Geotechnical Engineering Report

4-Lot Residential Development
SEC Pueblo Boulevard & Havre Avenue
APN: 179-04-402-003
Henderson, Nevada

Prepared for:
Las Vegas Civil Engineering

Prepared By:
UES
4480 W Hacienda Avenue, Suite 104, Las Vegas, NV 89118

October 11, 2024
Project No. 4030.2400182

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October 11, 2024

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Attention: Mr. Joseph R. DeBlanco, P.E.
702-515-6741, joey@lvce.net

Reference: **Geotechnical Engineering Report**
4-Lot Residential Development
SEC Pueblo Boulevard & Havre Avenue
APN: 179-04-402-003
Henderson, Nevada
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UES Professional Solutions 30, LLC ("UES") is pleased to submit this Geotechnical Engineering Report for the referenced project. This report includes the results from the field exploration and laboratory testing program, along with recommendations for use in preparation of the appropriate design and construction documents for this project.

UES appreciates the opportunity to provide this Geotechnical Engineering Report and looks forward to continuing participation during the design and construction phases of this project. UES also has great interest in providing construction services, including materials testing and inspection services during the construction of this project and will be glad to meet with you to discuss further how we can be of assistance as the project advances.

If there are questions pertaining to this report or if UES may be of further service, please contact us at your convenience.

Respectfully,
UES

Prepared by:
Suchan Lamichhane, Ph.D., P.E.
Geotechnical Department Manager

Reviewed by:
Martin D. Jensen, P.E.
Principal Engineer

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FIGURES

APPENDIX

1.0 INTRODUCTION

UES Profession Solutions 30, LLC ("UES"), has completed a field exploration and geotechnical evaluation for the 4-Lot Residential Development project. Mr. Joseph R. DeBlanco, representing Las Vegas Civil Engineering, authorized UES services on September 7, 2024, by signing UES Proposal No. 4030.0924.00009.

The site is located on the southeast corner of Pueblo Boulevard and Havre Avenue in Henderson, Nevada. The general location of the site is shown on Figure No. 1, Vicinity Map. The purpose of our services was to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil conditions
- General geology of the area
- Foundation design and construction
- Retaining wall design and construction
- Floor slab design and construction
- Pavement design and construction
- Earthwork

This report is for the purpose of providing geotechnical engineering and/or testing information and requirements. The scope of our services for this project did not include any environmental assessment or investigation for the presence or absence of hazardous or toxic material in structures, soil, surface water, groundwater, or air, below or around this site.

2.0 PROJECT INFORMATION

The site consists of a vacant parcel of approximately 2.11-acres and will be used for a proposed 4-lot residential development. It is assumed the structures will be one and/or two-stories in height, of wood-frame construction with concrete slab-on-grade lower floors and no basement levels. Structural loads for the proposed building**s** were not provided. We have assumed maximum dead- plus live-loads for columns and wall loading at approximately 70 kips and 3 kips per lineal foot, respectively. There will be on-site paved areas. It is further assumed that final grades will generally be at or near existing grades (plus or minus four feet). The City of Henderson will require that final street sections be verified based on R-value test results taken at the time of construction.

3.0 SITE EXPLORATION

The scope of our services for this project included a subsurface exploration program. The subsurface exploration program consisted of drilling two (2) borings to depths of approximately 15 feet below existing site grades. The borings were logged during drilling by a graduate geologist and samples were obtained to aid in material classification and for possible laboratory testing. The approximate locations of the borings are shown in Figure No. 2, Site Map. The locations of the borings were determined in the field by approximating distances from existing features or improvements. The locations of the borings should be considered accurate only to the degree implied by the method used. Results of the borings are presented in the Appendix.

4.0 SITE CONDITIONS

4.1 SURFACE

At the time of our exploration, the site was vacant, undeveloped and appeared in native conditions with spread out vegetation. The site gently slopes down from the northwest corner towards southeast corner. The site was bordered by existing residential development to the south and east. Havre Avenue bordered the north with undeveloped lot across it, and N Pueblo Blvd bordered the west with concrete drainage channel beyond. N Pueblo Blvd and Havre Avenue were both two lane wide paved roadways with no improvements along the roadside. Site drainage appears to be by sheet flow from northwest to southeast.

4.2 SUBSURFACE

Fill was not encountered in any of our explorations. However, fill could be encountered in other areas of the site beyond our explorations.

Natural soils at the site predominantly consisted of medium dense to very dense silty sand with gravel soils varying to silty gravel with sand soils. On-site soils are predominantly granular and cohesionless, and considered to be non- to low-expansive. The boring logs and laboratory test results presented in the Appendix should be referred to for more detailed information.

4.3 GROUNDWATER

Groundwater was not encountered within the depths explored. The anticipated depth of groundwater is 50 feet or greater based on well log data (Well Log No. 12333) within the vicinity of the site as provided by the Nevada Division of Water Resources. Based on the anticipated groundwater and scope of the project, it is our opinion that groundwater should not be affecting the design and construction of the project.

5.0 GEOLOGIC INFORMATION

The site is located in the southeast portion of the Las Vegas Valley. This location places the site in an area underlain by thick alluvial deposits (hundreds of feet).

Based on our review of available information, no mapped faults or fissures are present at the project site. The nearest mapped fissure zone is approximately 5.3 miles west of the site.[1] The cumulative evidence indicates that fissures are the result of a subsurface erosional process. The erosional process occurs in tensional fractures at or near the surface in uncemented, relatively fine-grained soils. The nearest mapped fault is approximately 1 mile east of the site.[2]

Liquefaction is defined as the condition when saturated, loose, finer-grained sand-type soils lose their support capabilities because of excessive pore water pressure which develops during a seismic event. Due to the nature and consistency/relative density of the native soils within the vicinity of the lot and the

[1] Bell, John W., et. al., 2001, "Las Vegas Valley, 1998 Subsidence Report", Nevada Bureau of Mines and Geology, Open-File Report 01-4, Plate No. 1.

[2] Clark County Geographic Information System Management Office (GISMO), 2016

anticipated depth of groundwater being at depths of 50 feet or greater, as discussed in *Groundwater* section, liquefaction potential should be considered as low during the design seismic event.

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 GEOTECHNICAL DISCUSSION

Our recommendations are based on the assumption that the soil conditions are similar to those disclosed by the explorations. If variations are noted during construction or if changes are made in the site plan, structural loading, foundation type or floor level, we should be notified so we can supplement our recommendations, as applicable.

As noted previously, no fill was encountered in our borings but could be present in areas beyond our exploration. This fill would be considered uncontrolled fill unless observation and testing were performed during placement. All uncontrolled fill should be removed and replaced with properly compacted fill. The uncontrolled fill soils can be re-used for controlled fill provided almost all oversized material, unsuitable material (as determined by the geotechnical engineer), vegetation, and debris are removed, as determined by visual observation by the 3rd party inspector.

6.2 EARTHWORK

6.2.1 General

- All earthwork should be performed in accordance with the guidelines presented in *Chapter 18* of the *2021 IBC* and the *City of Henderson Amendments to the 2021 IBC*, except where specific recommendations are presented in this report. It is recommended that contractors perform their own reconnaissance of the site. If the contractors have any questions regarding site conditions, site preparation, or recommendations in this report, they should contact a representative of UES.

6.2.2 Site Clearing

- Strip and remove existing vegetation, debris, uncontrolled fill, all loose or disturbed natural soils, and other deleterious materials from proposed building areas, adjacent walks and slabs, and in areas to be paved. Excavations should extend at least 5 feet beyond the areas to be improved in plan view. If practical, excavations should extend property line to property line. Uncontrolled fill is defined as any existing fill that was not properly placed, observed and tested.
- All exposed surfaces should be free of mounds and depressions which could prevent uniform compaction.

6.2.3 Subgrade Preparation

- Following site clearing activities, areas designated to receive fill, at-grade areas, or those achieved by excavation should be scarified to a depth of at least 6 inches, moisture conditioned and compacted as recommended in the *Fill Placement and Compaction* section of this report.
- Difficulty in achieving the recommended compaction may require drying the near-surface subgrade to a compactable moisture content, removal and replacement. In addition, difficulty in subgrade

compaction may be an indication of loose, soft or unstable soil conditions that could require additional excavation. If these conditions exist, additional subgrade stabilization recommendations may be required at the time of construction.

- Recommendations to achieve the recommended compaction can be made during construction and will depend on the conditions encountered in the field and other factors, such as project schedule and prevailing weather conditions.

6.2.4 Excavation

- It is anticipated that excavation of the on-site natural non-cemented deposits for the proposed project can be accomplished with conventional earthmoving equipment.
- Contractors, especially those excavating for utilities, should satisfy themselves as to the hardness of materials and equipment required.
- Temporary unsurcharged construction excavations should be sloped or shored. Slopes should not be steeper than 2H:1V. Slopes may need to be flattened depending on conditions exposed during construction. Exposed slopes should be kept moist (but not saturated) during construction. If there is not enough space for sloped excavations, shoring should be used. Traffic and surcharge loads should be kept back at least 10 feet from the top of the excavation.
- If excavations, including utility trenches, are extended to a depth of more than 20 feet, OSHA requires that the protective system of such excavations be designed by a professional engineer. Excavation, trenching and shoring should be conducted in accordance with the *U.S. Department of Labor Occupational Safety and Health Administration's (OSHA) Excavation and Trenching Standard, Title 29 of the Code of Federal Regulation (CFR), Part 1926.650*. The safety of construction personnel is the responsibility of the contractor.

6.2.5 Fill Materials

- On-site soils meeting the following criteria, as determined by visual observation by the 3rd party inspector, may be used in required fills:

Sieve Size	Percent Passing
12-inches	100%
6-inches	85-100%
3/4-inches	40-100%

Notes:
1. Material should be free of all debris and organic matter.
2. Material has an expansion potential of less than 4 percent. Expansion test will not be required for non-plastic/cohesionless soils.
3. Where materials with less than 70% passing the 3/4-inch sieve (more than 30% retained on ¾-inch sieve) is used, such materials should be verified to be firm and unyielding by performing proof-rolling and/or probing by the 3rd party inspector.

- In general, material greater than 12 inches in diameter should not be used in fills within 5 feet below the bottom of the footing within building pad areas.

- Fill containing material greater than 6 inches in diameter should not be used in any utility trenches, behind retaining walls or against foundations or grade beams.
- Imported material should be compatible with on-site soils in addition to being suitable for its intended use. All imported materials should be approved by the geotechnical firm providing testing during construction prior to importing. In general, imported soils should be granular and non-expansive or have a maximum expansion potential of 4%, a maximum solubility of 1%, a maximum sulfate content of 0.2% and a maximum sodium sulfate content of 0.2%. If post-tensioned slabs are used, imported materials shall also have a maximum chloride content of 500 mg/Kg.
- Select free draining granular materials should be used as backfill immediately behind retaining walls (6 to 12 inches). As an option, a prefabricated drain may be used and should be installed in accordance with the manufacturer's recommendations.

6.2.6 Fill Placement and Compaction

- After performing required excavations, the exposed soils should be carefully observed to verify removal of all unsuitable deposits. Exposed soils should then be scarified to a depth of 6 inches, watered as necessary, and compacted as recommended.
- Fill materials should be placed on a horizontal plane unless otherwise accepted by the geotechnical engineer.
- Where the slope ratio of the original ground is steeper than 5 horizontal to 1 vertical, the slope should be benched to create near-level areas for the placement of fill. The maximum allowable height of the bench is 3 feet. Bench excavation should be continued to the top of the existing slope in structural fill areas or the daylight (cut/fill) contact.
- All required fill should be placed in loose lifts, generally not over 8 to 12 inches in thickness.
- Materials should be compacted to the following:

Material	Percent Compaction (ASTM D1557)	Minimum Moisture Content
Granular (including aggregate base)	95 (minimum)	-2 percent of optimum moisture content

Notes:
1. Street/pavement subgrade and retaining wall backfill only need to be compacted to a minimum of 90 percent.

- Soils should not be allowed to dry out such that cracking occurs during or after grading. Sufficient moisture contents should be maintained, to prevent cracking, at least until foundations, floor slabs, flatwork, and pavements are constructed. Any significantly dried or cracked soils could be wetted until they reach acceptable moisture contents or they could be excavated and replaced with acceptable properly compacted fill.
- Structural fill should be observed and tested as necessary to determine compliance with the compaction requirements presented in this report. In general, one compaction test should be performed for approximately every 500 cubic yards of fill, one for one foot of fill placed, or change in material. For residential projects, at least one compaction test should be performed for each lot.

6.3 FOUNDATIONS

Based on the encountered soil conditions, assumed/provided structural loads and our understanding of the project, the proposed structures can be supported on shallow foundations. Recommendations for the foundations are provided in the section below.

6.3.1 Shallow Foundations

If the grading recommendations presented in the *Earthwork* section of this report are complied with, the proposed structures may be supported by conventional or post-tensioned type foundations. Any proposed retaining walls or block walls may be established on conventional footings. Foundations should be established on undisturbed natural soils having a consistency of at least medium dense and/or properly compacted fill. Foundation design parameters are summarized below.

Description	Parameter
Allowable bearing pressure [1,2]	2,000 psf
Minimum width [3]	12 inches
Minimum embedment depth [3, 4]	12 inches
Anticipated total settlement	Less than 1 inch
Anticipated differential settlement	Less than ½ inch

Notes:
1. The bearing value may be increased by 500 psf for each additional 12 inches of embedment up to a maximum of 4,000 psf.
2. A one-third increase may be used for wind or seismic loads.
3. Minimum width and embedment depth are for conventional spread footings or the thickened edge of post-tension slab foundations.
4. Below the lowest adjacent final compacted subgrade (generally pad grade before landscaping; exterior footings) or the top of the finished floor slab (interior footings).

Post-tensioned foundations should be designed using the Post-Tensioning Institute (PTI), Design and Construction of Post-Tensioned Slabs-On-Ground (3rd Edition) method and presented in *Table 1808.6.2* of the *City of Henderson Amendments to the 2021 IBC*. It should be understood that the PTI post-tensioned design methodology reflected in the Southern Nevada Building Code is in part based on the assumption that soil-moisture changes around and beneath the post-tensioned slabs are influenced only by climatological conditions. Soil-moisture change below foundations and floor slabs is the major factor in damages relating to expansive soil. The PTI design methodology has no consideration for presaturation, homeowner irrigation, or other non-climate-related influences on the moisture content of subgrade soils. Therefore, it is important that the recommendations presented in the *Drainage and Moisture Protection* Section of this report be strictly adhered to. Post-tensioned slab design parameters are summarized below.

Description	Parameter
Expansion Range	Non-expansive to 2
Em (center lift)	Crack control only, the structural engineer should determine the appropriate design values for the BRAB Type I or Type II slabs
Em (edge lift)	
Ym (center lift)	
Ym (edge lift)	

Settlement of the proposed structures, supported as recommended, should be within acceptable limits as provided above. Our settlement estimation assumed that the moisture content below the foundations will not vary significantly. Therefore, it is important that the recommendations presented in the *Drainage and Moisture Protection* section of this report be adhered to.

6.4 Site Class

Based on the information presented on the City of Henderson Site Class Map, a Site Class C may be used at this site for seismic design.

The site is located at approximately the following latitude and longitude:

Latitude	Longitude
36.05751°	- 114.95806°

A search of the USGS Earthquake Hazards Program's ASCE 7-16 data, as published by the ASCE 7 Hazard Tool (https://asce7hazardtool.online/), indicated the following spectral acceleration parameters for the location indicated above and a Site Class C:

Period (s)	MCE_R ground motion (g)		Site-modified spectral acceleration value (g)		Numeric seismic design value (g)		Site amplification factor (g)	
0.2	S_S	0.487	S_{MS}	0.632	S_{DS}	0.422	F_a	1.3
1.0	S_1	0.164	S_{M1}	0.246	S_{D1}	0.164	F_v	1.5

6.5 Lateral Earth Pressures and Retaining Walls

For soils above any free water surface, with level backfill and no surcharge loads, we recommend the following equivalent fluid pressures and coefficient of friction:

Soil Parameter	Value
Soil Unit Weight	130 pcf
Internal Angle of Friction	32°
Cohesion	0 psf
Coefficient of Friction	0.39

Loading Condition	Lateral Earth Coefficient		Equivalent Fluid Pressures (pcf)
Horizontal backfill	K_0	0.31	61
	K_a	0.47	40
	K_p	3.25	420

Notes:

1. The above values do not include factor of safety. The designer should employ an adequate factor of safety.
2. The above values assume no hydrostatic pressure.
3. Active pressure assumes unrestrained (cantilever) wall and assumes no loading from heavy compaction equipment.
4. Passive pressure should not exceed a maximum of 2,000 psf. A one-third increase may be used for wind or seismic loads.
5. The passive pressure and the frictional resistance of the soils may be combined without reduction in determining the total lateral resistance.
6. Passive earth pressures should be considered negligible for block or retaining walls within 5-feet of a descending slope. In addition, passive earth pressure within the upper 12 inch of the soil not protected by pavement or concrete slab should be neglected.

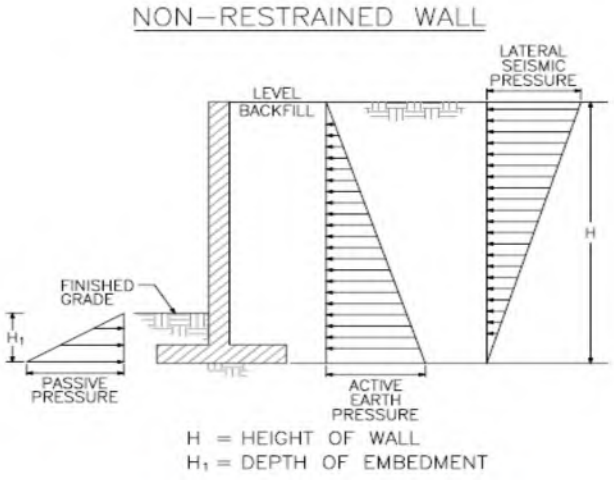
If required by the *2021 IBC*, the lateral seismic pressure acting on an unrestrained wall can be estimated by the method presented in *Section 1610.1.1* of the *City of Henderson Amendments to the 2021 IBC*, where the dynamic (seismic) lateral thrust, ΔP_{AE}, per linear foot of wall may be determined as follows:

$$\Delta P_{AE} = {}^{3}/_{8}(k_h)H^2\gamma$$

- k_h is equal to $S_{DS}/2.5$
- H is the height of the wall in feet
- γ is equal to the unit weight of the backfill material, in pcf

The resultant dynamic force acts at 0.6H above the base of the wall. This equation applies to level backfill and walls that retain no more than 15 feet.

Where the design includes unrestrained walls, above any free water, with level backfill and no surcharge loads, we recommend the wall be designed to resist an earth pressure with the distribution shown below:



Any surcharge from adjacent loadings should be added to the retaining wall pressures using the K_a factor for non-restrained walls. K_a is presented in the table above. As indicated, the pressures assume that there will be no build-up of hydrostatic pressure. Therefore, if walls are subject to saturated conditions, we recommend weep holes (if practical) and a wall drainage system. The wall drainage may consist of a minimum of 2 cubic feet of drain rock per foot of length of retaining wall wrapped in filter fabric, Mirafi 140N or equivalent, placed at the base of the wall and discharged to an appropriate outlet. Drain rock should consist of clean, uniformly sized gravel, ¾-inch in nominal size. Alternatively, a drainage system including a perforated pipe with a filter sock placed within the drain rock is also acceptable. The structural fill immediately behind retaining walls (6 to 12 inches) should be granular and free draining. The upper 2 feet of backfill should consist of compacted native soils. As an option, a prefabricated drain may be used behind walls. The wall drainage system is an integral part of the retaining wall design. The retaining wall designer is ultimately responsible for the retaining wall design and shall ensure that the above recommended drainage system is compatible with the design of the wall or select a different drainage system at their discretion. All walls below grade should be waterproofed or at least dampproofed.

Fill against foundations, grade beams and retaining walls should be properly placed and compacted. Backfill should be mechanically compacted in layers (12 inches maximum thickness); flooding should not be permitted. Backfill within a lateral distance equal to the height of retaining walls should be compacted to at least 90 percent of the maximum dry density obtainable by the ASTM D1557 method. The backfill materials within this zone should consist of none to low expansive soils. If expansive soils are used within this backfill zone, the wall should be designed to resist the additional pressure that the expansive soils may exert. Backfill outside this zone should be compacted as outlined in the *Fill Placement and Compaction* section of this report. Care should be taken when placing backfill so as not to damage the walls. Compaction of each lift adjacent to walls should be accomplished with hand-operated tampers or other lightweight compactors. Over-compaction may cause excessive lateral earth pressures which could result in wall movements. Retaining walls should not be backfilled until the concrete or masonry has reached adequate strength as specified by the wall designer.

6.6 INTERIOR FLOOR SLABS

If grading recommendations are complied with, concrete floor slabs may be supported on a 4-inch layer of Type II. If the potential for a damp floor slab is a concern, moisture protection should be provided by a relatively impervious vapor barrier/retarder placed beneath interior slabs. The vapor barrier/retarder should be a Class A vapor barrier at least 10 mils in thickness, meeting the requirements of ASTM E1745, and should conform to and be placed in accordance with the requirements of the project structural engineer or architect. If the concrete is to be placed directly on Type II or sand, the Type II or sand should be moistened (but not saturated) prior to the placement of concrete.

Recommendations presented by the American Concrete Institute (ACI 302) for slabs-on-grade should be complied with for all concrete placement and curing operations. Improper curing techniques and/or excessive slump (water-cement ratio) could cause excessive drying/shrinkage resulting in random cracking and/or slab curling. Concrete slabs should be allowed to cure adequately before placing vinyl or other moisture sensitive floor coverings.

6.7 Drainage and Moisture Protection

Foundation soils should generally not be allowed to become saturated during or after construction, except when necessary to increase moisture contents prior to construction. Infiltration of water into foundation or utility excavations should be prevented during construction. Utility lines should be properly installed and the backfill properly compacted to avoid possible sources for subsurface saturation.

Positive drainage away from the buildings should be provided during construction and maintained throughout the life of the buildings. Any downspouts, roof drains or scuppers should discharge into splash blocks or extensions and away from the buildings. Backfill against footings, exterior walls, and in utility trenches should be properly compacted and free of all construction debris to reduce the possibility of moisture infiltration.

Performance of the foundation system recommended in this report is dependent on the ability to keep moisture from penetrating the soils below foundations and slabs. Therefore, we recommend the following:

- Positive drainage should be maintained away from the buildings. Positive drainage of 2% minimum shall be maintained for areas adjacent to the buildings that are not covered by concrete or asphalt. Areas, where concrete or asphalt abut the buildings, should be sloped a minimum of 2% away from the buildings. Positive drainage of 1% minimum shall be maintained for areas adjacent to block walls. Positive drainage should be maintained for 10 feet. If physical obstructions or lot lines prohibit 10 feet of horizontal distance, the slope should be provided to an approved alternate method of drainage.
- Landscape watering should be kept to a minimum.

If the above recommendations are not followed there would be an increased risk/potential for increasing moisture below foundations and slabs, resulting in additional movement and distress to structures and slabs.

6.8 Pavement

The pavement area subgrade should be properly prepared as outlined in the *Earthwork* section of this report before placing any asphalt or base materials. Proper drainage of the paved areas should be provided to increase pavement life. In addition, pavements must be maintained for durability and integrity during their life. Therefore, periodic seal coating, crack sealing, and/or patching may be required.

Asphalt and base course materials and compaction should meet the criteria set forth in the Uniform Standard Specifications for Public Works' Construction, Off-Site Improvements, Clark County Area, Nevada. In addition, concrete curbs and gutters should meet the criteria set forth in the Uniform Standard Specifications for Public Works' Construction. Subgrade should be compacted to a minimum of 90 percent (ASTM D1557). Field and laboratory testing of asphalt and base materials should be performed to determine whether specified requirements have been met.

Base course materials and compaction should meet the criteria set forth in the Uniform Standard Specifications for Public Work' Construction, Off-Site Improvements, Clark County Area, Nevada. Field and laboratory testing of base materials should be performed to determine whether specified requirements have been met.

The performance of the pavement can be enhanced by minimizing excess moisture which can reach the subgrade soils. The following recommendations should be followed, where possible:

- Site grading at a minimum 2% grade away from the pavements unless otherwise required for ADA compliance.
- Compaction of any utility trenches for landscaped areas to the same criteria as the pavement subgrade.
- Landscaped areas should have cutoff walls/moisture barriers adjacent to pavement areas to minimize or prevent moisture migration to subgrade soils.
- Consideration should be given to using "desert" landscaping and/or minimizing watering to help prevent surface runoff.
- Placing compacted backfill against the exterior side of curb and gutter.

6.8.1 On-site Asphalt Pavements

Based on the soil classifications and assumed traffic volumes, the following minimum pavement sections are recommended for on-site paved areas:

Traffic area	Assumed Traffic Index	Asphalt (inches)	Type II Base Course (inches)
Automobile Parking	4.5	2.0	4.0
Main Corridors and Truck Access	6.5	3.0	4.0

6.8.2 Off-site Pavements

Based on our experience, the on-site soils should have an R-value on the order of 55. Therefore, based on the Pavement Structure Design Guideline Chart (DWG. Nos. 200 and 200.1) in the Uniform Standard Drawings for Clark County Area, Nevada, the following preliminary pavement sections should be applicable:

Roadway Type	Pavement Section (inches)	
	Asphalt Concrete	Type II Base Course
Residential	2.0	4.0
Minor Collector	3.0	4.0
Major Collector	4.5	5.0
Arterial	5.5	8.0

As indicated, the pavement sections presented are preliminary. The City of Henderson will require that final sections be based on R-value tests performed at subgrade. Therefore, final pavement sections may vary depending on those R-value test results.

6.9 CORROSIVITY

Based on test results and *Table 19.3.1.1* of *ACI 318-14 Section 19.3*, the on-site soils classify as having a "**S1**" (moderate) sulfate exposure. Please refer to *Table 19.3.2.1* of *ACI 318-14* for the requirements for concrete by exposure class. Consideration should be given to providing protection to buried metal pipes or the use of nonmetallic pipes where permitted by local building codes. Non-corrosive backfill, protective coatings and wrappings, sacrificial anodes, or a combination of these methods could be considered. UES personnel are

not experts regarding corrosion and/or corrosion protection, and we recommend that a "Corrosion Engineer" be consulted for actual recommendations regarding the necessity and/or method of cathodic protection.

7.0 PLAN REVIEW

UES should be retained to provide a general review of final design plans and specifications so that grading and foundation recommendations may be interpreted and implemented. If any changes of the proposed project are planned, the conclusions and recommendations contained in this report should be reviewed and the report modified or supplemented as necessary.

8.0 CONSTRUCTION ITEMS

UES should be retained to provide services during excavation, grading, foundation, and construction phases of work. Observation of foundation excavations should be performed prior to placement of reinforcing and concrete to confirm that satisfactory bearing materials are present. Field and laboratory testing of concrete and soils should be performed to determine whether applicable requirements have been met. In addition, the level of special inspection required for soils should not be less than **4a** as specified in the *City of Henderson Amendments to the 2021 IBC, Table 1705.6*.

The analyses and recommendations in this report are based in part upon data obtained from the field exploration. The nature and extent of variations beyond the locations of the explorations may not become evident until construction. If variations then appear evident, it may be necessary to re-evaluate the recommendations of this report.

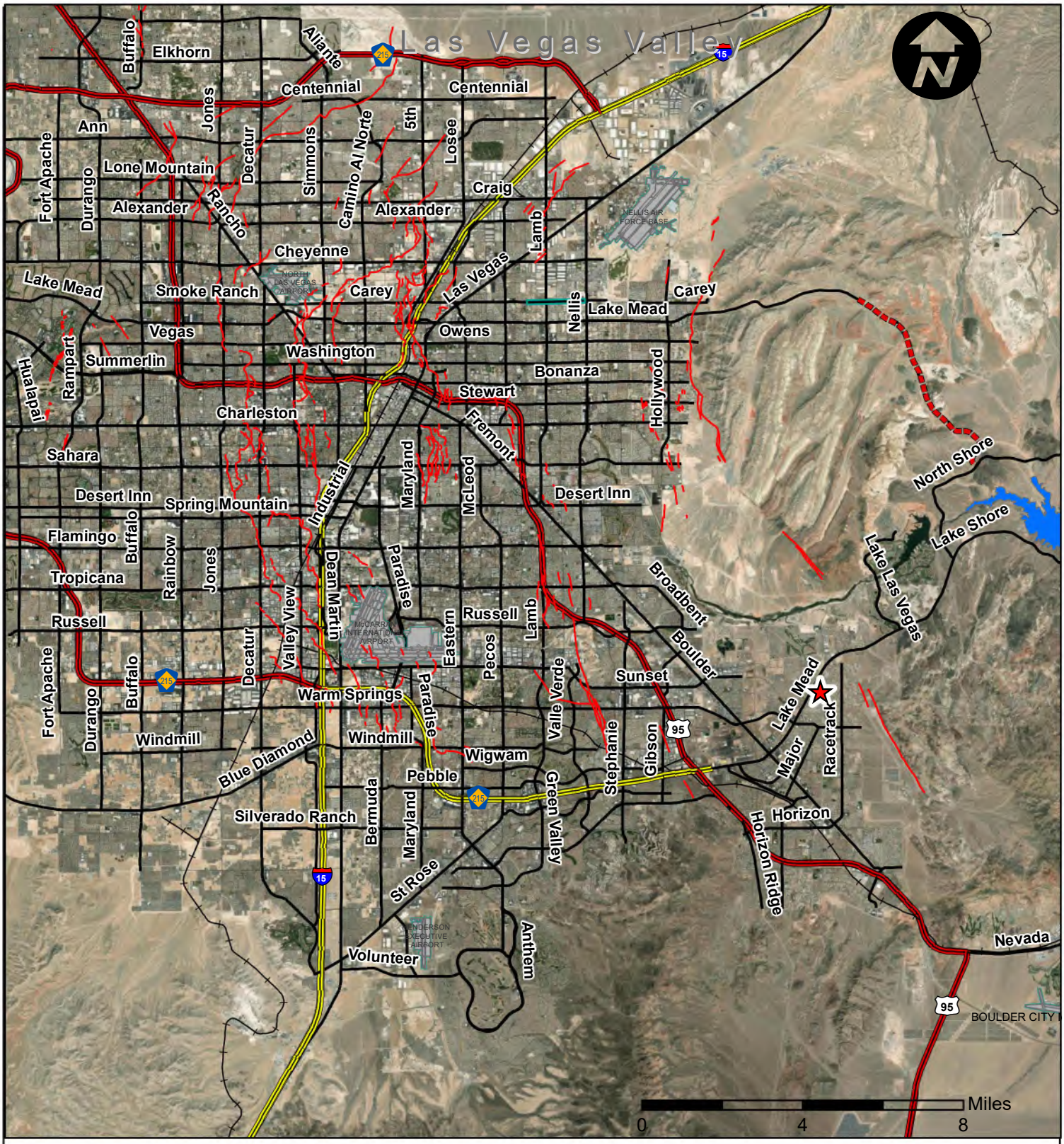
9.0 GEOTECHNICAL RISK AND LIMITATIONS

Our recommendations are based upon the information provided and our assumptions regarding the proposed construction, combined with our analysis of site conditions revealed by the field exploration and laboratory testing programs. We have used prudent engineering and geologic judgment based upon the information provided and the data generated from our investigation. This report has been prepared in substantial compliance, using a degree of care and skill, with generally accepted geotechnical engineering practices that exist in the area of the project at the time the report was prepared. No warranty, either express or implied, is provided.

If the proposed construction is modified or relocated or, if it is found during construction that subsurface conditions differ from those we encountered at our explorations, we should be afforded the opportunity to review the new information or changed conditions to determine if our conclusions and recommendations must be modified.

We emphasize that this report is applicable only to the proposed construction and the investigated site. This report should not be utilized for construction on any other site. Any contractor reviewing this report must draw his own conclusions regarding site conditions and specific construction techniques to be used on this project. As per the guidelines of *City of Henderson Amendments to 2021 IBC*, this report is considered valid for the proposed construction for a period of one year following the date of this report. If construction has

not started within one year, we must re-evaluate the recommendations of this report and update the report, if necessary.



Legend

- Las Vegas Faults (CCBD GISMO, 2016)
- Approximate Project Site

The presented layers were obtained from various sources including ESRI, USGS, USDA, CCBD GISMO, CCFCD, GIS User Community among others. The GIS information is presented for reference only. No warranties, either expressed or implied, are intended or made. If you have any questions regarding this information, please contact UES.

UES	PROJECT: **4-Lot Residential Development SEC Pueblo Blvd & Havre Ave Henderson, Nevada**	**VICINITY MAP**	
	CLIENT: **Las Vegas Civil Engineerings**	PROJECT NO: **4030.2400182**	FIGURE NO: **1**

Legend

Approximate Project Site Boundary

Approximate Boring Location

Feet

0 30 60 120 180 240

The presented layers were obtained from various sources including ESRI, USGS, USDA, CCBD GISMO, CCFCD, GIS User Community among others. The GIS information is presented for reference only. No warranties, either expressed or implied, are intended or made. If you have any questions regarding this information, please contact UES.

UES	PROJECT: **4-Lot Residential Development SEC Pueblo Blvd & Havre Ave Henderson, Nevada**	SITE MAP	
	CLIENT: **Las Vegas Civil Engineering**	PROJECT NO: **4030.2400182**	FIGURE NO: **2**

APPENDIX

Site Exploration

The subsurface conditions of the site were explored by drilling two (2) borings to depths of approximately 15 feet below existing site grades. Borings were drilled using a rotary drill rig.

Soils were logged during drilling by a graduate geologist/engineer, and samples were obtained to aid in material classification and for possible laboratory testing. Boring logs are presented on Plates 1 and 2. Sampling was performed using a standard split spoon sampler ("SPT" in boring logs). The SPT sampler was driven in three 6-inch intervals into the substrata with blows from a 140-pound automatic hammer free-falling 30 inches. Penetration resistance (blow counts) was recorded for each 6-inch drive. Blow counts for the final 12 inches of the total 18 inches are presented as blows per foot in boring logs at the respective depths the samples were taken. Bag/bulk samples ("B" in boring logs) were also collected from the borings for laboratory testing. The soils are generally classified by the Unified Soil Classification System. Plate 3 presents an explanation of material classifications used in this report.

Laboratory Testing

Laboratory testing was performed on selected samples of on-site soils. Tests were performed in general accordance with applicable ASTM or local standards.

Field moisture content was performed on select samples. The results of these tests are presented on the boring logs.

A sieve analysis and Atterberg Limits were performed to determine the grain-size distribution and soil classification of a representative sample. The test results are presented on Plate 4.

Chemical tests were performed on representative samples. Tests were performed to determine the percent chloride, water-soluble sodium, sulfate and sodium sulfate, as well as the soil solubility. Test results are presented on Plate 5.

BORING LOG B-1

CLIENT:	PROJECT:
Las Vegas Civil Engineering	4-Lot Residential Development

BORING LOCATION:	ELEVATION (ft):	SITE:
See site map	N/A	SEC Pueblo Boulevard & Havre Avenue

MOISTURE CONTENT %	DRY DENSITY PCF	SAMPLE TYPE*	SAMPLE	BLOWS/FT	DEPTH, FT	USCS SYMBOL	GRAPHIC	SOIL DESCRIPTION	CONSISTENCY
					0	GM		Silty GRAVEL with sand, slightly moist, light brown	M. Dense
		B			1.25				
		SPT		50/6"	2.5	SM		Silty SAND with gravel, slightly moist, light brown	V. Dense
					3.75				
					5				Dense
		SPT		30	6.25				
					7.5				
					8.75				V. Dense
		SPT		57	10				
					11.25				
					12.5				
					13.75				
					15				
		SPT		51	16.25				
								Bottom of Boring at 16.5 feet	

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

* SAMPLE TYPE: R = RING B = BAG SPT = STANDARD PENETRATION BN = BULL NOSE C = CORE

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER WITH TIME AND AT OTHER LOCATIONS.

UES

NOTES:
Groundwater was not encountered within the depth drilled.

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PROJECT NO.:	PLATE NO.:
4030.2400182	1

BORING LOG B-2

CLIENT:	PROJECT:
Las Vegas Civil Engineering	4-Lot Residential Development

BORING LOCATION:	ELEVATION (ft):	SITE:
See site map	N/A	SEC Pueblo Boulevard & Havre Avenue

MOISTURE CONTENT %	DRY DENSITY PCF	SAMPLE TYPE*	SAMPLE	BLOWS/FT	DEPTH, FT	USCS SYMBOL	GRAPHIC	SOIL DESCRIPTION	CONSISTENCY
					0	GM		Silty GRAVEL with sand, slightly moist, light brown	M. Dense
					1.25				
		SPT	■	42	2.5	SM		Silty SAND with gravel, slightly moist, light brown	Dense
					3.75				
		SPT	■	24	5				M. Dense
					6.25				
		SPT	■	50/5"	7.5				V. Dense
					8.75				
					10				
					11.25				
					12.5				
					13.75				
		SPT	■	64/11"	15				
					16.25			Bottom of Boring at 16.4 feet	

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

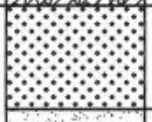
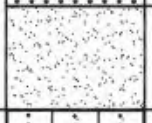
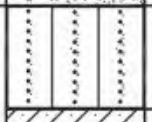
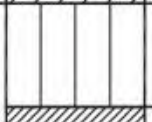
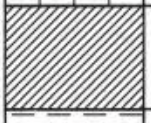
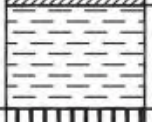
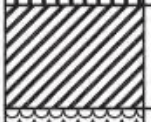
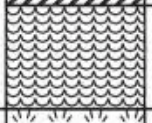
* SAMPLE TYPE: R = RING B = BAG SPT = STANDARD PENETRATION BN = BULL NOSE C = CORE

UES

NOTES:
Groundwater was not encountered within the depth drilled.

DATE DRILLED:	PAGE NO:
9/27/24	1 of 1
PROJECT NO.:	PLATE NO.:
4030.2400182	2

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER WITH TIME AND AT OTHER LOCATIONS.

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	(LITTLE OR NO FINES)		GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
		(APPRECIABLE AMOUNT OF FINES)		GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	SAND AND SANDY SOILS	CLEAN SANDS		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	(LITTLE OR NO FINES)		SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES		SM	SILTY SANDS, SAND - SILT MIXTURES
		(APPRECIABLE AMOUNT OF FINES)		SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

UES

CLIENT : Las Vegas Civil Engineering

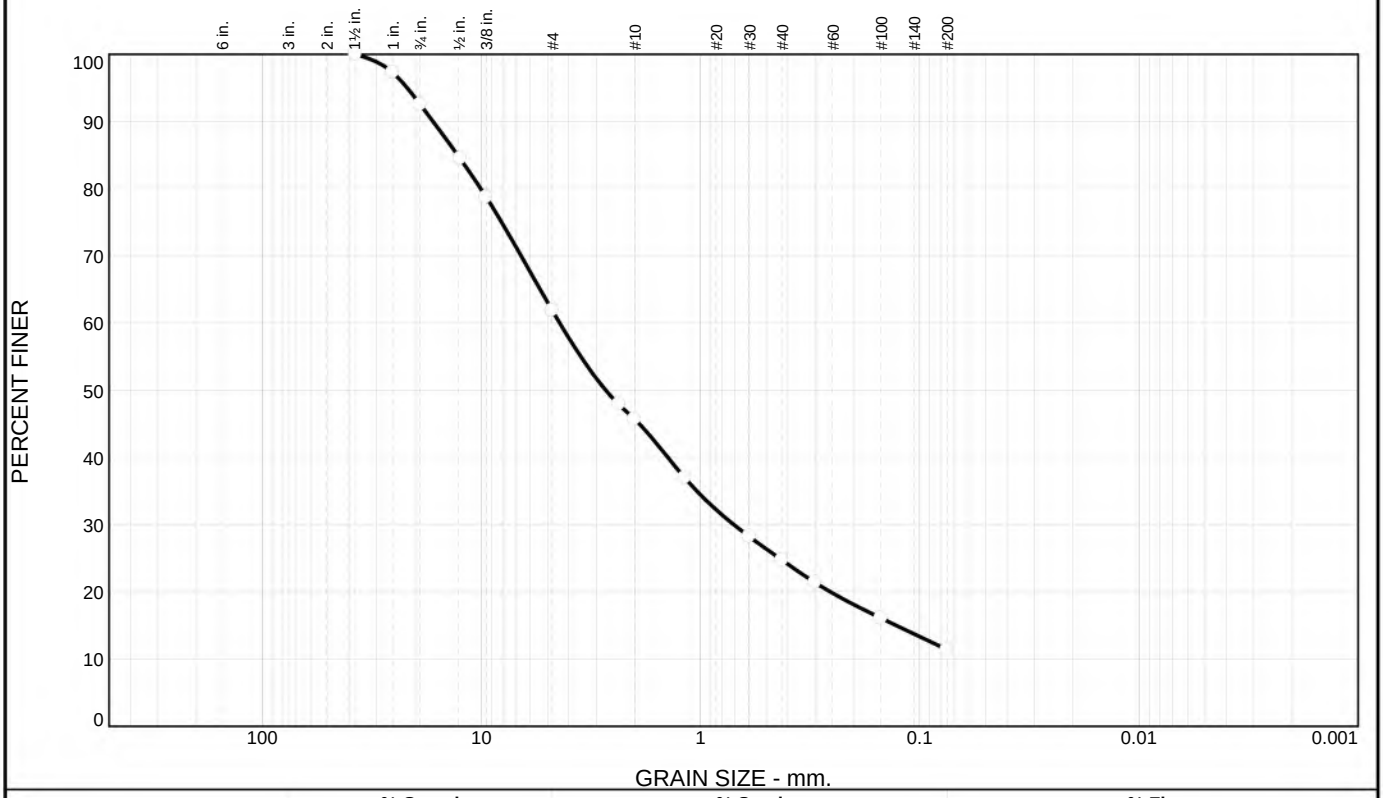
PROJECT: 4-Lot Residential Development

Materials Classification

PROJECT NO.: 4030.2400182

PLATE NO.: 3

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	7	31	16	21	14	11	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1 1/2"	100		
1"	97		
3/4"	93		
1/2"	84		
3/8"	79		
#4	62		
#8	48		
#10	46		
#16	37		
#30	28		
#40	25		
#50	21		
#100	16		
#200	11		

* (no specification provided)

Material Description

SP-SM poorly graded sand with silt and gravel

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{90}= 16.6223 D_{85}= 12.8416 D_{60}= 4.3908
D_{50}= 2.7090 D_{30}= 0.7049 D_{15}= 0.1281
D_{10}= C_u= C_c=

Classification

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

Remarks

Source of Sample: B-1 **Depth:** 0-5

Date: 10/8/2024

Universal Engineering Sciences

Las Vegas, Nevada

Client: Las Vegas Civil Engineering
Project: 4-Lot Residential Development

Project No: 4030.2400182 **Plate** 4

Tested By: DP **Checked By:** SL

4480 West Hacienda Ave,Suite 104
Las Vegas, NV 89118
(702) 873-3478

SUMMARY OF SOIL AND AGGREGATE TEST RESULTS

CLIENT: Las Vegas Civil Engineering
2251 N Rampart Blvd #418
Las Vegas, NV 89128

REPORT DATE: 10/8/2024
PROJECT: 4-Lot Residential Development

PROJECT NO.: **4030.2400182.0000**

Tested By: J. Sloan
Sample Loc.: B1 @ 0'-5'
Sample Description:

CHEMICAL LABORATORY TEST RESULTS

Laboratory Test	Results	Spec's.	Pass/Fail
Soluble Sodium, ASTM D2791, %	<0.01		
Soluble Sulfate, 4500 E, %	0.14		
Soluble Sodium Sulfate, AWWA SM3500 & SM 4500 by Calc., %	<0.01		
Solubility, AWWA 2540 C, %	0.32		
Chloride, 4500 CL B, mg/kg	9.4		

Comments:

Reviewed By: John Sloan
For John Sloan
Chemistry Laboratory Director