

**GEOTECHNICAL EVALUATION
SCOTTISH ISLE SUBDIVISION
A 22.4+ ACRE SINGLE-FAMILY RESIDENTIAL DEVELOPMENT
NEC OF EDINBURGH STREET NE AND HEDINGHAM AVENUE NE
RIO RANCHO, NEW MEXICO**

August 8, 2023

GeoTek Project No. 2347-ABR

Prepared For:

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August 8, 2023
Project No. 2347-ABR

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9798 Coors Boulevard NW #400
Albuquerque, New Mexico

Subject: Geotechnical Evaluation
Scottish Isle Subdivision
A 22.4± Acre Single-Family Residential Development
NEC of Edinburgh Street NE and Hedingham Avenue NE
Rio Rancho, New Mexico

In accordance with your request, GeoTek Residential, LLC (GeoTek) has completed a geotechnical evaluation for the proposed residential development. The purpose of our study was to evaluate the earth materials underlying the site and to provide recommendations for project design and construction of proposed single-family residences based on our findings. This report outlines the geologic and geotechnical conditions of the site based on current data and provides earthwork and construction recommendations with respect to those conditions.

SCOPE OF SERVICES

The scope of our services has included the following:

1. Review of soils and geologic reports and maps for the site (Appendix A).
2. Site reconnaissance and geotechnical mapping.
3. Review of aerial photographs.
4. Advancing and logging of six exploratory test pits and four exploratory borings (Appendix B).
5. Obtaining samples of representative earth materials, as the test pits and borings were advanced.
6. Performing laboratory testing to measure physical and chemical properties on representative soil samples (Appendix C).
7. Assessment of potential geologic constraints.
8. Engineering and geologic analysis regarding foundation settlement, site preparation and foundation design/construction.
9. Preparation of this report.

SITE DESCRIPTION

The subject site consists of approximately 22.4 acres and is comprised of Rio Rancho Estates Unit 13, Block 45, Lots 1-21 and Lots 41-62. The site is bound by Leeds Castle Avenue NE to the north, vacant land and Broadmoor Boulevard NE to the east, Hedingham Avenue NE to the south, and Edinburgh Street NE to the west. The enclosed Figure 1: Site Map shows the approximate boundaries of the property.

Based on a review of aerial photographs available from Google Earth and the National Environmental Title Research (NETR) Online Historical Aerials Viewer website, the site has been depicted as vacant desert land with an ephemeral drainage traversing north to south on the west side of the site since at least 1951. By 1981, Leeds Castle Avenue NE, Broadmoor Boulevard NE, Hedingham Avenue NE, and Edinburgh Street NE had been developed as unpaved roads surrounding the boundaries of the site. The site and surrounding properties have generally remained in a similar condition through recent aerial photographs. Due to construction activities surrounding the site, artificial spread fill and/or native soils were observed along the property boundaries and throughout portions of the site. According to Google Earth, the elevation of the site ranges from approximately 5,526 to 5,492 feet above mean sea level (msl) and topography generally directs surface runoff to the south and west.

PROPOSED DEVELOPMENT

It is our understanding that site development would consist of performing typical cut and fill earthwork to attain the desired graded configuration for the construction of approximately 118 individual one-to two-story single-family residences with concrete slab-on-ground foundations and associated improvements. It is also our understanding that final site grades for the residences will be within 5 feet of existing site grades. Dead and live foundation loading conditions are expected to be up to 50 kips for column loads and up to 3 kips per lineal foot for wall loads.

FIELD STUDIES

Subsurface conditions were explored using a track mounted mini-excavator and a truck mounted hollow stem auger drill rig. Six exploratory test pits were advanced onsite to depths up to 11 feet below the existing ground surface (bgs), and four exploratory borings were advanced onsite to depths up to 21 feet bgs. Logs of each exploration are included with this report in Appendix B. The test pits and borings were located in the field by use of a cell phone application providing latitude and longitude coordinates. The locations should be considered accurate only to the degree implied by the location method used. The Unified Soil Classification System (USCS) was used to visually classify the subgrade soils. A representative of GeoTek conducted field mapping, logged the explorations, and obtained samples of representative material for laboratory testing. The approximate locations of the explorations are indicated on the enclosed Geotechnical Map (Figure 3).

REGIONAL GEOLOGY

The site is located within the Rio Grande Rift physiographic province and within piedmont surfaces on the west side of the Albuquerque-Belen Basin.

The Albuquerque-Belen basin is part of an interconnected series of north-south aligned grabens and structural basins which have subsided between mountain and highland uplifts comprising the Rio Grande Rift, bisecting the southern Rocky Mountains of northern New Mexico. The Albuquerque-Belen Basin is approximately 100 miles long and varies from 20 to 30 miles wide and was formed during the Tertiary Period when the Sandia-Manzano fault block was uplifted and tilted, forming what is now the present-day Sandia, Manzanita, and Manzano Mountains. The gently sloping surface of the valley fill consists of a series of alluvial fans deposited unconformably on the formations of the Santa Fe Group. The primary stratigraphic units within the Santa Fe Group are the result of fluvial, alluvial, volcanic, and eolian processes related to changes in basin tectonics and to changes in climate over the past few million years.

The site vicinity lies within surficial eolian sand and alluvium deposits of Holocene to upper Pleistocene age (Qae). These deposits contain moderately sorted sand and silt developed with intermittent layers of carbonate morphology and thin clay lenses. Within the site vicinity and unconformably overlaying the Santa Fe formation are Rio Grande Valley deposits of upper to mid Pleistocene intermediate stream valley alluvium (Qam).

SUBSURFACE MATERIALS

Artificial Fill / Disturbed Native Soils

Artificial fill soils and/or disturbed native soils were noted within dirt access roads across the site and along the northern, western, and southern site boundaries. The soils are similar to the native alluvial soils and consist of silty sand and were noted range from loose to medium dense in consistency/relative density. Disturbed native soils were encountered throughout the upper 12 inches of the subsurface materials across the site and were noted to typically be loose due to vegetation and erosion. Deeper fills/disturbed soils may be encountered locally. All artificial fill and disturbed native/loose soils in structural areas will need to be removed and replaced or processed and cleaned of organic material and debris to be used as structural fill material.

Native Alluvial Soils

Native alluvial soils generally consisted of silty sand and poorly graded sand with varying amounts of silt, sand, gravel, and occasional nodules of clay. The consistency of the alluvial soils was noted to be loose to depths of up to 4 feet bgs, and medium dense to dense below. Deeper loose soils may be encountered locally. The exploration logs presented in Appendix B should be referred to for more detailed information. The earthwork recommendations section of this report discusses remedial recommendations for loose alluvial soils.

Hydro-Collapse Potential

Hydro-collapsible soils can be identified in the field by evaluation of potential settlement to existing surrounding improvements, geologic setting, visual porosity/meta-stable soil structure, low in place dry density of approximately 90 pounds per cubic foot (pcf) or less, and laboratory testing, including hydro-consolidation. According to the New Mexico Bureau of Mines and Mineral Resources in an article titled "Geologic Hazards in New Mexico – Part I", by William C Haneberg, dated 1992, hydro collapsible soils in the New Mexico area are typically of Holocene age and have never been wetted.

They are typically composed of poorly graded aeolian fine sand and recent debris flows on gently sloping alluvial fan complexes, with minor amounts of clay or evaporites. The soils encountered during our field investigation were generally eolian sands of Holocene age (Qae) overlaying intermediate fluvial deposits of upper to mid- Pleistocene Alluvium (Qam) stream valley deposits that fit this published description.

Hydro-collapsible soil structure is generally identified in the field or laboratory as porous with sand grains supported by point-to-point contacts and slightly cemented by thin veneers of clays or evaporites (meta-stable soil structure). The soil samples obtained during our field investigation were inspected by representatives of GeoTek in the field and in the laboratory and were generally not noted to contain visible porosity or open-grained structure. As a result, meta-stable soil structures were generally not identified. During drilling and test pit explorations, the alluvial soils were typically medium dense below the upper 48 inches and generally increased in relative density / consistency at depth.

Hydro-collapsible soils can also be identified by low in place dry densities (typically 90 pcf or less). In-situ dry density and moisture testing was performed on samples obtained at depths near the surface to 21 feet bgs. The dry densities in samples tested across the site ranged from 96.1 to 118.7 pcf with an average dry density of 107.1 pcf.

Relatively undisturbed ring-lined samples were obtained within the borings at selected depths and tested for one-dimensional collapse by inundating with water at varying loading conditions in pounds per square foot (psf), dependent on the estimated in-situ overburden pressure. Our testing indicated collapse potentials of 1.5 and 2.9 percent for soil samples obtained at depths of 5 to 6 feet bgs (500 psf load), and 1.1 percent for a sample obtained at 10 to 11 feet bgs (1,000 psf load). The samples with 1.5 and 2.9 percent collapse do indicate some concern, although the samples were not noted to contain visible porosity.

Houston 1988, also noted that comparison prediction of collapse settlement ranged from 70 percent underestimation to a 300 percent overestimation. During drilling operations and sampling, some disturbance can be caused due to the driving of the soil into the rings. Clearly the exact prediction and assessment of the potential and likelihood of hydro-collapse of subsurface soils is at best difficult. Due to this difficulty, it is our opinion that several methods of identification of hydro-collapsible soils should be performed including evaluation of the nearby and surrounding areas for indications of distress or settlement due to possible hydro-collapse.

Areas on and around the site were observed during our investigation for signs of distress, including roadway concrete, asphaltic pavement, and nearby structures surrounding landscaped areas. The areas were noted to display little to no distress. The streets, in general, do not contain depressed areas within the asphalt ("bird baths") or alligator cracking. Some linear shrinkage cracking of concrete and asphalt was noted, although this is typically not indicative of subgrade failure or hydro-collapse. It should also be noted that water can typically enter the subgrade soils through these shrinkage cracks and ultimately cause subgrade failure due to saturated conditions. If the site contained hydro-collapsible soils, it would be our opinion that this would have resulted in subgrade failure or excessive settlement in these areas.

Due to the lack of porosity observed within the subsurface soils, the in-situ moisture-density testing results, the general thicknesses of eolian sand layers, and our observations of existing structures in the site vicinity, it is our opinion that the potential for hydro-collapse at the site is generally low. The local geology and in-situ hydro-consolidation/collapse loading test results do pose some risk and could indicate the potential for meta-stable soils at the site. Therefore, during grading operations, the bottoms of excavations should be potholed and carefully inspected for signs of porous materials or open-grained soil structures, and further appropriate remedial measures be taken dependent upon conditions exposed. Maintaining relatively uniform moisture conditions in the bearing soils beneath footing and floor slabs will be important to the overall performance of these features. The site grading, foundation, and drainage recommendations presented herein are intended to further reduce the potential for structural movements due to hydro-collapse potential of the subsurface soils.

Expansion Potential

The current surface and near surface soil samples contain 13 to 33 percent fines (passing the No. 200 sieve) and exhibit Non-Plastic (NP) plasticity indices. Swell potential testing was performed on the surface and near surface soils and indicate swell potentials of 0.7, 1.2, and 1.6 percent (60 psf surcharge). The onsite soils are considered low expansive. During earthwork, the as-graded expansive nature of the near surface soils within the graded building pads should be determined, and appropriate expansive foundation and construction design recommendations should be provided, based on the as-graded soil conditions. Laboratory test results are presented in Appendix C.

SURFACE & GROUND WATER

Surface water was not observed during our evaluation and topography directs surface runoff towards the south and west. The project's design civil engineer should evaluate the potential for flooding. Seeps, springs, or other indications of high ground water levels were not noted on the subject property.

Ground water was not encountered within the subsurface explorations advanced onsite and is not anticipated to adversely affect planned development, provided that earthwork construction methods and/or foundation systems comply with recommendations contained in this report or those made subsequent to review of the improvement plan(s). According to ground water data obtained from the USGS National Water Information System, wells within 1.5 miles of the site with data available (both inactive) contain ground water depth last measured to be approximately 625 and 900 feet bgs in 1988 and 2008, respectively. These observations reflect conditions at the time of this investigation and do not preclude changes in local ground water conditions in the future from natural causes, damaged structures (lines, pipes etc.), or heavy irrigation.

TECTONIC FAULTING AND REGIONAL SEISMICITY

Geologic mapping of the area does not indicate any faults or earth fissures crossing the site. No evidence of faulting onsite was observed during our field reconnaissance and review of historic aerial photos. Geologic mapping does indicate the presence of faults trending north-northwest near the site.

Detailed paleoseismic studies have not been conducted in the area of our investigation; however, studies regarding the Loma Colorado de Abajo hill southeast of the site indicate offsetting of early Pleistocene deposits. None of the faults offset younger (mid-to-late Pleistocene and later) deposits. From the lack of recent displacement in overlying surficial deposits, the USGS infers a low rate of movement associated with the faults in this area.

The possibility of ground acceleration or shaking at the site may be considered as approximately similar to the New Mexico region as a whole. It is reasonable to assume that structures built in this area will be subject to at least one seismic event during their life, therefore, it is recommended that all structures be designed and constructed in accordance with the International Residential Code (IRC) and New Mexico Residential Building Code (RBC).

The site is located at approximately 35.2847 °N Latitude and -106.6823° W Longitude in Rio Rancho, New Mexico. The City of Rio Rancho and New Mexico as a state adopted the current New Mexico Residential Building Code. The 2015 New Mexico RBC further adopts the 2015 International Building Code (IBC). Based on the onsite soils, the site may be characterized as site Class “D” as determined by the IBC. The 2015 IBC uses a site profile extending to a depth of 100 feet for seismic site classification. Borings and test pits at the site were extended to a maximum depth of 25 feet. Deeper borings or geophysical testing can be performed to confirm the conditions below the current exploration depth. The mapped spectral response accelerations (SA) for 0.2 second and 1.0 second periods at the site were determined from the ATC, Hazards by Location, Interpolated Probabilistic Ground Motion for the Conterminous 48 States by Latitude/Longitude, 2015 IBC reference document. The results are presented in the following table:

Mapped Spectral Response Acceleration (SA)	% of g
0.2 sec period Mapped Spectral Acceleration (S_s)	48.4
1.0 sec period Mapped Spectral Acceleration (S_1)	14.5
0.2 sec period Design Spectral Acceleration (SD_s) – Site Class D	45.6
1.0 sec period Design Spectral Acceleration (SD_1) – Site Class D	21.5

The structural Engineer may either choose the IRC or the IBC design provisions for their structural design as long as the design method complies with local design requirements.

Secondary Seismic Constraints

The following list includes other potential seismic related hazards that have been evaluated with respect to the site, but in our opinion, the potential for these seismically related constraints to affect the site is considered negligible.

- * Liquefaction
- * Dynamic Settlements
- * Surface Fault Rupture
- * Ground Lurching or Shallow Ground Rupture

Summary

It is important to keep in perspective that if a seismic event were to occur on any major fault, intense ground shaking could be induced to this general area. Potential damage to any settlement sensitive structures would likely be greatest from the vibrations and impelling force caused by the inertia of the structures mass than that created from secondary seismic constraints. Considering the subsurface soil conditions and local seismicity, it is estimated that the site has a low risk associated with the potential for these phenomenon to occur and adversely affect surface improvements. These potential risks are no greater at this site than they are for other structures and improvements developed on the colluvial and alluvial materials in this vicinity.

RESULTS OF LABORATORY TESTING

Laboratory tests were performed on representative samples of the onsite earth materials in order to evaluate their physical and chemical characteristics. The tests performed and the results obtained are presented in Appendix C.

CONCLUSIONS

Based on our field exploration, laboratory testing, engineering and geologic analyses, it is our opinion that the subject site is suited for development from a geotechnical engineering and geologic viewpoint. The recommendations presented herein should be incorporated into the final design, grading, and construction phases of development. The engineering analyses performed concerning site preparation and the recommendations presented below, have been completed using the information provided to us regarding site development. In the event that the information concerning proposed development is not correct, the conclusion and recommendations contained in this report shall not be considered valid unless the changes are reviewed and conclusions of this report are modified or approved in writing by this office.

RECOMMENDATIONS-EARTHWORK CONSTRUCTION

General

All grading should conform to the International Residential Code (IRC) and local requirements, except where specifically superseded in the text of this report. During earthwork construction all removals, overexcavation, and grading procedures should be observed and the fill selectively tested by a representative of GeoTek. If unusual or unexpected conditions are exposed in the field, they should be reviewed by this office and if warranted, modified and/or additional recommendations will be offered. It is recommended that the earthwork contractor(s) perform their own independent reconnaissance of the site to observe field conditions first hand. If the contractor(s) should have any questions regarding site conditions, site preparation, or the remedial recommendations provided, they should contact an engineer at GeoTek for any necessary clarifications prior to submitting earthwork bids. All applicable requirements of local and national construction and general industry safety orders, the Occupational Safety and Health Act, and the Construction Safety Act should be met.

Removals/Processing - General

Presented below are removal/processing recommendations for the various earth materials encountered on the project. Debris, vegetation, and other deleterious material should be stripped/removed from areas proposed for structural fill placement and disposed of offsite prior to the start of construction. All artificial fill and disturbed native soils should be removed to expose competent native material. The materials can be reused provided they are cleaned of organic material, debris/deleterious material, and oversized materials to comply with the structural fill recommendations of this report. If existing improvements or property line restrictions limit removals, condition specific recommendations would be provided on a case-by-case basis.

Based on a review of the exploratory logs, our field observations, and laboratory testing results, at a minimum, all loose soils should be removed to expose competent native material. Loose soils were encountered up to 3 feet bgs in explorations TP-1 and TP-3, and up to 4 feet bgs in explorations B-1 and B-3. Deeper removals may be required locally dependent on the conditions exposed. Potholing should be performed at removal bottoms during grading to verify competent native material is exposed. Although we do not suspect the deeper alluvial soils onsite to be prone to significant hydro-collapse potential, removal bottoms and potholing should be carefully inspected for localized signs of porous and/or meta-stable materials, and if encountered, further appropriate remedial measures should be taken based on the conditions exposed. Removal bottom areas should then be processed, moisture conditioned, and compacted in accordance with the requirements presented herein.

For support of structures, in cut and shallow fill areas, the structure areas should be provided a minimum 48-inch thick fill blanket (or a minimum 30 inches of compacted fill below the footings, whichever is deeper) for adequate and more uniform support conditions for the proposed structures and improvements (e.g., flatwork, block walls, etc.). Processing should extend at least five feet laterally beyond proposed structures and improvements (e.g., flatwork, block walls, etc.). During overexcavation for the fill blanket, the exposed ground surface should be moisture conditioned and compacted to generate any near surface settlements.

Fill Placement

Subsequent to completing the recommended removals/processing and ground preparation, excavated onsite soils may be placed in relatively thin lifts (with a maximum lift thickness of 12 inches), cleaned of vegetation and debris, brought to at least optimum moisture content, and compacted to a minimum relative compaction of 90 percent of the laboratory standard ASTM D-1557. It should be noted that the maximum lift thickness requirement to meet both the minimum relative compaction and moisture content requirements is a function of several variables including (but not limited to) the type of soil (e.g., clay, silt, sand, gravel, cobbles, etc.), type and size of compaction equipment (e.g., sheep's foot roller, scraper, jumping jack, etc.), number of passes, frequency of operation of compaction equipment, moisture content, confinement (e.g., relatively soft bottom versus bedrock), etc. Thus, the maximum lift thickness can vary considerably and still achieve proper moisture content and relative compaction.

The maximum lift thickness should be appropriately decreased based on the factors listed above. It is left to a representative of GeoTek (e.g., grading/field technician) to determine the appropriate lift thickness based on observation and testing of the fill. Excessive lift thickness (in the judgment of a GeoTek representative) will result in issuing of non-compliance.

A sufficient number of field density tests shall be performed to provide an opinion to the degree of compaction achieved. Field density tests should be performed at a minimum rate of one test for every 1000 cubic yards of material placed, one for every two vertical feet of material placed, or where there is a change in material, whichever is greater. If needed, when testing the fill for dry density and moisture content, a pothole/test pit should be excavated to a minimum depth to remove any loose surficial material. The area should then be leveled prior to performing a density test. A failing soil density test is based on either a dry density of less than 90% relative compaction and/or moisture content less than the soil's optimum moisture content as determined by ASTM D-1557.

Fill Material

On-Site Soil:

On-site soils that are cleaned of organics, oversized material, and debris may be used as structural fill, provided that foundation recommendations provided herein are followed.

Import Material:

It is possible that additional soils will be imported to the site for earthwork construction purposes in the future. A sample of any intended import material should first be submitted to GeoTek so that, if necessary, additional laboratory or chemical testing can be performed to verify that the intended import material is compatible with onsite soils. In general, import material should be within the following minimum guidelines:

- * Free of organic matter and debris.
- * Maintain less than 4.0 percent expansion (60 psf surcharge).
- * Maximum plasticity index (PI) of 12
- * One hundred percent passing the six-inch screen.
- * Less than 55 percent passing a No. 200 screen.
- * Maintain less than 500 ppm (parts per million) chloride content
- * Maintain less than 1,000 ppm (parts per million) sulfate content

Excavation Difficulty

We present the following general comments regarding excavation conditions for the owners' and designers' information with the understanding that they are approximations based on widely spaced borings and test pits. More accurate information regarding the excavation conditions should be evaluated by contractors or other interested parties from test pit excavations using the intended equipment and extending to the required depths.

During our field evaluation, practical refusal was not encountered during subsurface exploration to depths to 21 feet bgs. Based on the results of the test pits and borings, shallow excavations should be possible with conventional excavating equipment. Deeper excavations extending into the underlying soil could be difficult to excavate and may require special excavation equipment (i.e., hoe-ram, rock saw, large excavator). Instability in the form of slope raveling, caving, and sloughing is possible in excavations and trenches at the site. Excavations and trenches should be braced, sloped, and/or designed as required to provide personnel safety and satisfy safety code regulations.

Observation and Testing

During earthwork construction all removal/processing and the general grading procedures should be observed and the fill selectively tested by a representative(s) of GeoTek. If unusual or unexpected conditions are exposed in the field, they should be reviewed by GeoTek and if warranted, modified and/or additional recommendations will be offered. All applicable requirements both the local and national construction and general industry safety orders, the Occupational Safety and Health Act, and the Construction Safety Act should be met.

Earthwork Settlements

Ground settlement should be anticipated due to primary consolidation and secondary compression. The total amount of settlement and time over which it occurs is dependent upon various factors, including material type, depth of fill, depth of removals, initial and final moisture content, and in-place density of subsurface materials. Compacted fills, to the heights anticipated, are not generally prone to excessive settlement. However, some settlement of the left in-place alluvium is expected and the majority of this settlement is anticipated to occur during grading.

Slope Stability

No significantly higher (greater than 10 feet) slopes are anticipated to be constructed onsite. All slopes should be designed at gradients of 2 to 1 (Horizontal to Vertical) or flatter. The slopes should be constructed in accordance with the minimum requirements of the IRC and local municipalities. Cut and fill slopes are anticipated to perform adequately in the future with respect to gross and surficial stability if the soil materials are maintained in a solid to semi-solid state (as defined by the soils Atterberg Limits) and are limited to the heights prescribed herein. The slopes should be adequately protected from erosion.

Earthwork Balance

The volume change of excavated materials upon compaction as engineered fill is anticipated to vary with material type and location. It is anticipated that the alluvial materials will subside approximately 0.025 to 0.075 feet due to soil consolidation and the loading conditions created by earthwork equipment. Graded areas are not anticipated to have significant subsidence due to earthwork. The overall earthwork shrinkage may be approximated by using the following parameters:

Artificial Fill / Alluvium (Upper 48 Inches).....	15% to 25% shrinkage
Alluvium (Below Upper 48 Inches)	10% to 20% shrinkage

It should be noted that the above factors are estimates only, based on experience and preliminary data. Final earthwork balance factors could vary. In this regard, it is recommended that balance areas be reserved where grades could be adjusted up or down near the completion of grading in order to accommodate yardage imbalance for the project.

RECOMMENDATIONS – FOUNDATIONS

General

Foundation design and construction recommendations are based on laboratory testing and engineering analysis performed on near surface earth materials.

The proposed foundation systems should be designed and constructed in accordance with the guidelines contained herein, local requirements, and the IRC. Based on our preliminary laboratory testing, the soils onsite were low expansive. During earthwork, the as-graded expansive nature of the near surface soils within the graded building pads should be determined. Appropriate expansive foundation and construction design recommendations should be provided, based on the as-graded soil conditions. For budget and design consideration it is our opinion the following foundation recommendations could be utilized, however, at the completion of grading final foundation recommendations should be determined by GeoTek.

The information and recommendations presented below are not meant to supersede design by a registered structural engineer. Upon request, GeoTek could provide additional input/consultation regarding soil parameters as related to foundation design.

All footings should maintain a minimum horizontal distance of five (5) feet from the outside bottom edge of the footing to the face of an adjacent descending slope. These recommendations are provided for relatively light foundation loading conditions, such as those anticipated for the proposed structures. Foundation loads are anticipated to be less than 50 kips for column loads and less than 3 kips per lineal foot for wall loads.

Conventional Foundations

The proposed structures can be supported on a conventional shallow foundation system; provided the soils are reworked as outlined in this report and our recommendations are followed:

Shallow spread foundations bearing on the properly compacted engineered fill as outlined above can be designed for a total allowable soil bearing pressure of 2,000 psf. Generally, a one-third increase may be applied to the design bearing pressure when considering short duration wind and seismic loads.

- The allowable soil bearing pressure may be increased by 300 psf, to a maximum of 3,000 psf, for each additional foot of either the width or depth beyond those recommended below.
- For lateral sliding resistance, a 0.40 coefficient of friction may be utilized for a concrete to soil contact when multiplied by the dead load.
- Passive earth pressure may be computed as an equivalent fluid having a density of 300 pounds per square foot per foot of depth with a maximum earth pressure of 3,000 pounds per square foot.
- Exterior footings should be founded at least 18 inches below lowest adjacent grade to provide adequate embedment depth. Individual, and continuous wall footings should have a minimum width of 12 inches, or as determined by building codes or the Structural Engineer.
- All footings should be reinforced with a minimum of two No. 4 reinforcing bars, one placed near the top and one placed near the bottom of the footing.
- Interior footings, including individual column and continuous wall footings, should be founded with a nominal width of 12 inches or as determined by building codes or the Structural Engineer.

- Isolated footings should be founded at least 18 inches below adjacent grade and should be a minimum of 4 square feet in area. Isolated footings should be provided with sufficient flexural and dowel reinforcement.
- The interior flat portions of the slab should be underlain by a minimum of four (4) inches of sand or gravel.
- The concrete slab should be a minimum thickness of 4 inches and reinforced with No. 3 rebar reinforcing bars located on 18-inch center in two directions or as determined by the Structural Engineer.
- The minimum area, depths and widths are recommended for ease of construction and to provide a margin of safety against a local shear or punching failure of the foundation soils.
- The need for interior stiffening beams should be assessed by the Structural Engineer in accordance with the applicable building codes.
- Final determination on the use of a vapor retarder or radon barrier should be left to the slab designer or architect. If a vapor retarder is used it should conform to the specifications presented in ASTM E1745 and should be placed as described in ASTM E1643 and the Guide for Concrete Floor and Slab Construction, published by the American Concrete Institute (ACI 302.1R) or to local standard-of-care.

Compacted engineered fill materials will lose moisture and density over time in the arid environment of New Mexico. The upper 12 inches of fill material in structural areas should be re-moisture conditioned, proof rolled as necessary, and re-certified prior to placement of the foundation system.

Foundation Settlement

Total settlement of the structure with foundations supported entirely on engineered fill is estimated to be less than 1 inch. Differential settlement should be less than $\frac{3}{4}$ of an inch. Two-way angular distortions of $\frac{1}{360}$ should be incorporated into foundation design. The settlement estimates presented assume that a stable subgrade soil moisture content will be maintained and that fill soils are properly compacted.

Retaining and Block Walls

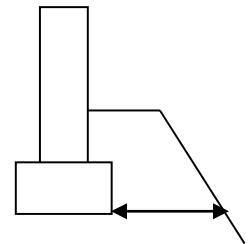
The design parameters provided below assume that low expansive soils are used to backfill any retaining walls. If expansive soils are used to backfill the walls, increased active and at-rest earth pressures will need to be utilized for design. Building walls, below grade, should be waterproofed or damp-proofed, depending on the degree of moisture protection desired.

Design

- I. An allowable bearing value of 2,000 pounds per square foot may be used for design of footings which maintain a minimum width of 12 inches and a minimum embedment depth below the frost line into the properly compacted fill soils. The bearing value may be increased by one-third for seismic or other temporary loads. A bearing value increase of 300 psf is allowed for each additional foot (width or depth) up to a maximum bearing value of 3,000 psf without additional review.

2. For lateral sliding resistance, a 0.40 coefficient of friction may be utilized for a concrete to soil contact when multiplied by the dead load.
3. Passive earth pressure may be computed as an equivalent fluid having a density of 300 pounds per square foot per foot of depth with a maximum earth pressure of 3,000 pounds per square foot. However, for block and retaining walls within 5 feet of descending slopes, passive earth pressures should be considered negligible without further review by GeoTek.
4. When combining passive pressure and frictional resistance, the passive pressure component should be reduced by one-third.
5. GeoTek recommends the following with regards to horizontal set back of block and retaining wall footings. The recommendations are minimums and do not account for erosion, therefore, slopes should be maintained. For block or retaining walls near slopes, the horizontal set back measured from the outside edge of the block or retaining wall footing to any adjacent descending slope face should follow the table shown below:

Descending Slope Height	Minimum Horizontal Setback
Up to 5 feet high	2' 8"
Greater than 5 feet and up to 8 feet high	3' 8"
Greater than 8 feet and up to 10 feet high	4' 8"



Wall Foundation Construction

The following table contains foundation design and construction recommendations for walls that are constructed on low expansive soils. Footings should be founded at a minimum depth below the lowest adjacent grade per the table below.

EXPANSIVE NATURE OF SOIL	MINIMUM FOOTING DEPTH (1)
	Retaining Walls & Block Walls
LOW	18 inches

(1) denotes that depth should be measured from the lowest adjacent grade

All walls should be reinforced per the design of the structural engineer. GeoTek projects that the graded condition of the lots will be low expansive. The structural engineer should consider this in their design for reinforcing and control joint spacing. The walls should use both vertical and horizontal reinforcement and be designed to resist the effects a two-way 1/400 angular distortion would impart on a wall. Prior to pouring concrete, the subgrade soils should be lightly moisture conditioned to prevent loss of water during pouring and curing of the concrete.

Restrained Walls

Any retaining walls that will be restrained prior to placing and compacting backfill material or that have reentrant or male corners, should be designed for an at-rest equivalent fluid pressure of 65 pcf, plus any applicable surcharge loading. For areas of male or re-entrant corners, the restrained wall design should extend a minimum distance of twice the height of the wall laterally from the corner.

Cantilevered Walls

The recommendations presented below are for cantilevered retaining walls up to 10 feet high. Active earth pressure may be used for retaining wall design, provided the top of the wall is not restrained from minor deflections. An equivalent fluid pressure approach may be used to compute the horizontal pressure against the wall. Appropriate fluid unit weights are given below for specific slope gradients of the retained material. These do not include other superimposed loading conditions such as traffic, structures, seismic events, or adverse geologic conditions.

Surface Slope of Retained Material (H:V)	Equivalent Fluid Weight (P.C.F.)
Level	40
3 to 1	50
2 to 1	65

Wall Backfill and Drainage

All retaining walls should be provided with an adequate backdrain and outlet system (a minimum 1 outlet per 10 feet of wall) to prevent buildup of hydrostatic pressures and be designed in accordance with minimum standards presented herein. Gravel used in backdrain systems should be a minimum of 12 inches of 3/4 to 1-1/2 inch clean crushed rock wrapped in filter fabric that extends to within 18 inches of the surface (Figure 5).

The surface of the backfill should be sealed by pavement or the top 18 inches compacted with native low permeability soil. Proper surface drainage should also be provided. Manufactured alternatives to a gravel backdrain system are available but should be reviewed by GeoTek prior to installation.

Expected Wall Movements

A retaining wall has to translate laterally to reach full passive pressure/resistance. At 0.5% strain, 1/2 the passive pressure is mobilized, and at 2% strain the full passive pressure is mobilized. For an 18-inch embedment this can be 0.36 inches. In addition, wall rotation is expected to reach an active design state. This rotation, at a minimum, needs to undergo 0.5% strain and walls are often considered to rotate between 0.005 to 0.02 times their height, dependent upon the soil condition, with no adverse effects expected. In the undersigned opinion, a value of 0.01 times the height of the wall is a maximum rotation that should typically be expected. For a 10-foot-high wall this amounts to 1.2 inches of movement that can occur at the top of the wall. Walls should be expected to translate/move/rotate quite a bit, and the higher the wall the more movement that should be expected.

PRELIMINARY PAVEMENT SECTIONS

Onsite Pavement Sections

Traffic information was not provided to us for the planned internal streets; however, we anticipate that traffic will consist of passenger vehicles and periodic small to medium sized trucks. The natural soils at the site should provide suitable support for pavements, provided that they are prepared as recommended in this report. We assumed that the pavements would be supported by a compacted subgrade of the on-site soil. The recommended pavement sections are designed utilizing the City of Rio Rancho Pavement Section Drawings PS-01, dated May 22, 2008 for residential and collector streets. The pavement section is recommended as shown in the following table:

Pavement Area	Minimum Asphalt Concrete Thickness (inches)	Minimum Base Course Material Thickness (inches)
Residential Streets	3.0	4.0
Collector Streets	5.0	6.0

All Base Course and asphaltic concrete should conform with City of Rio Rancho specifications.

Pavement Construction and Maintenance

All section changes should be properly transitioned. If adverse conditions are encountered during the preparation of subgrade materials, special construction methods may need to be employed. All subgrade materials should be processed to a minimum depth of 12 inches and compacted to a minimum relative compaction of 95 percent near optimum moisture content. All aggregate Base Course should be compacted to a minimum relative compaction of 95 percent at or below optimum moisture content. Materials within the City of Rio Rancho right-of-way should further conform to the municipality's requirements and specifications.

The recommended pavement sections provided in the previous table are meant as minimums. If thinner or highly variable pavement sections are constructed, increased maintenance and repair should be expected. If the ADT (average daily traffic) or ADTT (average daily truck traffic) increases beyond that intended, as reflected by the traffic index(s) used for design, increased maintenance and repair could be required for the pavement section. Positive site drainage should be maintained at all times. Water should not be allowed to pond or seep into the ground. If planters or landscaping are adjacent to paved areas, measures should be taken to minimize the potential for water to enter the pavement section.

DEVELOPMENT CRITERIA

Homeowner's Maintenance Criteria

Appendix D contains some homeowner maintenance criteria as developed from a geotechnical perspective. We would strongly suggest that this section be reviewed and fully disclosed to the future homeowners so they better understand their responsibility in properly maintaining the exterior of the residence and the adverse effects to the structure and improvements when not properly maintained.

Site Improvements

Soil movement is problematic with respect to the design, construction, and long-term performance of concrete flatwork. Due to the nature of concrete flatwork, it is essentially impossible to totally mitigate the effects of soil movement. Recommendations for exterior concrete flatwork design and construction can be provided upon request. If, in the future, any additional improvements are planned for the site, additional recommendations concerning the geological or geotechnical aspects of design and construction of said improvements could be provided upon request. This office should be notified in advance of any fill placement, grading, or trench backfilling after rough grading has been completed. This includes any grading, utility trench, and retaining wall backfills.

Landscape Maintenance and Planting

Water has been shown to weaken the inherent strength of all earth materials. Graded slopes constructed within and utilizing onsite materials may be erosive. Eroded debris may be reduced, and surficial slope stability enhanced by establishing and maintaining a suitable vegetation cover as soon as possible after construction. Compaction to the face of fill slopes would help to reduce short-term erosion until vegetation is established. Plants selected for landscaping should be lightweight, deep-rooted types, which require little water and are capable of surviving the prevailing climate. From a geotechnical standpoint, leaching is not recommended for establishing landscaping. If the surface soils are processed to adding amendments, they should be recompacted to 90 percent compaction (Based on ASTM D-1557). Only the minimum amount of irrigation necessary to sustain plant life should be provided. Over watering landscape areas could adversely affect proposed site improvements. We recommend that any proposed open bottom planter areas adjacent to the structure be eliminated or set back a minimum distance of five (5) feet and suggest that desert landscape using xeriscape technology is used outside of this buffer zone. As an alternative, closed bottom type planters could be utilized. An outlet, placed in the bottom of the planter, could be installed to direct drainage away from structures or any exterior concrete flatwork. Irrigation timers should be adjusted on a monthly basis in accordance with the local Water Authority/Water District's requirements.

Soil Corrosion

Soils within the area vary in corrosive potential to concrete and metal; therefore, materials selected for construction purposes should be resistant to corrosion as discussed below. Testing of on-site soils indicated a sulfate content of 78 ppm, which may be characterized as negligible sulfate content (ACI 318 – less than 1,000 ppm). Type II cement or equivalent for negligible sulfate exposure conditions is acceptable for concrete mixtures. All concrete should be designed, mixed, placed, finished, and cured in accordance with guidelines presented by the Portland Cement Association (PCA), the American Concrete Institute (ACI), and the International Building Code (IBC).

Testing of on-site soils indicate a chloride content of 25 ppm, which is below the typical limit of 500 ppm where protection of steel tendon in concrete slab-on-grade. The designer should use the corrosion test results in this report to evaluate the need for corrosion protection in accordance with ACI requirements. All concrete should be designed, mixed, placed, finished, and cured in accordance with guidelines presented by the Portland Cement Association (PCA), ACI, and IBC. During earthwork construction operations, additional testing for corrosive potential should be performed on the as-graded condition of the near surface soils within building pad areas.

Trench Excavation

All footing trench excavations should be observed by a representative of this office prior to placing reinforcement. Footing trench spoil and any excess soils generated from utility trench excavations should be compacted to a minimum relative compaction of 90 percent if not removed from the site. Considering the nature of the onsite soils, it should be anticipated that caving or sloughing could be a factor in subsurface excavations. Shoring or excavating the trench walls at the angle of repose (typically 25 to 45 degrees) may be necessary and should be anticipated in non-cemented soils. All excavations should be observed and conform to national and local safety codes.

Utility Trench Backfill

Materials may need to be imported to the site for use as pipe bedding and pipe zone material. Utility trench backfill should be placed to the following standards:

1. All onsite interior and exterior utility trench backfill should be brought to near optimum moisture content and then compacted to obtain a minimum relative compaction of 90 percent of the laboratory standard. Sand backfill, unless excavated from the trench, should not be used adjacent to perimeter footings or in trenches on slopes. Compaction testing and observation, along with probing should be performed to verify the desired results.
2. Offsite utility trenches should be compacted to a minimum of 95 percent relative compaction. Compaction testing and observation, along with probing should be performed to verify the desired results.

Drainage

Positive site drainage should be maintained at all times in accordance with the IBC (Figure 6). The slope of the ground away from the foundations should be a minimum of one unit vertical to 20 units horizontal (5-percent slope). Drainage should not flow uncontrolled down any descending slope. Water should be directed away from foundations and not allowed to pond and/or seep into the ground. Pad drainage should be directed toward the street or other approved area. Roof gutters and down spouts should be considered to control roof drainage. Down spouts should outlet onto paved areas or a minimum of five feet from proposed structures or into a subsurface drainage system. Areas of seepage may develop due to irrigation or heavy rainfall. Minimizing irrigation will lessen this potential. If areas of seepage develop, recommendations for minimizing this effect could be provided upon request.

PLAN REVIEW AND CONSTRUCTION OBSERVATIONS

Final foundation and improvement plans should be submitted to this office for review and comment as they become available, to minimize any misunderstandings between the plans and recommendations presented herein. In addition, foundation excavations and earthwork construction performed on the site should be observed and tested by this office. If conditions are found to differ substantially from those stated, appropriate recommendations would be offered at that time. We recommend that site preparation and foundation construction activities be observed and tested by a representative of GeoTek. This representative would have at least the following duties:

- Observe and document adequate removal of existing surficial vegetation, artificial fill, and other deleterious materials.
- Observe and approve the exposed removals and potholing under structural areas to document that it meets project requirements.
- Approve material used as engineered fill in structural areas and document that it meets project requirements.
- Monitor and test the progress of earthwork and compaction operations
- Inspect footing excavations to document that footings are founded in competent material.

LIMITATIONS

The materials encountered on the project site and utilized in the referenced laboratory study are believed representative of the area; however, soil materials vary in character between excavations. Site conditions may vary due to seasonal changes or other factors. Grading, trench backfilling and/or foundation construction procedures should be observed and selectively tested by a representative of GeoTek. If unusual or unexpected conditions are exposed in the field, they should be reviewed by this office and if warranted, modified and/or additional recommendations will be offered.

Since our study is based upon the site materials observed, selective laboratory testing and engineering analysis, the conclusions and recommendations are professional opinions. These opinions have been derived in accordance with current standards of practice and no warranty is expressed or implied. Standards of practice are subject to change with time. GeoTek assumes no responsibility or liability for work, testing, or recommendations performed or provided by others. If another party provides observation and testing during the earthwork phases of the project, the testing company must assume responsibility as the Geotechnical Engineer of Record by concurring with the findings and recommendations of this report or by providing amended recommendations and testing.

The opportunity to be of service is greatly appreciated. If you have any questions concerning this report or if we may be of further assistance, please do not hesitate to contact the undersigned.

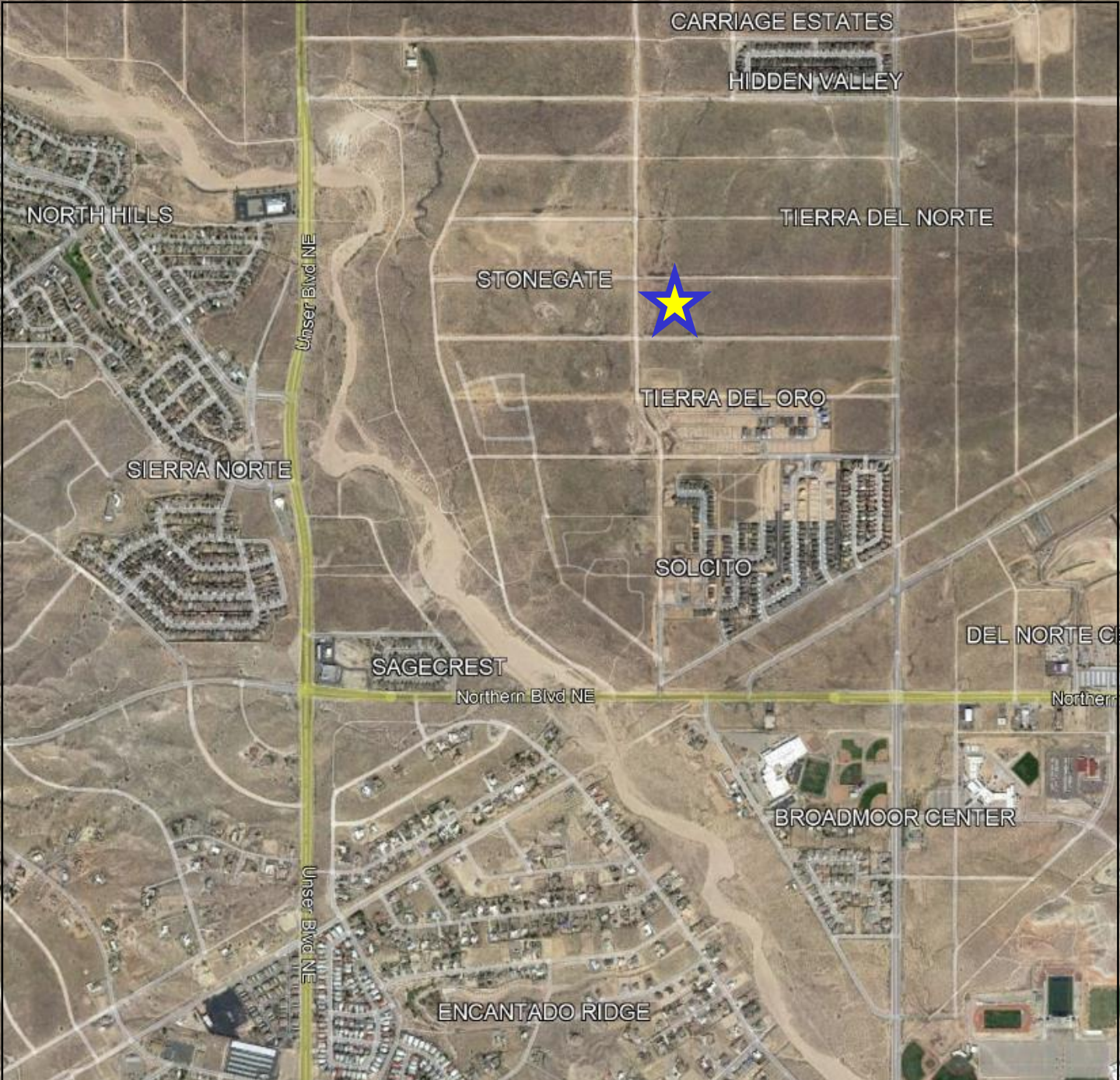
Respectfully submitted,
GeoTek Residential, LLC


Kevin Kennedy
Staff Engineer



Alex S. Koehler, PE
Project Engineer

STP Review By: Ryne C. Stoker, PE



APPROXIMATE SITE LOCATION



NOT TO SCALE



GeoTek Residential, LLC
2100 Aztec Rd. NE Suite A
Albuquerque, NM 87107

FIGURE I
SITE LOCATION MAP
Scottish Isle Subdivision
Rio Rancho, New Mexico
Prepared for: Abrazo Homes

GEOTECHNICAL ENVIRONMENTAL MATERIALS

Project No.:

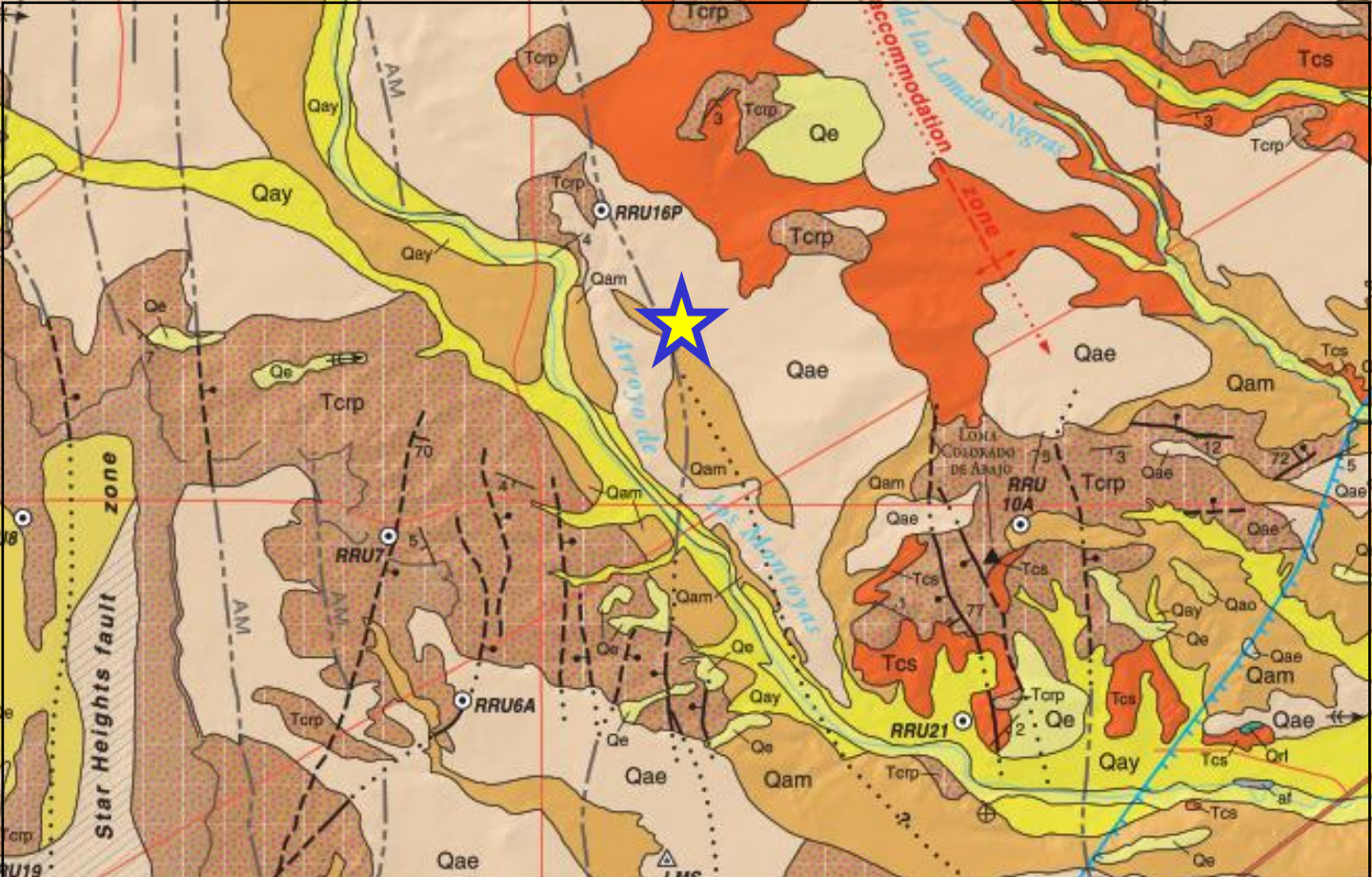
2347-ABR

Report Date:

August 2023

Drawn By:

ASK



Qae Eolian sand and alluvium, undivided (Holocene-upper Pleistocene)—Pale-brown to light-reddish-brown, moderately sorted sand and silt with scattered pebbles; weakly to moderately developed soils with stage I to II pedogenic carbonate morphology and thin clay films; 1–3 m thick

Qam Intermediate stream-valley alluvium (upper-middle Pleistocene)—Yellowish-brown to reddish-yellow sand, silty clay, and gravel associated with abandoned tributary streams; pink Sandia granite and limestone gravel common east of Rio Grande; variable lithology dominated by chert, volcanic, and red granitic to west; surface is commonly mantled by eolian sand west of Rio Grande; variable soil development; divided into two subunits based on surface morphological soil development, and inset relationships: **younger subunit (Qam2)** exhibits soils with stage II+ pedogenic carbonate morphology; **older subunit (Qam1)** contains soils with stage III+ pedogenic carbonate morphology; 8–65 m above local base level; 5–51 m thick



APPROXIMATE SITE LOCATION



NOT TO SCALE

***Legend Descriptions From USGS**



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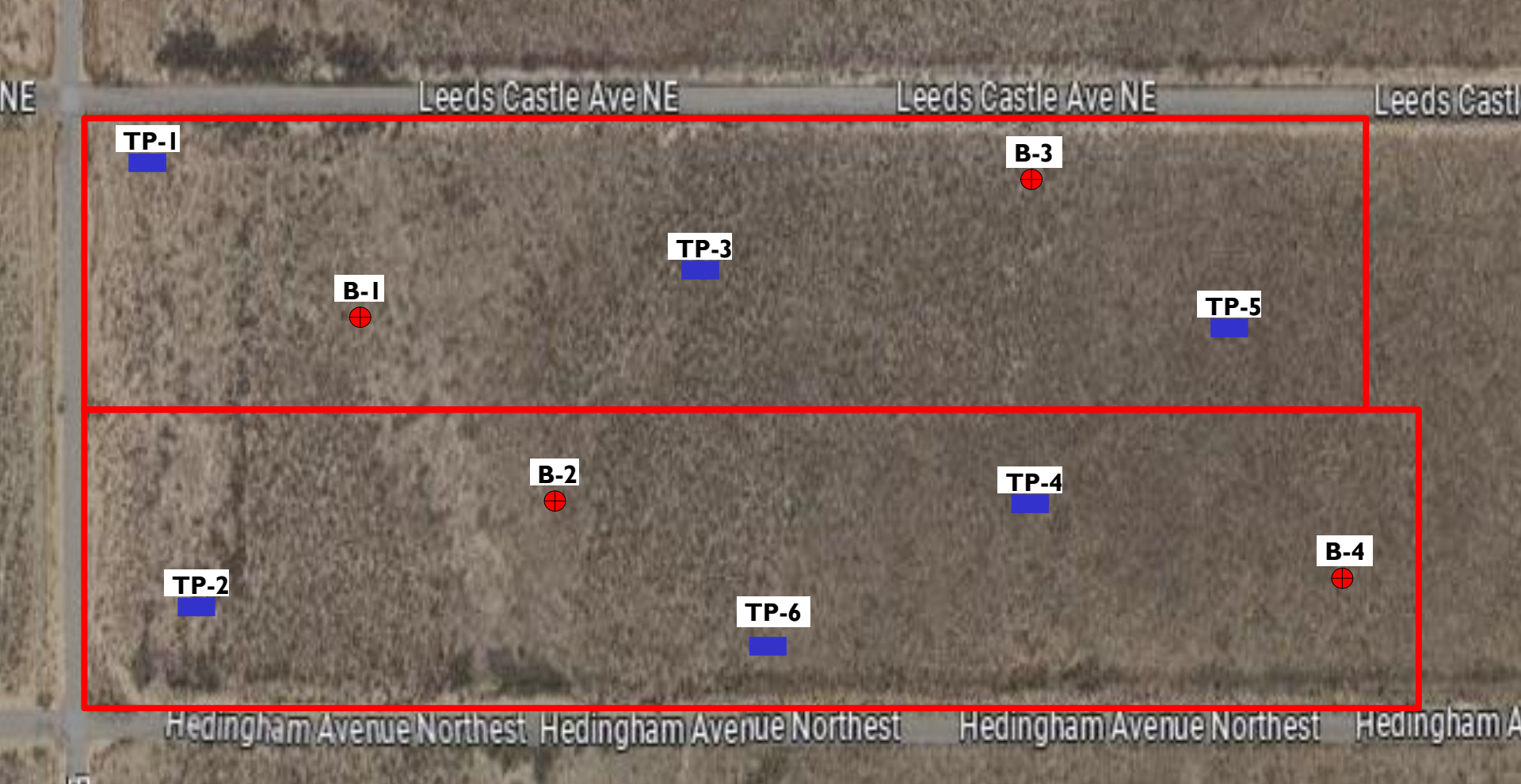
FIGURE 2
REGIONAL GEOLOGY
Scottish Isle Subdivision
Rio Rancho, New Mexico
Prepared for: Abrazo Homes

GEOTECHNICAL ENVIRONMENTAL MATERIALS

Project No.:
2347-ABR

Report Date:
August 2023

Drawn By:
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 **APPROXIMATE SITE BOUNDARY**
 **APPROXIMATE BORING LOCATIONS**

 **APPROXIMATE TEST PIT LOCATIONS**



NOT TO SCALE



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Albuquerque, NM 87107

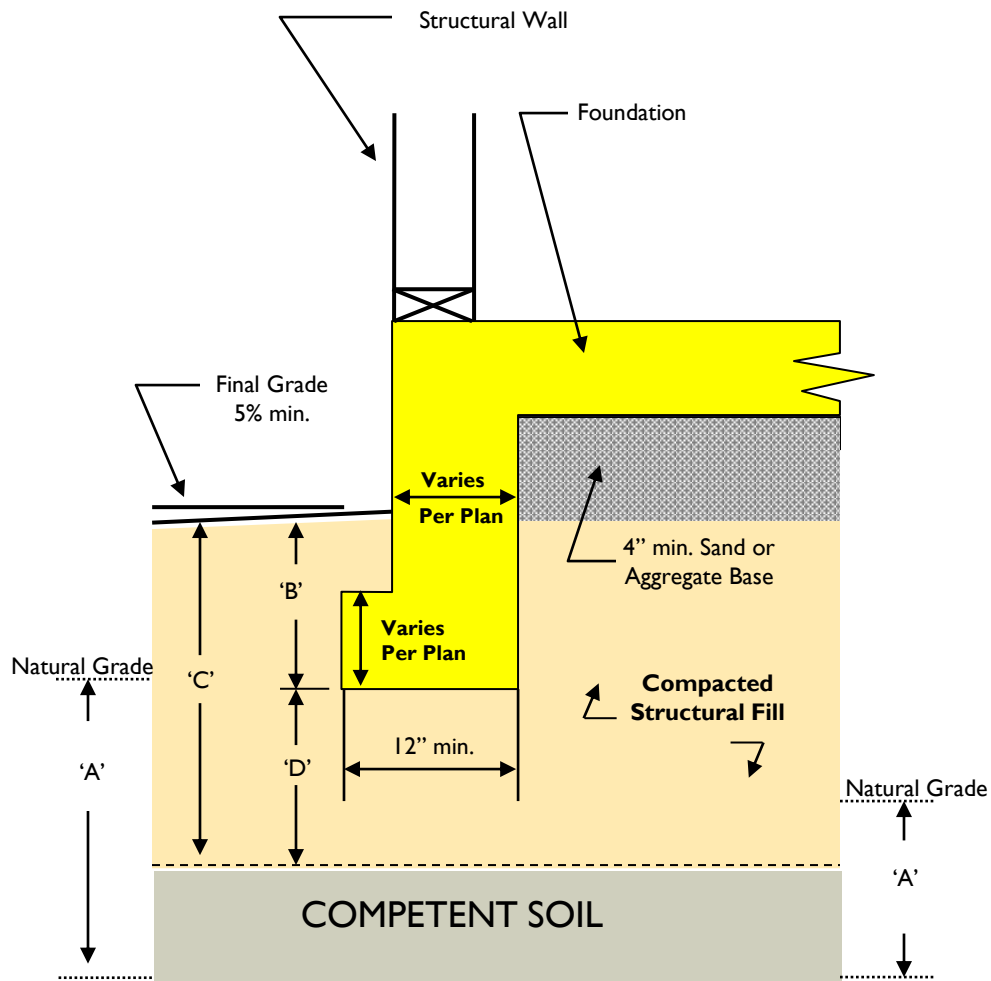
FIGURE 3
GEOTECHNICAL MAP
Scottish Isle Subdivision
Rio Rancho, New Mexico
Prepared for: Abrazo Homes

GEOTECHNICAL ENVIRONMENTAL MATERIALS

Project No.:
2347-ABR

Report Date:
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'A' – Minimum Removals = Remove All Loose Soils and Artificial Fill Below Existing Grade & As Deep as Necessary For Fill Blanket

'B' – Depth of Footing = 18" min

'C' – 48" min. Fill Blanket

'D' – 30" min. Compacted Structural Fill Below Foundation

LOW EXPANSIVE CONDITIONS

Note: Concrete Slab shown is a "typical" detail only. Actual shape and dimensions to be designed by structural engineer and detailed in the project plans. The purpose of this detail is to show minimum footing depth, width, loose soil processing depths, and fill blanket thickness.

NOT TO SCALE



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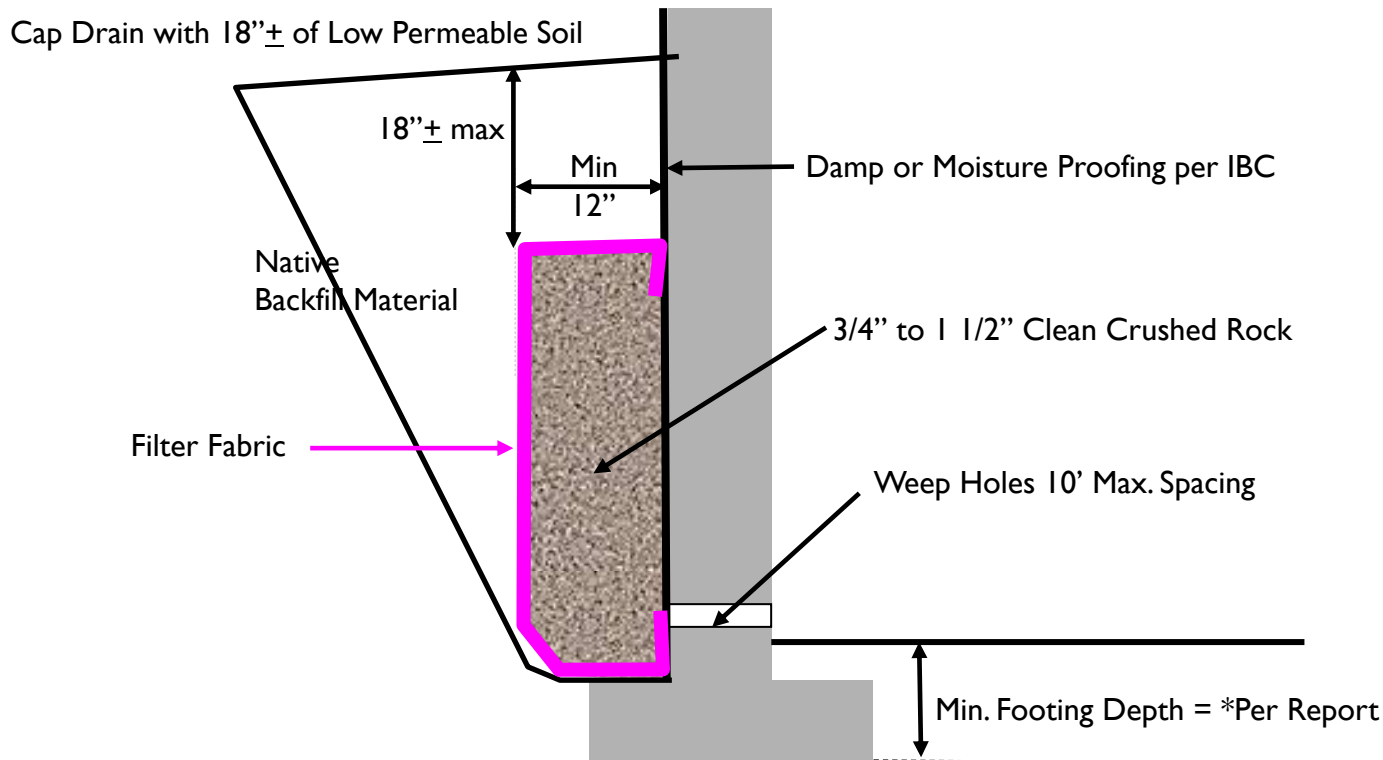
GEOTECHNICAL ENVIRONMENTAL MATERIALS

FIGURE 4
OVEREXCAVATION / FILL BLANKET
Scottish Isle Subdivision
Rio Rancho, New Mexico
Prepared for: Abrazo Homes

Project No.:
2347-ABR

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RETAINING WALL DETAIL

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Albuquerque, NM 87107

FIGURE 5
RETAINING WALL DETAIL
Scottish Isle Subdivision
Rio Rancho, New Mexico
Prepared for: Abrazo Homes

Project No.:

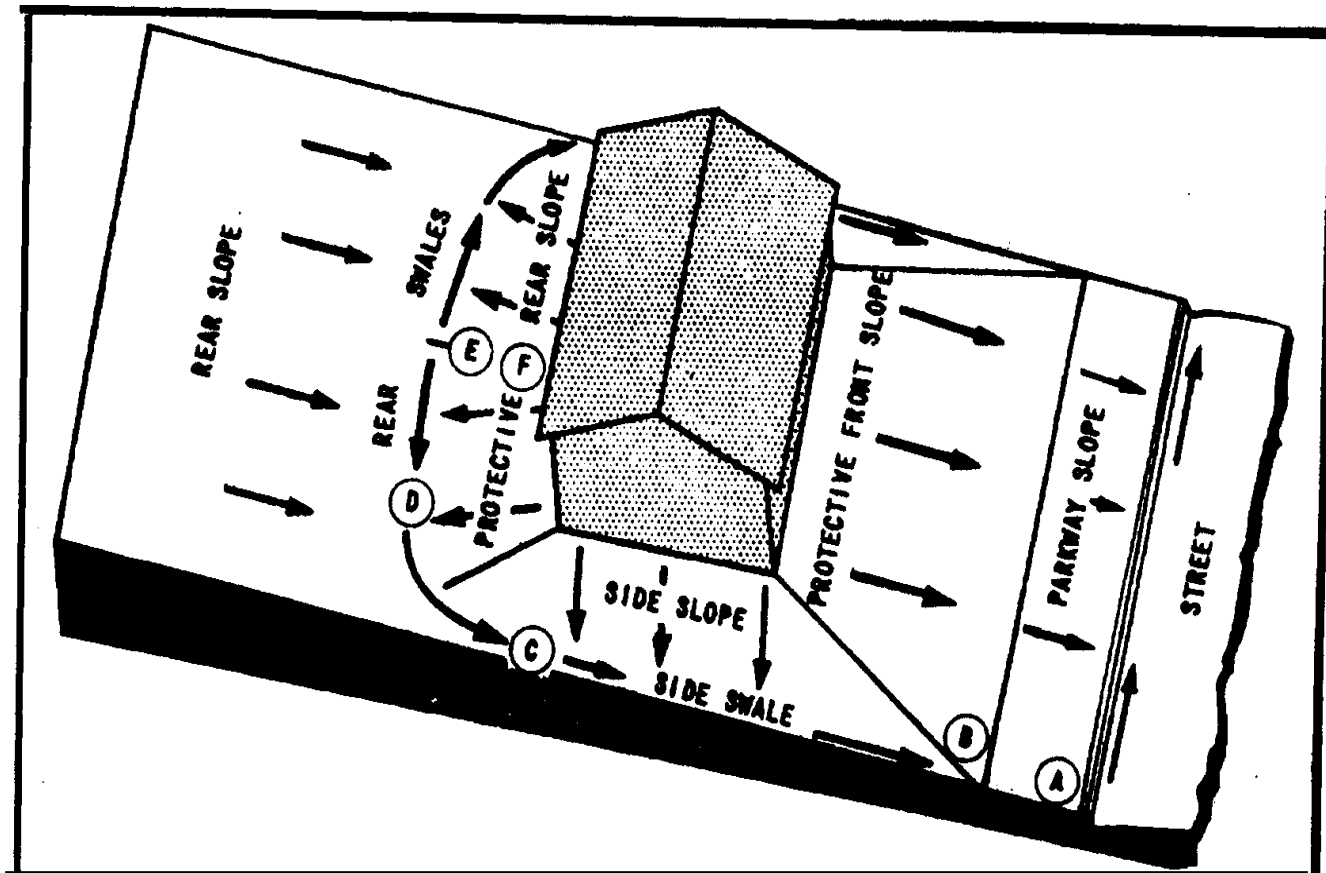
2347-ABR

Report Date:

August 2023

Drawn By:

ASK



Positive site drainage should be maintained at all times. Drainage should not flow uncontrolled down any descending slope. Water should be directed away from foundations and not allowed to pond and/or seep into the ground. Pad drainage should be directed towards the street or other approved area. Roof gutters and down spouts should be considered to control roof drainage. Down spouts should outlet onto paved areas or a minimum of five feet from proposed structures or into a subsurface drainage system. Areas of seepage may develop due to irrigation or heavy rainfall. Minimizing irrigation will lessen this potential. If areas of seepage develop, recommendations for minimizing this effect could be provided upon request.



GeoTek Residential, LLC
2100 Aztec Rd. NE Suite A
Albuquerque, NM 87107

GEOTECHNICAL ENVIRONMENTAL MATERIALS

FIGURE 6
SITE DRAINAGE DETAIL
Scottish Isle Subdivision
Rio Rancho, New Mexico
Prepared for: Abrazo Homes

Project No.:

2347-ABR

Report Date:

August 2023

Drawn By:

ASK

APPENDIX A

REFERENCES

City of Rio Rancho Department of Public Works, Pavement Sections, DWG. No. PS-01, dated May 22, 2008.

“Geologic Map of the Albuquerque – Rio Rancho Metropolitan Area and Vicinity, Bernalillo and Sandoval Counties, New Mexico” by Sean D. Connell, New Mexico Bureau of Geology and Mineral Resources, dated 2008.

HUD Expansive Soil – Foundation & Slab Design, 1-2 Story Slab-on-Grade, issued September 4, 1991.

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Personius, S.F., and Jochems, A.P., compilers, 2016, Fault number 2047, unnamed faults near Loma Colorado de Abajo, in Quaternary fault and fold database of the United States: U.S. Geological Survey website, <https://earthquakes.usgs.gov/hazards/qfaults>

Robert W. Day, “Sample Disturbance of Collapsible Soil”, dated 1990.

Sandoval County Assessors Webpage

Sandra L. Houston, “Sample Disturbance of Cemented Collapsible Soils”, 1988.

USGS Website, Earthquake Hazards Program, Interpolated Probabilistic Ground Motion for the Conterminous 48 States by Latitude/Longitude, 2015 International Building Code Data Edition.

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Walter L. Snowden, “Design of Slab-On-Ground Foundations, An Update”, dated March 1996

William C Haneberg, New Mexico Bureau of Mines and Mineral Resources, Geologic Hazards in New Mexico – Part I, May 1992

APPENDIX B

BORING LOG GENERAL NOTES

CONSISTENCY OF FINE-GRAINED SOILS			RELATIVE DENSITY OF COARSE-GRAINED SOILS	
Unconfined Compressive Strength, Q_u , psf	Standard Penetration or N-Value (SS) Blows/Ft	Consistency	Standard Penetration (SPT) or N-Value (SS) Blows/Ft	Relative Density
< 500	<2	Very Soft	0 - 3	Very Loose
500 - 1,000	2 - 3	Soft	4 - 9	Loose
1,001 - 2,000	4 - 7	Firm	10 - 29	Medium Dense
2,001 - 4,000	8 - 16	Stiff	30 - 49	Dense
4,001 - 8,000	17 - 32	Very Stiff	50+	Very Dense
> 8,001	32+	Hard		

SPT penetration test using 140 pound hammer, with 30 inch free fall on 2 inch outside diameter(1-3/8 ID) sampler
 For ring sampler using 140 lb hammer, with a 30 inch free fall on 3 inch outside diameter (2-1/2 ID) sample,
 use N-value x 0.636 to get Standard N-value
 For fine grained soil consistency, thumb penetration used per ASTM D-2488

RELATIVE PROPORTIONS OF SAND AND GRAVEL		GRAIN SIZE TERMINOLOGY	
Descriptive Term of other constituents	Percent of Dry Weight	Major Component of Sample	Particle Size
Trace	< 15	Boulders	Over 12 inches
With	15 - 29	Cobbles	3 inches to 12 inches
Modifier	> 30	Gravel	#4 Sieve to 3 inches
		Sand	#200 Sieve to #4 Sieve
		Silt or Clay	Passing #200 Sieve

RELATIVE HARDNESS OF CEMENTED SOILS (CALICHE)	
Description	General Characteristics
Very Dense to Moderately Hard	Partially Cemented Granular Soil - Can be carved with a knife and broken with force by hand.
Very Stiff to Moderately Hard	Partially Cemented Fine-Grained Soil - Can be carved with a knife and broken with force by hand.
Moderately Hard	Moderate hammer blow required to break a sample
Hard	Heavy hammer blow required to break a sample
Very Hard	Repeated heavy hammer blow required to break a sample

MOISTURE CLASSIFICATION	
Description*	Degree of Saturation
Dry	0%
Slightly Moist	1% - 50%
Moist	51%-75%
Wet	76% - 99%
Saturated	100%

*Defined as Condition of Sand

BORING LOG LEGEND

MATERIAL DESCRIPTION		
Soil Pattern	USCS Symbol	USCS Classification
	FILL	Artificial Fill
	GP or GW	Poorly/Well graded GRAVEL
	GM	Silty GRAVEL
	GC	Clayey GRAVEL
	GP-GM or GW-GM	Poorly/Well graded GRAVEL with Silt
	GP-GC or GW-GC	Poorly/Well graded GRAVEL with Clay
	GC-GM	Silty Clayey GRAVEL
	SP or SW	Poorly/Well graded SAND
	SM	Silty SAND
	SC	Clayey SAND
	SP-SM or SW-SM	Poorly/Well graded SAND with Silt
	SP-SC or SW-SC	Poorly/Well graded SAND with Clay
	SC-SM	Silty Clayey SAND
	ML	SILT
	MH	Elastic SILT
	CL-ML	Silty CLAY
	CL	Lean CLAY
	CH	Fat CLAY
	PCEM	PARTIALLY CEMENTED
	CEM	CEMENTED
	BDR	BEDROCK

SAMPLING	
	SPT
	Ring Sample
	No Recovery
	Bulk Sample
	Water Table

CONSISTENCY							
Cohesionless Soils		Cohesive Soils		Cementation		Bedrock	
VL	Very Loose	So	Soft	MH	Mod. Hard	Est	Extremely Strong
L	Loose	F	Firm	H	Hard	VSt	Very Strong
MD	Medium Dense	S	Stiff	VH	Very Hard	St	Strong
D	Dense	VS	Very Stiff			MSt	Moderately Strong
VD	Very Dense	H	Hard			W	Weak
						Fr	Friable



BORING LOG

PROJECT #: 2347-ABR
PROJECT: Scottish Isle Subdivision
CLIENT: Abrazo Homes
LOCATION: Rio Rancho, NM

LOGGED BY: KK
METHOD: H.S.A.
DRILLER: Enviro-Drill
DATE: 7/14/23

Depth (ft)	SAMPLES			USCS Symbol	BORING NUMBER: B-3	Consistency	LABORATORY TESTING			
	Sample Type	Blows/Foot	Soil Pattern				Water Content (%)	Dry Density (pcf)	Collapse (%)	Plasticity Index
1				FILL	(SM) Disturbed Native / Artificial Fill; Lt. Brown Silty SAND, Some Gravel, Loose, Slightly Moist	L				
2				SM	Lt. Brown Silty SAND, Some Gravel, Slightly Moist, Lt. Cementation, Loose to Med. Dense	L				
3		10					3	100		
4					-Medium Dense	MD				
5										
6		22					4	97		
7										
8										
9					-Increase in Gravel and Cementation, Dense	D				
10										
11		62					7	117		
12										
13										
14										
15					-Decrease in Cementation					
16		45					3	118		
17					Boring Ends at Approximately 16 Feet Depth No Groundwater Encountered					
18										
19										
20										
21										

TEST PIT LOG GENERAL NOTES

CONSISTENCY OF FINE-GRAINED SOILS

Unconfined Compressive Strength, Qu, psf	Standard Penetration or N-Value (SS) Blows/Ft	Consistency
< 500	<2	Very Soft
500 - 1,000	2 - 3	Soft
1,001 - 2,000	4 - 7	Firm
2,001 - 4,000	8 - 16	Stiff
4,001 - 8,000	17 - 32	Very Stiff
> 8,001	32+	Hard

RELATIVE DENSITY OF COARSE-GRAINED SOILS

Standard Penetration (SPT) or N-Value (SS) Blows/Ft	Relative Density
0 - 3	Very Loose
4 - 9	Loose
10 - 29	Medium Dense
30 - 49	Dense
50+	Very Dense

SPT penetration test using 140 pound hammer, with 30 inch free fall on 2 inch outside diameter(1-3/8 ID) sampler
 For ring sampler using 140 lb hammer, with a 30 inch free fall on 3 inch outside diameter (2-1/2 ID) sample,
 use N-value x 0.636 to get Standard N-value
 For fine grained soil consistency, thumb penetration used per ASTM D-2488

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term of other constituents	Percent of Dry Weight
Trace	< 15
With	15 - 29
Modifier	> 30

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 inches
Cobbles	3 inches to 12 inches
Gravel	#4 Sieve to 3 inches
Sand	#200 Sieve to #4 Sieve
Silt or Clay	Passing #200 Sieve

RELATIVE HARDNESS OF CEMENTED SOILS (CALICHE)

Description	General Characteristics
Very Dense to Moderately Hard	Partially Cemented Granular Soil - Can be carved with a knife and broken with force by hand.
Very Stiff to Moderately Hard	Partially Cemented Fine-Grained Soil - Can be carved with a knife and broken with force by hand.
Moderately Hard	Moderate hammer blow required to break a sample
Hard	Heavy hammer blow required to break a sample
Very Hard	Repeated heavy hammer blow required to break a sample

MOISTURE CLASSIFICATION

Description*	Degree of Saturation
Dry	0%
Slightly Moist	1% - 50%
Moist	51%-75%
Wet	76% - 99%
Saturated	100%

*Defined as Condition of Sand

TEST PIT LOG LEGEND

MATERIAL DESCRIPTION		
Soil Pattern	USCS Symbol	USCS Classification
	FILL	Artificial Fill
	GP or GW	Poorly/Well graded GRAVEL
	GM	Silty GRAVEL
	GC	Clayey GRAVEL
	GP-GM or GW-GM	Poorly/Well graded GRAVEL with Silt
	GP-GC or GW-GC	Poorly/Well graded GRAVEL with Clay
	GC-GM	Silty Clayey GRAVEL
	SP or SW	Poorly/Well graded SAND
	SM	Silty SAND
	SC	Clayey SAND
	SP-SM or SW-SM	Poorly/Well graded SAND with Silt
	SP-SC or SW-SC	Poorly/Well graded SAND with Clay
	SC-SM	Silty Clayey SAND
	ML	SILT
	MH	Elastic SILT
	CL-ML	Silty CLAY
	CL	Lean CLAY
	CH	Fat CLAY
	PCEM	PARTIALLY CEMENTED
	CEM	CEMENTED
	BDR	BEDROCK

SAMPLING	
	SPT
	Ring Sample
	No Recovery
	Bulk Sample
	Water Table

CONSISTENCY							
Cohesionless Soils		Cohesive Soils		Cementation		Bedrock	
VL	Very Loose	So	Soft	VD/VS-	Partially	ESt	Extremely Strong
L	Loose	F	Firm	MH	Cemented	VSt	Very Strong
MD	Medium Dense	S	Stiff	MH	Mod. Hard	St	Strong
D	Dense	VS	Very Stiff	H	Hard	MSt	Moderately Strong
VD	Very Dense			VH	Very Hard	W	Weak
						Fr	Friable

[illegible]

Depth (ft)	SAMPLES			USCS Symbol	TEST PIT NUMBER: TP-2	Consistency	LABORATORY TESTING			
	Sample Type	Blows/Foot	Soil Pattern				Water Content (%)	Dry Density (pcf)	Swell (%)	Plasticity Index
					MATERIAL DESCRIPTION AND COMMENTS					
1				FILL	(SM) Disturbed Native/Artificial Fill, Lt. Brown Silty SAND, Some Gravel and Organics, Loose to Med. Dense, Slightly Moist	L-MD				
2				SM	Lt. Brown Silty SAND, Some Gravel, Medium Dense, Slightly Moist, Lt. Cementation	MD				
3										
4										
5										
6										
7										
8										
9										
10										
11										
12	Test Pit Ends at Approximately 11 Feet Depth No Groundwater Encountered									
13										
14										
15										
16										
17										
18										
19										
20										

LOGGED BY:	MW
METHOD:	Mini-Ex
OPERATOR:	RAC
DATE:	7/19/23

LOGGED BY:	MW
METHOD:	Mini-Ex
OPERATOR:	RAC
DATE:	7/19/23

LOGGED BY:	MW
METHOD:	Mini-Ex
OPERATOR:	RAC
DATE:	7/19/23

APPENDIX C

LABORATORY TESTS RESULTS (2347-ABR)

MOISTURE CONTENT AND IN SITU DRY DENSITY OF SOIL

Moisture content and in situ dry density tests were performed on samples of soil. The samples were weighed and dried back in a low temperature oven to determine the weight of the dried sample and moisture loss. The dry density was calculated using the known volume of the thin-walled brass ring sample. The percent moisture and dry density were then determined in accordance with ASTM D7263. The test results are presented on the boring logs.

MAXIMUM DRY DENSITY AND OPTIMUM MOISTURE CONTENT

The maximum dry density and optimum moisture content of selected representative soil samples were evaluated using the Modified Proctor method in general accordance with ASTM D1557. Test results are presented in the following pages.

PARTICLE SIZE ANALYSIS

Sieve analyses were performed in general accordance with ASTM test method C136 / C117. Test results are presented in the following plates.

ATTERBERG LIMITS

Atterberg limits were performed on representative samples in general accordance with AASHTO T89 and T90. Test results are shown in the following pages.

CHEMICAL TESTING (Sulfates and Chlorides)

Testing was performed to determine the amount of water-soluble salt in representative samples of the soil. Individual test results denote the parts per million analytes soluble in water at a 1:5 (soil to water) extraction ratio. The samples were prepared and tested in accordance with EPA procedures. All chemical testing was performed by *Hall Environmental Analysis Laboratory*. Test results are presented on the following pages.

SWELL TESTS

Swell tests were performed on remolded samples of soil. The samples were remolded at ± 90 percent of the material's maximum dry density and oven dried to below the materials shrinkage limit. All samples were then placed under a 60 pound per square foot surcharge to simulate typical residential floor slab loading conditions, and inundated with water for at least 24 hours. The percent swell was then recorded as the amount of vertical rise compared to the original one-inch sample height.

COLLAPSE TESTING

In-situ soil samples were obtained from ring samples and various loads were applied to determine the percent collapse in general accordance with ASTM D2435 and D4546. The samples were inundated with water at predetermined loads to estimate the percent hydro-collapse. Test results are presented in the following pages.



GeoTek, Inc.
2100 Aztec Road NE, Albuquerque, NM 87107
(505) 456-4900 Office (505) 456-4901 Fax www.geotekusa.com

In-Situ Moisture/Density of Ring Samples

GeoTek Project No. 2347-ABR

Client: Abrazo Homes

Project: Scottish Isle Subdivision

Sample Location	Sample Depth	Moisture (%)	Dry Density (lb/ft ³)
B-1	1-2'	2.5	103.4
B-1	10-11'	3.1	109.3
B-1	15-16'	3.7	106.8
B-2	1.5-2.5'	8.0	96.1
B-2	5-6'	1.9	99.0
B-2	10-11'	1.0	101.7
B-2	15-16'	3.2	112.9
B-2	20-21'	3.5	118.7
B-3	2.5-3.5'	3.3	99.5
B-3	5-6'	4.0	97.1
B-3	10-11'	6.7	117.1
B-3	15-16'	2.8	118.2
B-4	3.5-4.5'	2.9	105.6
B-4	5-6'	1.9	104.5
B-4	10-11'	3.1	107.7
B-4	15-16'	1.1	115.6

Material Test Report

Report No: MAT:23-00331-S01

Issue No: 1

Client: Abrazo Homes
9798 Coors Boulevard NW #400
Albuquerque NM 87114

CC:

Project: 2347-ABR
Scottish Isle Subdivision



Alexander Koehler

Reviewed By: Alexander Koehler
(Staff Professional)
Date of Issue: 8/7/2023

THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

Sample Details

Sample ID 23-00331-S01
Date Sampled 7/14/2023
Specification Generic Sieve
Sampled By Kevin Kennedy
Location B-3, 5-10'

Other Test Results

Description	Method	Result	Limits
Liquid Limit (%)	AASHTO T 89	18	
Plastic Limit (%)	AASHTO T 90	NP	
Plasticity Index	AASHTO T 90	NP	
Group Symbol	ASTM D 2487	SM	
Group Name		Silty sand	

Particle Size Distribution

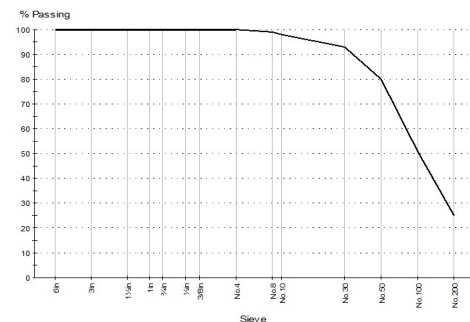
Method: ASTM C 136, ASTM C 117

Date Tested:

Tested By:

Sieve Size	% Passing	Limits
6in	100	
3in	100	
1½in	100	
1in	100	
¾in	100	
½in	100	
3/8in	100	
No. 4	100	
No. 8	99	
No. 10	98	
No. 30	93	
No. 50	80	
No. 100	51	
No. 200	25	

Chart



Comments

NP = Non Plastic

Material Test Report

Report No: MAT:23-00331-S02

Issue No: 1

Client: Abrazo Homes
9798 Coors Boulevard NW #400
Albuquerque NM 87114

CC:

Project: 2347-ABR
Scottish Isle Subdivision



Alexander Koehler

Reviewed By: Alexander Koehler
(Staff Professional)
Date of Issue: 8/7/2023

THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

Sample Details

Sample ID 23-00331-S02
Date Sampled 7/14/2023
Specification Generic Sieve
Sampled By Kevin Kennedy
Location B-4, 1-5'

Other Test Results

Description	Method	Result	Limits
Liquid Limit (%)	AASHTO T 89	N/A	
Plastic Limit (%)	AASHTO T 90	NP	
Plasticity Index	AASHTO T 90	NP	
Maximum Dry Unit Weight (lb/ft ³)	ASTM D 1557	125.8	
Corrected Maximum Dry Unit Weight (lb/ft ³)		125.8	
Optimum Water Content (%)		9.1	
Corrected Optimum Water Content (%)		9.1	
Method		A	
Group Symbol	ASTM D 2487	SM	
Group Name		Silty sand	
Swell (%)	ASTM D 4546	1.2	

Particle Size Distribution

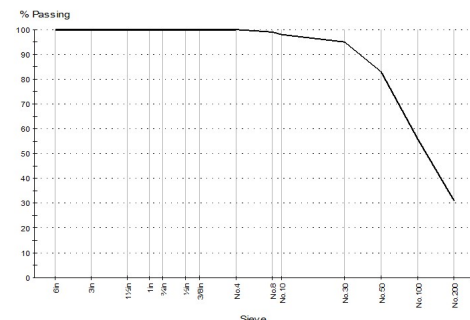
Method: ASTM C 136, ASTM C 117

Date Tested:

Tested By:

Sieve Size	% Passing	Limits
6in	100	
3in	100	
1½in	100	
1in	100	
¾in	100	
½in	100	
3/8in	100	
No. 4	100	
No. 8	99	
No. 10	98	
No. 30	95	
No. 50	83	
No. 100	56	
No. 200	31	

Chart



Comments

NP = Non Plastic

Material Test Report

Report No: MAT:23-00338-S01

Issue No: 1

Client: Abrazo Homes
9798 Coors Boulevard NW #400
Albuquerque NM 87114

CC:

Project: 2347-ABR
Scottish Isle Subdivision




Reviewed By: Alexander Koehler
(Staff Professional)
Date of Issue: 8/7/2023

THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

Sample Details

Sample ID 23-00338-S01
Date Sampled 7/19/2023
Specification Generic Sieve
Sampled By Mariah Welch
Location TP-1, 1-4'

Other Test Results

Description	Method	Result	Limits
Liquid Limit (%)	AASHTO T 89	N/A	
Plastic Limit (%)	AASHTO T 90	NP	
Plasticity Index	AASHTO T 90	NP	
Group Symbol	ASTM D 2487	SM	
Group Name		Silty sand	
Swell (%)	ASTM D 4546	0.7	

Particle Size Distribution

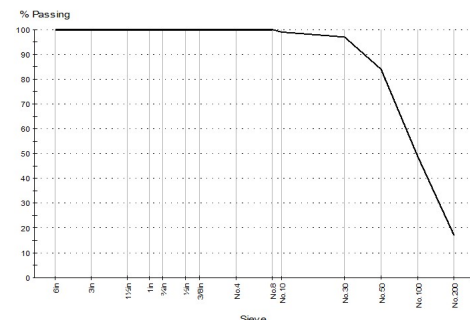
Method: ASTM C 136, ASTM C 117

Date Tested:

Tested By:

Sieve Size	% Passing	Limits
6in	100	
3in	100	
1½in	100	
1in	100	
¾in	100	
½in	100	
3/8in	100	
No. 4	100	
No. 8	100	
No. 10	99	
No. 30	97	
No. 50	84	
No. 100	49	
No. 200	17	

Chart



Comments

NP = Non Plastic

Material Test Report

Report No: MAT:23-00338-S02

Issue No: 1

Client: Abrazo Homes
9798 Coors Boulevard NW #400
Albuquerque NM 87114

CC:

Project: 2347-ABR
Scottish Isle Subdivision



Alexander Koehler

Reviewed By: Alexander Koehler
(Staff Professional)
Date of Issue: 8/7/2023

THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

Sample Details

Sample ID 23-00338-S02
Date Sampled 7/19/2023
Specification Generic Sieve
Sampled By Mariah Welch
Location TP-5, 4-5'

Other Test Results

Description	Method	Result	Limits
Liquid Limit (%)	AASHTO T 89	N/A	
Plastic Limit (%)	AASHTO T 90	NP	
Plasticity Index	AASHTO T 90	NP	
Group Symbol	ASTM D 2487	SM	
Group Name		Silty sand	
Swell (%)	ASTM D 4546	1.6	

Particle Size Distribution

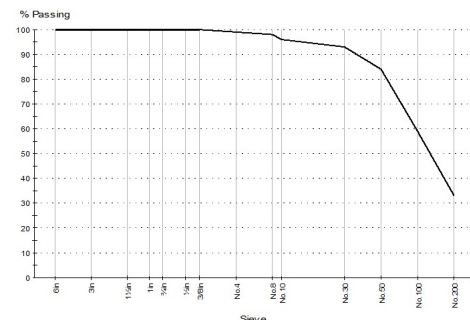
Method: ASTM C 136, ASTM C 117

Date Tested:

Tested By:

Sieve Size	% Passing	Limits
6in	100	
3in	100	
1½in	100	
1in	100	
¾in	100	
½in	100	
3/8in	100	
No.4	99	
No.8	98	
No.10	96	
No.30	93	
No.50	84	
No.100	59	
No.200	33	

Chart



Comments

NP = Non Plastic

Material Test Report

Report No: MAT:23-00338-S03

Issue No: 1

Client: Abrazo Homes
9798 Coors Boulevard NW #400
Albuquerque NM 87114

CC:

Project: 2347-ABR
Scottish Isle Subdivision



Reviewed By: Alexander Koehler
(Staff Professional)
Date of Issue: 8/7/2023

THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

Sample Details

Sample ID 23-00338-S03
Date Sampled 7/19/2023
Specification Generic Sieve
Sampled By Mariah Welch
Location TP-6, 6-7'

Other Test Results

Description	Method	Result	Limits
Liquid Limit (%)	AASHTO T 89	N/A	
Plastic Limit (%)	AASHTO T 90	NP	
Plasticity Index	AASHTO T 90	NP	
Group Symbol	ASTM D 2487	SM	
Group Name		Silty sand	

Particle Size Distribution

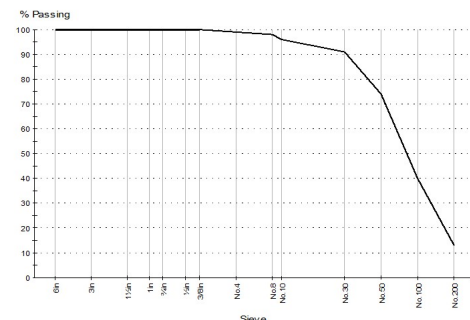
Method: ASTM C 136, ASTM C 117

Date Tested:

Tested By:

Sieve Size	% Passing	Limits
6in	100	
3in	100	
1½in	100	
1in	100	
¾in	100	
½in	100	
3/8in	100	
No.4	99	
No.8	98	
No.10	96	
No.30	91	
No.50	74	
No.100	40	
No.200	13	

Chart



Comments

NP = Non Plastic

Proctor Report

Report No: PTR:23-00331-S02

Issue No: 1

Client: Abrazo Homes
9798 Coors Boulevard NW #400
Albuquerque NM 87114

CC:

Project: 2347-ABR
Scottish Isle Subdivision



Alexander Koehler

Reviewed By: Alexander Koehler
(Staff Professional)
Date of Issue: 8/7/2023

THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

Sample Details

Sample ID: 23-00331-S02

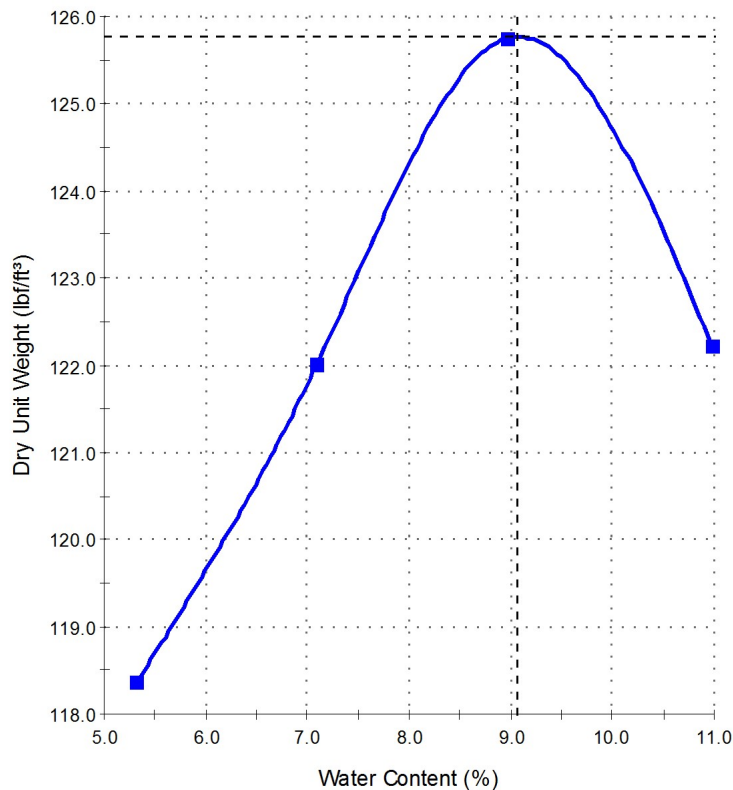
Date Sampled: 7/14/2023

Sampled By: Kevin Kennedy

Specification: Generic Sieve

Location: B-4, 1-5'

Dry Unit Weight - Water Content Relationship



Test Results

ASTM D 1557

Maximum Dry Unit Weight (lb/ft³): 125.8

Optimum Water Content (%): 9.1

Method: A

Preparation Method:

Tested By:

Date Tested:

AASHTO T 89/T 90

Liquid Limit (%): N/A

Plastic Limit (%): NP

Plasticity Index (%): NP

Tested By:

Date Tested:

Comments

NP = Non Plastic



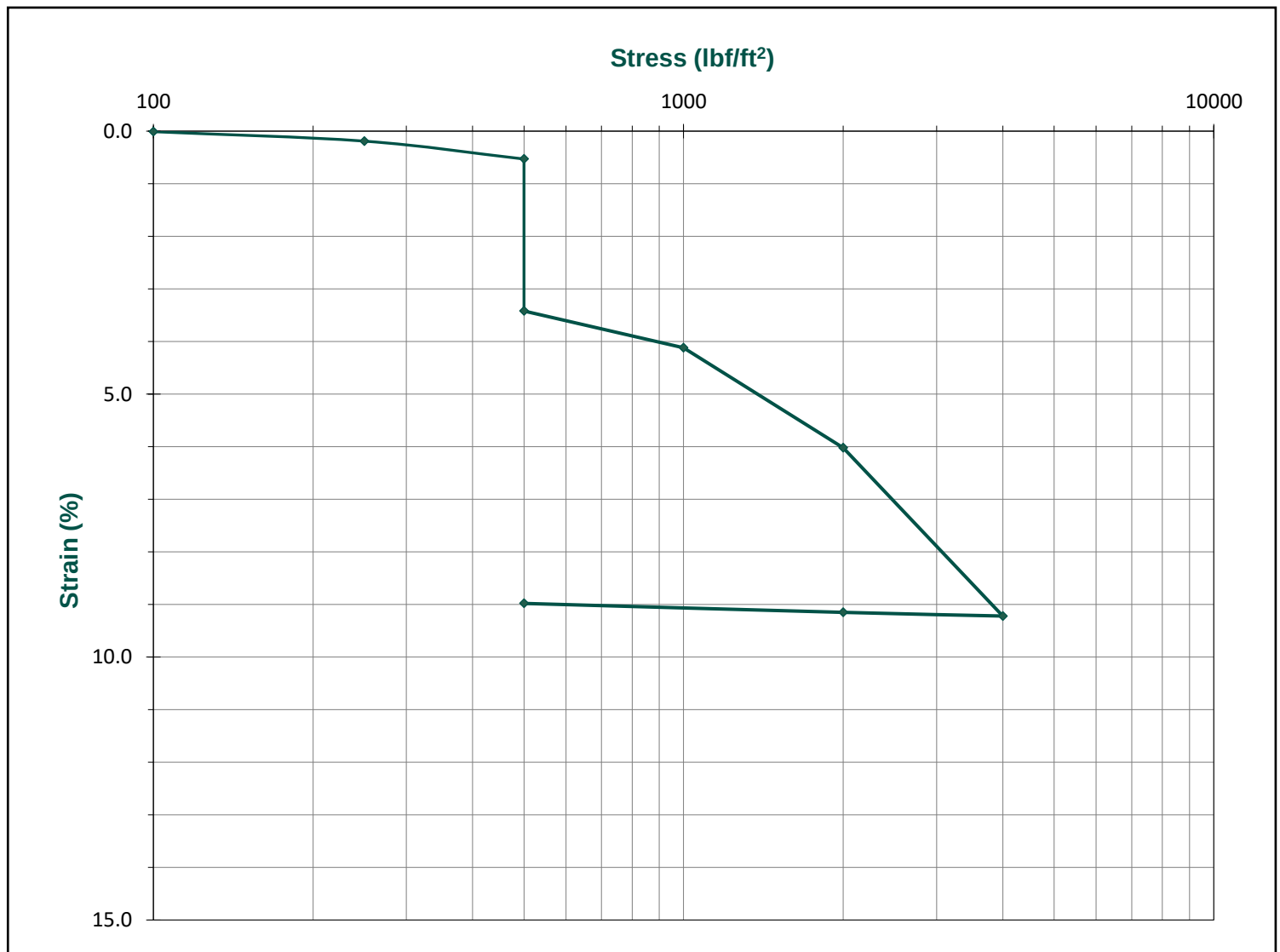
In-Situ Consolidation of Ring Samples

GeoTek Project No.: 2347-ABR

Client: Abrazo Homes

Project: Scottish Isle Subdivision

Sample Location	Sample Depth	Dry Density (lb/ft ³)	Moisture (%)	Collapse (%)	Applied Load at Saturation (lb/ft ²)
B-2	5-6'	99.0	1.9	2.9	500





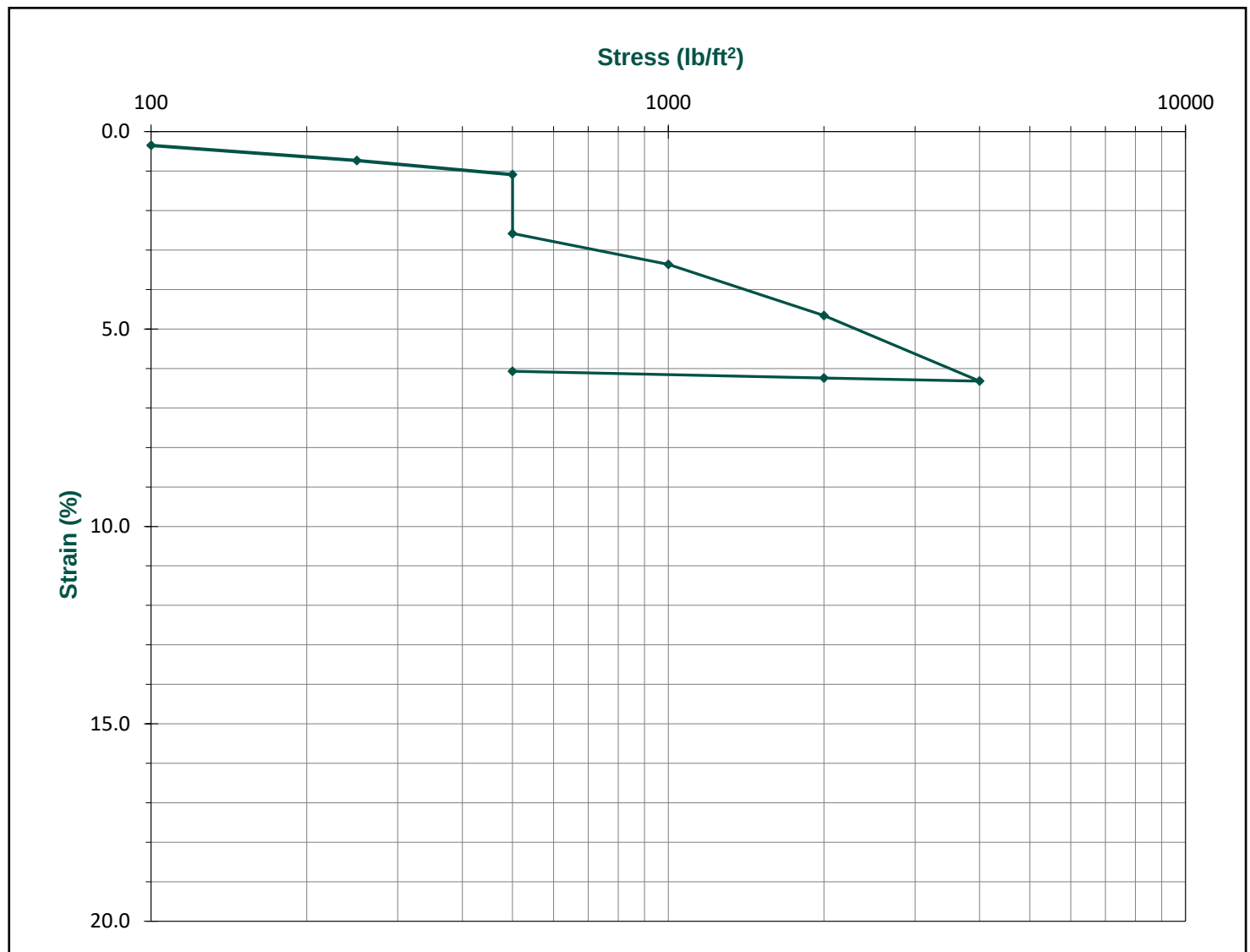
In-Situ Consolidation of Ring Samples

GeoTek Project No.: 2347-ABR

Client: Abrazo Homes

Project: Scottish Isle Subdivision

Sample Location	Sample Depth	Dry Density (lb/ft ³)	Moisture (%)	Collapse (%)	Applied Load at Saturation (lb/ft ²)
B-4	5-6'	104.5	1.9	1.5	500





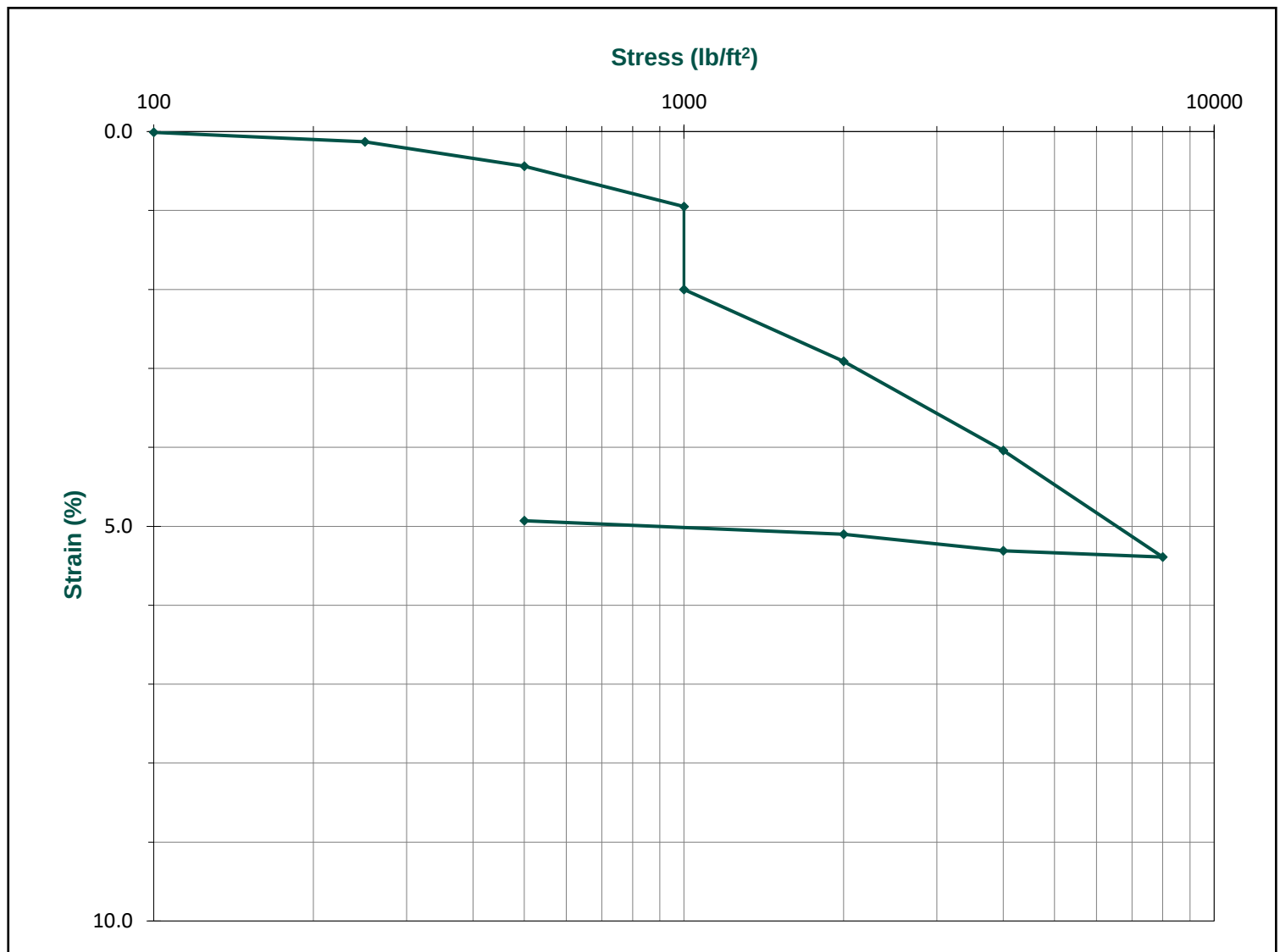
In-Situ Consolidation of Ring Samples

GeoTek Project No.: 2347-ABR

Client: Abrazo Homes

Project: Scottish Isle Subdivision

Sample Location	Sample Depth	Dry Density (lb/ft ³)	Moisture (%)	Collapse (%)	Applied Load at Saturation (lb/ft ²)
B-1	10-11'	108.9	3.1	1.1	1000



Hall Environmental Analysis Laboratory, Inc.

Analytical Report

Lab Order 2307763

Date Reported: 7/25/2023

CLIENT: Geotek

Client Sample ID: B-5, 0-3'

Project: Scottish Isle

Collection Date: 7/14/2023 1:30:00 PM

Lab ID: 2307763-001

Matrix: SOIL

Received Date: 7/17/2023 4:48:00 PM

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
EPA METHOD 300.0: ANIONS						Analyst: SNS
Chloride	25	7.5		mg/Kg	5	7/20/2023 7:57:17 PM
Sulfate	78	7.5		mg/Kg	5	7/20/2023 7:57:17 PM

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:	*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
	D	Sample Diluted Due to Matrix	E	Above Quantitation Range/Estimated Value
	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
	ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
	PQL	Practical Quantitative Limit	RL	Reporting Limit
	S	% Recovery outside of standard limits. If undiluted results may be estimated.		

APPENDIX D

HOMEOWNER MAINTENANCE CRITERIA

Landscape Maintenance and Planting

Only the amount of irrigation necessary to sustain plant life should be provided. Over watering the landscape areas could adversely affect proposed site improvements and cause residential distress. Irrigation systems should be reviewed on at least a monthly basis for; leaks, damaged pipes, breaks, dysfunctional sprinkler heads, etc., and if found should be repaired as soon as possible. We recommend that any proposed open bottom planter areas, adjacent to proposed structures, be eliminated for a minimum distance of 5 feet and, outside the zone, desert landscape using xeriscape technology be used. As an alternative, closed bottom type planters could be utilized. An outlet, placed in the bottom of the planter, could be installed to direct drainage away from structures or any exterior concrete flatwork.

Water has been shown to weaken the inherent strength of all earth materials. Slope stability is significantly reduced by overly wet conditions. Graded slopes constructed within and utilizing onsite materials would be erosive. Eroded debris may be minimized and surficial slope stability enhanced by establishing and maintaining a suitable vegetation cover as soon as possible after construction. Compaction to the face of fill slopes would tend to minimize short-term erosion until vegetation is established. Plants selected for landscaping should be lightweight, deep-rooted types, which require little water and are capable of surviving the prevailing climate. From a geotechnical standpoint leaching is not recommended for establishing landscaping. If the surface soils are processed for the purpose of adding amendments, they should be recompact to 90 percent compaction.

Drainage

Positive site drainage should be maintained at all times in accordance with the IBC. Drainage should not flow uncontrolled down any descending slope. Water should be directed away from foundations and not allowed to pond and/or seep into the ground. Pad drainage should be directed toward the street or other approved area. Roof gutters and down spouts should be considered to control roof drainage. Down spouts should outlet onto paved areas or a minimum of five feet from proposed structures or into a subsurface drainage system. Areas of seepage may develop due to irrigation or heavy rainfall. Minimizing irrigation will lessen this potential. If areas of seepage develop, recommendations for minimizing this effect could be provided upon request.

Site Improvements

As is commonly known, expansive soils are problematic with respect to the design, construction and long-term performance of concrete flatwork. Due to the nature of concrete flatwork, it is essentially impossible to totally mitigate the effects of soil expansion. Typical measures to control soil expansion for structures include; low expansive soil caps, deepened foundation system, post-tensioned slabs, increased structural design, and soil pre-saturation. As they are generally not cost effective, these measures are very seldom utilized for flatwork because it's less costly to simply replace any damaged or distressed sections than to "structurally" design them. Even if "structural" design parameters are applied to flatwork construction, there would still be relative movements between adjoining types of structures and other improvements (i.e., curb and sidewalk). This is particularly true as the level of care during construction of flatwork is often not as meticulous as that for structures. Unfortunately, it is fairly common practice for flatwork to be poured on subgrade soils, which have been allowed to dry out since site grading.

HOMEOWNER MAINTENANCE CRITERIA (Cont.)

Generally after flatwork construction is completed, landscape irrigation begins, utility lines are pressurized, and drainage systems are utilized presenting the potential for water to enter the dry subgrade soils and causing the soil to expand. Recommendations for exterior concrete flatwork design and construction can be provided upon request.

If, in the future, any additional improvements are planned for the site, recommendations concerning the geological or geotechnical aspects of design and construction of said improvements could be provided upon request, please contact a representative of GeoTek for appropriate geotechnical consultation. All trench excavations should be observed by a representative of this office. Trench spoil and any excess soils generated from trench excavations should be compacted to a minimum relative compaction of 90 percent if not removed from the site. This office should be notified in advance of any fill placement, grading, or trench backfilling after rough grading has been completed. This includes any grading, utility trench and retaining wall backfills.

Soil Corrosion

Chemical testing was performed on soils representative of this project. According to the test results, the soil contains concentrations of sulfates to be categorized as “negligible” as defined by the International Building Code (IBC) Section 1904 and American Concrete Institute (ACI) Building Code Requirements for Structural Concrete (ACI 318). However, we recommend the use of sulfate resistant concrete for “severe” conditions (Type V Portland Cement or equivalent for severe sulfate exposure conditions) for all concrete mixtures in contact with soil. According to Section 1904 of the 2018 International Building Code, concrete exposed to “severe” sulfate exposure conditions must use Type V cement, have a minimum specified compressive strength (f'_c) of 4,500 psi and a maximum water-cementitious materials ratio of 0.45. All concrete should be designed, mixed, placed, finished, and cured in accordance with guidelines presented by the Portland Cement Association (PCA), the American Concrete Institute (ACI), and the International Building Code (IBC).

According to the test results, no additional corrosion mitigation is required as the on-site soils contain less than 500 ppm soluble soil chloride concentrations. Provided on-site soils and required import fill contain less than 500 ppm chlorides, protection from corrosion due to chlorides is not required. If concrete is in direct contact with soils containing concentrations of greater than 500 ppm chlorides, tendons and reinforcing steel should be protected from corrosion in conformance with Table 10.1 in Section 10 of the Standard Requirements for Design and Analysis of Shallow Post-Tensioned Concrete Foundations on Expansive and Stable Soils.