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

GEOTECHNICAL EVALUATION
SOUTHERN NEVADA HEALTH DISTRICT EXPANSION
700 S MARTIN LUTHER KING BOULEVARD
LAS VEGAS, NEVADA

PROJECT NO. 20246923E1
MAY 8, 2024

Prepared for:

Southern Nevada Health District
280 S. Decatur Boulevard
Las Vegas, Nevada 89106

GES
GEOTECHNICAL &
ENVIRONMENTAL
SERVICES, INC.

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

May 8, 2024
Project No. 20246923E1

Sean Beckham
Southern Nevada Health District
280 S. Decatur Boulevard
Las Vegas, Nevada 89106

RE: ***Geotechnical Evaluation***
Southern Nevada Health District Expansion
700 S. Martin Luther King Boulevard
Las Vegas, NV 89106
APN: 13933402031

Dear Mr. Beckham,

Geotechnical & Environmental Services, Inc. (GES) is pleased to present the Geotechnical Evaluation Report for the proposed Southern Nevada Health District Expansion located at 700 S. Martin Luther King Boulevard.

The contents of this report include the findings of a geologic review, the results of the field exploration and of the laboratory testing programs, conclusions, and recommendations for site development based on subsurface soil conditions.

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
Anthony Todechiney
ANTHONY TODECHINEY
Exp. 6/30/2024
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No. 23427

Carmen Thomas
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EXECUTIVE SUMMARY
SOUTHERN NEVADA HEALTH DISTRICT EXPANSION
700 S. MARTIN LUTHER KING BOULEVARD
LAS VEGAS, 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	A two-story attached expansion to the southwest side of the existing building. Below grade structures are not anticipated. The project includes the demolition of existing improvements in the area of the proposed structure.
Geotechnical Site Characterization	Fill soils underlain by alternating layers of coarse- and fine-grained native soils. Near surface clay soils are moderately expansive. **Groundwater** encountered at 14 feet. **Liquefaction potential** is low. **Seismic site class:** D.
Earthwork	Raze existing improvements and remove uncontrolled fill from the improvement area. An is overexcavation required due to expansive soils. Native soils are generally not anticipated to meet the requirements for structural fill. Processing of the native soils or using imported soils should be anticipated to be required for structural fill.
Spread Footing Foundations	Shallow footings are acceptable. Allowable bearing pressure = 2,000 psf up to maximum 4,000psf Expected settlement of 1 inch (total) and ½ inch (differential)
Pavement Sections	**Flexible pavement sections** include 4 inches of AC over 8 inches of Type II. **Rigid pavement sections** include 6 inches of PCC over 4 inches of Type II.
Concrete Flatwork	4-inch minimum concrete thickness with 4-inch minimum aggregate base thickness. Concrete should contain Type V cement and have a design compressive strength of >4,500 psi and water-cement ratio of <0.45 by weight.
Drainage	Positive drainage should be established and maintained away from the proposed structure(s).

GEOTECHNICAL EVALUATION
SOUTHERN NEVADA HEALTH DISTRICT EXPANSION
700 S. MARTIN LUTHER KING BOULEVARD
LAS VEGAS, NEVADA

1. INTRODUCTION

This report presents the results of a geotechnical evaluation performed by Geotechnical & Environmental Services, Inc. (GES) for the proposed building expansion project in Las Vegas, Nevada. Figure A-1 presents a vicinity map showing the approximate location of the site within Las Vegas valley. Figure A-2 presents the exploration location map within the project site. The following sections present the purpose and scope of our geotechnical exploration, and project and site descriptions

1.1. PURPOSE AND SCOPE

The purpose of our geotechnical study was 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 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 March 13, 2023.

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 2021 International Building Code (IBC) and 2021 Southern Nevada Amendments to the IBC.

We understand the proposed project will include the design and construction of a two-story building expansion approximately 14,000 square feet in size to be located on the southwest side of the existing building. We assume column loads on the order of 80 kips and wall loads on the order of 3 kips per lineal foot. Below grade structures are not anticipated. We anticipate finish grade will be roughly at the same elevation as existing grade.

1.3. SITE DESCRIPTION

The project site consists of approximately 1.47-acres of developed land located at 700 S. Martin Luther King within Assessor Parcel Number (APN) 139-334-02-031. Parking and landscaping make up majority of the site. The site is surrounded by metal fencing and masonry walls and is bordered by commercial developments. Overhead electrical lines run parallel to the site at its immediate east.

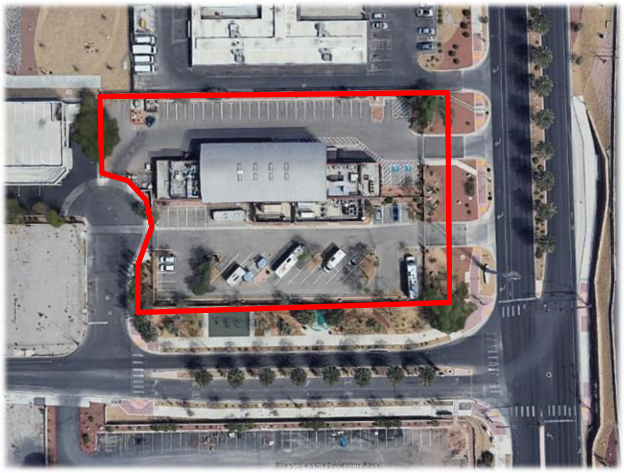


Figure 1.3 Project Site

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.

2.1. GEOLOGY

The subject site is located in the Las Vegas Valley, a fault-bounded graben structure surrounded by mountain ranges. The Las Vegas Valley is physiographically characteristic of the Basin and Range Province with generally northwest-trending parallel mountain ranges and an intervening basin. Unlike many basins within the Basin and Range Province, which are internally draining, the Las Vegas Valley is unique in that the basin drains through the Las Vegas Wash into Lake Mead and the Colorado River.

Tertiary and Quaternary unconsolidated alluvial deposits, derived from the surrounding mountain ranges, fill the valley. These deposits may be up to 4,000 feet thick at the site near the center of the valley. The surrounding mountain ranges are comprised of sedimentary and igneous rocks. Alluvial fan deposits, consisting of coarser grained sediments such as sands and gravels, slope down from the surrounding mountain fronts towards the valley floor. Sediments here are typically less coarse, ranging from grades of fine sand and silt to clay, near the valley bottom. Beds of amorphous and crystalline gypsum are common. Zones of calcareous cemented deposits (caliche) are present at various locations and depths throughout the valley.

The subject site is located on the referenced, Las Vegas NW Quadrangle Geologic Map within an area mapped as Intermittently Active Alluvium (Qai). These deposits consist mostly of pink to pale-brown sand and pebble to cobble gravel with slight to moderate consolidation. Figure 2.1-1 shows the site (in red) in relation to the geologic unit described.

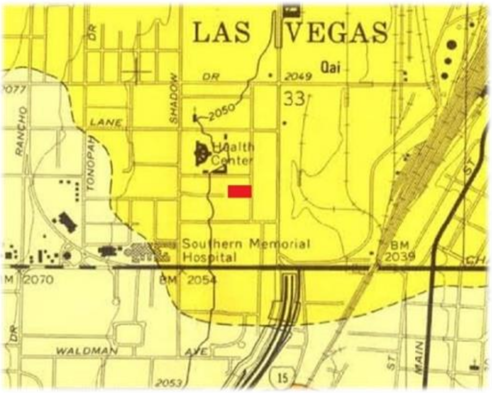


Figure 2.1-1 Geological Map

2.2. CLARK COUNTY MAPPED SOIL CONDITIONS

The project site is located within an area reported as having high swell potential (8-12 percent) and the potential for high solubility, clay swell, corrosion, gypsum salt, and expansive or hydro-collapsible potential.

2.3. SEISMICITY

The U.S. National Oceanic and Atmospheric Administration Earthquake Catalog lists about 800 events of magnitude greater than or equal to 4 with epicenters within about 120 miles of Las Vegas. Only 19 events greater than or equal to magnitude 4 are estimated to have occurred during the 1881 through 1938 period in the southern Nevada region.

After about 1947, nuclear testing began at the Nevada Test Site. Therefore, many of the recorded earthquakes after about 1947 may be due to nuclear blasts occurring more than about 60 miles from the subject site. Several hundred earthquakes occurred from 1936 to 1965 near Hoover Dam, presumably due to filling of the Lake Mead reservoir, with 24 of these events reportedly greater than or equal to magnitude 4.

Table 2.3: Nearby Faults and Earth Fissures

Fault		Distance From Project Vicinity	Direction
Quaternary Age	Frenchman Mountain	8 miles	East
	Eglington	6 miles	Northwest
	Las Vegas Valley Faults	1 mile	West
Holocene Age	Black Hills Fault	22 miles	Southeast
Fissure zone	Near Valley View Blvd and US 95	1 ½ miles	Northwest

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.

2.4. 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.

Due to the anticipated presence of groundwater within the upper 50 feet of the ground surface and the potential for low-density granular subsurface layers, GES performed an exploratory boring to a depth of 50 feet in general accordance with the requirements for screening for potential liquefaction hazards presented in Appendix O Section 0103 of the SNA to the 2021 IBC. Low density soils having standardized blow counts (ASTM D1586) less than 15 were not observed in either boring below the historical groundwater depth. Therefore, based on our review of Criteria No. 2 Section O103.1.1 (Screening for Potential Liquefaction Hazards) of the Southern Nevada Amendments to the 2021 International Building Code, it is our opinion that the potential for liquefaction at the site is low.

2.5. GROUNDWATER

Groundwater was encountered in both borings during drilling at 14 feet. A review of a water wells listed on the State of Nevada Department of Conservation & Natural Resources, Division of Water Resources website, reported the historical groundwater level in the vicinity of the site at approximately 10-25 feet below grade.

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 observed exploration and on historical depth to groundwater it is anticipated that groundwater will present a constructability challenge.

2.6. FIELD EXPLORATION

GES evaluated the subsurface conditions at the project site, by drilling 2 borings (B-1 and B-2) on April 15, 2024. The inset Figure 2.5-1, and Figure A-2 in Appendix A of this report, show the approximate boring locations within the project area. Boring 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 2.6-1 Approximate Boring Locations

The borings were drilled with a Diedrich-D120 drill rig using 8-inch hollow stem augers. Soil samples and penetration blow counts were obtained with a 3-inch outside diameter ring-lined drive sampler and with a 2-inch outside diameter split-spoon sampler in general accordance with ASTM D3550 and ASTM D1586, respectively. The samplers were driven with a 140-pound automatic trip hammer falling about 30 inches. The penetration resistance (hammer blows) measured by driving the sampler was used to evaluate the consistency of the in-place soil. The boreholes were backfilled with soil cuttings and bentonite chips. The borings were surface completed with ready mix concrete. Table 2.6 provides a summary of the explorations. The boring logs are presented in Appendix A.

Table 2.6 Field Exploration Summary

Exploration ID	Depth (ft)	Latitude	Longitude	Ground Elevation (ft)	Equipment	Exploration Size / Type
B-1	16.5	36.142025°	-115.163117°	2048	D-120	8-inch Hollow Stem Auger
B-2	51.5	36.162171°	-115.163004°	2048	D-120	8-inch Hollow Stem Auger

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.

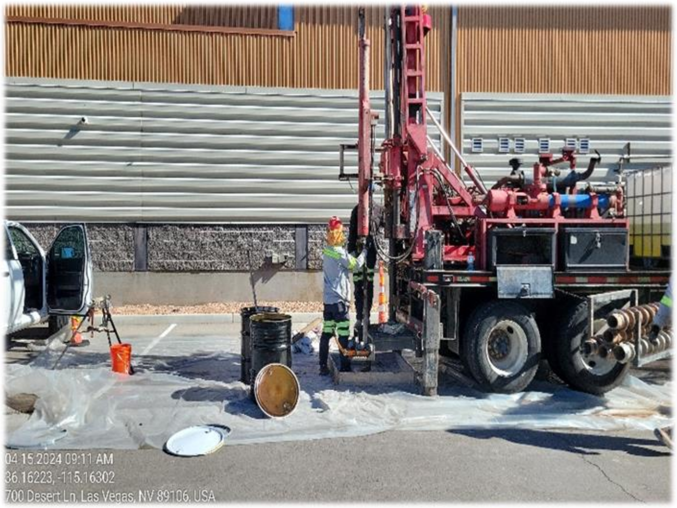


Figure 2.6-2 Geotechnical Drilling

2.7. 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.

2.8. 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 logs, Figure No. A-4 and A-5, in Appendix A.

2.8.1. FILL SOIL

Up to approximately two feet of fill was encountered in both of the borings beneath the pavement section. The fill consisted of brown sand and lean clay with silt and gravel. Fill may be encountered beyond or between our boring locations to various depths. Fill placed without documentation to indicate that the fill soils were placed under the supervision of a Geotechnical Engineer are considered uncontrolled fill. The term uncontrolled fill soils refer to artificial fill which was placed without engineering observation, testing, or documentation and is considered unsuitable for the support of project improvements. Our scope did not include an evaluation of existing fill soils or certification of existing fill or improvements.

2.8.2. NATIVE SOIL

The native material was generally variable, consisting of alternating layers of coarse-grained and fine-grained soils. The coarse-grained soils were observed as medium dense to very dense clayey sand and poorly graded sand. The fine-grained soils were observed as stiff to hard lean clay and fat clay. Some of the soil layers were observed to be weakly cemented, but strongly cemented (rock-like) soils were not observed. Some layers also contained gypsum. The soils were generally moist but were observed to be wet near the groundwater table. Laboratory testing indicates the near surface fine-grained soils are moderately expansive. Due to the inconsistent nature of cemented soil, weakly to strongly soils may be encountered beyond or between our boring locations at varying depths. Detailed information regarding subsurface materials and conditions, are presented on the exploration logs in Appendix A.

Weakly and moderately cemented soil refers to cemented soil that will crumble or break with little or considerable finger pressure, respectively. Strongly cemented soil refers to rock-like soil that will not crumble or break at any finger pressure. In general, weakly to moderately cemented soils can be excavated with a backhoe, although with a corresponding reduction in excavation production as degree of cementation increases. Moderately cemented soils can be excavated with a ripper tooth or by a backhoe with extreme difficulty. However, to excavate strongly cemented rock-like materials, a heavy-duty excavator or trencher, Caterpillar D-10 Dozer or larger (or equivalent) with ripper, hoe-ram, headache ball, rock-saw or similar rock excavation technique is recommended and will likely be needed.

A detailed excavatability or rippability evaluation is beyond the scope of this study. The contractor should perform the independent investigations necessary to determine the type of equipment required to perform the work. Independent investigations may include test excavations, rock probes, and/or seismic refraction surveys. If the contractor(s) have any questions regarding site conditions, site preparation, or the recommendations provided, they should contact a representative of GES for any needed clarifications prior to submitting earthwork bids. It is the express responsibility of the contractor to perform independent evaluations of the rippability of cemented soils prior to preparing their bid. GES is not an earthwork or underground contractor.

2.8.3. TRENCH BACKFILL SUITABILITY

GES evaluated the suitability of non-cemented soils collected from the borings for use as Selected Backfill as specified in Section 207.02.01 and Granular Backfill as specified in Sections 207.02.02 and 704.03.01 of the Uniform Standard Specifications for Public Works' Construction (USS). Specifications for gradation and plasticity, results of laboratory tests, and an evaluation of suitability are provided in the following tables:

Table 2.7.3 -1 Trench Backfill Suitability

			Sieve Size										Plasticity Index*	Liquid Limit**	Meets Select Backfill Requirement?	Meets Granular Backfill Requirement?
			6-inch		3-inch		No. 4		No. 16		No. 200					
Boring	Depth (ft)	USCS	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max				
Select Backfill			100	100	80	100	35	100	--	--	--	--	Table 2.8.2	50 max	--	--
Granular Backfill			--	--	100	100	35	100	25	100	5	15	Table 2.8.3	--	--	--
B-1	5.0'	CL	100		100		100		97		58		20	37	No	No
B-2	1.0'	CL	100		100		98		84		52		15	33	No	No
B-3	15.0'	SC	100		100		75		56		17		11	28	No	No

* NP = Non-Plastic
** NV = No Value

Table 2.7.3 -2 Maximum Plasticity Index for Selected Backfill

Percent by Weight Passing No. 200 Sieve	Maximum Plasticity Index
0-10.0	15
10.1-20.0	12
20.1-50.0	10
50.1-80.0	8
81.1-100.0	6

Table 2.7.3 -3 Maximum Plasticity Index for Granular Backfill

Percent by Weight Passing No. 200 Sieve	Maximum Plasticity Index
0.1 to 3.0	15
3.1 to 4.0	12
4.1 to 5.0	9
5.1 to 8.0	6
8.1 to 11.0	4
11.1 to 15.0	3

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 expansive, high-plasticity clays. A summary of geotechnical considerations is described below.

- Fill materials were encountered within our explorations to depths of 3 feet below existing grade (2 feet below the pavement section). Fill materials should be considered undocumented unless documentation of their placement and compaction is provided. Undocumented fill is considered unsuitable in its present condition for support of the proposed improvements and should be overexcavated completely down to native soils.
- The native soils consisted of alternating layers of medium dense to very dense coarse-grained soils and stiff to hard fine-grained soils. The fine-grained soils were found to be moderately expansive.
- Groundwater was observed at about 14 feet in both borings. Historical groundwater levels are consistent with the depth to groundwater observed in the borings.
- The tested soils generally did not meet the specifications recommended in this report for re-use as structural fill. The tested soils also do not meet the requirements for Selected or Granular Backfill as specified in Sections 207.02.02 and 704.03.01 of the USS. Processing of the native soils or importing soils meeting the specifications of this report should be anticipated to be required for soils used as structural fill or trench backfill.
- The tested soils have a moderate swell potential as tested and defined according to subsection 1803.5.3 and Table 1808.6.1.1, respectively of the SNA to the 2021 IBC. In accordance with Table 1808.6.1.1 of the 2021 SNA, swell potential is defined per the below classifications:
    - Low >0 to <4
    - Moderate ≥4 to <8
    - High ≥8 to <12
    - Critical ≥12
- The results of the chemical testing indicate the encountered native soils exhibit the following chemical properties:
    - S2 sulfate exposure class
    - 150 ppm soil chloride concentration
    - Low solubility potential
    - Low potential for chemical heave
- A seismic site class D is applicable to the site unless additional studies are performed to classify the soils to a depth of 100 feet.
- It's our opinion that the potential for liquefaction at the site is low based on the geotechnical properties of the onsite soils and the screening criteria presented in the SNA.

- It’s our opinion that the level of verification and inspection should be 4b - ***continuous*** due to moderately expansive soils being observed in the near surface soils.
- The nearest mapped fault is about 1 mile away from the site. It’s our opinion, the potential for fissure and fault-related surface rupture is low.

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. DEMOLITION

The project site is located in an improved area with landscaping, asphalt pavement, and other improvements. To facilitate the construction of the proposed project, some existing improvements will be demolished. Demolished improvements will not be suitable for incorporation into backfill and should be disposed of in a legal manner. Existing underground utilities that will not be reused should be excavated and removed from the site. The resulting excavations should be backfilled, where needed, with IQAC approved Controlled Low Strength Materials (CLSM) or compacted fill as described in this report.

4.1.2. SITE PREPARATION

Moderately expansive soils and moderately plastic soils were encountered within both borings. To reduce the potential for unwanted vertical movement to improvements due to expansive soil it’s recommended that a zone of engineered soil, known as a fill blanket, be provided under proposed improvements.

Site preparation prior to constructing the fill blanket should consist of removing existing improvements, undocumented fill, deleterious material, debris, and loose or disturbed native soils, from within the improvement areas to expose medium dense to very dense or stiff to very stiff native soils. Stockpiled soil generated from this process should be removed from the site or processed for use as structural fill meeting the recommendations outlined in this report. After the removal of existing unsuitable soils, the exposed native soils in structural areas should be scarified to a depth of at least 8-inches, moisture conditioned and compacted to a firm and unyielding state. The exposed subgrade may be observed and acceptable if probing yields 1 inch or less penetration into the subgrade. Density testing of the exposed subgrade is not necessary; however, the exposed subgrade may also be considered acceptable if it is properly moisture conditioned to approximately optimum moisture content and compacted to at least 90% relative density per ASTMD1557.

Materials used for the fill blanket should meet the requirements of Section 4.1.3 of this report. The recommended thickness of the fill blanket is presented in Table 4.1.2.

Table 4.1.2 Recommended Fill Blanket Thickness

Proposed Improvement	Recommended Fill Blanket Thickness
Entire Building Pad (extends 5 feet laterally beyond foundations)	At least 18 inches below bottom of foundations*.
Concrete Flatwork and Pavement	12 inches below the bottom of the proposed aggregate base*

*If uncontrolled fill soils remain below the overexcavated soils, they should be removed. We estimate uncontrolled fill soils extend to about 3 feet below existing grade.

The geotechnical consultant should observe exposed materials, after recommended removals of unsuitable materials, to evaluate whether additional removal down to competent materials is needed. The soil preparation area should extend laterally at least 5 feet beyond the exterior edge of foundations and at least 2 feet beyond exterior concrete flatwork and pavements. The vertical and lateral extent of the recommended excavations should be evaluated under the direction of the geotechnical consultant.

4.1.3. STRUCTURAL FILL AND BACKFILL SUITABILITY

It should be anticipated that some of the on-site native soil will not meet structural fill and backfill suitability and will need to be removed from the site or processed to meet the specifications recommended in Table 4.1.3. 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, if used, or soil materials used for structural fill, should satisfy the following requirements:

Table 4.1.3 Imported and/or On-site Structural Fill Recommendations

Description*	Recommendation
4-inch Sieve Gradation*	100 Percent Passing
3/4-inch Sieve Gradation*	100-70 Percent Passing
No. 200 Sieve Gradation*	Less than 50 Percent Passing
Remolded Swell Potential	<6
Liquid Limit	<35
Plasticity Index	<15
Dry Weight Soluble Solids	<2.0% as determined by American Water Works Association (AWWA) Standard Method (SM) 2540 C
Dry Weight Soluble Sulfate	<2.0 % 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.

4.1.4. FILL PLACEMENT

Areas to receive structural fill should be prepared prior to fill placement as described in Section 4.1.2 of this report. Structural fill should be uniformly moisture conditioned at least optimum moisture content, placed in horizontal, loose lifts up to a maximum of 12 inches thick, and compacted to at least 90 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 12 inches in loose thickness.

4.1.5. 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 approximately one test per 250 cubic yards of fill material placed or at least two tests per foot of fill material placed, whichever is more. Additional field tests may also be performed in structural and non-structural areas at the discretion of the geotechnical consultant.

Observation and testing of soils should be performed as indicated in Table 1705.6 of the referenced SNA to the 2021 IBC. Based on the results of our laboratory testing which indicated the presence of moderately expansive soils, it's our opinion that the level of verification and inspection, as indicated in Table 1705.6 of the SNA, should be 4b; ***continuous*** observations during earthwork will be needed.

4.2. 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.

4.2.1. TEMPORARY EXCAVATIONS

Temporary excavations should be performed in accordance with Appendix B to Subpart P of Occupational Safety and Health Standards for the Construction Industry (OSHA) 29 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. Excavations deeper than 4 feet in non-cemented soils should be shored or laid back at a slope no steeper than 1 horizontal to 1 vertical measured from the bottom of the excavation. Alternatively, the excavations could be rigidly braced. Temporary earth retaining systems will be subject to lateral earth pressure loads.

An experienced structural engineer should be consulted by the contractor for design and implementation of the bracing system. Worker protection, such as trench boxes, may be needed to protect against minor sloughing and/or falling materials. On-site safety is the responsibility of the contractor.

Spoils from the excavations, heavy construction equipment, and other surcharge loading should not be placed adjacent to the excavations within a 1 horizontal to 1 vertical plane extending up and back from the bottom of the excavation to the ground surface. Surface drainage should be directed away from the excavations.

4.2.2. CEMENTED SOIL CONSIDERATIONS

Weakly to moderately cemented soils were encountered in both borings, observed as shallow as 6 feet below existing ground surface, however, strongly cemented rock-like soils (caliche) were not encountered. Due to the inconsistent nature of cemented soil, moderately hard to very hard and difficult to excavate cemented soils may be encountered beyond or between our boring locations at varying depths. Detailed information regarding subsurface materials and conditions is presented in the boring logs in Appendix A.

Weakly and moderately cemented soil refers to cemented soil that can be crumbled or broken with little or considerable finger pressure, respectively. Strongly cemented soil, however, refers to rock-like soil that will not crumble or break at any finger pressure. In general, very dense or weakly cemented soils can be excavated with a backhoe or excavator and moderately cemented soils can be excavated with a ripper tooth or by a backhoe or excavator with extreme difficulty. However, to excavate strongly cemented rock-like materials, a trencher, Caterpillar D-10 Dozer or larger (or equivalent), ripper, hoe-ram, headache ball, rock-saw or similar rock excavation techniques are anticipated to be needed.

Excavation/ripping of cemented soils is dependent on several factors in addition to equipment type, including but not limited to age and mechanical condition of the equipment, maintenance and care, condition of cutting surfaces and ripper shanks, and the skill of the equipment operators. The earthwork and underground contractors should consider these factors in preparing their respective bids and schedules.

The contractor should be aware of the potential for (and take adequate precautions to reduce the potential for) vibrational damage to adjacent or nearby structures, and take appropriate precautions, when using heavy impact equipment during removal of strongly cemented materials. Pre-construction documentation of existing distress to structures near construction areas, and monitoring of these structures and ground motions generated, should be considered to reduce the potential for damage and construction-related claims.

A detailed excavatability or rippability evaluation was beyond the scope of this study. The contractor should perform the independent investigations necessary to determine the type of equipment required for grading and excavation operations. If the contractor(s) have any questions regarding site conditions, site preparation, or the recommendations provided, they should contact a representative of GES for any needed clarifications prior to submitting earthwork bids. It is the express responsibility of the contractor to perform independent evaluations of the rippability of cemented soils prior to preparing their bid. GES is not an earthwork or underground contractor.

4.3. FOUNDATIONS

Shallow foundations are anticipated for supporting the proposed structures. Foundations for the proposed structures, as defined in Section 1.2, should be designed in accordance with the below recommendations based on the foundation type.

4.3.1. SHALLOW FOOTINGS

Shallow foundations (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 described in Section 4.1.2. Spread footings should be at least 12-inches wide and founded at least 18 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 2,000 pounds per square foot (psf). The allowable bearing pressure for conventional spread footings may be increased by 500 psf for each additional foot of embedment and/or 250 psf for each additional foot of width up to a maximum allowable pressure of 4,000 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 95 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 400 pcf up to a maximum passive lateral pressure of 2,700 psf. A coefficient of friction of 0.39 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 bearing pressures are limited to the recommendations described above, total and differential post-construction settlements are not anticipated to exceed 1 inches and ½-inch, respectively. If the stated information is incorrect or larger design pressures are needed, we should be contacted to revise our recommendations.

4.3.2. CONVENTIONALLY REINFORCED SLABS-ON-GRADE

Conventionally reinforced slabs-on-grade should be supported entirely on structural fill prepared as recommended in Section 4.1.2. Conventionally reinforced slabs-on-grade should be at least 4 inches thick. Actual thickness and reinforcing requirements should be determined by an experienced structural engineer based on the anticipated loading conditions. Aggregate base course materials beneath the floor slab-on-grade should be 4 inches or thicker and should consist of Type II Aggregate Base. The Type II Aggregate Base should be moisture conditioned to within 2 percent of optimum moisture content and compacted to at least 95 percent of the maximum laboratory dry density, per ASTM D1557. A vertical Modulus of Subgrade Reaction (k_v) of 150 pounds per cubic inch, applicable for a 1-foot square area, may be used for design. For the actual slab-on-grade size, the value for the modulus of subgrade reaction presented above will need to be reduced. We understand many structural analysis software packages perform this reduction, however, GES can provide guidance on reducing the modulus of subgrade reaction if requested.

If moisture-sensitive floor coverings are not used, a vapor retarder is not required. However, when moisture-sensitive floor coverings are used, a vapor retarder is recommended beneath slabs-on-grade and should consist of 10-mil minimum sheet plastic overlain by at least 4 inches of Type II Aggregate Base materials or other similar material approved by the Geotechnical Engineer. The vapor retarder should comply with the Class A rating as set forth in ASTM E1745. Installation of the vapor retarder should be performed in accordance with ASTM E1643.

4.3.3. 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 II 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 at or near optimum moisture content (ASTM D1557).

The subgrade soils beneath concrete flatwork should be prepared as recommended as described in Section 4.1.2 of this report 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)).

4.4. RECOMMENDED MINIMUM PAVEMENT SECTIONS

The following sections provide the minimum recommended flexible and rigid pavement sections for the proposed improvements. The following pavement section thickness design is based on a correlated R-value of 20. The R-value of exposed subgrade materials should be confirmed during construction and the pavement section thickness modified as necessary. When subgrade materials are exposed during construction, an evaluation should be made (either visual or by testing) that the materials present between and beyond the boring locations will have properties similar to those used as the basis of the pavement design.

We estimate the vehicles that will use the facility will include mainly passenger vehicles with limited used by heavier service vehicles such as delivery trucks or garbage trucks (6 passes a day by the heavier vehicles). Our pavement design is based on this premise. The pavement design will need to be revised if the traffic demand is different than this assumption.

4.4.1. MINIMUM FLEXIBLE PAVEMENT SECTIONS

The following design parameters were used in determining the pavement structural sections.

- 20-year design period
- 80 percent reliability
- 0.45 standard deviation
- 4.2 initial serviceability
- 2.5 terminal serviceability
- 0.35 structural coefficient for asphalt
- 0.12 for Type II Aggregate Base
- 34,000 ESAL's (equivalent TI of 6.0) based on the traffic analysis described above
- Resilient modulus (MR) of 4,800 pounds per square inch (psi) for an R-value of 20

The recommended minimum asphalt concrete pavement sections for the project are presented in the following table.

Table 4.4.1: Minimum Asphalt Pavement Section

Roadway	Design Subgrade R-value	Asphalt Thickness (Inches)	Type II Aggregate Base Thickness (Inches)
Parking Lot	20	4.0	8.0

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

4.4.2. MINIMUM RIGID PAVEMENT SECTIONS

Rigid pavement should be considered for dumpster approaches and in areas with high truck (service vehicle) traffic. To form a basis for design of rigid pavement sections, we have assumed the following:

- 90 percent reliability.
- 0.35 standard deviation.
- 4.2 initial serviceability.
- 2.5 terminal serviceability.
- Effective modulus of subgrade reaction of 150 psi
- Drainage coefficient = 1
- Concrete modulus of rupture of 450 psi and elastic modulus of 3,600,000 psi
- Load transfer using aggregate interlock
- Traffic as described in Section 4.4.1

The recommended minimum rigid concrete pavement sections for the project are presented in the following table.

Table 4.4.2: Recommended Minimum Rigid Pavement Sections

Roadway	Portland Cement Concrete Thickness (Inches)	Type II Aggregate Base Thickness (Inches)
Parking Lot	6	4

Joint spacing, steel reinforcing, doweling, and/or curing procedures should be incorporated into the final rigid pavement design by the project structural or civil engineer to resist shrinkage, cracking or curling. Concrete design, placement and curing operations should be performed in accordance with the American Concrete Institute (ACI) Manual of Concrete Practice (ACI, 2019).

4.5. SEISMIC SITE CLASS

The following seismic design parameters based on ASCE 7-16 per the 2021 IBC for a Seismic Site Class D may be utilized using representative site coordinates of 36.1623187 degrees latitude and -115.1624455 degrees longitude with an assumed Risk Category of I/II/III:

Table 4.5 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
0.567g	0.189g	0.509g	0.28	0.251	0.339

4.6. SOIL CORROSIVITY

Based on the results of the reviewed chemical testing, the tested on-site soils have a sulfate exposure class S2 as described in Table 19.3.1.1 of American Concrete Institute (ACI) Publication 318-19. In accordance with ACI 318-19, concrete in contact with on-site soils along with subsurface walls up to 12 inches above finished grade be designed as follows:

Table 4.6 Concrete Recommendations for Severe Sulfate Exposure

Description	Recommendation per ACI 318-19
Cement Type	V
28- Day Design Compressive Strength	4,500 psi
Water to Cement Ratio	0.45 Maximum

In addition, it is recommended that reinforcing bars in cast-against-grade concrete, with the exception of 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.

Fill materials should be tested during construction for chloride concentration. If testing indicates that chloride concentrations in the fill materials is more than 500 ppm, then the project structural engineer and/or corrosion engineer should implement appropriate corrosion protection methods. Corrosion mitigation includes minimum concrete cover, use of epoxy coated reinforcement, and blending on-site soils with imported soil having relatively low chloride content so that the resulting blended materials have a chloride concentration of less than 500 ppm. If reinforcing bars are covered by a minimum of 3-inches of concrete, a chloride concentration of up to 5,000 ppm is acceptable.

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.

4.7. 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 2021 IBC (ICC, 2017) may be placed at the top of the slope.

- 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.

4.8. PLAN REVIEW

The recommendations presented in this report are based on preliminary design information for the proposed project and on the findings of our geotechnical evaluation. When finished, project grading and foundation plans should be reviewed, at the option of the building official, by the Geotechnical Engineer to evaluate whether the project grading and foundation plans are consistent with the geotechnical design criteria presented in this report.

4.9. 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.

4.10. 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 was obtained from 2 borings performed at the 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 are based on the assumption 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) 318, 2019, 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

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

Google Earth, at approximate location 36.205612° latitude and -115.079604° longitude, accessed on July 15, 2022

International Code Council, 2021 International Building Code

Matti, J.C., Bachhuber, F.W., Morton, D.M., and Bell, J.W., 1987, Las Vegas NW Quadrangle Geologic Map, Nevada Bureau of Mines and Geology, scale 1:24,000.

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

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

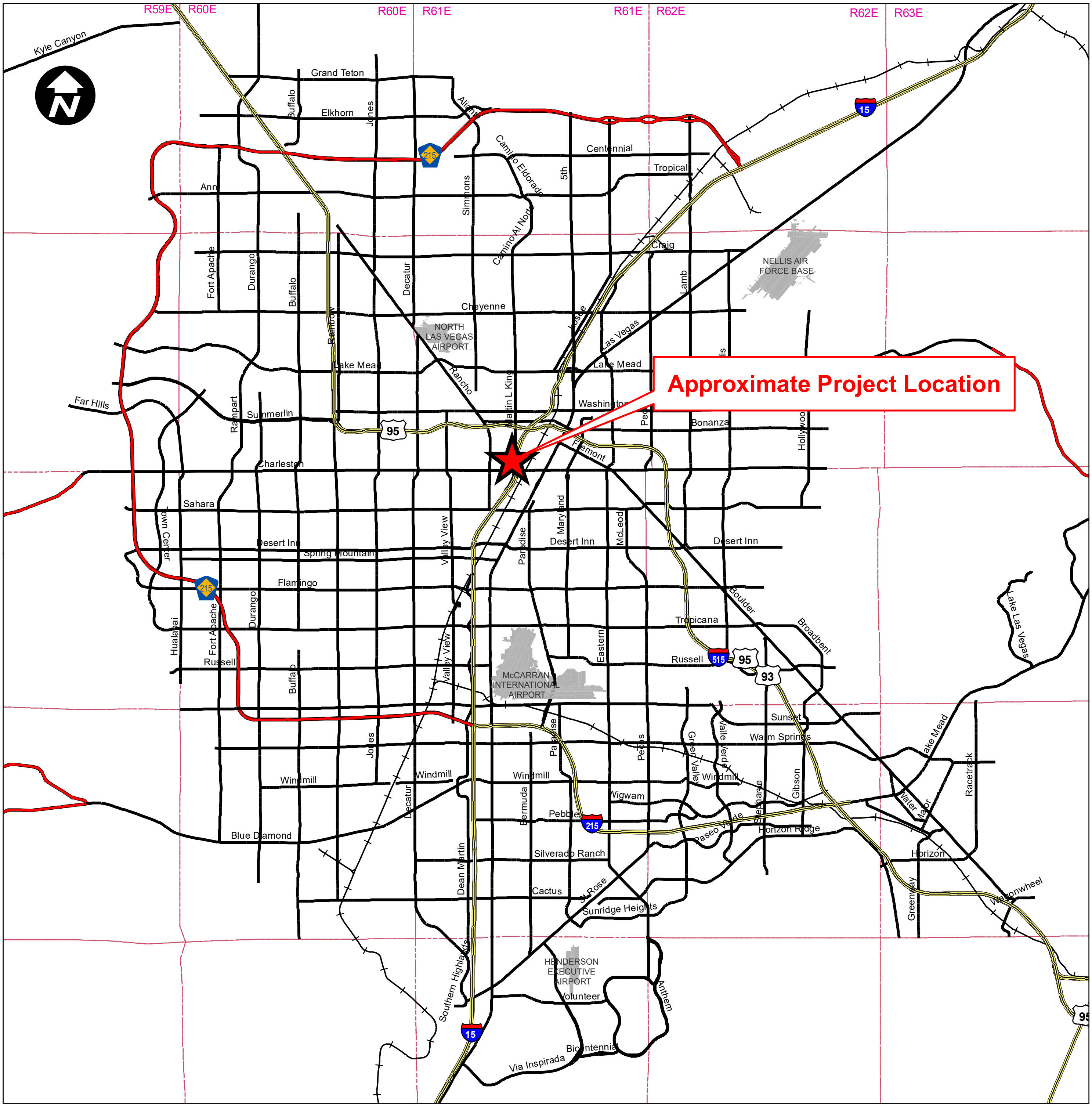
Standard Requirements for Design of Shallow Post- Tensioned Concrete Foundations on Expansive Soils, 2008, Post-Tension Institute.

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

2021 Southern Nevada Amendments to the IBC

APPENDIX A – SUBSURFACE STUDY



Legend

★ Approximate Project Location
▨ Airports
Interstate
Major Streets
Railroad
State or County Highway
Township & Range

0 1 2 4 6 8 Miles

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GES

7150 Placid St.
Las Vegas, NV 89119

702-365-1001
www.gesnevada.com

NOTE: Data presented on this map is a compilation of GIS Metadata extracted from a variety of sources. Major Streets, Airports, and Railroads is data obtained from the Southern Nevada GIS Management Office. 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.

SITE VICINITY MAP
SOUTHERN NEVADA HEALTH DISTRICT EXPANSION
700 S MARTIN LUTHER KING BOULEVARD
LAS VEGAS, NEVADA

Drawn By:	Date Drawn:
CDM	4/17/2024
Project No.	Figure No.
20246923E1	A-1

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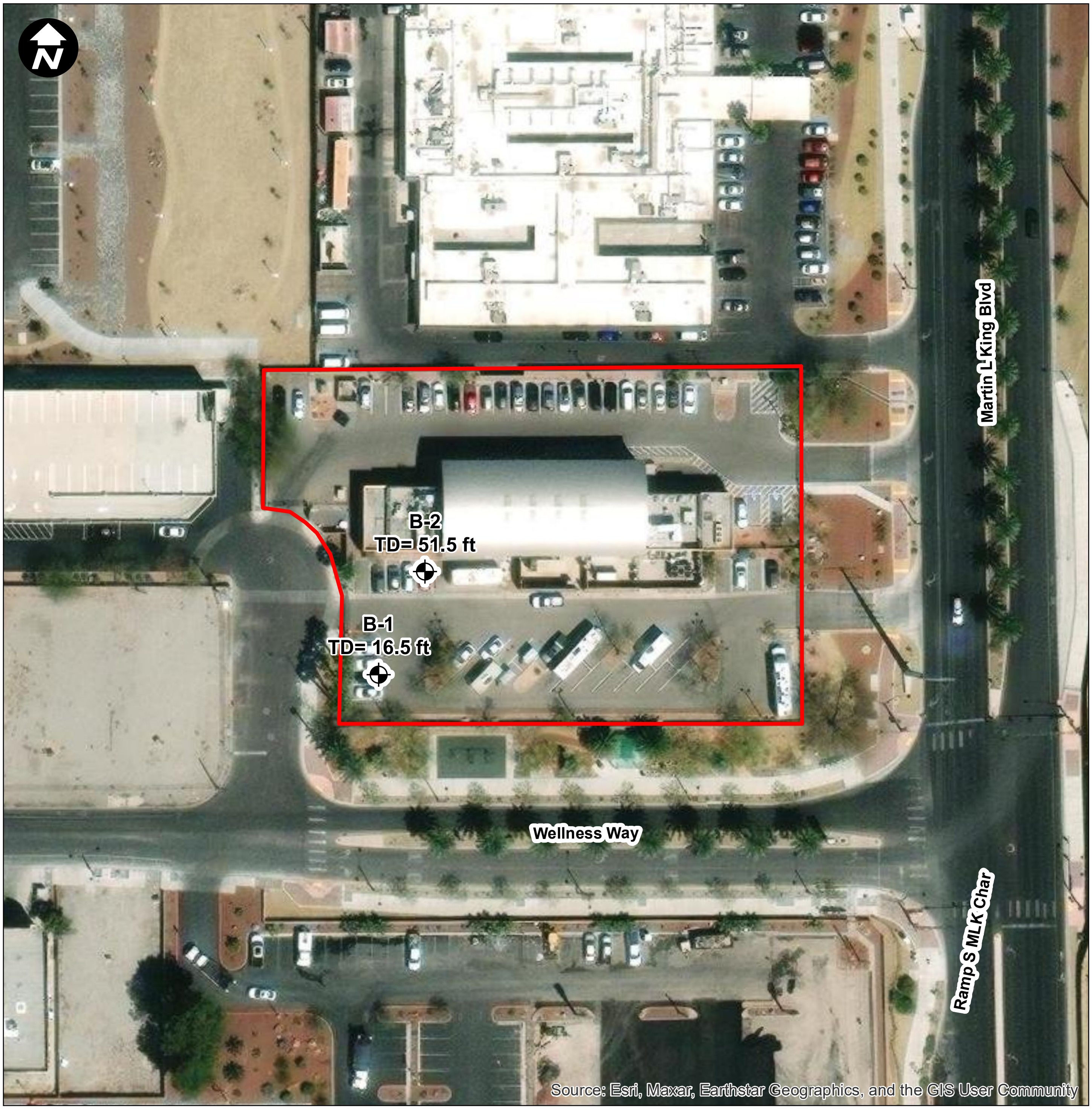

Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Legend

⌖ B-1 Approximate Boring Location

🟥 Approximate Site Boundary

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EXPLORATION LOCATION MAP SOUTHERN NEVADA HEALTH DISTRICT EXPANSION 700 S MARTIN LUTHER KIND BOULEVARD LAS VEGAS, NEVADA	Drawn By: CDM	Date Drawn: 4/17/2024
	Project No. 20246923E1	Figure No. A-2

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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.
20-40	15-30	Very Stiff	>2.00	Thumbnail will not indent soil.
>40	>30	Hard	>2.00	Thumbnail will not indent soil.

*ASTM D3550 using a 140-pound hammer falling 30 inches.
**ASTM D1586-18

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 D1586-18

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 - Visible 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

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GEOTECHNICAL &
ENVIRONMENTAL
GES SERVICES, INC.

BORING NUMBER B-1

PROJECT NAME Southern Nevada Health District Expansion
CLIENT Southern Nevada Health District
PROJECT NUMBER 20246923E1
PROJECT LOCATION 700 S Martin Luther King Blvd.
DATE STARTED 4/15/24
COMPLETED 4/15/24
GROUND ELEVATION 2048 ft
HOLE SIZE 8" inches
DRILLING CONTRACTOR Eagle Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow-Stem Auger
∇ **AT TIME OF DRILLING** 14.00 ft / Elev 2034.00 ft
LOGGED BY T. Weiss
DRILLER D. Wiggins
AT END OF DRILLING ---
LAT. 36.142025
LONG. -115.163117
AFTER DRILLING ---

DEPTH (ft)	SAMPLER TYPE	RECOVERY %	BLOW COUNTS	TESTS	U.S.C.S.	GRAPHIC LOG		MATERIAL DESCRIPTION	
0					AC	■	0.5	**ASPHALT CONCRETE:** Unit is approximately 6" thick.	2047.5
					AB	▩	1.0	**AGGREGATE BASE:** Unit is approximately 6" thick.	2047.0
					FILL	▩	3.0	**FILL:** Brown poorly graded SAND with silt and gravel, medium dense, dry.	2045.0
					SC	▨	5.0	**NATIVE:** Brown clayey SAND, medium dense, moist, with trace gypsum.	2043.0
5	■	83	3 4 9	LL = 37 PL = 17 Fines = 58% Swell = 7.7%	CL	▨	8.5	Brown lean CLAY with sand, stiff, moist, with trace gypsum.	2039.5
10	■	58	16 41 50		SC	▨		Brown clayey SAND with gravel, very dense, dry, weakly cemented with few gypsum.	
							∇		
15	■	83	8 10 13			▨	16.5	...medium dense	2031.5

Bottom of borehole at 16.5 feet.

GENERAL BH/TP/WELL - GES - GES_GEOTECHNICAL_STD.GDT - 5/7/24 12:47 - J:\GES\CLIENTS\LAS VEGAS OFFICE\PROJECTS\2024_PROJECTS\20246923 - SNHD EXPANSION\E1\GINT\20246923E1.GPJ

Soils were classified in general accordance with ASTM D2488
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. 1

GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

BORING NUMBER B-2

PAGE 1 OF 2

PROJECT NAME Southern Nevada Health District Expansion

CLIENT Southern Nevada Health District

PROJECT NUMBER 20246923E1

PROJECT LOCATION 700 S Martin Luther King Blvd.

DATE STARTED 4/15/24 **COMPLETED** 4/15/24

GROUND ELEVATION 2048 ft **HOLE SIZE** 8" inches

DRILLING CONTRACTOR Eagle Drilling

GROUND WATER LEVELS:

DRILLING METHOD Hollow-Stem Auger

AT TIME OF DRILLING 14.00 ft / Elev. 2034.00 ft.

LOGGED BY T. Weiss **DRILLER** D. Wiggins

AT END OF DRILLING --

LAT. 36.162171 **LONG.** -115.163004

AFTER DRILLING --

DEPTH (ft)	BULK SAMPLE	SAMPLER TYPE	RECOVERY %	BLOW COUNTS	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0						AC		0.5 **ASPHALT CONCRETE:** Unit is approximately 6" thick. 2047.5
						AB		1.0 **AGGREGATE BASE:** Unit is approximately 6" thick. 2047.0
	⧗				LL = 33 PL = 18 Fines = 52% Swell = 5.6%	FILL		**FILL:** Brown lean CLAY with gravel, medium dense, dry, with trace asphalt. 3.0 2045.0
						SC		**NATIVE:** Brown clayey SAND, moist, with trace gypsum. 4.0 2044.0
5		◣	44	4 11 23		CL		Brown lean CLAY with sand, very stiff, moist. ...tan sandy CLAY, dry, weakly cemented with trace gypsum. 9.0 2039.0
10		◣	56	28 17 7		SC		Tan clayey SAND, medium dense, dry, weakly cemented with trace gypsum.
							∇	...wet.
15		◣	56	4 5 13	LL = 28 PL = 17 Fines = 17%			18.0 2030.0
20		◣	83	11 23 31		CL		Tan lean CLAY with sand, very stiff, wet, with few gravel. 23.5 2024.5
25		◣	72	16 11 8		CH		Brown fat CLAY with sand, stiff, moist. 27.5 2020.5
30						SP-SC		Tan poorly graded SAND with clay and gravel, dense, wet.

Soils were classified in general accordance with ASTM D2488
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. 2

GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

GES

BORING NUMBER B-2

PAGE 2 OF 2

PROJECT NAME Southern Nevada Health District Expansion

CLIENT Southern Nevada Health District

PROJECT NUMBER 20246923E1

PROJECT LOCATION 700 S Martin Luther King Blvd.

DEPTH (ft)	BULK SAMPLE	SAMPLER TYPE	RECOVERY %	BLOW COUNTS	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
30		◤	44	36 50 4		SP-SC		Tan poorly graded SAND with clay and gravel, dense, wet. *(continued)* ...very dense, weakly cemented.	
							33.0		2015.0
						CH		Brown fat CLAY with sand, stiff, moist.	
35		◤	72	16 12 7					
40		◤	78	25 17 31				...hard.	
45		◤	67	9 13 8				...very stiff.	
							48.0		2000.0
						CL		Tan sandy lean CLAY, very stiff, moist, with trace gravel.	
50		◤	78	12 7 14					
							51.5		1996.5

Bottom of borehole at 51.5 feet.

GENERAL BH/TP/WELL - GES - GES_GEOTECHNICAL_STD.GDT - 5/7/24 12:47 - J:\GES\CLIENTS\LAS VEGAS OFFICE\PROJECTS\2024_PROJECTS\20246923 - SNHD EXPANSION\E1\GINT\20246923E1.GPJ

APPENDIX B – LABORATORY TEST RESULTS

GEOTECHNICAL EVALUATION

SOUTHERN NEVADA HEALTH DISTRICT EXPANSION
700 S. MARTIN LUTHER KING BOULEVARD
LAS VEGAS, NEVADA

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 were evaluated. For the sample, the wet weight of the sample was obtained. The sample was then oven dried. After drying, the dry weight of the sample was measured, and the subsequent moisture contents calculated. The moisture contents of the sampled soil is presented in the Summary Table presented on Figure B-1 in Appendix B.

2. GRAIN SIZE DISTRIBUTION

Grain size distribution tests were performed by sieve analysis in general accordance with ASTM D6913. The soil samples were oven dried to a constant weight and sorted by several 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-2 in Appendix B.

3. ATTERBERG LIMITS

Atterberg limits testing was completed 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 boring logs in Appendix A and on Figure B-3 in Appendix B.

4. SWELL POTENTIAL

Selected samples were tested to evaluate swell potential in general accordance with Section 1803.5.3 of the SNA to the 2021 IBC. A vertical confining pressure of approximately 60 pounds per square foot was applied to the oven-dried sample and then the sample was inundated with water. The deformation of the sample was recorded until 3 consecutive readings were the same or for a period of 24 hours of soaking, whichever occurred first. Results of potential swell performed by GES were recorded and presented on the lab summary presented on Figure B-1 and on the boring logs.

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5. CHEMICAL TESTS

A selected sample was tested with a suite of chemical corrosivity tests to aid in evaluating the potential for concrete degradation and corrosion. The suite of chemical corrosivity tests included sodium content, water soluble sulfate, total available water soluble sodium sulfate, total salts (solubility), sulfide content, pH, reduction-oxidation (red-ox) potential, and soluble soil chlorides. Miller box resistivity testing was also performed. The results of the tests are shown on Figure B-4 and Figure B-5 in Appendix B.

SUMMARY OF LABORATORY RESULTS

PAGE 1 OF 1

PROJECT NAME Southern Nevada Health District Expansion

CLIENT Southern Nevada Health District

PROJECT NUMBER 20246923E1

PROJECT LOCATION 700 S Martin Luther King Blvd.

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	Class-ification	Water Content (%)	Dry Density (pcf)	Swell (%)
B-1	5.0	37	17	20	9.5	58	CL	22.0	--	8
B-2	1.0	33	18	15	12.5	52	CL	11.6	--	6
B-2	15.0	28	17	11	19	17	SC	21.1	--	--

LAB SUMMARY - GES_GEOTECHNICAL_STD.GDT - 4/24/24 15:33 - J:\GES\CLIENTS\LAS VEGAS OFFICE\PROJECTS\2024_PROJECTS\20246923 - SNHD EXPANSION\E1\GINT\20246923E1.GPJ

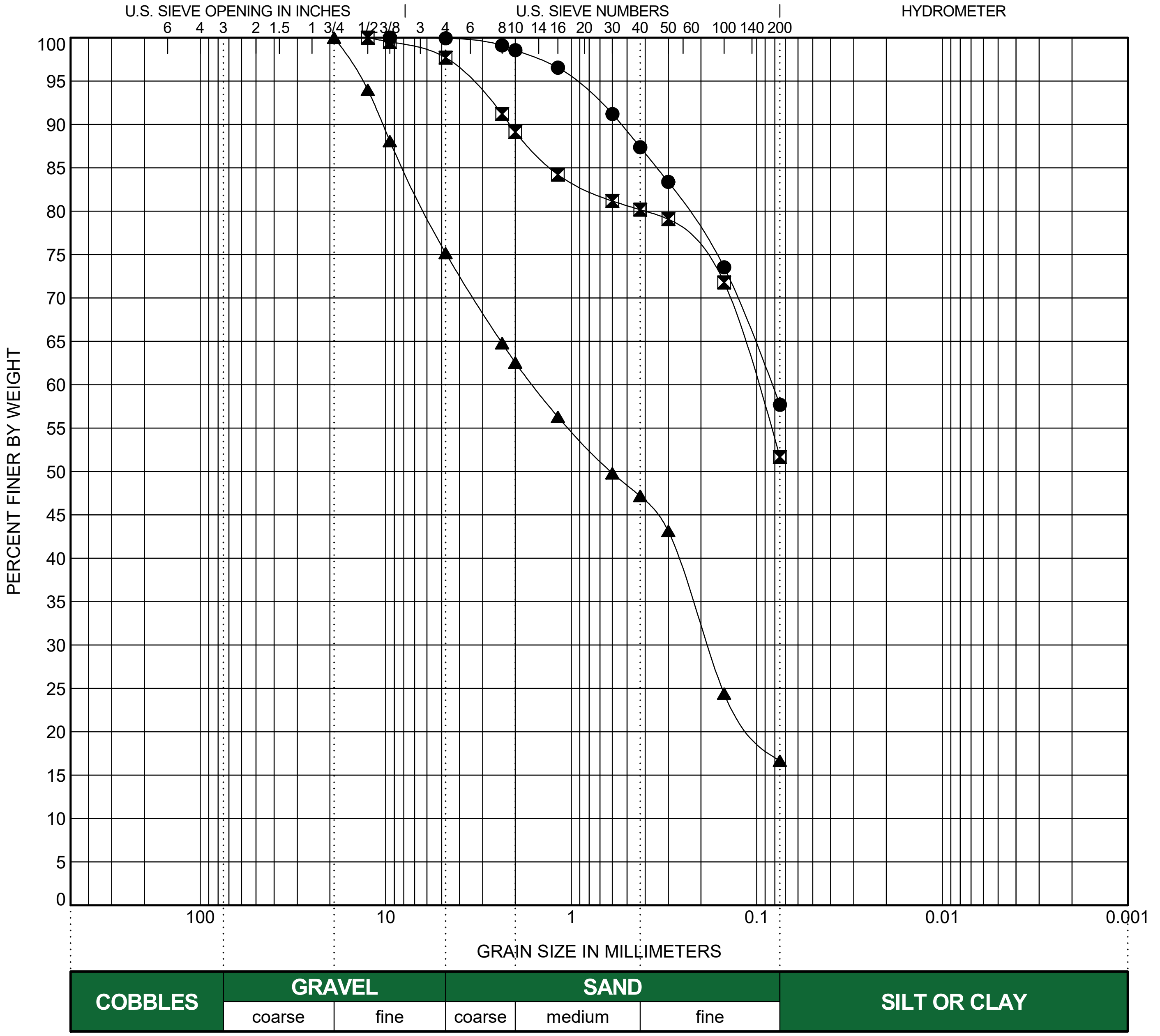
GRAIN SIZE DISTRIBUTION

CLIENT Southern Nevada Health District

PROJECT NAME Southern Nevada Health District Expansion

PROJECT NUMBER 20246923E1

PROJECT LOCATION 700 S Martin Luther King Blvd.



Location		Classification	LL	PL	PI
● B-1	5.0'	SANDY LEAN CLAY (CL)	37	17	20
☒ B-2	1.0'	SANDY LEAN CLAY (CL)	33	18	15
▲ B-2	15.0'	CLAYEY SAND with GRAVEL (SC)	28	17	11

Location		D100	D60	D30	D10	Cc	Cu	%Gravel	%Sand	%Silt	%Clay
● B-1	5.0'	9.5	0.083	--	--	--	--	0.1	42.2	57.7	
☒ B-2	1.0'	12.5	0.1	--	--	--	--	2.3	46.0	51.7	
▲ B-2	15.0'	19	1.614	--	--	--	--	24.8	58.5	16.6	

GES GEOTECHNICAL &
ENVIRONMENTAL
SERVICES, INC.

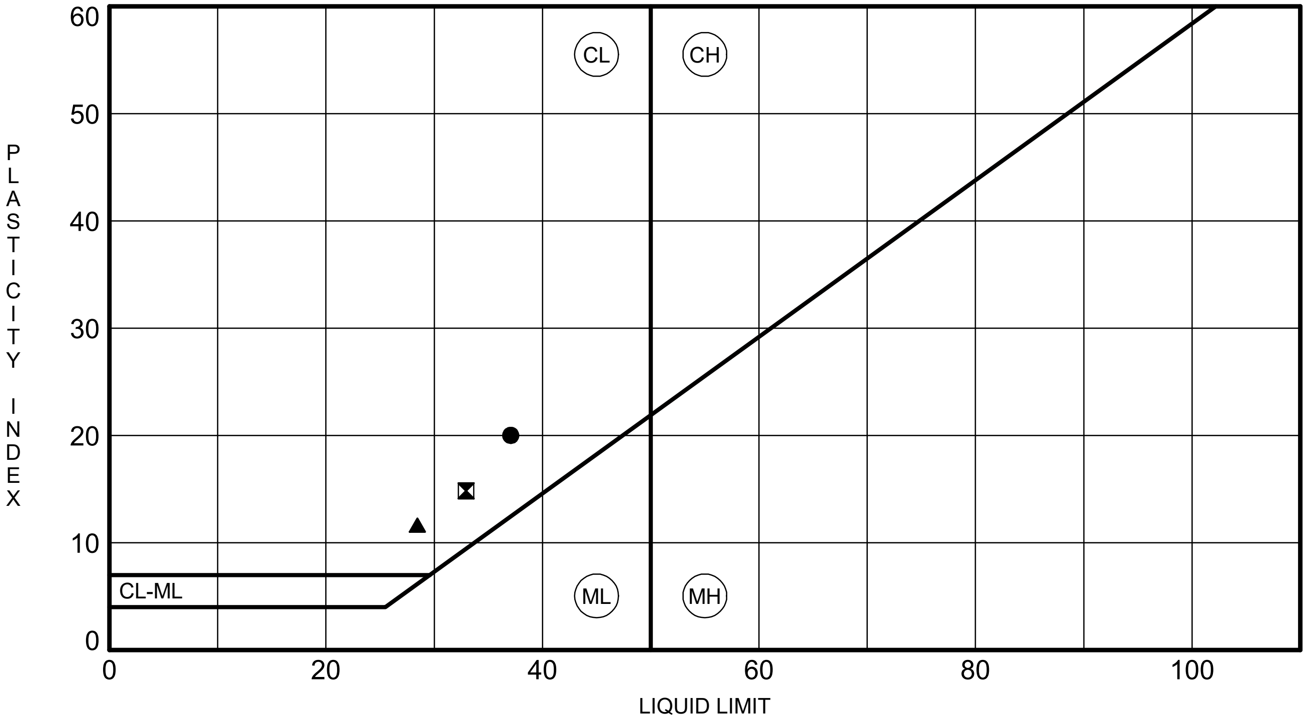
ATTERBERG LIMITS' RESULTS

CLIENT Southern Nevada Health District

PROJECT NAME Southern Nevada Health District Expansion

PROJECT NUMBER 20246923E1

PROJECT LOCATION 700 S Martin Luther King Blvd.



	Location		Classification	LL	PL	PI	Fines
●	B-1	5'	SANDY LEAN CLAY (CL)	37	17	20	58
⊠	B-2	1'	SANDY LEAN CLAY (CL)	33	18	15	52
▲	B-2	15'	CLAYEY SAND with GRAVEL (SC)	28	17	11	17

SGS Silver State Analytical Laboratories
3626 E. Sunset Road, Suite 100
Las Vegas, NV 89120
(702) 873-4478
www.ssalabs.com

Analytical Report

WO#: **24041072**
Date Reported: **5/3/2024**

CLIENT: GES
Project: 20246923E1
Lab ID: 24041072-01
Client Sample ID: 24-240 B2@ 1'-3'
Collection Date:
Matrix: SOIL

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
SOIL-CORROSION SUITE PLUS SOLUBILITY CHLORIDE - SOILS				**SM 4500CL B**		Analyst: **LJ**
Chloride	150	5.0		mg/Kg	5	4/25/2024 11:41:00 AM
SOIL-CORROSION SUITE PLUS SOLUBILITY SODIUM SULFATES - CALCULATION 0NLY.				**CALCULATION**		Analyst: **LJ**
Sodium Sulfate as Na2SO4	0.0940	0		%	1	4/25/2024 3:34:00 PM
SOIL-CORROSION SUITE PLUS SOLUBILITY PH - SOILS				**SW-846 9045D**		Analyst: **JJF**
pH	8.04	0		pH Units	1	4/29/2024 1:51:00 PM
SOIL-CORROSION SUITE PLUS SOLUBILITY REDUCTION - OXIDATION POTENTIAL - SOILS				**SM 2580 B**		Analyst: **LJ**
Oxidation-Reduction Potential	413	1.00		mV	1	5/3/2024 9:17:00 AM
SOIL-CORROSION SUITE PLUS SOLUBILITY WATER SOLUBLE SULFATE (SO4)				**SM 4500 SO4 E**		Analyst: **LJ**
Sulfate	0.840	0.0100		%	1	4/25/2024 2:22:00 PM
SOIL-CORROSION SUITE PLUS SOLUBILITY WATER SOLUBLE SODIUM (NA)				**ASTM D2791**		Analyst: **LJ**
Sodium	0.0300	0.0100		%	1	4/25/2024 11:41:00 AM
SOIL-CORROSION SUITE PLUS SOLUBILITY TOTAL SALTS (SOLUBILITY)				**SM 2540 C**		Analyst: **LJ**
Solubility	0.930	0.0100		%	1	4/25/2024 11:41:00 AM
SOIL-CORROSION SUITE PLUS SOLUBILITY SULFIDE - SOILS				**SM 4500S2 F**		Analyst: **LJ**
Sulfide	ND	1.00		mg/Kg	1	5/3/2024 9:17:00 AM

Qualifiers: (Qual)

DF	Dilution Factor.	H	Holding times for preparation or analysis exceeded.
MCL	Maximum Contaminant Level.	ND	Not Detected at the PQL.
PQL	Practical Quantitation Limit.		

7150 PLACID STREET
LAS VEGAS NV, 89119
1-702-365-1001

Sample Number: 24-240

Date Received: 4/18/2024 **Date Tested:** 4/23/2024 **Due Date:** 4/24/2024

Project Number: 20246923E1

Project Name: Souther Nevada Health District Expansion

Sample Location: B-2 @ 1' - 3'

Remarks: N/A **Tested By:** JF

ASTM G187 ☐ AASHTO T288 ☒

Moisture Percent	Dial Reading	Multiplier	Resistance (ohms)
Recieved Moisture @ 10.6%	3.3	1000	3300
10.0	3.4	1000	3400
16.7	1.6	1000	1600
23.4	7.9	100	790
30.1	5.6	100	560
36.8	5.2	100	520
43.5	4.9	100	490
50.2	4.7	100	470
56.9	4.6	100	460
63.6	4.5	100	450
70.3	4.6	100	460
77.0			
83.7			
90.4			
97.1			

As-Received Resistivity (ohm-cm) (x.99 for Box Factor)	3267
Minimum Resistivity (ohm-cm) (x.99 for Box Factor)	445

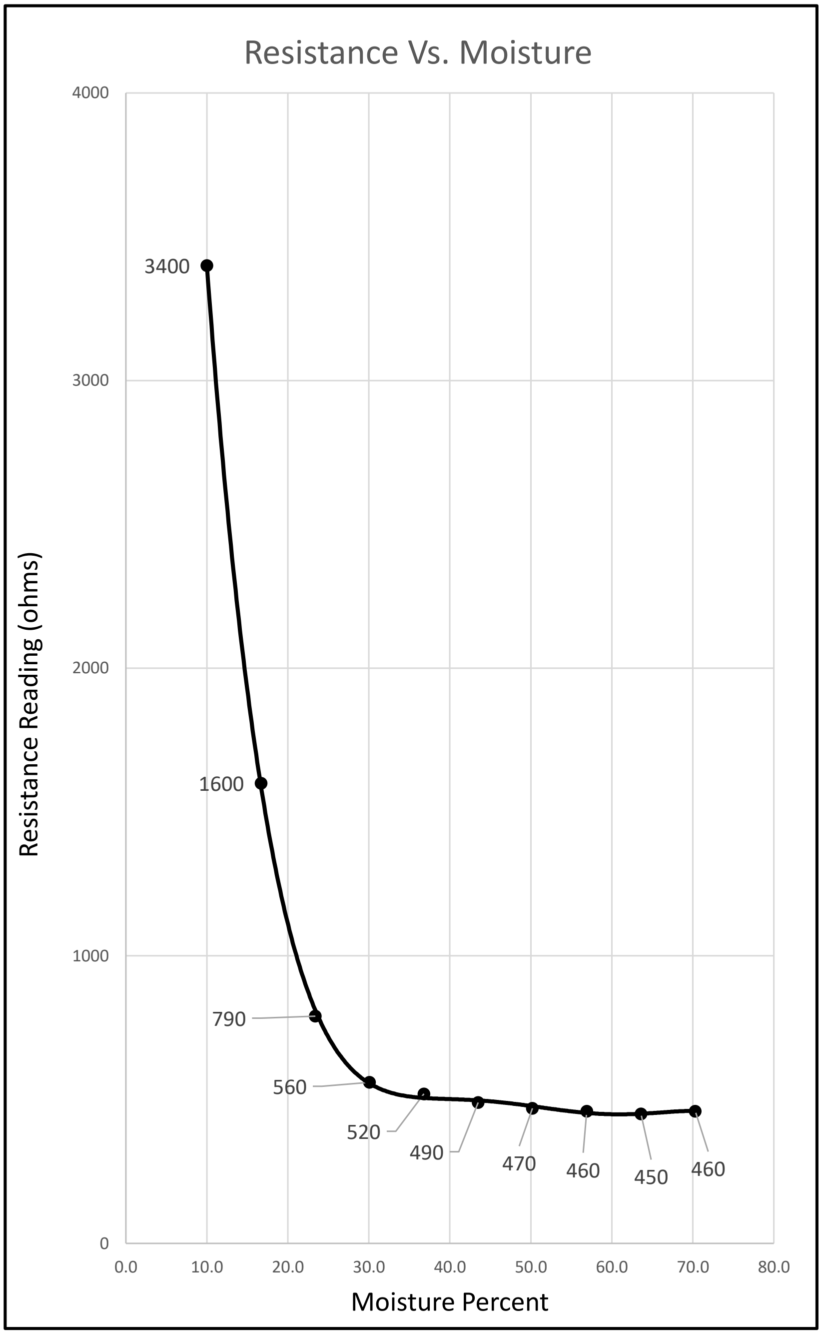


Figure B-5