Appendix E

Geotechnical Engineering Report
GEOTECHNICAL ENGINEERING STUDY
FOR
FOLSOM PLAN AREA PARCEL 85A (HOSPITAL SITE)
350 Placerville Road
Folsom, California

Project No. E17053.094
November 2020
Dear Mr. Galovan:

In accordance with your authorization, Youngdahl Consulting Group, Inc. has prepared this geotechnical engineering study for the project site located at 350 Placerville Road in Folsom, California. The purpose of this study was to prepare a project specific geotechnical report based on existing and new information that can be incorporated into design of the proposed site. To complete this task, our firm completed a subsurface exploration program, laboratory test program, and prepared this report in accordance with the Reference 1 proposal and contract.

Based upon our observations, the geotechnical aspects of the site appear to be suitable for support of the proposed structural improvements following grading and site improvement operations provided the recommendations presented in this report are incorporated into the design and construction. Geotechnical conditions associated with site development are anticipated to include improvement for drainage controls, cuts into native soils and rock, placement of engineered fills, foundation construction, and pavement improvements.

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 the addressee of this report 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.

Reviewed by:

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Distribution: PDF to Client
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1.0 INTRODUCTION
This report presents the results of our geotechnical engineering study performed for the proposed improvements planned to be constructed at 350 Placerville Road in Folsom, California. The vicinity map provided on Figure A-1, Appendix A shows the approximate project location.

Project Understanding
We understand that the project consists of the construction of 4 building location sites located throughout the project site. Based on the information provided to our firm to date, the current phase of the project consists of construction of 3 buildings located on the center and north side of the site. The buildings are planned to be separated from each other and have a total of approximately 80,000 square feet of floor space. The area surrounding the buildings is proposed to receive flatwork improvements and parking areas. The buildings are anticipated to be supported on conventional shallow foundations. Anticipated cuts and fills are on the order of 20 feet across the site. Fills on the order of 20 feet and cuts of about 5 feet or less are anticipated to be in the main building envelope.

Background
Youngdahl Consulting Group, Inc. has been involved with development of Folsom Plan Area since circa 1995 with the majority of work occurring after 2007. Since this time, our firm has performed subsurface explorations, geotechnical engineering studies, environmental evaluations, and provided construction support services throughout a significant portion of the development area.

Based on a limited review of aerial photography, the site appears to have been vacant until around 2019, when Alder Creek Parkway was constructed along the south property line and excess fill materials were placed at the southwest corner of the site. A review of our records indicated that the fill materials were placed and compacted as engineered fill; however, the surface of the pile was disturbed at a later date. Our firm has not observed other operations or construction services on the project site during the execution of our other services.

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.

Purpose and Scope
Youngdahl Consulting Group, Inc. has prepared this report to provide geotechnical engineering recommendations and considerations for incorporation into the design and development of the site. The recommendations provided in this report supersede those provided in the previous studies. The following scope of services were developed and performed for preparation of this report:

- A review of geotechnical and geologic data available to us at the time of our study;
- Performance of a field study consisting of a site reconnaissance and subsurface explorations to observe and characterize the subsurface conditions;
- Laboratory testing on representative samples collected during our field study;
- Evaluation of the data and information obtained from our field study, laboratory testing, and literature review for geotechnical conditions;
• Development of the following geotechnical recommendations and considerations regarding earthwork construction including, site preparation and grading, engineered fill criteria, excavation characteristics, seasonal moisture conditions, slope configurations, underground improvements, and drainage;

• Development of geotechnical design criteria for code-based seismicity, foundations, retaining walls, and pavements;

• Preparation of this report summarizing our findings, conclusions, and recommendations regarding the above described information.

2.0 SITE CONDITIONS
The following section describes our findings regarding the site conditions that we observed during our site reconnaissance and subsurface explorations.

Surface Observations
The 28.3± acre project site is located at 350 Placerville Road in Folsom, California and is bounded by undeveloped land and East Bidwell Street to the west, a subdivision and Alder Creek Parkway to the south, undeveloped land to the east, and undeveloped land and a freeway ramp to the north. The site has about 40 feet of relief with a drainage feature working its way through the site from the northeast to the southwest. A stockpile of soil is present at the southwest corner of the site and appears to have originated from the subdivision to the south. Vegetation at the site is generally minimal consisting of seasonal grasses with sparse trees located near the drainage feature adjacent to East Bidwell Street.

Subsurface Conditions
Our field study included a site reconnaissance by a representative of our firm and a subsurface exploration program. The exploration program included the excavation of 16 test pits to evaluate the near surface soils conditions. The approximate locations of the test pits are presented on Figure A-2, Appendix A.

The subsurface soils at the project site appear to be typical for the region and consist of a thin layer of soils overlying shallow rock which has weathered to various degrees. The surface soils generally composed of a blend of silts and sands in a medium stiff/dense condition. Occasional thin clay layers up to 2 feet thick which occurs about 1 to 2 feet below the existing grades where observed overlying the bedrock. Based on the observations in the test pits, it appears the clay is more likely to be present near the drainage feature. The underlying bedrock is generally composed of meta-andesite and slates which ranged from highly weathered to fresh.

Groundwater Conditions
Groundwater was not encountered during our explorations with the exception of near surface perched water conditions at test pits TP-13 (near the lower lying area to the southwest) and TP-14 which was nearest the existing drainage feature. 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.
3.0 GEOTECHNICAL SOIL CHARACTERISTICS

The geotechnical soil characteristics presented in this section of the report are based on information from previous studies and observations and testing of samples collected from subsurface soils.

Laboratory Testing

Laboratory testing of the collected samples was directed towards determining the physical and engineering properties of the soil underlying the site. The results of the tests performed for this project are presented in Appendix B. In summary, the following tests were performed for the preparation of this report:

**Table 1: Laboratory Tests**

<table>
<thead>
<tr>
<th>Laboratory Test</th>
<th>Test Standard</th>
<th>Summary of Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct Shear</td>
<td>ASTM D3080</td>
<td>TP-7 @3-5', TP-16 @ 2-4', $\Phi = 34.2^\circ$, $c = 349$ psf (90%RC)</td>
</tr>
<tr>
<td>Maximum Dry Density</td>
<td>ASTM D1557</td>
<td>TP-7 @3-5', TP-16 @ 2-4', $\gamma_{max} = 126.7$ pcf, $\omega_{opt} = 11.3$ %</td>
</tr>
<tr>
<td>Resistance Value</td>
<td>ASTM CTM 301</td>
<td>TP-7 @3-5', TP-16 @ 2-4', 37</td>
</tr>
<tr>
<td>Corrosivity Suite</td>
<td>CA DOT Tests 417, 422 and 643</td>
<td>See Soil Corrosivity Section</td>
</tr>
</tbody>
</table>

Soil Expansion Potential

Intermittent or isolated pockets of highly expansive clay soils were present on top of the weathered bedrock in some of the test pit excavations. In concentrated amounts, such clays could cause distress to concrete slab-on-grade floors and foundations if present in the upper 3 feet of the structural improvement areas. However, due to the cuts and fills associated with hillside grading activities it has been our experience that these materials can be sufficiently blended such that expansive soil mitigation measures may not be required. Depending on the proposed grading plans and cuts or fills in the areas where clay is encountered, some focused excavations of the clay may be required. In addition, if during the site preparation operations, the clay soils are determined to be soft and/or unstable under the weight of the construction equipment, they will require overexcavation as discussed in the recommendations section below. 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 this study.

Soil Corrosivity

A corrosivity testing suite consisting of soil pH, resistivity, sulfate, and chloride content tests were performed on selected soil samples collected during our site exploration. We are not corrosion specialists and recommend that the results be evaluated by a qualified corrosion expert. The laboratory test results (provided by Sunland Analytical, Inc.) are provided in Appendix B and are summarized in Table 2, below.
Table 2: Corrosivity Summary

<table>
<thead>
<tr>
<th>Location</th>
<th>Depth (ft)</th>
<th>Soil pH</th>
<th>Minimum Resistivity ohm-cm (x1000)</th>
<th>Chloride (ppm)</th>
<th>Sulfate (ppm)</th>
<th>Caltrans Environment</th>
<th>ACI Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>TP-4</td>
<td>3.5</td>
<td>6.39</td>
<td>3.75</td>
<td>2.1</td>
<td>9.1</td>
<td>Non-Corrosive</td>
<td>S0 (Not a Concern)</td>
</tr>
<tr>
<td>TP-10</td>
<td>3-4</td>
<td>6.43</td>
<td>2.12</td>
<td>2.1</td>
<td>4.0</td>
<td>Non-Corrosive</td>
<td>S0 (Not a Concern)</td>
</tr>
<tr>
<td>TP-16</td>
<td>2-4</td>
<td>6.61</td>
<td>4.02</td>
<td>1.5</td>
<td>0.2</td>
<td>Non-Corrosive</td>
<td>S0 (Not a Concern)</td>
</tr>
</tbody>
</table>

According to Caltrans Corrosion Guidelines Version 3.0, March 2018, the test results appear to indicate a non-corrosive environment. According to the 2019 California Building Code Section 1904.1 and ACI 318-14 Table 19.3.1.1, the test results indicate the onsite soils have a negligible potential for sulfide attack of concrete. Accordingly, Type I/II Portland cement is appropriate for use in concrete construction.

A certified corrosion engineer should be consulted to review the above tests and site conditions in order to develop specific mitigation recommendations if metallic pipes or structural elements are designed to be in contact with or buried in soil.

4.0 GEOLOGY AND SEISMICITY

The geologic portion of this report includes a review of geologic data pertinent to the site based on an interpretation of our observations of the surface exposures and our observations in our explorations.

Geologic Conditions

The site is located within the Great Valley geomorphic province of California. According to the 1:250,000 scale Geologic Map of the 30’x60’ Quadrangle (Gutierrez, C. I. 2011), the vicinity is mapped as Jurassic age Gopher Ridge Volcanics (map unit Jgo) and Salt Springs Slate (map unit JSS). The mapped conditions appear to be consistent with the rock types observed in our exploratory test pits. A more detailed description of the geologic conditions is presented in Appendix D.

Seismicity

Our evaluation of seismicity for the project site included reviewing existing fault maps and obtaining seismic design parameters from the USGS online calculators and databases. For the purpose of this study, we used a latitude and longitude of 38.640829, -121.112416 to identify the project site.

Alquist-Priolo Regulatory Faults

Based upon the records currently available from the California Department of Conservation, the project site is not located within an Alquist-Priolo Regulatory Review Zone and there are no known faults located at the subject site. We do not anticipate special design or construction requirements for faulting at this project site.

Code Based Seismic Criteria

Based upon the subsurface conditions encountered during our study and our experience in the area, the site may be classified as Site Class C. This is consistent with the map “A next-generation Vs30 Map for California based on geology and topography” (Wills, Gutierrez, et al 2015) developed for the California Geological Survey.
The seismic design parameters based on latitude and longitude, the associated site class, and the USGS Seismic Design Web Service are provided in the following table. The use of more stringent design parameters is the purview of the structural engineer.

### Table 3: Seismic Design Parameters*

<table>
<thead>
<tr>
<th>Reference</th>
<th>Seismic Parameter</th>
<th>Recommended Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASCE 7-16</td>
<td>Site Class</td>
<td>C</td>
</tr>
<tr>
<td>Figure 22-7</td>
<td>Maximum Considered Earthquake Geometric Mean (MCE) PGA</td>
<td>0.172g</td>
</tr>
<tr>
<td>Table 11.8-1</td>
<td>Site Coefficient ( F_{PGA} )</td>
<td>1.228</td>
</tr>
<tr>
<td>Equation 11.8-1</td>
<td>PGA = ( F_{PGA} ) PGA</td>
<td>0.211g</td>
</tr>
<tr>
<td>2019 CBC</td>
<td>Short-Period MCE at 0.2s, ( S_s )</td>
<td>0.404g</td>
</tr>
<tr>
<td>Figure 1613A.2.1(1)</td>
<td>1.0s Period MCE, ( S_1 )</td>
<td>0.209g</td>
</tr>
<tr>
<td>Table 1613A.2.3(1)</td>
<td>Site Coefficient, ( F_a )</td>
<td>1.300</td>
</tr>
<tr>
<td>Table 1613A.2.3(2)</td>
<td>Site Coefficient, ( F_v )</td>
<td>1.500</td>
</tr>
<tr>
<td>Equation 16A-36</td>
<td>Adjusted MCE Spectral Response Parameters, ( S_{MS} = F_a S_s )</td>
<td>0.526g</td>
</tr>
<tr>
<td>Equation 16A-37</td>
<td>Adjusted MCE Spectral Response Parameters, ( S_{M1} = F_v S_1 )</td>
<td>0.313g</td>
</tr>
<tr>
<td>Equation 16A-38</td>
<td>Design Spectral Acceleration Parameters, ( S_{DS} = 0.5 S_{MS} )</td>
<td>0.350g</td>
</tr>
<tr>
<td>Equation 16A-39</td>
<td>Design Spectral Acceleration Parameters, ( S_{D1} = 0.5 S_{M1} )</td>
<td>0.209g</td>
</tr>
<tr>
<td>Section 1613A.2.5</td>
<td>Seismic Design Category (Short Period), Occupancy I to IV</td>
<td>D</td>
</tr>
<tr>
<td>Section 1613A.2.5</td>
<td>Seismic Design Category (1-sec Period), Occupancy I to IV</td>
<td>D</td>
</tr>
</tbody>
</table>

*Based on the online calculator available at [https://earthquake.usgs.gov/ws/designmaps/](https://earthquake.usgs.gov/ws/designmaps/)

### Earthquake Induced Liquefaction, Settlement, and Surface Rupture Potential

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 bedrock, the potential for seismically induced damage due to liquefaction, surface ruptures, and settlement is considered nil. For the above-mentioned reasons mitigation for these potential hazards is not considered necessary for the development of this project.

### Static and Seismically 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 low.

### Naturally Occurring Asbestos

The Sacramento Metropolitan Air Quality Management District (SMAQMD) is the lead agency for regulating NOA in Sacramento County, and has implemented the construction Air Toxic Control Measure (ATCM) (CCR Section 93015) for projects in East Folsom located within the metavolcanic Copper Hill and Gopher Ridge Formations. Following release of a generalized geologic map of eastern Sacramento County by the California Geologic Survey in 2006, the
SMAQMD established a policy of applying the construction ATCM (CCR Section 93105) to all areas identified on the map as being underlain by rocks moderately likely to contain NOA.

The relative likelihood for the presence of NOA is considered to be least for the Salt Springs Slate, yet moderately likely for the Copper Hills, Gopher Ridge, and gabbro units. The low-grade, greenschist facies regional metamorphism, with hydrothermal alteration is characteristic of NOA containing rocks of this region. Trace levels of asbestos (less than 0.25% as measured by California Air Resources Board Test Method 435) are not uncommon in the Folsom area north of US50 but has been rare in all testing completed to date by Youngdahl south of US50.

5.0 DISCUSSION AND CONCLUSIONS
Based upon the results of our field explorations, findings, and analysis described above, 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, specifications, and implemented during construction. The on-site soils, once processed and compacted as recommended below, may be considered “engineered” and suitable for support of the planned improvements.

Geotechnical Considerations for Development
The project site is generally comprised of a thin layer of soils over shallow rock which is considered suitable for support of the proposed improvements. Generally, issues associated with development on similar sites are associated with the excavation of shallow rock and the presence of seepage at the soil to rock contact. Project sites with similar conditions, are generally developed by addressing existing drainage features through the installation of a canyon drain followed by mass grading operations to construct a suitable building pad. Blasting to excavate into the underlying rock has been performed on sites in the vicinity of the project and cannot be precluded for development of this project site.

Additionally, buildings spanning across transition lines (e.g. rock to soil, or native soils to engineered fills) may be more prone to differential settlements compared to sites built on relatively flat lots. We anticipate that the proposed buildings may be supported by native soils or rock and engineered fills on the order of 15 feet. For these conditions, we have included the comments below. The geotechnical recommendations for this project are presented in the following sections.

- This report includes a recommendation for compaction of engineered fills to 95 percent and a minimum of 18 inches of embedment for foundations to reduce the potential for differential settlement.
- Improvements constructed below slopes may be more subject to seepage and poor drainage. Special attention should be given to configuring the landscaping to drain away from the foundation and how underground utilities are configured to prevent water migrating through the trench becoming impounded against the foundation. The installation of a subdrain along the building is anticipated to provide increased protection against unwanted water conditions.
- Due to the strength of rock, it may be difficult to excavate utilities where the utility line penetrates the underlying rock. Consideration may be given to pre-excavating utility alignments during the building pad grading when larger equipment could be used and there is more site access. Some sites with shallow rock overexcavate the rock approximately 2 feet from finish grade during grading to improve future foundation construction, landscape performance and utility installations.
6.0 SITE GRADING AND EARTHWORK IMPROVEMENTS

Soil Moisture Considerations

The compaction of soil to a desired relative compaction is dependent on conditioning the soil to a target range of moisture content. Moisture contents that are excessively dry or wet could limit the ability of the contractor to compact soils to the requirements for engineered fill. When dry, moisture should be added to the soil and the soils blended to improve consistency. Wet soil will need to be dried to become compactable. Generally, this includes blending and working the soil to avoid trapping moisture below a dryer surficial crust. Other options are available to reduce the time involved but typically have higher costs and require more evaluation prior to implementation.

The largest contributor to excessive soil moisture is generally precipitation and seepage during the rainy season. In recognition of this, 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.

Excavation Characteristics

Based on our experience with the bedrock conditions on the project site, we anticipate that 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.

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. However, blasting cannot be ruled out in areas of resistant rock.

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.

Site Preparation

Preparation of the project site should involve, site drainage controls, dust control, clearing and stripping, expansive clay mitigation, overexcavation and recompaction of loose/soft/saturated soils, and exposed grade compaction considerations. The following paragraphs state our geotechnical comments and recommendations concerning site preparation.

Our recommendations are based on limited windows into the subsurface and interpretations thereof; therefore, a representative of our firm should be present during site clearing operations to identify the location and depth of potential fills or loose soils, some of which may not have been found during our evaluation. We should also be present to observe removal of deleterious materials, and to identify any existing site conditions which may require mitigation or further recommendations prior to site development.
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. The implementation of stormwater controls is the purview of the grading contractor.

Swales and natural hillside drainage proposed to receive engineered fill may require the installation of canyon style drains (similar to Figure C-1, Appendix C) to mitigate for potential subsurface waters. Close coordination between the design professionals for placement and discharge of canyon style drains should be performed. Based on the Reference 2 plans, some of these features appear to have been incorporated into the civil planning at this current stage.

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) and Airborne Toxic Control Measure (ATCM) requirements. Dust control is the purview of the grading contractor.

Clearing and Stripping of Organic Materials
Clearing and stripping operations should include the removal of all organic laden materials including trees, bushes, root balls, root systems, and any soft or loose soil generated by the removal operations. 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.** Preserved trees may require tree root protection which should be addressed on an individual basis by a qualified arborist.

Expansive Clay Mitigation
Potentially expansive clays should be mixed thoroughly with less expansive on-site materials (sils, sands, and gravels) and should not be present in concentration in pavement areas or within 5 feet of the building envelope, either vertically or laterally where grading is performed. Proper disposition of clays on site should be documented by a representative of Youngdahl Consulting Group, Inc. Any final determination of mitigation measures should be based on the conditions observed during grading.

Overexcavation and Recompaction of Loose/Soft/Saturated Soils
Following general site clearing, all loose/soft or saturated soils (native or existing non-engineered fills) within the development footprint should be overexcavated down to firm native materials or engineered fills then backfilled with engineered fill as detailed in the engineered fill section below. Any depressions extending below final grade resulting from the removal of fill materials or other deleterious materials should be properly prepared as discussed below and backfilled with engineered fill.

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. Generally, where bedrock conditions are exposed, no scarification should be
necessary; however, these surfaces may be moisture conditioned and compacted to mitigate
disturbance resulting from site preparation. Prior to placing fill, the exposed grades should be in
a firm and unyielding state. Any localized zones of soft or pumping soils observed within the
exposed grade should either be scarified and recompacted or be overexcavated and replaced
with engineered fill as detailed in the engineered fill section below.

**Engineered Fill Criteria**
All 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**
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 the maximum size specifications
listed below.

Rock fragments or boulders exceeding 24 inches in maximum dimension should not be placed
within the upper five feet of site grades or utility corridors. The upper two feet of the site grades
and within the zone of proposed underground facilities should consist of predominantly rocks and
rock fragments less than 12 inches in maximum dimension. Boulders over 24 inches in maximum
dimension should be placed within the deeper portions of fill embankments below a depth of 5
feet and a minimum of 5 feet from the finish slope face. The individual boulders should be spaced
such that compaction of finer rock and soil materials between the boulders can be achieved with
the equipment being used for compaction. Materials placed between the boulders should consist
of predominantly soil and rock less than 12 inches in maximum dimension. The soil/rock mixture
should be thoroughly mixed and placed between the boulders so as to preclude nesting or the
formation of voids. Should insufficient deep fill areas exist for oversize rock disposal, the
contractor should either dispose of the excess materials to an offsite location or mechanically
reduce the rocks to less than 12 inches.

**Compaction Equipment**
Due to the significant quantity of rock materials that will comprise a majority of the fills on the
project site, a Caterpillar 825 steel-wheel compactor or approved equivalent should be employed
as a minimum to facilitate breakdown of oversize bedrock materials and generation of soil fines
during the fill placement process. If the quantity of rock fragments in the fills preclude traditional
compaction testing, then the proposed fills should be compacted using method specifications as
indicated below.

In focused or isolated areas where significant rock quantities will not be present, we anticipate
that a large vibratory padded drum compactor or approved equivalent will be capable of achieving
the compaction requirements for engineered fill provided the soil is placed and compacted within
0 to 3 percent over the optimum moisture content as determined by the ASTM D1557 test method
and in lifts not greater than 12 inches in uncompacted thickness. The use of handheld equipment
such as jumping jack or plate vibration compactors may require thinner lifts of 6 inches or less to
achieve the desired relative compaction parameters.

**Fill Placement and Compaction**
Engineered fills should be placed in thin horizontal lifts not to exceed 12 inches in uncompacted
thickness. If the contractor can achieve the recommended relative 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 recommended relative compaction.
Table 4: Recommended Relative Compaction

<table>
<thead>
<tr>
<th>Fill Materials</th>
<th>Relative Compaction</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineered Fill</td>
<td>95 percent</td>
<td>ASTM D1557</td>
</tr>
<tr>
<td>Utility Trench Backfill*</td>
<td>95 percent</td>
<td>ASTM D1557</td>
</tr>
<tr>
<td>Subgrade</td>
<td>95 percent</td>
<td>ASTM D1557</td>
</tr>
<tr>
<td>Aggregate Baserock Grade</td>
<td>95 percent</td>
<td>ASTM D1557</td>
</tr>
<tr>
<td>Asphalt Concrete Pavement</td>
<td>92 to 96 percent</td>
<td>ASTM D2041 or CTM 309</td>
</tr>
</tbody>
</table>

* Unless otherwise noted by the governing agency.

Our firm should be requested for consultation, observation, and testing for the earthwork operations prior to the placement of any fills. 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 evaluated as earthwork progresses. If performed, method specification methods will likely include the excavation of test pits within the fill materials to observe and document that a uniform over-optimum moisture condition, and absence of large and/or concentrated voids has been achieved prior to additional fill placement.

Method Specification
Soils exceeding 30 percent rock by mass may be considered non-testable by conventional methods. The materials may be placed as engineered fill if placed in accordance with the following method specification during full time observation by a representative of our firm.

Soils should be moisture conditioned and compacted in place by a minimum of six completely covering passes with a Caterpillar 825, or approved equivalent. The compactor’s last three passes should be at 90 degrees to the initial passes. Engineered fill should be constructed in lifts not exceeding 12 inches in uncompacted thickness, moisture conditioned and compacted in accordance with the above specification. Additional passes as deemed necessary during fill placement to achieve the desired condition based upon field conditions may be recommended.

Import Materials
The recommendations presented in this report are based on the assumption that the import materials will be similar to the materials present at the project site. High quality materials are preferred for import; however, these materials can be more dependent on source availability. Import material should be approved by our firm prior to transporting it to the project site.

Material for this project should consist of a material with the geotechnical characteristics presented below. 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.
Table 5: Select Import Criteria

<table>
<thead>
<tr>
<th>Behavior Property</th>
<th>Reference Document</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct Shear Strength</td>
<td>ASTM D3080</td>
<td>≥ 34° when compacted</td>
</tr>
<tr>
<td>Plasticity Index</td>
<td>ASTM D4318</td>
<td>≤ 12</td>
</tr>
<tr>
<td>Expansion Index</td>
<td>ASTM D4829</td>
<td>≤ 20</td>
</tr>
<tr>
<td>Sieve Analysis</td>
<td>ASTM D1140</td>
<td>Not more than 30% Passing the No. 200 sieve Rocks ≤ 6 inches in diameter</td>
</tr>
<tr>
<td>Resistance Value</td>
<td>CTM 301</td>
<td>≥ 35</td>
</tr>
</tbody>
</table>

Slope Configuration and Grading
The project site is proposed to 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 2 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 6 feet horizontally into firm soils or 4 feet into bedrock 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 C-2 in Appendix C 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.

Detention Basin Embankment Construction
The following sections outline geotechnically related design and construction recommendations for the proposed embankments.

Keyway and Foundation Configuration
The keyway should extend 1 foot minimum into the underlying bedrock along the centerline of the embankment. The width of the keyway should be a minimum of 10 feet wide.
Slope Configuration
We recommend that the embankment configuration have a downstream or outside slope of no steeper than 2H:1V with an upstream or inside slope no steeper than 3H:1V. The slope face should be otherwise constructed in accordance with the recommendations provided in the Slope Configuration and Grading Section of this report.

Embankment Penetrations
We understand that the proposed embankments at the project site are planned to contain underground utilities and outlet pipes. Where drainage structures exit the basin, a plug of controlled low strength materials (CLSM) should be placed as backfill to reduce the potential for seepage and piping which could impact the stability of the embankment. The contractor should employ measures to prevent the pipe from floating during the slurry placement procedures.

Underground Improvements
Trench Excavation
Trenches or excavations in soil should be shored or sloped back in accordance with current Cal/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 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 site 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 or to the recommendations of this report, whichever is greater. Where backfill compaction is not specified by the local jurisdiction, the backfill should be compacted to achieve the minimum relative compactions specified above.

Exposure to Water
The configuration of a trench increases the likelihood that the trench may be exposed to or retain water. The presence of water can adversely impact the performance of the trench by increasing the potential for the transmission of water to undesired outlets and settlement, even when compacted to the requirements of engineered fill. The contractor should consider these
conditions when managing water during interim and post construction periods. This topic is discussed further in the Drainage section of this report.

7.0 DESIGN RECOMMENDATIONS
The contents of this section include recommendations for foundations, pavements, and drainage.

Shallow Conventional Foundations
Shallow conventional foundation systems are considered suitable for construction of the planned improvements, provided that the site is prepared in accordance with the recommendations discussed in Section 6.0 of this report.

The provided values do not constitute a structural design of foundations which should be performed by the structural engineer. In addition to the provided recommendations, foundation design and construction should conform to applicable sections of the 2019 California Building Code.

Foundation Capacities
The foundation bearing and lateral capacities are presented in the table below. The allowable bearing capacity is for support of dead plus live loads based on the foundation configuration presented in this report. The allowable capacity may be increased by 1/3 for short-term wind and seismic loads. Lateral forces on structures may be resisted by passive pressure acting against the sides of shallow footings and/or friction between the foundation bearing material and the bottom of the footing. Section 1806A.3 of the 2019 CBC allows for the combination of the friction factor and passive resistance value to lateral resistance. Consideration should be given to ignoring passive resistance where soils could be disturbed later or within 6 feet horizontally of the slope face.

<table>
<thead>
<tr>
<th>Soil Type</th>
<th>Design Condition</th>
<th>Design Value</th>
<th>Applied Factor of Safety</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineered Fill or Firm Native Soil</td>
<td>Allowable Bearing Capacity</td>
<td>2,500 psf</td>
<td>3.0</td>
</tr>
<tr>
<td></td>
<td>Allowable Fiction Factor*</td>
<td>0.45</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td>Allowable Passive Resistance</td>
<td>315 psf/ft</td>
<td>1.5</td>
</tr>
<tr>
<td>Rock</td>
<td>Allowable Bearing Capacity</td>
<td>4,000 psf</td>
<td>3.0</td>
</tr>
<tr>
<td></td>
<td>Allowable Fiction Factor</td>
<td>0.50</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td>Allowable Passive Resistance*</td>
<td>360 psf/ft</td>
<td>1.5</td>
</tr>
</tbody>
</table>

* Friction Factor is calculated as tan(φ)

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 for up to two stories. The footings should be increased to 12 inches wide and founded a minimum of 24 inches below the lowest adjacent soil grade for three- and four-story buildings. Isolated pad foundations should be a minimum of 24 inches in plan dimension.

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.

**Foundation Settlement**
Using the Schmertmann 1978 method with a conservatively estimated blow count of 20 for 95 percent relative compaction engineered fills for a depth of 20 feet, 80 feet from the cut to fill transition zone, and the loading conditions described in this report, the settlement the project site is expected to be less than the 0.002L threshold described in ASCE 7-16 Table 12.13-3 for conventional foundations.

For design purposes, a total settlement of less than 1 inch may be anticipated with a differential settlement of 0.5 inches in 25 feet where foundations are bearing on like materials. The settlement criteria are based upon the assumption that foundations will be sized and loaded in accordance with the recommendations in this report.

**Foundation Influence Line and Slope Setback**
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 the criteria for engineered fill as recommended in Section 6.0 of this report.

**Retaining Walls**
Our design recommendations and comments regarding retaining walls for the project site are discussed below. *Retaining wall foundations should be designed in accordance with the Shallow Conventional Foundations section above.*

**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 the table below. The values presented below are not factored and are for conditions when firm native soil or engineered fill is used within the zone behind the wall defined as twice the height of the retaining wall. Additionally, the values do not account for the friction of the backfill on the retaining wall which may or may not be present depending on the wall materials and construction.

The lateral pressures presented in the table below include recommendations for earthquake loading which is required for structures to be designed in Seismic Design Categories D, E or F per Section 1803A.5.12.1 of the 2019 California Building Code states. The lateral pressures presented have been calculated using the Mononobe-Okabe Method derived from Wood (1973) and modified by Whitman et al. (1991)). The values are intended to be used as the multiplier for uniformly distributed loads and the parameter “H” is the total height of the wall including the footing but excluding any key, if used.
### Table 7: Retaining Wall Pressures

<table>
<thead>
<tr>
<th>Wall Type</th>
<th>Wall Slope Configuration</th>
<th>Equivalent Fluid Weight (pcf)</th>
<th>Lateral Pressure Coefficient</th>
<th>Earthquake Loading (plf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Free Cantilever</td>
<td>Flat</td>
<td>38</td>
<td>0.28</td>
<td>4H² Applied 0.6H above the base of the wall</td>
</tr>
<tr>
<td></td>
<td>2H:1V</td>
<td>56</td>
<td>0.42</td>
<td>15H²</td>
</tr>
<tr>
<td>Restrained*</td>
<td>Flat</td>
<td>60</td>
<td>0.44</td>
<td></td>
</tr>
</tbody>
</table>

*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.

### Generalized Design Values

Some software and design methods do not use the equivalent fluid weight method presented above; instead they use design soil properties for a given soil condition such as the internal friction angle, cohesion, and bulk unit weight. Generally, this occurs for keyed or interlocking non-mortared walls such as segmental block (Basalite, Keystone, Allan Block, etc.) or rockery walls. When this occurs, the following soil parameters would be applicable for design with the on-site native materials in a firm condition or for engineered fills. The seismic coefficient is considered to be ½ of the adjusted peak ground acceleration for the site conditions is given in Section 4.0 of this report. Some software allows for the extension of the Mononobe-Okabe Method beyond the conventional limitations and, if the method is applied, could calculate seismic values significantly higher than those provided by the multiplier method provided above.

### Table 8: Generalized Design Parameters

<table>
<thead>
<tr>
<th>Internal Angle of Friction</th>
<th>Cohesion</th>
<th>Bulk Unit Weight</th>
<th>Seismic Coefficient, Kh</th>
</tr>
</thead>
<tbody>
<tr>
<td>34°</td>
<td>0 psf</td>
<td>135 psf</td>
<td>0.11g</td>
</tr>
</tbody>
</table>

### Wall Drainage

The criteria presented above is based on fully drained conditions as detailed in the attached Figure C-3, Appendix C. For these conditions, we recommend that a blanket of filter material be placed behind all proposed walls. The filter material should conform to Class 1, Type B permeable material in combination with a filter fabric to separate the open graded gravel/rock from the surrounding soils. Generally, a clean ¾ inch crushed rock should be acceptable. Consistent with Caltrans Standards, when Class 2 permeable materials are used, the filter fabric may be omitted unless otherwise designed. Permeable materials are specified in Section 68 of the California Department of Transportation Standard Specifications, current edition.

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 top 12 inches of wall backfill should consist of a compacted soil cap. A filter fabric having specifications equal to or greater than those for Mirafi 140N should be placed between the gravel filter material and the surrounding soils to reduce the potential for infiltration of soil into the gravel. 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 building 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 floor 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 design, curing procedures, 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 Section 6.0 of this report.

**Slab Underlayment**

As a minimum for slab support conditions, the slab should be underlain by a minimum 4-inch thick crushed rock layer that is covered by a minimum 10-mil thick moisture retarding plastic 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.

An optional 1-inch blotter sand layer placed above the plastic membrane, is sometimes used to aid in curing of the concrete. Although historically common, this blotter layer is not currently included in slabs designed according to the 2019 Green Building Code. When omitted, special wet curing procedures will be necessary. If installed, 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.

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.

**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 standalone 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 and 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 preliminary design of concrete floors, a modulus of subgrade reaction of $k = 150$ psi per inch would be applicable for engineered fills.

Exterior Flatwork
Exterior concrete flatwork is recommended to have a 4-inch thick 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 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.

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.

Relative Compaction
The asphalt concrete pavement section should be constructed to achieve the minimum relative compactions specified in Section 6.0 of this report. Deviation from the following table should be reviewed by the governing agency when the pavements are to be constructed within their right-of-way. Final acceptance of the constructed pavement section is the purview of the governing agency or owner of the site.

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.

Subgrade Resistance Value
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).
Laboratory testing was performed on a bulk sample considered to be representative of the materials expected to be exposed at subgrade. The tested soil had an R-Value of 37. To account for the variability of materials, have used an R-Value of 35 for the pavement sections this report.

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.

Due to the redistribution of materials that occurs during grading operations, we should review pavement subgrades to determine the appropriateness of the provided sections.

**Section Thickness**

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>
<th>Asphalt Concrete *</th>
<th>Aggregate Base **</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.0</td>
<td>3.0</td>
<td>4.5</td>
<td></td>
</tr>
<tr>
<td>6.0</td>
<td>3.0</td>
<td>7.5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.5</td>
<td>6.5</td>
<td></td>
</tr>
<tr>
<td>6.5</td>
<td>3.5</td>
<td>8.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4.0</td>
<td>7.0</td>
<td></td>
</tr>
<tr>
<td>7.0</td>
<td>4.0</td>
<td>8.5</td>
<td></td>
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<td></td>
<td>4.5</td>
<td>7.5</td>
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<td>8.0</td>
<td>4.5</td>
<td>10.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5.0</td>
<td>9.5</td>
<td></td>
</tr>
<tr>
<td>9.0</td>
<td>5.5</td>
<td>11.0</td>
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<td>6.0</td>
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<td>6.0</td>
<td>13.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7.0</td>
<td>11.0</td>
<td></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)

**Portland Cement Concrete Pavement Design**

We understand that Portland cement concrete pavements may be considered for various aspects of the parking and drive access areas. The American Concrete Institute (ACI) Concrete Pavement Design method (ACI 330R-08) was used for design of the exterior concrete (rigid) pavements at the site.

**Relative Compaction**

The asphalt concrete pavement section should be constructed to achieve the minimum relative compactions specified in Section 6.0 of this report. Deviation from the following table should be
reviewed by the governing agency when the pavements are to be constructed within their right-of-way. Final acceptance of the constructed pavement section is the purview of the governing agency.

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.

Soil Design Parameters
The pavement thicknesses were evaluated based on the soil design parameters provided in the following table.

Table 10: Soil Parameters

<table>
<thead>
<tr>
<th>Subgrade Soil Description</th>
<th>k, Modulus of Subgrade Reaction*</th>
<th>Base Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silty SAND</td>
<td>150 pci</td>
<td>6 inches</td>
</tr>
</tbody>
</table>

* Based on an R-Value of 35 as recommended above and correlated to a k-Value recommended by ACI 330R.

Section Thickness
Based on the subgrade soil parameters shown in the above table, the recommended concrete thicknesses for various traffic descriptions are presented in the table below. The recommended thicknesses provided below assume the use of plain (non-reinforced) concrete pavements.

Table 11: Concrete Pavement Section Recommendations

<table>
<thead>
<tr>
<th>Category</th>
<th>ADTT*</th>
<th>Pavement Traffic Description</th>
<th>Thickness (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>3000 psi**</td>
</tr>
<tr>
<td>A</td>
<td>1</td>
<td>Car parking areas and access lanes</td>
<td>4.5</td>
</tr>
<tr>
<td>A</td>
<td>10</td>
<td>Autos, pickups, and panel trucks only</td>
<td>5.0</td>
</tr>
<tr>
<td>B</td>
<td>25</td>
<td>Shopping center entrance and service lanes</td>
<td>6.0</td>
</tr>
<tr>
<td>B</td>
<td>300</td>
<td>Bus parking areas and interior lanes</td>
<td>6.5</td>
</tr>
<tr>
<td>B</td>
<td>100</td>
<td>Single-unit truck parking areas and interior lanes</td>
<td>7.0</td>
</tr>
<tr>
<td>C</td>
<td>300</td>
<td>Roadway Entrances and Exterior Lanes</td>
<td>7.0</td>
</tr>
<tr>
<td>C</td>
<td>700</td>
<td></td>
<td>8.0</td>
</tr>
</tbody>
</table>

* Average Daily Truck Traffic
** 28-day concrete compressive strength

Jointing and Reinforcement
From a geotechnical perspective, contraction joints should be placed in accordance with the American Concrete Institute (ACI) recommendations which include providing a joint spacing about 30 times the slab thickness up to a maximum of 10 feet. The joint patterns should also divide the slab into nearly square panels. If increased joint spacing is desired, reinforcing steel should be installed within the pavement in accordance with ACI recommendations. Final determination of steel reinforcement configurations (if used within the pavements) remains the purview of the Project Structural Engineer.

Drainage
In order to maintain the engineering strength characteristics of the soil presented for use in this report, maintenance of the site 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, onsite 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; 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; proper design and maintenance of landscaping and drainage facilities.

**Drainage Adjacent to Buildings**

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 1808A.7.4 of the 2019 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 1804A.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. 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 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 are which do not meet building code requirements.

**Subdrainage**

Reduction of potential moisture related issues could be addressed by the construction of subdrains in addition to the drainage provisions provided in the 2019 CBC. Considering that this site is down sloping from the road (future McCarthy) and has shallow rock conditions, a subdrain should be considered along the uphill of the buildings to collect and redirect unwanted water from the structure.

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 C-4, Appendix C. 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. Our firm could provide additional recommendations during a plan review of the civil plans for building grading.

**Subsurface Water within Utilities**

Water can become perched on the relatively impermeable rock horizons and eventually inundate utility trench backfill. The variable support condition between native soils and compacted trench backfill materials, coupled with prolonged water exposure can lead to subsidence of trench backfill materials, especially if bridging of trench backfill occurs during placement or natural jetting of soils into voids around pipes occurs. Joint utility trenches are generally more susceptible to the jetting
issues due to the quantity of pipe placed in the trench. Recommendations to reduce the risk associated with this condition may be provided based on observed field conditions.

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 can become collection points for subsurface water and typically provide a conduit for water distribution. Provisions may be necessary to mitigate adverse effects of perched water conditions. Where this condition arises, we recommend plug and drains within the utility trenches (Figure C-5, Appendix C) 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. As the observed site conditions dictate, representatives from our firm, the contractor, City of Folsom representative, and the civil engineer should coordinate the locations of plug and drains.

Roadway or Parking Area Landscaping Drainage
Prolonged water seepage into pavement sections can result in softening of subgrade soils and subsequent pavement distress. It is anticipated that heavy landscape watering could enter and pond within the aggregate base section as it permeates through the aggregate base under the sidewalks and/or curbs. Prolonged seepage within the pavement section could cause distress to pavements in heavy traffic areas. Some measures that can be employed to minimize the saturation of the subgrade and aggregate base materials include, but are not limited to, construction of cut-off drains or moisture barriers alongside the roadway adjacent to the roadway interface, construction of subdrains within landscape medians and installation of plug and drain systems within utility trenches. Due to the elusive and discontinuous nature of drainage related issues, a risk-based approach should be determined by the developer based on consultation and discussions with the design professionals and the amount of protection of facilities that the developer may want to provide against potential moisture related issues.

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 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.

8.0 LOW IMPACT DEVELOPMENT STANDARDS
Low Impact Development or LID standards have become a consideration for many projects in the region. LID standards are intended to address and mitigate urban storm water quality concerns. These methods include the use of Source Controls, Run-off Reduction and Treatment Controls. For the purpose of this report use of Run-off Reduction measures and some Treatment Controls may impact geotechnical recommendations for the project.

Hydrologic Soil Group
A review of soil survey and the data collected from test pits indicate that soils within the project are Hydrologic Soil Group D (very slow infiltration). Use of any LID measure that would require infiltration of discharge water to surfaces adjacent to structures/pavement or include infiltration type measures should be reviewed by Youngdahl Consulting Group, Inc. during the design process.
Infiltration and Retention Basins

The introduction of water to soils adjacent to structures could increase the potential for undesirable effects such as settlement, high floor moisture, and pavement distress. For this reason, we recommend that infiltration trenches and basins are kept a minimum of 30 feet from a proposed structure unless they are lined with a 30-mil HDPE membrane to prevent the concentration of water into the subsurface soils at the structure. Further recommendations may be provided based on future civil plans for the project site.

9.0 DESIGN REVIEW AND CONSTRUCTION MONITORING

Geotechnical engineering can be affected by natural variability of soils and, as with many projects, the contents of this report could be used and interpreted by many design professionals for the application and development of their plans. For these reasons, we recommend that our firm provide support through plan reviews and construction monitoring to aid in the production of a successful project.

Plan Review

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 interpreted and incorporated into the project plans and specifications. Modifications to the recommendations provided in this report or to the design may be necessary at the time of our review based on the proposed plans.

Construction Monitoring

Construction monitoring is a continuation of geotechnical engineering to confirm or enhance 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, overexcavation of loose/soft or saturated soils and existing fills, and provide consultation, observation, and testing services to the grading contractor in the field. At a minimum, Youngdahl Consulting Group, Inc. should be retained to provide services listed in Table 12 below.

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.

10.0 LIMITATIONS AND UNIFORMITY OF CONDITIONS

1. This report has been prepared for the exclusive use of the addressee of this report for specific application to this project. The addressee may provide their consultants authorized use of this report. 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 2019 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.
Table 12: 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</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>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>✓</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
Logs of Exploratory Test Pits
Soil Classification Chart and Log Exploration
Introduction
The contents of this appendix shall be integrated with the geotechnical engineering study of which it is a part. They shall not be used in whole or in part as a sole source for information or recommendations regarding the subject site.

Our recent field study included a site reconnaissance by a Youngdahl Consulting Group, Inc. representative followed by a subsurface exploration program conducted on 23 October 2020, which included the excavation of 16 test pits under his direction at the approximate locations shown on Figure A-2, this Appendix. Excavation of the test pits was accomplished with a CAT 430F backhoe equipped with a 24-inch-wide bucket. The bulk and bag samples collected from the test pits returned to our laboratory for further examination and testing.

The Exploratory Test Pit Logs describe the vertical sequence of soils and materials encountered in each test pit, based primarily on our field classifications and supported by our subsequent laboratory examination and testing. Where a soil contact was observed to be gradual, our logs indicate the average contact depth. Our logs also graphically indicate the sample type, sample number, and approximate depth of each soil sample obtained from the test pits.

The soils encountered were logged during this and a previous excavation and provide the basis for the "Logs of Test Pits", Figures A-3 through A-18, this Appendix. These logs show a graphic representation of the soil profile, the location, and depths at which samples were collected.
Note: The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations. Note, too, that the passage of time may affect conditions at the sampling locations.

<table>
<thead>
<tr>
<th>Depth (Feet)</th>
<th>Geotechnical Description &amp; Unified Soil Classification</th>
<th>Sample</th>
<th>Tests &amp; Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>@ 0' - 3'</td>
<td>Brown meta-andesite <strong>BEDROCK</strong>, completely weathered, soft, slightly moist</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 3' - 6'</td>
<td>Grades olive brown, highly weathered, closely spaced fractured, hard, with manganese oxide and iron oxide staining</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 6'</td>
<td>Grades very hard</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Test pit terminated at 6'</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No free groundwater encountered</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No caving noted</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Logged By:** KAW  **Date:** 23 October 2020  **Lat / Lon:** N 38.64190° / W 121.11295°  **Pit No.:** TP-1

**Equipment:** CAT 430 F with 24“ Buckets  **Pit Orientation:** 315°  **Elevation:** ~436’

**Project No.:** E17053.094  **EXPLORATORY TEST PIT LOG**  **Folsom Plan Area 85A (Hospital Site) GES**  **Folsom, California**  **November 2020**
Note: The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations. Note, too, that the passage of time may affect conditions at the sampling locations.

### Geotechnical Description & Unified Soil Classification

<table>
<thead>
<tr>
<th>Depth (Feet)</th>
<th>Geotechnical Description &amp; Unified Soil Classification</th>
<th>Sample</th>
<th>Tests &amp; Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>@ 0' - 0.5'</td>
<td>Grey and mottled orange sandy SILT (ML), soft, dry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 0.5' - 6'</td>
<td>Black slate BEDROCK, fresh, very closely fractured, very hard, dry</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Test pit terminated at 6'</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No free groundwater encountered</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No caving noted</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**Scale:** 1" = 4 Feet

---

**Logged By:** KAW **Date:** 23 October 2020 **Lat / Lon:** N 38.64185° / W 121.11137° **Pit No.:** TP-2 **Equipment:** CAT 430 F with 24" Buckets **Pit Orientation:** 350° **Elevation:** ~435' **Pit Orientation:**

---

**Project No.:** E17053.094 **EXPLORATORY TEST PIT LOG** **Folsom Plan Area 85A (Hospital Site) GES** **Folsom, California** **November 2020**
Logged By: KAW
Date: 23 October 2020
Equipment: CAT 430 F with 24" Buckets

Lat / Lon: N 38.64146° / W 121.11201°

Pit Orientation: 0°
Elevation: ~424'

Pit No. TP-3

<table>
<thead>
<tr>
<th>Depth (Feet)</th>
<th>Geotechnical Description &amp; Unified Soil Classification</th>
<th>Sample</th>
<th>Tests &amp; Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>@ 0' - 1'</td>
<td>Red brown sandy Silt (ML), medium stiff, dry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 1' - 9'</td>
<td>Brack slate Bedrock, fresh, very close clay filled fractures, very hard, with manganese oxide and iron oxide staining</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Test pit terminated at 9'
No free groundwater encountered
No caving noted

---

**Note:** The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations. Note, too, that the passage of time may affect conditions at the sampling locations.
The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations. Note, too, that the passage of time may affect conditions at the sampling locations.

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<tr>
<th>Depth (Feet)</th>
<th>Geotechnical Description &amp; Unified Soil Classification</th>
<th>Sample</th>
<th>Tests &amp; Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>@ 0' - 3'</td>
<td>Brown silty SAND (SM) with gravel, rounded, dense, slightly moist (alluvium)</td>
<td>TP-4</td>
<td>@ 0-3'</td>
</tr>
<tr>
<td></td>
<td>Brack slate BEDROCK, fresh, thin clay filled foliations, hard</td>
<td>TP-4</td>
<td>@ 3-5'</td>
</tr>
</tbody>
</table>

Test pit terminated at 9'
No free groundwater encountered
No caving noted

Note: The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations. Note, too, that the passage of time may affect conditions at the sampling locations.
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<th>Sample</th>
<th>Tests &amp; Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>@ 0' - 3'</td>
<td>Red brown sandy <strong>SILT (ML)</strong>, medium stiff, dry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 3' - 9'</td>
<td>Olive brown meta-andesite <strong>BEDROCK</strong>, moderately weathered, close clay filled fractures, slightly moist, with manganese oxide and iron oxide staining</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Test pit terminated at 9'</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No free groundwater encountered</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No caving noted</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note:**

- **EXPLORATORY TEST PIT LOG**
- **Folsom Plan Area 85A (Hospital Site) GES**
- **Folsom, California**
- **November 2020**
Note: The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations. Note, too, that the passage of time may affect conditions at the sampling locations.

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<th>Sample</th>
<th>Tests &amp; Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>@ 0' - 1.5'</td>
<td>Orange and mottled grey sandy SILT (ML), medium stiff, dry, with 1/8&quot; roots</td>
<td></td>
<td>@ 2-4' Fracture 50° dip 140° direction</td>
</tr>
<tr>
<td>@ 1.5' - 2'</td>
<td>Grades with clay and gravel, angular, hard</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 2' - 4'</td>
<td>Green brown meta-andesite BEDROCK, fresh, close clay filled fractures, very hard, with manganese oxide and iron oxide staining</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 4'</td>
<td>Test pit terminated at 4' No free groundwater encountered No caving noted</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depth (Feet)</td>
<td>Geotechnical Description &amp; Unified Soil Classification</td>
<td>Sample</td>
<td>Tests &amp; Comments</td>
</tr>
<tr>
<td>-------------</td>
<td>------------------------------------------------------</td>
<td>--------</td>
<td>-----------------</td>
</tr>
<tr>
<td>@ 0' - 2'</td>
<td>Red brown sandy <strong>SILT (ML)</strong> with cobble and boulders, angular, stiff, dry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 2' - 5'</td>
<td>Olive brown meta-andesite <strong>BEDROCK</strong>, highly weathered, moderately hard, with manganese oxide and iron oxide staining</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note:** The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations. Note, too, that the passage of time may affect conditions at the sampling locations.
Note: The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations. Note, too, that the passage of time may affect conditions at the sampling locations.

EXPLORATORY TEST PIT LOG
Folsom Plan Area 85A (Hospital Site) GES
Folsom, California

November 2020
Note: The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations. Note, too, that the passage of time may affect conditions at the sampling locations.

<table>
<thead>
<tr>
<th>Depth (Feet)</th>
<th>Geotechnical Description &amp; Unified Soil Classification</th>
<th>Sample</th>
<th>Tests &amp; Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>@ 0' - 8&quot;</td>
<td>Red brown sandy Silt (ML) with gravel, rounded, 2&quot; max clast size, soft, dry</td>
<td></td>
<td>@ 2' Fracture 55° dip 335° direction</td>
</tr>
<tr>
<td>@ 8&quot; - 4&quot;</td>
<td>Olive brown meta-andesite BEDROCK, moderately weathered, closely fractured, hard</td>
<td></td>
<td>@ 2' Fracture 76° dip 042° direction</td>
</tr>
<tr>
<td>@ 4'</td>
<td>Grades black green, fresh, very hard</td>
<td></td>
<td>@ 2' Fracture 76° dip 210° direction</td>
</tr>
<tr>
<td></td>
<td>Test pit terminated at 4'</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No free groundwater encountered</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No caving noted</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations. Note, too, that the passage of time may affect conditions at the sampling locations.

Scale: 1" = 4 Feet

EXPLORATORY TEST PIT LOG
Folsom Plan Area 85A (Hospital Site) GES
Folsom, California

Figure A-11
<table>
<thead>
<tr>
<th>Depth (Feet)</th>
<th>Geotechnical Description &amp; Unified Soil Classification</th>
<th>Sample</th>
<th>Tests &amp; Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>@ 0' - 1.5'</td>
<td>Red brown sandy SILT (ML) with gravel, rounded, 2&quot; max clast size, soft, dry</td>
<td>TP-8</td>
<td>@ 3'-4' Corrosivity Suite</td>
</tr>
<tr>
<td>@ 1.5' - 2'</td>
<td>Orange brown CLAY (CH), high plasticity, very stiff, slightly moist</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 2' - 12'</td>
<td>Light brown meta-andesite BEDROCK, moderately weathered, closely fractured, slightly moist with manganese staining</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Test pit terminated at 12'
No free groundwater encountered
No caving noted

---

Scale: 1" = 4 Feet

Note: The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations. Note, too, that the passage of time may affect conditions at the sampling locations.

EXPLORATORY TEST PIT LOG
Folsom Plan Area 85A (Hospital Site) GES
Folsom, California

Logged By: KAW  Date: 22 October 2020  Lat / Lon: N 38.63970° / W 121.11298°
Equipment: CAT 430 F with 24" Buckets  Pit Orientation: 20°  Elevation: ~418'

Pit No. TP-10
Project No.: E17053.094

November 2020
**Note:** The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations. Note, too, that the passage of time may affect conditions at the sampling locations.

<table>
<thead>
<tr>
<th>Depth (Feet)</th>
<th>Geotechnical Description &amp; Unified Soil Classification</th>
<th>Sample</th>
<th>Tests &amp; Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>@ 0' - 1.5'</td>
<td>Red brown silty <strong>SAND (ML)</strong> with gravel, angular, soft, dry, with fine roots</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 1.5' - 3'</td>
<td>Light brown slate <strong>BEDROCK</strong>, moderately weathered, very thinly foliated, moderately hard</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 3'</td>
<td><strong>Grades black, fresh, very hard</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
|              | Test pit terminated at 3'
No free groundwater encountered
No caving noted |        |                 |

**EXPLORATORY TEST PIT LOG**

**Folsom Plan Area 85A (Hospital Site) GES**

**Folsom, California**

**Project No.:** E17053.094

**November 2020**

**Scale:** 1" = 4 Feet

**Logged By:** KAW

**Date:** 22 October 2020

**Equipment:** **CAT 430 F with 24" Buckets**

**Lat / Lon:** N 38.63928° / W 121.11302°
**Logged By:** KAW  
**Date:** 22 October 2020  
**Lat / Lon:** N 38.63879° / W 121.11246°  
**Equipment:** CAT 430 F with 24" Buckets  
**Pit Orientation:** 15°  
**Elevation:** ~420’  
**Pit No.:** TP-12

<table>
<thead>
<tr>
<th>Depth (Feet)</th>
<th>Geotechnical Description &amp; Unified Soil Classification</th>
<th>Sample</th>
<th>Tests &amp; Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>@ 0' - 1.5'</td>
<td>Red brown sandy Silt (ML) with gravel, angular, soft, dry, with fine roots</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 1.5' - 4'</td>
<td>Blue green meta-andesite Bedrock, fresh, closely fractured, very hard</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
|              | Test pit terminated at 4’  
|              | No free groundwater encountered  
|              | No caving noted |        |                 |

*Note:* The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations. Note, too, that the passage of time may affect conditions at the sampling locations.
Note: The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations. Note, too, that the passage of time may affect conditions at the sampling locations.

<table>
<thead>
<tr>
<th>Depth (Feet)</th>
<th>Geotechnical Description &amp; Unified Soil Classification</th>
<th>Sample</th>
<th>Tests &amp; Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>@ 0’ - 2’</td>
<td>Olive brown silty <strong>GRAVEL (GM)</strong> with boulders, loose, dry (FILL)</td>
<td></td>
<td>PP @ 3’ = 1.0 tsf</td>
</tr>
<tr>
<td>@ 2’ - 4’</td>
<td>Green brown <strong>CLAY (CH)</strong>, highly plasticity, medium stiff, moist (NATIVE)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 4’ - 9’</td>
<td>Black slate <strong>BEDROCK</strong>, moderately weathered, moderately hard</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Test pit terminated at 9’
Seepage encountered at 7’
No caving noted

---

**EXPLORATORY TEST PIT LOG**
Folsom Plan Area 85A (Hospital Site) GES
Folsom, California

**Logged By:** KAW  **Date:** 22 October 2020  **Lat / Lon:** N 38.63864° / W 121.11343°
**Equipment:** CAT 430 F with 24” Buckets  **Pit Orientation:** 30°  **Elevation:** ~408’

**Pit No.:** TP-13  **Project No.:** E17053.094

---

**Scale:** 1” = 4 Feet
The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations. Note, too, that the passage of time may affect conditions at the sampling locations.

### Geotechnical Description & Unified Soil Classification

<table>
<thead>
<tr>
<th>Depth (Feet)</th>
<th>Geotechnical Description &amp; Unified Soil Classification</th>
<th>Sample</th>
<th>Tests &amp; Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>@ 0’ - 2’</td>
<td>Orange and mottled grey sandy <strong>SILT (ML)</strong>, medium stiff, dry, with 1/8” roots</td>
<td></td>
<td>@ 3’ Fracture 80° dip 055° direction</td>
</tr>
<tr>
<td>@ 2’ - 3’</td>
<td>Green brown <strong>CLAY (CH)</strong> boulders, angular, highly plasticity, medium stiff, moist</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 3’ - 6’</td>
<td>Olive green meta-andesite <strong>BEDROCK</strong>, moderately weathered, close clay filled fractured, very hard</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Test pit terminated at 6’
Seepage encountered at 4’
No caving noted

---

**Note:** The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations. Note, too, that the passage of time may affect conditions at the sampling locations.
<table>
<thead>
<tr>
<th>Depth (Feet)</th>
<th>Geotechnical Description &amp; Unified Soil Classification</th>
<th>Sample</th>
<th>Tests &amp; Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>@ 0’ - 8”</td>
<td>Red brown sandy SILT (ML), stiff, dry</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Olive green meta-andesite BEDROCK, fresh, close clay</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>filled fractures, hardness, with manganese oxide and iron oxide staining</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 8” - 2’</td>
<td>Test pit terminated at 2’</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No free groundwater encountered</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No caving noted</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations. Note, too, that the passage of time may affect conditions at the sampling locations.
### Geotechnical Description & Unified Soil Classification

<table>
<thead>
<tr>
<th>Depth (Feet)</th>
<th>Geotechnical Description &amp; Unified Soil Classification</th>
<th>Sample</th>
<th>Tests &amp; Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>@ 0' - 8&quot;</td>
<td>Red brown sandy SILT (ML) with cobble and boulders,</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>sub-angular, stiff, dry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 8&quot; - 2'</td>
<td>Olive brown meta-andesite BEDROCK, highly weathered,</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>close clay filled fractures moderately hard, with</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>manganese oxide and iron oxide staining</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Test pit terminated at 2'
No free groundwater encountered
No caving noted

---

**Note:** The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations. Note, too, that the passage of time may affect conditions at the sampling locations.
Standard Penetration test
2.5" O.D. Modified California Sampler
3" O.D. Modified California Sampler
Shelby Tube Sampler
2.5" Hand Driven Liner
Bulk Sample
Water Level At Time Of Drilling
Water Level After Time Of Drilling
Perched Water

Joint
Foliation
Water Seepage
NFWE No Free Water Encountered
FWE Free Water Encountered
REF Sampling Refusal
DD Dry Density (pcf)
MC Moisture Content (%)
LL Liquid Limit
PI Plasticity Index
PP Pocket Penetrometer
UCC Unconfined Compression (ASTM D2166)
TVS Pocket Torvane Shear
EI Expansion Index (ASTM D4829)
Su Undrained Shear Strength
APPENDIX B
Laboratory Testing

Direct Shear Test
Resistance Value Test
Modified Proctor Test
Corrosivity Tests
**Direct Shear Test of Soils Under Consolidated Drained Conditions, ASTM D3080**

![Graphs showing shear test results](image)

### Direct Shearbox Results
- **Friction Angle**: 34.2°
- **Cohesion**: 349 psf

### Test Results
<table>
<thead>
<tr>
<th>Test No.</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wet Density, pcf</td>
<td>126.9</td>
<td>126.9</td>
<td>126.9</td>
</tr>
<tr>
<td>Dry Density, pcf</td>
<td>114.0</td>
<td>114.0</td>
<td>114.0</td>
</tr>
<tr>
<td>Moisture Content, %</td>
<td>11.3</td>
<td>11.3</td>
<td>11.3</td>
</tr>
<tr>
<td>Diameter, in</td>
<td>2.50</td>
<td>2.50</td>
<td>2.50</td>
</tr>
<tr>
<td>Height, in</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Wet Density, pcf</td>
<td>138.0</td>
<td>140.0</td>
<td>140.4</td>
</tr>
<tr>
<td>Dry Density, pcf</td>
<td>116.0</td>
<td>117.3</td>
<td>119.0</td>
</tr>
<tr>
<td>Moisture Content, %*</td>
<td>19.0</td>
<td>19.4</td>
<td>18.0</td>
</tr>
<tr>
<td>Diameter, in</td>
<td>2.50</td>
<td>2.50</td>
<td>2.50</td>
</tr>
<tr>
<td>Height, in</td>
<td>0.98</td>
<td>0.97</td>
<td>0.96</td>
</tr>
<tr>
<td>Normal Stress, psf</td>
<td>1000</td>
<td>2000</td>
<td>4000</td>
</tr>
<tr>
<td>Failure Stress, psf</td>
<td>1053</td>
<td>1672</td>
<td>3082</td>
</tr>
<tr>
<td>Failure Strain, %</td>
<td>4.14</td>
<td>2.57</td>
<td>17.70</td>
</tr>
<tr>
<td>Rate, in/min</td>
<td>0.002</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Based on post shear moisture content

---

**Sample Type:** Remolded to 90% RC

**Material Description:** Yellow Brown Silty SAND with Gravel

**Source:**

**Notes:** Gravel removed from test sample.

**Sample No./Depth:** Combined TP-7 @ 3-5' and TP-16 @ 2-4'

<table>
<thead>
<tr>
<th>Date Sampled</th>
<th>Date Test Started</th>
</tr>
</thead>
<tbody>
<tr>
<td>10/22/2020</td>
<td>11/4/2020</td>
</tr>
</tbody>
</table>

**Project:** Folsom Plan Area Parcel 85A (Hospital Site) GES

<table>
<thead>
<tr>
<th>Project No.</th>
<th>Figure</th>
</tr>
</thead>
<tbody>
<tr>
<td>E17053.094</td>
<td>B-1</td>
</tr>
</tbody>
</table>

**Reviewed By:** DN  
**Date:** 11/9/2020
Resistance "R" Value of Soil and Soil-Aggregate Mixtures, CTM 301

R-Value Chart

<table>
<thead>
<tr>
<th>Test Specimen No.</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture Content at Test, %</td>
<td>11.9</td>
<td>12.5</td>
<td>13.0</td>
</tr>
<tr>
<td>Dry Density at Test, pcf</td>
<td>131.6</td>
<td>128.2</td>
<td>126.7</td>
</tr>
<tr>
<td>Expansion Pressure, psf</td>
<td>9</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Exudation Pressure, psi</td>
<td>408</td>
<td>285</td>
<td>222</td>
</tr>
<tr>
<td>Resistance &quot;R&quot; Value</td>
<td>46</td>
<td>35</td>
<td>27</td>
</tr>
<tr>
<td>&quot;R&quot; Value at 300 psi Exudation Pressure</td>
<td>37</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Material Description: Yellow Brown Silty SAND with Gravel

Source:

Notes:

Sample No./Depth: Combined TP-7 @ 3-5' and TP-16 @ 2-4'

USCS Class. | Liquid Limit | Plasticity Index | % Greater than No. 4 | % Less than No. 200
---|---|---|---|---

Date Sampled: 10/22/2020 Date Test Started: 11/4/2020

Project: Folsom Plan Area Parcel 85A (Hospital Site) GES

Project No.: E17053.094

Reviewed By: JLC Date: 11/5/2020

Figure B-2
Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 lf-lbf/ft³), ASTM D1557, Method A

Material Description: Yellow Brown Silty SAND with Gravel

Source:

Notes:

Sample No./Depth: Curve 1, Combined TP-7 @ 3-5' and TP-16 @ 2-4'

Date Sampled: 10/22/2020
Date Test Started: 11/4/2020

Maximum Dry Density, pcf: 126.7
Optimum Moisture Content, %: 11.3

Dry Density, pcf vs Moisture Content, %

Zero Air Voids Curve at 100% Saturation; Specific Gravity Estimated at: 2.80

Project: Folsom Plan Area Parcel 85A (Hospital Site) GES
Project No.: E17053.094
Reviewed By: LEK Date: 11/5/2020
Figure B-3
To: Jeffry Cannon  
Youngdahl Consulting Group  
1234 Glenhaven Ct.  
El Dorado Hills, CA 95630

From: Gene Oliphant, Ph.D. \ Randy Horney  
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location: E17053.094 Site ID: TP-4@3.5FT.
Thank you for your business.

* For future reference to this analysis please use SUN # 83350-173928.

----------------------------------
EVALUATION FOR SOIL CORROSION

Soil pH  6.39
Minimum Resistivity  3.75 ohm-cm (x1000)
Chloride  2.1 ppm  00.00021 %
Sulfate  9.1 ppm  00.00091 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422m
Date Reported 11/04/2020
Date Submitted 10/28/2020

To: Jeffry Cannon
    Youngdahl Consulting Group
    1234 Glenhaven Ct.
    El Dorado Hills, CA 95630

From: Gene Oliphant, Ph.D. \ Randy Horney
        General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location: E17053.094  Site ID: TP-10@3-4F7.
Thank you for your business.

* For future reference to this analysis please use SUN # 83350-173929.

----------------------------------------------------------------
EVALUATION FOR SOIL CORROSION
----------------------------------------------------------------

Soil pH 6.43

Minimum Resistivity 2.12 ohm-cm (x1000)

Chloride 2.1 ppm  00.00021 %

Sulfate 4.0 ppm  00.00040 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422m
To: Jeffry Cannon  
Youngdahl Consulting Group  
1234 Glenhaven Ct.  
El Dorado Hills, CA 95630

From: Gene Oliphant, Ph.D.  
Randy Horney  
General Manager  
Lab Manager

The reported analysis was requested for the following location:  
Location: E17053.094  Site ID: TP16@2-4+TP7@3.  
Thank you for your business.

* For future reference to this analysis please use SUN # 83363-173946.

EVALUATION FOR SOIL CORROSION

Soil pH 6.61
Minimum Resistivity 4.02 ohm-cm (x1000)
Chloride 1.5 ppm  0.00015 %
Sulfate 0.2 ppm  0.00002 %

METHODS  
pH and Min. Resistivity CA DOT Test #643  
Sulfate CA DOT Test #417, Chloride CA DOT Test #422m
APPENDIX C
Geotechnical Drainage Details

Canyon Style Drain
Keyway and Bench with Drain
Site Wall Drainage
Sub-Drain
Storm Drain / Sub-Drain
Canyon Drain Installation
(Typical)

2' Minimum Embedment
Into Bedrock

4" - 6"

4 X Pipe Diameter
or 3' Maximum

“Filter-fabric”
Layer Wrapped Around
Drain Material
(Mirafi 140 N or Equivalent)

Permeable Material:
3/4" Crushed Rock

4" Schedule 40 PVC Perforated
Pipe or Approved Equivalent, Installed
As Field Conditions Dictate
(Centered in Trench)
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.

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

10' Min or as designated by geotechnical engineer  

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.

Design Grade  

Brow Berm  

Natural Grade  

Zone of soil to be removed.  

Max Inclination of fill slope 2H:1V  

3' Max  

6' Minimum  

Benches to be cut as fills are being placed.  

Keyway a minimum of two feet into competent material; ten feet minimum width at 2% inclination into slope.
Notes: 1. Slope footing and “rigid-wall” pipes along flow line parallel to wall 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
Seal Plastic Sheeting To Foundation

Slab

Footing

8"

4"

2%

6" Minimum Compacted Soil Cover

Zone Of Anticipated Infiltration

Permeable Material:

3/4" Crushed Rock

"Filter-fabric" Layer Wrapped Around Drain Material
(Mirafi 140 N or Equivalent)

Trench To Be Excavated
A Minimum Of 12" Below Zone Of Infiltration

Trench Width
(12" Typical)

Min ½D

½D

Min ½D

“Rigid-wall” “Perforated Pipe”
With Holes Turned Down
Pipe Diameter (D) = 4"

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 90° elbows).
3. Provide sweeps to periodic “clean-outs”.
4. Washed clean permeable material.
Grout Collar Cut-Off Subdrain Detail (Typical)

Plan View

Sand Lean Grout Slurry Collar (Placement To Be Determined By Geotechnical Engineer)

"Rigid-wall" Perforated Pipe
With Holes Turned Down
Pipe Diameter = 4"

"Non-Perforated Pipe"
(Tight Pipe)
Pipe Diameter = 4"

Permeable Material:
3/4" Crushed Rock
NOTE: Filter Fabric On Top
Of Drain Material

Class II Aggregate Base Manhole Backfill
(90% R.C.)

Storm Drain

Notes:
1. Slope trench and "rigid-wall" pipes at least 1% gradient to drain.
2. Washed clean permeable material.
3. Slurry collar to extend into trench sidewalls and to top of pipe envelope.

4 Inch "Rigid-wall" Tight Pipe

Storm Drain Manhole

Compacted Native Soils to 90% Relative Compaction per ASTM D1557

"Filter-fabric" Layer Across Top of Drain Material
Mirfl 140N

Notes: Slope trench and "rigid-wall" pipes at least 1% gradient to drain.
APPENDIX D
Geohazards Study
GEOLOGIC HAZARDS ASSESSMENT
for
Folsom Plan Area Parcel 85A (Hospital Site)
350 Placerville Road
Folsom, California 95630

Prepared by:
Youngdahl Consulting Group, Inc.
1234 Glenhaven Court
El Dorado Hills, California 95762

Prepared for:
Enclave at Folsom Ranch, LLC
100 Pine St., 29th Floor
San Francisco, California 94111

Project No. E17053.094
November 2020
Attention: Mr. James Galovan

Subject: FOLSOM PLAN AREA PARCEL 85A (HOSPITAL SITE)
350 Placerville Road, Folsom, Sacramento County, California
GEOLOGIC HAZARDS ASSESSMENT

References: See References Section.

Dear Mr. Galovan

With your authorization, Youngdahl Consulting Group, Inc. has completed a Geologic Hazards Assessment for the proposed new Dignity Health Hospital and appurtenant improvements at the Folsom Plan Area (FPA) Parcel 85A. This study is designed to address the specific items listed in the California Geological Survey (CGS) Note 48 Checklist (CGS, 2019). If you have questions or require any additional updates, please do not hesitate to contact us at (916) 933-0633.

Very truly yours,
Youngdahl Consulting Group, Inc.

Kenneth A. Williams, P.G., C.E.G.
Project Engineering Geologist

Distribution: 1 Electronic Copy to Client
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GEOLOGIC HAZARDS ASSESSMENT FOR
FPA PARCEL 85A (HOSPITAL SITE)
350 Placerville Road, Folsom, Sacramento County, California

1.0 EXECUTIVE SUMMARY
The proposed new hospital and appurtenant improvements construction at the Folsom Plan Area (FPA) Parcel 85A will be located at 350 Placerville Road in Folsom, Sacramento County, California (Figure 1). Significant findings of this report are presented below:

- The nearest active fault was identified as the Dunnigan Hills Fault, approximately 65 kilometers west-northwest of the project site.
- Historically, the largest earthquake within 100km of the site was a 6.6 magnitude event approximately 85 kilometers west-southwest of the project site in 1892.
- According to the 2012 Federal Emergency Management Agency (FEMA) Flood Map for Sacramento County, the subject site is in an area outside of the 0.2% annual chance of flood, areas of 1% annual chance flood with average depths of less than 1-foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

2.0 INTRODUCTION
This report presents the results of our analysis of geologic hazards for the proposed new hospital and appurtenant improvements planned to be constructed at the Folsom Planning Area Parcel 85A located at 350 Placerville Road in Folsom, California. An annotated vicinity map is provided on Figure 1 to identify the approximate project location. This report is designed to supplement the Geotechnical Engineering Study (GES, Reference 3) for the Folsom Plan Area Parcel 85A (Hospital Site) prepared by Youngdahl Consulting Group, Inc. (Youngdahl). The scope of this study includes the following:

- A review of geotechnical engineering studies.
- A review of the geotechnical engineering studies test pit logs and borings.
- Addressing-items listed on the checklist of Note 48 published by the California Geological Survey.
- Engineering geology analysis of geological hazards for the planned facility location.
- Preparation of this report.

3.0 PROJECT DESCRIPTION
Based on a limited review of aerial photography, the site was vacant until around 2019, when Alder Creek Parkway was constructed along the south property line and excess fill material was placed at the southwest corner. No other improvements have occurred since then. The site address is 350 Placerville Road in Folsom, California and is located on approximately 28.3 acres of rolling foothills property that is currently being used intermittently for grazing. Our firm prepared a geotechnical engineering study for the proposed new hospital and appurtenant site improvements of the site on 26 October 2020.

We understand that the project consists of the construction of 3 buildings at the approximate center of the site. The buildings are planned to be separated from each other and be a total of approximately 80,00 square feet of floor space. The area surrounding the buildings is proposed to receive flatwork improvements and parking areas. The buildings are anticipated to be supported on conventional shallow foundations.
4.0 SITE LOCATION AND DESCRIPTION
The Dignity Hospital site is located at the northeast corner of East Bidwell Street and Alder Creek Parkway in Folsom, Sacramento County, California. The site is at Latitude/Longitude coordinates 38.640829°N, -121.112416° W, which has been plotted and is presented on the vicinity map (Figure 1).

5.0 ENGINEERING GEOLOGY
The geology of the site is based on Youngdahl’s Geotechnical Engineering Studies (Report Reference No. 3) along with a review of published literature.

5.1 Regional Geology
The site is located within the Great Valley geomorphic province of California. The Great Valley is an alluvial plain about 50 miles wide and 400 miles long in the central part of California. Its northern part is the Sacramento Valley, drained by the Sacramento River and its southern part is the San Joaquin Valley drained by the San Joaquin River. The Great Valley is a trough in which sediments have been deposited almost continuously since the Jurassic Period (about 160 million years ago). Great oil fields have been found in the southernmost San Joaquin Valley and along with anticlinal uplifts on its southwestern margin. In the Sacramento Valley, the Sutter Buttes, the remnants of an isolated Pliocene volcano, rise above the valley floor. Based upon a review of published geologic data for the Preliminary Geologic Map of the Sacramento 30’ x 60’ Quadrangle (Gutierrez, C. I. 2011), the vicinity is mapped as Jurassic age Gopher Ridge Volcanics (map unit Jgo) and Salt Springs Slate (map unit Jss) (Figure 2).

According to the National Resources Conservation Service web-based soil survey (Web Soil Survey accessed on 23 October 2020), the site is underlain by the Argonaut-Auburn complex,3 to 8 percent slopes, (map unit symbol 107). The Argonaut-Auburn complex series consists of shallow to moderately deep soils, well and moderately well-drained soils derived from metavolcanic bedrock. The soil is not prime farmland.

5.2 Site Subsurface Geology
Youngdahl Consulting Group, Inc. advanced 16 exploratory test pits across the project site. Subsurface soil conditions at the project site included interbedded layers of clays, silts, and sands. The silts and sands encountered throughout the depth of the test pits were observed to be in medium stiff to hard and medium dense to very dense conditions. The upper 3 to 4 feet of soils consisted of silty sands that were underlain by shallow metavolcanic (meta-andesite) and metasedimentary bedrock (slate).

According to Gutierrez (2011), the metavolcanic bedrock could be described as Jurassic-aged (~145 to 201 million years) meta-andesite of the Gopher Ridge Volcanics Formation and is described as metamorphosed mafic to andesitic pyroclastic rocks, lava, and pillow lava with subordinate felsic porphyritic and pyroclastic rocks. The metavolcanic bedrock is characterized by an olive-green color on a fresh surface, weathering to olive-brown, and typically without foliation. The bedrock is usually observed to contain various degrees of fracturing and weathering. The degree of weathering typically decreases with depth. Foliations, where present, and lenticular rock bodies, had a northwesterly trend and steep dip to the east (Figure 3).

The metasedimentary bedrock encountered is described by Gutierrez as a dark gray slate with subordinate tuff, greywacke, rare conglomerate, and mica schist. The metasedimentary bedrock encountered on the project site is characterized by black slate weathered to a light brown with very closely spaced fractures with unknown contacts with the meta-andesite.
The slate was encountered in the southwest corner and northeast side and generally paralleling a belt of meta-andesite bedrock through the center of the site (Figure 3 through 5).

5.3 Faulting
No active faulting or coseismic deformation is present on or near the site. According to the Fault Activity Map of California and Adjacent Areas (Jennings, C.W., and Bryant, W.A., 2010), and based on field evidence, no active faults are located within the general proximity of the subject property. No evidence of recent shear movements, such as soil off-set, springs, seeps, sag ponds, or other indications of recent ground rupture was observed on the project site during our study.

According to the Fault Activity Map of California and Adjacent Areas (Jennings, C.W., and Bryant, W.A., 2010), no active faults or Earthquake Fault Zones (Special Studies Zones) are located on the project site. The nearest mapped fault is an unnamed fault approximately 4 km to the east and the nearest active fault to the site is the Dunnigan Hills Fault, approximately 65 kilometers west-northwest of the project site.

6.0 SEISMOLOGY & CALCULATION OF EARTHQUAKE GROUND MOTION

6.1 Evaluation of Historical Seismicity
Figure 5 shows historical epicenters obtained from the California Geological Survey Historic Earthquake Online Database. The inspection of Figure 6 shows that the largest and closest source of historical seismicity within 100 kilometers of the project site reported in the database was a 6.6 magnitude earthquake in 1892 approximately 85 kilometers to the southwest of the project site. Figures 7 and 8 show mapped faults near the project site. Mapped spectral acceleration parameters are provided in the Reference No. 3 report.

7.0 LIQUEFACTION AND SEISMIC SETTLEMENT
The project site is not in a mapped liquefaction hazard zone. Reference No. 3 addresses the potential for liquefaction and seismic settlement.

8.0 SLOPE STABILITY
The project site and area surrounding the project site are of relatively low relief with no significant slopes present on or near the project site. The project site doesn’t lie within a mapped landslide hazard zone.

9.0 OTHER GEOLOGIC HAZARDS
There are no natural or manmade sources of methane on or near the site. According to the California Division of Oil, Gas, and Geothermal Resources maps, the closet gas field of the Northern District is the Florin Gas field approximately 30 kilometers to the southwest.

According to the USGS, the nearest volcano field is the Clear Lake volcanic field, which lies approximately 141 kilometers to the northwest. It has a high to very high threat ranking, however, the project site does not lie in a volcanic hazard zone.

According to the 2012 Federal Emergency Management Agency (FEMA) Flood Map for Sacramento County (Map 06067C140H), the subject site is in an area outside of the 0.2% annual chance of flood, areas of 1% annual chance flood with average depths of less than 1-foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood. There are no nearby bodies of water capable of inundating the site with a tsunami or a seiche.
According to the Special Report 192 (SR 192) the site is located in an area moderately likely to contain naturally occurring asbestos (NOA). According to Plate 1 of SR 192, the rock type that is least likely to contain NOA on the site is Salt Spring slate. Clark (1964) states that the Salt Springs slate is comprised of dominantly black epiclastic rocks that overlie and intertongue with Gopher Ridge volcanics. The slate dominates formation, but graywacke and tuff are widespread and thin conglomerate layers occur in some places. In the vicinity of the project site and to the south of Alder Creek Parkway, the slate forms single formation that overlies Gopher Ridge volcanics.

Youngdahl mapped slate on the project site in portions of the southwest and northeast corners while meta-andesite was prevalent in the center. SR 192 also states that metavolcanic rocks of the Gopher Ridge Volcanics are moderately likely to contain NOA, however, the nearest mapped ultramafic geologic unit is approximately 5 kilometers to the northwest. It follows that the nearest alteration (serpentinization) of the bedrock would be within the margins of the ultramafic unit and the likelihood of encountering serpentinized bedrock or alluvium containing serpentinized bedrock at the site is very remote.

Elevated radon gas levels in indoor air are a result of radon moving into buildings from the soil, either by diffusion or flow due to air pressure differences. The ultimate source of radon gas in buildings is the uranium naturally present in rock, water, and soil. Some rock types are known to contain more uranium than others. In California, most uranium deposits are relatively small in aerial extent and are located in rural areas. Consequently, the chance of severe radon levels (>200 pCi/L) occurring in buildings in California should be very low. The California Department of Health Services database on radon levels, last updated in February 2016, has the Sacramento zip code 95630 listed. The number of tests does not necessarily represent the number of houses tested.

A single house may have had several tests conducted. The California Department of Health Services recommends that you take action to reduce radon levels in your house if they are 4pCi/L or greater. Nine (9) of the results of fifty-five (83) tests in the California Department of Health Services Database for this zip code were greater than or equal to 4 pCi/l with a maximum result of 9.9 pCi/l. Also, the Geologic Radon Potential of EPA Region 9 (USGS Open-File Report 93-292-1) report was consulted and indicated that Sacramento County was in an area with predicted indoor radon levels ranging from 2 to 4 pCi/L:

Report Reference No. 3 did not find conditions conducive to the hydrocollapse of soils, regional subsidence, or for clays subject to cyclic softening.

### 9.1 Soil Corrosivity

Youngdahl Consulting Group, Inc. performed geotechnical laboratory testing of numerous soil select soil samples collected during our geotechnical drilling. These corrosivity testing suites consisted of soil pH, resistivity, sulfate, and chloride content tests. We are not corrosion specialists and recommend that the results be evaluated by a qualified corrosion expert. The laboratory test results (provided by Sunlab, Inc.) are provided in Appendix A and are summarized in Table 1, below.

<table>
<thead>
<tr>
<th>Location</th>
<th>Depth (ft)</th>
<th>Soil pH</th>
<th>Minimum Resistivity ohm-cm (x1000)</th>
<th>Chloride (ppm)</th>
<th>Sulfate (ppm)</th>
<th>Caltrans Environment</th>
<th>ACI Environment</th>
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<td>3-5</td>
<td>6.61</td>
<td>4.02</td>
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<td>TP-4</td>
<td>3-5</td>
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<td>3.75</td>
<td>2.1</td>
<td>9.1</td>
<td>Non-Corrosive</td>
<td>S0 (Not a Concern)</td>
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According to Caltrans Corrosion Guidelines Version 3.0, March 2018, the test results appear to indicate a potentially corrosive environment for mechanically stabilized earth (MSE) structure backfill; however, we do not anticipate the use of MSE structures at the project site. According to the 2019 California Building Code Section 1904.1 and ACI 318-14 Table 19.3.1.1, the test results indicate the onsite soils have a negligible potential for sulfide attack of concrete. Accordingly, Type I/II Portland cement is appropriate for use in concrete construction. A certified corrosion engineer should be consulted to review the above tests and site conditions to develop specific mitigation recommendations if metallic pipes or structural elements are designed to be in contact with or buried in soil.

10.0 RECOMMENDATIONS
The project is not located within an area of significant geologic hazards. No special measures need to be taken to mitigate geologic hazards beyond standard practices for school construction.

11.0 LIMITATIONS AND UNIFORMITY OF CONDITIONS

1. This report has been prepared for the exclusive use of the Enclave at Folsom Ranch, LLC, their clients, and their subcontractors for specific application to the proposed Folsom Plan Area Parcel 85A (Hospital Site) project and improvements. Youngdahl Consulting Group, Inc. has endeavored to comply with generally accepted engineering geology practice common to the local area. Youngdahl Consulting Group, Inc. makes no other warranty, express or implied.

2. As of the present date, the findings of this report are valid for the property studied. Over 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 three years without our review nor should it be used, or is it applicable for any properties other than those studied.

3. 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.
12.0 REFERENCES

Geologic References

- Association of Engineering Geologists, (1996): “Seismic Hazards Analysis, Southern California Earthquake Center”, AEG Short Course Notes


• Gutierrez, Carlos, I., (2011): “Preliminary Geologic Map of the Sacramento 30’ X 60’ Quadrangle, California, California Department of Conservation, California Geological Survey, Scale 1:100,000.


• Jennings, C.W., Bryant, W.A. (2010): "Fault Activity Map of California and Adjacent Areas", California Department of Conservation, Division of Mines and Geology, Geologic Data Map No. 6, Scale 1:750,000; Accompanying Text 94 pages.

• Naturally Occurring Asbestos in Eastern Sacramento County Map, prepared by the California Geological Survey and Sacramento County, undated.


• Toppozada, T.R. and D. Branum (2002): California M>=5.5 earthquakes, history, and areas


Report References

2. Grading Plans for Folsom Ranch Medical Center, prepared by McKay & Somps, Inc., dated October 2020, (Project No. 7692.P85A)
FIGURES
REFERENCE: Preliminary Geological Map of the Sacramento Quadrangle, California, California Department of Conservation, Carlos I. Gutierrez, Dated 2011
REFERENCE: Erosion Control and Overland Release Plan, Folsom Ranch Medical Center, MacKay & Somps, Job #: 7692P85A, Sheet 17 of 19, Dated October 2020; Overlaid onto Google Earth, Aerial Data Dated 9/12/2019

SITE PLAN
Folsom Plan Area 85A (Hospital Site)
Folsom, California

Approximate Scale: 1" = 200'

TP-1 = Approximate Test Pit Locations
MOB = Approximate Formation Contact

Project No.: E17053.094
November 2020
BASE MAP REF: 2007 Caltrans Deterministic PGA Map, Fault Identification Numbers (FID) Shown. September 2007, Martha Merriam, Tom Shantz, GIS by Ke Zhou, Fault Map Legend Follows On Figure 7

Scale: Kilometers

Fault Map Legend Follows On Figure 7
### Fault Map Legend

**Caltrans_2007_Active_Faults (w/ FID Labels)**

- **Surface Faults**
- **Concealed Faults**

**Peak Ground Acceleration Countours**

*PGA for sites with VS30 = 760 m/s*

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- Lat and Long
- County Boundary

### Fault Name

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<td>Bear Mountains fault zone (Swain Ravine fault zone section)</td>
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<td>Melones fault zone</td>
<td>50</td>
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<tr>
<td>Dunnigan Hills fault</td>
<td>75</td>
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<td>Bear Mountains fault zone (Spenceville fault section)</td>
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<td>Bear Mountains fault zone (Dewitt fault section)</td>
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<td>Bear Mountains fault zone (Deadman fault section)</td>
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<td>Bear Mountains fault zone (Rescue fault section)</td>
<td>83</td>
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<td>West Tahoe - Dollar Point fault</td>
<td>84</td>
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<td>Bear Mountains fault zone (Negro Jack fault section)</td>
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<td>Bear Mountains fault zone (Green Springs Run fault)</td>
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<td>Cordelia fault</td>
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<td>Bear Mountains fault zone (Bowie Flat fault section)</td>
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</tbody>
</table>

**ESTABLISHED 1984**
APPENDIX A
SOIL CORROSIVITY TESTING
To: Jeffry Cannon  
Youngdahl Consulting Group  
1234 Glenhaven Ct.  
El Dorado Hills, CA 95630

From: Gene Oliphant, Ph.D. \ Randy Horney  
General Manager \ Lab Manager

The reported analysis was requested for the following location:  
Location: E17053.094 Site ID: TP-4@3.5FT.  
Thank you for your business.

* For future reference to this analysis please use SUN # 83350-173928.

----------------------------------------
EVALUATION FOR SOIL CORROSION

Soil pH 6.39
Minimum Resistivity 3.75 ohm-cm (x1000)
Chloride 2.1 ppm 0.00021%
Sulfate 9.1 ppm 0.00091%

METHODS  
pH and Min.Resistivity CA DOT Test #643  
Sulfate CA DOT Test #417, Chloride CA DOT Test #422m
To: Jeffry Cannon  
Youngdahl Consulting Group  
1234 Glenhaven Ct.  
El Dorado Hills, CA 95630

From: Gene Oliphant, Ph.D. \ Randy Horney  
General Manager \ Lab Manager

The reported analysis was requested for the following location: 
Location : E17053.094  Site ID : TP-10@3-4FT.  
Thank you for your business.

* For future reference to this analysis please use SUN # 83350-173929.

-----------------------------------------------
EVALUATION FOR SOIL CORROSION

Soil pH  6.43

Minimum Resistivity  2.12 ohm-cm (x1000)

Chloride  2.1 ppm  00.00021 %

Sulfate  4.0 ppm  00.00040 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422m
To: Jeffry Cannon  
Youngdahl Consulting Group  
1234 Glenhaven Ct.  
El Dorado Hills, CA 95630

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

Date Reported: 11/04/2020  
Date Submitted: 10/30/2020

The reported analysis was requested for the following location:  
Location: E17053.094  Site ID: TP16@2-4+TP7@3.  
Thank you for your business.

* For future reference to this analysis please use SUN # 83363-173946.

-------------------------------------------------------------------------  
EVALUATION FOR SOIL CORROSION  
-------------------------------------------------------------------------

Soil pH: 6.61

Minimum Resistivity: 4.02 ohm-cm (x1000)

Chloride: 1.5 ppm  00.00015 %

Sulfate: 0.2 ppm  00.00002 %

METHODS
pH and Min.Resistivity CA DOT Test #643  
Sulfate CA DOT Test #417, Chloride CA DOT Test #422m
GEOTECHNICAL ENGINEERING STUDY
FOR
FOLSOM PLAN AREA PARCEL 85A (MULTI FAMILY / HOTEL SITE)
350 Placerville Road
Folsom, California

Project No. E17053.095
November 2020
Attention:    Mr. James Galovan

Subject:  FOLSOM PLAN AREA PARCEL 85A (MULTI FAMILY / HOTEL SITE)
          350 Placerville Road, Folsom, California
          GEOTECHNICAL ENGINEERING STUDY

References:
3. Refraction Seismic Investigation at the Folsom Plan Area Parcel 85A (Multi-Family/Hotel) GES Project Site, prepared by Gasch Geophysical Services, Inc., dated 14 November 2020 (GGSI No. 2020-27.01).

Dear Mr. Galovan:

In accordance with your authorization, Youngdahl Consulting Group, Inc. has prepared this geotechnical engineering study for the project site located at 350 Placerville Road in Folsom, California. The purpose of this study was to prepare a project specific geotechnical report based on existing and new information that can be incorporated into design of the proposed site. To complete this task, our firm completed a subsurface exploration program, laboratory test program, and prepared this report in accordance with the Reference 1 proposal and contract.

Based upon our observations, the geotechnical aspects of the site appear to be suitable for support of the proposed structural improvements following grading and site improvement operations provided the recommendations presented in this report are incorporated into the design and construction. Geotechnical conditions associated with site development are anticipated to include improvement for drainage controls, cuts into native soils and rock, placement of engineered fills, foundation construction, and pavement improvements.

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 the addressee of this report 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.

Reviewed by:

Matthew J. Gross, P.E., G.E.
Senior Engineer

Brandon K. Shimizu, P.E., G.E.
Senior Engineer

Distribution: PDF to Client
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GEOTECHNICAL ENGINEERING STUDY
FOR
FOLSOM PLAN AREA PARCEL 85A (MULTI FAMILY / HOTEL SITE)

1.0 INTRODUCTION
This report presents the results of our geotechnical engineering study performed for the proposed improvements planned to be constructed at 350 Placerville Road in Folsom, California. The vicinity map provided on Figure A-1, Appendix A shows the approximate project location.

Project Understanding
We understand that the project consists of the development of 3 parcels (Parcel 2, 3, and 4) located along the future Westwood Drive and Placerville Road. The buildings conditions are unknown at this time but are anticipated to be 2 to 4 stories in height and supported on conventional shallow foundations. The area surrounding the buildings is anticipated to receive flatwork improvements and parking areas. Anticipated cuts up to 40 feet are anticipated in Parcel 4 and cuts and fills on the order of 20 feet or less are anticipated to be generally used for the other parcels.

Background
Youngdahl Consulting Group, Inc. has been involved with development of Folsom Plan Area since circa 1995 with the majority of work occurring after 2007. Since this time, our firm has performed subsurface explorations, geotechnical engineering studies, environmental evaluations, and provided construction support services throughout a significant portion of the development area.

Based on a limited review of aerial photography, the site appears to have been vacant until around 2019, when Alder Creek Parkway was constructed along the south property line. A review of our records indicated that the fill materials were placed and compacted as engineered fill; however, the surface of the pile was highly disturbed at a later date in an effort to harvest boulders for rockery walls. Our firm has not observed other operations or construction services on the project site during the execution of our other services.

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.

Purpose and Scope
Youngdahl Consulting Group, Inc. has prepared this report to provide geotechnical engineering recommendations and considerations for incorporation into the design and development of the site. The recommendations provided in this report supersede those provided in the previous studies. The following scope of services were developed and performed for preparation of this report:

- A review of geotechnical and geologic data available to us at the time of our study;
- Performance of a field study consisting of a site reconnaissance and subsurface explorations to observe and characterize the subsurface conditions;
- Laboratory testing on representative samples collected during our field study;
- Evaluation of the data and information obtained from our field study, laboratory testing, and literature review for geotechnical conditions;
- Development of the following geotechnical recommendations and considerations regarding earthwork construction including, site preparation and grading, engineered fill
criteria, excavation characteristics, seasonal moisture conditions, underground improvements, and drainage;
- Development of geotechnical design criteria for code-based seismicity, foundations, retaining walls, and pavements;
- Preparation of this report summarizing our findings, conclusions, and recommendations regarding the above described information.

2.0 SITE CONDITIONS
The following section describes our findings regarding the site conditions that we observed during our site reconnaissance and subsurface explorations.

Surface Observations
The 20± acre project site is located at 350 Placerville Road in Folsom, California and is bounded by undeveloped land and East Bidwell Street to the west, a subdivision and Alder Creek Parkway to the south, rough graded parcels and Placerville Road to the east, and a freeway ramp and existing pump station to the north. The site has about 50 feet of relief with a drainage feature working its way through Parcel 3 east to west and a centrally located knoll in Parcel 4.

Subsurface Conditions
Our field study included a site reconnaissance by a representative of our firm and a subsurface exploration program. The exploration program included the excavation of 15 test pits to evaluate the near surface soils conditions. The approximate locations of the test pits are presented on Figure A-2, Appendix A.

The subsurface soils at the project site appear to be typical for the region and consist of a thin layer of soils overlying shallow rock which has weathered to various degrees. The surface soils generally composed of a blend of silts and sands in a medium stiff/dense condition. Occasional thin clay layers up to 2 feet thick which occurs about 1 to 2 feet below the existing grades where observed overlying the bedrock. Based on the observations in the test pits, it appears the clay is more likely to be present near the seepage or water sources. The underlying bedrock is generally composed of meta-andesite and slates which ranged from highly weathered to fresh.

Groundwater Conditions
Groundwater was not encountered during our explorations with the exception of near surface perched water conditions at test pit TP-8 which are located on Parcel 3. 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.

3.0 GEOTECHNICAL SOIL CHARACTERISTICS
The geotechnical soil characteristics presented in this section of the report are based on information from previous studies and observations and testing of samples collected from subsurface soils.

Laboratory Testing
Laboratory testing of the collected samples was directed towards determining the physical and engineering properties of the soil underlying the site. The results of the tests performed for this
project are presented in Appendix B. In summary, the following tests were performed for the preparation of this report:

<table>
<thead>
<tr>
<th>Laboratory Test</th>
<th>Test Standard</th>
<th>Summary of Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct Shear</td>
<td>ASTM D3080</td>
<td>TP-8 @0-1’  ( \Phi = 38.1^\circ, c = 100 \text{ psf} \text{ (90%RC)} )</td>
</tr>
<tr>
<td>Maximum Dry Density</td>
<td>ASTM D1557</td>
<td>TP-8 @0-1’  ( y_{max} = 122.3 \text{ pcf}, \omega_{opt} = 12.3 % )</td>
</tr>
<tr>
<td>Expansion Index</td>
<td>ASTM D4829</td>
<td>TP-8 @0-1’  12 (Very Low)</td>
</tr>
<tr>
<td>Resistance Value</td>
<td>ASTM CTM 301</td>
<td>TP-8 @0-1’  51</td>
</tr>
<tr>
<td>Corrosivity Suite</td>
<td>CA DOT Tests 417, 422 and 643</td>
<td>See Soil Corrosivity Section</td>
</tr>
</tbody>
</table>

### Soil Expansion Potential

Although not encountered in our test pits, intermittent or isolated pockets of highly expansive clay soils have been found in the region, typically on top of the weathered bedrock. In concentrated amounts, such clays could cause distress to concrete slab-on-grade floors and foundations if present in the upper 3 feet of the structural improvement areas. However, due to the cuts and fills associated with hillside grading activities it has been our experience that these materials, if encountered, can be sufficiently blended such that expansive soil mitigation measures may not be required. Depending on the proposed grading plans and cuts or fills in the areas where clay is encountered, some focused excavations of the clay may be required. In addition, if during the site preparation operations, the clay soils are determined to be soft and/or unstable under the weight of the construction equipment, they will require overexcavation as discussed in the recommendations section below. 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 this study.

### Soil Corrosivity

A corrosivity testing suite consisting of soil pH, resistivity, sulfate, and chloride content tests were performed on selected soil samples collected during our site exploration. We are not corrosion specialists and recommend that the results be evaluated by a qualified corrosion expert. The laboratory test results (provided by Sunland Analytical, Inc.) are provided in Appendix B and are summarized in Table 2, below.

<table>
<thead>
<tr>
<th>Location</th>
<th>Depth (ft)</th>
<th>Soil pH</th>
<th>Minimum Resistivity ohm-cm (x1000)</th>
<th>Chloride (ppm)</th>
<th>Sulfate (ppm)</th>
<th>Caltrans Environment</th>
<th>ACI Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>TP-8</td>
<td>0-1</td>
<td>5.37</td>
<td>2.90</td>
<td>1.5</td>
<td>2.5</td>
<td>Potentially-Corrosive</td>
<td>S0 (Not a Concern)</td>
</tr>
<tr>
<td>TP-14</td>
<td>0-2</td>
<td>5.67</td>
<td>3.22</td>
<td>1.3</td>
<td>3.0</td>
<td>Non-Corrosive</td>
<td>S0 (Not a Concern)</td>
</tr>
</tbody>
</table>

According to Caltrans Corrosion Guidelines Version 3.0, March 2018, the test results appear to indicate a potentially corrosive environment due to having a pH lower than 5.5. According to the 2019 California Building Code Section 1904.1 and ACI 318-14 Table 19.3.1.1, the test results indicate the onsite soils have a negligible potential for sulfide attack of concrete. A certified corrosion engineer should be consulted to review the above tests and site conditions in order to
develop specific mitigation recommendations if metallic pipes or structural elements are designed to be in contact with or buried in soil.

4.0 GEOLGY AND SEISMICITY
The geologic portion of this report includes a review of geologic data pertinent to the site based on an interpretation of our observations of the surface exposures and our observations in our explorations.

Geologic Conditions
The site is located within the Great Valley geomorphic province of California. According to the 1:250,000 scale Geologic Map of the 30'x60' Quadrangle (Gutierrez, C. I. 2011), the vicinity is mapped as Jurassic age Gopher Ridge Volcanics (map unit Jgo) and Salt Springs Slate (map unit JSS). The mapped conditions appear to be consistent with the rock types observed in our exploratory test pits.

Seismicity
Our evaluation of seismicity for the project site included reviewing existing fault maps and obtaining seismic design parameters from the USGS online calculators and databases. For the purpose of this study, we used a latitude and longitude of 38.640454, -121.110218 to identify the project site.

Alquist-Priolo Regulatory Faults
Based upon the records currently available from the California Department of Conservation, the project site is not located within an Alquist-Priolo Regulatory Review Zone and there are no known faults located at the subject site. We do not anticipate special design or construction requirements for faulting at this project site.

Code Based Seismic Criteria
Based upon the subsurface conditions encountered during our study and our experience in the area, the site may be classified as Site Class C. This is consistent with the map “A next-generation Vs30 Map for California based on geology and topography” (Wills, Gutierrez, et al 2015) developed for the California Geological Survey.

The seismic design parameters based subject latitude and longitude, the associated site class, and the USGS Seismic Design Web Service are provided in the following table. The use of more stringent design parameters is the purview of the structural engineer.
Earthquake Induced Liquefaction, Settlement, and Surface Rupture Potential
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 bedrock, the potential for seismically induced damage due to liquefaction, surface ruptures, and settlement is considered nil. For the above-mentioned reasons mitigation for these potential hazards is not considered necessary for the development of this project.

Static and Seismically 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 low.

Naturally Occurring Asbestos
The Sacramento Metropolitan Air Quality Management District (SMAQMD) is the lead agency for regulating NOA in Sacramento County, and has implemented the construction Air Toxic Control Measure (ATCM) (CCR Section 93015) for projects in East Folsom located within the metavolcanic Copper Hill and Gopher Ridge Formations. Following release of a generalized geologic map of eastern Sacramento County by the California Geologic Survey in 2006, the SMAQMD established a policy of applying the construction ATCM (CCR Section 93105) to all areas identified on the map as being underlain by rocks moderately likely to contain NOA.
The relative likelihood for the presence of NOA is considered to be least for the Salt Springs Slate, yet moderately likely for the Copper Hills, Gopher Ridge, and gabbro units. The low-grade, greenschist facies regional metamorphism, with hydrothermal alteration is characteristic of NOA containing rocks of this region. Trace levels of asbestos (less than 0.25\% as measured by California Air Resources Board Test Method 435) are not uncommon in the Folsom area north of US50 but has been rare in all testing completed to date by Youngdahl south of US50.

5.0 DISCUSSION AND CONCLUSIONS
Based upon the results of our field explorations, findings, and analysis described above, 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, specifications, and implemented during construction. The on-site soils, once processed and compacted as recommended below, may be considered “engineered” and suitable for support of the planned improvements.

Geotechnical Considerations for Development
The project site is generally comprised of a thin layer of soils over shallow rock which is considered suitable for support of the proposed improvements. Generally, issues associated with development on similar sites are associated with the excavation of shallow rock and the presence of seepage at the soil to rock contact. Project sites with similar conditions, are generally developed by addressing existing drainage features through the installation of a canyon drain followed by mass grading operations to construct a suitable building pad. Based on the results of the Reference 3 document (included in Appendix D) some blasting operations are anticipated to achieve the target grading configuration presented in the Reference 2 plans.

Additionally, buildings spanning across transition lines (e.g. rock to soil, or native soils to engineered fills) may be more prone to differential settlements compared to sites built on relatively flat lots. We anticipate that the proposed buildings may be supported by native soils or rock and engineered fills on the order of 15 feet. For these conditions, we have included the comments below. The geotechnical recommendations for this project are presented in the following sections.

- This report includes a recommendation for compaction of engineered fills to 95 percent and a minimum of 18 inches of embedment for foundations to reduce the potential for differential settlement.
- Improvements constructed below slopes may be more subject to seepage and poor drainage. Special attention should be given to configuring the landscaping to drain away from the foundation and how underground utilities are configured to prevent water migrating through the trench becoming impounded against the foundation. The installation of a subdrain along the building is anticipated to provide increased protection against unwanted water conditions.
- Due to the strength of rock, it may be difficult to excavate utilities where the utility line penetrates the underlying rock. Consideration may be given to pre-excavating utility alignments during the building pad grading when larger equipment could be used and there is more site access. Some sites with shallow rock overexcavate the rock approximately 2 feet from finish grade during grading to improve future foundation construction, landscape performance and utility installations.

6.0 SITE GRADING AND EARTHWORK IMPROVEMENTS
Soil Moisture Considerations
The compaction of soil to a desired relative compaction is dependent on conditioning the soil to a target range of moisture content. Moisture contents that are excessively dry or wet could limit the
ability of the contractor to compact soils to the requirements for engineered fill. When dry, moisture should be added to the soil and the soils blended to improve consistency. Wet soil will need to be dried to become compactable. Generally, this includes blending and working the soil to avoid trapping moisture below a dryer surficial crust. Other options are available to reduce the time involved but typically have higher costs and require more evaluation prior to implementation.

The largest contributor to excessive soil moisture is generally precipitation and seepage during the rainy season. In recognition of this, 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.

**Excavation Characteristics**

Based on our experience with the bedrock conditions on the project site, we anticipate that 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.

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. Based on the Refraction Seismic Investigation findings (Appendix D), blasting is anticipated to achieve some of the design grade elevations.

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.

**Site Preparation**

Preparation of the project site should involve, site drainage controls, dust control, clearing and stripping, expansive clay mitigation, overexcavation and remcompaction of loose/soft/saturated soils, and exposed grade compaction considerations. The following paragraphs state our geotechnical comments and recommendations concerning site preparation.

Our recommendations are based on limited windows into the subsurface and interpretations thereof; therefore, a representative of our firm should be present during site clearing operations to identify the location and depth of potential fills or loose soils, some of which may not have been found during our evaluation. We should also be present to observe removal of deleterious materials, and to identify any existing site conditions which may require mitigation or further recommendations prior to site development.

**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. The implementation of stormwater controls is the purview of the grading contractor.

Swales and natural hillside drainage proposed to receive engineered fill may require the installation of canyon style drains (similar to Figure C-1, Appendix C) to mitigate for potential subsurface waters. Close coordination between the design professionals for placement and discharge of canyon style drains should be performed. Based on the Reference 2 plans, some of these features appear to have been incorporated into the civil planning at this current stage.

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) and Airborne Toxic Control Measure (ATCM) requirements. Dust control is the purview of the grading contractor.

Clearing and Striping of Organic Materials
Clearing and stripping operations should include the removal of all organic laden materials including trees, bushes, root balls, root systems, and any soft or loose soil generated by the removal operations. 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.** Preserved trees may require tree root protection which should be addressed on an individual basis by a qualified arborist.

Expansive Clay Mitigation
Potentially expansive clays should be mixed thoroughly with less expansive on-site materials (sils, sands, and gravels) and should not be present in concentration in pavement areas or within 5 feet of the building envelope, either vertically or laterally where grading is performed. Proper disposition of clays on site should be documented by a representative of Youngdahl Consulting Group, Inc. Any final determination of mitigation measures should be based on the conditions observed during grading.

Overexcavation and Recompaction of Loose/Soft/Saturated Soils
Following general site clearing, all loose/soft or saturated soils (native or existing non-engineered fills) within the development footprint should be overexcavated down to firm native materials or engineered fills then backfilled with engineered fill as detailed in the engineered fill section below. This includes the surface of the stockpile that was observed to have been harvested of rocks for rockery walls. Any depressions extending below final grade resulting from the removal of fill materials or other deleterious materials should be properly prepared as discussed below and backfilled with engineered fill.

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. Generally, where bedrock conditions are exposed, no scarification should be necessary; however, these surfaces may be moisture conditioned and compacted to mitigate disturbance resulting from site preparation. Prior to placing fill, the exposed grades should be in
a firm and unyielding state. Any localized zones of soft or pumping soils observed within the exposed grade should either be scarified and recompacted or be overexcavated and replaced with engineered fill as detailed in the engineered fill section below.

**Engineered Fill Criteria**
All 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**
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 the maximum size specifications listed below.

Rock fragments or boulders exceeding 24 inches in maximum dimension should not be placed within the upper five feet of site grades or utility corridors. The upper two feet of the site grades and within the zone of proposed underground facilities should consist of predominantly rocks and rock fragments less than 12 inches in maximum dimension. Boulders over 24 inches in maximum dimension should be placed within the deeper portions of fill embankments below a depth of 5 feet and a minimum of 5 feet from the finish slope face. The individual boulders should be spaced such that compaction of finer rock and soil materials between the boulders can be achieved with the equipment being used for compaction. Materials placed between the boulders should consist of predominantly soil and rock less than 12 inches in maximum dimension. The soil/rock mixture should be thoroughly mixed and placed between the boulders so as to preclude nesting or the formation of voids. Should insufficient deep fill areas exist for oversize rock disposal, the contractor should either dispose of the excess materials to an offsite location or mechanically reduce the rocks to less than 12 inches.

**Compaction Equipment**
Due to the significant quantity of rock materials that will comprise a majority of the fills on the project site, a Caterpillar 825 steel-wheel compactor or approved equivalent should be employed as a minimum to facilitate breakdown of oversize bedrock materials and generation of soil fines during the fill placement process. If the quantity of rock fragments in the fills preclude traditional compaction testing, then the proposed fills should be compacted using method specifications as indicated below.

In focused or isolated areas where significant rock quantities will not be present, we anticipate that a large vibratory padded drum compactor or approved equivalent will be capable of achieving the compaction requirements for engineered fill provided the soil is placed and compacted within 0 to 3 percent over the optimum moisture content as determined by the ASTM D1557 test method and in lifts not greater than 12 inches in uncompacted thickness. The use of handheld equipment such as jumping jack or plate vibration compactors may require thinner lifts of 6 inches or less to achieve the desired relative compaction parameters.

**Fill Placement and Compaction**
Engineered fills should be placed in thin horizontal lifts not to exceed 12 inches in uncompacted thickness. If the contractor can achieve the recommended relative 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 recommended relative compaction.
Table 4: Recommended Relative Compaction

<table>
<thead>
<tr>
<th>Fill Materials</th>
<th>Relative Compaction</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineered Fill</td>
<td>95 percent</td>
<td>ASTM D1557</td>
</tr>
<tr>
<td>Utility Trench Backfill*</td>
<td>95 percent</td>
<td>ASTM D1557</td>
</tr>
<tr>
<td>Subgrade</td>
<td>95 percent</td>
<td>ASTM D1557</td>
</tr>
<tr>
<td>Aggregate Baserock Grade</td>
<td>95 percent</td>
<td>ASTM D1557</td>
</tr>
<tr>
<td>Asphalt Concrete Pavement</td>
<td>92 to 96 percent</td>
<td>ASTM D2041 or CTM 309</td>
</tr>
</tbody>
</table>

* Unless otherwise noted by the governing agency.

Our firm should be requested for consultation, observation, and testing for the earthwork operations prior to the placement of any fills. 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 evaluated as earthwork progresses. If performed, method specification methods will likely include the excavation of test pits within the fill materials to observe and document that a uniform over-optimum moisture condition, and absence of large and/or concentrated voids has been achieved prior to additional fill placement.

Method Specification

Soils exceeding 30 percent rock by mass may be considered non-testable by conventional methods. The materials may be placed as engineered fill if placed in accordance with the following method specification during full time observation by a representative of our firm.

Soils should be moisture conditioned and compacted in place by a minimum of six completely covering passes with a Caterpillar 825, or approved equivalent. The compactor’s last three passes should be at 90 degrees to the initial passes. Engineered fill should be constructed in lifts not exceeding 12 inches in uncompacted thickness, moisture conditioned and compacted in accordance with the above specification. Additional passes as deemed necessary during fill placement to achieve the desired condition based upon field conditions may be recommended.

Import Materials

The recommendations presented in this report are based on the assumption that the import materials will be similar to the materials present at the project site. High quality materials are preferred for import; however, these materials can be more dependent on source availability. Import material should be approved by our firm prior to transporting it to the project site.

Material for this project should consist of a material with the geotechnical characteristics presented below. 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.
Table 5: Select Import Criteria

<table>
<thead>
<tr>
<th>Behavior Property</th>
<th>Reference Document</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct Shear Strength</td>
<td>ASTM D3080</td>
<td>≥ 34° when compacted</td>
</tr>
<tr>
<td>Plasticity Index</td>
<td>ASTM D4318</td>
<td>≤ 12</td>
</tr>
<tr>
<td>Expansion Index</td>
<td>ASTM D4829</td>
<td>≤ 20</td>
</tr>
<tr>
<td>Sieve Analysis</td>
<td>ASTM D1140</td>
<td>Not more than 30% Passing the No.200 sieve Rocks ≤ 6 inches in diameter</td>
</tr>
<tr>
<td>Resistance Value</td>
<td>CTM 301</td>
<td>≥ 35</td>
</tr>
</tbody>
</table>

Slope Configuration and Grading
The project site is proposed to 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 2 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 6 feet horizontally into firm soils or 4 feet into bedrock 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 C-2 in Appendix C 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.

Detention Basin Embankment Construction
The following sections outline geotechnically related design and construction recommendations for the proposed embankments.

Keyway and Foundation Configuration
The keyway should extend 1 foot minimum into the underlying bedrock along the centerline of the embankment. The width of the keyway should be a minimum of 10 feet wide.
Slope Configuration
We recommend that the embankment configuration have a downstream or outside slope of no steeper than 2H:1V with an upstream or inside slope no steeper than 3H:1V. The slope face should be otherwise constructed in accordance with the recommendations provided in the Slope Configuration and Grading Section of this report.

Embankment Penetrations
We understand that the proposed embankments at the project site are planned to contain underground utilities and outlet pipes. Where drainage structures exit the basin, a plug of controlled low strength materials (CLSM) should be placed as backfill to reduce the potential for seepage and piping which could impact the stability of the embankment. The contractor should employ measures to prevent the pipe from floating during the slurry placement procedures.

Underground Improvements

Trench Excavation
Trenches or excavations in soil should be shored or sloped back in accordance with current Cal/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 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 site 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 or to the recommendations of this report, whichever is greater. Where backfill compaction is not specified by the local jurisdiction, the backfill should be compacted to achieve the minimum relative compactions specified above.

Exposure to Water
The configuration of a trench increases the likelihood that the trench may be exposed to or retain water. The presence of water can adversely impact the performance of the trench by increasing the potential for the transmission of water to undesired outlets and settlement, even when compacted to the requirements of engineered fill. The contractor should consider these
conditions when managing water during interim and post construction periods. This topic is discussed further in the Drainage section of this report.

7.0 DESIGN RECOMMENDATIONS

The contents of this section include recommendations for foundations, pavements, and drainage.

Shallow Conventional Foundations

Shallow conventional foundation systems are considered suitable for construction of the planned improvements, provided that the site is prepared in accordance with the recommendations discussed in Section 6.0 of this report.

The provided values do not constitute a structural design of foundations which should be performed by the structural engineer. In addition to the provided recommendations, foundation design and construction should conform to applicable sections of the 2019 California Building Code.

Foundation Capacities

The foundation bearing and lateral capacities are presented in the table below. The allowable bearing capacity is for support of dead plus live loads based on the foundation configuration presented in this report. The allowable capacity may be increased by 1/3 for short-term wind and seismic loads. Lateral forces on structures may be resisted by passive pressure acting against the sides of shallow footings and/or friction between the foundation bearing material and the bottom of the footing. Section 1806.3 of the 2019 CBC allows for the combination of the friction factor and passive resistance value to lateral resistance. Consideration should be given to ignoring passive resistance where soils could be disturbed later or within 6 feet horizontally of the slope face.

<table>
<thead>
<tr>
<th>Soil Type</th>
<th>Design Condition</th>
<th>Design Value</th>
<th>Applied Factor of Safety</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineered Fill or Firm Native Soil</td>
<td>Allowable Bearing Capacity</td>
<td>2,500 psf</td>
<td>3.0</td>
</tr>
<tr>
<td></td>
<td>Allowable Fiction Factor*</td>
<td>0.45</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td>Allowable Passive Resistance</td>
<td>315 psf/ft</td>
<td>1.5</td>
</tr>
<tr>
<td>Rock</td>
<td>Allowable Bearing Capacity</td>
<td>4,000 psf</td>
<td>3.0</td>
</tr>
<tr>
<td></td>
<td>Allowable Fiction Factor</td>
<td>0.50</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td>Allowable Passive Resistance*</td>
<td>360 psf/ft</td>
<td>1.5</td>
</tr>
</tbody>
</table>

* Friction Factor is calculated as tan(ϕ)

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 for up to two stories. The footings should be increased to 12 inches wide and founded a minimum of 24 inches below the lowest adjacent soil grade for three- and four-story buildings. Isolated pad foundations should be a minimum of 24 inches in plan dimension.

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.

Foundation Settlement
For design purposes, a total settlement of less than 1 inch may anticipated with a differential settlement of 0.5 inches in 25 feet where foundations are bearing on like materials. The settlement criteria are based upon the assumption that foundations will be sized and loaded in accordance with the recommendations in this report.

Foundation Influence Line and Slope Setback
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 the criteria for engineered fill as recommended in Section 6.0 of this report.

Retaining Walls
Our design recommendations and comments regarding retaining walls for the project site are discussed below. Retaining wall foundations should be designed in accordance with the Shallow Conventional Foundations section above.

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 the table below. The values presented below are not factored and are for conditions when firm native soil or engineered fill is used within the zone behind the wall defined as twice the height of the retaining wall. Additionally, the values do not account for the friction of the backfill on the retaining wall which may or may not be present depending on the wall materials and construction.

The lateral pressures presented in the table below include recommendations for earthquake loading which is required for structures to be designed in Seismic Design Categories D, E or F per Section 1803.5.12.1 of the 2019 California Building Code states. The lateral pressures presented have been calculated using the Mononobe-Okabe Method derived from Wood (1973) and modified by Whitman et al. (1991)). The values are intended to be used as the multiplier for uniformly distributed loads and the parameter “H” is the total height of the wall including the footing but excluding any key, if used.
Table 7: Retaining Wall Pressures

<table>
<thead>
<tr>
<th>Wall Type</th>
<th>Wall Slope Configuration</th>
<th>Equivalent Fluid Weight (pcf)</th>
<th>Lateral Pressure Coefficient</th>
<th>Earthquake Loading (pf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Free Cantilever</td>
<td>Flat</td>
<td>38</td>
<td>0.28</td>
<td>4H^2</td>
</tr>
<tr>
<td></td>
<td>2H:1V</td>
<td>56</td>
<td>0.42</td>
<td>15H^2</td>
</tr>
<tr>
<td>Restrained*</td>
<td>Flat</td>
<td>60</td>
<td>0.44</td>
<td></td>
</tr>
</tbody>
</table>

* 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.

Generalized Design Values
Some software and design methods do not use the equivalent fluid weight method presented above; instead they use design soil properties for a given soil condition such as the internal friction angle, cohesion, and bulk unit weight. Generally, this occurs for keyed or interlocking non-mortared walls such as segmental block (Basalite, Keystone, Allan Block, etc.) or rockey walls. When this occurs, the following soil parameters would be applicable for design with the onsite native materials in a firm condition or for engineered fills. The seismic coefficient is considered to be ½ of the adjusted peak ground acceleration for the site conditions is given in Section 4.0 of this report. Some software allows for the extension of the Mononobe-Okabe Method beyond the conventional limitations and, if the method is applied, could calculate seismic values significantly higher than those provided by the multiplier method provided above.

Table 8: Generalized Design Parameters

<table>
<thead>
<tr>
<th>Internal Angle of Friction</th>
<th>Cohesion</th>
<th>Bulk Unit Weight</th>
<th>Seismic Coefficient, Kh</th>
</tr>
</thead>
<tbody>
<tr>
<td>34°</td>
<td>0 psf</td>
<td>135 psf</td>
<td>0.11g</td>
</tr>
</tbody>
</table>

Wall Drainage
The criteria presented above is based on fully drained conditions as detailed in the attached Figure C-3, Appendix C. For these conditions, we recommend that a blanket of filter material be placed behind all proposed walls. The filter material should conform to Class 1, Type B permeable material in combination with a filter fabric to separate the open graded gravel/rock from the surrounding soils. Generally, a clean ¾ inch crushed rock should be acceptable. Consistent with Caltrans Standards, when Class 2 permeable materials are used, the filter fabric may be omitted unless otherwise designed. Permeable materials are specified in Section 68 of the California Department of Transportation Standard Specifications, current edition.

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 top 12 inches of wall backfill should consist of a compacted soil cap. A filter fabric having specifications equal to or greater than those for Mirafi 140N should be placed between the gravel filter material and the surrounding soils to reduce the potential for infiltration of soil into the gravel. 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 building 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 floor 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 design, curing procedures, 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 Section 6.0 of this report.

**Slab Underlayment**

As a minimum for slab support conditions, the slab should be underlain by a minimum 4-inch thick crushed rock layer that is covered by a minimum 10-mil moisture retarding plastic 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.

An optional 1-inch blotter sand layer placed above the plastic membrane, is sometimes used to aid in curing of the concrete. Although historically common, this blotter layer is not currently included in slabs designed according to the 2019 Green Building Code. When omitted, special wet curing procedures will be necessary. If installed, 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.

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.

**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 standalone 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 and 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 preliminary design of concrete floors, a modulus of subgrade reaction of \( k = 150 \text{ psi per inch} \) would be applicable for engineered fills.

**Exterior Flatwork**

Exterior concrete flatwork is recommended to have a 4-inch thick 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 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.

**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.

**Relative Compaction**

The asphalt concrete pavement section should be constructed to achieve the minimum relative compactions specified in Section 6.0 of this report. Deviation from the following table should be reviewed by the governing agency when the pavements are to be constructed within their right-of-way. Final acceptance of the constructed pavement section is the purview of the governing agency or owner of the site.

**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.

**Subgrade Resistance Value**

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).
Laboratory testing was performed on a bulk sample considered to be representative of the materials expected to be exposed at subgrade. The tested soil had an R-Value of 51. To account for the variability of materials, have used and R-Value of 35 for the pavement sections this report.

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.

Due to the redistribution of materials that occurs during grading operations, we should review pavement subgrades to determine the appropriateness of the provided sections.

Section Thickness
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>
<th>Aggregate Base **</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Asphalt Concrete *</td>
<td></td>
</tr>
<tr>
<td>5.0</td>
<td>3.0</td>
<td>4.5</td>
</tr>
<tr>
<td>6.0</td>
<td>3.0</td>
<td>7.5</td>
</tr>
<tr>
<td></td>
<td>3.5</td>
<td>6.5</td>
</tr>
<tr>
<td>6.5</td>
<td>3.5</td>
<td>8.0</td>
</tr>
<tr>
<td></td>
<td>4.0</td>
<td>7.0</td>
</tr>
<tr>
<td>7.0</td>
<td>4.0</td>
<td>8.5</td>
</tr>
<tr>
<td></td>
<td>4.5</td>
<td>7.5</td>
</tr>
<tr>
<td>8.0</td>
<td>4.5</td>
<td>10.0</td>
</tr>
<tr>
<td></td>
<td>5.0</td>
<td>9.5</td>
</tr>
<tr>
<td>9.0</td>
<td>5.5</td>
<td>11.0</td>
</tr>
<tr>
<td></td>
<td>6.0</td>
<td>10.5</td>
</tr>
<tr>
<td>10.0</td>
<td>5.0</td>
<td>15.0</td>
</tr>
<tr>
<td></td>
<td>6.0</td>
<td>13.0</td>
</tr>
<tr>
<td></td>
<td>7.0</td>
<td>11.0</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)

Portland Cement Concrete Pavement Design
We understand that Portland cement concrete pavements may be considered for various aspects of the parking and drive access areas. The American Concrete Institute (ACI) Concrete Pavement Design method (ACI 330R-08) was used for design of the exterior concrete (rigid) pavements at the site.

Relative Compaction
The asphalt concrete pavement section should be constructed to achieve the minimum relative compactions specified in Section 6.0 of this report. Deviation from the following table should be
reviewed by the governing agency when the pavements are to be constructed within their right-of-way. Final acceptance of the constructed pavement section is the purview of the governing agency.

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.

Soil Design Parameters
The pavement thicknesses were evaluated based on the soil design parameters provided in the following table.

<table>
<thead>
<tr>
<th>Subgrade Soil Description</th>
<th>k, Modulus of Subgrade Reaction*</th>
<th>Base Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silty SAND</td>
<td>150 pci</td>
<td>6 inches</td>
</tr>
</tbody>
</table>

* Based on an R-Value of 35 as recommended above and correlated to a k-Value recommended by ACI 330R.

Section Thickness
Based on the subgrade soil parameters shown in the above table, the recommended concrete thicknesses for various traffic descriptions are presented in the table below. The recommended thicknesses provided below assume the use of plain (non-reinforced) concrete pavements.

<table>
<thead>
<tr>
<th>Category</th>
<th>ADTT¹</th>
<th>Pavement Traffic Description</th>
<th>Thickness (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>3000 psi²</td>
</tr>
<tr>
<td>A</td>
<td>1</td>
<td>Car parking areas and access lanes Autos, picking, and panel trucks only</td>
<td>4.5</td>
</tr>
<tr>
<td>A</td>
<td>10</td>
<td>Shopping center entrance and service lanes Bus parking areas and interior lanes</td>
<td>5.0</td>
</tr>
<tr>
<td>B</td>
<td>25</td>
<td>Single-unit truck parking areas and interior lanes</td>
<td>6.0</td>
</tr>
<tr>
<td>B</td>
<td>300</td>
<td>Roadway Entrances and Exterior Lanes</td>
<td>6.5</td>
</tr>
<tr>
<td>C</td>
<td>100</td>
<td></td>
<td>7.0</td>
</tr>
<tr>
<td>C</td>
<td>300</td>
<td></td>
<td>7.0</td>
</tr>
<tr>
<td>C</td>
<td>700</td>
<td></td>
<td>8.0</td>
</tr>
</tbody>
</table>

* Average Daily Truck Traffic
** 28-day concrete compressive strength

Jointing and Reinforcement
From a geotechnical perspective, contraction joints should be placed in accordance with the American Concrete Institute (ACI) recommendations which include providing a joint spacing about 30 times the slab thickness up to a maximum of 10 feet. The joint patterns should also divide the slab into nearly square panels. If increased joint spacing is desired, reinforcing steel should be installed within the pavement in accordance with ACI recommendations. Final determination of steel reinforcement configurations (if used within the pavements) remains the purview of the Project Structural Engineer.

Drainage
In order to maintain the engineering strength characteristics of the soil presented for use in this report, maintenance of the site 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; 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; proper design and maintenance of landscaping and drainage facilities.

**Drainage Adjacent to Buildings**

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 2019 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
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. 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 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 are which do not meet building code requirements.

Subdrainage
Reduction of potential moisture related issues could be addressed by the construction of subdrains in addition to the drainage provisions provided in the 2019 CBC. Considering that this site is down sloping from the road (future Westwood Drive) and has shallow rock conditions, a subdrain should be considered along the uphill of the buildings to collect and redirect unwanted water from the structure.

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 C-4, Appendix C. 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. Our firm could provide additional recommendations during a plan review of the civil plans for building grading.

Subsurface Water within Utilities
Water can become perched on the relatively impermeable rock horizons and eventually inundate utility trench backfill. The variable support condition between native soils and compacted trench backfill materials, coupled with prolonged water exposure can lead to subsidence of trench backfill materials, especially if bridging of trench backfill occurs during placement or natural jetting of soils into voids around pipes occurs. Joint utility trenches are generally more susceptible to the jetting issues due to the quantity of pipe placed in the trench. Recommendations to reduce the risk associated with this condition may be provided based on observed field conditions.

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 can become collection points for subsurface water and typically provide a conduit for water distribution. Provisions may be necessary to mitigate adverse effects of perched water conditions. Where this condition arises, we recommend plug and drains within the utility trenches (Figure C-5, Appendix C) 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. As the observed site conditions dictate,
representatives from our firm, the contractor, City of Folsom representative, and the civil 
engineer should coordinate the locations of plug and drains.

Roadway or Parking Area Landscaping Drainage
Prolonged water seepage into pavement sections can result in softening of subgrade soils and 
subsequent pavement distress. It is anticipated that heavy landscape watering could enter and 
pond within the aggregate base section as it permeates through the aggregate base under the 
sidewalks and/or curbs. Prolonged seepage within the pavement section could cause distress to 
pavements in heavy traffic areas. Some measures that can be employed to minimize the 
saturation of the subgrade and aggregate base materials include, but are not limited to, 
construction of cut-off drains or moisture barriers alongside the roadway adjacent to the roadway 
interface, construction of subdrains within landscape medians and installation of plug and drain 
systems within utility trenches. Due to the elusive and discontinuous nature of drainage related 
issues, a risk-based approach should be determined by the developer based on consultation and 
discussions with the design professionals and the amount of protection of facilities that the 
developer may want to provide against potential moisture related issues.

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 could contribute to 
misleading related problems and/or cause distress to foundations and slabs, pavements, and 
underground utilities, as well as creating a nuisance where seepage occurs.

8.0 LOW IMPACT DEVELOPMENT STANDARDS
Low Impact Development or LID standards have become a consideration for many projects in the 
region. LID standards are intended to address and mitigate urban storm water quality concerns. 
These methods include the use of Source Controls, Run-off Reduction and Treatment Controls. 
For the purpose of this report use of Run-off Reduction measures and some Treatment Controls 
may impact geotechnical recommendations for the project.

Hydrologic Soil Group
A review of soil survey and the data collected from test pits indicate that soils within the project 
are Hydrologic Soil Group D (very slow infiltration). Use of any LID measure that would require 
infiltration of discharge water to surfaces adjacent to structures/pavement or include infiltration 
type measures should be reviewed by Youngdahl Consulting Group, Inc. during the design 
process.

Infiltration and Retention Basins
The introduction of water to soils adjacent to structures could increase the potential for 
undesirable effects such as settlement, high floor moisture, and pavement distress. For this 
reason, we recommend that infiltration trenches and basins are kept a minimum of 30 feet from a 
proposed structure unless they are lined with a 30-mil HDPE membrane to prevent the 
concentration of water into the subsurface soils at the structure. Further recommendations may 
be provided based on future civil plans for the project site.

9.0 DESIGN REVIEW AND CONSTRUCTION MONITORING
Geotechnical engineering can be affected by natural variability of soils and, as with many projects, 
the contents of this report could be used and interpreted by many design professionals for the 
application and development of their plans. For these reasons, we recommend that our firm
provide support through plan reviews and construction monitoring to aid in the production of a successful project.

**Plan Review**
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 interpreted and incorporated into the project plans and specifications. Modifications to the recommendations provided in this report or to the design may be necessary at the time of our review based on the proposed plans.

**Construction Monitoring**
Construction monitoring is a continuation of geotechnical engineering to confirm or enhance 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, overexcavation of loose/soft or saturated soils and existing fills, and provide consultation, observation, and testing services to the grading contractor in the field. At a minimum, Youngdahl Consulting Group, Inc. should be retained to provide services listed in Table 12 below.

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.

**10.0 LIMITATIONS AND UNIFORMITY OF CONDITIONS**
1. This report has been prepared for the exclusive use of the addressee of this report for specific application to this project. The addressee may provide their consultants authorized use of this report. 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 2019 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.
<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Recommended</th>
<th>Not Anticipated</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Provide foundation design parameters</td>
<td>Included</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Review grading plans and specifications</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Review foundation plans and specifications</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Observe and provide recommendations regarding demolition</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Observe and provide recommendations regarding site stripping</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Observe and provide recommendations on moisture conditioning removal, and/or recompaction of unsuitable existing soils</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Observe and provide recommendations on the installation of subdrain facilities</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Observe and provide testing services on fill areas and/or imported fill materials</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Review as-graded plans and provide additional foundation recommendations, if necessary</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Observe and provide compaction tests on storm drains, water lines and utility trenches</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Observe foundation excavations and provide supplemental recommendations, if necessary, prior to placing concrete</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>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</td>
<td>Provide design parameters for retaining walls</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Provide finish grading and drainage recommendations</td>
<td>Included</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Provide geologic observations and recommendations for keyway excavations and cut slopes during grading</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>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
Logs of Exploratory Test Pits
Soil Classification Chart and Log Exploration
Introduction
The contents of this appendix shall be integrated with the geotechnical engineering study of which it is a part. They shall not be used in whole or in part as a sole source for information or recommendations regarding the subject site.

Our recent field study included a site reconnaissance by a Youngdahl Consulting Group, Inc. representative followed by a subsurface exploration program conducted on 22 and 23 October 2020, which included the excavation of 15 test pits under his direction at the approximate locations shown on Figure A-2, this Appendix. Excavation of the test pits was accomplished with a CAT 430F backhoe equipped with a 24-inch-wide bucket. The bulk and bag samples collected from the test pits returned to our laboratory for further examination and testing.

The Exploratory Test Pit Logs describe the vertical sequence of soils and materials encountered in each test pit, based primarily on our field classifications and supported by our subsequent laboratory examination and testing. Where a soil contact was observed to be gradual, our logs indicate the average contact depth. Our logs also graphically indicate the sample type, sample number, and approximate depth of each soil sample obtained from the test pits.

The soils encountered were logged during this and a previous excavation and provide the basis for the "Logs of Test Pits", Figures A-3 through A-18, this Appendix. These logs show a graphic representation of the soil profile, the location, and depths at which samples were collected.
<table>
<thead>
<tr>
<th>Depth (Feet)</th>
<th>Geotechnical Description &amp; Unified Soil Classification</th>
<th>Sample</th>
<th>Tests &amp; Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>@ 0' - 1.5'</td>
<td>Red brown sandy SILT (ML), moderately cemented, medium stiff, dry (NATIVE)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 1.5' - 4'</td>
<td>Olive green meta-andesite BEDROCK, completely weathered, soft, moist</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 4' - 5'</td>
<td>Grades olive brown, moderately weathered, closely fractured, hard, with manganese oxide and iron oxide staining</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Test pit terminated at 5'
No free groundwater encountered
No caving noted

---

**Note:** The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations. Note, too, that the passage of time may affect conditions at the sampling locations.
<table>
<thead>
<tr>
<th>Depth (Feet)</th>
<th>Geotechnical Description &amp; Unified Soil Classification</th>
<th>Sample</th>
<th>Tests &amp; Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>@ 0' - 0.75'</td>
<td>Light brown sandy <strong>SILT (ML)</strong>, soft, dry (NATIVE)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 0.75' - 3'</td>
<td>Olive grey meta-andesite <strong>BEDROCK</strong>, moderately weathered, closely fractured, hard</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 3' - 4'</td>
<td>Grades brown and red, fresh, close clay filled fractures, very hard</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Test pit terminated at 4'
No free groundwater encountered
No caving noted

---

**Note:** The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations. Note, too, that the passage of time may affect conditions at the sampling locations.
<table>
<thead>
<tr>
<th>Depth (Feet)</th>
<th>Geotechnical Description &amp; Unified Soil Classification</th>
<th>Sample</th>
<th>Tests &amp; Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>@ 0' - 1'</td>
<td>Yellow brown sandy SILT (ML) with cobbles, rounded, soft, dry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 1' - 2'</td>
<td>Red brown slate BEDROCK, completely weathered, soft, dry (Salt Springs Slate)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 2' - 6'</td>
<td>Grades olive, completely to highly weathered, moderately soft</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 6' - 9'</td>
<td>Grades moderately hard</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 9' - 9.25'</td>
<td>Grades hard</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Test pit terminated at 9.25'</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No free groundwater encountered</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No caving noted</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations, Note, too, that the passage of time may affect conditions at the sampling locations.
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<thead>
<tr>
<th>Depth (Feet)</th>
<th>Geotechnical Description &amp; Unified Soil Classification</th>
<th>Sample</th>
<th>Tests &amp; Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>@ 0' - 1'</td>
<td>Yellow brown sandy SILT (ML) with gravel, medium stiff, dry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 1' - 2.5'</td>
<td>Red brown slate BEDROCK, highly weathered, closely fractured, moderately hard (Salt Springs Slate)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 2.5' - 4'</td>
<td>Grades olive grey</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 4' - 6'</td>
<td>Grades slightly weathered, hard</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Test pit terminated at 6'
No free groundwater encountered
No caving noted

Note: The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations. Note, too, that the passage of time may affect conditions at the sampling locations.
<table>
<thead>
<tr>
<th>Depth (Feet)</th>
<th>Geotechnical Description &amp; Unified Soil Classification</th>
<th>Sample</th>
<th>Tests &amp; Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>@ 0' - 1'</td>
<td>Light brown grey sandy <strong>SILT (ML)</strong>, soft, dry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 1' - 8'</td>
<td>Olive grey slate <strong>BEDROCK</strong>, moderately weathered, closely fractured, moderately hard to hard (Salt Springs Slate)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 8' - 9'</td>
<td>Grades slightly weathered, hard, slightly moist</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Test pit terminated at 9'</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No free groundwater encountered</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No caving noted</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note:** The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations. Note, too, that the passage of time may affect conditions at the sampling locations.
### Depth (Feet)

<table>
<thead>
<tr>
<th>Depth (Feet)</th>
<th>Geotechnical Description &amp; Unified Soil Classification</th>
<th>Sample</th>
<th>Tests &amp; Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>@ 0' - 1.25'</td>
<td>Olive yellow sandy SILT (ML), soft, dry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 1.25' - 4'</td>
<td>Pale olive and yellow brown slate BEDROCK, highly weathered, closely to very closely fractured, soft, dry (Salt Springs Slate)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 4' - 8.5'</td>
<td>Grades olive grey, moderately soft</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 8.5' - 11'</td>
<td>Grades moderately hard</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 11' - 11.5'</td>
<td>Grades hard</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Test pit terminated at 11.5'
- No free groundwater encountered
- No caving noted

---

**Diagram:**

- **ML**
- **BEDROCK**

**Scale:** 1" = 4 Feet

---

**Note:** The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations. Note, too, that the passage of time may affect conditions at the sampling locations.
<table>
<thead>
<tr>
<th>Depth (Feet)</th>
<th>Geotechnical Description &amp; Unified Soil Classification</th>
<th>Sample</th>
<th>Tests &amp; Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>@ 0' - 0.5'</td>
<td>Olive yellow sandy SILT (ML) with gravel, soft, dry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 0.5' - 5'</td>
<td>Blue grey and olive slate BEDROCK, highly weathered, moderately soft, dry (Salt Springs Slate)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 5' - 5.5'</td>
<td>Grades olive and mottled orange, with gravel, slightly moist, with interbedded clay</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 5.5' - 6.5'</td>
<td>Grades grey and olive grey, very hard</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Test pit terminated at 6.5'  
No free groundwater encountered  
No caving noted

Note: The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations, Note, too, that the passage of time may affect conditions at the sampling locations.

Scale: 1" = 4 Feet

EXPLORATORY TEST PIT LOG  
Folsom Plan Area 85A  
(Multi Family / Hotel Site) GES  
Folsom, California

FIGURE A-9
<table>
<thead>
<tr>
<th>Depth (Feet)</th>
<th>Geotechnical Description &amp; Unified Soil Classification</th>
<th>Sample</th>
<th>Tests &amp; Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>@ 0' - 2'</td>
<td>Dark red gravelly SAND (SP) with silt, medium dense, slightly moist</td>
<td>TP-8</td>
<td>TP-8 @ 0-1'</td>
</tr>
<tr>
<td>@ 2' - 6.5'</td>
<td>Blue grey slate BEDROCK, moderately weathered, moderately hard, slightly moist (Salt Springs Slate)</td>
<td></td>
<td>( \phi = 38.1^\circ ), ( c = 100 ) psf</td>
</tr>
<tr>
<td>@ 6.5' - 7.5'</td>
<td>Grades olive grey, hard</td>
<td></td>
<td>R-Value = 51</td>
</tr>
<tr>
<td></td>
<td>Test pit terminated at 7.5' Seepage encountered at 7.25' No caving noted</td>
<td></td>
<td>El = 12</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Corrosion Suite</td>
</tr>
</tbody>
</table>

Note: The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations, Note, too, that the passage of time may affect conditions at the sampling locations.
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<tr>
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<th>Sample</th>
<th>Tests &amp; Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>@ 0' - 1.5'</td>
<td>Yellow brown sandy <strong>SILT (ML)</strong> with cobble, rounded, soft, dry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 1.5' - 4'</td>
<td>Olive grey slate <strong>BEDROCK</strong>, highly weathered, moderately hard, slightly moist, with interbedded clay seams (Salt Springs Slate)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 4' - 7'</td>
<td><strong>Grades moderately hard</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 7' - 8'</td>
<td><strong>Grades hard</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Test pit terminated at 8'
No free groundwater encountered
No caving noted

**Note:** The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations, Note, too, that the passage of time may affect conditions at the sampling locations.
# Geotechnical Description & Unified Soil Classification

<table>
<thead>
<tr>
<th>Depth (Feet)</th>
<th>Geotechnical Description &amp; Unified Soil Classification</th>
<th>Sample</th>
<th>Tests &amp; Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>@ 0' - 1.5'</td>
<td>Yellow brown sandy SILT (ML), medium stiff, dry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 1.5' - 5.5'</td>
<td>Olive and olive grey slate BEDROCK, highly weathered, closely fractured, moderately soft, slightly moist (Salt Springs Slate)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 5.5' - 7'</td>
<td>Grades moderately hard</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 7' - 9.5'</td>
<td>Grades hard</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 9.5' - 10'</td>
<td>Grades very hard</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Test pit terminated at 10' (practical refusal) <0.5' in 5 min  
No free groundwater encountered  
No caving noted

---

Note: The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations. Note, too, that the passage of time may affect conditions at the sampling locations.
**Geotechnical Description & Unified Soil Classification**

- **@ 0’ - 2.5’**
  - Light brown grey slate **BEDROCK**, slightly weathered, closely fractured, hard, dry (Salt Springs Slate)

- **@ 2.5’ - 4’**
  - Grades moderately hard

**Tests & Comments**

- Test pit terminated at 4’
- No free groundwater encountered
- No caving noted

---

**EXPLORATORY TEST PIT LOG**

**Folsom Plan Area 85A**

(Multi Family / Hotel Site) GES

Folsom, California

**November 2020**

---

**Note:** The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations. Note, too, that the passage of time may affect conditions at the sampling locations.
<table>
<thead>
<tr>
<th>Depth (Feet)</th>
<th>Geotechnical Description &amp; Unified Soil Classification</th>
<th>Sample</th>
<th>Tests &amp; Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>@ 0' - 1'</td>
<td>Red yellow sandy <strong>SILT (ML)</strong> with gravel, soft, slightly moist</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 1' - 6'</td>
<td>Olive and red yellow meta-andesite <strong>BEDROCK</strong>, slightly weathered, moderate clay filled fractures, hard, slightly moist</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Test pit terminated at 6'
No free groundwater encountered
No caving noted

---

**Note:** The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngha Consulting Group, Inc., exist at the sampling locations. Note, too, that the passage of time may affect conditions at the sampling locations.
<table>
<thead>
<tr>
<th>Depth (Feet)</th>
<th>Geotechnical Description &amp; Unified Soil Classification</th>
<th>Sample</th>
<th>Tests &amp; Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>@ 0' - 1'</td>
<td>Yellow brown sandy SILT (ML) with gravel and cobbles, soft, slightly moist</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 1' - 4'</td>
<td>Yellow brown meta-andesite BEDROCK, completely weathered, soft, slightly moist</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 4' - 5'</td>
<td>Grades completely weathered, moderately soft</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 5' - 7'</td>
<td>Grades light brown grey, moderately weathered, hard</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 7' - 8'</td>
<td>Grades fresh, very hard</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Test pit terminated at 8' (practical refusal) 0.5< in 5 min
No free groundwater encountered
No caving noted

---

**Note:** The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations. Note, too, that the passage of time may affect conditions at the sampling locations.
<table>
<thead>
<tr>
<th>Depth (Feet)</th>
<th>Geotechnical Description &amp; Unified Soil Classification</th>
<th>Sample</th>
<th>Tests &amp; Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>@ 0' - 3'</td>
<td>Yellow brown sandy SILT (ML) with gravel, medium stiff, slightly moist</td>
<td>TP-14</td>
<td>Corrosion Suite @ 2'</td>
</tr>
<tr>
<td>@ 3' - 5'</td>
<td>Yellow brown and olive meta-andesite BEDROCK, highly weathered, soft, with manganese staining</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 5' - 13'</td>
<td>Grades moderately soft</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Test pit terminated at 13'</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No free groundwater encountered</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No caving noted</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note:** The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations, Note, too, that the passage of time may affect conditions at the sampling locations.
<table>
<thead>
<tr>
<th>Depth (Feet)</th>
<th>Geotechnical Description &amp; Unified Soil Classification</th>
<th>Sample</th>
<th>Tests &amp; Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>@ 0' - 0.75'</td>
<td>Red yellow sandy <strong>SILT (ML)</strong> with gravel, soft, dry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 0.75' - 6'</td>
<td>Red yellow and light brown grey meta-andesite <strong>BEDROCK</strong>, completely weathered, moderately hard</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 6' - 7.75'</td>
<td><strong>Grades hard</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 7.75' - 8'</td>
<td><strong>Grades very hard</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Test pit terminated at 8'
No free groundwater encountered
No caving noted

---

Note: The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations, Note, too, that the passage of time may affect conditions at the sampling locations.
### Unified Soil Classification Systems

<table>
<thead>
<tr>
<th>Major Division</th>
<th>Symbols</th>
<th>Typical Names</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Coarse Grained Soils</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Over 50% &lt; #200 sieve</td>
<td><strong>Clean GRAVELS</strong> With Little Or No Finer</td>
<td>GW</td>
</tr>
<tr>
<td></td>
<td><strong>GRAVELS</strong> With Over 12% Finer</td>
<td>GP</td>
</tr>
<tr>
<td><strong>SANDS</strong></td>
<td><strong>Clean SANDS</strong> With Little Or No Finer</td>
<td>SW</td>
</tr>
<tr>
<td></td>
<td><strong>SANDS</strong> With Over 12% Finer</td>
<td>SM</td>
</tr>
<tr>
<td><strong>Silt &amp; Clays</strong></td>
<td><strong>Silt</strong> With Low Plasticity</td>
<td>OL</td>
</tr>
<tr>
<td>Liquid Limit &lt; 50</td>
<td></td>
<td>MH</td>
</tr>
<tr>
<td></td>
<td><strong>Clay</strong></td>
<td>CH</td>
</tr>
<tr>
<td>Liquid Limit &gt; 50</td>
<td><strong>Organic Clays</strong></td>
<td>OH</td>
</tr>
</tbody>
</table>

### Plasticity Chart

<table>
<thead>
<tr>
<th>Plasticity Index</th>
<th>Liquid Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>00</td>
</tr>
<tr>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>20</td>
<td>40</td>
</tr>
<tr>
<td>30</td>
<td>60</td>
</tr>
<tr>
<td>40</td>
<td>80</td>
</tr>
</tbody>
</table>

**Note:** Used for classification of fine grained soils

### Sample Driving Record

<table>
<thead>
<tr>
<th>Blows Per Foot</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>25 Blows drove sampler 12 inches, after initial 6 inches of seating</td>
</tr>
<tr>
<td>50/7&quot;</td>
<td>50 Blows drove sampler 7 inches, after initial 6 inches of seating</td>
</tr>
<tr>
<td>50/3&quot;</td>
<td>50 Blows drove sampler 3 inches during or after initial 6 inches of seating</td>
</tr>
</tbody>
</table>

*Note: To avoid damage to sampling tools, driving is limited to 50 blows per 6 inches during or after seating interval.*

### Soil Grain Size

<table>
<thead>
<tr>
<th>U.S. Standard Sieve</th>
<th>Soil Grain Size in Millimeters</th>
</tr>
</thead>
<tbody>
<tr>
<td>6&quot;</td>
<td>Boulder 150</td>
</tr>
<tr>
<td>3&quot;/4&quot;</td>
<td>Cobble 75</td>
</tr>
<tr>
<td>4</td>
<td>Gravel 4.75</td>
</tr>
<tr>
<td>10</td>
<td>Sand 2.0</td>
</tr>
<tr>
<td>40</td>
<td>Coarse Fine 0.425</td>
</tr>
<tr>
<td>200</td>
<td>Silty 0.075</td>
</tr>
<tr>
<td></td>
<td>Clay 0.002</td>
</tr>
</tbody>
</table>

### Key to Pit & Boring Symbols

- **Standard Penetration Test**
- **2.5" O.D. Modified California Sampler**
- **3" O.D. Modified California Sampler**
- **Shelby Tube Sampler**
- **2.5" Hand Driven Liner**
- **Bulk Sample**
- **Water Level At Time Of Drilling**
- **Water Level After Time Of Drilling**
- **Perched Water**

- **Joint**
- **Foliation**
- **Water Seepage**
- **NFWE** No Free Water Encountered
- **FWE** Free Water Encountered
- **REF** Sampling Refusal
- **DD** Dry Density (pcf)
- **MC** Moisture Content (%)
- **LL** Liquid Limit
- **PI** Plasticity Index
- **PP** Pocket Penetrometer
- **UCC** Unconfined Compression (ASTM D2166)
- **TVS** Pocket Torvane Shear
- **EI** Expansion Index (ASTM D4829)
- **Su** Undrained Shear Strength
APPENDIX B
Laboratory Testing

Direct Shear Test
Resistance Value Test
Expansion Index Test
Modified Proctor Test
Corrosivity Tests
**Direct Shear Test of Soils Under Consolidated Drained Conditions, ASTM D3080**

![Graphs of Direct Shear Test Results](image)

<table>
<thead>
<tr>
<th>Direct Shearbox Results</th>
<th>Friction Angle</th>
<th>Cohesion</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>38.1°</td>
<td>100 psf</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Test No.</th>
<th>Wet Density, pcf</th>
<th>Dry Density, pcf</th>
<th>Moisture Content, %</th>
<th>Diameter, in</th>
<th>Height, in</th>
<th>Wet Density, pcf</th>
<th>Dry Density, pcf</th>
<th>Moisture Content, %</th>
<th>Diameter, in</th>
<th>Height, in</th>
<th>Normal Stress, psf</th>
<th>Failure Stress, psf</th>
<th>Failure Strain, %</th>
<th>Rate, in/min</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>123.6</td>
<td>110.1</td>
<td>12.3</td>
<td>2.50</td>
<td>1.00</td>
<td>134.3</td>
<td>113.2</td>
<td>18.6</td>
<td>2.50</td>
<td>0.97</td>
<td>1000</td>
<td>1084</td>
<td>17.24</td>
<td>0.002</td>
</tr>
<tr>
<td>2</td>
<td>123.6</td>
<td>110.1</td>
<td>12.3</td>
<td>2.50</td>
<td>1.00</td>
<td>135.8</td>
<td>113.9</td>
<td>18.0</td>
<td>2.50</td>
<td>0.97</td>
<td>2000</td>
<td>1366</td>
<td>1.97</td>
<td>8.32</td>
</tr>
<tr>
<td>3</td>
<td>123.6</td>
<td>110.1</td>
<td>12.3</td>
<td>2.50</td>
<td>1.00</td>
<td>132.3</td>
<td>112.1</td>
<td>18.0</td>
<td>2.50</td>
<td>0.98</td>
<td>4000</td>
<td>3333</td>
<td>8.32</td>
<td></td>
</tr>
</tbody>
</table>

*Based on post shear moisture content

<table>
<thead>
<tr>
<th>Sample Type:</th>
<th>Remolded to 90% RC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material Description:</td>
<td>Dark Red Gravelly SAND with Silt</td>
</tr>
<tr>
<td>Source:</td>
<td></td>
</tr>
<tr>
<td>Notes:</td>
<td>Gravel removed from test sample.</td>
</tr>
<tr>
<td>Sample No./Depth:</td>
<td>TP-8 @ 0-1'</td>
</tr>
<tr>
<td>Date Sampled:</td>
<td>10/27/2020</td>
</tr>
<tr>
<td>Date Test Started:</td>
<td>11/2/2020</td>
</tr>
<tr>
<td>USCS Class.</td>
<td></td>
</tr>
<tr>
<td>Liquid Limit</td>
<td></td>
</tr>
<tr>
<td>Plasticity Index</td>
<td></td>
</tr>
<tr>
<td>% Greater than No. 4</td>
<td>26</td>
</tr>
<tr>
<td>% Less than No. 200</td>
<td></td>
</tr>
<tr>
<td>Project:</td>
<td>Folsom Plan Area Parcel 85A (Multi-Family/Hotel Site) GES</td>
</tr>
<tr>
<td>Project No.:</td>
<td>E17053.095</td>
</tr>
<tr>
<td>Reviewed By:</td>
<td>DN</td>
</tr>
<tr>
<td>Date:</td>
<td>11/3/2020</td>
</tr>
<tr>
<td>Figure</td>
<td>B-1</td>
</tr>
</tbody>
</table>
Resistance "R" Value of Soil and Soil-Aggregate Mixtures, CTM 301

R-Value Chart

<table>
<thead>
<tr>
<th>Test Specimen No.</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture Content at Test, %</td>
<td>11.7</td>
<td>12.2</td>
<td>12.8</td>
</tr>
<tr>
<td>Dry Density at Test, pcf</td>
<td>129.2</td>
<td>127.1</td>
<td>122.6</td>
</tr>
<tr>
<td>Expansion Pressure, psf</td>
<td>117</td>
<td>35</td>
<td>9</td>
</tr>
<tr>
<td>Exudation Pressure, psi</td>
<td>470</td>
<td>316</td>
<td>219</td>
</tr>
<tr>
<td>Resistance &quot;R&quot; Value</td>
<td>70</td>
<td>52</td>
<td>48</td>
</tr>
</tbody>
</table>

"R" Value at 300 psi Exudation Pressure | 51

Material Description: Dark Red Gravelly SAND with Silt

Source:

Notes:

Sample No./Depth: TP-8 @ 0-1'

<table>
<thead>
<tr>
<th>Date Sampled</th>
<th>Date Test Started</th>
<th>USCS Class</th>
<th>Liquid Limit</th>
<th>Plasticity Index</th>
<th>% Greater than No. 4</th>
<th>% Less than No. 200</th>
</tr>
</thead>
<tbody>
<tr>
<td>10/22/2020</td>
<td>11/4/2020</td>
<td></td>
<td></td>
<td></td>
<td>26</td>
<td></td>
</tr>
</tbody>
</table>

Project: Folsom Plan Area Parcel 85A (Multi-Family/Hotel Site) GES

Project No.: E17053.095

Reviewed By: JLC Date: 11/5/2020

Figure B-2
Expansion Index of Soils, ASTM D4829

Test Results

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Expansion Index</td>
<td>12</td>
</tr>
<tr>
<td>Dry Density, as molded, pcf</td>
<td>106.3</td>
</tr>
<tr>
<td>Moisture Content, as molded, %</td>
<td>10.9</td>
</tr>
<tr>
<td>Final Moisture Content, %</td>
<td>22.8</td>
</tr>
<tr>
<td>Initial Saturation, as molded, %</td>
<td>50.6</td>
</tr>
</tbody>
</table>

Classification of Potentially Expansive Soil

<table>
<thead>
<tr>
<th>Expansion Index, EI</th>
<th>Potential Expansion</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 20</td>
<td>Very Low</td>
</tr>
<tr>
<td>21 - 50</td>
<td>Low</td>
</tr>
<tr>
<td>51 - 90</td>
<td>Medium</td>
</tr>
<tr>
<td>91 - 130</td>
<td>High</td>
</tr>
<tr>
<td>Above 130</td>
<td>Very High</td>
</tr>
</tbody>
</table>

Material Description: Dark Red Gravelly SAND with Silt

Source:

Notes:

Sample No./Depth: TP-8 @ 0-1'

<table>
<thead>
<tr>
<th>Date Sampled:</th>
<th>Date Test Started:</th>
<th>USCS Class.</th>
<th>Liquid Limit</th>
<th>Plasticity Index</th>
<th>% Greater than No. 4</th>
<th>% Less than No. 200</th>
</tr>
</thead>
<tbody>
<tr>
<td>10/22/2002</td>
<td>10/30/2020</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Project: Folsom Plan Area Parcel 85A (Multi-Family/Hotel Site) GES

Project No.: E17053.095

Reviewed By: DN Date: 11/3/2020

Figure B-3
Laboratory Compaction Characteristics of Soil
Using Modified Effort (56,000 lf-lbf/ft³), ASTM D1557, Method A

Maximum Dry Density, pcf: 122.3
Optimum Moisture Content, %: 12.3

Material Description: Dark Red Gravelly SAND with Silt

Source:

Notes:

Sample No./Depth: Curve 1, TP-8 @ 0-1'

<table>
<thead>
<tr>
<th>USCS Class.</th>
<th>Liquid Limit</th>
<th>Plasticity Index</th>
<th>% Greater than No. 4</th>
<th>% Less than No. 200</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Date Sampled: 10/27/2020
Date Test Started: 10/28/2020

Project: Folsom Plan Area Parcel 85A (Multi-Family/Hotel Site) GES

Project No.: E17053.095

Reviewed By: JLC
Date: 10/29/2020

Figure B-4
To: Jeffry Cannon  
Youngdahl Consulting Group  
1234 Glenhaven Ct.  
El Dorado Hills, CA 95630

From: Gene Oliphant, Ph.D. \ Randy Horney  
General Manager \ Lab Manager

Date Reported 10/30/2020  
Date Submitted 10/26/2020

The reported analysis was requested for the following location:  
Location : E17053.095  Site ID : TP-8 @ 0-1 FT.  
Thank you for your business.

* For future reference to this analysis please use SUN # 83330-173888.

------------------------------------------  
EVALUATION FOR SOIL CORROSION  
------------------------------------------

Soil pH  5.37

Minimum Resistivity  2.90 ohm-cm (x1000)

Chloride  1.5 ppm  00.00015 %

Sulfate  2.5 ppm  00.00025 %

METHODS  
pH and Min.Resistivity CA DOT Test #643  
Sulfate CA DOT Test #417,  Chloride CA DOT Test #422m
To:  Jeffry Cannon  
Youngdahl Consulting Group  
1234 Glenhaven Ct.  
El Dorado Hills, CA 95630

From: Gene Oliphant, Ph.D. \ Randy Horney  
General Manager  \ Lab Manager

The reported analysis was requested for the following location:
Location: E17053.095  Site ID: TP-14 @ 0-2 FT.
Thank you for your business.

* For future reference to this analysis please use SUN # 83330-173889.

----------------------------------------------------------------------------------------------------

EVALUATION FOR SOIL CORROSION

Soil pH 5.67

Minimum Resistivity 3.22 ohm-cm (x1000)

Chloride 1.3 ppm 00.00013 %

Sulfate 3.0 ppm 00.00030 %

METHODS
pH and Min Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422m
APPENDIX C
Geotechnical Drainage Details

Canyon Style Drain
Keyway and Bench with Drain
Site Wall Drainage
Sub-Drain
Storm Drain / Sub-Drain
Canyon Drain Installation
(Typical)

- Engineered Fill
- 2' Minimum Embedment Into Bedrock
- "Filter-fabric" Layer Wrapped Around Drain Material (Mirafi 140 N or Equivalent)
- Permeable Material: 3/4" Crushed Rock
- 4" Schedule 40 PVC Perforated Pipe or Approved Equivalent, Installed As Field Conditions Dictate (Centered in Trench)
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.

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

10' Min or as designated by geotechnical engineer

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.

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

Benches to be cut as fills are being placed.

Max Inclination of fill slope 2H:1V

Zone of soil to be removed.

Design Grade

Brow Berm

Natural Grade

6' Minimum

10' Min

2'
Retaining Wall With
“Perforated Pipe Sub-Drain”
(Typical Cross Section)

Wall

Height

12” Minimum

2%

12” Native Soil Compacted to 90%

“Filter-fabric”
Layer Wrapped Around
Drain Material
(Mirafi 140 N or Equivalent)

Permeable Material:
3/4” Crushed Gravel
Black plastic sheeting
Over Waterproofing
(2 layers - 6 mil or 1 layer 10 mil)

Waterproofing
By Wall Designer

“Rigid-wall” “Perforated Pipe”
With Holes Turned Down
D = Pipe Diameter
D = 4”

2” Max

Notes:
1. Slope footing and “rigid-wall” pipes along flow line parallel to wall 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 90° elbows).
3. Provide sweeps to periodic “clean-outs”.
4. Washed clean permeable material.
Grout Collar Cut-Off
Subdrain Detail (Typical)

Plan View

Sand Lean Grout Slurry Collar
(Placement To Be Determined By Geotechnical Engineer)

"Rigid-wall" "Perforated Pipe"
With Holes Turned Down
Pipe Diameter = 4"

"Rigid-wall" "Non-Perforated Pipe"
(Tight Pipe)
Pipe Diameter = 4"

4 Inch "Rigid-wall" "Perforated Pipe"
At Flow Line With Holes Turned Down
4 Inch Diameter Pipe, section through slurry plug should not be perforated.
APPENDIX D
Refraction Seismic Line (Reference 3)
Refraction Seismic Investigation
at the
Folsom Plan Area Parcel 85A
(Multi-Family/Hotel) GES Project Site
in
Folsom, Sacramento County, California

GGSI Project No. 2020-27.01

Prepared by:
Gasch Geophysical Services, Inc.
Rancho Cordova, California 95742-6576

Submitted to:
Mr. Kenneth Williams
Youngdahl Consulting Group, Inc.
1234 Glenhaven Court
El Dorado Hills, California 95762

November, 2020
November 14, 2020

Mr. Kenneth Williams
Youngdahl Consulting Group, Inc.
1234 Glenhaven Court
El Dorado Hills, California 95762

Re: Refraction Seismic Investigation at the Folsom Plan Area Parcel 85A (Multi-Family/Hotel Site) GES Project Site in Folsom, Sacramento County, California.
GGSI Project No. 2020-27.01
YCG Project No. E17053.095

Dear Mr. Williams:

At your request and authorization, Gasch Geophysical Services, Inc. (GGSI) has completed a refraction seismic investigation at the Folsom Plan Area Parcel 85A (Multi-Family/Hotel Site) GES Project Site in Folsom, Sacramento County, California (Figure 1).

Purpose

It was our understanding that the purpose of this investigation was to determine the depth to higher velocity material and also define the rippability (excavatability) characteristics of the sub-surface materials at the Folsom Plan Area Parcel 85A (Multi-Family/Hotel Site) GES Project Site.

Method, Instrumentation and Software

The refraction seismic (RS) method was used to evaluate the rock velocities on site, as seismic primary-wave travel times are used to quantify the rock velocities and, as a result, can determine the general competency/rippability in areas of various rock types.

The RS method measures the velocity at which a seismic wave propagates through a soil or rock medium. In this case, the primary seismic wave (p-wave or compression wave) was measured. Higher seismic p-wave velocities (measured in feet per second, ft/s) indicate material of higher density, thus quantifying the competency, or strength, of the soil or rock medium and providing an estimation of the rippability and/or excavatability of the sub-surface materials.

The seismic data acquisition system used by GGSI was a Seistronix EX-6 Explorer, which is a distributed, 24-bit digital instrument with data output to electronic media for subsequent processing. Geophones were single, 10-Hz, digital grade units manufactured by OYO Geospace Corporation. Spread cables were manufactured by
Pro-Seismic Services. The energy source for this project was a propelled energy generator employing a 40 kilogram (88 pound) accelerated weight drop system mounted on an off-road utility vehicle with a hardwired link for system triggering. All data were processed in house on our data reduction and plotting workstation.

Refraction seismic data processing was carried out using Rayfrac® version 3.36. This refraction seismic processing software utilizes Wavepath Eikonal Traveltime (WET) tomography, which models multiple signal propagation paths contributing to one first break (the Fresnel volume approach). Conventional ray tracing tomography is limited to the modeling of just one ray path per first break. The WET inversion method is founded upon a back-projection formula for inverting velocities from travel times computed by a finite-difference solution to the Eikonal equation (Qin, et al. 1992). An Eikonal solver is used for traveltime field computation, which models diffraction in addition to refraction and transmission of acoustic waves. As a result, the velocity anomaly imaging capability is enhanced with the WET tomographic inversion method compared to conventional ray tomography. This software is developed by Intelligent Resources, Inc. of Vancouver, British Colombia, Canada.

A color-coded seismic velocity cross-section of the subsurface has been generated for each RS line, where cool colors (blues) indicate lower seismic velocities and warm colors (reds, purple) indicate higher velocities. Color scaling of these seismic velocity sections is based on the range of seismic velocity values calculated. Velocity scaling has been normalized on all RS velocity sections.

Data Acquisition Parameters

A total of three RS lines were acquired during this investigation. The RS Line locations were suggested by Youngdahl personnel and slightly adjusted in the field to allow for safe and efficient data acquisition. Geophone stations were spaced at 20-foot intervals with energy source points located between every other geophone station as well as off the ends of each line. All three Lines were acquired with 15 active geophone stations giving a line length of 320 feet each for a total of 960 lineal feet of data collected for this investigation. Field data acquisition was carried out on November 5th, 2020 by a field crew consisting of Professional Geophysicist Kent Gasch. The location of the RS lines are presented on Figure 2.

Rippability

Rippability is dependent on the physical condition of the rock masses to be excavated. In addition to rock type and degree of weathering, structural features in the rock such as bedding planes, cleavage planes, joints, fractures, consolidation, and shear zones also influence rippability. Rock masses tend to be more easily ripped if they have well defined, fractures, joints, or other planes of weakness. Massive rock bodies which lack discontinuities may allow for slow and difficult ripping or refusal, even where partially weathered, and may require blasting to break the rock for efficient removal.
The association between the seismic velocity of any given earth material and its rippability varies greatly from one type of earth-moving equipment to another. For example, although a large track laying dozer with a single ripper tooth can sometimes rip material with seismic velocities in excess of 10,000 ft/s, GGSI has experienced a limiting (refusal) velocity for large excavators ranging from 3,500 ft/s to 4,500 ft/s, and a standard backhoe may meet refusal at seismic velocities as low as 2,000 ft/s. Ultimately, the relationship between seismic velocity and rippability is dependent on a combination of site conditions, equipment used, and operator ability.

Seismic p-wave velocities are related to both rock hardness and fracture density. Rippability has been empirically correlated to refraction seismic velocities by Caterpillar Inc., as displayed on Figure 6 for a CAT D10T2 (Caterpillar Performance Handbook, Edition 49, September 2019). According to this chart, metamorphic rock, in this case slate, becomes marginally rippable around 8,000 ft/s and non-rippable at about 9,800 ft/s for a D10T2 dozer. These estimations are based on the published values for metamorphic rocks on the CAT chart; however, site geology and topography may cause some variations of these values.

The Caterpillar Chart of Ripper Performance should be considered as being only one indicator of rippability. Ripper tooth penetration is the key to successful ripping, regardless of seismic velocity. This is particularly true in finer-grained, homogeneous materials and in tightly cemented formations. Ripping success may ultimately be determined by the operator finding the proper combination of factors, such as: number of shanks used, length and depth of shank, tooth angle, direction of travel, and use of throttle. Although low seismic velocities in any rock type indicate probable rippability; if the fractures, bedding and/or joints do not allow tooth penetration, the material still may not be ripped efficiently, and, in some cases, drilling and blasting may be required to induce sufficient fracturing to allow for excavation.

**Seismic Velocities**

Generally, seismic p-wave velocities less than 3,000 ft/s indicate native soil, fill material, or highly weathered and/or decomposed rock, while velocities in excess of 10,000 ft/s indicate fresh (essentially non-weathered) rock. Seismic velocities between these two values typically indicate rock with varying degrees of weathering and/or fracturing. Consolidation and cementation, as well as fracture spacing and density, also affect the measured seismic velocities. Moderate velocities may indicate compacted soil, moderately weathered rock, or loosely consolidated sediment such as gravel, sand, and silt. Saturated sediment below the water table characteristically displays seismic velocities near or slightly above 5,000 ft/s.

Extremes in seismic velocities may range from below 1,000 ft/s to over 20,000 ft/s. Very low seismic velocities usually indicate highly weathered or poorly compacted material, either natural or man-made. Extremely high velocities are rare in the near-surface, and only possible in certain types of rock. Rock velocities are dependent on the
physical condition of the rock masses evaluated, as a result, seismic p-wave velocities are related to rock hardness, fracture density and sediment consolidation, saturation, and cementation.

Findings

The results of this refraction seismic investigation are summarized by Figures 3 through 5. These seismic velocity sections, which were created through the inversion process, have very low error and provide a high degree of lateral definition of the seismic velocity horizons found beneath each line. The seismic velocity sections have been scaled from 1,500 ft/s to 20,000 ft/s for the velocity window. Spatial axes have been scaled to 30 feet per inch in the horizontal and 20 feet per inch in the vertical.

RS Line 1 (Figure 3)

RS Line 1 is located in the central portion of the northern project area and spans a total length of 320 feet. This Line is oriented approximately west to east (see Figure 2). Measured seismic velocities at this location show a rapid gradation from low to moderate velocities (1,500 to 6,000 ft/s) at the surface to depths ranging from approximately 9 feet to 14 feet below ground surface (bgs). This low to moderate velocity horizon quickly grades to velocities of marginally rippable (~8,000 ft/s) to non rippable material (~9,800 ft/sec) at depths of approximately 14 to 21 feet bgs. This marginally rippable and non rippable horizon undulated across the length of the line and the velocities at or above the depth of this horizon (<8,000 ft/s) suggest materials that should be rippable with a D10T2 dozer (or equivalent); however, should excavations extend below this horizon, ripping may become difficult, and drilling and blasting may be the most efficient method to fracture the rock for deeper excavation.

RS Line 2 (Figure 4)

RS Line 2 is located in the north-central portion of the southern project area and spans a total length of 320 feet. This Line is oriented approximately southwest to northeast (see Figure 2). Measured seismic velocities at this location show a rapid gradation from low to moderate velocities (1,500 to 6,000 ft/s) at the surface to depths ranging from approximately 10 feet to 15 feet below ground surface (bgs). This low to moderate velocity horizon quickly grades to velocities of marginally rippable (~8,000 ft/s) to non rippable material (~9,800 ft/sec) at depths of approximately 17 to 28 feet bgs. This marginally rippable and non rippable horizon undulated slightly across the length of the line and the velocities at or above the depth of this horizon (<8,000 ft/s) suggest materials that should be rippable with a D10T2 dozer (or equivalent). Based on plan maps provided, a dashed line has been added to the velocity cross section to illustrate the rock velocities to be encountered at the planned excavation depth. Velocities greater than the non-rippable values (according to the CAT chart) will be encountered at the planned excavation depth and will likely require drilling and blasting to fracture the rock for excavation to this depth.
RS Line 3 (Figure 5)

RS Line 3 is located in the southern-central portion of the southern project site. This Line is also oriented approximately southwest to northeast and is 320 feet in length (see Figure 2). Measured seismic velocities at this location show a rapid gradation from low to moderate velocities (1,500 to 6,000 ft/s) across the length of the line at approximate depths ranging from 12 to 18 feet bgs. Velocities show the marginally rippable material (~8,000 ft/s) at depths of approximately 16 to 26 feet bgs with a slight undulating nature. Velocities at or above the depth of this horizon (<8,000 ft/s) suggest materials that should be rippable with a D10T2 dozer (or equivalent); however, planned excavation depths, shown with a dashed line on the velocity cross section, extend below this horizon, in which case, ripping will become difficult, and drilling and blasting may be the most efficient method to fracture the rock for deeper excavation.

Summary

This refraction seismic investigation was designed to provide a good sampling of the subsurface conditions along portions of the Folsom Plan Area Parcel 85A (Multi-Family/Hotel Site) GES Project Site. This investigation revealed a moderate to high degree of variation in the calculated seismic velocities of the subsurface materials, with the highest seismic velocity of greater than 19,000 ft/s measured at the maximum depth of exploration on all three RS Lines. Low velocity material was encountered in the near surface, which suggests highly weathered/fractured rock and soil or fill. The moderate velocity range of 3,000 ft/s to approximately 6,000 ft/s, suggests soil/ﬁll to moderately weathered/fractured rock. The RS Lines shows this low to moderate velocity section of material from surface to varying depths and higher velocity material at the maximum depth of exploration. The higher velocity horizon (8,000 ft/s and greater) suggests rock of moderate weathering and/or fractures which continues to slightly weathered and/or less fractured rock at depth.

In general, rippability with a D10T2 dozer (or equivalent) should not be problematic to the depths noted above for each RS Line; however, depending on the maximum depth of excavation, progress may be slower as zones of higher velocity material are encountered. In such instances, alternative means of excavation, such as drilling and blasting, may be necessary.

Warranty and Limitations

Gasch Geophysical Services, Inc. has performed these services in a manner which is consistent with standards of the profession. Site conditions can cause some variations of the calculated seismic velocities. Refraction seismic velocities assume that velocities increase with depth; therefore, a lower seismic velocity layer beneath a higher seismic velocity layer will not be resolved. No guarantee, with respect to the results and performance of services or products delivered for this project, is implied or expressed by Gasch Geophysical Services, Inc.
We trust that this is the information you require; however, should you have comments or questions, please contact our Rancho Cordova office at your convenience. Thank you for this opportunity to again be of service.

Sincerely,

GASCH GEOPHYSICAL SERVICES, INC.

[Signature]

Kent L. Gasch
Professional Geophysicist #1061
Expires 12/31/2021