

**STRUCTURAL SECTION AND
SUBGRADE INVESTIGATION
2026 DRAINAGE AND ROADWAY
REHABILITATION PROJECT
L STREET FROM PYRAMID WAY TO STANFORD WAY
AND 5TH STREET FROM L STREET TO GREENBRAE DRIVE
SPARKS, NEVADA**



**CONSTRUCTION
MATERIALS
ENGINEERS, INC.**



PREPARED FOR:



**NOVEMBER 2025
FILE: 3630**



300 Sierra Manor Drive, Suite 1
Reno, NV 89511

November 5, 2025
File: 3630

Ms. Becca Epstein, PE
City of Sparks
431 Prater Way
Sparks, NV 89431

**RE: Structural Section and Subgrade Investigation
2026 Drainage and Roadway Rehabilitation Project
L Street from Pyramid Way to Stanford Way
and 5th Street from L Street to Greenbrae Drive
Sparks, Nevada**

Dear Ms. Epstein:

Construction Materials Engineers, Inc. is pleased to submit our Structural Section and Subgrade Investigation report for the 2026 Drainage and Roadway Rehabilitation Project along L Street from Pyramid Way to Stanford Way and 5th Street from L Street to Greenbrae Drive in Sparks, Washoe County, Nevada.

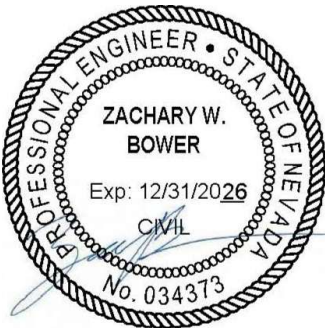
The following report includes the results of our field investigation, laboratory analysis, and presents design and construction recommendations related to the pavement structural section rehabilitation/reconstruction.

Thank you for the opportunity to provide our services and we look forward to working on future endeavors together.

Please feel free to contact the undersigned if you have any questions or require additional information.

Sincerely,

CONSTRUCTION MATERIALS ENGINEERS, INC.



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STRUCTURAL SECTION AND SUBGRADE INVESTIGATION

2026 Drainage and Roadway Rehabilitation Project L Street from Pyramid Way to Stanford Way and 5th Street from L Street to Greenbrae Drive Sparks, Nevada

1.0 INTRODUCTION

Presented herein are the results of Construction Materials Engineers, Inc.'s (CME) geotechnical exploration, laboratory testing, and associated geotechnical/pavement design and construction recommendations for the proposed 2026 Drainage and Roadway Rehabilitation Project on L Street from Pyramid Way to Stanford Way and 5th Street from L Street to Greenbrae Drive in Sparks, Washoe County, Nevada.

Our study included field exploration, laboratory testing, and engineering analyses to identify the physical and mechanical properties of the various on-site materials. Results of our field exploration and testing programs are included in this report and form the basis for all conclusions and recommendations. These recommendations are based on subsurface conditions encountered in our explorations and on details of the proposed project as described in this report. The objectives of this study were to:

- Determine the existing structural section thicknesses including both the pavement and aggregate base;
- Evaluate general subgrade soil conditions relevant to the design and construction of the proposed improvements; and
- Provide roadway rehabilitation/reconstruction design and construction recommendations, as related to these geotechnical conditions.

Per our scoping discussions with the City of Sparks, the geotechnical work for this project including the subsurface investigation, laboratory testing, and engineering analysis will comply with the 2007 RTC Flexible Pavement Design Manual, 1993 AASHTO Guide for Design of Pavement Structures, and local standard practices.

The location and general limits of the proposed project are presented on Plate A-1 (Exploration Location Map) in Appendix A.

2.0 PROJECT DESCRIPTION & SITE CONDITIONS

2.1 PROJECT DESCRIPTION

The 2026 Drainage and Roadway Rehabilitation Project will be localized to L Street from Pyramid Way to Stanford Way and 5th Street from L Street to Greenbrae Drive. The general details of the roadways are summarized in Table 1 with the approximate limits highlighted in green on Figure 1.

Table 1: Proposed Rehabilitated Roadway Summary				
Roadway Segment	Roadway Functional Classification	Approximate Width (ft)	Approximate Length (ft)	Approximate Quantity of Residences Served
5th Street from L Street to Greenbrae Drive	Local	30±	500±	75±
L Street from Pyramid Way to Stanford Way	Local	30±	2,300±	75±

NOTES:
1. Approximate lengths and widths should not be used for bidding purposes.

Pavement reconstruction or rehabilitation includes replacement of the existing paved traveled way and parking lanes.



Figure 1: 2026 Drainage and Roadway Rehabilitation Project Extents

2.2 SITE CONDITIONS

The existing roadways are two-lane roads with a single lane in each travel direction and on-street parking on both sides. The roads have total widths of approximately 30 feet. Surface drainage is facilitated by concrete curbs and gutters, which channel runoff into underground storm drain systems. Based on the pavement distress (refer to Section 5.1), the existing pavement has deteriorated significantly, showing signs of wear and distress consistent with having surpassed its service life.

3.0 FIELD EXPLORATION

Field exploration was completed on November 19th and 20th, 2024 and included performing a total of eight (8) asphalt core locations (C-24-06 through C-24-13) within the existing paved right-of-way using both 6-inch and 8-inch diameter core barrels. Asphalt cores collected were measured for thickness and evaluated for structural distresses. The approximate locations of the asphalt cores are shown on Plate A-1 in Appendix A.

Following coring, hand excavations were performed to:

- Evaluate the existing underlying aggregate base layer for thickness and general material composition.
- Assess and classify the subgrade soil below the aggregate base to determine subgrade soil characteristics.

Bulk samples of the aggregate base and subgrade soil were collected and sealed in the field to preserve moisture content. CME personnel visually examined and classified the materials in general accordance with ASTM D2488. Where applicable, material classifications were subsequently updated based on laboratory testing in general accordance with ASTM D2487. Asphalt core logs are presented as Plate A-2 and a Soil Classification Chart is included as Plate A-3.

4.0 LABORATORY TESTING

Soil testing performed in CME's laboratory was conducted in general accordance with ASTM Standards. Significant soil types were selected and analyzed to determine index and mechanical properties. The following laboratory tests were completed as part of this investigation:

- Grain size distribution (ASTM D6913);
- Plasticity index (ASTM D4318),
- R-value (ASTM D2844),
- Moisture Density Curve (ASTM D558-19 Method B); and
- Unconfined Compressive Strength of Cement Treated Base (ASTM D1633).

Laboratory test results are presented in Appendix B.

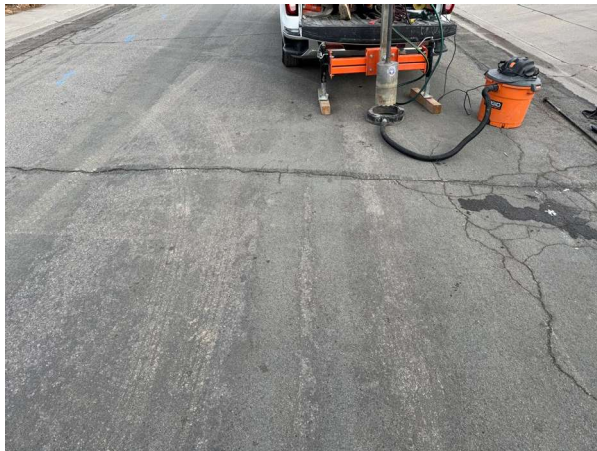
5.0 PAVEMENT STRUCTURAL SECTION AND SUBGRADE SOIL CONDITIONS

5.1 EXISTING PAVEMENT DISTRESSES

CME performed visual observations of the existing roadway distresses between November 19th and 20th, 2024. Pavement conditions and general distress was relatively consistent throughout the alignment. A summary of the observed pavement distresses include:

- Regularly spaced low to high severity transverse (thermal) cracking
- Longitudinal cracking
- Alligator cracking
- Block cracking
- Extensive areas of the roadway show large areas of medium severity fatigue cracking.
- Minor and major patching is observed, likely due to utility work.
- Evidence of previous crack sealant and slurry seal applications. The Crack sealant appears old and likely past its functional life.

Photographs 1 and 2 show the typical pavement condition on 5th Street while Photographs 3 through 8 show typical pavement conditions at several locations across the L Street segment.



Photograph 1: Pavement Condition at C-24-06



Photograph 2: Pavement Condition at C-24-07



Photograph 3: Pavement Condition at C-24-08



Photograph 4: Pavement Condition at C-24-09



Photograph 5: Pavement Condition at C-24-10



Photograph 6: Pavement Condition at C-24-11



Photograph 7: Pavement Condition at C-24-12



Photograph 8: Pavement Condition at C-24-13

5.2 EXISTING STRUCTURAL SECTION THICKNESS

The existing structural section encountered consisted of an asphaltic concrete (AC) pavement overlying an existing base course. Structural section thicknesses encountered are presented in Table 2.

Table 2: Summary of Existing Structural Section Thicknesses				
Roadway Segment	Core ID	Asphalt Concrete Pavement Thickness (in)	Aggregate Base Thickness (in)	Total Structural Section Thickness (in)
5 th St from L St to Greenbrae Dr	C-24-06	3 $\frac{3}{8}$	10	13 $\frac{3}{8}$
	C-24-07	4	9 $\frac{1}{2}$	13 $\frac{1}{2}$
L St from Pyramid Wy to Stanford Wy	C-24-08	4	11 $\frac{1}{2}$	15 $\frac{1}{2}$
	C-24-09	3 $\frac{3}{4}$	6	9 $\frac{3}{4}$
	C-24-10	3 $\frac{1}{2}$	6 $\frac{1}{2}$	10
	C-24-11	3 $\frac{3}{4}$	12	15 $\frac{3}{4}$
	C-24-12	5 $\frac{1}{2}$	14 $\frac{1}{2}$	20
	C-24-13	3 $\frac{1}{2}$	14	17 $\frac{1}{2}$
Average	-	3$\frac{3}{8}$	10$\frac{1}{2}$	14$\frac{3}{8}$

5.3 EXISTING AGGREGATE BASE DESCRIPTION

The existing aggregate base consists of generally coarse-grained material with maximum particle sizes ranging from 2 to 3 inches, low plasticity fines, and high R-value. Table 3 summarizes the laboratory test results relevant to the proposed roadway rehabilitation.

Table 3: Aggregate Base Laboratory Testing Summary							
General Location	Exploration ID	Maximum Particle Size	Percent Passing Sieve Size			Plasticity Index (PI)	R-value
			2-inch	¾-inch	No. 200		
5 th Street	C-24-06 & C-24-07	2.5-inch	94	57	6.7	5	79
L Street from Pyramid Way to Stanford Way	C-24-08, C-23-09, & C-24-10	2.5-inch	89	63	5.5	NP	81
	C-24-11, C-23-12, & C-24-13	3-inch	96	78	7.8	4	
Average		2.5-inch	93	66	6.6	3	80
Recycled On-Site Aggregate Base Specification							
SSPWC, Table 200.01.04-I		2-inch Minus	100	N/A	0-12	N/A	70 Min
NOTES:							
1. This table is strictly intended to summarize the laboratory testing; for detailed laboratory test results, refer to Appendix B.							
2. NP = non-plastic							

The in-place base material appears to closely comply with a Type 2 Recycled Aggregate Base (SSPWC, Table 200.01.04-I). In our professional opinion, based on the current performance of the existing structural section and laboratory test results, the existing in-place aggregate base may be considered for on-site reuse, subject to approval by the owner or agency.

5.4 SUBGRADE SOIL CONDITIONS

Based on the *Preliminary Revised Geologic Maps of the Reno Urban Area, Nevada* (Ramelli et al, 2011), the subject site is geologically mapped as young alluvium (Qay). In this area, young alluvium is typically a mixture of slowly deposited sand and low to medium plasticity clays.

Based on our laboratory testing, a summary of the subgrade soil classifications and material properties are presented in Table 4.

Table 4: Subgrade Soil Summary				
Exploration ID	USCS Classification	In-situ Moisture Content %	Percent Passing the No. 200 Sieve	Plasticity Index (PI)
C-24-07	Silty, clayey sand	18.6	33.2	7
C-24-09	Silty, clayey sand with gravel	9.7	23.6	4
C-24-11	Sandy lean clay	20.7	54.0	15
C-24-13	Sandy lean clay	22.9	62.3	27
50th Percentile Value	-	18.0	43.3	13

Subgrade soil material and strength characteristics at this site are generally described as exhibiting moderate to high fines, low to high plasticity, over optimum moisture, and low R-values with a corresponding medium to high expansion/swell potential and moderate to high potential for subgrade instability under construction vehicle loading.

5.4.1 SOIL MOISTURE AND GROUNDWATER CONDITIONS

Groundwater was not encountered during our exploration and is not anticipated to be at a depth that will impact construction. Subgrade soils were generally encountered in a moist to very moist condition with moisture contents on the order of 10 to 23 percent. Based on index properties, optimum moisture is anticipated to be on the order of 10 to 18 percent. Due to the anticipated above optimum moisture conditions and the potential for surface infiltration through existing cracks and pavement distresses, the risk of oversaturated zones increases significantly. Therefore, the contractor should be prepared for potentially unstable subgrade soil once the overlying pavement is removed during reconstruction.

6.0 DISCUSSION AND GENERAL INFORMATION

6.1 DISCUSSION

Based on discussions with the City of Sparks, the preferred roadway rehabilitation method includes the pulverization of existing asphalt concrete, treatment of the in-place asphalt grindings and aggregate base with cement to create Cement Treated Base (CTB), and replacement with new asphalt concrete.

In our professional opinion, the preferred reconstruction method is a suitable design solution for the following reasons:

- The existing structural section (refer to Section 5.2) has held up well throughout its life
- The existing pavement distresses do not indicate excessive base failure or subgrade failure
- Cement treatment of the in-place aggregate base will reduce off-haul, increase the shear strength and overall durability of the base material, and limit exposure of potentially unstable subgrade material under construction traffic loading.
- The proposed reconstructed structural section will have a higher structural number (SN) than the existing structural section and is expected to provide better overall support and durability for the roadway.

6.2 GENERAL INFORMATION

The following definitions and standards are applicable for recommendations in this report relating to design and construction of the proposed project:

Table 5: General Definitions and Standards for Report Recommendations	
Fine Grained Soil	<p>For the purposes of this report, fine-grained soil may be defined as:</p> <ul style="list-style-type: none"> • Soil with more than 35 percent by weight passing the number 200 sieve; and • A plasticity index less than 15 ($PI < 15$), or expansion index less than 20 ($EI < 20$).
Clay Soil	<p>For the purposes of this report, clay soil may be defined as:</p> <ul style="list-style-type: none"> • Soil with more than 15 percent by weight passing the number 200 sieve; and • A plasticity index greater than or equal to 15 ($PI \geq 15$), or expansion index greater than 20 ($EI > 20$).
Granular Soil	<p>Existing onsite soil not meeting the requirement for a fine-grained or clay soil with:</p> <ul style="list-style-type: none"> • A maximum particle size of 4-inches or less, • Less than 30 percent retained on the $\frac{3}{4}$ inch sieve; • Less than 35 percent passing the No. 200 sieve; • Plasticity index less than 15 ($PI < 15$), or expansion index less than 20 ($EI < 20$).
Structural Fill	<ul style="list-style-type: none"> • Soil generated from onsite grading may be reused as structural fill provided it meets the requirements of a granular soil and is free of organics or deleterious materials. • Structural fill is the supporting soil placed in densified lifts below foundations, concrete slabs-on-grade, pavements, or any structural element that derives support from the underlying sub-soils material. • Imported structural fill shall meet the requirements in SSPWC Section 200.01.09.
Structural Areas	<ul style="list-style-type: none"> • Includes all areas that will be used for the support of concrete slabs, flatwork, foundations, pavements, or other structures deriving support from the underlying soil.
Cement Treated Base	<ul style="list-style-type: none"> • Cement treated base is defined as aggregate base treated with cement, cured, and resulting in a 7-day unconfined compressive strength of 300 psi or greater.
Subgrade	<ul style="list-style-type: none"> • The elevation directly below the aggregate base layer for both concrete slabs-on-grade and pavements; • Bottom of excavation for foundations bottomed on native soil materials and structural fill. • The native soil surface elevation below structural fill.
Relative Compaction	<ul style="list-style-type: none"> • The dry density of soil after compaction and placement in the field, expressed as a percentage of the maximum dry density in accordance with ASTM D1557. Optimum moisture content shall be determined in accordance with ASTM D1557.
Standard Specifications	<ul style="list-style-type: none"> • Work shall be performed in general conformance with the Standard Specifications for Public Works Construction, 2012, Revision No. 8, Dated 10/19/2018 (SSPWC).

7.0 DESIGN RECOMMENDATIONS

7.1 SUBGRADE SOIL STRENGTH (RESILIENT MODULUS)

Subgrade soil resilient modulus (M_R) is based on the *2007 RTC Flexible Pavement Design Manual* Section 3.2.6:

$$\text{Resilient Modulus } (M_R) = 772 + 369 \times (R\text{-value})$$

The *2007 RTC Flexible Pavement Design Manual* is based on the *1993 AASHTO Guide for Design of Pavement Structures*, which in Chapter 1, Section 1.5, states "...the following correlation may be used for fine-grained soils (R-value less than or equal to 20) until designers develop their own capabilities."

The minimum R-value needed for the structural section design thickness in Section 7.4 to be correct is 5. Based upon index testing, the subgrade soils encountered are anticipated to have an R-value greater than 5. Consequently, the following calculations are performed using an R-value of 5 and a corresponding resilient modulus of 2,617 psi.

7.2 ESAL CALCULATIONS

ESAL estimates are based on 20-year design life using the following vehicular loading assumptions:

Standard Passenger Vehicle Loading	<ul style="list-style-type: none"> 75 dwellings with a total of 10 trips per day per dwelling unit (5 departures and returns, which is equivalent to a directional distribution factor of 0.5). Note that local traffic patterns that might warrant this number to be higher were not considered as the ESALs associated with passenger vehicles are typically not meaningful to pavement structural design. Typical automobile weight: 2,000 to 7,000 lbs., with an average ESAL of 0.0004. No growth in traffic over the design period.
Trash Service and Delivery Trucks	<p>General Shipping/Receiving Traffic:</p> <ul style="list-style-type: none"> Includes water service vehicles, UPS/FedEx trucks, recreational vehicles, and others (FHWA Class 5 and Class 6). Average ESAL per trip: 0.20. Assumed to account for approximately 1% of total trips generated over a 20-year design period (AADT of 4 trips per day). Traffic patterns of the delivery truck traffic and recreational vehicles will be variable with the potential for one lane to experience more passes than the other. Therefore a directional distribution of 1.0 was considered for design. <p>Trash and Recycling Trucks:</p> <ul style="list-style-type: none"> Trash collection: once per week. Recycling service: every other week. Average ESAL per trip: 3.0 Trash and recycling trucks trips include 1 pass over each directional lane.

Table 6: Design-Life ESAL Counts

Vehicular Loading Condition	Estimated AADT	Directional Distribution Factor	Days per Year	Years	Average Estimated ESAL Per Vehicle	Estimated Design Life ESAL Count
Passenger Vehicle Residential Traffic	750	0.5	365	20	0.0004	1,095
Delivery Trucks and Recreation Vehicles	4	1.0	365	20	0.2	5,840
Trash+ Recycling	3	0.5	52	20	3.0	4,680
Total Estimated 20-Year Design Life ESAL:						11,615

7.3 DESIGN STRUCTURAL NUMBER CALCULATION

The design structural number for the roadway segment is determined by the following calculation, as presented in the 1993 AASHTO Guide for Design of Pavement Structures:

$$\log_{10}(ESAL_{20}) = Z_R * S_o + 9.36 * \log_{10}(SN + 1) - 0.20 * \frac{\log_{10}\left(\frac{\Delta PSI}{4.2 - 1.5}\right)}{0.40 + \frac{1094}{(SN + 1)^{5.19}}} + 2.32 * \log_{10}(M_R) - 8.07$$

Where:

SN = Structural Number

R = Reliability

Z_R = Standard Normal Deviate

S_o = combined standard error of the traffic prediction and performance prediction

ΔPSI = difference between the initial design serviceability index, p_o , and the design terminal serviceability index, p_t

Table 7 presents the remaining input parameters and their respective sources.

Table 7: Design Structural Number Parameters		
Design Parameter	Value	Reference
Reliability, R	70%	AASHTO Guide for Design of Pavement Structures, 1993, Table 2.2 recommends 50-80%
Standard Normal Deviate, Z_R	-0.524	Based on R
Combined standard error of the traffic prediction and performance prediction, S_o	0.45	2007 RTC Flexible Pavement Design Manual Section 3.2.4
Design initial serviceability index, p_o	4.2	2007 RTC Flexible Pavement Design Manual Table 3.3 for Collector
Design terminal serviceability index, p_t	2.0	2007 RTC Flexible Pavement Design Manual Table 3.3 for Collector

Using these design values and the previously calculated ESAL estimates, the minimum calculated structural number (SN) is 1.80. The City of Sparks minimum pavement structural section for local/residential roads is 4-inches of asphalt concrete (AC) on 6-inches of aggregate base (AB); using the layer coefficients in the 2007 RTC Flexible Pavement Design Manual, this is a structural number (SN) of 2.28. Consequently, the minimum structural number (SN) for this project is 2.28.

7.4 DESIGN STRUCTURAL SECTION

Based on the 2007 RTC Flexible Pavement Design Manual Table 3 and 1993 AASHTO Table L5.1, the following layer coefficients were used:

Table 8: Structural Section Layer Coefficient Values		
Material Type	Layer Coefficient (a_i)	Drainage Coefficient (M_i)
Plantmix Bituminous Surface (AC)	0.39	N/A
Cement Treated Base (CTB)	0.23	1.0

Based on the recommendations, calculations, and assumptions in this report, the recommended pavement structural section is provided in Table 9.

Table 9: Recommended Design Pavement Structural Section Thickness		
Roadway Segment	Asphalt Concrete Pavement (in)	Cement Treated Base (in)
5 th Street and L Street from Pyramid Way to Stanford Way	4.0	6.0

8.0 STRUCTURAL SECTION CONSTRUCTION RECOMMENDATIONS

8.1 DEMOLITION/PULVERIZATION OF EXISTING ASPHALT CONCRETE

Demolition of the existing asphalt concrete surface shall be carefully planned to maximize useable materials. The demolition efforts may utilize milling, pulverizing, or sawcut methods typically implemented for public roadway construction. Care should be made to not mix in any subgrade.

The contractor should be aware of the risk in milling asphalt concrete with alligator cracking; the milling process may result in larger than desired pieces of asphalt due to the existing alligator cracking. The selected process of removing/ processing the existing asphalt concrete should consider the existing asphalt concrete distresses.

Except for proof rolling, construction traffic over the exposed aggregate base should be limited, where possible, to prevent the development of subgrade instability in an otherwise stable subgrade.

8.2 PROOF-ROLL EXISTING AGGREGATE BASE

Within older cracked pavements, surface moisture can seep into the existing structural section and oversaturated subgrade soil. Subgrade soil with over optimum moisture contents are susceptible to pumping instabilities especially when subjected to construction traffic.

To determine if pumping instability is present following demolition of the asphalt, the exposed base shall be proof-rolled with heavy rubber-tired construction equipment such as a fully loaded water truck. Unstable areas, where encountered, should be marked for stabilization. Recommendations for stabilization are presented in Section 8.3.

8.3 SUBGRADE STABILIZATION

The method of remediation of pumping instabilities will be contingent upon the extent of instability, construction season, soil type, and construction methods employed by the earthwork contractor. It is important to note that alternative stabilization methods may be applicable, and the contractor bears the responsibility of stabilizing pumping soil prior to placement of the proposed structural section.

The contractor may need to adjust site activities to prevent damage to otherwise firm site soil throughout construction. Limiting exposure of unpaved roadways to construction traffic prior to paving is critical. If unstable subgrade is encountered, remediation shall include removal and replacement as described below:

- Stabilization can be achieved by removing oversaturated soil and replacing it with stabilizing fill overlying a high-performance geotextile.
- This method is preferred in areas where drying of oversaturated zones is unlikely due to the fine-grained nature of the material or project timeframe.
- A test section is recommended to determine the required thickness of stabilizing fill. Stabilization is always a trial-and-error procedure with requirements and effectiveness varying within the same project. Depending on the magnitude of loading from construction vehicles, a stabilizing fill thickness of 18 inches is anticipated. However, it is recommended that, unless a more stable surface is encountered at a shallower depth, the thickness of the stabilizing fill layer shall not be less than 12 inches. Shallow utilities may be present impacting the depth of removal, we recommend all utility locations be identified prior to excavation.
- To ensure optimal performance, a high-performance geotextile shall be placed directly below the stabilizing fill, providing both separation and stabilization functions. The geotextile shall adhere to Class 1 (AASHTO M288) woven fabric specifications, such as Mirafi HP570, Terra Tex HPG-57, or any approved equal.

- Prior to placement of the geotextile, the ground surface should be smooth without sharp particles or abrupt edges. The geotextile should be laid in accordance with the manufacturer's recommendation with a minimum joint overlap of 18 inches. Construction equipment is prohibited from traveling directly over the geotextile. It is recommended that the initial lift of stabilizing fill be placed from outside the excavation or should be pushed ahead of the construction equipment during placement over the geotextile. Construction equipment should be light weight such as a rubber-tired backhoe.
- A minimum densified stabilizing fill thickness of 12 inches is required over the geotextile layer, with the potential for additional thicknesses to ensure optimal stabilization. Prior to the densification process, stabilizing fill shall be uniformly moisture condition to within plus or minus 2 percent of optimum moisture. Stabilizing fill material must adhere to the specifications outlined below:

Table 10: Stabilizing Fill Gradation Specifications	
Sieve Size	Percent by Dry Weight Passing
4 Inch	100
¾ Inch	70 – 100
No. 4	20 – 70
No. 200	0 – 8
Maximum Liquid Limit	Maximum Plastic Index
35	5
R-value	
70 Minimum	

- The initial lift of stabilizing fill shall have a minimum loose lift thickness of 15-inches. Subsequent lifts should be placed in maximum 12-inch lifts. It is recommended that prior to placement, the stabilizing fill be uniformly moisture conditioned to plus or minus 2 percent of optimum moisture then densified. Higher moisture contents are acceptable if the soil lift is stable and required relative compaction can be attained in the soil lift and succeeding soil lifts. Stabilizing fill shall be densified to at least 90 percent relative compaction.

8.4 CEMENT TREATED BASE (CTB)

CTB as used in this report, includes the addition of cement to the mixture of in-place aggregate base. CTB increases the strength of the structural section component.

Unconfined Compressive Strength (UCS) testing was conducted on the existing base with cement additives of 2, 3, and 4 percent using Nevada Cement Type II cement. Detailed laboratory test results are provided in Appendix B.

A minimum 7-day unconfined compressive strength of 300 psi is required for the cement treated base material. Based on mix designs performed for this project, a 7-day unconfined compressive strength minimum of 300 psi was achieved with 2% cement. We recommend cement treated base should be created by mixing the in place aggregate base with at least 2% cement by dry mass aggregate base.

The cement treated base shall be constructed in accordance with SSPWC Section 309 using the "Roadmix Method".

Extra care should be taken where the existing aggregate base is less than 8 inches thick at the start of cement treating. Without the additional 2+ inches of existing aggregate base, construction equipment is more likely to cause subgrade instability during construction. Care should also be taken to not mix subgrade materials into the CTB during mixing.

8.5 IMPORTED AGGREGATE BASE MATERIAL (IF REQUIRED)

If, during construction, it is discovered that the existing base material does not meet the recommended minimum thickness or if the removal of saturated base material is necessary to facilitate stabilization efforts, imported aggregate base material may be required.

Any imported aggregate base material should be brought to the site prior to the mixing of CTB, as described in Section 8.4. Imported material must consist of Type 2, Class B aggregate base conforming to Section 200.01 of the SSPWC.

If aggregate base material is required after site mixing has been completed, please contact our office for further guidance.

8.6 ASPHALT CONCRETE PAVEMENT

Based on our local experience, Table 11 presents recommended plantmix recommendations for various project areas.

Table 11: Flexible Pavement Plantmix Recommendations							
Project Area	ESAL Range	Plantmix Aggregate	Air Voids	Blows per Side	Asphalt Binder	Maximum Recycled Asphalt Pavement (%)	Minimum Hydrated Lime by Dry Weight of Aggregate (%)
Local Roads	≤ 10 ⁴	Type 3	3%	50	PG64-28NV	15	1½
NOTES: 1. All plantmix elements shall comply with the SSPWC.							

Densification and placement of asphalt concrete pavement shall be performed in accordance with the recommendations of the SSPWC.

The contractor shall submit a pavement mix design to the owner at least 10 working days prior to construction for approval. It is recommended that when pavement is placed adjacent to concrete flatwork, the finish compacted grade of the pavement be at least ¼ to ½ of an inch higher than the edge of adjacent concrete surface. This is to allow adequate compaction of the pavement without damaging the concrete.

8.7 PAVEMENT MAINTENANCE

Maintenance is mandatory for long-term pavement performance. Maintenance refers to any activity performed on the pavement that is intended to preserve its original service life or load-carrying capacity. Examples of maintenance activities include patching, crack or joint sealing, and seal coats. If these maintenance activities are ignored or deferred, premature failure of the pavement will occur.

The cost associated with proper maintenance is generally much less than the cost for reconstruction due to premature failure of the pavement. Therefore, since pavement quality is an integral consideration in the formulation of our design recommendations, we strongly recommend the owner/project manager implement a pavement management program.

8.8 TESTING & DOCUMENTATION

The recommendations presented in this report are based on the assumption that the owner/project manager provides sufficient field testing and construction review during all phases of construction. These construction observations and testing services should include but not be limited to:

- Engineer approval of all imported material;
- QA testing of concrete, cement, cement treated base, aggregate base, asphalt concrete and other imported materials in accordance with the SSPWC;
- Aggregate base proof-rolling;
- Unstable subgrade remediation;
- Site preparation and grading onsite inspection and compaction testing;
- Asphalt paving onsite inspection and compaction testing.

CME employs a large staff of certified inspectors and testers to provide these services. Prior to construction, the owner/project manager should schedule a preconstruction conference to include, but not be limited to: owner/project manager, project engineer, general contractor, earthwork and materials subcontractors, and geotechnical engineer. It is the owner's/project manager's responsibility to set-up this meeting and contact all responsible parties. The conference will allow parties to review the project plans, specifications, and recommendations presented in this report, and discuss applicable material quality and mix design requirements. All quality control reports should be submitted to the owner/project manager for review and distributed to the appropriate parties.

Additionally, all plans and specifications should be reviewed by the engineer responsible for this geotechnical report to determine if they have been completed in accordance with the recommendations contained herein. It is the owner's/project manager's responsibility to provide the plans and specifications to the geotechnical engineer.

9.0 LIMITATIONS

Exploration Location and Geologic Variations	<ul style="list-style-type: none"> This report has been prepared in accordance with generally accepted local geotechnical practices. The conclusions and recommendations of this report are provided for the design and construction of the proposed project as described in this report. The analyses and recommendations contained herein are based upon field exploration locations included on Plate A-1. Exploration locations included as part of this report should be considered accurate only to the degree implied by the methods used. This report does not reflect soil, rock, or groundwater variations that may become evident during the construction period, at which time re-evaluation of the recommendations may be necessary.
General Intent and Information Distribution	<ul style="list-style-type: none"> The intent of this report is to provide geotechnical information related to construction and design of the project. The owner/project manager is responsible for distribution of this report to all designers and contractors whose work is affected by geotechnical recommendations provided. In the event of changes in the design, location, or ownership of the project prior to construction, our recommendations should be reviewed by our geotechnical representative. If our engineer is not accorded the privilege of making this recommended review, CME can assume no responsibility for misinterpretation or misapplication of their recommendations or their validity in the event changes have been made in the original design concept without our prior review.
Warranties	<ul style="list-style-type: none"> CME makes no other warranties, either expressed or implied, as to the professional advice provided under the terms of this agreement and included in this report. Any use, reliance on, or decisions, which a third party makes based upon the information contained in this report, are the sole responsibility of such third parties. CME accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.
Clay Soil Clause	<ul style="list-style-type: none"> Clay soils may be present in discontinuous areas below the proposed improvements. Clay soils may potentially shrink or swell (volume changes) in response to changes in the moisture content of the soil. Moisture changes in these soils can occur as a result of seasonal variations in precipitation, poor site drainage, landscape irrigation, leaking underground pipes, capillary action, or from other sources. Volume changes in clay soils can cause differential movements in structural elements constructed in the sphere of influence or bearing on the clay soil. The project geotechnical engineer shall be notified where questionable soils are encountered.
Standard Owner Maintenance and Monitoring Responsibility	<ul style="list-style-type: none"> All structures are subjected to deterioration from environmental and manmade exposures. As a result, all structures require frequent monitoring and regular maintenance to prevent damage and/or deterioration. Such monitoring and maintenance are the sole responsibility of the Owner. CME, Inc. shall have no responsibility for such issues or resulting damages.
Environmental Hazards Evaluation	<ul style="list-style-type: none"> Any evaluation of the site for the presence of surface or subsurface hazardous substances is beyond the scope of this study. When suspected hazardous substances are encountered during routine geotechnical investigations, they are noted in the exploration logs and reported to the client.

APPENDIX A



Project Exten

Greenbrae Dr

O St

M St

K St

J St

4th St

4th St

K St

J St

C-24-06

C-24-07

C-24-08

C-24-09

C-24-10

C-24-11

C-24-12

C-24-13

Greenbrae Shopping Center West

ON

CITY OF SPARKS

LEGEND

APPROXIMATE CORE LOCATION

PROJECT/LOCATION

Project No. 3630 Client City of Sparks
 Project Name COS 2025 Drainage & Roadway Project Date 11/19/2024
 Location 5th Street, NB No. 1 Lane (39.54692, -119.75) Logger GP
 3.125" AC

CORE INFORMATION

Surface Material A.C.
 Surface Distress Raveling Rutting N/A
 Surface Cracking Longitudinal (wheelpath) Longitudinal (non-wheelpath) Transverse
 Block Alligator N/A
 Stripping Stripping ___ " thick N/A

CORE LAYER DATA

Core No.	Layer Type	Layer Description	Layer Thickness (in)
C-24-06	AC	Type 2	3 1/8

Total Core Thickness

3 1/8

AGGREGATE BASE INFORMATION

Sample No.	Layer Description	Layer Thickness (in)
C-24-06	Aggregate base, up to 1.5"	10

SUBGRADE INFORMATION

Sample No.	Layer Description	Layer Thickness (in)
C-24-06	Moist, sandy fat clay	12

COMMENTS



10" AB

12" SG

PROJECT/LOCATION

Project No. 3630 Client City of Sparks
Project Name COS 2025 Drainage & Roadway Project Date 11/19/2024
Location 5th Street, SB No. 1 Lane Logger GP
(39.54613, -119.75006)

CORE INFORMATION

Surface Material A.C. Rutting N/A
Surface Distress Raveling Longitudinal (non-wheelpath) Transverse
Surface Cracking Longitudinal (wheelpath) Alligator N/A
Stripping Stripping " thick N/A

CORE LAYER DATA

Core No.	Layer Type	Layer Description	Layer Thickness (in)
C-24-07	AC	Type 2	4

Total Core Thickness 4

AGGREGATE BASE INFORMATION

Sample No.	Layer Description	Layer Thickness (in)
C-24-07	Aggregate base, up to 2"	9 1/2

SUBGRADE INFORMATION

Sample No.	Layer Description	Layer Thickness (in)
C-24-07	Brown, moist, low plastic silty, clayey sand with pockets of medium plastic sandy clay	11 1/2

COMMENTS

TOP



4" AC

9.5" AB

11.5" SG

PROJECT/LOCATION

Project No. 3630 Client City of Sparks
 Project Name COS 2025 Drainage & Roadway Project Date 11/19/2024
 Location L Street, EB No. 1 Lane Logger GP
 (39.54597, -119.75154)

CORE INFORMATION

Surface Material A.C.
 Surface Distress Raveling Rutting N/A
 Surface Cracking Longitudinal (wheelpath) Longitudinal (non-wheelpath) Transverse
 Block Alligator N/A
 Stripping Stripping ___ " thick N/A

CORE LAYER DATA

Core No.	Layer Type	Layer Description	Layer Thickness (in)
C-24-08	AC	Type 2	4

TOP



4" AC

11.5" AB

1" SG

Total Core Thickness 4

AGGREGATE BASE INFORMATION

Sample No.	Layer Description	Layer Thickness (in)
C-24-08	Aggregate base, up to 3"	11 1/2

SUBGRADE INFORMATION

Sample No.	Layer Description	Layer Thickness (in)
C-24-08	Clayey sand	1

COMMENTS

Large 8" cobble encountered at 15.5". Borehole terminated

CME CONSTRUCTION MATERIALS ENGINEERS, INC.

300 Sierra Manor Drive, Suite 1
 Reno, Nevada 89511

CORING RESULTS

CORE

C-24-08

PROJECT/LOCATION

Project No. 3630
Project Name COS 2025 Drainage & Roadway Project
Location L Street, WB No. 1 Lane
(39.54601, -119.7505)

Client City of Sparks
Date 11/19/2024
Logger GP

TOP



CORE INFORMATION

Surface Material A.C.
Surface Distress Raveling Rutting N/A
Surface Cracking Longitudinal (wheelpath) Longitudinal (non-wheelpath) Transverse
 Block Alligator N/A
Stripping Stripping _____ " thick N/A

6" AB

CORE LAYER DATA

Core No.	Layer Type	Layer Description	Layer Thickness (in)
C-24-09	AC	Type 2	3 3/4

Total Core Thickness

3 3/4

AGGREGATE BASE INFORMATION

Sample No.	Layer Description	Layer Thickness (in)
C-24-09	Aggregate base, up to 3"	6

SUBGRADE INFORMATION

Sample No.	Layer Description	Layer Thickness (in)
C-24-09	Silty, clayey sand with _____ and cobbles up to 6"	12

COMMENTS

CORING RESULTS

CORE

C-24-09

PROJECT/LOCATION

Project No. 3630 Client City of Sparks
Project Name COS 2025 Drainage & Roadway Project Date 11/20/2024
Location L Street, EB No. 1 Lane Logger GP
(39.54595, -119.74899)

CORE INFORMATION

Surface Material A.C. N/A
Surface Distress Raveling Rutting N/A
Surface Cracking Longitudinal (wheelpath) Longitudinal (non-wheelpath) Transverse
 Block Alligator N/A
Stripping Stripping ___ " thick N/A

CORE LAYER DATA

Core No.	Layer Type	Layer Description	Layer Thickness (in)
C-24-10	AC	Type 2	3 1/2

Total Core Thickness

3 1/2

AGGREGATE BASE INFORMATION

Sample No.	Layer Description	Layer Thickness (in)
C-24-10	Aggregate base, up to 3/4"	6 1/2

SUBGRADE INFORMATION

Sample No.	Layer Description	Layer Thickness (in)
C-24-10	Coarse grain soil with rounded gravel up to 2.5" Brown, moist low to medium plastic clayey sand	7 7

COMMENTS

CME CONSTRUCTION MATERIALS ENGINEERS, INC.
300 Sierra Manor Drive, Suite 1
Reno, Nevada 89511

CORING RESULTS

CORE

C-24-10

TOP



3.5" AC

6.5" AB

14" SG

PROJECT/LOCATION

Project No. 3630
Project Name COS 2025 Drainage & Roadway Project
Location L Street, WB No. 1 Lane
(39.54595, -119.74681)

Client City of Sparks
Date 11/20/2024
Logger GP

CORE INFORMATION

Surface Material A.C.
Surface Distress Raveling Rutting N/A
Surface Cracking Longitudinal (wheelpath) Longitudinal (non-wheelpath) Transverse
 Block Alligator N/A
Stripping Stripping _____ " thick N/A

CORE LAYER DATA

Core No.	Layer Type	Layer Description	Layer Thickness (in)
C-24-11	AC	Type 2	3 3/4

Total Core Thickness

3 3/4

AGGREGATE BASE INFORMATION

Sample No.	Layer Description	Layer Thickness (in)
C-24-11	Aggregate base, up to 3"	12

SUBGRADE INFORMATION

Sample No.	Layer Description	Layer Thickness (in)
C-24-11	Brown, moist, sandy lean clay	11 1/2

COMMENTS

TOP



12" AB

11.5" SG

PROJECT/LOCATION

Project No. 3630 Client City of Sparks
Project Name COS 2025 Drainage & Roadway Project Date 11/20/2024
Location L Street, EB No. 1 Lane Logger GP
(39.54587, 119.74522) 5.25" AC

CORE INFORMATION

Surface Material A.C.
Surface Distress Raveling Rutting N/A
Surface Cracking Longitudinal (wheelpath) Longitudinal (non-wheelpath) Transverse
 Block Alligator N/A
Stripping Stripping ___ " thick N/A

CORE LAYER DATA

Core No.	Layer Type	Layer Description	Layer Thickness (in)
C-24-12	AC	Type 3	1 3/4
	AC	Type 2	3 1/2
			14.5" AB

Total Core Thickness 5 1/4

AGGREGATE BASE INFORMATION

Sample No.	Layer Description	Layer Thickness (in)
C-24-12	Aggregate base, up to 3"	14 1/2

SUBGRADE INFORMATION

Sample No.	Layer Description	Layer Thickness (in)
C-24-12	Dark grey, moist medium plastic fat clay	7 1/2

COMMENTS

7.5" SG

TOP



PROJECT/LOCATION

Project No. 3630 Client City of Sparks
Project Name COS 2025 Drainage & Roadway Project Date 11/20/2024
Location L Street, WB No. 1 Lane Logger GP
(39.54589, -119.74356)

CORE INFORMATION

Surface Material A.C.
Surface Distress Raveling Rutting N/A
Surface Cracking Longitudinal (wheelpath) Longitudinal (non-wheelpath) Transverse
 Block Alligator N/A
Stripping Stripping ___ " thick N/A

CORE LAYER DATA

Core No.	Layer Type	Layer Description	Layer Thickness (in)
C-24-13	AC	Type 2	3 1/2

Total Core Thickness

3 1/2

AGGREGATE BASE INFORMATION

Sample No.	Layer Description	Layer Thickness (in)
C-24-13	Aggregate base, up to 1"	14

SUBGRADE INFORMATION

Sample No.	Layer Description	Layer Thickness (in)
C-24-13	Grey, moist, sandy lean clay clay	7 1/2

COMMENTS

TOP



3.5" AC

14" AB

7.5" SG

SOIL CLASSIFICATION CHART					
MAJOR DIVISIONS			SYMBOLS		TYPICAL CLASSIFICATION NAMES
			GRAPH	LETTER	
Course grained soils More than 50% of the material is larger than No. 200 sieve size	Gravel and gravelly soils	Clean gravels		GW	Well-graded gravels, gravel-sand mixtures, few or no fines
				GP	Poorly-graded gravels, gravel-sand mixtures, few or no fines
		Gravels with fines		GM	Silty gravels, gravel-sand-silt mixtures
	Sand and sandy soils	Clean sands		SW	Well-graded sands, gravelly sands, few or no fines
				SP	Poorly-graded sands, gravelly sands, few or no fines
		Sands with fines		SM	Silty sands, sand-silt mixtures
Fine grained soils More than 50% of the material is smaller than No. 200 sieve size	Silt and silty soils	Liquid Limit less than 50		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with slight plasticity
				CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
				OL	Organic silts and organic silt-clays of low plasticity
	Clays	Liquid Limit greater than 50		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
				CH	Inorganic clays of medium to high plasticity
				OH	Organic clays of medium to high plasticity
			PT	Peat or other highly organic soils	

NOTES:
1. Dual classifications may occur (e.g. SP-SM, CL-ML, GP-GC)

PARTICLE ANGULARITY	
Angular	Particles have sharp edges and relatively plane sides with unpolished surfaces
Subangular	Particles are similar to angular, but have rounded edges
Subrounded	Particles have nearly plane sides, but have well-rounded corners and edges
Rounded	Particles have smoothly curved sides and no edges

PARTICLE SHAPE	
Flat	Particles with width/thickness >3
Elongated	Particles with length/width >3
Flat and Elongated	Particles meet criteria for both flat and elongated

MOISTURE	
Dry	No discernable moisture
Moist	Moisture present, but no free water
Wet	Visible free water

CEMENTATION	
Weak	Crumbles or breaks with handling or light finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

PARTICLE SIZE, Ps	
Boulders	Ps > 12"
Cobbles	3" < Ps ≤ 12"
Gravel	coarse 3/4" < Ps ≤ 3"
	fine 3/16" < Ps ≤ 3/4"
Sand	coarse 1/16" < Ps ≤ 3/8"
	medium 1/64" < Ps ≤ 1/16"
	fine 1/300" < Ps ≤ 1/64"
Fines	Ps ≤ 1/300"

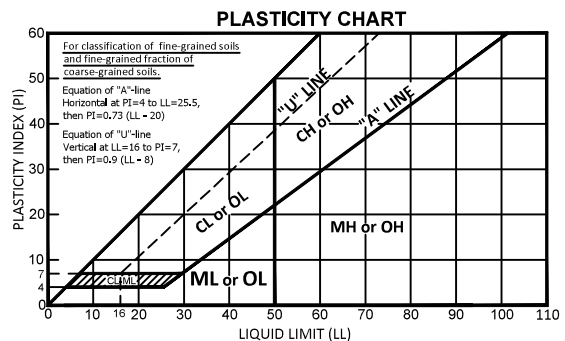
PERCENT OF SOIL, Pp	
Trace	Pp < 5%
Few	5 ≤ Pp ≤ 15%
Little	15 ≤ Pp ≤ 30%
Some	30 ≤ Pp ≤ 50%
Mostly	50 ≤ Pp ≤ 100%

SOIL SAMPLE TYPES

- Bulk Sample
- Grab Sample
- Standard Penetration Test (2.0" OD, 1.42" ID)
- California Modified Sampler (3.0" OD, 2.42" ID)
- Thin walled Shelby Tube (3.0" OD)
- Rock Core

GROUNDWATER SYMBOLS

- Water level during drilling
- Water level after drilling



APPARENT DENSITY OF COHESIONLESS SOIL	
	SPT (1.4" ID) N ₆₀
Very Loose	< 5
Loose	5 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	> 50

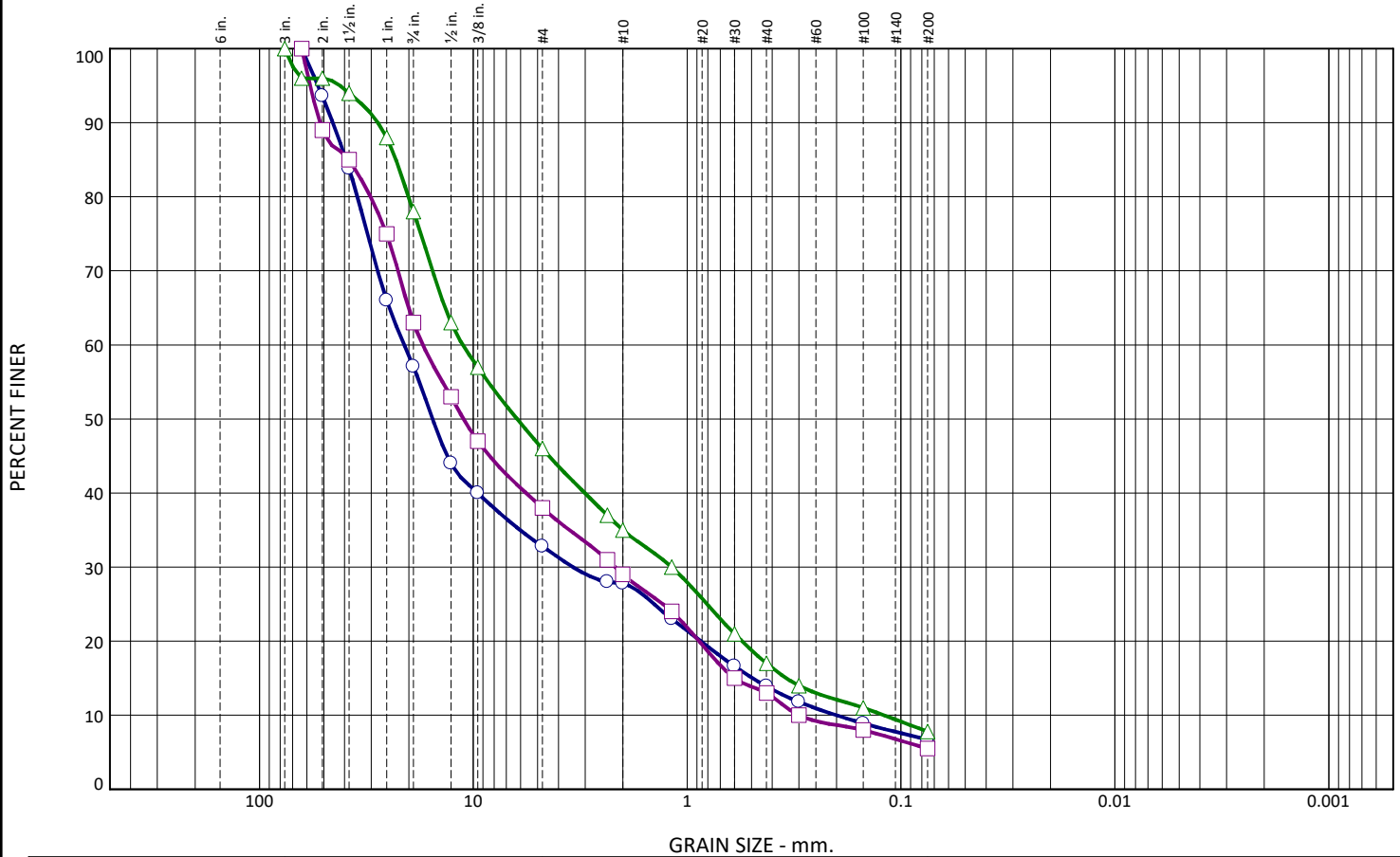
Based on 60% energy ratio (ER). $N_{60} = N_{measured} * (ER/60)$
California Modified Sampler can be corrected to SPT by multiplying by 0.62

CONSISTENCY OF COHESIVE SOIL			
	SPT (1.4" ID) N ₆₀	Unconfined Compressive Strength (psf)	Pocket Penetrometer (tsf)
Very Soft	0 - 1	< 500	< 0.25
Soft	2 - 4	500 - 1,000	0.25 - 0.5
Medium Stiff	5 - 8	1,000 - 2,000	0.5 - 1.0
Stiff	9 - 15	2,000 - 4,000	1.0 - 2.0
Very Stiff	16 - 30	4,000 - 8,000	2.0 - 4.0
Hard	31 - 60	8,000 - 16,000	> 4.0
Very Hard	> 60	> 16,000	

APPENDIX B

Particle Size Distribution Report

ASTM C117 & C136



	% +3"	% Gravel		% Sand			% Fines			
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay		
○	0.0	42.9	24.3	5.0	13.9	7.2	6.7			
□	0.0	37.0	25.0	9.0	16.0	7.5	5.5			
△	0.0	22.0	32.0	11.0	18.0	9.2	7.8			
×	LL	PL	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
○	23	18	39.3149	20.9980	15.5014	3.4173	0.4937	0.2005	2.77	104.71
□	NV	NP	38.1000	17.2279	11.1071	2.1735	0.6000	0.3000	0.91	57.43
△	23	19	23.0001	11.2116	6.2396	1.1800	0.3431	0.1204	1.03	93.12

Material Description	Test Date	USCS	NM
○ well-graded gravel with silty clay and sand		GW-GC	
□ poorly graded gravel with silt and sand		GP-GM	
△ well-graded gravel with silty clay and sand		GW-GC	

Project No. 3630 **Client:** CITY OF SPARKS
Project: 2025-2027 COS DRAINAGE & ROADWAY PROJECTS

 ○ **Source of Sample:** C-24-06 & C-24-07 **Sample Number:** BASE
 □ **Source of Sample:** C-24-08,09, & 10 **Sample Number:** BASE
 △ **Source of Sample:** C-24-11,12, & 13 **Sample Number:** BASE

Remarks:

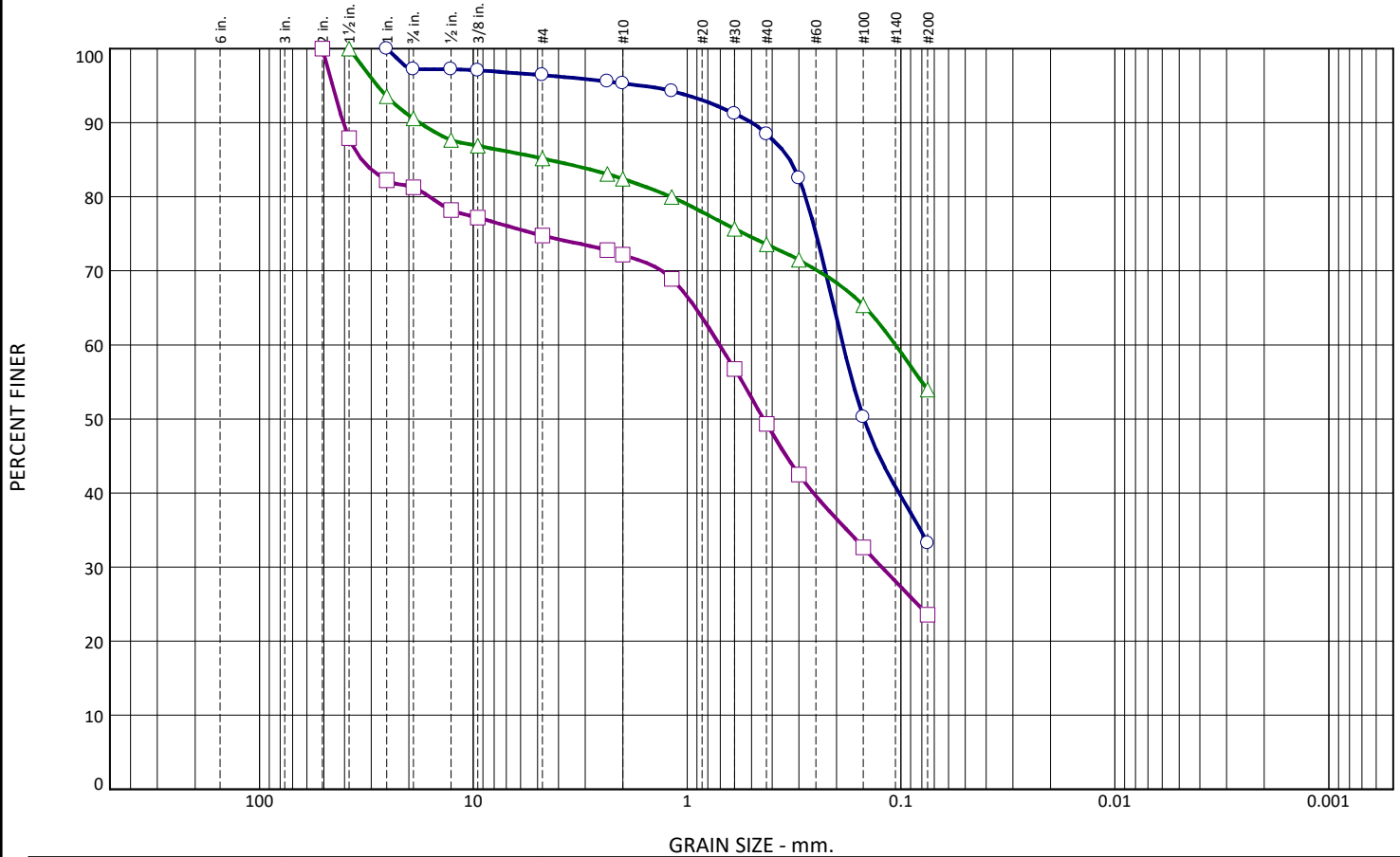
PLATE



Checked By: _____

Particle Size Distribution Report

ASTM C117 & C136



	% +3"	% Gravel		% Sand			% Fines
		Coarse	Fine	Coarse	Medium	Fine	
○	0.0	2.8	0.8	1.1	6.8	55.3	33.2
□	0.0	18.7	6.5	2.6	22.9	25.7	23.6
△	0.0	9.4	5.4	2.8	8.8	19.6	54.0

	LL	PL	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
○	28	21	0.3305	0.1866	0.1489					
□	22	18	33.2552	0.7058	0.4387	0.1229				
△	36	21	4.4589	0.1061						

Material Description	Test Date	USCS	NM
○ silty, clayey sand	12/17/2024	SC-SM	18.6
□ silty, clayey sand with gravel	12/17/2024	SC-SM	9.7
△ sandy lean clay	12/12/2024	CL	20.7

Project No. 3630 **Client:** CITY OF SPARKS
Project: 2025-2027 COS DRAINAGE & ROADWAY PROJECTS

○ **Source of Sample:** C-24-07 **Sample Number:** SUBGRADE
□ **Source of Sample:** C-24-09 **Sample Number:** SUBGRADE
△ **Source of Sample:** C-24-11 **Sample Number:** SUBGRADE

Remarks:

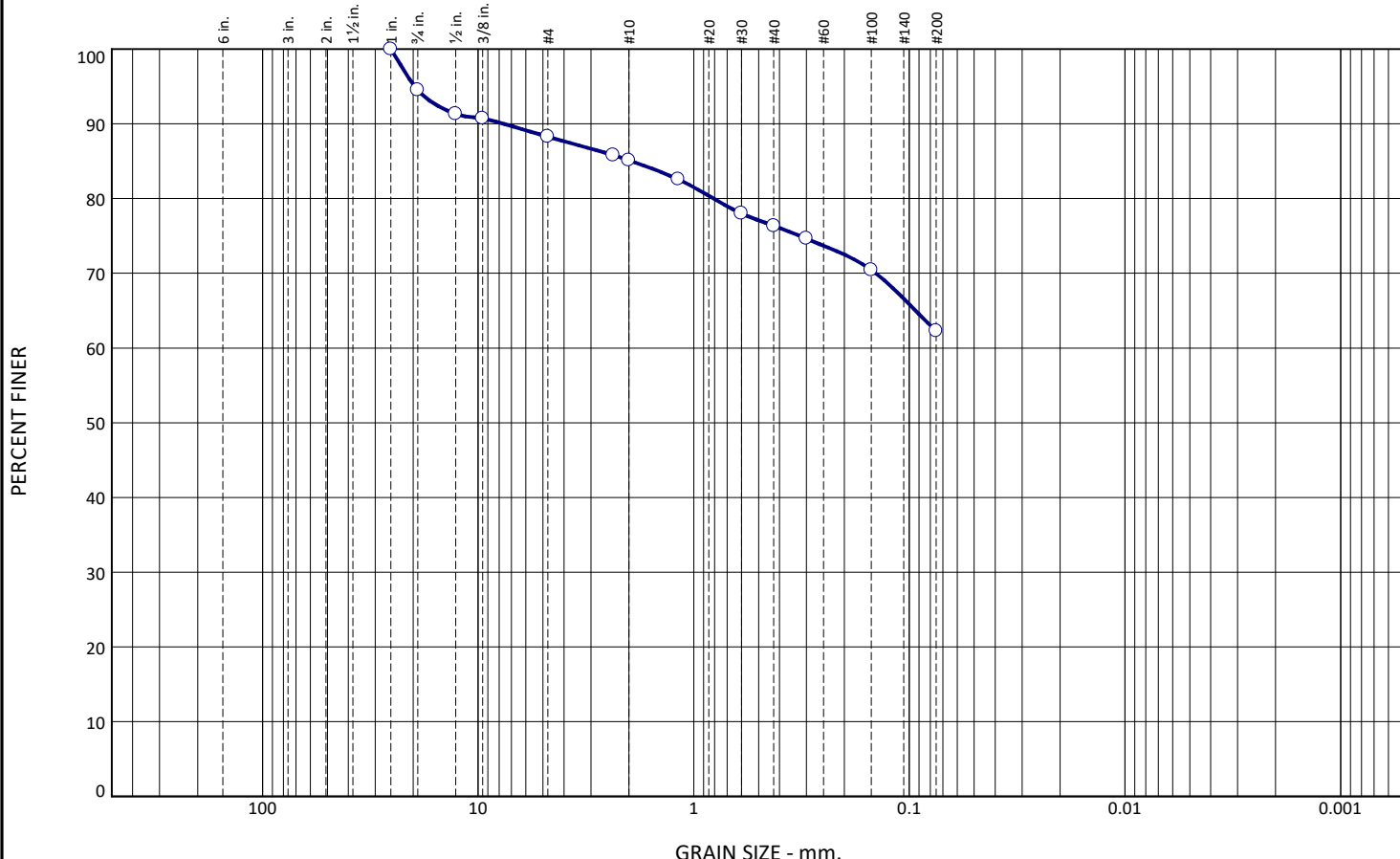


PLATE

Checked By: S. SCHWEITZER

Particle Size Distribution Report

ASTM C117 & C136



%	+3"	% Gravel		% Sand			% Fines
		Coarse	Fine	Coarse	Medium	Fine	
<input type="radio"/>	0.0	5.5	6.2	3.2	8.8	14.0	62.3

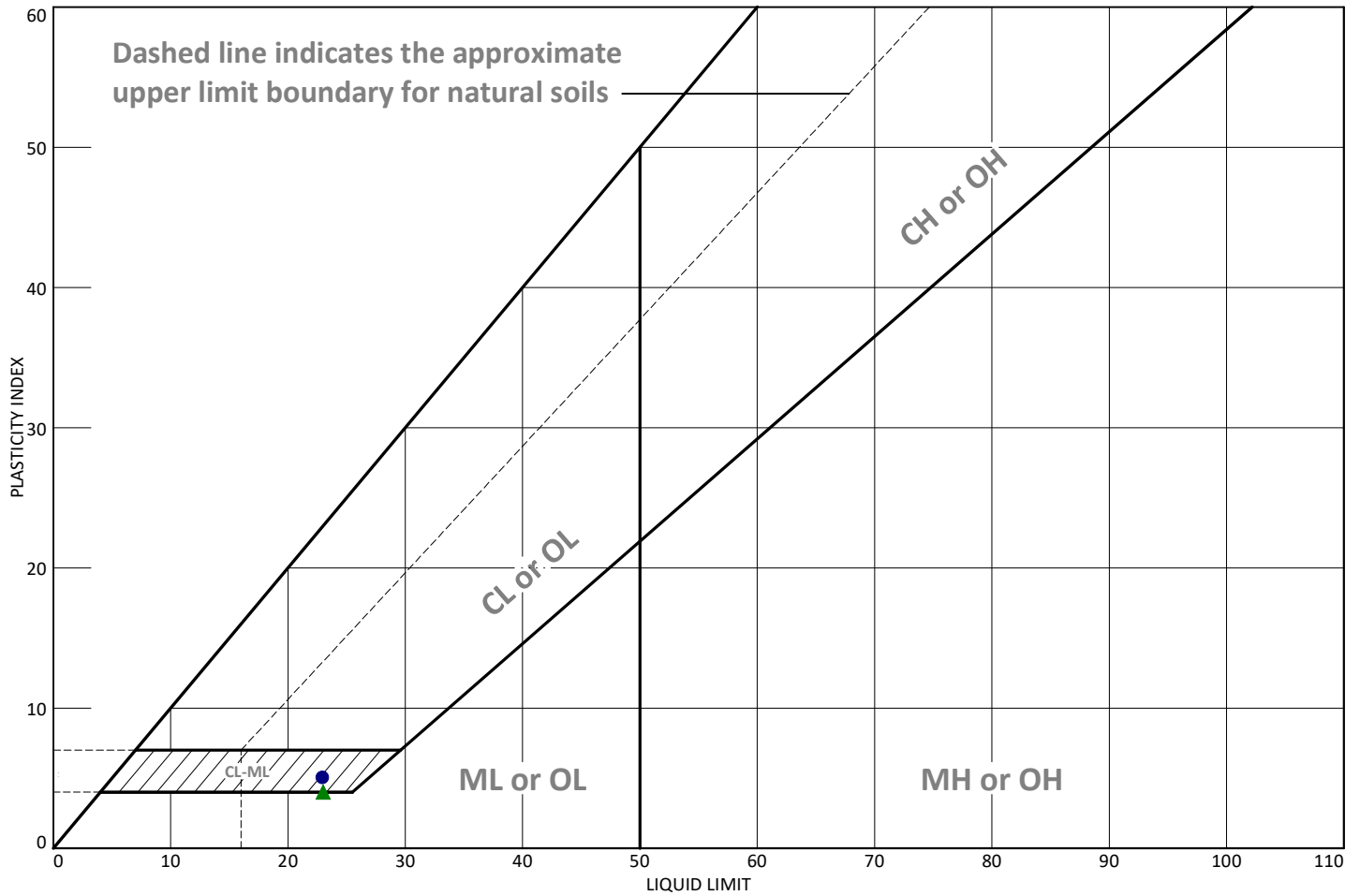
	LL	PL	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
<input type="radio"/>	46	19	1.9468							

Material Description	Test Date	USCS	NM
<input type="radio"/> sandy lean clay	12/12/2024	CL	22.9

Project No. 3630 Client: CITY OF SPARKS Project: 2025-2027 COS DRAINAGE & ROADWAY PROJECTS <input type="radio"/> Source of Sample: C-24-13 Sample Number: SUBGRADE	Remarks: <div style="text-align: right; font-weight: bold;">PLATE</div>

Checked By: S. SCHWEITZER

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	well-graded gravel with silty clay and sand	23	18	5	13.9	6.7	GW-GC
■	poorly graded gravel with silt and sand	NV	NP	NP	13.0	5.5	GP-GM
▲	well-graded gravel with siltyclay and sand	23	19	4	17.0	7.8	GW-GC

Project No. 3630 Client: CITY OF SPARKS

Project: 2025-2027 COS DRAINAGE & ROADWAY PROJECTS

● Source of Sample: C-24-06 & C-24-07 Sample Number: BASE

■ Source of Sample: C-24-08,09, & 10 Sample Number: BASE

▲ Source of Sample: C-24-11,12, & 13 Sample Number: BASE

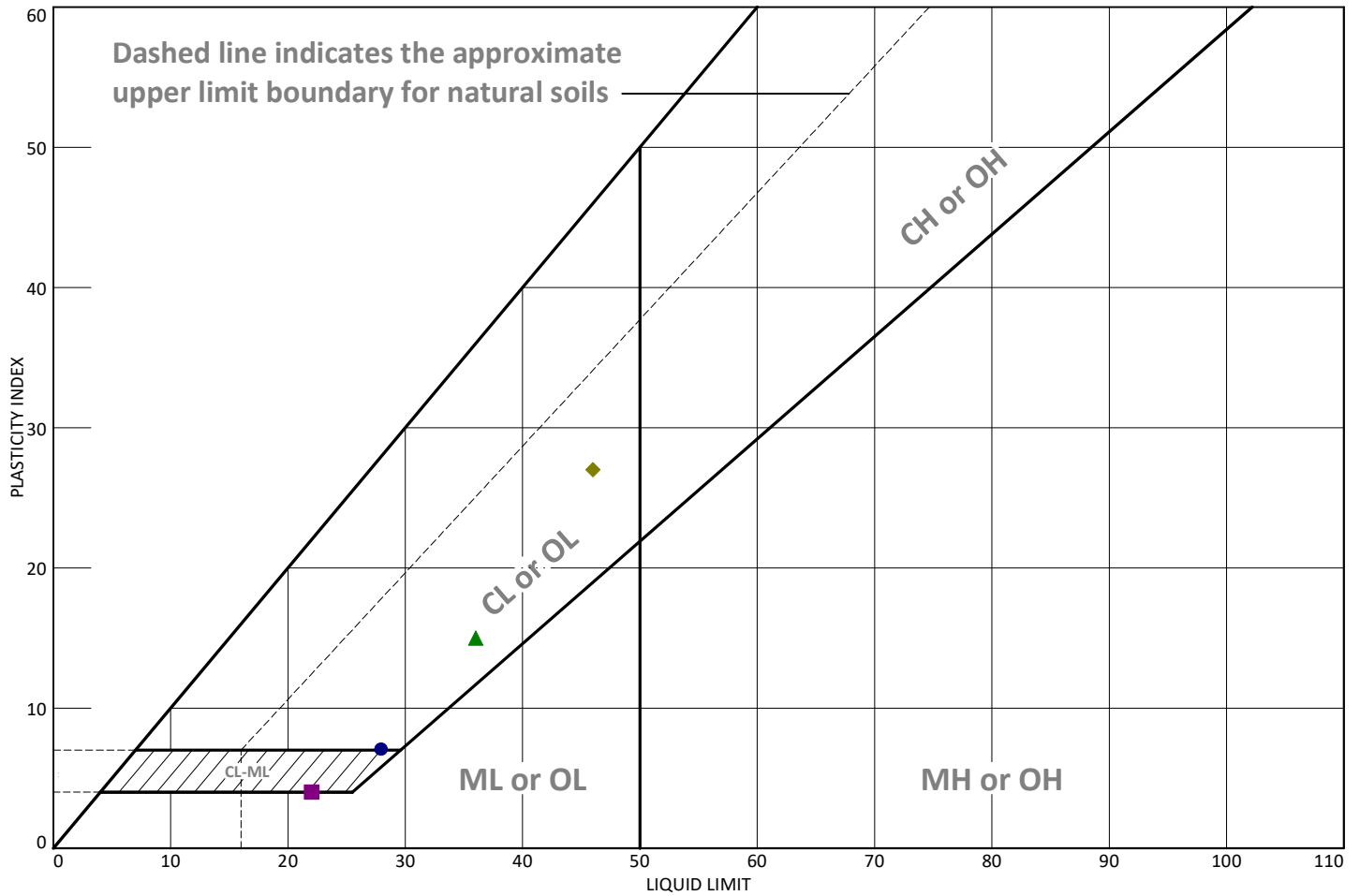
Remarks:



PLATE

Checked By: _____

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	silty, clayey sand	28	21	7	88.5	33.2	SC-SM
■	silty, clayey sand with gravel	22	18	4	49.3	23.6	SC-SM
▲	sandy lean clay	36	21	15	73.6	54.0	CL
◆	sandy lean clay	46	19	27	76.3	62.3	CL

Project No. 3630 **Client:** CITY OF SPARKS
Project: 2025-2027 COS DRAINAGE & ROADWAY PROJECTS

 ● **Source of Sample:** C-24-07 **Sample Number:** SUBGRADE
 ■ **Source of Sample:** C-24-09 **Sample Number:** SUBGRADE
 ▲ **Source of Sample:** C-24-11 **Sample Number:** SUBGRADE
 ◆ **Source of Sample:** C-24-13 **Sample Number:** SUBGRADE

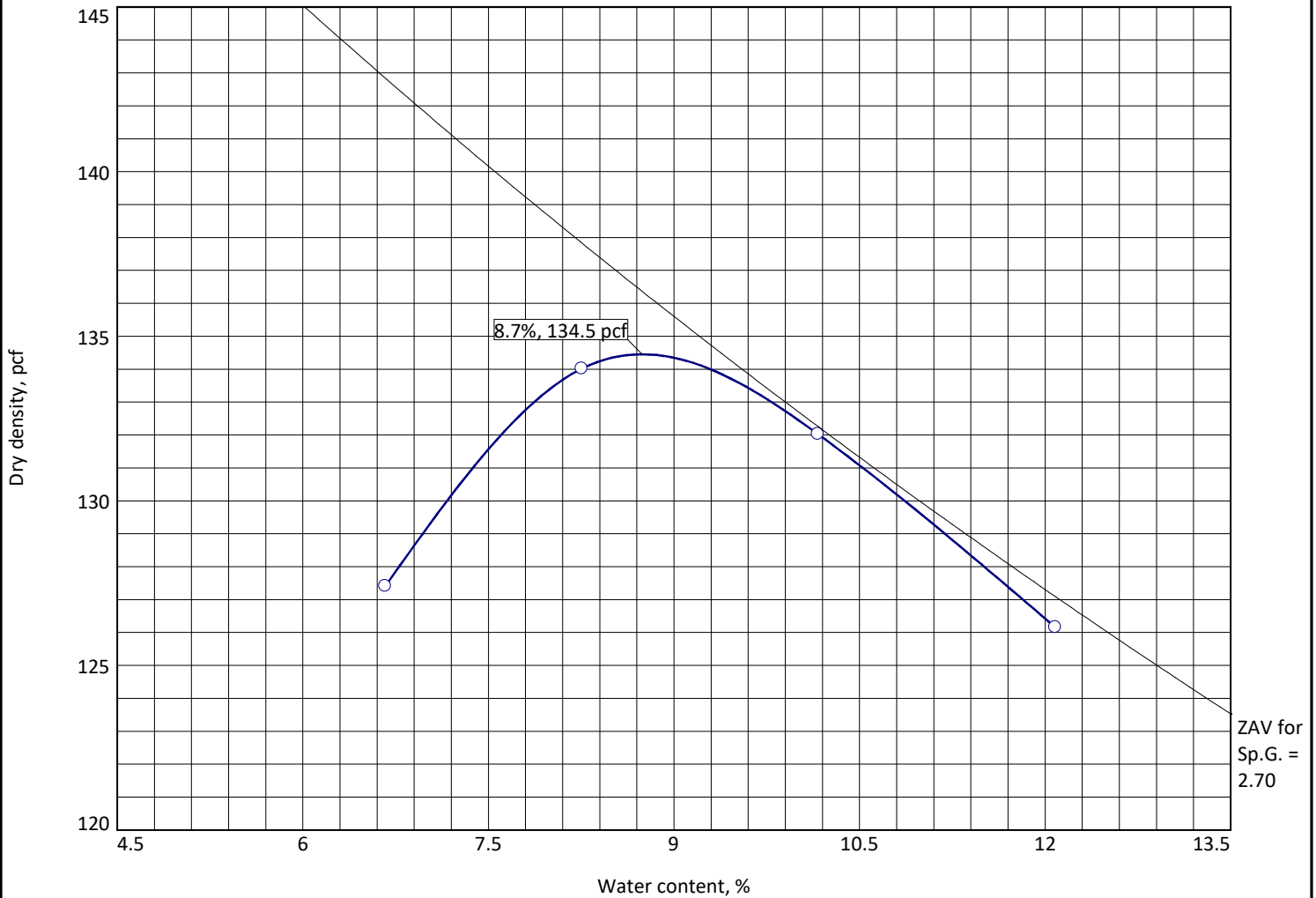
Remarks:



PLATE


Tested By: ○ V. GONZALEZ □ E. MILLIKEN ▲ E. MILLIKEN ◆ E. MILLIKEN Checked By: S. SCHWEITZER

MOISTURE DENSITY CURVE for Curve No. 39452



Test specification: AASHTO T 99-22 Method A Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > #4	% < No.200
	USCS	AASHTO						

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 134.5 pcf Optimum moisture = 8.7 %	DARK BROWN SILTY SAND W/ GRAVEL EXISTING AGG. BASE W/ 3% CEMENT.
Project No. 3630 Client: CITY OF SPARKS Project: 2025-2027 COS DRAINAGE & ROADWAY PROJECTS Date: _____ Source of Sample: C-24-06,07,08,09,10,11,12, & 13 Sample Number: 39452	Remarks:
	PLATE

Tested By: M. PONTONI Checked By: N. ANDERSON

SOIL-ADDITIVE UNCONFINED COMPRESSIVE STRENGTH TEST

CLIENT:	CITY OF SPARKS			JOB NO:	3630
PROJECT:	2026 CITY OF SPARKS NEIGHBORHOOD DRAINAGE AND ROADWAY PROJECTS			LOG IN NO.:	39452
SAMPLE LOCATION:	C-24-06, C-24-07, C-24-08, C-24-09, C-24-10, C-24-11, C-24-12, C-24-13			DATE:	12/10/2024
MATERIAL SOURCE:	100% AGGREGATE BASE			SAMPLED BY:	GP
AS RECEIVED USCS:				DATE COMPLETED	12/10/2024
MATERIAL DESCRIPTION:	COMPOSITE CTB			TESTED BY:	MP
MAX DENSITY METHOD:	D558	OPTIMUM MOISTURE (%):	8.9	MAXIMUM DRY DENSITY (pcf):	134.2

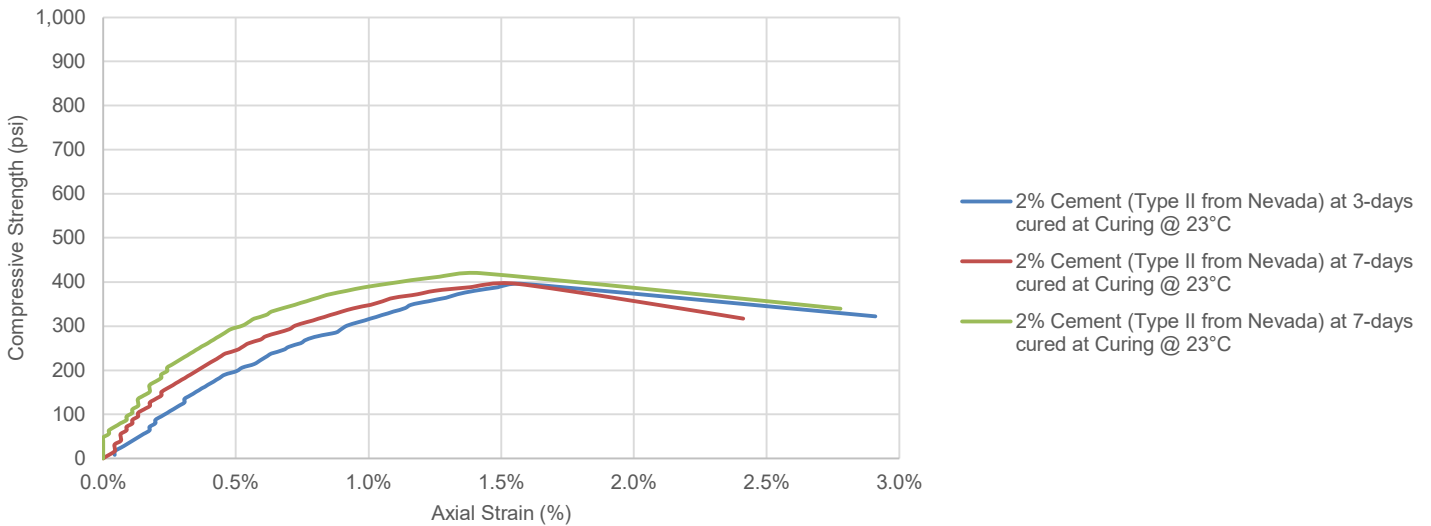
	Percent Additive by Dry Weight of Soil (%)			
	2%	2%	2%	
Additive	Cement	Cement	Cement	
Additive Type	Type II	Type II	Type II	
Additive Source	Nevada	Nevada	Nevada	
ASTM Standard	D1633	D1633	D1633	
Preparation Procedure	A	A	A	
Post Additive USCS Classification	-	-	-	
Mellow Period (hrs)	-	-	-	
Curing Duration (days)	3	7	7	
Curing Environment	Curing @ 23°C	Curing @ 23°C	Curing @ 23°C	
Initial Specimen Diameter (in)	4.01	4.02	4.02	
Initial Specimen Height (in)	4.57	4.56	4.57	
Initial Specimen Cross Sectional Area (in ²)	12.63	12.69	12.69	
Before Curing				
Moisture Content (%)	8.8	8.8	8.8	
Moist Unit Weight (pcf)	144.2	144.9	144.9	
Dry Unit Weight (pcf)	132.5	133.2	133.2	
Relative Compaction per D558 (%)	98.8	99.2	99.2	
After Curing				
Moisture Content (%)	9.1	9.2	9.3	
Moist Unit Weight (pcf)	144.6	145.4	145.6	
Dry Unit Weight (pcf)	132.5	133.2	133.2	
Stress-Strain Data				
Strain Rate (%/min)	0.05	0.05	0.05	
Change in Specimen Height at Failure (in)	0.072	0.071	0.065	
Strain at Failure (%)	1.6	1.6	1.4	
Failure Type	Brittle Failure	Brittle Failure	Brittle Failure	
Cross Sectional Area at Failure (in ²)	12.63	12.63	12.63	
Maximum Compressive Load (lbs)	4,999	5,004	5,342	
Unconfined Compressive Strength (psi)	396	396	423	
Curing Duration (days)	3	7	7	
Curing Environment	D1632	D1632	D1632	

SOIL-ADDITIVE UNCONFINED COMPRESSIVE STRENGTH TEST

CLIENT:	CITY OF SPARKS			JOB NO:	3630
PROJECT:	2026 CITY OF SPARKS NEIGHBORHOOD DRAINAGE AND ROADWAY PROJECTS			LOG IN NO.:	39452
SAMPLE LOCATION:	C-24-06, C-24-07, C-24-08, C-24-09, C-24-10, C-24-11, C-24-12, C-24-13			DATE:	12/10/2024
MATERIAL SOURCE:	100% AGGREGATE BASE			SAMPLED BY:	GP
AS RECEIVED USCS:				DATE COMPLETED	12/10/2024
MATERIAL DESCRIPTION:	COMPOSITE CTB			TESTED BY:	MP
MAX DENSITY METHOD:	D558	OPTIMUM MOISTURE (%):	8.9	MAXIMUM DRY DENSITY (pcf):	134.2

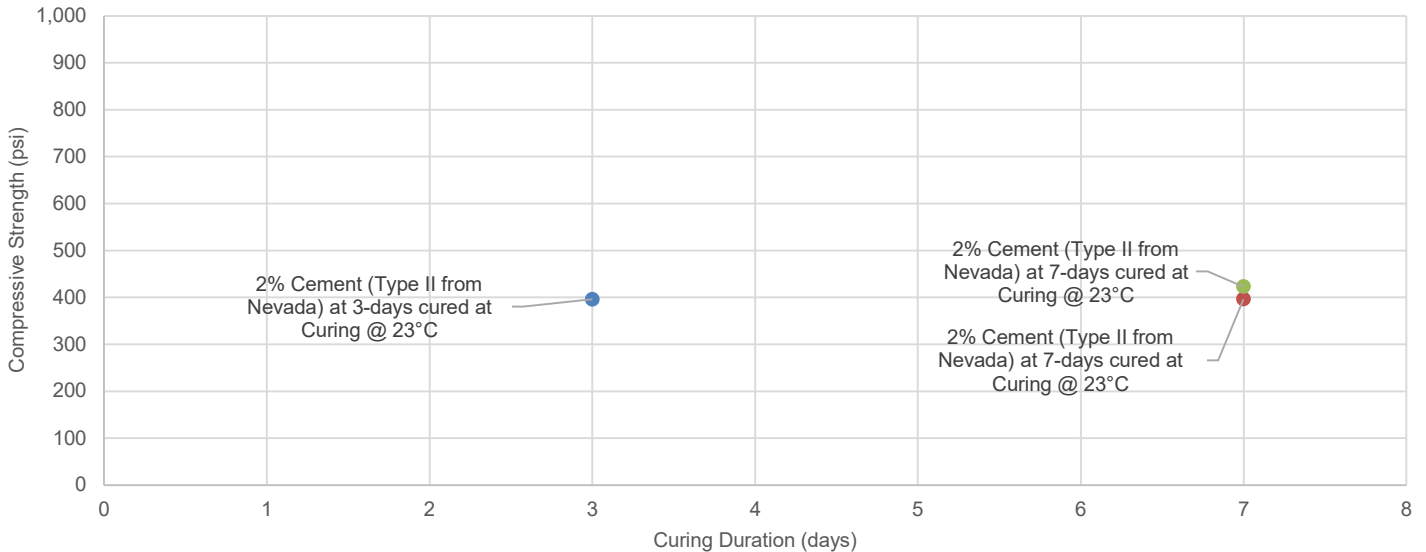
Stress-Strain Curves

Stress-Strain Curve



Stress Time Gain Curves

Stress Time Gain Curve



SOIL-ADDITIVE UNCONFINED COMPRESSIVE STRENGTH TEST

CLIENT:	CITY OF SPARKS			JOB NO:	3630
PROJECT:	2026 CITY OF SPARKS NEIGHBORHOOD DRAINAGE AND ROADWAY PROJECTS			LOG IN NO.:	39452
SAMPLE LOCATION:	C-24-06, C-24-07, C-24-08, C-24-09, C-24-10, C-24-11, C-24-12, C-24-13			DATE:	12/10/2024
MATERIAL SOURCE:	100% AGGREGATE BASE			SAMPLED BY:	GP
AS RECEIVED USCS:				DATE COMPLETED	12/10/2024
MATERIAL DESCRIPTION:	COMPOSITE CTB			TESTED BY:	MP
MAX DENSITY METHOD:	D558	OPTIMUM MOISTURE (%):	8.9	MAXIMUM DRY DENSITY (pcf):	134.2

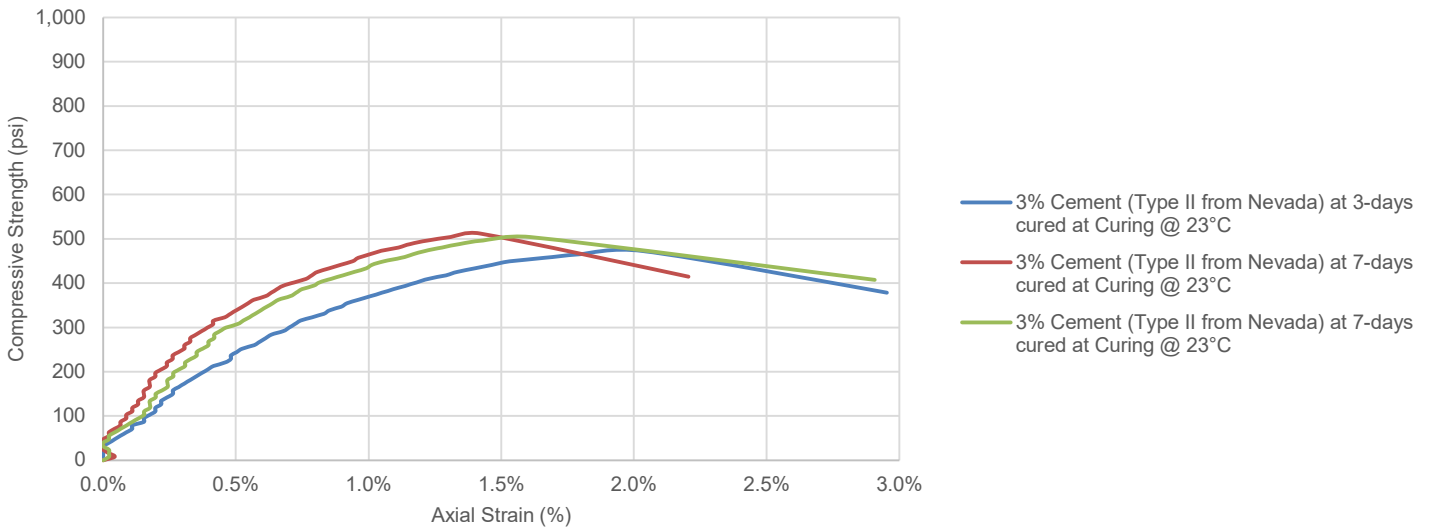
	Percent Additive by Dry Weight of Soil (%)			
	3%	3%	3%	
Additive	Cement	Cement	Cement	
Additive Type	Type II	Type II	Type II	
Additive Source	Nevada	Nevada	Nevada	
ASTM Standard	D1633	D1633	D1633	
Preparation Procedure	A	A	A	
Post Additive USCS Classification	-	-	-	
Mellow Period (hrs)	-	-	-	
Curing Duration (days)	3	7	7	
Curing Environment	Curing @ 23°C	Curing @ 23°C	Curing @ 23°C	
Initial Specimen Diameter (in)	4.02	4.02	4.02	
Initial Specimen Height (in)	4.57	4.58	4.54	
Initial Specimen Cross Sectional Area (in ²)	12.69	12.69	12.69	
Before Curing				
Moisture Content (%)	8.7	8.7	8.7	
Moist Unit Weight (pcf)	145.3	145	145.4	
Dry Unit Weight (pcf)	133.7	133.4	133.8	
Relative Compaction per D558 (%)	99.6	99.4	99.7	
After Curing				
Moisture Content (%)	9	9.2	8.8	
Moist Unit Weight (pcf)	145.7	145.7	145.5	
Dry Unit Weight (pcf)	133.7	133.4	133.8	
Stress-Strain Data				
Strain Rate (%/min)	0.05	0.05	0.05	
Change in Specimen Height at Failure (in)	0.097	0.068	0.075	
Strain at Failure (%)	2.0	1.4	1.6	
Failure Type	Brittle Failure	Brittle Failure	Brittle Failure	
Cross Sectional Area at Failure (in ²)	12.69	12.69	12.69	
Maximum Compressive Load (lbs)	6,000	6,518	6,418	
Unconfined Compressive Strength (psi)	473	514	506	
Curing Duration (days)	3	7	7	
Curing Environment	D1632	D1632	D1632	

SOIL-ADDITIVE UNCONFINED COMPRESSIVE STRENGTH TEST

CLIENT:	CITY OF SPARKS			JOB NO:	3630
PROJECT:	2026 CITY OF SPARKS NEIGHBORHOOD DRAINAGE AND ROADWAY PROJECTS			LOG IN NO.:	39452
SAMPLE LOCATION:	C-24-06, C-24-07, C-24-08, C-24-09, C-24-10, C-24-11, C-24-12, C-24-13			DATE:	12/10/2024
MATERIAL SOURCE:	100% AGGREGATE BASE			SAMPLED BY:	GP
AS RECEIVED USCS:				DATE COMPLETED	12/10/2024
MATERIAL DESCRIPTION:	COMPOSITE CTB			TESTED BY:	MP
MAX DENSITY METHOD:	D558	OPTIMUM MOISTURE (%):	8.9	MAXIMUM DRY DENSITY (pcf):	134.2

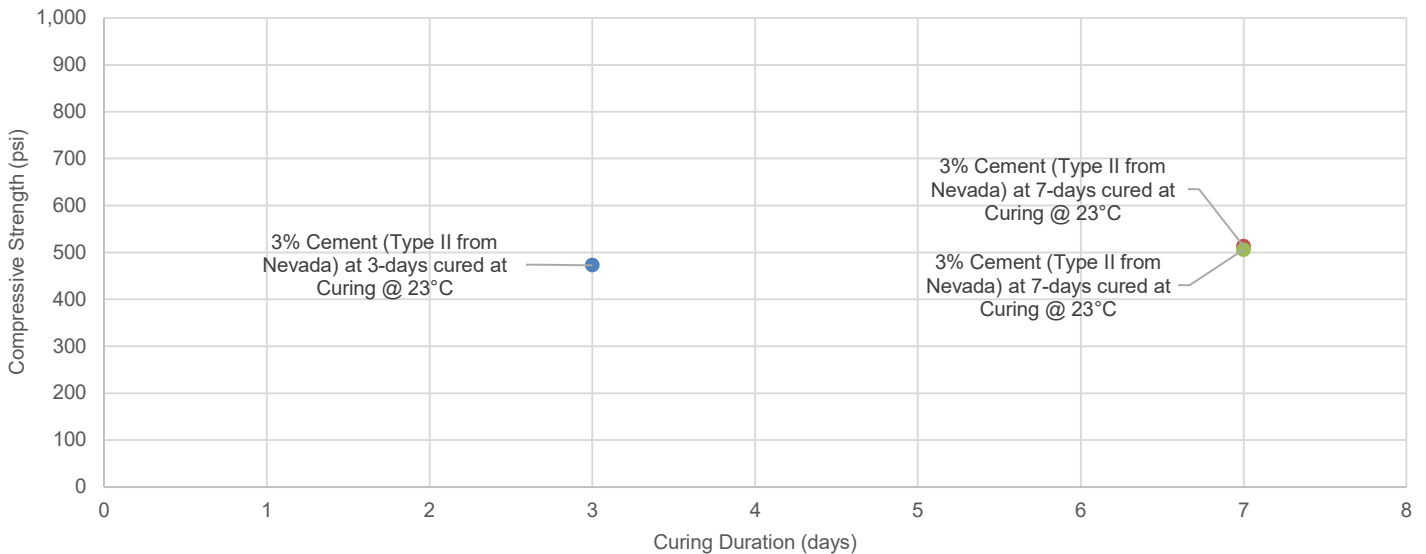
Stress-Strain Curves

Stress-Strain Curve



Stress Time Gain Curves

Stress Time Gain Curve



SOIL-ADDITIVE UNCONFINED COMPRESSIVE STRENGTH TEST

CLIENT:	CITY OF SPARKS			JOB NO:	3630
PROJECT:	2026 CITY OF SPARKS NEIGHBORHOOD DRAINAGE AND ROADWAY PROJECTS			LOG IN NO.:	39452
SAMPLE LOCATION:	C-24-06, C-24-07, C-24-08, C-24-09, C-24-10, C-24-11, C-24-12, C-24-13			DATE:	12/10/2024
MATERIAL SOURCE:	100% AGGREGATE BASE			SAMPLED BY:	GP
AS RECEIVED USCS:				DATE COMPLETED	12/10/2024
MATERIAL DESCRIPTION:	COMPOSITE CTB			TESTED BY:	MP
MAX DENSITY METHOD:	D558	OPTIMUM MOISTURE (%):	8.9	MAXIMUM DRY DENSITY (pcf):	134.2

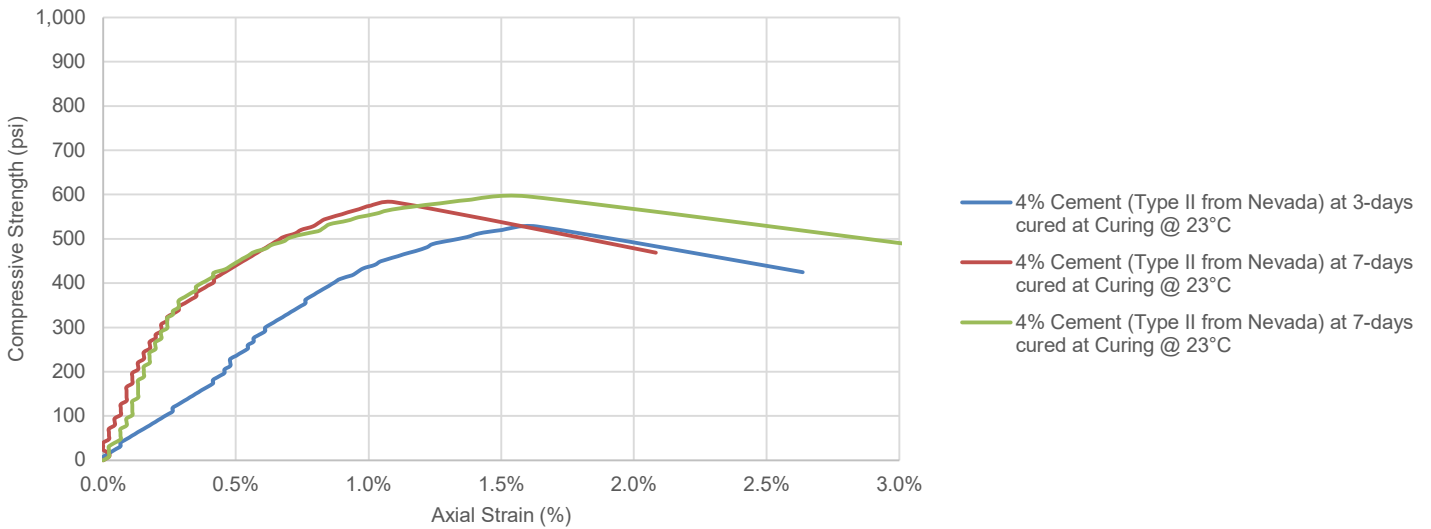
	Percent Additive by Dry Weight of Soil (%)			
	4%	4%	4%	
Additive	Cement	Cement	Cement	
Additive Type	Type II	Type II	Type II	
Additive Source	Nevada	Nevada	Nevada	
ASTM Standard	D1633	D1633	D1633	
Preparation Procedure	A	A	A	
Post Additive USCS Classification	-	-	-	
Mellow Period (hrs)	-	-	-	
Curing Duration (days)	3	7	7	
Curing Environment	Curing @ 23°C	Curing @ 23°C	Curing @ 23°C	
Initial Specimen Diameter (in)	4.02	4.02	4.03	
Initial Specimen Height (in)	4.59	4.56	4.57	
Initial Specimen Cross Sectional Area (in ²)	12.69	12.69	12.76	
Before Curing				
Moisture Content (%)	8.6	8.6	8.6	
Moist Unit Weight (pcf)	145.5	144.8	145.7	
Dry Unit Weight (pcf)	134.0	133.3	134.2	
Relative Compaction per D558 (%)	99.8	99.4	100.0	
After Curing				
Moisture Content (%)	8.7	9.1	9.1	
Moist Unit Weight (pcf)	145.6	145.5	146.4	
Dry Unit Weight (pcf)	134.0	133.3	134.2	
Stress-Strain Data				
Strain Rate (%/min)	0.05	0.05	0.05	
Change in Specimen Height at Failure (in)	0.079	0.052	0.077	
Strain at Failure (%)	1.6	1.1	1.6	
Failure Type	Brittle Failure	Brittle Failure	Brittle Failure	
Cross Sectional Area at Failure (in ²)	12.69	12.69	12.76	
Maximum Compressive Load (lbs)	6,697	7,447	7,619	
Unconfined Compressive Strength (psi)	528	587	597	
Curing Duration (days)	3	7	7	
Curing Environment	D1632	D1632	D1632	

SOIL-ADDITIVE UNCONFINED COMPRESSIVE STRENGTH TEST

CLIENT:	CITY OF SPARKS			JOB NO:	3630
PROJECT:	2026 CITY OF SPARKS NEIGHBORHOOD DRAINAGE AND ROADWAY PROJECTS			LOG IN NO.:	39452
SAMPLE LOCATION:	C-24-06, C-24-07, C-24-08, C-24-09, C-24-10, C-24-11, C-24-12, C-24-13			DATE:	12/10/2024
MATERIAL SOURCE:	100% AGGREGATE BASE			SAMPLED BY:	GP
AS RECEIVED USCS:				DATE COMPLETED	12/10/2024
MATERIAL DESCRIPTION:	COMPOSITE CTB			TESTED BY:	MP
MAX DENSITY METHOD:	D558	OPTIMUM MOISTURE (%):	8.9	MAXIMUM DRY DENSITY (pcf):	134.2

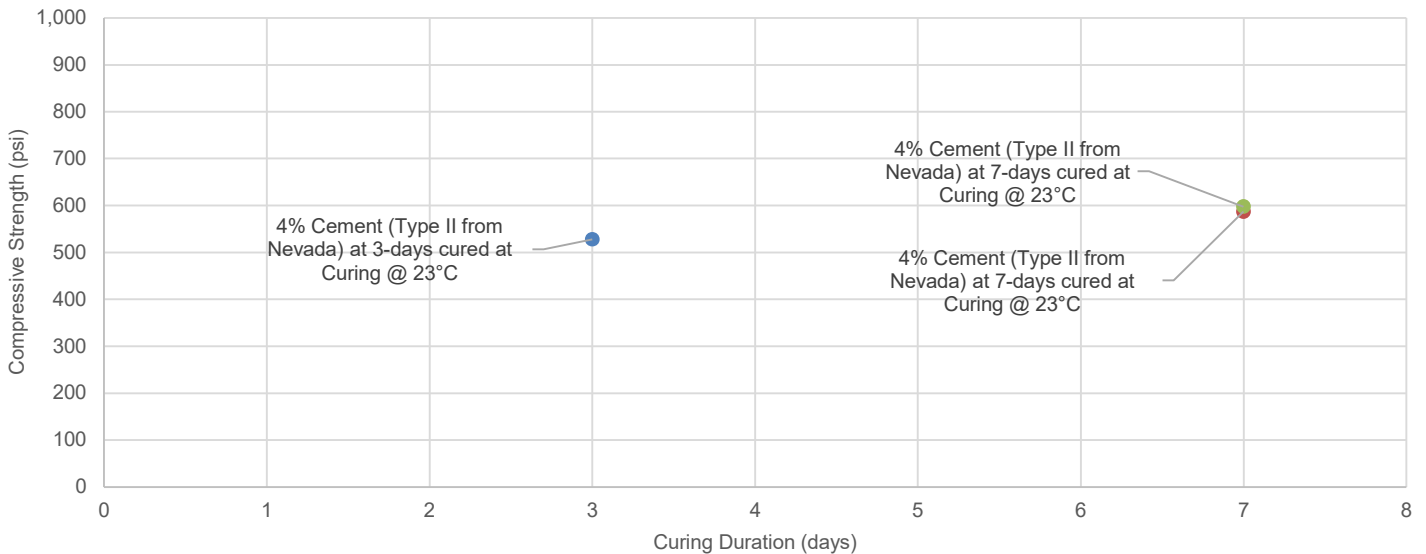
Stress-Strain Curves

Stress-Strain Curve

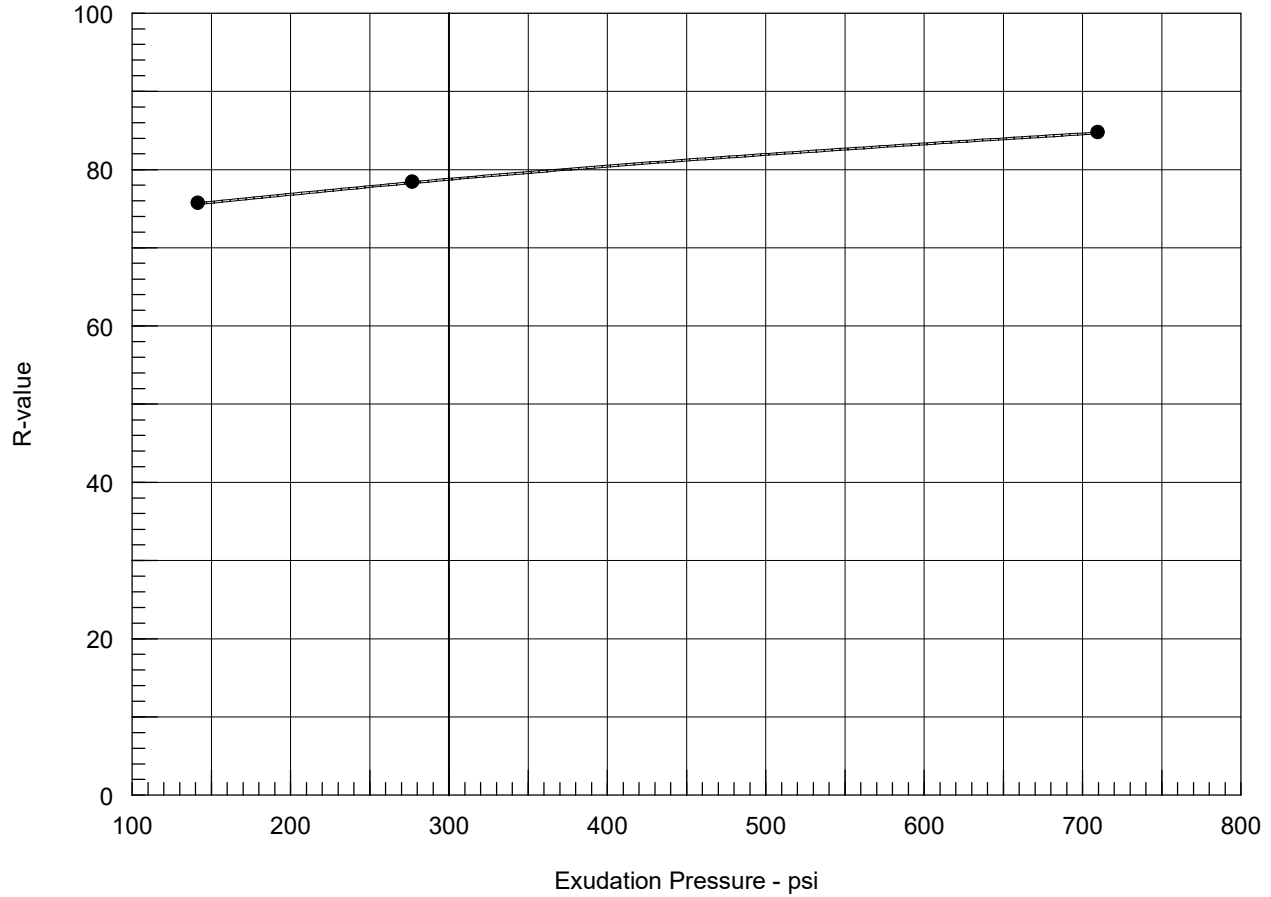


Stress Time Gain Curves

Stress Time Gain Curve




R-VALUE TEST REPORT

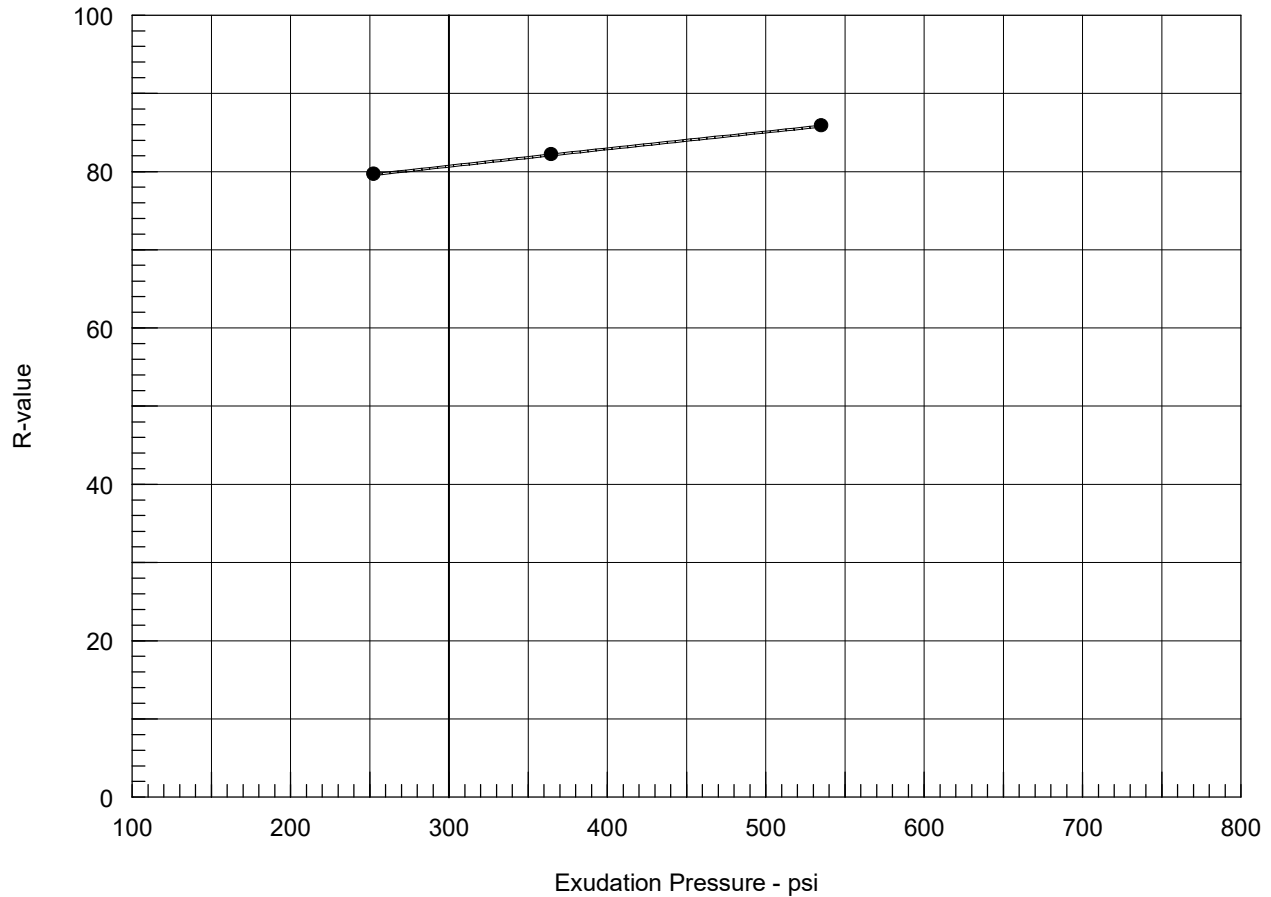


Resistance R-Value and Expansion Pressure - ASTM D2844

No.	Compact. Pressure psi	Density pcf	Moist. %	Expansion Pressure psi	Horizontal Press. psi @ 160 psi	Sample Height in.	Exud. Pressure psi	R Value	R Value Corr.
1	250	140.4	9.8	0.00	22	2.45	142	76	76
2	350	142.7	7.6	0.00	13	2.50	710	85	85
3	350	141.4	8.6	0.00	19	2.50	277	78	78


Test Results	Material Description
<p>R-value at 300 psi exudation pressure = 79</p>	<p>well-graded gravel with silty clay and sand</p>
<p>Project No.: 3630 Project: 2025-2027 COS DRAINAGE & ROADWAY PROJECTS Source of Sample: C-24-06 & C-24-07 Sample Number: BASE Date: 1/3/2025</p>	<p>Tested by: J. COLLETT Checked by: S. SCHWEITZER Remarks: RECEIVED ON 12/12/2024 SCREENED OVER 1"</p>
	<p>PLATE _____</p>

R-VALUE TEST REPORT



Resistance R-Value and Expansion Pressure - ASTM D2844

No.	Compact. Pressure psi	Density pcf	Moist. %	Expansion Pressure psi	Horizontal Press. psi @ 160 psi	Sample Height in.	Exud. Pressure psi	R Value	R Value Corr.
1	350	134.6	8.4	0.00	14	2.45	535	86	86
2	250	132.0	10.0	0.00	20	2.50	253	80	80
3	300	133.7	9.4	0.00	18	2.50	365	82	82

Test Results	Material Description
R-value at 300 psi exudation pressure = 81	BASE
Project No.: 3630 Project: 2025-2027 COS DRAINAGE & ROADWAY PROJECTS Source of Sample: C-24-08,09,10,11,12, & 13 Sample Number: BASE Date: 1/3/2025	Tested by: J. COLLETT Checked by: S. SCHWEITZER Remarks: RECEIVED ON 12/12/2024 SCREENED OVER 1"
	PLATE _____