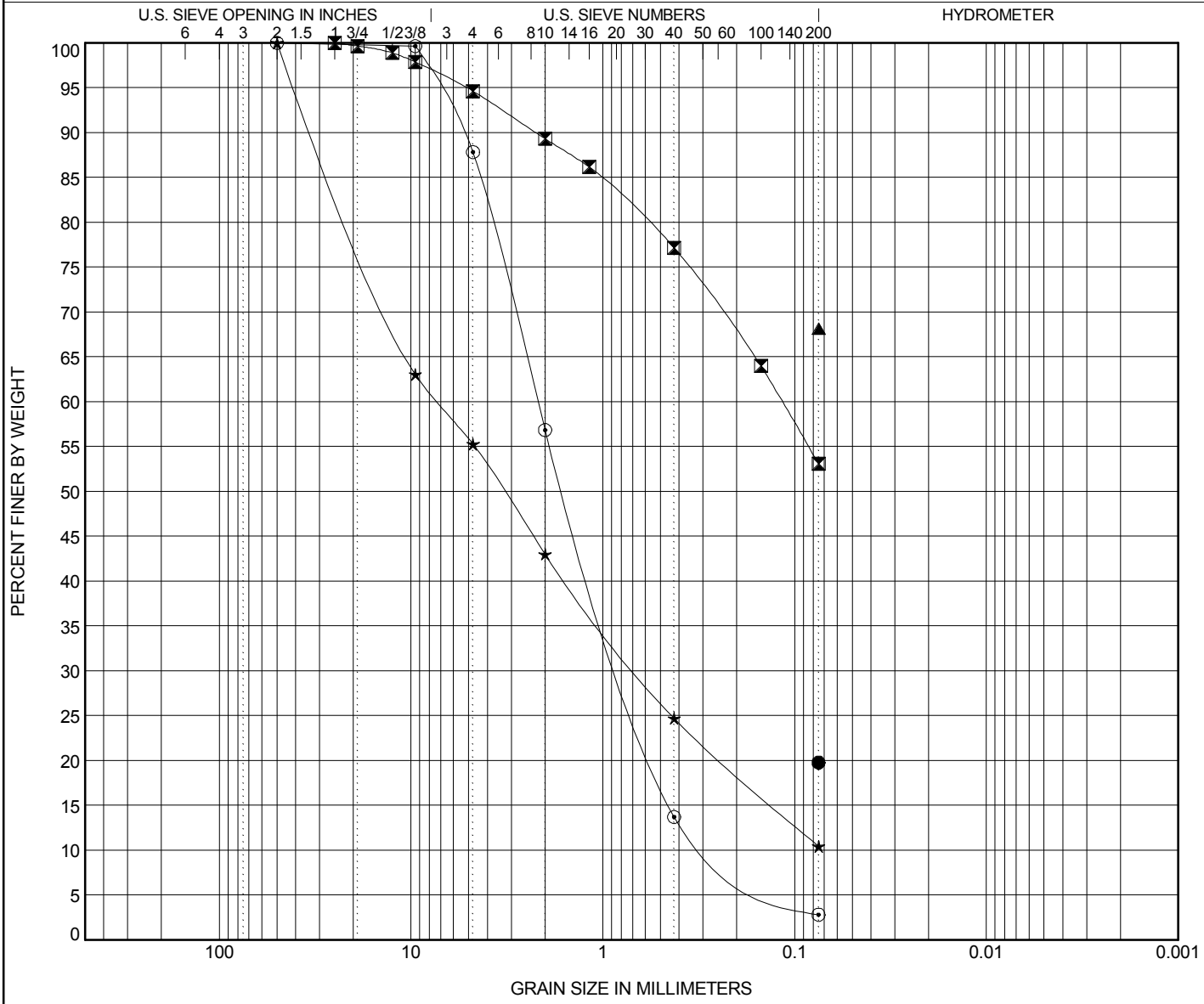

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification			Classification	LL	PL	PI	Cc	Cu
●	BR- 7	30	(Bedrock) SILTY SANDSTONE (SM)	NP	NP	NP		
⊠	BR- 8	9"-10'	SANDY LEAN CLAY (CL)	38	15	23		
▲	BR- 8	2	(Fill) SANDY LEAN CLAY (CL)	25	15	10		
★	BR- 9	10	POORLY GRADED SAND with SILT and GRAVEL (SP-SM)	NP	NP	NP	0.86	101.86
⊙	BR- 9	15	WELL-GRADED SAND (SW)	NP	NP	NP	1.13	9.27

Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	BR- 7	30	0.075						19.8	
⊠	BR- 8	9"-10'	25	0.116			5.4	41.5	53.1	
▲	BR- 8	2	0.075						68.1	
★	BR- 9	10	50	7.238	0.665		44.7	44.8	10.4	
⊙	BR- 9	15	50	2.185	0.763	0.236	12.2	85.0	2.8	

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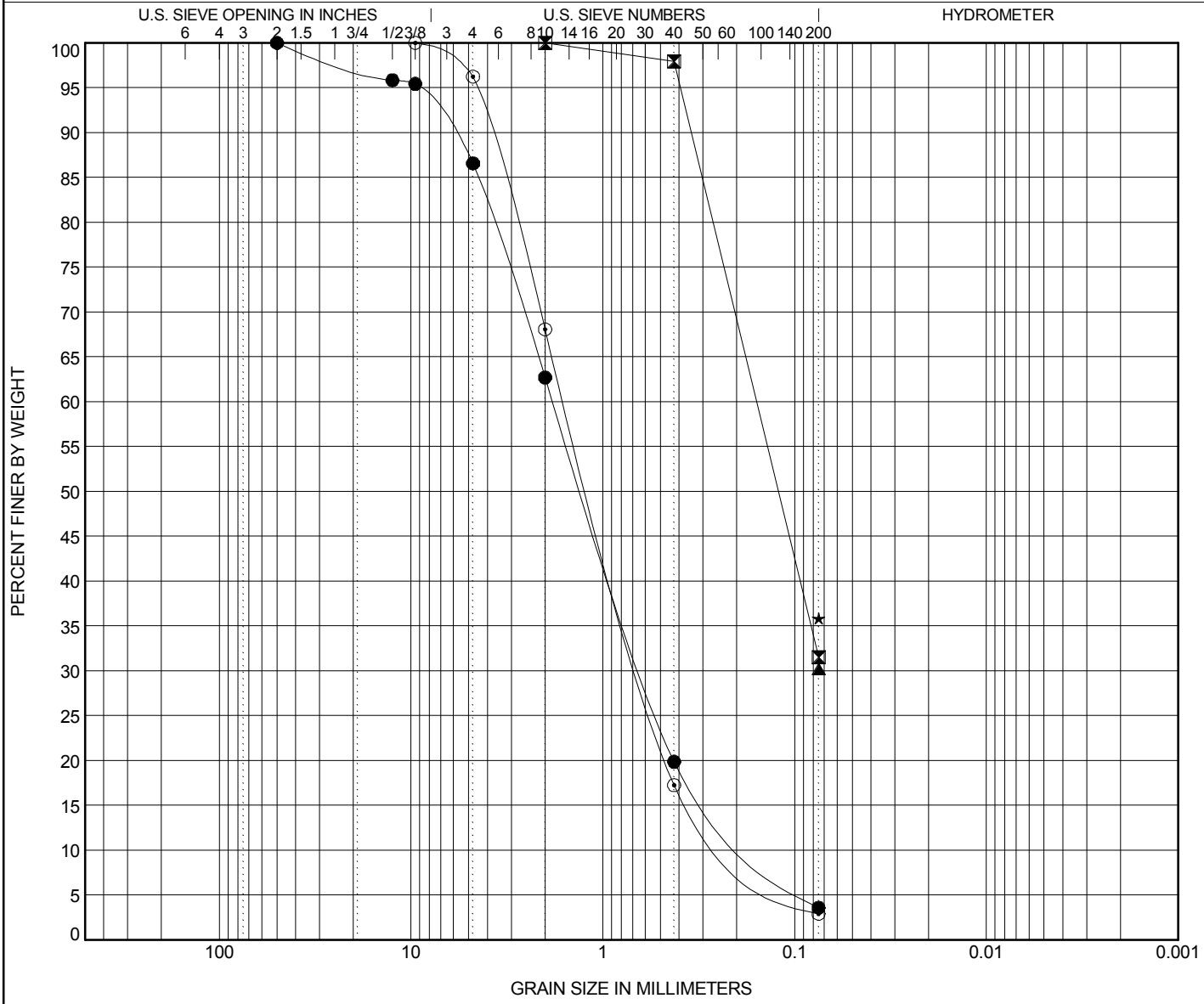

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification			Classification	LL	PL	PI	Cc	Cu
●	BR- 9	20	WELL-GRADED SAND (SW)	NP	NP	NP	1.40	12.21
⊠	BR- 9	25	(Bedrock) SILTY SANDSTONE (SM)	26	28	NP		
▲	BR- 9	30	(Bedrock) SILTY SANDSTONE (SM)	42	29	13		
★	BR- 9	40	(Bedrock) SILTY SANDSTONE (SM)	NP	NP	NP		
⊙	BR- 10	10	WELL-GRADED SAND (SW)	NP	NP	NP	1.42	8.84

Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	BR- 9	20	50	1.814	0.613	0.149	13.4	83.0	3.6	
⊠	BR- 9	25	2	0.158			0.0	68.5	31.5	
▲	BR- 9	30	0.075						30.2	
★	BR- 9	40	0.075						35.9	
⊙	BR- 10	10	9.5	1.564	0.627	0.177	3.8	93.3	2.9	

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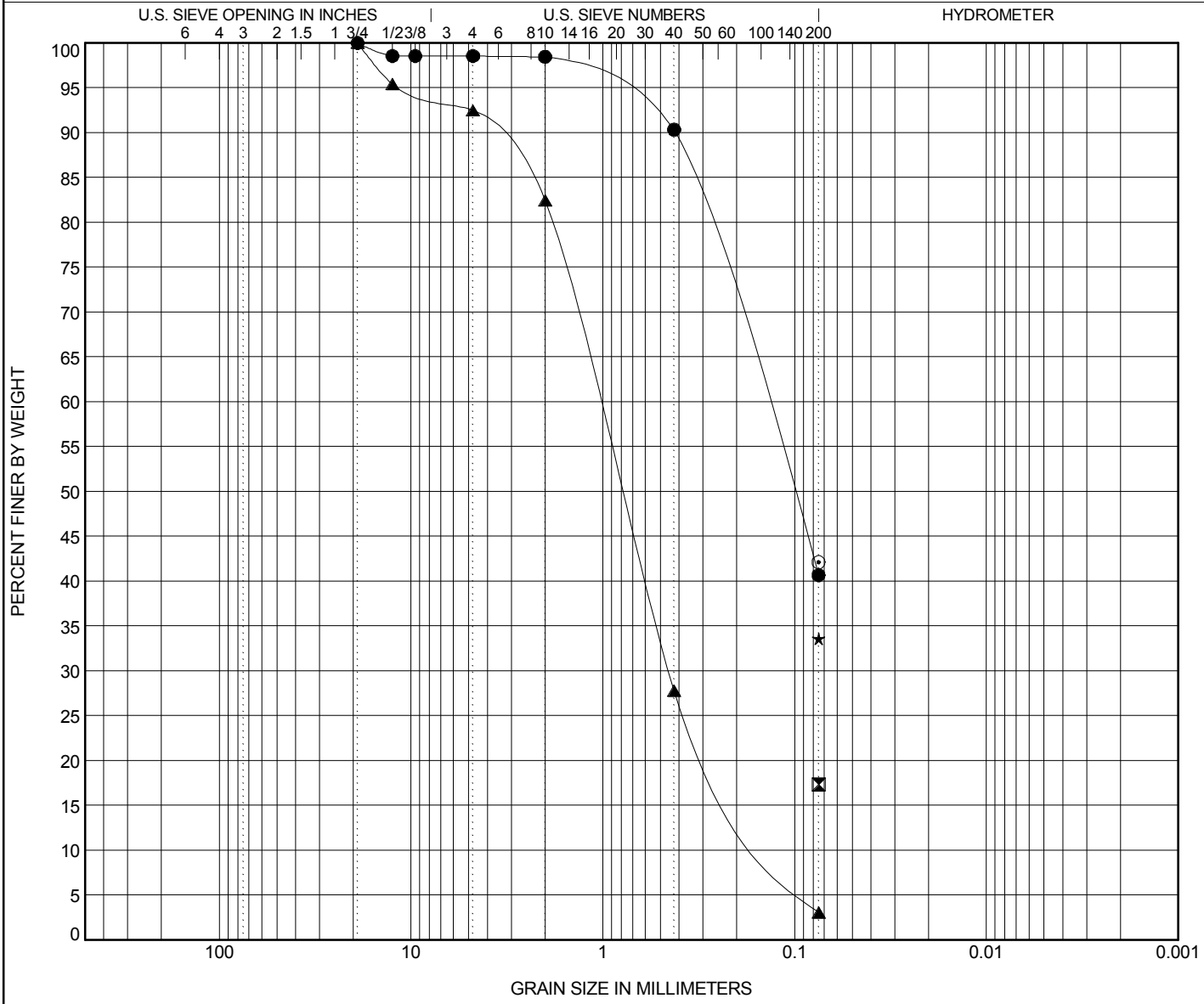

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification			Classification	LL	PL	PI	Cc	Cu
●	BR- 10	15	(Bedrock) SILTY SANDSTONE (SM)	NP	NP	NP		
⊠	BR- 10	25	(Bedrock) SILTY SANDSTONE (SM)	NP	NP	NP		
▲	BR- 11	5	WELL-GRADED SAND (SW)	NP	NP	NP	1.59	8.68
★	BR- 11	10	(Bedrock) SILTY SANDSTONE (SM)	40	34	6		
⊙	BR- 11	17	(Bedrock) SILTY SANDSTONE (SM)	40	28	12		

Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	BR- 10	15	19	0.147			1.5	57.9	40.7	
⊠	BR- 10	25	0.075						17.3	
▲	BR- 11	5	19	1.059	0.453	0.122	7.5	89.4	3.1	
★	BR- 11	10	0.075						33.6	
⊙	BR- 11	17	0.075						42.1	

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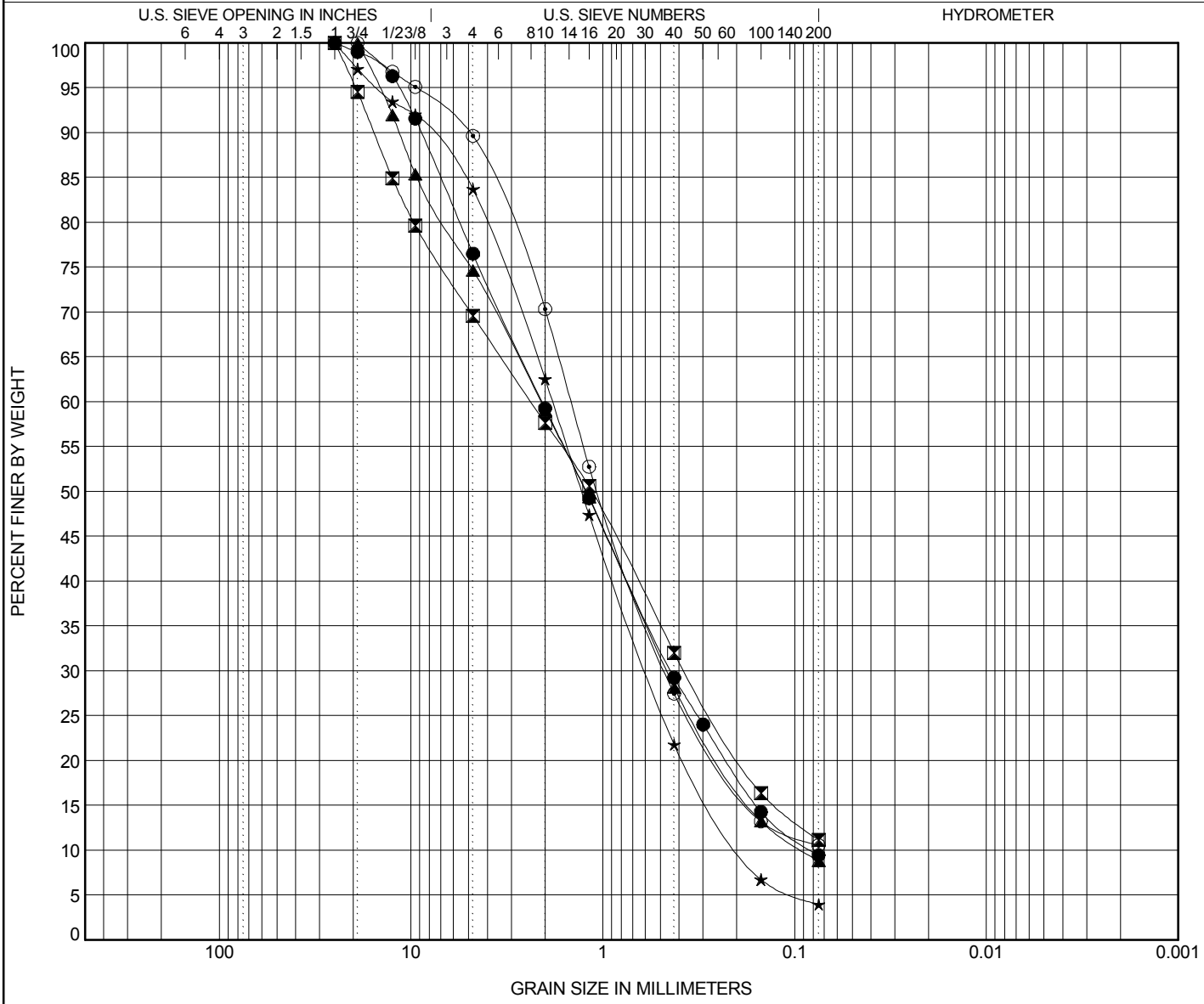

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification			Classification	LL	PL	PI	Cc	Cu
●	BR- 12	13"-5'	WELL-GRADED SAND with SILT and GRAVEL (SW-SM)	NP	NP	NP	1.16	25.53
⊠	BR- 12	1	POORLY GRADED SAND with SILT and GRAVEL (SP-SM)	NP	NP	NP	0.90	36.85
▲	BR- 12	9	WELL-GRADED SAND with SILT and GRAVEL (SW-SM)	NP	NP	NP	1.14	23.37
★	BR- 12	19	WELL-GRADED SAND with GRAVEL (SW)	NP	NP	NP	1.01	9.73
⊙	BR- 13	9	WELL-GRADED SAND with SILT (SW-SM)	NP	NP	NP	2.33	22.61

Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	BR- 12	13"-5'	25	2.076	0.442	0.081	23.5	67.1	9.4	
⊠	BR- 12	1	25	2.373	0.371		30.4	58.4	11.2	
▲	BR- 12	9	19	2.106	0.464	0.09	25.4	65.8	8.8	
★	BR- 12	19	25	1.83	0.589	0.188	16.3	79.7	4.0	
⊙	BR- 13	9	19	1.467	0.471		10.4	79.1	10.6	

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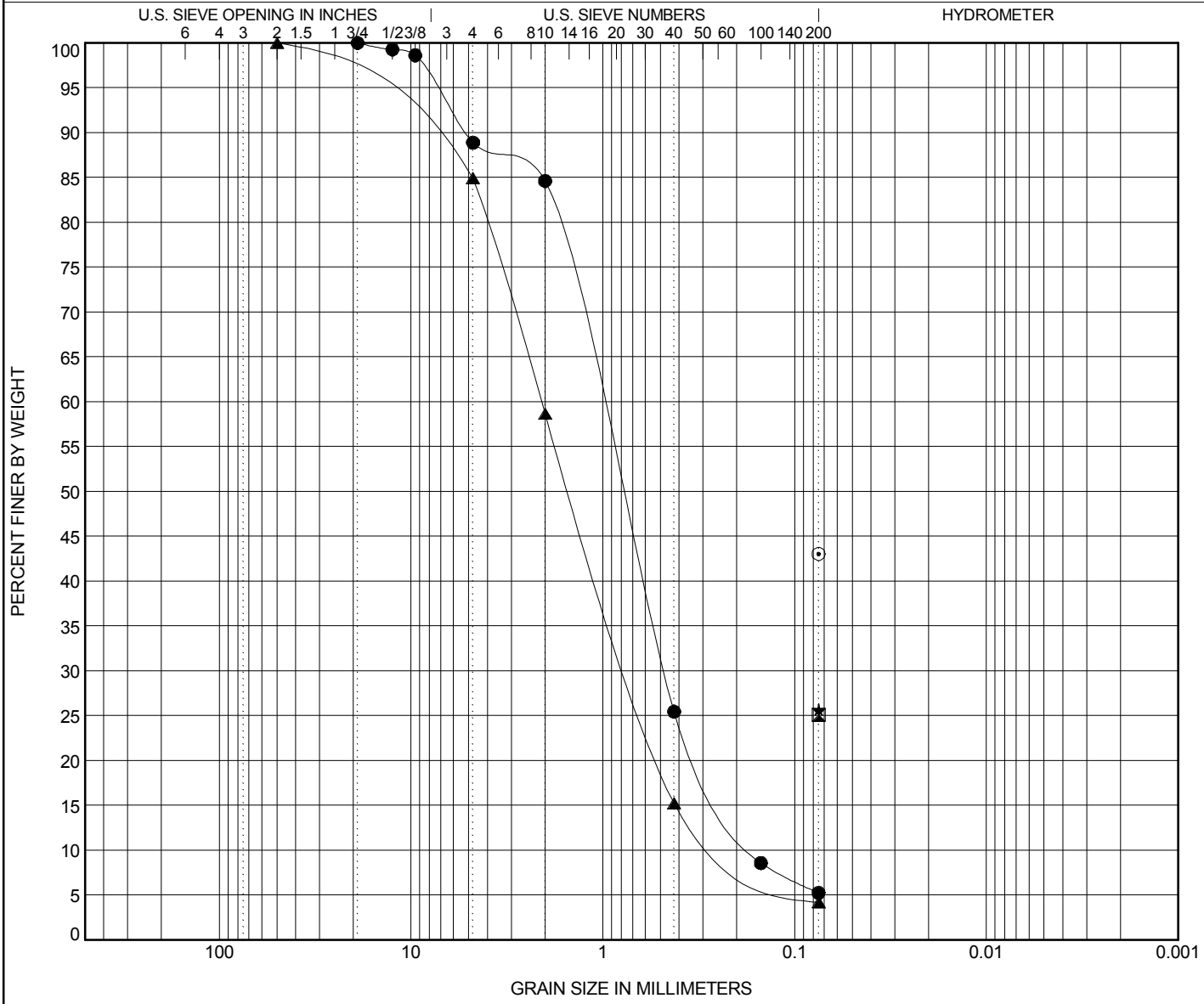

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	BR- 13	19	WELL-GRADED SAND with SILT (SW-SM)	NP	NP	NP	1.33	6.41
⊠	BR- 13	29	(Bedrock) SILTY SANDSTONE (SM)	34	24	10		
▲	BR- 14	9	WELL-GRADED SAND with GRAVEL (SW)	NP	NP	NP	1.33	11.22
★	BR- 14	14	(Bedrock) SILTY SANDSTONE (SM)	39	33	6		
⊙	BR- 14	22	(Bedrock) SILTY SANDSTONE (SM)	39	29	10		

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	BR- 13	19	19	1.05	0.479	0.164	11.1	83.6	5.3	
⊠	BR- 13	29	0.075						25.1	
▲	BR- 14	9	50	2.09	0.719	0.186	15.1	80.7	4.2	
★	BR- 14	14	0.075						25.7	
⊙	BR- 14	22	0.075						43.0	

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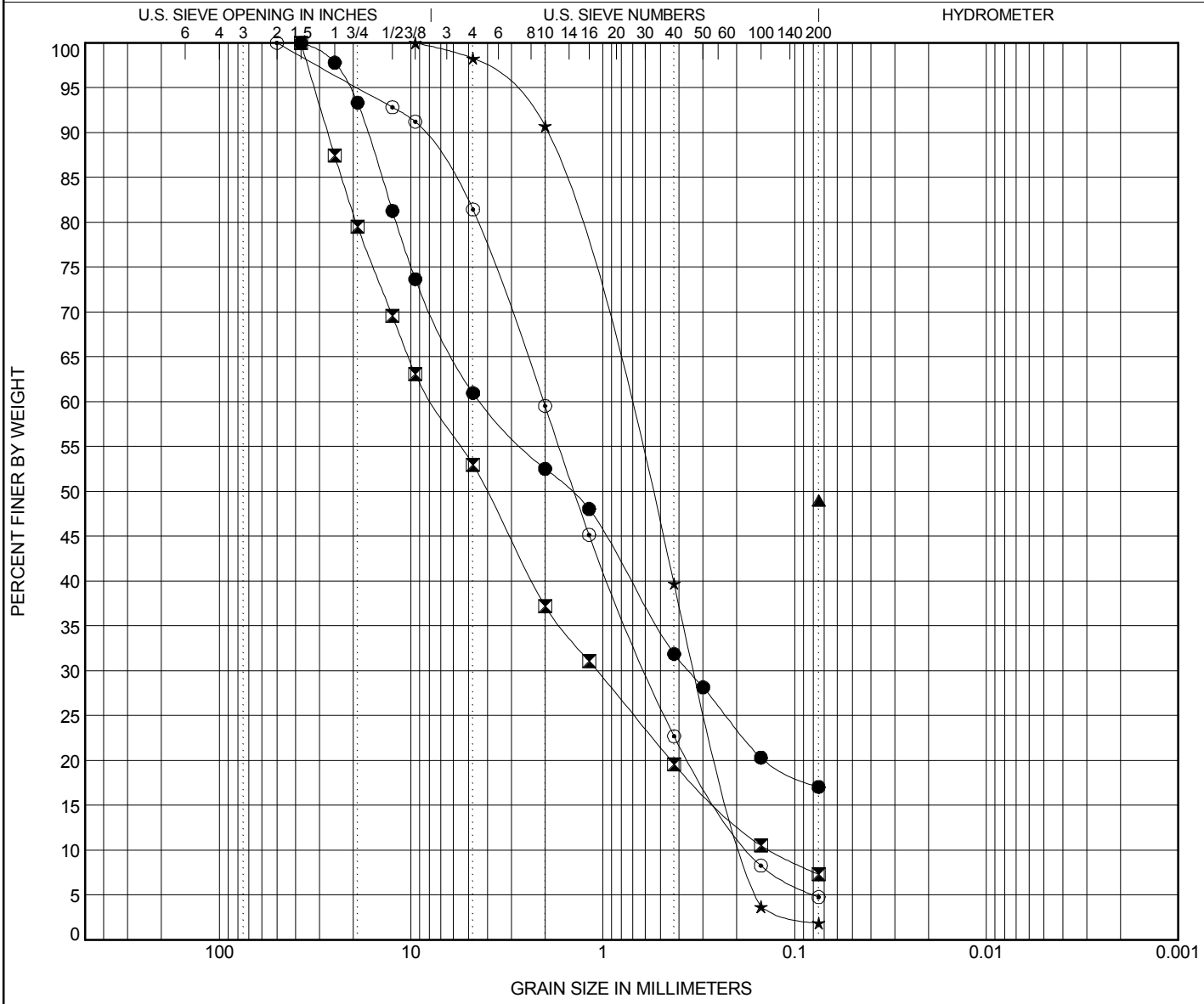

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification			Classification	LL	PL	PI	Cc	Cu
●	BR- 15	8.5"-5'	SILTY SAND with GRAVEL (SM)	NP	NP	NP		
⊠	BR- 15	1	WELL-GRADED GRAVEL with SILT and SAND (GW-GM)	NP	NP	NP	1.12	57.47
▲	BR- 15	14	CLAYEY SAND (SC)	30	14	16		
★	BR- 15	25	POORLY GRADED SAND (SP)	NP	NP	NP	0.73	4.37
⊙	BR- 15	34	WELL-GRADED SAND with GRAVEL (SW)	NP	NP	NP	1.01	11.99

Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	BR- 15	8.5"-5'	37.5	4.303	0.356		39.0	43.9	17.1	
⊠	BR- 15	1	37.5	7.684	1.074	0.134	47.0	45.7	7.3	
▲	BR- 15	14	0.075						49.0	
★	BR- 15	25	9.5	0.786	0.321	0.18	1.7	96.4	1.9	
⊙	BR- 15	34	50	2.038	0.592	0.17	18.6	76.7	4.8	

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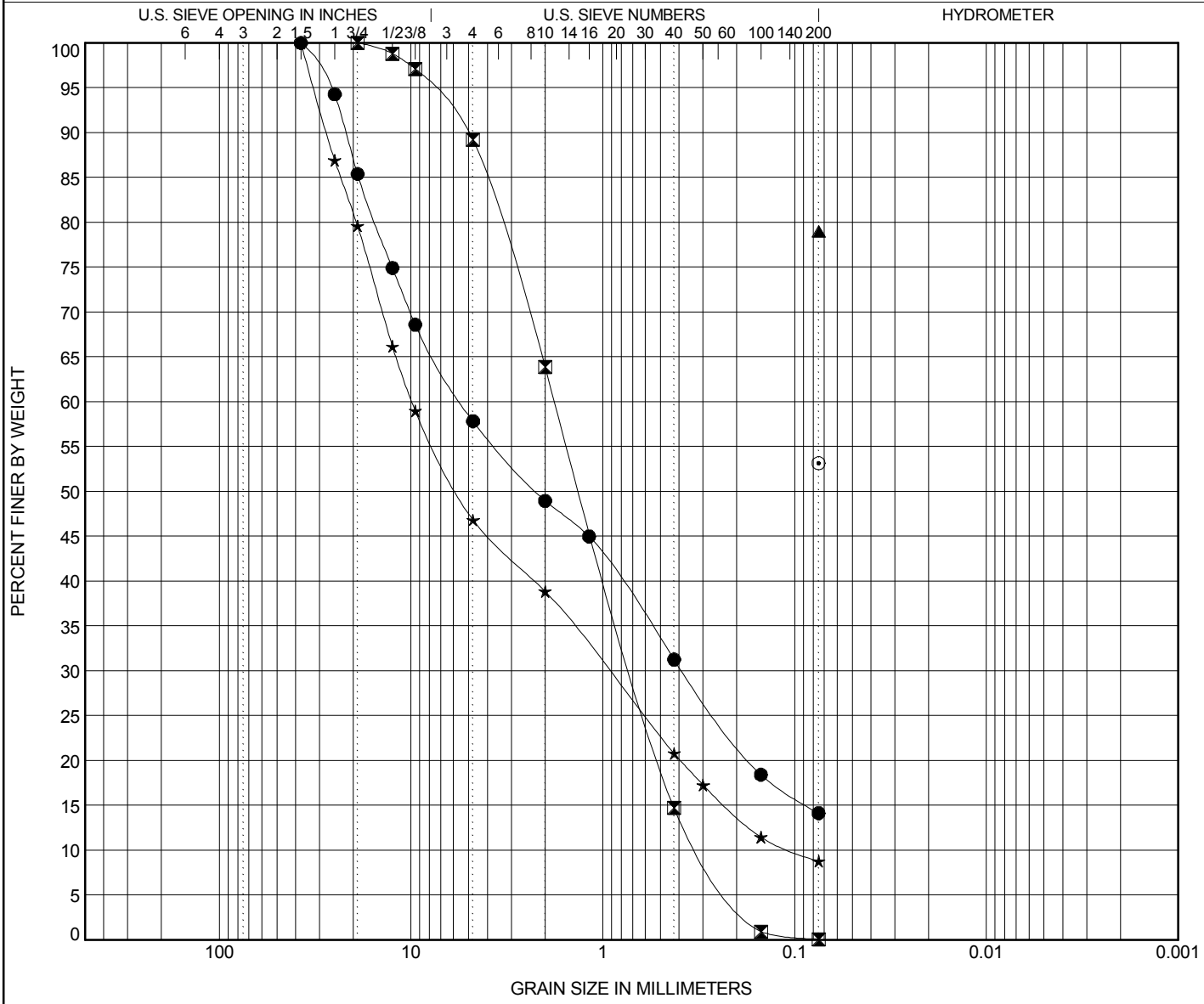

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification			Classification	LL	PL	PI	Cc	Cu
●	BR- 16	8"-5'	CLAYEY SAND with GRAVEL (SC)	25	16	9		
⊠	BR- 16	25	POORLY GRADED SAND (SP)	NP	NP	NP	0.90	5.94
▲	BR- 16	50	(Bedrock) CLAYSTONE (CL)	41	20	21		
★	BR- 17	9"-5'	POORLY GRADED GRAVEL with SILT and SAND (GP-GM)	NP	NP	NP	0.86	96.12
⊙	BR- 17	5	SANDY LEAN CLAY (CL)	37	15	22		

Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	BR- 16	8"-5'	37.5	5.462	0.384		42.2	43.7	14.1	
⊠	BR- 16	25	19	1.769	0.688	0.298	10.8	89.1	0.1	
▲	BR- 16	50	0.075						79.0	
★	BR- 17	9"-5'	37.5	9.879	0.935	0.103	53.2	38.0	8.8	
⊙	BR- 17	5	0.075						53.1	

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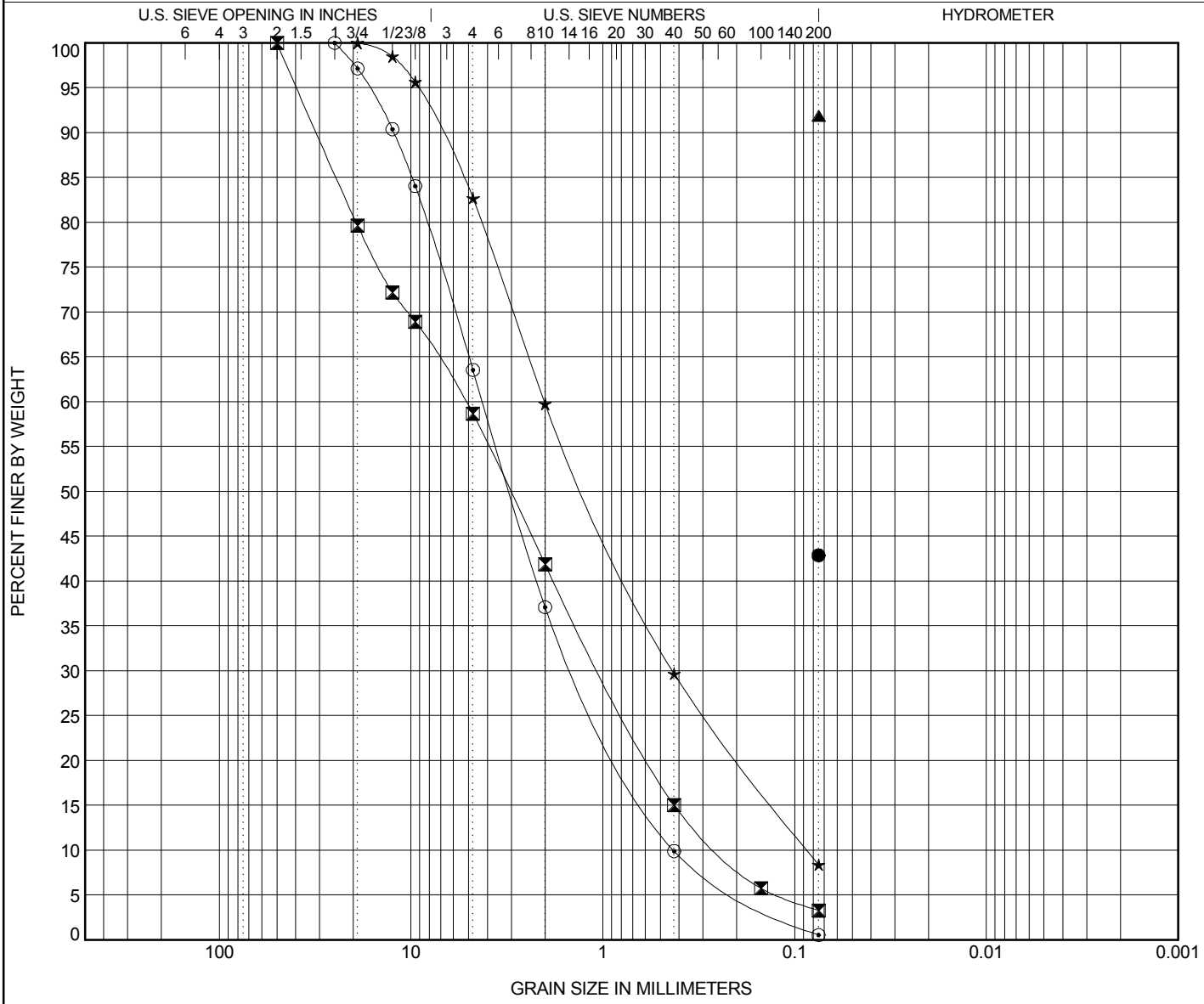

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification			Classification	LL	PL	PI	Cc	Cu
●	BR- 17	15	CLAYEY SAND (SC)	27	15	12		
⊠	BR- 17	30	POORLY GRADED SAND with GRAVEL (SP)	NP	NP	NP	0.81	21.51
▲	BR- 17	50	(Bedrock) CLAYSTONE (CL)	39	21	18		
★	BR- 18	16"-5'	WELL-GRADED SAND with SILT and GRAVEL (SW-SM)	NP	NP	NP	1.08	23.61
⊙	BR- 18	9	POORLY GRADED SAND with GRAVEL (SP)	NP	NP	NP	0.99	9.90

Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	BR- 17	15	0.075						42.9	
⊠	BR- 17	30	50	5.195	1.008	0.241	41.3	55.4	3.3	
▲	BR- 17	50	0.075						91.9	
★	BR- 18	16"-5'	19	2.018	0.432	0.086	17.3	74.3	8.4	
⊙	BR- 18	9	25	4.231	1.336	0.427	36.5	63.0	0.5	

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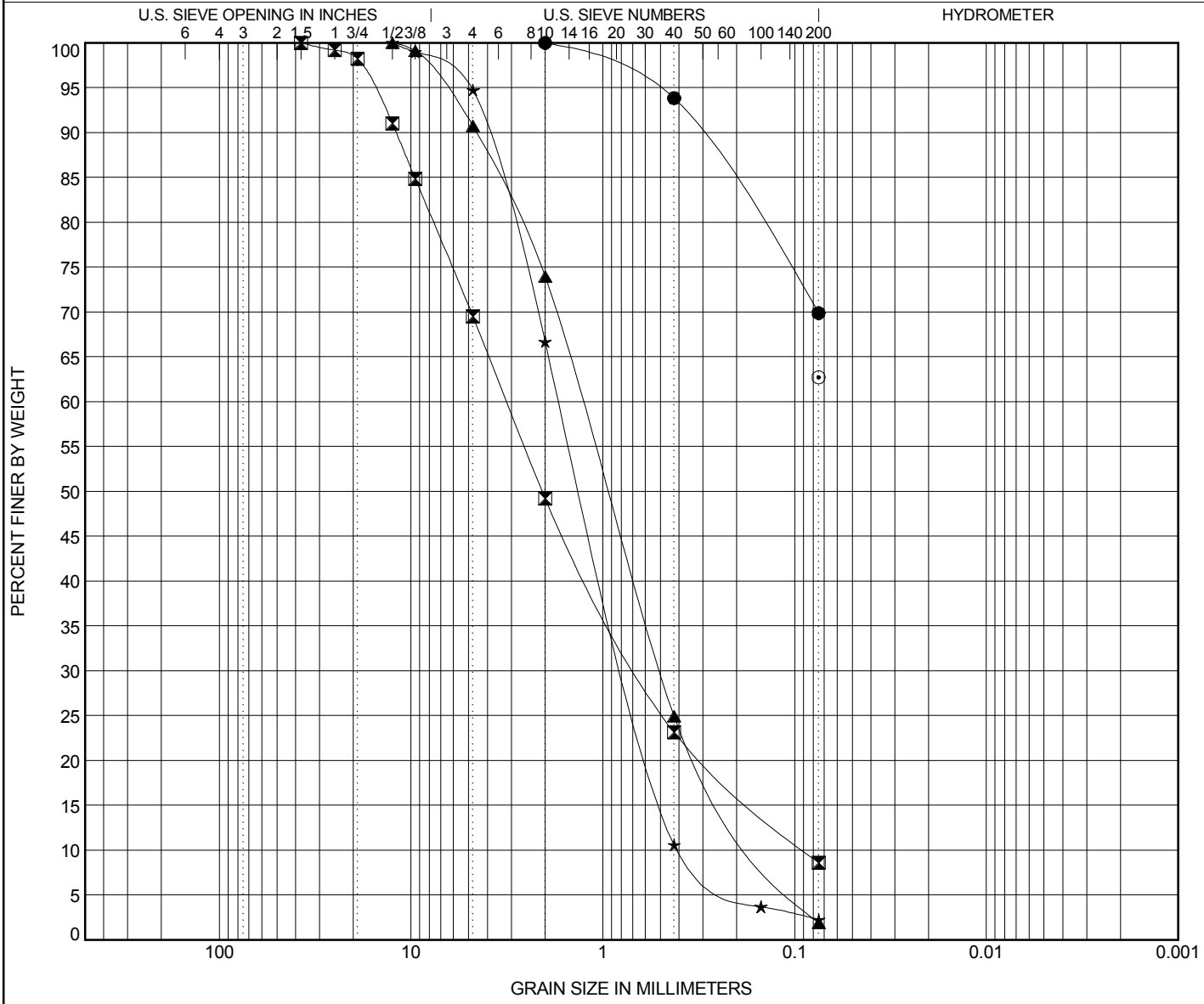

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	BR- 18	34	(Bedrock) CLAYSTONE (CL)	34	20	14		
⊠	BR- 19	16"-5'	WELL-GRADED SAND with SILT and GRAVEL (SW-SM)	17	18	NP	1.45	35.82
▲	BR- 19	5	WELL-GRADED SAND (SW)	NP	NP	NP	1.40	9.33
★	BR- 19	15	POORLY GRADED SAND (SP)	NP	NP	NP	0.82	4.28
⊙	BR- 19	29	(Bedrock) CLAYSTONE (CL)	41	19	22		

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	BR- 18	34	2				0.0	30.1	69.9	
⊠	BR- 19	16"-5'	37.5	3.167	0.638	0.088	30.5	60.9	8.6	
▲	BR- 19	5	12.5	1.286	0.498	0.138	9.3	88.8	1.9	
★	BR- 19	15	12.5	1.662	0.726	0.388	5.2	92.5	2.3	
⊙	BR- 19	29	0.075						62.7	

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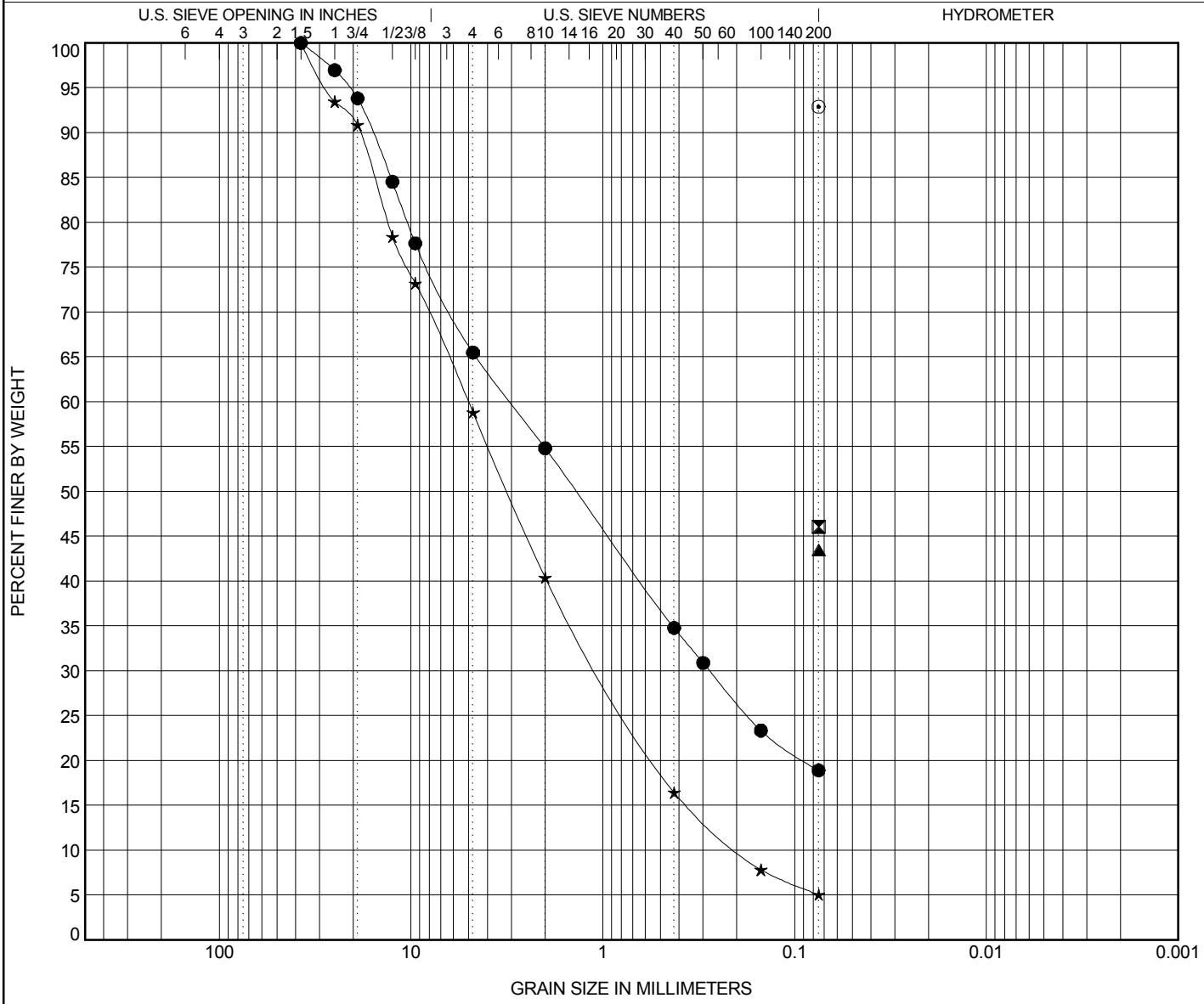

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification			Classification	LL	PL	PI	Cc	Cu
●	BR- 20	8"-5'	SILTY SAND with GRAVEL (SM)	NP	NP	NP		
⊠	BR- 20	15	CLAYEY SAND (SC)	29	13	16		
▲	BR- 20	25	CLAYEY SAND (SC)	29	14	15		
★	BR- 20	35	WELL-GRADED SAND with SILT and GRAVEL (SW-SM)	NP	NP	NP	1.06	25.79
⊙	BR- 20	50	(Bedrock) CLAYSTONE (CH)	50	22	28		

Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	BR- 20	8"-5'	37.5	3.045	0.277		34.5	46.6	18.9	
⊠	BR- 20	15	0.075						46.0	
▲	BR- 20	25	0.075						43.5	
★	BR- 20	35	37.5	5.028	1.021	0.195	41.2	53.8	5.1	
⊙	BR- 20	50	0.075						92.9	

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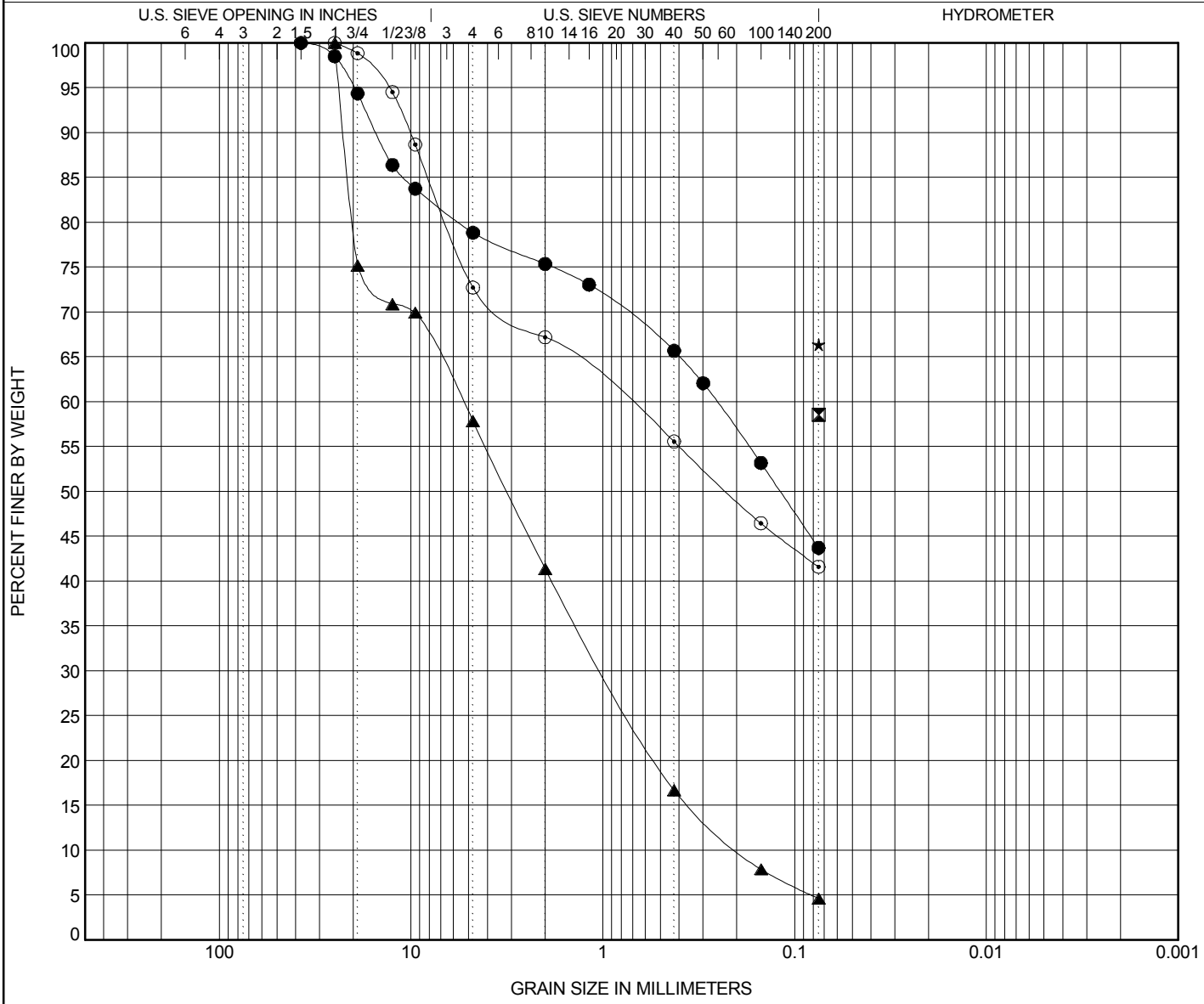

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification			Classification	LL	PL	PI	Cc	Cu
●	BR- 21	7"-5'	CLAYEY SAND with GRAVEL (SC)	30	15	15		
⊠	BR- 21	20	SANDY LEAN CLAY (CL)	42	15	27		
▲	BR- 21	35	POORLY GRADED SAND with GRAVEL (SP)	NP	NP	NP	0.93	27.87
★	BR- 21	55	(Bedrock) SILTSTONE (ML)	38	25	13		
⊙	BR- 22	8.5"-5'	SILTY SAND with GRAVEL (SM)	NP	NP	NP		

Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	BR- 21	7"-5'	37.5	0.255			21.2	35.1	43.7	
⊠	BR- 21	20	0.075						58.6	
▲	BR- 21	35	25	5.375	0.98	0.193	42.2	53.2	4.6	
★	BR- 21	55	0.075						66.4	
⊙	BR- 22	8.5"-5'	25	0.768			27.3	31.1	41.6	

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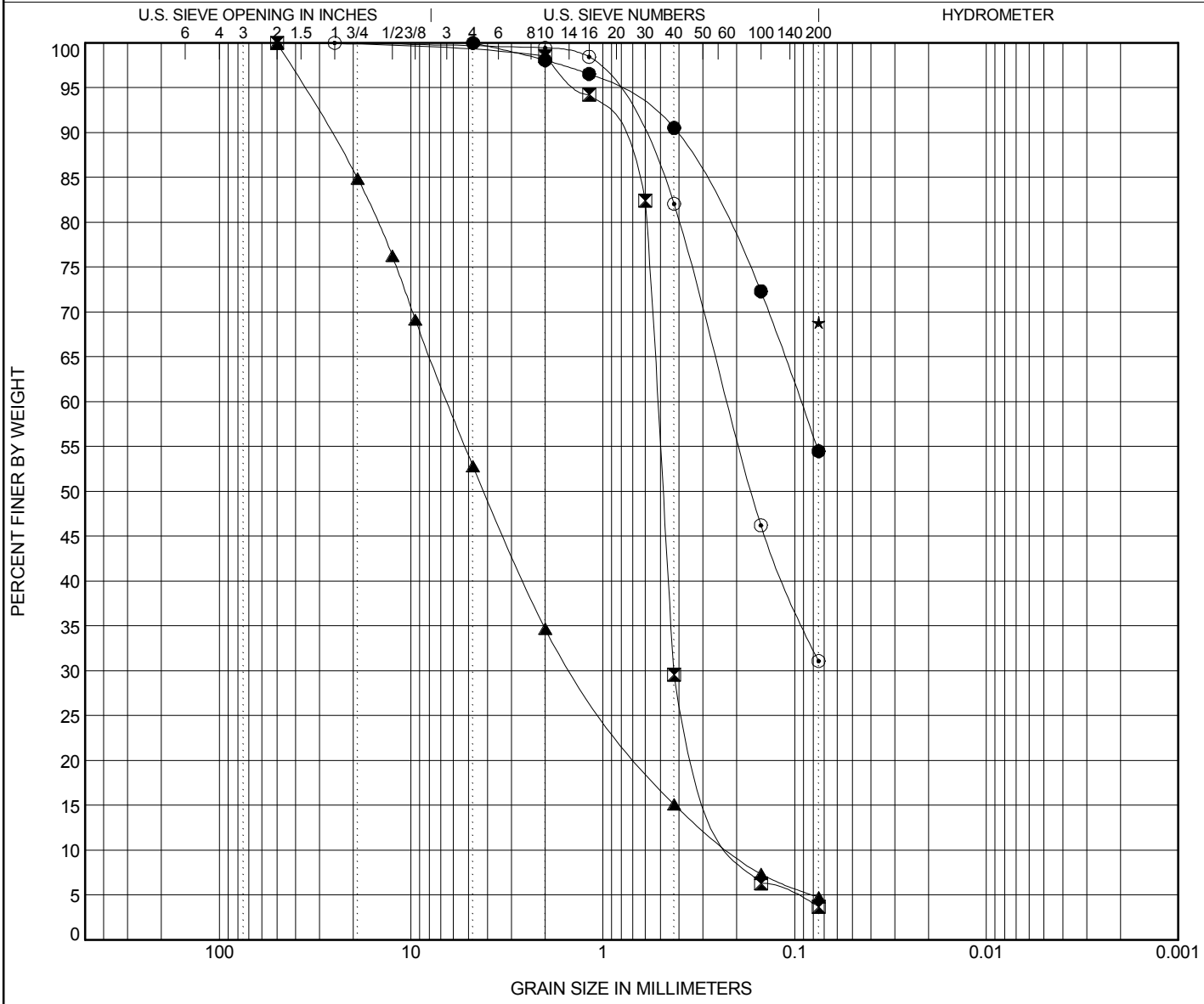

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	BR- 22	14	SANDY LEAN CLAY (CL)	31	16	15		
⊠	BR- 22	34	POORLY GRADED SAND (SP)	NP	NP	NP	1.98	2.93
▲	BR- 22	39	WELL-GRADED SAND with GRAVEL (SW)	NP	NP	NP	1.38	30.10
★	BR- 22	54	SANDY LEAN CLAY (CL)	40	22	18		
⊙	BR- 23	19	(Bedrock) SANDSTONE	36	21	15		

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	BR- 22	14	4.75	0.093			0.0	45.5	54.5	
⊠	BR- 22	34	50	0.518	0.426	0.177	1.0	95.2	3.7	
▲	BR- 22	39	50	6.443	1.38	0.214	47.2	48.0	4.8	
★	BR- 22	54	0.075						68.8	
⊙	BR- 23	19	25	0.224			0.4	68.5	31.1	

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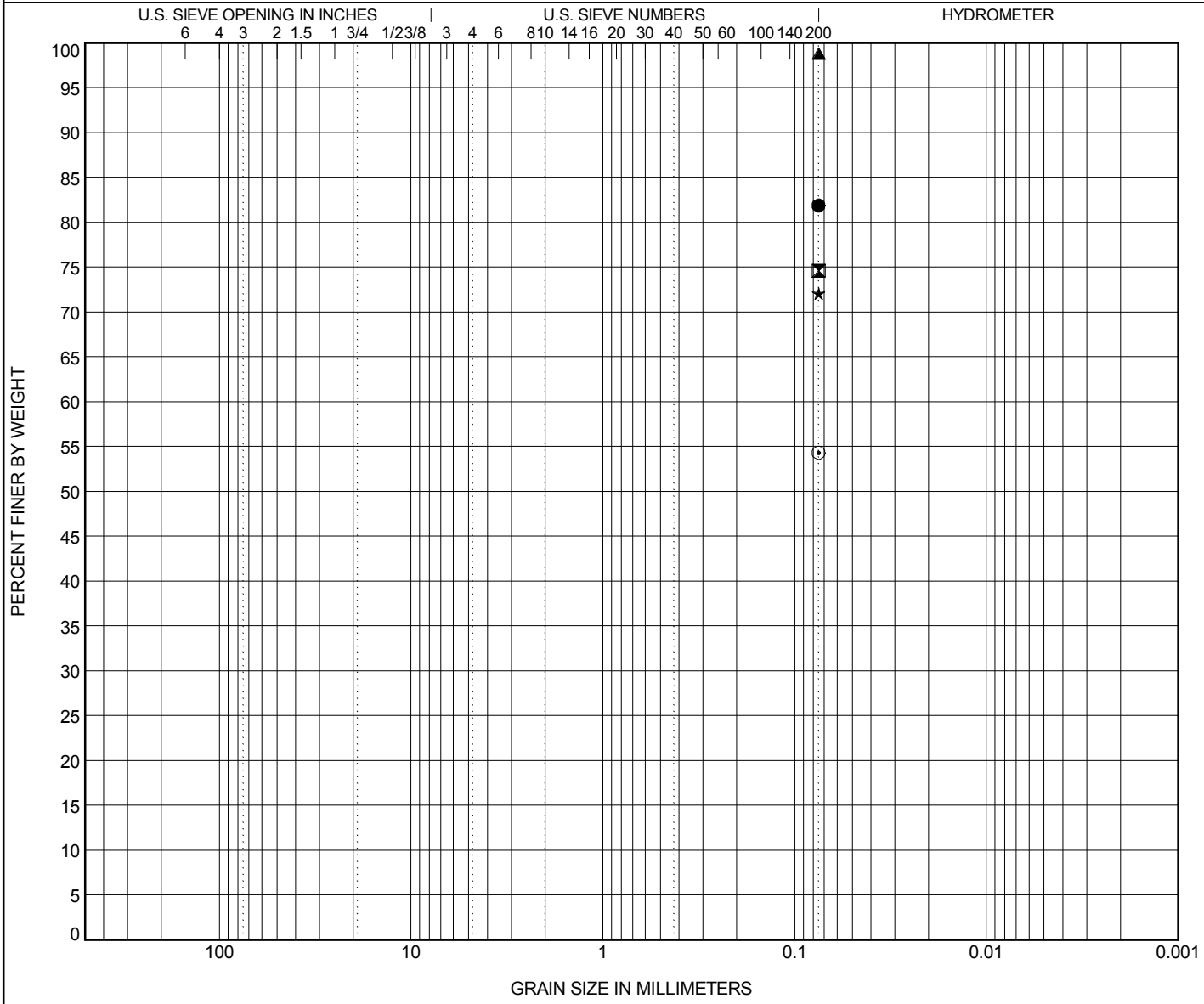

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	BR- 23 34	(Bedrock) CLAYSTONE	48	17	31		
⊠	BR- 24 14	LEAN CLAY with SAND (CL)	48	11	37		
▲	BR- 24 34	(Bedrock) CLAYSTONE	49	23	26		
★	BR- 25 4	LEAN CLAY with SAND (CL)	45	12	33		
⊙	BR- 25 15	(Bedrock) CLAYSTONE	40	23	17		

Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	BR- 23 34	0.075						81.9	
⊠	BR- 24 14	0.075						74.6	
▲	BR- 24 34	0.075						98.8	
★	BR- 25 4	0.075						72.1	
⊙	BR- 25 15	0.075						54.3	

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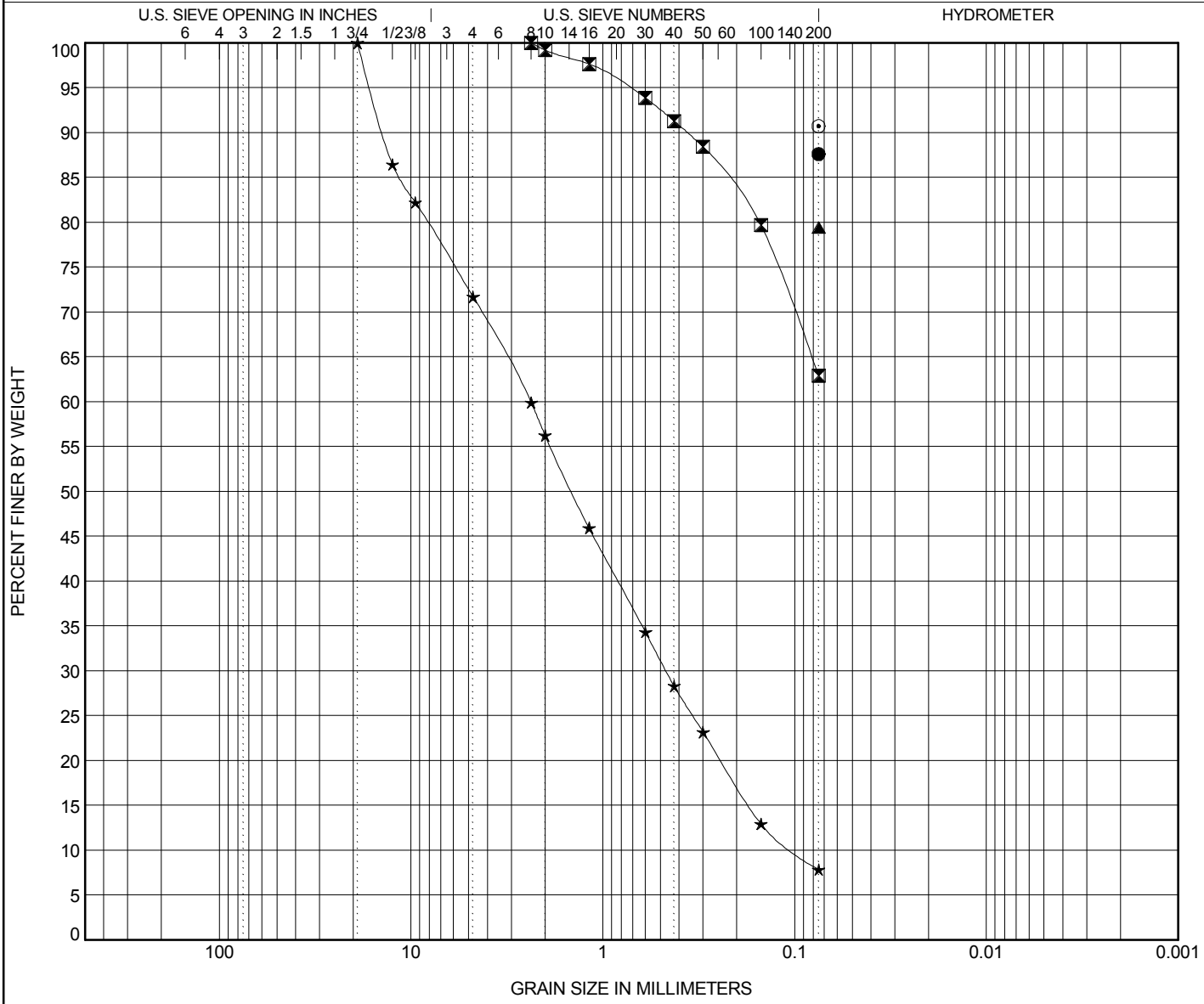

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	BR- 26	5	FAT CLAY (CH)	53	18	35		
⊠	BR- 26	20	SANDY LEAN CLAY (CL)	41	18	23		
▲	BR- 26	40	FAT CLAY with SAND (CH)	65	20	45		
★	BR- 26	75	POORLY GRADED SAND with SILT and GRAVEL (SP-SM)	NP	NP	NP	0.92	23.60
⊙	BR- 26	90	(Bedrock) SILTSTONE	52	29	23		

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	BR- 26	5	0.075						87.6	
⊠	BR- 26	20	2.36				0.0	37.1	62.9	
▲	BR- 26	40	0.075						79.4	
★	BR- 26	75	19	2.372	0.468	0.1	28.3	63.9	7.8	
⊙	BR- 26	90	0.075						90.7	

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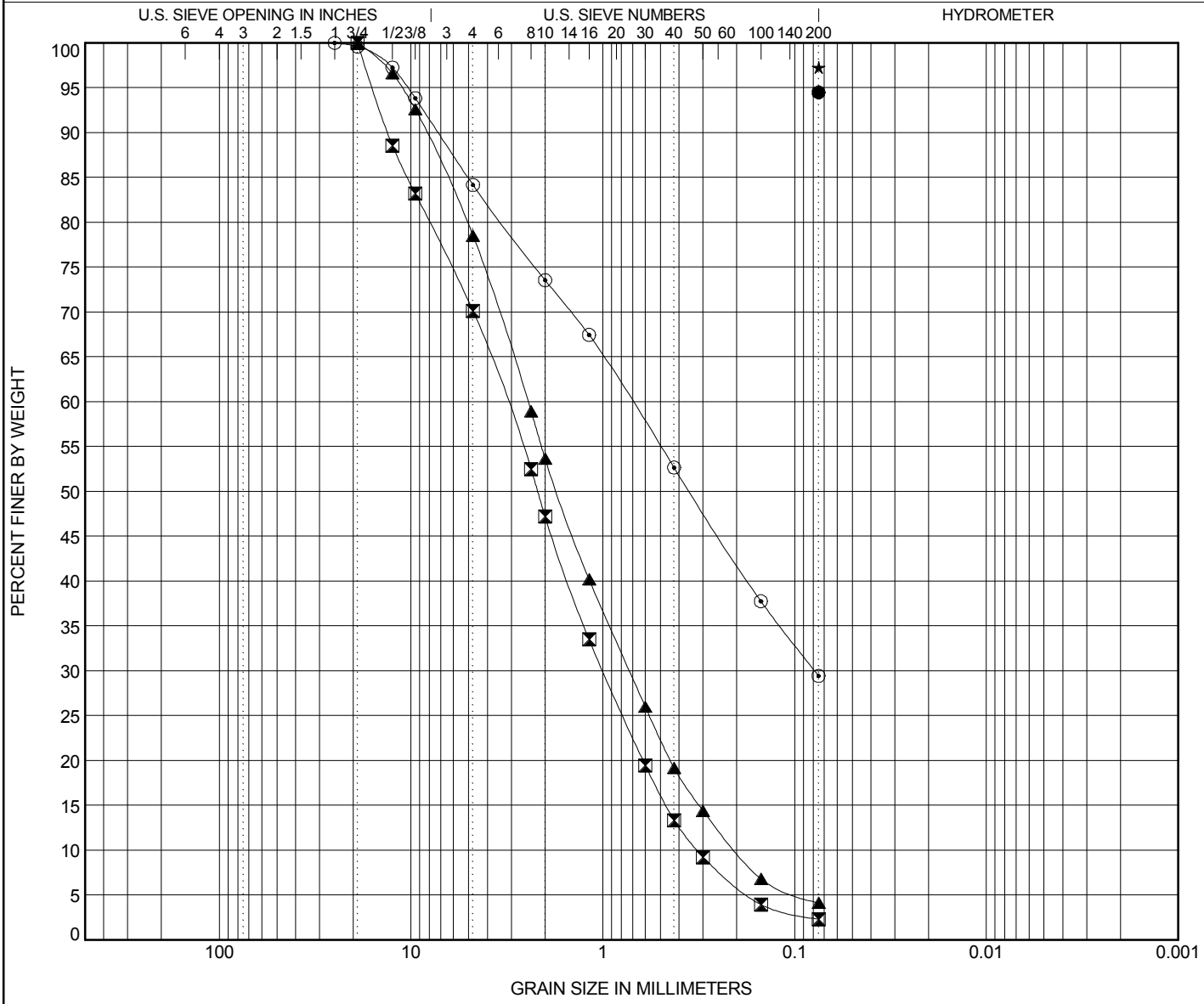

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	BR- 27	15	FAT CLAY (CH)	69	20	49		
⊠	BR- 27	30	POORLY GRADED SAND with GRAVEL (SP)	NP	NP	NP	0.98	9.95
▲	BR- 27	45	WELL-GRADED SAND with GRAVEL (SW)	NP	NP	NP	1.07	12.22
★	BR- 27	65	(Bedrock) CLAYSTONE	48	27	21		
⊙	RW 1-1	6"-5'	SILTY, CLAYEY SAND with GRAVEL (SC-SM)	22	17	5		

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	BR- 27	15	0.075						94.5	
⊠	BR- 27	30	19	3.182	0.997	0.32	29.9	67.8	2.3	
▲	BR- 27	45	19	2.453	0.726	0.201	21.5	74.4	4.1	
★	BR- 27	65	0.075						97.3	
⊙	RW 1-1	6"-5'	25	0.706	0.079		15.8	54.7	29.4	

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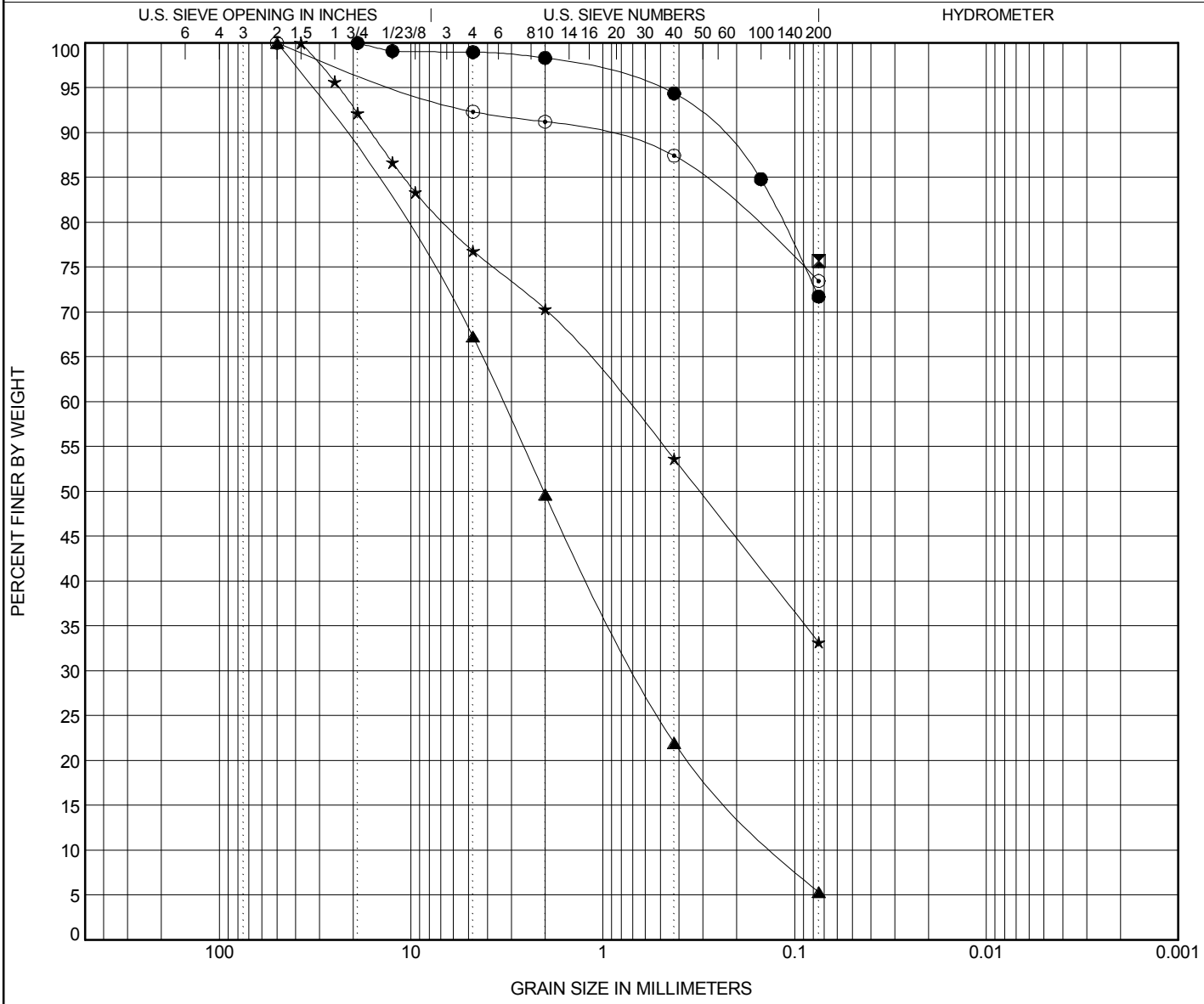

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification			Classification	LL	PL	PI	Cc	Cu
●	RW 1-1	9	LEAN CLAY with SAND (CL)	46	17	29		
⊠	RW 1-2	4	FAT CLAY with SAND (CH)	54	18	36		
▲	RW 1-2	14	WELL-GRADED SAND with SILT and GRAVEL (SW-SM)	NP	NP	NP	1.09	27.25
★	RW 2-1	0-5'	CLAYEY SAND with GRAVEL (SC)	35	17	18		
⊙	RW 2-1	10	FAT CLAY with SAND (CH)	52	21	31		

Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	RW 1-1	9	19				1.0	27.3	71.7	
⊠	RW 1-2	4	0.075						75.7	
▲	RW 1-2	14	50	3.322	0.665	0.122	32.7	61.9	5.3	
★	RW 2-1	0-5'	37.5	0.766			23.2	43.6	33.2	
⊙	RW 2-1	10	50				7.7	18.9	73.5	

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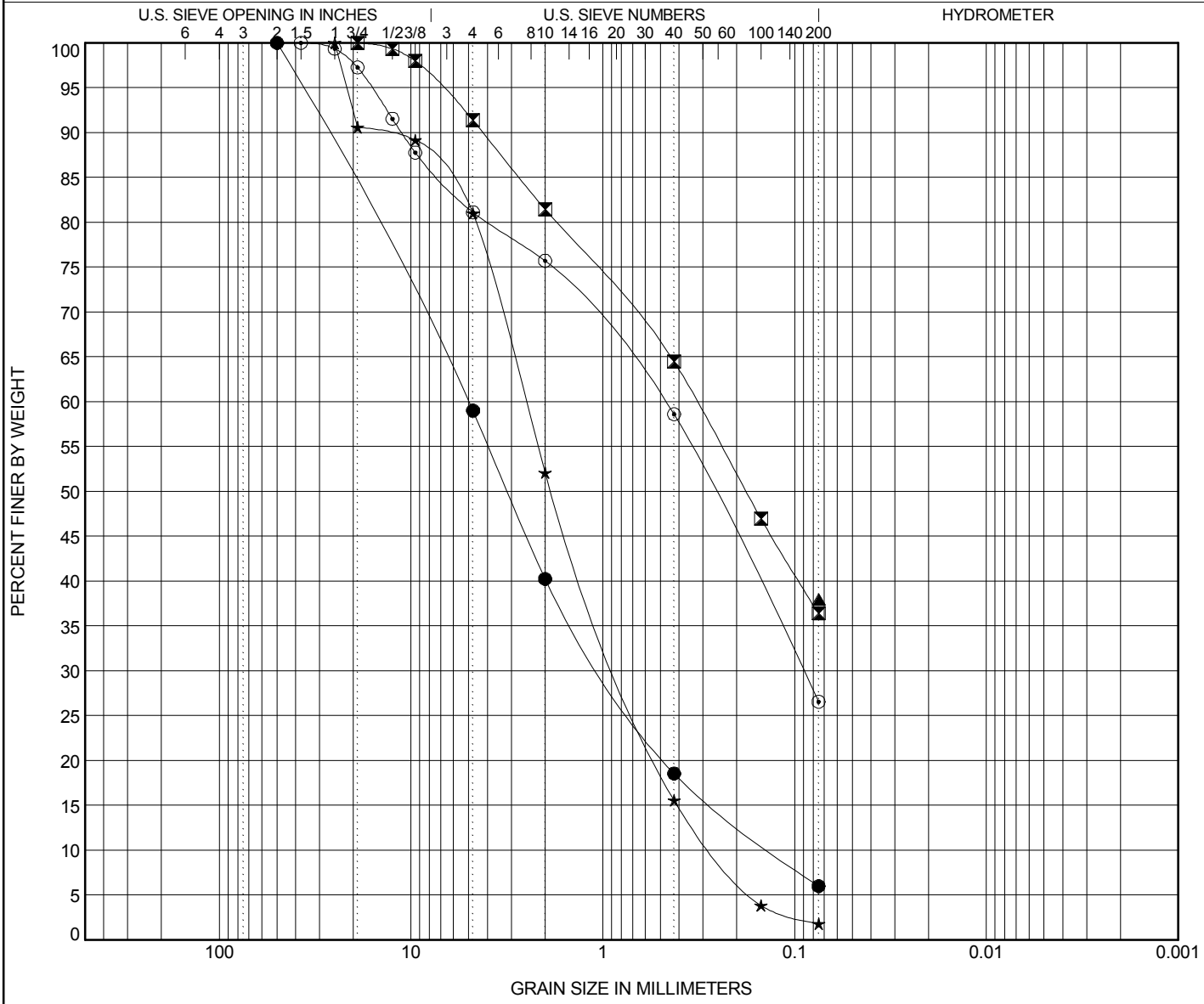

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	RW 2-1	20	WELL-GRADED SAND with SILT and GRAVEL (SW-SM)	NP	NP	NP	1.41	38.58
⊠	RW 2-2	0-5'	CLAYEY SAND (SC)	35	17	18		
▲	RW 2-2	9	CLAYEY SAND					
★	RW 2-2	14	POORLY GRADED SAND with GRAVEL (SP)	NP	NP	NP	0.94	9.77
⊙	RW 3-1	0-5'	CLAYEY SAND with GRAVEL (SC)	25	15	10		

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	RW 2-1	20	50	5.027	0.962	0.13	41.0	53.0	6.0	
⊠	RW 2-2	0-5'	19	0.326			8.6	55.0	36.4	
▲	RW 2-2	9	0.075						38.0	
★	RW 2-2	14	25	2.533	0.784	0.259	19.0	79.2	1.8	
⊙	RW 3-1	0-5'	37.5	0.482	0.09		18.9	54.6	26.6	

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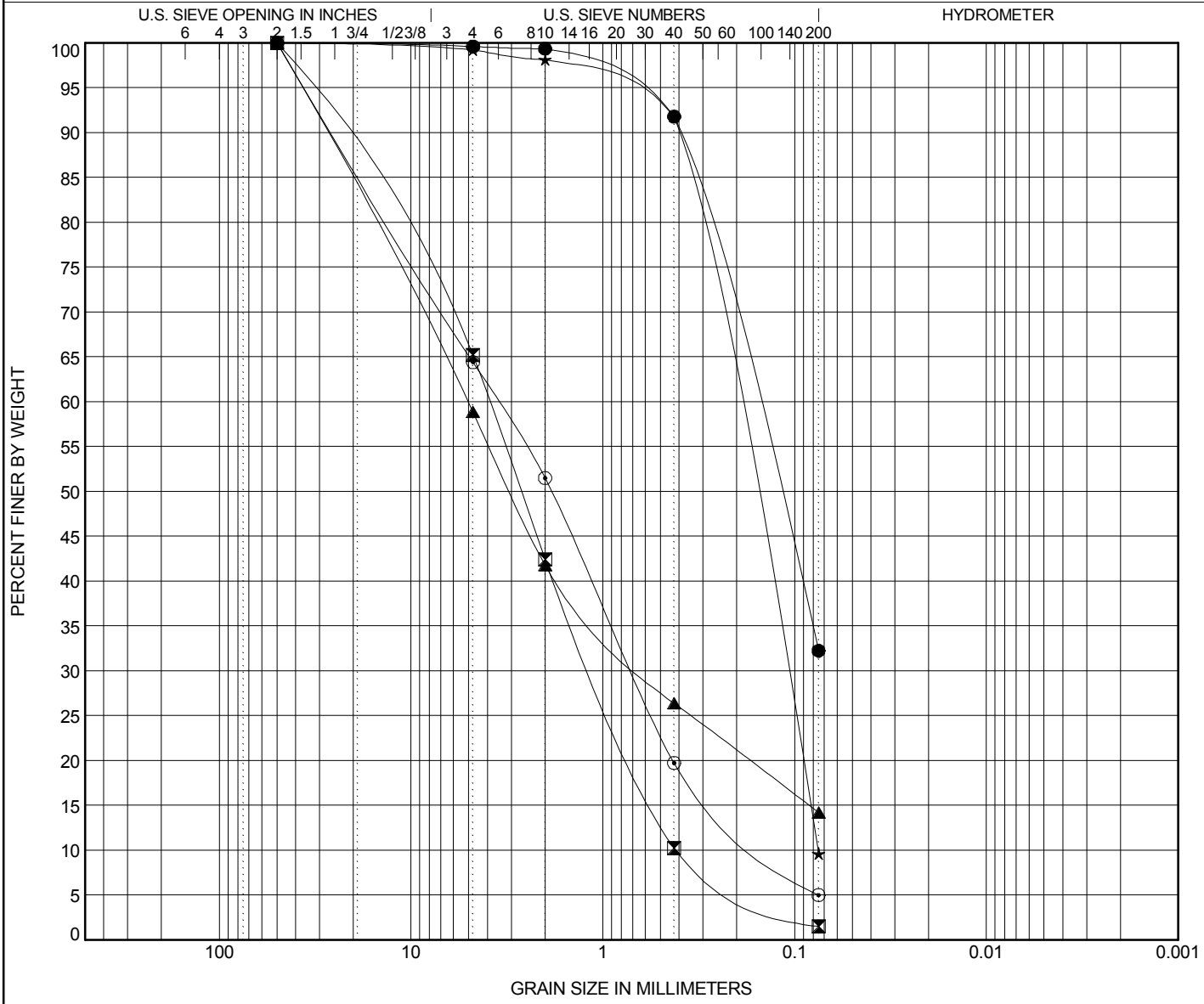

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification			Classification	LL	PL	PI	Cc	Cu
●	RW 3-1	2	CLAYEY SAND (SC)	39	15	24		
⧓	RW 3-1	20	POORLY GRADED SAND with GRAVEL (SP)				0.77	9.67
▲	RW 3-2	5	CLAYEY SAND with GRAVEL (SC)	25	16	9		
★	RW 3-2	10	POORLY GRADED SAND with SILT (SP-SM)	NP	NP	NP	0.81	2.87
⊙	RW 3-2	17	WELL-GRADED SAND with GRAVEL (SW)	NP	NP	NP	1.03	26.14

Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	RW 3-1	2	50	0.168			0.4	67.4	32.2	
⧓	RW 3-1	20	50	3.897	1.1	0.403	34.8	63.7	1.5	
▲	RW 3-2	5	50	5.066	0.612		41.1	44.7	14.2	
★	RW 3-2	10	50	0.217	0.115	0.076	0.8	89.6	9.6	
⊙	RW 3-2	17	50	3.536	0.701	0.135	35.6	59.4	5.0	

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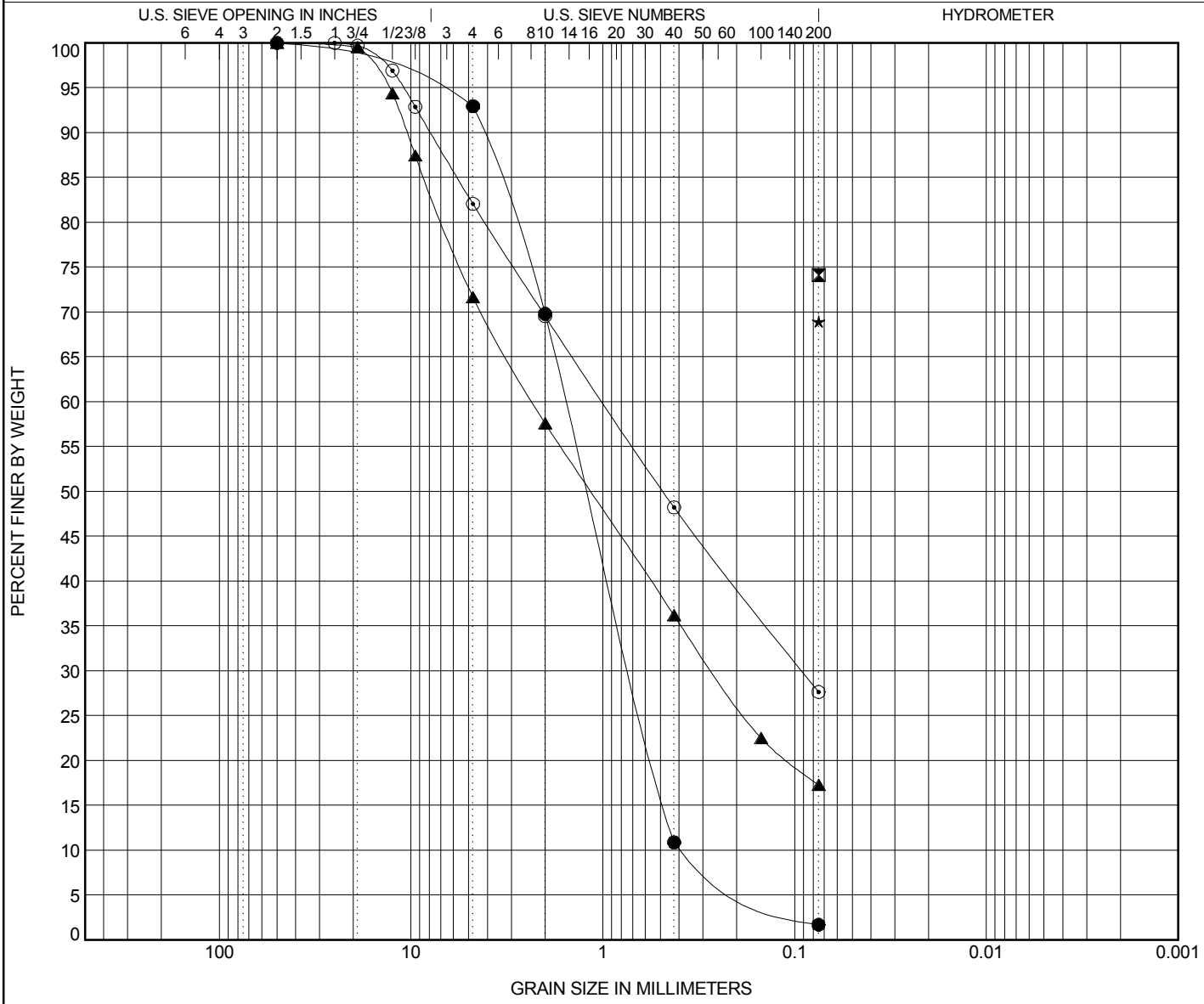

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification			Classification	LL	PL	PI	Cc	Cu
●	RW 3-2	20	POORLY GRADED SAND (SP)	NP	NP	NP	0.89	4.30
⊠	RW 3-2	25	(Bedrock) CLAYSTONE (CH)	51	25	26		
▲	RW 4-1	8"-5'	SILTY SAND with GRAVEL (SM)	NP	NP	NP		
★	RW 4-1	9	SANDY LEAN CLAY (CL)	43	20	23		
⊙	RW 4-2	8"-5'	SILTY SAND with GRAVEL (SM)	NP	NP	NP		

Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	RW 3-2	20	50	1.546	0.703	0.36	7.1	91.3	1.7	
⊠	RW 3-2	25	0.075						74.1	
▲	RW 4-1	8"-5'	50	2.318	0.265		28.3	54.4	17.3	
★	RW 4-1	9	0.075						68.9	
⊙	RW 4-2	8"-5'	25	1	0.092		18.0	54.4	27.6	

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GRAIN SIZE DISTRIBUTION

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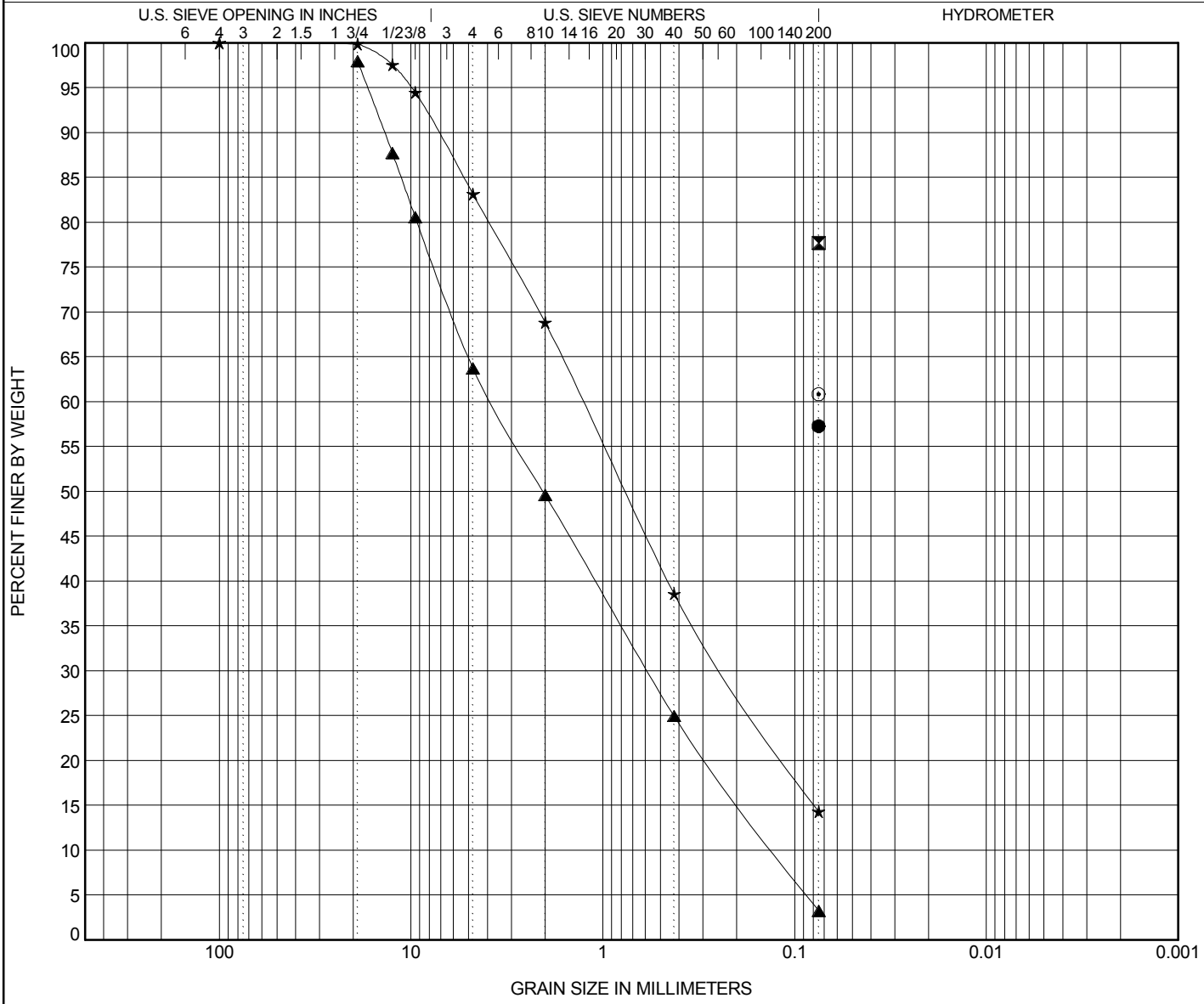
PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	RW 4-2	9	SANDY LEAN CLAY (CL)	40	18	22		
⊠	RW 4-2	14	FAT CLAY with SAND (CH)	59	23	36		
▲	RW 4-2	19	POORLY GRADED SAND with GRAVEL (SP)	NP	NP	NP	0.70	29.40
★	RW 4-3	20"-5'	SILTY SAND with GRAVEL (SM)	NP	NP	NP		
⊙	RW 4-3	9	SANDY LEAN CLAY (CL)	45	18	27		

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	RW 4-2	9	0.075						57.3	
⊠	RW 4-2	14	0.075						77.7	
▲	RW 4-2	19	19	3.781	0.583	0.129	34.2	60.5	3.2	
★	RW 4-3	20"-5'	100	1.272	0.23		16.8	68.9	14.3	
⊙	RW 4-3	9	0.075						60.8	

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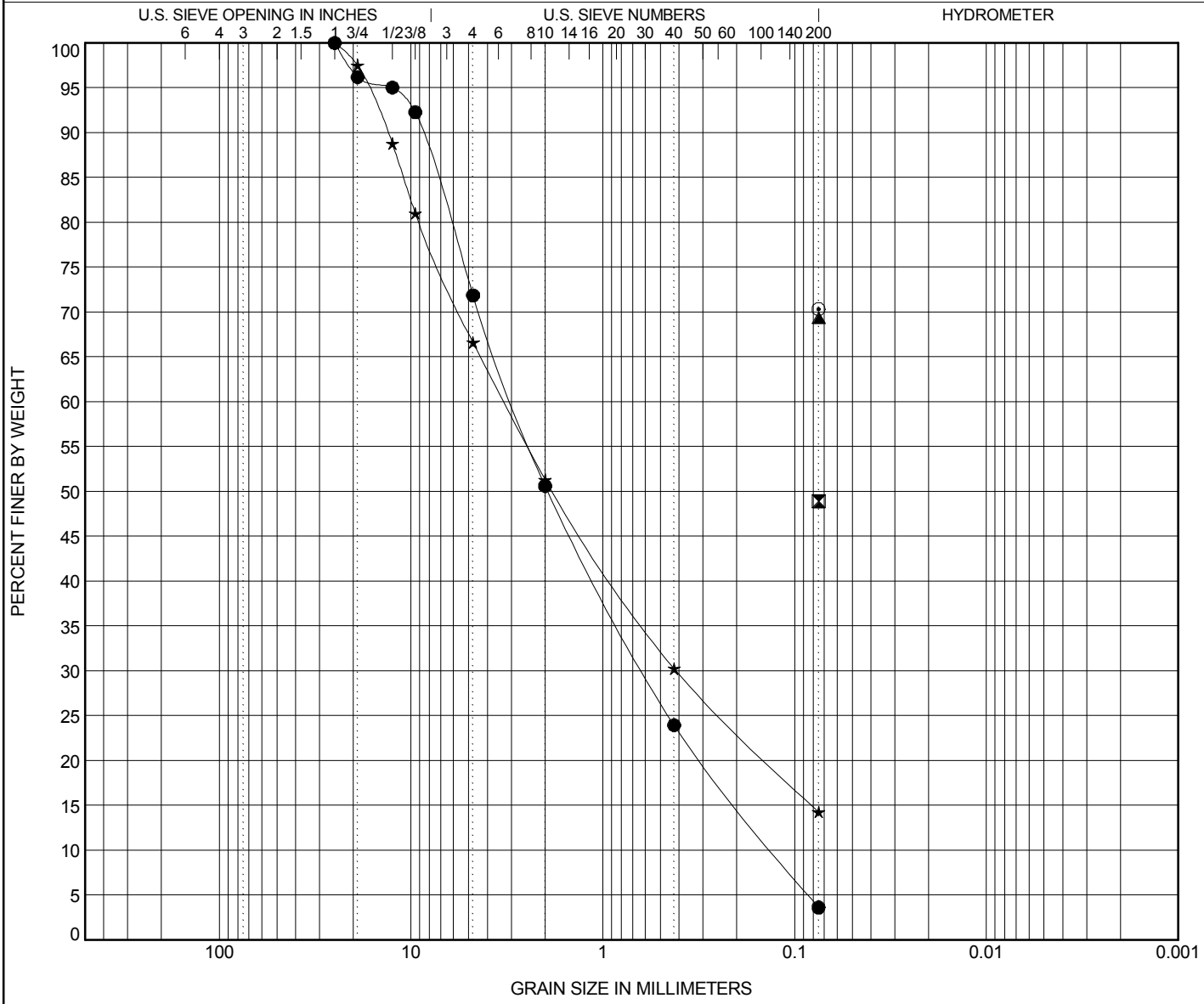

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification			Classification	LL	PL	PI	Cc	Cu
●	RW 4-3	14	POORLY GRADED SAND with GRAVEL (SP)	NP	NP	NP	0.96	22.67
⊠	RW 5-1	4	(Fill) CLAYEY SAND (SC)	34	17	17		
▲	RW 5-1	14	SANDY LEAN CLAY (CL)	47	16	31		
★	RW 5-2	1'-5'	SILTY SAND with GRAVEL (SM)	20	20	NP		
⊙	RW 5-2	9	LEAN CLAY with SAND (CL)	38	20	18		

Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	RW 4-3	14	25	2.931	0.604	0.129	28.1	68.2	3.6	
⊠	RW 5-1	4	0.075						48.9	
▲	RW 5-1	14	0.075						69.3	
★	RW 5-2	1'-5'	25	3.269	0.413		33.4	52.3	14.3	
⊙	RW 5-2	9	0.075						70.3	

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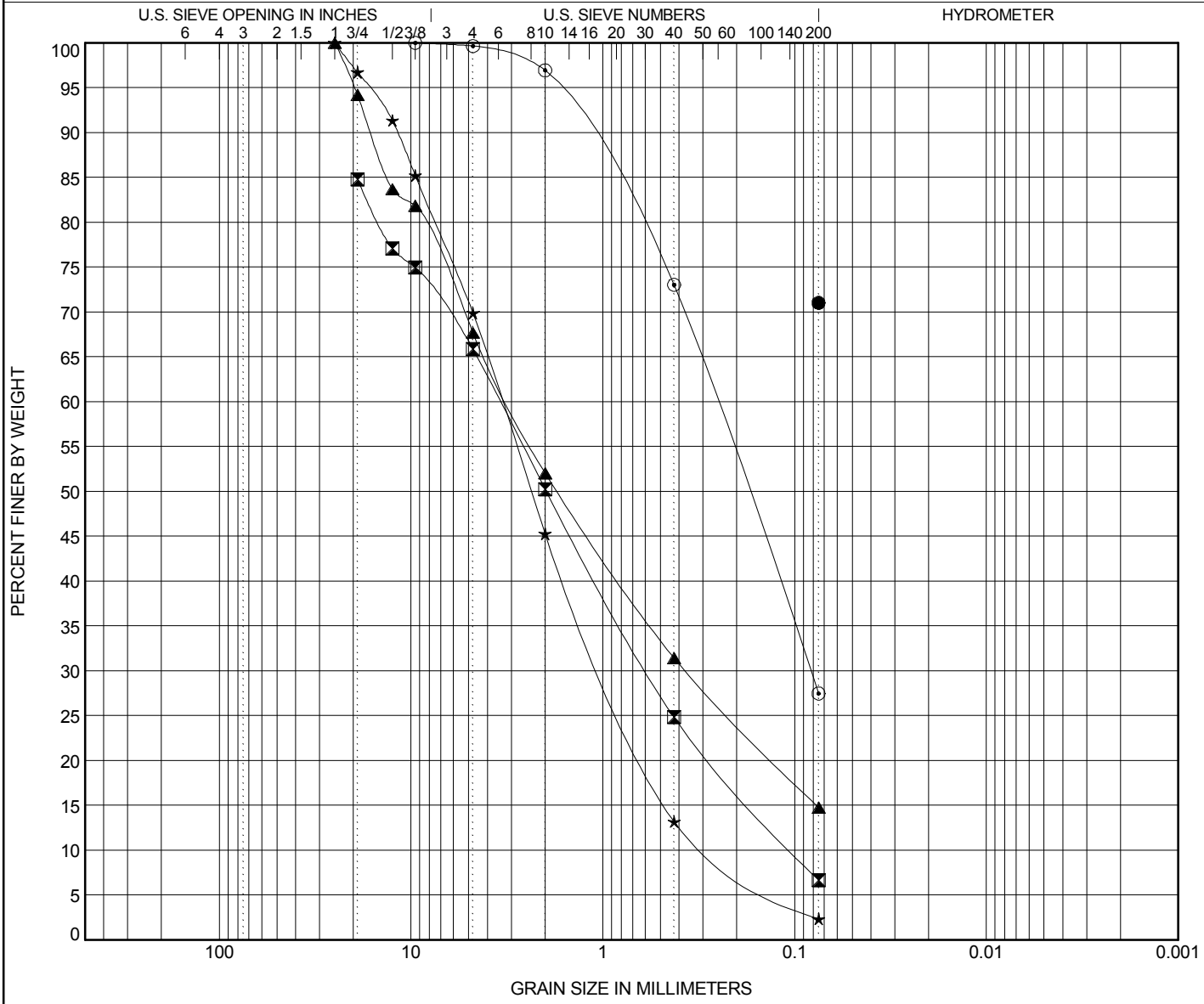

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	RW 5-2	19	FAT CLAY with SAND (CH)	50	17	33		
⊠	RW 5-2	29	POORLY GRADED SAND with SILT and GRAVEL (SP-SM)	NP	NP	NP	0.96	33.21
▲	RW 6-1	5	CLAYEY SAND with GRAVEL (SC)	26	17	9		
★	RW 6-1	20	WELL-GRADED SAND with GRAVEL (SW)	NP	NP	NP	1.07	13.16
⊙	RW 6-2	5	SILTY SAND (SM)	NP	NP	NP		

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	RW 5-2	19	0.075						71.0	
⊠	RW 5-2	29	19	3.433	0.583	0.103	18.9	59.2	6.6	
▲	RW 6-1	5	25	3.105	0.366		32.3	52.9	14.7	
★	RW 6-1	20	25	3.355	0.957	0.255	30.1	67.6	2.3	
⊙	RW 6-2	5	9.5	0.259	0.083		0.4	72.2	27.5	

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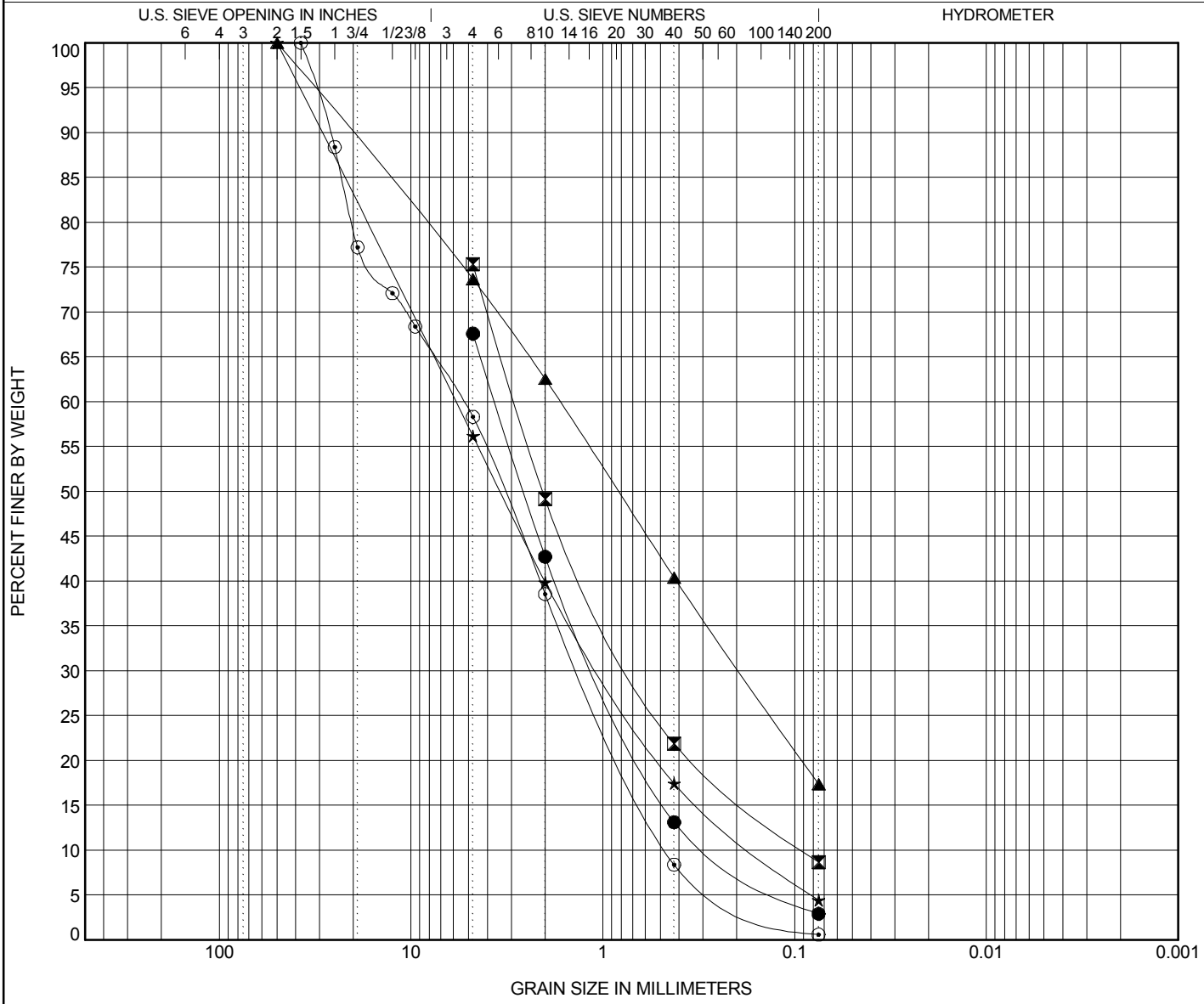

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	RW 6-2	10	WELL-GRADED SAND with GRAVEL (SW)	NP	NP	NP	1.16	14.58
⧓	RW 6-2	15	WELL-GRADED SAND with SILT and GRAVEL (SW-SM)	NP	NP	NP	1.78	32.02
▲	RW 6-3	5	SILTY, CLAYEY SAND with GRAVEL (SC-SM)	23	18	5		
★	RW 6-3	10	WELL-GRADED SAND with GRAVEL (SW)	NP	NP	NP	1.11	37.01
⊙	RW 6-3	15	POORLY GRADED SAND with GRAVEL (SP)	NP	NP	NP	0.68	11.55

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	RW 6-2	10	4.75	3.648	1.028	0.25		64.7	2.9	
⧓	RW 6-2	15	4.75	2.864	0.675	0.089		66.7	8.7	
▲	RW 6-3	5	50	1.673	0.194		26.3	56.3	17.3	
★	RW 6-3	10	50	5.827	1.011	0.157	43.8	51.8	4.4	
⊙	RW 6-3	15	37.5	5.332	1.289	0.462	41.7	57.7	0.6	

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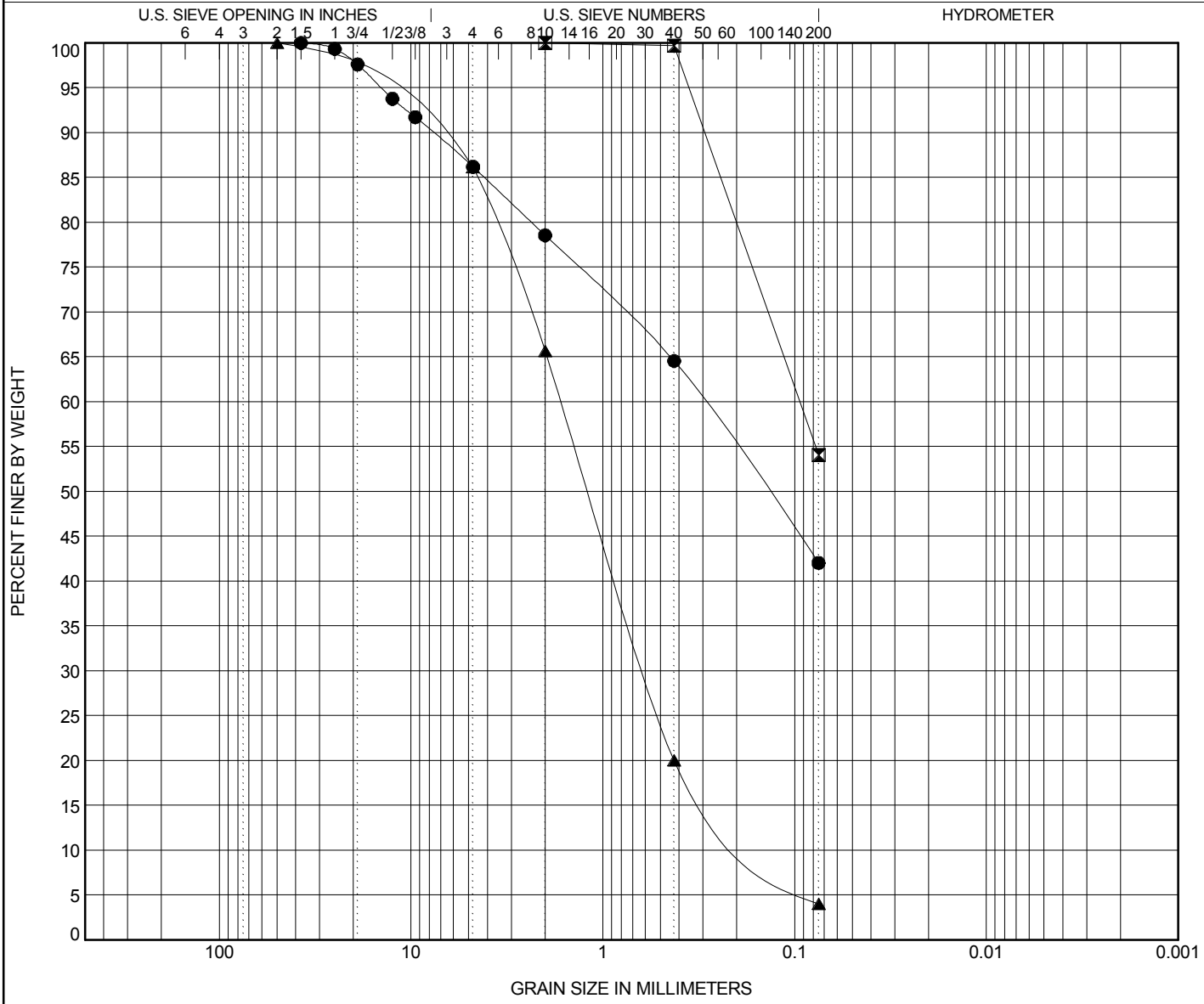

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	RW 7-1	6"-5'	CLAYEY SAND (SC)	35	15	20		
⧓	RW 7-1	9	SANDY SILT (ML)	23	25	NP		
▲	RW 7-1	24	WELL-GRADED SAND (SW)	NP	NP	NP	1.50	11.50

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	RW 7-1	6"-5'	37.5	0.299			13.8	44.2	42.0	
⧓	RW 7-1	9	2	0.094			0.0	45.9	54.1	
▲	RW 7-1	24	50	1.65	0.596	0.143	13.8	82.1	4.0	

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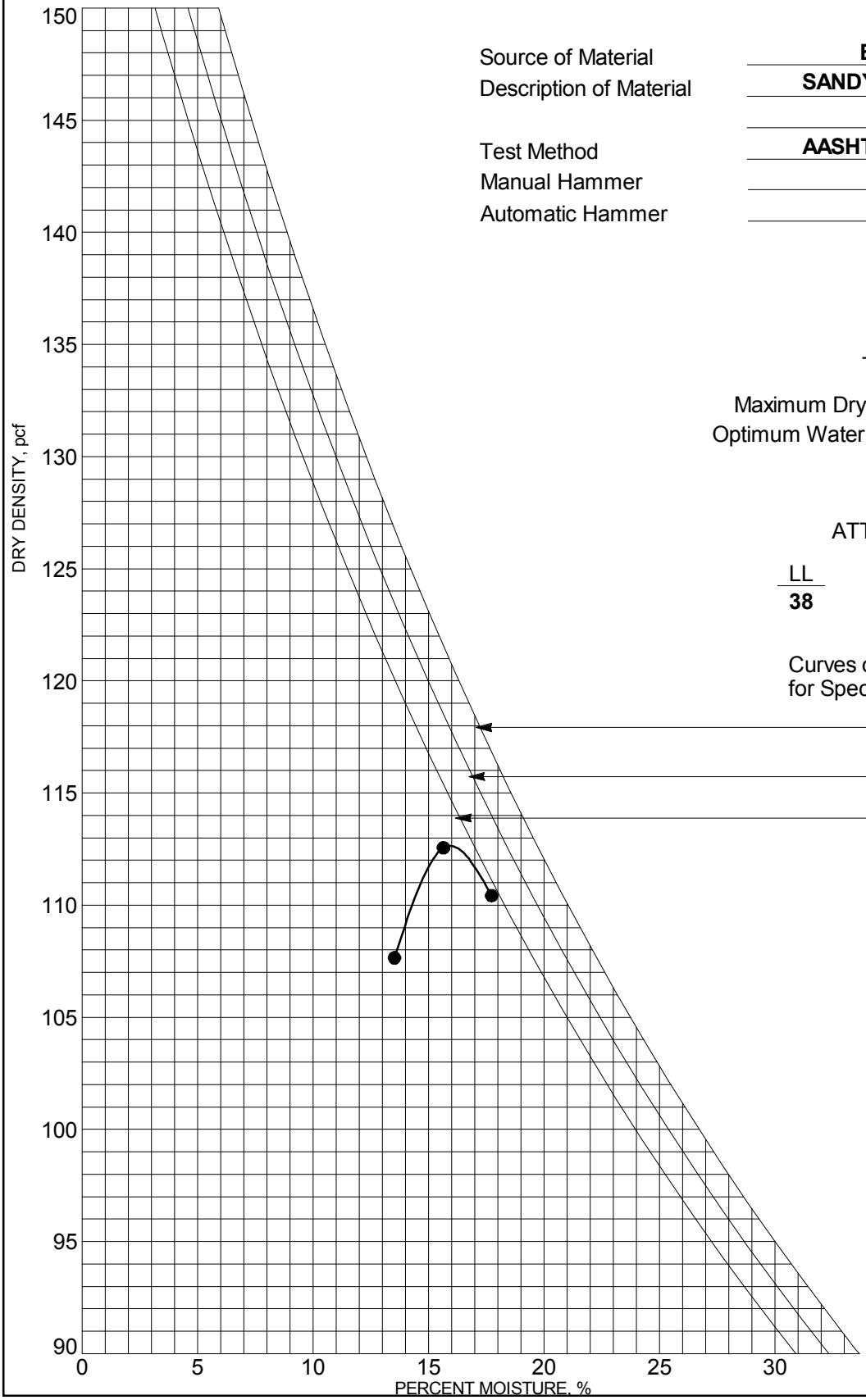

Source of Material	**BR- 8 9"-10'**
Description of Material	**SANDY LEAN CLAY(CL)**
Test Method	**AASHTO T99 Method A**
Manual Hammer	X
Automatic Hammer	

TEST RESULTS

Maximum Dry Density	**112.7**	**PCF**
Optimum Water Content	**16.0**	**%**

ATTERBERG LIMITS

LL	PL	PI
38	**15**	**23**

Curves of 100% Saturation for Specific Gravity Equal to:

2.80

2.70

2.60

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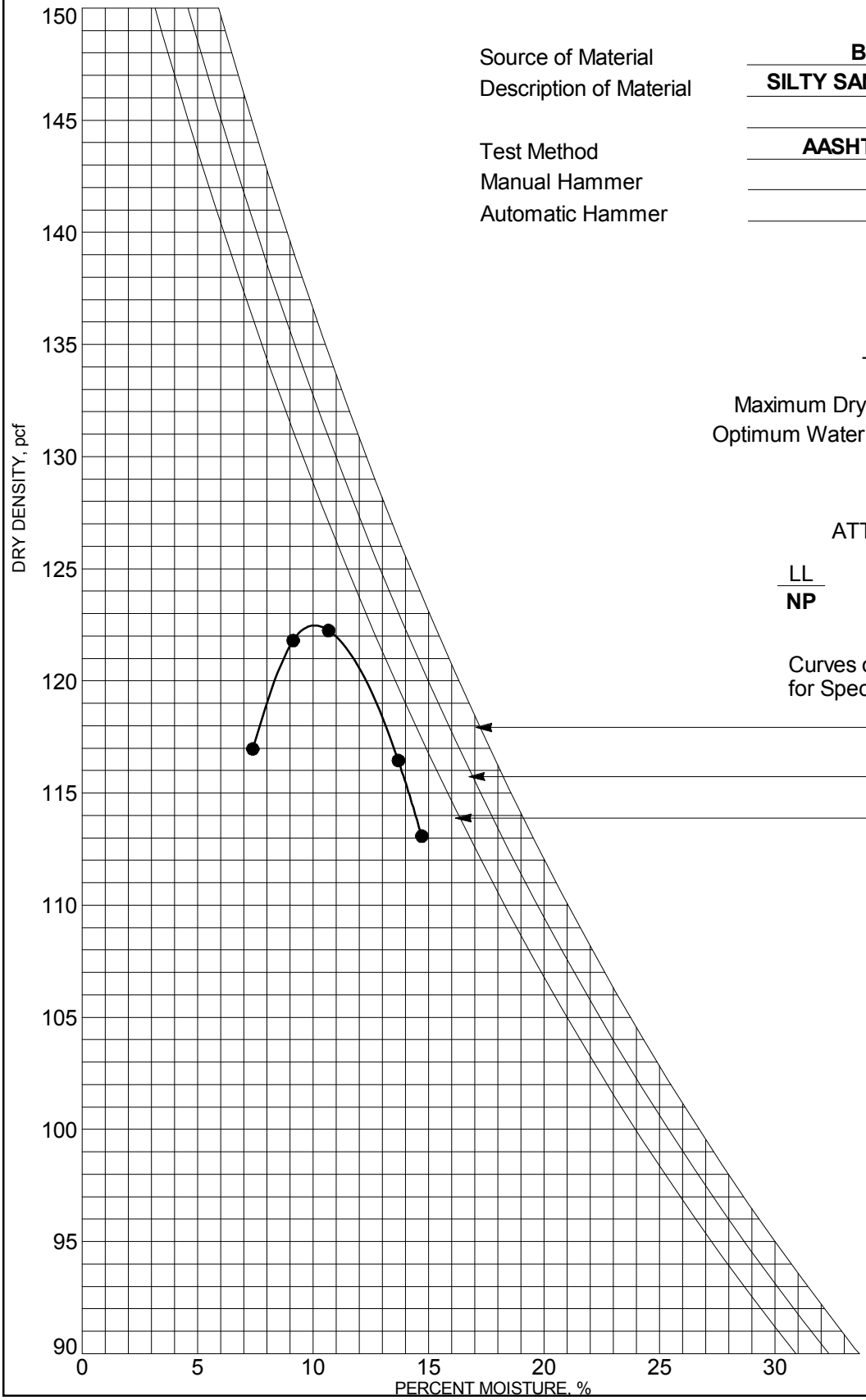

Source of Material	**BR- 22 8.5"-5'**
Description of Material	**SILTY SAND with GRAVEL(SM)**
Test Method	**AASHTO T99 Method A**
Manual Hammer	X
Automatic Hammer	

TEST RESULTS

Maximum Dry Density	**122.5**	**PCF**
Optimum Water Content	**10.1**	**%**

ATTERBERG LIMITS

LL	PL	PI
NP	**NP**	**NP**

Curves of 100% Saturation for Specific Gravity Equal to:

2.80

2.70

2.60

SWELL - CONSOLIDATION TEST

RockSol Consulting Group, Inc.

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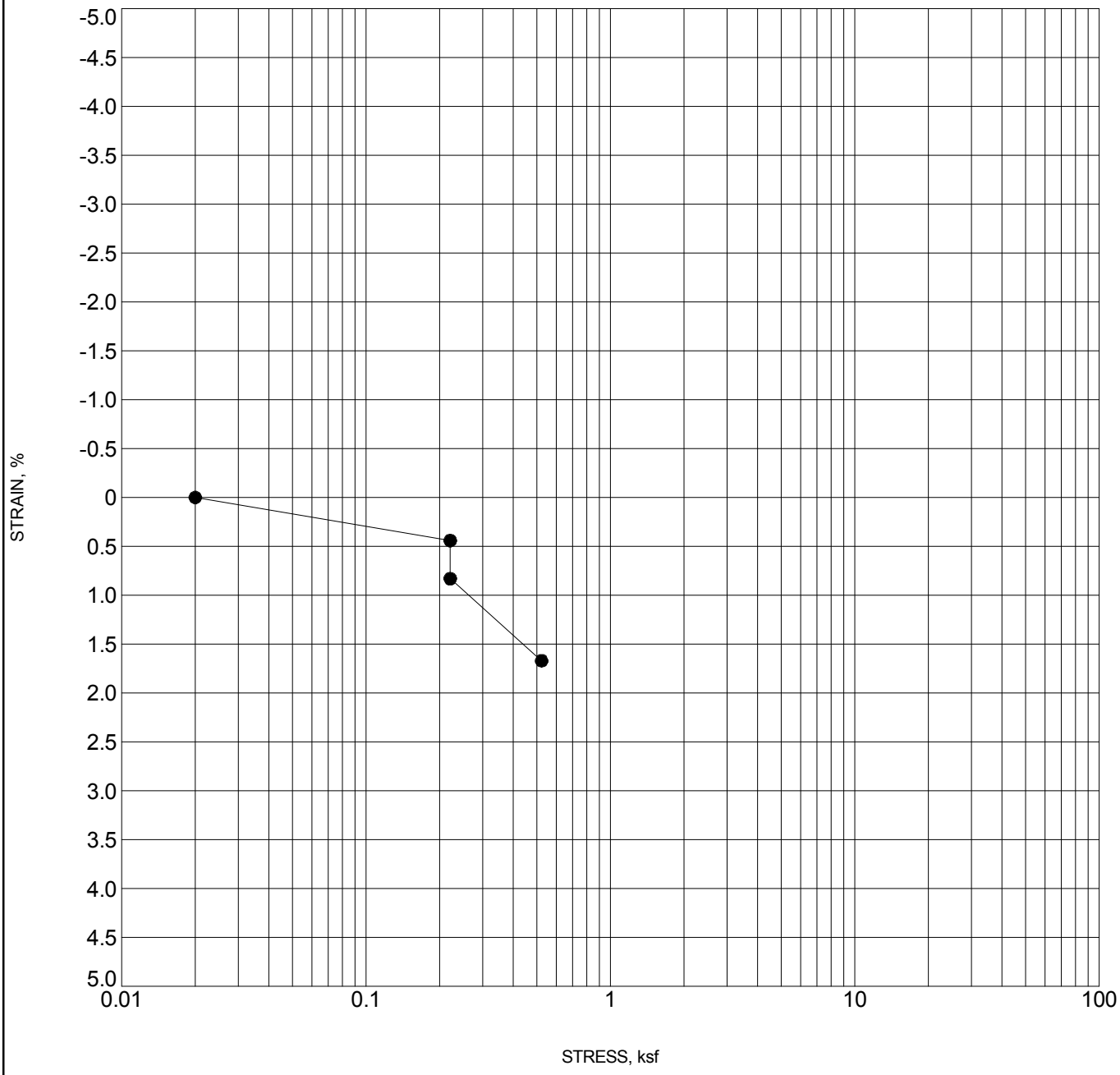

Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● BR- 1	4.0	LEAN CLAY (CL)	-0.4	88.2	35.5

SWELL - STANDARD 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 8/10/12

SWELL - CONSOLIDATION TEST

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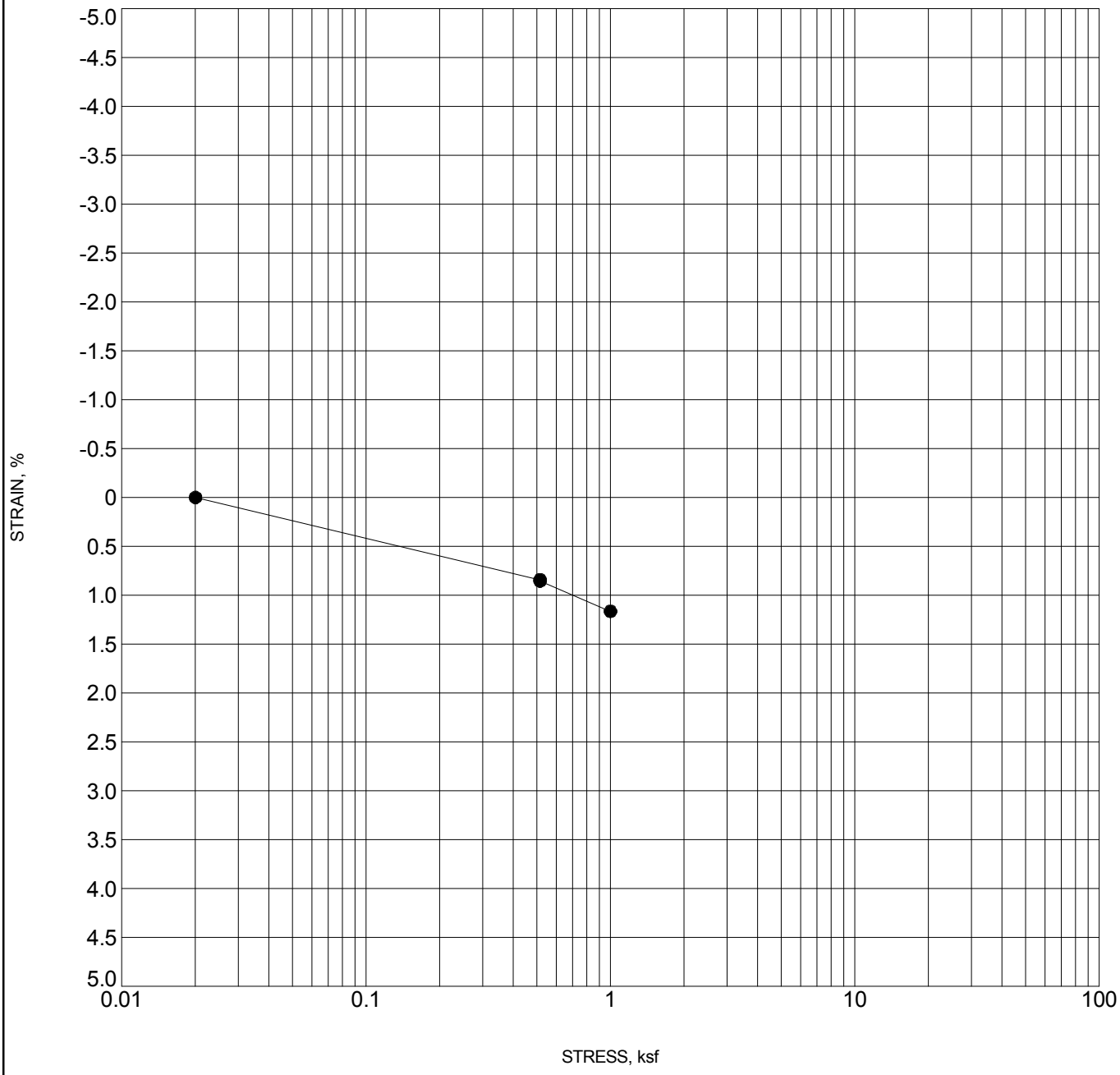

Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **BR- 2**	**5.0**	**(Fill) SANDY, CLAY**	**0.0**	**100.2**	**21.0**

SWELL - CONSOLIDATION TEST

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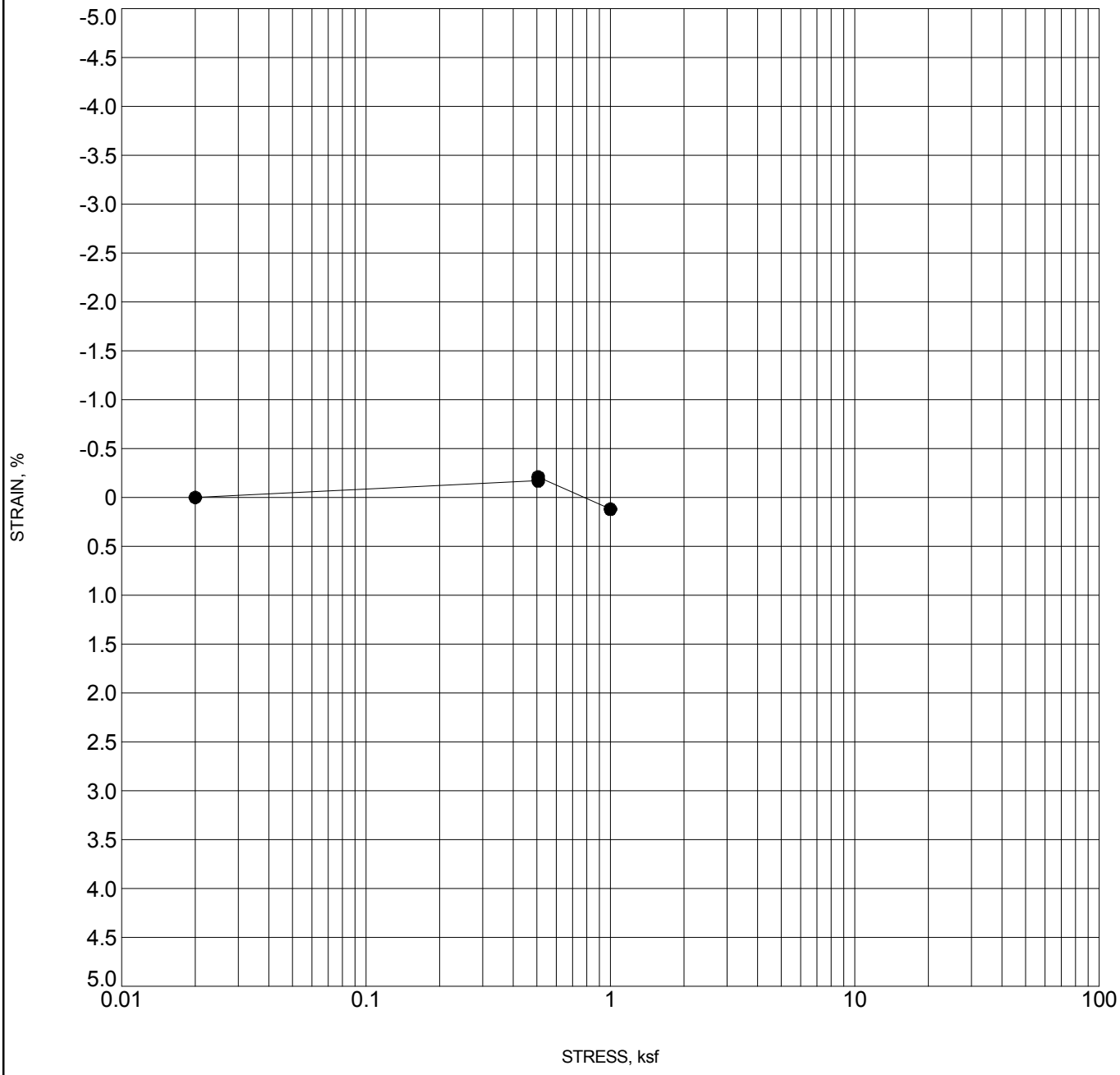

Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **BR- 2**	**9.0**	**(Fill) SANDY CLAY**	**0.0**	**98.8**	**21.0**

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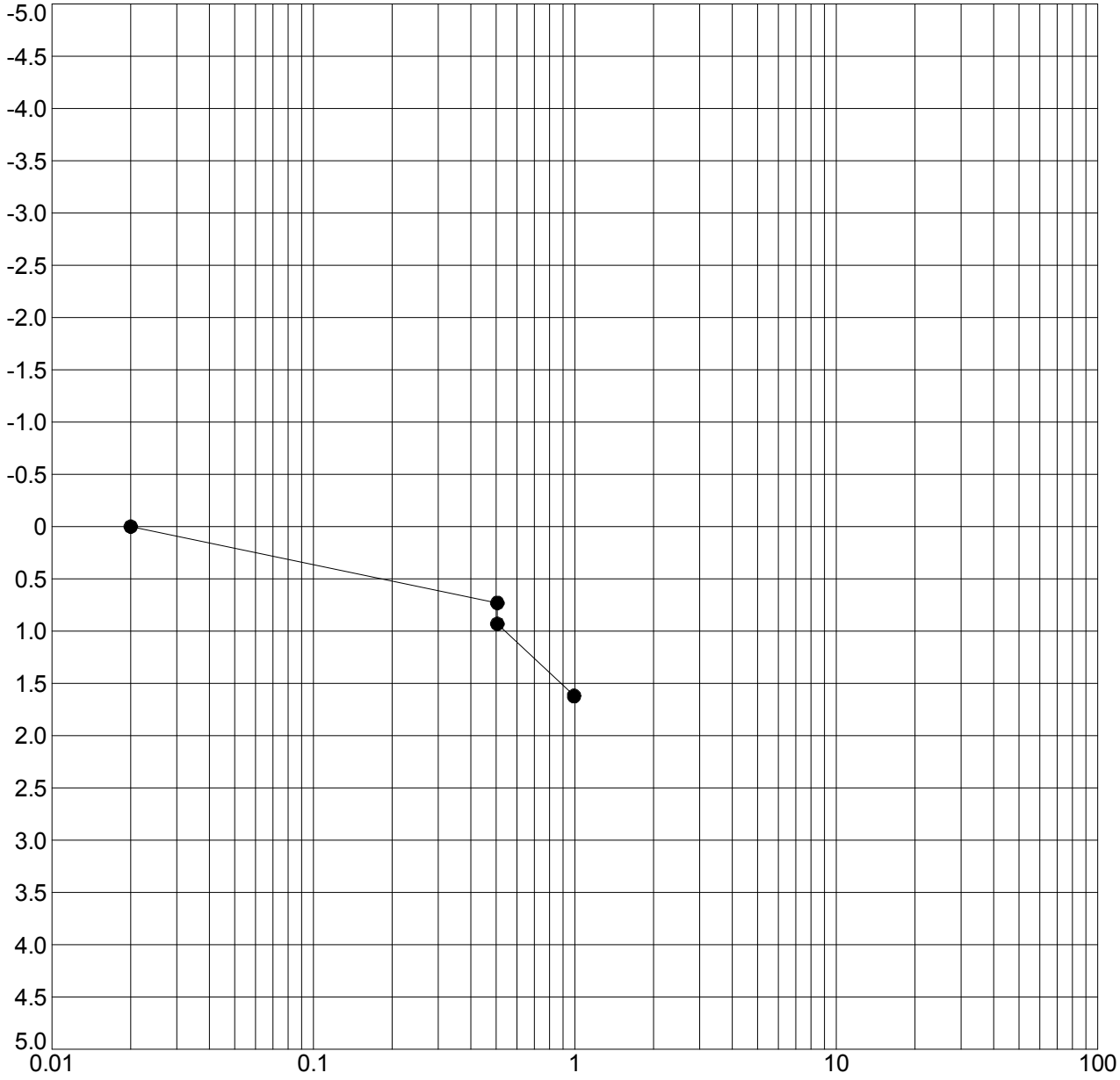

Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **BR- 2**	**14.0**	**(Fill) SANDY CLAY**	**-0.2**	**103.0**	**19.9**

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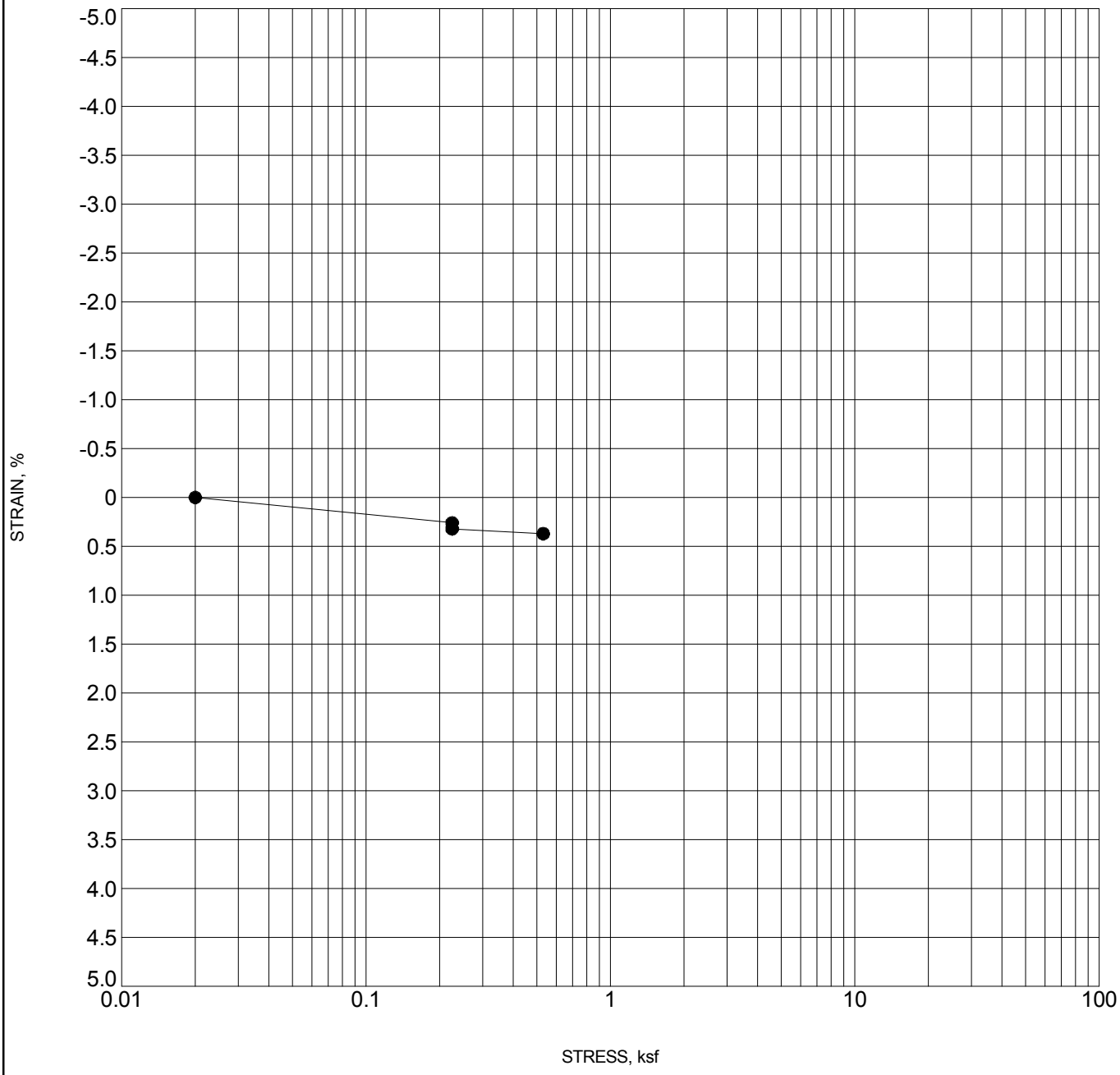

Specimen Identification	Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **BR- 8 2.0**	**(Fill) SANDY LEAN CLAY (CL)**	**-0.1**	**111.1**	**18.1**

SWELL - STANDARD 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 8/10/12

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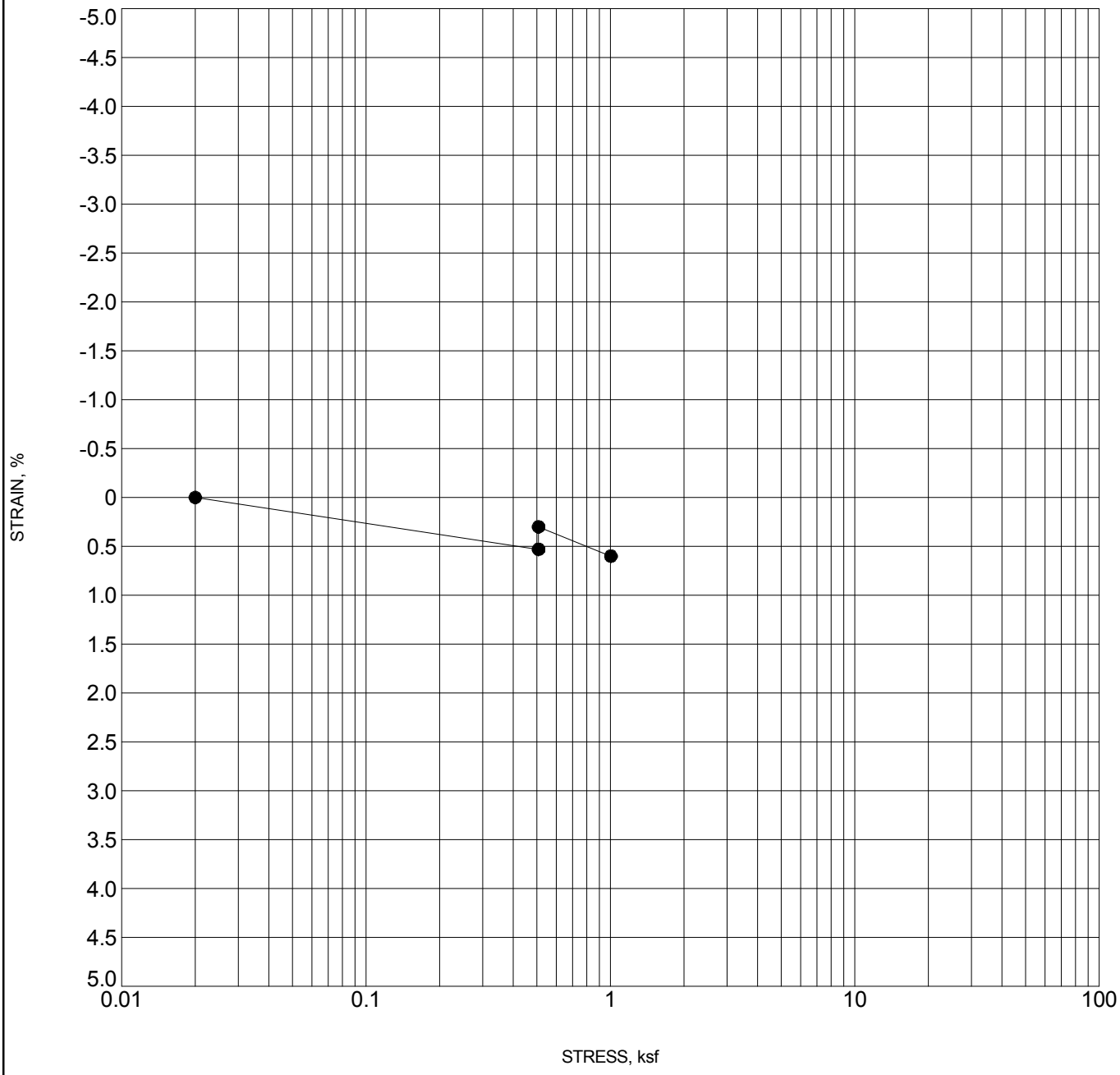

Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **BR- 8**	**4.0**	**(Fill) SANDY CLAY**	**0.2**	**101.5**	**23.0**

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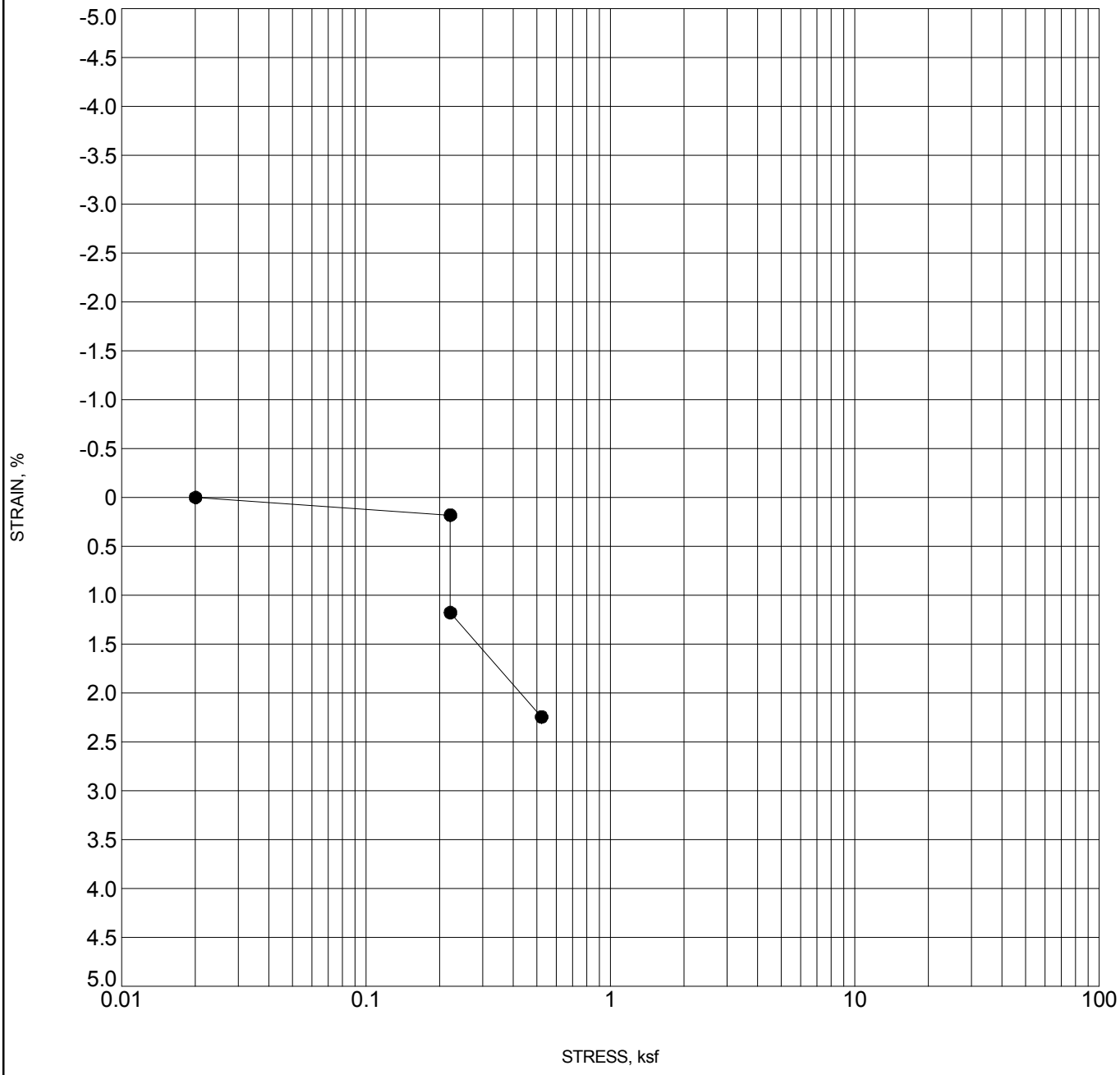

Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● BR- 13	2.0	(Fill) SILTY SAND (SM)	-1.0	119.3	6.9

SWELL - CONSOLIDATION TEST

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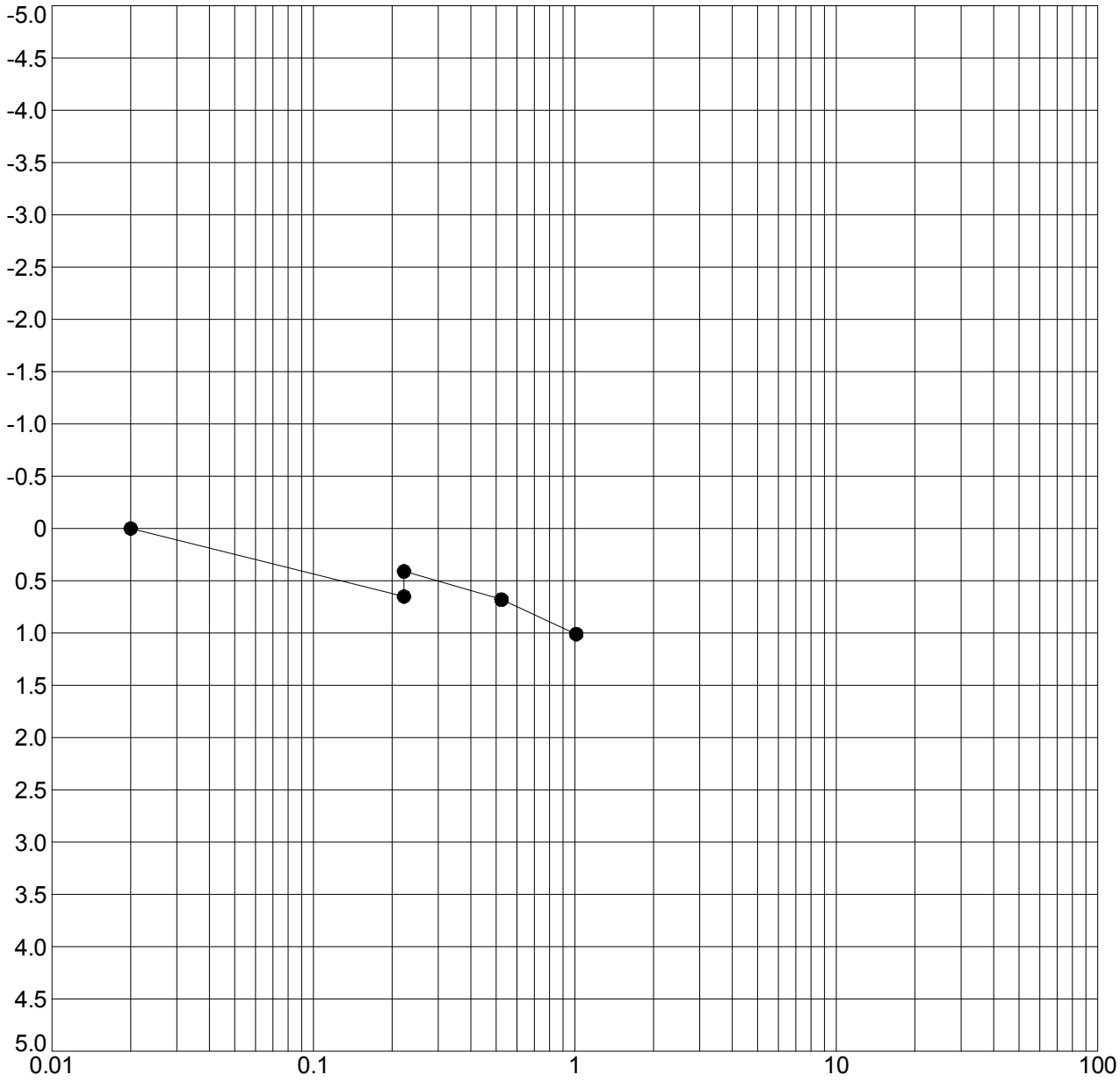

Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **BR- 15**	**4.0**	**(Fill) SANDY CLAY with GRAVEL**	**0.2**	**116.0**	**10.7**

SWELL - CONSOLIDATION TEST

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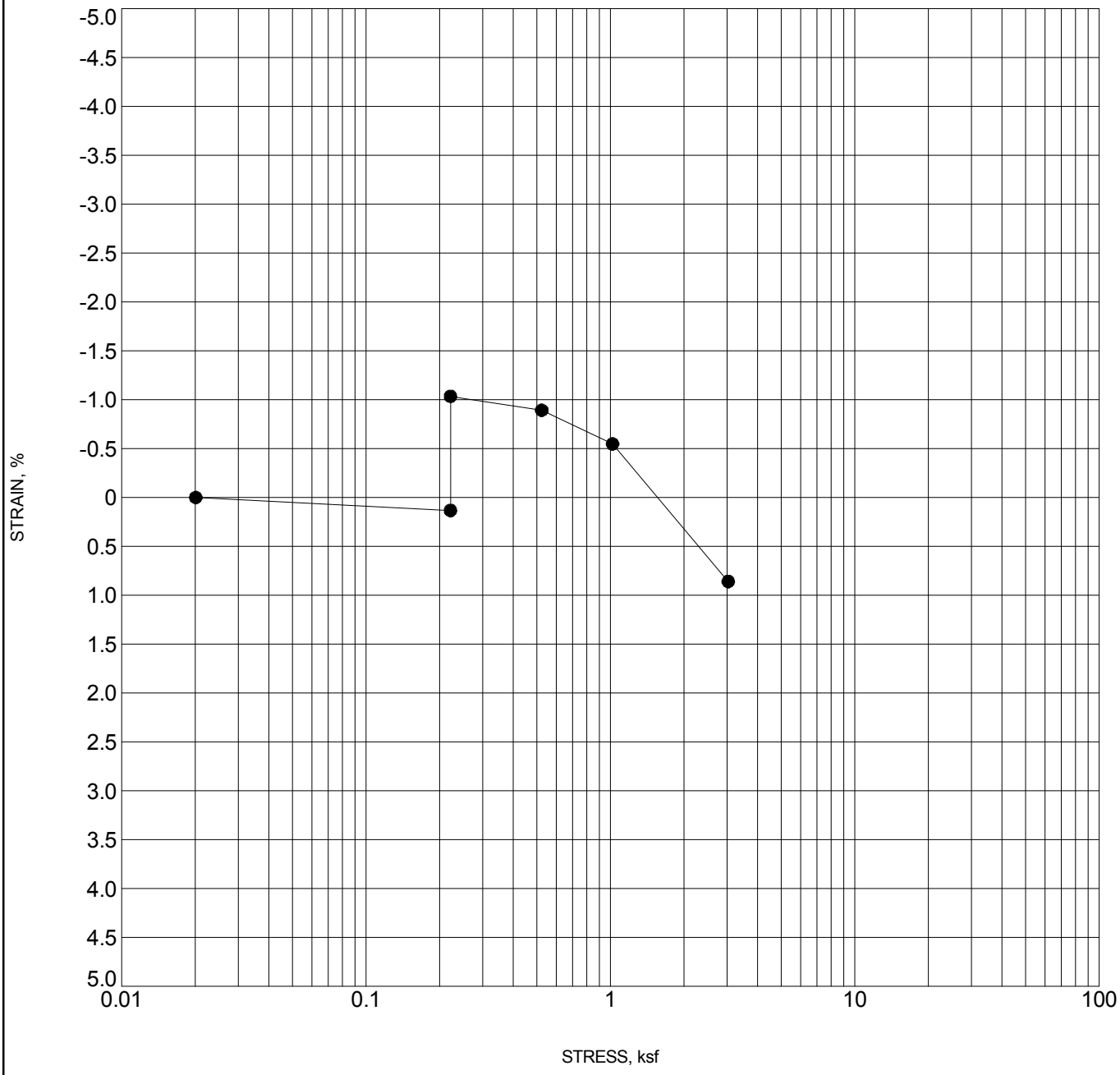

Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **BR- 16**	**2.0**	**(Fill) SANDY CLAY**	**1.2**	**117.2**	**17.1**

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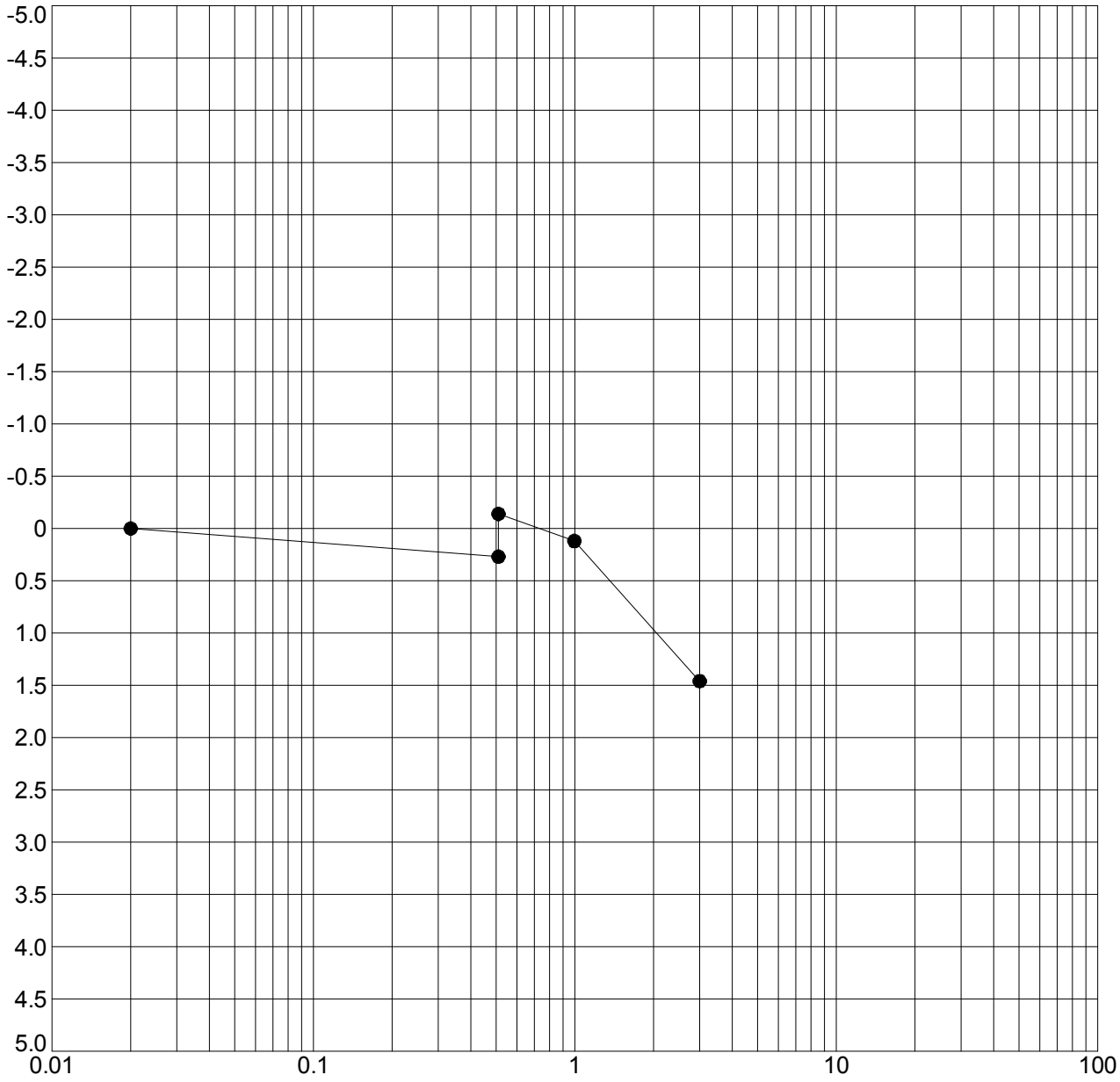

Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● BR- 16	5.0	(Fill) SANDY CLAY	0.4	110.2	20.8

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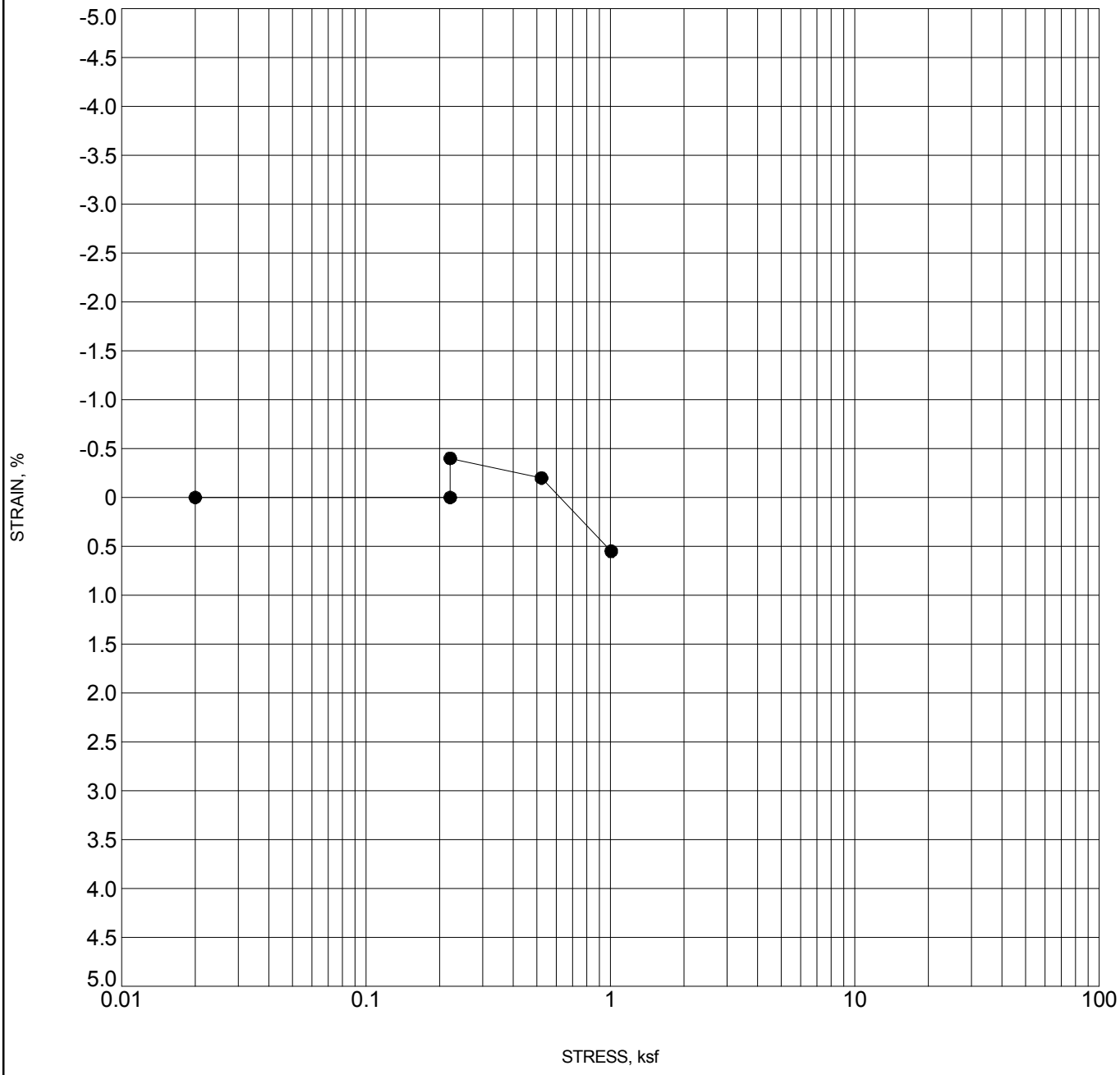

Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● BR- 20	5.0	(Fill) SANDY CLAY	0.4	106.8	19.1

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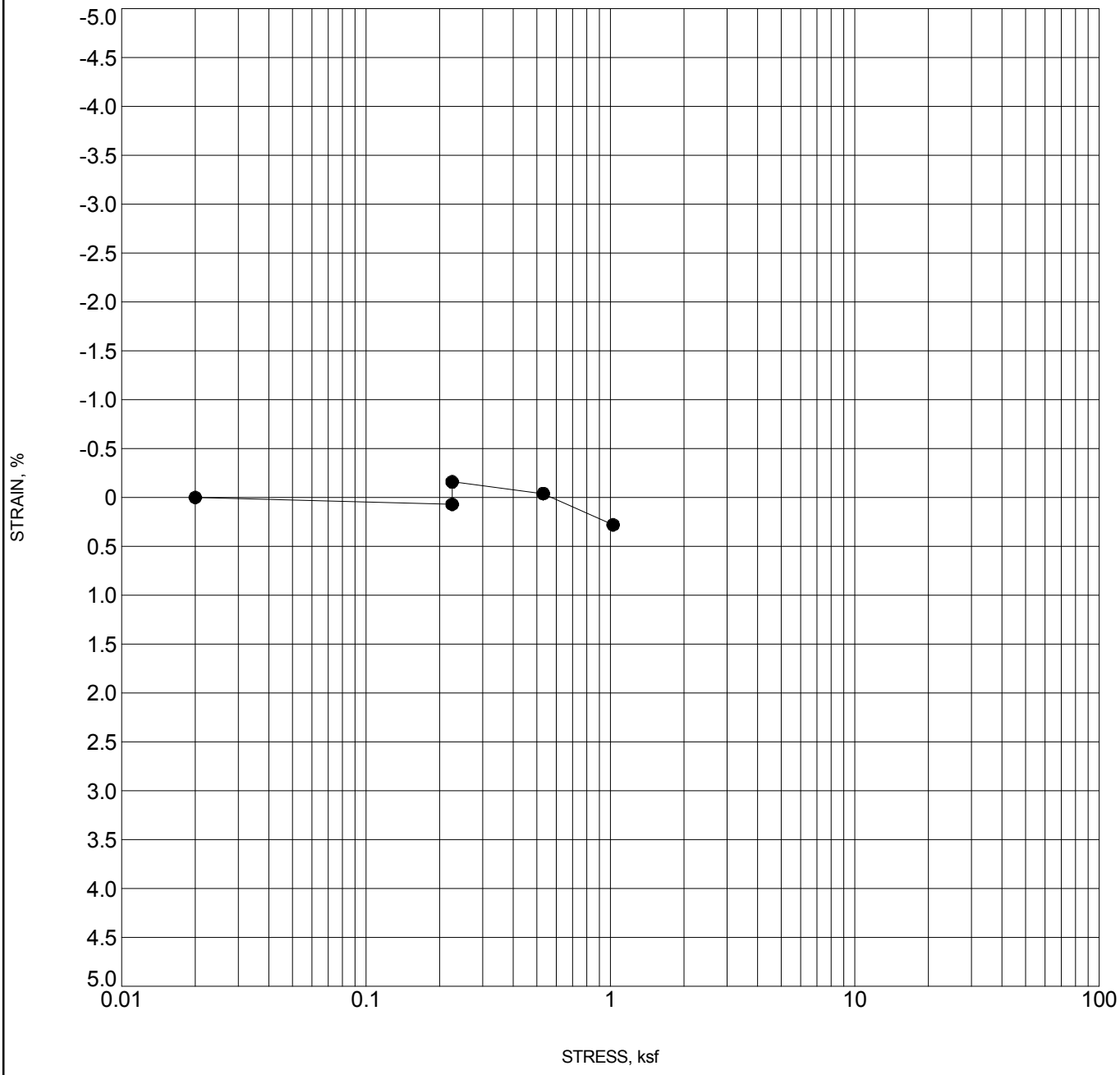

Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **BR- 21**	**2.0**	**(Fill) SANDY CLAY**	**0.2**	**104.3**	**20.3**

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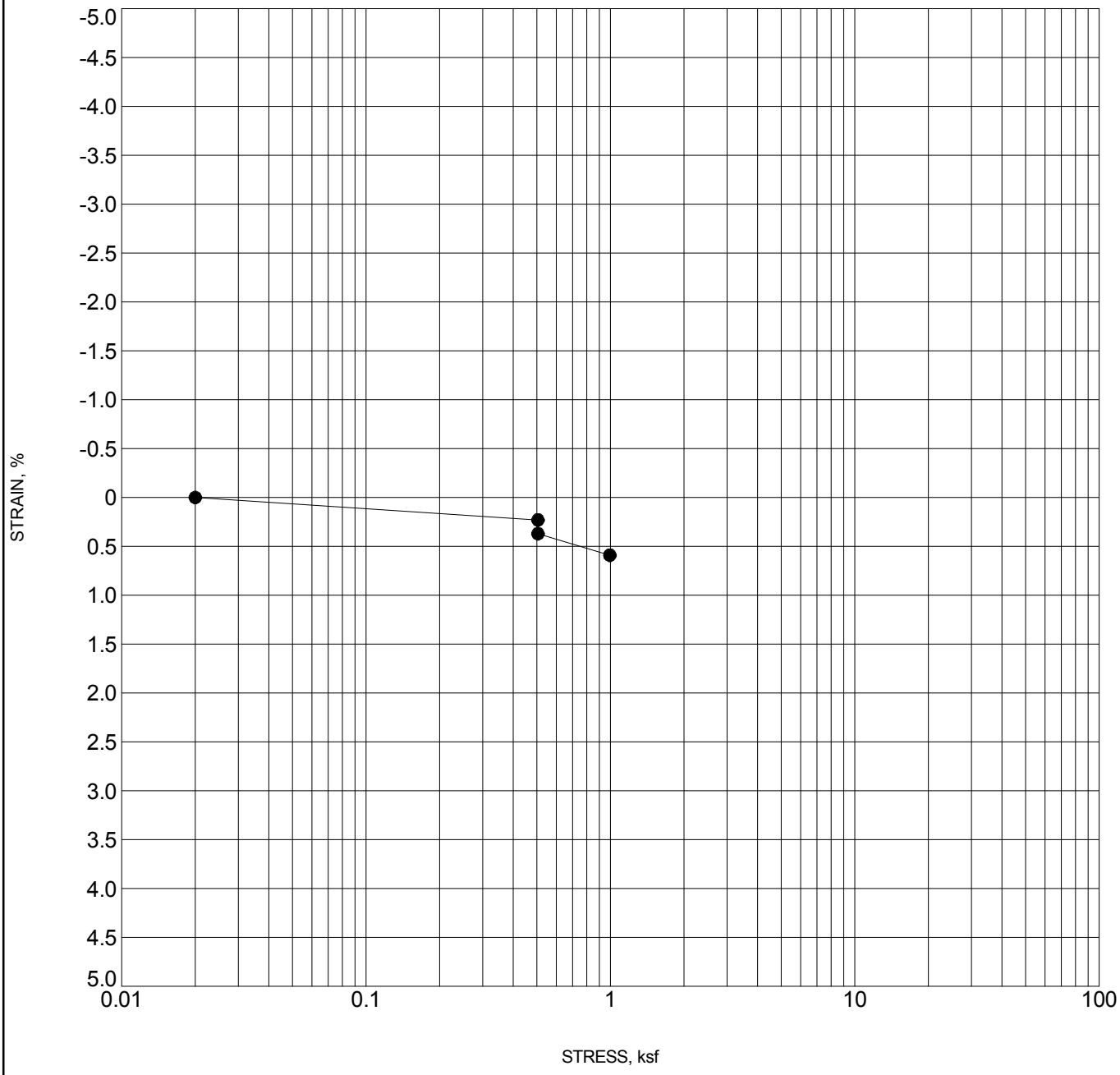

Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● BR- 21	5.0	(Fill) SANDY CLAY	-0.1	103.0	30.5

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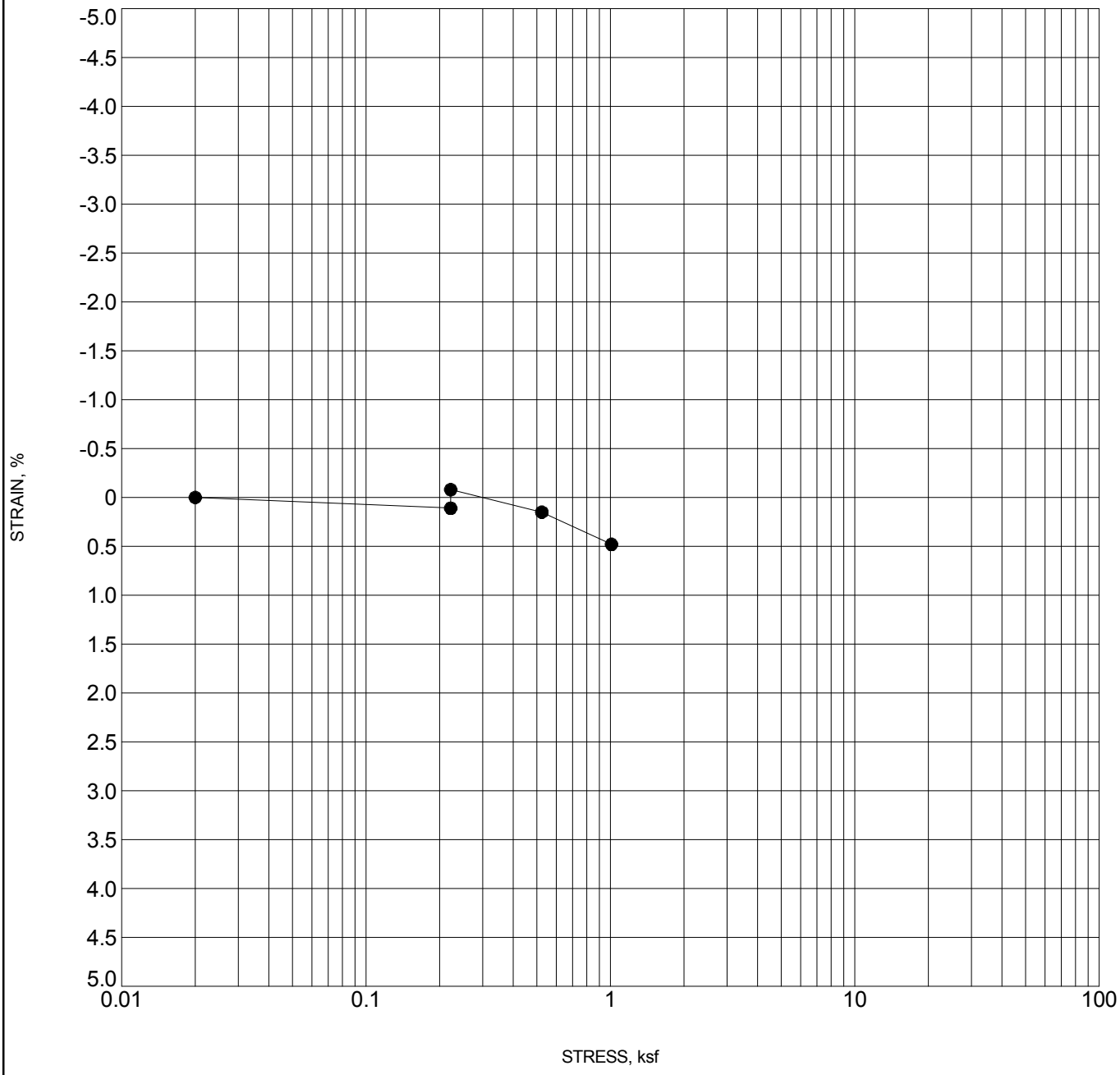


Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● BR- 22	4.0	(Fill) SANDY CLAY	0.2	112.9	16.1

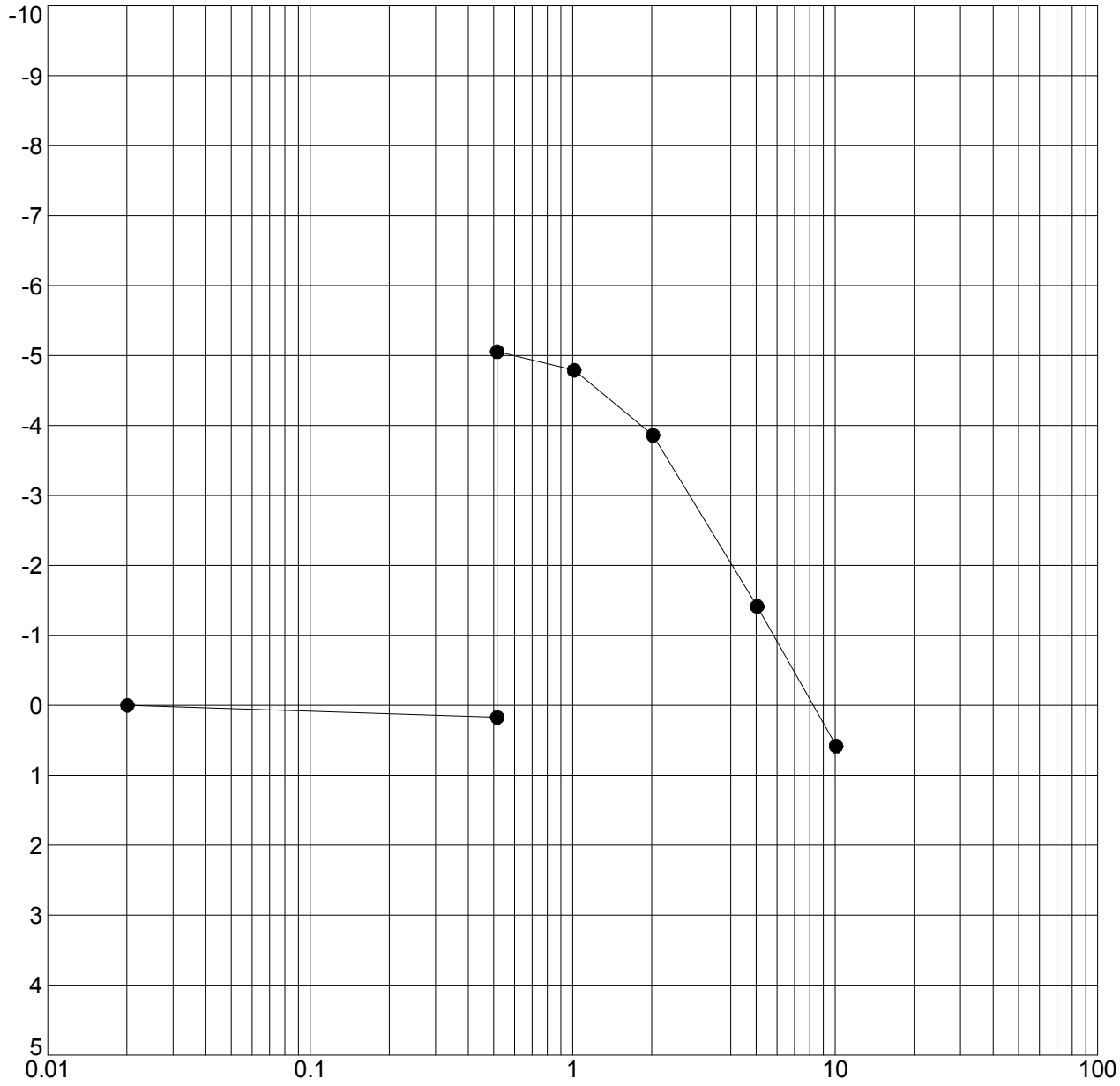
SWELL - STANDARD 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 8/10/12

SWELL - CONSOLIDATION TEST

RockSol Consulting Group, Inc.

CLIENT Hartwig and Associates **PROJECT NAME** US6 Bridges Design Build Project

PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado



Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **BR- 23**	**4.0**	**SANDY CLAY**	**5.2**	**115.2**	**14.0**

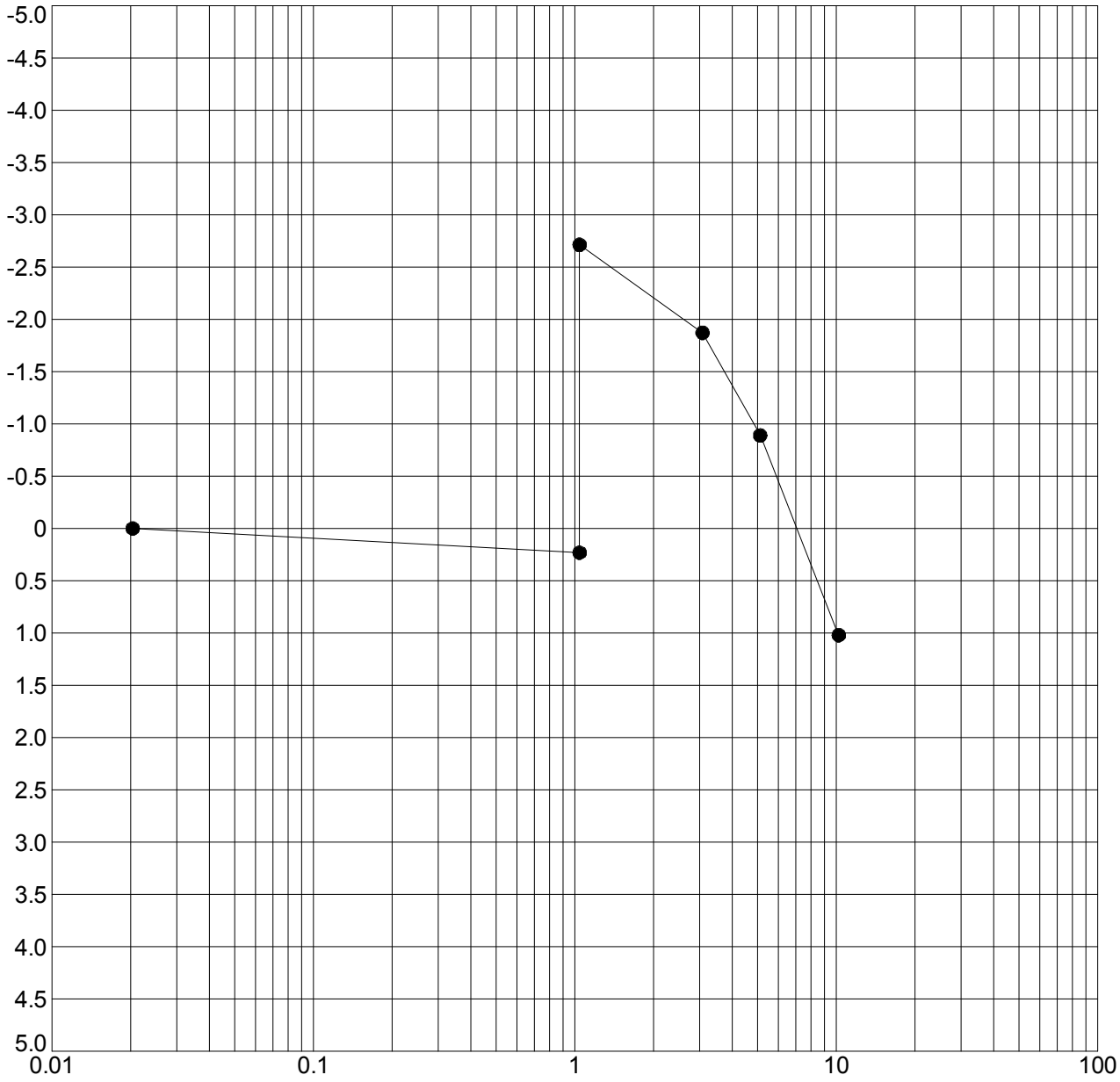
SWELL - STANDARD 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 8/17/12

SWELL - CONSOLIDATION TEST

RockSol Consulting Group, Inc.

CLIENT Hartwig and Associates **PROJECT NAME** US6 Bridges Design Build Project

PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado



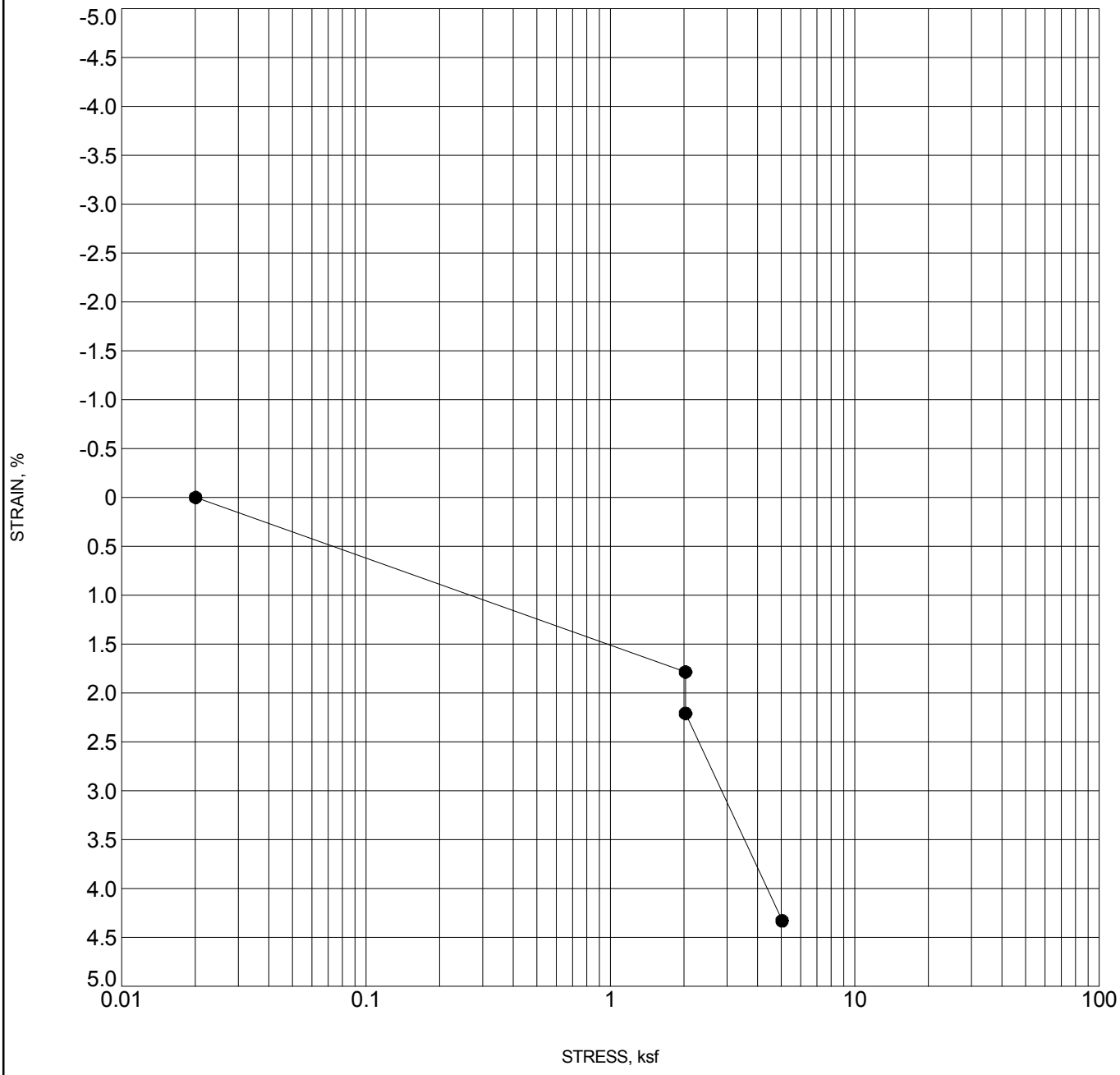
Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● BR- 23	14.0	SANDY CLAY	2.9	98.2	25.6

SWELL - CONSOLIDATION TEST

RockSol Consulting Group, Inc.

CLIENT Hartwig and Associates **PROJECT NAME** US6 Bridges Design Build Project

PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado



Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **BR- 23**	**39.0**	**(Bedrock) CLAYSTONE**	**-0.4**	**98.9**	**14.3**

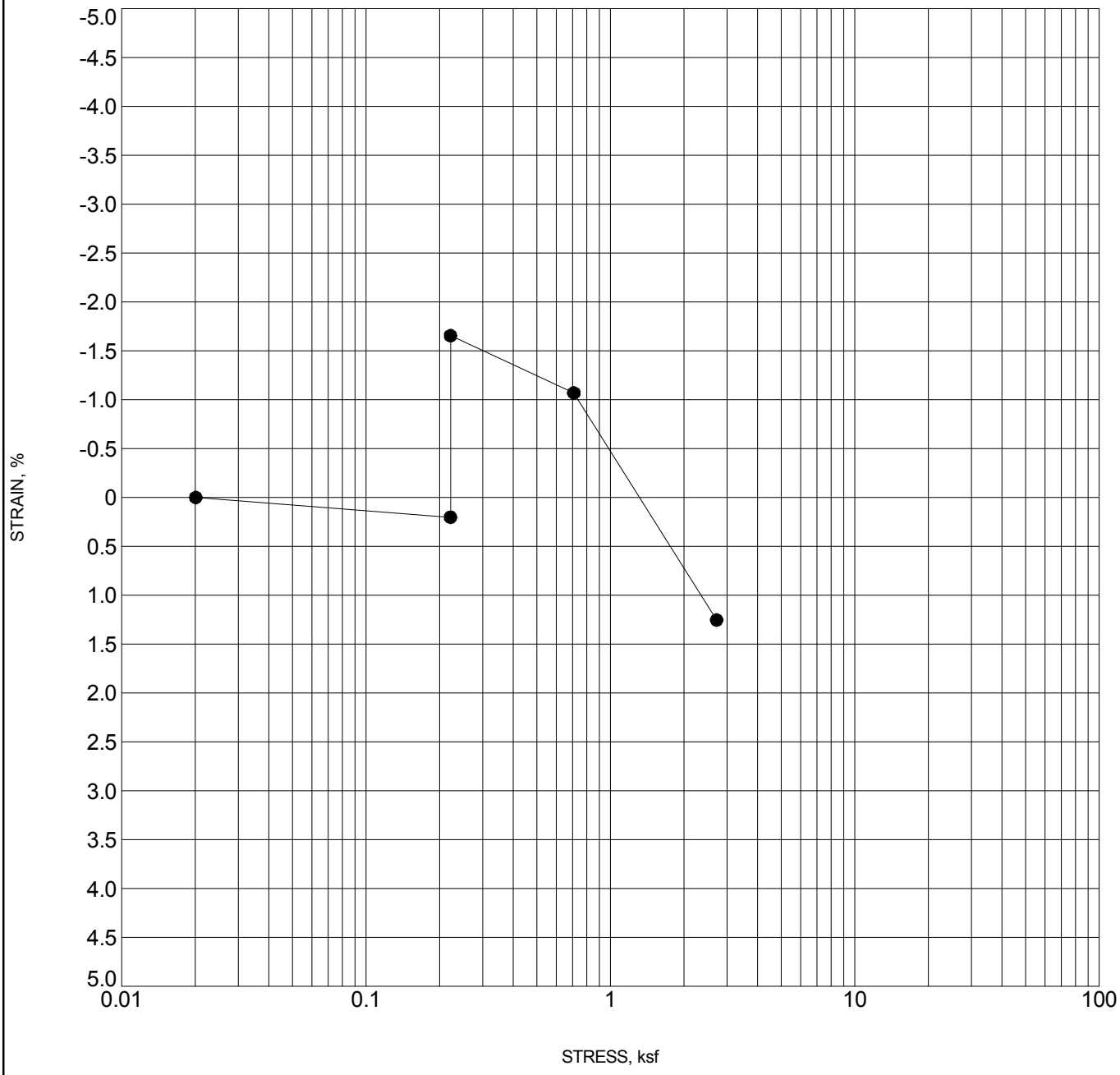
SWELL - STANDARD 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 8/10/12

SWELL - CONSOLIDATION TEST

RockSol Consulting Group, Inc.

CLIENT Hartwig and Associates **PROJECT NAME** US6 Bridges Design Build Project

PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado



Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● BR- 24	4.0	SANDY CLAY	1.9	98.8	22.0

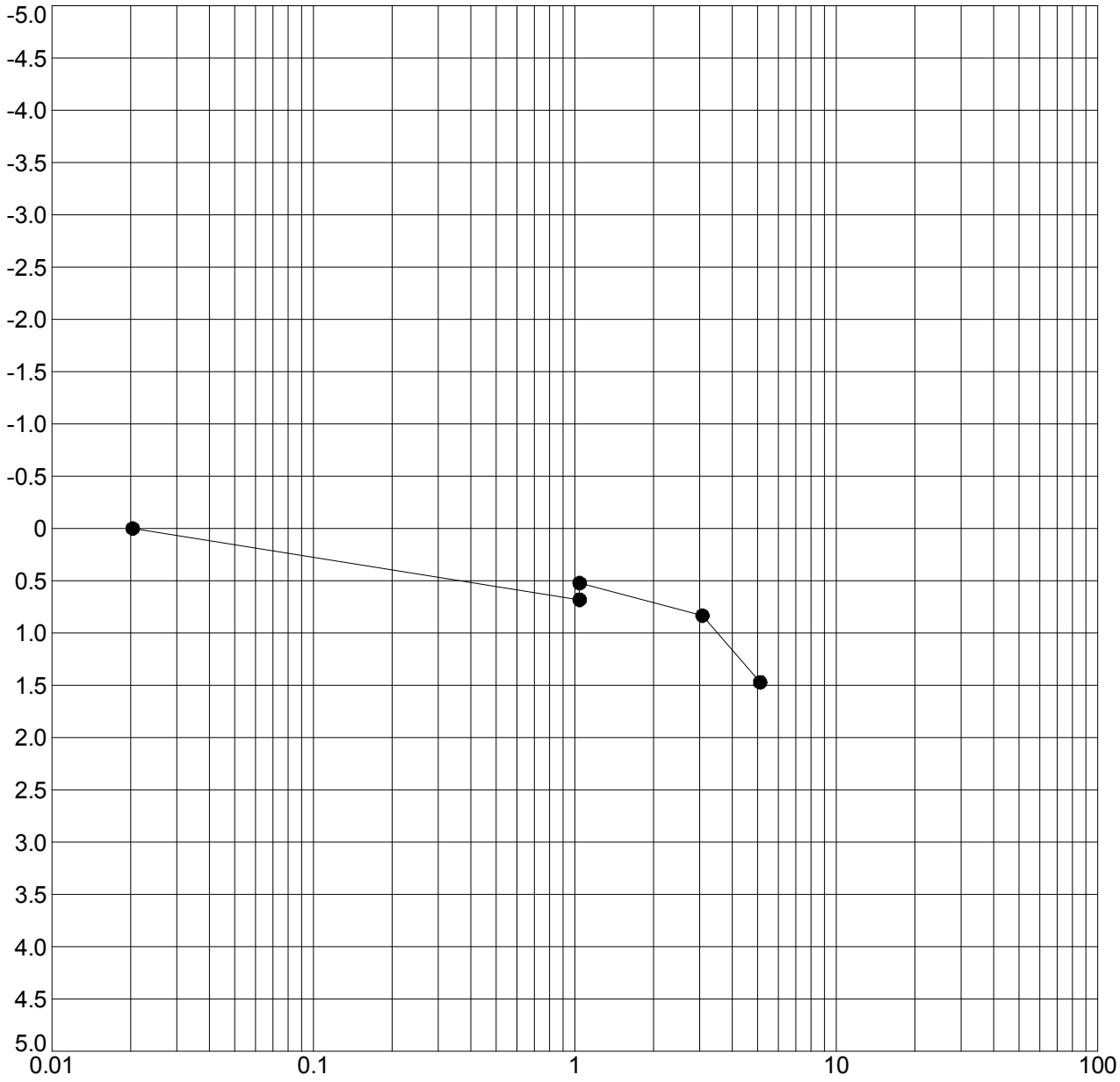
SWELL - STANDARD 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 8/10/12

SWELL - CONSOLIDATION TEST

RockSol Consulting Group, Inc.

CLIENT Hartwig and Associates **PROJECT NAME** US6 Bridges Design Build Project

PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado



Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **BR- 24**	**19.0**	**CLAY (Weathered Claystone)**	**0.2**	**94.2**	**30.5**

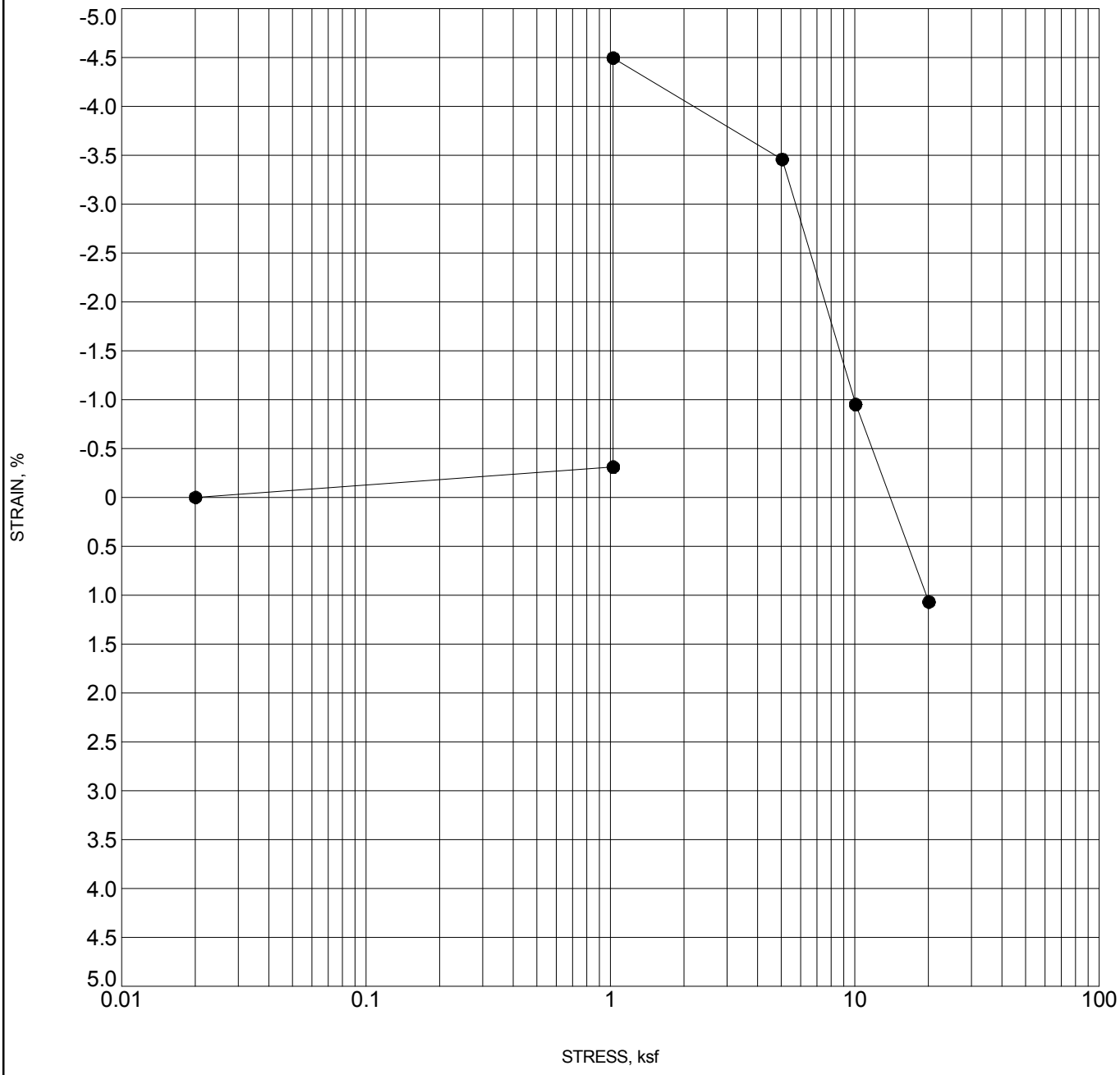
SWELL - STANDARD 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 8/10/12

SWELL - CONSOLIDATION TEST

RockSol Consulting Group, Inc.

CLIENT Hartwig and Associates **PROJECT NAME** US6 Bridges Design Build Project

PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado



Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **BR- 24**	**29.0**	**(Bedrock) CLAYSTONE**	**4.2**	**114.7**	**16.9**

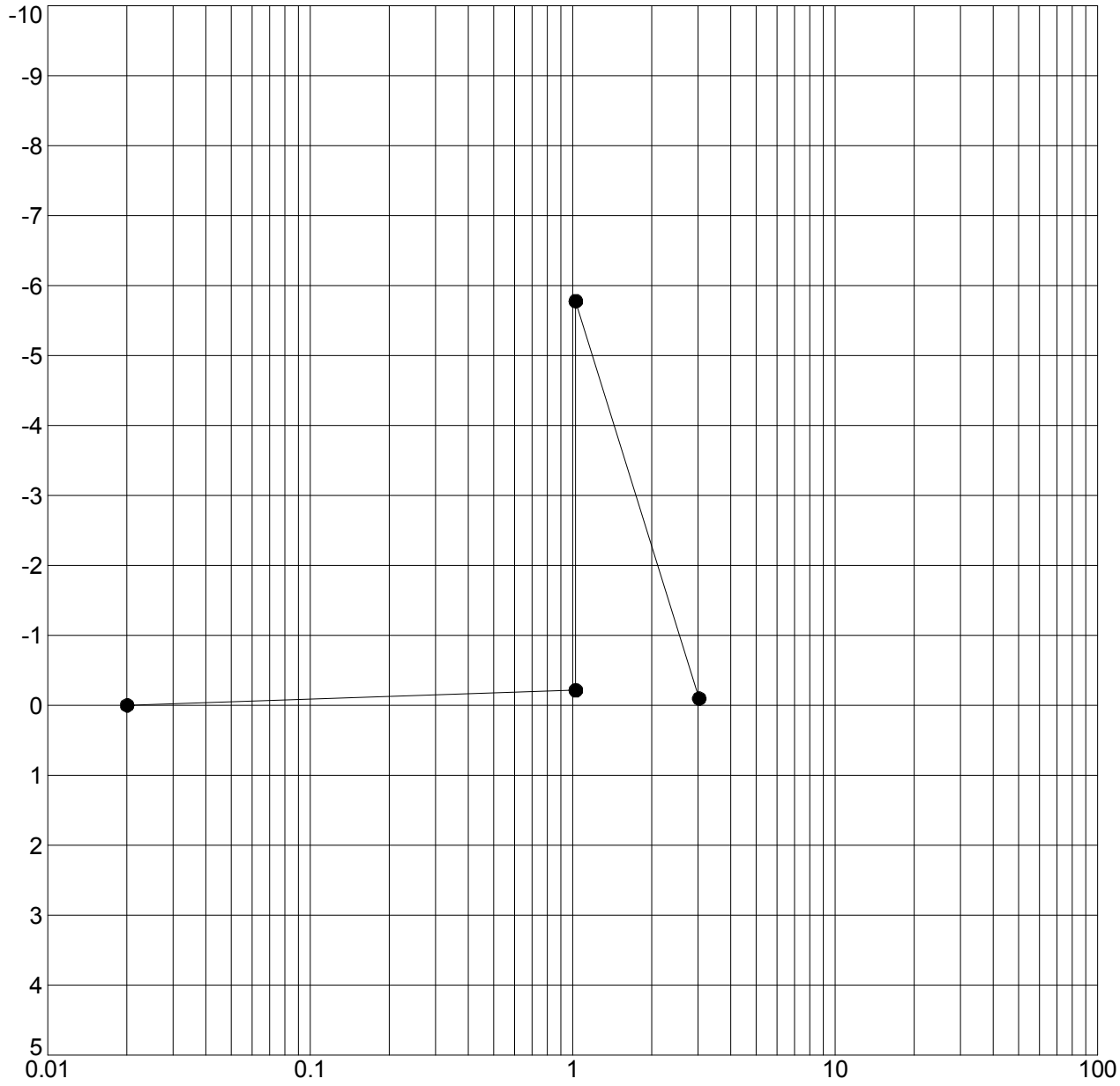
SWELL - STANDARD 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 10/15/12

SWELL - CONSOLIDATION TEST

RockSol Consulting Group, Inc.

CLIENT Hartwig and Associates **PROJECT NAME** US6 Bridges Design Build Project

PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado



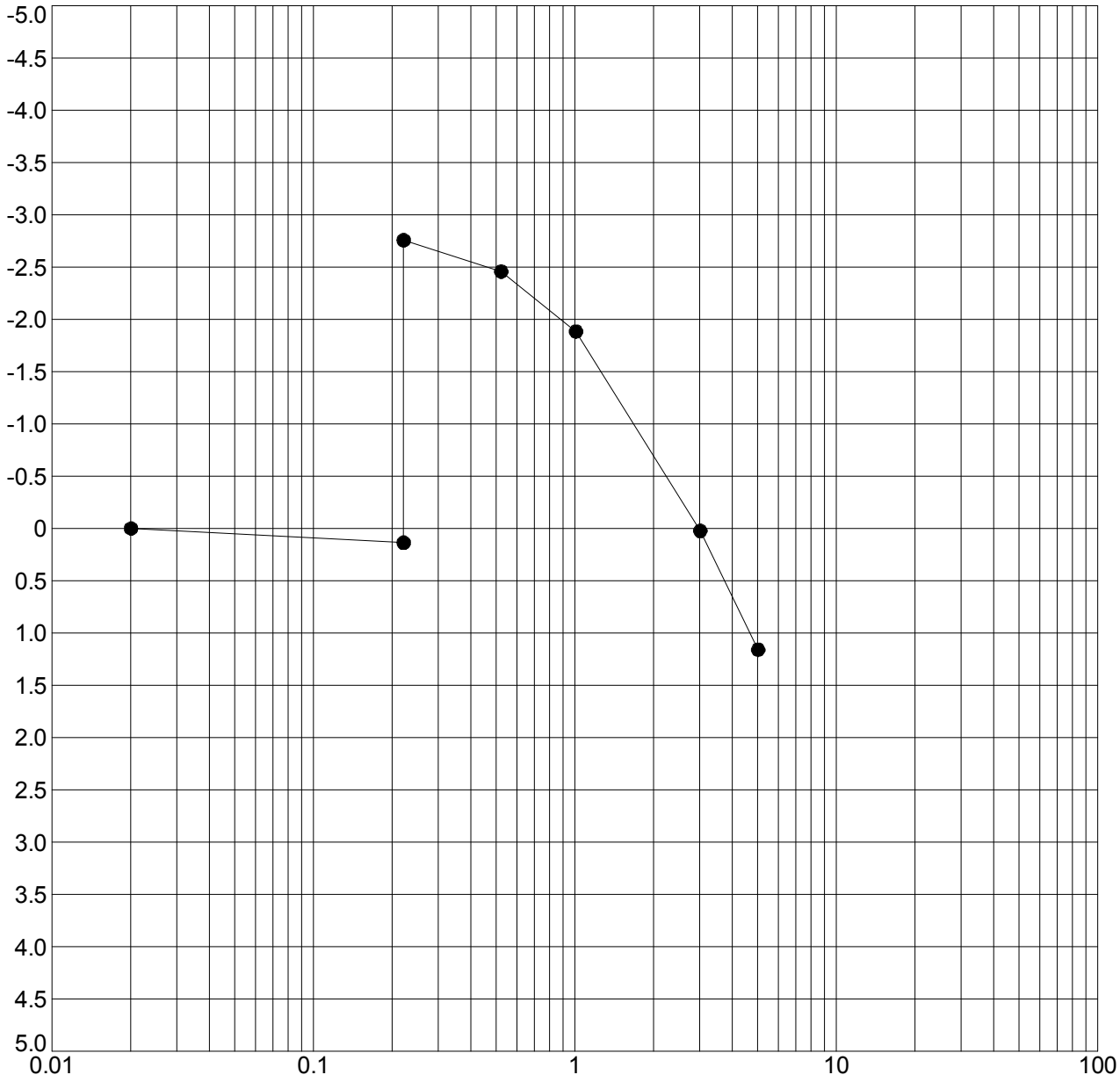
Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **BR- 24**	**39.0**	**(Bedrock) CLAYSTONE**	**5.6**	**124.0**	**12.8**

SWELL - CONSOLIDATION TEST

RockSol Consulting Group, Inc.

CLIENT Hartwig and Associates **PROJECT NAME** US6 Bridges Design Build Project

PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado



Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● BR- 25	2.0	SANDY CLAY	2.9	105.7	21.3

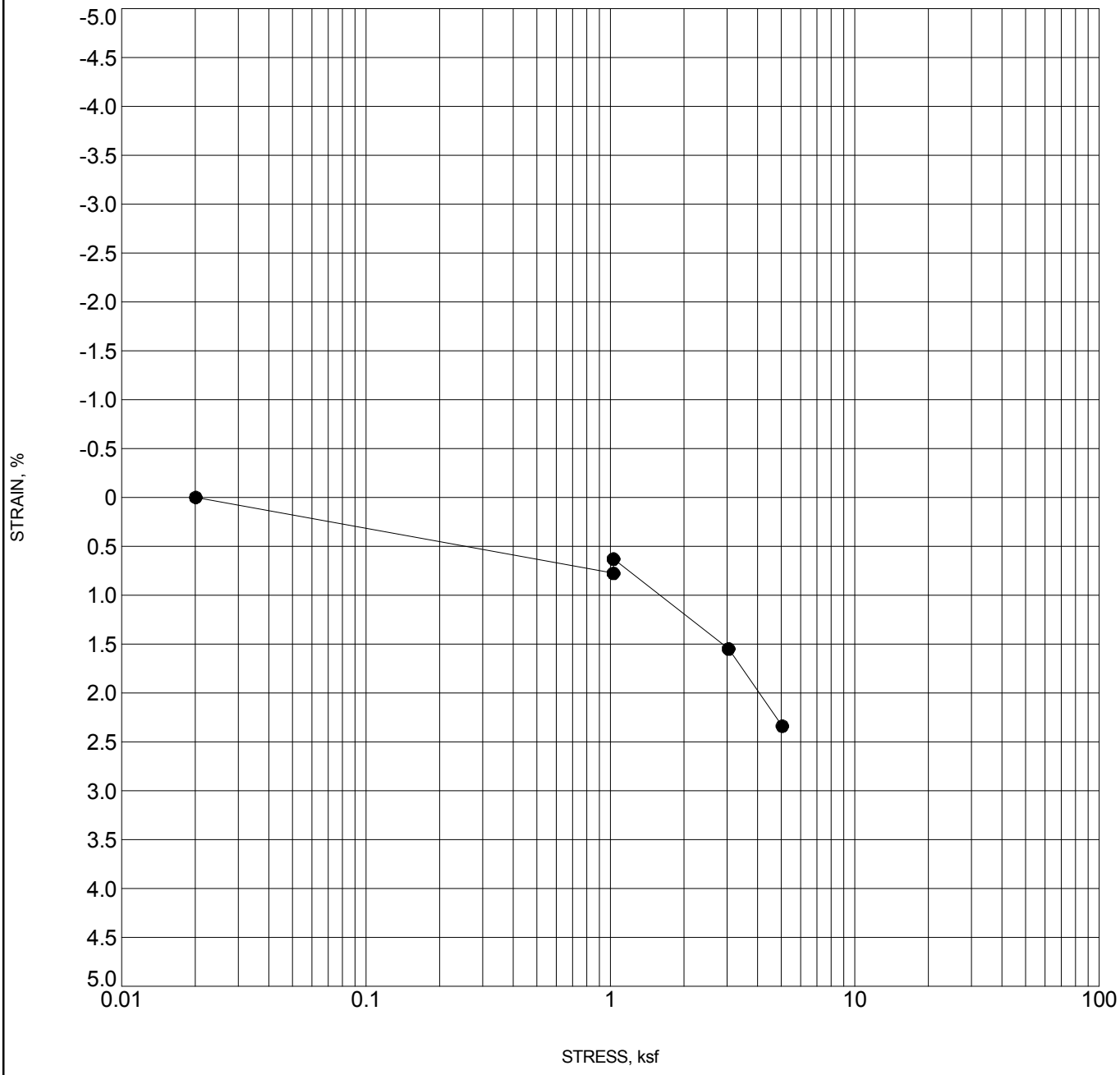
SWELL - STANDARD 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 8/10/12

SWELL - CONSOLIDATION TEST

RockSol Consulting Group, Inc.

CLIENT Hartwig and Associates **PROJECT NAME** US6 Bridges Design Build Project

PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado



Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **BR- 25**	**19.0**	**(Bedrock) CLAYSTONE**	**0.2**	**115.0**	**15.9**

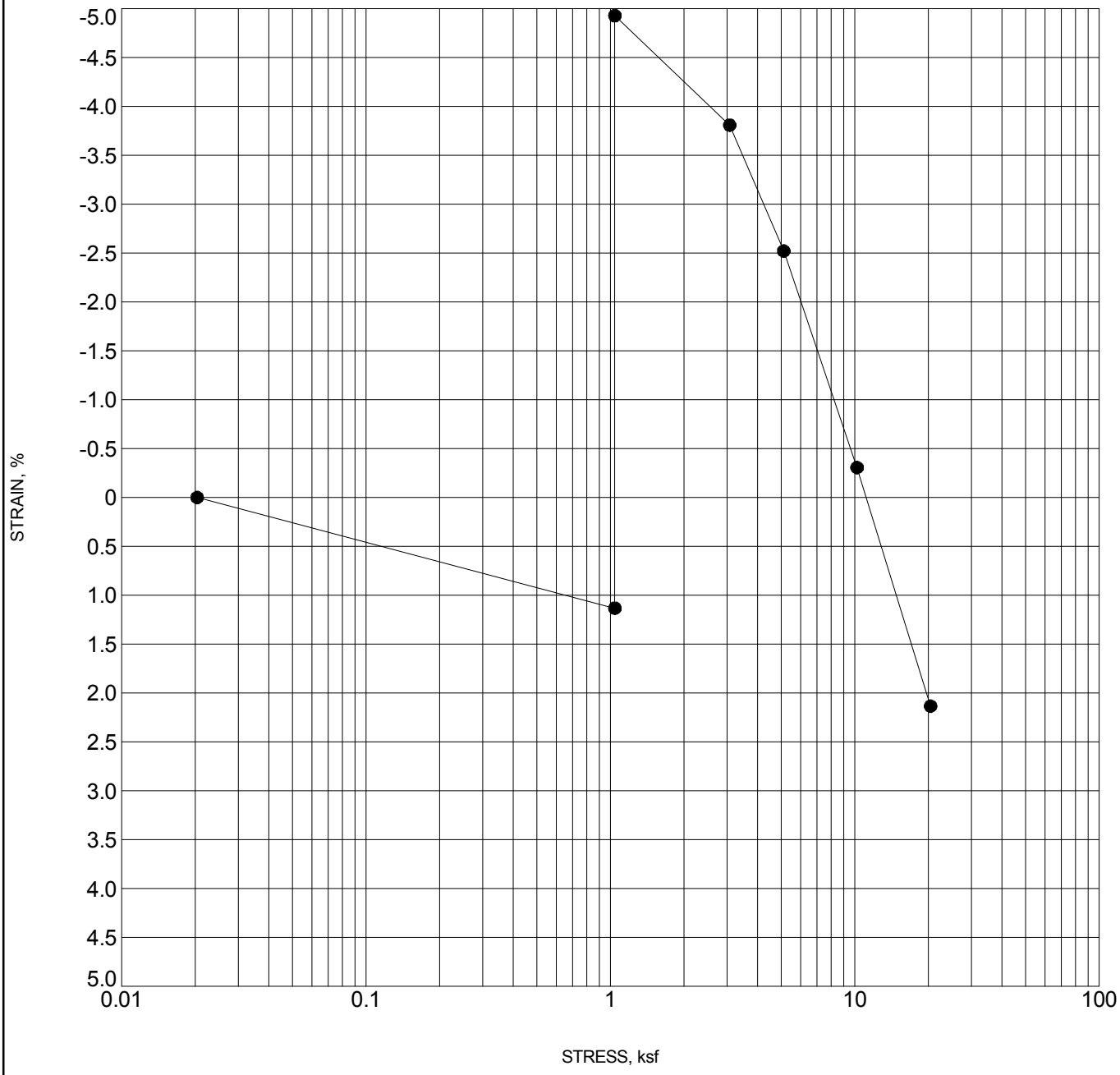
SWELL - STANDARD 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 8/10/12

SWELL - CONSOLIDATION TEST

RockSol Consulting Group, Inc.

CLIENT Hartwig and Associates **PROJECT NAME** US6 Bridges Design Build Project

PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado



Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **BR- 26**	**10.0**	**sandy CLAY**	**6.1**	**103.0**	**16.1**

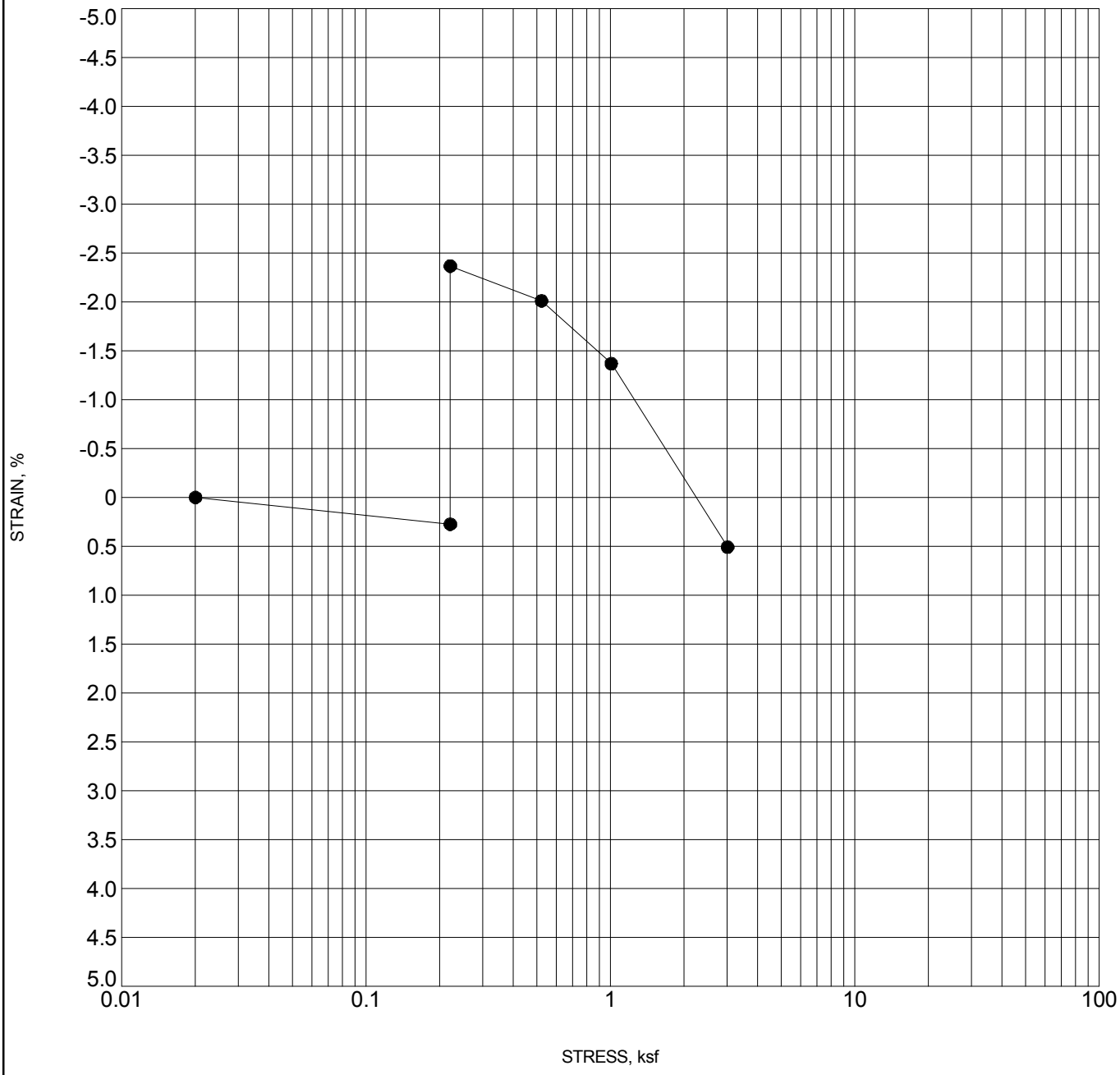
SWELL - STANDARD 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 8/10/12

SWELL - CONSOLIDATION TEST

RockSol Consulting Group, Inc.

CLIENT Hartwig and Associates **PROJECT NAME** US6 Bridges Design Build Project

PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado



Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **BR- 27**	**2.0**	**CLAY with SAND**	**2.6**	**100.9**	**24.1**

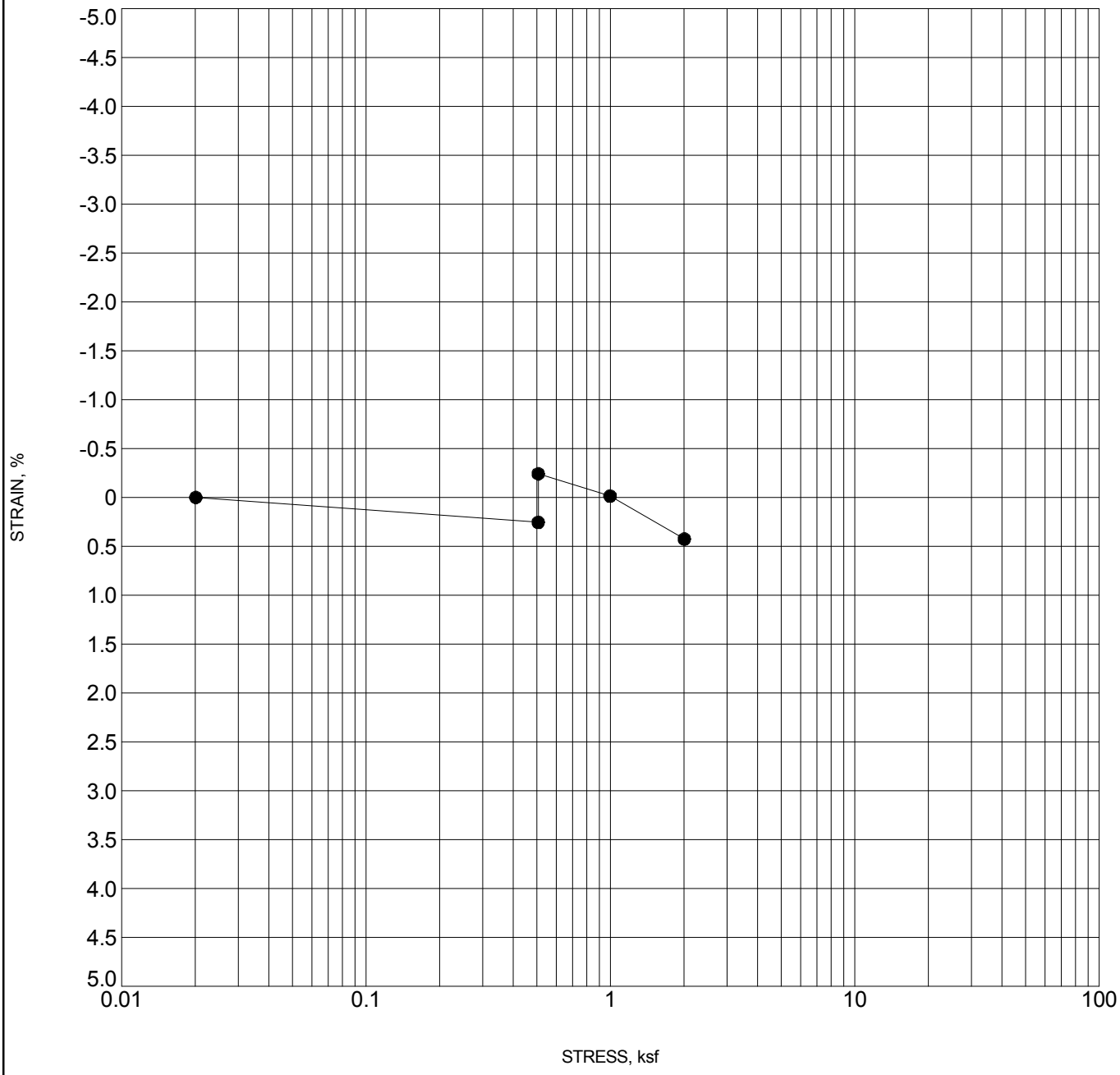
SWELL - STANDARD 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 8/10/12

SWELL - CONSOLIDATION TEST

RockSol Consulting Group, Inc.

CLIENT Hartwig and Associates **PROJECT NAME** US6 Bridges Design Build Project

PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado



Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● BR- 27	5.0	CLAY with SAND	0.5	89.4	39.6

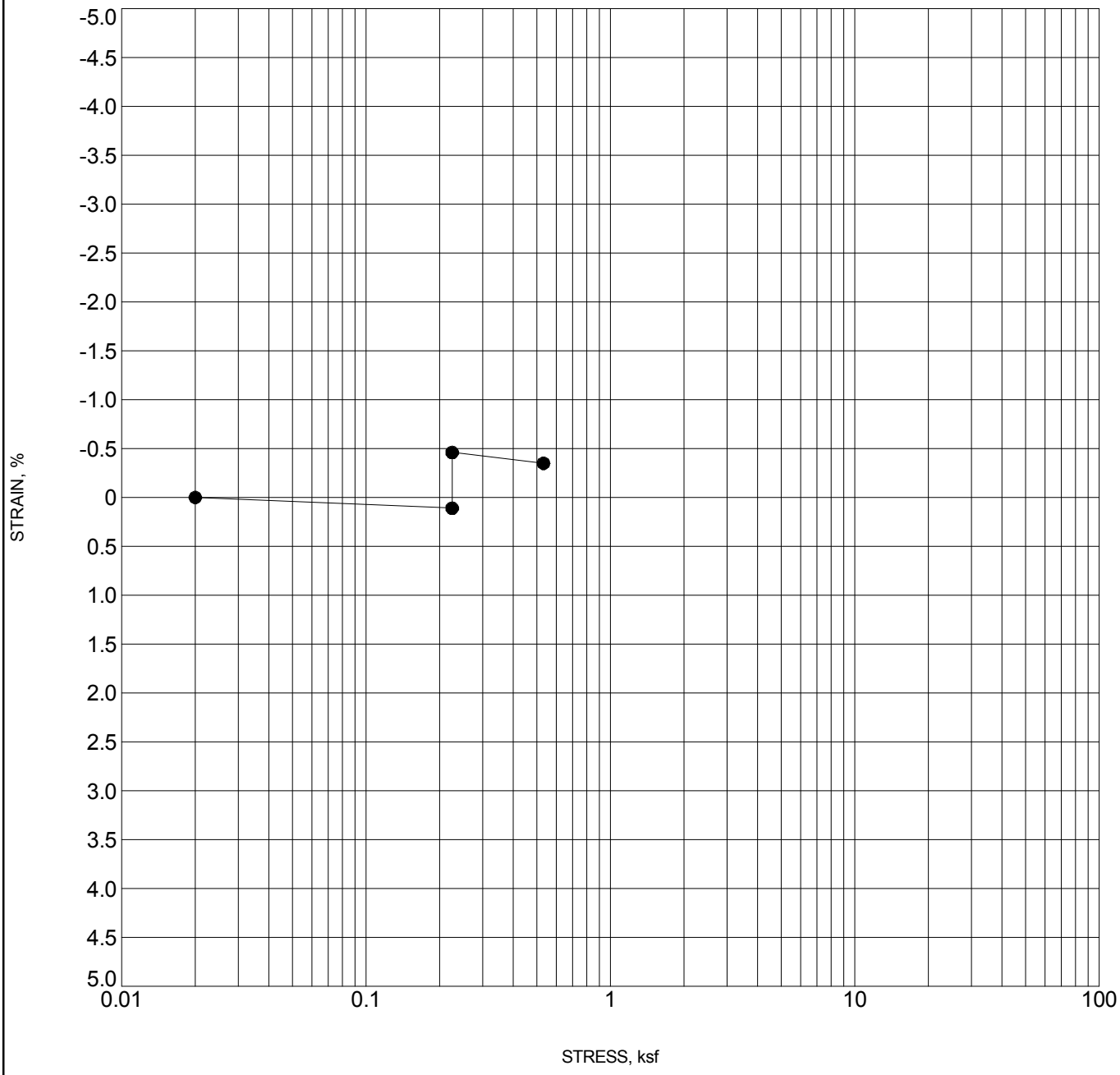
SWELL - STANDARD 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 8/10/12

SWELL - CONSOLIDATION TEST

RockSol Consulting Group, Inc.

CLIENT Hartwig and Associates **PROJECT NAME** US6 Bridges Design Build Project

PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado



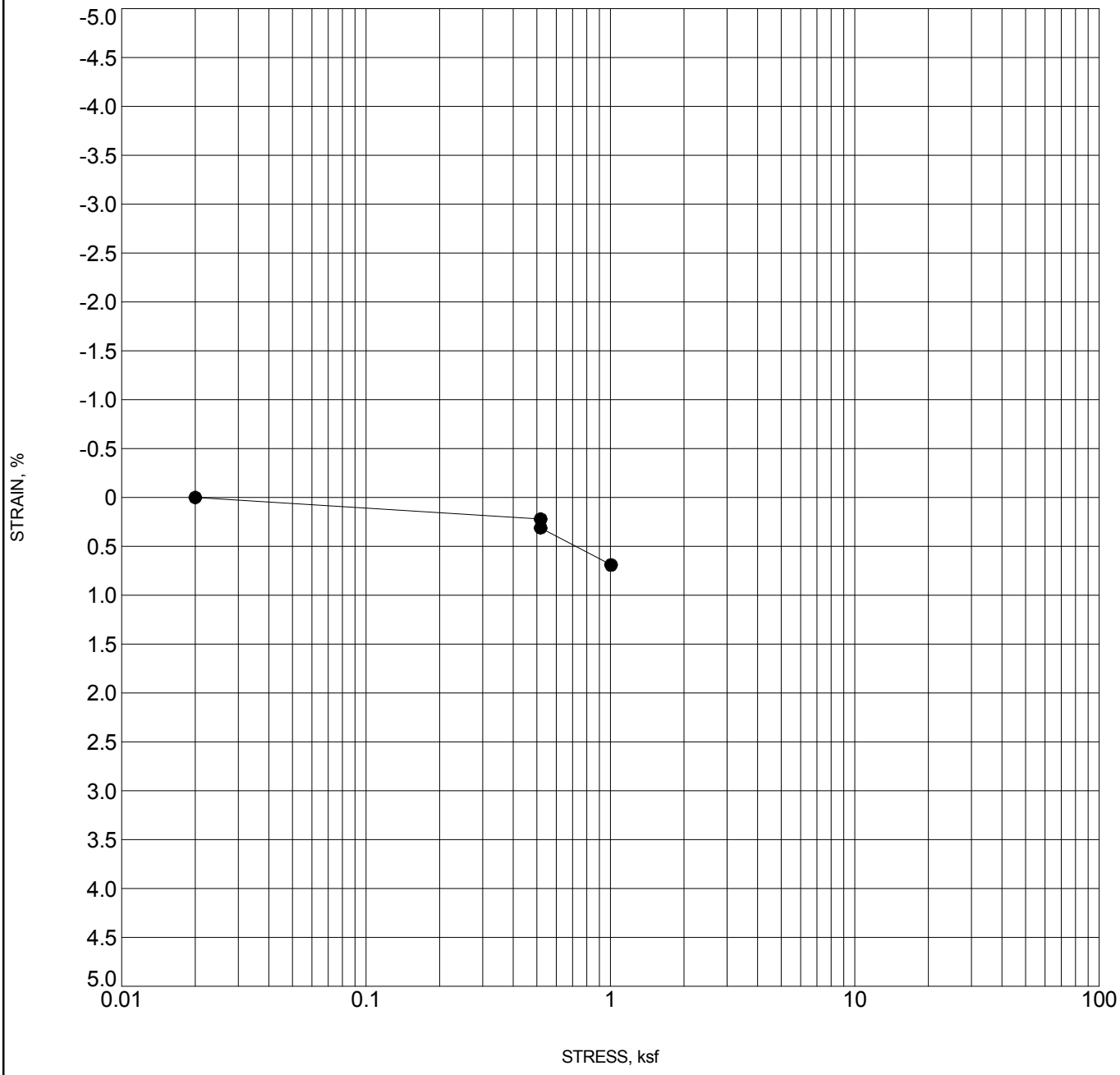
Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **RW 1-1**	**2.0**	**(Fill) SANDY CLAY**	**0.6**	**97.1**	**24.6**

SWELL - CONSOLIDATION TEST

RockSol Consulting Group, Inc.

CLIENT Hartwig and Associates **PROJECT NAME** US6 Bridges Design Build Project

PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado



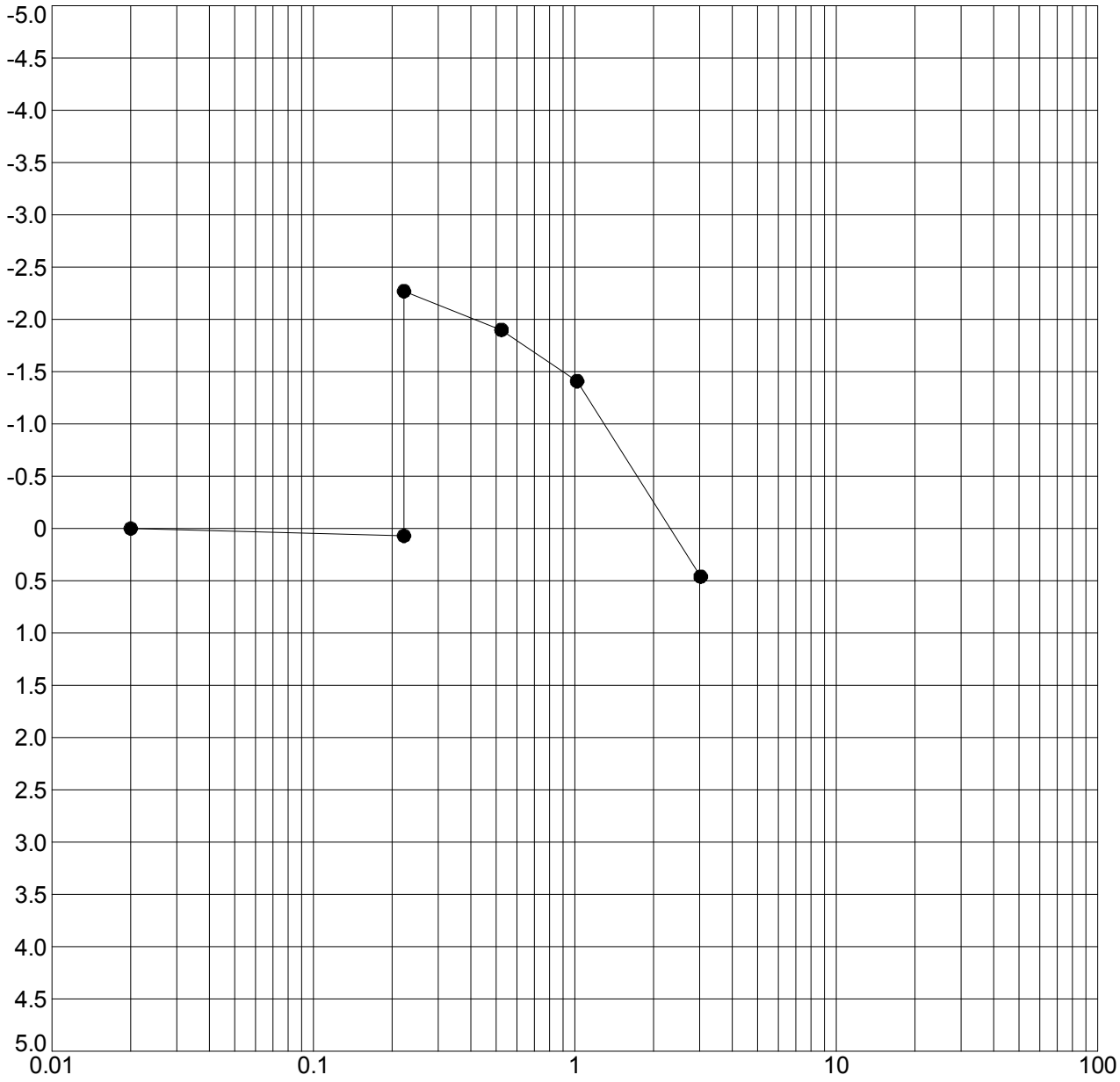
Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **RW 1-1**	**5.0**	**(Fill) SANDY CLAY**	**-0.1**	**99.5**	**24.2**

SWELL - CONSOLIDATION TEST

RockSol Consulting Group, Inc.

CLIENT Hartwig and Associates **PROJECT NAME** US6 Bridges Design Build Project

PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado



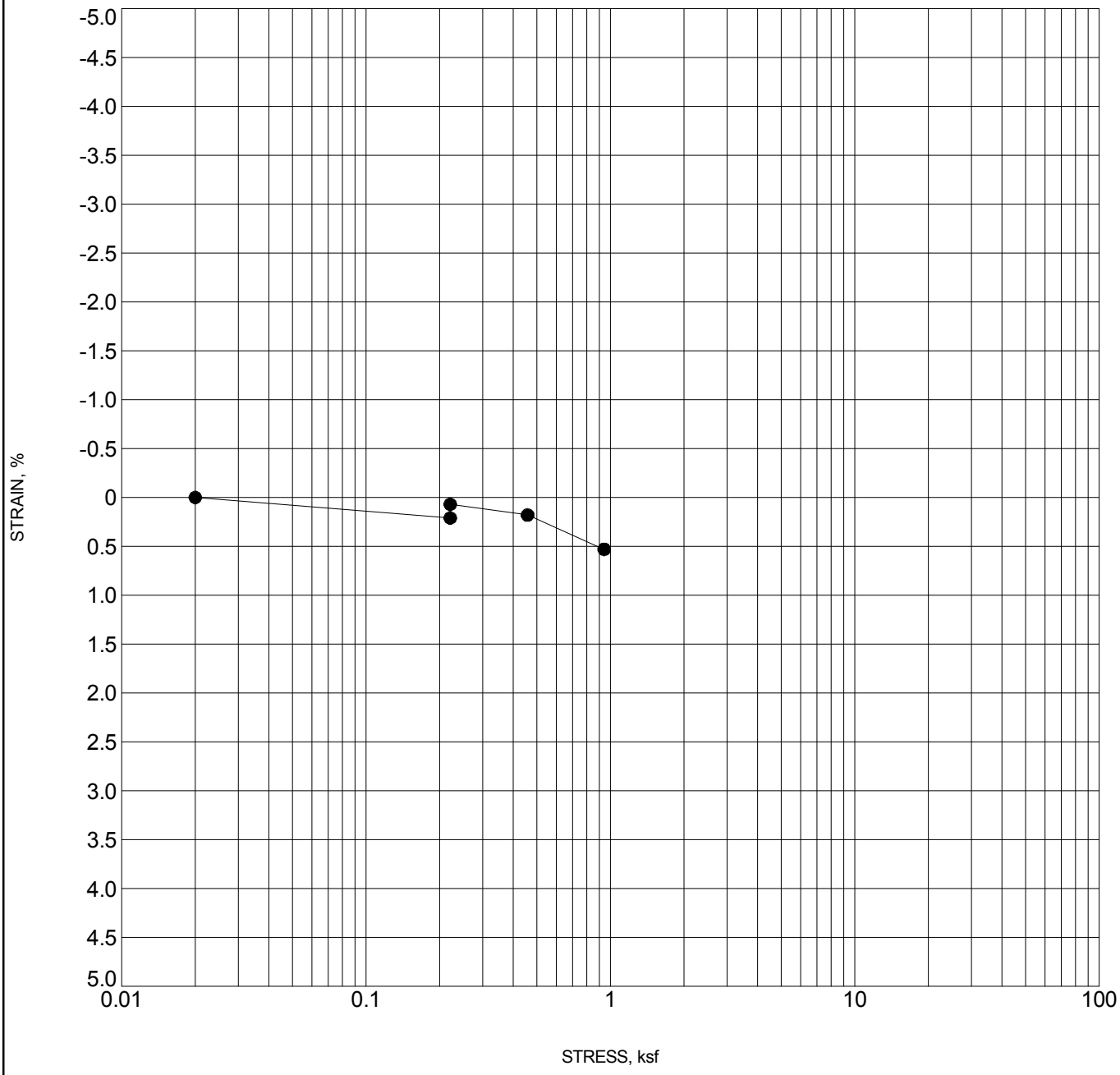
Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **RW 1-2**	**2.0**	**(Fill) SANDY CLAY**	**2.3**	**111.1**	**17.1**

SWELL - CONSOLIDATION TEST

RockSol Consulting Group, Inc.

CLIENT Hartwig and Associates **PROJECT NAME** US6 Bridges Design Build Project

PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado



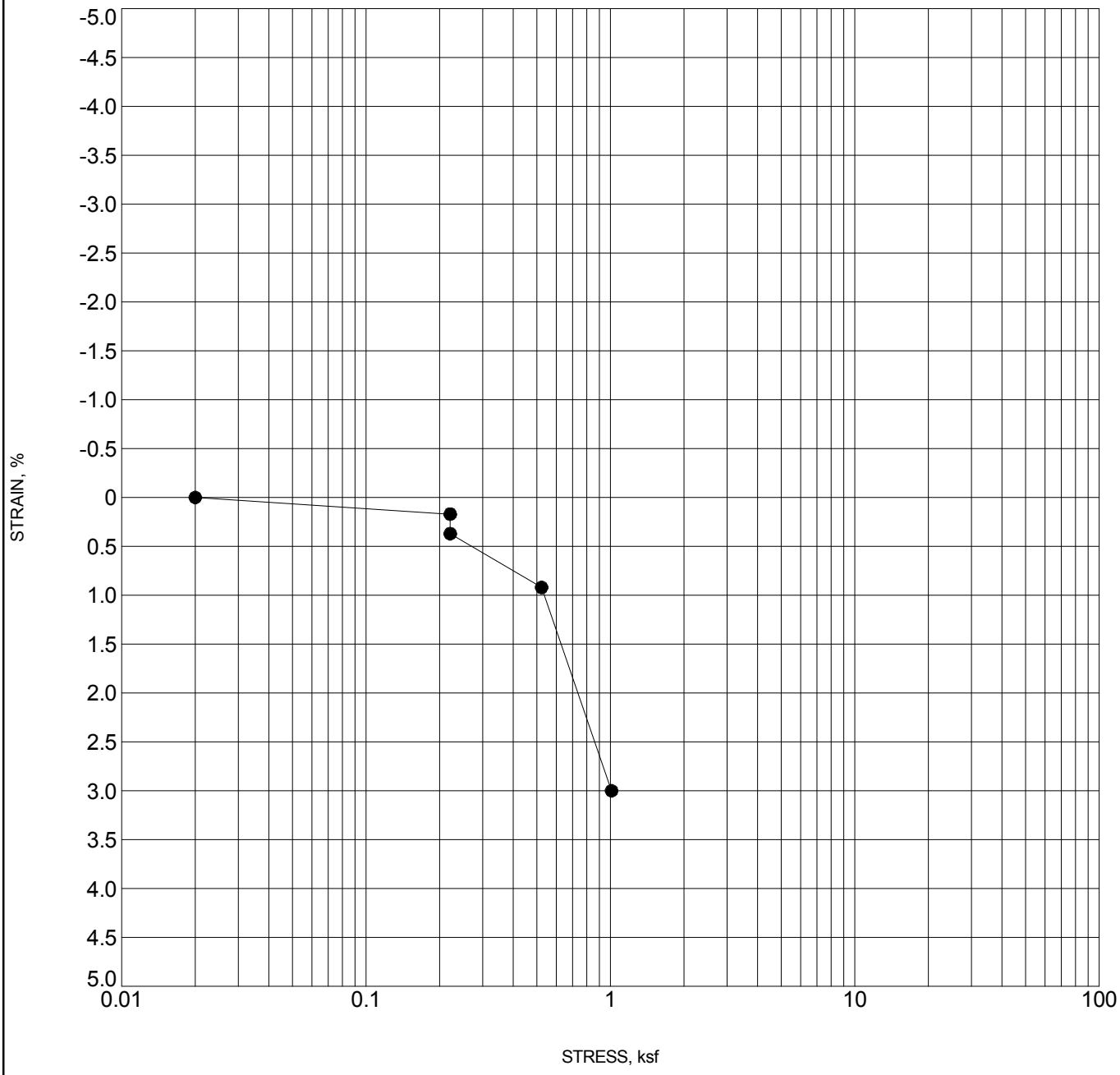
Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **RW 2-1**	**2.0**	**(Fill) CLAYEY SAND**	**0.2**	**99.7**	**22.2**

SWELL - CONSOLIDATION TEST

RockSol Consulting Group, Inc.

CLIENT Hartwig and Associates **PROJECT NAME** US6 Bridges Design Build Project

PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado



Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **RW 2-2**	**2.0**	**(Fill) CLAYEY SAND**	**-0.2**	**117.8**	**11.9**

SWELL - CONSOLIDATION TEST

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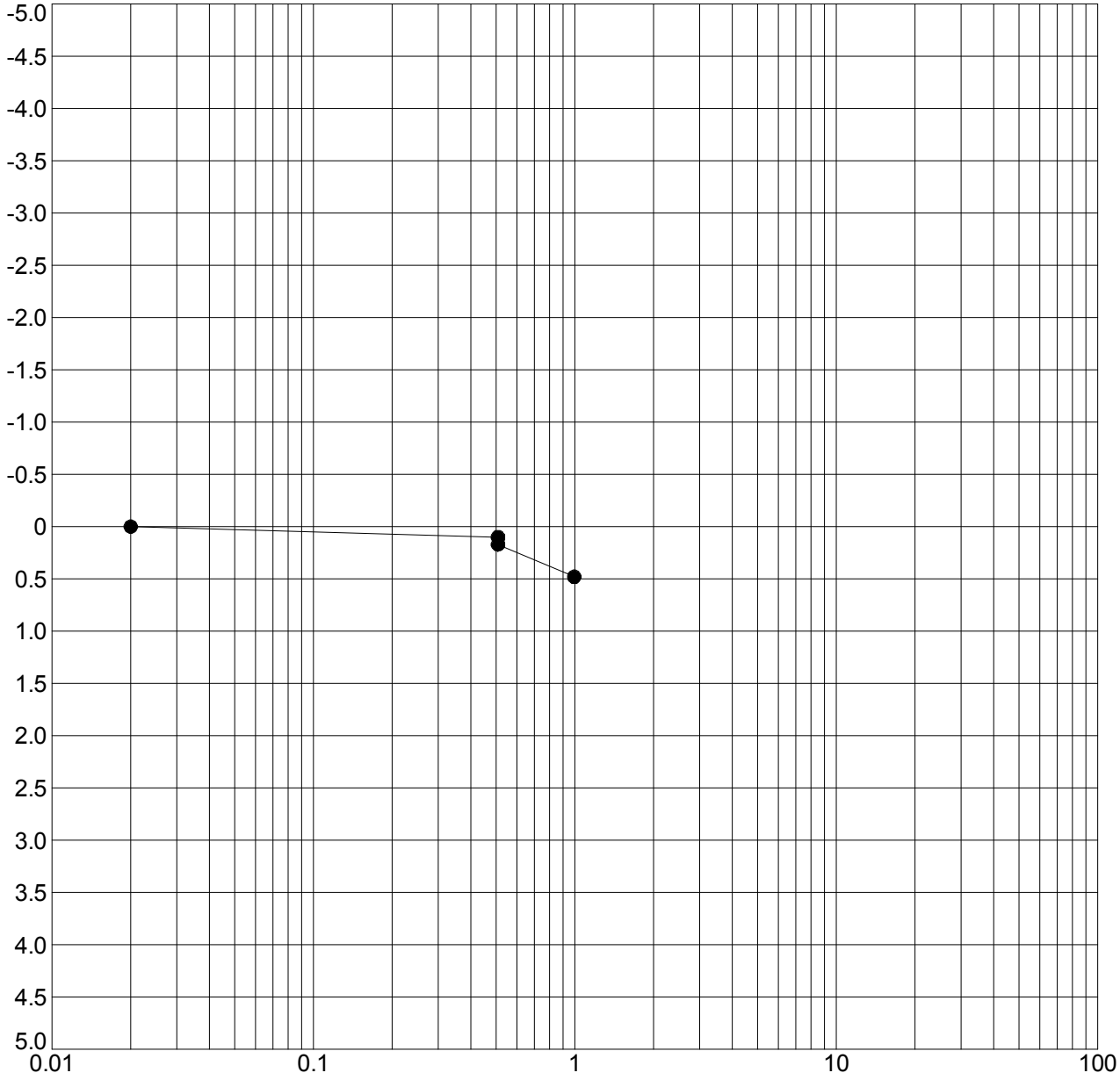
PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado



Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **RW 2-2**	**4.0**	**(Fill) CLAYEY SAND**	**-0.1**	**112.8**	**14.2**

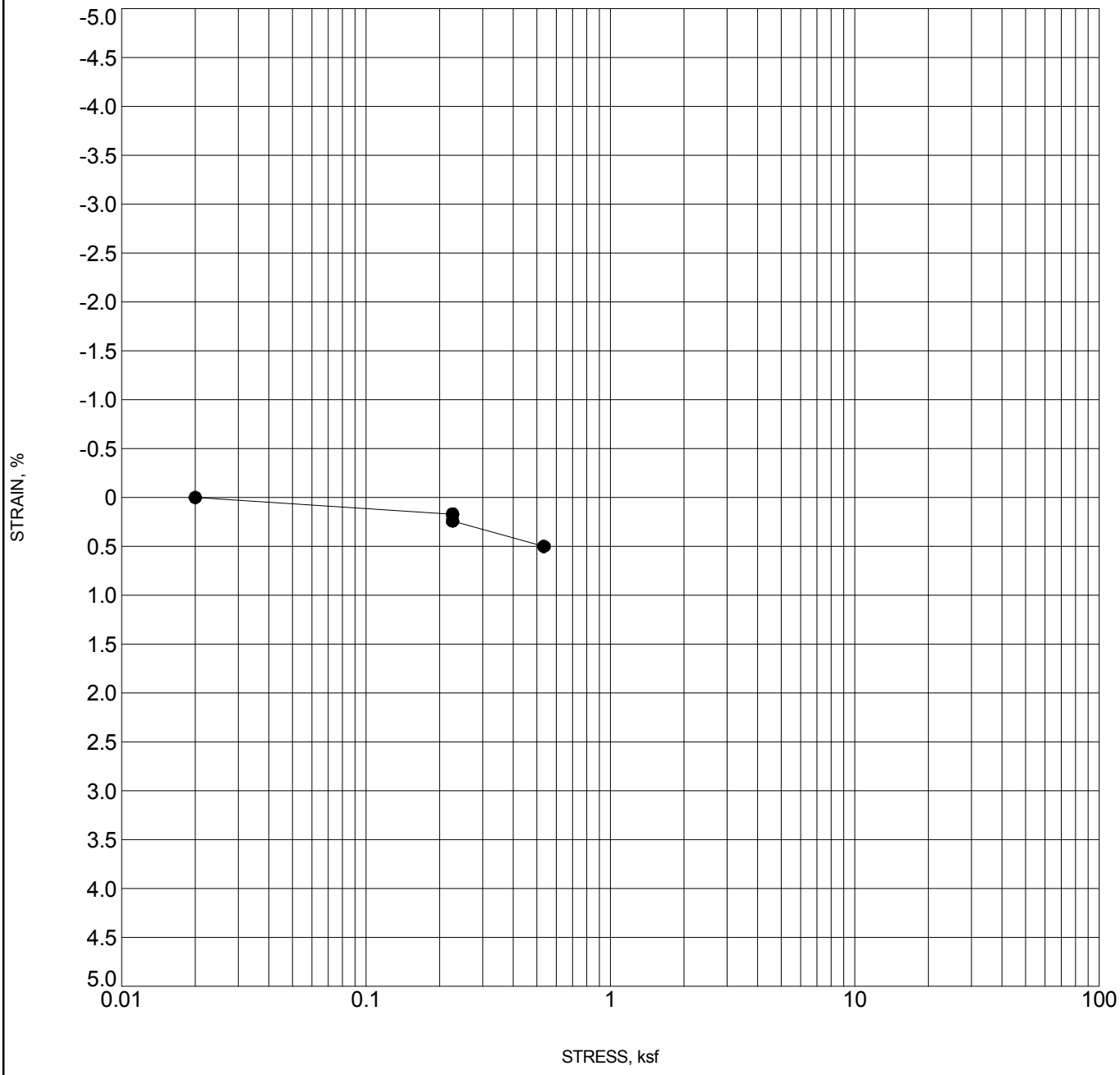
SWELL - STANDARD 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 8/10/12

SWELL - CONSOLIDATION TEST

RockSol Consulting Group, Inc.

CLIENT Hartwig and Associates **PROJECT NAME** US6 Bridges Design Build Project

PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado



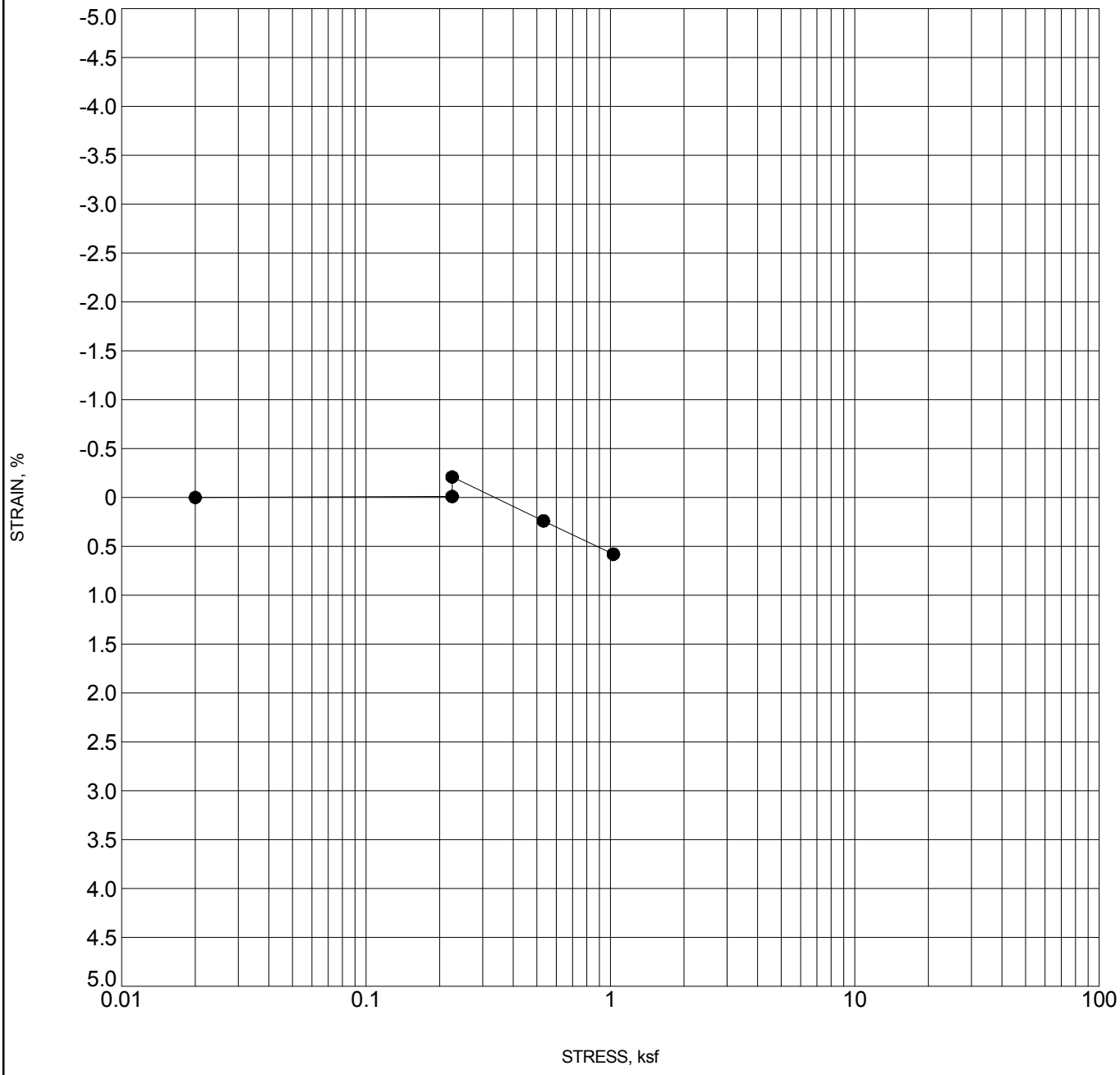
Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **RW 3-2**	**2.0**	**(Fill) CLAYEY SAND**	**-0.1**	**118.0**	**15.0**

SWELL - CONSOLIDATION TEST

RockSol Consulting Group, Inc.

CLIENT Hartwig and Associates **PROJECT NAME** US6 Bridges Design Build Project

PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado



Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **RW 4-1**	**2.0**	**(Fill) CLAYEY SAND**	**0.2**	**101.1**	**22.8**

SWELL - STANDARD 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 8/10/12

SWELL - CONSOLIDATION TEST

RockSol Consulting Group, Inc.

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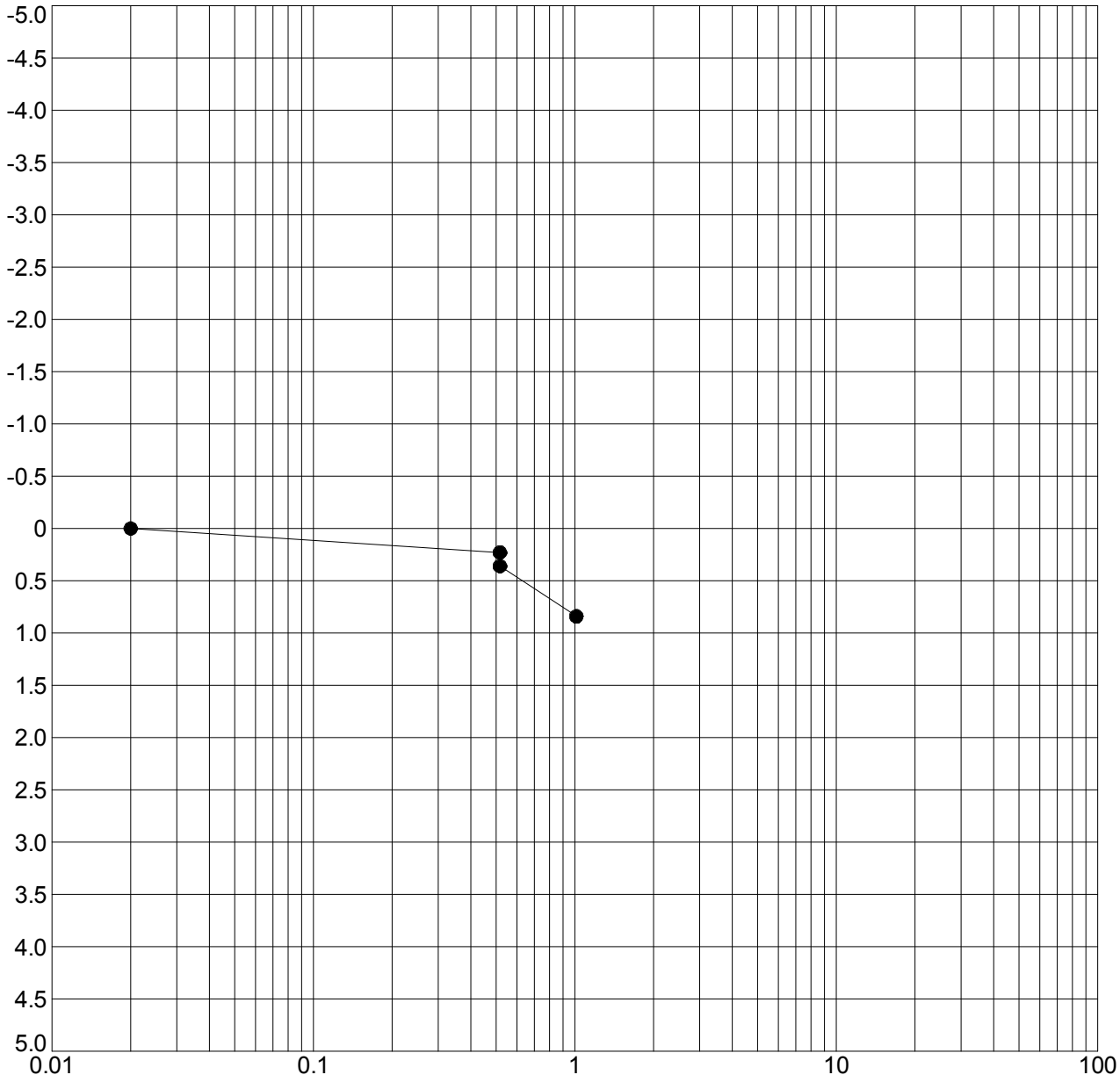
PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado



Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **RW 4-1**	**4.0**	**(Fill) CLAYEY SAND**	**-0.1**	**99.2**	**22.5**

SWELL - STANDARD 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 8/10/12

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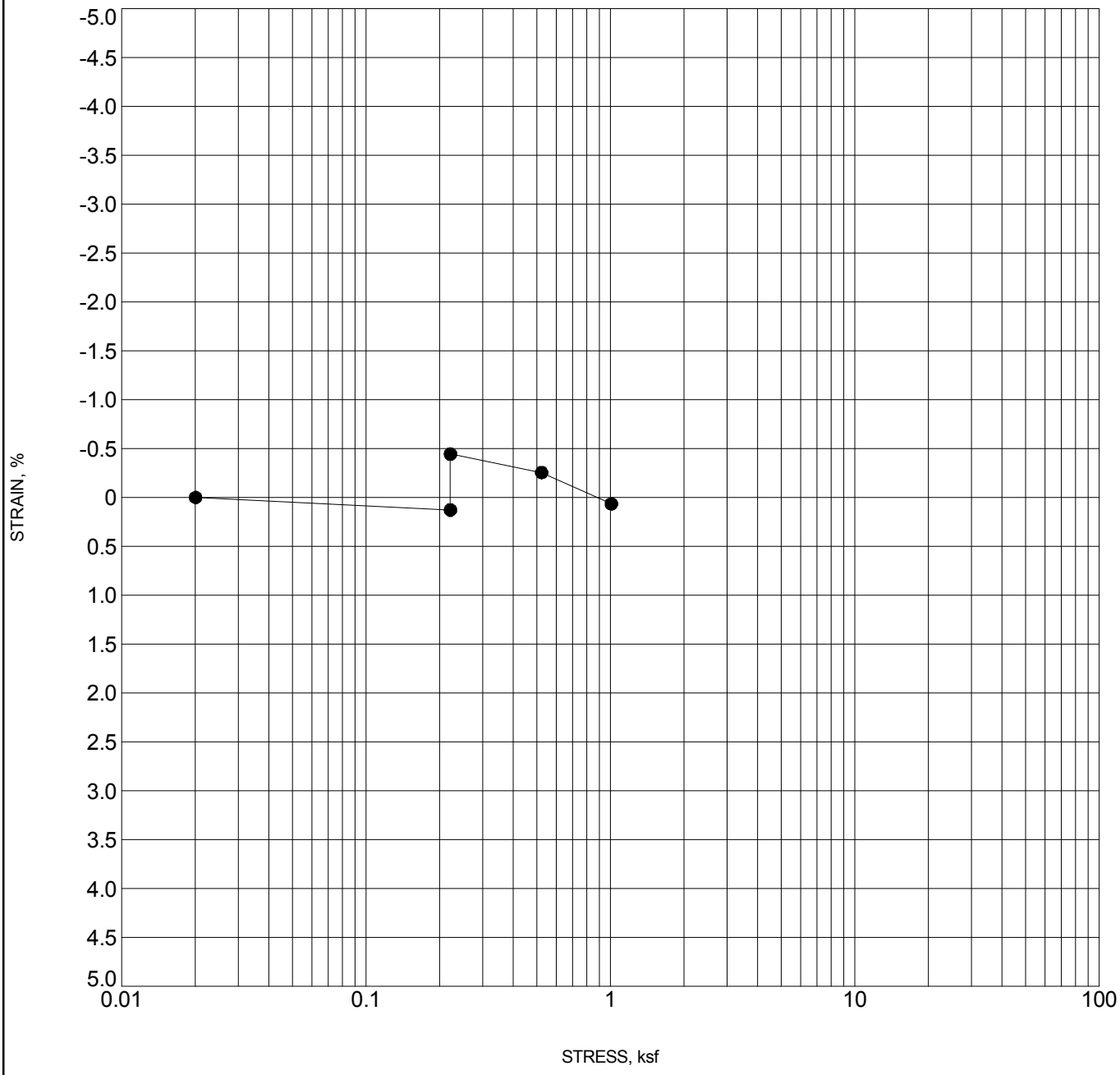
PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado



Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **RW 4-2**	**2.0**	**(Fill) SANDY CLAY with GRAVEL**	**0.6**	**98.8**	**26.5**

SWELL - CONSOLIDATION TEST

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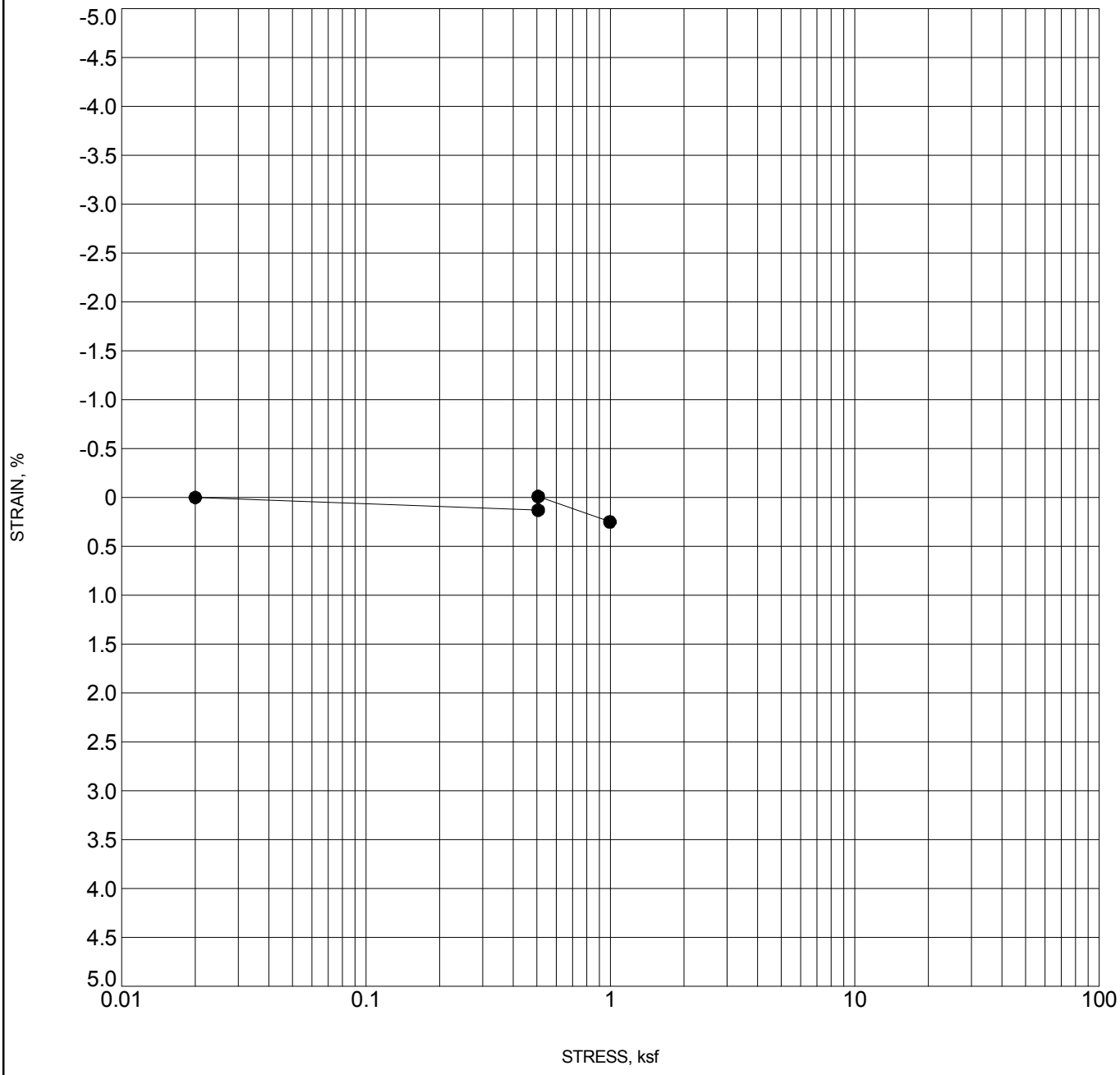
PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado



Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **RW 4-2**	**4.0**	**(Fill) SANDY CLAY**	**0.1**	**98.6**	**24.8**

SWELL - CONSOLIDATION TEST

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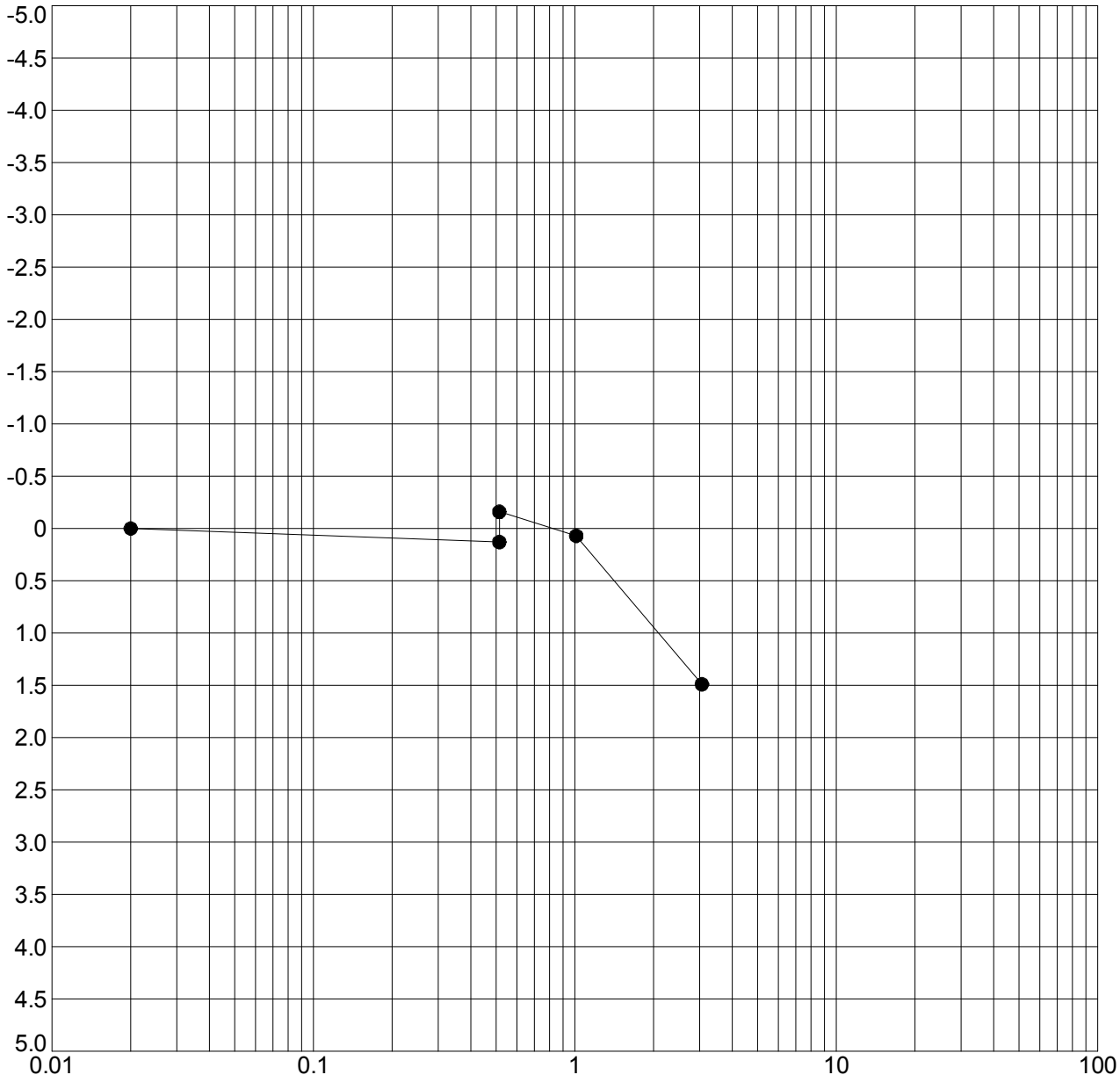

Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **RW 4-3**	**4.0**	**(Fill) SANDY CLAY**	**0.3**	**105.2**	**21.6**

SWELL - STANDARD 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 8/10/12

SWELL - CONSOLIDATION TEST

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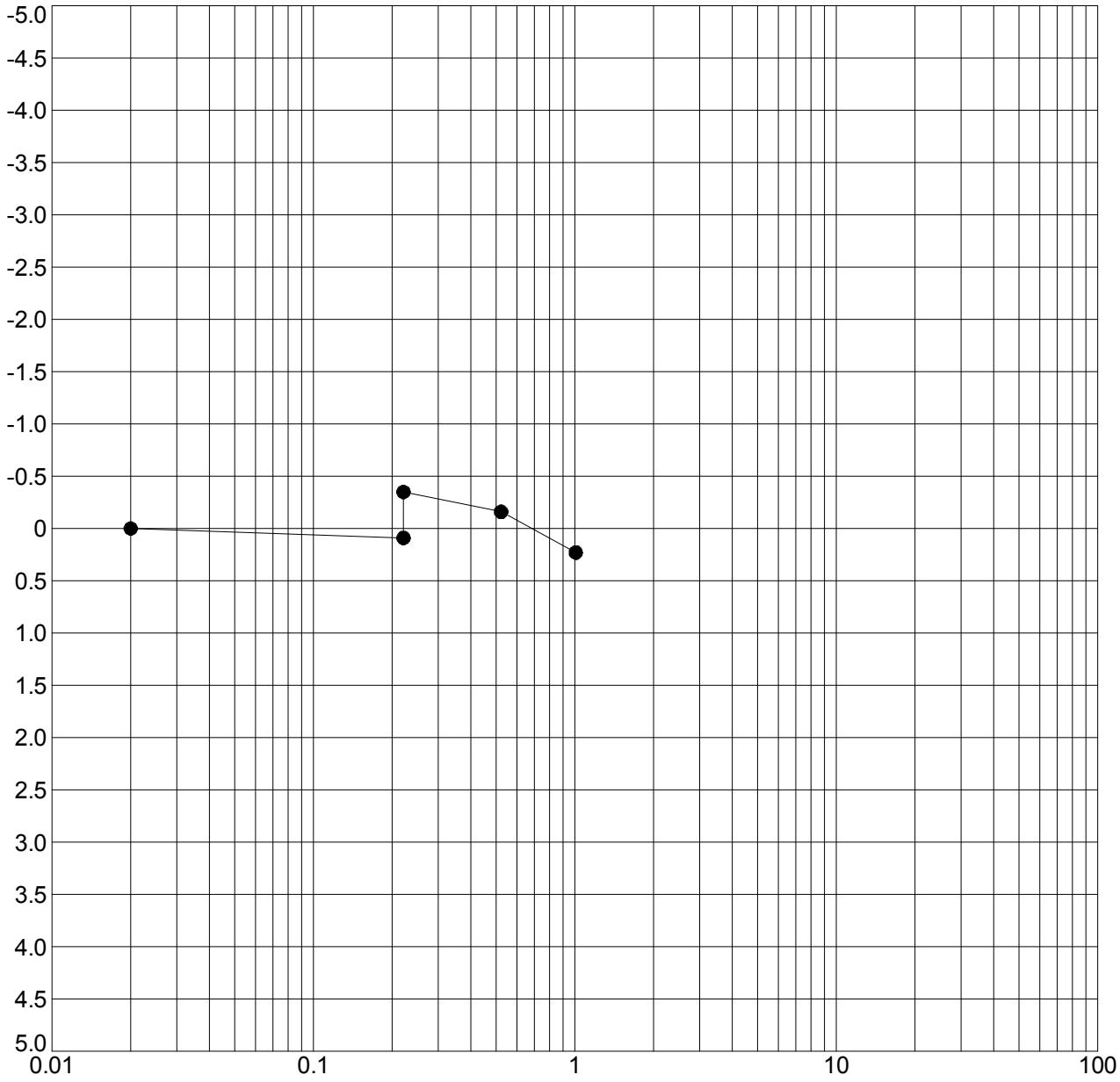
PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado



Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **RW 5-1**	**4.0**	**(Fill) CLAYEY SAND (SC)**	**0.4**	**108.7**	**20.4**

SWELL - CONSOLIDATION TEST

RockSol Consulting Group, Inc.

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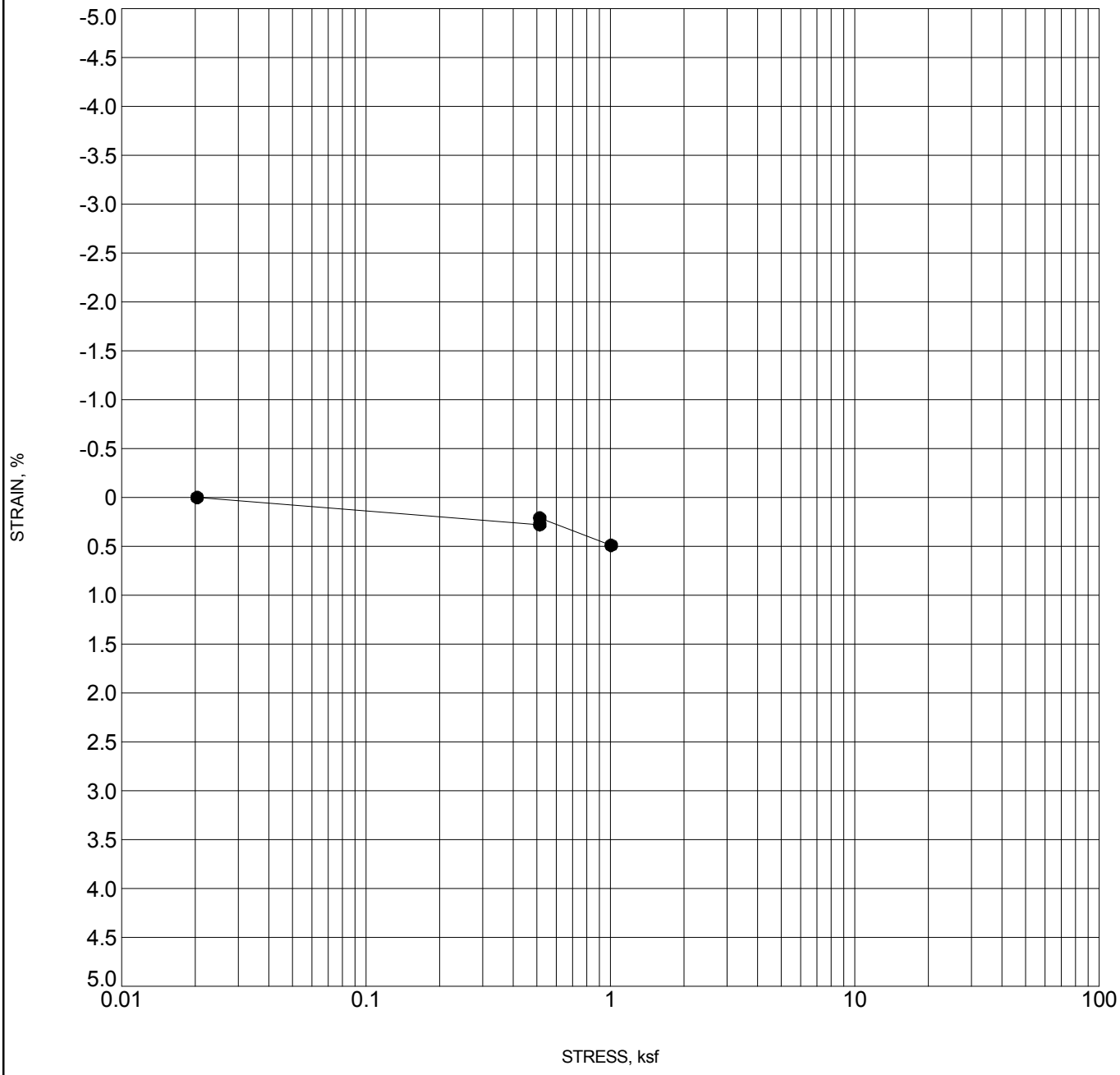
PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado



Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **RW 5-1**	**9.0**	**(Fill) SANDY CLAY**	**0.1**	**109.5**	**19.5**

SWELL - STANDARD 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 8/10/12

SWELL - CONSOLIDATION TEST

RockSol Consulting Group, Inc.

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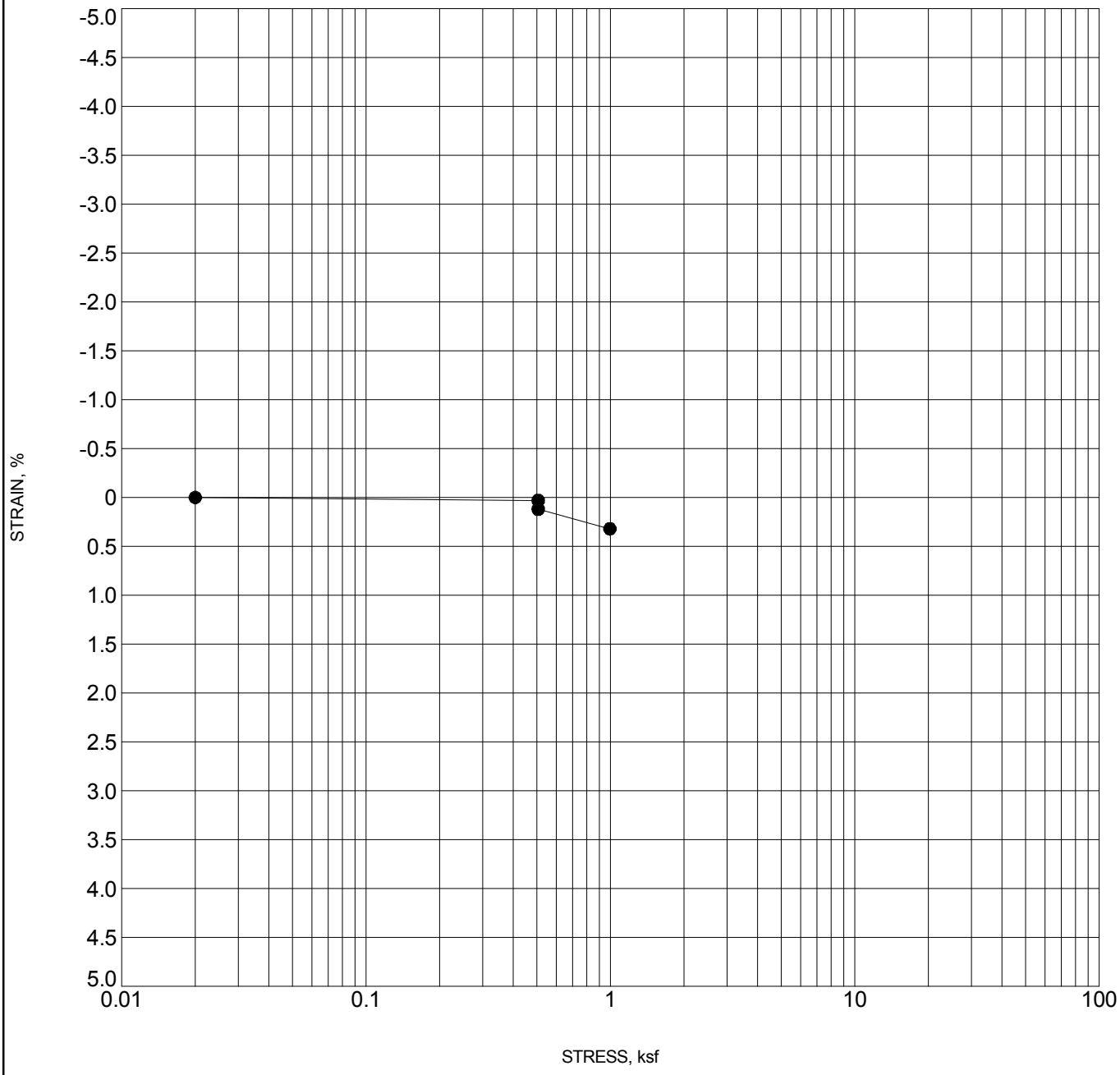
PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado



Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **RW 5-2**	**14.0**	**(Fill) SANDY CLAY**	**-0.1**	**107.6**	**18.7**

SWELL - STANDARD 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 8/10/12

SWELL - CONSOLIDATION TEST

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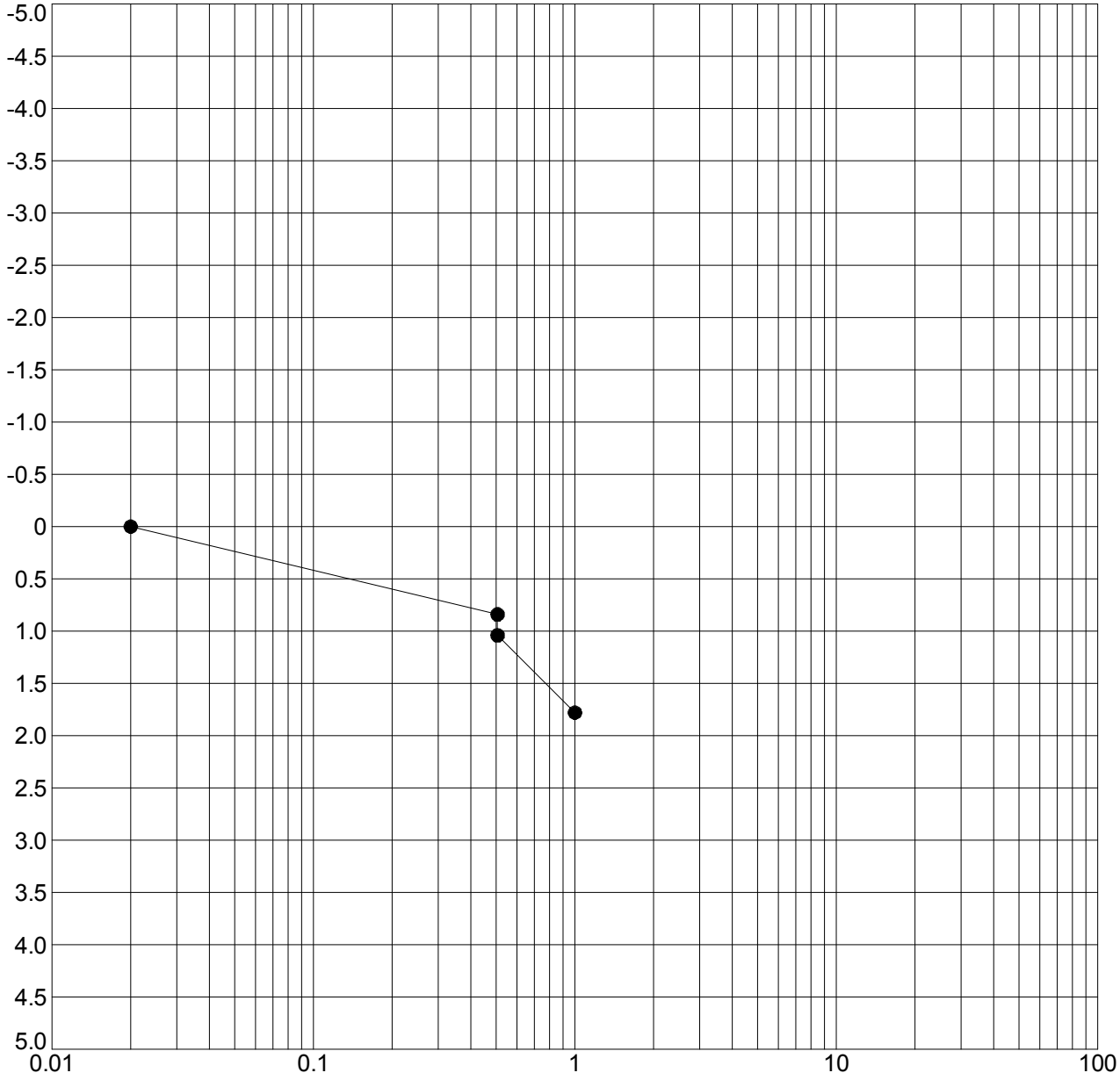

Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **RW 5-2**	**24.0**	**CLAY with trace SAND**	**-0.2**	**93.0**	**27.9**

SWELL - CONSOLIDATION TEST

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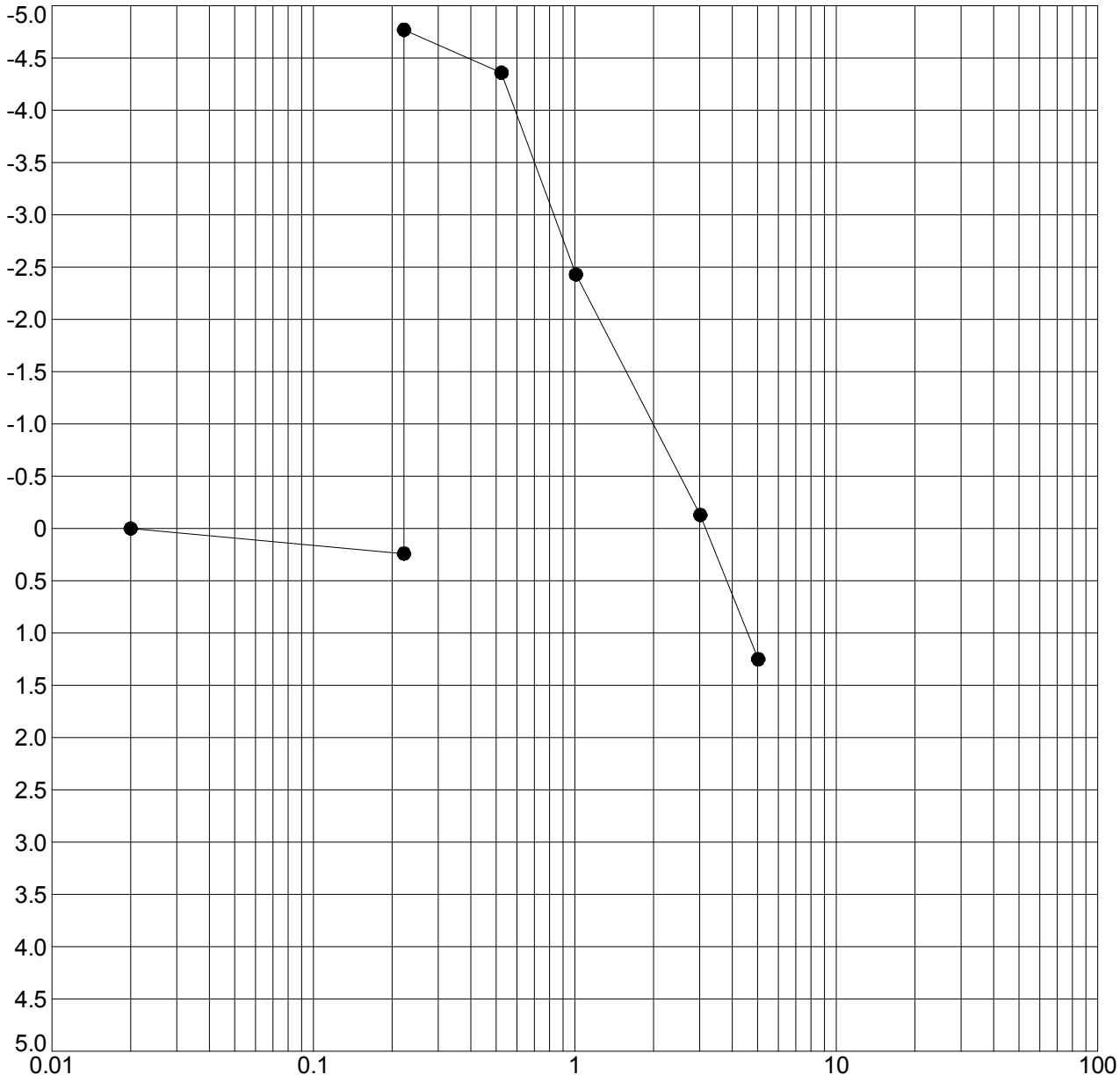
PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado



Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **RW 7-1**	**2.0**	**(FIII) CLAYEY SAND**	**5.0**	**126.3**	**7.3**

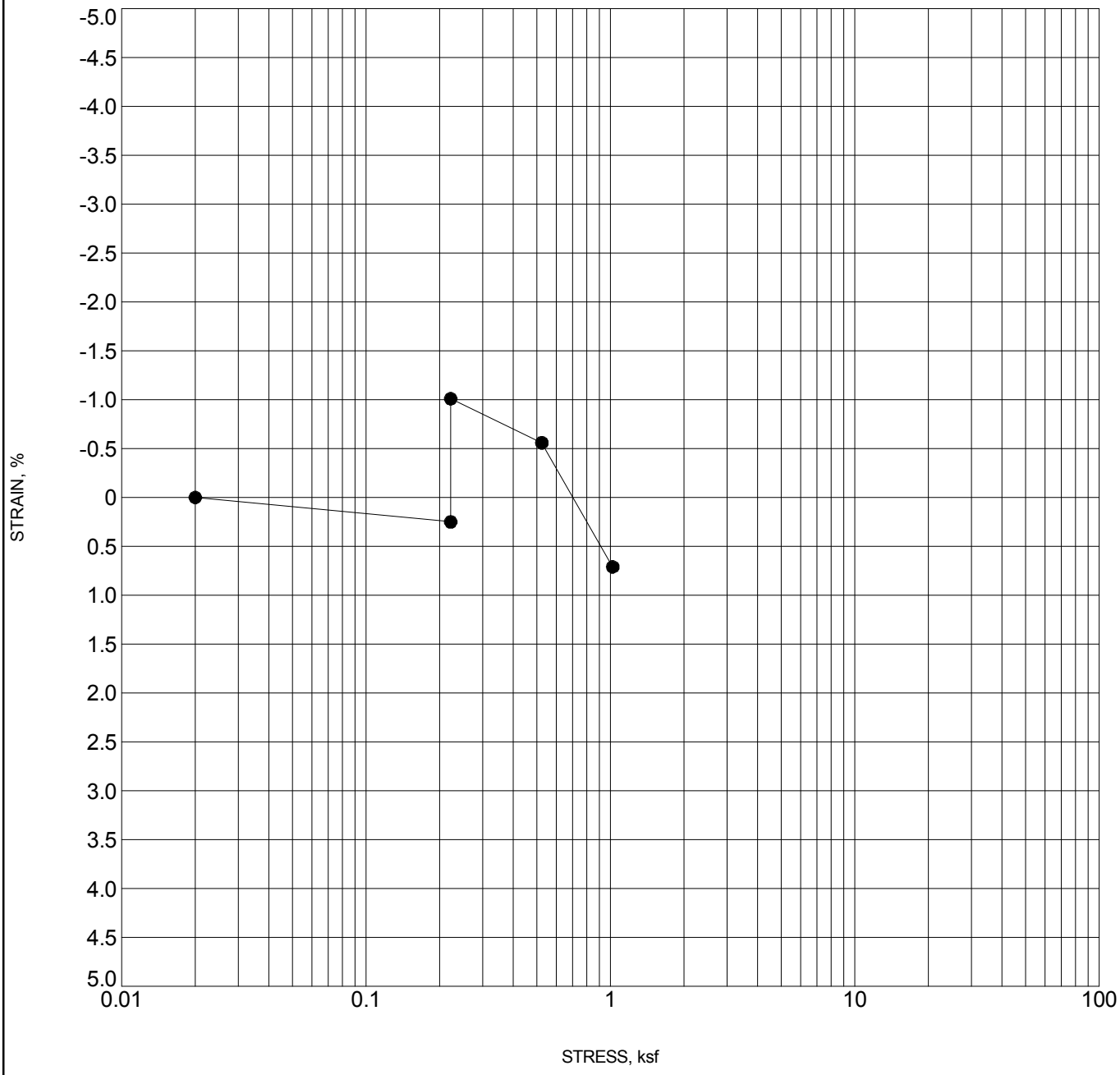
SWELL - STANDARD 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 8/10/12

SWELL - CONSOLIDATION TEST

RockSol Consulting Group, Inc.

CLIENT Hartwig and Associates **PROJECT NAME** US6 Bridges Design Build Project

PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado



Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **RW 7-1**	**4.0**	**(Fill) CLAYEY SAND**	**1.3**	**105.7**	**14.3**

SWELL - STANDARD 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 8/10/12

APPENDIX D

SEISMIC DESIGN PARAMETERS

US6 Bridges – Pedestrian Bridge Location
Conterminous 48 States
2007 AASHTO Bridge Design Guidelines
AASHTO Spectrum for 7% PE in 75 years

Latitude = 39.725511
Longitude = -105.029166

Site Class B

Data are based on a 0.05 deg grid spacing.

Period (sec)	Sa (g)	
0.0	0.060	PGA, Site Class B
0.2	0.127	Ss, Site Class B
1.0	0.034	S1, Site Class B

As = FpgaPGA, SDs = FaSs, and SD1 = FvS1

Site Class D -

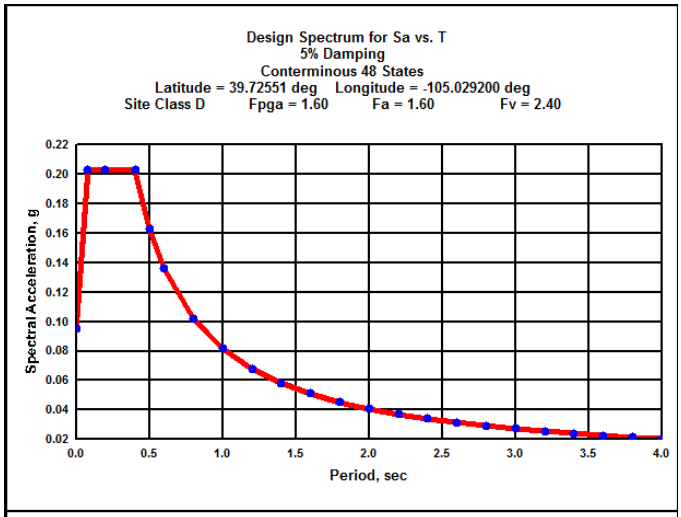
Fpga = 1.60, Fa = 1.60, Fv = 2.40

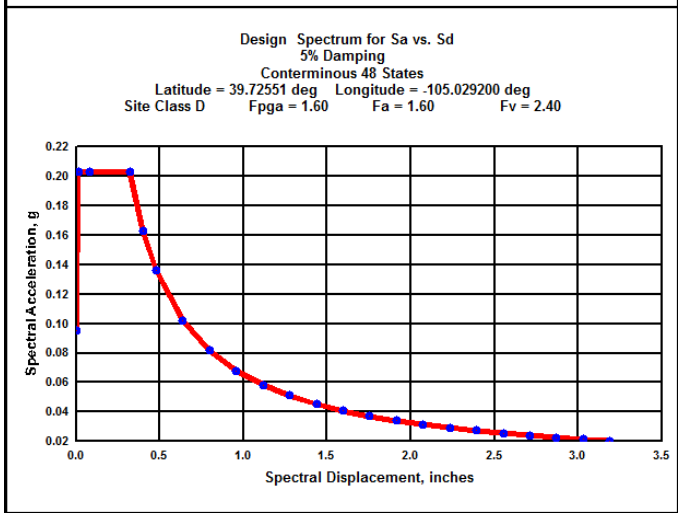
Data are based on a 0.05 deg grid spacing.

Period (sec)	Sa (g)	
0.0	0.095	As, Site Class D
0.2	0.203	SDs, Site Class D
1.0	0.082	SD1, Site Class D

Data are based on a 0.05 deg grid spacing.

Period (sec)	Sa (g)	Sd in.
0.000	0.095	0.000
0.080	0.203	0.013
0.200	0.203	0.079
0.402	0.203	0.320
0.500	0.163	0.399
0.600	0.136	0.478
0.800	0.102	0.638
1.000	0.082	0.797
1.200	0.068	0.957
1.400	0.058	1.116
1.600	0.051	1.276
1.800	0.045	1.435
2.000	0.041	1.595
2.200	0.037	1.754
2.400	0.034	1.914
2.600	0.031	2.073
2.800	0.029	2.233
3.000	0.027	2.392
3.200	0.026	2.552
3.400	0.024	2.711
3.600	0.023	2.871
3.800	0.021	3.030
4.000	0.020	3.190





US6 Bridges – Braided Ramp Bridge Location
Conterminous 48 States
2007 AASHTO Bridge Design Guidelines
AASHTO Spectrum for 7% PE in 75 years

Latitude = 39.725258
Longitude = -105.023243

Site Class B

Data are based on a 0.05 deg grid spacing.

Period (sec)	Sa (g)		
0.0	0.059	PGA,	Site Class B
0.2	0.127	Ss,	Site Class B
1.0	0.034	S1,	Site Class B

Spectral Response Accelerations SDs and SD1

As = FpgaPGA, SDs = FaSs, and SD1 = FvS1

Site Class D

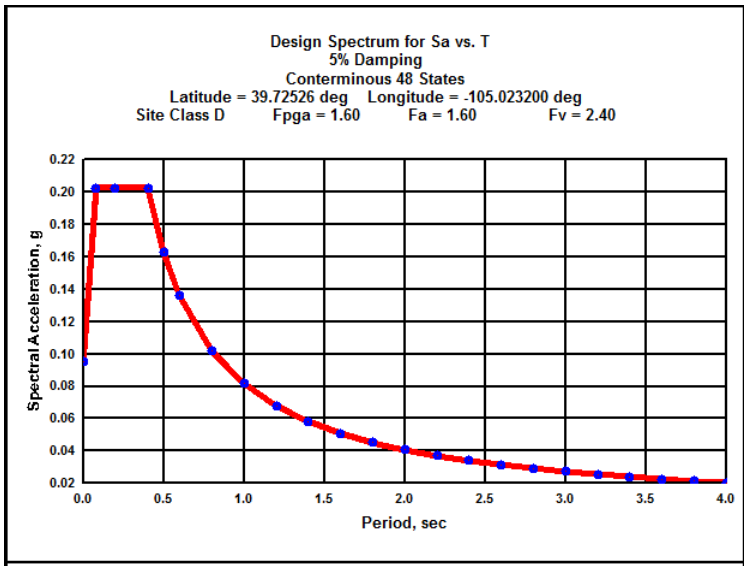
Fpga = 1.60,Fa = 1.60,Fv = 2.40

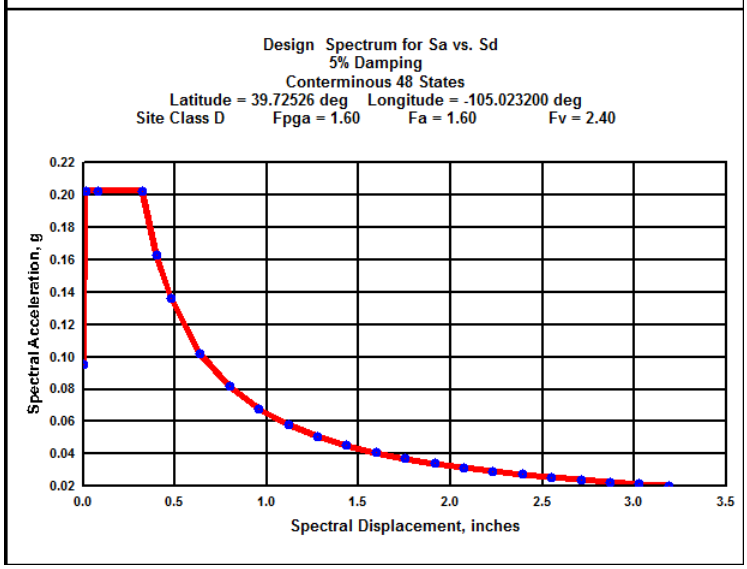
Data are based on a 0.05 deg grid spacing.

Period (sec)	Sa (g)		
0.0	0.095	As,	Site Class D
0.2	0.203	SDs,	Site Class D
1.0	0.082	SD1,	Site Class D

Data are based on a 0.05 deg grid spacing.

Period (sec)	Sa (g)	Sd in.
0.000	0.095	0.000
0.080	0.203	0.013
0.200	0.203	0.079
0.402	0.203	0.320
0.500	0.163	0.398
0.600	0.136	0.478
0.800	0.102	0.637
1.000	0.082	0.797
1.200	0.068	0.956
1.400	0.058	1.115
1.600	0.051	1.275
1.800	0.045	1.434
2.000	0.041	1.593
2.200	0.037	1.753
2.400	0.034	1.912
2.600	0.031	2.071
2.800	0.029	2.231
3.000	0.027	2.390
3.200	0.025	2.549
3.400	0.024	2.709
3.600	0.023	2.868
3.800	0.021	3.027
4.000	0.020	3.187





US6 Bridges – Bryant Street Bridge Location
Conterminous 48 States
2007 AASHTO Bridge Design Guidelines
AASHTO Spectrum for 7% PE in 75 years

Latitude = 39.725269
Longitude = -105.018659

Site Class B

Data are based on a 0.05 deg grid spacing.

Period (sec)	Sa (g)	
0.0	0.059	PGA, Site Class B
0.2	0.127	Ss, Site Class B
1.0	0.034	S1, Site Class B

As = FpgaPGA, SDs = FaSs, and SD1 = FvS1

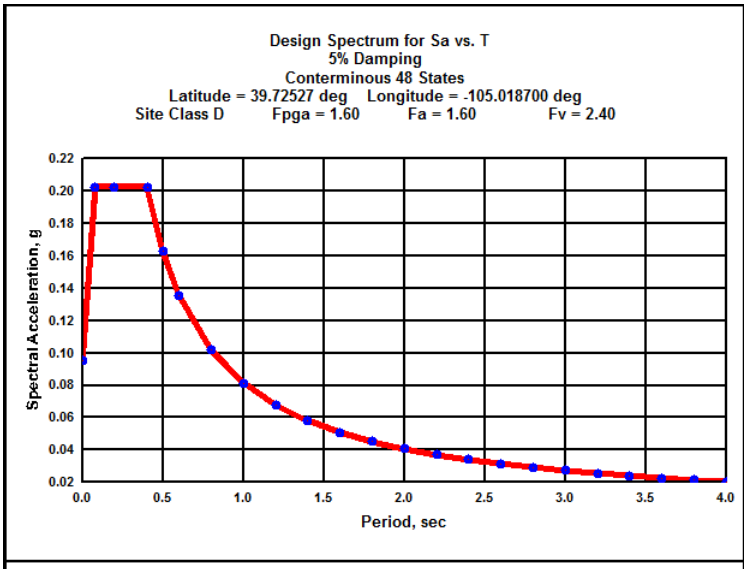
Site Class D - Fpga = 1.60, Fa = 1.60, Fv = 2.40

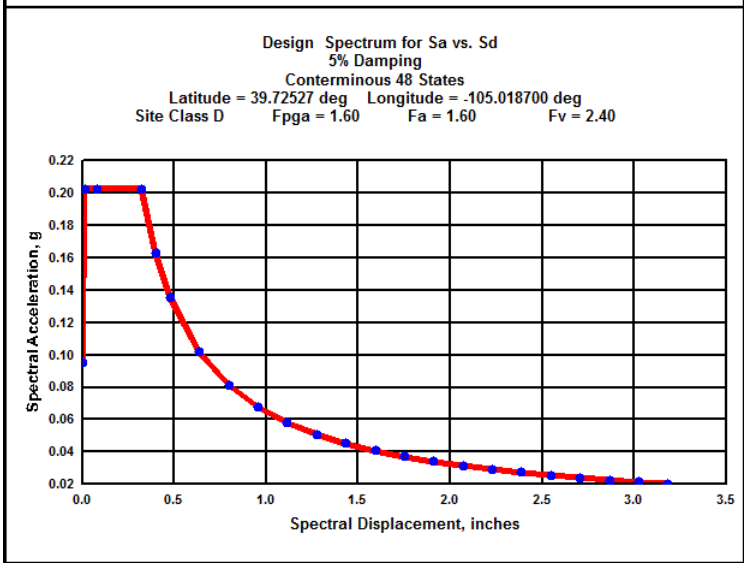
Data are based on a 0.05 deg grid spacing.

Period (sec)	Sa (g)	
0.0	0.095	As, Site Class D
0.2	0.203	SDs, Site Class D
1.0	0.081	SD1, Site Class D

Design Response Spectra for Site Class D
Data are based on a 0.05 deg grid spacing.

Period (sec)	Sa (g)	Sd in.
0.000	0.095	0.000
0.080	0.203	0.013
0.200	0.203	0.079
0.402	0.203	0.320
0.500	0.163	0.398
0.600	0.136	0.478
0.800	0.102	0.637
1.000	0.081	0.796
1.200	0.068	0.955
1.400	0.058	1.114
1.600	0.051	1.274
1.800	0.045	1.433
2.000	0.041	1.592
2.200	0.037	1.751
2.400	0.034	1.910
2.600	0.031	2.070
2.800	0.029	2.229
3.000	0.027	2.388
3.200	0.025	2.547
3.400	0.024	2.706
3.600	0.023	2.866
3.800	0.021	3.025
4.000	0.020	3.184





US6 Bridges – South Platte River Bridge Location
Conterminous 48 States
2007 AASHTO Bridge Design Guidelines
AASHTO Spectrum for 7% PE in 75 years

Latitude = 39.725434
Longitude = -105.015802

Site Class B

Data are based on a 0.05 deg grid spacing.

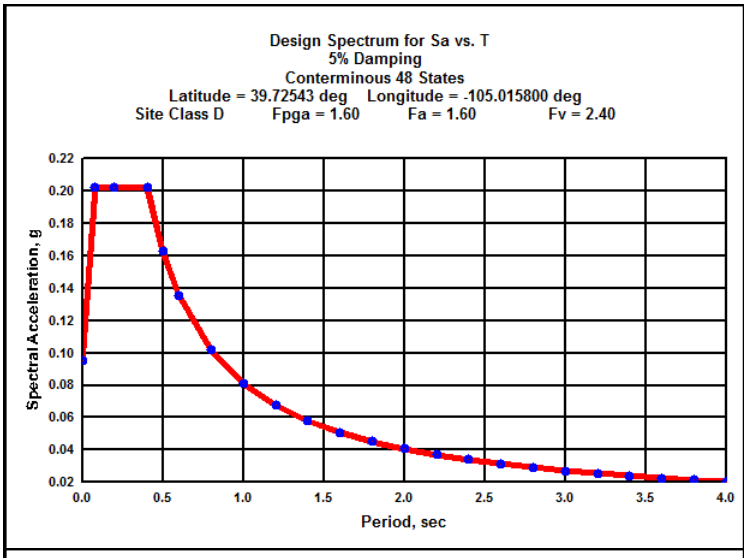
Period (sec)	Sa (g)	
0.0	0.059	PGA, Site Class B
0.2	0.126	Ss, Site Class B
1.0	0.034	S1, Site Class B

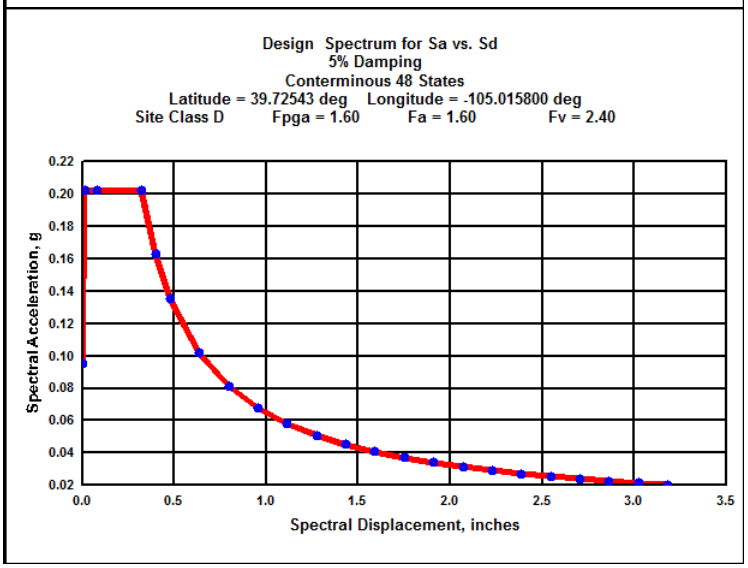
Spectral Response Accelerations SDs and SD1
As = FpgaPGA, SDs = FaSs, and SD1 = FvS1
Site Class D -Fpga = 1.60, Fa = 1.60,Fv = 2.40
Data are based on a 0.05 deg grid spacing.

Period (sec)	Sa (g)	
0.0	0.095	As, Site Class D
0.2	0.202	SDs, Site Class D
1.0	0.081	SD1, Site Class D

Design Response Spectra for Site Class D
Data are based on a 0.05 deg grid spacing.

Period (sec)	Sa (g)	Sd in.
0.000	0.095	0.000
0.080	0.202	0.013
0.200	0.202	0.079
0.402	0.202	0.320
0.500	0.163	0.398
0.600	0.136	0.477
0.800	0.102	0.636
1.000	0.081	0.796
1.200	0.068	0.955
1.400	0.058	1.114
1.600	0.051	1.273
1.800	0.045	1.432
2.000	0.041	1.591
2.200	0.037	1.750
2.400	0.034	1.909
2.600	0.031	2.068
2.800	0.029	2.228
3.000	0.027	2.387
3.200	0.025	2.546
3.400	0.024	2.705
3.600	0.023	2.864
3.800	0.021	3.023
4.000	0.020	3.182





US6 Bridges – I-25 Bridge Location
Conterminous 48 States
2007 AASHTO Bridge Design Guidelines
AASHTO Spectrum for 7% PE in 75 years

Latitude = 39.725581
Longitude = -105.013212

Site Class B

Data are based on a 0.05 deg grid spacing.

Period (sec)	Sa (g)	
0.0	0.059	PGA, Site Class B
0.2	0.126	Ss, Site Class B
1.0	0.034	S1, Site Class B

Spectral Response Accelerations SDs and SD1
As = FpgaPGA, SDs = FaSs, and SD1 = FvS1
Site Class D Fpga = 1.60,Fa = 1.60,Fv = 2.40
Data are based on a 0.05 deg grid spacing.

Period (sec)	Sa (g)	
0.0	0.095	As, Site Class D
0.2	0.202	SDs, Site Class D
1.0	0.081	SD1, Site Class D

Design Response Spectra for Site Class D
Data are based on a 0.05 deg grid spacing.

Period (sec)	Sa (g)	Sd in.
0.000	0.095	0.000
0.080	0.202	0.013
0.200	0.202	0.079
0.402	0.202	0.320
0.500	0.163	0.398
0.600	0.136	0.477
0.800	0.102	0.636
1.000	0.081	0.795
1.200	0.068	0.954
1.400	0.058	1.113
1.600	0.051	1.272
1.800	0.045	1.431
2.000	0.041	1.590
2.200	0.037	1.749
2.400	0.034	1.908
2.600	0.031	2.067
2.800	0.029	2.227
3.000	0.027	2.386
3.200	0.025	2.545
3.400	0.024	2.704
3.600	0.023	2.863
3.800	0.021	3.022
4.000	0.020	3.181