Black Eagle Consulting, Inc.

Geotechnical Investigation

Single Family Townhomes - APN 004-021-13

Carson City, Nevada

March 4, 2016

Prepared for
Capstone Communities LLC

Black Eagle Consulting, Inc.
Geotechnical & Construction Services

Mr. Mike Branson
Capstone Communities LLC
9441 Double Diamond Parkway #14
Reno, NV 89521

March 4, 2016
Project No.: 1487-05-1

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RE: **Geotechnical Investigation**
Single Family Townhomes - APN 004-021-13
Carson City, Nevada

Dear Mr. Branson:

Black Eagle Consulting, Inc. is pleased to present the results of our geotechnical investigation for the above-referenced project. Our investigation consisted of research, field exploration, laboratory testing, and engineering analysis to allow formulation of geotechnical conclusions and recommendations for design and construction of this residential project.

We understand the project will consist of the design and construction of approximately 154 single-family townhomes. The townhomes will be multi-story, wood-framed structures supported by Portland cement concrete (PCC) shallow footings and will have PCC slab-on-grade floors at the ground level. Asphalt concrete paved drives and parking lots will be constructed throughout the project site to provide access throughout the development. A system of PCC curbs, gutters, and sidewalks is also anticipated. It is expected that all improvements will be private except where project egress enters Little Lane.

The soil profile consists of a surficial layer of fine-grained to clay soils through approximately 4 feet beneath the ground surface underlain by complexly interbedded sands, silts and clays. The surficial fine-grained and clay soils are poor foundation materials due to their low strength characteristics and potential for shrink-swell movements with moisture fluctuation. These clay and fine-grained soils should be separated via 1.5 feet of structural fill (includes any base section) from footings, slabs, and pavements.

We appreciate having the opportunity to work with you on this project. If you have any questions regarding the content of the attached report, please do not hesitate to contact us.

Sincerely,

Black Eagle Consulting, Inc.

PROFESSIONAL ENGINEER - STATE OF NEVADA
PANCHALINGAM VIMALARAJ
Exp. 6-30-16
CIVIL
No. 19732

3/4/16

Vimal P. Vimalaraj, P.E.
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Project Engineer

Copies to: Addressee (4 copies, PDF)
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Introduction

Presented herein are the results of Black Eagle Consulting, Inc.'s (BEC's) geotechnical investigation, laboratory testing, and associated geotechnical design recommendations for the proposed townhome residential development to be located near Little Lane in Carson City, Nevada. These recommendations are based on surface and subsurface conditions encountered in our explorations and on details of the proposed project as described in this report. The objectives of this study were to:

1. Determine general soil and groundwater conditions pertaining to design and construction of the proposed townhomes.

2. Provide recommendations for design and construction of the project as related to these geotechnical conditions.

The area covered by this report is shown on Plate 1 (Plot Plan). Our investigation included field exploration, laboratory testing, and engineering analysis to determine the physical and mechanical properties of the various on-site materials. Results of our field exploration and testing programs are included in this report and form the basis for all conclusions and recommendations.

The services described above were conducted in accordance with the BEC Professional Geotechnical Agreement dated October 23, 2015, that was signed by Mr. Mike Branson, President of Capstone Communities LLC.

Project Description

The site to host the proposed townhome development consists of a roughly rectangular parcel of approximately 10.2 acres located in Carson City, Nevada. The subject parcel is assigned assessor's parcel number 004-021-13. The site is entirely contained in Section 17, Township 15 North, Range 20 East, Mount Diablo Meridian. The parcel is bordered to the north by an existing residential subdivision, to the east by a vacant parcel, to the south by Little Lane, and to the west by an existing apartment/townhome development. The property is presently undeveloped land with a network of undeveloped road and paths that traverse the site. Access to the site is obtained from Little Lane.

Limited details of the project are known at the time of this report. We understand the project will consist of the design and construction of approximately 154 single-family townhomes. The townhomes will be multi-story, wood-framed structures supported by Portland cement concrete (PCC) shallow footings and will have PCC slab-on-grade floors at the ground level. Asphalt concrete paved drives and parking lots will be constructed throughout the project site to provide access throughout the development. A system of PCC curbs, gutters, and sidewalks is also anticipated. It is expected that all improvements will be private except where project egress enters Little Lane.

Utilities will be extended to the site from existing underground sources along Little Lane and along the western portion of the site.

A grading plan is unavailable at the time of this investigation. However, from discussions with the project civil engineer, Manhard Consulting, Ltd., and because the site is essentially flat, it is estimated that minimal cuts and fills (less than 3 feet) will be required to provide the necessary surface drainage across the property.

Site Conditions

Existing Structures

The project site consists of undeveloped land crisscrossed by several undeveloped roads (dirt tracks). Along the western border of the site is a raised roadbed constructed with an estimated 2 to 3 feet of fill.

Within the elevated roadway is an existing natural gas pipeline. Along the southern border of the parcel, adjacent to Little Lane, is an approximate 4-foot-deep by 8-foot-wide drainage swale.

Site Conditions

The existing dirt tracks exhibit large depressions and promote ponding of water, such that most were impassible during site exploration. Bicycle (BMX style) riders and dirt bike riders have constructed several jump tracks throughout the area and use the area extensively for recreation.

The site has also been subject to uncontrolled dumping. Minor piles of landscaping and concrete debris are present in addition to other piles of garbage that include mattresses and televisions. Much of this material is located adjacent to the perimeter paths on the western and northern sides of the parcel. This trash and debris material is estimated to be less than 50 cubic yards.

Topography

The site exhibits very low gradients and slopes at less than 0.5 percent towards the southeast. Vertical relief within the parcel is generally less than 3 to 4 feet within the undisturbed portions of the site; the fill associated with the natural gas line increases the vertical relief a few feet. Areas of the project site that are not disturbed exhibit a high elevation within the northwestern portion of the site of around 4,650 feet above mean seal level to low elevations of around 4,647 feet in the southeastern portion of the site.

Vegetation

The site is densely populated by sagebrush up to 5 feet tall. Minor areas have been stripped and grasses have regrown.

Exploration

Test Pits

Test Pit Exploration

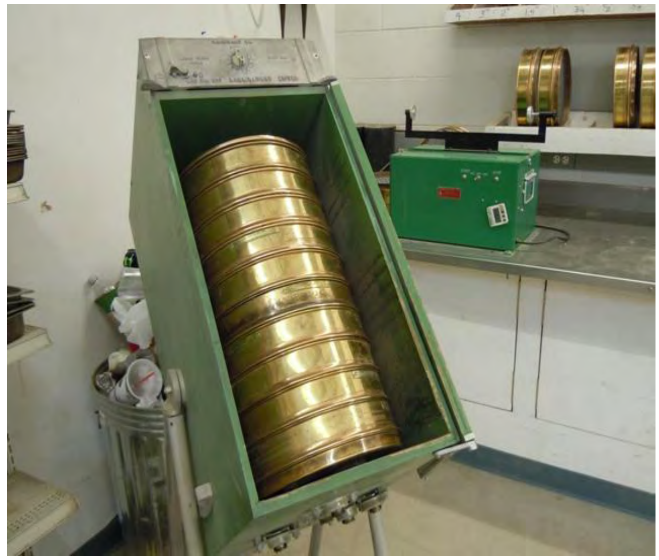
The proposed townhome site was explored on February 15, 2016, by excavating 11 test pits using a rubber-tracked Kubota® KX 91-3 mini-excavator. Locations of the test pits are shown on Plate 1. The maximum depth of exploration was 10 feet below the existing ground surface. Bulk samples for index testing were collected from the trench wall sides at specific depths in each soil horizon. Pocket penetrometer testing was performed in exposed, fine-grained soil strata to assess in-place, unconfined compressive strength for evaluating trench stability. The depth to groundwater was measured at the time of exploration. The test pits were backfilled immediately after exploration. Backfill was loosely placed and the area re-graded to the extent possible with equipment on hand.

Material Classification

A geologist examined and identified all soils in the field in accordance with American Society for Testing and Materials [ASTM] D 2488. During test pit exploration, representative bulk samples were placed in sealed plastic bags and returned to our Reno, Nevada laboratory for testing. Additional soil classification was subsequently performed in accordance with ASTM 2487 (Unified Soil Classification System [USCS]) upon completion of laboratory testing, as described in the **Laboratory Testing** section. Logs of the test pits are presented as Plate 2 (Test Pit Logs), and a USCS chart has been included as Plate 3 (USCS Soil Classification Chart).

Laboratory Testing

All soils testing performed in the BEC soils laboratory is conducted in general accordance with the standards and methodologies described in Volume 4.08 of the ASTM Standards.



Grain Size Analysis

Index Tests

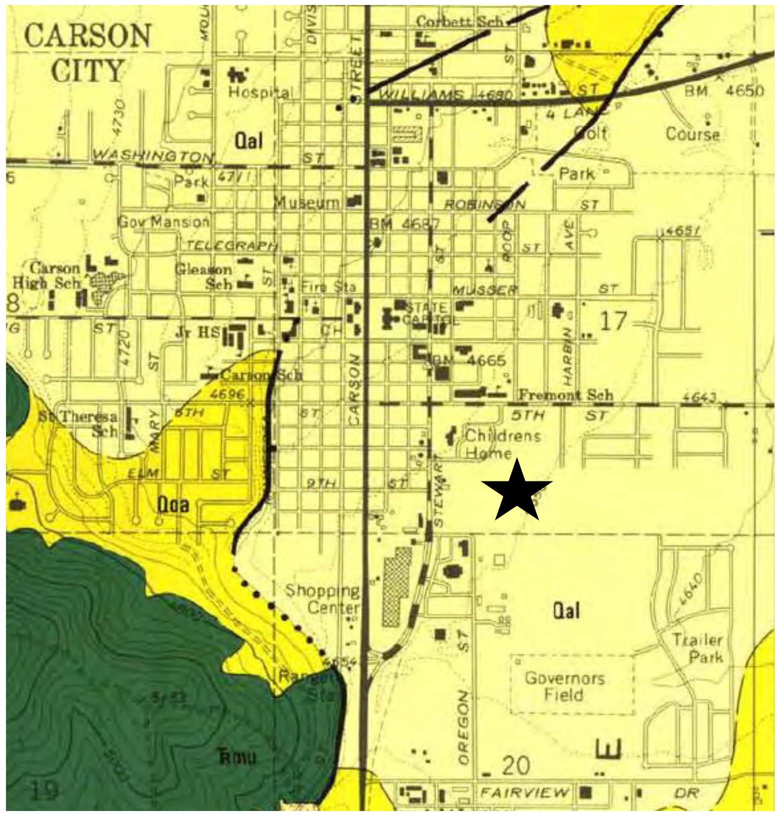
Samples of each significant soil type were analyzed to determine their in-situ moisture content (ASTM D 2216), grain size distribution (ASTM D 422), and plasticity index (ASTM D 4318). The results of these tests are shown on Plate 4 (Index Test Results). Test results were used to classify the soils according to ASTM D 2487 and to verify field logs, which were then updated as appropriate. Classification in this manner provides an indication of the soil's mechanical properties and can be correlated with published charts (Bowles, 1996; Naval Facilities Engineering Command [NAVFAC], 1986a and b) to evaluate bearing capacity, lateral earth pressures, and settlement potential.

Chemical Tests

Chemical testing was performed on representative samples of site foundation soils to evaluate the site materials' potential to corrode steel and PCC in contact with the ground. The samples were tested for pH, resistivity, redox potential, soluble sulfates, and sulfides. The results of the chemical tests are shown on Appendix A (Chemical Test Results). Chemical testing was performed by Sierra Environmental Monitoring of Reno, Nevada.

Geologic and General Soil Conditions

The site lies in an area mapped by the Nevada Bureau of Mines and Geology (NBMG) as Quaternary Age *Alluvial-plain deposits of Eagle Valley* (Trexler, 1977). The NBMG describes these soils as *yellowish-brown to gray, unbedded to poorly bedded, poorly to moderately sorted, fine silty sand, sandy silt, granular muddy coarse sand, and minor sandy gravel. Underlies broad surfaces of low gradient.* The soils encountered during site exploration are consistent with the geologic map.



Geologic Map

The site materials include fill soils within an undeveloped, and slightly raised, roadway on the western parcel boundary. Fill materials are generally silty sand. The native soils consist of a surficial layer of sandy silt to clayey sand soils about 2 to 4 feet thick; underlain by silty to clayey sand from 3 to 6 feet beneath the ground surface; and interbedded silt, clay, and sand to the maximum depth of exploration, about 10 feet beneath the ground surface.

The existing fill material at the site is located within an embankment that creates a slightly raised and undeveloped roadway along the western parcel boundary. This roadway shares a similar alignment to the existing natural gas line, delineated on Plate 1, which deterred test pit exploration in this area. The embankment is estimated to be 2 to 3 feet thick. Materials within the side slopes of the fill consist of silty sand. They are described as dark brown, moist, and loose, with an estimated 30 percent low plasticity fines and up to 10 percent gravel up to 1 inch in diameter. Isolated areas of dumped concrete debris and organic debris were observed in this area but do not appear to be a part of the embankment.

The surficial (approximately 0 to 3 feet below the ground surface) soils are sandy silt, silty sand and clayey sand. They are described as dark brown, moist, medium dense or stiff, and contain 30 to 53 percent non-plastic to medium plasticity fines with trace amounts of fine gravel. The intermediate depth (approximately 3 to 6 feet below the ground surface) silty sand and clayey sand soils are described as light brown to light gray with orange mottling (the degree of mottling within this soil profile increases with depth), moist to very moist, medium dense, and contain 15 to 38 percent non-plastic to medium plasticity fines and up to 5 percent gravel up to 1 inch in diameter. The deeper soils consist of lean clay, silt, and silty sand soils that are described as light gray to tan to olive with strong orange mottling, very moist to wet, medium dense or firm to very stiff, and contain an estimated 35 to 80 percent low to medium plasticity fines.

Groundwater was encountered at depths of 7 to 9 feet beneath the existing ground surface throughout the site. Below a 4-foot depth, the soils exhibit orange mottling that increases with depth, indicating the previous elevation of high groundwater level to be relatively shallow. The Carson City area has been subject to several years of drought conditions, and the observed groundwater levels are most likely lower due to this drought. Shallower groundwater conditions are expected to return due to spring snowmelt and increased precipitation compared to the recent drought conditions.

Geologic Hazards

Seismicity

Much of the western United States is a region of moderate to intense seismicity related to movement of crustal masses (plate tectonics). By far, the most seismically active regions, outside of Alaska, are in the vicinity of the San Andreas Fault system of western California. Other seismically active areas include the Wasatch Front in Salt Lake City, Utah, which forms the eastern boundary of the Basin and Range physiographic province, and the eastern front of the Sierra Nevada Mountains, which is the western margin of the province. The Carson City area lies along the eastern base of the Sierra Nevadas, within the western extreme of the Basin and Range. It must be recognized that there are probably few regions in the United States not underlain at some depth by older bedrock faults. Even areas within the interior of North America have a history of strong seismic activity.

Carson City lies within an area with a high potential for strong earthquake shaking. Seismicity within the Carson City area is considered about average for the western Basin and Range Province (Ryall and Douglas, 1976). It is generally accepted that a maximum credible earthquake in this area would be in the range of magnitude 7 to 7.5 along the frontal fault system of the Eastern Sierra Nevadas. The most active segment of this fault system in the Carson City area is the Genoa fault, located at the base of the mountains some 2.5 miles west of the project.

Faults

The published geologic hazards map (Trexler and Bell, 1979) shows several Late Pleistocene and Holocene Age faults located approximately 0.5 to 1.5 miles from the site. The nearest faults are Late Pleistocene in age and are located approximately 0.5 to 0.75 miles west and north of the project site, respectively. The nearest Holocene age faults are located approximately 1.2 to 1.5 miles south and northwest of the site, respectively.

The Nevada Earthquake Safety Council (NESC, 1998) has developed and adopted the criteria for evaluation of Quaternary age earthquake faults. *Holocene Active Faults* are defined as those with evidence of movement within the past 10,000 years (Holocene time). Those faults with evidence of displacement during the last 130,000 years are termed *Late Quaternary Active Faults*. A *Quaternary Active Fault* is one that has moved within the last 1.6 million years. An *Inactive Fault* is a fault *without recognized activity within Quaternary time* (last 1.6 million years). Holocene Active Faults normally require that occupied structures be set back a minimum of 50 feet (100-foot-wide zone) from the ground surface fault trace. An *Occupied Structure* is considered a building, as defined by the *International Building Code* (*IBC*), *which is expected to have a human occupancy rate of more than 2,000 hours per year* (International Code Council [ICC], 2012).

The setback from Quaternary Active Faults is left to the judgment of the geologist/engineer; however, no *Critical Facility* is permitted to be placed over the trace of a Late Quaternary Active Fault. A *Critical Facility* is defined as *a* *building or structure that is considered critical to the function of the community or the project under consideration. Examples include, but are not limited to, hospitals, fire stations, emergency management operations centers and schools.*

Based on the geologic map, the faults in the vicinity of the project are *Holocene Active Faults* and *Late Quaternary Active Faults*. However, because no faults are mapped as passing through or adjacent to the site, no fault setback or further investigation is necessary for this project.

Ground Motion and Liquefaction

Mapping by the United States Geological Survey (USGS, 2016) indicates that there is a 2 percent probability that a *bedrock* ground acceleration of 0.933g will be exceeded in any 50-year interval. Only localized amplification of ground motion would be expected during an earthquake.

Detailed liquefaction analysis is beyond BEC's scope of work for this investigation. The site area is underlain by fine-grained, poorly consolidated, sandy soils with a shallow groundwater table (about 7 to 9 feet). The Eagle Valley area of Carson City has long been suspected of having some liquefaction potential. Liquefaction is a nearly complete loss of soil shear strength that can occur during a seismic event as cyclic shear stresses cause excessive pore water pressure between the soil grains. This phenomenon is generally limited to unconsolidated, clean to silty sand (up to 35 percent non-plastic fines) lying below the groundwater table. The higher the ground acceleration caused by a seismic event, the more likely liquefaction is to occur. Severe liquefaction can result in catastrophic settlements of large civil structures.

The soil profile encountered within the site through 10 feet depth consists of predominantly fine-grained and clay soils with greater than 35 percent low to medium plasticity fines and interbedded layers of medium dense silty sand soils that will have a low potential for liquefaction. However, based on our experience within the general area (Eagle Valley) of the project site, soil profiles beneath 10 feet depth are expected to include relatively thin layers of loose to medium dense sandy soils with a relatively low percentage of non-plastic fines that can liquefy for a design earthquake. Where a non-liquefiable, near-surface deposit is present (including soil layers above groundwater table) and the deeper, potentially liquefiable layers are relatively thin, the surface manifestation of liquefaction-induced settlement and associated differential settlements will generally be within tolerable levels for lightly loaded, wood-framed residential structures.

Flood Plains

The Federal Emergency Management Agency (FEMA) has identified the site as lying in Stippled Zone X, Other Flood Areas, *areas of 0.2 percent annual chance flood; areas of 1 percent annual chance flood with average depths less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1 percent annual chance flood* (FEMA, 2014).

Other Geologic Hazards

A moderate potential for dust generation is present if grading is performed in dry weather. Clay soils exist across the project site as interbedded soil lenses. No other geologic hazards were identified.

Discussion and Recommendations

General Information

The site is geotechnically suitable to host the proposed townhome development provided the following geotechnical and construction recommendations are incorporated into the project design and followed during construction. The native materials encountered within the property are predominantly fine-grained soils. The low gradient across the site has allowed ponding of water, resulting in localized areas of soft, wet surface soils at the time of our exploration. A grading plan for the townhouse development is not available at the time of this investigation; however, it is our understanding that grading for the project will include minimal cut and fill to provide positive drainage away from improvements.

The soil profile consists of a surficial layer of fine-grained to clay soils through approximately 4 feet beneath the ground surface underlain by complexly interbedded sands, silts and clays. The surficial fine-grained and clay soils are poor foundation materials due to their low strength characteristics and potential for shrink-swell movements with moisture fluctuation; as such, separation from structural improvements will be required, as described in the Site Preparation section. The existing fill material within the raised roadway along the western parcel boundary, as well as localized areas of trash and debris that exist throughout the parcel, will require mitigation, as also discussed within the Site Preparation section. Groundwater is present at depths of approximately 7 feet beneath the ground surface, and deep utility installation will likely require dewatering, as described in the Trenching, Excavation and Utility Backfill section.

The recommendations provided herein, and particularly under Site Preparation, Mass Grading, Foundation, and Quality Control, are intended to minimize risks of structural distress related to consolidation or expansion of native soils and/or structural fills. These recommendations, along with proper design and construction of the structure and associated improvements, work together as a system to improve overall performance. If any aspect of this system is ignored or is poorly implemented, the performance of the project will suffer. Sufficient quality control should be performed to verify that the recommendations presented in this report are followed.

Structural areas referred to in this report include all areas of buildings, concrete slabs and asphalt pavements, as well as pads for any minor structures. The term engineer, as presented below, pertains to the civil or geological engineer that has prepared the geotechnical engineering report for the project or who serves as a qualified geotechnical professional on behalf of the owner.

All compaction requirements presented in this report are relative to ASTM D 1557. For the purposes of this project:

- Fine-grained soils are defined as those with more than 35 percent by weight passing the number 200 sieve, and a plastic index lower than 15.
- Clay soils are defined as those with more than 30 percent passing the number 200 sieve, and a plastic index greater than 15.
- Granular soils are those not defined by the above criteria.

Any evaluation of the site for the presence of surface or subsurface hazardous substances is beyond the scope of this investigation. When suspected hazardous substances are encountered during routine geotechnical investigations, they are noted in the exploration logs and immediately reported to the client. No such substances were revealed during our exploration.

Site Preparation

All vegetation shall be stripped and grubbed from structural areas and removed from the site. A stripping depth of 0.2 to 0.3 feet is anticipated. Sagebrush and associated roots greater than ½ inch in diameter shall be removed, where necessary, to a minimum depth of 12 inches below finished grade. Resulting excavations shall be backfilled with structural fill compacted to 90 percent relative compaction.

The test pits were excavated by mini-excavator at the approximate locations shown on Plate 1. Locations were determined in the field by approximate means. All test pits were backfilled upon completion of the field portion of our study, and the backfill was compacted to the extent possible with equipment on hand. However, the backfill was not compacted to the requirements presented herein under Mass Grading. If structures, concrete flatwork, pavement, utilities or other improvements are to be located in the vicinity of any of the test pits, the backfill should be removed and recompacted in accordance with the requirements contained in this report. Failure to properly compact backfill could result in excessive settlement of improvements located over test pits.

Fine-grained and clay soils were found to exist from the ground surface through depths of 10 feet below the ground surface. These soils were classified as moist to wet, firm to very stiff (medium dense), and as exhibiting low to medium plasticity. Laboratory testing performed on these materials determined the clay soils exhibit plasticity indices on the order of 12, indicative of low expansion potential (Nelson and Miller, 1992). Fine-grained soils are considered unsuitable to directly support project improvements because of their low strength characteristics, particularly with moisture level increases.

Structural improvements shall be separated from all fine-grained and clay soils by structural fill following Table 1 (Required Thickness of Structural Fill between Fine-Grained/Clay Soils and Improvements).

TABLE 1 - REQUIRED THICKNESS OF STRUCTURAL FILL BETWEEN FINE-GRAINED/CLAY SOILS AND IMPROVEMENTS	
Improvement	**Minimum Separation**
Footings	1.5 feet
Interior Floor Slabs[1]	1.5 feet
Exterior Concrete Slabs, including Curbs, Gutters, Sidewalks[1]	1.5 feet
Asphalt Pavements	1.5 feet[2]

[1] Includes aggregate base section.
[2] Alternative separation requirements for asphalt pavements from native fine-grained and clay soils are included in the **Asphalt Concrete Pavement Design** section.

During our exploration, fine-grained and clay soils were found to exist across the ground surface through an average depth of about 2.5 feet, but ranged from less than 1.5 feet to as much as 4 feet. Fine-grained and clay soils also exist as interbedded lenses within the deeper strata. Any over-excavation shall be backfilled with structural fill to footing grade, or to subgrade for pavements and slabs. The required separation may be achieved by any combination of site filling or over-excavation and replacement. The width of over-excavation shall extend laterally from the edge of footings, concrete slabs or asphalt pavements at least one-half the depth of the over-excavation.

Fine-grained and clay soils to be left in place and covered with fill shall be moisture-conditioned to 2 to 4 percent over optimum for a minimum depth of 12 inches. This moisture level will significantly decrease the magnitude of shrink-swell movements in the upper foot of material. The high moisture content must be maintained by periodic surface wetting, or other methods, until the surface is covered by at least 1 lift of fill. If allowed to dry out, subsequent expansion or settlement of fine-grained soils beneath foundations and floor slabs could significantly exceed the design criteria set forth previously.

No documentation regarding inspection or testing of the placement of fill materials (located along the gas line alignment in the western portion of the site) under the supervision of a geotechnical professional exist. As a result these materials will require mitigation consisting of removal through a depth such that no more than 12 inches remains. The resulting surface shall then be scarified through 12 inches, moisture conditioned to near optimum, and densified to at least 90 percent relative compaction.

All areas to receive structural fill or structural loading shall be densified to at least 90 percent relative compaction.

The surficial fine-grained and clay soils are of low permeability, such that ponding of water existed at the time of exploration. The native site soils are highly moisture sensitive; if allowed to become over-optimum moisture content, they will be impossible to compact. If project scheduling and weather allow, it may be possible to moisture condition these soils by scarifying the top 12 inches of subgrade and allowing it to air-dry to near-optimum moisture prior to compaction. Where this procedure is ineffective or where construction schedules preclude delays, mechanical stabilization will be necessary.

Mechanical stabilization may be achieved by over-excavation and/or placement of an initial 12- to 18-inch-thick lift of 12-inch-minus, 3-inch-plus, well graded, angular rock fill. The more angular and well graded the rock is, the more effective it will be. This fill shall be densified with large equipment, such as a self-propelled sheeps-foot or a large loader, until no further deflection is noted. Additional lifts of rock may be necessary to achieve adequate stability. The use of a separator geotextile will prevent mud from pumping up between the rocks, thereby increasing rock-to-rock contact and decreasing the required thickness of stabilizing fill. The separator geotextile shall meet or exceed the following minimum properties presented in Table 2 (Minimum Required Properties for Separator Geotextile).

TABLE 2 - MINIMUM REQUIRED PROPERTIES FOR SEPARATOR GEOTEXTILE	
Trapezoid Strength (ASTM D 4533)	80 x 80 lbs.
Puncture Strength (ASTM D 4833)	500 lbs.
Grab Tensile Strength/Elongation (ASTM D 4632)	200 x 200 @ 50 %

As an alternate to rock fill, a geotextile/gravel system may be used for stabilization. Aggregate base (*Standard Specifications for Public Works Construction* [*SSPWC*], 2012), Class C or D drain rock (*SSPWC*, 2012), or pit run gravels shall be placed above the geotextile. Regardless of which alternate is selected, a test section is recommended to determine the required thickness of stabilization.

Trenching, Excavation, and Utility Backfill

The test pits were excavated using a small mini-excavator with moderate to difficult effort, such that conventional medium-sized backhoes or excavators should operate with relative ease during construction. In general, the sidewalls of test pits were stable during excavation.

Temporary trenches with near-vertical sidewalls should be stable to a depth of approximately 4 feet. Temporary trenches are defined as those that will be open for less than 24 hours. Excavations to greater depths will require shoring or laying back of sidewalls to maintain adequate stability. Regulations contained in Part 1926, Subpart P, of Title 29 of the Code of Federal Regulations (CFR, 2010) require that temporary sidewall slopes be no greater than those presented in Table 3 (Maximum Allowable Temporary Slopes).

TABLE 3 - MAXIMUM ALLOWABLE TEMPORARY SLOPES	
Soil or Rock Type	**Maximum Allowable Slopes[1] for Deep Excavations less than 20 Feet Deep[2]**
Stable Rock	Vertical (90 degrees)
Type A[3]	3H:4V (53 degrees)
Type B	1H:1V (45 degrees)
Type C	3H:2V (34 degrees)
Notes:	
[1] Numbers shown in parentheses next to maximum allowable slopes are angles expressed in degrees from the horizontal. Angles have been rounded off. [2] Sloping or benching for excavations greater than 20 feet deep shall be designed by a registered professional engineer. [3] A short-term (open 24 hours or less) maximum allowable slope of 1H:2V ([horizontal to vertical] 63 degrees) is allowed in excavation in Type A soils that are 12 feet or less in depth. Short-term maximum allowable slopes for excavations greater than 12 feet in depth shall be 3H:4V (53 degrees).	

The State of Nevada, Department of Industrial Relations, Division of Occupational Safety and Health Administration (OSHA) has adopted and strictly enforces these regulations, including the classification system and the maximum slopes. In general, Type A soils are cohesive, non-fissured soils with an unconfined compressive strength of 1.5 tons per square foot (tsf) or greater. Type B are cohesive soils with an unconfined compressive strength between 0.5 and 1.5 tsf. Type C soils have an unconfined compressive strength below 0.5 tsf. Numerous additional factors and exclusions are included in the formal definitions. The client, owner, design engineer, and contractor shall refer to Appendix A and B of Subpart P of the previously referenced Federal Register for complete definitions and requirements on sloping and benching of trench sidewalls. Appendices C through F of Subpart P apply to requirements and methodologies for shoring.

On the basis of our exploration, the site soils are predominately Type B. Native sandy soils with non-plastic fines and soils beneath the groundwater table shall be considered Type C. Any area in question shall be considered Type C unless specifically examined by the engineer during construction. All trenching shall be performed and stabilized in accordance with local, state, and OSHA standards.

Utility Trench Backfill

In general, bedding and initial backfill 12 inches over the pipe will require import and shall conform to the requirements of the utility having jurisdiction. Bedding and initial backfill shall be densified to at least 90 percent relative compaction. Native granular soil will provide adequate final backfill, and shall be placed in maximum 8-inch-thick loose lifts that are densified to a minimum of 90 percent relative compaction in all structural areas.

Dewatering

Groundwater was encountered at depths of 7 to 9 feet during exploration and could rise following wet winters. Excavations below the groundwater table will likely require dewatering. Below the waterline, bedding and backfill shall consist of compacted drain rock graded in accordance with the requirements for Class C drain backfill presented in the Carson City *SSPWC* (*SSPWC*, 2012). When drain rock is used as trench backfill, it shall be considered a rock backfill (greater than 30 percent retained on the ¾-inch sieve) and shall be placed in maximum 12-inch-thick loose lifts, with each lift densified by at least 5 complete passes with approved compaction equipment and until no deflection is observed. A separator geotextile (Table 2) shall be placed between the drain rock and any native soil backfill.

Mass Grading

The topographic gradient across the site is minimal, such that mass grading activities will primarily include grading of roadways to subgrade elevation and raising building pads to host townhomes. The native surficial materials will be predominantly fine-grained and clay soils. Native fine-grained and clay soils shall be placed as fill only in nonstructural areas.

The site will be developed densely with townhomes, parking areas, and walking paths, such that few non-structural areas will be available to dispose of excess fine-grained soils. In effect, project economics will require importing structural fill for footings, slabs, pavements and sidewalks, and potentially exporting native fine-grained and clay soils. We recommend imported structural fill satisfy the specifications presented in Table 4 (Guideline Specification for Imported Structural Fill).

TABLE 4 - GUIDELINE SPECIFICATION FOR IMPORTED STRUCTURAL FILL		
Sieve Size	**Percent by Weight Passing**	
4 Inch	100	
3/4 Inch	70 – 100	
No. 40	15 – 70	
No. 200	5 – 20	
Percent Passing No. 200 Sieve	**Maximum Liquid Limit**	**Maximum Plastic Index**
5 – 10	50	20
11 – 20	40	15

These recommendations are intended as guidelines to specify a readily available, prequalified material. Adjustments to the recommended limits can be provided to allow the use of other granular, non-expansive material. Any such adjustments must be made and approved by the engineer, in writing, prior to importing fill to the site.

Any structural fill on this project shall be placed in maximum 8-inch-thick loose lifts, each densified to at least 90 percent relative compaction. Nonstructural fill shall be densified to at least 85 percent relative compaction to minimize consolidation and erosion. This is particularly important for yard areas because soil consolidation can cause water to pond in the drainage swales. Loose yard fill also allows water to infiltrate the backfill rather than flowing to the swale. Grading shall not be performed with or on frozen soils.

Seismic Design Parameters

The 2012 *IBC* (ICC, 2012), adopted by Carson City, requires a detailed soils evaluation to a depth of 100 feet to develop appropriate soils criteria. However, the code states that a Site Class D may be used as a default value when the soil properties are not known in sufficient detail to determine the soil profile type. The Site Class D soil profile is for stiff soils with a shear velocity between 600 and 1,200 feet per second, or with an N (Standard Penetration Test [SPT]) value between 15 and 50, or an undrained shear strength between 1,000 and 2,000 pounds per square foot (psf). Based on our experience and the geology at the APN 004-021-13 site, it is our opinion that the default Site Class D is appropriate. With that assumption, the recommended seismic design criteria are presented in Table 5 (Seismic Design Criteria Using 2012 *International Building Code*).

TABLE 5 - SEISMIC DESIGN CRITERIA USING 2012 *INTERNATIONAL BUILDING CODE* (USGS, 2016)	
Approximate Latitude	39.159
Approximate Longitude	-119.758
Spectral Response at Short Periods, S_s, percent of gravity	233.2
Spectral Response at 1-Second Period, S_1, percent of gravity	82.8
Site Class	D
Occupancy Category	II
Site Coefficient F_a, decimal	1.00
Site Coefficient F_v, decimal	1.50
Site Adjusted Spectral Response at Short Periods, S_{MS}, percent of gravity	233.2
Site Adjusted Spectral Response at Long Periods, S_{M1}, percent of gravity	124.2
Design Spectral Response at Short Periods, S_{DS}, percent of gravity	155.4
Design Spectral Response at Long Periods, S_{D1}, percent of gravity	82.8

Foundation

The near-surface fine-grained soils are poor foundation soils, such that footings should not bear directly in these materials. The most economical method of foundation support lies in spread footings bearing on structural fill.

Individual column footings and continuous wall footings underlain by a minimum of 1.5 feet of granular native soil or structural fill can be designed for a net maximum allowable bearing pressure of 2,500 psf, and should have minimum footing widths of 24 and 12 inches, respectively. The net allowable bearing pressure is the pressure at the base of the footing in excess of the adjacent overburden pressure. This allowable bearing value should be used for dead plus ordinary live loads. Ordinary live loads are that portion of the design live load which will be present during the majority of the life of the structure. Design live loads are loads which are produced by the use and occupancy of the building, such as by moveable objects, including people or equipment, as well as snow loads. This bearing value may be increased by one-third for total loads. Total loads are defined as the maximum load imposed by the required combinations of dead load, design live loads, snow loads, and wind or seismic loads.

With this allowable bearing pressure, total foundation movements of approximately ¾ inch should be anticipated. Differential movement between footings with similar loads, dimensions, and base elevations should not exceed two-thirds of the values provided above for total movements. The majority of the anticipated movement will occur during the construction period as loads are applied.

Lateral loads, such as wind or seismic, may be resisted by passive soil pressure and friction on the bottom of the footing. The recommended coefficient of base friction is 0.42 and has been reduced by a factor of 1.5 on the ultimate soil strength. Design values for active and passive equivalent fluid pressures are 38 and 400 psf per foot of depth, respectively. These design values are based on spread footings bearing on and backfilled with structural fill. All exterior footings should be placed a minimum 2 feet below adjacent finished grade for frost protection.

If loose, soft, wet, or disturbed soils are encountered at the foundation subgrade, these soils should be removed to expose undisturbed structural fill material, and the resulting over-excavation backfilled with compacted structural fill. The base of all excavations should be dry and free of loose soils at the time of concrete placement.

Subsidence and Shrinkage

Subsidence of about 0.1 feet should be anticipated from construction traffic. Native soils excavated and recompacted in fills should experience quantity shrinkage of approximately 10 to 15 percent. In other words, 1 cubic yard of excavated native soil will generate about 0.85 to 0.9 cubic yards of fill at 90 percent relative compaction.

Slope Stability and Erosion Control

There are no major cut or fill slopes planned for this project. Dust potential at this site will be moderate during dry periods. Temporary (during construction) and permanent (after construction) erosion control will be required for all disturbed areas. The contractor shall prevent dust from being generated during construction in compliance with all applicable city, county, state, and federal regulations. The contractor shall submit an acceptable dust control plan to the controlling jurisdiction prior to starting site preparation or earthwork. Project specifications should include an indemnification by the contractor of the owner and engineer for any dust generation during the construction period. The owner will be responsible for mitigation of dust after accepting the project.

In order to minimize erosion and downstream impacts to sedimentation from this site, best management practices with respect to stormwater discharge shall be implemented.

Site Drainage

Adequate surface drainage shall be provided so moisture is directed away from structures.

Foundation backfill shall be thoroughly compacted to decrease permeability and reduce the potential for irrigation and stormwater to migrate below the floor slab. The ponding of water on finished grade or at the edge of pavements shall be prevented by grading the site in accordance with *IBC* (ICC, 2012) requirements.

Concrete Slabs

All concrete slabs shall be directly underlain by imported, 1-inch-minus, granular material with a minimum R-value of 60. Type 2, Class B, aggregate base (*SSPWC*, 2012) is the preferred alternate, although other materials may be acceptable for non-dedicated improvements. Base material shall be a minimum of 4 inches beneath curbs, gutters, sidewalks, floor slabs, and private flatwork. Any curbs and gutters along streets dedicated to Carson City shall be underlain by a minimum 6 inches of Type 2, Class B aggregate base (*SSPWC*, 2012). All base courses shall be densified to at least 95 percent relative compaction.

Final design of the floor slab shall be performed by the project structural engineer. Any interior concrete slab-on-grade floors shall be a minimum of 4 inches thick. Floor slab reinforcement, as a minimum, shall consist of No. 3 reinforcing steel placed on 24-inch-centers in each direction or flat sheets of 6x6, W4.0xW4.0 welded wire mesh (WWM). Rolls of WWM are not recommended for use since vertically centered placement of rolled WWM within a floor slab is difficult to achieve. All reinforcing steel and WWM shall be centered in the floor slab through the use of concrete dobies or an approved equivalent.

The Carson City area is a region with exceptionally low relative humidity. As a consequence, concrete flatwork is prone to excessive shrinking and curling. Concrete mix proportions and construction techniques, including the addition of water and improper curing, can adversely affect the finished quality of concrete and result in cracking, curling, and the spalling of slabs. We recommend that all placement and curing be performed in accordance with procedures outlined by the American Concrete Institute (ACI, 2008) and this report. Special considerations shall be given to concrete placed and cured during hot or cold weather temperatures, low humidity conditions, and windy conditions such as are common in the Carson Valley area.

Proper control joints and reinforcement shall be provided to minimize any damage resulting from shrinkage, as discussed below. In particular, crack-control joints shall be installed on maximum 10-foot-centers and shall be installed to a minimum depth of 25 percent of the slab thickness. Saw-cuts, zip strips, and/or trowel joints are acceptable; however, saw-cut joints must be installed as soon as initial set allows and prior to the development of internal stresses that will result in a random crack pattern. If trowel joints are used in the main living area floor slab, they will need to be grouted over prior to installation of floor coverings.

Concrete shall not be placed on frozen in-place soils.

Any interior concrete slab-on-grade floors will require a moisture barrier system. Installation shall conform to the specifications provided for a Class B vapor restraint (ASTM E 1745-97). The vapor barrier shall consist of placing a 10-mil-thick StegoRap® vapor barrier or an approved equal directly on a properly prepared subgrade surface. A 4-inch-thick layer of aggregate base shall be placed over the vapor barrier and compacted with a vibratory plate.

The base layer that overlies the moisture barrier membrane shall remain compacted and a uniform thickness maintained during the concrete pour, as its intended purpose is to facilitate even curing of the concrete and minimize curling of the slab. Extra attention shall be given during construction to ensure that rebar reinforcement and equipment do not damage the integrity of the vapor barrier. Care must be taken so that concrete discharge does not scour the base material from the vapor barrier. This can be accomplished by maintaining the discharge hose in the concrete and allowing the concrete to flow out over the base layer.

Asphalt Concrete

Asphalt Concrete Pavement Design

Paved areas subject to residential traffic within the townhome development shall consist of 3 inches of asphalt concrete underlain by 6 inches of Type 2, Class B, aggregate base (*SSPWC*, 2012) supported by 12 inches of structural fill providing separation from the native fine-grained and clay soils. As an alternate, the aggregate base section can be increased to 12 inches, eliminating the structural fill separation requirement discussed in the Site Preparation section. All aggregate base beneath asphalt pavements shall be densified to at least 95 percent relative compaction.

Pavement Maintenance

Asphalt concrete pavements have been designed for a standard 20-year life expectancy as detailed above. Due to the local climate and available construction aggregates, a 20-year performance life requires diligent maintenance. Between 15 and 20 years after initial construction (average 17 years), major rehabilitation (structural overlay or reconstruction) is often necessary if maintenance has been lax. To achieve maximum performance life, maintenance must include regular crack sealing, seal coats, and patching as needed. Crack filling is commonly necessary every year or at least every other year. Seal coats, typically with a Type II slurry seal, are generally needed every 3 to 6 years, depending on surface wear. Failure to provide thorough maintenance will significantly reduce pavement design life and performance.

Corrosion Potential

Metal Pipe Design Parameters

Laboratory testing was performed to evaluate the corrosion potential of the soils with respect to metal pipe in contact with the ground. The results of the laboratory testing indicate that the site foundation soils exhibit low corrosion potential (American Water Works Association [AWWA], 1999). As a result, metal pipe in contact with the ground will not require corrosion protection.

Portland Cement Concrete Mix Design Parameters

Soluble sulfate content has been determined for representative samples of the site foundation soils. The sulfate was extracted from the soil at a 10:1 water to soil ratio in order to assure that all soluble sodium sulfate was dissolved. The results are reported in milligrams of sulfate per kilogram of soil and can be directly converted to percent by dividing by 10,000. The percent sulfate in the soil is used to determine the sulfate exposure Class (S) from the information presented in Table 6 (Sulfate Exposure Class).

TABLE 6 - SULFATE EXPOSURE CLASS*

			Water-Soluble Sulfate (SO_4) in Soil, Percent by Weight	**Dissolved Sulfate (SO_4) in Water, ppm**
S Sulfate	Not Applicable	S0	$SO_4 < 0.10$	$SO_4 < 150$
	Moderate	S1	$0.10 \leq SO_4 < 0.20$	$150 \leq SO_4 < 1{,}500$ Seawater
	Severe	S2	$0.20 \leq SO_4 \leq 2.00$	$1{,}500 \leq SO_4 \leq 10{,}000$
	Very Severe	S3	$SO_4 > 2.00$	$SO_4 > 10{,}000$

*From Table 4.2.1 Exposure Categories and Classes. ACI 318, *Buildings Code and Comments.*

The results of the testing (Appendix A) indicate that concrete in contact with the site foundation soils should be designed for Class S0 Sulfate exposure. Therefore, Type II cement can be used for all concrete work.

Anticipated Construction Problems

Depending on the season of construction, soft, wet surface soils may make it difficult for construction equipment to travel and operate. Relatively shallow groundwater may make trenching difficult unless adequate dewatering activities are performed prior to utility installation.

Quality Control

All plans and specifications should be reviewed for conformance with this geotechnical report and approved by the engineer prior to submitting them to the building department for review.

The recommendations presented in this report are based on the assumption that sufficient field testing and construction review will be provided during all phases of construction. We should review the final plans and specifications to check for conformance with the intent of our recommendations. Prior to construction, a pre-job conference should be scheduled to include, but not be limited to, the owner, architect, civil engineer, general contractor, earthwork and materials subcontractors, building official, and engineer. The conference will allow parties to review the project plans, specifications, and recommendations presented in this report and discuss applicable material quality and mix design requirements. All quality control reports should be submitted to and reviewed by the engineer.

During construction, we should have the opportunity to provide sufficient on-site observation of preparation and grading, over-excavation, fill placement, foundation installation, and paving. These observations would allow us to verify that the geotechnical conditions are as anticipated and that the contractor's work is in conformance with the approved plans and specifications.

Homeowner's Responsibilities

The developer of this project will mitigate potentially expansive soils in driveways and exterior concrete walkways during construction. The homeowner is responsible to mitigate potentially expansive clay soils below any addition flatwork installed by the homeowner (e.g., concrete and/or paver stone walkways, concrete patios, etc.). Such mitigation would include over-excavating clay soils to a minimum depth of 2 feet below the flatwork and backfilling the over-excavation with granular, non-expansive material.

The developer will finish grade the lot to prevent ponding of water adjacent to structural improvements and provide drainage away from the structure in accordance with local building codes. If the homeowner alters the drainage present at the time of sale, either by landscaping and/or making improvements on the lot, he/she must provide drainage way from the structure in accordance with local building codes. If positive drainage is not provided by the homeowner, differential movement of structural improvements could be experienced and result in cracking of interior walls and foundations.

The site is located in an area with active earthquakes in relatively close proximity. While the potential for ground rupture is minimal and liquefaction-induced settlement at the surface is low, the site does lie within a seismically active region with a high potential for ground shaking. The recurrence interval for earthquakes along the major active faults in the region is generally thought to be in the range of 1,000 years or more. The most recent earthquakes in northern Nevada, however, have occurred along lesser-known faults that seem to represent tectonic plate boundary motion. Approximately 85 percent of this motion is taken up along the San Andreas Fault in California, but as much as 15 percent of the plate motion appears to be occurring along numerous, smaller strike-slip faults in western Nevada. The realization that plate boundary faulting extends so far inland is relatively recent, such that the probable recurrence intervals and magnitudes of the consequent earthquakes are unknown. For this reason, and the general high potential for ground shaking in this area, homebuyers should be advised to consider purchasing earthquake insurance. Typically such insurance is of very low cost but has such a high deductible that it is only beneficial during a very large-scale seismic event.

Standard Limitations Clause

This report has been prepared in accordance with generally accepted geotechnical practices. The analyses and recommendations submitted are based on field exploration performed at the locations shown on Plate 1. This report does not reflect soils variations that may become evident during the construction period, at which time re-evaluation of the recommendations may be necessary. We recommend our firm be retained to perform construction observation in all phases of the project related to geotechnical factors to ensure compliance with our recommendations.

Equilibrium water level readings were made on the date shown on Plate 2. Fluctuations in the water table may occur due to rainfall, temperature, seasonal runoff or adjacent irrigation practices. Construction planning should be based on assumptions of possible variations in the water table.

Townhome residential construction results in a complex composite of steel, PCC, lumber and soils. Each element responds differently to loading and, as a consequence, minor cracking and distortion can occur. Such cracking and distortion is not in and of itself evidence of the structure failing to meet a reasonable standard or level of performance, but rather typical of new residential construction. Repair of such conditions is considered aesthetic in nature and not a structural defect.

This report has been produced to provide information allowing the architect or engineer to design the project. The owner is responsible for distributing this report to all designers and contractors whose work is affected by geotechnical aspects. In the event there are changes in the design, location, or ownership of the project from the time this report is issued, recommendations should be reviewed and possibly modified by the engineer. If the engineer is not granted the opportunity to make this recommended review, he or she can assume no responsibility for misinterpretation or misapplication of his or her recommendations or their validity in the event changes have been made in the original design concept without his or her prior review. The engineer makes no other warranties, either expressed or implied, as to the professional advice provided under the terms of this agreement and included in this report.

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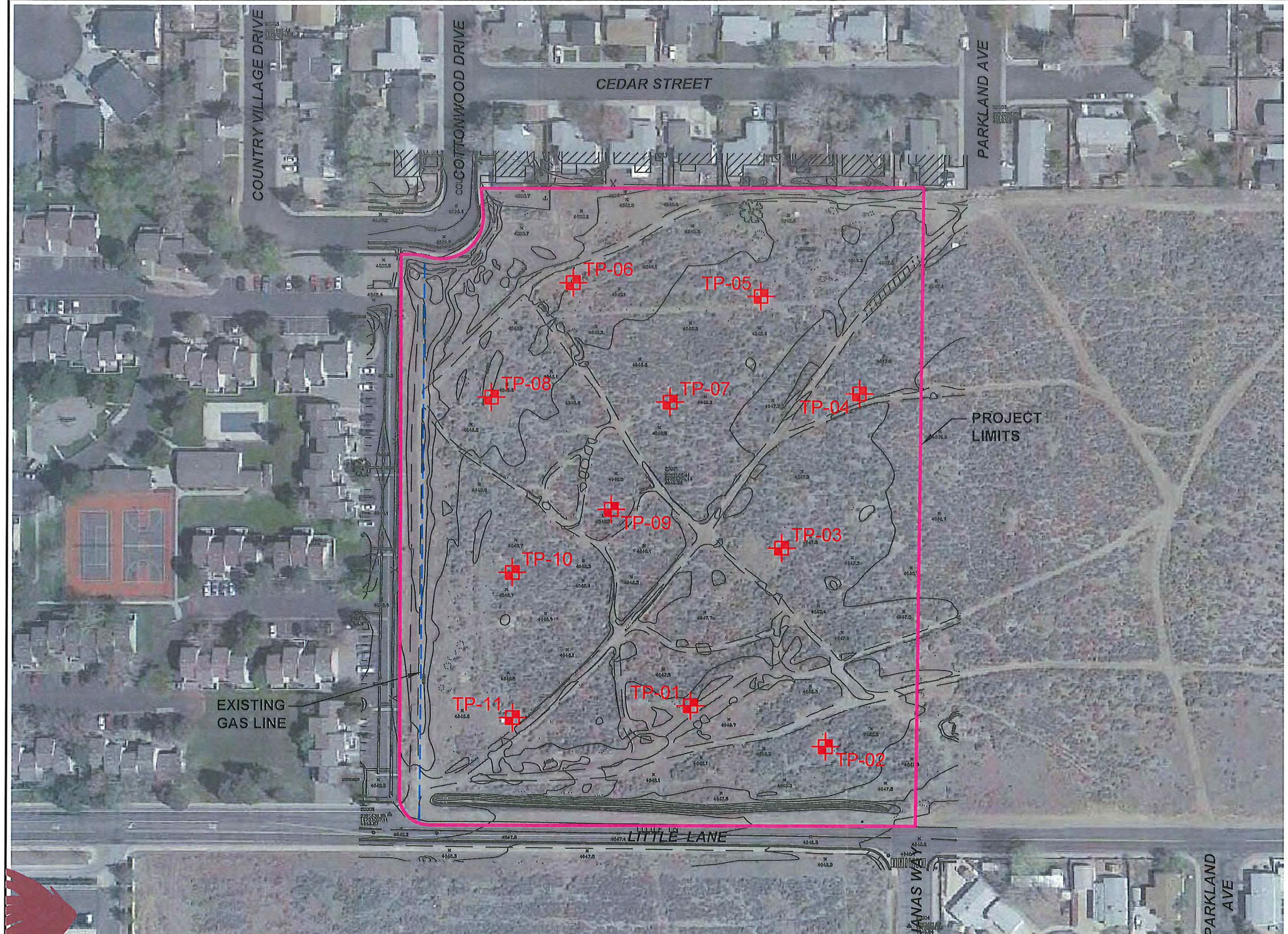
PLATES



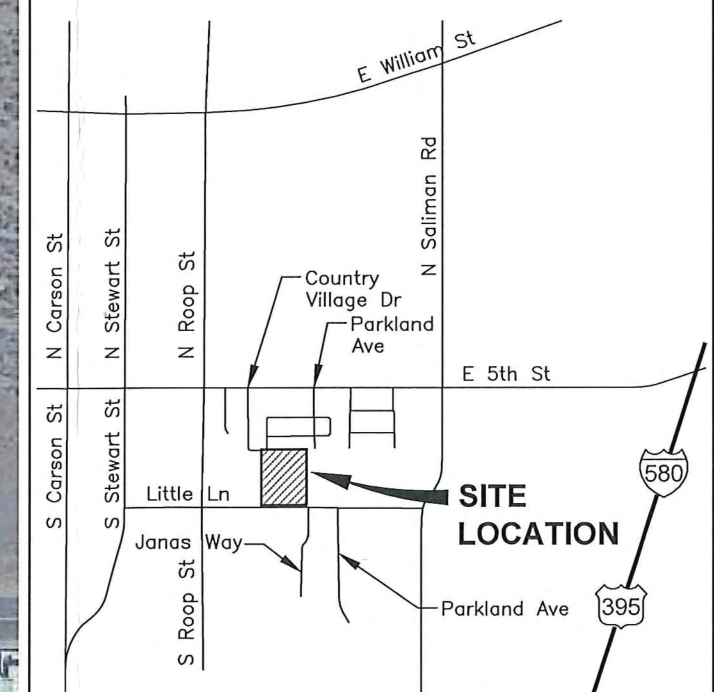
SCALE: 1"=120'
(APPROXIMATE)

LEGEND

TP-01 APPROXIMATE TEST PIT LOCATION

NOTES

1. BASE MAP PROVIDED BY GOOGLE EARTH, INC. AND MANHARD CONSULTING (TOPO).



SITE LOCATION MAP

N.T.S.

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CAPSTONE COMMUNITIES

PLOT PLAN

SINGLE FAMILY TOWNHOMES (APN 004-021-13)

CARSON CITY, NEVADA

Project No.
1487-05-1

Plate 1

LOG OF TEST PIT TP-01

Date Excavated: 2/15/2016 | Logged by: JP

Equipment: Kubota KX91-3 | Surface Elevation (ft) 4648 (Topo)

Depth to Ground Water: 7.75 ft.
Comments: N 4337904 E 261720 UTM NAD83

SAMPLE NUMBER	SAMPLE	POCKET PEN. (tsf)	MOISTURE (%)	PI	DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION
A					0–2	SM	**Silty Sand (Fill)** Dark brown, moist, loose, with an estimated 30% non-plastic to low plasticity fines and 70% fine to coarse sand.
						SM	Less than 5% of the total soil mass (tsm) consists of minor organics and occasional debris including metal scraps.
B			13.9	10	3	SC	**Silty Sand** Light brown, moist, medium dense, with an estimated 25% non-plastic to low plasticity fines and 75% fine to medium sand.
						SC	**Clayey Sand** Light brown to olive with orange mottling, moist, medium dense, with 38% low plasticity fines, 61% fine to coarse sand, and 1% fine gravel.
C		1.0-1.5			6–7.5	CL	**Sandy Lean Clay** Light gray to tan with orange mottling, moist to very moist, stiff, with an estimated 55% medium plasticity fines and 35% fine to medium sand.
D					7.5–10 (▼ 7.75)	SM	**Silty Sand** Light gray to tan, very moist to wet, medium dense, with an estimated 30% non-plastic fines and 70% fine to medium sand.

LOG OF TEST PIT TP-02

Date Excavated: 2/15/2016 | Logged by: JP

Equipment: Kubota KX91-3 | Surface Elevation (ft) 4648 (Topo)

Depth to Ground Water: 8.0 ft.
Comments: N 4337891 E 261777 UTM NAD83

SAMPLE NUMBER	SAMPLE	POCKET PEN. (tsf)	MOISTURE (%)	PI	DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION
A			15.3	NP	0–3	ML	**Sandy Silt** Dark brown, moist, stiff, with 53% non-plastic fines and 47% fine to medium sand. Roots up to 1/2 inch in diameter present to 6 inches below the ground surface (bgs).
B					3–4	SC	**Clayey Sand** Brown with orange mottling, moist, medium dense, with an estimated 40% low to medium plasticity fines and 60% fine to coarse sand.
C					4–7	SM	**Silty Sand** Light brown with orange mottling, moist, medium dense, with an estimated 25% low plasticity fines and 75% fine to coarse sand.
					7–8 (▼ 8.0)	SM	**Silty Sand** Tan to brown with orange mottling, moist to very moist, medium dense, with an estimated 20% non-plastic fines and 80% fine to coarse sand.
D		1.0			8–10	CL	**Lean Clay with Sand** Olive with orange motting, very moist to wet, firm, with an estimated 80% medium plasticity fines and 20% fine to medium sand.

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Capstone Communities
Single Family Townhomes APN 004-021-13
Carson City, NV 1487-05-1 Plate 2

LOG OF TEST PIT TP-03

Date Excavated: 2/15/2016 Logged by: JP

Equipment: Kubota KX91-3 Surface Elevation (ft) 4647 (Topo)

Depth to Ground Water: 8.0 ft.
Comments: N 4337967 E 261763 UTM NAD83

SAMPLE NUMBER	SAMPLE	POCKET PEN. (tsf)	MOISTURE (%)	PI	DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION
					0–2	SM	**Silty Sand** Dark brown, moist, medium dense, with an estimated 40% non-plastic to low plasticity fines and 60% fine to medium sand. Roots up to 1/2 inch in diameter present to 6 inches bgs.
A	Grab				2–4	SC	**Clayey Sand** Brown to tan, moist, medium dense, with an estimated 25% low to medium plasticity fines and 75% fine to coarse sand.
					4–6.5	SM	**Silty Sand** Brown to tan, moist, medium dense, with an estimated 20% non-plastic fines and 80% fine to coarse sand.
B	Grab				6.5–9.3 (water at 8)	SM	**Silty Sand** Olive to brown with orange mottling, very moist to wet, medium dense with an estimated 30% low plasticity fines and 70% fine to medium sand. Contains interbedded silt.

LOG OF TEST PIT TP-04

Date Excavated: 2/15/2016 Logged by: JP

Equipment: Kubota KX91-3 Surface Elevation (ft) 4647 (Topo)

Depth to Ground Water: 8.5 ft.
Comments: N 4338016 E 261798 UTM NAD83

SAMPLE NUMBER	SAMPLE	POCKET PEN. (tsf)	MOISTURE (%)	PI	DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION
A	Grab				0–1.5	SM	**Silty Sand** Dark brown, moist, medium dense, with an estimated 40% non-plastic to low plasticity fines and 60% fine to medium sand. Roots up to 1/2 inch in diameter present to 6 inches bgs.
B	Grab		10.7	12	1.5–3	SC	**Clayey Sand** Brown to tan, moist, medium dense, with 28% medium plasticity fines, 69% fine to coarse sand, and 3% fine gravel.
					3–4	SM	**Silty Sand** Tan, moist, medium dense, with an estimated 15% non-plastic fines, 80% fine to coarse sand, and 5% subangular gravel up to 3/8 inch in diameter. Decomposed granite sand.
C	Grab				4–7	SM	**Silty Sand** Reddish brown to orange brown, moist, medium dense, with an estimated 15% non-plastic fines, 75% fine to coarse sand, and 10% subangular gravel up to 1-1/2 inches in diameter. Decomposed granite sand.
					7–9 (water at 8.5)	SM	**Silty Sand** Light gray with orange mottling, very moist, medium dense, with an estimated 40% low plasticity fines and 60% fine to medium sand. Contains interbedded silt.

BEC-TP1 1487051.GPJ LAGNNN07.GDT 3/2/2016

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Capstone Communities
Single Family Townhomes APN 004-021-13
Carson City, NV 1487-05-1 Plate 2

LOG OF TEST PIT TP-05

Date Excavated: 2/15/2016 | Logged by: JP

Equipment: Kubota KX91-3 | Surface Elevation (ft) 4648 (Topo)

Depth to Ground Water: 8.25 ft.
Comments: N 4338046 E 261760 UTM NAD83

SAMPLE NUMBER	SAMPLE	POCKET PEN. (tsf)	MOISTURE (%)	PI	DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION
					0–2	SM	**Silty Sand** Dark brown, moist, medium dense, with an estimated 40% non-plastic to low plasticity fines and 60% fine to medium sand. Roots up to 1/2 inch in diameter present to 6 inches bgs.
A	(hand)		9.5	6	2–3	SC-SM	**Silty, Clayey Sand** Brown, moist, medium dense, with 19% low plasticity fines, 77% fine to coarse sand, and 4% fine gravel.
B	(hand)				3–4.5	SM	**Silty Sand** Tan, moist, medium dense, with an estimated 15% non-plastic fines, 80% fine to coarse sand, and 5% subangular gravel up to 3/8 inch in diameter. Decomposed granite sand.
					4.5–6	SM	**Silty Sand** Light gray to olive with orange mottling, moist to very moist, medium dense, with an estimated 20% non-plastic fines and 80% fine to medium sand.
					6–9 (▼ 8.25)	SM	**Silty Sand** Light gray to olive with orange mottling, very moist to wet, medium dense, with an estimated 20% non-plastic to low plasticity fines and 80% fine to coarse sand. Very strong mottling.

LOG OF TEST PIT TP-06

Date Excavated: 2/15/2016 | Logged by: JP

Equipment: Kubota KX91-3 | Surface Elevation (ft) 4649 (Topo)

Depth to Ground Water: 8.7 ft.
Comments: N 4338056 E 261689 UTM NAD83

SAMPLE NUMBER	SAMPLE	POCKET PEN. (tsf)	MOISTURE (%)	PI	DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION
A	(hand)		15.1	9	0–2	SC	**Clayey Sand** Dark brown, moist, medium dense, with 40% low plasticity fines and 60% fine to medium sand. A 3-inch-thick layer of topsoil and grasses is present in exploration area.
B	(hand)				2–3	SC	**Clayey Sand** Brown to tan, moist, medium dense with an estimated 30% low to medium plasticity fines and 70% fine to coarse sand.
					3–6	SM	**Silty Sand** Light brown to light gray with orange mottling, moist, medium dense, with an estimated 20% non-plastic fines and 80% fine to coarse sand. Very slight mottling.
					6–9.5 (▼ 8.7)	SM	**Silty Sand** Light brown to light gray with orange mottling, very moist to wet, medium dense, with an estimated 20% non-plastic fines and 80% fine to coarse sand. Strong mottling.

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Capstone Communities
Single Family Townhomes APN 004-021-13
Carson City, NV 1487-05-1 Plate 2

LOG OF TEST PIT TP-07

Date Excavated: 2/15/2016 Logged by: JP

Equipment: Kubota KX91-3 Surface Elevation (ft) 4648 (Topo)

Depth to Ground Water: 7.5 ft.
Comments: N 4338014 E 261714 UTM NAD83

SAMPLE NUMBER	SAMPLE	POCKET PEN. (tsf)	MOISTURE (%)	PI	DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION
A	✋				1	SC	**Clayey Sand** Dark brown, moist, medium dense, with an estimated 40% low to medium plasticity fines and 60% fine to medium sand. Roots up to 1/2 inch in diameter present to 6 inches bgs.
					2–3	SC	**Clayey Sand** Brown to tan, moist, medium dense with an estimated 25% low plasticity fines and 75% fine to coarse sand.
B	✋				4–6	SM	**Silty Sand** Light brown to light gray with orange mottling, moist, medium dense, with an estimated 20% non-plastic fines, 75% fine to coarse sand, and 5% subangular gravel up to 3/8 inch in diameter. Decomposed granite sand.
					6–9 (▼ 7.5)	SM	**Silty Sand** Brown with orange mottling, very moist to wet, medium dense, with an estimated 10-15% non-plastic fines and 85-90% fine to coarse sand.
					10		

LOG OF TEST PIT TP-08

Date Excavated: 2/15/2016 Logged by: JP

Equipment: Kubota KX91-3 Surface Elevation (ft) 4649 (Topo)

Depth to Ground Water: 7.7 ft.
Comments: N 4338007 E 261658 UTM NAD83

SAMPLE NUMBER	SAMPLE	POCKET PEN. (tsf)	MOISTURE (%)	PI	DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION
A	✋				1	SC	**Clayey Sand** Dark brown, moist, medium dense, with an estimated 30% low plasticity fines and 70% fine to coarse sand. A 3-inch-thick layer of topsoil and grasses are present in exploration area.
B	✋				2–3	SC	**Clayey Sand** Brown, moist, medium dense, with an estimated 25% low plasticity fines and 75% fine to coarse sand.
					3–6	SM	**Silty Sand** Light gray to light brown with orange mottling, moist, medium dense, with an estimated 20% non-plastic fines and 80% fine to coarse sand. Slight mottling.
C	✋				6–8 (▼ 7.7)	SM	**Silty Sand** Light gray to light brown with orange mottling, very moist to wet, medium dense, with an estimated 35% non-plastic fines and 65% fine to coarse sand. Interbedded silty sand and sandy silt. Strong mottling.
					8–9	SM	**Silty Sand** Light gray to light brown with orange mottling, wet, medium dense, with an estimated 20% non-plastic fines and 80% fine to coarse sand.
					10		

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Capstone Communities
Single Family Townhomes APN 004-021-13
Carson City, NV 1487-05-1 Plate 2

LOG OF TEST PIT TP-09

Date Excavated: 2/15/2016 | Logged by: JP

Equipment: Kubota KX91-3 | Surface Elevation (ft) 4648 (Topo)

Depth to Ground Water: 7.9 ft.
Comments: N 4337976 E 261700 UTM NAD83

SAMPLE NUMBER	SAMPLE	POCKET PEN. (tsf)	MOISTURE (%)	PI	DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION
					0–1	SM	**Silty Sand** Dark brown, moist, medium dense, with an estimated 25% low plasticity fines and 75% fine to coarse sand. Fine organics and roots up to 1/2 inch in diameter present to 6 inches bgs.
					1–3	SM	**Silty Sand** Brown, moist, medium dense, with an estimated 20% low plasticity fines and 80% fine to coarse sand.
					3–5.5	SM	**Silty Sand** Brown to tan, moist, medium dense, with an estimated 15% non-plastic fines, 80% fine to coarse sand, and 5% subangular gravel up to 3/8 inch in diameter. Decomposed granite sand.
					5.5–8.3 (▼ 7.9)	SM	**Silty Sand** Light brown to light gray with orange mottling, moist to wet, with an estimated 40% non-plastic to low plasticity fines and 60% fine to coarse sand. Interbedded silty sand and sandy silt.

LOG OF TEST PIT TP-10

Date Excavated: 2/15/2016 | Logged by: JP

Equipment: Kubota KX91-3 | Surface Elevation (ft) 4648 (Topo)

Depth to Ground Water: 7.5 ft.
Comments: N 4337956 E 261660 UTM NAD83

SAMPLE NUMBER	SAMPLE	POCKET PEN. (tsf)	MOISTURE (%)	PI	DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION
A	(hand sample)		15.9	12	0–4	SC	**Clayey Sand** Dark brown, moist, medium dense, with 45% medium plasticity fines and 55% fine to medium sand. Very slight mottling. Fine organics and roots up to 1/2 inch in diameter present to 6 inches bgs.
					4–5.5	SM	**Silty Sand** Tan, moist, medium dense, with an estimated 20% non-plastic fines and 80% fine to coarse sand. No mottling.
					5.5–8.2 (▼ 7.5)	SM	**Silty Sand** Light gray to light brown with orange mottling, moist to wet, with an estimated 25% low plasticity fines and 75% fine to coarse sand. Interbedded fine and coarse silty sand.

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Capstone Communities
Single Family Townhomes APN 004-021-13
Carson City, NV 1487-05-1 Plate 2

LOG OF TEST PIT TP-11

Date Excavated: 2/15/2016 Logged by: JP

Equipment: Kubota KX91-3 Surface Elevation (ft) 4648 (Topo)

Depth to Ground Water: 7.5 ft.
Comments:

SAMPLE NUMBER	SAMPLE	POCKET PEN. (tsf)	MOISTURE (%)	PI	DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION
					1	SC	**Clayey Sand** Dark brown, moist, medium dense, with an estimated 40% low to medium plasticity fines and 60% fine to medium sand.
A	(hand)				2	SC	Fine organics and roots up to 1/2 inch in diameter present to 12 inches bgs.
					3	SM	**Silty Sand** Tan, moist, medium dense, with an estimated 20% non-plastic to low plasticity fines and 80% fine to coarse sand. Decomposed granite sand.
					4	SM	
					5	SM	
B	(hand)				6	ML	**Sandy Silt** Light gray to light brown with orange mottling, wet, firm, with an estimated 50% low plasticity fines and 50% fine to coarse sand. Interbedded silt and silty sand.
					7 ▼	ML	
					8	SM	**Silty Sand** Light gray to light brown with orange mottling, wet, medium dense, with an estimated 30% non-plastic fines and 70% fine to coarse sand.
					9		
					10		

BEC-TP1 1487051.GPJ LAGNNN07.GDT 3/2/2016

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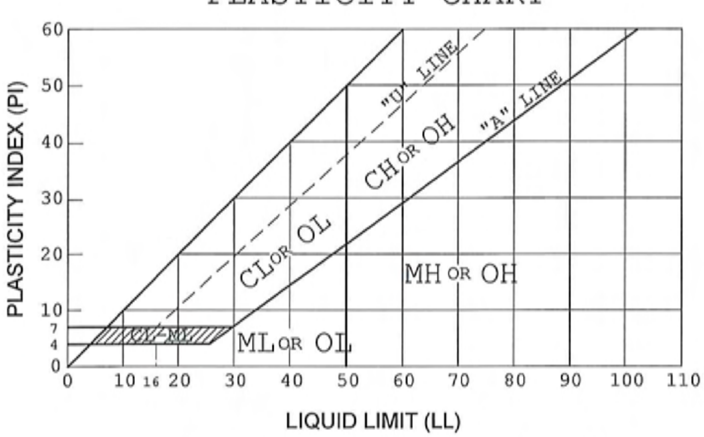
Capstone Communities
Single Family Townhomes APN 004-021-13
Carson City, NV 1487-05-1 Plate 2

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				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 (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				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
FILL MATERIAL				--	FILL MATERIAL, NON-NATIVE

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS.

PLASTICITY CHART



FOR CLASSIFICATION OF FINE-GRAINED SOILS AND FINE-GRAINED FRACTION OF COARSE-GRAINED SOILS

EXPLORATION SAMPLE TERMINOLOGY

Sample Type	Sample Symbol	Sample Code
Auger Cuttings		Auger
Bulk (Grab) Sample		Grab
Modified California Sampler		MC
Shelby Tube		SH or ST
Standard Penetration Test		SPT
Split Spoon		SS
No Sample		

GRAIN SIZE TERMINOLOGY

Component of Sample	Size Range
Boulders	Over 12 in. (300mm)
Cobbles	12 in. to 3 in. (300mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 4.75mm)
Sand	# 4 to #200 sieve (4.75mm to 0.074mm)
Silt or Clay	Passing #200 sieve (0.074mm)

RELATIVE DENSITY OF GRANULAR SOILS

N - Blows/ft	Relative Density
0 - 4	Very Loose
5 - 10	Loose
11 - 30	Medium Dense
31 - 50	Dense
greater than 50	Very Dense

CONSISTENCY OF COHESIVE SOILS

Unconfined Compressive Strength, psf	N - Blows/ft	Consistency
less than 500	0 - 1	Very Soft
500 - 1,000	2 - 4	Soft
1,000 - 2,000	5 - 8	Firm
2,000 - 4,000	9 - 15	Stiff
4,000 - 8,000	16 - 30	Very Stiff
8,000 - 16,000	31 - 60	Hard
greater than 16,000	greater than 60	Very Hard

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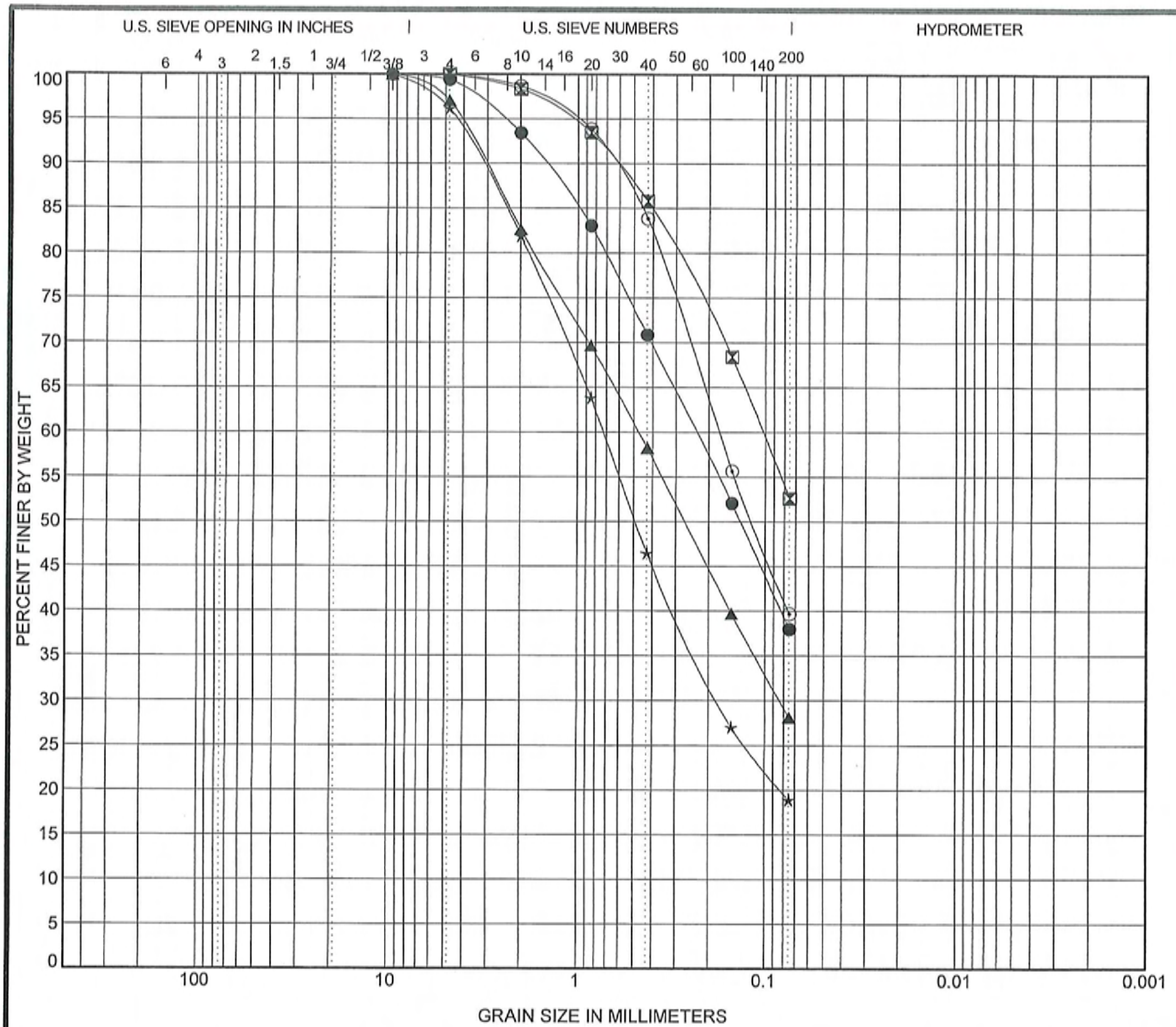
USCS Soil Classification Chart

Project: Single Family Townhomes APN 004-021-13

Location: Carson City, NV

Project Number: 1487-05-1 Plate: 3

USCS CHART 1487051.GPJ US LAB.GDT 2/23/2016



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification		USCS Classification	LL	PL	PI	Cc	Cu
● TP-01	3.0'	CLAYEY SAND (SC)	32	22	10		
⊠ TP-02	0.0'	SANDY SILT (ML)	NP	NP	NP		
▲ TP-04	1.5'	CLAYEY SAND (SC)	30	18	12		
★ TP-05	2.0'	SILTY, CLAYEY SAND (SC-SM)	26	20	6		
⊙ TP-06	0.0'	CLAYEY SAND (SC)	27	18	9		

Specimen Identification		D100	D60	D30	D10	MC %	%Gravel	%Sand	%Silt	%Clay
● TP-01	3.0'	9.5	0.233			13.9	0.6	61.4	38.0	
⊠ TP-02	0.0'	4.75	0.104			15.3	0.0	47.4	52.6	
▲ TP-04	1.5'	9.5	0.474	0.084		10.7	2.9	69.0	28.1	
★ TP-05	2.0'	9.5	0.73	0.176		9.5	3.8	77.3	18.9	
⊙ TP-06	0.0'	4.75	0.176			15.1	0.0	60.3	39.7	

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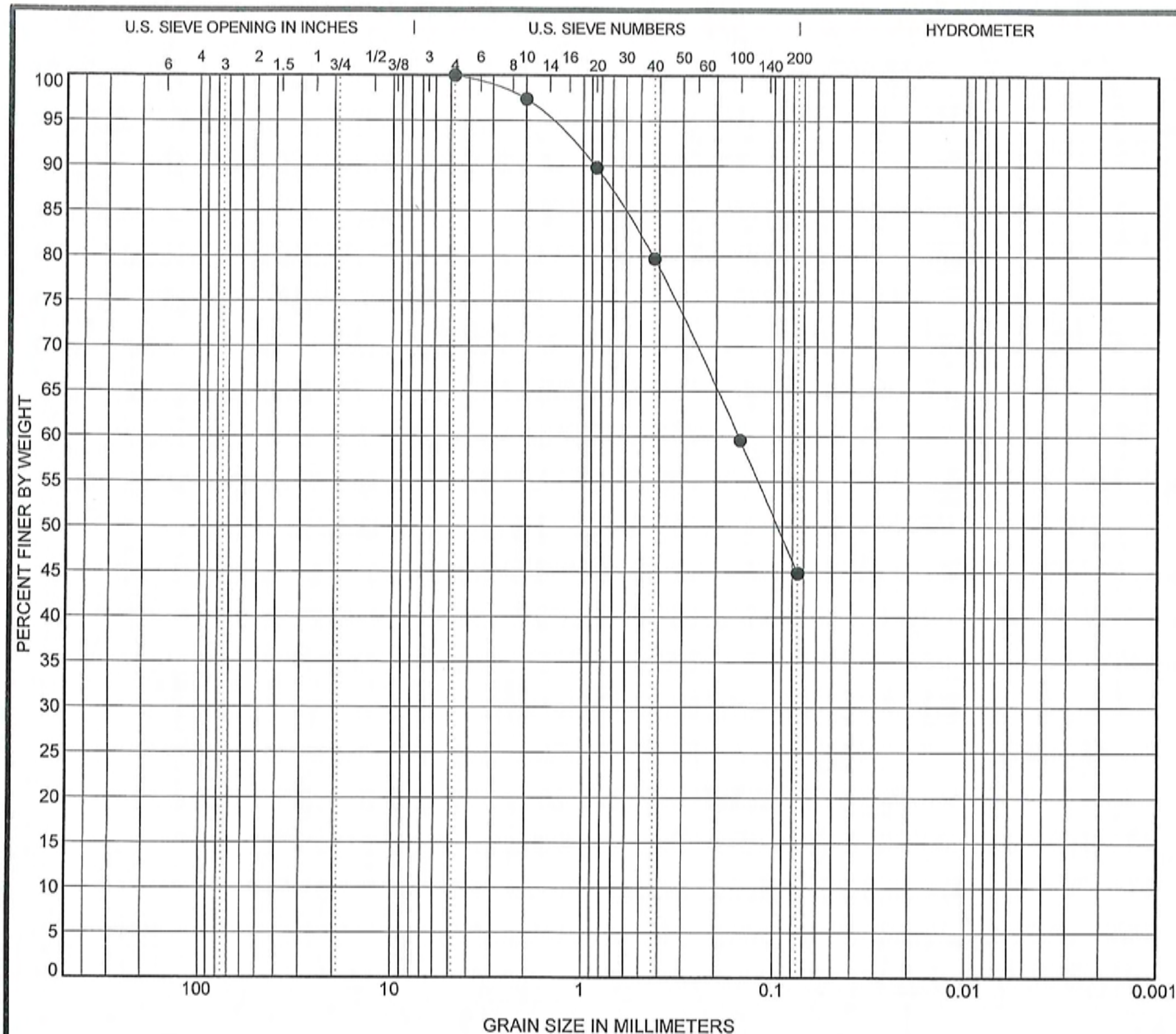
GRAIN SIZE DISTRIBUTION

Project: Single Family Townhomes APN 004-021-13

Location: Carson City, NV

Project Number: 1487-05-1 Plate: 4a



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification		USCS Classification	LL	PL	PI	Cc	Cu
● TP-10	1.0'	**CLAYEY SAND (SC)**	**30**	**18**	**12**		

Specimen Identification		D100	D60	D30	D10	MC %	%Gravel	%Sand	%Silt	%Clay
● TP-10	1.0'	**4.75**	**0.153**			**15.9**	**0.0**	**55.1**	**44.9**	

US_GRAIN_SIZE2 1487051.GPJ US_LAB.GDT 2/23/2016

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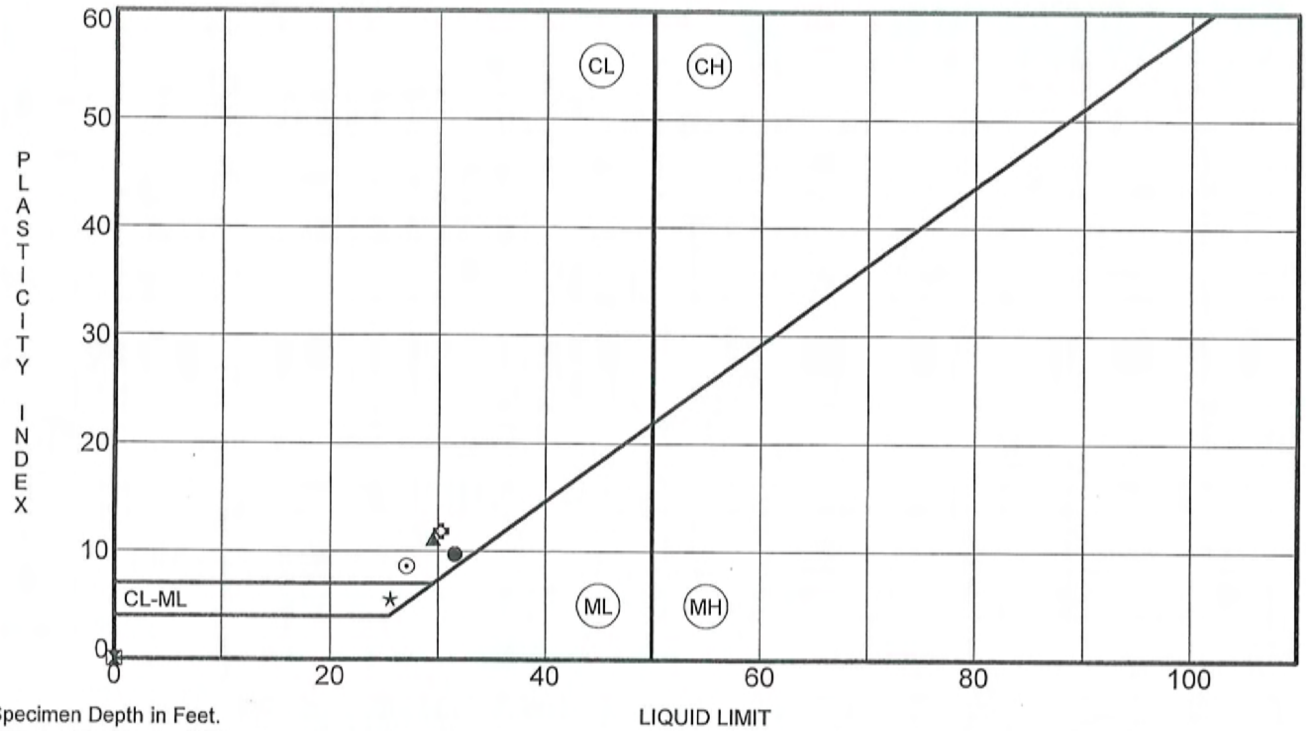
GRAIN SIZE DISTRIBUTION

Project: Single Family Townhomes APN 004-021-13

Location: Carson City, NV

Project Number: 1487-05-1 Plate: 4b



Specimen Depth in Feet.

	Specimen Identification			LL	PL	PI	Fines	USCS Classification
●	TP-01	B	3.0'	32	22	10	38	CLAYEY SAND (SC)
⊠	TP-02	A	0.0'	NP	NP	NP	53	SANDY SILT (ML)
▲	TP-04	B	1.5'	30	18	12	28	CLAYEY SAND (SC)
★	TP-05	A	2.0'	26	20	6	19	SILTY, CLAYEY SAND (SC-SM)
⊙	TP-06		0.0'	27	18	9	40	CLAYEY SAND (SC)
✪	TP-10	A	1.0'	30	18	12	45	CLAYEY SAND (SC)

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ATTERBERG LIMITS RESULTS

Project: Single Family Townhomes APN 004-021-13

Location: Carson City, NV

Project Number: 1487-05-1 Plate: 4c

APPENDIX A

CHEMICAL TEST RESULTS

Laboratory Report
Report ID: 146714

Sierra Environmental Monitoring

Black Eagle Consulting, Inc.
Attn: Jeff Wilbrecht
1345 Capital Blvd., Suite A
Reno, NV 89502-7140

Date: 3/1/2016
Client: BEC-100
Taken by: J. Wilbrecht
PO #:

Analysis Report

Laboratory Accreditation Number: NV-00015

Laboratory Sample ID	Customer Sample ID	Date Sampled	Time Sampled	Date Received
S201602-0724	1487-05-1 TP-02 A 0'	2/15/2016	10:00 AM	2/19/2016

Parameter	Method	Result	Units	Reporting Limit	Analyst	Date Analyzed	Data Flag
pH - Saturated Paste	SW-846 9045A	8.31	pH Units		Lax	2/22/2016	
pH - Temperature	SW-846 9045A	21.4	°C		Lax	2/22/2016	
Redox Potential	SM 2580 B	382	MV		Faulstich	2/29/2016	
Resistivity	EPA 120.1	6700	ohm cm		Lax	3/1/2016	
Sulfate - Ion Chromatography	EPA 300.0	5	mg/Kg	2	Mott	2/29/2016	
Sulfide	EPA 376.1	NEGATIVE	Pos/Neg	1	Faulstich	2/29/2016	

Data Flag Legend:

John Faulstich
Laboratory Director

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