Appendix 6.0

Fault Hazards Investigation

ARAGÓN GEOTECHNICAL, INC.
Consultants in the Earth & Material Sciences

FAULT HAZARD INVESTIGATION
RIVERSIDE COUNTY REFERENCE GEO 02503
PROPOSED CHURCH COMPLEX
APN 376-410-002 and 376-410-024
CITY OF WILDOMAR, CALIFORNIA

FOR
FAITH BIBLE CHURCH – MURRIETA
23811 WASHINGTON AVENUE, #C110-313
MURRIETA, CALIFORNIA 92562

IN COOPERATION WITH
MICHAEL BAKER INTERNATIONAL
40810 COUNTY CENTER DRIVE, SUITE 100
TEMECULA, CALIFORNIA 92591

PROJECT NO. 4348-F
FEBRUARY 17, 2017

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February 17, 2017
Project No. 4348-F

Faith Bible Church – Murrieta
23811 Washington Avenue #C110-313
Murrieta, California 92562

Attention: Mr. John Pleasnick

Subject: Fault Hazard Investigation Report
Proposed Church Complex, APN 376-410-002 & 024
City of Wildomar, Riverside County, California.

Gentlemen:

In accordance with our proposal dated September 30, 2015 and related addendum letter, Aragón Geotechnical Inc. (AGI) has completed scientific and engineering assessments of earthquake fault hazard potential for the above-referenced institutional project. Entitlement is being sought for up to 7 separate buildings on a 24.31-acre vacant site featuring about 70 feet of relief. Mass grading is proposed for the building pads and parking lots for over 800 vehicles. The attached report details AGI findings, opinions, and recommendations developed as a result of surface mapping, subsurface exploration, and literature research concerning the potential for surface fault rupture hazard in the listed parcels.

AGI's geological hazard studies were conducted concurrently with a preliminary geotechnical design investigation. Subsurface soil borings from the latter studies provided key information for quantifying some risks such as subsidence from dynamic settlement or hydrocollapse. Drill logs, field and laboratory test results, and AGI recommendations for site earthwork and construction materials selections are included in a companion *Preliminary Geotechnical Investigation* report under separate cover.

The proposed church complex is located within an official Riverside County Fault Hazard Management Zone for a mapped trace of the Glen Ivy North fault. The regulatory zone mandates that investigations be undertaken for defined projects, in order that occupancy structures not be sited astride active fault traces. Avoidance is the sole allowed mitigation for surface rupture risks to buildings.

Our fault studies expanded upon previous site work completed between 2003 and 2007 by the firm LGC Inland, Inc. Our work was primarily geared to qualifying previously unexplored terrain in the northeastern half of the site. Observations were conducted in 4 exploratory fault trenches totaling about 811 linear feet. While undertaking the field studies, AGI also interpreted historical aerial imagery, reviewed published geological literature and unpublished investigation reports for adjacent residential and commercial developments, and performed reconnaissance over broader areas of surrounding terrain to help refine structural models and assess risks.

Both LGC Inland and AGI have concluded that the site is bisected by an active segment of the Glen Ivy North fault. Additionally, we encountered and have characterized an active splay fault. Parts of the project site are not suitable for buildings. The accompanying report includes a site plan exhibit with a revised and enlarged Restricted Use Zone encompassing the fault traces. The boundaries of the Restricted Use Zone constitute recommended 50-foot lateral buffers between buildings and documented active faults.

It is our opinion that the remainder of the site can be feasibly and safely developed for institutional uses, pending in-grading geological inspections of soil and bedrock exposures during mass grading. Mitigation for other geologic constraints should include structural measures to mitigate the high likelihood of strong earthquake ground motions at the site, and remedial grading to replace young deposits of low-density and settlement-prone soils. However, probabilities of buildings being affected by liquefaction, gross instability or landsliding, debris flows, seiching, induced flooding, and tsunami appear to be extremely low or zero.

We are grateful for the opportunity to help the owner mitigate development risks and achieve a quality, long-lasting project. Please ask for either of the undersigned at our Riverside office if you should have any questions.

Very truly yours,
Aragón Geotechnical, Inc.

Mark G. Doerschlag, CEG 1752
Engineering Geologist

C. Fernando Aragón, P.E., M.S.
Geotechnical Engineer, G.E. 2994

MGD/CFA:mma

Distribution: (4) Addressee

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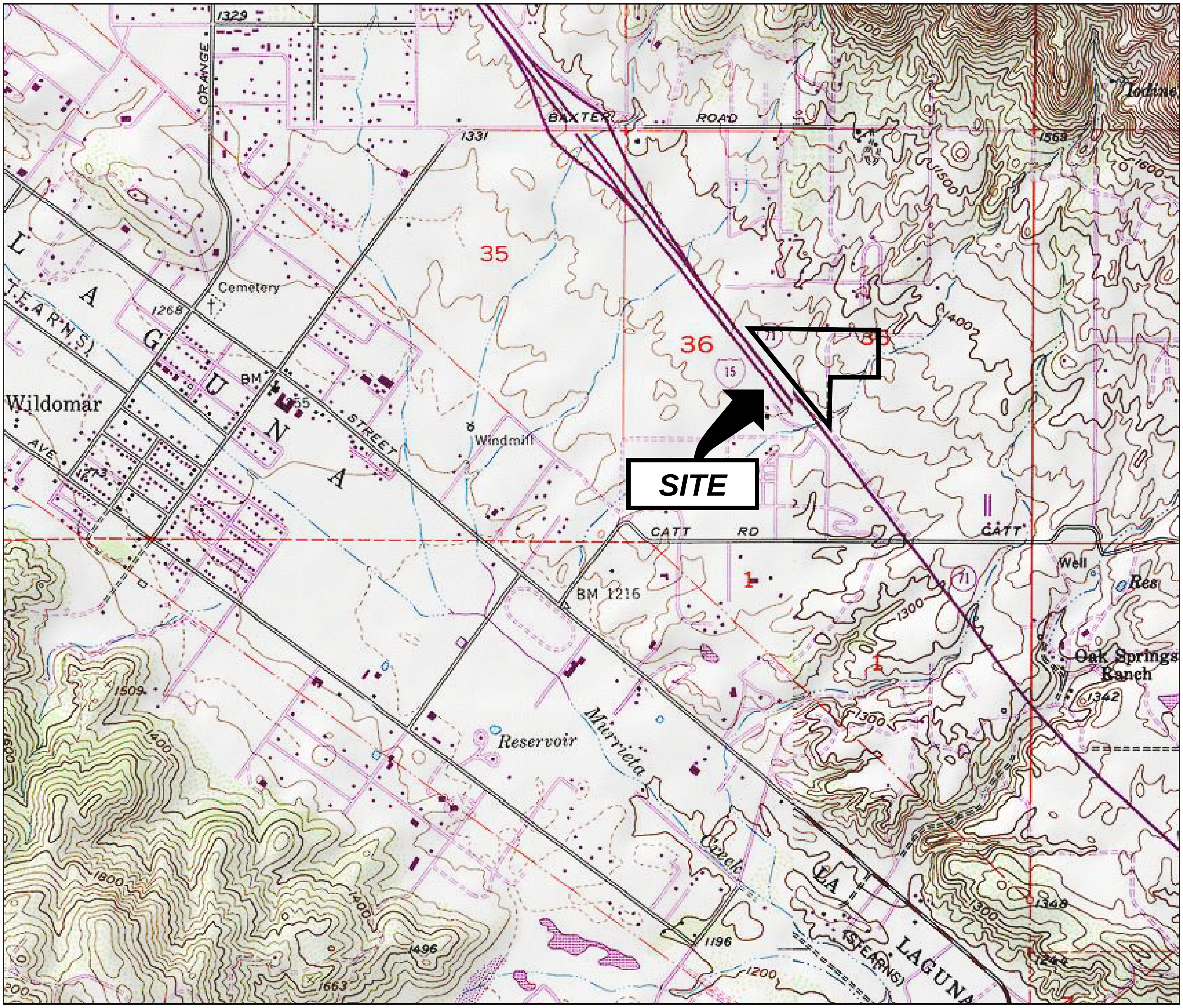
PROPOSED CHURCH COMPLEX
RIVERSIDE COUNTY TLMA REPORT REFERENCE GEO 02503
APN 376-410-002 and 024
WILDOMAR, RIVERSIDE COUNTY, CALIFORNIA

1.0 Introduction

Aragón Geotechnical, Inc. (AGI) has completed site-specific geological and engineering assessments for a proposed array of church buildings and related improvements in the incorporated community of Wildomar, Riverside County. Entitlement actions for a religious institution are being sought for the two listed contiguous parcels that together span 24.53 total acres gross. Geographic coordinates are 33.6044°N x 117.2497°W at the approximate geometric center of the proposed development. Situs per the Public Land Survey System is the S½ of Section 36, Township 6 South, Range 4 West (San Bernardino Baseline and Meridian). The accompanying Site Location Map (Figure No. 1) depicts the approximate project boundaries with respect to older community roads and surrounding natural terrain on a 1:24,000-scale topographic base map. The shaded-relief index map is out-of-date with respect to regional growth, however, and lacks many newer cultural features added to the area in the last decade.

Several objectives were targeted by this comprehensive investigation. Our prime investigation objective was to extend the geographic limits of previous fault hazard studies done by the Murrieta-based consulting firm LGC Inland, Inc. more than decade ago. These studies determined the *location* and *recency of movement* of a relatively narrow fault zone through the properties. LGC Inland's subsurface trench exposures were situated across prominent lineaments and lithological contrasts, but did not encompass the entire church development site. There were in fact no mandatory requirements for fault hazard studies at that time in the area. Rather, LGC Inland's studies built upon pioneering work of others who characterized a previously unmapped active fault line trending toward the church site from a neighboring property scheduled to become a residential subdivision.

Other objectives included characterizing site risks from earthquake shaking, landsliding, unsaturated soil subsidence, induced flooding, and finally liquefaction with its related ground deformation phenomena such as settlement, fissuring, liquefied soil expulsion to the surface (sand boils), lateral spread, and structural bearing capacity loss. Our fault hazard investigation was completed concurrently with a preliminary geotechnical design study within the subject property (AGI, 2016), issued under separate cover. Analyses for many of the listed secondary site risks rely on the tools and methods of geotechnical



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Reference: U. S. Geological Survey 7½-Minute Series Topographic Maps, Wildomar (1998) and Murrieta (1979) Quadrangles. Site outline is approximate.

AGI	**SITE LOCATION MAP**
	FAITH BIBLE CHURCH [APN 376-410-002 & 024], CITY OF WILDOMAR, CA.
	PROJECT NO. 4348-F · DATE: 2/17/17 · **FIGURE 1**

engineering. The combined scientific and engineering scope included property reconnaissance, geologic field mapping, in-office literature research, aerial photo interpretation, subsurface explorations in excavated trenches and drilled borings, recovery of representative soil samples, laboratory testing, and geotechnical analyses. However, environmental services such as Phase I or Phase II environmental site assessments, or contaminant testing of air, soil, or groundwater found in the project site, were beyond the scope of either investigation.

Faults defined as *active* have a heightened probability of causing physical displacement of the ground surface and are automatically deemed hazardous. Mitigation for active faults is specified under State of California laws to exclude occupancy buildings from placement directly atop surface traces. A recommended "no-build" zone was formally delineated for the church site by LGC Inland. AGI's investigation findings include additional data that locate and characterize a newly discovered splay fault. Refinements have been made to LGC Inland's avoidance zone, consistent with our synthesis of a revised geological model of the site. These data should also be closely reviewed by building officials in determining suitability for nearby future developments.

2.0 Proposed Construction

AGI was furnished with the latest-available conceptual development plans from Michael Baker International, subsequently used as a base map for AGI's Geotechnical Map, Plate No. 1 (Appendix B pocket). The church complex will be sited in territory zoned for general commercial uses (C-1/C-P). Most of the site would be graded. Small areas of steeper hillsides, one intermittent streambed, and a narrow buffer strip along the adjacent Interstate 15 freeway right-of-way will remain natural.

AGI also reviewed limited architectural concept drawings for the church buildings and surrounding landscape. The development would be anchored by a large sanctuary building placed on elevated terrain in the north-central part of the site. Around 45,000 square feet of enclosed space would feature an assembly hall with seating for over 1,100 persons, with an attached secondary auditorium, classrooms, and communal facilities. Additional classroom space could be added in a later development phase. To the east, two graded pads would be prepared for a maintenance building and a future athletic facility. Another graded pad is proposed near the southern corner of the project for an unspecified building use. Lastly, a collection of three guest houses is depicted near the southeastern project corner, tucked into the south side of a low hill. Buildings will variously be surrounded by parking lots and driveways, an outdoor stage/performance area, and open space.

Conceptual mass grading would involve cuts and fills topping out at around 25 feet and 13 feet, respectively. The sanctuary building would require the deepest cuts, but it would also span cut-fill daylight lines. Quantities were not calculated on the available civil plans, but AGI believes the project is intended to result in balanced earthwork. Manufactured permanent slopes created in natural materials and soil fill are depicted at inclinations of 2:1 (horizontal:vertical), or slightly flatter. A maximum cut slope height of about 27 feet is depicted north of the sanctuary building. Plans also show several engineered retaining walls 4 feet or less in height. The sole public street right-of-way that will be affected by site mass grading will be Glazebrook Road, where preparations for curbs, gutters, and sidewalks will be needed next to the site.

Structural drawings have not been reviewed. We predict the sanctuary building with its larger clear-span interior spaces may rely on steel-frame or reinforced masonry construction. Other structures could include these approaches along with conventional chipboard-sheathed, wood-stud balloon framing. Concrete slabs-on-grade and shallow spread footings are assumed. Appurtenant features would include buried wet and dry utility infrastructure, including municipal sewer hookups, that we expect will be installed before construction of driveway pavements and related parking lot improvements.

3.0 Regulatory Framework

In response to severe damage to buildings and infrastructure from the 1971 Sylmar (San Fernando Valley) earthquake, the State of California enacted the 1972 Alquist-Priolo Special Studies Zones Act (PRC §2621 *et seq.*). The intent of the act was to reduce risks to people and buildings from the hazard of surface rupture or creep along earthquake fault lines. Regulations were adopted to prohibit the location of occupancy structures that were part of a defined "project", such as large institutional buildings or subdivisions of land governed by the Subdivision Map Act, across the traces of active faults. Structural avoidance was (and remains) the sole allowed mitigation for rupture or creep hazards.

State geologists subsequently fanned out across urban and rural areas to assess known faults for rupture potential. Early work was often of a reconnaissance nature, and only rarely were data available from trenches or borings to pinpoint fault traces. A standard policy quickly evolved to identify “sufficiently active and well-defined” faults. These faults would be placed within defined Special Studies Zones (since renamed Earthquake Fault Zones), most commonly consisting of strips of land extending roughly 500 feet to either side of mapped traces. Zone boundaries were established as line segments between turning points placed at prominent topographic or cultural features.

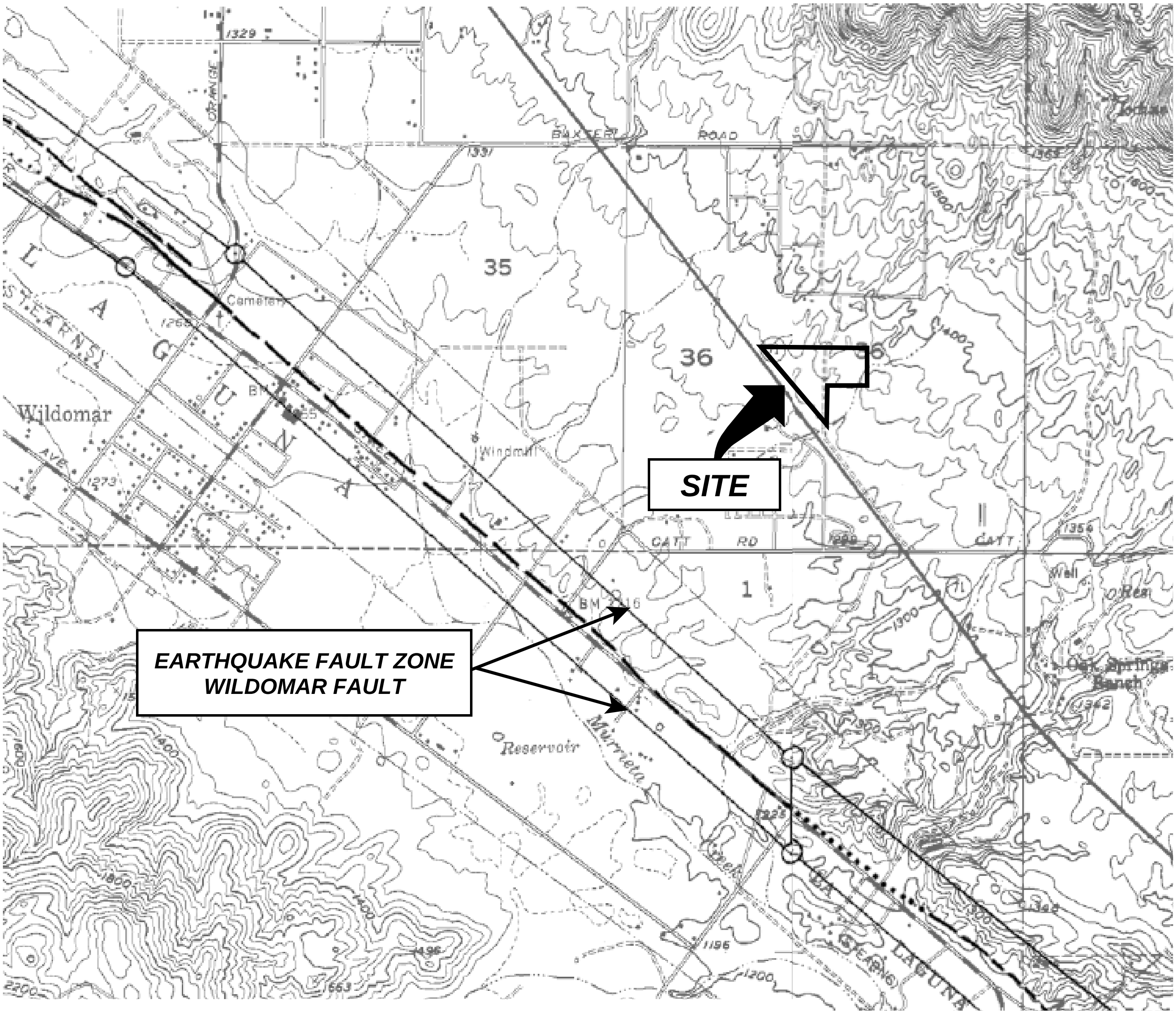
Earthquake Fault Zones are regulatory zones, and do not depict ground automatically classified as hazardous or excluded from future structural development. Cities and counties in their role as lead agencies for projects have mandatory requirements for geological investigations in State zones to find, map, and characterize faults for their hazard potential. There are three important corollaries to the provisions of Earthquake Fault Zones: (1) Not all active faults are located in State regulatory zones; (2) Faults within an official State zone may in fact not meet criteria for “active” faults, and therefore have acceptable risk for unrestricted development across fault traces; and (3) Local lead agencies may expand the definition of “projects” requiring special studies, establish stricter criteria for activity or mitigation, or add official regulatory zones beyond State-defined zones.

Riverside County has delineated scores of County Fault Zones as part of the latest approved General Plan Safety Element (County of Riverside TLMA, 2017). County Fault Zones often encompass smaller or less-distinct fault lines that nonetheless appear to have affected geologically young materials. County Fault Zones are updated much more frequently than Alquist-Priolo zone maps. They commonly reflect the recent findings of professional consultants who perform site investigations for land development. Riverside County regulations concerning projects within County hazard management zones mirror State regulations, e.g., CCR Title 14, Article 3 §3600-3603.

The City of Wildomar includes three primary fault strands that are segments of the 175-mile-long Elsinore fault zone. The Willard fault (Engle, 1959) comprises multiple short, discontinuous, and often overlapping traces usually close to the topographic boundary of the Elsinore Mountains to the west and the Temecula-Elsinore trough to the east. The Wildomar fault (Mann, 1955) is delineated by prominent scarps, sag ponds, and other fault-created topographic features aligned more or less with the middle of the Temecula-Elsinore trough. Palomar Street in the City of Wildomar is parallel to and and locally even coincident with the Wildomar fault. Lastly, an extension of the Glen Ivy North fault strand, originally known only in the subsurface from water well data obtained near Lake Elsinore, has been mapped along the eastern side of the trough within the City in recent years. The fault line was missed by State workers in the technical report used as the basis for Alquist-Priolo Earthquake Fault Zones in the valley. The official State zones adopted in 1980 included all of the Wildomar strand from Lake Elsinore to Temecula and beyond, while the Willard fault was excluded entirely from zonation after maps were revised to re-characterize surface displacements as older offsets of sediments along several Willard traces west of the historic Wildomar town center (Figure No. 2; ref. Saul, 1978).

APN 376-410-002 and 376-410-024 are not in an official Alquist-Priolo Earthquake Fault Zone. However, they are almost wholly within a County Fault Zone established along the mapped southeastern extension of the Glen Ivy North fault (Figure No. 3). The City of Wildomar has adopted all County hazard zones into their General Plan and City ordinances. Criteria that would support a hypothesis of a fault line with recent activity within the church site would include well-expressed geomorphic lineaments, vegetation contrasts, and juxtaposition of disparate soil and rock units.

The 1972 Act defines an active fault as *"a fault that has had surface displacement within Holocene time (about the last 11,000 years), hence constituting a potential hazard to structures that might be located across it"* (CCR Title 14, Article 3 §3601(a)). The definition of the Holocene epoch has changed slightly in the last decade, and now extends to 11,700 calendar years before present as ratified by the International Union of Geological Sciences. It follows that the implied danger to buildings is based on a pair of fundamental precepts: (1) Fault lines with demonstrated Holocene offsets have higher rupture frequencies and pose elevated probabilities of future offset versus faults limited to only pre-Holocene



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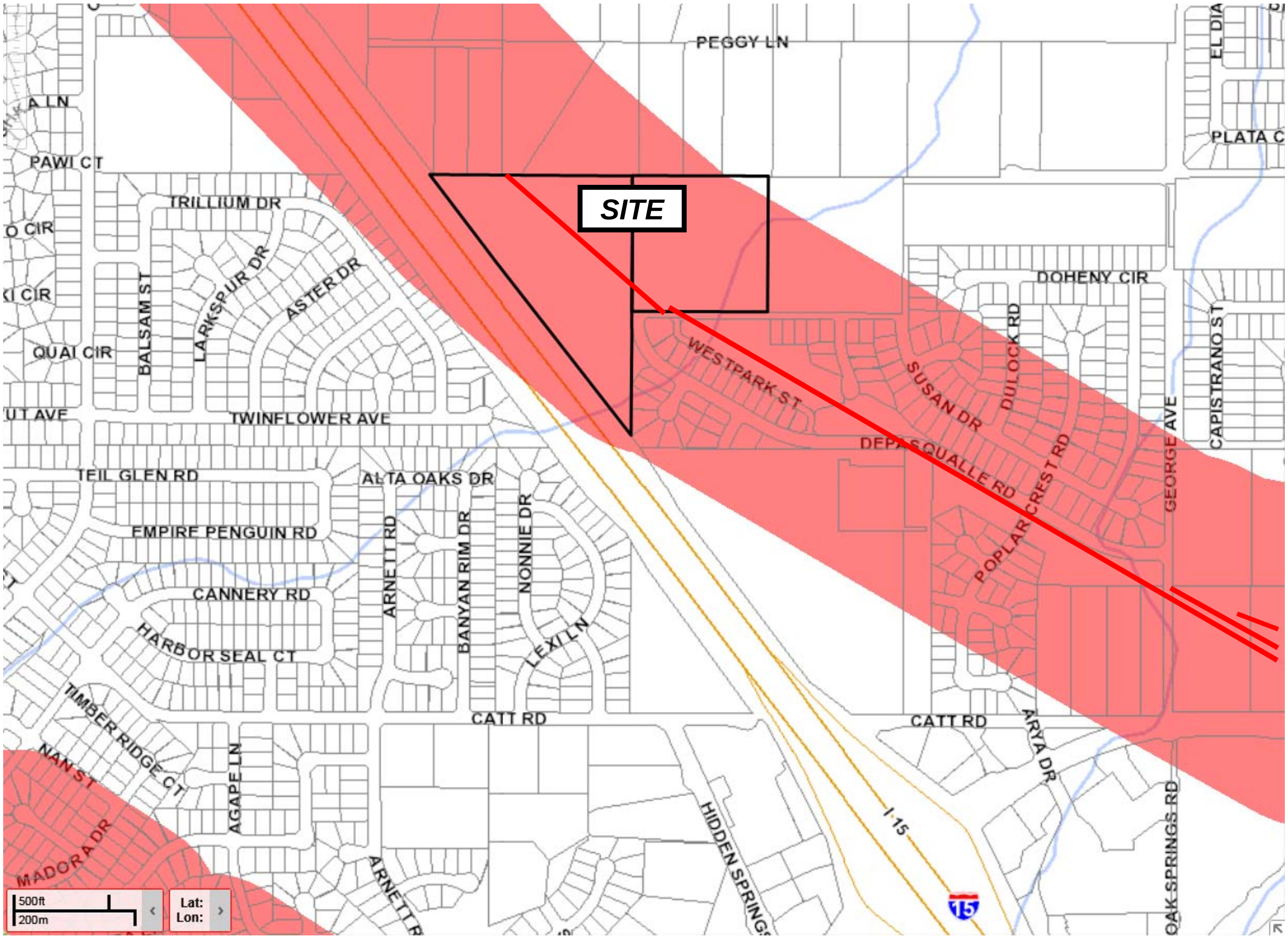
Reference: California Geological Survey Special Studies Zones Official Maps, Wildomar (1980) and Murrieta Quadrangles (1990).
Site outline is approximate.

AGI

CALIFORNIA EARTHQUAKE FAULT ZONE MAP		
FAITH BIBLE CHURCH [APN 376-410-002 & 024], CITY OF WILDOMAR, CA.		
PROJECT NO. 4348-F	DATE: 2/17/17	**FIGURE 2**



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Scale as shown

Reference: Riverside County Transportation and Land Management Agency, "Map My County" utility (2016), access date 2/13/17. County regulatory zones shown in red; mapped active or potentially active faults shown in darker red; remaining lines are parcel boundaries.

AGI

RIVERSIDE COUNTY FAULT HAZARD ZONES

FAITH BIBLE CHURCH [APN 376-410-002 & 024], CITY OF WILDOMAR, CA.

PROJECT NO. 4348-F	DATE: 2/17/17	**FIGURE 3**

rupture; and (2) Future lines of ground rupture will track previous fault traces with high fidelity. Neither precept is universally true, however. These scientific uncertainties mean that any ground rupture investigation, regardless of the intensity or resources used to complete the study, cannot guarantee or ensure that site risks have been reduced to zero.

4.0 Fault Investigation Protocols

The field operations were conducted in accordance with procedures recommended by the California Geological Survey Note 49 (Calif. Dept. of Conservation, 2002), and the guidelines of McCalpin (1996). Preliminary estimates of a field trenching scope were based on office research, limited field reconnaissance, conceptual church building layouts, and early analyses of aerial photographs. Operated equipment was procured by AGI.

Four trench excavations were excavated with a conventional John Deere 310C rubber tire backhoe between June 6 and June 30, 2016. The two-foot-wide trenches ranged from 103 to 362 feet in length, totaling 811 feet. About 300 additional linear feet from proposed footage was added as a pair of adjunct trenches based on later field and office findings. AGI's recommended exploration scope included sufficient trenching to detect potential fault strands located northeast of already-explored terrain containing the known fault zone. AGI's determination after intensive report reviews and lineament interpretations was that the LGC Inland work was adequate to locate hazards within their defined "no-build" zone and at all points west of the fault zone. Currently proposed church structures would not be threatened by LGC's fault line. AGI therefore accepted the previous work and would not reopen old trenches. AGI's Geotechnical Map exhibit includes plotted LGC Inland and AGI fault trench locations along with other geotechnical and geologic data.

All AGI trenches encountered weathered crystalline bedrock or cemented detrital units, and were cut as vertical-walled slots. Except for surficial colluvium, *in situ* soil relative density was typically very dense, and some cemented soils proved to be very firm digging for the rubber-tire backhoe. Caving or significant raveling was not observed in the slots. Average achieved target depths were about 6 feet. Excavation refusal was occasionally encountered, though, and a few short reaches could not achieve even 2 feet of depth. Groundwater was not encountered in the slots. The elimination of benches facilitated the production of graphical trench logs without geometric distortions or obscured zones, and minimized spoil volumes and disturbed surface ground areas.

The northwest wall of each trench was cleaned of smeared soils with flat-blade shovels, mason's trowels, and brushes. Spot cleaning was also done on the southeastern wall in selected locations. A progressive approach of shovel scraping, light "dry scrubbing" with stiff-bristle palmyra brushes, and finishing with soft horsehair shop brushes was the preferred and most-common method to expose fine textural details.

Horizontal stationing was established using a taut fiberglass tape referencing a zero-point at the southwestern end of each trench. Survey control hubs placed at selected points along the tops of the trenches were located by Michael Baker International to a horizontal and vertical precision of 0.001 foot or better in State Plane coordinates. Level stringlines variably spaced 2 to 5 feet apart were placed on the slot trench walls for easy and efficient elevation referencing of exposed features, using a folding rod graduated in tenths and hundredths of a foot. In general, along-axis horizontal errors are believed to be less than 0.5 foot and vertical elevation errors have an estimated range of ±0.1 foot.

Graphical logs were drawn at a scale of 1 inch = 5 feet to illustrate larger detrital clasts, soil contacts, sedimentary structures, and faults. Most rock particles larger than about 3 inches in diameter were logged at approximate true scale, shape, and orientation; smaller particles, gravel trains, and bedded or laminated materials were illustrated in a slightly more schematic fashion. Two types of granitic rock were found on the site. These were depicted by graphic devices on field logs to show either relatively homogeneous end-member types, or heterogeneous mixed-composition rock masses. Sediments in the trenches were visually-manually classified, based on texture and plasticity, utilizing the procedures outlined in ASTM D2487-93. The assignment of a group name to soil-stratigraphic units was performed according to the Unified Soil Classification System (ASTM D2488-93). Munsell color designations were made on fresh soil or rock samples collected at field moisture content at representative spots. All logging was performed by a senior engineering geologist highly experienced in the recognition and interpretation of paleoseismic features. Scanned reproductions of the actual drawn field logs with added descriptive information, soil classifications and color data are presented on the Trench Logs included in Appendix B.

Completed fault trench FT-1, view northeast from approximately Sta. 0+90. Viewed area is site of proposed sanctuary and classrooms.

Completed fault trench FT-2, view northeast. Foreground features shallow excavation reaches met by backhoe refusal in crystalline bedrock .

In early July, 2016, Mr. Dan Walsh, Assistant Geologist with Riverside County TLMA, visited the site. Riverside County is contracted by the City of Wildomar for technical reviews of fault hazard investigations. Prepared trench walls in all four excavations were examined by Mr. Walsh while tectonic and structural implications were discussed in the field with the project lead investigator.

The four AGI trenches were backfilled with non-engineered fill. Surfaces were wheel-rolled with a large front-end loader to help minimize erosion. The LGC Inland (2007) fault trenches had also been loosely backfilled as non-engineered fill. They could still be discerned as faint lines of denser vegetation with some localized surface subsidence.

5.0 Geotechnical Investigation

Subsurface site exploration comprising 9 exploratory soil borings and 10 supplemental backhoe pits was completed by AGI between June 8 and June 29, 2016. Drilling was completed before backfilling of AGI fault investigation trenches. Soil boring and pit locations are shown on the Geotechnical Map. The site had localized drill rig access impediments posed mostly by steep grades. Backhoe pits served as effective substitute explorations. AGI-selected drilling localities were considered adequate to (1) Ascertain the classifications, relative densities, possible origins, and depths of man-made fills and native detrital soils; (2) Find the tops of buried formation units; (3) Check for the presence of shallow groundwater; and (4) Acquire representative samples of local earth materials for laboratory testing. Geotechnical data were key to our assessments of other ground deformation hazards besides surface rupture.

The 9 soil borings were drilled with a truck-mounted hollow-stem auger rig capable of driving and retrieving soil sample barrels. Test pits were excavated with the same backhoe used for the fault investigation. Eight borings were voluntarily terminated in either very dense sedimentary bedrock or crystalline granitic units, while a single instance of rig refusal occurred in granitic rock. Achieved depths ranged from 17.0 to 51.0 feet. Relatively undisturbed samples were recovered by driving a 3.0-inch-diameter "California modified" split-barrel sampler. In selected drill holes, Standard Penetration Tests were performed with a 2.0-inch-diameter split spoon. All sampler driving was done using rods and a mechanically actuated automatic 140-pound hammer free-falling 30 inches. Bulk and drive-tube geotechnical samples were brought to AGI's Riverside laboratory for assigned soils testing.

Drill cuttings and each discrete soil sample were visually/manually examined and classified according to the Unified Soil Classification System, and observations made concerning relative density, constituent grain size, visible macro-porosity, cementation, plasticity, and past or present groundwater conditions. "Soil-like" sedimentary formations were described in the manner of regular soils. Crystalline bedrock was described in conformance with ISRM terminology for weathering, hardness, strength, and rock mass discontinuities. Continuous logs of the subsurface conditions encountered were recorded by the senior lead investigator for the fault hazard study. Geotechnical data, professional opinions of site suitability, and recommendations for site earthwork and construction materials may be found in the companion AGI *Preliminary Geotechnical Investigation* report for the proposed church complex prepared under separate cover (AGI, 2016).

6.0 Site-Specific Findings

6.1 Previous Work

LGC Inland (2007) excavated and logged 10 fault trench exposures between October 2004 and April 2006 to locate the Glen Ivy North fault line and establish structural setback limits for a proposed residential development concept. Episodic site visits and interim report reviews were reported to have been made by the Riverside County Geologist and assistant staff. The LGC Inland (2007) report is reproduced in its entirety in Appendix A as supporting documentation for AGI's site-wide characterization of rupture hazard.

6.2 Project Area Conditions

The irregularly shaped project area abuts rural-residential properties to the north, a 10-acre vacant parcel plus portions of residential Tract No. 30155 to the east, and the Interstate 15 freeway to the southwest. Access for the project would be from existing residential streets (Depasquale Road and Glazebrook Road), completed as part of the neighboring subdivision. The partially fenced site is easily entered from these two streets, or can be approached on rough dirt roads extending toward the project from the vicinity of Ronald Reagan Elementary School located about a quarter-mile to the east.

Varied terrain is present, ranging from nearly flat swales filled with alluvium to steeper rolling topography usually denoting site areas underlain by granitic rock units. Large surface rocks are absent, and the few granitic rock outcroppings in the site are very inconspicuous. Local slopes range from less than 5 percent to around 60 percent and are typically mantled with at least a few inches of soil. Alluvial areas generally lack stones larger than coarse gravel, although excavations are expected to find an occasional cobble or small boulder. Total relief in the site is just under 70 feet.

The site is a receptor of off-site runoff from 5 individual watersheds. The largest watercourse is classified as an intermittent blueline stream on government maps, and drains bedrock areas located east and north of the site towards "Iodine Spring" (Figure No. 1). Stream flows pass through a corner of adjacent Tract No. 30155 in a pipe culvert (the upstream end of the culvert was plugged with debris at the time of our studies). Sheet flow and smaller concentrated stream inputs enter the site across the northern property lines. All surface runoff eventually arrives at one of two pipe culverts crossing beneath the Interstate 15 freeway. Most of the freeway is situated on an embankment fill.

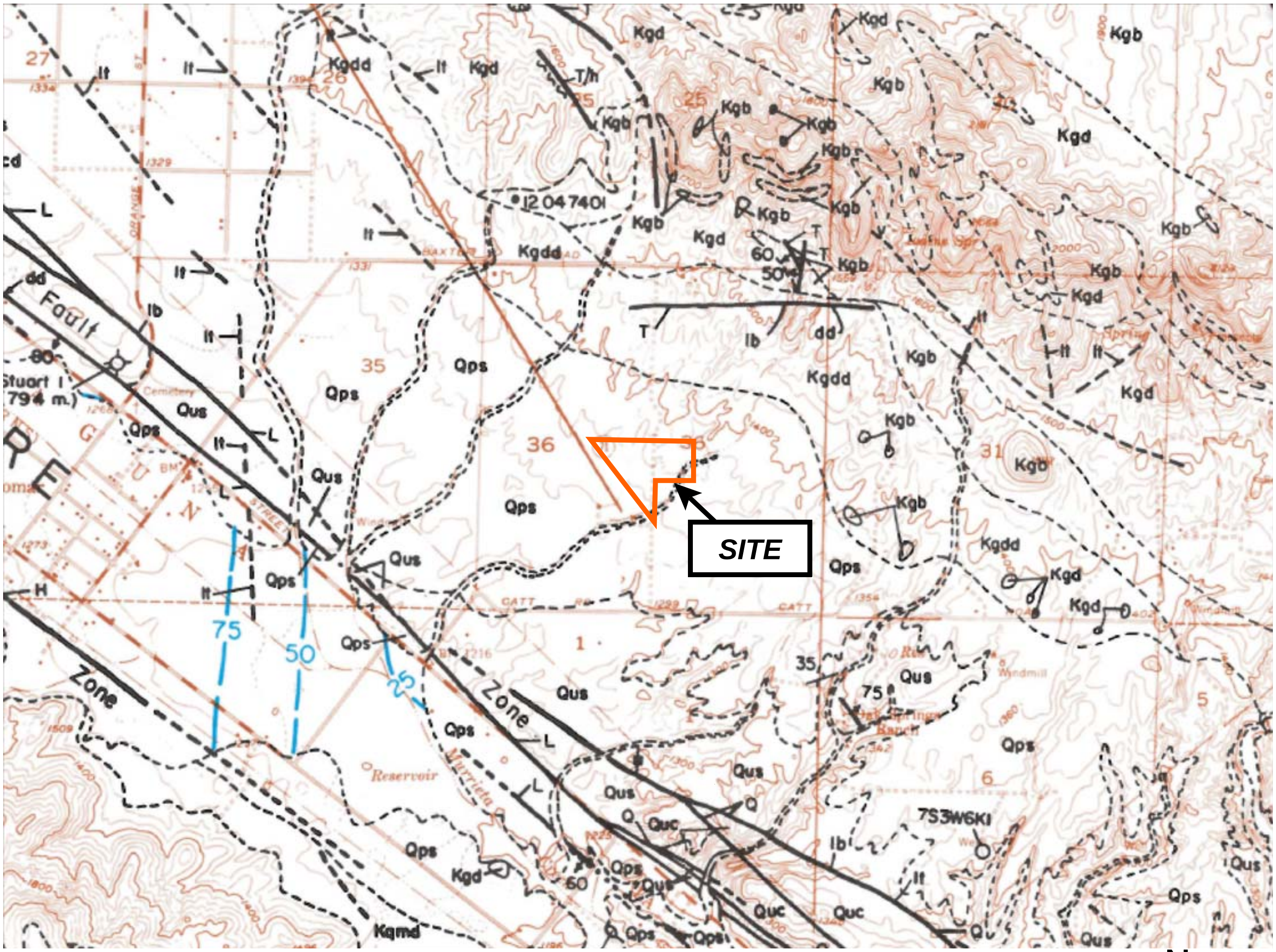
At the time of AGI's field studies, surface soils had already returned to seasonally dry and dusty conditions after a poor rainfall year. Vegetation in flatter terrain was dominated by sparse grasses and dried flowering annuals. Tamarisk and cottonwood tree saplings were noted in one area close to Glazebrook Road, more or less coincident with mapped fault trace locations plotted in LGC Inland's (2007) report. The site was traversed by numerous dirt trails created by decades of itinerant off-road vehicle passage.

6.3 Literature Reviews

Easily the most important published geological maps of the Temecula-Elsinore trough are the plates included with the technical report of Kennedy (1977). Kennedy's maps predated major urbanization and freeway construction in the vicinity. Fine-scale geomorphic features were thus presumably still intact. The maps plotted the surface traces of the Wildomar and Willard faults (while only partly recognizing unnamed and very short portions of the Glen Ivy North fault extension just north of Wildomar), and provided the first interpretations of fault *activity* (Figure No. 4).

Private consultant's studies of fault hazard on adjacent properties destined to become Tract No. 30155 were completed in 2003 (Gary S. Rasmussen, 2003; Riverside County file GEO 01187). Wildomar was not yet an incorporated city, and entitlement authority rested with Riverside County. County officials were apprised of newly discovered active strands of the Glen Ivy North fault zone characterized in 7 trenches. Building exclusion zones were defined. Today a neighborhood park is situated on the fault zone.

Morton and Miller (2006) prepared a widely cited digital 1:100,000-scale regional map incorporating the site and nearby portions of Riverside, San Bernardino, Los Angeles, and Orange Counties. Based largely on Kennedy's (1977) map in the Wildomar area, the small scale of the digital map misses details shown on the older 1977 map and the project-specific maps of local consultants. However, the Morton and Miller map presents a regional chronostratigraphic framework for coeval Quaternary sediments, and additional interpretive classifications concerning sediment origins (alluvial fan, axial valley floodplain, etc.). The authors also recognized updated formation or unit names assigned to basement rocks and older sedimentary cover. These newer data can help in resolving the tectonic history of an area. An except of the 2006 digital map is presented as Figure No. 5.



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Selected geologic units:

Qal *Undifferentiated younger alluvium, washes & valley floor [Holocene]*

Qps *Pauba Formation: Brown-colored, cross-bedded and channeled sandstone and siltstone [Pleistocene]*

Qus *"Unnamed sandstone": Distinctively pale-colored, friable, caliche-rich sandstone [Plio-Pleistocene]*

Kgdd *Paloma Valley Ring Complex: Granodiorite-type granitic rocks, decomposed bedrock pediment [Cretaceous]*

Kgd *Paloma Valley Ring Complex: Granodiorite-type granitic rocks, less weathered [Cretaceous]*

Kgb *Gabbro & quartz-bearing gabbro, undifferentiated [Cretaceous]*

Fault activity: H = Holocene; L = late Pleistocene; Q = Quaternary; P = late Pliocene; T = pre-Pliocene

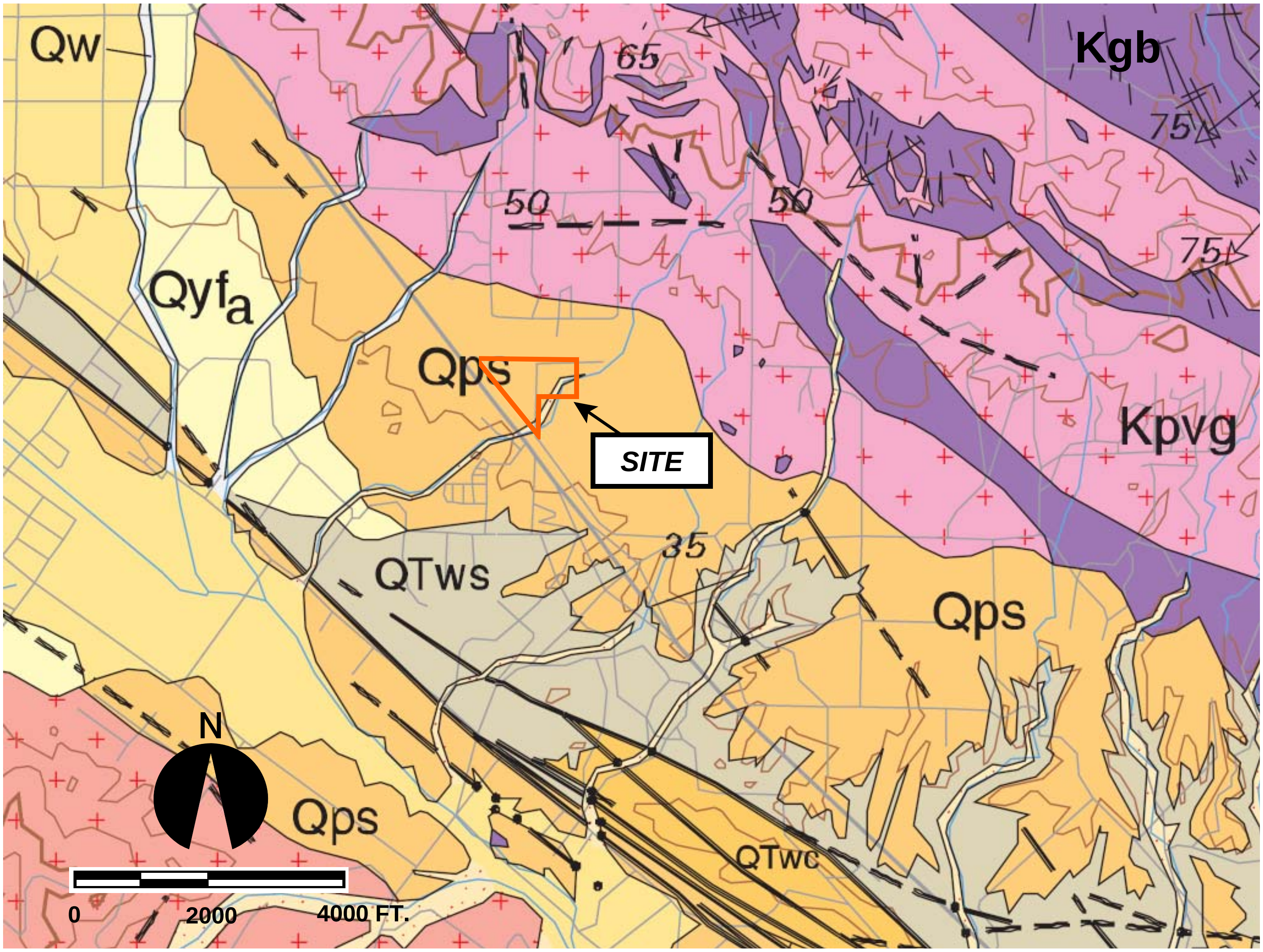
Reference: Map and descriptions after Kennedy (1977). Site outline and map scale are approximate.

AGI

VICINITY GEOLOGIC & FAULT ACTIVITY MAP (1977)

FAITH BIBLE CHURCH [APN 376-410-002 & 024], CITY OF WILDOMAR, CA.

PROJECT NO. 4348-F	DATE: 2/17/17	**FIGURE 4**



Selected geologic units:

Qw	*Very young sandy wash alluvium [Holocene]*
Qyf_a	*Younger axial-valley alluvial deposits [Holocene and late Pleistocene]*
Qps	*Pauba Formation: Brown-colored and poorly indurated (soil-like) sandstone and siltstone [Pleistocene]*
QTws	*Wildomar sandstone: Distinctively pale-colored, coarse-grained, and friable sandstone [Plio-Pleistocene]*
Kpvg	*Paloma Valley Ring Complex: Monzogranite and granodiorite-type granitic rocks [Cretaceous]*
Kgb	*Gabbro, undifferentiated [Cretaceous]*

Reference: Modified after Morton and Miller (2006). Site outline and map scale are approximate.

AGI

VICINITY GEOLOGIC MAP

FAITH BIBLE CHURCH [APN 376-410-002 & 024], CITY OF WILDOMAR, CA.

PROJECT NO. 4348-F	DATE: 2/17/17	**FIGURE 5**

6.4 Aerial Photographic Interpretations

Black-and-white and newer color stereo-pair orthophotographs, most at a scale of about 1 inch = 1600 feet, were examined in the offices of the Riverside County Flood Control & Water Conservation District. The earliest examined series was from 1962, and pre-dated substantial development of the area. The Google Earth Pro application provided additional monoscopic historical imagery. Lastly, digitized older topographic map quadrangle sheets dating to 1953 were downloaded for analysis (U.S. Geological Survey, 2016). Reviewed photographs and maps are listed under “References” at the end of this report.

Neither constituent parcel is believed to have had homes, outbuildings, or wells in the past. Year-1962 historical photos indicated that all but a few percent of the site area was used for dry farming of grain crops. Agricultural cultivation later ceased. Woody sage scrub vegetation became re-established on parts of APN 376-410-002, while grasses and forbs were the typical seasonal land cover over the bulk of the site. Intensive irrigated cultivation, orchards, and livestock raising have been excluded as past uses.

Evaluations of local land uses and site geomorphology were made prior to trenching. Of particular interest were photolineaments potentially indicative of tectonic faults. Lineaments may be expressed as topographic irregularities (aligned benches, saddles, valleys, etc.), abrupt color or tonal contrasts of soil or rock, changes from incision to aggradation along stream courses crossing a fault line, and differing vegetation density or species. Figure No. 6 (next page) presents our interpreted photolineaments plotted on a 400'-scale Riverside County Flood Control topographic base sheet, with a generalized classification into “strong” or “weak” lineaments.

6.5 Regional Geologic Setting

The majority of western Riverside County including the City of Wildomar lies within the Peninsular Ranges Physiographic Province, one of 11 continental provinces recognized in California. The physiographic provinces are topographic-geologic groupings of convenience based primarily on landforms, characteristic lithologies, and late Cenozoic structural and geomorphic history. The Peninsular Ranges encompass southwestern California west of the Imperial-Coachella Valley trough and south of the escarpments of

STRUCTURAL DOMAINS

QTws Basin fill domain, dominated by Wildomar sandstone in the site vicinity, but with minor superjacent cover of Pauba Formation, younger alluvium, and man-made fill. Basement rock depths could exceed 1,300 feet at the site, projected from State Well No. 07S03W6K1 located near Inland Valley Drive and Prielipp Road (see Figure 4, this report).

Kpvg Crystalline basement-rock domain composed of granitic rock members of the Paloma Valley Ring Complex. Primarily yellowish-gray monzogranite, but includes large inclusions of gray, fine-grained gabbroic rock. Comprises a eroded, incised bedrock pediment within the map limits. Mostly highly weathered and with thin surficial layers of residual soils, colluvium, and sandy alluvium.

LINEAMENTS

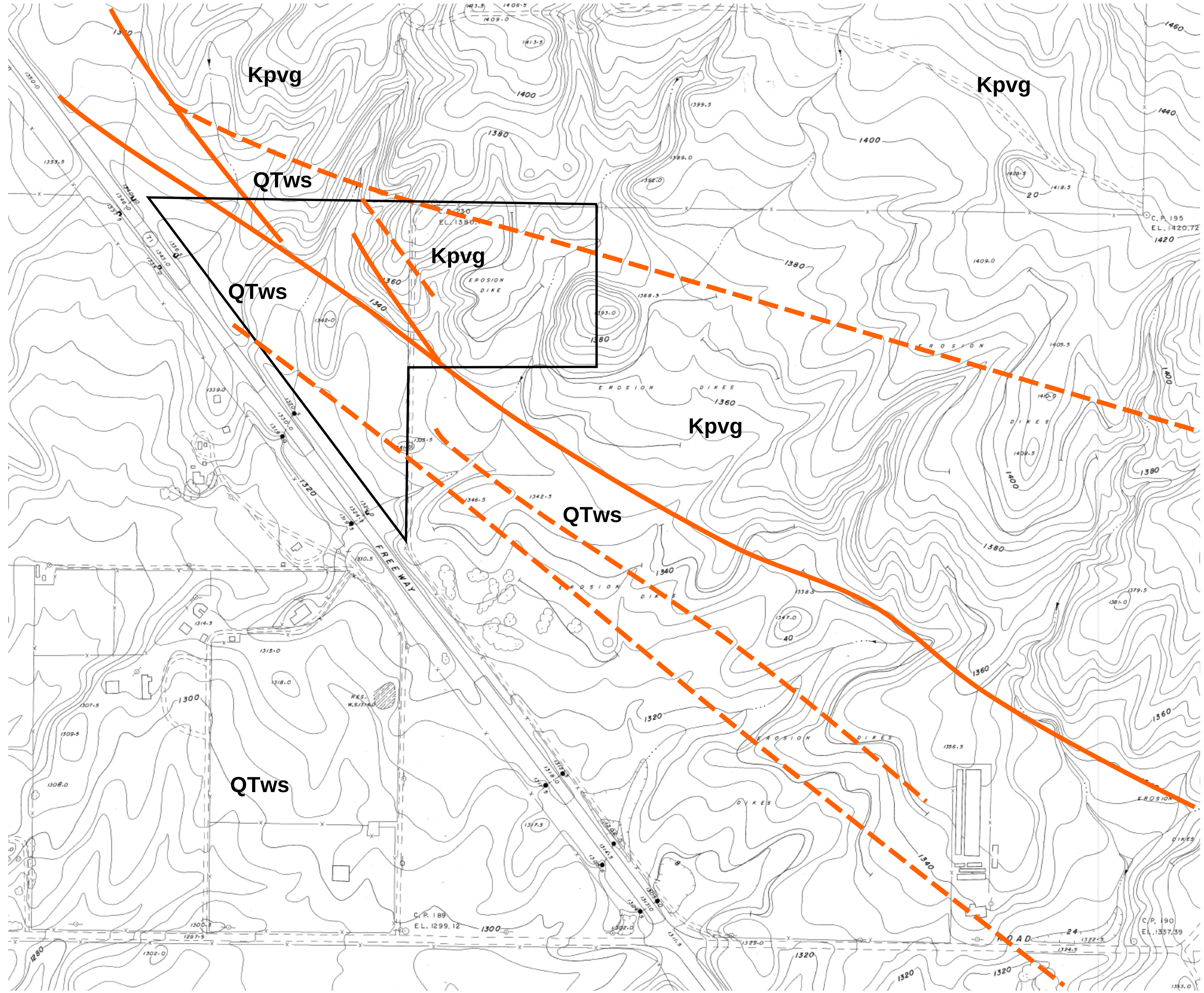
Solid where well-defined by multiple, coincident indicators such as topography, vegetation alignments, and tonal contrasts.

Dashed where lineament trace is less certain, often defined by only one indicator element, or is detectible in only one or two stereo-pair image sets.

N

0 400 800 FT.

Reference: Base map clipped from Riverside County Flood Control topographic sheet, Section 36, T. 6S., R 4W (SBBM), compiled from aerial photos dated 11/23/64. Contour interval = 4 feet. Scale is approximate.



AGI

LINEAMENT INTERPRETATION MAP

FAITH BIBLE CHURCH [APN 376-410-002 & 024], CITY OF WILDOMAR, CALIF.

PROJECT NO. 4346-F	DATE: 2/17/17	**FIGURE 6**

the San Gabriel and San Bernardino Mountains. The province is characterized by youthful, steeply sloped, northwest-trending elongated ranges and intervening valleys.

Structurally, the Peninsular Ranges province in California is composed of several relatively coherent, elongated crustal blocks bounded by active faults of the San Andreas transform system. Although some folding, minor faulting, and random seismic activity can be found within the blocks, intense structural deformation and large earthquakes are mostly limited to the block margins. Exceptions are most notable approaching the Los Angeles Basin, where compressive stress gives rise to increasing degrees of vertical offset along the transform faults and a change in deformation style that includes young folds and active thrust ramps. The Temecula-Elsinore trough represents the geomorphic expression of the structural "seam" between the Santa Ana Mountains and Perris crustal blocks. Multiple active, inactive, and often overlapping fault segments that are members of the Elsinore Fault Zone have splintered the margins of these two major blocks.

The Peninsular Ranges structural blocks are dominated by the presence of intrusive granitic rock types similar to those in the Sierra Nevada, although the province additionally contains a diverse array of metamorphic, sedimentary, and extrusive volcanic rocks. The metamorphic rocks represent the now-altered host rocks for the episodic emplacement of Mesozoic-age granitic masses of varying composition. Coastal parts of the province include thick sequences of younger marine and non-marine clastic sedimentary rocks of Mesozoic and Tertiary age, ranging from claystones to conglomerate. Some of the latter sedimentary units are also preserved in tectonically displaced fragments between Corona and Lake Elsinore. Slightly farther inland, pre-Quaternary sedimentary rocks become conspicuously rare. The Perris tectonic block, for example, is dominated by crystalline basement materials.

6.6 Site Geologic Units

The Geotechnical Map outlines the surface contacts of the site's six exposed soil and bedrock units (Plate No. 1). Our findings are that unit distributions correlate very poorly with older and newer regional maps. We have adopted the rock and alluvial soil unit nomenclature of Morton and Miller (2006), but with significant re-assignments to correct the erroneous regional map. Our assignments are also at variance with the previous site work of LGC Inland (2007). AGI's site-specific discrimination of each unit reflects our experience with these key formation units at multiple localities throughout the Wildomar and Murrieta communities. From oldest to youngest, the identified on-site native geological units and man-made deposits are briefly described as follows:

Paloma Valley Ring Complex (Kpvg, Cretaceous): Consists primarily of pale brownish to yellowish-colored, medium-grained, equigranular granitic rock compositionally classified as a monzogranite. Weathered rock is very weak (from a rock mechanics viewpoint), soft, and friable. Sandy colluvium covers slopes. There are a few harder dikes of unusual fine-grained micropegmatite consisting solely of quartz and perthitic feldspar, ranging from inches to maybe two or three feet thick. Inconspicuous dike rock outcrops are sources for hard and strong rock fragments up to basketball size that litter some hillslopes.

Owing to its emplacement mode via a "stoping" process into older intrusives, the monzogranite features abundant blocks of included gabbro (a second granitic rock type; symbol Kgb on trench logs). The inclusions are commonly light gray, fine-grained, and highly weathered with near-total alteration of calcium feldspar to clay. In AGI fault trench exposures, gabbro proportions locally varied from near-absence to near-100-percent of rock masses over scales of 50 to 100 feet. Individual blocks ranged from small discoidal xenoliths a few inches across to house-sized inclusions that sometimes ranged into moderately weathered rock that was not excavatable with a standard backhoe.

Wildomar sandstone (QTws, Plio-Pleistocene): The Wildomar sandstone (unit QTws of Morton and Miller, 2006; "Unnamed sandstone" of Kennedy, 1977; Figure No. 4) and related deeper conglomerate unit QTwc are the oldest exposed detrital valley fill units in the local area. On the site, Wildomar sandstone composes eroded finger ridges poking above younger alluvium. The arkosic and usually silty sandstone is poorly indurated and in fact has little true cohesion except where intense near-surface weathering has created cemented hardpans or silcretes. Carbonate concentrations as ped coatings, shear or fracture infillings, or interstitial laminar precipitates are very common. Distinguishing characteristics besides the ubiquitous carbonate include (1) Color, mostly very pale grayish and yellowish hues; (2) Massive to thickly stratified deposits that are internally plane and cross-laminated; and (3) Generally poorly graded and "gritty" immature sand that is almost entirely derived from a granitic source terrain.

Some degree of overconsolidation in addition to weak cementation is interpreted from high drilling log blow counts and high in-place densities. Figure No. 5 highlights a moderate northwest bedding dip close to the project. AGI's on-site trench exposures, however, broadly suggested nearly flat to gentle south-dipping bedding orientations, although steeper dips were sometimes depicted by LGC Inland in their 2007 fault trench logs. QTws contains distinctive subangular volcanic rock fragments with reported geochemical affinity to lava flows found at The Hogbacks in eastern Murrieta. Local sources and short transport distances are assumed for the immature unit sediments.

Pauba Formation (Qps, Pleistocene): Distinctly yellowish brown and strong brown silty sand, clayey sand, sandy gravel, and clayey gravel are correlated to the Pauba Formation of Mann (1955). Pauba materials are mostly uncemented, medium dense, and have crude thick stratification. The unit is typically easy to dig and drill. A very dense gravel and cobble-bearing zone ranging from inches to possibly 2 or 3 feet thick is a reliable Wildomar-area marker for the bottom of the formation, where it rests unconformably on an erosional surface atop Wildomar sandstone. In the project site, Pauba sediments are thickest in a fault-bounded block that composes the only on-site surface exposure of this unit. Scraps of Pauba sediments may also occur under younger alluvium. The formation is absent from all project areas located northeast of active fault strands (Plate No. 1).

Very old alluvium (Qvoa, Pleistocene). Strongly cemented, light yellowish brown, and slightly clayey silty sand has a localized distribution bordering fault strands at the site. Very old alluvium includes clasts of extremely weathered monzogranite and small angular pieces of hard micropegmatite. The unstratified deposits thicken toward fault strands, while quickly pinching out northward along sedimentary contacts atop granitic bedrock. Color and particle composition discriminate Qvoa from Wildomar sandstone. The two are in fault contact. The unit may be significantly older than Pauba strata. The site deposits are interpreted to be Pleistocene-age relicts of sedimentation along the Glen Ivy North fault zone along an east-facing scarp such as a shutter ridge condition.

Younger alluvium (Qal, Holocene). Loose to medium dense, bedded, and uncemented alluvial soils in swales and ravines comprise recent and even historic-age deposits. Data suggest most filled-in ravines south of fault strands have V-shaped cross-sections. Most younger alluvium has textural and grain composition characteristics proving origin from nearby granitic rock bodies. Close to ridges and hills, alluvium grades into darker-colored porous colluvium and granular slopewash.

Fill (af): One fairly large fill is located in the southern part of the site. The top surface is almost flat but unfinished, and the side slopes are mostly very loose and near angles of repose. The fill appears to be leftover stockpile soils from construction of neighboring Tract No. 30155. The stockpile partly rests on engineered compacted fill and partly on alluvium. Engineered grading for the residential tract was monitored and tested by the Bloomington firm of John R. Byerly. The mass grading compaction report (January 17, 2007) was reviewed by AGI from Riverside County files. The stockpile is both above and largely beyond the reported limits of compacted fill and is considered undocumented. Based on AGI subsurface findings, the silty sand and clayey sand stockpile fill was probably created from "lot pulls" generated by precise grading and house footing excavations. Bits of construction wastes (lumber, metal, roof tile, wire, concrete, etc.) were common in AGI test pits placed in the fill.

6.7 Exploration Trench Findings

Ages for all map-scale sedimentary units encountered in the AGI trenches are far older than the Holocene epoch lower bound of 11,700 years. Pauba Formation strata, cemented very old alluvium, and the Wildomar sandstone have depositional ages of hundreds of thousands to millions of years according to reported paleontological data and AGI interpretations. Fault traces in these older units thus cannot be discriminated into "pre-Holocene" or "Holocene" rupture ages unless the traces have disrupted age-diagnostic surficial horizons. At the church site, the latter commonly take the form of pedogenic soil layers alternatively depleted or enriched in certain mineral components, and thin capping layers of topsoil or colluvium.

Commercially offered laboratory methods such as carbon-14 radiometric dating can result in fairly precise calendric dates for detrital deposits younger than roughly 55,000 years. However, the ^{14}C method requires suitable organic matter. Whole-soil dates obtained from organic separates were briefly considered as an option for site topsoils, but the idea was rejected as unreliable due to bioturbation or cultivation effects and the mixing of modern carbon with deposited carbon. Research-oriented soil dating methods (OSL, cosmogenic ^{10}Be) were not considered, and fall outside of conventional professional practice.

Fault Trench FT-1. This trench was situated with the goal of extending LGC Inland's exploration trench FT-5 farther northeast, through the proposed church sanctuary building envelope to the northern property line. The trench more or less followed the top of a ridgeline. Some overlap with LGC Inland's FT-5 and FT-4 explorations was achieved. Map units encountered in the trench included Wildomar sandstone, AGI's newly defined Qvoa unit, and Paloma Valley monzogranite.

Faulted and fragmented Wildomar sandstone in the southern end of FT-1 was relatively easily excavated to the target depth of about 6 feet. Pedogenic cementation was modest and limited more toward illuvial clay enrichment rather than the very cohesive and siliceous(?) laminar cemented horizons found in some flatter areas of the project site (example: geotechnical trench T-7 on Plate No. 1). Pale-colored and crudely layered sandstone and siltstone were capped with thin darker-brown colored horizons of sandy colluvium. FT-1 colluvium, like all colluvial soils in the project site, was disturbed within a few inches of the ground surface from past cultivation. Deeper deposits filled several minor grabens and half-grabens caused by tectonically displaced sandstone blocks. Colluvium was everywhere interpreted to be Holocene in age.

At trench Sta. 0+61, Wildomar sandstone and very old alluvium were juxtaposed in fault contact. This relationship was later mirrored by findings at AGI's FT-4. The very old alluvium pinched out to the north, where the unit was very strongly cemented and locally non-excavatable before terminating against crystalline bedrock along an erosional contact. Essentially no internal structure was apparent in the cohesive unit.

From roughly Sta. 1+06 to the northern trench terminus, the backhoe encountered usually easy excavating in medium-grained, highly weathered monzogranite. A few smaller gabbro inclusions were logged. Medium- to very wide-spaced joints were occasionally measurable as planar partings within 4 to 5 feet of the ground surface. Joints were most commonly oriented east-northeast with steep southeast dips, or near north with very steep easterly dips. The sole example of a bedrock shear appeared to be old, with a hard and cemented infilling. The shear was also not accompanied by noticeable irregularities in either surface micro-topography or the bedrock-colluvium interface.

Fault Trench FT-2. This excavation alignment was placed to investigate the nature of a mapped granitic bedrock – "Pauba" geological contact shown on LGC Inland's (2007) geotechnical map. One early AGI hypothesis was that all sedimentary formation contacts with granitic basement were actually tectonic fault contacts. An active fault contact would significantly expand the width of the Glen Ivy North fault zone and require modifications to previously recommended structural setbacks.

The trench proved that sedimentary materials were absent from the area. However, faulting was found near the southern end of the trench as a shallowly dipping set of anastomosing strands in crystalline rock with apparent normal offset. Hanging-wall gabbro bedrock was extremely altered, soft, and pervasively mottled by iron oxide. The primary conclusion was that the "main strand" fault trace was still south of the trench line, probably under Glazebrook Road. The remainder of the trench north of the faulted bedrock comprised moderately weathered and non-excavatable gabbro, and highly weathered mixed rock featuring abundant blocks of gabbro surrounded by intruded monzogranite.

Fault Trench FT-3. A tonal lineament observed in several sets of older aerial photographs was evaluated by this shallow excavation through Paloma Valley granitic basement rocks. The northern and southern thirds of the 103-foot-long trench encountered highly weathered gabbro. The middle third of the trench was excavated primarily in friable and weakly foliated monzogranite. One hard monzogranite corestone was found. Abundant animal burrows (*Krotovina*) characterized the monzogranite zone, while burrows were absent from the finer-grained and more-compact gabbro. No faults were found. The trench bottom was relatively hard and difficult to excavate for the entire trench length. The origin of the lineament was thus ascribed to the lithologic contrasts of a monzogranite dike in primarily gabbroic host rock.

Fault Trench FT-4. This trench was added to AGI's field scope once accurate fault trend measurements were available from FT-1 and FT-2. Trench FT-4 would also complement findings from LGC Inland's trench FT-3, which included logged "Pauba Formation" strata uphill (north) from a somewhat ambiguous fault zone.

As at AGI's FT-1, Wildomar sandstone was logged in fault contact with very old alluvium. The trench in fact penetrated the entire thickness of very old alluvium, with the bottom encountering machine refusal on highly weathered but cemented monzogranite. Exactly at the fault line, monzogranite disappeared. The very old alluvial unit was well-cemented, non-porous, massive, and grossly featureless except for reddish pedogenic horizons near the ground surface. Rock clasts had local provenance. Fragments of light pinkish micropegmantite were hard and nearly fresh. Scattered well-rounded monzogranite clasts were soft, highly weathered, and could be cut with a shovel blade.

South of the single rather inconspicuous fault, Wildomar sandstone was highly altered and stained. The sandstone trench bottom was noticeably moist. Similar conditions were noted by LGC Inland in 2007, accompanied by data hinting at much larger fault displacements starting roughly 50 feet south of AGI's achieved trenching end point.

6.8 Local Neotectonic Structural Evolution & Basin Model

The Elsinore Fault Zone and certain extensions trend northwesterly from the Laguna Salada region in northern Mexico to an indistinct terminus near Whittier in Los Angeles County. Like similar parallel faults such as the San Jacinto fault zone bounding the northeast side of the Perris block, the Elsinore zone is one component part of the San Andreas transform fault boundary. Geomorphic expression of the Elsinore fault zone is strongest in the 50-odd miles between Pauma Valley and Corona, where many parallel, left- and right-stepping *en-échelon* fault strands bound deep sediment-filled basins. The predominant sense of offset in the zone is right-lateral strike-slip. Basin-bounding segments have some normal or reverse offset. Total dextral offset is on the order of 10 to 15 kilometers (Hull, 1990; Morton & Miller, 2006). Conspicuous evidence for recurrent Holocene-age ruptures characterizes most strands in the zone.

The Elsinore structural basin just northwest of the site owes its origin to a 1.6-mile-wide right step between the three principal local strands of the Elsinore Fault Zone: The paired Wildomar fault plus the Willard fault zone, and the Glen Ivy North fault. Several other subsidiary strands interpreted from water well records and geophysical studies accompany the principal strands. Right-lateral motion across a right step results in a classic extensional "pull-apart" basin. The Elsinore structural basin is the largest pull-apart along the fault zone. It is a stepped graben containing in excess of 2,300 feet of sedimentary deposits over basement rock. Considering the valley escarpments on either side, total subsidence of the basin has amounted to thousands of feet. Tectonic subsidence of the basin has exceeded the rate of filling by late Tertiary and Quaternary sediments, and the resulting closed depression is the site of Lake Elsinore.

The Wildomar fault is very well-located southeast of Lake Elsinore, beginning near Rome Hill and passing through the communities of Wildomar, Murrieta, and Temecula. Terrain is usually elevated on the northeastern side of the slightly arcuate fault trace that is marked by sag ponds, faceted spurs, and laterally deflected stream channels. Murrieta Creek, the main local watercourse, meanders through the flat-floored valley axis just southwest of the fault. Tributary streams have incised through the scarp toward headwaters regions on the Perris block. Sometimes subparallel fault strands bound elongated hills composed of various consolidated sedimentary units (Figure No. 5).

The Glen Ivy North fault bounds the northeastern side of the lake, trending parallel to Lakeshore Drive in the City of Lake Elsinore. Geomorphic expression becomes pronounced beginning about 2 miles northwest of the lake. The Glen Ivy North fault has long been characterized as an unbroken active fault line beyond the pull-apart basin to the vicinity of Corona. Earlier investigators did not view the fault as a surface rupture hazard southeast of the lake, although structural continuity into the Wildomar area was recognized even in the 1970's (Department of Water Resources, 1981; EVMWD, 2005). The southeastern lake-shore end had ostensibly not experienced rupture offset within the last 33,000 to 39,000 years, according to subsurface interpretations made for a large planned development (Shlemon and Ginter, 2001). Since then, the newer findings of this report and many others appear to clearly demonstrate both continuity and Holocene activity for the Glen Ivy North fault at least as far as parcels near the intersection of Clinton Keith Road and Inland Valley Drive in the City of Wildomar, e.g., Section 31 in T.6S, R.3W (Rasmussen, 2003; Leighton Consulting Inc., 2005; LGC Inland, 2007).

AGI's work strongly confirms and expands upon the interpretations of Kennedy (1977) and Department of Water Resources (1981) regarding structural relationships across the greater Elsinore fault zone, supported by our trenching studies, our interpreted unit correlations, and regional seismicity. In Wildomar, the Glen Ivy North fault is <u>the</u> major structural and lithologic divide between the Perris crustal block and a disrupted band of early Mesozoic metasedimentary units (Bedford Canyon Formation) and superjacent detrital units such as the Pliocene-age Wildomar sandstone and (very likely) deeper concealed strata that are age-equivalent to the Temecula Arkose. Total vertical throw could be more than 1,200 feet. The Temecula – Elsinore valley axis is tectonically subsiding relative to graben steps and the adjacent mountain blocks, and probably in an absolute sense *vis-à-vis* sea level datum. The closed Elsinore depression and very low-gradient Murrieta Creek watercourse attest to aggrading conditions. A wildcat petroleum exploration well spudded close to the intersection of Orange Street and Palomar Street and less than 1½ miles west of the site did not encounter metamorphic basement rock until reaching a depth of 2,604 feet at the "Stuart-1" locality on Figure No. 4, per Department of Water Resources (1981). State Well No. 7S3W6KI penetrated 1,355 feet of sediments without encountering bedrock (well site also depicted on Figure No. 4). AGI has thus predicted that Plio-Pleistocene deposits are a minimum of hundreds of feet deep southwest of the on-site fault zones plotted on the Geotechnical Map exhibit in this report.

The Wildomar fault strand, customarily cited as the main active strand of the Elsinore zone through the valley, is in fact accommodating the majority of tectonic strain in the present-day stress field. However, it is interpreted that some slip is "leaking" as a right-step onto the Glen Ivy North strand beginning somewhere southeast of the project site. Data do not support classification of the on-site Glen Ivy North strand as an independent seismic source with separate hazard potential from the Wildomar fault, but rather a minor but still important line of coseismic displacement should the latter rupture in a major earthquake.

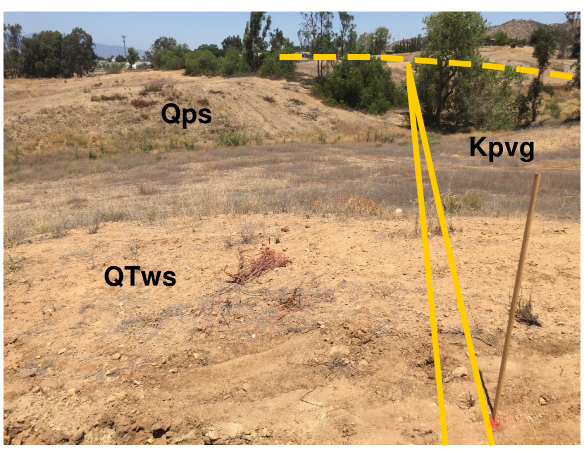
6.9 On-Site Faulting

Three out of the four exploratory trenches encountered fault offsets and related deformed unconsolidated soils. Faults are depicted as solid or long-dash lines on the Trench Logs presented on Plates 2 through 4. Faults were demarcated based on the presence of one or more of the following features:

(1) A measurable offset of sedimentary or pedogenic layers.
(2) Vertical or steeply inclined cracks and fissures visible on both sidewalls of the trench, accompanied by open apertures, loose soil infillings of surficial origin not ascribable to animal activity, and abrupt changes in colluvial soil thickness.
(3) Sudden lateral change in soil classification, color, or clast composition.
(4) Discrete bedrock shears with gouge, usually with textural or alteration contrasts on either side of shears.

The Glen Ivy North "main zone" precisely tracks a relatively bold topographic lineament picked on Figure No. 6 and already investigated by LGC Inland. AGI's novel finding and interpretation is the presence of a right-step in the Glen Ivy North fault zone along a previously undetected splay fault. The splay fault has some expression as a tonal photolineament. Also, a subtle micro-topographic "bump" in the side of the ridge explored by fault trench FT-1 would be consistent with right-lateral offset of the ridge nose. The splay fault splits from the "main zone" very close to AGI's FT-4 location, trending slightly more northerly to an inferred intersection with another fault strand somewhere off-site. The wedge-shaped block between the "main zone" and splay fault preserves a remnant deposit of Pauba Formation sediments perched on Wildomar sandstone (*below left*).

In the FT-1 trench exposure, cracks and shears spanned a width of at least 45 feet, although the most intense disturbances were limited to a narrower zone (*below right*). Very closely spaced cracks and disturbed textures could be traced virtually to the ground surface. Small-scale grabens and half-grabens with south-side-down displacements had been created by apparent normal slip. Some logged fault planes had measurable vertical offsets on the order of a fraction of an inch to more than a foot. Wedge-shaped deposits of colluvium had collected in the depressed surfaces. The lack of erosion of the tops of each graben structure and the stair-stepped lateral changes in thickness of clearly Holocene-age surficial soils were viewed as age-diagnostic for recent activity.



View northwest along edge of splay fault zone at FT-1 Sta. 0+61, showing trend line to intersection of interpreted right step in Glen Ivy North zone (dashed line). Large tree in upper right is native cottonwood, hinting at groundwater barrier effects next to the fault.

Intensely fractured and faulted Wildomar sandstone, FT-1 at Sta. 0+35. Pictured soil-filled fissures were exactly on trend with similar soil filled cracks probably mis-identified as Krotovina by LGC Inland (2007) in their trench FT-5, Sta. 0+20.

The splay fault's orientation and apparent offsets would be consistent with AGI's interpretation of a trans-tensional shear regime across the right-step. The trench exposures did not permit the development of a chronostratigraphic history of ruptures at the site. However, given the magnitudes of basement rock offsets for the greater Glen Ivy North zone, repetitive offset events have almost certainly occurred. We think future horizontal and vertical offsets in a single event would be small, on the order of inches to a couple of feet, similar to what is inferred for the Glen Ivy North "main zone" in the present tectonic regime.

Faults considered important to establishing the limits of impacted areas were located by stakes and flagging. The stakes were surveyed for plotting onto georeferenced site development plans supplied by Michael Baker International, and are illustrated by graphic devices on the Trench Logs. Recommended structural setbacks were scaled in AutoCAD 2016 from the stake locations. Fault zone limits and the correlative setback lines are projected as straight line segments between known fault locations at trenches. No representation is made or should be assumed that there are any continuous rupture-line entities between logged or surveyed faults.

6.10 Groundwater

One deep AGI geotechnical soil boring (B-2 on Plate No. 1) encountered perched groundwater at an approximate depth of 43 feet. This was about 21 feet below the erosional contact between younger alluvium and very dense Wildomar sandstone interpreted to have mostly low permeability. Soil samples from depths shallower than 43 feet were free of oxide mottles that would indicate past episodic saturation. Nonetheless, in average or above-average rainfall seasons when surface runoff enters the site, we would predict occurrences of short-lived unconfined saturated zones within younger alluvium atop buried sedimentary formations or granitic bedrock. Future fluctuations in local groundwater elevations should be expected, consistent with variations in precipitation, temperature, consumptive uses, local stormwater recharge, and other factors.

The project site is interpreted to be near a hydrogeological groundwater divide between the large Elsinore groundwater basin to the northwest and the Temecula Valley groundwater basin to the southeast. Both of these named basins are heavily exploited sources of municipal and agricultural water supplies. Groundwater gradients at the site are believed to tilt to the north-northwest, toward the center of a depressed piezometric surface caused by well pumping. There are no historical data for the minimum depth to groundwater in the immediate project vicinity. Based on topographic relief and known water depths closer to the Temecula valley axis, however, we would estimate that permanent and continuous groundwater is more than 100 feet deep. Kennedy (1977) included limited historic phreatic surface contours near the valley axis, partly shown on Figure No. 4.

There is circumstantial evidence for rising water potential along the fault traces bisecting the site. Fault gouge and comminuted rock often act as barriers to subsurface groundwater movement. Although no springs or seeps were seen, LGC Inland (2007) and two AGI fault trenches found elevated soil moisture near fault zones. Cottonwood and tamarisk trees are becoming established just northwest of Tract No. 30155. These are indicator species for perennially moist or wet ground conditions. Mature examples of cottonwoods in fact exist (or once existed) near known fault traces beginning at the northern property line and extending for nearly a mile to the southeast. We think rising water potentials will increase as low-density rural-residential uses are supplanted by landscaped tracts in upgradient areas.

7.0 Seismicity & Strong Motion Hazards

7.1 Regional Seismicity

The project is situated in region of active and potentially active faults, as is all of metropolitan Southern California. Active faults present several potential dangers to structures and people besides geographically constrained lines of surface rupture which can be avoided. These hazards include strong earthquake ground shaking and a variety of induced phenomena: Mass wasting (landsliding); liquefaction and related ground deformation mechanisms; subsidence; and flooding. Generally, the following four factors are the principal determinants of seismic risk at a given location:

- Distance to seismogenically capable faults.
- The maximum or "characteristic" magnitude earthquake for a capable fault.
- Seismic recurrence interval, in turn related to tectonic slip rates.
- Nature of earth materials underlying the site.

The searchable ANSS Comprehensive Earthquake Catalog indicates about 154 events of local magnitude M4.5 or greater have occurred within 100 kilometers of the project since instrumented recordings started in 1932. Clusters of epicenters are associated with the 1992 Landers main shock and triggered Big Bear Lake events, various Los Angeles Basin earthquakes, and a very seismically active area near the community of Anza in Riverside County (Figure No. 7). Detected earthquakes of any magnitude are far fewer for the Elsinore Fault Zone than the San Jacinto or San Andreas faults, consistent with a slower mean slip rate and a longer mean recurrence interval between events. The exhibit in fact shows zero ≥M4.5 events along the Elsinore Fault Zone from Lake Elsinore to the Anza Borrego Desert region at the limits of the radius search area. The plotted epicenters do exclude the sole damaging historic earthquake ascribed to the Elsinore fault zone in California, an estimated magnitude M_L6.0 event that occurred between Lake Elsinore and Corona in May 1910.

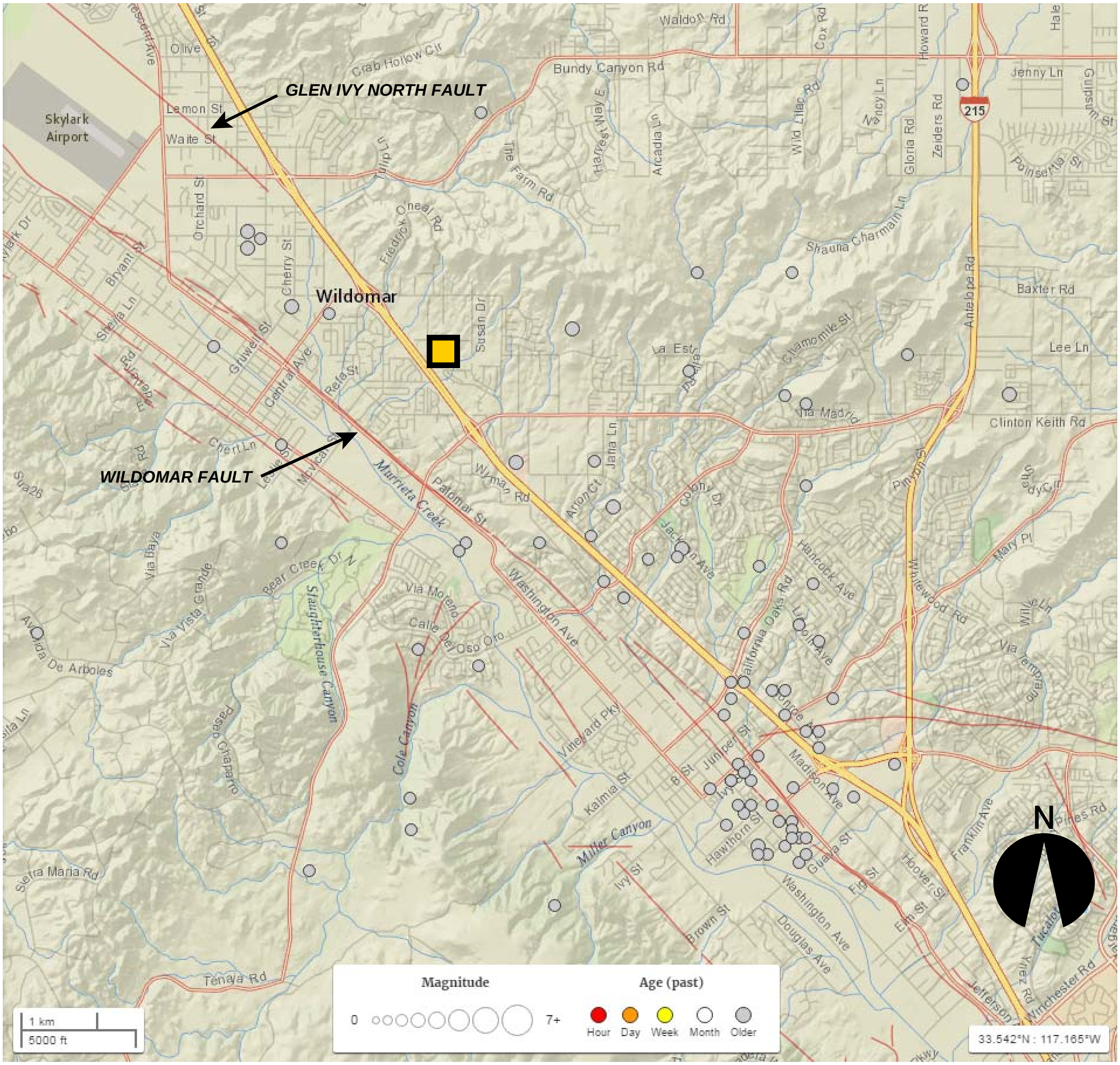
Near the project site, instrument-detected microearthquake activity and infrequent felt shocks attributed to the Elsinore fault zone define a seismic trend located more or less parallel to the Wildomar fault line. Activity is most strongly clustered near Murrieta, where the Murrieta Hot Springs fault splits on an eastward trend from the Wildomar trace (Figure No. 8). The map shows an intriguing number of epicenters located northeast of the Wildomar fault that could conceivably have originated on Glen Ivy North fault line projections. In contrast, microearthquakes are rare in areas southwest of the Wildomar fault. The largest local event has been only M3.4 in 2007. Recent favorable historical loss experience should not be viewed as predictive of future risks, however.

Southern California awaits the day a truly major event of magnitude M7.0 or larger occurs in the modern urban environment. For the proposed church complex, the following regional faults are the greatest seismic threats besides the Elsinore fault zone:

San Jacinto Fault: The San Jacinto fault zone constitutes a set of *en-échelon* or right- and left-stepping fault segments stretching from the Imperial Valley region to the Cajon Pass area in the Transverse Ranges. Individual named traces closest to the site include the Casa Loma and Claremont faults in the San Jacinto Valley. The latter feature is a virtual duplicate of the Elsinore structural basin, and the two bounding fault traces are analogous to the Wildomar and Glen Ivy North faults at Lake Elsinore. The primary sense of slip along the zone is right-lateral, although many individual fault segments show evidence of at least several thousand feet of cumulative vertical displacement. The communities of

Reference: U. S. Geological Survey (2017a) real-time earthquake epicenter map. Plotted are 154 epicenters of instrument-recorded events from 1932 to present (2/13/17) of local magnitude M4.5 or greater within a radius of ~62 miles (100 kilometers) of the site. Location accuracy varies. The site is indicated by the gold square. The selected magnitude corresponds to a threshold intensity value where very light damage potential begins. These events are also generally widely felt by persons. Notable Southern California historical events with epicenters just beyond the selected search radius would include the Sylmar and Northridge earthquakes [San Fernando Valley], and the Hector Mine event north of Yucca Valley.

	SIGNIFICANT EVENT EPICENTER EXHIBIT		
	FAITH BIBLE CHURCH [APN 376-410-002 & 024], CITY OF WILDOMAR, CA.		
	PROJECT NO. 4346-F	DATE: 2/17/17	**FIGURE 7**



Reference: U. S. Geological Survey (2017a) real-time earthquake epicenter map. Plotted epicenters are all instrument-recorded events from 1932 to present (2/13/17) of local magnitude M2.0 or larger within the image view. Location accuracy varies. Red lines mark the surface traces of known Quaternary-age faults. The site is indicated by the gold square. The selected magnitude corresponds to a threshold intensity value where events can be felt by persons in the vicinity. They are also normally ascribable to active tectonic deformation.

AGI	NEAR-SOURCE EARTHQUAKE EPICENTER EXHIBIT		
	FAITH BIBLE CHURCH [APN 376-410-002 & 024], CITY OF WILDOMAR, CA.		
	PROJECT NO. 4346-F	DATE: 2/17/17	**FIGURE 8**

Hemet and San Jacinto were heavily damaged in 1918 and again in 1923 from events on the San Jacinto Fault. Pre-instrumental interpreted magnitudes for these events were M_L6.8 and M_L6.3, respectively. The fault zone seems to have experienced greater seismicity in segments farther to the south. The historical record suggests each discrete segment *usually* reacts to tectonic stress more or less independently from the others, and to have its own characteristic large earthquake with differing maximum magnitude potential and recurrence interval. Researchers and code development authorities now model the fault with potential for multi-segment rupture, however, with consequent increases in calculated risk to structures.

San Joaquin Hills Blind Thrust: Grant et al. (1997) and Grant (1999) described a late Quaternary history of uplift of the San Joaquin Hills in southern Orange County, only about 24½ miles from the church site. Modeling posits the existence of a thrust ramp below what may be one of the youngest major folds in the Los Angeles Basin region. The fault has not been mapped at the ground surface or imaged by geophysical means. Nevertheless, the evidence was considered compelling for inclusion of a blind thrust source in California seismic hazard models from 2008 onward.

Newport-Inglewood Fault Zone: This fault zone trends northwesterly from the San Diego Bay region (where it is termed the Rose Canyon fault) to the vicinity of Beverly Hills in Los Angeles County. At its closest approach to the site, the fault zone is offshore, and seems to comprise many short strands. Subaerial geomorphic expression of the zone includes a string of uplifted coastal mesas and hills between Newport Beach and West Los Angeles. The San Joaquin Hills thrust ramp is inferred to intersect the zone at depth. The predominant sense of offset in the zone is right-lateral strike-slip, although basement relief and offset Tertiary formations indicate substantial vertical offset (e.g., Freeman et al., 1992). Slip rates are considered to be low, about 1.0 millimeter per year. Activity is limited to occasional micro-earthquakes. However, the zone was the probable source for the 1933 M_W6.4 Long Beach earthquake, centered about 45 miles west of the study site.

San Andreas Fault: For most of its over-550-mile length, the San Andreas Fault can be clearly defined as a narrow, discrete zone of predominantly right-lateral shear. The southern terminus is close to the eastern shore of the Salton Sea, where it joins a crustal spreading center marked by the Brawley Seismic Zone. At the northwest end of the

Coachella Valley, a major interruption of the otherwise relatively simple slip model for the fault is centered in the San Gorgonio Pass region. Here, structural complexity resulting from a 15-kilometer left step in the fault zone has created (or reactivated) a myriad of separate faults spanning a zone 5 to 7 kilometers wide (Matti, et al., 1985; Sieh and Yule, 1997; 1998). Continuing research is beginning to disprove earlier speculation that propagation of ruptures from other portions of the San Andreas Fault might be impeded through the Pass region. Instead, continuing research suggests the San Bernardino and Coachella Valley segments of the fault have a heightened probability of concurrent rupture in a single event. Multi-segment cascade rupture scenarios are now the basis for emergency preparedness drills such as the annual ShakeOut exercise.

Source characteristics for the regional active fault zones with the highest contributions to site risks are listed in the following table. Fault data have been summarized from WGCEP (2013) as implemented for the latest California fault model. Magnitudes are based on a probabilistic recurrence interval of 2,475 years for each source, binned to nearest 0.05 magnitude decrement. The reference magnitudes usually reflect cascade ruptures.

Regional Seismic Source Parameters

Fault Name	Distance from Site (km)	Length (km)	Geologic Slip Rate (mm/yr)	Magnitude @ 2% in 50 Yr. Prob., M_W
Elsinore (Glen Ivy North)	14.2*	25.8	5.0	7.55
Elsinore (Temecula)	1.2	40.0	5.0	7.55
San Jacinto (S.J. Valley)	34	18.5	14.0	8.15
San Joaquin Hills	40	27.5	0.6	6.65
Newport-Inglewood (offshore)	49	66.5	1.0	6.95
San Andreas (Coachella→Mojave South)	50	302	10.0 to 32.5	8.25

***** Southeast end of WGCEP (2013) model fault trace. Fault line projection farther to the southeast of 33.6852°N 117.3727°E is not presently modeled as an active seismic source.

7.2 Strong Motion Potential

All Southern California construction is considered to be at high risk of experiencing strong ground motion during a structure's design life. Due to proximity, the most likely source of damaging ground motion at the project is the Elsinore fault zone. Other, more-distant regional faults are very unlikely to produce shaking intensities as great as a significant Elsinore fault zone rupture. However, depending upon structural design and building fundamental periods, distant-source ground motions with their lower frequency and longer durations may require special considerations. The San Jacinto Fault, and the San Andreas Fault where it trends through the San Bernardino Valley and San Gorgonio Pass regions, would be the most significant sources of longer-period motions. Probabilistic risk models for the Wildomar area assign the highest single-source contribution to hazard from a characteristic rupture along the Temecula [Wildomar fault] segment of the Elsinore fault zone. The mode-magnitude event for peak ground acceleration at a 2% in 50-year exceedance risk is a M_w6.8 earthquake on this fault line (U.S. Geological Survey, 2017b). Seismic source models do not include the Glen Ivy North fault southeast of Lake Elsinore as an independent source.

Version 3 of the Uniform California Earthquake Rupture Forecast (UCERF3) is the reference fault source model for future building codes and insurance risk analyses. Utilizing knowledge of tectonic slip rates and last historical or constrained paleoseismic event dates, UCERF3 includes *time-dependent* rupture probabilities for many major California faults. For the Glen Ivy North fault, the model ascribes a 3.8% chance for an earthquake of $M \geq 6.7$ in the next 30 years beginning in 2015 (Field, 2015).

Earthquake shaking hazards are quantified by deterministic calculation (specified source, specified magnitude, and a distance attenuation function), or probabilistic analysis (chance of intensity exceedance considering all sources and all potential magnitudes for a specified exposure period). With certain special exceptions, today's engineering codes and practice generally utilize (time-independent) probabilistic hazard analysis. Prescribed parameter values calculated for the 2008 U.S. national hazard model indicate the site has a 10 percent risk in 50 years of peak ground accelerations (pga) exceeding approximately 0.48g, and 2 percent chance in 50-year exposure period of exceeding 0.96g (U.S. Geological Survey, 2017b). The reported pga values were linearly interpolated from 0.01-degree gridded data and include soil correction (AGI weathered-rock shear wave velocity estimate $V_{s30} \approx 530$ m/sec, correlating to NEHRP site class C. The stiffer granitic bedrock proved to have slightly higher zero-period accelerations than sedimentary basin fill in AGI's sensitivity analyses).

Neither deterministic nor probabilistic acceleration values should be construed as exact predictions of site response. *Actual* shaking intensities from any seismic source may be substantially higher or lower than estimated for a given earthquake event, due to complex and unpredictable effects from variables such as:

- Near-source directivity of horizontal shaking components
- Propagation direction, length, and mode of fault rupture (strike-slip, normal, reverse)
- Depth and consistency of unconsolidated sediments or fill
- Topography
- Geologic structure underlying the site
- Seismic wave reflection, refraction, and interference (basin effects)

7.3 Secondary Seismic Hazards

Secondary hazards include landsliding and rockfall, liquefaction and other forms of permanent ground deformation, flooding (from ruptured tanks, inundation following dam collapse, surface oscillations in enclosed water bodies, or tsunami), and unsaturated-zone subsidence as a result of dynamic soil densification. All of these induced hazards are consequences of earthquake ground motion given the right set of initial conditions.

AGI categorically rules out tsunami, seiche and dam breaching hazards. The project site is inland, not adjacent to lakes or open-reservoir impoundments, and not within mapped inundation pathways for embankment failures of West Dam, Saddle Dam, or East Dam at Diamond Valley Lake. Tanks are absent from upslope areas.

Unlike neighboring Murrieta, most of the Wildomar area has not yet been mapped by the California Geological Survey for State-delineated "Zones of Required Investigation" for either landsliding or liquefaction. The eastern two-thirds of the site does encroach into the Murrieta quadrangle, however. Neither hazard was specifically zoned on the site (California Department of Conservation, 2007). Landsliding, liquefaction, and subsidence susceptibility maps have also been prepared for western Riverside County as a part of the

County General Plan. Local safety element maps place most of the study area in a "moderate" liquefaction hazard classification.

Many aspects of AGI's concurrent geotechnical investigation were geared to evaluating liquefaction and settlement potentials in younger alluvium, based on site-specific estimates of historical high groundwater and soil relative densities. Investigation findings were that the site lacks liquefaction potential due to a lack of shallow groundwater plus very low soil susceptibility (AGI, 2016). The site *passed* screening criteria used to differentiate sites with liquefaction hazard from those that have no hazard (California Department of Conservation, 2008). Related permanent ground deformation phenomena such as ground cracking or fissuring, ejection of pressurized sand-water mixtures from shallow liquefied layers (sand boils), flow slides, and lateral spreading have also been ruled out as hazards.

Other than younger alluvium, site geological units are also judged to have zero subsidence potential from dynamic strain settlement. It is expected that younger alluvium will be fully removed from fill and structural improvement areas. Accordingly, the as-built project site should be free of this risk. With proper shaping of engineered fill "bottoms", differential settlements between similarly loaded structural elements from consolidation settlements were predicted to remain under ¼ to ½ of an inch in a 20-foot span (AGI, 2016).

It is our opinion that induced landslide hazard risks (collectively deep-seated landslides, shallow earth flows, slumps, or rockfall) are very low. High material strengths and steeply inclined, wide-spaced fracturing in the plutonic rocks composing the higher-relief slopes on the site appear to make deep-seated landslide potential virtually nil. Rockfall potential is zero. Rock slope stabilization measures are not expected at this time.

8.0 Conclusions and Recommendations

8.1 Restricted Use Zones

Based on the results of the field exploration program and professional experience, it is our conclusion that APN 376-410-002 and 376-410-024 are transected by an active fault zone. Parts of the project site are not suitable for occupancy buildings, i.e., any structure with an intended occupancy of more than 2,000 person-hours per year per State law. AGI recommends establishment of an enhanced "Restricted Use Zone" encompassing the Glen Ivy North "main zone" and subsidiary splay fault. The boundaries of the Restricted Use

Zone shall constitute structural setback lines. The recommended setback line is set 50 feet laterally from the last detected offsets logged in LGC Inland and AGI trenches. No changes were made to LGC's southwestern setback limits. It is our opinion that 50-foot setbacks will be sufficient to avoid hazard, given fault geometry, kinematic style, depth and character of detrital basin fill, and expected site grading. Contemporary risk management practices normally allow for open space, parks, driveways, streets, parking lots, detention basins, and other non-occupancy improvements within setback zones.

It is our opinion that the remainder of the site can be feasibly and safely developed for the proposed institutional buildings. AGI's *Preliminary Geotechnical Investigation* should be referenced for important earthwork and structural design information.

Prescriptive mitigation for strong ground motion hazard is nominally provided by structural design adherence to local and national building codes. Statutory adoption of the 2016 California Building Code and 2016 California Residential Code is assumed for the City of Wildomar as of January 1, 2017. AGI (2016) contains recommended short- and long-period design spectral accelerations for the project. The report references the older 2013 code editions, but the 2016 codes did not alter either the hazard model or soil correction factors used to derive the design response spectrum. No changes have occurred at the 0.1 and 1.0-second spectral ordinates.

8.2 Construction Observation

It is recommended that all natural, undisturbed "bottoms" created in the course of mass grading be examined for fault traces by the project Engineering Geologist. This work would be done in tandem with tests and judgments of material competency for support of engineered compacted fill. Daily reports should be prepared, and the geological findings summarized as a subsection of the project rough grading report. Cut slopes in Pauba Formation, Wildomar sandstone, or the crystalline basement rocks should be checked for cracks or fault planes that could impact stability. Although problems are not expected, we advise that stabilization fills could be recommended if cracking is severe.

All LGC Inland (2007) and AGI fault trenches were loosely backfilled with only surface densification. Observation and compaction testing to create engineered backfills were outside the services scope. All non-engineered backfills in both structural and open-space areas must be removed during future mass grading and replaced as engineered fill. Sample specifications for fill placement are included in AGI (2016).

8.3 Investigation Limitations

The present findings and recommendations are based on the results of surface reconnaissance combined with projections of identified hazards between a limited number of subsurface explorations. The currently defined Restricted Use Zone should be considered preliminary. Revised geological site models, prompted by findings from in-grading inspections, new data from off-site work by others, or advances in the science of paleoseismology may be cause to expand or change the current hazard zone. Any faults encountered during construction that are beyond the delineated Restricted Use Zone on the Geotechnical Map exhibit must be assessed for activity potential. These studies can result in requests for temporary holds on grading work. AGI recommends a pre-construction meeting with the owner, grading contractor, and civil engineer to explain geological inspection requirements, uncertainties, and recommendations for the site.

9.0 Closure

This report was prepared for the use of the project principals at the Faith Bible Church – Murrieta, the civil designers with Michael Baker International, and regulatory authorities in cooperation with this office. All professional services provided in connection with the preceding report were prepared in accordance with generally accepted investigational methods and Southern California professional practice in the discipline of engineering geology, as well as the general requirements of the City of Wildomar and Riverside County in effect at the time of report issuance. We make no other warranty, either expressed or implied. We cannot guarantee acceptance of the hazard report by local lead agencies without needs for additional services outside of our authorized scope.

We are pleased to have been trusted with the opportunity to help engineer this proposed asset to the Wildomar community. Questions concerning our findings and recommendations should be directed to the undersigned at our Riverside office at (951) 776-0345.

Respectfully submitted,
Aragón Geotechnical, Inc.

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MGD/CFA:mma

Attachments: Appendix A
- LGC Inland Inc. *Geotechnical Fault Investigation Report*, 2007

Appendix B
- AGI Geotechnical Map, Plate No. 1
- AGI Exploratory Trench Logs, Plate Nos. 2-4
- CD-ROM with this report in .pdf format

Distribution: (4) Addressee

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AERIAL PHOTOGRAPHS

Riverside County Flood Control & Water Conservation District Archive

Date Flown	Flight Number	Scale	Frame Numbers
1-30-62	1962 County	1:24,000	Line 3, Nos. 460-462
6-20-74	1974 County	1:24,000	Nos. 506-508
4-14-80	1980 County	1:24,000	Nos. 638-540
1-20-84	1984 County	1:19,200	Nos. 944-945
3-21-90	1990 County	1:19,200	Line 11, Nos. 4-6
1-30-95 2-1-95	1995 County	1:19,200	Line 10, Nos. 9-11 Line 11, Nos. 6-8
3-18-00	2000 County	1:19,200	Line 11, Nos. 4-12
4-14-05 8-2-05	2005 County	1:19,200	Line 10, Nos. 9-12 Line 11, Nos. 4-6
3-28-10 3-29-10	2010 County	1:19,200	Line 10, Nos. 9-12 Line 11, Nos. 4-6

Google Earth Pro Historical Image Archive

Image dates as shown in application:

9/29/96	1/11/07	1/8/13
6/5/02	6/5/09	11/12/13
12/31/02	11/15/09	4/27/14
12/31/04	3/9/11	2/9/16
1/30/06	6/7/12	10/21/16

Our fault studies expanded upon previous site work completed between 2003 and 2007 by the firm LGC Inland, Inc. Our work was primarily geared to qualifying previously unexplored terrain in the northeastern half of the site. Observations were conducted in 4 exploratory fault trenches totaling about 811 linear feet. While undertaking the field studies, AGI also interpreted historical aerial imagery, reviewed published geological literature and unpublished investigation reports for adjacent residential and commercial developments, and performed reconnaissance over broader areas of surrounding terrain to help refine structural models and assess risks.

Both LGC Inland and AGI have concluded that the site is bisected by an active segment of the Glen Ivy North fault. Additionally, we encountered and have characterized an active splay fault. Parts of the project site are not suitable for buildings. The accompanying report includes a site plan exhibit with a revised and enlarged Restricted Use Zone encompassing the fault traces. The boundaries of the Restricted Use Zone constitute recommended 50-foot lateral buffers between buildings and documented active faults.

It is our opinion that the remainder of the site can be feasibly and safely developed for institutional uses, pending in-grading geological inspections of soil and bedrock exposures during mass grading. Mitigation for other geologic constraints should include structural measures to mitigate the high likelihood of strong earthquake ground motions at the site, and remedial grading to replace young deposits of low-density and settlement-prone soils. However, probabilities of buildings being affected by liquefaction, gross instability or landsliding, debris flows, seiching, induced flooding, and tsunami appear to be extremely low or zero.

We are grateful for the opportunity to help the owner mitigate development risks and achieve a quality, long-lasting project. Please ask for either of the undersigned at our Riverside office if you should have any questions.

Very truly yours,
Aragón Geotechnical, Inc.

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APPENDIX A

LGC INLAND INC. (2007) ***Geotechnical Fault Investigation Report***

GEOTECHNICAL FAULT INVESTIGATION REPORT FOR THE PROPOSED "OAK GROVE" PROJECT, ASSESSORS PARCEL NUMBERS 376-410-001 AND -002, TENTATIVE TRACT MAP NO. 33987, LOCATED APPROXIMATELY AT THE INTERSECTION OF LA ESTRELLA ROAD AND INTERSTATE 15 IN THE WILDOMAR AREA, RIVERSIDE COUNTY, CALIFORNIA

Project No. 042409-10

Dated: May 18, 2007

Prepared For:

Mr. Glen Daigle
OAK GROVE EQUITIES
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Murrieta, California 92562

LGC INLAND, INC.
Geotechnical Consulting

May 18, 2007

Project No. 042409-10

Mr. Glen Daigle
OAK GROVE EQUITIES
25109 Jefferson Street, Suite 305
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Subject: ***Geotechnical Fault Investigation Report for the Proposed "Oak Grove" Project, Assessors Parcel Numbers 376-410-001 and -002, Tentative Tract Map No. 33987, Located Approximately at the Intersection of La Estrella Road and Interstate 15 in the Wildomar Area, Riverside County, California***

LGC Inland, Inc. (LGC) is pleased to submit herewith our preliminary geotechnical fault investigation report for the proposed 25±-acre attached residential condominium development site located approximately at the intersection of La Estrella Road and Interstate 15 in the Wildomar Area, Riverside County, California. This work was performed in accordance with the scope of work outlined in our proposals and supplementals dated March 15, and October 28, 2004, July 13, 2005 and February 1 and March 15, 2006. This report presents the results of our field investigation, aerial photograph review, and our engineering judgment, opinions, conclusions and recommendations pertaining to the geotechnical design aspects of the proposed development. This report also addresses the comments from the previous county review sheets in one comprehensive final report.

It has been a pleasure to be of service to you on this project. Should you have any questions regarding the content of this report or should you require additional information, please do not hesitate to contact this office at your earliest convenience.

Respectfully submitted,

LGC INLAND, INC.

Mark Bergmann
President

MB/kg

Distribution: (4) Addressee
(2) County of Riverside Planning Department, Attn. Mr. David Jones

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1.0 INTRODUCTION

LGC is pleased to present this fault investigation report for the subject property. A fault mapped by Rasmussen & Assoc., in a report dated July 31, 2003, projects across the subject property. Additionally, the fault is reported to be active (having displaced Holocene deposits) by Rasmussen & Assoc. This report utilized a fault trenching program to identify the location of the projected faulting through the subject property. The general location of the property is indicated on the Site Location Map (Figure 1). The Tentative Tract Map Number 33987 you provided was used as the base map to show geologic conditions within the subject site (see Fault Map, Plate 1).

1.1 Purpose and Scope of Services

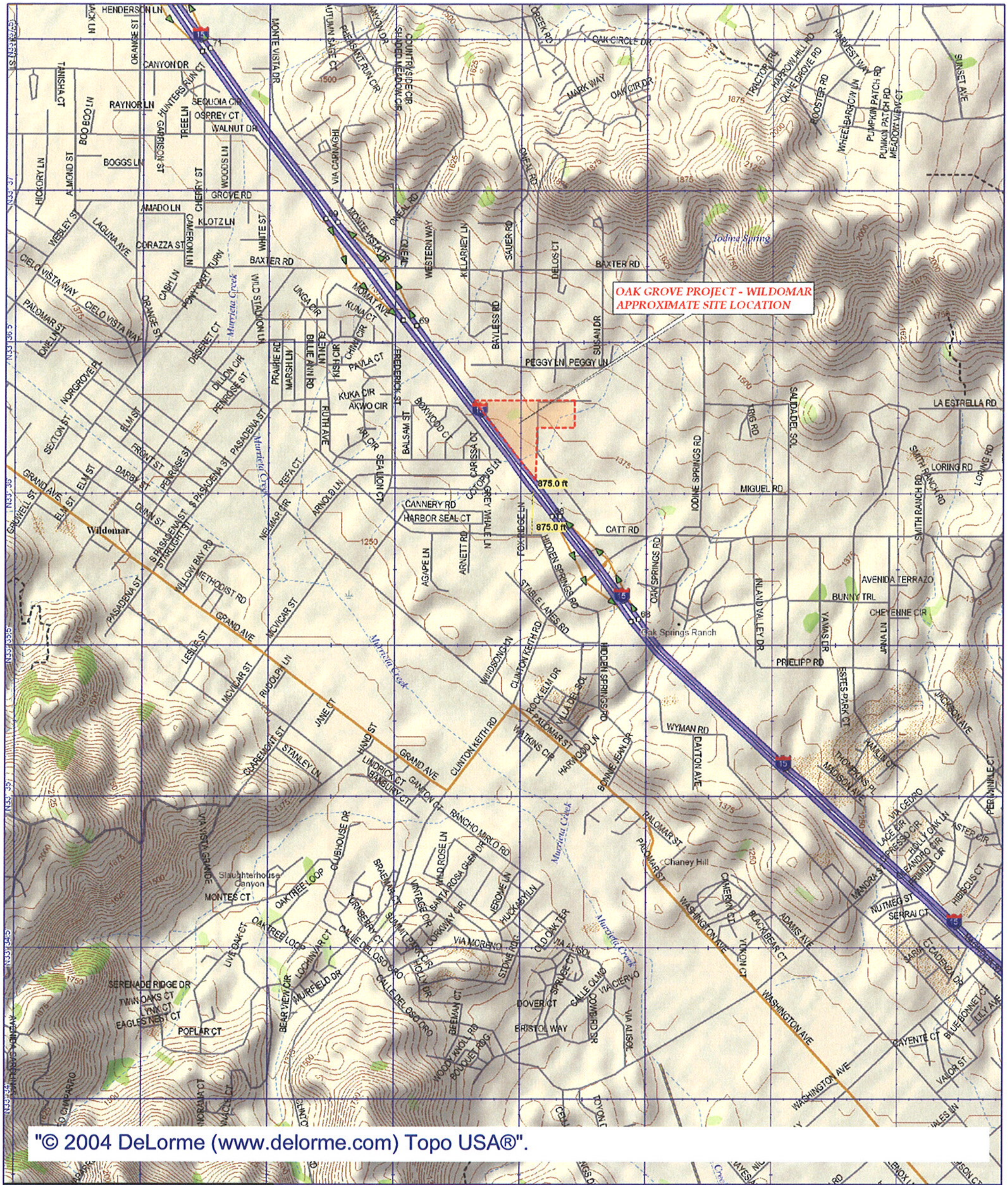
The purposes of this investigation were to obtain information on the surface/subsurface soil and geologic conditions within the subject site with respect to onsite faulting, evaluate the data, and then provide structural setback recommendations, if required. The scope of our investigation included the following:

- Review of readily available published and unpublished literature and geologic maps pertaining to active and potentially active faults that lie in close proximity to the site which may have an impact on the proposed development (see Appendix A, References).
- Coordinate with Underground Service Alert to locate any known underground utilities.
- Excavating, logging, and backfilling of ten (10) fault trenches totaling approximately 1,880 feet in length. Exploration locations are shown on the enclosed Fault Map (Plate 1) and descriptive logs are presented in Plates 2 through 8.
- Geologic analysis of the data with respect to the proposed development.
- An evaluation of faulting as it pertains to the site with recommended setback locations.
- Preparation of this report presenting our findings, conclusions and preliminary structural setback recommendations for the proposed development.

1.2 Location and Site Description

The subject site, Tentative Tract 33987, Assessors Parcel Numbers 376-410-001 and 376-410-002 is located on the south side of La Estrella Road if projected west to intersect with Interstate 15 in the Wildomar Area, Riverside County, California. The general location and configuration of the site is shown on the Site Location Map (Figure 1).

The topography of the site is relatively flat to moderately sloping. The elevation of the property generally ranges from 1,320 to 1,380 feet above mean sea level (msl) with differences of roughly 60± feet across the entire site. The northeasterly roughly two thirds of the site is generally hilly, while the southwestern portion of the site includes more gently sloping topography. Local drainage is generally directed to the southwest.



LGC INLAND	FIGURE 1 SITE LOCATION MAP	Project Name	OAK GROVE EQUITIES
		Project No.	042409-10
		Geol./ Eng.	MB/ YP
		Scale	NOT TO SCALE
		Date	May 2007

The subject property is currently vacant undeveloped land. The northern perimeter of the site is bordered by residential structures on large lots while the properties east and south of the site consist of similar vacant undeveloped land. Interstate Highway 15 makes up the western boundary of the site. No underground structures are known to exist at the site. Vegetation consists of a sparse to moderate cover of annual weeds/grasses and native plants.

1.3 ***Proposed Development and Grading***

The proposed development is expected to be wood, or steel framed one- and two-story attached residential condominium structures utilizing slab on ground construction with associated streets, parking, landscape areas, and utilities. A total of 32 attached structures are proposed with a central park totaling 2.2 acres that coincides with our recommended fault setback zone. Lots 4 and 5 are proposed as open space totaling 3.7 acres.

The Tentative Tract Map, provided by you, was utilized in our investigation and forms the base for our Fault Map (Plate 1).

1.4 ***Previous Investigations***

A previous report by Rasmussen and Associates dated July 31, 2003, states that an active fault was encountered on the property adjacent to and south of the subject site. The fault projects onto Tentative Tract 33987 at a general orientation of N 59° W. No distinct single splay of this fault was reported and they have established a relatively wide setback zone (240') to accommodate the non linear zone of faulting that they have interpreted to be active.

2.0 ***INVESTIGATION AND LABORATORY TESTING***

2.1 ***Field Investigation***

Subsurface exploration and logging within the subject site was performed in October and December of 2004, July and August of 2005 and March and April of 2006 for the exploratory fault trenches. A backhoe was utilized to excavate the fault trenches to a maximum depth of 17 feet. Prior to the subsurface work, an underground utilities clearance was obtained from Underground Service Alert of Southern California.

Earth materials encountered during exploration were classified and logged in general accordance with the visual-manual procedures of ASTM D 2488. Additionally; Munsell soil color descriptions were utilized subsequent to our first phase of trenching. The approximate exploration locations are shown on Plate 1 and descriptive logs are presented herein.

Ten (10) fault trenches totaling approximately 1,880 feet long were excavated and logged at the site. Fault trenches FT-1, FT-2, and FT-3, were initially excavated across the projected alignment of the fault mapped by Rasmussen and Associates, Inc. Fault trenches FT-4 and FT-5 were excavated to address review comments from a County of Riverside Transportation and Land Management Agency review sheet dated June 27, 2005. Fault trenches FT-6 through FT-10 were subsequently excavated to address County of Riverside Review comments from a December 14, 2005 conditions of approval letter. Mr. Dave Jones, CEG, with The County of Riverside, periodically observed the trenches excavated for this study.

2.3 *Aerial Photograph Interpretation*

Two weak geomorphic lineaments were interpreted to project through the site during our review of aerial photographs of the subject property and are shown on the accompanying Fault Map Plate 1. These lineaments are relatively indistinct and one generally corresponds to the location of the fault encountered onsite. Generally, the linear features trend northwest to southeast through the site. No evidence of faulting was observed in trenches FT-1, FT-2, FT-3, FT-5 and FT-6 where the second lineament transects these trenches. Geomorphic evidence of active landsliding was not observed during our aerial photographic review. These interpretations along with our site reconnaissance and review of the Rasmussen 2003 report served as a starting point in developing our subsurface exploration. A table summarizing the aerial photographs utilized in our geomorphic interpretation of lineaments and landslides is included in Appendix A - Aerial Photograph Interpretation Table.

3.0 *FINDINGS*

3.1 *Regional Geologic Setting*

Regionally, the site is located in the Peninsular Ranges Geomorphic Province of California. The Peninsular Ranges are characterized by steep, elongated valleys that trend west to northwest. The northwest-trending topography is controlled by the Elsinore fault zone, which extends from the San Gabriel River Valley southeasterly to the United States/Mexico border. The Santa Ana Mountains lie along the western side of the Elsinore fault zone, while the Perris Block is located along the eastern side of the fault zone. The mountainous regions are underlain by Pre-Cretaceous, metasedimentary and metavolcanic rocks and Cretaceous plutonic rocks of the Southern California Batholith. Tertiary and Quaternary rocks are generally comprised of non-marine sediments consisting of sandstone, mudstones, conglomerates, and occasional volcanic units. A map of the regional geology is presented on the Regional Geologic Map, Figure 2.

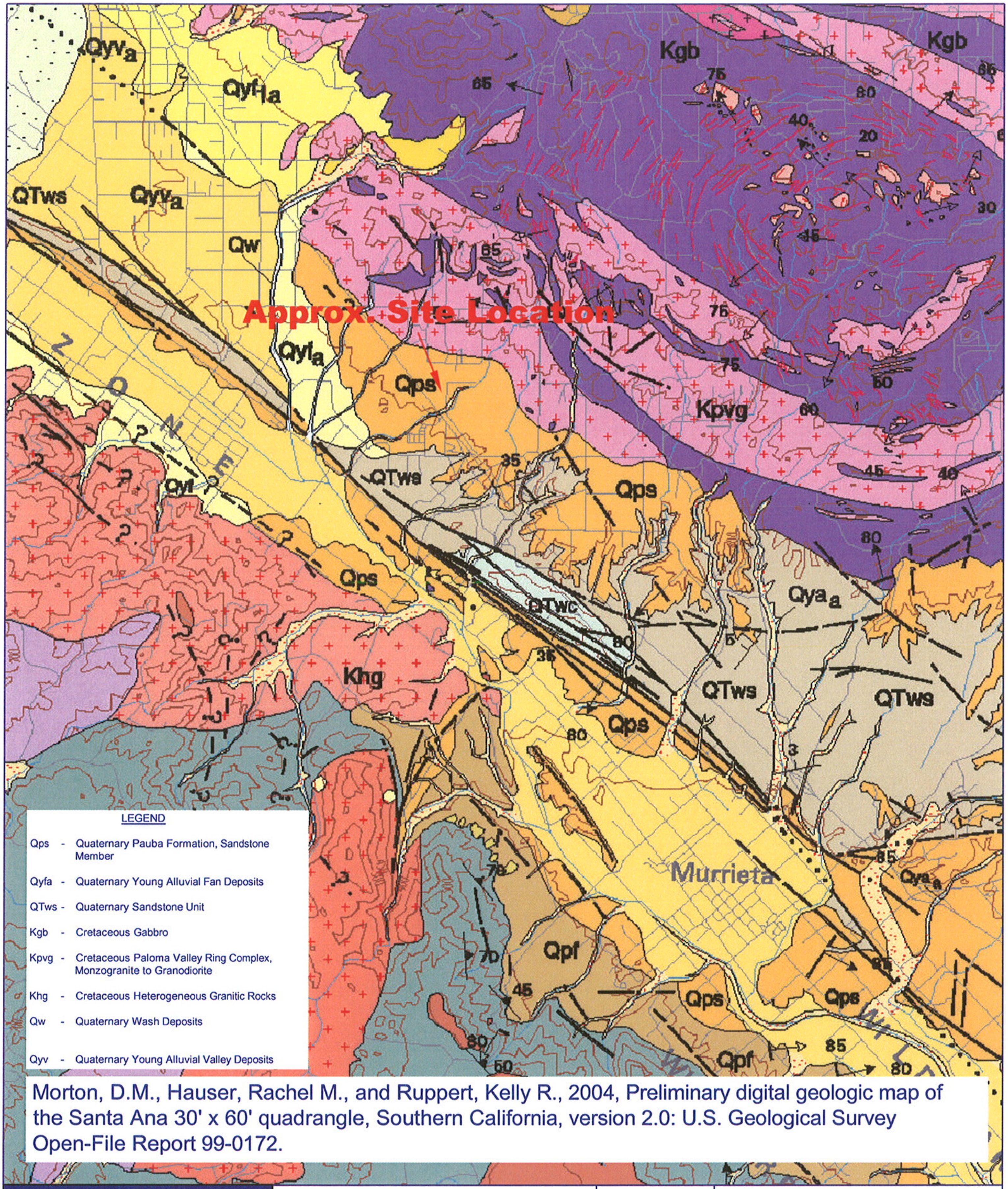
3.2 *Local Geology and Soil Conditions*

The earth materials encountered in the trenches are primarily comprised of topsoil, Quaternary alluvium, colluvium, and bedrock. A general description of the soil materials observed on the site is provided in the following paragraphs:

- Topsoil: Residual topsoil, generally encountered in the upper 1 to 3 feet, blankets much of the site and underlying bedrock. These materials were noted to be generally dark reddish brown, clayey sand which was very porous, slightly moist, and in a loose to medium dense state. The age of this unit is estimated to range from present day to several hundred years old.

- Quaternary Colluvium: Quaternary colluvium generally consisted of reddish brown silty clayey sand and clayey sand which was slightly moist to moist, loose to medium dense with occasional gravel. The age of this unit is estimated to be from near present day to a couple of thousand years.

- Quaternary Alluvium: Quaternary alluvium was encountered directly from the surface to a maximum depth of 11 feet. This alluvial unit consists predominately brown, fine to coarse grained clayey sand interbedded with lenses of gravel. This unit is generally dry and loose to medium dense in condition. The Quaternary alluvium ranges in age from the present day to several thousand years old.



LEGEND

Qps - Quaternary Pauba Formation, Sandstone Member

Qyfa - Quaternary Young Alluvial Fan Deposits

QTws - Quaternary Sandstone Unit

Kgb - Cretaceous Gabbro

Kpvg - Cretaceous Paloma Valley Ring Complex, Monzogranite to Granodiorite

Khg - Cretaceous Heterogeneous Granitic Rocks

Qw - Quaternary Wash Deposits

Qyv - Quaternary Young Alluvial Valley Deposits

Morton, D.M., Hauser, Rachel M., and Ruppert, Kelly R., 2004, Preliminary digital geologic map of the Santa Ana 30' x 60' quadrangle, Southern California, version 2.0: U.S. Geological Survey Open-File Report 99-0172.

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FIGURE 2
REGIONAL GEOLOGIC MAP

Project Name	OAK GROVE EQUITIES
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Scale	NOT TO SCALE
Date	May 2007

- Quaternary Pauba Formation: Pauba Formation clayey sandstone was encountered. These materials consisted primarily of olive green, orange brown to reddish brown, fine to coarse grained sandstone and clayey sandstone, with interbedded sand lenses. These materials were typically moderately hard to hard and slightly moist to moist. The age of Pauba Formation is reported to range from 11,000 years before present to approximately 2.5 million years (Kennedy, 1977).

3.3 Groundwater

Groundwater was not encountered to the maximum depth explored, approximately 17 feet.

3.4 Description of Fault Trenches

Fault Trench 1 (FT-1) was excavated to a maximum depth of approximately 10½ feet deep and a total length of 352 feet. Massive bedrock of the Pauba formation was encountered and due to the lack of marker beds, displacement of this material was difficult to discern. Therefore; Fault Trench 7 was excavated directly adjacent to FT-1 to further evaluate faulting in this area. Based on our logging and analysis, of Fault Trench 7 and Fault Trench 1, the main trace of the fault is interpreted to project through Fault Trench 1 near Station -0+90. A zone of faulting has been interpreted from Station -0+65 to -1+65 that extends beyond the faulting found in FT-7 to include a possible erosional feature at station -0+74. Areas of higher moisture content were also noted in this area of faulting. No offset of Holocene materials was observed and only minor caliche infilled fractures were noted west of Station -0+45.

Fault Trench 2 (FT-2) was excavated to a maximum depth of approximately 9½ feet deep and a total length of 300 feet. FT-2 encountered topsoil overlying alluvium throughout its length. No faulting, fractures or other relevant features were noted in the alluvial soils of FT-2. A zone of faulting, projected from adjacent fault trenches, has been added from Station 0+25 to 0+67. A structural setback of 50 feet and 72 feet is recommended West and East of the projected fault zone respectively. FT-2, did not encounter noticeable evidence of active faulting. An area of apparent higher moisture content was noted at Station 2+25 to 2+50, possibly due to increased infiltration due to a more permeable sand lense in the topsoil.

Fault Trench 3 (FT-3) was excavated to a maximum depth of approximately 15 feet deep and a total length of 115 feet. FT-3 was located on the projected strike from the closest Rasmussen Fault Trench 4. A fault was encountered in Pauba Bedrock at approximately station 0+54. In FT-3, the fault trace was well defined and evident due to clayey gouge material with slickensides generally oriented at N50W being observed near Station 0+54. The gouge material was buried under several feet of alluvial materials, with no obvious offset, displacement or shearing of the alluvial materials. Caliche stringers within this trench are most likely the result of groundwater percolating through the topsoil and accumulating on the less permeable Pauba Formation. The calcium carbonate precipitates out of solution over time.

Fault Trench 4 (FT-4) was excavated to a maximum depth of approximately 7 feet deep and a total length of 122 feet. FT-4 encountered a localized slump/small landslide that was also observed in FT-5 located only 18 feet south of FT-4. Intensely fractured Pauba Bedrock was observed overlying less fractured Pauba formation materials. The intense fracturing is apparently due to the down slope movement of these materials within the slump and may also explain the presence of a decomposed granitic boulder derived from up slope bedrock sources. In FT-4, the main trace of the fault is interpreted to be at about Station 0+80. A zone of faulting has been interpreted from Station 0+68 to 0+90 to coincide with the fault location observed in FT-5. However, there was no apparent offset of observed fractures in this zone probably because the slumping occurred subsequent to the last fault activity and the trench did not extend deep enough to get through this material. No evidence of faulting was observed within the bedrock or overlying topsoil. The landslide debris has apparently been deposited over the fault as encountered in adjacent Trench FT-5. The slide debris coincides well with the location of faulting observed in FT-5. Caliche lined fractures are most likely due to groundwater penetration and precipitation of calcium carbonate over time.

Fault Trench 5 (FT-5) was excavated to a maximum depth of approximately 11 feet deep and a total length of 300 feet. A zone of faulting was encountered from Station 1+13 to 1+37. A small landslide/slump was also encountered in FT-5 overlying the zone of faulting. A distinct lithologic difference between one side of the fault and the other was observed. As in FT-3, a shear zone with slickensides having a general strike of N50W was noted between the two earth materials. Only minor fracturing was observed throughout the remaining portion of the trench. Specifically, FT-8 was excavated adjacent to FT-5 to further evaluate fractures observed in FT-5 with respect to the potential for small displacements. A distinct siltstone bed was encountered throughout FT-8 and numerous fractures were also observed that essentially coincide with those noted in FT-5. No evidence of displacement was observed where fracturing transected the distinct siltstone bed in FT-8 or the calcic beds in FT-5. Additionally, no shearing or displacement of the overlying topsoil was observed. Units C and C-2 have gradational contacts with C-1 shown that represents a slightly higher clay content in C-1 and associated slightly higher moisture content that correlates with the increased clay content.

Fault Trench 6 (FT-6) was excavated to a maximum depth of approximately 17 feet deep and a total length of 389 feet. During our logging of FT-6 an "apparent" fault was encountered at Station 2+89. To further evaluate this area with respect to the possibility of faulting, FT-9 and FT-10 were excavated across the projected strike of this feature (N 30°W). FT-10 approximately 83 feet southeast of FT-6 encountered Pauba Formation bedrock overlain by approximately 3 to 8 feet of alluvial soils. No faults were encountered in FT-10. FT-9 was excavated approximately 66 feet southeast of FT-10 on strike with the fracture observed in FT-6. FT-9 was approximately 165 feet long and up to 20 feet deep exposing Holocene alluvial soils. No offset bedding or shearing was observed in FT-9. Therefore, the "apparent" fault noted in FT-6 is considered a fracture since no offset was observed in FT-6 and no faults were encountered in FT-9 and FT-10 excavated along the projected strike of this feature. The western end of FT-6 gradually transitioned to alluvial deposits overlying Pauba Formation clayey siltstone and sandstone. The majority of the fault trench exposed thickly to thinly bedded Pauba Formation with minor to moderately sized fractures and occasional soil infilling.

LGC's FT-6 was excavated to further evaluate fractures encountered in FT-5, intercept the projected trace of Rasmussen's Fault further into the property and to evaluate a generalized alignment of ridges ending near the southwest property line. Numerous fractures were encountered in Pauba Formation material throughout the trench excavation. Several fractures were noted to be open near the surface and infilled with soil, specifically at Stations 1+42, 1+63, 1+70, 1+81, 1+84, 2+23, 2+91, and 2+95. As can be seen on the FT-6 trench log this is an area of anticlinal folding creating open tensional fractures near surface from the extensional forces exerted near the upper portion of the anticline. All fractures close at depth and do not offset or displace any bedding features observed or the topsoil deposits. Therefore, the extensive fractures in FT-6 are in response to folding and are not faults. The projected trace of the Rasmussen Fault transets FT-6 at Station 0+30. Minor closed fractures were noted and logged in this area. No fractures offset or displaced bedding in this area and no topsoil is displaced or sheared. Therefore, no faulting can be associated with Rasmussen's projected fault trace in this trench.

Fault Trench 7 (FT-7) was excavated to a maximum depth of approximately 12 feet deep and a total length of 155 feet. FT-7 was excavated next to Fault Trench 1 in order to reevaluate features encountered in Fault Trench 1. Evidence of faulting consisted of offset scour and fill deposits, along with some offset layers of fine deposits which were observed near the bend in Fault Trench 7, roughly between Stations 0+52 and 0+75. The faulting did not appear to extend into the overlying topsoil and the age of the scour and fill/fine deposits are estimated to be older than 11,000 years based on the fact that they were encountered in Quaternary Pauba Formation Bedrock. No evidence of faulting was observed from Station 0+00 to about 0+52. However; the fault zone was widened to Station 0+37 to correlate with features found in FT-1. A questionable feature was observed near Station 1+30 that appears to be an erosional scour feature. Out of conservatism, we included this feature in our zone of faulting, which extends from Stations 0+37 to 1+36. A setback is recommended outside this fault zone extending 50 feet west and 50 feet east.

Fault Trench 8 (FT-8) was excavated to a maximum depth of approximately 10½ feet deep and a total length of 100 feet. FT- 8 was excavated next to FT-5 in order to further evaluate fractures encountered in FT-5. The excavation exposed traceable bedding that was followed across similar fractures encountered in FT-5, as illustrated in FT-8. Soil infilled fractures were noted during our logging of FT-8, but no displacement or faulting was observed and no shearing or displacement of the overlying topsoil was observed. The infilled fractures are again apparently the result of anticlinal folding as noted in FT-6.

Fault Trench 9 (FT-9) was excavated to a maximum depth of approximately 16 feet deep and a total length of 165 feet. FT-9 was excavated specifically to address the apparent fault encountered in FT-6 at about Station 2+88 and to address concerns expressed by the county geologist regarding other potential faults. This fault trench generally exposed alluvial deposits over older alluvial deposits that could possibly be Pauba formation bedrock. A section of Pauba Formation bedrock was encountered below the older alluvial deposits at a depth of approximately 10 feet from Stations 0+00 to 0+40. The older alluvial deposits were estimated to be older than 11,000 years due to the degree of in place weathering of clasts, translocation of clay films and the depth of the deposits. No displaced bedding or shearing was observed in this trench.

Fault Trench 10 (FT-10) was excavated to a maximum depth of approximately 11 feet deep and a total length of 47 feet. FT-10 was excavated specifically to address the apparent fault encountered in FT-6 at about Station 2+89. The trench exposed alluvial deposits over older alluvium and inclined Pauba Formation bedrock. No features similar to the one observed in Fault Trench 6 were observed. No faulting was encountered in FT-10.

3.5 <u>Faulting</u>

The geologic structure of the entire Southern California area is dominated by northwest-trending faults associated with the San Andreas Fault system. Faults, such as the Newport-Inglewood, Whittier-Elsinore, San Jacinto and San Andreas are major faults in this system and all are known to be active. In addition, the San Andreas, Elsinore, and San Jacinto faults are known to have ruptured the ground surface in historic times. The site does not lie within an Alquist-Priolo Earthquake Fault Zone (previously called an Alquist-Priolo Special Studies Zone). However; previous studies (Rasmussen, 2003) have reported an active fault on property south of the subject site projecting onto Tentative Tract 33987.

Based on our review of published and unpublished geologic maps and literature pertaining to the site and regional geology, the Glen Ivy Fault, if projected southeast from previous mapping by others (bearing N49W), would align with the fault observed at the site. The Glen Ivy Fault is capable of producing a moderate magnitude earthquake and Holocene displacement was reported south of the subject property (Rasmussen, 2003). Faulting was encountered in our trenches FT-3, FT-5 and FT-7 with a strike of N50° to N51°W. These distinct areas of faulting generally correspond to the weak air photo lineament noted during our aerial photograph review and correlates well with the projected location and trend (N49°W) of the Glen Ivy Fault located northwest of the site. This trend varies from the trend reported by Rasmussen (2003). However; the Rasmussen did not report a single splay of the fault but provided a general trend based upon a non linear zone of faulting and reported Holocene displacement. Additionally the projected trend of Rasmussen fault was intercepted by our fault trenches FT-1, FT-2, FT-3, FT-5 and FT-6. No evidence of faulting was encountered in these fault trenches where the projected fault transected these trenches. Based on the information obtained during this fault investigation we are considering this portion of the Glen Ivy Fault to be active and the appropriate structural setbacks have been recommended, (see Conclusions and Recommendations Section 4.0).

3.6 Landslides

A minor landslide slump feature was noted in FT-4 and FT-5. The approximate location of this minor landslide is shown on the accompanying Fault Map, Plate 1.

4.0 CONCLUSIONS AND RECOMMENDATIONS

4.1 General

From an engineering geologic point of view, the subject property is considered suitable for the proposed development, provided the following conclusions and recommendations are incorporated into the design criteria and project specifications.

4.2 Faulting Conclusions

Distinct faulting was encountered in Pauba formational bedrock in trenches FT-3, FT-5, and FT-7 excavated across the site. This fault zone widens as it progresses northward (see Plate 1) toward the active Glen Ivy segment of the Elsinore Fault. Supplemental trenching was conducted to shadow any suspected features or fractures to further evaluate the potential for displacement in these areas. No evidence of displacement was observed outside of the fault zone identified during this study. No evidence of Holocene displacement was observed in topsoil deposits or alluvial soils overlying the faults identified. Additionally, only two weak aerial photographic lineaments were noted one of which somewhat corresponds to observed faulting. Due to the lack of displacement, shearing or faulting of Holocene soils and the lack of a distinct aerial photo lineament, no evidence of active faulting was noted on this site. However; based upon the evidence of active faulting on the site to the south (Rasmussen, 2003) and the correlation of trend matching the Glen Ivy Fault to the northwest, there is sufficient evidence to classify this fault as active and a setback zone has been established to mitigate the hazard of ground surface displacement along its length. We have conservatively established an extensive setback zone that encompasses all faulting encountered, extends to cover extensively fractured areas and is further extended a minimum of 50 feet and up to 80 feet outside the faulted/fractured areas. This study and recommended structural setback zones will provide a safe environment for habitable structures and will not subject future structures to the hazard of ground surface displacement.

4.2 Structural Setback Zone

Proposed structures for human occupancy should not be constructed within the structural setback zone, as it is shown on Plate 1 – Fault Map. The trend of the Glen Ivy Fault mapped by LGC across the site is closely related with the mapped trend of the Glen Ivy Fault by Morton, 2004. Both trends are mapped with bearings of approximately N49W. However, this is a 10 degree change from the trend that is reported by Rasmussen, which has a bearing of N59W. Our setback zone is smaller than Rasmussen's because; we did much more extensive trenching to accurately identify a main fault trace that coincides with that of the projected Glen Ivy Fault; whereas Rasmussen identified a non-linear zone of faulting and provided a wide setback to accommodate this. We have locally widened the setback beyond the commonly accepted 50 feet to maintain a linear setback on the western side of the fault and to correlate better with Rasmussen's setback.

The site should be designed and constructed to resist the effects of seismic ground motions as provided in the 1997 UBC Sections 1626 through 1633. The method of design is dependent on the seismic zoning, site characteristics, occupancy category, building configuration, type of structural system and building height.

4.3 Additional Fault Studies

Geologic mapping should be performed during rough grading operations to geologically map the fault transecting the site. Modifications to the recommended setback zone may be needed based upon the depth of cut with respect to the dip of the fault and the possibility of slight variations to the location based upon the depth of cut.

5.0 GRADING PLAN REVIEW AND CONSTRUCTION SERVICES

This report has been prepared for the exclusive use of **Oak Grove Equities** to assist the project engineer and architect in the design of the proposed development. It is recommended that **LGC** be engaged to review the final design drawings and specifications prior to construction. This is to verify that the recommendations contained in this report have been properly interpreted and are incorporated into the project specifications. If **LGC** is not accorded the opportunity to review these documents, we can take no responsibility for misinterpretation of our recommendations.

We recommend that **LGC** be retained to provide geotechnical engineering services during construction of the excavation and foundation phases of the work. This is to observe compliance with the design, specifications or recommendations and to allow design changes in the event that the subsurface conditions differ from those anticipated prior to the start of construction.

If the project plans change significantly (e.g., building loads or type of structures), we should be retained to review our original design recommendations and their applicability to the revised construction. If conditions are encountered during the construction operations that appear to be different than those indicated in this report, this office should be notified immediately. Design and construction revisions may be required.

6.0 INVESTIGATION LIMITATIONS

Our services were performed using the degree of care and skill ordinarily exercised, under similar circumstances, by reputable engineers and geologists practicing in this or similar localities. No other warranty, expressed or implied, is made as to the conclusions and professional advice included in this report. The samples taken and submitted for laboratory testing, the observations made, and the in-situ field testing performed are believed to be representative of the entire project; however, soil and geologic conditions revealed during construction may be different than our preliminary findings. If this occurs, the changed conditions must be evaluated by the project soils engineer and geologist, and design(s) adjusted or required as alternate design(s) recommended.

This report is issued with the understanding that it is the responsibility of the owner, or of his/her representative, to ensure that the information and recommendations contained herein are brought to the attention of the architect and/or project engineer and incorporated into the plans, and the necessary steps are taken to see that the contractor and/or subcontractor properly implements the recommendations in the field. The contractor and/or subcontractor should notify the owner if they consider any of the recommendations presented herein to be unsafe.

The findings of this report are valid as of the present date. However, changes in the conditions of a property can and do occur with the passage of time, whether they be due to natural processes or the works of man on this or adjacent properties.

In addition, changes in applicable or appropriate standards may occur, whether they result from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated wholly or partially by changes outside our control. Therefore, this report is subject to review and modification, and should not be relied upon after a period of 3 years.

This report has not been prepared for use by parties or projects other than those named or described herein. It may not contain sufficient information for other parties or other purposes.

The professional opinions contained herein have been derived in accordance with current standards of practice and no warranty is expressed or implied.

The opportunity to be of service is appreciated. Should you have any questions regarding the content of this report, or should you require additional information, please do not hesitate to contact this office at your earliest convenience.

Respectfully submitted,

LGC INLAND, INC.

CERTIFIED ENGINEERING GEOLOGIST
MARK C. BERGMANN
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EXP. 10/31/08
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Mark Bergmann, CEG 1348
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Principal Engineering Geologist

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APPENDIX A

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APPENDIX A

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Gary S. Rasmussen & Associates, Inc., 2003, Subsurface Engineering Geology Investigation Tentative Tract No. 30155 Wildomar Area Riverside County, California, Project No. 3455, July 31.

LGC Inland, Inc., 2005, Preliminary Geotechnical Fault Investigation for the Proposed "Oak Grove" Project, Assessors Parcel Numbers 376-410-001 and -002, Located Approximately at the Intersection of La Estrella Road and Interstate 15 in the Wildomar Area, Riverside County, California, dated January 21.

______, 2005, Response to the County of Riverside Review Comments Regarding County Geologic Report 1422 (Fault Hazard), Geotechnical Fault Investigation for the Proposed 10-Acre Commercial Development Located Approximately at the Intersection of La Estella Street and Interstate 15 in the Wildomar Area, Riverside County, California, dated June 2.

______, 2005, Second Response to the County of Riverside Review Comments #2 Regarding County Geologic Report 1422 (Fault Hazard), Geotechnical Fault Investigation for the Proposed 10-Acre Commercial Development, Located Approximately at the Intersection of La Estella Street and Interstate 15 in the Wildomar Area, Riverside County, California, dated September 13.

______, 2006, Preliminary Geotechnical Investigation for the Proposed 25-Acre Residential Development, Assessors Parcel Numbers 376-410-001 And – 002, Located Approximately Southeast of the Intersection of La Estrella Road and Interstate 15 Wildomar Area of Riverside County, California, dated August 9.

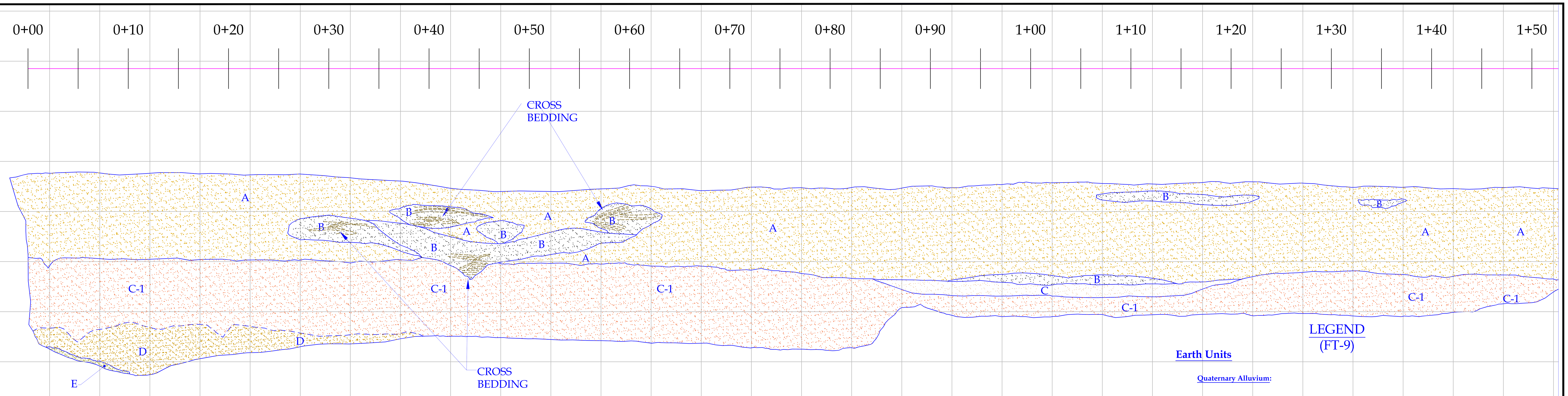
______, 2006, Third Response to the County of Riverside Conditions of Approval Regarding County Geologic Report 1422 #3 (Fault Hazard), Geotechnical Fault Investigation for the Proposed 25-Acre Residential Development, Located Approximately at the Intersection of La Estrella Street and Interstate 15 in the Wildomar Area of Riverside County, California, dated August 9.

______, 2006, Clarification of Response Letter dated August 9, 2006, 25-Acre Residential Development, Located Near La Estrella Street and Interstate 15, Wildomar Area, Riverside County, California, dated December 20.

Aerial Photograph Interpretation Table

DATE	***FLIGHT NUMBER***	***SCALE***
03-18-2000	15-17	1" = 1,600'
01-29-1995	15-13, 15-14	1" = 1,600'
01-25-1990	15-16, 15-17	1" = 1,600'
12-15-1983	584, 585	1" = 1,600'
05-04-1980	757, 758	1" = 2,000'
06-20-1974	804, 805	1" = 2,000'
01-28-1962	68, 69	1" = 2,000'

FT-9



TREND: N45E
GRAPHIC REPRESENTATION: SOUTH WALL

LEGEND
(FT-9)

Earth Units

Quaternary Alluvium:

A - **Silty SAND;** dark yellowish brown (10YR 4/2), slightly moist, loose to medium dense, fine to coarse sand, abundant rootlets, numerous scour and fill ("B").

B - **SAND;** yellow dark greenish gray (GY 4/10) to pale yellow (5Y 8/2), slightly moist, soft, fine to coarse sand, fine to coarse gravel, up to 1' boulders.

Quaternary Older Alluvium:

C - **Sandy CLAY;** light olive brown (2.5Y 5/4), moist, very stiff, fine sand.

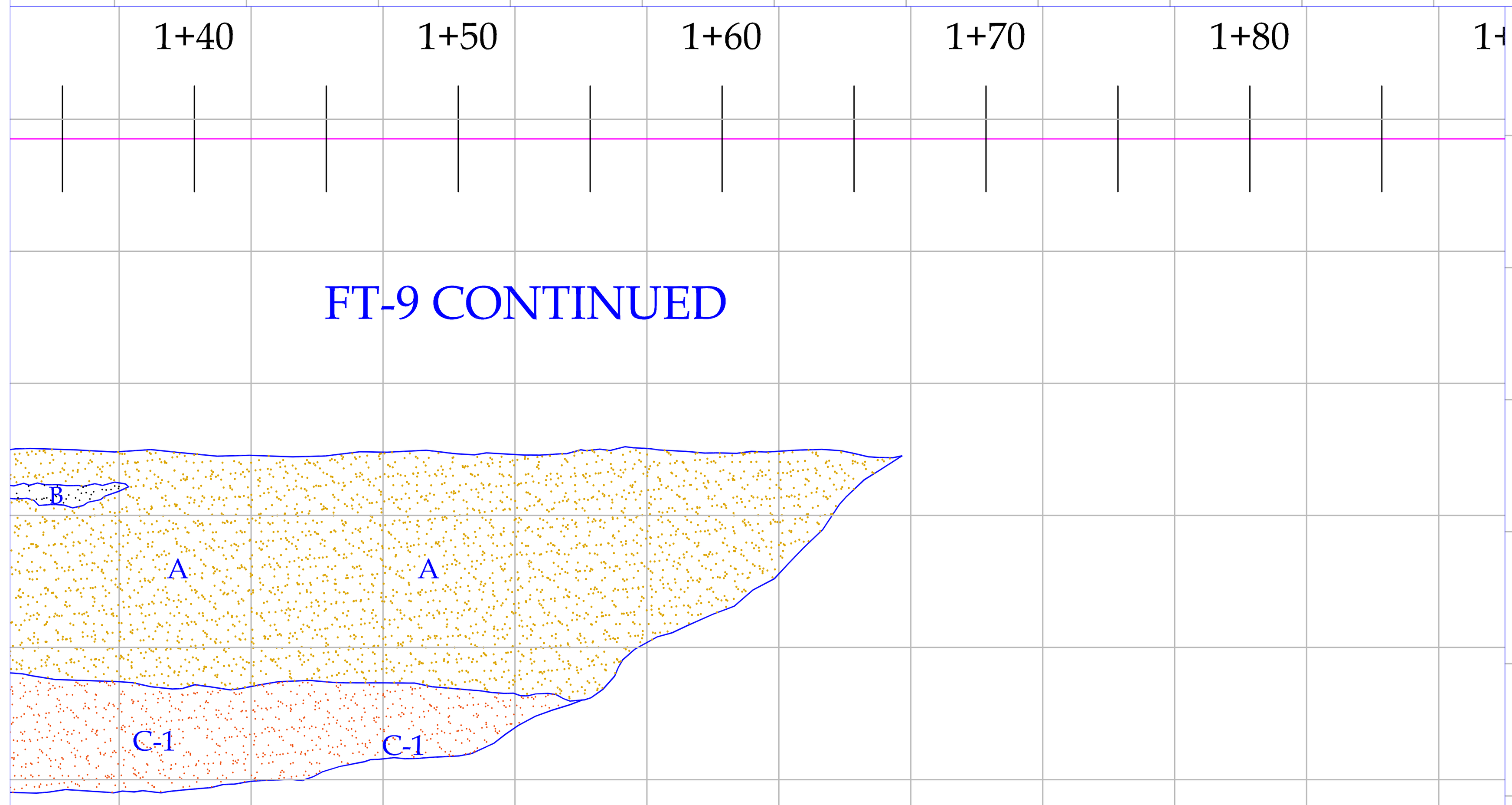
C-1 - **Clayey SAND;** brown (10YR 5/6), slightly moist, medium dense, fine to coarse sand, fine to coarse gravel, occasional cobbles 4" to 11" in diameter, translocation of clay films, clasts highly weathered in place.

Quaternary Pauba Formation:

D - **Sandstone;** light pinkish white (5YR 8/2), slightly moist to moist, moderately soft, very weathered.

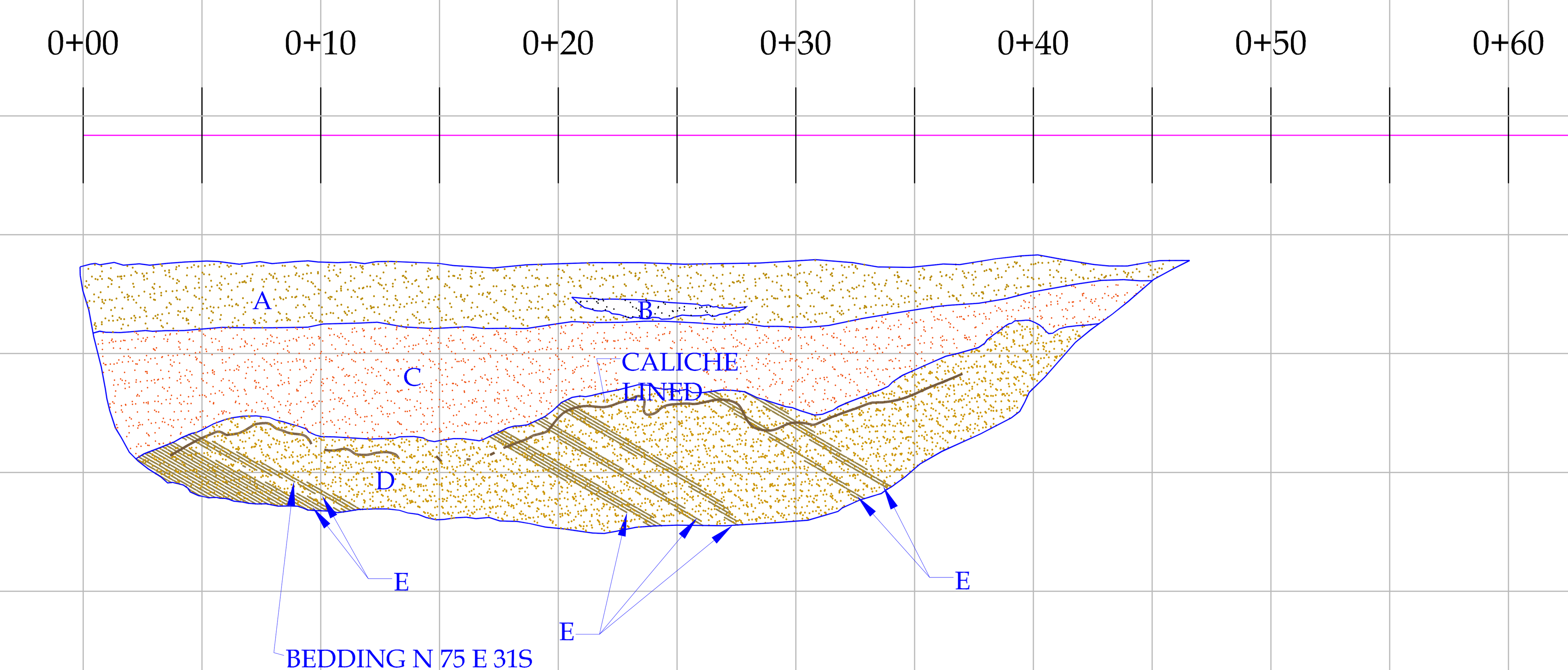
E - **Claystone;** light greenish gray (7/5G), moist, moderately soft, slightly weathered.

FT-9 CONTINUED



FT-10

TREND: N 45 E
GRAPHIC REPRESENTATION: SOUTH WALL



LEGEND
(FT-10)

Earth Units

Quaternary Alluvium:

A - **Silty SAND;** dark yellowish brown (10YR 4/2), slightly moist, loose to medium dense, fine to coarse sand, abundant rootlets, numerous scour and fill lenses ("B").

B - **SAND;** yellow dark greenish gray (GY 4/10) to pale yellow (5Y 8/2), slightly moist, soft, fine to coarse sand, fine to coarse gravel, up to 1' boulders.

Quaternary Older Alluvium:

C - **Clayey SAND;** brown (10YR 5/6), slightly moist, medium dense, fine to coarse sand, fine to coarse gravel, occasional cobbles 4" to 11" in diameter.

Quaternary Pauba Formation:

D - **Sandstone;** light pinkish white (5YR 8/2), slightly moist to moist, moderately soft to weathered.

E - **Siltstone;** brownish yellow (10YR 6/8), moist, moderately soft, slightly weathered, fine sand.

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Mark Bergmann
Principal Geologist

FAULT TRENCH LOGS
FAULT TRENCHES 9 & 10

Name:	OAK GROVE PROJECT
Project No.	I04409-10
Client:	OAK GROVE EQUITIES
Scale:	1" = 5'
Date:	May 2007
Sheet No.	
Plate No.	PLATE NO. 8 OF 8

P:\2004 Projects\I04409 Oak Grove Equities - La Estrella St. & I-15\CAD In Progress\4th revision May 2007\FT-6_7_8_9_10_rev._5_07.dwg

Structural Setback

Structural Setback

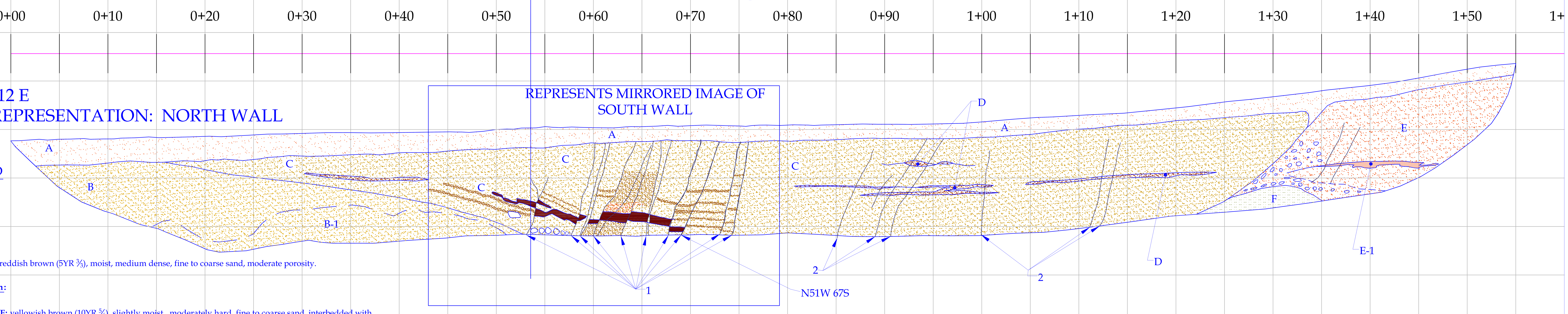
50' FAULT ZONE 50'

FT-7

BEND IN FAULT TRENCH TREND @ 0+54
TREND: N 12° E

BEND IN FAULT TRENCH TREND @ 0+54
TREND: N 30° E

TREND: N 12 E
GRAPHIC REPRESENTATION: NORTH WALL



LEGEND
(FT-7)

Earth Units

Topsoil:

A - **Clayey SAND;** dark reddish brown (5YR 3/3), moist, medium dense, fine to coarse sand, moderate porosity.

Quaternary Pauba Formation:

B - **Clayey SANDSTONE;** yellowish brown (10YR 5/6), slightly moist, moderately hard, fine to coarse sand, interbedded with Sand lenses D,

B-1 - yellowish brown (10YR 5/4), moist, moderately hard.

C - yellowish brown (10YR 5/4), slightly moist, moderately soft to moderately hard, fine to coarse sand, interbedded with sand lenses (D), poorly to slightly indurated.

D - **SANDSTONE;** reddish brown (5YR 3/4), slightly moist, soft, fine to coarse Sand with Clay, poorly indurated.

E - **Clayey SANDSTONE;** reddish brown (5YR 4/4), slightly moist, moderately hard, fine to coarse Sand, fine to coarse Gravel.

E-1 - yellowish brown (10YR 5/4), slightly moist, moderately hard, fine to medium sand.

F - **Clayey SILTSTONE;** light olive brown (2.5YR 5/3), moist, moderately hard.

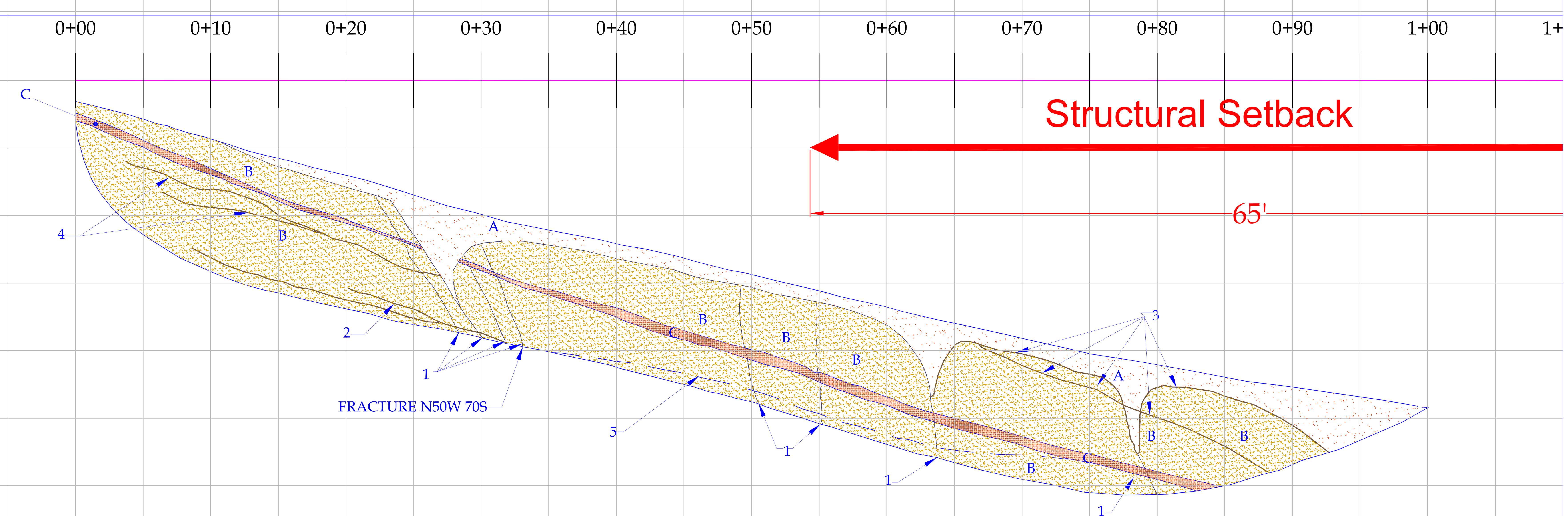
Graphic Descriptions

1 - Caliche filled Faults

2 - Caliche filled Fractures

FT-8

TREND: N 53 E
GRAPHIC REPRESENTATION: SOUTH WALL



LEGEND
(FT-8)

Earth Units

Topsoil:

A - **Clayey SAND;** dark reddish brown (5YR 3/2), moist, loose, fine to coarse sand, clay films, slight porosity.

Quaternary Pauba Formation:

B - **Clayey SANDSTONE;** yellowish brown (10YR 5/4), slightly moist, moderately hard, fine to coarse sand.

C - **Clayey SILTSTONE;** yellowish brown, slightly moist, very stiff, fine to medium sand, top of unit marked by blocky peds with high calcium carbonate concentrations.

Graphic Descriptions

1 - Caliche Filled fractures
2 - Oxidation layers
3 - Caliche rich platy silty layers
4 - Caliche rich layers
5 - Elevated moisture content

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FAULT TRENCH LOGS
FAULT TRENCHES 7 & 8

Name:	OAK GROVE PROJECT
Project No.	I04409-10
Client:	OAK GROVE EQUITIES
Scale:	1" = 5'
Date:	May 2007
Sheet No.	
Plate No.	PLATE NO. 7 OF 8

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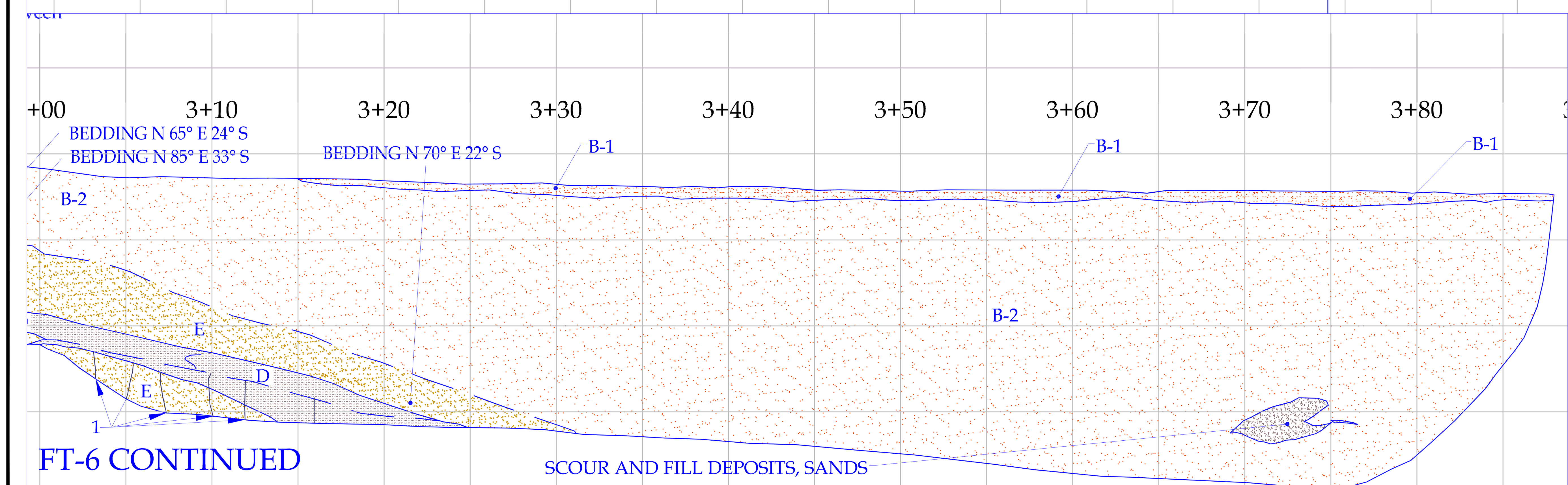

LEGEND (FT-6)

Earth Units

Topsoil:

A - **Clayey SAND**; dark reddish brown (5YR 3/4), moist, loose to medium dense, fine to coarse sand.

Quaternary Alluvium:

B-1 - **Silty SAND**; dark brown, (7.5YR 3/3), slightly moist, loose, fine to coarse sand.

B-2 - **Silty SAND**; dark brown (7.5YR 3/3), slightly moist, loose to medium dense, fine to coarse sand.

Quaternary Pauba Formation:

C - **Clayey SANDSTONE**; dark yellowish brown (10YR 4/4), slightly moist, moderately hard, fine to coarse sand, interbedded with Clayey SANDSTONE.

D - **Clayey SILTSTONE**; dark olive gray (5Y 3/2), slightly moist, moderately hard, blocky shrink / swell peds, light brownish gray (10Y 6/2).

E - **SANDSTONE**; yellowish brown (10YR 5/4), slightly moist to moist, moderately hard to hard, fine to coarse gravel, light yellowish gray (10YR 6/2).

Graphic Descriptions

1 - Tension cracks, caliche infilled
2 - Soil infilled fractures; infilled with Clayey SAND
3 - Void space, 1-3 inches wide, 6-12 inches long, Clay infilled, rootlets growing along bottom
4 - Severely weathered cobbles
5 - Oxidation along bedding
6 - SAND lenses

SYMBOLS

Boulders

Fractures, caliche infilled

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FAULT TRENCH LOGS

FAULT TRENCH 6

Name:	OAK GROVE PROJECT
Project No.	I04409-10
Client:	OAK GROVE EQUITIES
Scale:	1" = 5'
Date:	May 2007
Sheet No.	
Plate No.	PLATE NO. 6 OF 8

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FAULT TRENCH LOG
FT-5

Name:	OAK GROVE PROJECT
Project No.	I04409-10
Client:	OAK GROVE EQUITIES
Scale:	1"=5'
Date:	May 2007
Sheet No.	
Plate No.	5 OF 8

GRAPHICAL REPRESENTATION: SOUTH WALL

GRAPHICAL REPRESENTATION: SOUTH WALL

LEGEND

A - **Topsoil: Clayey SAND;** dark reddish brown, slightly moist, medium dense, moderately developed block ped structure, numerous rootlets.

B - **Pauba Formation Bedrock:** Clayey SANDSTONE; orange brown, dry, moderately hard to hard.

C - **Colluvium: Silty Clayey SAND;** reddish brown, loose to medium dense, very moist, very porous, sand lenses, trace gravel, roots, fine to medium sand, 5" diameter cobbles.

D - **Alluvium: Clayey SAND;** dry, loose to medium dense, fine to medium grained, many krotovinas.

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FAULT TRENCH LOGS

FAULT TRENCHES 3 AND 4

Name:	OAK GROVE PROJECT
Project No.	I04409-10
Client:	OAK GROVE EQUITIES
Scale:	1" = 5'
Date:	May 2007
Sheet No.	
Plate No.	PLATE NO. 4 OF 8

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LEGEND

A - **Topsoil: Clayey SAND;** dark reddish brown, slightly moist, medium dense, moderately developed block ped structure, numerous rootlets.

B - **Pauba Formation Bedrock:** Clayey SANDSTONE; orange brown, dry, moderately hard to hard.

C - **Colluvium: Silty Clayey SAND;** reddish brown, loose to medium dense, very moist, very porous, sand lenses, trace gravel, roots, fine to medium sand, 5" diameter cobbles.

D - **Alluvium: Clayey SAND;** dry, loose to medium dense, fine to medium grained, many krotovinas.

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FAULT TRENCH LOGS

FAULT TRENCH 2

Name:	OAK GROVE PROJECT
Project No.	I04409-10
Client:	OAK GROVE EQUITIES
Scale:	1" = 5'
Date:	May 2007
Sheet No.	
Plate No.	PLATE NO. 3 OF 8

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LEGEND

A - **Topsoil: Clayey SAND;** dark reddish brown, slightly moist, medium dense, moderately developed block ped structure, numerous rootlets.

B - **Pauba Formation Bedrock:** Clayey SANDSTONE; orange brown, dry, moderately hard to hard, minor caliche filled fractures were noted between stations (-30+00) to (185+00).

C - **Colluvium: Silty Clayey SAND;** reddish brown, loose to medium dense, very moist, very porous, sand lenses, trace gravel, roots, fine to medium sand, 5" diameter cobbles.

D - **Alluvium: Clayey SAND;** dry, loose to medium dense, fine to medium grained, many krotovinas.

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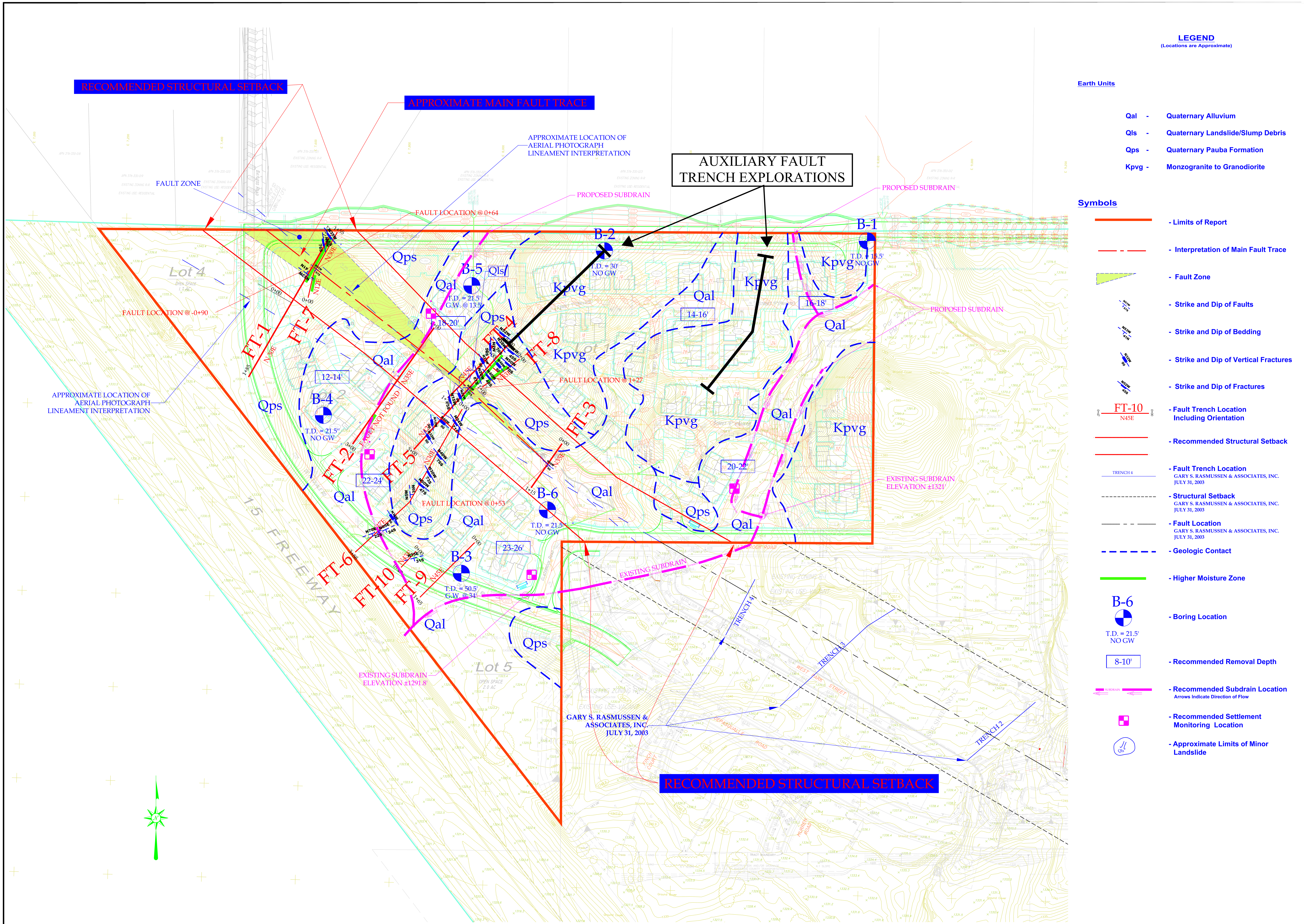
FAULT TRENCH LOGS
FAULT TRENCH 1

Name:	OAK GROVE PROJECT
Project No.	I04409-10
Client:	OAK GROVE EQUITIES
Scale:	1" = 5'
Date:	May 2007
Sheet No.	
Plate No.	PLATE NO. 2 OF 8



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FAULT MAP

WILDOMAR, RIVERSIDE COUNTY, CALIFORNIA

Name:	OAK GROVE PROJECT
Project No.	I04409-10
Client:	OAK GROVE EQUITIES
Scale:	1" = 60'
Date:	May 2007
Reference:	TTM AND TOPO PROVIDED BY MLB ENGINEERING 8/4/06
Plate No.	PLATE 1 OF 8

APPENDIX B

AGI Geotechnical Map & Trench Log Exhibits

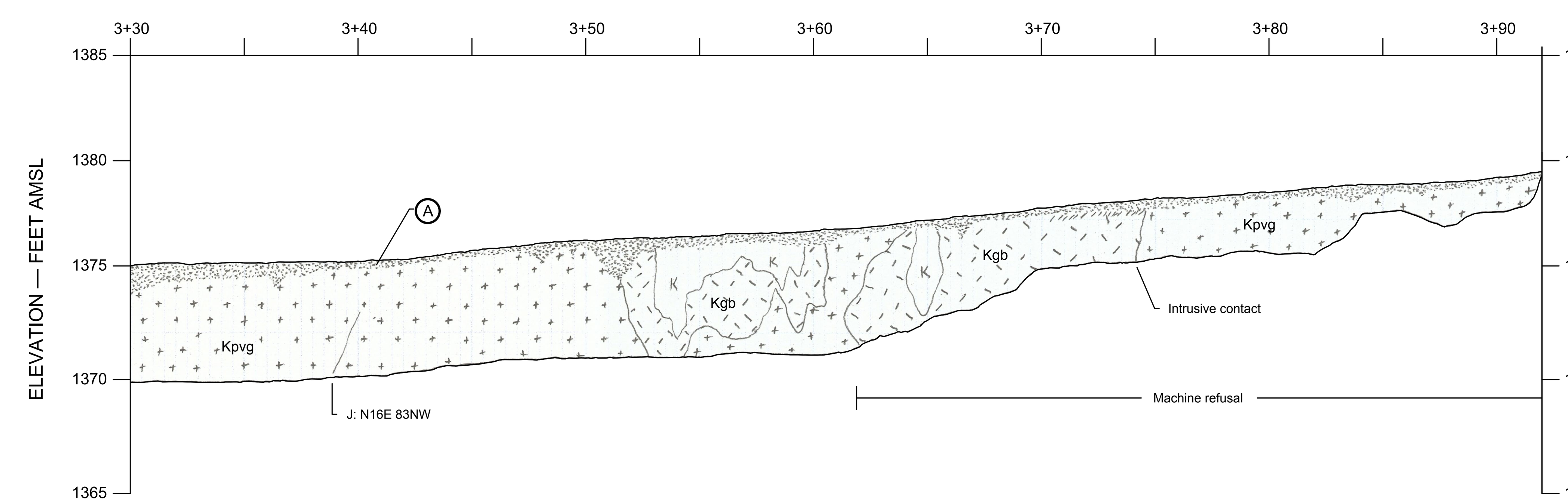
GEOTECHNICAL MAP

APN 376-410-002 & 024, CITY OF WILDOMAR, CA

PROJECT NO. 4348-SF	DATE: 2/17/17	PLATE NO. 1

Trench FT-1

View Northwest



TRENCH FT-1 KEY

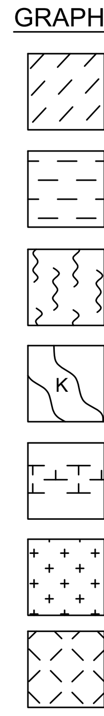
(A) Modern topsoil and colluvium: Loose to sometimes slightly cemented and medium dense silty sand, Unified Soil Classification System symbol SM. Traces of clay contributed by underlying units can be found downslope of Sta. 1+00. Unit is locally absent from fault-bounded wedges in the Wildomar sandstone, but is generally continuous elsewhere. In crystalline basement rock areas, the base of the unit is normally abrupt and ranges from fairly even and smooth to very irregular. Deeper deposits are porous and bioturbated; most soils have some visible humus and fine roots. Unit contains frequent small angular fragments of resistant vein quartz and micropegmatite dike rock, plus typical equigranular Kpvg bedrock. Disturbed by past cultivation in upper several inches. Interpreted latest Holocene and historic age.

(B) Very old alluvium and colluvium (map unit Qvoa): Massive, well-cemented fine to coarse grained yellowish brown silty sand with trace to some clay (USCS symbol SM). Prominent Bt illuvial clay and grain alteration zone near subaerial surfaces up to 18" thick, with rare vertical fissures hinting at mildly active soils capable of seasonal volumetric shrink-swell. Lacks obvious Bk horizons except for localized carbonate laminae near bounding fault at Sta. 0+62. Distinguishable from unit QTws by yellower and slightly darker color hues, and presence of hard and durable angular micropegmatite and quartz vein fragments derived from Kpvg unit, plus weathered and cleavable subangular monzogranite stones up to 9" across. Hard excavating with JD 310 backhoe. Pleistocene age.

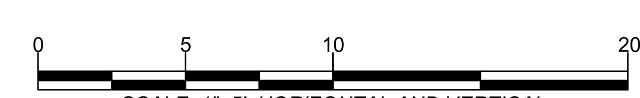
(C) Wildomar sandstone (map unit QTws): Light gray arkosic pebbly sandstone, composed of immature "gritty" fine to coarse sand particles that are usually highly weathered/altered to clay, along with common ¼"-½" granules. Sandstone is silty and poorly lithified, soft, and friable. Faint, thick bedding is defined by diffuse siltstone horizons with apparent dips to south that are slightly steeper than ground surface. Pedogenic carbonate laminae up to ½" thick occur, and were used as markers for vertical offset along faults. Near-surface zones have moderate illuvial clay enrichment and closely spaced laminar partings parallel to ground surfaces from Sta. 0+00 to 0+20. Firm excavating but no refusals.

Kpvg / Kgb Granitic basement rocks (map unit Kpvg): Consists of equigranular, non-foliated, primarily medium-grained, slightly yellowish-colored monzogranite (log symbol and graphic device "Kpvg") with variable proportions of fine-grained, gray-colored gabbro (log symbol and graphic device "Kgb"). Trench FT-1 features primarily massive-appearing monozogranite. Gabbro in FT-1 and other exploration trenches consists of commonly angular to subangular blocks as inclusions in the younger intrusive monzogranite. The blocks can range to house-sized. Intrusive contacts are sharp and appear to lack chilled margins or contact metamorphic rinds. Mixed-rock zones have been generalized on logs. Both rock classes are mostly highly weathered, with calcium feldspar in the gabbro notably altered to clay minerals. Excavatable rocks are friable and extremely weak. Refraction data indicate highly weathered conditions extend to more than 20 feet deep along trench FT-1. Joints with narrow filled apertures are mostly visible only in the upper 4-5 feet of trenches before becoming tight and imperceptible with depth. Both rock types locally host abundant shallow animal burrows (*Krotovina*), especially where relict spheroidal weathering and expansion has loosened the rock masses.

GRAPHIC DEVICES (ALL LOGS)



- Illuvial clay or clayey bedrock alteration, pattern density varies with relative proportion
- Silt or siltstone (unit QTws)
- Residual soil with columnar ped structure
- *Krotovina* (animal burrow)
- Interstitial or laminar pedogenic carbonate
- Basement rock: Palomar Valley Ring Complex monzogranite
- Basement rock: Gabbro

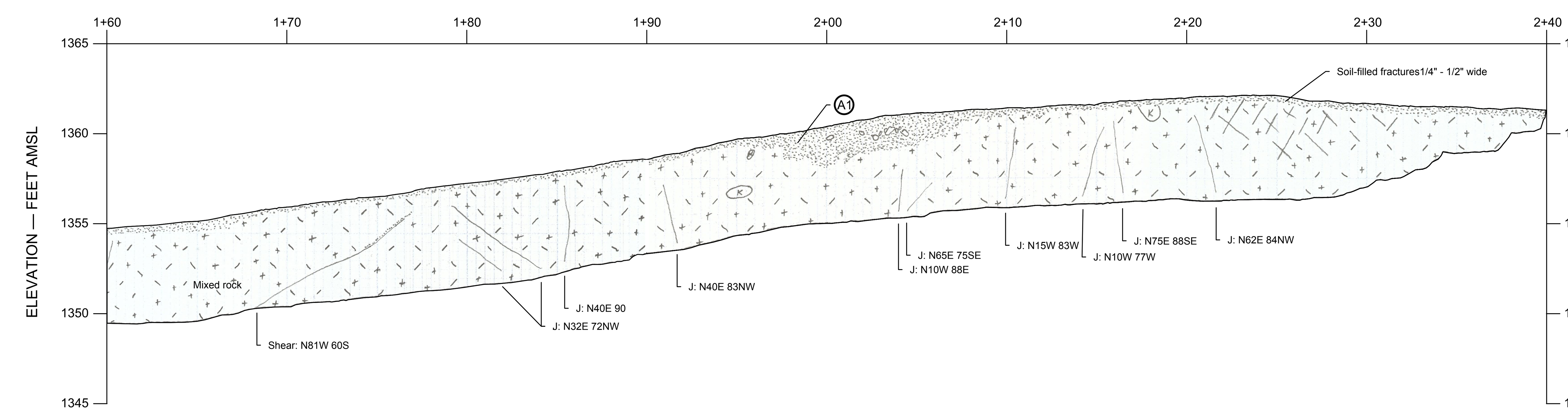


SCALE: 1"=5' HORIZONTAL AND VERTICAL

FAULT TRENCH LOG		
APN 376-410-002 & 024, CITY OF WILDOMAR, CA		
PROJECT NO. 4248-F	DATE: 2/17/17	PLATE NO. 2

Trench FT-2

View Northwest



TRENCH FT-2 KEY

(A1) Modern topsoil and colluvium: Brown, fine to coarse grained silty sand, Unified Soil Classification System symbol SM, usually with a trace of clay to impart slight dry strength. Surficial colluvium ranges from only inches thick up to about 2½ feet thick near Sta. 2+00. Unit A1 is typically massive, porous, and derived from monzogranite bedrock. Disturbed by past cultivation in upper several inches. Grades into indistinct laminar jointing near relatively sharp basement rock contacts. Interpreted latest Holocene and historic age.

(A2) Older colluvium and residual soil: Mostly classifies as fine to coarse grained reddish brown clayey sand (USCS symbol SC) with moderately well-developed blocky to columnar ped structure. Cohesive, with common root networks on desiccated ped faces. Texturally coarser than "pure" residual soil, and probably a blend of latter with monzogranite-derived colluvium. Unit A2 is preferentially found on mixed basement rocks estimated to be ~80% Kgb and 20% Kpvg. Log highlights the noticeably irregular basal contact with parent rock. Disturbed in upper few inches by past cultivation. Early Holocene (?) and Pleistocene age.

Kpvg
Kgb
Granitic basement rock. See Plate 2 for general description. Machine refusal was encountered on materials grading toward moderately weathered, low hardness, and weak. Mixed-rock labels and graphic devices indicate rock masses comprising angular to subangular stoped blocks of grayish gabbro surrounded by thinner zones of coarser-grained and light brownish-colored monzogranite. Blocks range from under 6 inches across to more than 20 feet. Sharp intrusive contacts lack chilled margins. Fractures in granitic basement rock tended to be visible only within 5 feet or so of the ground surface, becoming tight and indistinguishable (die out down) in "decomposed granite" near the trench bottom.

0 5 10 20

SCALE: 1"=5' HORIZONTAL AND VERTICAL

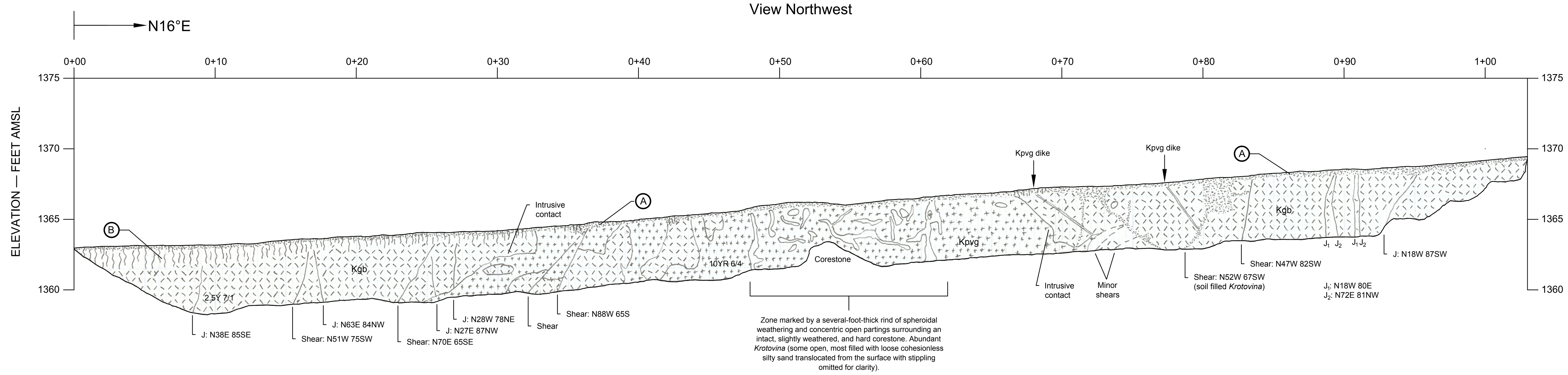
FAULT TRENCH LOG

APN 376-410-002 & 024, CITY OF WILDOMAR, CA

PROJECT NO. 4248-F	DATE: 2/17/17	**PLATE NO. 3**

Trench FT-3

View Northwest



TRENCH FT-3 KEY

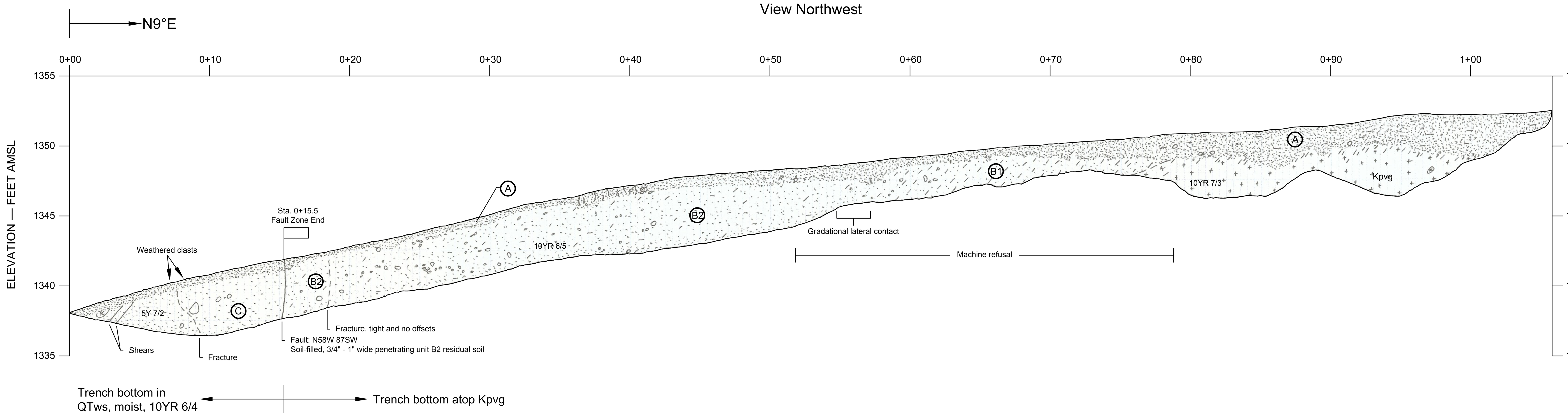
(A) Modern topsoil and colluvium: Primarily loose, brown-colored (10YR 5/3) silty sand with variable but low proportions of angular gravel and a trace of clay. Unified Soil Classification symbol SM. Horizon is typically low in cohesion, porous, and features visible organic humus and scattered fine roots. Disturbed by past cultivation in upper several inches. Derived entirely from underlying intrusive rock units. Interpreted latest Holocene and historic age.

(B) Residual soil: Clayey sand and sandy clay (in thicker zones) with slight to well-developed blocky and columnar ped structure, reddish brown color (5YR 4/4), and significant dry cohesion. Usually slightly porous. Desiccated at time of trench studies due to previous poor rainfall season. Soil is marked by irregular and sometimes indistinct lower contact that usually has a 2"-3" thick zone of laminar carbonate (and silica?) cement. Preferentially developed almost solely on gabbro, and interpreted to represent end-stage *in situ* alteration and weathering of the parent rock. Pre-Holocene age, possibly >50 ka.

Kgb / Kpvg Granitic basement rocks. See Plate 2 for general descriptions. Trench FT-3 features fewer fractures and generally more-uniform zones of the older gabbro and younger monzogranite than other exploration trenches. Units highly weathered except at the noted corestone locality.

Trench FT-4

View Northwest



TRENCH FT-4 KEY

(A) Modern topsoil and colluvium: Loose to very locally cemented, brown (10YR 5/3) to yellowish brown (10YR 5/4) silty sand, Unified Soil Classification System symbol SM. Surficial colluvium ranges from only inches thick up to about 3 feet thick near Sta. 1+00. Most colluvium northeast of Sta. 0+75 is siltier than typical, very porous, and heavily bioturbated. Unit rarely has small angular stones derived from Kpvg bedrock. Disturbed by past cultivation in upper several inches. Interpreted latest Holocene and historic age.

(B1) Subunit of very old alluvium and colluvium (map unit Qvoa): Massive fine to coarse grained clayey sand (USCS symbol SC). Near the overlying modern colluvium, the upper 8 to 10 inches usually darkens slightly and has a weak blocky ped structure. Cohesive, and not visibly porous. Desiccated at time of trench studies due to previous poor rainfall season. Subunits B1 and B2 both rest directly on well-cemented monzogranite bedrock exposed in the trench bottom. Pleistocene age.

(B2) Subunit of very old alluvium and colluvium (map unit Qvoa): Massive, cemented fine to coarse grained silty sand with trace to some clay (USCS symbol SM). Lacks obvious Bk horizons or vertical fissures that would be suggestive of active soils capable of seasonal volumetric shrink-swell. Distinguishable from unit QTws by yellower and slightly darker color hues, and presence of hard and durable angular micropegmatite and quartz vein fragments derived from Kpvg unit, plus weathered and cleavable subangular monzogranite stones up to 9" across. Clay-enriched and slightly blocky ped structure within 8-10 inches of modern colluvium (not illustrated by graphic devices). Pleistocene age.

(C) Wildomar sandstone (map unit QTws): Variegated light gray (5Y 7/2) to FeO-stained very pale brown (10YR 7/4) massive sandstone, composed of immature “gritty” fine to coarse sand particles and occasional non-local subrounded granitic clasts that are friable and highly weathered. Sandstone is poorly lithified. Weakly cemented and subhorizontal orange limonitic FeO laminae up to ¼” thick occur. Near-surface zones have moderate illuvial clay enrichment and are slightly more cohesive. Few fractures. Firm excavating. Achieved bottom was moist at time of excavation.

Kpvg Granitic basement rock. See Plate 2 for general description. Highly weathered, with secondary clay, carbonate, and possibly silica cements in upper several inches of the rock mass. Massive appearance.

0 5 10 20

SCALE: 1"=5' HORIZONTAL AND VERTICAL

AGI

FAULT TRENCH LOG

APN 376-410-002 & 024, CITY OF WILDOMAR, CA

PROJECT NO. 4248-F	DATE: 2/17/17	**PLATE NO. 4**