DRAFT
TECHNICAL REPORT
ATASCADERO GROUNDWATER BASIN
BASIN BOUNDARY MODIFICATION APPLICATION

Prepared for:
DEPARTMENT OF WATER RESOURCES

February 2016

CONTENTS

TABLES

Page

PLATES
(following text)

DRAFT
TECHNICAL REPORT
ATASCADERO GROUNDWATER BASIN
BASIN BOUNDARY MODIFICATION APPLICATION

EXECUTIVE SUMMARY

INTRODUCTION

The Atascadero area (referred to here as the Atascadero Basin) has long been identified as a hydraulically distinct portion of the larger Paso Robles Groundwater Basin because the Rinconada Fault, which forms the boundary between the Atascadero Basin and the Paso Robles Basin, impedes groundwater flow between the two areas. The Atascadero Basin has maintained relatively stable groundwater levels and groundwater in storage, while groundwater levels on the eastern side of the Rinconada Fault, in the Paso Robles Basin, have been declining for years. Even with this information, the California Department of Water Resources (DWR) Bulletin 118 has identified the Atascadero Basin as part of the larger Paso Robles Groundwater Basin. While this difference was noted in numerous technical studies and by local agencies, there was not an urgent need to formally separate the two basins.

The passage of the Sustainable Groundwater Management Act (SGMA) in 2014 and its emphasis on sustainable groundwater management at the basin level has elevated the importance of groundwater basin boundaries and their impact on future groundwater management activities. While groundwater levels in the Atascadero Basin have remained stable over the last 20 years, groundwater levels in the central and west-central parts of the Paso Robles Basin have declined by an average rate of 5 feet per year totaling 100 feet or more of drawdown. Because of this continued groundwater level decline in the Paso Robles Basin, and the lack of a formal separation or distinction between the Paso Robles Basin and the Atascadero Basin, the Atascadero Basin has been identified by DWR to share the same status as the Paso Robles Basin:

- **High Priority Basin** – SGMA revised the State Water Code to direct DWR to develop initial statewide groundwater basin priorities by January 31, 2015. In early 2015, DWR concluded that the basin prioritization process was finalized in June 2014 under the California Statewide Groundwater Elevation Monitoring (CASGEM) Program. As a result of the analysis, the Atascadero Basin shares the *high priority* designation of the Paso Robles Basin.
- **Critical Overdraft** - SGMA also directed DWR to identify groundwater basins and subbasins in conditions of critical overdraft. As defined by SGMA, ‘A basin is subject to critical overdraft when continuation of present water management practices would probably result in significant adverse overdraft-related environmental, social, or economic impacts’. As a result of this analysis, the Atascadero Basin shares the *critical overdraft* designation of the Paso Robles Basin.

In both of these cases, the decline in groundwater levels within the greater Paso Robles Basin overshadows the localized conditions of the Atascadero Basin. By viewing both basins as a single basin, localized groundwater conditions in the Atascadero area are not able to be properly addressed because these localized conditions are not as basin-wide as the critical overdraft conditions that caused the Paso Robles Basin to be identified as being in critical overdraft.

In order to comply with the requirements of the SGMA and its emphasis on the basin-level groundwater management, the property owners overlying the Atascadero Basin, in collaboration with the Templeton Community Services District, City of Atascadero, and Atascadero Mutual Water Company (collectively Atascadero Basin Stakeholders), are working together to develop a Groundwater Sustainability Agency (GSA) that will develop and implement a Groundwater Sustainability Plan (GSP) for the Atascadero Basin. As identified by the SGMA, the first step in this process includes establishing the Atascadero Basin as separate and independent from the Paso Robles Basin.

While the Atascadero Basin Stakeholders are looking to sustainably manage the groundwater resources of the Atascadero Basin, they plan to do it in a coordinated and cooperative manner with groundwater management activities in the Paso Robles Basin.

BACKGROUND

The Atascadero Basin is a hydraulically distinct portion of the Paso Robles Area Subbasin No. 3-4.06, which is itself a portion of the greater Salinas Basin No. 3-4 as defined by the California Department of Water Resources (DWR) in Bulletin 118 (1975, 1980, 2003, and 2004 update). According to Bulletin 118 (update 2/27/2004), the Paso Robles Area Basin is bordered on the north by the Upper Valley Aquifer Subbasin of the Salinas Basin.

Bulletin 118 (update 2/27/2004) describes the water-bearing formations of the basin to include the Holocene-age alluvium found in river gravels throughout the basin, and the Pleistocene-age Paso Robles Formation. The Bulletin 118 further describes that the Rinconada Fault zone forms a leaky barrier that restricts flow from the Atascadero Basin to the main part of the Paso Robles Basin.

Other studies published before and after Bulletin 118 identified that the Rinconada Fault forms a clear and distinct hydraulic separation along approximately 85% of the boundary between the Atascadero Basin and the main Paso Robles Basin. This hydraulic separation and discontinuity, which forms the southernmost part of the boundary, is based on the juxtaposition of basin aquifer sediments west of the fault (in the Atascadero Basin) against impermeable bedrock east of the fault. Along the remaining approximately 15% of the boundary between the two basins, there appears to be some hydraulic communication between the Atascadero Basin and the Paso Robles Basin; however there is a clear distinction between the two basins based on differences in groundwater levels and differences in groundwater level change trends between the two basins. While groundwater levels in the western portion of the Paso Robles Basin (east of the Rinconada Fault) have generally and dramatically declined since the late 1990's, groundwater levels in the Atascadero Basin have remained relatively steady, with either consistently high water levels or slight declines due to the recent drought beginning in 2011.

SUSTAINABLE GROUNDWATER MANAGEMENT ACT – BASIN BOUNDARY MODIFICATION REQUEST

In response to SGMA, the Basin Stakeholders intend to submit a request to DWR to revise the boundaries of the Paso Robles Basin to formally identify the Atascadero Basin as a separate groundwater basin to support the independent and sustainable groundwater management of the Paso Robles Formation within the Atascadero Basin. The Atascadero Basin will be managed in a coordinated and cooperative manner with groundwater management activities in the greater Paso Robles Basin.

The Atascadero Basin Boundary Modification Request (Modification Request) is based on reports and technical analyses that more accurately defines the extent of the Paso Robles Formation within the Atascadero Basin, and defines the describes the effect of the Rinconada Fault on flow between the Atascadero Basin and the Paso Robles Basin. The specific modification requests are described below.

Modification Request No. 1 – Update Extent of the Paso Robles Formation and Western Boundary of the Atascadero Basin – Updated mapping of the surface geology of the northern San Luis Obispo County completed as part of the Paso Robles Groundwater Basin Study (Fugro, 2002) redefined the groundwater basin boundary compared to Bulletin 118. More recent mapping conducted since the passage of SGMA has further refined the extent of the Paso Robles Formation within the proposed Atascadero Basin.

Modification Request No. 2 – Document the Rinconada Fault Zone as a Basin Boundary – This modification request is intended to establish the Rinconada Fault zone as a basin boundary of the Paso Robles Formation between the Paso Robles Basin and the proposed Atascadero Basin. This effort includes defining the extent of the fault zone as a basin boundary.

Modification Request No. 3 – Update the Southern Basin Boundary. Updated mapping of the surface geology and detailed inspection of water well logs in the southern portion of the Atascadero Basin shows that the southern extent of the basin should be modified to a point north of Garden Farms.

ONGOING OUTREACH AND COORDINATION

To date, coordination and outreach regarding the Basin Boundary Modifications has taken place with the County of San Luis Obispo, City of Paso Robles, and basin stakeholders. Information regarding the formation of the Atascadero Basin GSA can be found at http://atascaderobasin.com/ .

TECHNICAL REPORT
ATASCADERO GROUNDWATER BASIN
BASIN BOUNDARY MODIFICATION APPLICATION

INTRODUCTION

The property owners overlying the Atascadero Basin, in collaboration with the Templeton Community Services District, City of Atascadero, and Atascadero Mutual Water Company (collectively Basin Stakeholders), are working together to develop a Groundwater Sustainability Agency (GSA) that will develop and implement a Groundwater Sustainability Plan (GSP) for the Atascadero Basin in compliance with the Sustainable Groundwater Management Act (SGMA). The Basin Stakeholders are looking to sustainably manage the groundwater resources of the Atascadero Basin in a coordinated and cooperative manner with groundwater management activities in the greater Paso Robles Basin.

This Technical Report presents the results of efforts to develop a scientific basis for basin boundary modifications of the Atascadero Groundwater Basin as a separate and distinct groundwater basin from the Paso Robles Groundwater Basin. A vicinity map showing the location of the basins is presented on Plate 1. A map of the proposed Atascadero Groundwater Basin boundary is presented on Plate 2.

As will be presented in this report, a significant volume of new scientific data has been compiled and analyzed in preparing for this basin boundary modification application. Much of the background information has been previously documented in reports and can be found in, among other studies, Fugro (2002) and GEI Consultants (2011).

The Atascadero Basin is a portion of the Paso Robles Area Subbasin No. 3-4.06, which is itself a portion of the greater Salinas Basin No. 3-4 as defined by the California Department of Water Resources (DWR) in Bulletin 118 (1975, 1980, 2003, and 2004 update). According to Bulletin 118 (update 2/27/2004), the Paso Robles Area Subbasin is bordered on the north by the Upper Valley Aquifer Subbasin of the Salinas Basin, on the east by the Temblor Range, on the south by the La Panza Range, and on the west by the Santa Lucia Range.

The Paso Robles Area Basin No. 3-4.06, as defined and delineated by California Department of Water Resources (DWR) Bulletin 118, later refined by Fugro (2002), encompasses an area of approximately 505,000 acres (800 square miles). The areal extent of the basin ranges from the Garden Farms area south of Atascadero to as far north as San Ardo in Monterey County, and from the Highway 101 corridor as far east as Shandon. Most of the Basin is hydraulically connected by thick sedimentary sections and has been informally divided into smaller planning subareas based on water quality, source of recharge, groundwater movement, and the contours of the base of permeable sediments.

The Paso Robles Basin supplies water for 29 percent of the County's population and an estimated 40 percent of the agricultural production of the County. The rural domestic and agricultural demands in the Basin currently rely exclusively on groundwater (including the underflow of streams); the municipal and industrial (M&I) demands are met through a combination of groundwater and imported surface water supplies provided through the

Nacimiento Water Project. The M&I water users include the cities of Paso Robles and Atascadero, the communities of Templeton, Shandon, Creston, and San Miguel, Bradley, Camp Roberts, and the small community system in Whitley Gardens. Individual domestic groundwater users and isolated subdivisions are located throughout the Basin, often in the more rural areas dispersed among the agricultural areas. Presently, agricultural water users constitute an estimated 72 percent of the pumpage in the Basin.

The Atascadero Basin is located southwest of the Paso Robles Basin and has an area of approximately 14,600 acres. As will be described in detail within this Technical Report, the Atascadero Basin is separated from the Paso Robles Basin by the Rinconada Fault, which forms an effective hydraulic barrier to groundwater flow over about 85% of the mutual boundary between the two basins; hydraulic communication between the two basins occurs over about 15% of the boundary. The Salinas River flows north roughly paralleling Highway 101 through the basin, flowing into the Paso Robles Basin near the south end of the City of Paso Robles.

SUMMARY OF FINDINGS

The following is a general summary of findings that provide geologic or hydrogeologic evidence to support the proposed modification of the Atascadero Basin boundary and indicate the basin is sufficiently distinct and separate from the Paso Robles Basin as to warrant the delineation and definition of a new Atascadero Basin.

- The Rinconada Fault forms a clear and distinct hydraulic separation along approximately 85% of the boundary between the Atascadero Basin and the main Paso Robles Basin; this hydraulic separation and discontinuity, which forms the southernmost 85% of the boundary, is based on the juxtaposition of basin aquifer sediments west of the fault (in the Atascadero Basin) against impermeable bedrock units east of the fault;
- Along the remaining approximately 15% of the boundary between the two basins, there appears to be hydraulic communication between the Atascadero Basin and the Paso Robles Basin; however, there is a clear distinction between the two basins based on differences in groundwater elevations and differences in groundwater level trends between the two basins;
- While groundwater levels in the western portion of the Paso Robles Basin (east of the Rinconada Fault) have generally and dramatically declined since the late 1990s, groundwater levels in the Atascadero Basin have remained relatively steady, and;
- The maximum estimated flux of percolating groundwater between the Atascadero Basin and Paso Robles Basin varies between approximately 350 and 550 acre-feet per year, depending on rainfall. For comparison, approximately 600 acre-feet per year of percolating groundwater flows across the DWR Bulletin 118 (B-118) boundary between the Paso Robles Area Basin No. 3-4.06 and the Salinas Valley Basin No. 3-4.

BACKGROUND

The Paso Robles Groundwater Basin identified by DWR is located in northern San Luis Obispo County and southern Monterey County and was described in the 1958 DWR Bulletin 118, San Luis Obispo County Investigation. As part of the efforts to map the State of California groundwater basins presented in B-118, DWR identified the Paso Robles Basin as a subbasin (Number 3-4.06) of the Salinas Valley Groundwater Basin.

The Basin boundary was later updated in Fugro (2002) and further refined by this investigation, which identifies the Atascadero Basin as that portion of the Paso Robles Basin west of the Rinconada Fault. The Atascadero Basin encompasses the Salinas River corridor area south of Paso Robles, including the communities of Atascadero, and Templeton. The basin borders are defined using information obtained from oil well and geothermal well logs, water well logs, geologic mapping, and fault investigations. DWR Bulletin 118 (rev. 2/27/2004) now recognizes the Fugro (2002) basin boundary and mapping, and numerous subsequent studies have either affirmed or acknowledged the existence of the subbasin and nature of the boundary.

DWR Bulletin 118 (rev. 2/27/2004) notes that the Rinconada Fault zone forms a leaky barrier that restricts flow from the Atascadero portion of the basin to the main part of the Paso Robles Bbasin. Bulletin 118 describes the water-bearing formations of the subbasin to include the saturated basin sediments consisting of Holocene-age alluvium found in river gravels throughout the basin, and the Pleistocene-age Paso Robles Formation. The alluvial deposits along the Salinas River overlie the Paso Robles Formation and are not affected by the fault, so groundwater flow in the alluvium (underflow) between the Atascadero Basin and the remainder of the Paso Robles Basin is not impeded.

Water users in the Paso Robles Groundwater Basin and the Atascadero Basin have, prior to development of the Nacimiento Water Project, relied exclusively on groundwater. The property owners overlying the Atascadero Basin, in collaboration with the Templeton Community Services District, City of Atascadero, and Atascadero Mutual Water Company (collectively Basin Stakeholders), are working together to develop a Groundwater Sustainability Agency that will develop and implement a Groundwater Sustainability Plan for the Atascadero Basin in compliance with the new Sustainable Groundwater Management Act. The Basin Stakeholders are looking to sustainably manage the groundwater resources of the Atascadero Basin in a coordinated and cooperative manner with groundwater management activities in the greater Paso Robles Basin. The proposed Atascadero Basin Boundary modification will support the Basin Stakeholder's efforts to sustainably manage groundwater.

PROPOSED MODIFICATIONS TO THE DWR BULLETIN 118 BASIN BOUNDARY OF THE ATASCADERO BASIN

According to DWR B-118, "lateral boundaries are features that significantly impede groundwater flow such as rock or sediments with very low permeability or a geologic structure such as a fault. Bottom boundaries would include rock or sediments of very low permeability if no aquifers occur below those sediments within the basin."

On the basis of technical findings by numerous groundwater studies published before and after DWR Bulletin 118 (update 2/27/2004), and on the basis of the extensive geologic cross section work described in this Technical Report, we propose the following modifications to the existing DWR B-118 boundaries. A map showing the proposed Atascadero Groundwater Basin boundary and the DWR B-118 boundary is presented on Plate 3.

MODIFICATION REQUEST NO. 1

Update the Western Basin Boundary. In the vicinity of Templeton, the DWR B-118 boundary extends the basin boundary several thousand feet west of the proposed basin boundary, which was likely done by DWR on the basis of surface mapping showing older alluvium (Qoa) at the surface. We propose to modify the basin boundary by moving the line east (Plate 3) to where well logs indicate the presence of Paso Robles Formation below the older alluvium.

Geologic evidence to develop a scientific basis for this modification consists of stratigraphy encountered by several wells drilled in this area. As discussed in the *Analysis of Geologic Setting and Structure* section below, these well logs indicate a thin veneer (sometimes only 10-15 feet) of unsaturated Qoa overlying relatively impermeable Monterey shale bedrock, which constitutes the bedrock unit in this area and significantly impedes groundwater flow. Therefore, primary basin aquifer materials (i.e., Paso Robles Formation) are absent in this area and, in our opinion, the proposed boundary accurately represents the B-118 definition of a lateral and vertical boundary.

MODIFICATION REQUEST NO. 2

Document the Rinconada Fault Zone as the Eastern Basin Boundary. This modification request is intended to establish the Rinconada Fault zone as a basin boundary of the Paso Robles Formation between the Paso Robles Basin and the Atascadero Basin. This effort includes defining the extent of the fault zone between the basins as the eastern Atascadero Basin boundary.

The following geologic and hydrogeologic evidence supports our assertion that the fault significantly impedes groundwater flow.

- Logs from wells on opposite sides of the Rinconada Fault indicate stratigraphic offsets that juxtapose basin aquifer sediments with impermeable bedrock (refer to *Analysis of Geologic Setting and Structure* section);
- Water elevation data (hydrographs) show water level trends of wells in the Paso Robles Basin are significantly different than those of wells in the Atascadero Basin (refer to *Water Level Trends and Groundwater Movement* section); and
- Groundwater flux estimates indicate flux between the Atascadero Basin and Paso Robles Basin is relatively small in volume, and similar in magnitude to the flux between the Paso Robles Basin and the Salinas River Valley Basin boundary defined by DWR (refer to *Groundwater Flux* section).

MODIFICATION REQUEST NO. 3

Update the Southern Basin Boundary. We propose modifying the southern boundary of the Atascadero Basin just south of the southern end of the Atascadero Mutual Water Company service area and just north of Garden Farms, as shown on Plate 2.

This modification is based on stratigraphy and lithologies encountered in the boreholes by several water wells at the southern end of the basin. As discussed in the *Analysis of Geologic Setting and Structure* section below, these well logs show the presence of Santa Margarita Formation at or near the surface in all logs. In some instances, the Santa Margarita Formation underlies alluvium, and in a few minor instances, a very thin veneer of unsaturated Paso Robles Formation sits on top of the Santa Margarita Formation, which significantly impedes groundwater flow.

GEOLOGY

A geologic map of the Paso Robles Basin showing the extent of the basin and the underlying geology is presented on Plate 4. Fugro (2002) includes detailed geologic cross sections and geologic descriptions of the stratigraphic relationships of the primary geologic units found in the basin. See Fugro (2002) for additional descriptions of non-water bearing formations and geologic structural features that are present in or adjacent to the Paso Robles Basin but that are not found in or adjacent to the Atascadero Basin.

WATER BEARING GEOLOGIC FORMATIONS

The stratigraphy in the watershed of the Paso Robles and Atascadero basins includes the water-bearing geologic units that form the basin aquifer, and the non-water bearing geologic units that underlie and are adjacent to the basin sediments. Plate 4 shows the extent of the geologic formations described in the following paragraphs. Descriptions of the water bearing and some of the non-water bearing geologic formations are provided below, including hydrogeologic characterizations of each formation. In addition, the critical structural features within and bounding the basins are identified.

The main criteria for defining the water bearing geologic formations in the Atascadero and Paso Robles basins are that they exhibit both sufficient permeability and storage potential for the movement and storage of groundwater such that wells can reliably produce more than 50 gallons per minute (gpm) on a long-term basis. Another criterion is that the groundwater produced from the geologic formation must have generally acceptable quality. DWR (1979) used groundwater conductivity of 3,000 micromhos/centimeter as the maximum limit for basin groundwater quality. Application of these two criteria limits definition of the basin sediments to Quaternary-age alluvial deposits and the Tertiary-age Paso Robles Formation.

The Paso Robles Basin boundary generally follows the outcrop contact of these water-bearing geologic units but also follows fault lines, particularly on the eastern edge of the basin. The bottom of the basin, defined generally as the base of the Paso Robles Formation, is a reflection of the folding, faulting, and erosion that formed the highly variable surface upon which the non-marine Paso Robles Formation sediments were deposited.

Alluvium

Alluvial deposits occur beneath the flood plains of the rivers and streams within the Atascadero and Paso Robles basins. These deposits reach a depth of about 100 feet below ground surface (bgs) or less and are typically comprised of coarse sand and gravel. The alluvium is generally much coarser than the Paso Robles Formation sediments, with higher permeability that results in well production capability that often exceeds 1,000 gpm. The principal areas of groundwater recharge to the basin occur where the shallow alluvial sand and gravel beds are in direct contact with the Paso Robles Formation.

Paso Robles Formation

The Paso Robles Basin and Atascadero Basin are comprised predominantly of Paso Robles Formation sedimentary layers that extend from the ground surface to more than 2,000 feet below sea level in some areas of the Paso Robles Basin, resulting in basin sediments with a thickness of more than 2,500 feet in the Paso Robles Basin and 500 to 600 feet in the Atascadero Basin.

The Paso Robles Formation is a Plio-Pleistocene, predominantly non-marine geologic unit comprised of relatively thin, often discontinuous sand and gravel layers interbedded with thicker layers of silt and clay. It was deposited in alluvial fan, flood plain, and lake depositional environments. Seashells are reported in some well logs near the base of the Paso Robles Formation, suggesting a near-shore marine depositional environment. The formation is unconsolidated and generally poorly sorted. It is not usually intensely deformed, except locally near fault zones. The sand and gravel beds within the unit have a high percentage of Monterey shale gravel and generally have moderately lower permeability compared to the shallow, unconsolidated alluvial sand and gravel beds. The formation is typically sufficiently thick such that water wells generally produce several hundred gpm. In the area near Atascadero, the Paso Robles Formation has been folded, exposing the basal gravel beds. With the basal gravel exposed and in direct contact with the shallow alluvium, the Paso Robles Formation is recharged directly from the river alluvium.

NON-WATER BEARING GEOLOGIC FORMATIONS

Underlying the Paso Robles Basin sedimentary beds are older geologic formations that typically have lower permeability and/or porosity. In some cases, these older beds occasionally yield flow in excess of 50 gpm to wells, but wells drilled into these units are also often dry or produce groundwater less than 10 gpm. Generally, the water quality from the bedrock units is poor. In general, the geologic units underlying the basin include Tertiary-age consolidated sedimentary beds, Cretaceous-age metamorphic rocks, and granitic rock.

Tertiary-Age Consolidated Sedimentary Formations

The Tertiary-age older consolidated sedimentary formations include the Pancho Rico Formation, an unnamed clastic unit, the Santa Margarita Formation, the Monterey Formation, the Obispo Formation, and the Vaqueros Formation. These units crop out around most of the basin edge and underlie the basin sediments.

The Santa Margarita Formation (Tsm) is an upper Miocene-age marine deposit, consisting of a white, fine-grained sandstone and siltstone with a thickness of up to 1,400 feet. The unit is found beneath most of the basin. The Santa Margarita Formation crops out in the Santa Margarita area where more than 300 domestic water wells depend on its very limited flow capabilities. It is also a host to a number of springs. South of Templeton, water produced from the Santa Margarita Formation is often of acceptable water quality. However, north of Templeton in the area south of the City of Paso Robles, the unit becomes progressively more permeable and is the main reservoir for the historical presence of geothermal water. Groundwater in the geothermal areas is often under pressure and artesian flow is a common occurrence, with flow rates at times exceeding 400 gpm. The Santa Margarita Formation aquifer in this area is not considered part of the Paso Robles basin because the produced water quality is usually very poor and because it is relatively impermeable in many areas in the vicinity of the basin. The geothermal waters contained in the Santa Margarita Formation in this area are often highly mineralized and characterized by elevated boron concentrations that restrict agricultural uses.

The Miocene-age Monterey Formation (Tm/Tml) consists of interbedded argillaceous and siliceous shale, sandstone, siltstone, and diatomite. The unit is exposed south and west of the Atascadero Basin and forms the adjacent bedrock unit as well as the base of the Paso Robles Formation aquifer throughout most of the Atascadero Basin. Within the basin, the unit thickness is as great as 2,000 feet, and the unit is often highly deformed. Water wells completed in the Monterey Formation are occasionally productive if a sufficient thickness of highly deformed and brittle siliceous shale is encountered. More often, however, the Monterey shale produces groundwater to wells in very low quantities. Springs issue from the Monterey Formation in the Atascadero area and on Cuesta Ridge south of the Paso Robles Basin. The Monterey Formation can also be a source for oil in the area near Hames Valley, downstream of Lake San Antonio, and in upper Indian Valley. Groundwater produced from the Monterey Formation often has high concentrations of hydrogen sulfide, total organic carbon, and manganese. In the Paso Robles area, the Monterey Formation may be a host to geothermal water that has high sulfide concentrations in addition to high boron, iron, manganese, and total dissolved solids.

Metamorphic and Granitic Rock

A portion of the eastern edges of the Atascadero Basin is bordered by Cretaceous-age metamorphic and granitic rock. The metamorphic rock units include the Franciscan, Toro, and Atascadero formations. The Franciscan Formation (fm) consists of discontinuous outcrops of shale, chert, metavolcanics, graywacke, and blue schist, with or without serpentinite. The Franciscan Formation has an undetermined thickness and has low permeability and porosity. Limited volumes of groundwater can be produced from this geologic unit, generally only where the metavolcanics rock has been highly fractured.

The Toro Formation (Ktsh) is a highly consolidated claystone and shale that does not typically yield significant water to wells. The Atascadero Formation (Kas) is highly consolidated but does have some sandstone beds that yield limited amounts of water to wells. Both the Toro and Atascadero formations are exposed in the hills west of Santa Margarita, Atascadero, and Templeton.

The granitic rock (gr) lies east of the Rinconada Fault zone, east of the City of Atascadero. The Park Hill area south of Creston and east of Atascadero is well known for the difficulty of finding sufficient groundwater to serve single residences. Where water is found, it is typically low in salinity. The granitic rocks often have a decomposed regolith up to 80 feet in thickness in the valley floor areas that may contain limited amounts of groundwater despite low sediment permeability due to the breakdown of feldspar and iron and magnesium silicates into clays and fine grained sediment. Springs are occasionally found where the rock is fractured.

GROUNDWATER BASIN DEFINITION

Paso Robles Basin

The lateral extent of the Paso Robles Basin is generally defined by the contact of water-bearing unconsolidated aquifer sediments (Paso Robles Formation and alluvial sediments) with older geologic units. In some areas, however, the basin boundary is a structural boundary defined by faults (Plate 4). The entire eastern boundary of the Paso Robles Basin is defined by the Red Hill, San Juan, and White Canyon faults.

Atascadero Basin

The northwestern, western, and southern boundaries of the Atascadero Basin are defined by the contact of Paso Robles Formation sediments with older, relatively impermeable geologic units, including Tertiary-age consolidated sedimentary beds, Cretaceous-age metamorphic rocks, and granitic rock.

The Rinconada Fault defines the eastern boundary of the Atascadero Basin and forms a hydraulic barrier between the Paso Robles Basin and the Atascadero Basin. Between Atascadero and Creston, the Rinconada Fault juxtaposes less permeable granitic and Monterey Formation rocks with the Paso Robles Formation basin sediments. Farther north, the Rinconada Fault zone was exposed in trenches on the Santa Ysabel Ranch (GeoSolutions, 2000), where the investigation concluded that the fault was a barrier to groundwater flow in the Paso Robles Formation as evidenced by differences in water levels at the Santa Ysabel warm water spring and wells drilled at the edge of the terrace above the Salinas River flood plain. South of the City of Paso Robles, the Paso Robles Formation is found on both sides of the Rinconada Fault, however we found limited data to suggest that the fault acted as a barrier to flow, so we have assumed that the fault zone forms, at the most, a leaky barrier that restricts flow from the Atascadero Basin to the main part of the Paso Robles Basin.

Dibblee (1976) suggests that vertical displacement along the Rinconada Fault exists, but the data conflict depending on location. In the fault reach along the boundary of the Atascadero Basin, evidence exists to suggest relative uplift of the northeast block. Dibblee (1976) suggests that the earliest displacement since Miocene time was up on the northeast, then up on the southwest in the late Pleistocene. All evidence indicates that horizontal displacement on the fault is right lateral (Dibblee, 1976; Campion, et al, 1983).

Groundwater flow from the Atascadero Basin west of the Rinconada Fault into the Paso Robles Basin is limited to underflow in the alluvial Salinas River deposits and minor subsurface groundwater flux in the Paso Robles Formation (described in more detail, below). The Rinconada Fault is not considered active because it does not displace Holocene-age deposits, but it is considered potentially active because it displaces the Quaternary-age Paso Robles Formation. North of the Paso Robles Basin, however, the Rinconada Fault zone and the San Marcos Fault zone are considered active and are classified as Alquist-Priolo special studies zones.

HYDROGEOLOGIC SETTING

AQUIFER CHARACTERISTICS

Hydrogeologic parameters include estimates of average specific yield and the transmissivity, hydraulic conductivity, and specific capacity of aquifer zones perforated by wells. Fugro (2002) estimated average specific yield by analyzing well completion logs. Each lithologic interval (discrete bed) was assigned a specific yield by comparison of the formation description with published estimates based on extensive field and laboratory investigations conducted in southern coastal basins by the DWR and modified for the Paso Robles Formation (DWR, 1958). The assigned specific yield was then weighted according to the thickness of each bed and averaged over the entire depth of the well.

Pumping test data from wells in the Atascadero Basin suggest the presence of three aquifer groups with distinctly different hydraulic parameters. These three groups include the shallow younger alluvium along the Salinas River (underflow) and associated tributaries, the Paso Robles Formation deposits directly underlying the younger alluvium, and the Paso Robles Formation deposits along the east side of the basin that are not directly connected to the younger alluvium. The aquifer characteristics of each unit is summarized below, and presented with pumping test data in Table 1.

Younger Alluvium (Qa). Water wells penetrating and extracting groundwater from the younger alluvium are located along the full length of the Salinas River. The unit, consisting almost entirely of sand and gravel, is everywhere unconfined with very high transmissivity values. The thickness of the younger alluvium ranges widely, with an estimated maximum thickness of 75 to 90 feet. Specific capacity values for wells in the alluvium range from 20 to 60 gallons per minute per foot (gpm/ft) at production rates as high as 1,000 gpm.

Paso Robles Formation Below Qa (QTp/Qa). In the Atascadero area and in the area north of Templeton but just south of the Rinconada Fault, the Paso Robles Formation underlies and is in hydraulic contact with the younger alluvium along the Salinas River channel. Wells in the Paso Robles Formation in hydraulic communication with the overlying younger alluvium tend to have higher transmissivity values than wells that penetrate the portions of the Paso Robles Formation not in contact with the alluvium. Constant discharge aquifer pumping tests for wells in Atascadero on the west side of the Salinas River showed production rates up to 1,000 gpm, with an average specific capacity of 15 gpm/ft and storativity of 0.04 to 0.0001 (Table 1).

Paso Robles Formation (QTp). Paso Robles Formation deposits east of the Salinas River comprise the largest portion of the Atascadero Basin aquifer. Lithology descriptions from driller's logs include sand and gravel with interbedded clays. The upper 300 feet of sediments in this area is characterized by thin (5 feet to 15 feet thick) interbedded brown or yellow clays with sand and "shale gravel." The beds tend to be thicker below 300 feet, with an increasing proportion of sand and gravel.

Table 1. Aquifer Parameters, Atascadero Basin (from Fugro (2002))

Well Location	Test (hours)	Flow (gpm)	Well Depth (ft)	Perf. Int. (ft)	Trans. (gpd/ft)	Q/s (gpm/ft)	Hyd. Cond. (ft/day)	Storativity	Type
28S/12E-5	8	90	55	30	101,106	110	450.6		Qa (Salinas)
27S/12E-29	24	740	60	25	650,000	105	3475.9		Qa (Salinas)
27S/12E-31	20	220	60	20	24,200	27.2	161.8		Qa (creek)
27S/12E-31	24	15	25	10	15,840	7.1	211.8		Qa (creek)
28S/12E-03	72	1300	425	270	45,760	17.6	22.7		QTp/Qa
28S/12E-03	72	1300 (obs)	505	332	45,760	na (obs)	18.4	0.04	QTp/Qa
28S/13E-31a	12	1000	450	300	52,800	11.5	23.5		QTp/Qa
28S/13E-31b	12	950 (obs)	450	300	36,000	na (obs)	16	0.0002	QTp/Qa
28S/13E-31c	24	1000	330	120	22,000	14.5	24.5		QTp/Qa
28S/13E-31d	24	1000 (obs)	320	87	26,400	na (obs)	40.6	0.0001	QTp/Qa
28S/13E-31e	24	1000 (obs)	310	283	--	na (obs)	146.4	0.004	QTp/Qa
28S/12E-03	24	325	370	225	5,400	3	3.2		QTp
28S/12E-11	72	810	600	300	6,198	5.7	2.8		QTp
28S/12E-11	72	810(obs)	350	200	8,250	na (obs)	5.5	0.002	QTp
27S/12E-9	72	475	605	312	6,600	2.3	2.8		QTp
27S/12E-16	24	426	640	380	2,900	2.1	1		QTp
27S/12E-16	24	441	280	115	7,300	4.6	8.5		QTp
27S/12E-20	103	110	290	120	1,700	0.9	1.9		QTp
27S/12E-20	24	150	195	87	7,275	2.8	11.2		QTp
27S/12E-17	50	200	270	170	2,122	1.8	1.7		QTp
Summary:									
Qa (average Salinas)		415	58	28	376000	108	1963		
Qa (average creeks)		118	43	15	20020	17	187		
QTp/Qa (average)		471	399	242	38120	6	42	0.011	
QTp (average)		367	450	212	5305	3	4	0.002	
Specific Yield: Number of wells used to calculate:					20	Average Value:		0.11	

Notes:

Qa – Quaternary Alluvium
QTp – Paso Robles Formation
gpm – Gallons per minute
Hyd. Cond. - Hydraulic conductivity
Trans. – Transmissivity
gpd/ft - Gallons per day per foot
Perf. Int. – Perforated interval
Q/s – Specific capacity
obs – Observation well data
na - Not applicable

The results of several controlled aquifer pumping tests were reviewed for wells in the Paso Robles Formation, including wells in the both the Templeton area and the City of Atascadero area. None of these wells were in direct hydraulic communication with the shallow younger alluvium. The specific capacity in these wells ranged from 0.9 to 5.7 gpm/ft at pumping rates of 110 to 810 gpm (Table 1). The average hydraulic conductivity of the Paso Robles

Formation for the depth intervals tapped by wells in the Atascadero Basin is estimated at 4 ft/day.

WATER QUALITY

Based on our review, the water quality of the Paso Robles Basin and the Atascadero Basin has not been investigated in enough detail to highlight differences, which may or may not exist, between the two basins. In general, the groundwater quality of the basins is relatively good, with few areas of unacceptable quality and few significant trends of deteriorating water quality. The following general descriptions of water quality for each basin were presented in Fugro (2002).

Paso Robles Basin

> Analyses indicated generally good overall water quality, but noted some areas of rising concentrations of total dissolved solids (TDS), chloride, and nitrate. Potential sources of these three constituents could include wastewater discharges, agricultural practices, irrigation with recycled water, and/or pumping or upwelling from deeper aquifers.

The dominant water type in the Paso Robles Basin is calcium-bicarbonate water. Groundwater recharge to the basin from southern drainages, draining the Cretaceous-age granitic rocks and sedimentary beds of the La Panza Range, is typically a calcium-bicarbonate water, which is the predominant water type of the underflow of the Salinas River and Huerhuero, Navajo, Camatta, and Shell creeks.

Atascadero Basin

The main source of recharge to the Atascadero Basin is the percolation of streamflow from the Salinas River, which drains the Cretaceous-age granitic rocks and sedimentary beds of the northwestern La Panza Range. This recharge, typically a calcium and magnesium bicarbonate water, has the greatest influence on water quality in the basin. Increasing TDS and chlorides in shallow Paso Robles Formation deposits along the Salinas River in the central portion of the basin was identified as a trend of slight water quality deterioration.

COMPONENTS OF RECHARGE AND DISCHARGE, AND HYDROLOGIC BUDGET

Recharge to the Paso Robles and Atascadero basins occurs predominantly by percolation of streamflow water and by deep percolation of precipitation. The results of Fugro (2005) calculated a perennial yield value of 97,700 acre-feet per year (AFY) for the Paso Robles Basin (which, at the time, included the Atascadero Basin). Calculated separately, the perennial yield of the Atascadero Basin was estimated to be 16,400 AFY.

An ongoing investigation by GEOSCIENCE (2014) is intended to update the Fugro (2005) numerical groundwater flow model. Although not finalized, the revised perennial yield of the Paso Robles Basin, as calculated by GEOSCIENCE (2014) is 89,600 AFY. A separate perennial yield value of the Atascadero Basin was not calculated.

The Paso Robles Basin outlet is northwest of and downstream of Bradley, where it is hydraulically connected with the Salinas Valley Groundwater Basin. Outflow (primarily surface flow and Salinas River underflow) from the Atascadero Basin enters the Estrella subrea of the Paso Robles Basin.

General descriptions of the primary recharge and discharge sources in the Atascadero Basin are presented below. These sources are represented in the following hydrologic budget relationship.

$$Sb_I + P + S_I + PR + WW + W_I = Sb_o + Q + EP + W_E \pm \Delta S$$

where:
- Sb_I = Subsurface Inflow
- P = Percolation of Precipitation
- S_I = Streambed Percolation
- PR = Percolation of Irrigation Return Water
- WW = Percolation of Wastewater Discharge
- W_I = Imported Water
- Sb_o = Subsurface Outflow
- Q = Gross Groundwater Pumpage
- EP = Extraction by Phreatophytes
- W_E = Exported Water
- ΔS = Change in Groundwater Storage

Subsurface Inflow (Sb_I)

Subsurface inflow is the flow of groundwater from the surrounding "non-water bearing bedrock" into the basin sediments. Flow across the basin boundary is predominantly via highly conductive, but random and discontinuous, fractures.

The rate of subsurface inflow to the Atascadero basin from the surrounding hill and mountain area varies considerably from year to year depending upon precipitation (intensity, frequency and duration, seasonal totals, etc.) and groundwater level gradients. There are no available published or unpublished tunnel inflow data for the hill and mountain areas surrounding the basins, or for geologic units that border the basin sediments. Fugro (2002) estimated average quantities of inflow are about 800 AFY.

Percolation of Precipitation (P)

The volume of precipitation that percolates vertically downward into a groundwater basin aquifer can vary considerably, depending mostly upon the type of soil, density of vegetation, the quantity, intensity, and duration of rainfall, the vertical permeability of the soil, and topography. Fugro (2002) estimated an average percolation inflow of approximately 3,900 AFY for deep percolation of precipitation into the Atascadero Basin.

Streambed Percolation (S_I)

Groundwater recharge from deep percolation of streamflow takes place in the narrow stream and alluvial valleys overlying the basin sediments. The amount of recharge varies annually with the quantity and duration of runoff.

The Salinas River within the Atascadero Basin receives runoff from several tributaries within its 390 square mile watershed. Flow along the uppermost reaches is controlled by Salinas Reservoir (Santa Margarita Lake) releases. The reservoir is operated for water supply purposes and diverts water to the City of San Luis Obispo, outside the watershed. Significant inflow from Paso Robles Creek and Santa Margarita Creek increase flow of the Salinas River through the Atascadero Basin. Groundwater recharge from percolation of streamflow is known to occur near Atascadero with lesser recharge occurring in the Templeton area, downstream of the confluence of the Salinas River with Graves and Paso Robles creeks.

The alluvial deposits have an available groundwater storage capacity of about 7,700 AFY. Once the alluvial deposits are saturated, additional recharge occurs as a result of the deep percolation of alluvial water into the Paso Robles Formation. Deep percolation of streamflow along this reach ranges from 300 AFY to as much as 19,000 AFY. The average total annual percolation of streamflow in this reach is about 10,500 AFY (Fugro, 2002).

Most precipitation in the area occurs between November and May, mostly in the mountainous regions along the west side of the Paso Robles and Atascadero basins. Annual precipitation in the headwater areas of the Salinas River can reach 30 inches or more. In contrast, annual precipitation east of Paso Robles and Atascadero is generally between 10 and 13 inches. As a result, more than 90 percent of the total streamflow is produced in the western hills surrounding the basin. Fugro (2002) estimated an average annual surface flow runoff of 93,000 AFY for the Salinas River within the Atascadero Basin.

Percolation of Irrigation Return Water (PR)

Percolation of irrigation return water in the Atascadero Basin is a function of both irrigation efficiency and required leaching of the soils, and is dependent on a variety of factors including crop type, climate factors, irrigation management practices, and soil types. Fugro (2002) estimated an annual percolation of irrigation return water average of 200 AFY for the Atascadero Basin.

Percolation of Wastewater Discharge (WW)

The City of Atascadero discharges treated effluent to the river alluvium via percolation ponds adjacent to Chalk Mountain golf course, and in late 2001, the Templeton CSD began operating a wastewater treatment plant that discharges effluent into the Salinas River via percolation ponds. Templeton CSD reclaims the entire amount of effluent discharge (minus a 2% loss factor), so factoring out evaporation losses from the ponds and the approximately 300 AFY supplied to the Chalk Mountain golf course for reclaimed irrigation use, the wastewater return flow to the Salinas River averages approximately 1,000 AFY, with a range of 733 AFY to 1,185 AFY (Fugro, 2002).

Subsurface Outflow (Sb_O)

Groundwater in the Atascadero Basin flows generally from south to north toward the Paso Robles Basin. The fault displaces the Paso Robles Formation along most of the interface between the Atascadero Basin and Paso Robles Basin, and restricts groundwater flow across the fault. There is some hydraulic communication, and at least some groundwater flow within the Paso Robles Formation across the Rinconada Fault where the Salinas River crosses the fault. The fault does not displace the alluvial deposits and does not restrict flow in the alluvium.

The area of subsurface outflow from the Atascadero Basin to the Paso Robles Basin has a width of about 5,000 feet and a composite transmissivity of 38,120 gpd/ft. With an average gradient of $7x10^{-4}$ ft/ft, average subsurface outflow from the Atascadero Basin to the Paso Robles Basin was calculated to be approximately 200 AFY (Fugro, 2002). Subsequent calculations performed during the present investigation resulted in an estimated volume of subsurface flow in the Paso Robles Formation across the Rinconada Fault at approximately 350 to 550 AFY.

Gross Groundwater Pumpage (Q)

The groundwater pumpage component consists of the combination of agricultural pumpage and municipal, community, and rural domestic pumpage. The most recent pumping update for the Atascadero Basin concluded that total pumpage for the basin was 14,900 acre feet in 2009 (Fugro, 2010).

Groundwater in Storage and Change in Storage

In the Atascadero Basin, Fugro (2002) estimated total groundwater in storage averaged about 513,600 acre feet. By the specific yield method of calculating perennial yield, approximately 2,600 AF more groundwater was in storage in the basin in 1997 compared to 1980, an approximate 0.5% increase in total groundwater in storage during the base period. This averages out to about 200 AFY increase in storage. Calculations of change in storage have not been performed more recently than Fugro (2002).

ANALYSIS OF GEOLOGIC SETTING AND STRUCTURE

A geologic map of the Atascadero Basin showing the extent of the basin, underlying geology, and the locations of geologic cross sections is presented on Plate 5 (a full-size 48" x 36" PDF version of Plate 5 is submitted separately). Starting from the north end of the basin, we prepared geologic cross sections that started west of the western boundary of the basin, and trended across the basin, crossing the Rinconada Fault on a sub-perpendicular line, ending several thousand feet east of the fault in the main part of the Paso Robles Basin.

A line of profile was drawn every 4,000 feet from the northern end of the Atascadero Basin to the southern end (Plate 5); of these profiles, 13 east-west cross sections are presented herein (Plates 6 through 13). A north-south cross section was also prepared that more or less follows the thalweg of the Salinas River that extended the full 82,000 feet, or 15.5 miles, of the length of the basin (Plate 14). We also prepared three more, shorter north-south cross sections, each about 5 miles long, across the northern boundary of the basin to better understand the characteristics of the northern boundary (Plate 15).

We reviewed several thousand pages of DWR well logs on both sides of the fault. Some of the well logs could not be used because the location of the well could not be interpreted, or because the reproduction was too poor to read. We plotted each well location in Google Earth so we could then import the locations directly into GIS. We entered data from the logs, including a well log ID number, well depth, lithology intervals, and geologic unit interpretation into a spreadsheet, which was then also imported directly into GIS.

In general, aquifer stratigraphy in the Atascadero Basin is defined by alluvium (younger and older) and active stream channel deposits locally overlying the Paso Robles Formation aquifer, which varies in thickness due to depositional surface differences and displacements of aquifer sediments in the vicinity of the Rinconada Fault. The non-water bearing bedrock consisting of sedimentary Santa Margarita (Tsm) and Monterey (Tm/Tml) formations defines the base of the Atascadero Basin north of about Section Line 600. South of this section, the

Monterey Formation is relatively thin and overlies older non-water bearing metamorphic and granitic bedrock formations.

Generalized descriptions of stratigraphic relationships at cross section locations are provided below. The descriptions address the effect of these stratigraphic relationships on basin boundaries, including effect of the Rinconada Fault on hydraulic continuity between the Atascadero Basin and Paso Robles Basin.

CROSS SECTION AB (PLATE 5)

At the northern boundary of the Atascadero Basin, the Rinconada Fault is interpreted to offset the relatively impermeable Santa Margarita and Monterey formations and the overlying Paso Robles Formation. Well log data in the northern part of the basin, near Templeton, indicate the Rinconada Fault has uplifted bedrock to a depth of approximately 250 feet below the ground surface. The aquifer's hydraulic continuity across the fault is limited to a thickness of approximately 150 to 200 feet at this location. This length of limited aquifer continuity is estimated to be about 12,000 feet, or about 15% of the boundary length, where the fault crosses the Salinas River floodplain (also shown on Sections 80 and 120). North of the Salinas River, well log data suggest aquifer deposits west of the Rinconada Fault are generally unsaturated and hydrologically disconnected from aquifer deposits of the Paso Robles Basin.

Water-bearing sedimentary deposits in the Atascadero Basin are estimated to be up to approximately 700- to 800-feet thick. Based on inspection of well logs and the base of permeable sediments, the deepest part of the basin is the area between Templeton and the Rinconada Fault (Fugro, 2002). Shallow wells up to 100 feet deep in the immediate vicinity of the Salinas River typically tap the younger alluvium and/or shallow Paso Robles Formation aquifer zones. Deep wells reach several hundred feet deep and tap the Paso Robles Formation, although a few of the deeper wells also tap the upper portion of the upper Miocene-age Santa Margarita Formation. The thickness of the aquifer decreases at the southern end of the basin, near the upper reaches of the Salinas River Valley.

Most of the southern portion of the Atascadero Basin is underlain by light gray and white sandstone of the Santa Margarita Formation. Multiple well logs at the southern end of the basin, as mapped by DWR B-118, show the presence of Santa Margarita Formation at or near the surface in all logs. In some instances, the Santa Margarita Formation underlies the alluvium and Salinas River stream channel deposits, and in a few minor instances, a very thin veneer of unsaturated Paso Robles Formation sits on top of the Santa Margarita Formation. Thus, aquifer sediments are considered absent from the southernmost portion of the basin mapped by DWR B-118, and we propose modifying the southern boundary of the basin to a point north of Garden Farms.

CROSS SECTIONS 720 TO 600 (PLATES 6 AND 7)

Water bearing strata consisting of alluvium and Paso Robles Formation are relatively shallow at these cross section locations, with interpreted thicknesses ranging from about 100 to 300 feet, and a maximum width of approximately 5,000 feet.

The Rinconada Fault juxtaposes basin aquifer sediments west of the fault (Atascadero Basin) against impermeable bedrock east of the fault at these cross section locations, with the exception of Section 720, where approximately 50 to 100 feet of alluvium and younger deposits of Paso Robles Formation mantle the fault trace and impermeable bedrock east of the fault.

The proposed Atascadero Basin boundary has been modified to include these water bearing sediments for a length of approximately 3,300 feet along the eastern boundary of the basin (Plate 3).

CROSS SECTIONS 520 TO 160 (PLATES 8 – 12)

Offsets in stratigraphy across the Rinconada Fault preclude hydraulic continuity at these cross section locations. In addition, the fault is more or less aligned with a topographic divide at the eastern edge of the Salinas River flood plain. Surface elevations generally rise to the east of the fault, and descend to the active river channel west of the fault.

East of the fault, stratigraphy consists of older alluvium locally overlying the Paso Robles Formation, which is interpreted to be uplifted and approximately 100- to 200-feet thick near the fault. Immediately west of the fault, the Paso Robles Formation in the Atascadero Basin is up to approximately 300- to 700-feet thick, 7,500- to 15,000-feet wide, and locally overlain by alluvium and active stream channel deposits. Where the Paso Robles Formation is shown on the geologic map as possibly contiguous across the Rinconada Fault (Sections 200, 320, and 520), inspection of well log data immediately east of the fault clearly indicate that these thin surface exposures of Paso Robles Formation are shallow, discontinuous, and unsaturated. Based on these data and hydrogeologic effects associated with the topographic divide noted above, there is no hydraulic continuity across the fault at these locations.

Inspection of the cross section profiles from the southern end of the Atascadero Basin (Section 720) to Section 160 shows a continuous boundary along approximately 85% of the length of the eastern edge of the Atascadero Basin with no hydraulic communication to the Paso Robles Basin.

In the area west of Templeton (near Sections 240 and 280), north of Paso Robles Creek, the DWR B-118 basin boundary extends west to the base of bedrock slopes, on the basis of surface mapping showing Qoa at the surface. Logs of several wells drilled in this area suggest that the area has a thin veneer (sometimes only 10-15 feet) of unsaturated Qoa overlying Monterey shale. Similar to the interpreted subsurface conditions for Section A-A’ discussed below, there are no basin materials (Paso Robles Formation) in this area, and our proposed basin mapping has modified the boundary accordingly.

CROSS SECTION 120 (PLATE 12)

Relatively thick and saturated sections of Paso Robles Formation aquifer materials are first found on both sides of the Rinconada Fault in the vicinity of Section 120. Alluvium and active stream channel deposits overlie Paso Robles Formation, which is interpreted to be up to approximately 400- to 500- feet thick. Strata of the non-water bearing Santa Margarita and Monterey formations are offset by the Rinconada Fault, however, the overlying Paso Robles Formation appears to be contiguous across the fault (i.e., the eastern boundary of the Atascadero Basin). Hydraulic continuity across the fault is likely limited to the 150- to 200-thickness of contiguous aquifer noted in the Cross Section AB description above.

CROSS SECTIONS 40 AND 80 (PLATE 13)

East of the Rinconada Fault, alluvium and active stream channel deposits along the Salinas River channel overlie the Paso Robles Formation, which is relatively deep at the east end of the section and tapers to a thickness of about 200 feet at the fault, where Santa Margarita Formation and Monterey Formation have been uplifted by the fault.

West of the Rinconada Fault, stratigraphy is defined by an anticline structure composed of Monterey Formation that is likely associated with regional deformation prior to deposition of the Paso Robles Formation. West of the anticline structure, a syncline consisting of Paso Robles Formation and minor alluvium deposits bounded by Monterey Formation bedrock is interpreted to be approximately 7,500 feet wide and 550 feet deep.

The eastern flank of the anticline terminates at the Rinconada Fault, and is overlain by relatively thin strata of Santa Margarita Formation, Paso Robles Formation, alluvium, and active stream channel deposits along the Salinas River channel. The Paso Robles Formation is contiguous across the Rinconada Fault, however, well log data suggest deposits are generally unsaturated on the eastern flank of the anticline. Therefore, the aquifer's hydraulic continuity at these locations is likely limited to the 150- to 200-thickness of contiguous aquifer noted in the Cross Section AB description above.

CROSS SECTIONS A-A', B-B', AND C-C' (PLATES 14 AND 15)

The southern end of Section A-A' shows alluvium and stream channel deposits overlying the Monterey Formation bedrock, with thicknesses of approximately 10 to 50 feet. Similar to the interpreted subsurface conditions for Sections 240 and 280 discussed above, there are no Paso Robles Formation deposits in this area, and our proposed basin mapping has modified the boundary accordingly.

The Rinconada Fault defines the eastern boundary of the Atascadero Basin (Sections B-B' and C-C') and hydraulic continuity is limited across the fault by stratigraphic offsets that juxtapose a substantial thickness of basin aquifer sediments against impermeable bedrock. The estimated thickness of contiguous sediments at these cross section locations is approximately 100 to 150 feet. North and south of the Rinconada Fault zone, the thickness of aquifer sediments ranges from about 200 feet to more than 900 feet.

SUMMARY OF ANALYSIS OF GEOLOGIC SETTING AND GEOLOGIC DELINEATION OF THE EASTERN BOUNDARY OF THE ATASCADERO BASIN

Based on geologic mapping, inspections of several hundreds of water well completion reports (driller's logs), and preparation and analysis of multiple geologic and hydrogeologic cross sections, the data show that the Rinconada Fault juxtaposes the unconsolidated basin aquifer materials of the Atascadero Basin on the west side of the fault against impermeable bedrock east of the fault, from the southern tip of the basin to a point a few hundred feet south of and across the river from where Highway 46 West hits Highway 101. This distance constitutes approximately 85% of the length of the eastern boundary of the basin, forming a clear and distinct basin boundary. From this point north, until the Rinconada Fault crosses the river and extends into bedrock west of the south end of Paso Robles, the fault displaces Paso Robles Formation sediments, or basin materials, on both sides of the fault.

For the northernmost 15% of the length of the boundary, the data are not as conclusive. To further investigate the hydrogeologic relationship of the Atascadero Basin materials with the Paso Robles Basin aquifer across the Rinconada Fault in this area, other lines of evidence were required, including analysis of groundwater flow and movement, water levels, water quality, and estimates of groundwater flux. The water quality data is quite limited, but meaningful analyses related to water levels and groundwater flux are described, below.

WATER LEVEL TRENDS AND GROUNDWATER MOVEMENT

COMPARISON OF WATER LEVEL CHANGE AND TRENDS

A groundwater elevation change map of the Paso Robles Basin was prepared by GEI Consultants (2011, modified) that showed changes in groundwater levels for the period from 1997 to 2013 (Plate 16). The map shows that the greatest change in groundwater elevations occurred in the Estrella subarea of the Paso Robles Basin, with significant areas of the basin experiencing water level declines greater than 70 feet (with some wells experiencing water level declines greater than 250 feet). Within the same time period, water level changes in wells within the Atascadero Basin remained relatively steady (Plate 16), with a small area in the northern part of the basin showing minor declines (in part, as a result of the ongoing drought), and some areas of the basin showing water level increases over the time period.

To evaluate the potential effect that the Rinconada Fault might have on groundwater flow between the Atascadero Basin and the Paso Robles Basin along the northernmost portion of the mutual boundary, water level data were obtained from Atascadero Mutual Water Company, Templeton CSD, and the County of San Luis Obispo, Public Works Department groundwater level monitoring program database. The data were used to prepare water level hydrographs, assess the differences, if any, in water level elevations across the fault, and analyze time-dependent water level trends and responses to stresses in the two basins.

Data from wells with known construction details were used, only, and the data were also filtered to include wells that penetrated and extracted groundwater solely from the percolating groundwater basin materials (in other words, no data were included in this analysis for wells screened only in the shallow, Salinas River underflow). The hydrographs presented on Plate 17 (a full sized, 24” x 36” PDF version of this plate is submitted, separately) show data from wells that are screened within the Paso Robles Formation. In general, the water level data on Plate 17 reflects similar responses shown on Plate 16, that is, that while groundwater levels in the western portion of the Paso Robles Basin (east of the Rinconada Fault) have generally and dramatically declined since the mid to late 1990s, groundwater levels in the Atascadero Basin have remained relatively stable.

Water levels in the deeper Paso Robles Formation wells along the Salinas River corridor in the Atascadero Basin often show seasonal fluctuations up to 100 feet or more. Despite these wide seasonal fluctuations, water level recovery back to original Spring levels is generally consistent and reflects a relatively stable hydrologic regime. In the eastern portion of the Atascadero Basin, east of the Salinas River, seasonal fluctuations are less pronounced in deep wells and the long-term trend is generally stable or gradually increasing water levels, particularly east of Templeton.

As shown in the hydrographs on Plate 17, standing groundwater elevations in the Paso Robles Basin range from approximately 1,140 feet mean sea level (msl) in upland areas (Well No. 18) to about 550 feet msl near the southeastern edge of the City of Paso Robles (Well No. 20). In contrast, standing groundwater elevations in the Atascadero Basin range from approximately 850 feet msl in the upper reaches of the Salinas River Valley (Well No. 2) to about 660 feet msl near the northern basin boundary (Well No. 17). Furthermore, as shown in the hydrographic data from Well Nos. 18 through 24, collected from wells southeast of the City of Paso Robles in the Paso Robles Basin, the aquifer has experienced a significant decline in water levels, starting around the mid-1990s and continuing today. In comparison, the data from wells in the Atascadero Basin (Wells Nos. 2 through 17 on Plate 17) appear to be generally stable over the same time period (mid 1960s to present).

COMPARISON OF WATER LEVEL HYDROGRAPHS

The only water wells near the northern end of the Atascadero Basin with long water level histories that are located relatively close to, but on opposite sides, of the Rinconada Fault are Well Nos. 17 and 24 (see Plate 17). Well No. 24 is located approximately 7,100 feet northwest (and downstream) of Well No. 17, and both wells are located in the floodplain of the Salinas River. Well Nos. 17 and 24 are as close as approximately 3,200 feet and 1,800 feet, respectively, to the mapped trace of the Rinconada Fault. A direct comparison of the two hydrographs is shown on Plate 18. Inspection of the two hydrographs show that water elevations in both wells are generally stable and relatively close to the same elevation, without a substantial difference that would otherwise clearly indicate a fault barrier effect. On very close inspection of the well hydrographs, it appears that the seasonal fluctuations and the apparent responses to stresses may be slightly different in wells on opposite sides of the fault, but the differences are not significant enough to be a clear marker.

In addition, the water level trends on the two hydrographs are generally similar, and do not clearly indicate a fault barrier effect. It appears that the similarity in water levels across the fault and in near vicinity of the fault may be the result of a substantial recharge effect that the Salinas River has in the immediate area. For the northernmost 15% of the length of the boundary, deep percolation of Salinas River streamflow (underflow) likely maintains high water levels in the deep Paso Robles Formation aquifer along the Salinas River corridor on both sides of the fault through subsurface streambed infiltration, thereby masking or at least muting any effects that may be caused by the fault boundary.

Thus, near the fault, it appears hydrograph data may be slightly different in wells on opposite sides of the fault, but the differences are not significant enough to suggest a fault barrier effect. It is quite clear, however, that in wells a certain distance east of the fault, the water level trends in the Paso Robles Basin are significantly different than those of wells in the Atascadero Basin. Water level declines in the Paso Robles Basin are pronounced, as indicated by the individual hydrographs, as evidenced by inspection of paired hydrographs shown on Plates 19 through 21.

Located in the central portion of the Atascadero Basin, Well Nos. 15 and 13 (Plates 19 and 20) show that water elevations in both wells were generally stable at approximately 770 feet msl until about 2012 to 2013, when slight declines were observed due to the ongoing drought. In contrast, water elevations at Well Nos. 22 and 23 in the Paso Robles Basin have illustrated a pronounced decline beginning in the early 2000s. Comparison of these data show that pumping stresses in the Paso Robles Basin do not affect water levels in the Atascadero Basin.

Plate 21 compares water levels in Well No. 11 in the Atascadero Basin with Well No. 18 in the Paso Robles Basin. Prior to about 2000, water elevations in both wells were generally stable, however, the water elevation in Well No. 18 is approximately 350 feet above the water elevation in Well No. 11. After 2000, water elevations in Well No. 11 remained relatively stable, reflecting the general condition of the Atascadero Basin, while there is a concurrent clear decline in water levels in Well No. 18 and the Paso Robles Basin.

GROUNDWATER FLUX

Groundwater in the Atascadero Basin flows northward across the Rinconada Fault toward the Paso Robles Basin. As noted above, there may be some flow within the Paso Robles Formation in the proximity of the Salinas River because the fault does not displace the full thickness of the formational deposits or apparently fully restrict subsurface flow.

Groundwater flow across the Rinconada Fault varies as the groundwater gradient varies. The flow direction is generally to the north from Templeton to Paso Robles. A review of water level data from wells on both sides of the fault show that the gradient has varied from near level to as much as 0.002 (Fugro 2002).

For this Technical Report and for purposes of the groundwater flux assessment, our evaluation conservatively assumed that there is a limited or null boundary effect along the northernmost 15% of the eastern basin boundary length where the Rinconada Fault crosses the Salinas River. To estimate the volume of groundwater flux across the fault, we performed a series of calculations at different points and in different years along the fault. Table 2 shows the range of calculated groundwater flux in the Paso Robles Formation across the northern end of the Atascadero Basin.

Table 2. Estimated Maximum Groundwater Flux in the Paso Robles Formation across the North End of the Atascadero Basin

Month/Year	Groundwater Elevation (1) feet msl	Paso Robles Fm Saturated Area A (ft2)	Gradient (3) i (ft/ft)	Hydraulic Conductivity (4) K (ft/day)	Computed Flux(5) AFY
April 2010	703.6	4,899,019	0.0028	4.0	460
April 2011	706.5	4,934,670	0.0031	4.0	513
April 2012	702.2	4,881,778	0.003	4.0	491
April 2013	698.6	4,837,347	0.0026	4.0	422
April 2014	691.5	4,749,130	0.0024	4.0	382
April 2015	682.5	4,634,548	0.0028	4.0	435

Notes:

(1) GW Elevation taken as interpolation from gradient lines perpendicular to flow in QTp wells.

(2) Saturated area computed by computing the area of the saturated QTp along the cross section line.

(3) Gradient calculated from groundwater elevations observed as specified wells located perpendicular and close to section lines.

(4) K values for QTp in Atascadero Basin from Fugro (2002).

(5) Computed groundwater flux rate perpendicular to indicated section line using Darcy's Law (Q=KiA).

As shown in Table 2, the estimated groundwater flux in the percolating basin aquifer materials (Paso Robles Formation) across the northern boundary from the Atascadero Basin to the Paso Robles Basin has ranged from 382 AFY to 513 AFY in the past five years. These calculated volumes compare with the Fugro (2002) estimated of groundwater flux 200 AFY across the boundary of the Atascadero Basin into the Estrella Subarea of the Paso Robles Basin.

For comparison, the subsurface outflow, or flux, in the Paso Robles Formation across the northern boundary of the Paso Robles Basin into the Salinas Valley Basin was estimated at 600 AFY (Fugro, 2002). The comparison of geologic setting, hydrogeology, cross sectional area, and volume of groundwater flux at both boundaries is exceedingly similar. Given the accepted boundary between the Paso Robles Basin and the Salinas Valley Basin, the conditions at the northern end of the Atascadero Basin are closely analogous and supports the conclusion that the Atascadero Basin is sufficiently separate from the Paso Robles Basin and should be considered a distinct groundwater basin.

PREVIOUS REPORTS AND ORDINANCES

Over the past 35 to 40 years, numerous published and unpublished reports, technical investigations, and regulatory actions have described, or at least acknowledged, the hydraulic separation of the Atascadero Basin from the Paso Robles Basin and help form the discussion of the hydraulic distinction of the two basins. Brief summaries of the major reports and regulatory actions and ordinances are included in this section.

California Department of Water Resources, 1979, *Ground Water in the Paso Robles Basin*. This study was undertaken to assess the amount of groundwater resources available to meet the growing demands on the basin. The report did not consider the existence of subbasins within the Paso Robles Basin. The report acknowledged that water levels were in decline in parts of the basin, particularly in the Estrella area east of the City of Paso Robles, and that the basin was experiencing a decline in groundwater in storage. However, the report also noted that groundwater in the Atascadero area had experienced a long-term increase in storage.

Morro Group, 1991, *Long-Term Viability of Water Supply, City of Atascadero*. Authored by Dr. Donald Asquith, Ph.D., the report was commissioned by the City of Atascadero to assess whether the groundwater basin in the vicinity of the Atascadero Mutual Water Company's wells were capable of providing the City with a reliable, long-term supply of water. The report also addressed the effects of drought on the reliability of the supply, and the degree to which the Paso Robles Basin might be in a state of overdraft. This report was the first formal acknowledgement of the Atascadero Basin as a separate and distinct "sub-basin" of the Paso Robles Basin, and that the Rinconada Fault formed a hydrologic barrier to flow between the Atascadero "sub-basin" and the Paso Robles Basin. Major conclusions of the report included (1) the City is located at the upper end of the Atascadero sub-basin, (2) the sub-basin is separated from the Paso Robles Basin by the Rinconada Fault, and (3) groundwater levels in the Atascadero sub-basin are "substantially to totally independent of changes in water levels in the main Paso Robles groundwater basin." Furthermore, the report noted that water level declines in the Estrella area of the Paso Robles Basin were not observed in the Atascadero sub-basin, which appeared to be experiencing a long-term increase in groundwater in storage.

Lastly, the report noted that the area had experienced two major drought periods (1976-1977 and 1987-1990) and that there had been no long-term decline of groundwater supply.

Coastal Resources Institute, 1993, *A Study of the Paso Robles Ground Water Basin to Establish Best Management Practices and Establish Salt Objectives*. Authored by Dr. David Chipping, et al and commissioned by the Coastal Resources Institute through the Physics Department at Cal Poly State University, the objectives of the study were to establish salt objectives and best management practices for the Paso Robles Basin. In describing the geologic setting, the report stated that the Rinconada Fault, to the east of the City of Atascadero, had resulted in the uplift of several consolidated-rock geologic units on the east site of the structure and isolated them from similar rocks on the west side. The report further noted that the hydrologic regime of the sub-basin west of the Rinconada Fault was distinct from the main part of the Paso Robles Basin. The report also noted that the fault disrupts the Paso Robles Formation in the subsurface, and acknowledged that the Atascadero sub-basin was separate from the main Paso Robles Basin.

Baldwin vs. Atascadero Mutual Water Company, 1993, Court of Appeals (unpublished). In a ruling affirming the rights of Atascadero Mutual Water Company to pump groundwater from a water supply well east of the Salinas River, on the question of the relevant basin from which the well pumped groundwater, the Court ruled *"Without any serious question the relevant basin is the sub-basin identified as the Atascadero sub-basin and not the Paso Robles Basin."* The Superior Court also asked if the relevant basin was in overdraft. Evidence provided by County of San Luis Obispo Public Works Director Clint Milne supported an overdraft condition in the Paso Robles Basin, but there was no overdraft in the Atascadero sub-basin (based on 30 years of groundwater level monitoring data). Timothy Cleath, a registered geologist, testified that the Atascadero sub-basin was physically separated from the Paso Robles Basin by the Rinconada Fault, that the fault retards flow of groundwater out of the basin, and that no more than 500 acre-feet per year flows out of the sub-basin into the Paso Robles Basin.

Hoover and Associates, 1996, *Hydrogeologic Analysis of the Creston Sub-Area*. Authored by Michael F. Hoover, PG, CHg, the purpose of the study was to evaluate the presence or absence of surplus groundwater in the Creston Sub-area. The investigation concluded that a series of northwest-trending faults intersect the Paso Robles Basin, including the Rinconada, La Panza, San Juan Hills, and San Andreas faults. These faults appear to disrupt the migration of groundwater either by acting as barriers or by juxtaposing non-water bearing rocks against water-bearing deposits. Uplift along the Rinconada Fault resulted in a ridge comprised of low-permeability shales and bedrock units that effectively separated the portion of the basin located along the Salinas River from the Creston Sub-area and the main part of the basin located east of the Eureka and Chicago grades. The bedrock ridge extends along the Rinconada Fault from Santa Margarita, northward past Templeton almost to the City of Paso Robles. The presence of the structural barrier caused by the Rinconada Fault prevented the migration of groundwater between Atascadero Sub-area and the main part of the Paso Robles Basin.

Fugro West, Inc. and Cleath and Associates, 2000, *Water Supply Evaluation for Atascadero Mutual Water Company*. Commissioned by the Atascadero Mutual Water Company, the report noted that that no separate subbasins had been previously recognized by the 1979 DWR study. The report noted further that the hydraulic connection between the aquifers tapped by the water company and the main Paso Robles Basin across the Rinconada Fault was sufficiently restricted to warrant subbasin classification. The investigation defined the Atascadero Subbasin as that portion of the Paso Robles Basin laying west of the main strand of the Rinconada Fault.

Fugro West, Inc. and Cleath and Associates, 2000, *Final Report, Paso Robles Groundwater Basin Study*. Commissioned by the County of San Luis Obispo, the report refined the lateral extent of the boundaries of the Paso Robles Basin based on the geologic contact of the Paso Robles Formation with bedrock units, and defined and delineated the Atascadero Subbasin as a single, hydraulically distinct subbasin within the Paso Robles basin. On the basis of detailed geologic mapping and inspection of well logs, the investigators concluded that the Rinconada Fault juxtaposes the Paso Robles Formation sediments with the granite bedrock and the Monterey Formation in the southern part of the Atascadero Subbasin and that the presence of bedrock units east of the fault forms an effective barrier to groundwater flow between the Atascadero Subbasin and the Creston subarea. In the area north of Templeton and south of the City of Paso Robles, the report concluded that the Rinconada Fault was a leaky barrier to groundwater flow in the Paso Robles Formation as evidenced by differences in water levels at the Santa Ysabel warm water spring and water supply wells drilled at the edge of the terrace above the Salinas River flood plain. For the first time in a technical investigation, the aquifer characteristics of the Atascadero Subbasin were defined separately from the main part of the Paso Robles Basin, and reported that groundwater in storage for the Atascadero Subbasin was approximately 514,000 acre-feet. Based on inspection of water level data, groundwater storage increased in the Subbasin by about 0.5% between 1980 and 1997. A separate perennial yield value for the Atascadero Subbasin was calculated, estimated at 16,500 acre-feet/year, and a breakdown of the water budget revealed that 91% of the total groundwater pumping in the Atascadero Subbasin was comprised of municipal, rural domestic, and small commercial pumping, which contrasted with the Paso Robles Basin where 69% of the pumping was for agricultural irrigation.

Fugro West, Inc., 2010, *Paso Robles Groundwater Basin, Water Balance Review and Update*. The purpose of the investigation was to provide the County of San Luis Obispo with updated information to assist in the preparation of a Resource Capacity Study for the Paso Robles Basin and the Atascadero Subbasin, and update the water balance for the two basins.

County of San Luis Obispo, Department of Planning and Building, 2011, *Resource Capacity Study, Water Supply in the Paso Robles Groundwater Basin*. Authored by San Luis Obispo County Planning Department staff, the purpose of the study was to “address the state of the Paso Robles Groundwater Basin” and assess whether potential deficiencies in the water resource warranted implementation of measures to better balance the land development pressures against the long-term water resource, by establishing “Levels of Severity” (LOS) for groundwater resources. At the time, the County Planning Department defined levels of severity as:

- Level I -- Potential Resource Capacity Problem
- Level II -- Diminishing Resource Capacity
- Level III -- Resource Capacity Met or Exceeded

The study noted that the water balance in the Atascadero Subbasin differed from the Paso Robles Basin in that a majority of the subbasin pumping was from and for the urban sector (City of Paso Robles, Atascadero Mutual Water Company, and Templeton Community Services District). The City of Paso Robles produces approximately one-half of its water supply from wells in the Atascadero Subbasin, while the Templeton CSD and the AMWC produce all of their water from the subbasin. Together, these groundwater users account for more than 65% of the water use in the subbasin. The study concluded that a separate LOS can be assigned to the Atascadero Subbasin, because the subbasin is hydrologically distinct from the Paso Robles Basin and has a separate and distinct safe operating yield. The study concluded that an LOS I designation was appropriate for the Atascadero Subbasin, and an LOS III designation was appropriate for the Paso Robles Basin.

GEI Consultants, Inc., Fugro Consultants, Inc., Cleath-Harris Geologists, Inc., 2011, *Paso Robles Basin Groundwater Management Plan*. The Plan was prepared to provide a framework for future groundwater management activities, to develop a common understanding of the groundwater issues and management opportunities in the Basin, and identify and support projects that would improve groundwater management. During the course of the study, water level hydrographs, composite water surface elevation trends, and water level contour maps were prepared that illustrated a distinct difference between conditions in the Atascadero Subbasin and conditions in the main part of the Paso Robles Basin. In particular, the composite water surface hydrgraphs showed significant declines in water levels in wells in the Estrella and Creston subareas of the Paso Robles Basin, with concurrent water level stability in the Atascadero Subbasin.

GEOSCIENCE Support Services, Inc., and Todd Groundwater, 2014, *Paso Robles Groundwater Basin Model Update*. As described in the update report, an evaluation of the hydraulic separation of the Atascadero Subbasin from the main part of the Paso Robles Basin noted that "the barrier conductivity values that were established by the [Fugro (2002)] Phase I Study were maintained for this Basin Model Update." The report also concluded that "The Rinconada Fault defines the entire eastern border of the Atascadero sub-basin, and hydraulically separates the confined aquifer associated with the Paso Robles formation from the rest of the groundwater basin."

County of San Luis Obispo, 2013, *Ordinance No. 3246, "Urgency Ordinance"*. The Board of Supervisors of the County of San Luis Obispo passed an Urgency Ordinance, effective for two years, to address the urgent water supply needs within the Paso Robles Basin. The ordinance placed limitations on uses within the basin for new or expanded irrigation crop production, conversion of dry farm or grazing land to new irrigated crop production, and new development dependent on a well in the basin. The County, through the ordinance, recognized the distinction of the Atascadero Subbasin from the main part of the Paso Robles Basin, and acknowledged the ability of the groundwater users within the subbasin to effectively manage the water resources of the subbasin. The ordinance applied to all properties within the unincorporated area of San Luis Obispo County that overlie the Paso Robles Basin except those properties that overlie the Atascadero Subbasin and those properties served by County Service Area 16 or the San Miguel Community Service District.

County of San Luis Obispo, 2015, *Resolution No. 2015-288*. The Board of Supervisors passed a series of ordinances that affected new construction new irrigated agriculture in the Paso Robles Basin as well as other parts of the County affected by aquifers experiencing declining groundwater levels. The resolution and accompanying ordinances excluded the Atascadero Subbasin.

Local Agency Formation Commission, San Luis Obispo County, 2015, *Formation of Paso Robles Water District – Financing and Formation*. The LAFCO authorized the formation of the Paso Robles Water District pursuant to Assembly Bill 2453 and funding through a special tax, to be approved by voters. The boundary of the proposed Paso Robles Water District is based on the Fugro (2002) boundary of the Paso Robles Basin, and excludes the Atascadero Subbasin from the proposed district.

SUMMARY OF PROPOSED MODIFICATIONS TO THE DWR BULLETIN 118 BASIN BOUNDARY OF THE ATASCADERO BASIN

On the basis of this Technical Report, we propose the following modifications to the existing DWR B-118 boundaries. A map showing the proposed Atascadero Basin boundary and the DWR B-118 boundary is presented on Plate 3.

As discussed earlier, we note that north of Templeton, southwest of the City of Paso Robles, the DWR B-118 boundary extends a significant distance west of the original boundary mapped by Fugro (2002). We believe that the DWR B-118 boundary in this area is more appropriate than the Fugro (2002) boundary, and have modified the proposed Atascadero Basin boundary to more closely reflect the original DWR B-118 line.

MODIFICATION REQUEST NO. 1

Update the Western Basin Boundary. In the area just south of Templeton, north of Paso Robles Creek, the DWR B-118 boundary extends the basin boundary several thousand feet west of the proposed basin boundary, which was likely done by DWR on the basis of surface mapping showing older alluvium (Qoa) at the surface. We propose to modify the basin boundary by moving the line east (Plate 3) to where well logs indicate the presence of Paso Robles Formation below the older alluvium.

Geologic evidence to develop a scientific basis for this modification consists of stratigraphy encountered by several wells drilled in this area. As discussed in the *Analysis of Geologic Setting and Structure* section, these well logs indicate a thin veneer (sometimes only 10-15 feet) of unsaturated Qoa overlying relatively impermeable Monterey shale bedrock, which constitutes the bedrock unit in this area and significantly impedes groundwater flow. Therefore, primary basin aquifer materials (i.e., Paso Robles Formation) are absent in this area and, in our opinion, the proposed boundary accurately represents the B-118 definition of a lateral and vertical boundary.

MODIFICATION REQUEST NO. 2

Document the Rinconada Fault Zone as the Eastern Basin Boundary. This modification request is intended to establish the Rinconada Fault zone as a basin boundary of the Paso Robles Formation between the Paso Robles Basin and the Atascadero Basin. This effort includes defining the extent of the fault zone between the basins as the eastern Atascadero Basin boundary.

The following geologic and hydrogeologic evidence supports our assertion that the fault significantly impedes groundwater flow.

- Logs from wells on opposite sides of the Rinconada Fault indicate stratigraphic offsets that juxtapose basin aquifer sediments with impermeable bedrock (refer to *Analysis of Geologic Setting and Structure* section);
- Water elevation data (hydrographs) show water level trends of wells in the Paso Robles Basin are significantly different than those of wells in the Atascadero Basin (refer to *Water Level Trends and Groundwater Movement* section); and
- Groundwater flux estimates indicate flux between the Atascadero Basin and Paso Robles Basin is relatively small in volume, and similar in magnitude to the flux between the Paso Robles Basin and the Salinas River Valley Basin boundary defined by DWR (refer to *Groundwater Flux* section).

MODIFICATION REQUEST NO. 3

Update the Southern Basin Boundary. We propose modifying the southern boundary of the Atascadero Basin to a point north of Garden Farms, which has the effect of removing the communities of Garden Farms and Santa Margarita from the basin, as shown on Plate 3.

This modification is based on stratigraphy and lithologies encountered in the boreholes by several water wells at the southern end of the basin. As discussed in the *Analysis of Geologic Setting and Structure* section below, these well logs show the presence of Santa Margarita Formation at or near the surface in all logs. In some instances, the Santa Margarita Formation underlies alluvium, and in a few minor instances, a very thin veneer of unsaturated Paso Robles Formation sits on top of the Santa Margarita Formation, which significantly impedes groundwater flow.

CONCLUSIONS

- Based on the subsurface conditions interpreted by numerous groundwater studies within the Atascadero Basin, it is our opinion that the proposed basin boundary modifications accurately reflect the DWR B-118's definition of basin boundaries.
- The northern, western, and southern boundaries of the Atascadero Basin are generally defined by the contact of aquifer sediments with older, low-permeability geologic units. On the basis of well log data at the western and southern ends of the basin, as defined by the DWR B-118, the basin boundaries have been modified to account for the absence of aquifer materials.
- The Rinconada Fault defines the eastern boundary of the Atascadero Basin and forms an impermeable basin boundary and hydraulic barrier between the Paso Robles Basin and the Atascadero Basin over about 85% of the length of the eastern boundary of the Atascadero Basin. The remaining 15% of the boundary appears to have hydraulic connectivity with the Paso Robles Basin.
- Along the southernmost 85% of the basin's eastern boundary, in addition to the overwhelming geologic evidence of an impermeable boundary, there is a clear distinction between the Atascadero Basin and the Paso Robles Basin based on differences in groundwater elevations and differences in groundwater level trends

between the two basins. While groundwater levels in the western portion of the Paso Robles Basin (east of the Rinconada Fault) have generally and dramatically declined since the late 1990's, groundwater levels in the Atascadero Basin have remained relatively steady.

- In the northernmost 15% of the boundary, in the general vicinity where the Rinconada Fault crosses the Salinas River floodplain, there is apparent hydraulic communication between the Paso Robles Formation on both sides of the fault, however, there is some evidence that the fault zone forms at least a leaky barrier that somewhat restricts flow from the Atascadero Basin to the main part of the Paso Robles Basin. The aquifer's hydraulic continuity across the fault is limited to a thickness of approximately 150 to 200 feet for a length of about 12,000 to 15,000 feet, or about 15% of the boundary length.
- Water level differences across the fault along the northern portion of the basin boundary are slight, suggesting that the similarity in water levels across the fault and in near vicinity of the fault may be the result of a substantial recharge effect that the Salinas River has in the immediate area. For the northernmost 15% of the length of the boundary, deep percolation of Salinas River streamflow (underflow) likely maintains high water levels in the deep Paso Robles Formation aquifer along the Salinas River corridor on both sides of the fault through subsurface streambed infiltration, thereby masking or at least muting any effects that may be caused by the fault boundary.
- The maximum estimated flux of percolating groundwater between the Atascadero Basin and Paso Robles Basin is between approximately 200 and 550 acre-feet per year. For comparison, a similar volume of percolating groundwater flows across the DWR B-118 boundary between the Paso Robles Basin and the Salinas Valley Basin.
- In summary, it is our opinion that sufficient evidence to justify a basin boundary modification and definition, identification, and delineation of the Atascadero Basin as a separate basin from the Paso Robles Basin.

REFERENCES

Baldwin, John, et al. v. Atascadero Mutual Water Company (1996), 2d Civil No. B088428 (Super. Ct. No. CV67351)

California Department of Water Resources (1958), San Luis Obispo County Investigation, Bulletin 18.

California Department of Water Resources, (1962), Planned Utilization of the Ground Water Basins of the Coastal Plain of Los Angeles County, Bulletin No. 104, Appendix 3, Safe Yield Determinations.

California Department of Water Resources, (1966), Planned Utilization of Ground Water Basins, San Gabriel Valley, Bulletin No. 104-2, Appendix A, Geohydrology.

California Department of Water Resources (1975), California's Ground Water: Bulletin 118.

California Department of Water Resources (1979), Ground Water in the Paso Robles Basin: prepared by the California Department of Water Resources, Southern District, for the San Luis Obispo Flood Control and Water Conservation District.

California Department of Water Resources (1980), Ground Water Basins in California: Bulletin 118-80.

California Department of Water Resources (1981), "Water Quality in the Paso Robles Area," Memorandum Report.

California Department of Water Resources (1986), San Luis Obispo County Master Water Plan Update: prepared by the California Department of Water Resources, Southern District, in cooperation with the San Luis Obispo Flood Control and Water Conservation District, March 1986.

California Department of Water Resources (2003), Ground Water Basins in California: Bulletin 118-80.

Campion et al. (1983), "Resource Investigation of Low and Moderate – Temperature Geothermal Areas in Paso Robles, California"; California Division of Mines and Geology, Open File Report 83-11 SAC.

Coastal Resources Institute (1993), A Study of the Paso Robles Ground Water Basin to Establish Best Management Practices and Establish Salt Objectives: consultant report prepared for the California Regional Water Quality Control Board, June 1993.

County of San Luis Obispo, Department of Planning and Building (2011), Resource Capacity Study, Water Supply in the Paso Robles Groundwater Basin: staff report prepared for the Board of Supervisors, Adopted by the Board of Supervisors February 2011.

County of San Luis Obispo (2013), Ordinance No. 3246, An Urgency Ordinance of the County of San Luis Obispo, State of California establishing a moratorium on new or expanded irrigated crop production, conversion of dry farm or grazing land to new or expanded irrigated crop production and new development dependent upon a well in the Paso Robles Groundwater Basin unless such uses offset their total project water use, including certain exemptions: passed and adopted by the Board of Supervisors, August 27, 2013.

County of San Luis Obispo (2015), Resolution No. 2015-288, Resolution adopting specific amendments to the Agriculture Element and the Conservation and Open Space Element of the General Plan; specific amendments to Title 8 (Health and Sanitation Code), Title 19 (Building and Construction Ordinance), and Title 22 (Land Use Ordinance) of the County Code in order to implement the water neutral new development and water waste prevention components of the proposed Countywide Water Conservation Program; specific amendments to Ordinance 3274 (County Fee Schedule) to establish new fees associated with the implementation of the proposed Countywide Water Conservation Program; and establishment of a Plumbing Retrofit Program and Turf Removal Program: passed and adopted by the Board of Supervisors, October 27, 2015.

Dibblee, Jr., T.W. (1976), The Rinconada and Related Faults in the Southern Coast Ranges, California and Their Tectonic Significance, U.S. Geological Survey Professional Paper 981.

Fugro West, Inc., and Cleath and Associates (2000), Water Supply Evaluation for Atascadero Mutual Water Company: unpublished consultant report for the Atascadero Mutual Water Company, August 2000.

Fugro West, Inc., and Cleath and Associates (2002), Final Report, Paso Robles Groundwater Basin Study: unpublished consultant report prepared for the County of San Luis Obispo Public Works Department, August 2002.

Fugro West, Inc. (2010), Paso Robles Groundwater Basin, Water Balance Review and Update: unpublished consultant report prepared for the County of San Luis Obispo Public Works Department, City of Atascadero, Atascadero Mutual Water Company, Templeton Community Services District, and City of Paso Robles, March 2010.

GEI Consultants, Inc., Fugro Consultants, Inc., and Cleath-Harris Geologists, Inc. (2011), Paso Robles Groundwater Basin Management Plan: unpublished consultant report prepared for the County of San Luis Obispo Public Works Department, March 2011.

GEOSCIENCE Support Services, Inc., and Todd Groundwater (2014), Paso Robles Groundwater Basin Update: unpublished consultant report prepared for the San Luis Obispo County Flood Control and Water Conservation District, December 2014.

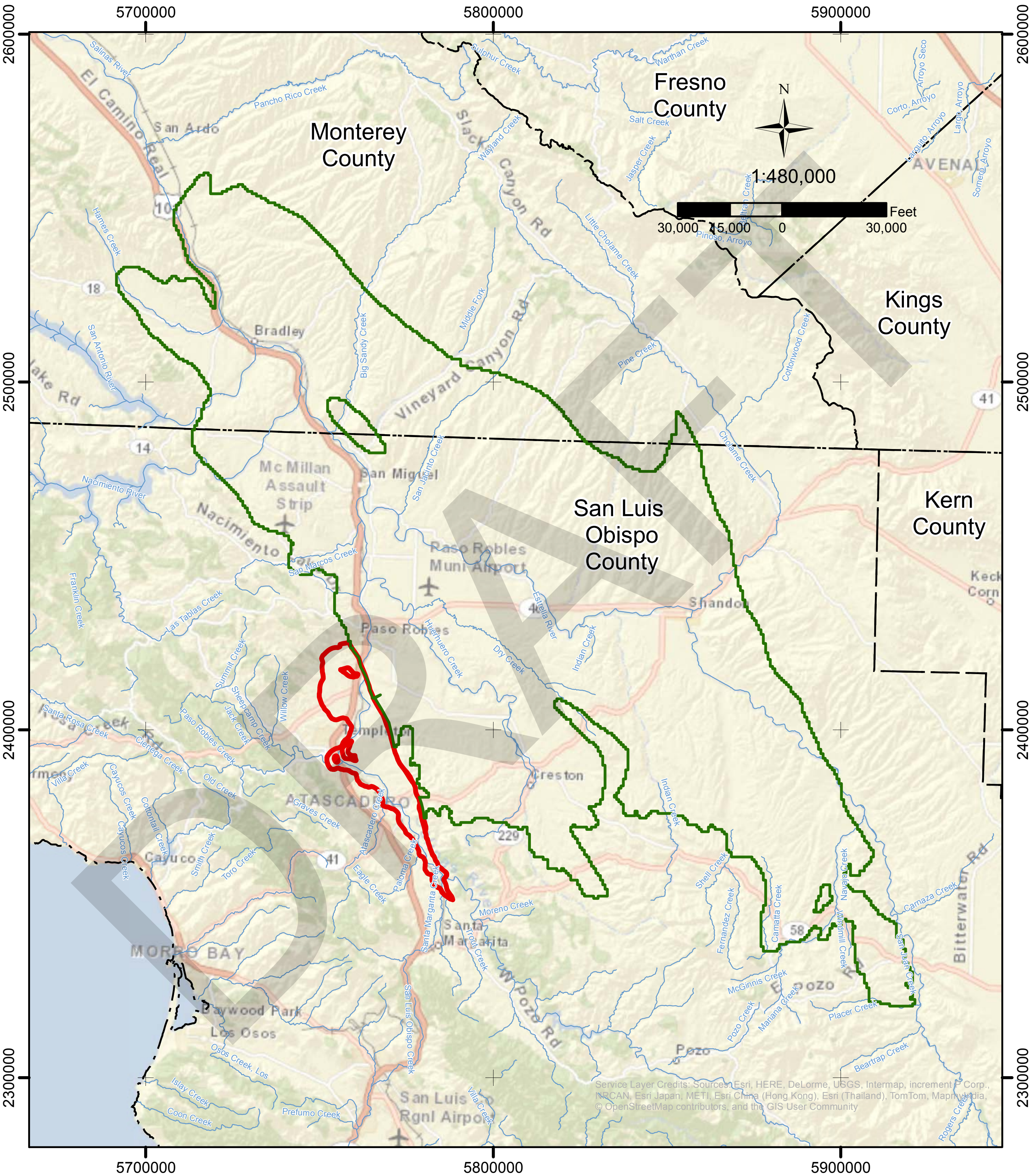
GeoSolutions (2000), Fault Investigation Report, Santa Ysabel Ranch, Santa Ysabel Road, Paso Robles Area, County of San Luis Obispo, California: unpublished consultant report prepared for Weyrich Development, LLC, March 31, 2000.

Hoover & Associates (1996), Hydrogeologic Analysis of the Creston Sub-Area, Paso Robles Basin, San Luis Obispo County, California: unpublished consultant's report prepared for Best, Best, & Krieger, August 22, 1996.

Local Agency Formation Commission, County of San Luis Obispo (2015), Formation of Paso Robles Water District – Financing and Formation, LAFCO File No. 2-R-15: passed and adopted by LAFCO Commission September 17, 2015.

Morro Group (1991), Long-Term Viability of Water Supply, City of Atascadero: unpublished consultant report prepared for the City of Atascadero, Department of Public Works, April 1991.

PLATES



Legend

Atascadero Basin

Paso Robles Basin (Fugro 2002)

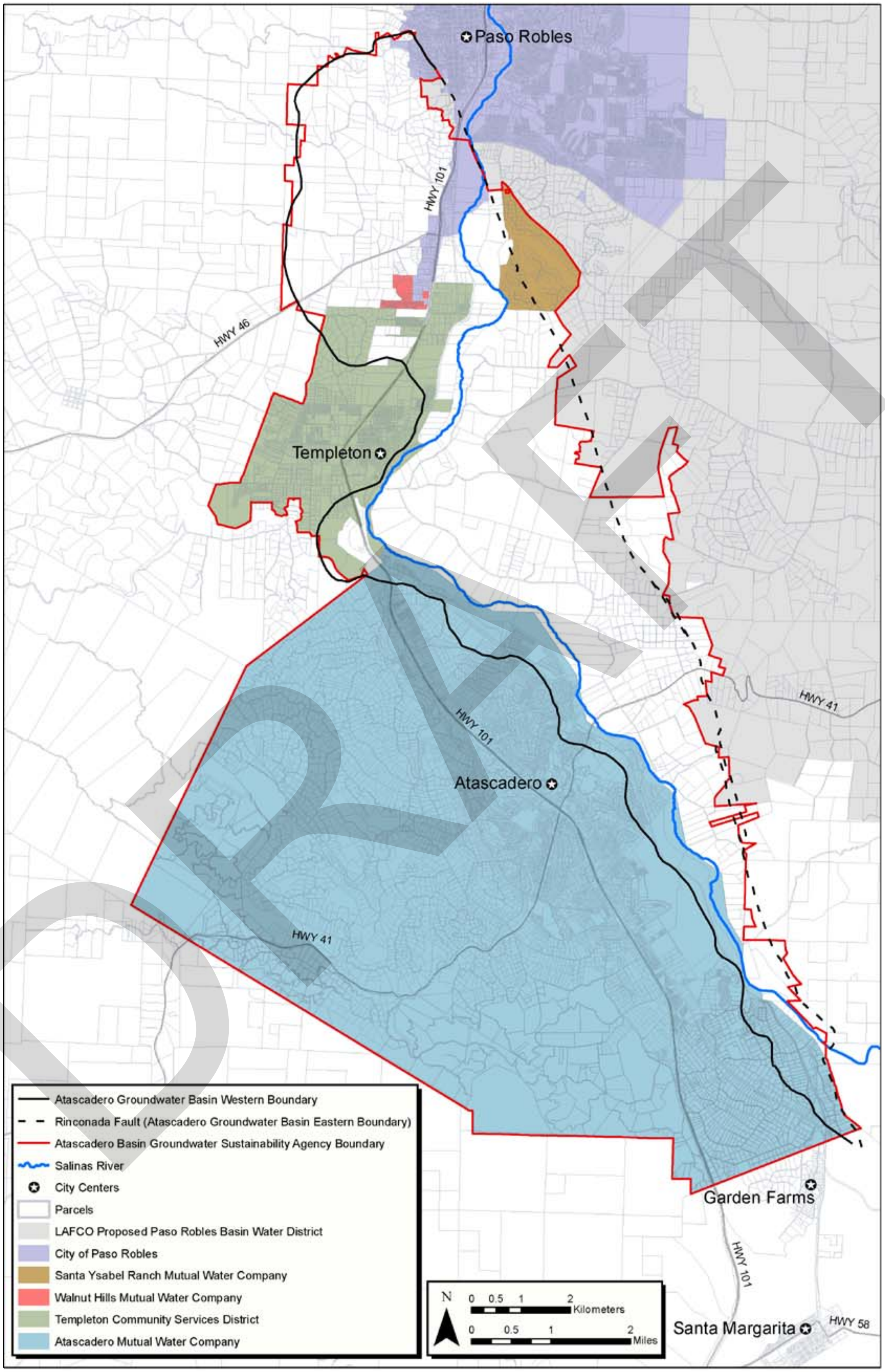
County Line

N:\Projects\04_2015\04_6215_0041_AtascaderoBasinMod\mxd\Plate01_VicinityMap.mxd, 2/19/2016, cdean

VICINITY MAP

Atascadero Basin Boundary Modification Application

PLATE 1

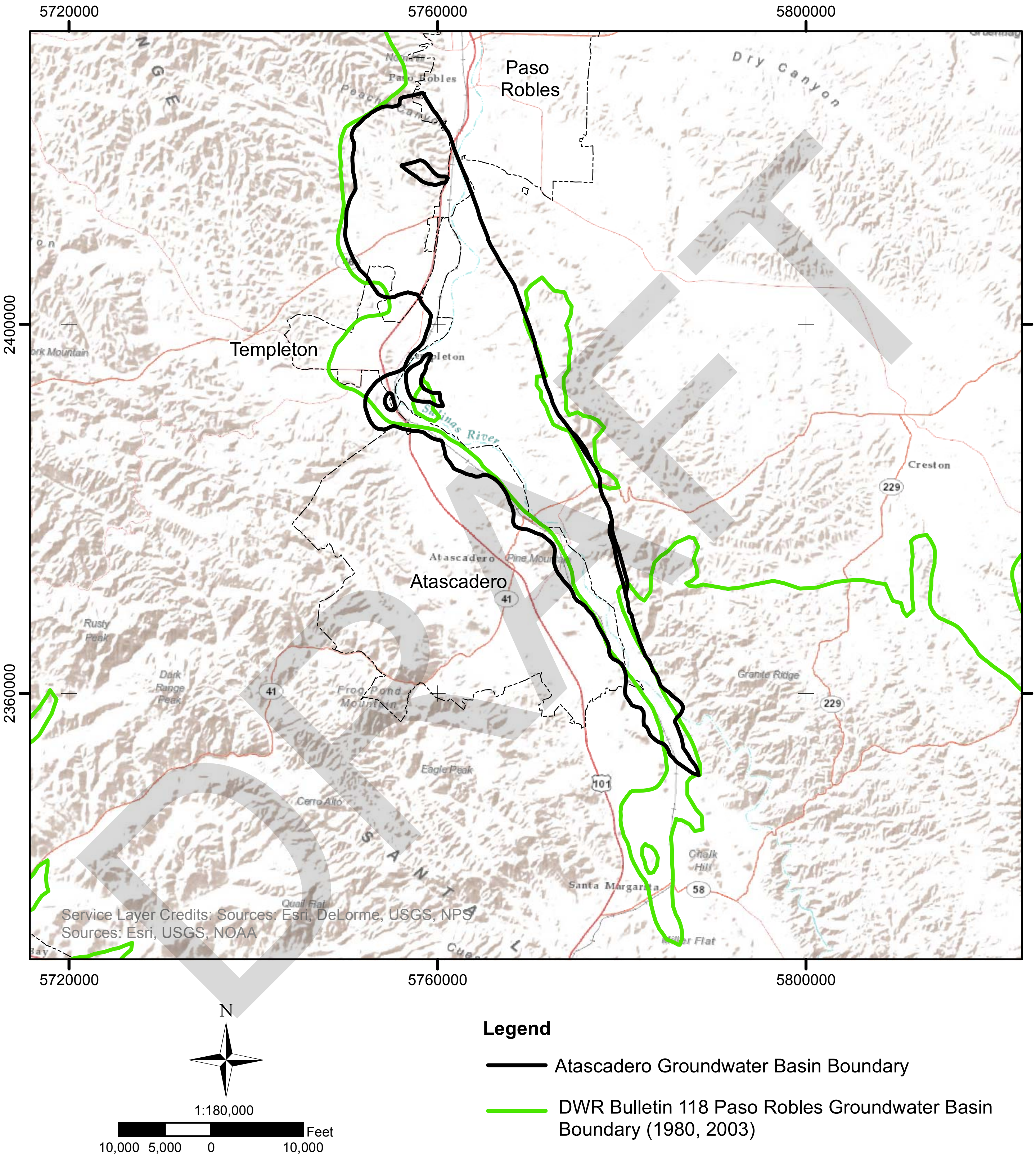


ATASCADERO BASIN

Atascadero Basin Boundary Modification Application

PLATE 2

N:\Projects\04_2015\04_6215_0041_AtascaderoBasin\Outputs\2016_02_11_AtascaderoBasinMod\mxd\Plate02_Atascadero_Basin.mxd, 2/12/2016, CDean



Legend

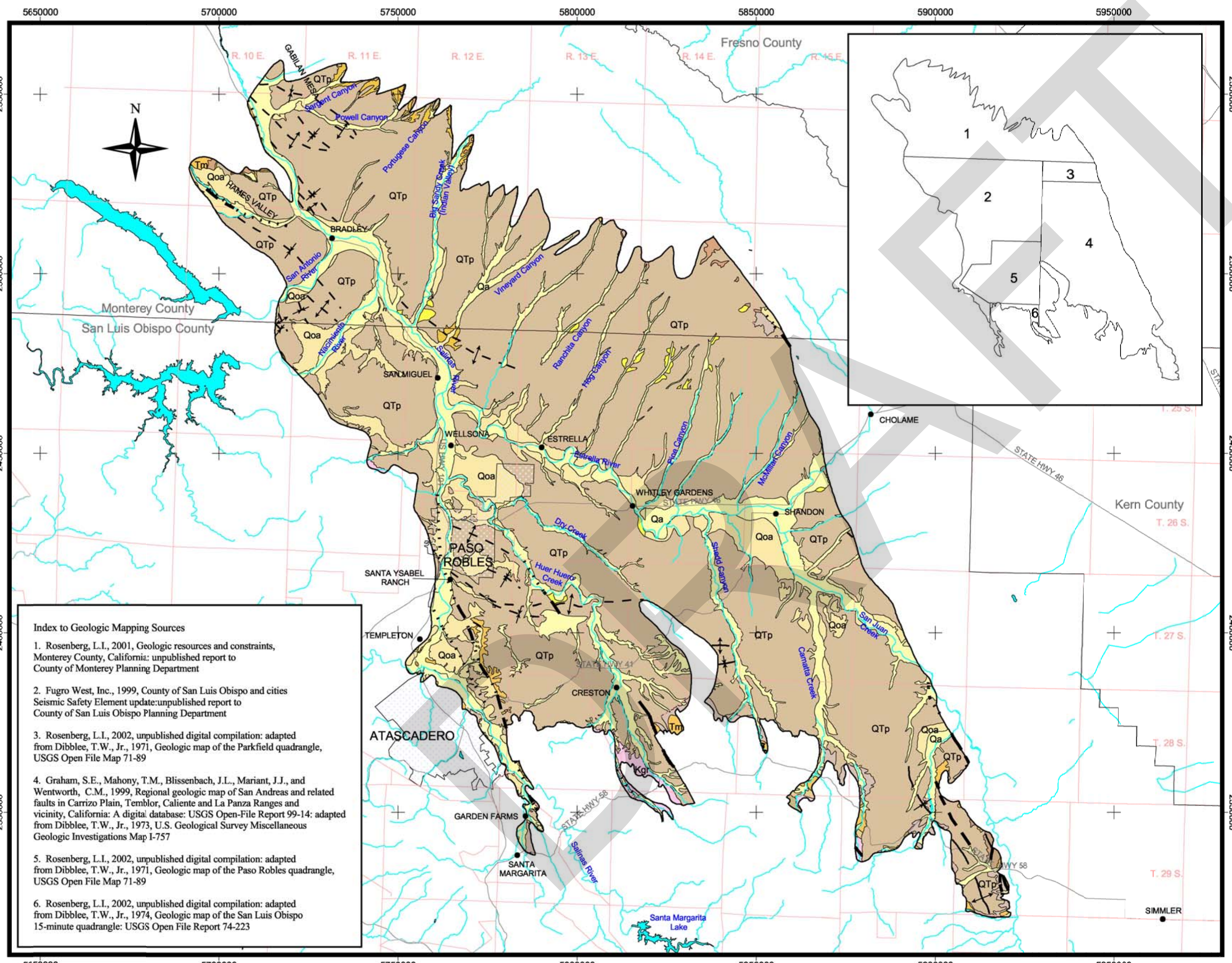
- Atascadero Groundwater Basin Boundary
- DWR Bulletin 118 Paso Robles Groundwater Basin Boundary (1980, 2003)

N:\Projects\04_2015\04_6215_0041_AtascaderoBasinMod\mxd\Plate03_Atascadero_DWR118.mxd, 2/12/2016, CDean

ATASCADERO BASIN BOUNDARY V. DWR BULLETIN 118 BOUNDARY

Atascadero Basin Boundary Modification Application

PLATE 3



Index to Geologic Mapping Sources

1. Rosenberg, L.I., 2001, Geologic resources and constraints, Monterey County, California: unpublished report to County of Monterey Planning Department

2. Fugro West, Inc., 1999, County of San Luis Obispo and cities Seismic Safety Element update:unpublished report to County of San Luis Obispo Planning Department

3. Rosenberg, L.I., 2002, unpublished digital compilation: adapted from Dibblee, T.W., Jr., 1971, Geologic map of the Parkfield quadrangle, USGS Open File Map 71-89

4. Graham, S.E., Mahony, T.M., Blissenbach, J.L., Mariant, J.J., and Wentworth, C.M., 1999, Regional geologic map of San Andreas and related faults in Carrizo Plain, Temblor, Caliente and La Panza Ranges and vicinity, California: A digital database: USGS Open-File Report 99-14: adapted from Dibblee, T.W., Jr., 1973, U.S. Geological Survey Miscellaneous Geologic Investigations Map I-757

5. Rosenberg, L.I., 2002, unpublished digital compilation: adapted from Dibblee, T.W., Jr., 1971, Geologic map of the Paso Robles quadrangle, USGS Open File Map 71-89

6. Rosenberg, L.I., 2002, unpublished digital compilation: adapted from Dibblee, T.W., Jr., 1974, Geologic map of the San Luis Obispo 15-minute quadrangle: USGS Open File Report 74-223

Legend

Geologic Units

Paso Robles Groundwater Basin Sediments

- **Qa** Quaternary alluvium, undifferentiated (Holocene)
- **Qoa** Older alluvium, undifferentiated (Pleistocene)
- **Qls** Landslide deposits (Holocene-Pleistocene)
- **QTp** Paso Robles Formation, undifferentiated (Pliocene-Pleistocene)

Other Geologic Units

- **Tuc** Unnamed clastic sedimentary unit (probably Pliocene)
- **Tp** Pancho Rico Formation, undifferentiated (late Miocene to early Pliocene)
- **Tsm** Santa Margarita Sandstone (late Miocene)
- **Tbs** Branch Canyon Sandstone (middle to late Miocene)
- **Tm** Monterey Shale, undifferentiated (middle Miocene)
- **Tv** Vaqueros Formation, undifferentiated (Oligocene)
- **Ts** Simmler Formation, undifferentiated (Oligocene?)
- **Tsg** unnamed conglomerate (Oligocene or Miocene)
- **Kgr** Granitic rocks (Cretaceous)

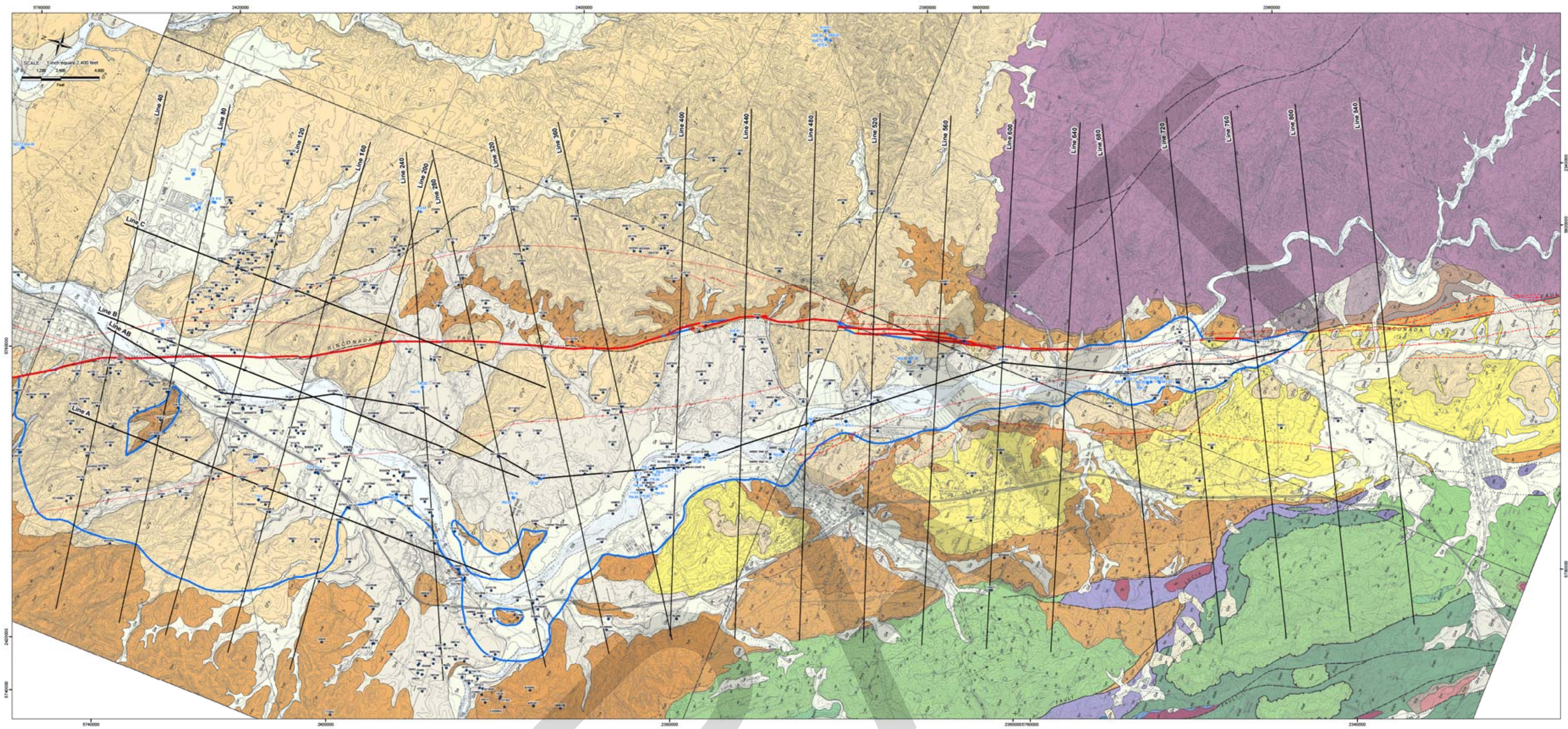
- Fault, certain
- Fault, approximately located
- Fault, concealed
- Anticline, certain
- Anticline, approximately located
- Syncline, certain
- Syncline, approximately located
- Streams
- Highways
- County Line
- Township and Range Grid

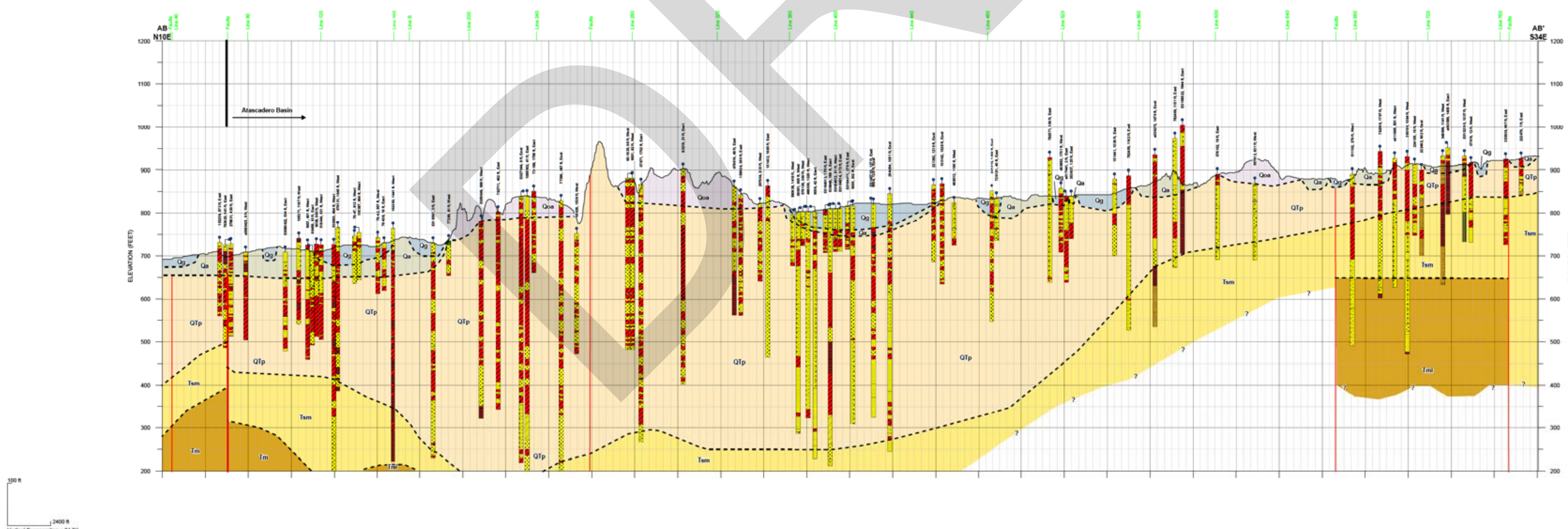
Note:
1. Township and Range grid reference: Federal Township and Range System, Mt. Diablo Baseline and Meridian

30000 0 30000 Feet

GEOLOGIC MAP OF THE PASO ROBLES GROUNDWATER BASIN

Atascadero Basin Boundary Modification Application





LEGEND

- Wells With Water Level Data, feet MSL
- Wells
- Line 200 — Cross Section Lines
- Proposed Atascadero Groundwater Basin

RINCONADA FAULT ZONE

- Main Fault Trace (Basin Boundary)
- Certain
- Approximate
- Concealed
- Concealed Queried
- Inferred

GEOLOGIC MAP LEGEND

- Qa / Qg — QUATERNARY ALLUVIUM AND GRAVELS
- Qls / Qlsp — LANDSLIDES
- Qoa — OLDER ALLUVIUM
- QTp — PASO ROBLES FORMATION
- Tsm — SANTA MARGARITA SANDSTONE
- MONTEREY SHALE
- OBISPO FORMATION
- Tvs — VAQUEROS SANDSTONE
- Tcg — TERRESTRIAL SEDIMENTS
- ATASCADERO FORMATION
- TORO FORMATION
- COAST RANGE OPHIOLITE
- SERPENTINE
- FRANCISCAN ASSEMBLAGE
- GRANITE

Reference: Dibblee, Thomas W. Jr., *Geologic Map of the Atascadero, Templeton, Creston, and Shedd Canyon, and Santa Margarita Quadrangles*, 2004.

Soil/RockTypes

Well graded GRAVEL (GW)	GRAVEL with silt (GP)
Poorly graded GRAVEL (GP)	Silty GRAVEL (GM)
GRAVEL with sand (GP)	Base
GRAVEL with clay (GW)	Cobble
Clayey GRAVEL (GC)	Undifferentiated Fill
Well graded SAND (SW)	Silty SAND to Sandy SILT (SM to ML)
Poorly graded SAND (SP)	SAND with gravel (SW)
SAND with gravel (SP)	Silty SAND with gravel (SM)
SAND with clay (SP-SC)	SAND with silt and gravel (SP-SM)
Clayey SAND (SC)	SAND with silt (SP-SM)
Silty SAND (SM)	Clayey to Silty SAND (SC to SM)
SAND with silt (SW-SM)	
Fat CLAY (CH)	Sandy lean CLAY (CL)
Sandy fat CLAY (CH)	Silty CLAY (CL-ML)
Lean CLAY (CL)	Fat CLAY to Elastic Silt (CH to MH)
Elastic SILT (MH)	Clayey SILT (ML/CL)
SILT (ML)	Sandy SILT with gravel (ML)
Sandy SILT (ML)	
Highly plastic ORGANICS (OH)	Peat
Low plasticity ORGANICS (OL)	
SANDSTONE (Rx)	Rock Fragments (Rx)
SILTSTONE (Rx)	MUDSTONE (Rx)
LIMESTONE (Rx)	Igneous (Rx)
SHALE (RX)	
Pavement/AC	

Notes:

GEODETIC INFORMATION

Geographic Coordinate System: GCS_North_American_1983
Angular Unit: Degree (0.0174532925199433)
Prime Meridian: Greenwich (0.0)
Datum: D_North_American_1983
Spheroid: GRS_1980
Semimajor Axis: 6378137.0
Semiminor Axis: 6356752.314140356
Inverse Flattening: 298.257222101

Projection: Lambert_Conformal_Conic
False_Easting: 6561666.666666666
False_Northing: 1640416.666666667
Central_Meridian: -118.0
Standard_Parallel_1: 34.03333333333333
Standard_Parallel_2: 35.46666666666667
Latitude_Of_Origin: 33.5
Linear Unit: Foot_US (0.3048006096012192)

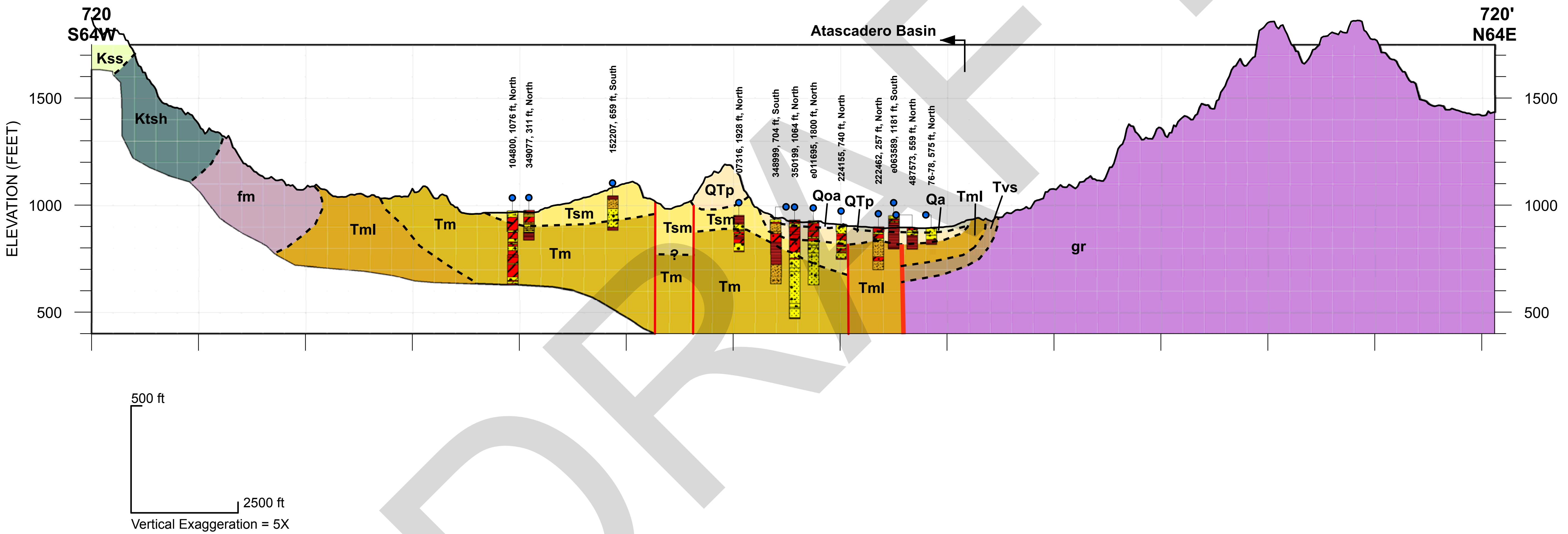
FUGRO CONSULTANTS, INC.
4820 McGrath St., Suite 100,
Ventura, California 93003
Tel: (805) 650-7000,
Fax: (805) 650-7010
www.fugroconsultants.com

GEOLOGIC MAP OF THE ATASCADERO GROUNDWATER BASIN

Atascadero Basin Boundary Modification Application

NO:	DATE:	DESCRIPTION:	DRAWN:	CHKD:	APPR:
1	Feb 2016	Plan and Profile	CBD		

JOB NUMBER: 04.62150041 PLATE 5

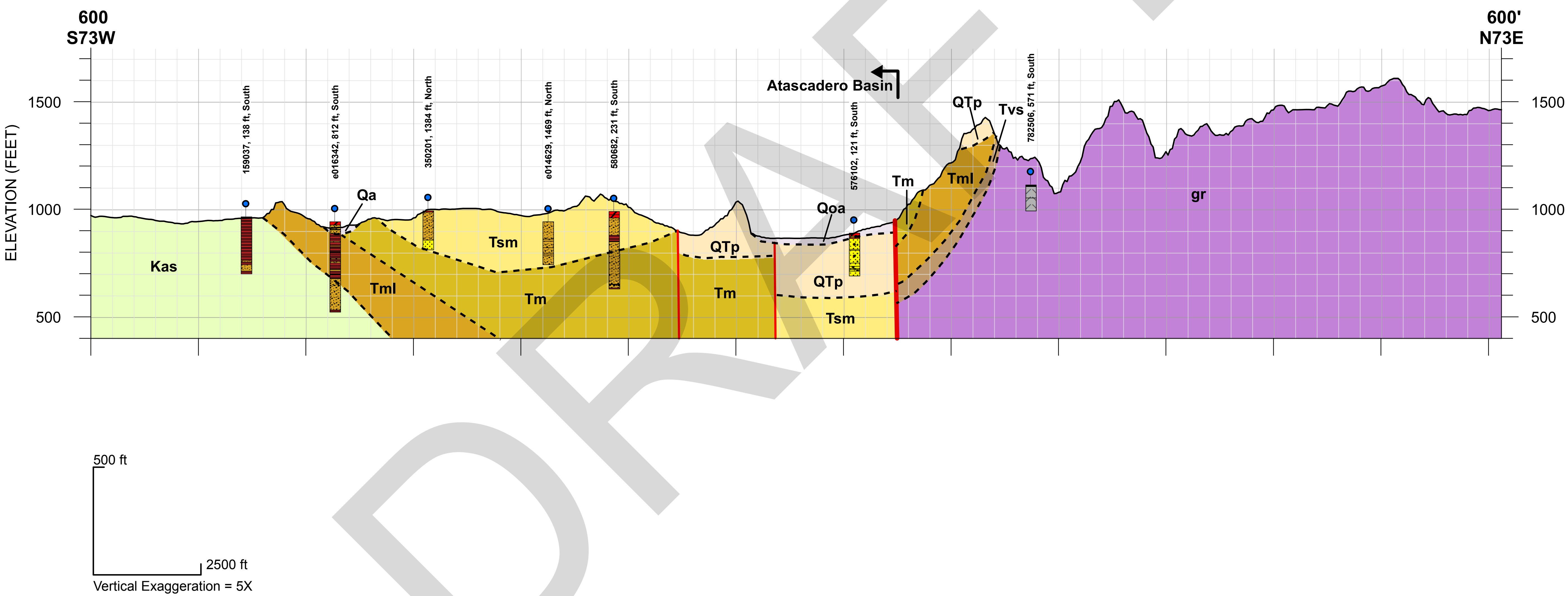


CROSS SECTION 720

Atascadero Basin Boundary Modification Application

PLATE 6

N:\Projects\04_2015\04_6215_0041_AtascaderoBasin\Outputs\2016_02_11_AtascaderoBasinMod\mxd\Plate06_Prof720_Color.mxd, 2/19/2016, cdean

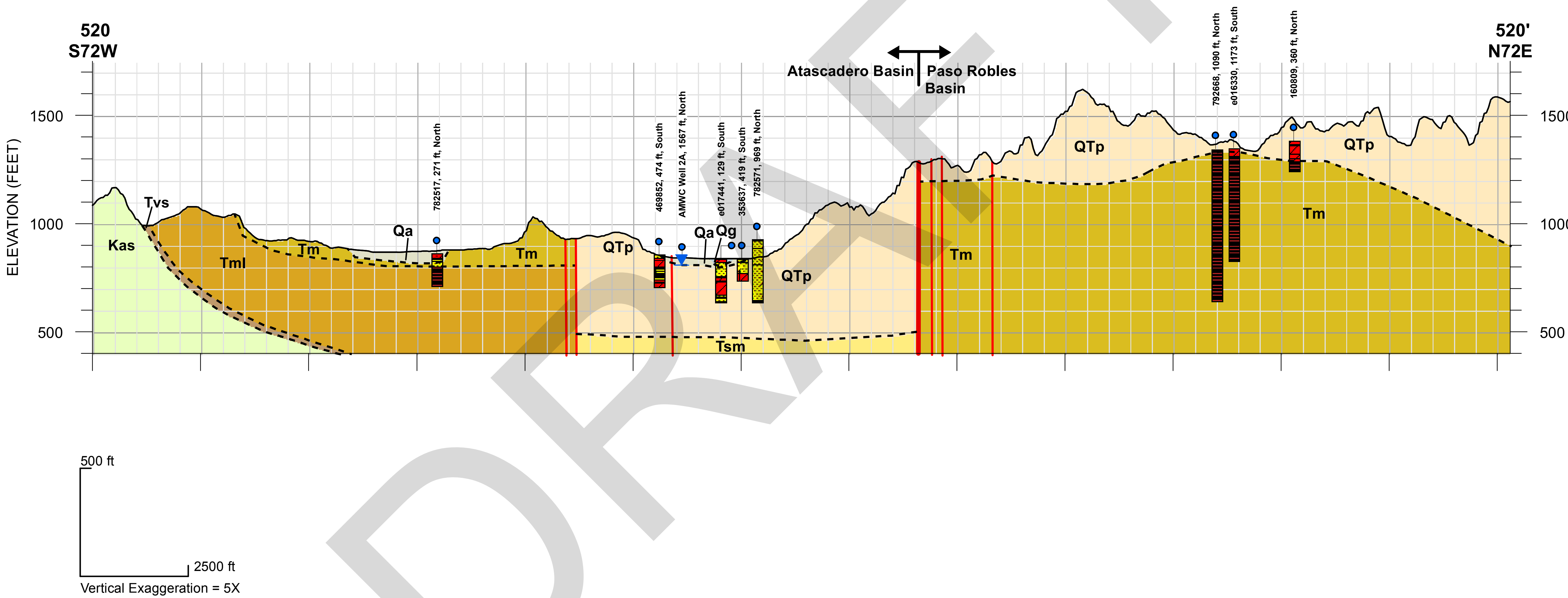


CROSS SECTION 600

Atascadero Basin Boundary Modification Application

PLATE 7

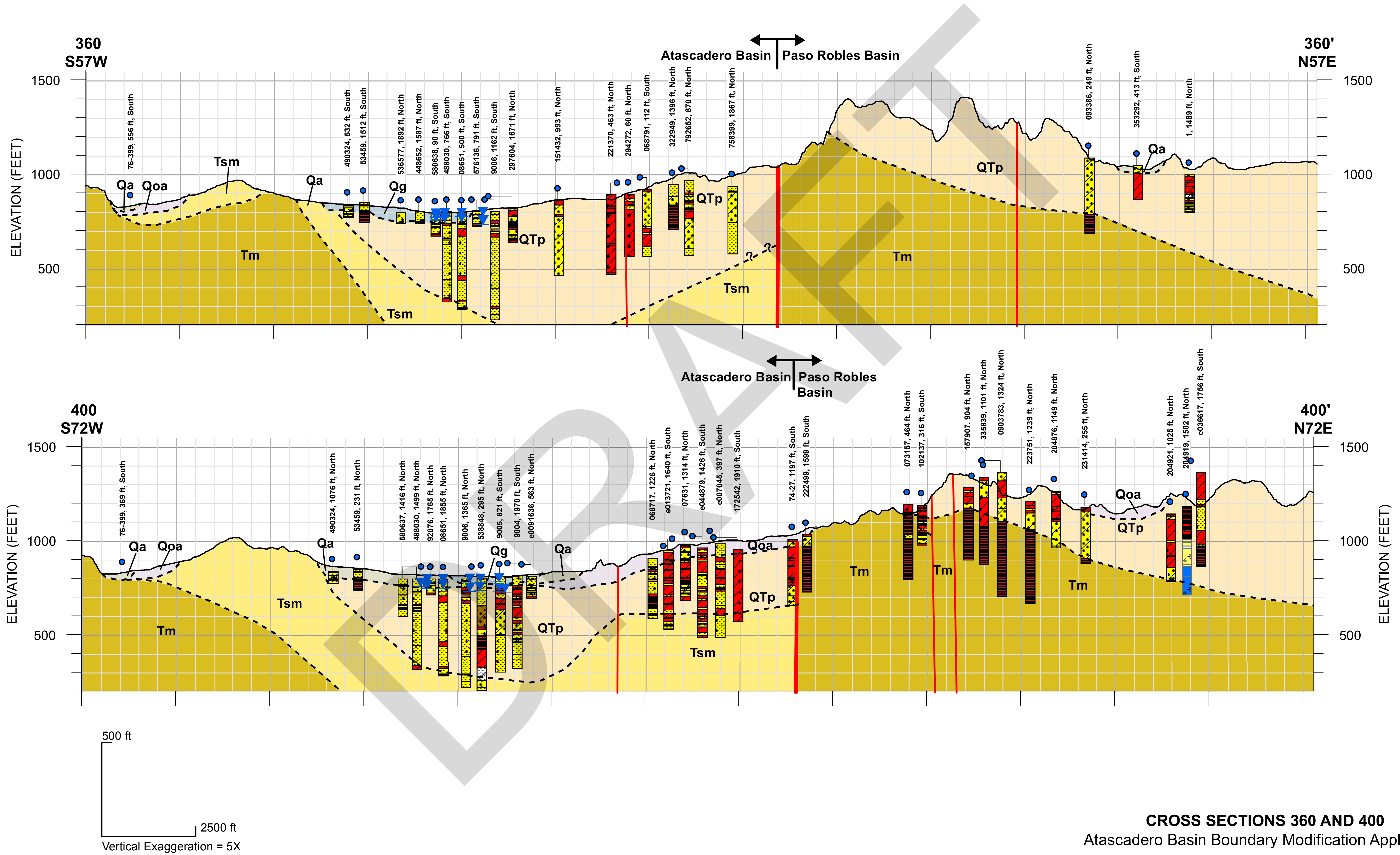
N:\Projects\04_2015\04_6215_0041_AtascaderoBasin\Outputs\2016_02_11_AtascaderoBasinMod\mxd\Plate07_Prof600_Color.mxd, 2/19/2016, cdean



CROSS SECTION 520

Atascadero Basin Boundary Modification Application

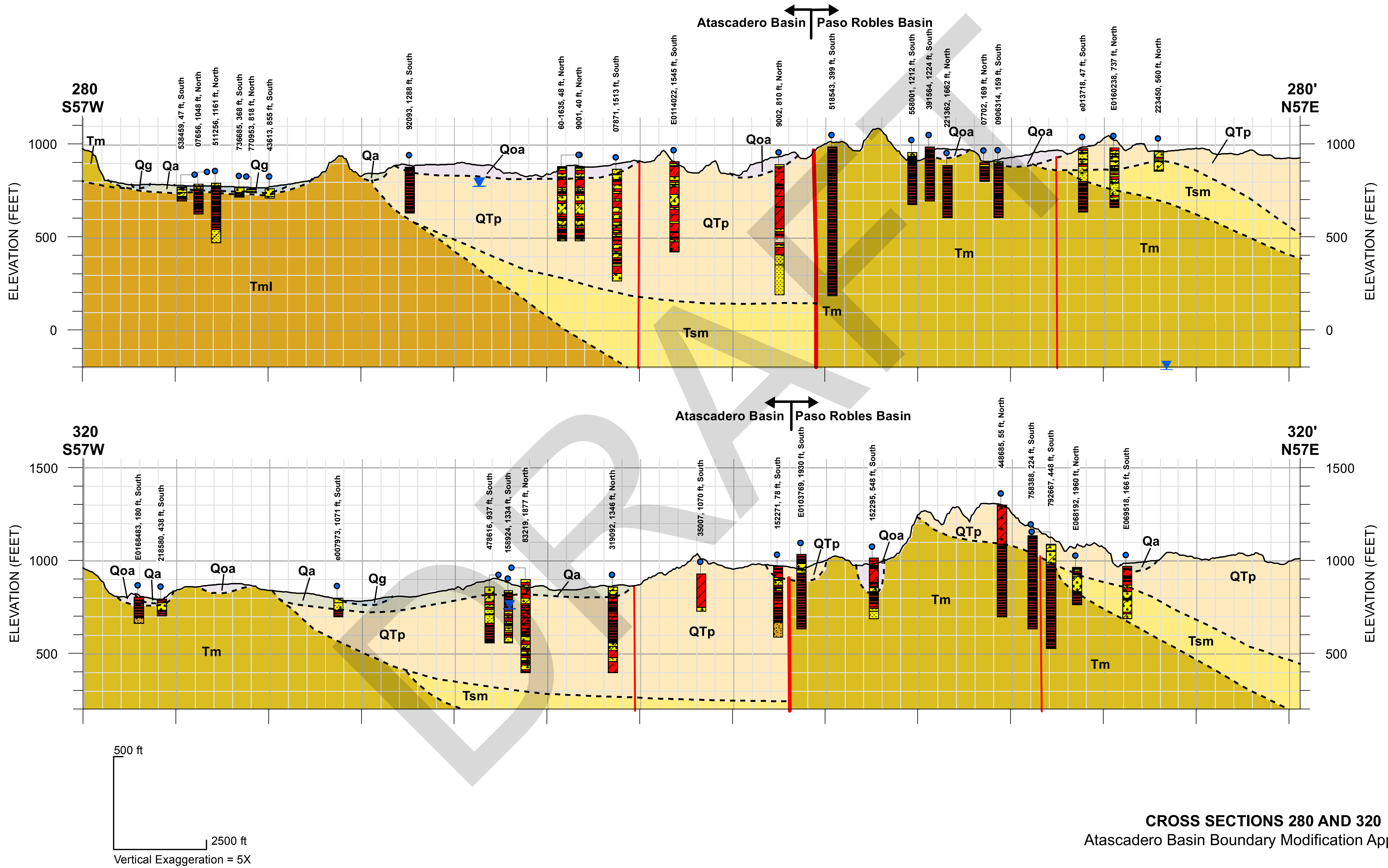
PLATE 8



CROSS SECTIONS 360 AND 400

Atascadero Basin Boundary Modification Application

PLATE 9

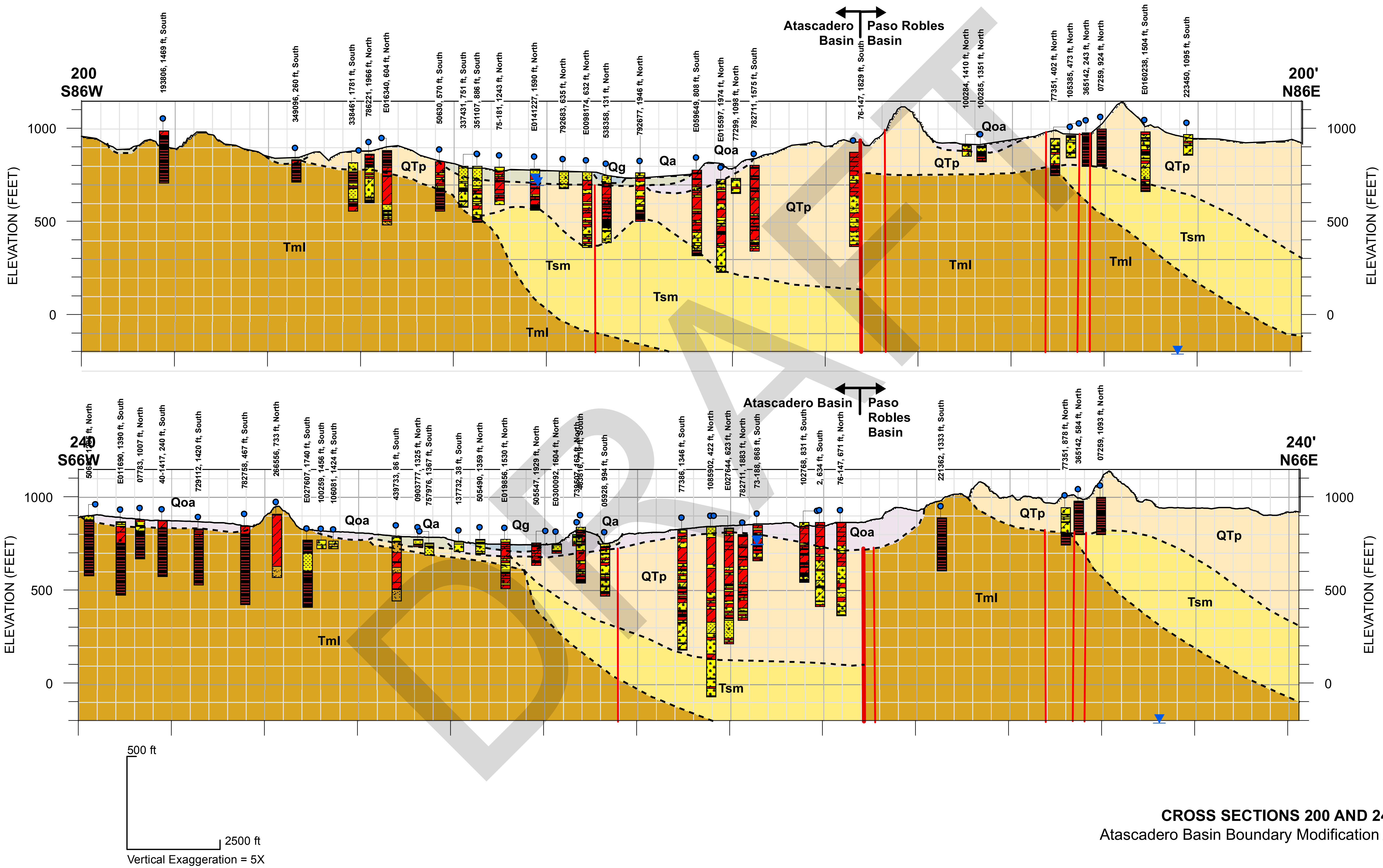


CROSS SECTIONS 280 AND 320

Atascadero Basin Boundary Modification Application

PLATE 10

N:\Projects\04_2015\04_6215_0041_AtascaderoBasin\Outputs\2016_02_11_AtascaderoBasinMod\mxd\Plate10_Prof280_320_Color.mxd, 2/12/2016, CDean

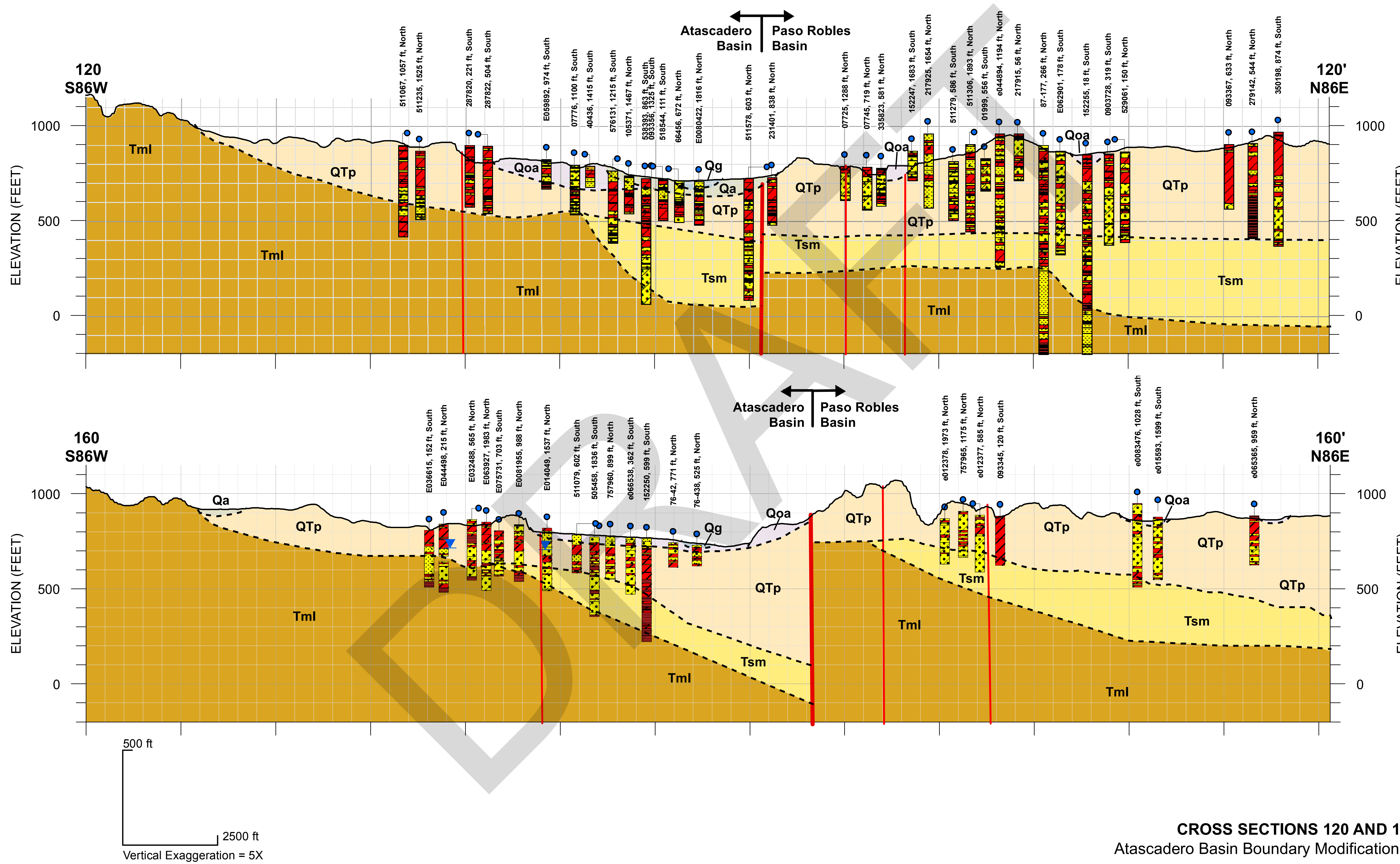


CROSS SECTIONS 200 AND 240

Atascadero Basin Boundary Modification Application

PLATE 11

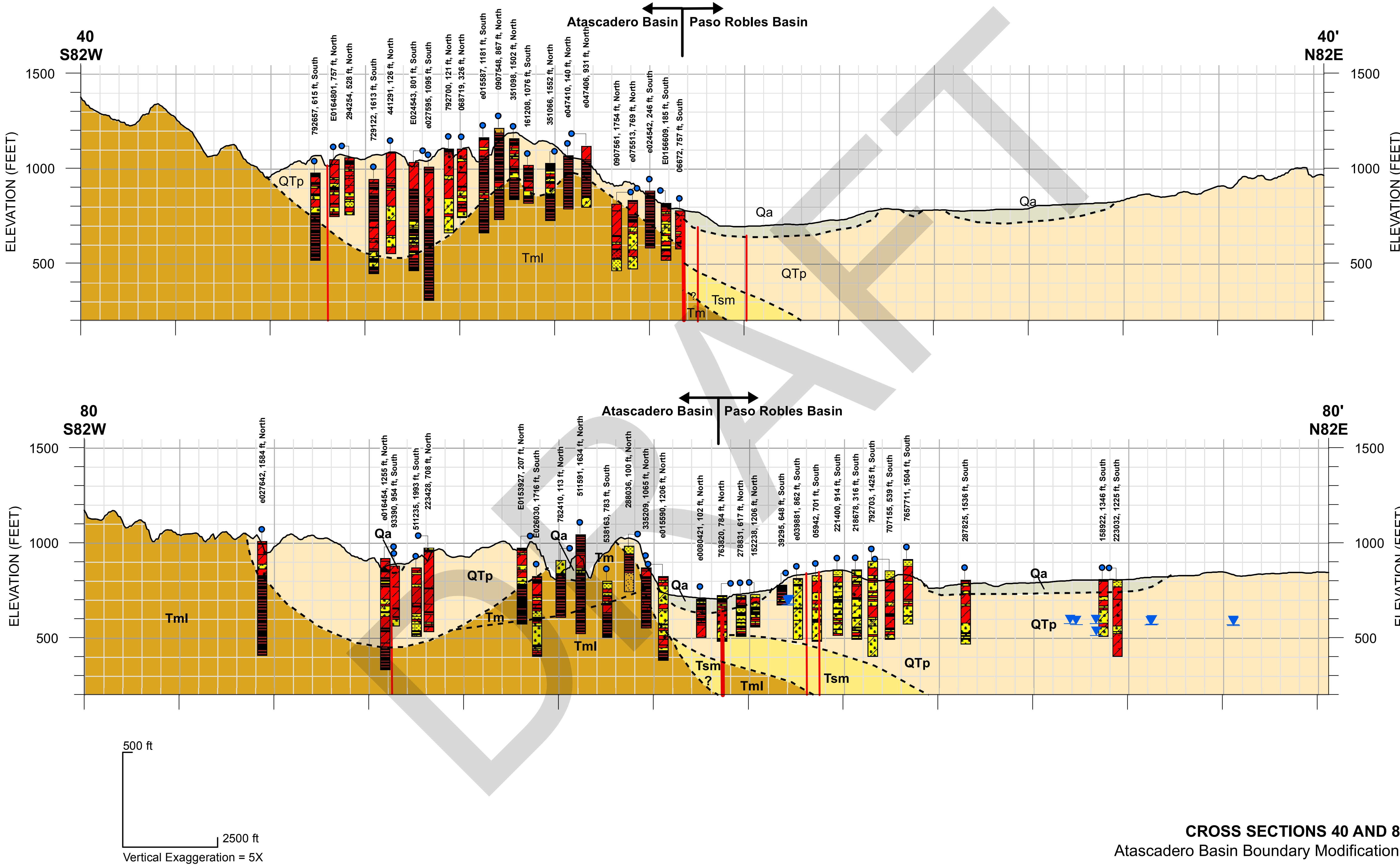
N:\Projects\04_2015\04_6215_0041_AtascaderoBasin\Outputs\2016_02_11_AtascaderoBasinMod\mxd\Plate11_Prof200_240_Color.mxd, 2/12/2016, CDean



CROSS SECTIONS 120 AND 160

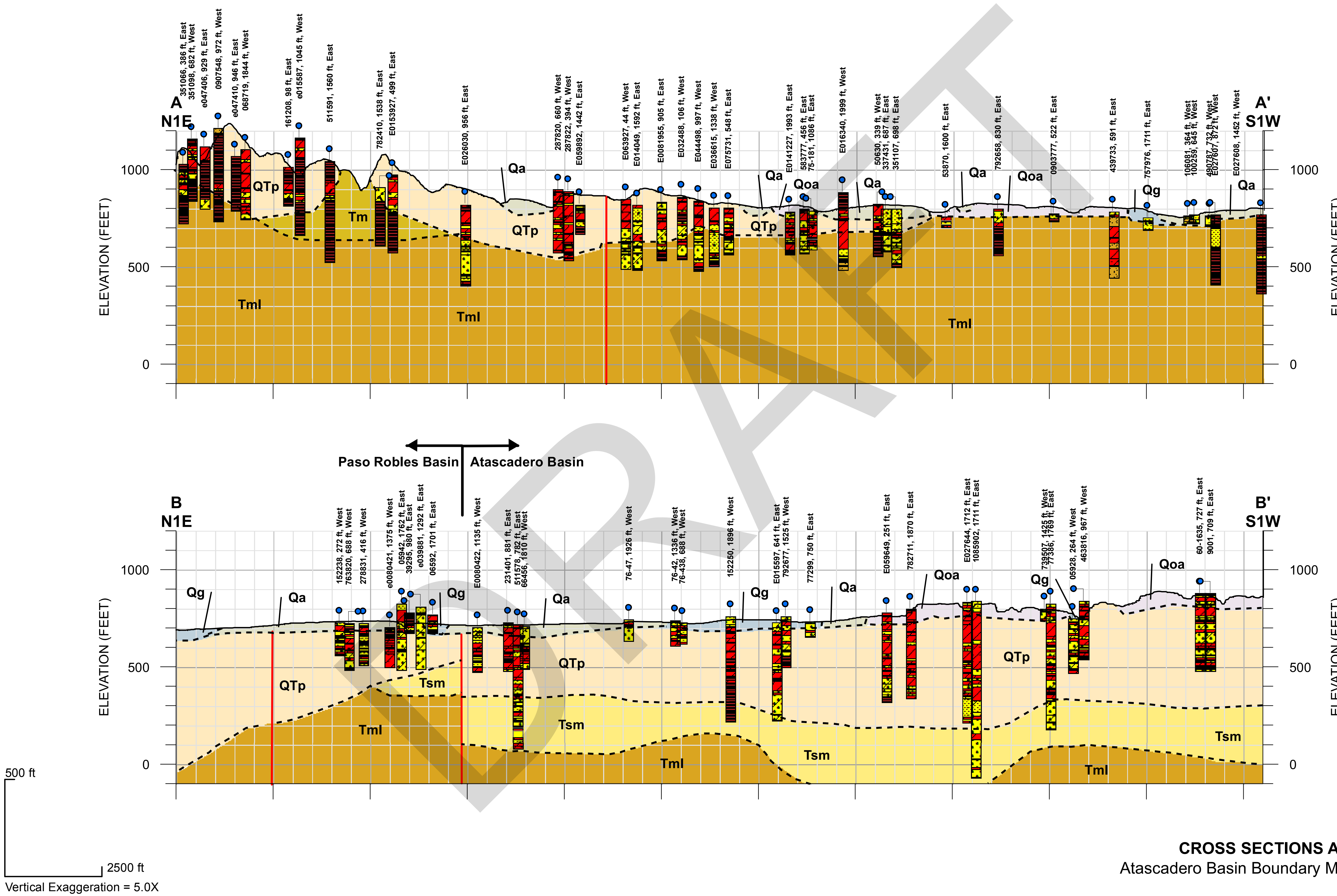
Atascadero Basin Boundary Modification Application

PLATE 12



CROSS SECTIONS 40 AND 80

Atascadero Basin Boundary Modification Application

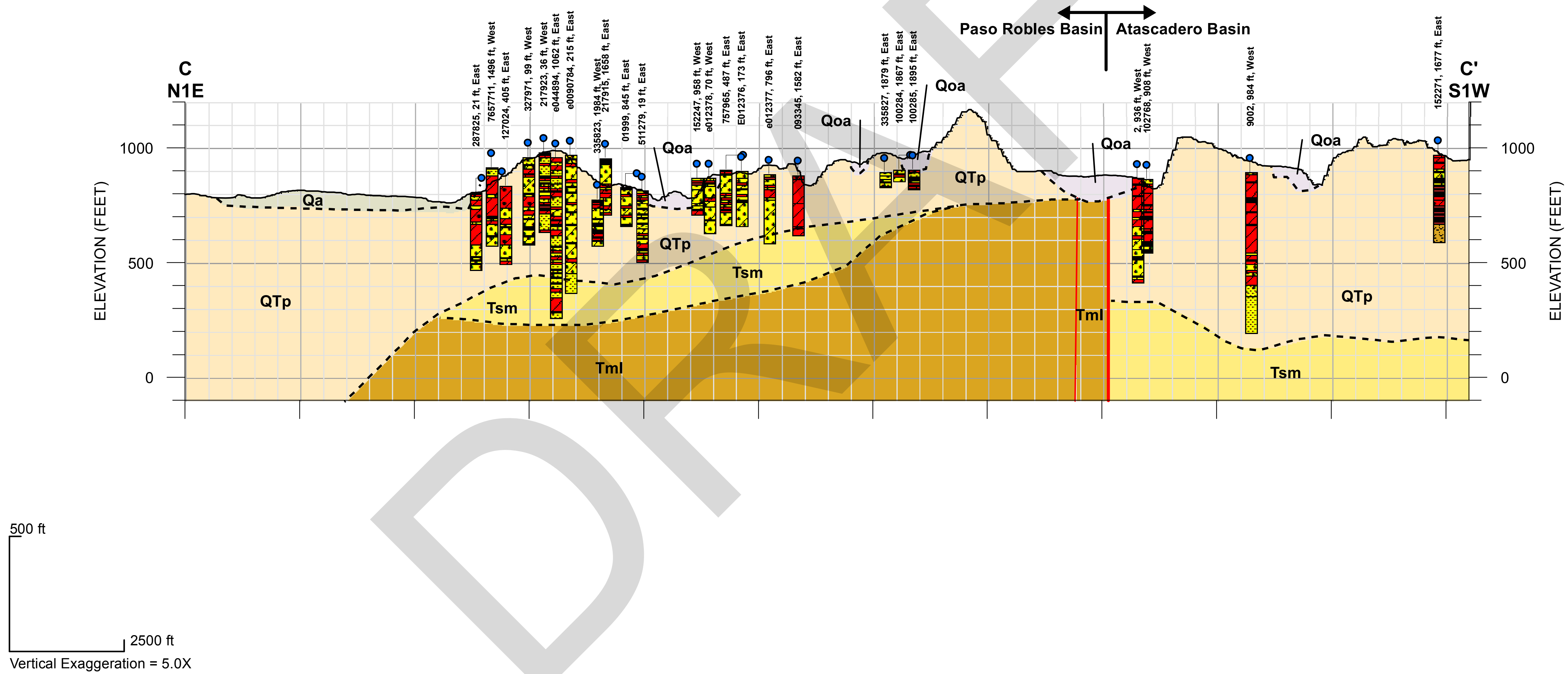


CROSS SECTIONS A-A' AND B-B'

Atascadero Basin Boundary Modification Application

PLATE 14

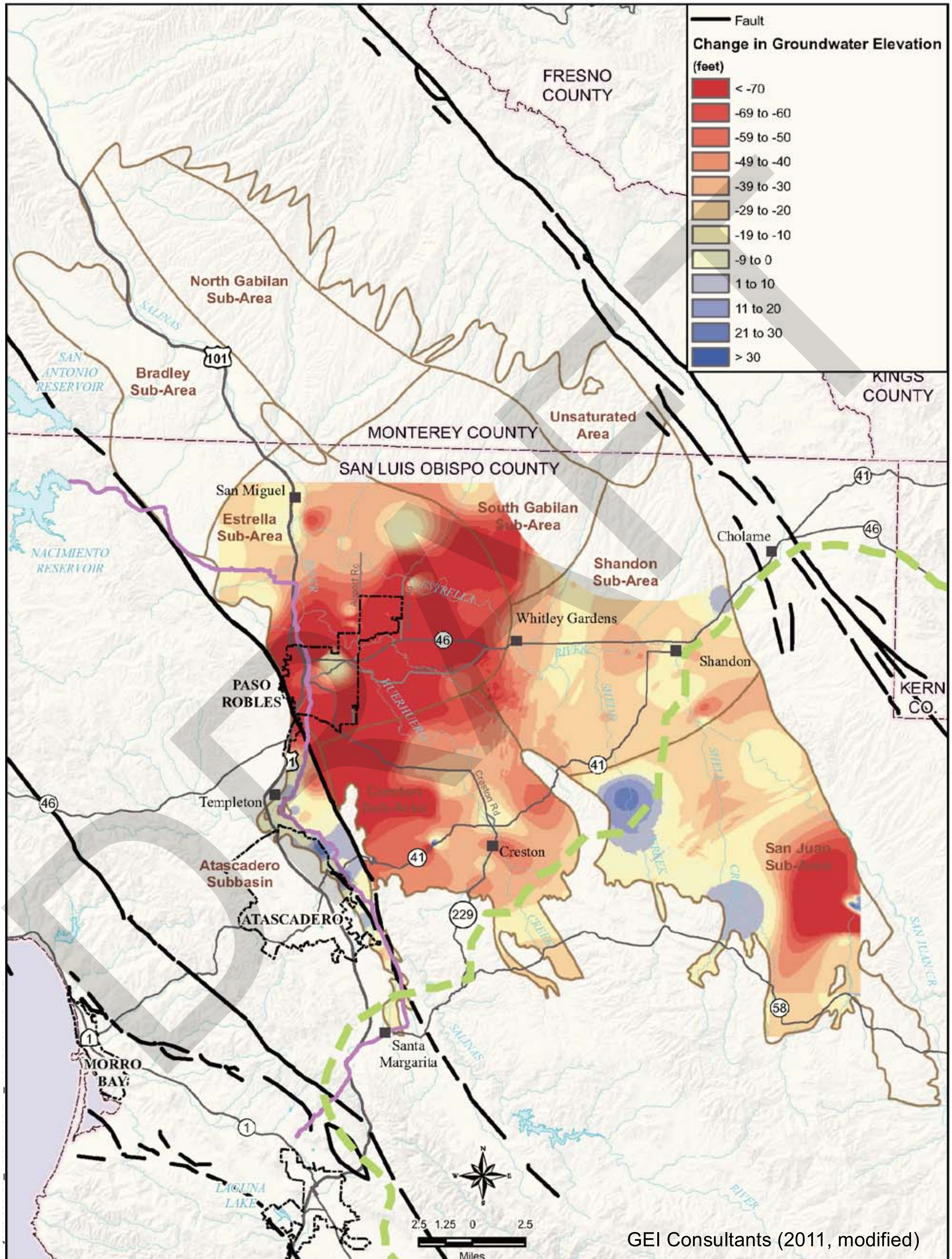
N:\Projects\04_2015\04_6215_0041_AtascaderoBasin\Outputs\2016_02_11_AtascaderoBasinMod\mxd\Plate14_ProfilesAandB.mxd, 2/12/2016, CDean



N:\Projects\04_2015\04_6215_0041_AtascaderoBasin\Outputs\2016_02_11_AtascaderoBasinMod\mxd\Plate15_ProfileC.mxd, 2/12/2016, CDean

CROSS SECTIONS C-C'

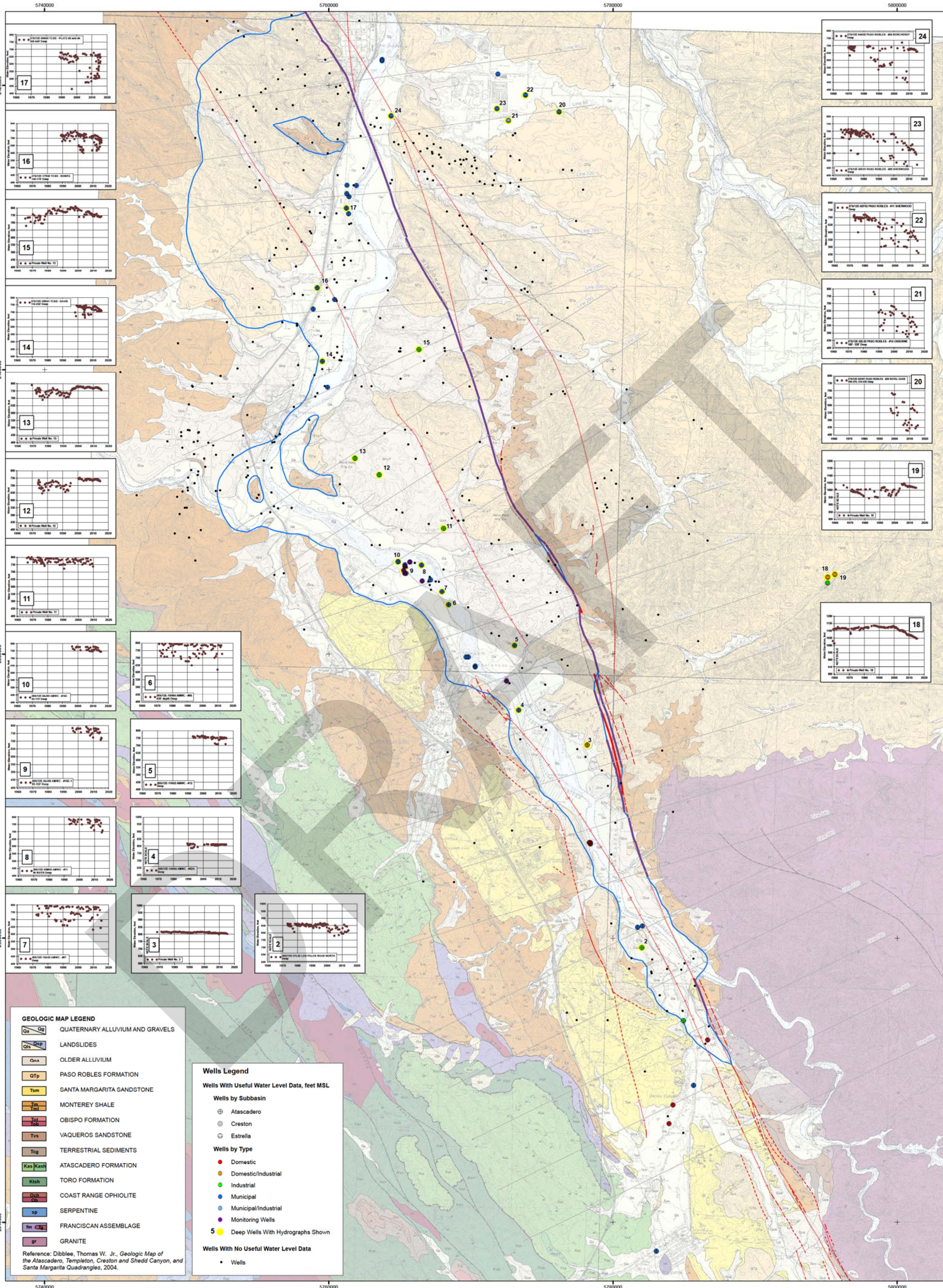
Atascadero Basin Boundary Modification Application



GENERALIZED DIFFERENCE IN SPRING GROUND-WATER ELEVATIONS BETWEEN 1997 - 2013

Atascadero Basin Boundary Modification Application PLATE 16

N:\Projects\04_2015\04_6215_0041_AtascaderoBasin\AtascaderoBasinMod\mxd\Plate16_1997_2013GW.mxd, 2/15/2016, CDean



LEGEND

Line 200 — Cross Section Lines

Atascadero Basin

Rinconada Fault Zone

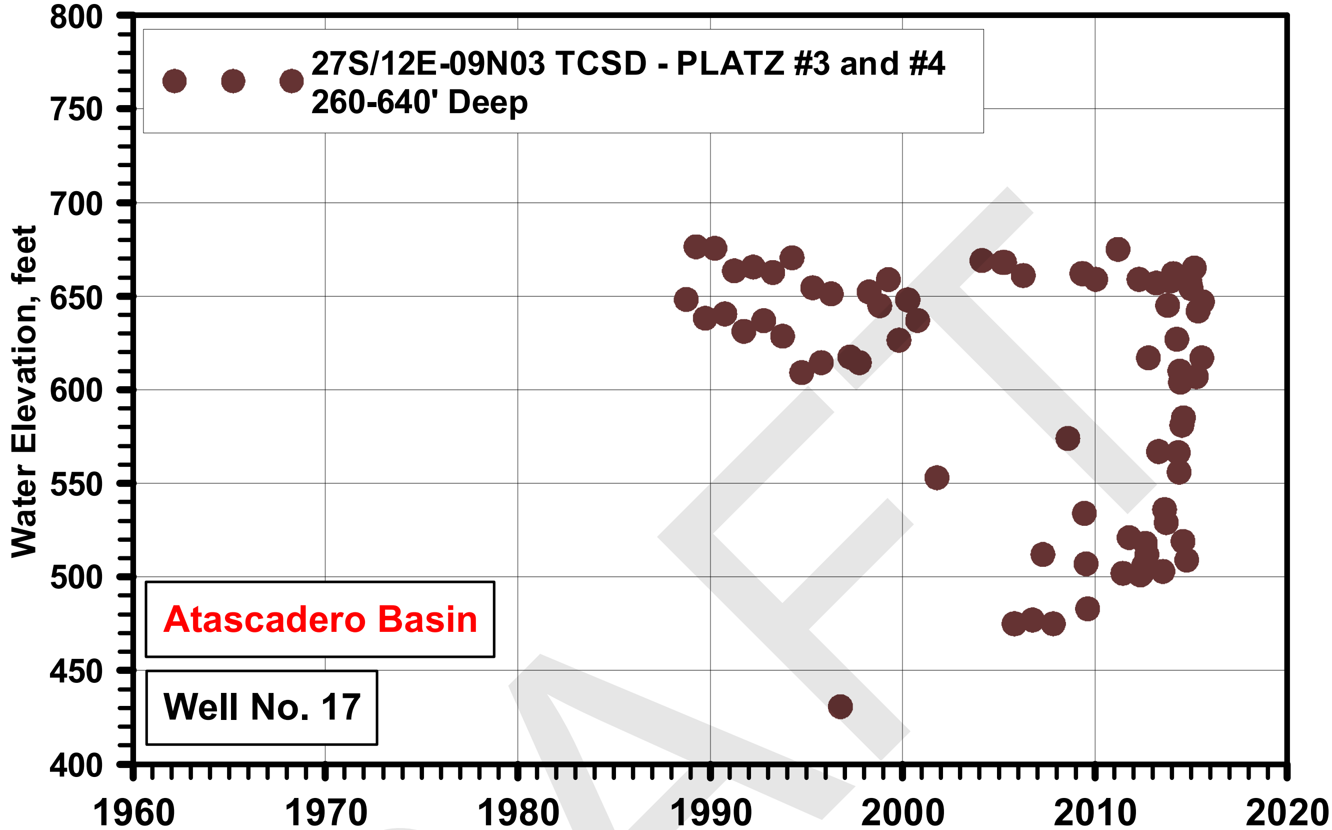
- Main Fault Trace (Basin Boundary)
- Certain
- Approximate
- Concealed
- Concealed Queried
- Inferred

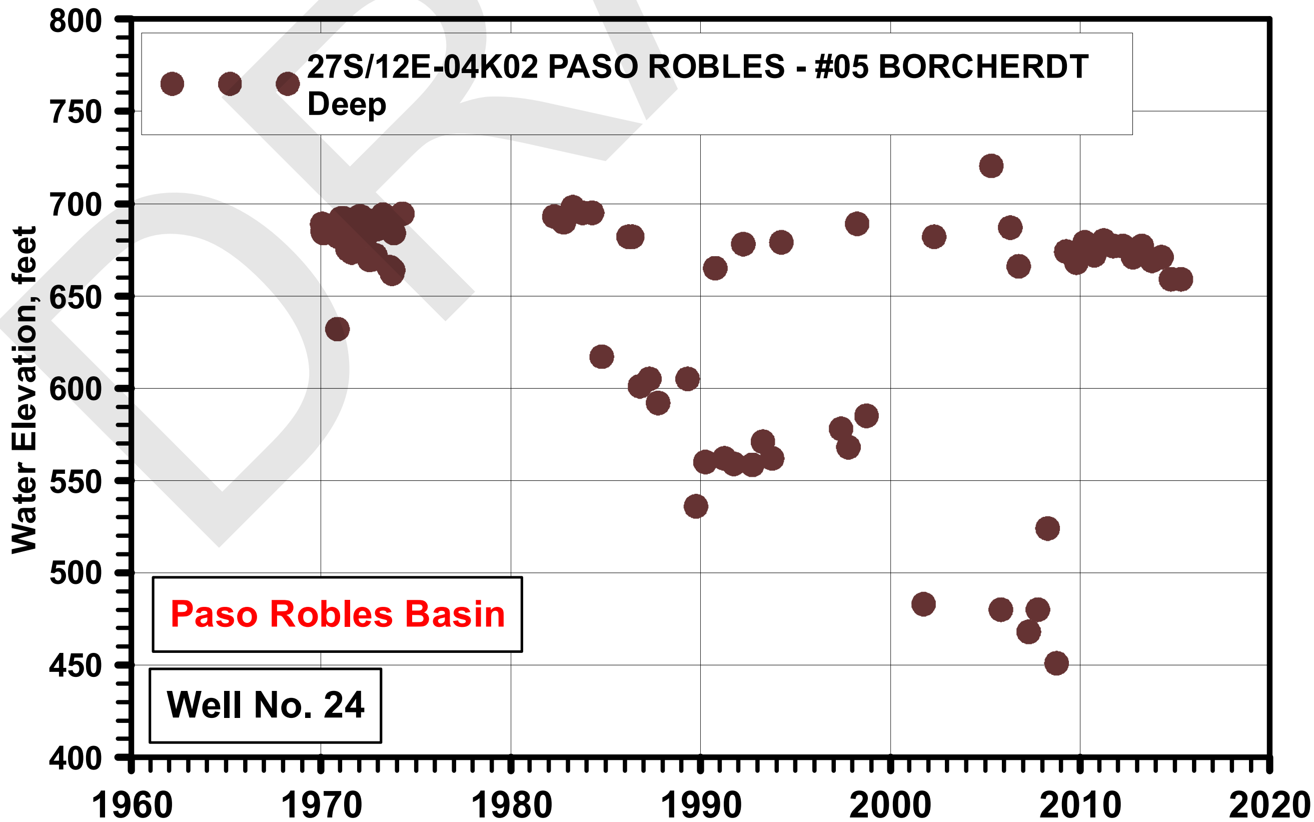
WATER LEVEL HYDROGRAPH LOCATION MAP

Atascadero Basin Boundary Modification Application

0 0.5 1 2 3 Miles

1:36,000





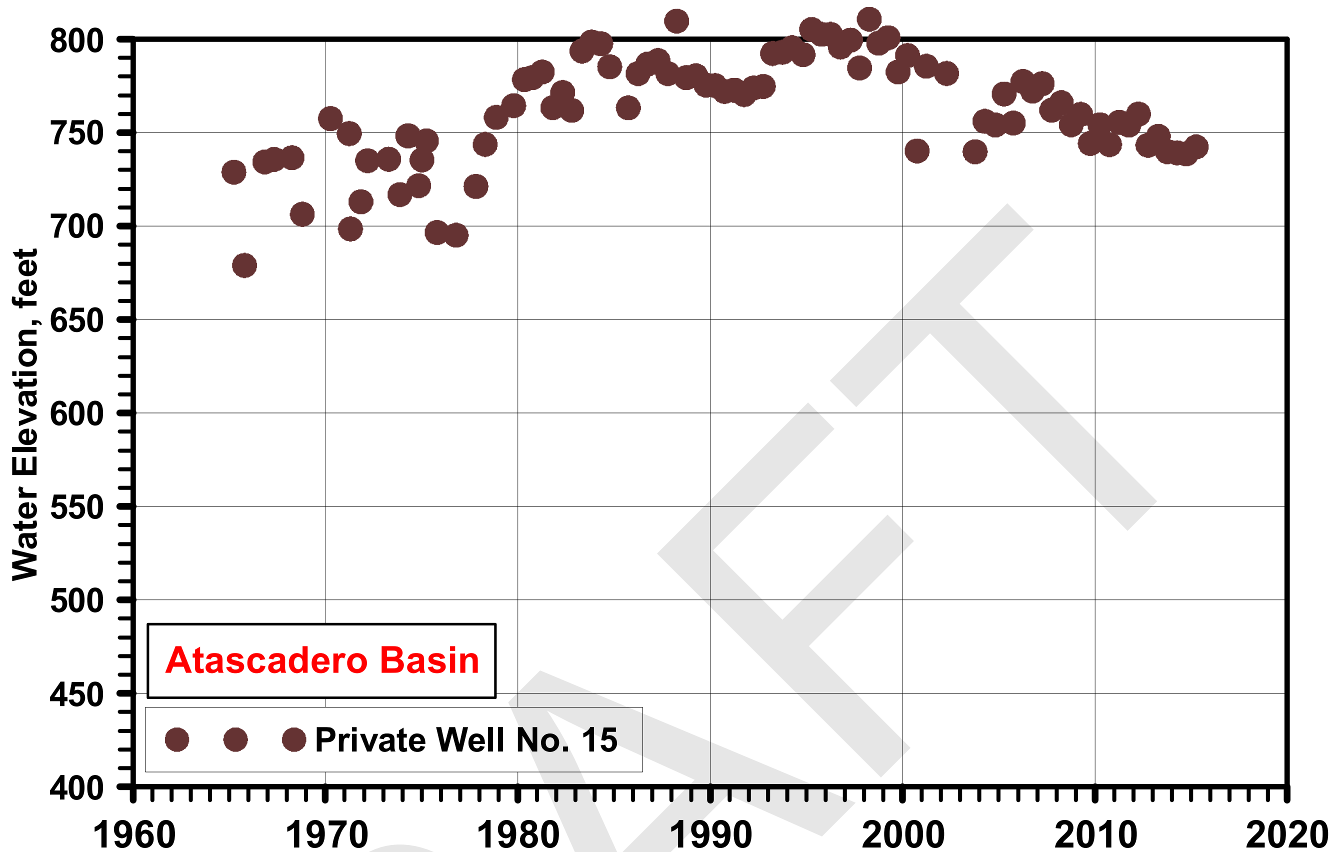
DRAFT

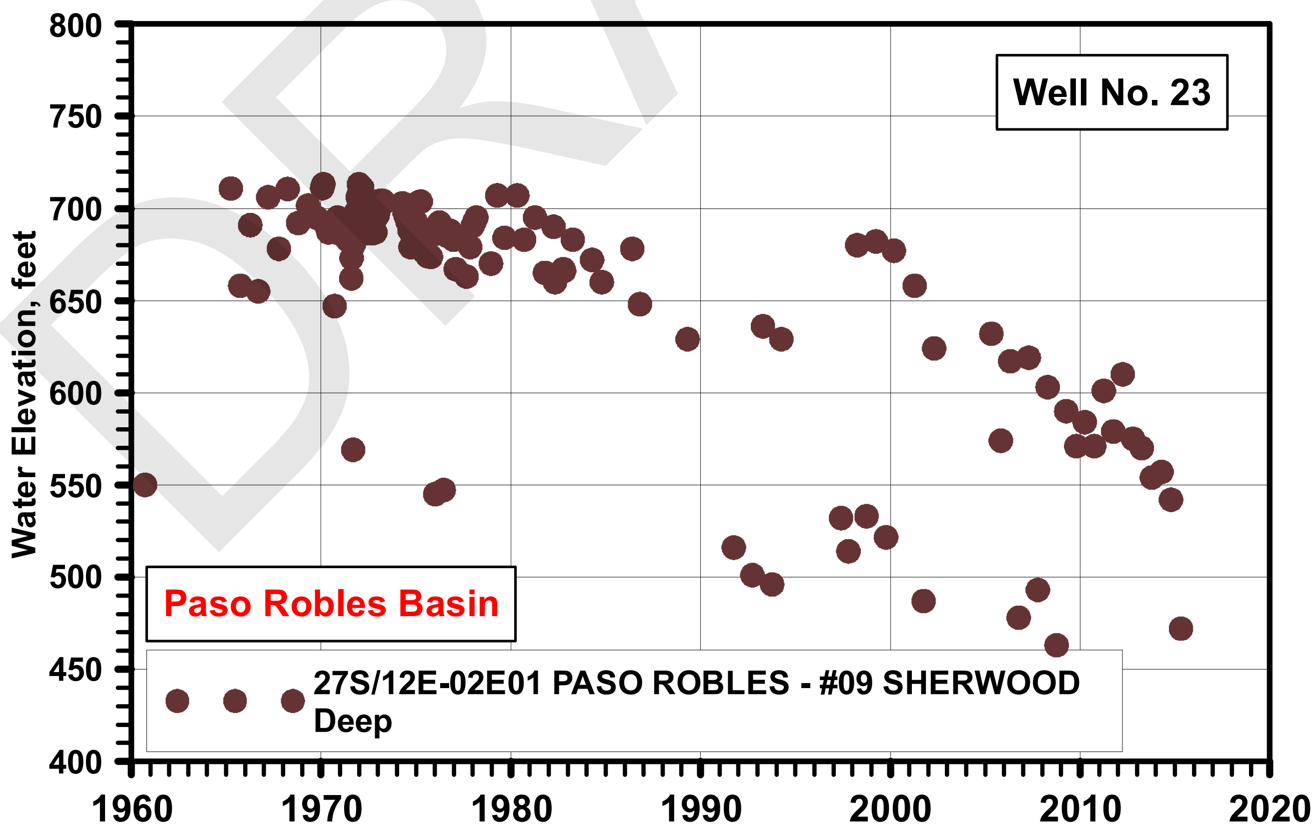
HYDROGRAPHS 17 AND 24

Atascadero Basin Boundary Modification Application

PLATE 18

N:\Projects\04_2015\04_6215_0041_AtascaderoBasin\Outputs\2016_02_11_AtascaderoBasinMod\mxd\Plate18_Hydrograph17_24.mxd, 2/16/2016, CDean



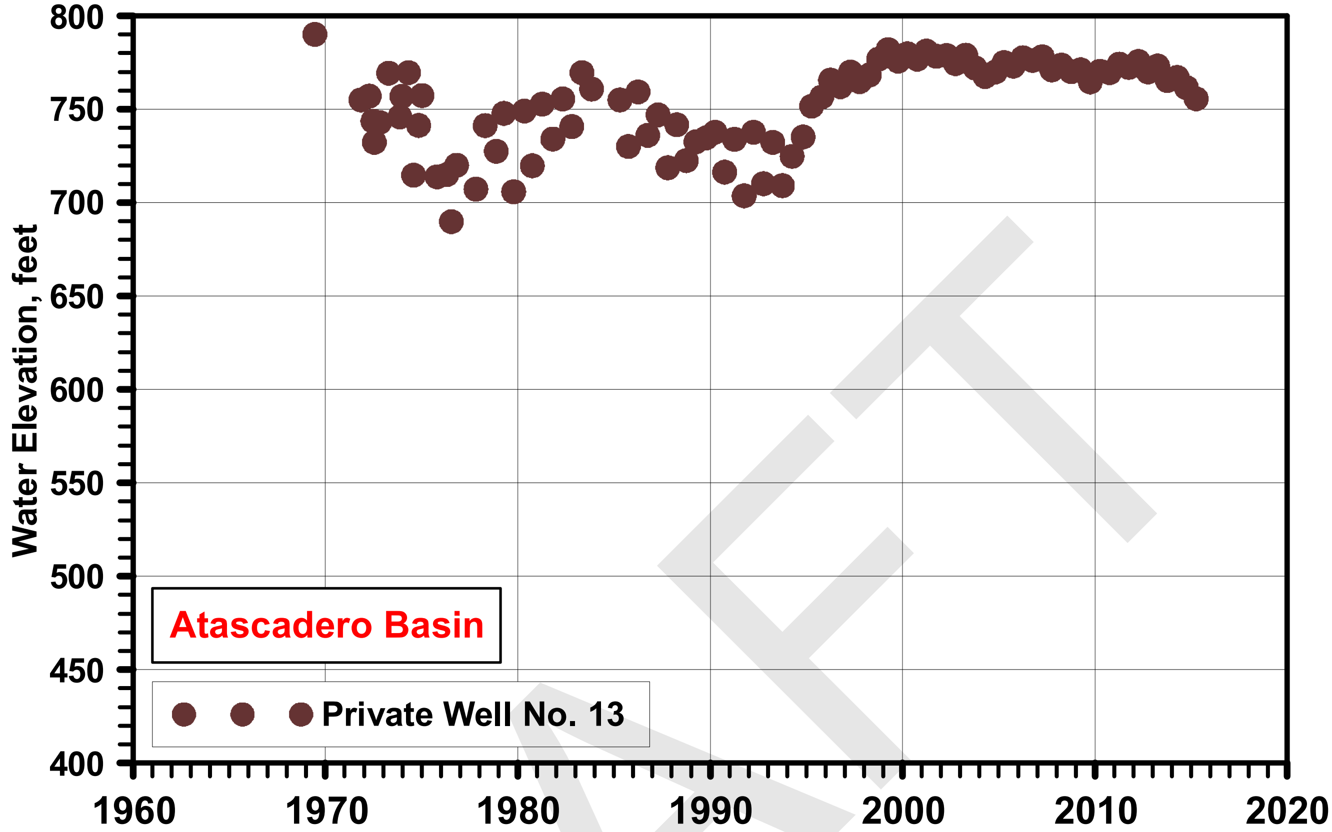


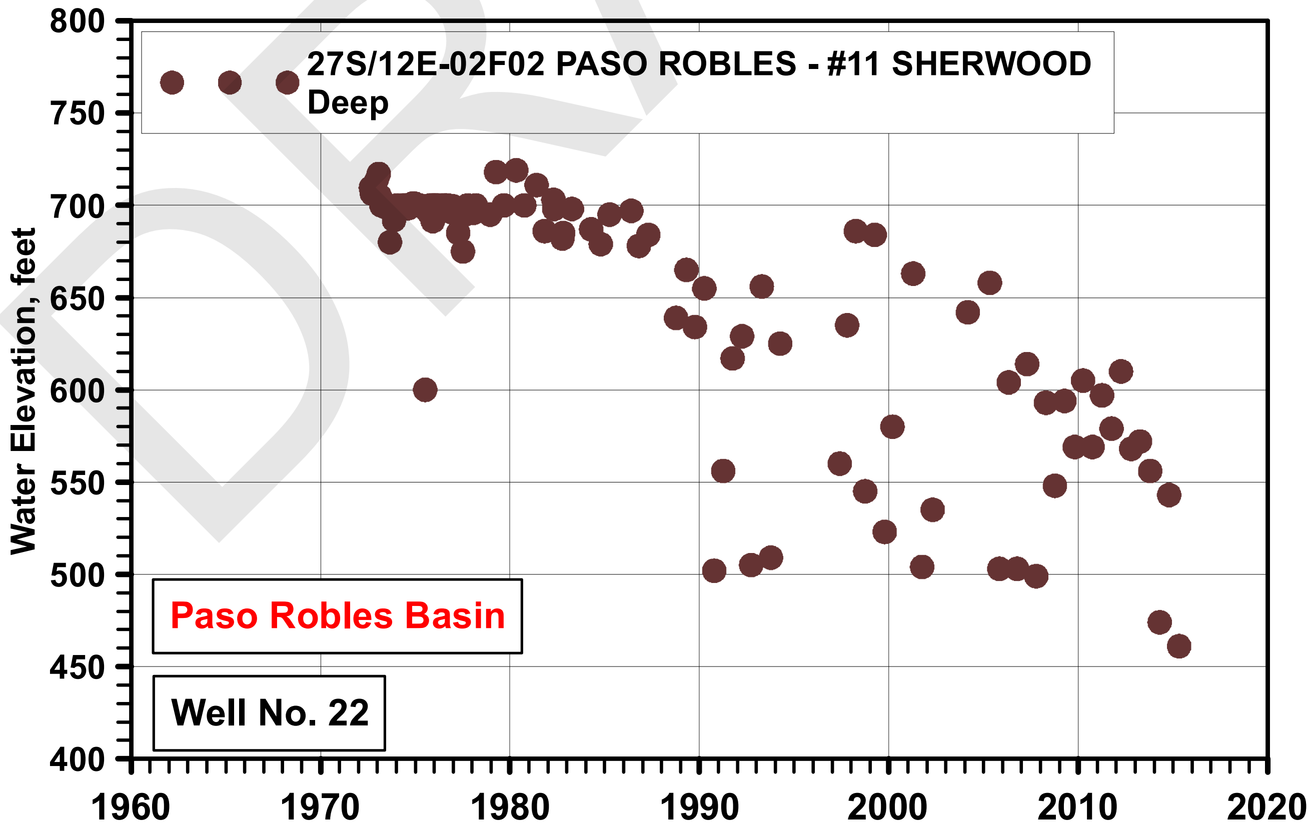
HYDROGRAPHS 15 AND 23

Atascadero Basin Boundary Modification Application

PLATE 19

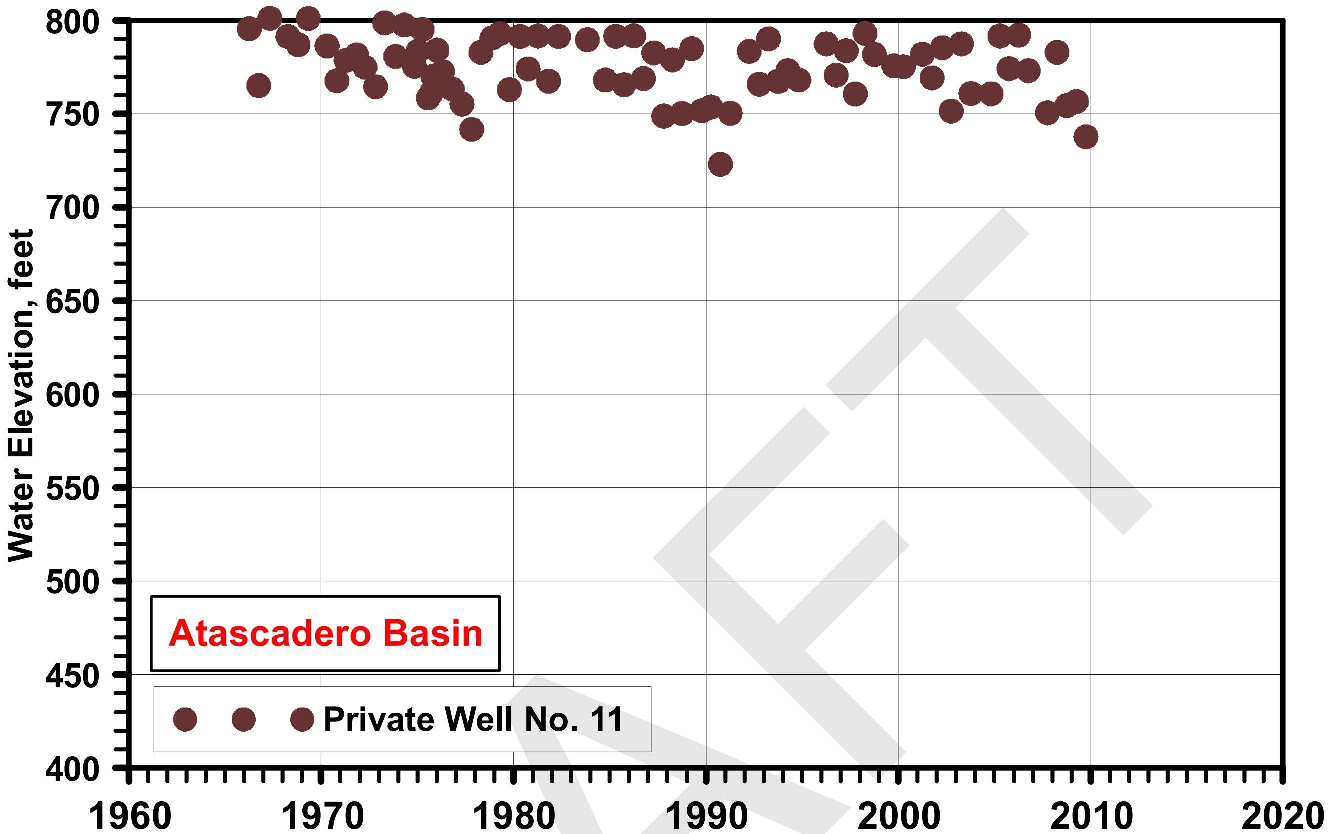
N:\Projects\04_2015\04_6215_0041_AtascaderoBasinMod\mxd\Plate19_Hydrograph15_23.mxd, 2/16/2016, CDean

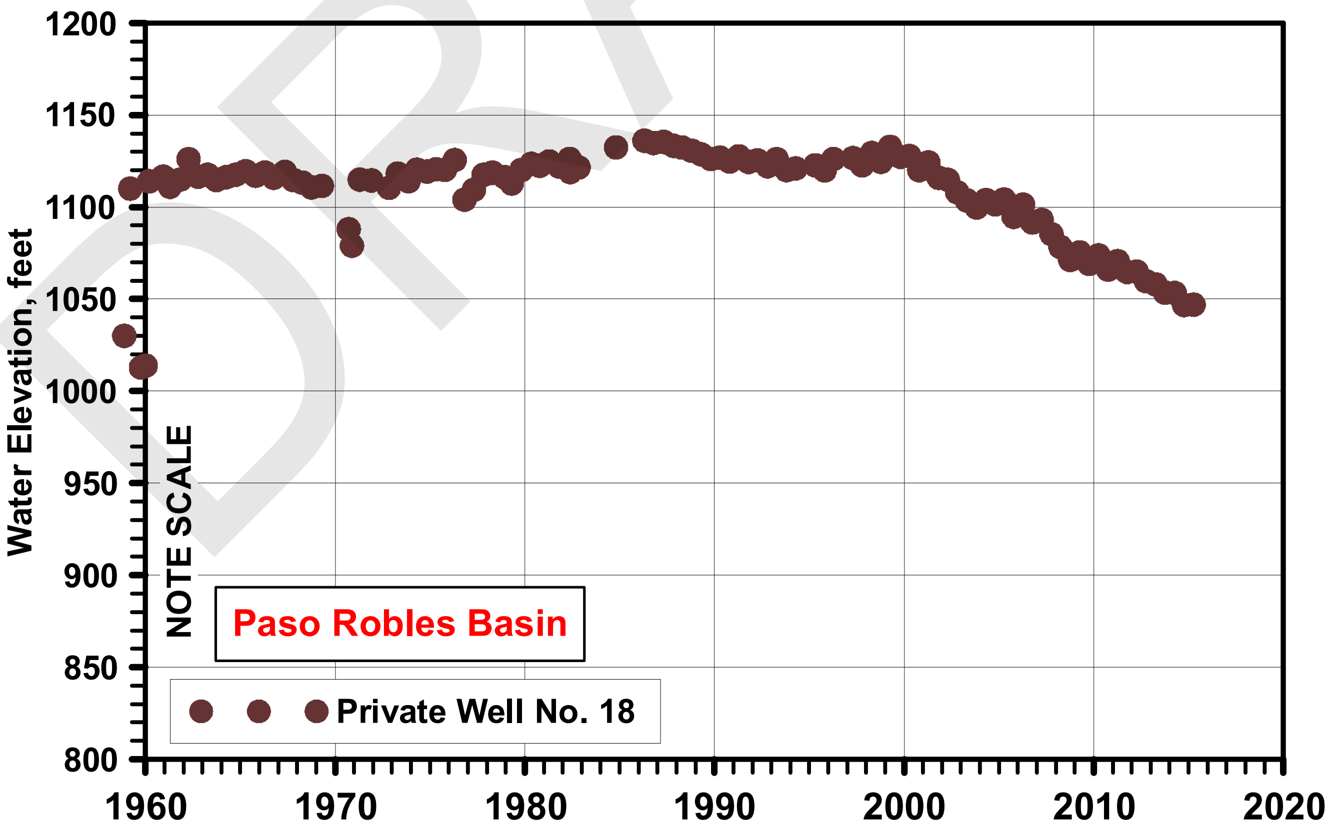




HYDROGRAPHS 13 AND 22

Atascadero Basin Boundary Modification Application





HYDROGRAPHS 11 AND 18

Atascadero Basin Boundary Modification Application

PLATE 21

N:\Projects\04_2015\04_6215_0041_AtascaderoBasin\Outputs\2016_02_11_AtascaderoBasinMod\mxd\Plate21_Hydrograph11_18.mxd, 2/16/2016, CDean