August 7, 2012  
Alpha Project #12-G-2697  

GRIC Property and Supply  
312 W. Casa Blanca Rd., Post Office Box 97  
Sacaton, AZ 84257  

Attention: Ms. Cynthia Gerard  

RE: Geotechnical Subsurface Exploration  
GRIC Central Housing Subdivision  
SEC Cholla Road and Seed Farm Road  
Sacaton, Arizona  

Dear Ms. Gerard:  

In accordance with your request and authorization, Alpha Geotechnical & Materials, Inc. (Alpha) has performed a geotechnical subsurface exploration for the GRIC Central Housing Subdivision residential development located on the southeastern corner of Cholla Road and Seed Farm Road in Sacaton, Arizona. The purpose of this report is to provide recommendations relative to the geotechnical aspects of design and construction of the project.  

Based on our findings, the site is considered suitable for the proposed construction, provided foundation systems are properly designed, specified site grading recommendations are used, and foundation bearing soils are not exposed to moisture infiltration or moisture content fluctuation. Specific recommendations regarding the geotechnical aspects of project design and construction are presented in the following report. The recommendations contained within this report are dependent on the provisions provided in the Limitations and Recommended Additional Services sections of this report.  

We appreciate the opportunity to provide our services for this project. If you have questions regarding this report or if we may be of further assistance, please contact the undersigned.  

Sincerely,  

ALPHA GEOTECHNICAL & MATERIALS, INC.  

Scott R. Smith, P.E.  
Senior Geotechnical Engineer
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1. EXECUTIVE SUMMARY

August 7 2012
Alpha Project #12-G-2697

GRIC Property and Supply
312 W. Casa Blanca Road, Post Office Box 97
Sacaton, AZ 84257

Attention: Ms. Cynthia Gerard

RE: Geotechnical Subsurface Investigation
GRIC Central Subdivision
SEC Cholla Road and Seed Farm Road
Sacaton, Arizona

The purpose of this exploration was to evaluate the general surface and subsurface conditions at the referenced site, and to present geotechnical design recommendations for foundations, slab-on-grade, and on-site pavements for the proposed development.

Geotechnical Site Reconnaissance
The project is bounded to the north by Seed Farm Road, to the west by Cholla Road, to the east by residential single family subdivisions, and south by vacant land. Both Seed Farm Road and Cholla Road were paved with asphaltic concrete as were the interior streets (Wipsmal Street, Chiadag Street, Nakshel Street, Toha Street, and Whog Street). Site topography was relatively flat with 124 existing single level homes across the site. At the time of our study, the majority of lots had none to a light growth of shrubs and trees present.

Site Soils
The naturally occurring coarse grained site surface and subsurface soils encountered during our exploration consisted primarily of clayey sand (SC) with lesser amounts of silty sand (SM) and poorly graded sand (SP). The relative densities of these soils ranged from loose to medium dense. The soils sampled during our exploration had low expansive characteristics. See attached report for details. Weak carbonate cementation was found several of the soil test borings. No bedrock was encountered during our field investigation.

Project Description
The proposed project will include a replacement of the existing housing within the subdivision over several years. The Central Housing Subdivision (AZ 15-15, AZ 15-20, AZ 15-24, and AZ 15-30) is approximately 41 acres in area located at the southeast corner of Cholla Road and Seed Farm Road in Sacaton, GRIC, Arizona. All of the homes will be single level slab on grade. It is anticipated that the proposed residential buildings construction will be either wood frame or masonry block walls. We have not been provided with structural loads. However, based on our previous experience with similar structures, we estimate the maximum column and wall loads for the structures will be about 40 kips and 3 KLF, respectively. It is understood that the existing roadways and utilities are planned to remain in service.
Site Drainage
Positive drainage is essential to the successful performance of any foundation or slab-on-grade. Good surface and subsurface drainage should be established during and after construction to prevent the soils below or adjacent to the building areas from becoming wet. Desert-type landscaping is advisable near the building and pavement areas. Plants, which require more water, should be located and drained away from the structural and pavement areas.

Foundations
Post-tensioned slabs and/or conventional footings bearing on properly compacted engineered fills may be used to support the structures. We anticipate that total and differential settlements for foundations designed in accordance with the recommendations provided in the attached report, will be within generally acceptable tolerance as presented in the attached report. Additional foundation movements could occur if water from any source infiltrates the foundation soils.

Land Subsidence and Earth Fissures
The project site is located approximately ten (10) miles east of an area of documented earthen fissures in the Signal Butte area and in an area with a measured land subsidence of between zero and one foot (Land Subsidence and Earth Fissures in Alluvial Deposits in Phoenix area, Arizona by H.H. Schumann, 1974, and http://azmap.org/fissures).

Conclusion
Based on our findings, the site is considered suitable for the proposed residential development, imposing relatively light foundation loads provided slab/foundation systems are properly designed, specified compaction for fill material is used, and foundation bearing soils are not exposed to moisture infiltration or moisture content fluctuation.

Should you have any questions concerning the contents of this report or any other matter, please do not hesitate to contact the undersigned at (602) 453-3265.

Respectfully submitted,

Alpha Geotechnical & Materials, Inc.

Scott R. Smith, P.E. (expires 3/31/2014)
Senior Geotechnical Engineer
2. INTRODUCTION

2.1. General

The purpose of this geotechnical exploration was to evaluate the general surface and subsurface conditions at the referenced site, and to present recommendations related to geotechnical aspects of design and construction of the project for foundations. Results of our field/laboratory testing are also presented within this report. Our scope of services was in general accordance with our proposal 12-G-2697, dated June 27, 2012. This geotechnical report is based on available project information and the site plan provided by the client and our experience with similar construction and soil conditions.

Our study included a site reconnaissance, subsurface exploration, soil sampling, field and laboratory testing, engineering analyses, and preparation of this report. This report presents recommendations for design of suitable foundation types, site grading and structural fill placement, moisture protection, and construction considerations. The recommendations contained in this report are subject to the limitations presented herein. Attention is directed to the “Limitations” section of this report.

2.2. Proposed Project

The proposed project will include a replacement of the existing housing within the subdivision over several years. The Central Housing Subdivision (AZ 15-15, AZ 15-20, AZ 15-24, and AZ 15-30) is approximately 41 acres in area located at the southeast corner of Cholla Road and Seed Farm Road in Sacaton, GRIC, Arizona. All of the homes will be single level slab on grade. It is anticipated that the proposed residential buildings construction will be either wood frame or masonry block walls. We have not been provided with structural loads. However, based on our previous experience with similar structures, we estimate the maximum column and wall loads for the structures
will be about 40 kips and 3 KLF, respectively. It is understood that the existing roadways and utilities are planned to remain in service.

### 3. FIELD EXPLORATION

Eight soil test borings were advanced at the subject site to an approximate depth of fifteen (15) feet below existing ground level with a CME 55 power drill rig. The soil test borings were advanced using 8-inch hollow stem augers to develop information relative to foundation and pavement design recommendations. The borings were located in the field at the approximate locations shown on the sample location plan included in the Appendix A of this report. Prior to the start of drilling, the Arizona Blue Stake Center was contacted to locate existing utilities at the boring locations. Upon completion of the borings, the boreholes were backfilled with excavated materials.

Soil classifications made during our field exploration from excavated soil samples were confirmed in the laboratory after further examination. The site soils were classified in accordance with the Unified Soil Classification System presented, along with the soil test logs, in Appendix B. Sample classifications and other related information are recorded on the soil boring logs which are presented in Appendix B.

### 4. LABORATORY TESTING

Selected soil samples from the borings were tested in the laboratory for classification purposes and to evaluate their engineering properties. The laboratory tests included:

- Gradation;
- Atterberg limits;
- Moisture content;
- One-dimensional consolidation;
- Undisturbed ring density;
- Sulfate content;
- Chloride content;
- Soluble salts;
- Expansion index.

A brief description of each test performed on the soil samples and the results are presented in Appendix C.

5. GEOLOGY CONDITIONS

5.1. Regional Geology

The southwest region of Arizona is referred to as the Basin and Range Geologic Province. This province consists primarily of a low dry desert environment with a mixture of long faults, fractured rock and wide alluvial basins. The mountain ranges within the province consist of Precambrian plutonic, volcanic and metamorphic rock.

6. GENERAL SITE CONDITIONS

6.1. Surface Conditions

The project is bounded to the north by Seed Farm Road, to the west by Cholla Road, to the east by residential single family subdivisions, and south by vacant land. Both Seed Farm Road and Cholla Road were paved with asphaltic concrete as were the interior streets (Wipsmal Street, Chiadag Street, Nakshel Street, Toha Street, and Whog Street). Site topography was relatively flat with 124 existing single level homes across the site. At the time of our study, the majority of lots had none to a light growth of shrubs and trees present.

The existing asphaltic concrete streets pavements were observed during the field investigation. Wipsmal Street had extensive cracking of the asphaltic concrete surface with cracking at an approximately 6 inch spacing with one inch wide transverse cracking
approximately every 10 feet. Most of a chip seal surfacing had worn off of the pavement surface. Chiadag Street had extensive cracking of the asphaltic concrete surface with cracking at an approximately 6 inch spacing with one inch wide transverse cracking approximately every 10 feet. The pavement surface was raveled and there were some recent patches in the wider cracks. Nakshel Street had large block cracking at approximate 6 foot spacing with cracks of one to one and one half inch width. Toha Street had extensive cracking of the asphaltic concrete surface with cracking at approximate 6 inch spacing. Whog Street had block cracking at 6 to 8 feet spacing with areas of eight inch spacing between cracks adjacent to the some of the larger block cracks.

6.2. Subsurface Conditions

The naturally occurring coarse grained site surface and subsurface soils encountered during our exploration consisted primarily of clayey sand (SC) with lesser amounts of silty sand (SM) and poorly graded sand (SP). The relative densities of these soils ranged from loose to medium dense. The soils sampled during our exploration had low expansive characteristics. Weak carbonate cementation was found several of the soil test borings. No bedrock was encountered during our field investigation.

6.3. Groundwater Conditions

At the time of our field investigation, free groundwater was not encountered in our explorations. It should be noted that groundwater and soil moisture conditions within the area will vary depending on rainfall, irrigation practices, and/or runoff conditions not apparent at the time of our field investigation.
6.4. Geologic Hazards

6.4.1. Liquefaction Potential

Based on the type and densities of the native site soils encountered during this investigation and groundwater not being encountered at depth explored, the preliminary potential for soil liquefaction is considered to be negligible.

6.4.2. Collapsible Soils

Collapsible soils are soils with the potential for a decrease in volume with an increase of external load or moisture. These soils are typically found in areas of alluvial deposits with semi-arid to arid climates. Based on the information collected during our field investigation and subsequent laboratory testing, we anticipate collapse-susceptible soils will be encountered during construction. Based on ASTM D 5333, the collapse potential of the undisturbed ring samples collected during our field investigation indicated a moderate to high collapse potential. The potential for damage due to the collapse of the site soil is considered low provided that the overexcavation and recompaction measures for the sub-grade improvements are implemented in accordance with the recommendations presented in section 7 of this report.

6.5. Seismic Considerations

The project site is located in south-central Arizona which is an area of low seismic activity. The following values were developed using the 2006 International Building Code (IBC) and are based on knowledge of local geologic conditions, and subsurface soils encountered during our investigation. A 100 foot soil test boring was not advanced during our field investigation and, therefore, our recommendations are based on our knowledge of subsurface conditions and our experience in the vicinity of the project site. A site class D (stiff soil profile 1.60 and 2.40) may be used for design.
Central Latitude………………………………………33.071543˚
Central Longitude……………………………………-111.744733˚
$S_s$ Spectral Acceleration for Short Period………………0.202g
$S_1$ Spectral Acceleration for a 1-Second Period…………0.101g
$F_s$ Site Coefficient for Short Period……………………1.6
$F_v$ Site Coefficient for a 1-Second Period………………2.4

6.6. Land Subsidence and Earth Fissures

The project site is located approximately ten (10) miles east of an area of documented earthen fissures in the Signal Butte area and in an area with a measured land subsidence of between zero and one foot (Land Subsidence and Earth Fissures in Alluvial Deposits in Phoenix area, Arizona by H.H. Schumann, 1974, and http://azmap.org/fissures).

7. ENGINEERING ANALYSES AND RECOMMENDATIONS

7.1. Earthwork

7.1.1. Post-Tension Slabs

All existing structural remnants, fill, pavement, topsoil, vegetation and organic soils should be removed from below the structure areas. The on-site soils are acceptable for use as engineered fill. The site soil should be over-excavated to a depth of two feet below the existing grade or proposed bottom of footing elevation, whichever elevation is lower. The exposed subsurface soils should then be scarified to a depth of 8-inches: moisture conditioned to within 2 percent of optimum moisture content and compacted to a minimum of 95% of maximum dry density. The excavated material should then be moisture conditioned to within 2 percent of optimum moisture content and compacted to
a minimum of 95% of maximum dry density as engineered fill. Optimum moisture content and maximum dry density should be determined by American Society for Testing and Materials (ASTM) D 698. It is our recommendation that the entire footprint plus a 5-foot blow out be prepared as described above.

7.1.2. Exterior Slabs

All existing structural remnants, fill, pavement, topsoil, vegetation and organic soils should be removed from below the exterior slab location. The soils below exterior slabs are collapsible and have the potential for post-construction movement. To decrease the potential for post-construction movement the site soils should be scarified to a depth of twelve inches; moisture conditioned to within 2 percent of optimum moisture content and compacted to a minimum of 95% of maximum dry density.

7.1.3. Conventional Spread Footings (Secondary Structures)

(If secondary only) All existing structural remnants, fill, pavement, topsoil, vegetation and organic soils should be removed from below the structure areas. Conventional foundations are recommended to support secondary structures (e.g. site walls). The soil below the footing elevation should be removed to a depth of one foot. The exposed subsurface soils should then be scarified to a depth of 8-inches: moisture conditioned to within 2 percent of optimum moisture compacted to a minimum of 95 percent of maximum dry density. Optimum moisture content and maximum dry density should be determined by ASTM D 698. The over excavation of site soils should be extend laterally for a minimum distance of 3-feet beyond the perimeter of secondary structures.
7.1.4. Aggregate Base Course

A layer of clean granular material, a minimum of 4 inches thick, should be placed beneath concrete slabs to serve as a leveling base, and to aid in concrete curing. The material should conform to the gradation requirements set by the local governing and/or MAG section 702 specifications for Aggregate Base Course (ABC). The use of moisture barriers beneath the floor slabs may be helpful, but is not a geotechnical requirement; however, the architect or the slab designer should evaluate their need.

All aggregate base should be placed in lifts not thicker than eight inches and compacted to a minimum of 98 percent of maximum dry density as determined by American Society for Testing and Materials (ASTM) Test Method D 698 or as specified by local specifications. The moisture content during compaction should be maintained within two percent of optimum moisture content.

7.1.5. Engineered Fill

Engineered fill materials should be composed of on-site soils or imported soils, generally meeting the requirements for imported soils presented below. All engineered fills should be compacted as noted.

1. Native granular soils or imported soils with low expansive potentials could be used as fill material for the following:
   - general site grading
   - foundation areas
   - interior floor slab areas
   - exterior slab areas
   - foundation backfill

2. Select granular materials should be used as backfill behind walls which retain earth.

3. Engineered fill should conform to the following:
Percent finer by weight

### Gradation (ASTM C136)
- 3".............................................................................................................. 100
- No. 200 Sieve ......................................................................................... 50 (max)

### Expansion Index (ASTM D4829)
- Maximum expansive index........................................................................ 20

### Corrosion Potential (PPM)
- Sulfate Content (ARIZ 733)................................................................. 1,000(max)*
- Chloride Content (ARIZ 736)............................................................... 500(max)*

*Native site soils generally have an elevated level of sulfates and chlorides, if used within building pad fill foundations and slabs on grade need to be designed for elevated levels of concrete and reinforcement corrosion. Soil imported to the site from outside its boundaries needs to conform to the maximum allowable sulfate and chloride contents.

4. Aggregate base should conform to MAG and/or local governing specifications (or applicable local standards)

5. The following are intended to guide in establishing adequate support for the conventional foundation elements:
   - Any natural washes, depressions or new excavations which are to be filled, should be widened as necessary to accommodate compaction equipment and provide a level base for placing fill.
   - Any engineered fill (backfill) materials placed beneath the foundations should meet the requirements for Engineered Fill Materials.
   - All footing excavations should be relatively level and free of loose or disturbed material and inspected by a qualified representative of the Geotechnical Engineer.

6. All fill soils to be used beneath the foundations; slabs and pavements should be approved by the Geotechnical Engineer. Fill should be placed in eight inch loose lifts and should extend beyond the edge of the structure for a minimum distance of five feet. Fill should be compacted as recommended in the following table.
<table>
<thead>
<tr>
<th>Material</th>
<th>Area of Placement</th>
<th>Compaction Percent (%) (ASTM D698)</th>
<th>Percent Moisture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subgrade Soil, Subgrade Fill or Site Soils Meeting Gradation and Expansive Requirements For Import Soils (Fill Less than 5 feet of finish grade)</td>
<td>Below Foundations and Slabs: 95 min</td>
<td>Opt. +2%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Below Concrete Driveways 95 min</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Expansive Native Subgrade Soil, or Expansive Subgrade Fill (Fill Less than 5 feet of finish grade)</td>
<td>Below Exterior Slabs 90-95</td>
<td>Opt. +4%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Below Concrete Driveways: 90-95</td>
<td>Opt. to +2%</td>
<td></td>
</tr>
<tr>
<td>Native Subgrade Soils, Subgrade Fill of Site Soil or Imported Fill Soils (Total fill depth more than 5 feet below finished grade)</td>
<td>All Areas 100 min</td>
<td>Opt. +3%</td>
<td></td>
</tr>
</tbody>
</table>

Optimum moisture content and maximum dry density should be determined in accordance with ASTM D698 (standard Proctor).

7.1.6. Temporary Excavations

General
All excavations must comply with applicable local, state, and federal safety regulations including the current Occupational Safety and Health Administration (OSHA) Excavation and Trench Safety Standards. Construction site safety generally is solely the responsibility of the Contractor, who shall also be solely responsible for the means, methods, and sequencing of construction operations. We are providing the information below strictly as a service to our client. Under no circumstances should the information be interpreted to mean that Alpha is assuming responsibility for construction site safety or the Contractor’s activities; such responsibility is not being implied and should not be inferred.

**Excavations and Slopes**

The Contractor should be aware that slope height, slope inclination, or excavation depths (including utility trench excavations) should in no case exceed those specified in local, state, and/or federal safety regulations (e.g., OSHA Health and Safety Standards for Excavations, 29 CFR Part 1926, or successor regulations). Such regulations are strictly enforced and, if they are not followed, the Owner, Contractor, and/or earthwork and utility subcontractors could be liable for substantial penalties.

Near-surface soils encountered during our field investigation consisted predominantly of clayey sands with layers of poorly graded sand and silty sand. In our opinion, these soils would be considered a Type C soil when applying OSHA regulations. For this soils type OSHA recommends a maximum slope inclination of $11/2(h):1(v)$ or flatter for excavations 20 feet or less in depth. Steeper cut slopes may be utilized for excavations less than 5 feet deep depending on the strength, moisture content, and homogeneity of the soils as observed in the field. Flatter slopes and/or trench shields may be required if loose, cohesionless soils and/or water are encountered along the slope face.

**Construction Considerations**
Heavy construction equipment, building materials, excavated soil, and vehicular traffic should not be allowed within one-third the slope height from the top of any excavation. Where the stability of adjoining buildings, walls, or other structures is endangered by excavation operations, support systems such as shoring, bracing, or underpinning may be required to provide structural stability and to protect personnel working within the excavation. Shoring, bracing, or underpinning required for the project (if any) should be designed by a professional engineer registered in the State of Arizona.

During wet weather, earthen berms or other methods should be used to prevent runoff water from entering all excavations. All runoff water should be collected and disposed of outside the construction limits.

7.1.7. Trench Backfill

Materials

Pipe zone backfill (i.e., material beneath and in the immediate vicinity of the pipe) should consist of soil with a maximum particle size less than one inch. Trench zone backfill (i.e., material placed between the pipe zone backfill and finished subgrade) may consist of soil that meets the requirements for structural fill provided above. Also, to reduce potential for moisture migration through trench backfill, refer to section 7.3.

If import material is used for pipe or trench zone backfill, we recommend it consist of fine-grained sand. In general, poorly graded coarse-grained sand and gravel should not be used for pipe or trench zone backfill due to the potential for soil migration into the relatively large void spaces present in this type of material and water seepage along trenches backfilled with coarse-grained sand and/or gravel.
Recommendations provided above for pipe zone backfill are minimum requirements only. More stringent material specifications may be required to fulfill local codes and/or bedding requirements for specific types of pipes. We recommend the project Civil Engineer develop these material specifications based on planned pipe types, bedding conditions, and other factors beyond the scope of this study.

**Compaction Criteria**

Backfill of trenches should utilize non-expansive (preferably granular) soils, in order to aid compaction and reduce potential differential settlement problems. Backfilling of utility trenches should be in 6 to 8-inch maximum loose lifts, and compacted to a minimum of 90%, and 95% of ASTM D-698 (standard Proctor), in non-structural areas and structurally loaded areas, respectively. Please note that the local governing agency specifications may surpass these trench backfill requirements. Water settling of granular backfill soils should be done in strict accordance with the local governing agency and/or MAG Section 601.4. Jetting or flooding of cohesive backfill soils should not be utilized under any circumstances.

7.1.8. Permanent Excavations and Slopes

We recommend all permanent cut and fill slopes in soil be constructed at a gradient no steeper than 3(h):1(v). During wet weather, erosion could become a problem. Proper drainage and maintenance is recommended. To reduce the potential for surface erosion, a berm or "V" ditch may be located at the top of slopes subject to significant overland water flows in order to intercept and redirect surface runoff.

Fill placed on slopes steeper than 5(h):1(v) should be benched into the existing slope. It is recommended that the slope face be compacted as presented in the earthwork section of this report.
7.2. Shallow Foundations

7.2.1. Shallow Spread Footings

7.2.1.1. Allowable Bearing Pressure

Shallow spread footings bearing on engineered fill could be used to support the secondary structures as recommended in section 7.1.3. Recommended footing depths and allowable bearing pressures are presented in the following table.

<table>
<thead>
<tr>
<th>Footing Depth Below Finished Grade (ft.)*</th>
<th>Allowable Bearing Pressure (psf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5 (min. *)</td>
<td>1,500</td>
</tr>
<tr>
<td>2.0</td>
<td>2,000</td>
</tr>
</tbody>
</table>

*Note: Footing depth is defined as the depth below the lowest adjacent finished grade elevation within 5-feet of the edge of the footing. Footing depth to the base of interior footings is measured from the top of the floor slab.

A one-third increase may be applied to the design bearing pressures when considering short duration loads, such as wind and seismic.

Individual column footings should have a minimum width of 24-inches. Footings supporting walls of light-framed construction should have a minimum width of 12-inches. The minimum widths are recommended for ease of construction, and to provide a margin of safety against a local or punching shear failure of the foundation soils. All footings stem walls, and masonry walls should be reinforced to reduce potential distress caused by differential foundation movement. The use of joints in masonry walls is recommended.

All the footing excavations should be observed by the Geotechnical Engineer prior to placement of reinforcing steel and/or concrete. If subsurface conditions are encountered
that are different than indicated by the test borings, revised recommendations may be required.

7.2.1.2. Estimated Settlements

Settlement of footings designed as recommended above are estimated not to exceed ¾-inch. Differential settlements between similarly loaded, adjacent footings are expected to be less than ½-inch. Significant moisture increases above those recommended for compaction could result in additional movements. In order to minimize the sensitivity of the structure to differential settlements, footings should be reinforced to allow for a degree of load redistribution should a localized zone of supporting soils become saturated.

7.2.2. Floor Slab

A modulus of subgrade reaction of 250 pound per cubic inch (PCI) may be used in design of the concrete slabs-on-grade. This modulus of subgrade reaction is based on soils encountered during our field exploration, recommendations for subgrade soils preparation stated within the above referenced report, our experience with similar subgrade conditions and estimates obtained from ACI design charts.

7.2.3. Structural slabs (post-tensioned or reinforced mat-type slabs)

Structural slabs (post-tensioned or reinforced mat-type slabs) are recommended to support the structures.

Based on the design procedure outlined in the Post-Tensioning Institute’s Design and Construction of Post-Tensioned Slabs-on-Ground, 3rd Edition, including addendum 1
dated May 21, 2007 and addendum 2 dated May 2008, the site soils classifies as **Non-Active**.

**Recommended design parameters:**

**Maximum Allowable Bearing Pressure, \( q_a \):** 1250 psf (at grade)

**Coefficient of Subgrade Reaction, \( k \):** 250 pci

Structures bearing on prepared subgrade as presented in the above section 6.2.2. Post-Tensioned Floor Slab Preparation may experience total settlements up to \( \frac{1}{2} \)-inch. Differential settlement is expected to be less than \( \frac{1}{4} \)-inch between similarly load areas. The majority of the settlement is expected to occur during construction. Additional foundation movements could occur if the supporting soils become wetted, please refer to Section 7.3 Moisture Protection.

Post-tensioned slabs’ thickened or turn-down edges and/or interior beams should be designed and constructed in accordance with the requirements of the Post-Tensioning Institute and the American Concrete Institute.

**7.2.4. Resistance to Lateral Loads**

Proposed walls/structures that will retain soil must be designed to withstand lateral soil pressures. Cantilevered retaining walls, or unrestrained walls subject to lateral earth pressures, should be designed for an equivalent fluid pressure (EFP) of 32 PCF. Restrained walls should be designed to withstand a residual or long-term at-rest (Ko) earth pressure condition of 50 pounds per cubic foot (PCF).

A passive EFP of 354 PCF may be used for shallow spread footings. A coefficient of friction of 0.43 is recommended for computing lateral resistance between the base of
footing and soil in analyzing lateral loads. Vehicular surcharge loads and/or hydrostatic pressure will increase the recommended EFP.

Only cohesionless, free-draining granular materials should be used as backfill, adjacent to earth-retaining structures. We recommend that backfill directly behind the walls be compacted with light, hand-held compactors. Heavy compactors and grading equipment should not be allowed to operate within 3 feet of the walls during backfilling, to avoid developing excessive temporary or long-term lateral soil pressures. Positive gravity drainage of the backfill should be provided.

7.2.5. Retaining Walls

7.2.5.1. Lateral Earth Pressures

If retaining walls are utilized in this project, they should be designed to resist the earth pressure exerted by the retained, compacted backfill plus any additional lateral force that will be applied to the wall due to surface loads placed at or near the top of the wall. The at-rest earth pressure against walls that are restrained at the top and with level backfill may be taken as equivalent to the pressure exerted by a fluid weighing 50 pounds per cubic foot (pcf). Fifty percent of any uniform area surcharge placed at the top of a restrained wall may be assumed to act as a uniform horizontal pressure over the entire height of the wall.

Retaining walls that are not restrained at the top and with backfill, which is level behind the wall, may be designed for an active earth pressure developed by an equivalent fluid weighing 32 pcf. Thirty percent of any uniform surcharge may be assumed to act as a uniform horizontal pressure over the entire height of the wall.
7.2.5.2. Wall Drainage

The above-recommended values do not include lateral pressures due to hydrostatic forces. Therefore, wall backfill should be free draining and provisions should be made to collect and dispose of excess water that may accumulate behind earth retaining structures.

Wall drainage should be collected by continuous perforated drainpipes, filter fabric, and gravel connected to weep holes. The drainpipe must run parallel to the wall. We recommend drainrock consist of durable stone having 100 percent passing the 1-inch sieve and zero percent passing the No. 4 sieve. Synthetic filter fabric should have an equivalent opening size (EOS), U.S. Standard Sieve, of between 40 and 70, a permeability of at least 0.02 centimeters per second and minimum puncture strength of 50 pounds.

7.2.5.3. Backfill Placement

All backfill should be placed and compacted in accordance with recommendations provided above for engineered fill. Light equipment should be used during backfill compaction to minimize possible over stressing of the wall.

7.3. Moisture Protection

Positive drainage is essential to the successful performance of any foundation or slab on grade. Good surface and subsurface drainage should be established during and after construction to prevent the soils below or adjacent to the building areas from becoming wet.

Infiltration of water into utility or foundation excavations must be prevented during construction. The drainage design must route all storm and sprinkler water away from
the buildings in a positive manner. All water should be diverted away from areas where it could penetrate the ground surface near the buildings. If used, gutters and downspouts should be designed to collect and direct roof runoff away from the building foundations. In areas where sidewalks or pavements do not immediately adjoin the structures, protective slopes should be provided. These slopes should have a minimum 5% grade for a distance of at least 10 feet from the perimeter of the foundations. Where lot lines, walls, slopes or other physical barriers prohibit 6 inches of fall within 10 feet, drains or swales shall be provided to ensure drainage away from the structure. Watering of plants should be avoided adjacent to the buildings. Desert-type landscaping is advisable near the building. Plants, which require more water, should be located and drained away from the building areas.

7.4. Corrosion Potential

7.4.1. Sulfate and Chloride Content

Selected samples of the near-surface soils encountered at the site were subjected to chemical analysis for the purpose of corrosion assessment. The samples were tested for soluble sulfates, and soluble chlorides. The samples were tested in general accordance with Arizona Test Methods 733, and 736 for soluble sulfates, and soluble chlorides, respectively. The test results are provided in Appendix C.

Based on provisions of American Concrete Institute (ACI) 318 Section 4.3, Table 4.3.1, Requirements for Concrete Exposed to Sulfate-Containing Solutions a sulfate concentration below 0.10 percent by weight (1,000 ppm) is negligible. Based on the laboratory results, sulfate contents of the site soils tested indicate a negligible to approaching moderate corrosion potential to concrete.
Based on results, ACI 318 recommends the use of concrete with a minimum design compressive strength of 4,000 psi and a maximum water-cement ratio of 0.50 for structural concrete.

Based on *Standard Requirements for Design of Shallow Post-Tensioned Concrete Foundations on Expansive Soils*, dated May, 2008 published by Post-Tensioning Institute, levels below 500 parts per million should be considered negligible for concentrations of chlorides in soils as it pertains to steel tendons and reinforcing steel cast in concrete. Based on the laboratory result, chloride contents of the site soils tested indicate an elevated corrosion potential to concrete reinforcing. Please refer for section 6.2.2 of the above referenced manual for mitigating methods.

Soluble salt content of representative soil samples was also measured; the results are presented in appendix C.

### 7.4.2. Aggregate Base Course

Aggregate base used in support of concrete or asphalt pavements should conform to the local governing and/or M.A.G. Section 702 Specifications. The plasticity index of the fraction of material passing the No. 40 sieve should not exceed five when tested in accordance with ASTM Test Method D 4318. Coarse aggregate should have a percent of wear, when subjected to the Los Angeles abrasion test (ASTM Test Method C 131), of no greater than 40.

All aggregate base should be placed in lifts not thicker than eight inches and compacted to a minimum of 98 percent of maximum dry density as determined by American Society for Testing and Materials (ASTM) Test Method D 698 or as specified by local specifications. The moisture content during compaction should be maintained within two percent of optimum moisture content.
8. CLOSURE

8.1. Limitations

Our professional services have been performed using that degree and skill ordinarily exercised, under similar circumstances, by reputable Geotechnical Engineers practicing in this or similar localities. No warranty is expressed or implied.

The recommendations contained in this report are based on our field exploration, laboratory test results, and our understanding of the proposed construction. The subsurface data used in the preparation of this report was obtained from the test borings excavated during the field subsurface exploration. It is anticipated that some variations in the soil conditions will exist on-site. The nature and extent of variations may not be evident until construction occurs. If any conditions are encountered at this site that are different from those described in this report, we should be immediately notified so that we may make any necessary revisions to the recommendations contained in this report. In addition, if the scope of the proposed construction changes from that described in this report, our firm should also be notified.

It is the Client’s responsibility to see that all parties to the project including the designer, contractor, subcontractor, etc. are made aware of this report in its entirety. The use of information contained in this report for bidding purposes should be done at the contractor's option and risk.

This report is for the exclusive purpose of providing Geotechnical Engineering and/or testing information and recommendations. The scope of services for this project does not include, either specifically or by implication, any environmental assessment of the site or identification of contaminated or hazardous materials or conditions. If the owner is concerned about the potential for such contamination, other studies should be
undertaken. This report has also not addressed the site geology and the possible presence of geologic hazards.

This report may be used only by the Client and only for the purposes stated, within a reasonable time from its issuance. Land use, site conditions (both on and off-site), or other factors may change over time, and additional work may be required with the passage of time. Any party, other than the Client, who wishes to use this report, shall notify Alpha of such intended use. Based on the intended use of this report, Alpha may require that additional work be performed and that an updated report be issued.

8.2. Recommended Additional Services

The recommendations provided in this report are based on the assumption that an adequate program of tests and observations will be performed during the construction. These tests and observations should be performed by the Geotechnical Engineer's representative and should include, but are not necessarily be limited to the following:

- Observe and document that any existing surficial vegetation and other deleterious materials have been removed from the site as required in site preparation section.

- Approve any material used as engineered fill in building areas to document that it meets the requirements outlined above before placement.

- Monitor the scarification operations of the exposed subgrade.

- Monitor footing excavation operations to document those footings are bearing in soils as recommended above.

- Monitor the backfill procedures.

- Perform field density tests, as needed, to verify compaction compliance. The representative should monitor the progress of compaction and filling operations.
• Keep records of on-site activity and progress.

Observation of footing excavations should be performed prior to placement of reinforcing and concrete to confirm that satisfactory bearing materials are present. Construction testing, including field and laboratory evaluation of fill and backfill materials, concrete and steel should be performed to determine whether applicable project requirements have been met.
APPENDIX A
Sample Location Plan
APPENDIX B
BORING LOGS
APPENDIX B
FIELD INVESTIGATION

TEST BORINGS

The subsurface conditions at the site were explored on July 12, 2012, by advancing 8 soil test borings using a CME 55 power drill rig. The locations of soil test borings performed for this investigation are shown in appendix A of the report.

Our engineer maintained a log of the excavations; visually classified soils encountered according to the Unified Soil Classification System (USCS) (see USCS Table) and obtained samples of the subsurface materials.

SAMPLING PROCEDURES

Bulk samples were taken from the test borings at selected intervals. Soil samples were packaged and sealed in the field to reduce moisture loss and disturbance, and returned to our laboratory for further testing. After the soil test borings were completed, they were backfilled with the excavated soils.

LIST OF ATTACHMENTS

The following plates are attached and complete this appendix.

Unified Soil Classification System
Logs of Soil Test Borings
<table>
<thead>
<tr>
<th>Major Divisions</th>
<th>Group Symbols</th>
<th>Typical Names</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gravels 50% or more of coarse fraction retained on No. 4 sieve</td>
<td>GW</td>
<td>Well graded gravels and gravel-sand mixtures, little or no fines</td>
<td>Standard Penetration Test (blows/ft)</td>
</tr>
<tr>
<td>Gravels With Fines</td>
<td>GP</td>
<td>Poorly graded gravels and gravel-sand mixtures, little or no fines</td>
<td>Penetration Resistance N (blows/ft)</td>
</tr>
<tr>
<td>Sands More than 50% of coarse fraction passes No. 4 sieve</td>
<td>GM</td>
<td>Silty gravels, gravel-sand-silt mixtures</td>
<td>Relative Density</td>
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<tr>
<td>Sands With Fines</td>
<td>GC</td>
<td>Clayey gravels, gravel-sand-silt mixtures</td>
<td></td>
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<tr>
<td>Sands and Clays Liquid Limit 50% or less</td>
<td>SW</td>
<td>Well graded sands and gravelly sands, little or no fines</td>
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</tr>
<tr>
<td>Sands and Clays Liquid Limit greater than 50%</td>
<td>SP</td>
<td>Poorly graded sands and gravelly sands, little or no fines</td>
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</tr>
<tr>
<td>Silts and Clays Liquid Limit 50% or less</td>
<td>SM</td>
<td>Silty sands, sand-silt mixtures</td>
<td></td>
</tr>
<tr>
<td>Silts and Clays Liquid Limit greater than 50%</td>
<td>SC</td>
<td>Clayey sands, sand-silt mixtures</td>
<td></td>
</tr>
<tr>
<td>Silts and Clays Liquid Limit 50% or less</td>
<td>ML</td>
<td>Inorganic silts, very fine sands, rock flour, silty or clayey fine sands</td>
<td>Standard Penetration Test Consistency of Cohesive Soils</td>
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<tr>
<td>Silts and Clays Liquid Limit greater than 50%</td>
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<td>Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silt clayey clays, less clay</td>
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<td>Organic silts and organic silt clays of low plasticity</td>
<td>OL</td>
<td>Organic silts and organic silt clays of medium plasticity, gravelly clays, sandy clays, silt clayey clays, less clay</td>
<td>Consistency</td>
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<tr>
<td>Organic silts, organic silt clays, or natural clays</td>
<td>MH</td>
<td>Organic silts, silty organic clays</td>
<td>Unconfined Compressive Strength (tons/ft²)</td>
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<tr>
<td>Organic clays of high plasticity</td>
<td>CH</td>
<td>Organic clays of high plasticity</td>
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</tr>
<tr>
<td>Organic clays of medium to high plasticity</td>
<td>OH</td>
<td>Organic clays of medium to high plasticity</td>
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<tr>
<td>Organic clays of medium to high plasticity</td>
<td>PT</td>
<td>Peat, mud, and other highly organic soils</td>
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### Unified Soil Classification

<table>
<thead>
<tr>
<th>Classification</th>
<th>Gravel</th>
<th>Sand</th>
<th>Silt or Clay</th>
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<tr>
<td>Uniform</td>
<td>coarse</td>
<td>fine</td>
<td>coarse</td>
</tr>
<tr>
<td>Non-Uniform</td>
<td>coarse</td>
<td>medium</td>
<td>fine</td>
</tr>
</tbody>
</table>

### Moisture Conditions
- Dry: Absence of moist, dusty, dry to the touch
- Slightly Damp: Below optimum moisture content for compaction
- Moist: Near optimum moisture content, will moisten the hand
- Very Moist: Above optimum moisture content
- Wet: Visible free water; below water table

### Material Quantity
- Trace: 0 - 5%
- Few: 5 - 10%
- Little: 10 - 25%
- Some: 25 - 45%
- Mostly: 50 - 100%

### Other Symbols
- C: Core Sample
- S: SPT Sample
- B: Bulk Sample
- *: Groundwater
- Op: Pocket Penetrometer

### Example
Brown, loose fine to medium Sand (SP), little fine gravel, dense.

**UNIFIED SOIL CLASSIFICATION SYSTEM**
**Log of Boring No.:** B-1  
**Project:** Central Subdivision  
**Client:** GRIC Property and Supply  

**Boring Location:** See attached site plan  

<table>
<thead>
<tr>
<th>Sample Type</th>
<th>Blows Per 6&quot;</th>
<th>Dry Density (PCF)</th>
<th>Moisture (%)</th>
<th>Depth (Feet)</th>
<th>USCS Code</th>
<th>Remarks</th>
</tr>
</thead>
</table>
| R           | 5-6          | 97.0              | 7.0          | 1            | SC        | CLAYEY SAND  
Light brown, loose, slightly damp, medium plasticity, non-cemented |
| S           | 5-7-6        |                   |              | 2            |           |         |
| S           | 4-4-3        |                   |              | 3            |           |         |
|             |              |                   |              | 4            |           |         |
|             |              |                   |              | 5            |           |         |
|             |              |                   |              | 6            |           |         |
|             |              |                   |              | 7            |           |         |
|             |              |                   |              | 8            |           |         |
|             |              |                   |              | 9            |           |         |
|             |              |                   |              | 10           |           |         |

**Description of Subsurface Conditions**

End of boring @ 15'. No ground water.

**Remarks:** Existing home on site, hole drilled in front yard. Drilled with eight inch hollow stem auger.

---

**Sample Date:** 07/12/12  
**Drill Rig:** CME 55  

---

**Alpha Geotechnical & Materials, Inc.**  
2504 West Southern Avenue  
Tempe, Arizona 85282  

---

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.  

Sample Type Key:  
- S = Split Spoon  
- B = Bulk Sample  
- BN = Bull Nose  
- R = Ring Sample
**Log of Boring No.**  B-2  
**Project:**  Central Subdivision  
**Client:**  GRIC Property and Supply  
**Project Location:**  SEC Cholla Rd. & Seed Farm Rd.  
**Boring Location:**  See attached site plan

<table>
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<tr>
<th>Sample Type</th>
<th>Blows Per 6”</th>
<th>Dry Density (PCF)</th>
<th>Moisture (%)</th>
<th>Depth (Feet)</th>
<th>USCS Code</th>
<th>Remarks</th>
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<tr>
<td>S</td>
<td>6-7-8</td>
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<td>3</td>
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<tr>
<td>S</td>
<td>4-4-8</td>
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</tbody>
</table>

**Description of Subsurface Conditions**

SC  CLAYEY SAND  
- Light brown, medium dense, slightly damp, medium plasticity, non-cemented  

SM  SILTY SAND  
- Light brown, loose, slightly damp, non-plastic, non-cemented  

End of boring @ 15’. No ground water. 

The stratification lines represent the approximate boundary lines between soil and rock types: In-situ, the transition may be gradual. 

**Sample Type Key:**  S = Split Spoon  B = Bulk Sample  
BN = Bull Nose  R = Ring Sample

---

**Sample Date:**  07/12/12  
**Drill Rig:**  CME 55
### Boring Location Details

- **Log of Boring No.**: B-3
- **Project**: Central Subdivision
- **Client**: GRIC Property and Supply
- **Project Location**: SEC Cholla Rd. & Seed Farm Rd.
- **Boring Location**: See attached site plan

### Sample Details

<table>
<thead>
<tr>
<th>Sample Type</th>
<th>Blows Per 6&quot;</th>
<th>Dry Density (PCF)</th>
<th>Moisture (%)</th>
<th>Depth (Feet)</th>
<th>USCS Code</th>
<th>Remarks</th>
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<tr>
<td>S</td>
<td>3-1-2</td>
<td>5.2</td>
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<td>1</td>
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<td>Light brown, medium dense, slightly damp, medium plasticity, non-cemented</td>
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<tr>
<td>S</td>
<td>6-7-7</td>
<td></td>
<td></td>
<td>5</td>
<td>SC</td>
<td>CLAYEY SAND</td>
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<tr>
<td></td>
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<td>Light brown, medium dense, slightly damp, medium plasticity, non-cemented</td>
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<tr>
<td>S</td>
<td>5-4-5</td>
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<td></td>
<td>10</td>
<td>SP</td>
<td>POORLY GRADED SAND</td>
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<td></td>
<td></td>
<td>Light brown, loose, slightly damp, non-plastic, non-cemented.</td>
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</tbody>
</table>

**Description of Subsurface Conditions**

- **Depth (Feet)**: 17
- **USCS Code**: SC
- **Remarks**: Existing home on site, hole drilled in front yard. Drilled with eight inch hollow stem auger.

**Alpha Geotechnical & Materials, Inc.**

2504 West Southern Avenue  
Tempe, Arizona 85282

**Sample Key**:  
S = Split Spoon  
B = Bulk Sample  
BN = Bull Nose  
R = Ring Sample

**Sample Date**: 07/12/12  
**Drill Rig**: CME 55
### Project Details

**Alpha Project Number:** 12-G-2697  
**Log of Boring No.:** B-4  
**Project:** Central Subdivision  
**Client:** GRIC Property and Supply  
**Project Location:** SEC Cholla Rd. & Seed Farm Rd.  
**Boring Location:** See attached site plan

### Geotechnical Data

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<thead>
<tr>
<th>Sample Type</th>
<th>Blows Per 6”</th>
<th>Dry Density (PCF)</th>
<th>Moisture (%)</th>
<th>Depth (Feet)</th>
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<td>S</td>
<td>6-7-7</td>
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</table>

**Remarks:** Existing home on site, hole drilled in front yard. Drilled with eight inch hollow stem auger.

**End of boring @ 15'.** No ground water.

**Remarks:** Light brown, medium dense, slightly damp, medium plasticity, non-cemented

**End of boring @ 15'.** No ground water.

### Sample Type Key:
- S = Split Spoon
- B = Bulk Sample
- BN = Bull Nose
- R = Ring Sample

### Alpha Geotechnical & Materials, Inc.
**2504 West Southern Avenue**  
**Tempe, Arizona 85282**

**Sample Date:** 07/12/12  
**Drill Rig:** CME 55
<table>
<thead>
<tr>
<th>Sample Type</th>
<th>Blows Per 6&quot;</th>
<th>Dry Density (pcf)</th>
<th>Moisture (%)</th>
<th>Depth (Feet)</th>
<th>USCS Code</th>
<th>Description of Subsurface Conditions</th>
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<tbody>
<tr>
<td>S</td>
<td>6-9-11</td>
<td></td>
<td>5.7</td>
<td>1</td>
<td>SC</td>
<td>CLAYEY SAND Light brown, medium dense, slightly damp, medium plasticity, weak cementation below 1 foot.</td>
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<td>9-9-11</td>
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<td>S</td>
<td>2-3-4</td>
<td></td>
<td></td>
<td>10</td>
<td>SP</td>
<td>POORLY GRADED SAND Light brown, loose, slightly damp, non-plastic, non-cemented</td>
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</tbody>
</table>

Remarks: Existing home on site, hole drilled in front yard. Drilled with eight inch hollow stem auger.

End of boring @ 15'. No ground water.

The stratification lines represent the approximate boundary lines between soil and rock types: In-situ, the transition may be gradual.

Sample Type Key: S = Split Spoon  B = Bulk Sample  BN = Bull Nose  R = Ring Sample

Sample Date: 07/12/12

Drill Rig: CME 55
### Log of Boring No. B-6

- **Alpha Project Number:** 12-G-2697
- **Log of Boring No.:** B-6
- **Project:** Central Subdivision
- **Client:** GRIC Property and Supply
- **Project Location:** SEC Cholla Rd. & Seed Farm Rd.
- **Boring Location:** See attached site plan

#### Sample Type

<table>
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<tr>
<th>Depth (Feet)</th>
<th>Blows Per 6”</th>
<th>Dry Density (pcf)</th>
<th>Moisture (%)</th>
<th>USCS Code</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>SC</td>
<td>R</td>
<td>6-6</td>
<td>1</td>
<td>CLAYEY SAND</td>
<td>Light brown, medium dense, slightly damp, medium plasticity, non-cemented.</td>
</tr>
<tr>
<td></td>
<td>S</td>
<td>6-7-10</td>
<td></td>
<td>POORLY GRADED SAND</td>
<td>Light brown, loose, slightly damp, non-plastic, non-cemented</td>
</tr>
<tr>
<td></td>
<td>S</td>
<td>4-4-3</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### End of Boring @ 15’. No ground water.

---

**Latitude:** 33° 04.248'N  
**Longitude:** 111° 44.639'W  
**Remarks:** Existing home on site, hole drilled in front yard. Drilled with eight inch hollow stem auger.

---

**Sample Date:** 07/12/12  
**Drill Rig:** CME 55
### Alpha Geotechnical & Materials, Inc.
2504 West Southern Avenue
Tempe, Arizona 85282

#### Log of Boring No.

**Boring Location:** See attached site plan

**Sample Date:** 07/12/12

**Drill Rig:** CME 55

---

<table>
<thead>
<tr>
<th>Sample Type</th>
<th>Blows Per 6&quot;</th>
<th>Dry Density (PCF)</th>
<th>Moisture (%)</th>
<th>Depth (Feet)</th>
<th>USCS Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>4-5</td>
<td>98.3</td>
<td>6.1</td>
<td>1</td>
<td>SC</td>
</tr>
<tr>
<td>S</td>
<td>4-6-5</td>
<td></td>
<td></td>
<td>2</td>
<td></td>
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<tr>
<td>S</td>
<td>4-4-4</td>
<td></td>
<td></td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

**Remarks:** Existing home on site, hole drilled in front yard. Drilled with eight inch hollow stem auger.

---

**Description of Subsurface Conditions**

<table>
<thead>
<tr>
<th>Depth (Feet)</th>
<th>Remarks</th>
</tr>
</thead>
</table>
| 1            | SC CLAYEY SAND 
Light brown, loose to medium dense, slightly damp, medium plasticity, weak cementation below 2 feet. |
| 2            |         |
| 3            |         |
| 4            |         |
| 5            |         |
| 6            |         |
| 7            |         |
| 8            |         |
| 9            |         |
| 10           |         |
| 11           |         |
| 12           |         |
| 13           | SP POORLY GRADED SAND 
Light brown, loose, slightly damp, non-plastic, non-cemented |
| 14           |         |
| 15           | End of boring @ 15'. No ground water. |
| 16           |         |
| 17           |         |

---

**Sample Type Key:**
- **S** = Split Spoon
- **B** = Bulk Sample
- **BN** = Bull Nose
- **R** = Ring Sample

---

**Latitude:** 33Deg 04.201Min  
**Longitude:** 111Deg 44.739Min

---

**Project Location:** SEC Cholla Rd. & Seed Farm Rd.  
**Boring Location:** See attached site plan

**Client:** GRIC Property and Supply

---

**Sample Type:**  
- **R** = Ring Sample
- **S** = Split Spoon

---

**USCS Code:**  
- **SC**
- **SP**
**Log of Boring No.**: B-8  
**Project Location**: SEC Cholla Rd. & Seed Farm Rd.  
**Boring Location**: See attached site plan

**Latitude**: 33° 04.181'S  
**Longitude**: 111° 44.666'W

**Remarks**: Existing home on site, hole drilled in front yard. Drilled with eight inch hollow stem auger.

<table>
<thead>
<tr>
<th>Sample Type</th>
<th>Blows Per 6&quot;</th>
<th>Dry Density (PCF)</th>
<th>Moisture (%)</th>
<th>Depth (Feet)</th>
<th>USCS Code</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td>4-4-4</td>
<td></td>
<td></td>
<td>1</td>
<td>SC</td>
<td>CLAYEY SAND</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>2</td>
<td></td>
<td>Light brown, loose to medium dense, slightly damp, medium plasticity, weak cementation below 1 foot.</td>
</tr>
<tr>
<td>S</td>
<td>5-7-8</td>
<td></td>
<td></td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4</td>
<td>5.1</td>
<td></td>
</tr>
<tr>
<td>S</td>
<td>7-5-5</td>
<td></td>
<td></td>
<td>9</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>10</td>
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<td></td>
</tr>
</tbody>
</table>

**Sample Type Key**:  
- S = Split Spoon  
- B = Bulk Sample  
- BN = Bull Nose  
- R = Ring Sample

**Description of Subsurface Conditions**

- **End of boring @ 15'. No ground water.**

---

**Alpha Geotechnical & Materials, Inc.**  
2504 West Southern Avenue  
Tempe, Arizona 85282
LABORATORY TESTS
Laboratory tests were performed on selected samples to aid in soil classification and to evaluate physical properties of the soils, which may affect the Geotechnical aspects of project design and construction. A description of the laboratory testing program is presented below.

Sieve Analysis
Sieve analyses were performed to evaluate the gradation characteristics of the material and to aid in soil classification. Tests were performed in general accordance with ASTM Test Method C 136 and D 2487.

Atterberg Limits
Atterberg Limits tests were performed to aid in soil classification and to evaluate the plasticity characteristics of the material. Additionally, test results were correlated to published data to evaluate the shrink/swell potential of near-surface site soils. Tests were performed in general accordance with ASTM Test Method D 4318.

Moisture Content
Moisture content tests were performed to evaluate moisture-conditioning requirements during site preparation and earthwork grading. Moisture content was evaluated in general accordance with ASTM Test Method D 2216.

Expansion Index
Expansion index tests were performed on bulk soil samples to evaluate the expansion potential of the site soils. Test procedures were in general accordance with ASTM Test Method D 4829.

One-Dimensional Consolidation
A one-dimensional consolidation test was performed on a ring samples to evaluate consolidation potential of the site soil. Test procedure was in general accordance with ASTM Test Method D 2435.

Sulfate Content
Sulfate content tests were performed to evaluate the corrosion potential of the on-site soils. Tests were performed in general accordance with ARIZ 733.

Chloride Content
Chloride content tests were performed to evaluate the corrosion potential of the on-site soils. Tests were performed in general accordance with ARIZ 736.
One-Dimensional Consolidation Properties of Soils (ASTM D2435)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Initial Value</th>
<th>Final Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial Volume (cu.in)</td>
<td>4.60</td>
<td>4.21</td>
</tr>
<tr>
<td>Initial Moisture Content</td>
<td>7.0%</td>
<td>19.3%</td>
</tr>
<tr>
<td>Initial Dry Density (pcf)</td>
<td>67.0</td>
<td>105.9</td>
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<tr>
<td>Initial Degree of Saturation</td>
<td>26%</td>
<td>61%</td>
</tr>
<tr>
<td>Initial Void Ratio</td>
<td>0.7</td>
<td>0.6</td>
</tr>
<tr>
<td>Estimated Specific Gravity</td>
<td>2.65</td>
<td>Saturated at 1 ksf</td>
</tr>
</tbody>
</table>

Reviewed by: RS
One-Dimensional Consolidation Properties of Soils (ASTM D2435)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Initial Value</th>
<th>Final Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial Volume (cu.in)</td>
<td>4.60</td>
<td>4.41</td>
</tr>
<tr>
<td>Initial Moisture Content</td>
<td>6.6%</td>
<td>16.3%</td>
</tr>
<tr>
<td>Initial Dry Density(pcf)</td>
<td>108.7</td>
<td>113.3</td>
</tr>
<tr>
<td>Initial Degree of Saturation</td>
<td>35%</td>
<td>94%</td>
</tr>
<tr>
<td>Initial Void Ratio</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>Estimated Specific Gravity</td>
<td>2.65</td>
<td></td>
</tr>
</tbody>
</table>

Reviewed by: RS

Alpha Geotechnical & Materials, Inc.
Project: Central Housing Subdivision
Project Location: SEC Cholla Rd. & Seed Farm Rd.
Client: GRIC Property and Supply
Material: Native
Sample Source: Ring Sample B-2 @ 1.5'-2.5'
Sample Prep: Insitu

Project Number: 12-G-2697
Sample Number: 14013
Date Sampled: 07/16/12
One-Dimensional Consolidation Properties of Soils (ASTM D2435)

<table>
<thead>
<tr>
<th>Property</th>
<th>Initial Value</th>
<th>Final Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial Volume (cu.in)</td>
<td>4.60</td>
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<tr>
<td>Initial Moisture Content</td>
<td>6.1%</td>
<td>19.5%</td>
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<td>Initial Dry Density (pcf)</td>
<td>96.3</td>
<td>106.8</td>
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<tr>
<td>Initial Degree of Saturation</td>
<td>24%</td>
<td>94%</td>
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<tr>
<td>Initial Void Ratio</td>
<td>0.7</td>
<td>0.6</td>
</tr>
<tr>
<td>Estimated Specific Gravity</td>
<td>2.65</td>
<td>Saturated at</td>
</tr>
</tbody>
</table>

Reviewed by: RS
# Alpha Geotechnical & Materials, Inc.

**Project:** Central Housing Subdivision  
**Project Location:** SEC Cholla Rd. & Seed Farm Rd.  
**Client:** GRIC Property & Supply  
**Sample Source:** See Below  
**Sample Date:** 07/12/12  
**Material:** Native

---

## Mechanical Sieve Analysis

**Group Symbol, USCS (ASTM D-2487)**

<table>
<thead>
<tr>
<th>Sample Number</th>
<th>Location &amp; Depth</th>
<th>USCS</th>
<th>LL</th>
<th>PI</th>
<th>#200</th>
<th>#100</th>
<th>#50</th>
<th>#40</th>
<th>#30</th>
<th>#16</th>
<th>#10</th>
<th>#8</th>
<th>#4</th>
<th>1/4&quot;</th>
<th>3/8&quot;</th>
<th>1/2&quot;</th>
<th>3/4&quot;</th>
<th>1&quot;</th>
<th>1 1/4&quot;</th>
<th>1 1/2&quot;</th>
<th>2&quot;</th>
<th>3&quot;</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>14015</td>
<td>Bulk Sample B-1 @ 0'-5'</td>
<td>SC</td>
<td>31</td>
<td>14</td>
<td>46</td>
<td></td>
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</tr>
<tr>
<td>14017</td>
<td>Bulk Sample B-3 @ 0'-2'</td>
<td>SC</td>
<td>31</td>
<td>12</td>
<td>40</td>
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<tr>
<td>14018</td>
<td>Bulk Sample B-4 @ 0'-5'</td>
<td>SC-SM</td>
<td>27</td>
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<tr>
<td>14019</td>
<td>Bulk Sample B-5 @ 0'-5'</td>
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<td>13</td>
<td>42</td>
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<tr>
<td>14022</td>
<td>Bulk Sample B-8 @ 2'-5'</td>
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<td>9</td>
<td>39</td>
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</table>

**Percent Passing By Weight**

<table>
<thead>
<tr>
<th>Sample Number</th>
<th>Location &amp; Depth</th>
<th>USCS</th>
<th>LL</th>
<th>PI</th>
<th>#200</th>
<th>#100</th>
<th>#50</th>
<th>#40</th>
<th>#30</th>
<th>#16</th>
<th>#10</th>
<th>#8</th>
<th>#4</th>
<th>1/4&quot;</th>
<th>3/8&quot;</th>
<th>1/2&quot;</th>
<th>3/4&quot;</th>
<th>1&quot;</th>
<th>1 1/4&quot;</th>
<th>1 1/2&quot;</th>
<th>2&quot;</th>
<th>3&quot;</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>14015</td>
<td>Bulk Sample B-1 @ 0'-5'</td>
<td>SC</td>
<td>31</td>
<td>14</td>
<td>46</td>
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</tr>
<tr>
<td>14017</td>
<td>Bulk Sample B-3 @ 0'-2'</td>
<td>SC</td>
<td>31</td>
<td>12</td>
<td>40</td>
<td></td>
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</tr>
<tr>
<td>14018</td>
<td>Bulk Sample B-4 @ 0'-5'</td>
<td>SC-SM</td>
<td>27</td>
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</tr>
<tr>
<td>14019</td>
<td>Bulk Sample B-5 @ 0'-5'</td>
<td>SC</td>
<td>33</td>
<td>13</td>
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</tr>
<tr>
<td>14022</td>
<td>Bulk Sample B-8 @ 2'-5'</td>
<td>SC</td>
<td>28</td>
<td>9</td>
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</tr>
</tbody>
</table>

**Sieve Screens Not Included in Test**

**Reviewed By:** RS
## Expansion Index of Soils (ASTM D 4829)

| Sample Number | Sample Description | Dry Weight | Wet Weight | % Water | Wet Mass of Specimen (g) | Dry Density (pcf) | Saturation | Final Reading (in) | Measured | Expansion Index |
|---------------|--------------------|------------|------------|---------|--------------------------|------------------|-------------|--------------------|----------|----------------|---|
| 14019         | Bulk Sample B-5 @ 0'-5' | 184.5      | 198.6      | 7.6%    | 430.2                    | 120.6            | 52%         | 0.0190             | 19.0     | 20             |
| 14022         | Bulk Sample B-8 @ 2'-5' | 201.3      | 215.9      | 7.3%    | 398.4                    | 112.0            | 39%         | 0.0115             | 11.5     | 7              |

Reviewed by: RS
## Soil Analysis Report

**Project:** 12-G-2697  
**PO Number:** 12-G-2697

### Lab Number: 905721-01 B1 (0-5)

<table>
<thead>
<tr>
<th>Soluble Salts, Sulfate &amp; Chloride</th>
<th>Method</th>
<th>Result</th>
<th>Units</th>
<th>Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soluble Salts</td>
<td>ARIZ 237b SS</td>
<td>7136</td>
<td>ppm</td>
<td></td>
</tr>
<tr>
<td>Sulfate, SO4</td>
<td>ARIZ 733</td>
<td>344</td>
<td>ppm</td>
<td></td>
</tr>
<tr>
<td>Chloride</td>
<td>ARIZ 736</td>
<td>718</td>
<td>ppm</td>
<td></td>
</tr>
</tbody>
</table>

Soluble Salts 0.71%; Sulfate 0.034%; Chloride 0.072%

### Lab Number: 905721-02 B2 (0-5)

<table>
<thead>
<tr>
<th>Soluble Salts, Sulfate &amp; Chloride</th>
<th>Method</th>
<th>Result</th>
<th>Units</th>
<th>Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soluble Salts</td>
<td>ARIZ 237b SS</td>
<td>550</td>
<td>ppm</td>
<td></td>
</tr>
<tr>
<td>Sulfate, SO4</td>
<td>ARIZ 733</td>
<td>65</td>
<td>ppm</td>
<td></td>
</tr>
<tr>
<td>Chloride</td>
<td>ARIZ 736</td>
<td>17</td>
<td>ppm</td>
<td></td>
</tr>
</tbody>
</table>

Soluble Salts 0.055%; Sulfate 0.0065%; Chloride 0.0017%

### Lab Number: 905721-03 B3 (0-2)

<table>
<thead>
<tr>
<th>Soluble Salts, Sulfate &amp; Chloride</th>
<th>Method</th>
<th>Result</th>
<th>Units</th>
<th>Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soluble Salts</td>
<td>ARIZ 237b SS</td>
<td>10899</td>
<td>ppm</td>
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</tr>
<tr>
<td>Sulfate, SO4</td>
<td>ARIZ 733</td>
<td>790</td>
<td>ppm</td>
<td></td>
</tr>
<tr>
<td>Chloride</td>
<td>ARIZ 736</td>
<td>1473</td>
<td>ppm</td>
<td></td>
</tr>
</tbody>
</table>

Soluble Salts 1.1%; Sulfate 0.079 %; Chloride 0.15%

### Lab Number: 905721-04 B4 (0-5)

<table>
<thead>
<tr>
<th>Soluble Salts, Sulfate &amp; Chloride</th>
<th>Method</th>
<th>Result</th>
<th>Units</th>
<th>Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soluble Salts</td>
<td>ARIZ 237b SS</td>
<td>4064</td>
<td>ppm</td>
<td></td>
</tr>
<tr>
<td>Sulfate, SO4</td>
<td>ARIZ 733</td>
<td>540</td>
<td>ppm</td>
<td></td>
</tr>
<tr>
<td>Chloride</td>
<td>ARIZ 736</td>
<td>300</td>
<td>ppm</td>
<td></td>
</tr>
</tbody>
</table>

Soluble Salts 0.41%; Sulfate 0.054% ; Chloride 0.030%
### Soil Analysis Report

**Project:** 12-G-2697  
**Sampler:**  
**Date Received:** 7/17/2012  
**Date Reported:** 7/20/2012  
**PO Number:** 12-G-2697

#### Lab Number: 905721-05  
**B5 (0-5)**

<table>
<thead>
<tr>
<th>Soluble Salts, Sulfate &amp; Chloride</th>
<th>Method</th>
<th>Result</th>
<th>Units</th>
<th>Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soluble Salts</td>
<td>ARIZ 237b SS</td>
<td>4051</td>
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<tr>
<td>Sulfate, SO4</td>
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<td>491</td>
<td>ppm</td>
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<td>Chloride</td>
<td>ARIZ 736</td>
<td>611</td>
<td>ppm</td>
<td></td>
</tr>
</tbody>
</table>

Soluble Salts 0.41%; Sulfate 0.049%; Chloride 0.061%

#### Lab Number: 905721-06  
**B6 (0-5)**

<table>
<thead>
<tr>
<th>Soluble Salts, Sulfate &amp; Chloride</th>
<th>Method</th>
<th>Result</th>
<th>Units</th>
<th>Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soluble Salts</td>
<td>ARIZ 237b SS</td>
<td>4614</td>
<td>ppm</td>
<td></td>
</tr>
<tr>
<td>Sulfate, SO4</td>
<td>ARIZ 733</td>
<td>406</td>
<td>ppm</td>
<td></td>
</tr>
<tr>
<td>Chloride</td>
<td>ARIZ 736</td>
<td>668</td>
<td>ppm</td>
<td></td>
</tr>
</tbody>
</table>

Soluble Salts 0.46%; Sulfate 0.041%; Chloride 0.067%

#### Lab Number: 905721-07  
**B7 (0-5)**

<table>
<thead>
<tr>
<th>Soluble Salts, Sulfate &amp; Chloride</th>
<th>Method</th>
<th>Result</th>
<th>Units</th>
<th>Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soluble Salts</td>
<td>ARIZ 237b SS</td>
<td>6406</td>
<td>ppm</td>
<td></td>
</tr>
<tr>
<td>Sulfate, SO4</td>
<td>ARIZ 733</td>
<td>979</td>
<td>ppm</td>
<td></td>
</tr>
<tr>
<td>Chloride</td>
<td>ARIZ 736</td>
<td>977</td>
<td>ppm</td>
<td></td>
</tr>
</tbody>
</table>

Soluble Salts 0.64%; Sulfate 0.098%; Chloride 0.098%

#### Lab Number: 905721-08  
**B8 (0-5)**

<table>
<thead>
<tr>
<th>Soluble Salts, Sulfate &amp; Chloride</th>
<th>Method</th>
<th>Result</th>
<th>Units</th>
<th>Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soluble Salts</td>
<td>ARIZ 237b SS</td>
<td>7001</td>
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</tr>
<tr>
<td>Sulfate, SO4</td>
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<td>438</td>
<td>ppm</td>
<td></td>
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<tr>
<td>Chloride</td>
<td>ARIZ 736</td>
<td>937</td>
<td>ppm</td>
<td></td>
</tr>
</tbody>
</table>

Soluble Salts 0.70%; Sulfate 0.044%; Chloride 0.094%