Appendix I: Geotechnical Exploration

PRELIMINARY GEOTECHNICAL EXPLORATION

BALL PROPERTY
ALAMO, CALIFORNIA

Submitted to:
Ms. Shannon Ball Jones
Camille Ironwork Properties, LLC
Danville, California

Prepared by:
ENGEO Incorporated

April 3, 2013
Revised April 26, 2013

Project No.
8346.000.002

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April 3, 2013
Revised April 26, 2013

Ms. Shannon Ball Jones
Camille Ironwork Properties, LLC
PO Box 67
Danville, CA 94526

Subject: Ball Property
Alamo, California

PRELIMINARY GEOTECHNICAL EXPLORATION

Dear Ms. Jones:

With your authorization, we conducted a preliminary geotechnical exploration at the Ball Property located in Alamo, California. The accompanying report presents the results of our site exploration and preliminary geotechnical recommendations for the planning and development. Based on our study, it is our opinion that future development of the site is feasible from a geotechnical standpoint provided the recommendations included herein are incorporated into project planning and design.

We are pleased to have been of service to you on this project and will be glad to consult further with you and your design team as planning progresses.

Sincerely,

ENGEO Incorporated

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1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE

The purpose of this exploration has been to provide a preliminary characterization of site conditions and potential geologic hazards in the study area and to develop planning level recommendations regarding the geotechnical aspects of the project. This exploration included the following scope of services:

- Published geologic maps and literature pertinent to the site were reviewed.
- A geologic reconnaissance of the site was performed by an engineering geologist from our office.
- Aerial photographs of the site were examined to identify geomorphic features that may be related to faulting, landsliding and other geologic conditions.
- The findings of previous explorations adjacent to site were reviewed.
- Excavation and logging of seven exploratory test pits (TP-1 through TP-7) to characterize existing fill, soil, and bedrock conditions across the study area.
- Excavation and logging of one exploratory trench (ET-1) to evaluate a previously mapped trace of the Northern Calaveras fault crossing the site.
- Bag samples and relatively undisturbed samples of representative fill and native soil materials were collected and limited laboratory testing was performed to characterize the engineering properties of the soil materials.
- Preparation of this preliminary geotechnical exploration report summarizing our findings, conclusions and development of preliminary recommendations to assist in site planning.

This report was prepared for the exclusive use of you and your design team consultants. In the event that any changes are made in the character, design, or layout of the development, the conclusions and recommendations contained in this report should be reviewed by ENGEO Incorporated to determine whether modifications to the report are necessary. This document may not be reproduced in whole or in part by any means whatsoever, nor may it be quoted or excerpted without the express written consent of ENGEO Incorporated.

1.2 SITE LOCATION AND DESCRIPTION

The Ball property is located west of the existing terminus of Camille Avenue in Alamo, California, as shown on the Vicinity Map, Figure 1. The property is located approximately 7 miles west of Mount Diablo and just east of the northwest trending Las Trampas

Ridge in the San Ramon Valley. The western portion of the site is situated on a broad bedrock spur ridge that extends northeast into the valley from the prominent surrounding hills.

Elevations on site range from a low of about 348 feet above mean sea level (msl) towards to the southeast portion of the site and Camille Lane, to a high of about 450 feet above msl on the ridgeline at the southwest corner of the property. Much of the topography in the study area has been altered by previous grading to create a large building pad area for the existing residence, maintenance buildings and office structures.

The site is currently improved with a residence, pool house, swimming pool and office buildings. Vegetation consists of areas of open grassland with scattered orchards to the east and dense redwood, oak, cedar and maple trees around the existing structures. Dense oak woodlands were noted on the hillsides in the western portion of the site.

1.3 PLANNED DEVELOPMENT

A preliminary site grading and development plan has been prepared by Aliquot dated March 23, 2013. The plan indicates that the site will be developed with approximately 35 single-family residential lots. Grading will involve cuts and fills up to about 10 feet thick to create properly draining building pads and the associated roadways.

1.4 PREVIOUS STUDIES

William Lettis & Associates (WLA) conducted a paleoseismic investigation of the Northern Calaveras Fault (Simpson, 1994), whose goal was to determine the slip-rate and location of the fault trace between southern Sunol and Camille Lane. In order to determine Holocene fault displacement, an approximately 140-foot-long, 16-foot-deep trench was excavated between the southern property boundary and Camille Lane, as shown on Figure 2. In the trench, fine-grained alluvial deposits consisting of clayey silt and gravelly sands were encountered. No evidence of faulting was observed in the Holocene deposits, supporting the interpretation that the active trace of the fault terminated north of Danville (Simpson, 1994). In addition, radiocarbon analysis was performed on two samples collected during the study and yielded ages between 3,600 to 4,000 years before present (ybp) and 5,600 to 6,000 ybp, respectively, giving way to mid to late Holocene depositional development (Simpson, 1994).

2.0 GEOTECHNICAL EXPLORATION

2.1 FIELD EXPLORATION

Our field exploration was conducted from July 30, 2008, to August 1, 2008, and included excavating seven test pits (TP-1 through TP-7) and a 218-foot-long exploratory trench that averaged 10 to 12 feet deep. Geologic field mapping was undertaken concurrently with the exploration. The test pit and trench logs of the excavations are presented in Appendix A.

The exploratory trench and test pits were excavated using a rubber-tired backhoe. The approximate locations of the trench and test pits are shown on Figure 2. The trench and test pits were located in the field by pacing and estimating distances from features shown on the topographic base map prepared by Aliquot dated December 2012. The location of the trench was also surveyed by the project civil engineer. The trench and test pits were backfilled with nominal compactive effort. Any portion of the trench and/or test pits that are not completely removed by design cuts and are within the development area will require overexcavation and recompaction during site grading.

During our test pit exploration various bag samples and Modified-California samples were collected for laboratory testing. The 3-inch Modified-California samplers were driven into the ground with the backhoe bucket at the desired sample elevation. The purpose of sampling was to characterize the nature of in-place undocumented fill.

2.2 LABORATORY TESTING

Following the field exploration, the collected soil samples were reexamined in our laboratory to confirm field classifications. Representative samples recovered from our test pits were tested for the following physical characteristics:

TABLE 2.2-1

Characteristic	Test Method	Location of Results Within this Report
Natural Unit Weight	ASTM D-2216	Appendix B
Natural Moisture Content	ASTM D-2216	Appendix B
Atterberg Limits	ASTM D-4318	Appendix B

3.0 GEOLOGY AND SEISMICITY

3.1 REGIONAL GEOLOGY

The site is located in the Northern San Ramon Valley, at the east flank of the Las Trampas Ridge. The San Ramon Valley lies within the region of coastal California known as the Coast Ranges geomorphic province. The Coast Ranges have experienced a complex geological history characterized by Late Tertiary folding and faulting that has resulted in a series of northwest-trending mountain ranges and intervening valleys. The San Francisco Bay Valley and enclosing peripheral hills, in association with the two main fault structures (the San Andreas and Hayward-Rodgers Creek faults), comprise the main geological features of the local Bay Area. Diverse crustal movements within this tectonic framework are responsible for the morphology and seismicity of the area.

The project's lowland areas in the east were mapped by Dibblee (2005) as Quaternary alluvial gravel, sand and silt; the highland areas in the west were mapped as Late Miocene Monterey Formation clay shale and sandy siltstone (Figure 3). Dibblee shows bedding as the overturned east limb of the Las Trampas anticline, dipping to the southwest approximately 60 to 70 degrees. Nilsen (1975) further details small colluvial or alluvial swales at various locations along the western range front of the site. Quaternary mapping by Helley and Graymer (1997) shows Pleistocene alluvium consisting of clayey gravels to sandy clays on the southern portion of the site and Holocene alluvium consisting of gravelly sand to sand to silty clay on the northern portion of the site. For the purposes of this report Dibblee (2005) map will be used as reference for surficial geology characteristics; however, geologic maps by Graymer (2000) and Crane (1988) were reviewed in this study. Bedrock encountered in various test pits is described in later portions of this report.

To further characterize the extent and nature of these surficial deposits including undocumented fill and alluvial and colluvial deposits throughout the site, additional subsurface exploration should be performed at the time of a design-level study.

3.2 FAULTING AND SEISMICITY

The site is not located within a State of California Earthquake Fault Hazard Zone (CDMG, 1982) for known active faults. The Northern Calaveras Fault is queried and/or inferred by Dibblee (2005), Graymer (2000), Crane (1988), and Jennings (1994) as crossing the west portion of the site at the east flank of the Las Trampas Ridge. More recent Quaternary movement along the southern trace of the Calaveras can be identified by linear features and displaced tributaries; however, these features become obscured within the Las Trampas Quadrangle and it becomes difficult to identify this northern trace, Hart (1980).

In addition to the Calaveras fault, significant seismic sources in the region include the San Andreas fault located about 28 miles to the west, the Concord fault located about 5 miles to the northeast, the Hayward Fault located about 9 miles to the west and the Greenville Fault located about 9½ miles to the east of the site. A Regional Faulting and Seismicity Map showing the approximate location of major active faults with respect to the site is included on Figure 4.

3.3 SOIL STRATIGRAPHY AND BEDROCK

3.3.1 Artificial Fill

As noted above, a large portion of the site has been affected by previous grading activity. Areas where larger existing fills were observed are identified as "Qaf" on the Preliminary Geologic Map, Figure 2. In general, smaller sliver fills associated with side-hill roadways and thin fills adjacent to drainage courses or associated with underground utilities, parking lots and other paved areas are not shown on Figure 2. In general, the existing fills appear to have been derived from onsite sources and most of the fill encountered in test pits was free of deleterious debris.

Two areas of existing fill were encountered in the southern portion of the site that contains a substantial quantity of asphaltic concrete and minor nesting of cobble size sandstone fragments. The existing fills observed in the test pits appear to range up to about 3 to 4 feet thick.

No records pertaining to the placement of the existing fills were found at the time this report was prepared. Extensional cracking was observed along some of the driveway pavement areas that suggest the underlying fills in these areas may be experiencing creep. Conditions observed in test pits suggest that most of the fills were compacted to some degree and many of the existing fills appear to be performing in a satisfactory manner. However, it appears unlikely that the fills were constructed with keyways, benching and subdrains, etc. that would be required for engineered fill that is designed to current standards.

3.3.2 Colluvium

Colluvium (Qc) has been mapped in the swales on the hillside areas of the site. Colluvium is material that erodes from ridgelines and slopes, is transported predominantly by sheet wash, and accumulates in the adjacent swales. The colluvium encountered in test pits consisted primarily of brown to dark brown silty clay. The colluvium was generally moderately stiff to stiff. Atterberg Limits testing of a silty clay colluvial soil from Test Pit TP-7 resulted in Plasticity Index (PI) of 22 and a Liquid Limit of 36. Based on the results of the laboratory testing and our observations, the colluvial soils are considered highly to critically expansive when subjected to fluctuations in moisture content.

3.3.3 Alluvium

Alluvial deposits (Qa) have been mapped in the low lying areas around the residence and office structures, extending to the east property limits. Based on the findings of our trenching and test pits, the alluvial deposits are a heterogeneous mixture of material types including silty clay, clayey silt, and clayey gravel. Based on our observations, the clayey alluvial soils appear to vary from low to high plasticity and are considered highly expansive when subjected to fluctuations in moisture content.

3.3.4 Older Alluvium

The extent of the older alluvium (Qoa) deposits was not mapped on Figure 2 because they are obscured by more recent deposits; however, older alluvial deposits were encountered in the trench excavation. The older alluvial deposits encountered consisted primarily of silty clay with variable amounts of gravel and rock fragments. The older alluvial deposits encountered are very stiff to hard. The older alluvial soils appear to have moderate to low plasticity and moderate expansion potential.

3.3.5 Landslide Deposits

Regional landslide mapping by Nilsen (1975) shows no landslides within the site development, Figure 5. Based on our geologic mapping (Figure 2); in the hillsides just west of the site limits, there are three landslides (Qls) consisting of shallow slump-type failures or earth flow failures that predominantly involve soil with some highly weathered bedrock material. Geomorphic features suggest that the landslide deposits on site are generally in the range of about 10 to 20 feet thick.

3.3.6 Bedrock

Based on the findings in various test pit excavations, bedrock at the site appears to consist primarily of moderately weathered sandstone of the Monterey Formation (Tmc) as mapped by Dibblee (2005). The rock encountered varied from moderately strong to very strong and moderately fractured. The rubber-wheeled backhoe used for this exploration had varying degrees of success excavating into the bedrock.

3.4 GROUNDWATER CONDITIONS

Groundwater was not encountered during our field exploration. Fluctuations in groundwater elevations occur seasonally and over a period of years because of variations in precipitation, temperature, irrigation, and other factors. Future irrigation may cause an overall rise in groundwater levels.

4.0 FAULT EXPLORATION

4.1 TRENCH EXPLORATION

An exploratory trench (ET-1), totaling approximately 218 lineal feet, was excavated at the location shown on Figure 2. The trench was located in the field by tape measuring from existing features at the site. The log of the trench is included in Appendix A. The location of the trench was established within the mouth of a side canyon to increase the likelihood of encountering thicker deposits of soil that could demonstrate the presence or absence of Holocene faulting.

The depth of the trench averaged 10 to 12 feet below the adjacent ground surface. The south wall of each trench was cleaned with hand tools and examined by ENGEO geologists. The exposure was logged at a horizontal and vertical scale of 1 inch to 5 feet. A level line was established in the trench and measurements were referenced to this line.

Bedrock was not encountered within the trench. Rock fragments ranging form gravel- to boulder-sized consisting of Monterrey Formation and locally derived Briones sandstone was encountered within the alluvium.

Soil stratigraphy representing up to 22,000 years of soil development was exposed within the trench. The lowermost portions of the section, consisting of a Bt paleosol appeared laterally continuous across the base of the entire excavation. A channel profile consisting of older alluvial gravels incised the older soil section down to the Bt paleosol between stations 0+28 and 0+90. Evidence of clay films within the older alluvial gravels suggests that the base of the channel may have experienced soil development for at least 10,000 years. Pedochronological age dating of the soil profiles was provided by Dr. Glenn Borchardt and the results of his evaluation are included in Appendix C. A detailed description of the soil units is shown on the attached trench log (Appendix A).

No evidence of Holocene or active faulting was observed in Trench ET-1. As described above, the oldest soil units exposed in the trench were laterally continuous and undisturbed.

Prior to our exploration of the site our proposed fault exploration scope was discussed with Darwin Meyers of Darwin Meyers and Associates the geotechnical consultant for the Contra Costa County Planning Department. Darwin Meyers made a site visit to observe the exposed trench, and our observations were discussed in the field with him during the visit.

5.0 CONCLUSIONS AND RECOMMENDATIONS

The main geotechnical concerns for future site development include potential seismic hazards, slope stability and behavior of undocumented fills. These concerns and other geotechnical issues are discussed in the following sections of this report.

5.1 SEISMIC HAZARDS

Potential seismic hazards resulting from a nearby moderate to major earthquake can generally be classified as primary and secondary. The primary effect is ground rupture, also called surface faulting. The common secondary seismic hazards include ground shaking, ground lurching, soil liquefaction, lateral spreading and seismically induced landsliding. These hazards are discussed in the following sections. Based on topographic setting relative to natural and man-made bodies of water, the risk from tsunamis or seiches does not exist at the site.

5.1.1 Ground Rupture

The site is not within a State of California Earthquake Fault Zone (1982); however, a potentially active trace of the Calaveras Fault crosses the site (Dibblee, 1980, Graymer, 2000, Jennings, 1994). Possible historic ground rupture along the Calaveras Fault was documented after the 1861 earthquake, which occurred a few miles south of the site; however, this reported rupture is not confirmed to be fault related, Hart (1980). Exploratory trenching was performed across the queried Northern Calaveras fault trace crossing the site and no indications of faulting were encountered in ET-1 and no surface expression of recent ground rupture was observed. Based on the findings of our exploration, the potential for fault rupture across explored areas of the site appears to be low.

5.1.2 Ground Shaking

An earthquake of moderate to high magnitude generated within the San Francisco Bay Region could cause considerable ground shaking at the site. The degree of shaking is dependent on the magnitude of the event, the distance to its epicenter, and local geologic conditions. To mitigate the ground shaking effects, all structures should be designed using sound engineering judgment and the latest California Building Code (CBC) requirements as a minimum.

Seismic design provisions of current building codes generally prescribe minimum lateral forces, applied statically to the structure, combined with the gravity forces of dead-and-live loads. The code-prescribed lateral forces are generally considered to be substantially smaller than the equivalent forces that would be associated with a major earthquake. Therefore, structures should be able to: (1) resist minor earthquakes without damage, (2) resist moderate earthquakes without structural damage but with some nonstructural damage, and (3) resist major earthquakes without collapse but with some structural as well as nonstructural damage. Conformance to current building code recommendations does not constitute any kind of guarantee that significant structural damage would not occur in the event of a maximum magnitude earthquake; however, it is reasonable to expect that a well-designed and well-constructed structure will not collapse or cause loss of life in a major earthquake.

5.1.3 Liquefaction

Liquefaction is a phenomenon in which saturated cohesionless soils are subject to a temporary loss of shear strength because of pore pressure build up under the cyclic shear stresses associated with earthquakes. ABAG maps show the eastern low lying portion of the site to be moderately susceptible to liquefaction; however, based on our findings and the cohesive nature of site soils, the potential for liquefaction at the site is considered low.

We recommend that additional exploration be performed to more fully characterize site susceptibility to liquefaction.

5.1.4 Lurching and Lateral Spreading

Ground lurching is a result of the rolling motion imparted to the ground surface during energy released by an earthquake. Such rolling motion can cause ground cracks to form in weaker soil materials and cause weaker soil material to move laterally on slopes or adjacent to open channels. Based on mapped extent of young soil, site topography, and our field exploration, the potential for lateral spreading is considered to be low.

The potential lurching hazard for weaker soils on slopes can be mitigated by site grading techniques such as keying and benching where fills are placed on sloping ground and foundation design measures. Structures situated on slopes should have drilled pier foundation systems designed to accommodate lateral loads that are expected from soil on slopes. Specific

recommendations for grading and foundation design measures to mitigate this concern will be developed during design level studies for the project.

5.1.5 Seismically Induced Landslides

Seismically induced landslides are triggered by earthquake ground shaking. The risk of this hazard is generally greatest in the late winter when groundwater levels are highest and surficial soils are saturated. As with all slopes in the region, this risk is also present at the site to varying degrees depending on the slope conditions and time of year. The hazard of seismically induced landslides can be mitigated by design of properly engineered cut and fill slopes and stabilization of landslides or creation of sufficient buffers between the identified landslide areas and development areas. The stability of proposed cut and fill slopes will be specifically evaluated during design-level studies. Stabilization measures or setbacks from the identified landslide areas will also be evaluated on cases by case basis.

5.1.6 Densification Due to Earthquake Shaking

Densification of loose granular soils above and below the groundwater level can cause settlement due to earthquake-induced vibrations. This potential hazard is discussed above in the liquefaction section of this report.

5.1.7 Regional Uplift and Crustal Folding

The Jurassic and Cretaceous bedrock at this site is considered to be in the range of 5 to 15 million years old, and as such, the rock has experienced deformation from periods of tectonic stress. As for all sites in the Bay Area, the site may experience broad scale deformations during future seismic events, such as regional uplift or crustal warping. These potential hazards generally must be accepted throughout the Bay Area.

5.2 LANDSLIDES

It is our opinion that the landslide areas shown on the attached Preliminary Geologic Map, Figure 2, have a relatively low likelihood of experiencing future instability that would affect the lower lying portions of the site. Appropriate measures to mitigate potential landslide hazards are dependent on factors such as the size and type of landslide, the relationship of the landslide to the proposed development, and environmental factors such as visibility and tree preservation. Where development encroaches into the mapped landslide areas, remedial grading will be needed to reduce the potential for adverse impacts from slide movement. Specific remedial grading measures should be developed on a case-by-case basis where development encroaches into the mapped landslide areas.

Clayey soils on steeper natural slopes are subject to soil creep. Soil creep is the slow downslope movement of soil that occurs with the annual cycle of wetting and drying under the influence of gravity. The potential for adverse impacts from soil creep can be minimized by benching through

surficial soils during fill placement as recommended in this report and by design of drilled pier foundation systems to accommodate lateral loads from soil creep.

5.3 GRADING CONCEPTS

As project planning progresses, a geotechnical exploration of the site should be performed to further evaluate the geologic conditions described in this report; to characterize the engineering properties of soil and bedrock materials; and to address geotechnical engineering issues such as site preparation, grading, subdrains, keyways, foundations, etc. The recommendations presented herein are for planning purposes and will be refined as part of the geotechnical exploration.

5.3.1 Graded Slopes

Existing cut slopes on the site have gradients as steep as 1.5:1 (horizontal:vertical) and have experienced localized erosion, raveling and instability. It appears that existing cut and fill slopes with gradients of about 2:1, up to about 10 feet high have preformed satisfactorily over a period of many years. Based on our findings at the site and our previous grading experience in the area, we recommend that graded slopes for the project be designed in accordance with the following criteria:

TABLE 5.3.1-1

Graded Condition of Slope	Slope Height (feet)	Maximum Recommended Slope Gradient (horizontal:vertical)
Cut	Up to 10	2:1
Cut	10 to 20	2.5:1
Cut	Greater than 20	3:1
Fill	Up to 15	2:1
Fill	15 to 30	2.5:1
Fill	Greater than 30	3:1

Depending on the findings of future exploration and the availability of select fill material, or if geogrid reinforcement is used, it may be possible to construct fill slopes that exceed the criteria in the above table. Design details for the geogrid-reinforced fill slopes or slopes constructed with higher strength select fill material should be developed during a design-level geotechnical investigation for the project based on laboratory tests of the anticipated fill materials.

A maintenance bench should be provided at the toe of major cut slopes (cut slopes higher than 10 feet) or natural slopes that extend upslope of the area of planned development. The width of

the bench should be approximately 15 feet wide depending on the height and steepness of the adjacent slope. Access to these benches should be provided for maintenance purposes.

A cut slope is currently planned on the upslope side of proposed Lot 29 that would be about 18 feet high and have a gradient of about 2:1. This proposed cut slope is situated on the nose of a spur ridge where we expect to encounter relatively shallow bedrock. We recommend that additional exploration be performed to determine if a 2:1 slope is feasible in this location. If subsurface conditions are such that a 2:1 slope is not feasible, we would recommend that the slope be flattened to a gradient no steeper than 2½:1, or that the slope be reconstructed as an engineered fill slope with an appropriate keyway and subdrainage.

5.3.2 Existing Fill

As noted above, the existing fills have not been constructed in a manner that is consistent with current standards for engineered fill. The character of the existing fills varies widely in terms of material type, thickness, and placement methods. To reduce the potential for adverse settlement or stability problems, we recommend that all existing fills located within the area of planned improvements be removed and replaced with engineered fill. Existing fill materials that are free of deleterious debris may be place on site as engineered fill.

We understand that in some building pad areas, it may be preferable to leave existing fill in place to avoid damage to tree root systems. Additional exploration should be performed in these areas to characterize the thickness and characteristics of the fill. Based on the finding of this exploration it may be possible leave fill in place although specific foundation design recommendations may be needed. Foundation systems such as drilled pier and grade beam foundations may be need that gain support below the depth of the existing fill material.

Most of the existing fill slope located along the rear of Lots 11 through 14 and Lots 18 through 20 will be repaired. For existing fills to be left in place, setbacks from the toe of the existing fill slope can be developed based on the findings of additional exploration to better define the extent of the existing fills. For planning purposes we suggest that all proposed improvements be set back from the toe of the slope a distance equal to, or greater than, the height of the existing fill slope.

5.3.2.1 Existing Drainage Course

An existing drainage course crosses the central portion of the site in the area of proposed Lots 31 and 35. The drainage course is about 4 to 6 feet deep. We recommend that building pads be located outside of a 3:1 upward projection from the toe of bank.

5.3.3 Compressible Alluvium

Compressible alluvial deposits may exist on site and should be characterized and located in future design-level explorations. Placement of compacted engineered fill to achieve design pad

grades will cause settlement of the underlying compressible alluvial deposits. For planning purposes, we estimate approximately ¼ inch of settlement for each foot of engineered fill. The settlement resulting from the fill will be in addition to the settlement from the building loads. The majority of these settlements should occur in the elastic range; therefore, it is anticipated that they should be completed predominantly during construction.

5.3.4 Fill Placement

To reduce the expansion potential of the fill, moisture conditioning of clayey fill materials to above-optimum moisture content should also be anticipated. Detailed fill placement recommendations will be provided based on laboratory testing and analysis performed in conjunction with a design-level geotechnical exploration for the project.

5.4 EXCAVATION CHARACTERISTICS

Based on our previous grading experience in the area, we anticipate that the bedrock materials should, in general, be rippable with conventional heavy grading equipment. Localized well-cemented beds or lenses may be encountered that generate some oversized rocks larger than one foot in diameter. In general, oversized rocks can be placed in areas of deeper fill provided that they are properly placed.

Trenching in areas of deeper bedrock cuts may not be practical for conventional backhoes. Use of heavy duty excavators or removal of bedrock to planned depth of utilities and replacement with engineered fill should be considered in these areas.

5.5 EXPANSIVE SOILS

The expansive nature of the native soil is of significant geotechnical concern in this region. The clayey soil materials at the site are considered highly expansive. Expansive soils are susceptible to shrink and swell resulting from variations in moisture content. Expansive soils and bedrock may cause heaving and cracking of slabs-on-grade, pavements, and foundations. The shrink-swell properties of these materials should be further characterized during a design-level geotechnical investigation for the project. The effects of expansive soils can be mitigated by appropriate grading and foundation design measures. Foundation design is further discussed in the "Preliminary Foundation Design" section of this report.

5.6 PRELIMINARY FOUNDATION DESIGN

The primary considerations for foundation design will be the location of structures on or near slopes and expansive soil conditions. Specific foundation design criteria should be developed for any future structures that are planned. The foundation design should address the highly expansive soil conditions and the potential for foundation elements to experience lateral loads on or near slopes.

In general, for residential structures located on level building pads at least 10 feet from any top of major slopes, mat foundation systems can be used to support small one- or two-story wood-frame structures. Either post-tensioned (PT) slabs or conventional steel reinforced slabs may be used. It is anticipated that structural mats constructed on swelling soils may move differentially. Structural mats may need to be stiffened to reduce differential movements from heaving or settlement to a value compatible with the proposed superstructure type and architectural finishes.

As noted above, it may be preferable in some cases to leave relatively thin existing fills in place on some proposed building pads to avoid damage to existing tree root systems. Depending on the findings of additional exploration it may be possible to leave fill in place although specific foundation design recommendations will be needed. Foundation systems such as drilled pier and grade beam foundations may be need that gain support below the depth of the existing fill material.

5.7 ADDITIONAL GEOTECHNICAL EXPLORATION

As noted above, a geotechnical exploration should be performed to develop design level recommendations for the project. The purpose of these additional studies will be to address geotechnical engineering issues such as site preparation, grading, retaining walls, foundation design, and other improvements. Based on the current development plan, we also anticipate that the design level geotechnical will need to address issues including treatment of areas that will be disturbed by tree removal and demolition of existing improvements.

6.0 LIMITATIONS AND UNIFORMITY OF CONDITIONS

This report is issued with the understanding that it is the responsibility of the owner to transmit the information and recommendations of this report to developers, owners, buyers, architects, engineers, and designers for the project so that the necessary steps can be taken by the contractors and subcontractors to carry out such recommendations in the field. The conclusions and recommendations contained in this report are solely professional opinions.

The professional staff of ENGEO Incorporated strives to perform its services in a proper and professional manner with reasonable care and competence but is not infallible. There are risks of earth movement and property damages inherent in land development. We are unable to eliminate all risks or provide insurance; therefore, we are unable to guarantee or warrant the results of our work.

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0 METERS 1000

BASE MAP SOURCE: GOOGLE EARTH PRO

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VICINITY MAP

BALL PROPERTY

ALAMO, CALIFORNIA

PROJECT NO.: 8346.000.002		FIGURE NO.
SCALE: AS SHOWN		1
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EXPLANATION

TP-7	APPROXIMATE LOCATION OF TEST PIT
B8	APPROXIMATE LOCATION OF BORING
ET-1	APPROXIMATE LOCATION OF TRENCH (ENGEO, 2008)
S-1	APPROXIMATE LOCATION OF TRENCH (SIMPSON, 1994)
	APPROXIMATE LOCATION OF SITE BOUNDARY
	APPROXIMATE LOCATION OF GEOLOGIC CONTACT
Qa	QUATERNARY ALLUVIUM
Qaf	ARTIFICIAL FILL
Tmc	LATE TO MIDDLE MIOCENE MONTEREY FORMATION (CLAY SHALE AND SANDSTONE)
	LANDSLIDE DEPOSIT (ARROW SHOWING GENERAL DIRECTION OF DOWNSLOPE MOVEMENT)

BASE MAP SOURCE: ALIQUOT

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SITE PLAN
BALL PROPERTY
CONTRA COSTA COUNTY, CALIFORNIA

PROJECT NO.: 8346.000.000
SCALE: AS SHOWN
DRAWN BY: PC
CHECKED BY: RPS
FIGURE NO 2

ORIGINAL FIGURE PRINTED IN COLOR

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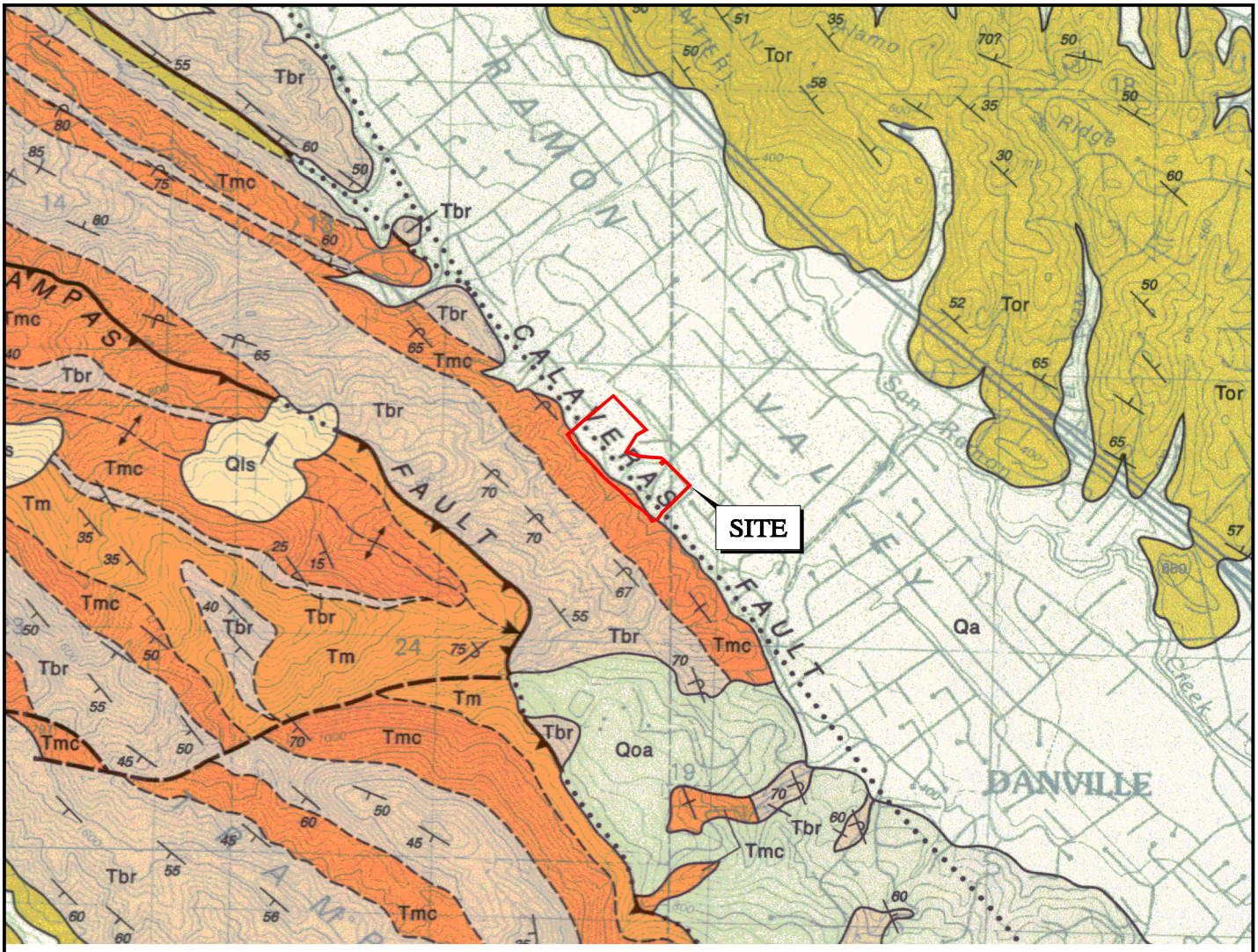

EXPLANATION

Qa	SURFICIAL SEDIMENTS, ALLUVIAL GRAVELS (HOLOCENE, HISTORIC)
Qoa	OLDER SURFICIAL SEDIMENTS (PLEISTOCENE)
Tor	PEBBLE CONGLOMERATE, INTERBEDDED SANDSTONE AND CLAYSTONE OF THE ORINDA FORMATION (PLIOCENE)
Tbr	BRIONES SANDSTONE (LATE MIOCENE)
Tm	SILICEOUS SHALE OF THE MONTEREY FORMATION (MIDDLE TO LOWER MIOCENE)
Tmc	CLAYSTONE, SHALE, AND SILTSTONE OF THE MONTEREY FORMATION (LATE TO MIDDLE MIOCENE)

BEDROCK CONTACT-DASHED WHERE GRADATIONAL OR APPROXIMATELY LOCATED

FAULT-DASHED WHERE INFERRED, DOTTED WHERE CONCEALED, QUERIED WHERE EXISTENCE IS DOUBTFUL

AXIS OF FOLD

ANTICLINE

STRIKE AND DIP OF STRATA

INCLINED VERTICAL OVERTURNED

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BASE MAP SOURCE: DIBBLEE, 2005

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REGIONAL GEOLOGIC MAP

BALL PROPERTY

ALAMO, CALIFORNIA

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SCALE:	AS SHOWN
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FIGURE NO. 3

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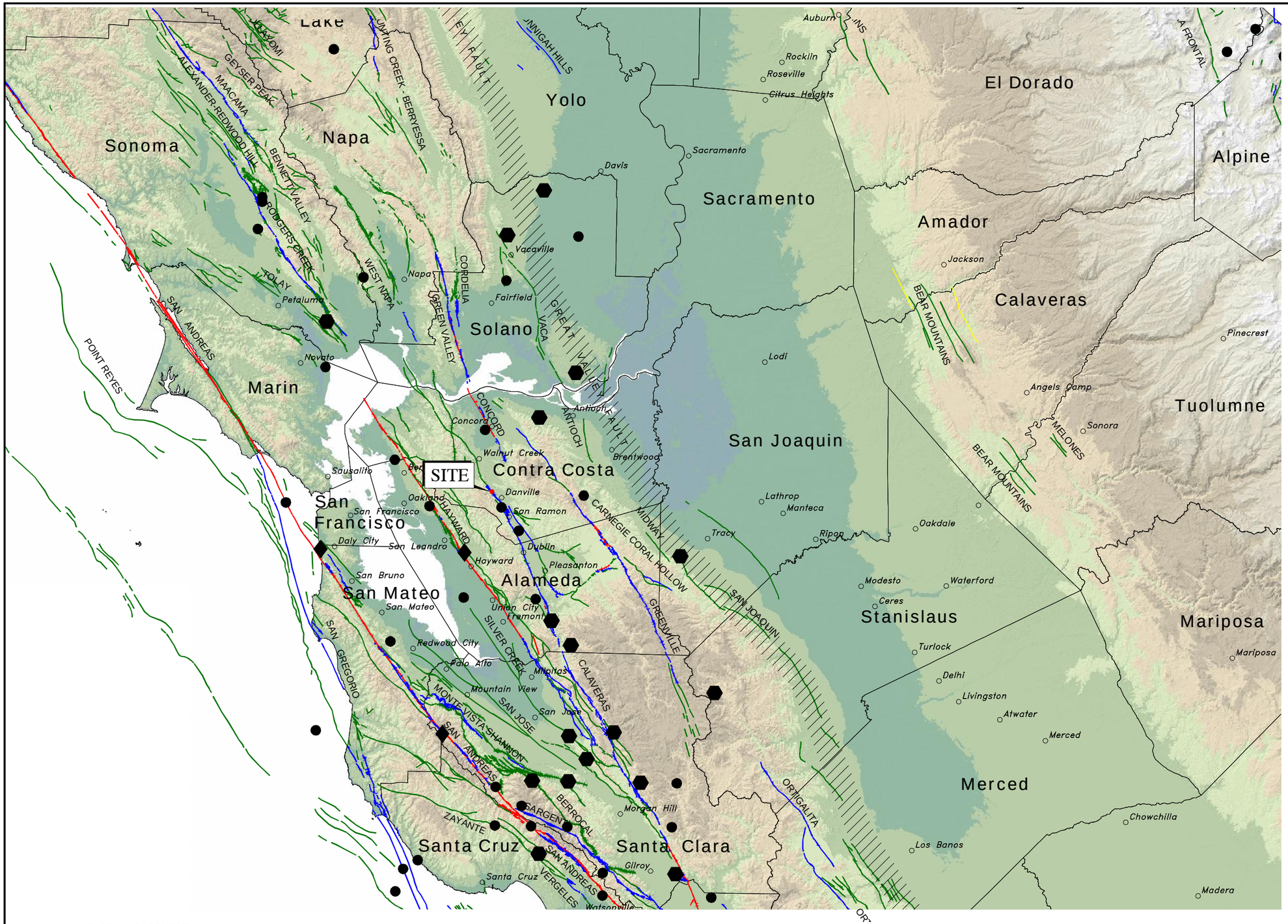

BASE MAP SOURCE:
U.S.G.S. 1-ARC SECOND S.R.T.M. DATABASE
U.S.G.S. QUATERNARY FAULT DATABASE, MARCH, 2006
U.S.G.S. HISTORIC EARTHQUAKE DATABASE (1800-2000)

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REGIONAL FAULTING AND SEISMICITY
BALL PROPERTY
ALAMO, CALIFORNIA

PROJECT NO.: 8346.000.002	FIGURE NO
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EXPLANATION

- LANDSLIDE DEPOSIT. ARROWS INDICATE GENERAL DIRECTION OF DOWNSLOPE MOVEMENT. QUERIED WHERE UNCERTAIN
- Qal — ALLUVIAL DEPOSIT
- Qt — ALLUVIAL TERRACE DEPOSIT. QUERIED WHERE UNCERTAIN
- COLLUVIAL DEPOSIT AND/OR SMALL ALLUVIAL FAN DEPOSIT
- Qaf — ARTIFICIAL FILL
- BEDROCK. QUERIED WHERE IDENTIFICATION UNCERTAIN

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BASE MAP SOURCE: NILSEN, 1975

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REGIONAL LANDSLIDE MAP
BALL PROPERTY
ALAMO, CALIFORNIA

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