Dear Mr. Granade:

In accordance with your authorization, Youngdahl Consulting Group, Inc. has performed a Geotechnical Engineering Study for the project site located on the northwest side of Business Drive in Shingle Springs, California. The purpose of this study was to perform a site reconnaissance and review and update the Reference 1 report to provide geotechnical information and design criteria for the proposed project in accordance with the 2016 California Building Code. Our scope was limited to a site reconnaissance and preparation of this report per the Reference 6 proposal.

Based upon our site reconnaissance and review of previous information, it is our opinion that the primary geotechnical issues to be addressed consist of processing of loose surface soils and recompaction as engineered fills, excavations into bedrock, and drainage related to the shallow bedrock conditions. Due to the non-uniform nature of soils, other geotechnical issues may become more apparent during grading operations which are not listed above. The descriptions, findings, conclusions, and recommendations provided in this report are formulated as a whole; specific conclusions or recommendations should not be derived or used out of context. Please review the limitations and uniformity of conditions section of this report.

This report has been prepared for the exclusive use of Granade Family Trust and their consultants, for specific application to this project, in accordance with generally accepted geotechnical engineering practice. Should you have any questions or require additional information, please contact our office at your convenience.

Very truly yours,

Youngdahl Consulting Group, Inc.

Devin S. Fielding
Staff Engineer

Reviewed By:

John C. Youngdahl, P.E.
Principal Engineer

Distribution: PDF to Client
# TABLE OF CONTENTS

1.0 INTRODUCTION ............................................................................................................ 1  
   Purpose and Scope ........................................................................................................ 1  
   Project Understanding .................................................................................................... 1  
   Background .................................................................................................................... 1  

2.0 FINDINGS ...................................................................................................................... 1  
   Surface Observations ..................................................................................................... 2  
   Subsurface Conditions ................................................................................................... 2  
   Groundwater Conditions ................................................................................................. 2  
   Geologic Conditions ....................................................................................................... 2  
   Seismicity ....................................................................................................................... 2  
   Earthquake Induced Liquefaction, Surface Rupture Potential, and Settlement ............... 3  
   Static and Earthquake Induced Slope Instability ............................................................. 3  
   Soil Expansion Potential ................................................................................................. 3  
   Naturally Occurring Asbestos ......................................................................................... 3  

3.0 DISCUSSION AND CONCLUSIONS .............................................................................. 4  
   General .......................................................................................................................... 4  
   Foundations ................................................................................................................... 4  
   Drainage ......................................................................................................................... 4  

4.0 SITE GRADING AND EARTHWORK IMPROVEMENTS ................................................ 4  
   Site Preparation .............................................................................................................. 4  
   Excavation Characteristics ............................................................................................. 5  
   Soil Moisture Considerations .......................................................................................... 6  
   Engineered Fill Criteria ................................................................................................... 6  
   Slope Configuration and Grading .................................................................................... 7  
   Underground Improvements ........................................................................................... 7  

5.0 DESIGN RECOMMENDATIONS .................................................................................... 8  
   Seismic Criteria .............................................................................................................. 8  
   Shallow Conventional Foundations ................................................................................. 9  
   Retaining Walls ............................................................................................................. 10  
   Slab-on-Grade Construction ..........................................................................................11  
   Asphalt Concrete Pavement Design ..............................................................................14  
   Drainage........................................................................................................................16  

6.0 DESIGN REVIEW AND CONSTRUCTION MONITORING ............................................17  
   Construction Monitoring ................................................................................................. 17  
   Post Construction Monitoring ....................................................................................... 17  

7.0 LIMITATIONS AND UNIFORMITY OF CONDITIONS ...................................................17  

APPENDIX A ............................................................................................................................20  
   Vicinity Map (Figure A-1) ...............................................................................................21  
   Site Plan (Figure A-2) .....................................................................................................22  

APPENDIX B ............................................................................................................................23  
   Keyway and Bench with Drain (Figure B-1) ....................................................................24  
   Plug and Drain (Figure B-2) ...........................................................................................25  
   Site Wall Drainage (Figure B-3) .....................................................................................26  
   Subdrain (Figure B-4) ....................................................................................................27
GEOTECHNICAL ENGINEERING STUDY UPDATE
FOR
BARNETT BUSINESS PARK UNIT 2 PHASE 2 PARCEL 3

1.0 INTRODUCTION
This report presents the results of our Geotechnical Engineering Study Update performed for the proposed commercial development planned to be constructed along Business Drive in Shingle Springs, California. An annotated vicinity map is provided on Figure A-1 to identify the approximate project location.

Purpose and Scope
The purpose of this study was to provide geotechnical information and design criteria and to update geotechnical recommendations for the proposed project. The scope of this study includes the following:

- A review of geotechnical and geologic data available to us at the time of our study;
- Engineering analysis of the data and information obtained from our previous field study and laboratory testing, and literature review;
- Development of geotechnical recommendations regarding earthwork construction including, site preparation and grading, excavation characteristics, soil moisture conditions, engineered fill criteria, slope configuration and grading, underground improvements, and drainage;
- Development of geotechnical design criteria for seismic conditions, shallow foundations, retaining walls, slabs on grade, and pavements;
- Preparation of this report summarizing our findings, conclusions, and recommendations regarding the above described information.

Project Understanding
We understand that the proposed development will consist of the construction of an 11,250 square foot steel building for warehouse and office building purposes (Building D as shown on Reference 5 plans). Based on the provided preliminary plans from 2006 (Reference 4), site development will likely include cuts on the order of 10 feet or less to generate the proposed building pad.

Background
Our firm observed the grading operations for the west adjacent lot in 2008 (Reference 2). During grading operations, the west side of the proposed building pad (Building D) was cut. We are not aware of other grading operations or disturbances on the Building D project site.

If studies or plans pertaining to the site exist and are not cited as a reference in this report, we should be afforded the opportunity to review and modify our conclusions and recommendations as necessary.

2.0 FINDINGS
The following section describes our findings regarding the site conditions that we observed during our site reconnaissance and previous subsurface exploration. In addition, this section also provides the results of our geologic review and engineering assessment related to the project site.
Surface Observations
The project site is located on the northwest side of Business Drive in Shingle Springs, California. The terrain at the site generally slopes toward the west at varying gradients with a maximum gradient of approximately 2H:1V (Horizontal:Vertical) on the west side of the lot where a previous cut was made. Vegetation throughout the project generally consisted of seasonal tall grasses and shrubs. The project site is bounded by office/warehouse structures to the southwest, an equipment yard to the northwest, undeveloped land to the northeast and east, and Business Drive to the southeast.

Subsurface Conditions
Our previous field study in 2005 included a subsurface exploration program consisting of the excavation of 5 exploratory test pits in the area. One test pit was conducted in the location of the proposed Building D and encountered silty sand in a dense condition from surface to a depth of 3½ feet below grade. The sands were underlain by bedrock in a moderately weathered condition. These conditions were representative of the area as similar subsurface conditions were encountered throughout the exploration. One test pit in the area encountered a clay layer with a thickness of ½ feet overlying bedrock and similar conditions may be present in the subsurface soils of Building D.

Groundwater Conditions
Groundwater conditions were not observed during our previous subsurface exploration. Generally, subsurface water conditions vary in the foothill regions because of many factors such as, the proximity to bedrock, fractures in the bedrock, topographic elevations, and proximity to surface water. Some evidence of past repeated exposure to subsurface water may include black staining on fractures, clay deposits, and surface markings indicating previous seepage. Based on our experience in the area, at varying times of the year water may be perched on less weathered rock and/or present in the fractures and seams of the weathered rock found beneath the site.

Geologic Conditions
The geologic portion of this report included a review of geologic data pertinent to the site and an interpretation of our observations of the surface exposures and our observations in our exploratory test pits excavated during the previous field study. The site is located within the western foothills region of the Sierra Nevada Mountain Range. According to the Geologic Map of the Sacramento Quadrangle, California (D.L. Wagner, et. al., 1981), this portion of the foothills and the project area are underlain by gabbroic rocks of the Mesozoic Age.

Seismicity
According to the Fault Activity Map of California and Adjacent Areas (Jennings, 2010) and the Alquist-Priolo Regulatory Maps, no active faults or Earthquake Fault Zones (Special Studies Zones) are located on the project site. Additionally, no evidence of recent or active faulting was observed during our field study. The nearest mapped potentially active and active faults pertinent to the site are summarized in the following table.
Table 1: Local Active and Potentially Active Faults

<table>
<thead>
<tr>
<th>Activity</th>
<th>Fault Name</th>
<th>Distance, Direction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Historic</td>
<td>Cleveland Hill</td>
<td>95 km N</td>
</tr>
<tr>
<td>Active</td>
<td>Dunnigan Hills</td>
<td>80 km W</td>
</tr>
<tr>
<td>Active</td>
<td>North Tahoe Fault</td>
<td>95 km E</td>
</tr>
<tr>
<td>Active</td>
<td>West Tahoe Fault</td>
<td>80 km E</td>
</tr>
<tr>
<td>Potentially Active</td>
<td>Bear Mountains Fault Zone</td>
<td>3 km E</td>
</tr>
<tr>
<td>Potentially Active</td>
<td>Maidu Fault</td>
<td>10 km N</td>
</tr>
</tbody>
</table>

Based on our literature review of shear-wave velocity characteristics of geologic units in California (Wills and Silva; August 1998: Earthquake Spectra, Volume 14, No. 3) and subsurface interpretations, we recommend that the project site be classified as Site Class C in accordance with Section 1613.3.2 of the 2016 CBC and Table 20.3-1 of ASCE 7-10.

**Earthquake Induced Liquefaction, Surface Rupture Potential, and Settlement**
Liquefaction is the sudden loss of soil shear strength and sudden increase in porewater pressure caused by shear strains, as could result from an earthquake. Research has shown that saturated, loose to medium-dense sands with a silt content less than about 25 percent and located within the top 40 feet are most susceptible to liquefaction and surface rupture/lateral spreading.

Due to the absence of permanently elevated groundwater table, the relatively low seismicity of the area and the relatively shallow depth to rock, the potential for seismically induced damage due to liquefaction, surface ruptures, and settlement is considered negligible. For the above-mentioned reasons mitigation for these potential hazards is not required for the development of this project.

**Static and Earthquake Induced Slope Instability**
The existing slopes on the project site were observed to have adequate vegetation on the slope face, appropriate drainage away from the slope face, and no apparent tension cracks or slump blocks in the slope face or at the head of the slope. No other indications of slope instability such as seeps or springs were observed. Additionally, due to the absence of permanently elevated groundwater table, the relatively low seismicity of the area, and the relatively shallow depth to rock, the potential for seismically induced slope instability for the existing slopes is considered negligible.

**Soil Expansion Potential**
The materials encountered in our explorations were generally non-plastic (rock, sand, and non-plastic silt). The non-plastic materials are generally considered to be non-expansive; therefore, we do not anticipate that special design considerations for expansive soils will be required for the design or construction of the proposed improvements. Based on our experience in the area, we anticipate that encountered clay soils can be sufficiently blended with non-expansive material. If necessary, recommendations can be made based on our observations at the time of construction should greater quantities of expansive soils be encountered at the project site which were not encountered during our study.

**Naturally Occurring Asbestos**
Asbestos is classified by the EPA as a known human carcinogen. Naturally occurring asbestos (NOA) has been identified as a potential health hazard. The California Geological Survey published a map in 2000 (Open File Report 2000-02) that qualitatively indicates the likelihood for
3.0 DISCUSSION AND CONCLUSIONS

General
It is our opinion that construction of the proposed improvements is feasible from a geotechnical standpoint, provided the recommendations contained in this report are incorporated into the design plans and implemented during construction. The native soils, once processed and recompacted as recommended below may be considered “engineered” and suitable for support of the planned improvements.

Foundations
In our opinion, conventional shallow foundations such as isolated pad footings or continuous footings will provide adequate support for the proposed buildings if the site grades are properly prepared as described in the Site Grading and Improvement section. Recommendations regarding foundation design parameters, including allowable bearing capacity, lateral resistance, and foundation configuration are provided in Section 5.0 of this report.

Drainage
Proper application of drainage practices are considered to be of paramount concern for effective development of the project site. We recommend the use of plug and drain systems within the utilities, proper surface drainage, and careful installation of the subdrain and back of wall drains detailed in this report to provide long term stability of the structural improvements as well as mitigate nuisance seepage.

It has also been our experience that potential sources of groundwater may not be present or observed during the site grading procedures, but can appear later as more persistent seepage as water becomes perched or flows through fractures of the shallow rock horizon. These conditions generally become more prevalent following up gradient development and the addition of moisture sources (i.e. landscape irrigation, run-off, etc.). Where this condition arises, drainage measures may be necessary to mitigate seepage conditions that were not initially observed during the site grading activities and/or lot development.

4.0 SITE GRADING AND EARTHWORK IMPROVEMENTS

Site Preparation
Preparation of the project site should involve site drainage controls, dust control, clearing and stripping, processing and recompaction of existing fills/loose native soils, and exposed grade compaction considerations. The following paragraphs state our geotechnical comments and recommendations concerning site preparation.

Site Drainage Controls: We recommend that initial site preparation involve intercepting and diverting any potential sources of surface or near-surface water within the construction zones. Because the selection of an appropriate drainage system will depend on the water quantity, season, weather conditions, construction sequence, and methods used by the contractor, final decisions regarding drainage systems are best made in the field at the time of construction. All drainage and/or water diversion performed for the site should be in accordance with the Clean Water Act and applicable Storm Water Pollution Prevention Plan.

Dust Control: Dust control provisions should be provided for as required by the local jurisdiction’s grading ordinance (i.e. water truck or other adequate water supply during grading).
Clearing and Stripping: Clearing and stripping operations should include the removal of all organic laden materials including root balls, root systems, and any soft or loose soil generated by the removal operations. Surface grass stripping operations are necessary based upon our observations during our site visit. Short or mowed dry grasses may be pulverized and lost within fill materials provided no concentrated pockets of organics result. It is the responsibility of the grading contractor to remove excess organics from the fill materials. **No more than 2 percent of organic material, by weight, should be allowed within the fill materials at any given location.**

General site clearing should also include removal of any loose or saturated materials within the proposed structural improvement and pavement areas. A representative of our firm should be present during site clearing operations to identify the location and depth of potential fills not disclosed by this report, to observe removal of deleterious materials, and to identify any existing site conditions which may require mitigation or further recommendations prior to site development.

Expansive Clay Mitigation: Expansive clays, if encountered, should be mixed thoroughly with less expansive on site materials (silts, sands, and gravels) and should not be present in concentration within 5 feet of the building envelope, either vertically or laterally. Proper disposition of clays on site should be documented by a representative of Youngdahl Consulting Group, Inc. We should be afforded the opportunity to review the project grading plans to make a preliminary determination where expansive soil mitigation measures may be warranted. Any final determination of mitigation measures should be based on the conditions observed during grading.

Exposed Grade Compaction: Exposed soil grades following initial site preparation activities and overexcavation operations should be scarified to a minimum depth of 8 inches and compacted to the requirements for engineered fill. Prior to placing fill, the exposed subgrades should be in a firm and unyielding state. Any localized zones of soft or pumping soils observed within a subgrade should either be scarified and recompacted or be overexcavated and replaced with engineered fill as detailed in the engineered fill section below.

Excavation Characteristics

We expect that the site soils can be excavated using conventional earthmoving equipment such as a Caterpillar D6 to D8 for grading and rubber tired backhoe for trench excavations not extending to the underlying bedrock materials. The underlying bedrock materials can likely be excavated to depths of several feet using dozers equipped with rippers. We expect that the upper, weathered portion of the rock will require use of a Caterpillar D9 equipped with a single or multiple shank rippers, or similar equipment. We anticipate that a ripper equipped D9 can penetrate at least as deep as our test pits at most locations with moderate effort. Deeper excavation into the less weathered rock may require heavier equipment such as a D10. Blasting cannot be ruled out in areas of resistant rock.

Where hard rock cuts in fractured rock are proposed, the orientation and direction of ripping will likely play a large role in the rippability of the material. When hard rock is encountered, we should be contacted to provide additional recommendations prior to performing an alternative such as blasting.

Utility trenches will likely encounter hard rock excavation conditions especially in deeper cut areas. Utility contractors should be prepared to use special rock trenching equipment such as large excavators (Komatsu PC400 or CAT 345 or equivalent). Blasting to achieve utility line grades, especially in planned cut areas, cannot be precluded. Water inflow into any excavation approaching the hard rock surface is likely to be experienced in all but the driest summer and fall
months. Pre-ripping during mass grading may be beneficial and should be considered with the Geotechnical Engineer prior to, or during mass grading.

**Soil Moisture Considerations**
The near-surface soils may become partially or completely saturated during the rainy season. Grading operations during this time period may be difficult since compaction efforts may be hampered by saturated materials. Therefore, we suggest that consideration be given to the seasonal limitations and costs of winter grading operations on the site. Special attention should be given regarding the drainage of the project site.

If the project is expected to work through the wet season, the contractor should install appropriate temporary drainage systems at the construction site and should minimize traffic over exposed subgrades due to the moisture-sensitive nature of the on-site soils. During wet weather operations, the soil should be graded to drain and should be sealed by rubber tire rolling to minimize water infiltration.

**Engineered Fill Criteria**
We anticipate that grading procedures will primarily consist of cut. If needed, any materials placed as fills on the site should be placed as “Engineered Fill” which is observed, tested, and compacted as described in the following paragraphs.

**Suitability of Onsite Materials:** If material is needed for fill, we expect that soil generated from excavations on the site, excluding deleterious material, may be used as engineered fill provided the material does not exceed 8 inches in maximum dimension. The contractor should either dispose of the excess materials to an offsite location or mechanically reduce the rocks to less than 8 inches.

**Import Materials:** If imported fill material is needed for this project, import material should be approved by our firm prior to transporting it to the project. It is preferable that import material meet the following requirements:

1. Plasticity index not to exceed 12;
2. "R"-value of equal to or greater than 18;
3. An angle of friction equal to or greater than 32 degrees;
4. Should not contain rocks larger than 6 inches in diameter;
5. Not more than 30 percent passing through the No. 200 sieve.

If these requirements are not met, additional testing and evaluation may be necessary to determine the appropriate design parameters for foundations, pavement, and other improvements.

**Fill Placement and Compaction:** All areas proposed to receive fill should be scarified to a minimum depth of 8 inches, moisture conditioned as necessary, and compacted to at least 90 percent of the maximum dry density based on the ASTM D1557 test method. The fill should be placed in thin horizontal lifts not to exceed 12 inches in uncompacted thickness. The fill should be moisture conditioned as necessary and compacted to a relative compaction of not less than 90 percent based on the ASTM D1557 test method. The upper 8 inches of fills placed under proposed pavement areas should be compacted to a relative compaction of not less than 95 percent based on the ASTM D1557 test method.
Fill soil compaction should be evaluated by means of in-place density tests performed during fill placement so that adequacy of soil compaction efforts may be determined as earthwork progresses.

**Slope Configuration and Grading**

The project site may have cuts and fill with a maximum slope orientation of 2H:1V (Horizontal:Vertical). Generally, a cut slope orientation of 2H:1V is considered stable with the material types encountered on the site. A fill slope constructed at the same orientation is considered stable if compacted to the engineered fill recommendations as stated in the recommendations section of this report. All slopes should have appropriate drainage and vegetation measures to minimize erosion of slope soils.

**Placement of Fills on Slopes:** Placement of fill material on natural slopes should be stabilized by means of keyways and benches. Where the slope of the original ground equals or exceeds 5H:1V, a keyway should be constructed at the base of the fill. The keyway should consist of a trench excavated to a depth of at least two feet into firm, competent materials. The keyway trench should be at least 10 feet wide or as designated by our firm based on the conditions at the time of construction. Benches should be cut into the original slope as the filling operation proceeds. Each bench should consist of a level surface excavated at least six feet horizontally into firm soils or four feet horizontally into rock. The rise between successive benches should not exceed 36 inches. The need for subdrainage should be evaluated at the time of construction. Refer to Figure B-1, Appendix B for typical keyway and bench construction.

**Slope Face Compaction:** All slope fills should be laterally overbuilt and cut back such that the required compaction is achieved at the proposed finish slope face. As a less preferable alternative, the slope face could be track walked or compacted with a wheel. If this second alternative is used, additional slope maintenance may be necessary.

**Slope Drainage:** Surface drainage should not be allowed to flow uncontrolled over any slope face. Adequate surface drainage control should be designed by the project civil engineer in accordance with the latest applicable edition of the CBC. All slopes should have appropriate drainage and vegetation measures to minimize erosion of slope soils.

**Underground Improvements**

**Trench Excavation:** Trenches or excavations in soil should be shored or sloped back in accordance with current OSHA regulations prior to persons entering them. Where clay rind in combination with moist conditions is encountered in fractured bedrock, the project engineering geologist should be consulted for appropriate mitigation measures. The potential use of a shield to protect workers cannot be precluded. Refer to the Excavation Characteristics section of Site Grading and Improvements of this report for anticipated excavation conditions.

**Backfill Materials:** Backfill materials for utilities should conform to the requirements of the local jurisdiction. It should be realized that permeable backfill materials will likely carry water at some time in the future.

When backfilling within structural footprints, compacted low permeability materials are recommended to be used a minimum of 5 feet beyond the structural footprint to minimize moisture intrusion. If the materials are too rocky, they may need to be screened prior to backfill in order to limit pipe damage. If a permeable material is used as backfill within this zone, subdrainage mitigation may be required. In addition, if the structure is oriented below the roadway and
associated utilities, grout cutoffs and/or plug and drains around all utility penetrations are useful to keep moisture out from underneath the structure.

A common problem occurs on sites graded with large equipment and rocky fill materials where the excavated spoils from the lot utilities are too rocky to place as engineered fill back in the trench with the common compaction practices employed by the subcontractors installing these utilities. We recommend that, where excavated soils are too rocky to place and compact to a tight condition with low void space, these materials be replaced with a proper import material for compaction.

**Backfill Compaction:** Backfill compaction should conform to the requirements of the local jurisdiction. Where backfill compaction is not specified by the local jurisdiction, the backfill should be compacted to a minimum of 90 percent relative compaction per the ASTM D1557 test method. Compaction should be accomplished using lifts which do not exceed 12 inches when compacting with a backhoe or larger equipment equipped with a compaction wheel. However, thickness of the lifts should be determined by the contractor. If the contractor can achieve the required compaction using thicker lifts, the method may be judged acceptable based on field verification by a representative of our firm using standard density testing procedures. Lightweight compaction equipment may require thinner lifts to achieve the required densities.

**Drainage Considerations:** In developments with the potential for a perched groundwater condition (i.e. shallow bedrock), underground utilities can become collection points for subsurface water. Due to this condition, we recommend plug and drains within the utility trenches (Figure B-2, Appendix B) to collect and convey water to the storm drain system or other approved outlet. Temporary dewatering measures may be necessary and could include the installation of submersible pumps and/or point wells. Once plans are developed, the civil engineer should coordinate with us to discuss the locations of plug and drains.

### 5.0 DESIGN RECOMMENDATIONS

**Seismic Criteria**

Based on the 2016 California Building Code, Chapter 16, and our site investigation findings, the following seismic parameters are recommended from a geotechnical perspective for structural design. The final choice of design parameters, however, remains the purview of the project structural engineer.
Table 2: Seismic Design Parameters

<table>
<thead>
<tr>
<th>2016 CBC</th>
<th>ASCE 7-10</th>
<th>Seismic Parameter</th>
<th>Recommended Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table 20.3-1</td>
<td>Site Class</td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>Figure 1613.3.1(1)</td>
<td>Short-Period MCE at 0.2s, $S_S$</td>
<td>0.447g</td>
<td></td>
</tr>
<tr>
<td>Figure 1613.3.1(2)</td>
<td>1.0s Period MCE, $S_1$</td>
<td>0.230g</td>
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</tr>
<tr>
<td>Table 1613.3.3(1)</td>
<td>Site Coefficient, $F_a$</td>
<td>1.200</td>
<td></td>
</tr>
<tr>
<td>Table 1613.3.3(2)</td>
<td>Site Coefficient, $F_v$</td>
<td>1.570</td>
<td></td>
</tr>
<tr>
<td>Equation 16-37</td>
<td>Adjusted MCE Spectral Response Parameters, $S_{MS} = F_a S_s$</td>
<td>0.536g</td>
<td></td>
</tr>
<tr>
<td>Equation 16-38</td>
<td>Adjusted MCE Spectral Response Parameters, $S_{M1} = F_v S_1$</td>
<td>0.361g</td>
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</tr>
<tr>
<td>Equation 16-39</td>
<td>Design Spectral Acceleration Parameters, $S_{DS} = \frac{2}{3}S_{MS}$</td>
<td>0.357g</td>
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</tr>
<tr>
<td>Equation 16-40</td>
<td>Design Spectral Acceleration Parameters, $S_{D1} = \frac{2}{3}S_{M1}$</td>
<td>0.241g</td>
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</tr>
<tr>
<td>Table 1613.3.5(1)</td>
<td>Seismic Design Category (Short Period), Occupancy I to III</td>
<td>C</td>
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</tr>
<tr>
<td>Table 1613.3.5(1)</td>
<td>Seismic Design Category (Short Period), Occupancy IV</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td>Table 1613.3.5(2)</td>
<td>Seismic Design Category (1-Second Period), Occupancy I to IV</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td>Figure 22-7</td>
<td>Maximum Considered Earthquake Geometric Mean (MCEC) PGA</td>
<td>0.141g</td>
<td></td>
</tr>
<tr>
<td>Table 11.8-1</td>
<td>Site Coefficient $F_{PGA}$</td>
<td>1.200</td>
<td></td>
</tr>
<tr>
<td>Equation 11.8-1</td>
<td>$PGA_M = F_{PGA} PGA$</td>
<td>0.169g</td>
<td></td>
</tr>
</tbody>
</table>


### Shallow Conventional Foundations

We offer the following comments and recommendations for purposes of design and construction of shallow continuous and/or isolated pad foundations. The provided minimums do not constitute a structural design of foundations which should be performed by the structural engineer. Our firm should be afforded the opportunity to review the project grading and foundation plans to confirm the applicability of the recommendations provided below. Modifications to these recommendations may be made at the time of our review. In addition to the provided recommendations, foundation design and construction should conform to applicable sections of the 2016 California Building Code.

**Foundation Bearing Capacities:** An allowable dead plus live load bearing pressure of 2,250 psf may be used for design of conventional shallow foundations based on firm native soils or engineered fills. The allowable pressures are for support of dead plus live loads and may be increased by 1/3 for short-term wind and seismic loads.

**Foundation Lateral Pressures:** Lateral forces on structures may be resisted by passive pressure acting against the sides of shallow footings and/or friction between the soil and the bottom of the footing. For resistance to lateral loads, a friction factor of 0.35 may be utilized for sliding resistance at the base of conventional shallow foundations in firm native materials or engineered fill. A passive resistance of 350 pcf equivalent fluid weight may be used against the side of conventional shallow footings in firm native soil or engineered fill. If friction and passive pressures are combined, the lesser value should be reduced by 50 percent.
Foundation Settlement: A total settlement of less than 1 inch is anticipated; a differential settlement of ½ of the total is anticipated where foundations are bearing on like materials. This settlement is based upon the assumption that foundation will be sized and loaded in accordance with the recommendations in this report.

Foundation Configuration: Conventional shallow foundations should be a minimum of 12 inches wide and founded a minimum of 18 inches below the lowest adjacent soil grade. Isolated pad foundation should be a minimum of 24 inches in diameter.

Foundation reinforcement should be provided by the structural engineer. The reinforcement schedule should account for typical construction issues such as load consideration, concrete cracking, and the presence of isolated irregularities. At a minimum, we recommend that continuous footing foundations be reinforced with four No. 4 reinforcing bars, two located near the bottom of the footing and two near the top of the stem wall.

All footings should be founded below an imaginary 2H:1V plane projected up from the bottoms of adjacent footings and/or parallel utility trenches, or to a depth that achieves a minimum horizontal clearance of 6 feet from the outside toe of the footings to the slope face, whichever requires a deeper excavation.

Subgrade Conditions: Footings should never be cast atop soft, loose, organic, slough, debris, nor atop subgrades covered by ice or standing water. A representative of our firm should be retained to observe all subgrades during footing excavations and prior to concrete placement so that a determination as to the adequacy of subgrade preparation can be made.

Shallow Footing / Stemwall Backfill: All footing/stemwall backfill soil should be compacted to at least 90 percent of the maximum dry density (based on ASTM D1557).

Retaining Walls
Our design recommendations and comments regarding retaining walls for the project site are discussed below.

Foundation Design Parameters: An allowable dead plus live load bearing pressure of 2,250 psf may be used for design of conventional shallow foundations based on firm native soils or engineered fills. The allowable pressures are for support of dead plus live loads and may be increased by 1/3 for short-term seismic loads.

Foundation Lateral Pressures: Lateral forces on structures may be resisted by passive pressure acting against the sides of shallow footings and/or friction between the soil and the bottom of the footing. For resistance to lateral loads, a friction factor of 0.35 may be utilized for sliding resistance at the base of conventional shallow foundations in firm native materials or engineered fill. A passive resistance of 350 pcf equivalent fluid weight may be used against the side of conventional shallow footings in firm native soil or engineered fill. If friction and passive pressures are combined, the lesser value should be reduced by 50 percent.

Retaining Wall Lateral Pressures: Based on our observations and testing, the retaining wall should be designed to resist lateral pressure exerted from a soil media having an equivalent fluid weight provided in Table 3, below. In accordance with Section 1803.5.12.1 of the 2016 California Building Code, application of the seismic design values for earthquake loading are required for retaining walls supporting more than 6 feet of backfill.
Table 3: Retaining Wall Pressures

<table>
<thead>
<tr>
<th>Wall Type</th>
<th>Wall Slope Configuration</th>
<th>Equivalent Fluid Weight (pcf)</th>
<th>Surcharge Load (psf)*</th>
<th>Lateral Pressure Coefficient</th>
<th>Earthquake Loading (plf)***</th>
</tr>
</thead>
<tbody>
<tr>
<td>Free Cantilever</td>
<td>Flat</td>
<td>45</td>
<td>per structural</td>
<td>0.31</td>
<td>5H^2</td>
</tr>
<tr>
<td></td>
<td>2H:1V</td>
<td>65</td>
<td>per structural</td>
<td>0.47</td>
<td>19H^2</td>
</tr>
<tr>
<td>Restrained**</td>
<td>Flat</td>
<td>65</td>
<td>per structural</td>
<td>0.47</td>
<td>Applied 0.6H above the base of the wall</td>
</tr>
</tbody>
</table>

* The surcharge loads should be applied as uniform loads over the full height of the walls as follows: Surcharge Load (psf) = (q) (K), where q = surcharge in psf, and K = coefficient of lateral pressure. Final design is the purview of the project structural engineer.

** Restrained conditions shall be defined as walls which are structurally connected to prevent flexible yielding, or rigid wall configurations (i.e. walls with numerous turning points) which prevent the yielding necessary to reduce the driving pressures from an at-rest state to an active state.

*** Section 1803.5.12 of the 2016 California Building Code states that a determination of lateral pressures on basement and retaining walls due to earthquake loading shall be provided for structures to be designed in Seismic Design Categories D, E or F (Load value derived from Wood (1973) and modified by Whitman (1991)).

Mechanically Stabilized Earth Walls: If keyed or interlocking non-mortared walls such as Keystone, Basalite, Allen Block, or rockery walls are utilized, the following soil parameters would be applicable for design within on-site, native materials:

Table 4: Modular Retaining Wall Design Parameters

<table>
<thead>
<tr>
<th>Internal Angle of Friction</th>
<th>Cohesion</th>
<th>Bulk Unit Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>32°</td>
<td>0 psf</td>
<td>125 psf</td>
</tr>
</tbody>
</table>

Site Wall Drainage: The above criteria are based on fully drained conditions as detailed in the attached Figure B-3, Appendix B. For these conditions, we recommend that a blanket of filter material be placed behind all proposed walls. The blanket of filter material should be a minimum of 12 inches thick and should extend from the bottom of the wall to within 12 inches of the ground surface. The filter material should conform to Class One, Type B permeable material as specified in Section 68 of the California Department of Transportation Standard Specifications, current edition. A clean ¾ inch crushed rock is also acceptable, provided filter fabric is used to separate the open graded gravel/rock from the surrounding soils. The top 12 inches of wall backfill should consist of a compacted soil cap. A filter fabric should be placed on top of the gravel filter material to separate it from the soil cap. A 4 inch diameter drain pipe should be installed near the bottom of the filter blanket with perforations facing down. The drainpipe should be underlain by at least 4 inches of filter-type material. An adequate gradient should be provided along the top of the foundation to discharge water that collects behind the retaining wall to a controlled discharge system.

The configuration of a long retaining wall generally does not allow for a positive drainage gradient within the perforated drain pipe behind the wall since the wall footing is generally flat with no gradient for drainage. Where this condition is present, to maintain a positive drainage behind the walls, we recommend that the wall drains be provided with a discharge to an appropriate non-erosive outlet a maximum of 50 feet on center. In addition, if the wall drain outlets are temporarily stubbed out in front of the walls for future connection during construction, it is imperative that the outlets be routed into the tight pipe area drainage system and not buried and rendered ineffective.

Slab-on-Grade Construction
It is our opinion that soil-supported slab-on-grade floors could be used for the main floors of the structure, contingent on proper subgrade preparation. Often the geotechnical issues regarding
the use of slab-on-grade floors include proper soil support and subgrade preparation, proper transfer of loads through the slab underlayment materials to the subgrade soils, and the anticipated presence or absence of moisture at or above the subgrade level. We offer the following comments and recommendations concerning support of slab-on-grade floors. The slab design (concrete mix, reinforcement, joint spacing, moisture protection, and underlayment materials) is the purview of the project Structural Engineer.

**Slab Subgrade Preparation:** All subgrades proposed to support slab-on-grade floors should be prepared and compacted to the requirements of engineered fill as discussed in the Site Grading and Improvements section of this report.

**Slab Underlayment:** As a minimum for slab support conditions, the slab should be underlain by a minimum 4 inch crushed rock layer and covered by a minimum 10-mil thick moisture retarding plastic membrane. An optional 1 inch blotter sand layer above the plastic membrane is sometimes used to aid in curing of the concrete in commercial structures. The blotter layer can become a reservoir for excessive moisture if inclement weather occurs prior to pouring the slab, excessive water collects in it from the concrete pour, or an external source of water enters above or bypasses the membrane. The membrane may only be functional when it is above the vapor sources. The bottom of the crushed rock layer should be above the exterior grade to act as a capillary break and not a reservoir, unless it is provided with an underdrain system. The slab design and underlayment should be in accordance with ASTM E1643 and E1745.

If the blotter sand layer is omitted (as may be required if slab design and construction is to be performed according to the 2016 Green Building Code), special wet curing procedures will be necessary. In all cases, development of appropriate slab mix design and curing procedures remains the purview of the project structural engineer.

**Slab Moisture Protection:** Due to the potential for landscape to be present directly adjacent to the slab edge/foundation or for drainage to be altered following our involvement with the project, varying levels of moisture below, at, or above the pad subgrade level should be anticipated. The slab designer should include the potential for moisture vapor transmission when designing the slab. Our experience has shown that vapor transmission through concrete is controlled through slab thickness as well as proper concrete mix design.

It should be noted that placement of the recommended plastic membrane, proper mix design, and proper slab underlayment and detailing per ASTM E1643 and E1745 will not provide a waterproof condition. If a waterproof condition is desired, we recommend that a waterproofing expert be consulted for slab design.

**Slab Thickness and Reinforcement:** Geotechnical reports have historically provided minimums for slab thickness and reinforcement for general crack control. The concrete mix design and construction practices can additionally have a large impact on concrete crack control. All concrete should be anticipated to crack. As such, these minimums should not be considered to be stand-alone items to address crack control, but are suggested to be considered in the slab design methodology.

In order to help control the growth of cracks in interior concrete from becoming significant, we suggest the following minimums. Interior concrete slabs-on-grade not subject to heavy loads should be a minimum of 4 inches thick. A 4 inch thick slab should be reinforced. A minimum of No. 3 deformed reinforcing bars placed at 24 inches on center both ways, at the center of the structural section is suggested. Joint spacing should be provided by the structural engineer.
Troweled joints recovered with paste during finishing or “wet sawn” joints should be considered every 10 feet on center. Expansion joint felt should be provided to separate floating slabs from foundations and at least at every third joint. Cracks will tend to occur at recurrent corners, curved or triangular areas and at points of fixity. Trim bars can be utilized at right angle to the predicted crack extending 40 bar diameters past the predicted crack on each side.

**Vertical Deflections:** Soil-supported slab-on-grade floors can deflect downward when vertical loads are applied, due to elastic compression of the subgrade. For design of concrete floors, a modulus of subgrade reaction of k = 150 psi per inch would be applicable for native soils and engineered fills.

**Exterior Flatwork:** Exterior concrete flatwork is recommended to have a 4 inch rock cushion. This could consist of vibroplate compacted crushed rock or compacted ¾ inch aggregate baserock.

If exterior flatwork concrete is against the floor slab edge without a moisture separator it may transfer moisture to the floor slab. Expansion joint felt should be provided to separate exterior flatwork from foundations and at least at every third joint. Contraction / groove joints should be provided to a depth of at least 1/4 of the slab thickness and at a spacing of less than 30 times the slab thickness for unreinforced flatwork, dividing the slab into nearly square sections. Cracks will tend to occur at recurrent corners, curved or triangular areas and at points of fixity. Trim bars can be utilized at right angle to the predicted crack extending 40 bar diameters past the predicted crack on each side.

**Drainage Adjacent to Slabs:** All grades should provide rapid removal of surface water runoff; ponding water should not be allowed on building pads or adjacent to foundations or other structural improvements (during and following construction). All soils placed against foundations during finish grading should be compacted to minimize water infiltration. Finish and landscape grading should include positive drainage away from all foundations. Section 1808.7.4 of the 2016 California Building Code (CBC) states that for graded soil sites, the top of any exterior foundation shall extend above the elevation of the street gutter at the point of discharge or the inlet of an approved drainage device a minimum of 12 inches plus 2 percent. If overland flow is not achieved adjacent to buildings, the drainage device should be designed to accept flows from a 100 year event. Grades directly adjacent to foundations should be no closer than 8 inches from the top of the slab (CBC 2304.12.1.2), and weep screeds are to be placed a minimum of 4 inches clear of soil grades and 2 inches clear of concrete or other hard surfacing (CBC 2512.1.2). From this point, surface grades should slope a minimum of 2 percent away from all foundations for at least 5 feet but preferably 10 feet, and then 2 percent along a drainage swale to the outlet (CBC 1804.4). Downspouts should be tight piped via an area drain network and discharged to an appropriate non-erosive outlet away from all foundations.
The above referenced elements pertaining to drainage of the proposed structures is provided as general acknowledgement of the California Building Code requirements, restated and graphically illustrated for ease of understanding. Surface drainage design is the purview of the Project Architect/Civil Engineer. Review of drainage design and implementation adjacent to the building envelopes is recommended as performance of these improvements is crucial to the performance of the foundation and construction of rigid improvements.

It should be noted that due to the Americans with Disabilities Act (ADA) requirements, design and construction of alternative site drainage configurations may be necessary, particularly for commercial developments. In this case, design and construction of adequate drainage adjacent to foundations and slabs are essential to preserving foundation support and reducing the potential for wet slab related issues. A typical example of this condition occurs in commercial developments where the landscape grades are situated at the same elevation as the parking areas so as to not create a drop off between the grades. This condition subsequently results in flat grades between the building, landscape area, and parking lot which do not meet building code requirements.

Asphalt Concrete Pavement Design

We understand that asphalt pavements will be used for the associated roadways. The following comments and recommendations are given for pavement design and construction purposes. All pavement construction and materials used should conform to applicable sections of the latest edition of the California Department of Transportation Standard Specifications.

Subgrade Compaction: After installation of any underground facilities, the upper 8 inches of subgrade soils under pavements sections should be compacted to a minimum relative compaction of 95 percent based on the ASTM D1557 test method at a moisture content near or above optimum. Aggregate bases should also be compacted to a minimum relative compaction of 95 percent based on the aforementioned test method.

Subgrade Stability: All subgrades and aggregate base should be proof-rolled with a full water truck or equivalent immediately before paving, in order to evaluate their condition. If unstable subgrade conditions are observed, these areas should be overexcavated down to firm materials and the resulting excavation backfilled with suitable materials for compaction (i.e. drier native soils or aggregate base). Areas displaying significant instability may require geotextile stabilization fabric within the overexcavated area, followed by placement of aggregate base. Final
determination of any required overexcavation depth and stabilization fabric should be based on the conditions observed during subgrade preparation.

Design Criteria: Critical features that govern the durability of a pavement section include the stability of the subgrade; the presence or absence of moisture, free water, and organics; the fines content of the subgrade soils; the traffic volume; and the frequency of use by heavy vehicles. Soil conditions can be defined by a soil resistance value, or “R-Value,” and traffic conditions can be defined by a Traffic Index (TI).

Design Values: The following table provides recommended pavement sections based on the R-Value test (CTM 301) previously performed on a bulk sample representative of the materials expected to be exposed at subgrade, as well as our experience with similar materials in the area. An R-value of 18 was determined for the silty SANDS previously tested and was used in our design.

Design values provided are based upon properly drained subgrade conditions. Although the R-Value design to some degree accounts for wet soil conditions, proper surface and landscape drainage design is integral in performance of adjacent street sections with respect to stability and degradation of the asphalt. If clay soils are encountered and cannot be sufficiently blended with non-expansive soils, we should review pavement subgrades to determine the appropriateness of the provided sections, and provide additional pavement design recommendations as field conditions dictate. Even minor clay constituents will greatly reduce the design R-Value.

The recommended design thicknesses presented in the following table were calculated in accordance with the methods presented in the Sixth Edition of the California Department of Transportation Highway Design Manual. A varying range of traffic indices are provided for use by the project Civil Engineer for roadway design.

<table>
<thead>
<tr>
<th>Design Traffic Indices</th>
<th>Alternative Pavement Sections (Inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Asphalt Concrete *</td>
</tr>
<tr>
<td>4.5</td>
<td>2.5</td>
</tr>
<tr>
<td></td>
<td>3.0</td>
</tr>
<tr>
<td>5.0</td>
<td>2.5</td>
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</tr>
<tr>
<td></td>
<td>4.0</td>
</tr>
<tr>
<td>7.0</td>
<td>4.0</td>
</tr>
<tr>
<td></td>
<td>4.5</td>
</tr>
</tbody>
</table>

* Asphalt Concrete: must meet specifications for Caltrans Hot Mix Asphalt Concrete  
** Aggregate Base: must meet specifications for Caltrans Class II Aggregate Base (R-Value = minimum 78)

Due to the redistribution of materials that occurs during mass grading operations, we should review pavement subgrades to determine the appropriateness of the provided sections.
Drainage
In order to maintain the engineering strength characteristics of the soil presented for use in this Geotechnical Engineering Study Update, maintenance of the building pads will need to be performed. This maintenance generally includes, but is not limited to, proper drainage and control of surface and subsurface water which could affect structural support and fill integrity. A difficulty exists in determining which areas are prone to the negative impacts resulting from high moisture conditions due to the diverse nature of potential sources of water; some of which are outlined in the paragraph below. We suggest that measures be installed to minimize exposure to the adverse effects of moisture, but this will not guarantee that excessive moisture conditions will not affect the structure.

Some of the diverse sources of moisture could include water from landscape irrigation, annual rainfall, offsite construction activities, runoff from impermeable surfaces, collected and channeled water, and water perched in the subsurface soils on the bedrock horizon or present in fractures in the weathered bedrock. Some of these sources can be controlled through drainage features installed either by the owner or contractor. Others may not become evident until they, or the effects of the presence of excessive moisture, are visually observed on the property.

Some measures that can be employed to minimize the buildup of moisture include, but are not limited to proper backfill materials and compaction of utility trenches within the footprint of the proposed structure; grout plugs at foundation penetrations; collection and channeling of drained water from impermeable surfaces (i.e. roofs, concrete or asphalt paved areas); installation of subdrain/cut-off drain provisions; utilization of low flow irrigation systems.

Building Pad Subdrain: It has been our experience that sites constructed within this area generally have an increased potential for moisture related issues related to water perched on the bedrock horizon and/or present in the fractures of the bedrock as well as moisture transmission through utility trenches. To mitigate for the potential of these issues, subdrains can be constructed in addition to the drainage provisions provided in the 2016 CBC. Typical subdrain construction would include a 3 feet deep trench (or depth required to intercept the bottom of utility trenches) constructed as detailed on Figure B-4, Appendix B. The water collected in the subdrain pipe would be directed to an appropriate non-erosive outlet. We recommend that a representative from our firm be present during the subdrain installation procedures to document that the drain is installed in accordance with the observed field conditions, as well as to provide additional consultation as the conditions dictate.

As noted in the previous discussions, the moisture conditions may not manifest until after the site is developed. As such, any recommendations for the subdrain orientation and location to mitigate the moisture conditions can be provided on an as requested basis as the conditions arise.

Post Construction: All drainage related issues may not become known until after construction and landscaping are complete. Therefore, some mitigation measures may be necessary following site development. Landscape watering is typically the largest source of water infiltration into the subgrade. Given the soil conditions on site, excessive or even normal landscape watering may contribute to groundwater levels rising, which could contribute to moisture related problems and/or cause distress to foundations and slabs, pavements, and underground utilities, as well as creating a nuisance where seepage occurs. On foothill developments constructed on shallow bedrock conditions, seepage may not be apparent until post construction. In order to mitigate these conditions additional subdrainage measures may be necessary.
6.0 DESIGN REVIEW AND CONSTRUCTION MONITORING
The design plans and specifications should be reviewed and accepted by Youngdahl Consulting Group, Inc. prior to contract bidding. A review should be performed to determine whether the recommendations contained within this report are still applicable and/or are properly reflected and incorporated into the project plans and specifications.

Construction Monitoring
Construction monitoring is a continuation of the findings and recommendations provided in this report. It is essential that our representative be involved with all grading activities in order for us to provide supplemental recommendations as field conditions dictate. Youngdahl Consulting Group, Inc. should be notified at least two working days before site clearing or grading operations commence, and should observe the stripping of deleterious material and provide consultation to the Grading Contractor in the field.

Post Construction Monitoring
As described in Post Construction section of this report, all drainage related issues may not become known until after construction and landscaping are complete. Youngdahl Consulting Group, Inc. can provide consultation services upon request that relate to proper design and installation of drainage features during and following site development.

7.0 LIMITATIONS AND UNIFORMITY OF CONDITIONS

1. This report has been prepared for the exclusive use of Granade Family Trust and their consultants for specific application to the Barnett Business Park Unit 2 Phase 2 Parcel 3 project. Youngdahl Consulting Group, Inc. has endeavored to comply with generally accepted geotechnical engineering practice common to the local area. Youngdahl Consulting Group, Inc. makes no other warranty, expressed or implied.

2. As of the present date, the findings of this report are valid for the property studied. With the passage of time, changes in the conditions of a property can occur whether they be due to natural processes or to the works of man on this or adjacent properties. Legislation or the broadening of knowledge may result in changes in applicable standards. Changes outside of our control may cause this report to be invalid, wholly or partially. Therefore, this report should not be relied upon after a period of three years without our review nor should it be used or is it applicable for any properties other than those studied.

3. Section [A] 107.3.4 of the 2016 California Building Code states that, in regard to the design professional in responsible charge, the building official shall be notified in writing by the owner if the registered design professional in responsible charge is changed or is unable to continue to perform the duties.

WARNING: Do not apply any of this report's conclusions or recommendations if the nature, design, or location of the facilities is changed. If changes are contemplated, Youngdahl Consulting Group, Inc. must review them to assess their impact on this report's applicability. Also note that Youngdahl Consulting Group, Inc. is not responsible for any claims, damages, or liability associated with any other party's interpretation of this report's subsurface data or reuse of this report's subsurface data or engineering analyses without the express written authorization of Youngdahl Consulting Group, Inc.

4. The analyses and recommendations contained in this report are based on limited windows into the subsurface conditions and data obtained from subsurface exploration. The methods used indicate subsurface conditions only at the specific locations where samples were
obtained, only at the time they were obtained, and only to the depths penetrated. Samples cannot be relied on to accurately reflect the strata variations that usually exist between sampling locations. Should any variations or undesirable conditions be encountered during the development of the site, Youngdahl Consulting Group, Inc. will provide supplemental recommendations as dictated by the field conditions.

5. The recommendations included in this report have been based in part on assumptions about strata variations that may be tested only during earthwork. Accordingly, these recommendations should not be applied in the field unless Youngdahl Consulting Group, Inc. is retained to perform construction observation and thereby provide a complete professional geotechnical engineering service through the observational method. Youngdahl Consulting Group, Inc. cannot assume responsibility or liability for the adequacy of its recommendations when they are used in the field without Youngdahl Consulting Group, Inc. being retained to observe construction. Unforeseen subsurface conditions containing soft native soils, loose or previously placed non-engineered fills should be a consideration while preparing for the grading of the property. It should be noted that it is the responsibility of the owner or his/her representative to notify Youngdahl Consulting Group, Inc., in writing, a minimum of 48 hours before any excavations commence at the site.

6. Our experience has shown that vapor transmission through concrete is controlled through proper concrete mix design. As such, proper control of moisture vapor transmission should be considered in the design of the slab as provided by the project architect, structural or civil engineer. It should be noted that placement of the recommended plastic membrane, proper mix design, and proper slab underlayment and detailing per ASTM E1643 and E1745 will not provide a waterproof condition. If a waterproof condition is desired, we recommend that a waterproofing expert be consulted for slab design.

7. Following site development, additional water sources (i.e. landscape watering, downspouts) are generally present. The presence of low permeability materials can prohibit rapid dispersion of surface and subsurface water drainage. Utility trenches typically provide a conduit for water distribution. Provisions may be necessary to mitigate adverse effects of perched water conditions. Mitigation measures may include the construction of cut-off systems and/or plug and drain systems. Close coordination between the design professionals regarding drainage and subdrainage conditions may be warranted.

Seepage may be observed emanating from the cut slopes following their excavation during the following rainy season or following development of the areas above the cut. Generally this seepage is not enough flow to be a stability issue to the cut slope, but may be an issue for the owner of the lot at the base of the cut from a surface drainage and standing water (damp spot) standpoint. This amount of water is generally collected easily with landscaping drainage, surface drainage at the toe of the slope, or subsurface toe drains. Recommendations may be provided at the time of observed seepage.
Table 6: Checklist of Recommended Services

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Recommended</th>
<th>Not Anticipated</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Provide foundation design parameters</td>
<td>Included</td>
<td></td>
</tr>
<tr>
<td>2 Review grading plans and specifications</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>3 Review foundation plans and specifications</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>4 Observe and provide recommendations regarding demolition</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>5 Observe and provide recommendations regarding site stripping</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>6 Observe and provide recommendations on moisture conditioning removal, and/or recompaction of unsuitable existing soils</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>7 Observe and provide recommendations on the installation of subdrain facilities</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>8 Observe and provide testing services on fill areas and/or imported fill materials</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>9 Review as-graded plans and provide additional foundation recommendations, if necessary</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>10 Observe and provide compaction tests on storm drains, water lines and utility trenches</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>11 Observe foundation excavations and provide supplemental recommendations, if necessary, prior to placing concrete</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>12 Observe and provide moisture conditioning recommendations for foundation areas and slab-on-grade areas prior to placing concrete</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>13 Provide design parameters for retaining walls</td>
<td>Included</td>
<td></td>
</tr>
<tr>
<td>14 Provide finish grading and drainage recommendations</td>
<td>Included</td>
<td></td>
</tr>
<tr>
<td>15 Provide geologic observations and recommendations for keyway excavations and cut slopes during grading</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>16 Excavate and recompact all test pits within structural areas</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX A
Field Study

Vicinity Map
Site Plan
Approximate Site Location
REFERENCE: Phase 2 Development Site Plan, Barret Business Park Lot 3, JK Architects, Sheet A12, Dated September 2008; Overlaid onto Google Earth, Aerial Data Dated 2/2/2018

SITE PLAN
Barnett Business Park Unit 2
Phase 2 Parcel 3
Shingle Springs, California

September 2018

Project No.: E90167.032

YOUNGDAHL
CONSULTING GROUP, INC.
GEO TECHNICAL • ENVIRONMENTAL • MATERIALS TESTING
APPENDIX B
Details
Keyway and Bench with Drain
Plug and Drain
Site Wall Drainage
Subdrain
PLACEMENT OF FILL ON NATURAL SLOPE
(Typical)

All keyways should be observed and approved prior to placement of fill.
A keyway is required by CBC for fills on natural slopes of 5H:1V or steeper.

Keyway a minimum of two feet into competent material; ten feet minimum width at 2% inclination into slope.

Filter fabric may be required as determined by a representative of our firm at time of construction.

Recommended installation of subdrain to be determined at time of excavation by a representative of our firm.

The toe of fill must be in competent material as verified by a representative of our firm.

Zone of soil to be removed.

Max Inclination of fill slope 2H:1V

Design Grade

Brow Berm

Natural Grade

3' Max

6' Minimum

Bench to be cut as fills are being placed.

10' Min or as designated by geotechnical engineer

2.5"
Notes: Slope trench and "rigid-wall" pipes at least 1% gradient to drain.
Retaining Wall With “Perforated Pipe Sub-Drain”  
*(Typical Cross Section)*

Notes:  
1. Slope trench and “rigid-wall” pipes at least 1% gradient to drain to an appropriate outfall area away from residence.  
2. Use “sweeps” for directional changes in pipe flow (*do not use 90° elbows*).  
3. Provide periodic “clean-outs”.  
4. Washed clean permeable material.

*Not To Scale*
Notes:
1. Slope trench and "rigid-wall" pipes at least 1% gradient to drain.
2. Use "sweeps" for directional changes in pipe flow (do not use 90º elbows).
3. Provide sweeps to periodic "clean-outs".
4. Washed clean permeable material.