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

FAULT HAZARD INVESTIGATION
TENTATIVE TRACT MAP NO. 37154
APN 290-160-011
TEMESCAL VALLEY, RIVERSIDE COUNTY, CALIFORNIA

FOR
THE HIGHLANDS AT SYCAMORE CREEK, LLC
4338 PALAZZO LANE
CORONA, CALIFORNIA 92883

IN COOPERATION WITH
ADKAN ENGINEERS
6879 AIRPORT DRIVE
RIVERSIDE, CALIFORNIA 92504

PROJECT NO. 4252-F
MAY 31, 2017

16801 Van Buren Blvd., Bldg. B
Riverside, CA 92504
Tel: 951.776.0345 • **Fax:** 951.776.0395
www.aragongeo.com

May 31, 2017
Project No. 4252-F

The Highlands at Sycamore Creek, LLC
4338 Palazzo Lane
Corona, California 92883

Attention: Mr. Jorge Orozco

Subject: Fault Hazard Investigation Report
Tentative Tract Map No. 37154
APN 290-160-011
Temescal Valley, Riverside County, California.

Gentlemen:

In accordance with our proposal dated April 17, 2014 and later addenda, Aragón Geotechnical Inc. (AGI) has completed scientific and engineering assessments of earthquake fault hazard potential for the above-referenced subdivision project. Entitlement is being sought for 18 residential parcels and other remainder lots on a 31.1-acre rural-residential ranch. Mass grading is proposed for the home sites and a future street. The attached report details AGI findings, opinions, and recommendations developed as a result of surface observations, subsurface exploration, and literature research concerning the potential for surface fault rupture hazard in TTM No. 37154.

AGI's geological 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.

TTM No. 37154 is located within an official Riverside County Fault Hazard Management Zone for a mapped trace of the Glen Ivy South fault. The regulatory zone mandates that investigations be undertaken for defined projects, in order that occupancy structures not be sited astride the traces of active earthquake faults. Avoidance is the sole allowed mitigation for surface rupture risks to buildings.

Geological mapping and observations conducted in 5 exploratory fault trenches were used to locate fault traces and characterize recency of movement. The majority of the project area has remained untouched by grading; thus, natural sedimentary deposits ranging in age from historic to at least middle Pleistocene were accessible to trenching explorations. While undertaking the field studies, AGI also interpreted historical aerial imagery, reviewed published geological literature and unpublished investigation reports for adjacent residential tracts, and performed reconnaissance over broader areas of surrounding terrain to help refine structural models and assess risks. Finally, site data were integrated with the results of AGI's subsurface work on two contiguous properties that are undergoing separate entitlement actions, but are also subject to the same hazard study requirements.

Findings indicate the tract site is bisected by an active segment of the Glen Ivy South fault. Parts of the project are not suitable for homes. The accompanying report includes a site plan exhibit with a structural setback line outlining the limits of a Restricted Use Zone containing active fault traces and unexplored areas presently not slated for development. Our recommended horizontal buffer from documented active faults is 50 feet.

It is our opinion that the remainder of the site can be feasibly and safely developed for residential uses, pending in-grading geological inspections of soil exposures during mass grading. Mitigation for other geologic constraints is expected to include structural measures to mitigate the high likelihood of strong earthquake ground motions at the site, and remedial grading to counteract certain surficial 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 range from very low to 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

TABLE OF CONTENTS

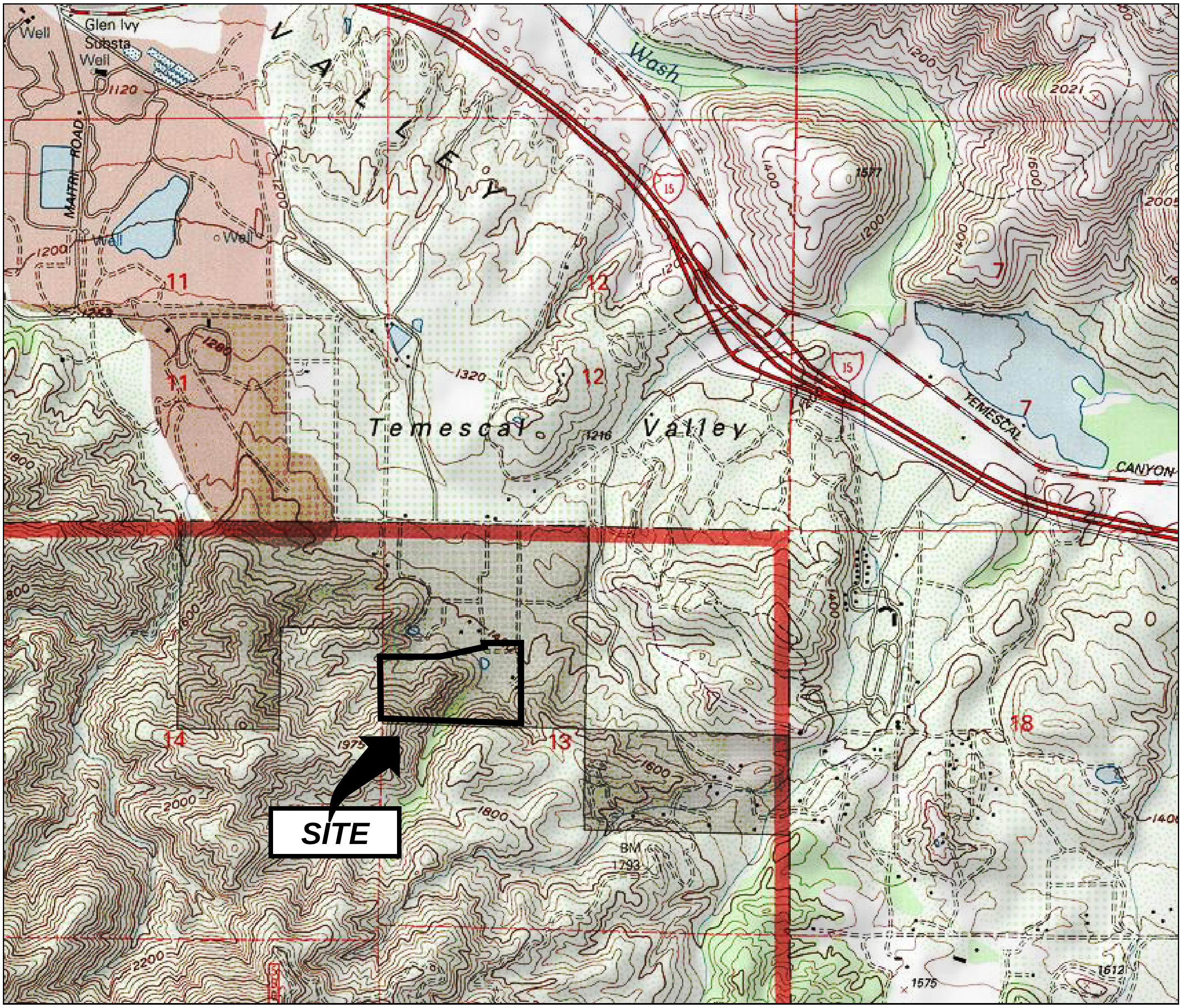
FAULT HAZARD INVESTIGATION
RIVERSIDE COUNTY TLMA REPORT REFERENCE GEO 02405
TENTATIVE TRACT MAP NO. 37154
TEMESCAL VALLEY, RIVERSIDE COUNTY, CALIFORNIA

1.0 Introduction

Aragón Geotechnical, Inc. (AGI) has completed site-specific geological and engineering assessments for a proposed 18-lot residential subdivision in the unincorporated community of Temescal Valley, Riverside County. Tentative Tract Map (TTM) entitlement actions are being sought for a single parcel identified in the Riverside County Land Information System as APN 290-160-011. The listed parcel area of 34.14 acres will be reduced slightly when lot line adjustments are completed to transfer a private road alignment into an adjacent approved tract. Geographic coordinates are 33.7370°N x 117.4632°W at the approximate geometric center of the proposed subdivision. Situs per the Public Land Survey System is the NW¼ of Section 13, Township 5 South, Range 6 West (San Bernardino Baseline and Meridian). The accompanying Site Location Map (Figure No. 1) depicts the approximate property 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 objectives were to determine the *location* and *recency of movement* of a mapped fault line through the site. 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 codes to exclude occupancy buildings from placement directly atop surface traces. AGI's investigation findings include new data that locate and characterize what is fundamentally an extension of a previously known active fault. These data should also be closely reviewed by building officials in determining suitability for future, neighboring developments by others.

Other objectives included characterizing site risks from earthquake shaking, landsliding, unsaturated soil subsidence, induced flooding, and finally liquefaction with its related ground deformation phenomena: 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, 2016a), issued under separate cover. Analyses for many



Printed from TOPO! ©2001 National Geographic Holdings (www.topo.com)

0 **2000** **4000 FT.**

N

Reference: U. S. Geological Survey 7½-Minute Series Topographic Maps, Lake Mathews and Alberhill Quadrangles (1997). Site outline is approximate.

AGI

SITE LOCATION MAP

TENTATIVE TRACT MAP NO. 37154, TEMESCAL VALLEY, CALIF.

PROJECT NO. 4252-F	DATE: 5/31/17	**FIGURE 1**

of the listed secondary site risks rely on the tools and methods of geotechnical 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.

AGI's authorized services included additional fault and geotechnical investigations for two neighboring parcels (under affiliated ownership). The opportunity to expand the geographic limits of our field studies and increase the number of explorations resulted in our development of a revised geological model for the site and surrounding parts of the Temescal Valley. The findings and recommendations for TTM No. 37154 are to a great degree interdependent on data from these sister sites:

- APN 290-160-013 and 290-160-014, consisting of a little less than 8 acres of rural-residential land next to the northern side of TTM No. 37154. Riverside County entitlements are being processed for a 18-lot subdivision, TTM No. 37027 (lot count reduction of 1 parcel after realignment of said lot to TTM No. 37154). Riverside County TLMA report reference GEO 02406.
- APN 290-150-004, encompassing 54 acres of undeveloped hilly terrain slated for limited medium-density tract development (TTM No. 37155) and conserved open space. Riverside County TLMA report reference GEO 02404.

2.0 Proposed Construction

AGI was furnished with the latest-available project civil engineer's conceptual development plans, subsequently used as a base map for AGI's Geotechnical Map, Plate No. 1 (back pocket). The subdivision will be sited in territory zoned very low density residential from previous R-R zoning per an enacted general plan amendment. The western and northern sides of APN 290-160-011 partially abut County-approved Tract No. 36317 [BGR 140071; GEO 02232], a 192-lot subdivision that is part of the Sycamore Creek Specific Plan. Construction of Tract No. 36317 had not yet started as of the completion date of this study. Access for the 18 studied homesites would be from an extension of an approved street passing through the neighboring subdivision. Two remainder lots will encompass a proposed water-quality infiltration trench, and close to 30 acres of high-relief conserved open space. The canyon and hillside terrain will remain undisturbed other than for limited trail improvements and flood control infrastructure that will include basins, access driveways, headwall/wingwall structures, and concrete storm drain pipes.

Mass grading is expected for the lots and single proposed street. Planned cuts and fills top out at around 19 feet and 21 feet, respectively. Like neighboring parts of the Sycamore Creek Specific Plan, we assume that future home construction will rely on conventional chipboard-sheathed, wood-stud balloon framing with concrete slabs-on-grade and shallow continuous strip footings. One- and two-story residential construction usually imposes only light to moderate foundation loads. Appurtenant tract features would include buried wet and dry utility infrastructure including municipal sewer hookups, and residential street improvements.

3.0 Regulatory Framework

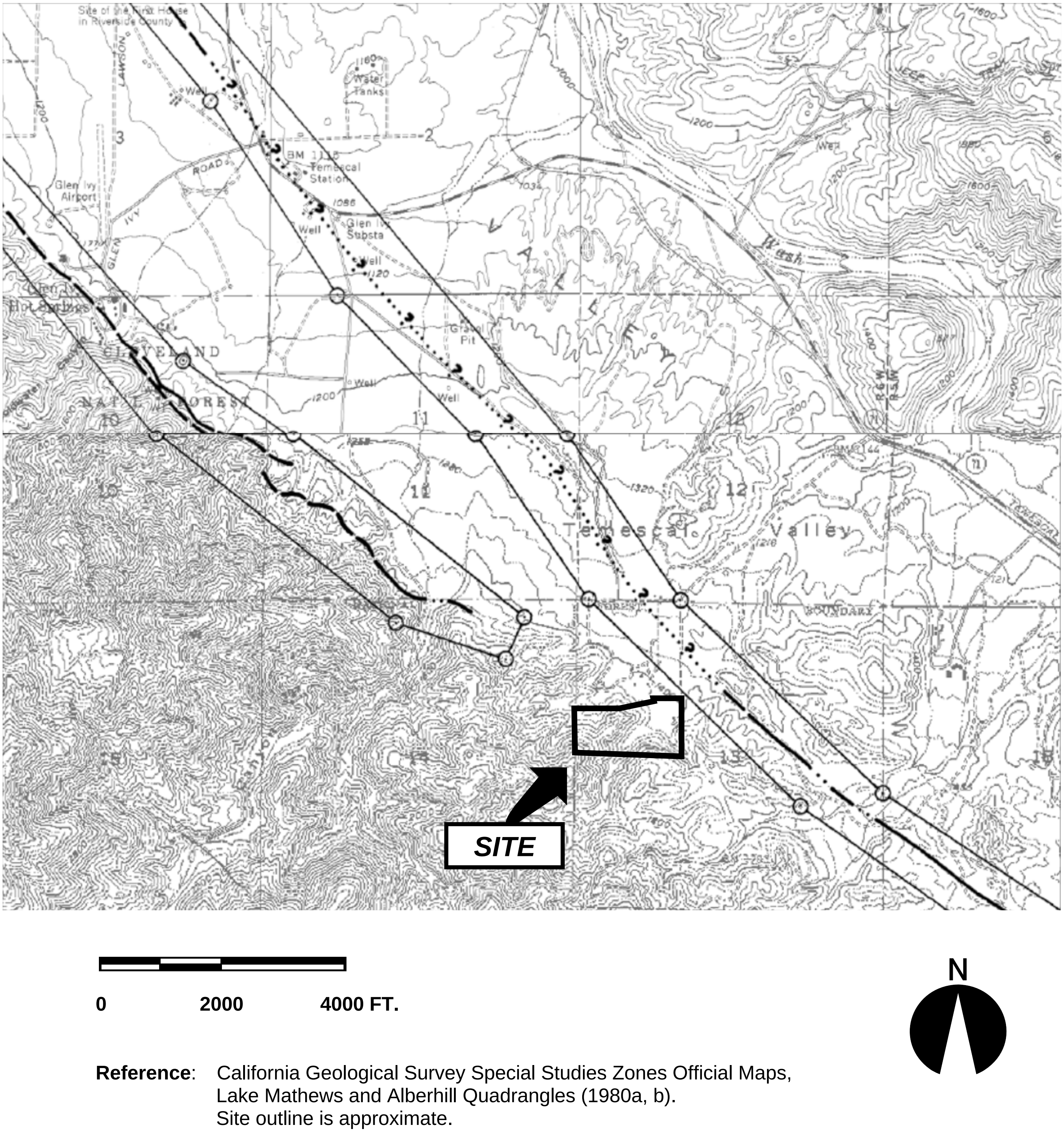
In response to severe damage to buildings and infrastructure from the 1971 Sylmar (San Fernando Valley) earthquake, the State of California enacted the 1972 Alquist-Priolo Special Studies Zones Act (PRC §2621 *et seq.*). The intent of the act was to reduce risks to people and buildings from the hazard 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 a subdivision 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.

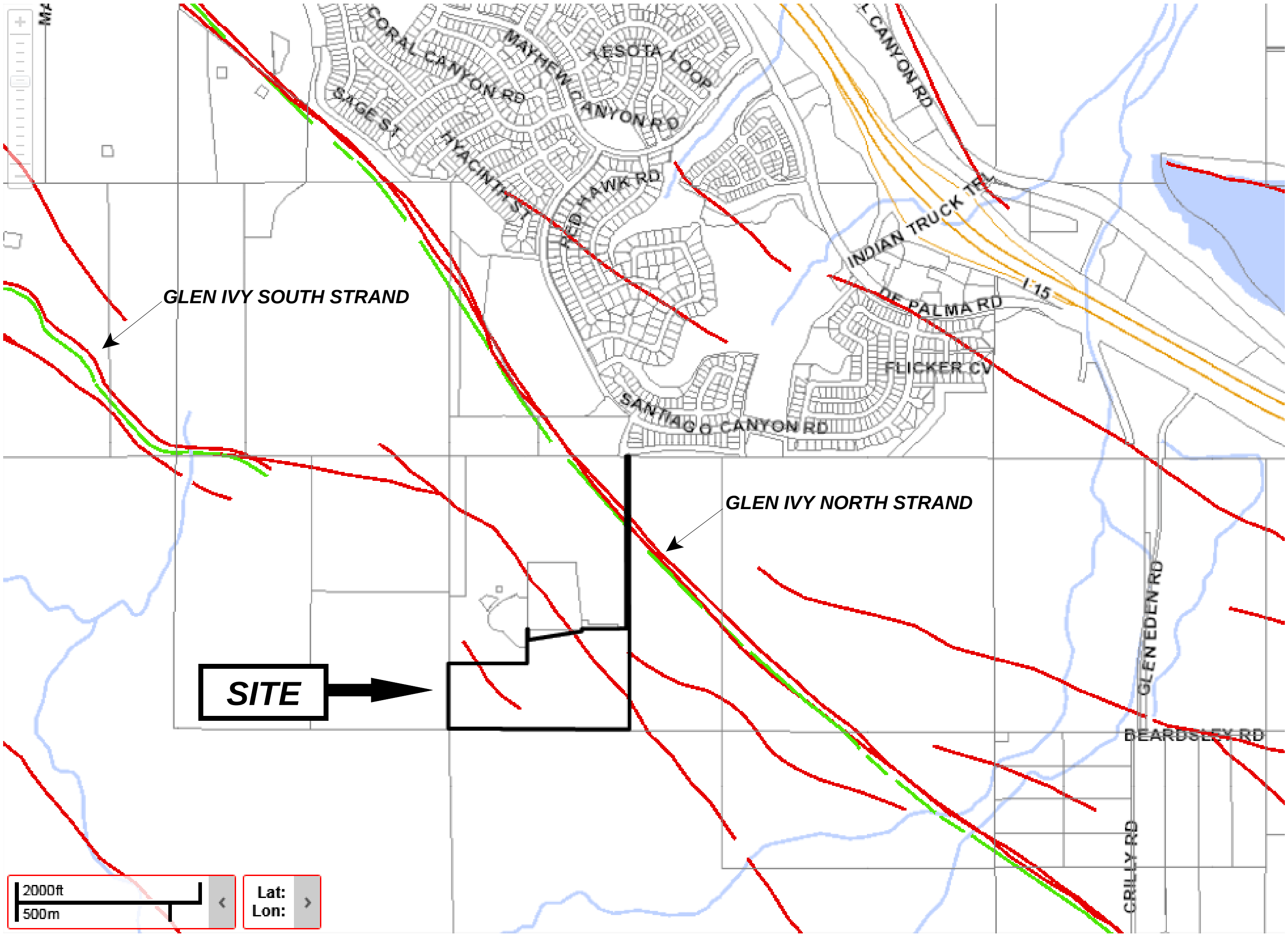
Two primary active fault strands that are segments of the 175-mile-long Elsinore fault zone pass through Temescal Valley. Weber (1977) termed the segments the Glen Ivy North and Glen Ivy South faults in the technical report used as the basis for Alquist-Priolo Earthquake Fault Zones in the valley. Curiously, the official State zones adopted in 1980 included all of the Glen Ivy North strand from Lake Elsinore to Corona, while the Glen Ivy South regulatory zone was limited to a short 2½-mile-long trace centered northeast of the mouth of Mayhew Canyon (Figure No. 2).

TTM No. 37154 is not in an official Alquist-Priolo Earthquake Fault Zone. However, it is wholly within a County Fault Zone established along the mapped southeastern extension of the Glen Ivy South fault (Figure Nos. 3 & 4, next pages). Criteria that would support a hypothesis of a fault line with recent activity within the tract site would include well-expressed geomorphic lineaments, vegetation contrasts, and juxtaposition of disparate soil and rock units.



Reference: California Geological Survey Special Studies Zones Official Maps, Lake Mathews and Alberhill Quadrangles (1980a, b). Site outline is approximate.

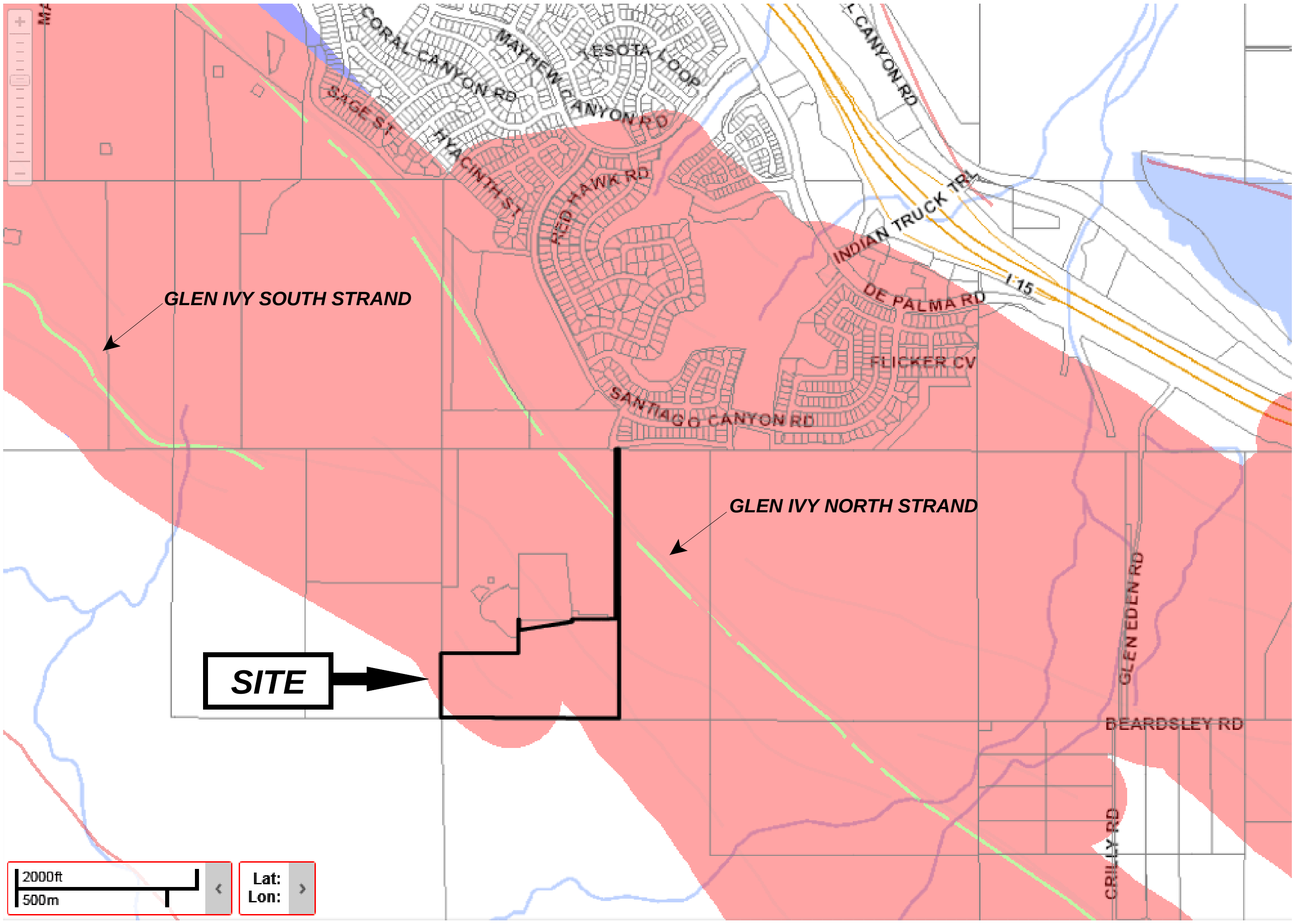
CALIFORNIA EARTHQUAKE FAULT ZONE MAP		
TENTATIVE TRACT MAP NO. 37154, TEMESCAL VALLEY, CALIF.		
PROJECT NO. 4252-F	DATE: 5/31/17	**FIGURE 2**

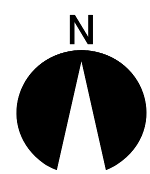


Scale as shown

Reference: Riverside County Transportation and Land Management Agency, "Map My County" utility (2017), access date 5/24/17. Active faults from official State Alquist-Priolo maps shown in yellow; Riverside County active and potentially active faults shown in red; remaining lines are parcel boundaries and stream courses.

AGI	**RIVERSIDE COUNTY FAULT TRACES MAP**		
	TENTATIVE TRACT MAP NO. 37154, TEMESCAL VALLEY, CALIF.		
	PROJECT NO. 4252-F	DATE: 5/31/17	**FIGURE 3**





Scale as shown

Reference: Riverside County Transportation and Land Management Agency, "Map My County" utility (2017), access date 5/24/17. County regulatory zones shown in red; active faults from official State Alquist-Priolo maps shown in yellow; remaining lines are parcel boundaries.

RIVERSIDE COUNTY FAULT HAZARD ZONES		
TENTATIVE TRACT MAP NO. 37154, TEMESCAL VALLEY, CALIF.		
PROJECT NO. 4252-F	DATE: 5/31/17	**FIGURE 4**

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 annual probabilities of future offset versus faults limited to only pre-Holocene 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 tract layouts, and early analyses of aerial photographs. Per County policy, an exploratory excavation permit and stormwater discharge permit were obtained with the assistance of the project civil designers at Adkan Engineers, Riverside, California. Operated equipment was supplied by the client.

Five trench excavations and a sidehill cut were excavated between December 2015 and April, 2016. Individual trenches ranged from roughly 118 to 330 feet in length, totaling approximately 888 feet. Four trenches were excavated with a Volvo EC480dl track excavator using a 5-foot-wide bucket. The sidehill cut and Trench FT-4, located in the northeast corner of the development area, were opened with a standard Case 580 rubber-tire backhoe equipped with a 3-foot bucket. New excavations were supplemented by detailed examination and logging of a pair of pre-existing bedrock cut slopes we informally referred to as "West Cut" and "East Cut". The new sidehill cut was termed "West Cut –

Section 2". Plotted fault trench and labeled cut slope locations along with other geotechnical and geologic data are presented on Plate No. 1 in the back of this report.

All of the exploratory trenches were excavated as wide, stepped cuts. Slightly irregular 5-foot bench and riser dimensions and total depths ranging between approximately 10 and 20 feet were achieved for Trenches FT-1, FT-2, FT-3, and FT-5. A 10-foot depth with narrower bench widths was typical for backhoe trench FT-4. Dry and nearly cohesionless sands in Trench FT-4 did result in localized moderate caving and raveling. Elsewhere, excavations proved stable. Some weathered bedrock proved to be quite firm digging even for the large equipment used. Groundwater was not encountered in the site trenches.

The northwest riser faces of each trench were cleaned of smeared soils with flat-blade shovels, mason's trowels, and brushes. Spot cleaning was also done on the southeastern risers in selected locations. A progressive approach of 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. The West Cut and East Cut rock slopes were manually stripped of chaparral vegetation and hand-scaled. The East Cut was also washed down using hoses and side-spray action of a standard water truck.

Trench FT-4 was conventionally logged on grid paper. Horizontal and vertical control points were established using wood hubs and a taut fiberglass tape referencing a zero-point at the western end of the trench. Level stringlines spaced 4 to 5 feet apart were placed on the bench risers for easy and efficient elevation referencing of exposed features, using a folding rod graduated in tenths and hundredths of a foot. Graphical logs were drawn at a scale of 1 inch = 5 feet to illustrate larger clasts, sedimentary structures, and faults. Most rock particles larger than about 4 to 6 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. 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.

Sediments in all trenches were visually-manually classified, based on texture and plasticity, utilizing the procedures outlined in ASTM D2487-11. The assignment of a group name to soil-stratigraphic units was performed according to the Unified Soil Classification System (ASTM D2488-09). Where appropriate, Munsell color designations were made on fresh soil samples collected at field moisture content. All logging was performed by a senior engineering geologist highly experienced in the recognition and interpretation of paleoseismic features. A scanned reproduction of the actual drawn FT-4 field log with added unit descriptive information and color data is presented on the Trench Log exhibits included in this report.

Trench FT-1 view, triple-riser benched excavation about 15 feet deep. Major horizons: Dark-colored bioturbated "topsoil" over bedded gravelly sands and silty, very moist debris flow layer (bottom riser)

Trench FT-3, quad-riser configuration, ~20 feet deep. Bottom is crystalline basement rock.

Digital photogrammetry was used to create the record logs for Trenches FT-1, FT-2, FT-3, and FT-5. The East Cut and West Cut rock slopes were also photographed to ensure data continuity was maintained across the proposed development area shown on Plate No. 1. Each printed photographic log is a *scaled, fully rectified and georeferenced orthomosaic* projected to a vertical plane aligned with the trench axis or cut slope trend. The methodology falls under the rubric of Structure from Motion (SfM) modeling. It is a calculation-intensive method. Data processing software consisted of Pix4Dmapper Pro (Ver 3.0.13, Pix4D Inc., San Francisco) operating in an Intel Core i7 4.0 GHz desktop workstation with Nvidia GTX 960 GPU support. Typical project workflow consisted of the following:

(1) Survey targets were nailed into the prepared trench or slope sidewalls by AGI and geo-located to 0.001-foot vertical and horizontal precision by Adkan Engineers.

(2) Overlapping pictures of the prepared surfaces were taken. AGI used a tripod-mounted and remotely triggered Sony α6000 24 MP digital camera with f = 16 mm and ISO 100 setting. Sixty percent overlap is the minimum required; trials found that 3X and 4X overlap produced better models. In larger trenches, for example, the final orthomosaic is based on images taken approximately every 8 feet from one of the intermediate southeast-side benches.

(3) The saved jpeg images were imported into Pix4Dmapper. Survey targets were manually located and assigned the field-measured coordinates. The program first identified matching pixels between image pairs (commonly 65,000 to 75,000 points). With known camera focal length, image sensor dimensions, and 3 or more absolutely known points in space, the program performed the trigonometric calculations needed to place matched pixels in a georeferenced 3-D point cloud model. A typical model run would take 4 to 8 hours. A dense surface mesh from the point cloud model was created and the remaining pixels were merged onto the surface. Output files would grow to as much as 1.2 gigabytes in the case of FT-3. Finally, error reports were generated and the 3-D model checked for missing data or image problems necessitating any camera re-shoots. Calculated pixel resolution of 2.8 mm per pixel and model location errors of approximately 5.5 millimeters were achieved for the final FT-3 log. Resolutions and location errors were even lower for the remaining trenches.

(4) Printed copies of trench or cut slope pictures were brought to the site and field-annotated with soil descriptions, classifications, soil and rock colors, and line work depicting stratigraphic boundaries or faults.

(5) A 2-D projected image of each 3-D surface model was created. The Trench Log plates include both the unaltered final orthomosaics and a semi-transparent version of the same images with interpretive details and the field notes added. Because there is an algorithmic “blending” of the overlapping pixel data used to create each surface model textural image, and a surprising degree of variability in printed output depending upon paper and printer settings, the color orthomosaics do not exactly match soil colors in the field. Munsell designations on the interpretive logs are based on field observations and should be relied upon. The DVD-ROM included with this report is supplied with the report plates (.pdf) and the seamless orthomosaics in tiff format for review in any photo viewing software.

Multiple site visits were arranged for trench viewing by Mr. David Jones and Mr. Dan Walsh, Riverside County Geologist and Assistant Geologist, respectively (Riverside County TLMA). AGI and County staff concurred that the completed site subsurface work appeared adequate for defining fault zone limits. Fault trench FT-4 had been added to help constrain a slight change in direction of the fault zone first detected in neighboring TTM No. 37027. Tectonic and structural implications highlighted in trenches FT-1, FT-2, and FT-4 were discussed in the field with the project lead investigator. AGI was also able to point out visible fault topography, and local evidence for unrelated mass wasting processes.

Per the County-approved exploratory grading plans, all trenches were backfilled with non-engineered fill. However, with regular water conditioning of stockpile soils and fill lifts, plus the use of a large rubber-tire loader, some degree of compaction was uniformly achieved in the wide trenches. Compaction shrinkage was noticeable in the backfills, even though organized effort was not applied. Surfaces were wheel-rolled with a front-end loader and lightly scarified with the loader bucket before receiving a hydroseed mix.

5.0 Geotechnical Investigation

Subsurface site exploration for soils engineering purposes comprised 5 exploratory soil borings drilled by AGI on April 12, 2016. Drilling was completed after backfilling of fault investigation trenches. Soil boring locations are shown on the Geotechnical Map. Site access impediments were locally posed by existing structures, fences, livestock enclosures, a man-made reservoir basin, and native oak trees. Nonetheless, AGI-selected drilling localities were considered adequate to (1) Ascertain the classifications, relative densities, possible origins, and depths of detrital soils; (2) Find the top of buried bedrock units, where reasonably achievable; (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 5 soil borings were drilled with a truck-mounted hollow-stem auger rig capable of driving and retrieving soil sample barrels. All but one boring were voluntarily terminated, at depths ranging from 20.3 to 61.5 feet. Two soil borings encountered crystalline bedrock. Relatively undisturbed samples were recovered by driving a 3.0-inch-diameter "California modified" split-barrel sampler. In the deeper portions of each drill hole, 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. 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 TTM No. 37154 prepared under separate cover (AGI, 2016a).

6.0 Site Specific Findings

6.1 Project Area Conditions

Property limits are defined by vacant, mountainous terrain to the south and west that is part of the Cleveland National Forest. To the north is a developed Temescal Valley W.D. reservoir property, portions of future Tract No. 36317, and acreage that will be retained mostly as open space south of future subdivided lots in Tentative Tract Map No. 37027. The partially fenced site is easily approached on private dirt roads extending south from developed portions of Sycamore Creek.

Existing site improvements include two residences and their related overhead electric utility services. Domestic wastewater is presumed to be treated on-site via septic tanks and absorption fields. The residences have reportedly been continuously occupied by tenants for years. Storage buildings, canopies, sheds, equestrian shelters, and similar outbuildings dot the site. There is a functional water well serving the property. Non-native trees are clustered near the homes. Native oaks and sycamores form dense groves on north-facing slopes and in the canyon bottom to the south.

The parcel encompasses varied terrain ranging from smooth, low-gradient alluvial fan areas to steep and very brushy slopes that continue rising off-site to the south into the greater Santa Ana Mountains. Even the steepest slopes are usually mantled with soil, though. A notable attribute of local terrain is the near-absence of large surface rocks or conspicuous natural rock outcroppings. On-site bedrock exposures are for the most part limited to man-made cut slopes and dozer roads. Alluvial areas generally lack surface stones larger than cobbles, although future excavations are expected to find some very large boulders. Residential development will be concentrated in the flat alluvial areas where natural gradients are mostly under 6 percent. As-built relief within the residential areas upon project completion is expected to be approximately 55 feet. Total relief in the property is roughly 495 feet, however. The approximately 30 acres of future open-space mountain slopes and canyon bottom will presumably be managed by a homeowners association or conservation district.

The tract site is a receptor of collected runoff from two canyon watersheds to the south. Calculated runoff volumes at the 1% annual probability value are reportedly over 415 cubic feet per second for the larger canyon. Steep slopes underlain by bedrock including less-fractured granitic types in the headwater regions have resulted in coarse sediment deposits. The primary canyon and channel are not classified as intermittent or permanent "blueline" stream courses. Incident rainfall moves as sheetflow runoff perpendicular to local topographic contours. Offsite, the discharges are intercepted by a newly built concrete trapezoidal channel parallel to the northern property line and ultimately directed into neighboring APN 290-150-004. Site design has changed since AGI's (2016) geotechnical investigation report, and the trapezoidal channel is proposed for removal in conjunction with residential lot development.

AGI's fault and geotechnical studies proceeded through the cool, moist conditions of a typical southern California winter. Periodic storms interrupted trenching work. Some trenches experienced unrecoverable erosion or soil wetting. Primary interpretation was always completed while exposures were fresh. Weather effects on record logs included reduced photographic contrast, introduction of distracting erosional artifacts into riser faces, and obscured views of internal structure in the site alluvial deposits.

6.2 Literature Reviews

Easily the most important published geological maps of Temescal Valley are the plates included with the technical report of Weber (1977). Weber's maps predated major urbanization, freeway construction, and the development of surface mines in the vicinity. Fine-scale geomorphic features were thus presumably still intact. The maps plotted the surface traces of the newly-named Glen Ivy North and Glen Ivy South fault strands, and provided the first interpretations of fault *activity* (Figure No. 5). The figure shows that Weber interpreted a continuous, Holocene-age fault line trending through the site and separating bedrock from various alluvial units (note circled "H 55" just north of the AGI-studied properties for TTM No. 37154 and TTM No. 37037, referencing a geological note in the technical report).

Greenwood (1992) extended Weber's Glen Ivy South fault trace to the southeast through crystalline bedrock terrain to a point near the northwestern corner of the Elsinore basin. The mapped fault line terminates at the basin alluvium. We informally refer to this fault segment as the "Glen Ivy South" fault; the U.S. Geological Survey Quaternary fault database identifies it as the Willard fault. Greenwood's bedrock fault lies directly in line with Holocene-age displacements we have documented at the northwest end of the Wildomar Fault close to Lake Elsinore (Medall, Aragón Geotechnical, 2004; Figure No. 6 and discussion in Section 6.7).

Private consultant's studies of fault hazard on properties destined to become the Sycamore Creek Specific Plan started in the late 1980's. Active strands of the Glen Ivy North fault zone were characterized in trenches. Building exclusion zones were defined. Geological and geotechnical studies of Tract No. 36317 next to TTM No. 37154 were summarized by Pacific Soils Engineering (2002) and Advanced Geotechnical Solutions (2010; 2014). The Glen Ivy South fault line was not found in Tract No. 36317. Oddly, exploratory trenches per the PSE (2002) reference seem to have stayed north of Weber's 1977 plotted fault line location at the contact between mountain bedrock and valley alluvium (ref. Figure No. 5). The latter oversight was addressed in a recent supplemental trenching study (Advanced Geotechnical Solutions, 2017), whereby a benched excavation was aligned to cross the projected fault trace west of TTM No. 37027. No fault planes were found. The trench was bottomed in materials purported to be pre-Holocene.

0 2500 5000 FT.

MAP LEGEND (Partial)

Maximum Age of Youngest Fault Offset

H Holocene

VQ Very late Quaternary (25-50 ka)

LQ Late Quaternary (500 ka)

PQ Pre-Quaternary (>2-3 million ypb)

Fault-Line Features

LC Linear canyon

LR Linear ridge

N Notch

Pa Ponded alluvium

S Scarp

Scb Beheaded stream course

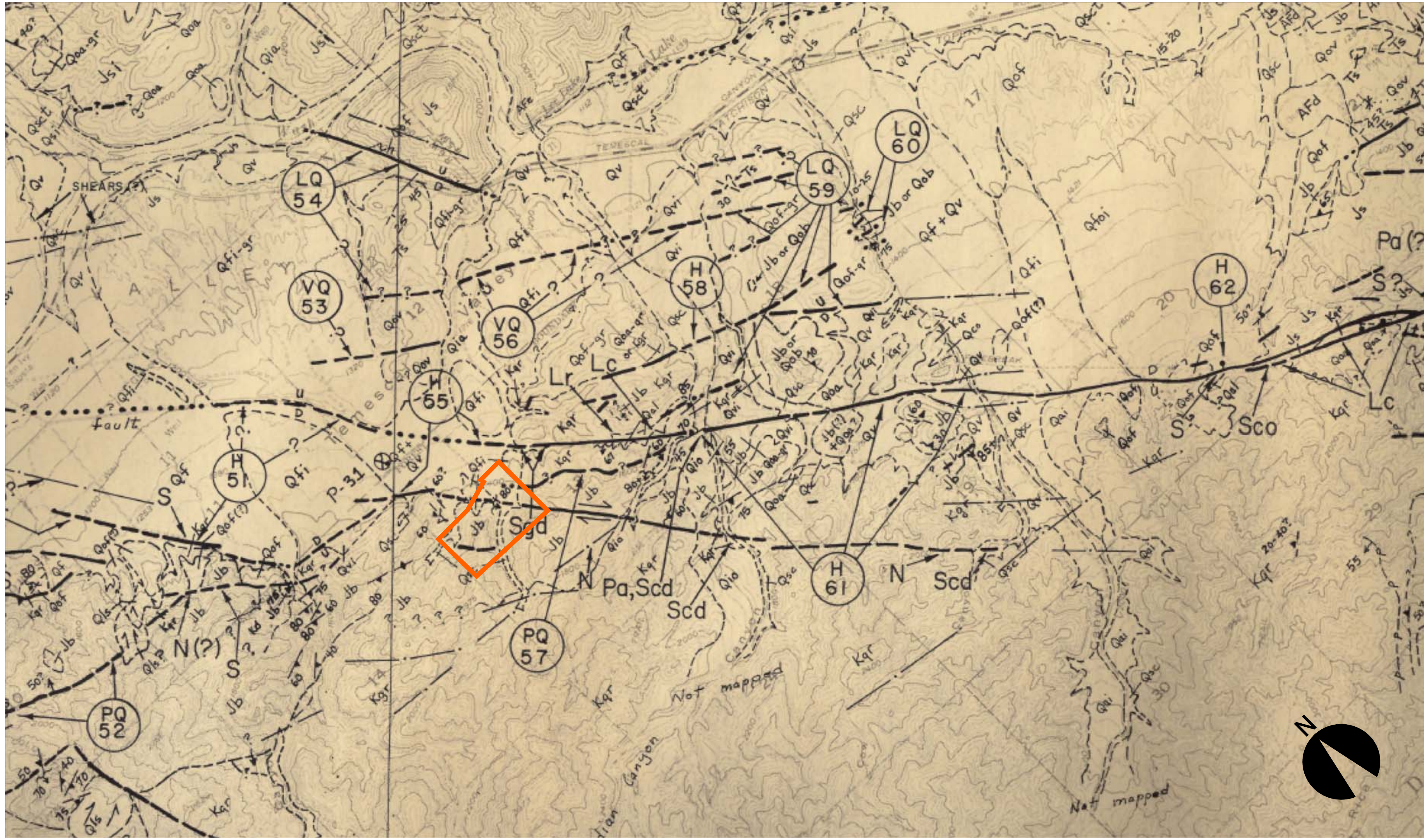
Scd Deflected stream course

Sgd Deflected gully

Scs Stream gradient steepens at fault

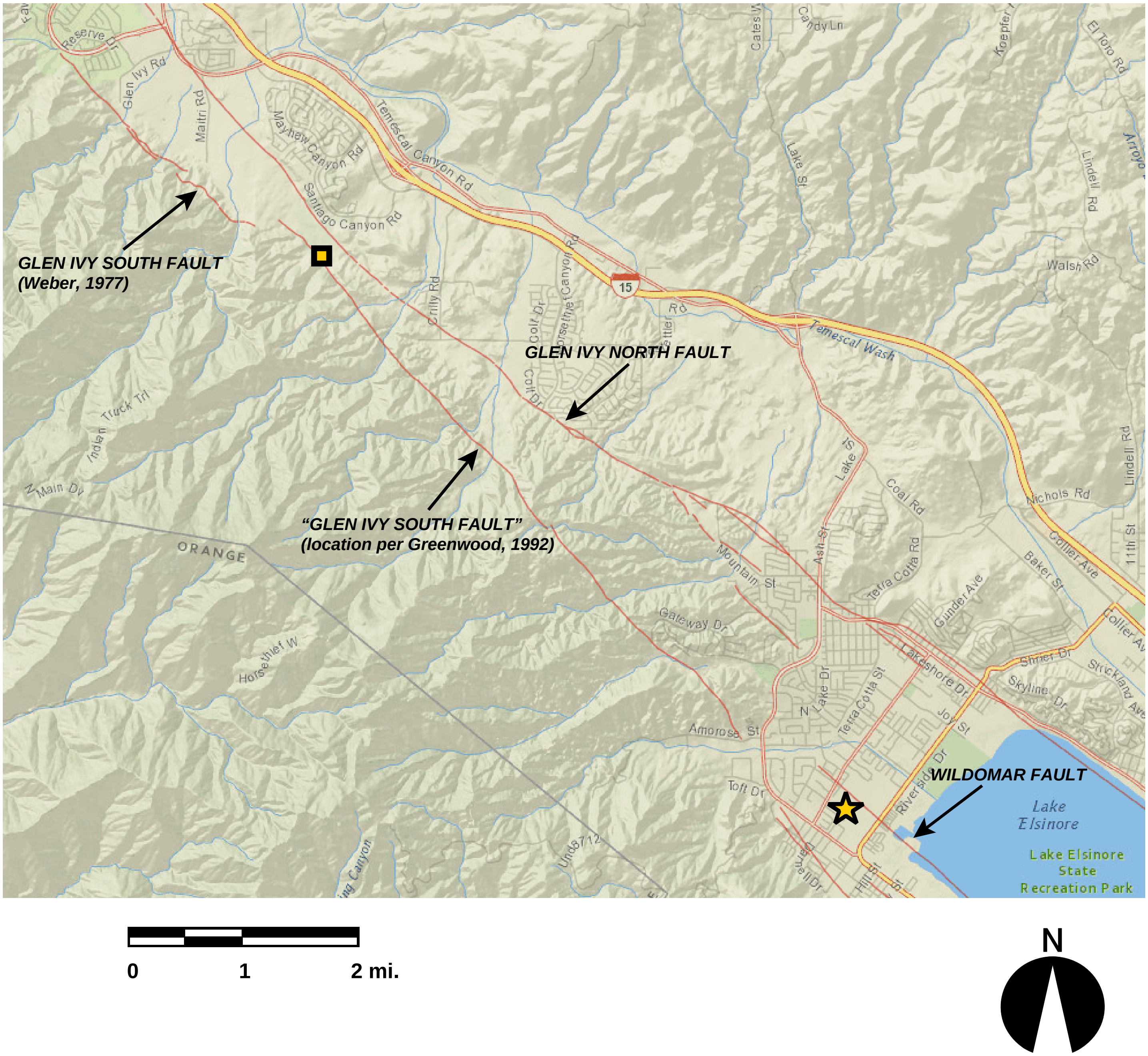
Sco Offset stream channel

Vc Vegetation or tonal lineament (Fig. 8, this report)



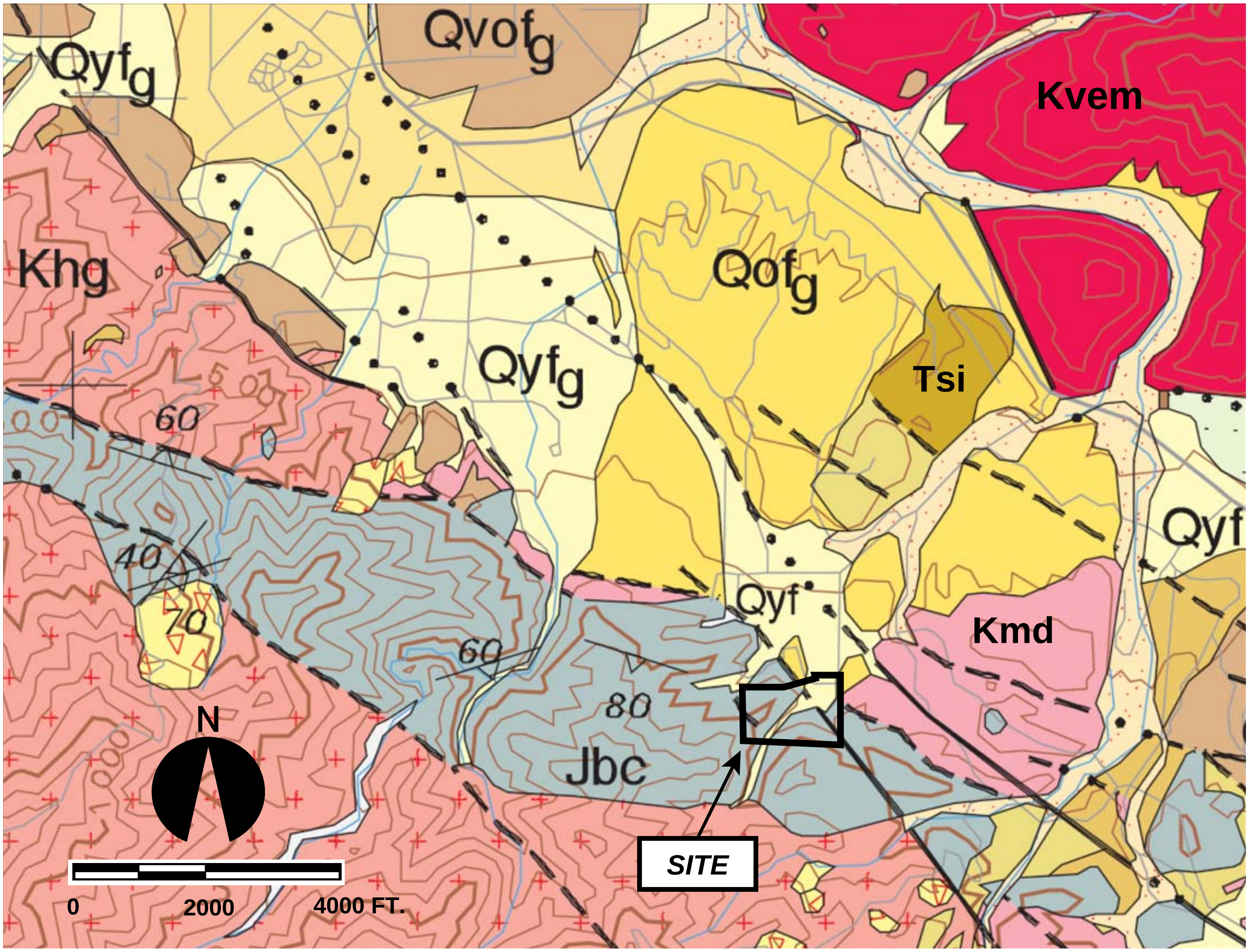
Reference: Modified after Weber (1977). Contour interval = 40 feet. Site outlined in orange (approximate).
Faults shown as heavy solid or dashed lines.
Tonal and topographic lineaments suggestive of faulting (not verified) shown as light dash-dot lines.
Scale is approximate.

TEMESCAL VALLEY FAULT MAP		
TENTATIVE TRACT MAP NO. 37154, TEMESCAL VALLEY, CALIF.		
PROJECT NO. 4252-F	DATE: 5/31/17	**FIGURE 5**



Reference: U. S. Geological Survey (2017a), shaded-relief base map with Quaternary-age faults plotted (red lines). The site is indicated by the gold square. "Glen Ivy South" fault is AGI's informally named extension of the Holocene-age Glen Ivy South strand as defined by Weber (1977), southeast of TTM No. 37154. Continuity is believed to exist between the two segments of the South strand. Activity of the "Glen Ivy South" extension is classified as <130 ka per the USGS Quaternary fault and fold database (catalog name is given as "Willard fault"). The gold star is the location of documented Holocene offset along the true trace of the Wildomar Fault (Medall, Aragón Geotechnical, 2004). The gap distance from the last known surface scarp of the Wildomar Fault near Machado St. and the southern end of the "Glen Ivy South" extension (Amorosa St. in the figure) is ~4,700 feet.

AGI	NEOTECTONIC STRUCTURES EXHIBIT		
	TENTATIVE TRACT MAP NO. 37154, TEMESCAL VALLEY, CALIF.		
	PROJECT NO. 4252-F	DATE: 5/31/17	**FIGURE 6**



Selected geologic units:

Qyf, Qyf$_g$ *Younger alluvial fan deposits [Holocene and late Pleistocene]*

Qof$_g$ *Older, gravelly alluvial fan deposits [late to middle Pleistocene]*

Tsi *Silverado Formation: Weakly lithified conglomerate, sandstone, siltstone, and clay beds [Paleocene]*

Kvem *Estelle Mountain Volcanics: Porphyritic rhyolite flows & breccia rocks [Cretaceous]*

Kmd *Unnamed monzodiorite (AGI label), possibly translocated from Paloma Valley Ring Complex [Cretaceous]*

Khg *Heterogeneous granitic rocks, primarily medium to coarse-grained tonalite near site [Cretaceous]*

Jbc *Bedford Canyon Formation: Low-grade weakly foliated argillite, impure quartzite [Jurassic]*

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

AGI	**VICINITY GEOLOGIC MAP**		
	TENTATIVE TRACT MAP NO. 37154, TEMESCAL VALLEY, CALIF.		
	PROJECT NO. 4252-F	DATE: 5/31/17	**FIGURE 7**

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 Weber's (1977) map in the Temescal Valley area, the small scale of the digital map misses details shown on the older 1977 maps and 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 previously undifferentiated granitic and metamorphic basement rocks. 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. 7.

6.3 Aerial Photographic Interpretations

Black-and-white and recent 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, 2016b). Reviewed photographs and maps are listed under "References" at the end of this report.

We have deduced that initial improvements on the site, including the two mobile home residences, were installed between 1954 and 1962. All structures were limited to the flatter northeastern corner of the property. Images from 1962 showed the developed area as cleared of brush and grasses, while mature Engelmann oaks were retained. An incised natural stream channel passed through the middle of the small ranch complex. A concrete-lined pond was already built near today's proposed residential Lots 5 and 6. To the west, a new or nearly-new and crudely built dozer road switchbacked up a mountain ridge to a series of small flat cut pads. No structures appeared to have been placed on these pads.

Between 1962 and 1984, episodic grading filled in the natural stream channel and relocated the ephemeral stream course to a present-day crude ditch located farther northwest. The "East Cut" was created on a hillside near the eastern property line. In

1984 a mobile home was present on the cut-and-fill pad, but the structure was removed within a few years. The "West Cut" may have been intended for a similar use, but grading was apparently halted before reaching completion. Most low-relief areas were divided into equestrian enclosures. The concrete-lined reservoir was almost always filled with water. The subject site was never used for agriculture, however, and the stored water was presumably used for citrus acreage in what would become the Sycamore Creek Specific Plan. It was reported to AGI that a canyon spring located some distance south of the property supplied the water via a pipeline. Citrus groves in future Tract No. 36317 north of the subject property were well-maintained and vigorous through the 1980's and 1990's.

Almost no discernable on-site changes occurred between 1984 and AGI's site investigations. Year-2005 photos showed the installation of a new Lee Lake Water District [Temescal Valley W.D.] steel reservoir adjacent to the northwestern property corner. Cut-and-fill grading was employed to lower the top of a small bedrock knob to create a tank pad and paved access road. Also around 2005, mass grading started to develop portions of the Sycamore Creek Specific Plan closer to the Interstate 15 freeway. Citrus groves next to the property were removed by 2010. The last few years have seen housing subdivisions, collector roads, and a Riverside County regional park steadily encroach toward the project site. Next to the northern property line, a concrete-lined trapezoidal diversion channel, culvert, and grouted rip-rap dissipator for floodwater and debris flows were completed in 2015. The facility is presently owned and maintained by the Riverside County Flood Control and Water Conservation District. The latest tract map plans suggest the flood control easement will be abandoned and the channel will be removed for tract lots and a street.

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, scarps, etc.), abrupt color or tonal contrasts of soil or rock, changes from incision to aggradation along stream courses crossing a fault line, and contrasts in vegetation density or species. Figure No. 8 (next page) presents our interpreted photolineaments plotted on a 400'-scale Riverside County Flood Control topographic base sheet, with notations of the features that define individual lineaments.

STRUCTURAL DOMAINS

Jbc/Khg Santa Ana Mountains domain, dominated by Bedford Canyon Formation rocks in site vicinity, but with extensive medium to coarse-grained heterogeneous granitic intrusions south and southeast of Temescal Valley.

Ŧmu/Kmd Temescal Valley/Elsinore domain, featuring older and slightly higher metamorphic grade phyllite + quartzite, and intruded bodies of quartz-poor leucocratic monzodiorite. The monzodiorite has a speculative and uncertain correlation to quartz-poor rocks in the Paloma Valley Ring Complex. The Estelle Mountain suite of shallow intrusive or extrusive igneous units is ruled out; the domain is considered to be displaced Perris Block fragments. Basement rock surficial cover includes various Tertiary sedimentary formations and Quaternary valley(?) and fan deposits.

LINEAMENTS

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

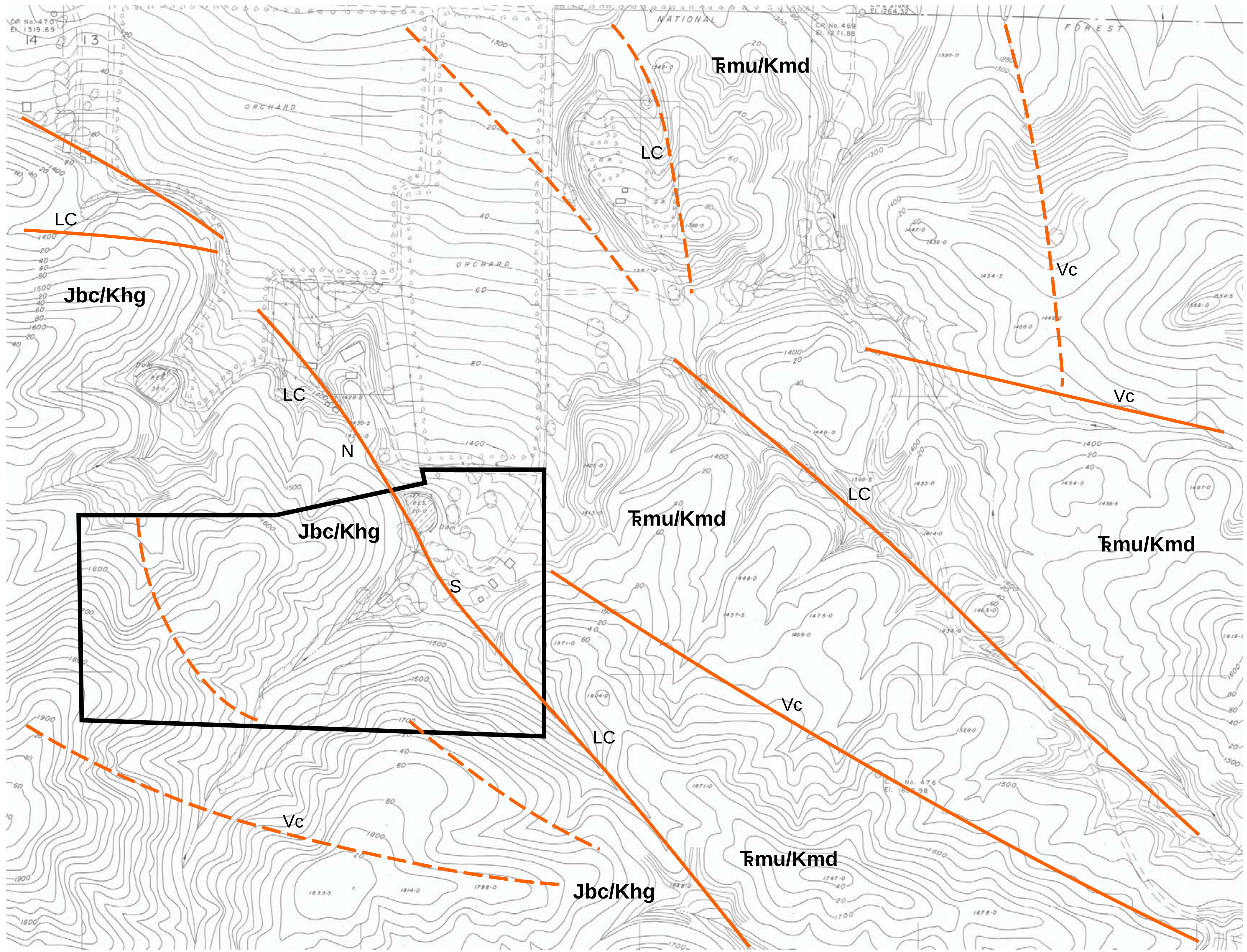
Dashed where lineament trace is less certain, often defined by only one indicator element, or is detectible in only one or two stereo-pair image sets.

Key as listed in Figure 5.

N

0 400 800 FT.

Reference: Base map clipped from Riverside County Flood Control topographic sheet, Section 13, T. 5S., R 6W (SBBM), compiled from aerial photos dated 11/22/69.
Contour interval = 4 feet.
Scale is approximate. Site boundary is approximate.



AGI

LINEAMENT INTERPRETATION MAP

TENTATIVE TRACT MAP NO. 37154, TEMESCAL VALLEY, CALIF.

PROJECT NO. 4252-F	DATE: 5/31/17	FIGURE 8

6.4 Regional Geologic Setting

The majority of western Riverside County including the Temescal Valley area 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 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. Temescal Valley 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.

6.5 Site Geologic Units

The Geotechnical Map outlines the limits of six surficial natural-soil and bedrock units plus areas of man-made fill (Plate No. 1). AGI has retained the rock and alluvial soil unit nomenclature of Morton and Miller (2006; Figure No. 7). However, we have independently arrived at several novel correlations of site units with other, differently named formation units located mostly in the Lake Elsinore region. From oldest to youngest, the mapped on-site geological units are briefly considered as follows:

Phyllite & Quartzite (₸mu, Triassic): Purplish-gray to nearly black and sometimes fissile metapelite and hard quartzite. The unit correlation is based on structural position and visual similarity to identified Triassic rocks located farther east per Morton and Miller (2006). Superficial similarity to other widely distributed dark-colored metamorphic rocks has led previous workers to lump the unit with the younger Bedford Canyon Formation. We observed many clues that the units are unrelated. The very dark and often purplish color is distinctive. The Triassic rocks are finer-grained and appear to be of slightly higher metamorphic grade. The phyllite exhibits schistosity with well-developed mica sheens on foliation partings. Off-site exposures hint at much greater internal folding than Bedford Canyon rocks. Finally, there are differences in structural orientations for foliation and fractures.

Fractured and faulted pinnacles of this unit were transected by Trench FT-4 near its west end. Even more intensely brecciated and clay-altered Triassic rocks were found in the "Section 2" appendage to the West Cut. Superposed on the unit were older fan sediments marked by strongly reddish-hued, clay-altered pedogenic horizons. Less-disrupted Triassic rock composes the majority of the East Cut and natural hillslopes near the southeastern side of APN 290-160-011.

Bedford Canyon Formation (Jbc, Jurassic): Primarily fine-grained, faintly layered or massive argillite, wacke and impure quartzite. Bedford rocks tend to various shades of brown and grayish brown. These low-grade meta-sedimentary rocks were the host rocks for younger intrusive granitic bodies in the Santa Ana Mountains. Within the parcel outlines the unit usually weathers into smooth soil-mantled slopes. Compositional layering (possibly relict primary sedimentary bedding) and sporadic foliation within the unit generally strike close to east-west, with steep southerly dips. Foliation is usually very poorly expressed and not an important contributor to plane discontinuities (partings) in rock masses. Joint sets are generally steep. Discontinuities range from planar and quite smooth closed fractures to wavy and rough joints. Near the surface the metamorphic unit is mostly moderately to highly weathered and moderately hard. Shear zones are very common, though, and broad belts of intensely fractured and soft altered rock can be traced in elevated terrain beyond the limits of Plate No. 1.

Monzodiorite (Kmd, Cretaceous): Fine- to medium-grained, speckled, and weakly foliated granitic rock. Color ranges from light brown to distinctly leucocratic and mafic-poor masses observed in Trench FT-3. Surface exposures of this unit occur in the East Cut and in subdued eroded ridges proceeding off-site to the east. Weber (1977) mapped the intrusive unit as undifferentiated intermediate granitic rocks, "Kgr". Morton and Miller (2006) correctly segregated the "Kmd" unit from much more widespread coarser-grained, more-resistant, and quartz-bearing tonalites found in the Santa Ana Mountains block to the south. The "Kmd" label has been added by AGI to Figure No. 7 based on our rock classification by estimated mineral percentages; the digital map reference in fact lacks any label or classification for this granitic unit. The digital regional map indicates the monzodiorite has a spotty distribution as distant as Old Town Lake Elsinore.

The monzodiorite is often pervasively sheared, closely to intensely fractured, soft, crumbly, and highly to extremely weathered in natural exposures or in local roadcuts such as along Indian Truck Trail. Feldspar minerals seem to be completely altered. The unit does not produce corestones (hard, unweathered residual boulders), unlike most Riverside County "granites". Soil-mantled slopes with deep ravines and a chaparral cover with species better adapted to relatively poor water retention are the typical features observed east of TTM No. 37154. Monzodiorite touches older metamorphic host rocks (unit Ŧmu) along mildly disrupted intrusive contacts. The contact zone is well-exposed in the East Cut, and in road cuts along the Indian Truck Trail motorway about a half-mile southeast of the site. The queried fault contact between granitic and metamorphic rock units mapped east of the site by Weber (1977) has been disproved by AGI as an active tectonic feature.

Older fan alluvium (Qof, middle to late Pleistocene): Older alluvium has only tiny exposures in TTM No. 37154, but is common in the neighboring parcels. Older fan alluvium also underlies Holocene-age alluvium in the site. Older alluvium is distinctively pale yellow to light yellowish brown, and often well-stratified with plane and shallow-angle cross-lamination. Detrital grains tend to be angular, "gritty" or immature particles. In adjacent TTM No. 37027 and the northern parts of proposed TTM No. 37155, cobbles and angular to subangular and highly weathered boulders up to more than 30 inches across occur singly or in thick layers or channels(?) that were found in fault trenches. Similar weathered boulders could be present on the subject site, although none were detected during AGI studies. Almost all large clasts and the surrounding silty coarse sand matrix were derived from a granitic (tonalite) source terrain. Soil profiles formed on old erosional surfaces exhibit very intense weathering and pedogenic alteration, with reddish illuvial clay horizons and subjacent strongly cemented and very cohesive zones. The entire soil profile can be more than 8 feet thick.

Older fan alluvium has erosional contacts atop both the Triassic phyllite + quartzite and the Cretaceous monzodiorite basement rock units in the area. Contacts with Bedford Canyon Formation rocks, however, are preliminarily interpreted as solely tectonic and not sedimentary. We believe the unit is far older than most mapped "Qof" deposits in the greater Temescal Valley, and like the underlying basement rocks we think these sediments have genetic affinity with map units in the Elsinore Basin.

Younger fan alluvium (Qyf, latest Pleistocene(?) and Holocene): Based on fault trench exposures and drilling data, up to roughly 22 feet of loose to medium dense and low-cohesion sediments are placed in this age range. An unconformable erosional contact separates the younger alluvium from yellowish older fan sediments. Younger fan alluvium has been derived from proximal Santa Ana Mountains bedrock sources that include Bedford Canyon Formation metamorphic rocks and tonalite.

Trenches FT-1 and FT-3 exposed stratified, mostly light grayish brown-colored sand and gravelly sand alluvium. A very silty horizon with matrix-supported hard boulders was partially penetrated in the bottom slot of FT-1. Possibly the same or slightly deeper silty layers were also found in FT-3. The layers would be interpreted as debris flow deposits. Sporadic boulders up to at least 60 inches across occurred in FT-3.

AGS (2017) encountered multiple, fining-upward sediment sequences in a fault trench northwest of TTM 37154. Basal cut-fill erosional surfaces were overlain by bedded sand and gravel capped by very silty and stratigraphically featureless layers interpreted to be mudflows. The latter were in turn reportedly partly modified into cumulic paleosols with interpreted ages of 12,000 to 35,000 years BP. It is possible that debris flow deposits in TTM 37154 could be depositional equivalents, i.e., the same events, expressed as flows from two different canyons. TTM 37154 silty layers lacked overlying pedogenic A or AO horizons, ped structure, or illuvial mineral colloids or organo-metallics in pores.

Colluvium (Qcol, Holocene): Consists mostly of locally derived and minimally transported very silty sand, silty gravelly sand, and silty gravel breccia that is porous and massive. Relatively dark colors (low-value, low-chroma colors in hues 7.5YR and 10YR) characterize colluvium. Most slope toe areas bordering the eastern side of the proposed development have 10 feet or more of colluvium present. Traces of unit Qof float (granitic rock grains) in colluvium hint at concealed Qof where dual symbols (Qcol/Qof) have been placed on the Geotechnical Map close to future TTM No. 37027.

Fill (af): Irregular man-made fills are widely scattered around the development area (some small or very thin fills have been omitted from the Geotechnical Map for clarity). Fill soils appeared to consist of either silty and gravelly sand derived from younger alluvium, or crushed metamorphic rock fragments in a silty matrix near rock slope cuts. Our interpretations are that the deepest (non-trench related) on-site fills probably do not exceed 8 feet or so. All preexisting fills are classified as undocumented fills.

6.6 Ages of Detrital Units

Ages for explored geotechnical map units encountered in the trenches and their estimated subaerial exposure time were deduced from soil profile development and other field observations. Commercially offered laboratory methods such as carbon-14 radiometric dating can result in fairly precise calendric dates, but the ^{14}C method requires suitable organic matter. Detrital carbon (charcoal) was not observed despite diligent searches. Whole-soil dates obtained from organic separates were briefly considered as an option, but were judged likely to be unreliable due to bioturbation 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.

All five site trenches encountered some thickness of recent or historic "topsoil" (O and A horizons). Modern topsoils were observed to be loose, uncemented, dry, and very porous. Parts of Trench FT-1 had some possibly historic flood deposits comprising faintly laminated silty sand up to a foot thick or so atop natural humic layers. Most photographic logs in this report highlight the peculiar disturbed, pock-marked textural attributes of topsoils and upper B-horizon soils within 3 to 10 feet of the native-ground surface. Burrowing fauna (gophers, ground squirrels, ants, and ground-dwelling bees and wasps) had acted to almost completely obliterate incipient pedogenic soil horizons. It has been estimated that bioturbation effects can completely turn-over a soil mass in the span of 200-300 years. This would be a reasonable maximum age for site surficial soils, in our opinion.

Bedded younger fan alluvium was interpreted to remain within the Holocene-epoch age range (<11,700 ybp) to minimum depths of 9 to 13 feet in trenches where this unit was encountered. Clasts remained hard and durable. Other age-diagnostic features such as clay or carbonate coatings on cobble bottoms, open partings in metamorphic clasts, and oxide stains were absent. Some reddening of color hue and textural changes hint that deeper zones might edge into the pre-Holocene epoch. However, we remain skeptical of the pedogenesis model and presumption of geomorphic stasis over enough time duration to create 12ka-35ka "cumulic" horizons in finer-grained sediments in FT-1 and FT-3.

Trenches FT-2, FT-3, and FT-5 intercepted loose to medium dense, slightly cohesive, very silty and stony colluvium (unit Qcol) derived from adjacent hillslopes. Based on the available criteria, most colluvial sediments were qualitatively interpreted as early to late Holocene materials. Colluvium remained visibly porous to the trench bottoms. Illuvial clay and carbonate-enriched zones were absent or faint. Rock fragment weathering and strength varied. Black quartzite (from unit ₮mu) was hard and nearly fresh. Other metamorphic clasts were softer and could be cut with a shovel blade.

Older fan alluvium, unit Qof, was slotted into a middle to late Pleistocene depositional age by Morton and Miller (2006). AGI (2016a; 2017) inferred from the observed degree of decomposition of boulder-size granite clasts that these materials have been in place for far longer than 11,700 years (cf. Burke and Birkeland, 1979). This detrital unit has experienced very intense and long-duration subaerial weathering. Where not removed by grading or natural erosion, strongly developed pedogenic profiles were logged in trenches.

Reddish-hued, high-chroma illuvial clay horizons had mild to moderate blocky ped structure exacerbated by several years of drought conditions. The bulk of the soil profile would usually feature massive and cohesive clayey silty sand where original bedding had been essentially completely destroyed. Parent alluvium consisted of dry, low-cohesion materials with excellent preservation of primary sedimentary structures. The entire pedogenic soil profile was sometimes measured at more than 8 feet thick. Clay-bearing profiles featured distinctive vertical cracks with downward die-out that were ascribed to cyclic shrink-swell activity. Soil development on unit Qof was judged to represent a span of at least 50,000 years and could easily date to the early Wisconsin glacial maximum (= wettest California climactic conditions) of >70,000 ybp.

6.7 Local Neotectonic Structural Evolution

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 and Miller, 2006). Conspicuous evidence for recurrent Holocene-age ruptures characterizes most strands in the zone.

The Elsinore structural basin southeast of the site owes its origin to a 1.6-mile-wide right step between three principal strands of the Elsinore Fault Zone: The paired Wildomar (or Temecula) fault plus the Willard fault zone, and the Glen Ivy North fault. 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 rates of filling by Quaternary alluvium, 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. However, northwest of Rome Hill the fault trace is apparently obscured by the lake. Weber (1977) approximately located the Wildomar fault parallel to, but several hundred feet northeast of the lake shoreline. Later, Morton and Weber (1991) and Morton (2004) retained the same approximate location. Each of these references placed a queried, concealed or putatively located on-shore extension of the trace northwest of the lake, through what would become the site of Lakeside High School.

School site studies were unsuccessful in finding active fault traces. However, an adjacent property investigated by AGI's predecessor company encountered unequivocal evidence for the fault (Medall, Aragón Geotechnical, 2004). Dramatic contrasts in groundwater surface elevations and soil properties on either side of a topographic scarp were found. The explored active fault trace had a northwesterly trend oriented about N40°W through the site, with visible surface expression from Grand Avenue to the vicinity of Machado Avenue. This trend projects almost perfectly to Greenwood's (1992) mapped bedrock fault shown on Figure No. 6. Looked at in the context of regional strain, we speculate that right-lateral strike-slip motion from the Wildomar fault is imperfectly transferred across the right-step onto the Glen Ivy North strand, and that the "Glen Ivy South" strand accommodates some fraction of the overall slip budget for the area.

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. To the southeast, it has been mapped beyond Mission Trail at the eastern City limits. The southeastern end has 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). Newer data, however, include findings of "minor" Holocene-age surface rupture at least as far as the City of Wildomar, e.g., Sections 26, 35, and 36 in T.6S, R.4W (Gary S. Rasmussen & Associates, 2003; LGC Inland Inc., 2007; AGI, 2016d). The Glen Ivy North fault continues unbroken to the vicinity of Corona.

TTM No. 37154 is perched on the side of another less-obvious but still very deep bedrock depression termed the Bedford-Coldwater Basin (proposed DWR Basin 8-10). The basin's presence suggests another active right-lateral stepover exists between the bounding Glen Ivy South and Glen Ivy North strands. Shallow basement rock occurs northeast of the Glen Ivy North fault within the Sycamore Creek Specific Plan, and as discussed earlier is also present in the subject tract map and along the mountain front toward Mayhew Canyon.

6.8 On-Site Faulting

Three out of the five exploratory trenches encountered fault offsets and related deformed unconsolidated soils. Faults and disrupted ground are depicted by several graphic devices on the Trench Logs and cut slope exhibits presented on Plates 2 through 9. Faults were demarcated based on the presence of one or more of the following features:

(1) A measurable offset of sedimentary structures.
(2) Vertical or steeply inclined traces of disturbed soil, visible on both sidewalls of the trench, with or without measurable vertical offset; rotated clasts.
(3) Open-aperture cracks.
(4) Carbonate-lined or filled fissures in unit Qof, especially if in nominally non-expansive or cohesionless sediments not part of a clayey pedogenic soil.
(5) Sudden lateral changes in soil classification, color, or clast composition.
(6) Discrete bedrock shears with gouge.
(7) Bedrock brecciation, especially with the development of oriented phacoidal broken-rock textures in broader shear zones (e.g., Trench FT-4).
(8) Changes in topsoil thickness coincident with one of the other items above.
(9) Deeply eroded and filled fissures with markedly finer- or coarser-grained fillings than the surrounding ground.

The active Glen Ivy South fault zone in TTM No. 37154 comprises a narrow "main trace" with relatively few auxiliary traces northeast of the main trace. The main trace precisely tracks an interpreted fault-related lineament picked on Figure No. 8, including correlation with an apparent scarp in Holocene-age alluvium between exploration sites FT-2 and FT-4. A colored hatch pattern has been added to the Geotechnical Map to highlight the interpreted limits of most Holocene offset. Additional imbricate bedrock faults of indeterminate rupture history are believed to be present southwest of the fault trench explorations. Some of these traces were mapped and measured in the West Cut. The alluvial scarp and main trace line up well with the principal structural boundary between dissimilar basement units found in AGI's West Cut – Section 2 exposure. Here, the Triassic-age phyllite, with its extremely weathered cover of unit Qof, has an intensely sheared and brecciated tectonic contact with Bedford Canyon rocks just west of FT-4.

Fault trench FT-1, view north at "main trace" of Glen Ivy South fault zone. Chimney-like fissure fills transect the 25-foot width of the excavation, trending almost perpendicular to apical fan stream flow direction. Noted topographic scarp continues beyond the image through a native oak grove before becoming obscured by a man-made irrigation water basin.

Rarely, cracks or disturbed textures could be traced virtually to the ground surface, within undoubted Holocene-age modern topsoil. Auxiliary faults in low-cohesion sediments typical of unit Qyf tended to be very indistinct, often consisting of little more than diffuse vertical planes of slightly silty and disturbed sand. The key findings were interruptions and warping in otherwise horizontally bedded Holocene sediments, and the presence of a fault zone topographic lineament. The trench exposures did not permit the development of a chronostratigraphic history of ruptures at the site. Nonetheless, the absolute magnitude for structural offsets of bedrock and older detrital alluvium along the zone argues for repetitive rupture events.

We think future horizontal and vertical offsets in a single event could match or exceed two to three feet, based in part on AGI fault hazard findings from next-door TTM No. 37027 and the preserved scarp height in TTM No. 37154. Total offset could be partitioned amongst multiple strands. Right-lateral oblique motion, southwest side up, is the interpreted displacement mode. Logged offsets depicted on the Trench Log plates should not be viewed as representing absolute measures of fault offset. Strike-slip components of movement cannot be determined from single trenches, but could realistically amount to a cumulative total of hundreds to even thousands(?) of feet for the Glen Ivy South fault zone at the site. Reverse throw must cumulatively exceed 1,000 feet, and might exceed 4,000 feet, based on petroleum explorations and water wells in the Bedford-Coldwater Basin.

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 Adkan Engineers, 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.

6.9 Groundwater

Geotechnical soil borings did not encounter groundwater to the maximum termination depth of 61.5 feet. All trenches were dry. AGI found no evidence for present-day or historical occurrences of rising water such as springs, seeps, or clustered phreatophytic vegetation. This was true even for mapped fault zones.

AGI was able to slip an electric water level probe into the well casing at a defunct windmill located in future Lot 17 of TTM No. 37027, or roughly 200 feet north of soil boring B-5 on Plate No. 1. Depth to water was measured at 146.7 feet from the top of casing in early May, 2016. Details of the well's construction are unknown, but we would interpret that the measured phreatic surface was far below the alluvium-bedrock contact in the area. Riverside County bedrock areas often harbor small amounts of permanent groundwater in deep fractures or joints. The depth could have been near a historical minimum, given multiple preceding drought years. No measurements were obtainable from the (sealed and operating) on-site well.

We think it is likely that average or above-average rainfall seasons result in the development of a short-lived unconfined saturated zone atop bedrock, when mountain watersheds produce copious surface runoff. Within the proposed lot and street areas, we speculate a *maximum* groundwater elevation of roughly 15 feet below ground surfaces closest to the canyon mouth, rapidly descending to somewhere near 40 feet near the northern tract boundary. Evidence for at least transient soil saturation would include iron oxide staining or limonitic spots that we in fact observed in samples from one deep soil boring. The steep bedrock gradients we interpret for the site mean that saturated zones would quickly drain once continuous inputs from surface infiltration stopped. Fluctuations in local groundwater elevations should be expected to continue indefinitely, consistent with variations in precipitation, temperature, consumptive uses, local stormwater recharge, and other factors.

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 116 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 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. 9, p. 36). 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.

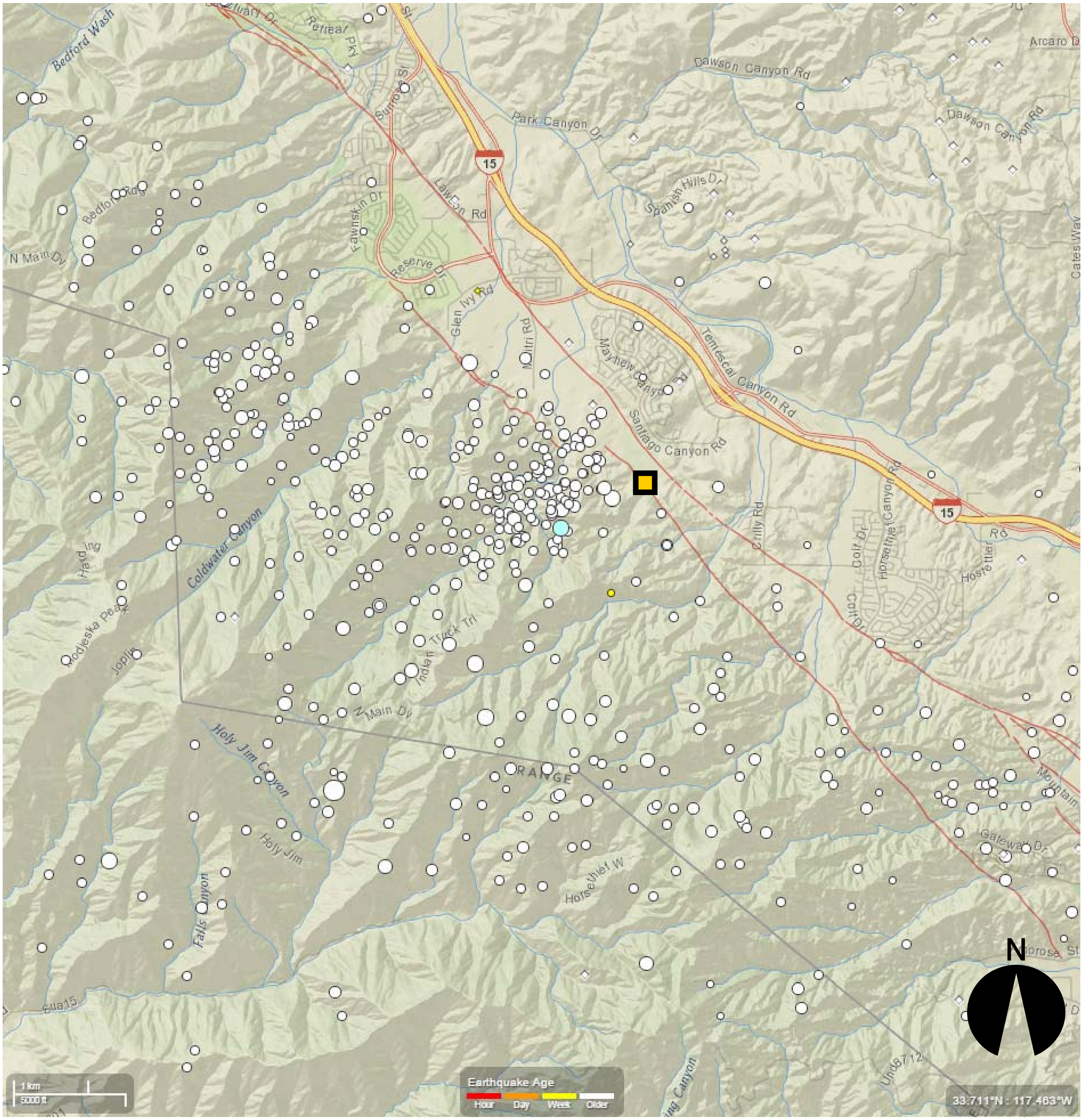
Near TTM No. 37154, instrument-detected microearthquake activity and infrequent felt shocks attributed to the Elsinore fault zone define a seismic trend located parallel to, but well south of, the Glen Ivy North and Glen Ivy South fault lines (Figure No. 10). Activity is clearly centered beneath some of the tallest relief in the Santa Ana Mountains such as Santiago Peak and Modjeska Peak. On September 2, 2007, a M4.7 earthquake with an epicenter only 3,300 feet southwest of APN 290-160-011 rattled Riverside County. No damage was reported in the area. The lateral distance and hypocentral depth (12.2 km) would match well with a projected dipping Glen Ivy South fault plane. An M4.7 earthquake would normally not be expected to produce measurable surface effects, given accepted rupture area – magnitude relationships, but trench findings in adjacent TTM No. 37027 (AGI, 2016c) hinted that some ground-crack dilation might have occurred. The mapped seismic trend likely also points to the source of the sole damaging historic earthquake ascribed to the Elsinore fault zone in California, an estimated magnitude M_L6.0 event that occurred in May 1910. No known surface rupture was associated with this event. Recent favorable historical loss experience should not be viewed as predictive of future risks.

Southern California awaits the day a truly major event of magnitude M7.0 or larger occurs in the modern urban environment. For TTM No. 37154, 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

Reference: U. S. Geological Survey (2017a) real-time earthquake epicenter map. Plotted are 116 epicenters of instrument-recorded events from 1932 to May 5, 2016, 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 Landers and Hector Mine events in the Mojave Desert north of Yucca Valley.

AGI	**SIGNIFICANT EVENT EPICENTER EXHIBIT**		
	TENTATIVE TRACT MAP NO. 37154, TEMESCAL VALLEY, CALIF.		
	PROJECT NO. 4252-F	DATE: 5/31/17	**FIGURE 9**



Reference: U. S. Geological Survey (2017a) real-time earthquake epicenter map. Plotted epicenters are all instrument-recorded events from 1932 to May 25, 2016 of local magnitude M1.0 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. Although the selected magnitude is below the level of most felt earthquakes, clustered low-energy events are also normally ascribable to active tectonic deformation. Gray-shaded epicenter = Sept. 9, 2007 M4.7 event.

AGI	NEAR-SOURCE EARTHQUAKE EPICENTER EXHIBIT		
	TENTATIVE TRACT MAP NO. 37154, TEMESCAL VALLEY, CALIF.		
	PROJECT NO. 4252-F	DATE: 5/31/17	**FIGURE 10**

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 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 15 miles from the tract 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 30 miles southwest 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, new data suggest 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)	0.3	25.8	5.0	7.55
Elsinore (Temecula)	22	40.0	5.0	7.55
San Jacinto (S.J. Valley)	37	18.5	14.0	8.15
San Joaquin Hills	25	27.5	0.6	6.65
Newport-Inglewood (offshore)	41	66.5	1.0	6.95
San Andreas (Coachella→Mojave South)	52	302	10.0 to 32.5	8.25

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 Temescal Valley area assign the highest single-source contribution to hazard from a characteristic rupture along the Glen Ivy North 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, 2016c). Seismic source models do not include the Glen Ivy South fault as an independent source, an omission we think is ripe for further research.

Version 3 of the Uniform California Earthquake Rupture Forecast (UCERF3) will be the reference fault source model for future California 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 0.49g, and 2 percent chance in 50-year exposure period of exceeding 0.92g (U.S. Geological Survey, 2016d). The reported pga values were linearly interpolated from 0.01-degree gridded data and include soil correction (NEHRP site class D; AGI local shear wave velocity estimate $V_{s30} \approx 280$ m/sec in deeper sediment areas of TTM No. 37154). 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, 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. Man-made Corona Lake located north of the tentative tract also poses zero hazard as it is much lower in elevation (Figure 1). The site is passively protected by intervening topography from flooding due to failure of the Temescal Valley W.D. tank next to the northwestern corner of the property. Accordingly, triggered flood risks are effectively zero.

Temescal Valley has not yet been mapped by the California Geological Survey for State-delineated "Zones of Required Investigation" for either landsliding or liquefaction. However, landsliding, liquefaction, and subsidence susceptibility maps have been prepared for western Riverside County as a part of the County General Plan. Local safety element maps place TTM No. 37154 in non-susceptible (bedrock) to "moderate" liquefaction potential classification zones. Many aspects of AGI's concurrent geotechnical investigation were geared to evaluating liquefaction and settlement potentials in younger fan alluvium, based on site-specific estimates of historical high groundwater and soil relative densities. Investigation findings were that site liquefaction potential was very low due to a lack of permanent shallow groundwater plus very low soil susceptibility (AGI, 2017). 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.

Estimated surface settlements from dry-sand volumetric changes were judged insignificant. Quantitative calculations in AGI (2017) suggested unsaturated soil seismic settlements after recommended remedial grading would be approximately 0.1 inches for strong motion with a 476-year mean return period. Differential settlements between opposite sides of residential structures were estimated to remain under one-quarter inch.

It is our opinion that induced landslide hazard risks (collectively deep-seated landslides, shallow earth flows, slumps, or rockfall) are low. Evidence for recent landsliding was not seen. Metamorphic bedrock in the southern hilly areas has high strength (from a soil mechanics point of view). Corestones or precarious rocks are absent. Finally, lots and homes will have substantial buffers from known areas of instability south of the limits of Plate No. 1 but discussed in AGI (2017). The developed areas will not be vulnerable to landslide or rockfall runout zones.

7.4 Temescal Valley Geological Model

AGI's work strongly confirms and expands upon the interpretations of Weber (1977) regarding structural relationships across the greater Elsinore fault zone, supported by our trenching studies, our interpreted unit correlations, and regional seismicity. The Glen Ivy South fault line (*sensu stricto*) and southward projection as the "Glen Ivy South" fault per Figure No. 6 is the major structural and lithologic divide between the main Santa Ana Mountains block and the disrupted band of early Mesozoic metasedimentary units, quartz-poor granitic intrusives, and Cenozoic sedimentary strata preserved along the Temescal Valley – Lake Elsinore topographic axis. Right-lateral and reverse, west-side-up offset is raising the Santa Ana Mountains block along a steeply inclined fault plane. The Glen Ivy

North fault strand, usually cited as the principal active strand of the Elsinore zone through the valley, does not appear to be accommodating significant vertical strain. Historical seismicity seems to be far less for the Glen Ivy North fault versus the Glen Ivy South fault, however. Data hint that the latter is actually an independent seismic source with separate hazard potential and (likely) a different offset rate than the Glen Ivy North strand.

The adjacent Bedford-Coldwater basin is tectonically subsiding relative to the mountain block and the Perris block, and probably in an absolute sense *vis-à-vis* sea level datum. Alluvial fans on the site attest to aggrading conditions. Weber (1977) reported that a wildcat petroleum exploration well spudded close to the northwestern corner of Section 13 and less than 2,000 feet from the site did not encounter basement rock (or even pre-Quaternary sediments) before reaching a terminal depth of 1,062 feet at site "P-31" on Figure No. 5. Late Quaternary and Holocene gravel deposits alone are hundreds of feet deep in nearby surface mining properties.

Near the subject site, we correlate all basement rock units located northeast of the Glen Ivy South fault lines as translocated pieces of units most commonly seen around the Elsinore basin. They are lithologically distinct from all Santa Ana Mountains structural block basement units. They are also completely unrelated to shallow-intrusive and extrusive volcanic rocks (Estelle Mountain complex) located north of Temescal Creek. It is inferred that older tectonic fault contacts exist close to the creek alignment.

The Temescal Valley trough features downdropped crustal slivers that have preserved superjacent detrital units such as the Paleocene-age Silverado Formation. Silverado strata and eroded crystalline bedrock are in turn mantled by "older alluvium" that we interpret as facies of one or more Elsinore Basin formation units. Farther north, unit "Qof" as distinguished by Morton and Miller (2006) is different in our experience, as it features locally derived Santa Ana Mountains metamorphic rock types. Pedogenic soils are less intensely developed. We interpret the northern areas as much younger. In contrast, the granitic-rock lithic fraction of "older fan alluvium" at TTM No. 37027 is remarkably similar to bedded fluvial sands of the Pleistocene-age [Irvingtonian and Rancholabrean] Pauba Formation we have explored and logged along the northwestern corner of Lake Elsinore. It is even possible, in our view, that site unit "Qof" could correlate with Pliocene sediments found in the Sedco Hills area near the southeastern corner of the lake, based on the degree of boulder clast weathering and soil development. However, soil colors and the absence of certain distinctive clast types would be significant differences. AGI's trench data and regional knowledge rule out assignment of unit "Qof" to any unit older than latest Tertiary (e.g., Williams Formation, a notably well-lithified Mesozoic-age sandstone and conglomerate unit), as was done by various consultants in early fault studies for the Sycamore Creek Specific Plan.

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 TTM No. 37154 is 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 a "Restricted Use Zone" encompassing the Glen Ivy South fault zone. The northeastern limits of the Restricted Use Zone shall constitute a structural setback line. The recommended setback line is set 50 feet laterally from the last detected active offsets logged in trenches and surveyed by the site civil engineer. It is our opinion that 50-foot setbacks will be sufficient to avoid hazard, given fault geometry, kinematic style, depth and character of alluvial basin fill, and expected site grading. Unexplored areas located southwest of completed fault trenches are lumped into the Restricted Use Zone unless and until further work is done to verify suitability. Contemporary risk management practices normally allow for private yards, 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 residential uses, from a geotechnical perspective. AGI's *Preliminary Geotechnical Investigation* should be reviewed for important earthwork and structural design information. Groundwater should not be a factor for construction or long-term performance.

Prescriptive mitigation for the hazard of strong ground motion is nominally provided by structural design adherence to local and national building codes. On January 1, 2017, statutory adoption of the 2016 California Building Code and 2016 California Residential Code was effected. AGI (2017) contains currently recommended short- and long-period design spectral accelerations for the project.

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 bedrock or older cemented fan alluvium should be checked for joints or fault planes that could impact stability. Although problems are not expected, we advise that stabilization fills could be recommended if unfavorably oriented or very close-spaced discontinuities are found.

Fault trenches were backfilled with limited compaction effort. Observation and compaction testing to create engineered backfills were outside the services scope. Based on the latest (revised) tract plans and AGI (2017), all fault trench backfills at sites FT-1, FT-2, FT-4, and FT-5 in both structural and open-space areas must be removed during future mass grading and replaced as engineered fill. AGI preliminarily accepts leaving backfill in place for the largest fault trench, FT-3, which was technically located on the neighboring property. Backfill in this trench, although permitted as a non-engineered fill, was placed with water conditioning and the casual compaction efforts of a heavy excavator and a wheel loader. FT-3 backfill is in AGI's view entirely suitable for conserved open space. Disturbed open-space areas will be allowed to revert to native chaparral. Guidelines and sample specifications for engineered fill placement are included in AGI (2017).

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 shaded 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 The Highlands at Sycamore Creek LLC and their designated parties 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 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 regulating agencies without needs for additional services outside of our authorized scope.

We are pleased to have been trusted with the opportunity to help engineer Tentative Tract No. 37154. 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.

Mark G. Doerschlag, CEG 1752
Engineering Geologist

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

MGD/CFA:mma

Attachments: Geotechnical Map, Plate No. 1
Fault Trench & Cut Slope Logs, Plate Nos. 2-9
DVD-ROM with this report in .pdf format, and orthomosaic image files.

Distribution: (4) Addressee

REFERENCES

Advanced Geotechnical Solutions, Inc, 2010, *Geotechnical Review of Tentative Tract Map 36317, Planning Area 17 (Formerly TTM 31907) and 24B, Sycamore Creek Development, County of Riverside, California:* private consultant's report dated November 17, 2010 (Report No. 1005-03-B-2; Riverside County GEO 2232, BGR 140071), 40 p. and appendices.

Advanced Geotechnical Solutions, Inc, 2014, *Geotechnical Review of Rough Grading Plan, Tract Map 36317, Sycamore Creek Development, County of Riverside, California:* private consultant's report dated April 25, 2014 (Report No. 1005-03-B-9; Riverside County GEO 2232, BGR 140071), 8 p. and appendices.

Advanced Geotechnical Solutions, Inc, 2017, *Supplemental Fault Study, Tract 36317, Sycamore Creek Development, County of Riverside, California:* private consultant's report dated January 27, 2017 (Report No. 1005-03-B-14), 21 p. and appendices.

Aragón Geotechnical, Inc., 2016a, *Preliminary Geotechnical Investigation, Tentative Tract Map No. 37027, APN 290-160-013 and 290-160-014, Temescal Valley, Riverside County, California:* private consultant's report dated August 29, 2016 (Project No. 4250-SF, Riverside County GEO 02406), 46 p. and appendices.

Aragón Geotechnical, Inc., 2016b, *Soil Infiltration Test Results & Stormwater BMP Recommendations, Tentative Tract Map No. 37027, APN 290-160-013 and Remainder Parcel 290-160-014, Temescal Valley, Riverside County, California:* private consultant's report dated May 24, 2016 (Project No. 4250-I), 8 p. and appendix.

Aragón Geotechnical, Inc., 2016c, *Earthquake Fault Hazard Investigation, Tentative Tract Map No. 37027, APN 290-160-013 and 290-160-014, Temescal Valley, Riverside County, California:* private consultant's report dated December 2, 2016 (Project No. 4250-F, Riverside County GEO 02406), 52 p.

Aragón Geotechnical, Inc., 2016d, *Earthquake Fault Hazard Investigation, Proposed Church Complex, APN 376-410-002 and 376-410-024, City of Wildomar, California:* private consultant's report (Project No. 4348-F, Riverside County GEO 02503) in pre-production.

Aragón Geotechnical, Inc., 2017, *Preliminary Geotechnical Investigation, Tentative Tract Map No. 37154, APN 290-160-011, Temescal Valley, Riverside County, California:* private consultant's report dated January 30, 2017 (Project No. 4252-SF, Riverside County GEO 02405), 51 p. and appendices.

Burke, R.M., and Birkeland, P.W., 1979, Reevaluation of multiparameter relative dating techniques and their application to the glacial sequence along the eastern escarpment of the Sierra Nevada, California: Quaternary Research, v. 11, p. 21-51.

California Department of Conservation, California Geological Survey, 2008, *Guidelines for Evaluation and Mitigation of Seismic Hazards in California:* CGS Special Publication 117 [Rev. September 11, 2008], online version at Internet URL http://www.consrv.ca.gov/dmg/pubs/sp/117.htm

California Department of Conservation, California Geological Survey, 1980, Official Earthquake Fault Zone Maps of California, Alberhill Quadrangle and Lake Mathews Quadrangle, download versions at Internet URL http://www.quake.ca.gov/gmaps/ap/ap_maps.htm

California Department of Conservation, California Geological Survey, 2002, Note 49, *Guidelines for Evaluating the Hazard of Surface Fault Rupture*, 4 p., Internet URL http://www.conservation.ca.gov/cgs/information/publications/cgs_notes/note_49/Documents/note_49.pdf

California Department of Conservation, California Geological Survey, 2007 (Interim Revision), Note 42, *Fault-Rupture Hazard Zones in California*, 42 p., Internet URL ftp://ftp.consrv.ca.gov/pub/dmg/pubs/sp/Sp42.pdf

County of Riverside Transportation and Land Management Agency, 2000, *Technical Guidelines for Review of Geotechnical and Geologic Reports*: 63 p.

County of Riverside Transportation and Land Management Agency, 2016, Map My County utility, Internet URL http://mmc.rivcoit.org/MMC_Public/Custom/disclaimer/Default.htm

EERI Clearinghouse, 2016, South Napa, USA Earthquake Clearinghouse, Internet URL http://www.eqclearinghouse.org/2014-08-24-south-napa/

Field, E.H., and 2014 Working Group on California Earthquake Probabilities, 2015, UCERF3: A new earthquake forecast for California's complex fault system: U.S. Geological Survey 2015–3009, 6 p., http://dx.doi.org/10.3133/fs20153009

Freeman, S.T., Heath, E.G., Guptill, P.D., and Waggoner, J.T., 1992, Seismic hazard assessment, Newport-Inglewood fault zone, in Pipkin, B.W., and Proctor, R.J., (eds.), Engineering Geology Practice in Southern California: Association of Engineering Geologists Special Publication No. 4, p. 211-231.

Gary S. Rasmussen & Associates, Inc, 2003, *Subsurface Engineering Geology Investigation, Tentative Tract No. 30155, Wildomar Area, Riverside County, California:* private consultant's report dated July 31, 2003 (Project No. 3455), 25 p. and appendices.

Grant, L.B., Gath, E., Munro, R., and Roquemore, R., 1997, Neotectonic and earthquake potential of the San Joaquin Hills, Orange County, California: Seismological Research Letters, v. 68, no. 2, p. 315.

Grant, L.B., Mueller, K.J., Gath, E.M., Cheng, H., Edwards, R.L., Munro, R., and Kennedy, G.L., 1999, Late Quaternary uplift and earthquake potential of the San Joaquin Hills, southern Los Angeles Basin, California: Geology, v. 27, p. 1031-1034.

Greenwood, R.B., 1992, Geologic map of the Alberhill 7½' quadrangle: California Department of Conservation, Division of Mines and Geology Open-File Report 92-10, scale 1:24,000.

Hull, A.G., 1990, Quaternary basin faulting and basin evolution in the northern Elsinore fault zone, California: GSA Abstract with Programs, v. 22, no. 3, p. 30.

Kennedy, M.P., 1977, Recency and character of faulting along the Elsinore fault zone in southern Riverside County, California: California Division of Mines and Geology Special Report 131, 12 p.

Knecht, A.A., 1971, *Soil Survey of Western Riverside County, California:* U.S. Department of Agriculture, Soil Conservation Service, Washington, D.C., 157 p.

LGC Inland, Inc., 2007, *Geotechnical Fault Investigation Report 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:* private consultant's report dated May 18, 2007 (Project No. 042409-10), 11 p. and appendices.

Matti, J.C., Morton, D.M., and Cox, B.F., 1985, Distribution and geologic relations of fault systems in the vicinity of the central Transverse Ranges, southern California: U.S. Geological Survey Open File Report OFR 85-365.

McCalpin, J.P. (Ed.), 1996, *Paleoseismology*, Academic Press, San Diego, California.

Medall, Aragón Geotechnical, Inc, 2004, *Preliminary Geotechnical & Geologic Hazards Investigation, Ulla Lane Parcels, City of Lake Elsinore, California:* private consultant's report dated September 24, 2004 (Project No. 3858-SFL), 47 p. and appendices.

Morton, D.M., 2004, Preliminary digital geologic map of the Santa Ana 30'x60' quadrangle, southern California (ver. 2.0): U.S. Geological Survey Open-File Report 99-172, scale 1:100,000.

Morton, D.M., and Miller, F.K., 2006, Geologic map of the San Bernardino and Santa Ana 30' x 60' quadrangles, California [ver. 1.0], U.S. Geological Survey Open File Report 2006-1217, scale 1:100,000.

Morton D.M., and Weber, F.H., Jr., 1991, Geologic map of the Elsinore quadrangle, southern California: U.S. Geological Survey Open File Report 90-700, scale 1:24,000.

Munsell Color, 2009, Munsell Soil-Color Charts, 2013 edition.

Natural Resources Conservation Service, 2016, Web Soil Survey utility, accessed 5/20/16 from Internet URL http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm

Petersen, Mark D., Frankel, Arthur D., Harmsen, Stephen C., Mueller, Charles S., Haller, Kathleen M., Wheeler, Russell L., Wesson, Robert L., Zeng, Yuehua, Boyd, Oliver S., Perkins, David M., Luco, Nicolas, Field, Edward H., Wills, Chris J., and Rukstales, Kenneth S., 2008, *Documentation for the 2008 Update of the United States National Seismic Hazard Maps:* U.S. Geological Survey Open-File Report 2008–1128, 61 p.

Pacific Soils Engineering, Inc., 2002, *Alquist-Priolo Earthquake Fault Zone Investigation, Planning Area 17 and Environs, Southwest Part of the Sycamore Creek Specific Plan, West of Indian Truck Trail Road, Glen Ivy Area, County of Riverside, California:* private consultant's report dated June 28, 2002 (Work Order 500550).

Shlemon, R.J., and Ginter, D.H., 2001, The location and relative activity of Elsinore fault zone splays, south shore of Lake Elsinore, Riverside County, California: GSA Abstracts with Programs, v. 33, no. 3, p. 78.

Sieh, K., and Matti, J.C., 1992, The San Andreas fault system between Palm Springs and Palmdale, southeastern California: field-trip guidebook: *in* Sieh, K., and Matti, J.C. (eds.), *Earthquake Geology San Andreas Fault System, Palm Springs to Palmdale:* Association of Engineering Geologists, 35th Annual Meeting Guidebook and Reprint Volume, p. 1-12.

Sieh, K, and Yule, D., 1997, Neotectonic and paleoseismic investigation of the San Andreas fault system, San Gorgonio Pass: Progress report to Southern California Earthquake Center, 4 p.

Sieh, K., and Yule, D., 1998, Neotectonic and paleoseismic investigation of the San Andreas fault system, San Gorgonio Pass: Southern California Earthquake Center, Annual Report for 1998, 2 p. and figures. Internet URL http://www.scec.org/research/98progreports/

Sieh, K., and Yule, D., 1999, Neotectonic and paleoseismic investigation of the San Andreas fault system, San Gorgonio Pass: Southern California Earthquake Center, Annual Report for 1999, 4 p. and figures. Internet URL http://www.scec.org/research/99progreports/

Southern California Earthquake Center [SCEC], 2002, *Recommended Procedures for Implementation of DMG Special Publication 117: Guidelines for Analyzing and Mitigating Landslide Hazards in California:* University of Southern California, June 20-21, 2002.

Streckeisen, 1973, Plutonic rocks – classification and nomenclature recommended by the IUGA Subcommission on Systematics of Igneous Rocks: Geotimes, v. 18, p. 26-30.

Tokimatsu, K., and Seed, H.B., 1987, Evaluation of settlement in sands due to earthquake shaking: Journal of Geotechnical Engineering, ASCE, vol. 113, no. 8, p. 861-878.

U.S. Geological Survey, 2017a, Worldwide Earthquake Map, with embedded access to Quaternary faults and folds, and ANSS Comprehensive Earthquake Catalog [COMCAT], Internet URL http://earthquake.usgs.gov/earthquakes/map/

U.S. Geological Survey, 2017b, Alberhill (1954) and Lake Mathews (1953) 7.5' topographic quadrangle sheets, editions as listed, download files at The National Map: Historical Topographical Map Collection, access date 1/10/16 from Internet URL http://nationalmap.gove/historical/

U.S. Geological Survey, 2017c, Interactive deaggregations: Internet URL https://geohazards/usgs.gov/deaggint/2008/

U.S. Geological Survey, 2017d, Design Maps utility, access date 5/20/16 from Internet URL http://geohazards.usgs.gov/designmaps/us/application.php

Weber, F.H., Jr., 1977, Seismic hazards related to geologic factors, Elsinore and Chino fault zones, northwestern Riverside County, California: California Department of Conservation, Division of Mines and Geology Open-File Report 77-4, 96 p. and plates.

WGCEP, 2008, The uniform California earthquake rupture forecast, Version 2 (UCERF 2): U.S. Geological Survey Open File Report 2007-1437 (ver. 1.0).

WGCEP, 2013, The uniform California earthquake rupture forecast, Version 3 (UCERF3) – the time-independent model: U.S. Geological Survey Open-File Report 2013-1165, 97 p.

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
6/5/02
12/31/02
12/31/04
1/30/06
1/11/07
6/5/09
11/15/09
3/9/11
6/7/12
1/8/13
11/12/13
4/27/14
2/9/16 *(trenches visible)*
10/21/16

IN THE COUNTY OF RIVERSIDE, STATE OF CALIFORNIA

TENTATIVE TRACT MAP NO. 37154

LEGAL DESCRIPTION

PARCEL 1

THAT PORTION OF THE WESTERLY RECTANGULAR 1752 OF THE NORTHWEST QUARTER OF SECTION 13, TOWNSHIP 5 SOUTH, RANGE 6 WEST, SAN BERNARDINO BASE AND MERIDIANS, AS SHOWN BY UNITED STATED GOVERNMENT SURVEY, DESCRIBED AS FOLLOWS:

BEGINNING AT A POINT ON THE NORTHERLY LINE OF THE SAID NORTHWEST QUARTER, DISTANT EASTERLY 1725.25 FEET FROM THE NORTHWEST CORNER THEREOF; THENCE SOUTHERLY PARALLEL WITH THE WESTERLY LINE OF THE SAID NORTHWEST QUARTER, 1656 FEET; THENCE WESTERLY PARALLEL WITH THE NORTHERLY LINE OF THE SAID NORTHWEST QUARTER, 430.5 FEET, MORE OR LESS, TO A POINT ON THE EASTERLY LINE OF THAT CERTAIN PARCEL OF LAND CONVEYED TO PAUL D BURNETT AND WIFE BY DEED RECORDED JUNE 3, 1957, AS INSTRUMENT NO. 40469; THENCE SOUTHEASTERLY ON THE EASTERLY LINE OF THE SAID BURNETT PARCEL, 25.5 FEET, TO THE SOUTHEASTERLY CORNER OF THE SAID BURNETT PARCEL; THENCE SOUTH 87° WEST ALONG THE SOUTHERLY LINE OF THE SAID BURNETT PARCEL, AND THE WESTERLY EXTENSION OF SAID BURNETT PARCEL 549 FEET, MORE OR LESS TO A POINT ON THE EASTERLY LINE OF THAT CERTAIN PARCEL CONVEYED TO FALCONER E CAMPBELL JR, BY DEED RECORDED JUNE18, 1957, AS INSTRUMENT NO. 44612, WHICH LIES 760 FEET EAST OF THE WEST LINE OF SECTION 13, AND NORTH 204.2 FEET MORE OR LESS FROM THE SOUTHEAST CORNER OF THE PARCEL CONVEYED TO FALCONER E CAMPBELL JR, THENCE SOUTHERLY ALONG THE EAST LINE OF THE P[ARCEL CONVEYED TO FALCONER CAMPBELL JR, 204.2 FEET MORE OR LESS TO THE MOST SOUTHEAST CORNER THEREOF; THENCE WESTERLY PARALLEL WITH THE NORTHERLY LINE OF SAID SECTION 13, 760 FEET MORE OR LESS, TO A POINT ON SAID WESTERLY BOUNDARY LINE; THENCE SOUTHERLY ALONG SAID WESTERLY BOUNDARY LINE, 660 FEET, MORE OR LESS TO THE SOUTHWEST CORNER OF THE NORTHWEST QUARTER OF SAID SECTION 13; THENCE EASTERLY, ALONG THE BOUNDARY LINE 2460 FEET, MORE OR LESS, TO NORTH LINE OF SAID SECTION 13; THENCE WESTERLY 26.75 FEET TO THE POINT OF BEGINNING.

PARCEL 2

THAT PORTION OF THE WESTERLY RECTANGULAR 1752 FEET OF THE NORTHWEST QUARTER OF SECTION 13, TOWNSHIP 5 SOUTH, RANGE 6 WEST, SAN BERNARDINO BASE AND MERIDIAN, AS SHOWN BY UNITED STATES GOVERNMENT SURVEY, DESCRIBED AS FOLLOWS:

COMMENCING AT A POINT IN THE NORTHERLY LINE OF SAID NORTHWEST QUARTER DISTANT EASTERLY 1725.25 FEET FROM THE NORTHWEST CORNER THEREOF; THENCE SOUTHERLY PARALLEL WITH THE WESTERLY LINE OF SAID NORTHWEST QUARTER 1656 FEET; THENCE WESTERLY PARALLEL WITH THE NORTHERLY LINE OF SAID NORTHWEST QUARTER 430.5 FEET MORE OR LESS TO A POINT ON THE EASTERLY LINE OF THAT CERTAIN PARCEL OF LAND CONVEYED TO PAUL D BURNETT AND WIFE, BY DEED RECORDED JUNE 3, 1957, AS INSTRUMENT NO. 40469; THENCE CONTINUING WESTERLY, PARALLEL WITH THE NORTHERLY LINE OF SAID NORTHWEST QUARTER TO A POINT IN THE EASTERLY LINE OF THAT CERTAIN PARCEL OF LAND CONVEYED TO FALCONER E CAMPBELL JR, BY DEED RECORDED ON JUNE 18, 1957, AS INSTRUMENT NO 44152, WHICH LIES 760 FEET EAST OF THE WEST LINE OF SECTION 13, BEING THE TRUE POINT OF BEGINNING; THENCE SOUTHERLY ALONG THE EASTERLY LINE LINE OF THE AFOREMENTIONED CAMPBELL PARCEL TO THE SOUTHWESTERLY EXTENSION OF THE SOUTHERLY LINE OF THE AFOREMENTIONED BURNETT PARCEL; THENCE NORTH 87° EAST ALONG THE SOUTHWESTERLY EXTENSION TO THE SOUTHWEST CORNER OF SAID PARCEL CONVEYED TO BURNETT; THENCE NORTHERLY ALONG THE WEST LINE OF HE PARCEL SO CONVEYED TO BURNETT TO A POINT THEREON WHICH EARS 10 FEET MORE OR LESS EAST OF THE POINT OF BEGINNING; THENCE WEST 10 FEET MORE OR LESS TO THE POINT OF BEGINNING.

PARCEL 3

THAT PORTION OF THE NORTHWEST QUARTER OF SECTION 13, TOWNSHIP 5 SOUTH, RANGE 6 WEST, SAN BERNARDINO BASE AND MERIDIAN, AS SHOWN BY UNITED STATES GOVERNMENT SURVEY, DESCRIBED AS FOLLOWS:

COMMENCING AT A POINT ON THE NORTHERLY LINE OF THE SAID NORTHWEST QUARTER DISTANT EASTERLY 1725.23 FEET FROM THE NORTHWEST CORNER THEREOF; THENCE SOUTHERLY PARALLEL WITH THE WESTERLY LINE OF THE SAID NORTHWEST QUARTER, 1656 FEET; THENCE WESTERLY, PARALLEL WITH THE NORTHERLY LINE OF THE SAID NORTHWEST QUARTER, 430.5 FEET, MORE OR LESS, TO A POINT ON THE EASTERLY LINE OF THAT CERTAIN PARCEL OF LAND CONVEYED TO PAUL D BURNETT AND WIFE, BY DEED RECORDED JUNE 3, 1957, AS INSTRUMENT NO 40469, THE TRUE POINT OF BEGINING; THENCE CONTINUING WESTERLY PARALLEL WITH THE NORTHERLY LINE OF THE SAID NORTHWEST QUARTER TO A POINT IN THE WESTERLY LINE OF SAID PARCEL OF LAND CONVEYED TO PAUL D BURNETT AND WIFE WHICH LIES 770 FEET EAST OF THE WEST LINE OF SAID SECTION 13; THENCE SOUTHERLY ALONG THE EASTERLY LINE OF THE AFOREMENTIONED BURNETT PARCEL TO THE SOUTHWEST CORNER OF THAT PARCEL OF LAND CONVEYED TO PAUL D BURNETT; THENCE NORTH 87° EAST ALONG THE SOUTHERLY LINE OF SAID BURNETT PARCEL 539 FEET TO THE SOUTHEAST CORNER THEREOF; THENCE NORTHERLY ALONG THE EASTERLY LINE OF SAID BURNETT PARCEL 25.5 FEET TO THE POINT OF BEGINNING.

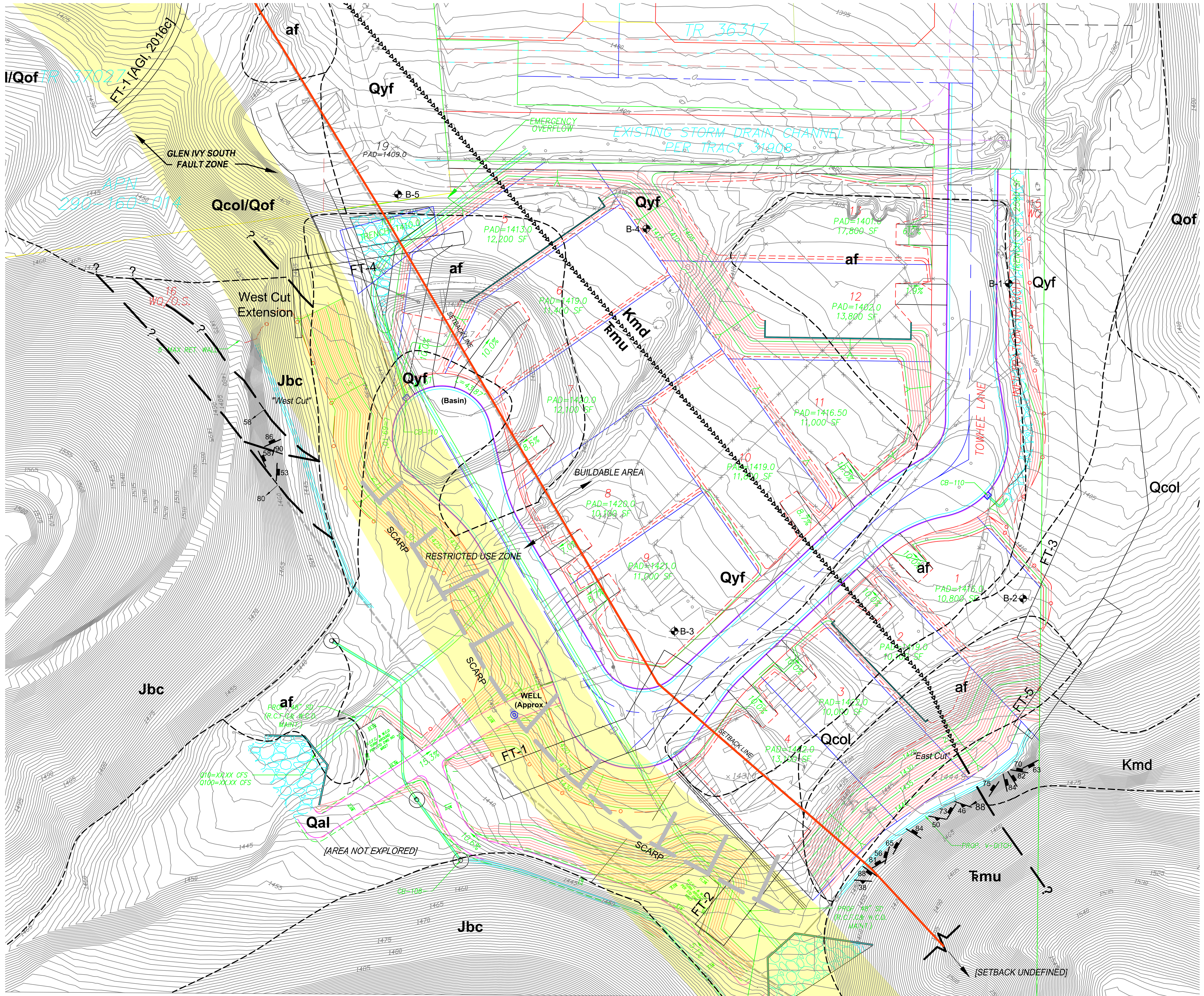
EXCEPTING THEREFROM AN EASEMENT FOR ROAD PURPOSES OVER THE EASTERLY 100 FEET OF THE ABOVE DESCRIBED PROPERTY,SAID 100 FEET BEING MEASURED ALONG THE NORTHERLY LINE THEREOF, AND THE WESTERLY LINE THEREOF BEING PARALLEL WITH THE WESTERLY LINE OF SAID NORTHWEST QUARTER.

PROJECT NOTES

1. THE EXISTENCE AND LOCATION OF ANY UNDERGROUND UTILITY PIPES OR STRUCTURES SHOWN ON THESE PLANS WERE OBTAINED BY A SEARCH OF THE AVAILABLE RECORDS. TO THE BEST OF OUR KNOWLEDGE, THERE ARE NO EXISTING UTILITIES EXCEPT AS SHOWN ON THIS PLAN. THE CONTRACTOR IS REQUIRED TO TAKE DUE PRECAUTIONARY MEASURES TO PROTECT THE UTILITY LINES SHOWN AND ANY OTHER LINES NOT OF RECORD OR NOT SHOWN ON THIS DRAWING.
2. CONSTRUCTION CONTRACTOR AGREES THAT IN ACCORDANCE WITH GENERALLY ACCEPTED CONSTRUCTION PRACTICES, HE/SHE WILL BE REQUIRED TO ASSUME SOLE AND COMPLETE RESPONSIBILITY FOR JOB SITE CONDITIONS DURING THE COURSE OF CONSTRUCTION OF THE PROJECT, INCLUDING SAFETY OF ALL PERSONS AND PROPERTY; THAT THIS REQUIREMENT SHALL BE MADE TO APPLY CONTINUOUSLY AND NOT BE LIMITED TO NORMAL WORKING HOURS, AND CONSTRUCTION CONTRACTOR FURTHER AGREES TO DEFEND, INDEMNIFY AND HOLD DESIGN PROFESSIONAL HARMLESS FROM ANY AND ALL LIABILITY, REAL OR ALLEGED, IN CONNECTION WITH THE PERFORMANCE OF WORK ON THIS PROJECT, EXCEPTING LIABILITY ARISING FROM THE SOLE NEGLIGENCE OF DESIGN PROFESSIONAL.
3. 2010 THOMAS BROS. MAP BOOK: PAGE 834, GRID G3
4. LAND IS NOT SUBJECT TO LIQUEFACTION OR OTHER GEOLOGICAL HAZARD AND IS NOT WITHIN A SPECIAL STUDIES ZONE.
5. LAND IS NOT SUBJECT TO OVERFLOW, INUNDATION OR FLOOD HAZARD.
6. PROJECT IS LOCATED IN A HIGH FIRE AREA.
7. ALL IMPROVEMENTS SHALL BE PER SCHEDULE "A" SUBDIVISION ORDINANCE 460.
8. NO SUBSURFACE SEPTIC SEWAGE DISPOSAL IS INTENDED.
9. THIS MAP DOES NOT INCLUDE THE ENTIRE CONTIGUOUS OWNERSHIP OF THE LAND DIVIDER.
10. THIS PROJECT IS LOCATED WITHIN THE TEMESCAL CSA #134 – STREET LIGHTING.
11. FLOOD ZONE X, AREA OF MINIMAL FLOODING PER FEMA PANEL 6065C2005G.
12. NO KNOWN EXISTING WELLS ON OR AROUND THE PROPERTY.

LOT	NET S.F.	PAD S.F.
1		10,800
2		10,100
3		10,000
4		13,100
5		12,200
6		11,400
7		12,100
8		10,100
9		11,000
10		11,800
11		11,000
12		13,800
13		17,800

AVG. LOT SIZE=11,940 S.F.
0.38 DU/ACRE



0 20 40 80 120 160

SCALE

SCALE: 1"=40'

GEOTECHNICAL LEGEND

- B-5 Approximate location of exploratory boring
- FT-3 Surveyed limits of exploratory fault trench
- Geologic contact, approximately located
- 79 Fault, approximately located, with dip and dip direction
- Interpreted basement rock contact, concealed
- 63 Strike and dip of joint
- 50 Strike and dip of foliation
- af — Man-made fill
- Qcol — Colluvium. Dark brown silty sand, porous
- Qyf — Younger fan alluvium. Predominantly silty sand and gravelly sand
- Qof — Older fan alluvium (Morton & Miller, 2006). Light yellow arkosic sediments, non-indurated but with cemented surficial horizons
- Jbc — Bedford Canyon Formation. Graywacke and impure quartzite
- Kmd — Granitic intrusive rock
- Ŧmu — Triassic metasediments. Foliated phyllite and quartzite

OWNER/APPLICANT

KYLIE FAMILY TRUST
2279 EAGLE GLEN PARKWAY
CORONA, CA 92883
PH: (951) 603-0966

ENGINEER

adkan ENGINEERS
6879 AIRPORT DRIVE
RIVERSIDE, CA. 92504
951-688-0241

UTILITY PURVEYORS

WATER: TEMESCAL VALLEY WATER DISTRICT
SEWER: TEMESCAL VALLEY WATER DISTRICT
GAS: SOUTHERN CALIFORNIA GAS COMPANY
ELECTRICITY: SOUTHERN CALIFORNIA EDISON COMPANY
TELEPHONE: AT&T, VERIZON
CATV: TIME WARNER CABLE

ASSESSORS PARCEL NUMBER

290-160-011

LEGEND

PROP DOMESTIC WATER
PROPOSED RECLAIMED WATER
PROPOSED SEWER
TRACT BOUNDARY
A.D.A ACCESS RAMP

SD = STORM DRAIN
TC = TOP OF CURB
FS = FINISH SURFACE
SWR = SEWER
TRW= TOP OF RETAINING WALL
CL = CENTER LINE
FG = FINISHED GROUND
WTR= WATER
E/P = EDGE OF PAVEMENT
P/L = PROPERTY LINE
R/W = RIGHT OF WAY
A.R = A.D.A ACCESS RAMP
SW = SIDEWALK
( ) = EXISTING ELEVATION
C&G = CURB AND GUTTER
S.F. = SQUARE FEET
FS = FINISH SURFACE
FH = FIRE HYDRANT
TW = TOP OF WALL
TF = TOP OF FOOTING
HOA = HOME OWNERS ASSOCIATION

EARTHWORK QUANTITIES

CUT: XXX CY FILL: XXX CY NET: 0 CY

THE QUANTITY SHOWN ABOVE IS FOR DISCUSSION PURPOSES ONLY.

TENTATIVE TRACT SUMMARY

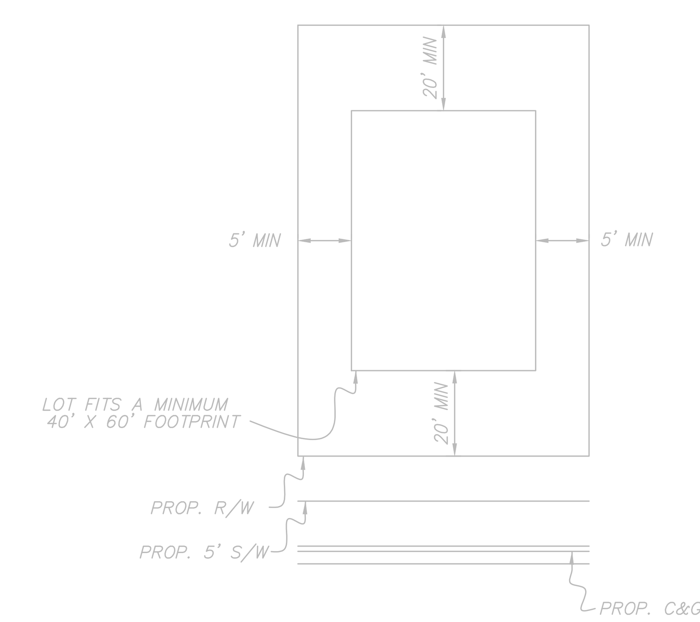
TOTAL AREA GROSS:	34.1 ACRES
EXISTING ZONING:	R-R
PROPOSED ZONING:	R-1
PROPOSED LAND USE:	VLDR
EXISTING LAND USE:	VLDR
EXISTING SURROUNDING LAND USE:	RESIDENTIAL & OPEN SPACE
EXISTING SURROUNDING ZONING:	SP (PER CZ 7317)

BENCHMARK

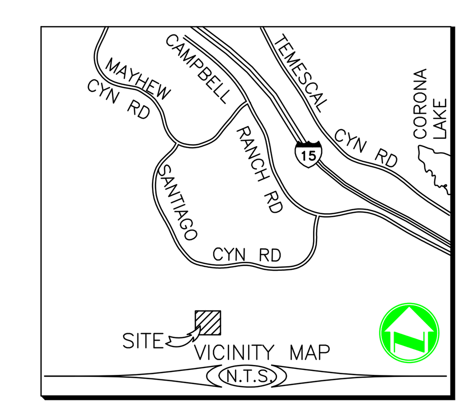
ELEV. 1170.39 NGVD 29
B.M. NO. CDH B.M. 58-B-77
BRASS DISK IN CONCRETE DOWN 0.5'
224' RT OF 575+48 1-15 CL IMP.

BASIS OF BEARINGS

THE WEST LINE OF THE SOUTHEAST ¼ OF SECTION 20, TOWNSHIP 2 SOUTH, RANGE 3 WEST WITH A BEARING OF N00°10'09"E WAS HELD AS THE BASIS OF BEARING FOR THIS MAP AS SHOWN ON PARCEL MAP BOOK 152, PAGES 60-61, LOCATED IN THE COUNTY OF RIVERSIDE RECORDERS OFFICE.



TYPICAL PAD/SETBACK DETAIL
N.T.S.



VICINITY MAP
(N.T.S.)

SEC. 13, T.5S, R.6W

AGI	GEOTECHNICAL MAP		
	TENTATIVE TRACT MAP NO. 37154, TEMESCAL VALLEY, CA		
	PROJECT NO. 4252-F	DATE: 5/31/17	PLATE NO. 1

REVISIONS

DELTA	DESCRIPTION

TENTATIVE TRACT NO. 37154
PREPARATION DATE : JUNE 2016

adkan ENGINEERS
Civil Engineering • Surveying • Planning
6879 Airport Drive, Riverside, CA 92504
Tel:(951) 688-0241 • Fax:(951) 688-0599

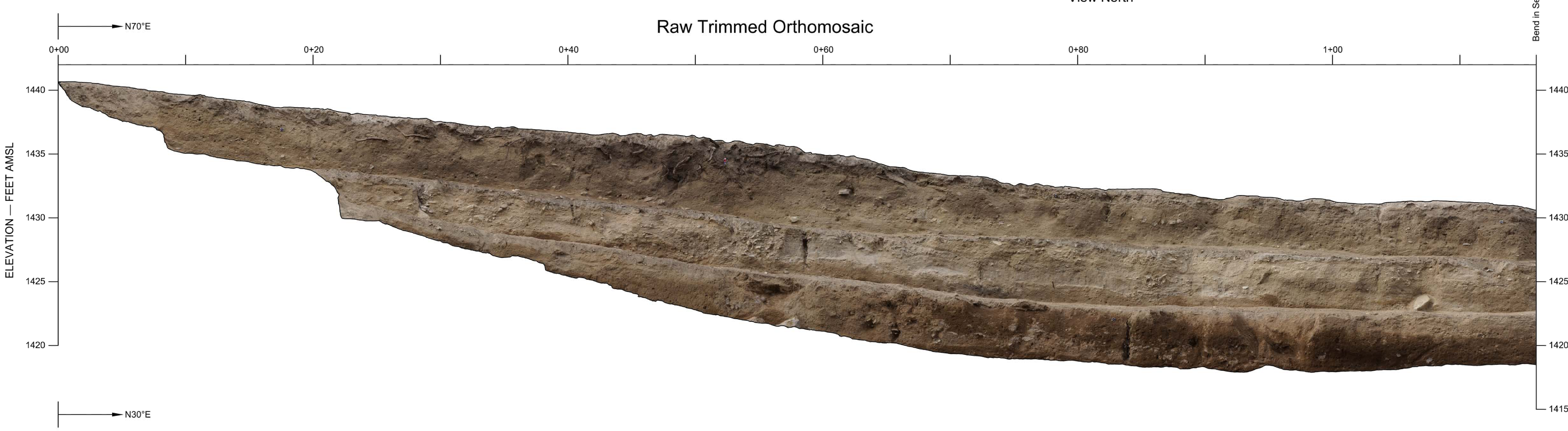
Plot Date: 7/6/2017

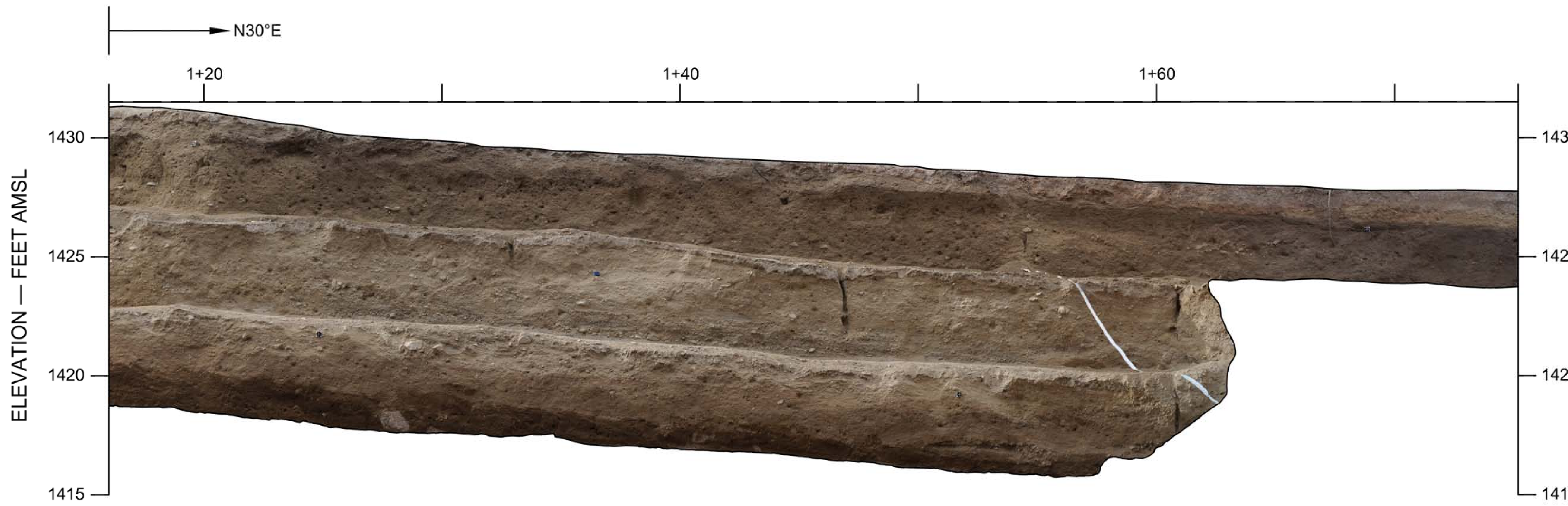
\\AGI\Documents\To File\Kiley Fault Studies\Kiley 35 Plans\8770 TTM

Trench FT-1

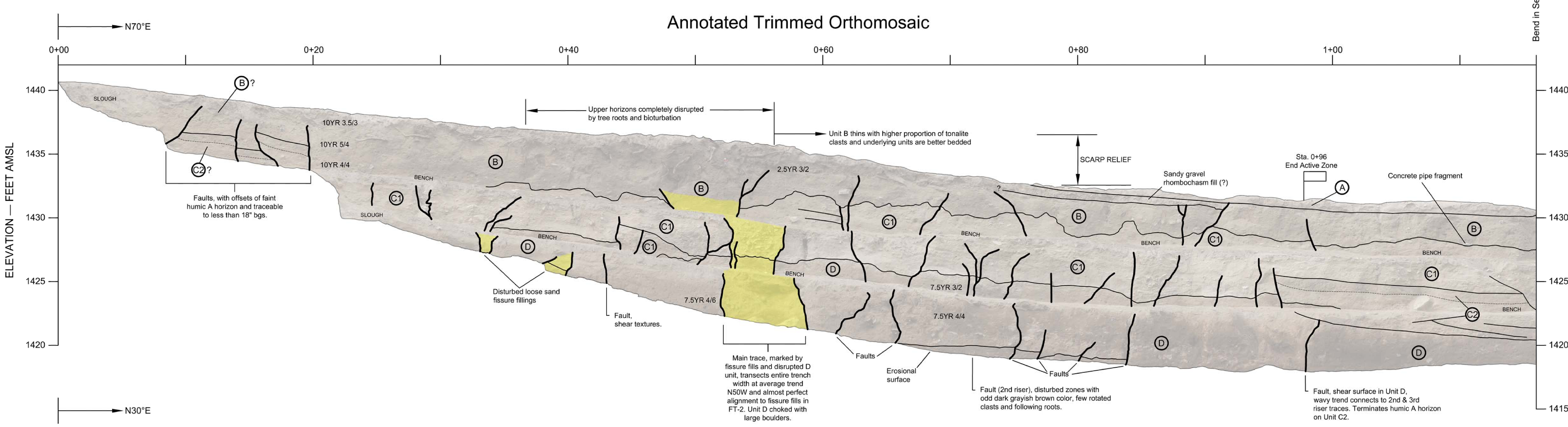
View North

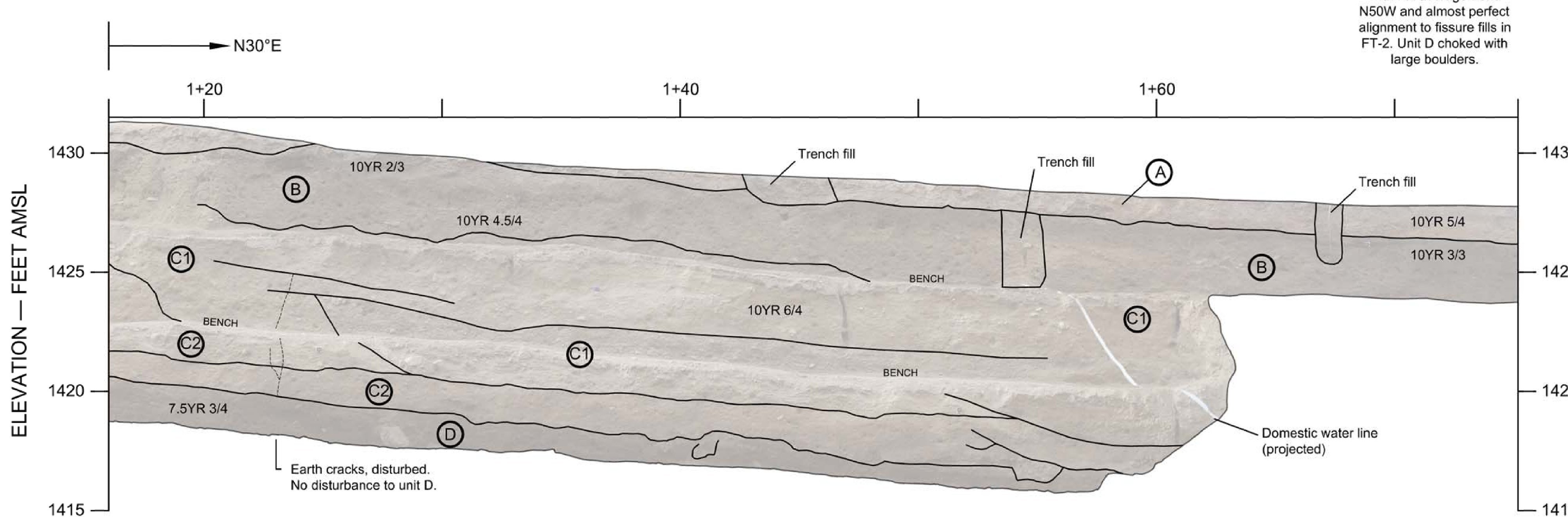
Raw Trimmed Orthomosaic





Annotated Trimmed Orthomosaic





TRENCH FT-1 NOTES & KEY

Excavation and Imagery Information

Trench FT-1 was opened in December, 2015, using a client-supplied Volvo EC480dl track excavator equipped with a 5-foot-wide bucket. Partial trench cleaning with flat shovels and brushes was accomplished before a holiday break.

On January 6-7, 2016, the TTM 37154 site received over 4 inches of rainfall. Except for relatively minor vertical erosional rills in bench risers, the north (logged) side of the excavation was not significantly impacted by the storm. However, younger and low-cohesion sediments in the south side of the trench were severely eroded and caved, due to interception of surface runoff from nearby upslope areas. The inner slot locally filled with up to a foot or so of washed-in sediment. Water did not pond, however.

The trench was allowed to dry back over roughly two weeks. Rain-crusted surfaces were scraped away and bench treads cleared of accumulated slough. Trowels and brushes restored the riser faces to near-pristine conditions except for several of the deeper erosional rills. Darker-toned (very moist) areas in the lower parts of the trench never fully dried back. These and the rills are artifacts that could not be corrected before digital photography had to be completed in advance of new approaching weather fronts. Fixed survey targets were nailed into the exposures by AGI and geo-located by Adkan Engineers according to State plane coordinates. Excavation observations and descriptive logging were completed by M. Doerschlag, CEG 1752 on January 26-27, 2016. Measurements and ground features were drawn onto non-overlapped monochrome working prints taken with point-and-shoot cameras and scaled to around 1" = 2' for later input into final CAD exhibits.

Orthomosaic Date:	January 27, 2016.
Camera:	Tripod mounted Sony α6000, 24 MP, 16 mm focal length at ISO 100. Remotely triggered via Bluetooth connection to smartphone. Average principal point spacing of ~8 feet, based on image line situated on the first bench below grade. Image count: 25.
SfM Modeling:	Pix4Dmapper Pro ver. 3.0.13 with 4X downsampling to create the dense point cloud surface. Vertical orthoplanes were oriented parallel to the trench axis, with bearings as shown. Matchline for bend in section is the lowest bench riser face; some overlap of riser face images occurs in orthographic projections above the lowest riser.

Units

Note: Unit designations at each trench are arbitrary, and should not be correlated to similar designations at other TTM 37154 trenches or AGI excavations on neighboring properties.

(A) Historic flood deposit: Crudely laminated silty fine to coarse sand resting atop a sharp contact with weak underlying A horizon. Derived from a granitic rock source. Covers plastic pipe backfill soils at Sta. 1+55.

(B) Modern "topsoil" and alluvium: Primarily loose silty sand with variable proportions of gravel. Slightly variegated color hues range from dark brown to yellowish brown and dark yellowish brown. Lighter- toned zones contain granitic granules; darker zones usually contain only dark metamorphic grains. Unit is porous and features visible organic humus (discontinuous and partly disturbed pedogenic AO and A horizons) in the uppermost few inches atop a cumulate B zone. Unit is a favored medium for tree roots, e.g., near Sta. 0+50. Almost all primary sedimentary structure has been destroyed by bioturbation; sometimes has a faint basal lag of hard gravel clasts. The distinctive "pocked" surface texture is not cause by tool marks, but forms during cleaning when cohesionless insect burrow fills (from bees and wasps) are dislodged by brushing. A concrete pipe fragment is exposed without overlying evidence of fill at Sta. 1+11 (circled). The unit is transected by multiple faint fault traces, often bounding horizontal reaches with varying total thickness. Unit B includes a localized layer of sandy gravel near Sta. 0+80 that could identify a slightly downdropped block (rhombochasm), terminated on at least one side by a fault trace. Historic flood deposits cover the rhombochasm fill. Interpreted latest Holocene (<2 ka) and historic age.

(C1) Younger fan alluvium (map unit Qyf): Primarily light yellowish brown, bedded, low-cohesion fluvial silty sand, silty gravelly sand, and sand with silt. Generally well-bedded with a sharp and slightly irregular erosional basal contact. Common internal cut-and-fill channels. Larger clasts comprise angular and subangular fragments of hard Santa Ana Mountains-derived tonalite, with much rarer fragments of metamorphic Bedford Canyon argillite. Multiple zones of disruption by tectonic fault lines, including fissure fills that are perpendicular to the fluvial gradient and could be picked in both trench sidewalls. Interpreted middle to latest Holocene depositional age.

(C2) Younger fan alluvium (map unit Qyf): Brown and yellowish brown, slightly cohesive, fine to coarse grained silty sand and gravelly sand. Clast population is mixed rock types. The unit consist of well-bedded and laminated fluvial sediments (low degrees of bioturbation) that appear to be derived from both upstream bedrock terrains and from reworking of the underlying unit D (siltier than unit C1). Eroded, slightly transitional lower contact. Unit C1 is noted for a partially preserved weak humic A horizon best expressed between Sta. 0+95 and a cut-and-fill channel at Sta. 1+25. Inferred early or middle Holocene deposit based on in-place relative density and observed pedogenic changes.

(D) Debris flow subunit, younger fan alluvium (map unit Qyf): Massive and crudely fining-up interval of brown to strong brown silty sand with gravel, cobbles and boulders. Base not exposed in trench. Lowest exposures feature matrix-supported and some clast-supported angular cobble-boulder diamictite, with granitic (tonalite) rock fragments up to 40"+ across found during excavation. Some fragments are moderately weathered through and through, and are cleavable; most are hard and show no weathering rinds. Clast size and frequency generally decrease towards top. Matrix is fines-rich (~30-40% silt, occasionally grading to a borderline sandy silt), uncemented, and at least partly visibly porous. No signs of a pedogenic solum near the top of the subunit; if it existed, it has been stripped by erosion. Ped structure is very weak, taking the form of occasional very narrow vertical partings (may also be tectonic). We interpret the reddish 7.5 YR color hues to be primary, i.e., a characteristic of the original flow's source terrain and soil cover, and not a product of pedogenesis. Based on geotechnical borings, subunit is believed to lie atop older fan alluvium, Qof, at depths of 15 to 20 feet. Age: Viewed as earliest Holocene or older. Workers in neighboring Sycamore Creek Specific Plan properties have assigned ages of 20-30 ka or more for similarly colored soil units.

0 5 10 20

SCALE: 1"=5' HORIZONTAL AND VERTICAL

FAULT TRENCH LOG

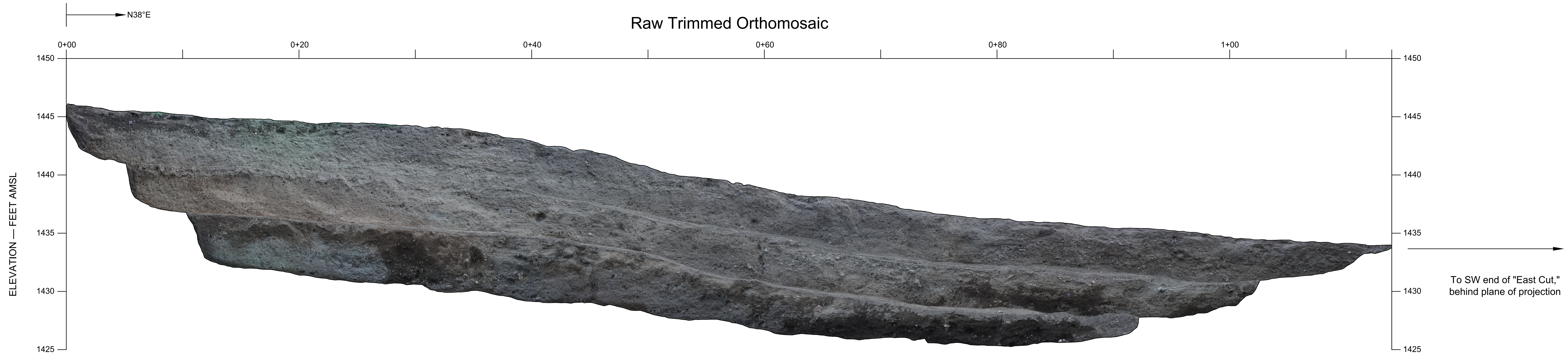
TENTATIVE TRACT MAP NO. 37154, TEMESCAL VALLEY, CA

PROJECT NO. 4252-F | DATE: 5/31/16 | **PLATE NO. 2**

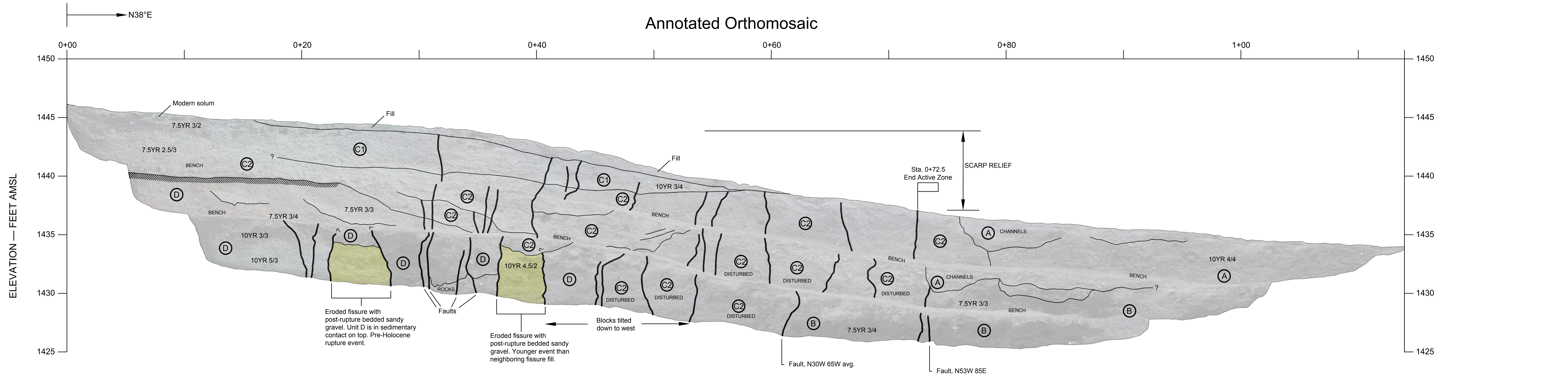
Trench FT-2

View Northwest

Raw Trimmed Orthomosaic



Annotated Orthomosaic



TRENCH FT-2 NOTES & KEY

Excavation and Imagery Information

Trench FT-2 was opened in late December, 2015, using a client-supplied Volvo EC480dl track excavator equipped with a 5-foot-wide bucket. Partial trench cleaning with flat shovels and brushes was accomplished before a holiday break. Newly exposed surfaces were examined by a geologist prior to the break.

On January 6-7, 2016, the TTM 37154 site received over 4 inches of rainfall. The north (logged) side of the excavation was not significantly impacted by the storm. However, the south side of the trench was severely eroded due to interception of surface runoff from the small canyon watershed southeast of the trench. The inner slot locally filled with up to a half-foot or so of washed-in mud and gravelly sediment. Siltier subunits were deeply moistened. Almost 18 inches of ponded water collected in the lowest part of the trench.

The trench was allowed to dry back for almost a month. Visqueen plastic sheeting covered certain key areas when new storms threatened. Unfortunately, cool temperatures and permanently shaded areas inhibited evaporation and some trench walls never dried back. The final orthomosaic thus includes some artifacts including very dark-toned (wet) areas, and a variety of mostly minor erosional features. Wet areas are not necessarily indicative of differing soil properties or unit boundaries.

Rain-crusted surfaces were scraped away and bench treads cleared of accumulated slough. Trowels and brushes restored the riser faces to acceptable conditions for pictures. Fixed survey targets were nailed into the exposures by AGI and geo-located by Adkan Engineers according to State plane coordinates. Excavation observations and descriptive logging were completed by M. Doerschlag, CEG 1752 in the second week of February, 2016. Measurements and ground features were drawn onto non-overlapped monochrome working prints taken with point-and-shoot cameras and scaled to around 1" = 2' for later input into final CAD exhibits.

Orthomosaic Date:	February 4, 2016.
Camera:	Tripod mounted Sony α6000, 24 MP, 16 mm focal length at ISO 100. Remotely triggered via Bluetooth connection to smartphone. Average principal point spacing of ~6 feet, based on image line situated on the first bench below grade. Image count: 17.
SfM Modeling:	Pix4Dmapper Pro ver. 3.0.13 with 4X downsampling to create the dense point cloud surface. Data were projected to a vertical orthoplane oriented parallel to the trench axis, with a bearing as shown.

Units

Note: Unit designations at each trench are arbitrary, and should not be correlated to similar designations at other TTM 37154 trenches or AGI excavations on neighboring properties.

(A) Stratified and sorted cut-and-fill fluvial deposits. Comprises coarse-grained soil types (gravelly sand, sandy gravel) with low fines proportions. Dark-colored clasts consist entirely of Bedford Canyon and interpreted Triassic metamorphic rocks from the linear drainage trending southeast of FT-2. Stacked channels are capped with a silty modern "topsoil" zone that has been disturbed by past ranch development and East Cut construction activity. Age: Late Holocene.

(B) Fluvial deposits: Primarily dark brown, well-bedded, low-cohesion silty gravelly sand, sand with silt and sandy gravel. Bedding style more even and planar than unit A, but with matching clast compositions. Clasts are hard and strong. Around Sta. 0+80, unit B is partly capped with massive and very silty sand inferred to be redeposited (mudflow?) from colluvium and/or landslide deposits farther west and south (not a cumulate soil). Probable Holocene deposits.

(C1) Silty gravelly sand: Crudely fining-up, bedded deposit of alluvium with an eroded base. Exhibits fine-scale bioturbation from insects, but few small mammalian Krotovina; generally quite porous. No granitic clasts. Marked by AO, A and weak cumulate B horizons toward southwest end of trench. Unit appears to be a "stranded" layer on upthrown side of Glen Ivy South fault zone, several feet higher than the modern drainage thalweg. Unit is transected by several fault strands, and has a back-tilted basal contact near Sta. 0+50. Interpreted early-middle Holocene deposit, based on geomorphic position and soil development.

(C2) Silty gravelly sand: Similar to unit C1, but increasingly disturbed and with much greater channelization influences from tectonic deformations. Base overlies a paleosol southwest of Sta 0+25. Northeast of Sta 0+50, becomes chaotically deformed and mixed with large blocks of underlying very silty colluvium, where it also grades upward into several feet of much siltier and probably younger "topsoil" and colluvium around the scarp toe. Early (?) Holocene.

(D) Colluvium: Massive or with very faint thick layers or wedges dipping gently to northeast (downslope). Comprises moderately cohesive, generally porous very silty sand and sandy silt with traces of clay; the latter is sometimes incorporated as mechanically emplaced fragments in tectonically churned unit C2. Pockmarked surfaces are not tool marks, but indicative of ubiquitous preserved bioturbation from insects and common small Krotovina. The unit is also partly chaotically disrupted by tectonic forces. Wide, eroded and re-filled fissures are distinctive. Little to no derivation from Triassic bedrock; clasts identified as moderately weathered Bedford Canyon types that can be crushed or cleaved. Paleosol at west end of trench exhibits illuvial zones with stronger reddened chroma and a preserved dark brown A horizon (hatched). Interpreted pre-Holocene depositional age from pedological development (>20-30 ka).

0 5 10 20

SCALE: 1"=5' HORIZONTAL AND VERTICAL

FAULT TRENCH LOG

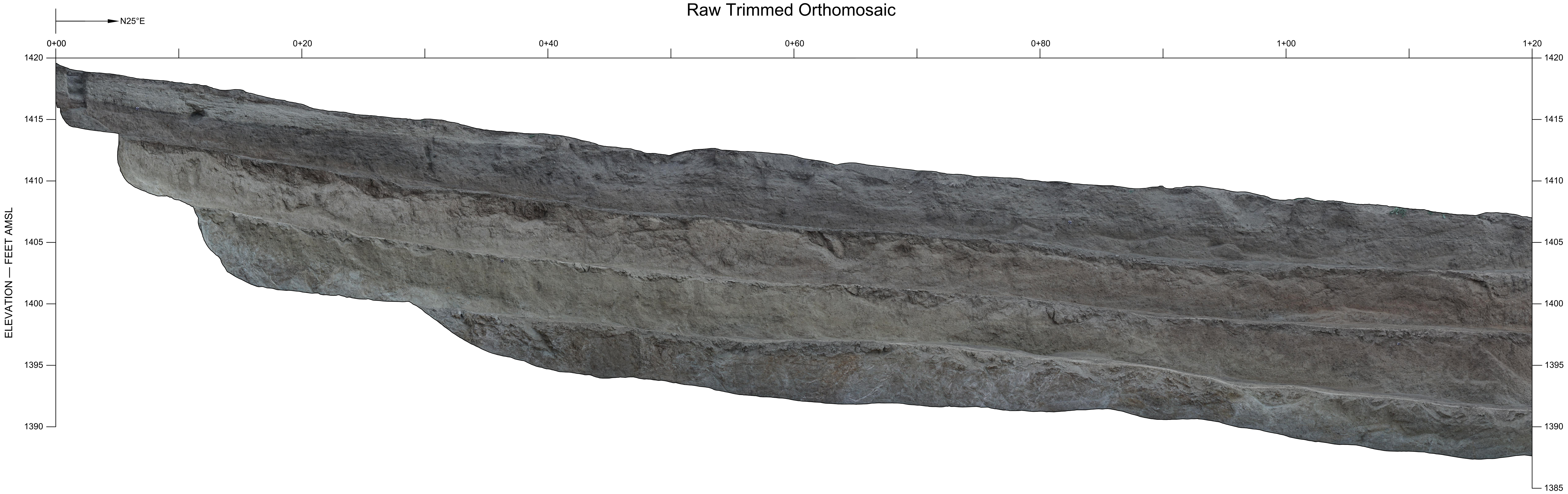
TENTATIVE TRACT MAP NO. 37154, TEMESCAL VALLEY, CA

PROJECT NO. 4252-F	DATE: 5/31/17	PLATE NO. 3

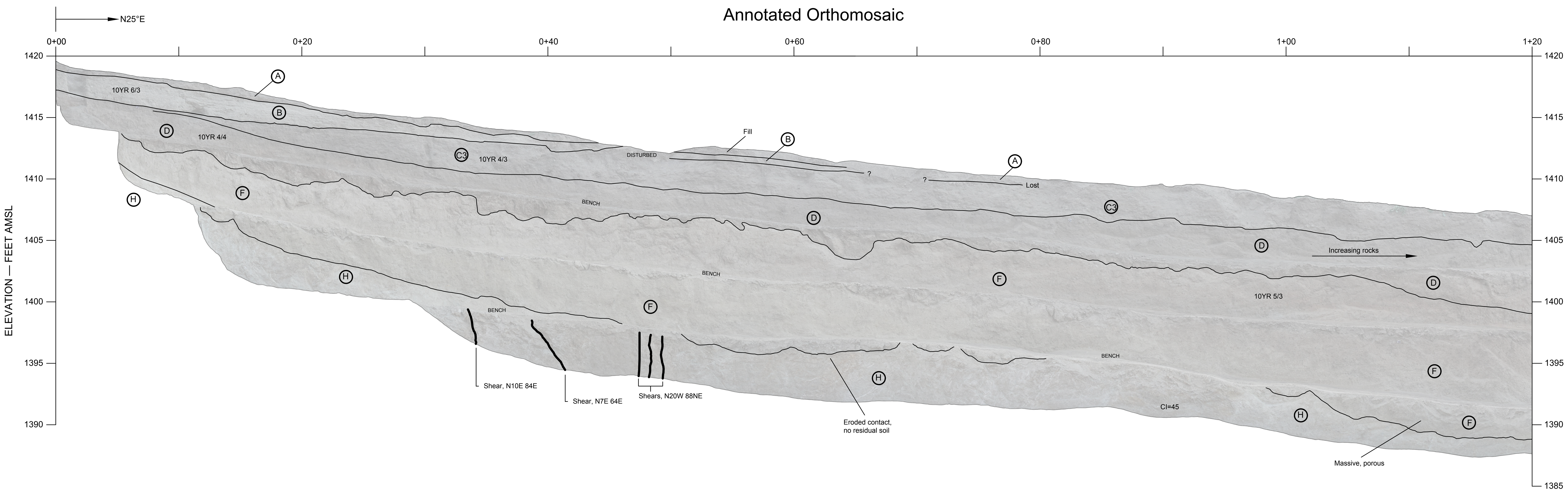
Trench FT-3

View North

Raw Trimmed Orthomosaic



Annotated Orthomosaic



TRENCH FT-2 NOTES & KEY

Excavation and Imagery Information

Trench FT-3 was opened in January and February, 2016, using a client-supplied Volvo EC480dl track excavator equipped with a 5-foot-wide bucket. A 4-bench design with 5-foot riser and tread dimensions was selected to achieve approximate total depths of 20 feet, as the area was hypothesized to have substantial thicknesses of younger alluvium. Support equipment included a large wheel loader to move spoils. The loader was also used to clear the land of scrub, locally dense chaparral, and scattered small trees in advance of the excavation. This activity resulted in some unavoidable disturbances to the shallowest topsoils. Small-scale relief created in the ground surface was thus an artifact of the construction process and not reflective of the originally quite smooth soil surfaces. Digging was easy in fill and natural soils. Moderately hard to hard excavating was observed in weathered granitic bedrock (partly a function of the large bucket).

A vertical view of the partially completed Trench FT-3 (and portions of completed Trench FT-2) can be viewed under the Historical Imagery tab in Google Earth. See image date of February 9, 2016.

Only brief and low-intensity rainfall events occurred during the 3-week-long excavation process. The trench was not materially impacted by the storms. Dry weather and the trench cleaning activities of shovel scraping, heavy brushing, and shop brush finishing removed minor tonal artifacts from variable soil moisture due to rainfall. Accordingly, depicted tonal contrasts are generally representative of actual differences in color value, hue, and chroma.

Fixed survey targets were nailed into the exposures by AGI and geo-located by Adkan Engineers according to State plane coordinates. Excavation observations and descriptive logging were completed by M. Doerschlag, CEG 1752 on March 1-3, 2016. Measurements and ground features were drawn onto non-overlapped monochrome working prints taken with point-and-shoot cameras and scaled to around 1" = 2' for later input into final CAD exhibits.

Orthomosaic Date:	February 25, 2016.
Camera:	Tripod mounted Sony α6000, 24 MP, 16 mm focal length at ISO 100. Remotely triggered via Bluetooth connection to smartphone. Average principal point spacing of ~8 feet, based on image line situated on the first bench below grade. Image count: 47.
SfM Modeling:	Pix4Dmapper Pro ver. 3.0.13 with 4X downsampling to create the dense point cloud surface. Data were projected to two vertical orthoplanes oriented parallel to the trench axes located north and south of a well-defined angle point, with bearings as shown.

Units

Note: Unit designations at each fault trench are arbitrary, and should not be correlated to similar designations at other TTM 37154 trenches or AGI excavations on neighboring properties.

(A) Fill and transported colluvium: Interpreted historic slopewash from "East Cut" fill located farther upslope to south. Consists of massive, very porous, and loose mixture of rock fragments and very silty sand. The thin unit was disturbed by the land clearing needed to construct FT-3.

(B) Very young alluvium: Bedded and laminated fine to coarse grained silty sand with gravel (USCS classification SM). Typified by pale brown color and immature, angular grains derived almost entirely from a granitic source (probable flood deposit from large watershed to SW). Some cohesion from minimal traces of clay, but has little internal disturbance from roots or animal fauna. Visibly porous. Sharp lower contact drapes over A horizon in unit D at SW end of trench, with little apparent erosion. Dies out (or scraped away) north of Sta. 0+80, although layer could be coeval with unit C1 farther north. Age inferred as latest Holocene or historic(?).

(C1) Very young alluvium (map unit Qyf): Light gray and very pale brown silty sand. Mostly loose and very low cohesion; stratified; porous. Exhibits a sharp and slightly irregular erosional basal contact. The unit has a predominantly granitic grain composition. Infrequent faunal disturbances. The upper several inches is very silty (outwash from fills just to the west?) and mechanically disrupted. Age is latest Holocene or possibly historic.

(C2) Younger alluvium (map unit Qyf): Pale brown to grayish brown silty sand. Part of a sequence of nested channel fills, unit C2 has a mixed clast composition of both metamorphic and granitic rock types in a very crudely fining-up package atop a lower erosional contact. Moderately bioturbated, and has variable preservation of original bedding. Top of unit has a discontinuous weakly developed humic A horizon, while remainder of section is devoid of illuvial accumulations. Late Holocene.

(C3) Younger alluvium (map unit Qyf): Brown, fine to coarse grained gravelly silty sand. Clast compositions dominated by metamorphic rock types. Locally well-stratified, but the majority of the unit is heavily bioturbated and disrupted, without obvious soil horizons. Very porous. Includes some later channel fills northeast of Sta. 1+60. Late Holocene.

(C4) Younger alluvium (map unit Qyf): Brown-colored and stratified silty sand, gravelly sand, and local sandy gravel. Mixed clast compositions, with some granitic contributions from the major drainage to the southwest; includes significant percentage of reworked silty slopewash from metamorphic terrains. Low cohesion. Exhibits a generally sharp erosional basal contact. Interpreted as the lowest member of several nested channel fills of middle Holocene to historic age.

(D) Colluvium and slopewash: Massive, dark yellowish brown, very silty sand with traces of clay (30-35% fines typical) plus ~15% angular rock fragments (usually impure quartzite). Granitic clasts are rare. Often weakly cohesive and very porous; pockmarked surface textures reflect extensive bioturbation and are not tool marks. Unit has a very sharp and irregular basal contact with underlying unit that is especially prominent toward southwestern end of trench, but lower contacts fade beyond roughly Sta. 1+30 where increasing fluvial reworking has created a second unit (D2). Little to no pedogenic development except for bit of preserved A horizon at southern end of trench; no illuvial Bt or filamentous carbonate noted. Holocene age.

(E1) Debris flow and fluvial deposits: Laterally and vertically heterogeneous zone of nearly massive to very well-bedded sand and gravel with variable fines proportions and internal grading. Cobble and boulder clasts of tonalite composition mark what could be interpreted as a single debris flow event; possibly 12-15 rocks up to 5'+ diameter were removed during trench excavation. Granitic clasts are mostly hard and fresh, although some smaller and usually notably angular fragments could be classified moderately weathered (fracturing interpreted to have occurred during transport). Little of the very silty matrix remains intact; most flow deposits have been reworked and winnowed by subsequent fluvial currents. Internal structure includes many smaller cut-and-fill channels. Erosional depths increase to the NE. Uncertain age assignment to early(?) Holocene or older. Potentially correlative to lowest part of fault trench FT-1.

(E2) Silty sandy gravel: Distinctive dark yellowish brown colored, coarse, crudely bedded angular gravel in a silty groundmass. Almost entirely metamorphic rock types (Triassic quartzite), resting on and partly intermixed with a relict cumulate horizon atop intrusive bedrock residual soil. Pre-Holocene age.

(F) Silty sand colluvium: Marked by pale brown to brown color that darkens to northeast as the unit gains silt and sand input from metamorphic sources. Internally, the unit is almost featureless except for sporadic faint bedding northeast of Sta. 0+55, occasional gravel trains, and a few preserved Krotovina. Fluvial reworking increases toward northeast. Slightly cemented with clay; slight to moderate dry strength/cohesion, and visibly porous. Usually has sharp erosional contact atop intrusive bedrock, with little or no remaining residual soils. Parent material = monzodiorite. No faults or fractures observed in this unit. Pre-Holocene age.

(G) Residual soil: Relict zone of strongly cohesive yellowish brown clayey sand created by *in situ* decomposition of parent granitic bedrock (not a transported material). Has been stripped away from areas where colluvium directly contacts basement rock. Age is pre-Holocene.

(H) Monzodiorite (map unit Kmd): Fine to medium grained; weakly foliated; equigranular hypidiomorphic texture. Classified highly weathered, soft or friable, and very weak. Notable for a lack of any hard residual corestones. Color indices (% mafic hornblende and biotite) as shown on orthomosaic; quartz is a very minor constituent and feldspar has been essentially completely altered. Exhibits very close to medium-spaced joints and minor shears. Foliation and/or unloading partings are frequently wide to very wide and soil-filled within 3-4 feet of former subaerial exposures, but discontinuities are otherwise typically very narrow apertures. Intrusive age: Cretaceous.

(I) Metasomatized phyllite and quartzite (map unit^ m u): Very fine grained, closely to intensely fractured and brecciated, with some wide soil-filled fractures. Blocks are moderately weathered, and moderately hard to hard, but with common hydrothermal alteration rinds. Interpreted to be a large xenolith within the larger Kmd intrusion.

0 5 10 20

SCALE: 1"=5' HORIZONTAL AND VERTICAL

AGI

FAULT TRENCH LOG

TENTATIVE TRACT MAP NO. 37154, TEMESCAL VALLEY, CA

PROJECT NO. 4252-F	DATE: 5/31/17	PLATE NO. 4

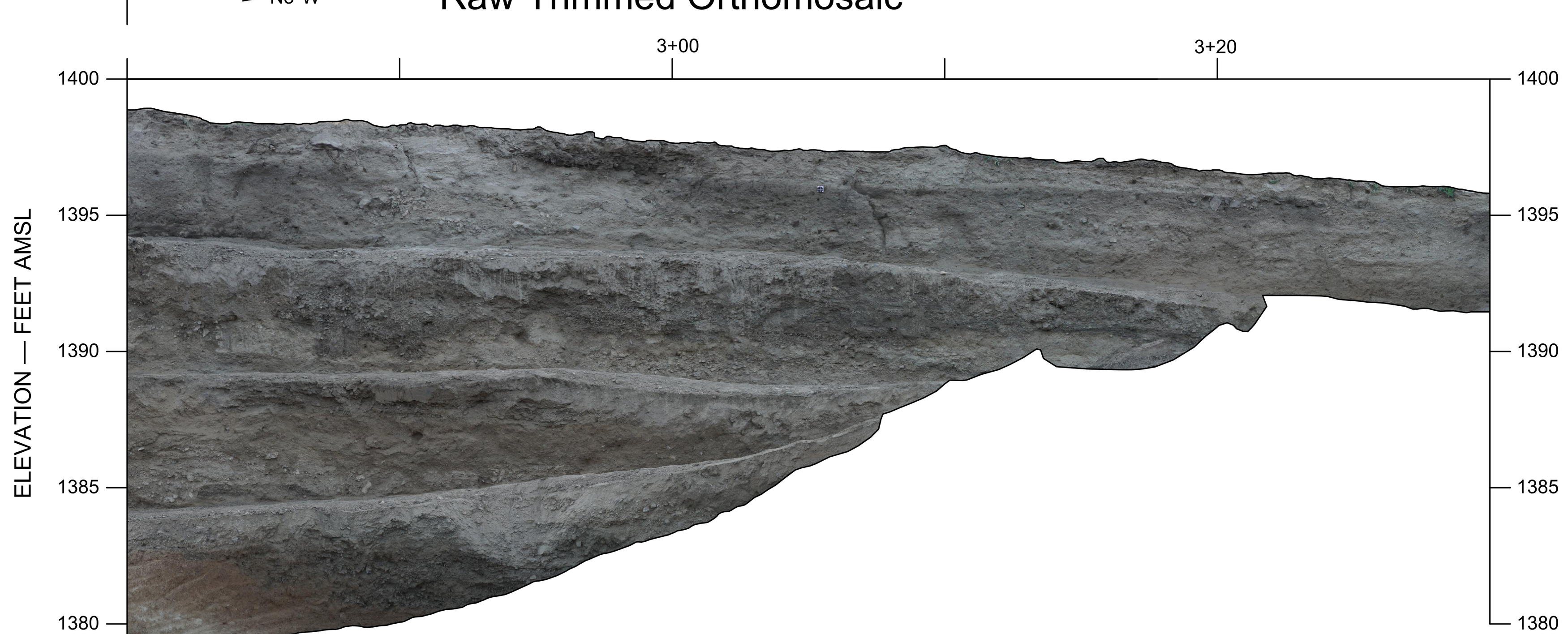
Trench FT-3

View North

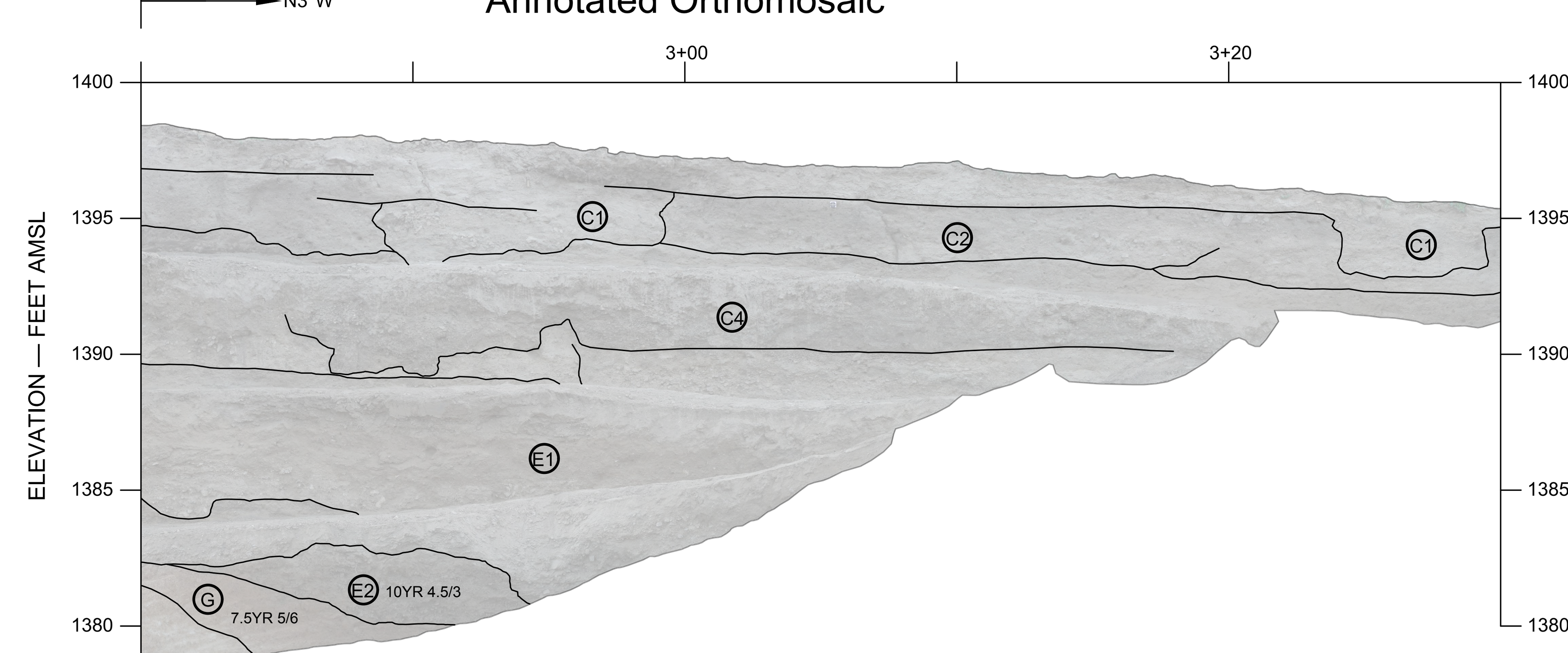
Raw Trimmed Orthomosaic

Annotated Orthomosaic

Raw Trimmed Orthomosaic



Annotated Orthomosaic



Refer to Plate No. 4 for unit descriptions

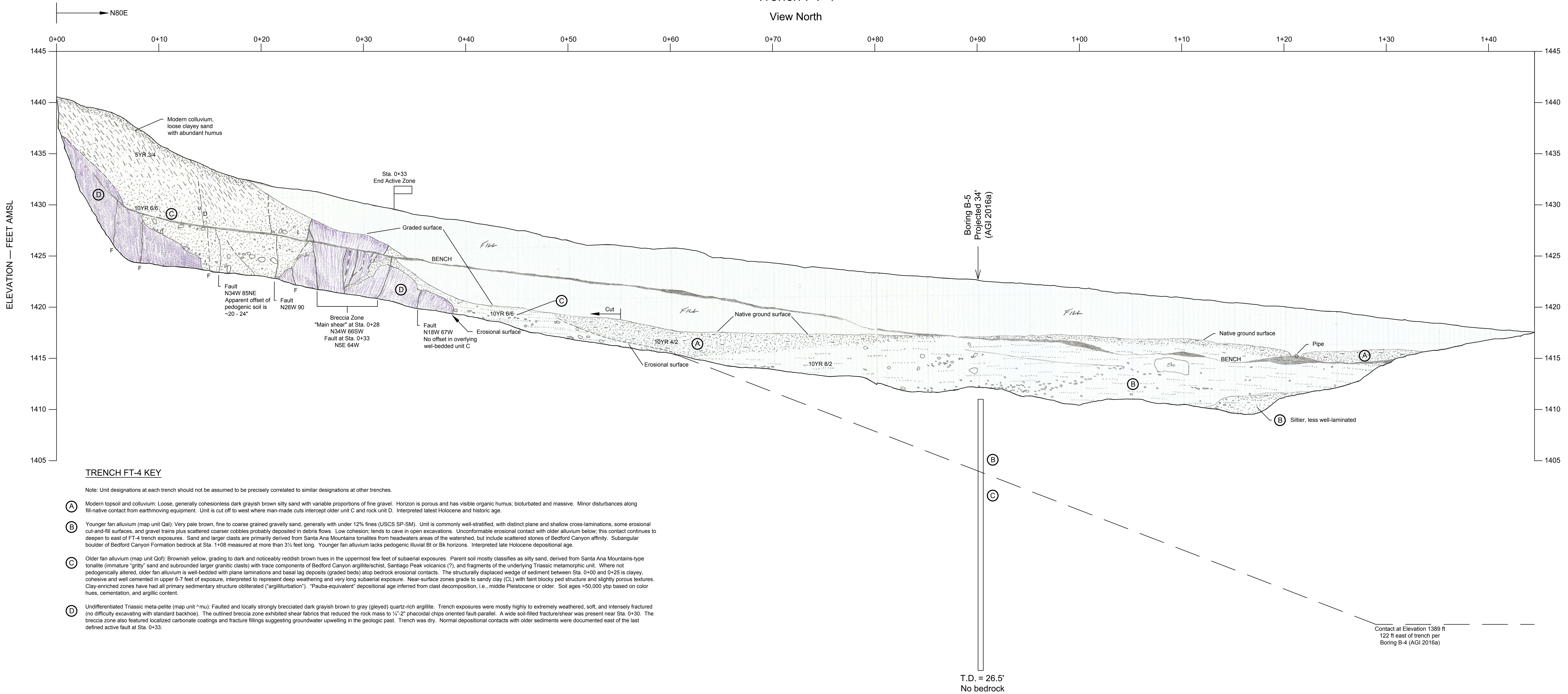
0 5 10 20

SCALE: 1"=5' HORIZONTAL AND VERTICAL

FAULT TRENCH LOG	
TENTATIVE TRACT MAP NO. 37154, TEMESCAL VALLEY, CA	
PROJECT NO. 4252-F	DATE: 5/31/17
PLATE NO. 5	

Trench FT-4

View North



TRENCH FT-4 KEY

Note: Unit designations at each trench should not be assumed to be precisely correlated to similar designations at other trenches.

(A) Modern topsoil and colluvium: Loose, generally cohesionless dark grayish brown silty sand with variable proportions of fine gravel. Horizon is porous and has visible organic humus; bioturbated and massive. Minor disturbances along fill-native contact from earthmoving equipment. Unit is cut off to west where man-made cuts intercept older unit C and rock unit D. Interpreted latest Holocene and historic age.

(B) Younger fan alluvium (map unit Qal): Very pale brown, fine to coarse grained gravelly sand, generally with under 12% fines (USCS SP-SM). Unit is commonly well-stratified, with distinct plane and shallow cross-laminations, some erosional cut-and-fill surfaces, and gravel trains plus scattered coarser cobbles probably deposited in debris flows. Low cohesion; tends to cave in open excavations. Unconformable erosional contact with older alluvium below; this contact continues to deepen to east of FT-4 trench exposures. Sand and larger clasts are primarily derived from Santa Ana Mountains tonalites from headwaters areas of the watershed, but include scattered stones of Bedford Canyon affinity. Subangular boulder of Bedford Canyon Formation bedrock at Sta. 1+08 measured at more than 3½ feet long. Younger fan alluvium lacks pedogenic illuvial Bt or Bk horizons. Interpreted late Holocene depositional age.

(C) Older fan alluvium (map unit Qof): Brownish yellow, grading to dark and noticeably reddish brown hues in the uppermost few feet of subaerial exposures. Parent soil mostly classifies as silty sand, derived from Santa Ana Mountains-type tonalite (immature “gritty” sand and subrounded larger granitic clasts) with trace components of Bedford Canyon argillite/schist, Santiago Peak volcanics (?), and fragments of the underlying Triassic metamorphic unit. Where not pedogenically altered, older fan alluvium is well-bedded with plane laminations and basal lag deposits (graded beds) atop bedrock erosional contacts. The structurally displaced wedge of sediment between Sta. 0+00 and 0+25 is clayey, cohesive and well cemented in upper 6-7 feet of exposure, interpreted to represent deep weathering and very long subaerial exposure. Near-surface zones grade to sandy clay (CL) with faint blocky ped structure and slightly porous textures. Clay-enriched zones have had all primary sedimentary structure obliterated (“argilliturbation”). “Pauba-equivalent” depositional age inferred from clast decomposition, i.e., middle Pleistocene or older. Soil ages >50,000 ybp based on color hues, cementation, and argillic content.

(D) Undifferentiated Triassic meta-pelite (map unit ^mu): Faulted and locally strongly brecciated dark grayish brown to gray (gleyed) quartz-rich argillite. Trench exposures were mostly highly to extremely weathered, soft, and intensely fractured (no difficulty excavating with standard backhoe). The outlined breccia zone exhibited shear fabrics that reduced the rock mass to ¼”-2" phacoidal chips oriented fault-parallel. A wide soil-filled fracture/shear was present near Sta. 0+30. The breccia zone also featured localized carbonate coatings and fracture fillings suggesting groundwater upwelling in the geologic past. Trench was dry. Normal depositional contacts with older sediments were documented east of the last defined active fault at Sta. 0+33.

0 5 10 20

SCALE: 1"=5' HORIZONTAL AND VERTICAL

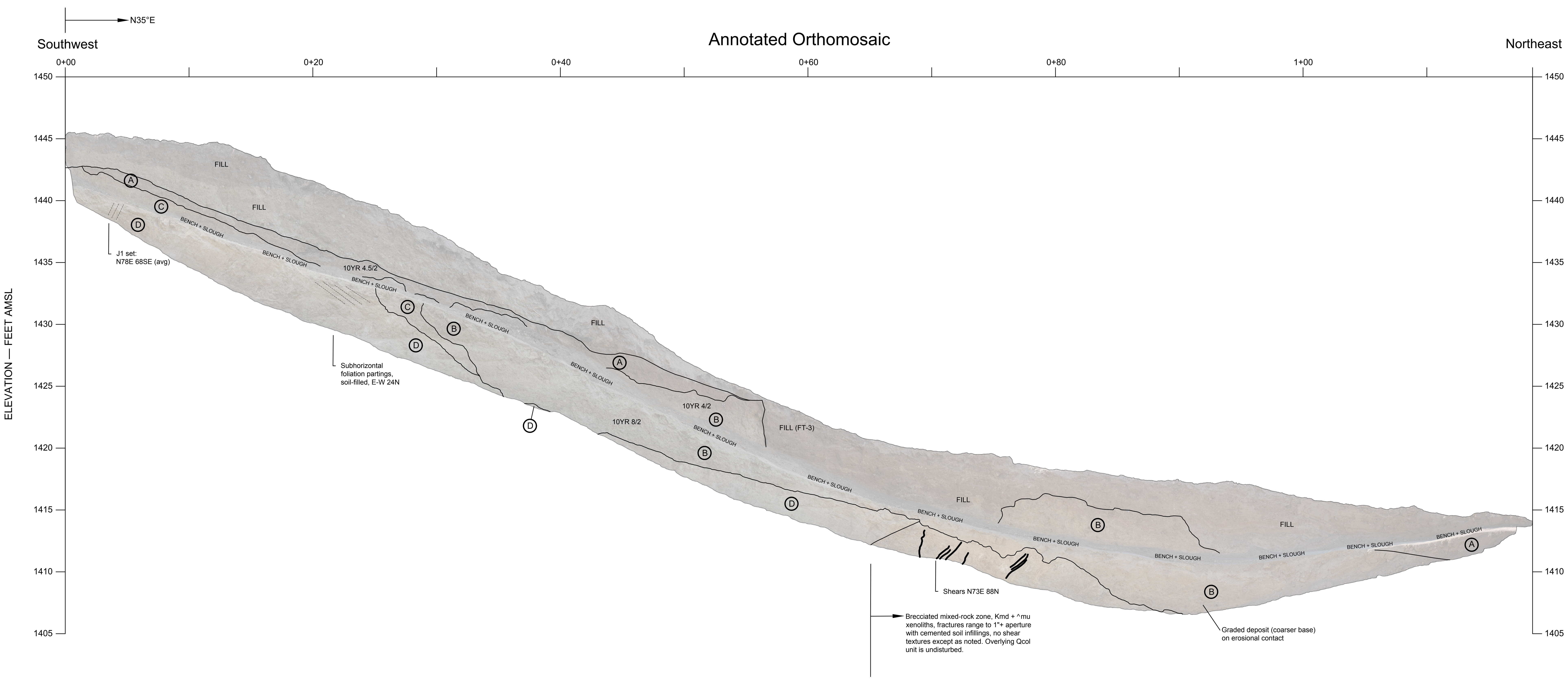
AGI	FAULT TRENCH LOG		
	TENTATIVE TRACT MAP NO. 37154, TEMESCAL VALLEY, CA		
	PROJECT NO. 4252-F	DATE: 5/31/17	**PLATE NO. 6**

Trench FT-5

View Northwest

Raw Trimmed Orthomosaic

Annotated Orthomosaic



TRENCH FT-5 NOTES & KEY

Excavation and Imagery Information

Trench FT-5 was opened to connect subaerial exposures of bedrock in the "East Cut" with previously examined subsurface exposures in the benched FT-3 fault excavation. The trench was part of an objective to have continuous, if segmented, subsurface exposures from the southwestern end of Trench FT-2 to the tract boundary at the north end of Trench FT-3. Steep slopes and poor access meant the trench could not be opened until March 2016. Trench FT-3 was backfilled with non-engineered fill before starting the new excavation. A client-supplied Volvo EC480dl track excavator equipped with a 5-foot-wide bucket was used. Digging was easy in fill and natural soils. Moderately hard to hard excavating was observed in weathered granitic bedrock (partly a function of the large bucket).

Only one brief and low-intensity rainfall event occurred between initial excavation and logging. The trench was not materially impacted by the storm. Dry weather and the trench cleaning activities of shovel scraping, heavy brushing, and shop brush finishing removed minor tonal artifacts from variable soil moisture. Accordingly, depicted tonal contrasts are generally representative of actual differences in color value, hue, and chroma.

Fixed survey targets were nailed into the exposures by AGI and geo-located by Adkan Engineers according to State plane coordinates. Excavation observations and descriptive logging were completed by M. Doerschlag, CEG 1752 in the first week of April, 2016. Measurements and ground features were drawn onto non-overlapped monochrome working prints taken with point-and-shoot cameras and scaled to around 1" = 2' for later input into final CAD exhibits.

Orthomosaic Date:	March 31, 2016.
Camera:	Tripod mounted Sony α6000, 24 MP, 16 mm focal length at ISO 100. Remotely triggered via Bluetooth connection to smartphone. Average principal point spacing of ~3 feet, based on image line situated on the first bench below grade. Image count: 44.
SfM Modeling:	Pix4Dmapper Pro ver. 3.0.13 with 4X downsampling to create the dense point cloud surface. Data were projected to a vertical orthoplane oriented parallel to the trench axis, with a bearing as shown.

Units

Note: Unit designations at each fault trench are arbitrary, and should not be correlated to similar designations at other TTM 37154 trenches or AGI excavations on neighboring properties.

Fill: In slope cut, consists of layered, heterogenous and loose mixtures of rock fragments and silty sand matrix derived from the "East Cut". Darker materials were derived from Triassic metasediments; lighter layer was derived from weathered monzogranite. The fill was pushed or dumped from the cut onto unprepared ground surfaces, burying some stumps and shrubs along the fill-native contact. Northwest of Sta. 0+56, the fill consists of uniformly brown trench backfill placed in the former FT-3 excavation.

(A) Modern "topsoil" and colluvium: Primarily loose to medium dense, very silty sand with small proportions of angular gravel and clay. Fine-grained components may reach 40%. Friable and crumbly when moist, but the clay imparts cohesion when dried back. Color is dark grayish brown to grayish brown, with typical decreasing-upward color values toward an organic-rich AO horizon buried by fill. Large spherical vesicles and smaller pores are ubiquitous. Exhibits internal disturbance from roots and bioturbation, but sometimes has an indistinct laminar (creep-induced) texture. Truncated by man-made cut and subsequent fill at the south end of the trench exposure. The basal zones are gradational over an inch or two with residual soil or older colluvial unit. Interpreted latest Holocene (<2 ka) and historic age.

(B) Colluvium (map unit Qcol): Variegated grayish brown to very pale brown, mostly massive, moderate-cohesion silty sandy gravel or silty gravelly sand. Matrix has trace to some clay, and is porous. Generally exhibits a sharp and slightly irregular erosional basal contact with crystalline bedrock, but is locally blended into scraps of clayey residual soil (e.g., near Sta. 0+75). Contains a mix of dark notably angular metasedimentary rock fragments and much less common speckled weathered monzodiorite rock. Clasts sometimes define a very crude fining-up texture above the basal contact, with very indistinct laminar texture interpreted to be a creep-related artifact and not true bedding. Undisturbed above bedrock shears. Age uncertain – illuvial clay and reddish hues near survey target at Sta. 0+53 hint strongly at a solum of >>15 ka development age under modern colluvium and fill, thus preliminarily classifying the unit as pre-Holocene age. Provisional correlation to unit F in FT-3.

(C) Residual soil: Discontinuous zone of yellowish brown clayey sand, massive, cohesive, and generally not visibly porous. Created by *in situ* decomposition of parent granitic bedrock (not a transported material). Has been stripped away from areas where colluvium directly contacts basement rock. Age is pre-Holocene.

(D) Monzodiorite (map unit Kmd): Fine to medium grained; weakly foliated; equigranular hypidiomorphic texture. Mostly highly weathered, soft or friable, and very weak except locally toward trench bottom where limited moderately weathered rock was hard to excavate. Typically exhibits very close to medium-spaced joints and minor shears. Foliation and/or unloading partings are frequently wide to very wide and soil-filled within 3-4 feet of former subaerial exposures. Intrusive age: Cretaceous.

0 5 10 20

SCALE: 1"=5' HORIZONTAL AND VERTICAL

AGI	**FAULT TRENCH LOG**		
	TENTATIVE TRACT MAP NO. 37154, TEMESCAL VALLEY, CA		
	PROJECT NO. 4252-F	DATE: 5/31/17	**PLATE NO. 7**

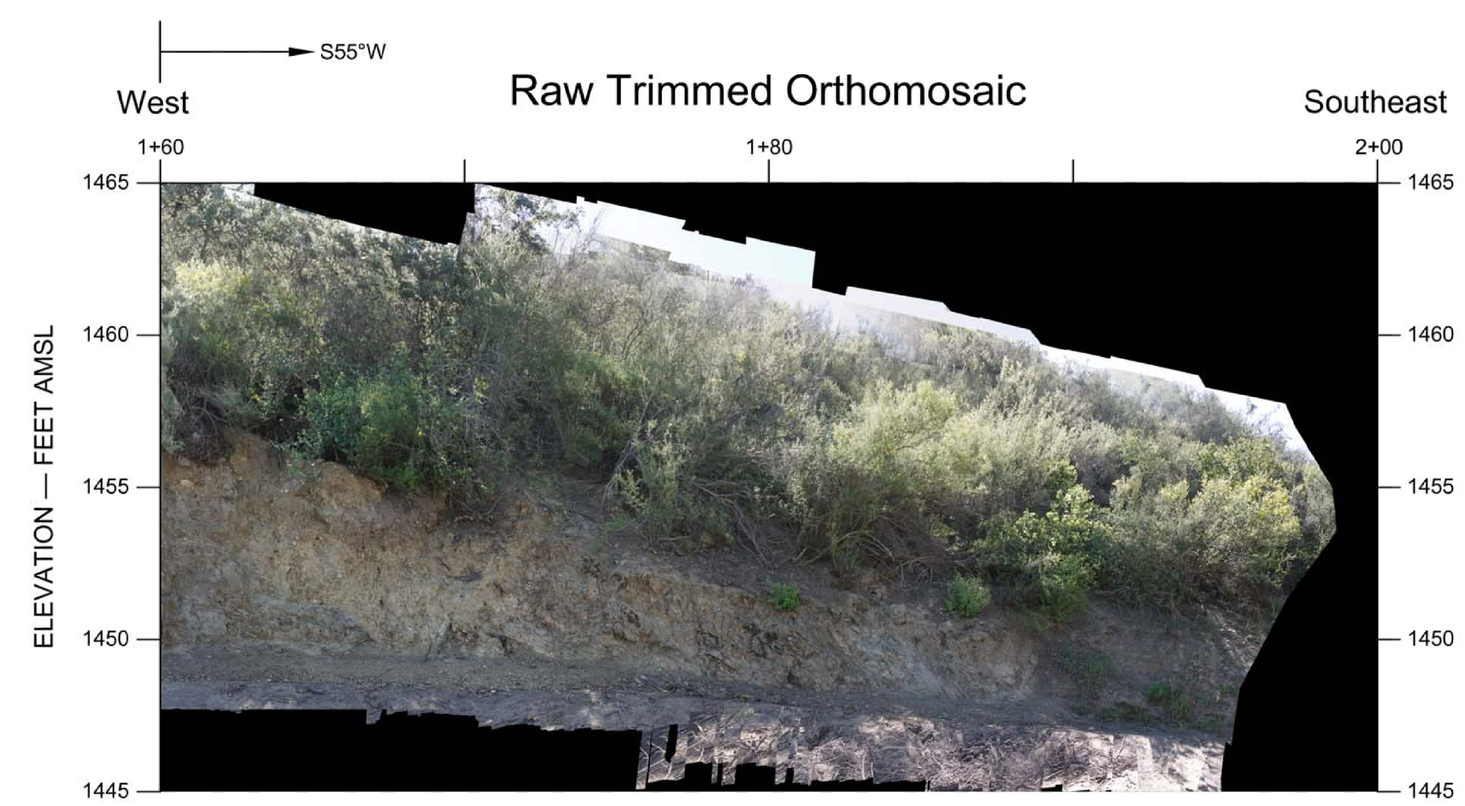
East Cut

View Southeast

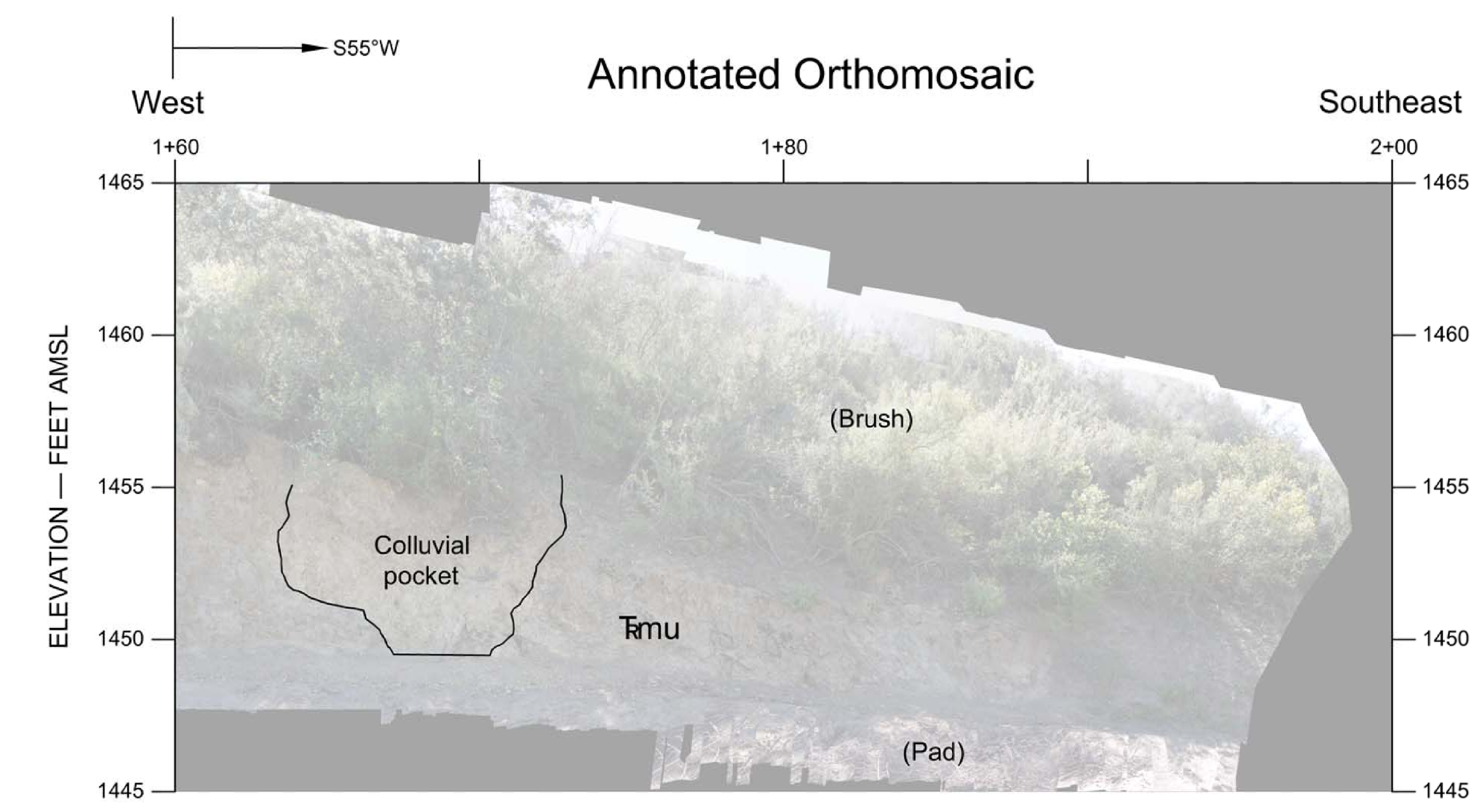
Raw Trimmed Orthomosaic

Annotated Orthomosaic

Raw Trimmed Orthomosaic



Annotated Orthomosaic



"EAST CUT" NOTES & KEY

Excavation and Imagery Information

East Cut represents a man-made bedrock slope created sometime between 1974 and 1980. The average slope inclination is about 59 degrees (0.66:1). Uneven gouges and benches from the dozer blade and rippers can still be found on the slope; the slope appears to have been entirely machine-excavated. East Cut links subsurface exposures created in trenches FT-2, FT-5, and FT-3 to produce a continuous data record spanning the TTM 37154 development area. The importance of the cut was established in pre-job planning, when reconnaissance found the contact line between crystalline intrusive rocks and older metamorphic host rocks was partly exposed in the slope toe area. The cut is expected to remain undisturbed by future construction.

The slope and slope toe areas were cleared of brush and small trees. Some metal fencing and tractor implements could not be moved, and are depicted in the orthomosaic. Accumulated slough was raked and shoveled from most small benches, and the resulting rock face washed using a water truck side spray. Fixed survey targets were nailed into the exposures by AGI and geo-located by Adkan Engineers according to State plane coordinates. Excavation observations and descriptive logging were completed by M. Doerschlag, CEG 1752 in April, 2016. Measurements and ground features were drawn onto a draft verison of the Structure from Motion (SfM) orthomosaic.

Orthomosaic Date:	April 1, 2016.
Camera:	Tripod mounted Sony α6000, 24 MP, 16 mm focal length at ISO 100. Remotely triggered via Bluetooth connection to smartphone. Average principal point spacing of ~8 feet (north half) to 4 feet (south half). Image count: 29.
SfM Modeling:	Pix4Dmapper Pro ver. 3.0.13 with 4X downsampling to create the dense point cloud surface. Data were projected to a vertical orthoplane oriented approximately parallel to the slope toe, with a bearing as shown. Pixel resolution varies with slope height and variations in offset to the slightly wavy slope face.

Bedrock Units

Kmd Monzodiorite: Consists of fine- to locally medium-grained, speckled, quartz-poor, and weakly foliated leucocratic granitic rock. Monzodiorite is mapped for some distance east of the project where the typical geomorphic expression comprises eroded, rolling slopes that are free of residual corestones. Natural outcroppings are rare. \-The East Cut represents the sole on-site surface exposure in TTM 37154. The monzodiorite is often pervasively sheared, closely to intensely fractured, soft, crumbly, and highly to extremely weathered. Exposures toward the left edge of the orthomosaic can be dug with shovels. A wavy intrusive contact with older metamorphic host rocks is exposed in the slope, along with one minor shear. Prominent joint sets in the image would be N65-70°E 65SE, N80°W 75N, and some N-S with into-slope dips of 70-75°. Inferred Cretaceous age.

TRmu Impure quartzite and phyllite: Moderately hard to very hard, fine-grained, and thoroughly recrystallized\-. Dark grayish brown and sometimes nearly purplish black colors plus degree of competency are distinctive. The cut exposes rock classified as highly weathered (within one to three feet of original ground surfaces) to slightly weathered, with the latter judged strong. The rock mass does not have distinct compositional layering. Wavy foliation plane partings are uncommon, with mean foliation orientations near N80W, 45-50°S dip (i.e., into-slope). A triplet of fairly distinct joint sets and common random discontinuities result in pyramidal and wedge-shaped fragments. Principal sets are oriented about N65°E, 65°SE; N75W, 75N°; and N35E, 55-70°NW. Joint spacing ranges from less than an inch to around 12 inches for regular sets and closer for most random and non-persistent fractures. Intact blocks are only rarely larger than a few inches across. Most joints have very narrow or tight apertures, are wavy over spans of 2 to 5 feet, and have coarse first-order asperities.

0 5 10 20

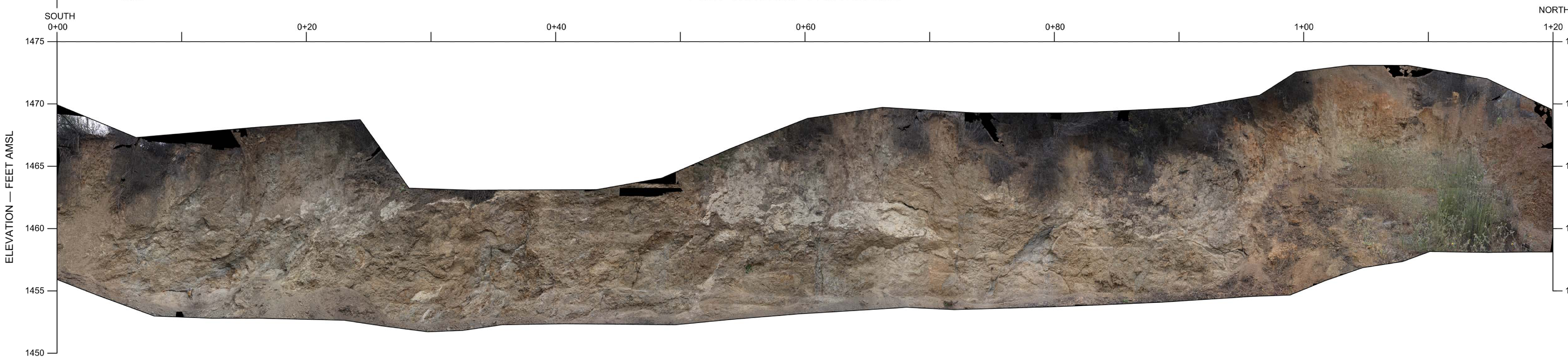
SCALE: 1"=5' HORIZONTAL AND VERTICAL

SLOPE EXCAVATION LOG	
TENTATIVE TRACT MAP NO. 37154, TEMESCAL VALLEY, CA	
PROJECT NO. 4252-F	DATE: 5/31/17
PLATE NO. 8	

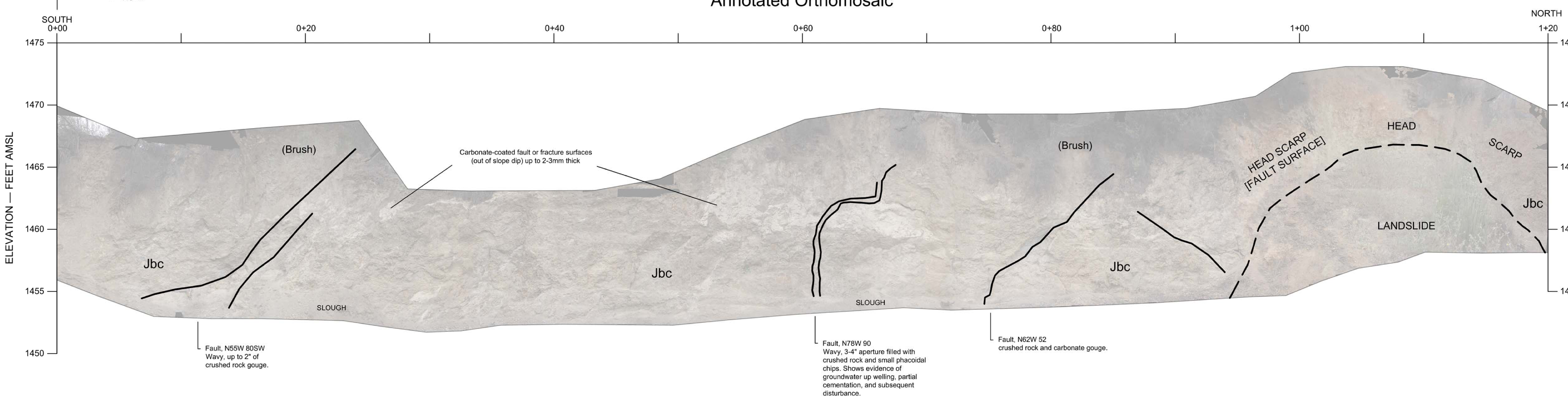
West Cut

View West

Raw Trimmed Orthomosaic



Annotated Orthomosaic



West Cut Extension

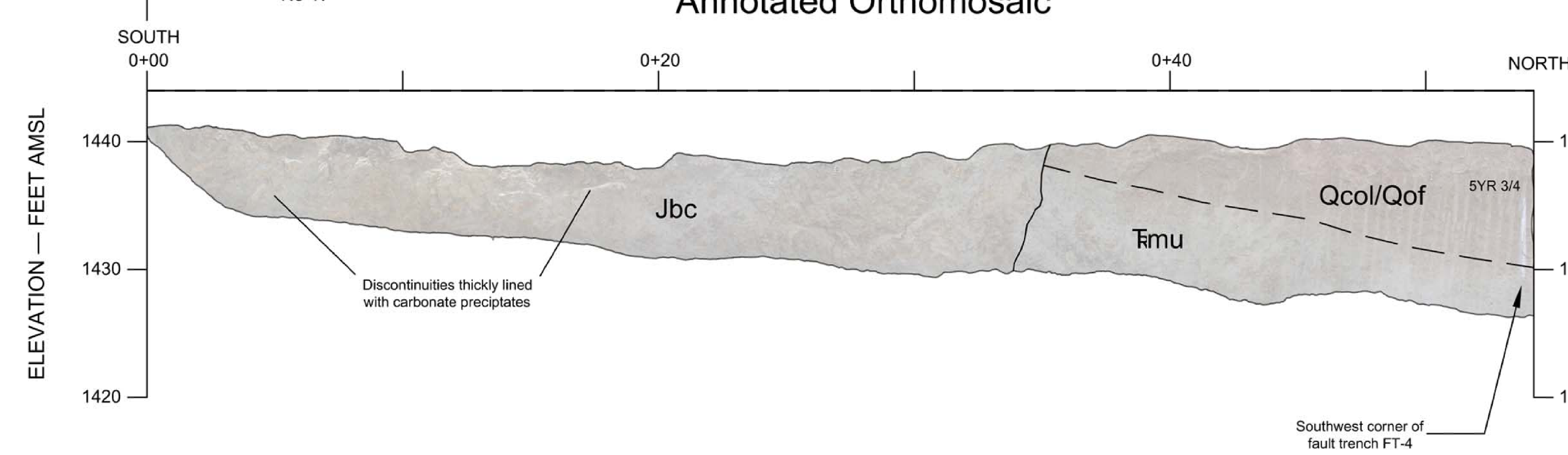
View West

Raw Trimmed Orthomosaic

West Cut Extension

View West

Annotated Orthomosaic



"WEST CUT" NOTES & KEY

Excavation and Imagery Information

West Cut represents a non-engineered and roughly cut bedrock slope created sometime before 1984. Wedge and block glide slope failures have resulted in a very irregular profile. Local slope inclinations range from almost vertical to less than 45 degrees on some slip surfaces. The West Cut is located west of the geomorphic trace of the main Glen Ivy South fault line based on low scarps in alluvium. The cut is expected to remain undisturbed by future construction.

The heavily overgrown slope and slope toe areas were manually cleared of brush. Some light scraping and work with stiff brushes was completed, but naturally weathered surfaces were ultimately found to best accentuate colors and structural details. Fixed survey targets were nailed into the exposures by AGI and geo-located by Adkan Engineers according to State plane coordinates. Excavation observations and descriptive logging were completed by M. Doerschlag, CEG 1752 in April, 2016. Measurements and ground features were drawn onto a draft verison of the Structure from Motion (SfM) orthomosaic.

Orthomosaic Date:	April 1, 2016.
Camera:	Tripod mounted Sony α6000, 24 MP, 16 mm focal length at ISO 100. Remotely triggered via Bluetooth connection to smartphone. Average principal point spacing of under 3 feet due to limited available space. Image count: 52.
SfM Modeling:	Pix4Dmapper Pro ver. 3.0.13 with 4X downsampling to create the dense point cloud surface. Data were projected to a vertical orthoplane oriented approximately parallel to the slope toe, with a bearing as shown. Pixel resolution varies with slope height and variations in offset to the irregular slope face.

Bedrock Unit

Jbc — Bedford Canyon Formation: Primarily fine-grained, faintly layered or massive wacke and impure quartzite of low metamorphic grade. The unit weathers into smooth soil-mantled slopes. West Cut rocks are variably sheared and brecciated, but rarely intact. The cut exposes progressively more-reddish hues and stronger chroma plus very close or intense fracturing beyond the landslide slump at the north end of the trench. Shears and joints are pervasively lined with whitish-colored precipitates of calcium carbonate. This and very common iron oxide staining in discontinuities and fault gauge hint at past upwelling of groundwater. Most joints are also quite rough and wavy. Planar joints or faults have contributed to wedge and block glide failures of the cut slope brow; some of these surfaces are highlighted in the orthomosaic by the pale carbonate coatings. Compositional layering is either absent or very hard to discern. \-Mostly classified as moderately to highly weathered, sometimes "punky" altered character, and moderately hard to low hardness.

"WEST CUT EXTENSION" NOTES & KEY

Excavation and Imagery Information

The West Cut Extension was opened with the same standard backhoe used to excavate fault trench FT-4. An existing crudely built and overgrown bedrock cut slope was notched at its base to create a low vertical exposure. The north end of the new cut was connected to the west end of Trench FT-4. The location was hypothesized to span a tectonic contact between the two metamorphic units identified by AGI on the property. The new cut was loosely backfilled after examination and is no longer visible.

The West Cut Extension was about 20 feet lower in elevation than the primary West Cut. The orthomodel was created independently of the larger cut. Fixed survey targets were nailed into the exposures by AGI and geo-located by Adkan Engineers according to State plane coordinates. Excavation observations and descriptive logging were completed by M. Doerschlag, CEG 1752 in April, 2016. Due to intense deformation, reliable structural measurements could not be obtained.

Orthomosaic Date:	April 1, 2016.
Camera:	Tripod mounted Sony α6000, 24 MP, 16 mm focal length at ISO 100. Remotely triggered via Bluetooth connection to smartphone. Average principal point spacing of under 3 feet due to limited available space and below-grade exposure toe. Image count: 24.
SfM Modeling:	Pix4Dmapper Pro ver. 3.0.13 with 4X downsampling to create the dense point cloud surface. Data were projected to a vertical orthoplane oriented parallel to the cut face, with a bearing as shown.

Units

Qcol/Qof — Clayey gravel / gravelly clay: Represents the onlap basal sequence of older fan alluvium and locally derived colluvium atop Triassic bedrock. Small blocky chips of dark quartzite are surrounded by silty clay, with notably strong red hues from pedological alteration. Blocky and prismatic ped features are partly obscured by tool marks and surface dessication. Based on FT-4 exposures, clayey gravel grades laterally into more-typical clayey sand derived from granitic sources within a horizontal distance of a few tens of feet. The soil appears to be only in tectonic and not sedimentary contact with Bedford rocks. There are no noticeable faults transecting the unit, even though the underlying bedrock is shattered and broken. Unit age is middle Pleistocene or older per Morton & Miller (2006); pedogenic soil is interpreted to be >50 ka development age.

Jbc — Bedford Canyon Formation: Intensely deformed and brecciated wacke and impure quartzite of low metamorphic grade. Brownish tones predominate in this unit. As in the main West Cut, shears and joints are pervasively lined with quite thick whitish-colored and hard precipitates of calcium carbonate. This and very common iron oxide staining in discontinuities and fault gauge hint at past upwelling of groundwater. The intact rock blocks are surrounded by grayish mixes of clay and rock flour. Compositional layering, if formerly present, has been completely disrupted by tectonic churning. \-Mostly classified as moderately to highly weathered, sometimes "punky" altered character, and moderately hard to low hardness.

Ŧmu — Impure quartzite and phyllite: Intensely brecciated with reticulate narrow to wide discontinuity apertures filled with grayish clayey fillings similar to adjacent Bedford Canyon rocks. The small intact fragments still \-show the dark grayish brown and sometimes nearly purplish black colors that are distinctive to the unit. Based on FT-4 exposures, brecciation intensity decreases northeast, away from the interpreted "main" fault line depicted on the image.

0 5 10 20

SCALE: 1"=5' HORIZONTAL AND VERTICAL

SLOPE EXCAVATION LOG

TENTATIVE TRACT MAP NO. 37154, TEMESCAL VALLEY, CA

PROJECT NO. 4252-F | DATE: 5/31/17 | PLATE NO. 9