ATASCADERO AREA SUBBASIN
HYDROGEOLOGIC CONCEPTUAL MODEL

SUMMARY OF FINDINGS

The following is a general summary of findings that describes the hydrogeologic conceptual model of the proposed Atascadero Area Subbasin, and that provides geologic or hydrogeologic evidence to support the proposed modification of the Atascadero Subbasin boundary. The hydrogeologic conceptual model is summarized here, and presented in greater detail along with accompanying graphics and maps in the *Technical Report, Atascadero Area Subbasin Basin Boundary Modification Application* (submitted separately). A geologic map of the proposed basin, showing the basin boundaries, is appended.

- The northwestern, western, and southern boundaries of the Atascadero Area Subbasin are primarily 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 (see attached map).
- The Rinconada Fault defines the eastern boundary of the Atascadero Area Subbasin and forms a clear and distinct hydraulic separation along approximately 85% of the boundary between the Atascadero Subbasin and the main Paso Robles Subbasin. 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 Subbasin) 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 Subbasin and the Paso Robles Subbasin; however, despite the likelihood of hydraulic communication across the fault, 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 Subbasin (east of the Rinconada Fault) have generally and dramatically declined since the late 1990s, groundwater levels in the Atascadero subbasin have remained relatively steady, and;
- The maximum estimated flux of percolating groundwater between the Atascadero Subbasin and Paso Robles Subbasin 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 boundary between the Paso Robles Area Subbasin No. 3-4.06 and the Salinas Valley Basin No. 3-4.

GROUNDWATER BASIN DEFINITION

The northwestern, western, and southern boundaries of the proposed Atascadero Area Subbasin are primarily 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 Subbasin and forms a hydraulic barrier between the Paso Robles subbasin and the Atascadero subbasin. 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, where site investigations 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. Limited data are available to suggest that the fault acts as a complete barrier to flow, so the investigations to date have assumed that the fault zone forms, at the most, a leaky barrier that restricts flow from the Atascadero Subbasin to the main part of the Paso Robles subbasin.

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 Subbasin, 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.

Groundwater flow from the Atascadero Subbasin west of the Rinconada Fault into the Paso Robles Subbasin is limited to underflow in the alluvial Salinas River deposits and minor subsurface groundwater flux in the Paso Robles Formation. 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 Subbasin, however, the Rinconada Fault zone and the San Marcos Fault zone are considered active and are classified as Alquist-Priolo special studies zones.

GEOLOGIC SETTING

WATER BEARING GEOLOGIC FORMATIONS

The stratigraphy in the watershed of the Paso Robles and Atascadero subbasins 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. 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 subbasins 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 Atascadero Subbasin boundary follows the outcrop contact of these water-bearing geologic units but also follows the Rinconada Fault line on the eastern edge of the subbasin. 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 Salinas River within the Atascadero subbasin. These deposits reach a depth of about 60 to 90 feet or less below ground surface (bgs) in the subbasin, 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 Atascadero subbasin is comprised of Paso Robles Formation sedimentary layers that extend from the ground surface to a depth of about 500 to 600 feet.

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. 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 Atascadero Subbasin 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 occasionally of acceptable water quality, although production capability from water wells is generally poor.

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 Subbasin and forms the adjacent bedrock unit as well as the base of the Paso Robles Formation aquifer throughout most of the Atascadero subbasin. 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, and groundwater produced from the Monterey Formation often has high concentrations of hydrogen sulfide, total organic carbon, and manganese.

Metamorphic and Granitic Rock. A portion of the eastern edges of the Atascadero Subbasin 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 Atascadero and Templeton.

The granitic rock (gr) lies east of the Rinconada Fault zone, east of the City of Atascadero. The area underlying the granitic rocks 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.

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. Estimated average specific yield were obtained 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. 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 Subbasin 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.

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 Subbasin 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.

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. The average hydraulic conductivity of the Paso Robles Formation for the depth intervals tapped by wells in the Atascadero Subbasin is estimated at 4 ft/day.

WATER QUALITY

In general, the groundwater quality of the Atascadero subbasin is relatively good, with few areas of unacceptable quality and few significant trends of deteriorating water quality.

The main source of recharge to the Atascadero subbasin 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 subbasin. Increasing TDS and chlorides in shallow Paso Robles Formation deposits along the Salinas River in the central portion of the basin has been identified as a trend of slight water quality deterioration.

RECHARGE AND DISCHARGE

Recharge to the Atascadero subbasin occurs throughout the entire basin, predominantly by percolation of streamflow water and by deep percolation of precipitation. Outflow (primarily surface flow and Salinas River underflow) flows from the Atascadero Basin into the Paso Robles Subbasin at the north end of the Atascadero Subbasin where the Salinas River crosses the Rinconada Fault. The calculated perennial yield of the Atascadero Basin is estimated to be 16,400 AFY.

5740000 5760000 5780000 5800000

2420000 2400000 2380000 2360000

GEOLOGIC MAP LEGEND

- Qa / Qg — QUATERNARY ALLUVIUM AND GRAVELS
- Qls / Qsp — LANDSLIDES
- Qoa — OLDER ALLUVIUM
- QTp — PASO ROBLES FORMATION
- Tsm — SANTA MARGARITA SANDSTONE
- Tm / Tml — MONTEREY SHALE
- Tot / Tob — OBISPO FORMATION
- Tvs — VAQUEROS SANDSTONE
- Tcg — TERRESTRIAL SEDIMENTS
- Kas / Kash — ATASCADERO FORMATION
- Ktsh — TORO FORMATION
- Och / Ob — COAST RANGE OPHIOLITE
- sp — SERPENTINE
- fm / fg — FRANCISCAN ASSEMBLAGE
- gr — GRANITE

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

LEGEND

- Atascadero Basin

Rinconada Fault Zone

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

0 0.5 1 2 3 Miles

1:36,000

Atascadero Basin

N:\Projects\04_2015\04_0215_0045_Atascadero_Basin\Outputs\2015_01_08_CourtCase\mxd\Fig05_GeologyMap.mxd, 3/17/2016, cdean