Geotechnical Engineering Report for Pavement Thickness Design

Bennett Crossing Subdivision, Filing No. 1

Pearl Street, Station 10+00 to Station 27+36

Bennett, Colorado

Prepared For:

Gayeski Capital Equities, LLC
905 West 124th Avenue, Suite 200
Westminster, Colorado 80234
Attn: Mr. Larry Gayeski

Prepared By:

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CGG Project No. 23.22.145
September 19, 2023

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September 19, 2023

Gayeski Capital Equities, LLC
905 West 124th Avenue, Suite 200
Westminster, Colorado 80234

Attn: Mr. Larry Gayeski

Re: Geotechnical Engineering Report for Pavement Thickness Design
Bennett Crossing Subdivision, Filing No. 1
Pearl Street, Station 10+00 to Station 27+36
Bennett, Colorado
CGG Project No. 23.22.145

Cole Garner Geotechnical (CGG) has completed a geotechnical engineering investigation for pavement thickness design for a portion of Pearl Street associated with the subject development. This geotechnical summary should be used in conjunction with the entire report for design and/or construction purposes. It should be recognized that specific details were not included or fully developed in this section, and the report must be read in its entirety for a comprehensive understanding of the items contained herein. The section titled General Comments should be read for an understanding of the report limitations.

- **Subsurface Conditions:** At the time of our exploration the roadway was graded and had varying amounts of gravel surfacing over lean clay with varying amounts of sand. Clayey sand soils were also encountered. Groundwater was not encountered during drilling and the holes were backfilled upon completion of drilling for safety reasons. The soils encountered at the site classified as primarily as A-6 and A-7-6 soil types in accordance with the AASHTO classification system, with Group Indices ranging from 6 to 21. One sample of clayey sand classified as A-4 with a Group Index of 0. Other specific information regarding the lithology encountered is noted on the Boring Logs. ***These subgrade soils are similar or better than those encountered in our borings completed for the previous public roadways within the development.***

- **Subgrade Preparation:** At current moisture contents, the lean clay soils are low expansive. ***Therefore, no additional swell mitigation is required by the Standards.*** In accordance with the Standards, subgrade preparation should include scarifying the subgrade soils to a depth of 12 inches below the base of the lowest pavement section (below base course, if used), moisture conditioning, and recompaction. The subgrade soils will also need to be proof-rolled prior to paving.

- **Pavement Thickness:** Based on the design methods presented in the current Town of Bennett Standards (December 2018), the minimum pavement section thickness alternatives for the proposed public roadways are summarized below:

Traffic Area	Alternative	Pavement Section Thickness (Inches)			
		Asphalt Concrete Surface	Aggregate Base Course	Portland Cement Concrete	Total
Pearl Street Minor Commercial Collector $ESAL_{20}$=183,633	A	5	12	--	17
	B	5-½	9	--	14-½
	C	8	--	--	8
	D	--	--	6	6

Details regarding design methods and other recommendations are included in the report. Please do not hesitate to contact us if you have any questions concerning this report or any of our testing, inspection, design, and consulting services.

Sincerely,

Cole Garner Geotechnical

COLORADO REGISTERED PROFESSIONAL ENGINEER
ANDREW J. GARNER
34273
9/19/23

Andrew J. Garner, P.E.
Principal, COO

Copies to: Addressee (1 PDF copy)

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CGG Project No. 23.22.145
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INTRODUCTION

This report contains the results of our geotechnical engineering exploration for pavements thickness design for a portion of the public roadways associated with the subject development in Bennett, Colorado. The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil conditions
- Groundwater conditions
- Pavement structural sections
- Earthwork and soil remediation
- Drainage

The recommendations contained in this report are based upon the results of field and laboratory testing, engineering analyses, our experience with similar soil conditions and structures, and current Town of Bennett and CDOT requirements (herein referred to as the Standards).

We previously prepared a *Geotechnical Engineering Report for Pavement Thickness Design, Bennett Crossing, Filing No. 1,* that included Marketplace Drive and Cedar Street (CGG Project No. 18.22.103 dated August 3, 2018) and a February 19, 2019 addendum presenting an alternative thickness design for Cedar Street. ***Information from that report, and in particular the R-value test result presented in that report for A-7-6 soils, was utilized in preparing the recommendations herein.***

PROJECT INFORMATION AND SITE CONDITIONS

Construction will include the installation of some underground utilities and construction of curb/gutter and flatwork to pave Pearl Street from Highway 79 east approx. 1,736 linear feet. We presume the roadways will be surface with hot-mix asphalt over a layer of aggregate base course, however, a full-depth section may also be considered following the Town of Bennett Development Standards. At the time of our exploration, the roadway was gravel-surfaced. Some drainage improvements had already been installed in segments where adjacent construction was previously completed. The roadway was essentially near rough grade. If our understanding of the project, or assumptions above, is not accurate, or if you have additional useful information, please inform us as soon as possible.

SITE EXPLORATION PROCEDURES

The scope of the services performed for this project included site reconnaissance by a field engineer, a subsurface exploration program, laboratory testing and engineering analysis.

Field Exploration: Our scope of services included geotechnical exploration of the subsurface materials at seven locations on the site, designated as Boring Nos. 1 through 7, as shown on the Boring Location Diagram, Figure 1 included in Appendix A. The borings were drilled within the roadway alignment at a maximum spacing of 250 linear feet and advanced to depths ranging from approximately 5 to 10 feet below the proposed roadway surface.

Borings were advanced with a truck-mounted drilling rig utilizing 4-inch diameter, solid stem auger. A lithologic log of each boring was recorded by our field personnel during the drilling operations. At selected intervals, samples of the subsurface materials were obtained by driving modified California barrel samplers. Penetration resistance measurements were obtained by driving the sample barrel into the subsurface materials with a 140-pound automatic hammer (or manual hammer as noted) falling 30 inches. The penetration resistance value is a useful index to the consistency, relative density or hardness of the materials encountered.

Groundwater measurements were obtained in the borings during exploration and subsequently the borings were backfilled immediately thereafter for safety considerations.

Laboratory Testing: Samples retrieved during the field exploration were returned to the laboratory for observation by the project geotechnical engineer, and were visually-manually classified in general accordance with the Unified Soil Classification System described in Appendix C. and the AASHTO soil classification system At that time, an applicable laboratory-testing program was formulated to determine engineering properties of the subsurface materials. Following the completion of the laboratory testing, the field descriptions were confirmed or modified as necessary, and Boring Logs were prepared. These logs are presented in Appendix A.

Laboratory test results are presented in Appendix B. These results were used for the geotechnical engineering analyses and the development of foundation and earthwork recommendations. Laboratory tests were performed in general accordance with the applicable local or other accepted standards.

Selected soil samples were tested for the following engineering properties:

- Water content
- Dry density
- Swell/Consolidation potential
- R-value (Hveem Stabilometer)*
  * from previous study
- Grain size
- Plasticity Index
- Water-soluble sulfates

SUBSURFACE CONDITIONS

Typical Subsurface Profile: At the time of our exploration the roadway was graded and had varying amounts of gravel surfacing over lean clay with varying amounts of sand. Clayey sand soils were also encountered. Other specific information regarding the lithology encountered is noted on the Boring Logs.

Groundwater Conditions: Groundwater was not encountered during drilling and the borings were backfilled upon completion of drilling for safety reasons. Groundwater levels are dependent upon several factors including hydrologic conditions, type of site development, irrigation demands on or adjacent to the site, fluctuations in water features, seasonal and weather conditions.

Field and Laboratory Test Results: Field test results indicate that the clay soils typically range from stiff to very stiff in relative consistency. Samples of the underlying sands were loose in relative density.

Samples of the subgrade soils were submitted to the laboratory for classification testing including percent passing the #200 sieve and Atterberg Limits. Laboratory test results indicate that the subgrade materials are of low to moderate plasticity with Plasticity Indices (PI) ranging from 15 to 25. The soils encountered at the site predominantly classified as A-6 and A-7-6 soil types in accordance with the AASHTO classification system, with Group Indices ranging from 6 to 15 for the A-6 soils and 21 for the A-7-6 soils. One sample of clayey sand classified as A-4 soil type with a group index of 0. Water-soluble sulfate testing of select samples indicated negligible concentrations.

As required by the Standards, swell/expansion testing was conducted on select relatively undisturbed subgrade sample(s). The samples tested exhibited swell potential generally ranging from +0.3 to +1.3 percent when inundated under a surcharge load of 200 psf.

A sample of the poorest-quality A-7-6 soil (a group index of 30 from our previous study) was submitted for R-value testing in accordance with the Standards, results of which indicated an R-value reported as "less than 5" per ASTM. ***These clayey subgrade soils are considered to provide poor support for pavements.***

RECOMMENDATIONS FOR DESIGN AND CONSTRUCTION

Geotechnical Considerations: In our opinion, the site appears suitable for the proposed roadway construction as long as the recommendations included herein are incorporated into the design and construction aspects of the project. At current moisture contents, the native lean clay soils exhibited low expansive potential and will not require mitigation beyond typical subgrade preparation required by the Town of Bennett.

Pavement Design and Construction: Design of pavements for the public roadways has been performed in general accordance with the Town of Bennett *Roadway Design and Construction Standards,* dated 2018. These Standards are based in part on methods outlined in the *Guide for Design of Pavement Structures* by the American Association of State Highway and Transportation Officials (AASHTO) as adopted by CDOT.

- **Subgrade Solis:** Subgrade soils along the proposed alignments included lean clay soils, which at current moisture contents, exhibit low expansive potential. As outlined in the Standards, the pavement thickness design is based on the poorest-quality A-7-6 subgrade soils present along the proposed alignment. Results of R-value testing indicated a value "less than 5". A correlated Resilient Modulus (M_R) of 3,025 psi for the A-7-6 subgrade soils was used for design per the Standards.

- **Design Traffic Values:** Design traffic values, used to determine pavement thickness are defined as 18-kip equivalent daily load applications ($EDLA_{20}$) and 18-kip equivalent single axle loads ($ESAL_{20}$) based on a 20-year design, per the Standards. These values are based on roadway classification and design traffic values.

  We understand that proposed public roadway is classified as Minor Commercial Collector according to the Town of Bennett Standards. In order to determine the design $ESAL_{20}$ value appropriate for the roadway, we reviewed the October 25, 2022 ***Traffic Impact Study*** for the development (prepared by Aldridge Transportation Consultants, LLC). This report provides both AM and PM Peak Hour Volumes for the roadway for the year 2045 (included in Appendix D). Based on typical correlations, daily Average Daily Traffic (ADT) volumes are conservatively estimated to be 10 times the maximum peak hour traffic. Using ADT and CDOT projected traffic distributions for vehicle type and ESAL factors, total design $ESAL_{20}$ were be estimated as presented in Appendix D. A summary of the information obtained from this report and CDOT calculations is presented below:

Roadway	Maximum Peak Hour Volume (vehicles)	Correlated Average Daily Traffic, ADT (vehicles/day)	Correlated Flexible ESAL	Correlated Rigid ESAL
Cedar Street	275	2,750	183,663	241,621

- **Recommended Pavement Sections:** Using the correlated design M_R value and the appropriate $ESAL_{20}$ values outlined above, the required structural number (SN) for the proposed improvements was determined using methods outlined by the Standards. Other factors utilized for design included a drainage coefficient of 1.0, a reliability of 90 percent, a standard deviation of 0.44, and a serviceability loss of 2.0 (terminal serviceability of 2.5).

We understand that the Town of Bennett typically requires composite asphaltic concrete/aggregate base course sections for public roadways, unless approved by the Public Works director. Structural coefficients of 0.44 and 0.12 were used for each inch of asphaltic concrete and aggregate base course, respectively. The thickness calculations are included in Appendix D.

The following table summarizes the recommended pavement sections. Recommended pavement sections outlined below exceed the minimum pavement sections outlined in the Standards.

Traffic Area	Alternative	Pavement Section Thickness (Inches)			
		Asphalt Concrete Surface	Aggregate Base Course	Portland Cement Concrete	Total
Pearl Street Minor Commercial Collector $ESAL_{20}$=183,633	A	5	12	--	17
	B	5-½	9	--	14-½
	C*	8	--	--	8
	D	--	--	6**	6

* In our opinion, full-depth asphalt sections may be structurally equivalent, but may result in premature cracking of the sections. Typically, these cracks are longitudinal in nature and do not constitute structural failure of the pavement, but should be sealed right away.

**Town of Bennett default minimum Portland cement concrete thickness

- **Pavement Materials:** Materials and construction of pavements for the project should be in accordance with the requirements and specifications of the Town of Bennett and the Colorado Department of Transportation (CDOT). Materials should be submitted to the Town of Bennett for approval prior to use on the site.

  Aggregate Base Course (if used) should consist of a blend of sand and gravel that meets strict specifications for quality and gradation. Use of materials meeting Colorado Department of Transportation (CDOT) Class 5 or 6 specifications is recommended. In addition, the base course material should be moisture stable. Aggregate base course material should be tested to determine compliance with these specifications prior to importation to the site. Aggregate base course should be placed in lifts not exceeding 6 inches and compacted to a minimum of 95 percent of modified Proctor density (ASTM D1557), within a moisture content range of 2 percent below to 2 percent above optimum. Where base course thickness exceeds 6 inches, the material should be placed and compacted in 2 or more lifts of equal thickness.

Asphalt concrete should be composed of a mixture of aggregate, filler and additives (if required) and approved bituminous material. Asphalt concrete should be obtained from a Town of Bennett approved mix design stating the Hveem properties, optimum asphalt content, job mix formula (JMF), and recommended mixing and placing temperatures. Aggregate used in asphalt concrete should meet a particular gradation. Asphalt concrete should consist of Grading SX for the top lift and Grading S or SG for the lower lifts, as outlined in the Standards. Based on the climate of the region and the traffic volumes of the roadways, the use of performance-graded binder PG64-22 is recommended. Mix designs should be submitted prior to construction to verify their adequacy. Asphalt material should be placed in maximum 3-inch lifts and compacted within a range of 92 to 96 percent of the theoretical maximum (Rice) density (AASHTO T209).

Portland cement concrete (PCC) pavements, if used, should be obtained from an approved mix design conforming to CDOT Class P specifications. Concrete should be deposited by truck mixers or agitators and placed a maximum of 90 minutes from the time the water is added to the mix. Longitudinal and transverse joints should be provided as needed in concrete pavements for expansion/contraction and isolation. The location and extent of joints should be based upon the final pavement geometry. Sawed joints should be cut within 24 hours of concrete placement and should be a minimum depth of 25 percent of slab thickness plus 1/4 inch. All joints should be sealed to prevent entry of foreign material and doweled where necessary for load transfer. Where dowels cannot be used at joints accessible to wheel loads, pavement thickness should be increased by 25 percent at the joints and tapered to regular thickness in 5 feet.

Earthwork: The following presents recommendations for site preparation, excavation, subgrade preparation and placement of pavement subgrade soils on the project. Earthwork on the project should be observed and evaluated by the Geotechnical Engineer. The evaluation of earthwork should include observation and testing of engineered fill, subgrade preparation, and other geotechnical conditions exposed during the construction of the project.

- **Site Preparation:** Strip and remove any loose, soft, or dry soils or other deleterious materials from the roadway alignment. We estimate that the roadways are at or near rough construction grade. Any soils noted to be dry (below optimum), expansive, or otherwise unsuitable should be removed and replaced or recompacted as directed by the geotechnical engineer. Any areas to receive fill should be scarified to a minimum depth of 12 inches, moisture conditioned and recompacted.

- **Subgrade Preparation:** Subgrade soils along the proposed alignments included lean clay soils with low expansive potential. The subgrade should be carefully evaluated at the time of pavement construction for signs of disturbance or excessive rutting. If disturbance has occurred, pavement subgrade areas should be reworked, moisture conditioned, and properly compacted to the recommendations in this report immediately prior to paving.

Pavement areas should then be thoroughly proofrolled within 24 hours of placement of asphalt pavements. Particular attention should be paid to high traffic areas that were rutted and disturbed earlier and to areas where backfilled trenches are located. The proof roller shall be a pneumatic-tired vehicle with tire pressure of at least 100 psi capable of applying ground loads of not less than 18,000 pounds per axle, provided by the Contractor. Complete coverage of the proof roller will be required. Rollers shall be operated between two and six miles per hour. Areas where unsuitable conditions are located should be repaired by removing and replacing the materials with properly compacted fills (to include cement-treated subgrade sections).

All pavement areas should be moisture conditioned and properly compacted to the recommendations in this report immediately prior to paving. All subgrade soils should be scarified to a depth of 12 inches, moisture conditioned, and recompacted just prior to paving.

- **Compaction, Testing, and Monitoring Requirements:** Over-excavated fill, scarified subgrade, and pavement subgrade soils should be placed and compacted in horizontal lifts, using equipment and procedures that will produce recommended moisture contents and densities throughout the lift. On-site soils should be compacted using the following criteria:

Item	Description
Fill Lift Thickness	8 inches or less in loose thickness, depending on equipment
Compaction Requirements	95% of standard Proctor maximum dry density (AASHTO T99)
Moisture Content	0 to +2% above the optimum moisture content

Observation and compaction testing should be performed by the Geotechnical Engineer during subgrade preparation. Should the results of the in-place density tests indicate the specified moisture or compaction limits have not been met, the area represented by the test should be reworked and retested as required until the specified moisture and compaction requirements are achieved.

Moisture conditioned fill and subgrade materials should not be allowed to dry out. Construction traffic over the completed subgrade should be avoided to the extent practical. A loss of moisture or overcompaction could result in an increase in the materials expansive potential. Subsequent wetting of these materials could result in undesirable movement.

Additional Recommendations:

- **Concrete Corrosion Protection:** Water soluble sulfate testing indicated negligible concentrations. ACI rates the measured concentrations as being a low risk of concrete sulfate attack. Therefore, Type II Portland cement, or equivalent, should be used for concrete on and below grade. Project concrete should be designed for moderate risk of attack in accordance with the provisions of the *ACI Design Manual*, Section 318, Chapter 4.

- **Drainage and Landscaping:** All grades should be adjusted to provide positive drainage away from the roadways during construction. Ponding of water on the subgrade should be avoided where possible. After roadway construction is completed, it is imperative that backfill be placed against the back of the curb (if present) to ensure that water does not pond behind curbs. Grades should be established that direct surface water away from or onto pavements and these grades should be maintained throughout the life of the development. Water permitted to pond near or adjacent to the perimeter of the roadway (either during or post-construction) can result in excessive distress.

  Landscaping irrigation adjacent to the roadways should be limited to only the amount needed to establish vegetation and sustain growth. Irrigation systems should be reviewed frequently to fix leaks and minimize over-spray.

GENERAL COMMENTS AND LIMITATIONS

CGG should be retained to review the final design plans and specifications so comments can be made regarding interpretation and implementation of our geotechnical recommendations in the design and specifications. CGG should also be retained to provide testing and observation during the over-excavation, subgrade preparation, and other construction phases of the project.

The analysis and recommendations presented in this report are based upon the data obtained from the borings performed at the indicated locations and from other information discussed in this report. This report does not reflect variations that may occur between borings, across the site, or due to the modifying effects of weather. The nature and extent of such variations may not become evident until during or after construction. If variations appear, we should be immediately notified so that further evaluation and supplemental recommendations can be provided.

The scope of services for this project does not include, either specifically or by implication, any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

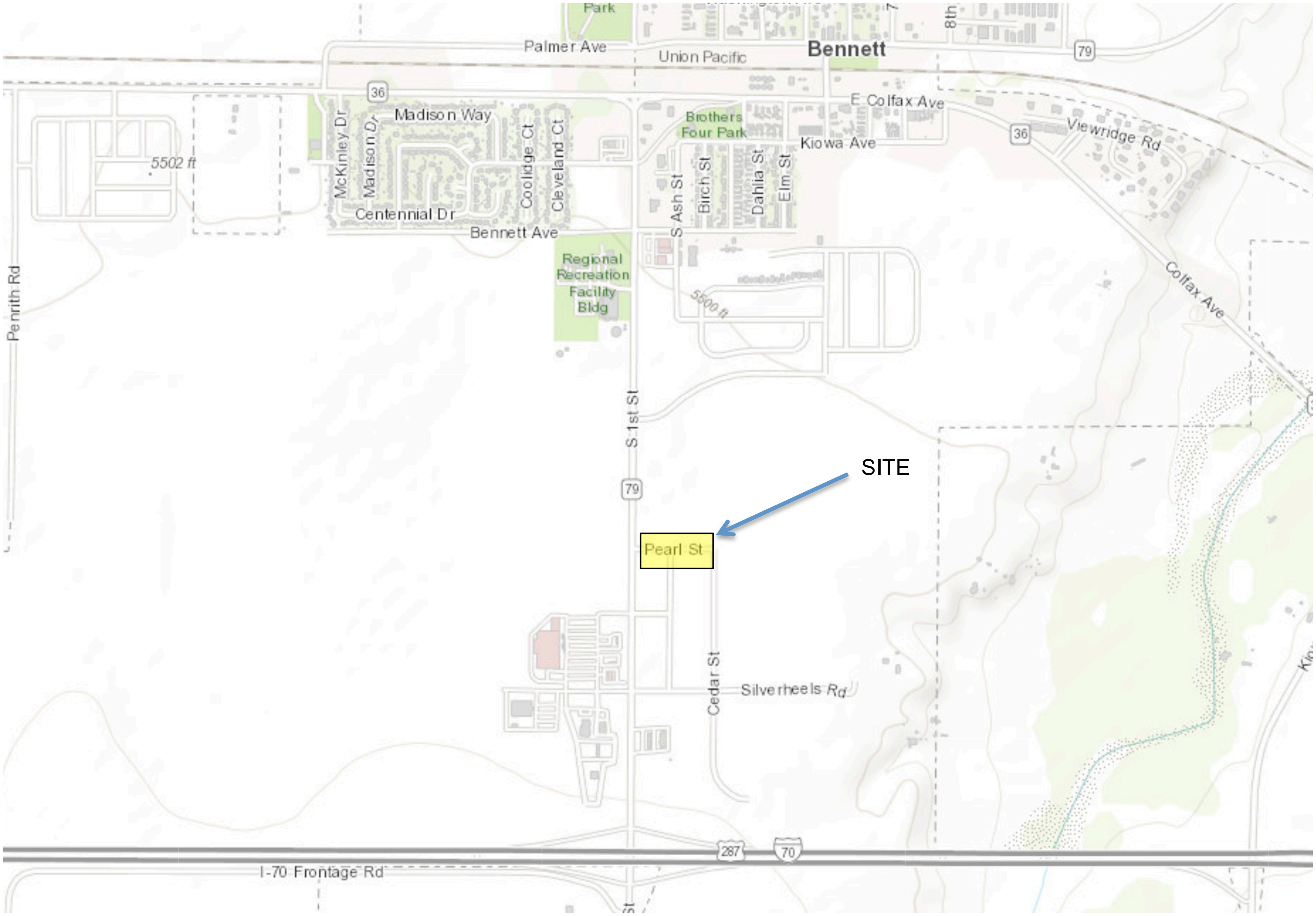
This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, express or implied, are intended or made. Site safety, excavation support, and dewatering requirements are the responsibility of others. In the event that changes are planned in the nature, design, or location of the project as outlined in this report, the conclusions and recommendations contained in this report shall not be considered valid unless CGG reviews the changes, and either verifies or modifies the conclusions of this report in writing.

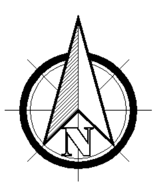
APPENDIX A

VICINITY MAP

FIGURE 1 - BORING LOCATION DIAGRAM

LOGS OF BORINGS





SITE VICINITY MAP
PEARL ST BENNETT CROSSING, FILING 1
BENNETT, COLORADO
CCG PROJECT NO. 23.22.145

Cole Garner Geotechnical
1070 W. 124th Ave., Suite 300
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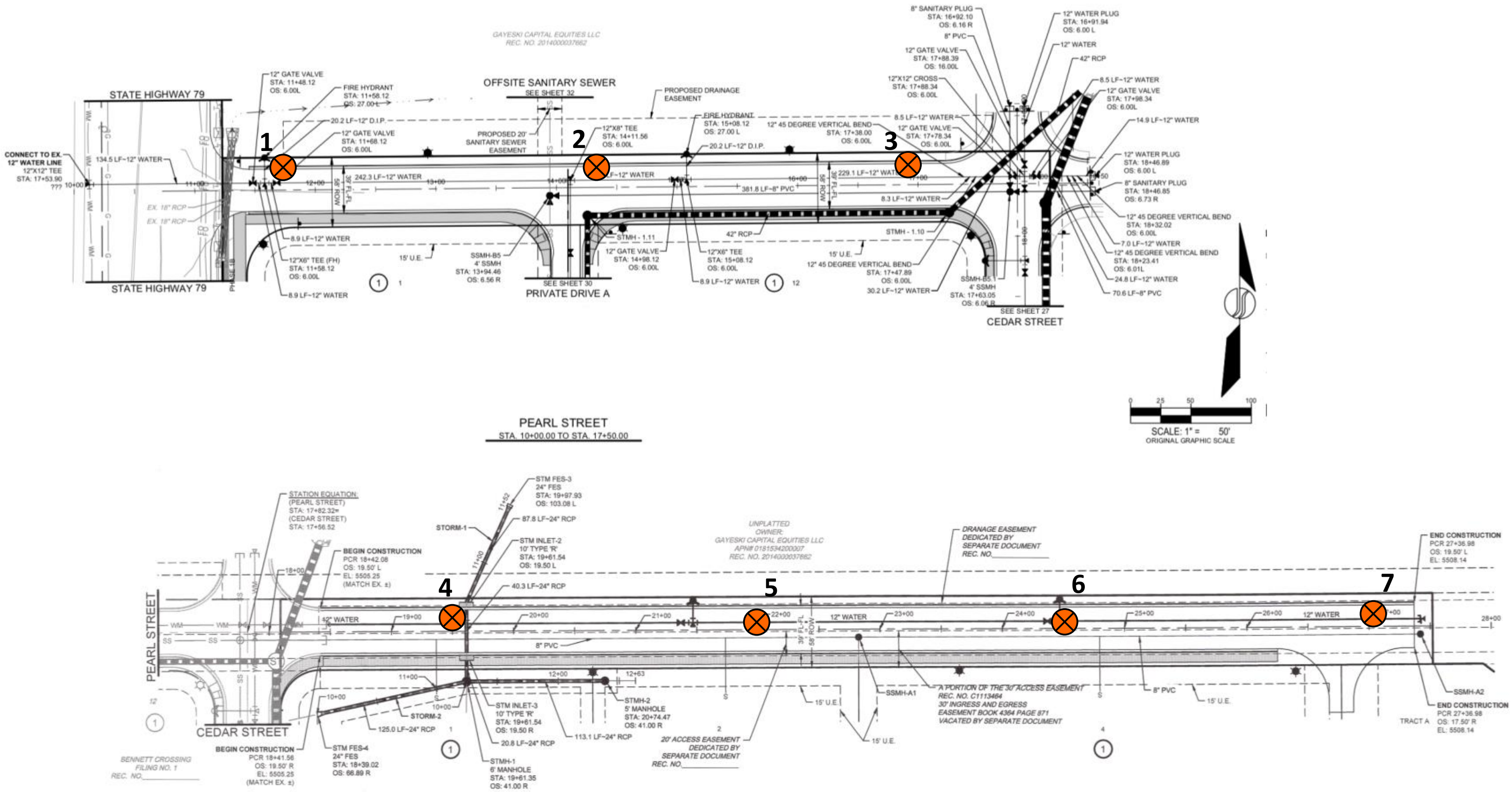

1 APPROXIMATE BORING LOCATIONS

FIGURE 1 - BORING LOCATION DIAGRAM
PEARL STREET – HWY 79 TO ADAMS ST
BENNETT CROSSING
BENNETT, COLORADO
CGG PROJECT NO. 23.22.145

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Cole Garner Geotechnical
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Westminster, CO 80234

BORING NUMBER 1

CLIENT Gayeski Capital Equities, LLC
PROJECT NAME Bennett Crossing - Pearl Street Pavement Design
PROJECT NUMBER 23.22.145
PROJECT LOCATION CO Hwy 79 to Adams Street
DATE STARTED 8/31/23 **COMPLETED** 8/31/23
GROUND SURFACE ELEV. Not Provided **PROPOSED ELEV.** Not Provided
DRILLING CONTRACTOR Vine Laboratories
SURFACE CONDITIONS Road Base
DRILLING METHOD CME-75 / Solid Stem Auger
GROUND WATER LEVELS:
HAMMER TYPE Automatic
DURING DRILLING None
LOGGED BY JL **CHECKED BY** AG
AFTER DRILLING Backfilled - 8/31/23

GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	USCS SYMBOL	SAMPLE TYPE	RECOVERY %	PENETRATION blows/in	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	SWELL-CONSOL /SURCHARGE LOAD, %psf
	SANDY LEAN CLAY, brown, moist, stiff to very stiff	0.0							
		2.5	CL	CB	100	11 / 12	14.4	114	+0.6/200
		5.0	CL	CB	100	22 / 12	17.5	113	
8	**CLAYEY TO SILTY SAND**, fine- to medium-grained, brown, dry to moist, loose	7.5							
10		10.0	SC	CB	100	14 / 12	4.9	114	

Approximate bottom of borehole at 10.0 feet.

Cole Garner Geotechnical
1070 W 124th Ave, Suite 300
Westminster, CO 80234

BORING NUMBER 2

CLIENT Gayeski Capital Equities, LLC
PROJECT NAME Bennett Crossing - Pearl Street Pavement Design
PROJECT NUMBER 23.22.145
PROJECT LOCATION CO Hwy 79 to Adams Street
DATE STARTED 8/31/23 **COMPLETED** 8/31/23
GROUND SURFACE ELEV. Not Provided **PROPOSED ELEV.** Not Provided
DRILLING CONTRACTOR Vine Laboratories
SURFACE CONDITIONS Road Base
DRILLING METHOD CME-75 / Solid Stem Auger
GROUND WATER LEVELS:
HAMMER TYPE Automatic
▽ **DURING DRILLING** None
LOGGED BY JL **CHECKED BY** AG
▼ **AFTER DRILLING** Backfilled - 8/31/23

GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	USCS SYMBOL	SAMPLE TYPE	RECOVERY %	PENETRATION blows/in	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	SWELL-CONSOL /SURCHARGE LOAD, %psf
	LEAN CLAY with SAND, brown to olive, moist, stiff to very stiff	0.0							
		2.5	CL	CB	100	23 / 12	15.6	117	
			CL	CB	100	18 / 12	15.4	123	
	5	5.0							

Approximate bottom of borehole at 5.0 feet.

BORING NUMBER 3

Cole Garner Geotechnical
1070 W 124th Ave, Suite 300
Westminster, CO 80234

CLIENT Gayeski Capital Equities, LLC

PROJECT NAME Bennett Crossing - Pearl Street Pavement Design

PROJECT NUMBER 23.22.145

PROJECT LOCATION CO Hwy 79 to Adams Street

DATE STARTED 8/31/23 **COMPLETED** 8/31/23

GROUND SURFACE ELEV. Not Provided **PROPOSED ELEV.** Not Provided

DRILLING CONTRACTOR Vine Laboratories

SURFACE CONDITIONS Road Base

DRILLING METHOD CME-75 / Solid Stem Auger

GROUND WATER LEVELS:

HAMMER TYPE Automatic

DURING DRILLING None

LOGGED BY JL **CHECKED BY** AG

AFTER DRILLING Backfilled - 8/31/23

GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	USCS SYMBOL	SAMPLE TYPE	RECOVERY %	PENETRATION blows/in	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	SWELL-CONSOL /SURCHARGE LOAD, %psf
	SANDY LEAN CLAY, brown, moist, stiff to very stiff	0.0							
		2.5	CL	CB	100	18 / 12	15.1	115	+0.9/200
		5.0	CL	CB	100	30 / 12	15.8	123	
		7.5							
8	**CLAYEY SAND**, fine- to medium-grained, brown, dry to moist, loose								
10		10.0	SC	CB	100	10 / 12	5.4	117	

Approximate bottom of borehole at 10.0 feet.

BORING NUMBER 4

Cole Garner Geotechnical
1070 W 124th Ave, Suite 300
Westminster, CO 80234

CLIENT Gayeski Capital Equities, LLC
PROJECT NAME Bennett Crossing - Pearl Street Pavement Design
PROJECT NUMBER 23.22.145
PROJECT LOCATION CO Hwy 79 to Adams Street
DATE STARTED 8/31/23 **COMPLETED** 8/31/23
GROUND SURFACE ELEV. Not Provided **PROPOSED ELEV.** Not Provided
DRILLING CONTRACTOR Vine Laboratories
SURFACE CONDITIONS Road Base
DRILLING METHOD CME-75 / Solid Stem Auger
GROUND WATER LEVELS:
HAMMER TYPE Automatic
DURING DRILLING None
LOGGED BY JL **CHECKED BY** AG
AFTER DRILLING Backfilled - 8/31/23

GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	USCS SYMBOL	SAMPLE TYPE	RECOVERY %	PENETRATION blows/in	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	SWELL-CONSOL /SURCHARGE LOAD, %psf
	SANDY LEAN CLAY, brown, moist, stiff	0.0							
		2.5	CL	CB	100	14 / 12	15.9	118	+0.3/200
3	**LEAN CLAY with SAND**, brown, iron-stained, moist, stiff								
5		5.0	CL	CB	100	18 / 12	19.8	106	+0.6/500

Approximate bottom of borehole at 5.0 feet.

Cole Garner Geotechnical
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Westminster, CO 80234

BORING NUMBER 5

CLIENT Gayeski Capital Equities, LLC
PROJECT NAME Bennett Crossing - Pearl Street Pavement Design
PROJECT NUMBER 23.22.145
PROJECT LOCATION CO Hwy 79 to Adams Street
DATE STARTED 8/31/23 **COMPLETED** 8/31/23
GROUND SURFACE ELEV. Not Provided **PROPOSED ELEV.** Not Provided
DRILLING CONTRACTOR Vine Laboratories
SURFACE CONDITIONS Road Base
DRILLING METHOD CME-75 / Solid Stem Auger
GROUND WATER LEVELS:
HAMMER TYPE Automatic
DURING DRILLING None
LOGGED BY JL **CHECKED BY** AG
AFTER DRILLING Backfilled - 8/31/23

GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	USCS SYMBOL	SAMPLE TYPE	RECOVERY %	PENETRATION blows/in	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	SWELL-CONSOL /SURCHARGE LOAD, %psf
	LEAN CLAY with SAND, brown, dry to moist, stiff to very stiff	0.0							
		2.5	CL	CB	100	27 / 12	9.7	116	
	5	5.0	CL	CB	100	17 / 12	13.9	117	

Approximate bottom of borehole at 5.0 feet.

Cole Garner Geotechnical
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BORING NUMBER 6

CLIENT Gayeski Capital Equities, LLC
PROJECT NAME Bennett Crossing - Pearl Street Pavement Design
PROJECT NUMBER 23.22.145
PROJECT LOCATION CO Hwy 79 to Adams Street
DATE STARTED 8/31/23 **COMPLETED** 8/31/23
GROUND SURFACE ELEV. Not Provided **PROPOSED ELEV.** Not Provided
DRILLING CONTRACTOR Vine Laboratories
SURFACE CONDITIONS Road Base
DRILLING METHOD CME-75 / Solid Stem Auger
GROUND WATER LEVELS:
HAMMER TYPE Automatic
DURING DRILLING None
LOGGED BY JL **CHECKED BY** AG
AFTER DRILLING Backfilled - 8/31/23

GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	USCS SYMBOL	SAMPLE TYPE	RECOVERY %	PENETRATION blows/in	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	SWELL-CONSOL /SURCHARGE LOAD, %psf
	CLAYEY SAND to SANDY LEAN CLAY, brown, dry to moist, stiff to very stiff	0.0							
		2.5	SC	CB	100	14 / 12	8.8	121	+1.3/200
		5.0	CL	CB	100	22 / 12	15.9	117	
7	**SANDY LEAN CLAY**, light brown, dark brown, moist, hard	7.5							
10		10.0	CL	CB	100	43 / 12	10.9	128	

Approximate bottom of borehole at 10.0 feet.

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BORING NUMBER 7

CLIENT Gayeski Capital Equities, LLC
PROJECT NAME Bennett Crossing - Pearl Street Pavement Design
PROJECT NUMBER 23.22.145
PROJECT LOCATION CO Hwy 79 to Adams Street
DATE STARTED 8/31/23 **COMPLETED** 8/31/23
GROUND SURFACE ELEV. Not Provided **PROPOSED ELEV.** Not Provided
DRILLING CONTRACTOR Vine Laboratories
SURFACE CONDITIONS Road Base
DRILLING METHOD CME-75 / Solid Stem Auger
GROUND WATER LEVELS:
HAMMER TYPE Automatic
DURING DRILLING None
LOGGED BY JL **CHECKED BY** AG
AFTER DRILLING Backfilled - 8/31/23

GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	USCS SYMBOL	SAMPLE TYPE	RECOVERY %	PENETRATION blows/in	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	SWELL-CONSOL /SURCHARGE LOAD, %psf
	LEAN CLAY with SAND, brown to olive, moist, very stiff	0.0							
		2.5	CL	CB	100	24 / 12	15.0	117	
		5.0	CL	CB	100	23 / 12	14.1	119	
5	Approximate bottom of borehole at 5.0 feet.								

APPENDIX B

LABORATORY TEST RESULTS

FIGURE 2 - SOIL SUBGRADE DIAGRAM

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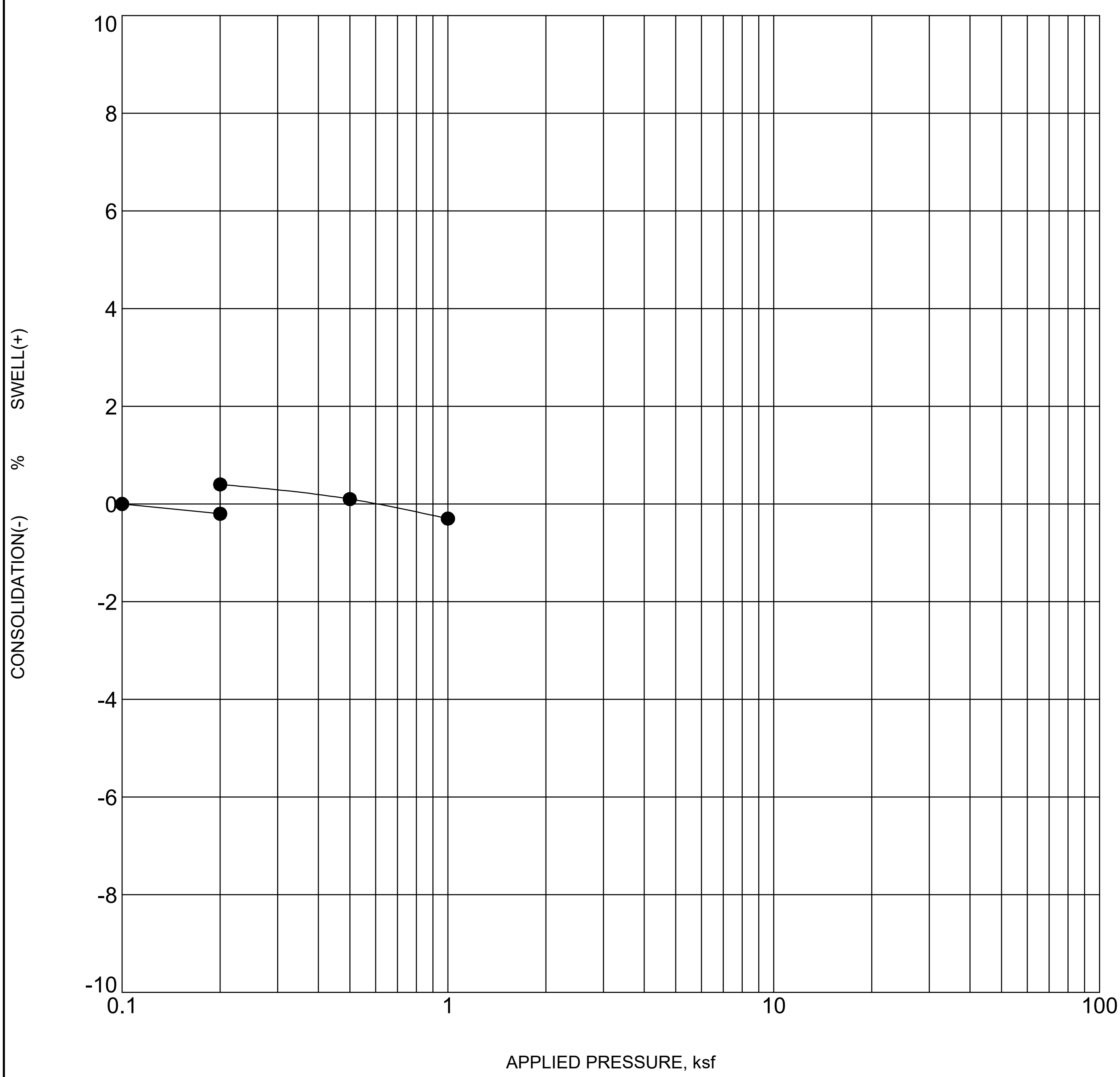
SWELL/CONSOLIDATION TEST

CLIENT Gayeski Capital Equities, LLC
PROJECT NAME Bennett Crossing - Pearl Street Pavement Design
PROJECT NUMBER 23.22.145
PROJECT LOCATION CO Hwy 79 to Adams Street



BOREHOLE	DEPTH	Classification	γ_d	MC%
● 1	2.0	SANDY LEAN CLAY(CL)	114	14

Note: Water Added to Sample at psf. **Date:**

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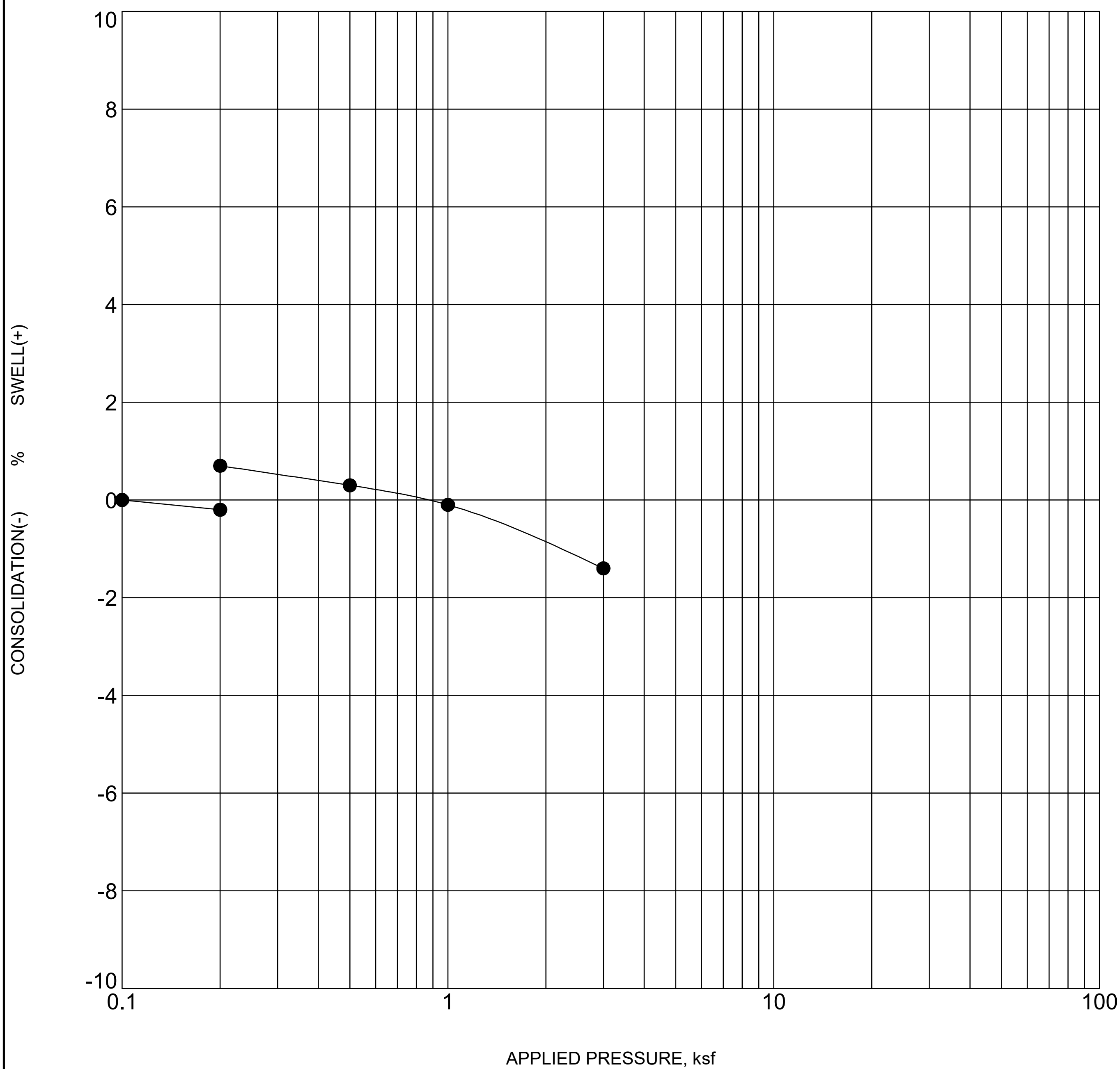
SWELL/CONSOLIDATION TEST

CLIENT Gayeski Capital Equities, LLC

PROJECT NAME Bennett Crossing - Pearl Street Pavement Design

PROJECT NUMBER 23.22.145

PROJECT LOCATION CO Hwy 79 to Adams Street



BOREHOLE	DEPTH	Classification	γ_d	MC%
● **3**	**2.0**	**SANDY LEAN CLAY(CL)**	**115**	**15**

Note: Water Added to Sample at psf.

Date:

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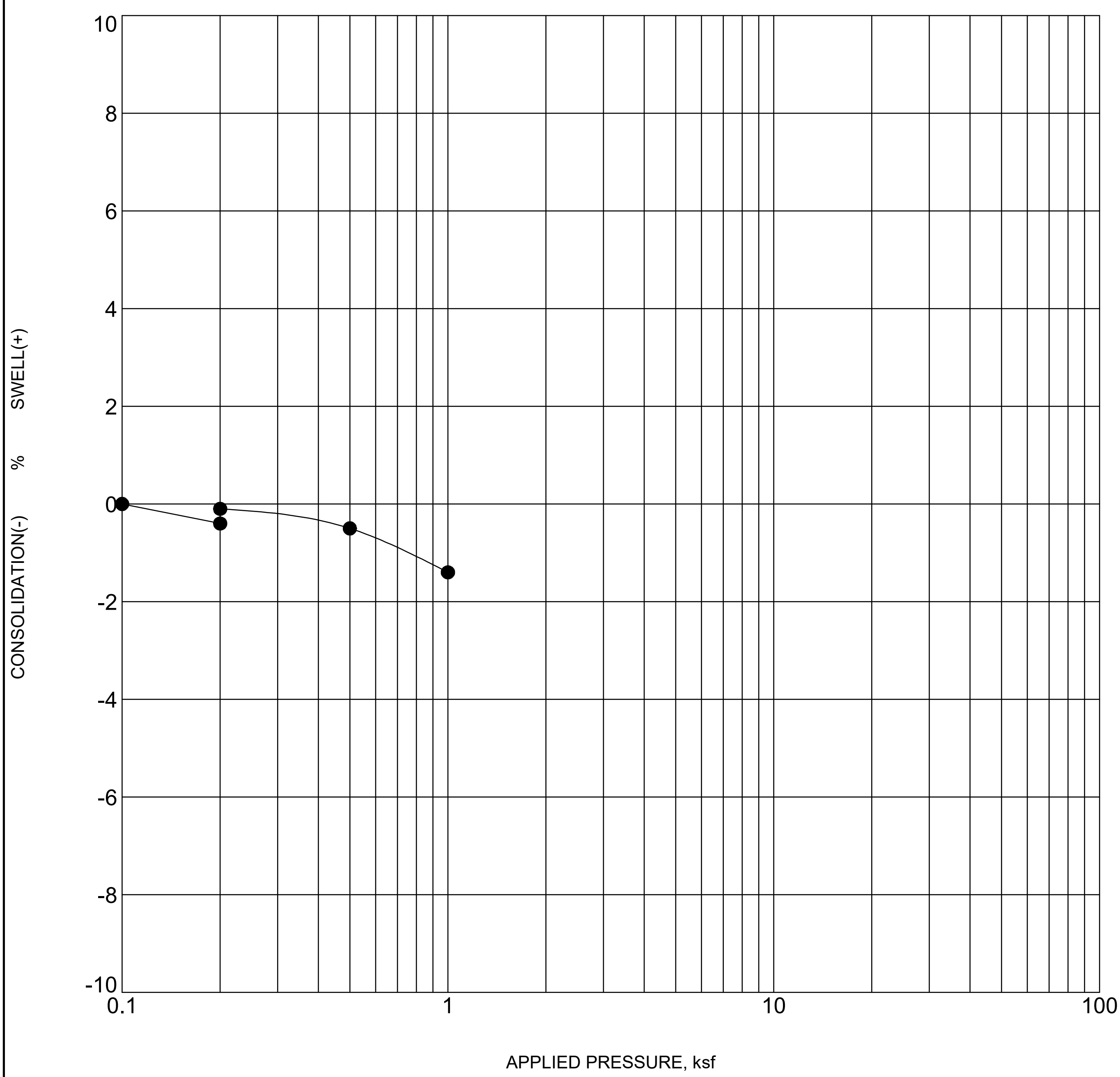
Westminster, CO 80234

SWELL/CONSOLIDATION TEST

CLIENT Gayeski Capital Equities, LLC
PROJECT NAME Bennett Crossing - Pearl Street Pavement Design
PROJECT NUMBER 23.22.145
PROJECT LOCATION CO Hwy 79 to Adams Street



BOREHOLE	DEPTH	Classification	γ_d	MC%
● 4	2.0	**SANDY LEAN CLAY(CL)**	118	16

Note: Water Added to Sample at psf. **Date:**

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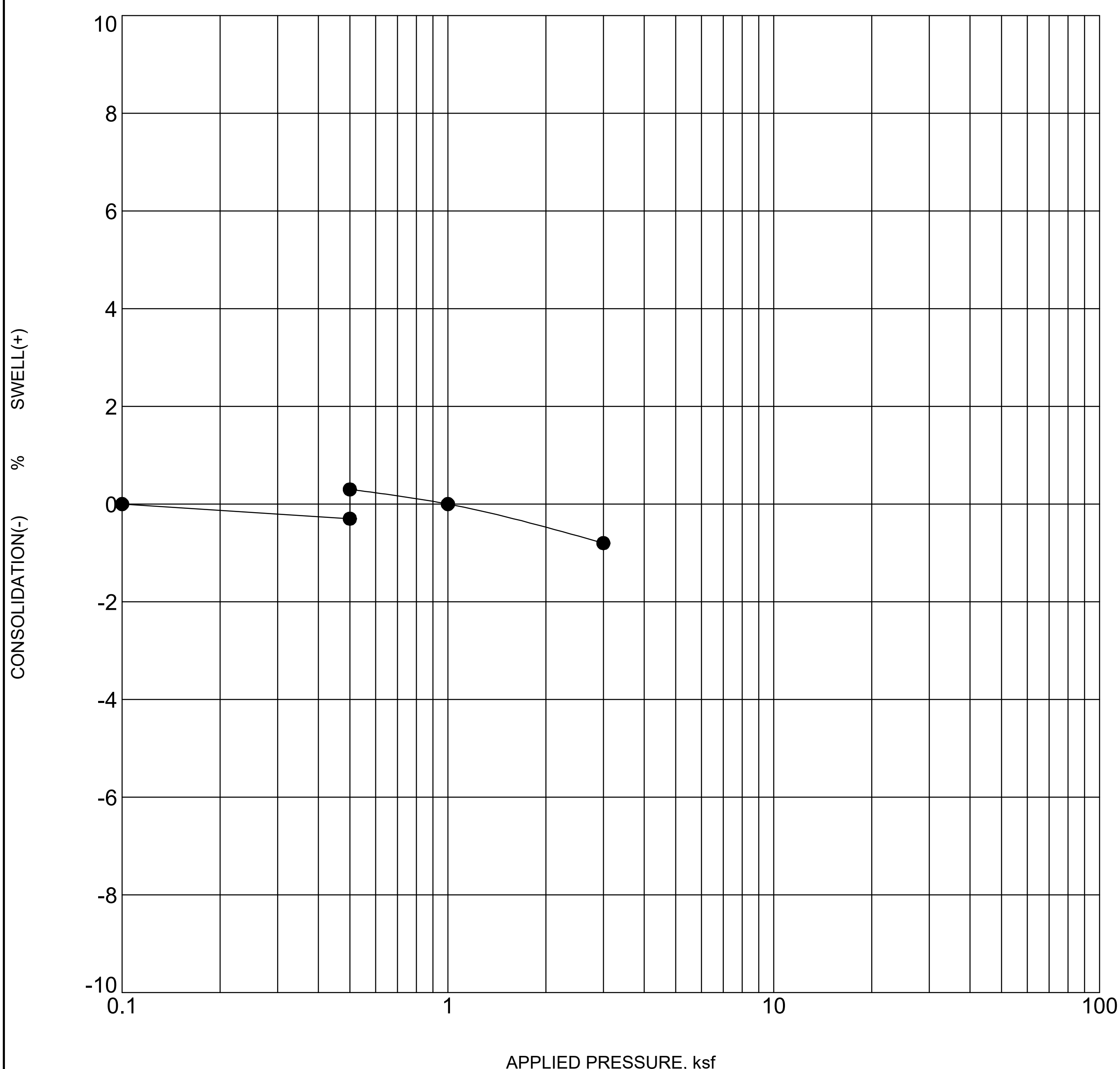
SWELL/CONSOLIDATION TEST

CLIENT Gayeski Capital Equities, LLC

PROJECT NAME Bennett Crossing - Pearl Street Pavement Design

PROJECT NUMBER 23.22.145

PROJECT LOCATION CO Hwy 79 to Adams Street



BOREHOLE	DEPTH	Classification	γ_d	MC%
● 4	4.0	**LEAN CLAY with SAND**	**106**	**20**

Note: Water Added to Sample at psf. **Date:**

SWELL/CONSOLIDATION TEST

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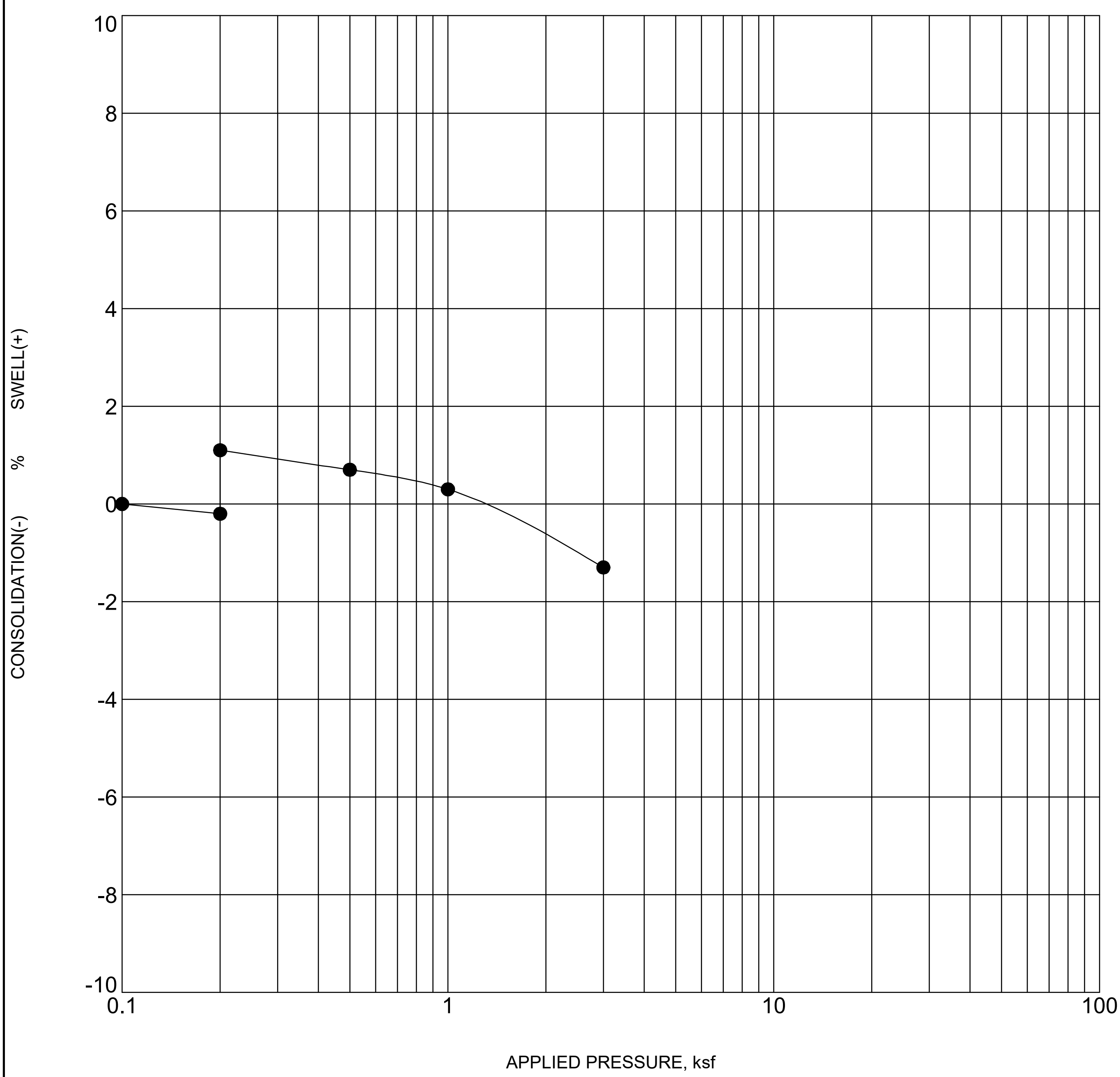
CLIENT Gayeski Capital Equities, LLC
PROJECT NAME Bennett Crossing - Pearl Street Pavement Design
PROJECT NUMBER 23.22.145
PROJECT LOCATION CO Hwy 79 to Adams Street



BOREHOLE	DEPTH	Classification	γ_d	MC%
● 6	2.0	**CLAYEY SAND(SC)**	**121**	**9**

Note: Water Added to Sample at psf. **Date:**

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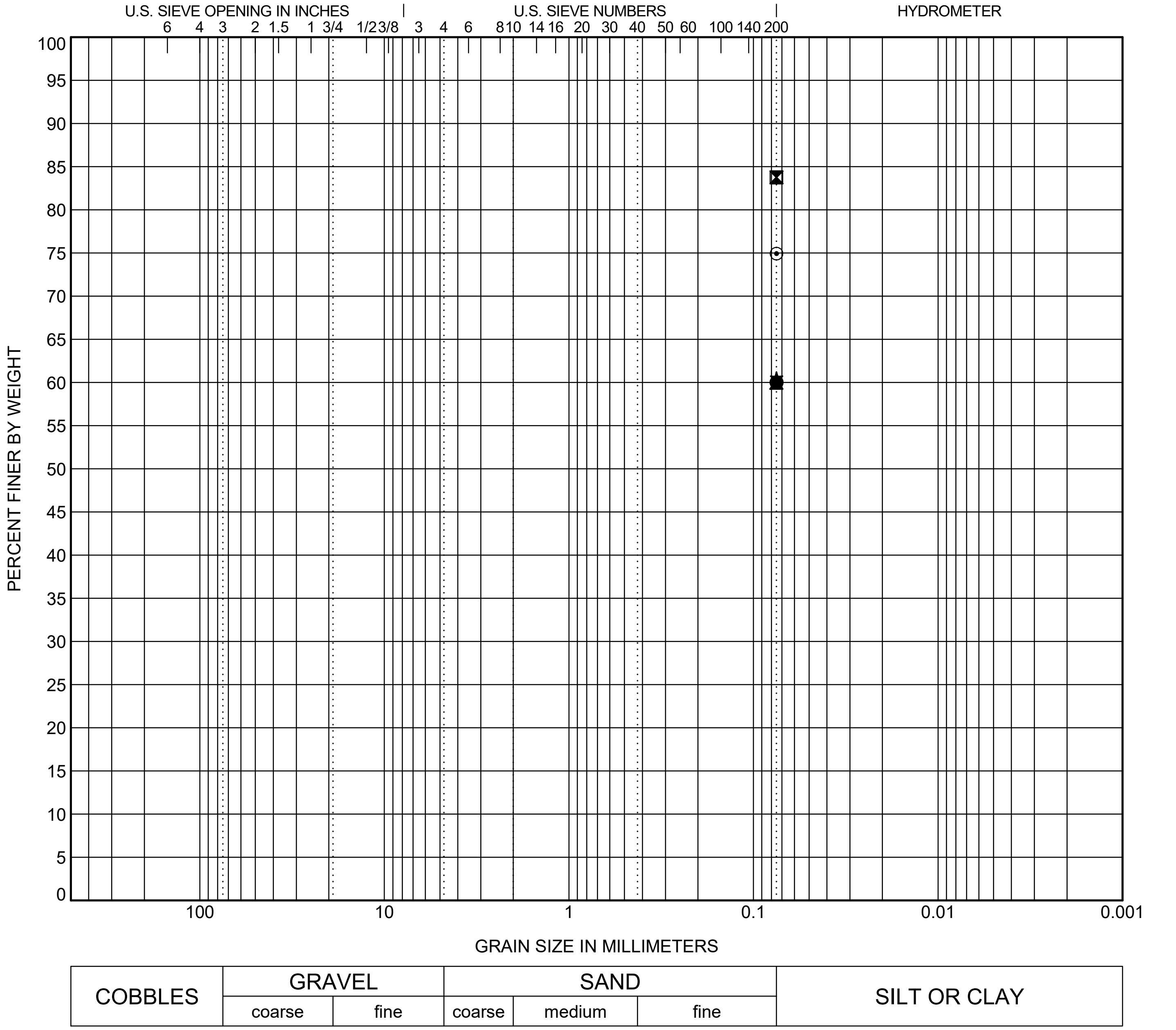
GRAIN SIZE DISTRIBUTION

CLIENT Gayeski Capital Equities, LLC

PROJECT NAME Bennett Crossing - Pearl Street Pavement Design

PROJECT NUMBER 23.22.145

PROJECT LOCATION CO Hwy 79 to Adams Street



	BOREHOLE	DEPTH	Classification	LL	PL	PI	Cc	Cu
●	1	2.0	**SANDY LEAN CLAY(CL)**	38	19	19		
⧗	2	2.0	**LEAN CLAY with SAND(CL)**	44	19	25		
▲	3	2.0	**SANDY LEAN CLAY(CL)**	37	21	16		
★	4	2.0	**SANDY LEAN CLAY(CL)**	32	17	15		
⊙	5	2.0	**LEAN CLAY with SAND(CL)**	28	16	12		

	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	1	2.0	0.075						60.0	
⧗	2	2.0	0.075						83.8	
▲	3	2.0	0.075						59.9	
★	4	2.0	0.075						60.6	
⊙	5	2.0	0.075						74.9	

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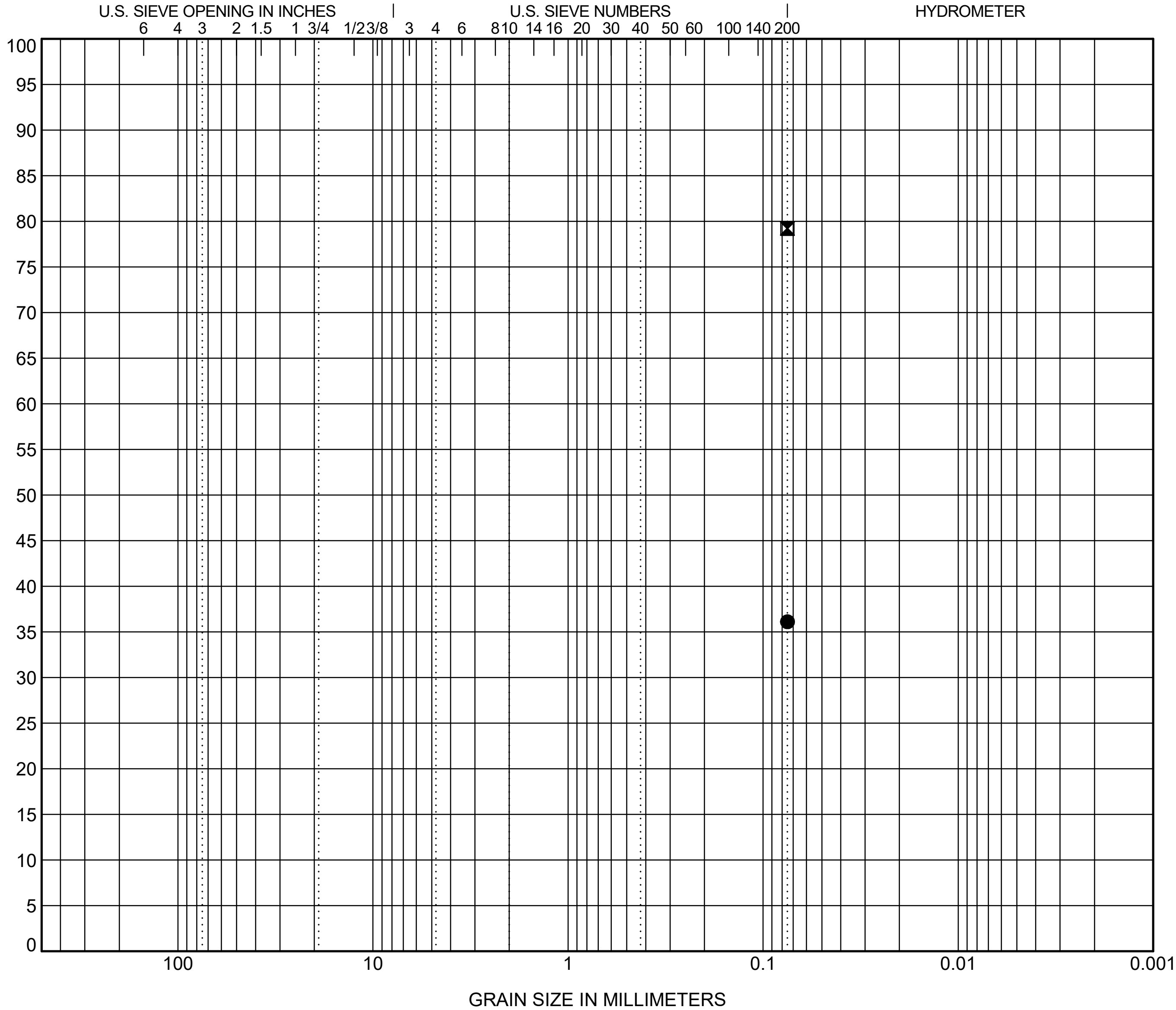
GRAIN SIZE DISTRIBUTION

CLIENT Gayeski Capital Equities, LLC
PROJECT NAME Bennett Crossing - Pearl Street Pavement Design
PROJECT NUMBER 23.22.145
PROJECT LOCATION CO Hwy 79 to Adams Street



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	Classification	LL	PL	PI	Cc	Cu
●	**6**	**2.0**	**CLAYEY SAND(SC)**	**25**	**15**	**10**		
⊠	**7**	**2.0**	**LEAN CLAY with SAND(CL)**	**38**	**17**	**21**		

	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**6**	**2.0**	**0.075**						**36.1**	
⊠	**7**	**2.0**	**0.075**						**79.2**	

GRAIN SIZE - GINT STD US LAB.GDT - 9/18/23 11:08 - Y:\GINT BACKUPS\MAIN TRANSFER 10.28\PROJECTS GEO 2023\23.22.145 PEARL STREET PAVEMENT DESIGN.GPJ

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SUMMARY OF LABORATORY RESULTS

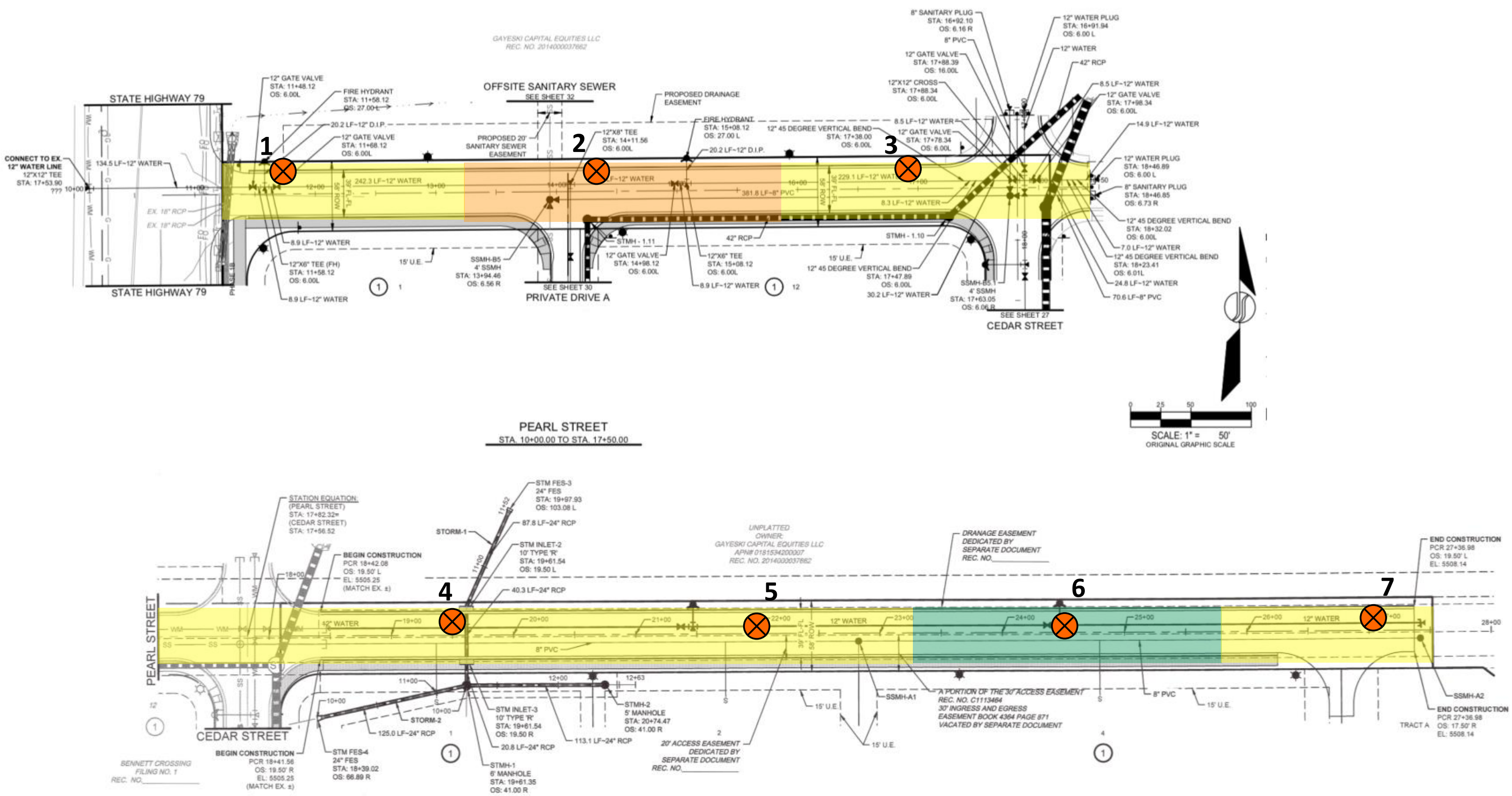
CLIENT Gayeski Capital Equities, LLC

PROJECT NAME Bennett Crossing - Pearl Street Pavement Design

PROJECT NUMBER 23.22.145

PROJECT LOCATION CO Hwy 79 to Adams Street

Borehole	Depth	Soil Description	AASHTO Class-ification	Group Index	Water Content (%)	Dry Density (pcf)	Swell (+) or Consolidation (-)/ Surcharge (%/psf)	Water Soluble Sulfates (ppm)	Passing #200 Sieve (%)	Atterberg Limits		
										Liquid Limit	Plastic Limit	Plasticity Index
1	2	SANDY LEAN CLAY(CL)	A-6	9	14.4	113.8	+0.6/200		60	38	19	19
1	4	SANDY LEAN CLAY			17.5	113.5						
1	9	CLAYEY SAND			4.9	114.1						
2	2	LEAN CLAY with SAND(CL)	A-7-6	21	15.6	117.2		0	84	44	19	25
2	4	LEAN CLAY with SAND			15.4	122.8						
3	2	SANDY LEAN CLAY(CL)	A-6	7	15.1	115.4	+0.9/200		60	37	21	16
3	4	SANDY LEAN CLAY			15.8	122.6						
3	9	CLAYEY SAND			5.4	117.3						
4	2	SANDY LEAN CLAY(CL)	A-6	6	15.9	117.8	+0.3/200		61	32	17	15
4	4	LEAN CLAY with SAND			19.8	106.3	+0.6/500					
5	2	LEAN CLAY with SAND(CL)	A-6	7	9.7	116.0		0	75	28	16	12
5	4	LEAN CLAY with SAND			13.9	117.1						
6	2	CLAYEY SAND(SC)	A-4	0	8.8	120.5	+1.3/200		36	25	15	10
6	4	SANDY LEAN CLAY			15.9	116.6						
6	9	SANDY LEAN CLAY			10.9	127.6						
7	2	LEAN CLAY with SAND(CL)	A-6	15	15.0	117.5			79	38	17	21
7	4	LEAN CLAY with SAND			14.1	119.0						



1 APPROXIMATE BORING LOCATIONS

SOIL TYPE KEY: A-6 | A-7-6 | A-4

FIGURE 2 – SUBGRADE SOIL TYPE DIAGRAM
PEARL STREET – HWY 79 TO ADAMS ST
BENNETT CROSSING
BENNETT, COLORADO
CGG PROJECT NO. 23.22.145

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APPENDIX C

GENERAL NOTES

GENERAL NOTES

DRILLING & SAMPLING SYMBOLS:

SS:	Split Spoon - 1⅜" I.D., 2" O.D., unless otherwise noted	HS:	Hollow Stem Auger
ST:	Thin-Walled Tube – 2.5" O.D., unless otherwise noted	PA:	Power Auger
RS:	Ring Sampler - 2.42" I.D., 3" O.D., unless otherwise noted	HA:	Hand Auger
CB:	California Barrel - 1.92" I.D., 2.5" O.D., unless otherwise noted	RB:	Rock Bit
BS:	Bulk Sample or Auger Sample	WB:	Wash Boring or Mud Rotary

The number of blows required to advance a standard 2-inch O.D. split-spoon sampler (SS) the last 12 inches of the total 18-inch penetration with a 140-pound hammer falling 30 inches is considered the “Standard Penetration” or “N-value”. For 2.5” O.D. California Barrel samplers (CB) the penetration value is reported as the number of blows required to advance the sampler 12 inches using a 140-pound hammer falling 30 inches, reported as “blows per inch,” and is not considered equivalent to the “Standard Penetration” or “N-value”.

WATER LEVEL MEASUREMENT SYMBOLS:

WL:	Water Level	WS:	While Sampling
WCI:	Wet Cave in	WD:	While Drilling
DCI:	Dry Cave in	BCR:	Before Casing Removal
AB:	After Boring	ACR:	After Casing Removal

Water levels indicated on the boring logs are the levels measured in the borings at the times indicated. Groundwater levels at other times and other locations across the site could vary. In pervious soils, the indicated levels may reflect the location of groundwater. In low permeability soils, the accurate determination of groundwater levels may not be possible with only short-term observations.

DESCRIPTIVE SOIL CLASSIFICATION: Soil classification is based on the Unified Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

FINE-GRAINED SOILS			COARSE-GRAINED SOILS			BEDROCK		
(CB) Blows/Ft.	(SS) Blows/Ft.	Consistency	(CB) Blows/Ft.	(SS) Blows/Ft.	Relative Density	(CB) Blows/Ft.	(SS) Blows/Ft.	Consistency
< 3	0-2	Very Soft	0-5	< 3	Very Loose	< 24	< 20	Weathered
3-5	3-4	Soft	6-14	4-9	Loose	24-35	20-29	Firm
6-10	5-8	Medium Stiff	15-46	10-29	Medium Dense	36-60	30-49	Medium Hard
11-18	9-15	Stiff	47-79	30-50	Dense	61-96	50-79	Hard
19-36	16-30	Very Stiff	> 79	> 50	Very Dense	> 96	> 79	Very Hard
> 36	> 30	Hard						

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Terms of Other Constituents	Percent of Dry Weight
Trace	< 15
With	15 – 29
Modifier	> 30

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300mm)
Cobbles	12 in. to 3 in. (300mm to 75 mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm)
Silt or Clay	Passing #200 Sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive Terms of Other Constituents	Percent of Dry Weight
Trace	< 5
With	5 – 12
Modifiers	> 12

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1-10
Medium	11-30
High	30+

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests[A]				Soil Classification: Group Symbol	Soil Classification: Group Name[B]
Coarse Grained Soils More than 50% retained on No. 200 sieve	Gravels More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5% fines[C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$[E]	GW	Well graded gravel[F]
			$Cu < 4$ and/or $1 > Cc > 3$[E]	GP	Poorly graded gravel[F]
		Gravels with Fines More than 12% fines[C]	Fines classify as ML or MH	GM	Silty gravel[F,G,H]
			Fines classify as CL or CH	GC	Clayey gravel[F,G,H]
	Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5% fines[D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$[E]	SW	Well graded sand[I]
			$Cu < 6$ and/or $1 > Cc > 3$[E]	SP	Poorly graded sand[I]
		Sands with Fines More than 12% fines[D]	Fines classify as ML or MH	SM	Silty sand[G,H,I]
			Fines classify as CL or CH	SC	Clayey sand[G,H,I]
Fine-Grained Soils 50% or more passes the No. 200 sieve	Silts and Clays Liquid limit less than 50	Inorganic	PI > 7 and plots on or above "A" line[J]	CL	Lean clay[K,L,M]
			PI < 4 or plots below "A" line[J]	ML	Silt[K,L,M]
		Organic	**Liquid limit - oven dried** / **Liquid limit - not dried** < 0.75	OL	Organic clay[K,L,M,N]
					Organic silt[K,L,M,O]
	Silts and Clays Liquid limit 50 or more	Inorganic	PI plots on or above "A" line	CH	Fat clay[K,L,M]
			PI plots below "A" line	MH	Elastic silt[K,L,M]
		Organic	Liquid limit - oven dried / Liquid limit - not dried < 0.75	OH	Organic clay[K,L,M,P]
					Organic silt[K,L,M,Q]
Highly organic soils	Primarily organic matter, dark in color, and organic odor			PT	Peat

[A] Based on the material passing the 3-in. (75-mm) sieve

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well graded gravel with silt, GW-GC well graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well graded sand with silt, SW-SC well graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.

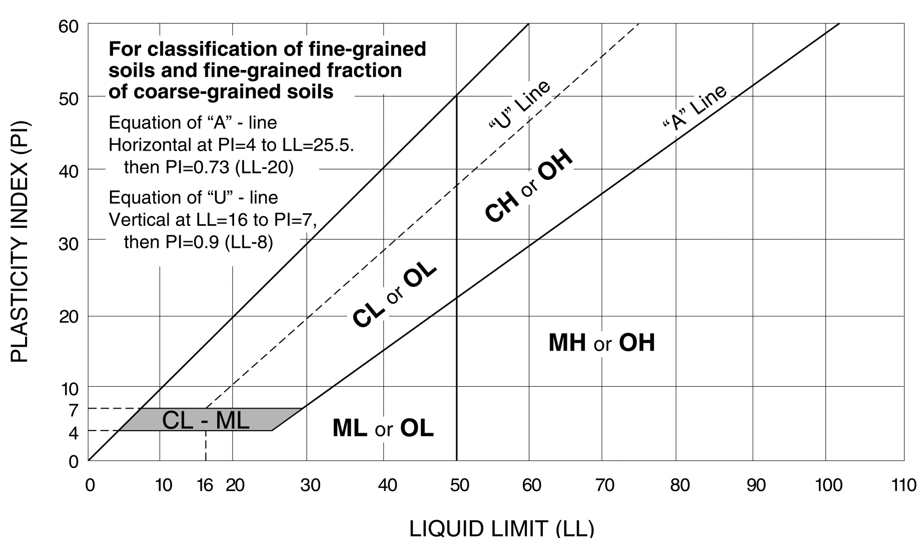
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] PI ≥ 4 and plots on or above "A" line.

[O] PI < 4 or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.



ROCK CLASSIFICATION

(Based on ASTM C-294)

Sedimentary Rocks

Sedimentary rocks are stratified materials laid down by water or wind. The sediments may be composed of particles or pre-existing rocks derived by mechanical weathering, evaporation or by chemical or organic origin. The sediments are usually indurated by cementation or compaction.

Chert Very fine-grained siliceous rock composed of micro-crystalline or cyrptocrystalline quartz, chalcedony or opal. Chert is various colored, porous to dense, hard and has a conchoidal to splintery fracture.

Claystone Fine-grained rock composed of or derived by erosion of silts and clays or any rock containing clay. Soft massive and may contain carbonate minerals.

Conglomerate Rock consisting of a considerable amount of rounded gravel, sand and cobbles with or without interstitial or cementing material. The cementing or interstitial material may be quartz, opal, calcite, dolomite, clay, iron oxides or other materials.

Dolomite A fine-grained carbonate rock consisting of the mineral dolomite [$CaMg(CO_3)_2$]. May contain noncarbonate impurities such as quartz, chert, clay minerals, organic matter, gypsum and sulfides. Reacts with hydrochloric acid (HCL).

Limestone A fine-grained carbonate rock consisting of the mineral calcite ($CaCO_3$). May contain noncarbonate impurities such as quartz, chert, clay minerals, organic matter, gypsum and sulfides. Reacts with hydrochloric acid (HCL).

Sandstone Rock consisting of particles of sand with or without interstitial and cementing materials. The cementing or interstitial material may be quartz, opal, calcite, dolomite, clay, iron oxides or other material.

Shale Fine-grained rock composed of or derived by erosion of silts and clays or any rock containing clay. Shale is hard, platy, of fissile may be gray, black, reddish or green and may contain some carbonate minerals (calcareous shale).

Siltstone Fine grained rock composed of or derived by erosion of silts or rock containing silt. Siltstones consist predominantly of silt sized particles (0.0625 to 0.002 mm in diameter) and are intermediate rocks between claystones and sandstones and may contain carbonate minerals.

LABORATORY TEST
SIGNIFICANCE AND PURPOSE

TEST	SIGNIFICANCE	PURPOSE
California Bearing Ratio	Used to evaluate the potential strength of subgrade soil, subbase, and base course material, including recycled materials for use in road and airfield pavements.	***Pavement Thickness Design***
Consolidation	Used to develop an estimate of both the rate and amount of both differential and total settlement of a structure.	***Foundation Design***
Direct Shear	Used to determine the consolidated drained shear strength of soil or rock.	***Bearing Capacity, Foundation Design, and Slope Stability***
Dry Density	Used to determine the in-place density of natural, inorganic, fine-grained soils.	***Index Property Soil Behavior***
Expansion	Used to measure the expansive potential of fine-grained soil and to provide a basis for swell potential classification.	***Foundation and Slab Design***
Gradation	Used for the quantitative determination of the distribution of particle sizes in soil.	***Soil Classification***
Liquid & Plastic Limit, Plasticity Index	Used as an integral part of engineering classification systems to characterize the fine-grained fraction of soils, and to specify the fine-grained fraction of construction materials.	***Soil Classification***
Permeability	Used to determine the capacity of soil or rock to conduct a liquid or gas.	***Groundwater Flow Analysis***
pH	Used to determine the degree of acidity or alkalinity of a soil.	***Corrosion Potential***
Resistivity	Used to indicate the relative ability of a soil medium to carry electrical currents.	***Corrosion Potential***
R-Value	Used to evaluate the potential strength of subgrade soil, subbase, and base course material, including recycled materials for use in road and airfield pavements.	***Pavement Thickness Design***
Soluble Sulfate	Used to determine the quantitative amount of soluble sulfates within a soil mass.	***Corrosion Potential***
Unconfined Compression	To obtain the approximate compressive strength of soils that possess sufficient cohesion to permit testing in the unconfined state.	***Bearing Capacity Analysis for Foundations***
Water Content	Used to determine the quantitative amount of water in a soil mass.	***Index Property Soil Behavior***

REPORT TERMINOLOGY
(Based on ASTM D653)

Allowable Soil Bearing Capacity The recommended maximum contact stress developed at the interface of the foundation element and the supporting material.

Alluvium Soil, the constituents of which have been transported in suspension by flowing water and subsequently deposited by sedimentation.

Aggregate Base Course A layer of specified material placed on a subgrade or subbase usually beneath slabs or pavements.

Backfill A specified material placed and compacted in a confined area.

Bedrock A natural aggregate of mineral grains connected by strong and permanent cohesive forces. Usually requires drilling, wedging, blasting or other methods of extraordinary force for excavation.

Bench A horizontal surface in a sloped deposit.

Caisson (Drilled Pier or Shaft) A concrete foundation element cast in a circular excavation which may have an enlarged base. Sometimes referred to as a cast-in-place pier or drilled shaft.

Coefficient of Friction A constant proportionality factor relating normal stress and the corresponding shear stress at which sliding starts between the two surfaces.

Colluvium Soil, the constituents of which have been deposited chiefly by gravity such as at the foot of a slope or cliff.

Compaction The densification of a soil by means of mechanical manipulation

Concrete Slab-on-Grade A concrete surface layer cast directly upon a base, subbase or subgrade, and typically used as a floor system.

Differential Movement Unequal settlement or heave between, or within foundation elements of structure.

Earth Pressure The pressure exerted by soil on any boundary such as a foundation wall.

ESAL Equivalent Single Axle Load, a criteria used to convert traffic to a uniform standard, (18,000 pound axle loads).

Engineered Fill Specified material placed and compacted to specified density and/or moisture conditions under observations of a representative of a geotechnical engineer.

Equivalent Fluid A hypothetical fluid having a unit weight such that it will produce a pressure against a lateral support presumed to be equivalent to that produced by the actual soil. This simplified approach is valid only when deformation conditions are such that the pressure increases linearly with depth and the wall friction is neglected.

Existing Fill (or Man-Made Fill) Materials deposited throughout the action of man prior to exploration of the site.

Existing Grade The ground surface at the time of field exploration.

REPORT TERMINOLOGY
(Based on ASTM D653)

Expansive Potential	The potential of a soil to expand (increase in volume) due to absorption of moisture.
Finished Grade	The final grade created as a part of the project.
Footing	A portion of the foundation of a structure that transmits loads directly to the soil.
Foundation	The lower part of a structure that transmits the loads to the soil or bedrock.
Frost Depth	The depth at which the ground becomes frozen during the winter season.
Grade Beam	A foundation element or wall, typically constructed of reinforced concrete, used to span between other foundation elements such as drilled piers.
Groundwater	Subsurface water found in the zone of saturation of soils or within fractures in bedrock.
Heave	Upward movement.
Lithologic	The characteristics which describe the composition and texture of soil and rock by observation.
Native Grade	The naturally occurring ground surface.
Native Soil	Naturally occurring on-site soil, sometimes referred to as natural soil.
Optimum Moisture Content	The water content at which a soil can be compacted to a maximum dry unit weight by a given compactive effort.
Perched Water	Groundwater, usually of limited area maintained above a normal water elevation by the presence of an intervening relatively impervious continuous stratum.
Scarify	To mechanically loosen soil or break down existing soil structure.
Settlement	Downward movement.
Skin Friction (Side Shear)	The frictional resistance developed between soil and an element of the structure such as a drilled pier.
Soil (Earth)	Sediments or other unconsolidated accumulations of solid particles produced by the physical and chemical disintegration of rocks, and which may or may not contain organic matter.
Strain	The change in length per unit of length in a given direction.
Stress	The force per unit area acting within a soil mass.
Strip	To remove from present location.
Subbase	A layer of specified material in a pavement system between the subgrade and base course.
Subgrade	The soil prepared and compacted to support a structure, slab or pavement system.

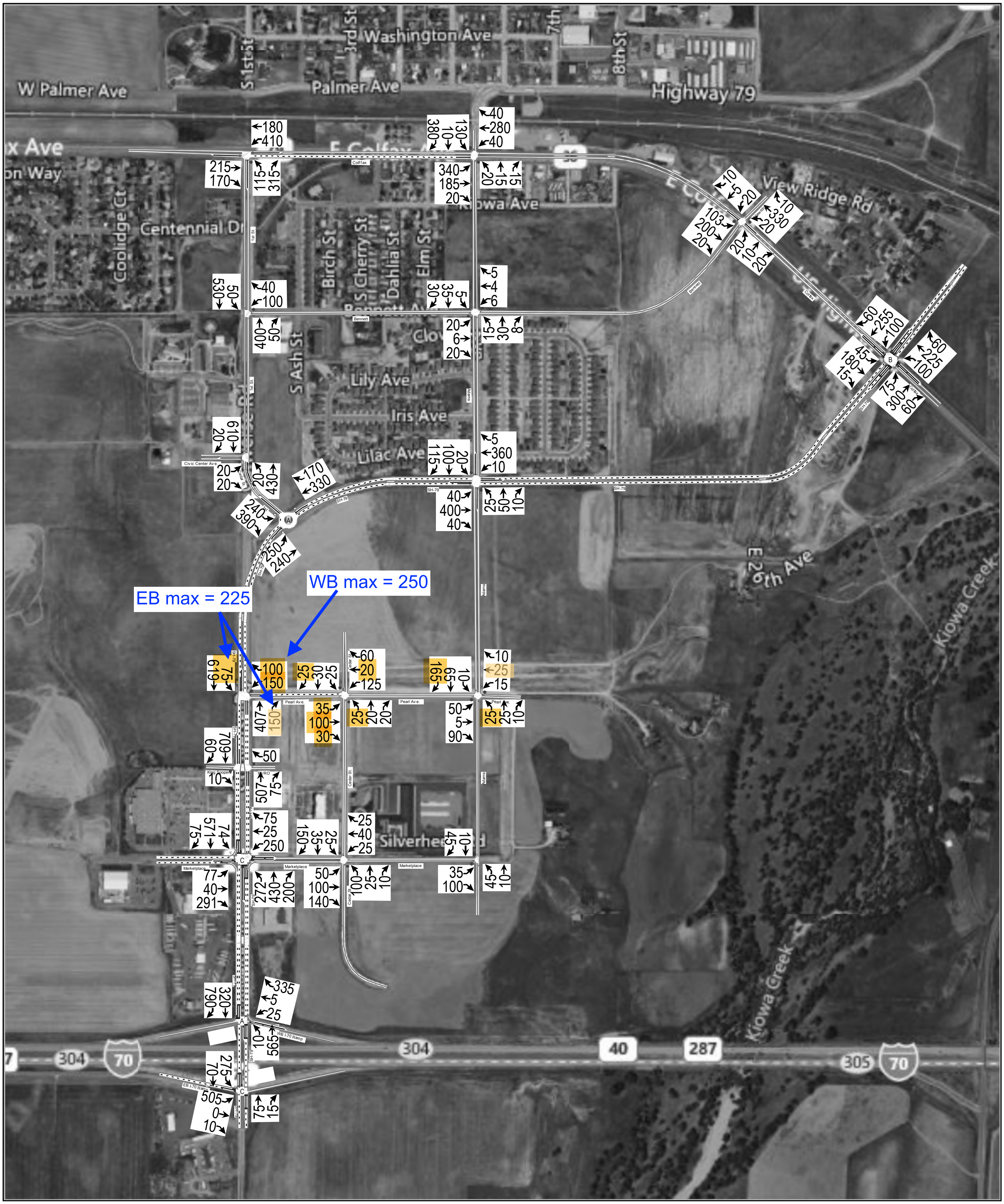
APPENDIX D

PEAK HOUR TRAFFIC ESTIMATION (FROM TRAFFIC STUDY)

CDOT ESAL CALCULATIONS

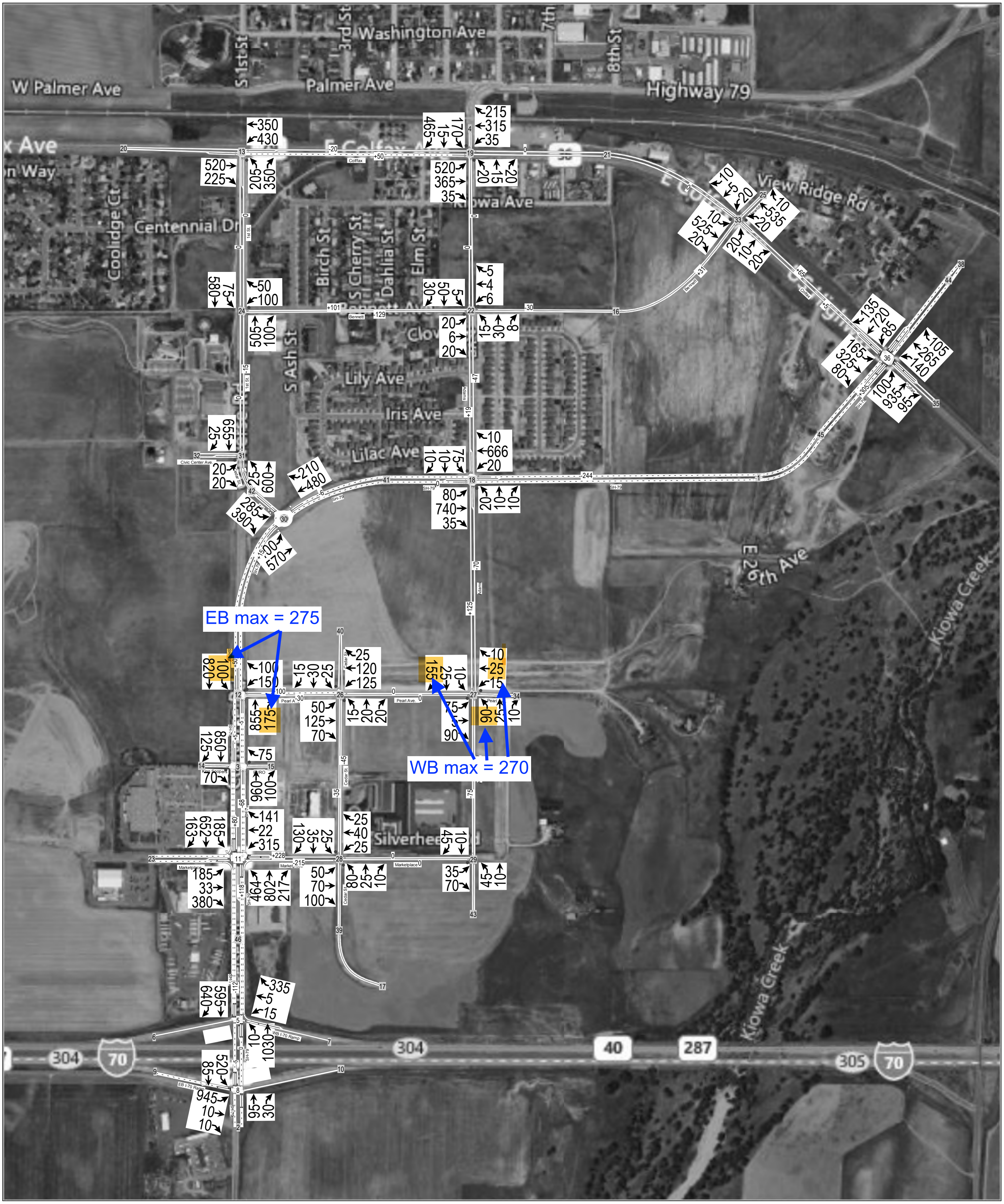
PAVEMENT DESIGN CALCULATIONS

Bennett **2045 AM TOTAL**



JMWA **10/24/2022**

Aldridge Transportation Consultants, LLC


EB max = 275
WB max = 270
Washington Ave
Palmer Ave
W Palmer Ave
Highway 79
Centennial Dr
Coolidge Ct
Birch St
S Cherry St
Dahlia St
Elm St
S Ash St
Lily Ave
Iris Ave
Lilac Ave
Kiowa Ave
View Ridge Rd
E 26th Ave
Kiowa Creek
Silverhead
S 1st St
3rd St
7th
8th St

ESAL Calculations using CDOT Traffic Type Estimations
Pearl Street - Bennett Crossing
CGG Project No. 23.22.145

PEARL STREET

Setting: Urban
Classification: Minor Collector

Max Peak Hour Volume (2036) = 275 from Traffic Impact Study (maximum = WB from Adams St.)
Design ADT = 2,750 (Peak Hour = 10% of total ADT)

ESAL CALCULATIONS USING CDOT PROJECTED TRAFFIC DISTRIBUTIONS

	Cars	Busses	SUT	STT&MTT	Total EDLA	Total ESAL
Flexible Pavements	7.91	0.00	21.98	26.01	55.90	408,073
Rigid Pavements	7.91	0.00	25.16	40.48	73.55	536,936

Total Flexible ESAL in Design Lane (2-lane Roadway)= 183,633
Total Rigid ESAL in Design Lane (2-lane Roadway)= 241,621

AASHTO FLEXIBLE PAVEMENT DESIGN

Project: Pearl Street - Bennett Crossing
Location: Bennett, CO
CGG Project No.: 23.22.145

Roadway: Pearl Street
Classification: Minor Commercial Collector
ADT **2,750** **vehicles/day at year 20, estimated from traffic study**
Poorest-Quality Subgrade Soil Type: A-7-6 (21), Boring No. 2, R-value = 7 from previous study

SN Determination

W18 =	183,633	*ESALs Applications Over Design Period*	Typ. Range 0.1 to 80 million
R =	90 %	*Reliability*	Typ. Range 80 to 95%
So =	0.44	*Standard Deviation*	Typ. Range 0.3 to 0.5
MR =	3,230 psi	*Subgrade Resilient Modulus*	Typ. Range 3000 to 9000 psi
Pi =	4.5	*Initial Serviceability*	Typ. Range 4.4 to 4.8
Pt =	2.5	*Terminal Serviceability*	Typ. Range 2.0 to 3.0

Design SN 3.50

Composite HMA+ABC Alternative A: Minor Commercial Collector

Layer No.	Description	Layer Coefficient, ai	Drainage Coefficient, mi	Layer Thickness, in	SN
Layer 1	HMA	0.44	1.00	**5.00**	2.20
Layer 2	ABC	0.12	1.00	**12.00**	1.44
				Trial SN	3.64

Design SN to Match 3.50
Design is sufficient

Composite HMA+ABC Alternative B: Minor Commercial Collector

Layer No.	Description	Layer Coefficient, ai	Drainage Coefficient, mi	Layer Thickness, in	SN
Layer 1	HMA	0.44	1.00	**5.50**	2.42
Layer 2	ABC	0.12	1.00	**9.00**	1.08
				Trial SN	3.50

Design SN to Match 3.50
Design is sufficient

Full-Depth HMA Alternative C: Minor Commercial Collector

Layer No.	Description	Layer Coefficient, ai	Drainage Coefficient, mi	Layer Thickness, in	SN
Layer 1	HMA	0.44	1.00	**8.00**	3.52
				Trial SN	3.52

Design SN to Match 3.50
Design is sufficient

AASHTO RIGID PAVEMENT DESIGN

Project: **Bennett Crossing, Filing No. 1**
Location: **Bennett, CO**
G Project No. **23.22.145**

Roadway: **Pearl Street**
lassification: **Minor Commercial Collector**

W18 =	241,621		*ESALs Applications Over Design Period*	Typ. Range 0.5 to 100 million
PCC MR =	650	psi	*Concrete Modulus of Rupture*	Typ. Range 550 to 750 psi
E =	3,400,000	psi	*Concrete Elastic Modulus*	Typ. Range 3 to 6 million psi
k-value =	166	psi/in	*Modulus of Subgrade Reaction*	Typ. Range 100 to 500 psi/in
R =	95	%	*Reliability*	Typ. Range 80 to 95%
So =	0.34		*Standard Deviation*	Typ. Range 0.3 to 0.5
J =	3.6		*Load Transfer Coefficient*	Typ. Range 2.2 to 4.4
Cd =	1		*Drainage Coefficient*	Typ. Range 0.9 to 1.1
Pi =	4.5		*Initial Serviceability*	Typ. Range 4.5 to 4.8
Pt =	2.5		*Terminal Serviceability*	Typ. Range 2.0 to 3.0

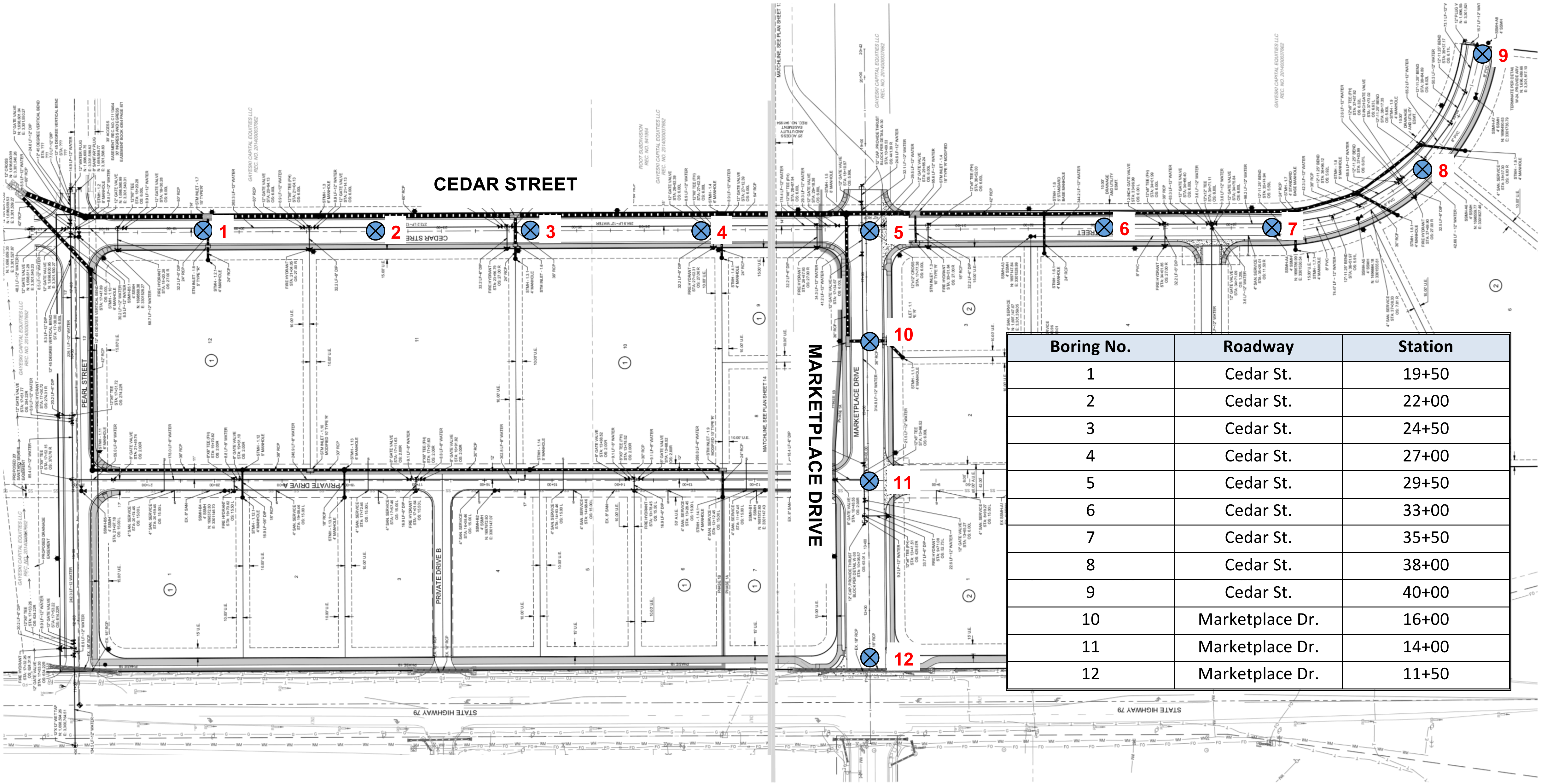
DESIGN D, inches, = 5.71

APPENDIX E

PREVIOUS STUDY – BORING LOCATION DIAGRAM

PREVIOUS STUDY – SUMMARY OF LABORATORY TEST RESULTS

PREVIOUS STUDY – R-VALUE



Boring No.	Roadway	Station
1	Cedar St.	19+50
2	Cedar St.	22+00
3	Cedar St.	24+50
4	Cedar St.	27+00
5	Cedar St.	29+50
6	Cedar St.	33+00
7	Cedar St.	35+50
8	Cedar St.	38+00
9	Cedar St.	40+00
10	Marketplace Dr.	16+00
11	Marketplace Dr.	14+00
12	Marketplace Dr.	11+50

1 APPROXIMATE BORING LOCATION

BORING LOCATION DIAGRAM
BENNETT CROSSING, FILING NO. 1
BENNETT, COLORADO
CGG PROJECT NO. P18.22.103

Cole Garner Geotechnical
1070 W. 124th Ave., Suite 300
Westminster, CO 80234
(303) 996-2999

Cole Garner Geotechnical
1070 W. 124th Avenue, Suite 300
Westminster, CO 80234
Telephone: 303.996.2999

SUMMARY OF LABORATORY RESULTS

CLIENT Gayeski

PROJECT NUMBER 18.22.103

PROJECT NAME Bennett Crossing Pavements

PROJECT LOCATION Bennett, Colorado

Borehole	Depth	Soil Description	AASHTO Class-ification	Group Index	Water Content (%)	Dry Density (pcf)	Swell (+) or Consolidation (-)/ Surcharge (%/psf)	Water Soluble Sulfates (ppm)	Passing #200 Sieve (%)	Atterberg Limits		
										Liquid Limit	Plastic Limit	Plasticity Index
1	1											
1	2	LEAN CLAY with SAND(CL)	A-6	12	6.8	116.2	+4.6/200	100	72	39	20	19
1	4	CLAYEY SAND			5.3	114.0						
1	9	SILTY SAND			0.8							
2	2	LEAN CLAY	A-7-6	28	11.4	110.8			94	48	20	28
2	4	CLAYEY to SILTY SAND			7.1	114.3						
3	2	LEAN CLAY	A-7-6	21	8.5	100.9			86	45	21	24
3	4	SILTY SAND			7.7	109.8						
4	2	LEAN CLAY(CL)	A-7-6	28	10.1	116.2	+11.3/200		94	48	20	28
4	4	LEAN CLAY with SAND			9.0	103.3						
5	2	LEAN CLAY(CL)	A-7-6	26	10.0	109.7	+8.4/200	0	88	48	20	28
5	4	LEAN CLAY			7.7	116.1						
5	9	SILTY SAND			1.1	110.3						
6	2	LEAN CLAY(CL)	A-7-6	30	11.5	108.6		200	95	49	20	29
6	4	LEAN CLAY			9.5	105.4						
7	2	LEAN CLAY(CL)	A-7-6	24	9.8	119.4	+6.3/200		87	47	20	27
7	4	LEAN CLAY			4.9	113.2						
8	2	SANDY LEAN CLAY(CL)	A-6	9	9.9				64	38	21	17
8	4	SANDY LEAN CLAY			10.0	105.3						
9	2	LEAN CLAY(CL)	A-7-6	24	11.0	111.9			87	47	20	27
9	4	LEAN CLAY			3.3	116.9						
9	9	LEAN CLAY			2.7	114.0						
10	2	LEAN CLAY(CL)	A-7-6	22	7.6	102.2	+3.6/200		86	45	20	25
10	4	CLAYEY to SILTY SAND			5.0	116.4						
11	2	LEAN CLAY with SAND(CL)	A-7-6	18	9.5	95.9	+4.2/200	100	80	44	21	23
11	4	LEAN CLAY with SAND			8.9	111.7						
12	2	LEAN CLAY with SAND(CL)	A-7-6	16	8.6	108.0			75	43	21	22
12	4	CLAYEY to SILTY SAND			4.4	115.3						
12	9	CLAYEY to SILTY SAND			11.4	116.6						
_BulkCL	1	Remolded Lean Clay (95% Comp. @ OMC)			16.7	103.3	+0.3/200					

R-Value conducted on this sample during previous investigation; representative of poorest-quality subgrade material on Pearl St.

Professional Service Industries, Inc.
1070 West 124th Avenue, Suite 800
Westminster, CO 80234

Phone: (303) 424-5578
Fax: (303) 423-5625

Report No: RV:05321313-41-S1
Issue No: 1

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R Value Report

Client: PICKERING COLE & HIVNER
1070 W 124TH AVE, SUITE 300
WESTMINSTER, CO 80234

CC: ANDREW GARNER
GLENN OHLSEN
PATRICK MALONEY

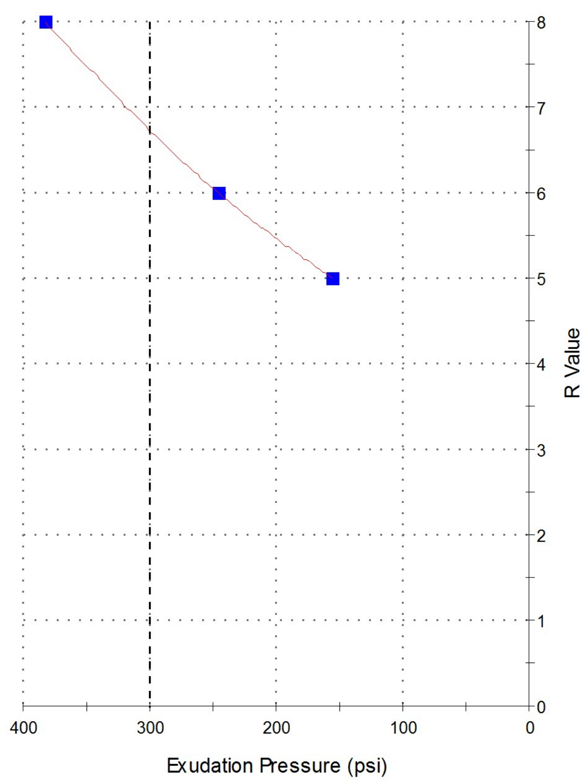
Project: CG GEOTECHNICAL
WESTMINSTER, CO

Approved Signatory: Donna Off (Project Engineer)
Date of Issue: 6/15/2018

Sample Details

Sample ID:	05321313-41-S1	**Date Sampled:**	6/2/2018
Sampling Method:		**Source:**	
Material:	sandy CLAY	**Specification:**	
Location:	Bennett Crossing Pavements 18.22.103 6@2'	**Tested By:**	William Wilson
Date Tested:	6/14/2018		

R Value



Test Results

ASTM D 2844

R Value at 300 psi Exudation: 7

Specimen Results

Moisture Content (%)	21.2	18.2	16.2
Dry Density (lb/ft³)	106.9	109.3	113.1
Exudation Pressure (psi)	156	246	383
R Value	5	6	8
Expansion Pressure (psi)	0.0	0.0	0.0

Comments