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UPDATE GEOTECHNICAL INVESTIGATION
PROPOSED PALA CLUB ESTATES
PALA ROAD
PAUMA VALLEY, CALIFORNIA

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EXECUTIVE SUMMARY

This investigation was performed to provide site-specific geotechnical engineering information for the proposed residential subdivision in Pauma Valley, California. Although a site plan was not provided for our services, it is understood that the proposed development includes construction of multiple single family residences and associated improvements (utilities, flatwork, landscaping, etc.).

Our investigation found that the site is underlain by Quaternary Alluvium to the maximum explored depth of approximately 19. 5 feet below grade (fbg). Quaternary Alluvium soils were found to consist dominantly of loose to medium dense, dry to slightly moist, silty fine sand with abundant cobbles and boulders. Groundwater was not encountered in any of the borings to the maximum explored depth of approximately 19. 5 fbg and therefore groundwater is not expected to affect the proposed development.

With respect to geologic and seismic hazards, the site is considered as safe as any within the San Diego County area, a region of moderate to high seismic risk. Based on the geologic findings and reference review, no active surface faults are known to exist at the site. However, the Julian Strand of the Elsinore Fault, the nearest active fault trace of the Elsinore fault zone lies approximately five kilometers northeast of the site. The site would experience significant ground shaking should earthquakes occur along this fault during the useful life of the development.

1.0 INTRODUCTION AND SCOPE OF SERVICES

1.1 Introduction

This report presents the results of our geotechnical engineering investigation and provides conclusions and design criteria for the proposed development. It is our understanding that site improvements will consist of multiple one- to two-story, wood frame, single family residences and ancillary development including landscaping, concrete flatwork, etc. Figures 1 and 2 are maps showing the general location of the site and locations of our explorations.

Our investigations included previous report review, field exploration, laboratory testing, geologic hazard evaluation, and engineering analysis. A previous geotechnical report was issued by Western Soil and Foundation Engineering, Inc. and is included with this report as Appendix E. Specific recommendations for excavations, fill placement, and foundation design for the proposed improvements are presented in this report. Cited references are presented in Appendix A.

1.2 Scope of Services

Our scope of services included:

- Review of readily available geologic reports and documents pertinent to the site area.
- Explorations to determine subsurface conditions to the depths influenced by the proposed construction.
- Laboratory testing of representative soil samples to provide data to evaluate the geotechnical design characteristics of the site foundation soils.
- Definition of the general geology and evaluation of potential geologic hazards at the site.
- Preparation of this report detailing the investigations performed and providing conclusions and geotechnical engineering recommendations for design and construction.

2.0 SITE LOCATION AND DESCRIPTION

The proposed approximate 30- acre project is located at an existing orchard/open space on Pala Road in Pauma Valley, California. The rectangular-shaped parcel is located on Pala Road, north of the intersection with Luiseno Circle Drive in Pauma Valley, California. The site area is primarily utilized for residential and agricultural purposes. The Pauma Valley Country Club borders the site to the southeast. The San Luis Rey River lies to the southwest of the site.

The site elevations range from approximately 795 to 885 feet above mean sea level (msl), sloping towards the river to the southwest. Figure 1 is a map showing the general site location and the topography of the area.

3.0 FIELD AND LABORATORY INVESTIGATION

3.1 Field Investigations

Field explorations, conducted September 27, 2005 included site reconnaissance, the drilling of six (6) exploratory borings, and the excavation of six (6) exploratory test pits to assess the condition of the subsurface soil materials. The soil borings were excavated using a truck-mounted drill rig equipped with 8-inch hollow-stem augers to a maximum depth explored of approximately 19. 5 fbg. Test pits were excavated using a rubber-tire backhoe. Soils were logged and visually classified (using the Unified Soil Classification System) in the field by a geologist. The field descriptions have been modified, where appropriate, to reflect laboratory test results. Soil exploration logs including descriptions of the soil, *in situ* field-testing data, and supplementary laboratory data are included in Appendix B. Approximate exploration locations are shown on Figure 2.

Relatively undisturbed soil samples were obtained with standard split-spoon samplers. Specifics of our soil boring and sampling program are presented in Appendix B. Bulk soil samples were also collected for geotechnical laboratory analysis. All soil samples were transported to the CTE geotechnical laboratory for analysis.

3.2 Laboratory Investigation

Specific laboratory tests conducted for this investigation included: in-place moisture and density, max dry density (modified proctor), grain size analysis, R-Value, chemical analysis, and consolidation. These tests were conducted to determine the engineering properties of onsite soils. Test method descriptions and laboratory results are presented in Appendix C.

4.0 GEOLOGY

4.1 General Physiographic Setting

The site is located in San Diego County, within the central mountain area of the Peninsular Ranges geomorphic province. The central –mountain area ranges in elevation from approximately 500 to 5000 feet above mean sea level and is characterized by Cretaceous and Jurassic crystalline ridges and mountains with intermontane basins that are generally underlain with a moderate thickness of alluvium and residual soils.

4.2 Geologic Conditions

According to mapping by Kennedy (2000), surface and near-surface soils at the site consist of Quaternary Alluvium. These materials represent sediments of stream terrace deposits generated by the nearby San Luis Rey River. Although not encountered during our explorations or those by others (Western, 2005), it is believed this material is underlain at depth by Cretaceous Granitic Bedrock.

4.2.2 Quaternary Alluvium

Recent alluvial floodplain deposits were encountered across the site and at depth within all of our explorations. Alluvial materials generally excavated with the backhoe to depths up to 13 fbg consisted of loose to medium dense, dry to slightly moist, gray brown to brown, silty fine grained SAND with abundant cobbles and occasional boulders. The pit walls typically collapsed within these materials due to there unconsolidated nature. These materials will require overexcavation and recompaction as outlined herein. Based on the blow counts collected during advancement of the bore holes, soils classified as dense to very dense from approximately 5 fbg to the maximum explored depth of 19.5 fbg. Correlation of the boring logs with the test pit logs indicates that these blow counts are elevated, due to the sample being driven on cobbles.

4.2.3 Cretaceous Bedrock

Cretaceous Bedrock, possibly a unit of the Tonalite of Cole Grade, is exposed along the hillsides surrounding the subject site. This granitic material, although not encountered is anticipated to underlie the site at depths greater than those influenced by the proposed construction.

4.3 Groundwater Conditions

Groundwater was not encountered in our explorations to the maximum explored depth of 19.5 fbg or the explorations performed by others (Western, 2005) to maximum depths of 50 fbg. Based on the depth to groundwater and our understanding of the project, we do not anticipate that groundwater will affect the proposed improvements if existing drainage patterns are maintained and site drainage is addressed by the civil engineer.

4.4 Geologic Hazards

Based on our reference review and observations, it appears that geologic hazards at the site are primarily limited to those caused by violent shaking from earthquake generated ground motion waves. The potential for damage from displacement or fault movement beneath the proposed structures should be considered low.

4.4.1 Local and Regional Faulting

Based on our site reconnaissance, evidence from our exploratory soil borings, and a review of appropriate geologic literature, it is our opinion that no known active fault traces underlie the site. The Elsinore Fault (Julian Strand), approximately five kilometers to the northeast, is the closest known active fault (Jennings, 1996). Other principal active regional faults include: Rose Canyon, Coronado Banks, San Clemente, Superstition Hills, Newport-Inglewood, San Jacinto, and San Andreas faults. According to the California Division of Mines and Geology, a fault is active if it displays evidence of activity in the last 11,000 years (Hart, 1994).

4.4.2 Site Near Source Factors and Seismic Coefficients

In accordance with the Uniform Building Code 2001 edition, Volume 2, Figure 16-2, the referenced site is located within seismic zone 4 and has a seismic zone factor of Z=0.4. The nearest active fault, the Elsinore Fault (Julian Strand), is approximately five kilometers to the northeast and is considered a Type A seismic source. Based on the distance from the site to the Elsinore Fault, near source factors of N_V=1.6 and N_a=1.2 are appropriate. Based on the subsurface explorations, we conservatively assigned a soil profile type of S_D and seismic coefficients C_V=1.02 and C_a=0.53.

4.4.3 Liquefaction and Seismic Settlement Evaluation

Liquefaction occurs when saturated fine-grained sands or silts lose their physical strengths during earthquake induced shaking and behave as a liquid. This is due to loss of point-to-point grain contact and transfer of normal stress to the pore water. Liquefaction potential varies with water level, soil type, material gradation, relative density, and probable intensity and duration of ground shaking.

Based on our understanding of site geology, the nature of the underlying materials (grain sizes and clay content), and the lack of a shallow groundwater table, it is our opinion that the potential for liquefaction damage to proposed improvements should be considered low.

Seismic settlement occurs when loose to medium dense granular soils densify during seismic events. The preparatory grading recommended herein is anticipated to minimize the adverse affects of differential seismic settlement.

4.4.4 Tsunamis and Seiche Evaluation

According to McCulloch (1985), the tsunami potential in the San Diego County coastal area for one-in-100 and one-in-500 year tsunami waves are approximately four and six feet. This suggests that there is a very low probability of site damage due to the elevation of the site (approximately 500 feet above msl) and distance (approximately 24 miles) from the ocean. The site is not near any significant bodies of water that could induce seiche damage.

4.4.5 Flooding

The site is located outside the 500 year and 100 year flood zones. Based on a review of the PGMA flood insurance maps for the San Diego County, map number 06073C0536F, June 19, 1997. Therefore the potential for flooding to affect the site is considered low.

4.4.6 Landsliding or Rocksliding

According to geologic mapping (Kennedy, 2000) and our observations, the site area is considered generally non-susceptible to landsliding. Active landslides were not encountered during our investigations and have not been mapped near the site. Therefore, we do not expect landsliding to be a significant hazard within or immediately adjacent to the proposed development if site grades are not dramatically modified. Based on our understanding of the project, such grading is not anticipated.

4.4.7 Compressible and Expansive Soils

Based on laboratory and *in-situ* testing, shallow alluvial soil materials at the site generally consist of loose to medium dense silty sands. However, these materials will be overexcavated and recompacted. Therefore, the as-graded site conditions will have low compressibility characteristics and low expansive characteristics, and are considered suitable for support of the proposed construction provided recommendations presented herein are implemented.

4.4.8 Corrosive Soils

Based the results of analytical testing performed on materials obtained from the site, it appears that soils have a low potential for corrosion to Portland cement concrete. However, soils may have a low to mild potential for corrosion to buried ferrous metals. CTE does not practice corrosion engineering. Therefore, if additional information or recommendations are required, the project coordinators shall retain a qualified corrosion engineer.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 General

We conclude that the proposed construction on the site is feasible from a geotechnical standpoint, provided the recommendations in this report are incorporated into the design of the project. The major geotechnical factor affecting the proposed development is the presence of loose alluvial materials in the proposed project development areas. Recommendations for the design and construction of the proposed structures and improvements are included below.

5.2 Site Preparation

Before grading, the site should be cleared of any existing debris, asphalt and other deleterious materials. In areas to receive structures or distress-sensitive improvements, expansive, surficial eroded, desiccated, burrowed, or otherwise loose or disturbed soils should be removed to the depth of competent materials, which are anticipated to vary between six and ten feet below existing grades. A determination of the suitability of the exposed subgrades should be made in the field by an engineer or geologist from this firm. Localized, deeper excavations may be necessary in order to remove inadequate soils. Organic rich or clayey soils, concrete slab debris and other deleterious materials not suitable for structural backfill should be disposed of offsite at a legal disposal site.

Based on the presence of loose alluvial soils, areas beneath the proposed new structure are to be excavated to the greater of either dense underlying materials (expected to be up to approximately six to ten fbg) or to a minimum depth of 24 inches below all proposed footings to minimize effects of differential settlements. Overexcavations shall extend a minimum 10 feet laterally beyond structures.

5.3 Site Excavations

Excavations can generally be accomplished using heavy-duty construction equipment. Although not anticipated, localized boulders or very hard zones may be encountered during these operations. Grading activities should be continuously monitored by CTE. Such observations are essential to identify field conditions that differ from those identified during our subsurface investigation and adjust designs to actual field conditions encountered.

5.4 Fill Placement and Compaction

As stated, an engineer or geologist from CTE should be called upon to verify that the proper site preparation has occurred before fill placement begins. Following the removal of loose or disturbed soils, areas to receive fills or concrete slabs on grade should be scarified, moisture conditioned to above optimum moisture content, and properly compacted. Fill and backfill should be compacted to a minimum relative compaction of 90 percent as evaluated by ASTM D-1557 at moisture contents between optimum and two percent above optimum. The optimum lift thickness for backfill soil will be dependent on the type of compaction equipment used. Generally backfill should be placed in uniform lifts not exceeding eight inches in loose thickness. Backfill placement and compaction should be done in overall conformance with geotechnical recommendations and local ordinances.

5.5 Fill Materials

Soils derived from on-site materials are considered suitable for reuse on the site as fill, provided they are screened of organic materials and materials greater than three inches in maximum dimension. Finish grade fill materials may require evaluation for expansion and corrosion potential upon completion of rough grading.

Imported fill beneath structures, pavements and walks should have an expansion index less than or equal to 30 (per UBC 18-I-B) with less than 35 percent passing the no. 200 sieve. Imported fill soils for use in structural or slope areas should be evaluated by the soils engineer to determine strength characteristics before placement on the site.

5.6 Temporary Construction Slopes

Sloping recommendations for unshored temporary excavations are provided herein. The recommended slopes should be relatively stable against deep-seated failure, but may experience localized sloughing. Recommended slope ratios are set forth in Table 1.

TABLE 1
RECOMMENDED TEMPORARY SLOPE RATIOS

SOILS TYPE	SLOPE RATIO (Horizontal: Vertical)	MAXIMUM HEIGHT
C (Quaternary Alluvium)	1.5:1 (MAXIMUM)	10 FEET

Actual field conditions and soil type designations must be verified by a "competent person" while excavations exist according to Cal-OSHA regulations. In addition, the above sloping recommendations do not allow for potential water seepage or surcharge loading at the top of slopes by vehicular traffic, equipment or materials. Appropriate surcharge setbacks must be maintained from the top of all unshored slopes.

5.7 Foundations and Slab Recommendations

The following recommendations are for structure design and improvement installation purposes only. These recommendations should be reviewed after completion of earthworks to verify that conditions exposed are as anticipated and structure design parameters recommended are appropriate.

The proposed project includes the constructing of a one-story building founded near existing grade. It is anticipated that the proposed base of the structure will be founded on engineered fill using shallow spread and continuous footings. To eliminate the potential for differential settlements of these lightly-loaded structures, building foundations should bear entirely on engineered fills designed as indicated herein.

5.7.1 Shallow Foundations

Continuous and isolated spread footings are suitable for use at this site. However, footings should not straddle cut/fill interfaces. We anticipate that all building footings will be founded entirely in properly recompacted fills. Foundation dimensions and reinforcement should be based on allowable bearing values of 1,000 pounds per square foot (psf) for footings founded in properly recompacted fill materials. The allowable bearing value may be increased by one third for short duration loading which includes the effects of wind or seismic forces.

Footings should be at least 12 inches wide and installed at least 12 inches below the lowest adjacent subgrade for single-story structure, and 15 inches wide and 18 inches below grade for two-story structures.. Footing reinforcement for continuous footings should consist of four No. 4 reinforcing bars; two placed near the top and two placed near the bottom or as per the project structural engineer. Isolated footing reinforcement should be designed by the structural engineer.

The maximum total static settlement is expected to be on the order of 1.0 inches and the maximum differential settlement is expected to be on the order of 0.5 inches. Due to absence of shallow groundwater, dynamic settlement is not expected to adversely effect the proposed improvements.

5.7.2 Foundation Setback

Footings for structures should be designed such that the minimum horizontal distance from the face of adjacent slopes to the outer edge of the footing is a minimum of 10 feet.

5.7.3 Lateral Load Resistance

The following recommendations may be used for shallow footings on the site. Foundations placed in engineered fill materials may be designed using a coefficient of friction of 0.30 (total frictional resistance equals the coefficient of friction times the dead load). A design passive resistance value of 250 pounds per square foot per foot of depth (with a maximum value of 1000 pounds per square foot) may be used. The allowable lateral resistance can be taken as the sum of the frictional resistance and the passive resistance, provided the passive resistance does not exceed two-thirds of the total allowable resistance.

5.7.4 Concrete Slab-On-Grade

Lightly loaded concrete slabs should be a minimum of four inches thick. Minimum slab reinforcement should consist of #3 reinforcing bars placed on 18-inch centers each way at mid-slab height. In moisture sensitive floor areas, a vapor barrier of ten-mil visqueen overlying a maximum two-inch layer of compacted clean sand or crushed gravel should be installed. At a maximum, a two-inch layer of clean sand or crushed gravel may be placed above the visqueen to protect the membrane during steel and concrete placement. Slabs subjected to heavier loads may require thicker slab sections and/or increased reinforcement.

5.7.5 Basement and Retaining Walls

For the design of walls below grade where the surface of the backfill is level, it may be assumed that the soils will exert an active lateral pressure equal to that developed by a fluid with a density of 38 pcf. The active pressure should be used for walls free to yield at the top at least 0.2 percent of the wall height. For walls restrained so that such movement is not permitted, an equivalent fluid pressure of 58 pcf should be used, based on at-rest soil conditions.

The above values assume non-expansive backfill and free draining conditions. Measures should be taken to prevent a moisture buildup behind all walls below grade. Drainage measures should include free draining backfill materials and perforated drains. Drains should discharge to an appropriate offsite location. The project architect should evaluate the necessity of waterproofing or a relatively flat composite drain system along the exterior of any basement walls.

We recommend that walls below grade be backfilled with soils having an expansion index of 20 or less. The backfill area should include the zone defined by a 1:1 sloping plane, extended back from the base of the wall. Wall backfill should be compacted to at least 90 percent relative compaction, based on ASTM D1557-91. Backfill should not be placed until walls have achieved adequate structural strength. Heavy compactors, which could cause distress to walls, should not be used.

5.8 Exterior Flatwork

To reduce the potential for distress to exterior flatwork caused by minor settlement of foundation soils, we recommend that such flatwork be reinforced and installed with crack-control joints at appropriate spacing as designed by the project architect. Flatwork, which should be installed with reinforcement and crack control joints, includes driveways, sidewalks, and architectural features. All subgrade should be prepared according to the earthwork recommendations previously given before placing concrete. Positive drainage should be established and maintained adjacent to all flatwork.

5.9 Plan Review

CTE should review project grading and foundation plans before the start of earthworks to identify potential conflicts with the recommendations contained in this report.

6.0 LIMITATIONS OF INVESTIGATION

The recommendations provided in this report are based on the anticipated construction and the subsurface conditions found in our explorations. The interpolated subsurface conditions should be checked in the field during construction to verify that conditions are as anticipated.

Recommendations provided in this report are based on the understanding and assumption that CTE will provide the observation and testing services for the project. All earthworks should be observed and tested to verify that grading activity has been performed according to the recommendations contained within this report. The project engineer should evaluate all footing trenches before reinforcing steel placement.

The field evaluation, laboratory testing and geotechnical analysis presented in this report have been conducted according to current engineering practice and the standard of care exercised by reputable geotechnical consultants performing similar tasks in this area. No other warranty, expressed or implied, is made regarding the conclusions, recommendations and opinions expressed in this report. Variations may exist and conditions not observed or described in this report may be encountered during construction.

Our conclusions and recommendations are based on an analysis of the observed conditions. If conditions different from those described in this report are encountered, our office should be notified and additional recommendations, if required, will be provided upon request. CTE should review project specifications for all earthwork, foundation, and shoring-related activities prior to the solicitation of construction bids. We appreciate this opportunity to be of service on this project. If you have any questions regarding this report, please do not hesitate to contact the undersigned.

Respectfully submitted,

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