

Fault Hazard Assessment

West Beverly Hills Lineament at
Beverly Hills High School

Metro Public Hearing
May 17, 2012



Leighton Consulting, Inc.

A LEIGHTON GROUP COMPANY

BEVERLY HILLS UNIFIED SCHOOL DISTRICT

Investigation Team Organization

HILL, FARRER & BURRILL
KEVIN BROGAN

PRIMESOURCE
TIM BURESH, PE



Leighton Consulting, Inc.

JOE ROE, PG, CEG
Project Manager

PHILIP BUCHIARELLI, PG, CEG
Lead Geologist

ANDY PRICE, PG, CEG
Chief Geologist

TOM BENSON, PE, GE
Principal in Charge

ED BURROWS, PG, CEG
Internal Quality Reviewer

JEFF PFLUEGER, PG, CEG

SEAN RICHARDS, PG, CEG

AVI SCHWARTZ, PG
Project Geologist



ELDON GATH, PG, CEG
TANIA GONZALEZ, PG, CEG
Second Party Reviewer

MARK LEGG, PH.D.
Legg Geophysics
Geophysical Study

Robert C. Graham, Ph.D
UCR
Soil Microfabric

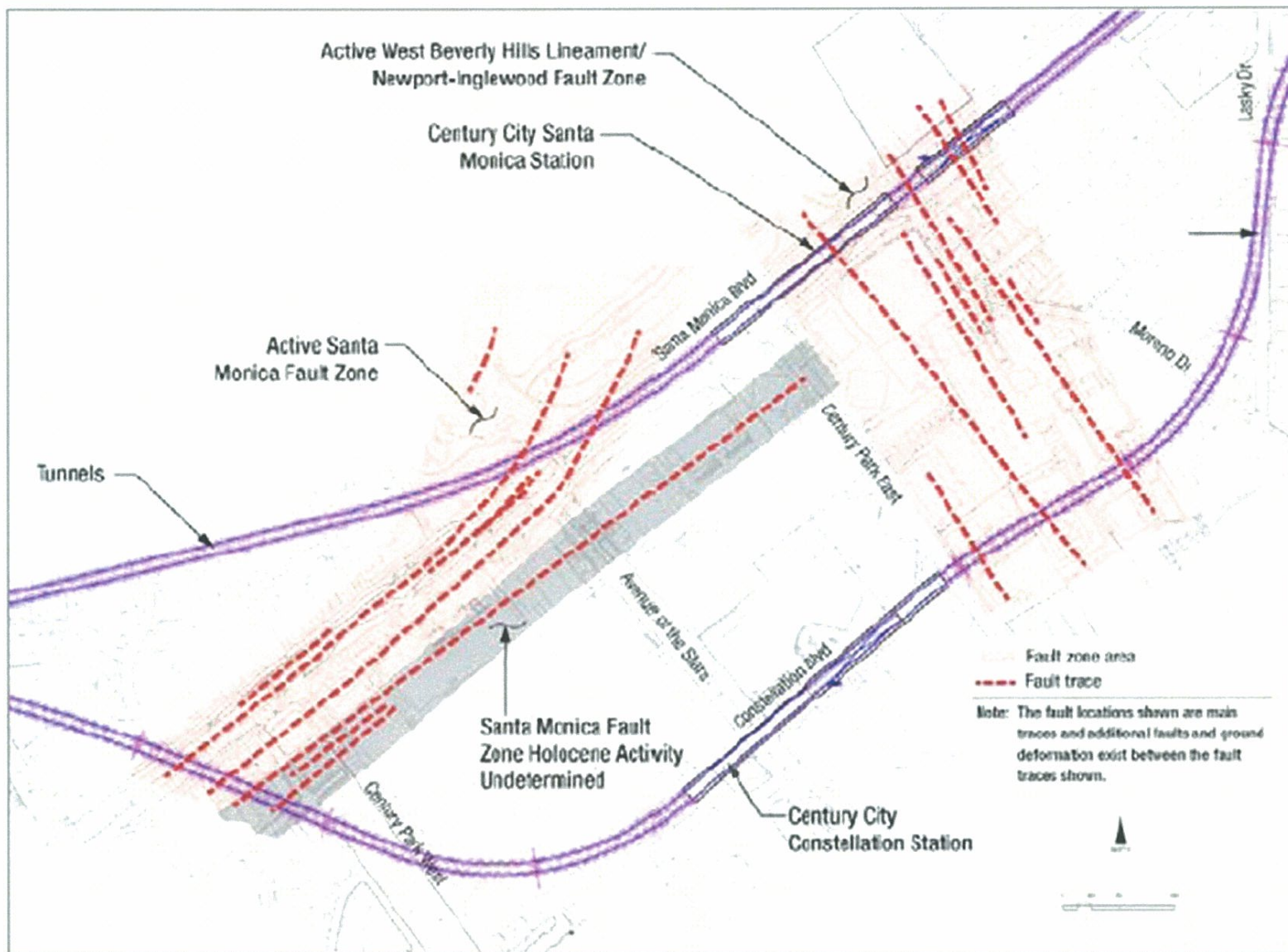
GLENN BORCHARDT
Soil Tectonics
Pedochronologist

EDWARD J. RHOADES
UCLA
Sedimentation Optical
Stimulated Luminescence



MILES KENNEY, PG
Overview Consultant

PB's Active Fault Map



**FAULT HAZARD ASSESSMENT OF
THE WEST BEVERLY HILLS LINEAMENT
BEVERLY HILLS HIGH SCHOOL
241 SOUTH MORENO DRIVE
BEVERLY HILLS, CALIFORNIA**

Prepared For

BEVERLY HILLS UNIFIED SCHOOL DISTRICT
255 South Lasky Drive
Beverly Hills, California 90212-3697

April 22, 2012

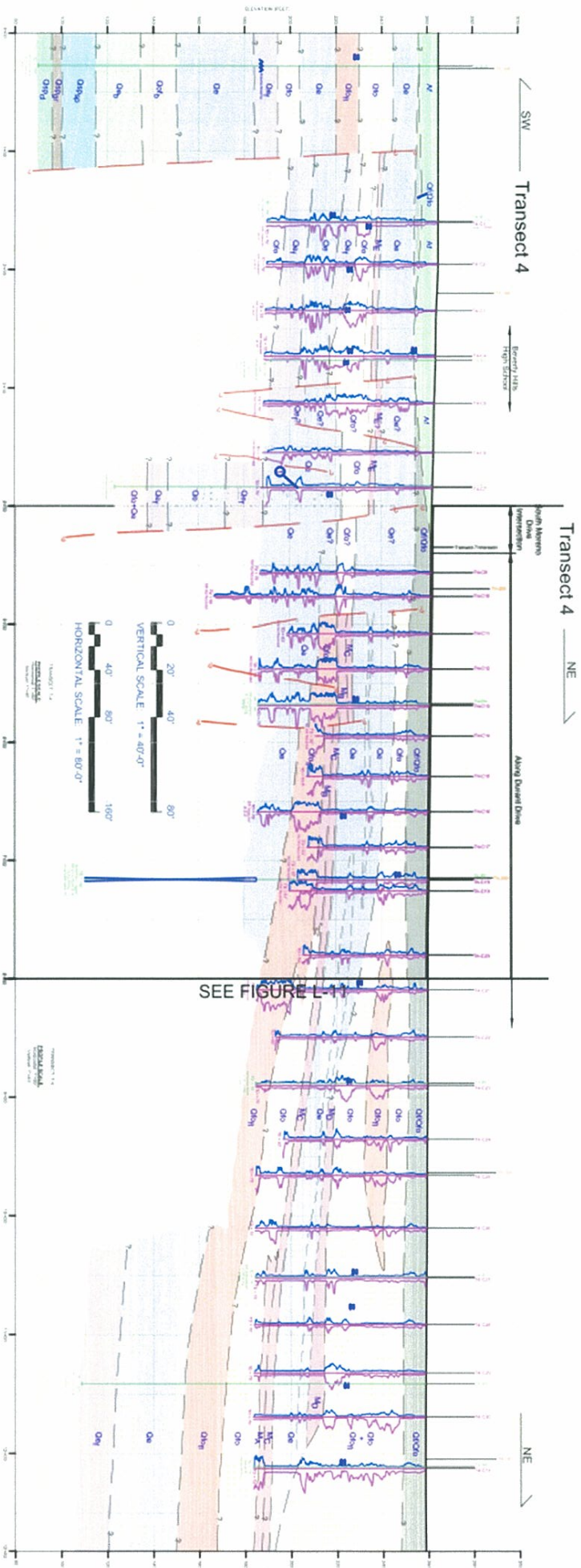
Project No. 603314-002



Leighton Consulting, Inc.
A LEIGHTON GROUP COMPANY

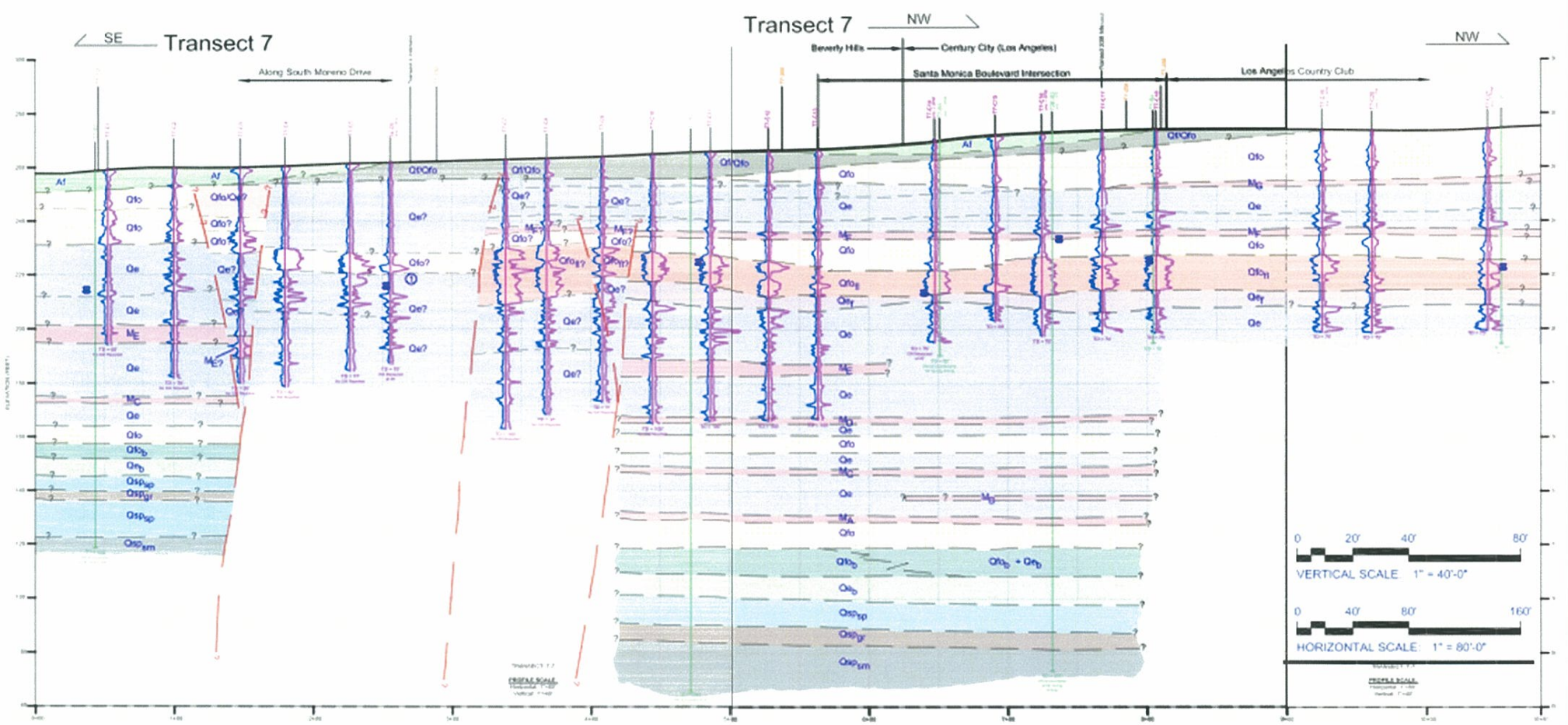
Report has been
delivered to School
District and California
Geological Survey

PB's Transect 4



Durant Drive - many faults

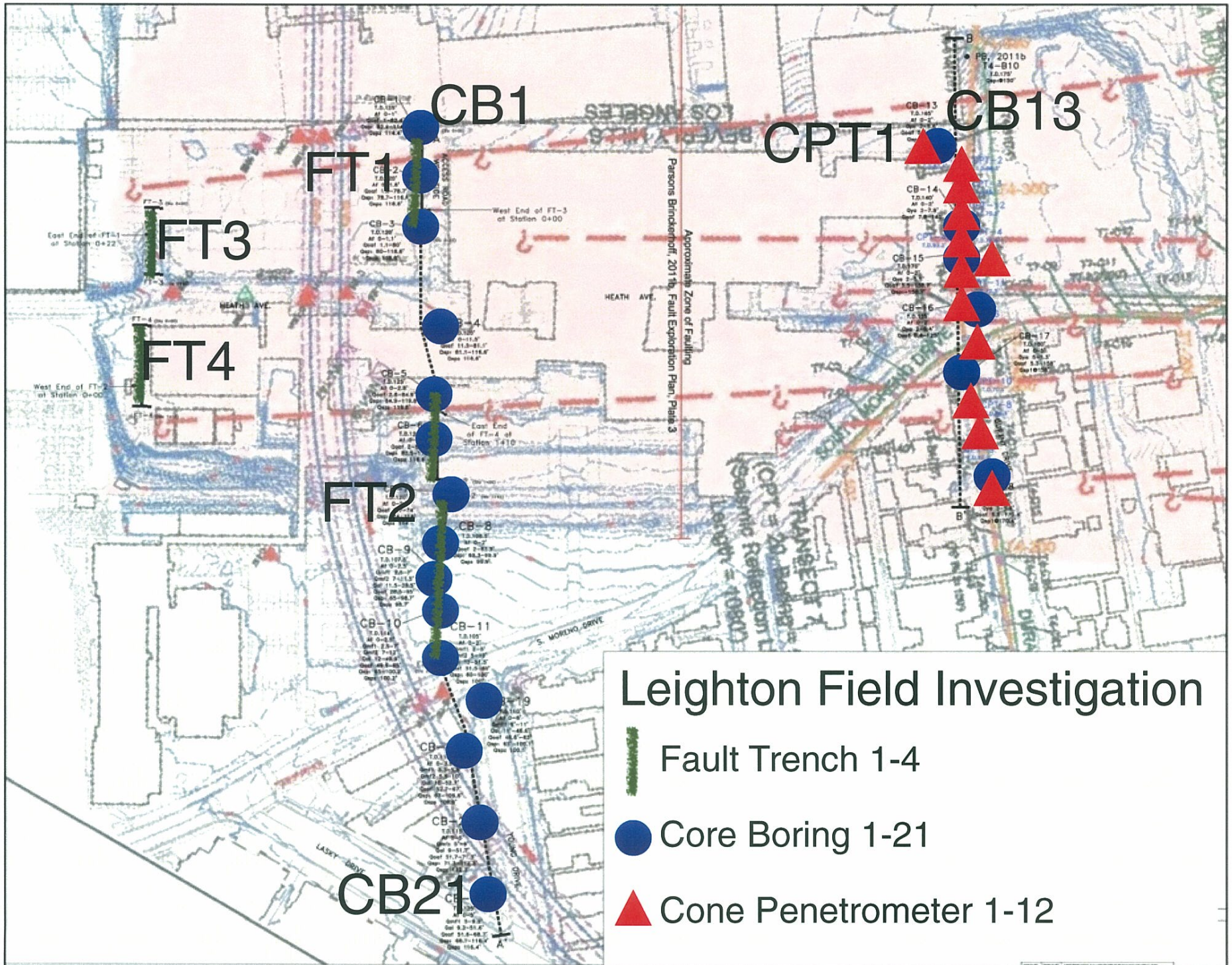
PB's Transect 7



S. Moreno Drive - many faults



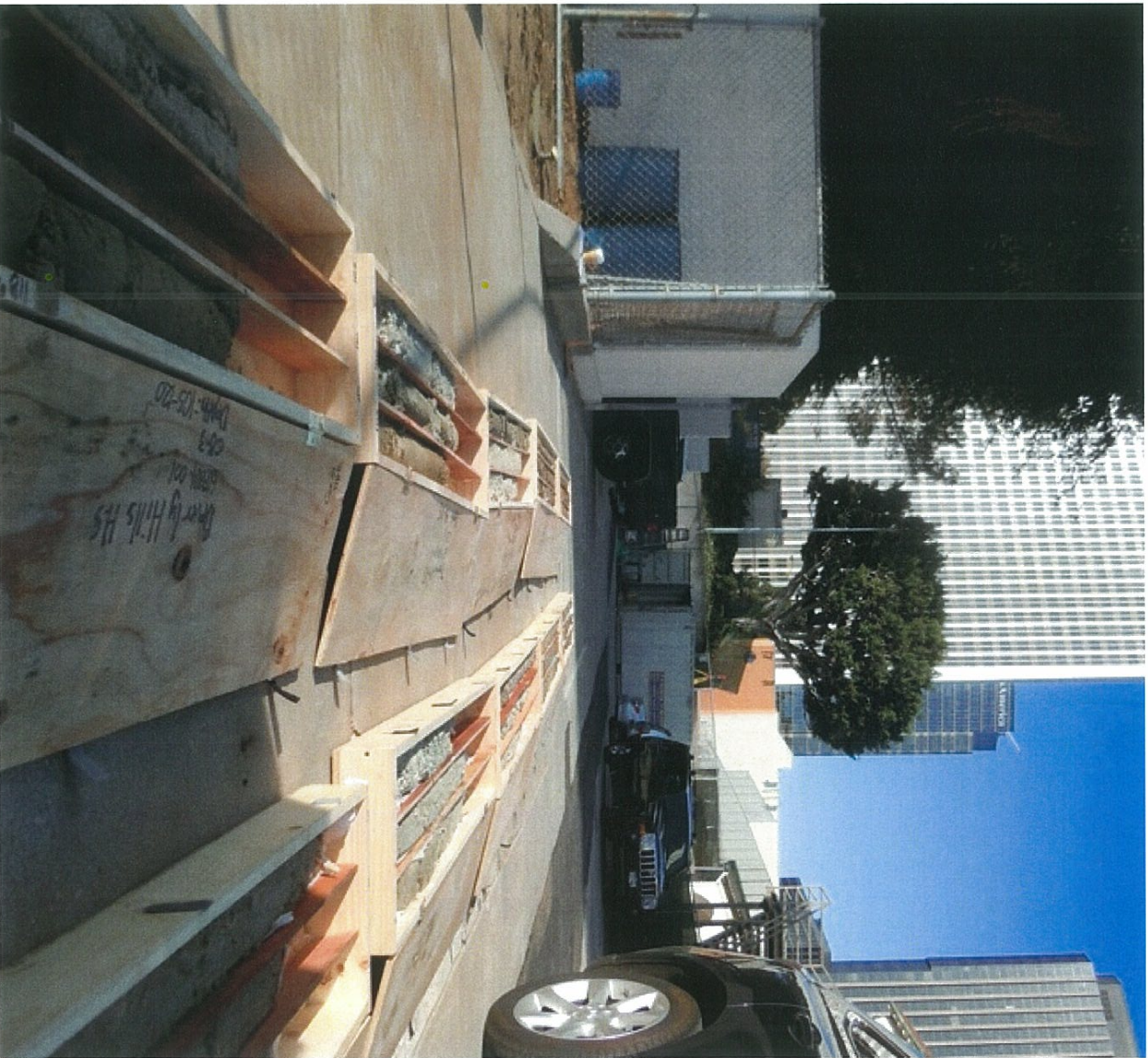
12.22.2011





Visual and Physical Correlation from Boring to Boring

- Enhances confidence in the conclusions





CB-3 @ 105-120' & CB-4



CB-3 @ 90-105' & CB-4



CB-3 @ 75-90' & CB-4

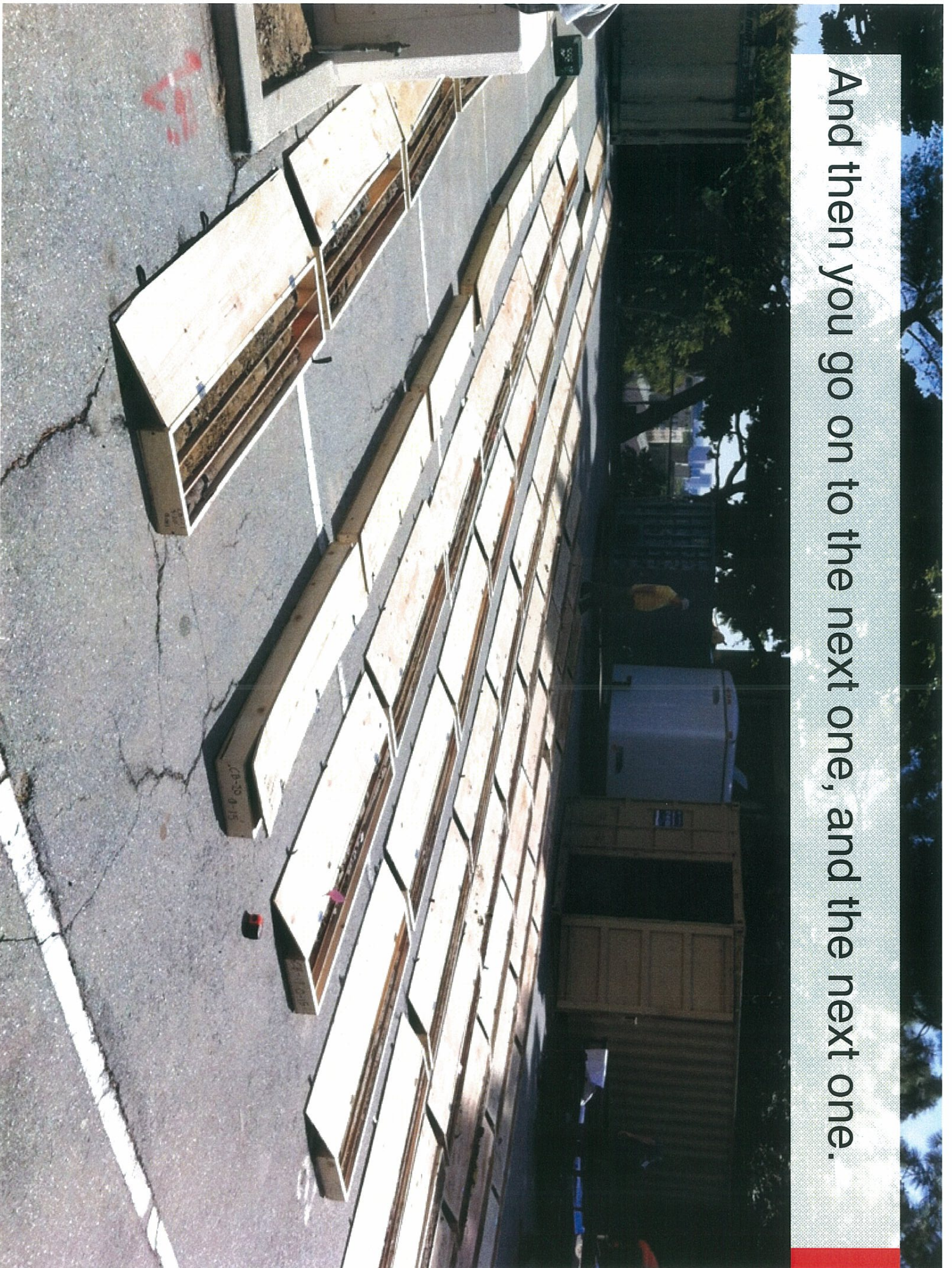


CB-3 @ 60-75' & CB-4



CB-3 @ 45-60' & CB-4

And then you go on to the next one, and the next one.

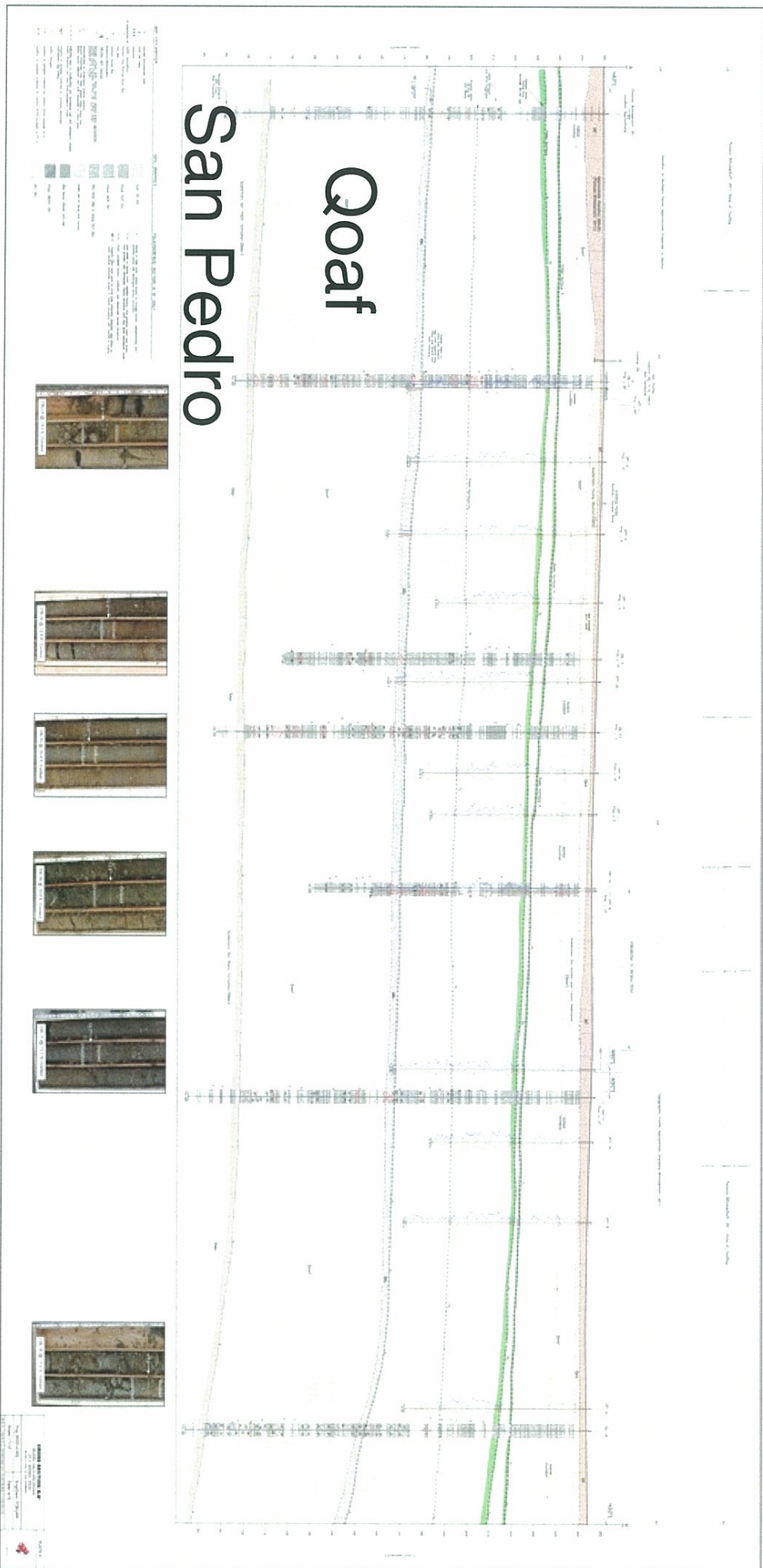


Leighton CB-13

PB T4-B10



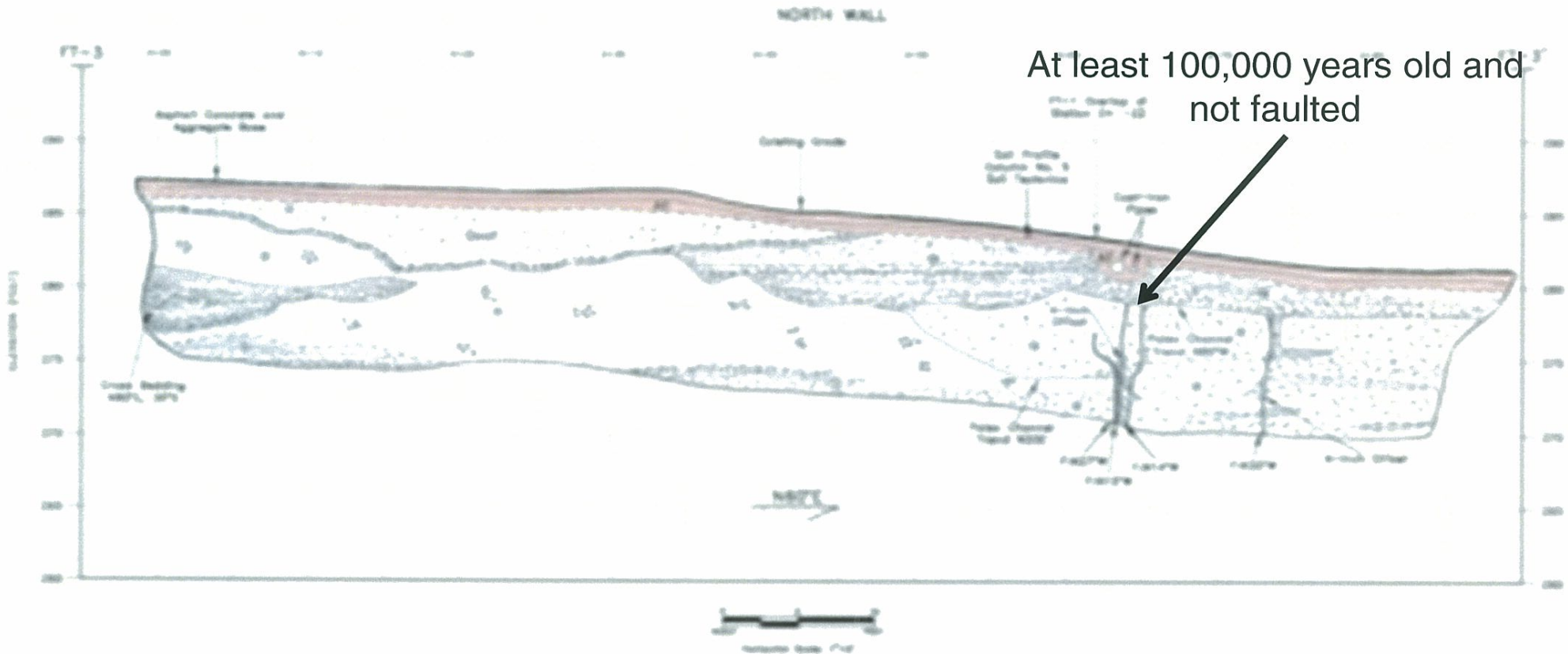
Boring Correlation





Fault Trench FT-3

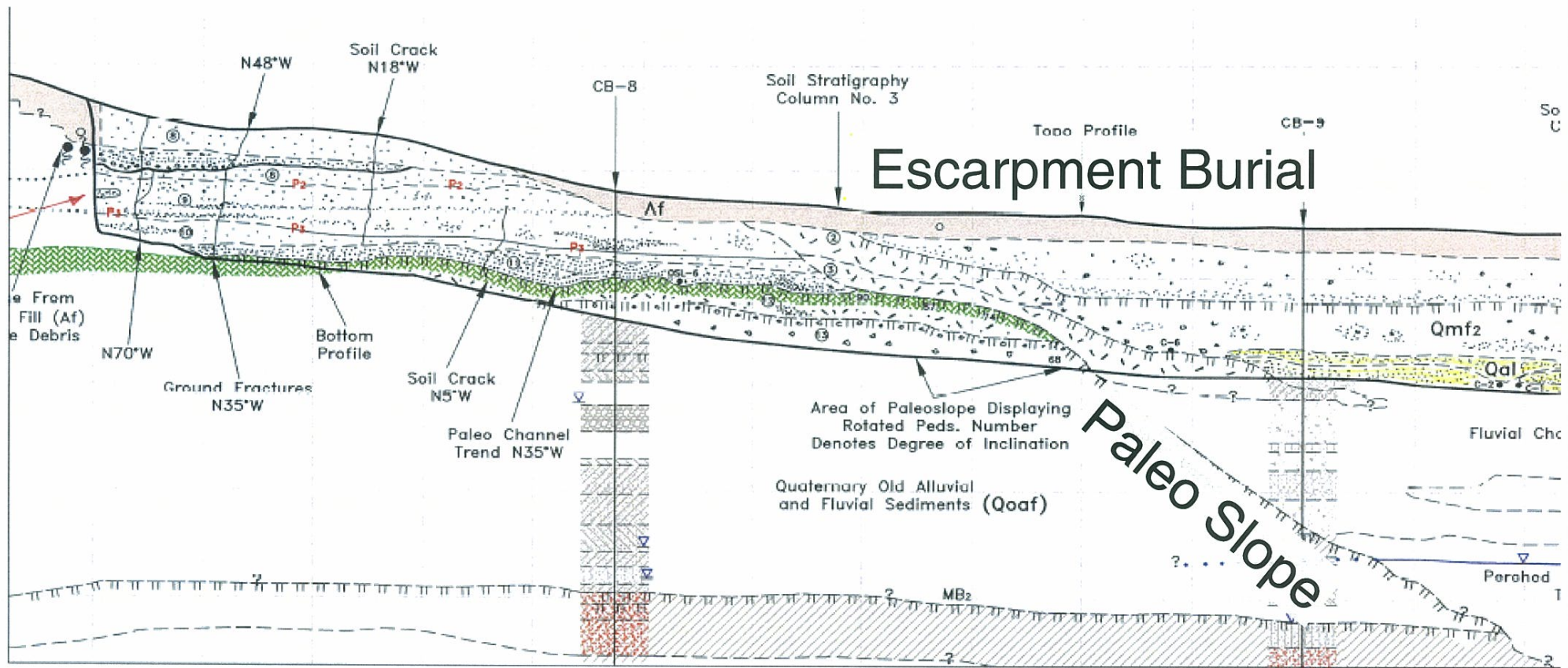
The only faults in any of the trenches



In CA, by law, an Active Fault is defined as
 ~11,000 years since last breaking surface

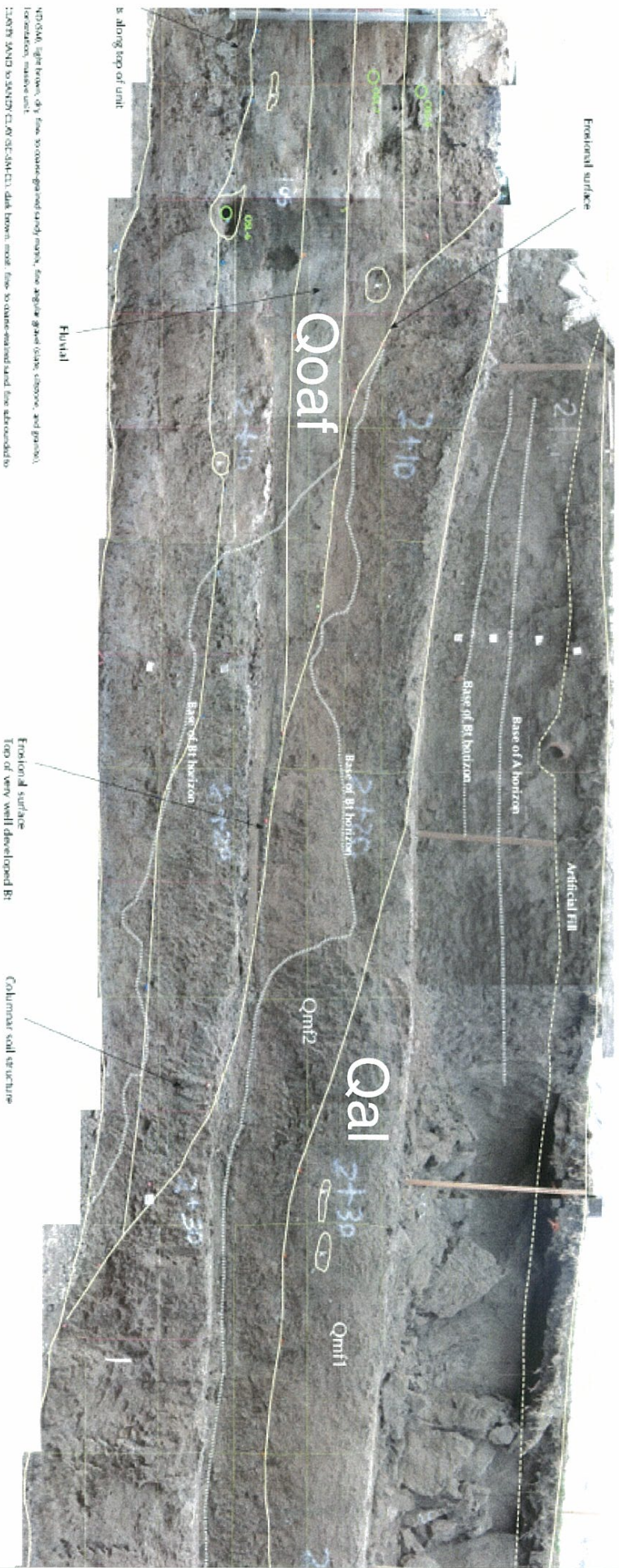
Fault Trench FT-2

The West Beverly Hills Lineament

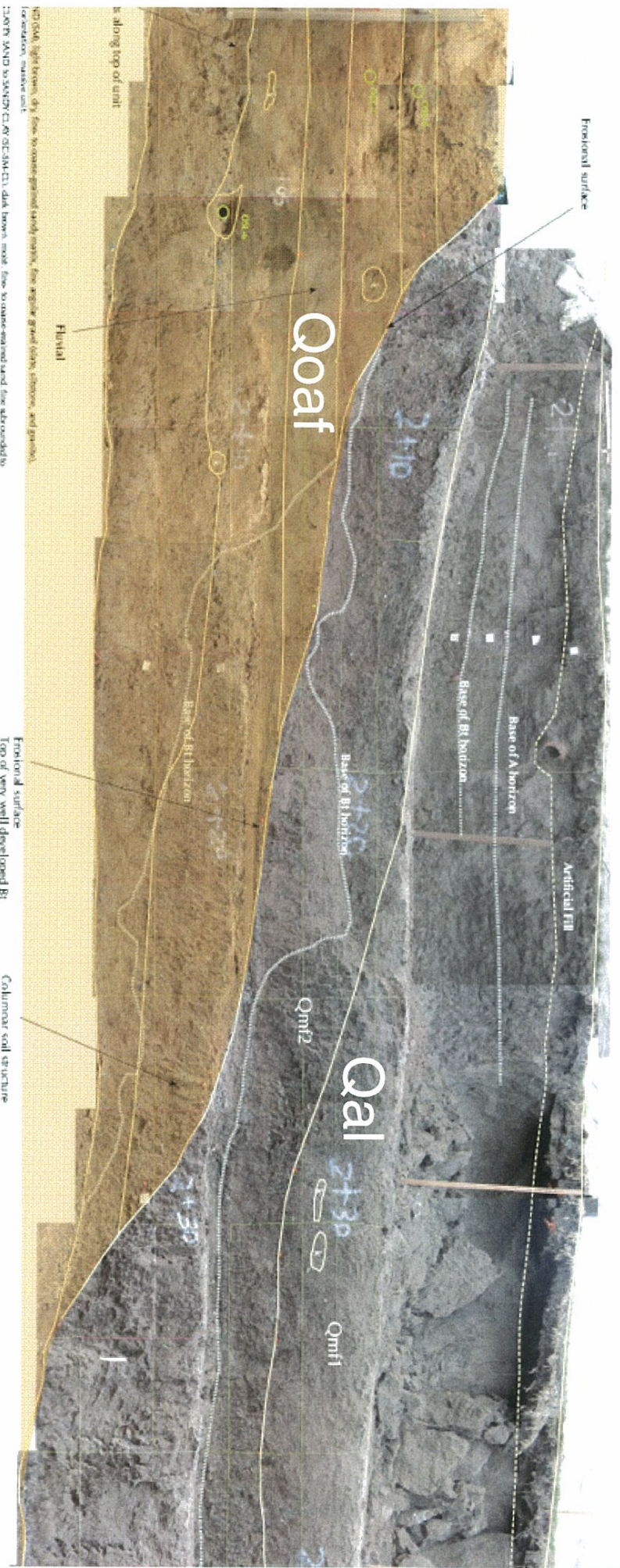


The "Lineament" is shown to be a buried valley slope

Trench 2 - Escarpment Burial

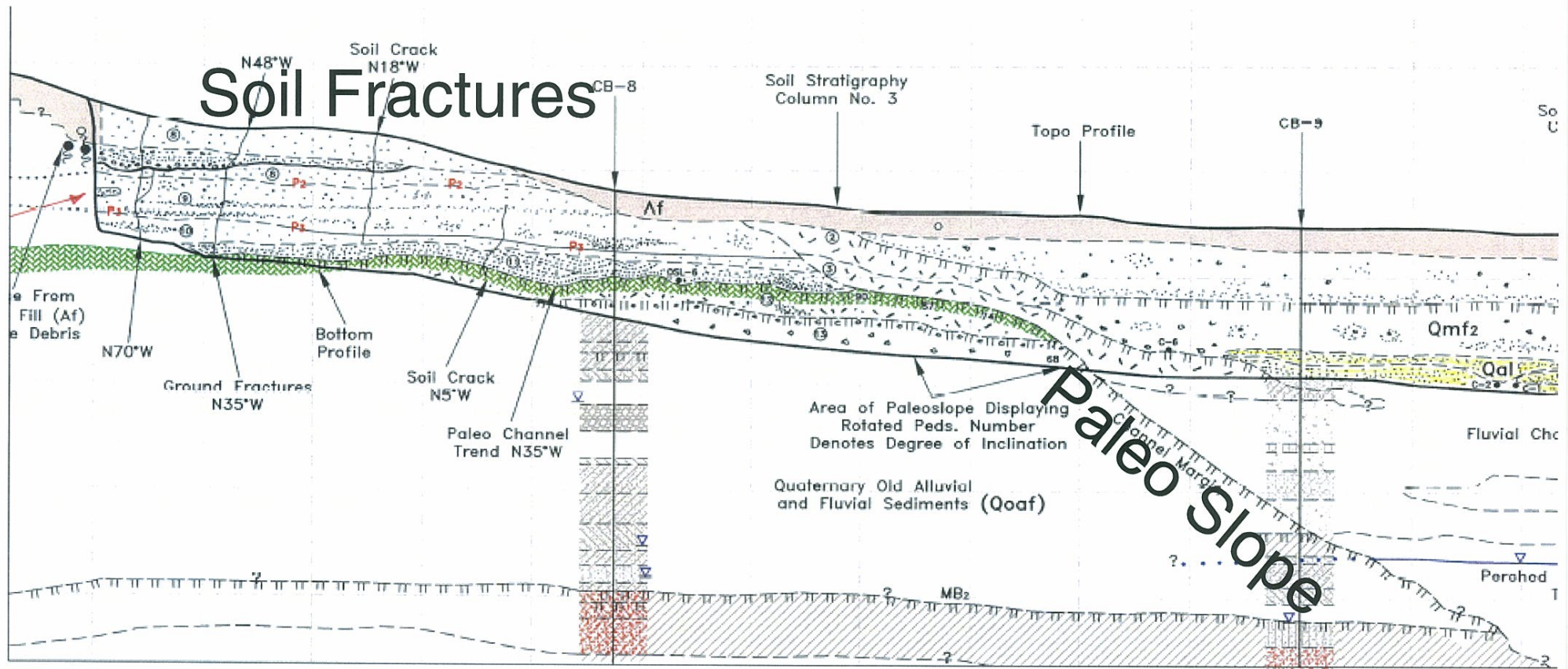


Trench 2 - Escarpment Burial



Fault Trench FT-2

The West Beverly Hills Lineament



The Fractures are shown not to be faults

Trench 2 Soil Fractures

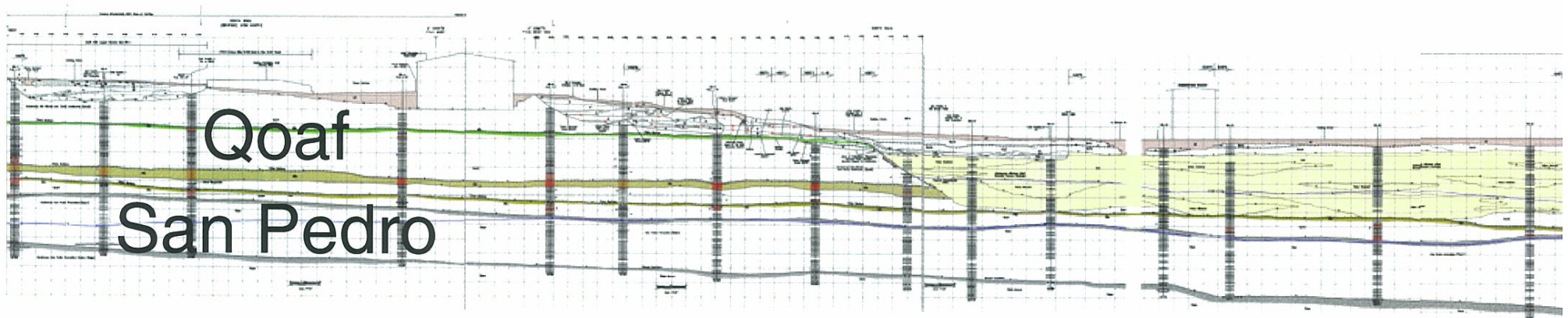


2" Offset
East-Side Up

These are fractures, not faults

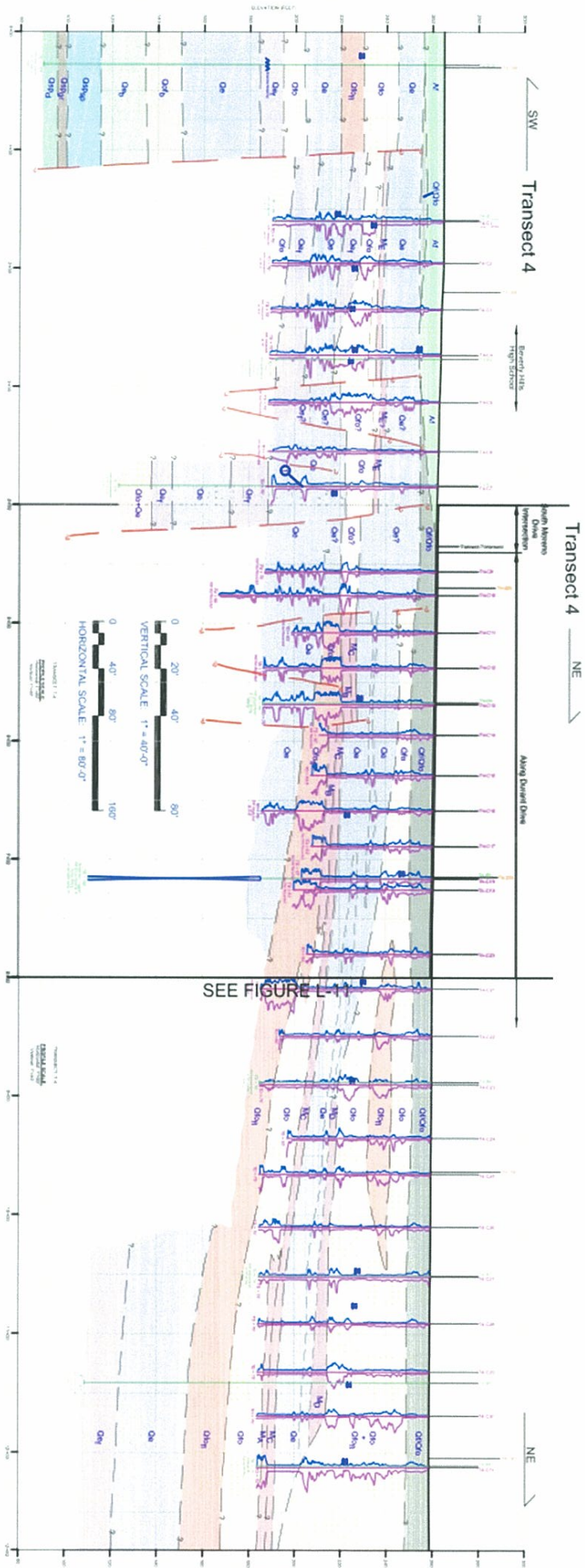
- They are irregular and not linear
- Most die out with depth
- No shearing within clays
- Clays are translocated from above
- Color is due to chemical reaction with water (redox)
- Soil properties within fractures require 10's of thousands of years to form
- They were probably generated by seismic shaking

Leighton Cross-section A-A' E-W Across Mid-Campus



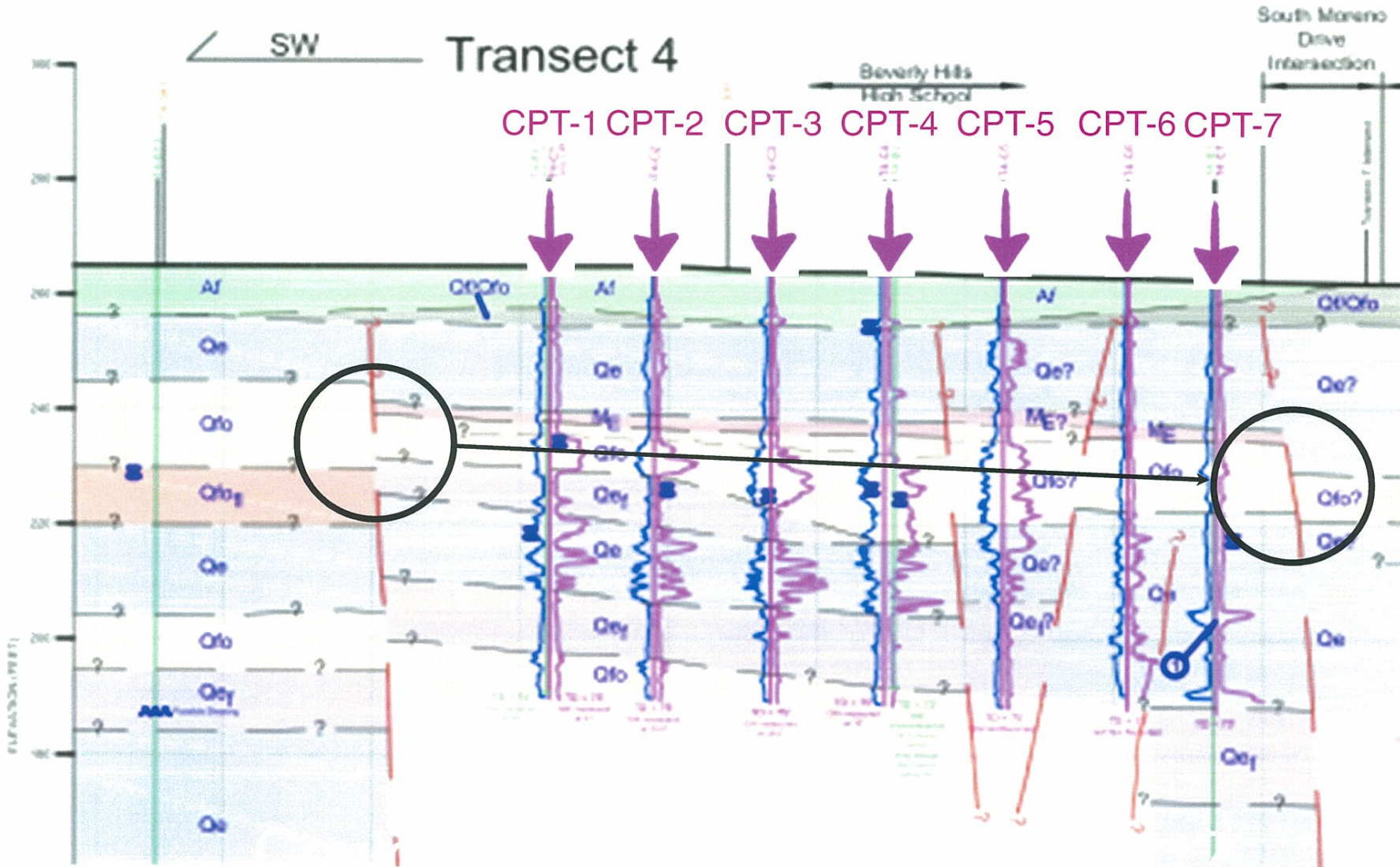
Continuous, gently-dipping sediments, show no evidence for faulting across entire width of BHHS

PB's Transect 4

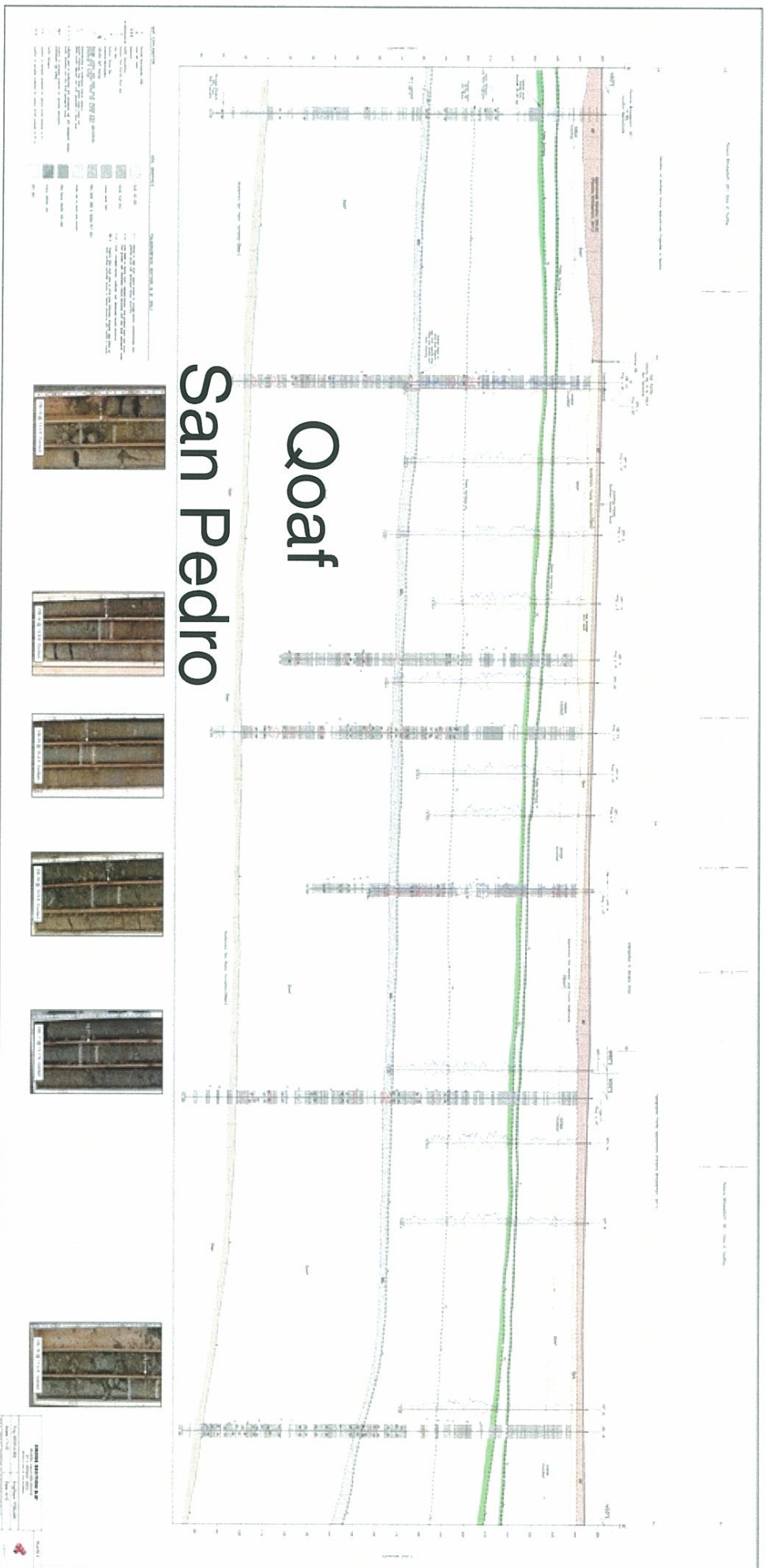


Durant Drive - many faults

Might there be data QC problems?



Leighton Cross-Section B-B

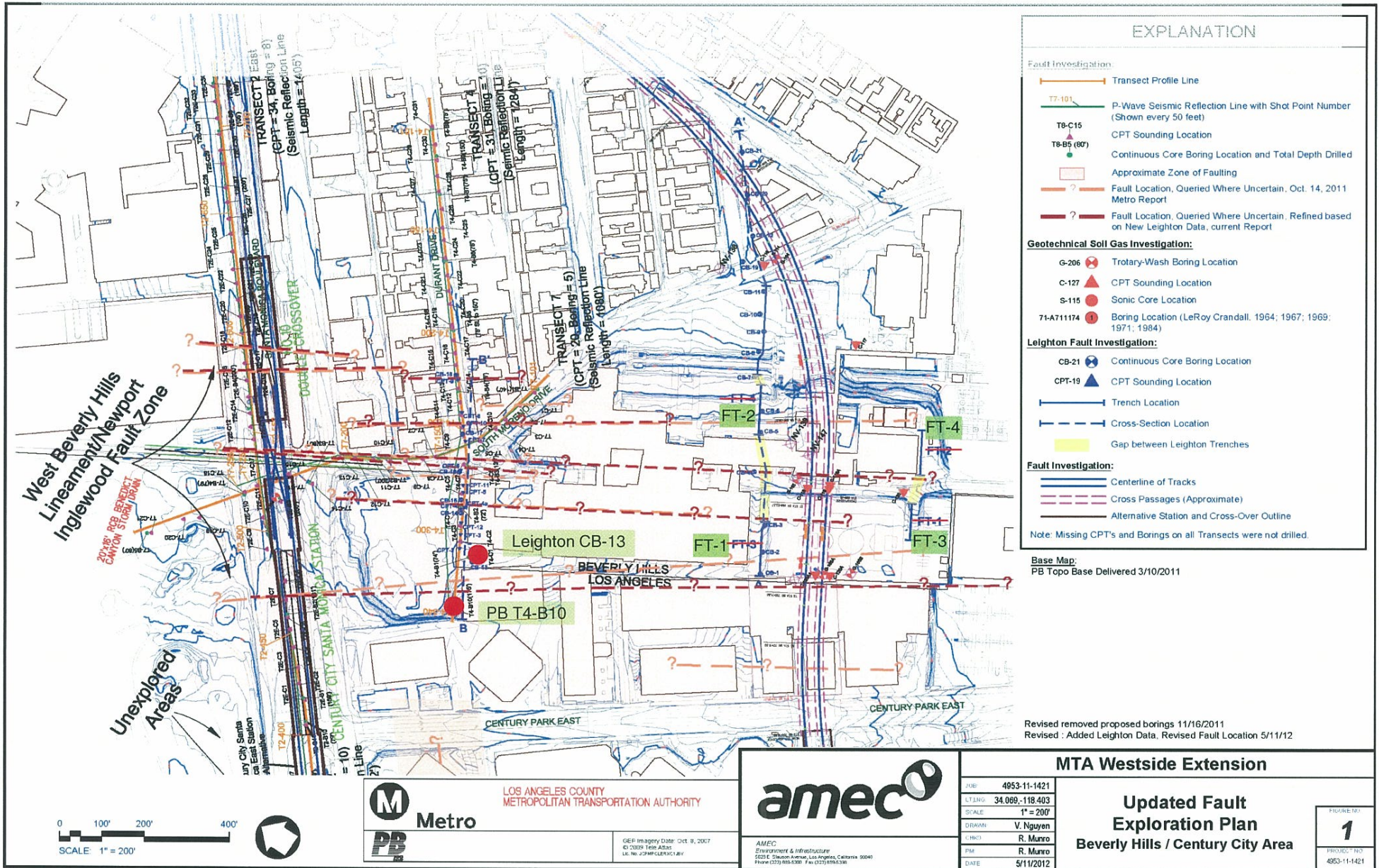


Durant Drive - no faults

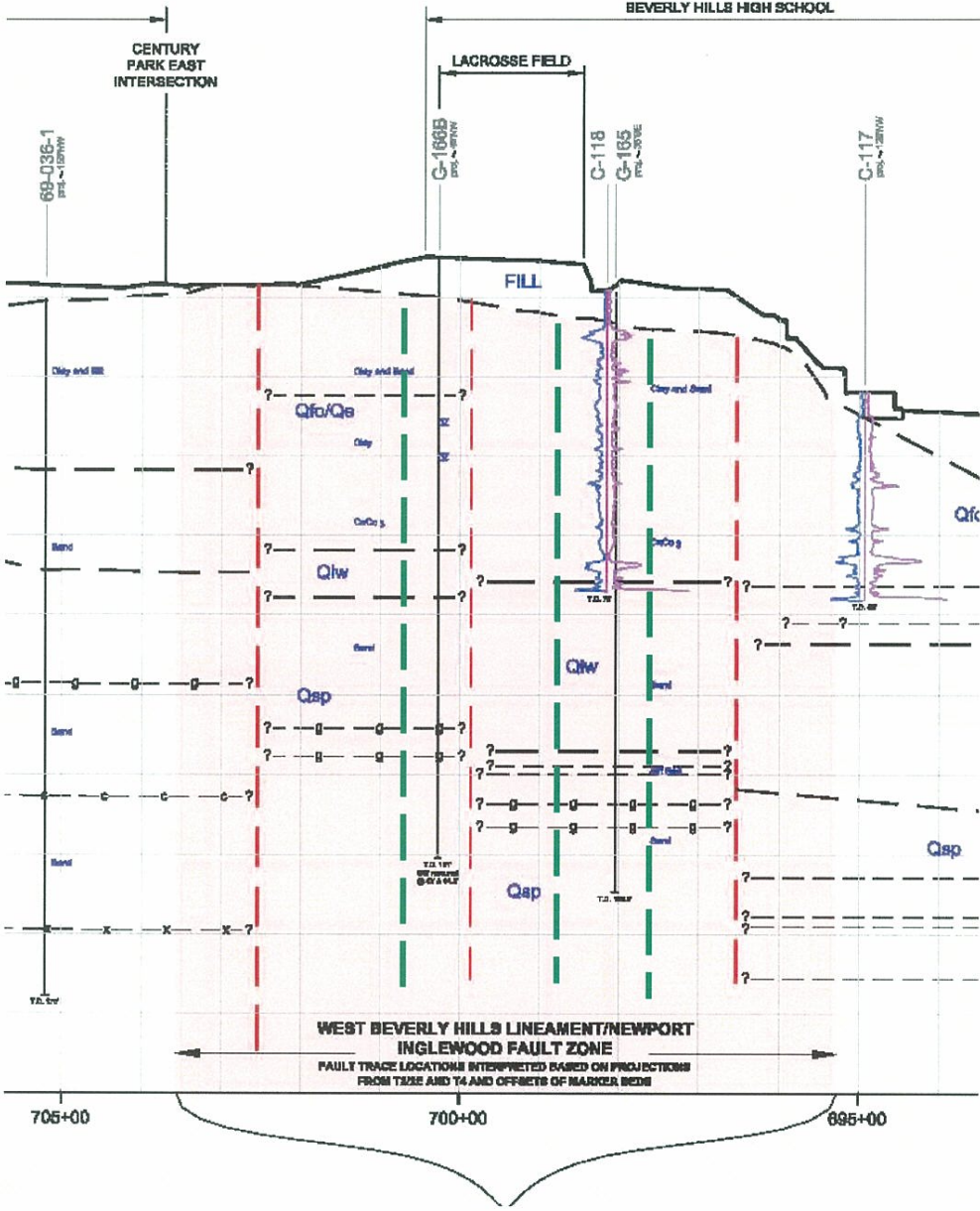
Conclusions

- The West Beverly Hills Lineament is an erosional feature and not of fault origin.
- We find direct geologic evidence that there has been no faulting associated with the West Beverly Hills Lineament at Beverly Hills High School for at least 100,000 years and perhaps more than 500,000 years.
- We have refuted the faults mapped by PB as part of the West Beverly Hills Lineament.
- Based on our study no fault-related structural setbacks associated with the WBHL are required for BHHS.

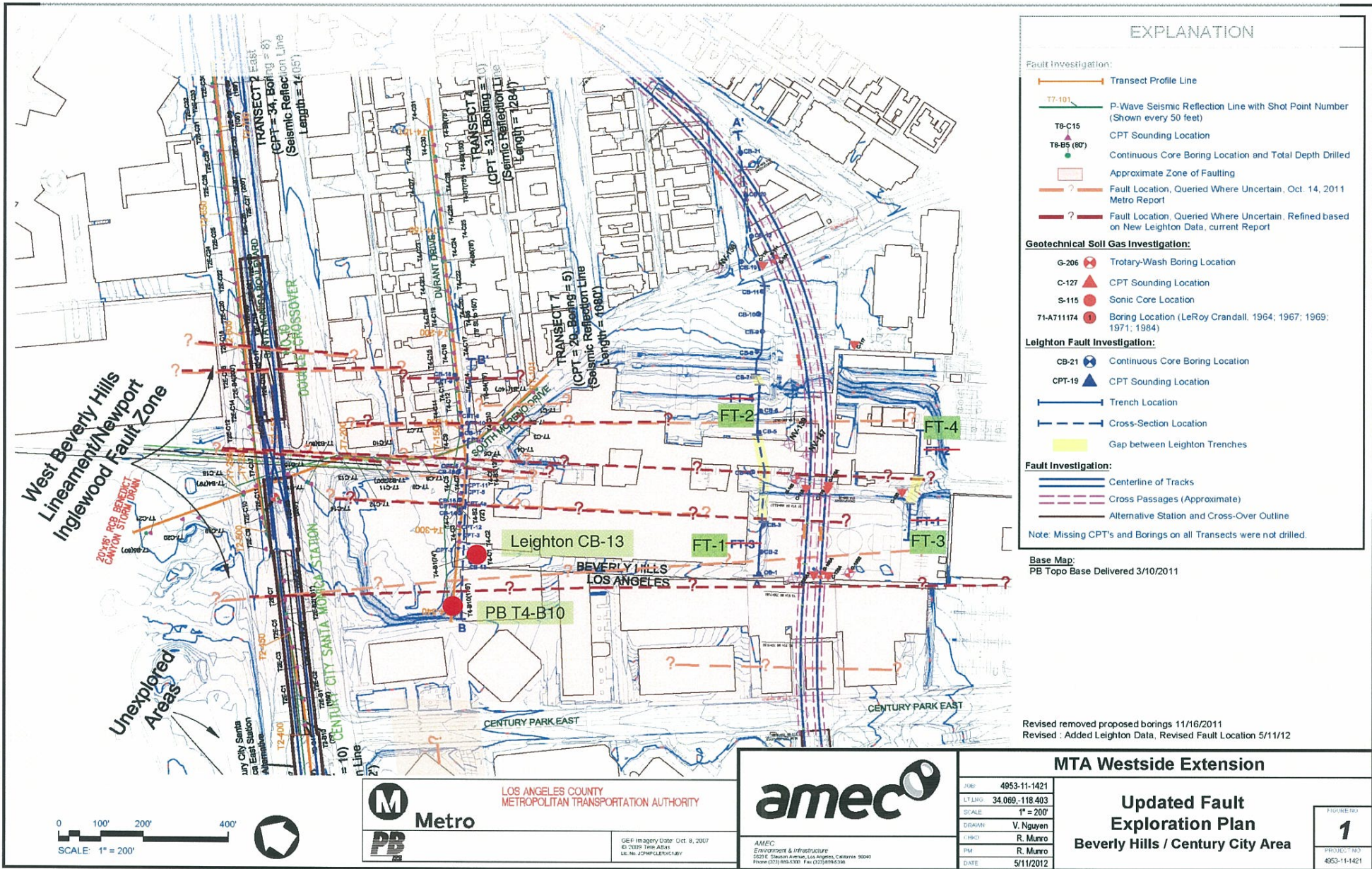
PB's May 14 Response to Leighton Report



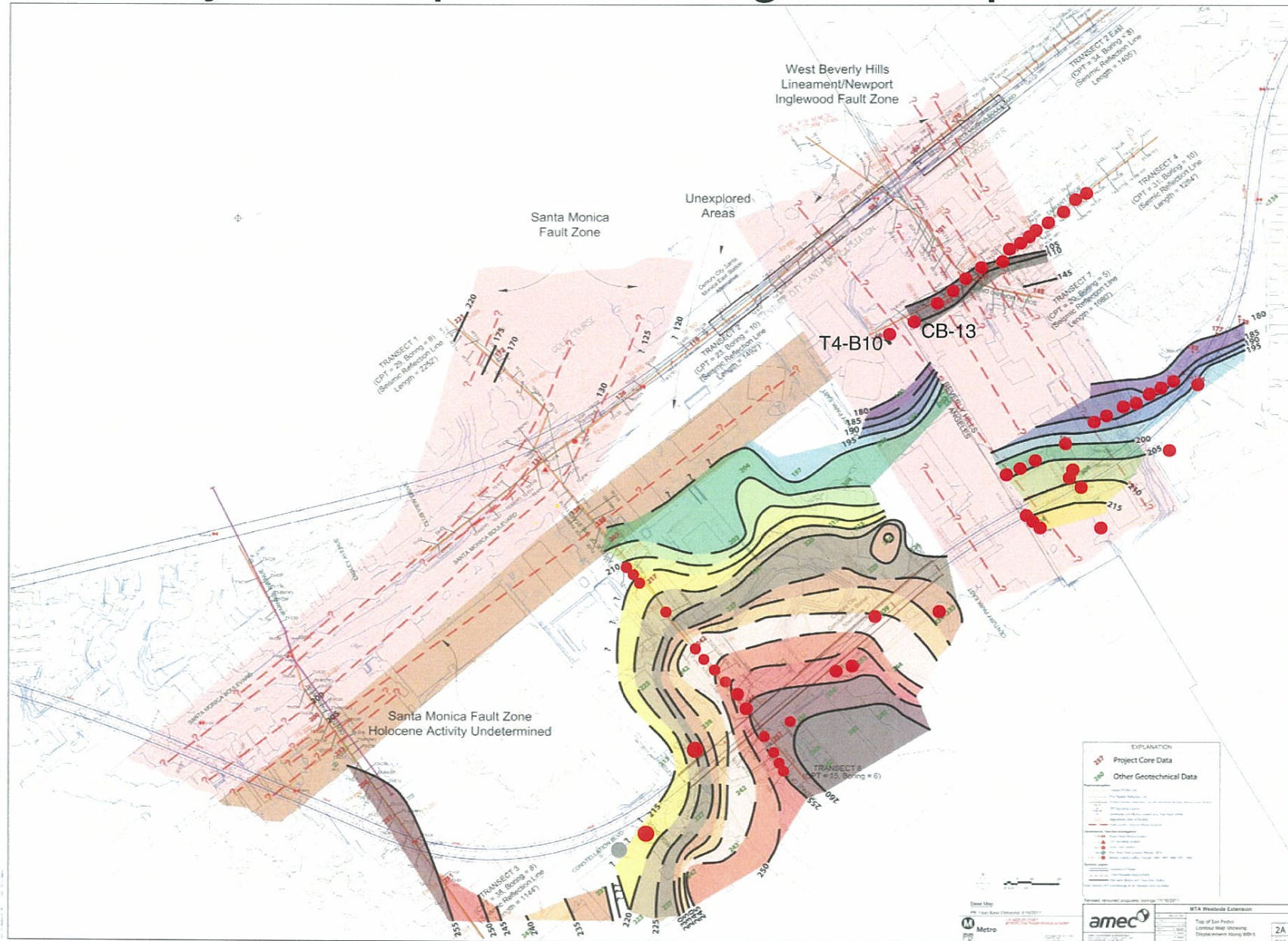
Constellation Profile



PB's May 14 Response to Leighton Report



PB's May 14 Response to Leighton Report

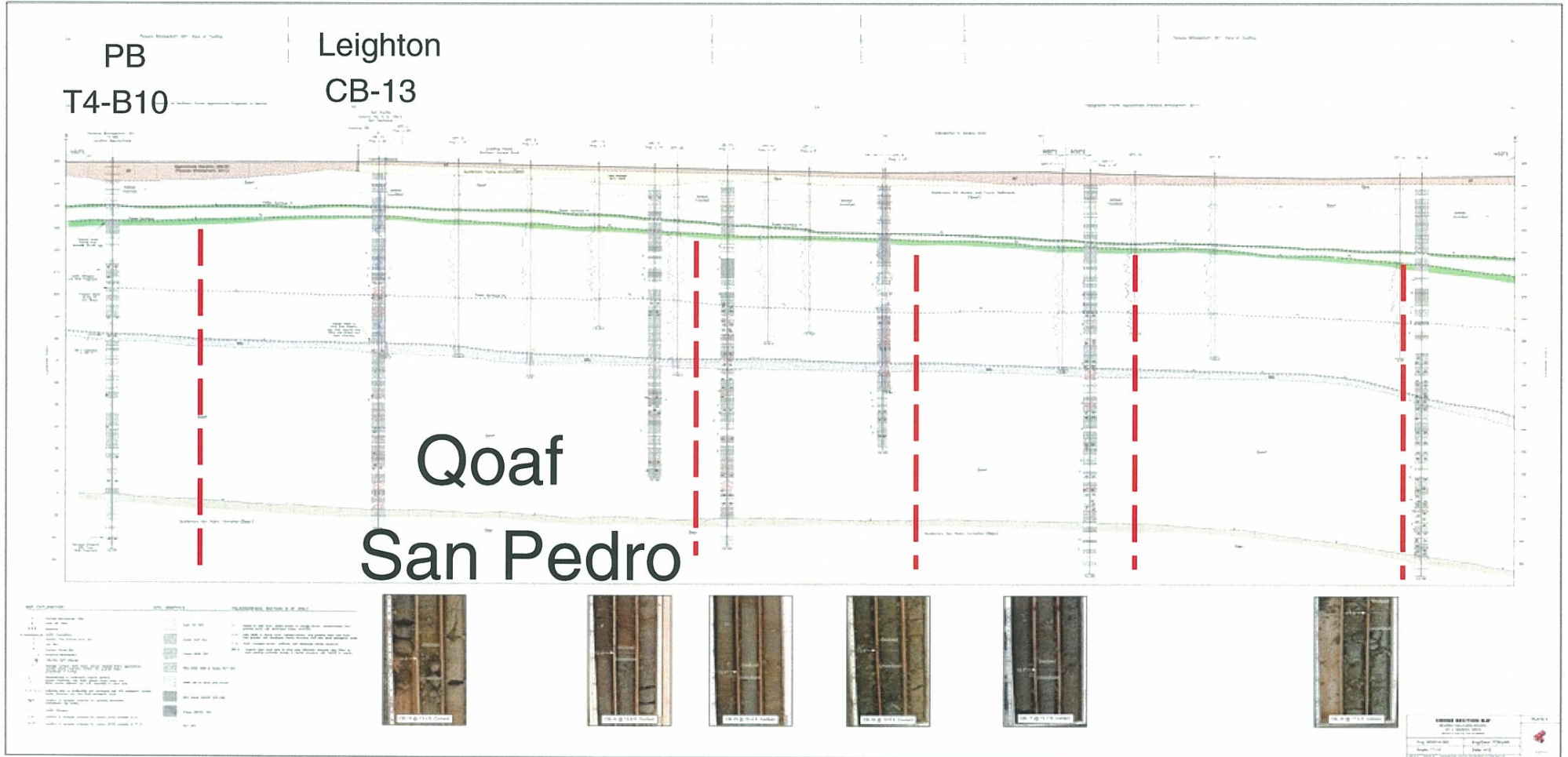


Leighton CB-13

PB T4-B10



Leighton Cross-Section B-B with PB's (May 14) Revised Faults



Qoaf
San Pedro

PB's May 14 Response to Leighton Report

- Page 3:
 - “Metro again notes that trenching is not the single most definitive tool to determine the activity or inactivity of faults. One must integrate all lines of evidence (geomorphic, seismicity, geophysical, borings, CPT and trenching) to judge fault activity”.
- Page 4:
 - “In the absence of continuous trench exposure showing unbroken deposits or soils of known age, it is not possible to prove that any particular fault strand that Metro identified within the WBHL is active or inactive. Such data can only be gleaned from trenches that provide continuous exposure of the entire width of the potential fault zone”.

PB's May 14 Response to Leighton Report

- Page 3:
Given the urban infrastructure and logistical constraints, especially the presence of subsurface infrastructure (e.g., storm drains, water mains, gas, sewer, and electric lines), it will be impossible to confirm that all of the faults that Metro has identified along the WBHL are inactive, particularly in the area of Santa Monica Boulevard.

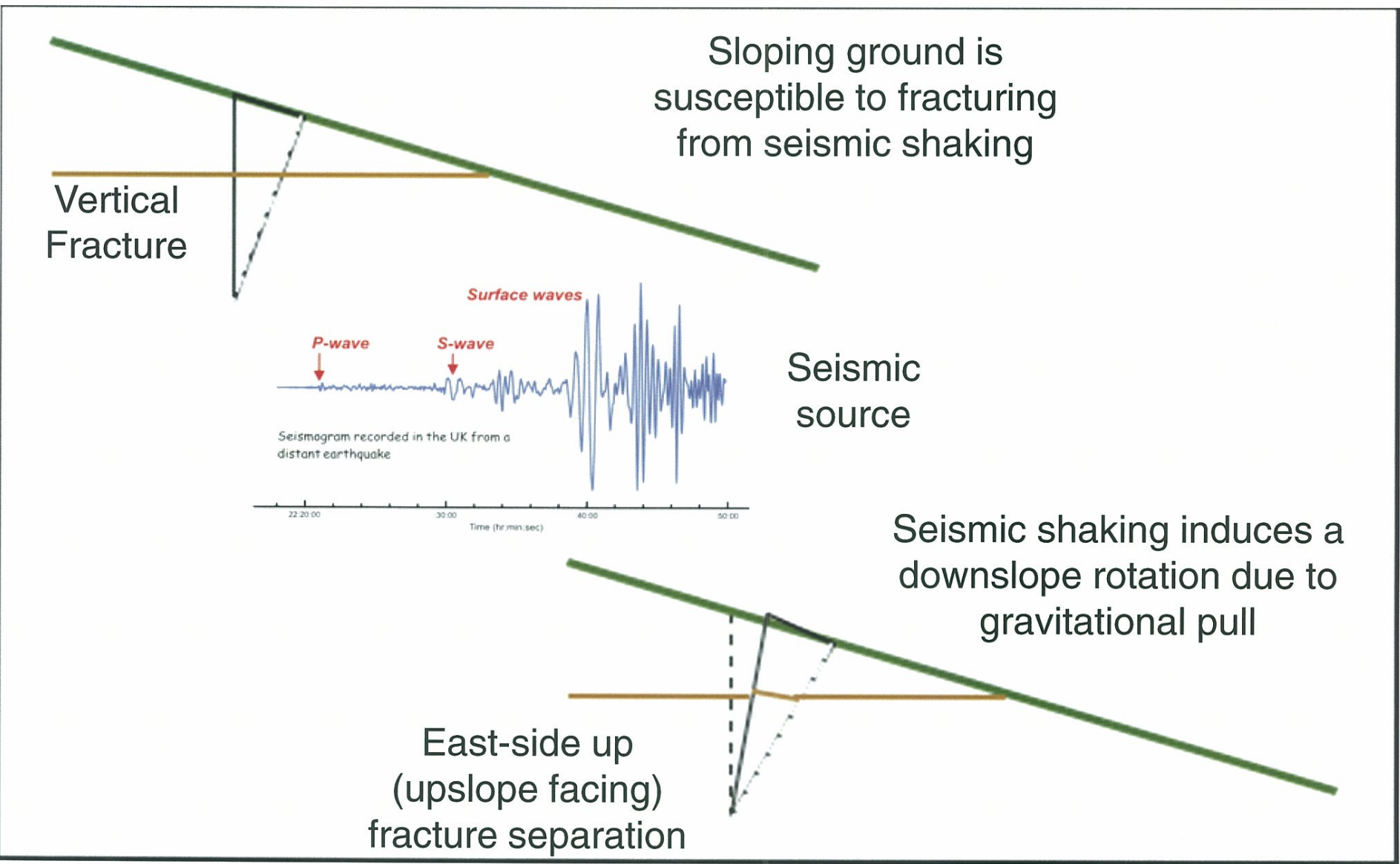


Thank you for your time

Why the differences?

- Geophysics is poor in the upper layers
- Poorly logged borings - no paleosols
- Poor delineation of the unit ages
- Poor use of borings to correlate across transects
- Almost total reliance on CPT correlations
- Conservative interpretation of those CPTs
- CPTs possibly mis-plotted on Transect 4

Trench 2 Soil Fractures - seismic shaking origin



Why this work is more conclusive

- Completely redid Transect 4 after questions emerged about its validity
- Supplemented the CPTs with substantially more borings
- Drilled those borings down to the San Pedro sand (~1 million years old)
- Trenched almost the entire width of the school, supplemented and extended east with borings
- Opened the trench site to California Geological Survey, U.S. Geological Survey, and other reviewing geologists
- Developed robust, multi-disciplinary age control on the sediments (OSL, 14C, soils)

PB's Geology

Table 1: Stratigraphic Units

Epoch	Time Scale	Symbol	Stratigraphic Unit (Age) Description
Holocene	11,000 years ago to present	af	ARTIFICIAL FILL (undocumented)
Pleistocene	1.8 million to 11,000 years ago	Qf/Qal	YOUNGER ALLUVIUM (Holocene)—predominantly sand, silt and clay
		Qfo	OLDER ALLUVIAL SAND DEPOSITS (late Pleistocene)—sandy silt, clay, and sand with gravel
		Qe	ESTUARINE DEPOSITS (late Pleistocene)—thin bedded to massive silty and clay with fine sand and occasional gravel
		Qlw	LAKWOOD FORMATION (late Pleistocene)—interbedded silty sands, silts, and clays with clayey sand and gravel layers
		Qsp	SAN PEDRO FORMATION (mid Pleistocene)—predominantly greenish gray and bluish gray fine-grained Sands, medium to coarse Sands and some Silt Layers.

The sediments are considerably older

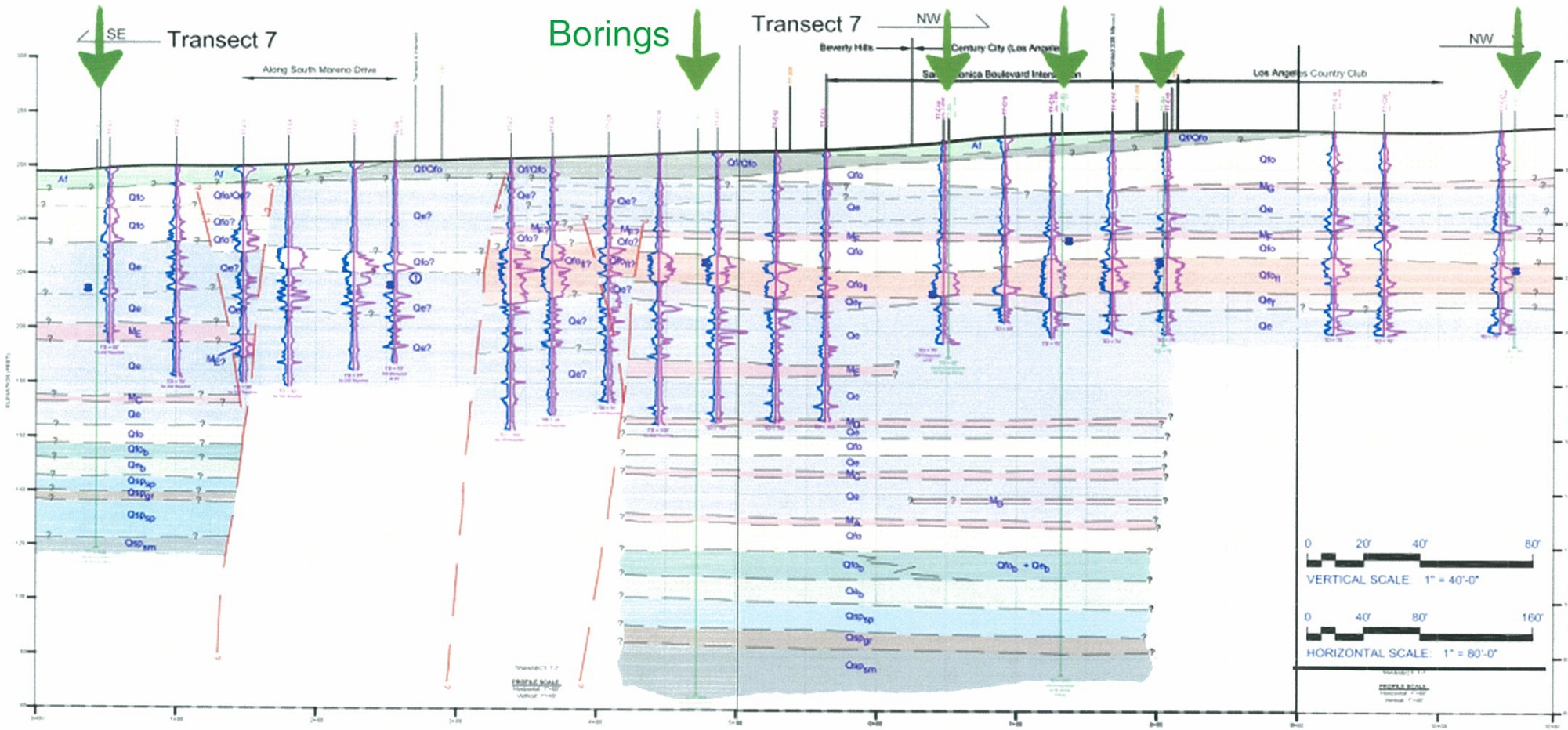
Epoch	Time Scale
Holocene	11,000 years ago to present
Pleistocene	1.8 million to 11,000 years ago

Symbol	Stratigraphic Unit (Age) Description
af	ARTIFICIAL FILL (undocumented)
Qf/Qal	YOUNGER ALLUVIUM (Holocene)—predominantly sand, silt and clay
Qfo	OLDER ALLUVIAL SAND DEPOSITS (late Pleistocene)—sandy silt, clay, and sand with gravel
Qe	ESTUARINE DEPOSITS (late Pleistocene)—thin bedded to massive silty and clay with fine sand and occasional gravel
Qlw	LAKEWOOD FORMATION (late Pleistocene)—interbedded silty sands, silts, and clays with clayey sand and gravel layers
Qsp	SAN PEDRO FORMATION (mid Pleistocene)—predominantly greenish gray and bluish gray fine-grained Sands, medium to coarse Sands and some Silt Layers.

PB's
geology

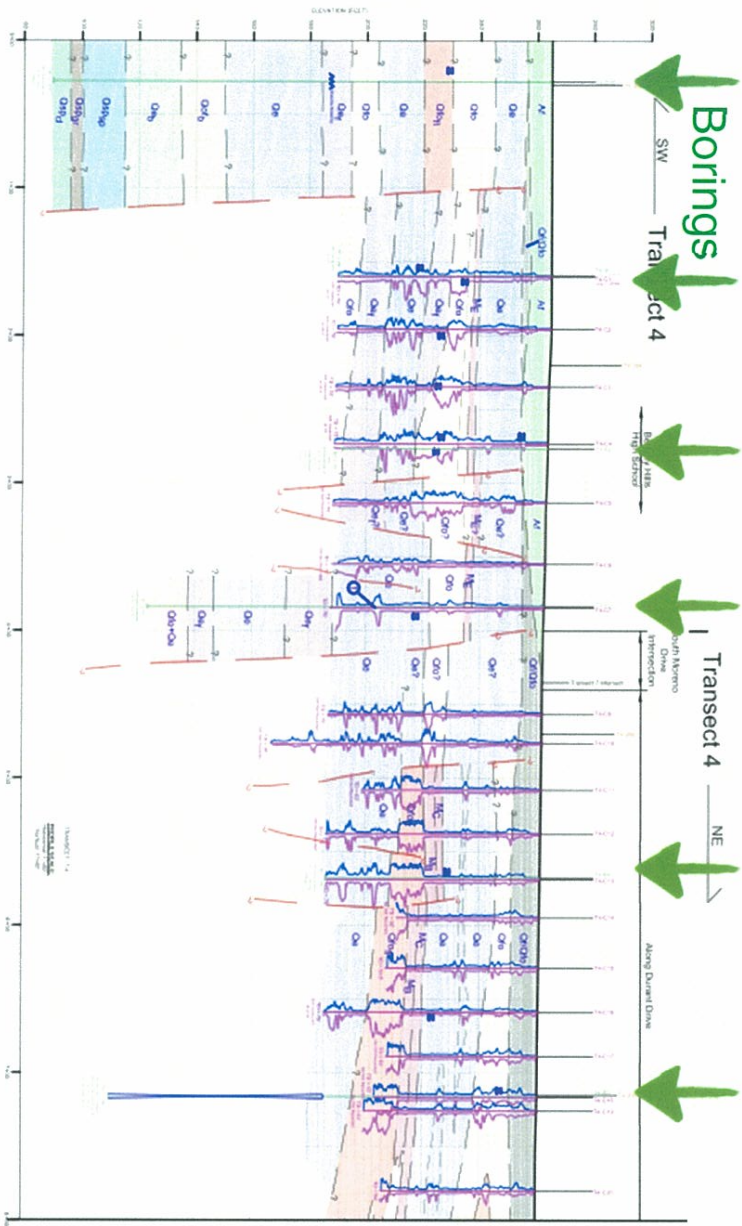


Metro's Transect 7

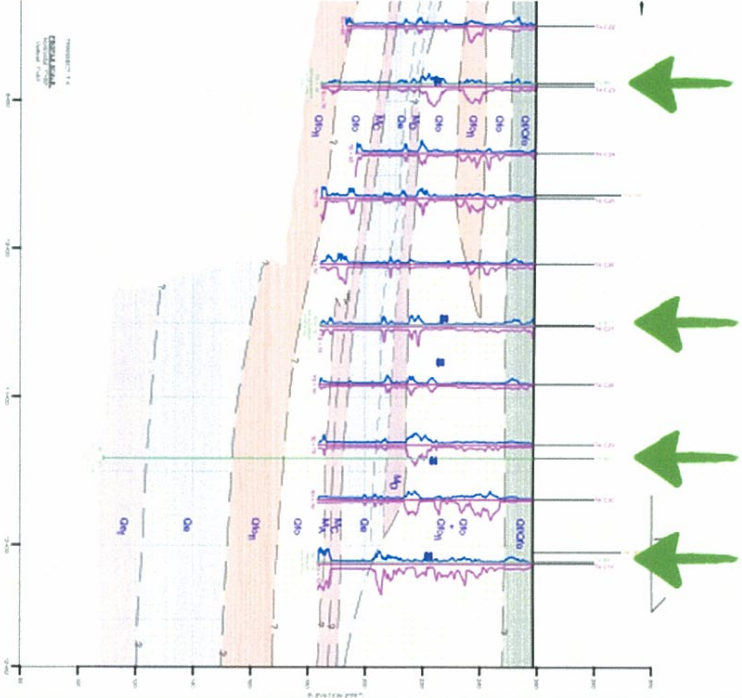


The faults are drawn where there are no borings
- CPT interpretations only

Metro's Transect 4



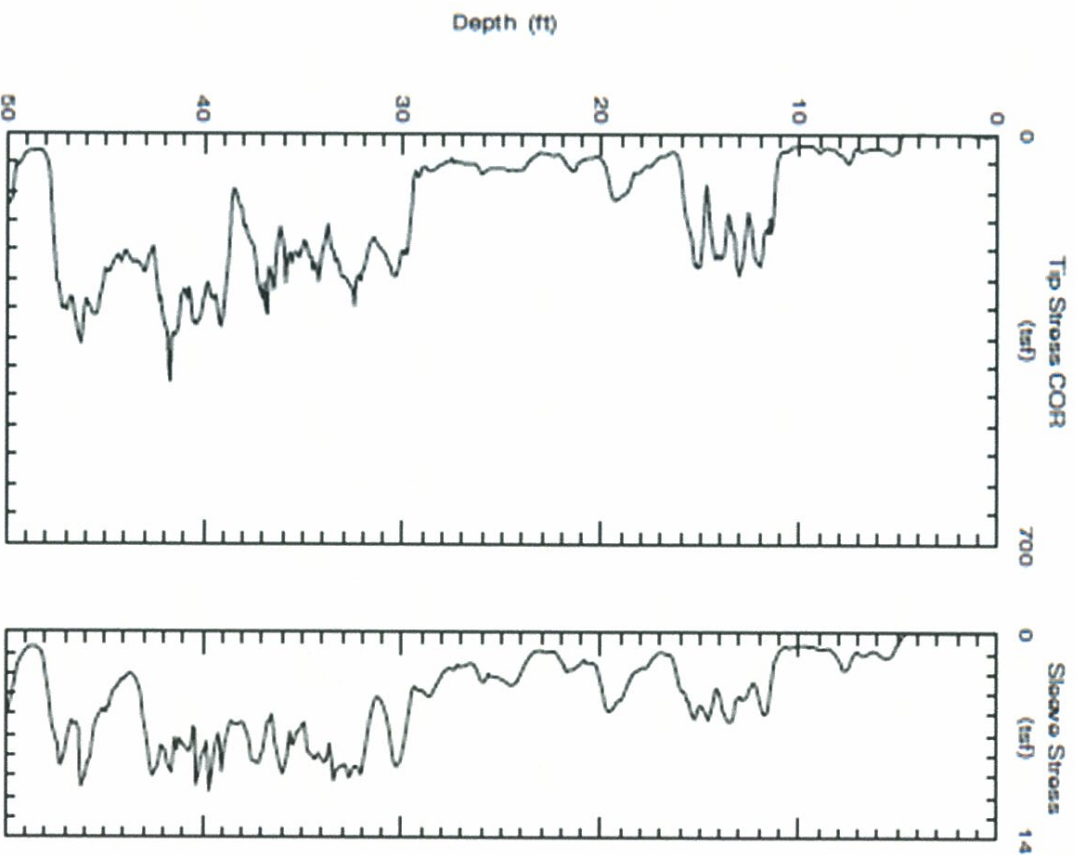
SEE FIGURE L-11





YES – because the Transect 4 CPTs could have been inverted Transect 4 was reinvestigated

When you do CPTs, this is all the geology that you see



When you drill, this is what you see



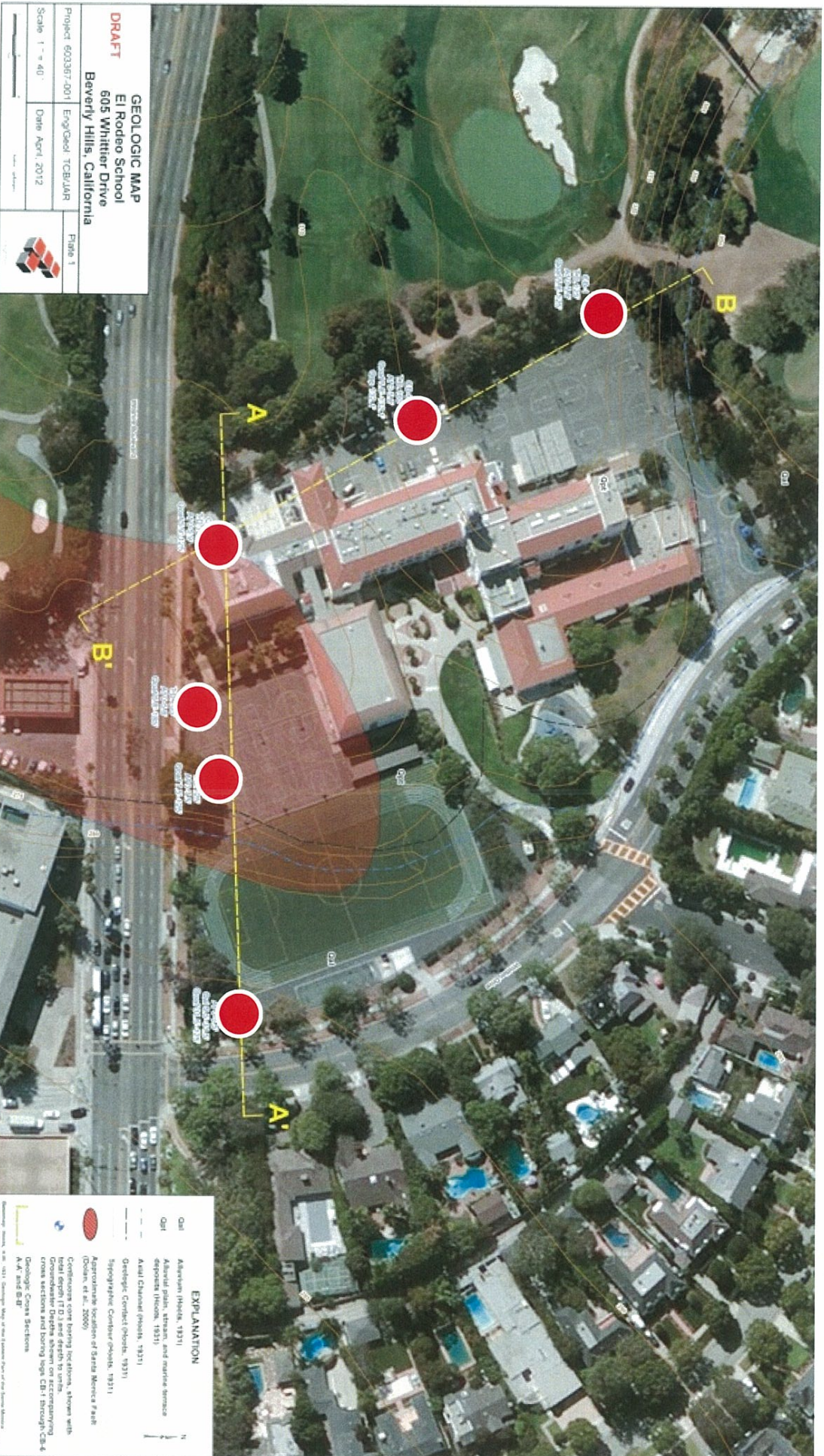
When you trench, you see everything



And everyone else can see it too



El Rodeo



Project Timing

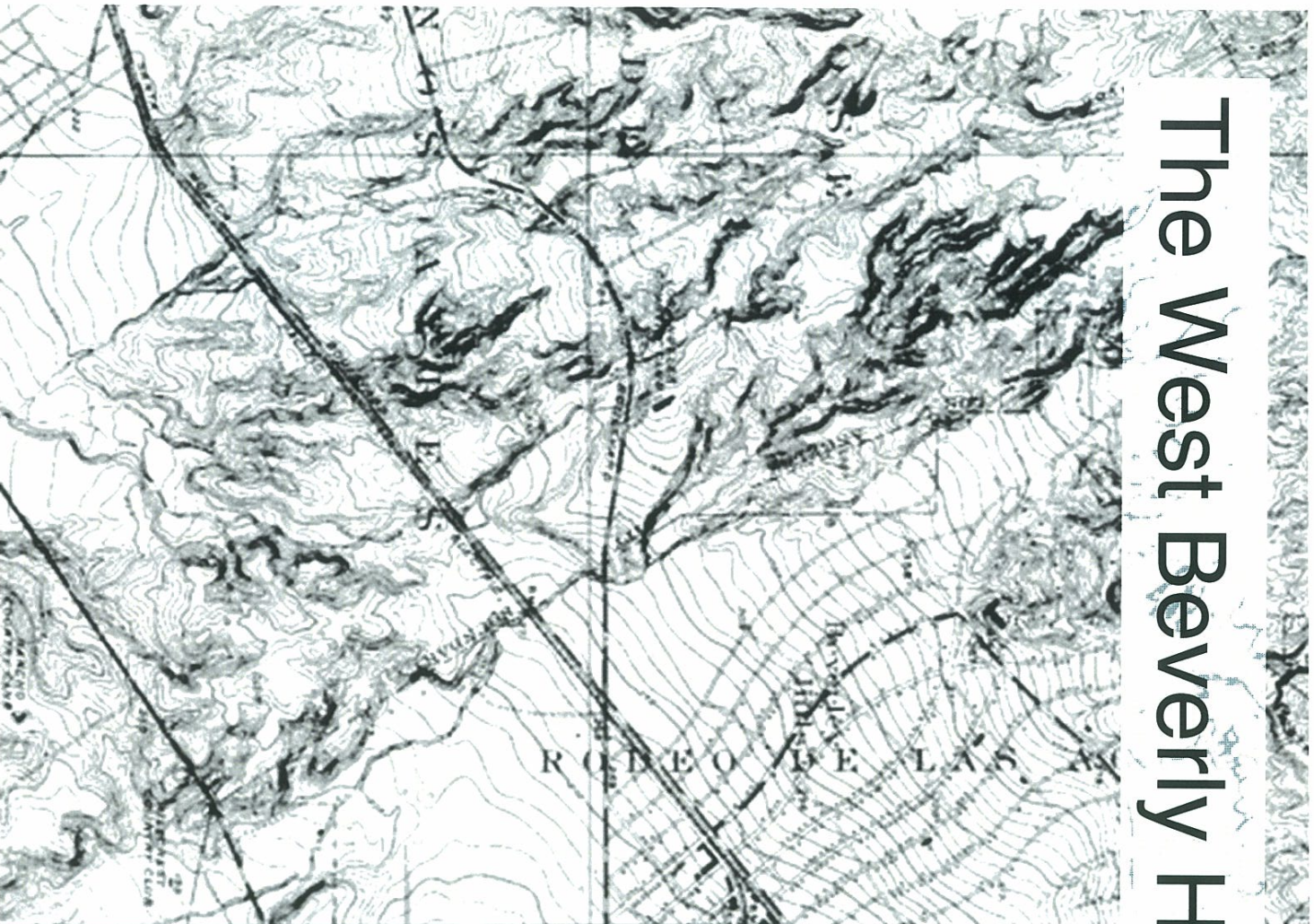
2011

14-Oct	PB issues Westside Extension Fault Report
10-Nov	BHUSD authorization to perform Phase I research
6-Dec	BHUSD authorizes Phase 2A and 2B for drilling and trenching activity at BHHS
16-Dec	Begin drilling with several contractors along mid campus transect on west and east sides of the HS.

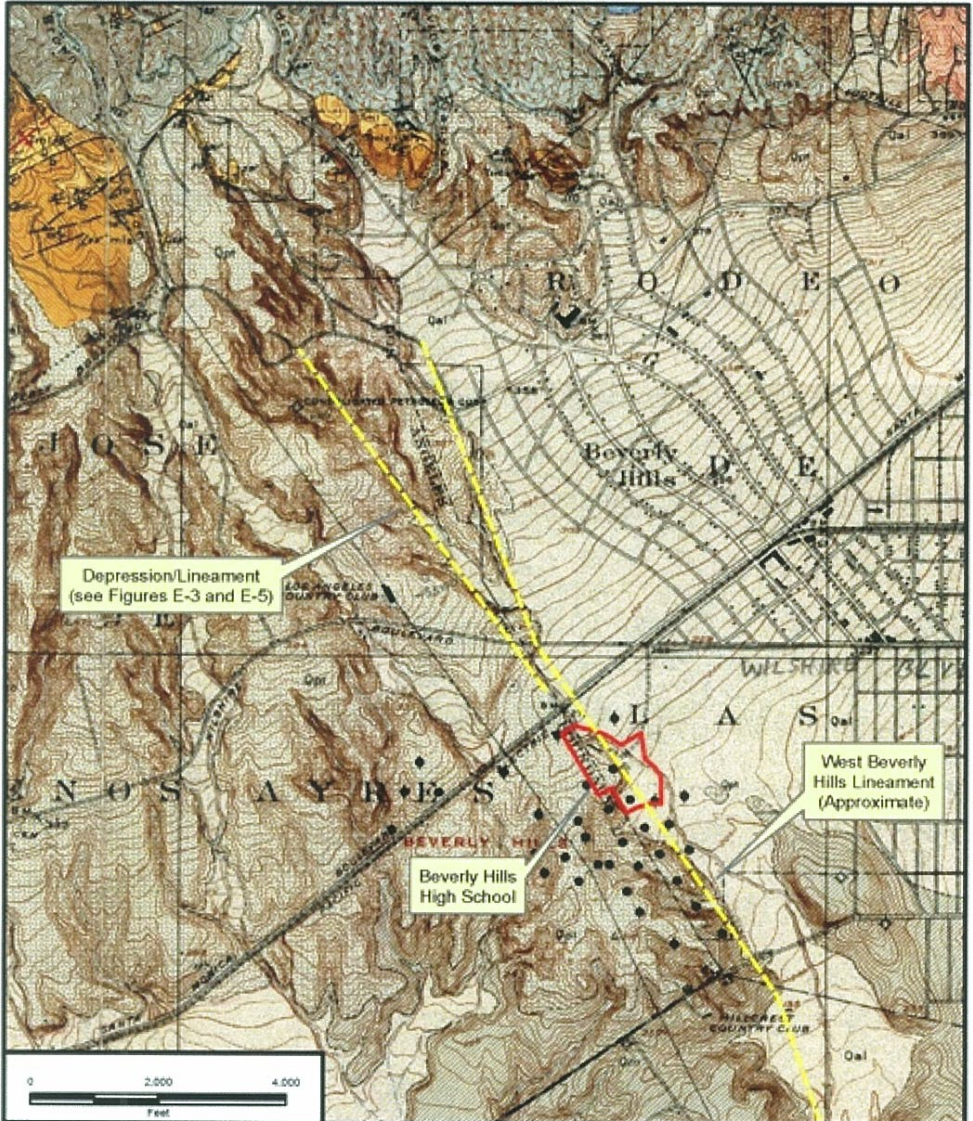
2012

3-Jan	Begin excavation of fault trenches on campus
25-Jan	AMEC core review at their offices
26-Jan	Site visit from CGS (several visits over next 2 weeks)
1 -Feb	Site visit from USGS - and CGS
16-Feb	Begin drilling northern transect borings and CPT
5-Mar	Backfill of trenches FT-1 through FT-4 complete, hardscape restored in parking areas
20-Mar	Begin drilling additional 3 borings at east mid-campus
22-Apr	Fault Hazard Assessment Report completed
24-Apr	Fault Hazard Assessment Report Delivered to CGS

The West Beverly Hills Lineament



- Fault Uplift Origin
- River Erosion Origin
- Both



Project: 603314-001	Engl/Geol: TCB/JAR
Scale: 1" = 2,000'	Date: April, 2012
Base Map: Hoots, H.W., 1931 Thematic Info: Leighton Author: [unavailable]	

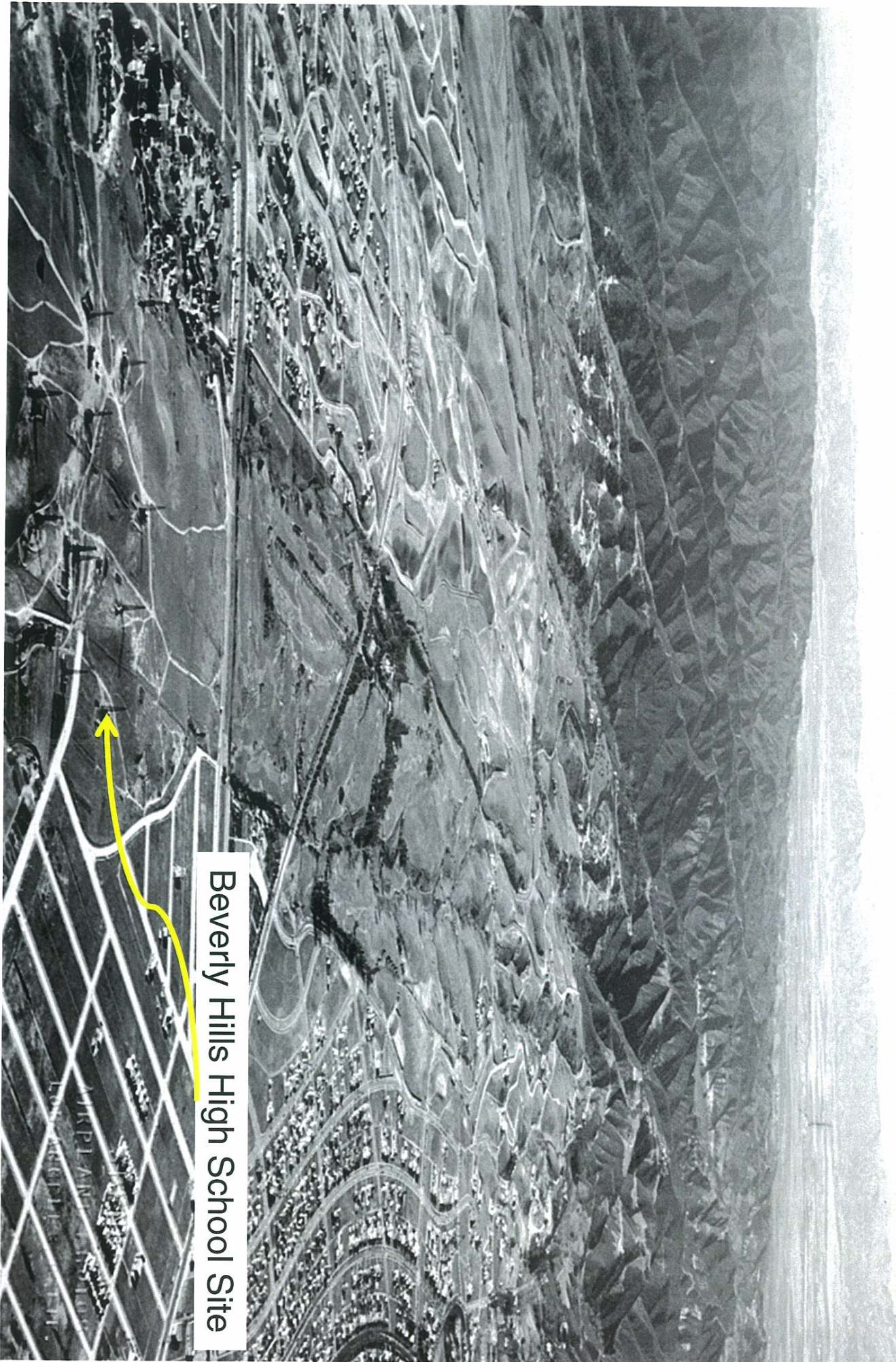
REGIONAL GEOLOGIC MAP (Hoots, 1931)

Beverly Hills High School
 241 South Moreno Drive
 Beverly Hills, California

Figure 3

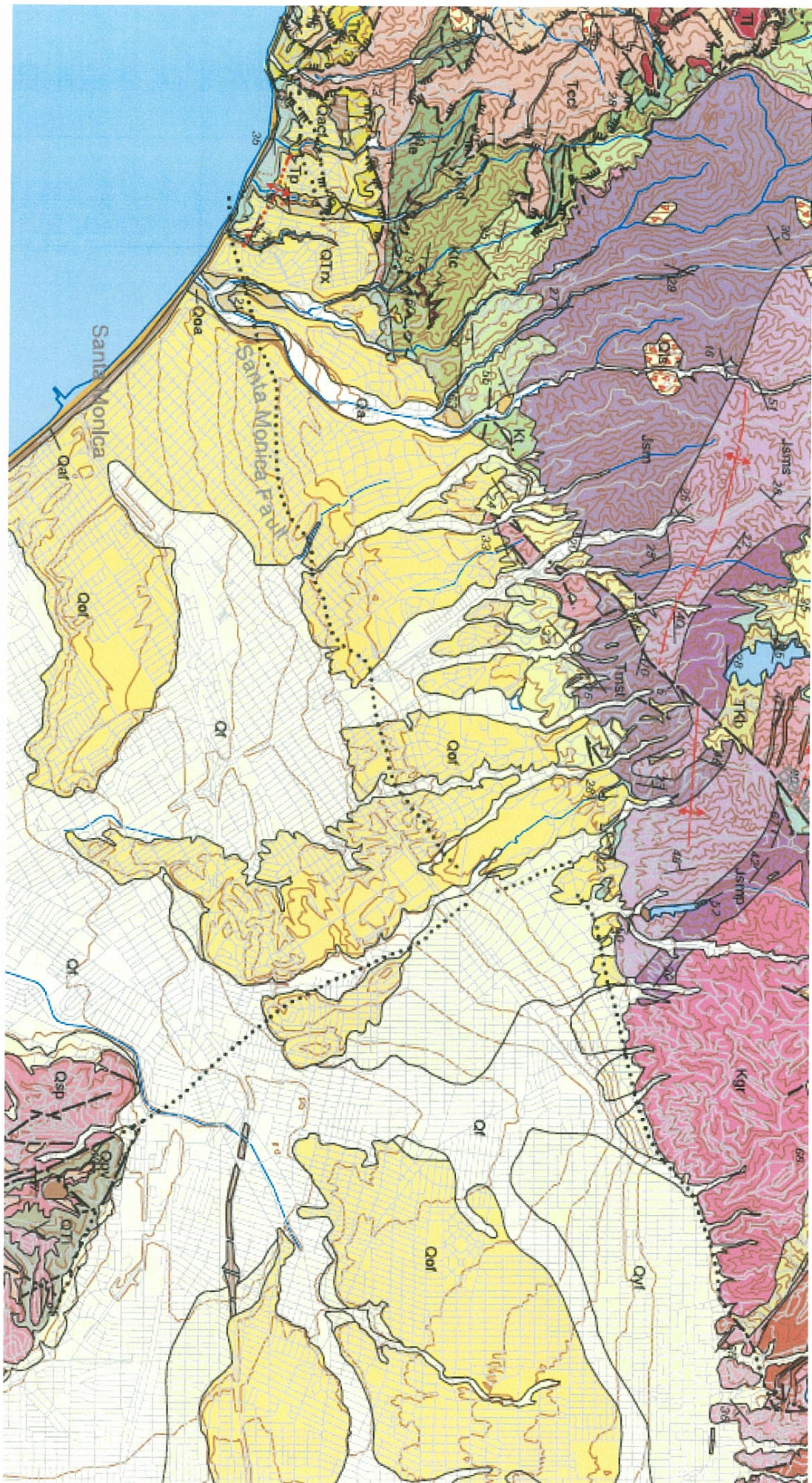
leighton

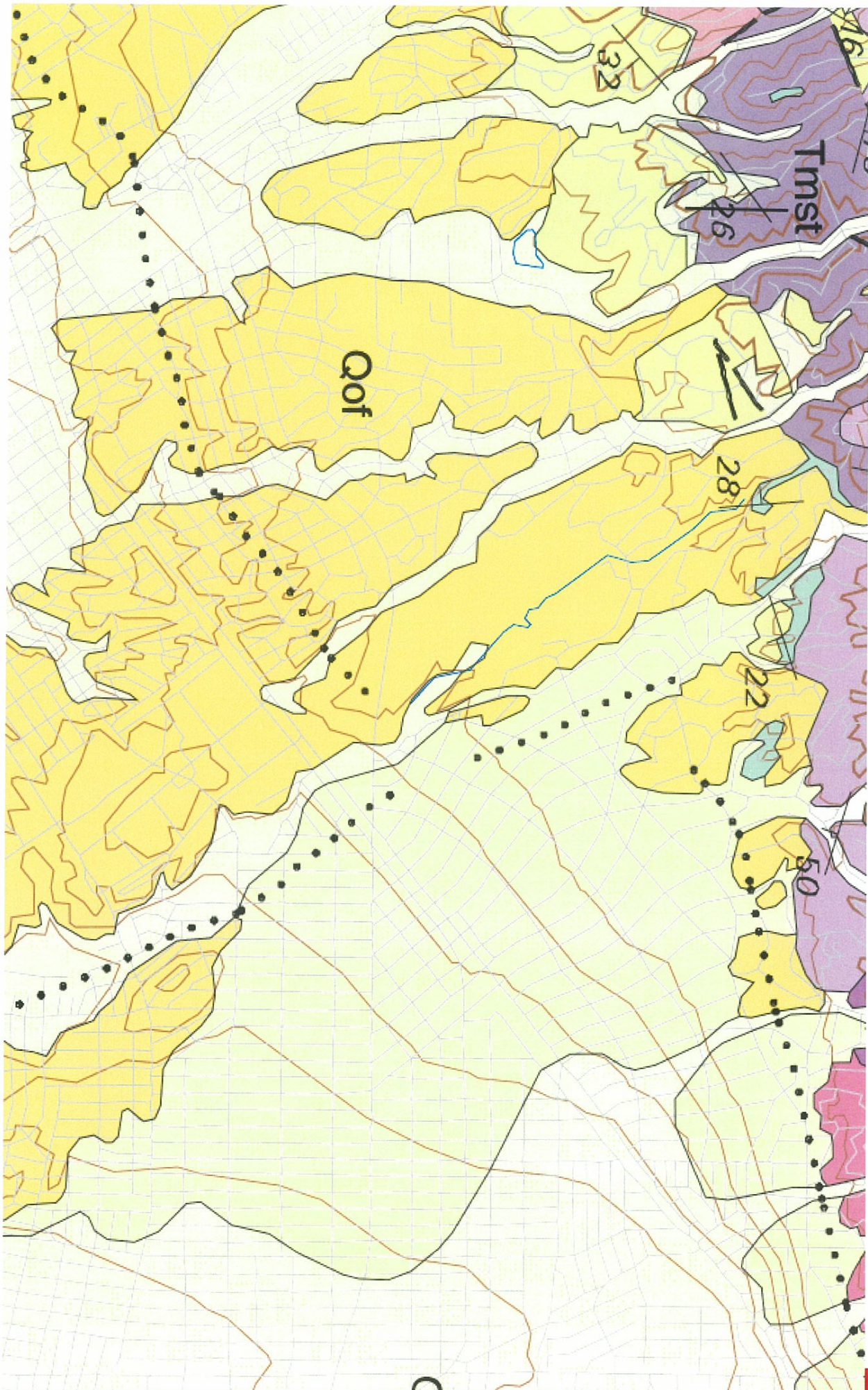
Map Saved as: Y:\Drafting\603314\001\GIS\Figures\Figures\RegionalGeologicMap.aprx.mxd on 4/11/2012 9:30:52 AM



Beverly Hills High School Site

USGS Los Angeles Quad - Geology



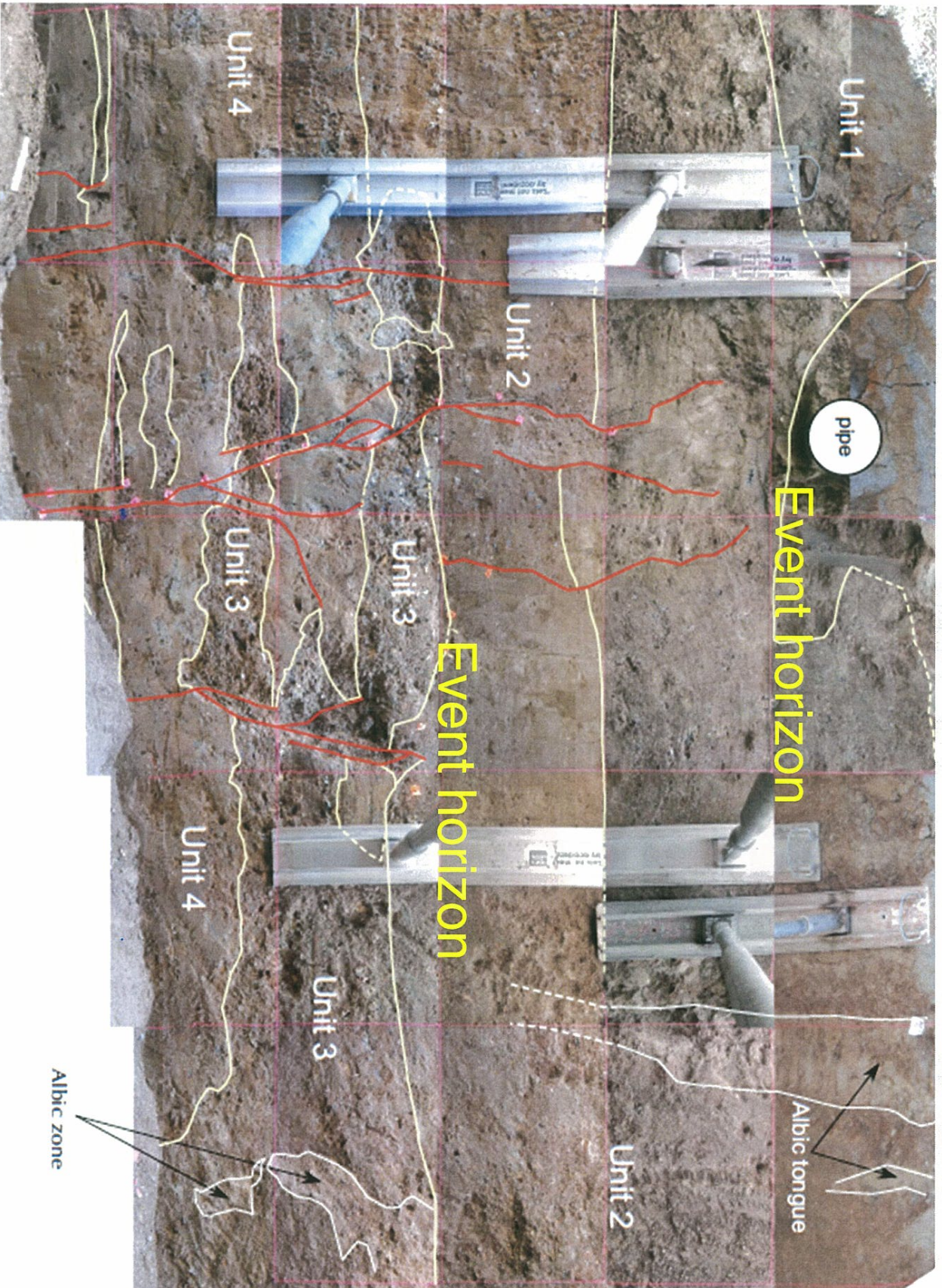


Fault Investigations

Methods and their difficulties

- Geophysics - difficult to see the shallow sediments
- Cone Penetrometers (CPT) - difficult to interpret complex alluvial deposits
- Borings - difficult to get good recovery
- Trenching - difficult site access

Trench 3 - South Wall



Trench 3 - North Wall

