Geotechnical & Environmental Services, Inc.
Las Vegas | Reno | Mesquite

GEOTECHNICAL EVALUATION
CARSON CITY FIRE STATION
CARSON CITY, NEVADA

PROJECT NO. R20215895E1
March 14, 2022

Prepared for:

CARSON CITY PUBLIC WORKS

3505 Butti Way
Carson City, NV 89701

GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

- Geotechnical Engineering
- Construction Materials Testing & Inspections
- Environmental Services
- AASHTO Accredited Testing Laboratories
- IAS Accredited

March 14, 2022
Project No. R20215895E1

Mr. Jim Morris
Carson City Public Works
3505 Butti Way
Carson City, NV 89701

RE: Geotechnical Evaluation
Carson City Fire Station
Butti Way
Carson City, Nevada

Dear Mr. Morris:

Geotechnical & Environmental Services, Inc. (GES) is pleased to present the Geotechnical Evaluation report for the proposed Fire Station in Carson City, Nevada.

The content of this report encompasses the findings of the geologic review, the results of the field exploration and laboratory testing programs, conclusions, and recommendations for the site development.

We appreciate this opportunity to provide our professional services. If you have any questions or comments regarding this information, please feel free to contact our office.

Sincerely,

Geotechnical & Environmental Services, Inc.

PROFESSIONAL ENGINEER-STATE OF NEVADA
SANDY SOLARES
EXP. 6-30-22
CIVIL
No. 026780

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EXECUTIVE SUMMARY
CARSON CITY FIRE STATION
CARSON CITY, NEVADA

This Executive Summary is for reference only and is not fully comprehensive of the **findings** and **recommendations** specified in this Geotechnical Evaluation. Select the topics and underlined subjects to go to the appropriate section of the report. GES will not be held responsible for interpretations made by others based solely on the information presented in the Executive Summary. We encourage a full reading and a clear understanding of the conclusions and recommendations presented in the full report.

Topic	Overview
Project Description	Design and construction of a new 15,000 square foot fire station, a 5,000 square foot E.O.C, possible equipment storage, staff parking, and visitor parking located southwest of the intersection of Butti Way and Fairway Drive in Carson City, Nevada. The project site is bordered by Butti Way to the north, vacant lots to the east and south and by the Carson City Public Works Department to the west. The final design grades will generally be 4-feet to 6-feet above of the existing site grade. We anticipate that the finished grade will be level with the grade of the adjacent Public Works building.
Geotechnical Site Characterization	**Groundwater** was encountered from about 1.0-foot to 5.5-feet below existing grade in our borings. Based on our analysis of soil properties and calculations discussed in this report the **liquefaction potential** is low. **Seismic site class:** D.
Earthwork	Excavate deleterious material, soft, loose or disturbed native soils from improvement areas. The excavated onsite material is recommended to be removed from the site or processed to meet the recommendations outlined in this report. Import fill is recommended and must be suitable for **structural backfill**.
Spread Footing Foundations	Mat and shallow footings are acceptable. Allowable bearing pressure = 2,100 psf Expected settlement 1 inch or less
Lateral Earth Pressures	If needed, design based on recommendations in this geotechnical report.
Concrete Flatwork	4-inch minimum concrete thickness with 4-inch minimum aggregate base thickness. Concrete should have a design compressive strength of 4,000 psi
Drainage	Positive drainage should be established and maintained away from the proposed structure and existing building.

GEOTECHNICAL EVALUATION
CARSON CITY FIRE STATION
CARSON CITY, NEVADA

1. INTRODUCTION

This report presents the results of a geotechnical evaluation performed by Geotechnical & Environmental Services, Inc. (GES) for the proposed Fire Station in Carson City, Nevada. Figure A-1 presents a vicinity map showing the approximate location of the site within Carson City, Nevada. Figure A-2a and A-2b presents the exploration location map within the sites. The following sections present the purpose and scope of our geotechnical exploration, project and site descriptions, field exploration, and laboratory testing.

1.1. PURPOSE AND RESOURCES

The purpose of our geotechnical study is to evaluate subsurface soils within the proposed project site and provide a design level geotechnical evaluation to aid in the design and construction of the proposed project improvements. The scope of this study included a review of referenced geologic literature and maps, subsurface exploration, soil sampling, laboratory testing of selected soil samples, engineering evaluations, and preparation of this report. The scope of work contained herein is provided in general accordance with our proposal, dated December 23, 2021.

1.2. PROJECT DESCRIPTION

Our understanding of the project is based on correspondence with the client, a review of aerial photographs and documents, and our experience with similar projects. Our design recommendations are based on the 2018 International Building Code (IBC) and 2018 Northern Nevada Amendments to the IBC and the Standard Specification for Public Works Construction, (SSPWC) (RTC, 2012 Revision 8).

We understand that the proposed project will include the design and construction of a 15,000 square foot fire station, a 5,000 square foot E.O.C, possible equipment storage, staff parking, and visitor parking. Based on our experience, we anticipate the pavement sections will experience loads of approximately 75,000 pounds due to fire engine travel. Below grade structures are not anticipated. We anticipate that final grade will be 4-feet to 6-feet above current grade. Fill material for the project

site is expected to be used from an adjacent site. We assume downward axial column loads up to approximately 100 kips and wall loads of up to 5 kips per lineal foot.

1.3. SITE DESCRIPTION

The project site consists of approximately 4.5-acres of vacant land. The project site is currently vacant and undeveloped, consisting of small native brushes. The site is bordered by a vacant property to the South, Fairview Drive to the east, Butti Way to the north, and the Carson City Public Works building to the west.

Figure 1.3 Project Site

The borrow site consists of undeveloped small to large desert brush located on uneven terrain. The site is bordered to the west by Airport Road, by the Public Works buildings to the north, by an irrigation ditch/sewage disposal facility to the south and by undeveloped land to the east.

2. GEOTECHNICAL SITE CHARACTERIZATION

The following sections describe the geology, seismicity, liquefaction, mapped soil conditions, field exploration, laboratory testing, and subsurface materials and conditions for the project site and borrow site.

2.1. GEOLOGY

The project site is located on the referenced, Geologic Map of the New Empire Quadrangle, (Bingler, E.C., 1977) within an area mapped as Older Alluvial Plain Deposits (Qoa) described as greyish orange to dark yellow-brown small gravel to muddy sand, pebble gravel and minor well sorted cobbles and gravel with angular to subangular clasts.

Figure 2.1 Geological Map

The borrow site is located within an area mapped as Alluvial-Plain Deposits (Qal) described as unbedded to

poorly bedded, poorly to moderately sorted yellowish-brown to grey fine silty sand, sandy silt, granular muddy coarse sand, and minor sandy gravel.

2.2. SEISMICITY

Based on a review of the USGS Quaternary Fault Database, accessed on February 9, 2022, the site lies in the New Empire Fault Zone (Fault ID 1730). The faults closest to the site in New Empire Fault Zone primarily consists of well constrained middle to late quaternary faults (older than 750,000 years). These faults are expected to move less than 0.2-millimeters per year.

Other significant fault zones in the area are the Kings Canyon Fault Zone and the Mt. Rose Fault Zone. The Mt. Rose Fault Zone has the capability of producing a magnitude 6.9 earthquake and is located about 12 miles north of the site. The Kings Canyon Fault Zone is a northeast-striking fault located about 3.5 miles from the site.

A detailed fault study is out of the scope of this report. Based on the results of our review of available literature, it is our opinion that the potential for fault-related surface rupture at the site is low.

2.3. LIQUEFACTION

Liquefaction is a phenomenon in which loose, saturated soils lose shear strength under short-term (dynamic) loading conditions. Ground shaking of sufficient duration results in the loss of grain-to-grain contact in potentially liquefiable soils due to a rapid increase in pore water pressure causing the soil to behave as a fluid for a short period of time.

To be potentially liquefiable, a soil is typically cohesionless with a grain-size distribution generally consisting of sand and silt. It is generally loose to medium dense and has a relatively high moisture content, which is typical near or below groundwater level. The potential for liquefaction decreases with increasing clay and gravel content but increases as the ground acceleration and duration of shaking increase. Potentially liquefiable soils need to be subjected to sufficient magnitude and duration of ground shaking for liquefaction to occur.

Effects of liquefaction include relatively large total and differential settlements, flotation of subsurface structures, slope failures, lateral ground displacements (lateral spreading), surface subsidence, ground cracking, and sand boils.

GES performed liquefaction analysis to evaluate the liquefaction potential of soil layers within the upper 50 feet that include saturated low-density silts and/or sands with standardized blow counts less than 15 blows per foot. A generalized soil profile created from boring B-3 with saturated silt and well graded sand layers and a depth to groundwater of 2-feet below ground surface was evaluated to a depth of approximately 50 feet below the existing ground surface was used in our liquefaction analysis.

For evaluating the factor of safety against liquefaction, the earthquake induced loading is expressed in terms of cyclic shear stress and this is compared to the liquefaction resistance of the soil. Ground level peak acceleration of 0.20 was obtained from ASCE 7-16 using a risk category of IV and a site class D. Liquefaction resistance of soil depends on how close the initial state of soil is to the state corresponding to failure. The ground acceleration is further used to estimate the cyclic stress ratio (CSR). The liquefaction analysis was performed using Rocscience Settle 3.

Based on our liquefaction analysis, the resulting liquefaction induced settlement and lateral displacement generated from a potential earthquake with a magnitude of 6.2 and a maximum acceleration of 0.2g is less than ½ inch. Based on these results, it is our opinion that the potential for liquefaction and lateral spreading at the site is low.

2.4. GROUNDWATER

At the project site, groundwater was encountered in all of the explorations at depths ranging from 3-feet to 5.5-feet below ground surface (bgs). Groundwater stabilized at 1-foot below existing surface in boring B-1. Groundwater was encountered at 3-feet in boring B-2, at 2-feet in boring B-3, and at 5.5-feet in boring B-4. At the borrow site, groundwater was encountered in two of the three explorations. Groundwater was encountered at 4.5-feet bgs in test pit TP-1 and at 10-feet bgs in test pit TP-3.

Groundwater levels should be anticipated to fluctuate due to seasonal precipitation, groundwater withdrawal and recharge, irrigation practices, and potential future dewatering efforts within and/or near the subject site. A detailed evaluation of possible groundwater fluctuations is beyond the scope of this study. Based on the encountered depth to groundwater, it is likely that construction equipment will need special considerations.

2.5. FIELD EXPLORATION

GES evaluated the subsurface conditions within the project site, by drilling 4 borings (B-1 through B-4) on January 19, 2022, and February 1, 2022. Boring B-1 was drilled to a total depth of 5-feet below existing surface, boring B-2 was drilled to 36-feet below existing surface, boring B-3 was drilled to a total depth of 51.5-feet below existing surface, and boring B-4 was drilled 25-feet below the existing surface. The total depth drilled was approximately 117.5 lineal feet. Figure A-2a, in Appendix A of this report, shows the approximate drilling locations within the project area. The boring location coordinates (datum NAD 1983 HARN) were recorded by GES staff using a handheld GPS unit and approximate surface elevation estimated from Google Earth. Coordinates and elevations are provided on the exploration logs included in Appendix A.

Figure 2.5 On-site Drilling

Borings B-1 and B-2 were drilled with a truck mounted CME 75 using 6-inch hollow stem auger switching over to mud rotary at 5-feet. Borings B-3 and B-4 were drilled using a track mounted CME 55 using a 6-inch hollow stem auger, switching over to mud rotary after 5-feet.

Table 2.5 Project Site Boring Summary

Exploration ID	Depth (ft)	Latitude	Longitude	Ground Elevation (ft)	Equipment	Exploration Size / Type
B-1	5	39.1671411	-119.259385	4620	CME-75	4 in, Solid Stem Auger
B-2	36	39.166851	-119.725204	4620	CME-75	6 in, Mud Rotary
B-3	51.5	39.1668123	-119.7258503	4620	CME-55	4 in, Solid Stem Auger
B-4	25	39.1667083	-119.7253420	4622	CME-55	6 in, Mud Rotary

GES evaluated the subsurface conditions within the vicinity of the borrow site, by excavating three test pits (TP-1 through TP-3) on February 15, 2022. Test Pit TP-1 was excavated to a total depth of 11-feet below existing surface, Test Pit TP-2 was excavated to a total depth of 10.5-feet below existing surface, and Test Pit TP-3 was excavated to a total depth of 13-feet below existing surface. The total depth excavated was approximately 34.5-feet. Figure No. A-2b, in Appendix A of this report, shows the approximate test pit locations within the borrow area. The test pit location coordinates (datum NAD 1983 HARN) were recorded by GES staff using a handheld GPS unit

and approximate surface elevation estimated from Google Earth. Coordinates and elevations are provided on the exploration logs included in Appendix A.

Table 2.6 Borrow Site Test Pit Summary

Exploration ID	Depth (ft)	Latitude	Longitude	Ground Elevation (ft)	Equipment	Exploration Size / Type
TP-1	11.0	39.1645876	-119.7317676	4631	CAT 312-E	18-in three tooth bucket
TP-2	10.5	39.1645666	-119.703889	4633	CAT 312-E	18-in three tooth bucket
TP-3	13.0	39.1645861	-119.7296411	4631	CAT 312-E	18-in three tooth bucket

A GES representative directed and supervised the subsurface explorations, while maintaining detailed logs of the subsurface conditions, classifying the soils encountered, and obtaining soil samples. The soils encountered were classified in general accordance with the Unified Soil Classification System (USCS). A Key to Symbols and Terms utilized on the exploration logs is presented on Figure No. A-3. The boring and test pit logs are presented in Appendix A.

2.6. LABORATORY TESTING

The laboratory testing program consisted of tests to classify the on-site soils and to evaluate engineering and physical properties. The test results are presented on the exploration log in Appendix A and on test reports presented in Appendix B. Detailed descriptions of the laboratory tests performed are also presented in Appendix B.

2.7. FROST SUSCEPTIBILITY

According to the 2018 Northern Nevada Amendments to the International Building Code section 1809.5, soils in Carson, Douglas, Story, and Washoe counties are susceptible to frost and thaw in the upper 24-inches of soil. It is our recommendation that structural foundations be embedded 24-inches below finished grade to avoid movement due to soil freezing and thawing. This is due to a soils ability to heave when moisture in it freezes and expands, increasing pressure.

2.8. SUBSURFACE MATERIALS AND CONDITIONS

The following sections describe the native soils encountered at the site. Detailed information regarding subsurface materials and conditions is presented on the boring and test pit logs in Appendix A.

2.8.1. FILL

Fill material was not encountered in the borings to the depths explored at the project site except for a rough gravel road within the upper 1/2 -foot at boring B-3. However, fill material was encountered at the borrow site. At TP-1 from 0-4.5-feet bgs, the fill material contained construction debris and consisted of dark brown silty sand with gravel, cobbles, and occasional boulders. At TP-2 from 0-8-feet bgs, the fill material consisted of a brown color with red streaks, well graded, subrounded to subangular sand with some gravel. This material also included construction debris, including concrete and asphalt, and household trash. At TP-3 from 0-4-feet bgs, the fill material consisted of a dark brown, clayey silty sand with rounded gravel, cobbles, and boulders. This material was also observed to contain construction debris and household trash.

It is our understanding that the material at the borrow site will be used as fill at the project site. The material imported to the project site from the borrow site will need to be processed to meet specifications provided in this report.

2.8.2. NATIVE SOIL

At the project site, the surface generally consisted of native desert brush with gravel. At borings B-1 and B-2, the native material consisted of a brown silty clayey sand. At boring B-3, there was more clay present, and the native material consisted of a light brown silty clayey sand. The native material at B-4 was also silty sand of an orange-brown color. At the borrow site, the native soils consisted of poorly graded gravel at TP-1. At TP-2, the native soil consisted of a dark green/gray fat clay. At TP-3, the native soil was observed as a dark brown to black clay. All native soils encountered at the borrow site were beneath the fill material described in section 2.8.1.

2.9. GEOTECHNICAL MATERIAL PARAMETERS

We relied on soil properties, our experience on similar site conditions and applied engineering to establish the pertinent geotechnical parameters.

3. FINDINGS

Based on the results of our field exploration and laboratory testing programs, it is our opinion that there are no known geologic or geotechnical conditions that would prevent development of the project. It is also our opinion that there are some geotechnical considerations that may affect site development, including the presence of shallow groundwater. A summary of geotechnical considerations is described below.

- The tested onsite soils at the project site and borrow site have soluble soil chloride content of 79 to less than 50 ppm, as evaluated by EPA 9056.
- The tested soils at the project site and borrow site have a sulfate exposure class S0 as defined in Table 19.3.1.1 of American Concrete Institute (ACI) Publication 318-14. However, in accordance with Table 19.3.2.1 of ACI 318-14 we recommend concrete in contact with on-site soils along the subsurface walls up to 12 inches above finished grade should be designed for a sulfate exposure class S1 and contain Type V or II cement and have a design compressive strength of 4,000 psi. Concrete in contact with on-site soils should also have a maximum water cement ratio of 0.50 by weight.
- The tested soils had a solubility content of 0.04 through 0.16 percent. Based on our experience, soils having solubility laboratory test results less than 2 percent by dry weight soluble solids as determined by American Water Works Association (AWWA) standard test method 2540 C are considered as having a low solubility.
- Based on the results of our review of available literature and the distance to mapped faults, it is our opinion that the potential for fault-related surface rupture at the site is low.
- Based on limited data available to evaluate the seismic site class for the project, the default value for Seismic Site Class (Site Class D) may be used for design.
- Based on our liquefaction analysis, it is our opinion that the potential for liquefaction at the site is low.
- Based on the results of our laboratory testing and our understanding of the subject project, it is our opinion that the level of verification and inspection, should be ***periodic*** observation during removal of undocumented fill and approved fill placement.

4. RECOMMENDATIONS

The following sections present recommendations concerning the proposed improvements at the project site. These recommendations are based upon our understanding of the project, the engineering properties of the tested on-site soils, the geologic conditions that are presented in this report, and the assumption that an adequate number of tests and observations will be made during construction to evaluate compliance with these recommendations.

4.1. EARTHWORK

Based on the results of our field exploration and laboratory testing programs, and our stated understanding of the proposed project, it is our opinion that the following earthwork recommendations are applicable to the project.

4.1.1. SITE PREPARATION

Where encountered, all existing uncontrolled fill, deleterious material, loose or disturbed native soils should be removed from improvement areas at the project site, and either removed from the site or processed to comply with the recommendations outlined in this report for structural fill.

The geotechnical consultant during construction should observe exposed materials after needed removals of unsuitable materials to evaluate whether additional removal down to competent materials is needed. After removal of materials, the exposed soils should be scarified to 8-inches or more, moisture conditioned to within 2 percent of optimum moisture content and compacted to 95 percent relative compaction as evaluated by ASTM D1557. Scarification may terminate on very hard and dense soil if encountered, as evaluated by the geotechnical consultant. The soil preparation area should extend laterally a minimum of 5 feet beyond the edges of buildings and exterior foundations, where practical. For exterior concrete flatwork or asphaltic concrete sections, the soil preparation area should extend laterally at least 2 feet beyond the edges. The vertical and lateral extent of the recommended excavations should be evaluated under the direction of the geotechnical consultant.

4.1.2. STRUCTURAL FILL AND BACKFILL SUITABILITY

Samples of materials proposed for use as structural fill should be submitted to the geotechnical consultant for testing and evaluation prior to being transported to the site. Imported materials or soil materials used for structural fill, should satisfy the following requirements:

Table 4.1.2 Imported and/or On-site Structural Fill Recommendations

Description*	Recommendation
4-inch Sieve Gradation**	100 Percent Passing
¾-inch Sieve Gradation	70-100 Percent Passing
No. 40 Sieve Gradation	10-50 Percent Passing
No. 200 Sieve Gradation**	0-35 Percent Passing
Remolded Swell Potential	<4 Percent
Dry Weight Soluble Solids	<2.0% as determined by American Water Works Association (AWWA) Standard Method (SM) 2540 C
Dry Weight Soluble Sulfate	<0.2 % by dry weight soluble sulfate as determined by AWWA SM 4500 SO4 E
Soluble Soil Chloride Content	<500 ppm as determined by AWWA SM 4500-CL B unless appropriate corrosion protection is utilized in the design of proposed structures

* Imported fill materials and excavated on-site material should be free of debris, organic materials, and other deleterious materials.

**Materials used as retaining wall backfill, which should have 10 percent, or less, of material passing the No. 200 sieve and 100 percent passing the 4-inch sieve.

4.1.3. FILL PLACEMENT

Areas to receive structural fill should be prepared prior to fill placement as described in Section 4.1.1 of this report. Fill should be uniformly moisture conditioned to within 2 percent of optimum moisture content, placed in horizontal, loose lifts up to 8 inches thick, and compacted to 95 percent of the maximum dry density, as determined by ASTM D1557. The optimal lift thickness of fill will depend on the type of soil and compaction equipment used but should generally not exceed approximately 8 inches in loose thickness.

4.1.4. OBSERVATION AND TESTING

A qualified geotechnical consultant should perform appropriate observation and testing services during grading and construction operations. These services should include observation of removal of soft, loose, or otherwise unsuitable soils, evaluation of subgrade conditions where soil removals are performed, and performance of observation and testing services during placement and compaction of structural fill and backfill soils. In-place density and moisture tests should be performed in accordance with ASTM D6938 or, alternatively, in accordance with ASTM D1556. The test frequency should be at least one test per 75 cubic yards of fill material placed. Additional field tests may also be performed in structural and non-structural areas at the discretion of the geotechnical consultant.

Based on the results of our laboratory testing and our understanding of the subject project, it is our opinion that the level of verification and inspection should periodic observations during earthwork operations.

4.2. MATERIAL VOLUME CHANGES

Shrinkage of the native soils is estimated to be in the range of 5 to 15 percent when compacted to at least 90 percent of the maximum dry density (ASTM D1557). Accordingly, with shrinkage of 5 to 15 percent, one cubic yard of excavated native soils compacted to 90 percent relative compaction (ASTM D1557) would generate approximately 0.95 to 0.85 cubic yards of structural fill, respectively.

4.3. EXCAVATION CONSIDERATIONS

The following sections provide recommendations to aid in the successful performance of excavations at the project site and include recommendations regarding temporary excavations.

It is the responsibility of the contractor to perform the independent investigations necessary to determine the type of equipment required to perform the work. The contractor should perform a pre-construction survey to establish a baseline survey prior to excavating.

4.3.1. TEMPORARY EXCAVATIONS

Temporary slope surfaces should be kept moist to retard raveling and sloughing. Water should not be allowed to flow over the top of excavations in an uncontrolled manner. Stockpiled material and/or equipment should be kept back from the top of excavations a distance equivalent to the depth of the excavation or more. Workers should be protected from falling debris, sloughing, and raveling in accordance with Occupational Safety and Health Administration (OSHA) regulations. Temporary excavations should be observed by the project's geotechnical consultant so that appropriate additional recommendations may be provided based on the actual field conditions. Temporary excavations are time sensitive, and failures are possible.

Excavations greater than 4 feet in depth into uncemented soils are not anticipated to stand vertically. Excavations greater than 4 feet in depth should be sloped back in accordance with the maximum allowable slope ratios presented in Appendix B to Subpart P of OSHA for the Construction Industry 29 Code of Federal Regulations (CFR), State of Nevada, Division of Occupational Safety and Health, Part 1926. The soil type definitions in Appendix A to Subpart P of OSHA 29 CFR, Part 1926 should be applied to soils encountered in excavations to determine the maximum allowable slope ratio. As an alternative to sloped excavation sidewalls, excavations could be shored and braced. Shoring and bracing should be designed in accordance with Appendices C and D to Subpart P of OSHA 29 CFR, Part 1926. Safety of construction personnel is the responsibility of the contractor.

4.4. MAT FOUNDATIONS

Appropriate type of foundation generally represents a compromise between performance, construction cost, design cost, and time. While mat foundation is more expensive to design than individual spread footings, they usually result in considerable cost reduction, provided the total area of spread footings is a large percentage (>50%) of the foundation area.

Reinforced mat foundation may be used to support the proposed fire station building. A mat foundation consists of a thick, rigid concrete mat that allows the entire footprint of the structure to

carry building loads. Mat can tolerate significantly greater total and differential movements in compared to isolated shallow footings.

The maximum allowable bearing capacity for mat foundation contact pressure can be taken as 2,100 psf with an estimated total post-construction settlement less than 1-inch. Total differential settlement can be estimated as half of the total settlement. The differential settlement will be controlled by the rigidity of the mat foundation.

It is recommended that the mat foundation also to bear on a minimum 2-feet thick compacted structural fill. The structural fill should extend laterally from the footing edges at least 5 feet. The structural fill should be placed as outlined in this report

Mat thickness and reinforcement should be designed by the project structural engineer.

The recommended modulus of subgrade reaction for **short-term (rapid) loadings,** to be used for loads such as lift-truck wheel loads, is 200 pci when the mat is supported by the recommended minimum of 2-feet of structural fill. The structural fill under the mat will have mostly initial elastic settlements. Therefore, the recommended value is not reduced for long-term soil.

The recommended modulus of subgrade reaction for **long-term loadings,** to be used for wide area storage loadings, such as rack or uniform storage loads, is 50 pci, which reduced due to long-term soil consolidation settlement.

4.5. SHALLOW FOOTINGS

Alternatively shallow footings (e.g. spread and continuous footings) supporting the proposed structure should be supported entirely on a zone of properly moisture conditioned and compacted structural fill, as previously described. Spread footings should be at least 12-inches wide and founded at least 24 inches below the lowest adjacent final compacted subgrade and should be reinforced in accordance with the project structural engineer's recommendations.

Footings may be designed based on an allowable net dead plus sustained live load bearing pressure of 2,100 pounds per square foot (psf). The allowable bearing pressure for conventional spread footings may be increased by 800 psf for each additional foot of embedment and/or 300 psf for each additional foot of width up to a maximum allowable pressure of 3,200 psf. The

allowable bearing pressures may be increased by one-third for temporary wind or seismic loads. The allowable bearing pressure presented above includes a factor of safety against generalized bearing capacity failure of 3.0.

Resistance to lateral loads may be estimated using both passive lateral earth support and friction developing between footings and underlying soil. Passive resistance may be used if foundation backfill soils in front of the foundation are level and compacted to 90 percent, or more, of the maximum laboratory dry density (ASTM D1557). The upper 12 inches below the ground surface should be neglected if passive resistance is used. The passive lateral earth support for subsurface walls and footings may be estimated based on an equivalent fluid density of 370 pcf up to a maximum passive lateral pressure of 2,500 psf. A coefficient of friction of 0.36 may be used for the interface between the wall footing and underlying properly compacted structural fill. The values for the equivalent fluid density and coefficient of friction presented above do not include a specific factor of safety.

Provided that the earthwork recommendations presented are followed and structural loads are less than 2,100 psf settlement is predicted to be less than 1-inch. If structural loads exceed these values, GES should be provided the opportunity to re-evaluate our settlement estimates. Structural loads in excess of these estimates may result in increased settlement that could exceed the design tolerance of the structure.

4.6. CONVENTIONALLY REINFORCED SLABS-ON-GRADE

Unless specifically designed and evaluated by the project structural engineer, where concrete paving will be utilized for support of vehicles, we recommend the concrete be a minimum of 6 inches thick and reinforced with No. 3 steel reinforcing bars placed on 18 inches or No. 4 bars placed on 24 inches center-to-center spacing each way, placed at mid-slab depth or ultimately as designed by the project structural engineer. The concrete thickness should be increased to 8 inches where heavy vehicular loading, such as fire engine, is anticipated. Concrete slabs-on-grade for structures, not subject to vehicle loading, should be a minimum of 4-inches thick and minimum slab reinforcement should consist of No. 3 steel reinforcing bars placed 18-inches or No. 4 bars placed on 24 inches center-to-center spacing each way, placed at mid-slab depth on center in both horizontal directions or as designed by the project structural engineer. Crack control joints should be spaced at intervals not greater than 10 feet and should be constructed using saw-cuts, or other methods as soon as practical following concrete placement. Crack control joints should extend a minimum depth of one-

fourth the slab thickness. The actual reinforcing should be designed by an experienced Structural Engineer based on the anticipated curing, joint spacing and loading conditions.

Aggregate base course materials beneath the floor slab-on-grade should be 6-inches and should consist of Type 2, Class B Aggregate Base materials, or other similar material acceptable to the geotechnical consultant, and be uniformly placed and compacted. The conventionally reinforced slab-on-grade foundation supported on Type 2 Aggregate Base may be designed using a vertical modulus of subgrade reaction (k_{v1}) of 200 pounds per cubic inch. These recommendations are only valid with the assumption that approved structural fill with an R-value greater than30 is used. Slab on grade design is generally only applicable to shallow footings (e.g. spread and continuous footings).

4.7. EXTERIOR CONCRETE FLATWORK CONSTRUCTION

Concrete flatwork should be at least 4 inches in thickness. Aggregate base course materials beneath concrete flatwork should be at least 4 inches in thickness and should consist of Type 2 Aggregate Base or other similar material approved by the Geotechnical Engineer. Aggregate base should be uniformly placed and compacted to at least 95 percent of the maximum dry density.

The existing on-site subgrade soils beneath concrete flatwork should be prepared as described in this report, including moisture-conditioning within 2 percent of optimum moisture, and compacting to 95 percent, of the maximum dry density as determined by ASTM D1557 prior to the placement of supportive aggregate base.

Excessive slump (due to a high water-cement ratio) of the concrete and/or improper curing procedures could lead to excessive shrinkage, cracking or curling of slabs and other flatwork. Concrete placement and curing operations should be performed in accordance with the American Concrete Institute (ACI) Manual of Concrete Practice (ACI, 2014).

4.8. ON-SITE FLEXIBLE PAVEMENT SECTIONS

The following sections present non-dedicated pavement sections for the project. Our pavement section design is based on the 1993 publication of the AASHTO Guide for Design of Pavement Structures and the SSPWC. Recommendations for the design and construction of new asphalt concrete pavement and associated earthwork in the project area are presented below:

Table 4.8 - Recommended Minimum Asphalt Concrete Pavement Sections

Roadway Condition	Design Structural Number	Asphalt Thickness (Inches)	Type 2 Untreated Aggregate Base Thickness (Inches)
Passenger Vehicle Lanes/Parking	1.65	3	4
Fire Truck Lanes/Parking	2.37	3	6

The recommended pavement sections assume that exposed on-site soils will consist of suitable structural fill with an R-value of 30 as described in the preceding section. If soils with R-values less than that described are observed as subgrade beneath pavement sections and the traffic loadings are not representative of anticipated traffic, the recommended pavement sections will need to be reevaluated.

Asphaltic concrete material and placement procedures should conform to appropriate sections of the SSPWC. Aggregate materials for asphalt concrete should conform to the requirements for Plant Mix Bituminous Pavements of the SSPWC. The compacted thickness of the asphalt concrete should be as shown on the plans. The Contractor should submit a proposed asphalt concrete mix design to the appropriate jurisdiction for review and evaluation prior to paving.

4.9. SEISMIC SITE CLASS

The following seismic design parameters based on ASCE 7-16 per the 2018 IBC for a Seismic Site Class D may be utilized using representative site coordinates of 39.166975 degrees latitude and -119.725823 degrees longitude with an assumed Risk Category of IV:

Table 4.9 Spectral Response Accelerations and Site Coefficients – Site Class D

Spectral Response Acceleration at Short Periods, S_s	Spectral Response Acceleration at 1-Second Period, S_1	Spectral Response Coefficient at Short Periods, SD_s	Spectral Response Coefficient at 1-Second Period, SD_1	MCE_G Peak Ground Acceleration, PGA	Site Modified Peak Ground Acceleration, PGA_M
2.03g	0.732g	1.624g	Null*	0.867	1.04

* See Section 11.4.8 of ASCE 7-16

4.10. LATERAL EARTH PRESSURES ON RETAINING WALLS

Retaining elements are not expected to be needed in this project. If retaining elements are needed for this project, GES will be happy to provide calculations and recommendations upon request.

4.11. SOIL CORROSIVITY

Based on the results of the reviewed chemical testing, the tested on-site soils have a negligible sulfate exposure as described in Table 19.3.1.1 of American Concrete Institute (ACI) Publication 318-14. Based on our experience in this area GES recommends an exposure class of S1 be used. In accordance with ACI 318-14, concrete in contact with on-site soils along with subsurface walls up to 12 inches above finished grade be designed as follows:

Table 4.11 Concrete Recommendations for Severe Sulfate Exposure

Description	Recommendation per ACI 318-14
Cement Type	V or II
28- Day Design Compressive Strength	4,000 psi
Water to Cement Ratio	0.50 Maximum

In addition, it is recommended that reinforcing bars in cast-against-grade concrete, except for slab-on-grade floors and exterior concrete flatwork, be covered by approximately 3 inches or more of concrete. Structural concrete should be placed in accordance with American Concrete Institute and project specifications.

We recommend that a Corrosion Engineer be consulted for protection recommendations for any buried metal pipe. Metal pipe may be protected by using cathodic protection or pipe coatings and wrappings, or, as an alternative, PVC pipe may be used if allowed by jurisdictional building codes.

4.12. DRAINAGE AND MOISTURE PROTECTION

Infiltration of water into subsurface soils can lead to soil movement and associated distress, and chemically and physically related deterioration of concrete structures. To reduce the potential for infiltration of moisture into subsurface soils at the site, we recommend the following:

- Positive drainage should be established and maintained away from the proposed building(s). drainage may be established by sloping the ground immediately adjacent to foundations away from building(s) with a slope of at least 5 percent for a distance of at least 10 feet measured perpendicular to the building wall from building foundations. Where physical obstructions prohibit 10-feet of horizontal distance from foundations, a 5 percent slope should be provided to an alternate method of diverting water away from foundations such as swales parallel to the foundations with a flow line slope of at least 1 percent. Impervious surfaces should have a surface gradient of 2 percent or more. Adequate surface drainage should be provided to channel surface water away from on-site structures and to a suitable outlet such as a storm drain or the street. Adequate surface drainage may be enhanced by utilization of

graded swales, area drains, and other drainage devices. Surface run-off should not be allowed to pond near structures.

- Adequate surface drainage should be provided to channel surface water away from on-site structures and to a suitable outlet such as a storm drain or the street. Adequate surface drainage may be enhanced by utilization of graded swales, area drains, and other drainage devices. Surface run-off should not be allowed to pond near structures.

- Building roof drains should have downspouts tight lined to an appropriate outlet, such as a storm drain or the street. If tight lining of the downspouts is not practicable, they should discharge 5 feet or more away from the building or onto concrete flatwork or asphalt that slopes away from the structure. Downspouts should not be allowed to discharge onto the ground surface adjacent to building foundations.

- Low-water use (drip irrigated) landscaping is recommended for use on-site, particularly within 5 feet of the building and exterior site improvements, including areas of concrete flatwork and masonry block walls.

- Irrigation heads should be oriented so that they spray away from building and block wall surfaces.

- A relatively impermeable barrier should be placed against retaining structures where retained soil is in contact with the retaining wall so that unsightly staining of the exposed wall face and potential for degradation of the wall will be reduced.

- Graded slopes may be subject to erosion, surface runoff over slopes should be controlled. To reduce the potential for erosion caused by surficial drainage over slopes, swales and/or interceptor drains as described in Section J109 of the 2018 IBC (ICC, 2017) may be placed at the top of the slope.

- The face of slopes should be prepared and maintained to control erosion. Erosion controls should be installed as soon as practical after grading. Erosion control may include ground cover, hardscaping, and/or lightweight, deep rooted landscaping requiring low water use. Whether erosion control measures are used or not, periodic maintenance of slopes will likely be required.

- Paved areas should have a surface gradient of 2 percent, or more. In addition, surface runoff from surrounding areas should be intercepted, collected, and not permitted to flow onto the pavement or to infiltrate the base and subgrade. We recommend that perimeter swales, edge drains, curbs and gutters, or combination of drainage devices, be construed to reduce the adverse effects of surface water runoff.

4.13. PRE-CONSTRUCTION MEETING

We recommend that a pre-construction meeting be held. The owner or the owner's representative, the architect/engineer of record, the contractor, material testing firm, and the geotechnical consultant should be in attendance to discuss the plans and the project.

4.14. CONTINUITY

GES, Inc. is an IAS Accredited Special Inspection Agency that can provide construction materials testing and observations services during the construction of this project. Consideration should be given to the benefit from continuity in service that is provided when the owner's geotechnical consultant is involved in both the design and construction of the project.

5. LIMITATIONS

The recommendations contained in this report are based on field exploration, laboratory testing, research of pertinent maps and literature, and our understanding of the proposed construction. The soil data used in the preparation of this report were obtained from 4 borings performed at the site and 3 test pits performed at the borrow site. It is possible that variation in the soil conditions will exist between the locations explored. Therefore, if any soil conditions are encountered at the site that are different from those outlined in this report, Geotechnical & Environmental Services, Inc. should be immediately notified so that we may review the situation that exists and make supplementary recommendations as needed. In addition, if the scope of the proposed construction, including the types of structures, anticipated loads and maximum cut and fill depths, changes from what is described in this report, our firm should be notified. A detailed excavatability or rippability evaluation is beyond the scope of this study.

The recommendations presented in this report assume that an adequate number of tests and observations will be made during site construction to evaluate compliance with the recommendations. These tests and observations should be provided under the direction of a qualified Geotechnical Engineer. Such testing and observations should include but not be limited to the following:

- Review of site construction plans for conformance with the soils investigation.
- Observation and testing during site preparation, grading, footing and other excavations, and placement of fill, aggregate base, and concrete.
- Consultation as may be required during construction.

Our services were performed using that degree of care and skill ordinarily exercised under similar circumstances by reputable engineering firms in this or similar localities. No other warranties, either express or implied, are included or intended in this report.

6. REFERENCES

American Concrete Institute (ACI), 2014, ACI Manual of Concrete Practice.

American Society for Testing and Materials (ASTM), 2011, Annual Book of ASTM Standards, Section 4 – Construction Volumes 04.02, 04.08, and 04.09

Bingler, E.C., 1977, Geologic Map of the New Empire Quadrangle, Nevada Bureau of Mines and Geology, Map 59, 1:24,000.

Geotechnical & Environmental Services, Inc., proprietary in-house data

Google Earth, at approximate location 39.4941038° latitude and -119.7254559° longitude, accessed on February 2, 2022

International Code Council, 2018 International Building Code

Occupational Safety and Health Administration (OSHA), 2002, OSHA Standards for the Construction Industry, 29 CFR Part 1926.

OSHPD Seismic Design Maps; https://seismicmaps.org/

State of Nevada Department of Conservation & Natural Resources, Division of Water Resources, 2019, Well Log Database: http://water.nv.gov/data/welllog/index.cfm

United States Geological Survey (USGS), Quaternary Faults and Folds Database of the United States: https://usgs.maps.arcgis.com/apps/webappviewer/index.html?id=5a6038b3a1684561a9b0aadf88412fcf

2018 Northern Nevada Amendments to the IBC

APPENDIX A – SUBSURFACE STUDY

Legend

★ Approximate Project Location

0 0.325 0.65 1.3 1.95 2.6 Miles

NOTE: Data presented on this map is a compilation of GIS Metadata extracted from a variety of sources. This data is downloaded by GES for incorporation into drawings generated by GES. Data contained within this page is to be used for informational purposes only. GES has not modified the data contained herein and uses it as it is acquired from the respective agency.

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Las Vegas, NV 89119
702-365-1001
www.gesnevada.com

SITE VICINITY MAP
CARSON CITY FIRE STATION
SW CORNER OF BUTTI WAY AND FAIRWAY DRIVE
CARSON CITY, NEVADA

Drawn By:	Date Drawn:
JJB	2/2/2022
Project No.	Figure No.
R20215895E1	A-1

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Legend

B-1 Approximate Boring Location

Approximate Site Boundary

Local Street

Minor Collector

Minor Arterial

0 50 100 200 300 400 Feet

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EXPLORATION LOCATION MAP
CARSON CITY FIRE STATION
SW CORNER OF BUTTI WAY AND FAIRWAY DRIVE
CARSON CITY, NEVADA

Drawn By:	Date Drawn:
JJB	2/2/2022
Project No.	Figure No.
R20215895E1	A-2a

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Legend

TP-1 Approximate Test Pit Location

Approximate Site Boundary

Minor Collector

Minor Arterial

0 75 150 300 450 600 Feet

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EXPLORATION LOCATION MAP
CARSON CITY FIRE STATION
SW CORNER OF BUTTI WAY AND FAIRWAY DRIVE
CARSON CITY, NEVADA

Drawn By:	Date Drawn:
CAB	2/21/2022
Project No.	Figure No.
R20215895E2	A-2b

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KEY TO SYMBOLS AND TERMS

Terms used according to the Unified Soil Classification System

Consistency or Condition of Soils

Fine-Grained Soils (Silt and Clay): Major portion passing #200 sieve

California Sampler* (blows/foot)	SPT** (blows/foot)	Relative Consistency	Unconfined Compressive Strength (tsf)	Manual Manipulation
< 2	< 2	Very Soft	< 0.25	Thumb will penetrate soil more than 1 in.
2-5	2-4	Soft	0.25-0.50	Thumb will penetrate soil about 1 in.
5-10	4-8	Firm	0.50-1.00	Thumb will penetrate soil about $\frac{1}{4}$ in.
10-20	8-15	Stiff	1.00-2.00	Thumb will not indent soil but readily indented with thumbnail.
>20	>15	Very Stiff	>2.00	Thumbnail will not indent soil.

*ASTM D3550 using a 140-pound hammer falling 30 inches.
**ASTM D1586

Coarse-Grained Soils (Sand and Gravel): Major portion retained on #200 sieve

California Sampler* (blows/foot)	SPT** (blows/foot)	Relative Density	Behavior of $\frac{1}{2}$-inch Diameter Probe Rod
0-7	0-4	Very Loose	Easily penetrated when pushed by hand.
7-18	4-10	Loose	Firmly penetrated when pushed by hand.
18-50	10-30	Medium Dense	Easily penetrated when driven by 1 lb. hammer.
50-70	30-50	Dense	Penetrated less than 1 inch when driven with a 1 lb. hammer.
>70	>50	Very Dense	Penetrated less than $\frac{1}{4}$ inch when driven with a 1 lb. hammer.

*ASTM D3550 using a 140-pound hammer falling 30 inches.
**ASTM D1586

Cementation	Characteristic
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

Hardness	Characteristic
Moderately Hard	Can be readily scratched by a knife blade; scratch leaves a heavy trace of dust and scratch is readily visible after the powder has been blown away.
Hard	Can be scratched with difficulty; scratch produces little powder and is often faintly visible; traces of the knife steel may be visible.
Very Hard	Cannot be scratched with pocket knife. Leave knife steel marks on surface.

Laboratory Testing Acronyms & Abbreviations

AL = Atterberg Limits
Consol = Consolidation
CBR = California Bearing Ratio
Corr = Corrosion Suite
DS = Direct Shear
MC = Moisture Content
MD = Moisture Content/ Dry Density
OC = Organic Content
PROC = Proctor
R-Val = R-Value
SA = Sieve Analysis
SPG = Specific Gravity
UU = Unconsolidated Undrained Triaxial Test

Misc. Symbols

- Exploration continues
- Initial groundwater depth
- Measured groundwater depth (after 24 hours or more)

Constituent Percentages

Trace - < 5%
Few - 5 to 10%
Little - 15-25%
Some - 30-45%
Mostly - 50-100%

Moisture Condition

Dry - Absence of moisture, dusty, dry to the touch
Moist - Damp but no visible water
Wet - Visible free water, usually soil is below water table

Notes

1. Subsurface explorations were performed using the equipment listed on the exploration logs.
2. Subsurface explorations were performed on the date(s) shown on the exploration logs.
3. Soil sampler(s) were driven with a 140 pound hammer falling 30 inches (unless otherwise noted in the text of this report).
4. The transitions between soil types shown on the exploration logs as occurring abruptly at particular depths in actuality may be a gradual progression from one soil type to the next.
5. Exploration logs are subject to the limitations, conclusions, and recommendations presented in this report.
6. DR = Drilling Rate (min/ft)

Strata Group Symbols

- AC - Asphalt Concrete
  PCC - Portland Cement Concrete
- CL- Low plasticity clay
- CH - High plasticity clay
- CL-ML - Silty low plasticity clay
- ML - Silt
- MH - Elastic silt
- SC - Clayey sand
- SM - Silty sand
- SP - Poorly graded sand
- SW - Well - graded sand
- GC - Clayey Gravel
- GM - Silty gravel
- GP - Poorly graded gravel
- GW - Well - graded gravel
- CSG - Cemented sand and gravel
- CALI - Caliche

Soil Sampler Symbols

- Air Knife
- Bulk Sample
- California Sampler
- Standard Penetration Test
- Core Barrel
- Shelby Tube

GES

Disclaimer

This Key to Symbols and Terms is part of a report prepared by Geotechnical & Environmental Services, Inc. and should be used with the report. The descriptions on the exploration logs apply only at the specific exploration locations and at the time the explorations were made. They are not warranted to be representative of subsurface conditions at other locations or times.

Figure No. A-3

GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

BORING NUMBER B-1

PROJECT NAME Carson City Fire Station
CLIENT Carson City Department of Public Works
PROJECT NUMBER R20215895
PROJECT LOCATION 3505 Butti Way
DATE STARTED 1/19/22 **COMPLETED** 1/19/22
GROUND ELEVATION 4620 ft **HOLE SIZE** 6in inches
DRILLING CONTRACTOR Taber Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow-Stem Auger
AT TIME OF DRILLING 3.00 ft / Elev 4617.00 ft
LOGGED BY Z. Bower **DRILLER** Taber
AT END OF DRILLING ---
LAT. 39.1671411 **LONG.** -119.7259385
AFTER DRILLING 1.00 ft / Elev 4619.00 ft

DEPTH (ft)	BULK SAMPLE	SAMPLER TYPE	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0					**NATIVE** Brown subrounded silty SAND, moist
2.5			SM		
5.0					4615.0

Bottom of borehole at 5.0 feet.

GENERAL BH/TP/WELL - GES - GES_GEOTECHNICAL_STD.GDT - 3/11/22 15:34 - J:\GES\CLIENTS\RENO OFFICE\PROJECTS\2021\R20215895\BORING LOGS\GINT BORING LOGS.GPJ

Figure No. A-4

GEOTECHNICAL & ENVIRONMENTAL GES SERVICES, INC.

BORING NUMBER B-2

PROJECT NAME Carson City Fire Station
CLIENT Carson City Department of Public Works
PROJECT NUMBER R20215895
PROJECT LOCATION 3505 Butti Way
DATE STARTED 1/19/22 **COMPLETED** 1/19/22
GROUND ELEVATION 4620 ft **HOLE SIZE** 6in inches
DRILLING CONTRACTOR Taber Drilling
GROUND WATER LEVELS:
DRILLING METHOD Mud Rotary
AT TIME OF DRILLING 3.00 ft / Elev 4617.00 ft
LOGGED BY Z. Bower **DRILLER** Taber
AT END OF DRILLING ---
LAT. 39.166851 **LONG.** -119.725204
AFTER DRILLING ---

DEPTH (ft)	BULK SAMPLE	SAMPLER TYPE	RECOVERY %	BLOW COUNTS	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0								**NATIVE** Brown subangular silty clayey SAND with organics, wet, loose	
			17	2 3 3					
5			61	9 10 6	MC = 18% LL = 25 PL = 20 Fines = 30%	SC-SM		...medium dense	
			83	3 8 13				...interbeded clay	
								9.0	4611.0
10			100	8 9 10		SC-SM		Brown silty clayey SAND, micas, wet, medium dense	
								11.5	4608.5
			89	6 7 9		SM		Brown silty fine SAND with oxidation, wet, medium dense	
								13.0	4607.0
						CH		Grey fat CLAY, very stiff, moist	
								13.5	4606.5
15			72	6 10 9		SW		Grey well graded subangualr SAND, wet, medium dense	
								16.5	4603.5
			94	5 13 18		ML		Dark grey fine sandy SILT, wet, very stiff	
								19.5	4600.5
20								Grey silty CLAY, moist, stiff	

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The descriptions contained within this exploration log apply only at the specific exploration location and at the time the exploration was made. It is not intended to be representative of subsurface conditions at other locations or times.

Figure No. A-5

GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

BORING NUMBER B-2

PROJECT NAME Carson City Fire Station **CLIENT** Carson City Department of Public Works

PROJECT NUMBER R20215895 **PROJECT LOCATION** 3505 Butti Way

DEPTH (ft)	BULK SAMPLE	SAMPLER TYPE	RECOVERY %	BLOW COUNTS	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
20			100	3 5 8	MC = 59%	CL-ML		Grey silty CLAY, moist, stiff *(continued)*
25			100	11 23 27				... very stiff, some gravel sized rocks approximately 1 inch in diameter ... driller notes: more gravel
30			100	14 32 39				... more gravel, clay pockets of higher plasticity
35			73	22 50				36.0 4584.0 Bottom of borehole at 36.0 feet.

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Figure No. A-5

GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

BORING NUMBER B-3

PROJECT NAME Carson City Fire Station
CLIENT Carson City Department of Public Works
PROJECT NUMBER R20215895
PROJECT LOCATION 3505 Butti Way
DATE STARTED 2/1/22 **COMPLETED** 2/1/22
GROUND ELEVATION 4620 ft **HOLE SIZE** 6in inches
DRILLING CONTRACTOR Taber Drilling
GROUND WATER LEVELS:
DRILLING METHOD Mud Rotary
AT TIME OF DRILLING 2.10 ft / Elev 4617.90 ft
LOGGED BY Z. Bower **DRILLER** Taber
AT END OF DRILLING ---
LAT. 39.1668123 **LONG.** -119.7258503
AFTER DRILLING ---

DEPTH (ft)	BULK SAMPLE	SAMPLER TYPE	RECOVERY %	BLOW COUNTS	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0								0.5 **FILL** Rough gravel road	4619.5
								NATIVE Light brown clayey silty subrounded SAND, moist, medium dense	
			100	5 6 7	MC = 19% LL = 25 PL = 18 Fines = 39%	SC-SM		▽	
5			72	8 8 6				...wet	
								5.5 Light brown fine sandy SILT, moist, stiff	4614.5
			89	4 7 7		ML			
			89	3 8 7				9.5 ...grey	4610.5
10						SW		Grey well graded SAND, wet, medium dense	
								10.5	4609.5
			100	5 6 8	MC = 27% LL = 26 PL = 20 Fines = 56%	CL-ML		Grey sandy silty CLAY, moist, medium dense	
								13.0 ... coarser sand	4607.0
			89	5 8 7		SW		Grey well graded subangular to subrounded SAND, wet, medium dense	
15								15.5	4604.5
			94	10 14 17		CL		Green grey sandy CLAY, fine sand, moist, very stiff	
								18.0	4602.0
			83	12 20 20		SW		Grey well graded subrounded SAND with some gravel sized rocks, moist, dense	
20									

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The descriptions contained within this exploration log apply only at the specific exploration location and at the time the exploration was made. It is not intended to be representative of subsurface conditions at other locations or times.

Figure No. A-6

PROJECT NAME Carson City Fire Station **CLIENT** Carson City Department of Public Works

PROJECT NUMBER R20215895 **PROJECT LOCATION** 3505 Butti Way

DEPTH (ft)	BULK SAMPLE	SAMPLER TYPE	RECOVERY %	BLOW COUNTS	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
20						SW		Grey well graded subrounded SAND with some gravel sized rocks, moist, dense *(continued)*	
								22.0	4598.0
								Grey clayey SAND, moist, medium dense	
25			89	7 10 14	MC = 27% LL = 41 PL = 24 Fines = 39%	SC			
30			100	7 8 11					
								33.0	4587.0
								Grey well graded subrounded SAND, moist, dense	
35			89	12 17 15		SW			
40								40.0	4580.0
				10 15 16	MC = 23% LL = 32 PL = 25 Fines = 57%	ML		Grey sandy SILT, moist, stiff	

The descriptions contained within this exploration log apply only at the specific exploration location and at the time the exploration was made. It is not intended to be representative of subsurface conditions at other locations or times.

Figure No. A-6

GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

BORING NUMBER B-3

PROJECT NAME Carson City Fire Station **CLIENT** Carson City Department of Public Works

PROJECT NUMBER R20215895 **PROJECT LOCATION** 3505 Butti Way

DEPTH (ft)	BULK SAMPLE	SAMPLER TYPE	RECOVERY %	BLOW COUNTS	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
								43.0 4577.0 Grey sandy CLAY, micas, fine to medium sand, moist, very stiff
45			100	9 14 21		CL		
50			100	8 11 13				...organic fragments (1-1.5mm) present
								51.5 4568.5 Bottom of borehole at 51.5 feet.

Figure No. A-6

GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

BORING NUMBER B-4

PROJECT NAME Carson City Fire Station
CLIENT Carson City Department of Public Works
PROJECT NUMBER R20215895
PROJECT LOCATION 3505 Butti Way
DATE STARTED 2/1/22 **COMPLETED** 2/1/22
GROUND ELEVATION 4622 ft **HOLE SIZE** 6in inches
DRILLING CONTRACTOR Taber Drilling
GROUND WATER LEVELS:
DRILLING METHOD Mud Rotary
AT TIME OF DRILLING 5.50 ft / Elev 4616.50 ft
LOGGED BY Z. Bower **DRILLER** Taber
AT END OF DRILLING ---
LAT. 39.1667083 **LONG.** -119.725342
AFTER DRILLING ---

DEPTH (ft)	BULK SAMPLE	SAMPLER TYPE	RECOVERY %	BLOW COUNTS	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0			100	6 13 14	LL = 24 PL = 17 Fines = 40%	SC-SM		**NATIVE** Orange brown silty clayey SAND with roots present, moist, medium dense
			100	14 21 23				
5								5.5 ▽ 4616.5 Light brown poorly graded SAND with silt, moist, loose
			100	5 6 8	MC = 25% DD = 82 pcf LL = NP PL = NP Fines = 11% Swell = 0%	SP-SM		
			100	4 8 10				
10								10.5 4611.5 Dark olive greenish grey silty SAND, moist, loose
			100	5 5 11	MC = 29% DD = 101 pcf LL = 31 PL = 24 Fines = 45% Swell = 0%	SM		
			100	11 9 8				
15								15.5 4606.5 Dark olive greenish grey well graded SAND with silt, moist, very dense
			100	20 26 33		SW-SM		
			100	12 27 24		CL		19.0 4603.0 Dark olive greenish grey sandy CLAY, moist, very stiff
20								

GENERAL BH/TP/WELL - GES - GES_GEOTECHNICAL_STD.GDT - 3/14/22 17:22 - J:\GES\CLIENTS\RENO OFFICE\PROJECTS\2021\R20215895\BORING LOGS\GINT BORING LOGS.GPJ

The descriptions contained within this exploration log apply only at the specific exploration location and at the time the exploration was made. It is not intended to be representative of subsurface conditions at other locations or times.

Figure No. A-9

PROJECT NAME Carson City Fire Station **CLIENT** Carson City Department of Public Works

PROJECT NUMBER R20215895 **PROJECT LOCATION** 3505 Butti Way

DEPTH (ft)	BULK SAMPLE	SAMPLER TYPE	RECOVERY %	BLOW COUNTS	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
20								Dark olive greenish grey sandy CLAY, moist, very stiff *(continued)*	
						CL			
								23.0	4599.0
								Cobbles encountered at this depth, no sample recovered.	
25			29	50				25.0	4597.0
								Bottom of borehole at 25.0 feet.	

GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

TEST PIT NUMBER TP-1

PROJECT NAME Carson City Fire Station
CLIENT Carson City Public Works
PROJECT NUMBER R20215895
PROJECT LOCATION Carson City Fire Station
DATE STARTED 2/15/22 **COMPLETED** 2/15/22
GROUND ELEVATION 4631 ft **TEST PIT SIZE** 18in feet
EXCAVATION CONTRACTOR Waters Vaccum Truck Service
GROUND WATER LEVELS:
EXCAVATION METHOD Test Pit
AT TIME OF EXCAVATION 4.50 ft / Elev 4626.50 ft
LOGGED BY Z. Bower **DRILLER** Waters
AT END OF EXCAVATION ---
LAT. 39.1645876 **LONG.** -119.7317676
AFTER EXCAVATION ---

DEPTH (ft)	BULK SAMPLE	SAMPLER TYPE	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0.0			LL = NP PL = NP Fines = 31%	SM		**FILL** Dark brown silty SAND with gravel and cobbles, medium dense occasional boulders, moist, construction debris	
2.5							
						4.5 ▽	4626.5
5.0				GP		**NATIVE** Medium brown poorly graded GRAVEL with sand, wet, medium dense	4626.0
						Light brown sandy SILT with gravel, moist, firm	
7.5				ML		...less gravel	
10.0							
						11.0	4620.0
						Bottom of test pit at 11.0 feet.	

GENERAL BH/TP/WELL - GES - GES_GEOTECHNICAL_STD.GDT - 3/11/22 15:02 - J:\GES\CLIENTS\RENO OFFICE\PROJECTS\2021\R20215895\E2\TEST PIT LOGS\GINT TEST PIT LOGS.GPJ

The descriptions contained within this exploration log apply only at the specific exploration location and at the time the exploration was made. It is not intended to be representative of subsurface conditions at other locations or times.

Figure No. A-8

GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

TEST PIT NUMBER TP-2

PROJECT NAME Carson City Fire Station
CLIENT Carson City Public Works
PROJECT NUMBER R20215895
PROJECT LOCATION Carson City Fire Station
DATE STARTED 2/15/22 **COMPLETED** 2/15/22
GROUND ELEVATION 4633 ft **TEST PIT SIZE** 18in feet
EXCAVATION CONTRACTOR Waters Vaccum Truck Service
GROUND WATER LEVELS:
EXCAVATION METHOD Test Pit
AT TIME OF EXCAVATION Not Encountered
LOGGED BY Z. Bower **DRILLER** Waters
AT END OF EXCAVATION N/A
LAT. 39.1645666 **LONG.** -119.703889
AFTER EXCAVATION N/A

DEPTH (ft)	BULK SAMPLE	SAMPLER TYPE	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0.0			LL = NP PL = NP Fines = 14%	SC-SM		**FILL** Brown with some red streaks silty clayey subrounded to subangular SAND with some gravel, medium dense, moist, construction debris (concrete and asphalt), household trash (wrappers and bottles).	
8.0							4625.0
				CH		**NATIVE** Dark greenish grey to tan fat CLAY, organics (roots <.25inch), moist, stiff	
10.5							4622.5
						Bottom of test pit at 10.5 feet.	

The descriptions contained within this exploration log apply only at the specific exploration location and at the time the exploration was made. It is not intended to be representative of subsurface conditions at other locations or times.

Figure No. A-9

GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

TEST PIT NUMBER TP-3

PROJECT NAME Carson City Fire Station
CLIENT Carson City Public Works
PROJECT NUMBER R20215895
PROJECT LOCATION Carson City Fire Station
DATE STARTED 2/15/22 **COMPLETED** 2/15/22
GROUND ELEVATION 4631 ft **TEST PIT SIZE** 18in feet
EXCAVATION CONTRACTOR Waters Vaccum Truck Service
GROUND WATER LEVELS:
EXCAVATION METHOD Test Pit
▽ **AT TIME OF EXCAVATION** 10.00 ft / Elev 4621.00 ft
LOGGED BY Z. Bower **DRILLER** Waters
AT END OF EXCAVATION ---
LAT. 39.1645861 **LONG.** -119.7296411
AFTER EXCAVATION ---

DEPTH (ft)	BULK SAMPLE	SAMPLER TYPE	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0.0			LL = 26 PL = 22 Fines = 20%	SC-SM		**FILL** Dark brown clayey silty SAND with rounded gravels, cobbles, and boulders, construction and household trash present, moist, medium dense	
4.0							4627.0
				CL-CH		**NATIVE** Dark brown to black CLAY, moist, firm	
9.0							4622.0
				SW		Olive green to grey well graded SAND, medium dense	
						▽ ...clay nodule approximately 2ft by 3ft	
						...gravel	
11.0						...iron oxidation	4620.0
				CL-ML		Greenish/ teal sandy CLAY, moist, stiff	
13.0							4618.0
						Bottom of test pit at 13.0 feet.	

2.5
5.0
7.5
10.0
12.5

GENERAL BH/TP/WELL - GES - GES_GEOTECHNICAL_STD.GDT - 3/11/22 15:02 - J:\GES\CLIENTS\RENO OFFICE\PROJECTS\2021\R20215895\E2\TEST PIT LOGS\GINT TEST PIT LOGS.GPJ

Figure No. A-10

APPENDIX B – LABORATORY TEST RESULTS

Laboratory tests were conducted on representative soil samples for the purpose of classification and to evaluate their engineering and physical properties. The amount and selection of the types of testing for a given study are based on the geotechnical conditions of the project. A summary of the various laboratory tests conducted for this project are presented below.

1. IN-PLACE MOISTURE CONTENT

The in-place moisture contents of selected soil samples obtained from the bulk samples were evaluated. The soil samples used were from the bulk buckets at borings B-3 and B-4, and from B-4 @ 6.0-7.5' and B-4 @ 11.0-12.5'. For each sample, the wet weight of the sample was obtained. The samples were then oven dried. After drying, the dry weight of each sample was measured, and the subsequent moisture contents calculated. The moisture contents of the sampled soils are presented at the respective sample depth on the exploration logs in Appendix A.

2. PERCENT PASSING #200 SIEVE

A selected soil sample was evaluated for percent of material passing the no. 200 sieve in accordance with ASTM C117 to evaluate the percentage of clay and silt sized particles. Each sample was over dried to a constant weight before and after being washed over the no. 200 sieve. The weight of the material passing the no. 200 sieve was then compacted to the total weight of the original sample. The percentages passing the no. 200 sieve for the sample tested is presented in the exploration log in Appendix A.

3. GRAIN SIZE DISTRIBUTION

Eleven grain size distribution tests were performed by sieve analysis in general accordance with ASTM D6913. Soil samples were oven dried to a constant weight and sorted by a number of different sized sieves. The amount of material retained on each sieve is measured and the percent of material passing each sieve is computed. The test results are presented as particle size distribution curves on Figures B-1 through B-11.

4. ATTERBERG LIMITS

Twelve samples were tested to evaluate Atterberg limits in general accordance with ASTM D4318. The liquid limit (LL) and plastic limit (PL) of tested samples were evaluated. The difference between the liquid limit and the plastic limit is the plasticity index (PI) and represents the range of water content over which the soil behaves in a plastic state. The term NP refers to non-plastic and the term NV refers to no value. Test results are presented on the test pit logs in Appendix A and on Figure B-12 through Figure B-14.

5. SWELL/COLLAPSE

Two swell/collapse tests were conducted following ASTM D4546. This test was performed to examine the potential for swell or collapse. Swell and collapse show the potential movement of a soil when water is added or taken away. The results of these tests are shown on Figure B-15 and B-16.

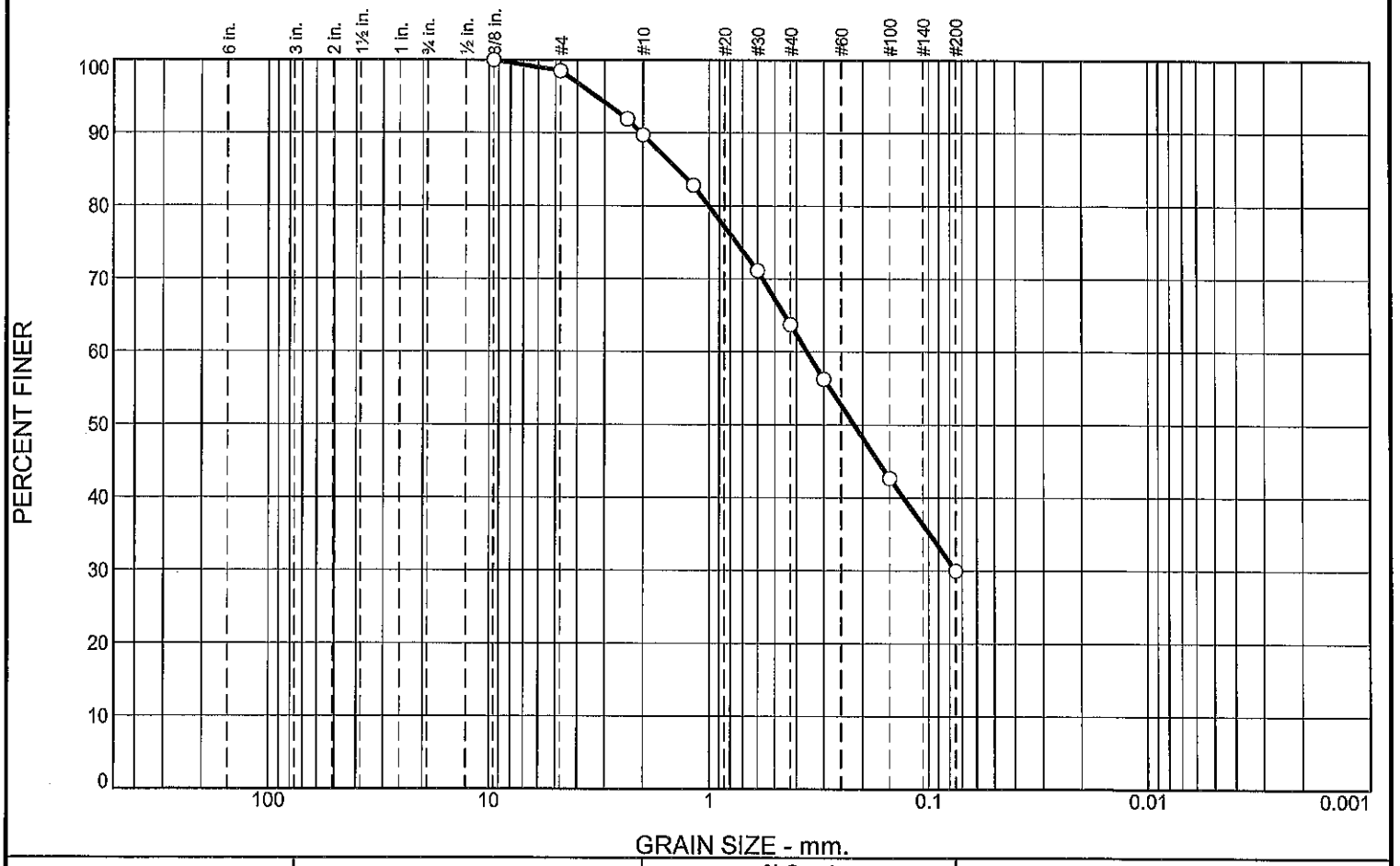
6. COMPACTION

Two compaction tests were run on soil samples from this project. Compaction testing shows the maximum dry density that a soil can obtain. Results from these tests are shown on Figure B-17 and Figure B-18.

7. CHEMICAL TESTS

Five tests were performed on selected soil samples to determine the contents of soluble sulfate, total soluble solids (i.e. solubility), and soluble soil chlorides. The tests were performed by Silver State Analytical, Inc. The results of the tests are shown on Figure B-19 and B-20.

Particle Size Distribution Report



% +3"	% Gravel	% Sand		% Fines	
		Coarse	Fine	Silt	Clay
0	10	26	34	30	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375	100		
#4	98		
#8	92		
#10	90		
#16	83		
#30	71		
#40	64		
#50	56		
#100	43		
#200	30		

* (no specification provided)

Soil Description

Silty, clayey sand

Atterberg Limits

PL= 20 LL= 25 PI= 5

Coefficients

D_{90}= 2.0396 D_{85}= 1.3944 D_{60}= 0.3571
D_{50}= 0.2181 D_{30}= 0.0751 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC-SM AASHTO= A-2-4(0)

Remarks

Sampled by:Z. Bower

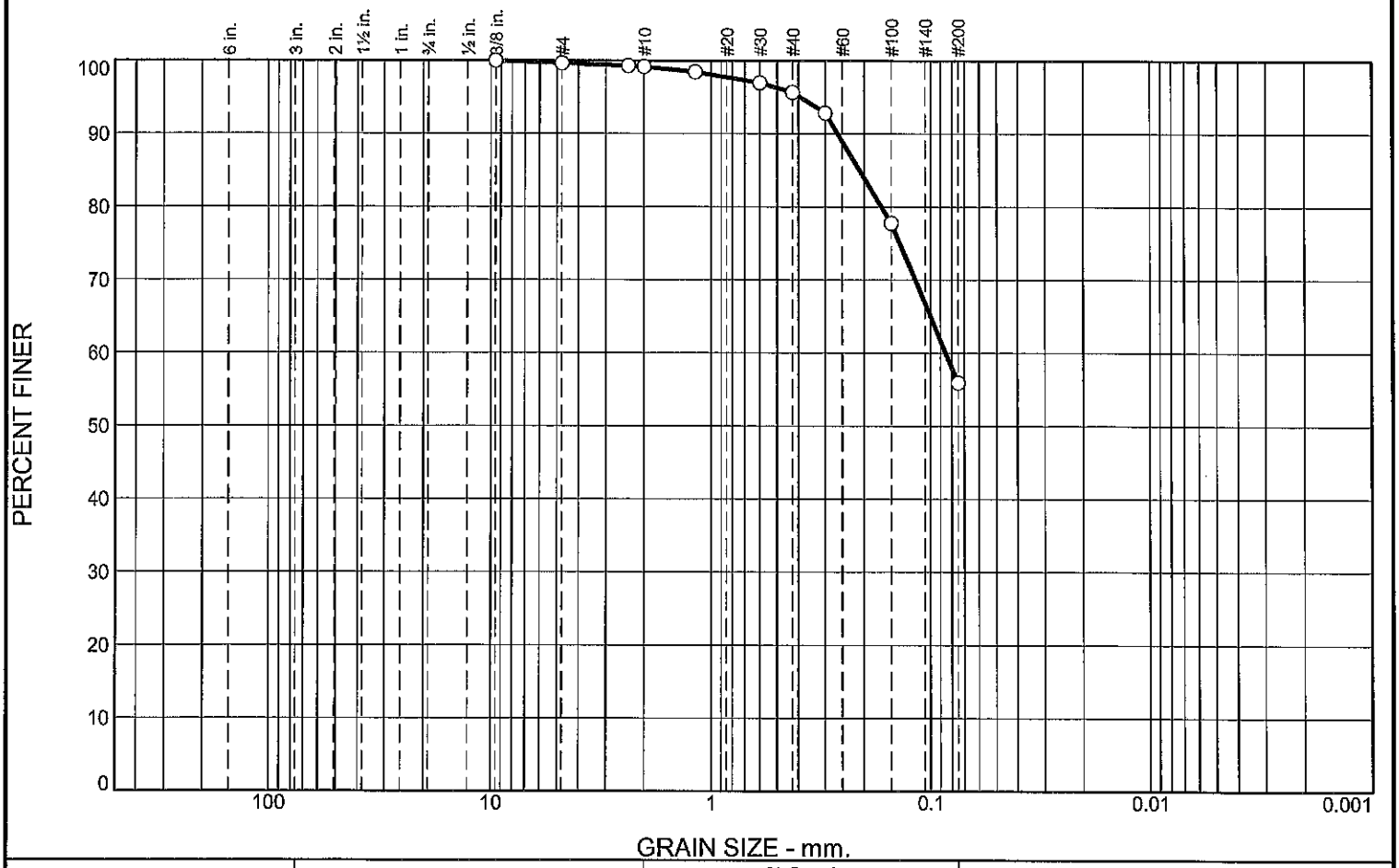
Location: B-2 @ 4.5'-6.0'
Sample Number: B-2 **Depth:** 4.5'-6.0' **Date:** 02/10/22

GES GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

Client: Carson City Public Works
Project: Carson City Fire Station
Project No: R20215895E1 **Figure** B-1

Tested By: J. Roybal

Particle Size Distribution Report



% +3"	% Gravel	% Sand		% Fines	
		Coarse	Fine	Silt	Clay
0	1	3	40	56	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375	100		
#4	100		
#8	99		
#10	99		
#16	98		
#30	97		
#40	96		
#50	93		
#100	78		
#200	56		

* (no specification provided)

Soil Description

Sandy silty clay

Atterberg Limits

PL= 20 LL= 26 PI= 6

Coefficients

D_{90}= 0.2631 D_{85}= 0.2092 D_{60}= 0.0854
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL-ML AASHTO= A-4(1)

Remarks

Sampled By:Z. Bower

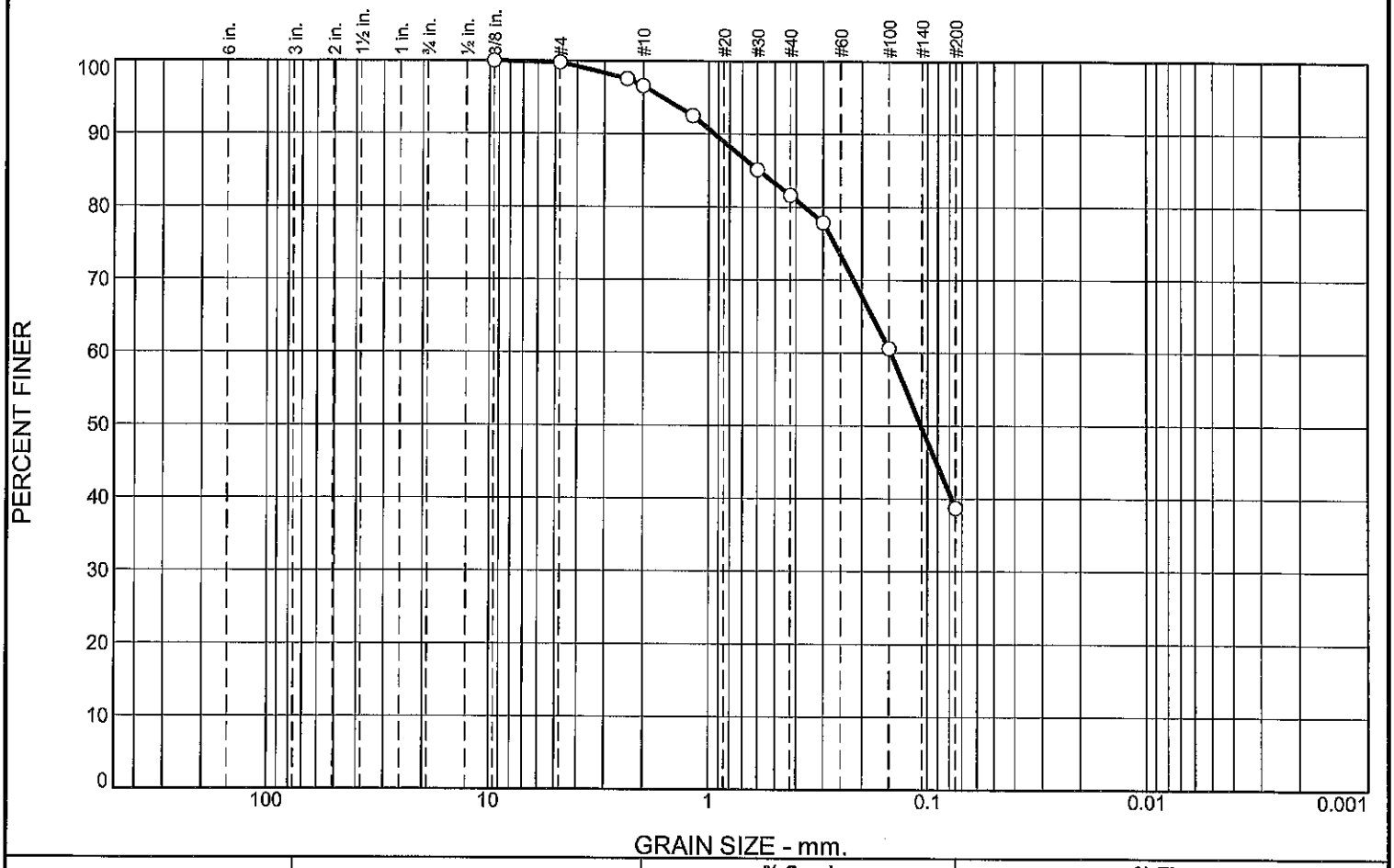
Location: B-3 @ 11.0'-12.5'
Sample Number: B-3 **Depth:** 11.0'-12.5' **Date:** 2/10/22

GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.
GES

Client: Carson City Public Works
Project: Carson City Fire Station
Project No: R20215895E1 **Figure** B-2

Tested By: J. Roybal

Particle Size Distribution Report



% +3"	% Gravel	% Sand		% Fines	
		Coarse	Fine	Silt	Clay
0	3	15	43	39	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375	100		
#4	100		
#8	98		
#10	97		
#16	93		
#30	85		
#40	82		
#50	78		
#100	61		
#200	39		

* (no specification provided)

Soil Description

Clayey sand

Atterberg Limits

PL= 24 LL= 41 PI= 17

Coefficients

D_{90}= 0.9366 D_{85}= 0.5922 D_{60}= 0.1471
D_{50}= 0.1072 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-7-6(2)

Remarks

Sampled By:Z. Bower

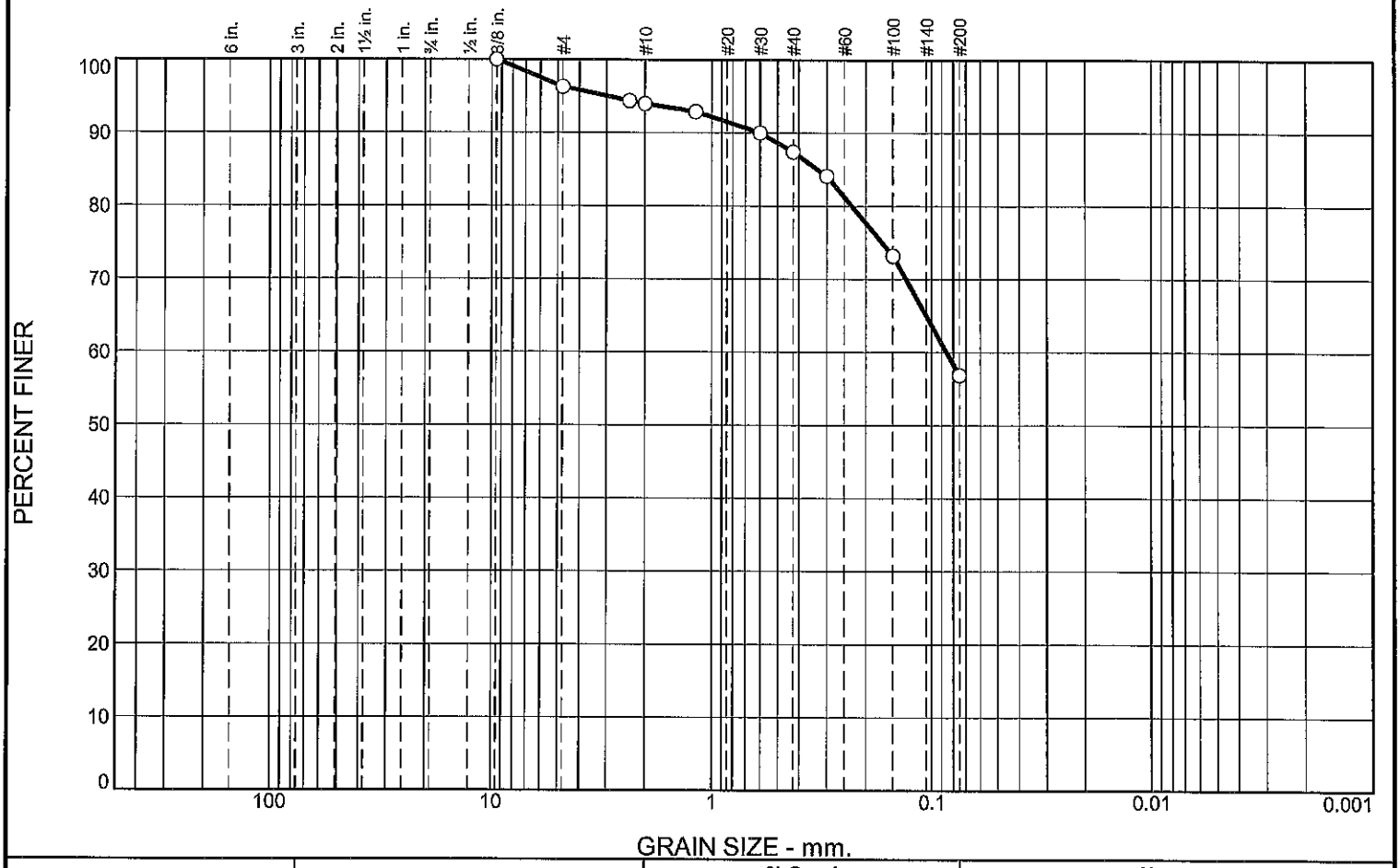
Location: B-3 @ 25.0'-26.5'
Sample Number: B-3 **Depth:** 25.0'-26.5' **Date:** 02/10/22

GES GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

Client: Carson City Public Works
Project: Carson City Fire Station
Project No: R20215895E1 **Figure** B-3

Tested By: J. Roybal

Particle Size Distribution Report



% +3"	% Gravel	% Sand		% Fines	
		Coarse	Fine	Silt	Clay
0	6	7	30	57	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375	100		
#4	96		
#8	94		
#10	94		
#16	93		
#30	90		
#40	87		
#50	84		
#100	73		
#200	57		

* (no specification provided)

Soil Description

Sandy silt

Atterberg Limits

PL= 25 LL= 32 PI= 7

Coefficients

D_{90}= 0.5974 D_{85}= 0.3297 D_{60}= 0.0856
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= ML AASHTO= A-4(2)

Remarks

Sampled By:Z. Bower

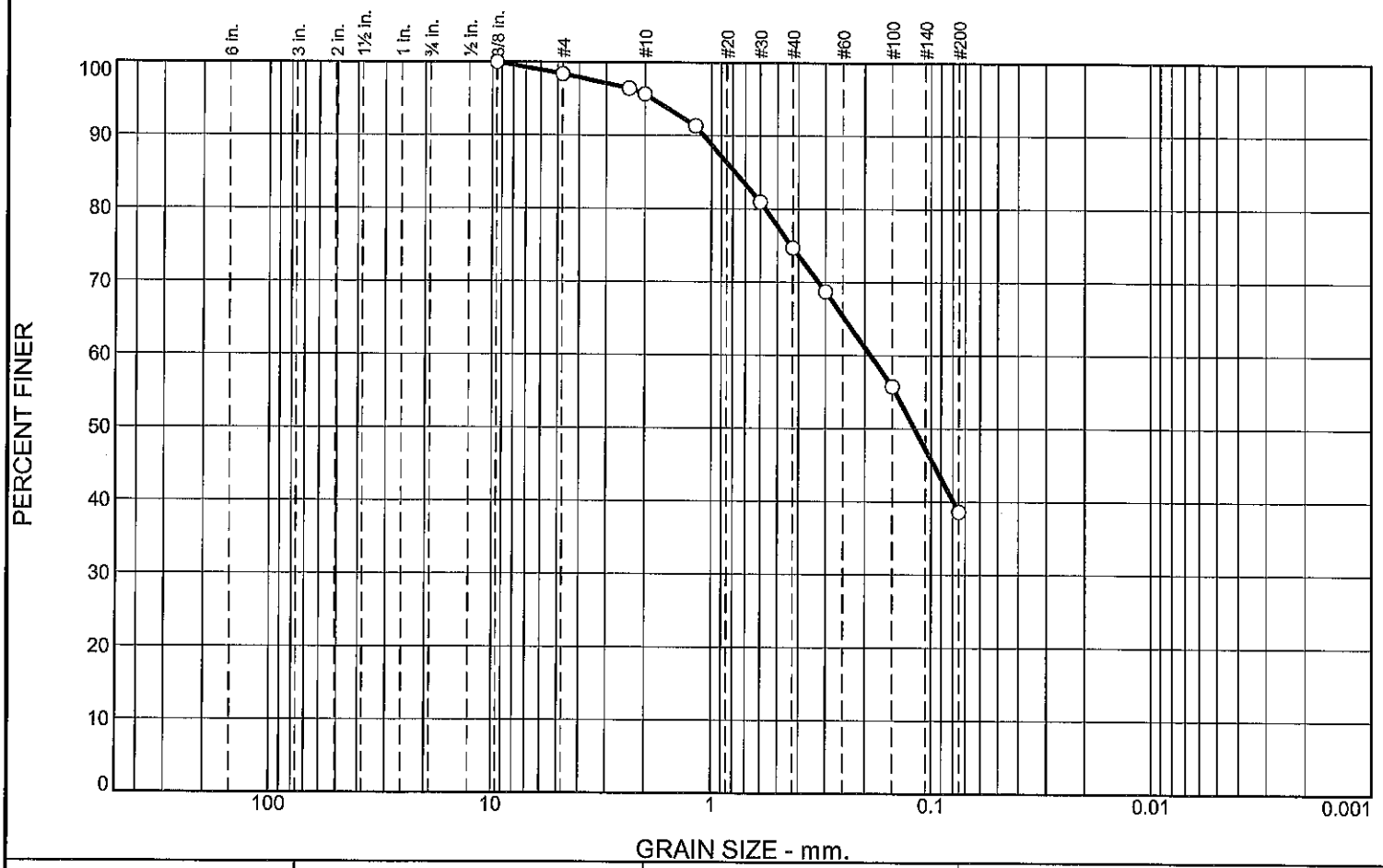
Location: B-3 @ 40.0'-41.5'
Sample Number: B-3 **Depth:** 40.0'-41.5' **Date:** 02/10/22

GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.
GES

Client: Carson City Public Works
Project: Carson City Fire Station
Project No: R20215895E1 **Figure** B-4

Tested By: J. Roybal

Particle Size Distribution Report



% +3"	% Gravel	% Sand		% Fines	
		Coarse	Fine	Silt	Clay
0	4	21	36	39	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375	100		
#4	98		
#8	96		
#10	96		
#16	91		
#30	81		
#40	75		
#50	69		
#100	56		
#200	39		

* (no specification provided)

Soil Description

Silty, clayey sand

Atterberg Limits

PL= 18 LL= 25 PI= 7

Coefficients

D_{90}= 1.0813 D_{85}= 0.7807 D_{60}= 0.1881
D_{50}= 0.1188 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC-SM AASHTO= A-4(0)

Remarks

Sampled By.Z. Bower

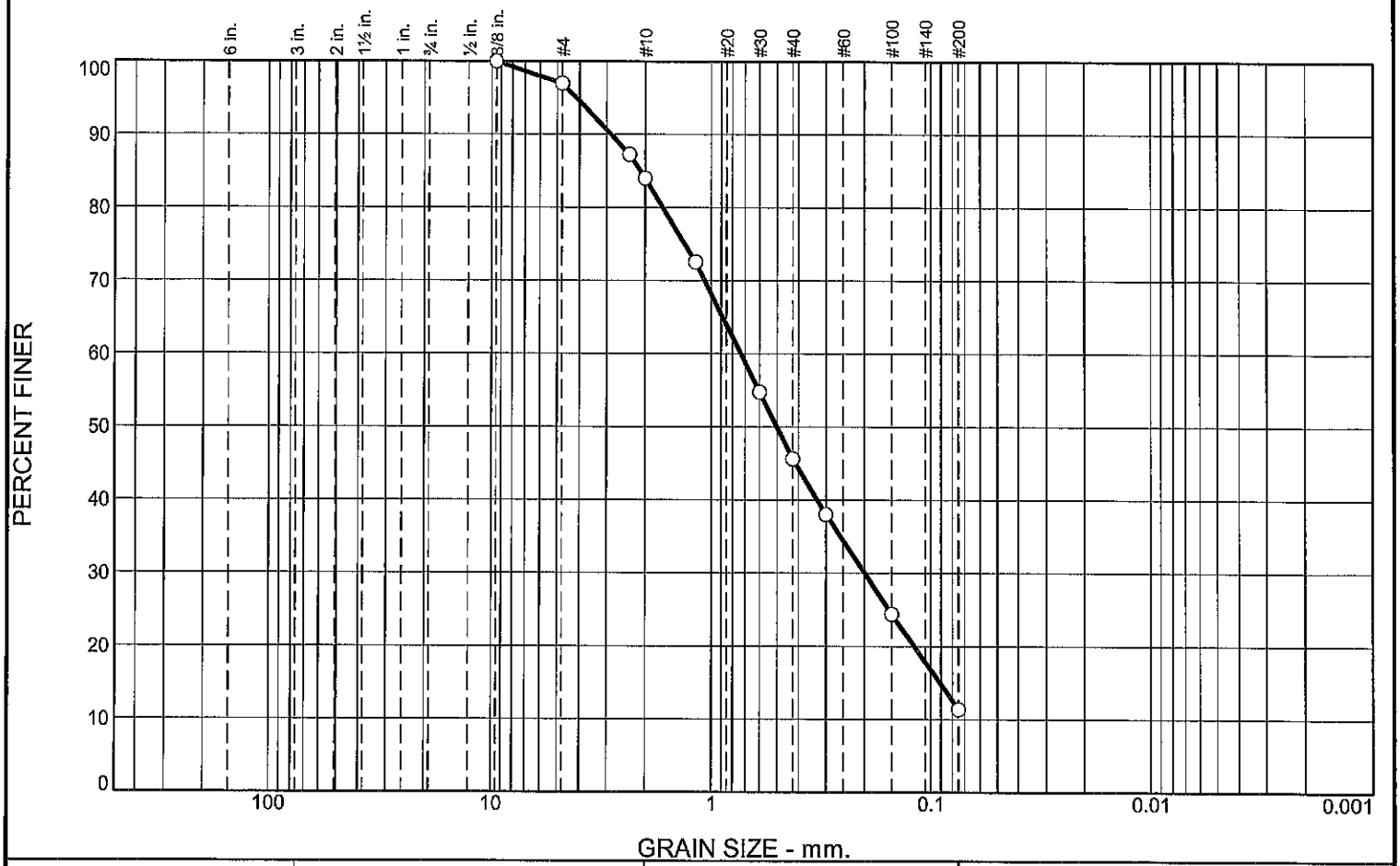
Location: B-3 Bulk Bag
Sample Number: B-3 **Depth:** Bulk Bag **Date:** 02/10/22

GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

Client: Carson City Public Works
Project: Carson City Fire Station
Project No: R20215895E1 **Figure** B-5

Tested By: J. Roybal

Particle Size Distribution Report



% +3"	% Gravel	% Sand		% Fines	
		Coarse	Fine	Silt	Clay
0	16	38	35	11	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375	100		
#4	97		
#8	87		
#10	84		
#16	73		
#30	55		
#40	46		
#50	38		
#100	24		
#200	11		

* (no specification provided)

Soil Description

Poorly graded sand with silt

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{90}= 2.8751 D_{85}= 2.1035 D_{60}= 0.7328
D_{50}= 0.5016 D_{30}= 0.1995 D_{15}= 0.0909
D_{10}= C_u= C_c=

Classification

USCS= SP-SM AASHTO= A-1-b

Remarks

Sampled By:Z. Bower

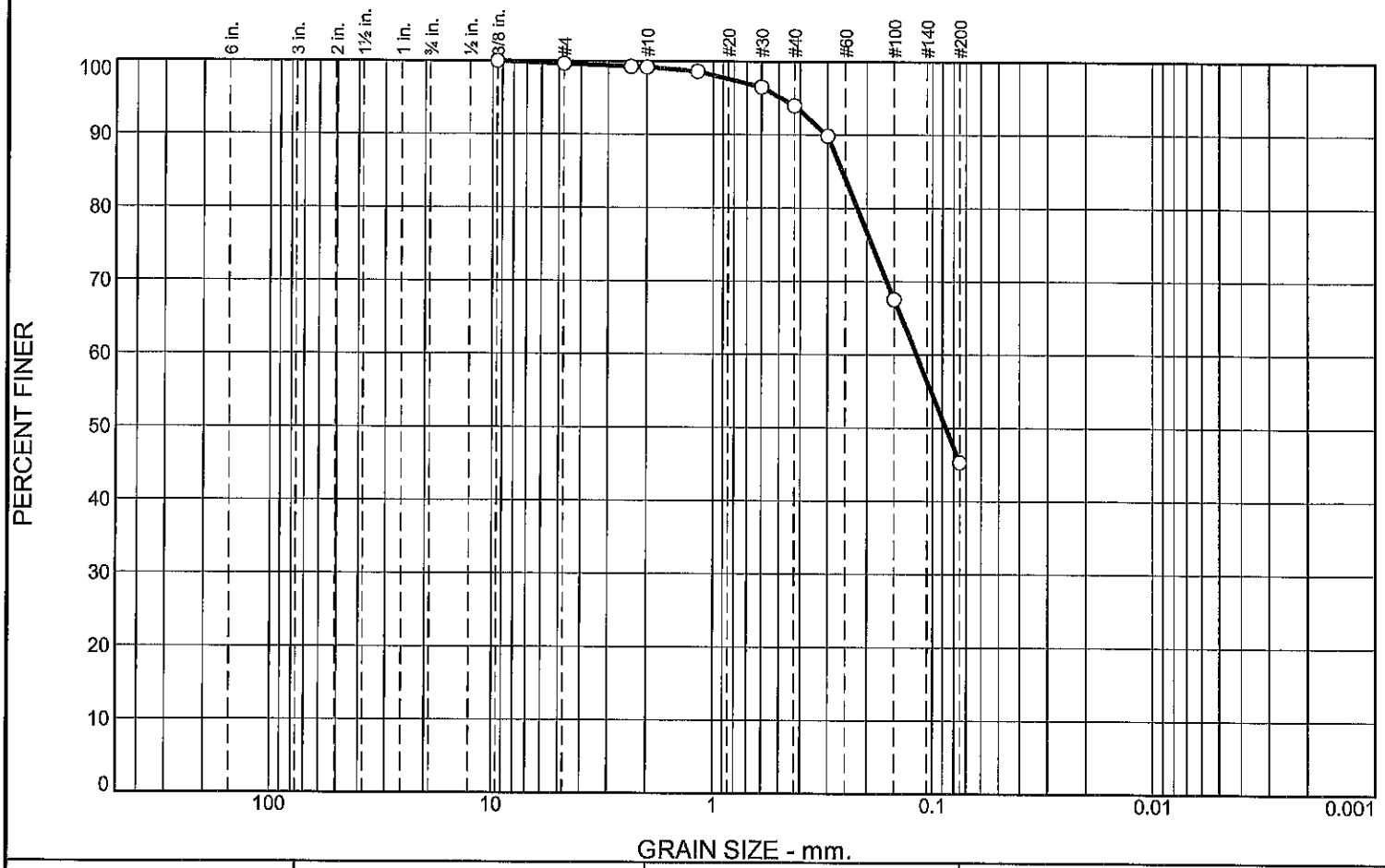
Location: B-4 @ 6.0'-7.5'
Sample Number: B-4 **Depth:** 6.0'-7.5' **Date:** 2/10/22

GES GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

Client: Carson City Public Works
Project: Carson City Fire Station
Project No: R20215895E1 **Figure** B-6

Tested By: J. Roybal

Particle Size Distribution Report



% +3"	% Gravel	% Sand		% Fines	
		Coarse	Fine	Silt	Clay
0	1	5	49	45	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375	100		
#4	100		
#8	99		
#10	99		
#16	99		
#30	97		
#40	94		
#50	90		
#100	68		
#200	45		

* (no specification provided)

Soil Description

Silty sand

Atterberg Limits

PL= 24 LL= 31 PI= 7

Coefficients

D_{90}= 0.3040 D_{85}= 0.2581 D_{60}= 0.1186
D_{50}= 0.0869 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-4(1)

Remarks

Sampled By:Z. Bower

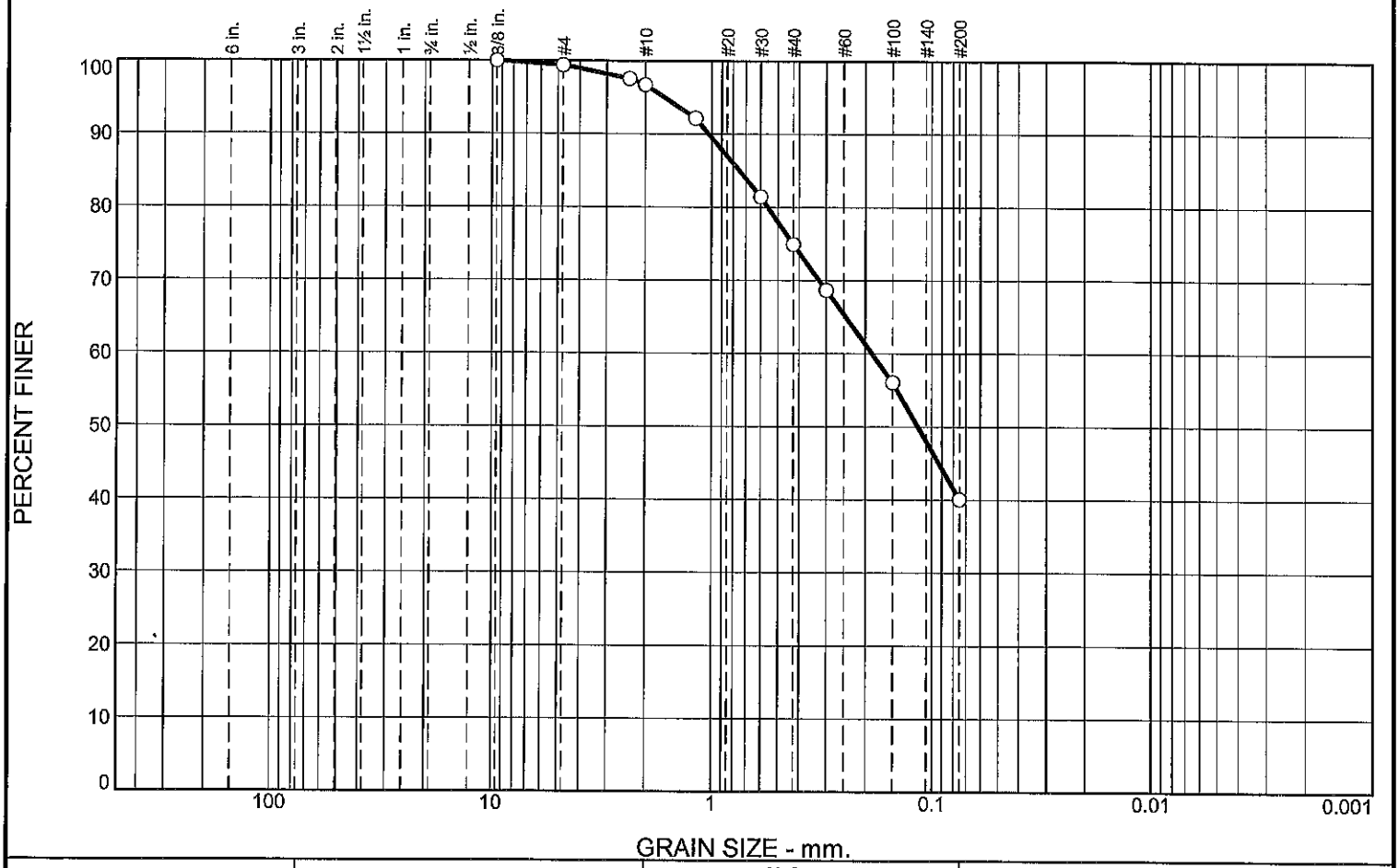
Location: B-4 @ 11.0'-12.5'
Sample Number: B-4 **Depth:** 11.0'-12.5' **Date:** 2/10/22

GES **GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.**

Client: Carson City Public Works
Project: Carson City Fire Station
Project No: R20215895E1 **Figure** B-7

Tested By: J. Roybal

Particle Size Distribution Report



% +3"	% Gravel	% Sand		% Fines	
		Coarse	Fine	Silt	Clay
0	3	22	35	40	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375	100		
#4	99		
#8	98		
#10	97		
#16	92		
#30	81		
#40	75		
#50	69		
#100	56		
#200	40		

* (no specification provided)

Soil Description

Silty, clayey sand

Atterberg Limits

PL= 17 LL= 24 PI= 7

Coefficients

D_{90}= 1.0291 D_{85}= 0.7510 D_{60}= 0.1864
D_{50}= 0.1154 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC-SM AASHTO= A-4(0)

Remarks

Sampled By:Z. Bower

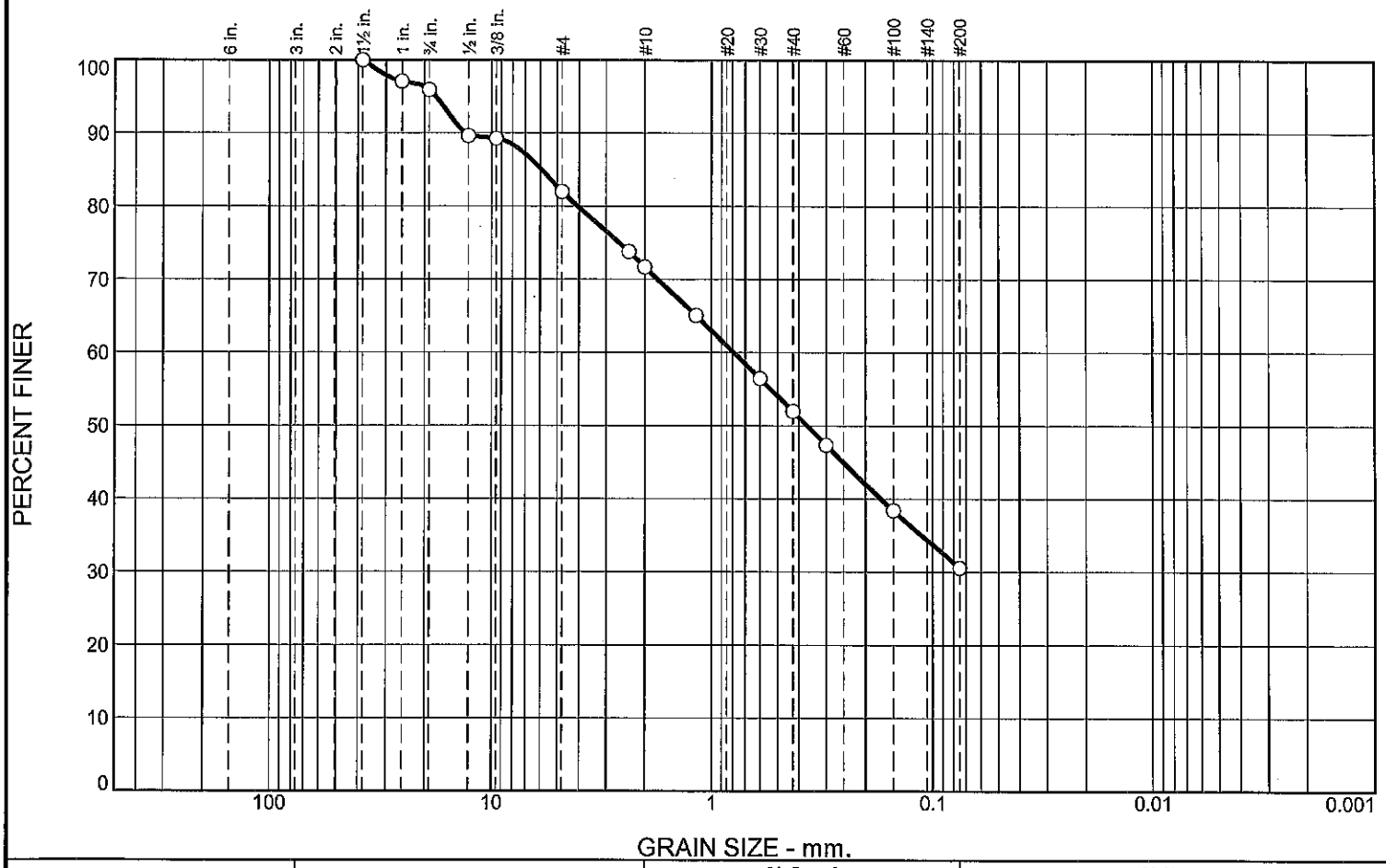
Location: B-4 Bulk Bag
Sample Number: B-4 **Depth:** Bulk Bag **Date:** 2/10/22

GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

Client: Carson City Public Works
Project: Carson City Fire Station
Project No: R20215895E1 **Figure** B-8

Tested By: J. Roybal

Particle Size Distribution Report



% +3"	% Gravel	% Sand		% Fines	
		Coarse	Fine	Silt	Clay
0	28	20	21	31	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100		
1	97		
.75	96		
.5	90		
.375	89		
#4	82		
#8	74		
#10	72		
#16	65		
#30	56		
#40	52		
#50	47		
#100	38		
#200	31		

* (no specification provided)

Material Description

Silty sand with gravel

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{90}= 13.1996 D_{85}= 5.9155 D_{60}= 0.7917
D_{50}= 0.3662 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-2-4(0)

Remarks

Sampled by: Z. Bower

Location: TP-1 @ 0.0'-4.5'
Sample Number: TP-1 **Depth:** 0.0'-4.5' **Date:** 02/17/22

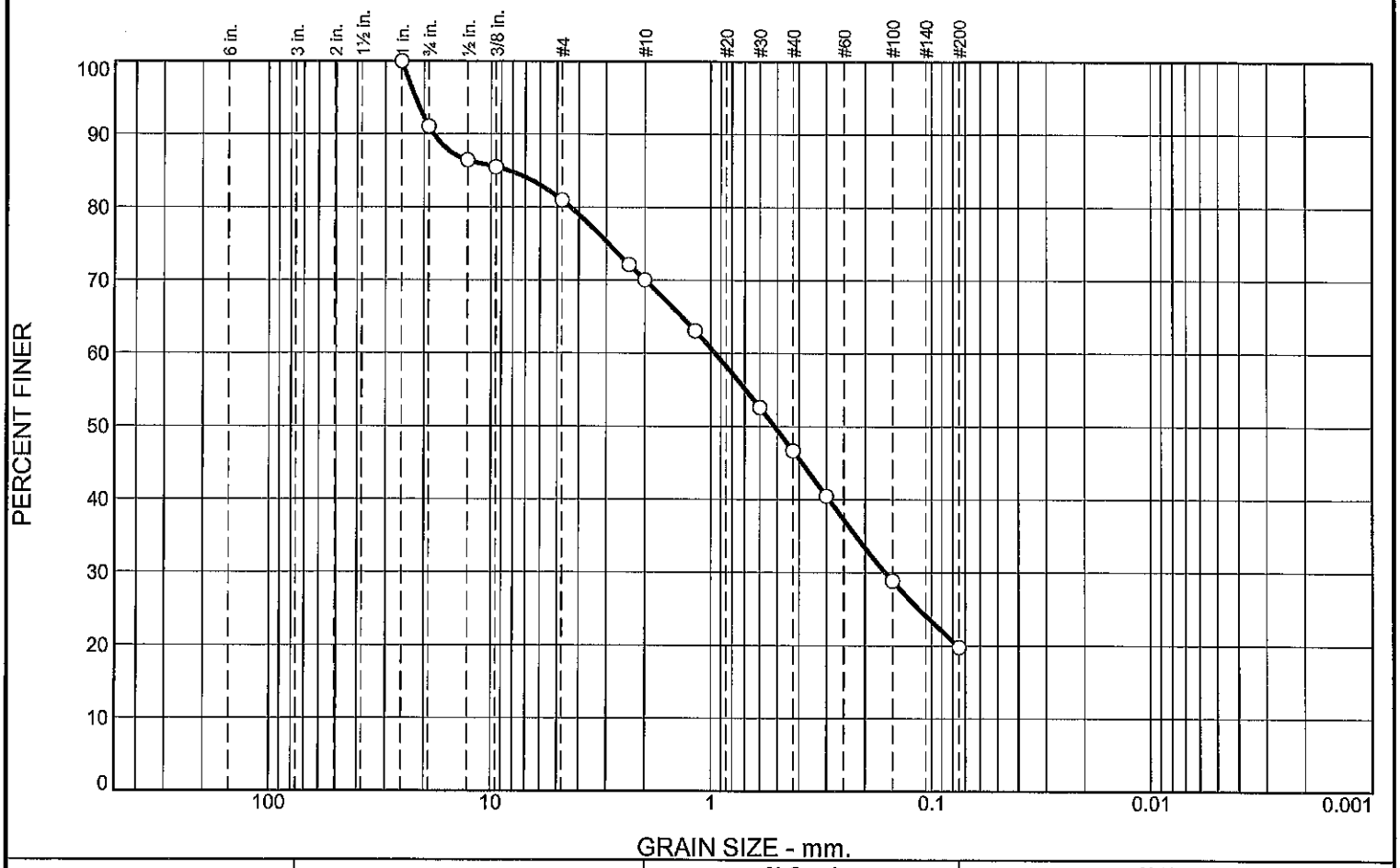
GES GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

Client: Carson City Public Works
Project: Carson City Fire Station

Project No: R20215895E2 **Figure** B-9

Tested By: J. Roybal

Particle Size Distribution Report



% +3"	% Gravel	% Sand		% Fines	
		Coarse	Fine	Silt	Clay
0	30	23	27	20	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100		
.75	91		
.5	86		
.375	86		
#4	81		
#8	72		
#10	70		
#16	63		
#30	53		
#40	47		
#50	40		
#100	29		
#200	20		

* (no specification provided)

Material Description

Silty, clayey sand with gravel

Atterberg Limits

PL= 22 LL= 26 PI= 4

Coefficients

D_{90}= 18.1074 D_{85}= 8.3609 D_{60}= 0.9543
D_{50}= 0.5144 D_{30}= 0.1615 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC-SM AASHTO= A-1-b

Remarks

Sampled by: Z. Bower

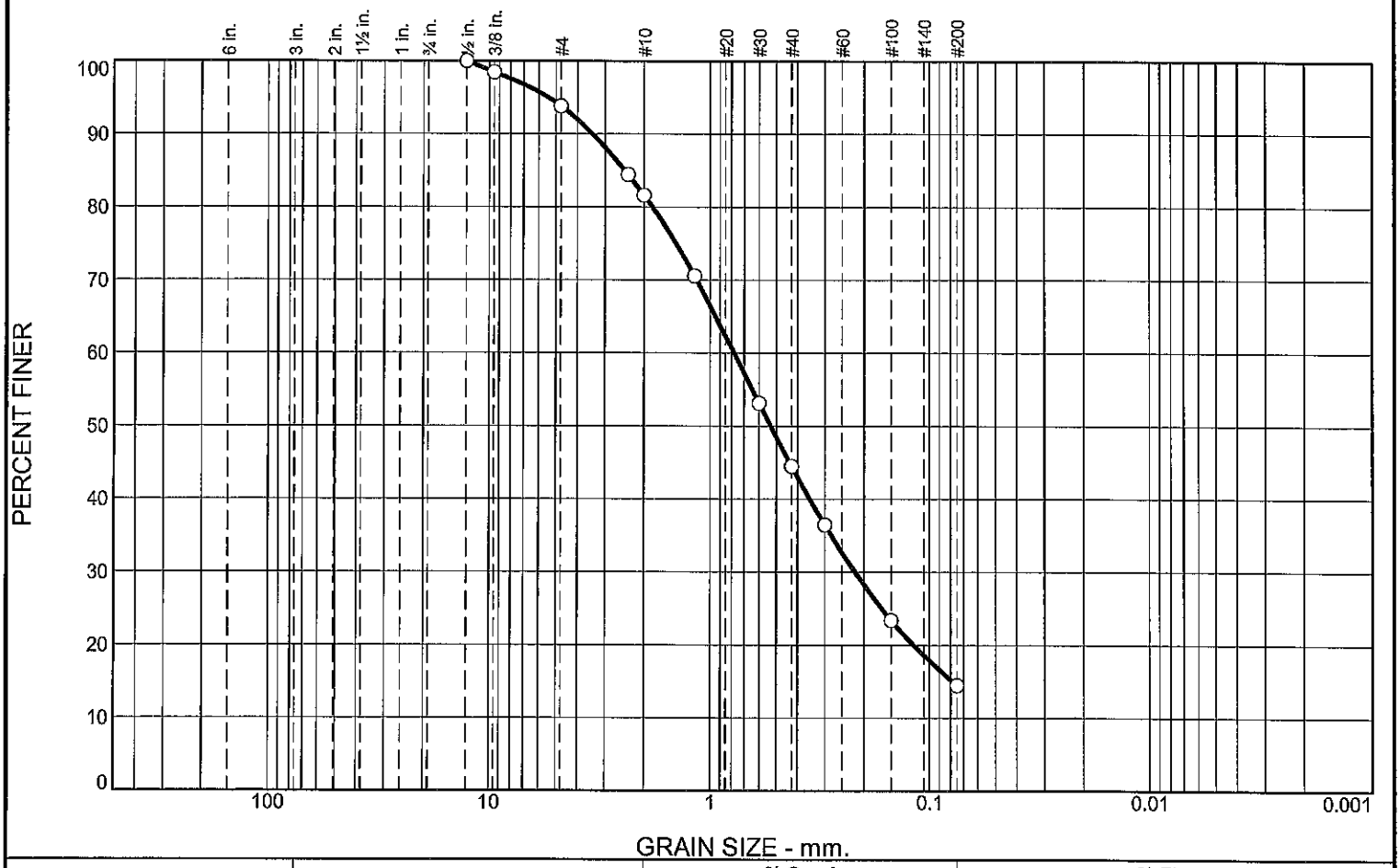
Location: TP-2 @ 0.0'-4.0'
Sample Number: TP-2 **Depth:** 0.0'-4.0' **Date:** 02/17/22

GES GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

Client: Carson City Public Works
Project: Carson City Fire Station
Project No: R20215895E2 **Figure** B-10

Tested By: J. Roybal

Particle Size Distribution Report



% +3"	% Gravel	% Sand		% Fines	
		Coarse	Fine	Silt	Clay
0	18	37	31	14	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.5	100		
.375	98		
#4	94		
#8	84		
#10	82		
#16	71		
#30	53		
#40	45		
#50	36		
#100	23		
#200	14		

* (no specification provided)

Material Description

Silty sand

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{90}= 3.4175 D_{85}= 2.4441 D_{60}= 0.7788
D_{50}= 0.5306 D_{30}= 0.2192 D_{15}= 0.0784
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-1-b

Remarks

Sampled By: Z. Bower

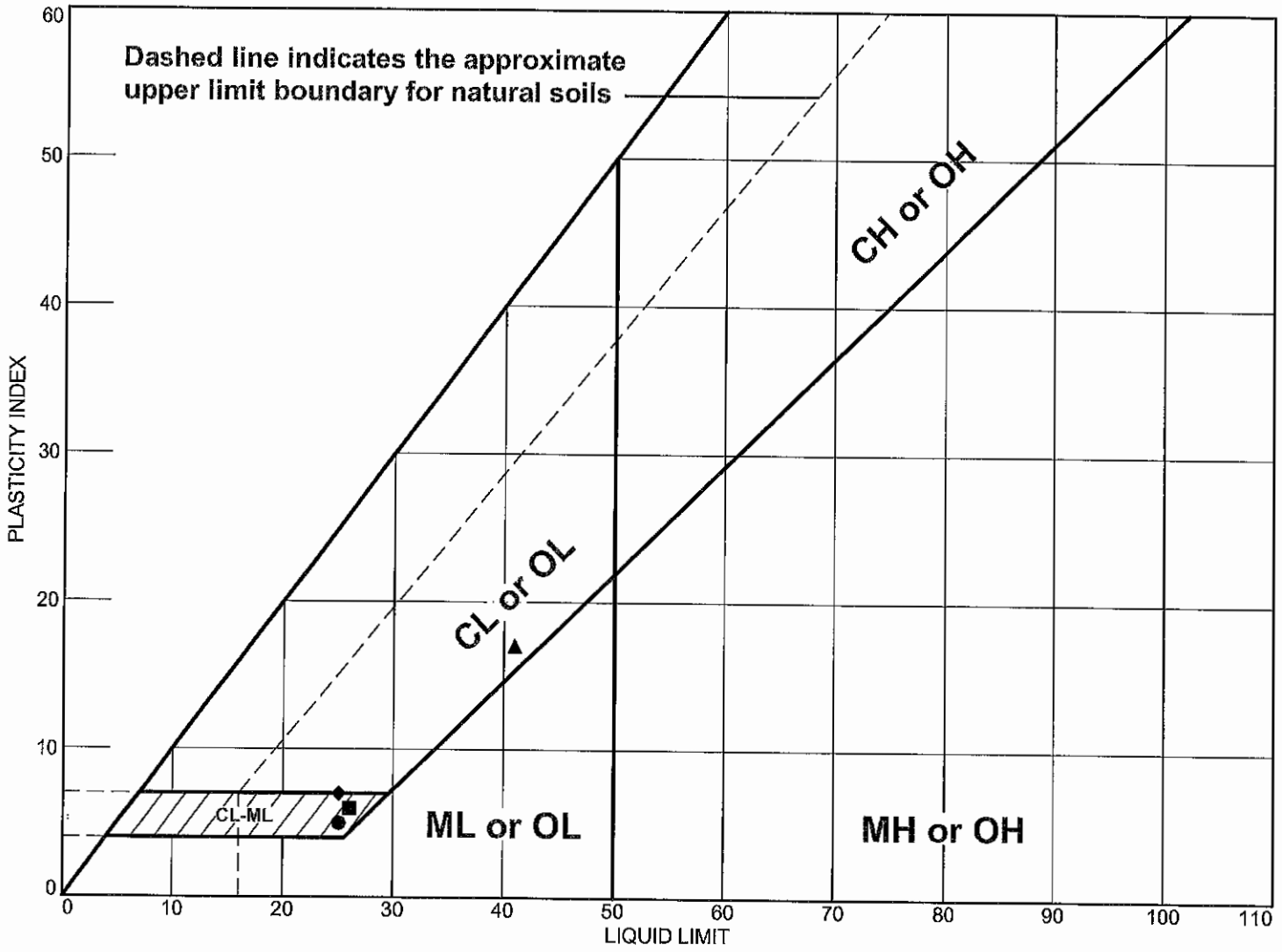
Location: TP-2 @ 0.0'-8.0'
Sample Number: TP-2 **Depth:** 0.0'-8.0' **Date:** 02/17/22

GES GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

Client: Carson City Public Works
Project: Carson City Fire Station
Project No: R20215895E2 **Figure** B-11

Tested By: J. Roybal

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Silty, clayey sand	25	20	5	64	30	SC-SM
■	Sandy silty clay	26	20	6	96	56	CL-ML
▲	Clayey sand	41	24	17	82	39	SC
◆	Silty, clayey sand	25	18	7	75	39	SC-SM
▼	Poorly graded sand with silt	NV	NP	NP	46	11	SP-SM

Project No. R20215895E1 **Client:** Carson City Public Works

Project: Carson City Fire Station

Remarks:

● **Location:** B-2 @ 4.5'-6.0' **Depth:** 4.5'-6.0' **Sample Number:** B-2

■ **Location:** B-3 @ 11.0'-12.5' **Depth:** 11.0'-12.5' **Sample Number:** B-3

▲ **Location:** B-3 @ 25.0'-26.5' **Depth:** 25.0'-26.5' **Sample Number:** B-3

◆ **Location:** B-3 Bulk Bag **Depth:** Bulk Bag **Sample Number:** B-3

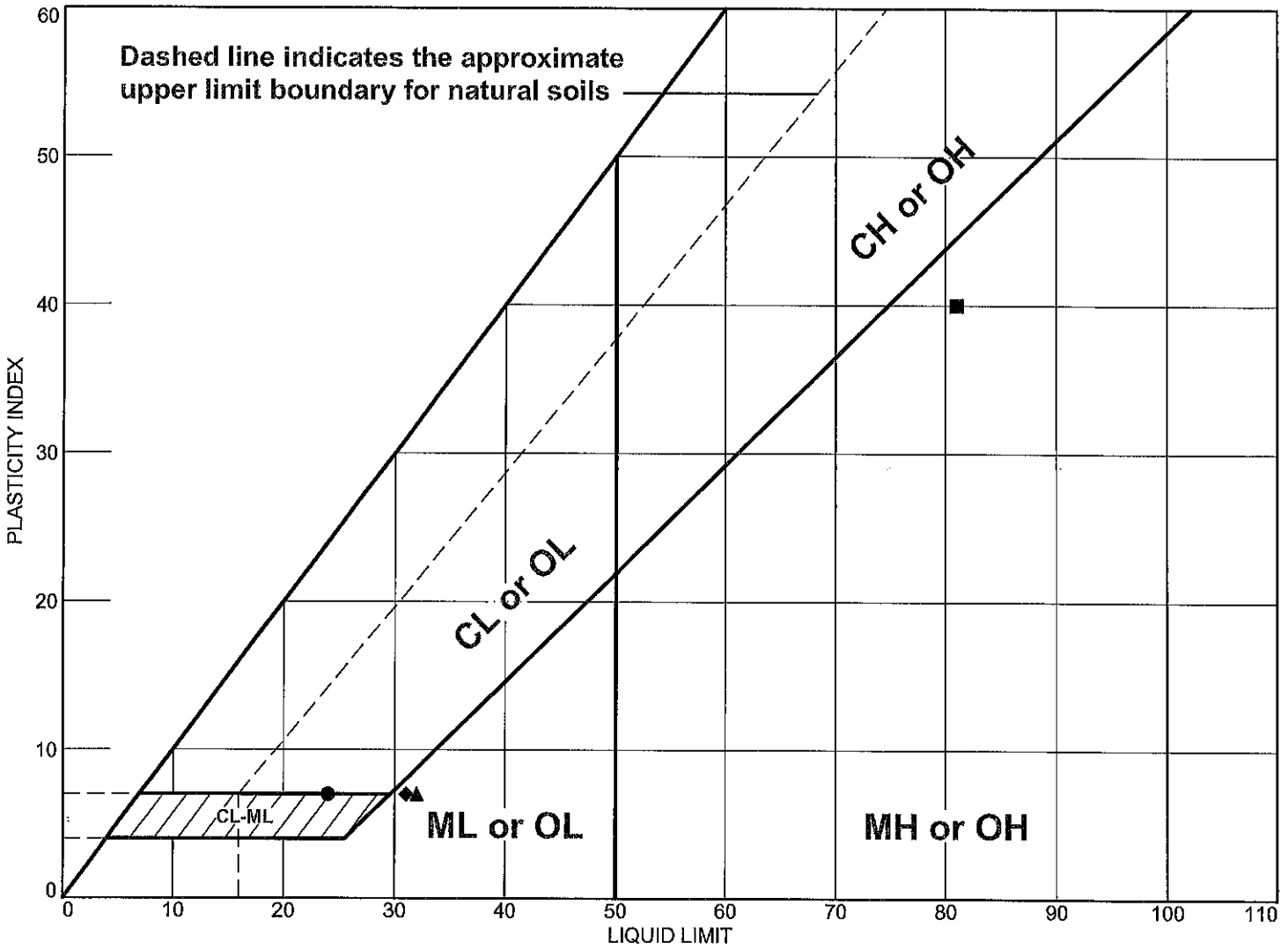
▼ **Location:** B-4 @ 6.0'-7.5' **Depth:** 6.0'-7.5' **Sample Number:** B-4

GES GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

Figure B-12

Tested By: J. Roybal

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Silty, clayey sand	24	17	7	75	40	SC-SM
■	Silty sand	81	41	40	–	47.5	SM
▲	Sandy silt	32	25	7	87	57	ML
◆	Silty sand	31	24	7	94	45	SM

Project No. R20215895E1 **Client:** Carson City Public Works

Project: Carson City Fire Station

Remarks:

● **Location:** B-4 Bulk Bag **Depth:** Bulk Bag **Sample Number:** B-4

■ **Location:** B-2 @ 20.0'-21.5' **Depth:** 20.0'-21.5' **Sample Number:** B-2

▲ **Location:** B-3 @ 40.0'-41.5' **Depth:** 40.0'-41.5' **Sample Number:** B-3

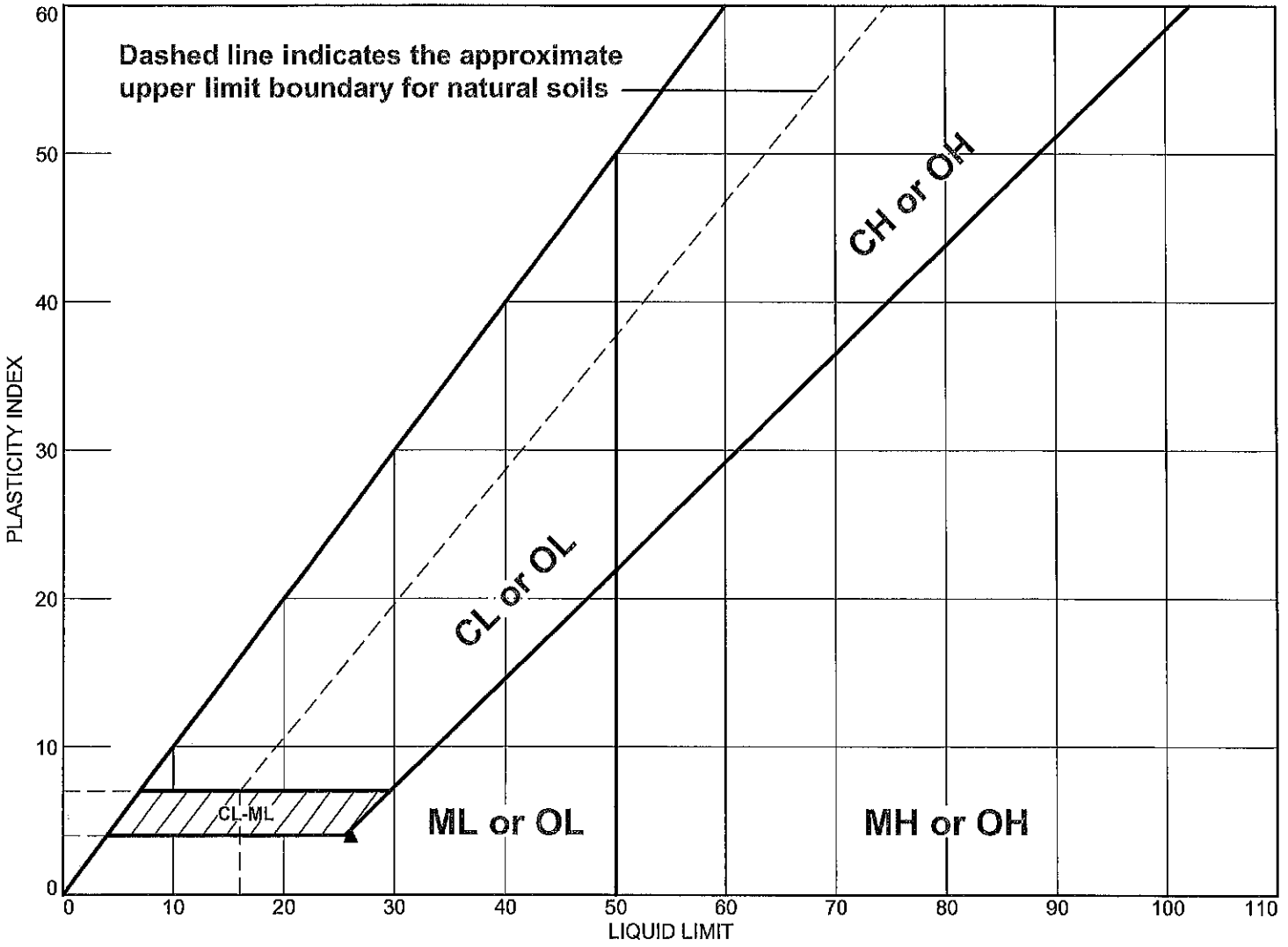
◆ **Location:** B-4 @ 11.0'-12.5' **Depth:** 11.0'-12.5' **Sample Number:** B-4

GES GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

Figure B-13

Tested By: J. Roybal

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Silty sand with gravel	NV	NP	NP	52	31	SM
■	Silty sand	NV	NP	NP	45	14	SM
▲	Silty, clayey sand with gravel	26	22	4	47	20	SC-SM

Project No. R20215895E2 **Client:** Carson City Public Works

Project: Carson City Fire Station

● **Location:** TP-1 @ 0.0'-4.5' **Depth:** 0.0'-4.5' **Sample Number:** TP-1

■ **Location:** TP-2 @ 0.0'-8.0' **Depth:** 0.0'-8.0' **Sample Number:** TP-2

▲ **Location:** TP-2 @ 0.0'-4.0' **Depth:** 0.0'-4.0' **Sample Number:** TP-2

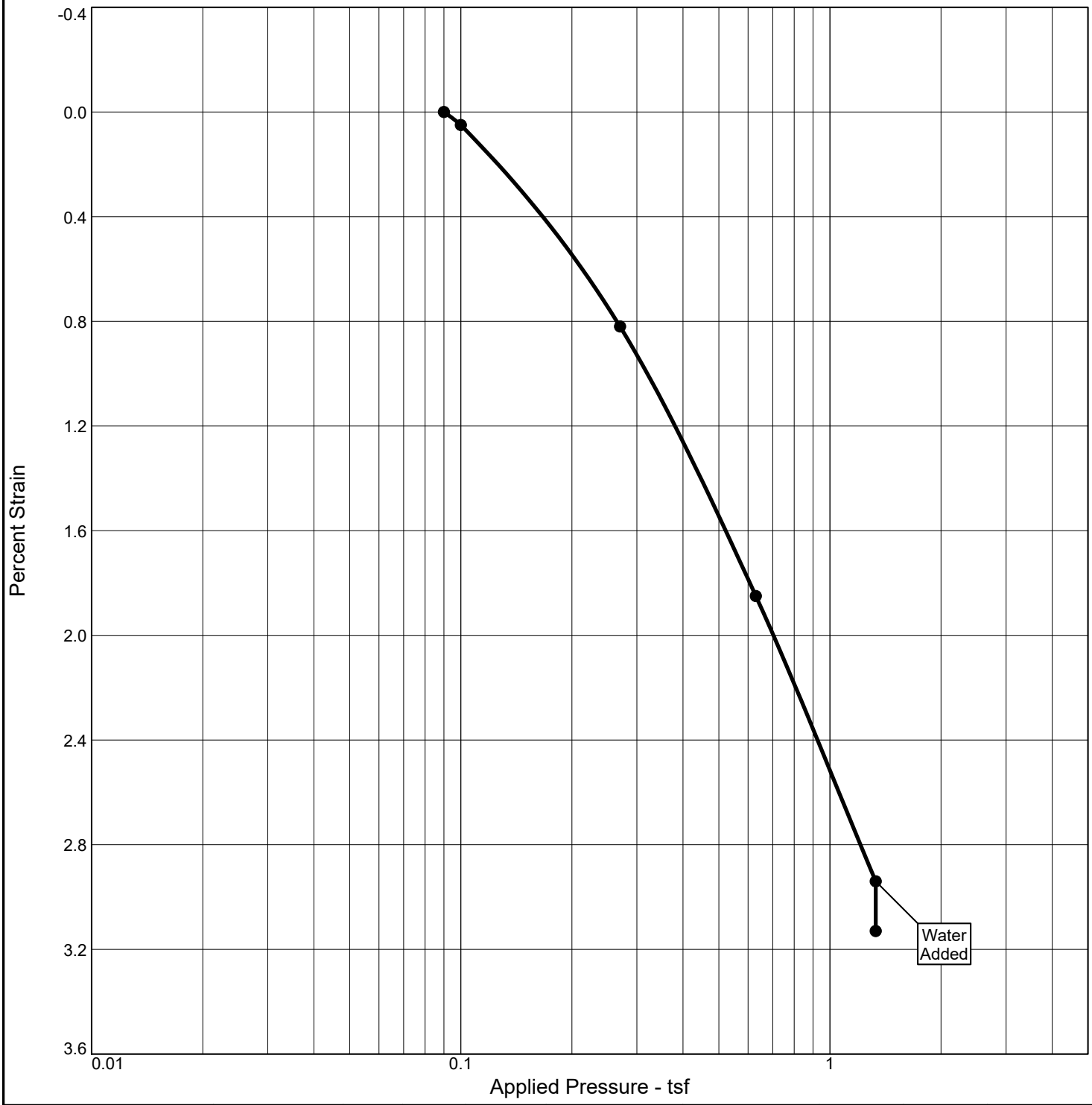
Remarks:

GES GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

Figure B-14

Tested By: J. Roybal

SWELL/COLAPSE POTENTIAL



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_r	Initial Void Ratio
Saturation	Moisture									
74.9 %	12.3 %	113.8	31	7	2.60	.71	-	-	-	0.426

MATERIAL DESCRIPTION	USCS	AASHTO
Silty sand	SM	A-4(1)

Project No. R20215895E1 **Client:** Carson City Public Works

Project: Carson City Fire Station

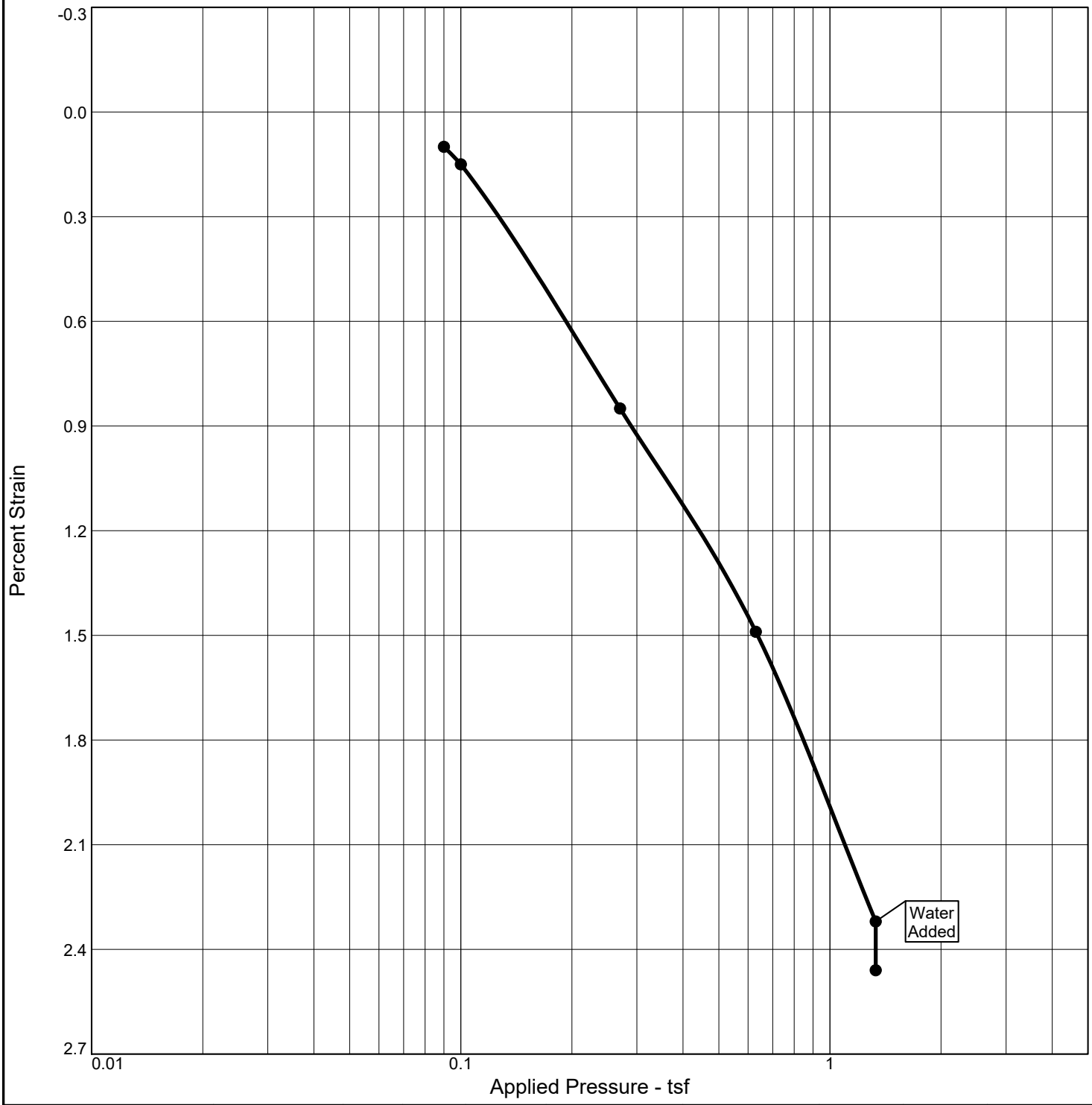
Location: B-4 @ 11.0'-12.5' **Depth:** 11.0'-12.5' **Sample Number:** B-4

GES GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

Remarks:

Figure B-15

SWELL/COLAPSE POTENTIAL



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_r	Initial Void Ratio
Saturation	Moisture									
108.2 %	25.0 %	101.4	NV	NP	2.60	.38	-	-	-	0.601

MATERIAL DESCRIPTION	USCS	AASHTO
Poorly graded sand with silt	SP-SM	A-1-b

Project No. R20215895E1 **Client:** Carson City Public Works

Project: Carson City Fire Station

Location: B-4 @ 6.0'-7.5' **Depth:** 6.0'-7.5' **Sample Number:** B-4

GES GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

Remarks:

Figure B-16

COMPACTION TEST REPORT

Project No.: R20215895E2 **Date:**
Project: Carson City Fire Station
Client: Carson City Public Works
Location: TP-1 @ 0.0'-4.5'
Sample Number: TP-1 **Depth:** 0.0'-4.5'
Remarks:

MATERIAL DESCRIPTION

Description: Silty sand with gravel

Classifications - **USCS:** SM **AASHTO:** A-2-4(0)
Nat. Moist. = **Sp.G. =** 2.60
Liquid Limit = NV **Plasticity Index =** NP
% < No.200 = 31 %

ROCK CORRECTED TEST RESULTS
Maximum dry density = 133.8 pcf
Optimum moisture = 8.3 %

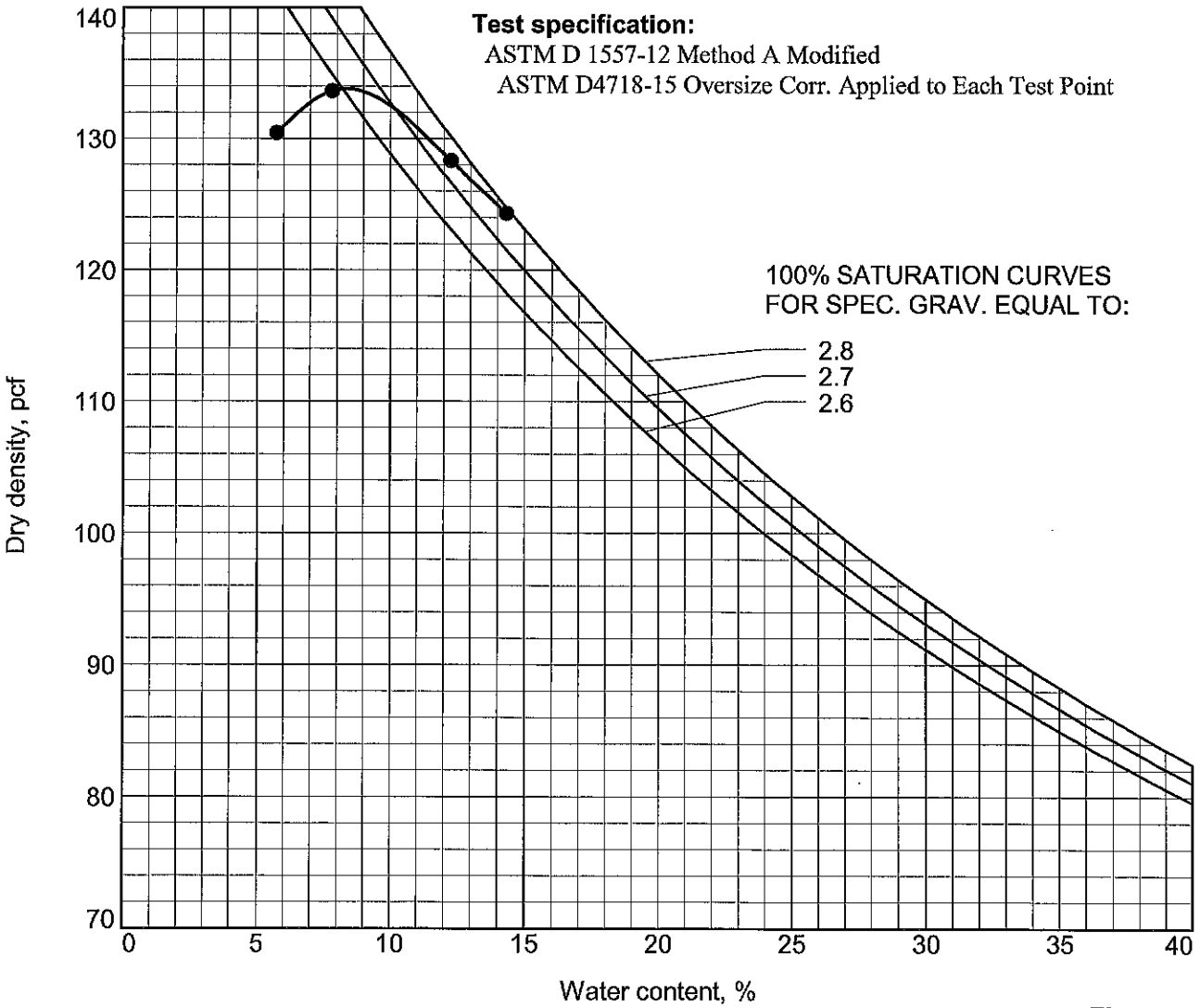


Figure B-17

GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

Tested By: T. Furlong

COMPACTION TEST REPORT

Project No.: R20215895E2 **Date:** 02/21/22
Project: Carson City Fire Station
Client: Carson City Public Works
Location: TP-2 @ 0.0'-8.0'
Sample Number: TP-2 **Depth:** 0.0'-8.0'
Remarks:

MATERIAL DESCRIPTION

Description: Silty sand

Classifications - **USCS:** SM **AASHTO:** A-1-b
Nat. Moist. = **Sp.G. =** 2.60
Liquid Limit = NV **Plasticity Index =** NP
% < No.200 = 14 %

ROCK CORRECTED TEST RESULTS
Maximum dry density = 125.4 pcf
Optimum moisture = 8.9 %

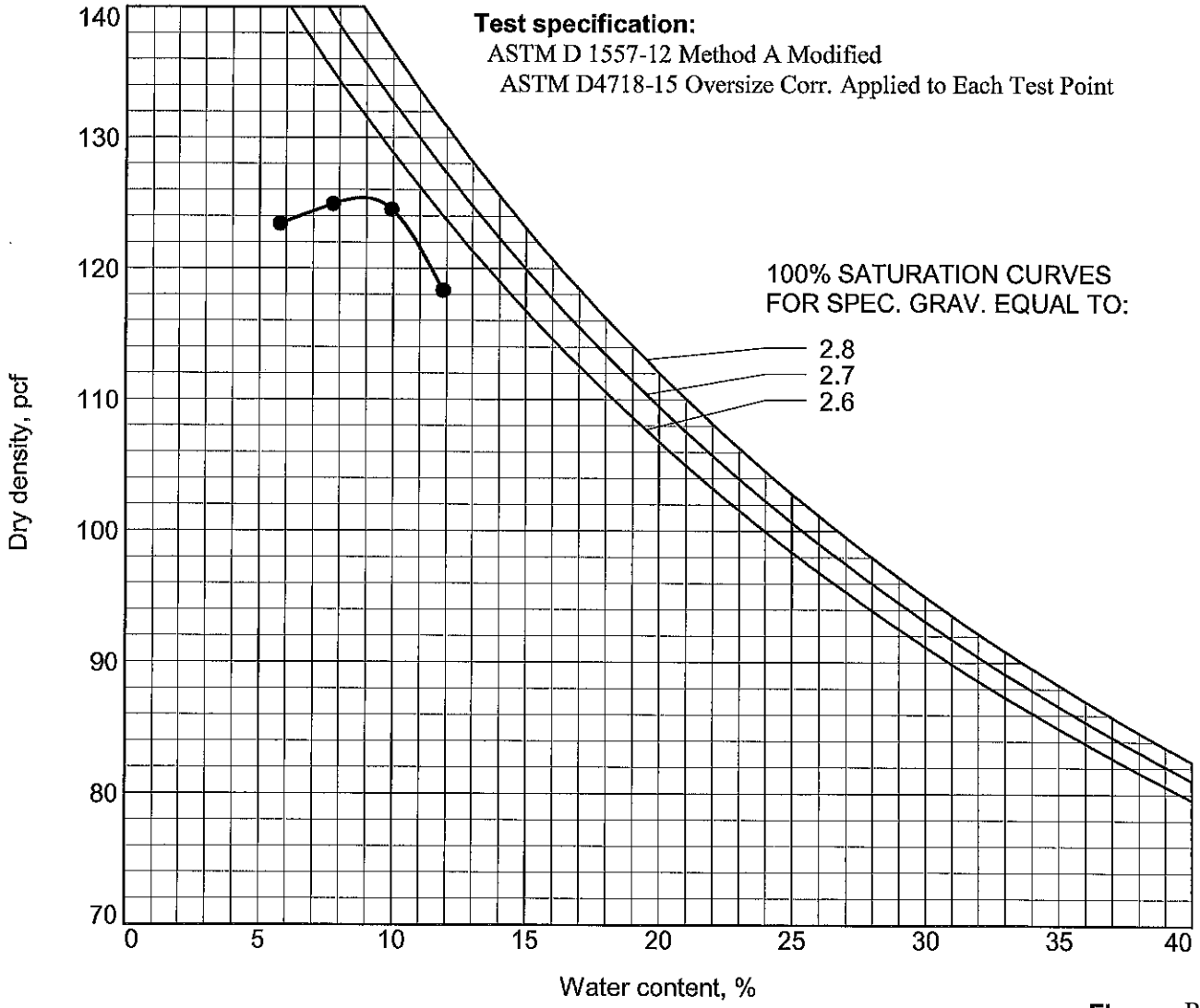


Figure B-18

GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

Tested By: T. Furlong

Silver State Labs-Reno
1135 Financial Blvd
Reno, NV 89502
(775) 857-2400 FAX: (888) 398-7002
www.ssalabs.com

Analytical Report

Workorder#: **22020385**
Date Reported: **2/23/2022**

Client: GES Nevada
Project Name: R2021 S895 E1 / B-3 BB
PO #:

Sampled By: Jillian Ruybul

Laboratory Accreditation Number: NV015/CA2990

Laboratory ID	Client Sample ID	Date/Time Sampled	Date Received
22020385-01	B-3 BB	02/01/2022 10:00	2/8/2022

Parameter	Method	Result	Units	PQL	Analyst	Date/Time Analyzed	Data Flag
Chloride	EPA 9056	78	mg/Kg	50	MA	02/18/2022 16:43	
Solubility	SM 2540C	0.16	%	0.01	SR	02/16/2022 11:00	
Sulfate	EPA 9056	460	mg/Kg	20	MA	02/18/2022 16:43	

Laboratory Accreditation Number: NV015/CA2990

Laboratory ID	Client Sample ID	Date/Time Sampled	Date Received
22020385-02	B-4 BB	02/01/2022 10:00	2/8/2022

Parameter	Method	Result	Units	PQL	Analyst	Date/Time Analyzed	Data Flag
Chloride	EPA 9056	<50	mg/Kg	50	MA	02/18/2022 16:59	
Solubility	SM 2540C	0.11	%	0.01	SR	02/16/2022 11:00	
Sulfate	EPA 9056	190	mg/Kg	20	MA	02/18/2022 16:59	

Silver State Labs-Reno
1135 Financial Blvd
Reno, NV 89502
(775) 857-2400 FAX: (888) 398-7002
www.ssalabs.com

Analytical Report

Workorder#: **22020925**
Date Reported: **3/4/2022**

Client: GES Nevada **Sampled By:** Villian Ruybul
Project Name: R2022 5940 & R20215895 / TP-1 @ 0.0 - 4.5',
PO #:

Laboratory Accreditation Number: NV015/CA2990

Laboratory ID	Client Sample ID	Date/Time Sampled	Date Received
22020925-01	TP-1 @ 0.0 - 4.5'	02/15/2022 10:00	2/17/2022

Parameter	Method	Result	Units	PQL	Analyst	Date/Time Analyzed	Data Flag
Chloride	EPA 9056	<50	mg/Kg	50	MA	03/01/2022 13:12	
Solubility	SM 2540C	0.10	%	0.01	SR	02/25/2022 14:00	
Sulfate	EPA 9056	<20	mg/Kg	20	MA	03/01/2022 13:12	

Laboratory Accreditation Number: NV015/CA2990

Laboratory ID	Client Sample ID	Date/Time Sampled	Date Received
22020925-02	TP-2 @ 0.0 - 8.0'	02/15/2022 10:00	2/17/2022

Parameter	Method	Result	Units	PQL	Analyst	Date/Time Analyzed	Data Flag
Chloride	EPA 9056	<50	mg/Kg	50	MA	03/01/2022 13:28	
Solubility	SM 2540C	0.04	%	0.01	SR	02/25/2022 14:00	
Sulfate	EPA 9056	<20	mg/Kg	20	MA	03/01/2022 13:28	

Laboratory Accreditation Number: NV015/CA2990

Laboratory ID	Client Sample ID	Date/Time Sampled	Date Received
22020925-03	TP-3 @ 0.0 - 4.0'	02/15/2022 10:00	2/17/2022

Parameter	Method	Result	Units	PQL	Analyst	Date/Time Analyzed	Data Flag
Chloride	EPA 9056	<50	mg/Kg	50	MA	03/01/2022 15:09	
Solubility	SM 2540C	0.15	%	0.01	SR	02/25/2022 14:00	
Sulfate	EPA 9056	600	mg/Kg	20	MA	03/01/2022 15:09	

Silver State Labs-Reno
1135 Financial Blvd
Reno, NV 89502
(775) 857-2400 FAX: (888) 398-7002
www.ssalabs.com

Definitions & Qualifiers

WO#: **22020925**
Date: **3/4/2022**

Definitions:

LCS: Laboratory Control Sample; prepared by adding a known mass of target analytes to a specified amount of de-ionized water and prepared with the batch of samples, used to calculate Accuracy (%REC).

LCSD: LCS Duplicate; used to calculate both Accuracy (%REC) and Precision (%RPD)

MBLK: Method Blank; a sample of similar matrix that is processed simultaneously with and under the same conditions as samples through all steps of the analytical procedure, and in which no target analytes
or interferences are present at concentrations that impact the analytical results for sample analyses.

MS: Matrix Spike; prepared by adding a known mass of target analytes to a specified amount of matrix sample for which an independent estimate of target analyte concentration is available, used to calculate Accuracy (%REC)

MSD: Matrix Spike Duplicate; used to calculate both Accuracy (%REC) and Precision (%RPD)

RPD: Relative Percent Difference; comparison between sample and duplicate and/or MS and MSD.

PQL: Practical Quantitation Limit; the limit to which data is quantitated for reporting.

MDL: Method Detection Limit; the limit to which the instrument can reliably detect.

MCL: Maximum Contaminant Level; value set according to EPA guidelines.

Qualifiers:

* - Analyte exceeds Safe Drinking Water Act MCL, does not meet drinking water standards.
C - Analyte value below Safe Drinking Water Act MCL, does not meet drinking water standards.
B - Analyte found above the PQL in associated method blank.
G - Calibration blank analyte detected above PQL.
H - Sample analyzed beyond holding time for this parameter.
J - Estimated Value; Analyte found between MDL and PQL limits.
L - Sample concentration is at least 5 times greater than spike contribution. Spike recovery criteria do not apply.
R - RPD between sample and duplicate sample outside the RPD acceptance limits.
S - Batch MS and/or MSD were outside acceptance limits, batch LCS was acceptable.
W - Sample temperature when recieved was out of limit as specified by method.
Z - Batch LCS and/or LCSD were outside acceptance limits.