CHAPTER 4
MONITORING NETWORKS

4.1 MONITORING NETWORK OBJECTIVES

The overall objective of the monitoring network in the Las Posas Valley Basin (LPVB) is to track and monitor parameters that demonstrate conditions in the LPVB related to the sustainability goals. In order to accomplish this objective, the monitoring network in the LPVB must be capable of:

- Monitoring changes in groundwater conditions (in six sustainability indicator categories)
- Monitoring progress toward minimum thresholds and measurable objectives
- Quantifying annual changes in water budget components

The existing network of groundwater wells includes both monitoring wells and production wells. This network is capable of delineating the groundwater conditions in the LPVB and has been used for this purpose in the past. The current groundwater well network will be used to monitor groundwater conditions moving forward, in order to continue to assess long term trends in groundwater elevation and groundwater quality in the LPVB.

In the future, to the extent possible, additional dedicated monitoring wells will be incorporated into the existing monitoring network. These wells will provide information on groundwater conditions in geographic locations where data gaps have been identified, or where a dedicated monitoring well would better represent conditions in the aquifers than a production well currently used for monitoring.

4.2 DESCRIPTION OF EXISTING MONITORING NETWORK

The existing monitoring network for groundwater and related surface conditions in the LPVB includes groundwater production wells, dedicated groundwater monitoring wells, stream gauges, and weather stations. The components of the monitoring network are discussed in Section 4.2.1, Network for Monitoring Groundwater; Section 4.2.2, Surface Conditions Monitoring; and Section 4.2.3, Network for Monitoring Precipitation, in the context of their ability to demonstrate short-term, seasonal, and long-term trends in groundwater and related surface conditions, as well as the ability of the network to provide representative conditions in the LPVB. A discussion of how the monitoring network relates to each of the sustainability criteria follows this discussion in Section 4.3, Monitoring Network Relationship to Stability Indicators.

4.2.1 Network for Monitoring Groundwater

Data collected from more than 200 wells in the LPVB have been used to demonstrate historical groundwater elevation conditions (Appendix C, CMWD Model Report). The current groundwater

well monitoring network is smaller, but still encompasses approximately 40 wells in the West Las Posas Management Area (WLPMA) and approximately 90 wells in the East Las Posas Management Area (ELPMA) (Figures 4-1 through 4-3). The groundwater well monitoring network contains wells that are screened in every primary aquifer in the LPVB. The network of groundwater wells includes agricultural, municipal, industrial, and domestic production wells and these are the primary wells used to assess groundwater conditions in the LPVB. In addition to the groundwater production wells used in the monitoring network the U.S. Geological Survey installed one dedicated nested monitoring well cluster (02N21W11J03S-06S) in the WLPMA and one dedicated nested monitoring well cluster (03N20W35R02S-04S) in the ELPMA. The only other dedicated monitoring wells in the LPVB are screened in the shallow alluvial aquifer.

West Las Posas Management Area

The majority of the groundwater elevation data in the WLPMA are collected by the Ventura County Watershed Protection District (VCWPD). VCWPD conducts manual groundwater sampling in 16 wells. The United Water Conservation District (UWCD) collects manual groundwater elevation measurements from three additional wells in the WLPMA. Two of these are municipal wells and one is an agricultural well.

Manual groundwater elevation measurements are used to assess seasonal and long-term trends in groundwater elevation in the WLPMA, where groundwater elevations were first measured in the 1940s (Appendix C). Seasonal and long-term groundwater elevation trends have been assessed based on the data collected from the existing and historical network of groundwater monitoring wells, and are discussed in Section 2.3, Groundwater Conditions, of this Groundwater Sustainability Plan (GSP).

The spatial and temporal coverage of the existing groundwater monitoring network is sufficient to provide an understanding of representative conditions in the Upper San Pedro Formation (USP), the Fox Canyon Aquifer (FCA), and the Grimes Canyon Aquifer (GCA) in the WLPMA. Therefore, this network will be used to demonstrate progress toward the sustainability goals for the LPVB. Although evaluation of the current network suggests that the network is sufficient to document groundwater conditions in the LPVB areas for future improvement of the network are identified in Section 4.6, Potential Monitoring Network Improvements.

East Las Posas Management Area

In the ELPMA groundwater elevations are monitored by Calleguas Municipal Water District (CMWD) and VCWPD. CMWD monitors 30 wells in the ELPMA, 15 of which are agricultural wells, 10 of which are dedicated monitoring wells, and 5 of which are municipal wells. VCWPD monitors an additional 18 wells in the ELPMA and the Epworth Gravels Management Area. Manual groundwater elevation measurements are collected by VCWPD, while CMWD records

water levels both manually and with pressure transducers. Pressure transducers record the pressure of water (or height of the water column) above the transducer in the well. The CMWD transducers record the height of the water column in the well every 30 minutes, thereby providing high-temporal-resolution data on groundwater conditions in the aquifers.

Manual groundwater elevation measurements are used to assess seasonal and long-term trends in groundwater elevation in the ELPMA, where groundwater elevations were first measured in the 1920s. Seasonal and long-term groundwater elevation trends have been assessed based on the data collected from the existing and historical network of groundwater monitoring wells, and are discussed in Section 2.3.

The spatial and temporal coverage of the existing groundwater monitoring network is sufficient to provide an understanding of representative conditions in the Shallow Alluvial Aquifer or shallow alluvium, the USP, the FCA, and the GCA in the ELPMA. Therefore, this network will be used to demonstrate progress toward the sustainability goals for the LPVB. Although evaluation of the current network suggests that the network is sufficient to document groundwater conditions in the LPVB, areas for future improvement of the network are identified in Section 4.6.

Groundwater Quality

VCWPD collects groundwater quality samples from 14 wells in the WLPMA and 13 wells in the ELPMA. In the WLPMA, eight of the wells from which groundwater quality samples are collected are screened in the FCA, one well is screened in the USP, and the remaining five wells are screened in multiple aquifers, or the aquifer designation is not known. All of the wells used for groundwater quality sampling in the WLPMA are agricultural production wells. In the ELPMA, six of the wells from which groundwater quality samples are collected are screened only in the FCA, and the remaining wells are screened in multiple aquifers, or the aquifer designation is not known. One well is a municipal production well and the remaining wells are agricultural production wells.

Groundwater quality samples are generally collected annually (Appendix E, UWCD Model Report). Annual monitoring of groundwater quality is sufficient to demonstrate long-term trends in groundwater quality. Water quality does not change as rapidly as groundwater elevation because the physical processes that drive changes in groundwater quality operate on a longer time scale. Currently, groundwater elevations are the primary metric by which progress toward sustainability will be measured. However, groundwater quality data will continue to be collected and analyzed in order to assess whether groundwater elevation thresholds are sufficiently protective of groundwater conditions in the LPVB. Recommendations for improvement of the groundwater quality monitoring network are identified in Section 4.6.

Groundwater Extraction

The Fox Canyon Groundwater Management Agency (FCGMA) has required reporting of groundwater extraction from the LPVB since 1983. Historically, groundwater extraction data from wells within the FCGMA jurisdictional boundary have been self-reported by the well owner semi-annually (Figure 2-5, Groundwater Extraction [acre-feet] in 2015 in the Las Posas Valley Basin). In 2018, FCGMA adopted an ordinance that required installation of advanced metering infrastructure (AMI) telemetry on wells that were equipped with flowmeters (FCGMA 2018). All agricultural wells were required to install AMI by December 31, 2018, municipal and industrial wells are required to install AMI by October 1, 2019, and all other metered wells are required to install AMI by October 1, 2020. Requiring AMI on all metered wells within FCGMA jurisdiction will provide for broader simultaneous reporting of groundwater extractions, improve FCGMA's ability to monitor and manage groundwater use, and facilitate implementation of this GSP.

4.2.2 Surface Conditions Monitoring

The primary surface conditions that impact groundwater conditions in the LPVB are surface water flows and precipitation. Additionally, evapotranspiration from riparian vegetation lining Arroyo Simi–Las Posas impacts surface conditions by using surface water in the Arroyo. The monitoring networks for surface water flows and precipitation are discussed in this section. There is no specific monitoring network for evapotranspiration.

Surface flows in the LPVB are monitored by a network of gauges that are maintained by the VCWPD (Table 4-1, Network of Stations Monitoring Surface Flows in the Vicinity of the Las Posas Valley Basin; Figure 4-4, Active Surface Water Monitoring Network for the Las Posas Valley Basin). The network includes two types of gauges:

1. Recording Stream Gauges (also known as Daily and Peak Stations). These stream gauges record daily average flowrates as well as "peak" flowrates during rain events.
2. Peak Only (Event) Gauges. This type of stream gauge records only "peak" flowrates during rain events (the threshold over which a flowrate is considered to be part of a rain event is site-specific).

Both of the surface water gauges in the LPVB are located in the ELPMA, because there are no major surface water bodies in the WLPMA. The recording station on Arroyo Simi above Hitch Boulevard provides the primary data on surface flows. This gauge collects daily data, while the Gabber–Walnut Canyon Drain gauge only record flows during precipitation events.

Surface water flows have been recorded in the LPVB since the 1930s (Figure 1-4, Monthly Minimum, Average, and Maximum Average Daily Flows in Arroyo Simi–Las Posas). The

historical and existing spatial and temporal coverage from the surface water flow gauge network provides adequate coverage for the short-term, seasonal, and long-term surface flow conditions in the LPVB. Although the current network is sufficient to document surface flow conditions in the LPVB, areas for improvement are identified in Section 4.6.

4.2.3 Network for Monitoring Precipitation

Seven precipitation gauges currently monitor precipitation in the LPVB (Table 4-2, Network of Stations Monitoring Precipitation in the Vicinity of the Las Posas Valley Basin; Figure 4-5, Active Precipitation Monitoring Network for the Las Posas Valley Basin). The precipitation gauges are maintained, and data are collected, by VCWPD and the National Weather Service.

Precipitation in the LPVB has been recorded for over a century (Figure 1-5, Las Posas Valley Precipitation). Although the locations of individual precipitation gauges have changed through time with some gauges being removed from service and others added, there is overlap between the records collected from the various gauges. Therefore a continuous precipitation record can be constructed for the LPVB to demonstrate long-term trends. More recent data collected at higher frequencies can be used to demonstrate short term and seasonal trends in precipitation.

In addition to providing adequate temporal coverage of the LPVB, the current network of precipitation gauges includes sites in both the ELPMA and WLPMA. This is sufficient spatial coverage to document precipitation in the LPVB and to connect the precipitation measurements to both streamflow and groundwater conditions. Additional precipitation monitoring locations are not currently recommended for characterizing surface conditions in the LPVB.

4.3 MONITORING NETWORK RELATIONSHIP TO SUSTAINABILITY INDICATORS

To document changes in groundwater conditions related to each of the six sustainability indicators, monitoring will be conducted, using the existing network of groundwater wells (Figures 4-1 through 4-3). This network includes a greater number of wells than the list of key wells provided in Chapter 3, Sustainable Management Criteria, of this GSP (see Tables 4-3 through 4-5 for monitoring schedules for wells in the LPVB). Minimum thresholds and measurable objectives have been selected for the set of key wells, but have not been selected for every well used to monitor groundwater conditions in the LPVB. Conditions measured in the key wells will be used to document progress toward the sustainability goals. Groundwater conditions measured in the broader network of wells, which includes the key wells, will be used to document conditions in the LPVB at a greater spatial coverage than is provided by the key wells. Recommendations and findings based on the key well data will be supported by the data collected by the broader well network.

4.3.1 Chronic Lowering of Groundwater Levels

To monitor conditions related to chronic lowering of groundwater levels, the groundwater monitoring network must be structured to accomplish the following:

- Track short-term, seasonal, and long-term trends in water elevation.
- Demonstrate groundwater elevations in mid-March and mid-October for each primary aquifer or aquifer system.
- Record groundwater elevations in key wells in which minimum thresholds and measurable objectives have been identified to track progress toward the sustainability goals for the LPVB.

Spatial Coverage by Aquifer

The LPVB monitoring well density for groundwater elevations varies by aquifer and by management area (Tables 4-3 through 4-5). In the WLPMA, nine wells are screened in the USP, which is not a principal aquifer but supplies water to the FCA (Figure 4-2, Monitoring Wells Screened in the Upper San Pedro Formation in the Las Posas Valley Basin). The density of wells in the USP in the WLPMA is approximately one well per 3 square miles (the WLPMA is approximately 27 square miles in area). In the FCA, there are 25 wells in the monitoring network. The density of wells in the FCA is approximately one well per square mile. There are five wells in the monitoring network screened within the GCA, for a density of approximately one well per 5 square miles.

Although there is no definitive rule for the density of groundwater monitoring points needed in a basin, for comparison the monitoring well density recommended by CASGEM Groundwater Elevation Monitoring Guidelines ranges from 1 to 10 wells per 100 square miles (DWR 2010). Additional DWR guidelines recommend a well network with a density of 1 observation per 16 square miles (DWR 2010, 2016b). Therefore, the density of wells in the monitoring network for the WLPMA the meets the criteria for adequate coverage and is sufficient to accomplish the objectives of the monitoring well network for determining chronic lowering of groundwater levels.

In the ELPMA, six wells are screened within the Shallow Alluvial Aquifer (Figure 4-1, Monitoring Wells Screened in the Shallow Alluvial Aquifer, Epworth Gravels Aquifer, and Grimes Canyon Aquifer in the Las Posas Valley Basin). The area of the entire ELPMA is approximately 42 square miles, but the Shallow Alluvial Aquifer is limited to the area adjacent to Arroyo Las Posas and is approximately 20 square miles. Thus the density of wells in the Shallow Alluvial Aquifer is approximately one well per 3 square miles. The density of wells in the FCA in the ELPMA is less than one well per square mile, with over 50 wells in the monitoring network screened in the FCA (Figure 4-3, Monitoring Wells Screened in the Fox Canyon Aquifer in the Las Posas Valley Basin). No wells in the monitoring network are screened in the GCA in

the ELPMA. Although the lack of wells screened in the GCA is a data gap, the overall density of wells in the monitoring well network is sufficient to document groundwater conditions in the FCA, which is the principal aquifer from which groundwater is produced in the ELPMA. Additionally, the density of wells in the Shallow Alluvial Aquifer and the USP also meets the general guidelines for adequate coverage (DWR 2010, 2016b). Therefore, the network of monitoring wells in the ELPMA is sufficient to document groundwater conditions and meet the objectives for determining chronic declines in groundwater elevation.

In the Epworth Gravels Management Area, there are five wells screened within the Epworth Gravels Aquifer. This aquifer is limited to an area of approximately 2.5 square miles. The density of wells in the Epworth Gravels Aquifer is approximately one well per 0.5 square miles. This density meets the DWR and CASGEM criteria for documenting groundwater elevations in the Epworth Gravels Aquifer.

Although the active network of wells used to document chronic lowering of groundwater levels in the management areas of the LPVB has sufficient spatial density on the scale of each management area, in some aquifers there are local areas in which coverage can be improved. Potential improvements in local coverage are discussed in Section 4.6.

Temporal Coverage by Aquifer

Groundwater elevation data will be collected from the network of groundwater wells to provide groundwater elevation conditions in the spring and fall of each year. Further discussion of the monitoring schedule is provided in Section 4.4, Monitoring Network Implementation.

4.3.2 Reduction of Groundwater Storage

To monitor conditions related to reduction of groundwater storage, the groundwater monitoring network must be structured to accomplish the following:

- Demonstrate groundwater elevations in mid-March and mid-October for each primary aquifer or aquifer system.
- Calculate year-over-year (mid-March to mid-March) change in storage by aquifer.
- Provide data from which lateral and vertical hydraulic gradients within and between aquifers can be calculated.
- Record groundwater elevations in key wells in which minimum thresholds and measurable objectives have been identified to track progress toward the sustainability goals for the Subbasin.

The requirements for documenting reduction in groundwater storage are similar to those for chronic lowering of groundwater levels (see Section 4.3.1), because these two sustainability indicators are interrelated. The primary difference between the two sets of requirements is the need to document potential gradients between aquifers. These gradients influence the movement of water between aquifers, which in turn influences storage in the aquifer.

Historically, the change in stored groundwater in the WLPMA has been modeled by UWCD, and the change in stored groundwater in the ELPMA has been modeled by CMWD. After GSP adoption, modeled volumes of annual change in storage will be reported by aquifer and by year in annual reports. A standardized method to calculate the change in storage that relies solely on water elevations within each aquifer, rather than a numerical model, may also be developed as a check on the model predictions.

The spatial and temporal density of groundwater elevation data necessary to document groundwater storage changes in the aquifers of the LPVB is the same as that necessary to document groundwater elevation changes. The current network of wells is capable of documenting changes to both sustainability indicators. Specific recommendations for potential improvements to local coverage are discussed in Section 4.6.

4.3.3 Seawater Intrusion

Direct seawater intrusion does not impact the LPVB. To monitor groundwater conditions related to seawater intrusion in the Oxnard Subbasin, groundwater elevations will be measured in the WLPMA in such a way as to accomplish the following:

- Track short-term, seasonal, and long-term trends in water elevation.
- Demonstrate groundwater elevations in mid-March and mid-October for each primary aquifer or aquifer system.
- Record groundwater elevations in key wells in which minimum thresholds and measurable objectives have been identified to track progress toward the sustainability goals for the Subbasin.

These goals are the same as those for chronic lowering of groundwater levels and the spatial density of monitoring network wells required to meet these goals is also the same as the density requirement for documenting chronic lowering of groundwater levels. The current monitoring network provides adequate spatial coverage to accomplish these goals (see Section 4.3.1).

4.3.4 Degraded Water Quality

To monitor conditions related to degraded water quality, water quality samples will be collected in such a way as to track long-term trends in water quality that may impact beneficial uses and users of groundwater in the LPVB. Specifically, these water quality samples should be targeted to constituents of concern and areas of the LPVB that have documented, or potential for degradation related to groundwater production from the LPVB.

Spatial Coverage by Aquifer

The network of wells currently used to monitor groundwater elevation conditions in each aquifer is sufficient to determine trends in groundwater quality as well. The primary area of concern for groundwater quality degradation is in the ELPMA, where infiltration of surface water in Arroyo Simi–Las Posas has resulted in increasing concentrations of total dissolved solids (TDS) in the groundwater adjacent to Arroyo Simi–Las Posas. The spatial density of groundwater elevation monitoring wells is discussed in Section 4.3.1. The spatial coverage provided by the existing monitoring network is sufficient to document changes in groundwater quality.

Water Quality Constituents

Monitoring and annual reporting has occurred for constituents that are associated with a water quality threshold adopted by the FCGMA Board of Directors or by the Los Angeles Regional Water Quality Control Board. These constituents are TDS, chloride, nitrate, sulfate, and boron. The network of existing wells is capable of providing an adequate assessment of groundwater quality trends for these constituents.

Temporal Resolution

Degradation of groundwater quality occurs on a longer timescale than changes in groundwater elevation. Historically, groundwater samples have been collected annually in many, but not all, wells in the monitoring network (Appendix E). More frequent sampling has occurred in some wells, while others have not been sampled as frequently. The temporal resolution of the data collection has been adequate to document trends in groundwater concentration for the constituents identified by the FCGMA Board of Directors and the Los Angeles Regional Water Quality Control Board.

4.3.5 Land Subsidence

To monitor conditions related to land subsidence, groundwater elevations will be measured to determine if water levels fall below historical lows until such time as a subsidence monitoring program can be established. Groundwater elevations are being used as a proxy for land subsidence in the

LPVB. The subsidence monitoring program will only be necessary in the northern part of the ELPMA, where minimum thresholds for chronic lowering of groundwater levels are lower than historical low groundwater elevations. In the southern part of the ELPMA and throughout the WLPMA and Epworth Gravels Management Area, the minimum thresholds identified at the key wells are above the historical low groundwater elevation. Therefore, in these areas it is not anticipated that specific land subsidence monitoring will be required. Instead, the network of groundwater monitoring wells discussed in Sections 4.2.1 and 4.3.1 will be used to determine if land subsidence related to groundwater production may occur.

4.3.6 Depletions of Interconnected Surface Water

To monitor conditions related to depletions of interconnected surface water, surface water flows and shallow groundwater will be measured in such a way as to accomplish the following:

- Track short-term, seasonal, and long-term trends in groundwater elevation in the semi-perched aquifer.
- Demonstrate groundwater elevations in mid-March and mid-October for the semi-perched aquifer.
- Record groundwater elevations in key wells in which minimum thresholds and measurable objectives have been identified to track progress toward the sustainability goals for the Subbasin.

Surface water flows in Arroyo Simi–Las Posas are a source of recharge to the ELPMA, and groundwater elevations in the underlying Shallow Alluvial Aquifer are generally below the bottom of the Arroyo. Portions of Arroyo Simi–Las Posas have been identified as potential groundwater-dependent ecosystems (GDEs) because riparian communities have developed adjacent to the stream bed. However, the Arroyo is a losing stream and the degree to which the vegetation adjacent to the Arroyo is reliant on groundwater versus unsaturated soil water is unknown (see Section 2.3.7, Groundwater-Dependent Ecosystems). To better characterize the relationship between the riparian vegetation and water levels in the Shallow Alluvial Aquifer (or shallow alluvium), an additional shallow monitoring well could be installed within the boundaries of the potential GDE. This potential improvement to the monitoring well network is discussed further in Section 4.6.

4.4 MONITORING NETWORK IMPLEMENTATION

4.4.1 Groundwater Elevation Monitoring Schedule

To reduce uncertainty associated with hydraulic gradients and to follow guidance documents produced by DWR (DWR 2016b), water level measurements used in the evaluation of seasonal high and seasonal low groundwater conditions should collected in a 2-week window in mid-March and mid-October (specifically, March 9–22 and October 9–22 of any given calendar year).

Short-term trends in groundwater elevation are currently, and will continue to be, monitored using transducers that are operated and maintained by UWCD and CMWD. Data from these transducers is downloaded quarterly and are stored in a central database.

Seasonal and long-term trends in groundwater elevation are monitored using the transducer data and manual measurements made by UWCD on a monthly or bimonthly basis, and manual measurements made by VCWPD on a quarterly basis. Other entities that generate water level and water quality data in the LPVB include the Ventura County Water Works Districts No. 1 and No. 19, the Moorpark Wastewater Treatment Plant, and small mutual water companies. Relevant data collected by these entities and UWCD is regularly sent to the VCWPD for inclusion in annual reporting data products such as water elevation contour maps (i.e., FCGMA 2014).

4.4.2 Groundwater Storage Monitoring Schedule

Groundwater storage is directly related to, and calculated from, groundwater elevations. Consequently, the schedule for monitoring groundwater storage is the same as that for monitoring groundwater elevations.

4.4.3 Seawater Intrusion Monitoring Schedule

No monitoring schedule is required for seawater intrusion because the LPVB does not experience direct seawater intrusion.

4.4.4 Water Quality Monitoring Schedule

UWCD, VCWPD, and CMWD conduct annual monitoring of groundwater quality in the LPVB. Groundwater quality monitoring should continue on the same schedule in order to document groundwater quality trends in the LPVB. Annual reviews of the groundwater quality trends will be used to assess whether sampling frequency needs to be adjusted.

4.4.5 Groundwater Extraction Monitoring Schedule

Monitoring of groundwater extraction rates will take place continuously, using flow meters and telemetry equipment installed on individual wellheads, and monthly totals of pumped water will be transmitted to a central database maintained by FCGMA.

4.5 PROTOCOLS FOR DATA COLLECTION AND MONITORING

Protocols for collecting groundwater level measurements and water quality samples, as well as downloading transducers and logging the borehole of newly drilled wells, are included in the Monitoring Protocols Best Management Practices (BMPs) produced by DWR (DWR 2016a). FCGMA plans to work with agency partners to ensure that future data collection is conducted according to relevant protocols in the BMP. Current practices used by VCWPD, UWCD, and CMWD are described in this section.

VCWPD Protocols

VCWPD technicians collect water levels using steel tapes. For a well that is too deep for the tape, an acoustical sounder or an air pressure gauge is used, and the measurement is stored in the database with a Questionable Measurement Code, indicating that alternate equipment was used.

VCWPD technicians collect water quality samples from production wells using the installed pump equipment. A three-volume purge, or a testing of groundwater parameters including pH, temperature, and electrical conductivity, is conducted to determine whether the water at the wellhead is representative of groundwater in the aquifer. Water quality samples are then sent to an analytical laboratory, where they are filtered and preserved.

UWCD Protocols

UWCD technicians collect water levels using a variety of equipment, including dual wire and single wire sounders, and metal tapes. In the event that the well contains a pump, the technician manually tests the approximate temperature of the pump housing. If the pump housing is warm, the water level that is entered into the database is qualified with a Questionable Measurement Code, indicating recent pumping.

UWCD technicians collect water quality samples using the three-volume purge method, and follow U.S. Geological Survey guidelines for groundwater quality sampling. For shallow wells, a Grundfos Redi-Flo pump is used to purge and sample the groundwater. For deeper wells, a compressor is used to airlift the groundwater for purging and sampling. On rare occasions, a bailer is used to purge and sample.

CMWD Protocols

CMWD monitors water level data using pressure transducers.

4.6 POTENTIAL MONITORING NETWORK IMPROVEMENTS

The existing monitoring network in the LPVB is sufficient to document groundwater and can be used to document progress toward the sustainability goals for the WLPMA, the ELPMA, and the Epworth Gravels Management Area. However, analysis of the monitoring network also indicates that there are areas in which data coverage and monitoring efforts can be improved in the future. Areas for improvement of the existing monitoring network and data infrastructure system are described in the following sections.

4.6.1 Water Level Measurements: Spatial Data Gaps

Additional monitoring wells could be used to improve spatial coverage for groundwater elevation measurements in the WLPMA and the ELPMA. Wells that are added to the network should be dedicated monitoring well clusters, with individual wells in the cluster screened in a single aquifer. The potential improvements to the monitoring network in each aquifer are shown on Figures 4-6 through 4-9.

In the WLPMA, the groundwater monitoring network could be improved by adding a monitoring well or wells near the boundary between the WLPMA and the Oxnard Subbasin to the west (Figure 4-6, Existing and Proposed New Wells Screened in the Upper San Pedro Formation in the Las Posas Valley Basin). Groundwater elevation measurements in this area would help constrain groundwater gradients across the boundary between the WLPMA and the Oxnard Subbasin.

In the ELPMA, the groundwater monitoring network could be improved by adding a monitoring well or wells adjacent to Arroyo Simi–Las Posas and a well or wells screened in the GCA. A new monitoring well adjacent to Arroyo Simi–Las Posas should be located within the boundaries of the potential GDE and would be used to characterize depth to groundwater and changes in groundwater elevation adjacent to the Arroyo. This well would provide data on whether the vegetation in the riparian corridor relies on groundwater or soil moisture from infiltrating surface water.

Currently, there are no dedicated monitoring wells screened in the GCA in the ELPMA. Adding a monitoring well would provide for aquifer specific water levels that would improve the understanding of groundwater gradients between the FCA and the GCA. The location of the new nested monitoring well should consider the areas of the ELPMA that are likely to experience groundwater elevation declines in the future, as well as the complexity of the underlying geology.

New wells will be constructed to applicable well installation standards set in California DWR Bulletin 74-81 and 74-90, or as updated (DWR 2016b). It is recommended that, where feasible, new wells be subjected to pumping tests in order to collect additional information about aquifer properties in the vicinity of new monitoring locations.

Proposed locations are approximate and subject to feasibility review (accounting for infrastructure, site acquisition, and site access among other factors), after GSP submittal. The schedule for new well installation will be developed in conjunction with feasibility review.

4.6.2 Water Level Measurements: Temporal Data Gap

The DWR Monitoring Protocols BMP (DWR 2016a) states the following:

> Groundwater elevation data … should approximate conditions at a discrete period in time. Therefore, all groundwater levels in a basin should be collected within as short a time as possible, preferably within a 1 to 2 week period.

The DWR Monitoring Networks BMP (DWR 2016b) states the following:

> Groundwater levels will be collected during the middle of October and March for comparative reporting purposes.

Currently, groundwater elevation measurements are not scheduled according to these criteria. To minimize the effects of this type of temporal data gap in the future, it will be necessary to coordinate the collection of groundwater elevation data so it occurs within a 2-week window during the key reporting periods of mid-March and mid-October. The recommended collection windows are October 9–22 in the fall and March 9–22 in the spring (see Section 4.4).

Additionally, as funding becomes available, pressure transducers should be added to wells in the groundwater monitoring network. Pressure transducer records provide the high-temporal-resolution data that allows for a better understanding of water level dynamics in the wells related to groundwater production, groundwater management activities, and climatic influence.

4.6.3 Groundwater Quality Monitoring

Improvements to the groundwater quality monitoring network include increasing the spatial density of samples by collecting water quality samples from a larger subset of wells in the monitoring network, and ensuring that water quality samples are collected at least annually from each well in the groundwater quality monitoring network. Annual groundwater quality samples should also be collected from wells that are added to the groundwater elevation monitoring network in the future.

Additionally, the proposed analyte list could be expanded to include a full general minerals suite so that Stiff or Piper diagrams can be created to fully characterize the geochemical characteristics of the groundwater and track changes over time.

4.6.4 Subsidence Monitoring

Currently, neither FCGMA nor its partner agencies in the region monitor land subsidence. Two monuments are used for measuring subsidence in the LPVB: monument MPWD, located in the foothills north of Moorpark in the ELPMA, and monument P729, located near Los Angeles Avenue in the WLPMA (Figure 2-37, Subsidence Monuments in the Las Posas Valley Basin). UNAVCO maintains and collects data from these monuments. Future subsidence related to groundwater production is not anticipated to occur in the WLPMA, where minimum threshold groundwater elevations are equal to or higher than historical low groundwater elevations. This is also true in the southern part of the ELPMA. In the area of the ELPMA north of the Moorpark Anticline, however, minimum threshold groundwater elevations are lower than the historical low groundwater elevations. Although subsidence risk related to groundwater withdrawal in this area is not high, a subsidence monitoring program should be established. Preexisting GPS-based benchmarks are not well suited for monitoring land subsidence.

A feasibility study is recommended to determine the following:

- The likelihood of subsidence related to groundwater withdrawal that could substantially interfere with surface land uses based on the measurable objective and minimum threshold groundwater elevations
- The appropriate location or locations for establishing a new subsidence monument in the ELPMA
- Recommended monitoring protocols and schedules

This study should consider the tectonic activity in the ELPMA and the location of faults that may influence ground movement. If the study indicates that subsidence related to groundwater withdrawal that substantially interferes with surface land uses may occur in the ELPMA, the findings of the feasibility study should be used to establish a subsidence monitoring monument and a subsidence monitoring plan with protocols for data measurement and reporting should be established before the monument is installed.

4.6.5 Shallow Groundwater Monitoring near Surface Water Bodies and GDEs

As discussed in Section 4.6.1 (Water Level Measurements: Spatial Data Gaps), there are no dedicated monitoring wells that can be used to monitor shallow groundwater within the boundaries of the potential GDE adjacent to Arroyo Simi–Las Posas in the ELPMA. To fill the existing data gap, and to assist with understanding the potential connectivity between groundwater and the potential GDEs, a shallow dedicated monitoring well or wells can be added within the boundaries of the potential GDE.

4.7 REFERENCES CITED

County of Ventura. 2016. Shapefile data of wells in Ventura County. *Ventura_County_Wells _08_17_2016.shp.* Attachment to an email from Jeff Dorrington. August 17, 2016.

DWR (California Department of Water Resources). 2010. *Department of Water Resources Groundwater Elevation Monitoring Guidelines.* December 2010. http://www.water.ca.gov/groundwater/casgem/pdfs/CASGEM%20DWR%20GW%20Guidelines%20Final%20121510.pdf

DWR. 2016a. *Best Management Practices for the Sustainable Management of Groundwater: Monitoring Protocols, Standards, and Sites*. December 2016.

DWR. 2016b. *Best Management Practices for the Sustainable Management of Groundwater: Monitoring Networks and Identification of Data Gaps*. December 2016.

DWR. 2016c. *Bulletin 118 Interim Update 2016: California's Groundwater—Working Toward Sustainability*. December 22, 2016. www.water.ca.gov/groundwater/bulletin118/index.cfm.

FCGMA (Fox Canyon Groundwater Management Agency). 2014. *Fox Canyon Groundwater Management Agency Calendar Year 2014 Annual Report*.

FCGMA. 2016. Minutes of the Fox Canyon Groundwater Management Agency's (FCGMA) Regular Board Meeting held Wednesday, May 25, 2016. http://www.fcgma.org/public-documents/board-of-directors-meetings. Accessed November 2017.

Table 4-1
Network of Stations Monitoring Surface Flows in the Vicinity of the Las Posas Valley Basin

Station Number	Station Name	Latitude	Longitude	Elevation (ft msl)	Station Type	USGS ID
839	Gabbert–Walnut Canyon Drain	34.271667	−118.915750	421	Peak Only (Event) Gauge	—
841A	Arroyo Simi above Hitch Blvd	34.271778	−118.923444	400	Recording Stream Gauge	—

Notes: ft msl = feet above mean sea level; USGS = U.S. Geological Survey.
This table shows results from active gauges only (as of August 2016).

Table 4-2
Network of Stations Monitoring Precipitation in the Vicinity of the Las Posas Valley Basin

Station Number	Station Name	Latitude	Longitude	Elevation (ft msl)	Station Type	USGS ID
126A	Moorpark–Ventura County Yard	34.295509	−118.877971	725	Recording Precipitation Gauge	—
189	Somis–Deboni	34.285250	−119.073250	520	Recording Precipitation Gauge	—
190	Somis–Bard	34.282413	−119.008178	460	Recording Precipitation Gauge	—
206B	Somis–Fuller	34.310926	−118.979983	733	Recording Precipitation Gauge	—
238	South Mountain–Shell Oil	34.331765	−119.008998	2240	Recording Precipitation Gauge	—
250[a]	Moorpark–Happy Camp Canyon	34.346494	−118.850524	1410	Recording Precipitation Gauge	—
507	South Mountain East (Type B)	34.301542	−119.045036	1020	Non-Standard Recorder	—
508	Moorpark–Home Acres ALERT (Type B)	34.271288	−118.924846	400	Non-Standard Recorder	—

Notes: ft msl = feet above mean sea level; USGS = U.S. Geological Survey.
This table shows results from active gauges only (as of August 2016).

[a] The Moorpark–Happy Camp Canyon precipitation gauge is located within the FCGMA jurisdictional boundary but is outside of the DWR basin boundary for the LPVB.

Table 4-3
Current VCWPD Monitoring Schedule for Wells in the Las Posas Valley Basin

State Well Number	Las Posas Management Area	Screened Aquifer	Main Use	Manual Water Levels Monitored by VCWPD?[a]	Water Quality Samples Collected by VCWPD?[a]	Screened Aquifer System	Twice-Yearly Water Quality Sampling Required after GSP Adoption?
03N19W29F06S	ELPMA	Epworth Gravels	Agricultural	Yes		Unassigned	Yes
02N19W07B02S	ELPMA	FCA	Agricultural		Yes	LAS	Yes
02N19W08H02S	ELPMA	FCA	Municipal	Yes	Yes	LAS	
02N20W01B02	ELPMA	Multiple	Municipal			LAS	Yes
02N20W04F02	ELPMA	FCA	Agricultural			LAS	Yes
02N20W09Q07S	ELPMA	FCA	Agricultural		Yes	LAS	Yes
02N20W10D02S	ELPMA	FCA	Domestic	Yes		LAS	Yes
02N20W10G01S	ELPMA	FCA	Agricultural	Yes	Yes	LAS	Yes
02N20W10J01S	ELPMA	FCA	Monitoring	Yes		LAS	Yes
02N20W16B06S	ELPMA	FCA	Agricultural		Yes	LAS	Yes
03N19W19J01S	ELPMA	FCA	Agricultural	Yes		LAS	Yes
03N19W30E06S	ELPMA	FCA	Agricultural		Yes	LAS	Yes
03N20W25H01S	ELPMA	FCA	Agricultural	Yes		LAS	
03N20W26R03S	ELPMA	FCA	Agricultural	Yes		LAS	Yes
03N20W27H03S	ELPMA	FCA	Agricultural	Yes		LAS	
03N20W35R02S	ELPMA	FCA	Monitoring	Yes		LAS	Yes
03N20W35R03S	ELPMA	FCA	Monitoring	Yes		LAS	Yes
03N19W19P02S	ELPMA	GCA	Industrial	Yes		LAS	
02N20W01Q02S	ELPMA	Multiple	Agricultural		Yes	Unassigned	Yes
03N20W34G01S	ELPMA	Multiple/FCA	Agricultural	Yes	Yes	Unassigned	Yes
02N19W07D02S	ELPMA	Unassigned	Agricultural		Yes	Unassigned	Yes
02N20W01Q01S	ELPMA	Unassigned	Agricultural		Yes	Unassigned	Yes
03N19W29K06S	ELPMA	Unassigned	Agricultural		Yes	Unassigned	Yes
03N19W29K08S	ELPMA	Unassigned	Agricultural		Yes	Unassigned	Yes

Table 4-3
Current VCWPD Monitoring Schedule for Wells in the Las Posas Valley Basin

State Well Number	Las Posas Management Area	Screened Aquifer	Main Use	Manual Water Levels Monitored by VCWPD?[a]	Water Quality Samples Collected by VCWPD?[a]	Screened Aquifer System	Twice-Yearly Water Quality Sampling Required after GSP Adoption?
03N20W28J04S	ELPMA	Unassigned	Agricultural		Yes	Unassigned	Yes
03N20W35R04S	ELPMA	USP	Monitoring	Yes		Unassigned	
02N20W06R01S	WLPMA	FCA	Agricultural	Yes		LAS	Yes
02N20W07R03S	WLPMA	FCA	Agriculture			LAS	Yes
02N21W08H03S	WLPMA	FCA	Agricultural	Yes		LAS	Yes
02N21W11A02S	WLPMA	FCA	Agricultural		Yes	LAS	Yes
02N21W11A03S	WLPMA	FCA	Agricultural		Yes	LAS	Yes
02N21W11J03S	WLPMA	FCA	Monitoring	Yes		LAS	Yes
02N21W12H01S	WLPMA	FCA	Agricultural	Yes	Yes	LAS	Yes
02N21W13A01S	WLPMA	FCA	Agricultural	Yes	Yes	LAS	Yes
02N21W17F05S	WLPMA	FCA	Agricultural		Yes	LAS	Yes
03N20W32H03S	WLPMA	FCA	Agricultural	Yes		LAS	
03N21W35P02S	WLPMA	FCA	Agricultural	Yes		LAS	
02N20W08F01S	WLPMA	Multiple	Domestic	Yes		Unassigned	Yes
02N20W17L01S	WLPMA	Multiple	Agricultural		Yes	LAS	Yes
02N21W10G03S	WLPMA	Multiple	Agricultural	Yes		LAS	
02N21W18H12S	WLPMA	Multiple	Agricultural	Yes		LAS	
02N21W18H03S	WLPMA	Oxnard	Agricultural	Yes		UAS	
02N20W06J01S	WLPMA	Unassigned	Agricultural		Yes	Unassigned	Yes
02N21W15M04S	WLPMA	Unassigned	Agricultural		Yes	Unassigned	Yes
02N21W20Q05S	WLPMA	Unassigned	Agricultural		Yes	LAS	Yes
02N21W11J04S	WLPMA	USP	Monitoring	Yes		Unassigned	
02N21W11J05S	WLPMA	USP	Monitoring	Yes		Unassigned	

Table 4-3
Current VCWPD Monitoring Schedule for Wells in the Las Posas Valley Basin

State Well Number	Las Posas Management Area	Screened Aquifer	Main Use	Manual Water Levels Monitored by VCWPD?[a]	Water Quality Samples Collected by VCWPD?[a]	Screened Aquifer System	Twice-Yearly Water Quality Sampling Required after GSP Adoption?
02N21W11J06S	WLPMA	USP	Monitoring	Yes		Unassigned	
02N21W15M03S	WLPMA	USP	Agricultural	Yes		Unassigned	
02N21W16J01S	WLPMA	USP	Agricultural	Yes		UAS	

Notes: ELPMA = East Las Posas Management Area; FCA = Fox Canyon Aquifer; GCA = Grimes Canyon Aquifer; GSP = Groundwater Sustainability Plan; LAS = Lower Aquifer System; UAS = Upper Aquifer System; USP = Upper San Pedro Formation; VCWPD = Ventura County Watershed Protection District; WLPMA = West Las Posas Management Area.
This table shows the monitoring schedule and status as of October 2017.
[a] As of October 2017.

Table 4-4
Current UWCD Monitoring Schedule for Wells in the Las Posas Valley Basin

State Well Number	Las Posas Management Area	Main Use	Screened Aquifer	Screened Aquifer System	Manual Water Levels Monitored by UWCD?[a]	Transducer Maintained by UWCD?[a]	Water Quality Samples Collected Monthly or Quarterly?[a]	Twice-Yearly Water Quality Sampling Required after GSP Adoption?
02N21W16J03S	WLPMA	Agricultural	Multiple	LAS	Yes			Yes
02N21W17F05S	WLPMA	Agricultural	FCA	LAS	Yes			Yes
02N21W20A02S	WLPMA	Agricultural	Unassigned	Unassigned	Yes			Yes
02N21W22G01S	WLPMA	Municipal	FCA	LAS	Yes			Yes
02N21W28A02S	WLPMA	Municipal	FCA	LAS	Yes			Yes

Notes: FCA = Fox Canyon Aquifer; GCA = Grimes Canyon Aquifer; GSP = Groundwater Sustainability Plan; LAS = Lower Aquifer System; UWCD = United Water Conservation District; WLPMA = West Las Posas Management Area.
This table shows the monitoring schedule and status as of October 2017.
[a] As of October 2017.

Table 4-5
Current CMWD Monitoring Schedule for Wells in the Las Posas Valley Basin

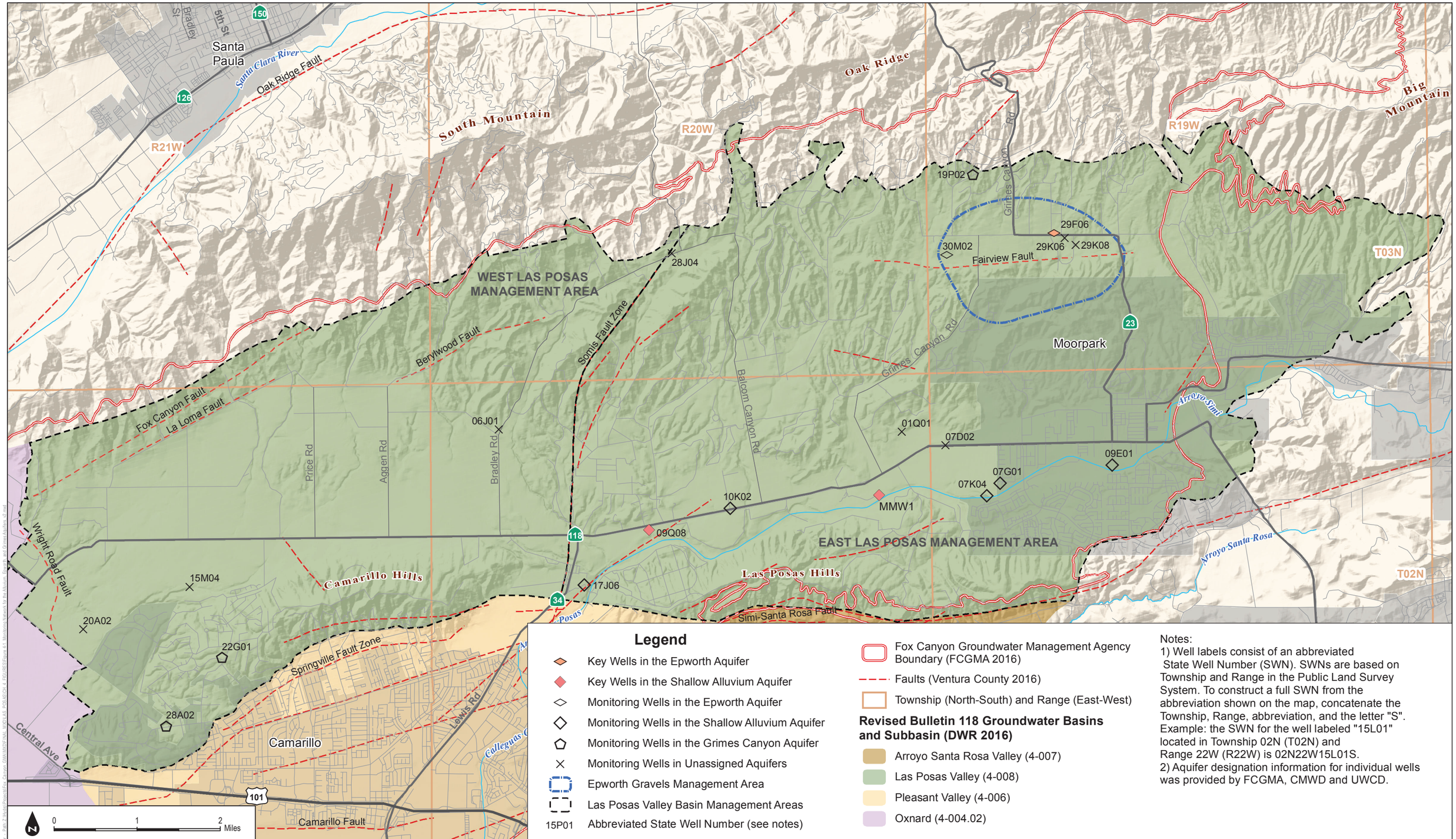
State Well Number	Main Use	Screened Aquifer	Screened Aquifer System	Manual Water Levels Monitored by CMWD?[a]	Transducer Maintained by CMWD?[a]	Twice-Yearly Water Quality Sampling Required after GSP Adoption?
02N20W06R01S	Monitoring	FCA	Unassigned	Yes	Yes	Yes
03N20W32H02S	Monitoring	FCA	Unassigned	Yes	Yes	Yes
02N19W06F01S	Monitoring	USP	Unassigned	Yes	Yes	Yes
02N19W07G01S	Monitoring	Alluvium	Unassigned	Yes	Yes	Yes
02N19W07K02S	Monitoring	FCA	Unassigned	Yes	Yes	Yes
02N19W07K03S	Monitoring	USP	Unassigned	Yes	Yes	Yes
02N19W07K04S	Agricultural	Alluvium	Unassigned	Yes	Yes	
02N19W09E01S	Agricultural	Alluvium	Unassigned	Yes	Yes	
02N20W02D02S	Monitoring	FCA	LAS	Yes	Yes	
02N20W02J01S	Agricultural	USP	LAS	Yes	Yes	
02N20W03H01S	Agricultural	FCA	LAS	Yes	Yes	Yes
02N20W03J01S	Agricultural	FCA	LAS	Yes	Yes	
02N20W04B01S	Agricultural	FCA	LAS	Yes	Yes	
02N20W09Q08S	Municipal	Alluvium	LAS	Yes	Yes	Yes
02N20W10K02S	Agricultural	Alluvium	LAS	Yes	Yes	
02N20W17J06S	Municipal	Alluvium	LAS	Yes	Yes	
03N19W28N03S	Agricultural	FCA	LAS	Yes	Yes	Yes
03N19W30D01S	Municipal	FCA	LAS	Yes	Yes	
03N19W30M02S	Agricultural	Epworth	LAS	Yes	Yes	
03N19W31B01S	Municipal	FCA	LAS	Yes	Yes	Yes
03N19W31H01S	Monitoring	FCA	LAS	Yes	Yes	
03N20W25R04S	Agricultural	FCA	LAS	Yes	Yes	
03N20W35J01S	Agricultural	FCA	LAS	Yes	Yes	
03N20W35R02S	Agricultural	FCA	LAS	Yes	Yes	
03N20W35R04S	Agricultural	USP	LAS	Yes	Yes	
03N20W36A02S	Agricultural	USP	Unassigned	Yes	Yes	

Table 4-5
Current CMWD Monitoring Schedule for Wells in the Las Posas Valley Basin

State Well Number	Main Use	Screened Aquifer	Screened Aquifer System	Manual Water Levels Monitored by CMWD?[a]	Transducer Maintained by CMWD?[a]	Twice-Yearly Water Quality Sampling Required after GSP Adoption?
03N20W36A04S	Monitoring	USP	Unassigned	Yes	Yes	
03N20W36G01S	Agricultural	USP	Unassigned	Yes	Yes	
03N20W36P01S	Monitoring	USP	Unassigned	Yes	Yes	
02N20W01A01S	Agricultural	FCA	LAS	Yes	Yes	
02N20W01E03S	Agricultural	FCA	LAS	Yes	Yes	

Notes: CMWD = Calleguas Municipal Water District; FCA = Fox Canyon Aquifer; GSP = Groundwater Sustainability Plan; LAS = Lower Aquifer System; USP = Upper San Pedro Formation.
This table shows the monitoring schedule and status as of October 2017.

[a] As of October 2017.



Legend

- Key Wells in the Epworth Aquifer
- Key Wells in the Shallow Alluvium Aquifer
- Monitoring Wells in the Epworth Aquifer
- Monitoring Wells in the Shallow Alluvium Aquifer
- Monitoring Wells in the Grimes Canyon Aquifer
- Monitoring Wells in Unassigned Aquifers
- Epworth Gravels Management Area
- Las Posas Valley Basin Management Areas
- 15P01 Abbreviated State Well Number (see notes)
- Fox Canyon Groundwater Management Agency Boundary (FCGMA 2016)
- Faults (Ventura County 2016)
- Township (North-South) and Range (East-West)

Revised Bulletin 118 Groundwater Basins and Subbasin (DWR 2016)

- Arroyo Santa Rosa Valley (4-007)
- Las Posas Valley (4-008)
- Pleasant Valley (4-006)
- Oxnard (4-004.02)

Notes:
1) Well labels consist of an abbreviated State Well Number (SWN). SWNs are based on Township and Range in the Public Land Survey System. To construct a full SWN from the abbreviation shown on the map, concatenate the Township, Range, abbreviation, and the letter "S". Example: the SWN for the well labeled "15L01" located in Township 02N (T02N) and Range 22W (R22W) is 02N22W15L01S.
2) Aquifer designation information for individual wells was provided by FCGMA, CMWD and UWCD.

SOURCE: DWR; Ventura County; UWCD; CMWD

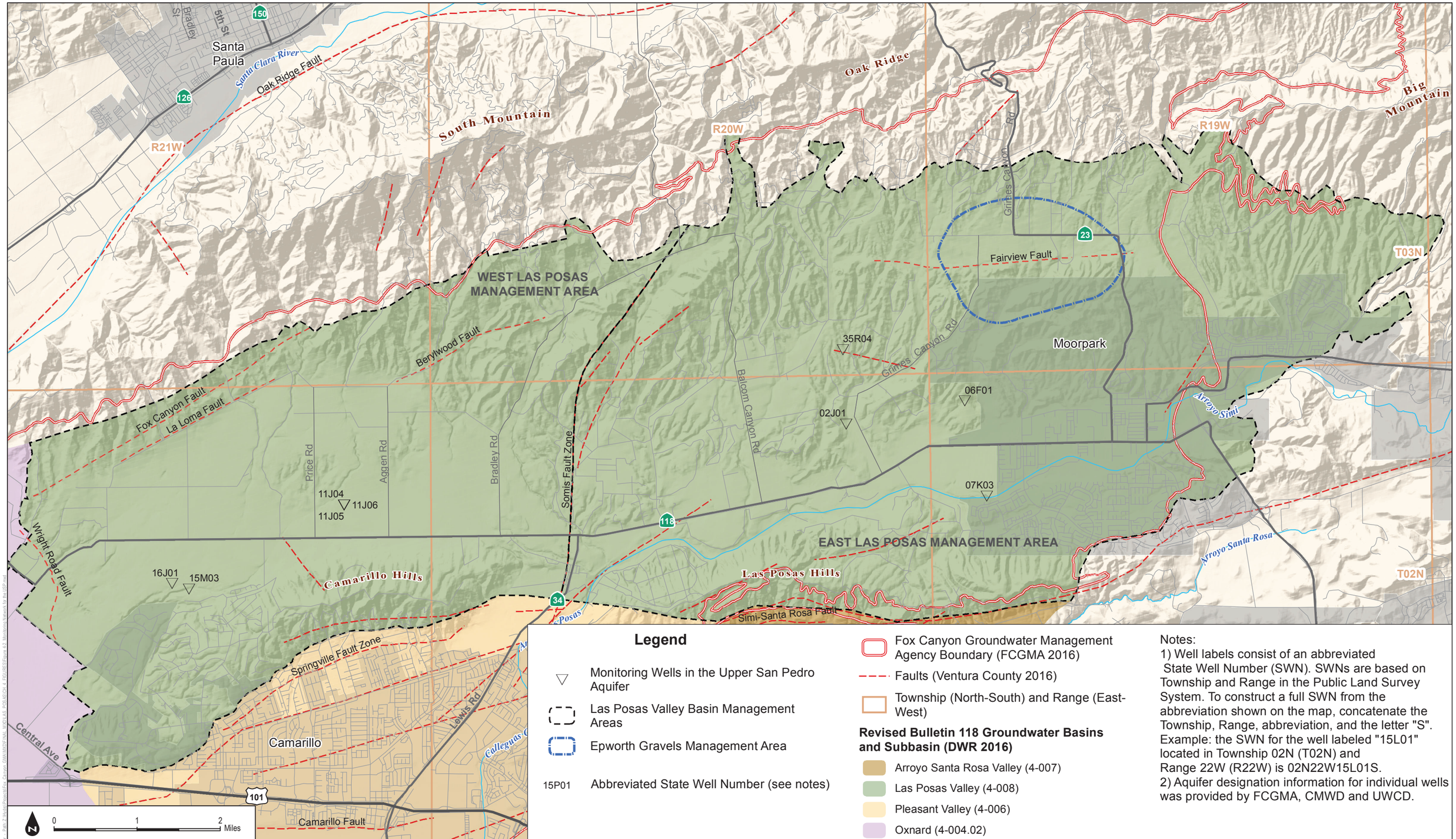
DUDEK

FIGURE 4-1

Monitoring Wells Screened in the Shallow Alluvial Aquifer, Epworth Gravels, and Grimes Canyon Aquifer in the Las Posas Valley Basin

Groundwater Sustainability Plan for the Las Posas Valley Basin

INTENTIONALLY LEFT BLANK



Legend

- ▽ Monitoring Wells in the Upper San Pedro Aquifer
- Las Posas Valley Basin Management Areas
- Epworth Gravels Management Area
- 15P01 Abbreviated State Well Number (see notes)
- Fox Canyon Groundwater Management Agency Boundary (FCGMA 2016)
- Faults (Ventura County 2016)
- Township (North-South) and Range (East-West)

Revised Bulletin 118 Groundwater Basins and Subbasin (DWR 2016)

- Arroyo Santa Rosa Valley (4-007)
- Las Posas Valley (4-008)
- Pleasant Valley (4-006)
- Oxnard (4-004.02)

Notes:
1) Well labels consist of an abbreviated State Well Number (SWN). SWNs are based on Township and Range in the Public Land Survey System. To construct a full SWN from the abbreviation shown on the map, concatenate the Township, Range, abbreviation, and the letter "S". Example: the SWN for the well labeled "15L01" located in Township 02N (T02N) and Range 22W (R22W) is 02N22W15L01S.
2) Aquifer designation information for individual wells was provided by FCGMA, CMWD and UWCD.

DUDEK

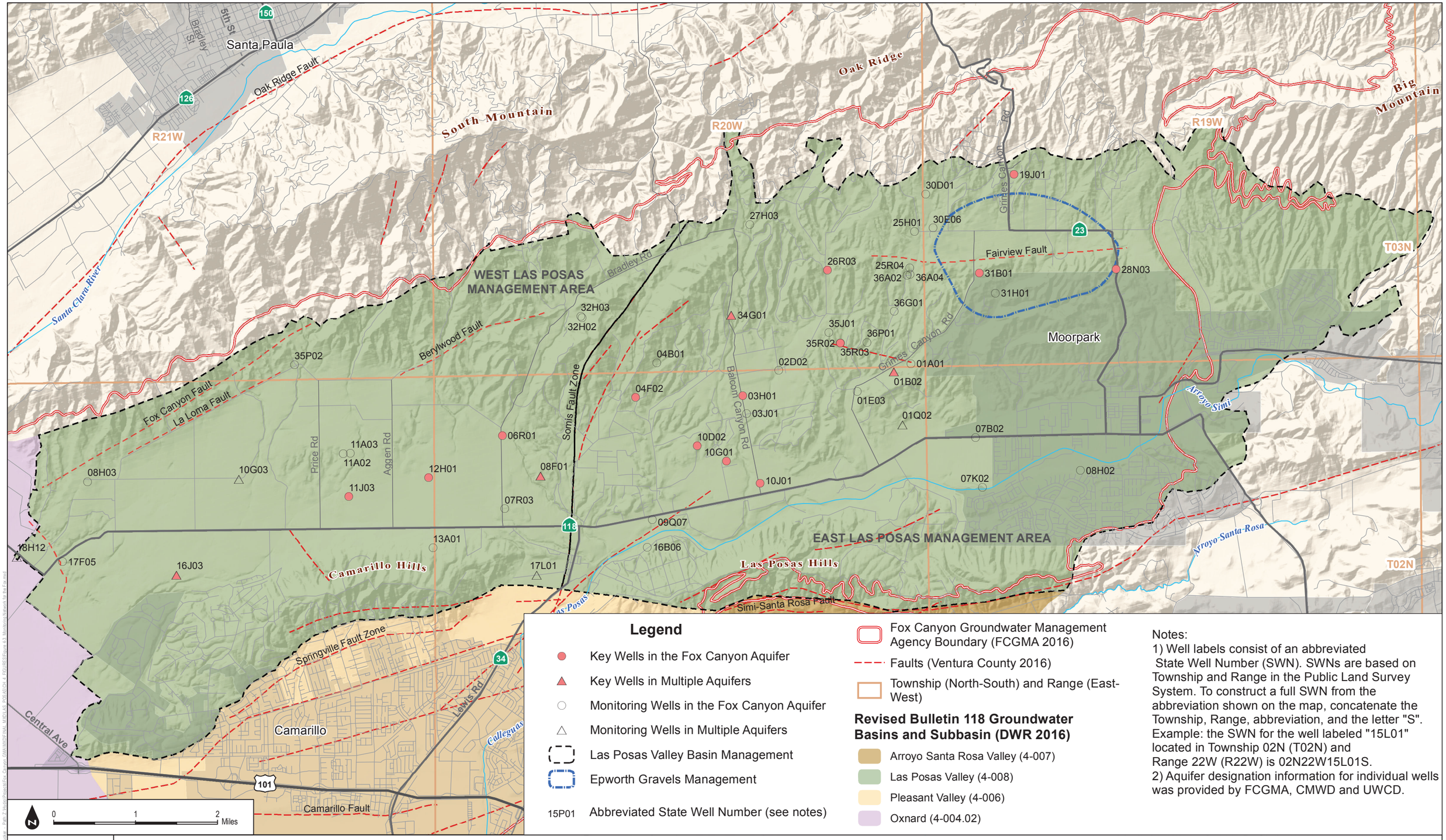
SOURCE: DWR; Ventura County; UWCD; CMWD

FIGURE 4-2

Monitoring Wells Screened in the Upper San Pedro Formation in the Las Posas Valley Basin

Groundwater Sustainability Plan for the Las Posas Valley Basin

INTENTIONALLY LEFT BLANK



Legend

- Key Wells in the Fox Canyon Aquifer
- Key Wells in Multiple Aquifers
- Monitoring Wells in the Fox Canyon Aquifer
- Monitoring Wells in Multiple Aquifers
- Las Posas Valley Basin Management
- Epworth Gravels Management
- 15P01 Abbreviated State Well Number (see notes)
- Fox Canyon Groundwater Management Agency Boundary (FCGMA 2016)
- Faults (Ventura County 2016)
- Township (North-South) and Range (East-West)

Revised Bulletin 118 Groundwater Basins and Subbasin (DWR 2016)

- Arroyo Santa Rosa Valley (4-007)
- Las Posas Valley (4-008)
- Pleasant Valley (4-006)
- Oxnard (4-004.02)

Notes:
1) Well labels consist of an abbreviated State Well Number (SWN). SWNs are based on Township and Range in the Public Land Survey System. To construct a full SWN from the abbreviation shown on the map, concatenate the Township, Range, abbreviation, and the letter "S". Example: the SWN for the well labeled "15L01" located in Township 02N (T02N) and Range 22W (R22W) is 02N22W15L01S.
2) Aquifer designation information for individual wells was provided by FCGMA, CMWD and UWCD.

0 1 2 Miles

SOURCE: DWR; Ventura County; UWCD; CMWD

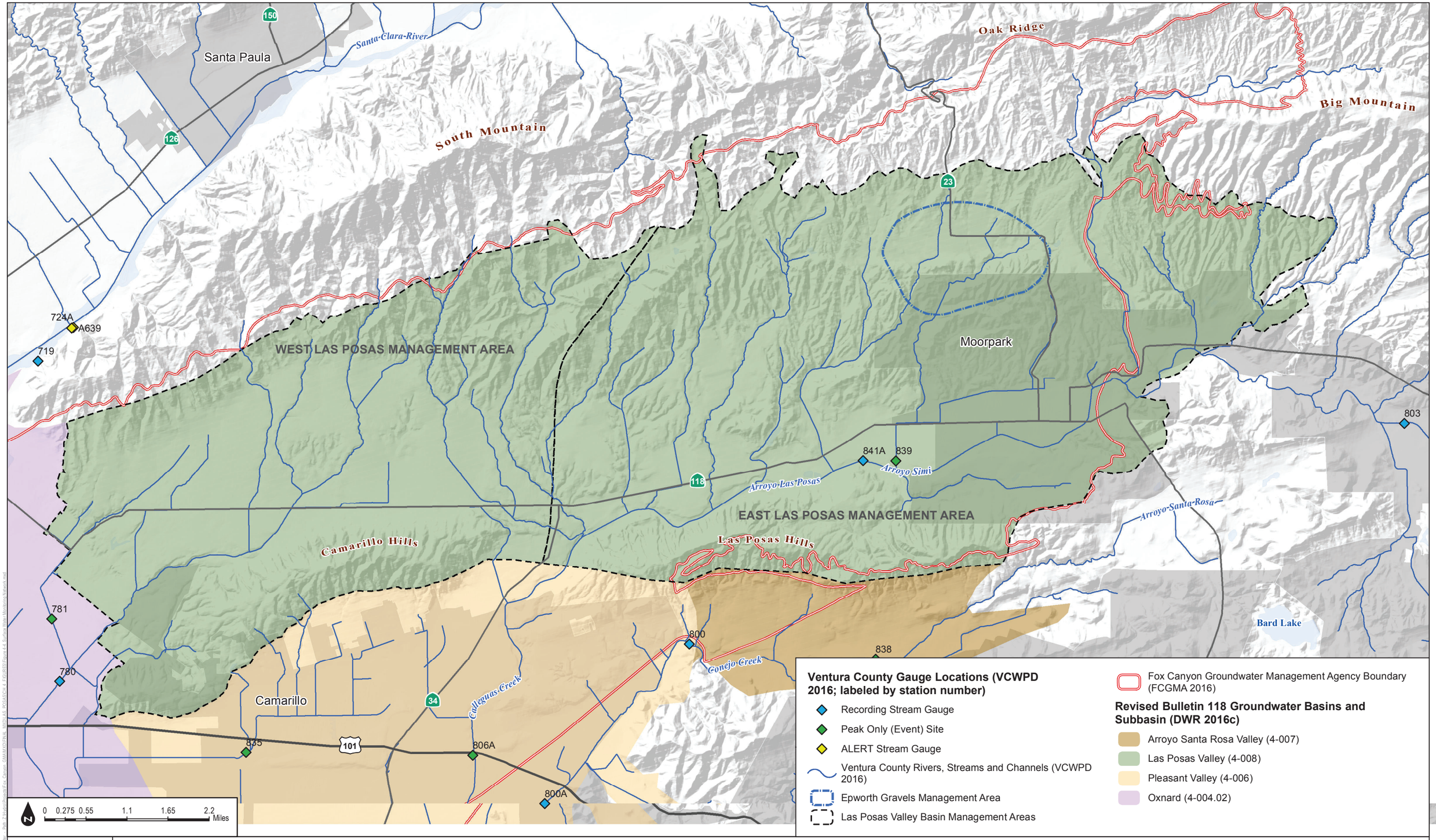
DUDEK

FIGURE 4-3

Monitoring Wells Screened in the Fox Canyon Aquifer in the Las Posas Valley Basin

Groundwater Sustainability Plan for the Las Posas Valley Basin

INTENTIONALLY LEFT BLANK



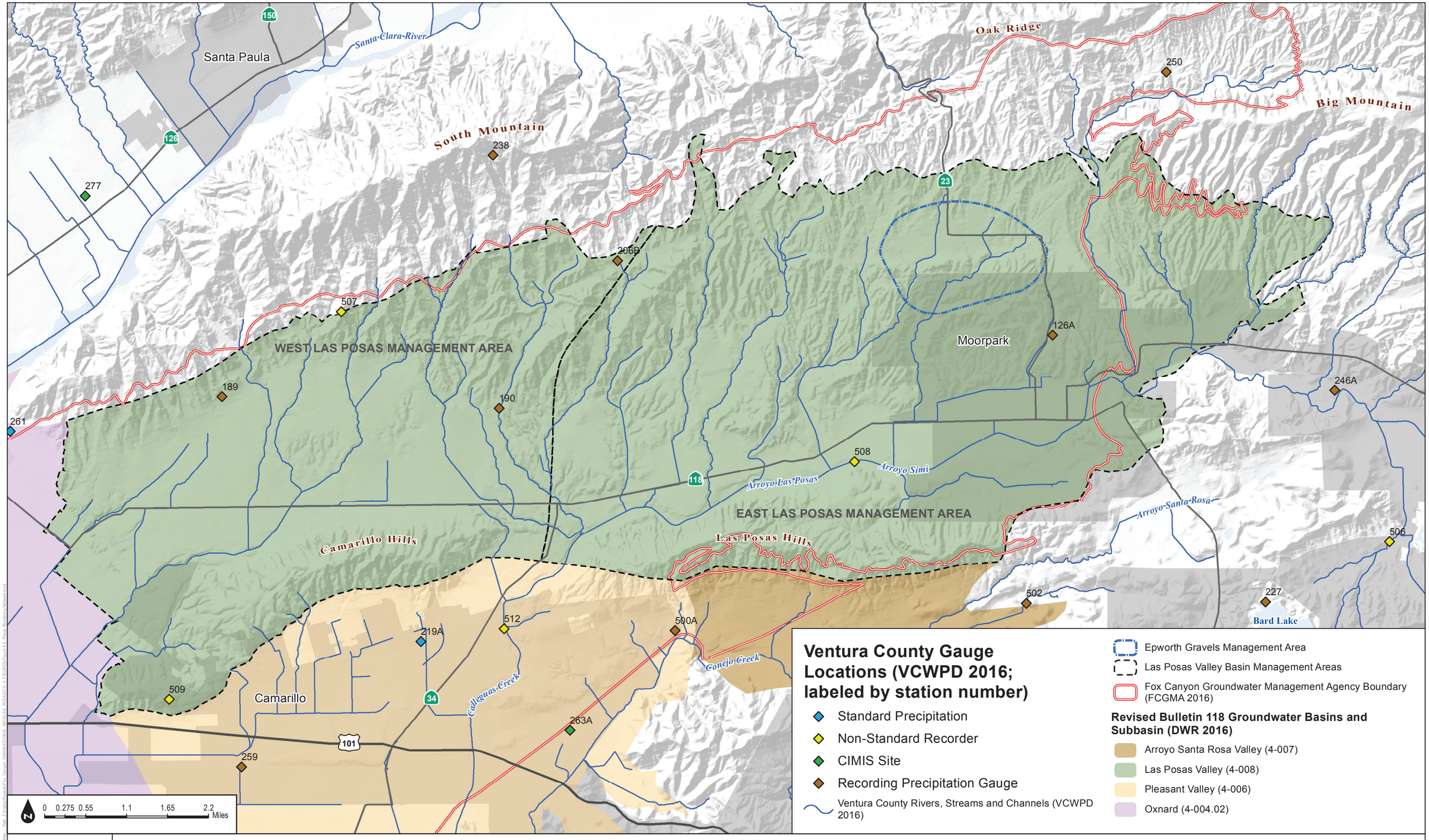
SOURCE: DWR; County of Ventura ; VCWPD

FIGURE 4-4

Active Surface Water Monitoring Network for the Las Posas Valley Basin

DUDEK

INTENTIONALLY LEFT BLANK



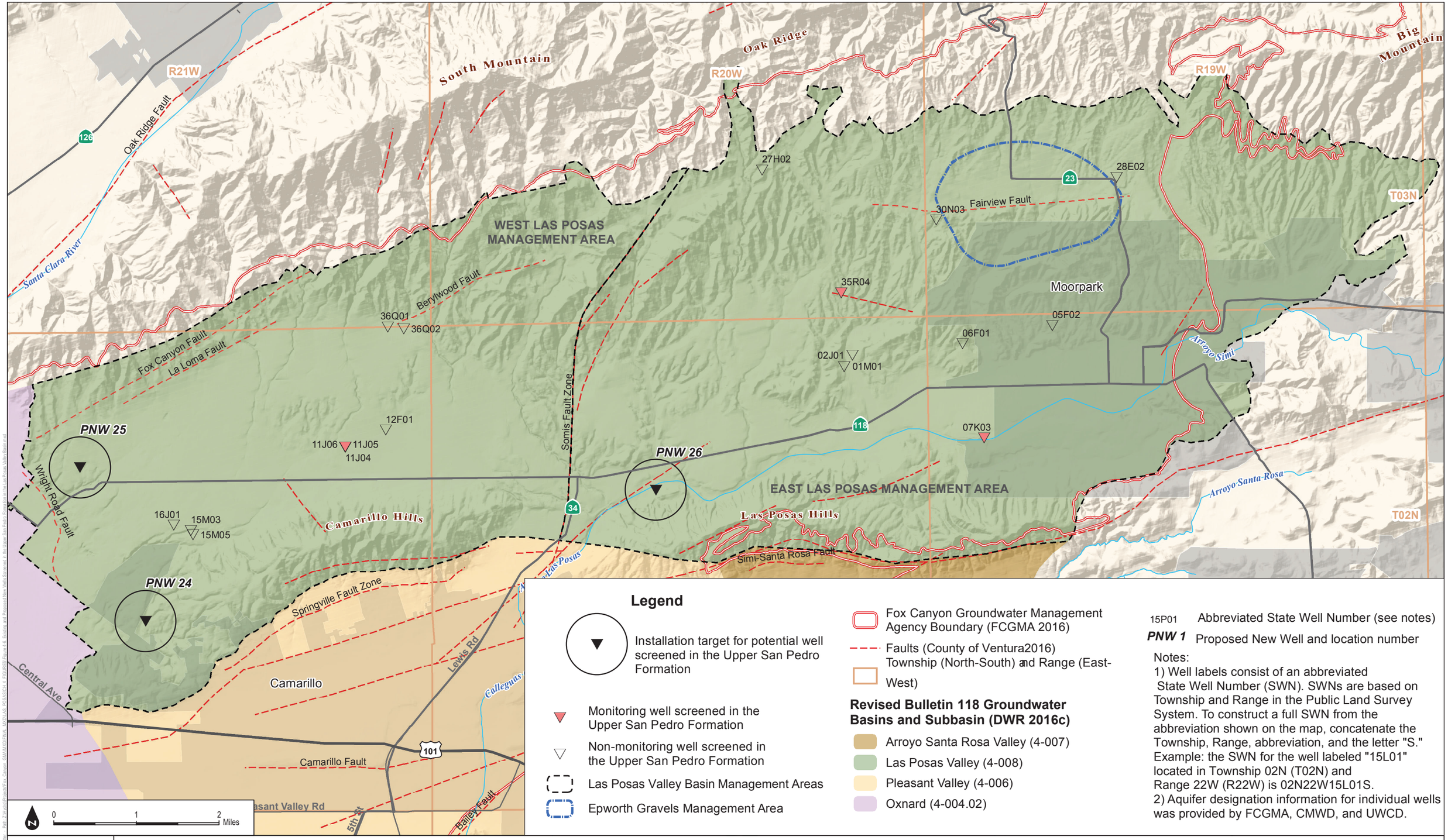
SOURCE: DWR; Ventura County; VCWPD

FIGURE 4-5

Active Precipitation Monitoring Network for the Las Posas Valley Basin

DUDEK

INTENTIONALLY LEFT BLANK



Legend

- Installation target for potential well screened in the Upper San Pedro Formation
- Monitoring well screened in the Upper San Pedro Formation
- Non-monitoring well screened in the Upper San Pedro Formation
- Las Posas Valley Basin Management Areas
- Epworth Gravels Management Area
- Fox Canyon Groundwater Management Agency Boundary (FCGMA 2016)
- Faults (County of Ventura2016)
- Township (North-South) and Range (East-West)

Revised Bulletin 118 Groundwater Basins and Subbasin (DWR 2016c)

- Arroyo Santa Rosa Valley (4-007)
- Las Posas Valley (4-008)
- Pleasant Valley (4-006)
- Oxnard (4-004.02)

15P01 Abbreviated State Well Number (see notes)

PNW 1 Proposed New Well and location number

Notes:
1) Well labels consist of an abbreviated State Well Number (SWN). SWNs are based on Township and Range in the Public Land Survey System. To construct a full SWN from the abbreviation shown on the map, concatenate the Township, Range, abbreviation, and the letter "S." Example: the SWN for the well labeled "15L01" located in Township 02N (T02N) and Range 22W (R22W) is 02N22W15L01S.
2) Aquifer designation information for individual wells was provided by FCGMA, CMWD, and UWCD.

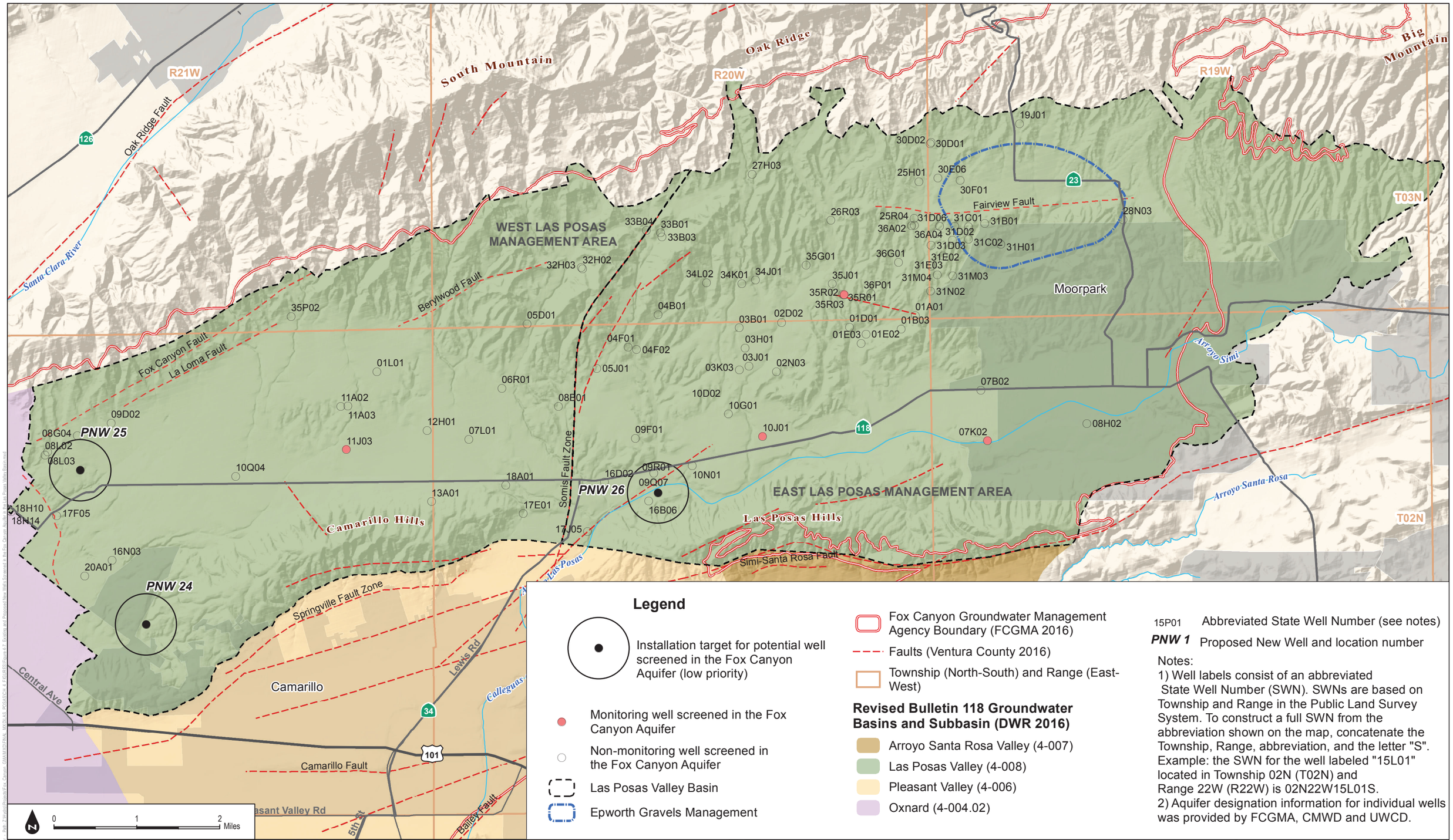
SOURCE: DWR; County of Ventura; UWCD; CMWD

FIGURE 4-6

Existing and Proposed New Wells Screened in the Upper San Pedro Formation in the Las Posas Valley Basin

DUDEK

INTENTIONALLY LEFT BLANK



Legend

- Installation target for potential well screened in the Fox Canyon Aquifer (low priority)
- Monitoring well screened in the Fox Canyon Aquifer
- Non-monitoring well screened in the Fox Canyon Aquifer
- Las Posas Valley Basin
- Epworth Gravels Management
- Fox Canyon Groundwater Management Agency Boundary (FCGMA 2016)
- Faults (Ventura County 2016)
- Township (North-South) and Range (East-West)

Revised Bulletin 118 Groundwater Basins and Subbasin (DWR 2016)

- Arroyo Santa Rosa Valley (4-007)
- Las Posas Valley (4-008)
- Pleasant Valley (4-006)
- Oxnard (4-004.02)

15P01 Abbreviated State Well Number (see notes)

PNW 1 Proposed New Well and location number

Notes:
1) Well labels consist of an abbreviated State Well Number (SWN). SWNs are based on Township and Range in the Public Land Survey System. To construct a full SWN from the abbreviation shown on the map, concatenate the Township, Range, abbreviation, and the letter "S". Example: the SWN for the well labeled "15L01" located in Township 02N (T02N) and Range 22W (R22W) is 02N22W15L01S.
2) Aquifer designation information for individual wells was provided by FCGMA, CMWD and UWCD.

SOURCE: DWR; Ventura County; UWCD; CMWD

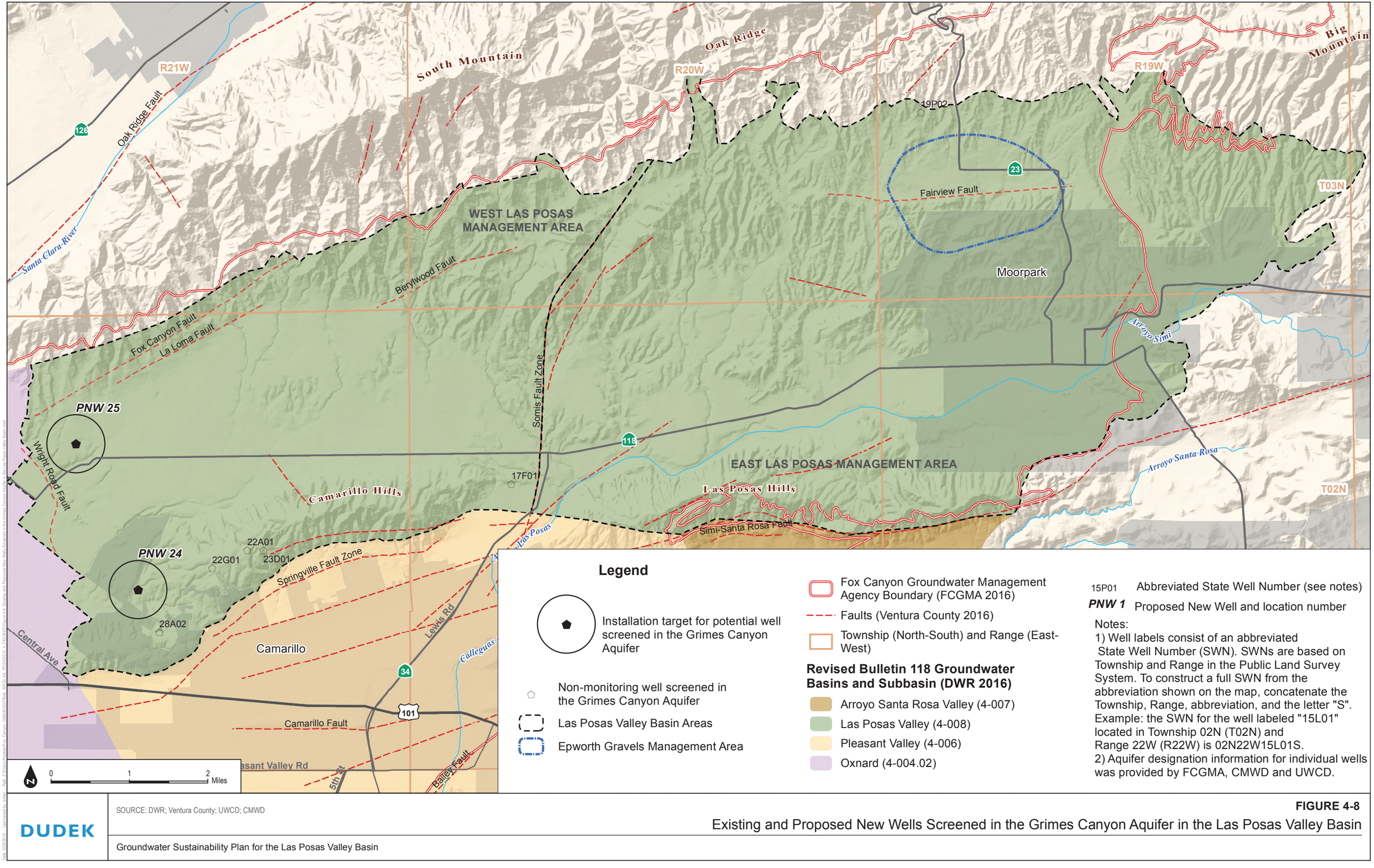
FIGURE 4-7

Existing and Proposed New Wells Screened in the Fox Canyon Aquifer in the Las Posas Valley Basin

DUDEK

Groundwater Sustainability Plan for the Las Posas Valley Basin

INTENTIONALLY LEFT BLANK



Legend

Installation target for potential well screened in the Grimes Canyon Aquifer

Non-monitoring well screened in the Grimes Canyon Aquifer

Las Posas Valley Basin Areas

Epworth Gravels Management Area

Fox Canyon Groundwater Management Agency Boundary (FCGMA 2016)

Faults (Ventura County 2016)

Township (North-South) and Range (East-West)

Revised Bulletin 118 Groundwater Basins and Subbasin (DWR 2016)

- Arroyo Santa Rosa Valley (4-007)
- Las Posas Valley (4-008)
- Pleasant Valley (4-006)
- Oxnard (4-004.02)

15P01 Abbreviated State Well Number (see notes)

PNW 1 Proposed New Well and location number

Notes:
1) Well labels consist of an abbreviated State Well Number (SWN). SWNs are based on Township and Range in the Public Land Survey System. To construct a full SWN from the abbreviation shown on the map, concatenate the Township, Range, abbreviation, and the letter "S". Example: the SWN for the well labeled "15L01" located in Township 02N (T02N) and Range 22W (R22W) is 02N22W15L01S.
2) Aquifer designation information for individual wells was provided by FCGMA, CMWD and UWCD.

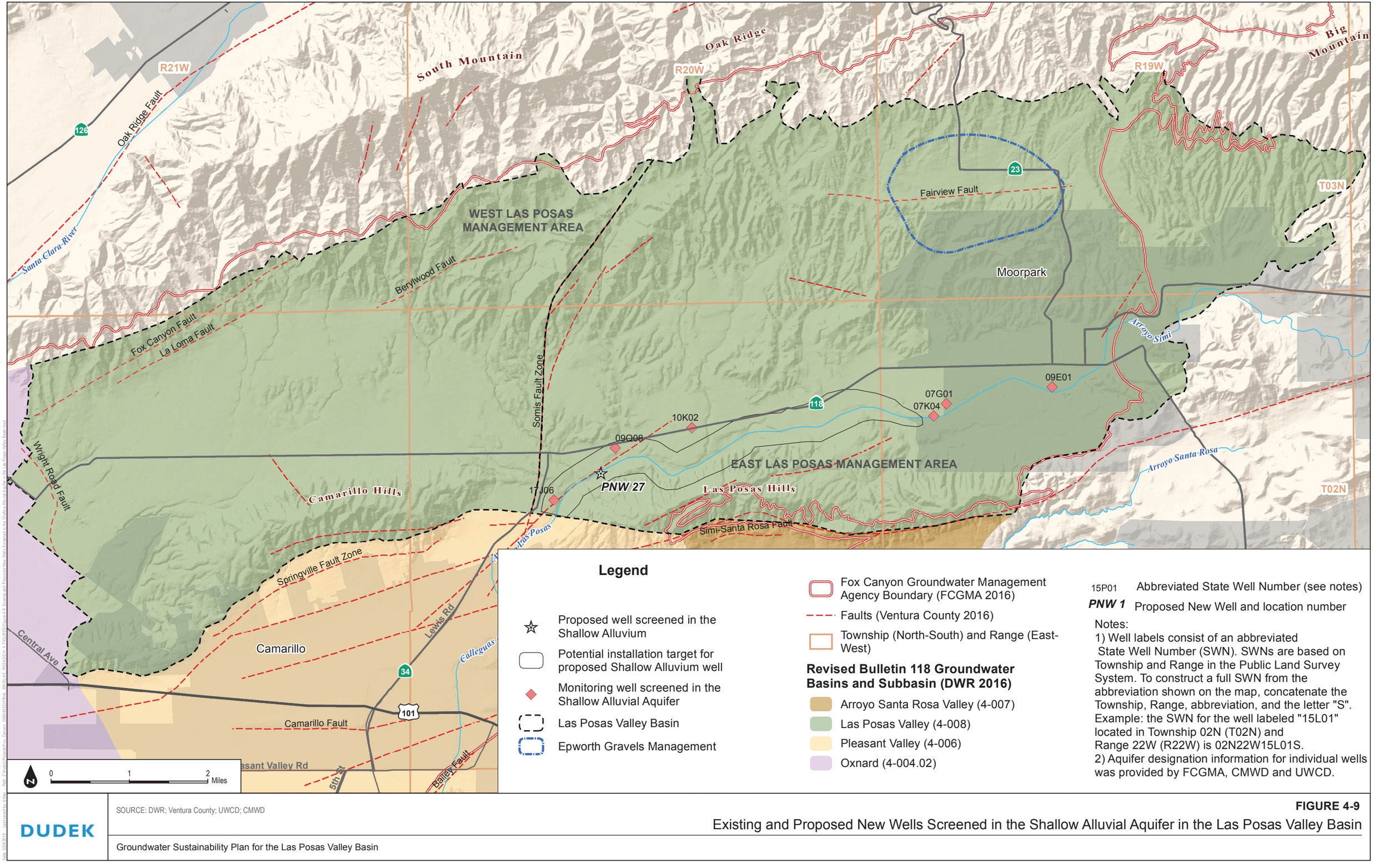
SOURCE: DWR; Ventura County; UWCD; CMWD

FIGURE 4-8

Existing and Proposed New Wells Screened in the Grimes Canyon Aquifer in the Las Posas Valley Basin

DUDEK

INTENTIONALLY LEFT BLANK



SOURCE: DWR; Ventura County; UWCD; CMWD

DUDEK

FIGURE 4-9

Existing and Proposed New Wells Screened in the Shallow Alluvial Aquifer in the Las Posas Valley Basin

INTENTIONALLY LEFT BLANK