Appendix H –
Fault Hazard Assessment Report
Prepared by American Geotechnical, Inc. dated November 2012

American Geotechnical, Inc.
GEOTECHNICAL ENGINEERING / MATERIALS TESTING & INSPECTION

FAULT HAZARD ASSESSMENT REPORT
"WHITTIER FAULT ZONE"
ADDRESSING A PORTION OF THE PROPOSED ESPERANZA HILLS RESIDENTIAL DEVELOPMENT PROJECT IN THE SOUTHEASTERN PUENTE HILLS
UNICORPORATED ORANGE COUNTY, SOUTHERN CALIFRONIA

Prepared for:

Yorba Linda Estates, LLC
7441 E. Stetson, Suite 350
Scottsdale, Arizona 95251

Prepared by:

American Geotechnical, Inc.
22725 Old Canal Road
Yorba Linda, California 92887
Project No. 33366-01

November 2012

American Geotechnical, Inc.
GEOTECHNICAL ENGINEERING / MATERIALS TESTING & INSPECTION

November 30, 2012

Project No. 33366-01

Yorba Linda Estates, LLC
7441 E. Stetson, Suite 350
Scottsdale, Arizona 85251

Attention: Mr. Doug G. Wymore, Attorney at Law

Subject: **FAULT HAZARD ASSESSMENT REPORT**
"Whittier Fault Zone"
Addressing a Portion of Proposed Esperanza Hills Residential Development in the Southeastern Puente Hills, Unincorporated County of Orange, Southern California

American Geotechnical, Inc. (AG) is pleased to submit this Fault Hazard Assessment Report relating to the planned 340-home residential subdivision project referred to as the Esperanza Hills Development (EHD). Conceptual design plans show the south margin of the EHD as occurring within the "active" Whittier fault zone (WFZ) designated by the state of California under the Alquist-Priolo Earthquake Fault Zone (AP Zone) Act.

The goals of the assessment were to identify fault locations within the AP Zone, evaluate the recency of activity and surface rupture potential associated with each fault, and establish a "seismic setback zone" within which future construction of habitable structures should be avoided.

An extensive review of geologic and geotechnical literature was conducted, and field work including excavation of five exploratory fault trenches over 2,500 feet in total length. Graphic trench logs, geologic maps and cross sections were prepared for inclusion in our report. Findings and conclusions of the assessment are provided herein along with recommendations for proposed development. The report format follows guidelines published by the state for such assessments (CGS, 2002).

The principal Whittier fault trace (trending N55W to N70W) was encountered within our trenches along a narrow zone a few feet in width. The zone contains one to two closely-spaced high-angle bedrock faults with associated local fault gouge and disarticulated bedding. Buried fault scarps and infilled grabens (partially truncated by grading) occur at the surface above the principal fault trace.

22725 Old Canal Road, Yorba Linda, CA 92887 - (714) 685-3900 - FAX (714) 685-3909
5764 Pacific Center Blvd., Suite 112, San Diego, CA 92121 - (858) 450-4040 - FAX (858) 457-0814
3100 Fite Circle, Suite 103, Sacramento, CA 95827 - (916) 368-2088 - FAX (916) 368-2188
5600 Spring Mountain Road, Suite 201, Las Vegas, NV 89146 - (702) 562-5046 - FAX (702) 562-2457

A series of secondary faults were observed as decreasing in frequency, dip angle and relative magnitude of offset away from the principal fault trace to the north. The pattern of principal and secondary faults forms a distinctive upward-flowering structure that is coincident with supporting evidence for active faulting including a major deflected stream channel, proximity to a narrow, linear, northwesterly trending ridgeline and zone of active oil wells. It also is in alignment with the main trace of the Whittier fault and consistent with the single trace configuration documented by past offsite earthwork to the northwest and southeast.

For design purposes the principal and secondary faults are considered active. We established a seismic setback zone that extends a maximum distance of 120 feet northward of the principal fault trace. Fault studies by other consultants are currently ongoing directly west of the property on the "Sage" parcel. These studies are also under purview of the County of Orange. Establishment of an appropriate seismic setback zone south of the principal trace is partly dependent upon the findings of that work. No habitable structures are currently proposed to the south of the principal fault trace. Our fault trenches did not therefore significantly extend into these areas. In a verbal agreement with the County, and to avoid publication of conflicting setback zones, we concluded we would await issuance of the forthcoming fault study by others before specifying a setback zone in this area.

A major linear canyon located northward of the setback zone is underlain by two distinct unbroken deposits of alluvium. Using a Carbon-14 radiometric dating technique on two in-situ charcoal samples collected from the older deposit, an age range of 12,000 to at least 13,310 years before the present (ybp) was obtained. The age dates confirm the absence of any active fault(s) within the canyon and provide further support for the location of the setback zone.

A few other much older faults were observed to the north of the canyon interpreted to be "inactive" based on an absence of any tectonic landform geomorphology, discontinuation of the fault traces into overlying surface deposits, significant degree of pedogenesis (soil formation) exhibited by capping surface deposits, relative severity of weathering exhibited by the bedrock, and absence of overlying scarps or infilled grabens.

The nearest proposed residential building lot lies approximately 30 feet north of the setback zone. Based on the findings of our assessment we conclude that the setback zone encompasses all active fault traces capable of possible future offset during a major earthquake, and potential surface rupture hazards to structures planned for human occupancy have been sufficiently mitigated.

Although not currently proposed, construction of buildings intended for human occupancy should be avoided inside the limits of the established seismic setback zone. The right-lateral style and magnitude of anticipated surface rupture should also be incorporated into future design plans within the seismic setback zone where possible. Construction of utilities across the fault zone should incorporate flexible connections capable of sustaining their integrity following an abrupt lateral offset associated with a surface rupture event.

Field exposures of faulting and general geology were observed within several of our trenches by professional geologists from the County of Orange, California Geological Survey and consultting geologists with Seward Engineering Geology, Inc. There was near universal agreement between all parties concerinig our geologic interpretations, including identification of principal and branch faults and absence of evidence for active faulting beyond the established 120-foot wide seismic setback zone. The professionals (excluding County of Orange) also reviewed draft copies of our tench logs and expressed a similar level of agreement with our interpretations.

A final copy of this report should be submitted to the California Geological Survey for inclusion in open-file records of the Alquist-Priolo Earthquake Fault Zoning Program.

We appreciate the opportunity to be of service and look forward to our continued professional relationship.

Respectfully submitted,

PROFESSIONAL GEOLOGIST
JEFF L. HULL
No. 2056
CERTIFIED
ENGINEERING
GEOLOGIST
STATE OF CALIFORNIA

Jeff L. Hull, CEG 2056, PG 8364
Chief Engineering Geologist
American Geotechnical, Inc.

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1.0 INTRODUCTION

1.1 General Statement

Presented herein are the findings of an Earthquake Fault Zone Hazard Assessment (HA) undertaken by American Geotechnical, Inc. (AG) to address proposed Option 1 and Option 2 conceptual design plans for a 340-unit residential community, referred to as the Esperanza Hills Development (the development), located within an unincorporated area of Orange County and sphere of influence of the City of Yorba Linda, southern California. Included herein are assessment findings and conclusions as well as certain recommendations pertaining to implementation of the conceptual design plan.

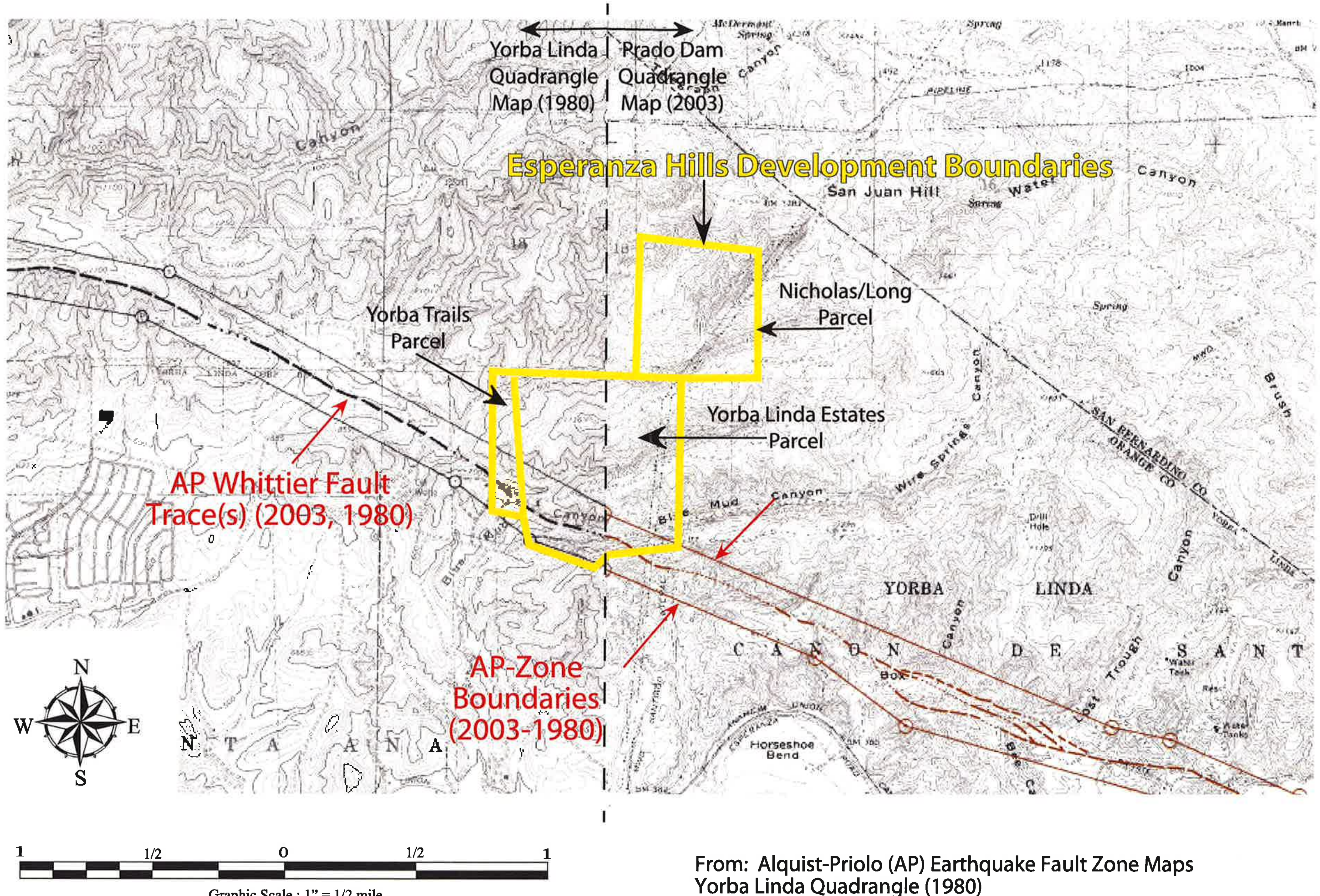
The scope of the HA and format of this report are based in part on guidelines published by the California Geological Survey (2002 version, Note 49 entitled “Guidelines for Evaluating the Hazard of Surface Fault Rupture,”). Fieldwork was completed in accordance with requirements of Orange County Grading Permit No. GA120003, and tasks outlined within our Draft Scope of Work and Cost Estimate Agreement submitted to Yorba Linda Estates, LLC (the client) dated October 10, 2011.

1.2 Property Description

1.2.1 Global Development Property

The overall Esperanza Hills Development property lies along the southeastern flank of the Puente Hills within the northern Peninsular Ranges Geomorphic Province of California (Figure 1). Property boundaries straddle both the Yorba Linda and Prado Dam 7.5-Minute Topographic Quadrangle Maps. Approximately 469 acres are bounded by an irregular-linear shaped borders. Except for local access roads and cut pads associated with oil/gas production and Southern California Edison (SCE) transmission towers, the property largely retains its original natural configuration (Figure 2).

Property ownership is divided into three contiguous parcels, each with specific boundaries and name designations periodically referred to by name throughout this report. The Yorba Linda Estates, LLC (YLE parcel) consists of 279 acres in the central and south portion of the property. The Yorba Trails, LLC (Simmons parcel) consists of 33 acres along the western property margin. And the Nicholas/Long parcel consists of 157 acres occupying the northeast portion of the property. Active oil/gas production operations



From: Alquist-Priolo (AP) Earthquake Fault Zone Maps
Yorba Linda Quadrangle (1980)
Prado Dam Quadrangle (2003)

Regional Topographic Location Map			Figure 1
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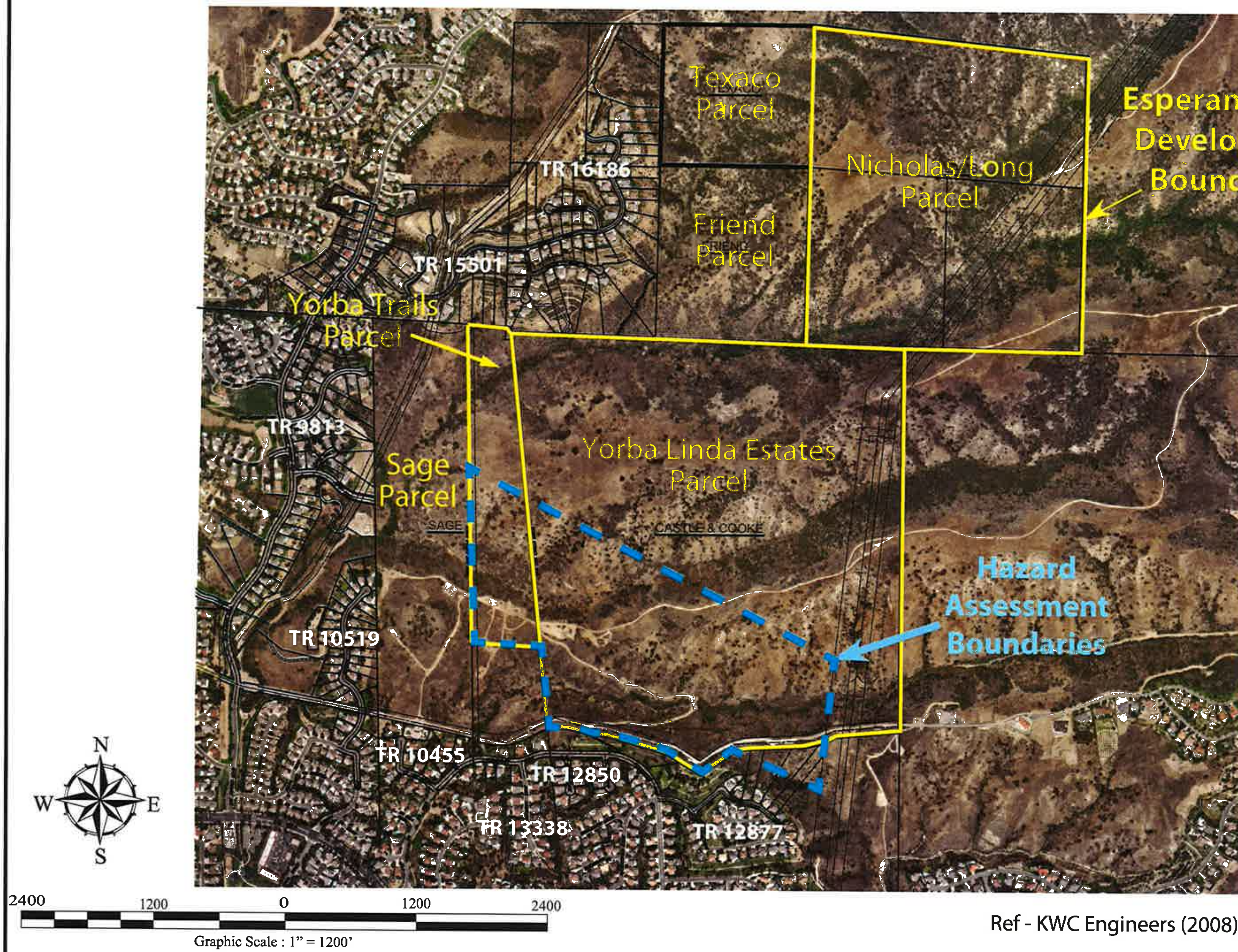

Ref - KWC Engineers (2008)

Orthophoto Map			Figure 2
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are limited to the southerly Simmons and YLE parcels just south of the principal trace of the Whittier fault, including pumping oil wells and aboveground storage tank facilities. The facilities operate under lease agreements with parcel owners.

Current 1:24,000-scale Alquist-Priolo Earthquake Fault Zone (AP Zone) Maps were used as the base map for attached Figure 1 (USGS, 2003; 1980). Topographic relief across the greater property area is manifest as a series of narrow alternating ridgelines and steep-walled canyons. Elevations range from approximately 600 feet above mean sea level (MSL) on the south to 1,540 feet above MSL on the north. The overall direction of drainage path is from east to west. The CGS is in the process of updating official AP Zone maps for the area.

Beyond the property boundaries are similar undeveloped hilly terrain to the north, east and west. Land to the north and east lies within the boundaries of the Chino Hills State Park. To the west, from north to south, is land designated as the Texaco, Friend and Sage parcels (Figure 2). The Texaco and Friend parcels are undeveloped while the Sage parcel is modified only locally by minor oil/gas production activities. It is our understanding that owners of the Sage parcel have plans to develop a residential subdivision under the name of Cielo Vista. Their geotechnical consultants were performing fault studies on that parcel concurrent with the subject investigation.

Further west are existing residential tracts incorporated within the City of Yorba Linda. These include Tract (TR) 16186 (Casino Ridge) to the west of Friend, TR 15501 to the north of Sage and TR 9813 and TR 10519 to the west of Sage (Figure 2). South of the YLE parcel are tracts TR 10455, TR 13338, TR 12850 and TR 12877, from west to east respectively.

Major nearby streets include Stonehaven Drive along the south and San Antonio Drive on the west (Figure 3a). Aspen Way, a branch street extending easterly from San Antonio Drive, terminates at the western margin of the Sage parcel. Current vehicular access to the property is via an unimproved dirt road connecting with Stonehaven Drive (Figure 2).

1.2.2 Hazard Assessment Area

Boundaries of the subject Fault Hazard Assessment area (HA-Site) generally span the southern portion of the Simmons and YLE parcels (Figures 3a/3b, Plates 1a/1b). The north boundary of the HA-Site extends beyond the northern AP Zone boundary and runs parallel to it. The southern limits of the proposed conceptual design plan occur within the boundaries of the AP Zone. Fault trenching was conducted in the northern portion of the HA-Site in areas generally coincident with proposed design grading improvements (Plate 1a/1b).

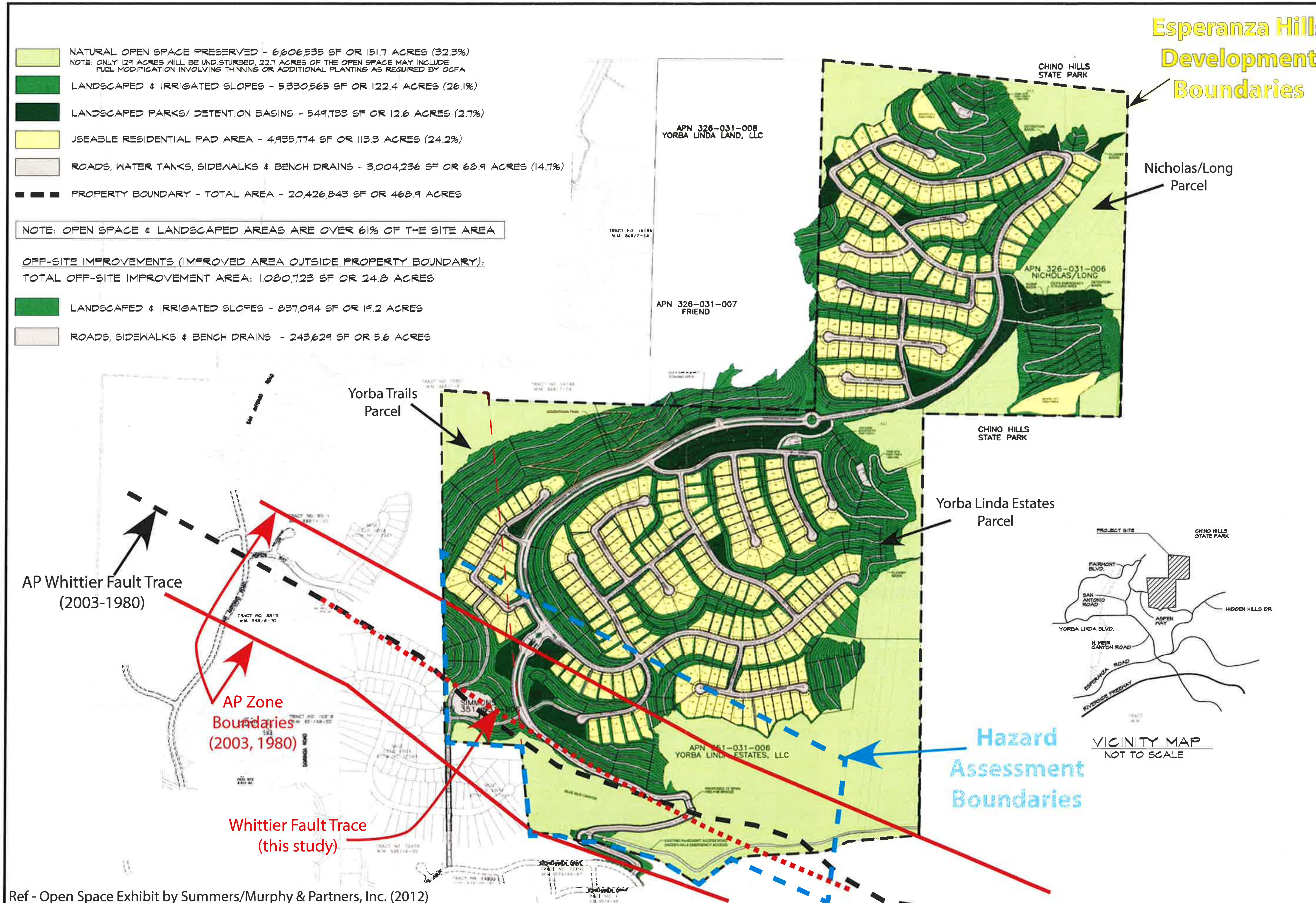
1.3 Conceptual Design Plans

Two conceptual design plan options are presented herein as Options 1 and 2. The plans differ most significantly in their proposed route of major access/egress. Both options include a total of 340 single family residential lots/building pads with supplemental roadways, emergency access routes, parks, cut/fill slopes, hiking trails, detention basins, water tanks, retaining walls and other infrastructure (Figures 3a/3b and Plates 1a/1b). The southerly portion of the main residential development encroaches into the northern end of the HA-Site area for each option.

1.3.1 Option 1 Plan

The main route of access/egress for Option 1 closely follows that of the existing unimproved access road connecting with Stonehaven Drive on the south (Figure 3a). From Stonehaven Drive the road descends the south wall of Blue Mud Canyon. Road grades are shown as accommodated by use of a retaining wall up to 35 feet in height along the downslope side of the roadway. A 75-foot pre-fabricated bridge is shown as accommodating the roadway across the bottom axis of the canyon. From the bridge to the development area the road generally follows the principal trace of the Whittier fault. Road grades are shown as accommodated by a retaining wall up to 45 feet high. The road transects the toe of a large fill slope along the side of the canyon, extending to its intersection with “G” Street.

The plan also includes construction of an emergency access road along the westerly property boundary, extending from existing Via del Agua on the south across Blue Mud Canyon to an intersection with proposed “C” Street on the north. Road grades are shown to be partially achieved by construction of 35-foot high retaining walls along each side of the road. The general configuration of the Option 1 plan is depicted on our Geologic Map (Plate 1a) and Generalized Geotechnical Cross Section A-A’ (Plate 2).



REVISIONS

AMERICAN GEOTECHNICAL, INC.
22725 Old Canal Road, Yorba Linda, CA 92887
PHONE: (714) 685-3900, FAX: (714) 685-3909

Esperanza Hills Conceptual Design Plan
Option 1
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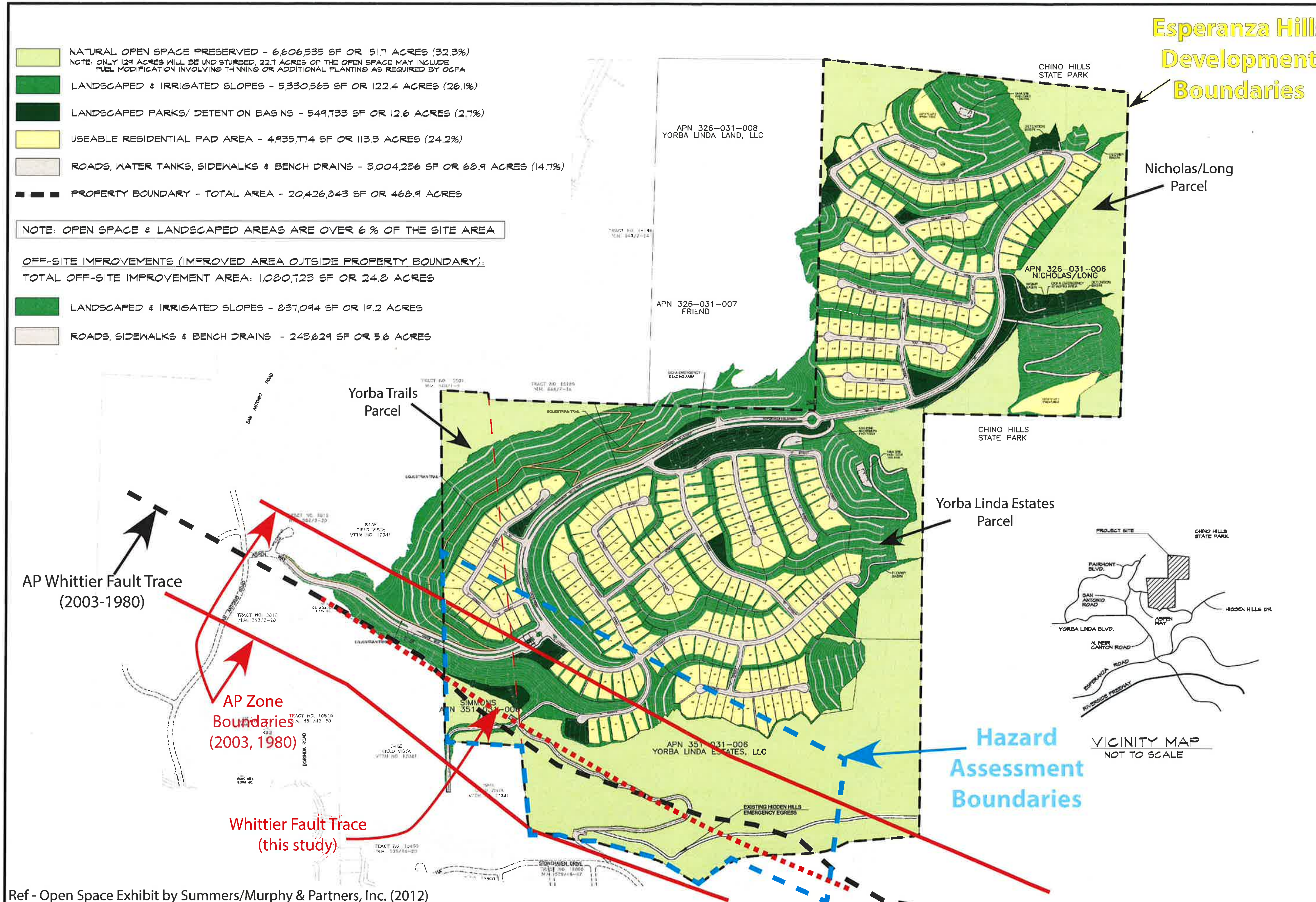
Figure 3a



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AMERICAN GEOTECHNICAL, INC.
22725 Old Canal Road, Yorba Linda, CA 92887
PHONE: (714) 685-3900, FAX: (714) 685-3909

Esperanza Hills Conceptual Design Plan
Option 2
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Figure 3b

1.3.2 Option 2 Plan

The option 2 plan includes extension of Aspen Way eastward across a north-south trending canyon on the Sage Parcel as the main route of access/egress. The proposed 90-foot wide roadway includes earthwork grading (placement of fill) to bridge the axis of the canyon. As depicted on Plate 1b, a fill slope would ascend from the canyon bottom to road grades and residential lots beyond. The unimproved road presently serving as the main access to the property from Stonehaven Drive on the south would be improved for emergency fire access (Figure 3b). The general configuration of the Option 2 plan is depicted on our Geologic Map (Plate 1b) and Generalized Geotechnical Cross Section B-B' (Plate 2).

1.4 Purpose of Hazard Assessment

In accordance with the Alquist-Priolo (AP) Earthquake Fault Zoning Act, the State of California is responsible for delineating appropriately wide earthquake fault zones to encompass all potentially and recently active traces of faults or segments thereof determined to be sufficiently active and well-defined as to constitute a potential hazard to structures from surface faulting or fault creep. The Earthquake Fault Zones (EFZ's) and locations of faults are published as Official Earthquake Fault Zone Maps on 7.5-Minute Quadrangle based maps.

Where structures for human occupancy are proposed inside the limits of an EFZ it becomes the responsibility of qualified professional geologists to critically investigate the presence of faults within the EFZ, identify/document their location and demonstrate that no critical structures will be impacted by surface rupture, mainly by their construction across active trace(s). According to the AP Act:

- an active fault is defined as having had surface displacement during Holocene time (last 11,000 years)
- unless proven otherwise, the area within 50 feet of an active fault is presumed to be underlain by active branches of the fault
- geologic reports are required, directed at the problem of potential surface faulting for all projects defined by the Act
- cities and counties are required to review geologic reports for adequacy, and
- geologic reports shall be submitted to the State Geologists for open-file

Where the Whittier fault crosses the HA-Site it has been mapped as a single trace by the CGS. In keeping with the guidelines of the AP Act the purpose of this Fault Hazard Assessment was to identify the presence of all faults within the EFZ (both active and inactive) and to establish a “seismic setback zone” encompassing all recognized active faults, within which structures proposed for human occupancy is to be avoided. Other objectives included evaluation of relative ages of most recent surface fault rupture and mapping of active fault location(s) to civil-survey accuracy.

The boundaries of the Official AP Zone Maps and Whittier fault trace are depicted on the combined Yorba Linda and Prado Dam Quadrangle Maps (Figure 1 and 3a/3b). The fault and AP boundaries are overlain onto conceptual design plans for both Options 1 and 2 (Figure 3a/b). For comparison, locations of the principal Whittier fault trace established by the CGS (2002) and that determined from our fault trenching are shown on Figures 3a/3b.

1.5 Scope of Work

The subject Hazard Assessment was conducted according to three phases of work as outlined below.

1.5.1 Preliminary Research

- Search and review of regulatory agency files, AG library and the world-wide-web for pertinent geologic reports, maps, cross sections, and professional consultant' fault studies and mass grading reports (Appendix A).
- Compilation of a 400-scale regional composite geologic map (not included)
- Stereographic review of historical aerial photographs (Appendix C)
- Processing and review of LIDAR imagery
- Reconnaissance geologic mapping
- Review of bedrock outcrops in surrounding communities
- Review of geomorphic landforms
- Coordination with Underground Service Alert (USA)
- Subcontracted Private Utilities Contractor to locate/clear oil/gas pipelines.

1.5.2 Field Exploration

- Excavation of six fault trenches over 2,500 feet in total length.
- Graphic fault trench logging at a scale of 1 inch equals 5 feet (Plates 3a through 7)
- Photo-documentation of fault trenches using a digital camera (retained in our files)
- Subcontracted consulting paleo-seismologist for review and comment on certain outcrops (no written report commissioned)
- Collected samples of organic material for Radiometric age date testing
- Organized fieldtrips for peer review

1.5.3 Report Preparation

- Constructed scaled graphic geologic cross-sections A-A' and B-B' (Plate 2)
- Prepared tables, figures, logs, maps and plates
- Prepared annotated figures from LIDAR imagery
- Prepared the text of this report

1.6 Field Methodology

1.6.1 Fault Trenching and Logging Summary

Trenching activities were conducted between the dates of June 12 and August 1, 2012. Prior to excavation a substantial amount of brush, shrubs and trees were cleared from trench alignments using hand tools and manual labor. A Caterpillar Model 314C Track-Mounted Excavator was employed to excavate the trenches. Each trench was assigned a specific name and number acronym including "AG" for American Geotechnical, "FT" for Fault Trench, and number designation of -1, -2, etc. for each separate trench. Resultant fault trench numbers are AGFT-1, AGFT -2, AGFT -2B, AGFT -3, AGFT -4 and AGFT-5. Trench locations were all surveyed by the project civil engineer as depicted on Generalized Geologic Maps (Plates 1a/1b).

The total combined measured length of trenching as established by civil survey was 2,535 linear feet. Excavations were accomplished using a 3-foot wide bucket attachment. Trench depths ranged between approximately 10 feet and a maximum of 20 feet below existing grades (Tables 3a through 7).
Trench walls were stabilized for entry by creating stair-stepped profiles with vertical walls no greater than 5 feet in height and steps (benches) of approximately equal width. The average combined side-wall ratio

was typically 1:1 (horizontal:vertical). Trench segments where walls exceeded 5 vertical feet in height were stabilized by installing a series of single or stacked vertical aluminum hydraulic Trench-Shore elements approximately 7 feet on-center.

Following excavation, longitudinal trench walls considered best suited for logging were selected and readied for detailed analysis. Where trenches transected across the face of a slope or followed top-of-slope areas, the walls furthest from the slope face were selected for logging. The northerly trench wall was selected for logging where trenches traversed slope faces in perpendicular trend.

Several different hand tools were used to remove the effects of bucket-smudging from log walls and otherwise reveal underlying geology. Pick-axes, shovels, flat-bladed trowels, scrapers and push and whisk-brooms were used. AG staff technicians established a grid-system across log-faces by installing a set of tensioned horizontal and vertical string lines anchored by 4-inch framing nails driven into trench walls. Horizontal string-lines were of variable length and nails were inserted at 5- to 10-foot intervals. Vertical string-lines were generally 3 feet in length. Zero stations (00+00) were established at a distal end of each trench and increasing station numbers denoted by marked flags attached to nails every 10 or 20 feet, along horizontal string lines.

Trench dimensions were drafted by plotting the top, bench and bottom locations relative to the grid system. A preliminary log was prepared by documenting the overall distribution of geologic contacts and structure. Several 11- by 17-inch dimensioned sheets were used to create logs at a scale of 1-inch equals 3 feet. A professional Certified Engineering Geologist employed by AG finalized each log in colored ink by performing in-field review and follow-up trench log mapping activities including final geologic interpretations.

Upon completion of field logging activities log walls were photo-documented using a hand-held digital camera and monopod. Photograph sets include a proximal series of the log-face at a minimum focal distance of approximately 3 feet, and a second from approximately 15 to 20 feet at a vantage point along the top of the opposite wall. Electronic copies of photos are retained within our files.

Final trench logs are presented on attached Plates 3a through 7. A discussion of observed log interpretations is summarized on each map plate, and in more detail within Section 3.1 of this report.

2.0 FINDINGS

2.1 Regional Geologic Setting

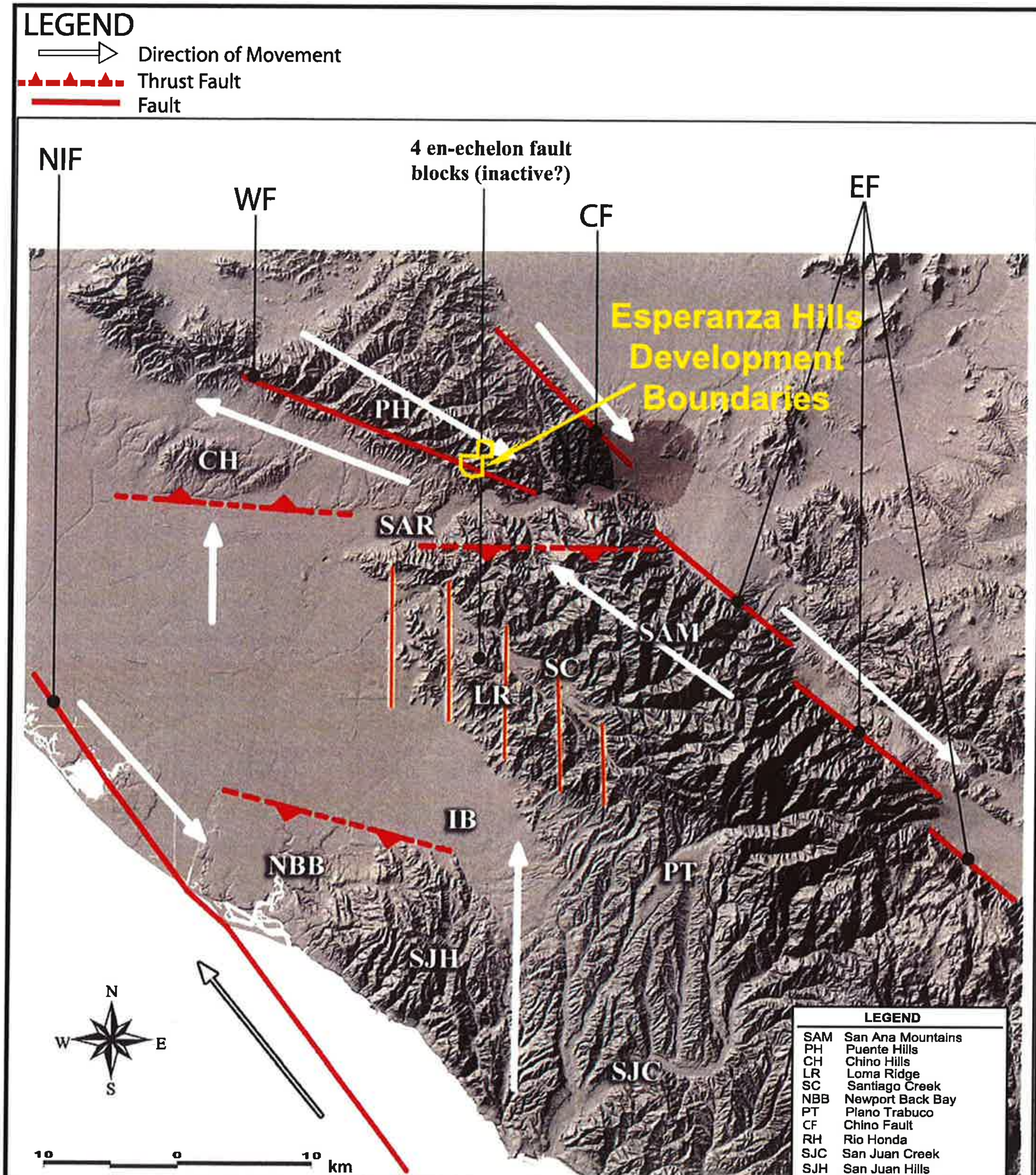
2.1.1 Geomorphology

The geomorphic character of the Puente/Chino Hills and southeast Los Angeles basin in general is depicted on the attached regional geomorphic and shaded relief maps (Figures 4a/4b). The Puente/Chino hills are a structural block of triangular shape that is distinctly elevated above the surrounding region. Major active faults bound the hills including the Chino Hills fault on the northeast and WFZ on the southwest. The ancestral meandering and southwesterly flowing Santa Ana River bounds the hills on the south, the San Jose Hills uplift and San Gabriel River on the northwest. Major fold structures with trends closely parallel to the Whittier fault are also shown.

Evidence exists which suggests that uplift of the Puente-Chino Hills block occurs along the relatively deep and gently northeasterly dipping Puente Hills Blind Thrust fault (PHBTF), buried beneath approximately 3 km of alluvial sediments to the west (Dolan, et.al., 2003). The uplift rate along the PHBTF is approximately 0.6 to 0.8 mm/yr based on the age of drainage within the hills (Gath, 2007). Provided the PHBTF configuration is accurate, the Whittier fault exists as an independent steeply northward-dipping fault within the hanging wall block of the thrust plate.

Emergence of the hills is thought to have begun approximately 600 to 700 thousand years (ka) ago (Gath, 2007). Since late Pleistocene time motion along the fault has been transformed from mostly vertical reverse motion into what is presently almost purely dextral right-lateral strike-slip motion (Gath, 1992). The waning of vertical uplift has apparently allowed rates of erosion to outpace uplift, a condition interpreted from the mature pattern of surface erosion in the hills. Surface erosion is even more advanced southwest of the Whittier fault where the juxtaposition of more youthful and erodible bedrock units exists (Figure 4a/4b).

The southwest flank of the hills consists of a series of stair-stepping river terraces associated with the Santa Ana River system. The terraces are incised by a network of distinct and separable drainage basins (Gath, 2007). All streams crossing the Whittier fault are right-laterally deflected at a rate of 2-3 mm/yr as measured by 3D paleoseismic trenching (Gath, et al., 1992; SCED, 1995).



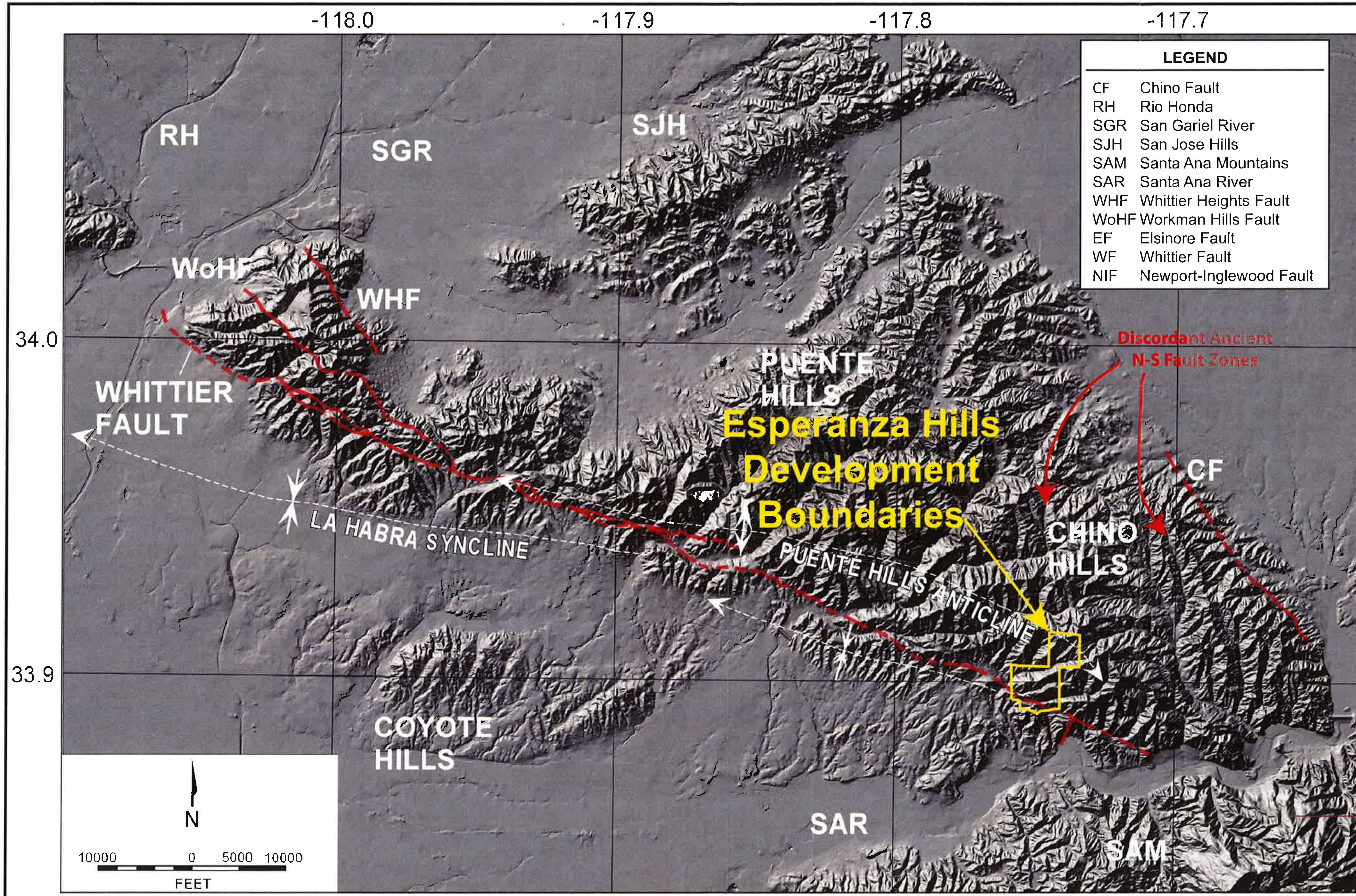
Reference - Grant, L., and Gath, E., "Active Deformation and Earthquake Potential of the Southern Los Angeles Basin, Orange County, California", 04HQGR0078, USGS.

LEGEND

SAM	San Ana Mountains
PH	Puente Hills
CH	Chino Hills
LR	Loma Ridge
SC	Santiago Creek
NBB	Newport Back Bay
PT	Plano Trabuco
CF	Chino Fault
RH	Rio Honda
SJC	San Juan Creek
SJH	San Juan Hills
SAM	Santa Ana Mountains
SAR	Santa Ana River
IB	Irvine Basin
WHF	Whittier Heights Fault
EF	Elsinore Fault
WF	Whittier Fault
NIF	Newport-Inglewood Fault

Regional Geomorphology Map

AMERICAN GEOTECHNICAL, INC.	FN. 33366.01	OCT 2012	Figure 4a



Shaded relief map of the northeastern Los Angeles basin (Mosaic of 11 USGS 10 meter 7.5 minute Digital Elevation Models (DEMS) with 3x vertical exaggeration. Ref - Bjorklund, 2003.

REVISIONS

AMERICAN GEOTECHNICAL, INC.
22725 Old Canal Road, Yorba Linda, CA 92887
PHONE: (714) 685-3900, FAX: (714) 685-3909

Regional Shaded Relief Map

Yorba Linda Estates
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Figure 4b

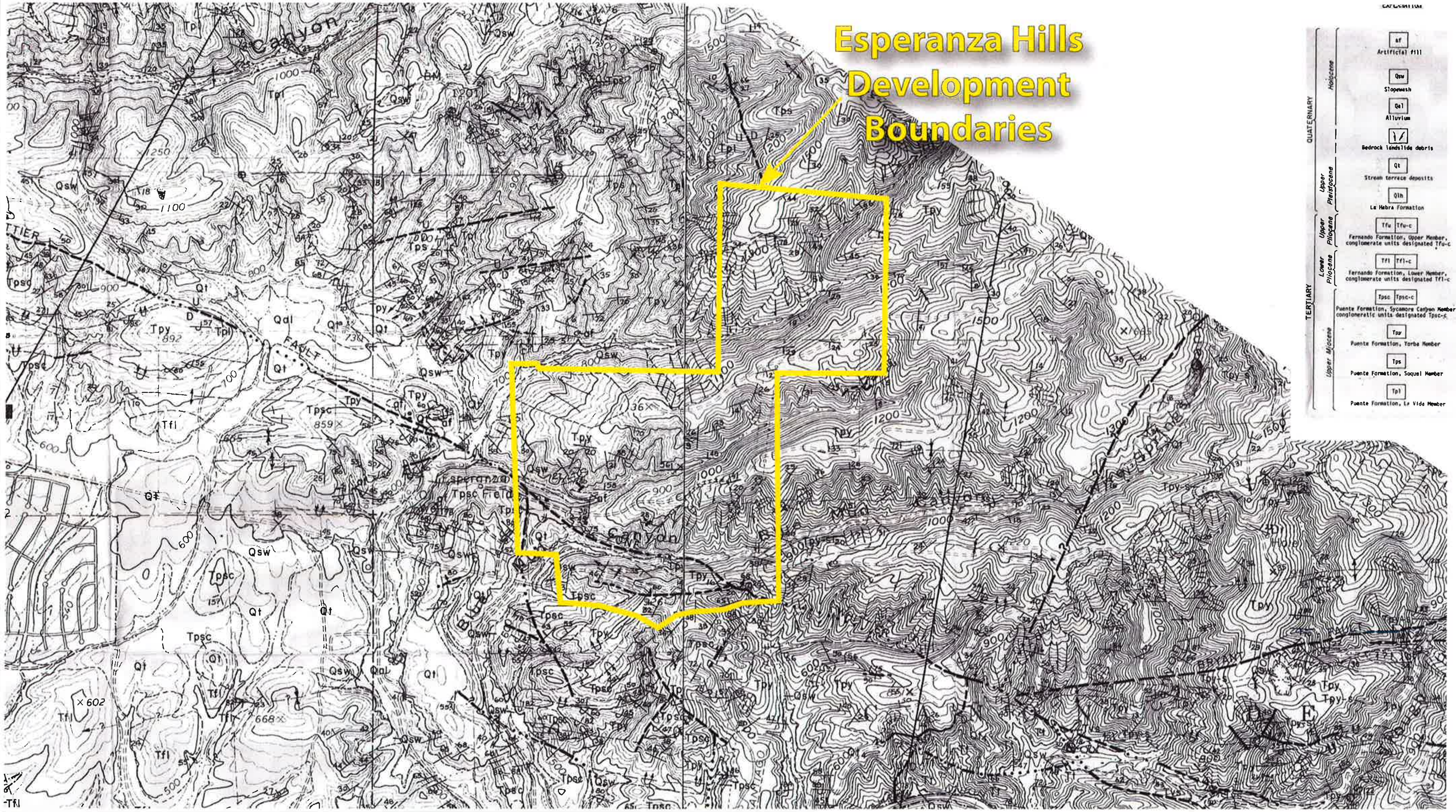
Deep and sharply-incised canyons and narrow ridges cross the property in a general east-northeasterly trend. The east-west canyon and ridge topography is locally interrupted offsite to the east by one or more distinct north-trending canyons and ridges which are likely the expression(s) of an ancient fault zone associated with uplift of the Puente/Chino Hills structural block (Figure 4b).

Significant active strike-slip motion associated with the WFZ is evident as consistently offset and beheaded drainage channels, enclosed basins and a northward bending of major topographic features in closer proximity to the Whittier fault.

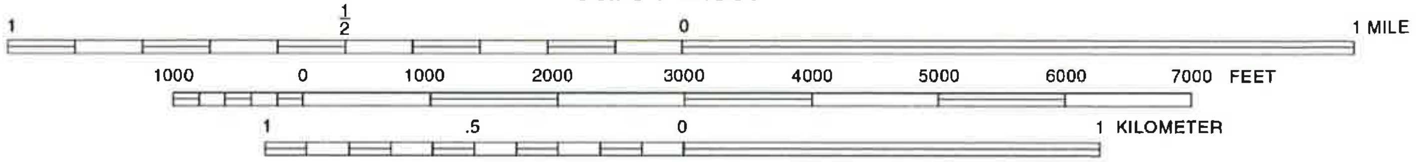
2.1.2 Stratigraphy

Occurring extensively at/near the surface and depths of approximately 2,000 feet within the subsurface is a sequence of deep water marine sedimentary bedrock of late Miocene age, assigned to the Puente Formation. The bedrock consists of well bedded shale and sandstone unit considered by some to be contemporaneous in deposition with the Monterey Formation, a regionally extensive unit found throughout the Los Angeles basin and elsewhere along western coastal North America. Regardless of nomenclature, both investigators similarly divide the formation into several distinct members. In order of increasing age as designated by Tan, et.al., members consist of the Sycamore Canyon, Yorba, Soquel and La Vida Members. The Yorba Member is conformable with the overlying Sycamore Canyon and underlying Soquel Members. These rocks reportedly attain a maximum cumulative thickness of more than 27,500 feet south of the Whittier fault and 16,600 feet to its north (Yerkes, 1972). Relationships show Pliocene and Pleistocene bedrock units mapped only to the south of the Whittier fault.

Although there is general agreement on the age and environment of this formation, different names are used to describe the rocks within the literature. For instance Dibblee (2001) groups them as part of the Monterey Formation while Tan, et.al. (1984) and assigns them by name to the Puente Formation. Regional geologic mapping and literature published by Dibblee and Tan, et.al. depict generally similar geologic contacts, structure and faulting relationships. The Dibblee map presents a more detailed depiction of regional geologic structure and the Tan map offers a more recognized use of stratigraphic nomenclature. For the purposes of this report we refer to the Tan publication for definitions of geologic stratigraphy, nomenclature and distribution of geologic contacts (Figure 5a).



Scale 1"=1500'



YORBA LINDA QUADRANGLE
CONTOUR INTERVAL 20 FEET
DOTTED LINES REPRESENT 10-FOOT CONTOURS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

PRADO DAM QUADRANGLE
CONTOUR INTERVAL 25 FEET
DOTTED LINES REPRESENT 5-FOOT CONTOURS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

Ref - Tan, Miller , and Evans, "Environmental Geology of Parts of the La Habra, Yorba Linda, and Prado Dam Quadrangles, Orange County, California", CDMG, 1984.

REVISIONS

AMERICAN GEOTECHNICAL, INC.
22725 Old Canal Road, Yorba Linda, CA 92887
PHONE: (714) 685-3900, FAX: (714) 685-3909

Regional Geologic Map - Tan, et.al.

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Figure 5a

It must be recognized that although the published maps provide an important perspective on the regional geology they were prepared in the absence of detailed subsurface investigation. Mapping depicted on Plates 1a/1b, and descriptions of geologic units herein are based on the direct findings of the subject investigation and should replace regional data in these locations.

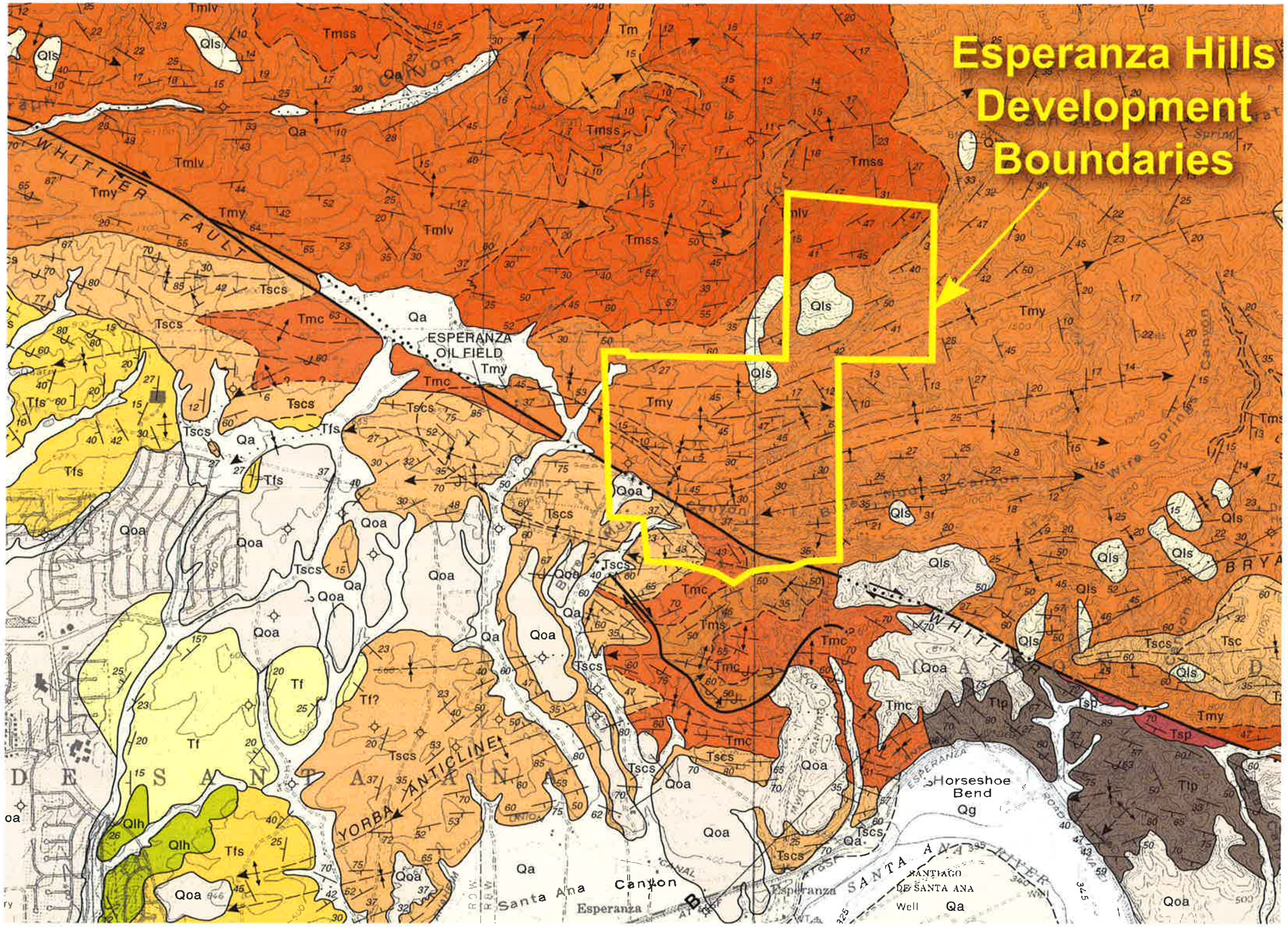
2.1.3 Geologic Structure

For the purposes of this assessment we refer to the Dibblee map for its more comprehensive treatment of regional geologic structure (Figure 5b).

The overall geologic structure of the Puente-Chino Hills is that of a northwest trending anticline elevated above surrounding alluvial basins by as much as 1,000 feet. Geologic structure across the subject property exhibits several tightly spaced parallel fold axes trending in a general east-northeasterly direction. The trend of the axes becomes more parallel to the strike of the Whittier fault with increasingly closer proximity to it. This change in axial strike is interpreted to represent a dragging of the folds into the fault in response to right-lateral strike-slip movement. It also suggests that the folds developed under a different set of strain conditions pre-dating the current strike slip motion, possibly relating to vertical reverse motion associated with uplift of the Puente/Chino Hills block. Fold axis locations apparently coincide with the trends of major canyons and ridges. This dragging/bending of ancient fold axes further complicates the geologic structure. No faults are depicted on the Dibblee map as crossing the HA-Site or other areas of the EHD property.

Plates 1a/1b depict the distribution of geologic units and structure on the HA-Site. The mapping is based on the findings of our field investigation. Mapped fault locations are based on exposures within our fault trenches. The prominence of the principal Whittier fault trace and excellent northwesterly alignment within three of our trenches allowed it to be mapped with confidence across the length of the HA-Site. A laterally contiguous and through going nature of secondary and ancient faults was not confirmed between any trench exposure. These less active or inactive faults are considered to be more localized and discontinuous, and they have not been included on the geologic map.

Our mapping confirms that of published data, which indicates that interbedded sandstones and shale of the Yorba Member of the Puente Formation are more prominent at the surface to the north and northeast of the WFZ. Geologic units south of the Whittier fault is a more chaotic, discontinuous, fault-bounded and



YORBA LINDA AND PRADO DAM MAP (DF-75)

LEGEND

SURFICIAL SEDIMENTS
Undissected alluvial deposits
af *Artificial fill, some recent areas may not be shown*
Qg *Gravel/sand of Santa Ana River*
Qa *Alluvial gravel, sand, and silt of valleys and floodplains*

Qls LANDSLIDE DEBRIS
See also landslides mapped by Tan, 1988

Qoa OLDER SURFICIAL SEDIMENTS
Qoa *Elevated, dissected remnants of alluvial gravel, sand and silt*

— *UNCONFORMITY* —

Qlh LA HABRA FORMATION
(Of Durham and Yerkes, 1964; Yerkes, 1972)
Terrestrial, weakly indurated; early Pleistocene age
Qlh *Tan to light gray sandstone and pebble conglomerate, poorly bedded, with many siliceous shale pebbles south of Puente Hills*

Tfs / Tf FERNANDO FORMATION
(Of Daviess and Woodford, 1949; Durham and Yerkes, 1964)
Mostly marine clastic, weakly indurated; Pliocene to early Pleistocene age
Tfs sandstone facies: *light gray, weathers light brown, fine to coarse-grained, bedded, locally fossiliferous; includes pebble conglomerate; locally includes minor gray siltstone*
Tf siltstone to claystone facies: *gray, vaguely bedded, commonly finely sandy, micaceous, locally includes thin layers of sandstone*

Tsc / Tscs / Tscc SYCAMORE CANYON FORMATION
(Named by Daviess and Woodford, 1949, as uppermost member of Puente Formation; adopted by Durham and Yerkes, 1964, and Yerkes, 1972, in Puente Hills; equivalent to ÒUnamed ShaleÓ in Los Angeles quadrangle [Dibblee, 1989m map DF-23], and to Sisquoc Formation in Ventura basin)
Mostly marine clastic, moderately indurated; late Miocene age
Tsc silty clay shale facies: *Gray, micaceous, vaguely to moderately bedded, locally nodular, in places includes thin layers of fine-grained sandstone*
Tscs sandstone facies: *Light gray to brown, nearly white near Prado Dam, coarse to fine-grained, arkosic, locally includes conglomerate like that of* **Tscc**
Tscc conglomerate or eastern facies: *Light gray, bedded, composed of cobbles and pebbles of mostly light-colored granitic rocks and others of gray quartz diorite, gneiss, andesitic porphyries and quartzite, in arkosic sandstone matrix; may be in part nonmarine*

Tmy / Tmc / Tmss / Tmcg / Tms / Tmlv / Tm MONTEREY FORMATION
(Major part of Puente Fm. of Eldridge and Arnold, 1907; Daviess and Woodford, 1949; Durham and Yerkes, 1964)
Marine biogenic and clastic, moderately lithified; middle Miocene age, Mohnian Stage
Tmy Yorba Shale Member: *Thin-bedded, light gray, white-weathering, platy, siliceous to semi-siliceous to silty, locally includes thin layers of yellowish-gray, hard dolomite, and thin layers of fine-grained sandstone, late Mohnian Stage (Yerkes, 1972)*
Tmss Soquel Sandstone Member and facies: *Mostly bedded sandstone, light gray, weathers tan, mostly medium-grained, arkosic, locally coarse and pebbly; with minor biotite; includes minor silty clay shale*
Tmcg *Conglomerate of granitic detritus*
Tms *Unassigned sandstone; similar to unit* **Tmss**
Tm *Unassigned shale; similar to* **Tmlv & Tmy**
Tmlv La Vida Shale Member: *Similar to* **Tmy**, *thin-bedded, cream-white weathering, platy, siliceous to semi-siliceous shale, includes some layers of hard, yellow-gray dolomite; and some thin strata of sandstone*
Tmc *Clay shale facies: gray, slightly siliceous, silty to finely sandy, micaceous*

Ttp TOPANGA SANDSTONE
Marine clastic, moderately lithified; middle Miocene age
Ttp *Sandstone, light gray, weathers tan, bedded, fine to medium grained, locally pebbly, arkosic, includes thin partings or interbeds of micaceous siltstone*

Tsp / Tcg SESPE(?) FORMATION
Terrestrial clastic, moderately indurated; possibly early Miocene age
Tsp ***red beds:*** *Red to pink sandstone, silty claystone and minor pebble conglomerate*
Tcg ***cobble conglomerate:*** *Brown, vaguely bedded, with detritus of mostly granitic rocks, some hard porphyritic volcanic rocks*

Holocene — Pleistocene — QUATERNARY — Pliocene — Miocene

Scale 1"=2000'

1 — 1/2 — 0 — 1 MILE
1000 — 0 — 1000 — 2000 — 3000 — 4000 — 5000 — 6000 — 7000 FEET
1 — .5 — 0 — 1 KILOMETER

YORBA LINDA QUADRANGLE
CONTOUR INTERVAL 20 FEET
DOTTED LINES REPRESENT 10-FOOT CONTOURS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

PRADO DAM QUADRANGLE
CONTOUR INTERVAL 25 FEET
DOTTED LINES REPRESENT 5-FOOT CONTOURS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

N — S — E — W

Ref - Dibblee Foundation - Yorba Linda and Prado Dam Map DF-75 (2001)

REVISIONS

AMERICAN GEOTECHNICAL, INC.
22725 Old Canal Road, Yorba Linda, CA 92887
PHONE: (714) 685-3900, FAX: (714) 685-3909

Regional Geologic Map - Dibblee
Yorba Linda Estates
Yorba Linda, CA

File No. 33366-01

Date : OCT 2012

Figure 5b

tightly folded configuration. Both the Yorba and Sycamore Canyon Members have been mapped south of the fault zone. Also notable is the presence of dissected terrace deposits south of the fault and absence to the north.

Interpretations of faulting from well data in the Esperanza Oil Field suggest that deformation of underlying Puente Formation has been accommodated mainly by flexural slip and not by faulting (Bjorklund, 2003). This interpretation is consistent with Dibble and Tan, et. al., where they map abrupt linear changes in the distribution of geologic units to be the result of tectonic uplift, tight folding and erosion instead of significant faulting.

The tight shape of many folds and mostly un-broken nature of sandstone and shale interbedds bent around their axes is a reflection of the relative age of tectonics involved in formation of the folds and the folds themselves. Brittle, moderately cemented sandstones which are tightly folded suggest folding could not have been accommodated to such a degree in their present lithified state. Folding must have occurred during a time when the beds were of a much softer and pliable texture, likely during uplift of the Puente Hills during the Pleistocene. Where the brittle sandstones lie in closer proximity to the active trace of the Whittier fault, and have been affected by recent fault movement, the folds containing sandstones exhibit a more fractured and broken texture due to an inability to accommodate flexture.

2.2 Whittier-Elsinore Fault Zone

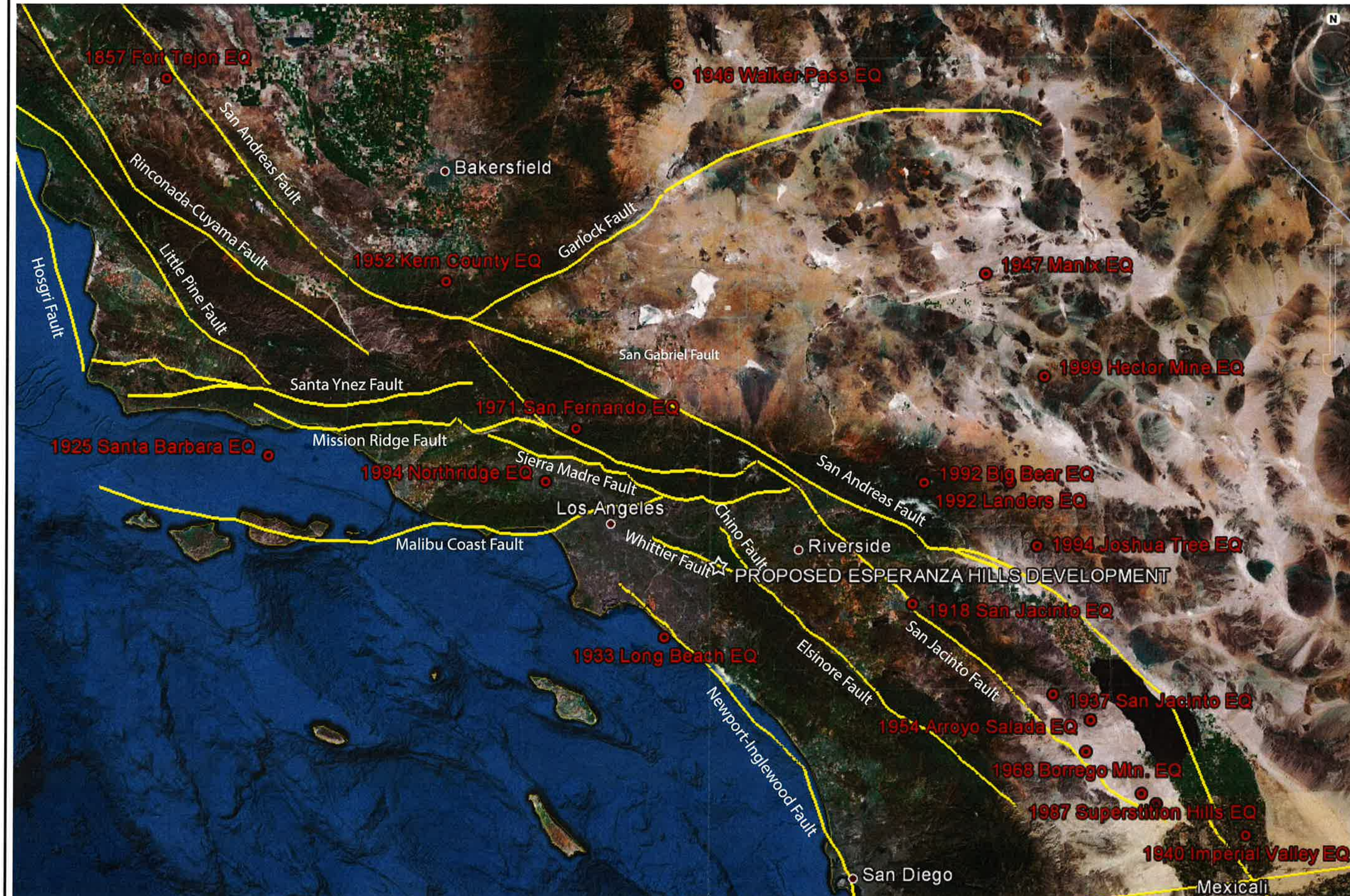
The Whittier-Elsinore Fault Zone (W-EFZ) is a major N51W-trending structure that closely parallels the San Andreas Fault in strike. It represents one of only a few prominent terrestrial fault zones accommodating active movement between the Pacific and North American global tectonic plates. It is classified as a major dextral right-lateral zone of faulting that extends from beyond the Mexican border on the southeast to the area of Whittier Narrows on the northwest (Figures 4a/4b and 6a).
The Whittier fault represents the northernmost 36 to 40 kilometers of the greater W-EFZ. Total translational offset reportedly ranges between 10 and 40 kilometers with a total vertical separation on the order of 200 meters (CGS, 1998; Hull and Nicholson, 1992). More recent estimates indicate the total offset is more likely in the range of 4.6 km (Gath, 1997). From a local viewpoint the WFZ (a transpressional dextral right-lateral strike slip fault) is differentiated from the W-EFZ by its more

northwesterly trend in strike (N55W to N70W) beginning at the boundary between Puente/Chino Hills and Santa Ana Mountains, southeast of the subject property.

A distinctive series of geomorphic fault features are recognized along the length of the WFZ. Mapped fault traces are manifest as either a bifurcating network of two or more faults or a single strand (Figure 1 and 4b). Based on its overall length, proximity to Orange and Los Angeles Counties and recognition that earthquakes transfer seismic strain directly toward nearby metropolitan areas, the WFZ represents one of the most prominent actively seismic hazards within southern California. Its structural companion, the Chino fault, forms the northeasterly boundary of the Puente/Chino Hills (Figures 4a/4b and 6a/6b). The Whittier and Chino faults extend northward from the Elsinore Fault in what has been termed a horsetail-shaped array (Gath, 1997), with the Whittier fault recognized as being the most active branch and accommodating a majority of strain from the Elsinore fault (Petersen, 1994).

The local slip rate of the WFZ is generally well-constrained by nearby paleoseismic trenching studies (Figure 6b). The slip rates are considerably lower than those estimated for the Elsinore fault (Petersen, 1994). The above studies include one undertaken approximately 5.62 miles northwest of the subject property by Rockwell (1993), another completed approximately 1.68 miles to the southeast by Shlemon (1987) and a third conducted approximately 3.41 miles to the southeast by Rockwell (1987). The study to the northwest, in Brea, established a slip-rate of 2 mm/yr by measurement of the lateral and vertical separation of fault-piercing paleo-alluvial channels. This study also concluded that offset occurs as nearly pure strike-slip motion. The study of alluvial deposits undertaken to the southeast identified stream channel deflection along the Whittier fault to be on the order of 400 meters, and derived a slip rate of 2.8+1.0 mm/yr (Rockwell, 1987), consistent with the Brea study area. As the subject property is bracketed by the nearby study areas it is reasonable to apply an average slip rate of 2-3 mm/yr to the property for the purposes of design. A published compilation of paleoseismic and historical earthquake literature indicates the slip rate for the Whittier fault as 2.5-3 mm/yr (Petersen, et al. 1994).

Past phases of geologic investigation and tract grading conducted directly adjacent to the subject development property during the 1980's have documented the Whittier fault as a single active trace. The documented traces of these faults and their specified seismic setback zones are noted on attached geologic map plates where they enter the property boundaries (Plate 1a/1b).



REVISIONS

AMERICAN GEOTECHNICAL, INC.

22725 Old Canal Road, Yorba Linda, CA 92887

PHONE: (714) 685-3900, FAX: (714) 685-3909

Earthquake and Fault Plan

Yorba Linda Estates

Yorba Linda, CA

File No. 33366.01

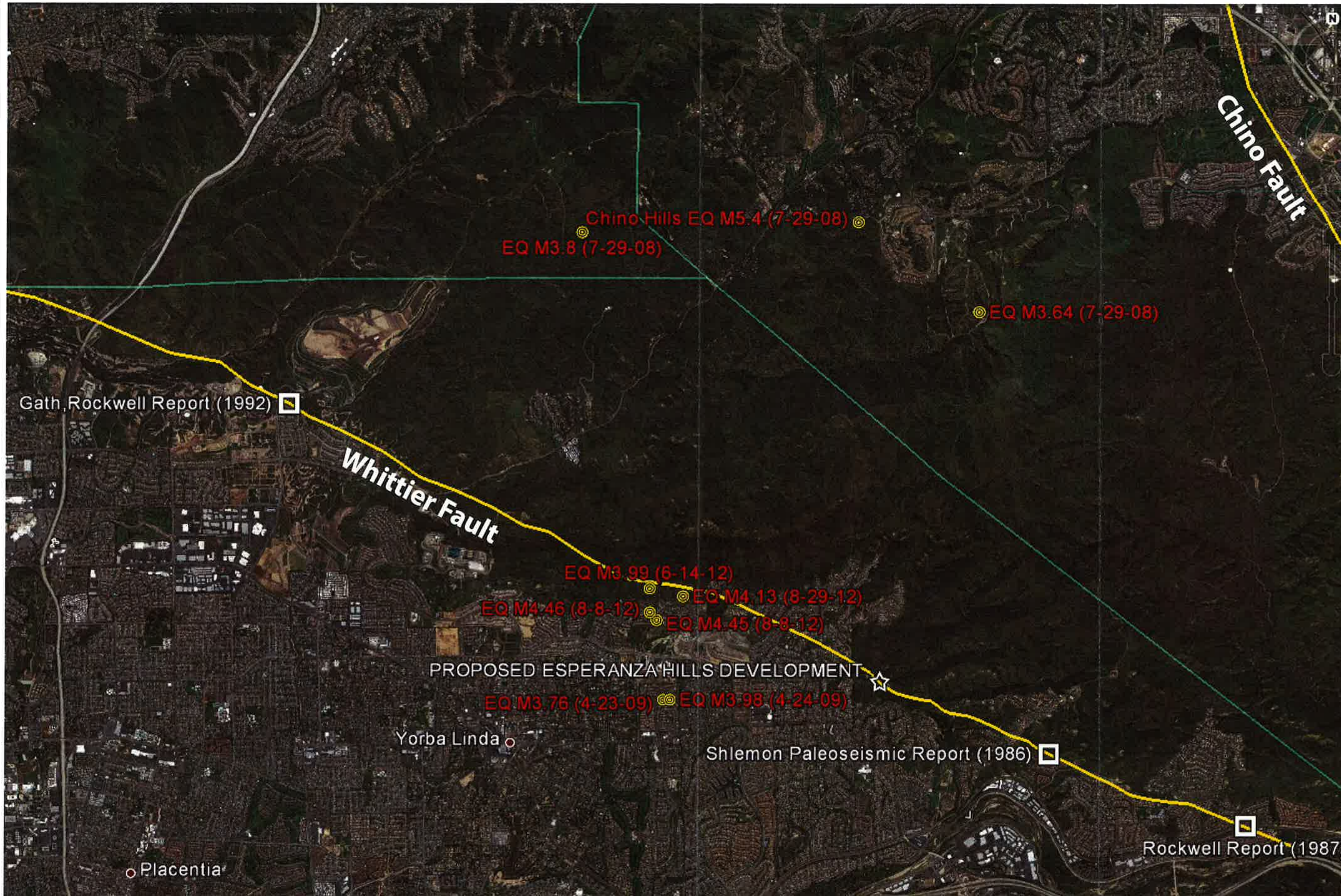
Date : OCT 2012

Plate 6a

On the southeast, within the Lost Trough Canyon area of Residential Tract 10657, the fault was identified as a single strand juxtaposing alluvium against bedrock (GSI, Inc., 1987). The Holocene age of the fault is based on radiometric age dating and geomorphic evidence at this location. The single active fault trace on the northwest was mapped during grading for residential Tract 9813. Final grading reports show the surveyed location of the fault as entering the HA-Site area to the south of Aspen Way. A seismic setback zone 50 feet in width is noted on each side of this off-site trace (Earth Research Associates, Inc., 1986). The fault locations align when extrapolated toward the principal active fault trace surveyed as part of the subject assessment.

2.3 Historical Seismicity and Earthquake History

Evaluation of earthquake history within the southern California region included a review of earthquake archives maintained by the United States Geological Survey. Significant and damaging earthquakes have been a common occurrence throughout the modern and geologic history of southern California. A list of notable events within the region was selected for a time period extending back roughly 120 years. Epicenters of regional quakes with magnitudes above 6.0 and traces of major fault lines obtained from the USGS website are depicted on Figure 6a. A more local series of earthquakes exceeding magnitude 3.5 were selected based on their proximity to the proposed development. The epicenters of these quakes and traces of major fault lines from the USGS are presented on Figure 6b. Table 1A presents a list of the above earthquakes and details of each event.



REVISIONS

AMERICAN GEOTECHNICAL, INC.
22725 Old Canal Road, Yorba Linda, CA 92887
PHONE: (714) 685-3900, FAX: (714) 685-3909

Site Earthquake and Fault Plan

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Yorba Linda, CA

File No.
33366.01

Date :
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Plate 6b

TABLE 1a: List of Regional Historical Earthquakes

Magnitude	Historical Earthquake Name	Latitude	Longitude	Depth (km)	Date
7.9	Fort Tejon EQ	35.72	-120.32		01/09/1857
7.0	San Jacinto EQ	33.75	-116.883333	7.0	04/21/1918
6.8	Santa Barbara EQ	34.3	-119.8		06/29/1925
6.4	Long Beach EQ	33.630833	-117.9995	6.0	03/10/1933
6.0	San Jacinto EQ	33.4	-116.25	6.0	03/25/1937
6.9	Imperial Valley EQ	32.844167	-115.381	6.0	05/18/1940
6.6	Fish Creek Mtns. EQ	32.975333	-115.785333	6.0	10/24/1942
6.3	Walker Pass EQ	35.702333	-117.944167	6.0	03/15/1946
6.5	Manix EQ	34.982833	-116.5315	6.0	04/10/1947
7.5	Kern County EQ	34.958167	-118.998	6.0	07/21/1952
6.4	Arroyo Salada EQ	33.2985	-116.0805	6.0	03/19/1954
6.6	Borrego Mtn. EQ	33.179833	-116.103	10.0	04/09/1968
6.6	San Fernando EQ	34.411467	-118.400743	8.7	02/09/1971
5.9	Whittier Narrows EQ	34.06	-118.08	9.53	10/01/1987
6.6	Superstition Hills EQ	33.015	-115.852	11.2	11/24/1987
6.1	Joshua Tree EQ	33.960	-116.317	12.3	04/22/1992
7.3	Landers EQ	34.200	-116.437	1.0	06/28/1992
6.3	Big Bear EQ	34.203	-116.827	5.4	06/28/1992
6.7	Northridge EQ	34.213	-118.537	6.7	01/17/1994
7.1	Hector Mine EQ	34.594	-116.271	5.0	10/16/1999
6.5	San Simeon EQ	35.706	-121.102	7.5	12/22/2003

Figure 6a suggests that no earthquakes greater than M6.0 have occurred within the adjacent vicinity of the development over the past 120 years. And, although ground shaking would certainly been felt on the subject property as a result of these quakes, their epicenters have been located along major faults other than the Whittier fault. Figure 6b reveals epicenters for quakes of lessor magnitude occurring either on or along secondary faults associated with the WFZ, in very close proximity to the subject property. Of interest is the occurrence of several quakes during the completion of our investigation. The first of these was a M3.99 quake that occurred on June 14, 2012, the very day trenching began. The epicenter was located only 1.7 miles from the property. Another M4.45 quake occurred on August 8, 2012, at the moment that logging of the principal Whittier fault trace in trench AGFT-2B was in progress. The epicenters of these quakes are depicted on Figure 6b.

Results of the study conducted by Rockwell (1993) concluded the timing of the last large (resulting in surface rupture) earthquake along the WFZ occurred between 1,400 and 2,200 years ago, with a minimum 1.9 meters of offset. The study also noted the minimum recurrence interval for probabilistic seismic hazard assessment was 760 (±640) years, but that much longer recurrence intervals are suggested by the geologic data (CGS, 1998). A list of these quakes is presented in Table 1b.

TABLE 1b: List of Local Historical Earthquakes

Magnitude	EQ Distance from Development	Latitude	Longitude	Depth (km)	Date (UTC) Time
5.39	6.27km N	33.953	-117.761	14.7	07/29/2008 18:42
3.8	7.46km NW	33.952	-117.802	16.2	07/29/2008 18:51
3.64	5.27km NNE	33.942	-117.743	15.3	07/29/2008 20:40
3.76	3.0km W	33.894	-117.790	4.7	04/23/2009 23:56
3.98	2.96km W	33.894	-117.789	4.2	04/24/2009 03:27
3.99	3.45km WNW	33.908	-117.792	9.8	06/14/2012 03:17
4.46	3.33km WNW	33.905	-117.792	10.1	08/08/2012 06:23
4.45	3.23km WNW	33.904	-117.791	10.4	08/08/2012 16:33
4.13	2.94km WNW	33.907	-117.787	9.1	08/29/2012 20:31

Current earthquake magnitude estimates are such that M6.7 quakes will occur every 700 years and M7.2 quakes every 1,000 to 1,500 years (ECI, 1997). In addition, ECI also reports that the last large earthquake had an offset of 4 to 7 feet right-laterally and reportedly occurred more than 1,600 years ago.

2.4 Local Surface Units

Surface units identified as underlying the project area range from early Quaternary to Recent age. Where distinct and mapable, each unit has been given a name designation and associated map symbol indicative of its geologic age, environment of deposition and aerial extent. The mapped subsurface (vertical) and aerial (lateral) distribution of each unit is depicted within our Generalized Geologic Maps, Geologic Cross Sections and the logs of fault trenches, presented on Plate 1a/1b, 2, and 3a through 7, respectively. Descriptions of each unit are presented below in order of increasing age.

2.4.1 Artificial Fill Deposits (Map Symbol Af)

Artificial Fill Deposits are typically associated with unimproved access roads and equipment pads graded for oil/gas drilling, production and storage. These are uncontrolled deposits that were dumped or pushed over the top of slopes, used to bridge across active creek channels during road and pad construction, or to construct berms around oil wells and storage tanks. These fills were encountered within our Fault Trenches AGFT-1, AGFT-2 and AGFT-2B as depicted on those logs (Plate 1a through 1f). Given their limited discontinuous distribution they are not differentiated as a separate unit on our geologic map. The composition of these deposits tends to closely mimic the earth material from which they were derived. Most commonly this includes a mixture of colluvium and fragments of shale, siltstone and/or sandstone bedrock. They typically consist of silty clay and clayey silt that is dark brown in color, ranges from loose and soft to dense and stiff in density, is dry to slightly moist, porous, and contains local roots and fragments of glass and other manmade debris. Sub-horizontal boundaries “contacts” between fill layers “lifts” are often visible, which represent repeated episodes or pulses of material placement by heavy equipment.

Nowhere were Artificial Fill Deposits observed to be truncated by faulting.

2.4.2 Topsoil (Map Symbol Qcol)

Except where buried by artificial fill, removed by grading or absent from active stream channels the surface is mantled by a deposits of Topsoil and Colluvium. Topsoil deposits were encountered within the upper portions of each of our fault trenches. For the purposes of this report, given a similarity in soil color texture and stratigraphic location these units have not been differentiated.

These soil deposits are generally considered to range from Quaternary to Recent in age and consist of dark brown to black silty clay to clayey silt that contains scattered cobble to pebble size fragments of bedrock. The soils are mostly stiff, dry to slightly moist, locally very porous, have a moderate to well-defined blocky structure and contain scattered roots. The unit exhibits a moderate degree of residual soil profile development. Its base commonly overlies bedrock in a moderately irregular and unconformable manner, however, it also is found as overlying landslide, debris flow, regolith and older alluvial deposits. Because topsoil deposits occur at the surface of the ground, its formation/alteration is in an ongoing active state of material accumulation or erosion. The source of its sediments tends to be eroded from upslope areas and/or imported by wind (aeolian). It tends to be pervasively altered by bioturbation with the occurrence of significant crotovina (backfilled rodent burrows) common.

Among other factors, the thickness of the Topsoil unit is dependent upon underlying bedrock lithology, slope gradient, climate and vegetation cycle. The thickness of Topsoil on the property ranges from approximately 0.5 to 5 feet.

2.4.3 Talus Deposits (Map Symbol Qcolt)

Talus Deposits were encountered at the distal southerly ends of our Fault Trenches AGFT-1 and AGFT-5. Certain recognizable lithologic and depositional characteristics distinguish this unit from other notable colluvium/slopewash deposits to the extent that we assigned it its own specific name designation herein. It's not included on our geologic map as it exists only in the subsurface.

The unit consists of a medium to light grey and white pebbly sand that is dense to very dense, slightly moist and very coarse-grained. A large fraction of the unit is typically composed of cobble- to pebble-size sandstone and shale bedrock fragments encased in a fine-grained matrix of silts and sands. The material is dense to very dense, slightly moist and has a color commonly matching that of the underlying bedrock. Several indistinct lenses, or pulses, of cobble, pebble and scattered boulder lineations are present. A highly weathered and moderately southerly dipping bedrock contact underlies the unit. The dip of this paleo slope-mantling deposit roughly parallels the underling bedrock contact. Although it has a thickness of approximately 10 feet within our trenches its configuration suggests it extends to depth in the shape of an increasingly thickening wedge (Plate 2). The unit has a significant amount of carbonate within its matrix, the lower portion of a well-developed soil profile.

Its course-grained nature and absence of paleosols (buried soils) suggests it was once located in close proximity to an elevated area of active erosion. Given its proximity to the WFZ to the north the origin of the unit is interpreted to be correlative with the occurrence of paleo earthquakes along the WFZ.
Given an almost pure right-lateral strike-slip style of offset established for the principal fault and current absence of any elevated source areas to the north, we estimate that deposition of this unit occurred at such a time when palinspastic-reconstruction would place the area a minimum of 600 feet southeast of their present location. Given the above and using the established average slip rate of ±3mm/year, the age of the deposit would range between approximately 60K to 100K years old. This estimate is further supported by the apparent relative age of soils developed on the material. Publisehd data indicated the terrace depostis could be as old as 200 Ka (Tan, et, al, 1984).

2.4.4 Regolith Deposits (Map Symbol Qcolr)

Regolith consists of the chaotic accumulation of light yellowish brown silty to sandy bedrock fragments and other earth material directly above bedrock. It is derived not far from an in-situ source and ranges from 6 inches to 4 feet thick. This unit was encountered as locally overlying bedrock and overlain by colluvial deposits and topsoil within AGFT-1 and underlying debris flow deposits or Topsoil. The unit is not included on our geologic map as it exists only in the subsurface.

2.4.5 Holocene Alluvium (Map Symbol Qal-2)

Holocene Alluvium Deposits were encountered within AGFT-1 as generally contained within the boundaries of the modern and adjacent tributary canyons. The thickest portion of this unit was measured to be approximately 12 feet within the central portion of the canyon. It pinches out laterally toward canyon margins.

It has a distinct lithology and relatively higher-energy environment of deposition than the underlying deposit of older Pleistocene Alluvium. It lies in unconformable contact with the underlying alluvial deposit and is locally channelized into it. A homogeneous slug of foreign organic rich material is interbedded within the alluvium we interpret to be a local debris flow deposit. Its source lies north within the adjacent tributary canyon. The unit is overlain at the surface by debris flow deposits and/or Topsoil.
The Holocene Alluvium consists of light gray gravel and cobble channels that are laterally pinching, upwardly cross-cutting and cuspate shaped. Fist-sized, normally graded, nested and locally self-truncating channel clasts grade laterally into a matrix of a light to medium gray coarse-grained sands and

silts. The unit is loose to very dense, dry, clast-supported, weakly cemented, ravelly and friable. Upper channel sediments tend to be fine-grained and exhibit a minor degree of pedogenesis. Cobble and pebble clasts include well rounded and imbricated siltstones derived from the Yorba Member of the Puente Formation.

We assign the unit a Holocene age based on its stratigraphic position above late Pleistocene Alluvium Deposits and its distinctive environment of deposition. It is assigned the map symbol of Qal-2, where the number "2" denotes its stratigraphic position age relative to the underlying alluvium unit.
The relative age of this unit is interpreted based on its stratigraphic position above the underlying Pleistocene Alluvium, and dramatic difference in depositional energy. The unit is unbroken by any faults.

2.4.6 Pleistocene Alluvium (Map Symbol Qal-1)

Underlying the Holocene Alluvium deposits in unconformable contact is Pleistocene Alluvium, underlain in turn by bedrock. This older unit is given a separate designation based on its characteristic lithology, stratigraphic location and age. It consists of medium reddish brown and yellow brown silty sands to sandy silts with local silty clay lenses mottled blue-gray. It is soft to medium dense, slightly moist to very moist or wet and friable, typically well sorted and horizontally laminated. Normally graded depositional events are commonly several inches thick. Moisture contents tend to increase with depth toward an underlying contact with bedrock where a perched groundwater table is present. Charcoal fragments were often concentrated in narrow planes or lenses at the top of depositional events. The charcoal layers are interpreted to indicate winter flood events subsequent to major paleo wildfires.

As explained in Section 2.10.3, an age range of 12,000 to 13,310 years before present (ybp) was established for this deposit. The unit was not observed to be broken by any faults.

2.4.7 Recent Debris Flow Deposits (Map Symbol Qdfr)

Recent Debris Flow Deposits were encountered within the upper portion of AGFT-2. They mainly exist at the surface, are around 3 feet thick and overlie deposits of Artificial Fill, Topsoil or bedrock. They represent the downslope failure of moisture-laden surficial materials as an earthflow, mobilized in response to wetting and gravity during periods of heavy precipitation. Material comprising the unit typically consists of medium brown silty clay to clayey silt with scattered local fragments of bedrock and organic matter. The unit tends to be massive, dense, dry and lobate-shaped in cross section.

2.4.8 Recent Landslide Deposits (Map Symbol Qlsr)

Recent Landslide Deposits are similar in nature to older slides but have a less significant weathering profile and more pronounced/recognizable geomorphic surface expression. Recent Landslide Deposits have been mapped by others on the site (Plate 1a/1b). None of these deposits were encountered in any of our fault trenches.

2.4.9 Older Debris Flow Deposits (Map Symbol Qdfo)

Older Debris Flow Deposits were encountered AGFT-1. This unit tends to underlie transition areas between canyon walls and main channel axes. Their subsurface distribution is noted on the log for AGFT-1 (Plate 3b). The unit is similar in lithology and depositional environment to that of Recent Debris Flow Deposits but differs in age, thickness, stratigraphic location and lithology depending source area. Individual flow events are commonly on the order of a few feet thick, with local stacked flows representing multiple events. Earth materials are typically medium reddish brown fine- to coarse-grained sands and silt that are dense to very dense, dry and friable, contain scattered organic matter including charcoal fragments and angular clasts of gravel to cobble, and have little to no internal structure. Locally the unit has a well-developed residual soil with moderate illuvial clay and carbonate horizons. Contacts with deposits above and below tend to be sharp.

A subtle change in slope gradient in the upper south wall of Trench AGFT-1 is coincident with an underlying secondary thrust fault and northward thickening of this unit. This phenomenon is interpreted as a response to offset along this fault. The unit is commonly overlain by a mantle of well-developed topsoil on the order of several feet in thickness.

Of particular interest are local flows interpreted to be associated with ancient wildfires, represented by accumulations of deep reddish brown "baked" earth. The wildfire deposits exhibit a more welded texture, possibly do the presence of oils, resins and other byproducts of the fire.

The thickest occurrence of Older Debris Flow Deposits was measured to be on the order of 12 feet along the margins of the southerly canyon wall. The thicker accumulation of these deposits at this location may be related to an increase in erosional material generated by surface rupture along traces of the Whittier fault, located upslope to the south. The deposit in this area is underlain by regolith, colluvium and bedrock, and is overlain by deposits of colluvium. It interfingers with Holocene and Pleistocene-age alluvium.

The occurrence of these deposits is comparatively limited along the north canyon margin where only a single slope failure event is interpreted, measured to be 7 feet thick and likely originating within the nearby tributary canyon to the north. It is overlain in this area by deposits of colluvium, capped by deposits of Holocene-age alluvium and interfingers with Pleistocene-age alluvium.

2.4.10 Older Quaternary Landslide Deposits (Map Symbol Qlso, Qlso1, Qlso2)

Older Quaternary Landslide Deposits are generally similar in character to those of Recent age but exhibit a more significant degree of weathering and less recognizable geomorphic expression or no expression at all. These deposits were encountered within the westerly limits of AGFT-3 and upper north AGFT-1. Where two or more landslides exist as part of the same complex, number designations are included with map symbols to denote the relative age of the slides (Qlso1 and Qlso2, etc.).

Slide material is derived from thinly bedded clayey to silty shale bedrock of the Yorba Member of the Puente Formation. Shales tend to be disarticulated, moderately to severely weathered, closely fractured, and locally sheared with a moderate degree of carbonate development along bedding, joint and fracture surfaces.

Rupture surfaces commonly develop along slopeward dipping bedding planes in clayey to silty shales often medium olive to bluish color. Slide movement tends to result in the alteration to clay and formation of clay seams along rupture surfaces. Basal rupture surfaces tend to be planar with well-developed polishing and indistinct slickenside grooves oriented in the direction of slide movement.

No geomorphic surface expression of Older Landslide Deposits was recognizable in Lidar imagery and historical stereo aerial photographs where mapped in AGFT-3 and upper north AGFT-1. Along with the relatively significant degree of weathering exhibited by these deposits we estimate the slides to be at least 15 ka in age.

2.4.11 Older Stream Terrace Deposits (Map Symbol Qto)

No direct evidence of Older Stream Terrace Deposits was encountered in any of our fault trenches. The presence of this unit south of the principal Whittier fault is based on a small triangular-shaped outcrop depicted on published geologic mapping and its exposure within the eroded tributary canyon walls. The unit typically exhibits a well-developed argillic horizon that is an orange brown color. The same level of residual soil development was observed within Talus Deposits at the south end of trenches AGFT-1, AGFT-2B and AGFT-5.

Published literature describes this unit as alluvial gravels, sands and silts deposited as part of the ancient Santa Ana River system. The oldest of the deposits is described as isolated, elevated, dissected, and occurring between elevations of 600 and 850 feet above MSL. The presence of thick reddish brown illuvial clay and underlying secondary carbonate horizons and elevated and dissected condition suggest a Pleistocene age for this unit (Tan, et al., 1984).

This unit is interpreted as interfingering with Talus Deposits south of the principal Whittier fault trace as depicted in our cross section B-B' (Plate 2). Our trenching did not extend far enough south or deep enough to confirm this relationship.

2.5 Local Bedrock Units

2.5.1 Puente Formation: Sycamore Canyon Member (Map Symbol Tpsc)

The Sycamore Canyon Member of the Puente Formation was not encountered in any of our fault trenches. It is noted on the regional map of Tan, et.al. as outcropping extensively to the south of the Whittier fault where it is juxtaposed in fault contact with the Yorba Member and locally buried by Older Quaternary Stream Terrace Deposits (Figure 6b). The unit is described as a light yellowish-brown to gray sandstone and sandy siltstone with interbeds of conglomerate. Weathering products tend to exhibit a more orange color due to higher iron contents.

2.52 Puente Formation: Yorba Member (Map Symbol Tpy)

Bedrock assigned to the Yorba Member of the Puente Formation was encountered in each of our fault trench excavations. Based on regional geologic mapping of Tan, et. al. and our interpretations of bedrock exposures it is the only member encountered within the excavations. Although significantly different stratigraphic sections abut one another across faults, the predominant bedrock type consists of thin to moderately thick rhythmically bedded shales. Lithology is a medium orange siltstone and medium to dark to medium gray and olive gray claystone, with less frequent medium yellow to white quartzo-feldspathic and micaceous sandstone beds which are thinly bedded to massive, medium hard and locally moderately cemented, locally closely fractured/jointed, locally diatomaceous, and range from six inches to several feet thick. Iron staining occurs along fracture surfaces. Contacts between shale beds are strongly fissile and sharp. Occurring even less frequently within the formation are distinctive concretionary or silicified interbeds that are deep reddish brown in color, heavily iron-stained, closely fractured, and often found in proximity to blue-gray shales. Thin films and thicker seams of white carbonate are precipitated along bedding which tend to aid observers in the mapping of bedrock structure. Carbonate concentrations tend to decrease with depth below the surface. Tectonic polish is common along bedding.

Local portions of the Yorba Member containing thicker sandstone beds are given a specific map designation by Tan, et.al noted as Tpy–s, outcropping east of the subject property (Figure 6b). The sandstones reportedly have a lithology similar to that of the underlying Soquel Member of the Puente Formation.

2.6 Local Geologic Structure

Our interpretation of local geologic structure stems direct from our observations of fault trench exposures. Secondary support is interpreted from reconnaissance geologic mapping, analysis of remote sensing (LIDAR) data, stereographic review of black-and-white and infrared historical aerial photographs and the existing on-site exploratory trench logs and geologic mapping of Seward. Generalized structural features are depicted on Geologic Maps (Plates 1a/1b) and within our Geologic Cross Section A-A' & B-B'.

Local geologic structure northward of the WFZ is generally expressed as a series of linear anticlinal and synclinal folds with broad-based limb-to-limb widths on the order of hundreds of feet (Plate 2a/2b). These older fold structures are interpreted to be more related to tectonic uplift of the Puente-Chino Hills. It appears that fold axes north of the Whittier Fault are being deflected northward, interpreted to be an effect of modern strike-slip motion along the WFZ.

Extrapolation of larger folds between trenches is done with a moderate degree of confidence given their relatively greater limb widths (Plate 1a/1b). Of interest is the coincidence of major anticlinal fold axes with that of significant drainage channels and canyons (Plate 2a/2b). This phenomenon is likely associated with anticlinal fold growth, tension fracturing, and greater convenience of weathering and erosion.

Folding on a smaller scale also occurs, often expressed as tight and laterally discontinuous isoclinal, recumbent and chevron styles. Some occur within a distance of only a few feet. These smaller folds are depicted only noted within our fault trench logs due to scale. The larger folds are depicted on our geologic maps (Plates 1a/1b).

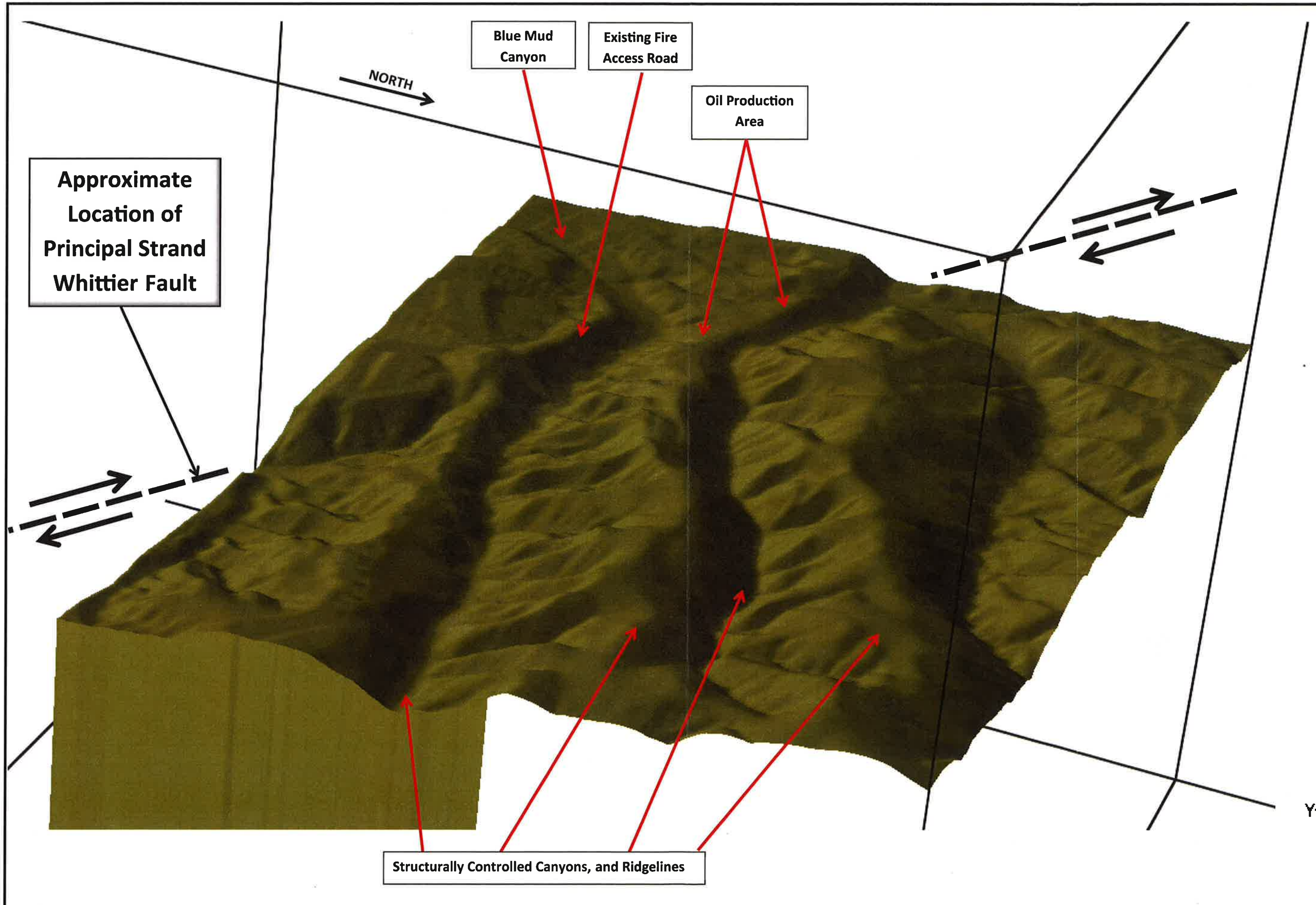
The strike and dip of bedding varies widely across the HA-Site and is strongly controlled by the presence of folds and faults. Steeply-dipping to over-turned beds are common. Dips tend to increase in steepness with closer proximity to the axes of folds and major fault traces.

2.7 Local Geomorphic Landforms

Local geomorphic landform conditions are clearly recognizable on light detection and ranging (LIDAR) imagery and aerial photographs (Figure 7a/7b). Notable are a major right-lateral deflected stream channel (Blue Mud Canyon), triangular slope faceting along canyon margins, side-hill benches and a major "scissor-ridge" in the area of the oil/gas operations.

The side-hill benches or breaks in slope gradient are often mistakenly interpreted to be the manifestation of active faults. Where our trench AGFT-1 crosses one of these landforms the bench was determined to be the result of an underlying anticlinal fold axis.

The geomorphic expression of the active WFZ is clearly recognized in the LIDAR Imagery. It crosses the HA-Site in the form of linear canyons.



REVISIONS

AMERICAN GEOTECHNICAL, INC.
22725 Old Canal Road, Yorba Linda, CA 92887
PHONE: (714) 685-3900, FAX: (714) 685-3909

LIDAR Image - Oblique Southwesterly View

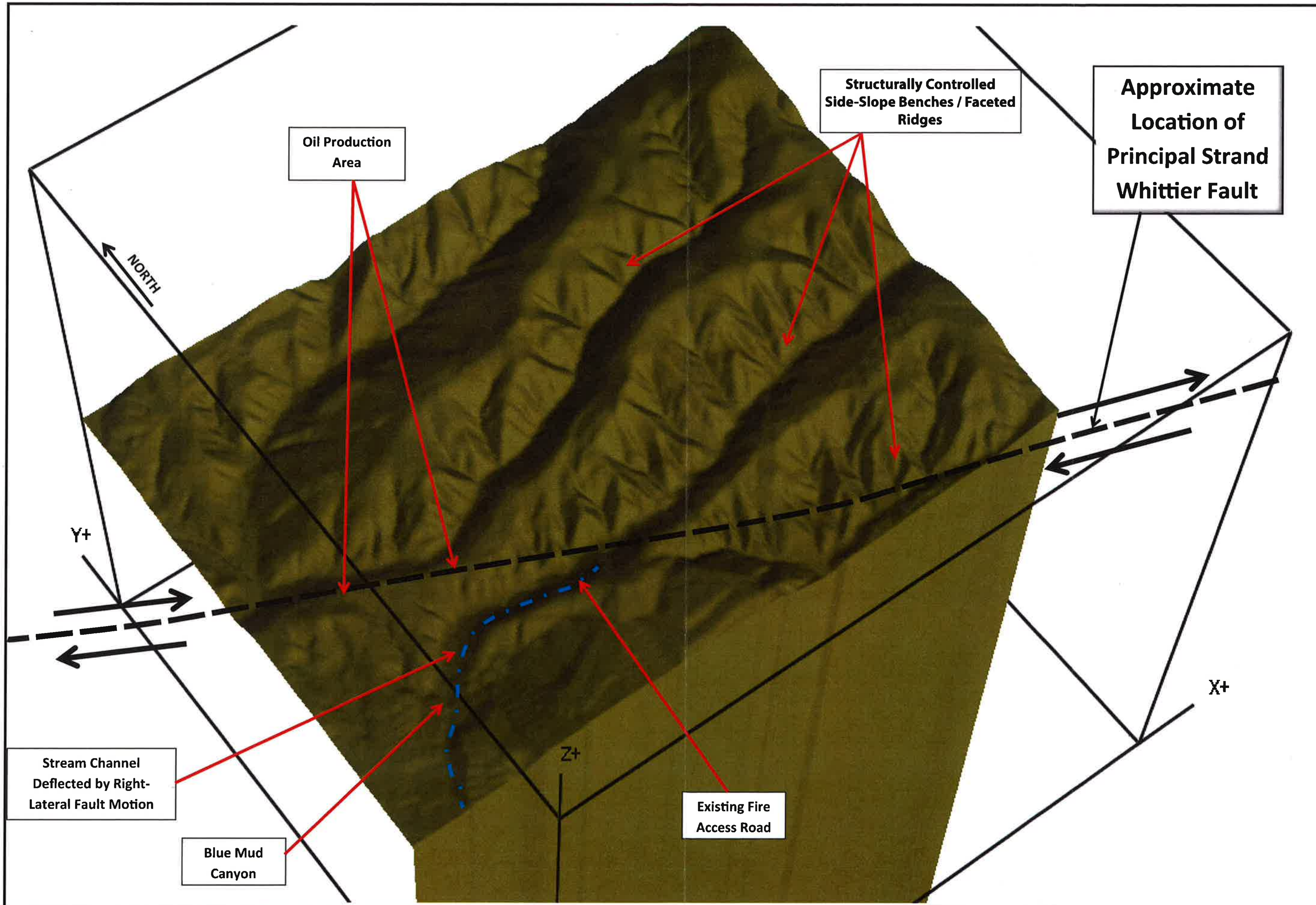
Yorba Linda Estates

Yorba Linda, CA

File No.
33366.01

Date :
OCT 2012

Plate 7a



REVISIONS

AMERICAN GEOTECHNICAL, INC.
22725 Old Canal Road, Yorba Linda, CA 92887
PHONE: (714) 685-3900, FAX: (714) 685-3909

LIDAR Image - Oblique Northeasterly View
Yorba Linda Estates
Yorba Linda, CA

File No. 33366.01

Date : OCT 2012

Plate 7b

2.8 Local Faults

Several generations of geologic maps exist each with differing interpretations of faulting on the property (Durham et.al, 1959, 1964; Tan et. al, 1984; Dibblee, 2001; ECI, 2008). These faults were mainly identified based on air photo lineaments, surface mapping, and most importantly, including little to no subsurface exploration. The maps show the location of the principal Whittier fault as both a bifurcating network with several strands or simply as one major trace. The differing interpretations do not necessarily stem from a lack of investigator ability but rather reveal the limitations associated with purely remote aerial photographic interpretation as a mapping tool. In neighboring areas it is not uncommon for lineaments to be labeled as “air photo faults,” only to be disproven later by fault trenching or grading. Many times these lineaments turned out to be related to the axes of intensely deformed fold structures (Leighton, 1989). A similar circumstance was noted in the northern end of our trench AGFT-1, where surface geomorphology noted in air photos (presence of a change in slope gradient or side-hill bench) suggested the possible presence of a fault. The geomorphic feature was verified to be the result of a differentially eroded anticlinal fold, overturned bedding and adjacent ancient landslide deposit.

Findings of the subject assessment, including surface mapping, LIDAR Imagery review and over 2,500 feet of continuous fault trenching provide conclusive documentation of fault locations on the property. The identification and mapped location of all local faults is from the logging of our fault trench exposures. Several bedrock faults were observed in our trenches, having varying degrees of offset, age and style. Three fault trenches encountered what is considered to be the principal active strand of the Whittier fault (AGFT-1, AGFT-2B and AGFT-5). This structure consists of a narrow well-defined zone approximately 2-feet in width, bounded by near vertical to steeply northeasterly dipping fault strands and additional internal high angle shears. The zone exhibits significantly disarticulated and fractured shales with increased concentration of carbonate precipitate but no significant clay gouge. At the scale of our geologic map it is depicted as a single trace (Plate 1a/1b).

Bedrock directly south of the principal fault extends upward nearly to the surface of the oil/gas cut pad, covered by only a few inches of residual topsoil. To the north, across what is interpreted to be a buried fault scarp, bedrock is covered by a 4-foot thick wedge-shaped graben deposit, infilled with organic-rich topsoil material that is heavily bioturbated. The principal fault extends upward to the base of the topsoil but does not offset this contact.

Several branch faults were observed within our trenches to the north and south of the principal fault trace (Plate 3a/3b). These faults tend to be planar and truncate bedding structure but also occur discontinuously along bedding. Our trench logs and geologic maps reveal dips of branch fault planes and bedding structure progressively flatten away from each side of the principal fault. The resulting positive flower structure configuration is a well-established phenomenon associated with strike-slip faulting. Bedding north of the principal fault strand dips to the south, while bedding south of the fault dips to the north.

Surface geomorphologic features evident of active faulting directly overlying the branch faults was noted as ranging from subtle to indistinct and non-existent. None of these fault traces was found to extend upward into overlying surficial deposits or break the contact between capping soil and underling bedrock. Although the branch faults are subsidiary to the principal fault, likely accommodate only a fraction of sympathetic movement on the order of millimeters to inches, and are laterally discontinuous, the branch faults should be considered active and included within the boundaries of a seismic setback zone, barring mitigation through special grading or construction measures.

In order to evaluate the deeper configuration of faulting observed in trenches, and relationship with geologic structure and tectonic geomorphology, cross sections were constructed across the property, projected through the axis of AGFT-1 to a depth of around 170 feet beneath the surface (Plate 2b). Structural conditions depicted within the boundaries of AGFT-1 represent an extrapolation of data directly from the trench log. Data shown beyond the trench excavation, especially to the south, is extrapolated from existing published maps and our reconnaissance mapping. The fault shown as offsetting the Soquel and Yorba Members of the Puente Formation is based on structure and stratigraphic requirements. Among other conditions, Plate 2b depicts the positive flowering structure configuration exhibited by the principal and secondary fault strands, a condition in which the branch faults are truncated at depth by the principal strand, and identifies that the zone of active faulting is closely related to the occurrence of a narrow topographic ridgeline it underlies.

Noted in trenches AFGT-4 and the north end of AFGT-1 several hundred feet north of the principal fault strand and designated setback zone are a few widely-spaced local faults considered to be inactive. No geomorphic evidence of recent faulting was noted in Lidar imagery or on aerial photographs as being associated wilth these faults, nor is any evidence of their precense depicted on as-graded geotechnical maps prepared for nearby tracts on file with the city of Yorba Linda. They are interpreted to be more closely related to and developed during a former phase of tectonic uplift and folding associated with emergence of the Puente Hills block. Observations of the above faults in the field by peers confirm the absence of active fault features.

Field exposures of faulting and general geology were observed within several of our trenches by professional geologists from the County of Orange, California Geological Survey and consultting geologists with Seward Engineering Geology, Inc. There was near universal agreement between all parties concerinig our geologic interpretations, including identification of principal and branch faults and absence of evidence for active faulting beyond the established 120-foot wide seismic setback zone. The professionals (excluding County of Orange) also reviewed draft copies of our tench logs and expressed a similar agreement with our interpretations.

The principal strand of the Whittier fault was staked at four different locations based on observations in our trenches and elsewhere in outcrop. The staked locations were surveyed by the project civil engineer (KWC, Inc.). Survey data is presented below in Table 1. The points are plotted on our Plate 2a/2b.

TABLE 1: LIST OF CIVIL SURVEY FAULT POINT LOCATIONS

POINT NO.	LOCATION	NORTHING	EASTING	ELEV	NOTE
WF-1	Fault Trench AGFT-1	6104236.752	2273100.787	737.1	Projection to surface of west trench wall
WF-2	Fault Trench AGFT-5	6104432.546	2272984.324	743.4	Outcrops at surface of east trench wall
WF-3	Fault Trench AGFT-2B	6104539.5830	2272913.977	746.8	Projection to surface of west trench wall
WF-4	Surface outcrop in erosional channel SE of property	6106612.447	2271830.827	790.7	Juxtaposition of sandstone and highly folded shales

2.9 Groundwater Conditions

Groundwater was encountered within the lower portion of trench AGFT-1, where it crosses the bottom of the main drainage canyon. The water occurs within the lower portion of the Pleistocene Alluvium Deposits, perched above bedrock. According to our log of AGFT-1, the elevation of the water table existed at approximately 673 feet above MSL at the time of our excavation.

2.10 Age Dating

In accordance with the Alquist-Priolo Earthquake Fault Zoning Act, an active fault is defined having evidence of surface displacement within Holocene time, about the past 11,000 years (CGS, 2007). Satisfactory geologic evidence must be present in order to presume that a fault is inactive, or older than 11,000 years.

Among other factors involved in evaluating the timing of last fault movement is an assessment of the age and disturbance of deposits overlying a fault. Both relative and/or absolute age dating techniques were used to assess the ages of geologic units overlying faults and thus recency of fault movement.

2.10.1 Weathering and Pedogenesis

The degree of weathering and residual soil profile development can be a useful tool in assessing the age of a deposit. A rather significant weathering profile was notable in surficial deposits and directly underlying bedrock across most of our trenches. In areas where a thicker deposit of Topsoil was present, blocky pedogenic textures were common along with weak to moderate argillic and carbonate soil horizons. In areas of thin capping Topsoil the underlying bedrock tended to exhibit a moderate to severe concentration of secondary, illuvial and nodular carbonate. A distinctive precipitate of white carbonate "caliche" was commonly found in these areas as films, seams and nodules along bedding planes, faults, joints, bedrock contacts, gouge zones and other structures. A comparison of these weathering characteristics with those of the alluvial deposits within trench AGFT-1 (which yielded an absolute age of greater than 11,000 ybp) suggests the above deposits may have been subjected to a more lengthy period of weathering, possibly since pre-Holocene. As no branch faults were found to cut the Topsoil deposits we consider the weathering profile to be a significant aid in designation of these faults as inactive.

A much older soil profile was found to have developed at the surface of the Older Stream Terrace and Talus Deposits exposed in the southerly end of our trenches AGFT-1 and AGFT-2B. Relatively thick argillic and calcic horizons are present along with nodular carbonate. These elevated and dissected terrace deposits are interpreted to be correlative to the Qt4 unit reported to occur at elevations between 760 and 800 feet within the Puente Hills, with a relative age of 200Ky or greater (Gath, 2007). The soil profile development is simply a confirmation of their antiquity.

2.10.2 Geomorphic Landforms

Close similarities exist between geomorphic landforms created by faulting and those resulting from geologic structure underlying the subject HA-Site. Interpreting landform origin in the absence of subsurface exploration is a difficult task.

The findings of our assessment reveal major geomorphic landforms indicative of active faulting include the right-laterally deflected Blue Mud Canyon located south of the principal Whittier fault, the narrow northwesterly trending scissor-ridge (or ridgeline saddle) spanning the entire HA-Site and are of successful oil/gas exploration and northwesterly trending scar-valley landform notable on LIDAR data. Supporting data includes observations of faulting in our trenches, the northwesterly trend of historically active pumping wells, and extrapolation of active fault mapping from adjacent mass grading geotechnical reports.

The combination of steeply dipping bedrock where paralleling steep-walled canyons, differential erosion and scattered ancient landslides tend to produce a variety of side-hill swales, benches and changes in slope gradient of variable orientation which can be laterally persistent and linear in outcrop. Where occurring away from the active WFZ and in an orientation not consistent with the trend of modern active northwest-trending strike-slip faulting, these features are often mistaken as the manifestation of active secondary faults, presenting investigators with a difficult task of interpretation.

2.10.3 Carbon-14

Use of the Accelerator Mass Spectrometry (AMS) radiometric age-dating technique on samples of in-situ charcoal proved to be a reliable method of establishing pre-Holocene age dates for certain alluvial sediments on the property. This method was not however considered useful in constraining the ages of last offset of the active Whittier fault strand.

Grading activities associated with historical gas/oil operations included removal of an undetermined thickness of in-situ surface deposits from areas directly overlying active fault strands. What were likely important chronostratigraphic sequences and other neo-tectonic evidence, including potential earthquake event horizons, were largely removed. Although the remaining soils are very thin to absent, a rather clear indication of active fault activity is still evident including the close relationship between fault scarps, grabens and active bedrock fault projections. Potential datable organic materials were also impacted by modern surface roots and likely subjected to long term surface water infiltration. If samples of this material were collected and tested by the Carbon-14 method, results would most certainly provide suspect age dates.

Establishment of absolute age dates for soils directly overlying this fault trace were thus not considered feasible. Fortunately, the assessment property is rich in other supplemental geomorphic evidence which allowed for the satisfactory establishment of principal fault location and classification.

The Carbon 14 method did prove to be a useful method of dating deposits of unbroken alluvium within the major linear canyon located directly north of the principal strand. No habitable structures are planned within the margins of this canyon, however, it is located in an area of proposed grading that might benfit from alternative grading measures whould an active fault be found. Thus, an age was desired for these sediments in an attempt to confirm the absence of an active fault trace(s) which, based on the distinctly linear trend of the canyon, could potentially underlie the alluvial deposit. The consulting paleo-seismologist subcontracted as part of this study, who also viewed these deposits in the canyon area of AGFT-1, contemplated that several charcoal fragments within the deposit were good enough candidates to submit for absolute age dating. The availability of datable material eliminated a need to establish a relative age date for nearby unbroken residual colluvial soils (pers. comm. ECI, 2012).

A total of 13 in-situ charcoal samples were collected from the wall of trench AFGT-1, at different elevations within oldest alluvial unit Qal1. The samples were obtained by scraping them into aluminum foil using cleaned knives and screwdriver tools, then transferring the foil into plastic zip-lock bags. The bags were then placed into cardboard boxes and delivered via overnight air to Beta Analytic, Inc. in Miami, Florida for Accelerator Mass Spectrometry (AMS) testing. Sample locations are noted on Plate 1a/1b. Sample Qal-1C@4+56 collected just below the contact with the overlying unit yielded an age of 12,000 to 12,310 ybp. Sample Qal-2C@4+00 collected approximately 2.5 feet below the upper contact yielded an age of 13,140 to 13,310 ybp. The deposit generally did not exhibit a significant degree of residual soil development or occurrence of paleosols. Locations of all charcoal samples are denoted within the log for AGFT-1. Results of age dating are attached as Appendix D.

Two additional bulk samples of organic material were collected from the body of the Older Quaternary Landslide Deposit, present within the upper portion of AGFT-1. The samples were scraped/chiseled from two of the deeper in-filled tension cracks at stations 1+10 and 1+07, and placed into plastic bags for delivered to our laboratory. Given the absolute absence of any geomorphic landslide features expressed in the surface, and further weathering of the area into a narrow ridgeline, these collected samples were not submitted for AMS testing.

TABLE 2: LIST OF CHARCOAL SAMPLES

SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DATE	TRENCH NUMBER	GEOLOGIC UNIT	STATION NUMBER	ELEVATION	NOTES
Qal-1C	Charcoal	7/19/2012	AGFT-1	Qal-1	4+56	683'	Age dated @ 12,400 to 12,000 ybp
Qal-2C	"	"	"	"	4+00	675.5'	Age dated @ 13,310 to 13,140 ybp
Qal-3C	"	"	"	"	3+92	681'	
Qal-4C	"	"	"	"	3+93	675.5'	
Qal-5C	"	"	"	"	3+92	677.5'	
Qal-6C	"	"	"	"	2+89	677.5'	
Qal-7C	"	"	"	"	3+87	678'	
Qal-8C	"	"	"	"	3+85	679'	
Qal-9C	"	"	"	"	3+85	678'	
Qal-10C	"	"	"	"	3+95	679.5'	

CONTINUED **TABLE 2: LIST OF CHARCOAL SAMPLES**

Qal-11C	"	7/17/2012	"	"	4+50	679'	
Qal-13C	"	7/17/2012	"	"	4+46	681'	
Qal-14C	"	7/19/2012	"	"	3+61	681'	
Qal-15C	"	"	"	"	4+02	678.5'	
Qcol-1C	Soil	7/24/2012	"	Topsoil	1+10	768'	Bulk sample from internal Qls graben
Qcol-2C	"	"	"	"	1+07	768'	Bulk sample from internal Qls graben

2.11 Historical Aerial Photography

Several pairs of historical aerial photographs were obtained for review in stereo as part of our preliminary research activities. The photos included a series of vertical black and white prints of varying scale obtained from Continental Aerial Photo, Inc. of Cypress, and four vertical false-colored infrared photos purchased from Geo-Imagery International, Inc. of Oceanside. The Continental photos cover the period between approximately 1950 through 1990 while the Geo-Imagery photos were flown on the date of March 16, 1987. The false-color infrared Geo-Imagery photos provide an accentuated view of surface moisture/vegetation conditions, typically notable as lineaments of concentrated vegetation.

The photographs revealed several geomorphic landforms indicative of active faulting in the area subsequently determined to contain the principal strand of the Whittier fault. These features include the right-lateral deflection of Blue Mud Canyon, presence of the "scissor-ridge" in the area of the active oil field, and the northwesterly alignment of the oil wells themselves. Also notable on the photos was the presence of inactive fault features outside the limits of the seismic setback zone, AP Zone, HA-Site and elsewhere on the property. These features included topographic alignments of canyons and ridges in trends that are typically linear and discordant with the surrounding areas.

A general historical description of the project area is presented below by decade based on our photo observations. A list of photographs is presented below in Appendix C.

1950: No surrounding development. Presence of orchards and agricultural activity to the south and southwest.

1959: Further development/widening of access roads. Oil well pads graded and established.

1970: Tract grading and development to the west. Orchards and agricultural activity south and north of the Santa Ana River. Additional oil wells established to the west in close proximity to the property. Edison towers/power lines constructed.

1973: Further grading and tract development to west. New orchards between property and tract construction to west.

1977: Further development of access road network to south.

1978: Grading and tract development to the southwest in close proximity to the property. Further tract development to far southwest adjacent to 91 freeway.

1980: Extensive grading and tract development to west and southwest in direct proximity to the property. Grading to the southeast near "horseshoe bend" in Santa Ana River.

1983: Tract development to the south and southeast.

1986: Tract development and grading immediately adjacent to the Sage parcel on the west. Extensive development far to the southwest within the city of Yorba Linda.

1988: Extensive grading and tract development immediately to the south (Via Del Agua vicinity).

1990: Grading and development directly to the southeast, south of Blue Mud Canyon. Further development of access road network in "Casino Ridge" area.

2.12 LIDAR Imagery

A tool useful for identification of geomorphic surface features is a system referred to as Light Detection and Ranging (LIDAR). Using specialized "airborne laser-scanning" equipment, LIDAR was employed during a 2004 topographic survey of the subject property. A very large database of surface elevations was captured by way of laser-returns. All buildings and vegetation elements were filtered from the data set to produce 3-dimensional "bare-earth" images of the ground surface. Processed images provide a clear picture of surface morphology, often revealing detailed characteristics of landslides, fault scarp lineaments and debris flows, etc.

The LIDAR images generated for this report clearly highlight the location of the active WFZ across the HA-Site (Figure 7a/7b). Figure 7a shows an oblique southwesterly view of the global property and other features on the HA-Site. The WFZ is notable as a well-developed northwesterly trending scar across the property, represented by a series of linear canyons cross-cutting a consistent east-west trending ridge-valley sequence. Similar features are depicted in an oblique northeasterly view of the global property (Figure 7b). The right-laterally deflected Blue Mud Canyon is highlighted southwest of the fault. Figure 7b indicates the presence of numerous side-hill benches representing a condition of steeply dipping bedrock structure and differential erosion often mistaken for faulting.

3.0 FAULT TRENCHING

We excavated over 2,500 total feet of fault trenches across the HA-Site, including a total of six continuous trenches designated as AGFT-1, -2, -2B, -3, -4 and AGFT-5.

The purpose of the layout was to provide for the intersection of major northwesterly trending faults within the area of proposed conceptual design. Locations and orientations were established to satisfy objectives of the investigation and meet project budget constraints. Where practical the trenches were oriented perpendicular to the prevailing trend of active strike-slip faulting known from existing literature and as depicted on regional geologic maps (North 50 to 70 degrees West). Also taken into consideration for trench layout was a need to explore certain geomorphic features suggestive of possible faulting. Equipment access and estimated depths to bedrock were also factors. Trench locations were slightly modified during excavation as field conditions and field observations warranted. The layout is in a pattern that results in an uninterrupted coverage and continuous observation of subsurface conditions across the northerly AP Zone and area of proposed habitable structures.

3.1 Fault Trench Excavation Summary

3.1.1 Fault Trench AGFT-1

Trench Location: In westerly area of HA-Site, inside AP Zone Boundaries. Extends from the southerly margin of proposed building pads, crosses a major northwesterly trending canyon and cut pad in oil exploration area.

Orientation: NNE
Depth: 5 to 21 feet
Exposed Units: Tpy, Qal1, Qal2, Qdfo, Qlso, Qcolt, Qcolr, Qcol
Excavation Date: 06/13/2012
Total Length: 761 Feet
Logged Face: West Wall
Geologic Overview: Highlights of certain geologic features in this trench are listed in Tables 3a, 3b and 3c. Exposed bedrock is assigned to the Yorba Member of the Puente Formation. It is covered by unbroken deposits of surficial colluvium and alluvium in lower margins of major canyon. Bedding structure consists of larger broad folds, local tight folds, steeply dipping to overturned shale bedding and tectonic shearing. An ancient eroded landslide deposit exists in upper north canyon area. Trench transects active principal trace of Whittier fault in oil production pad, location staked and surveyed as point WF-1 which aligns with WF-2 (AGFT-5) and WF-3 (AGFT-2B). Several less active branch faults observed north and south of principal strand. Principal and branch fault strands form a positive flower structure. The dip of beds on opposite sides of the principal fault trace also follow this pattern. A 120-foot wide seismic setback zone was established north of the principal fault trace that encompasses all observed branch faults. Evidence of active principal fault geomorphology was destroyed during grading of oil pad. An indistinct break in slope gradient was noted above a branch southwesterly dipping thrust fault north of principal strand. The hanging wall exhibits a more significant degree of disarticulation, fracturing, bedding plane shearing and carbonate precipitation relative to the footwall. Wedge of surficial material including older debris flow and topsoil deposits increases in thickness northward of this fault. The fault plane does not break the overlying regolith or topsoil deposits. Although scarps and grabens associated with the principal fault strand remain, the absence of the entire chronological suite of in-situ graben deposits and surface related surface morphology generally prohibits reliable evaluation of the age of last surface rupture.

Based on the decreasing evidence of geomorphological evidence for active faulting in surfaces above branch faults, and observations that these faults diminish in apparent offset and frequency away from the principal strand, and may not always accommodate movement during a major earthquakes, we consider the age of last offset along these faults to be similar to that of the principal fault.

TABLE 3a: AFGT-1 Geologic Trench Log Summary (Plate 3A)

TRENCH	PLATE	STATION RANGE			GEOLOGIC FEATURE
AGFT-1	PLATE 3A	00-18	to	00+30	Zone of geogrid placement in trench backfill
		00+05	to	01+80	Overall bench in slope due to differential erosion of ancient landslide deposits
				00+30	Tight anticlinal fold with overturned bedding, local discontinuous faulting
		00+42	to	02+17	Older Quaternary Landslide Deposit - rupture developed on synclinal structure
				00+42	Landslide rupture surface developed along bedding in fold limb
		00+42	to	00+60	Landslide graben
		01+07	to	01+10	C-14 sample locations - bulk organic material stored in AG laboratory
				00+60	Projection of landslide rupture surface beneath trench bottom
				02+17	Landslide toe daylights along in-situ bedding along tight anticlinal fold limb
				02+17	Resistant in-situ bedrock contact, thin topsoil cap, area coincident with steep slope ratio transition
		01+78	to	03+28	Zone of geogrid placement in trench backfill
				02+97	Location of thickening colluvial wedge

TABLE 3b: AFGT-1 Geologic Trench Log Summary (Plate 3B)

TRENCH	PLATE	STATION RANGE			GEOLOGIC FEATURE
AGFT-1	PLATE 3B			03+18	Interfingering Colluvium and Holocene Alluvium Deposits
				03+35	Axis of paleo tributary canyon
		3+40	to	03+90	Older Quaternary Debris Flow Deposits
				03+55	Active channel of tributary canyon
				03+60	Buried Pleistocene Alluvium contact
				03+75	Active channel of main canyon
				04+00	Charcoal sample location (Qal-2C 4+00)
				04+42	Interfingering Older Debris Flow and Alluvium Deposits
				04+55	Charcoal sample location (Qal-1C 4+55)
				04+65	South buried limit of Pleistocene Alluvium
		04+68	to	05+00	Limits of buried regolith deposit
				04+96	Branch fault with limited offset and discordant strike, coincident with buried scarp and limits of regolith, capped by 10-foot thick unbroken older debris flow deposit and topsoil, does not extend into surface deposits
				04+90	Localized area of dark "black" topsoil, possible earthflow headscarp graben, no related change in surface profile
				04+98	Buried scarp
				05+16	Buried scarp and coinciding change in slope gradient
				05+23	High-angle branch fault with relatively minor offset, minor change in bedrock structure across fault, does not extend into capping surficial deposits
		05+35	to	05+47	Cluster of low-angle branch faults, coincident with buried scarp and indistinct break in grade, moderate change in structure across faults, does not break capping surface deposits
				05+51	Buried scarp and indistinct grade break associated with branch fault, does not break capping surface deposits

CONTINUED **TABLE 3b: AFGT-1 Geologic Trench Log Summary (Plate 3B)**

				05+64	Branch fault with minor offset, does not break capping surface deposits
		05+70	to	05+73	Cluster of branch faults with disarticulated gouge zone and moderate change in structure across fault, does not break capping surface deposits
				05+70	MATCH LINE PLATES 1B/1C
		05+80	to	05+82	Branch fault associated with grade break, buried scarp and graben, minor offset of bedrock, does not break capping surficial deposits
				05+87	Branch fault with gouge zone and shear, significant change in bedrock structu4re across fault, tight folding of shales in close proximity to fault strands, does not break capping surficial deposits
				05+98	Branch fault with well-developed gouge zone, significant nodular carbonate precipitation, significant folding and change in structure across fault, topsoils disturbed but no thoroughgoing fault trace visible, does not break capping surficial deposits
		05+72	to	06+06	Approximate limits of oil/gas side-cast fill deposit
		06+00	to	06+25	Limits of principal fault graben
				06+20	Principal Trace - Whittier Fault, cluster of multiple closely spaced fault strands bounding gouge zone (disarticulated bedding), associated with buried scarp and infilled graben tight proximal folding, major stratigraphic and structural discordance across zone
		06+20	to	06+25	Branch bedding plane faults or shears, truncated by principal fault
				06+13	Approximate limits of oil/gas cut pad
				06+20	Boundary of northerly Seismic Setback Zone (Southerly zone designation pending findings of ongoing fault study on SAGE parcel)

TABLE 3c: AFGT-1 Geologic Trench Log Summary (Plate 3C)

TRENCH	PLATE	STATION RANGE			GEOLOGIC FEATURE
AGFT-1	PLATE 3C	06+23	to	06+45	Low angle branch fault with major discordance of structure across fault
				06+38	Graben truncated by cut pad
				06+45	scarp and grabens truncated by cut pad
				06+50	Local bedding plane fault
		06+45	to	06+64	Branch fault offsets geologic structure
				06+72	Buried scarp?
		06+20	to	06+85	Major change in stratigraphic section across principal fault strand (increased sandstone beds)
				06+72	Buried Older Talus Deposit contact
				07+00	Buried erosional scarp
		06+90	to	07+60	Well-developed soil profile in Talus Deposits

3.1.2 Fault Trench AGFT-2

Trench Location: In west-central area of HA-Site within limits of proposed fill slope, inside AP Zone boundaries. Transects abandoned oil road cut into north-facing wall of major canyon.

Orientation: ENE

Depth: 3 to 15 feet

Exposed Units: Tpy, Qdfr, Qcol, Af,

Excavation Date: 06/15/2012

Total Length: 380 Feet

Logged Face: South Wall

Geologic Overview: Highlights of certain geologic features in this trench are listed in Tables 4a. Exposed bedrock is assigned to the Yorba Member of the Puente Formation. It is covered by unbroken deposits of surficial regolith, colluvium, debris flow and artificial fill. Prominent bedding structure includes tight chevron folds and steeply dipping to overturned bedding. No evidence of active faulting was Observed. Only minor discontinuous faults or local bedding plane shearing associated with folding was observed.

TABLE 4a: AFGT-2 Geologic Trench Log Summary (Plate 4A)

TRENCH	PLATE	STATION RANGE			GEOLOGIC FEATURE
AGFT-2	PLATE 4A	00+00	to	00+20	Recent Debris Flow Deposit overlies Artificial Fill
		00+90	to	01+20	Recent Debris Flow Deposit overlies Artificial Fill
		01+53	to	02+10	Relatively thick, massive, jointed sandstone lithology
		01+92	to	02+00	Soft sediment deformation
				01+40	Fill placed above topsoil
				02+75	Contact of Artificial fill over Topsoil
				03+10	Buried regolith contact

3.1.3 Fault Trench AGFT-2B

Trench Location: Westerly area of HA-Site within limits of proposed development, crosses cut pad in oil production area (Darco Oil Lease), inside AP Zone boundaries, transects main Whittier fault strand. A similar fault trench was excavated in this area which was backfilled by oil lessor prior to commencement of logging activities.

Orientation: NNE

Depth: 4 to 9 feet

Exposed Units: Tpy, Qcol, Af

Excavation Date: 08/01/2012

Total Length: 82 Feet

Logged Face: West Wall

Geologic Overview: Highlights of certain geologic features in this trench are listed in Table 4b. Exposed bedrock is assigned to the Yorba Member of the Puente Formation. It is covered by unbroken deposits of surficial colluvium and artificial fill. Structure consists of tight folding, steeply dipping to overturned well-formed shale bedding and tectonic shearing. The trench transects the active principal trace of Whittier fault in oil production pad area. The fault location was staked and surveyed as point WF-3 which aligns with WF-2 (AGFT-5) and WF-1 (AGFT-2). Beds on opposite sides of the principal fault trace dip toward it. Evidence of active principal fault geomorphology appears to be somewhat preserved in the area above the fault, now capped by side-cast artificial fill deposits associated with oil pad grading. The projection of the fault to the surface aligns with a small scarp and adjacent graben deposit. Although scarps and grabens associated with the principal fault strand remain, the original surface morphology of the area was partially destroyed during grading. It does appear the projection of the fault is coincident with a break in slope profile (now infilled with fill), a reliable determination of the age of last surface rupture is not possible.

Two secondary faults are present in the distal southerly trench adjacent to an existing access road. The termination and final depth of the trench at this location was generally limited by the presence of the road. Although surface deposits and bedrock are significantly weathered, pervasively disarticulated and bioturbated, gouge zones and a possible scarp appear to exist. The fault strands were not observed to penetrate overlying surficial deposits. A small discontinuous fault was noted near the north end of the trench, interpreted to be associated with anticlinal folding. It extends to the surface of the cut pad but terminates before reaching the trench bottom. Although evidence of its interaction with surface material was removed by grading we suspect it did not penetrate topsoil deposits.

The north end of the trench extends only 40 feet beyond the principal fault strand. Nonetheless, a 120-foot wide seismic setback zone is considered reasonable based on faulting recognized in trench AGFT-1 and absence of faulting noted in trench AGFT-2.

TABLE 4b: AFGT-2B Geologic Trench Log Summary (Plate 4B)

TRENCH	PLATE	STATION RANGE			GEOLOGIC FEATURE
AGFT-2B	PLATE 4B	00-05	to	00+00	Buried gas line
		00+00	to	00+25	Approximate limits of oil/gas cut pad
				00+00	Well-developed anticlinal fold just outside north end of trench
				00+25	Axis of tight anticlinal fold, contact with side-cast oil/gas fill
				00+35	Buried scarp and graben
				00+40	Limits of northern Seismic Setback Zone (establishment of Southern Seismic Setback Zone pending review of fault trench study for SAGE parcel by others)
				00+41	Principal strand - Whittier Fault, high-angle bedding truncated and dipping into gouge zone

CONTINUED **TABLE 4b: AFGT-2B Geologic Trench Log Summary (Plate 4B)**

		00+42	to	00+45	Significant carbonate precipitation/weathering
				00+69	Bedding plane shear
				00+70	Branch fault, truncated geologic structure across fault, gouge zone, disarticulated bedding, significant weathering
				00+75	Branch fault, gouge zone
				00+81	Edge of oil/gas access road

3.1.4 Fault Trench AGFT-3

Trench Location: Central area of HA-Site within easterly margin of proposed development, crosses proposed building lots, parallels south side of SCE access road and apex of east-west trending ridgeline, inside and extends north of AP Zone boundaries.

Orientation: ENE

Depth: 10 to 15 feet

Exposed Units: Tpy, Qlso1, Qlso2, Qcol

Excavation Date: 06/19/2012

Total Length: 860 Feet

Logged Face: Northwest Wall

Geologic Overview: Highlights of certain geologic features in this trench are listed in Tables 5a and 5b. Exposed bedrock is assigned to the Yorba Member of the Puente Formation. It is covered by unbroken deposits of surficial colluvium and older Quaternary Landslide Debris. Topsoil thickness tends to be thin where underlain by resistant sandstones and thicker where underlain by more erodible shales or landslide debris. Bedrock structure consists of moderately dipping shale and sandstone beds with a marked absence of folding, except locally. No evidence of active faulting was observed. Only minor discontinuous faults and local bedding plane shears associated with tectonic or syndepositional folding was observed. Two distinct stratigraphic sections are notable within the easterly portion of the trench interpreted to have been deposited under more turbid conditions than the relatively quiescent strata occurring above and below. These units are approximately 12 feet thick and exhibit backfilled channels, isolated sand lenses and locally contorted/folded/truncated bedding. Portions of the stratigraphic sections are significantly folded and tectonically sheared (stations 02+90 to 03+50 and 04+07 to 04+50). As these sections contain several cemented interbeds we interpret the timing of folding to be more close to that of deposition, when the beds were still very pliable. The generally coherent paleo structure suggests these deposits result from syndepositional submarine landsliding or slumping.

The westerly end of the trench extends into an ancient landslide deposit and paired incipient slide behind it (Plate 1a/1b). Landslide debris is significantly weathered, disarticulated and locally impregnated by carbonate. Well-developed basal rupture surfaces with polished slickenside grooves are present.

TABLE 5a: AFGT-3 Geologic Trench Log Summary (Plate 5A)

TRENCH	PLATE	STATION RANGE			GEOLOGIC FEATURE
AGFT-3	PLATE 5A	00+00	to	00+90	Homoclinal structure, quiescent alternating sandstone, shale bedding
		00+90	to	02+20	Stratigraphic zone of relative turbulent deposition, submarine channelization, soft sediment deformation and tectonic shearing
		01+50	to	02+90	Stratigraphic zone of relative quiescent deposition
		02+20	to	03+50	Stratigraphic zone of relative turbulent deposition
		02+90	to	03+50	Zone of submarine channelization, soft sediment deformation and folding, cemented bedding and tectonic shearing (possibly relating to landsliding/slumping)
		04+07	to	04+50	Zone of submarine channelization and soft sediment deformation, tectonic shearing and cemented bedding

TABLE 5b: AFGT-3 Geologic Trench Log Summary (Plate 5B)

TRENCH	PLATE	STATION RANGE			GEOLOGIC FEATURE
AGFT-3	PLATE 5B	04+07	to	04+50	Zone of submarine channelization and soft sediment deformation, tectonic shearing and cemented bedding
				06+10	Relative increase in topsoil thickness relating to differential character of underlying sandstone/shale units
		06+45	to	08+05	Older Landslide rupture surface, failure along bedding

CONTINUED **TABLE 5b: AFGT-3 Geologic Trench Log Summary (Plate 5B)**

		07+85	to	08+60	Older Landslide Debris, significant increase in fracturing/weathering, disarticulated bedding and carbonate precipitation
		07+90	to	08+60	Thickening of topsoil wedge, increased pedogenesis

3.1.5 Fault Trench AGFT-4

Trench Location: NW Corner of HA-Site within limits of proposed building lots, inside and extending north of AP Zone boundaries, following apex of a south-trending ridgeline.

Orientation: NE

Depth: 10 feet

Exposed Units: Tpy, Qcol

Excavation Date: 07/10/2012

Total Length: 330 Feet

Logged Face: West Wall

Geologic Overview: Highlights of certain geologic features in this trench are listed in Table 6. Exposed bedrock is assigned to the Yorba Member of the Puente Formation. It is covered by unbroken topsoil deposits. Topsoil thickness is relatively thin to moderately thick. Bedrock structure consists of moderately to steeply dipping shale and sandstone interbeds that are broadly to tightly folded. No evidence of active faulting was observed. Local shears and faults truncate bedding and juxtapose discordant structure, their origin interpreted as related to ancient tectonic folding. A distinct series of shears and offset stratigraphic section within the northerly portion of the trench is interpreted to be the result of syndepositional submarine landsliding or slumping. Stratigraphic separation across these features is not significant and the shears are capped by continuous bedding. Fractures, bedding, fault and shear structures within the upper portion of the trench tend to be pervasively impregnated by secondary calcium carbonate. Bedrock deposits were very dry and powdery upon excavation as a result. The degree of this pedogenic carbonate development, absence of breaks in surface deposits, absence of graben or scarps above faults, and smoothly eroded profile of the ridgeline (absence of tectonic geomorphic landforms) are supporting evidence for the ancient nature of the geologic structure and more specifically, pre-Holocene faulting and folding activity.

TABLE 6: AFGT-4 Geologic Trench Log Summary (Plate 6)

TRENCH	PLATE	STATION RANGE			GEOLOGIC FEATURE
AGFT-4	PLATE 6			00+00	Anticlinal fold axis in end of trench
				00+32	Older fault related to folding, minor change in lithology across fault, does not extend into capping topsoil deposits
		01+35	to	01+48	Zone of limited apparent stratigraphic separation across shears (closely correlative bedding)
		00+58	to	00+65	Shear truncates bedding interpreted to be related to syndepositional submarine landsliding, capped by unbroken beds
		01+00	to	00+83	Series of shears, increased carbonate precipitation, capped by unbroken topsoil
				01+55	Old faults truncate bedding, do not extend into capping topsoil
				01+69	Cemented bedding
		01+70	to	01+90	Severely fractured bedding, increased carbonate precipitate
				01+96	Cemented bedding
				02+05	Discontinuous bedding plane shear, folding
				02+07	Cemented/jointed bedding
		02+06	to	02+40	Low angle fold-related shear truncates bedding
		02+25	to	02+35	Significant carbonate precipitate
				02+42	Soft sediment deformation
		02+50	to	02+58	Significant carbonate precipitation
		02+56	to	02+65	Soft sediment deformation
		02+73	to	03+12	Soft sediment deformation
		03+22	to	03+26	Cemented bedding

3.1.6 Fault Trench AGFT-5

Trench Location: SW area of HA-Site within limits of proposed design, inside limits of AP Zone. The trench transects the active principal trace of Whittier fault in the oil production cut pad area. Northern trench margin abuts existing access road. North trench limit and final depths are generally limited by the road.

Orientation: NNE

Depth: 10 to 15 feet

Exposed Units: Tpy, Qcol

Excavation Date: 07/16/2012

Total Length: 122 Feet

Logged Face: West Wall

Geologic Overview: Highlights of certain geologic features in this trench are listed in Tables 7. Exposed bedrock is assigned to the Yorba Member of the Puente Formation. It is covered by unbroken deposits of topsoil. Structure consists of tight folding and steeply dipping to overturned well-formed shale and sandstone interbeds. The principal trace of the Whittier fault is transected at the extreme north end of the trench. The log between stations 00+00 and 00-10 is a reverse-representation of its exposure within the east trench wall. The fault location was staked and surveyed as point WF-2 which aligns with WF-3 (AGFT-2B) and WF-1 (AGFT-1). Beds on opposite sides of the principal fault trace dip toward it. An unknown degree of original surface morphology and other active faulting evidence was destroyed during grading. Evidence of active principal fault geomorphology is somewhat preserved in the area above the fault. The projection of the fault to the surface aligns with a relatively significant scarp and adjacent graben deposit. Reliable use of absolute age dating techniques to determine an age of most recent offset was not possible due to the pervasive disturbance of graben material by bioturbation.

Several branch faults south of the principal fault strand juxtapose changes in stratigraphy and structure.

A highly weathered southward-dipping bedrock contact with overlying wedge of slope talus and capping topsoil were observed in the south end of the trench. The surface deposits exhibit a relatively old soil profile including well-developed horizons of carbonate (films along ped faces and local nodules in lower talus unit) and deep reddish-brown argillic horizon (blocky structure and thick clay films on peds) within the upper portions of the talus.

The 120-foot wide seismic setback zone is maintained through this area, extending north of the principal fault trace based on the location of branch faults observed in trench AGFT-1 and absence of faulting noted in trench AGFT-2.

TABLE 7: AFGT-5 Geologic Trench Log Summary (Plate 7)

TRENCH	PLATE	STATION RANGE			GEOLOGIC FEATURE
AGFT-5	PLATE 7	00-10	to	00+00	Logging from opposite "east" trench wall
				00-01	Principal trace - Whittier Fault, truncated high-angle bedding, trace extends to cut pad surface, scarp and graben, high-angle bedding plane shears in gouge, opposing geologic structure across fault
				00+07	Branch fault, truncates high-angle bedding, significant change in structure across fault, local gouge, does not extend to surface
				00+17	Branch fault, truncates high-angle bedding, significant change in structure across fault, does not extend to surface
				00+20	Branch fault, truncates high-angle bedding, local gouge, significant change in structure across fault, does not extend to surface
				00+40	Branch fault, decreased fault angle, north dipping structure toward principal strand, tight folding adjacent fault, does not extend to surface
				00+64	Branch fault, decreased fault angle, north dipping structure toward principal strand, tight folding adjacent fault, does not extend to surface
				00+68	Branch fault, decreased fault angle, north dipping structure toward principal strand, tight folding adjacent fault, does not extend to surface
				00+85	Low angle branch fault, dipping north toward principal strand, does not extend into capping topsoil

3.2 Fault Trench Backfill

All trench backfill operations were placed in agreement with Grading Permit GA120003, issued by the County of Orange for the subject investigation. Two separate placement methods were employed including a "General Backfill Method" in areas where final slopes are flatter than 2:1 (horizontal:vertical), and a "Geo-Grid Stabilized Backfill Method" in areas where slopes exceeded 2:1. Only Fault Trench AGFT-1 received geo-grid placement as it was the only trench in sloped areas exceeding 2:1.

3.2.1 General Backfill

General Backfill placement was performed using the Caterpillar 314C track-mounted excavator equipment between the dates of July 19 and August 23, 2012. Backfill material consisted of a mixture of on-site surficial soils and weathered bedrock derived from tailings of the trench excavations. Backfill in lowest trench slots was mechanically compacted by either track-walking with the excavator and/or wheel rolling with a sheeps-foot attachment. Subsequent backfill was placed using a similar methodology until adjacent previously existing surface grades were matched.

3.2.2 Geo-Grid-Stabilized Backfill

To minimize the occurrence of possible future surficial failures, settlement and/or creep within trench backfill, areas where trenches cross slope ratios equal to or greater than ratios of 2:1 (horizontal:vertical) were reinforced using a geo-grid textile material (Synteen SF 20) placed in 2-foot vertical intervals within the backfill. Geo-grid was placed in general accordance with requirements of our engineering recommendations (AG, 2012b). Geo-grid layers were extended across the entire width of the backfill and into the core of the fill a minimum of 10 feet. Backfill material between layers was placed in vertical lifts using a sheepsfoot wheel. The approximate locations of geo-grid placement are noted on our Geologic Map and Fault Trench Log AGFT-1 on Plates 1 and 2, respectively. A summary of fault trench dimensions and geo-grid placement are presented below in Table 1.

3.2 Peer Review

Our trenches were visited by professional geologists including Eric J. Seward and Stuart K. Mayes of Allan E. Seward Engineering Geology, Inc., Nick Bebek and Mike Fisher with the County of Orange, and Janis L. Hernandez and Jerome A. Treiman with the California Geologic Survey.

4.0 CONCLUSIONS

4.1 Faulting

4.1.1 Principal Whittier Fault Trace (ACTIVE)

The principal "active" trace of the Whittier fault is a single high-angle strand or narrow zone of multiple high-angle strands bounding a zone of gouge. Significant changes in the dip of bedding and stratigraphic section were observed across the fault. Bedding on opposite sides of the fault consistently dips toward, or into, the fault, resulting in a positive flower-structure configuration indicative of transpressive strike-slip motion. A significant right-lateral deflection of Blue Mud Canyon on the property is supporting evidence for motion in a right-lateral sense. Nearby investigations confirm this condition and further establish it is almost purely right-lateral. The most accurate measurement of offset seems to be around 4.6 kilometers.

Our trenches permitted continuous observation of structure and unequivocal evidence for the location of the principal fault strand. However, because the principal fault traces were encountered in a cut pad graded for oil production, a significant amount of delicate surface evidence necessary to evaluate the timing and age of most recent fault movement was removed or destroyed. Alignment of the principal fault trace fits extremely well with its documented location beyond the property boundaries to the northwest and southeast.

Nearby investigations constrain estimates of the age of last surface rupture and amount of translational offset associated with large earthquakes along the Whittier fault. Current research suggests that large infrequent earthquakes range from approximately Magnitude M6.7 every 700 years to M7.2 every 1,000 to 1,500 years, and that at least 1,600 years has passed since the last large event, which resulted in offset of 4 to 7 feet laterally (ECI, 1997).

4.1.2 Secondary Branch Faults (ACTIVE)

Several secondary faults were noted north and south of the principal trace of the Whittier fault. These bedrock faults are classified as normal, thrust and bedding-plane styles. All likely have had or are expected to accommodate a certain degree of minor translational movement on the order of millimeters to inches. Geomorphic evidence of recent movement along these faults ranged from subtle to non-existent. The only notable evidence of recent movement was a minor break in slope gradient and associated apex of a thickening surface soil wedge above one of these faults. Nowhere do they extend upward into the overlying cap of unbroken surface deposits. The branch faults diminish in frequency, magnitude and dip angle with increasing distance from the principal fault strand. As movement likely alternates between several different bedding planes and other geologic structures we suspect the branch faults are not laterally continuous for any great distance. The amount of future offset along these faults is expected to be variable and significantly less than that of the principal fault, likely on the order of only a few inches. As movement along branch faults is considered to occur only in response to movement along the principal strand, the timing of past and future faults is equivalent to that of principal faulting.

Branch faults were observed up to a distance of 120 feet from the trace of the principal fault. Due to the potential for sympathetic movement along these faults during major earthquakes we recommend they be incorporated into a seismic setback zone at least 120 feet in width.

4.1.3 Other Faults (INACTIVE)

A few inactive faults were noted in trench AGFT-4 within the elevated/uplifted area of the Puente Hills block. None of these faults were noted as breaking deposits of overlying topsoil or colluvium, nor are they associated with any geomorphic landforms indicative of active faulting. Unbroken surface deposits are relatively thin and provide little ability to age date the faulting. They are however impregnated by secondary carbonate indicative of an age older than Holocene. The inactive age of these faults is based on the following:

- Surface deposits overlying the faults are unbroken
- There is no linear geomorphic surface evidence along their strike that are indicative of recent faulting
- A relatively significant degree of pedogenic carbonate has developed in the surface soils and impregranted the underlhying bedrock
- The fautls are not through-going features as they do not occur within any of the other fault trenches to the southeast
- As-graded geologic mapping in neighboring residential tracts to the northwest documented the presence of no faulting (active or inactive) along the projected strike of these faults

5.0 RECOMMENDATIONS

5.1 Seismic Setback Zone (Area of Restricted Use)

A seismic setback zone has been established based on the mapped locations of principal and secondary branch faults within our trenches. Zone widths vary from a maximum of 120 feet in the area of our trenches AGFT-1, AGFT-2B and AGFT-5 to 50-feet where established by others outside the subject property to the northwest and southeast (Plates 1a/1b).

Per a verbal agreement with the County of orange, no setback zone has been established to the south of the principal fault trace as the results of ongoing fault studies by others on the adjacent Sage parcel are pending. Establishment of the zone in this area will be dependent upon the faulting they identify in their trenches. Furthermore, none of our trenches south of the principal trace were far enough or deep enough to thoroughly investigate conditions of faulting, as no planned habitable structures exist in this area and the thickness of younger surface soils would require more effort to penetrate. Also, relative to this subject, is the absence of any faults noted along the southerly existing access road based on our geologic mapping (Plate 1a/1b).

5.2 Fault-Related Grading and Construction Measures

The right-lateral style and magnitude of anticipated surface rupture should also be incorporated into future design plans within the seismic setback zone where possible. Construction of utilities across the fault zone should incorporate flexible connections capable of sustaining their integrity following an abrupt lateral offset associated with a surface rupture event.

5.3 Additional Work

The next phase of exploration on the EHD property will include performance of conceptual design level geotechnical studies. The work should be conducted in close coordination with County of Orange staff in order to assure satisfactory compliance with all residential development requirements for this level of design. Depending upon which plan option is finally selected, the studies will address development of proposed roadways, building lots, cut and fill slopes, bridges, retaining walls, detention basins and other improvements at a scale of 1-inch equals 100 feet.

5.4 Other

Copies of this report should first be issued to the County of Orange for their review. Following approval by the County, a finalized version of the report should be forwarded to the California Geological Survey for inclusion in their open-file library of Alquist-Priolo Earthquake Fault Study reports.

6.0 LIMITATIONS

6.1 Risk Statement

Exposures within our fault trenches and confirmation of their presence by several professional geologists, suggest the location of the principal Whittier fault trace and secondary fault strands have been mapped in high confidence. Equally confident are the absence for evidence of active faulting beyond the limits of the established seismic setback zone. Based on the above we find that the risk of surface rupture hazards to proposed habitable structures will be low.

The risk to improvements proposed within the seismic setback zone as a result of future surface rupture is considered significant.

6.2 Limitations of Data and Conclusions

This report was prepared for Yorba Linda Estates, LLC to assess faulting and related hazards in accordance with currently accepted engineering geology practices in the County of Orange. Geotechnical design services were not included as part of this assessment.

APPENDIX A

REFERENCES

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APPENDIX B

HISTORICAL AERIAL PHOTOGRAPHS LIST

Date	Photo Type	Scale	Flight #	Source	Comment
03- 30- 67	B&W, vertical				
03- 30- 67	B&W, vertical				
03- 30- 67	B&W, vertical				
03-26-59	B&W, vertical		261-5-22-93		
03-26-59	B&W, vertical		261-5-22-94		
01-30-70	B&W, vertical		60-4-103		
01-30-70	B&W, vertical		60-4-104		
01-30-70	B&W, vertical		60-4-104		
01-30-70	B&W, vertical		60-4-105		
01-30-70	B&W, vertical		60-4-105		
10-29-73	B&W, vertical		132-9-2		
10-29-73	B&W, vertical		132-9-3		
10-29-73	B&W, vertical		132-9-4		
01-13-75	B&W, vertical		157-10-3		
01-13-75	B&W, vertical		157-10-4		
01-13-75	B&W, vertical		157-10-5		
01-24-77	B&W, vertical		181-10-4		
01-24-77	B&W, vertical		181-10-5		
01-24-77	B&W, vertical		181-10-6		
12-14-78	B&W, vertical		203-10-6		
12-14-78	B&W, vertical		203-10-7		
01-31-81	B&W, vertical		211-10-7		
01-31-81	B&W, vertical		211-10-8		
04-02-83	B&W, vertical		218-10-7		
04-02-83	B&W, vertical		218-10-8		
04-02-83	B&W, vertical		218-10-9		
03-26-59	B&W, vertical		261-5-22-93		
03-26-59	B&W, vertical		261-5-22-94		
03-26-59	B&W, vertical		261-5-22-95		
03-26-59	B&W, vertical		261-5-R21-57		
03-26-59	B&W, vertical		261-5-R21-57		
03-26-59	B&W, vertical		261-5-R21-57		
12-12-52	B&W, vertical		AXK-3K-14		
12-12-52	B&W, vertical		AXK-3K-15		
12-12-52	B&W, vertical		AXK-3K-15		
12-12-52	B&W, vertical		AXK-3K-16		
12-12-52	B&W, vertical		AXK-3K-16		
06-12-90	B&W, vertical		C84-14-25		
06-12-90	B&W, vertical		C84-14-26		
01-23-92	B&W, vertical	1" = 2000'	C85-4-6		
01-23-92	B&W, vertical	1" = 2000'	C85-4-7		
01-23-92	B&W, vertical	1" = 2000'	C85-4-8		
06-09-93	B&W, vertical	1" = 2000'	C93-16-57		

Date	Photo Type	Scale	Flight #	Source	Comment
06-09-93	B&W, vertical	1" = 2000'	C93-16-58		
06-09-93	B&W, vertical	1" = 2000'	C93-16-59		
02-01-95	B&W, vertical	1" = 2000'	C105-32-43		
02-01-95	B&W, vertical	1" = 2000'	C105-32-44		
10-16-97	B&W, vertical	1" = 2000'	C119-32-42		
10-16-97	B&W, vertical	1" = 2000'	C119-32-43		
02-23-99	B&W, vertical	1" = 2000'	C-133-32-168		
02-23-99	B&W, vertical	1" = 2000'	C-133-32-168		
02-23-99	B&W, vertical	1" = 2000'	C-133-32-169		
02-23-99	B&W, vertical	1" = 2000'	C-133-32-169		YLE outlined in red
12-30-86	B&W, vertical		F-111		
12-30-86	B&W, vertical		F-112		
12-30-86	B&W, vertical		F-113		
01-1980	B&W, vertical		SBD-17-3		
01-1980	B&W, vertical		SBD-17-7		
12-02-88	B&W, vertical	1" = 1600'	Yorba Linda 2-6		
12-02-88	B&W, vertical	1" = 1600'	Yorba Linda 2-7		
12-02-88	B&W, vertical	1" = 1600'	Yorba Linda 2-8		
12-12-52	vertical, stereo image		AXK-3K-??		Flight # cropped
03-26-59	vertical, stereo image		261-5-22-9?		Flight # cropped
01-30-70	vertical, stereo image				Flight # cropped
10-29-73	vertical, stereo image		132-9-4		
01-24-77	vertical, stereo image		181-10-5		
01-24-77	vertical, stereo image		181-10-6		
12-14-78	vertical, stereo image		203-10-7		
01-31-81	vertical, stereo image		211-10-8		
04-02-83	vertical, stereo image		218-10-?		Flight # cropped
12-30-86	vertical, stereo image		F-112		
12-02-88	vertical, stereo image		Yorba Linda 2-7		
06-12-90	vertical, stereo image		C84-14-25		
10-16-97	vertical, stereo image		C119-32-42		
02-23-99	vertical, stereo image		C133-32-168		
08-09-70	B&W, vertical		FLT24 40		CGS
08-09-70	B&W, vertical		FLT24 39		CGS
08-09-70	B&W, vertical		FLT24 38		CGS
08-31-70	B&W, vertical		FLT23 34		CGS
08-31-70	B&W, vertical		FLT23 33		CGS
08-31-70	B&W, vertical		FLT23 32		CGS
1927	B&W, vertical		113 995		CGS
1927	B&W, vertical		113 996		CGS
1927	B&W, vertical		113 997		CGS
1939	B&W, vertical		5925-202		CGS
1939	B&W, vertical		5925-201		CGS

APPENDIX C

CARBON 14 LABORATORY RESULTS

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Darden Hood
President

Ronald Hatfield
Christopher Patrick
Deputy Directors

July 19, 2012

Mr. Jeff Hull
American Geotechnical, Inc
22725 Old Canal Road
Yorba Linda, CA 92887
USA

RE: Radiocarbon Dating Results For Samples QAL-1C@4+56, QAL-2C@4+00

Dear Mr. Hull:

Enclosed are the radiocarbon dating results for two samples recently sent to us. They each provided plenty of carbon for accurate measurements and all the analyses proceeded normally. The report sheet contains the dating result, method used, material type, applied pretreatment and two-sigma calendar calibration result (where applicable) for each sample.

This report has been both mailed and sent electronically, along with a separate publication quality calendar calibration page. This is useful for incorporating directly into your reports. It is also digitally available in Windows metafile (.wmf) format upon request. Calibrations are calculated using the newest (2004) calibration database. References are quoted on the bottom of each calibration page. Multiple probability ranges may appear in some cases, due to short-term variations in the atmospheric 14C contents at certain time periods. Examining the calibration graphs will help you understand this phenomenon. Calibrations may not be included with all analyses. The upper limit is about 20,000 years, the lower limit is about 250 years and some material types are not suitable for calibration (e.g. water).

We analyzed these samples on a sole priority basis. No students or intern researchers who would necessarily be distracted with other obligations and priorities were used in the analyses. We analyzed them with the combined attention of our entire professional staff.

Information pages are enclosed with the mailed copy of this report. They should answer most of questions you may have. If they do not, or if you have specific questions about the analyses, please do not hesitate to contact us. Someone is always available to answer your questions.

The cost of the analysis was charged to the VISA card provided. A receipt is enclosed with the mailed report copy. Thank you. As always, if you have any questions or would like to discuss the results, don't hesitate to contact me.

Sincerely,

Darden Hood
Digital signature on file

BETA ANALYTIC INC.
DR. M.A. TAMERS and MR. D.G. HOOD
4985 S.W. 74 COURT
MIAMI, FLORIDA, USA 33155
PH: 305-667-5167 FAX:305-663-0964
beta@radiocarbon.com

REPORT OF RADIOCARBON DATING ANALYSES

Mr. Jeff Hull

American Geotechnical, Inc

Report Date: 7/19/2012

Material Received: 7/13/2012

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 325820	10400 +/- 50 BP	-28.5 o/oo	10340 +/- 50 BP
SAMPLE : QAL-1C@4+56			
ANALYSIS : AMS-PRIORITY delivery			
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid			
2 SIGMA CALIBRATION : Cal BC 10450 to 10040 (Cal BP 12400 to 12000)			
Beta - 325821	11330 +/- 50 BP	-24.0 o/oo	11350 +/- 50 BP
SAMPLE : QAL-2C@4+00			
ANALYSIS : AMS-PRIORITY delivery			
MATERIAL/PRETREATMENT : (organic sediment): acid washes			
2 SIGMA CALIBRATION : Cal BC 11360 to 11190 (Cal BP 13310 to 13140)			

Dates are reported as RCYBP (radiocarbon years before present, "present" = AD 1950). By international convention, the modern reference standard was 95% the 14C activity of the National Institute of Standards and Technology (NIST) Oxalic Acid (SRM 4990C) and calculated using the Libby 14C half-life (5568 years). Quoted errors represent 1 relative standard deviation statistics (68% probability) counting errors based on the combined measurements of the sample, background, and modern reference standards. Measured 13C/12C ratios (delta 13C) were calculated relative to the PDB-1 standard.

The Conventional Radiocarbon Age represents the Measured Radiocarbon Age corrected for isotopic fractionation, calculated using the delta 13C. On rare occasion where the Conventional Radiocarbon Age was calculated using an assumed delta 13C, the ratio and the Conventional Radiocarbon Age will be followed by "*". The Conventional Radiocarbon Age is not calendar calibrated. When available, the Calendar Calibrated result is calculated from the Conventional Radiocarbon Age and is listed as the "Two Sigma Calibrated Result" for each sample.

CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-28.5:lab. mult=1)

Laboratory number: **Beta-325820**

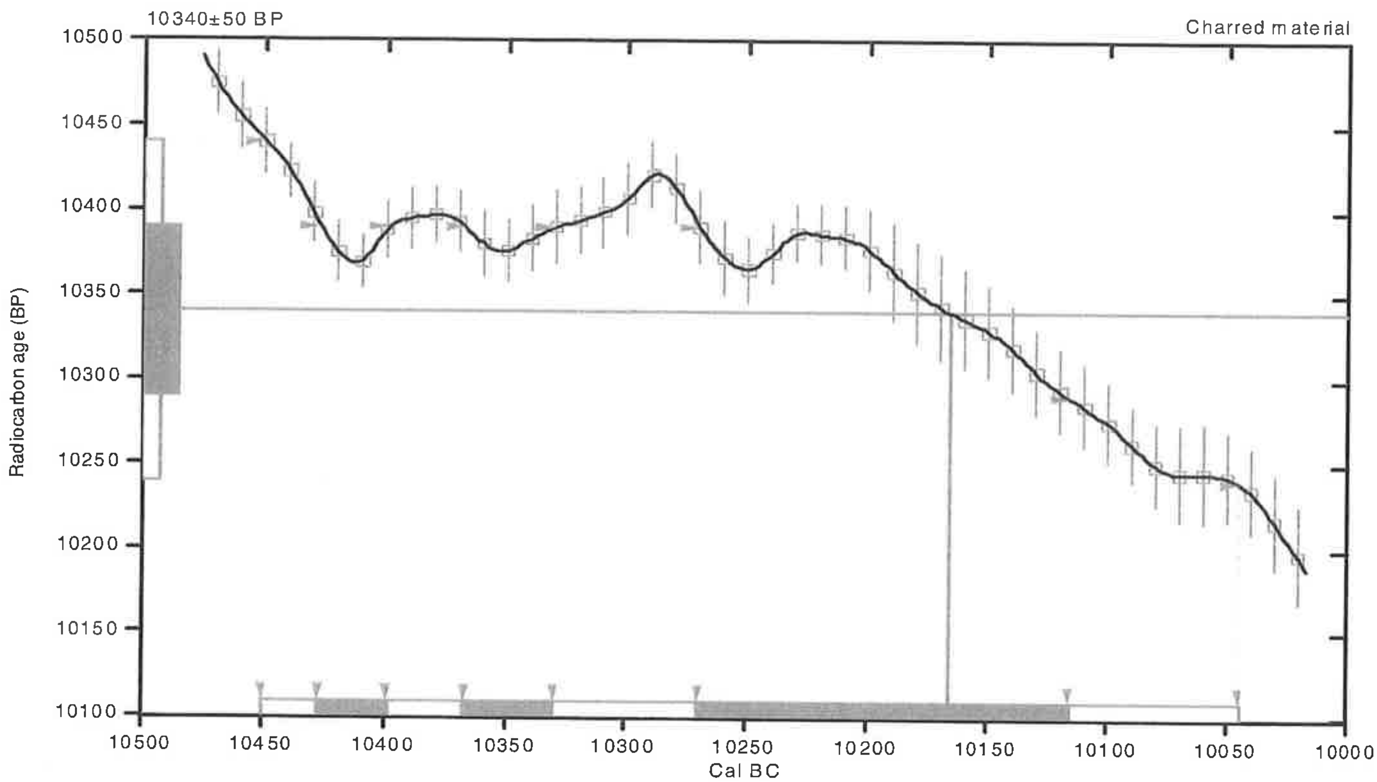
Conventional radiocarbon age: **10340±50 BP**

2 Sigma calibrated result: (95% probability) **Cal BC 10450 to 10040 (Cal BP 12400 to 12000)**

Intercept data

Intercept of radiocarbon age with calibration curve: Cal BC 10170 (Cal BP 12120)

1 Sigma calibrated results: (68% probability) Cal BC 10430 to 10400 (Cal BP 12380 to 12350) and
Cal BC 10370 to 10330 (Cal BP 12320 to 12280) and
Cal BC 10270 to 10120 (Cal BP 12220 to 12070)



References:

Database used

INTCAL09

References to INTCAL09 database

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Mathematics used for calibration scenario

A Simplified Approach to Calibrating C14 Dates

Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2):317-322

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-24:lab. mult=1)

Laboratory number: **Beta-325821**

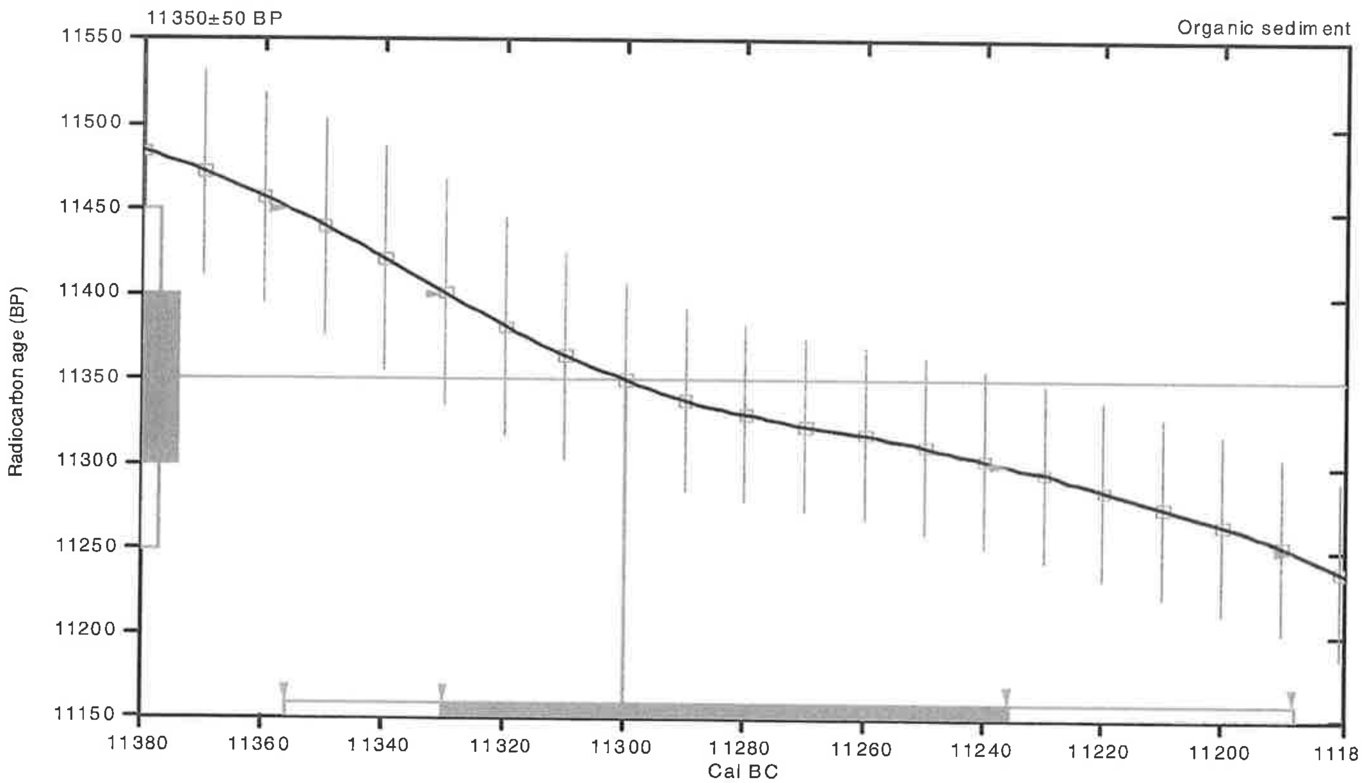
Conventional radiocarbon age: **11350±50 BP**

2 Sigma calibrated result: (95% probability) **Cal BC 11360 to 11190 (Cal BP 13310 to 13140)**

Intercept data

Intercept of radiocarbon age with calibration curve: Cal BC 11300 (Cal BP 13250)

1 Sigma calibrated result: (68% probability) Cal BC 11330 to 11240 (Cal BP 13280 to 13190)



References:

Database used

INTCAL09

References to INTCAL09 database

Heaton,et.al.,2009, Radiocarbon 51(4):1151-1164, Reimer,et.al, 2009, Radiocarbon 51(4):1111-1150, Stuiver,et.al,1993, Radiocarbon 35(1):137-189, Oeschger,et.al.,1975,Tellus 27:168-192

Mathematics used for calibration scenario

A Simplified Approach to Calibrating C14 Dates

Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2):317-322

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Deputy Directors

The Radiocarbon Laboratory Accredited to ISO-17025 Testing Standards (PJLA Accreditation #59423)

Final Report

The final report is accessed as a PDF via a secure personal directory on our website. UserID and password are initially provided to you, which you can change to values of your choosing (letters and numbers only). A mailed copy is also sent to you including a statement outlining our analytical procedures, a glossary of pretreatment terms, calendar calibration information, and billing documents. In addition to the analytical result, the final report sheet includes the individual analysis method, the delivery basis, the material type and the individual pretreatments applied.

Pretreatment

Pretreatment methods are reported along with each result. All necessary chemical and mechanical pretreatments of the submitted material were applied at the laboratory to isolate the carbon, which may best represent the time event of interest. When interpreting the results, it is important to consider the pretreatments. Some samples cannot be fully pretreated, making their ^{14}C ages more subjective than samples, which can be fully pretreated. Some materials receive no pretreatments. Please look at the pretreatment indicated for each sample and read the pretreatment glossary to understand the implications.

Analysis

Results reported using the AMS technique were derived from reduction of sample carbon (after pretreatment) to graphite (100 %C), along with standards and backgrounds, with subsequent detection in one of two AMS instruments here in our facilities. Results reported using the radiometric technique were analyzed by synthesizing sample carbon (after pretreatment) to benzene (92% C), measuring for ^{14}C content in one of 53 scintillation spectrometers. If the Extended Counting Service was used, the ^{14}C content was measured for a greatly extended period of time.

The Radiocarbon Age and Calendar Calibration

The Conventional ^{14}C Age and related "percent modern carbon" (pMC) is the result after applying $^{13}C/^{12}C$ corrections to account for isotopic fractionation differences between the sample and modern reference. Always cite both this age and the 13C/12C ratio in your reports and papers (as well as the laboratory number). The Conventional Radiocarbon Age is cited with the units "BP" (Before Present). "Present" is defined as AD 1950 for the purposes of radiocarbon dating. Results are reported as pMC for samples containing more ^{14}C than the modern reference standard. pMC results indicate the material was respiring carbon after the advent of thermo-nuclear weapons testing and is less than ~ 60 years old.

Calendar calibrations are included for applicable materials. If calibrations are not included for a result, it means it was too young, too old, or inappropriate for calibration. The calibration database and mathematics used are cited at the bottom of each calibration printout. The most appropriate approximation of age is the "2 sigma calibrated result". Be sure to cite this as well as the calibration database and mathematics used in your reports and papers.

PRETREATMENT GLOSSARY
Standard Pretreatment Protocols at Beta Analytic

Unless otherwise requested by a submitter or discussed in a final date report, the following procedures apply to pretreatment of samples submitted for analysis. This glossary defines the pretreatment methods applied to each result listed on the date report form (e.g. you will see the designation "acid/alkali/acid" listed along with the result for a charcoal sample receiving such pretreatment).

Pretreatment of submitted materials is required to eliminate secondary carbon components. These components, if not eliminated, could result in a radiocarbon date, which is too young or too old. Pretreatment does not ensure that the radiocarbon date will represent the time event of interest. This is determined by the sample integrity. Effects such as the old wood effect, burned intrusive roots, bioturbation, secondary deposition, secondary biogenic activity incorporating recent carbon (bacteria) and the analysis of multiple components of differing age are just some examples of potential problems. The pretreatment philosophy is to reduce the sample to a single component, where possible, to minimize the added subjectivity associated with these types of problems. If you suspect your sample requires special pretreatment considerations be sure to tell the laboratory prior to analysis.

"acid/alkali/acid"

The sample was first gently crushed/dispersed in deionized water. It was then given hot HCI acid washes to eliminate carbonates and alkali washes (NaOH) to remove secondary organic acids. The alkali washes were followed by a final acid rinse to neutralize the solution prior to drying. Chemical concentrations, temperatures, exposure times, and number of repetitions, were applied accordingly with the uniqueness of the sample. Each chemical solution was neutralized prior to application of the next. During these serial rinses, mechanical contaminants such as associated sediments and rootlets were eliminated. This type of pretreatment is considered a "full pretreatment". On occasion the report will list the pretreatment as "acid/alkali/acid - insolubles" to specify which fraction of the sample was analyzed. This is done on occasion with sediments (See "acid/alkali/acid - solubles"

Typically applied to: charcoal, wood, some peats, some sediments, and textiles "acid/alkali/acid - solubles"

On occasion the alkali soluble fraction will be analyzed. This is a special case where soil conditions imply that the soluble fraction will provide a more accurate date. It is also used on some occasions to verify the present/absence or degree of contamination present from secondary organic acids. The sample was first pretreated with acid to remove any carbonates and to weaken organic bonds. After the alkali washes (as discussed above) are used, the solution containing the alkali soluble fraction is isolated/filtered and combined with acid. The soluble fraction, which precipitates, is rinsed and dried prior to combustion.

"acid/alkali/acid/cellulose extraction"

Following full acid/alkali/acid pretreatments, the sample is bathed in (sodium chlorite) $NaClO_2$ under very controlled conditions (Ph = 3, temperature = 70 degrees C). This eliminates all components except wood cellulose. It is useful for woods that are either very old or highly contaminated.

Applied to: wood

"acid washes"

Surface area was increased as much a possible. Solid chunks were crushed, fibrous materials were shredded, and sediments were dispersed. Acid (HCI) was applied repeatedly to ensure the absence of carbonates. Chemical concentrations, temperatures, exposure times, and number of repetitions, were applied accordingly with the uniqueness of each sample. The sample was not be subjected to alkali washes to ensure the absence of secondary organic acids for intentional reasons. The most common reason is that the primary carbon is soluble in the alkali. Dating results reflect the total organic content of the analyzed material. Their accuracy depends on the researcher's ability to subjectively eliminate potential contaminants based on contextual facts.

Typically applied to: organic sediments, some peats, small wood or charcoal, special cases

Consistent Accuracy...
Delivered On Time.

Beta Analytic Inc.
4985 SW 74 Court
Miami, Florida 33155 USA
Tel: 305 667 5167
Fax: 305 663 0964
Beta@radiocarbon.com
Www.radiocarbon.com

Mr. Darden Hood
Director

Mr. Ronald Hatfield
Mr. Christopher Patrick
Deputy Directors

Calendar Calibration at Beta Analytic

Calibrations of radiocarbon age determinations are applied to convert BP results to calendar years. The short-term difference between the two is caused by fluctuations in the heliomagnetic modulation of the galactic cosmic radiation and, recently, large scale burning of fossil fuels and nuclear devices testing. Geomagnetic variations are the probable cause of longer-term differences.

The parameters used for the corrections have been obtained through precise analyses of hundreds of samples taken from known-age tree rings of oak, sequoia, and fir up to about 12,000 BP. Beyond that, back to about 42,000 BP, correlation is made using multiple lines of evidence. This older data is still subjective and should be interpreted conservatively.

The Pretoria Calibration Procedure (Radiocarbon, Vol 35, No.1, 1993, pg 317) program has been chosen for these calendar calibrations. It uses splines through the tree-ring data as calibration curves, which eliminates a large part of the statistical scatter of the actual data points. The spline calibration allows adjustment of the average curve by a quantified closeness-of-fit parameter to the measured data points. The calibration database used was INTCAL09. References for the calibration are listed at the bottom of each graphic page.

In describing our calibration curves, the solid bars on the graphs represent one sigma statistics (68% probability) and the hollow bars represent two sigma statistics (95% probability). When you see multiple calibration ranges reported, it is reflecting "wiggles" in the calibration data in the time range of the Conventional Radiocarbon Age. These wiggles create gaps in the calendar time scale corresponding to sections of the calibration curve which go outside of the precision limitations on the BP date (Y axis bars). In some cases it might be possible to exclude some of the ranges based on other lines of evidence. It is also acceptable to use the end-limits of the youngest and oldest ranges and preceed the single range with "circa". Use of probabilities to establish a "most likely" range within the set of ranges is not recommended since the radiocarbon result provides an inference of age and will vary within the precision limitations of the +/- cited. Consequently, the use of these probability calculations can lead to misleading interpretations.

Important Note: The correlation curve for organic materials assume that the material dated was living for exactly ten or twenty years (e.g. a collection of 10 or 20 individual tree rings taken from the outer portion of a tree that was cut down to produce the sample in the feature dated). For other materials, the maximum and minimum calibrated age ranges given by the computer program are uncertain. The possibility of an "old wood effect" must also be considered, as well as the potential inclusion of younger or older material in matrix samples. Since these factors are indeterminant error in most cases, these calendar calibration results should be used only for illustrative purposes. In the case of carbonates, reservoir correction is theoretical and the local variations are real, highly variable and dependent on provenience.

CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

Variables used in the calculation of age calibration → (Variables: C13/C12=-24.3:lab. mult=1)

Laboratory number: **Beta-123456**

Conventional radiocarbon age: **1260±30 BP** ← The uncalibrated Conventional Radiocarbon Age (± 1 sigma)

The calendar age range in both calendar years (AD or BC) and in Radiocarbon Years (BP) →

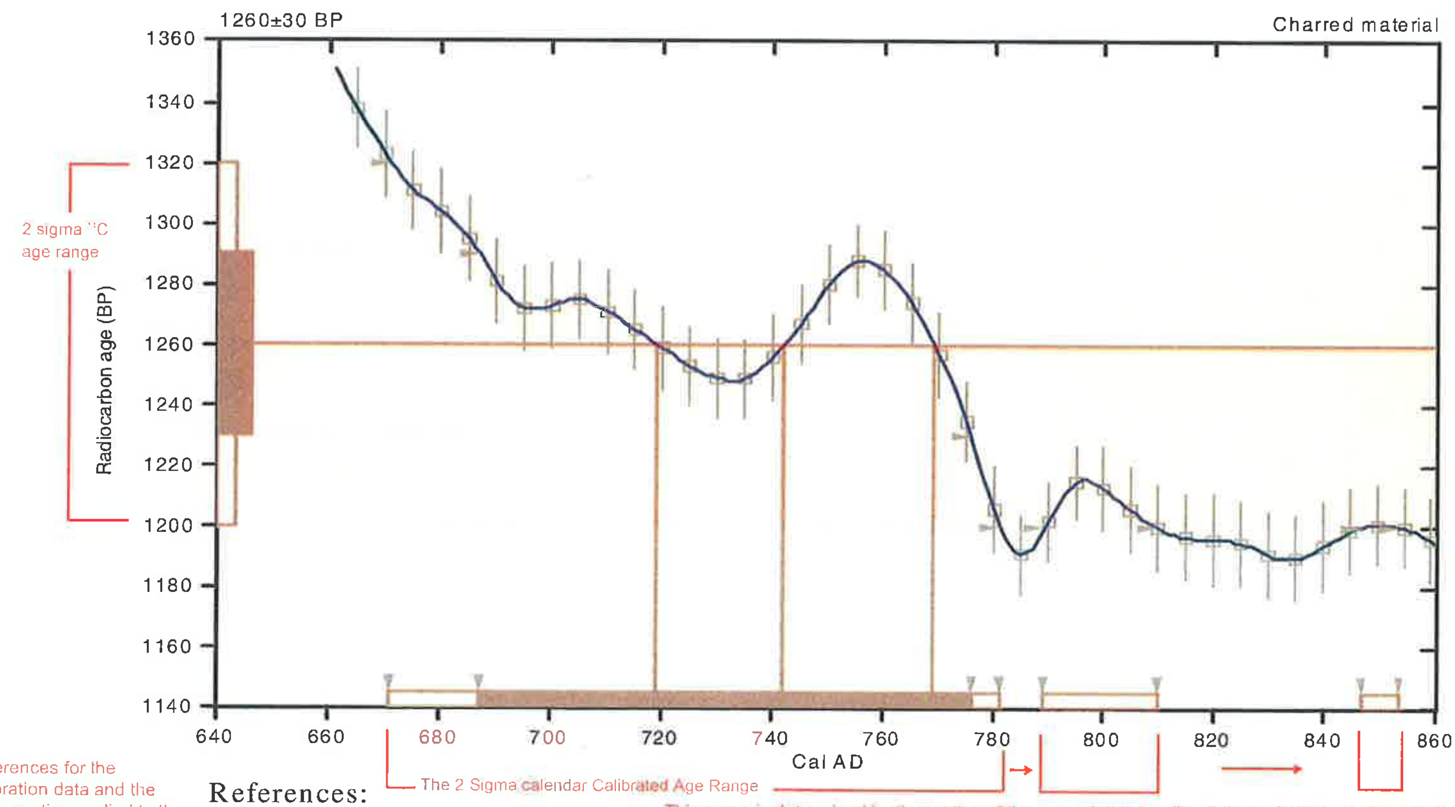
2 Sigma calibrated results: (95% probability)
Cal AD 670 to 780 (Cal BP 1280 to 1170) and
Cal AD 790 to 810 (Cal BP 1160 to 1140) and
Cal AD 850 to 850 (Cal BP 1100 to 1100)

Intercept data

Intercepts of radiocarbon age with calibration curve:
Cal AD 720 (Cal BP 1230) and
Cal AD 740 (Cal BP 1210) and
Cal AD 770 (Cal BP 1180)

← The intercept between the average radiocarbon age and the calibrated curve time scale. This value is illustrative and should not be used by itself.

1 Sigma calibrated result: (68% probability)
Cal AD 690 to 780 (Cal BP 1260 to 1170)



This range is determined by the portion of the curve that is in a "box" drawn from the 2 sigma limits on the radiocarbon age. If a section of the curve goes outside the "box", multiple ranges will occurs as shown by the two 1 sigma ranges which occur from sections going outside of a similar "box" which would be drawn at the sigma limits.

References for the calibration data and the mathematics applied to the data. These references, as well as the Conventional Radiocarbon Age and the 13C/12C ratio used should be included in your papers. →

References:

Database use
INTCAL09
References to INTCAL09 database
Heaton,et.al.,2009, Radiocarbon 51(4):1151-1164, Reimer,et.al, 2009, Radiocarbon 51(4):1111-1150,
Stuiver,et.al,1993, Radiocarbon 35(1):137-189, Oeschger,et.al.,1975,Tellus 27:168-192
Mathematics used for calibration scenario
A Simplified Approach to Calibrating C14 Dates
Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2):317-322

Beta Analytic Radiocarbon Dating Laboratory

4985 S.W. 74th Court, Miami, Florida 33155 • Tel: (305)667-5167 • Fax: (305)663-0964 • E-Mail: beta@radiocarbon.com

APPENDIX D

GRADING PERMIT
(OC GA120003)

ORANGE COUNTY
OC Public Works
Our Community. Our Commitment.

300 N. Flower Street
Santa Ana, CA

P.O. Box 4048
Santa Ana, CA 92702-4048

Telephone: (714) 834-2626

PRECISE GRADING PERMIT
PREGRADING MEETING

Date: 6-11-12
Inspector: Jonathan Tucker Tel: 714 599-0026
Supervisor: John Striffler Tel: 714 245-4524
Office Hrs, Mon-Fri.:6:30-3:00
Public Works Inspector: Jonathan Tucker

GRADING PERMIT NO: GB120003 TRACT # LOT # ' S

JOB ADDRESS: 21807 Old Esperanza, Yorba Linda

OWNER: Yorba Linda Estates, LLC PERMIT EXPIRES ON: 5-31-2014

I. General Requirements:

A. An original approved set of grading plans*, preliminary soil report, and a copy of the grading permit shall be on the job at all times; working hours are Monday thru Saturday, 7 a.m. to 8 p.m. Work other than this time requires prior authorization and may involve approval by Board of Supervisors.

* *An approved grading plan is defined as the set of plans containing a Grading Section departmental stamp and signature.*

B. **CALLING FOR INSPECTION:**

a. Inspection requests must be made the day **PRIOR** to the requested day of inspection.
b. To request inspection, use the automated inspection line by calling **(714) 796-0407**, or by going to the County of Orange's web site at ocpublicworks.com. Requests can be made up to **11:00 PM** for the next business day's inspection. Future inspection requests can also be made.
c. Use the Inspection Item Numbers identified during the pre-grade meeting to set up the required inspections.
d. If a specific time is needed to set up the inspection, contact the inspector on the morning of the inspection during the office hours noted above. Inspections will be provided on that day if workload and logistics allow.
e. You must recall your inspection if an inspection you called for was not made.
f. If you must cancel an inspection, please do so before the inspector leaves for the field by contacting him during the above noted office hours to avoid show-up charges to the permit.

C. **State Water Resources Control Board** requirements: This project must comply with State of California water quality standards. If this project is North of El Toro Road, refer to http://www.swrcb.ca.gov/rwqcb8/ (Santa Ana Regional Water Quality Control Board); if South of El Toro Road, refer to http://www.swrcb.ca.gov/rwqcb9/ (San Diego Regional Water Quality Control Board). Study the respective laws for their applications to this site. Inspectors from both the State and the County specializing in these water quality standards will routinely visit the site to verify compliance.

D. **CHANGES TO APPROVED GRADING PLAN AND SITE CONDITIONS:**

a. Work covered by this permit must conform to the approved grading plans and soil reports. Changes found during an inspection may result in a STOP WORK NOTICE.. Clearing of brush and/or grading activities that encroach beyond the approved grading and permit limits shown on the plan is strictly prohibited.
b. **AS-BUILT PLANS ARE NOT ALLOWED. Talk to the grading inspector & engineer before making any changes.**
c. Revisions to the plans must be submitted, reviewed, and approved PRIOR to starting the revised work.
d. Submit 5 sets of revised plans, 2 copies of a geotechnical review of the revised plans, and the last approved set of grading plans (all as a package) to the Main Office, to the attention of your inspector noted above. Plan check review will be required of all revisions.

INSPECTION CODE NO.

II. REQUIRED GRADING INSPECTION:

The **circled inspection codes** noted below are required grading inspections, specific to this project. If any work requiring inspection is covered or concealed by additional work without inspection, the grading inspector may require that the covered work be exposed for inspection.

801 A. **START OF WORK:** At time of brushing, clearing, demolition, and actual grading work.
- Limits of grading must be staked;
- Adequate water, erosion control, and toilet facilities must be on site;
- Erosion control devices (i.e., sandbags, siltfences, etc.) must be onsite.
- Sanitation facilities must be in place
- Working hours are Monday-Saturday 7am to 8pm; NO work allowed on Sunday and Federal Holidays

B. EXCAVATION AND FILL INSPECTION

802 1. **CANYON CLEANOUT**: After all brush and unsuitable material has been removed and an acceptable base has been exposed, and prior to fill placement.
- **Required paperwork** - memo from soil engineer/geologist approving area for fill.

803 2. **FILL OR BUTTRESS KEYWAY:** After suitable natural ground or bedrock is exposed; the bench or key must be excavated to design specifications; survey stakes are required to locate the toe of slope.
- **Required Paperwork** - memo from soil engineer/geologist approving buttress key.
- **Required Paperwork** – memo from soils technician approving fill slope bench.

804 3. **OVER-EXCAVATION:** After an area has been excavated to remove unsuitable material, and prior to any fill placement; any planned structures requiring over-excavation must be staked for location..
- **Required Paperwork** - memo from soil engineer/geologist approving area for fill.

805 4. **ROUTINE CUT & FILL:** Each working day of routine cut and/or fill; field memos for cut slopes and fill placement must be made available by the geotechnical firm, along with adequate engineered staking for limits of grading. **Note**: **Importing/exporting of soil may require traffic controls, flagman, and a haul route clearance. Clearance from Traffic Operations, or a Public Property Permit may be required. All exported soil must be taken to another site having a current grading permit, or a County dump/land-fill.**

806 4. **CANYON/BUTTRESS SUBDRAIN:** After filter fabric, gravel bedding, and pipe placement, but prior to covering pipe with gravel. .
- Required Paperwork: Memo from soils technician approving specifications and placement of filter fabric, subdrain pipe, and gravel.

C. **SEGMENTAL RETAINING WALLS (SWR) INSPECTIONS** (i.e., Keystone, Loffel, crib, etc.):

820 1. **WALL SUBGRADE:** Prior to placing any wall material, the bench or subgrade to the area receiving the wall members must be inspected and approved by geotechnical engineer of record. Wall materials (concrete members, fabric, gravel, geogrid) shall be on site for inspection by OC Public Works staff.

Prior to calling in for OC Public Works inspections the following information should be available on job site:

- Engineered stakes must be set for wall location (s)
- Line and Grade Certification letter/memo from civil engineer of record*
- Memo from geotechnical engineer of record approving excavation **and all materials on site***

* signatures must be wet signed by registered engineer

821 2. SUBDRAIN: Prior to covering with rock and fabric.
- Required Paperwork -- Memo from geotechnical engineer.

822 3. GEOGRID: At initial placement, and thereafter during placement.

823 4. FILL AND WALL MEMBER PLACEMENT: Daily inspection calls or as recommended by geotechnical engineer of record must be made during routine construction of wall once initial work above is completed memos from both design and geotechnical engineers may be required if work warrants clarification.

NOTE: Prior to start of work, the geotechnical engineer shall submit an inspection schedule to the OC Public Works inspector outlining the frequency and type of inspection needed for the proper placement of all wall materials components and fill during the above noted stages of wall construction. Inspection staff shall review and approve the submitted schedule.

All work required for the construction of these walls is to be inspected and approved by the Geotechnical Engineer of Record or a qualified designee. These inspections are in addition to the permit inspections performed by OC Public Works staff.

The design civil engineer must incorporate and show all geotechnical and manufacturer specifications on the plans.

D. ROUGH GRADE RELEASE INSPECTION

This inspection is required prior to any construction activities taking place but after completion of grading. After this inspection is made, the inspector may allow some aspects of the work to initiate, such as trenching for foundations and utilities. However, allowing the release for issuance of building permits will not occur until all required paperwork is submitted and approved. Granting the release for retaining wall construction or public works improvements must meet the requirements spelled out below.

This inspection may be called for as a partial release when portions of the grading work is being accomplished in stages, but must follow the requirements as noted below:

830 **1. BUILDING PADS (for release of building permits):**

Field requirements

- witness stake and blue-top for each pad elevation shown on plan;
- property corners, building corners (condos and single lot only) and top & toe of slope in accordance with inspector's requirements;
- terrace/down drains on slopes or any critical drainage structures must be completed

Required paperwork

- line & grade from civil engineer at time of field inspection *
- memo/letter from soil engineer at time of field inspection *
- statement of compliance from grading contractor at time of field inspection
- **Geotechnical report** - a formal compaction report for the completed grading work must be submitted for review and approval prior to granting formal rough grade release of pads.

* must be wet signed by registered engineer or geologist.

832 2. **RETAINING WALL EXCAVATION** (for release to building inspector): The building inspector will not inspect and approve the steel in the foundation excavation until the grading inspector signs off the excavation for the wall on the approved plans. *For steel reinforcement inspections, refer to the RW permit inspection card for information.*

Field requirements

- off-set stakes set by surveyor locating face of wall or foundation;
- the backcut for the wall and the foundation excavation must be made

Required field paperwork

- civil engineer's certification for footing excavation location*
- memo/letter from soil engineer *

*must be wet signed by registered engineer and/or geologist, as applicable; memo from soil engineer must list referenced reports, and state if recommendations remain unchanged.

831 3. **STREET IMPROVEMENTS/UTILITY PLACEMENT** (for release to public works inspector):

Field requirements

- off-set staking by surveyor locating road template, contact the inspector just prior to staking for these requirements.

Required field paperwork

- line & grade from civil engineer *
- memo/letter from soil engineer *

*must be wet signed by registered engineer and/or geologist.

833 5. **FOUNDATION/CAISSON EXCAVATION INSPECTION:** If conditions warrant, excavation work may be needed to extend foundations of planned structures into specific geologic strata, as required in the geotechnical reports. <u>This is not an inspection of any structural steel.</u> *An inspection under the RS or RW permit must be made, and inspection by the building inspector is required for all structural steel.*

At the time of this inspection, the excavations must be made and survey control stakes must be provided along with the following required paperwork.

Required field paperwork
- memo from the soil engineer/geologist*
- line & grade from the civil engineer may be required for location of excavations*

*must be wet signed by registered engineer/geologist, as applicable. Geotechnical memo must state if foundation recommendations are unchanged from previously recommended and the referenced reports must be listed on memo.

840 E. CONCRETE V-DITCH - TERRACE DRAINS, DOWN DRAINS, BROW DITCHES, AND RIBBON GUTTERS.

1. **Forms**: Reinforcement & thickness control-wires must be in place at the time of inspection;
   Required Paperwork
   - memo from soil engineer approving area to receive concrete and if type 5 concrete is needed;
   - line & grade certification letter or memo from design engineer*

   * must be wet signed by engineer

2. **Concrete or Gunite Placement:** Minimum 2500 P.S.I. required; load tickets from delivery truck must be available; soil subgrade must be moistened prior to concrete placement and reinforcement steel must be centered within concrete during placement of concrete.

841 **F. PCC SLAB SUBGRADE** (i.e., for driveways used as drainage devices & parking lots)

1. **Forms**: Required reinforcement and forms be in place at the time of inspection
   Required Paperwork
   - memo from soil engineer approving area to receive concrete and if type 5 concrete is needed
   - **line & grade** memo from design engineer or survey party chief

2. **Concrete Placement:** Minimum 2500 P.S.I. required; load tickets from delivery truck must be available; soil subgrade must be moistened prior to concrete placement and reinforcement steel must be centered within concrete during placement of concrete.

842 **G. CURB & GUTTER**

1. **Forms**: Required reinforcement (if any) must be in place with form-work in place. Off-set staking must be set by the surveyor for location of curb face.
   Required Paperwork
   - memo from soil engineer approving area to receive concrete
   - line & grade letter or memo from design engineer or survey party chief

2. Concrete placement

H. STORM / AREA DRAIN AND INLET / JUNCTION STRUCTURES

Only the drainage devices shown approved grading plans, **not those shown on street or tract improvement plans approved with the public works department.**

843 1. **RCP delivery**; provide certificate of "D" load from manufacture.

844 2. **Pipe Placement** - prior to covering with backfill, pipe must be staked by engineer for location. All pipe bells shall be glued and face upstream.
Required Paperwork - line & grade from the design engineer and a soils memo from a soils engineer.

845 3. **Pipe Collar/Anchor Forms** – prior to concrete, with required reinforcement in place.

846 4. **Inlet/Junction Structure Forms** - with required reinforcement in place.
Required Paperwork - line & grade from design engineer.

847 5. **Outlet Structure/Rip Rap** - prior to placing concrete or gunite, with the required reinforcement in place.

PAVING INSPECTION: PREPAVING MEETING REQUIRED (for all commercial sites, and for driveways or asphalt placement exceeding 3000 square feet)

A prepaving meeting shall be held prior to the establishment of subgrade. The project coordinator must contact the inspector at least (4) working days in advance and must also contact the following principals to be represented at the meeting: paving contractor, civil engineer, owner, and soil engineer. The required inspections for paving shall be discussed at that meeting.

J. SEDIMENT/EROSION CONTROL and STATE WATER QUALITY REQUIREMENTS:

Prevention measures to keep pollutants out of the storm drains and streambeds is a requirement 365 days a year, and is enforceable at any time. However, the official wet season is Oct. 1 thru April 30. During this time, all projects must have erosion control devices in place and functional. All sediment and construction contaminants must be contained within limits of permit so as to prevent deposition into downstream properties, including public streets, storm drains, creekbeds, and the ocean. The construction site will be subject to regular inspection for sediment control measure placement throughout the year. In addition, these requirements are enforceable throughout the entire year, including the dry season, especially if rain is imminent or practices on the project are cause for damage to water quality. The design and placement of control measures that mitigate water quality (called BMP's or Best Management Practices) must be designed by the project civil engineer. Erosion control plans, Storm Water Pollution Prevention Plans (SWPPP) and a suitable National Pollutant Discharge Elimination System (NPDES) must be current with the grading operation, available on site at all times, and be updated on a regular basis. If, in the opinion of the grading inspector, a lack of preparedness on the site is present for a possible rain event, or if housekeeping practices on the site impact requirements set forth within the SWPPP or NPDES, a stop work order my be given on construction activities until readiness is met. Further involvement by the County's authorized Water Quality Ordinance Inspector, or even the State of California Regional Water Quality Control Board inspector could result in severe fines for issues violating the Clean Water Act.

K. **DUST CONTROL:** Dust is considered a pollutant if excessive. All dust must be controlled during grading or heavy wind conditions. Failure to do so could result in all work being stopped or involvement by the AQMD (Air Quality Management District) who could impose fines.

Required inspections for typical erosion control

849 1. **PRE-BUILD/SANDBAG PLACEMENT**: Prior to starting erosion control work shown on erosion control plans, contact grading inspector to review erosion control program being planned and the required sand bag placement.

2. **DESILTING BASIN INSTALLATION**:

850 a. **Basin risers and outlet pipes** - prior to backfilling.
Required Paperwork
- line & grade from design engineer

851 b. **Anti-seep collar forms** – prior to concrete placement; all required reinforcement must be in place.

852 c. **Spillways** - prior to gunite; required reinforcement and guide wires must be in place.
Required Paperwork
- line & grade from design engineer
- memo from soil engineer for 90% RC for subgrade and the desilt basin embankment fill placement.

854 3. **COMPLETION OF EROSION CONTROL**:

When erosion control work is complete and readiness for the threat of rain is intact
Required Paperwork
- line & grade from the design engineer may be required.

870 L. **FINAL GRADING INSPECTION** (to obtain Certificate of Occupancy) **AND GRADING BOND RELEASE**:

Field requirements - When all work shown on approved grading plan is complete, including drainage device installation, swales, driveways, monumentation, and slope planting is established. In no case will a final be considered if safety is an issue.

Final requirements:

1. **Final line and grade from** civil engineer/architect

2 **Final geotechnical report from** soil engineer; this report must include all work after the rough grade compaction report. Final reports must include interior & exterior utility trench backfill, retaining wall backfill, subgrade/base/asphalt testing and inspection, a slope stability statement, and any other geotechnical condition that may have arisen. Report must be reviewed and approved before any final can be given.

3. **Final revised plan from civil engineer/architect** - if site deviates from last approved grading plan (REVISED PLAN MAY NEED PLAN CHECK REVIEW AND COULD DELAY OCCUPANCY)

4. **Slope Planting and Irrigation** - slopes must be fully established with plant material and irrigated in accordance with the grading code. A certification from the landscape architect may be required.

5. **Fire Marshal Clearance (if required)** - contact Fire Marshal to meet any fuel modification requirements and have them notify the grading inspector when clearance is met.

6. Public Works Clearance – occupancy requests, or release of bonding for the grading permit is subject to clearance by the Public Works Inspector. Contact your PW Inspector ahead of time when such requests or releases are needed.

7. Tract/site "Conditions of Approval" - grading issues relating to those planning conditions set forth in the initial stages of the project must be met; review any planning documents to insure they are met.

871 L. FINAL MONUMENTATION INSPECTION:

Lot and Tract corner monuments required of the recorded tract map must be inspected as a condition of finalling this permit, releasing the grading bond, and releasing all monumentation bonds. Prior to calling for this inspection, the monuments that designated on the tract map as "to be set" must be located and flagged for inspection. A copy of the recorded tract map and a letter from the engineer, certifying the setting of the monuments, is required at time of inspection.
Note: A grading permit and grading bond will not be released until all outstanding issues on the grading permit are complete including monumentation. It is responsibility of the permittee to maintain an active permit until this requirement is met. Permits that lapse and expire may have to be processed into new grading permits by the permittee.

M. OTHER CONCERNS / NOTES

APPENDIX E

**LETTER – SEISIMC HAZARD FIELD EXPLORATION APPROACH
(AMERICAN GEOTECHNICAL, INC., May 18, 2012)**

May 18, 2012

File No. 33366-01R

Doug G. Wymore
Yorba Linda Estates, LLC
7114 E.Stetson, Suite 350
Scottsdale, AZ 85251

Subject: **SEISMIC HAZARD FIELD EXPLORATION APPROACH FOR GRADING PERMIT APPLICATION**
Yorba Linda Estates, Simmons and Nicholas/Long Parcels
Proposed Tentative Tract Level Residential Development Project
County of Orange, California

Dear Mr. Wymore:

This document outlines the current approach of a seismic hazard field exploration program proposed by American Geotechnical, Inc. (AG) for that portion of the subject property (the Site) addressed by the pending grading permit application. The intent of the program is to evaluate the relationship between seismic hazards (specifically surface rupture hazards) and proposed residential design within the boundaries of a state-designated Alquist-Priolo (AP) Earthquake Fault Zone containing one or several strands of the active Whittier Fault. The AP Zone transects the southerly boundary of the project. The investigation represents the first of two pending exploration phases to be conducted as part of the tentative tract map approval process for development. The second phase will consist of a traditional geotechnical engineering investigation addressing tentative tract design plans in areas outside the AP Zone.

GENERAL SITE CONDITIONS

The site is situated within the eastern Puente Hills on the northern side of the Santa Ana Canyon within the County of Orange adjacent to the City of Yorba Linda. The total area of all parcels within the site is on the order of approximately 500 acres. Except for a few unimproved roads, scattered oil wells and overhead electrical transmission and buried natural gas utility lines the property remains in a natural undeveloped condition. Overall topographic relief across the global project area is on the order of approximately 1,200 feet, typically manifest as a series of narrow southwesterly trending ridges bounded by steep to moderate slopes on the order of 1:1 (horizontal:vertical) and flatter. The slopes descend to rather narrow intervening canyon axes with a gently winding pattern of drainage. No water has been noted as flowing within the axis of the canyons. Within the AP Zone are two major west-southwest linear trending ridges and adjacent canyons, with a maximum relief on the order of approximately 350 feet. Trenching is planned within accessible side canyon areas, crossing drainage axes and parallel to existing access roads.

SITE GEOLOGY

As a testament to the relatively rapid pace of tectonic uplift within the Puente Hills only a thin discontinuous deposit of slopewash and colluvium on the order of approximately 12 inches mantles bedrock in ridge and slope areas. These loose deposits increasingly thicken downslope in the proximity of drainage channel axes, where they are expected to interfinger with deposits of recent alluvium. Alluvial deposits are expected to range in thickness from approximately 5 to 20 feet and consist of horizontally interlaminated cohesive fine grained silts, sands and cobble-sized bedrock clasts. It is anticipated that the alluvium will be dry and competent yet readily excavated with heavy equipment.

Underlying the above surficial deposits is a marine sedimentary bedrock formation assigned to the Puente Formation of late Miocene age. Formational members of this unit include thinly interbedded siltstones and clayey siltstones and thin to more massive sandstone and conglomerate beds. The bedrock is expected to be soft to medium hard, dry, competent, moderately to severely fractured and excavated with relative ease using heavy equipment. Structure is expected to be moderate with local folding, fractures and faults represented.

EXPLORATION PROGRAM

The exploration program will include excavation of a series of approximately five carefully located/spaced trenches with a total overall length of approximately 3,600 linear feet. Major trench-segments will be excavated along a northeast/southwest bearing perpendicular to the strike of suspected the major fault trend. Local secondary trenches may be excavated parallel to fault strands in an effort to evaluate slip-rate, recurrence interval and magnitude of past earthquakes.

Track-mounted excavator (Caterpillar C314) equipment will be used to excavate the trenches using 3-foot wide bucket attachment. Trench locations will be cited using a variety of available geologic information including the results of published studies, field reconnaissance and remote sensing data such as shaded relief maps generated from LiDAR data and stereographic aerial photo pairs,. Trench locations will be cited within the AP Zone not only in areas of proposed development but also where geomorphic features suggest the presence of a possible fault line. Efforts will be made to extend trenches across the area in such a manner that no gaps result in the data set in areas of proposed development.

It is anticipated that excavation equipment will gain access to proposed trench locations through a combination of existing unimproved access roads and/or tracking through/over undisturbed areas. Clearing/brushing activities using manual labor and hand tools will be performed in a manner that results in as little disturbance to the surface soils as possible to preserve the integrity of surficial scientific evidence.

We anticipate average trench excavations will extend to depths between 8 and 15 feet below grade. An engineering geologist on staff will be present full time during trenching activities to assess conditions of depth, soil/bedrock type and resultant trench configuration. Trenches exposing competent soils may be extended up to 10 feet vertical without benching of side-walls. In less stable soil types or areas where a greater depth is warranted the side-walls are likely to be excavated in a series of vertical steps, or sloped in a manner appropriate to promote adequate safety. Tailings will be stockpiled in close proximity to the trench margins but outside the limits which could promote significant trench wall instability. A series of steps will be excavated into the bottom of trenches in sloped areas in order to permit an ease of access for logging and provide a stable surface upon which future backfill can be favorably placed from a stability standpoint.

As necessary, prior to entry into the trench by staff personnel, each will be stabilized by installing a series of hydraulic aluminum trench-shore elements spaced at linear intervals appropriate for encountered soil conditions. A square control grid pattern will be established on the active log-wall to establish a high degree of accuracy. Scaled graphic and photographic trench logs will be prepared. Bulk samples of soil and age-datable organic material and possible luminescence sampling will be conducted. The samples will be documented and delivered to our laboratory for temporary storage, testing and/or shipment to other pertinent labs. Once completed and logged, County staff will be informed of such conditions and invited to schedule visits for field review.

Backfill material will consist of trench excavation tailing. They will be filled to re-establish original pre-grade ground contours wherever feasible. In an effort to minimize potential backfill failures, settlement, creep or general relaxation, where trenches transect sloping ground a series of horizontal surfaces or "benches" will be established within trench bottoms upon which the fill will be placed. Vertical bench heights will be limited to 5 feet wherever possible. Where trenches transect natural slopes exceeding ratios of 2:1 (horizontal:vertical) a series of geo-grid layers will be installed within the trench backfill at intervals on the order of approximately 2 to 3 vertical feet. To re-establish original soil conditions replacement fills will be compacted in vertical lifts using a sheepsfoot compactor wheel excavator attachment. It is anticipated the above methods will result in a backfill condition equal to or greater than original conditions from a density standpoint.

Following completion of backfilling activities all disturbed surface areas will be re-vegetated/planted using an appropriate native seed mixture.

Should you have any questions, please do not hesitate to contact our office.

Respectfully submitted,

AMERICAN GEOTECHNICAL, INC.

Jeff L. Hull, PG, CEG
Senior Engineering Geologist

JLH:dl

Distribution: 2 – Addressee (Regular Mail and PDF via Email: dwymore@q.com)

wpdata/oc/33366-01.jlh.dl.may.2012.SeismicHazardInvestigation
wpdata/contract templates/CONTRACT-G-09.REV.Feb 2011

APPENDIX F

LETTER – BACKFILLING OF EXPLORATORY TRENCHES (AMERICAN GEOTECHNICAL, INC., July 20, 2012)

July 20, 2012

File No. 33366-01

Mr. Doug Wymore
Yorba Linda Estates, LLC
7114 E. Stetson, Suite 350
Scottsdale, AZ 85251

Subject: **BACKFILLING OF EXPLORATORY TRENCHES**
Yorba Linda Estates, Simmons and Nicholas/Long Parcels
Proposed Tentative Tract Level Residential Development Project
Yorba Linda, California

Dear Mr. Wymore:

Per the County of Orange Grading Permit No. 12003, wherever finished sloping gradient becomes 2:1 (horizontal to vertical) or greater, a geogrid reinforcement will be incorporated within the backfill soil to enhance surficial stability. We recommend that Synteen SF 20 or similar approved by the engineer be used. The geogrid layers should be placed horizontally at a minimum of 10 feet into the slope from the surface, with a vertical spacing not to exceed 2 feet. The initial soil layer placed on top of the grid has to be placed carefully so that the grid is not damaged. Experience has shown that this process does not produce any particular problems in the grading process.

We appreciate the opportunity to be of continued service. If you have any questions concerning the accompanying report, please do not hesitate to call.

Respectfully submitted,

AMERICAN GEOTECHNICAL, INC.

Arumugam Alvappillai, Ph.D.
Principal Engineer
GE 2504

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wpdata/oc/33366-01.aa.dl.july.2012.BackfillingOfExporatorTrenches

APPENDIX G

**COVER LETTER – REPORT ILLUSTRATIONS REVIEW (CALIFORNIA GEOLOGICAL SURVEY)
(AMERICAN GEOTECHNICAL, INC.)**

October 29, 2012

Ms. Janis L. Hernandez
Engineering Geologist
Seismic Hazard Assessment and Regional Geologic Mapping
California Geological Survey
888 S. Figueroa Street, Suite 475
Los Angeles, CA 90017

LETER OF TRANSMITTAL:

SUBJECT: **DRAFT FAULT TRENCH LOGS**
Fault Hazard Assessment Report – Whittier Fault Zone
Proposed Esperanza Hills Residential Development
Yorba Linda, CA

Dear Janis:

Thank you for offering to review the enclosed fault trench logs prior to their publication. Because you and Jerry were able to directly observe field exposures of geologic structure and faulting in the field, I'm pleased to be able to present the logs in their entirety for your review. I anticipate our interpretation of geologic conditions remains consistent with our field discussions.

Feel free to call me with any questions. I look forward to hearing your comments.

Thanks much.

Jeff L. Hull
Senior Engineering Geologist
RG 6364, CEG 2056

APPENDIX H

**COVER LETTER – REPORT ILLUSTRATIONS REVIEW (SEWARD ENGINEERING GEOLOGIC, INC.)
(AMERICAN GEOTECHNICAL, INC.)**

October 30, 2012

Stuart Mayes
Senior Associate Geologist
Allan E. Seward Engineering Geology, Inc.
27825 Smyth Drive
Valencia, CA 91355

LETER OF TRANSMITTAL:

SUBJECT: **DRAFT FAULT TRENCH LOGS**
Fault Hazard Assessment Report – Whittier Fault Zone
Proposed Esperanza Hills Residential Development
Yorba Linda, CA

Dear Stewart:

Enclosed please find copies of our draft fault trench logs for review. Because you and Eric were able to observe field conditions first hand, I wanted to give you an opportunity to provide comment before publication of our report. I anticipate our interpretations remain consistent with those discussed in the field.

Feel free to call me with any questions. I look forward to hearing any comments you may have.

Thanks much.

Jeff L. Hull
Senior Engineering Geologist
RG 6364, CEG 2056

APPENDIX I

SUMMARY/LIST OF ABBREVEATIONS

- AG: American Geotechnical, Inc.
- EHD: Esperanza Hills Development
- USGS: United States Geological Survey
- CGS: California Geological Survey
- AP Zone: Alquist - Priolo Earthquake Fault Zone
- PHBTF: Puente Hills Blind Thrust fault
- W-EFZ: Whittier – Elsinore Fault Zone
- WFZ: Whittier Fault Zone
- HA-Site: Hazard Assessment Site
- AMS: Accelerator Mass Spectrometry
- MSL: Mean Sea Level
- Af: Artificial Fill Deposits
- Qcol: Topsoil
- Qcolt: Talus Deposits
- Qcolr: Regolith Deposits
- Qal-2: Holocene Alluvium
- Qal-1: Pleistocene Alluvium
- Qdfr: Recent Debris Flow Deposits
- Qlsr: Recent Landslide Deposits
- Qdfo: Older Debris Flow Deposits
- Qlso, Qlso1, Qlso2: Older Quaternary Landslide Deposits
- Qto: Older Stream Terrace Deposits
- Tpy: Puente Formation- Yorba Member
- Tpsc: Puente Formation- Soquel Canyon Member
- LIDAR: Light Detection and Ranging
- AGFT-1: American Geotechnical, Fault Trench 1
- AGFT-2: American Geotechnical, Fault Trench 2
- AGFT-2B: American Geotechnical, Fault Trench 2B
- AGFT-3: American Geotechnical, Fault Trench 3
- AGFT-4: American Geotechnical, Fault Trench 4
- AGFT-5: American Geotechnical, Fault Trench 5

APPENDIX J

PLATES