Preliminary Pavement Design Report
US6 Bridges Design Build Project
Denver, Colorado
CDOT Project No. BR 0061-0083 [18838 (CN)]

RockSol Project No. 280.01

Prepared for:

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Attention: Ms. Marvinetta Hartwig, P.E.

September 20, 2012

RockSol Consulting Group, Inc.

6510 W 91st Ave, Ste 130
Westminster, CO 80031

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1.0 PROJECT PURPOSE AND DESCRIPTION

This report documents the subsurface soil investigation performed by RockSol Consulting Group, Inc. within existing and proposed pavement areas of the Colorado Department of Transportation (CDOT) Right-of-Way (ROW) for US6 from approximately Knox Court on the west to the bridge over the Burlington Northern Santa Fe Railroad corridor on the east and within a portion of the I-25 Corridor from approximately 5th Avenue on the south to 8th Avenue on the north in Denver, Colorado (see Figure 1, Site Location Map). The purpose of this investigation is to provide existing pavement condition information and a subsurface soil characterization which will assist in the design and construction of new pavement sections and for overlay of existing pavement sections within the project limits. Preliminary pavement design recommendations are included in this report for roadways within the project limits. The US6 Bridges Design Build Project incorporates the Federal Interchange Project, for which CDOT performed a preliminary pavement design report. The US6 Bridges Design Build Project also incorporates the US6 over BNSF Project.

CDOT prepared a pavement design report, dated March 2, 2010, for the Federal Interchange Project, which includes reconstruction of Federal Boulevard from approximately 5th Avenue on the south to 7th Avenue on the north, all ramps to and from Federal Boulevard at US6, 5th Avenue from Federal Boulevard to Decatur Street, and a new ramp from Federal Boulevard to Bryant Street.

Ultimate improvements considered to US6 in the project limits include construction of a new bridge to carry Federal Boulevard traffic over US6 and new bridges to carry US6 over Bryant Street, the South Platte River, I-25, and the BNSF Railroad. An eastbound US6 CD Road will be constructed as well as modifications to the existing westbound CD Road. Ramps to and from Federal Boulevard will be modified and a new ramp from Federal Boulevard to Bryant Street will be constructed. A new ramp from Federal Boulevard to eastbound US6 will also be constructed, which will include a short structure over the eastbound US6 CD Road. The ramps to and from US6 will be modified at I-25 and the ramp from northbound I-25 to eastbound US6 will be modified. A new pedestrian bridge is proposed over US6 just west of Federal Boulevard. The I-25 roadway is proposed to be lowered approximately 3 feet under US6 to accommodate clearance for the new US6 bridge structure.

In general, proposed US6 pavement grades will be near existing grades except between Bryant Street and the South Platte River Bridge where the road grade will be raised to match the South Platte River Bridge which is to be raised 5 to 10 feet to prevent overtopping in the one-hundred year water level.

Proposed ultimate lane configurations for the project roadways are indicated on the Borehole Location Plans shown in Figure 2A through 2F. The sheets were provided to RockSol by Hartwig and should be considered as preliminary.

2.0 SUBSURFACE EXPLORATION

RockSol conducted a subsurface exploration to evaluate subsurface conditions within the project limits for pavement design purposes. Twenty-four borehole locations, identified as PV-2 through PV-25 were drilled for specifically for pavement subgrade characterization purposes. Borehole PV-1 was proposed but not drilled due to conflicts with numerous utilities. Twenty-two borehole locations identified as BR-2, BR-5, BR-6, BR-8, BR-12, BR-15 through BR-22, RW1-1,

RW2-1, RW2-2, RW3-1, RW4-1 through RW4-3, RW5-2 and RW7-1 were drilled primarily for bridge (BR) or retaining wall (RW) purposes with pavement subgrade soil characterization also performed. The location of all boreholes drilled is shown on Figures 2A through 2F, Borehole Location Plan Sheets (Ultimate Configuration) and on Figures 4A through 4F, Borehole Location Plan Sheets (Existing Conditions). The borehole locations indicated on the Borehole Location Plan Sheets were located in the field after drilling by the project surveyor Lund Partnership, Inc. PV designation indicates a borehole drilled specifically for pavement design; a BR designation indicates a borehole drilled for bridge foundation design; a RW designation indicated a borehole drilled for retaining wall design. The pavement boreholes were drilled at a horizontal spacing of approximately 1,000 feet or less along US6, I-25, and on entrance and exit ramps. In general, soil samples for pavement subgrade characterization were collected to depths of approximately 5 to 10 feet below existing grade. Cores of existing pavement were obtained at pavement (PV) boreholes PV-3 through PV-25 using a 6-inch, 8-inch, or 10-inch diameter, diamond tipped, water cooled core bit. After pavement coring, the boreholes were advanced with 4-inch outside diameter solid stem auger or an 8-inch outside diameter hollow stem auger powered by a truck-mounted drill rig. Cores of existing pavement were obtained without advancing a soil borehole at three locations between Federal Boulevard and Bryant Street. The three cores were identified as C-1 through C-3. Cores of existing pavement were also obtained at Boreholes BR-2, BR-5, BR-7, BR-8, BR-13, BR-15, BR-16, BR-18, BR-19, and BR-22.

Truck mounted CME-45 and 55 drill rigs were used for drilling and sampling. The boreholes were advanced using 4-inch outside diameter solid stem auger and 3¼-inch inside diameter (8-inch outside diameter) hollow stem auger. The borings were drilled from November 2011 to February 2012 and June to July 2012. The borings were logged in the field by a representative of RockSol with the depth to groundwater noted (if encountered) at the time of drilling. Subsurface materials were retrieved from each borehole using modified California barrel samplers and standard Split Spoon samplers. The modified California barrel sampler had an outside diameter of approximately 2.5 inches and an inside diameter of 2 inches. The standard split spoon sampler had an outside diameter of 2 inches and an inside diameter of 1⅜-inches. Brass tube liners were used with the modified California barrel sampler to retain samples for density and swell testing. Sample retaining liners were not used with the standard split spoon sampler. In addition, bulk samples of drill cuttings were collected beneath existing pavements to approximate depths of 5 feet below the bottom of the pavement section in Boreholes PV-2 through PV-25, BR-2, BR-5, BR-6, BR-8, BR-12, BR-15 through BR-22, RW1-1, RW2-1, RW2-2, RW3-1, RW4-1 through RW4-3, RW5-2 and RW7-1.

Penetration Tests were performed at selected intervals using the modified California barrel sampler with a standard hammer weighing 140 pounds falling 30 inches per ASTM D3550. An automatic hammer system was used to raise and drop the hammer for Boreholes PV-22 through PV-25. A cat-head and rope system was used to raise and drop the hammer for all other boreholes. The standard split spoon sampling method is the Standard Penetration Test (SPT) described by ASTM Method D-1586. 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 and the recorded blow counts are shown on the borehole logs. Individual borehole logs are presented in Appendix A.

3.0 LABORATORY TESTING

Soil samples retrieved from the boreholes were examined by the project geotechnical engineer in the RockSol laboratory. Bulk samples from each borehole were tested and classified in general accordance with AASHTO Method M145 and ASTM D-2487. In addition, the following laboratory tests were performed in accordance with the American Society for Testing and Materials (ASTM), American Association of State Highway and Transportation Officials (AASHTO), and current local practice.

- Natural Moisture Content (ASTM D-2216)
- Percent Passing No. 200 Sieve (ASTM D-1140)
- Dry Density (ASTM D-2937)
- Soil Classification (AASHTO M145 and ASTM D-2487)
- Swell Test (ASTM D-4546), under 200 psf and 500 psf surcharge loads
- Moisture Density Relationship (AASHTO T99)
- Resistance Value (CP-L3101)
- Water Soluble Sulfates (CDOT CP-L 2103)
- Water Soluble Chloride Ion Content (AASHTO T291-91)
- pH (AASHTO T289)
- Soil Resistivity (ASTM G187-Soil Box)

For soil classification, RockSol conducted sieve analyses or percent passing the No. 200 sieve and Atterberg Limits tests. Swell tests were used to determine the swell or consolidation characteristics of the subsurface materials. Soil resistivity, chloride ion content, water soluble sulfate and pH testing were also performed on selected samples to assist in evaluation of corrosion potential of subsurface materials. A summary of the laboratory test results is presented in Appendix B.

4.0 SUBSURFACE CONDITIONS

A general discussion of the various subsurface materials encountered in the boreholes utilized for evaluation of roadway subgrade conditions is presented below. Surficial conditions consisted of existing pavement in forty-two boreholes and topsoil in four boreholes. The subsurface materials encountered by RockSol at the borehole locations included fill material, native soils, and sedimentary bedrock. Where depths are indicated, they are referenced to the top of the existing pavement or ground surface. The existing pavement surface is also referred to as the existing ground surface or the existing surface.

Pavement

Roadway pavement was encountered by RockSol at the ground surface at forty-two borehole locations and at three pavement core locations. In all but one case, the pavement type encountered was Hot Mix Asphalt (HMA). In Borehole BR-5, Portland Cement Concrete (PCC) was encountered below the HMA. Total pavement thicknesses ranged from approximately 5¾

inches at BR-16 to 20¾ inches at PV-18 within travel lanes, ramps, and shoulders for US6 and I-25. A summary of the pavement thickness measured at each borehole and corehole location is presented in Tables 4.1 through 4.5. Pavement thicknesses were obtained by either direct measurement of the pavement section during drilling operations or measurement of a recovered pavement core. A summary of the pavement thickness measured from recovered cores is presented in Appendix C, Pavement Core Log Summary. Included in the core logs are photographs of the recovered core sections and RockSol's general assessment of the condition of each core.

Table 4.1 – Existing Pavement Thickness
US6, Knox Court to Bryant Street

Borehole Number (Lane/Shoulder)	HMA Pavement Thickness (Inches)	PCC Pavement Thickness (Inches)
PV-22 (Lane 4) WB	14½	None Encountered
PV-23 (Shoulder) EB	15¾	None Encountered
BR-25 (Lane 4) EB	10	None Encountered
BR-24 (Lane 1) WB	6	None Encountered
PV-24 (Shoulder) EB	15½	None Encountered
PV-25 (Shoulder) EB	15	None Encountered
C-1 (Shoulder) WB	11½	None Encountered
PV-3 (Lane 2) WB	11¾	None Encountered
BR-27 (Shoulder) EB	6	None Encountered
C-2 (Shoulder) EB	7	None Encountered
PV-4 (Lane 1) EB	7	None Encountered
RW1-1 (Shoulder) Ramp	6	None Encountered
C-3 (Shoulder) WB	9¾	None Encountered
RW5-2 (Lane 5) EB	12	None Encountered
PV-5 (Lane 1) WB	7½	None Encountered
BR-2 (Lane 1) WB	10½	None Encountered

Table 4.2 – Existing Pavement Thickness
US6, Bryant Street to South Platte River

Borehole Number (Lane/Shoulder)	HMA Pavement Thickness (Inches)	PCC Pavement Thickness (Inches)
BR-5 (Lane 1) WB CD Road	7	7¾
PV-21 (Lane 2) Ramp	5¾	None Encountered
RW4-1 (Shoulder) EB	8	None Encountered
RW4-2 (Lane 4) EB	8	None Encountered
PV-6 (Lane 1) EB	8	None Encountered
RW4-3 (Shoulder) EB	20	None Encountered
BR-7 (Shoulder) EB	12¼	None Encountered
BR-8 (Lane 1) WB	8½	None Encountered

Table 4.3 – Existing Pavement Thickness
US6, South Platte River to I-25 including ramps

Borehole Number (Lane/Shoulder)	HMA Pavement Thickness (Inches)	PCC Pavement Thickness (Inches)
BR-13 (Lane 1) WB	7½	None Encountered
BR-12 (Lane 3) EB	13	None Encountered
PV-7 (Lane 1) WB	10¼	None Encountered
BR-17 (Shoulder) WB	9	None Encountered
BR-16 (Lane 1) WB	5¾	None Encountered
BR-15 (Shoulder) EB	7½	None Encountered
PV-8 (Shoulder) Ramp	10¾	None Encountered
PV-9 (Shoulder) Ramp	11½	None Encountered

Table 4.4 – Existing Pavement Thickness
US6, I-25 to BNSF

Borehole Number (Lane/Shoulder)	HMA Pavement Thickness (Inches)	PCC Pavement Thickness (Inches)
BR-20 (Lane 3) EB	8	None Encountered
BR-21 (Lane 1) WB	7¼	None Encountered
BR-22 (Shoulder) Ramp	8½	None Encountered

Table 4.5 – Existing Pavement Thickness
I-25 from 8th Ave. to 5th Ave.

Borehole Number (Lane/Shoulder)	HMA Pavement Thickness (Inches)	PCC Pavement Thickness (Inches)
PV-18 (Lane 6) SB	20¾	None Encountered
PV-17 (Shoulder) NB	15	None Encountered
PV-16 (Shoulder) NB Ramp	9¼	None Encountered
PV-11 (Lane 5) SB	12¾	None Encountered
PV-15 (Shoulder) NB	17¼	None Encountered
BR-19 (Lane 1) SB	16¼	None Encountered
BR-18 (Lane 1) SB	13¼	None Encountered
PV-10 (Lane 4) SB	12	None Encountered
PV-14 (Shoulder) NB	15½	None Encountered
PV-13 (Shoulder) NB	10¾	None Encountered

Compacted Subgrade (Fill Material)

Fill material was encountered beneath the pavement in forty-five of the borings. The fill generally consisted of two different types, slightly sandy to sandy clay and silty to gravelly sand.

Other materials noted in the fill included fragments of brick and other debris. The brick and other debris were encountered in Borehole BR-8 and were limited to the area directly adjacent to the west bank of the South Platte River.

The fill material encountered ranged in depth from approximately 2 feet to 32 feet below the top of pavement. The greatest depth of fill was associated with US6 embankment approaches to the bridge over I-25. The moisture content of the sand fill material ranged from approximately 3.7 percent to 22.8 percent, the moisture content for the clay fill material ranged from approximately 2.4 percent to 30.5 percent.

Water soluble sulfate ion concentration tests were performed on selected subgrade fill samples with test results indicating a concentration of water soluble sulfate ranging from 0.00 percent to 0.50 percent. Swell tests were performed on selected fill material samples with swell potential test results ranging from -0.2 percent to 1.2 percent when testes under a 200 pound per square foot (psf) surcharge. Additional discussion of water soluble sulfate content and swell potential is discussed in Section 5 of this report.

Natural Subgrade (Native Soils)

The native soils encountered in the borings generally were comprised of clays with inter-bedded and inter-mixed sands. These soils were encountered below the fill material. Inter-bedded and inter-mixed gravels were also noted. The sandy clays varied in color from gray to brown. The moisture content of the native clay ranged from 13.7 percent to 30.8 percent the moisture content of the native sand ranged from 1.0 percent to 22.4 percent.

Water soluble sulfate ion concentration tests were performed on selected native soil samples with test results indicating a concentration of water soluble sulfate of less than 0.01 percent. Swell tests were performed on selected native soil samples with swell potential test results ranging from -0.2 percent to 3.5 percent.

Rigid Layer (Bedrock)

Based on the United States Geological Survey (USGS), Geologic Map of the Fort Logan Quadrangle (Lindvall, 1978), sedimentary bedrock at the site is mapped as the Denver and Arapahoe Formations. These geologic formations are known to be composed of inter-bedded claystones, sandstone, siltstone, shale, and conglomerate.

Sedimentary bedrock was encountered by RockSol in 15 of the 47 boreholes to the depth drilled. The depth to bedrock ranged from approximately 4.5 feet to 55.5 feet below the existing ground surface. Bedrock was encountered shallower than 10 feet below existing grade only in borehole PV-22. The sedimentary bedrock may be considered as a rigid layer per Section 2.3 (pages 2-5) in the 2013 CDOT Pavement Design Manual. The approximate depth to bedrock at each borehole location, if encountered, is indicated on the borehole logs shown in Appendix B.

The bedrock types encountered in our boreholes consisted mostly of claystone with varying sand and silt content. Sandstone was encountered in five boreholes (BR-5, BR-6, BR-8, BR-12 and BR-18). The claystone bedrock varied in color with light brown, and gray to dark grey noted. The sandstone was also brown to gray the moisture condition of the claystone and sandstone ranged from 11.6 percent to 23.1 percent.

Groundwater

In general, groundwater was not noted in most of our pavement boreholes during drilling operations. Groundwater was encountered in the bridge structure boreholes at approximate depths ranging from 9½ feet to 38½ feet below the surface and at approximate depths ranging from 7 feet to 21 feet below the surface at the time of drilling operations in Boreholes PV-9, PV-15, PV-19, PV-21, PV-24, RW2-1, RW2-2, RW3-1 and RW7-1. However, groundwater may exist at deeper elevations than those drilled for this investigation. Groundwater encountered in most of the deep borings appears to be associated with the geologic flood plain of the South Platte River. Borehole PV-24 appears to have encountered groundwater associated with Wier Gulch. It should be noted that groundwater elevations are subject to change depending on climatic conditions, stream stages in the South Platte River and Wier Gulch, local landscape irrigation practices, changes in local topography, and changes in surface storm water management. Leakages from "wet" utility lines may also affect groundwater levels in isolated locations. A summary of the approximate depth to groundwater noted in our boreholes and the approximate groundwater elevation is shown on Table 4.6.

Table 4.6 – Approximate Groundwater Depth and Elevation Summary

Borehole	Approximate Location	Groundwater Depth (Feet)	Groundwater Elevation (Feet)
BR-2	WB US6, Lane 1, 20 feet west of Bryant St.	32	5,196
BR-5	WB US6 CD Road, Lane 1, 25 feet east of Bryant St.	32	5,192
BR-6	Southeast corner of US6 and Bryant St. (in sidewalk)	15.5	5,191.5
BR-8	WB US6, Lane 1, 90 feet west of South Platte River	18	5,190
BR-12	EB US6 Shoulder, 70 feet east of South Platte River	18	5,191
BR-15	EB US6 Shoulder, 10 feet west of bridge over I-25	32	5,193
BR-16	WB US6, Lane 1, 10 feet west of bridge over I-25	33.5	5,191.5
BR-17	WB US6 Shoulder, 10 feet west of bridge over I-25	30.5	5,192.5
BR-18	SB I-25, Lane 1, 5 feet south of US6 Bridge	16	5,191
BR-19	SB I-25, Lane 1, 5 feet north of the US6 Bridge	9.5	5,194.5
BR-20	EB US6, Lane 3, 40 feet east of bridge over I-25	39	5,194
BR-21	WB US6, Lane 1, 40 feet east of bridge over I-25	38.5	5,194.5
BR-22	WB US6 Shoulder, 40 feet east of bridge over I-25	38	5,194
PV-9	Exit ramp from SB I-25 to EB US6, on shoulder	14	5,193
PV-15	NB I-25 shoulder, 300 feet north of US6 Bridge	9	5,196
PV-19	Exit ramp from NB I-25 to WB US6, on shoulder	7	5,194
PV-21	Ramp from WB US6 to Bryant St., 10 feet east of Bryant St.	15	5,190
PV-24	WB US6 shoulder, 1,000 feet west of Federal Boulevard	10	5,262
RW2-1	WB US6 Ramp to Bryant St., in shoulder, 250 feet east of Bryant Street	19.5	5,189.5
RW2-2	WB US6 Ramp to Bryant St, in shoulder, 450 feet east of Bryant Street	20	5,191
RW3-1	SB I-25 Ramp to WB US6, shoulder, 100 feet north of US6	18	5,191
RW7-1	EB US6 shoulder, 335 feet west of bridge over I-25	21.2	5,193

5.0 SUBGRADE CHARACTERIZATION

Subgrade Soil Classification

Bulk samples were obtained by RockSol, from the upper five feet below the existing surface at thirty-nine locations along the project roadways and tested for AASHTO soil classification. The subgrade soils tested classified as A-1-a, A-1-b, A-2-4, A-2-6, A-4, A-6 and A-7-6 AASHTO soil types. A summary of the number of samples per soil classification is shown below in Table 5-1.

Table 5-1

AASHTO Soil Type	No. of Samples
A-7-6	5
A-6	11
A-4	5
A-2-6	4
A-2-4	8
A-1-a	4
A-1-b	9
Total	46

Based on the number of individual AASHTO soil types encountered in our samples, a predominant soil type for the project site is not indicated but A-6 subgrade soils comprise about ¼ of the samples tested. Subgrade soil classifications at each borehole location are shown on Figures 3A through 3F.

Frost Susceptible Soils

Slightly sandy to sandy clays were the dominant soil type observed in most boreholes for both the fill material and native soil type with some clayey sands also encountered. The soils were generally classified according to the Unified Soil Classification System (USCS) as lean clays (CL) and the clayey sands (SC) as indicated in Appendix C. The CL and SC soil types are identified as low to medium frost susceptibility soils as is indicated in Figure 2.15 in the 2013 CDOT Pavement Design Manual.

Water Soluble Sulfate Content

RockSol selected approximately fifty shallow (0 to 5 feet) subgrade samples and tested them for water soluble sulfate content. The water soluble sulfate content ranged from 0.0 percent to 0.25 percent in the fill material and combination of fill and native materials tested to depths of five feet below ground surface. The material tested primarily showed water soluble sulfate levels ranging from 0.0 percent to 0.1 percent. A bulk subgrade sample obtained from Borehole PV-15 in the upper 5 feet indicated a water soluble sulfate content of 0.24 percent. A bulk subgrade sample obtained from Borehole PV-25 in the upper 5 feet indicated a water soluble sulfate content of 0.13 percent and a bulk subgrade sample from Borehole RW2-1 obtained in the upper 5 feet indicated a water soluble sulfate content of 0.25 percent. A water soluble sulfate content of 0.5 percent was indicated in a sample tested in a sample obtained in Borehole RW2-1 at an approximate depth of 10 feet below the existing grade.

Water soluble sulfate test results are summarized on the Summary of Physical and Chemical Test Results in Appendix B. The majority of subgrade samples tested for water soluble sulfate content

indicated Class 0 Exposure conditions. Class 1 and Class 2 conditions were encountered at three borehole locations (PV-15, PV-25 and RW2-1). Project requirements for Class 1 or Class 2 Exposure conditions may be considered for this project. Concrete structures occurring in isolated or specific locations may use water soluble sulfate test results at the specific structure location as the basis for Exposure Class during final design and construction. Additional presentation of the water soluble sulfate data is presented in the Corrosion Resistance Levels section.

Corrosion Resistance Levels

Corrosive properties tests were assigned on selected subgrade samples to assist with selection of pipe materials using the CDOT pipe materials selection criteria. Water soluble sulfate concentrations, water soluble chloride ion concentrations, (electrical) soil resistivity, pH, and moisture content were tested for the borings indicated on the following page in Table 5-2. Soil Resistivity tests were performed on selected samples in the laboratory using the soil box method (ASTM G187-Soil Box).

Table 5-2 – Soil Corrosion Resistance Levels

Borehole Number	Sample Depth	AASHTO Soil Classification	Water Soluble Sulfate (%)	Chloride (%)	pH	Moisture Content (%) (Note 1)	Resistivity (ohm-cm) (Note 2)	CR Level (Note 3)
BR-8	9”-5’	A-6(8)	0.03	0.03	7.8	24.6	470	0
BR-12	13”-5’	A-1-b(0)	0.00		7.8	16.7	200	0
BR-21	7.5”-5’	A-6(3)	0.00	0.09	7.7	23.3	320	1
RW2-1	0’-5’	A-2-6(1)	0.25	0.04	7.8	26.5	420	3
RW3-1	0’-5’	A-2-4(0)	0.00	-	8.4	18.5	1800	0
PV-3	1.5”-5’	A-4(2)	0.00	0.05	7.6	28.1	370	0
PV-4	7”-5’	A-2-4(0)	0.00	0.01	8.3	24.6	1500	0
PV-5	7.5”-5’	A-2-6(1)	0.00	0.32	7.9	22.0	700	3
PV-6	8”-5’	A-4(1)	0.00	0.02	7.9	18.1	700	0
PV-7	12”-5’	A-2-4(0)	0.00	0.02	7.9	16.9	800	0
PV-10	12”-5’	A-7-6(16)	0.06	0.06	7.4	30.3	350	1
PV-14	16”-5’	A-6(1)	0.02	0.06	8.4	30.3	410	1
PV-15	17.5”-5’	A-6(8)	0.24	0.11	-	28.5	300	3
PV-18	21”-5’	A-7-6(3)	0.00	0.08	7.9	26.1	370	1
PV-19	0’-5’	A-2-4(0)	0.01	0.14	7.8	28.0	250	2
PV-22	16”-5’	A-6(4)	0.03	0.04	7.3	25.8	420	0
PV-23	14”-5’	A-7-6(18)	0.00	0.04	7.5	-	-	0
PV-24	13”-5’	A-7-6(13)	0.00	0.28	7.6	-	-	3
PV-25	14”-5’	A-7-6(16)	0.13	0.06	7.2	34.6	280	2

Note 1: Moisture content of sample tested for electrical resistivity
Note 2: Resistivity test performed at saturated moisture condition
Note 3: Corrosion Resistance (CR) level based on RockSol evaluation of data per guidelines for selection of corrosion resistance levels, CDOT Pipe Material Selection Policy, Table 1. Evaluation criteria used by others may result in assignment of a different CR Level.

In-situ moisture content test results for samples tested for this pavement design report are presented in the Summary of Physical Test Results in Appendix B. In general, the electrical resistivity test results indicate site soils, when saturated, exhibit resistivity values less than 1,500

ohm-cm. CR Level 3 conditions are indicated at four sample locations. The CR Level 3 condition appears to be the result of water soluble sulfate and water soluble chloride concentrations.

Expansive Subgrade Soils

Based on swell test results and plasticity index (PI) testing, expansive subgrade soils and bedrock have been identified along the project corridor.

PI was determined for the subgrade soils at each of the borehole locations and ranged from 0 to 31 in the fill and native soils within the depth of interest for pavement design. The PI test results indicates treatment may be necessary in the form of subexcavation and replacement of the soil or subexcavation and recompaction with moisture control of excavated soil as indicated in Table 2.5 of the CDOT Pavement Design Manual. From Knox Court to Federal Boulevard the PI ranged from 22 to 29, from Federal Boulevard to the South Platte River the PI ranged from 0 to 29, and from the South Platte River to the BNSF railroad the PI ranged from 0 to 31 at depths sampled for pavement design purposes. On I-25 from 8th Avenue to 5th Ave the PI ranged from 0 to 27.

Swell tests were performed on samples of existing fill, native soils, and bedrock using a 200-psf surcharge for pavement design purposes. Swell tests were generally performed on samples encountered within 10 feet of ground surface and within the bedrock.

Based on the results of laboratory testing, the subgrade soils exhibited swell percentages ranging from -0.2 percent (consolidation) to 4.8 percent (swell) from Knox Court to Federal Boulevard, -0.2 percent (consolidation) to 1.7 percent (swell) from Federal Boulevard to the South Platte River, -0.1 percent (consolidation) to 5.0 percent (swell) from the South Platte River to the BNSF, and 0.2 percent (swell) to 1.3 percent (swell) on I-25 from 8th Avenue to 5th Avenue. The majority of the swell test results were between 0 to 1 percent east of Federal Boulevard.

These swell percentages and swell pressures suggest a medium swell risk for pavement constructed on the fill materials and native soils from Knox Court to Federal Boulevard, as indicated in Table 2.7 of the 2013 CDOT Pavement Design Manual.

Subgrade Support Test Results

Subgrade support characteristics of the existing subgrade soils was evaluated with R-Value tests performed on bulk samples obtained from selected boreholes. Based on general classification test results, R-Values were performed on subgrade soil types A-2-6, A-4, A-6, and A-7-6 soils. A summary of the R-Value test results is presented in Table 5.4.

Table 5-4 – R-Value Test Summary

Borehole Sample ID	General Location	AASHTO Soil Type	R-Value	Resilient Modulus M_R,(psi)
PV-3	Federal Boulevard to Bryant Street	A-4(2)	8	3,337
PV-5		A-2-6(1)	20	4,940
PV-8	Bryant Street to I-25	A-6(7)	15	4,195
BR-21	I-25 to BNSF	A-6(3)	7	3,230
PV-18	I-25 from 8th Ave to 5th Avenue	A-7-6(3)	22	5,273
PV-14		A-6(10)	<5	3,025

Also included in Table 5.4 is the Resilient Modulus (M_R) which was determined by correlation to the R-Value by the formulas presented in equations 2.1 and 2.2 in Section 2.5.1 of the CDOT

Pavement Design Manual. For the sample with the R-Value designated as "less than 5" RockSol used an R-Value of 5 in the M_R correlation equations resulting in the M_R of 3,020 psi indicated above. Based on the results of the R-Value tests, RockSol assigned a design R-Value of 10 for most roadway sections within the project. A design R-Value of 5 was assigned to roadway subgrade within mainline I-25 and US6 east of I-25. A design R-Value of 20 was assigned to US6 between Bryant Street and the South Platte River Bridge.

6.0 PRELIMINARY PAVEMENT DESIGN RECOMMENDATIONS

New pavement is anticipated for roadways and ramps within the project limits, including a portion of I-25 under US6 and extending along I-25 for short distances north and south of US6. West of Federal Boulevard, where the project transitions from total reconstruction to the existing configuration of US6, near the Knox Court alignment, a section of existing US6 pavement is anticipated to be cold "milled and filled" with HMA to provide a smooth pavement transition surface from the existing pavement to the reconstructed pavement.

Thicknesses are presented for flexible pavement (Hot Mix Asphalt or HMA) and rigid pavement (Portland Cement Concrete), where appropriate. The roadways associated with the Federal Boulevard Interchange Project were evaluated by the Colorado Department of Transportation (CDOT) with preliminary recommendations for rigid pavement on Federal Boulevard and flexible pavement on other roadways associated with that project. New pavement on main-line I-25 is anticipated to be HMA to match existing pavement type to the south and north of the project limits.

6.1 ESAL Estimates

Average annual daily traffic (AADT) counts for the year 2011 and projected for the year 2035 were provided to RockSol by Parsons Brinkerhoff (PB) for US 6, I-25, and ramps to and from I-25 and US 6 in the project limits. Vehicle type percentages for passenger cars, light trucks, and combination trucks were also provided by PB for US6 and I-25. RockSol used the traffic data provided by PB to estimate the traffic for the end of construction year in 2016, 20-year traffic levels in 2035, and 30-year traffic levels in 2045. CDOT also provided AADT counts for the roadways associated with the Federal Boulevard Interchange redesign.

A summary of the AADT counts and RockSol's ESAL calculations are provided in Appendix D. Not included in the AADT summary sheet are the AADT counts for southbound I-25 to eastbound US6 but were provided by Parson Brinkerhoff in a telephone conversation. Table 6.1.1 presents a summary of the AADT's for US6 and I-25 roadway sections evaluated by RockSol.

Table 6.1.1 – AADT Summary US6 and I-25 Roadways
(Roadway Sections Evaluated by RockSol)

Roadway	AADT's				
	2011	2035	2016	2036	2046
US6, Knox Court to Bryant Street	132,100	185,600	143,108	187,142	219,627
US6, Bryant Street to South Platte River Bridge	132,100	185,600	143,108	187,142	219,627
US6, South Platte River Bridge to I-25	132,100	185,600	143,108	187,142	219,627
US6, I-25 to BNSF	69,600	92,500	74,385	93,525	106,491
EB US6 CD Road	43,460	75,100	50,070	76,508	100,227
Federal Boulevard to EB US6 Braided Ramp	Not Available	6,500	3,980	6,633	8,883
Federal Boulevard Ramp to Bryant Street	1,820	2,700	2,002	2,730	3,294
WB US6 CD Road	21,840	39,200	25,435	39,813	53,394
Bryant Street Ramp to Federal Boulevard	1,930	3,800	2,320	3,880	5,489
SB I-25 to WB US6 Ramp	25,260	35,400	27,365	35,785	41,890
NB I-25 Ramp to WB US6 Also referred to as the I-25 CD Road	21,260	27,100	22,437	27,383	30,578
NB I-25 to EB US6 Ramp	2,780	5,900	3,429	6,023	8,929
SB I-25 to EB US6 Ramp	7,400	10,000	7,490	10,098	11,604
I-25 (NB and SB)	237,500	353,600	261,745	358,724	433,013

6.2 Preliminary Pavement Thickness Calculations

Pavement thicknesses were calculated using the AASHTOWare DARWin Pavement Design and Analysis System, Version 3.1 and the AASHTO design formula (CDOT eq. 3.1) for flexible pavement and the NCHRP rigid pavement design supplemental spreadsheet software, based on the 1998 AASHTO Supplemental Guide, for rigid pavement. Where design life ESAL's are less than 1 million, rigid pavement sections were calculated by RockSol with the DARWin Pavement Design and Analysis System.

Structural coefficients of 0.15 and 0.44 were used for CDOT Class 6 aggregate base course and hot mix asphalt, respectively, when developing flexible pavement thickness recommendations. Elastic modulus values of 25,000 psi and 3,400,000 psi were used for CDOT Class 6 aggregate base course and Portland cement concrete, respectively, when developing rigid pavement thickness recommendations. A Reliability Level of 95 percent was used for the subject roadways.

All pavement thicknesses presented are to be placed on top of 6 inches of Colorado Department of Transportation (CDOT) Class 6 Aggregate Base Course (ABC) since the design life ESAL values

are greater than 500,000. The recommended flexible pavement thickness values are based on the calculated thickness rounded up to the nearest ½-inch. Recommended pavement thickness values for rigid pavement include a ¼-inch thickness added to the calculated thickness and then rounded up to the nearest ½-inch.

Recommended pavement thicknesses developed by CDOT for project roadways within the Federal Boulevard Interchange portion of the project are presented in Table 6.2.1. The ESAL and pavement thickness calculation sheets prepared by CDOT Region 6 Materials and provided to RockSol are presented in Appendix F. Recommended pavement thicknesses developed by RockSol for project roadways within the US 6 and I-25 portion of the project are presented in Table 6.2.2.

Table 6.2.1 – Preliminary Pavement Thickness Recommendations (Roadway Sections Evaluated by CDOT)

Roadway and (Number of Design Lanes)	Design R-Value	Pavement Type	Design Life (years)	Design Life ESAL's	Recommended Pavement Thickness (inches) (Note 1)
Federal Boulevard (6)	10	Flexible	20	2,777,203	10.0
		Rigid	30	5,790,899	9.5
Federal Boulevard to WB US6 On-Ramp (1)	10	Flexible	20	1,504,922	9.0
		Rigid	30	3,547,534	9.0
Federal Boulevard to WB US6 On-Ramp (2)	10	Flexible	20	902,953	8.5
		Rigid	30	2,128,520	8.5
Federal Boulevard to EB US6 CD Road (1)	10	Flexible	20	1,710,617	9.5
		Rigid	30	4,231,881	9.5
Federal Boulevard to Braided Ramp/EB CD Road/Bryant Street (2)	10	Flexible	20	1,473,944	9.0
		Rigid	30	3,617,310	9.0
WB US6 to Federal Boulevard Off-Ramp (2)	10	Flexible	20	788,615	8.5
		Rigid	30	2,080,717	8.5
EB US6 to Federal Boulevard Off-Ramp (1)	10	Flexible	20	1,441,789	9.0
		Rigid	30	4,054,504	9.5
EB US6 to Federal Boulevard Off-Ramp (2)	10	Flexible	20	865,073	8.5
		Rigid	30	2,432,718	8.5
5th Avenue	10	Flexible	20	644,750	8.5

Note 1) Pavement sections placed on 6 inches of CDOT Class 6 ABC.

Table 6.2.2 – Preliminary Pavement Thickness Recommendations (Roadway Sections Evaluated by RockSol)

Roadway and (Number of Lanes)	Design R-value	Pavement Type	Design Life (years)	Design ESAL's	Recommended Pavement Thickness (inches) (Note 1)
US6, Knox Court to Bryant Street (4)	10	Flexible	20	10,176,092	12.5
		Rigid	30	22,815,864	11.5
US6, Bryant Street to South Platte River Bridge (4)	20	Flexible	20	10,176,092	11.0
		Rigid	30	22,815,864	11.5
US6, South Platte River Bridge to I-25 (4)	10	Flexible	20	10,176,092	12.5
		Rigid	30	22,815,864	11.5
US6, I-25 to BNSF (4)	5	Flexible	20	5,173,861	12.0
		Rigid	30	11,377,017	11.0
EB US6 CD Road (3)	10	Flexible	20	5,200,381	11.0
		Rigid	30	12,604,816	10.5
Federal Boulevard to EB US6 Braided Ramp (1)	10	Flexible	20	726,715	8.0
		Rigid	30	1,797,948	8.0
Federal Boulevard Ramp to Bryant Street (1)	10	Flexible	20	324,019	7.0
		Rigid	30	740,258	7.0
WB US6 CD Road (2)	10	Flexible	20	2,680,675	10.0
		Rigid	30	6,611,077	10.0
Bryant Street Ramp to Federal Boulevard (1)	10	Flexible	20	424,539	7.5
		Rigid	30	1,091,517	7.5
SB I-25 to WB US6 Ramp (2)	10	Flexible	20	7,432,161	12.0
		Rigid	30	17,977,261	11.5
NB I-25 Ramp to WB US6 (1) Also referred to as the I-25 CD Road	5	Flexible	20	9,772,243	13.0
		Rigid	30	22,936,118	11.5
NB I-25 to EB US6 Ramp (1)	5	Flexible	20	1,854,019	10.0
		Rigid	30	5,346,497	9.5
SB I-25 to EB US6 Ramp (1)	10	Flexible	20	3,449,904	10.5
		Rigid	30	8,455,409	10.0
I-25 (NB and SB) (8)	5	Flexible	20	30,426,404	15.5
		Rigid	30	75,144,070	13.5

Note 1) Pavement sections placed on 6 inches of CDOT Class 6 ABC.

All flexible pavements shall be constructed using CDOT approved mix designs. RockSol recommends using Stone Matrix Asphalt (SMA) with fibers mix for the surface layer (2 to 3 inches) and Grade S mix for the lower (intermediate and base) layers. A gyratory design revolution (Ndes) of 100 is recommended for all mixes. Performance Grade Binder of PG 76-28 is recommended for the surface layer (SMA mix). The SMA mix shall use a nominal maximum aggregate size of ½ inch. Performance Grade Binder of PG 64-22 is recommended for the intermediate and base layers (Grade S mix). All rigid pavements should be constructed using CDOT approved mix designs.

In an email sent from CDOT Region 6 Materials to the US6 design team dated September 7, 2012, "Region 6 Materials would like to specify 8½ inches of asphalt over 6 inches of ABC Class 6 for 5th Avenue and the intersecting side street and 8 inches of asphalt over 6 inches of ABC Class 6 for other residential side streets such as 4th Avenue…….For the proposed asphalt sections, the top two inches of asphalt will be SMA (Fibers) (Asphalt). The rest of the asphalt will be composed of HMA (Grading S) (100) (PG 64-22)."

6.3 Subgrade Reconditioning (Existing Roadway)

Where new pavement is to replace existing pavement, subgrade soils shall be reconditioned following specifications outlined in Section 306 of CDOT Standard Specifications for Road and Bridge Construction (2011). Section 306.02 states the top 6 inches of existing subgrade soils shall be reconditioned by blading and rolling and shall be properly moisture conditioned and compacted to project specifications.

6.4 Subgrade Preparation (New Roadway)

Recommendations for subgrade preparation in this section apply to locations where roadway widening is proposed or roadway construction is proposed in areas where pavement did not previously exist. Based on swell test results and plasticity index (PI) testing, expansive subgrade soils and bedrock have been identified along the project alignment. From Knox Court to Federal Boulevard the PI ranged from 22 to 29 and from Federal Boulevard to the BNSF railroad the subgrade soil plasticity index ranged from 0 to 31 at depths sampled for pavement design purposes. On I-25 from 8th Avenue to 5th Avenue, the PI ranged from 0 to 27. Subgrade soils exhibiting low to moderate swell potential were generally encountered in borehole samples obtained between Knox Court to Federal Boulevard.

Based on requirements outlined in Table 2.6 of the 2013 CDOT Pavement Design Manual, if the existing onsite subgrade soils are used for new roadway construction, they should be moisture conditioned and compacted, in maximum 8 inch lifts, to the minimum depths outlined in Table 6.4.1.

Table 6.4.1 – Subgrade Preparation Recommendations

Approximate Location	Minimum Depth (feet) Below Final Pavement Subgrade
Knox Court to Federal Boulevard	3
Federal Boulevard to the BNSF Bridge	2
I-25 Mainline and Ramps	3

Where existing utilities are present within the recommended depth of moisture treatment, damage to an underlying utility may occur. Therefore, moisture conditioning to the maximum depth where damage to an underlying utility will not occur and placing a geotextile fabric at the top of the prepared subgrade, beneath the aggregate base course layer, is recommended to mitigate potential differential movements (settlement and heave). The geotextile is intended to provide stabilization and separation between clay subgrade soils and the aggregate base course. RockSol recommends that the geotextile extend for the entire area where moisture conditioning does not extend to the minimum depth recommended in Table 6.4.1. The geotextile selected and used must be on the New York Department of Transportation Approved Products list as indicated in Section 712.08 of the CDOT Standard Specifications for Road and Bridge Construction (2011).

For all new pavement areas, proof rolling with pneumatic tire equipment shall be performed using a minimum axle load of 18 kips per axle after specified subgrade compaction has been obtained. Areas found to be weak and those areas which exhibit soft spots, non-uniform deflection or excessive deflection as determined by the project engineer shall be ripped, scarified, wetted or dried if necessary, and re-compacted to the requirements for density and moisture. Complete coverage of the proof roller will be required. All pavement subgrade preparation, pavement materials, and pavement construction shall conform to CDOT Standard Specifications for Road and Bridge Construction (2011). At a minimum, subgrade moisture conditioning and compaction should meet the compaction specifications outlined in Table 6.4.2.

Table 6.4.2 –Compaction Specifications

AASHTO Classification	Minimum Relative Compaction (Percentage of MDD), %	Moisture Content (Deviation from OMC)
A-1, A-2-4, A-2-5, A-2-6, A-2-7, A-3,	95% of AASHTO T180	-2 to +2
A-4, A-5, A-6 and A-7	95% of AASHTO T99	0 to +3

7.0 LIFE CYCLE COST ANALYSIS SUMMARY

In a joint effort with CDOT Region 6 Materials Department, RockSol performed a Life Cycle Cost Analysis (LCCA) for east and west bound US6 as part of the pavement design evaluation. Following the guidelines in the 2013 CDOT Pavement Design Manual, the LCCA includes initial costs for pavement section alternatives reported in Tables 6.2.1 and 6.2.2, Section 6 of this report and future maintenance, rehabilitation, and user costs for east and west bound US6 and the proposed US6 CD lanes.

CDOT requires the use of the Federal Highway Administration (FHWA) *RealCost (Version 2.5) Software* for Probabilistic LCCA to calculate realistic and factual comparisons between pavement section alternatives and rehabilitation strategies. CDOT also utilizes *WorkZone-RUC* software to determine maintenance and rehabilitation costs to determine capital costs for performing the maintenance work and the cost imposed on road users while the maintenance work is being performed. Hourly traffic distribution information for US6 within the project limits was obtained from the CDOT DTD Online Transportation Information System webpage (http://dtdapps. coloradodot. info/otis) and entered into the WorkZone-RUC program.

Two pavement types were considered for the LCCA; rigid pavement consisting of Portland cement concrete pavement (PCCP) and flexible pavement consisting of hot mix asphalt (HMA). As part of the flexible pavement alternative, a surface layer of stone matrix asphalt (SMA) was also considered. The flexible pavement type is identified as Alternative 1 in the LCCA. The rigid pavement type is identified as Alternative 2 in the LCCA.

The proposed construction phasing for this project, developed by Hartwig and Associates, was based on the construction of a new bridge to carry Federal Boulevard traffic over US6, new bridge structures to carry US6 over Bryant Street, the South Platte River, I-25, and the BNSF Railroad and a new pedestrian bridge over US6 just west of Federal Boulevard. Construction phasing information is outlined in Table 7.1 and was provided to RockSol during a meeting held at Hartwig and Associates office on May 30, 2012. The estimated length of time for flexible and rigid pavement construction is also included in Table 7.1 and was based on the production rates outlined in Table 7.2.

Table 7.1 – Construction Phase General Summary

Phase Number and General Description	Estimated Length of Time for Phase Construction	Estimated Length of Time for Pavement Construction
1A – Moving US6 traffic to the south and construction northern third portion of structures.	10 months	27 days for Rigid 1 day for Flexible
1B – SB I-25 to WB US6 Ramp connections	1 week	1 day for Rigid
2 – WB US6 and WB US6 CD Road east of Federal construction. Ramps from Federal to WB US6.	8 months	8 days for Rigid 3 days for Flexible
3 – WB US6 west of Federal and ramp from EB US6 to Federal.	6 months	5 days for Rigid 1 day for Flexible
3A – Minor fill placement and pavement construction in WB US6 mainline, north of Braided Ramp Bridge.	1 month	2 days for Rigid
4 – US6 EB traffic shifted south at Federal and US6 WB traffic shifted to the north. Bridge construction continued and Bryant St. Bridge near completion.	6 months	13 days for Rigid 3 days for Flexible
5 – Bridge construction near completion, shift US6 mainline north and shift EB US6 to I-25 onto EB CD Lane.	6 months	17 days for Rigid 1 day for Flexible
6 – Pavement and Retaining Wall Construction.	3 months	10 days for Rigid
7 – EB US6 shifted to north and construction of Braided Ramp Bridge.	3 months	4 days for Rigid 1 day for Flexible

Based on the phasing information provided, the total project construction time period is approximately 43 months and is proposed to start in 2013. The estimate length of time for pavement construction in each phase is significantly less than the estimated length of time for each phase. Phasing construction plans were also provided to RockSol and are included in Appendix G.

The LCCA was performed using a 40 year analysis period and a 30-year initial design period for rigid pavement, assuming a base year (year of anticipated project completion) of 2016. Based on statewide average data, a triangular distribution with the most likely value of 27 years (2043) was used for the first rigid rehabilitation cycle. The rigid rehabilitation analysis included a ½ percent slab replacement in the travel lanes and 50 percent diamond grinding and longitudinal

and transverse joint resealing. The rehabilitation area for the LCCA included east and west bound mainline US6 and east and west bound US6 CD lanes. An *Urban Freeway* classification was used for mainline US6 and the US6 CD lanes.

The LCCA was performed using a 40 year analysis period and a 20-year initial design period for flexible pavement, assuming a base year (year of anticipated project completion) of 2016. A 2-inch SMA overlay for the flexible LCCA area was used with a rehabilitation cycle period of 13 years (2029), 11 years (2040) and 11 years (2051). The rehabilitation area for the LCCA included east and west bound mainline US6 and east and west bound US6 CD lanes.

Additional factors used in the LCCA for both flexible and rigid pavement include a discount rate of 2.8 percent, Preliminary Engineering (PE) of 3 percent, Cost of Engineering (CE) of 17.45 percent, Traffic Control Cost of 2 percent for the initial construction and 15 percent rehabilitation operations. An Asphalt Cement Adjustment of $1.25 per ton of mix was also used. Additional input design parameters used for the LCCA are included in the output summary results in Appendix F.

Five sources for the costs and/or production rates were evaluated. The total project quantities of each type of material was used to help determine unit costs. The five sources evaluated include:

1) 2013 CDOT Pavement Design Manual (Average Value Curves/Equations for Region 6 – Figures 10.35 to 10.37).

2) 2010 and 2011 CDOT Cost Data Books and 2012 Bid Tabulations. When possible, cost data was obtained from projects of similar size and similar geographic location.

3) Engineering Estimates and Market Analysis HMA and Market Information Newsletter, dated July 2012.

4) Discussion with the Executive Director of the Colorado Asphalt Pavement Association about flexible pavement production rates.

5) Discussions with CDOT Region 6 Materials Engineering Unit

Table 7.2 lists the material, construction and rehabilitation costs and production rates used in the LCCA.

Table 7.2 - Material, Construction and Rehabilitation Costs and Production Rates

Operation/Material	Production Rate (10 hour work shift)	Minimum Cost ($)	Most Likely Cost ($)	Maximum Cost ($)
Planing/Milling (flexible)	5,600 feet/day for a 12-ft wide lane	1.50	2.07	2.50
SMA (fibers)(ton)	1,500 tons/day	75.00	85.00	95.00
HMA Grading S 100 PG 64-22 (ton)	1,500 tons/day	45.00	55.00	62.00
Rigid (SY-in)	900 feet/day [6 panels (20SY) per hour]	3.00	3.50	4.00
Rigid Slab Replacement (SY)	2 panels per day	100.00	150.00	200.00
Grinding Concrete Pavement (SY)	4,000 SY/day (Two 6-ft Grinders)	2.75	3.25	3.75
Sawing and Sealing Concrete Joints (linear feet)	1 lane mile per day (352 slabs/day)	1.50	1.75	2.00

Based on the results of the LCCA, the probabilistic analysis indicates the rigid pavement option (Alternative 2) is less costly than the flexible pavement option (Alternative 1) by a difference of 36.9 percent at the 75 percentile as shown in Table 7.3. The output results for the WorkZone-RUC and RealCost (Version 2.5) are included in Appendix F.

Table 7.3 – Probabilistic LCCA Results

Statistics Probability Function	LCCA Output: Alternative 1: Agency Cost (Thousands) $ (Note 1)	LCCA Output: Alternative 1: User Cost (Thousands) $	Flexible Pavement Total (Thousands) $	LCCA Output: Alternative 2: Agency Cost (Thousands) $ (Note 2)	LCCA Output: Alternative 2: User Cost (Thousands) $	Rigid Pavement Total (Thousands) $
Minimum	7,105.94	131.97	7237.91	4,898.44	2.01	4,900.45
Maximum	9,717.52	498.30	10,215.82	7,015.82	185.58	7,201.40
Mean	8,233.18	218.76	8,451.94	6,028.71	104.17	6,132.87
Median	8,215.42	193.28	8,408.69	6,027.04	112.57	6,139.61
Standard Deviation	435.88	76.27	512.15	355.59	32.33	387.92
Percentile (5%)	7,534.71	145.63	7,680.34	5,451.15	41.34	5,492.49
Percentile (25%)	7,950.56	156.78	8,107.33	5,771.58	84.78	5,856.36
Percentile (75%)	8,497.80	268.29	8,766.09	6,278.35	126.46	6,404.81

Note 1: Alternative 1 is flexible pavement.
Note 2: Alternative 2 is rigid pavement.

Two comparisons were made to check the sensitivity of the rigid unit costs and the results of the percent differences in the total cost (Agency Cost and User Cost) of flexible versus rigid pavement. The total costs of flexible pavement was kept as a constant and the minimum, most likely, and maximum unit costs of rigid pavement were increased from the unit costs selected in the LCCA analysis. The results of the sensitivity check are presented in Table 7.4.

Table 7.4 – Sensitivity Check Results

Analysis	Minimum Rigid Cost $/SY-in	Most Likely Rigid Cost $/SY-in	Maximum Rigid Cost $/SY-in	LCCA Output: Total Flexible Cost (thousands)	LCCA Output: Total Rigid Cost (thousands)	(75%) Percentile Difference (Flexible vs. Rigid)
1 (Note 1)	3.00	3.50	4.00	$8,766.09	$6,404.81	36.9%
2	3.25	3.75	4.25		$6,616.69	32.5%
3	3.75	4.25	4.75		$7,384.12	18.7%

Note 1: Unit costs selected for the LCCA.

8.0 LIMITATIONS

This geotechnical field investigation and laboratory results were conducted in general accordance with the scope of work. This report has been prepared for use by Hartwig and Associates and the Colorado Department of Transportation exclusively for the project described in this report. The report is based on our observations and information, our exploratory borings and do not take into account variations in the subsurface conditions that may exist between borings. Additional investigation is required to address such variation. If during construction activities, materials or water conditions appear to be different from those described herein, RockSol should be advised at once so that a re-evaluation of the information presented in this report can be made. RockSol is not responsible for liability associated with interpretation if 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.

References

1. *2013 Pavement Design Manual*. Colorado Department of Transportation (CDOT). July 2012.

2. Lindvall, Robert M., *Geologic Map of the Fort Logan Quadrangle, Arapahoe, Denver, and Jefferson Counties, Colorado, Map GQ-1427*, U.S. Geological Survey, 1978.

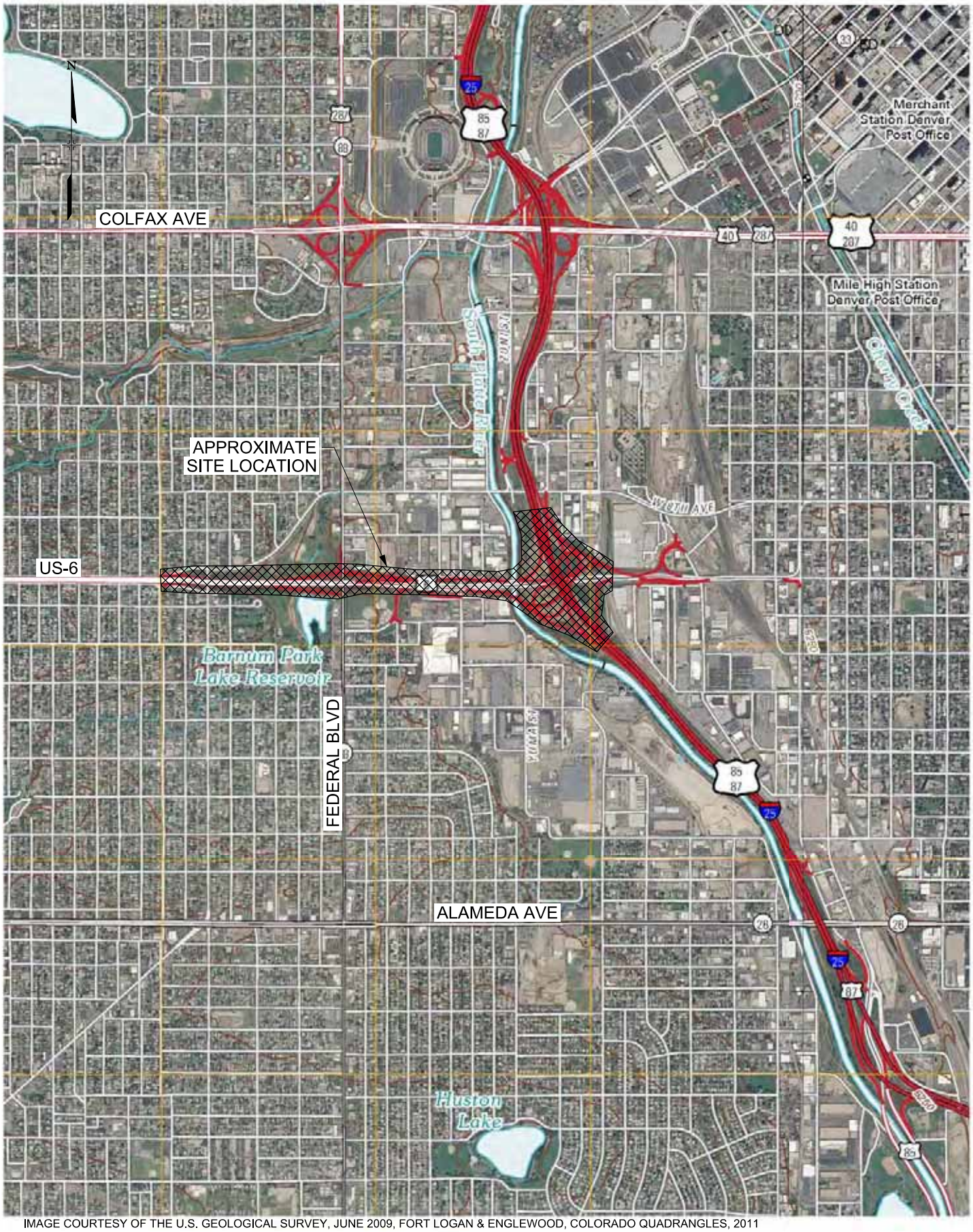

IMAGE COURTESY OF THE U.S. GEOLOGICAL SURVEY, JUNE 2009, FORT LOGAN & ENGLEWOOD, COLORADO QUADRANGLES, 2011

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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

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(FEET)

ROCKSOL NUMBER: 280.01
FIGURE 1

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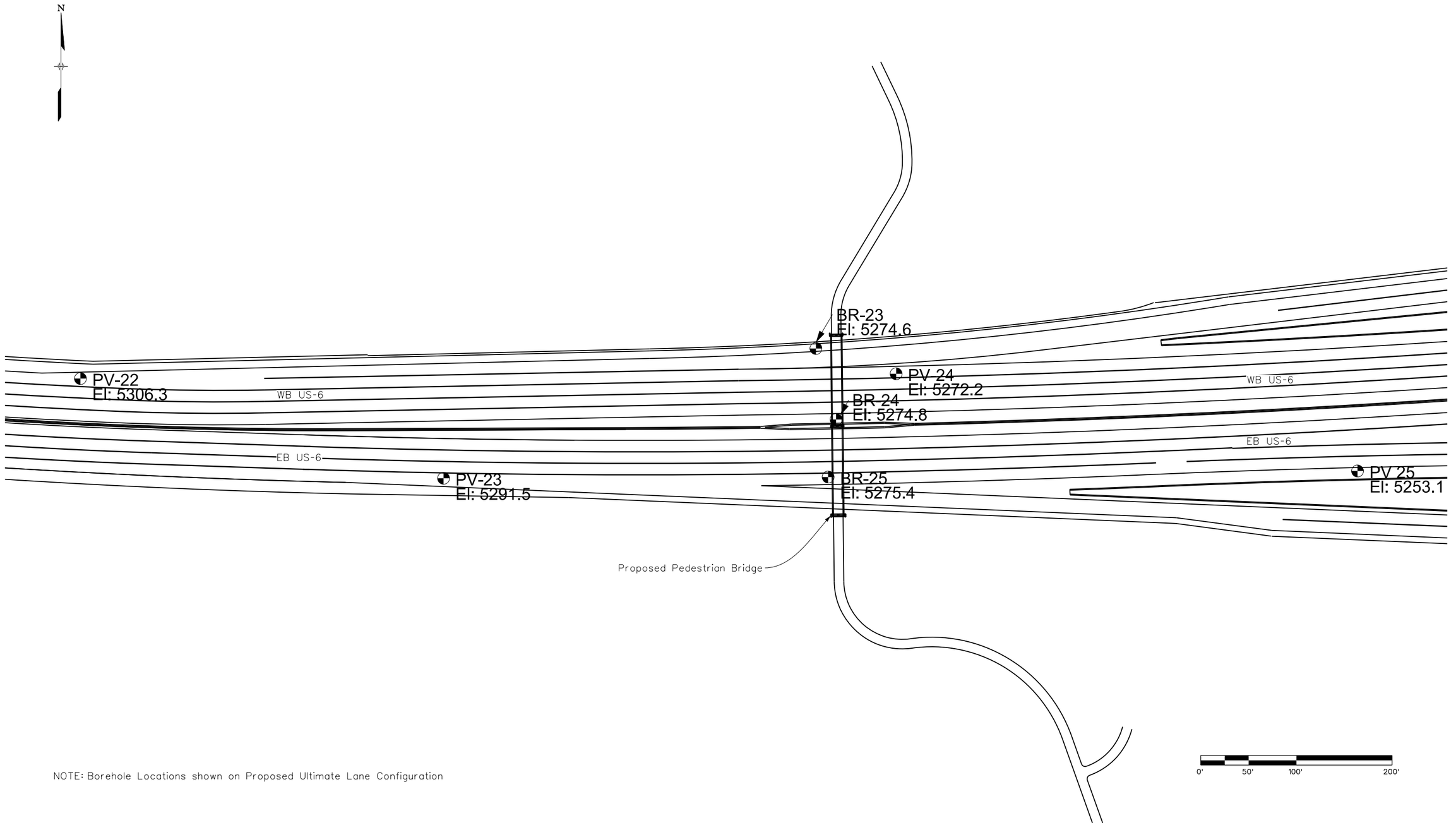
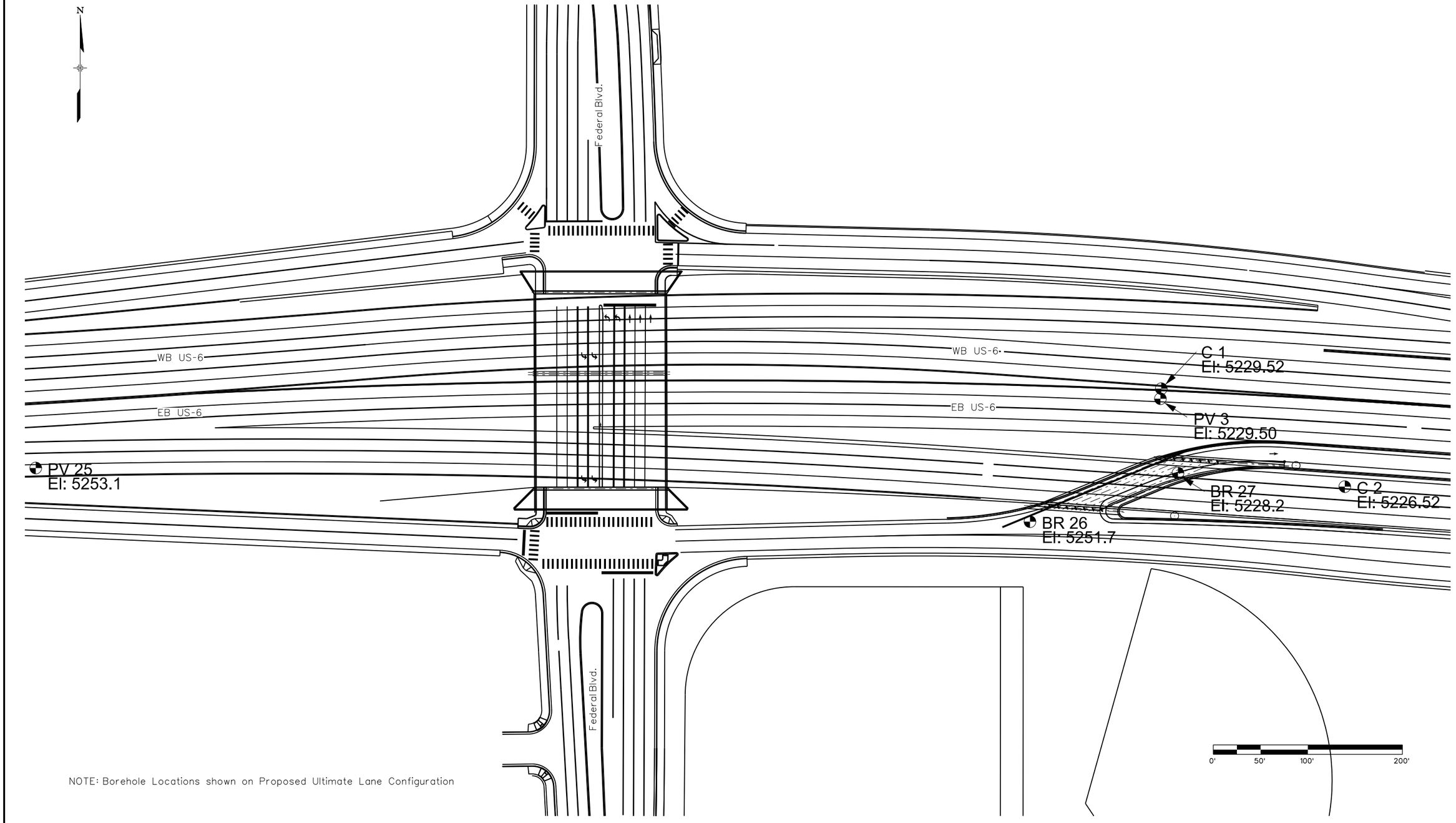


NOTE: Borehole Locations shown on Proposed Ultimate Lane Configuration

Print Date: 9/17/2012	R-X	Sheet Revisions			Colorado Department of Transportation
File Name: 18838-F-2A-Borehole Location Plan.dgn		Date:	Comments	Init.	8833 South Wadsworth Court
Horiz. Scale: 1:100 Vert. Scale: As Noted					Littleton, CO 80128
Unit Information Unit Leader Initials					Phone: 303-972-9112 FAX: 303-972-9114
RockSol Consulting Group, Inc. 6510 W 91st Ave, Ste 130 Westminster, CO 80031 Ph: 303-962-9300 Fax: 303-962-9350					Region 6 MDP

As Constructed	BOREHOLE LOCATION PLAN			Project No./Code
No Revisions:				US 6 BRIDGES DESIGN BUILD PROJECT
Revised:	Designer: R. Lepro	Structure Numbers		18838
Void:	Detailer: D. Knight			Figure 2A
	Sheet Subset:	Subset Sheets: 1 of 6		



NOTE: Borehole Locations shown on Proposed Ultimate Lane Configuration

Print Date: 8/13/2012		Sheet Revisions	
File Name: 18838-F-2B-Borehole Location Plan.dgn		Date:	Comments: Init.
Horiz. Scale: 1:100 Vert. Scale: As Noted	R-X		
Unit Information Unit Leader Initials			

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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:

SUBGRADE SOIL TYPE MAP

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

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

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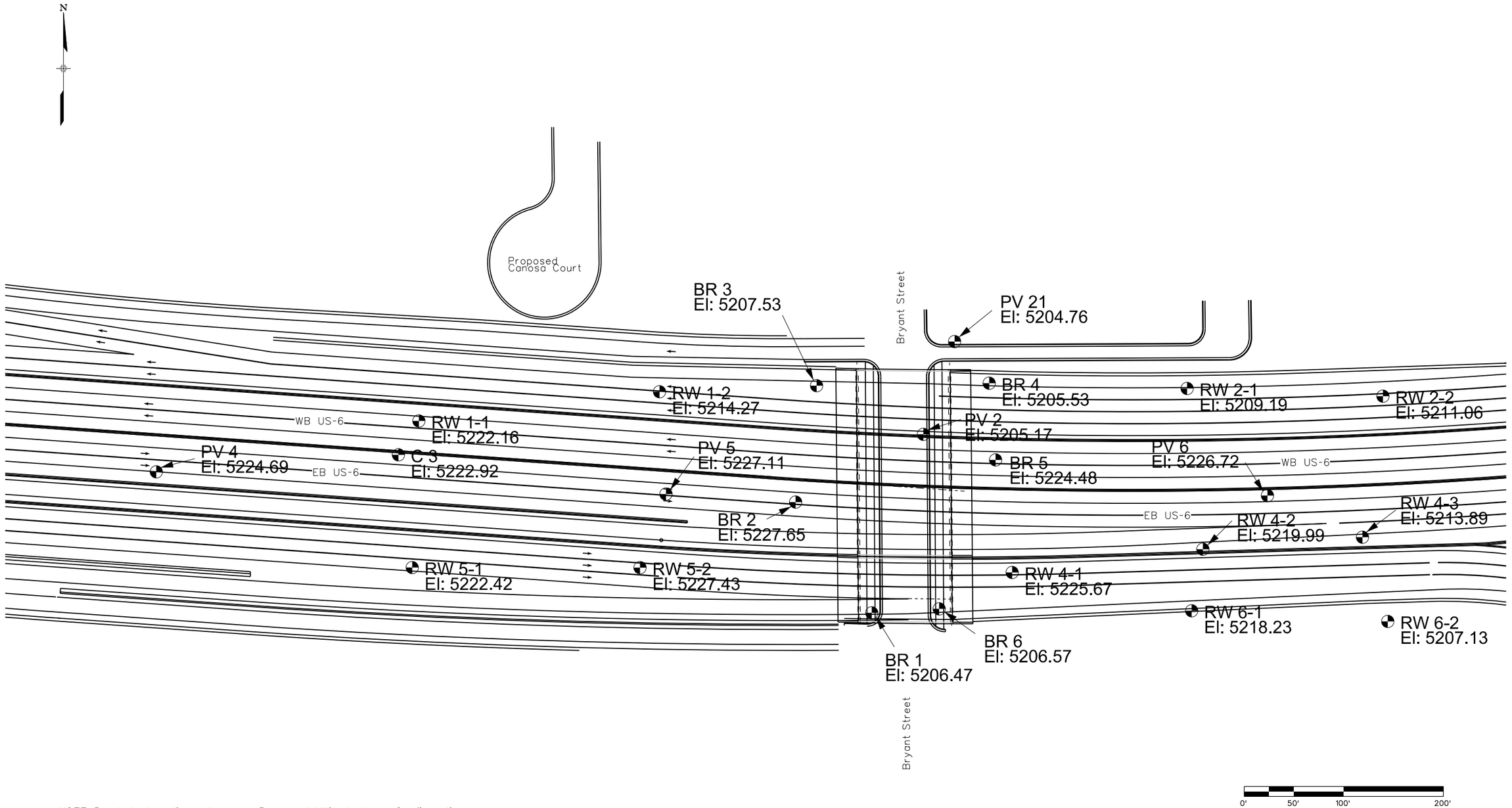

NOTE: Borehole Locations shown on Proposed Ultimate Lane Configuration

Print Date: 9/21/2012		Sheet Revisions			Colorado Department of Transportation	As Constructed	BOREHOLE LOCATION PLAN	Project No./Code
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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: 3 of 6	Figure 2C
RockSol Consulting Group, Inc. 6510 W 91st Ave, Ste 130 Westminster, CO 80031 Ph: 303-962-9300 Fax: 303-962-9350								

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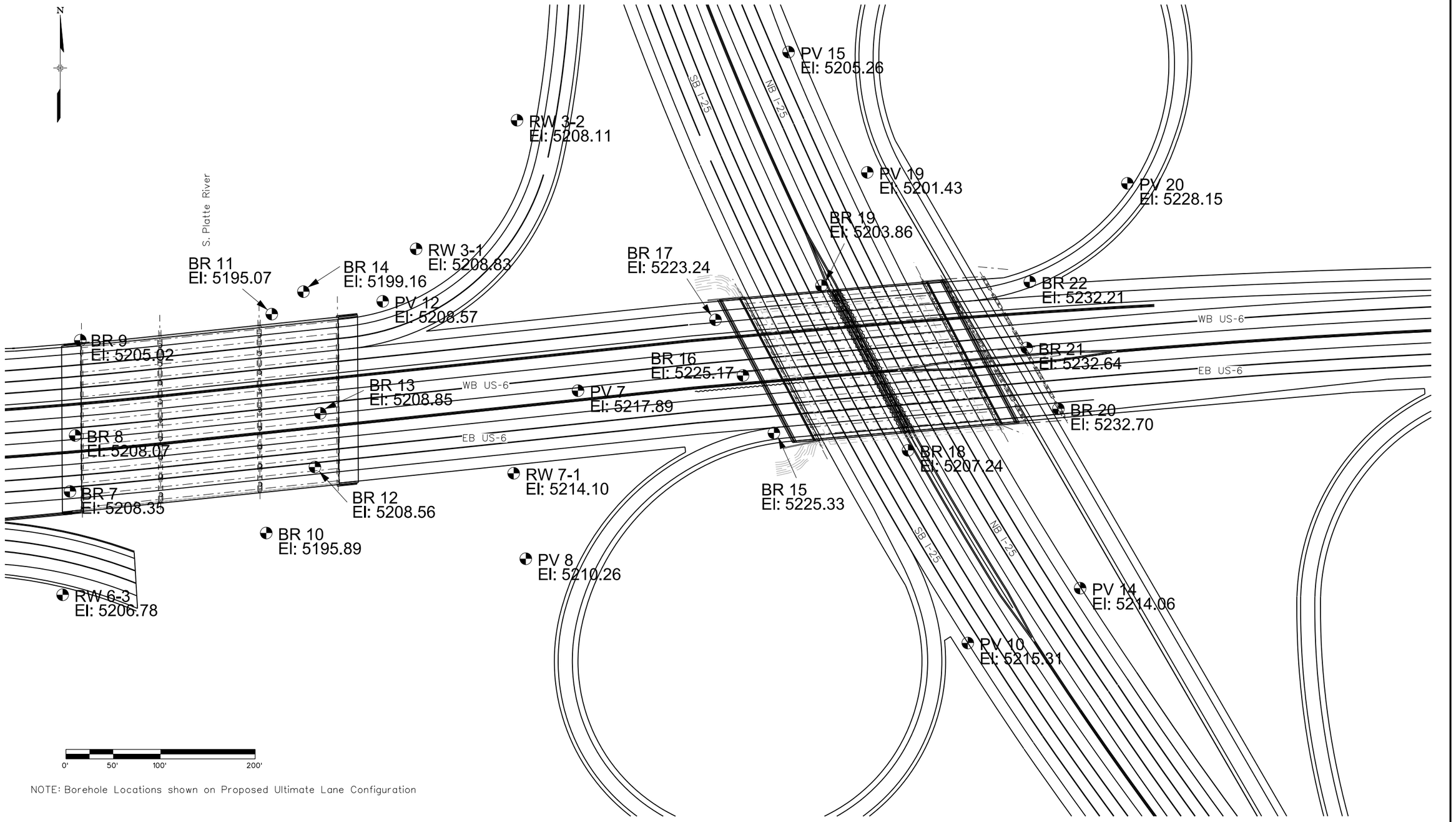

NOTE: Borehole Locations shown on Proposed Ultimate Lane Configuration

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Horiz. Scale: 1:100 Vert. Scale: As Noted	R-X				Region 6 MDP	Revised:	Designer: R. Lepro / Detailer: D. Knight / Structure Numbers	18838
Unit Information Unit Leader Initials						Void:	Sheet Subset: / Subset Sheets: 4 of 6	Figure 2D
RockSol Consulting Group, Inc. 6510 W 91st Ave, Ste 130 Westminster, CO 80031 Ph: 303-962-9300 Fax: 303-962-9350								

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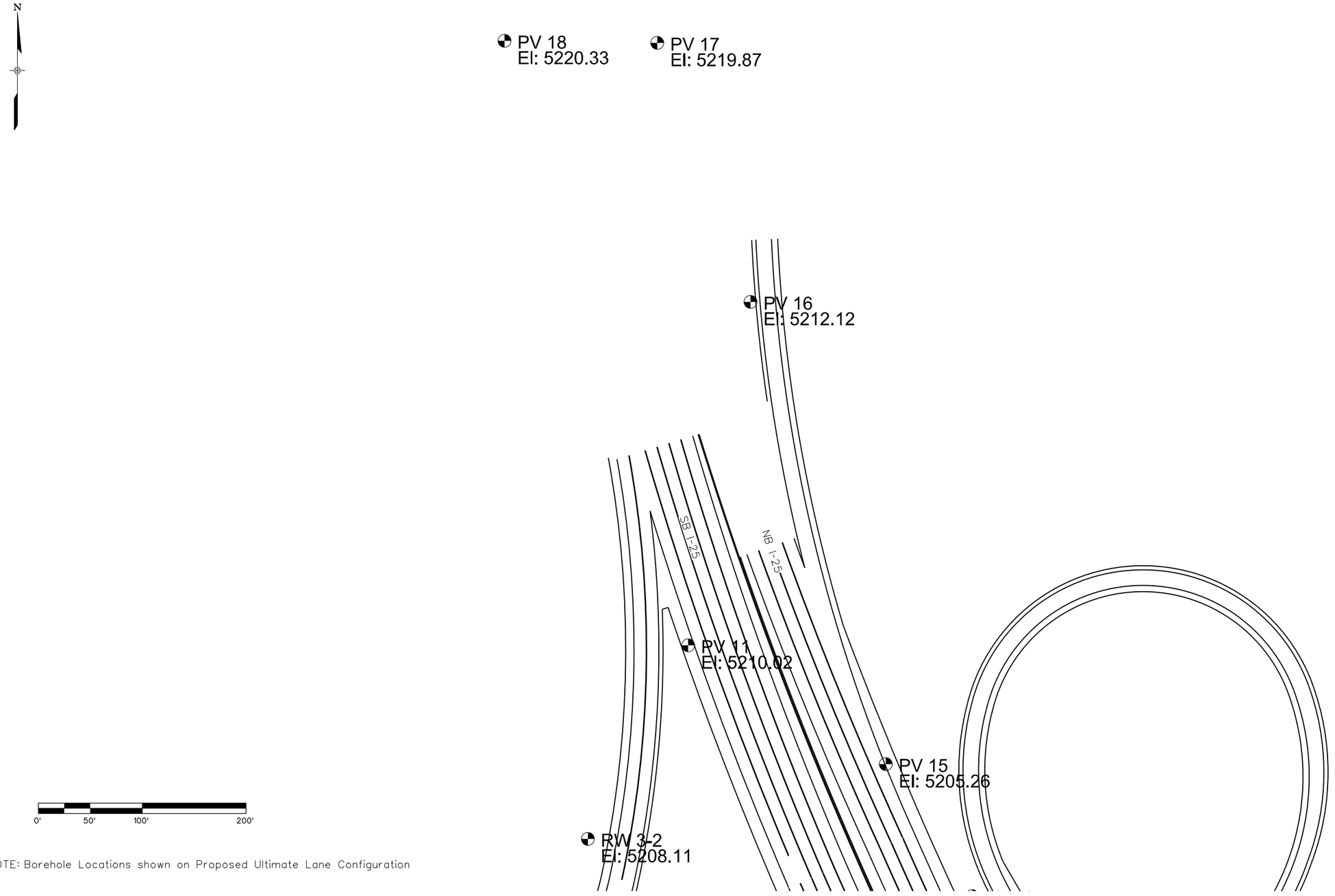

NOTE: Borehole Locations shown on Proposed Ultimate Lane Configuration

Print Date: 8/13/2012
File Name: 18838-F-2E-Borehole Location Plan.dgn
Horiz. Scale: 1:100 Vert. Scale: As Noted
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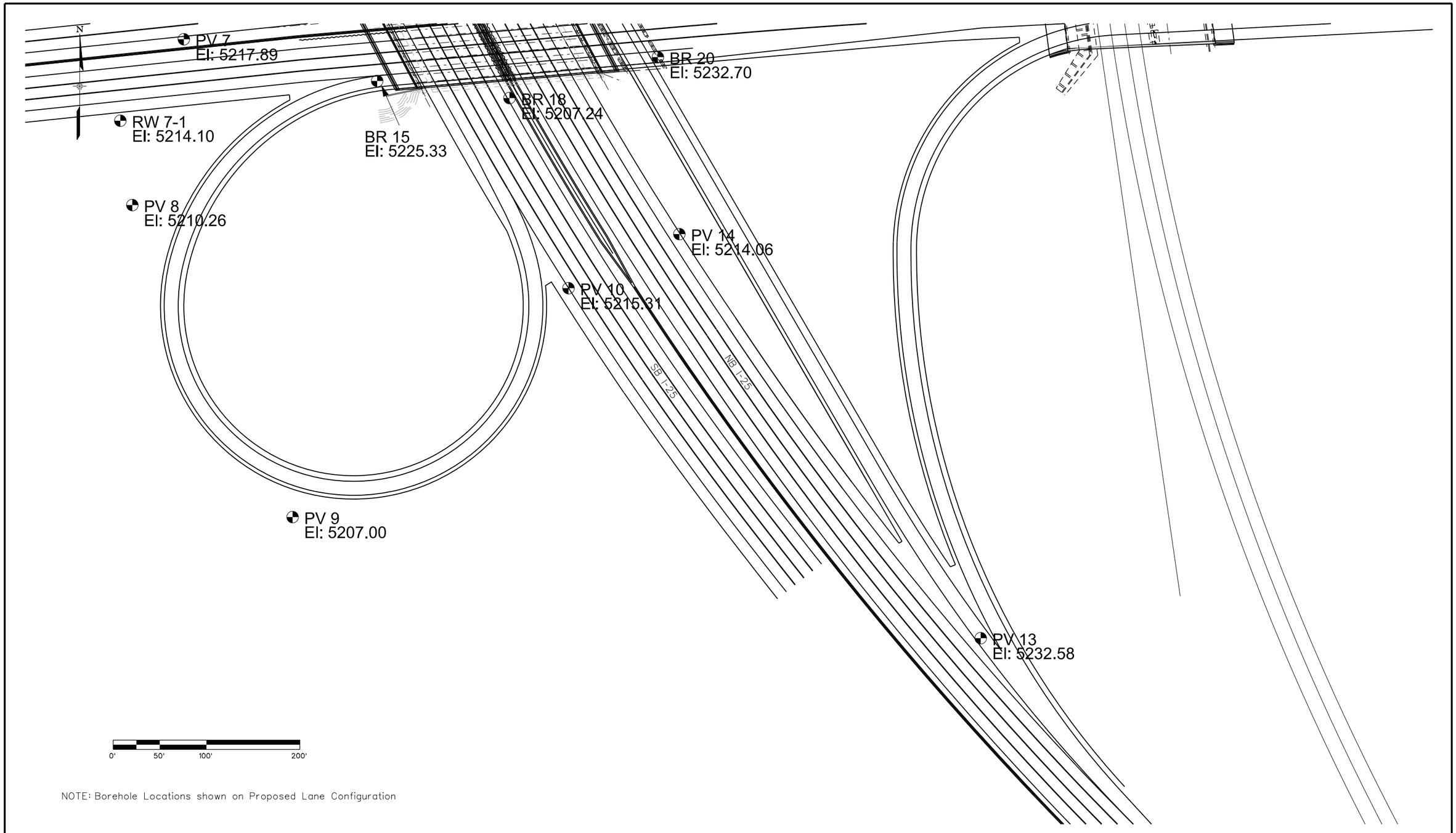
Region 6 MDP

As Constructed
No Revisions:
Revised:
Void:

BOREHOLE LOCATION PLAN

Designer: R. Lepro
Detailer: D. Knight
Sheet Subset:
Structure Numbers:
Subset Sheets: 5 of 6

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



NOTE: Borehole Locations shown on Proposed Lane Configuration

Print Date: 8/13/2012		Sheet Revisions	
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Horiz. Scale: 1:100 Vert. Scale: As Noted	R-X		
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Region 6 MDP

As Constructed
No Revisions:
Revised:
Void:

BOREHOLE LOCATION PLAN

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

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

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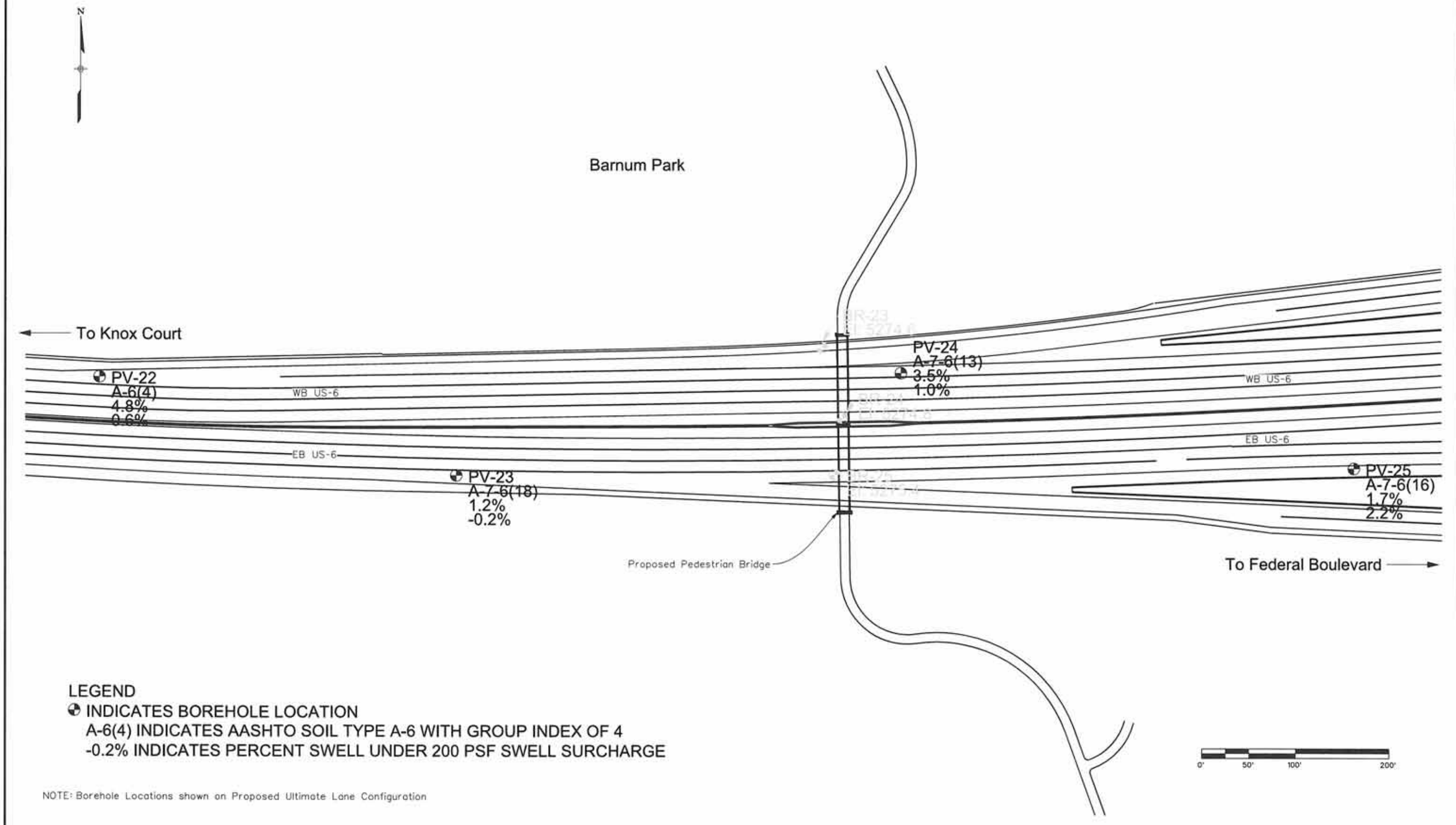

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INDICATES BOREHOLE LOCATION

A-6(4) INDICATES AASHTO SOIL TYPE A-6 WITH GROUP INDEX OF 4

-0.2% INDICATES PERCENT SWELL UNDER 200 PSF SWELL SURCHARGE

NOTE: Borehole Locations shown on Proposed Ultimate Lane Configuration

Print Date: 9/17/2012
File Name: 18838-F-3A-Subgrade Soil Type Map.dgn
Horiz. Scale: 1:100 Vert. Scale: As Noted
Unit Information Unit Leader Initials

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Sheet Revisions

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Void:

SUBGRADE SOIL TYPE MAP

Designer: R. Lepro
Detailer: S. McKanna-Koon
Sheet Subset:
Structure Numbers
Subset Sheets: 1 of 6

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

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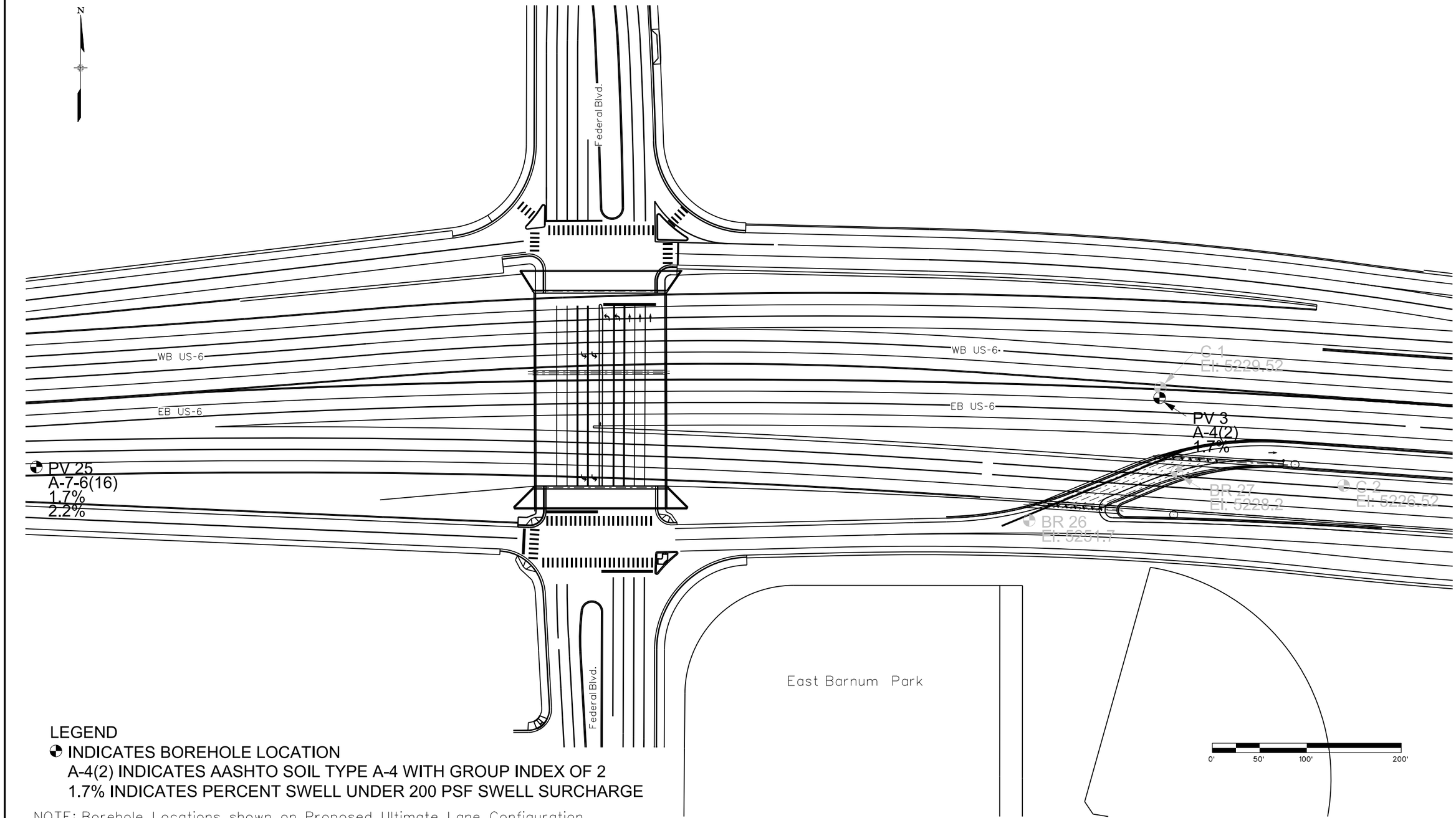

LEGEND

◓ INDICATES BOREHOLE LOCATION

A-4(2) INDICATES AASHTO SOIL TYPE A-4 WITH GROUP INDEX OF 2

1.7% INDICATES PERCENT SWELL UNDER 200 PSF SWELL SURCHARGE

NOTE: Borehole Locations shown on Proposed Ultimate Lane Configuration

Print Date: 8/13/2012		Sheet Revisions			Colorado Department of Transportation
File Name: 18838-F-3B-Subgrade Soil Type Map.dgn		Date:	Comments	Init.	8833 South Wadsworth Court
Horiz. Scale: 1:100 Vert. Scale: As Noted	R-X				Littleton, CO 80128
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As Constructed	SUBGRADE SOIL TYPE MAP		Project No./Code
No Revisions:			US 6 BRIDGES DESIGN BUILD PROJECT
Revised:	Designer: R. Lepro	Structure Numbers	18838
Void:	Detailer: S. McKanna-Koon		Figure 3B
	Sheet Subset:	Subset Sheets: 2 of 6	

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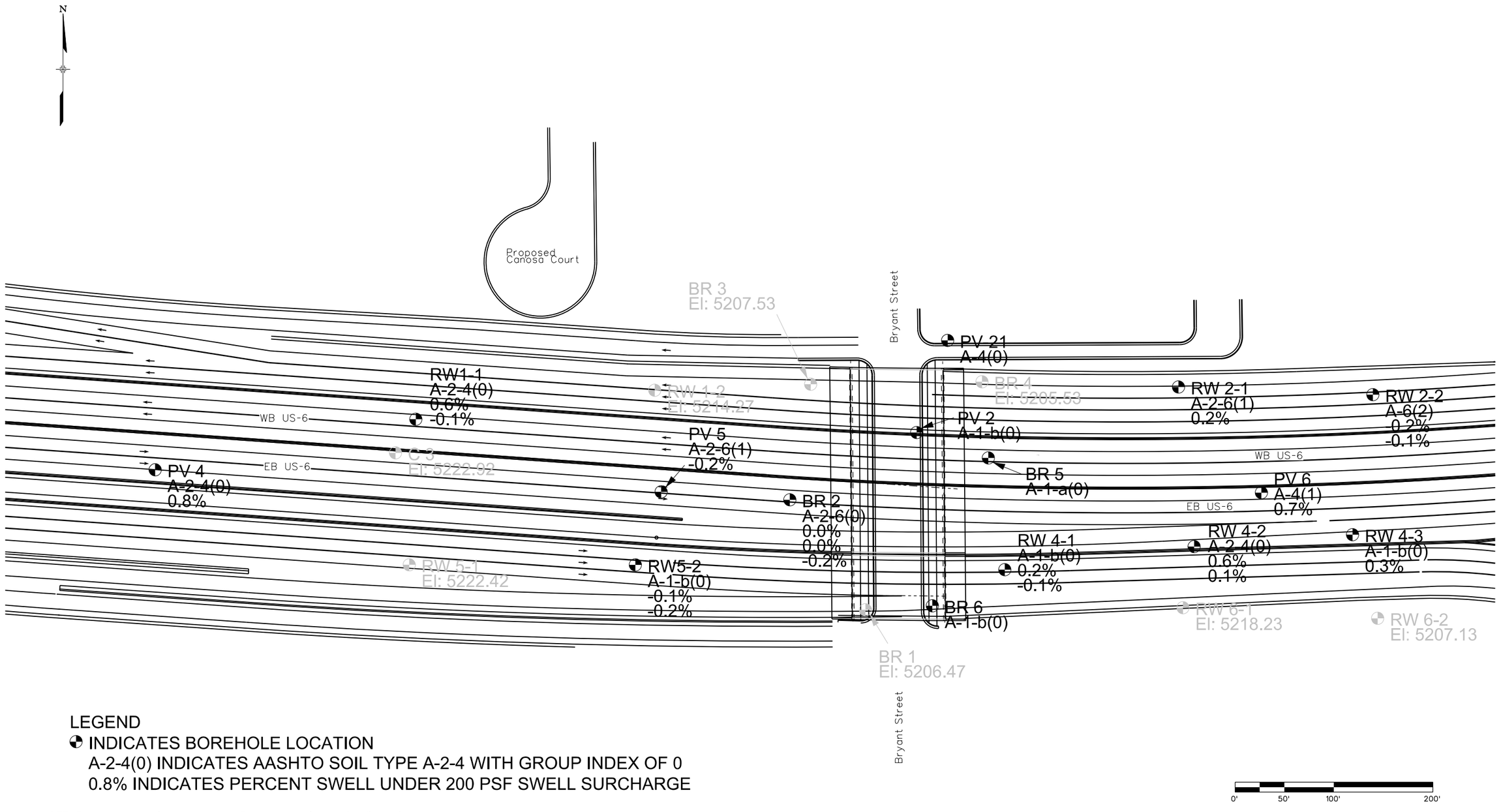

LEGEND

◔ INDICATES BOREHOLE LOCATION
A-2-4(0) INDICATES AASHTO SOIL TYPE A-2-4 WITH GROUP INDEX OF 0
0.8% INDICATES PERCENT SWELL UNDER 200 PSF SWELL SURCHARGE

NOTE: Borehole Locations shown on Proposed Ultimate Configuration

Print Date: 9/21/2012		Sheet Revisions			Colorado Department of Transportation
File Name: 18838-F-3C-Subgrade Soil Type Map.dgn		Date:	Comments	Init.	8833 South Wadsworth Court Littleton, CO 80128 Phone: 303-972-9112 FAX: 303-972-9114
Horiz. Scale: 1:100 Vert. Scale: As Noted	R-X				Region 6 MDP
Unit Information Unit Leader Initials					
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As Constructed	SUBGRADE SOIL TYPE MAP		Project No./Code
No Revisions:			US 6 BRIDGES DESIGN BUILD PROJECT
Revised:	Designer: R. Lepro	Structure Numbers	18838
Void:	Detailer: S. McKanna-Koon		Figure 3C
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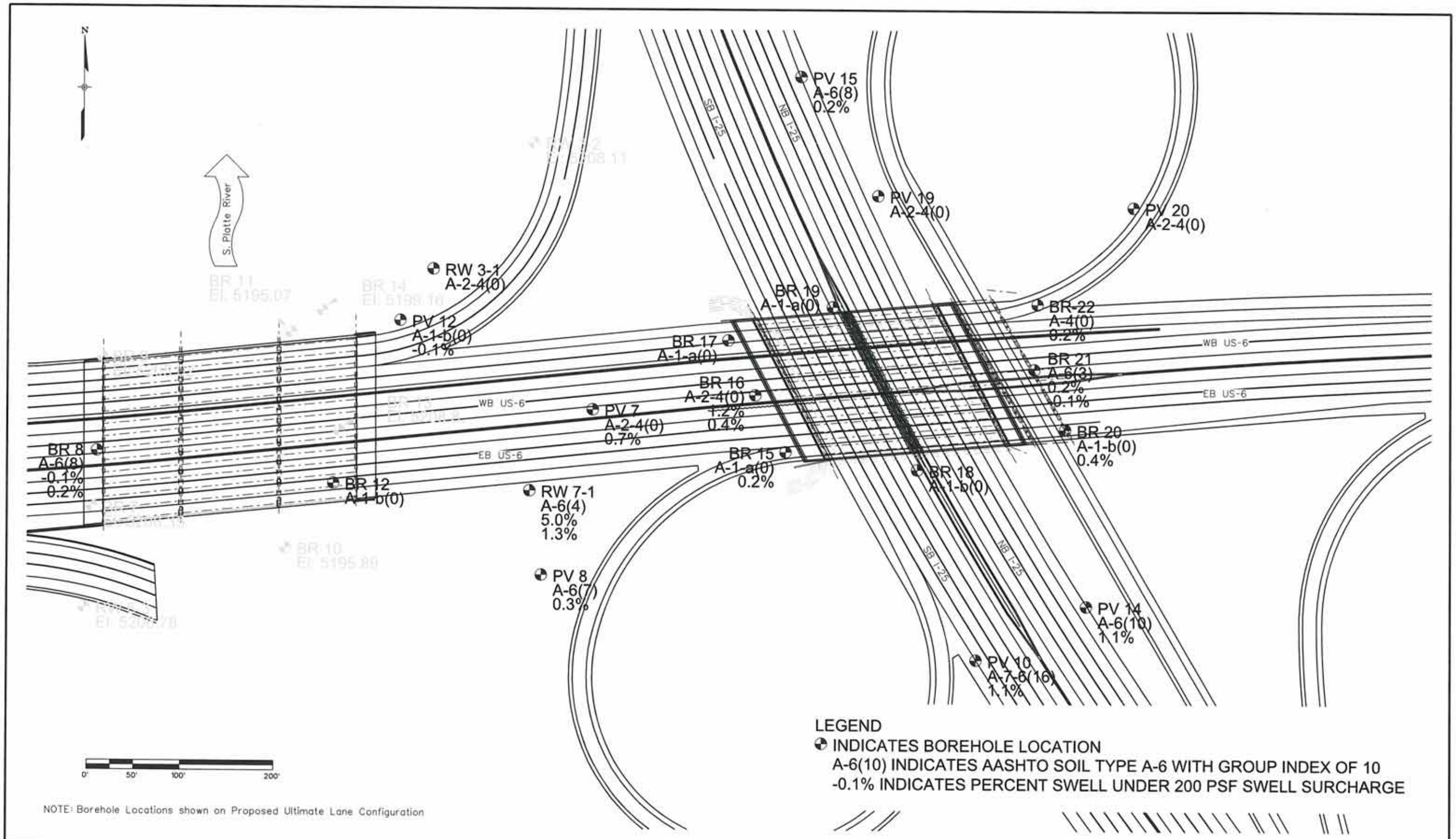

NOTE: Borehole Locations shown on Proposed Ultimate Lane Configuration

LEGEND

INDICATES BOREHOLE LOCATION

A-6(10) INDICATES AASHTO SOIL TYPE A-6 WITH GROUP INDEX OF 10

-0.1% INDICATES PERCENT SWELL UNDER 200 PSF SWELL SURCHARGE

Print Date: 9/18/2012
File Name: 18838-F-3D-Subgrade Soil Type Map.dgn
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Region 6 MDP

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No Revisions:
Revised:
Void:

SUBGRADE SOIL TYPE MAP

Designer: R. Lepro
Detailer: S. McKanna-Koon
Sheet Subset:
Structure Numbers
Subset Sheets: 4 of 6

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

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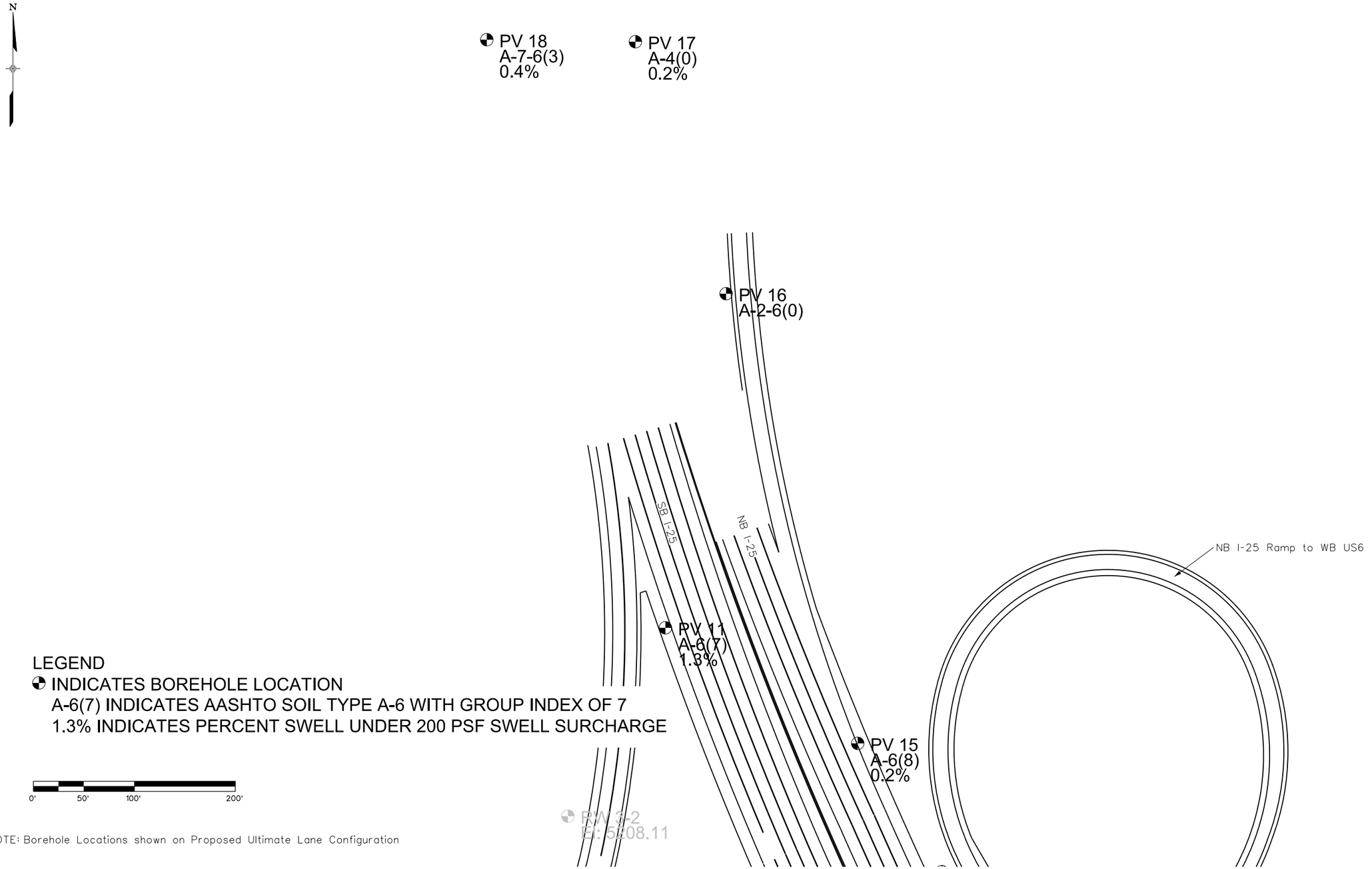

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Print Date: 8/13/2012		Sheet Revisions			Colorado Department of Transportation	As Constructed	SUBGRADE SOIL TYPE MAP	Project No./Code
File Name: 18838-F-3E-Subgrade Soil Type Map.dgn		Date:	Comments	Init.	8833 South Wadsworth Court Littleton, CO 80128 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 / Structure Numbers	18838
Unit Information Unit Leader Initials					Region 6 MDP	Void:	Detailer: S. McKanna-Koon	Figure 3E
RockSol Consulting Group, Inc. 6510 W 91st Ave, Ste 130 Westminster, CO 80031 Ph: 303-962-9300 Fax: 303-962-9350							Sheet Subset: / Subset Sheets: 5 of 6	

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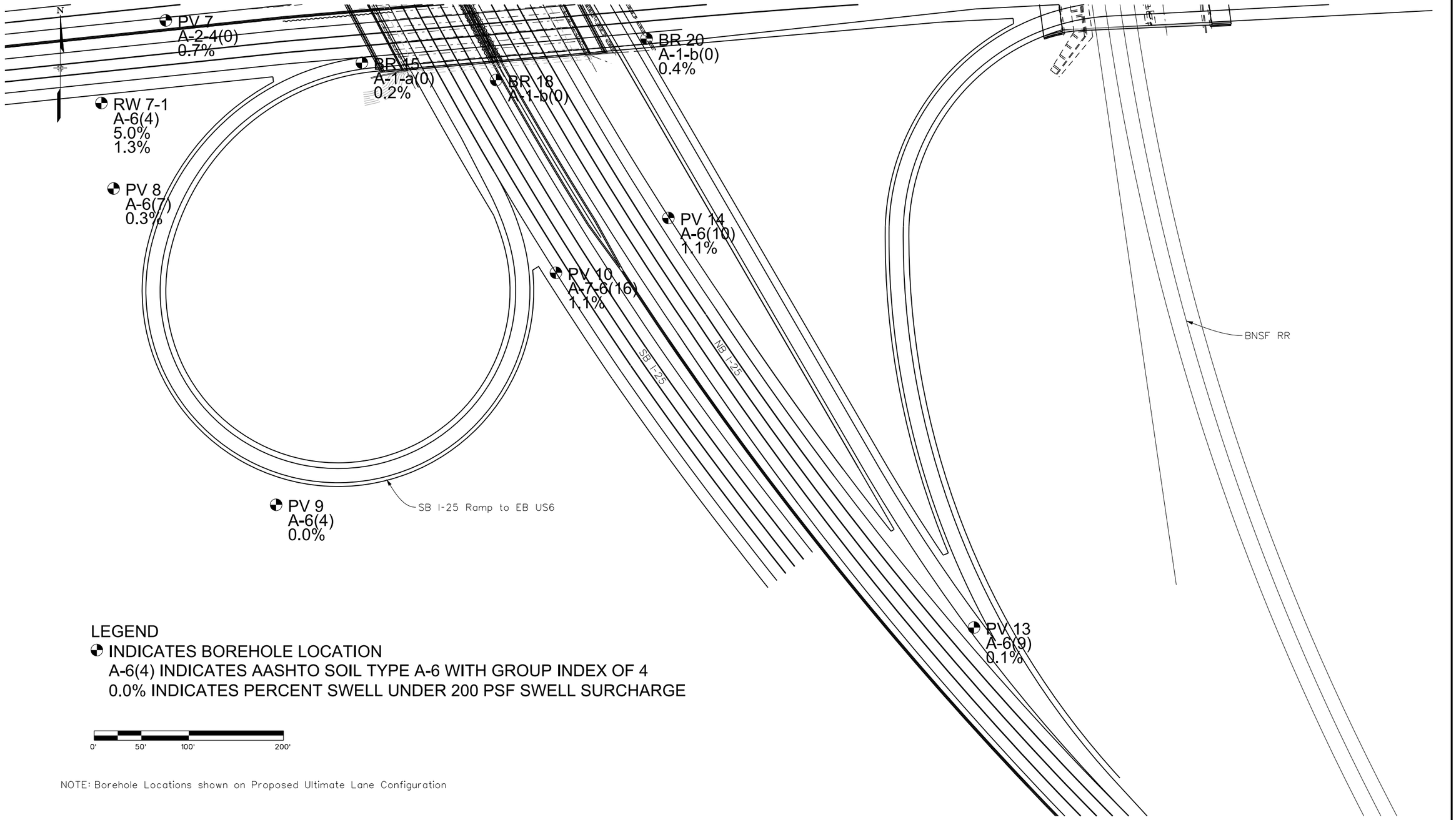

LEGEND

INDICATES BOREHOLE LOCATION

A-6(4) INDICATES AASHTO SOIL TYPE A-6 WITH GROUP INDEX OF 4

0.0% INDICATES PERCENT SWELL UNDER 200 PSF SWELL SURCHARGE

0' 50' 100' 200'

NOTE: Borehole Locations shown on Proposed Ultimate Lane Configuration

Print Date: 8/13/2012		Sheet Revisions	Colorado Department of Transportation
File Name: 18838-F-3F-Subgrade Soil Type Map.dgn		Date: Comments: Init.	8833 South Wadsworth Court
Horiz. Scale: 1:100 Vert. Scale: As Noted	R-X		Littleton, CO 80128
Unit Information Unit Leader Initials			Phone: 303-972-9112 FAX: 303-972-9114
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As Constructed	SUBGRADE SOIL TYPE MAP		Project No./Code
No Revisions:			US 6 BRIDGES DESIGN BUILD PROJECT
Revised:	Designer: R. Lepro	Structure Numbers	18838
Void:	Detailer: S. McKanna-Koon		Figure 3F
	Sheet Subset:	Subset Sheets: 6 of 6	

Print Date: 8/16/2012		Sheet Revisions	
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Horiz. Scale: 1:100 Vert. Scale: As Noted	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 4A

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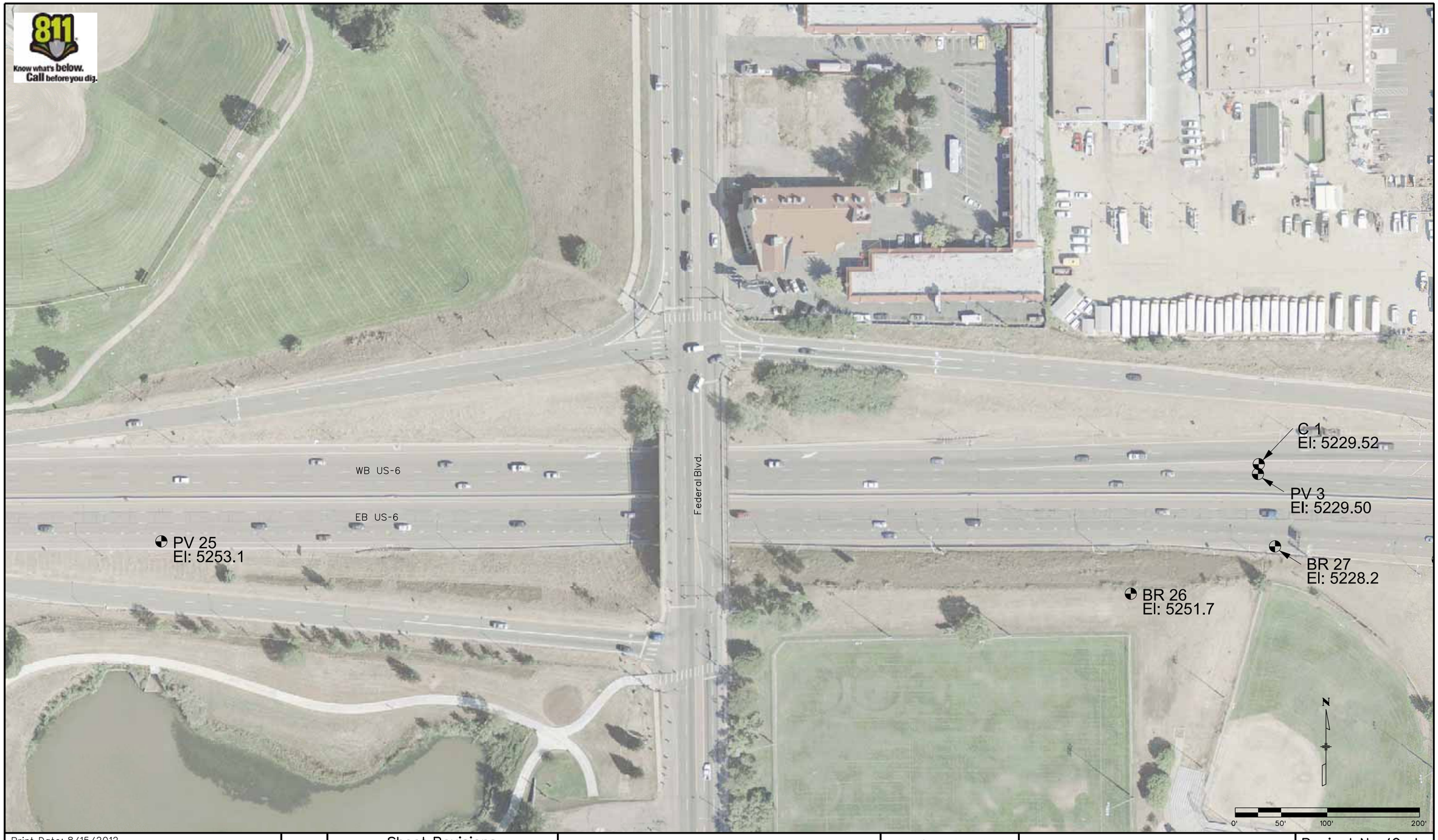

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No Revisions:
Revised:
Void:

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 4B

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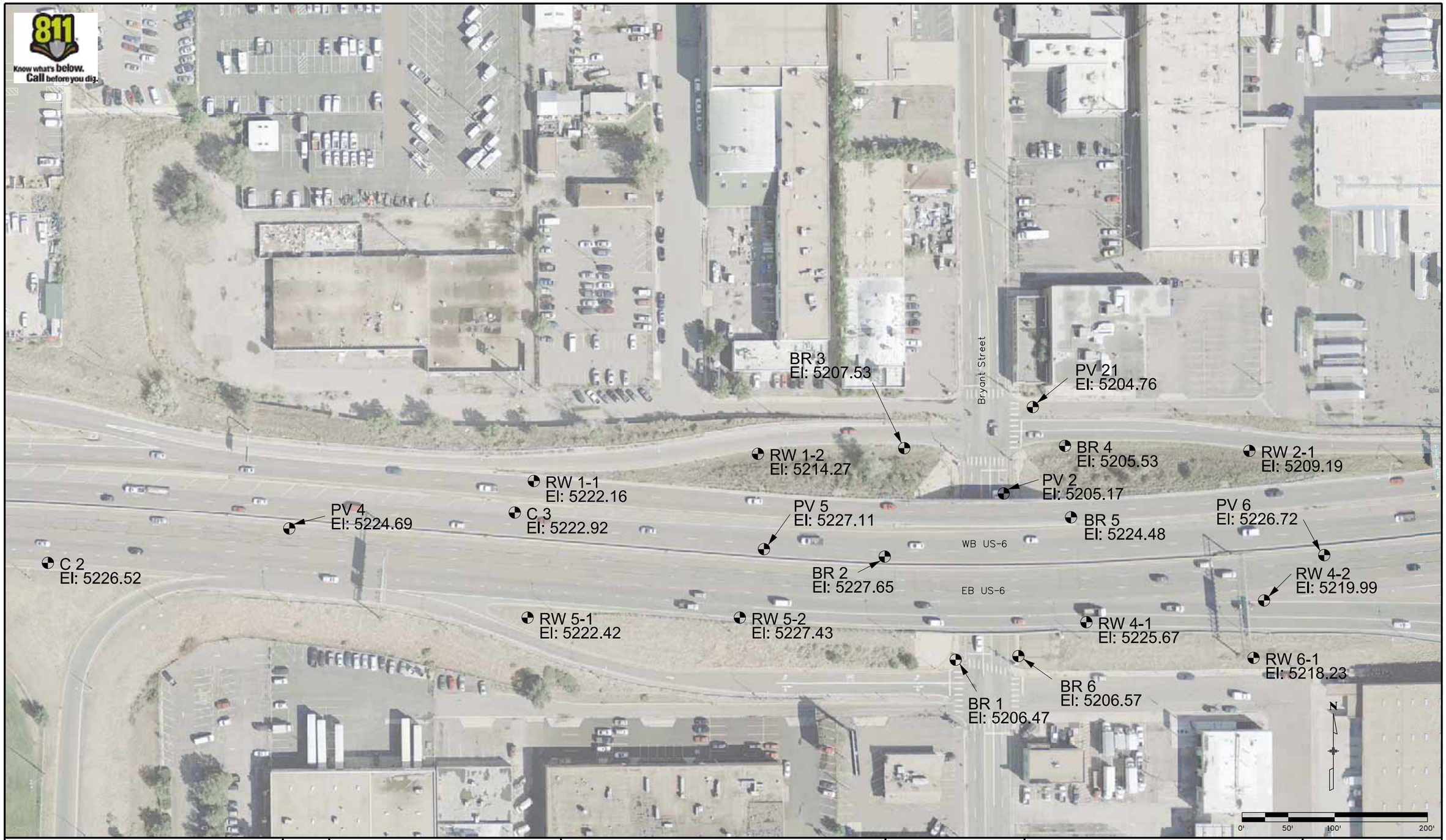

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Unit Information Unit Leader Initials

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Region 6 MDP

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BOREHOLE LOCATION PLAN EXISTING CONDITIONS

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

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

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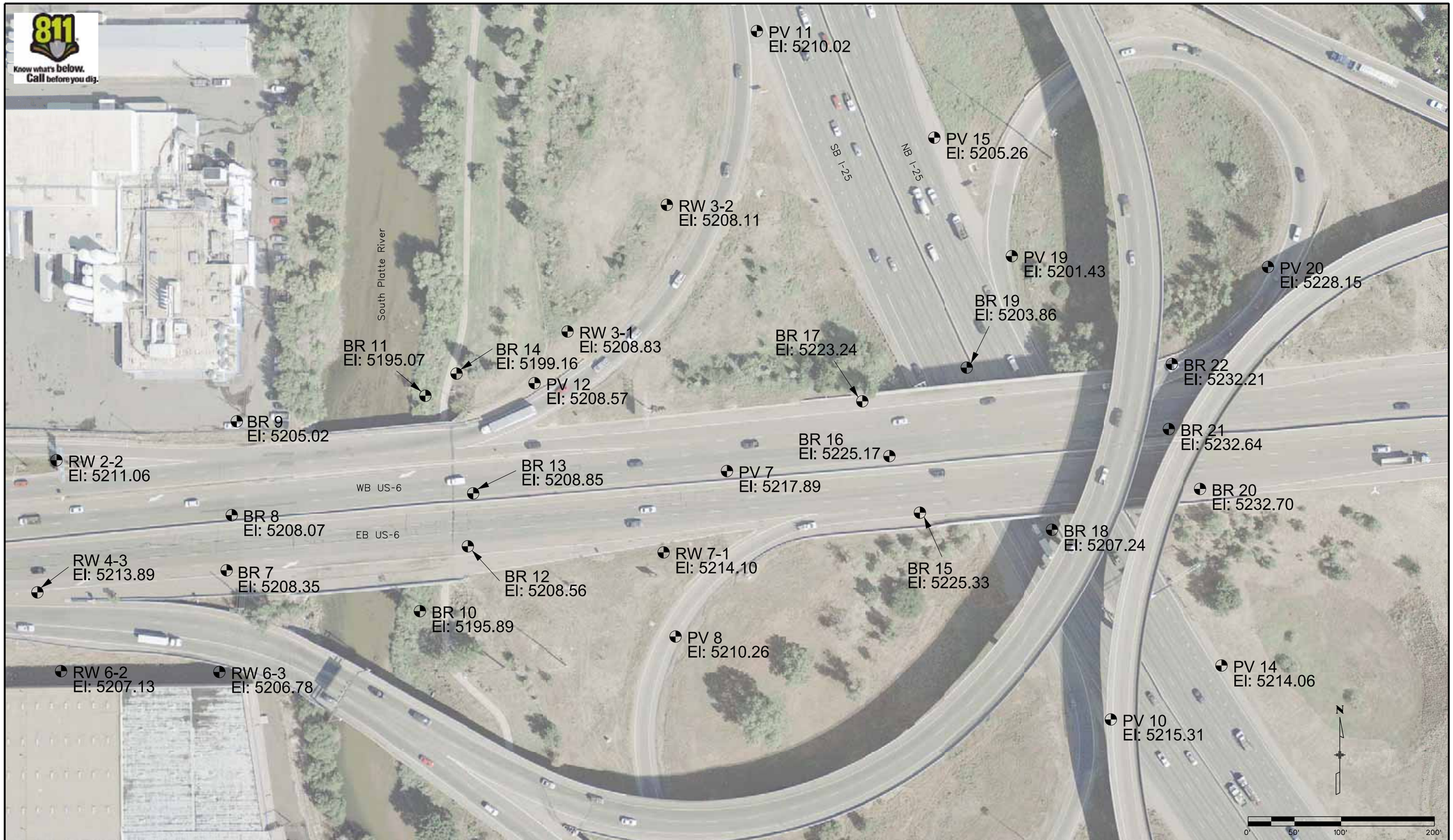

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Unit Information Unit Leader Initials

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Phone: 303-972-9112 FAX: 303-972-9114
Region 6 MDP

As Constructed
No Revisions:
Revised:
Void:

BOREHOLE LOCATION PLAN EXISTING CONDITIONS

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

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

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

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:

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 4E

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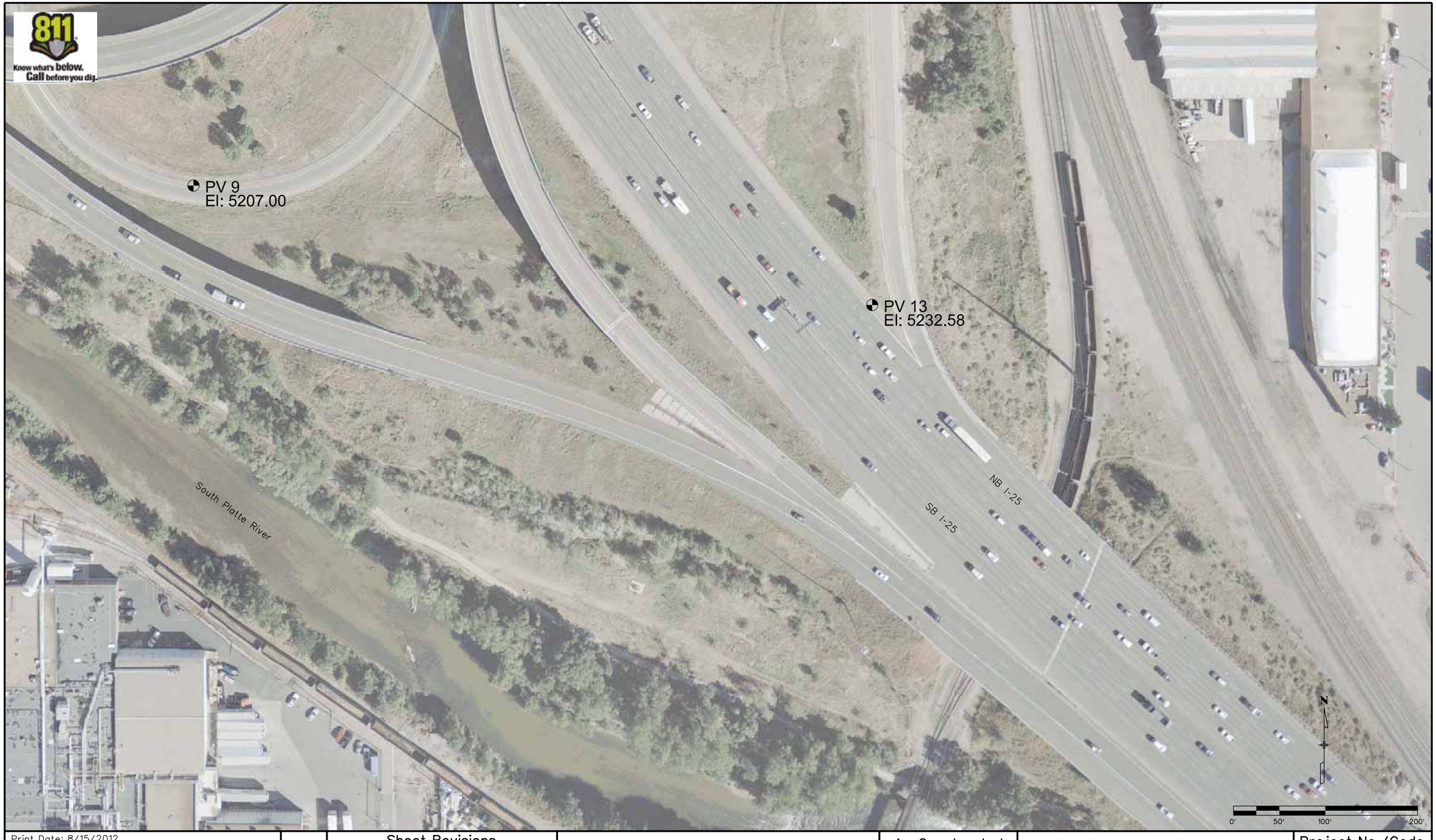

Print Date: 8/15/2012			
File Name: 18838-F-4F-Borehole Location - Existing.dgn			
Horiz. Scale: 1:100	Vert. Scale: As Noted	R-X	
Unit Information	Unit Leader Initials		

RockSol Consulting Group, Inc.
6510 W 91st Ave, Ste 130
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Sheet Revisions

Date:	Comments	Init.

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

As Constructed

No Revisions:
Revised:
Void:

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

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APPENDIX A

LEGEND
AND
INDIVIDUAL BOREHOLE LOGS

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

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- 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.

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- 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)	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- 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.

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- 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				

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
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.

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.

BORING : BR- 17

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.

BORING : BR- 18

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)*										
5167	40			SS	50/3				20.2				
				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				
5199	5		(Native) SAND, slightly silty to gravelly, slightly moist to moist, light brown, medium dense	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				

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										
			(Fill) SAND, with gravel and clay in parts, slightly moist, dark brown to black, medium dense	MC	21/12			117.2	10.5				
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 (%)
5188	45		(Native) SAND, slightly silty to gravelly, slightly moist to wet, light brown, medium dense to very dense *(continued)*	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

RockSol Consulting Group, Inc.

BORING : BR- 21

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.

BORING : BR- 21

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				
				SS	10/19/30				15.5				
5197	35		(Native) SAND, slightly silty to gravelly, slightly moist, light reddish brown, medium dense	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

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

RockSol Consulting Group, Inc.

BORING : PV-2

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 5205.0 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 687460.0 **EAST** 954509.0
DRILLING METHOD Solid Stem **HOLE SIZE** 6"
BORING LOCATION: Lane 2 NB Bryant, North of US6
LOGGED BY J, Biller
GROUND WATER LEVELS:
NOTES Manual Hammer
WATER DEPTH None Encountered 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 (%)
5205	0		(Asphalt) PAVEMENT, approximately 6"										
			(Fill) SAND, silty with traces of clay and gravel, slightly moist, light brown, medium dense	MC	39/12			117.2	3.0	NP	NP	NP	5.8
			(Native) SAND, gravelly, slightly moist, light brown, medium dense	MC	28/12			118.0	1.7	NP	NP	NP	2.4
5200	5		Bottom of hole at 5.0 feet.										

Bulk Sample 0-5'
LL=19
PL=21
PI=NP
-200=25%
WSS=0.00

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

RockSol Consulting Group, Inc.

BORING : PV-3

CLIENT Hartwig and Associates
PROJECT NAME US6 Bridges Design Build Project
PROJECT NUMBER 280.01
PROJECT LOCATION Denver, Colorado
DATE STARTED 1/17/12 **COMPLETED** 1/17/12
GROUND ELEVATION 5230.0 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 687478.0 **EAST** 953283.0
DRILLING METHOD Solid Stem **HOLE SIZE** 4.25"
BORING LOCATION: Lane 2 WB US6, West of Bryant St
LOGGED BY H. Ochoa
GROUND WATER LEVELS:
NOTES Manual Hammer
WATER DEPTH None Encountered on 1/17/12

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 (%)
5230	0		(Asphalt) PAVEMENT, approximately 11.5"										
			(Fill) SAND, with gravel, slightly moist, light brown, dense	SS	35/40/19				3.6	NP	NP	NP	12.2
			(Native) CLAY, with sand, slightly moist to moist, light brown to brown, very stiff										
5225	5			MC	19/12	1.7		103.9	18.3				
5220	10			SS	7/12/12				25.2				
5215	15			MC	17/12			91.3	30.8				
			Bottom of hole at 15.0 feet.										

Bulk Sample 11.5"-5'
LL=26
PL=16
PI=10
-200=52%
WSS=0.00
pH=7.6
Chloride Content=0.05%
Electrical Resistivity=370 Ohm-cm @ 28.5%

RockSol Consulting Group, Inc.

BORING : PV-4

CLIENT Hartwig and Associates
PROJECT NAME US6 Bridges Design Build Project
PROJECT NUMBER 280.01
PROJECT LOCATION Denver, Colorado
DATE STARTED 1/17/12 **COMPLETED** 1/17/12
GROUND ELEVATION 5225.0 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 687422.0 **EAST** 953739.0
DRILLING METHOD Solid Stem **HOLE SIZE** 4.25"
BORING LOCATION: Lane 1 EB US6, West of Bryant St
LOGGED BY H. Ochoa
GROUND WATER LEVELS:
NOTES Manual Hammer
WATER DEPTH None Encountered on 1/17/12

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 7"										
			(Fill) SAND, with gravel, slightly moist, light brown to brown, dense	SS	30/40/36				5.0	NP	NP	NP	10.5
			Chloride @ 7.5"-5' = 0.0113%										
5220	5		(Fill) CLAY, with sand, slightly moist, brown, very stiff	MC	20/12	0.8		99.2	24.2				
5215	10			SS	8/11/11				21.5	45	18	27	57.9
5210	15			MC	26/12			115.2	15.0				
			Bottom of hole at 15.0 feet.										

Bulk Sample 7.5"-5'
LL=NP
PL=NP
PI=NP
-200=30%
WSS=0.00
pH=8.3
Chloride Content=0.01%
Electrical Resistivity=1500 Ohm-cm @ 24.6%

RockSol Consulting Group, Inc.

BORING : PV-5

CLIENT Hartwig and Associates
PROJECT NAME US6 Bridges Design Build Project
PROJECT NUMBER 280.01
PROJECT LOCATION Denver, Colorado
DATE STARTED 1/18/12 **COMPLETED** 1/18/12
GROUND ELEVATION 5227.0 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 687400.0 **EAST** 954251.0
DRILLING METHOD Solid Stem **HOLE SIZE** 4.25"
BORING LOCATION: Lane 1 WB US6, West of Bryant St
LOGGED BY H. Ochoa
GROUND WATER LEVELS:
NOTES Manual Hammer
WATER DEPTH None Encountered on 1/18/12

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 (%)
5227	0		(Asphalt) PAVEMENT, approximately 7.5"										
			Aggregate Base Course, approximately 2"										
			(Fill) CLAY, with sand, slightly moist, light brown to brown, very stiff										
5222	5		Chloride @ 7.5" - 5' = 0.320%	SS	10/12/14				20.4				
5217	10			MC	16/12	-0.2	0.00	103.8	22.6				
5212	15			SS	6/7/10				23.8				
			Bottom of hole at 15.5 feet.										

Bulk Sample 7.5"-5'
LL=33
PL=16
PI=17
-200=32%
WSS=0.00
pH=7.6
Chloride Content=0.032%
Electrical Resistivity=750 Ohm-cm @ 22.2%

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

RockSol Consulting Group, Inc.

BORING : PV-6

CLIENT Hartwig and Associates
PROJECT NAME US6 Bridges Design Build Project
PROJECT NUMBER 280.01
PROJECT LOCATION Denver, Colorado
DATE STARTED 1/17/12 **COMPLETED** 1/17/12
GROUND ELEVATION 5227.0 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 687381.0 **EAST** 954243.0
DRILLING METHOD Solid Stem **HOLE SIZE** 4.25"
BORING LOCATION: Lane 1 EB US6, West of Bryant St
LOGGED BY H. Ochoa
GROUND WATER LEVELS:
NOTES Manual Hammer
WATER DEPTH None Encountered on 1/17/12

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 (%)
5227	0		(Asphalt) PAVEMENT, approximately 8"										
			(Fill) SAND with gravel, slightly moist, brown, dense (aggregate base course)	SS	37/37/20				4.7	NP	NP	NP	30.0
			Chloride @ 8"-5' = 0.0207%										
5222	5		(Fill) CLAY, with sand, slightly moist, light brown to brown, stiff to very stiff	MC	18/12	0.7		102.7	22.2				
5217	10			SS	8/11/15				20.9				
5212	15			MC	13/12			103.3	22.3				
			Bottom of hole at 15.0 feet.										

Bulk Sample 8"-5'
LL=26
PL=1516
PI=10
-200=41%
WSS=0.00
pH=7.9
Chloride Content=0.02%
Electrical Resistivity=700 Ohm-cm @ 18.1%

RockSol Consulting Group, Inc.

BORING : PV-7

CLIENT Hartwig and Associates
PROJECT NAME US6 Bridges Design Build Project
PROJECT NUMBER 280.01
PROJECT LOCATION Denver, Colorado
DATE STARTED 1/6/12 **COMPLETED** 1/6/12
GROUND ELEVATION 5218.0 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 687486.0 **EAST** 955691.0
DRILLING METHOD Hollow Stem Auger **HOLE SIZE** 8"
BORING LOCATION: Lane 1 WB US6, West of I-25
LOGGED BY J. Biller
GROUND WATER LEVELS:
NOTES Manual Hammer
WATER DEPTH None Encountered 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 (%)
5218	0		(Asphalt) PAVEMENT, approximately 12"										
			(Fill) SAND, gravelly with clay, slightly moist to moist, light brown to brown, medium dense	MC	33/12	0.7		114.3	16.4				
			Chloride @ 1-5 feet = 0.0157%										
5213	5			MC	13/12				13.5				
			(FIll) CLAY, sandy, moist, brown grey, stiff										
5208	10			MC	13/12			105.0	21.1	44	14	30	59.8
			Bottom of hole at 11.0 feet.										

Bulk Sample 1"-5"
LL=NP
PL=NP
PI=NP
-200=32%
WSS=0.00
pH=7.9
Chloride Content=0.02%
Electrical Resistivity=800 Ohm-cm @ 16.9%

RockSol Consulting Group, Inc.

BORING : PV-8

CLIENT Hartwig and Associates
PROJECT NAME US6 Bridges Design Build Project
PROJECT NUMBER 280.01
PROJECT LOCATION Denver, Colorado
DATE STARTED 1/18/12 **COMPLETED** 1/18/12
GROUND ELEVATION 5210.0 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 687309.0 **EAST** 955635.0
DRILLING METHOD Solid Stem **HOLE SIZE** 4.25"
BORING LOCATION: Inside Shoulder SB I-25 to EB US6 Loop Ramp
LOGGED BY H. Ochoa
GROUND WATER LEVELS:
NOTES Manual Hammer
WATER DEPTH None Encountered on 1/18/12

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 (%)
5210	0		(Asphalt) PAVEMENT, approximately 11"										
			(Fill) CLAY, sandy, moist, brown, very stiff						17.6				
				SS	10/10/10								
5205	5			MC	17/12	0.3		103.5	21.4				
			(Native) SAND, with silt, slightly moist, light brown to brown, medium dense										
5200	10			SS	14/16/18				2.0				
5195	15			SS	6/8/11				3.0	NP	NP	NP	8.2
			Bottom of hole at 15.5 feet.										

Bulk Sample 11"-5'
LL=40
PL=19
PI=21
-200=52%
WSS=0.00

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

RockSol Consulting Group, Inc.

BORING : PV-9

CLIENT Hartwig and Associates
PROJECT NAME US6 Bridges Design Build Project
PROJECT NUMBER 280.01
PROJECT LOCATION Denver, Colorado
DATE STARTED 1/18/12 **COMPLETED** 1/18/12
GROUND ELEVATION 5207.0 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 686975.0 **EAST** 955807.0
DRILLING METHOD Solid Stem **HOLE SIZE** 4.25"
BORING LOCATION: Inside Shoulder SB I-25 to EB US6 Loop Ramp
LOGGED BY H. Ochoa
GROUND WATER LEVELS:
NOTES Manual Hammer
WATER DEPTH 14.0 ft on 1/18/12

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 (%)
5207	0		(Asphalt) PAVEMENT, approximately 11"										
			(Fill) CLAY, sandy in parts, moist, brown, very stiff	SS	10/11/11				14.1				
			(Native) SAND, with silt, moist to wet, brown to reddish brown, medium dense										
5202	5			MC	12/12	0.0		92.6	9.7				
5197	10			SS	4/6/7				2.2				
5192	15			SS	2/4/6								
			Bottom of hole at 15.0 feet.										

Bulk Sample 11"-5'
LL=37
PL=19
PI=18
-200=43%
WSS=0.00

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

RockSol Consulting Group, Inc.

BORING : PV-10

CLIENT Hartwig and Associates
PROJECT NAME US6 Bridges Design Build Project
PROJECT NUMBER 280.01
PROJECT LOCATION Denver, Colorado
DATE STARTED 1/20/12 **COMPLETED** 1/20/12
GROUND ELEVATION 5215.0 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 687220.0 **EAST** 956103.0
DRILLING METHOD Solid Stem **HOLE SIZE** 4.25"
BORING LOCATION: Outside Shoulder SB I-25, South of US6
LOGGED BY H. Ochoa
GROUND WATER LEVELS:
NOTES Manual Hammer
WATER DEPTH None Encountered on 1/20/12

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 (%)
5215	0		(Asphalt) PAVEMENT, approximately 12"										
			Aggregate Base Course, approximately 4"										
			(Fill) CLAY, sandy, moist, brown, stiff to very stiff	SS	13/9/7				16.2				
			(Native) CLAY, sandy in parts, moist, light brown to dark brown, stiff to very stiff										
5210	5			MC	18/12	1.1		102.5	24.0				
5205	10			SS	3/4/11				15.2				
			(Native) SAND, trace silt, slightly moist, light reddish brown, medium dense										

Bottom of hole at 11.5 feet.

Bulk Sample 12"-5'
LL=43
PL=16
PI=27
-200=69%
WSS=0.06
pH=7.4
Chloride Content=0.06%
Electrical Resistivity=350 Ohm-cm @ 30.3%

RockSol Consulting Group, Inc.

BORING : PV-11

CLIENT Hartwig and Associates
PROJECT NAME US6 Bridges Design Build Project
PROJECT NUMBER 280.01
PROJECT LOCATION Denver, Colorado
DATE STARTED 1/20/12 **COMPLETED** 1/20/12
GROUND ELEVATION 5210.0 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 687959.0 **EAST** 955723.0
DRILLING METHOD Solid Stem **HOLE SIZE** 4.25"
BORING LOCATION: Outside Shoulder SB I-25, North of US6
LOGGED BY H. Ochoa
GROUND WATER LEVELS:
NOTES Manual Hammer
WATER DEPTH None Encountered on 1/20/12

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 (%)
5210	0		(Asphalt) PAVEMENT, approximately 13"										
			(Fill) CLAY, sandy, with gravel, moist, brown, medium stiff to stiff	SS	6/4/4				14.0				
5205	5		(Native) CLAY, with sand, moist, light brown, very stiff	MC	22/12	1.3		114.0	13.7				
5200	10		(Native) SAND, with clay in parts, slightly moist, reddish brown, medium dense	SS	11/7/6				3.8				
			Bottom of hole at 11.5 feet.										

Bulk Sample 13"-5'
LL=37
PL=15
PI=22
-200=51%
WSS=0.00

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

RockSol Consulting Group, Inc.

BORING : PV-15

CLIENT Hartwig and Associates
PROJECT NAME US6 Bridges Design Build Project
PROJECT NUMBER 280.01
PROJECT LOCATION Denver, Colorado
DATE STARTED 1/19/12 **COMPLETED** 1/19/12
GROUND ELEVATION 5205.0 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 687844.0 **EAST** 955913.0
DRILLING METHOD Solid Stem **HOLE SIZE** 4.25"
BORING LOCATION: Outside Shoulder NB I-25, North of US6
LOGGED BY H. Ochoa
GROUND WATER LEVELS:
NOTES Manual Hammer
WATER DEPTH 9.0 ft on 1/19/12

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 (%)
5205	0		(Asphalt) PAVEMENT, approximately 17.5"										
			(Fill) CLAY, with sand, sandy in parts, moist, brown, medium stiff to stiff	SS	8/10/11				15.5				
				MC	7/12	0.2		92.7	25.2				
5200	5		Chloride @ 17.5"-5' = 0.1054%	SS	4/5/7				26.1				
			(Native) SAND, with silt, wet, brown, medium dense										
5195	10			SS	6/11/12				13.1	NP	NP	NP	6.6
			Bottom of hole at 10.0 feet.										

Bulk Sample 17.5"-5'
LL=36
PL=20
PI=16
-200=65%
WSS=0.25
Chloride Content=0.11%
Electrical Resistivity=300 Ohm-cm @ 28.5%

RockSol Consulting Group, Inc.

BORING : PV-12

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
GROUND ELEVATION 5205.2 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 687459.6 **EAST** 954509.2
DRILLING METHOD Solid Stem **HOLE SIZE** 4.25
BORING LOCATION: In Grass SB I-25 to WB US6 Loop Ramp
LOGGED BY H. Ochoa
GROUND WATER LEVELS:
NOTES Manual Hammer
WATER DEPTH Not Encountered on 12/20/11

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		(Topsoil), Approximately 6", grass and weeds at ground surface										
			(Fill) SAND, silty with traces of clay, slightly moist, dark brown, medium dense	MC	28/12	-0.1	0.00	115.9	7.3				
5200	5			MC	9/12			106.9	7.3				
			(Native) SAND with gravel, slightly moist, reddish brown, medium dense										
5195	10			MC	18/12					NP	NP	NP	3.1
			Bottom of hole at 10.0 feet.										

Bulk Sample 6"-5'
LL=NP
PL=NP
PI=NP
-200=22%

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

RockSol Consulting Group, Inc.

BORING : PV-13

CLIENT Hartwig and Associates
PROJECT NAME US6 Bridges Design Build Project
PROJECT NUMBER 280.01
PROJECT LOCATION Denver, Colorado
DATE STARTED 1/19/12 **COMPLETED** 1/19/12
GROUND ELEVATION 5233.0 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 686845.0 **EAST** 956544.0
DRILLING METHOD Solid Stem **HOLE SIZE** 4.25"
BORING LOCATION: Outside Shoulder NB I-25, South of US6
LOGGED BY H. Ochoa
GROUND WATER LEVELS:
NOTES Manual Hammer
WATER DEPTH None Encountered on 1/19/12

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 13"										
			(Fill) SAND, gravel, moist, brown, medium stiff	SS	6/7/9				14.7				
			(Fill) CLAY, with sand, moist, brown, stiff	MC	12/12	0.1		104.3	20.3				
5228	5			SS	4/4/8				23.8				
5223	10			MC	15/12			101.0	22.5				
			Bottom of hole at 10.0 feet.										

Bulk Sample 13"-5'
LL=40
PL=18
PI=22
-200=56%
WSS=0.00

RockSol Consulting Group, Inc.

BORING : PV-16

CLIENT Hartwig and Associates
PROJECT NAME US6 Bridges Design Build Project
PROJECT NUMBER 280.01
PROJECT LOCATION Denver, Colorado
DATE STARTED 1/19/12 **COMPLETED** 1/19/12
GROUND ELEVATION 5212.0 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 688290.0 **EAST** 955783.0
DRILLING METHOD Solid Stem **HOLE SIZE** 4.25"
BORING LOCATION: Outside Shoulder NB I-25, North of US6
LOGGED BY H. Ochoa
GROUND WATER LEVELS:
NOTES Manual Hammer
WATER DEPTH None Encountered on 1/19/12

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 (%)
5212	0		(Asphalt) PAVEMENT, approximately 9"										
			(Fill) CLAY, with sand to sandy, moist, brown, very stiff to stiff	SS	5/16/24				15.5				
				MC	20/12			110.2	15.4				
5207	5			SS	6/5/4				17.0				
			(Fill) SAND, with gravel, moist, dark brown to black, medium dense	MC	25/12			89.5	18.5				
5202	10		Bottom of hole at 10.0 feet.										

Bulk Sample 9"-5'
LL=33
PL=17
PI=16
-200=5%
WSS=0.00

RockSol Consulting Group, Inc.

BORING : PV-14

CLIENT Hartwig and Associates
PROJECT NAME US6 Bridges Design Build Project
PROJECT NUMBER 280.01
PROJECT LOCATION Denver, Colorado
DATE STARTED 1/19/12 **COMPLETED** 1/19/12
GROUND ELEVATION 5214.0 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 687278.0 **EAST** 956221.0
DRILLING METHOD Solid Stem **HOLE SIZE** 4.25"
BORING LOCATION: Outside Shoulder NB I-25, South of US6
LOGGED BY H. Ochoa
GROUND WATER LEVELS:
NOTES Manual Hammer
WATER DEPTH None Encountered on 1/19/12

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 (%)
5214	0		(Asphalt) PAVEMENT, approximately 16"										
			(Fill) CLAY, sandy, moist, brown, stiff to very stiff	SS	4/5/5				20.7				
			(Native) CLAY, with sand, moist, brown, stiff to very stiff	MC	26/12	1.1		96.9	26.0				
5209	5		Chloride @ 16"-5' = 0.0557%	SS	5/8/10				22.7				
			(Native) SAND, with gravel, slightly moist, light reddish brown, medium dense										
5204	10			MC	25/12			102.5	1.0				
			Bottom of hole at 10.0 feet.										

Bulk Sample 16"-5'
LL=38
PL=18
PI=20
-200=63%
WSS=0.02
pH=8.4
Chloride Content=0.06%
Electrical Resistivity=410 Ohm-cm @ 30.3%

RockSol Consulting Group, Inc.

BORING : PV-17

CLIENT Hartwig and Associates
PROJECT NAME US6 Bridges Design Build Project
PROJECT NUMBER 280.01
PROJECT LOCATION Denver, Colorado
DATE STARTED 1/19/12 **COMPLETED** 1/19/12
GROUND ELEVATION 5220.0 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 688539.0 **EAST** 955693.0
DRILLING METHOD Solid Stem **HOLE SIZE** 4.25"
BORING LOCATION: Outside Shoulder NB I-25, North of US6
LOGGED BY H. Ochoa
GROUND WATER LEVELS:
NOTES Manual Hammer
WATER DEPTH None Encountered on 1/19/12

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 (%)
5220	0		(Asphalt) PAVEMENT, approximately 15"										
			(Fill) SAND, with gravel, slightly moist, light brown to brown, medium dense	SS	29/14/14				6.2				
			(Fill) SAND, clayey, moist, brown, medium dense										
5215	5			MC	31/12	0.2		113.8	17.2				
5210	10			SS	7/13/13		0.02		15.0	35	17	18	40.5
			Bottom of hole at 10.5 feet.										

Bulk Sample 15"-5'
LL=25
PL=16
PI=9
-200=40%
WSS=0.00

RockSol Consulting Group, Inc.

BORING : PV-18

CLIENT Hartwig and Associates
PROJECT NAME US6 Bridges Design Build Project
PROJECT NUMBER 280.01
PROJECT LOCATION Denver, Colorado
DATE STARTED 1/20/12 **COMPLETED** 1/20/12
GROUND ELEVATION 5220.0 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 688541.0 **EAST** 955546.0
DRILLING METHOD Solid Stem **HOLE SIZE** 4.25"
BORING LOCATION: Lane 6 SB I-25, North of US6
LOGGED BY H. Ochoa
GROUND WATER LEVELS:
NOTES Manual Hammer
WATER DEPTH None Encountered on 1/20/12

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 (%)
5220	0		(Asphalt) PAVEMENT, approximately 21"										
			Aggregate Base Course, approximately 4"										
			(Fill) SAND, clayey, moist, brown, medium dense	SS	12/4/7				16.8				
			Chloride @ 21" - 5' = 0.0826%	MC	10/12	0.4		107.4	15.3				
5215	5		Auger grinding on concrete at 7.5' no penetration by sampler	SS	5/5/6				9.6				
			Bottom of hole at 7.5 feet.	MC	50/0								

Bulk Sample 21"-5'
LL=41
PL=20
PI=21
-200=36%
WSS=0.00
pH=7.9
Chloride Content=0.08%
Electrical Resistivity=370 Ohm-cm @ 26.07%

RockSol Consulting Group, Inc.

BORING : PV-19

CLIENT Hartwig and Associates
PROJECT NAME US6 Bridges Design Build Project
PROJECT NUMBER 280.01
PROJECT LOCATION Denver, Colorado
DATE STARTED 1/20/12 **COMPLETED** 1/20/12
GROUND ELEVATION 5201.0 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 687717.0 **EAST** 955996.0
DRILLING METHOD Solid Stem **HOLE SIZE** 4.25"
BORING LOCATION: Inside Shoulder NB I-26 to WB US6 Loop Ramp
LOGGED BY H. Ochoa
GROUND WATER LEVELS:
NOTES Manual Hammer
WATER DEPTH 7.0 ft on 1/20/12

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 (%)
5201	0		Topsoil, approximately 6" off shoulder landscape area										
			(Fill) SAND, with silt and gravel, clayey in parts, slightly moist, dark brown, medium dense	SS	7/4/3				15.3				
			Chloride @ 0-5 Ft. = 0.1392%										
			(Native) SAND, with silt and gravel, slightly moist to wet, brown, loose to medium dense	MC	11/12			96.4	20.2				
5196	5			SS	3/3/3				3.6				
5191	10			MC	30/12			129.9	9.5				
			Bottom of hole at 10.0 feet.										

Bulk Sample 0-5'
LL=29
PL=20
PI=9
-200=34%
WSS=0.01
pH=7.8
Chloride Content=0.014%
Electrical Resistivity=250 Ohm-cm @ 28.0%

RockSol Consulting Group, Inc.

BORING : PV-20

CLIENT Hartwig and Associates
PROJECT NAME US6 Bridges Design Build Project
PROJECT NUMBER 280.01
PROJECT LOCATION Denver, Colorado
DATE STARTED 1/20/12 **COMPLETED** 1/20/12
GROUND ELEVATION 5228.0 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 687705.0 **EAST** 956271.0
DRILLING METHOD Solid Stem **HOLE SIZE** 4.25"
BORING LOCATION: Inside Shoulder NB I-26 to WB US6 Loop Ramp
LOGGED BY H. Ochoa
GROUND WATER LEVELS:
NOTES Manual Hammer
WATER DEPTH None Encountered on 1/20/12

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 (%)
5228	0		TOPSOIL, approximately 6" (off shoulder landscape area)										
			(Fill) SAND, gravelly, clayey in parts, moist, brown to black, medium dense	SS	12/11/12				8.0				
				MC	25/12	0.0		117.6	9.4				
5223	5		(Fill) CLAY, sandy, clayey SAND in parts moist, brown, very stiff to medium dense										
				SS	8/9/14				18.0				
5218	10			MC	30/12			117.8	13.3				
			Bottom of hole at 11.0 feet.										

Bulk Sample 0-5'
LL=26
PL=18
PI=8
-200=31%
WSS=0.00

RockSol Consulting Group, Inc.

BORING : PV-24

CLIENT Hartwig and Associates
PROJECT NAME US6 Bridges Design Build Project
PROJECT NUMBER 280.01
PROJECT LOCATION Denver, Colorado
DATE STARTED 6/19/12 **COMPLETED** 6/19/12
GROUND ELEVATION 5272.2 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 687506.2 **EAST** 951611.3
DRILLING METHOD Solid Stem **HOLE SIZE** 6"
BORING LOCATION: WB US6 W. of Federal
LOGGED BY J. Biller
GROUND WATER LEVELS:
NOTES Automatic Hammer
WATER DEPTH 10.0 ft on 6/19/12

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 (%)
5272	0		Asphalt Pavement, approximately 15.5"										
			(Fill) CLAY, sandy, moist, brown, stiff										
			(Native) SAND, clayey, slightly moist to moist, light brown, loose to medium dense	MC	9/12	3.5		111.3	18.7				
5267	5		(Native) CLAY, sandy, moist to very moist, light brown, stiff	MC	10/12	1.0		104.4	18.9				
5262	10		▼	MC	12/12			106.5	20.0				

Bottom of hole at 10.0 feet.

Bulk Sample 13"-5'
LL=41
PL=16
PI=25
-200=63%
WSS=0.00
pH=7.6
Chloride Content=0.28%

RockSol Consulting Group, Inc.

BORING : PV-21

CLIENT Hartwig and Associates
PROJECT NAME US6 Bridges Design Build Project
PROJECT NUMBER 280.01
PROJECT LOCATION Denver, Colorado
DATE STARTED 1/18/12 **COMPLETED** 1/18/12
GROUND ELEVATION 5204.8 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 687552.8 **EAST** 954540.5
DRILLING METHOD Solid Stem **HOLE SIZE** 4.25"
BORING LOCATION: Ramp from US6 to Bryant St., Lane 2, 30' E. of Bryant St.
LOGGED BY H. Ochoa
GROUND WATER LEVELS:
NOTES Manual Hammer
WATER DEPTH 15.0 ft on 1/18/12

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 (%)
5205	0		(Asphalt) PAVEMENT, approximately 5.5"										
			(Fill) SAND, with gravel, clayey in parts, moist, brown, soft						16.4	49	23	26	49.1
			(Fill) SAND, silty, moist, brown	SS	7/8/11								
5200	5		(Native) SAND, with silt, slightly moist, reddish brown, medium dense to dense	MC	37/12			122.2	5.8	NP	NP	NP	14.4
5195	10			SS	10/14/14				2.5				
			(Native) SAND, gravelly, wet, brown, medium dense										
5190	15			MC	15/12				9.1				
			Bottom of hole at 15.0 feet.										

Bulk Sample 6"-5'
LL=NP
PL=NP
PI=NP
-200=45%
WSS=0.00

RockSol Consulting Group, Inc.

BORING : PV-22

CLIENT Hartwig and Associates
PROJECT NAME US6 Bridges Design Build Project
PROJECT NUMBER 280.01
PROJECT LOCATION Denver, Colorado
DATE STARTED 6/19/12 **COMPLETED** 6/19/12
GROUND ELEVATION 5306.3 ft
DRILLING CONTRACTOR Old Dirt Drilling
NORTH 687501.1 **EAST** 950758.6
DRILLING METHOD Solid Stem **HOLE SIZE** 6"
BORING LOCATION: WB US6 E. of Knox Court
LOGGED BY J. Biller
GROUND WATER LEVELS:
NOTES Automatic Hammer
WATER DEPTH None Encountered on 6/19/12

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 (%)
5306	0		Asphalt Pavement, Approximately 14.5"										
			(Fill) SAND, clay, moist, light brown, medium dense	MC	10/12			103.1	21.5				
			(Native) SAND, silty, moist, grey to light brown, medium dense										
5301	5		(Bedrock) CLAYSTONE, sandy, slightly moist to mostly moist, light brown with rust to olive grey, hard to very hard	MC	35/12	4.8		104.0	23.4				
				MC	87/10	0.6		102.8	23.8				
			Bottom of hole at 9.8 feet.										

Bulk Sample 16"-5'
LL=38
PL=16
PI=22
-200=39%
WSS=0.03
pH=7.3
Chloride Content=0.04%
Electrical Resistivity=420 Ohm-cm @ 25.8%

RockSol Consulting Group, Inc.

BORING : PV-25

CLIENT Hartwig and Associates
PROJECT NAME US6 Bridges Design Build Project
PROJECT NUMBER 280.01
PROJECT LOCATION Denver, Colorado
DATE STARTED 6/19/12 **COMPLETED** 6/19/12
GROUND ELEVATION 5253.1 ft
DRILLING CONTRACTOR Old Dirt Drilling
NORTH 687404.5 **EAST** 952093.8
DRILLING METHOD Solid Stem **HOLE SIZE** 6"
BORING LOCATION: EB US 6 W. of Federal
LOGGED BY J. Biller
GROUND WATER LEVELS:
NOTES Automatic Hammer
WATER DEPTH None Encountered on 6/19/12

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 (%)
5253	0		Asphalt Pavement, approximately 15"										
			(Native) CLAY, sandy, very moist, brown, medium dense to stiff	MC	12/12	1.7		113.4	17.2				
5248	5			MC	12/12	2.2		102.0	23.2				
5243	10			MC	12/12			103.7	21.9	40	12	28	65.2
			Bottom of hole at 10.0 feet.										

Bulk Sample 14"-5'
LL=43
PL=19
PI=24
-200=71%
WSS=0.13
pH=7.2
Chloride Content=0.06%
Electrical Resistivity=280 Ohm-cm @ 34.6%

RockSol Consulting Group, Inc.

BORING : PV-23

CLIENT Hartwig and Associates
PROJECT NAME US6 Bridges Design Build Project
PROJECT NUMBER 280.01
PROJECT LOCATION Denver, Colorado
DATE STARTED 6/19/12 **COMPLETED** 6/19/12
GROUND ELEVATION 5291.5 ft
DRILLING CONTRACTOR Old Dirt Drilling
NORTH 687396.9 **EAST** 951138.2
DRILLING METHOD Solid Stem **HOLE SIZE** 6"
BORING LOCATION: EB US6 E of Knox Court
LOGGED BY J. Biller
GROUND WATER LEVELS:
NOTES Automatic Hammer
WATER DEPTH None Encountered on 6/19/12

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 (%)
5292	0		Asphalt Pavement, approximately 15.75"										
			(Fill) CLAY, sandy, moist, brown, stiff	MC	8/12	1.2		98.2	26.2				
5287	5		(Native) CLAY, with sand to sandy, very moist, brown and grey, medium stiff	MC	4/12	-0.2		89.0	31.2	36	17	19	
5282	10			MC	7/12			99.6	25.3				
			Bottom of hole at 10.0 feet.										

Bulk Sample 14"-5'
LL=47
PL=18
PI=29
-200=69%
WSS=0.00
pH=7.5
Chloride Content=0.04%

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

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

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

RockSol Consulting Group, Inc.

BORING : RW 4-1

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 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)	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

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

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

RockSol Consulting Group, Inc.

BORING : RW 3-1

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
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 4-3

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

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 7-1

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

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- 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- 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									

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- 6	15								12.1									
BR- 6	20								14.1			0.00						
BR- 6	25								11.0									
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- 8	9"-10'	38	15	23		53	CL	A-6 (8)				0.03	470 Ohms-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- 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- 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								

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

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- 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									
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									

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

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- 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	8"-5'	NP	NP	NP		19	SM	A-1-b (0)				0.00						
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									

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- 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									
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						

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- 22	54	40	22	18		69	CL	A-6 (11)	19.6									
PV-2	0-5'	19	21	NP		25	SM	A-1-b (0)				0.00						
PV-2	2	NP	NP	NP		6	SW-SM	A-1-a (0)	3.0	117.2								
PV-2	4	NP	NP	NP		2	GW	A-1-a (0)	1.7	118.0								
PV-3	11.5"-5'	26	16	10		52	CL	A-4 (2)				0.00	370 Ohms-cm @ 28.05%	7.6	0.05			
PV-3	1	NP	NP	NP		12	SM	A-1-b (0)	3.6									
PV-3	4				1.7				18.3	103.9								
PV-3	9								25.2									
PV-3	14								30.8	91.3								
PV-4	7.5"-5'	NP	NP	NP		30	GM	A-2-4 (0)				0.00	1500 Ohms-cm @ 24.6 %	8.3	0.01			
PV-4	1	NP	NP	NP		11	SP-SM	A-1-b (0)	5.0									
PV-4	4				0.8				24.2	99.2								
PV-4	9	45	18	27		58	CL	A-7-6 (12)	21.5									
PV-4	14								15.0	115.2								
PV-5	7.5"-5'	33	16	17		32	SC	A-2-6 (1)				0.00	750 Ohms-cm @ 22.02 %	7.6	0.32			
PV-5	4								20.4									
PV-5	9				-0.2				22.6	103.8		0.00						
PV-5	14								23.8									
PV-6	8"-5'	26	16	10		41	SC	A-4 (1)				0.00	700 Omhs-cm @18.1 %	7.9	0.02	118.3	13.0	S
PV-6	1	NP	NP	NP		30	SM	A-2-4 (0)	4.7									
PV-6	4				0.7				22.2	102.7								
PV-6	9								20.9									
PV-6	14								22.3	103.3								
PV-7	1"-5'	NP	NP	NP		32	SM	A-2-4 (0)				0.00	800 ohms-cm @ 16.9	7.9	0.02			
PV-7	2				0.7				16.4	114.3								
PV-7	5								13.5									
PV-7	10	44	14	30		60	CL	A-7-6 (15)	21.1	105.0								
PV-8	11"-5'	40	19	21		52	CL	A-6 (7)				0.00						
PV-8	1								17.6									
PV-8	4				0.3				21.4	103.5								

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
PV-8	9								2.0									
PV-8	14	NP	NP	NP		8	SW-SM	A-1-a (0)	3.0									
PV-9	11"-5'	37	19	18		43	SC	A-6 (4)				0.00						
PV-9	1								14.1									
PV-9	4				0.0				9.7	92.6								
PV-9	9								2.2									
PV-10	12"-5'	43	16	27		69	CL	A-7-6 (16)				0.06	350 Ohms-cm @ 30.3%	7.4	0.06			
PV-10	1								16.2									
PV-10	5				1.1				24.0	102.5								
PV-10	10								15.2									
PV-11	13"-5'	37	15	22		51	CL	A-6 (7)				0.00						
PV-11	1								14.0									
PV-11	5				1.3				13.7	114.0								
PV-11	10								3.8									
PV-12	6"-5'	NP	NP	NP		22	SM	A-1-b (0)										
PV-12	2				-0.1				7.3	115.9		0.00						
PV-12	4								7.3	106.9								
PV-12	9	NP	NP	NP		3	SW	A-1-b (0)										
PV-13	13"-5'	40	18	22		56	CL	A-6 (9)	14.7									
PV-13	3				0.1				20.3	104.3								
PV-13	4								23.8									
PV-13	9								22.5	101.0								
PV-14	16"-5'	38	18	20		63	CL	A-6 (10)				0.02	410 Ohms-cm @ 30.3 %	8.4	0.06			
PV-14	1.3								20.7									
PV-14	3				1.1				26.0	96.9								
PV-14	4.5								22.7									
PV-14	9								1.0	102.5								
PV-15	17.5"-5'	36	20	16		65	CL	A-6 (8)				0.24	300 Ohms-cm @ 28.5 %		0.11			
PV-15	1.5								15.5									
PV-15	3				0.2				25.2	92.7								

RockSol Consulting Group, Inc.

SUMMARY OF PHYSICAL & CHEMICAL TEST RESULTS

CLIENT Hartwig and Associates

PROJECT NAME US6 Bridges Design Build Project

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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
PV-15	4								26.1									
PV-15	9	NP	NP	NP		7	SP-SM	A-1-a (0)	13.1									
PV-16	9"-5'	33	17	16		5	SP	A-2-6 (0)				0.00						
PV-16	1								15.5									
PV-16	3								15.4	110.2								
PV-16	4.5								17.0									
PV-16	9								18.5	89.5								
PV-17	15"-5'	25	16	9		40	SC	A-4 (0)				0.00						
PV-17	1.25								6.2									
PV-17	4				0.2				17.2	113.8								
PV-17	9	35	17	18		40	SC	A-6 (3)	15.0			0.02						
PV-18	21"-5'	41	20	21		36	SC	A-7-6 (3)				0.00	370 Ohms-cm @ 26.07 %	7.9	0.08			
PV-18	2								16.8									
PV-18	3.5				0.4				15.3	107.4								
PV-18	5								9.6									
PV-19	0-5'	29	20	9		34	SC	A-2-4 (0)				0.01	250 Ohms-cm @28.0 %	7.8	0.14			
PV-19	1								15.3									
PV-19	3								20.2	96.4								
PV-19	4.5								3.6									
PV-19	9								9.5	129.9								
PV-20	0-5'	26	18	8		31	SC	A-2-4 (0)				0.00						
PV-20	1								8.0									
PV-20	2.5				0.0				9.4	117.6								
PV-20	5								18.0									
PV-20	10								13.3	117.8								
PV-21	6"-5'	NP	NP	NP		45	SM	A-4 (0)				0.00						
PV-21	1	49	23	26		49	SC	A-7-6 (9)	16.4									
PV-21	4	NP	NP	NP		14	GM	A-1-a (0)	5.8	122.2								
PV-21	9								2.5									
PV-21	14								9.1									

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
PV-22	16"-5'	38	16	22		39	SC	A-6 (4)				0.03	420 Ohm-cm @ 25.8%	7.3	0.04			
PV-22	2								21.5	103.1								
PV-22	4				4.8				23.4	104.0								
PV-22	9				0.6				23.8	102.8								
PV-23	14"-5'	47	18	29		69	CL	A-7-6 (18)				0.00		7.5	0.04			
PV-23	2				1.2				26.2	98.2								
PV-23	4	36	17	19	-0.2			A-6 (19)	31.2	89.0								
PV-23	9								25.3	99.6								
PV-24	13"-5'	41	16	25		63	CL	A-7-6 (13)				0.00		7.6	0.28			
PV-24	2				3.5				18.7	111.3								
PV-24	4				1.0				18.9	104.4								
PV-24	9								20.0	106.5								
PV-25	14"-5'	43	19	24		71	CL	A-7-6 (16)				0.13	280 Ohm-cm @ 34.6%	7.2	0.06			
PV-25	2				1.7				17.2	113.4								
PV-25	4				2.2				23.2	102.0								
PV-25	9	40	12	28		65	CL	A-6 (15)	21.9	103.7								
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 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									

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 2-1	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								
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 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						
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									

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

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

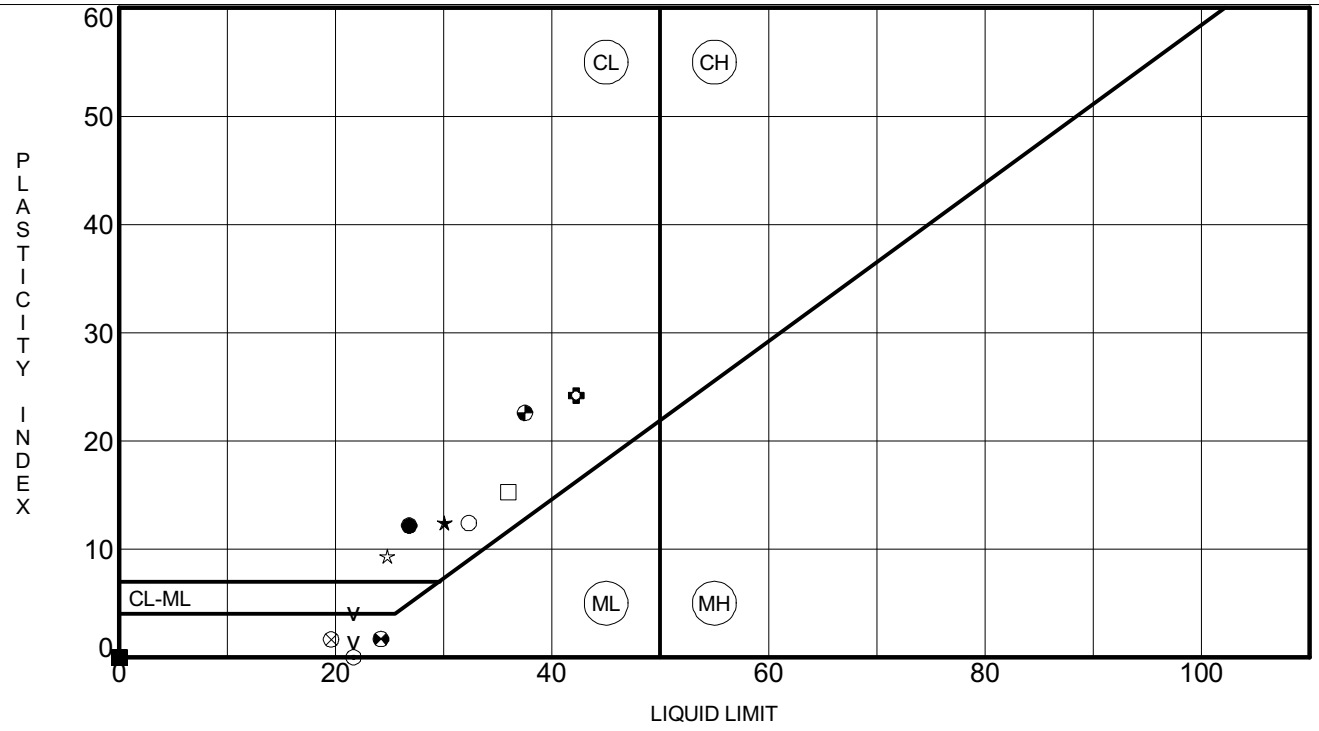
Borehole	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	Swell Potential (%)	%<#200 Sieve	Classification		Water Content (%)	Dry Density (pcf)	Unconfined Compressive Strength (psi)	Sulfate (%)	Resistivity Ohm-cm	pH	Chlorides (%)	Proctor S=Standard M=Modified		
							USCS	AASHTO								MDD	OMC	S/M
RW 4-3	14	NP	NP	NP		4	SP	A-1-b (0)	2.1									
RW 4-3	19								1.7									
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 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



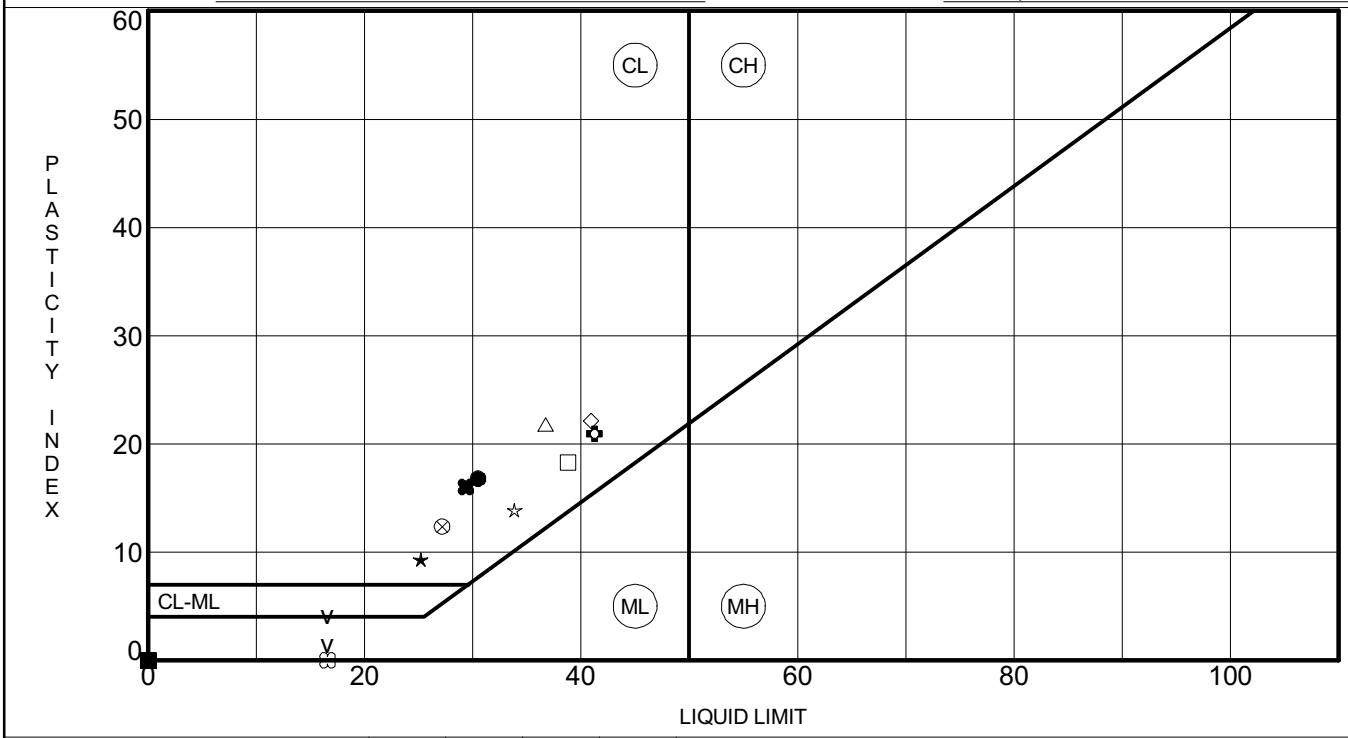
	Specimen Identification		LL	PL	PI	Fines	Classification
●	BR- 2	10"-5'	27	15	12	28.1	CLAYEY SAND with GRAVEL (SC)
⊠	BR- 2	34.0	NP	NP	NP	6.1	POORLY GRADED SAND with SILT and GRAVEL (SP-SM)
▲	BR- 2	44.0	NP	NP	NP	5.9	POORLY GRADED SAND with SILT (SP-SM)
★	BR- 2	54.0	30	18	12	22.2	CLAYEY SAND (SC)
⊙	BR- 5	14"-5'	22	22	NP	12.4	SILTY GRAVEL with SAND (GM)
✿	BR- 5	10.0	42	18	24	57.0	SANDY LEAN CLAY (CL)
○	BR- 5	20.0	32	20	12	54.6	SANDY LEAN CLAY (CL)
△	BR- 5	40.0	NP	NP	NP	4.4	WELL-GRADED SAND (SW)
⊗	BR- 6	0-5'	20	18	2	21.4	SILTY SAND with GRAVEL (SM)
⊕	BR- 6	5.0	NP	NP	NP	3.1	WELL-GRADED GRAVEL with SAND (GW)
□	BR- 6	35.0	36	21	15	42.7	(Bedrock) SANSTONE, clayey (SC)
☢	BR- 6	40.0	24	22	2	38.0	(Bedrock) SANDSTONE, silty (SM)
◒	BR- 8	9"-10'	38	15	23	53.1	SANDY LEAN CLAY (CL)
☆	BR- 8	2.0	25	15	10	68.1	(Fill) SANDY LEAN CLAY (CL)
⊠	BR- 12	13"-5'	NP	NP	NP	9.4	WELL-GRADED SAND with SILT and GRAVEL (SW-SM)
■	BR- 12	1.0	NP	NP	NP	11.2	POORLY GRADED SAND with SILT and GRAVEL (SP-SM)
◆	BR- 12	9.0	NP	NP	NP	8.8	WELL-GRADED SAND with SILT and GRAVEL (SW-SM)
◇	BR- 12	19.0	NP	NP	NP	4.0	WELL-GRADED SAND with GRAVEL (SW)
×	BR- 15	8.5"-5'	NP	NP	NP	17.1	SILTY SAND with GRAVEL (SM)
✖	BR- 15	1.0	NP	NP	NP	7.3	WELL-GRADED GRAVEL with SILT and SAND (GW-GM)

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



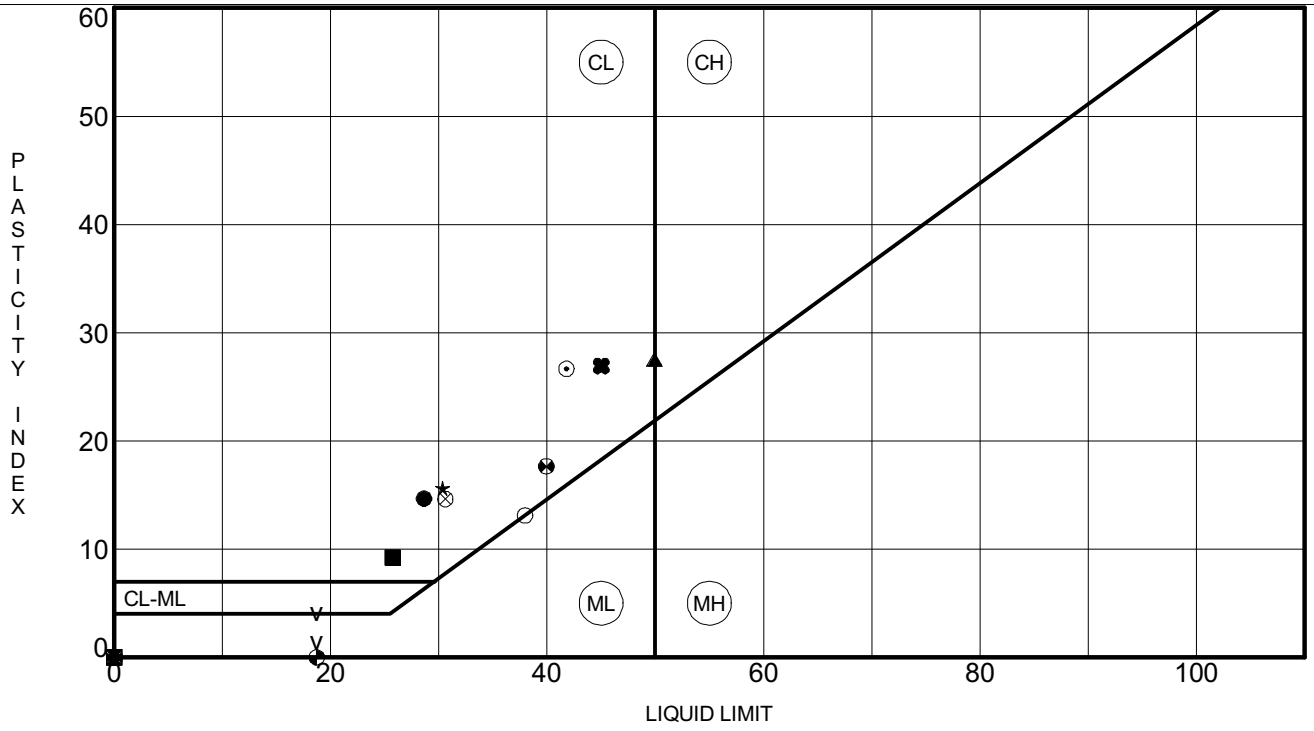
	Specimen Identification		LL	PL	PI	Fines	Classification
●	BR- 15	14.0	30	14	16	49.0	CLAYEY SAND (SC)
⊠	BR- 15	25.0	NP	NP	NP	1.9	POORLY GRADED SAND (SP)
▲	BR- 15	34.0	NP	NP	NP	4.8	WELL-GRADED SAND with GRAVEL (SW)
★	BR- 16	8"-5'	25	16	9	14.1	CLAYEY SAND with GRAVEL (SC)
⊙	BR- 16	25.0	NP	NP	NP	0.1	POORLY GRADED SAND (SP)
✿	BR- 16	50.0	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	5.0	37	15	22	53.1	SANDY LEAN CLAY (CL)
⊗	BR- 17	15.0	27	15	12	42.9	CLAYEY SAND (SC)
⊕	BR- 17	30.0	NP	NP	NP	3.3	POORLY GRADED SAND with GRAVEL (SP)
□	BR- 17	50.0	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	9.0	NP	NP	NP	0.5	POORLY GRADED SAND with GRAVEL (SP)
☆	BR- 18	34.0	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	5.0	NP	NP	NP	1.9	WELL-GRADED SAND (SW)
◆	BR- 19	15.0	NP	NP	NP	2.3	POORLY GRADED SAND (SP)
◇	BR- 19	29.0	41	19	22	62.7	(Bedrock) CLAYSTONE (CL)
×	BR- 20	8"-5'	NP	NP	NP	18.9	SILTY SAND with GRAVEL (SM)
✖	BR- 20	15.0	29	13	16	46.0	CLAYEY SAND (SC)

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



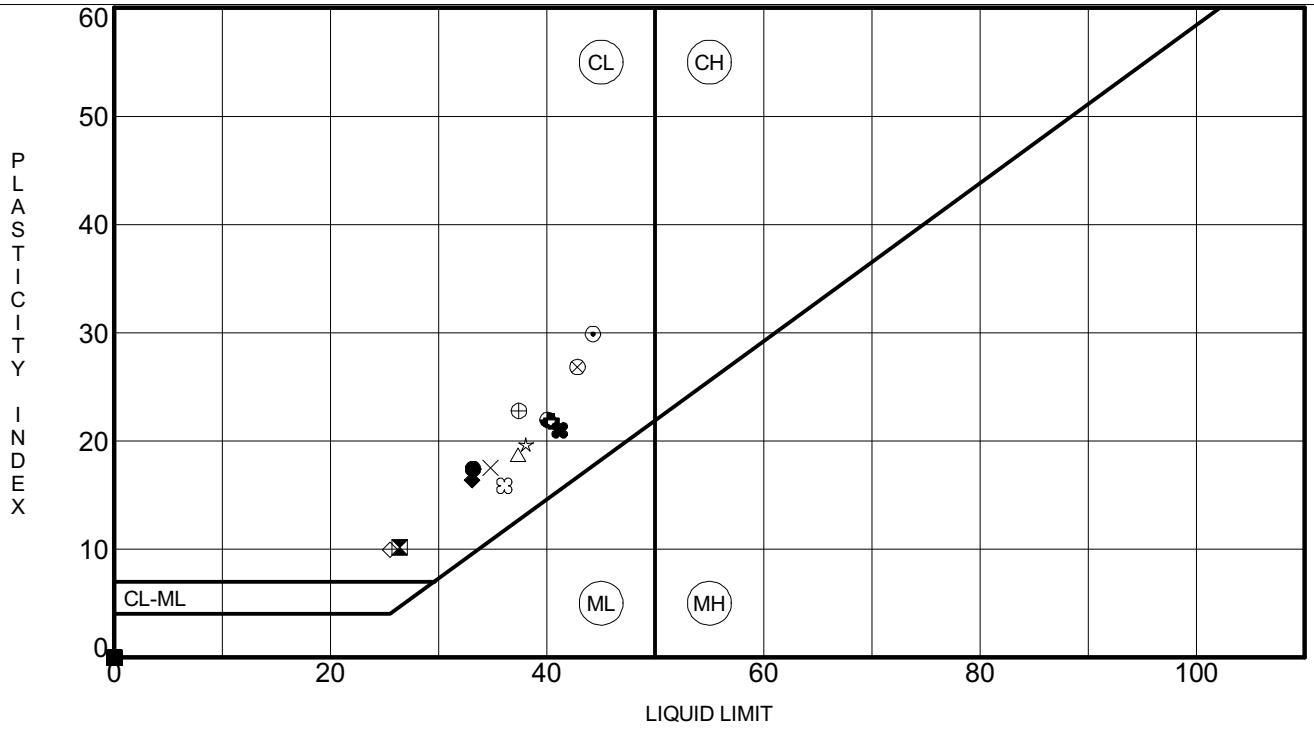
	Specimen Identification		LL	PL	PI	Fines	Classification
●	BR- 20	25.0	29	14	15	43.5	CLAYEY SAND (SC)
⊠	BR- 20	35.0	NP	NP	NP	5.1	WELL-GRADED SAND with SILT and GRAVEL (SW-SM)
▲	BR- 20	50.0	50	22	28	92.9	(Bedrock) CLAYSTONE (CH)
★	BR- 21	7"-5'	30	15	15	43.7	CLAYEY SAND with GRAVEL (SC)
⊙	BR- 21	20.0	42	15	27	58.6	SANDY LEAN CLAY (CL)
✿	BR- 21	35.0	NP	NP	NP	4.6	POORLY GRADED SAND with GRAVEL (SP)
○	BR- 21	55.0	38	25	13	66.4	(Bedrock) SILTSTONE (ML)
△	BR- 22	8.5"-5'	NP	NP	NP	41.6	SILTY SAND with GRAVEL (SM)
⊗	BR- 22	14.0	31	16	15	54.5	SANDY LEAN CLAY (CL)
⊕	BR- 22	34.0	NP	NP	NP	3.7	POORLY GRADED SAND (SP)
□	BR- 22	39.0	NP	NP	NP	4.8	WELL-GRADED SAND with GRAVEL (SW)
⊛	BR- 22	54.0	40	22	18	68.8	SANDY LEAN CLAY (CL)
◒	PV-2	0-5'	19	21	NP	24.6	SILTY SAND with GRAVEL (SM)
☆	PV-2	2.0	NP	NP	NP	5.8	WELL-GRADED SAND with SILT and GRAVEL (SW-SM)
⊠	PV-2	4.0	NP	NP	NP	2.4	WELL-GRADED GRAVEL with SAND (GW)
■	PV-3	11.5"-5'	26	16	10	51.7	SANDY LEAN CLAY with GRAVEL (CL)
◆	PV-3	1.0	NP	NP	NP	12.2	SILTY SAND with GRAVEL (SM)
◇	PV-4	7.5"-5'	NP	NP	NP	30.2	SILTY GRAVEL with SAND (GM)
×	PV-4	1.0	NP	NP	NP	10.5	POORLY GRADED SAND with SILT and GRAVEL (SP-SM)
✖	PV-4	9.0	45	18	27	57.9	SANDY LEAN CLAY (CL)

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
●	PV-5	7.5-5'	33	16	17	32.0	CLAYEY SAND with GRAVEL (SC)
⊠	PV-6	8"-5'	26	16	10	41.1	CLAYEY SAND with GRAVEL (SC)
▲	PV-6	1.0	NP	NP	NP	30.0	SILTY SAND with GRAVEL (SM)
★	PV-7	1"-5'	NP	NP	NP	32.3	SILTY SAND with GRAVEL (SM)
⊙	PV-7	10.0	44	14	30	59.8	SANDY LEAN CLAY (CL)
✿	PV-8	11"-5'	40	19	21	52.3	SANDY LEAN CLAY (CL)
○	PV-8	14.0	NP	NP	NP	8.2	WELL-GRADED SAND with SILT and GRAVEL (SW-SM)
△	PV-9	11"-5'	37	19	18	43.4	CLAYEY SAND (SC)
⊗	PV-10	12"-5'	43	16	27	68.9	SANDY LEAN CLAY (CL)
⊕	PV-11	13"-5'	37	15	22	50.7	SANDY LEAN CLAY (CL)
□	PV-12	6"-5'	NP	NP	NP	21.7	SILTY SAND with GRAVEL (SM)
⊛	PV-12	9.0	NP	NP	NP	3.1	WELL-GRADED SAND (SW)
◒	PV-13	13"-5'	40	18	22	55.6	SANDY LEAN CLAY (CL)
☆	PV-14	16"-5'	38	18	20	62.5	SANDY LEAN CLAY (CL)
⊠	PV-15	17.5"-5'	36	20	16	64.6	SANDY LEAN CLAY (CL)
■	PV-15	9.0	NP	NP	NP	6.6	POORLY GRADED SAND with SILT and GRAVEL (SP-SM)
◆	PV-16	9"-5'	33	17	16	4.6	POORLY GRADED SAND (SP)
◇	PV-17	15"-5'	25	16	9	39.6	CLAYEY SAND (SC)
×	PV-17	9.0	35	17	18	40.5	CLAYEY SAND (SC)
✖	PV-18	21"-5'	41	20	21	36.3	CLAYEY SAND with GRAVEL (SC)

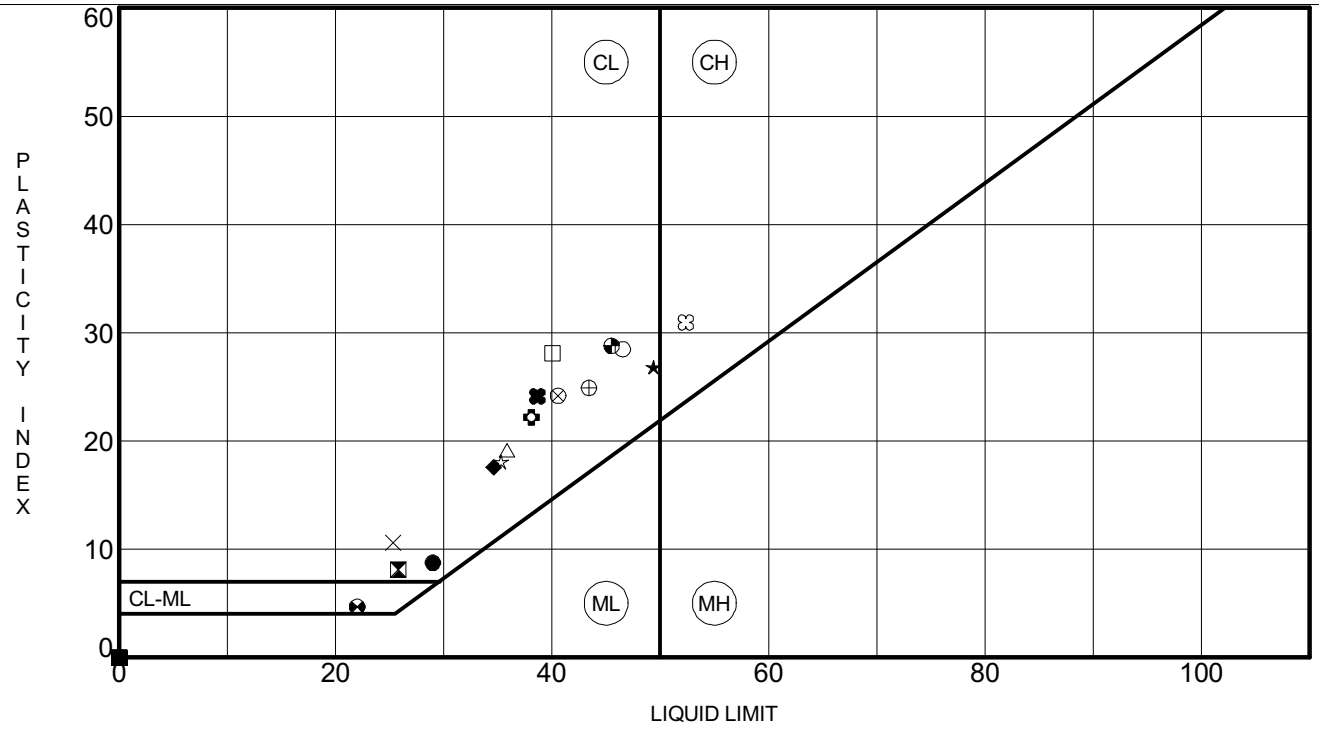
ATTERBERG LIMITS - STANDARD 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 9/21/12

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



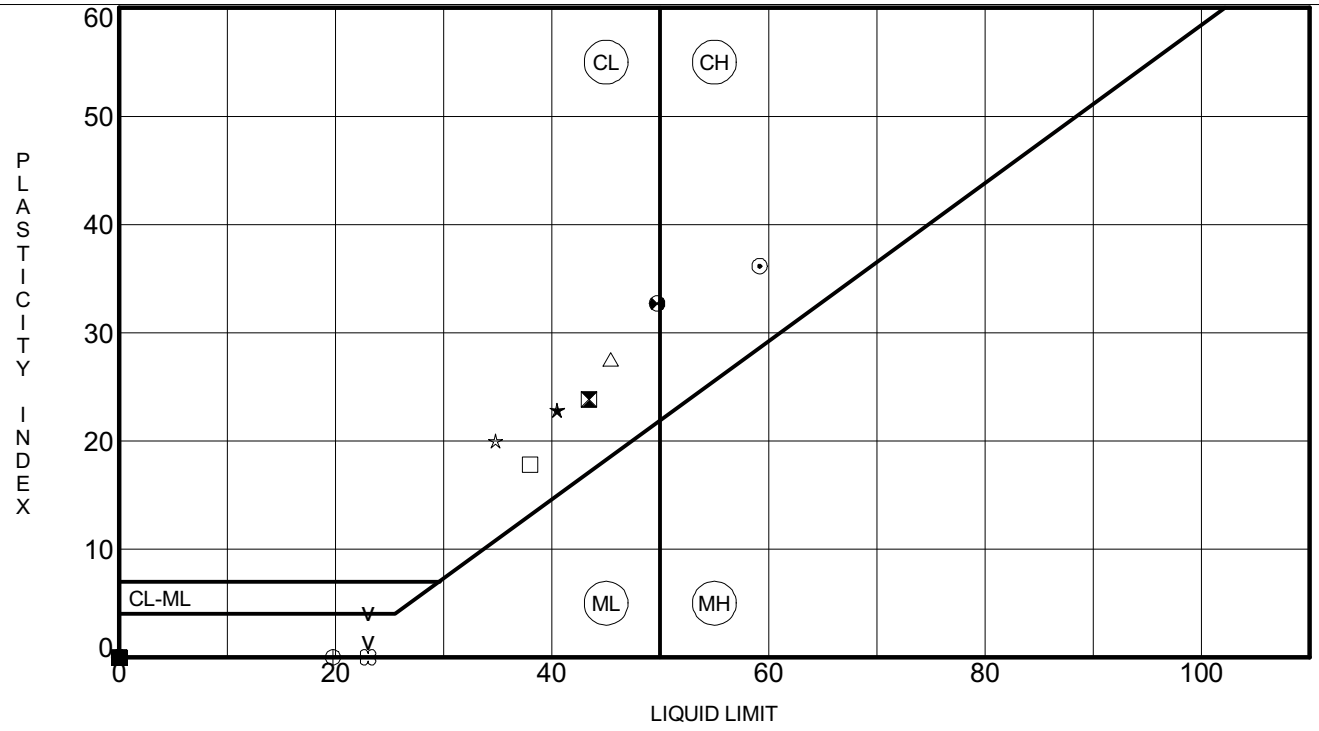
	Specimen Identification		LL	PL	PI	Fines	Classification
●	PV-19	0-5'	29	20	9	34.4	CLAYEY SAND (SC)
⊠	PV-20	0-5'	26	18	8	31.1	CLAYEY SAND with GRAVEL (SC)
▲	PV-21	6"-5'	NP	NP	NP	45.3	SILTY SAND (SM)
★	PV-21	1.0	49	23	26	49.1	CLAYEY SAND (SC)
⊙	PV-21	4.0	NP	NP	NP	14.4	SILTY GRAVEL with SAND (GM)
✿	PV-22	16"-5'	38	16	22	39.4	CLAYEY SAND (SC)
○	PV-23	14"-5'	47	18	29	69.2	SANDY LEAN CLAY (CL)
△	PV-23	4.0	36	17	19		CLAY with SAND
⊗	PV-24	13"-5'	41	16	25	62.5	SANDY LEAN CLAY (CL)
⊕	PV-25	14"-5'	43	19	24	71.5	LEAN CLAY with SAND (CL)
□	PV-25	9.0	40	12	28	65.2	SANDY LEAN CLAY (CL)
⊛	RW 1-1	6"-5'	22	17	5	29.4	SILTY, CLAYEY SAND with GRAVEL (SC-SM)
◒	RW 1-1	9.0	46	17	29	71.7	LEAN CLAY with SAND (CL)
☆	RW 2-1	0-5'	35	17	18	33.2	CLAYEY SAND with GRAVEL (SC)
⊠	RW 2-1	10.0	52	21	31	73.5	FAT CLAY with SAND (CH)
■	RW 2-1	20.0	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	14.0	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	2.0	39	15	24	32.2	CLAYEY SAND (SC)

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 4-1	8"-5'	NP	NP	NP	17.3	SILTY SAND with GRAVEL (SM)
⊠	RW 4-1	9.0	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	9.0	40	18	22	57.3	SANDY LEAN CLAY (CL)
⊙	RW 4-2	14.0	59	23	36	77.7	FAT CLAY with SAND (CH)
✿	RW 4-2	19.0	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	9.0	45	18	27	60.8	SANDY LEAN CLAY (CL)
⊗	RW 4-3	14.0	NP	NP	NP	3.6	POORLY GRADED SAND with GRAVEL (SP)
⊕	RW 5-2	1'-5'	20	20	NP	14.3	SILTY SAND with GRAVEL (SM)
□	RW 5-2	9.0	38	20	18	70.3	LEAN CLAY with SAND (CL)
❀	RW 5-2	19.0	50	17	33	71.0	FAT CLAY with SAND (CH)
◕	RW 5-2	29.0	NP	NP	NP	6.6	POORLY GRADED SAND with SILT and GRAVEL (SP-SM)
☆	RW 7-1	6"-5'	35	15	20	42.0	CLAYEY SAND (SC)
⊠	RW 7-1	9.0	23	25	NP	54.1	SANDY SILT (ML)
■	RW 7-1	24.0	NP	NP	NP	4.0	WELL-GRADED SAND (SW)

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GRAIN SIZE DISTRIBUTION

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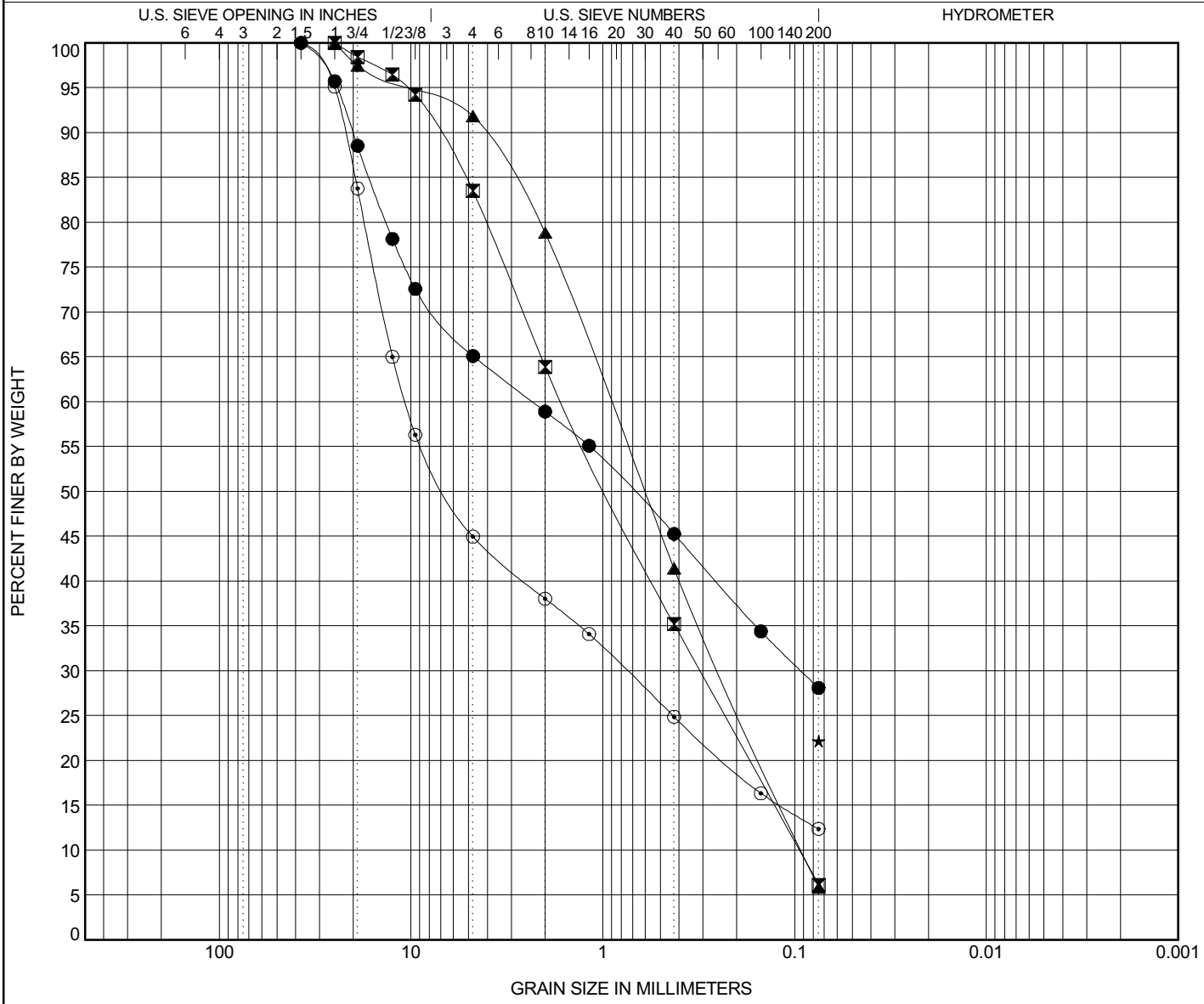
PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification			Classification	LL	PL	PI	Cc	Cu
●	BR- 2	10"-5'	CLAYEY SAND with GRAVEL (SC)	27	15	12		
⊠	BR- 2	34.0	POORLY GRADED SAND with SILT and GRAVEL (SP-SM)	NP	NP	NP	0.63	17.17
▲	BR- 2	44.0	POORLY GRADED SAND with SILT (SP-SM)	NP	NP	NP	0.70	9.99
★	BR- 2	54.0	CLAYEY SAND (SC)	30	18	12		
⊙	BR- 5	14"-5'	SILTY GRAVEL with SAND (GM)	22	22	NP	1.06	215.45

Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	BR- 2	10"-5'	37.5	2.331	0.092		34.9	37.0	28.1	
⊠	BR- 2	34.0	25	1.622	0.312	0.094	16.5	77.4	6.1	
▲	BR- 2	44.0	25	0.917	0.244	0.092	8.2	86.0	5.9	
★	BR- 2	54.0	0.075						22.2	
⊙	BR- 5	14"-5'	37.5	10.675	0.75		55.0	32.6	12.4	

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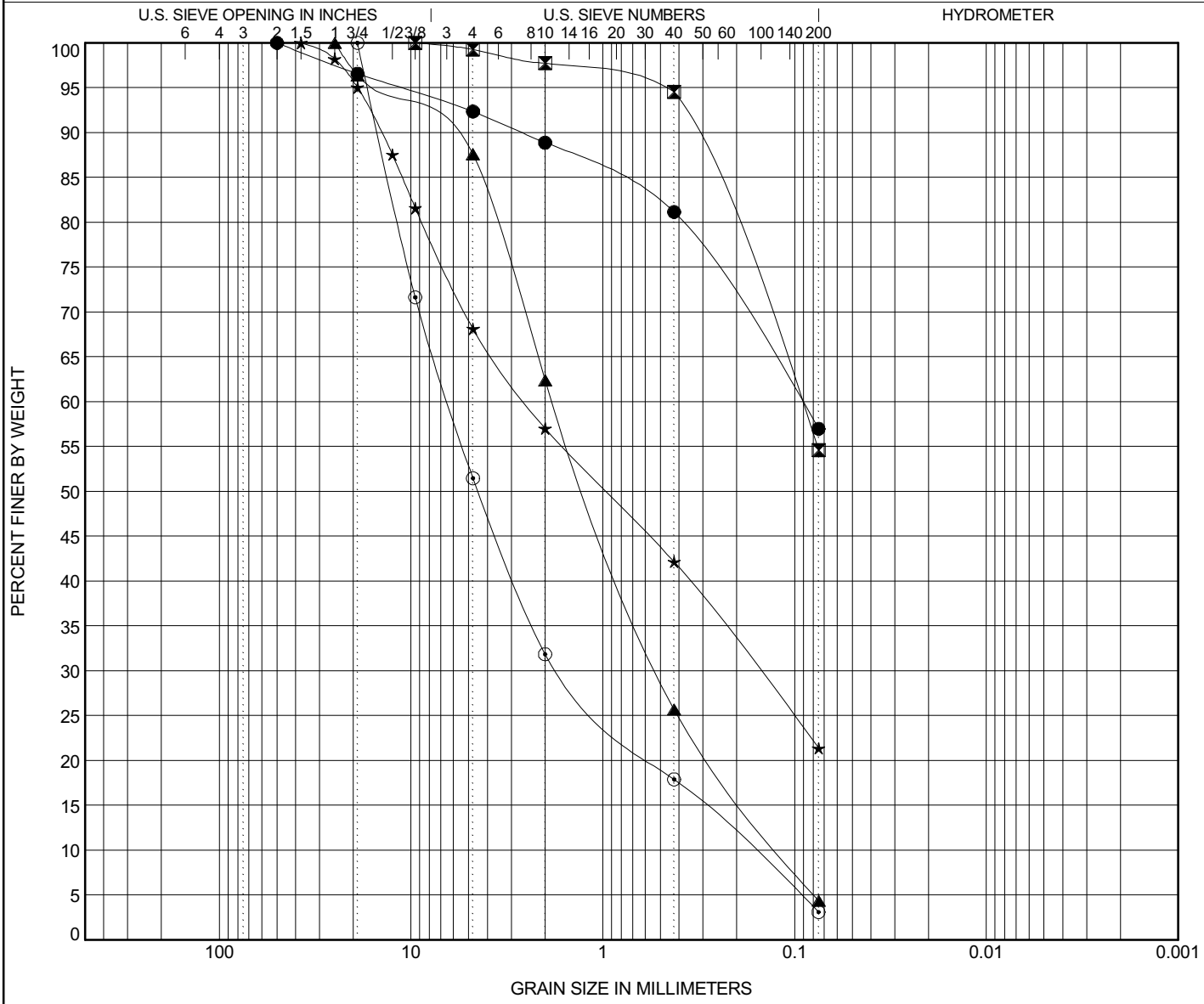

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification			Classification	LL	PL	PI	Cc	Cu
●	BR- 5	10.0	SANDY LEAN CLAY (CL)	42	18	24		
⊠	BR- 5	20.0	SANDY LEAN CLAY (CL)	32	20	12		
▲	BR- 5	40.0	WELL-GRADED SAND (SW)	NP	NP	NP	1.21	15.23
★	BR- 6	0-5'	SILTY SAND with GRAVEL (SM)	20	18	2		
⊙	BR- 6	5.0	WELL-GRADED GRAVEL with SAND (GW)	NP	NP	NP	2.48	37.83

Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	BR- 5	10.0	50	0.093			7.6	35.4	57.0	
⊠	BR- 5	20.0	9.5	0.095			0.7	44.7	54.6	
▲	BR- 5	40.0	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	
⊙	BR- 6	5.0	19	6.369	1.629	0.168	48.5	48.4	3.1	

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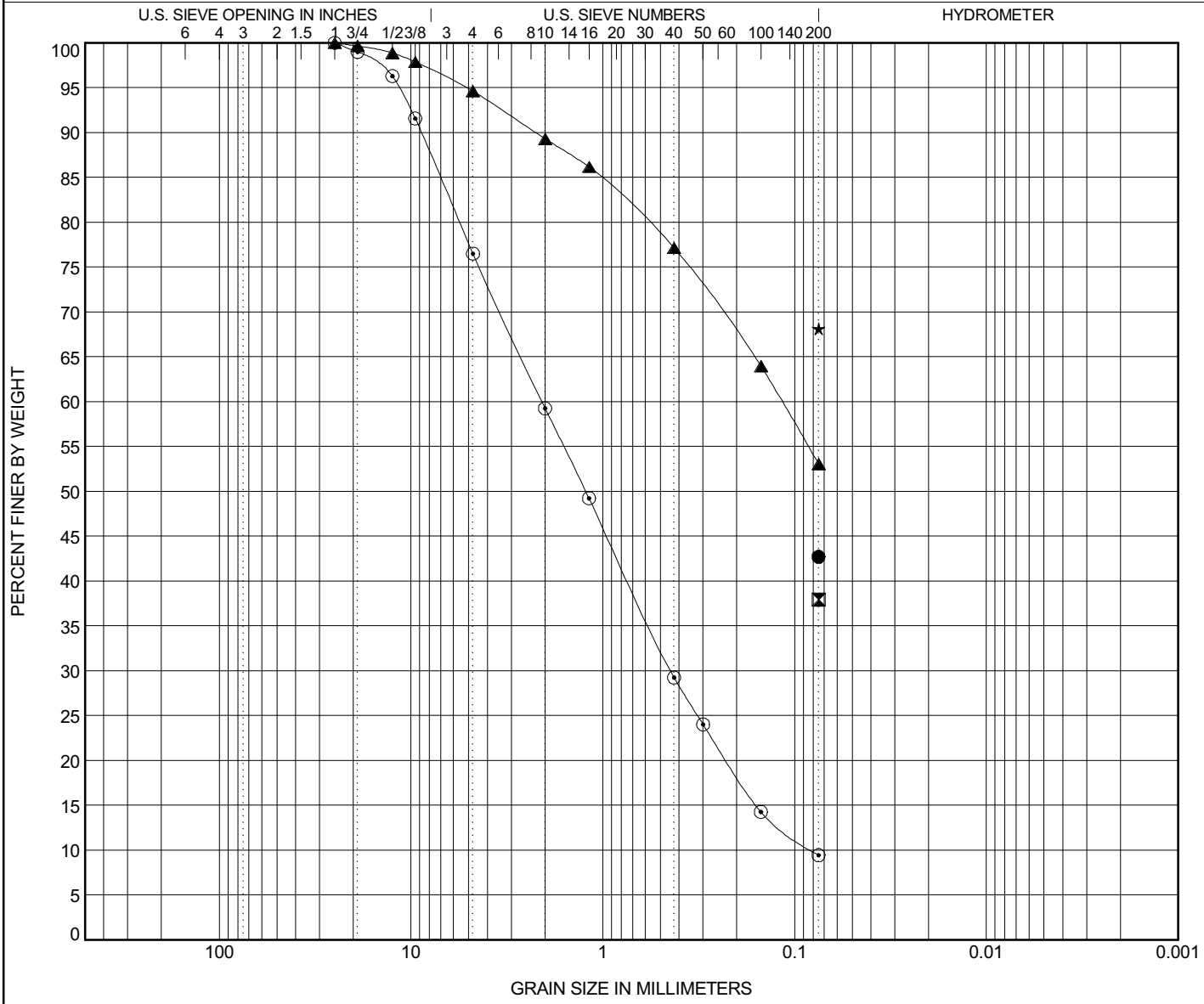

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification			Classification	LL	PL	PI	Cc	Cu
●	BR- 6	35.0	(Bedrock) SANSTONE, clayey (SC)	36	21	15		
⧓	BR- 6	40.0	(Bedrock) SANDSTONE, silty (SM)	24	22	2		
▲	BR- 8	9"-10'	SANDY LEAN CLAY (CL)	38	15	23		
★	BR- 8	2.0	(Fill) SANDY LEAN CLAY (CL)	25	15	10		
⊙	BR- 12	13"-5'	WELL-GRADED SAND with SILT and GRAVEL (SW-SM)	NP	NP	NP	1.16	25.53

Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	BR- 6	35.0	0.075						42.7	
⧓	BR- 6	40.0	0.075						38.0	
▲	BR- 8	9"-10'	25	0.116			5.4	41.5	53.1	
★	BR- 8	2.0	0.075						68.1	
⊙	BR- 12	13"-5'	25	2.076	0.442	0.081	23.5	67.1	9.4	

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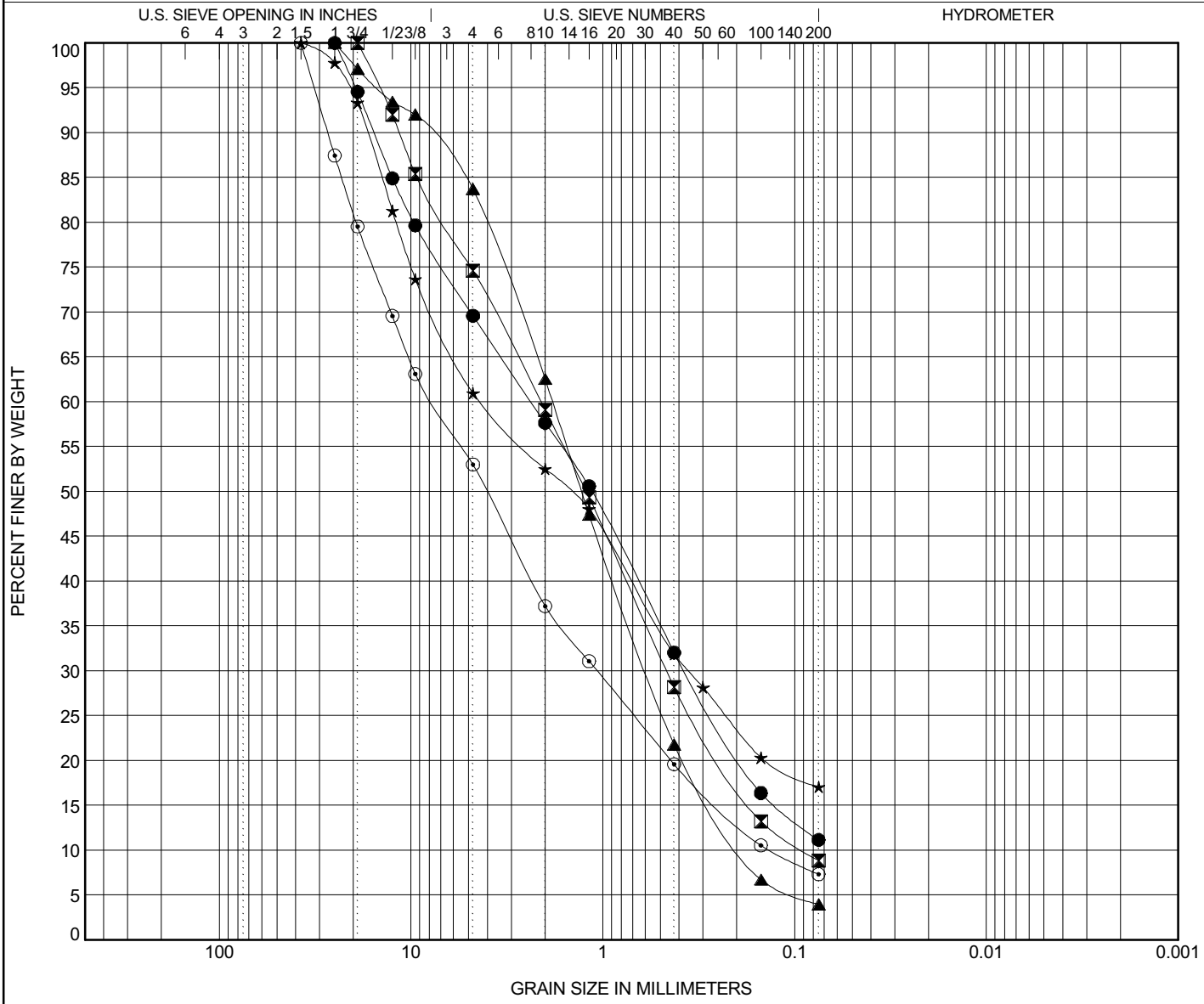

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	BR- 12	1.0	POORLY GRADED SAND with SILT and GRAVEL (SP-SM)	NP	NP	NP	0.90	36.85
⊠	BR- 12	9.0	WELL-GRADED SAND with SILT and GRAVEL (SW-SM)	NP	NP	NP	1.14	23.37
▲	BR- 12	19.0	WELL-GRADED SAND with GRAVEL (SW)	NP	NP	NP	1.01	9.73
★	BR- 15	8.5"-5'	SILTY SAND with GRAVEL (SM)	NP	NP	NP		
⊙	BR- 15	1.0	WELL-GRADED GRAVEL with SILT and SAND (GW-GM)	NP	NP	NP	1.12	57.47

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	BR- 12	1.0	25	2.373	0.371		30.4	58.4	11.2	
⊠	BR- 12	9.0	19	2.106	0.464	0.09	25.4	65.8	8.8	
▲	BR- 12	19.0	25	1.83	0.589	0.188	16.3	79.7	4.0	
★	BR- 15	8.5"-5'	37.5	4.303	0.356		39.0	43.9	17.1	
⊙	BR- 15	1.0	37.5	7.684	1.074	0.134	47.0	45.7	7.3	

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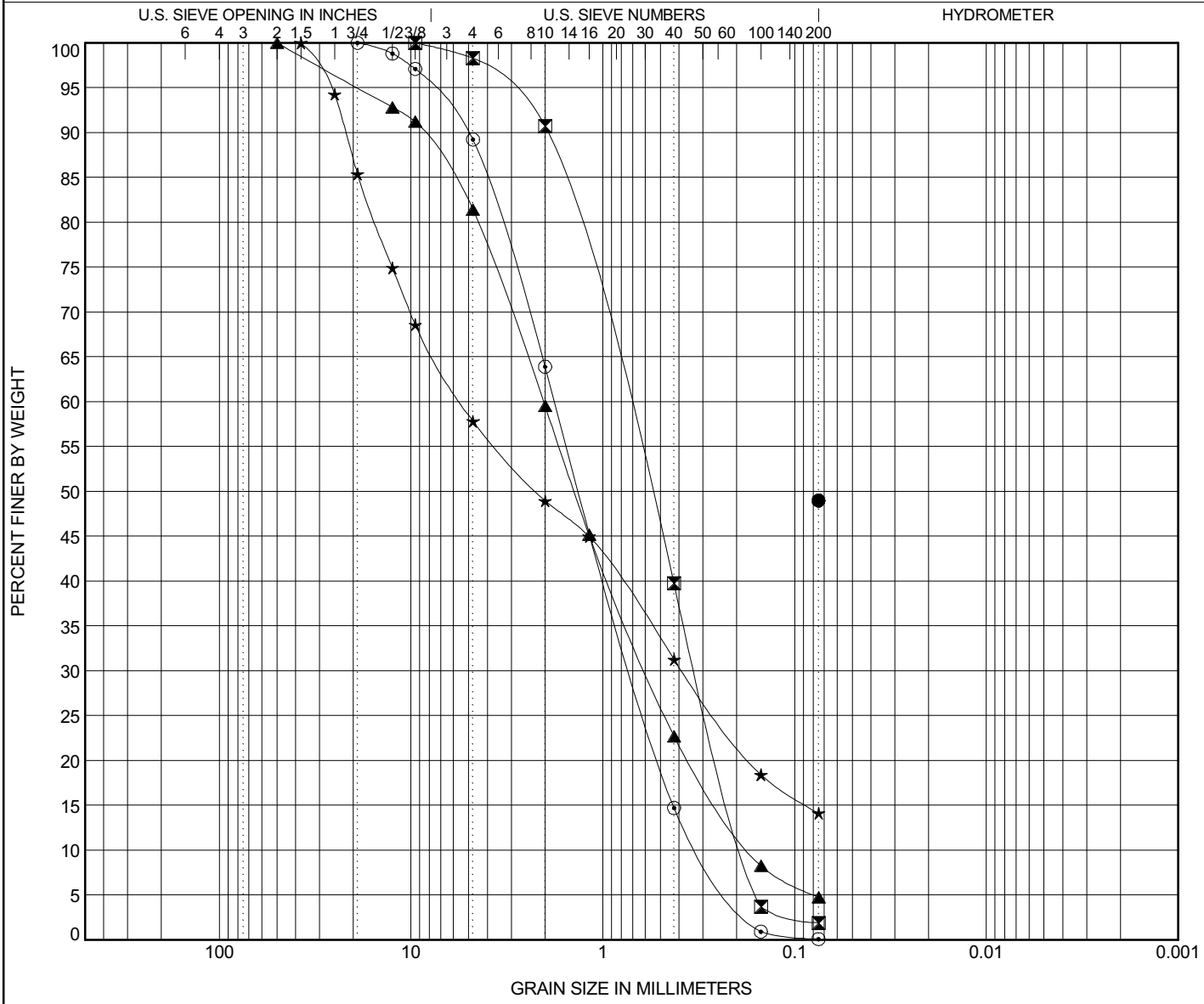

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	BR- 15	14.0	CLAYEY SAND (SC)	30	14	16		
⊠	BR- 15	25.0	POORLY GRADED SAND (SP)	NP	NP	NP	0.73	4.37
▲	BR- 15	34.0	WELL-GRADED SAND with GRAVEL (SW)	NP	NP	NP	1.01	11.99
★	BR- 16	8"-5'	CLAYEY SAND with GRAVEL (SC)	25	16	9		
⊙	BR- 16	25.0	POORLY GRADED SAND (SP)	NP	NP	NP	0.90	5.94

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	BR- 15	14.0	0.075						49.0	
⊠	BR- 15	25.0	9.5	0.786	0.321	0.18	1.7	96.4	1.9	
▲	BR- 15	34.0	50	2.038	0.592	0.17	18.6	76.7	4.8	
★	BR- 16	8"-5'	37.5	5.462	0.384		42.2	43.7	14.1	
⊙	BR- 16	25.0	19	1.769	0.688	0.298	10.8	89.1	0.1	

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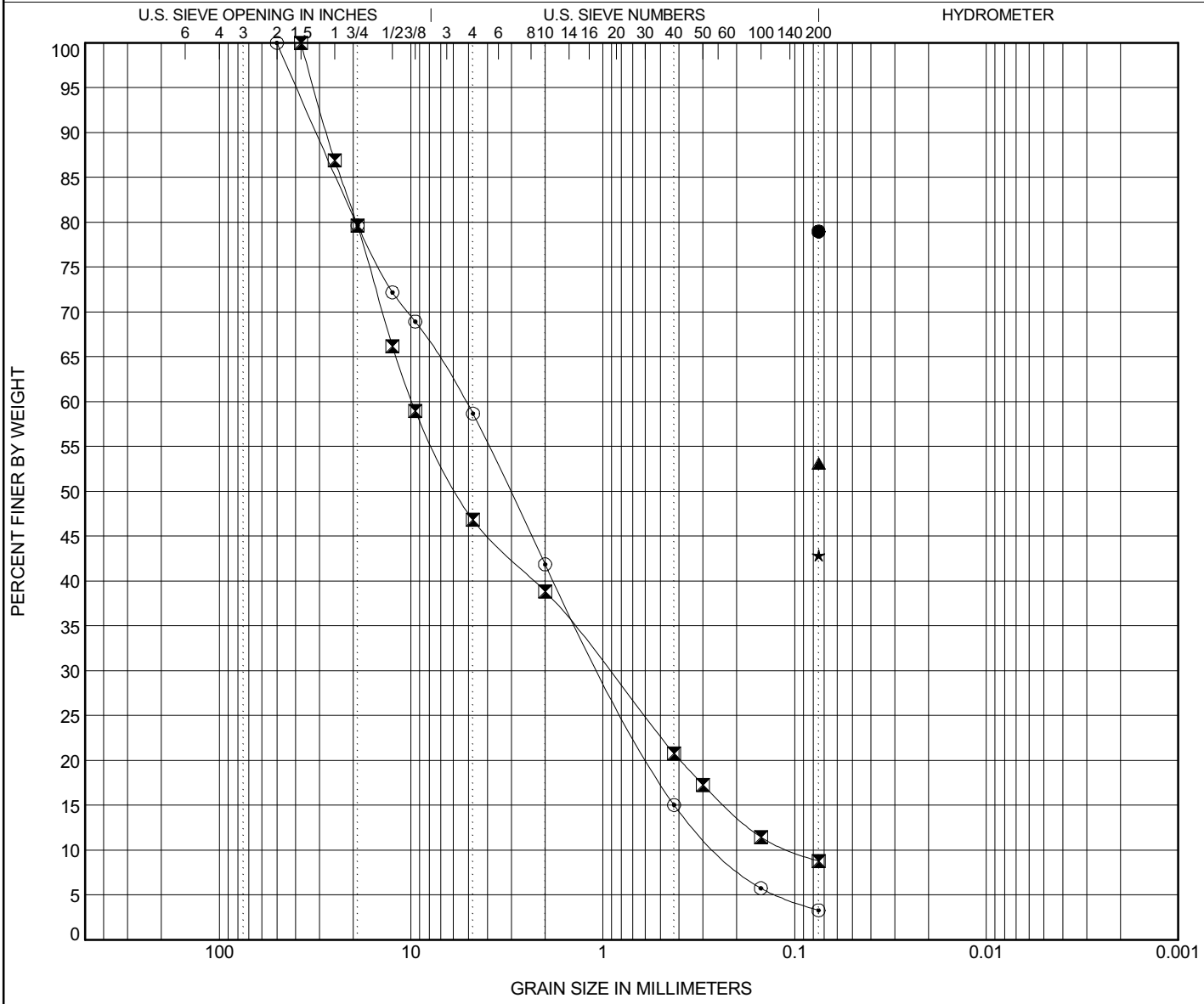

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	BR- 16	50.0	(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	5.0	SANDY LEAN CLAY (CL)	37	15	22		
★	BR- 17	15.0	CLAYEY SAND (SC)	27	15	12		
⊙	BR- 17	30.0	POORLY GRADED SAND with GRAVEL (SP)	NP	NP	NP	0.81	21.51

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	BR- 16	50.0	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	0.075						53.1	
★	BR- 17	15.0	0.075						42.9	
⊙	BR- 17	30.0	50	5.195	1.008	0.241	41.3	55.4	3.3	

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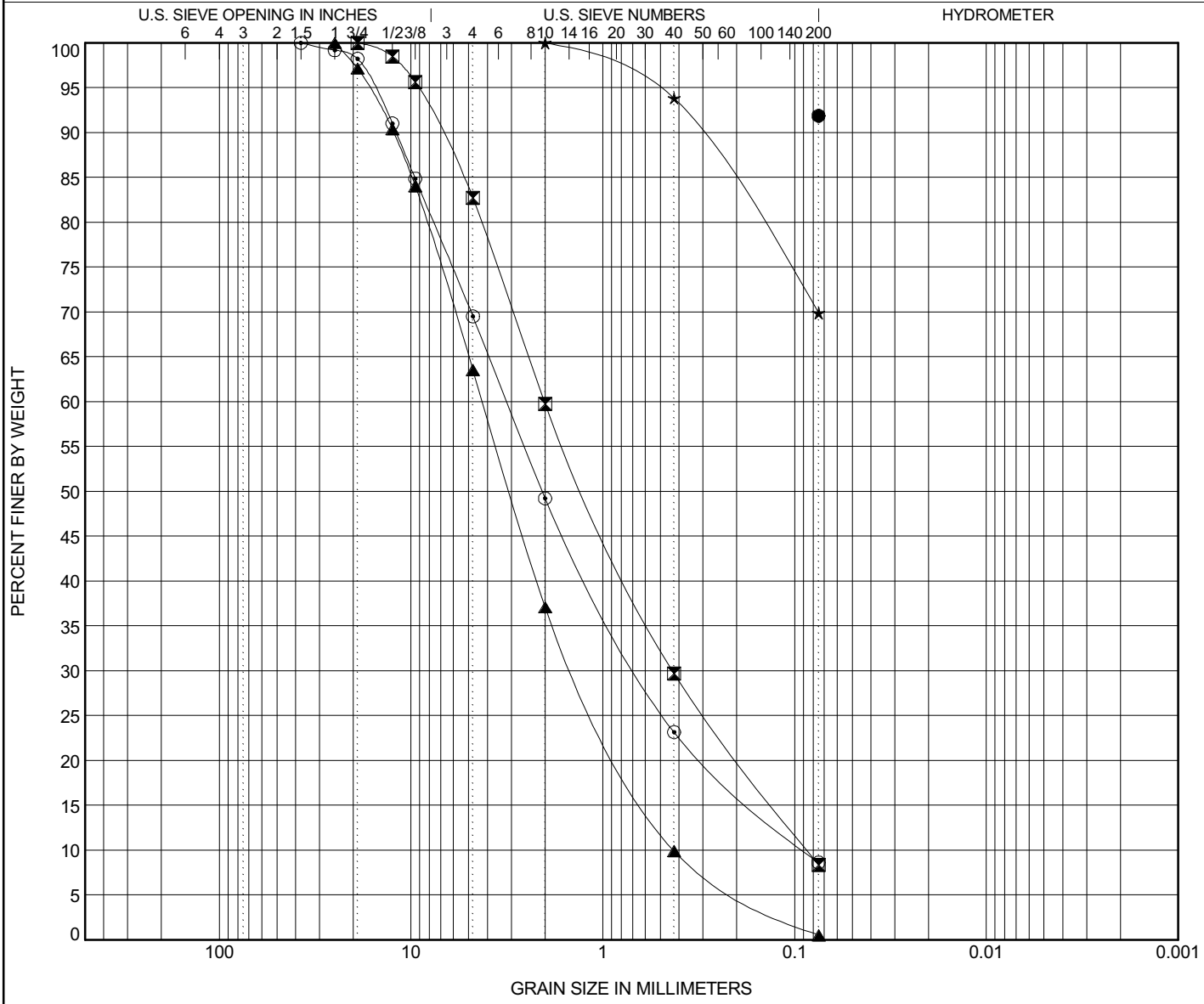

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification			Classification	LL	PL	PI	Cc	Cu
●	BR- 17	50.0	(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	9.0	POORLY GRADED SAND with GRAVEL (SP)	NP	NP	NP	0.99	9.90
★	BR- 18	34.0	(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

Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	BR- 17	50.0	0.075						91.9	
⊠	BR- 18	16"-5'	19	2.018	0.432	0.086	17.3	74.3	8.4	
▲	BR- 18	9.0	25	4.231	1.336	0.427	36.5	63.0	0.5	
★	BR- 18	34.0	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	

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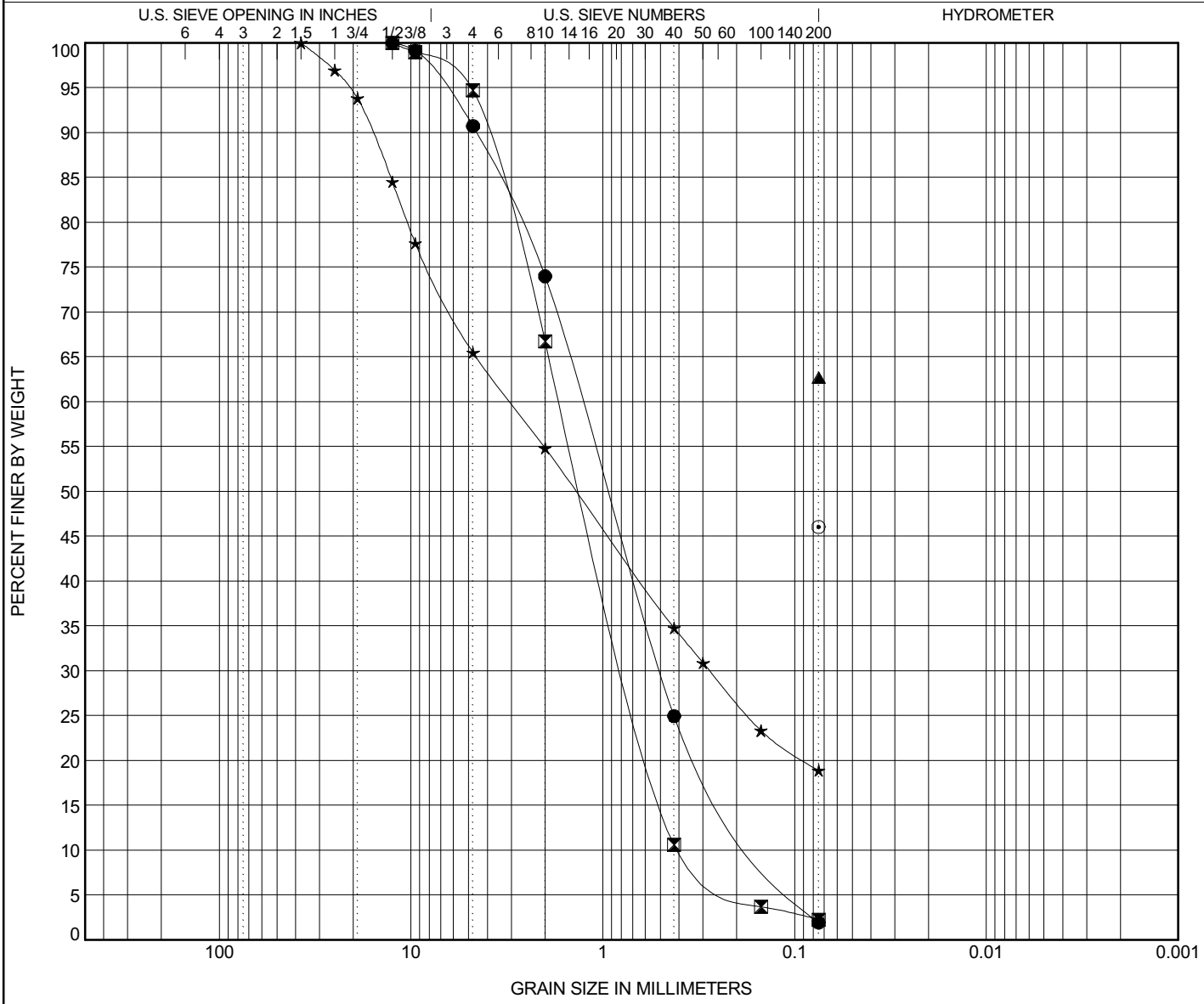

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	BR- 19	5.0	WELL-GRADED SAND (SW)	NP	NP	NP	1.40	9.33
⊠	BR- 19	15.0	POORLY GRADED SAND (SP)	NP	NP	NP	0.82	4.28
▲	BR- 19	29.0	(Bedrock) CLAYSTONE (CL)	41	19	22		
★	BR- 20	8"-5'	SILTY SAND with GRAVEL (SM)	NP	NP	NP		
⊙	BR- 20	15.0	CLAYEY SAND (SC)	29	13	16		

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	BR- 19	5.0	12.5	1.286	0.498	0.138	9.3	88.8	1.9	
⊠	BR- 19	15.0	12.5	1.662	0.726	0.388	5.2	92.5	2.3	
▲	BR- 19	29.0	0.075						62.7	
★	BR- 20	8"-5'	37.5	3.045	0.277		34.5	46.6	18.9	
⊙	BR- 20	15.0	0.075						46.0	

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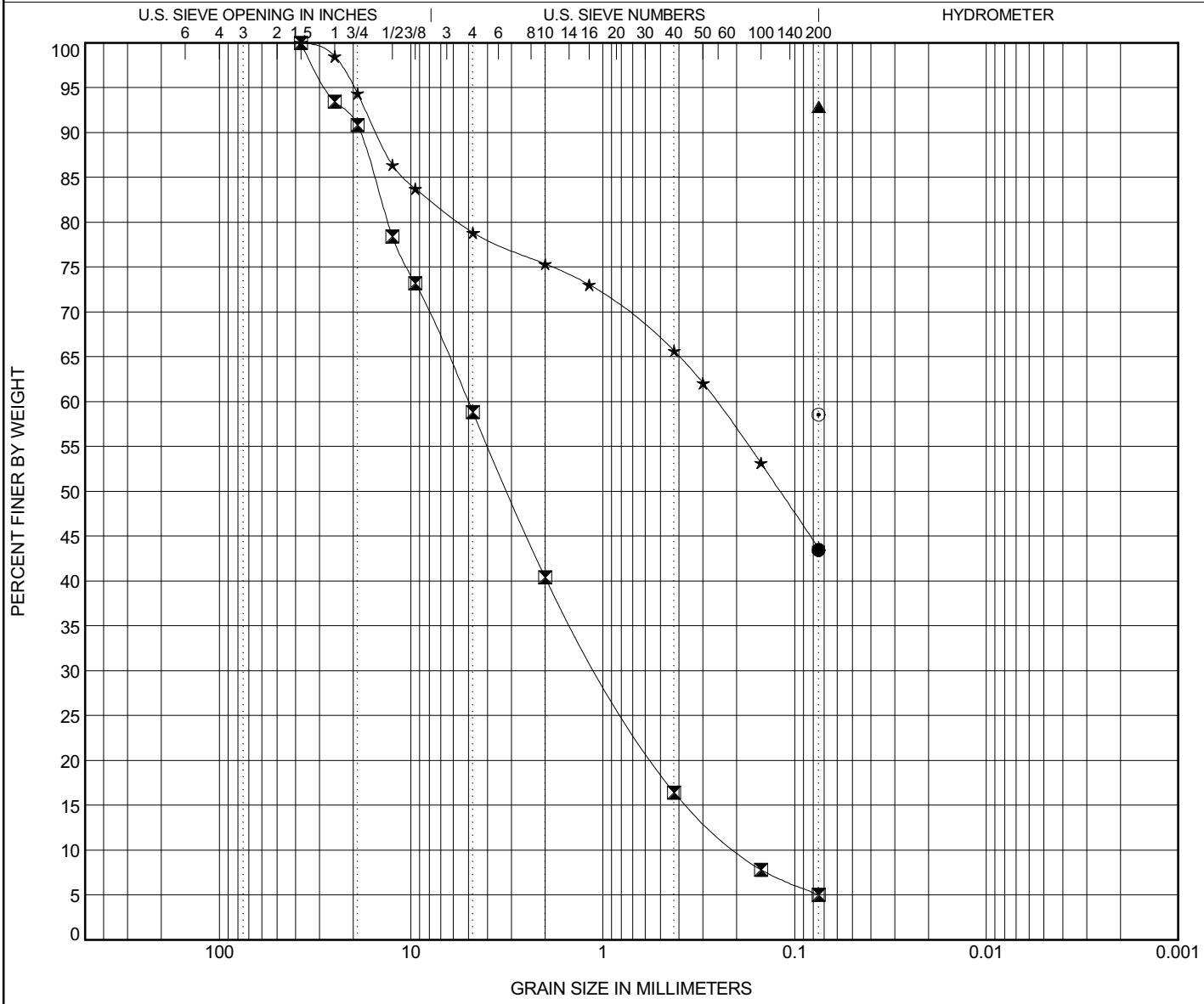

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	BR- 20	25.0	CLAYEY SAND (SC)	29	14	15		
⊠	BR- 20	35.0	WELL-GRADED SAND with SILT and GRAVEL (SW-SM)	NP	NP	NP	1.06	25.79
▲	BR- 20	50.0	(Bedrock) CLAYSTONE (CH)	50	22	28		
★	BR- 21	7"-5'	CLAYEY SAND with GRAVEL (SC)	30	15	15		
⊙	BR- 21	20.0	SANDY LEAN CLAY (CL)	42	15	27		

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	BR- 20	25.0	0.075						43.5	
⊠	BR- 20	35.0	37.5	5.028	1.021	0.195	41.2	53.8	5.1	
▲	BR- 20	50.0	0.075						92.9	
★	BR- 21	7"-5'	37.5	0.255			21.2	35.1	43.7	
⊙	BR- 21	20.0	0.075						58.6	

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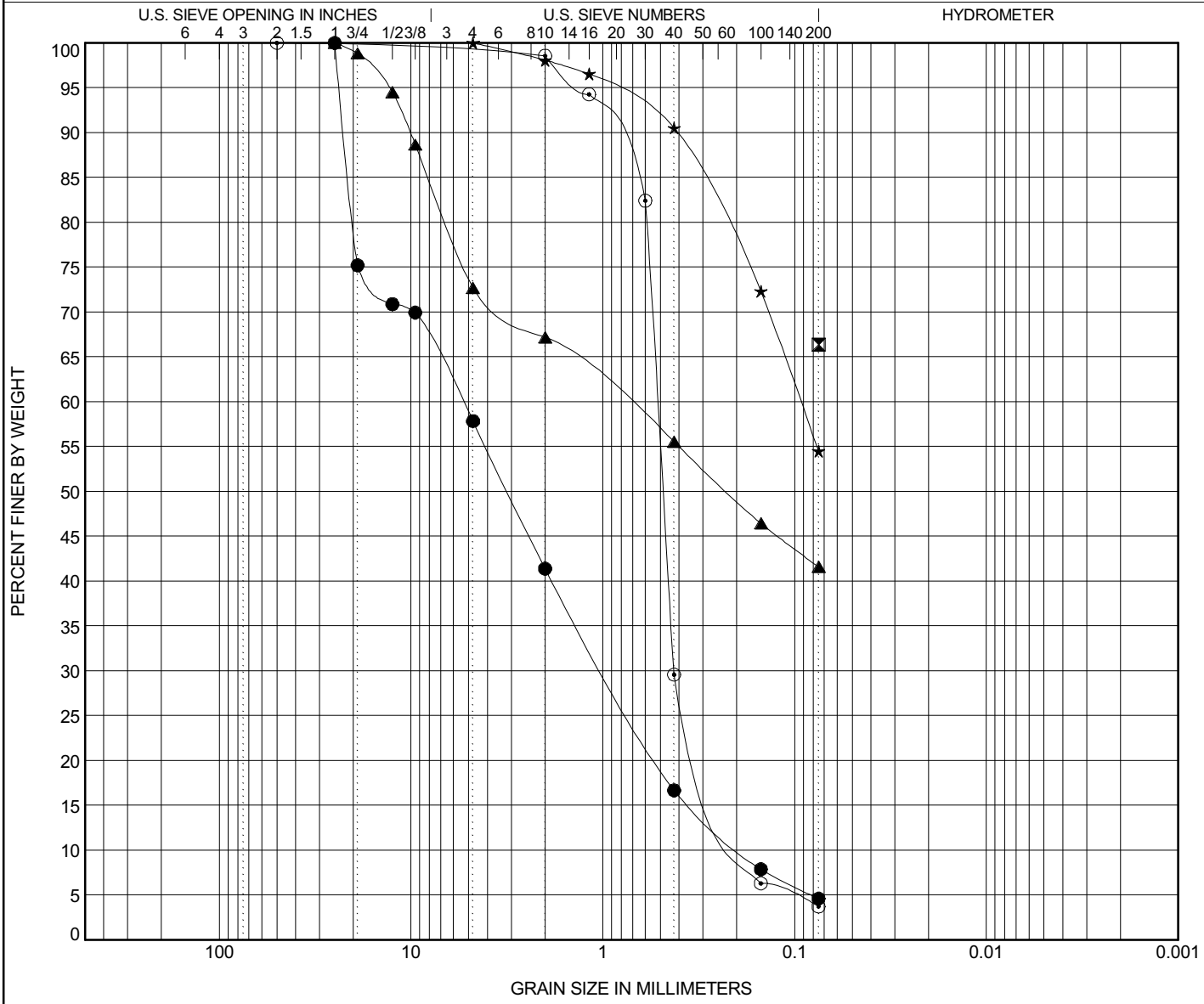

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	BR- 21	35.0	POORLY GRADED SAND with GRAVEL (SP)	NP	NP	NP	0.93	27.87
⊠	BR- 21	55.0	(Bedrock) SILTSTONE (ML)	38	25	13		
▲	BR- 22	8.5"-5'	SILTY SAND with GRAVEL (SM)	NP	NP	NP		
★	BR- 22	14.0	SANDY LEAN CLAY (CL)	31	16	15		
⊙	BR- 22	34.0	POORLY GRADED SAND (SP)	NP	NP	NP	1.98	2.93

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	BR- 21	35.0	25	5.375	0.98	0.193	42.2	53.2	4.6	
⊠	BR- 21	55.0	0.075						66.4	
▲	BR- 22	8.5"-5'	25	0.768			27.3	31.1	41.6	
★	BR- 22	14.0	4.75	0.093			0.0	45.5	54.5	
⊙	BR- 22	34.0	50	0.518	0.426	0.177	1.0	95.2	3.7	

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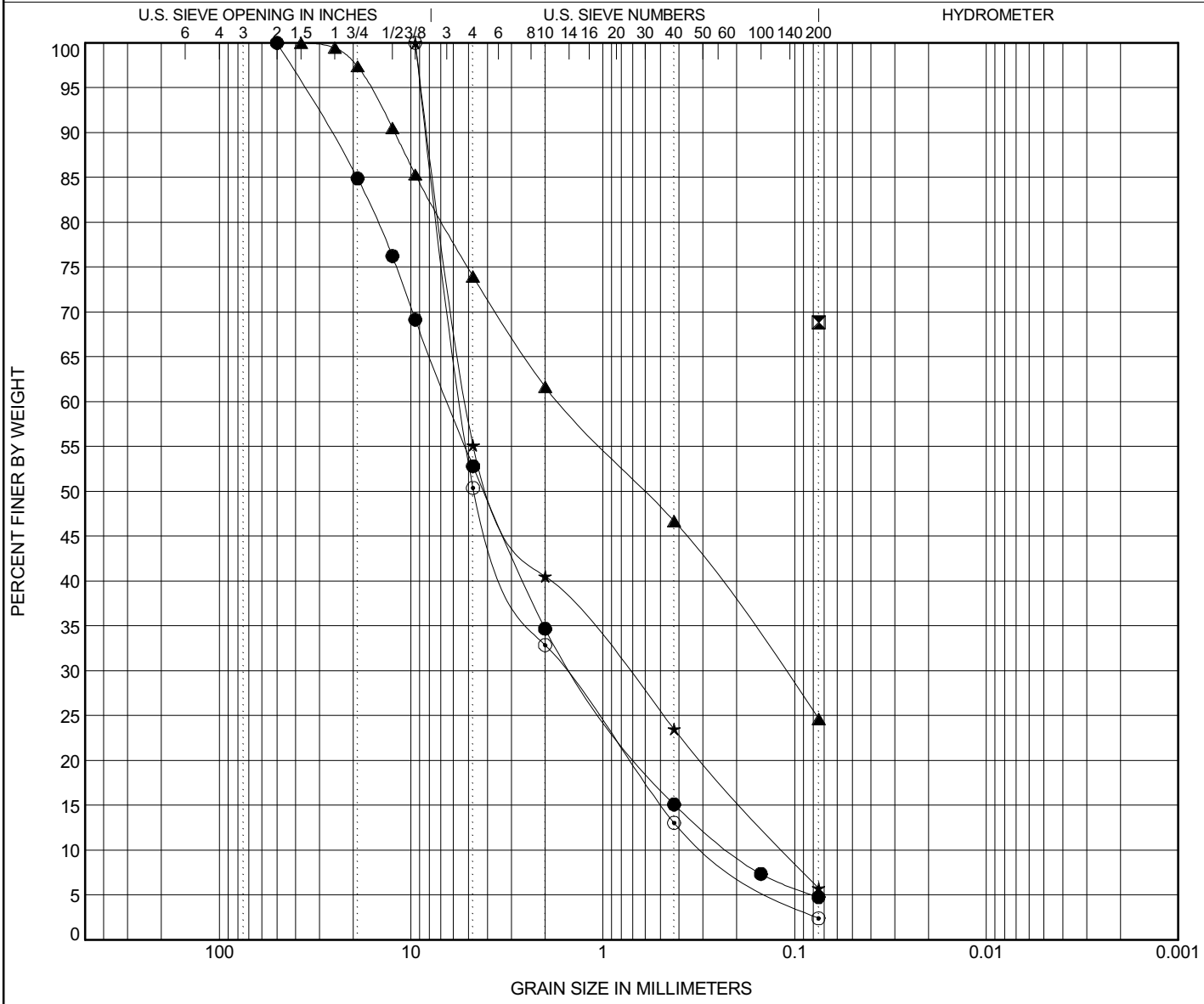

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	BR- 22	39.0	WELL-GRADED SAND with GRAVEL (SW)	NP	NP	NP	1.38	30.10
⧓	BR- 22	54.0	SANDY LEAN CLAY (CL)	40	22	18		
▲	PV-2	0-5'	SILTY SAND with GRAVEL (SM)	19	21	NP		
★	PV-2	2.0	WELL-GRADED SAND with SILT and GRAVEL (SW-SM)	NP	NP	NP	1.01	45.14
⊙	PV-2	4.0	WELL-GRADED GRAVEL with SAND (GW)	NP	NP	NP	1.82	21.00

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	BR- 22	39.0	50	6.443	1.38	0.214	47.2	48.0	4.8	
⧓	BR- 22	54.0	0.075						68.8	
▲	PV-2	0-5'	37.5	1.683	0.114		26.0	49.4	24.6	
★	PV-2	2.0	9.5	5.12	0.767	0.113	44.9	49.4	5.8	
⊙	PV-2	4.0	9.5	5.433	1.599	0.259	49.6	48.0	2.4	

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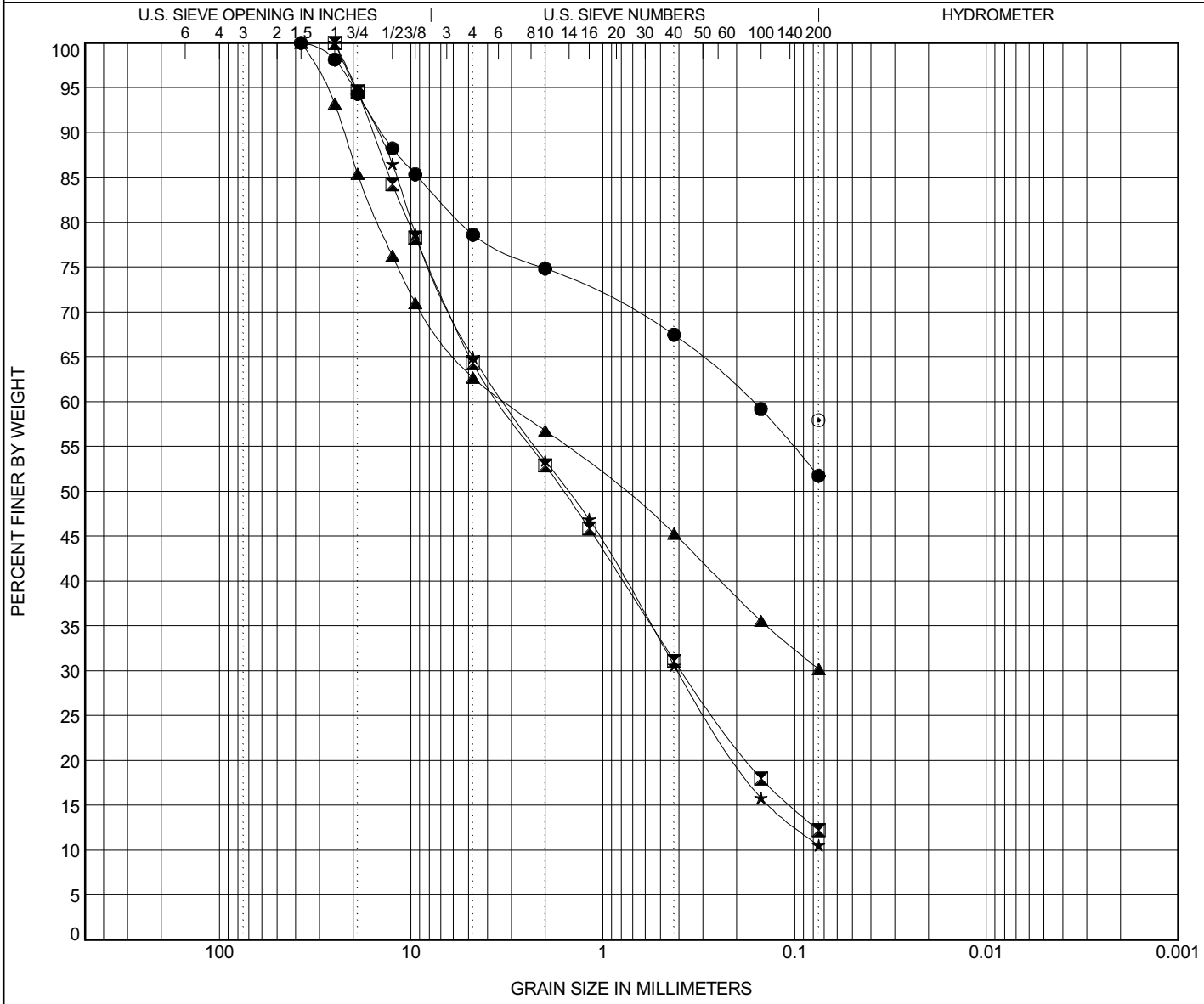
GRAIN SIZE DISTRIBUTION

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

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
●	PV-3	11.5"-5'	SANDY LEAN CLAY with GRAVEL (CL)	26	16	10		
⊠	PV-3	1.0	SILTY SAND with GRAVEL (SM)	NP	NP	NP	0.77	59.62
▲	PV-4	7.5"-5'	SILTY GRAVEL with SAND (GM)	NP	NP	NP		
★	PV-4	1.0	POORLY GRADED SAND with SILT and GRAVEL (SP-SM)	NP	NP	NP	0.73	46.85
⊙	PV-4	9.0	SANDY LEAN CLAY (CL)	45	18	27		

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	PV-3	11.5"-5'	37.5	0.166			21.4	26.9	51.7	
⊠	PV-3	1.0	25	3.43	0.389		35.7	52.1	12.2	
▲	PV-4	7.5"-5'	37.5	3.203			37.3	32.5	30.2	
★	PV-4	1.0	25	3.27	0.408		35.0	54.4	10.5	
⊙	PV-4	9.0	0.075						57.9	

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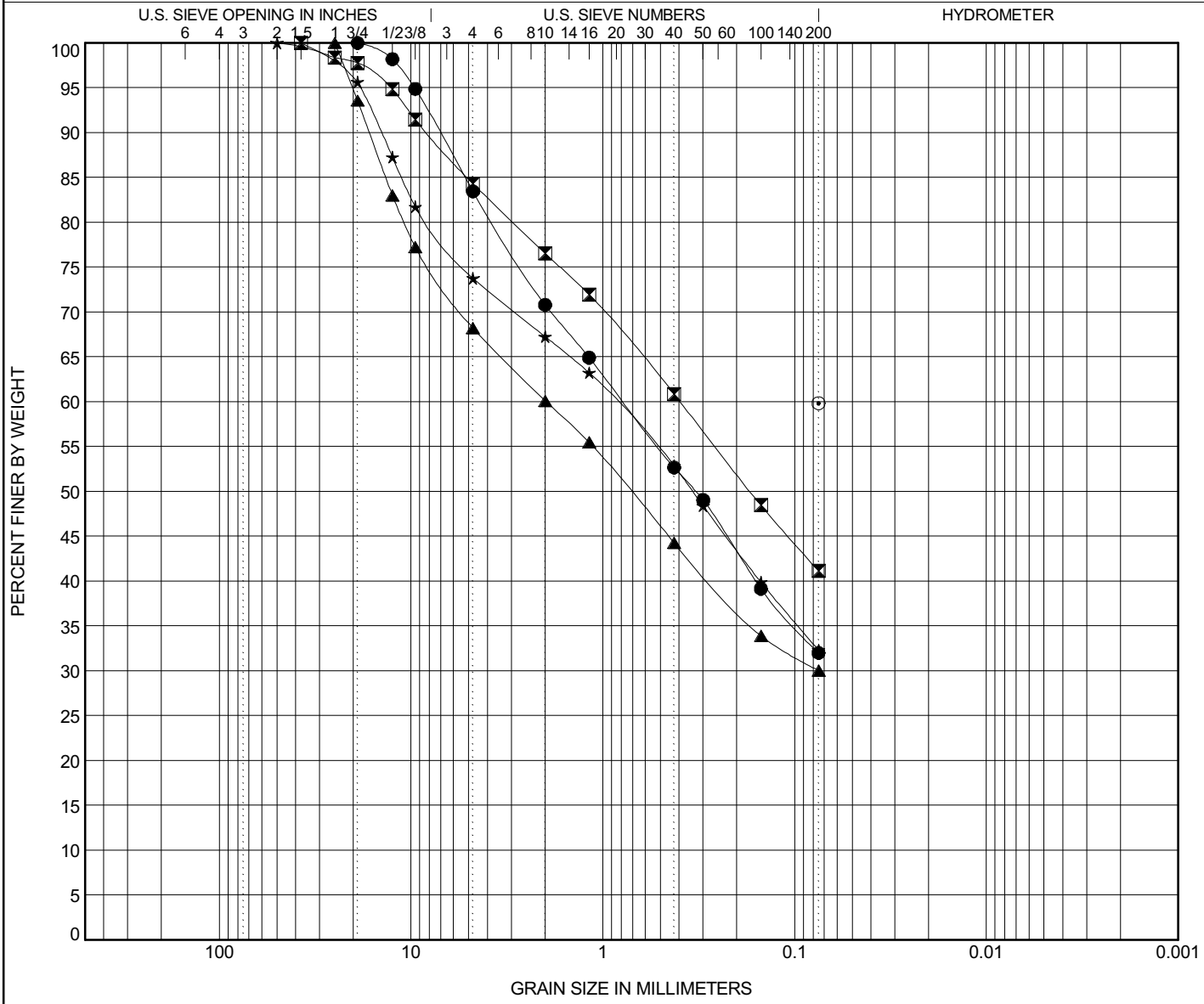

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification			Classification	LL	PL	PI	Cc	Cu
●	PV-5	7.5"-5'	CLAYEY SAND with GRAVEL (SC)	33	16	17		
⊠	PV-6	8"-5'	CLAYEY SAND with GRAVEL (SC)	26	16	10		
▲	PV-6	1.0	SILTY SAND with GRAVEL (SM)	NP	NP	NP		
★	PV-7	1"-5'	SILTY SAND with GRAVEL (SM)	NP	NP	NP		
⊙	PV-7	10.0	SANDY LEAN CLAY (CL)	44	14	30		

Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	PV-5	7.5"-5'	19	0.783			16.5	51.5	32.0	
⊠	PV-6	8"-5'	37.5	0.395			15.7	43.2	41.1	
▲	PV-6	1.0	25	1.974			31.8	38.2	30.0	
★	PV-7	1"-5'	50	0.858			26.2	41.5	32.3	
⊙	PV-7	10.0	0.075						59.8	

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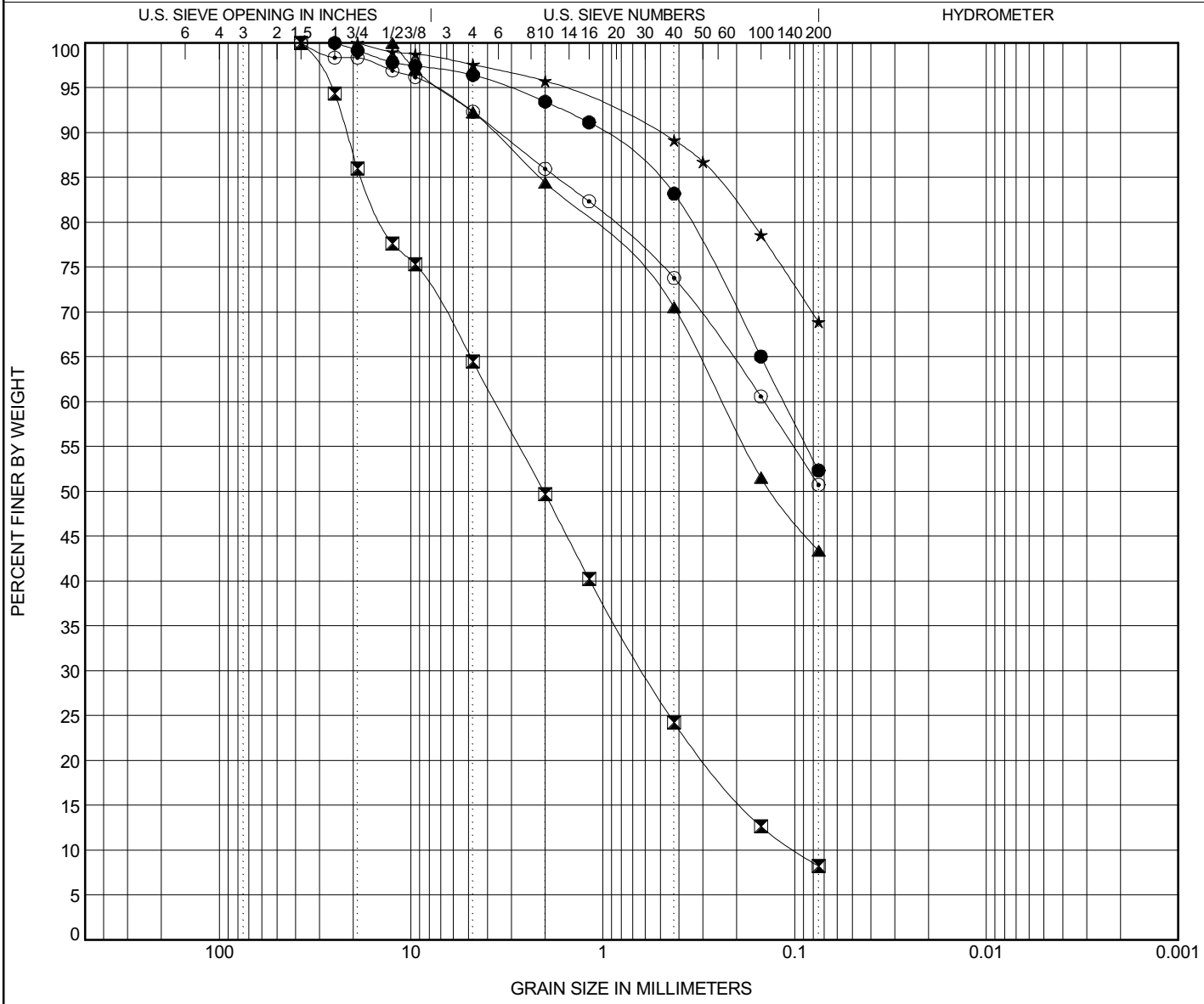

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification			Classification	LL	PL	PI	Cc	Cu
●	PV-8	11"-5'	SANDY LEAN CLAY (CL)	40	19	21		
⊠	PV-8	14.0	WELL-GRADED SAND with SILT and GRAVEL (SW-SM)	NP	NP	NP	1.04	36.82
▲	PV-9	11"-5'	CLAYEY SAND (SC)	37	19	18		
★	PV-10	12"-5'	SANDY LEAN CLAY (CL)	43	16	27		
⊙	PV-11	13"-5'	SANDY LEAN CLAY (CL)	37	15	22		

Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	PV-8	11"-5'	25	0.114			3.6	44.1	52.3	
⊠	PV-8	14.0	37.5	3.653	0.614	0.099	35.5	56.3	8.2	
▲	PV-9	11"-5'	12.5	0.239			7.7	48.9	43.4	
★	PV-10	12"-5'	19				2.4	28.7	68.9	
⊙	PV-11	13"-5'	37.5	0.144			7.7	41.6	50.7	

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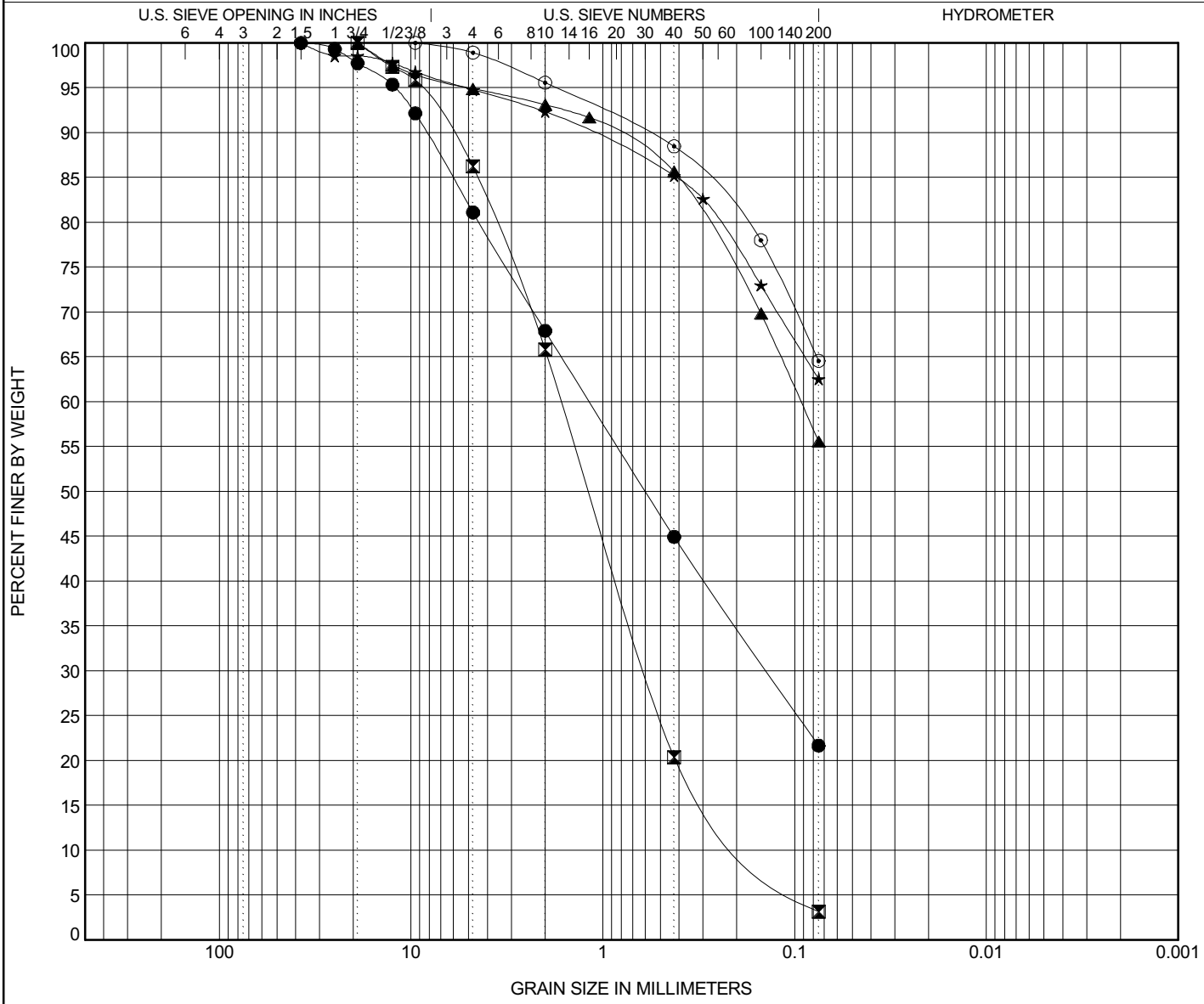

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification			Classification	LL	PL	PI	Cc	Cu
●	PV-12	6"-5'	SILTY SAND with GRAVEL (SM)	NP	NP	NP		
⊠	PV-12	9.0	WELL-GRADED SAND (SW)	NP	NP	NP	1.42	10.96
▲	PV-13	13"-5'	SANDY LEAN CLAY (CL)	40	18	22		
★	PV-14	16"-5'	SANDY LEAN CLAY (CL)	38	18	20		
⊙	PV-15	17.5"-5'	SANDY LEAN CLAY (CL)	36	20	16		

Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	PV-12	6"-5'	37.5	1.173	0.14		18.9	59.5	21.7	
⊠	PV-12	9.0	19	1.64	0.59	0.15	13.8	83.1	3.1	
▲	PV-13	13"-5'	19	0.093			5.1	39.3	55.6	
★	PV-14	16"-5'	37.5				5.2	32.2	62.5	
⊙	PV-15	17.5"-5'	9.5				1.1	34.4	64.6	

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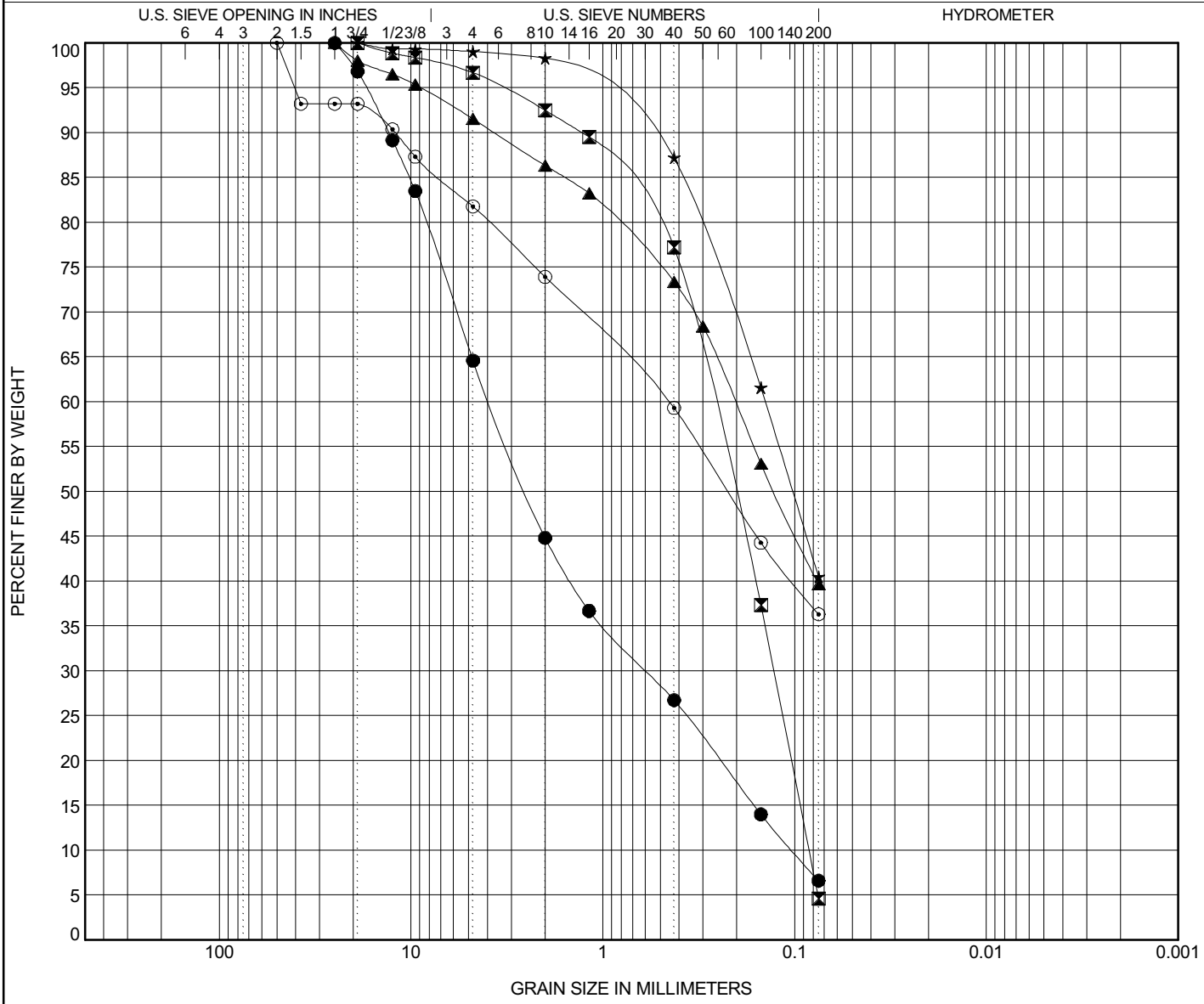

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification			Classification	LL	PL	PI	Cc	Cu
●	PV-15	9.0	POORLY GRADED SAND with SILT and GRAVEL (SP-SM)	NP	NP	NP	0.88	37.67
⊠	PV-16	9"-5'	POORLY GRADED SAND (SP)	33	17	16	0.72	3.23
▲	PV-17	15"-5'	CLAYEY SAND (SC)	25	16	9		
★	PV-17	9.0	CLAYEY SAND (SC)	35	17	18		
⊙	PV-18	21"-5'	CLAYEY SAND with GRAVEL (SC)	41	20	21		

Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	PV-15	9.0	25	3.887	0.594	0.103	35.4	58.0	6.6	
⊠	PV-16	9"-5'	19	0.271	0.128	0.084	3.3	92.1	4.6	
▲	PV-17	15"-5'	25	0.205			8.5	51.9	39.6	
★	PV-17	9.0	19	0.142			1.0	58.5	40.5	
⊙	PV-18	21"-5'	50	0.457			18.2	45.5	36.3	

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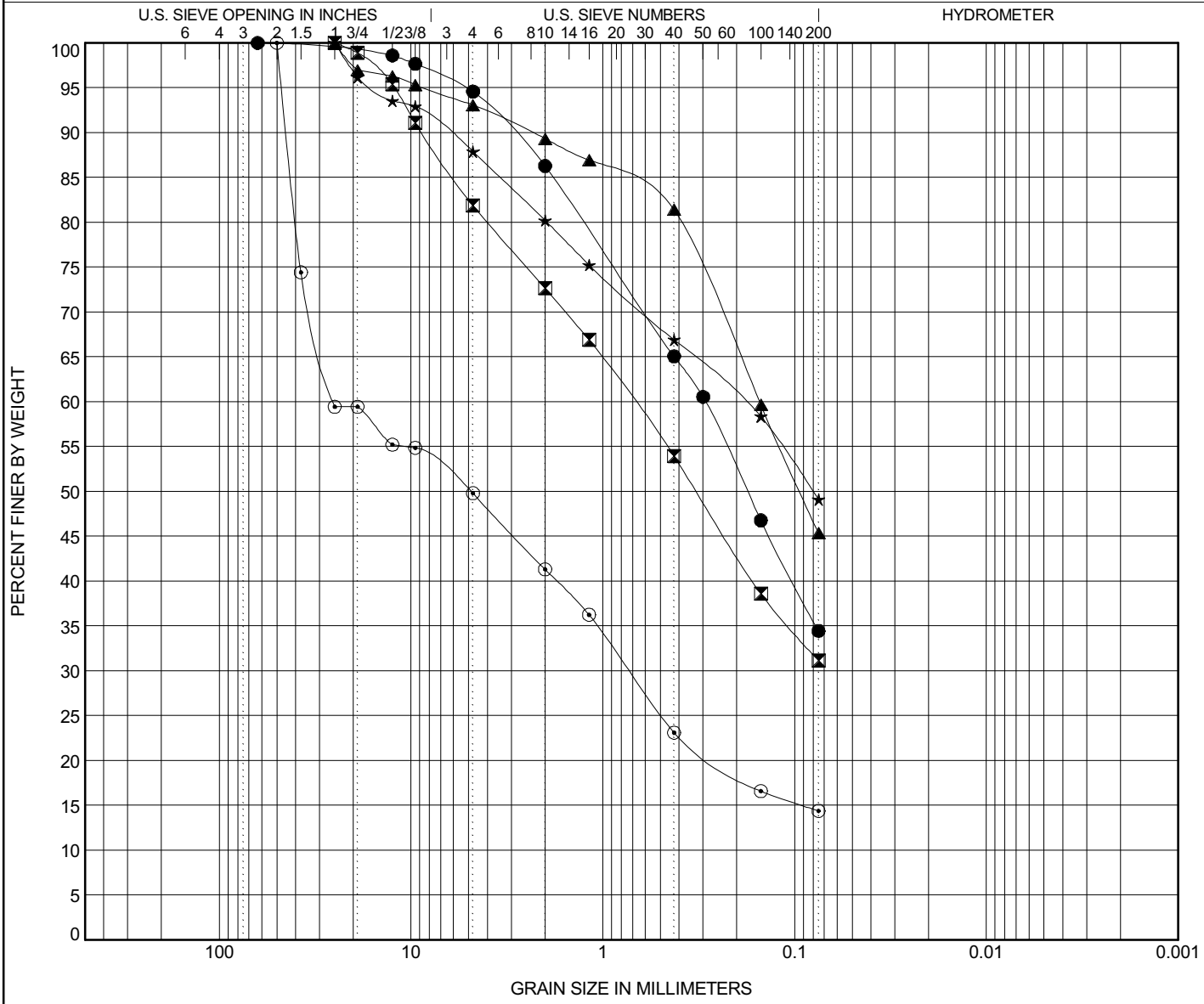

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification			Classification	LL	PL	PI	Cc	Cu
●	PV-19	0-5'	CLAYEY SAND (SC)	29	20	9		
⊠	PV-20	0-5'	CLAYEY SAND with GRAVEL (SC)	26	18	8		
▲	PV-21	6"-5'	SILTY SAND (SM)	NP	NP	NP		
★	PV-21	1.0	CLAYEY SAND (SC)	49	23	26		
⊙	PV-21	4.0	SILTY GRAVEL with SAND (GM)	NP	NP	NP		

Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	PV-19	0-5'	63	0.292			5.4	60.1	34.4	
⊠	PV-20	0-5'	25	0.686			18.1	50.8	31.1	
▲	PV-21	6"-5'	25	0.152			6.9	47.7	45.3	
★	PV-21	1.0	25	0.183			12.1	38.8	49.1	
⊙	PV-21	4.0	50	25.386	0.726		50.2	35.4	14.4	

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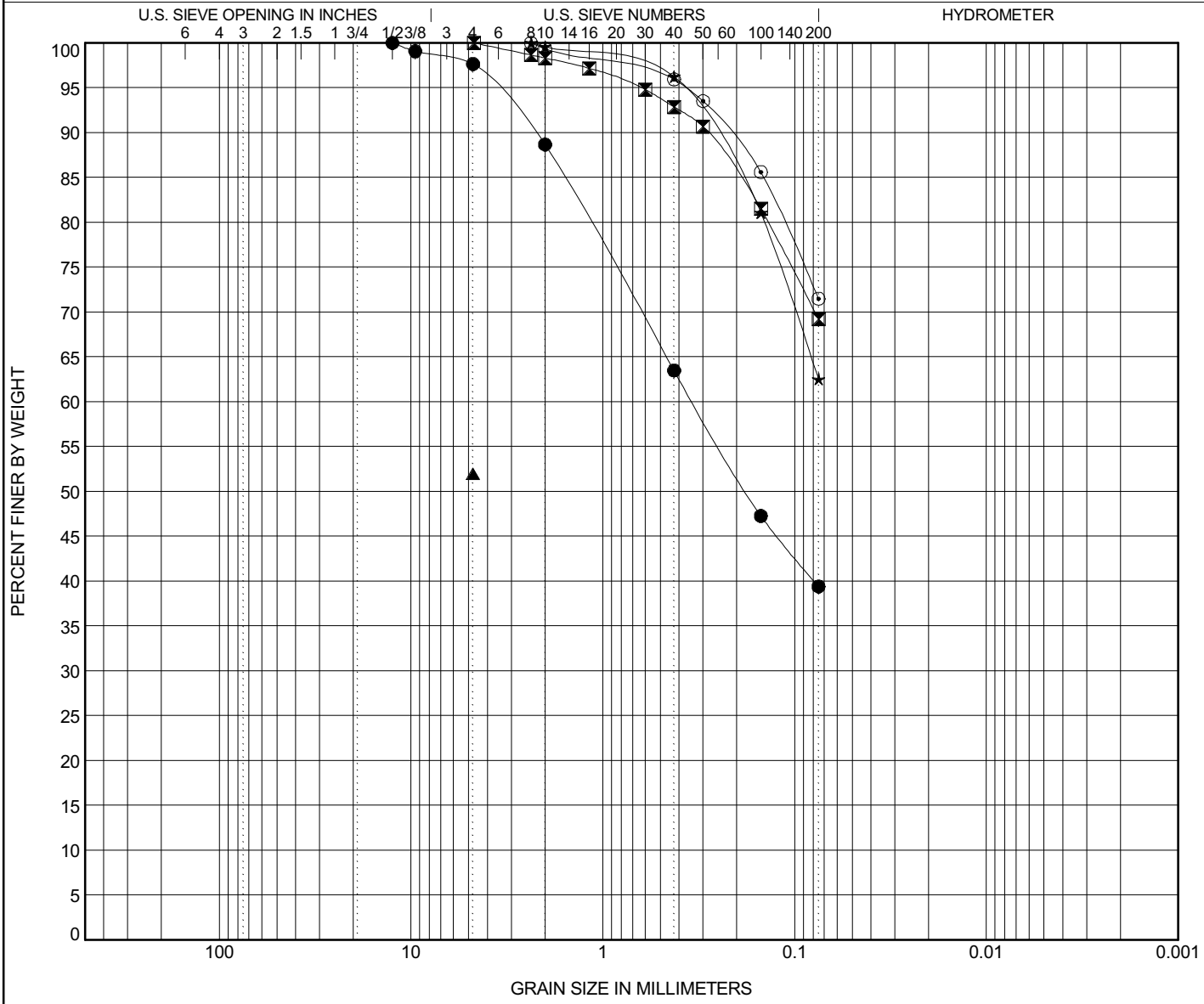

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification			Classification	LL	PL	PI	Cc	Cu
●	PV-22	16"-5'	CLAYEY SAND (SC)	38	16	22		
⊠	PV-23	14"-5'	SANDY LEAN CLAY (CL)	47	18	29		
▲	PV-23	4.0	CLAY with SAND	36	17	19		
★	PV-24	13"-5'	SANDY LEAN CLAY (CL)	41	16	25		
⊙	PV-25	14"-5'	LEAN CLAY with SAND (CL)	43	19	24		

Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	PV-22	16"-5'	12.5	0.34			2.3	58.2	39.4	
⊠	PV-23	14"-5'	4.7				0.0	30.8	69.2	
▲	PV-23	4.0	4.75							
★	PV-24	13"-5'	2.36				0.0	37.5	62.5	
⊙	PV-25	14"-5'	2.369				0.0	28.5	71.5	

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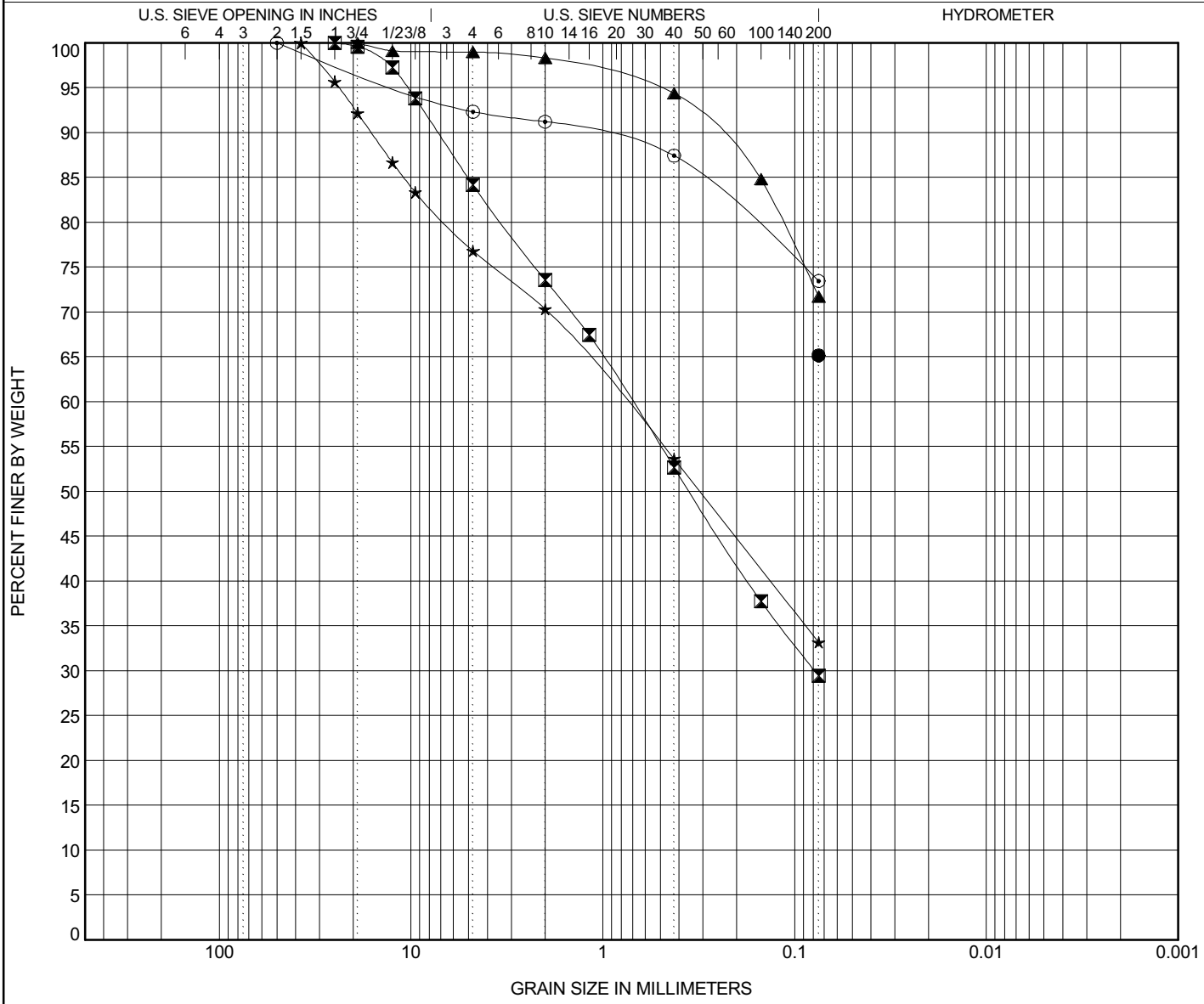

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	PV-25	9.0	SANDY LEAN CLAY (CL)	40	12	28		
⊠	RW 1-1	6"-5'	SILTY, CLAYEY SAND with GRAVEL (SC-SM)	22	17	5		
▲	RW 1-1	9.0	LEAN CLAY with SAND (CL)	46	17	29		
★	RW 2-1	0-5'	CLAYEY SAND with GRAVEL (SC)	35	17	18		
⊙	RW 2-1	10.0	FAT CLAY with SAND (CH)	52	21	31		

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	PV-25	9.0	0.075						65.2	
⊠	RW 1-1	6"-5'	25	0.706	0.079		15.8	54.7	29.4	
▲	RW 1-1	9.0	19				1.0	27.3	71.7	
★	RW 2-1	0-5'	37.5	0.766			23.2	43.6	33.2	
⊙	RW 2-1	10.0	50				7.7	18.9	73.5	

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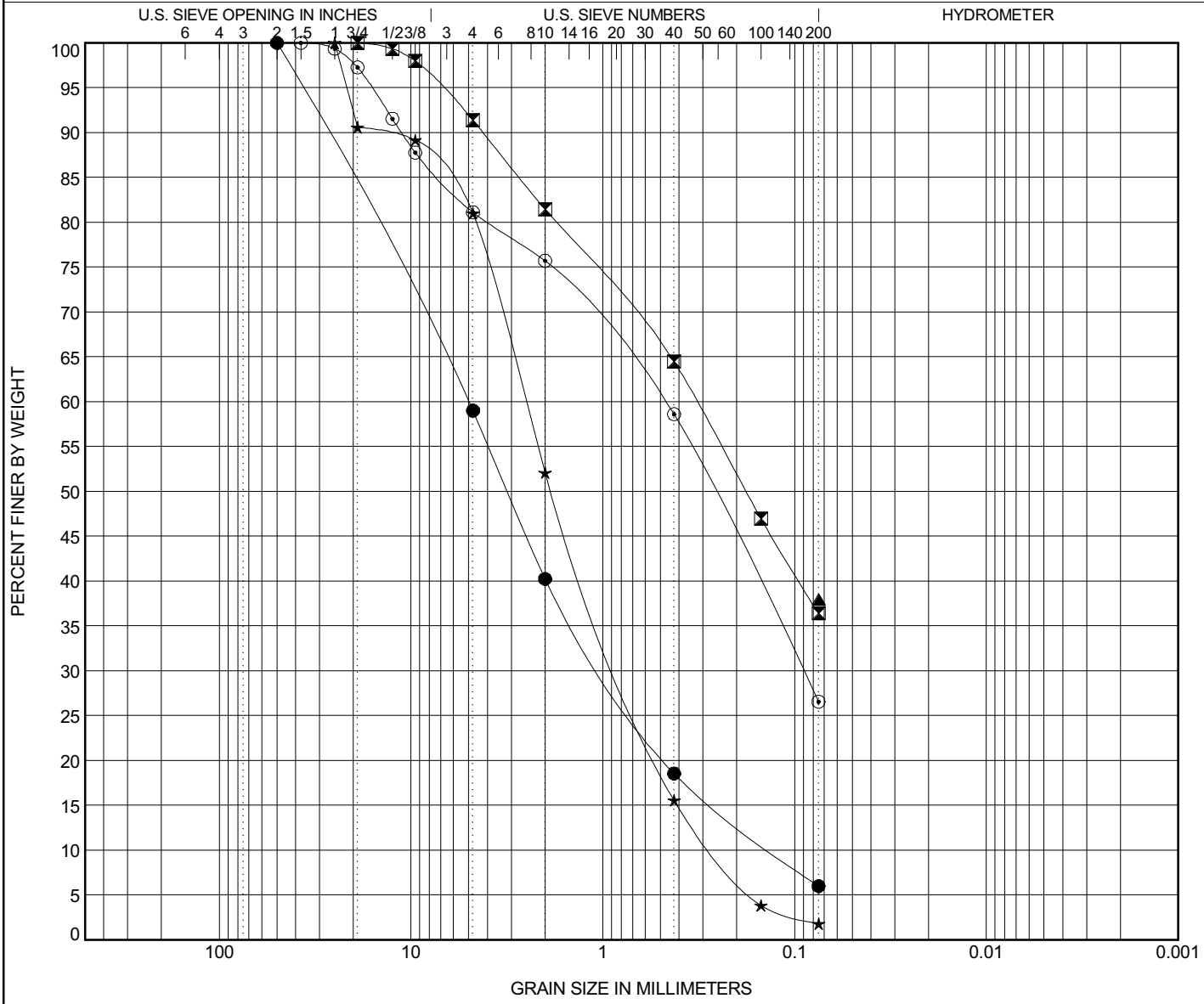

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	RW 2-1	20.0	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	9.0	CLAYEY SAND					
★	RW 2-2	14.0	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	20.0	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	0.075						38.0	
★	RW 2-2	14.0	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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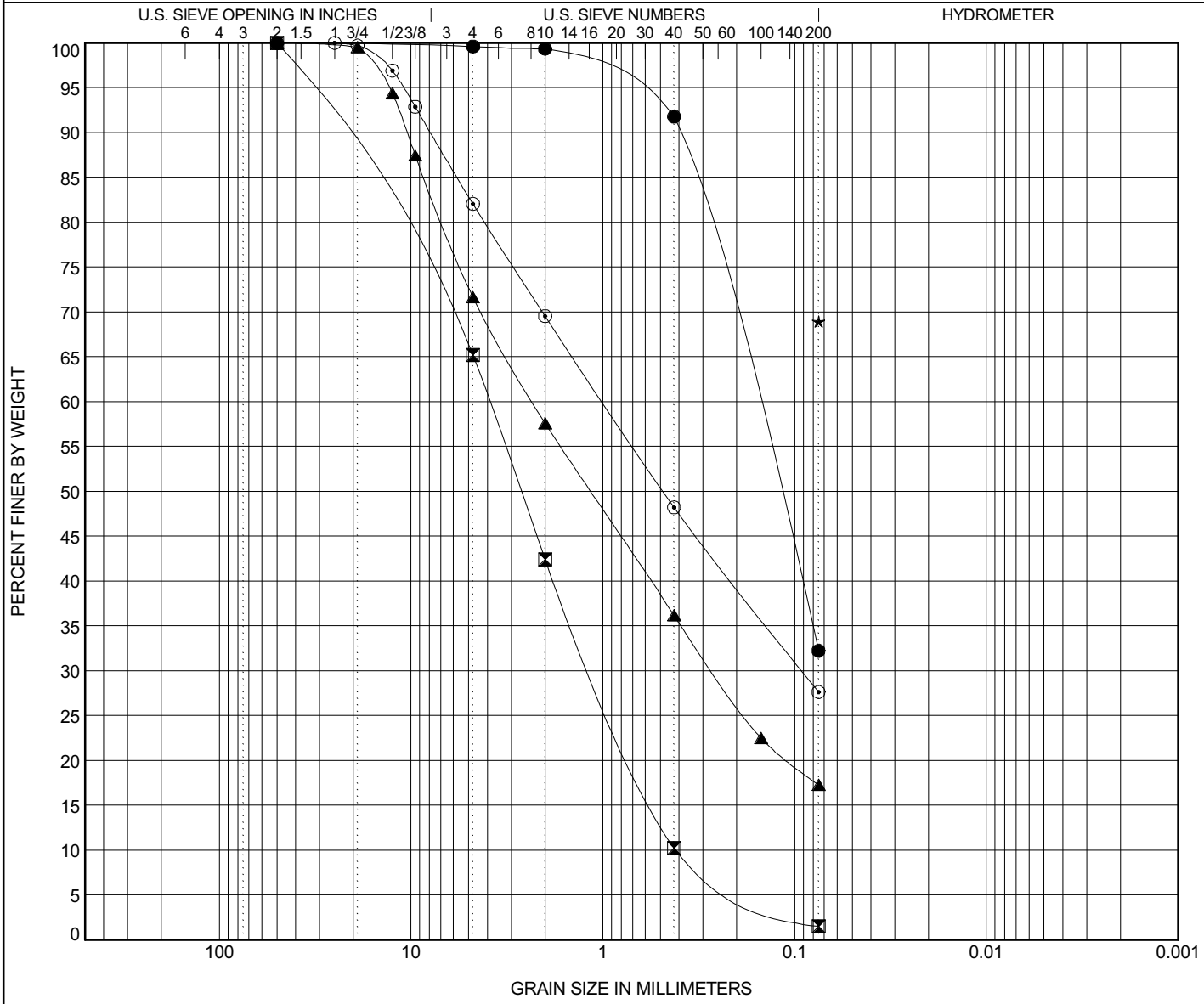

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification			Classification	LL	PL	PI	Cc	Cu
●	RW 3-1	2.0	CLAYEY SAND (SC)	39	15	24		
⊠	RW 3-1	20.0	POORLY GRADED SAND with GRAVEL (SP)				0.77	9.67
▲	RW 4-1	8"-5'	SILTY SAND with GRAVEL (SM)	NP	NP	NP		
★	RW 4-1	9.0	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 3-1	2.0	50	0.168			0.4	67.4	32.2	
⊠	RW 3-1	20.0	50	3.897	1.1	0.403	34.8	63.7	1.5	
▲	RW 4-1	8"-5'	50	2.318	0.265		28.3	54.4	17.3	
★	RW 4-1	9.0	0.075						68.9	
⊙	RW 4-2	8"-5'	25	1	0.092		18.0	54.4	27.6	

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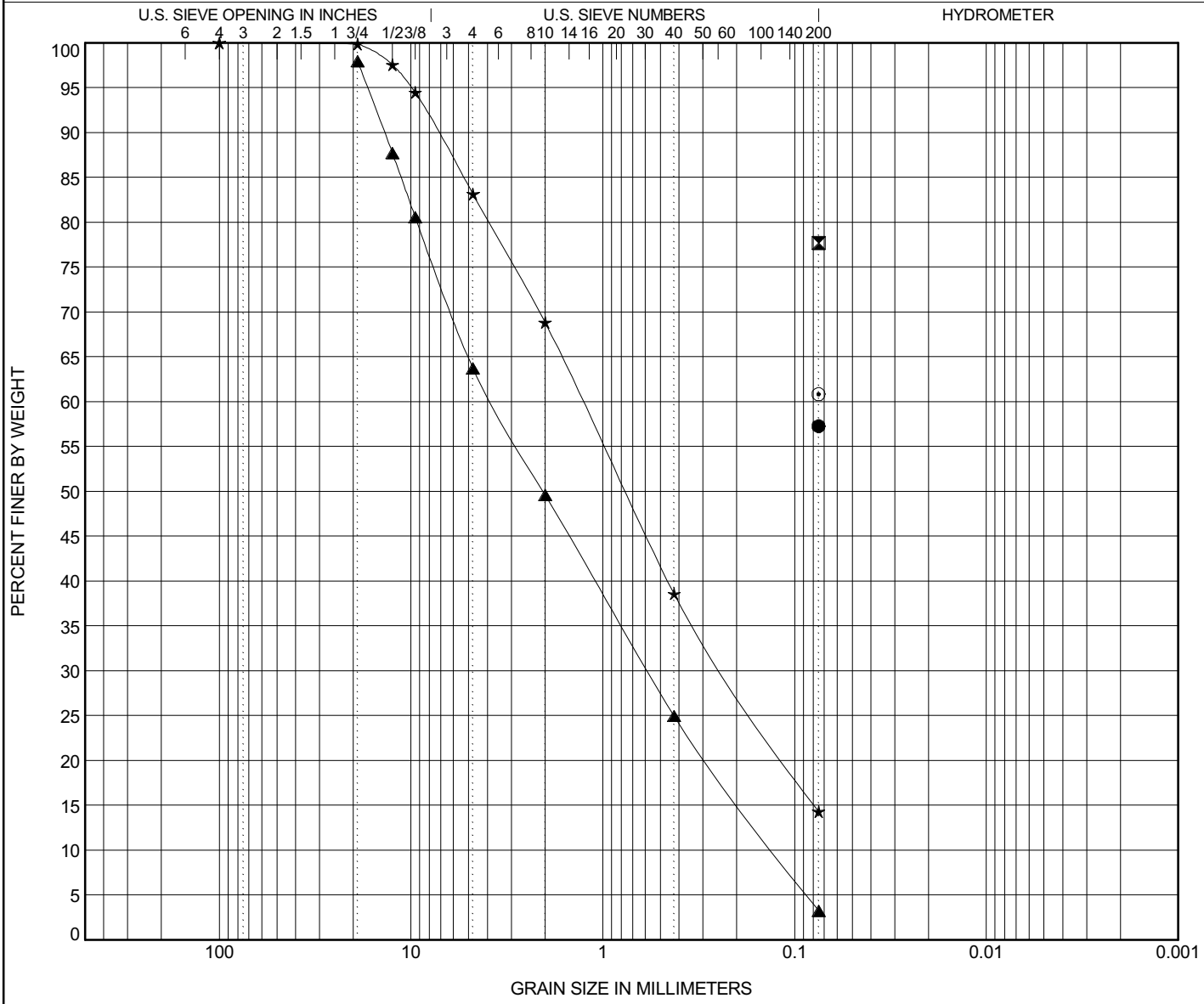


COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	RW 4-2	9.0	SANDY LEAN CLAY (CL)	40	18	22		
⊠	RW 4-2	14.0	FAT CLAY with SAND (CH)	59	23	36		
▲	RW 4-2	19.0	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	9.0	SANDY LEAN CLAY (CL)	45	18	27		

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	RW 4-2	9.0	0.075						57.3	
⊠	RW 4-2	14.0	0.075						77.7	
▲	RW 4-2	19.0	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	0.075						60.8	

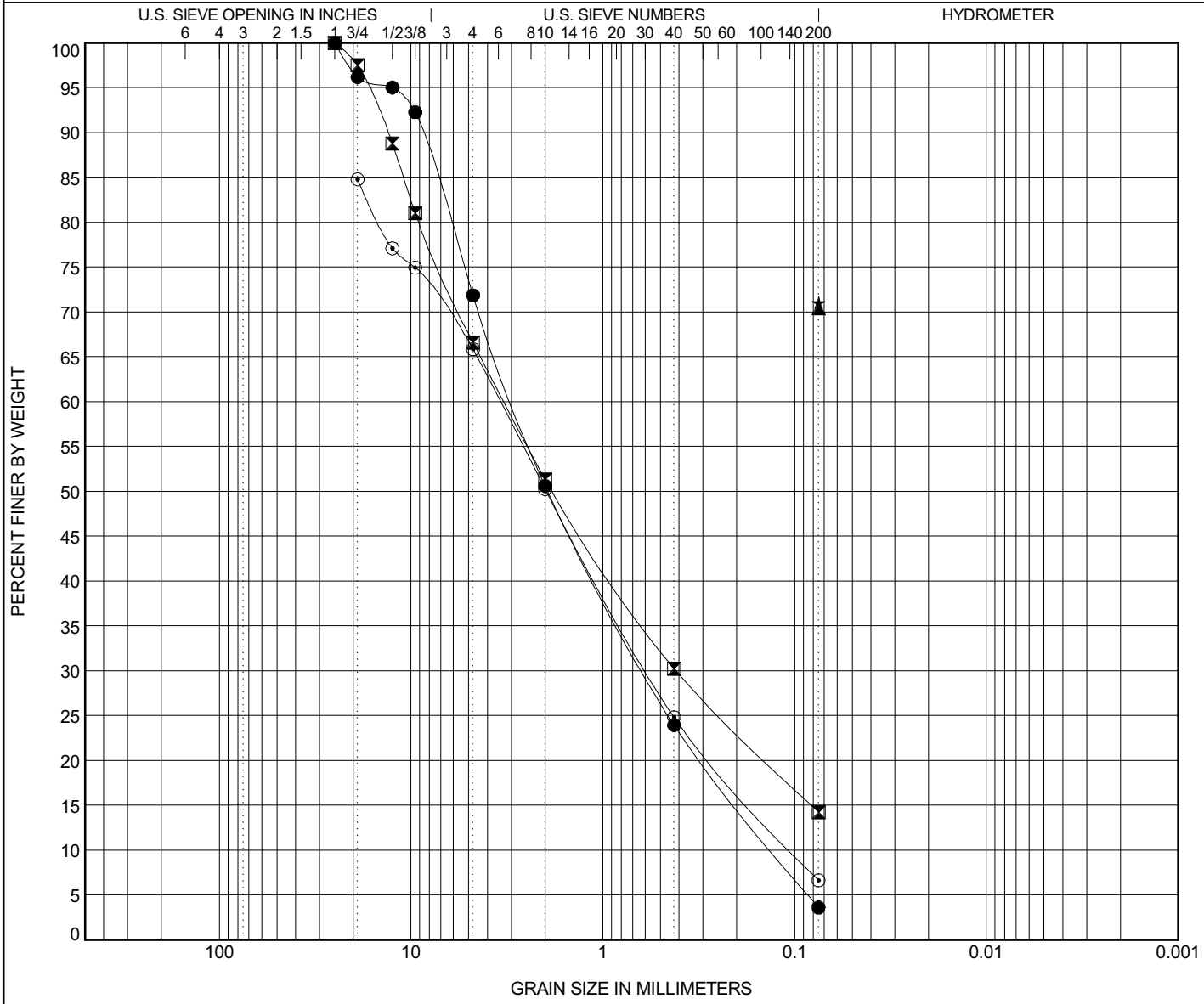
GRADATION - STANDARD 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 9/21/12

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

GRAIN SIZE DISTRIBUTION

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

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 4-3	14.0	POORLY GRADED SAND with GRAVEL (SP)	NP	NP	NP	0.96	22.67
⊠	RW 5-2	1'-5'	SILTY SAND with GRAVEL (SM)	20	20	NP		
▲	RW 5-2	9.0	LEAN CLAY with SAND (CL)	38	20	18		
★	RW 5-2	19.0	FAT CLAY with SAND (CH)	50	17	33		
⊙	RW 5-2	29.0	POORLY GRADED SAND with SILT and GRAVEL (SP-SM)	NP	NP	NP	0.96	33.21

Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	RW 4-3	14.0	25	2.931	0.604	0.129	28.1	68.2	3.6	
⊠	RW 5-2	1'-5'	25	3.269	0.413		33.4	52.3	14.3	
▲	RW 5-2	9.0	0.075						70.3	
★	RW 5-2	19.0	0.075						71.0	
⊙	RW 5-2	29.0	19	3.433	0.583	0.103	18.9	59.2	6.6	

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

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GRAIN SIZE DISTRIBUTION

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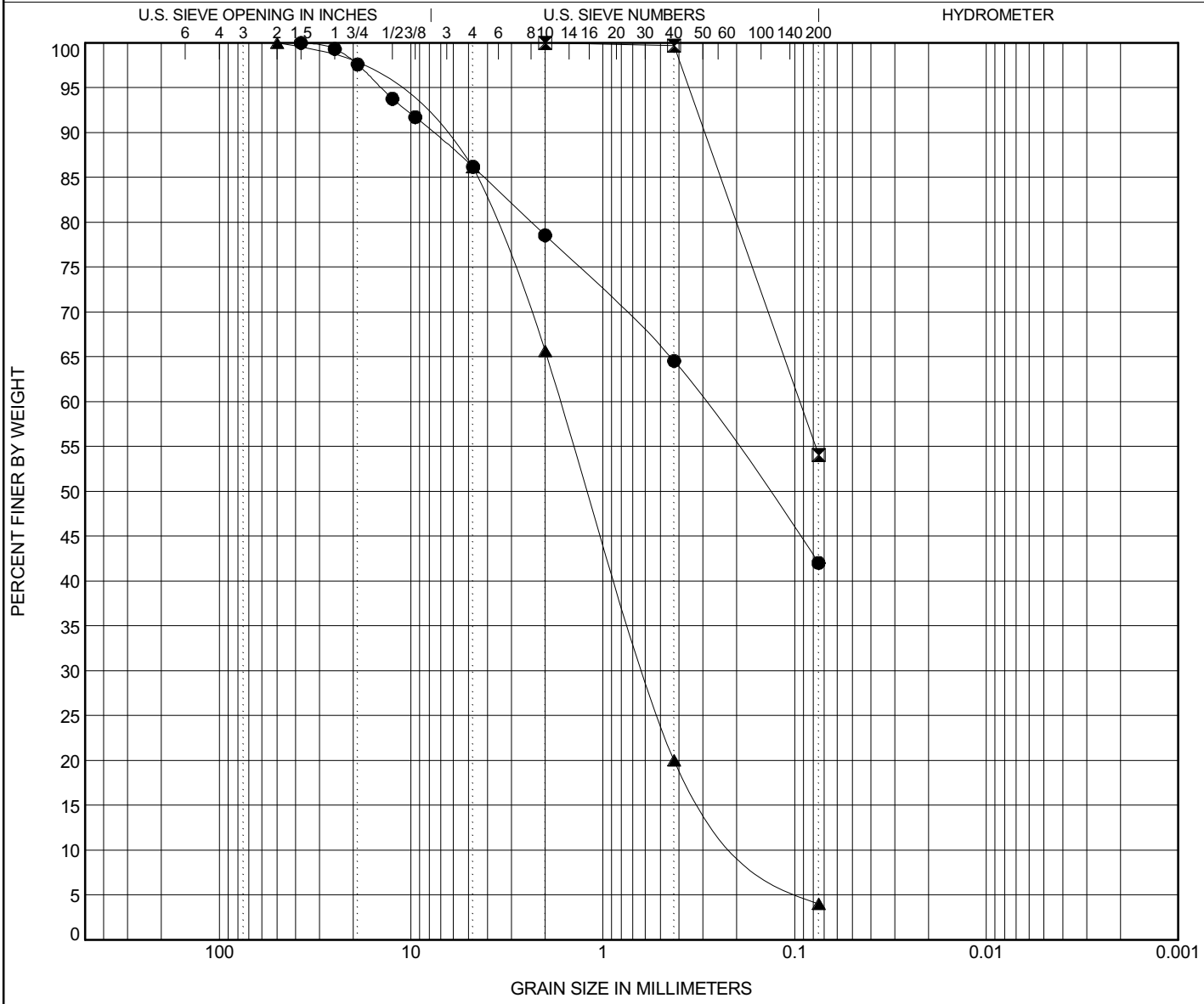
PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	RW 7-1	6"-5'	CLAYEY SAND (SC)	35	15	20		
⊠	RW 7-1	9.0	SANDY SILT (ML)	23	25	NP		
▲	RW 7-1	24.0	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	9.0	2	0.094			0.0	45.9	54.1	
▲	RW 7-1	24.0	50	1.65	0.596	0.143	13.8	82.1	4.0	

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

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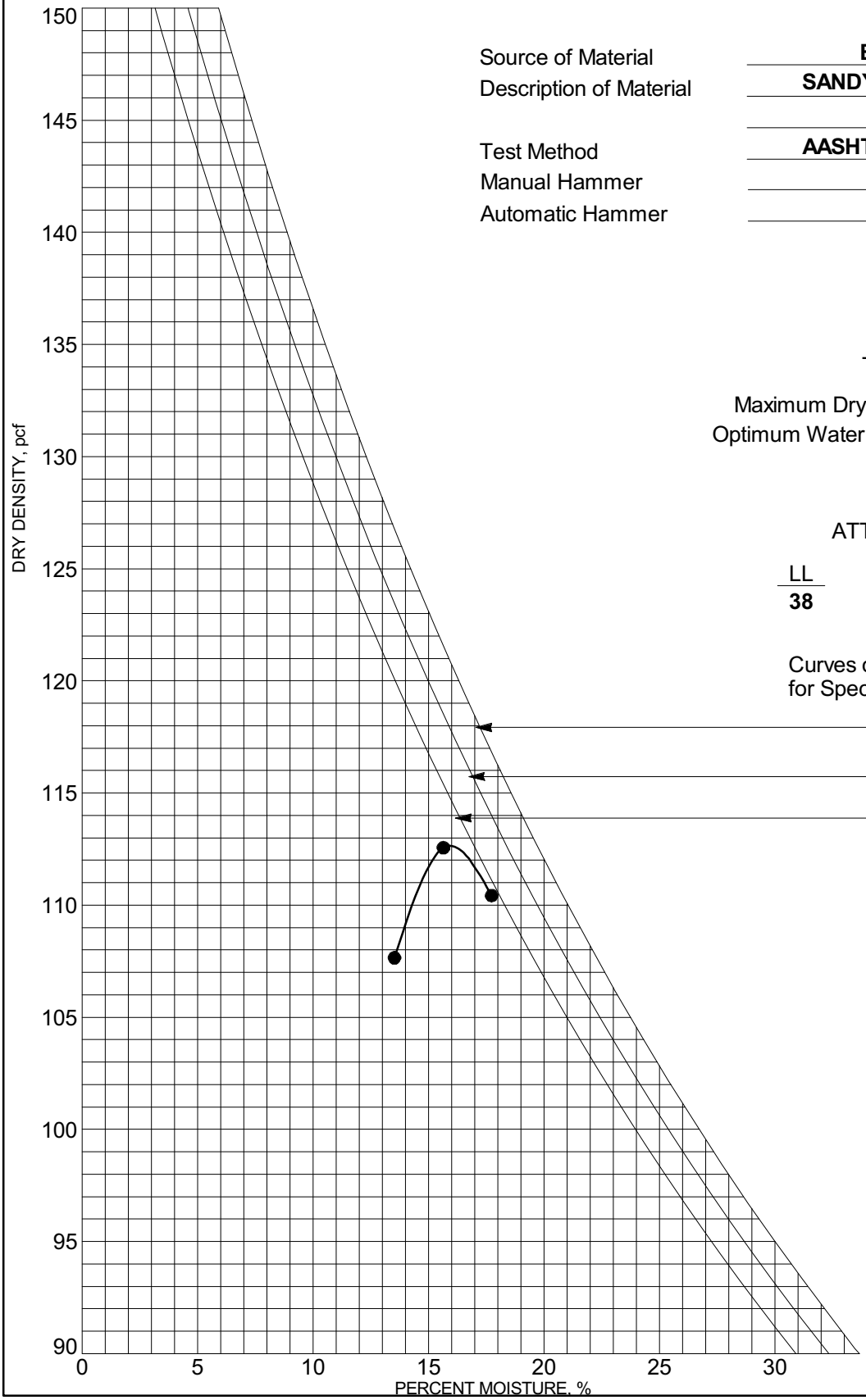
CLIENT Hartwig and Associates **PROJECT NAME** US6 Bridges Design Build Project

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



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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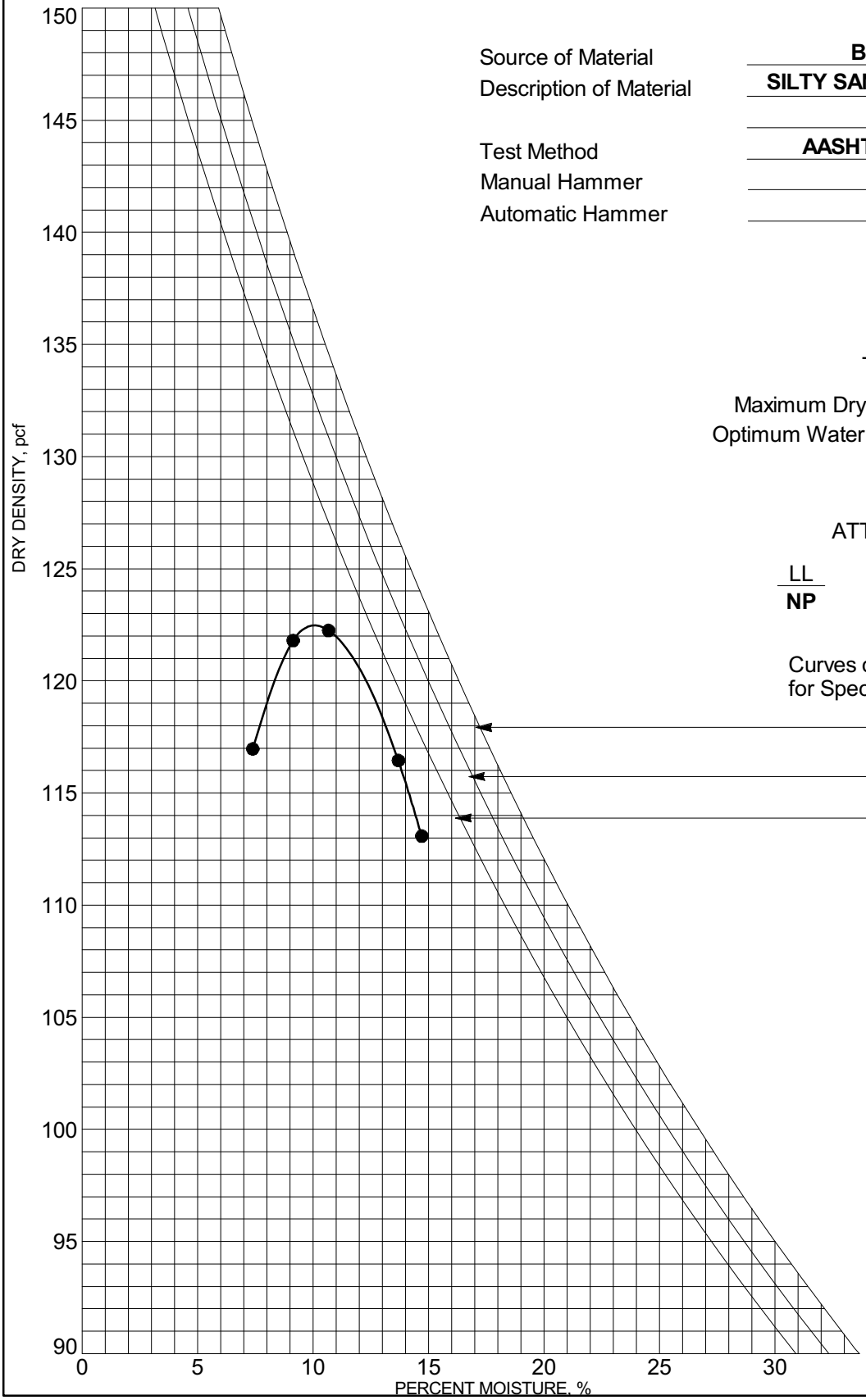

Source of Material	**BR- 22 8.5"-5'**
Description of Material	**SILTY SAND with GRAVEL(SM)**
Test Method	**AASHTO T99 Method A**
Manual Hammer	X
Automatic Hammer	

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

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

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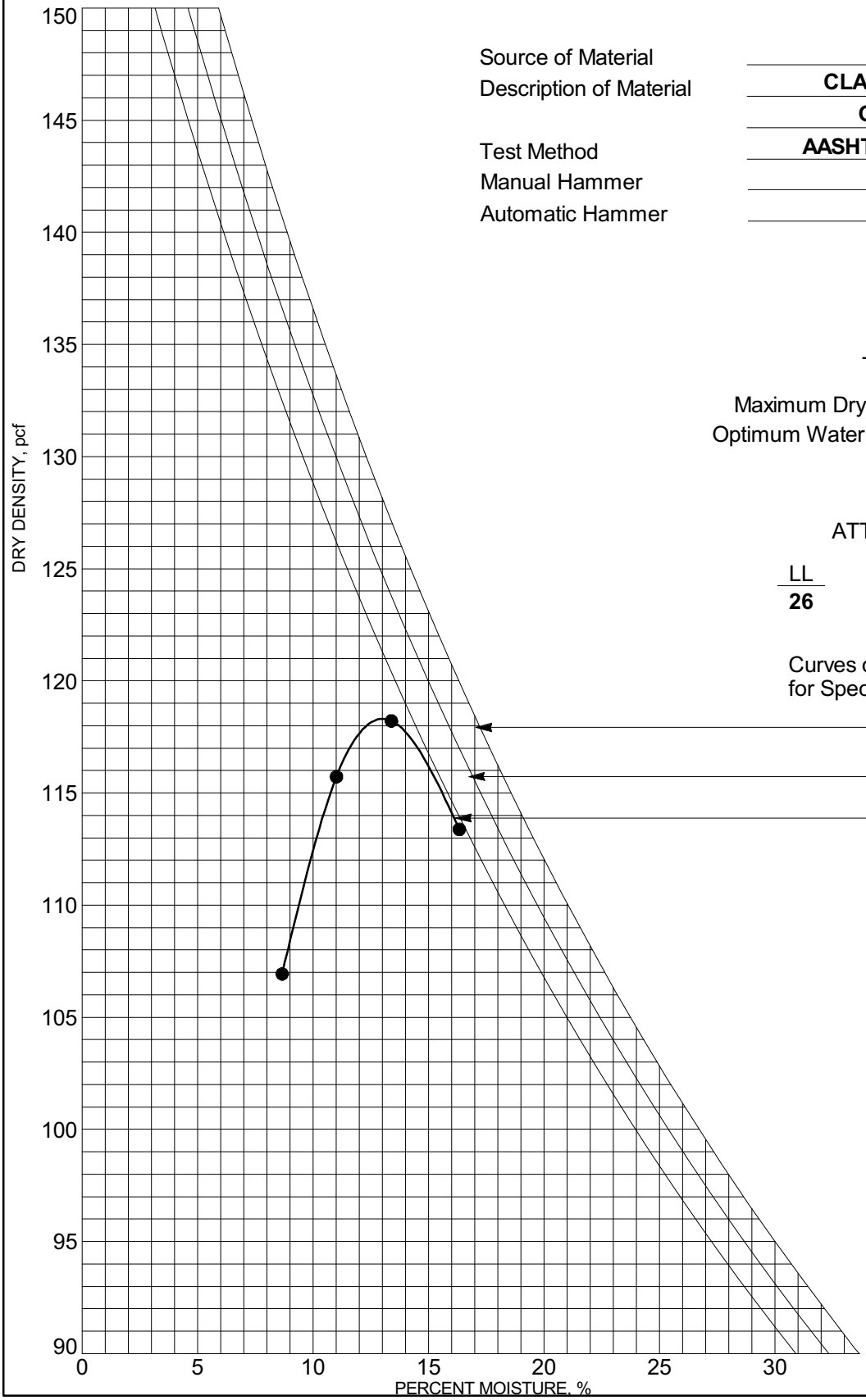


Source of Material	**PV-6 8"-5'**
Description of Material	**CLAYEY SAND with GRAVEL(SC)**
Test Method	**AASHTO T99 Method A**
Manual Hammer	X
Automatic Hammer	

TEST RESULTS

Maximum Dry Density	**118.3**	**PCF**
Optimum Water Content	**13.0**	**%**

ATTERBERG LIMITS

LL	PL	PI
26	**16**	**10**

Curves of 100% Saturation for Specific Gravity Equal to:

2.80

2.70

2.60

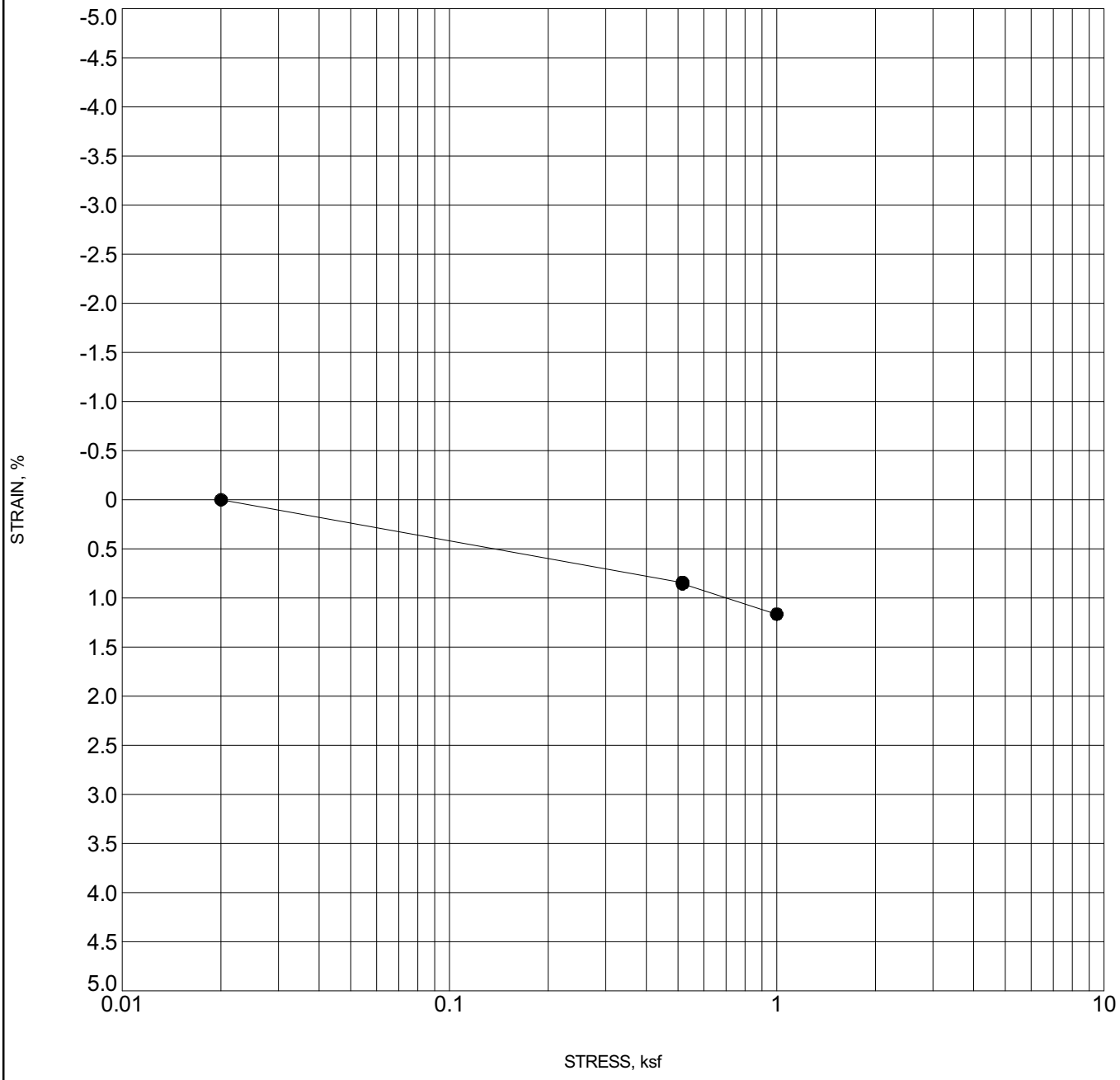
PROCTOR - STANDARD 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 9/21/12

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- 2	5.0	(Fill) SANDY, CLAY	0.0	100.2	21.0

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

SWELL - CONSOLIDATION TEST

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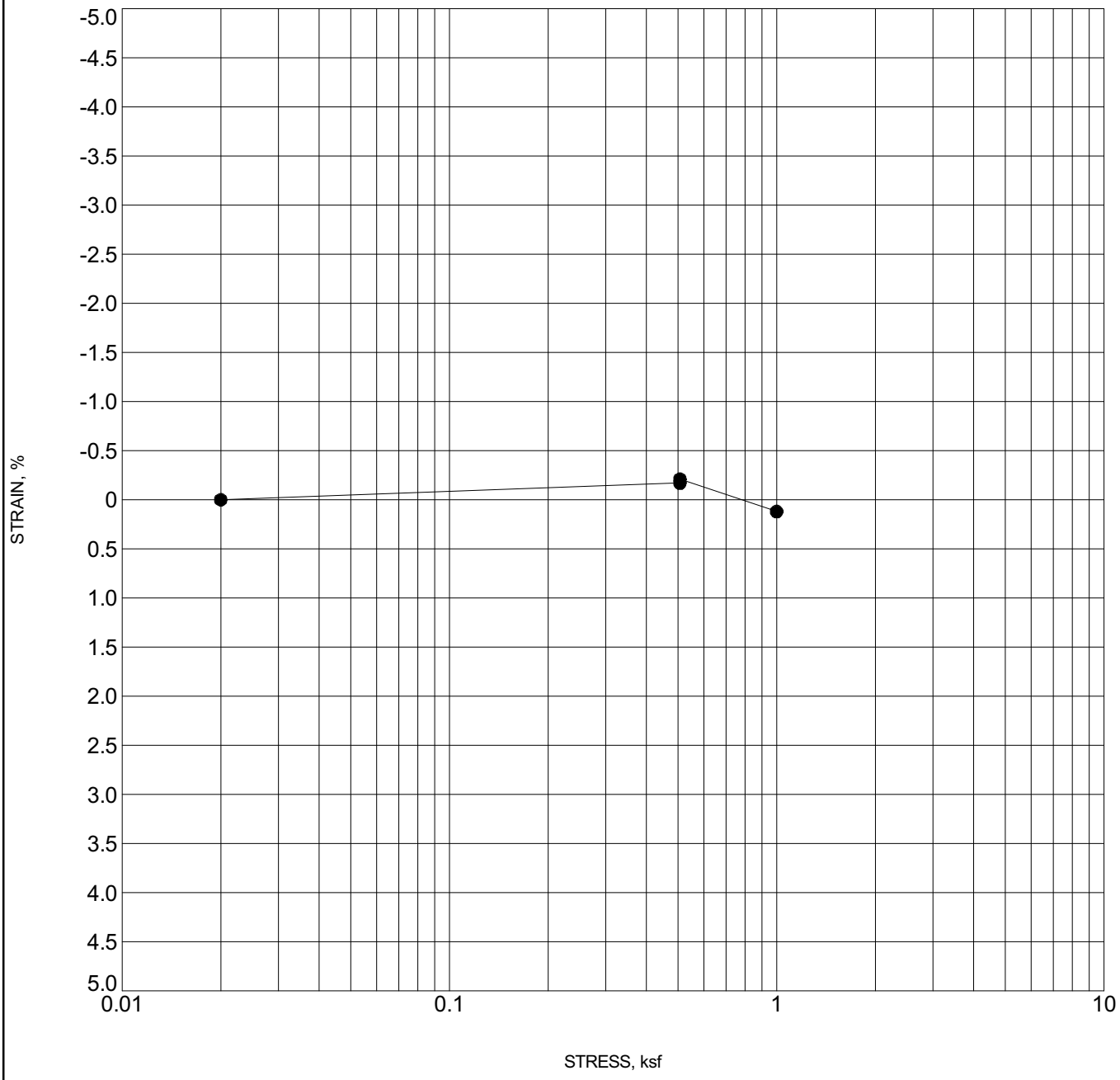

Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **BR- 2**	**9.0**	**(Fill) SANDY CLAY**	**0.0**	**98.8**	**21.0**

SWELL - CONSOLIDATION TEST

RockSol Consulting Group, Inc.

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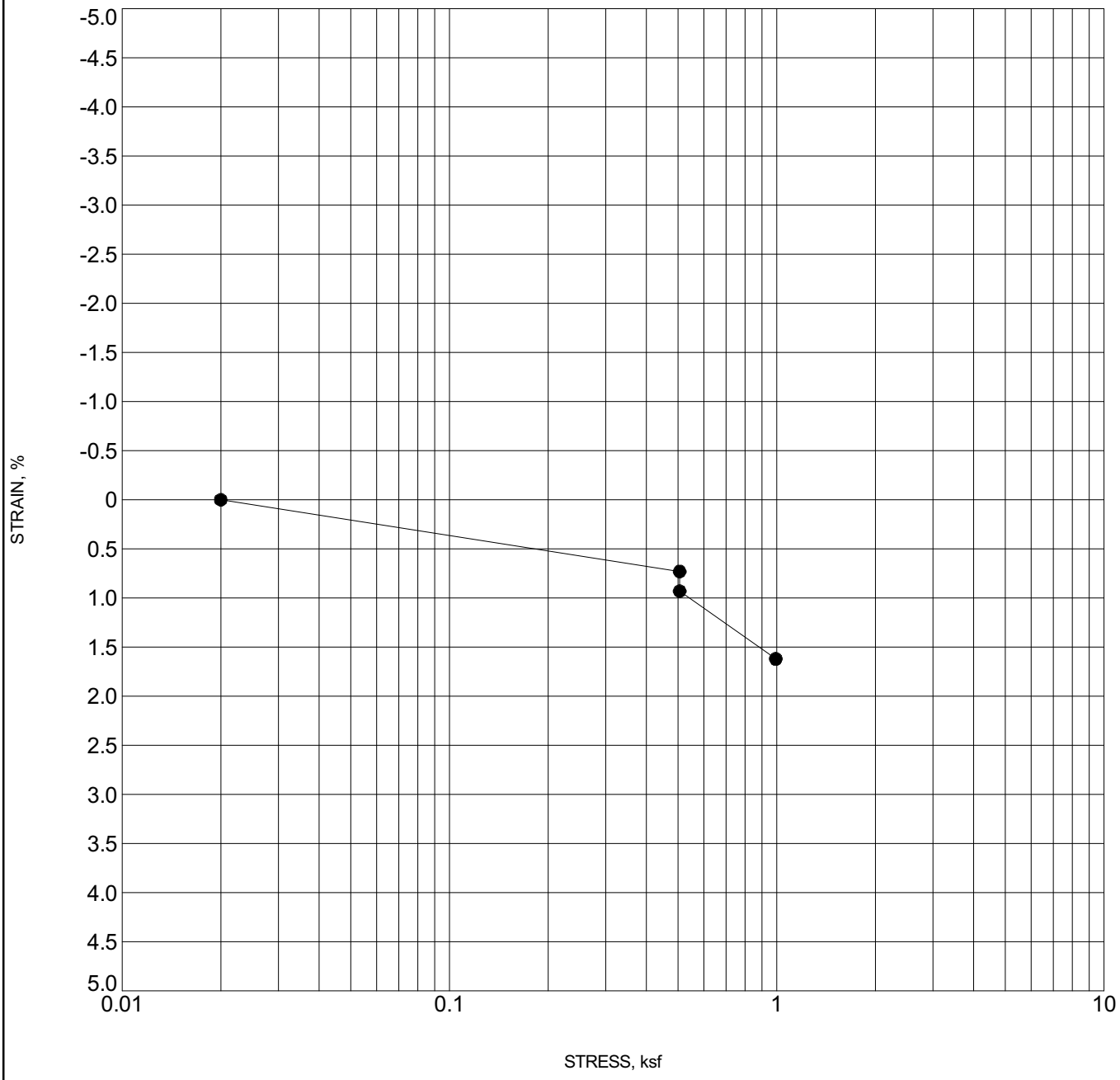
PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado



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

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

SWELL - CONSOLIDATION TEST

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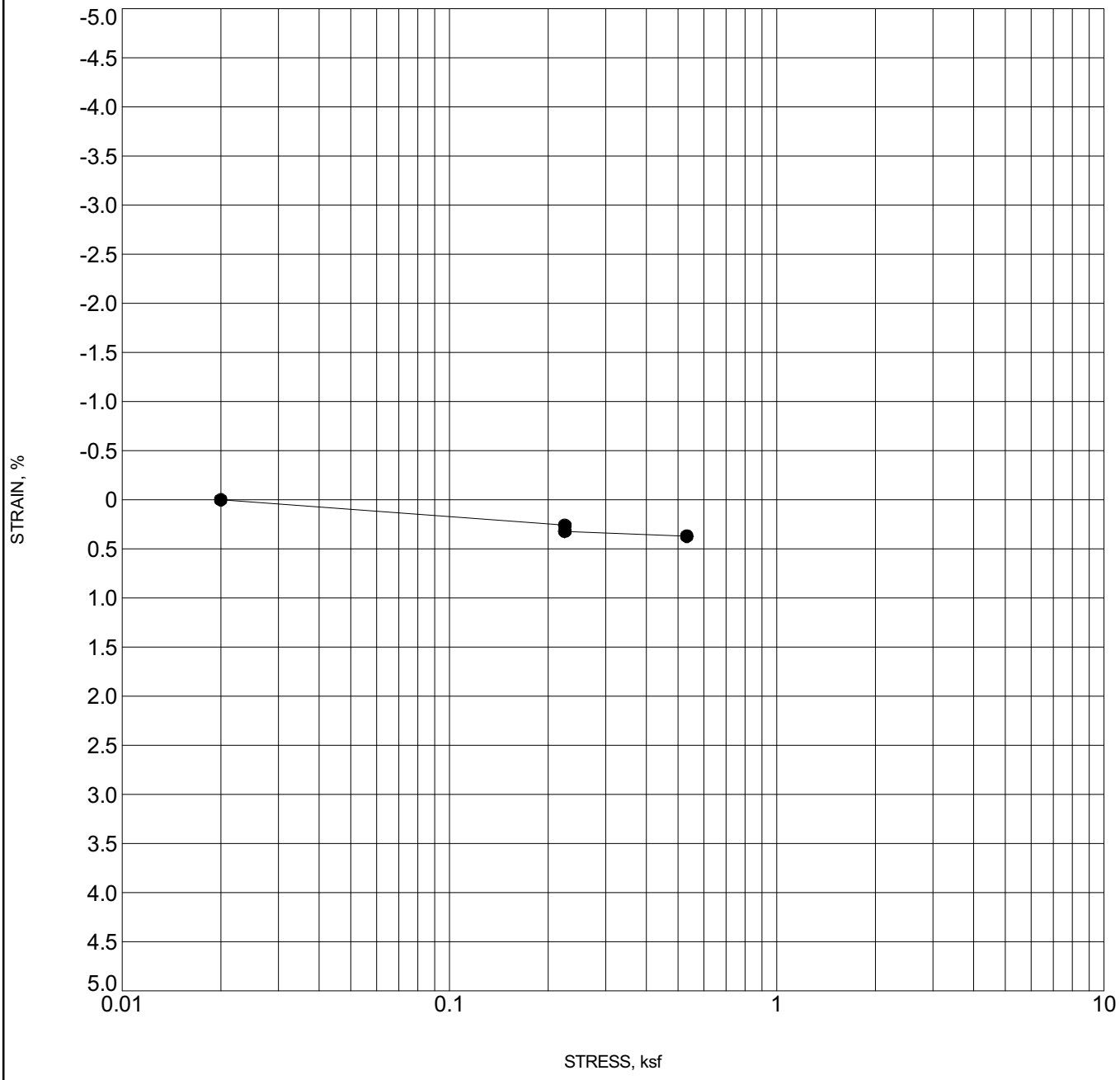
PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado



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

SWELL - CONSOLIDATION TEST

RockSol Consulting Group, Inc.

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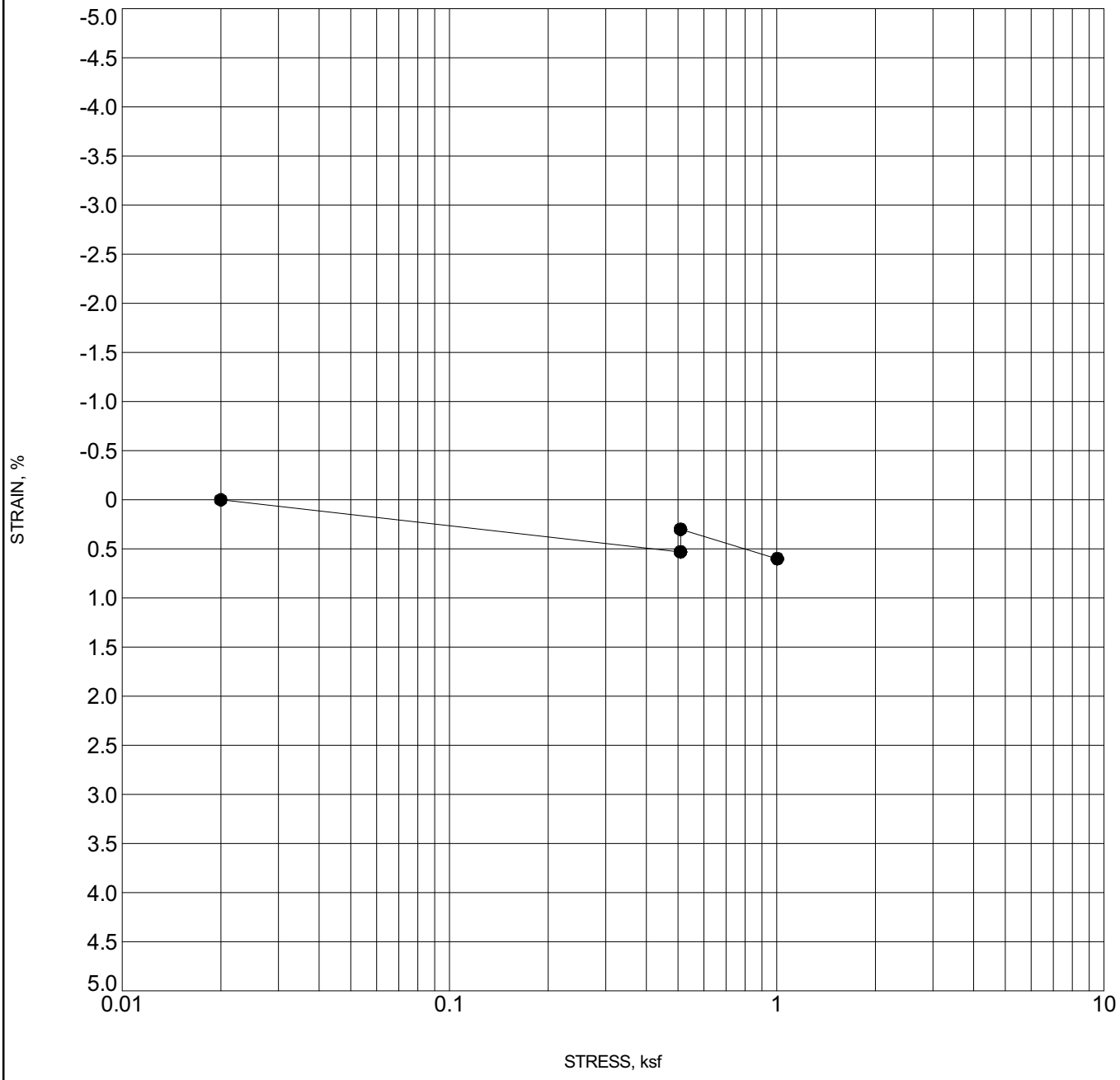

Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● BR- 8	4.0	(Fill) SANDY CLAY	0.2	101.5	23.0

SWELL - CONSOLIDATION TEST

RockSol Consulting Group, Inc.

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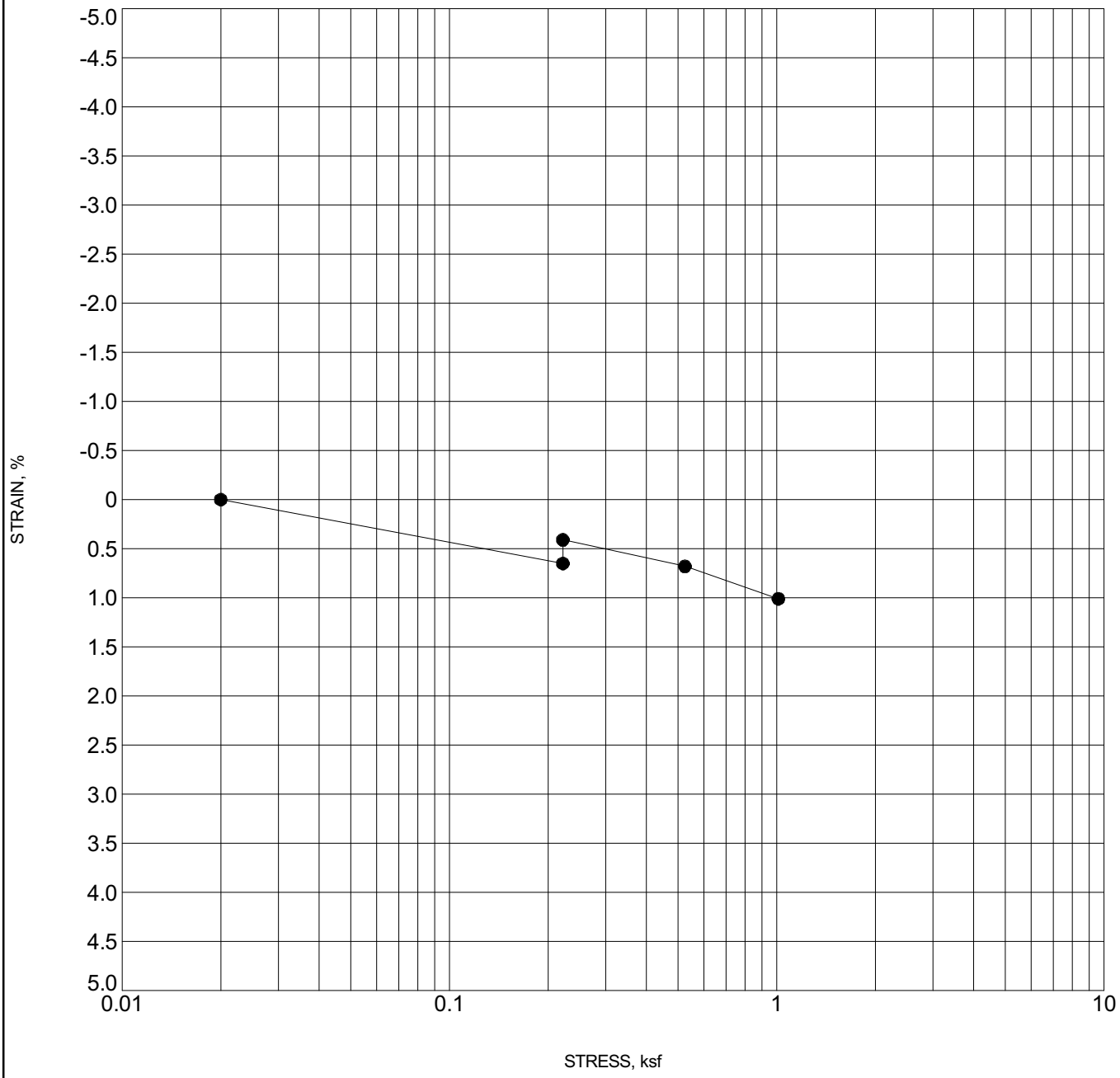
PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado



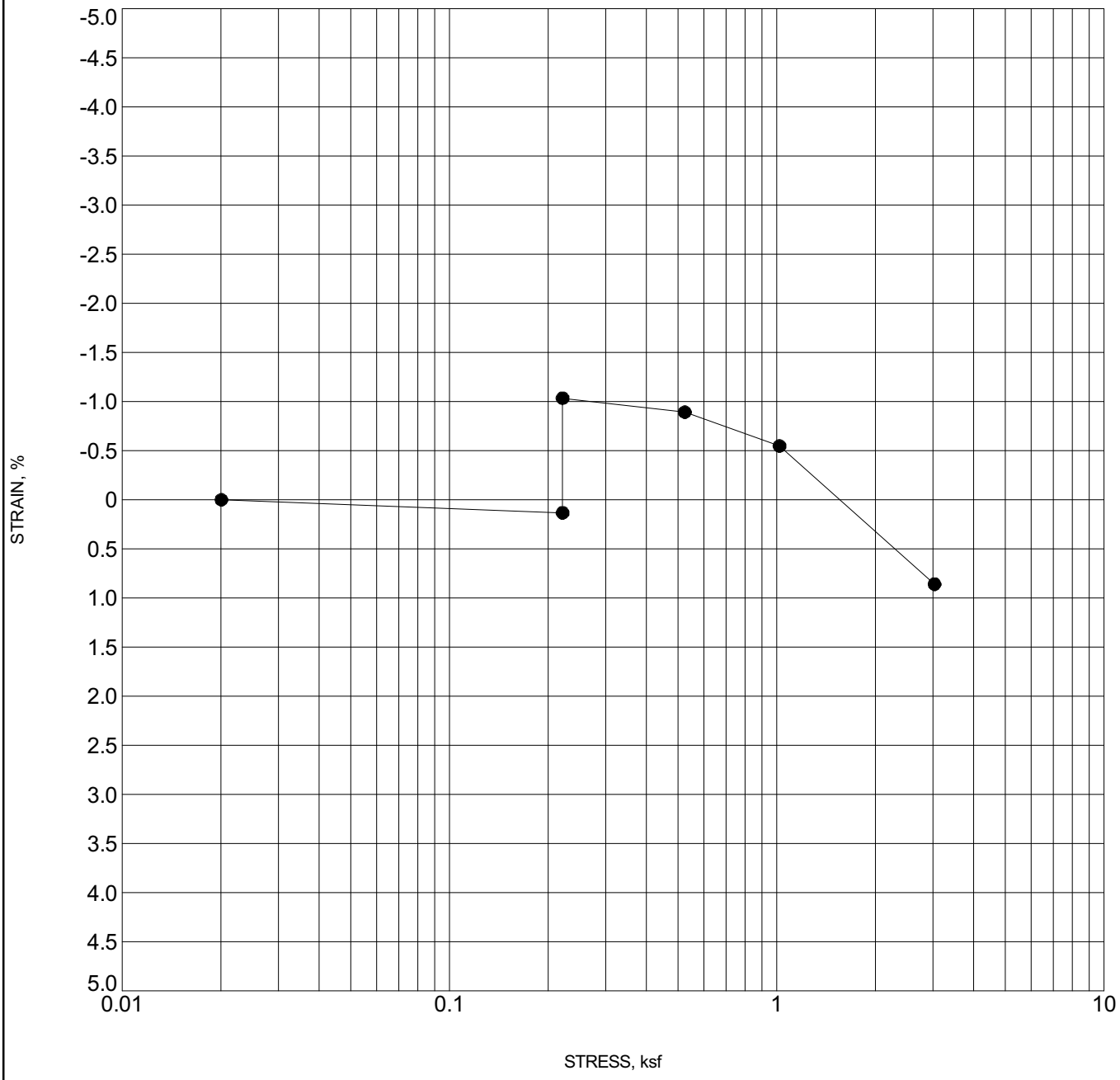
Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● BR- 15	4.0	(Fill) SANDY CLAY with GRAVEL	0.2	116.0	10.7

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- 16	2.0	(Fill) SANDY CLAY	1.2	117.2	17.1

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

SWELL - CONSOLIDATION TEST

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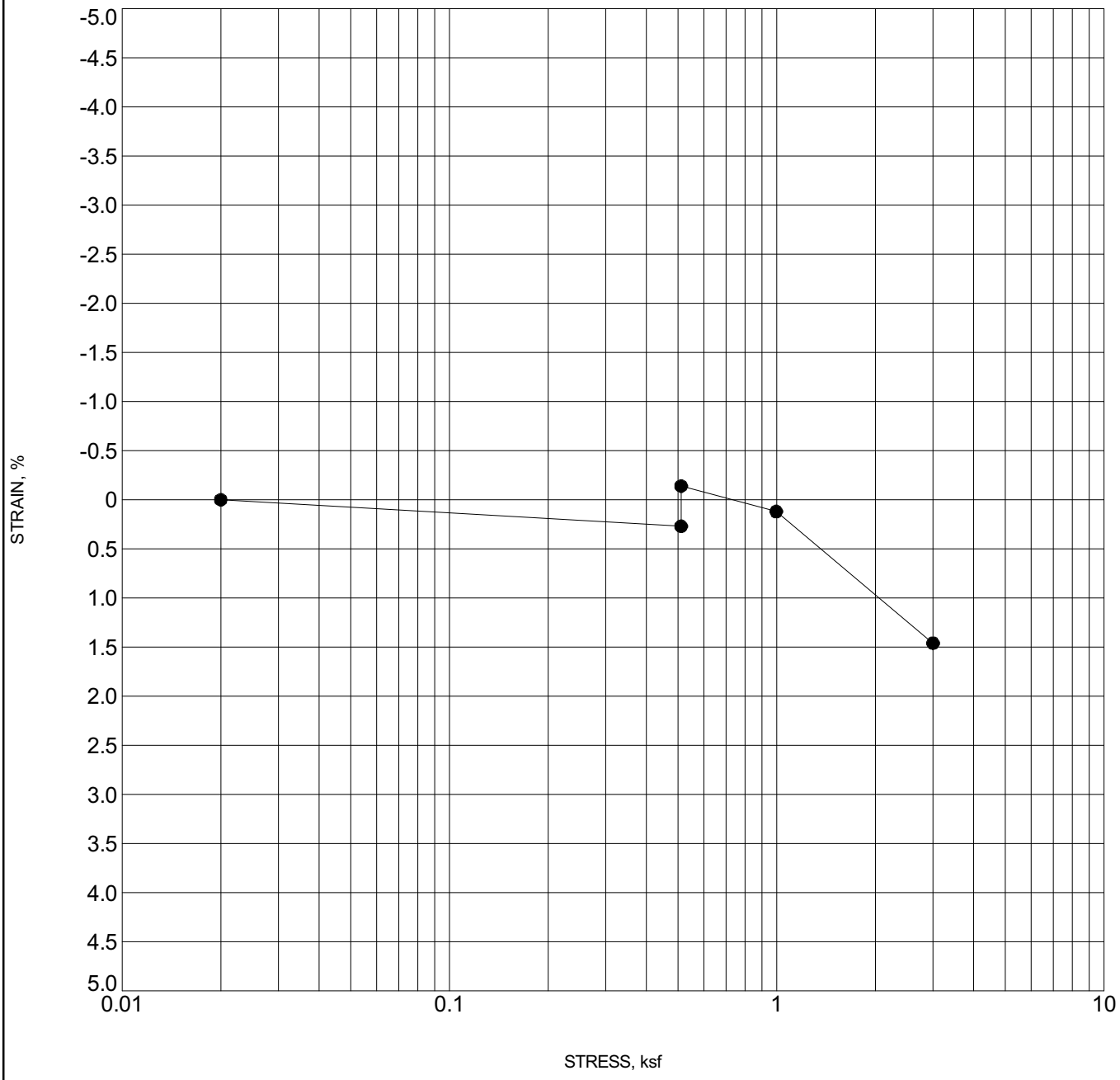
PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado



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

SWELL - CONSOLIDATION TEST

RockSol Consulting Group, Inc.

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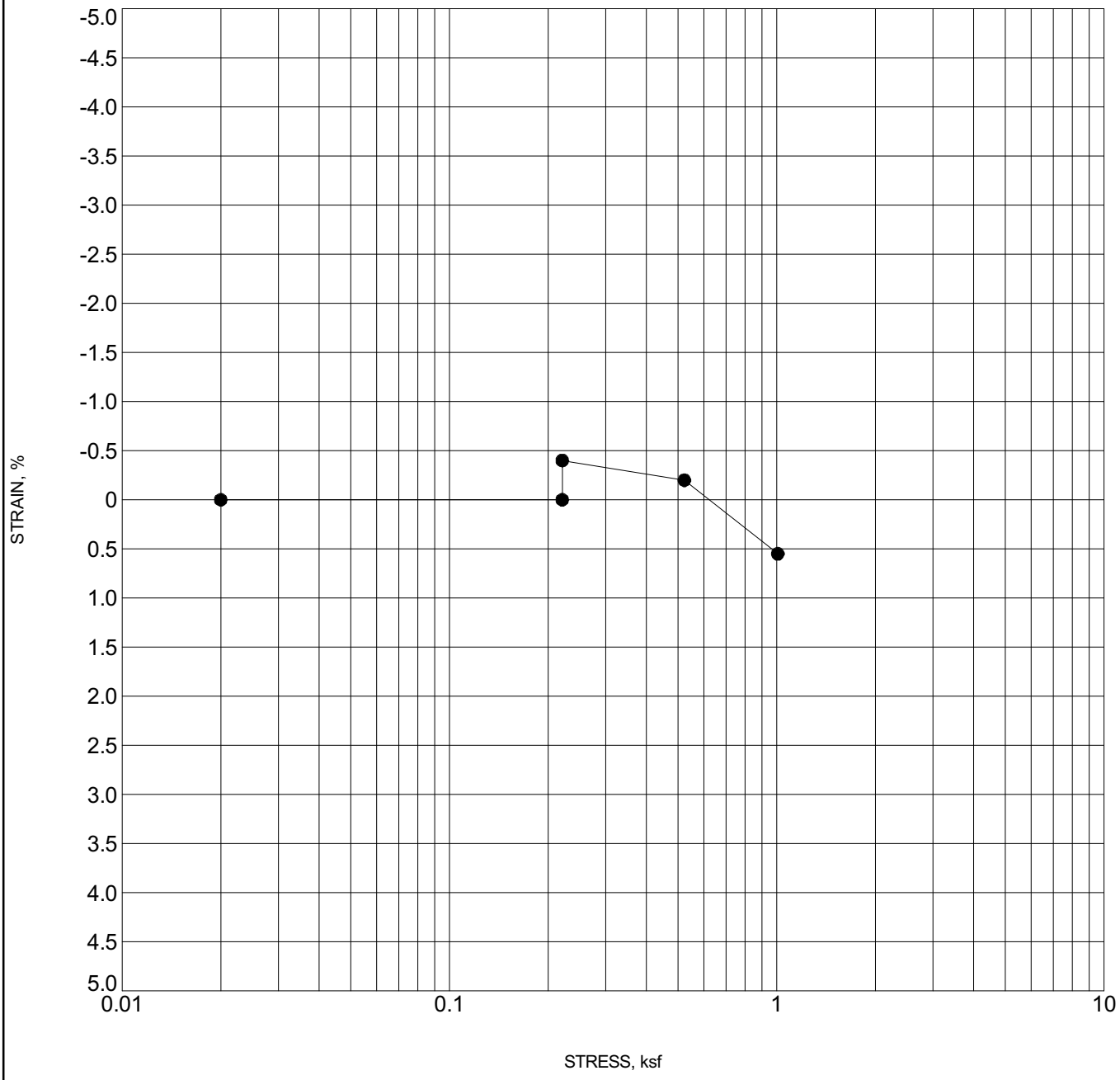
PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado



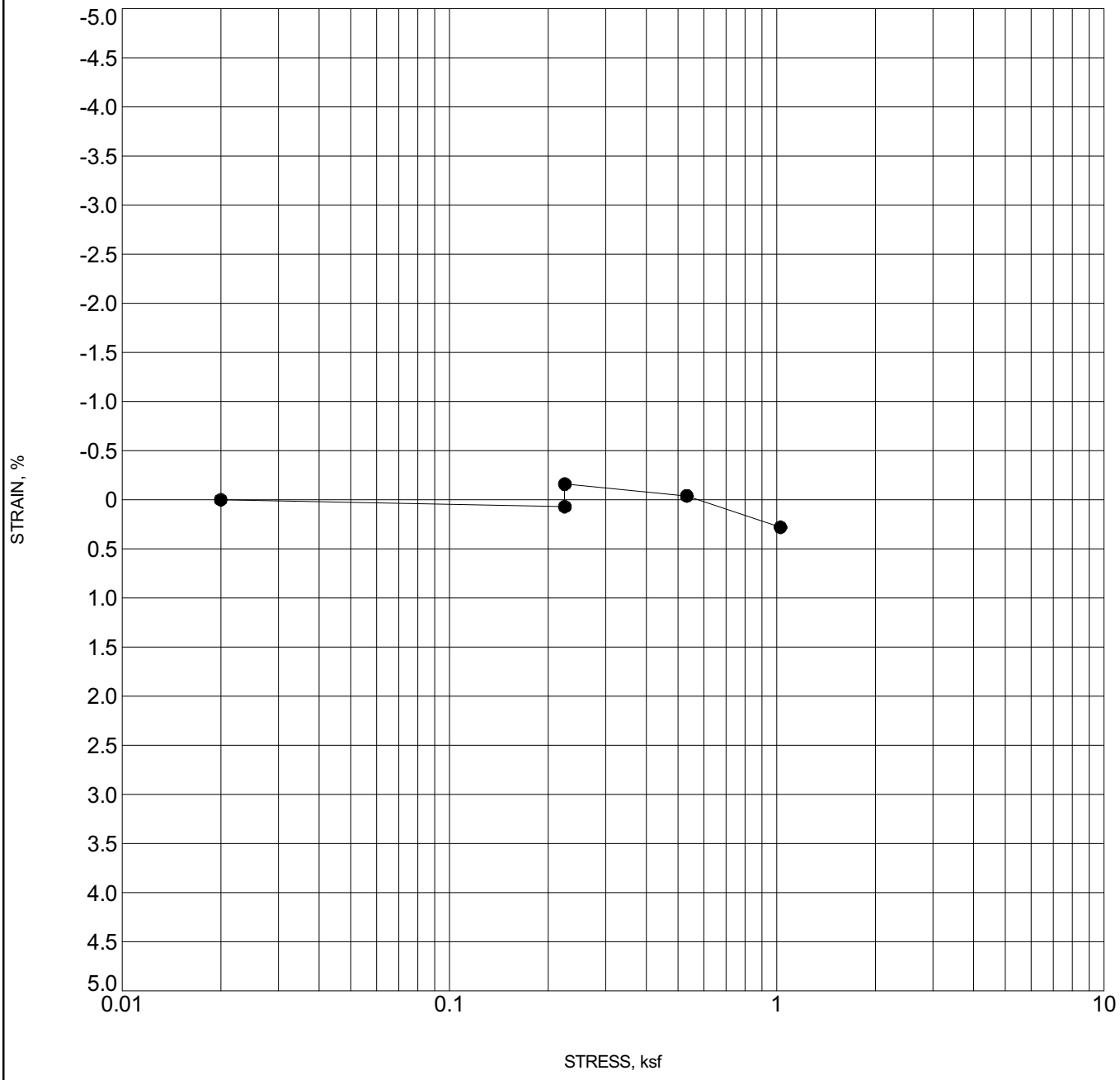
Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **BR- 20**	**5.0**	**(Fill) SANDY CLAY**	**0.4**	**106.8**	**19.1**

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%
● **BR- 21**	**2.0**	**(Fill) SANDY CLAY**	**0.2**	**104.3**	**20.3**

SWELL - CONSOLIDATION TEST

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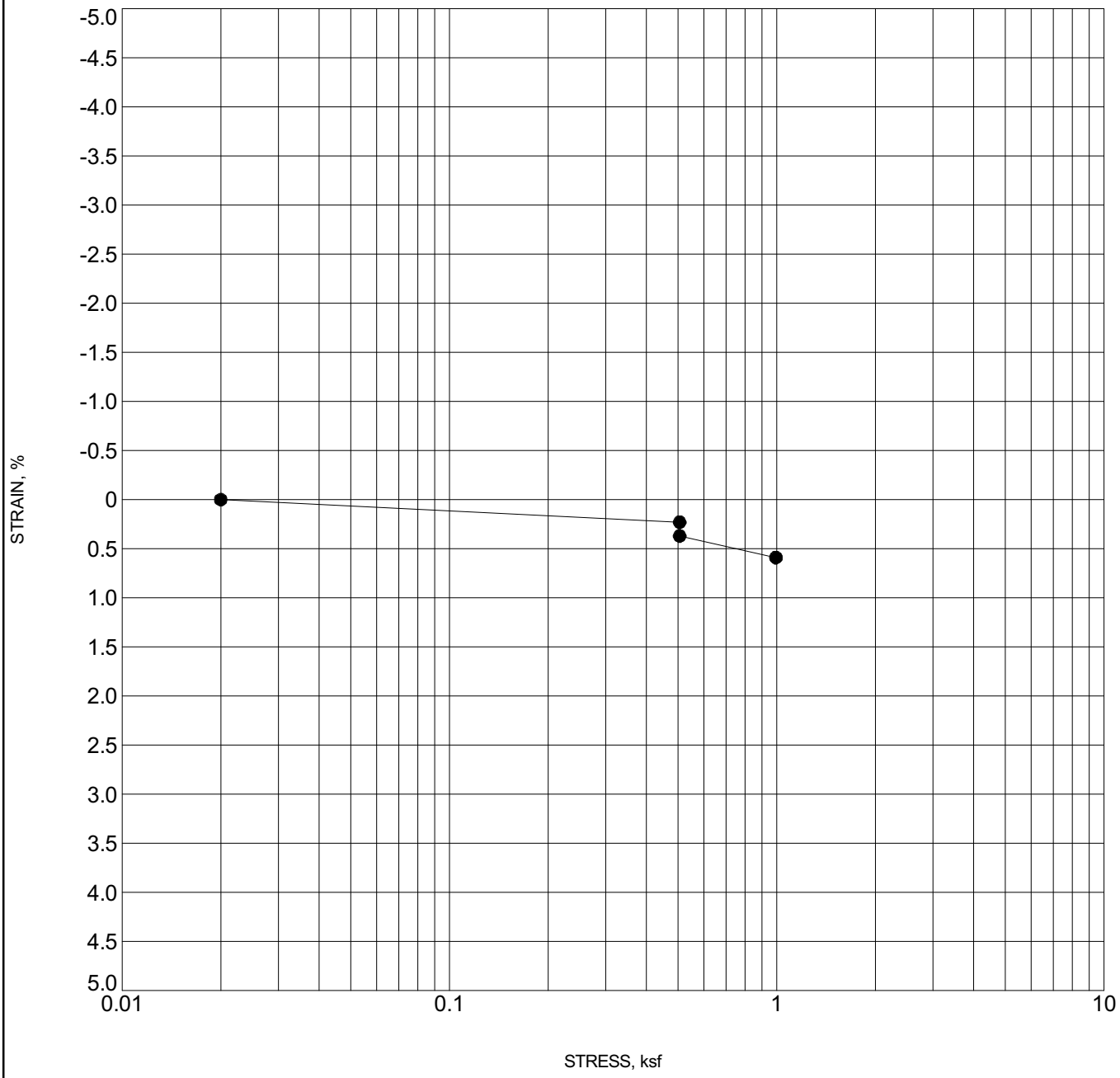


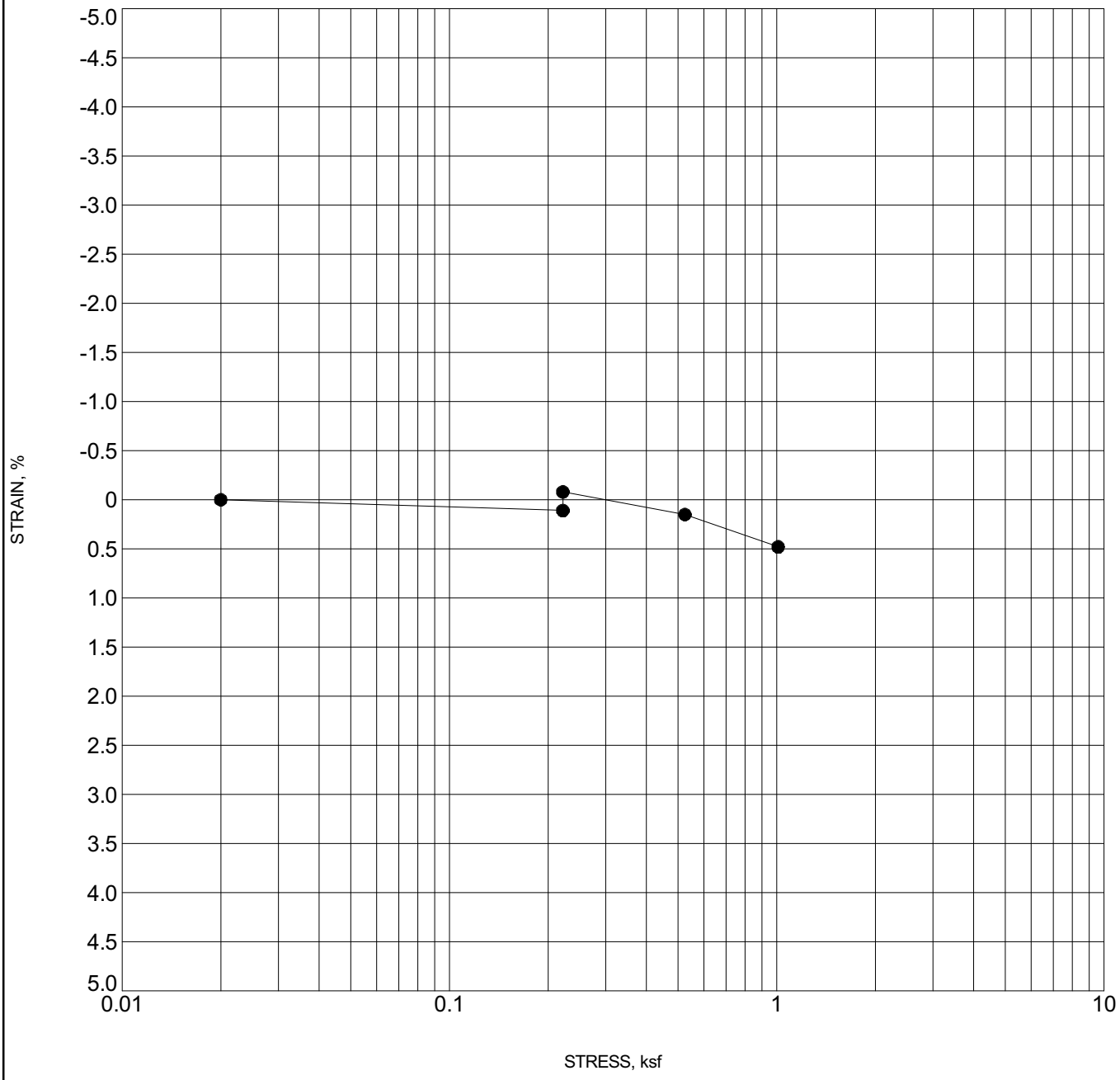
Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● BR- 21	5.0	(Fill) SANDY CLAY	-0.1	103.0	30.5

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- 22	4.0	(Fill) SANDY CLAY	0.2	112.9	16.1

SWELL - CONSOLIDATION TEST

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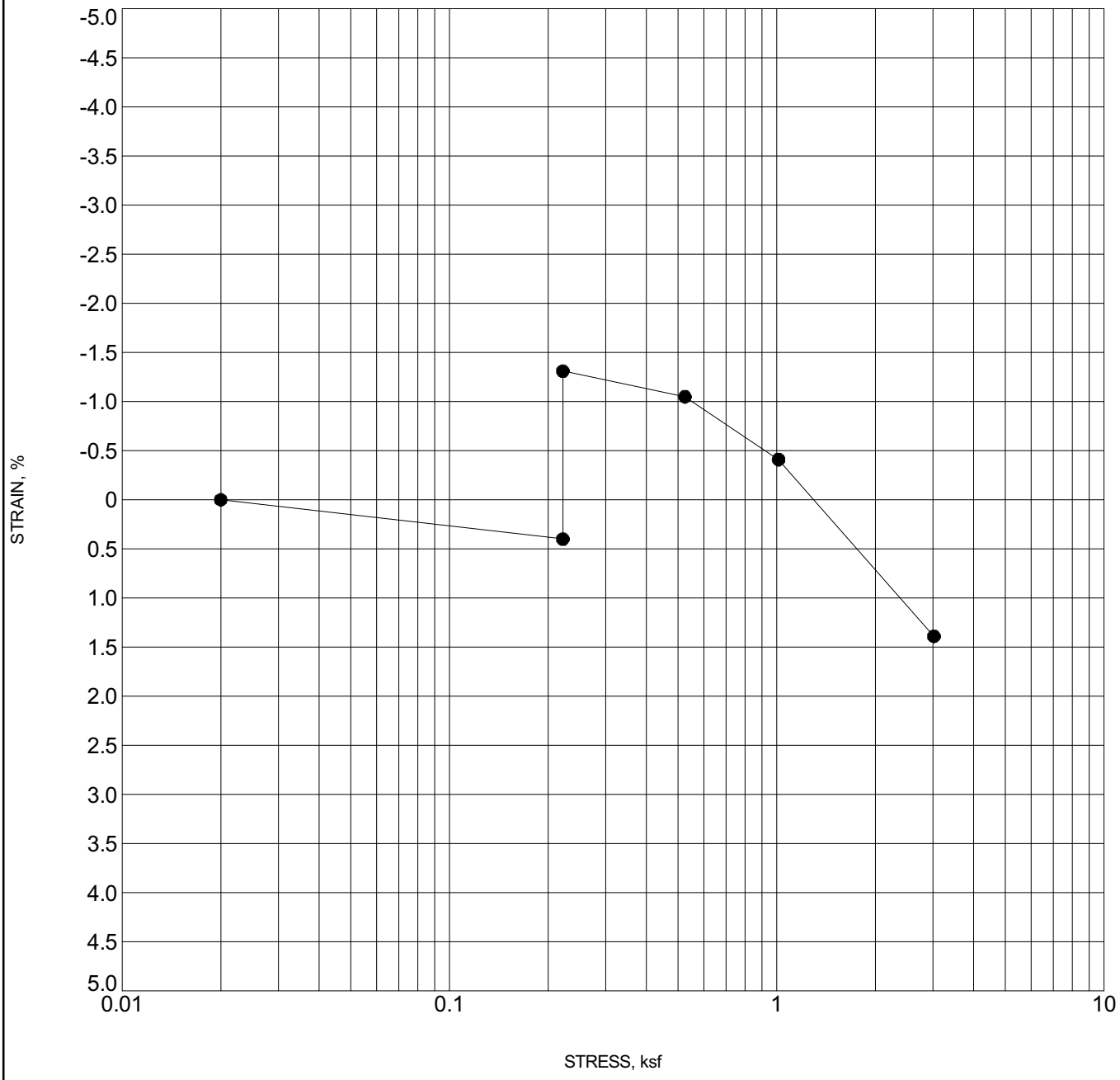
PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado



Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **PV-3**	**4.0**	**CLAY and SAND**	**1.7**	**103.9**	**18.3**

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

SWELL - CONSOLIDATION TEST

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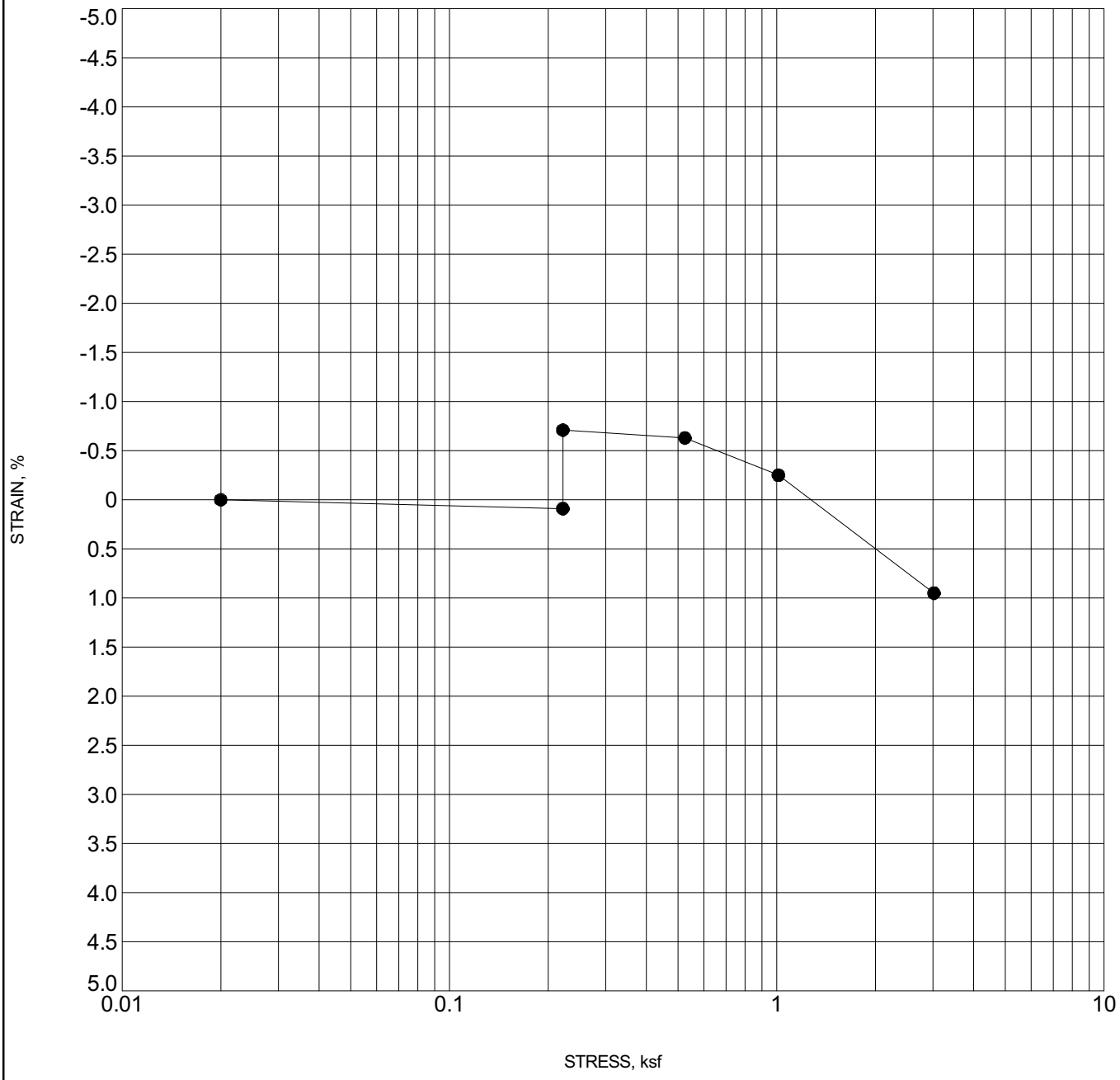
PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado



Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **PV-4**	**4.0**	**SANDY CLAY**	**0.8**	**99.2**	**24.2**

SWELL - CONSOLIDATION TEST

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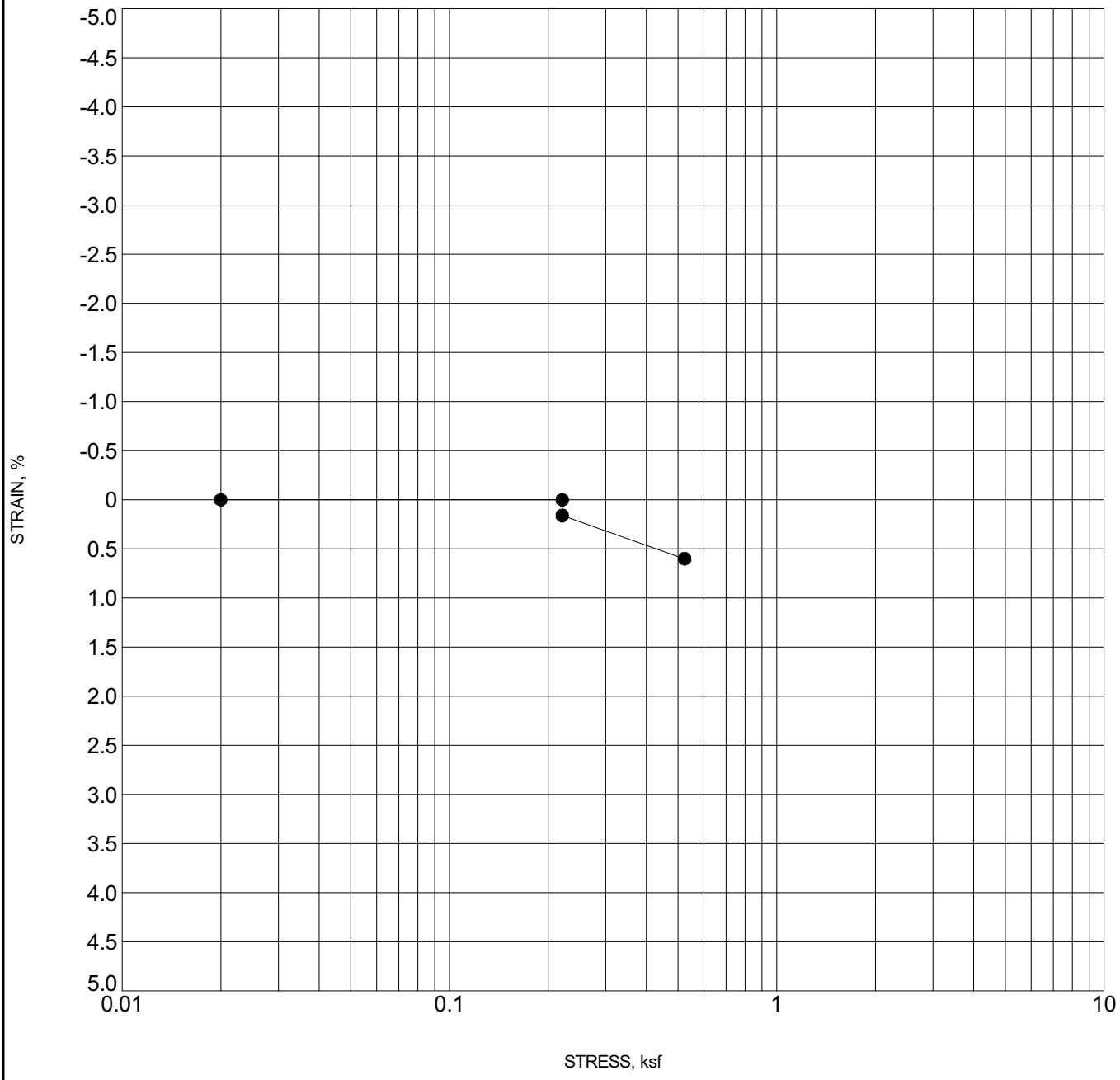

Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **PV-5**	**9.0**	**CLAY with SAND**	**-0.2**	**103.8**	**22.6**

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

SWELL - CONSOLIDATION TEST

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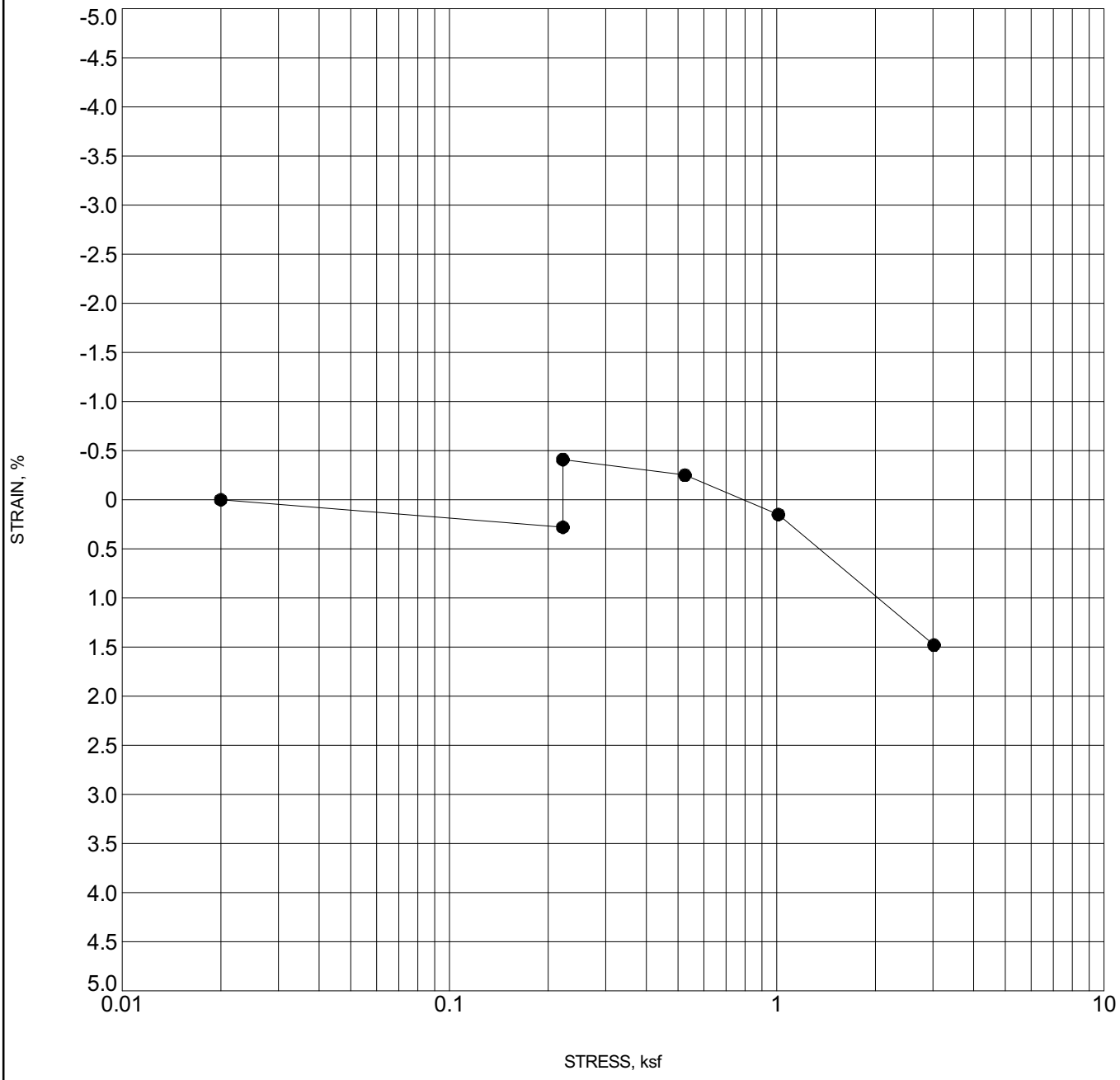
PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado



Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **PV-6**	**4.0**	**CLAY with SAND**	**0.7**	**102.7**	**22.2**

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

SWELL - CONSOLIDATION TEST

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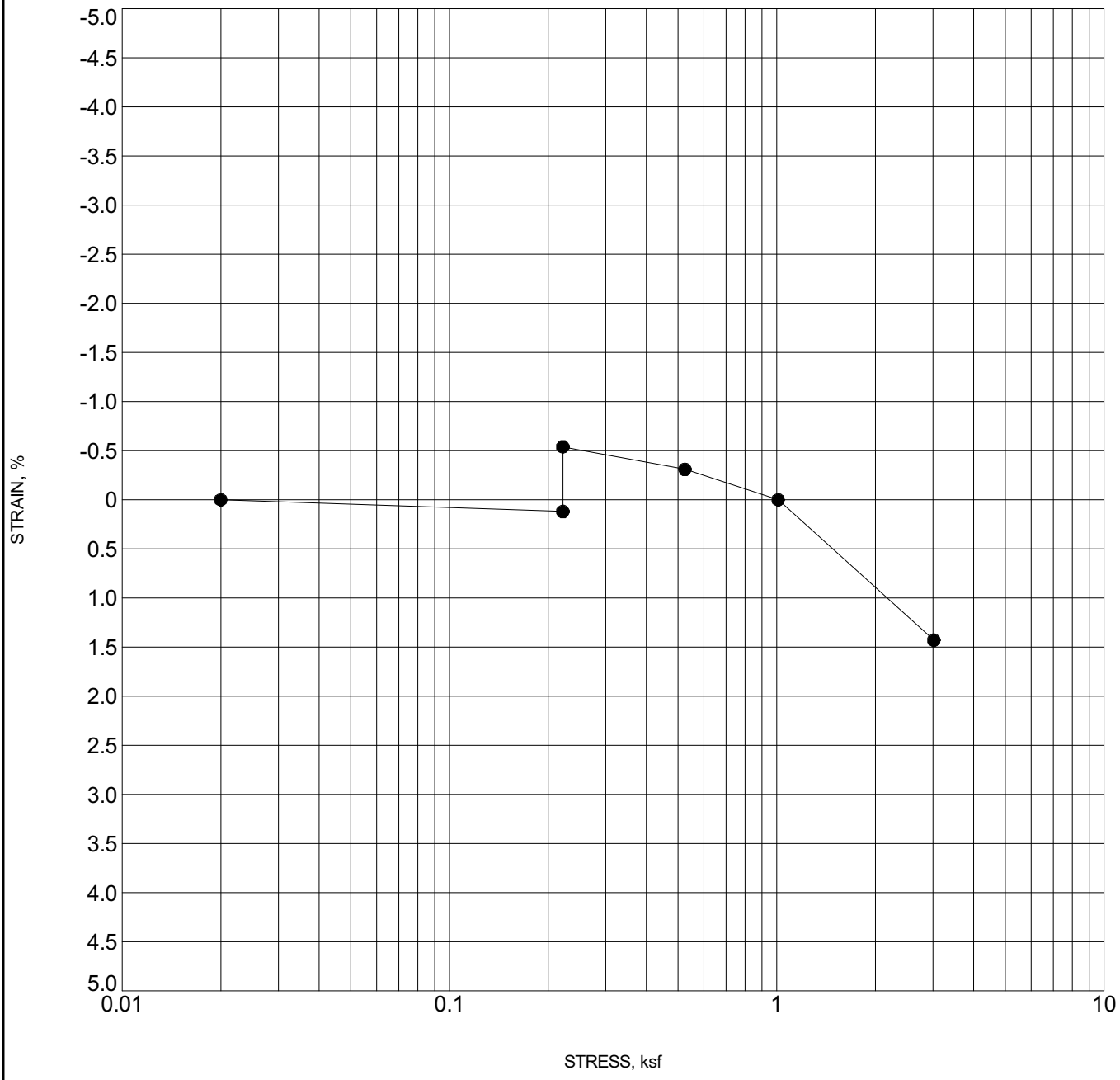

Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **PV-7**	**2.0**	**GRAVELLY SAND with CLAY**	**0.7**	**114.3**	**16.4**

SWELL - CONSOLIDATION TEST

RockSol Consulting Group, Inc.

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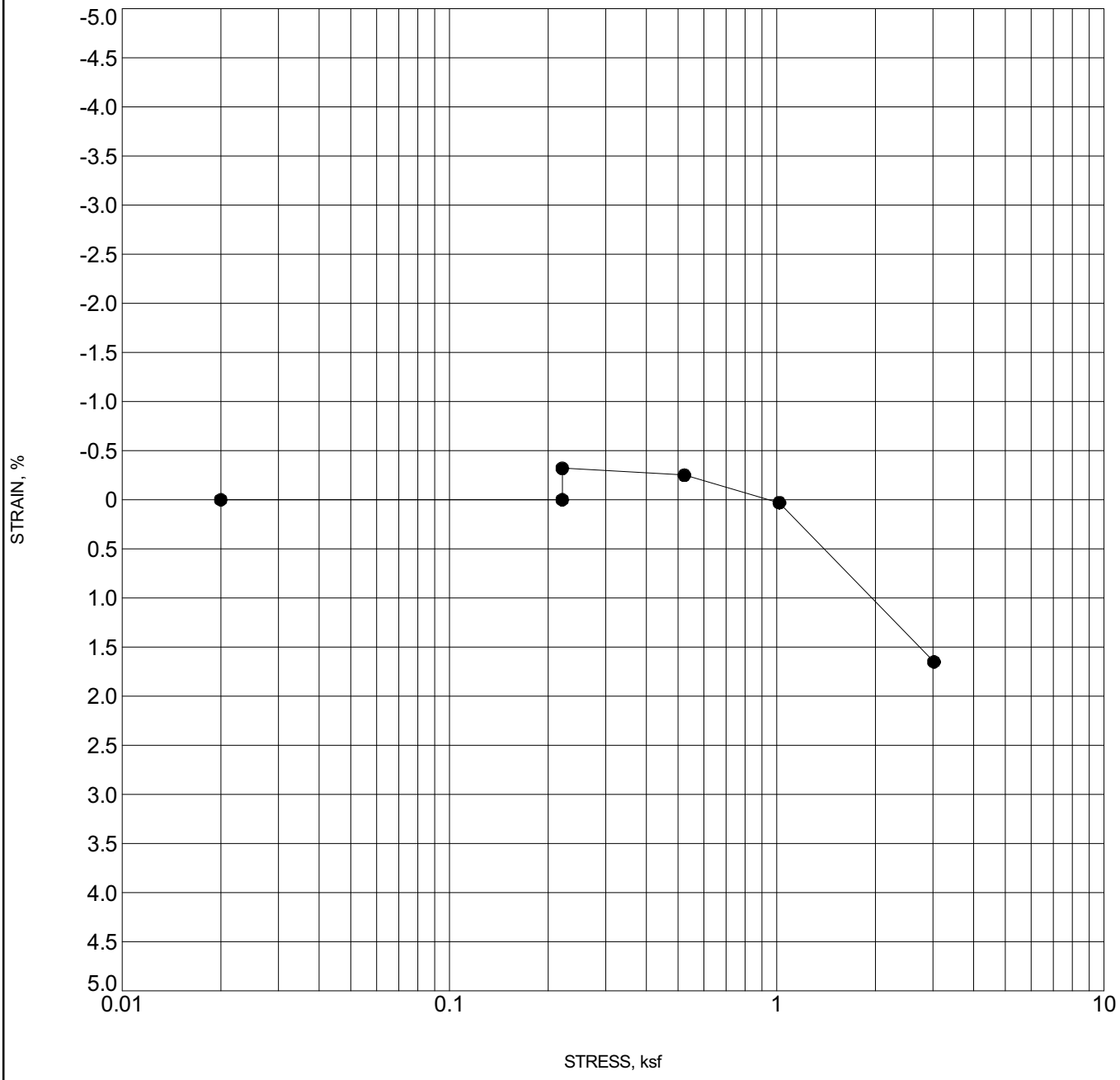
PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado



Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **PV-8**	**4.0**	**SANDY CLAY**	**0.3**	**103.5**	**21.4**

SWELL - CONSOLIDATION TEST

RockSol Consulting Group, Inc.

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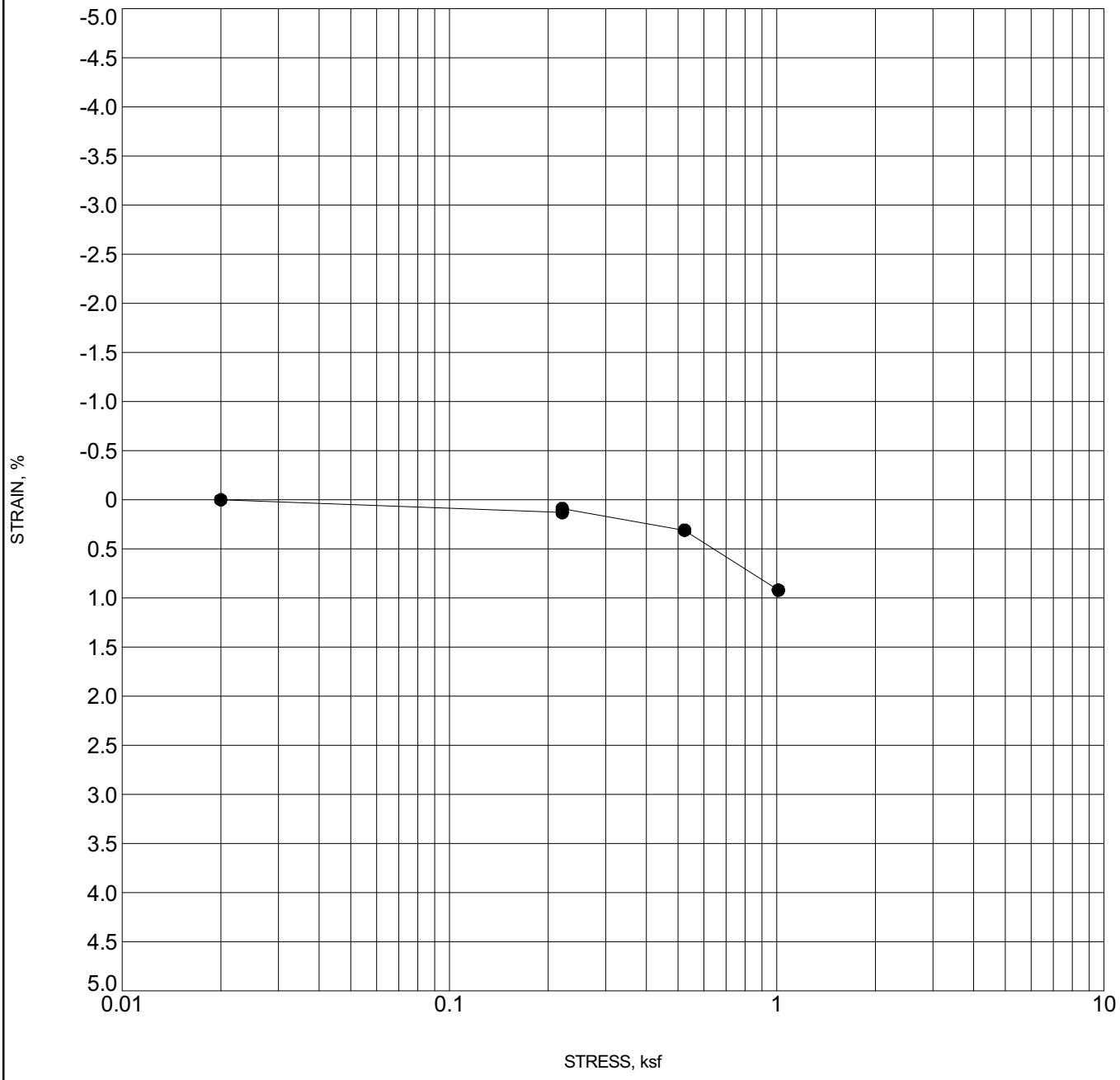

Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **PV-9**	**4.0**	**SAND with SILT**	**0.0**	**92.6**	**9.7**

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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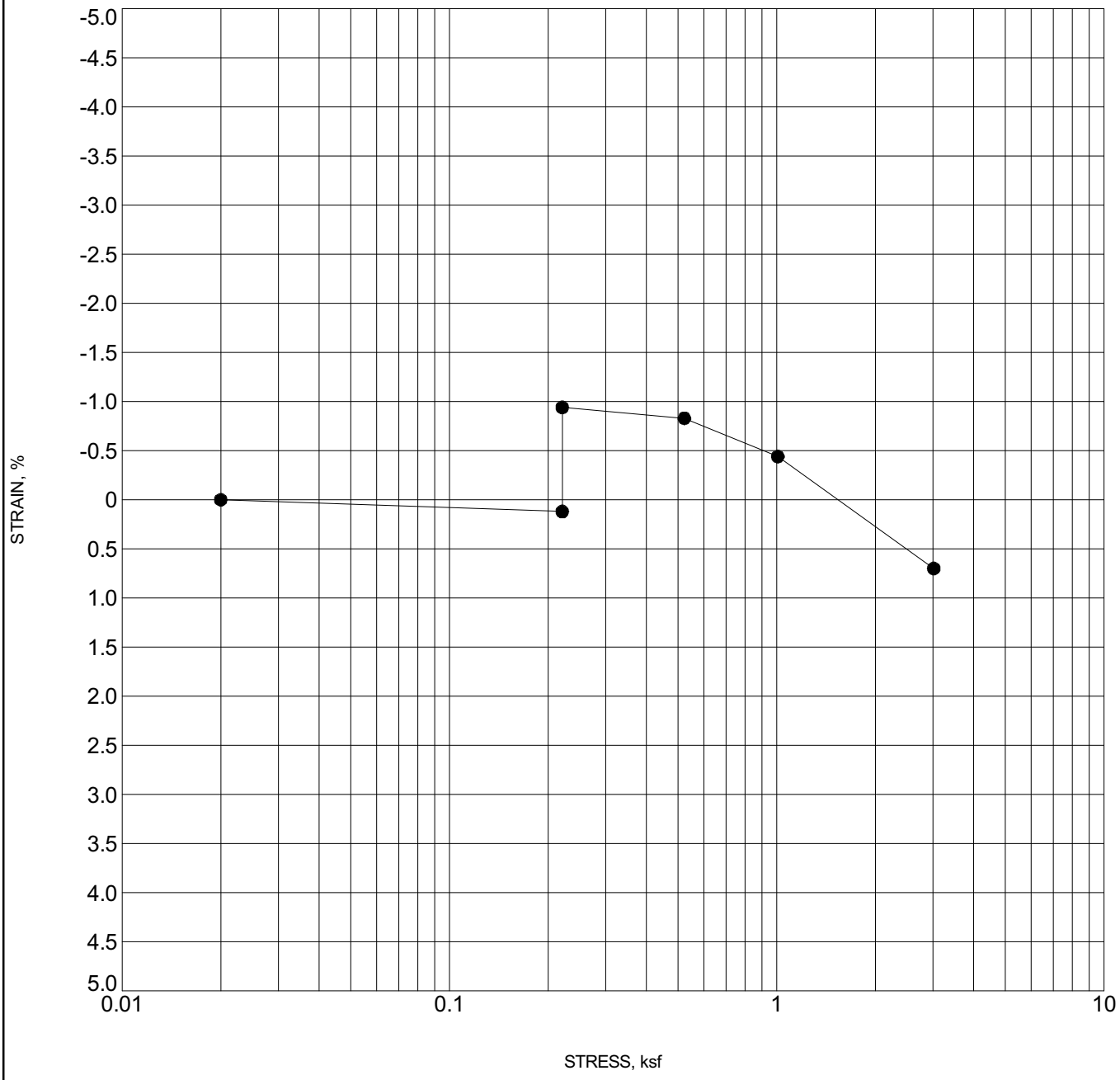


Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **PV-10**	**5.0**	**SANDY CLAY**	**1.1**	**102.5**	**24.0**

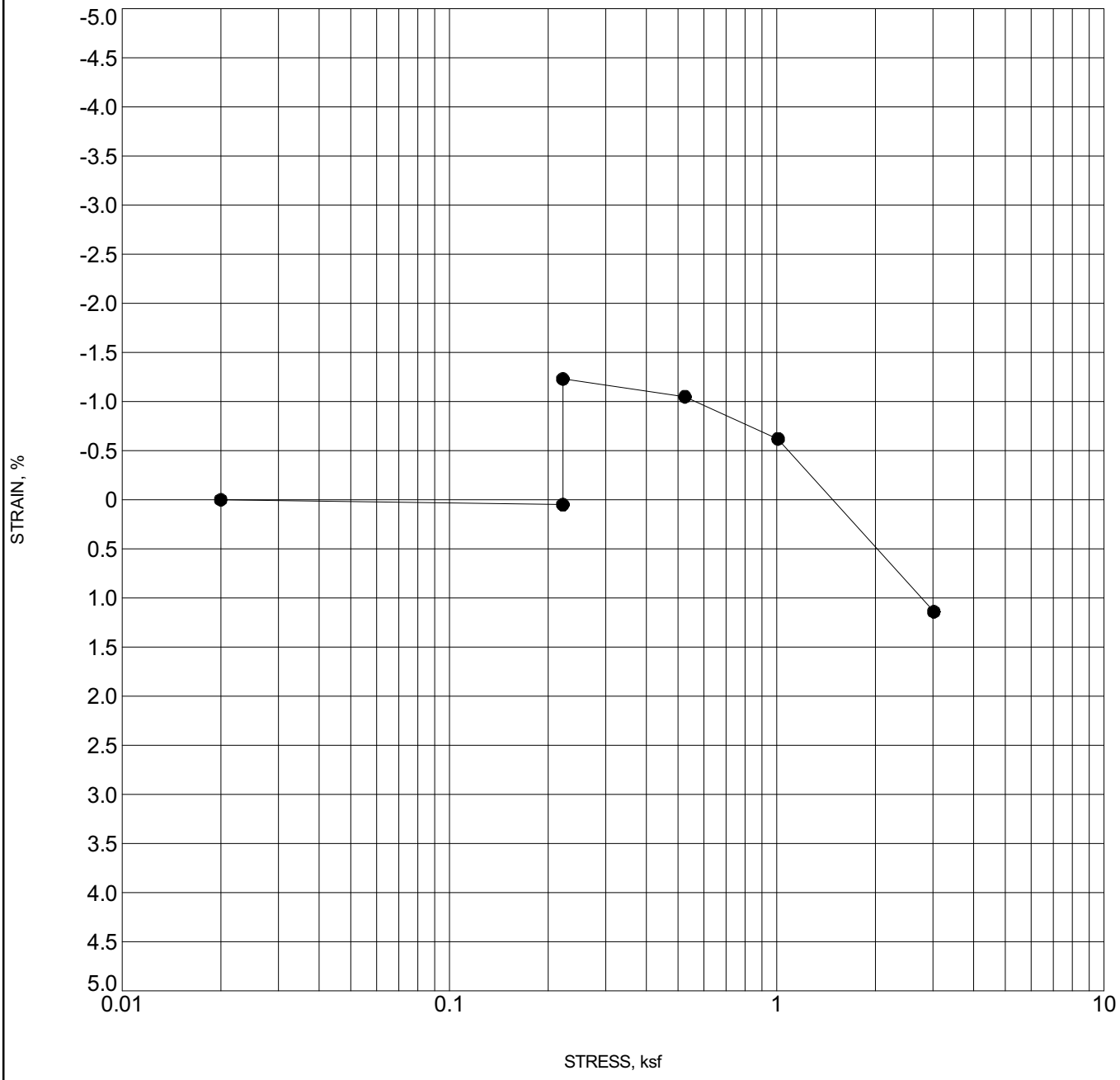
SWELL - STANDARD 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 8/10/12

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



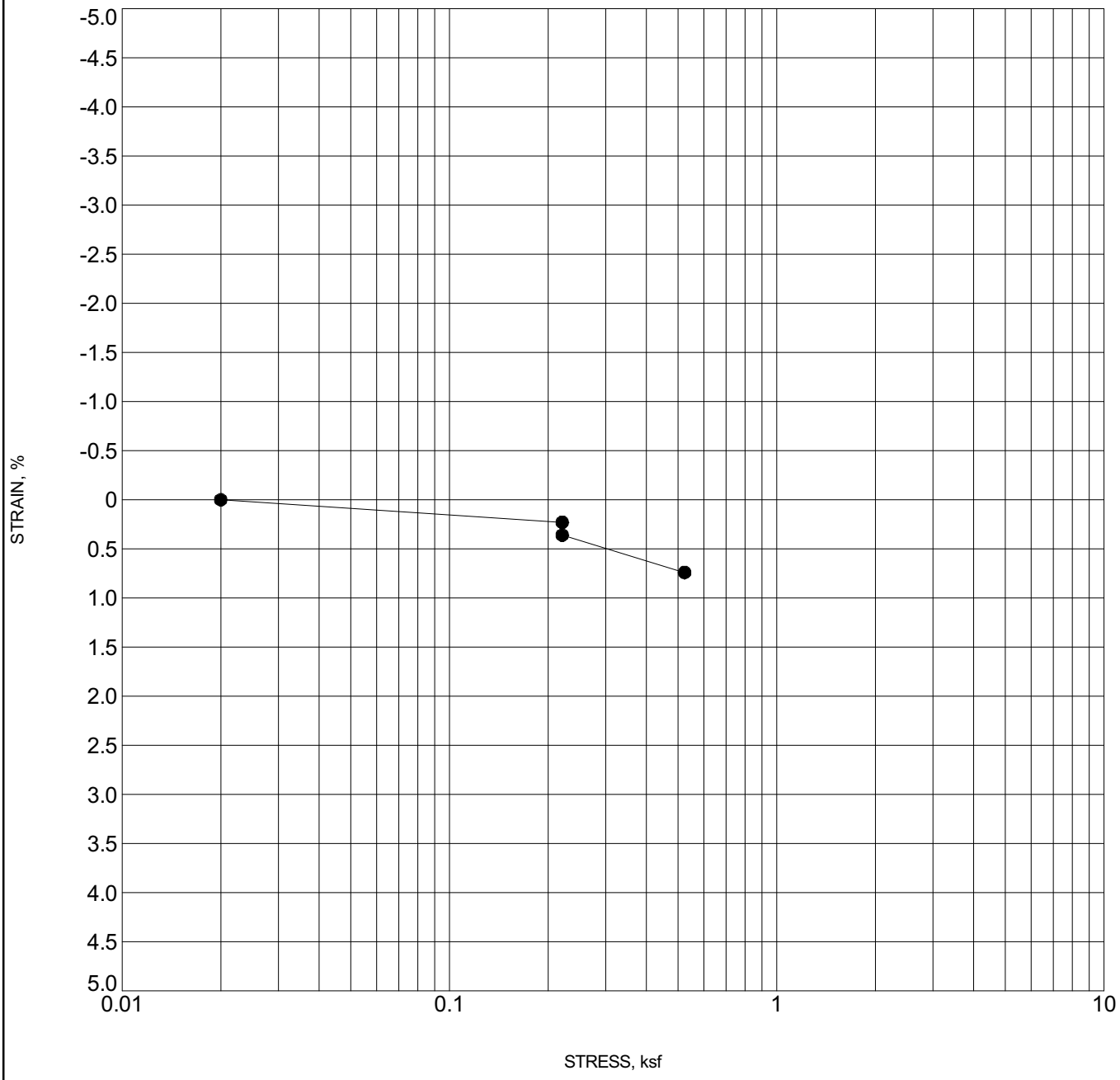
Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **PV-11**	**5.0**	**SANDY CLAY**	**1.3**	**114.0**	**13.7**

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%
● **PV-12**	**2.0**	**SILTY SAND**	**-0.1**	**115.9**	**7.3**

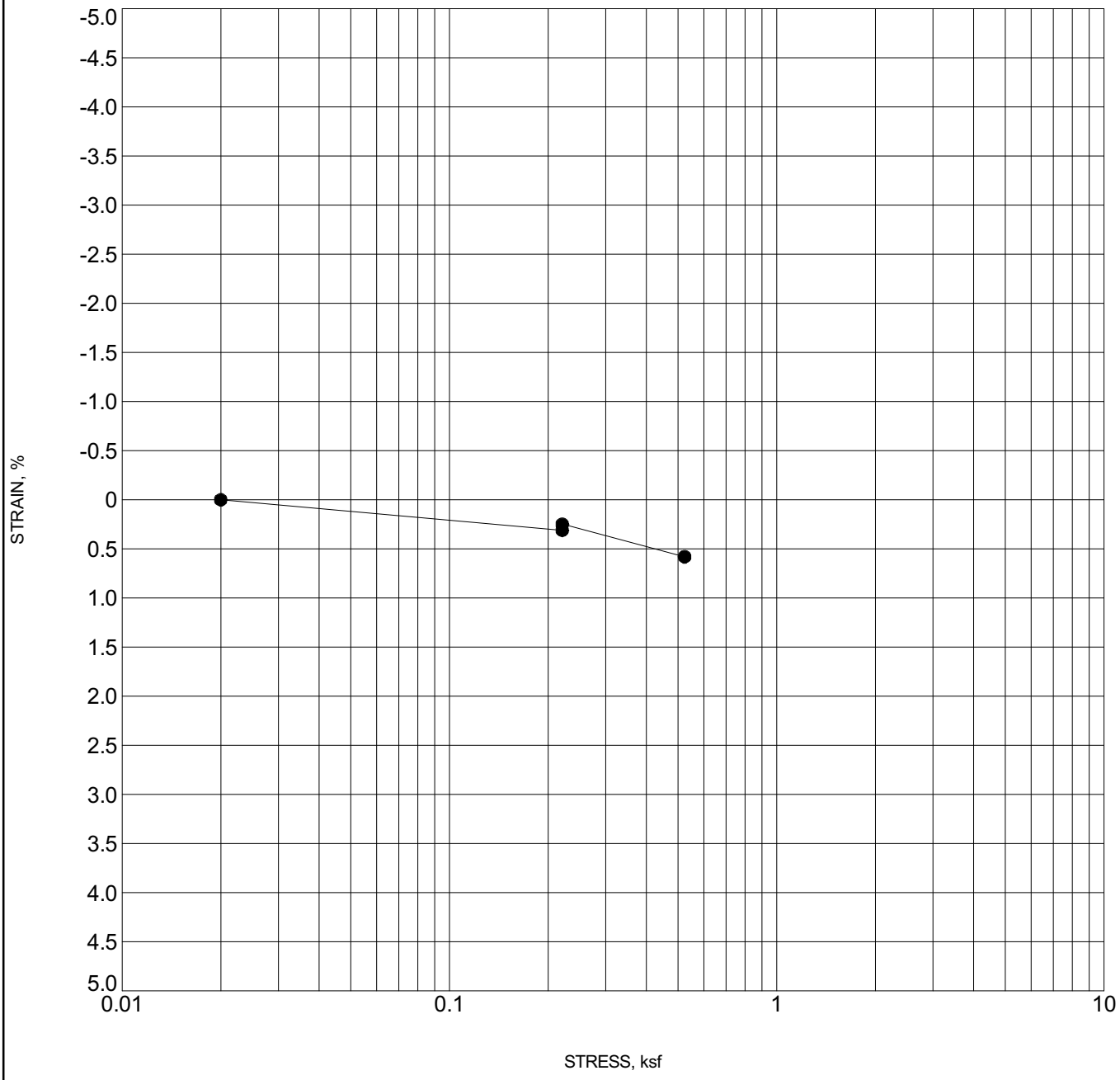
SWELL - STANDARD 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 8/10/12

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



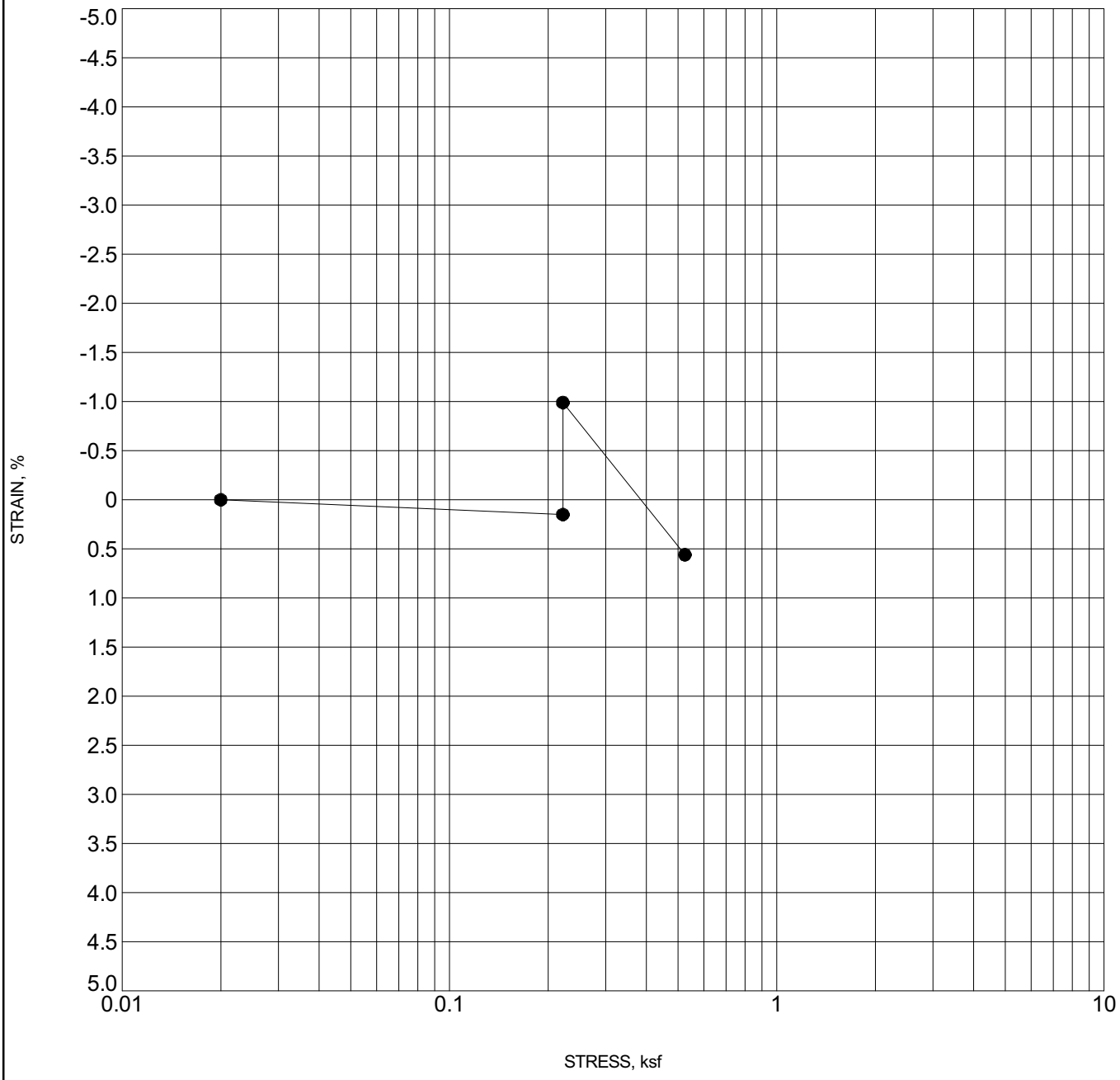
Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **PV-13**	**3.0**	**SANDY LEAN CLAY (CL)**	**0.1**	**104.3**	**20.3**

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%
● **PV-14**	**3.0**	**CLAY with SAND**	**1.1**	**96.9**	**26.0**

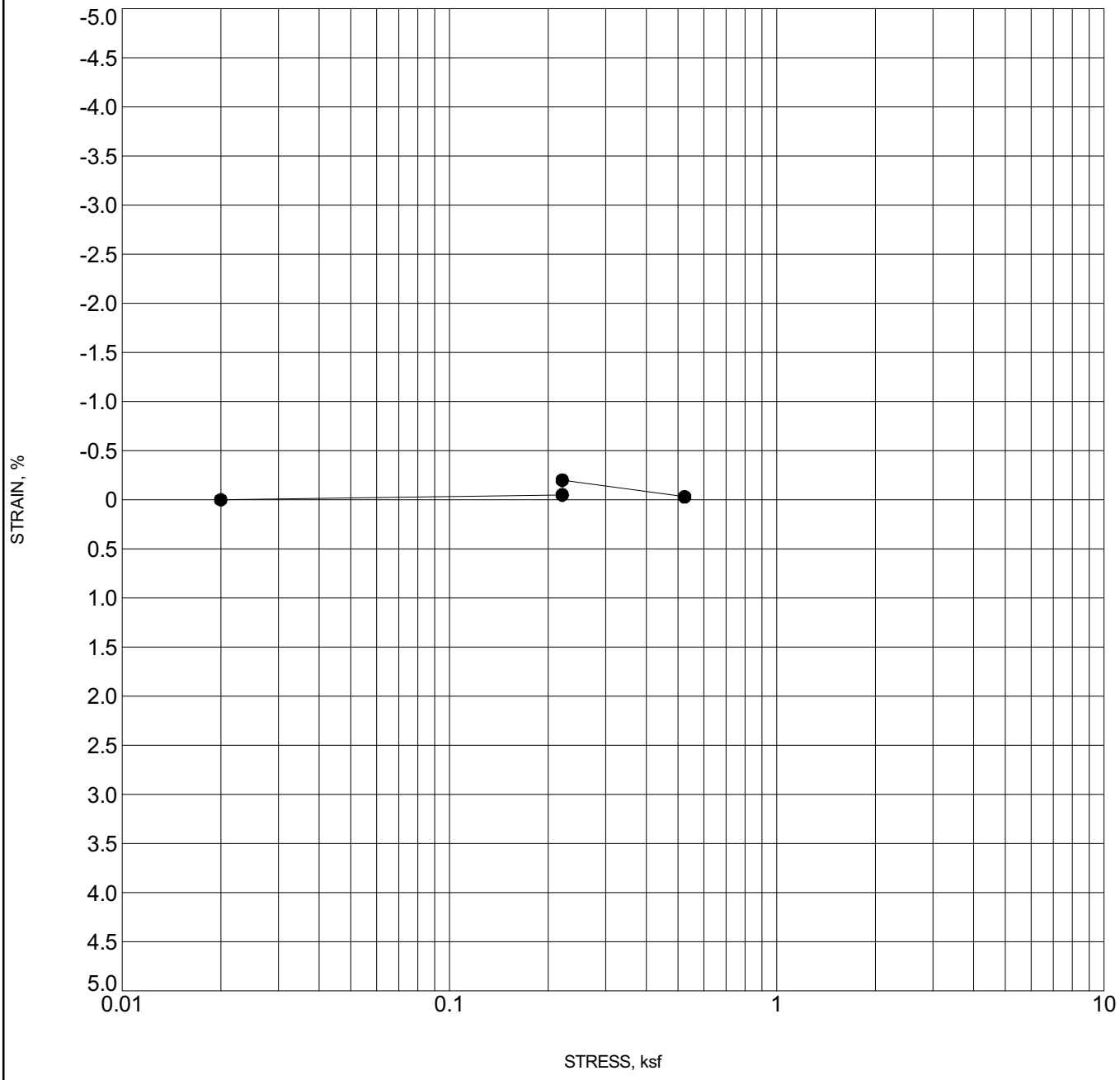
SWELL - STANDARD 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 8/10/12

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



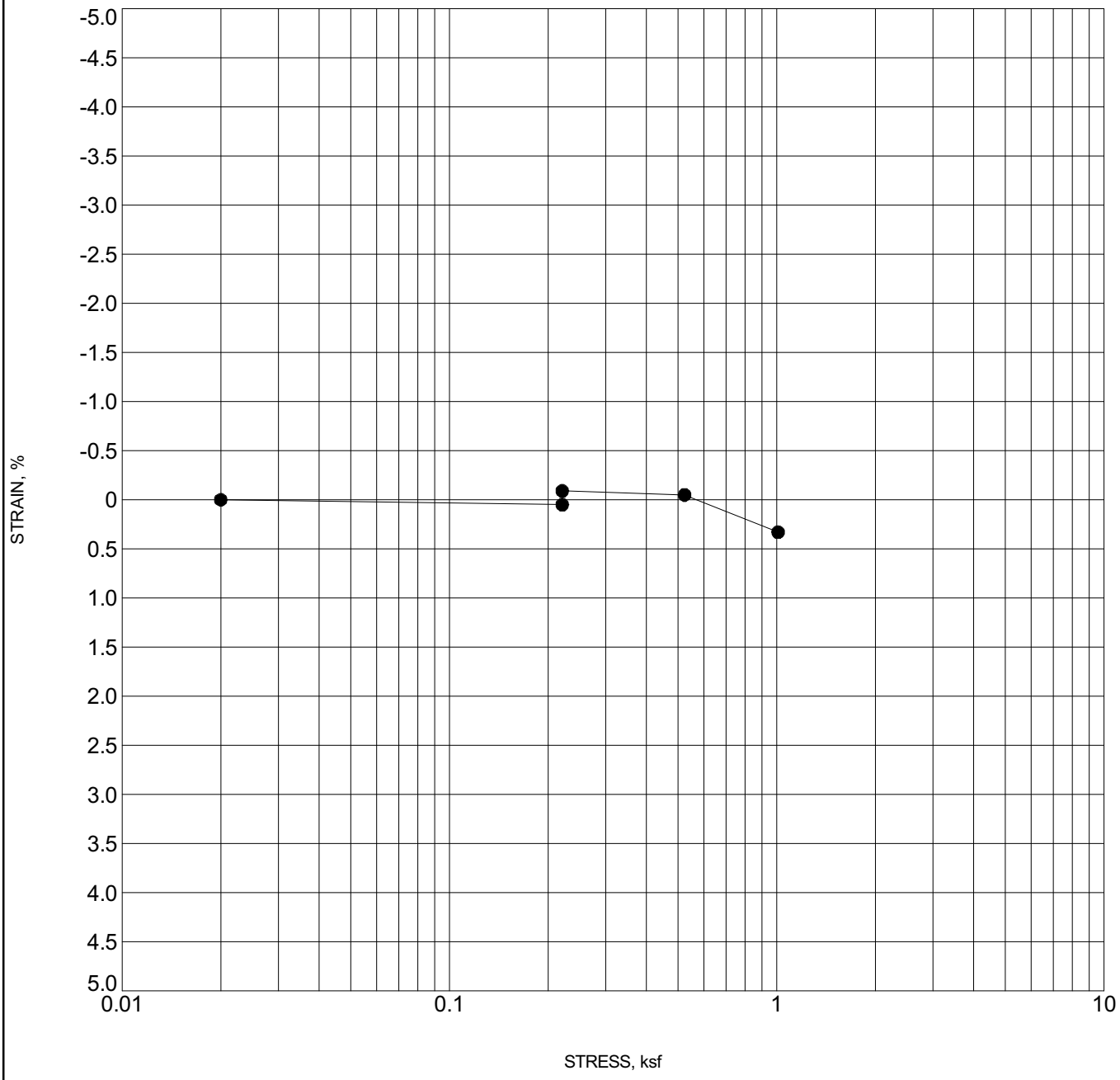
Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **PV-15**	**3.0**	**CLAY with SAND**	**0.2**	**92.7**	**25.2**

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



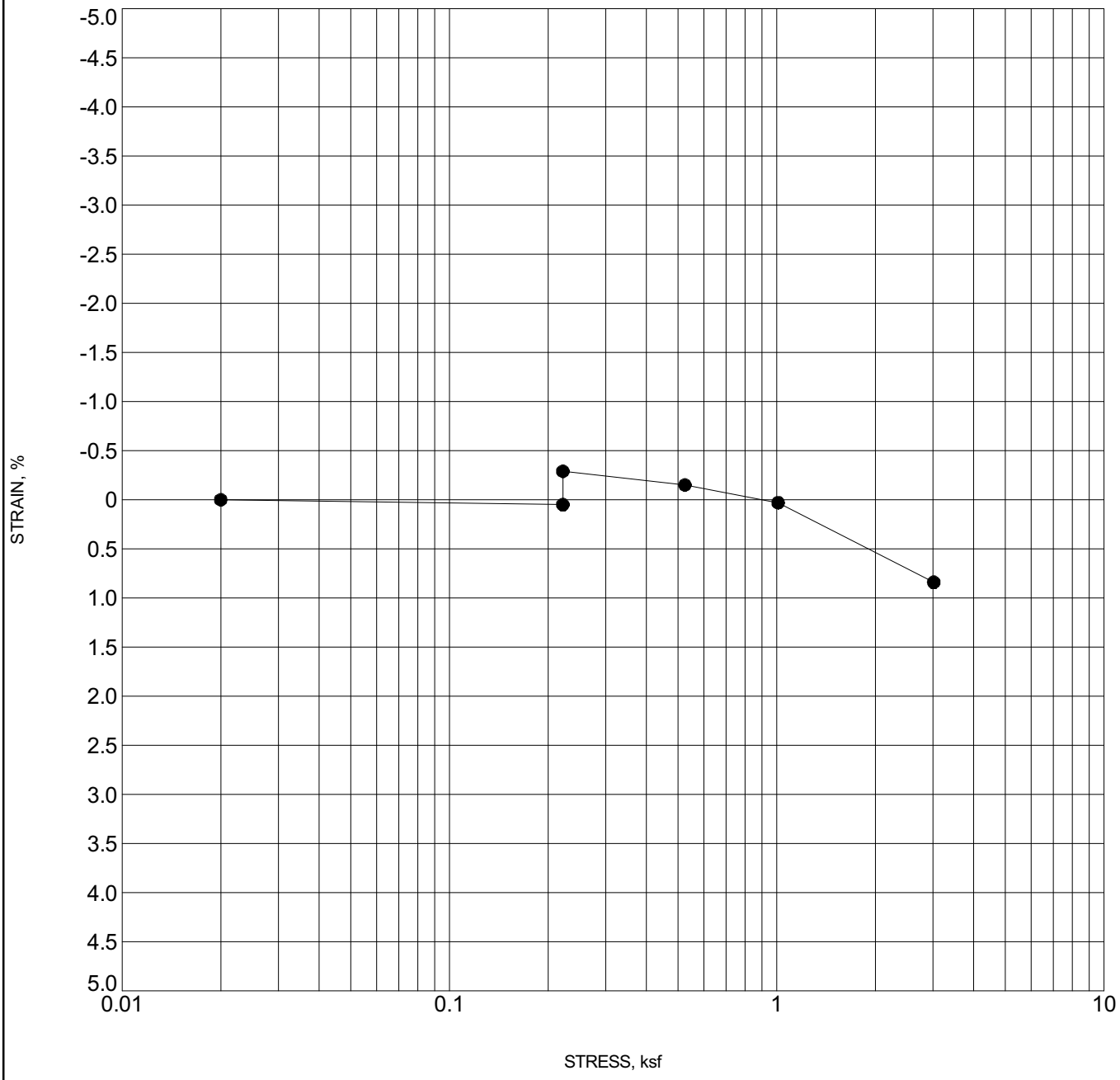
Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **PV-17**	**4.0**	**CLAYEY SAND**	**0.2**	**113.8**	**17.2**

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%
● **PV-18**	**3.5**	**CLAYEY SAND**	**0.4**	**107.4**	**15.3**

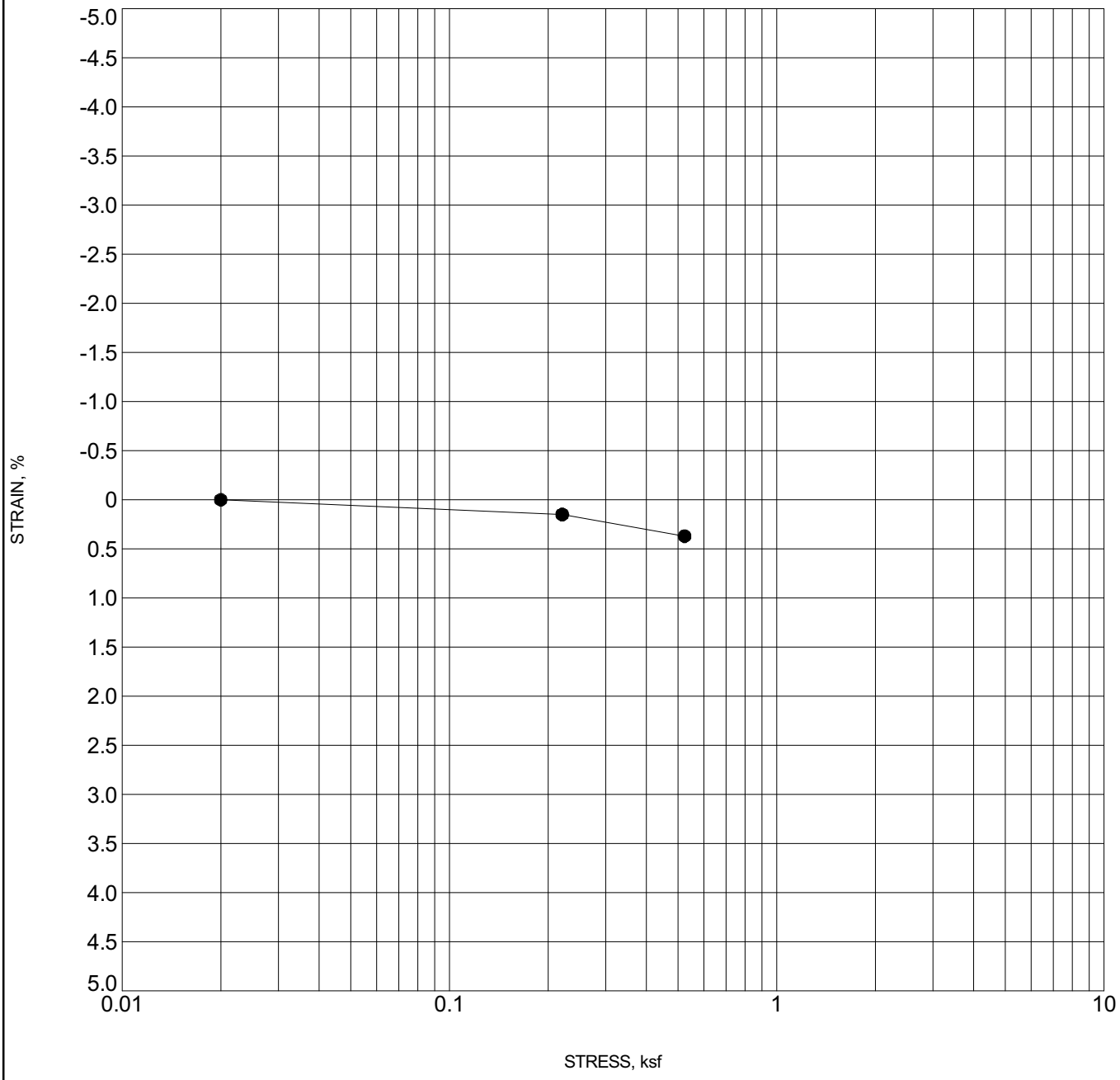
SWELL - STANDARD 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 8/10/12

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



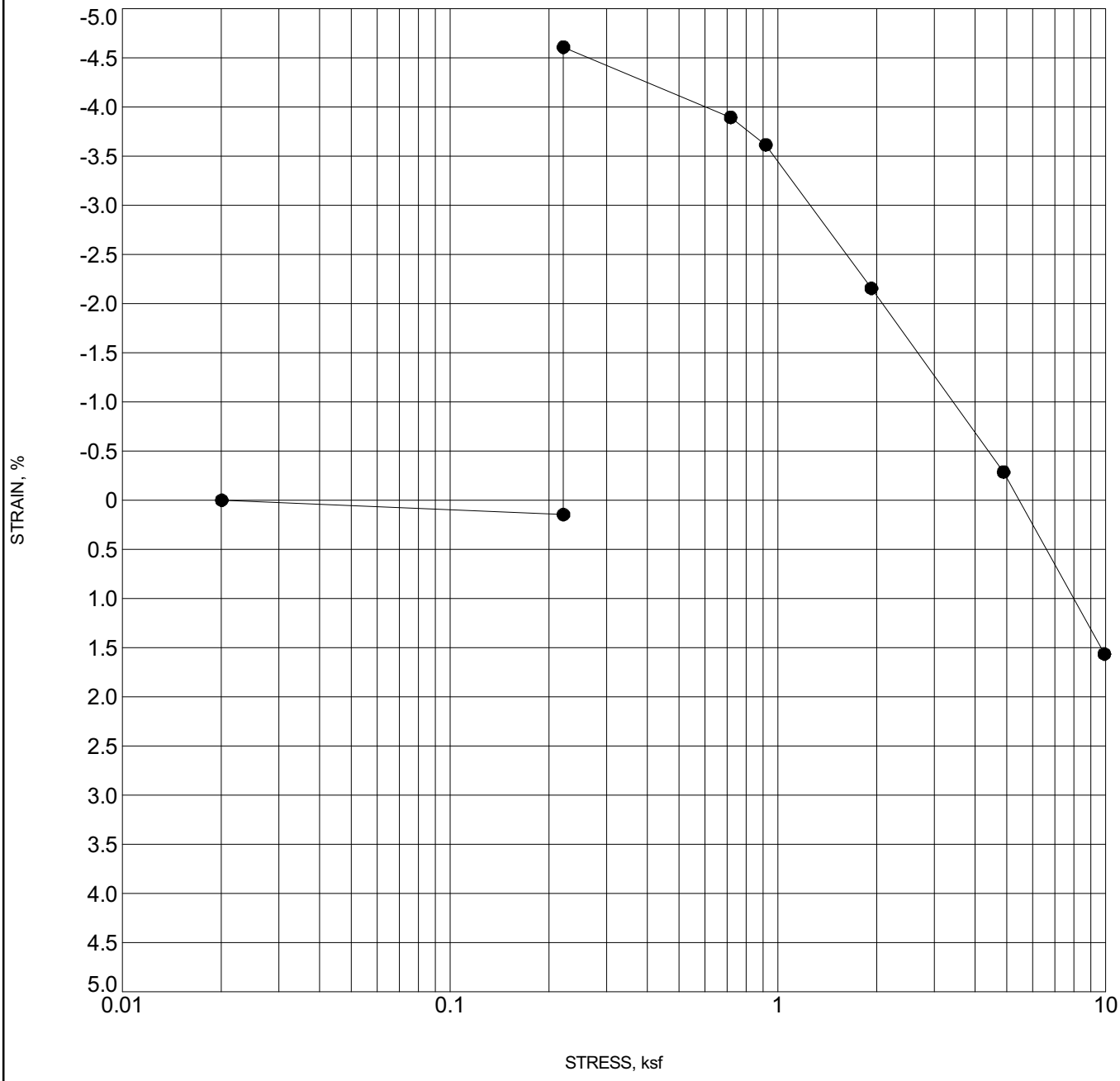
Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **PV-20**	**2.5**	**GRAVELLY SAND**	**0.0**	**117.6**	**9.4**

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



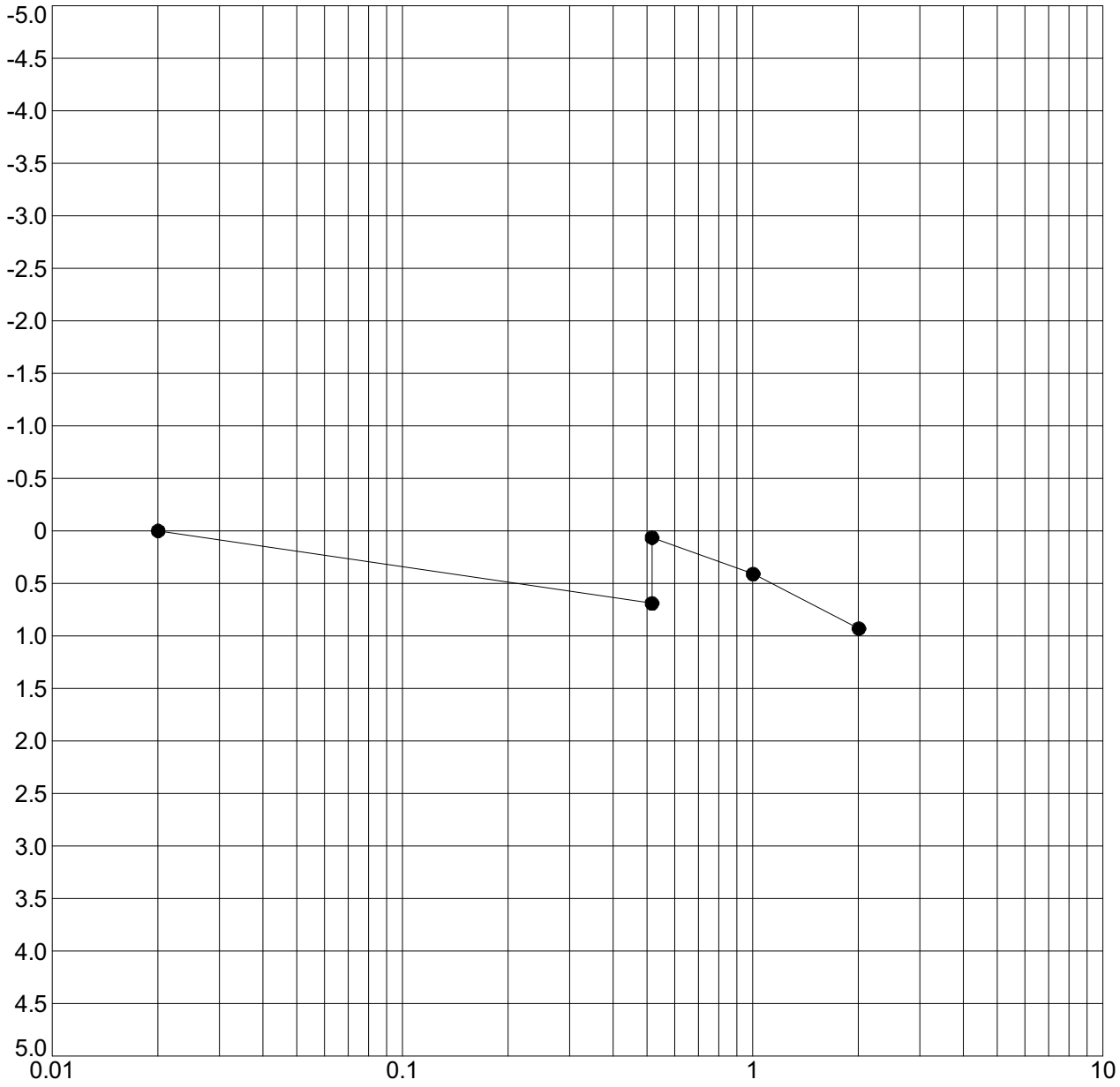
Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **PV-22**	**4.0**	**(Bedrock) CLAYSTONE**	**4.8**	**104.0**	**23.4**

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



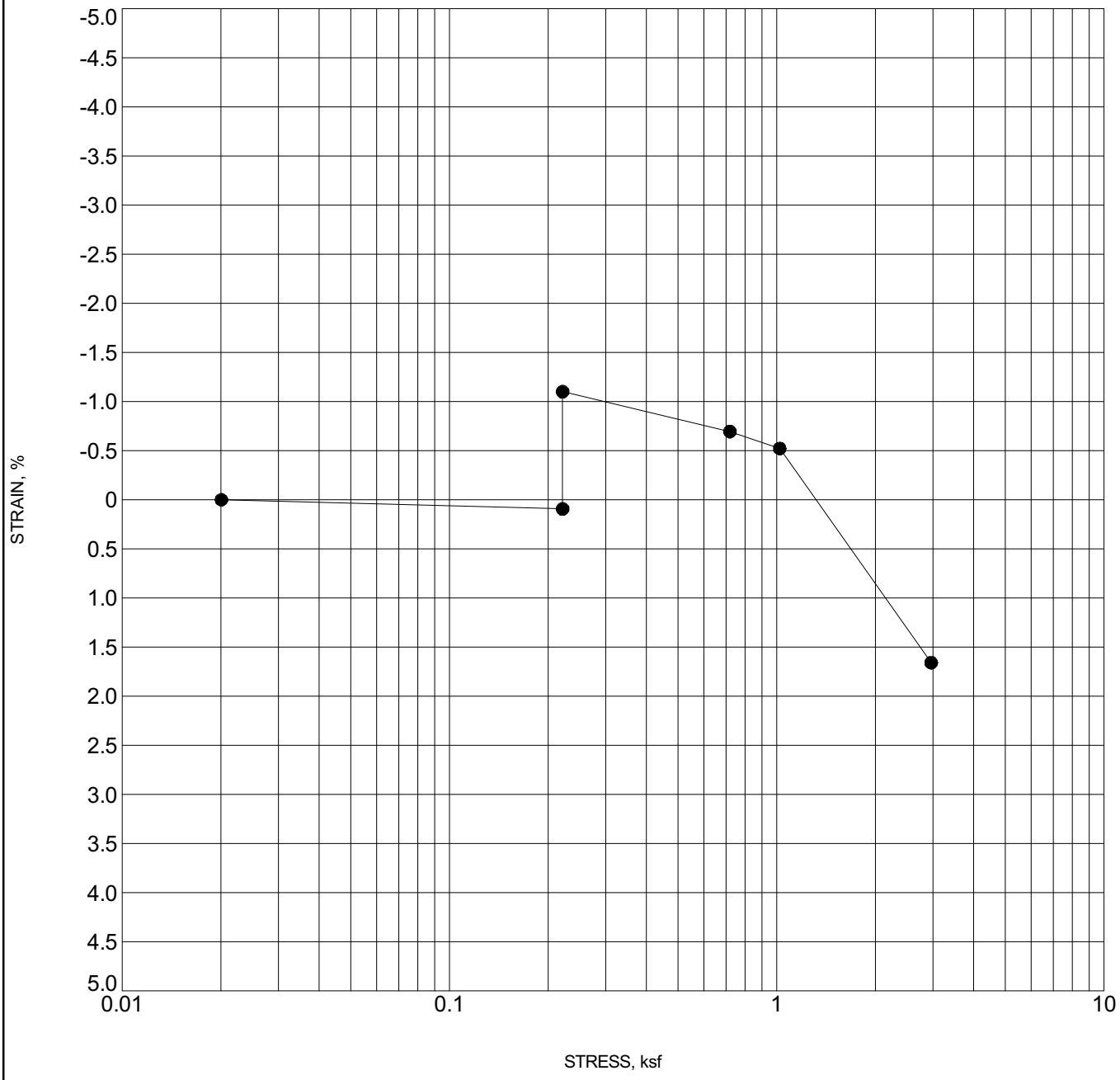
Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **PV-22**	**9.0**	**(Bedrock) CLAYSTONE**	**0.6**	**102.8**	**23.8**

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



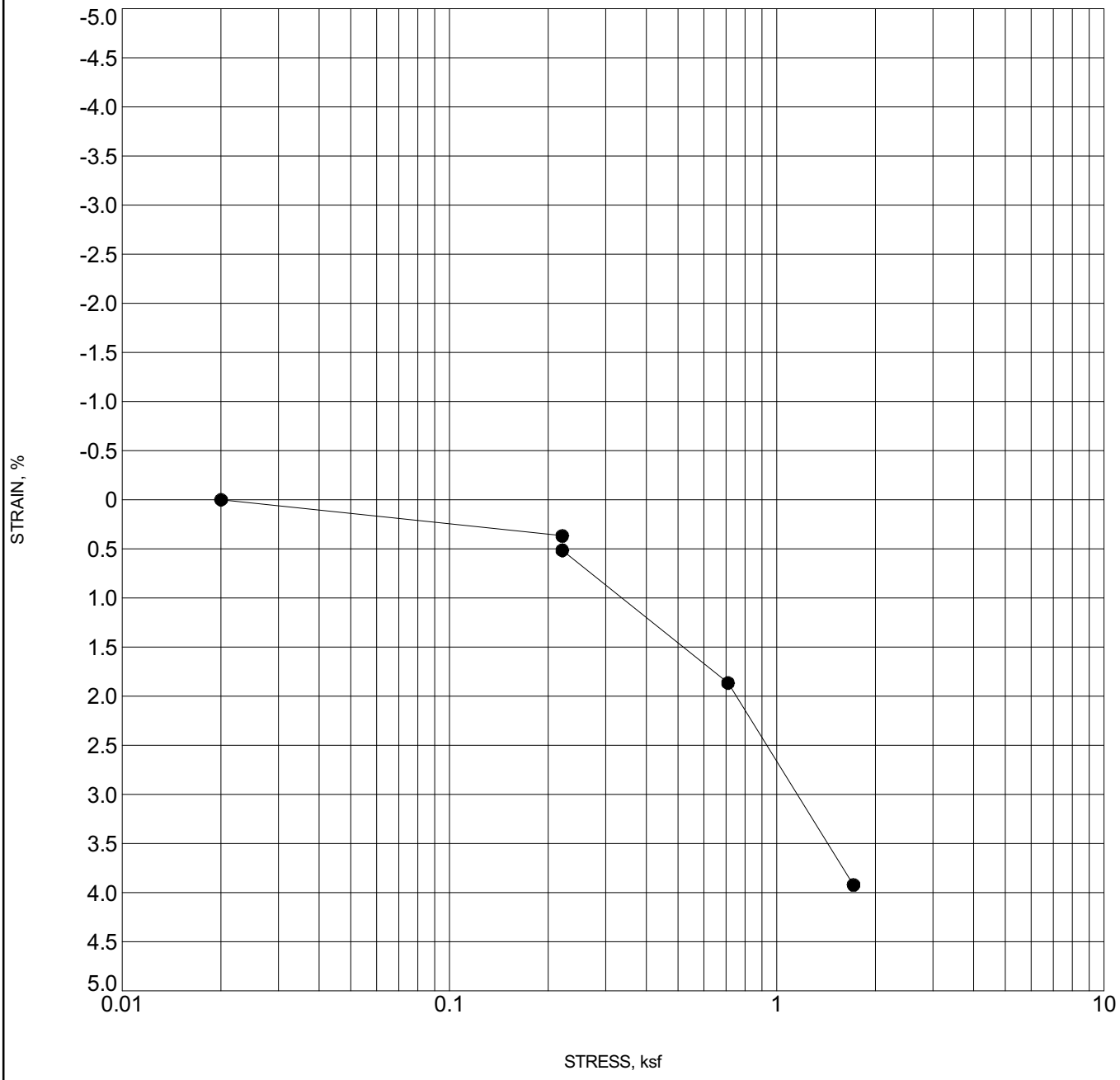
Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **PV-23**	**2.0**	**SANDY CLAY**	**1.2**	**98.2**	**26.2**

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%
● **PV-23**	**4.0**	**CLAY with SAND**	**-0.2**	**89.0**	**31.2**

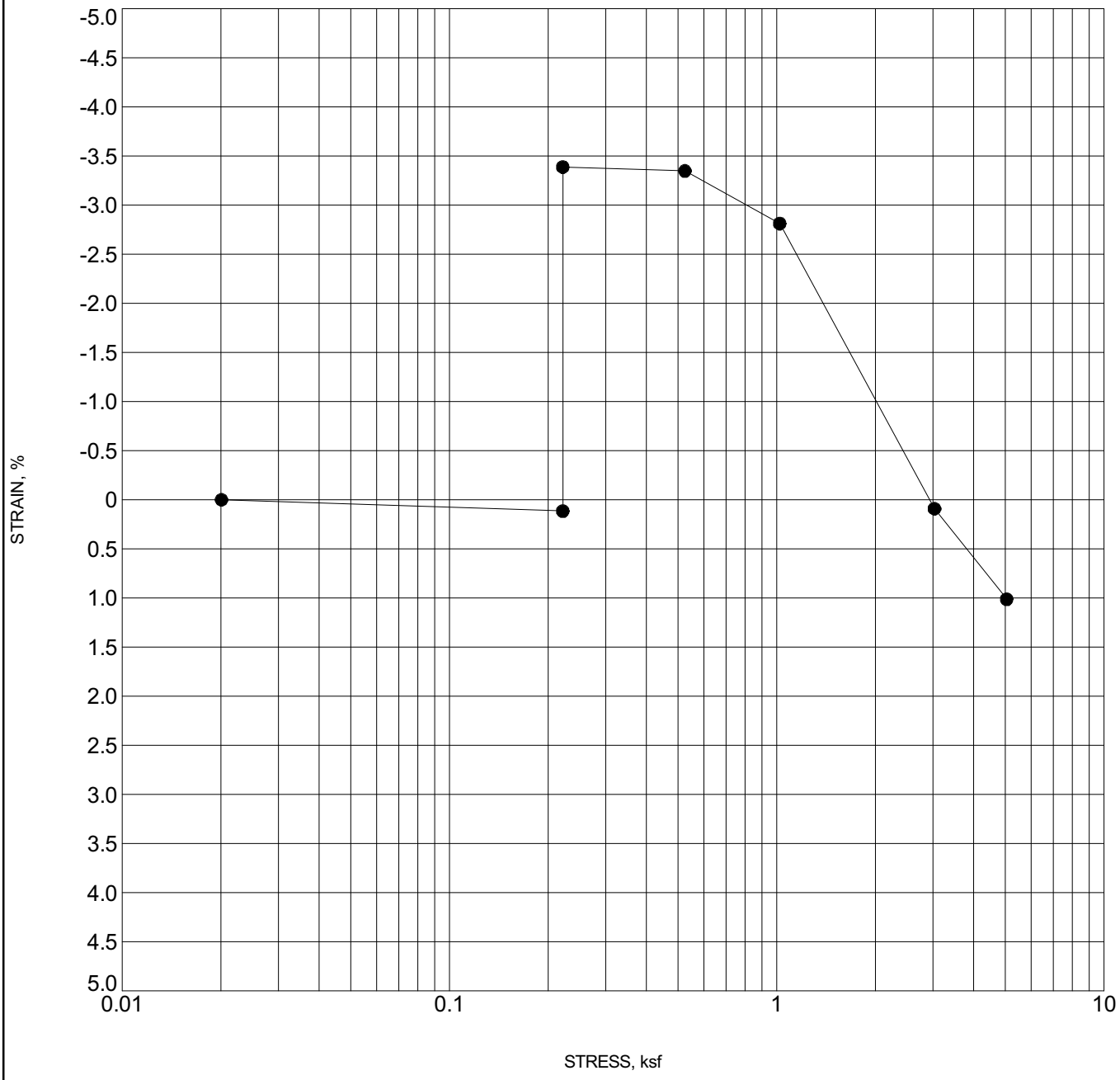
SWELL - STANDARD 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 8/10/12

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%
● **PV-24**	**2.0**	**CLAYEY SAND**	**3.5**	**111.3**	**18.7**

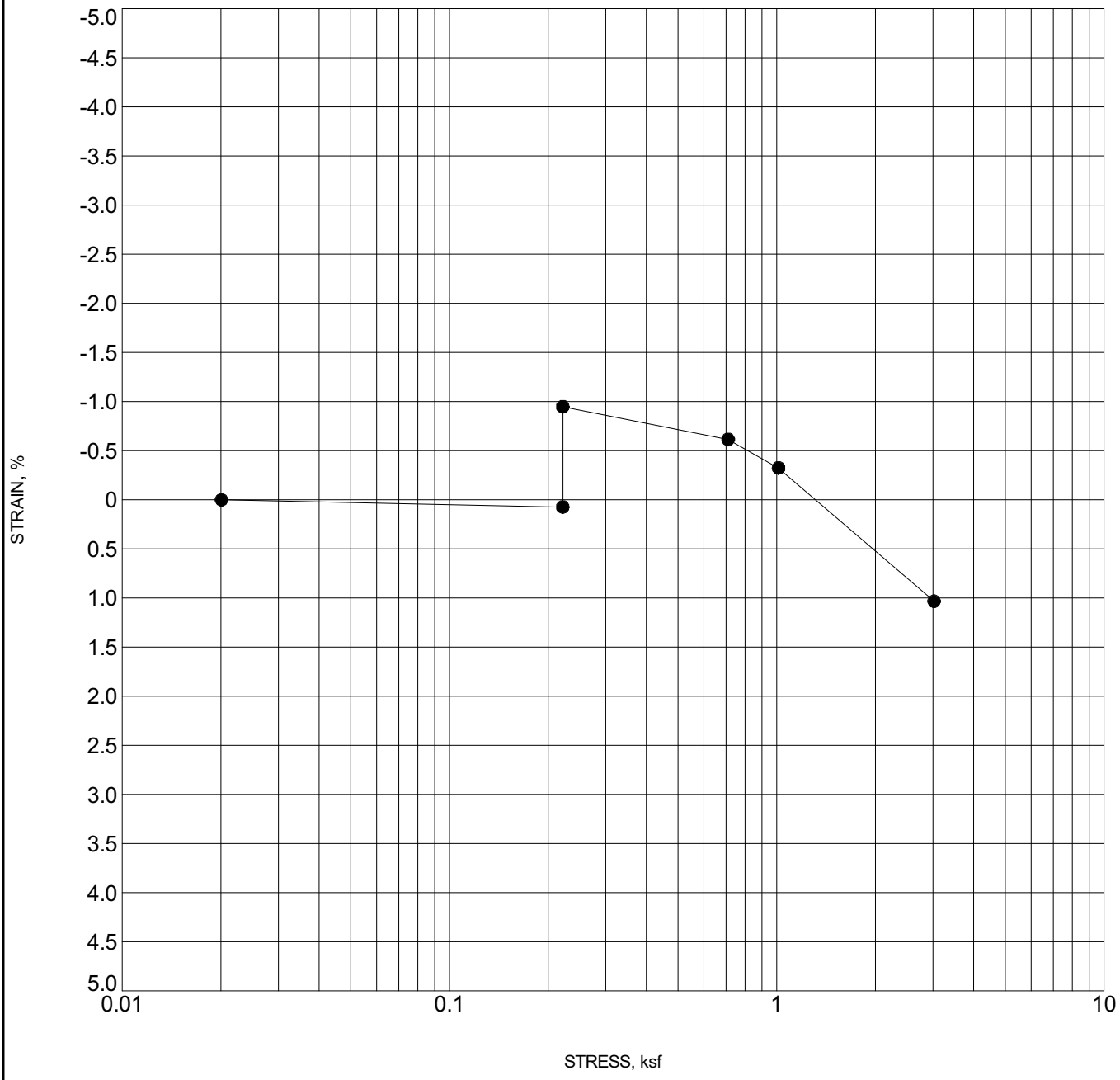
SWELL - STANDARD 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 8/10/12

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%
● **PV-24**	**4.0**	**SANDY CLAY**	**1.0**	**104.4**	**18.9**

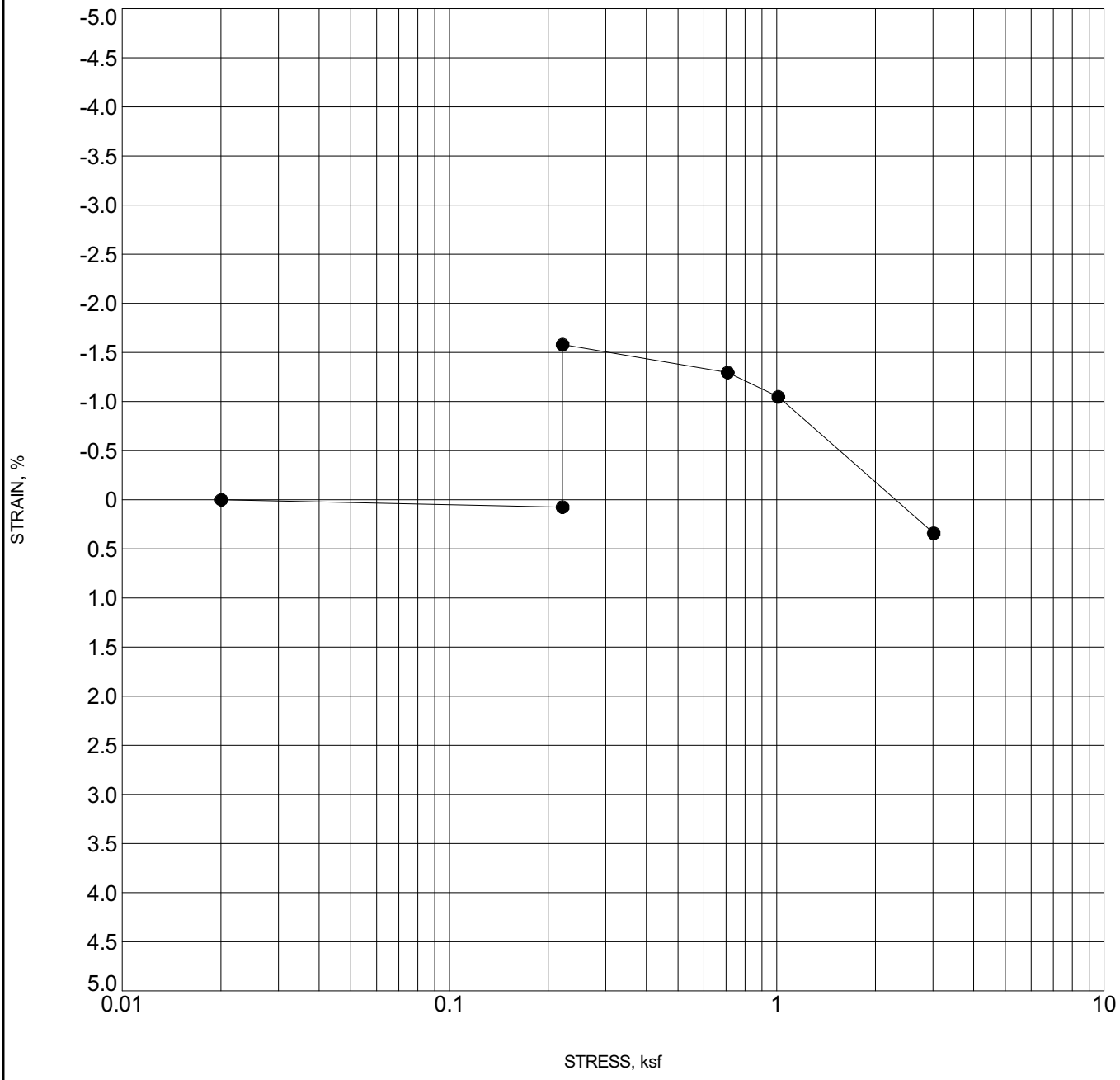
SWELL - STANDARD 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 8/10/12

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



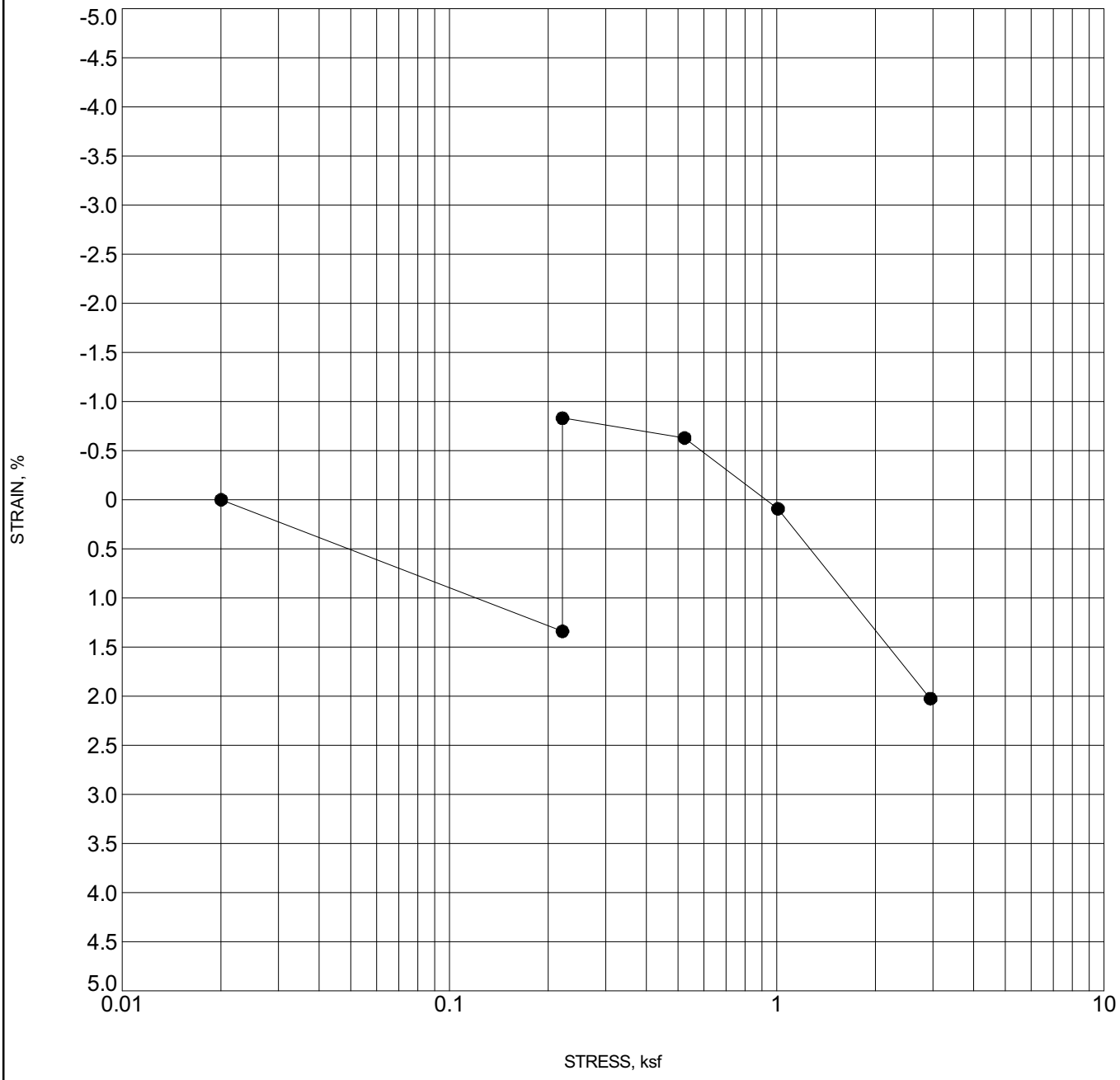
Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **PV-25**	**2.0**	**SANDY CLAY**	**1.7**	**113.4**	**17.2**

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



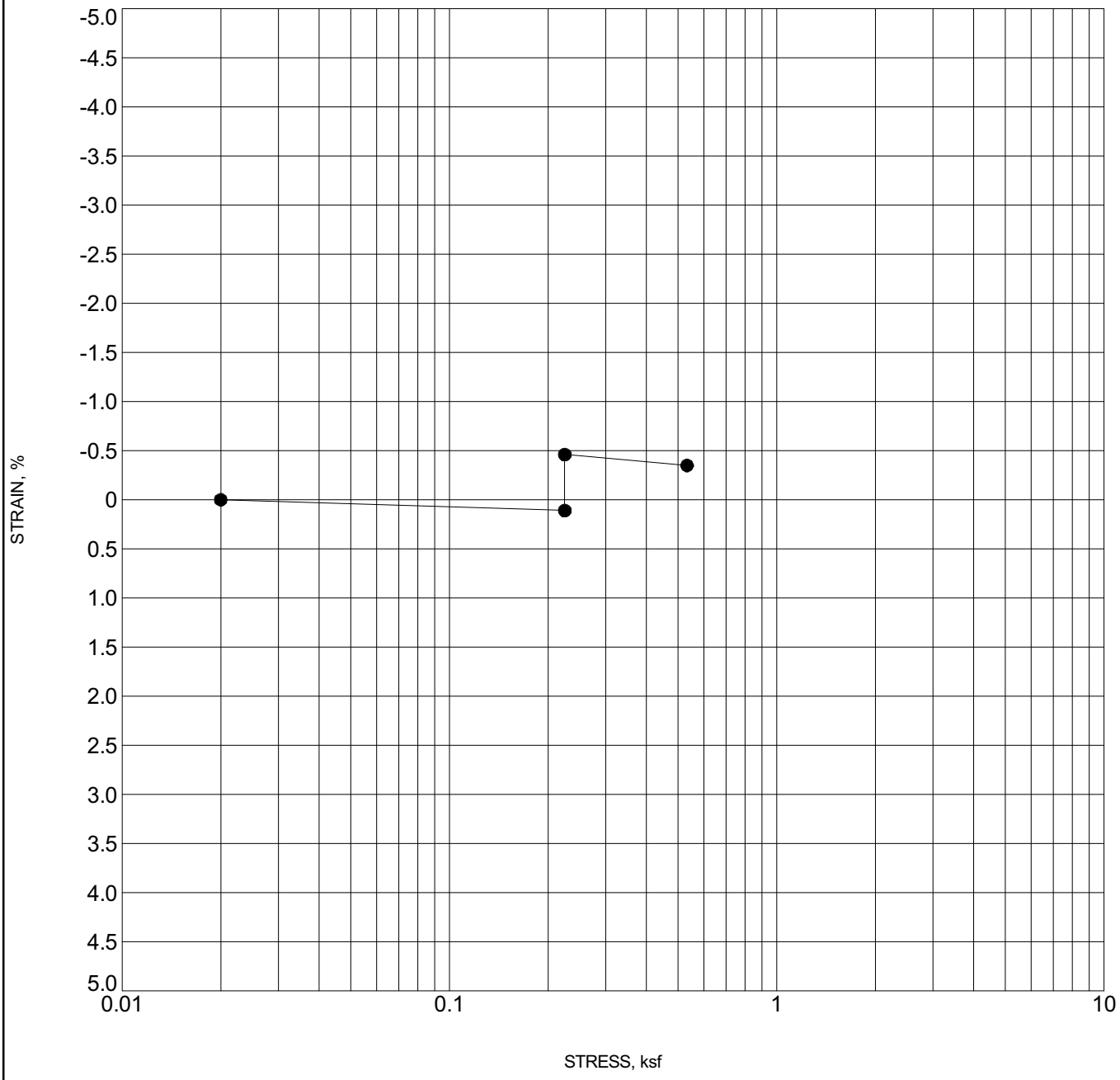
Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **PV-25**	**4.0**	**SANDY CLAY**	**2.2**	**102.0**	**23.2**

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



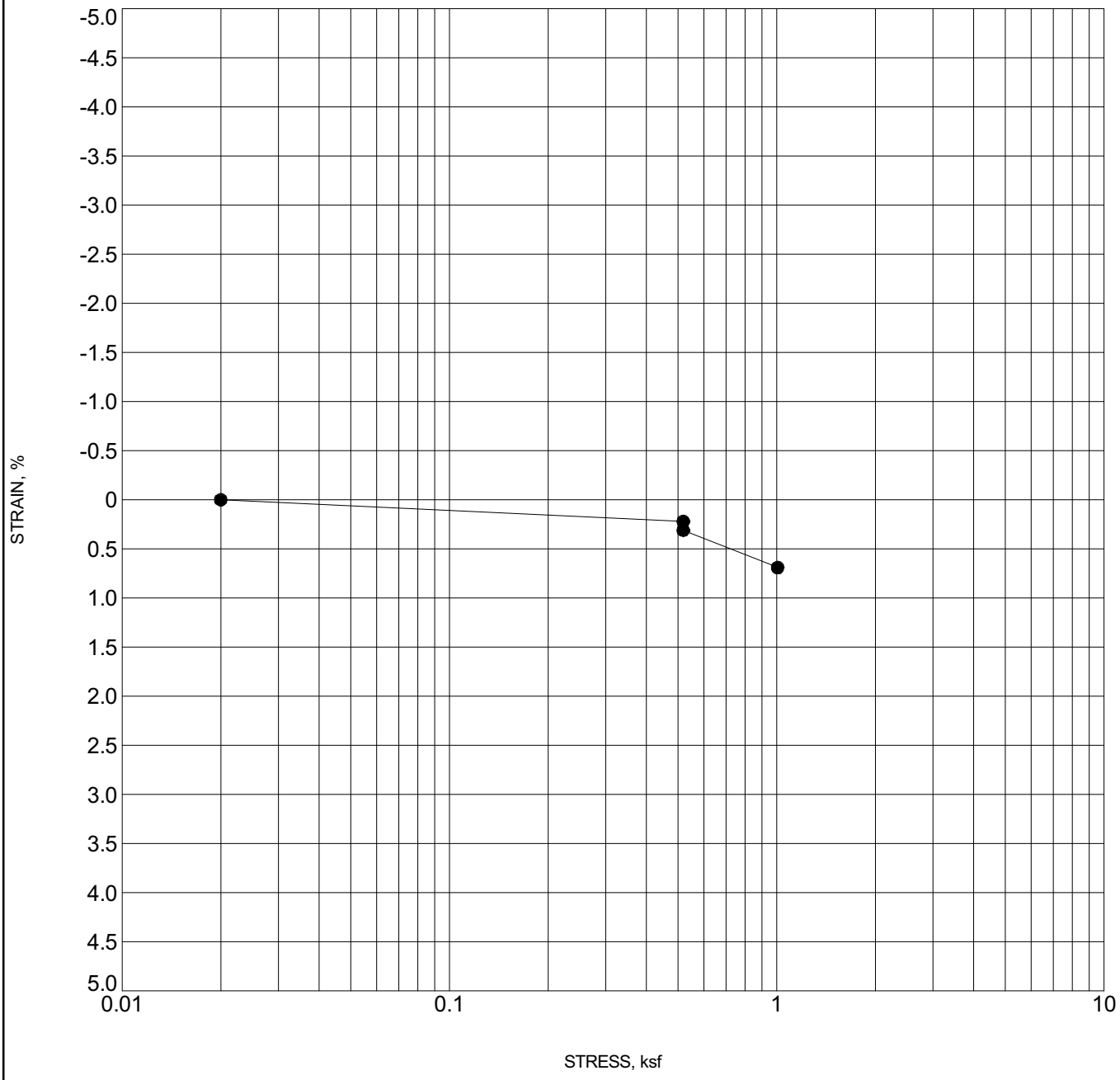
Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **RW 1-1**	**2.0**	**(Fill) SANDY CLAY**	**0.6**	**97.1**	**24.6**

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



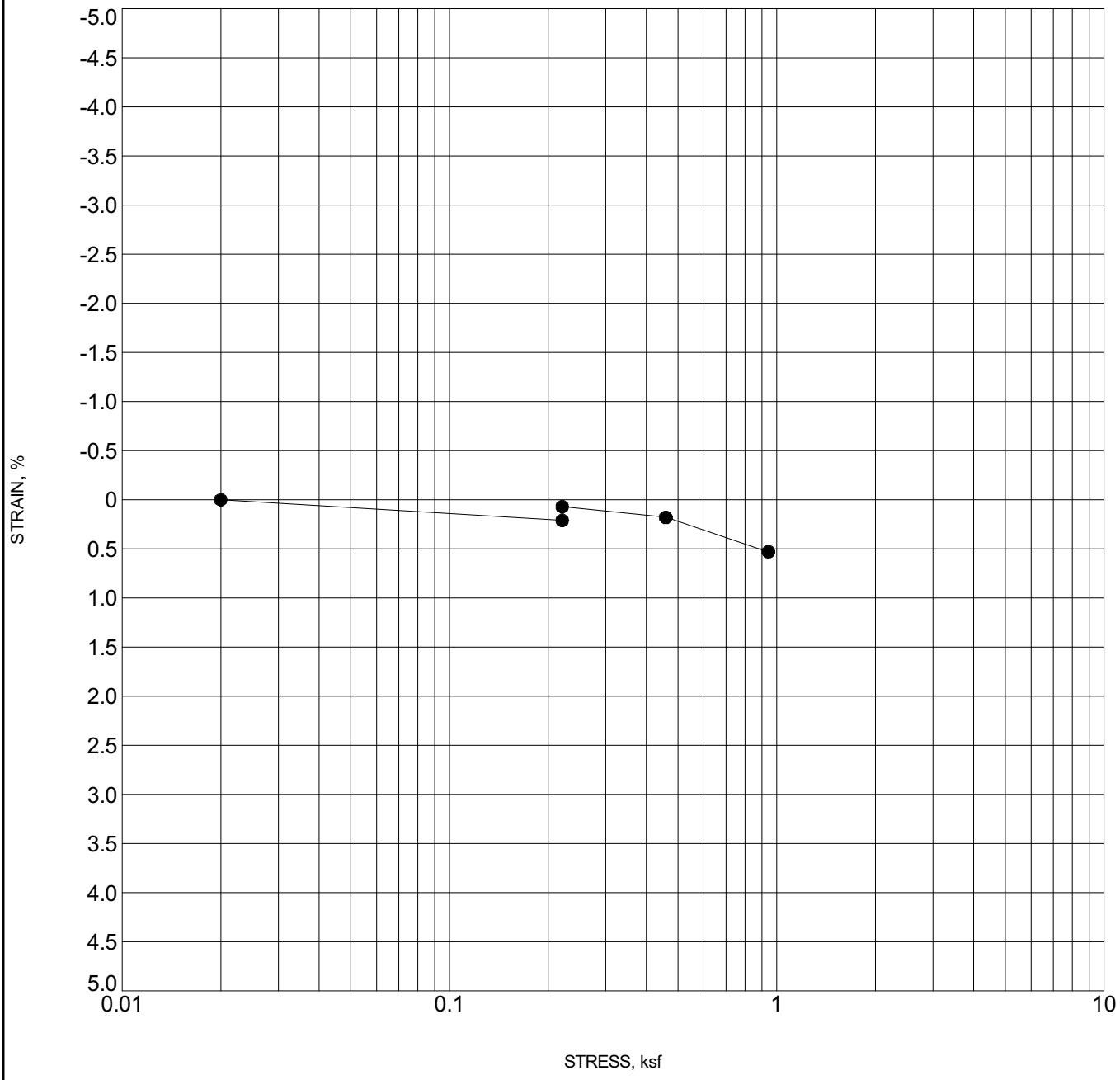
Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **RW 1-1**	**5.0**	**(Fill) SANDY CLAY**	**-0.1**	**99.5**	**24.2**

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



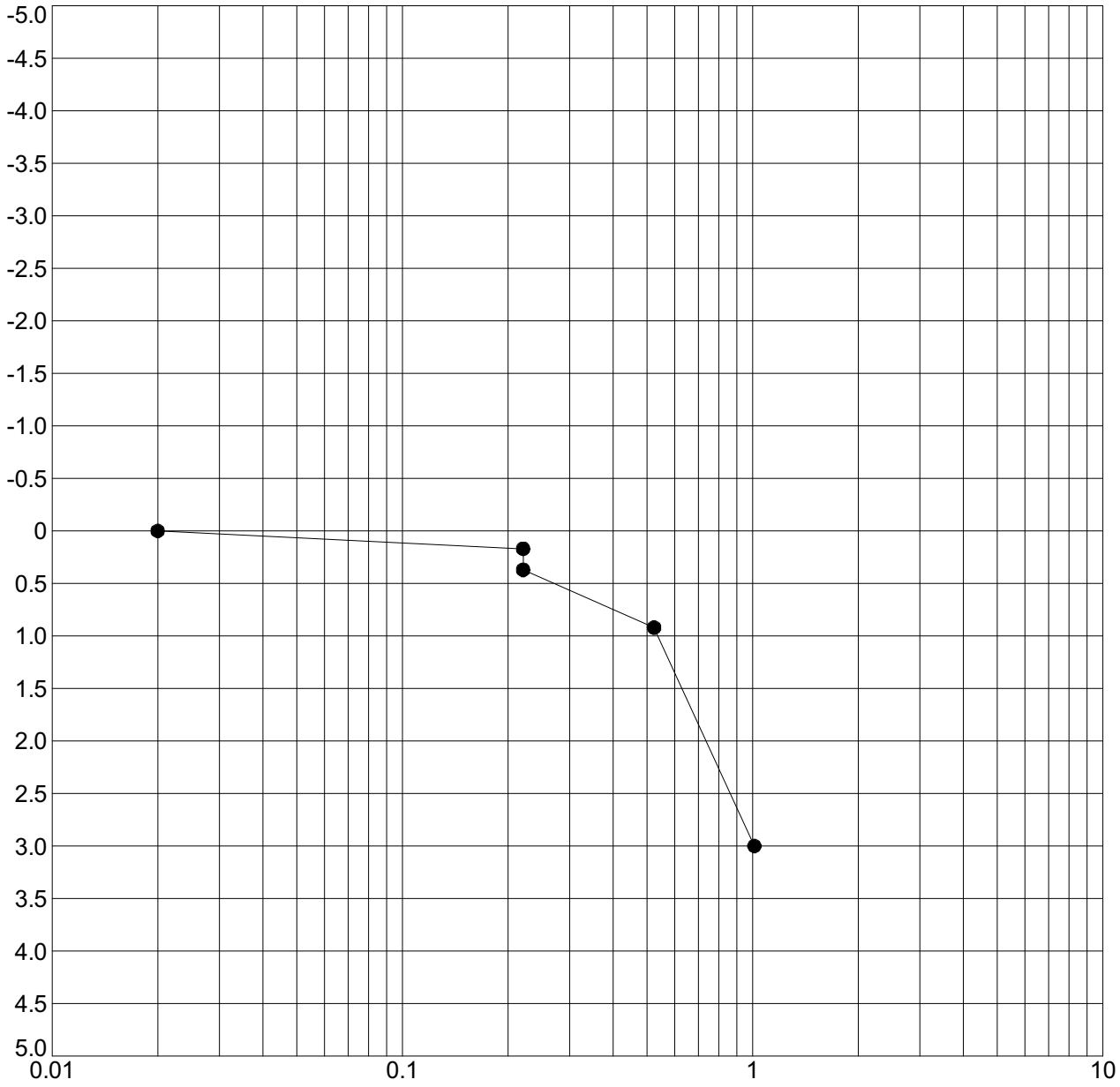
Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **RW 2-1**	**2.0**	**(Fill) CLAYEY SAND**	**0.2**	**99.7**	**22.2**

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



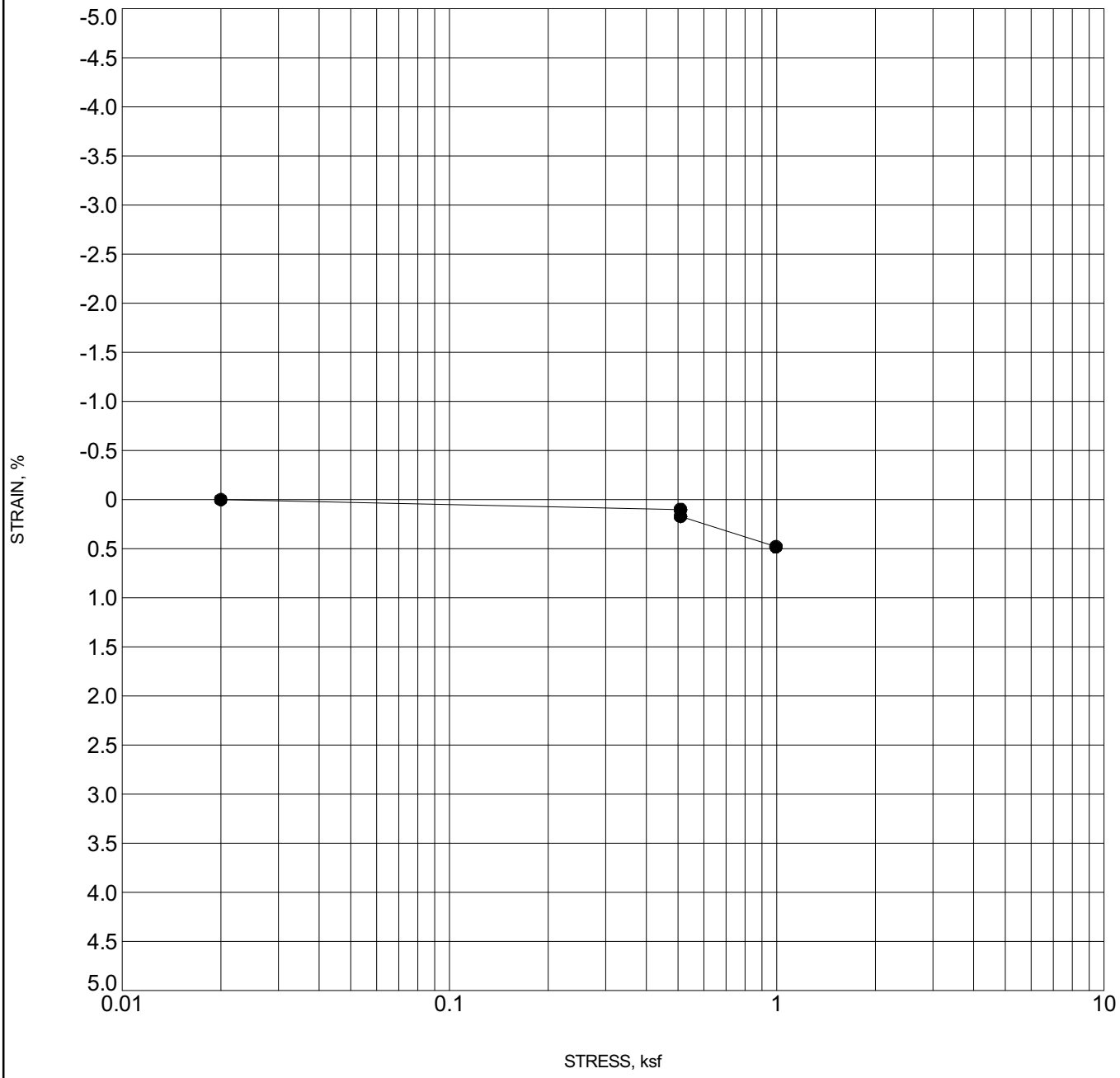
Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **RW 2-2**	**2.0**	**(Fill) CLAYEY SAND**	**-0.2**	**117.8**	**11.9**

SWELL - CONSOLIDATION TEST

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**	**4.0**	**(Fill) CLAYEY SAND**	**-0.1**	**112.8**	**14.2**

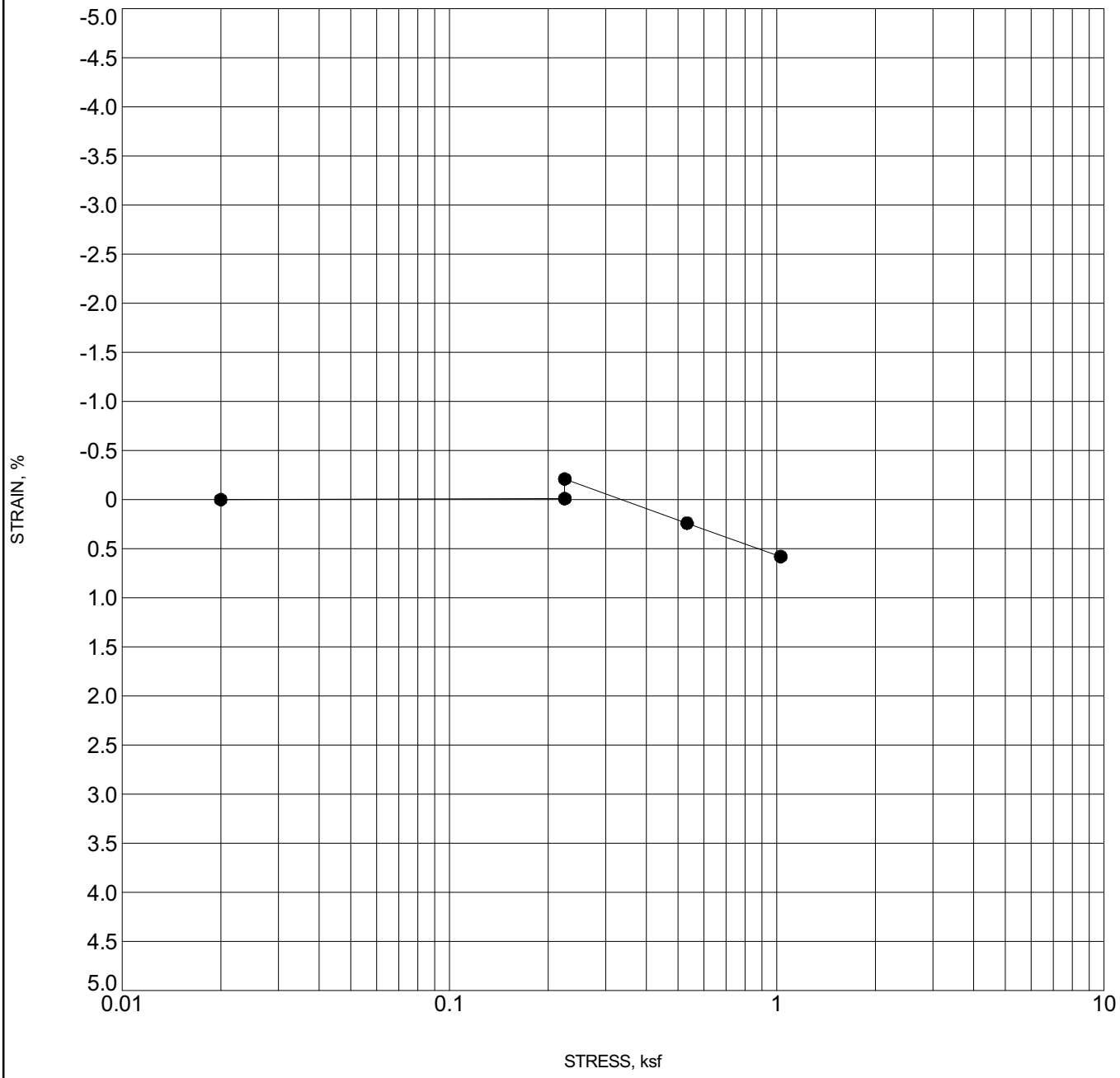
SWELL - STANDARD 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 8/10/12

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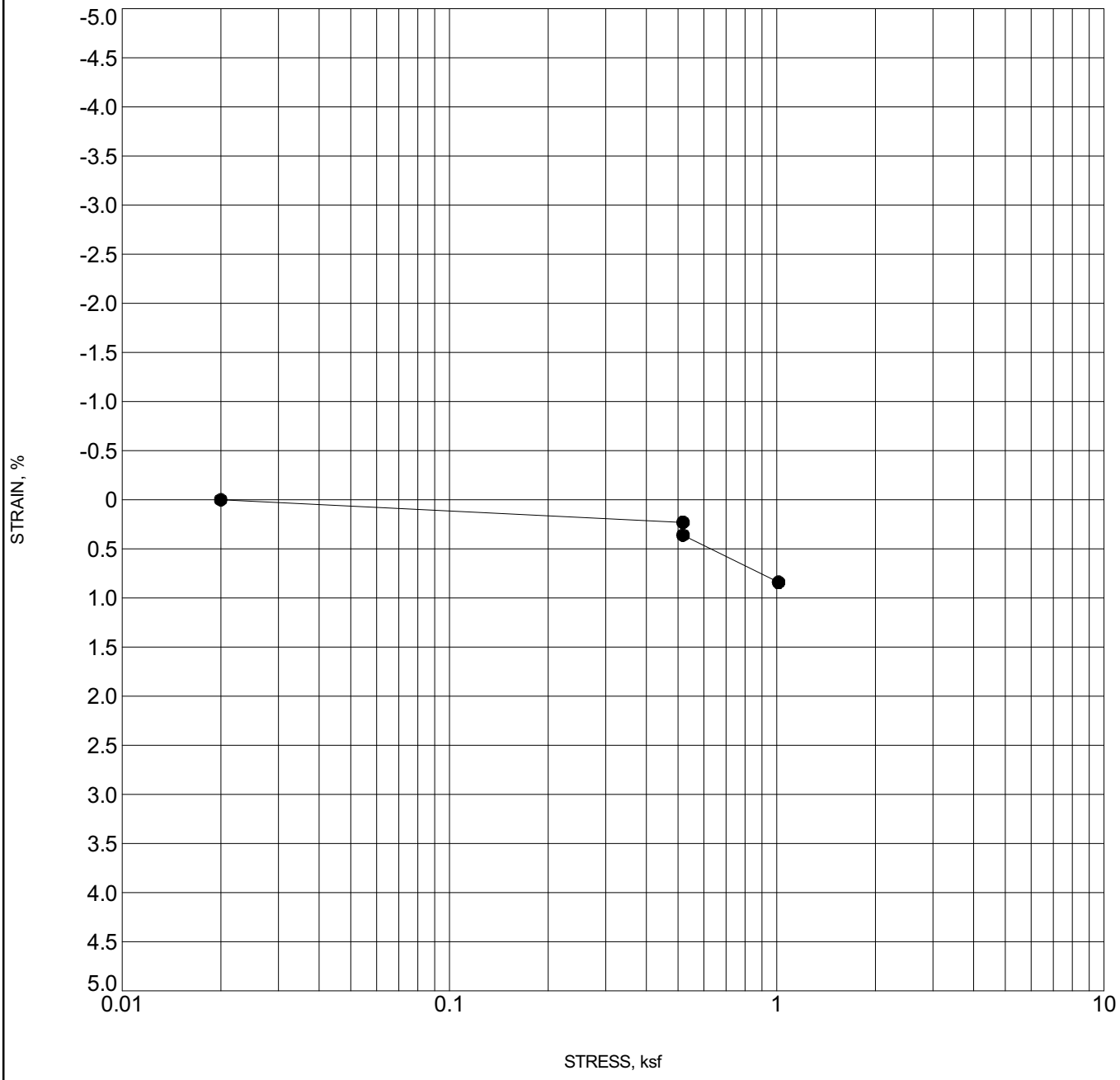
PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado



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

SWELL - CONSOLIDATION TEST

RockSol Consulting Group, Inc.

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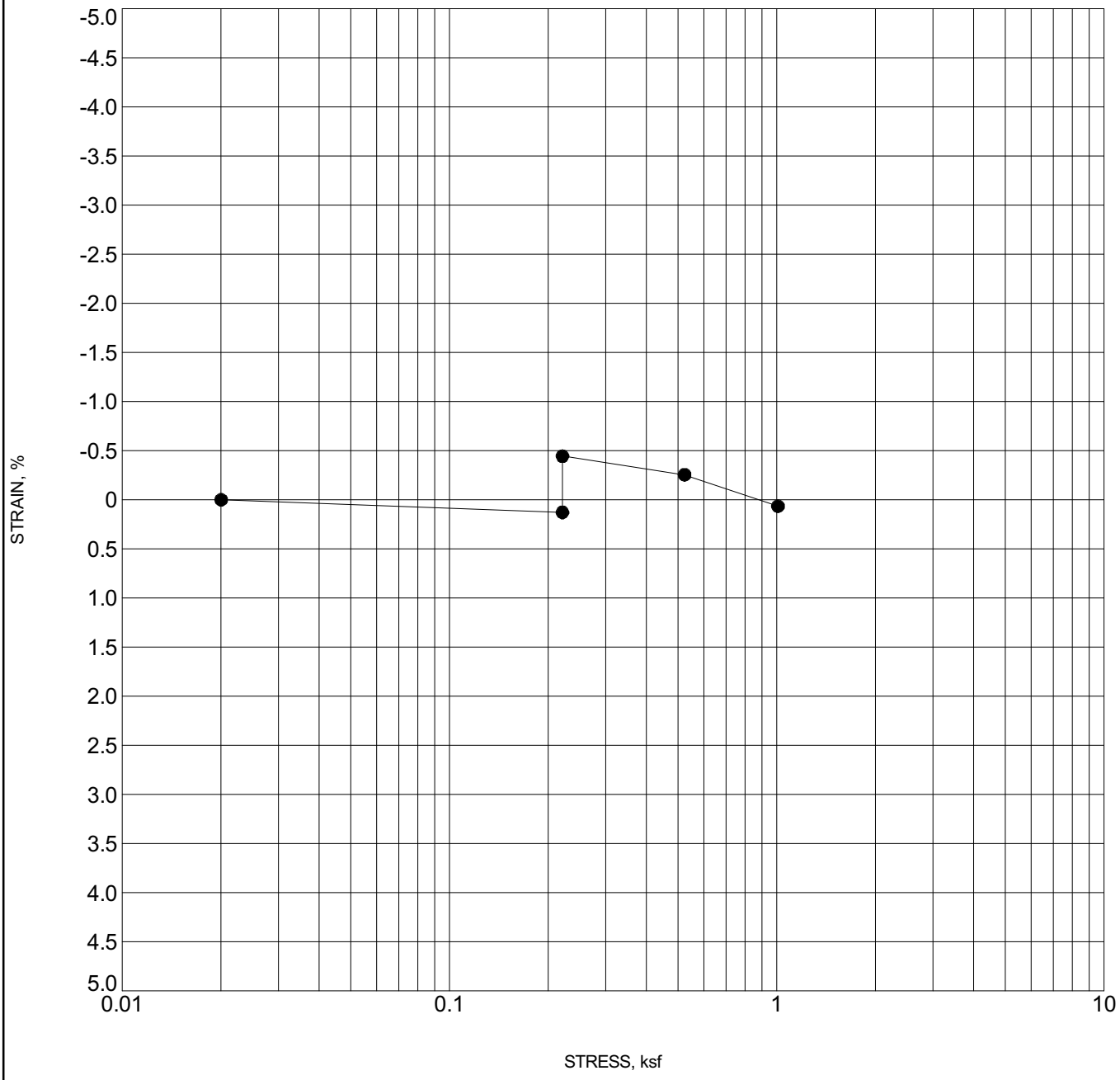
PROJECT NUMBER 280.01 **PROJECT LOCATION** Denver, Colorado



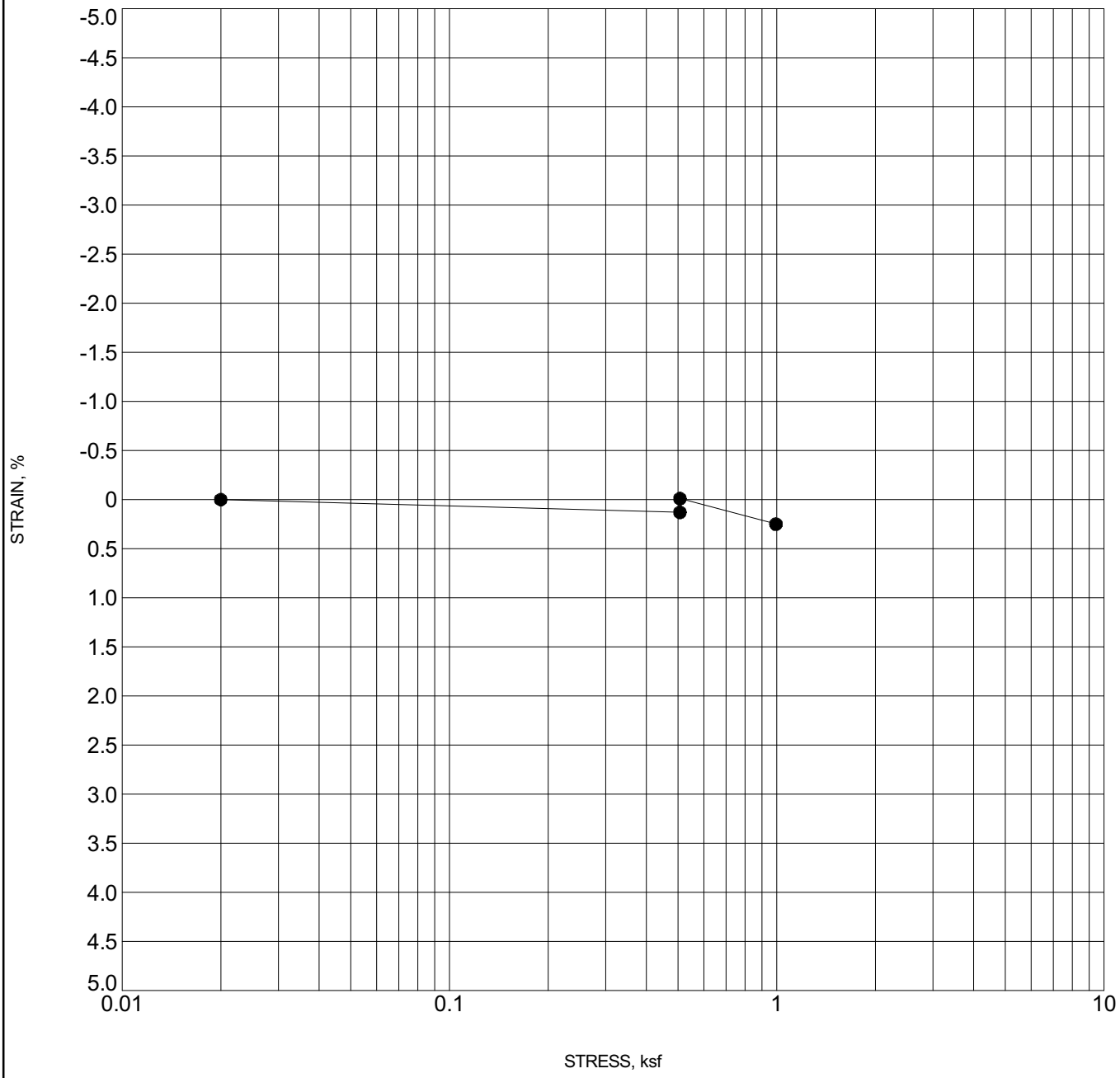
Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **RW 4-2**	**2.0**	**(Fill) SANDY CLAY with GRAVEL**	**0.6**	**98.8**	**26.5**

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



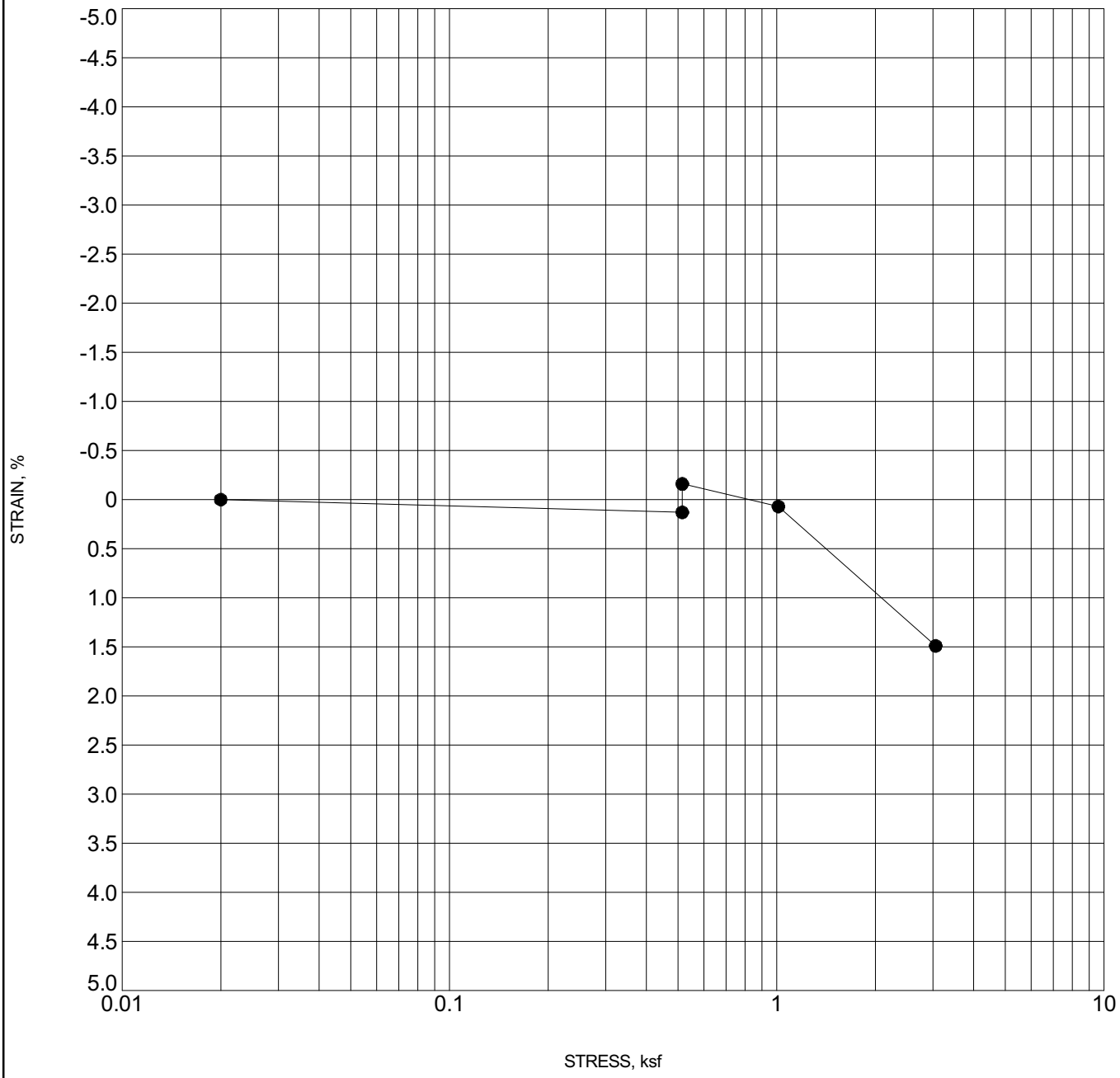
Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **RW 4-2**	**4.0**	**(Fill) SANDY CLAY**	**0.1**	**98.6**	**24.8**

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



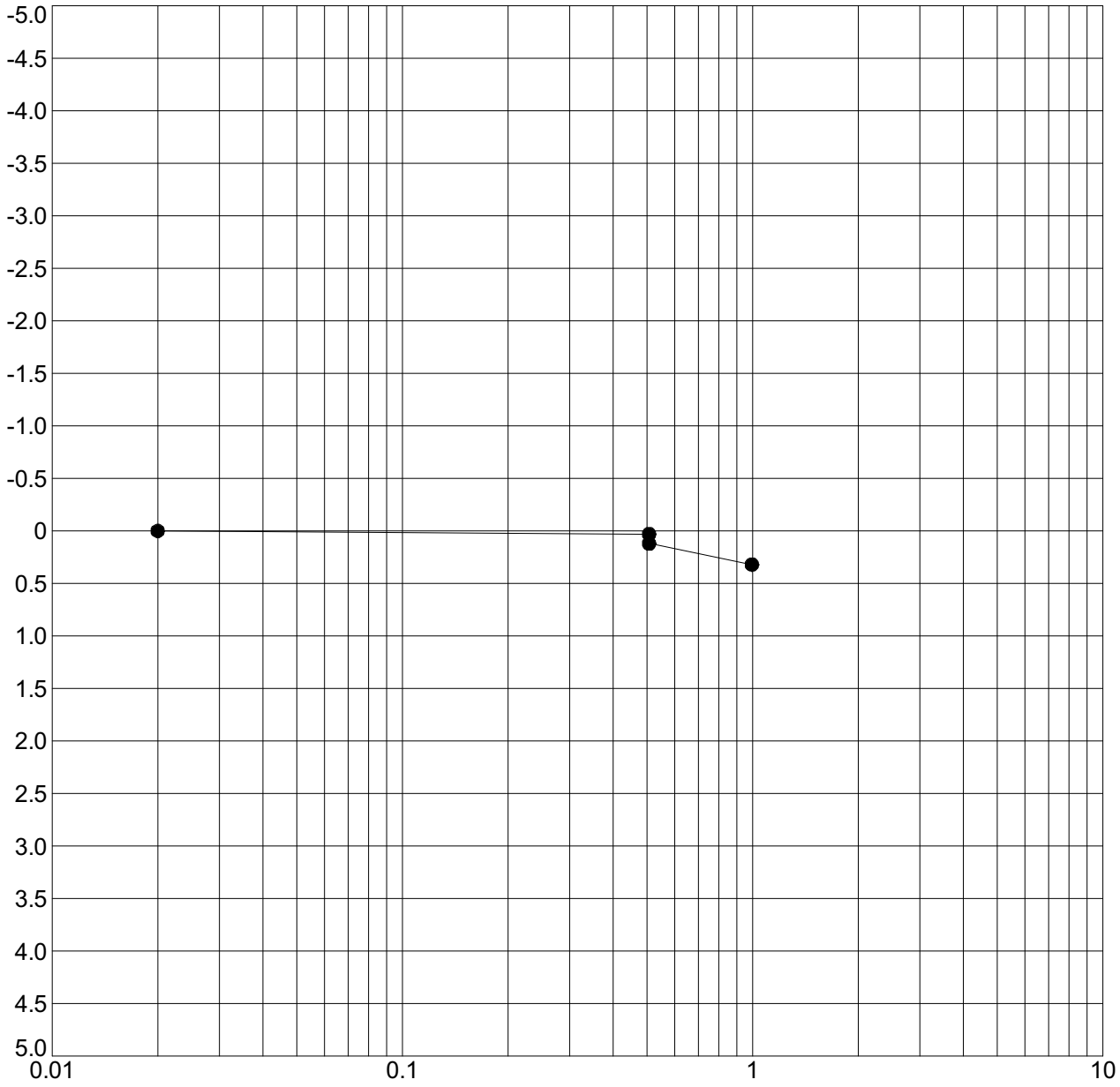
Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **RW 4-3**	**4.0**	**(Fill) SANDY CLAY**	**0.3**	**105.2**	**21.6**

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



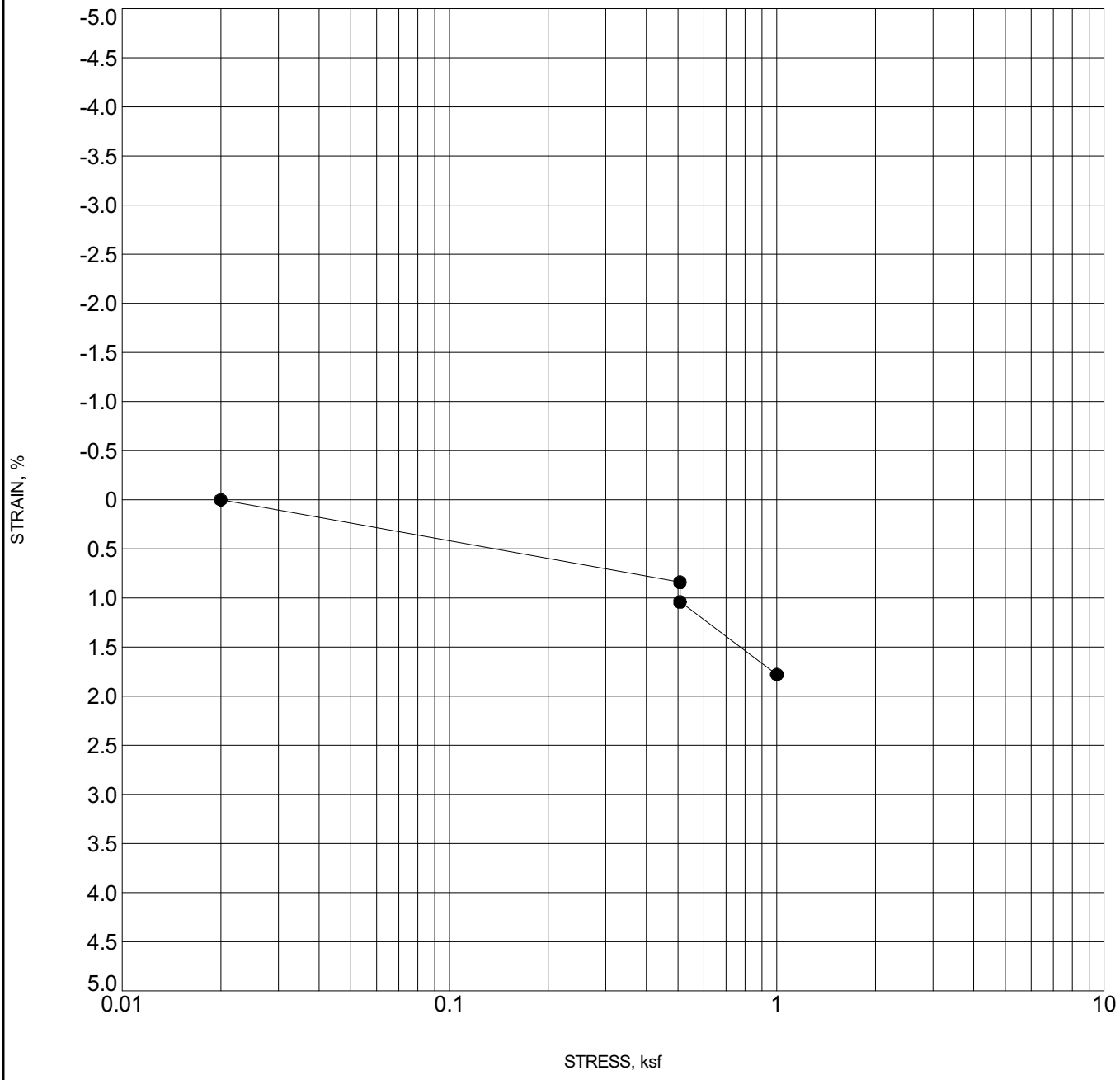
Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **RW 5-2**	**14.0**	**(Fill) SANDY CLAY**	**-0.1**	**107.6**	**18.7**

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



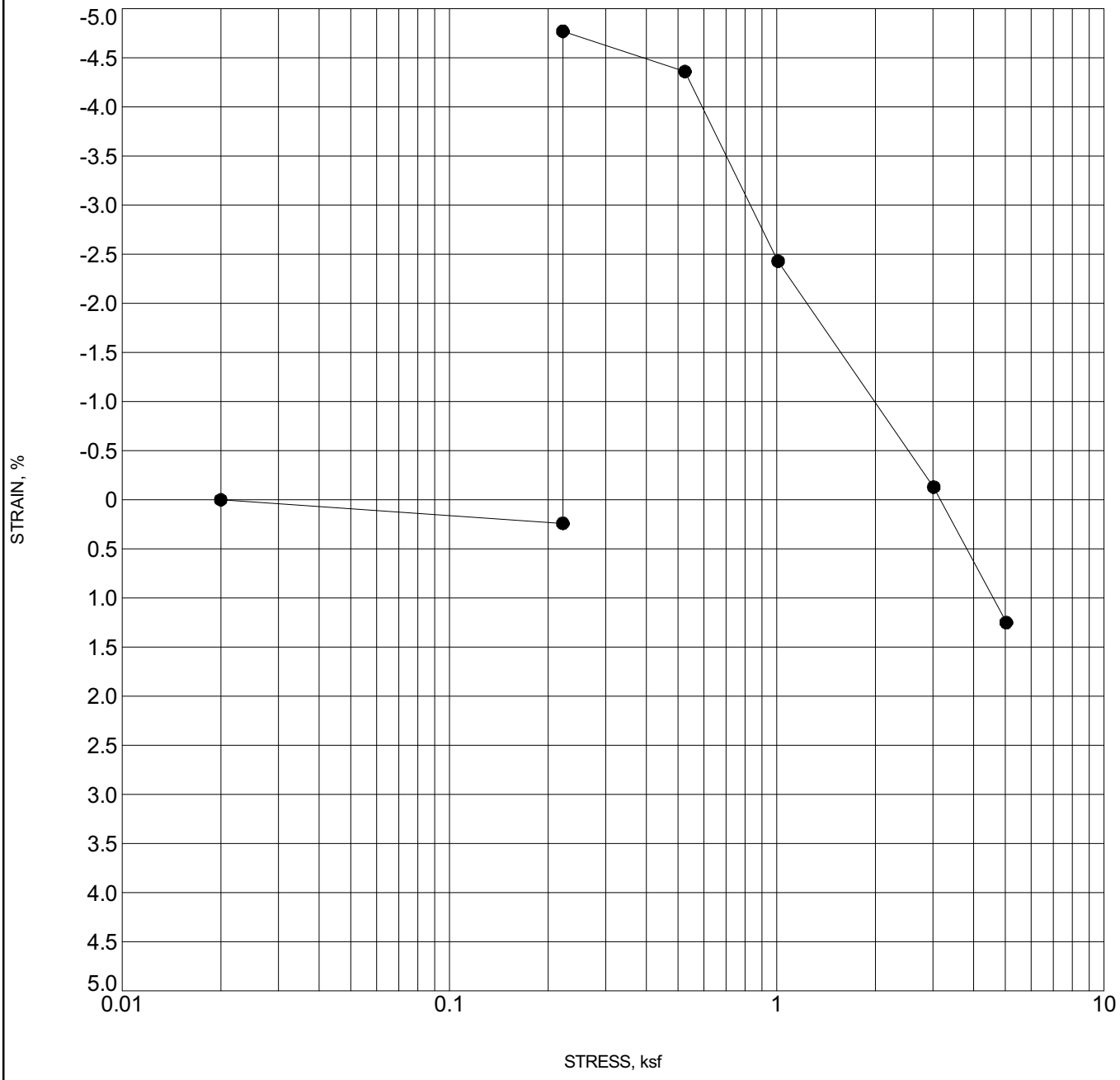
Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **RW 5-2**	**24.0**	**CLAY with trace SAND**	**-0.2**	**93.0**	**27.9**

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	2.0	(FIII) CLAYEY SAND	5.0	126.3	7.3

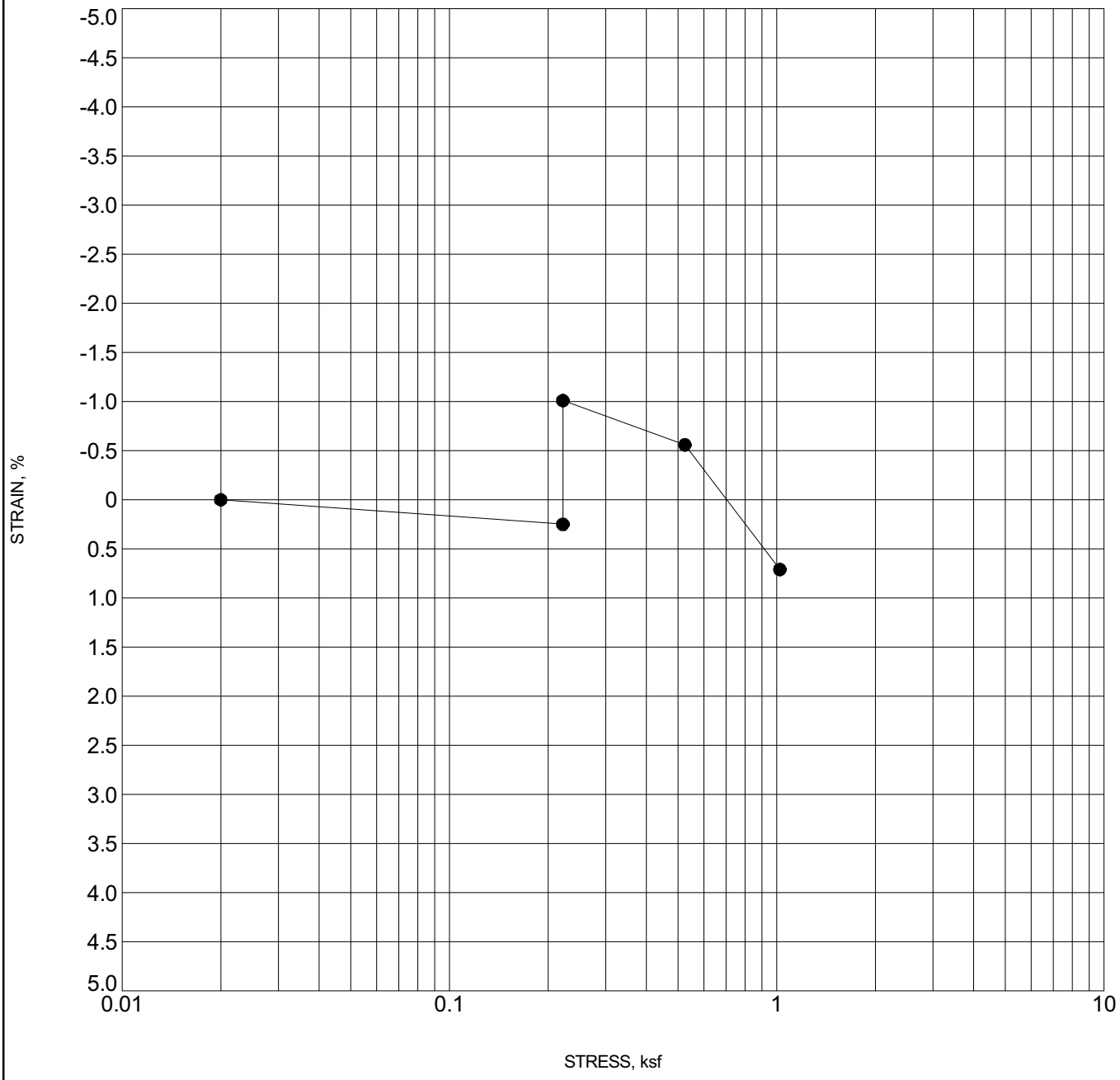
SWELL - STANDARD 280.01 6TH AND PLATTE RIVER.GPJ ROCKSOL TEMPLATE.GDT 8/10/12

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 C

PAVEMENT CORE PHOTO LOG SUMMARY
(Sheets C1 through C17)

BR-2: Lane 1 westbound US6 5 feet west of Bryant Street bridge abutment	
	Depth of Asphalt: 10.5” Depth of Concrete: Not Encountered Condition of Asphalt: Fair to Poor Condition of Concrete: N/A Number of Discrete Layers: 4 Comments: Major deterioration between layers 2 and 3.

BR-5: Lane 1 of off-ramp from US6 to Federal Blvd 5 feet east of Bryant Street Bridge abutment	
	Depth of Asphalt: 7” Depth of Concrete: 7.75” Condition of Asphalt: Good Condition of Concrete: Good Number of Discrete Layers: 5 Comments: Concrete and Asphalt looked in good condition but were not bonded well.

BR-7: Outside Shoulder eastbound US6, 90 feet west of US6 Bridge over the South Platte River	
	Depth of Asphalt: 12.25” Depth of Concrete: Not Encountered Condition of Asphalt: Good Condition of Concrete: N/A Number of Discrete Layers: 7 Comments:

BR-8: Lane 1 westbound US6, 90 feet west of US6 Bridge over the South Platte River	
	Depth of Asphalt: 8.5” Depth of Concrete: Not Encountered Condition of Asphalt: Fair Condition of Concrete: N/A Number of Discrete Layers: 4 Comments: Minor loss of fines, raveling at bottom

BR-13: Lane 1 westbound US6, 10 feet east of US6 Bridge over the South Platte River	
	Depth of Asphalt: 7.5” Depth of Concrete: Not Encountered Condition of Asphalt: Fair to poor Condition of Concrete: N/A Number of Discrete Layers: 3 Comments: Asphalt in upper layers is in fair condition with a minor loss of fines, the asphalt in lower layers is in poor condition with major raveling.

BR-15: Outside shoulder eastbound US6, 15 feet west of US6 Bridge over I-25	
	Depth of Asphalt: 7.5” Depth of Concrete: Not Encountered Condition of Asphalt: Fair Condition of Concrete: N/A Number of Discrete Layers: 4 Comments: Asphalt in fair condition, minor loss of fines, slight raveling at bottom.

BR-16: Lane 1 westbound US6, 15 feet west of US6 Bridge over I-25	
	Depth of Asphalt: 5.75” Depth of Concrete: Not Encountered Condition of Asphalt: Fair to poor Condition of Concrete: N/A Number of Discrete Layers: 2 Comments: Asphalt in fair condition, de-bonding at layer interface with loss of fines and raveling.

BR-18: Lane 1 southbound I-25, 5 feet south of US6 Bridge over I-25	
	Depth of Asphalt: 13.25” Depth of Concrete: Not Encountered Condition of Asphalt: Good Condition of Concrete: N/A Number of Discrete Layers: 5 Comments: Asphalt in good condition, no visible raveling or loss of fines.

BR-19: Lane 1 southbound I-25, 15 feet north of US6 Bridge over I-25

Depth of Asphalt: 16.25”

Depth of Concrete: Not Encountered

Condition of Asphalt: Fair

Condition of Concrete: N/A

Number of Discrete Layers: 7

Comments:

Minor loss of fines, de-bonding at layer interface with some raveling. Lowermost layer is in very poor condition and is crumbling.

BR-21: Lane 1 westbound US6, 40 feet east of US6 Bridge over I-25

Depth of Asphalt: 7.25”

Depth of Concrete: Not Encountered

Condition of Asphalt: Poor

Condition of Concrete: N/A

Number of Discrete Layers: 3

Comments:

Asphalt in poor condition, major loss of fines, and de-bonding at layer interface, major raveling at layer interface.

BR-24: Lane 1 westbound US6, 1,100 feet west of Federal Boulevard over US6 Bridge

Depth of Asphalt: 6.0”

Depth of Concrete: Not Encountered

Condition of Asphalt: Fair

Condition of Concrete: N/A

Number of Discrete Layers: 3

Comments:

Minor loss of fines, with some raveling. Lowermost layer is in fair to poor condition and has raveling.

BR-27: Lane 4 eastbound US6, 600 feet east of Federal over US6 Bridge

Depth of Asphalt: 6.0”

Depth of Concrete: Not Encountered

Condition of Asphalt: Poor

Condition of Concrete: N/A

Number of Discrete Layers: 3

Comments:

Asphalt in poor condition, loss of fines, and de-bonding at layer interface, major raveling at layer interface.

C-1: Median between westbound US6 and on ramp, 525 feet east of Federal Blvd.

Depth of Asphalt: 11.5”

Depth of Concrete: Not Encountered

Condition of Asphalt: Fair

Condition of Concrete: N/A

Number of Discrete Layers: 4

Comments:

Minor loss of fines

C-2: Outside shoulder eastbound US6, 750 feet east of Federal Blvd.

Depth of Asphalt: 7”

Depth of Concrete: Not Encountered

Condition of Asphalt: Poor

Condition of Concrete: N/A

Number of Discrete Layers: 4

Comments:

Raveling at bottom, minor loss of fines throughout, some voids, top layer is falling apart.

C-3: Median between westbound US6 and on ramp, 300 feet west of US6 Bridge over Bryant St.	
	Depth of Asphalt: 9.75” Depth of Concrete: Not Encountered Condition of Asphalt: fair to poor Condition of Concrete: N/A Number of Discrete Layers: 5 Comments: Minor loss of fines throughout, some major loss of fines, slight raveling at bottom.

PV-3: Lane 2 westbound US6, 525 feet east of Federal Blvd.	
	Depth of Asphalt: 11.75” Depth of Concrete: Not Encountered Condition of Asphalt: Fair Condition of Concrete: N/A Number of Discrete Layers: 4 Comments: Minor loss of fines in places, slight raveling at bottom, upper layer is in good condition.

PV-4: Lane 1 eastbound US6, 660 feet west of US6 Bridge over Bryant Street	
	Depth of Asphalt: 7” Depth of Concrete: Not Encountered Condition of Asphalt: Fair to Poor Condition of Concrete: N/A Number of Discrete Layers: 4 Comments: Major loss of fines, slight raveling at bottom.

PV-6: Lane 1 eastbound US6, 290 feet east of US6 Bridge over Bryant Street	
	Depth of Asphalt: 8” Depth of Concrete: Not Encountered Condition of Asphalt: Fair Condition of Concrete: N/A Number of Discrete Layers: 6 Comments: Minor loss of fines and layers of crack seal present. Slight raveling at bottom.

PV-7: Lane 1 westbound US6, 180 feet west of US6 Bridge over I-25	
	Depth of Asphalt: 10.25” Depth of Concrete: Not Encountered Condition of Asphalt: Poor to fair Condition of Concrete: N/A Number of Discrete Layers: 4 Comments: Loss of fines in lower layers, de-bonding between layers 1 and 2, raveling and deterioration between layers 1 and 2.

PV-8: Onramp to eastbound US6 from southbound I-25, 220 feet from merge point with US6	
	Depth of Asphalt: 10.75 Depth of Concrete: Not Encountered Condition of Asphalt: Good to Excellent Condition of Concrete: N/A Number of Discrete Layers: 4 Comments: Asphalt in like new or near new condition, no visible signs of raveling and no visible loss of fines.

PV-9: Onramp to eastbound US6 from southbound I-25, 675 feet from merge point with US6	
	Depth of Asphalt: 11.5” Depth of Concrete: Not Encountered Condition of Asphalt: Good to Excellent Condition of Concrete: N/A Number of Discrete Layers: 5 Comments: Asphalt in like new or near new condition, no visible signs of raveling and no visible loss of fines.

PV-10: Lane 4 southbound I-25, 175 feet south of US6 Bridge over I-25	
	Depth of Asphalt: 12” Depth of Concrete: Not Encountered Condition of Asphalt: Poor to Fair Condition of Concrete: N/A Number of Discrete Layers: 5 Comments: Loss of fines throughout, de-bonding, major loss of fines and raveling between layers 1 and 2.

PV-11: Lane 5 southbound I-25, 450 feet north of US6 Bridge over I-25	
	Depth of Asphalt: 12.75” Depth of Concrete: Not Encountered Condition of Asphalt: Fair to good Condition of Concrete: N/A Number of Discrete Layers: 6 Comments: Asphalt in good condition, minor loss on fines in some layers.

PV-13: Outside shoulder northbound I-25, 725 feet south of US6 Bridge over I-25	
	Depth of Asphalt: 10.75” Depth of Concrete: Not Encountered Condition of Asphalt: Fair Condition of Concrete: N/A Number of Discrete Layers: 2 Comments: Asphalt in fair condition, minor loss of fines and de-bonding at layer interface.

PV-14: Shoulder northbound I-25, 215 feet south of US6 Bridge over I-25	
	Depth of Asphalt: 15.5” Depth of Concrete: Not Encountered Condition of Asphalt: Good Condition of Concrete: N/A Number of Discrete Layers: 7 Comments: Asphalt in good condition, minor loss of fines. De-lamination between lowermost layers.

PV-15: Outside shoulder northbound I-25, 280 feet north of US6 Bridge over I-25	
	Depth of Asphalt: 17.25” Depth of Concrete: Not Encountered Condition of Asphalt: Good to fair Condition of Concrete: N/A Number of Discrete Layers: 7 Comments: Minor loss of fines, de-lamination and slight raveling between lowermost layers.

PV-16: Outside shoulder northbound I-25, 750 feet north of US6 Bridge over I-25	
	Depth of Asphalt: 9.25” Depth of Concrete: Not Encountered Condition of Asphalt: Fair Condition of Concrete: N/A Number of Discrete Layers: 5 Comments: Minor loss of fines throughout, no signs of raveling.

PV-17: Outside shoulder northbound I-25, 270 feet south of I-25 Bridge over W 8th Ave	
	Depth of Asphalt: 15” Depth of Concrete: Not Encountered Condition of Asphalt: Fair to Good Condition of Concrete: N/A Number of Discrete Layers: 7 Comments: Minor loss of fines, de-lamination and slight raveling between lower layers.

PV-18: Lane 6 southbound I-25, 270 feet south of I-25 Bridge over W 8th Ave	
	Depth of Asphalt: 20.75” Depth of Concrete: Not Encountered Condition of Asphalt: Fair Condition of Concrete: N/A Number of Discrete Layers: 7 Comments: Minor loss of fines throughout, de-lamination and raveling between layers 1 and 2 and layers 6 and 7. No visible raveling other places.

PV-21: Ramp from WB US6 to Bryant Street, Lane 2, 30 feet east of Bryant Street	
	Depth of Asphalt: 5.75” Depth of Concrete: Not Encountered Condition of Asphalt: Poor Condition of Concrete: N/A Number of Discrete Layers: 3 Comments: Major loss of fines throughout, cracking, major raveling in lower layer.

PV-22: Lane 4 westbound US6, 100 feet east of Knox Court.	
	Depth of Asphalt: 14.5” Depth of Concrete: Not Encountered Condition of Asphalt: Fair Condition of Concrete: N/A Number of Discrete Layers: 4 Comments: Minor loss of fines throughout, de-lamination and raveling between layers 2 and 3.

PV-23: Lane 4 eastbound US6, 500 feet east of Knox Court	
	Depth of Asphalt: 15.75” Depth of Concrete: Not Encountered Condition of Asphalt: Poor Condition of Concrete: N/A Number of Discrete Layers: 7 Comments: Major loss of fines throughout, cracking, major raveling in lower layer. De-lamination between several layers and major loss of fines and raveling at the de-bonding locations.

PV-24: Lane 4 westbound US6, 1,000 feet west of Federal Boulevard	
	Depth of Asphalt: 15.5” Depth of Concrete: Not Encountered Condition of Asphalt: Poor Condition of Concrete: N/A Number of Discrete Layers: 5 Comments: Minor loss of fines throughout, de-lamination and raveling between layers 1 and 2, layers 2 and 3 and layers 4 and 5. Upper layers were broken during coring operations and asphalt in layers is in good condition.

PV-25: Lane 4 eastbound US6, 1,100 feet west of Federal Boulevard	
	Depth of Asphalt: 15.0” Depth of Concrete: Not Encountered Condition of Asphalt: Fair Condition of Concrete: N/A Number of Discrete Layers: 7 Comments: Minor loss of fines throughout, -lamination and raveling between layers 1 and 2. No major signs of raveling.

APPENDIX D

TRAFFIC PROJECTIONS AND ROCKSOL ESAL CALCULATION SUMMARY

PARSONS BRINCKERHOFF

555 17th Street, Suite 500
Denver, CO 80202
Main: 303-832-9091
Fax: 303-832-9096

www.pbworld.com

TO: **Rocksol Consulting Group, Inc**

CC: **Hartwig & Associates, Inc**

RE: **US 6 Bridges – Sheridan to BNSF:**
Traffic Projections for ESALS

Attached with the memorandum, please find the existing traffic volumes for the US 6 project and the 2035 projected traffic volumes. Following, please find the assumed growth rate for the project and truck percentages for the ESAL calculation.

Traffic counts and traffic projections

Existing traffic counts were collected mid-November of 2011. Based upon a comparison of these existing counts with both the I-25 Valley Highway EIS traffic counts and 2025 volumes, it
was agreed to with Region 6 traffic that the I-25 Valley Highway EIS 2025 volumes will be projected forward to 2035 using the DRCOG 2035 Metro Vision Regional Transportation Plan growth rate rounded up to 1 percent per year. This is very similar to the projected growth rate found in the I-25 Valley Highway EIS.

Truck Percentages

The percentage of trucks for US 6 is 3% while I-25 is 7%. These numbers are consistent with the EIS percentages. The approximate split of single unit and heavy trucks is:

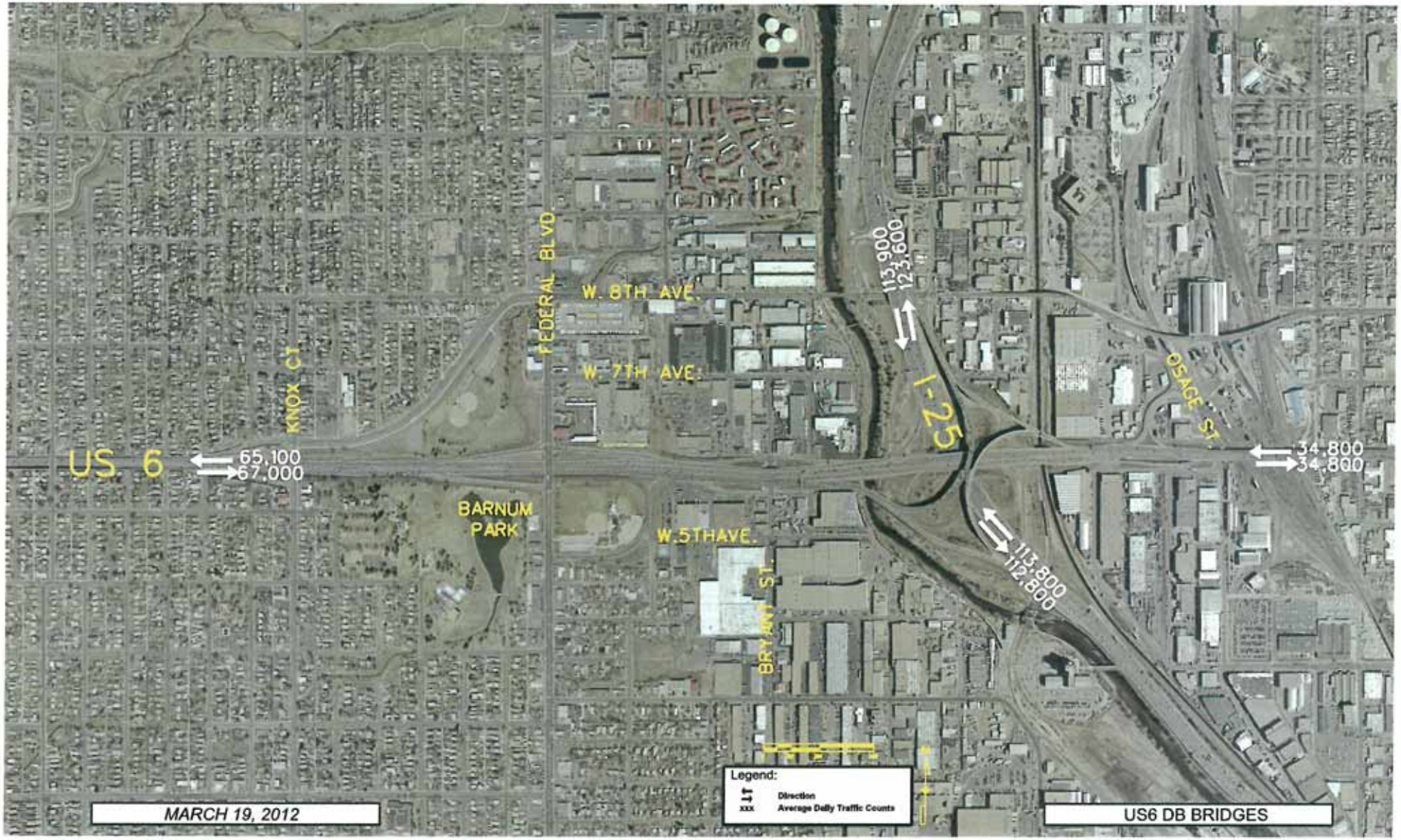
- Along 6th Ave – the total 3% trucks is split at approximately 2% single unit and 1% heavy trucks
- Along I-25 the total 7% trucks is split at approximately 3% single unit and 4% heavy trucks

Attachments:

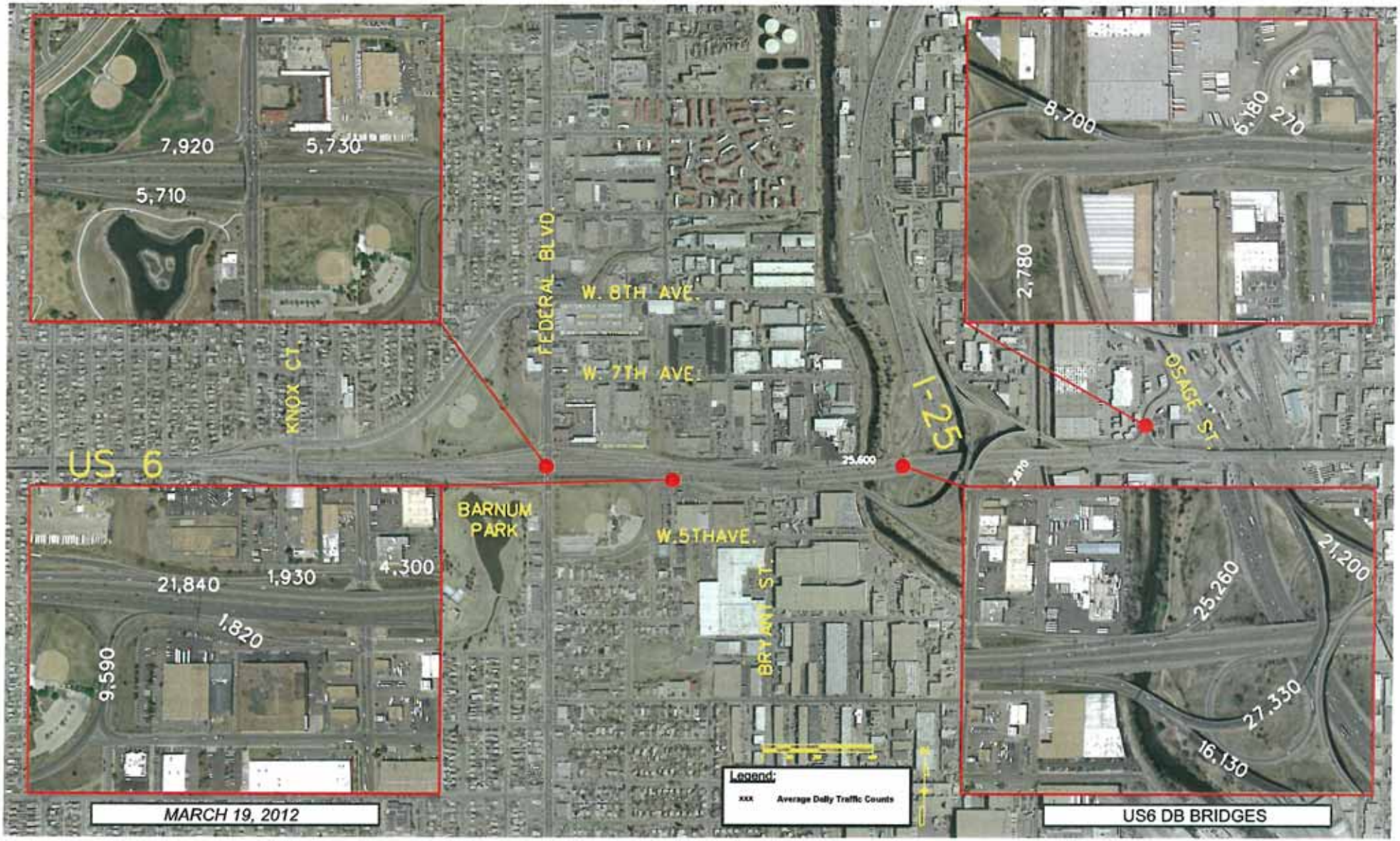
Existing Traffic Counts – Mainline ADT 031912 Submitted
Existing Traffic Counts – Ramps ADT 031912 Submitted
2035 Traffic Projections – Mainline ADT 031912 Submitted
2035 Traffic Projections – Ramps ADT 031912 Submitted
2035 Traffic Projections-Updates With Federal_ADT

cc: Gary Gonzales

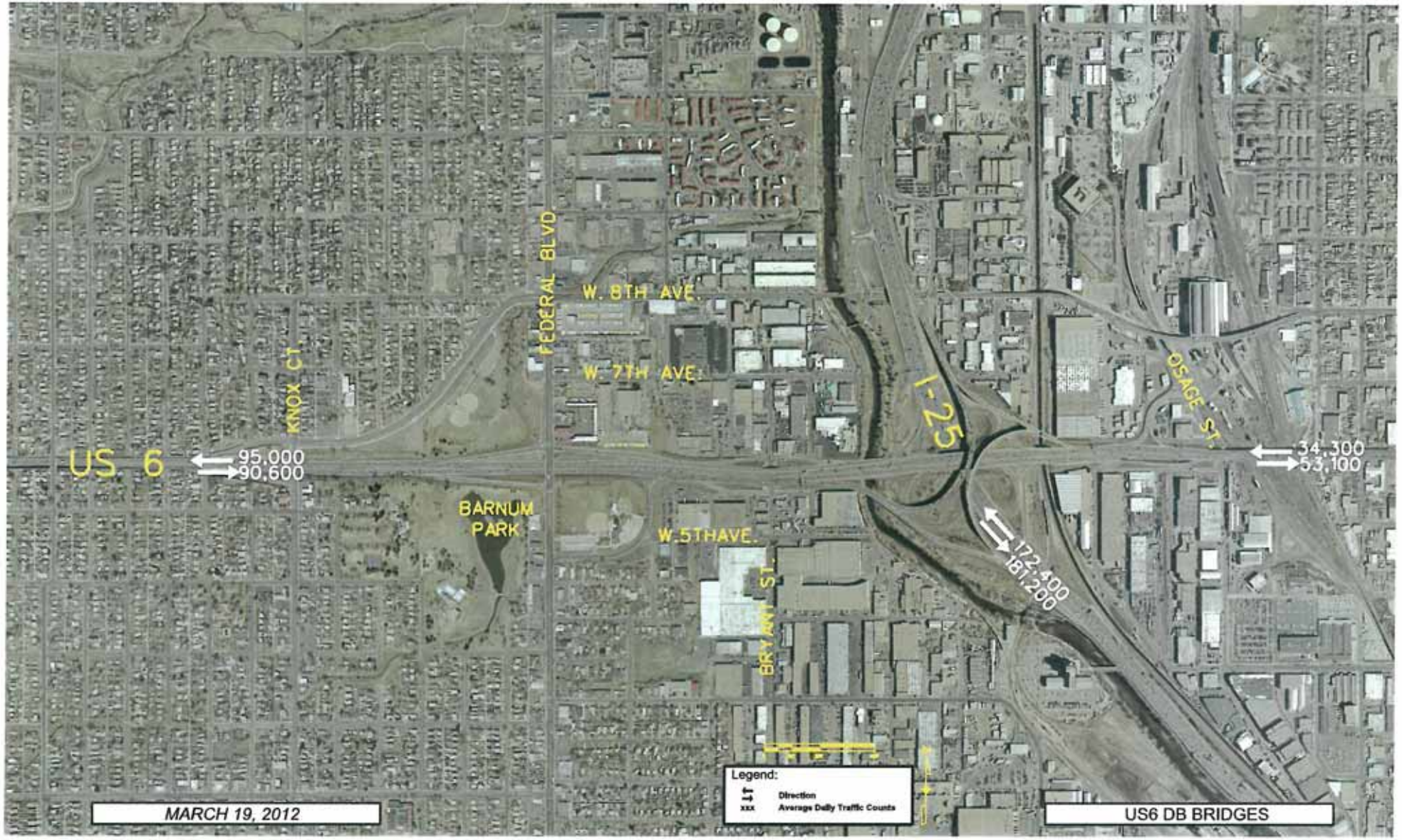
EXISTING TRAFFIC COUNTS - MAINLINE US6 AND I-25 (ADTS)



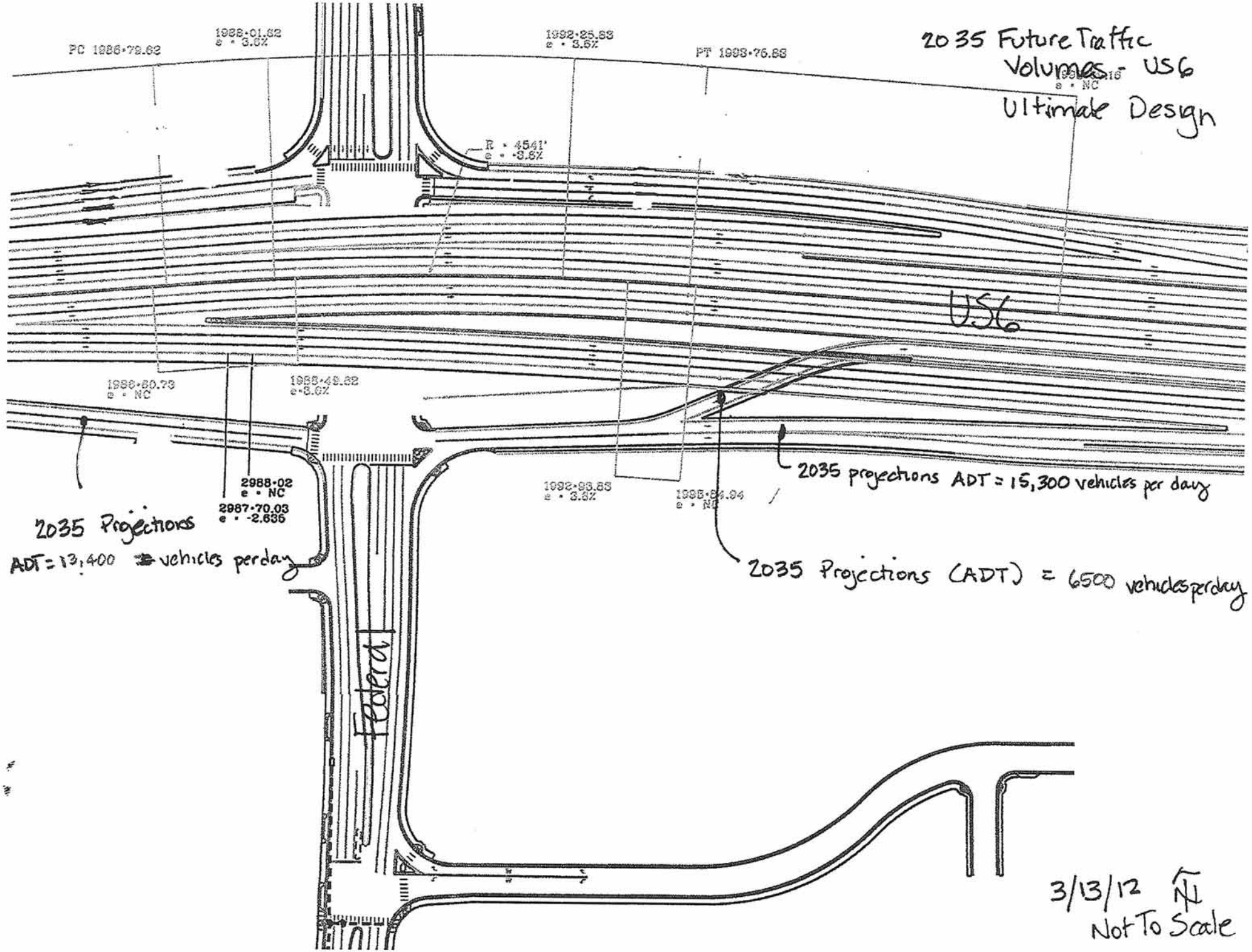
EXISTING TRAFFIC COUNTS - RAMP LOCATIONS (WEEKDAY ADTS)



2035 TRAFFIC COUNTS - MAINLINE US6 AND I-25 (ADTS)



2035 TRAFFIC COUNTS - RAMP LOCATIONS (WEEKDAY ADTS)


2035 Future Traffic Volumes - US6 Ultimate Design
PC 1986+79.62
1988+01.62 e = 3.0%
1992+25.63 e = 3.6%
PT 1993+76.63
R = 4541' e = -3.6%
US6
1986+60.79 e = NC
1988+48.62 e=3.0%
2988+02 e = NC
2987+70.03 e = -2.635
1992+93.63 e = 3.3%
1995+84.04 e = NC
2035 projections ADT = 15,300 vehicles per day
2035 Projections ADT = 13,400 vehicles per day
2035 Projections (ADT) = 6500 vehicles per day
Federal
3/13/12
Not To Scale

DEFAULT ASPHALT PAVEMENT DESIGN CRITERIA AND MINIMUM THICKNESS BY ROADWAY CLASSIFICATION FOR RECONSTRUCTION OF EXISTING STREETS

Table 12.4–1

Traffic Level	Residential	Local Collector	Heavy Collector (Truck or Bus Route)	Arterial	Industrial
Design Lane ESALS	70,000 + 80 x num. of new dwelling units to be constructed	500,000	3,000,000	5,000,000	Must perform MGPEC pavement design
Minimum total full depth asphalt section (T+M+B) without geotechnical pavement thickness design	7.0" *	10.0" *	13.5" *	14.5" *	14.5" or per pavement design

* Or match existing, whichever is greater

Table 12.4–2 REQUIRED ASPHALT MATERIALS–BY LIFT

Traffic Level	Residential	Local Collector	Heavy Collector (Truck or Bus Route)	Arterial	Industrial
Top Lift (T) Asphalt Mix Grading (nominal size)	SX (½")	SX (½")	SX (½")	SX (½")	SX (½"), or S (¾") by permission of PW
Mix Design Gyration Compaction Effort Level	N=75	N=75	N=100	N=100	N=100 or N=125 (from design)
Asphalt Binder Grade (PG hh–ll)	PG 58–28	PG 58–28 if ESALS <100,000 PG 64–22 if ESALS >100,000	PG 64–22	PG 76–28 (polymer modified)	PG 64–22 or by design
Lower Lifts (M,B) Ashpalt Mix Grading (nominal size)	S (¾") or SG (1.0") Note: 1	S (¾") or SG (1.0") Note: 1	S (¾") or SG (1.0") Note: 1	S (¾") or SG (1.0") Note: 1	S (¾") or SG (1.0") Note: 1
Mix Design Gyratory Compaction Effort Level	N=75	N=75	N=100	N=100	N=100 or N=125
Asphalt Binder Grade (PG hh–ll)	Same as for top lift	Same as for top lift	PG 64–22 Note: 2	PG 64–22 Note: 2	PG 64–22 Note: 2

Notes:

1. Grading SG may be allowed based upon ability of paving operation to obtain required % of Rice compaction, and lift thickness, and length of paving.
2. A one grade softer binder may be allowed to meet "perpetual pavement" designs.

DENVER THE MILE HIGH CITY PUBLIC WORKS	City and County of Denver Department of Public Works	Date: 06/10
	Typical Asphalt Detail Lift Mix Design Criteria	STD. DWG. NO. 12.4

I25 Mainline
8 Lanes
RockSol Consulting Group, Inc.

Average Daily Traffic Volume

Existing	Future Year
2011	2035
237500	353600

Flexible Pavement Design Period 20 years

		Mid-Point YR		
Base Year	2016	[illegible]	2036	Required Design Year
ADT	261745	[illegible]	358724	

Rigid Pavement Design Period 30 years

		Mid-Point YR		
Base Year	2016	[illegible]	2046	Required Design Year
ADT	261745	[illegible]	433013	

Growth Rate (GR) Calculation (if initial and future traffic is provided)

ADTi =	237500	Average daily traffic for initial year
ADTf =	353600	Average daily traffic for future year
Initial Year =	2011	
Future Year =	2035	
GR =	[illegible]	

Note: Growth Rate is not CDOT Growth Factor

ESAL Calculation

Flexible Pavement

Vehicle Type	Vehicle Percentage	Total Design Life Volume	Equivalency Factor	Design Lane Factor	Design Lane 18k ESAL's
Passenger Cars and P.U. Trucks	93.0	[illegible]	0.003	0.25	[illegible]
Single Unit Trucks	3.0	[illegible]	0.249	0.25	[illegible]
Combination Trucks	4.0	[illegible]	1.087	0.25	[illegible]
TOTAL	100.0	2,264,711,850			30,426,404

Design Lane Factor = 0.25

Rigid Pavement

Vehicle Type		Total Design Life Volume	Equivalency Factor	Design Lane Factor	Design Lane 18k ESAL's
Passenger Cars and P.U. Trucks	93.0	[illegible]	0.003	0.25	[illegible]
Single Unit Trucks	3.0	[illegible]	0.285	0.25	[illegible]
Combination Trucks	4.0	[illegible]	1.692	0.25	[illegible]
TOTAL	100.0	3,803,800,050			75,144,070

[illegible] | 7/25/2012 | [illegible]
DGH | Rev_7_25_12

Future Traffic Estimates Based on CDOT Growth Factor
CDOT Growth Factor = Tf

Future ADT (ADTf) Calc
(if present ADT (ADTi)
and CDOT growth factor are known

	Initial Year =	2035
	Final Year =	2046
Final Year Daily Traffic (ADTf) =	[illegible]	
Initial Year Daily Traffic (ADTi) =	353600	
CDOT Growth Factor =	1.49	expressed as percent (%)

CDOT Growth Factor Tf:
if Initial Year ADTi
and Final Year ADTf are known

Initial Year Daily Traffic (ADTi) =	237500	Note: Enter Traffic Info at Growth Rate Section Also
Final Year Daily Traffic (ADTf) =	353600	
Initial Year =	2011	
Final Year =	2035	
Final Year - Initial Year =	[illegible]	Number of Years (CDOT Growth Factor years)
Tf =	[illegible]	Enter Tf to cell J39

I25 CD Road (essentially the NB I25 Ramp to WB US6
1 Lane
RockSol Consulting Group, Inc.

Average Daily Traffic Volume

Existing	Future Year
2011	2035
21200	27100

Flexible Pavement Design Period 20 years

	Base Year	Mid-Point YR		
Base Year	2016	[illegible]	2036	Required Design Year
ADT	22437	[illegible]	27383	

Rigid Pavement Design Period 30 years

	Base Year	Mid-Point YR		
Base Year	2016	[illegible]	2046	Required Design Year
ADT	22437	[illegible]	30578	

Growth Rate (GR) Calculation (If initial and future traffic is provided)

ADTi = 21200 Average daily traffic for initial year
ADTf = 27100 Average daily traffic for future year
Initial Year = 2011
Future Year = 2035
GR = [illegible]

Note: Growth Rate is not CDOT Growth Factor

ESAL Calculation

Flexible Pavement

Vehicle Type	Vehicle Percentage	Total Design Life Volume	Equivalency Factor	Design Lane Factor	Design Lane 18k ESAL's
Passenger Cars and P.U. Trucks	93.0	[illegible]	0.003	1.00	[illegible]
Single Unit Trucks	3.0	[illegible]	0.249	1.00	[illegible]
Combination Trucks	4.0	[illegible]	1.087	1.00	[illegible]
TOTAL	100.0	181,843,000			9,772,243

Design Lane Factor = 1.00

Rigid Pavement

Vehicle Type		Total Design Life Volume	Equivalency Factor	Design Lane Factor	Design Lane 18k ESAL's
Passenger Cars and P.U. Trucks	93.0	[illegible]	0.003	1.00	[illegible]
Single Unit Trucks	3.0	[illegible]	0.285	1.00	[illegible]
Combination Trucks	4.0	[illegible]	1.692	1.00	[illegible]
TOTAL	100.0	290,257,125			22,936,118

[illegible] 7/25/2012 Rev_7_25_12
DGH

Future Traffic Estimates Based on CDOT Growth Factor
CDOT Growth Factor = Tf

Future ADT (ADTf) Calc (if present ADT (ADTi) and CDOT growth factor are known)
Initial Year = 2035
Final Year = 2046
Final Year Daily Traffic (ADTf) = [illegible]
Initial Year Daily Traffic (ADTi) = 27100
CDOT Growth Factor = 1.28 expressed as percent (%)

CDOT Growth Factor Tf: (if Initial Year ADTi and Final Year ADTf are known)
Initial Year Daily Traffic (ADTi) = 21200
Final Year Daily Traffic (ADTf) = 27100
Note: Enter Traffic Info at Growth Rate Section Also

Initial Year = 2011
Final Year = 2035

Final Year - Initial Year = [illegible] Number of Years (CDOT Growth Factor years)

Tf = [illegible] Enter Tf to cell J39

US6 Knox to I25
4 Lane
RockSol Consulting Group, Inc.

Average Daily Traffic Volume

Existing	Future Year
2011	2035
132100	185600

Flexible Pavement Design Period 20 years

		Mid-Point YR		
Base Year	2016	[illegible]	2036	Required Design Year
ADT	143108	[illegible]	187142	

Rigid Pavement Design Period 30 years

		Mid-Point YR		
Base Year	2016	[illegible]	2046	Required Design Year
ADT	143108	[illegible]	219627	

Growth Rate (GR) Calculation (If initial and future traffic is provided)

ADTi =	132100	Average daily traffic for initial year
ADTf =	185600	Average daily traffic for future year
Initial Year =	2011	
Future Year =	2035	
GR =	[illegible]	

Note: Growth Rate is not CDOT Growth Factor

ESAL Calculation

Flexible Pavement

Vehicle Type	Vehicle Percentage	Total Design Life Volume	Equivalency Factor	Design Lane Factor	Design Lane 18k ESAL's
Passenger Cars and P.U. Trucks	97.0	[illegible]	0.003	0.45	[illegible]
Single Unit Trucks	2.0	[illegible]	0.249	0.45	[illegible]
Combination Trucks	1.0	[illegible]	1.087	0.45	[illegible]
TOTAL	100.0	1,205,412,500			10,176,092

Design Lane Factor = 0.45

Rigid Pavement

Vehicle Type		Total Design Life Volume	Equivalency Factor	Design Lane Factor	Design Lane 18k ESAL's
Passenger Cars and P.U. Trucks	97.0	[illegible]	0.003	0.45	[illegible]
Single Unit Trucks	2.0	[illegible]	0.285	0.45	[illegible]
Combination Trucks	1.0	[illegible]	1.692	0.45	[illegible]
TOTAL	100.0	1,985,974,125			22,815,864

Date of Calculation Originator Initials	
7/25/2012	
DGH	Rev_7_25_12

Future Traffic Estimates Based on CDOT Growth Factor
CDOT Growth Factor = Tf

Future ADT (ADTf) Calc
(if present ADT (ADTi)
and CDOT growth factor are known

Initial Year =	2035	
Final Year =	2046	
Final Year Daily Traffic (ADTf) =	[illegible]	
Initial Year Daily Traffic (ADTi) =	185600	
CDOT Growth Factor =	1.40	expressed as percent (%)

CDOT Growth Factor Tf:
if Initial Year ADTi
and Final Year ADTf are known

Initial Year Daily Traffic (ADTi) =	132100	Note: Enter Traffic Info at Growth Rate Section Also
Final Year Daily Traffic (ADTf) =	185600	
Initial Year =	2011	
Final Year =	2035	
Final Year - Initial Year =	[illegible]	Number of Years (CDOT Growth Factor years)
Tf =	[illegible]	Enter Tf to cell J39

US6 I25 to BNSF
4 Lane
RockSol Consulting Group, Inc.

Average Daily Traffic Volume

Existing	Future Year
2011	2035
69600	92500

Flexible Pavement Design Period 20 years

		Mid-Point YR		
Base Year	2016	[illegible]	2036	Required Design Year
ADT	74385	[illegible]	93525	

Rigid Pavement Design Period 30 years

		Mid-Point YR		
Base Year	2016	[illegible]	2046	Required Design Year
ADT	74385	[illegible]	106491	

Growth Rate (GR) Calculation (If initial and future traffic is provided)

ADTi = 69600 Average daily traffic for initial year
ADTf = 92500 Average daily traffic for future year
Initial Year = 2011
Future Year = 2035
GR = [illegible]

Note: Growth Rate is not CDOT Growth Factor

ESAL Calculation

Flexible Pavement

Vehicle Type	Vehicle Percentage	Total Design Life Volume	Equivalency Factor	Design Lane Factor	Design Lane 18k ESAL's
Passenger Cars and P.U. Trucks	97.0	[illegible]	0.003	0.45	[illegible]
Single Unit Trucks	2.0	[illegible]	0.249	0.45	[illegible]
Combination Trucks	1.0	[illegible]	1.087	0.45	[illegible]
TOTAL	100.0	612,871,500			5,173,861

Design Lane Factor = 0.45

Rigid Pavement

Vehicle Type		Total Design Life Volume	Equivalency Factor	Design Lane Factor	Design Lane 18k ESAL's
Passenger Cars and P.U. Trucks	97.0	[illegible]	0.003	0.45	[illegible]
Single Unit Trucks	2.0	[illegible]	0.285	0.45	[illegible]
Combination Trucks	1.0	[illegible]	1.692	0.45	[illegible]
TOTAL	100.0	990,296,100			11,377,017

[illegible] 7/25/2012
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Future Traffic Estimates Based on CDOT Growth Factor
CDOT Growth Factor = Tf

Future ADT (ADTf) Calc
(if present ADT (ADTi)
and CDOT growth factor are known

Initial Year = 2035
Final Year = 2046
Final Year Daily Traffic (ADTf) = [illegible]
Initial Year Daily Traffic (ADTi) = 92500
CDOT Growth Factor = 1.33 expressed as percent (%)

CDOT Growth Factor Tf:
if Initial Year ADTi
and Final Year ADTf are known

Initial Year Daily Traffic (ADTi) = 69600 Note: Enter Traffic Info at Growth Rate Section Also
Final Year Daily Traffic (ADTf) = 92500

Initial Year = 2011
Final Year = 2035

Final Year - Initial Year = [illegible] Number of Years (CDOT Growth Factor years)

Tf = [illegible] Enter Tf to cell J39

US6 EB CD Road
3 Lane
RockSol Consulting Group, Inc.

Average Daily Traffic Volume

Existing	Future Year
2011	2035
43460	75100

Flexible Pavement Design Period 20 years

	Base Year	Mid-Point YR		
	2016	[illegible]	2036	Required Design Year
ADT	50070	[illegible]	76508	

Rigid Pavement Design Period 30 years

	Base Year	Mid-Point YR		
	2016	[illegible]	2046	Required Design Year
ADT	50070	[illegible]	100227	

Growth Rate (GR) Calculation (If initial and future traffic is provided)

ADTi =	43460	Average daily traffic for initial year
ADTf =	75100	Average daily traffic for future year
Initial Year =	2011	
Future Year =	2035	
GR =	[illegible]	

Note: Growth Rate is not CDOT Growth Factor

ESAL Calculation

Flexible Pavement

Vehicle Type	Vehicle Percentage	Total Design Life Volume	Equivalency Factor	Design Lane Factor	Design Lane 18k ESAL's
Passenger Cars and P.U. Trucks	97.0	[illegible]	0.003	0.60	[illegible]
Single Unit Trucks	2.0	[illegible]	0.249	0.60	[illegible]
Combination Trucks	1.0	[illegible]	1.087	0.60	[illegible]
TOTAL	100.0	662,000,700			5,200,351

Design Lane Factor = 0.60

Rigid Pavement

Vehicle Type		Total Design Life Volume	Equivalency Factor	Design Lane Factor	Design Lane 18k ESAL's
Passenger Cars and P.U. Trucks	97.0	[illegible]	0.003	0.60	[illegible]
Single Unit Trucks	2.0	[illegible]	0.285	0.60	[illegible]
Combination Trucks	1.0	[illegible]	1.692	0.60	[illegible]
TOTAL	100.0	822,876,075			12,604,816

[illegible] 7/25/2012
[illegible] DGH Rev_7_25_12

Future Traffic Estimates Based on CDOT Growth Factor
CDOT Growth Factor = Tf

Future ADT (ADTf) Calc
(if present ADT (ADTi)
and CDOT growth factor are known

Initial Year =	2035	
Final Year =	2046	
Final Year Daily Traffic (ADTf) =	[illegible]	
Initial Year Daily Traffic (ADTi) =	75100	
CDOT Growth Factor =	1.73	expressed as percent (%)

CDOT Growth Factor Tf:
if Initial Year ADTi
and Final Year ADTf are known

Initial Year Daily Traffic (ADTi) =	43460	Note: Enter Traffic Info at Growth Rate Section Also
Final Year Daily Traffic (ADTf) =	75100	
Initial Year =	2011	
Final Year =	2035	
Final Year - Initial Year =	[illegible]	Number of Years (CDOT Growth Factor years)
Tf =	[illegible]	Enter Tf to cell J39

US6 WB CD Road
2 Lane near Federal
RockSol Consulting Group, Inc.

Average Daily Traffic Volume

Existing	Future Year
2011	2035
21840	39200

Flexible Pavement Design Period 20 years

		Mid-Point YR		
Base Year	2016	[illegible]	2036	Required Design Year
ADT	25435	[illegible]	39813	

Rigid Pavement Design Period 30 years

		Mid-Point YR		
Base Year	2016	[illegible]	2046	Required Design Year
ADT	25435	[illegible]	53394	

Growth Rate (GR) Calculation (If initial and future traffic is provided)

ADTi =	21840	Average daily traffic for initial year
ADTf =	39200	Average daily traffic for future year
Initial Year =	2011	
Future Year =	2035	
GR =	[illegible]	

Note: Growth Rate is not CDOT Growth Factor

ESAL Calculation

Flexible Pavement

Vehicle Type	Vehicle Percentage	Total Design Life Volume	Equivalency Factor	Design Lane Factor	Design Lane 18k ESAL's
Passenger Cars and P.U. Trucks	97.0	[illegible]	0.003	0.60	[illegible]
Single Unit Trucks	2.0	[illegible]	0.249	0.60	[illegible]
Combination Trucks	1.0	[illegible]	1.087	0.60	[illegible]
TOTAL	100.0	238,155,200			2,680,675

Design Lane Factor = 0.60

Rigid Pavement

Vehicle Type		Total Design Life Volume	Equivalency Factor	Design Lane Factor	Design Lane 18k ESAL's
Passenger Cars and P.U. Trucks	97.0	[illegible]	0.003	0.60	[illegible]
Single Unit Trucks	2.0	[illegible]	0.285	0.60	[illegible]
Combination Trucks	1.0	[illegible]	1.692	0.60	[illegible]
TOTAL	100.0	431,588,775			6,611,077

Date of Calculation Delineated Initials	
7/25/2012	
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Future Traffic Estimates Based on CDOT Growth Factor
CDOT Growth Factor = Tf

Future ADT (ADTf) Calc
(if present ADT (ADTi)
and CDOT growth factor are known

Initial Year =	2035	
Final Year =	2046	
Final Year Daily Traffic (ADTf) =	[illegible]	
Initial Year Daily Traffic (ADTi) =	39200	
CDOT Growth Factor =	1.79	expressed as percent (%)

CDOT Growth Factor Tf:
if Initial Year ADTi
and Final Year ADTf are known

Initial Year Daily Traffic (ADTi) =	21840	Note: Enter Traffic Info at Growth Rate Section Also
Final Year Daily Traffic (ADTf) =	39200	
Initial Year =	2011	
Final Year =	2035	
Final Year - Initial Year =	[illegible]	Number of Years (CDOT Growth Factor years)
Tf =	[illegible]	Enter Tf to cell J39

North Bound I-25 Ramp to EB US6
1 lane
RockSol Consulting Group, Inc.

Average Daily Traffic Volume

Existing	Future Year
2011	2035
2780	5900

Flexible Pavement Design Period 20 years

		Mid-Point YR		
Base Year	2016	[illegible]	2036	Required Design Year
ADT	3429	[illegible]	6023	

Rigid Pavement Design Period 30 years

		Mid-Point YR		
Base Year	2016	[illegible]	2046	Required Design Year
ADT	3429	[illegible]	8929	

Growth Rate (GR) Calculation (If initial and future traffic is provided)

ADTi = 2780 Average daily traffic for initial year
ADTf = 5900 Average daily traffic for future year
Initial Year = 2011
Future Year = 2035
GR = [illegible]

Note: Growth Rate is not CDOT Growth Factor

ESAL Calculation

Flexible Pavement

Vehicle Type	Vehicle Percentage	Total Design Life Volume	Equivalency Factor	Design Lane Factor	Design Lane 18k ESAL's
Passenger Cars and P.U. Trucks	93.0	[illegible]	0.003	1.00	[illegible]
Single Unit Trucks	3.0	[illegible]	0.249	1.00	[illegible]
Combination Trucks	4.0	[illegible]	1.087	1.00	[illegible]
TOTAL	100.0	34,499,800			1,854,019

Rigid Pavement

Vehicle Type		Total Design Life Volume	Equivalency Factor	Design Lane Factor	Design Lane 18k ESAL's
Passenger Cars and P.U. Trucks	93.0	[illegible]	0.003	1.00	[illegible]
Single Unit Trucks	3.0	[illegible]	0.285	1.00	[illegible]
Combination Trucks	4.0	[illegible]	1.692	1.00	[illegible]
TOTAL	100.0	67,660,050			5,346,497

Date of Calculation Originator Initials	
7/24/2012	
DGH	Rev_7_24_12

Future Traffic Estimates Based on CDOT Growth Factor
CDOT Growth Factor = Tf

Future ADT (ADTf) Calc
(if present ADT (ADTi)
and CDOT growth factor are known

Initial Year = 2035
Final Year = 2046
Final Year Daily Traffic (ADTf) = [illegible]
Initial Year Daily Traffic (ADTi) = 5900
CDOT Growth Factor = 2.12 expressed as percent (%)

CDOT Growth Factor Tf:
if Initial Year ADTi
and Final Year ADTf are known

Initial Year Daily Traffic (ADTi) = 2780
Final Year Daily Traffic (ADTf) = 5900

Note: Enter Traffic Info at Growth Rate Section Also

Initial Year = 2011
Final Year = 2035

Final Year - Initial Year = [illegible] Number of Years (CDOT Growth Factor years)

Tf = [illegible]

South Bound I-25 Ramp to EB US6
1 lane
RockSol Consulting Group, Inc.

Average Daily Traffic Volume

Existing	Future Year
2011	2035
7400	10000

Flexible Pavement Design Period 20 years

	Mid-Point YR		
Base Year	2016	2036	Required Design Year
ADT	7490	10098	

Rigid Pavement Design Period 30 years

	Mid-Point YR		
Base Year	2016	2046	Required Design Year
ADT	7940	11604	

Growth Rate (GR) Calculation (If initial and future traffic is provided)

ADTi = 7400 Average daily traffic for initial year
ADTf = 10000 Average daily traffic for future year
Initial Year = 2011
Future Year = 2035
GR =

Note: Growth Rate is not CDOT Growth Factor

ESAL Calculation

Flexible Pavement

Vehicle Type	Vehicle Percentage	Total Design Life Volume	Equivalency Factor	Design Lane Factor	Design Lane 18k ESAL's
Passenger Cars and P.U. Trucks	93.0		0.003	1.00	
Single Unit Trucks	3.0		0.249	1.00	
Combination Trucks	4.0		1.087	1.00	
TOTAL	100.0	64,196,200			3,449,904

Rigid Pavement

Vehicle Type	Vehicle Percentage	Total Design Life Volume	Equivalency Factor	Design Lane Factor	Design Lane 18k ESAL's
Passenger Cars and P.U. Trucks	93.0		0.003	1.00	
Single Unit Trucks	3.0		0.285	1.00	
Combination Trucks	4.0		1.692	1.00	
TOTAL	100.0	107,003,400			8,455,409

Date of Calculation / Engineer Initials: 7/24/2012 DGH

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Future Traffic Estimates Based on CDOT Growth Factor
CDOT Growth Factor = Tf

Future ADT (ADTf) Calc
(if present ADT (ADTi)
and CDOT growth factor are known

Initial Year = 2035
Final Year = 2046
Final Year Daily Traffic (ADTf) =
Initial Year Daily Traffic (ADTi) = 10000
CDOT Growth Factor = 1.35 expressed as percent (%)

CDOT Growth Factor Tf:
if Initial Year ADTi
and Final Year ADTf are known

Initial Year Daily Traffic (ADTi) = 7400
Final Year Daily Traffic (ADTf) = 10000

Note: Enter Traffic Info at Growth Rate Section Also

Initial Year = 2011
Final Year = 2035

Final Year - Initial Year = Number of Years (CDOT Growth Factor years)

Tf =

South Bound I-25 Ramp to WB US6
2 lanes
RockSol Consulting Group, Inc.

Average Daily Traffic Volume

Existing		Future Year
2011		2035
25260		35400

Flexible Pavement Design Period 20 years

		Mid-Point YR		
Base Year	2016	[illegible]	2036	Required Design Year
ADT	27365	[illegible]	35785	

Rigid Pavement Design Period 30 years

		Mid-Point YR		
Base Year	2016	[illegible]	2046	Required Design Year
ADT	27365	[illegible]	41890	

Growth Rate (GR) Calculation (If initial and future traffic is provided)

ADTi = 25260 Average daily traffic for initial year
ADTf = 35400 Average daily traffic for future year
Initial Year = 2011
Future Year = 2035
GR = [illegible]

Note: Growth Rate is not CDOT Growth Factor

ESAL Calculation

Flexible Pavement

Vehicle Type	Vehicle Percentage	Total Design Life Volume	Equivalency Factor	Design Lane Factor	Design Lane 18k ESAL's
Passenger Cars and P.U. Trucks	93.0	[illegible]	0.003	0.60	[illegible]
Single Unit Trucks	3.0	[illegible]	0.249	0.60	[illegible]
Combination Trucks	4.0	[illegible]	1.087	0.60	[illegible]
TOTAL	100.0	230,497,500			7,432,161

Rigid Pavement

Vehicle Type		Total Design Life Volume	Equivalency Factor	Design Lane Factor	Design Lane 18k ESAL's
Passenger Cars and P.U. Trucks	93.0	[illegible]	0.003	0.60	[illegible]
Single Unit Trucks	3.0	[illegible]	0.285	0.60	[illegible]
Combination Trucks	4.0	[illegible]	1.692	0.60	[illegible]
TOTAL	100.0	379,171,125			17,977,261

[illegible] 7/24/2012 Rev_7_24_12
DGH

Future Traffic Estimates Based on CDOT Growth Factor
CDOT Growth Factor = Tf

Future ADT (ADTf) Calc
(if present ADT (ADTi)
and CDOT growth factor are known

Initial Year = 2011
Final Year = 2016
Final Year Daily Traffic (ADTf) = [illegible]
Initial Year Daily Traffic (ADTi) = 25260
CDOT Growth Factor = 1.40 expressed as percent (%)

CDOT Growth Factor Tf:
if Initial Year ADTi
and Final Year ADTf are known

Initial Year Daily Traffic (ADTi) = 25260 Note: Enter Traffic Info at Growth Rate Section Also
Final Year Daily Traffic (ADTf) = 35400

Initial Year = 2011
Final Year = 2035

Final Year - Initial Year = [illegible] Number of Years (CDOT Growth Factor years)

Tf = [illegible]

Bryant Street Ramp to Federal Boulevard
1 Lane
RockSol Consulting Group, Inc.

Average Daily Traffic Volume

Existing	Future Year
2011	2035
1930	3800

Flexible Pavement Design Period 20 years

		Mid-Point YR		
Base Year	2016	[illegible]	2036	Required Design Year
ADT	2320	[illegible]	3880	

Rigid Pavement Design Period 30 years

		Mid-Point YR		
Base Year	2016	[illegible]	2046	Required Design Year
ADT	2320	[illegible]	5489	

Growth Rate (GR) Calculation (If initial and future traffic is provided)

ADTi =	1930	Average daily traffic for initial year
ADTf =	3800	Average daily traffic for future year
Initial Year =	2011	
Future Year =	2035	
GR =	[illegible]	

Note: Growth Rate is not CDOT Growth Factor

ESAL Calculation

Flexible Pavement

Vehicle Type	Vehicle Percentage	Total Design Life Volume	Equivalency Factor	Design Lane Factor	Design Lane 18k ESAL's
Passenger Cars and P.U. Trucks	97.0	[illegible]	0.003	1.00	[illegible]
Single Unit Trucks	2.0	[illegible]	0.249	1.00	[illegible]
Combination Trucks	1.0	[illegible]	1.087	1.00	[illegible]
TOTAL	100.0	22,630,000			424,539

Rigid Pavement

Vehicle Type		Total Design Life Volume	Equivalency Factor	Design Lane Factor	Design Lane 18k ESAL's
Passenger Cars and P.U. Trucks	97.0	[illegible]	0.003	1.00	[illegible]
Single Unit Trucks	2.0	[illegible]	0.285	1.00	[illegible]
Combination Trucks	1.0	[illegible]	1.692	1.00	[illegible]
TOTAL	100.0	42,754,275			1,091,517

	Date of Calculation Onemotive Details	
[illegible]	7/24/2012	[illegible]
	DGH	Rev_7_24_12

Future Traffic Estimates Based on CDOT Growth Factor
CDOT Growth Factor = Tf

Future ADT (ADTf) Calc
(if present ADT (ADTi)
and CDOT growth factor are known

Initial Year =	2035	
Final Year =	2046	
Final Year Daily Traffic (ADTf) =	[illegible]	
Initial Year Daily Traffic (ADTi) =	3800	
CDOT Growth Factor =	1.97	expressed as percent (%)

CDOT Growth Factor Tf:
if Initial Year ADTi
and Final Year ADTf are known

Initial Year Daily Traffic (ADTi) =	1930	**Note: Enter Traffic Info at Growth Rate Section Also**
Final Year Daily Traffic (ADTf) =	3800	
Initial Year =	2011	
Final Year =	2035	
Final Year - Initial Year =	[illegible]	Number of Years (CDOT Growth Factor years)
Tf =	[illegible]	

Federal Ramp to Bryant Street

RockSol Consulting Group, Inc.

Average Daily Traffic Volume

Existing	Future Year
2011	2035
1820	2700

Flexible Pavement Design Period 20 years

		Mid-Point YR		
Base Year	2016	[illegible]	2036	Required Design Year
ADT	2002	[illegible]	2730	

Rigid Pavement Design Period 30 years

		Mid-Point YR		
Base Year	2016	[illegible]	2046	Required Design Year
ADT	2002	[illegible]	3294	

Growth Rate (GR) Calculation (If initial and future traffic is provided)

ADTi =	1820	Average daily traffic for initial year
ADTf =	2700	Average daily traffic for future year
Initial Year =	2011	
Future Year =	2035	
GR =	[illegible]	

Note: Growth Rate is not CDOT Growth Factor

ESAL Calculation

Flexible Pavement

Vehicle Type		Vehicle Percentage	Total Design Life Volume	Equivalency Factor	Design Lane Factor	Design Lane 18k ESAL's
Passenger Cars and P.U. Trucks		97.0	[illegible]	0.003	1.00	[illegible]
Single Unit Trucks		2.0	[illegible]	0.249	1.00	[illegible]
Combination Trucks		1.0	[illegible]	1.087	1.00	[illegible]
	TOTAL	100.0	17,271,800			324,019

Rigid Pavement

Vehicle Type		Vehicle Percentage	Total Design Life Volume	Equivalency Factor	Design Lane Factor	Design Lane 18k ESAL's
Passenger Cars and P.U. Trucks		97.0	[illegible]	0.003	1.00	[illegible]
Single Unit Trucks		2.0	[illegible]	0.285	1.00	[illegible]
Combination Trucks		1.0	[illegible]	1.692	1.00	[illegible]
	TOTAL	100.0	28,955,600			740,258

[illegible]	7/24/2012	Rev_7_24_12
	DGH	

Future Traffic Estimates Based on CDOT Growth Factor

CDOT Growth Factor = Tf

Future ADT (ADTf) Calc
(If present ADT (ADTi)
and CDOT growth factor are known

Initial Year =	2011	
Final Year =	2036	
Final Year Daily Traffic (ADTf) =	[illegible]	
Initial Year Daily Traffic (ADTi) =	1820	
CDOT Growth Factor =	1.48	expressed as percent (%)

CDOT Growth Factor Tf:
if Initial Year ADTi
and Final Year ADTf are known

Initial Year Daily Traffic (ADTi) =	1820	Note: Enter Traffic Info at Growth Rate Section Also
Final Year Daily Traffic (ADTf) =	2700	
Initial Year =	2011	
Final Year =	2035	
Final Year - Initial Year =	[illegible]	Number of Years (CDOT Growth Factor years)
Tf =	[illegible]	

Braided Ramp
1 Lane
RockSol Consulting Group, Inc.

Average Daily Traffic Volume

Existing	Future Year
2011	2035
Not Available	6500

Flexible Pavement Design Period 20 years

		Mid-Point YR		
Base Year	2016	[illegible]	2036	Required Design Year
ADT	3980	[illegible]	6633	

Rigid Pavement Design Period 30 years

		Mid-Point YR		
Base Year	2016	[illegible]	2046	Required Design Year
ADT	3980	[illegible]	8883	

Growth Rate (GR) Calculation (If initial and future traffic is provided)

ADTi =	3980	Average daily traffic for initial year
ADTf =	6500	Average daily traffic for future year
Initial Year =	2016	
Future Year =	2035	
GR =	[illegible]	

Note: Growth Rate is not CDOT Growth Factor

ESAL Calculation

Flexible Pavement

Vehicle Type		Vehicle Percentage	Total Design Life Volume	Equivalency Factor	Design Lane Factor	Design Lane 18k ESAL's
Passenger Cars and P.U. Trucks		97.0	[illegible]	0.003	1.00	[illegible]
Single Unit Trucks		2.0	[illegible]	0.249	1.00	[illegible]
Combination Trucks		1.0	[illegible]	1.087	1.00	[illegible]
	TOTAL	100.0	38,737,450			726,715

Rigid Pavement

Vehicle Type		Vehicle Percentage	Total Design Life Volume	Equivalency Factor	Design Lane Factor	Design Lane 18k ESAL's
Passenger Cars and P.U. Trucks		97.0	[illegible]	0.003	1.00	[illegible]
Single Unit Trucks		2.0	[illegible]	0.285	1.00	[illegible]
Combination Trucks		1.0	[illegible]	1.692	1.00	[illegible]
	TOTAL	100.0	70,424,925			1,797,948

[illegible]	[illegible]	[illegible]
Date of Calculation	7/24/2012	
Originally written	DGH	Rev_7_24_12

Future Traffic Estimates Based on CDOT Growth Factor
CDOT Growth Factor = Tf

Future ADT (ADTf) Calc:
(if present ADT (ADTi)
and CDOT growth factor are known

Initial Year =	2035	
Final Year =	2046	
Final Year Daily Traffic (ADTf) =	[illegible]	
Initial Year Daily Traffic (ADTi) =	6500	
CDOT Growth Factor =	1.63	expressed as percent (%)

CDOT Growth Factor Tf:
if Initial Year ADT)
and Final Year ADTf are known

Initial Year Daily Traffic (ADTi) =	0	Note: Enter Traffic Info at Growth Rate Section Also
Final Year Daily Traffic (ADTf) =	6500	
Initial Year =	2016	
Final Year =	2035	
Final Year - Initial Year =	[illegible]	Number of Years (CDOT Growth Factor years)
Tf =	[illegible]	

Federal Blvd to EB CD Road
1 Lane
RockSol Consulting Group, Inc.

Average Daily Traffic Volume

Existing		Future Year
2011		2035
Not Available		15300

Flexible Pavement Design Period 20 years

		Mid-Point YR		
Base Year	2016	[illegible]	2036	Required Design Year
ADT	9370	[illegible]	15612	

Rigid Pavement Design Period 30 years

		Mid-Point YR		
Base Year	2016	[illegible]	2046	Required Design Year
ADT	9370	[illegible]	20906	

Growth Rate (GR) Calculation (If initial and future traffic is provided)

ADTi =	9370	Average daily traffic for initial year
ADTf =	15300	Average daily traffic for future year
Initial Year =	2016	
Future Year =	2035	
GR =	[illegible]	

Note: Growth Rate is not CDOT Growth Factor

ESAL Calculation

Flexible Pavement

Vehicle Type		Vehicle Percentage	Total Design Life Volume	Equivalency Factor	Design Lane Factor	Design Lane 18k ESAL's
Passenger Cars and P.U. Trucks		97.0	[illegible]	0.003	1.00	[illegible]
Single Unit Trucks		2.0	[illegible]	0.249	1.00	[illegible]
Combination Trucks		1.0	[illegible]	1.087	1.00	[illegible]
	TOTAL	100.0	91,184,300			1,730,617

Rigid Pavement

Vehicle Type			Total Design Life Volume	Equivalency Factor	Design Lane Factor	Design Lane 18k ESAL's
Passenger Cars and P.U. Trucks		97.0	[illegible]	0.003	1.00	[illegible]
Single Unit Trucks		2.0	[illegible]	0.285	1.00	[illegible]
Combination Trucks		1.0	[illegible]	1.692	1.00	[illegible]
	TOTAL	100.0	165,761,100			4,231,831

[illegible] Date of Calculation / Designer Initials
7/24/2012
DGH
Rev_7_24_12

Future Traffic Estimates Based on CDOT Growth Factor
CDOT Growth Factor = Tf

Future ADT (ADTf) Calc
(if present ADT (ADTi)
and CDOT growth factor are known

Initial Year =	2016	
Final Year =	2035	
Final Year Daily Traffic (ADTf) =	[illegible]	
Initial Year Daily Traffic (ADTi) =	9370	
CDOT Growth Factor =	1.63	expressed as percent (%)

CDOT Growth Factor Tf:
if Initial Year ADTi
and Final Year ADTf are known

Initial Year Daily Traffic (ADTi) =	9370	Note: Enter Traffic Info at Growth Rate Section Also
Final Year Daily Traffic (ADTf) =	15300	
Initial Year =	2016	
Final Year =	2035	
Final Year - Initial Year =	[illegible]	Number of Years (CDOT Growth Factor years)
Tf =	[illegible]	

Federal Blvd SE
2 Lanes
RockSol Consulting Group, Inc.

Average Daily Traffic Volume

Existing		Future Year
2011		2035
Not Available		21800

Flexible Pavement Design Period 20 years

		Mid-Point YR		
Base Year	2016	2026	2036	Required Design Year
ADT	13350	17550	22526	

Rigid Pavement Design Period 30 years

		Mid-Point YR		
Base Year	2016	2031	2046	Required Design Year
ADT	13350	23566	29782	

Growth Rate (GR) Calculation (If initial and future traffic is provided)

ADTi = 13350 Average daily traffic for initial year
ADTf = 21800 Average daily traffic for future year
Initial Year = 2016
Future Year = 2035
GR = 2.63

Note: Growth Rate is not CDOT Growth Factor

ESAL Calculation

Flexible Pavement

Vehicle Type	Vehicle Percentage	Total Design Life Volume	Equivalency Factor	Design Lane Factor	Design Lane 18k ESAL's
Passenger Cars and P.U. Trucks	97.0	[illegible]	0.003	0.60	[illegible]
Single Unit Trucks	2.0	[illegible]	0.249	0.60	[illegible]
Combination Trucks	1.0	[illegible]	1.087	0.60	[illegible]
TOTAL	100.0	130,947,400			1,473,944

Rigid Pavement

Vehicle Type		Total Design Life Volume	Equivalency Factor	Design Lane Factor	Design Lane 18k ESAL's
Passenger Cars and P.U. Trucks	97.0	[illegible]	0.003	0.60	[illegible]
Single Unit Trucks	2.0	[illegible]	0.285	0.60	[illegible]
Combination Trucks	1.0	[illegible]	1.692	0.60	[illegible]
TOTAL	100.0	236,147,700			3,617,310

Date of Calculation, Designation Initials: 7/24/2012 DGH

Rev_7_24_12

Future Traffic Estimates Based on CDOT Growth Factor
CDOT Growth Factor = Tf

Future ADT (ADTf) Calc
(if present ADT (ADTi)
and CDOT growth factor are known

Initial Year = 2035
Final Year = 2046
Final Year Daily Traffic (ADTf) = [illegible]
Initial Year Daily Traffic (ADTi) = 21800
CDOT Growth Factor = 1.63 expressed as percent (%)

CDOT Growth Factor Tf:
if Initial Year ADTi
and Final Year ADTf are known

Initial Year Daily Traffic (ADTi) = 13350 **Note: Enter Traffic Info at Growth Rate Section Also**
Final Year Daily Traffic (ADTf) = 21800

Initial Year = 2016
Final Year = 2035

Final Year - Initial Year = 19 Number of Years (CDOT Growth Factor years)

Tf = 1.63

Federal Blvd NE Ramp
2 Lanes
RockSol Consulting Group, Inc.

Average Daily Traffic Volume

Existing	Future Year
2011	2035
5730	11900

Flexible Pavement Design Period 20 years

		Mid-Point YR		
Base Year	2016	[illegible]	2036	Required Design Year
ADT	7019	[illegible]	12176	

Rigid Pavement Design Period 30 years

		Mid-Point YR		
Base Year	2016	[illegible]	2046	Required Design Year
ADT	7019	[illegible]	17791	

Growth Rate (GR) Calculation (If initial and future traffic is provided)

ADTi =	5730	Average daily traffic for initial year
ADTf =	11900	Average daily traffic for future year
Initial Year =	2011	
Future Year =	2035	
GR =	[illegible]	

Note: Geowth Rate is not CDOT Growth Factor

ESAL Calculation

Flexible Pavement

Vehicle Type	Vehicle Percentage	Total Design Life Volume	Equivalency Factor	Design Lane Factor	Design Lane 18k ESAL's
Passenger Cars and P.U. Trucks	97.0	[illegible]	0.003	0.60	[illegible]
Single Unit Trucks	2.0	[illegible]	0.249	0.60	[illegible]
Combination Trucks	1.0	[illegible]	1.087	0.60	[illegible]
TOTAL	100.0	70,061,750			738,615

Rigid Pavement

Vehicle Type		Total Design Life Volume	Equivalency Factor	Design Lane Factor	Design Lane 18k ESAL's
Passenger Cars and P.U. Trucks	97.0	[illegible]	0.003	0.60	[illegible]
Single Unit Trucks	2.0	[illegible]	0.285	0.60	[illegible]
Combination Trucks	1.0	[illegible]	1.692	0.60	[illegible]
TOTAL	100.0	135,834,750			2,080,717

[illegible]	[illegible]	[illegible]
[illegible]	7/24/2012	[illegible]
[illegible]	DGH	Rev_7_24_12

Future Traffic Estimates Based on CDOT Growth Factor
CDOT Growth Factor = Tf

Future ADT (ADTf) Calc
(If present ADT (ADTi)
and CDOT growth factor are known

Initial Year =	2035	
Final Year =	2046	
Final Year Daily Traffic (ADTf) =	[illegible]	
Initial Year Daily Traffic (ADTi) =	11900	
CDOT Growth Factor =	2.08	expressed as percent (%)

CDOT Growth Factor Tf:
If Initial Year ADTi
and Final Year ADTf are known

Initial Year Daily Traffic (ADTi) =	5730	Note: Enter Traffic Info at Growth Rate Section Also
Final Year Daily Traffic (ADTf) =	11900	
Initial Year =	2011	
Final Year =	2035	
Final Year - Initial Year =	[illegible]	Number of Years (CDOT Growth Factor years)
Tf =	[illegible]	

Federal Blvd SW Ramp 1 lane

RockSol Consulting Group, Inc.

Average Daily Traffic Volume

Existing	Future Year
2011	2035
5710	13400

Flexible Pavement Design Period 20 years

		Mid-Point YR		
Base Year	2016	[illegible]	2036	Required Design Year
ADT	7316	[illegible]	13740	

Rigid Pavement Design Period 30 years

		Mid-Point YR		
Base Year	2016	[illegible]	2046	Required Design Year
ADT	7316	[illegible]	21691	

Growth Rate (GR) Calculation (If initial and future traffic is provided)

ADTi = 5710 Average daily traffic for initial year
ADTf = 13400 Average daily traffic for future year
Initial Year = 2011
Future Year = 2035
GR = [illegible]

Note: Growth Rate is not CDOT Growth Factor

ESAL Calculation

Flexible Pavement

Vehicle Type	Vehicle Percentage	Total Design Life Volume	Equivalency Factor	Design Lane Factor	Design Lane 18k ESAL's
Passenger Cars and P.U. Trucks	97.0	[illegible]	0.003	1.00	[illegible]
Single Unit Trucks	2.0	[illegible]	0.249	1.00	[illegible]
Combination Trucks	1.0	[illegible]	1.087	1.00	[illegible]
TOTAL	100.0	76,854,400			1,441,789

Rigid Pavement

Vehicle Type		Total Design Life Volume	Equivalency Factor	Design Lane Factor	Design Lane 18k ESAL's
Passenger Cars and P.U. Trucks	97.0	[illegible]	0.003	1.00	[illegible]
Single Unit Trucks	2.0	[illegible]	0.285	1.00	[illegible]
Combination Trucks	1.0	[illegible]	1.692	1.00	[illegible]
TOTAL	100.0	158,813,325			4,054,504

Date of Calculation Outgrown Details	
7/24/2012	
DGH	Rev_7_24_12

Future Traffic Estimates Based on CDOT Growth Factor
CDOT Growth Factor = Tf

Future ADT (ADTf) Calc
(if present ADT (ADTi)
and CDOT growth factor are known

Initial Year = 2035
Final Year = 2046

Final Year Daily Traffic (ADTf) = [illegible]
Initial Year Daily Traffic (ADTi) = 13400
CDOT Growth Factor = 2.35 expressed as percent (%)

CDOT Growth Factor Tf:
if Initial Year ADTi
and Final Year ADTf are known

Initial Year Daily Traffic (ADTi) = 5710 **Note: Enter Traffic Info at Growth Rate Section Also**
Final Year Daily Traffic (ADTf) = 13400

Initial Year = 2011
Final Year = 2035

Final Year - Initial Year = [illegible] Number of Years (CDOT Growth Factor years)

Tf = [illegible]

Federal Blvd SW Ramp 2 lane

RockSol Consulting Group, Inc.

Average Daily Traffic Volume

Existing	Future Year
2011	2035
5710	13400

Flexible Pavement Design Period 20 years

		Mid-Point YR		
Base Year	2016	[illegible]	2036	Required Design Year
ADT	7316	[illegible]	13740	

Rigid Pavement Design Period 30 years

		Mid-Point YR		
Base Year	2016	[illegible]	2046	Required Design Year
ADT	7316	[illegible]	21691	

Growth Rate (GR) Calculation (If initial and future traffic is provided)

ADTi =	5710	Average daily traffic for initial year
ADTf =	13400	Average daily traffic for future year
Initial Year =	2011	
Future Year =	2035	
GR =	[illegible]	

Note: Growth Rate is not CDOT Growth Factor

ESAL Calculation

Flexible Pavement

Vehicle Type	Vehicle Percentage	Total Design Life Volume	Equivalency Factor	Design Lane Factor	Design Lane 18k ESAL's
Passenger Cars and P.U. Trucks	97.0	[illegible]	0.003	0.60	[illegible]
Single Unit Trucks	2.0	[illegible]	0.249	0.60	[illegible]
Combination Trucks	1.0	[illegible]	1.087	0.60	[illegible]
TOTAL	100.0	76,854,400			865,073

Rigid Pavement

Vehicle Type		Total Design Life Volume	Equivalency Factor	Design Lane Factor	Design Lane 18k ESAL's
Passenger Cars and P.U. Trucks	97.0	[illegible]	0.003	0.60	[illegible]
Single Unit Trucks	2.0	[illegible]	0.285	0.60	[illegible]
Combination Trucks	1.0	[illegible]	1.692	0.60	[illegible]
TOTAL	100.0	158,813,325			2,432,703

	Date of Calculation Computer Initials	
	7/24/2012	
	DGH	Rev_7_24_12

Future Traffic Estimates Based on CDOT Growth Factor
CDOT Growth Factor = Tf

Future ADT (ADTf) Calc
(if present ADT (ADTi)
and CDOT growth factor are known

Initial Year =	2035	
Final Year =	2046	
Final Year Daily Traffic (ADTf) =	[illegible]	
Initial Year Daily Traffic (ADTi) =	13400	
CDOT Growth Factor =	2.35	expressed as percent (%)

CDOT Growth Factor Tf:
if Initial Year ADTi
and Final Year ADTf are known

Initial Year Daily Traffic (ADTi) =	5710	**Note: Enter Traffic Info at Growth Rate Section Also**
Final Year Daily Traffic (ADTf) =	13400	
Initial Year =	2011	
Final Year =	2035	
Final Year - Initial Year =	[illegible]	Number of Years (CDOT Growth Factor years)
Tf =	[illegible]	

Federal Blvd NW Ramp 2 lane

RockSol Consulting Group, Inc.

Average Daily Traffic Volume

Existing	Future Year
2011	2035
7920	12800

Flexible Pavement Design Period 20 years

		Mid-Point YR		
Base Year	2016	[illegible]	2036	Required Design Year
ADT	8943	[illegible]	13035	

Rigid Pavement Design Period 30 years

		Mid-Point YR		
Base Year	2016	[illegible]	2046	Required Design Year
ADT	8943	[illegible]	16437	

Growth Rate (GR) Calculation (If initial and future traffic is provided)

ADTi =	7920	Average daily traffic for initial year
ADTf =	12800	Average daily traffic for future year
Initial Year =	2011	
Future Year =	2035	
GR =	[illegible]	

Note: Growth Rate is not CDOT Growth Factor

ESAL Calculation

Flexible Pavement

Vehicle Type	Vehicle Percentage	Total Design Life Volume	Equivalency Factor	Design Lane Factor	Design Lane 18k ESAL's
Passenger Cars and P.U. Trucks	97.0	[illegible]	0.003	0.60	[illegible]
Single Unit Trucks	2.0	[illegible]	0.249	0.60	[illegible]
Combination Trucks	1.0	[illegible]	1.087	0.60	[illegible]
TOTAL	100.0	80,219,700			902,953

Rigid Pavement

Vehicle Type		Total Design Life Volume	Equivalency Factor	Design Lane Factor	Design Lane 18k ESAL's
Passenger Cars and P.U. Trucks	97.0	[illegible]	0.003	0.60	[illegible]
Single Unit Trucks	2.0	[illegible]	0.285	0.60	[illegible]
Combination Trucks	1.0	[illegible]	1.692	0.60	[illegible]
TOTAL	100.0	138,955,500			2,128,520

Date of Calculation Originator Initials	
7/24/2012	
DGH	Rev_7_24_12

Future Traffic Estimates Based on CDOT Growth Factor
CDOT Growth Factor = Tf

Future ADT (ADTf) Calc
(if present ADT (ADTi)
and CDOT growth factor are known

Initial Year =	2035	
Final Year =	2046	
Final Year Daily Traffic (ADTf) =	[illegible]	
Initial Year Daily Traffic (ADTi) =	12800	
CDOT Growth Factor =	1.62	expressed as percent (%)

CDOT Growth Factor Tf:
If Initial Year ADTi
and Final Year ADTf are known

Initial Year Daily Traffic (ADTi) =	7920	**Note: Enter Traffic Info at Growth Rate Section Also**
Final Year Daily Traffic (ADTf) =	12800	
Initial Year =	2011	
Final Year =	2035	
Final Year - Initial Year =	[illegible]	Number of Years (CDOT Growth Factor years)
Tf =	[illegible]	

Federal Blvd NW Ramp 1 lane

RockSol Consulting Group, Inc.

Average Daily Traffic Volume

Existing	Future Year
2011	2035
7920	12800

Flexible Pavement Design Period 20 years

	Base Year	Mid-Point YR		
	2016	2026	2036	Required Design Year
ADT	8943	10837	13035	

Rigid Pavement Design Period 30 years

	Base Year	Mid-Point YR		
	2016	2031	2046	Required Design Year
ADT	8943	12690	16437	

Growth Rate (GR) Calculation (If initial and future traffic is provided)

ADTi =	7920	Average daily traffic for initial year
ADTf =	12800	Average daily traffic for future year
Initial Year =	2011	
Future Year =	2035	
GR =	2.62	

Note: Growth Rate is not CDOT Growth Factor

ESAL Calculation

Flexible Pavement

Vehicle Type	Vehicle Percentage	Total Design Life Volume	Equivalency Factor	Design Lane Factor	Design Lane 18k ESAL's
Passenger Cars and P.U. Trucks	97.0	77,812,939	0.003	1.00	233,439
Single Unit Trucks	2.0	1,604,354	0.249	1.00	399,557
Combination Trucks	1.0	802,177	1.087	1.00	871,926
TOTAL	100.0	80,219,700			1,504,922

Rigid Pavement

Vehicle Type	Vehicle Percentage	Total Design Life Volume	Equivalency Factor	Design Lane Factor	Design Lane 18k ESAL's
Passenger Cars and P.U. Trucks	97.0	134,967,833	0.003	1.00	404,903
Single Unit Trucks	2.0	2,783,110	0.285	1.00	793,036
Combination Trucks	1.0	1,391,555	1.692	1.00	2,353,337
TOTAL	100.0	138,955,500			3,547,534

Date of Calculation: 7/24/2012

Designer Initials: DGH

Rev_7_24_12

Future Traffic Estimates Based on CDOT Growth Factor

CDOT Growth Factor = Tf

Future ADT (ADTf) Calc
(if present ADT (ADTi) and CDOT growth factor are known

Initial Year =	2035	
Final Year =	2046	
Final Year Daily Traffic (ADTf) =	16429	
Initial Year Daily Traffic (ADTi) =	12800	
CDOT Growth Factor =	1.62	expressed as percent (%)

CDOT Growth Factor Tf
If Initial Year ADTi and Final Year ADTf are known

Initial Year Daily Traffic (ADTi) =	7920	Note: Enter Traffic Info at Growth Rate Section Also
Final Year Daily Traffic (ADTf) =	12800	
Initial Year =	2011	
Final Year =	2035	
Final Year - Initial Year =	24	Number of Years (CDOT Growth Factor years)
Tf =	0.62	

North Bound I-25 Ramp to WB US6
1 lane
RockSol Consulting Group, Inc.

Average Daily Traffic Volume

Existing	Future Year
2011	2035
21200	27100

Flexible Pavement Design Period 20 years

		Mid-Point YR		
Base Year	2016	[illegible]	2036	Required Design Year
ADT	22437	[illegible]	27383	

Rigid Pavement Design Period 30 years

		Mid-Point YR		
Base Year	2016	[illegible]	2046	Required Design Year
ADT	22437	[illegible]	30578	

Growth Rate (GR) Calculation (if initial and future traffic is provided)

ADTi =	21200	Average daily traffic for initial year
ADTf =	27100	Average daily traffic for future year
Initial Year =	2011	
Future Year =	2035	
GR =	[illegible]	

Note: Growth Rate is not CDOT Growth Factor

ESAL Calculation

Flexible Pavement

Vehicle Type	Vehicle Percentage	Total Design Life Volume	Equivalency Factor	Design Lane Factor	Design Lane 18k ESAL's
Passenger Cars and P.U. Trucks	93.0	[illegible]	0.003	1.00	[illegible]
Single Unit Trucks	3.0	[illegible]	0.249	1.00	[illegible]
Combination Trucks	4.0	[illegible]	1.087	1.00	[illegible]
TOTAL	100.0	151,843,000			9,772,243

Rigid Pavement

Vehicle Type	Total Design Life Volume	Equivalency Factor	Design Lane Factor	Design Lane 18k ESAL's
Passenger Cars and P.U. Trucks 93.0	[illegible]	0.003	1.00	[illegible]
Single Unit Trucks 3.0	[illegible]	0.285	1.00	[illegible]
Combination Trucks 4.0	[illegible]	1.692	1.00	[illegible]
TOTAL 100.0	290,257,125			22,936,118

[illegible]
7/24/2012
DGH
Rev_7_24_12

Future Traffic Estimates Based on CDOT Growth Factor
CDOT Growth Factor = Tf

Future ADT (ADTf) Calc (if present ADT (ADTi) and CDOT growth factor are known)

Initial Year =	2035	
Final Year =	2046	
Final Year Daily Traffic (ADTf) =	[illegible]	
Initial Year Daily Traffic (ADTi) =	27100	
CDOT Growth Factor =	1.28	expressed as percent (%)

CDOT Growth Factor Tf: (if Initial Year ADT and Final Year ADTf are known)

Initial Year Daily Traffic (ADTi) =	21200	Note: Enter Traffic Info at Growth Rate Section Also
Final Year Daily Traffic (ADTf) =	27100	
Initial Year =	2011	
Final Year =	2035	
Final Year - Initial Year =	[illegible]	Number of Years (CDOT Growth Factor years)
Tf =	[illegible]	

APPENDIX E

PAVEMENT THICKNESS CALCULATION SHEETS (ROCKSOL)

1993 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare
Computer Software Product
RCG

Flexible Structural Design Module

Federal Blvd to WB US6 On-Ramp (1 Lane) (R10)

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	1,504,922
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	3,562 psi
Stage Construction	1
Calculated Design Structural Number	4.86 in

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	New HMA	0.44	1	9	-	3.96
2	ABC (CDOT Class 6)	0.15	1	6	-	0.90
Total	-	-	-	15.00	-	4.86

Layered Thickness Design

Thickness precision: Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(in)	Min Thickness (Di)(in)	Elastic Modulus (psi)	Width (ft)	Calculated Thickness (in)	Calculated SN (in)
Total	-	-	-	-	-	-	-	-	-

*Note: This value is not represented by the inputs or an error occurred in calculation.

1993 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare
Computer Software Product
RCG

Flexible Structural Design Module

Federal Blvd to WB US6 On-Ramp (2 Lane) (R10)

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	902,953
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	3,562 psi
Stage Construction	1
Calculated Design Structural Number	4.52 in

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	New HMA	0.44	1	8.23	-	3.62
2	ABC (CDOT Class 6)	0.15	1	6	-	0.90
Total	-	-	-	14.23	-	4.52

Layered Thickness Design

Thickness precision: Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(in)	Min Thickness (Di)(in)	Elastic Modulus (psi)	Width (ft)	Calculated Thickness (in)	Calculated SN (in)
Total	-	-	-	-	-	-	-	-	-

*Note: This value is not represented by the inputs or an error occurred in calculation.

1993 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare
Computer Software Product
RCG

Flexible Structural Design Module

WB US 6 to Federal Blvd Off-Ramp (R10)

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	788,615
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	3,562 psi
Stage Construction	1
Calculated Design Structural Number	4.43 in

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	New HMA	0.44	1	8.03	-	3.53
2	ABC (CDOT Class 6)	0.15	1	6	-	0.90
Total	-	-	-	14.03	-	4.43

Layered Thickness Design

Thickness precision: Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(in)	Min Thickness (Di)(in)	Elastic Modulus (psi)	Width (ft)	Calculated Thickness (in)	Calculated SN (in)
Total	-	-	-	-	-	-	-	-	-

*Note: This value is not represented by the inputs or an error occurred in calculation.

1993 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare
Computer Software Product
RCG

Flexible Structural Design Module

Federal Blvd to EB US6 Braided Ramp (R10)

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	726,715
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	3,562 psi
Stage Construction	1
Calculated Design Structural Number	4.38 in

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	New HMA	0.44	1	7.92	-	3.48
2	ABC (CDOT Class 6)	0.15	1	6	-	0.90
Total	-	-	-	13.92	-	4.38

Layered Thickness Design

Thickness precision: Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(in)	Min Thickness (Di)(in)	Elastic Modulus (psi)	Width (ft)	Calculated Thickness (in)	Calculated SN (in)
Total	-	-	-	-	-	-	-	-	-

*Note: This value is not represented by the inputs or an error occurred in calculation.

1993 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare
Computer Software Product
RCG

Flexible Structural Design Module

EB US6 to Federal Blvd Off-Ramp (1 Lane) (R10)

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	1,441,789
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	3,562 psi
Stage Construction	1
Calculated Design Structural Number	4.83 in

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	New HMA	0.44	1	8.94	-	3.93
2	ABC (CDOT Class 6)	0.15	1	6	-	0.90
Total	-	-	-	14.94	-	4.83

Layered Thickness Design

Thickness precision: Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(in)	Min Thickness (Di)(in)	Elastic Modulus (psi)	Width (ft)	Calculated Thickness (in)	Calculated SN (in)
Total	-	-	-	-	-	-	-	-	-

*Note: This value is not represented by the inputs or an error occurred in calculation.

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Flexible Structural Design Module

EB US6 to Federal Blvd Off-Ramp (2 Lane) (R10)

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	865,073
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	3,562 psi
Stage Construction	1
Calculated Design Structural Number	4.49 in

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	New HMA	0.44	1	8.16	-	3.59
2	ABC (CDOT Class 6)	0.15	1	6	-	0.90
Total	-	-	-	14.16	-	4.49

Layered Thickness Design

Thickness precision: Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(in)	Min Thickness (Di)(in)	Elastic Modulus (psi)	Width (ft)	Calculated Thickness (in)	Calculated SN (in)
Total	-	-	-	-	-	-	-	-	-

*Note: This value is not represented by the inputs or an error occurred in calculation.

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Flexible Structural Design Module

Federal Blvd to EB US6 CD Road (R10)

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	1,710,617
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	3,562 psi
Stage Construction	1
Calculated Design Structural Number	4.94 in

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	New HMA	0.44	1	9.19	-	4.04
2	ABC (CDOT Class 6)	0.15	1	6	-	0.90
Total	-	-	-	15.19	-	4.94

Layered Thickness Design

Thickness precision: Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(in)	Min Thickness (Di)(in)	Elastic Modulus (psi)	Width (ft)	Calculated Thickness (in)	Calculated SN (in)
Total	-	-	-	-	-	-	-	-	-

*Note: This value is not represented by the inputs or an error occurred in calculation.

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Flexible Structural Design Module

WB US6 CD Road 2 Lane West of Federal (R10)

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	2,680,675
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	3,562 psi
Stage Construction	1
Calculated Design Structural Number	5.26 in

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	New HMA	0.44	1	9.91	-	4.36
2	ABC (CDOT Class 6)	0.15	1	6	-	0.90
Total	-	-	-	15.91	-	5.26

Layered Thickness Design

Thickness precision: Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(in)	Min Thickness (Di)(in)	Elastic Modulus (psi)	Width (ft)	Calculated Thickness (in)	Calculated SN (in)
Total	-	-	-	-	-	-	-	-	-

*Note: This value is not represented by the inputs or an error occurred in calculation.

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Flexible Structural Design Module

EB US6 CD Road (R10)

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	5,200,381
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	3,562 psi
Stage Construction	1
Calculated Design Structural Number	5.74 in

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	New HMA	0.44	1	11	-	4.84
2	ABC (CDOT Class 6)	0.15	1	6	-	0.90
Total	-	-	-	17.00	-	5.74

Layered Thickness Design

Thickness precision: Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(in)	Min Thickness (Di)(in)	Elastic Modulus (psi)	Width (ft)	Calculated Thickness (in)	Calculated SN (in)
Total	-	-	-	-	-	-	-	-	-

*Note: This value is not represented by the inputs or an error occurred in calculation.

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Flexible Structural Design Module

US6, Knox Ct to Bryant St and S.Platte River to I-25 (R10)

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	10,176,092
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	3,562 psi
Stage Construction	1
Calculated Design Structural Number	6.26 in

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	New HMA	0.44	1	12.25	-	5.39
2	ABC (CDOT Class 6)	0.15	1	6	-	0.90
Total	-	-	-	18.25	-	6.29

Layered Thickness Design

Thickness precision Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(in)	Min Thickness (Di)(in)	Elastic Modulus (psi)	Width (ft)	Calculated Thickness (in)	Calculated SN (in)
Total	-	-	-	-	-	-	-	-	-

*Note: This value is not represented by the inputs or an error occurred in calculation.

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Flexible Structural Design Module

US6, Bryant St to S.Platte River (R20)

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	10,176,092
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	4,940 psi
Stage Construction	1
Calculated Design Structural Number	5.67 in

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	New HMA	0.44	1	10.86	-	4.78
2	ABC (CDOT Class 6)	0.15	1	6	-	0.90
Total	-	-	-	16.86	-	5.68

Layered Thickness Design

Thickness precision: Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(in)	Min Thickness (Di)(in)	Elastic Modulus (psi)	Width (ft)	Calculated Thickness (in)	Calculated SN (in)
Total	-	-	-	-	-	-	-	-	-

*Note: This value is not represented by the inputs or an error occurred in calculation.

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Flexible Structural Design Module

US6, I-25 to BNSF (R5)

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	5,173,861
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	3,025 psi
Stage Construction	1
Calculated Design Structural Number	6.03 in

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	New HMA	0.44	1	11.66	-	5.13
2	ABC (CDOT Class 6)	0.15	1	6	-	0.90
Total	-	-	-	17.66	-	6.03

Layered Thickness Design

Thickness precision: Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(in)	Min Thickness (Di)(in)	Elastic Modulus (psi)	Width (ft)	Calculated Thickness (in)	Calculated SN (in)
Total	-	-	-	-	-	-	-	-	-

*Note: This value is not represented by the inputs or an error occurred in calculation.

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Flexible Structural Design Module

SB I-25 to WB US6 Ramp (R10)

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	7,432,161
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	3,562 psi
Stage Construction	1
Calculated Design Structural Number	6.01 in

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	New HMA	0.44	1	11.62	-	5.11
2	ABC (CDOT Class 6)	0.15	1	6	-	0.90
Total	-	-	-	17.62	-	6.01

Layered Thickness Design

Thickness precision: Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(in)	Min Thickness (Di)(in)	Elastic Modulus (psi)	Width (ft)	Calculated Thickness (in)	Calculated SN (in)
Total	-	-	-	-	-	-	-	-	-

*Note: This value is not represented by the inputs or an error occurred in calculation.

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Flexible Structural Design Module

NB I-25 to WB US6 Ramp (I-25 CD Road) (R5)

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	9,772,243
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	3,025 psi
Stage Construction	1
Calculated Design Structural Number	6.54 in

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	New HMA	0.44	1	12.82	-	5.64
2	ABC (CDOT Class 6)	0.15	1	6	-	0.90
Total	-	-	-	18.82	-	6.54

Layered Thickness Design

Thickness precision Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(in)	Min Thickness (Di)(in)	Elastic Modulus (psi)	Width (ft)	Calculated Thickness (in)	Calculated SN (in)
Total	-	-	-	-	-	-	-	-	-

*Note: This value is not represented by the inputs or an error occurred in calculation.

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Flexible Structural Design Module

NB I-25 to EB US6 Ramp (R5)

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	1,854,019
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	3,025 psi
Stage Construction	1
Calculated Design Structural Number	5.26 in

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	New HMA	0.44	1	9.91	-	4.36
2	ABC (CDOT Class 6)	0.15	1	6	-	0.90
Total	-	-	-	15.91	-	5.26

Layered Thickness Design

Thickness precision: Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(in)	Min Thickness (Di)(in)	Elastic Modulus (psi)	Width (ft)	Calculated Thickness (in)	Calculated SN (in)
Total	-	-	-	-	-	-	-	-	-

*Note: This value is not represented by the inputs or an error occurred in calculation.

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Flexible Structural Design Module

SB I-25 to EB US6 Ramp (R10)

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	3,449,904
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	3,562 psi
Stage Construction	1
Calculated Design Structural Number	5.44 in

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	New HMA	0.44	1	10.32	-	4.54
2	ABC (CDOT Class 6)	0.15	1	6	-	0.90
Total	-	-	-	16.32	-	5.44

Layered Thickness Design

Thickness precision: Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(in)	Min Thickness (Di)(in)	Elastic Modulus (psi)	Width (ft)	Calculated Thickness (in)	Calculated SN (in)
Total	-	-	-	-	-	-	-	-	-

*Note: This value is not represented by the inputs or an error occurred in calculation.

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Flexible Structural Design Module

I-25 (NB and SB) (R5)

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	30,426,404
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	3,025 psi
Stage Construction	1
Calculated Design Structural Number	7.53 in

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	New HMA	0.44	1	15.07	-	6.63
2	ABC (CDOT Class 6)	0.15	1	6	-	0.90
Total	-	-	-	21.07	-	7.53

Layered Thickness Design

Thickness precision: Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(in)	Min Thickness (Di)(in)	Elastic Modulus (psi)	Width (ft)	Calculated Thickness (in)	Calculated SN (in)
Total	-	-	-	-	-	-	-	-	-

*Note: This value is not represented by the inputs or an error occurred in calculation.

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Flexible Structural Design Module

Bryant St Ramp to Federal Blvd (R10)

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	424,539
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	3,562 psi
Stage Construction	1
Calculated Design Structural Number	4.05 in

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	New HMA	0.44	1	7.17	-	3.15
2	ABC (CDOT Class 6)	0.15	1	6	-	0.90
Total	-	-	-	13.17	-	4.05

Layered Thickness Design

Thickness precision: Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(in)	Min Thickness (Di)(in)	Elastic Modulus (psi)	Width (ft)	Calculated Thickness (in)	Calculated SN (in)
Total	-	-	-	-	-	-	-	-	-

*Note: This value is not represented by the inputs or an error occurred in calculation.

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Flexible Structural Design Module

Federal Blvd Ramp to Bryant St Ramp (R10)

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	324,019
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	3,562 psi
Stage Construction	1
Calculated Design Structural Number	3.89 in

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	New HMA	0.44	1	6.8	-	2.99
2	ABC (CDOT Class 6)	0.15	1	6	-	0.90
Total	-	-	-	12.80	-	3.89

Layered Thickness Design

Thickness precision: Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(in)	Min Thickness (Di)(in)	Elastic Modulus (psi)	Width (ft)	Calculated Thickness (in)	Calculated SN (in)
Total	-	-	-	-	-	-	-	-	-

*Note: This value is not represented by the inputs or an error occurred in calculation.

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Rigid Structural Design Module

Bryant Street Ramp to Federal Boulevard

Rigid Structural Design

Pavement Type	JPCP
18-kip ESALs Over Initial Performance Period	1,091,517
Initial Serviceability	4.5
Terminal Serviceability	2.5
28-day Mean PCC Modulus of Rupture	650 psi
28-day Mean Elastic Modulus of Slab	3,400,000 psi
Mean Effective k-value	60 psi/in
Reliability Level	95 %
Overall Standard Deviation	0.34
Load Transfer Coefficient, J	2.8
Overall Drainage Coefficient, Cd	1
Calculated Design Thickness	7.03 in

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Rigid Structural Design Module

Federal Blvd Ramp to Bryant Street Ramp

Rigid Structural Design

Pavement Type	JPCP
18-kip ESALs Over Initial Performance Period	740,258
Initial Serviceability	4.5
Terminal Serviceability	2.5
28-day Mean PCC Modulus of Rupture	650 psi
28-day Mean Elastic Modulus of Slab	3,400,000 psi
Mean Effective k-value	60 psi/in
Reliability Level	95 %
Overall Standard Deviation	0.34
Load Transfer Coefficient, J	2.8
Overall Drainage Coefficient, Cd	1
Calculated Design Thickness	6.56 in

Rigid Pavement Design - Based on AASHTO Supplemental Guide

Reference: *LTPP DATA ANALYSIS - Phase I: Validation of Guidelines for k-Value Selection and Concrete Pavement Performance Prediction*

Results

Project # 280.01
Description: US 6 Bridges - Knox Ct to BNSF

Location: US6, Knox Ct. to Bryant St.

Slab Thickness Design

Pavement Type	JPCP	
18-kip ESALs Over Initial Performance Period (million)	22.82	million
Initial Serviceability	4.5	
Terminal Serviceability	2.5	
28-day Mean PCC Modulus of Rupture	650	psi
Elastic Modulus of Slab	3,400,000	psi
Elastic Modulus of Base	25,000	psi
Base Thickness	6.0	in.
Mean Effective k-Value	60	psi/in
Reliability Level	95	%
Overall Standard Deviation	0.34	
Calculated Design Thickness	**11.15**	in

Temperature Differential

Mean Annual Wind Speed	8.8	mph
Mean Annual Air Temperature	50.2	°F
Mean Annual Precipitation	19.5	in
Maximum Positive Temperature Differential	**8.36**	°F

Modulus of Subgrade Reaction

Period	Description	Subgrade k-Value, psi
12	1	60

Seasonally Adjusted Modulus of Subgrade Reaction	**52**	psi/in
Modulus of Subgrade Reaction Adjusted for Rigid Layer and Fill Section		psi/in

Traffic

Performance Period		years
Two-Way ADT		
Number of Lanes in Design Direction		
Percent of All Trucks in Design Lane		
Percent Trucks in Design Direction		

Vehicle Class	Percent of ADT	Annual Growth	Initial Truck Factor	Annual Growth in Truck Factor	Accumulated 18-kip ESALs (millions)

Total Calculated Cumulative ESALs		million

Faulting

Doweled

Dowel Diameter	1.5	in
Drainage Coefficient	1.00	
Average Fault for Design Years with Design Inputs	**0.06**	in
Criteria Check **PASS**		

Nondoweled

Drainage Coefficient	1	
Average Fault for Design Years with Design Inputs		in
Criteria Check		

Rigid Pavement Design - Based on AASHTO Supplemental Guide

Reference: *LTPP DATA ANALYSIS - Phase I: Validation of Guidelines for k-Value Selection and Concrete Pavement Performance Prediction*

Results

Project # 280.01
Description: US 6 Bridges - Knox Ct to BNSF

Location: US 6 - I-25 to BNSF

Slab Thickness Design

Pavement Type	JPCP	
18-kip ESALs Over Initial Performance Period (million)	11.38	million
Initial Serviceability	4.5	
Terminal Serviceability	2.5	
28-day Mean PCC Modulus of Rupture	650	psi
Elastic Modulus of Slab	3,400,000	psi
Elastic Modulus of Base	25,000	psi
Base Thickness	6.0	in.
Mean Effective k-Value	52	psi/in
Reliability Level	95	%
Overall Standard Deviation	0.34	
Calculated Design Thickness	**10.13**	in

Temperature Differential

Mean Annual Wind Speed	8.8	mph
Mean Annual Air Temperature	50.2	°F
Mean Annual Precipitation	19.5	in
Maximum Positive Temperature Differential	**7.89**	°F

Modulus of Subgrade Reaction

Period	Description	Subgrade k-Value, psi
12	1	52

Seasonally Adjusted Modulus of Subgrade Reaction	**52**	psi/in
Modulus of Subgrade Reaction Adjusted for Rigid Layer and Fill Section		psi/in

Traffic

Performance Period		years
Two-Way ADT		
Number of Lanes in Design Direction		
Percent of All Trucks in Design Lane		
Percent Trucks in Design Direction		

Vehicle Class	Percent of ADT	Annual Growth	Initial Truck Factor	Annual Growth in Truck Factor	Accumulated 18-kip ESALs (millions)

Total Calculated Cumulative ESALs		million

Faulting

Doweled

Dowel Diameter	1.5	in
Drainage Coefficient	1.00	
Average Fault for Design Years with Design Inputs	**0.05**	in
Criteria Check **PASS**		

Nondoweled

Drainage Coefficient	1	
Average Fault for Design Years with Design Inputs		in
Criteria Check		

Rigid Pavement Design - Based on AASHTO Supplemental Guide

Reference: *LTPP DATA ANALYSIS - Phase I: Validation of Guidelines for k-Value Selection and Concrete Pavement Performance Prediction*

Results

Project # 280.01
Description: US 6 Bridges - Knox Ct to BNSF

Location: WB US6 CD Road 2 Lane

Slab Thickness Design

Pavement Type	JPCP	
18-kip ESALs Over Initial Performance Period (million)	6.61	million
Initial Serviceability	4.5	
Terminal Serviceability	2.5	
28-day Mean PCC Modulus of Rupture	650	psi
Elastic Modulus of Slab	3,400,000	psi
Elastic Modulus of Base	25,000	psi
Base Thickness	6.0	in.
Mean Effective k-Value	60	psi/in
Reliability Level	95	%
Overall Standard Deviation	0.34	
Calculated Design Thickness	**9.36**	in

Temperature Differential

Mean Annual Wind Speed	8.8	mph
Mean Annual Air Temperature	50.2	°F
Mean Annual Precipitation	19.5	in
Maximum Positive Temperature Differential	**7.46**	°F

Modulus of Subgrade Reaction

Period	Description	Subgrade k-Value, psi
12	1	60

Seasonally Adjusted Modulus of Subgrade Reaction	**52**	psi/in
Modulus of Subgrade Reaction Adjusted for Rigid Layer and Fill Section		psi/in

Traffic

Performance Period — years
Two-Way ADT
Number of Lanes in Design Direction
Percent of All Trucks in Design Lane
Percent Trucks in Design Direction

Vehicle Class	Percent of ADT	Annual Growth	Initial Truck Factor	Annual Growth in Truck Factor	Accumulated 18-kip ESALs (millions)

Total Calculated Cumulative ESALs — million

Faulting

Doweled

Dowel Diameter	1.25	in
Drainage Coefficient	1.00	
Average Fault for Design Years with Design Inputs	**0.05**	in
Criteria Check **PASS**		

Nondoweled

Drainage Coefficient	1	
Average Fault for Design Years with Design Inputs		in
Criteria Check		

Rigid Pavement Design - Based on AASHTO Supplemental Guide

Reference: *LTPP DATA ANALYSIS - Phase I: Validation of Guidelines for k-Value Selection and Concrete Pavement Performance Prediction*

Results

Project # 280.01
Description: US 6 Bridges - Knox Ct to BNSF

Location: EB US6 CD Road

Slab Thickness Design

Pavement Type	JPCP	
18-kip ESALs Over Initial Performance Period (million)	12.60	million
Initial Serviceability	4.5	
Terminal Serviceability	2.5	
28-day Mean PCC Modulus of Rupture	650	psi
Elastic Modulus of Slab	3,400,000	psi
Elastic Modulus of Base	25,000	psi
Base Thickness	6.0	in.
Mean Effective k-Value	60	psi/in
Reliability Level	95	%
Overall Standard Deviation	0.34	
Calculated Design Thickness	**10.26**	in

Temperature Differential

Mean Annual Wind Speed	8.8	mph
Mean Annual Air Temperature	50.2	°F
Mean Annual Precipitation	19.5	in
Maximum Positive Temperature Differential	**7.95**	°F

Modulus of Subgrade Reaction

Period	Description	Subgrade k-Value, psi
12	1	60

Seasonally Adjusted Modulus of Subgrade Reaction	**52**	psi/in
Modulus of Subgrade Reaction Adjusted for Rigid Layer and Fill Section		psi/in

Traffic

Performance Period — years
Two-Way ADT
Number of Lanes in Design Direction
Percent of All Trucks in Design Lane
Percent Trucks in Design Direction

Vehicle Class	Percent of ADT	Annual Growth	Initial Truck Factor	Annual Growth in Truck Factor	Accumulated 18-kip ESALs (millions)

Total Calculated Cumulative ESALs — million

Faulting

Doweled

Dowel Diameter	1.5	in
Drainage Coefficient	1.00	
Average Fault for Design Years with Design Inputs	**0.05**	in
Criteria Check **PASS**		

Nondoweled

Drainage Coefficient	1	
Average Fault for Design Years with Design Inputs		in
Criteria Check		

Rigid Pavement Design - Based on AASHTO Supplemental Guide

Reference: *LTPP DATA ANALYSIS - Phase I: Validation of Guidelines for k-Value Selection and Concrete Pavement Performance Prediction*

Results

Project # 280.01
Description: US 6 Bridges - Knox Ct to BNSF

Location: NW Ramp 1 Lane Segment

Slab Thickness Design

Pavement Type	JPCP	
18-kip ESALs Over Initial Performance Period (million)	3.55	million
Initial Serviceability	4.5	
Terminal Serviceability	2.5	
28-day Mean PCC Modulus of Rupture	650	psi
Elastic Modulus of Slab	3,400,000	psi
Elastic Modulus of Base	15,000	psi
Base Thickness	6.0	in.
Mean Effective k-Value	71	psi/in
Reliability Level	95	%
Overall Standard Deviation	0.34	
Calculated Design Thickness	**8.59**	in

Temperature Differential

Mean Annual Wind Speed	8.8	mph
Mean Annual Air Temperature	50.2	°F
Mean Annual Precipitation	19.5	in
Maximum Positive Temperature Differential	**6.96**	°F

Modulus of Subgrade Reaction

Period	Description	Subgrade k-Value, psi
12	1	71

Seasonally Adjusted Modulus of Subgrade Reaction	**52**	psi/in
Modulus of Subgrade Reaction Adjusted for Rigid Layer and Fill Section		psi/in

Traffic

Performance Period		years
Two-Way ADT		
Number of Lanes in Design Direction		
Percent of All Trucks in Design Lane		
Percent Trucks in Design Direction		

Vehicle Class	Percent of ADT	Annual Growth	Initial Truck Factor	Annual Growth in Truck Factor	Accumulated 18-kip ESALs (millions)

Total Calculated Cumulative ESALs		million

Faulting

Doweled

Dowel Diameter	1.25	in
Drainage Coefficient	1.00	
Average Fault for Design Years with Design Inputs	**0.05**	in
Criteria Check **PASS**		

Nondoweled

Drainage Coefficient	1	
Average Fault for Design Years with Design Inputs		in
Criteria Check		

Rigid Pavement Design - Based on AASHTO Supplemental Guide

Reference: *LTPP DATA ANALYSIS - Phase I: Validation of Guidelines for k-Value Selection and Concrete Pavement Performance Prediction*

Results

Project # 280.01
Description: US 6 Bridges - Knox Ct to BNSF

Location: NW Ramp 2 Lane Segment

Slab Thickness Design

Pavement Type	JPCP	
18-kip ESALs Over Initial Performance Period (million)	2.13	million
Initial Serviceability	4.5	
Terminal Serviceability	2.5	
28-day Mean PCC Modulus of Rupture	650	psi
Elastic Modulus of Slab	3,400,000	psi
Elastic Modulus of Base	15,000	psi
Base Thickness	6.0	in.
Mean Effective k-Value	71	psi/in
Reliability Level	95	%
Overall Standard Deviation	0.34	
Calculated Design Thickness	**7.96**	in

Temperature Differential

Mean Annual Wind Speed	8.8	mph
Mean Annual Air Temperature	50.2	°F
Mean Annual Precipitation	19.5	in
Maximum Positive Temperature Differential	**6.48**	°F

Modulus of Subgrade Reaction

Period	Description	Subgrade k-Value, psi
12	1	71

Seasonally Adjusted Modulus of Subgrade Reaction	**52**	psi/in
Modulus of Subgrade Reaction Adjusted for Rigid Layer and Fill Section		psi/in

Traffic

Performance Period — years
Two-Way ADT
Number of Lanes in Design Direction
Percent of All Trucks in Design Lane
Percent Trucks in Design Direction

Vehicle Class	Percent of ADT	Annual Growth	Initial Truck Factor	Annual Growth in Truck Factor	Accumulated 18-kip ESALs (millions)

Total Calculated Cumulative ESALs — million

Faulting

Doweled

Dowel Diameter	1.25	in
Drainage Coefficient	1.00	
Average Fault for Design Years with Design Inputs	**0.04**	in
Criteria Check **PASS**		

Nondoweled

Drainage Coefficient	1	
Average Fault for Design Years with Design Inputs		in
Criteria Check		

Rigid Pavement Design - Based on AASHTO Supplemental Guide

Reference: *LTPP DATA ANALYSIS - Phase I: Validation of Guidelines for k-Value Selection and Concrete Pavement Performance Prediction*

Results

Project # 280.01
Description: US 6 Bridges - Knox Ct to BNSF

Location: US6 and Federal Blvd SE Ramp

Slab Thickness Design

Pavement Type	JPCP	
18-kip ESALs Over Initial Performance Period (million)	3.62	million
Initial Serviceability	4.5	
Terminal Serviceability	2.5	
28-day Mean PCC Modulus of Rupture	650	psi
Elastic Modulus of Slab	3,400,000	psi
Elastic Modulus of Base	15,000	psi
Base Thickness	6.0	in.
Mean Effective k-Value	71	psi/in
Reliability Level	95	%
Overall Standard Deviation	0.34	
Calculated Design Thickness	**8.62**	in

Temperature Differential

Mean Annual Wind Speed	8.8	mph
Mean Annual Air Temperature	50.2	°F
Mean Annual Precipitation	19.5	in
Maximum Positive Temperature Differential	**6.98**	°F

Modulus of Subgrade Reaction

Period	Description	Subgrade k-Value, psi
12	1	71

Seasonally Adjusted Modulus of Subgrade Reaction	**52**	psi/in
Modulus of Subgrade Reaction Adjusted for Rigid Layer and Fill Section		psi/in

Traffic

Performance Period years
Two-Way ADT
Number of Lanes in Design Direction
Percent of All Trucks in Design Lane
Percent Trucks in Design Direction

Vehicle Class	Percent of ADT	Annual Growth	Initial Truck Factor	Annual Growth in Truck Factor	Accumulated 18-kip ESALs (millions)

Total Calculated Cumulative ESALs million

Faulting

Doweled

Dowel Diameter	1.25	in
Drainage Coefficient	1.00	
Average Fault for Design Years with Design Inputs	**0.05**	in
Criteria Check **PASS**		

Nondoweled

Drainage Coefficient	1	
Average Fault for Design Years with Design Inputs		in
Criteria Check		

Rigid Pavement Design - Based on AASHTO Supplemental Guide

Reference: *LTPP DATA ANALYSIS - Phase I: Validation of Guidelines for k-Value Selection and Concrete Pavement Performance Prediction*

Results

Project # 280.01
Description: US 6 Bridges - Knox Ct to BNSF

Location: NE Ramp 2 Lane Segment

Slab Thickness Design

Pavement Type	JPCP	
18-kip ESALs Over Initial Performance Period (million)	2.08	million
Initial Serviceability	4.5	
Terminal Serviceability	2.5	
28-day Mean PCC Modulus of Rupture	650	psi
Elastic Modulus of Slab	3,400,000	psi
Elastic Modulus of Base	15,000	psi
Base Thickness	6.0	in.
Mean Effective k-Value	71	psi/in
Reliability Level	95	%
Overall Standard Deviation	0.34	
Calculated Design Thickness	**7.93**	in

Temperature Differential

Mean Annual Wind Speed	8.8	mph
Mean Annual Air Temperature	50.2	°F
Mean Annual Precipitation	19.5	in
Maximum Positive Temperature Differential	**6.46**	°F

Modulus of Subgrade Reaction

Period	Description	Subgrade k-Value, psi
12	1	71

Seasonally Adjusted Modulus of Subgrade Reaction	**52**	psi/in
Modulus of Subgrade Reaction Adjusted for Rigid Layer and Fill Section		psi/in

Traffic

Performance Period years
Two-Way ADT
Number of Lanes in Design Direction
Percent of All Trucks in Design Lane
Percent Trucks in Design Direction

Vehicle Class	Percent of ADT	Annual Growth	Initial Truck Factor	Annual Growth in Truck Factor	Accumulated 18-kip ESALs (millions)

Total Calculated Cumulative ESALs million

Faulting

Doweled

Dowel Diameter	1.25	in
Drainage Coefficient	1.00	
Average Fault for Design Years with Design Inputs	**0.04**	in
Criteria Check **PASS**		

Nondoweled

Drainage Coefficient	1	
Average Fault for Design Years with Design Inputs		in
Criteria Check		

Rigid Pavement Design - Based on AASHTO Supplemental Guide

Reference: *LTPP DATA ANALYSIS - Phase I: Validation of Guidelines for k-Value Selection and Concrete Pavement Performance Prediction*

Results

Project # 280.01
Description: US 6 Bridges - Knox Ct to BNSF

Location: SW Ramp 1 Lane Segment

Slab Thickness Design

Pavement Type	JPCP	
18-kip ESALs Over Initial Performance Period (million)	4.05	million
Initial Serviceability	4.5	
Terminal Serviceability	2.5	
28-day Mean PCC Modulus of Rupture	650	psi
Elastic Modulus of Slab	3,400,000	psi
Elastic Modulus of Base	15,000	psi
Base Thickness	6.0	in.
Mean Effective k-Value	71	psi/in
Reliability Level	95	%
Overall Standard Deviation	0.34	
Calculated Design Thickness	**8.76**	in

Temperature Differential

Mean Annual Wind Speed	8.8	mph
Mean Annual Air Temperature	50.2	°F
Mean Annual Precipitation	19.5	in
Maximum Positive Temperature Differential	**7.08**	°F

Modulus of Subgrade Reaction

Period	Description	Subgrade k-Value, psi
12	1	71

Seasonally Adjusted Modulus of Subgrade Reaction	**52**	psi/in
Modulus of Subgrade Reaction Adjusted for Rigid Layer and Fill Section		psi/in

Traffic

Performance Period		years
Two-Way ADT		
Number of Lanes in Design Direction		
Percent of All Trucks in Design Lane		
Percent Trucks in Design Direction		

Vehicle Class	Percent of ADT	Annual Growth	Initial Truck Factor	Annual Growth in Truck Factor	Accumulated 18-kip ESALs (millions)

Total Calculated Cumulative ESALs		million

Faulting

Doweled

Dowel Diameter	1.25	in
Drainage Coefficient	1.00	
Average Fault for Design Years with Design Inputs	**0.05**	in
Criteria Check **PASS**		

Nondoweled

Drainage Coefficient	1	
Average Fault for Design Years with Design Inputs		in
Criteria Check		

Rigid Pavement Design - Based on AASHTO Supplemental Guide

Reference: *LTPP DATA ANALYSIS - Phase I: Validation of Guidelines for k-Value Selection and Concrete Pavement Performance Prediction*

Results

Project # 280.01
Description: US 6 Bridges - Knox Ct to BNSF

Location: SW Ramp 2 Lane Segment

Slab Thickness Design

Pavement Type	JPCP	
18-kip ESALs Over Initial Performance Period (million)	2.43	million
Initial Serviceability	4.5	
Terminal Serviceability	2.5	
28-day Mean PCC Modulus of Rupture	650	psi
Elastic Modulus of Slab	3,400,000	psi
Elastic Modulus of Base	15,000	psi
Base Thickness	6.0	in.
Mean Effective k-Value	71	psi/in
Reliability Level	95	%
Overall Standard Deviation	0.34	
Calculated Design Thickness	**8.12**	in

Temperature Differential

Mean Annual Wind Speed	8.8	mph
Mean Annual Air Temperature	50.2	°F
Mean Annual Precipitation	19.5	in
Maximum Positive Temperature Differential	**6.61**	°F

Modulus of Subgrade Reaction

Period	Description	Subgrade k-Value, psi
12	1	71

Seasonally Adjusted Modulus of Subgrade Reaction	**52**	psi/in
Modulus of Subgrade Reaction Adjusted for Rigid Layer and Fill Section		psi/in

Traffic

Performance Period		years
Two-Way ADT		
Number of Lanes in Design Direction		
Percent of All Trucks in Design Lane		
Percent Trucks in Design Direction		

Vehicle Class	Percent of ADT	Annual Growth	Initial Truck Factor	Annual Growth in Truck Factor	Accumulated 18-kip ESALs (millions)

Total Calculated Cumulative ESALs		million

Faulting

Doweled

Dowel Diameter	1.25	in
Drainage Coefficient	1.00	
Average Fault for Design Years with Design Inputs	**0.04**	in
Criteria Check **PASS**		

Nondoweled

Drainage Coefficient	1	
Average Fault for Design Years with Design Inputs		in
Criteria Check		

Rigid Pavement Design - Based on AASHTO Supplemental Guide

Reference: *LTPP DATA ANALYSIS - Phase I: Validation of Guidelines for k-Value Selection and Concrete Pavement Performance Prediction*

Results

Project # 280.01
Description: US 6 Bridges - Knox Ct to BNSF

Location: Federal Blvd to EB CD Road

Slab Thickness Design

Pavement Type	JPCP	
18-kip ESALs Over Initial Performance Period (million)	4.23	million
Initial Serviceability	4.5	
Terminal Serviceability	2.5	
28-day Mean PCC Modulus of Rupture	650	psi
Elastic Modulus of Slab	3,400,000	psi
Elastic Modulus of Base	25,000	psi
Base Thickness	6.0	in.
Mean Effective k-Value	60	psi/in
Reliability Level	95	%
Overall Standard Deviation	0.34	
Calculated Design Thickness	**8.78**	in

Temperature Differential

Mean Annual Wind Speed	8.8	mph
Mean Annual Air Temperature	50.2	°F
Mean Annual Precipitation	19.5	in
Maximum Positive Temperature Differential	**7.09**	°F

Modulus of Subgrade Reaction

Period	Description	Subgrade k-Value, psi
12	1	60

Seasonally Adjusted Modulus of Subgrade Reaction	**52**	psi/in
Modulus of Subgrade Reaction Adjusted for Rigid Layer and Fill Section		psi/in

Traffic

Performance Period years
Two-Way ADT
Number of Lanes in Design Direction
Percent of All Trucks in Design Lane
Percent Trucks in Design Direction

Vehicle Class	Percent of ADT	Annual Growth	Initial Truck Factor	Annual Growth in Truck Factor	Accumulated 18-kip ESALs (millions)

Total Calculated Cumulative ESALs million

Faulting

Doweled

Dowel Diameter	1.25	in
Drainage Coefficient	1.00	
Average Fault for Design Years with Design Inputs	**0.05**	in
Criteria Check **PASS**		

Nondoweled

Drainage Coefficient	1	
Average Fault for Design Years with Design Inputs	**0.09**	in
Criteria Check **FAIL**		

Rigid Pavement Design - Based on AASHTO Supplemental Guide

Reference: *LTPP DATA ANALYSIS - Phase I: Validation of Guidelines for k-Value Selection and Concrete Pavement Performance Prediction*

Results

Project # 280.01
Description: US 6 Bridges - Knox Ct to BNSF

Location: Federal Blvd to EB US6 Braided Ramp

Slab Thickness Design

Pavement Type	JPCP	
18-kip ESALs Over Initial Performance Period (million)	1.80	million
Initial Serviceability	4.5	
Terminal Serviceability	2.5	
28-day Mean PCC Modulus of Rupture	650	psi
Elastic Modulus of Slab	3,400,000	psi
Elastic Modulus of Base	25,000	psi
Base Thickness	6.0	in.
Mean Effective k-Value	60	psi/in
Reliability Level	95	%
Overall Standard Deviation	0.34	
Calculated Design Thickness	**7.74**	in

Temperature Differential

Mean Annual Wind Speed	8.8	mph
Mean Annual Air Temperature	50.2	°F
Mean Annual Precipitation	19.5	in
Maximum Positive Temperature Differential	**6.30**	°F

Modulus of Subgrade Reaction

Period	Description	Subgrade k-Value, psi
12	1	60

Seasonally Adjusted Modulus of Subgrade Reaction	**52**	psi/in
Modulus of Subgrade Reaction Adjusted for Rigid Layer and Fill Section		psi/in

Traffic

Performance Period years
Two-Way ADT
Number of Lanes in Design Direction
Percent of All Trucks in Design Lane
Percent Trucks in Design Direction

Vehicle Class	Percent of ADT	Annual Growth	Initial Truck Factor	Annual Growth in Truck Factor	Accumulated 18-kip ESALs (millions)

Total Calculated Cumulative ESALs million

Faulting

Doweled

Dowel Diameter	1.25	in
Drainage Coefficient	1.00	
Average Fault for Design Years with Design Inputs	**0.04**	in
Criteria Check **PASS**		

Nondoweled

Drainage Coefficient	1	
Average Fault for Design Years with Design Inputs		in
Criteria Check		

Rigid Pavement Design - Based on AASHTO Supplemental Guide

Reference: *LTPP DATA ANALYSIS - Phase I: Validation of Guidelines for k-Value Selection and Concrete Pavement Performance Prediction*

Results

Project # 280.01
Description: US 6 Bridges - Knox Ct to BNSF

Location: Bryant Street to Ramp to Federal Boulevard

Slab Thickness Design

Pavement Type	JPCP	
18-kip ESALs Over Initial Performance Period (million)	1.09	million
Initial Serviceability	4.5	
Terminal Serviceability	2.5	
28-day Mean PCC Modulus of Rupture	650	psi
Elastic Modulus of Slab	3,400,000	psi
Elastic Modulus of Base	25,000	psi
Base Thickness	6.0	in.
Mean Effective k-Value	60	psi/in
Reliability Level	95	%
Overall Standard Deviation	0.34	
Calculated Design Thickness	**7.18**	in

Temperature Differential

Mean Annual Wind Speed	8.8	mph
Mean Annual Air Temperature	50.2	°F
Mean Annual Precipitation	19.5	in
Maximum Positive Temperature Differential	**5.77**	°F

Modulus of Subgrade Reaction

Period	Description	Subgrade k-Value, psi
12	1	60

Seasonally Adjusted Modulus of Subgrade Reaction	**52**	psi/in
Modulus of Subgrade Reaction Adjusted for Rigid Layer and Fill Section		psi/in

Traffic

Performance Period		years
Two-Way ADT		
Number of Lanes in Design Direction		
Percent of All Trucks in Design Lane		
Percent Trucks in Design Direction		

Vehicle Class	Percent of ADT	Annual Growth	Initial Truck Factor	Annual Growth in Truck Factor	Accumulated 18-kip ESALs (millions)

Total Calculated Cumulative ESALs		million

Faulting

Doweled

Dowel Diameter	1.25	in
Drainage Coefficient	1.00	
Average Fault for Design Years with Design Inputs	**0.04**	in
Criteria Check **PASS**		

Nondoweled

Drainage Coefficient	1	
Average Fault for Design Years with Design Inputs		in
Criteria Check		

Rigid Pavement Design - Based on AASHTO Supplemental Guide

Reference: *LTPP DATA ANALYSIS - Phase I: Validation of Guidelines for k-Value Selection and Concrete Pavement Performance Prediction*

Results

Project # 280.01
Description: US 6 Bridges - Knox Ct to BNSF

Location: SB I-25 to WB US 6 Ramp

Slab Thickness Design

Pavement Type	JPCP	
18-kip ESALs Over Initial Performance Period (million)	17.98	million
Initial Serviceability	4.5	
Terminal Serviceability	2.5	
28-day Mean PCC Modulus of Rupture	650	psi
Elastic Modulus of Slab	3,400,000	psi
Elastic Modulus of Base	25,000	psi
Base Thickness	6.0	in.
Mean Effective k-Value	60	psi/in
Reliability Level	95	%
Overall Standard Deviation	0.34	
Calculated Design Thickness	**10.79**	in

Temperature Differential

Mean Annual Wind Speed	8.8	mph
Mean Annual Air Temperature	50.2	°F
Mean Annual Precipitation	19.5	in
Maximum Positive Temperature Differential	**8.20**	°F

Modulus of Subgrade Reaction

Period	Description	Subgrade k-Value, psi
12	1	60

Seasonally Adjusted Modulus of Subgrade Reaction	**52**	psi/in
Modulus of Subgrade Reaction Adjusted for Rigid Layer and Fill Section		psi/in

Traffic

Performance Period years
Two-Way ADT
Number of Lanes in Design Direction
Percent of All Trucks in Design Lane
Percent Trucks in Design Direction

Vehicle Class	Percent of ADT	Annual Growth	Initial Truck Factor	Annual Growth in Truck Factor	Accumulated 18-kip ESALs (millions)

Total Calculated Cumulative ESALs million

Faulting

Doweled

Dowel Diameter	1.5	in
Drainage Coefficient	1.00	
Average Fault for Design Years with Design Inputs	**0.05**	in
Criteria Check **PASS**		

Nondoweled

Drainage Coefficient	1	
Average Fault for Design Years with Design Inputs		in
Criteria Check		

Rigid Pavement Design - Based on AASHTO Supplemental Guide

Reference: *LTPP DATA ANALYSIS - Phase I: Validation of Guidelines for k-Value Selection and Concrete Pavement Performance Prediction*

Results

Project # 280.01
Description: US 6 Bridges - Knox Ct to BNSF

Location: NB I-25 to WB US6 Ramp

Slab Thickness Design

Pavement Type	JPCP	
18-kip ESALs Over Initial Performance Period (million)	22.94	million
Initial Serviceability	4.5	
Terminal Serviceability	2.5	
28-day Mean PCC Modulus of Rupture	650	psi
Elastic Modulus of Slab	3,400,000	psi
Elastic Modulus of Base	25,000	psi
Base Thickness	6.0	in.
Mean Effective k-Value	52	psi/in
Reliability Level	95	%
Overall Standard Deviation	0.34	
Calculated Design Thickness	**11.17**	in

Temperature Differential

Mean Annual Wind Speed	8.8	mph
Mean Annual Air Temperature	50.2	°F
Mean Annual Precipitation	19.5	in
Maximum Positive Temperature Differential	**8.36**	°F

Modulus of Subgrade Reaction

Period	Description	Subgrade k-Value, psi
12	1	52

Seasonally Adjusted Modulus of Subgrade Reaction	**52**	psi/in
Modulus of Subgrade Reaction Adjusted for Rigid Layer and Fill Section		psi/in

Traffic

Performance Period years
Two-Way ADT
Number of Lanes in Design Direction
Percent of All Trucks in Design Lane
Percent Trucks in Design Direction

Vehicle Class	Percent of ADT	Annual Growth	Initial Truck Factor	Annual Growth in Truck Factor	Accumulated 18-kip ESALs (millions)

Total Calculated Cumulative ESALs million

Faulting

Doweled

Dowel Diameter	1.5	in
Drainage Coefficient	1.00	
Average Fault for Design Years with Design Inputs	**0.06**	in
Criteria Check **PASS**		

Nondoweled

Drainage Coefficient	1	
Average Fault for Design Years with Design Inputs		in
Criteria Check		

Rigid Pavement Design - Based on AASHTO Supplemental Guide

Reference: *LTPP DATA ANALYSIS - Phase I: Validation of Guidelines for k-Value Selection and Concrete Pavement Performance Prediction*

Results

Project # 280.01
Description: US 6 Bridges - Knox Ct to BNSF

Location: NB I-25 to EB US6 Ramp

Slab Thickness Design

Pavement Type	JPCP	
18-kip ESALs Over Initial Performance Period (million)	5.35	million
Initial Serviceability	4.5	
Terminal Serviceability	2.5	
28-day Mean PCC Modulus of Rupture	650	psi
Elastic Modulus of Slab	3,400,000	psi
Elastic Modulus of Base	25,000	psi
Base Thickness	6.0	in.
Mean Effective k-Value	52	psi/in
Reliability Level	95	%
Overall Standard Deviation	0.34	
Calculated Design Thickness	**9.12**	in

Temperature Differential

Mean Annual Wind Speed	8.8	mph
Mean Annual Air Temperature	50.2	°F
Mean Annual Precipitation	19.5	in
Maximum Positive Temperature Differential	**7.31**	°F

Modulus of Subgrade Reaction

Period	Description	Subgrade k-Value, psi
12	1	52

Seasonally Adjusted Modulus of Subgrade Reaction	**52**	psi/in
Modulus of Subgrade Reaction Adjusted for Rigid Layer and Fill Section		psi/in

Traffic

Performance Period years
Two-Way ADT
Number of Lanes in Design Direction
Percent of All Trucks in Design Lane
Percent Trucks in Design Direction

Vehicle Class	Percent of ADT	Annual Growth	Initial Truck Factor	Annual Growth in Truck Factor	Accumulated 18-kip ESALs (millions)

Total Calculated Cumulative ESALs million

Faulting

Doweled

Dowel Diameter	1.25	in
Drainage Coefficient	1.00	
Average Fault for Design Years with Design Inputs	**0.05**	in

Criteria Check **PASS**

Nondoweled

Drainage Coefficient	1	
Average Fault for Design Years with Design Inputs		in

Criteria Check

Rigid Pavement Design - Based on AASHTO Supplemental Guide

Reference: *LTPP DATA ANALYSIS - Phase I: Validation of Guidelines for k-Value Selection and Concrete Pavement Performance Prediction*

Results

Project # 280.01
Description: US 6 Bridges - Knox Ct to BNSF

Location: SB I-25 to EB US6 Ramp

Slab Thickness Design

Pavement Type	JPCP	
18-kip ESALs Over Initial Performance Period (million)	8.46	million
Initial Serviceability	4.5	
Terminal Serviceability	2.5	
28-day Mean PCC Modulus of Rupture	650	psi
Elastic Modulus of Slab	3,400,000	psi
Elastic Modulus of Base	25,000	psi
Base Thickness	6.0	in.
Mean Effective k-Value	60	psi/in
Reliability Level	95	%
Overall Standard Deviation	0.34	
Calculated Design Thickness	**9.69**	in

Temperature Differential

Mean Annual Wind Speed	8.8	mph
Mean Annual Air Temperature	50.2	°F
Mean Annual Precipitation	19.5	in
Maximum Positive Temperature Differential	**7.65**	°F

Modulus of Subgrade Reaction

Period	Description	Subgrade k-Value, psi
12	1	60

Seasonally Adjusted Modulus of Subgrade Reaction	**52**	psi/in
Modulus of Subgrade Reaction Adjusted for Rigid Layer and Fill Section		psi/in

Traffic

Performance Period years
Two-Way ADT
Number of Lanes in Design Direction
Percent of All Trucks in Design Lane
Percent Trucks in Design Direction

Vehicle Class	Percent of ADT	Annual Growth	Initial Truck Factor	Annual Growth in Truck Factor	Accumulated 18-kip ESALs (millions)

Total Calculated Cumulative ESALs million

Faulting

Doweled

Dowel Diameter	1.25	in
Drainage Coefficient	1.00	
Average Fault for Design Years with Design Inputs	**0.05**	in

Criteria Check **PASS**

Nondoweled

Drainage Coefficient	1	
Average Fault for Design Years with Design Inputs		in

Criteria Check

Rigid Pavement Design - Based on AASHTO Supplemental Guide

Reference: *LTPP DATA ANALYSIS - Phase I: Validation of Guidelines for k-Value Selection and Concrete Pavement Performance Prediction*

Results

Project # 280.01
Description: US 6 Bridges - Knox Ct to BNSF

Location: I-25 (North and South Bound)

Slab Thickness Design

Pavement Type	JPCP	
18-kip ESALs Over Initial Performance Period (million)	75.14	million
Initial Serviceability	4.5	
Terminal Serviceability	2.5	
28-day Mean PCC Modulus of Rupture	650	psi
Elastic Modulus of Slab	3,400,000	psi
Elastic Modulus of Base	25,000	psi
Base Thickness	6.0	in.
Mean Effective k-Value	52	psi/in
Reliability Level	95	%
Overall Standard Deviation	0.34	
Calculated Design Thickness	**13.16**	in

Temperature Differential

Mean Annual Wind Speed	8.8	mph
Mean Annual Air Temperature	50.2	°F
Mean Annual Precipitation	19.5	in
Maximum Positive Temperature Differential	**9.07**	°F

Modulus of Subgrade Reaction

Period	Description	Subgrade k-Value, psi
12	1	52

Seasonally Adjusted Modulus of Subgrade Reaction	**52**	psi/in
Modulus of Subgrade Reaction Adjusted for Rigid Layer and Fill Section		psi/in

Traffic

Performance Period		years
Two-Way ADT		
Number of Lanes in Design Direction		
Percent of All Trucks in Design Lane		
Percent Trucks in Design Direction		

Vehicle Class	Percent of ADT	Annual Growth	Initial Truck Factor	Annual Growth in Truck Factor	Accumulated 18-kip ESALs (millions)

Total Calculated Cumulative ESALs		million

Faulting

Doweled

Dowel Diameter	1.5	in
Drainage Coefficient	1.00	
Average Fault for Design Years with Design Inputs	**0.07**	in
Criteria Check **FAIL**		

Nondoweled

Drainage Coefficient	1	
Average Fault for Design Years with Design Inputs		in
Criteria Check		

APPENDIX F

ESAL AND PAVEMENT THICKNESS CALCULATION SHEETS (CDOT)

Rigid Pavement Design - Based on AASHTO Supplemental Guide

Reference: *LTPP DATA ANALYSIS - Phase I: Validation of Guidelines for k-Value Selection and Concrete Pavement Performance Prediction*

I. General

Agency:	CDOT
Street Address:	4670 Holly St, Unit C
City:	Denver
State:	CO, 80216-6408

Project Number: 18192 6th Ave Design Build ID: Default

Description: Redo of Rigid Design using R = 10 6" ABC, Base Year 2016

Location: Federal over 6th Ave

II. Design

Serviceability

Initial Serviceability, P1:	4.5	
Terminal Serviceability, P2:	2.5	

PCC Properties

28-day Mean Modulus of Rupture, $(S'_c)'$:	650	psi
Elastic Modulus of Slab, E_c:	3,400,000	psi
Poisson's Ratio for Concrete, m:	0.15	

Base Properties

Elastic Modulus of Base, E_b:	20,000	psi
Design Thickness of Base, H_b:	6.0	in
Slab-Base Friction Factor, f:	1.0	

Reliability and Standard Deviation

Reliability Level (R):	95.0	%
Overall Standard Deviation, S_0:	0.34	

Climatic Properties

Mean Annual Wind Speed, WIND:	8.8	mph
Mean Annual Air Temperature, TEMP:	50.2	°F
Mean Annual Precipitation, PRECIP:	19.5	in

Subgrade k-Value

71 psi/in

Design ESALs

5.9 million

Pavement Type, Joint Spacing (L)

- (•) JPCP
- ( ) JRCP
- ( ) CRCP

Joint Spacing: 15.0 ft

JPCP

Effective Joint Spacing: 180 in

Edge Support

- ( ) Conventional 12-ft wide traffic lane
- (•) Conventional 12-ft wide traffic lane + tied PCC
- ( ) 2-ft widened slab w/conventional 12-ft traffic lane

Edge Support Factor: 0.94

Sensitivity Analysis

Slab Thickness used for Sensitivity Analysis: 9.21 in

- ( ) Modulus of Rupture
- ( ) Elastic Modulus (Slab)
- ( ) Elastic Modulus (Base)
- ( ) Base Thickness
- (•) k-Value
- ( ) Joint Spacing
- ( ) Reliability
- ( ) Standard Deviation

Calculated Slab Thickness for Above Inputs: 9.21 in

Faulting

DOWELED PAVEMENT

Dowel Diameter:	1.25	in
K_i:	1,500,000	psi/in
E_s:	29,000,000	psi

Base/Slab Frictional Restraint

- ○ Stabilized Base
- ◉ Aggregate Base or LCB w/ bond breaker

ALPHA:	0.000006	/°F
TRANGE:	109.5	°F
e:	0.00015	strain
D:	9.50	in
P:	9,000	lbf
T:	0.45	

Base Type

- ○ Stabilized Base
- ◉ Unstabilized Base

FI:	425	°F-days
CESAL:	5.93	million
Age:	22.0	years
C_d:	1.00	

Faulting (doweled)

0.05 **in**

Faulting Check - **PASS**

NONDOWELED PAVEMENT

Days90:	30	days
D:	9.21	in

Base Type

- ○ Stabilized Base
- ◉ Unstabilized Base

FI:	600	°F-days
CESAL:	5.93	million
Age:	20.0	years
C_d:	1.00	

Faulting (nondoweled)

in

Faulting Check -

Recommended critical mean joint faulting levels for design (Table 28)

Joint Spacing	Critical Mean Joint Faulting
< 25 ft	0.06 in
> 25 ft	0.13 in

Note: Joint load position stress checks need to be performed only for nondoweled pavements

Only two numbers need to be entered in this sheet:

Temperature gradient

Tensile stress at top of slab

Step 1:

Total Negative Temperature Differential

Slab Thickness: 9.21 in

Total Negative Temperature Differential: -5.4 °F

Construction Curling and Moisture Gradient Temperature Differential

Enter temperature gradient: 2.0 °F/in (enter positive value from below)

For temperature gradient use:

Wet Climate:	0 to 2 °F/in	(Annual Precipitation >= 30 in or Thornthwaite Moisture Index > 0)
Dry Climate:	1 to 3 °F/in	(Annual Precipitation < 30 in or Thornthwaite Moisture Index < 0)

Total Effective Negative Temp. Differential: -23.9 °F

Step 2:

Use one or more of the following charts to estimate the tensile stress at top of slab.
Note that the charts show the variation of tensile stress with negative temperature differential for slab thicknesses ranging from 7 to 13 in. These are plotted for a base course thickness of 6 in. The six charts represent three k-values (100, 250 and 500 psi/in) and two values for the elastic modulus of the base (25,000 psi and 1,000,000 psi). Use judgment to extrapolate the value of the tensile stress at the top of the slab from these charts.

Enter Tensile Stress at Top of Slab: 194.37 psi (use charts below)

Step 3:

Compare the above tensile stress with the maximum tensile stress at the bottom of the slab for which the slab is designed. For the given inputs and the above thickness, this value is

238 psi

The slab is designed for a tensile stress of 238 psi.

If the tensile stress at the top of the slab (obtained from the charts below and entered above) is less than the design stress, the design is acceptable. If the check fails, new inputs have to be provided.

Corner Break Check: **PASS**

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☺

1993 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

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Flexible Structural Design Module

PCN 18192
Federal Blvd at 6th Ave
Design for Federal Blvd 6 Lane
Using Parsons DTD projections
20 Year Flexible 18-kip ESALs
Base Year = 2016
Midpoint Year = 2026
Last Year of Design = 2036

Assume R=10, 6" ABC CL 6
Date: 7/25/2012
By: JIC

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	2,777,203
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	3,562 psi
Stage Construction	1
Calculated Design Structural Number	5.28 in

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	New HMA	0.44	1	9.95	24	4.38
2	ABC CL 6	0.15	1	6	24	0.90
Total	-	-	-	15.95	-	5.28

1993 AASHTO Pavement Design

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Flexible Structural Design Module

PCN 18192
Federal Blvd at 6th Ave
Design for SE Ramp 2 Lane
Using Parsons Brinckerhoff 2011 and 2035 projections
20 Year Flexible 18-kip ESALs
Base Year = 2016
Midpoint Year = 2026
Last Year of Design = 2036

Assume R=10, 6" ABC CL 6
Date: 7/25/2012
By: JIC

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	1,440,237
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	3,562 psi
Stage Construction	1
Calculated Design Structural Number	4.83 in

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	New HMA	0.44	1	8.93	24	3.93
2	ABC CL 6	0.15	1	6	24	0.90
Total	-	-	-	14.93	-	4.83

Project #	FBR 06A-050
Subaccount	18192
Description	US 6 DB
Date	7/23/2012
By	JIC
WHATS GOING ON???	Determining 20 year 18-kip ESALs for SE Ramp 2 Lane

Given:	Existing traffic only.

Yellow	cells require user input.
Green	cells are calculated results of note.

	2035 Existing Volume
Braided+CD+ Bryant ADT	24500

This is the info they give you. 3/19/2012
So is this.
This too. Just kidding! ;o)

Adjusting the Base and Design Year AADTs Almost as good as visiting the dentist...almost.

Projection Base Year	2035	This is the year they give you traffic data for.
Required Base Year	2016	This is the year construction will be completed.
Required Design Year	2036	This is the completed construction year + the design period.
30-Year Growth Factor (T_f)	1.6324	Note: Source = Factor for Bryant determined from Parsons Brinckerhoff

Enter 20 or 30 year ESALs	20

Given Year	Required Year	AADT in Projection Base Year	20 Year Factor	AADT in Required Year
2035	2016	24,500	1.6324	9,781
2035	2036	24,500	1.6324	25,275

Note: Feel Free to Copy the cells down if more adjustments are necessary. Just don't mess up my formatting or else!!! ;o)

Midpoint AADT 17,528

ESAL BREAKDOWN

Vehicle Type	%
Cars	97
Single Unit Trucks	2
Combination Trucks	1
Total	100

Equivalency Factors

Vehicle Type	Flexible	Rigid
Cars	0.003	0.003
Single Unit Trucks	0.249	0.285
Combination Trucks	1.087	1.692

Source: 6th Ave from Parsons Brinkerhoff

Design Lane Factor	0.6

Comments: Used 2 Lane Design Lane Factor of 0.6.
Danger! Danger! This can mess you up so chose carefully!

WARNING **20** YEAR ESALS FOLLOW!!! (And sometimes waaaay too closely!!!) ;o)

Flexible 18-k ESALs Caution: They can't do full splits!!!

Vehicle Type	# of Vehicles in Design Year	Daily 18-kip ESALs	Design Period 18-kip ESALs	Design Lane 18-kip ESALs
	Midpoint AADT x Vehicle %	A x Equiv. Factor	B x 365 x Design Period	C x Design Lane Factor
	A	B	C	D
Cars	17,002	51	372,343	223,406
Single Unit Trucks	351	87	637,205	382,323
Combination Trucks	175	191	1,390,848	834,509
Total	17,528	329	2,400,396	1,440,237

Rigid 18-k ESALs Caution: Remember to use the correct design period!!!

Vehicle Type	# of Vehicles in Design Year	Daily 18-kip ESALs	Design Period 18-kip ESALs	Design Lane 18-kip ESALs
	Midpoint AADT x Vehicle %	A x Equiv. Factor	B x 365 x Design Period	C x Design Lane Factor
	A	B	C	D
Cars	17,002	51	372,343	223,406
Single Unit Trucks	351	100	729,331	437,599
Combination Trucks	175	297	2,164,963	1,298,978
Total	17,528	447	3,266,637	1,959,982

1993 AASHTO Pavement Design

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PCN 18192
Federal Blvd at 6th Ave
Design for SE Braided Ramp 1 Lane
Using Parsons Brinckerhoff 2011 and 2035 projections
20 Year Flexible 18-kip ESALs
Base Year = 2016
Midpoint Year = 2026
Last Year of Design = 2036

Assume R=10, 6" ABC CL 6
Date: 7/25/2012
By: JIC

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	636,840
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	3,562 psi
Stage Construction	1
Calculated Design Structural Number	4.30 in

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	New HMA	0.44	1	7.73	24	3.40
2	ABC CL 6	0.15	1	6	24	0.90
Total	-	-	-	13.73	-	4.30

Project #	FBR 06A-050
Subaccount	18192
Description	US 6 DB
Date	7/23/2012
By	JIC
WHATS GOING ON???	Determining 20 year 18-kip ESALs for Braided Ramp

Given:	Existing traffic only.

Yellow	cells require user input.
Green	cells are calculated results of note.

	2035 Existing Volume
Braided	6500

This is the info they give you. 3/19/2012
So is this.
This too. Just kidding! ;o)

Adjusting the Base and Design Year AADTs Almost as good as visiting the dentist...almost.

Projection Base Year	2035	This is the year they give you traffic data for.
Required Base Year	2016	This is the year construction will be completed.
Required Design Year	2036	This is the completed construction year + the design period.
20-Year Growth Factor (T_f)	1.6324	Note: Source = Factor for Bryant determined from Parsons Brinckerhoff

Enter 20 or 30 year ESALs	20

Given Year	Required Year	AADT in Projection Base Year	20 Year Factor	AADT in Required Year
2035	2016	6,500	1.6324	2,595
2035	2036	6,500	1.6324	6,706

Note: Feel Free to Copy the cells down if more adjustments are necessary. Just don't mess up my formatting or else!!! ;o)

Midpoint AADT 4,650

ESAL BREAKDOWN

Vehicle Type	%
Cars	97
Single Unit Trucks	2
Combination Trucks	1
Total	100

Equivalency Factors

Vehicle Type	Flexible	Rigid
Cars	0.003	0.003
Single Unit Trucks	0.249	0.285
Combination Trucks	1.087	1.692

Source: 6th Ave from Parsons Brinkerhoff

Design Lane Factor	1

Comments: Used 1 Lane Design Lane Factor of 0.3.
Danger! Danger! This can mess you up so chose carefully!

WARNING **20** -YEAR ESALS FOLLOW!!! (And sometimes waaaay too closely!!!) ;o)

Flexible 18-k ESALs Caution: They can't do full splits!!!

Vehicle Type	# of Vehicles in Design Year	Daily 18-kip ESALs	Design Period 18-kip ESALs	Design Lane 18-kip ESALs
	Midpoint AADT x Vehicle %	A x Equiv. Factor	B x 365 x Design Period	C x Design Lane Factor
	A	B	C	D
Cars	4,511	14	98,785	98,785
Single Unit Trucks	93	23	169,054	169,054
Combination Trucks	47	51	369,000	369,000
Total	4,650	87	636,840	636,840

Rigid 18-k ESALs Caution: Remember to use the correct design period!!!

Vehicle Type	# of Vehicles in Design Year	Daily 18-kip ESALs	Design Period 18-kip ESALs	Design Lane 18-kip ESALs
	Midpoint AADT x Vehicle %	A x Equiv. Factor	B x 365 x Design Period	C x Design Lane Factor
	A	B	C	D
Cars	4,511	14	98,785	98,785
Single Unit Trucks	93	27	193,496	193,496
Combination Trucks	47	79	574,378	574,378
Total	4,650	119	866,659	866,659

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Federal Blvd at 6th Ave
Design for SE EB CD 1 Lane
Using Parsons Brinckerhoff 2011 and 2035 projections
20 Year Flexible 18-kip ESALs
Base Year = 2016
Midpoint Year = 2026
Last Year of Design = 2036

Assume R=10, 6" ABC CL 6
Date: 7/25/2012
By: JIC

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	1,499,023
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	3,562 psi
Stage Construction	1
Calculated Design Structural Number	4.85 in

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	New HMA	0.44	1	8.98	24	3.95
2	ABC CL 6	0.15	1	6	24	0.90
Total	-	-	-	14.98	-	4.85

Project #	FBR 06A-050
Subaccount	18192
Description	US 6 DB
Date	7/23/2012
By	JIC
WHATS GOING ON???	Determining 20 year 18-kip ESALs for Federal Blvd to EB CD Road

Given:	Existing traffic only.

Yellow	cells require user input.
Green	cells are calculated results of note.

	2035 Existing Volume
Fed to EB CD Road	15300

This is the info they give you. 3/19/2012
So is this.
This too. Just kidding! ;o)

Adjusting the Base and Design Year AADTs Almost as good as visiting the dentist...almost.

Projection Base Year	2035	This is the year they give you traffic data for.
Required Base Year	2016	This is the year construction will be completed.
Required Design Year	2036	This is the completed construction year + the design period.
20-Year Growth Factor (T_f)	1.6324	Note: Source = Factor for Bryant determined from Parsons Brinckerhoff

Enter 20 or 30 year ESALs	20

Given Year	Required Year	AADT in Projection Base Year	20 Year Factor	AADT in Required Year
2035	2016	15,300	1.6324	6,108
2035	2036	15,300	1.6324	15,784

Note: Feel Free to Copy the cells down if more adjustments are necessary. Just don't mess up my formatting or else!!! ;o)

Midpoint AADT 10,946

ESAL BREAKDOWN

Vehicle Type	%
Cars	97
Single Unit Trucks	2
Combination Trucks	1
Total	100

Equivalency Factors

Vehicle Type	Flexible	Rigid
Cars	0.003	0.003
Single Unit Trucks	0.249	0.285
Combination Trucks	1.087	1.692

Source: 6th Ave from Parsons Brinkerhoff

Design Lane Factor	1

Comments: Used 1 Lane Design Lane Factor of 0.3.
Danger! Danger! This can mess you up so chose carefully!

WARNING 20 YEAR ESALS FOLLOW!!! (And sometimes waaaay too closely!!!) ;o)

Flexible 18-k ESALs Caution: They can't do full splits!!!

Vehicle Type	# of Vehicles in Design Year	Daily 18-kip ESALs	Design Period 18-kip ESALs	Design Lane 18-kip ESALs
	Midpoint AADT x Vehicle %	A x Equiv. Factor	B x 365 x Design Period	C x Design Lane Factor
	A	B	C	D
Cars	10,618	32	232,524	232,524
Single Unit Trucks	219	55	397,928	397,928
Combination Trucks	109	119	868,570	868,570
Total	10,946	205	1,499,023	1,499,023

Rigid 18-k ESALs Caution: Remember to use the correct design period!!!

Vehicle Type	# of Vehicles in Design Year	Daily 18-kip ESALs	Design Period 18-kip ESALs	Design Lane 18-kip ESALs
	Midpoint AADT x Vehicle %	A x Equiv. Factor	B x 365 x Design Period	C x Design Lane Factor
	A	B	C	D
Cars	10,618	32	232,524	232,524
Single Unit Trucks	219	62	455,460	455,460
Combination Trucks	109	185	1,351,997	1,351,997
Total	10,946	279	2,039,981	2,039,981

1993 AASHTO Pavement Design

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PCN 18192
Federal Blvd at 6th Ave
Design for SE Bryant Ramp 1 Lane
Using Parsons Brinckerhoff 2011 and 2035 projections
20 Year Flexible 18-kip ESALs
Base Year = 2016
Midpoint Year = 2026
Last Year of Design = 2036

Assume R=10, 6" ABC CL 6
Date: 7/25/2012
By: JIC

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	325,662
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	3,562 psi
Stage Construction	1
Calculated Design Structural Number	3.90 in

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	New HMA	0.44	1	6.82	24	3.00
2	ABC CL 6	0.15	1	6	24	0.90
Total	-	-	-	12.82	-	3.90

Project #	FBR 06A-050
Subaccount	18192
Description	US 6 DB
Date	7/23/2012
By	JIC
WHATS GOING ON???	Determining 20 year 18-kip ESALs for Bryant St Ramp.

Given	Existing Traffic and future projected traffic.

Yellow	cells require smart user input.
Green	cells are calculated results of note.

	2011 Existing Volume	2035 Estimated Volume	24 Year Factor
Bryant St Ramp	1820	2700	1.48
N/A	1	1	1.00

Adjusting the Base and Design Year AADTs Almost as good as visiting the dentist...almost.

Projection Base Year	2011	This is the earlier year they give you traffic data for.
Projection Design Year	2035	This is the year they give you the projection for.
Required Base Year	2016	This is the year construction will be completed.
Required Design Year	2036	This is the completed construction year + the design period.
24-Year Growth Factor (T_f)	1.48	Update the given growth factor year. It should match the year in the previous table.

Given Year	Required Year	AADT in Projection Base Year and Design Year	24 Year Factor	AADT in Required Year
2011	2016	1,820	1.48	2,002
2035	2036	2,700	1.48	2,754

Note: Feel Free to Copy the cells down if more adjustments are necessary. Just don't mess up my formatting or else!!! ;o)

Midpoint AADT 2,378

ESAL BREAKDOWN

Vehicle Type	%
Cars	97
Single Unit Trucks	2
Combination Trucks	1
Total	100

Equivalency Factors

Vehicle Type	Flexible	Rigid
Cars	0.003	0.003
Single Unit Trucks	0.249	0.285
Combination Trucks	1.087	1.692

Source: Parsons Brinckerhoff 3/19/2012

Design Lane Factor	1	See Current Pavement Design Manual, CDOT Method

Notes: Used 1 Lane, 1 lane Each Direction Design Lane Factor of 1.
Danger! Danger! This can mess you up so chose carefully!

WARNING **20**-YEAR ESALS FOLLOW!!! (And sometimes waaaay too closely!!!) :o)

Flexible 18-k ESALs Caution: They can't do full splits!!!

Vehicle Type	# of Vehicles in Design Year	Daily 18-kip ESALs	Design Period 18-kip ESALs	Design Lane 18-kip ESALs
	Midpoint AADT x Vehicle %	A x Equiv. Factor	B x 365 x Design Period	C x Design Lane Factor
	A	B	C	D
Cars	2,307	7	50,516	50,516
Single Unit Trucks	48	12	86,450	86,450
Combination Trucks	24	26	188,697	188,697
Total	2,378	45	325,662	325,662

Rigid 18-k ESALs Caution: Remember to use the correct design period!!!

Vehicle Type	# of Vehicles in Design Year	Daily 18-kip ESALs	Design Period 18-kip ESALs	Design Lane 18-kip ESALs
	Midpoint AADT x Vehicle %	A x Equiv. Factor	B x 365 x Design Period	C x Design Lane Factor
	A	B	C	D
Cars	2,307	7	50,516	50,516
Single Unit Trucks	48	14	98,949	98,949
Combination Trucks	24	40	293,721	293,721
Total	2,378	61	443,185	443,185

1993 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare Computer Software Product

Flexible Structural Design Module

PCN 18192
Federal Blvd at 6th Ave
Design for SW Ramp 2 Lane
Using Parsons Brinckerhoff 2011 and 2035 projections
20 Year Flexible 18-kip ESALs
Base Year = 2016
Midpoint Year = 2026
Last Year of Design = 2036

Assume R=10, 6" ABC CL 6
Date: 7/25/2012
By: JIC

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	882,069
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	3,562 psi
Stage Construction	1
Calculated Design Structural Number	4.51 in

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	New HMA	0.44	1	8.2	24	3.61
2	ABC CL 6	0.15	1	6	24	0.90
Total	-	-	-	14.20	-	4.51

Project #	FBR 06A-050
Subaccount	18192
Description	US 6 DB
Date	7/23/2012
By	JIC
WHATS GOING ON???	Determining 20 year 18-kip ESALs for SW Ramp 2 Lane Segment.

Given:	Existing Traffic and future projected traffic.

Yellow	cells require smart user input.
Green	cells are calculated results of note.

	2011 Existing Volume	2035 Estimated Volume	24 Year Factor
Bryant St Ramp	5710	13400	2.35
N/A	1	1	1.00

Adjusting the Base and Design Year AADTs Almost as good as visiting the dentist...almost.

Projection Base Year	2011	This is the earlier year they give you traffic data for.
Projection Design Year	2035	This is the year they give you the projection for.
Required Base Year	2016	This is the year construction will be completed.
Required Design Year	2036	This is the completed construction year + the design period.
24-Year Growth Factor (T_f)	2.35	Update the given growth factor year. It should match the year in the previous table.

Given Year	Required Year	AADT in Projection Base Year and Design Year	24 Year Factor	AADT in Required Year
2011	2016	5,710	2.35	7,316
2035	2036	13,400	2.35	14,154

Note: Feel Free to Copy the cells down if more adjustments are necessary. Just don't mess up my formatting or else!!! ;o)

Midpoint AADT 10,735

ESAL BREAKDOWN

Vehicle Breakdown Vehicle Type	%
Cars	97
Single Unit Trucks	2
Combination Trucks	1
Total	100

Equivalency Factors

Vehicle Type	Flexible	Rigid
Cars	0.003	0.003
Single Unit Trucks	0.249	0.285
Combination Trucks	1.087	1.692

Source: Parsons Brinckerhoff 3/19/2012

Design Lane Factor	0.6	See Current Pavement Design Manual, CDOT Method

Notes: Used 2 Lane, 2 lane Each Direction Design Lane Factor of 0.6.
Danger! Danger! This can mess you up so chose carefully!

WARNING **20** -YEAR ESALS FOLLOW!!! (And sometimes waaaay too closely!!!) ;o)

Flexible 18-k ESALs Caution: They can't do full splits!!!

Vehicle Type	# of Vehicles in Design Year	Daily 18-kip ESALs	Design Period 18-kip ESALs	Design Lane 18-kip ESALs
	Midpoint AADT x Vehicle %	A x Equiv. Factor	B x 365 x Design Period	C x Design Lane Factor
	A	B	C	D
Cars	10,413	31	228,040	136,824
Single Unit Trucks	215	53	390,255	234,153
Combination Trucks	107	117	851,821	511,092
Total	10,735	201	1,470,115	882,069

Rigid 18-k ESALs Caution: Remember to use the correct design period!!!

Vehicle Type	# of Vehicles in Design Year	Daily 18-kip ESALs	Design Period 18-kip ESALs	Design Lane 18-kip ESALs
	Midpoint AADT x Vehicle %	A x Equiv. Factor	B x 365 x Design Period	C x Design Lane Factor
	A	B	C	D
Cars	10,413	31	228,040	136,824
Single Unit Trucks	215	61	446,677	268,006
Combination Trucks	107	182	1,325,925	795,555
Total	10,735	274	2,000,642	1,200,385

1993 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

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Flexible Structural Design Module

PCN 18192
Federal Blvd at 6th Ave
Design for SW Ramp 1 Lane
Using Parsons Brinckerhoff 2011 and 2035 projections
20 Year Flexible 18-kip ESALs
Base Year = 2016
Midpoint Year = 2026
Last Year of Design = 2036

Assume R=10, 6" ABC CL 6
Date: 7/25/2012
By: JIC

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	1,470,115
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	3,562 psi
Stage Construction	1
Calculated Design Structural Number	4.84 in

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	New HMA	0.44	1	8.95	24	3.94
2	ABC CL 6	0.15	1	6	24	0.90
Total	-	-	-	14.95	-	4.84

Project #	FBR 06A-050
Subaccount	18192
Description	US 6 DB
Date	7/23/2012
By	JIC
WHATS GOING ON???	Determining 20 year 18-kip ESALs for SW Ramp 1 Lane Segment.

Given	Existing Traffic and future projected traffic.

Yellow	cells require smart user input.
Green	cells are calculated results of note.

	2011 Existing Volume	2035 Estimated Volume	24 Year Factor
Bryant St Ramp	5710	13400	2.35
N/A	1	1	1.00

Adjusting the Base and Design Year AADTs Almost as good as visiting the dentist...almost.

Projection Base Year	2011	This is the earlier year they give you traffic data for.
Projection Design Year	2035	This is the year they give you the projection for.
Required Base Year	2016	This is the year construction will be completed.
Required Design Year	2036	This is the completed construction year + the design period.
24-Year Growth Factor (T_f)	2.35	Update the given growth factor year. It should match the year in the previous table.

Given Year	Required Year	AADT in Projection Base Year and Design Year	24 Year Factor	AADT in Required Year
2011	2016	5,710	2.35	7,316
2035	2036	13,400	2.35	14,154

Note: Feel Free to Copy the cells down if more adjustments are necessary. Just don't mess up my formatting or else!!! ;o)

Midpoint AADT 10,735

ESAL BREAKDOWN

Vehicle Breakdown Vehicle Type	%
Cars	97
Single Unit Trucks	2
Combination Trucks	1
Total	100

Equivalency Factors

Vehicle Type	Flexible	Rigid
Cars	0.003	0.003
Single Unit Trucks	0.249	0.285
Combination Trucks	1.087	1.692

Source: Parsons Brinckerhoff 3/19/2012

Design Lane Factor	1	See Current Pavement Design Manual, CDOT Method

Notes: Used 1 Lane, 1 lane Each Direction Design Lane Factor of 1.
Danger! Danger! This can mess you up so chose carefully!

WARNING **20** YEAR ESALS FOLLOW!!! (And sometimes waaaay too closely!!!) ;o)

Flexible 18-k ESALs Caution: They can't do full splits!!!

Vehicle Type	# of Vehicles in Design Year	Daily 18-kip ESALs	Design Period 18-kip ESALs	Design Lane 18-kip ESALs
	Midpoint AADT x Vehicle %	A x Equiv. Factor	B x 365 x Design Period	C x Design Lane Factor
	A	B	C	D
Cars	10,413	31	228,040	228,040
Single Unit Trucks	215	53	390,255	390,255
Combination Trucks	107	117	851,821	851,821
Total	10,735	201	1,470,115	1,470,115

Rigid 18-k ESALs Caution: Remember to use the correct design period!!!

Vehicle Type	# of Vehicles in Design Year	Daily 18-kip ESALs	Design Period 18-kip ESALs	Design Lane 18-kip ESALs
	Midpoint AADT x Vehicle %	A x Equiv. Factor	B x 365 x Design Period	C x Design Lane Factor
	A	B	C	D
Cars	10,413	31	228,040	228,040
Single Unit Trucks	215	61	446,677	446,677
Combination Trucks	107	182	1,325,925	1,325,925
Total	10,735	274	2,000,642	2,000,642

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PCN 18192
Federal Blvd at 6th Ave
Design for NW Ramp 2 Lane
Using Parsons Brinckerhoff 2011 and 2035 projections
20 Year Flexible 18-kip ESALs
Base Year = 2016
Midpoint Year = 2026
Last Year of Design = 2036

Assume R=10, 6" ABC CL 6
Date: 7/25/2012
By: JIC

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	906,883
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	3,562 psi
Stage Construction	1
Calculated Design Structural Number	4.52 in

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	New HMA	0.44	1	8.23	24	3.62
2	ABC CL 6	0.15	1	6	24	0.90
Total	-	-	-	14.23	-	4.52

Project #	FBR 06A-050
Subaccount	18192
Description	US 6 DB
Date	7/23/2012
By	JIC
WHATS GOING ON???	Determining 20 year 18-kip ESALs for NW Ramp 2 Lane Segment.

Given:	Existing Traffic and future projected traffic.

Yellow	cells require smart user input.
Green	cells are calculated results of note.

	2011 Existing Volume	2035 Estimated Volume	24 Year Factor
Bryant St Ramp	7920	12800	1.62
N/A	1	1	1.00

Adjusting the Base and Design Year AADTs Almost as good as visiting the dentist...almost.

Projection Base Year	2011	This is the earlier year they give you traffic data for.
Projection Design Year	2035	This is the year they give you the projection for.
Required Base Year	2016	This is the year construction will be completed.
Required Design Year	2036	This is the completed construction year + the design period.
24-Year Growth Factor (T_f)	1.62	Update the given growth factor year. It should match the year in the previous table.

Given Year	Required Year	AADT in Projection Base Year and Design Year	24 Year Factor	AADT in Required Year
2011	2016	7,920	1.62	8,943
2035	2036	12,800	1.62	13,131

Note: Feel Free to Copy the cells down if more adjustments are necessary. Just don't mess up my formatting or else!!! ;o)

Midpoint AADT 11,037

ESAL BREAKDOWN

Vehicle Breakdown Vehicle Type	%
Cars	97
Single Unit Trucks	2
Combination Trucks	1
Total	100

Equivalency Factors

Vehicle Type	Flexible	Rigid
Cars	0.003	0.003
Single Unit Trucks	0.249	0.285
Combination Trucks	1.087	1.692

Source: Parsons Brinckerhoff 3/19/2012

Design Lane Factor	0.6	See Current Pavement Design Manual, CDOT Method

Notes: Used 2 Lane, 2 lane Each Direction Design Lane Factor of 0.6.
Danger! Danger! This can mess you up so chose carefully!

WARNING **20** -YEAR ESALS FOLLOW!!! (And sometimes waaaay too closely!!!) :o)

Flexible 18-k ESALs Caution: They can't do full splits!!!

Vehicle Type	# of Vehicles in Design Year	Daily 18-kip ESALs	Design Period 18-kip ESALs	Design Lane 18-kip ESALs
	Midpoint AADT x Vehicle %	A x Equiv. Factor	B x 365 x Design Period	C x Design Lane Factor
	A	B	C	D
Cars	10,706	32	234,455	140,673
Single Unit Trucks	221	55	401,233	240,740
Combination Trucks	110	120	875,784	525,470
Total	11,037	207	1,511,472	906,883

Rigid 18-k ESALs Caution: Remember to use the correct design period!!!

Vehicle Type	# of Vehicles in Design Year	Daily 18-kip ESALs	Design Period 18-kip ESALs	Design Lane 18-kip ESALs
	Midpoint AADT x Vehicle %	A x Equiv. Factor	B x 365 x Design Period	C x Design Lane Factor
	A	B	C	D
Cars	10,706	32	234,455	140,673
Single Unit Trucks	221	63	459,243	275,546
Combination Trucks	110	187	1,363,226	817,935
Total	11,037	282	2,056,924	1,234,154

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PCN 18192
Federal Blvd at 6th Ave
Design for NW Ramp 1 Lane
Using Parsons Brinckerhoff 2011 and 2035 projections
20 Year Flexible 18-kip ESALs
Base Year = 2016
Midpoint Year = 2026
Last Year of Design = 2036

Assume R=10, 6" ABC CL 6
Date: 7/25/2012
By: JIC

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	1,511,472
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	3,562 psi
Stage Construction	1
Calculated Design Structural Number	4.86 in

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	New HMA	0.44	1	9	24	3.96
2	ABC CL 6	0.15	1	6	24	0.90
Total	-	-	-	15.00	-	4.86

Project #	FBR 06A-050
Subaccount	18192
Description	US 6 DB
Date	7/23/2012
By	JIC
WHATS GOING ON???	Determining 20 year 18-kip ESALs for NW Ramp 1 Lane Segment.

Given	Existing Traffic and future projected traffic.

Yellow	cells require smart user input.
Green	cells are calculated results of note.

	2011 Existing Volume	2035 Estimated Volume	24 Year Factor
Bryant St Ramp	7920	12800	1.62
N/A	1	1	1.00

Adjusting the Base and Design Year AADTs Almost as good as visiting the dentist...almost.

Projection Base Year	2011	This is the earlier year they give you traffic data for.
Projection Design Year	2035	This is the year they give you the projection for.
Required Base Year	2016	This is the year construction will be completed.
Required Design Year	2036	This is the completed construction year + the design period.
24-Year Growth Factor (T_f)	1.62	Update the given growth factor year. It should match the year in the previous table.

Given Year	Required Year	AADT in Projection Base Year and Design Year	24 Year Factor	AADT in Required Year
2011	2016	7,920	1.62	8,943
2035	2036	12,800	1.62	13,131

Note: Feel Free to Copy the cells down if more adjustments are necessary. Just don't mess up my formatting or else!!! ;o)

Midpoint AADT 11,037

ESAL BREAKDOWN

Vehicle Breakdown Vehicle Type	%
Cars	97
Single Unit Trucks	2
Combination Trucks	1
Total	100

Equivalency Factors

Vehicle Type	Flexible	Rigid
Cars	0.003	0.003
Single Unit Trucks	0.249	0.285
Combination Trucks	1.087	1.692

Source: Parsons Brinckerhoff 3/19/2012

Design Lane Factor	1	See Current Pavement Design Manual, CDOT Method

Notes: Used 1 Lane, 1 lane Each Direction Design Lane Factor of 1.
Danger! Danger! This can mess you up so chose carefully!

WARNING **20** -YEAR ESALS FOLLOW!!! (And sometimes waaaay too closely!!!) :o)

Flexible 18-k ESALs Caution: They can't do full splits!!!

Vehicle Type	# of Vehicles in Design Year	Daily 18-kip ESALs	Design Period 18-kip ESALs	Design Lane 18-kip ESALs
	Midpoint AADT x Vehicle %	A x Equiv. Factor	B x 365 x Design Period	C x Design Lane Factor
	A	B	C	D
Cars	10,706	32	234,455	234,455
Single Unit Trucks	221	55	401,233	401,233
Combination Trucks	110	120	875,784	875,784
Total	11,037	207	1,511,472	1,511,472

Rigid 18-k ESALs Caution: Remember to use the correct design period!!!

Vehicle Type	# of Vehicles in Design Year	Daily 18-kip ESALs	Design Period 18-kip ESALs	Design Lane 18-kip ESALs
	Midpoint AADT x Vehicle %	A x Equiv. Factor	B x 365 x Design Period	C x Design Lane Factor
	A	B	C	D
Cars	10,706	32	234,455	234,455
Single Unit Trucks	221	63	459,243	459,243
Combination Trucks	110	187	1,363,226	1,363,226
Total	11,037	282	2,056,924	2,056,924

1993 AASHTO Pavement Design

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PCN 18192
Federal Blvd at 6th Ave
Design for NE Ramp 2 Lane
Using Parsons Brinckerhoff 2011 and 2035 projections
20 Year Flexible 18-kip ESALs
Base Year = 2016
Midpoint Year = 2026
Last Year of Design = 2036

Assume R=10, 6" ABC CL 6
Date: 7/25/2012
By: JIC

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	799,287
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	3,562 psi
Stage Construction	1
Calculated Design Structural Number	4.44 in

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	New HMA	0.44	1	8.05	24	3.54
2	ABC CL 6	0.15	1	6	24	0.90
Total	-	-	-	14.05	-	4.44

Project #	FBR 06A-050
Subaccount	18192
Description	US 6 DB
Date	7/23/2012
By	JIC
WHATS GOING ON???	Determining 20 year 18-kip ESALs for NE Ramp 2 Lane Segment.

Given	Existing Traffic and future projected traffic.

Yellow	cells require smart user input.
Green	cells are calculated results of note.

	2011 Existing Volume	2035 Estimated Volume	24 Year Factor
Bryant St Ramp	5730	11900	2.08
N/A	1	1	1.00

Adjusting the Base and Design Year AADTs Almost as good as visiting the dentist...almost.

Projection Base Year	2011	This is the earlier year they give you traffic data for.
Projection Design Year	2035	This is the year they give you the projection for.
Required Base Year	2016	This is the year construction will be completed.
Required Design Year	2036	This is the completed construction year + the design period.
24-Year Growth Factor (T_f)	2.08	Update the given growth factor year. It should match the year in the previous table.

Given Year	Required Year	AADT in Projection Base Year and Design Year	24 Year Factor	AADT in Required Year
2011	2016	5,730	2.08	7,019
2035	2036	11,900	2.08	12,436

Note: Feel Free to Copy the cells down if more adjustments are necessary. Just don't mess up my formatting or else!!! ;o)

Midpoint AADT 9,727

ESAL BREAKDOWN

Vehicle Breakdown Vehicle Type	%
Cars	97
Single Unit Trucks	2
Combination Trucks	1
Total	100

Equivalency Factors

Vehicle Type	Flexible	Rigid
Cars	0.003	0.003
Single Unit Trucks	0.249	0.285
Combination Trucks	1.087	1.692

Source: Parsons Brinckerhoff 3/19/2012

Design Lane Factor	0.6	See Current Pavement Design Manual, CDOT Method

Notes: Used 2 Lane, 2 lane Each Direction Design Lane Factor of 0.6.
Danger! Danger! This can mess you up so chose carefully!

WARNING 20 -YEAR ESALS FOLLOW!!! (And sometimes waaaay too closely!!!) ;o)

Flexible 18-k ESALs Caution: They can't do full splits!!!

Vehicle Type	# of Vehicles in Design Year	Daily 18-kip ESALs	Design Period 18-kip ESALs	Design Lane 18-kip ESALs
	Midpoint AADT x Vehicle %	A x Equiv. Factor	B x 365 x Design Period	C x Design Lane Factor
	A	B	C	D
Cars	9,436	28	206,639	123,983
Single Unit Trucks	195	48	353,629	212,177
Combination Trucks	97	106	771,877	463,126
Total	9,727	182	1,332,145	799,287

Rigid 18-k ESALs Caution: Remember to use the correct design period!!!

Vehicle Type	# of Vehicles in Design Year	Daily 18-kip ESALs	Design Period 18-kip ESALs	Design Lane 18-kip ESALs
	Midpoint AADT x Vehicle %	A x Equiv. Factor	B x 365 x Design Period	C x Design Lane Factor
	A	B	C	D
Cars	9,436	28	206,639	123,983
Single Unit Trucks	195	55	404,756	242,854
Combination Trucks	97	165	1,201,486	720,892
Total	9,727	248	1,812,881	1,087,729

1993 AASHTO Pavement Design

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Federal Blvd at 6th Ave, PCN 18192

Updated Design for 5th Avenue

Using Valley Highway, Logan to 6th EIS Projections
Adjusted for Design Year, Growth Rate, 9% DHV to AADT
20 Year Flexible 18-kip ESALs

Other Info
Base Year = 2016, Midpoint Year = 2026, Last Year of Design = 2036
24 yr Growth Factor ~ 1.6, 1 year Growth Factor ~ 1.007
EIS Data Peak Hour 380 WB + 240 EB = 620 in 2025
Assume 3% Single Unit, 1% Combo
Assume R=10, 6" ABC CL 6

Date: 8/23/2012, Traffic by RM, Design by JIC

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	644,750
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	3,562 psi
Stage Construction	1
Calculated Design Structural Number	4.31 in

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	New HMA	0.44	1	7.75	24	3.41
2	ABC CL 6	0.15	1	6	24	0.90
Total	-	-	-	13.75	-	4.31

Project #	IM 088A-024		
Subaccount	16628		
Description	Federal Blvd at 6th	Updated for 6th Avenue Design Build	
Date	2/17/2010	8/23/2012	
By	JIC	JIC	
WHATS GOING ON???	Determining 18-kip ESALs for side streets	Using Federal Truck %	

Given: Design Hourly Volume from 1/2008

Sea Foam Blue	cells require user input.	What? I didn't know what else to call the color OK???
Green	cells are calculated results of note.	

Traffic Volume

Adjustments[1]	1	(None)

1st Ave	Adjustments None (x 1)	DHV % of AADT	AADT
222	222	9	2,467

Notes:
Source: City and County of Denver, 2008 count, for Project 13810. Federal, Alameda to 5th
Count on WB 1st at Julian =444. Assume side streets are 50% of 1st. 50% of count = 222.
[1] Enter 1 if no Adjustments. Update sea foam blue cell in next table as well.

AADT BREAKDOWN

Count Year	2008
Base Year	2016
Last Year of Design	2036

Annual Growth Rate [1]	2 %	
8	-Year Growth Factor	1.17
20	-Year Growth Factor	1.49

Annual Growth Rate Calculator [2]	
Base Year	2016
Projected Year	2036
20-Year Growth Factor	1.19
Growth Rate (%)	0.8736

[1] Manually enter value in % format!!! Based on what you decide to use.
[2] Info from DTD for SH 088A.

Note: Source of Annual Growth Rate = Rate calculated from annual growth rate calculator.

AADT in Count Year	AADT in Base Year	AADT in Last Year	Midpoint AADT
2008	2016	2036	2026
T_0	T_1	T	T_m
2,467	2,890	4,295	3,592

ESAL BREAKDOWN (Yes, it's time for a breakdown!)

Vehicle Breakdown Vehicle Type	%
Cars	94.316
Single Unit Trucks	4.59
Combination Trucks	1.094
Total	100

Equivalency Factors

Vehicle Type	Flexible	Rigid
Cars	0.003	0.003
Single Unit Trucks	0.249	0.285
Combination Trucks	1.087	1.692

Notes: Traffic breakdown not provided by CCD. Assumed Federal percentages.

Design Lane Factor	0.6	See 2010 Pavement Design Manual, CDOT Method

Comments:

Used 2 Lane, 1 lane Each Direction Design Lane Factor of 0.6.
Danger! Danger! This can mess you up so chose carefully!

WARNING **20** -YEAR ESALS FOLLOW!!! (And sometimes waaaay too closely!!!) ;o)

Flexible 18-k ESALs Caution: They can't do full splits!!!

Vehicle Type	# of Vehicles in Design Year	Daily 18-kip ESALs	Design Period 18-kip ESALs	Design Lane 18-kip ESALs
	Midpoint AADT x Vehicle %	A x Equiv. Factor	B x 365 x Design Period	C x Design Lane Factor
	A	B	C	D
Cars	3,388	10	74,200	44,520
Single Unit Trucks	165	41	299,715	179,829
Combination Trucks	39	43	311,848	187,109
Total	3,592	94	685,763	411,458

Rigid 18-k ESALs "Witty" Comment: Hard pavement is good to find.

Vehicle Type	# of Vehicles in Design Year	Daily 18-kip ESALs	Design Period 18-kip ESALs	Design Lane 18-kip ESALs
	Midpoint AADT x %	A x Equiv. Factor	B x 365 x Design Period	C x Design Lane Factor
	A	B	C	D
Cars	3,388	10	74,200	44,520
Single Unit Trucks	165	47	343,047	205,828
Combination Trucks	39	66	485,416	291,250
Total	3,592	124	902,664	541,598

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PCN 13810
Federal Blvd, Alameda to 5th

Using Traffic Count from City and County of Denver
Westbound 1st Avenue, East of Julian
Assume traffic on side street is 50% of that on 1st

Assume R=5, 6" ABC CL 6
Date: 10/7/09, Updated 8/23/2012
By: JIC

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	411,458
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	3,025 psi
Stage Construction	1
Calculated Design Structural Number	4.26 in

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	New HMA	0.44	1	7.64	24	3.36
2	ABC CL 6	0.15	1	6	24	0.90
Total	-	-	-	13.64	-	4.26

APPENDIX G

PAVEMENT LIFE CYCLE COST ANALYSIS DATA SHEETS (REALCOST VERSION 2.5 AND WORKZONE-RUC)

RealCost Input Data

1. Economic Variables	
Value of Time for Passenger Cars ($/hour)	$17.00
Value of Time for Single Unit Trucks ($/hour)	$35.00
Value of Time for Combination Trucks ($/hour)	$36.50

2. Analysis Options	
Include User Costs in Analysis	Yes
Include User Cost Remaining Life Value	Yes
Use Differential User Costs	Yes
User Cost Computation Method	Specified
Include Agency Cost Remaining Life Value	Yes
Traffic Direction	Both
Analysis Period (Years)	40
Beginning of Analysis Period	2016
Discount Rate (%)	2.8 LCCANORMAL(2.8,0.19)
Number of Alternatives	2

3. Project Details	
State Route	SH006G
Project Name	6th Avenue Design Build
Region	Region 6
County	Denver
Analyzed By	CDOT R6 and RockSol Consulting Group, Inc.
Mileposts	
Begin	282.00
End	283.00
Length of Project (miles)	1.00
Comments	

4. Traffic Data	
AADT Construction Year (total for both directions)	243,142
Cars as Percentage of AADT (%)	97.0
Single Unit Trucks as Percentage of AADT (%)	2.0
Combination Trucks as Percentage of AADT (%)	1.0
Annual Growth Rate of Traffic (%)	1.3 LCCATRIANG(0.34,1.34,2.34)
Speed Limit Under Normal Operating Conditions (mph)	55
No of Lanes in Each Direction During Normal Conditions	3
Free Flow Capacity (vphpl)	2200
Rural or Urban Hourly Traffic Distribution	Urban
Queue Dissipation Capacity (vphpl)	2057
Maximum AADT (total for both directions)	316,800
Maximum Queue Length (miles)	5.0

Alternative 1	6th Ave DB Flexible Alternative
Number of Activities	5

Activity 1	Initial Flexible Construction Completed 2016	
Agency Construction Cost ($1000)	$5,361.76 LCCATRIANG(4553.3507,5433.75395,6098.1848)	
User Work Zone Costs ($1000)	$0.00	
Work Zone Duration (days)	53	
No of Lanes Open in Each Direction During Work Zone	4	
Activity Service Life (years)	13.3 LCCATRIANG(11,13,16)	
Activity Structural Life (years)	20.0	
Maintenance Frequency (years)	1	
Agency Maintenance Cost ($1000)	20.16	
Work Zone Length (miles)	1.00	
Work Zone Speed Limit (mph)	55	
Work Zone Capacity (vphpl)	1600	
Traffic Hourly Distribution	Week Day 1	
Time of Day of Lane Closures (use whole numbers based on a 24-hour clock)		
Inbound	Start	End
First period of lane closure	0	24
Second period of lane closure		
Third period of lane closure		
Outbound	Start	End
First period of lane closure	0	24
Second period of lane closure		
Third period of lane closure		

Activity 2	2029 Flex Rehab 2" Mill and Fill with SMA	
Agency Construction Cost ($1000)	$1,853.04 LCCATRIANG(1592.26927,1860.46023,2106.38464)	
User Work Zone Costs ($1000)	$70.15	
Work Zone Duration (days)	27	
No of Lanes Open in Each Direction During Work Zone	2	
Activity Service Life (years)	11.7 LCCATRIANG(6,13,16)	
Activity Structural Life (years)	10.0	
Maintenance Frequency (years)	1	
Agency Maintenance Cost ($1000)	20.16	
Work Zone Length (miles)	0.96	
Work Zone Speed Limit (mph)	45	
Work Zone Capacity (vphpl)	1600	
Traffic Hourly Distribution	Week Day 1	
Time of Day of Lane Closures (use whole numbers based on a 24-hour clock)		
Inbound	Start	End
First period of lane closure	22	5
Second period of lane closure		
Third period of lane closure		
Outbound	Start	End
First period of lane closure	22	5
Second period of lane closure		
Third period of lane closure		

Activity 3	2040 Flex Rehab 2" Mill and Fill with SMA	
Agency Construction Cost ($1000)	$1,853.04 **LCCATRIANG(1592.26927,1860.46023,2106.38464)**	
User Work Zone Costs ($1000)	$224.17	
Work Zone Duration (days)	27	
No of Lanes Open in Each Direction During Work Zone	2	
Activity Service Life (years)	11.7 **LCCATRIANG(6,13,16)**	
Activity Structural Life (years)	10.0	
Maintenance Frequency (years)	1	
Agency Maintenance Cost ($1000)	20.16	
Work Zone Length (miles)	0.96	
Work Zone Speed Limit (mph)	45	
Work Zone Capacity (vphpl)	1600	
Traffic Hourly Distribution	Week Day 1	
Time of Day of Lane Closures (use whole numbers based on a 24-hour clock)		
Inbound	Start	End
First period of lane closure	22	5
Second period of lane closure		
Third period of lane closure		
Outbound	Start	End
First period of lane closure	22	5
Second period of lane closure		
Third period of lane closure		

Activity 4	2051 Flex Rehab 2" Mill and Fill with SMA	
Agency Construction Cost ($1000)	$1,853.04 **LCCATRIANG(1592.26927,1860.46023,2106.38464)**	
User Work Zone Costs ($1000)	$599.89	
Work Zone Duration (days)	27	
No of Lanes Open in Each Direction During Work Zone	2	
Activity Service Life (years)	11.7 **LCCATRIANG(6,13,16)**	
Activity Structural Life (years)	10.0	
Maintenance Frequency (years)	1	
Agency Maintenance Cost ($1000)	20.16	
Work Zone Length (miles)	0.96	
Work Zone Speed Limit (mph)	45	
Work Zone Capacity (vphpl)	1600	
Traffic Hourly Distribution	Week Day 1	
Time of Day of Lane Closures (use whole numbers based on a 24-hour clock)		
Inbound	Start	End
First period of lane closure	22	5
Second period of lane closure		
Third period of lane closure		
Outbound	Start	End
First period of lane closure	22	5
Second period of lane closure		
Third period of lane closure		

Activity 5	2051 Flex Rehab 2" Mill and Fill with SMA	
Agency Construction Cost ($1000)	$1,853.04 **LCCATRIANG(1592.26927,1860.46023,2106.38464)**	
User Work Zone Costs ($1000)	$599.89	
Work Zone Duration (days)	27	
No of Lanes Open in Each Direction During Work Zone	2	
Activity Service Life (years)	11.7 **LCCATRIANG(6,13,16)**	
Activity Structural Life (years)	10.0	
Maintenance Frequency (years)	1	
Agency Maintenance Cost ($1000)	20.16	
Work Zone Length (miles)	0.96	
Work Zone Speed Limit (mph)	45	
Work Zone Capacity (vphpl)	1600	
Traffic Hourly Distribution	Week Day 1	
Time of Day of Lane Closures (use whole numbers based on a 24-hour clock)		
Inbound	Start	End
First period of lane closure	22	5
Second period of lane closure		
Third period of lane closure		
Outbound	Start	End
First period of lane closure	22	5
Second period of lane closure		
Third period of lane closure		

Alternative 2	6th Ave DB Rigid Alternative
Number of Activities	3

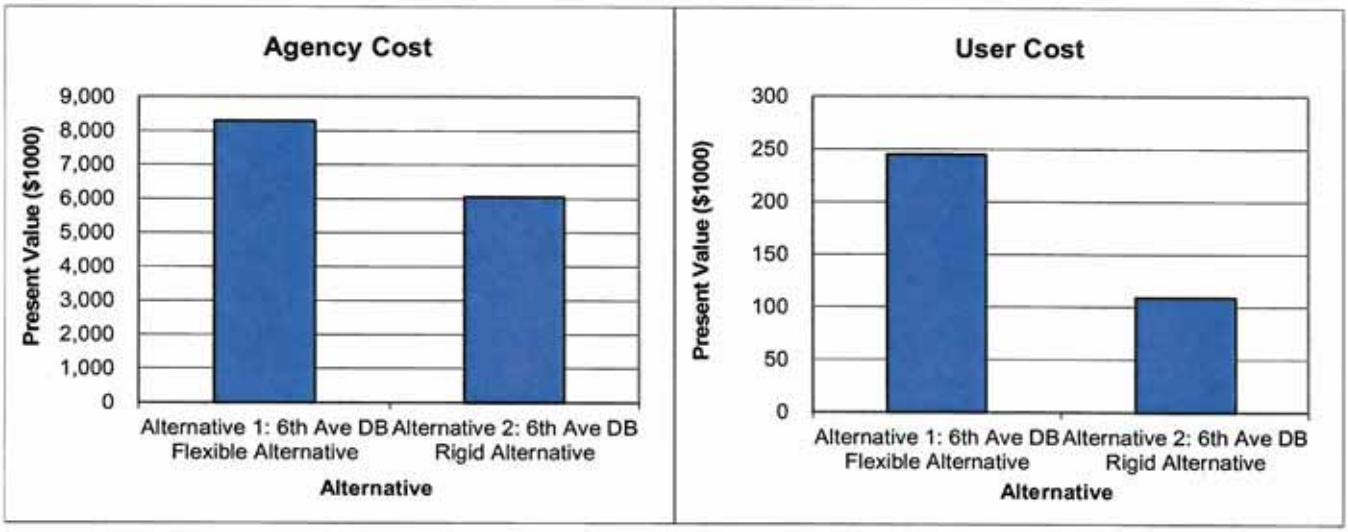
Activity 1	Initial Rigid Construction Completed 2016	
Agency Construction Cost ($1000)	$5,371.99 **LCCATRIANG(4604.56511,5371.99262,6139.42014)**	
User Work Zone Costs ($1000)	$0.00	
Work Zone Duration (days)	100	
No of Lanes Open in Each Direction During Work Zone	4	
Activity Service Life (years)	27.7 **LCCATRIANG(16,27,40)**	
Activity Structural Life (years)	30.0	
Maintenance Frequency (years)	1	
Agency Maintenance Cost ($1000)	5.144	
Work Zone Length (miles)	0.96	
Work Zone Speed Limit (mph)	55	
Work Zone Capacity (vphpl)	1600	
Traffic Hourly Distribution	Week Day 1	
Time of Day of Lane Closures (use whole numbers based on a 24-hour clock)		
Inbound	Start	End
First period of lane closure	0	24
Second period of lane closure		
Third period of lane closure		
Outbound	Start	End
First period of lane closure	0	24
Second period of lane closure		
Third period of lane closure		

Activity 2	2043 Rigid Rehab 1/2% Slab, 50% Grinding, 50% Sawing and Sealing	
Agency Construction Cost ($1000)	$1,265.47 **LCCATRIANG(1029.20734,1265.46736,1501.72738)**	
User Work Zone Costs ($1000)	$244.04	
Work Zone Duration (days)	23	
No of Lanes Open in Each Direction During Work Zone	2	
Activity Service Life (years)	27.7 **LCCATRIANG(16,27,40)**	
Activity Structural Life (years)	13.0	
Maintenance Frequency (years)	1	
Agency Maintenance Cost ($1000)	5.144	
Work Zone Length (miles)	0.96	
Work Zone Speed Limit (mph)	55	
Work Zone Capacity (vphpl)	1600	
Traffic Hourly Distribution	Week Day 1	
Time of Day of Lane Closures (use whole numbers based on a 24-hour clock)		
Inbound	Start	End
First period of lane closure	22	5
Second period of lane closure		
Third period of lane closure		
Outbound	Start	End
First period of lane closure	22	5
Second period of lane closure		
Third period of lane closure		

Activity 3	2043 Rigid Rehab 1/2% Slab, 50% Grinding, 50% Sawing and Sealing	
Agency Construction Cost ($1000)	$1,265.47 **LCCATRIANG(1029.20734,1265.46736,1501.72738)**	
User Work Zone Costs ($1000)	$244.04	
Work Zone Duration (days)	23	
No of Lanes Open in Each Direction During Work Zone	2	
Activity Service Life (years)	27.7 **LCCATRIANG(16,27,40)**	
Activity Structural Life (years)	13.0	
Maintenance Frequency (years)	1	
Agency Maintenance Cost ($1000)	5.144	
Work Zone Length (miles)	0.96	
Work Zone Speed Limit (mph)	55	
Work Zone Capacity (vphpl)	1600	
Traffic Hourly Distribution	Week Day 1	
Time of Day of Lane Closures (use whole numbers based on a 24-hour clock)		
Inbound	Start	End
First period of lane closure	22	5
Second period of lane closure		
Third period of lane closure		
Outbound	Start	End
First period of lane closure	22	5
Second period of lane closure		
Third period of lane closure		

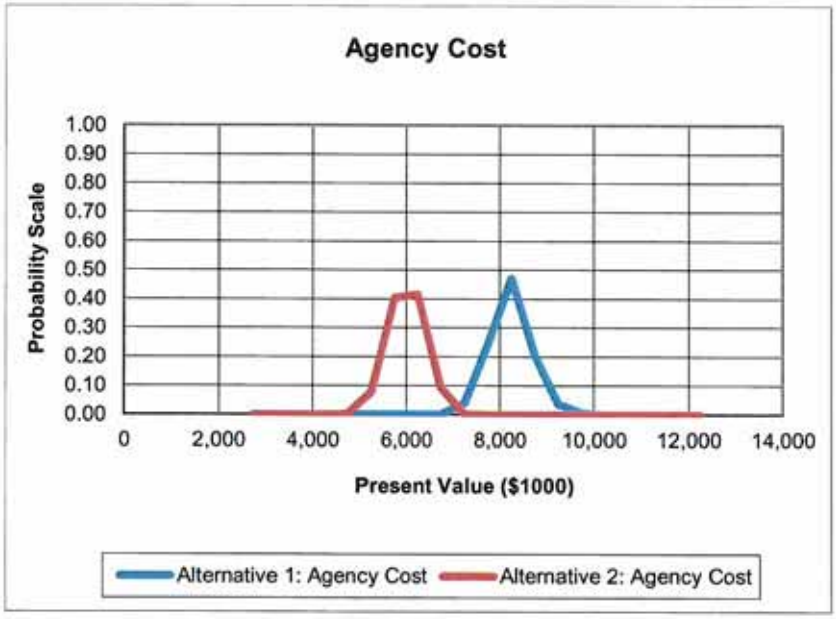
Deterministic Results

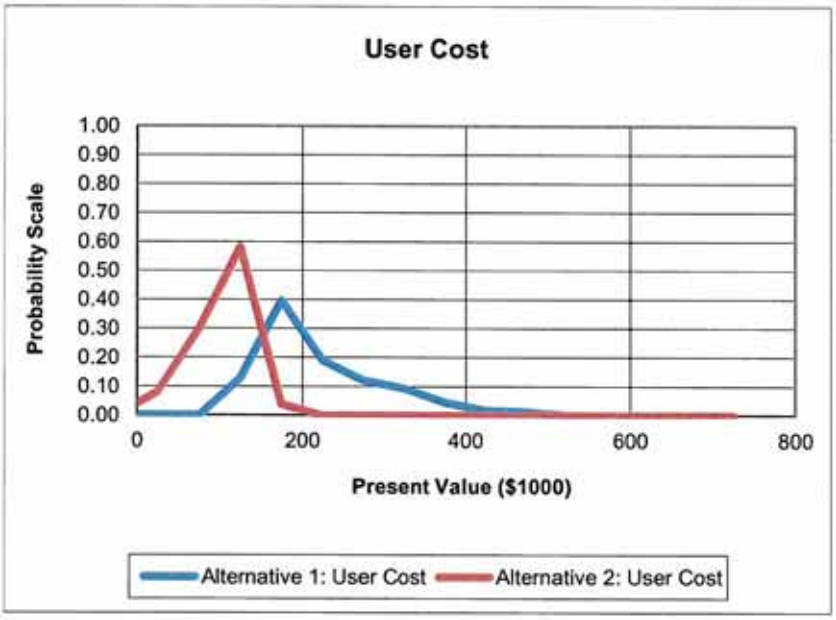
Total Cost	Alternative 1: 6th Ave DB Flexible Alternative		Alternative 2: 6th Ave DB Rigid Alternative	
	Agency Cost ($1000)	User Cost ($1000)	Agency Cost ($1000)	User Cost ($1000)
Undiscounted Sum	$10,411.28	$494.29	$6,768.04	$231.53
Present Value	$8,285.98	$244.81	$6,053.29	$108.48
EUAC	$346.97	$10.25	$253.48	$4.54

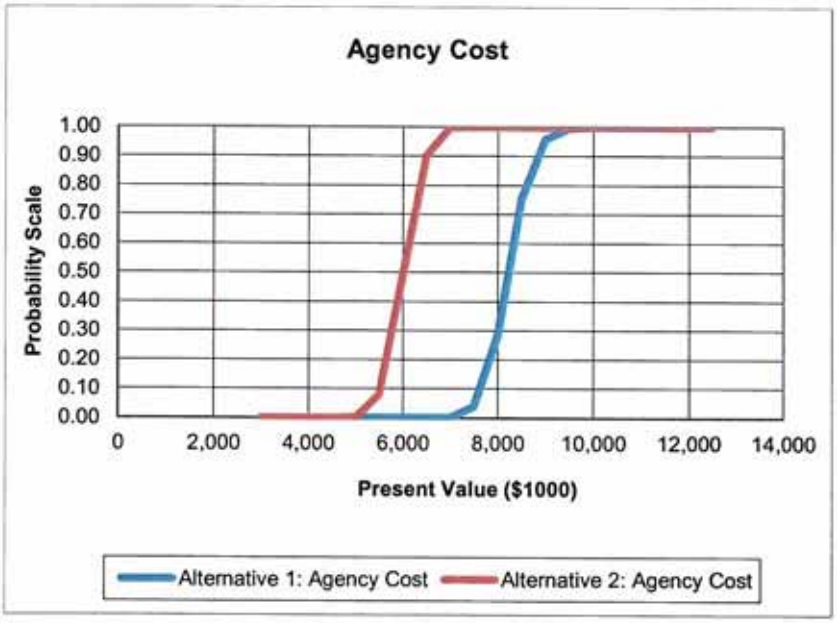


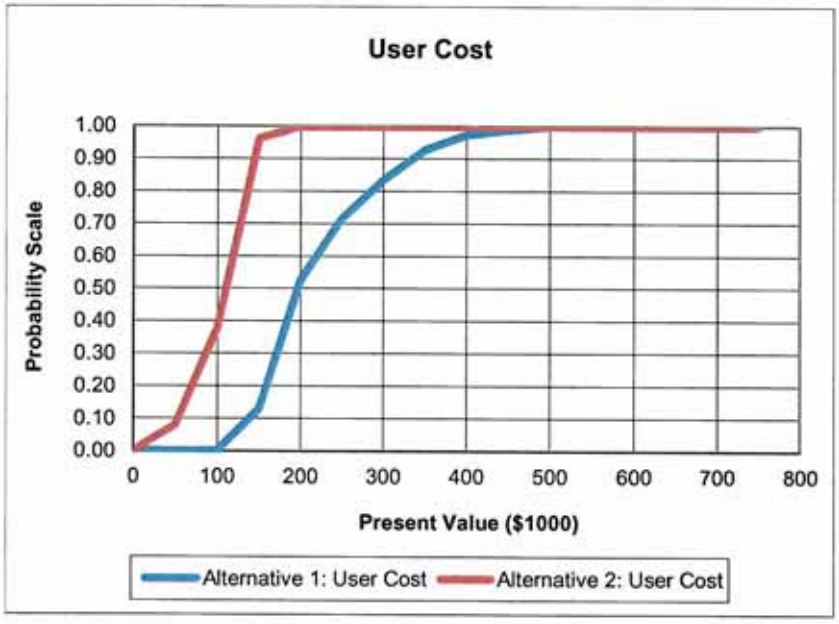
Probabilistic Results

Total Cost (Present Value)	Alternative 1: 6th Ave DB Flexible Alternative		Alternative 2: 6th Ave DB Rigid Alternative	
	Agency Cost ($1000)	User Cost ($1000)	Agency Cost ($1000)	User Cost ($1000)
Mean	$8,233.18	$218.76	$6,028.71	$104.17
Standard Deviation	$435.88	$76.27	$355.59	$32.33
Minimum	$7,105.94	$131.97	$4,898.44	$2.01
Maximum	$9,717.52	$498.30	$7,015.82	$185.58

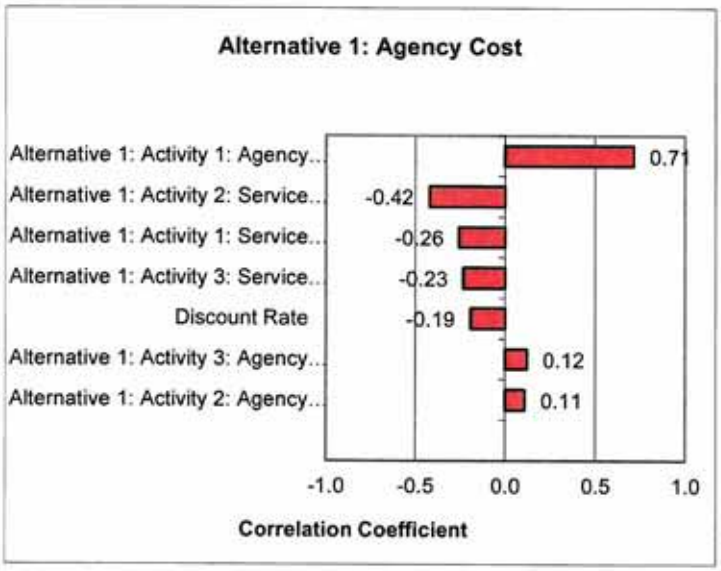


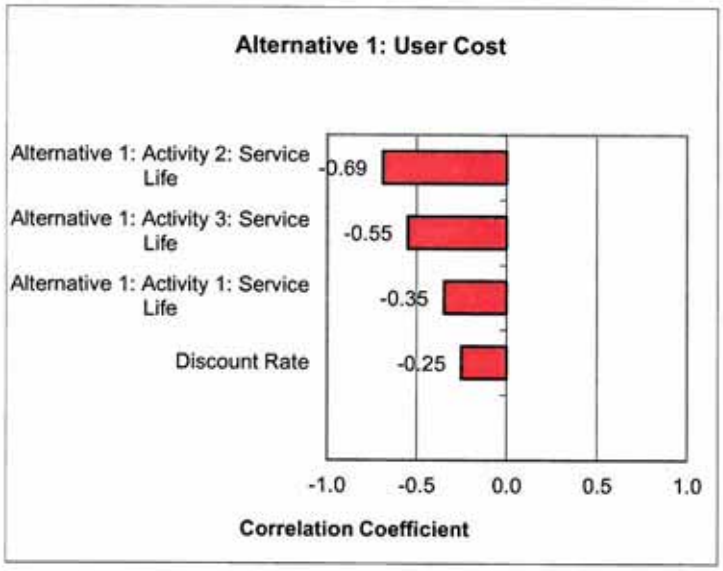


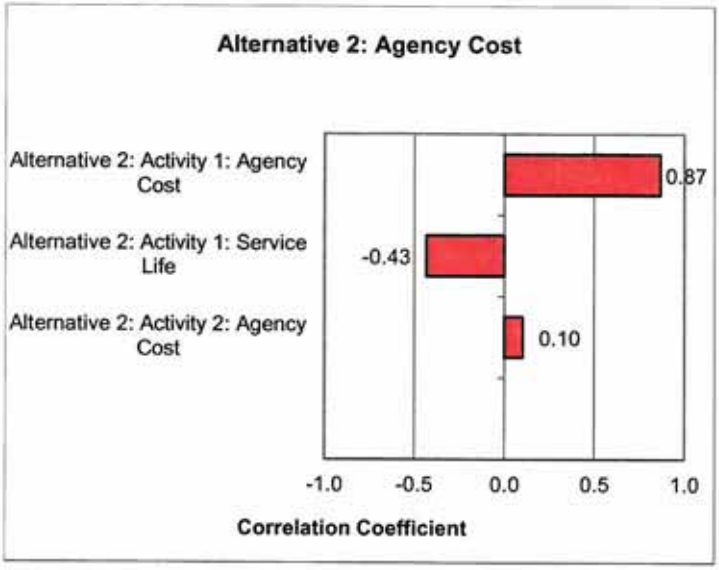

Agency Cost
Probability Scale
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0
2,000
4,000
6,000
8,000
10,000
12,000
14,000
Present Value ($1000)
Alternative 1: Agency Cost
Alternative 2: Agency Cost

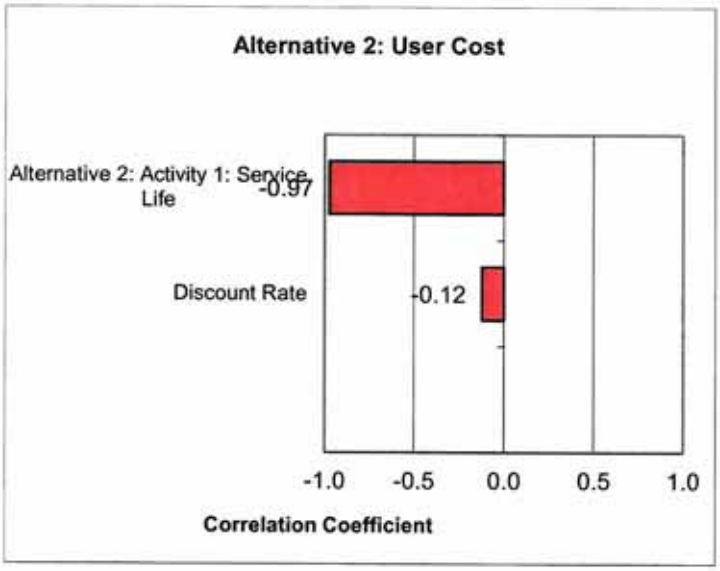

User Cost
Probability Scale
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0
100
200
300
400
500
600
700
800
Present Value ($1000)
Alternative 1: User Cost
Alternative 2: User Cost

Tornado Graphs






Alternative 2: Agency Cost
Alternative 2: Activity 1: Agency Cost
Alternative 2: Activity 1: Service Life
Alternative 2: Activity 2: Agency Cost
0.87
-0.43
0.10
-1.0
-0.5
0.0
0.5
1.0
Correlation Coefficient


Alternative 2: User Cost
Alternative 2: Activity 1: Service Life
Discount Rate
-0.97
-0.12
-1.0
-0.5
0.0
0.5
1.0
Correlation Coefficient

CDOT REPORT - Summary Input and Output for the Single Lane Closure Strategy

	INPUT DATA	
Project Name	6DB	
Freeway Name	WB006G	
Input Filename	...WORKZO~1\WB62029.WZM	
Project Start Date		
Project End Date		
Design Speed	60 mph	
Speed Limit	55 mph	
Workzone Speed Limit	45 mph	
Grade	2.0 %	
Work Zone Length	0.96 miles	
Total Number of Lanes	3	
Number of Open Lanes	1	
Number of Temporary Lanes	1	
AADT, Directional	87560	
Percentage of Single Unit Trucks	2.0 %	
Percentage of Combination Trucks	1.0 %	
Functional Class	Urban Freeway (Weekday)	
	OUTPUT SUMMARY	
TYPE OF WORK	**ADDITIONAL USER COST DUE TO WORKZONE**	**DURATION**
202-Removal of Asphalt (Planing)	$7,734.49	4
403-HBP (Asphalt) <= 2.0 inch	$5,907.66	3
TOTAL ADDL. USER COST	$13,642.16	7
TOTAL USER COST FOR NORMAL CONDITION (WITH NO WORKZONE) FOR A DURATION OF 7 DAYS = $41,108.34		
Disclaimer:		
The values presented in this program are intended to provide guidelines only. Engineering judgement must be applied to use these values. No one but the user can assure that these results are properly applied.		

CDOT REPORT - Summary Input and Output for the Single Lane Closure Strategy

	INPUT DATA	
Project Name	6DB	
Freeway Name	WB006G	
Input Filename	...WORKZO~1\WB62040.WZM	
Project Start Date		
Project End Date		
Design Speed	60 mph	
Speed Limit	55 mph	
Workzone Speed Limit	45 mph	
Grade	2.0 %	
Work Zone Length	0.96 miles	
Total Number of Lanes	3	
Number of Open Lanes	1	
Number of Temporary Lanes	1	
AADT, Directional	104104	
Percentage of Single Unit Trucks	2.0 %	
Percentage of Combination Trucks	1.0 %	
Functional Class	Urban Freeway (Weekday)	
	OUTPUT SUMMARY	
TYPE OF WORK	**ADDITIONAL USER COST DUE TO WORKZONE**	**DURATION**
202-Removal of Asphalt (Planing)	$36,634.41	4
403-HBP (Asphalt) <= 2.0 inch	$30,430.71	3
TOTAL ADDL. USER COST	$67,065.12	7
TOTAL USER COST FOR NORMAL CONDITION (WITH NO WORKZONE) FOR A DURATION OF 7 DAYS = $48,935.55		
Disclaimer:		
The values presented in this program are intended to provide guidelines only. Engineering judgement must be applied to use these values. No one but the user can assure that these results are properly applied.		

CDOT REPORT - Summary Input and Output for the Single Lane Closure Strategy

	INPUT DATA	
Project Name	6DB	
Freeway Name	WB006G	
Input Filename	...ORKZO~1\WB62043R.WZM	
Project Start Date		
Project End Date		
Design Speed	60 mph	
Speed Limit	55 mph	
Workzone Speed Limit	45 mph	
Grade	2.0 %	
Work Zone Length	0.96 miles	
Total Number of Lanes	3	
Number of Open Lanes	1	
Number of Temporary Lanes	1	
AADT, Directional	109567	
Percentage of Single Unit Trucks	2.0 %	
Percentage of Combination Trucks	1.0 %	
Functional Class	Urban Freeway (Weekday)	
	OUTPUT SUMMARY	
TYPE OF WORK	**ADDITIONAL USER COST DUE TO WORKZONE**	**DURATION**
202-Removal of Concrete (Diamond Grinding)	$49,786.43	4
202-Removal of Concrete	$0.00	0
412-Concrete Pavement <= 14.0 inch	$0.00	0
412-Routing & Sealing PCCP Cracks	$28,523.70	2
TOTAL ADDL. USER COST	$78,310.13	6
TOTAL USER COST FOR NORMAL CONDITION (WITH NO WORKZONE)		
FOR A DURATION OF 6 DAYS = $44,163.94		
Disclaimer:		
The values presented in this program are intended to provide guidelines only.		
Engineering judgement must be applied to use these values.		
No one but the user can assure that these results are properly applied.		

CDOT REPORT - Summary Input and Output for the Single Lane Closure Strategy

	INPUT DATA	
Project Name	6DB	
Freeway Name	WB006G	
Input Filename	...WORKZO~1\WB62051.WZM	
Project Start Date		
Project End Date		
Design Speed	60 mph	
Speed Limit	55 mph	
Workzone Speed Limit	45 mph	
Grade	2.0 %	
Work Zone Length	0.96 miles	
Total Number of Lanes	3	
Number of Open Lanes	1	
Number of Temporary Lanes	1	
AADT, Directional	124133	
Percentage of Single Unit Trucks	2.0 %	
Percentage of Combination Trucks	1.0 %	
Functional Class	Urban Freeway (Weekday)	
	OUTPUT SUMMARY	
TYPE OF WORK	**ADDITIONAL USER COST DUE TO WORKZONE**	**DURATION**
202-Removal of Asphalt (Planing)	$113,757.26	4
403-HBP (Asphalt) <= 2.0 inch	$94,013.20	3
TOTAL ADDL. USER COST	$207,770.46	7
TOTAL USER COST FOR NORMAL CONDITION (WITH NO WORKZONE) FOR A DURATION OF 7 DAYS = $58,438.64		
Disclaimer:		
The values presented in this program are intended to provide guidelines only. Engineering judgement must be applied to use these values. No one but the user can assure that these results are properly applied.		

CDOT REPORT - Summary Input and Output for the Single Lane Closure Strategy

	INPUT DATA	
Project Name	6DB	
Freeway Name	WBCD	
Input Filename	...ORKZO~1\WBC62029.WZM	
Project Start Date		
Project End Date		
Design Speed	60 mph	
Speed Limit	55 mph	
Workzone Speed Limit	45 mph	
Grade	2.0 %	
Work Zone Length	0.72 miles	
Total Number of Lanes	3	
Number of Open Lanes	1	
Number of Temporary Lanes	1	
AADT, Directional	58656	
Percentage of Single Unit Trucks	2.0 %	
Percentage of Combination Trucks	1.0 %	
Functional Class	Urban Freeway (Weekday)	
	OUTPUT SUMMARY	
TYPE OF WORK	**ADDITIONAL USER COST DUE TO WORKZONE**	**DURATION**
202-Removal of Asphalt (Planing)	$2,631.99	3
403-HBP (Asphalt) <= 2.0 inch	$2,658.37	3
TOTAL ADDL. USER COST	$5,290.36	6
TOTAL USER COST FOR NORMAL CONDITION (WITH NO WORKZONE) FOR A DURATION OF 6 DAYS = $18,681.32		
Disclaimer:		
The values presented in this program are intended to provide guidelines only. Engineering judgement must be applied to use these values. No one but the user can assure that these results are properly applied.		

CDOT REPORT - Summary Input and Output for the Single Lane Closure Strategy

	INPUT DATA	
Project Name	6DB	
Freeway Name	WBCD	
Input Filename	...ORKZO~1\WBC62040.WZM	
Project Start Date		
Project End Date		
Design Speed	60 mph	
Speed Limit	55 mph	
Workzone Speed Limit	45 mph	
Grade	2.0 %	
Work Zone Length	0.72 miles	
Total Number of Lanes	3	
Number of Open Lanes	1	
Number of Temporary Lanes	1	
AADT, Directional	67057	
Percentage of Single Unit Trucks	2.0 %	
Percentage of Combination Trucks	1.0 %	
Functional Class	Urban Freeway (Weekday)	
	OUTPUT SUMMARY	
TYPE OF WORK	**ADDITIONAL USER COST DUE TO WORKZONE**	**DURATION**
202-Removal of Asphalt (Planing)	$3,241.23	3
403-HBP (Asphalt) <= 2.0 inch	$3,281.56	3
TOTAL ADDL. USER COST	$6,522.79	6
TOTAL USER COST FOR NORMAL CONDITION (WITH NO WORKZONE) FOR A DURATION OF 6 DAYS = $21,369.87		
Disclaimer:		
The values presented in this program are intended to provide guidelines only. Engineering judgement must be applied to use these values. No one but the user can assure that these results are properly applied.		

CDOT REPORT - Summary Input and Output for the Single Lane Closure Strategy

	INPUT DATA	
Project Name	6DB	
Freeway Name	WBCD	
Input Filename	...ORKZO~1\WBC2043R.WZM	
Project Start Date		
Project End Date		
Design Speed	60 mph	
Speed Limit	55 mph	
Workzone Speed Limit	45 mph	
Grade	2.0 %	
Work Zone Length	0.72 miles	
Total Number of Lanes	3	
Number of Open Lanes	1	
Number of Temporary Lanes	1	
AADT, Directional	69792	
Percentage of Single Unit Trucks	2.0 %	
Percentage of Combination Trucks	1.0 %	
Functional Class	Urban Freeway (Weekday)	
	OUTPUT SUMMARY	
TYPE OF WORK	**ADDITIONAL USER COST DUE TO WORKZONE**	**DURATION**
202-Removal of Concrete	$0.00	0
202-Removal of Concrete (Diamond Grind	$4,615.15	4
412-Concrete Pavement <= 10.0 inch	$0.00	0
412-Routing & Sealing PCCP Cracks	$1,182.65	1
TOTAL ADDL. USER COST	$5,797.80	5
TOTAL USER COST FOR NORMAL CONDITION (WITH NO WORKZONE)		
FOR A DURATION OF 5 DAYS = $18,538.23		
Disclaimer:		
The values presented in this program are intended to provide guidelines only.		
Engineering judgement must be applied to use these values.		
No one but the user can assure that these results are properly applied.		

CDOT REPORT - Summary Input and Output for the Single Lane Closure Strategy

	INPUT DATA	
Project Name	6DB	
Freeway Name	WBCD	
Input Filename	...ORKZO~1\WBC62051.WZM	
Project Start Date		
Project End Date		
Design Speed	60 mph	
Speed Limit	55 mph	
Workzone Speed Limit	45 mph	
Grade	2.0 %	
Work Zone Length	0.72 miles	
Total Number of Lanes	3	
Number of Open Lanes	1	
Number of Temporary Lanes	1	
AADT, Directional	77083	
Percentage of Single Unit Trucks	2.0 %	
Percentage of Combination Trucks	1.0 %	
Functional Class	Urban Freeway (Weekday)	
	OUTPUT SUMMARY	
TYPE OF WORK	**ADDITIONAL USER COST DUE TO WORKZONE**	**DURATION**
202-Removal of Asphalt (Planing)	$4,110.03	3
403-HBP (Asphalt) <= 2.0 inch	$4,174.73	3
TOTAL ADDL. USER COST	$8,284.75	6
TOTAL USER COST FOR NORMAL CONDITION (WITH NO WORKZONE) FOR A DURATION OF 6 DAYS = $24,582.86		
Disclaimer:		
The values presented in this program are intended to provide guidelines only. Engineering judgement must be applied to use these values. No one but the user can assure that these results are properly applied.		

CDOT REPORT - Summary Input and Output for the Single Lane Closure Strategy

	INPUT DATA	
Project Name	6DB	
Freeway Name	EB006G	
Input Filename	...WORKZO~1\EB62029.WZM	
Project Start Date		
Project End Date		
Design Speed	60 mph	
Speed Limit	55 mph	
Workzone Speed Limit	45 mph	
Grade	2.0 %	
Work Zone Length	0.96 miles	
Total Number of Lanes	3	
Number of Open Lanes	1	
Number of Temporary Lanes	1	
AADT, Directional	84588	
Percentage of Single Unit Trucks	2.0 %	
Percentage of Combination Trucks	1.0 %	
Functional Class	Urban Freeway (Weekday)	
	OUTPUT SUMMARY	
TYPE OF WORK	**ADDITIONAL USER COST DUE TO WORKZONE**	**DURATION**
202-Removal of Asphalt (Planing)	$25,425.66	5
403-HBP (Asphalt) <= 2.0 inch	$18,178.79	3
TOTAL ADDL. USER COST	$43,604.44	8
TOTAL USER COST FOR NORMAL CONDITION (WITH NO WORKZONE) FOR A DURATION OF 8 DAYS = $50,027.97		
Disclaimer:		
The values presented in this program are intended to provide guidelines only. Engineering judgement must be applied to use these values. No one but the user can assure that these results are properly applied.		

CDOT REPORT - Summary Input and Output for the Single Lane Closure Strategy

	INPUT DATA	
Project Name	6DB	
Freeway Name	EB006G	
Input Filename	...WORKZO~1\EB62040.WZM	
Project Start Date		
Project End Date		
Design Speed	60 mph	
Speed Limit	55 mph	
Workzone Speed Limit	45 mph	
Grade	2.0 %	
Work Zone Length	0.96 miles	
Total Number of Lanes	3	
Number of Open Lanes	1	
Number of Temporary Lanes	1	
AADT, Directional	97206	
Percentage of Single Unit Trucks	2.0 %	
Percentage of Combination Trucks	1.0 %	
Functional Class	Urban Freeway (Weekday)	
	OUTPUT SUMMARY	
TYPE OF WORK	**ADDITIONAL USER COST DUE TO WORKZONE**	**DURATION**
202-Removal of Asphalt (Planing)	$69,041.37	5
403-HBP (Asphalt) <= 2.0 inch	$44,389.50	3
TOTAL ADDL. USER COST	$113,430.86	8
TOTAL USER COST FOR NORMAL CONDITION (WITH NO WORKZONE) FOR A DURATION OF 8 DAYS = $57,555.94		
Disclaimer:		
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CDOT REPORT - Summary Input and Output for the Single Lane Closure Strategy

	INPUT DATA	
Project Name	6DB	
Freeway Name	EB006G	
Input Filename	...ORKZO~1\EB62043R.WZM	
Project Start Date		
Project End Date		
Design Speed	60 mph	
Speed Limit	55 mph	
Workzone Speed Limit	45 mph	
Grade	2.0 %	
Work Zone Length	0.96 miles	
Total Number of Lanes	3	
Number of Open Lanes	1	
Number of Temporary Lanes	1	
AADT, Directional	101170	
Percentage of Single Unit Trucks	2.0 %	
Percentage of Combination Trucks	1.0 %	
Functional Class	Urban Freeway (Weekday)	
	OUTPUT SUMMARY	
TYPE OF WORK	**ADDITIONAL USER COST DUE TO WORKZONE**	**DURATION**
202-Removal of Concrete (Diamond Grinding)	$66,263.30	4
202-Removal of Concrete	$0.00	0
412-Concrete Pavement <= 14.0 inch	$0.00	0
412-Routing & Sealing PCCP Cracks	$37,279.67	2
TOTAL ADDL. USER COST	$103,542.98	6
TOTAL USER COST FOR NORMAL CONDITION (WITH NO WORKZONE)		
FOR A DURATION OF 6 DAYS = $44,943.44		
Disclaimer:		
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No one but the user can assure that these results are properly applied.		

CDOT REPORT - Summary Input and Output for the Single Lane Closure Strategy

	INPUT DATA	
Project Name	6DB	
Freeway Name	EB006G	
Input Filename	...WORKZO~1\EB62051.WZM	
Project Start Date		
Project End Date		
Design Speed	60 mph	
Speed Limit	55 mph	
Workzone Speed Limit	45 mph	
Grade	2.0 %	
Work Zone Length	0.96 miles	
Total Number of Lanes	3	
Number of Open Lanes	1	
Number of Temporary Lanes	1	
AADT, Directional	111740	
Percentage of Single Unit Trucks	2.0 %	
Percentage of Combination Trucks	1.0 %	
Functional Class	Urban Freeway (Weekday)	
	OUTPUT SUMMARY	
TYPE OF WORK	**ADDITIONAL USER COST DUE TO WORKZONE**	**DURATION**
202-Removal of Asphalt (Planing)	$135,851.10	5
403-HBP (Asphalt) <= 2.0 inch	$87,320.77	3
TOTAL ADDL. USER COST	$223,171.87	8
TOTAL USER COST FOR NORMAL CONDITION (WITH NO WORKZONE) FOR A DURATION OF 8 DAYS = $66,249.41		
Disclaimer:		
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CDOT REPORT - Summary Input and Output for the Single Lane Closure Strategy

	INPUT DATA	
Project Name	6DB	
Freeway Name	EB006G	
Input Filename	...ORKZO~1\EBCD2029.WZM	
Project Start Date		
Project End Date		
Design Speed	60 mph	
Speed Limit	55 mph	
Workzone Speed Limit	45 mph	
Grade	2.0 %	
Work Zone Length	0.56 miles	
Total Number of Lanes	3	
Number of Open Lanes	1	
Number of Temporary Lanes	1	
AADT, Directional	67254	
Percentage of Single Unit Trucks	2.0 %	
Percentage of Combination Trucks	1.0 %	
Functional Class	Urban Freeway (Weekday)	
	OUTPUT SUMMARY	
TYPE OF WORK	**ADDITIONAL USER COST DUE TO WORKZONE**	**DURATION**
202-Removal of Asphalt (Planing)	$5,048.21	4
403-HBP (Asphalt) <= 2.0 inch	$2,569.53	2
TOTAL ADDL. USER COST	$7,617.74	6
TOTAL USER COST FOR NORMAL CONDITION (WITH NO WORKZONE) FOR A DURATION OF 6 DAYS = $19,515.19		
Disclaimer:		
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CDOT REPORT - Summary Input and Output for the Single Lane Closure Strategy

	INPUT DATA	
Project Name	6DB	
Freeway Name	EB006G	
Input Filename	...ORKZO~1\EBCD2040.WZM	
Project Start Date		
Project End Date		
Design Speed	60 mph	
Speed Limit	55 mph	
Workzone Speed Limit	45 mph	
Grade	2.0 %	
Work Zone Length	0.56 miles	
Total Number of Lanes	3	
Number of Open Lanes	1	
Number of Temporary Lanes	1	
AADT, Directional	86521	
Percentage of Single Unit Trucks	2.0 %	
Percentage of Combination Trucks	1.0 %	
Functional Class	Urban Freeway (Weekday)	
	OUTPUT SUMMARY	
TYPE OF WORK	**ADDITIONAL USER COST DUE TO WORKZONE**	**DURATION**
202-Removal of Asphalt (Planing)	$23,471.05	4
403-HBP (Asphalt) <= 2.0 inch	$13,680.38	2
TOTAL ADDL. USER COST	$37,151.43	6
TOTAL USER COST FOR NORMAL CONDITION (WITH NO WORKZONE) FOR A DURATION OF 6 DAYS = $25,148.82		
Disclaimer:		
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CDOT REPORT - Summary Input and Output for the Single Lane Closure Strategy

	INPUT DATA	
Project Name	6DB	
Freeway Name	EB006G	
Input Filename	...ORKZO~1\ECD2043R.WZM	
Project Start Date		
Project End Date		
Design Speed	60 mph	
Speed Limit	55 mph	
Workzone Speed Limit	45 mph	
Grade	2.0 %	
Work Zone Length	0.56 miles	
Total Number of Lanes	3	
Number of Open Lanes	1	
Number of Temporary Lanes	1	
AADT, Directional	93374	
Percentage of Single Unit Trucks	2.0 %	
Percentage of Combination Trucks	1.0 %	
Functional Class	Urban Freeway (Weekday)	
	OUTPUT SUMMARY	
TYPE OF WORK	**ADDITIONAL USER COST DUE TO WORKZONE**	**DURATION**
202-Removal of Concrete (Diamond Grinding)	$31,677.94	3
202-Removal of Concrete	$0.00	0
412-Routing & Sealing PCCP Cracks	$24,712.04	2
412-Concrete Pavement <= 10.0 inch	$0.00	0
TOTAL ADDL. USER COST	$56,389.98	5
TOTAL USER COST FOR NORMAL CONDITION (WITH NO WORKZONE)		
FOR A DURATION OF 5 DAYS = $22,631.23		
Disclaimer:		
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CDOT REPORT - Summary Input and Output for the Single Lane Closure Strategy

	INPUT DATA	
Project Name	6DB	
Freeway Name	EB006G	
Input Filename	...ORKZO~1\EBCD2051.WZM	
Project Start Date		
Project End Date		
Design Speed	60 mph	
Speed Limit	55 mph	
Workzone Speed Limit	45 mph	
Grade	2.0 %	
Work Zone Length	0.56 miles	
Total Number of Lanes	3	
Number of Open Lanes	1	
Number of Temporary Lanes	1	
AADT, Directional	111649	
Percentage of Single Unit Trucks	2.0 %	
Percentage of Combination Trucks	1.0 %	
Functional Class	Urban Freeway (Weekday)	
	OUTPUT SUMMARY	
TYPE OF WORK	**ADDITIONAL USER COST DUE TO WORKZONE**	**DURATION**
202-Removal of Asphalt (Planing)	$104,538.72	4
403-HBP (Asphalt) <= 2.0 inch	$56,125.16	2
TOTAL ADDL. USER COST	$160,663.87	6
TOTAL USER COST FOR NORMAL CONDITION (WITH NO WORKZONE) FOR A DURATION OF 6 DAYS = $32,526.81		
Disclaimer:		
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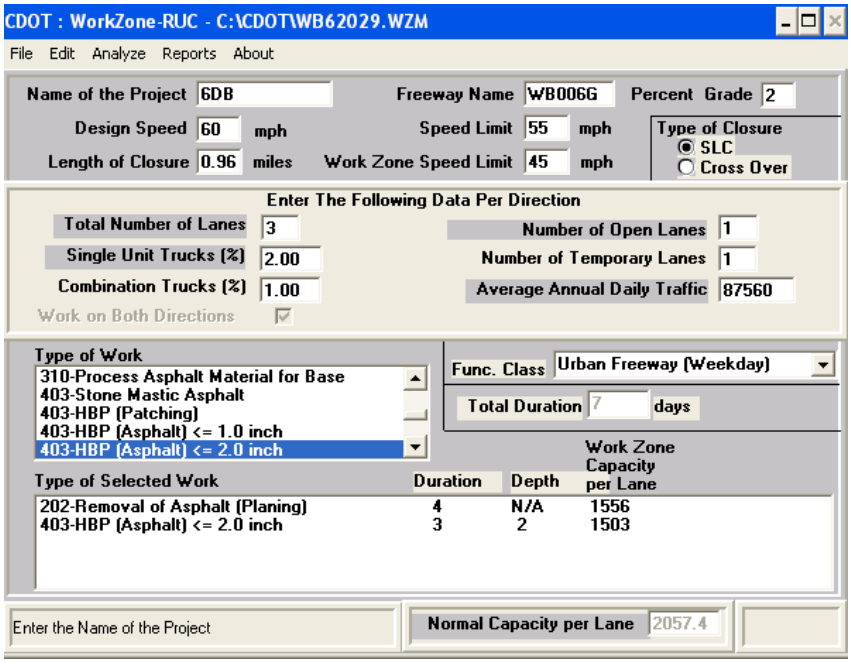
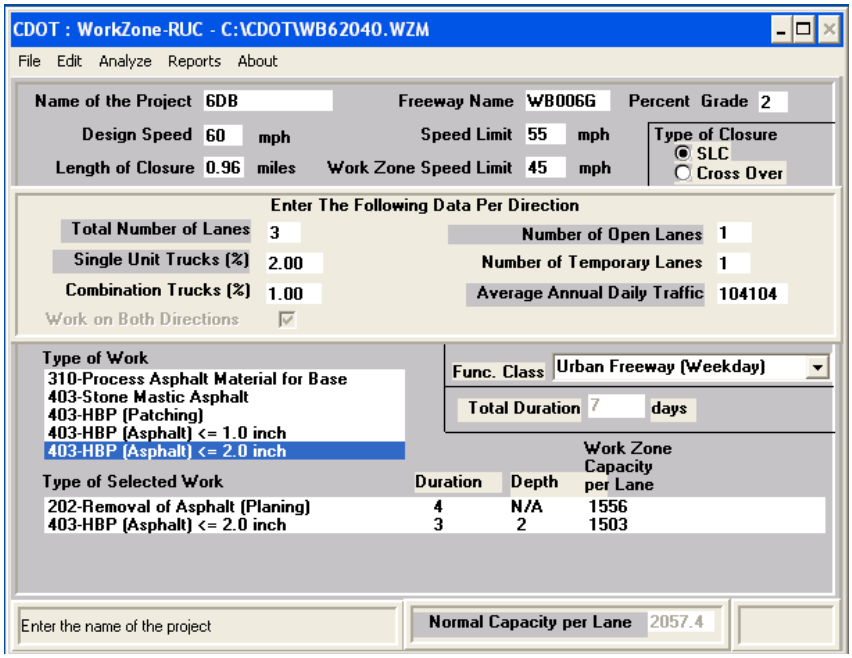
Westbound 6th Avenue Flex 2029



Westbound 6th Avenue Flex 2040



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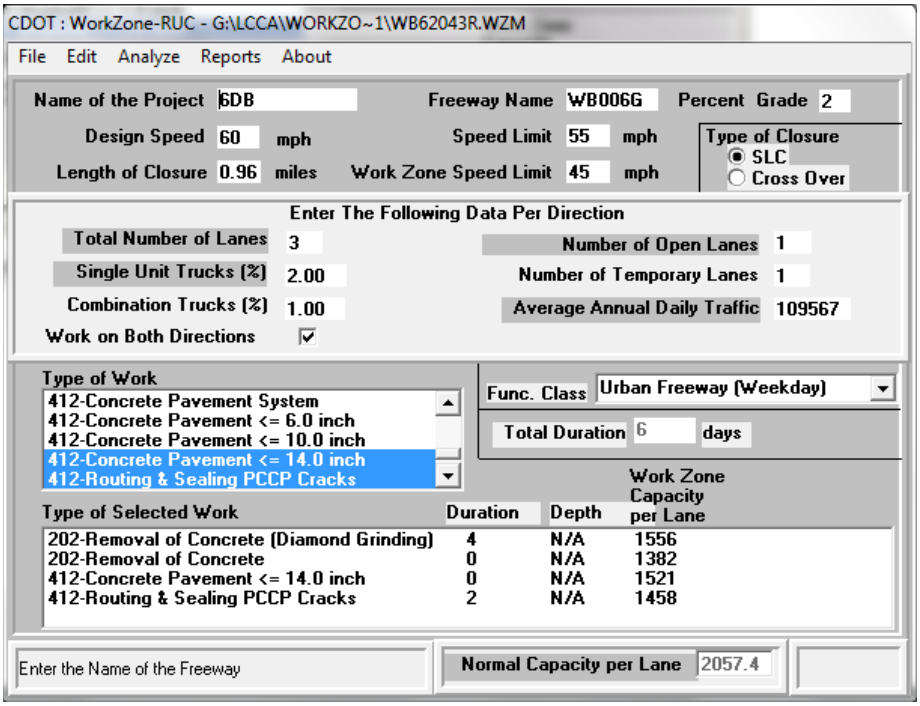

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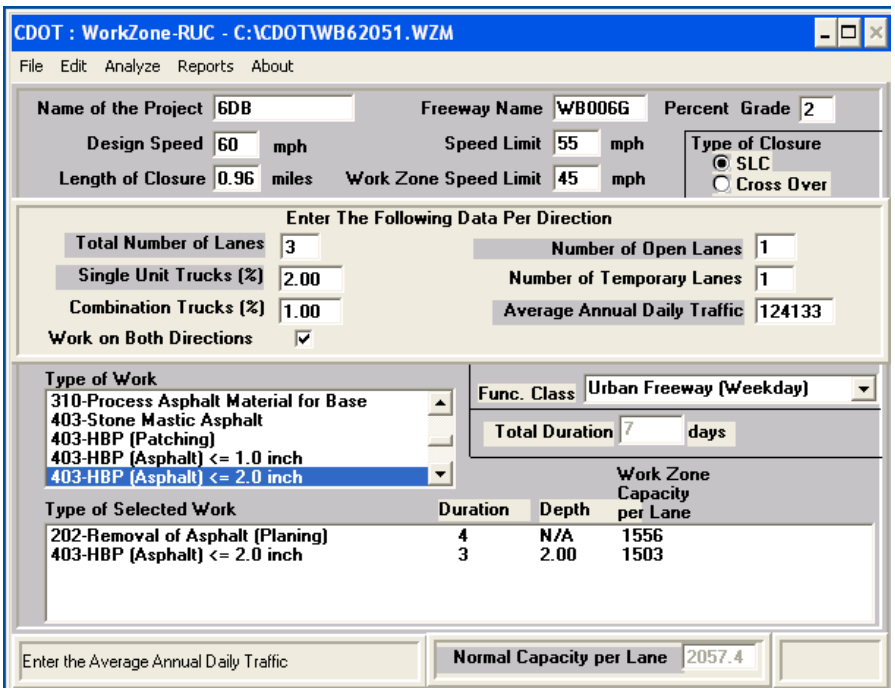
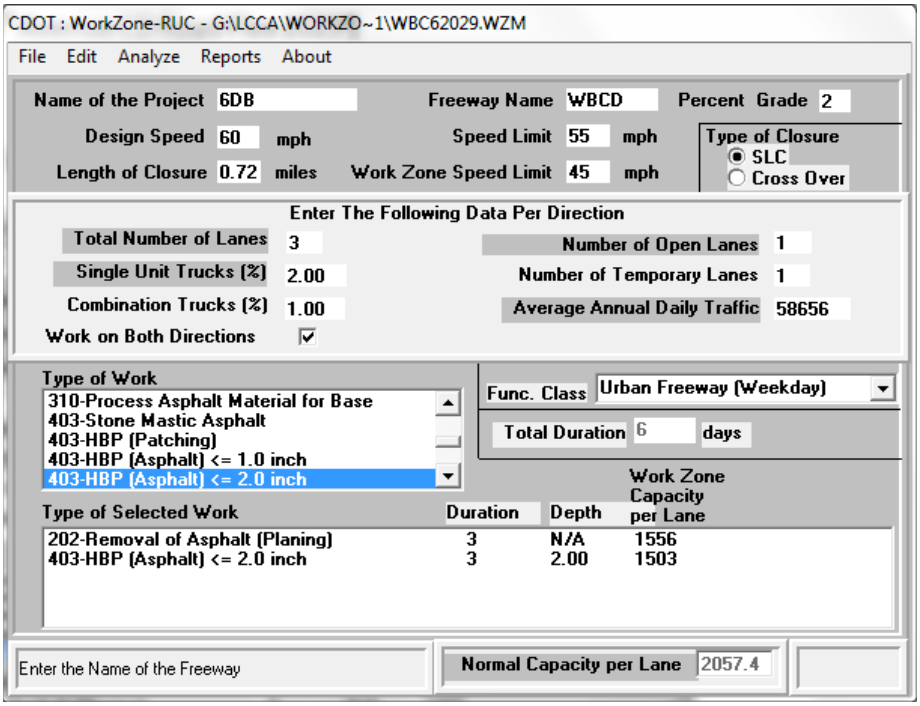


Westbound 6th Avenue CD Road Flex 2029



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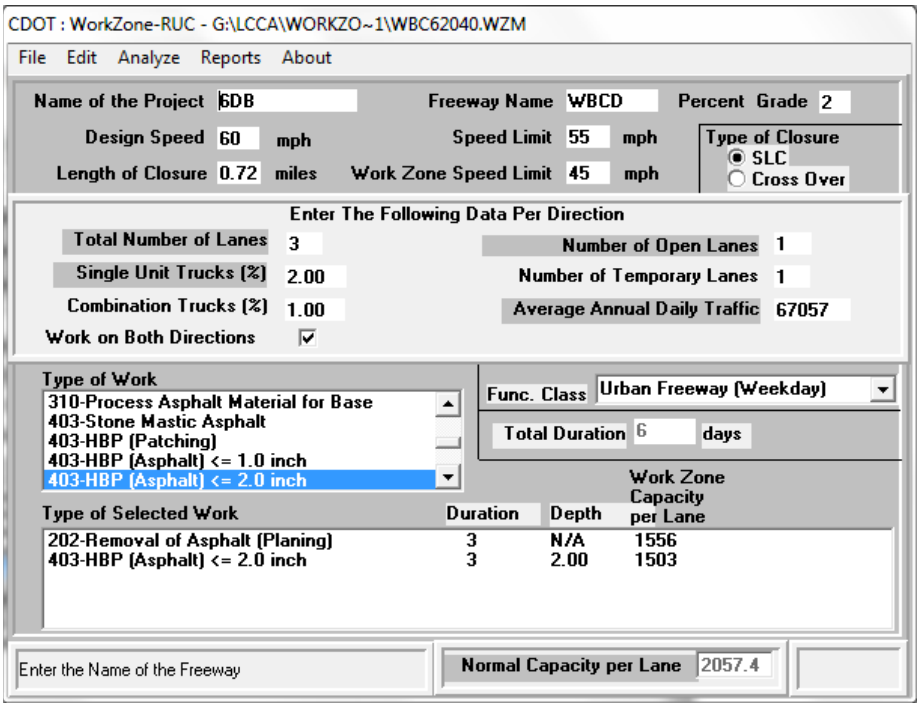

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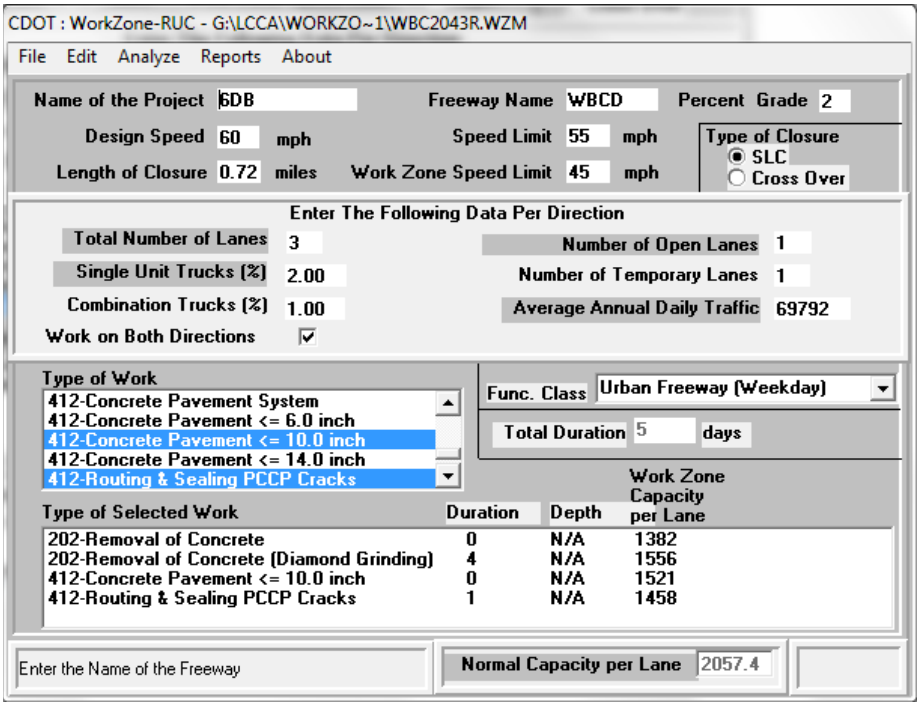

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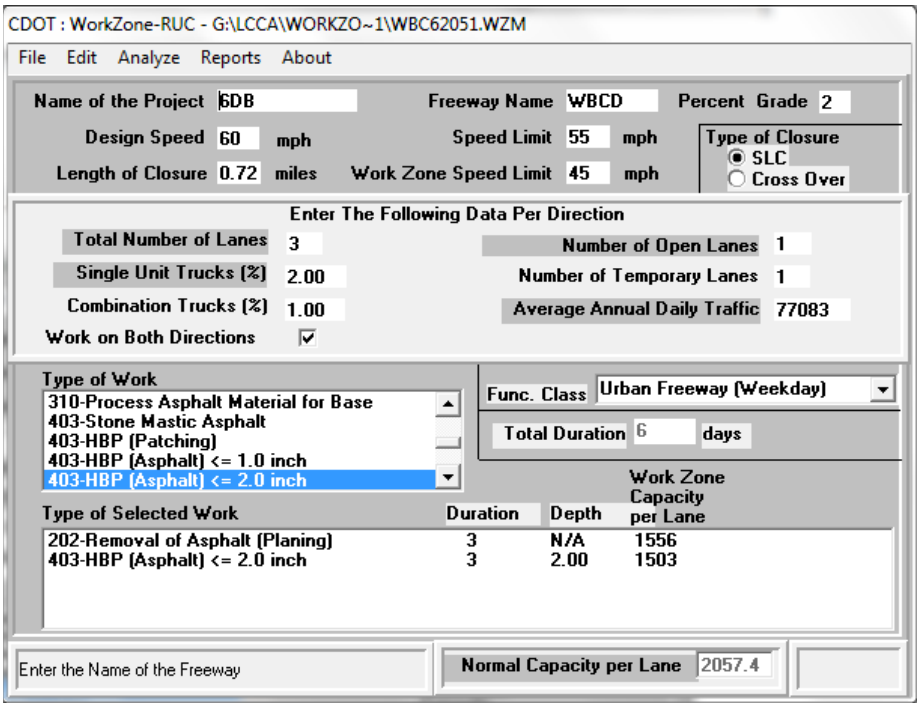

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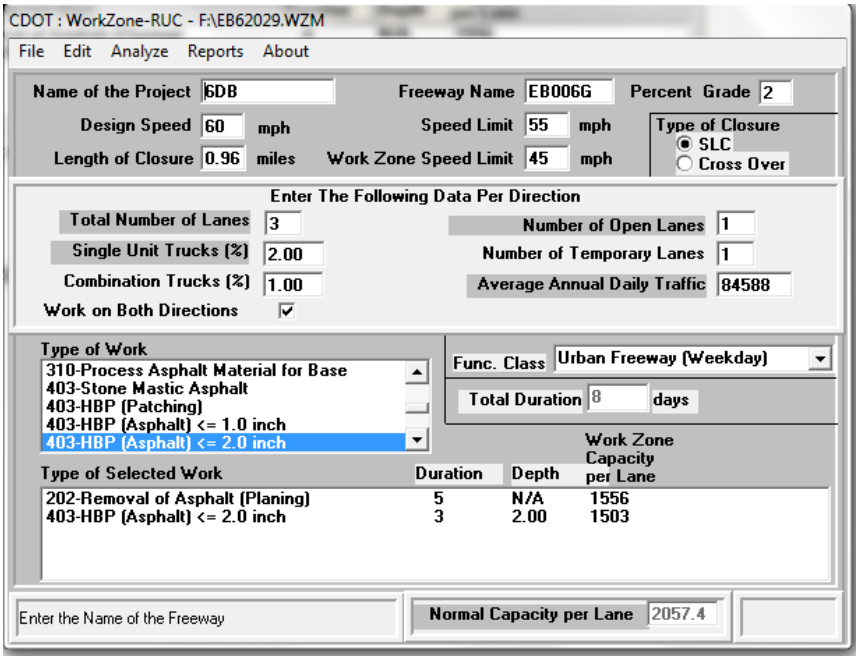

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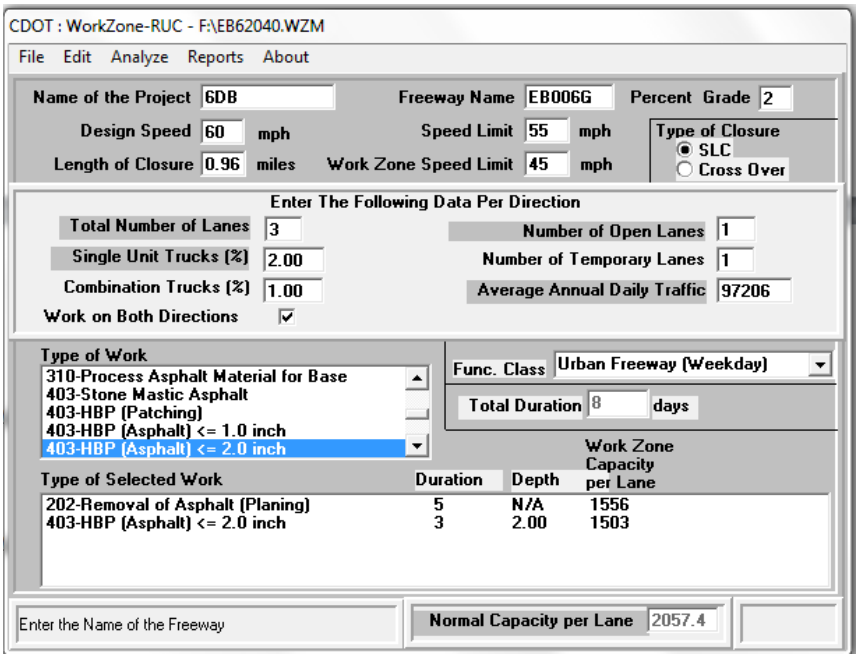

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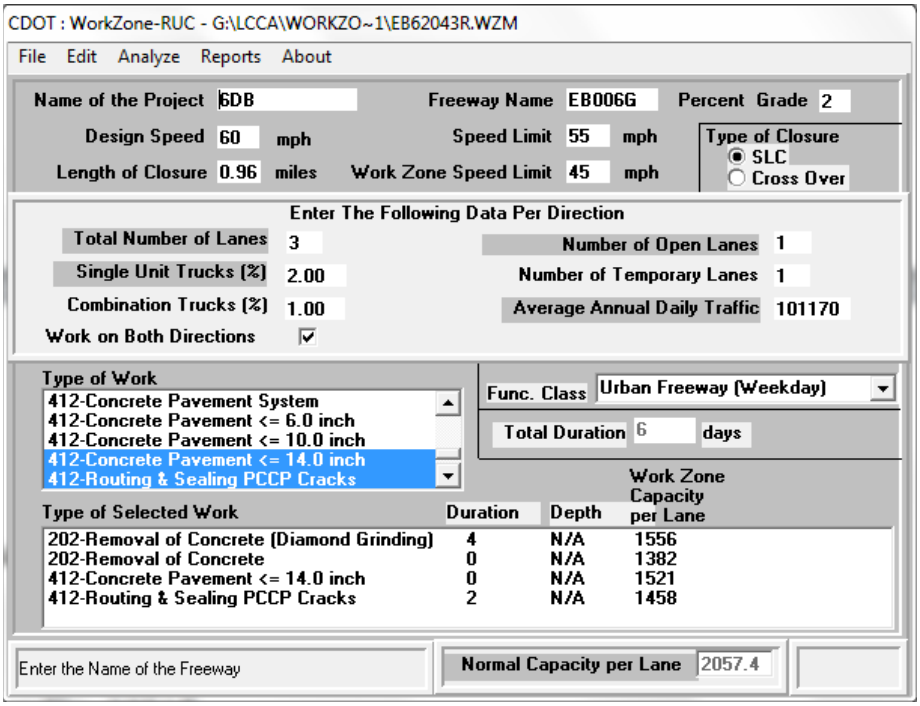

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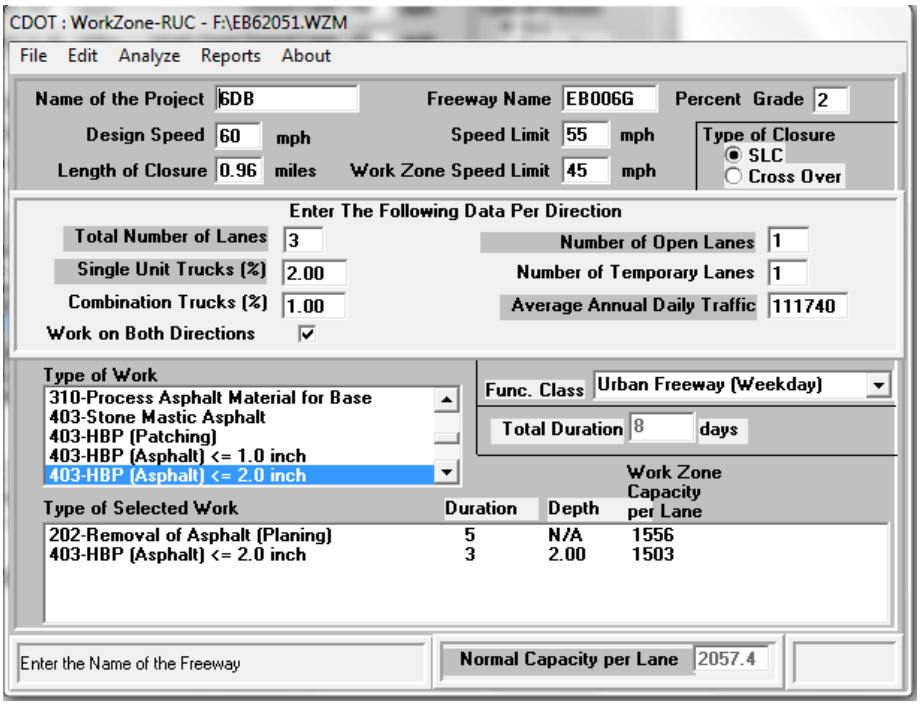
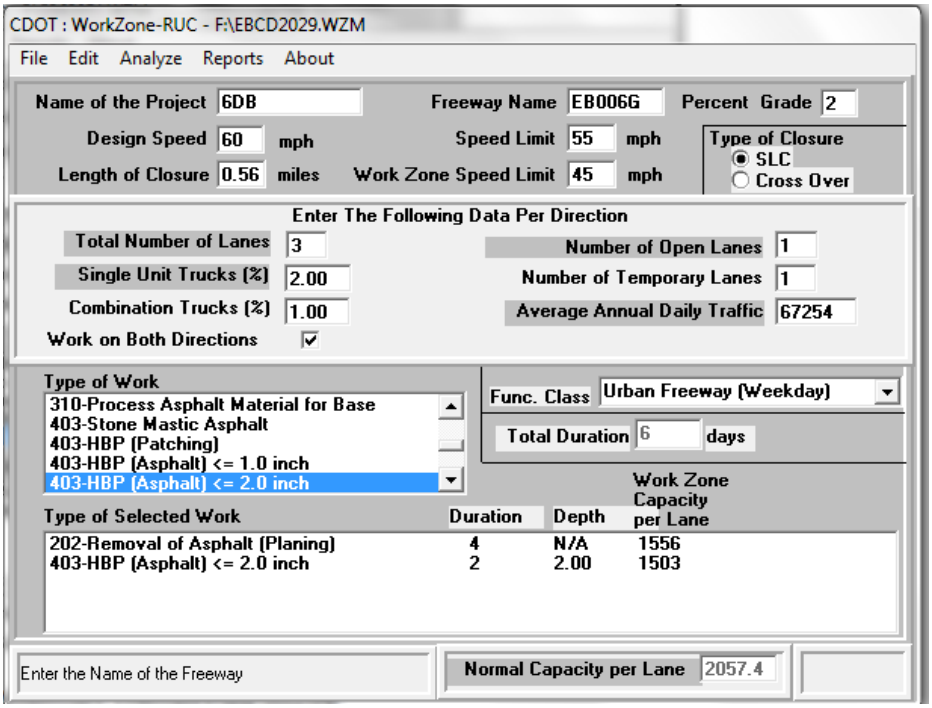


Eastbound 6th Avenue CD Road Flex 2029



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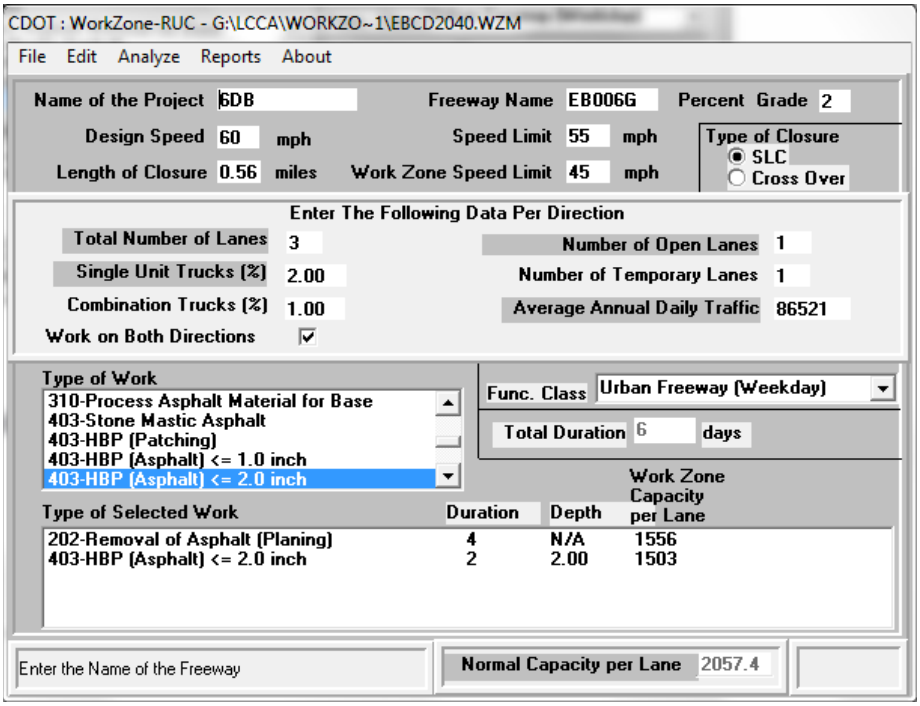
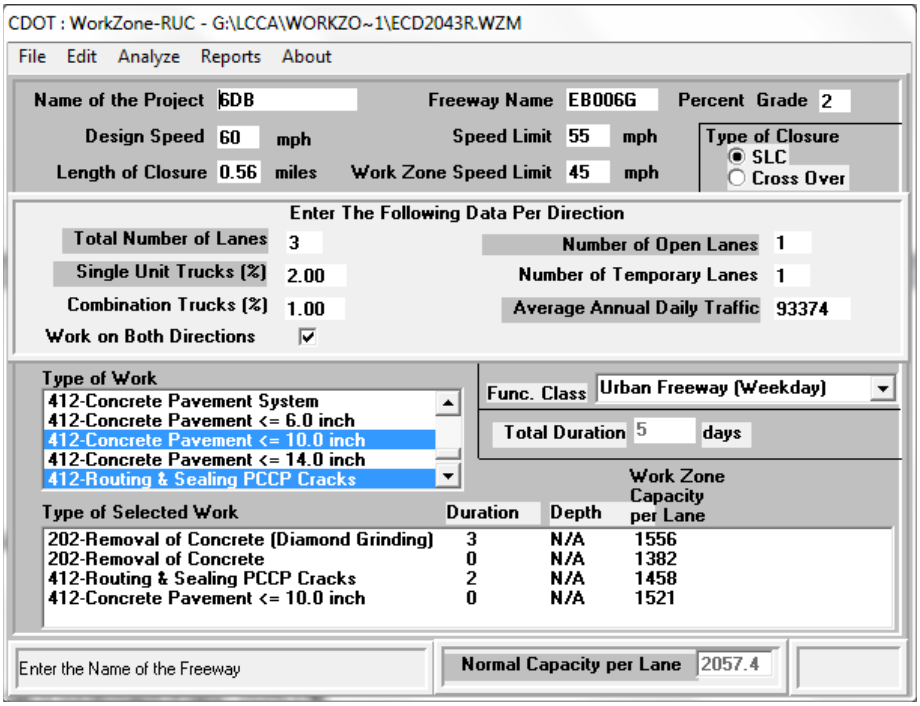


Eastbound 6th Avenue CD Road Rigid 2043



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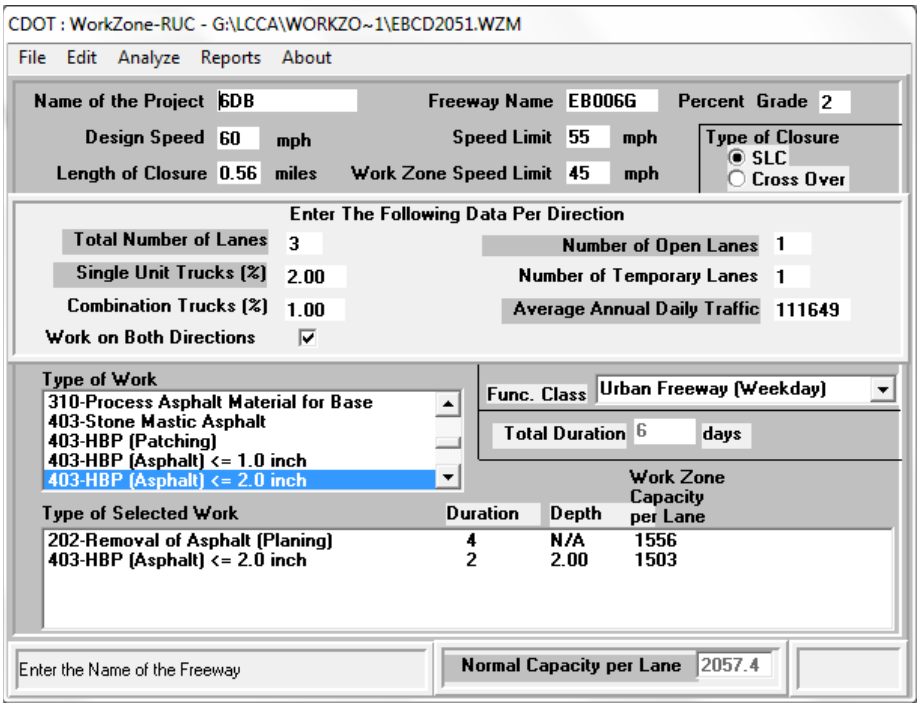


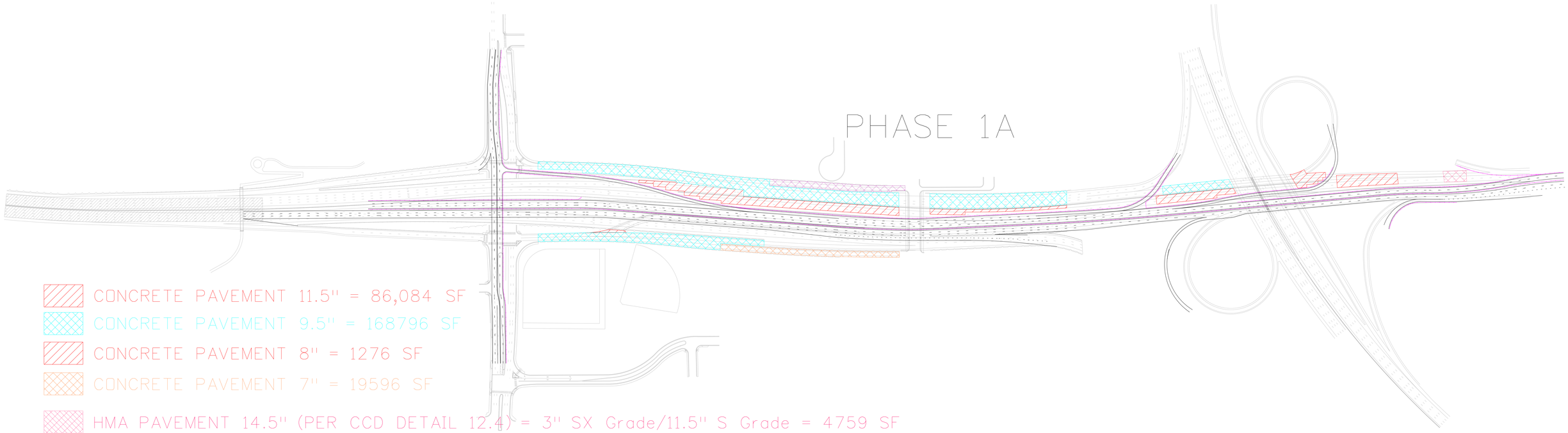
Costs Evaulated

SMA (Fibers) (Asphalt)	20,028 tons	(2-inch lift for 209,519 SQY = 20,028 tons)		
Min ($/ton)	$75.00	LCCA on 8/1/2012		
Most Likely ($/ton)	$85.00			
Max ($/ton)	$95.00			
2013 PDM (Figure 10.37, $/ton)	$76.63	Average Value Curve for Normalized Modified Asphalt - R6		
2011 Cost Data Book ($/ton)		Project	Quantity	
Est	$92.50	BR0252-047	5,380 tons	
Avg	$89.87			
Awarded	$82.75			
Est	$75.00	BRR600-297	10,394 tons	
Avg	$89.71			
Awarded	$91.34			
EEMAQ3 2011 ($/ton)	$88.00	FY 2011 Third Quarter Averages for Region 6		
2011 CDOT Cost Data Book	$92.85	Average 2011 unit cost for SMA (fibers), $ per ton		
HMA Grading S 100 PG 64-22	97,024 tons			
Min ($/ton)	$45.00	LCCA on 8/1/2012		
Most Likely ($/ton)	$55.00			
Max ($/ton)	$62.00			
2013 PDM (Figure 10.36, $/ton)	$41.25	Average Value Curve for Normalized Unmodified Asphalt - R6		
2011 Cost Data Book ($/ton)		Project	Quantity	
Est	$57.00	STA0072-010	20,299 tons	
Avg	$56.70			
Awarded	$57.40			
EEMA Q3 2011	$62.00	FY 2011 Third Quarter Averages for Regions 1,2,4, and 6		
2011 CDOT Cost Data Book	$52.56	Average 2011 unit cost for HMA Grading S 100 PG 64-22		
PCCP 7"	3,911 SY	LCCA on 8/1/2012	7	
Min	$30.00	$4.29	($/SY-in)	
Most Likely	$35.00	$5.00	($/SY-in)	
Max	$40.00	$5.71	($/SY-in)	
2013 PDM (Figure 10.35)	$35.35	Average Value Curve for 7" PCCP, $5.05 / SY-in		
EEMA July 2012		> 30,000 SY, price between $25 - $50 per SY		
PCCP 7.5"	4,313 SY	LCCA on 8/1/2012	7.5	
Min ($/SY)	$32.00	$4.27	($/SY-in)	
Most Likely ($/SY)	$37.00	$4.93	($/SY-in)	
Max ($/SY)	$42.00	$5.60	($/SY-in)	
2013 PDM (Figure 10.35)	$37.13	Average Value Curve for 7.5" PCCP, $4.95 / SY-in		
EEMA July 2012		> 30,000 SY, price between $25 - $50 per SY		

	PCCP 8.0"	4,229 SY	LCCA on 8/1/2012		8	
	Min	$35.00	$4.38	($/SY-in)		
	Most Likely	$40.00	$5.33	($/SY-in)		
	Max	$45.00	$6.00	($/SY-in)		
	2013 PDM	$39.77	Average Value Curve for PCCP, $4.97 / SY-in			
	2010 Cost Data Book		STU 0831-107, **19,533 SY**			
	Est	$32.00	$4.00	($/SY-in)		
	Avg	$33.36	$4.17	($/SY-in)		
	Awarded	$31.95	$3.99	($/SY-in)		
	EEMA July 2012		> 30,000 SY, price between $25 - $50 per SY			
	PCCP 8.5"	10,518 SY	LCCA on 8/1/2012		8.5	
	Min	$30.00	$3.53	($/SY-in)		
	Most Likely	$35.00	$4.12	($/SY-in)		
	Max	$40.00	$4.71	($/SY-in)		
	2013 PDM (Figure 10.35)	$35.17	Average Value Curve for PCCP, $4.14 / SY-in			
	2011 Cost Data Book		IM 392A-012, **14,002 SY**			
	Est	$30.00	$3.53	($/SY-in)		
	Avg	$37.12	$4.37	($/SY-in)		
	Awarded	$35.74	$4.20	($/SY-in)		
	EEMA July 2012		> 30,000 SY, price between $25 - $50 per SY			
	PCCP 9"	3,645 SY	LCCA on 8/1/2012		9	
	Min	$40.00	$4.44	($/SY-in)		
	Most Likely	$45.00	$5.00	($/SY-in)		
	Max	$50.00	$5.56	($/SY-in)		
	2013 PDM (Figure 10.35)	$46.09	Average Value Curve for PCCP, $5.12 / SY-in			
	2011 Cost Data Book		IM 392A-012, **21,629 SY**			
	Est	$35.00	$3.89	($/SY-in)		
	Avg	$39.84	$4.43	($/SY-in)		
	Awarded	$38.85	$4.32	($/SY-in)		
	EEMA July 2012		> 30,000 SY, price between $25 - $50 per SY			
	PCCP 9.5"	34,315 SY	LCCA on 8/1/2012		9.5	
	Min	$26.00	$2.74	($/SY-in)		
	Most Likely	$31.00	$3.26	($/SY-in)		
	Max	$36.00	$3.79	($/SY-in)		
	2013 PDM (Figure 10.35)	$30.99	Average Value Curve for PCCP, $3.26 / SY-in			
	2011 Cost Data Book		STA 1211-069, **977 SY**			
	Est	$45.00	$4.74	($/SY-in)		
	Avg	$46.63	$4.91	($/SY-in)		
	Awarded	$53.20	$5.60	($/SY-in)		
	EEMA July 2012		> 30,000 SY, price between $25 - $50 per SY			

PCCP 10.0"	23,762 SY	LCCA on 8/1/2012		10	
Min	$30.00	$3.00	($/SY-in)		
Most Likely	$35.00	$3.50	($/SY-in)		
Max	$40.00	$4.00	($/SY-in)		
2013 PDM (Figure 10.35)	$35.12	Average Value Curve for PCCP, $3.51 / SY-in			
2011 Cost Data Book		STU 2254-01000, **20,775 SY**			
Est	$45.00	$4.50	($/SY-in)		
Avg	$42.22	$4.22	($/SY-in)		
Awarded	$45.00	$4.50	($/SY-in)		
EEMA July 2012		> 30,000 SY, price between $25 - $50 per SY			
PCCP 10.5"	5,400 SY	LCCA on 8/1/2012		10.5	
Min	$45.00	$4.29	($/SY-in)		
Most Likely	$50.00	$4.76	($/SY-in)		
Max	$55.00	$5.24	($/SY-in)		
2013 PDM (Figure 10.35)	$49.69	Average Value Curve for PCCP, $4.73 / SY-in			
2011 Cost Data Book		NH C460-002, **69,699 SY**			
Est	$28.00	$2.67	($/SY-in)		
Avg	$38.09	$3.63	($/SY-in)		
Awarded	$31.50	$3.00	($/SY-in)		
EEMA July 2012		> 30,000 SY, price between $25 - $50 per SY			
PCCP 11"	16220 sy	LCCA on 8/1/2012		11	
Min	$37.00	$3.36	($/SY-in)		
Most Likely	$42.00	$3.82	($/SY-in)		
Max	$47.00	$4.27	($/SY-in)		
2013 PDM (Figure 10.35)	$41.72	Average Value Curve for PCCP, $3.79 / SY-in			
2011 Cost Data Book		FBR 1211-078, **94 SY**			
Est	$75.00	$6.82	($/SY-in)		
Avg	$67.53	$6.14	($/SY-in)		
Awarded	$60.67	$5.52	($/SY-in)		
EEMA July 2012		> 30,000 SY, price between $25 - $50 per SY			
PCCP 11.5"	63,429 SY	LCCA on 8/1/2012		11.5	
Min	$28.00	$2.43	($/SY-in)		
Most Likely	$33.00	$2.87	($/SY-in)		
Max	$38.00	$3.30	($/SY-in)		
2013 PDM (Figure 10.35)	$33.15	Average Value Curve for PCCP, $2.88 / SY-in			
EEMA July 2012		> 30,000 SY, price between $25 - $50 per SY			
PCCP 13.5"	35,333 SY	LCCA on 8/1/2012		13.5	
Min	$39.00	$2.89	($/SY-in)		
Most Likely	$44.00	$3.26	($/SY-in)		
Max	$49.00	$3.63	($/SY-in)		
2013 PDM (Figure 10.35)	$43.78	Average Value Curve for PCCP, $3.24 / SY-in			
2011 Cost Data Book		FBR 0761-209, **27,523 SY**			
Est	$50.00	$3.70	($/SY-in)		
Avg	$49.12	$3.64	($/SY-in)		
Awarded	$49.00	$3.63	($/SY-in)		
EEMA July 2012		> 30,000 SY, price between $25 - $50 per SY			

Removal of Asphalt Mat (Planing)	117,421 SY	LCCA on 8/1/2012	
Min	$1.00		
Most Likely	$1.50		
Max	$2.00		
2011 Cost Data Book			
Est	$1.50	BRR600-297, I-25 Bridge over South Platte, 67,510 SY	
Avg	$1.87		
Awarded	$1.72		
Est	$1.40	STA0361-095, Broomfield County, 200,805 SY	
Avg	$1.17		
Awarded	$0.80		
Est	$0.50	STA1121-069, 500' N. of 88th to 104th, 121,990 SY	
Avg	$1.14		
Awarded	$1.55		
Est	$2.00	NHR600-376, SH287 Federal to Laurel, 176,492 SY	
Avg	$1.73		
Awarded	$1.90		
Slab Replacement	380 SY	LCCA on 8/1/2012	
Min	$100.00		
Most Likely	$150.00		
Max	$200.00		
FY 2011 Project			
Est	$117.00	NH2872-018, US287 Rush Creek North, 1,972 SY	
Avg	$158.45		
Awarded	$135.00		
FY 2010 Project			
Est	$180.00	NH 287-157, SH287: Broomfield to Lafayette, 7,576 SY	
Avg	$135.20		
Awarded	$100.00		
Sawing and Sealing Joints	69,133 LF	(Combines Longitudinal and Transverse Joints)	
Min	$1.50	LCCA on 8/1/2012	
Most Likely	$1.75		
Max	$2.00		
FY 2011 Project			
Est	$1.40	NH2872-018, US287 Rush Creek North, 29,469 SY	
Avg	$2.13		
Awarded	$1.75		
FY 2010 Project			
Est	$2.00	STA083A-036, SH83: E-470 to Peoria, 60,000 SY	
Avg	$1.85		
Awarded	$1.60		
Grinding and Texturing Concrete	58,713 SY		
Min	$2.75	LCCA on 8/1/2012	
Most Likely	$3.25		
Max	$3.75		
FY 2011 Project			
Est	$6.25	NH2872-018, US287 Rush Creek North, 31,300 SY	
Avg	$3.42		
Awarded	$3.00		



CONCRETE PAVEMENT 11.5" = 86,084 SF

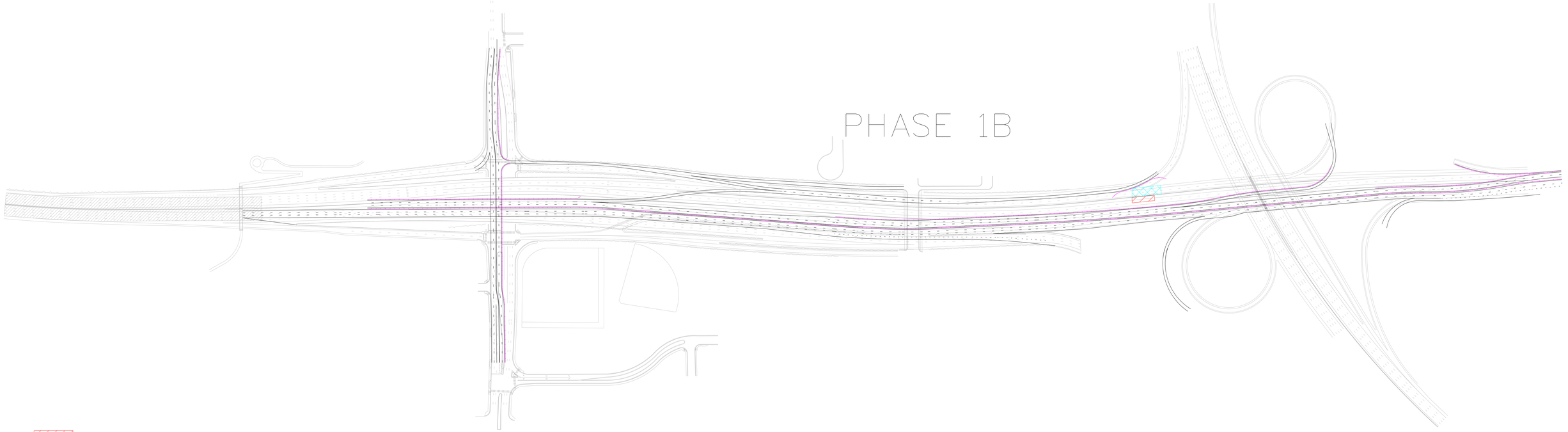
CONCRETE PAVEMENT 9.5" = 168796 SF

CONCRETE PAVEMENT 8" = 1276 SF

CONCRETE PAVEMENT 7" = 19596 SF

HMA PAVEMENT 14.5" (PER CCD DETAIL 12.4) = 3" SX Grade/11.5" S Grade = 4759 SF

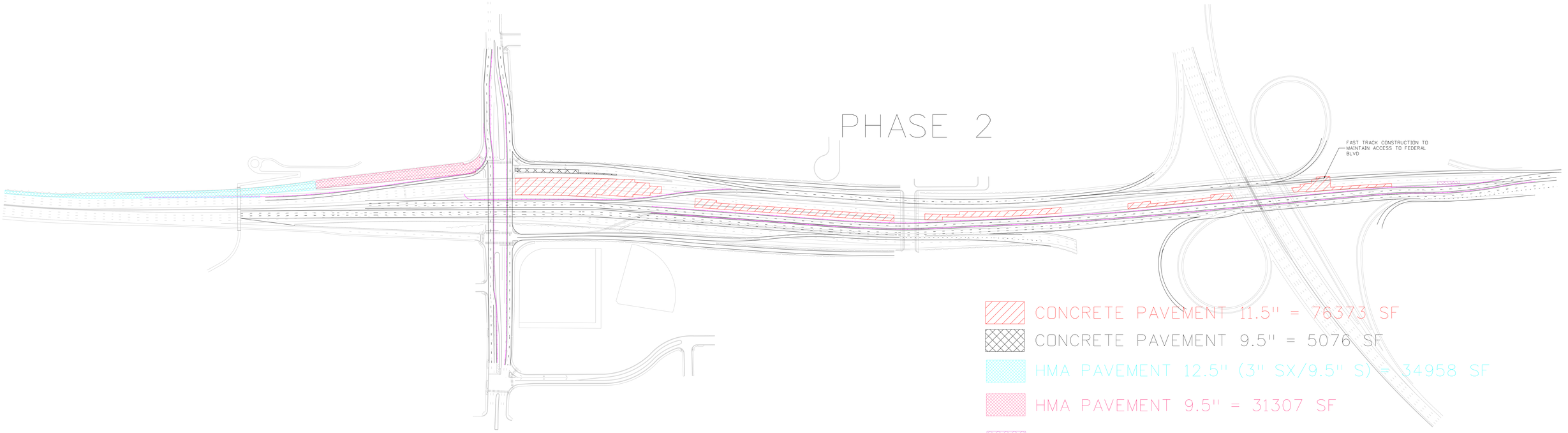
CONCRETE PAVEMENT 7.5" = 15579 SF



CONCRETE PAVEMENT 11.5" = 2367 SF

CONCRETE PAVEMENT 9.5" = 4864 SF

PHASE 2



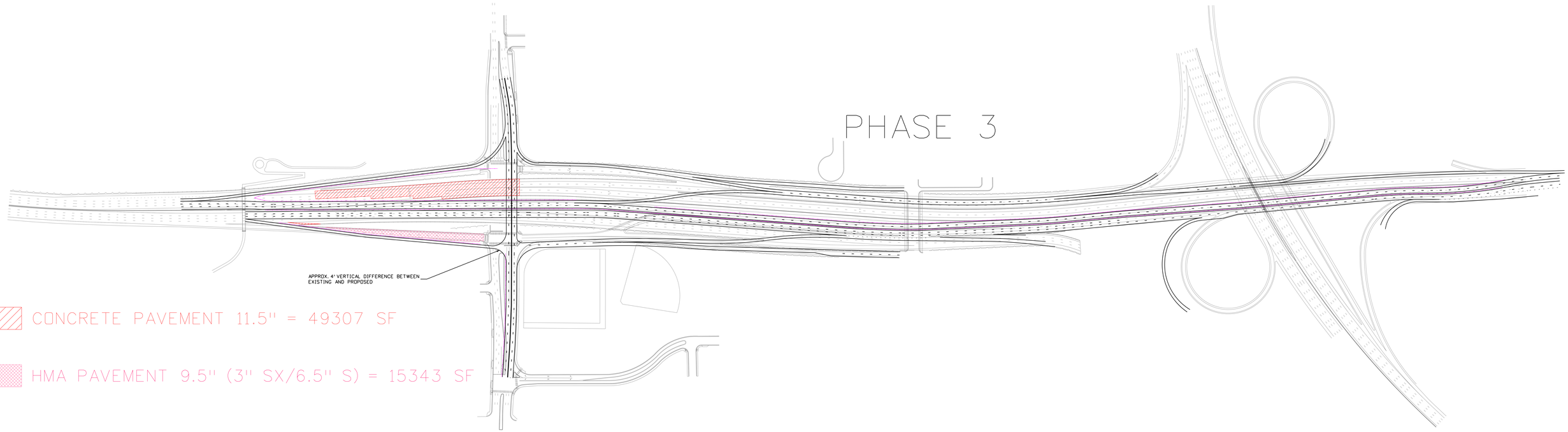
CONCRETE PAVEMENT 11.5" = 76373 SF

CONCRETE PAVEMENT 9.5" = 5076 SF

HMA PAVEMENT 12.5" (3" SX/9.5" S) = 34958 SF

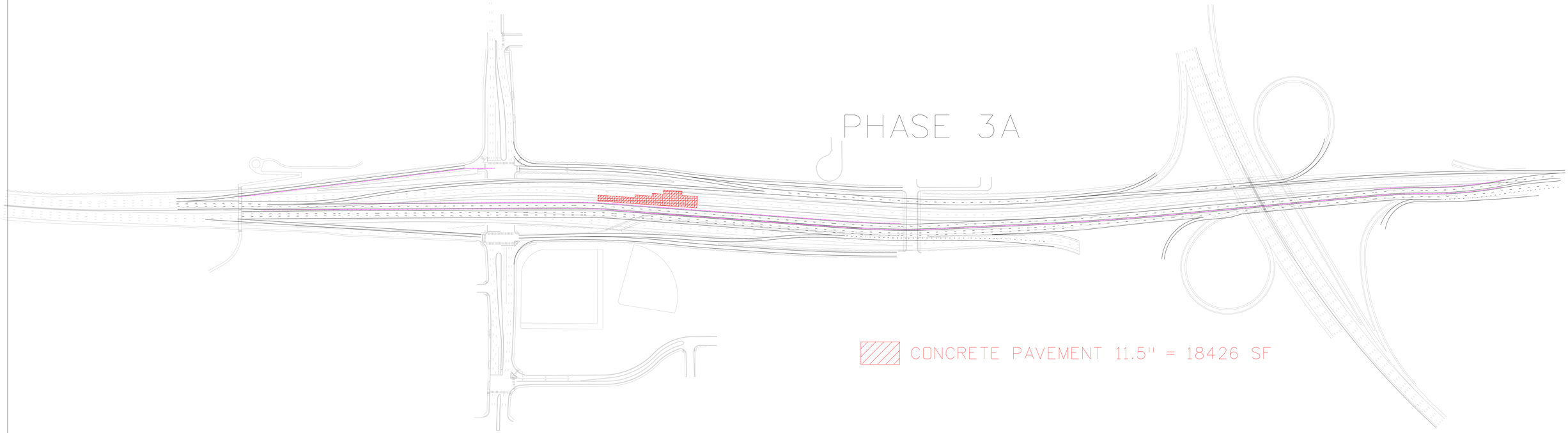
HMA PAVEMENT 9.5" = 31307 SF

CONCRETE PAVEMENT 14.5" = 1063 SF

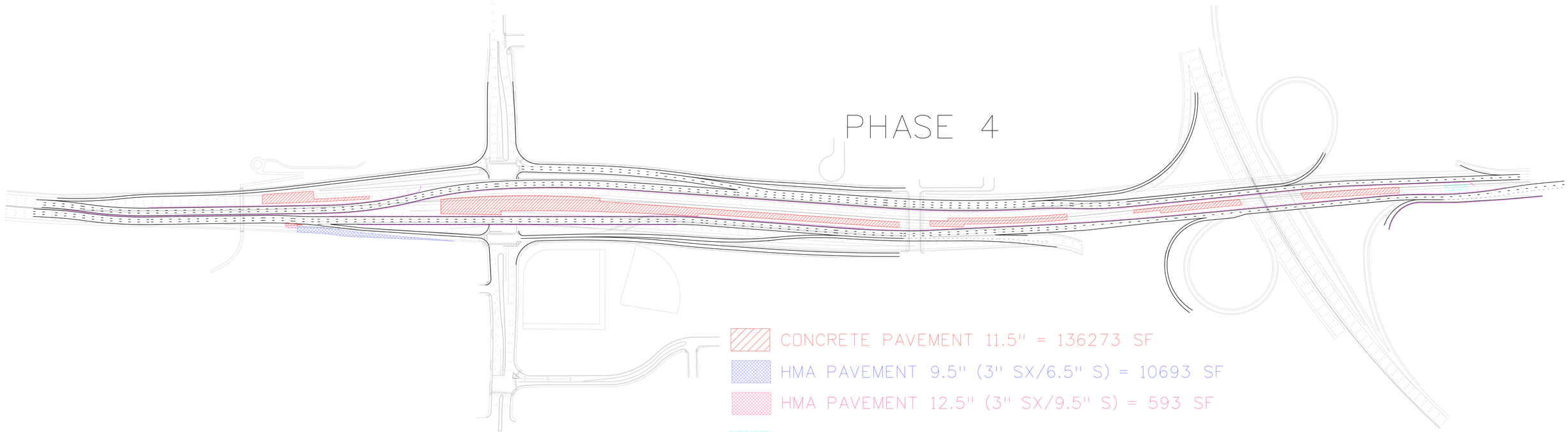


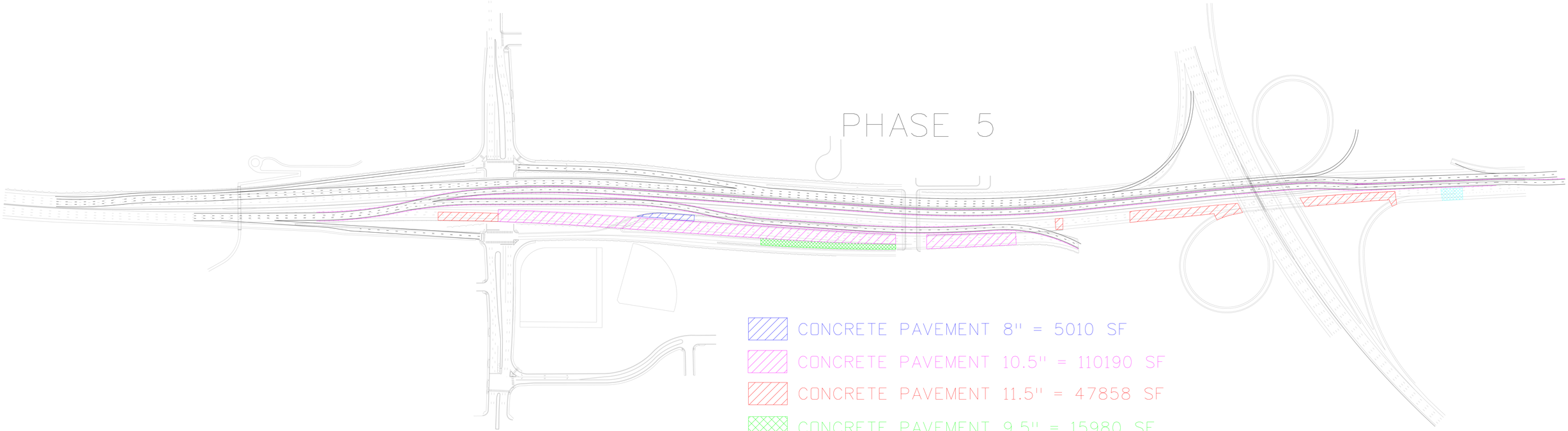
CONCRETE PAVEMENT 11.5" = 49307 SF

HMA PAVEMENT 9.5" (3" SX/6.5" S) = 15343 SF



CONCRETE PAVEMENT 11.5" = 18426 SF


PHASE 4
CONCRETE PAVEMENT 11.5" = 136273 SF
HMA PAVEMENT 9.5" (3" SX/6.5" S) = 10693 SF
HMA PAVEMENT 12.5" (3" SX/9.5" S) = 593 SF
HMA PAVEMENT 14.5" (PER CCD DETAIL 12.4) = 3" SX Grade/11.5" S Grade = 2225 SF



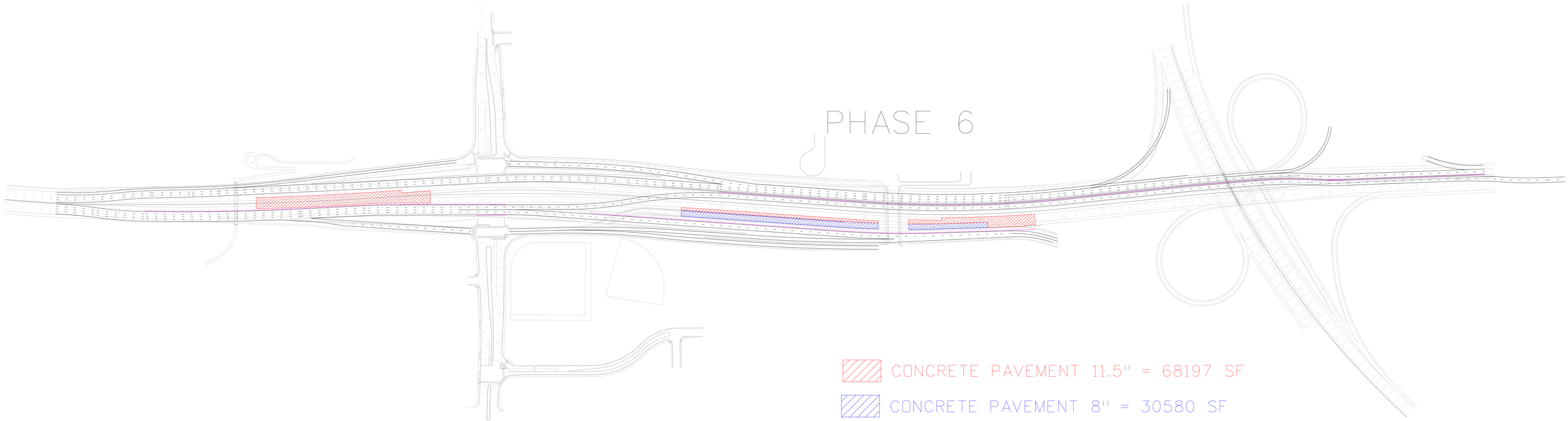
CONCRETE PAVEMENT 8" = 5010 SF

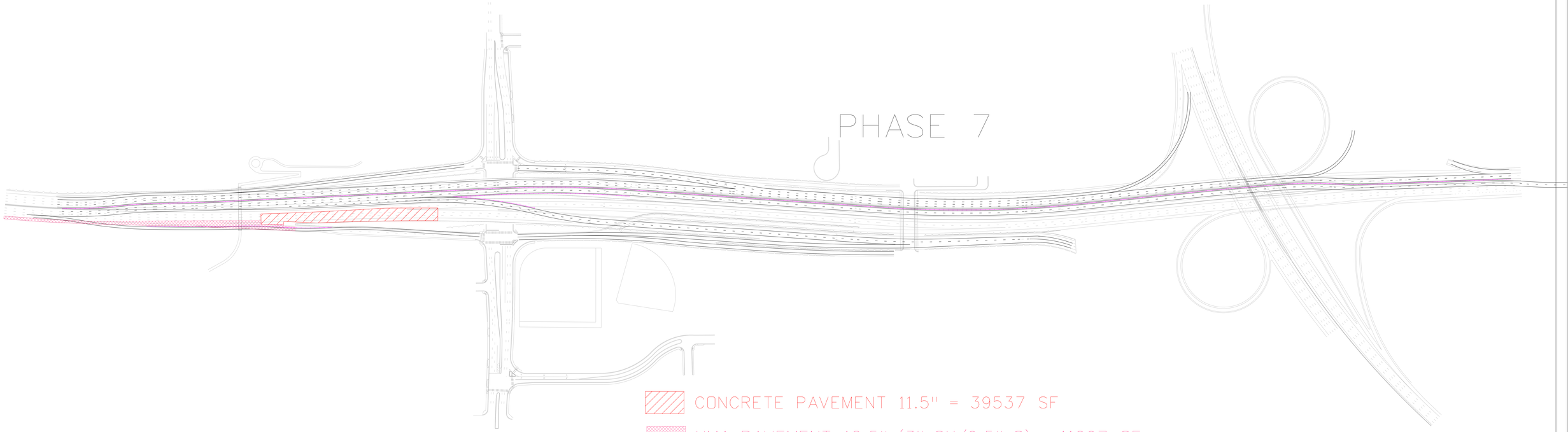
CONCRETE PAVEMENT 10.5" = 110190 SF

CONCRETE PAVEMENT 11.5" = 47858 SF

CONCRETE PAVEMENT 9.5" = 15980 SF

HMA PAVEMENT 14.5" (PER CCD DETAIL 12.4) = 3" SX Grade/11.5" S Grade = 4682 SF


PHASE 6
CONCRETE PAVEMENT 11.5'' = 68197 SF
CONCRETE PAVEMENT 8'' = 30580 SF



CONCRETE PAVEMENT 11.5" = 39537 SF

HMA PAVEMENT 12.5" (3" SX/9.5" S) = 11097 SF