Pleasant Valley Basin Groundwater Sustainability Plan 2022 Annual Report: Covering Water Year 2021

Prepared for:

Fox Canyon Groundwater Management Agency

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Executive Summary

The Fox Canyon Groundwater Management Agency (FCGMA), the Groundwater Sustainability Agency (GSA) for the portions of the Pleasant Valley Basin (PVB) (4-006) within its jurisdictional boundaries, in coordination with the other two GSAs in the basin, has prepared this third annual report for the Pleasant Valley Basin Groundwater Sustainability Plan (GSP) in compliance with the 2014 Sustainable Groundwater Management Act (SGMA) (California Water Code, Section 10720 et seq.). This annual report covers the entire PVB. The GSP for the PVB was submitted to the Department of Water Resources (DWR) on January 13, 2020 and was approved by DWR on November 18, 2021. SGMA regulations require that an annual report be submitted to the DWR by April 1 of each year following the adoption of the GSP. The data presented in the PVB GSP ends in water year 2015. This third annual report for the PVB provides an update on the groundwater conditions for water year 2021 (October 1, 2020 through September 30, 2021).

Since 2015, the PVB experienced three critical water years, 2016, 2018, and 2021, in which precipitation was below 50% of the long-term average precipitation, and two above normal water years, 2017 and 2019, in which precipitation was greater than the average precipitation. Water year 2020 was a below normal water year, in which precipitation was 81% of the long-term average precipitation. The volume of precipitation received in the PVB and surrounding watershed influenced direct recharge to the PVB, the availability of surface water in the Conejo Creek, and the availability of surface water in the Santa Clara River that could be diverted and delivered to the PVB via the Pleasant Valley Pipeline (PVP). In water year 2021, UWCD diverted approximately 1,873 acre-feet (AF) of Santa Clara River water for delivery to agricultural users in the PVB and adjacent Oxnard Subbasin via the PVP. Of this, approximately 824 AF was delivered to the PVB.

Between spring 2020 and spring 2021, groundwater elevations declined by approximately 9 feet in the age-equivalent stratigraphic unit as the Oxnard aquifer in the older alluvium. The spring 2021 groundwater elevations in this stratigraphic unit are approximately 15 feet lower than spring 2015 conditions. Between spring 2020 and spring 2021, groundwater elevations in the age equivalent stratigraphic unit as the Mugu aquifer declined by approximately 1 foot. Over this same period, groundwater elevations in the Fox Canyon aquifer declined by approximately 1 foot in northern PVB, near the boundary with the Las Posas Valley Basin, and approximately 4 to 10 feet in western PVB, near the boundary with the Oxnard Subbasin. Spring 2020 groundwater elevations in western PVB in the Fox Canyon aquifer ranged from 5 feet lower than 2015 conditions to 20 feet higher than 2015 conditions.

Calculations of change in storage in the PVB were updated as part of this Annual Report to estimate change in storage across the entire PVB for the older alluvium and Fox Canyon aquifer . Since 2015, groundwater in storage in the older alluvium has decreased by approximately 5,000 AF, the majority of which occurred in the age equivalent stratigraphic unit as the Oxnard aquifer. In the Fox Canyon aquifer, groundwater in storage has declined by approximately 1,600 AF since 2015. This reduction in storage reflects a general decline in groundwater elevations compared to 2015 conditions within the Pumping Depression Management Area, adjacent to the Oxnard Subbasin.

Data gaps identified in the GSP remain in this annual report. One of the critical data gaps include the aerial coverage of aquifer-specific groundwater elevation measurements available for preparing spring and fall contour maps. Spatial data gaps were filled using results from newly installed nested groundwater monitoring wells located in north PV, near the boundary between PVB and Las Posas Valley Basin (LPVB), and within the Pumping Depression Management Area in the Oxnard Subbasin. The data gaps identified in the GSP will continue to be addressed as implementation of the GSP progresses.

FCGMA has undertaken several steps toward implementing the GSP, with implementation planning occurring concurrently with the GSP development process and throughout the past year. The extraction allocation ordinance adopted by the FCGMA Board of Directors in 2019 went into effect on October 1, 2020. This ordinance transitions to water year reporting and provides the regulatory framework for management of groundwater extractions consistent with the sustainable yield of the Basin. Additionally, FCGMA successfully conducted ongoing stakeholder discussions that resulted in the development of a recommended suite of projects that were modeled and evaluated as part of an overall basin management evaluation. Additional projects were also identified during this process and FCGMA solicited project details from stakeholders to create an updated list of feasible projects for the PVB. The FCGMA Board of Directors continues to prioritize stakeholder feedback in the implementation phase of the GSP because of the vital role stakeholders play in ensuring the long-term sustainable use of groundwater resources in the PVB.

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1 Plan Area and Background

1.1 Background

FCGMA, the GSA for the portions of the PVB within its jurisdictional boundaries, in coordination with the other two GSAs in the basin, has prepared this annual report for the GSP in compliance with SGMA (California Water Code, Section 10720 et seq.). SGMA requires that an annual report be submitted to the Department of Water Resources (DWR) by April 1 of each year following the adoption of the GSP. FCGMA adopted a GSP for the PVB in December 2019 and submitted the GSP to DWR on January 13, 2020 (DWR 2020). DWR approved the GSP for the PVB on November 18, 2021.

FCGMA is one of three Groundwater Sustainability Agencies (GSAs) in the PVB. The other two GSAs are the Camrosa Water District (CWD)–Pleasant Valley GSA and the Pleasant Valley Outlying Areas GSA (County of Ventura). This annual report applies to the entirety of the PVB. To coordinate management and reporting in the basin, FCGMA and CWD have executed a Memorandum of Understanding, and FCGMA and the County have formed a Joint Powers Authority.

1.1.1 Fox Canyon Groundwater Management Agency

FCGMA is an independent special district formed by the California Legislature in 1982 to manage and protect the aquifers within its jurisdiction for the common benefit of the public and all agricultural, and M&I users (FCGMA et al. 2007). FCGMA's boundaries include all land overlying the Fox Canyon Aquifer (FCA) and includes portions of the following DWR Bulletin 118 groundwater basins: PVB (4-006), Arroyo Santa Rosa Valley Basin (ASRVB, 4-007), Las Posas Valley Basin (LPVB, 4-008), and Santa Clara River Valley Basin - Oxnard Subbasin (4-004.02). ,

FCGMA is governed by a Board of Directors (Board) with five members who represent: (1) the County of Ventura (County), (2) the United Water Conservation District (UWCD), (3) seven mutual water companies and water districts within the Agency[1], (4) five incorporated cities which are all or a portion of each is within the FCGMA jurisdictional area[2], and (5) a farmer representative. The Board members representing the County, UWCD, the mutual water companies and water districts, and the incorporated cities are appointed by their respective organizations or groups. The representative for the farmers is appointed by the other four seated Board members from a list of candidates jointly supplied by the Ventura County Farm Bureau and the Ventura County Agricultural Association. An alternate Board member is selected by each appointing agency or group in the same manner as the regular member and acts in place of the regular member in case of absence or inability to act. All members and alternates serve for a 2-year term of office, or until the member or alternate is no longer an eligible official of the member agency. Information regarding current FCGMA Board representatives can be found on the FCGMA website.

1 The seven mutual water companies and water districts are: Alta Mutual Water Company, Pleasant Valley County Water District (PVCWD), Berylwood Mutual Water Company, Calleguas Municipal Water District (CMWD), CWD, Zone Mutual Water Company, and Del Norte Mutual Water Company.

2 The five incorporated cities which are all or in part within the FCGMA jurisdictional area are: Ventura, Oxnard, Camarillo, Port Hueneme, and Moorpark

1.1.2 PVB Groundwater Sustainability Plan

The GSP for the PVB defined the conditions under which the groundwater resources of the entire PVB will be managed sustainably in the future (FCGMA 2019a). Groundwater conditions were evaluated in four hydrostratigraphic units in the PVB. These hydrostratigraphic units are similar to the five principal aquifers in the Oxnard Subbasin, which adjoins the PVB, commonly grouped into an upper and lower aquifer system. In the PVB there are four principal aquifers: (1) the older alluvium, which is the time equivalent stratigraphic unit to the Upper Aquifer System (UAS) in the Oxnard Subbasin, (2) the Upper San Pedro Formation, (3) the Fox Canyon aquifer, and (4) Grimes Canyon aquifer. The Upper San Pedro Formation, Fox Canyon aquifer, and Grimes Canyon aquifer compose the Lower Aquifer System (LAS) in the PVB. The primary sustainability goal for the PVB adopted in the GSP, is "to maintain a sufficient volume of groundwater in storage in the older alluvium and the Lower Aquifer System so that there is no net decline in groundwater elevation or storage over wet and dry climatic cycles." (FCGMA 2019a). Additionally, "groundwater levels in the PVB should be maintained at elevations that are high enough to not inhibit the ability of the Oxnard Subbasin to prevent net landward migration of the saline water impact front" in the Oxnard Subbasin after 2040 (FCGMA 2019a). These goals were established based on both historical and potential future undesirable results to the groundwater resources of the PVB from six sustainability indicators: chronic lowering of groundwater levels, reduction of groundwater storage, seawater intrusion, degraded water quality, land subsidence, and depletions of interconnected surface water. The PVB was found not to experience direct impacts from seawater intrusion or depletion of interconnected surface water.

The GSP established minimum threshold groundwater elevations, defined for the PVB, as groundwater levels that: allow declines during periods of future drought to be offset by recovery during future periods of above-average rainfall (FCGMA 2019a). These groundwater elevations were also found to limit seawater intrusion in the Oxnard Subbasin (FCGMA 2019a). In addition to minimum threshold groundwater elevations, the GSP also established measurable objective groundwater elevations. Measurable objective groundwater elevations were defined as "the groundwater levels throughout the PVB at which there is neither seawater flow into, nor freshwater flow out of the Upper Aquifer System or Lower Aquifer System in the Oxnard Subbasin" (FCGMA 2019a). Minimum threshold and measurable objective groundwater elevations were established at nine representative monitoring points (or "key wells") in the PVB (FCGMA 2019a).

The GSP documented conditions throughout the PVB through the fall of 2015. The first and second annual reports evaluated progress toward sustainability based on a review of groundwater elevation data, groundwater extraction data, surface water supply available for use or surface water supply used, total water used, and change in groundwater storage between the fall of 2015 and the end of water year 2020[3]. This third annual report for the PVB documents conditions and the progress toward sustainability for water year 2021.

1.2 Plan Area

The PVB (DWR Groundwater Basin 4-006) is bounded to the north by the Springville fault zone and Somis Gap, to the east by the ASRVB (DWR Bulletin 118 Groundwater Basin 4-007) and Conejo Mountain, to the southeast by the

[3] A water year begins on October 1 and ends on September 30 of the following year. The convention for naming the water year is to name the water year based on the year in which it ends. For example, the 2020 water year begins on October 1, 2019, and ends on September 30, 2020.

Santa Monica Mountains, and to the west and southwest by the Oxnard Subbasin of the Santa Clara River Valley Groundwater Basin (DWR Groundwater Basin 4-004.02; Figure 1-1, Vicinity Map for the Pleasant Valley Basin).

On the west and southwest, the PVB is in hydrogeologic communication with the Oxnard Subbasin. The boundary between the PVB and Oxnard Subbasin is defined by a facies change between the predominantly coarser-grained sand and gravel deposits that compose the UAS in the Oxnard Subbasin and the finer-grained clay and silt-rich deposits of the UAS in the PVB. To the north, in the Camarillo Hills area, the Springville Fault Zone is believed to form a groundwater flow barrier at depth between the aquifers in the LPVB and the PVB, based on historical hydraulic head differences of up to 60 feet across the fault zone (DWR 1975). However, shallow alluvial deposits in the vicinity of Arroyo Las Posas and the Somis Gap are in hydraulic communication with the LPVB (CMWD 2017). The eastern boundary of the PVB is formed by a constriction in Arroyo Santa Rosa Valley (SWRCB 1956; DWR 2003). The southern boundary of the PVB is delineated by the contact between the alluvial deposits and surface exposures of bedrock in the Santa Monica Mountains (DWR 2003).

The PVB is divided into three management areas that reflect the current understanding of the hydrogeologic characteristics of the Basin (FCGMA 2019a). These three management areas are the East Pleasant Valley Management Area (EPVMA), the North Pleasant Valley Management Area, and the Pleasant Valley (PV) Pumping Depression Management Area (Figure 1-2). These areas are distinguished by differing hydrogeologic and water quality characteristics (FCGMA 2019a).

1.2.1 Climate

The climate of Pleasant Valley is typical of coastal Southern California, with average daily temperatures ranging generally from 43°F to 80°F in summer and from 41°F to 74°F in winter (FCGMA 2019a). Typically, the majority of the precipitation in the Ventura County region falls between November and April. Precipitation is measured at several stations in the PVB (Figure 1-3; Precipitation and Stream Gauges in the Pleasant Valley Basin). Water year precipitation, measured at Stations 003 and 259, in the central PVB is highly variable, ranging from 2.6 inches in 2021 to 34.9 inches in 1998 (Figure 1-4; Pleasant Valley Basin Historical Water Year Precipitation). On average, the PVB received approximately 13.4 inches of precipitation per water year between 1957 and 2021.

The GSP for the PVB included precipitation through the 2015 water year (FCGMA 2019a). Since 2015, the PVB has experienced two above normal[4] water years (2017 and 2019), three critical water years (2016, 2018, and 2021), and one below normal water year (2020). The average precipitation between 2016 and 2020 was 9.92 inches, which is approximately 25% less than the long-term mean precipitation in the PVB. Overall, the PVB has continued to experience drier than average conditions since 2015.

1.2.2 Surface Water and Drainage Features

The dominant surface water bodies in Pleasant Valley are the Arroyo Las Posas, Calleguas Creek, and Conejo Creek, which drain watersheds that extend beyond the boundaries of the PVB (Figure 1-2). There is only one active streamflow gauging station in the PVB. This station, maintained by the Ventura County Public Works Agency - Watershed Protection, is located on Calleguas Creek near California State University Channel Islands (Station ID:

[4] Water years have been classified into five types based on their relationship to the mean water year precipitation. The five types are: critical, dry, below normal, above normal, and wet. Critical water years are < 50% of the mean annual precipitation. Dry water years are ≥ 50% and <75% of the mean annual precipitation. Below normal water years are ≥ 75% and <100% of the mean annual precipitation. Above normal water years are ≥ 100% and <150% of the mean annual precipitation. Wet water years are ≥ 150% of the mean annual precipitation.

805), downstream of the confluence of Arroyo Las Posas and Conejo Creek. Streamflow measured at this gauge for the past 11 water years is presented in Table 1-1 and shown on Figure 1-5.

The highest average daily flows in Calleguas Creek between 2010 and 2020 occurred in 2010 and 2011 (Table 1-1). Water years 2010 and 2011 were above normal and wet water years, respectively, in which annual precipitation was approximately 107% and 160% of the long-term average. Measurements of daily average flows for water year 2021 were not available during preparation of the Pleasant Valley Basin GSP 2022 Annual Report.

Table 1-1. Streamflow on Calleguas Creek for Water Years 2010 through 2021

Water Year	Average Daily Flow (cfs) at Gauge 805
2010	52.5
2011	67.1
2012	19.1
2013	12.9
2014	9.2
2015	9.1
2016	6.9
2017	44.9
2018	11.4
2019	35.2
2020	42.7
2021	-DATA NOT AVAILABLE-

Note: cfs = cubic feet per second

1.3 Annual Report Organization

This is the third Annual Report prepared since the GSP for the PVB was submitted to DWR. This report is organized according to the GSP Emergency Regulations. Chapter 1 provides the background information on the GSP, the PVB, and the Fox Canyon Groundwater Management Agency. Chapter 2 provides information on the groundwater conditions in the PVB since 2015, including groundwater elevations, groundwater extractions, surface water supply, total water available, and change in groundwater storage. Chapter 3 provides an update on the GSP implementation process.

2 Groundwater Conditions

This chapter presents the change in groundwater conditions in the PVB since water year 2015. Comparison of water year 2021 conditions to water year 2020 conditions characterizes the impact that water year type, groundwater production, imported and recycled water availability, and surface water availability in water year 2021 have had on groundwater conditions in the PVB. Data from water years 2016 through 2020 are provided as context. These data were discussed in detail in the first and second annual reports (FCGMA 2020a, FCGMA 2021).

2.1 Groundwater Elevations

Groundwater elevation contour maps for the older alluvium (Oxnard and Mugu aquifer age-equivalents), and the Fox Canyon aquifer are presented in Figures 2-1 through 2-6. These maps show the seasonal low (fall 2020) and high (spring 2021) groundwater elevations. Fall 2020 groundwater elevations were defined as any groundwater elevation measured between October 2 and October 31, 2021. Spring 2021 groundwater elevations were defined as any groundwater elevation measured within a four-week window between March 2 and March 29, 2021. These four-week windows are approximately the same measurement windows as those used to generate fall and spring groundwater elevation contour maps in the 2020 Annual Report covering water years 2016 through 2019. The 2021 Annual Report covering water year 2020 utilized a six-week measurement window to ensure similar spatial coverage of groundwater elevation measurements for comparison of groundwater contours, and corresponding changes in groundwater in storage, between water years 2016, 2017, 2018, 2019, and 2020. The GSP recommended collecting groundwater elevations within a two-week window in the future (FCGMA 2019a). FCGMA is in the process of prioritizing recommendations made in the GSP and evaluating the timeframe and feasibility of implementing these recommendations; however, FCGMA relies on other agencies for some groundwater elevation data.

The groundwater elevation contour maps are based on the groundwater elevations measured at wells screened solely within an individual aquifer. The intent of using groundwater elevations from wells screened within a single aquifer is to accurately represent groundwater flow directions within an aquifer, and vertical gradients between aquifers. It is important to note, however, that production wells in the PVB are typically screened across multiple aquifers. Therefore, using wells only screened within an individual aquifer limits the spatial coverage for each contour map. This limitation is particularly apparent in an area of high groundwater production in the PVB and adjoining Oxnard Subbasin that extends south from Highway 101 (FCGMA 2019a). This area was identified as being impacted by groundwater production based on groundwater elevations measured in wells screened in multiple aquifers and was identified in the GSP as a separate management area in the PVB (FCGMA 2019a). A consequence of using wells screened only within an individual aquifer, the lateral extent of the pumping depression is not well characterized.

At FCGMA's request, DWR installed a nested monitoring well cluster in close proximity to the PV Pumping Depression Management Area of the PVB, in the contiguous Oxnard Pumping Depression Management Area of the Oxnard Subbasin, through its TSS program. The nested well cluster, which has two separate completions, is located in the Oxnard Subbasin adjacent to the Revolon Slough. The shallow well cluster, which was completed on November 22, 2019, contains three monitoring wells individually screened in the Oxnard, Mugu, and Hueneme aquifers. The Oxnard and Mugu aquifers are age-equivalent to the older alluvium in the PVB and the Hueneme aquifer is age-equivalent to the Upper San Pedro aquifer in the PVB. The deep well cluster, which was completed on March 19, 2020, contains three monitoring wells individually screened within the Fox Canyon-Upper, Fox Canyon-Basal, and Grimes Canyon aquifers. Groundwater elevations measured at the shallow and deep well cluster were used to help constrain groundwater conditions in the PVB and Oxnard Subbasin Pumping Depression Management Areas in the 2021 water year (Section 2.1.1).

In addition to the nested well cluster in the Oxnard Subbasin Pumping Depression Management Area, DWR installed a second nested monitoring well cluster located in the northwestern portion of the PVB, adjacent to the Arroyo Las Posas per FCGMA's request and specifications (Figures 2-1 through 2-9). Like the monitoring well cluster installed within the Oxnard Pumping Depression Management Area, the new PVB monitoring well was constructed using two separate well completions. The first well completion contains two monitoring wells, one of which is screened within the older alluvium (in age-equivalent stratigraphic units of the Mugu aquifer in the Oxnard Subbasin) and the second of which is screened in the Upper San Pedro Formation (age-equivalent to the Hueneme aquifer in the Oxnard Subbasin). The second completion contains three monitoring wells individually screened in the older alluvium (in the age-equivalent stratigraphic unit as the Oxnard aquifer in the adjacent Oxnard Subbasin), Fox Canyon-Upper aquifer, and Fox Canyon-Basal aquifer. Construction of the two separate well completions was completed in September 2019. Groundwater elevations measured at the shallow and deep well cluster were used to help constrain groundwater conditions in the northwestern portion of the PVB in the 2021 water year (Section 2.1.1).

2.1.1 Groundwater Elevation Contour Maps

2.1.1.1 Older alluvium (Age Equivalent Oxnard and Mugu Aquifers)

There are six wells screened solely within the older alluvium in the PVB (Figures 2-1 through 2-4). Three of these wells were measured in both fall 2020 and spring 2021: 02N21W34G05S, 02N21W34G04S, and 02N20W20D05S (Figures 2-1 through 2-4). Additionally, the fall 2020 groundwater elevation was measured at well 01N21W03K01S; the groundwater elevation at this well was not measured in spring 2021.

Measurements collected at these four wells in fall 2020 indicate that groundwater elevations are highest along the northern boundary of the PVB, adjacent to the LPVB, and decline south towards the PV Pumping Depression Management Area. The groundwater elevation measured at well 02N20W20D05S (screened in the age-equivalent stratigraphic unit to the Mugu aquifer) was approximately 65 feet (ft.) above mean sea level (msl) in fall 2020 (Figure 2-3). Downgradient of this well, and within the PV Pumping Depression Management Area, fall 2020 groundwater elevations ranged from approximately -54 to -70 ft. msl (measured at wells 02N21W34G04S and 01N21W03K01S, respectively; Figure 2-3).

Wells 02N21W34G04S and 02N21W34G05S are part of a nested well cluster in the PV Pumping Depression Management Area, with well 02N21W34G04S screened in the age-equivalent stratigraphic unit to the Mugu aquifer and well 02N21W34G05S screened in the age-equivalent stratigraphic unit to the Oxnard aquifer. In fall 2020, the groundwater elevation measured at well 02N21W34G05S was approximately -3 ft. msl and the groundwater elevation measured at well 02N21W34G04S was approximately -54 ft. msl, indicating a downward vertical gradient within the older alluvium (Figures 2-1 and 2-3). Fall 2020 groundwater elevations measured in the older alluvium were approximately 10 to 23 feet higher than fall 2019 conditions.

Spring 2021 groundwater elevations measured in the age-equivalent of the Mugu aquifer in older alluvium ranged from approximately -50 ft. msl in the PV Pumping Depression Management Area to approximately 60 ft msl in the North Pleasant Valley Management Area (Figure 2-4). Spring 2021 groundwater elevations were measured at one well in the age-equivalent of the Oxnard aquifer; the groundwater elevation measured at this one well, 02N21W34G05S, was approximately -4 ft. msl (Figure 2-3).

Groundwater elevations declined by approximately 9 feet at well 02N2134G05S and approximately 1 foot at 02N21W34G04S between spring 2020 and spring 2021. The spring groundwater elevation in well 02N21W34G04S was approximately 8 feet higher than it was in spring of 2015. The spring groundwater elevation in well 02N21W34G05S was approximately 15 feet lower than it was in the spring of 2015.

2.1.1.2 Fox Canyon Aquifer

Fall 2020 groundwater elevations in the Fox Canyon aquifer ranged from a low of approximately -133 ft. msl (measured at well 02N21W33R02S; Figure 2-7) to a high of approximately 48 ft. msl (measured at well 02N20W20D01S; Figure 2-7) and were consistently higher than fall 2019 and fall 2015 conditions. In western PVB, groundwater elevations were approximately 8 to 27 feet than fall 2019 (measured at wells 02N21W33R02S and 01N21W03C01S, respectively). In northern PVB, groundwater elevations rose by approximately 2 to 8 feet from fall 2019 (measured at wells 02N20W29B02S and 02N20W19M05S, respectively; Figure 2-5).

In the PV Pumping Depression Management Area, spring 2021 groundwater elevations ranged from approximately -116 ft msl to -76 ft msl (measured at well 02N21W33R02S and 02N21W34G02S, respectively; Figure 2-8). In this part of the PVB, spring groundwater elevations declined by 4 to 10 feet between 2020 and 2021 (measured at wells 02N21W34G02S and 01N21W03C01S, respectively). South of these wells, the spring groundwater elevation measured at well 01N21W09C04S, which is located within the Oxnard Pumping Depression Management Area, increased by approximately 2 feet between spring 2020 and 2021. Since 2015, spring groundwater elevation changes in western PVB have ranged from declines of approximately 10 feet (measured at well 02N21W31R02S) to recoveries of approximately 20 feet (measured at well 02N21W34G03S). In northern PVB, near the boundary with LPVB, the spring groundwater elevation measured at well 02N20W19M05S declined by approximately 1 foot between spring 2020 and spring 2021. Since 2015, the spring groundwater elevations in northern PVB have declined by 35 to 50 feet.

Spring groundwater elevations measured at wells 02N20W20D01S and 02N20W20D02S, which are part of the new PVB well cluster constructed through DWR's TSS Program, help characterize groundwater conditions in the northern part of the PVB, adjacent to its boundary with the LPVB. The spring 2021 groundwater elevation measured at these wells was approximately 43 ft msl. This groundwater elevation is approximately 40 feet higher than that measured at well 02N20W19M05S and 75 feet higher than the spring elevation measured at well 02N20W29B02S (Figure 2-6).

2.1.2 Groundwater Elevation Hydrographs

Groundwater elevation hydrographs for each of the key wells identified in the GSP are presented in Figures 2-7 through 2-9. These key wells are the designated representative monitoring points for the PVB (FCGMA 2019a). The fall 2020 and spring 2021 water levels measured at each representative monitoring point are presented in Table 2-1, which also provides a comparison of fall and spring water levels to: (i) water year 2020 conditions, (ii) the established minimum threshold groundwater elevations, (iii) the established measurable objective groundwater elevations, and (iv) the interim milestones for dry climate conditions. The GSP dry climate interim milestone is used for comparison in this annual report because the average of the annual precipitation measured in the Basin between water years 2016 and 2021 is below average. However, it should also be noted that the first interim milestone is set for 2025, not 2020, and the groundwater elevations in the representative wells in the PVB have three years to reach this first interim milestone.

Groundwater elevations are monitored at three key wells screened in the older alluvium in the PVB (Table 2-1). In fall 2020, groundwater elevations measured at these wells were approximately 9 to 12 feet higher than they were in fall 2019 and ranged from 6 to 35 feet below the minimum threshold groundwater elevations. In spring 2021, groundwater elevations were approximately 1 to 9 feet lower than spring 2020 conditions and ranged from 1 to 36 feet below the minimum threshold groundwater elevations. In spring 2021, groundwater elevations in the older alluvium ranged from 4 feet below (measured at well 02N21W34G05S) to 22 feet above (measured at well 02N21W34G04S) the 2025 interim milestone for dry climate conditions (Table 2-1).

Groundwater conditions in the Fox Canyon aquifer are monitored using four representative monitoring points in the PVB (Table 2-1). Groundwater elevations rose at all representative monitoring points screened in the Fox Canyon aquifer between fall 2019 and fall 2020 (Table 2-1). Between spring 2020 and spring 2021, groundwater elevations declined by approximately 1 to 10 feet (Table 2-1). In spring 2021, groundwater elevations in the Fox Canyon aquifer were 6 to 40 feet below the minimum threshold groundwater elevations at all wells except well 02N20W19M05S. The spring 2021 groundwater elevation was approximately 145 feet higher than the minimum threshold groundwater elevation at this well.

Table 2-1. Water Year 2021 Groundwater Elevations, Minimum Thresholds, Measurable Objectives, and Interim Milestones for Representative Monitoring Points in the PVB

Well Number	Aquifer	Fall Groundwater Conditions		Spring Groundwater Conditions		Minimum Threshold (ft MSL)	Measurable Objective (ft MSL)	2025 Interim Milestone Dry Climate (ft MSL) [b]
		2020 Groundwater Elevation (ft MSL)	Change from 2019 to 2020 (ft)[a]	2021 Groundwater Elevation (ft MSL)	Change from 2020 to 2021 (ft)[a]			
02N21W34G05S	Older alluvium (Oxnard)	-3.36	9.81	-4.37	**-9.05**	32	40	0
01N21W03K01S	Older alluvium (Mugu)	-69.98	23.0	NM	-	-53	5	-73
02N21W34G04S	Older alluvium (Mugu)	-54.09	12.36	-49.59	**-1.15**	-48	5	-72
01N21W03C01S	Fox	-88.72	26.7	-85.02	**-10.8**	-48	0	-100
02N20W19M05S	Fox	10.07	8.5	4.27	**-1.4**	-135	65	-
02N21W34G02S	Fox	-76.66	25.5	-75.56	**-4**	-53	0	-101
02N21W34G03S	Fox	-76.89	25.55	-75.6	**-4.08**	-53	0	-104
01N21W02P01S	Multiple	NM	-	NM	-	-43	5	-80
01N21W04K01S	Multiple	-81.18	38.4	-88.38	**-27.15**	-48	0	-112

Notes: NM = *Not Measured*

[a] Data in this column shows the year-to-year difference in groundwater elevation measured at each representative monitoring point. Positive (+) values indicate that groundwater elevations have increased. Negative (-) values indicate that groundwater elevations have decreased. Groundwater elevation declines are presented in **bold** text. Blank cells indicate that water levels were not measured in either the current, or previous, fall and spring measurement window.

[b] There is no interim milestone for well 02N20W19M05S because the water levels in this well were above the minimum threshold when the GSP was prepared.

2.2 Groundwater Extraction

On October 23, 2019, the FCGMA Board of Directors adopted an Ordinance to Establish an Allocation System for the Oxnard and Pleasant Valley Groundwater Basins. The new allocation system went into effect on October 1, 2020 and is designed to "facilitate adoption and implementation of the groundwater sustainability plan and to ensure that the Basins are operated within their sustainable yields" (FCGMA, 2019c). To facilitate implementation and assessment of the new allocation system, FCGMA transitioned the groundwater extraction reporting period from a calendar year to a water year basis. The new reporting period went into effect on October 1, 2020 and requires local groundwater producers to report production from October 1 through March 31, and April 1 through September 30.

Historically, groundwater extractions in the FCGMA have been reported in two periods over the course of a single calendar year. Because groundwater extractions are not reported monthly, groundwater production prior to the 2021 water year cannot be reported on a water year basis. Therefore, the groundwater extractions for 2016 through 2019 reported in Table 2-2, and shown on Figures 2-10 and 2-11, follow the historical precedent and are for calendar years (Table 2-2). Due to the transition from calendar year to water year reporting in 2020, groundwater extractions reported for 2020 represent extractions for the nine-month period from January 1, 2020 through September 30, 2020 (Table 2-2). Groundwater extractions for water year 2020 are preliminary and will be updated as additional data becomes available.

Water year 2021 groundwater extractions reported in Table 2-2 represent a combination of reported and estimated extractions. FCGMA has experienced some delay in reporting for the second reporting period of the 2021 water year (April 1, 2021 through September 30, 2021). To estimate groundwater extractions for this period, FCGMA multiplied the groundwater extractions reported during the first half of the water year by the average ratio of validated AMI data for agricultural production wells and assumed that production rates remained constant for domestic and municipal and industrial users. Groundwater extraction values for water year 2021 will be updated as additional data becomes available.

Table 2-2. Groundwater Extractions in the Pleasant Valley Basin by Aquifer System and Water Use Sector

Year	Upper Aquifer System (Acre-Feet)			Lower Aquifer System (Acre-Feet)				Wells Screened in both the UAS and LAS (Acre-Feet)				Wells in Unassigned Aquifer Systems (Acre-Feet)			Total (Acre-Feet)
	AG	*Dom*	*Sub-Total*	*AG*	*Dom*	*M&I*	*Sub-Total*	*AG*	*Dom*	*M&I*	*Sub- Total*	*AG*	*Dom*	*Sub-Total*	
CY 2016	93	4	97	4,077	2	2,852	6,931	7,268	42	1,625	8,935	-	<1	0	15,963
CY 2017	82	5	87	3,392	2	2,548	5,942	7,668	10	2,008	9,686	-	<1	0	15,715
CY 2018	154	4	158	3,139	2	2,602	5,743	5,180	35	1,707	6,922	510	<1	510	13,333
CY 2019	91	5	96	2,433	2	2,120	4,544	3,314	26	1,607	4,948	876	<1	876	10,473
2020[a]	76	4	79	1,623	2	2,422	4,046	1,947	27	1,253	3,227	777	0	777	8,130
WY 2021[b]	103	3	106	3,331	2	3,253	6,586	4,260	19	2,142	6,421	1,254	0	1,254	14,367

Notes: CY = Calendar Year; WY = Water Year; AG = Agriculture; Dom = domestic; M&I = Municipal and Industrial

a Groundwater extraction reporting is for the period from January 1, 2020 through September 30, 2020.due to transition to water year reporting.

b Groundwater extractions in the second half of the water year (April 1 through September 30) are estimated values; extraction reporting was not available at the time of preparation of the 2022 Annual Report.

The estimated water year 2021 groundwater extractions are similar to calendar year 2016 through 2018 extractions (Table 2-2). However, as previously noted, the extractions for the second half of 2021 will be updated upon receipt of additional data

2.3 Surface Water Supply

The primary surface water supplies to the PVB are from the Santa Clara River, via the UWCD Freeman Diversion and the Pleasant Valley Pipeline (PVP), and Conejo Creek, via a diversion operated by CWD. Within the PVB, CWD supplies surface water to the Pleasant Valley County Water District (PVCWD) and also distributes a portion of its diversions to other agricultural water users[6] (FCGMA 2019a). Surface water deliveries to the PVB for water years 2016 through 2021 are reported in Table 2-3.

CWD provided historical surface water supply data through calendar year 2021 to support preparation of this 2022 Annual Report for the PVB. To convert these data to water year deliveries, 25% of the surface water deliveries by CWD from a given calendar year was assigned to the following water year, and the 75% of the calendar year surface water deliveries by CWD was assigned to the current water year. This division, while approximate, is based on the monthly split between water year and calendar year, with January through September (75% of the calendar year) belonging to the current water year, and October through December (25% of the calendar year) belonging to the following water year.

6 44% of the total CWD deliveries to PVCWD, and 44% of the total PVP surface water deliveries from UWCD, were assigned to the PVB based on an analysis of the size of PVCWD's service area (FCGMA 2019a).

Table 2-3. Summary of Surface Water Deliveries to the Pleasant Valley Basin

Water Year	CWD		PVCWD	United Water Conservation District		Total (acre-feet)
				PVP (Pleasant Valley Basin) (acre-feet)		
	Conejo Creek for M&I (acre-feet)	*Conejo Creek for Agriculture (acre-feet)*	*Conejo Creek Flows Delivered to PVCWD for Agriculture (acre-feet)*	*Diversions of Santa Clara River Water Used for Agriculture (PVP)*	*Recharged Spreading Water Pumped and Used for Agriculture (Saticoy Wells)[a]*	
2016	740	2,804	816	0	0	4,361
2017	802	3,207	1,394	0	0	5,404
2018	777	3,107	1,456	0	0	5,341
2019	598	2,389	2,196	243	0	5,426
2020	541	2,099	1,815	759	0	5,214
2021	624	2,401	1,551	824	0	5,400

Notes: CWD = Camrosa Water District, PVCWD = Pleasant Valley County Water District; PVP = Pleasant Valley Pipeline
[a]PVP deliveries of recharged spreading water used for agriculture in the PVB was incorrectly reported for water years 2016 through 2019 in the 2020 Annual Report. This data has been corrected and updated in Table 2-3. A description of the error in the 2020 Annual Report is provided in Appendix A.

2.4 Total Water Available

Total water available was tabulated from the groundwater extractions reported in Table 2-2, the surface water supply reported in Table 2-3, and imported water, and recycled water used in the PVB. The total water available is reported in Table 2-4 by water year. For Table 2-2, in order to convert the reported groundwater production from calendar year to water year prior to water year 2020, 25% of the groundwater production from a given calendar year was assigned to the following water year, and the 75% of the calendar year production was assigned to the current water year. This division, while approximate, is based on the monthly split between water year and calendar year, with January through September (75% of the calendar year) belonging to the current water year, and October through December (25% of the calendar year) belonging to the following water year. Preliminary advanced metering infrastructure (AMI) data reported to FCGMA indicates that this division is reasonable for M&I and domestic groundwater extractions. AMI data from agricultural users in the PVB indicate that production can be highly variable, but preliminary data suggest the January through September period accounts for 70% of the total calendar year extractions, while the October through December period accounts for the remaining 30% of the total calendar year extraction. Using a 70-30% division based on this AMI data to convert from calendar year to water year results in an estimate of agricultural extractions equal to approximately 6,500 AF in water year 2020. This estimate is approximately 400 AF, or 7%, more than the water year 2020 agricultural extractions estimated using a 75-25% division.

Calleguas Municipal Water District (CMWD) provides imported water to Camrosa Water District, the City of Camarillo and Pleasant Valley Mutual Water Company. CMWD provided monthly delivery volumes to each customer but did not report “imported water use” by sector. Therefore, the total reported CMWD water use was divided among the water use sectors based on the average reported water use, by sector, in the PVB GSP since 2010 (FCGMA 2019a). Between 2010 and 2015, 99% of the imported water supplied by CMWD was provided to the M&I sector and only 1% was used for agriculture. This ratio was applied to CMWD total imports in Table 2-4.

Table 2-4. Total Water Available in the Pleasant Valley Basin

Water Year	Groundwater [a] (acre-feet)			Surface Water (acre-feet)	Recycled Water (acre-feet)		Imported Water[b] (acre-feet)		Total (acre-feet)
	Ag	Dom	M&I	Ag	Ag	M&I	Ag	M&I	
2016	12,650	88	3,698	816	2,352	577	113	6,334	26,619
2017	11,216	24	4,536	1,394	2,300	651	153	8,275	28,548
2018	9,523	35	4,371	5,341	2,062	602	155	8,326	30,414
2019	7,281	35	3,873	5,426	2,212	412	332	8,337	27,908
2020[c]	6,100	41	4,607	5,214	4,272	494	1,181	8,103	30,011
2021[c]	8,948	24	5,395	5,400	3,477	413	1,284	8,695	33,636

Notes:

[a] Groundwater production by water year (2016 through 2019) is estimated from groundwater production by calendar year. Water Year 2020 extractions represent groundwater extractions reported for the period from January 1, 2020 through September 30, 2020 plus 25% of the Calendar Year 2019 extractions.

[b] Imported water supplied by CMWD to the City of Camarillo and PVMWC was divided into AG and M&I based on the ratio of AG and M&I imported water used between 2010 and 2015. 99% of the total imported water was used for M&I over that time period.

[c] Groundwater production is preliminary and expected to charge. Additional extraction reporting is anticipated.

2.5 Change in Groundwater Storage

Change in storage estimates were calculated for the older alluvium[7] and Fox Canyon aquifer by comparing seasonal high groundwater elevations between 2015 and 2021. Annual change in storage was calculated for each of the six water years by comparing seasonal high groundwater elevations between 2015 and 2021. Annual and cumulative change in storage for water years 2016 through 2021 are presented in Tables 2-5a and 2-5b. The change in storage for each aquifer between spring 2020 and spring 2021 is shown on Figures 2-12 through 2-14. Annual and cumulative change in storage for the older alluvium and Fox Canyon aquifer are shown in Figures 2-15 and 2-16.

Change in groundwater in storage was calculated using a series of linear regression models that correlate measured groundwater elevations to simulated storage change values extracted from the Ventura Regional Groundwater Flow Model (UWCD, 2018). These regression models were computed using seasonal high elevations and corresponding model-calculated storage change values for water years 1986 through 2015 (Appendix A). This methodology differs from previous estimates of storage change presented in the first and second annual reports. The methodology presented in Appendix A builds on the approach used in the previous annual reports and addresses identified data gaps by: (1) removing the influence of contouring algorithms on the resulting estimates of storage change, and (2) estimating storage change across the entire PVB. In addition, the regression-based methodology provides estimates of storage change within the older alluvium; the contour maps prepared as part of the 2020 and 2021 Annual Reports for water years 2016 through 2020 did not provide resolution to estimate storage change in the older alluvium (FCGMA 2020a, FCGMA 2021).

The change in groundwater in storage was recalculated for water years 2016 through 2020. The updated estimates are presented in Table 2-5A, Table 2-5B, and Figures 2-15 and 2-16. A comparison of the estimated change in storage using the two methodologies is provided in Appendix A.

2.5.1 Older Alluvium

Groundwater in storage decreased by approximately 3,100 AF in the older alluvium between spring 2020 and 2021 (Table 2-5a). The majority of this decline occurred in the age-equivalent stratigraphic unit to the Oxnard aquifer. Storage change within this part of the older alluvium is estimated using a single well, 02N21W34G05S, which is located in the Pumping Depression Management Area, near the boundary with the Oxnard Subbasin.

Since 2015, groundwater in storage in the older alluvium has declined by a total of approximately 5,000 AF (Table 2-5b).

2.5.2 Fox Canyon Aquifer

Groundwater in storage in the Fox Canyon aquifer declined by approximately 170 AF between spring 2020 and 2021 (Table 2-5a). This estimate of groundwater storage decline is based on linear regression models developed using groundwater elevations measured at four wells: 02N20W19M05S, 02N21W34G03S, 01N21W03C01S, and 01N21W09C04S (Figure 2-14). The estimated decline in groundwater in storage reflects the 1 to 10-foot decline in groundwater elevations measured at three of the four regression wells (Figure 2-14).

[7] For the older alluvium, storage change was calculated for both the age equivalent stratigraphic units as the Oxnard and Mugu aquifers .

Since 2015, groundwater in storage has declined by an estimated 1,600 AF in the Fox Canyon aquifer (Table 2-5b). As noted in Section 2.1.1, this decline reflects general declining trends in groundwater elevations in western and northern PVB.

Table 2-5a. Annual Change in Groundwater Storage in the Pleasant Valley Basin

Water Year	Water Year Type	Change in Storage (Acre-Feet)				
		Older Alluvium			*Fox Canyon aquifer*	*Combined Annual*
		Oxnard equivalent	**Mugu equivalent**	**Total**		
2016	Critical	-3,305	-61	**-3,365**	-1,078	**-4,443**
2017	Above Normal	2,762	15	**2,778**	153	**2,931**
2018	Critical	-4,921	-21	**-4,942**	-866	**-5,808**
2019	Above Normal	2,440	25	**2,465**	233	**2,698**
2020	Below Normal	1,156	6	**1,162**	90	**1,252**
2021	Critical	-3,106	-11	**-3,117**	-166	**-3,283**

Table 2-5b. Cumulative Change in Groundwater Storage in the Pleasant Valley Basin

Water Year	Water Year Type	Change in Storage (Acre-Feet)				
		Older Alluvium			*Fox Canyon aquifer*	*Combined Cumulative*
		Oxnard equivalent	**Mugu equivalent**	**Total**		
2016	Critical	-3,305	-61	**-3,365**	-1,078	**-4,443**
2017	Above Normal	-542	-45	**-588**	-924	**-1,512**
2018	Critical	-5,463	-67	**-5,530**	-1,791	**-7,320**
2019	Above Normal	-3,023	-41	**-3,065**	-1,558	**-4,622**
2020	Below Normal	-1,867	-35	**-1,902**	-1,468	**-3,370**
2021	Critical	-4,972	-47	**-5,019**	-1,634	**-6,653**

2.5.3 Total Change in Storage

Total change in groundwater in storage for the PVB was calculated as the sum of the groundwater storage change in the Fox Canyon aquifer and older alluvium. Groundwater storage change for the age equivalent Hueneme aquifer and Grimes Canyon aquifer were not estimated because groundwater elevations were not historically collected from wells screened solely within these aquifers in the PVB.

Between spring 2020 and spring 2021, groundwater in storage declined by approximately 3,300 AF (Table 2-5a), resulting in a cumulative decline in storage since 2015 of approximately 6,700 AF (Table 2-5b). Approximately 75% of this cumulative reduction occurred in the older alluvium, within the age equivalent stratigraphic unit to the Oxnard aquifer. As noted in Section 2.5.1, groundwater storage change in this stratigraphic unit is estimated using a single well; while this approach does not capture local variations in water levels, there is a good correlation between groundwater elevations measured at this well and simulated storage change extracted from the UWCD numerical model (Appendix A).

Annual and cumulative change in storage from 1985 through 2015 were reported in the GSP (FCGMA 2019a). Annual and cumulative change in storage between 2015 and 2021 are shown in Figures 2-15 and 2-16. The change in storage volumes reported in the GSP were extracted from the UWCD model and represented changes within the older alluvium, lower aquifer system, and semi-perched aquifer in the PVB. Therefore, the results of the long-term change in storage calculations presented in the GSP cannot be directly compared to the change in storage calculations conducted for this GSP annual update.

3 GSP Implementation Progress

The GSP for the PVB was submitted to DWR in January 2020 and approved on November 18, 2021. This is the third annual report prepared since the GSP was submitted. The GSP implementation progress reported in this report covers work begun during development of the GSP as well as development of projects and management actions over the 2 years since the GSP was submitted.

Project Implementation Progress

During development of the GSP, FCGMA identified the northern Pleasant Valley, adjacent to the boundary between the PVB and the LPVB, as a critical area in which aquifer specific groundwater elevations were lacking. This is an area where subsurface flows between the two basins are poorly constrained. In response to FCGMA's request, DWR via the TSS Program installed two new nested monitoring wells in this area in 2019, per FCGMA's technical specifications. Combined, the new nested wells are screened in the older alluvium (one each in the Oxnard aquifer equivalent, and Mugu aquifer equivalent), upper San Pedro Formation (Hueneme aquifer equivalent), and the Fox Canyon aquifer (one each in the upper and basal portions). Groundwater elevation data from these wells were incorporated into this annual report to characterize groundwater conditions at the boundary between the PVB and LPVB, and vertically between aquifers in the northern PVB.

In addition to northern Pleasant Valley, FCGMA also identified the Oxnard Pumping Depression Management Area, adjacent to the boundary between the PVB and the Oxnard Subbasin, as a critical area in which aquifer specific groundwater elevations were lacking. This is an area of known groundwater production, with wells in the area typically screened in multiple aquifers in the LAS. Similarly, in response to FCGMA's request, DWR via the TSS Program installed two nested monitoring well clusters to monitor water levels in the individual principal aquifers in the Oxnard Subbasin Pumping Depression Management Area which is contiguous with the PV Pumping Depression Management Area. These nested monitoring wells were installed specifically to address the spatial data gap identified in the GSP. Groundwater elevation data from these wells were incorporated into this annual report to better characterize groundwater conditions in the PVB and the adjacent Oxnard Subbasin.

Since completing the GSP, FCGMA continued conducting stakeholder meetings and in June 2020 a facilitator provided through DWR's Facilitation Support Services program began leading the meetings. Participants in these meetings, which included stakeholders in both the PVB and the Oxnard Subbasin, identified a suite of projects that could help the basins achieve sustainability by 2040. Significant additional projects to those identified in the GSP were discussed as part of these meetings. Upon additional evaluation, the projects committee of the stakeholder group recommended a subset of the projects identified for further assessment and modeling. FCGMA is working with UWCD to develop the numerical groundwater model scenarios that will be used to evaluate the potential effectiveness of the projects identified.

As a result of the stakeholder driven project discussions, FCGMA solicited project descriptions and details for projects that were not included in the initial GSP but have been identified since the GSP was prepared. For the PVB, these projects include:

- Development of a private surface water storage network within the PVCWD system.
- Construction of a recycled water interconnection pipeline for PVCWD.

- A seawater intrusion extraction barrier and brackish water treatment project for the UAS in the Oxnard Subbasin, and project components relevant to the PVB.
- An updated version of the Freeman Expansion project discussed in the Oxnard Subbasin GSP, and associated project components relevant to the PVB.
- Construction of a new pipeline interconnection along Laguna Road to allow conveyance of recycled water from PVCWD's system to UWCD's Pumping Trough Pipeline (PTP).
- Purchase of supplemental State Water Projected water.
- New multi-depth monitoring wells to resolve data gaps identified in the GSP.
- New shallow monitoring wells to assess groundwater conditions along Arroyo Las Posas, Conejo Creek, and Calleguas Creek in the PVB.
- Installation of pressure transducers at representative monitoring points to better constrain temporal variations in groundwater conditions.
- Study to understand the feasibility of diverting stormwater flows from the City of Camarillo's stormwater collection system to Camarillo Sanitary District's (CSD) Water Reclamation Plant, to be treated and reused for irrigation purposes.
- Study to understand the feasibility of diverting a portion of stormwater flows form Camarillo Hills Drain, near the Camarillo Airport, to the CSD sanitary sewer Pump Station No. 3.
- Study to understand the feasibility of implementing a regional stormwater capture and infiltration project in the vicinity of the Camarillo Airport.
- Study to understand the feasibility of adding stormwater infiltration or detention areas to the existing CSD flood management project.
- City of Camarillo North Pleasant Valley Desalter expansion feasibility study.
- And Houweling Nursery's indoor grow facility RO Brine Recovery System.

The details of each of these projects is provided in Appendix B. As demonstrated by the process by which additional projects were identified, the FCGMA Board of Directors continues to prioritize stakeholder feedback in the implementation phase of the GSP and recognizes the vital role stakeholders play in ensuring the long-term sustainable use of groundwater resources in the Pleasant Valley Basin.

Management Action Implementation Progress

FCGMA has made progress on several management actions since publication of the 2020 Annual Report. First, the allocation system for the Oxnard and Pleasant Valley Basins adopted by the FCGMA Board in 2019 went into effect on October 1, 2020. This allocation system is designed to "facilitate adoption and implementation of the groundwater sustainability plan and to ensure that the Basins are operated within their sustainable yields" (FCGMA, 2019c). As part of the new allocation system, FCGMA changed the reporting time periods for groundwater production to better quantify groundwater production by water-year, rather than calendar year. Additionally, the goal under the new allocation system is to eventually transition from well-based allocations to a land-based allocation. Both sets of changes will allow for improved management of the PVB and Oxnard Subbasin, which are managed jointly by the FCGMA, and a more comprehensive understanding of the water use requirements that drive groundwater production in the two basins.

Second, in anticipation of the additional reporting associated with implementing the allocation ordinance, FCGMA is conducting an analysis of its data management system needs. The updated data management system will incorporate the new AMI data and will be structured to allow for land-based extraction assignments. Changes to the data management system will target the specific needs of the FCGMA moving toward sustainable management of the PVB and Oxnard Subbasin by 2040.

Third, FCGMA has begun to evaluate implementing a replenishment fee that could be used to purchase water for recharge in the Oxnard Subbasin or to help fund a voluntary temporary fallowing program to reduce groundwater demand in the PVB. These management actions can be implemented over a shorter time period than large capital projects and, while not sufficient on their own to achieve sustainability, play an important role in progressing toward sustainable use of the groundwater resources in the PVB.

The progress made over the past year on projects and management actions applicable to the PVB demonstrates FCGMA's commitment to allocating the necessary time and resources to achieve long-term sustainable management of the groundwater resources of the PVB.

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4 References

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FCGMA (Fox Canyon Groundwater Management Agency). 2019a. Groundwater Sustainability Plan for the Pleasant Valley Basin.

FCGMA (Fox Canyon Groundwater Management Agency). 2019b. Groundwater Sustainability Plan for the Las Posas Valley Basin: Appendix K.

FCGMA (Fox Canyon Groundwater Management Agency). 2019c. Ordinance to Establish a New Pumping Allocation System for the Oxnard and Pleasant Valley Basins.

FCGMA (Fox Canyon Groundwater Management Agency). 2020a. Pleasant Valley Basin Groundwater Sustainability Plan 2020 Annual Report: Covering Water Years 2016 through 2019.

FCGMA (Fox Canyon Groundwater Management Agency). 2021. Pleasant Valley Basin Groundwater Sustainability Plan 2021 Annual Report: Covering Water Year 2020.

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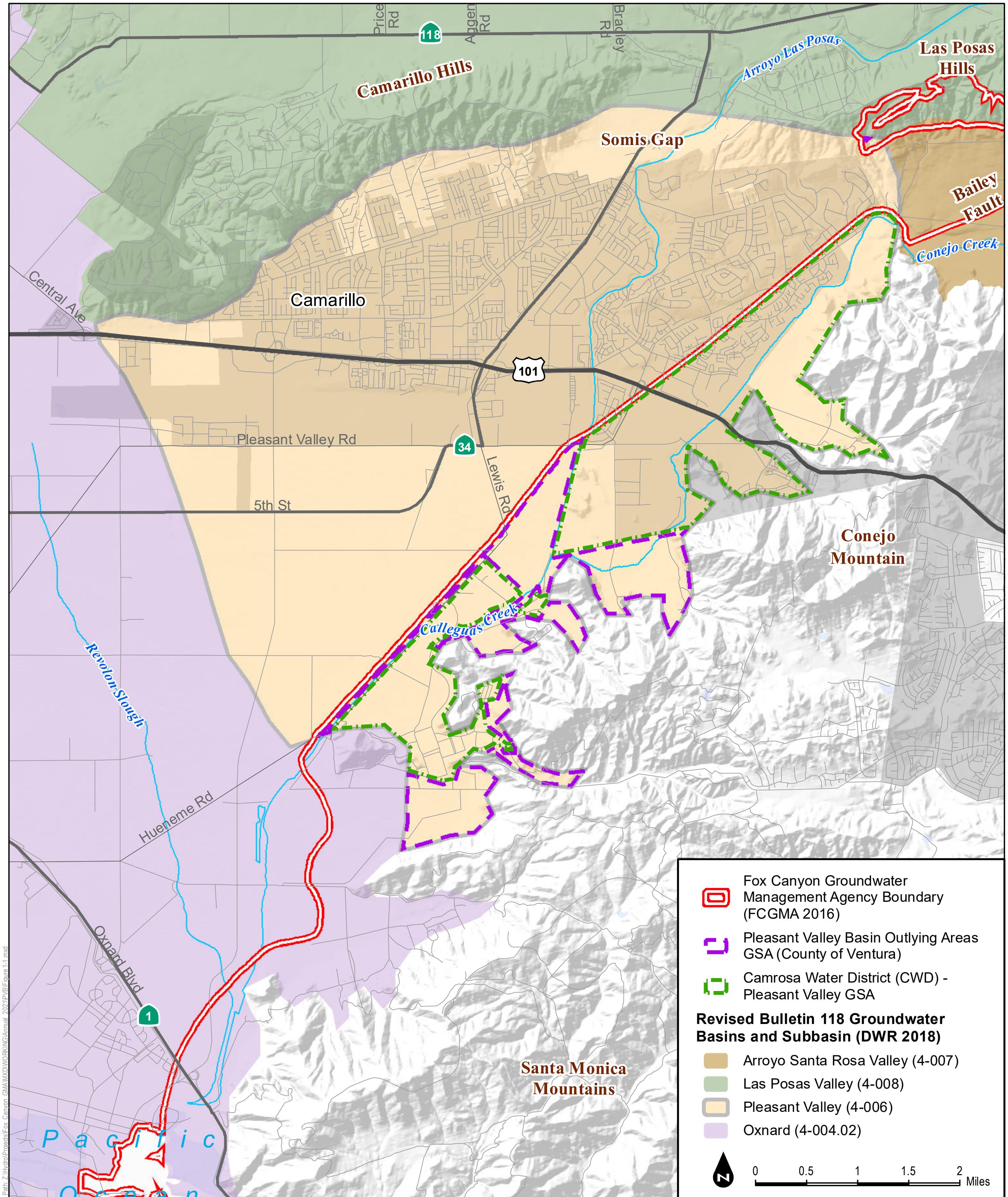
5 Figures



SOURCE: DWR; Ventura County; FCGMA

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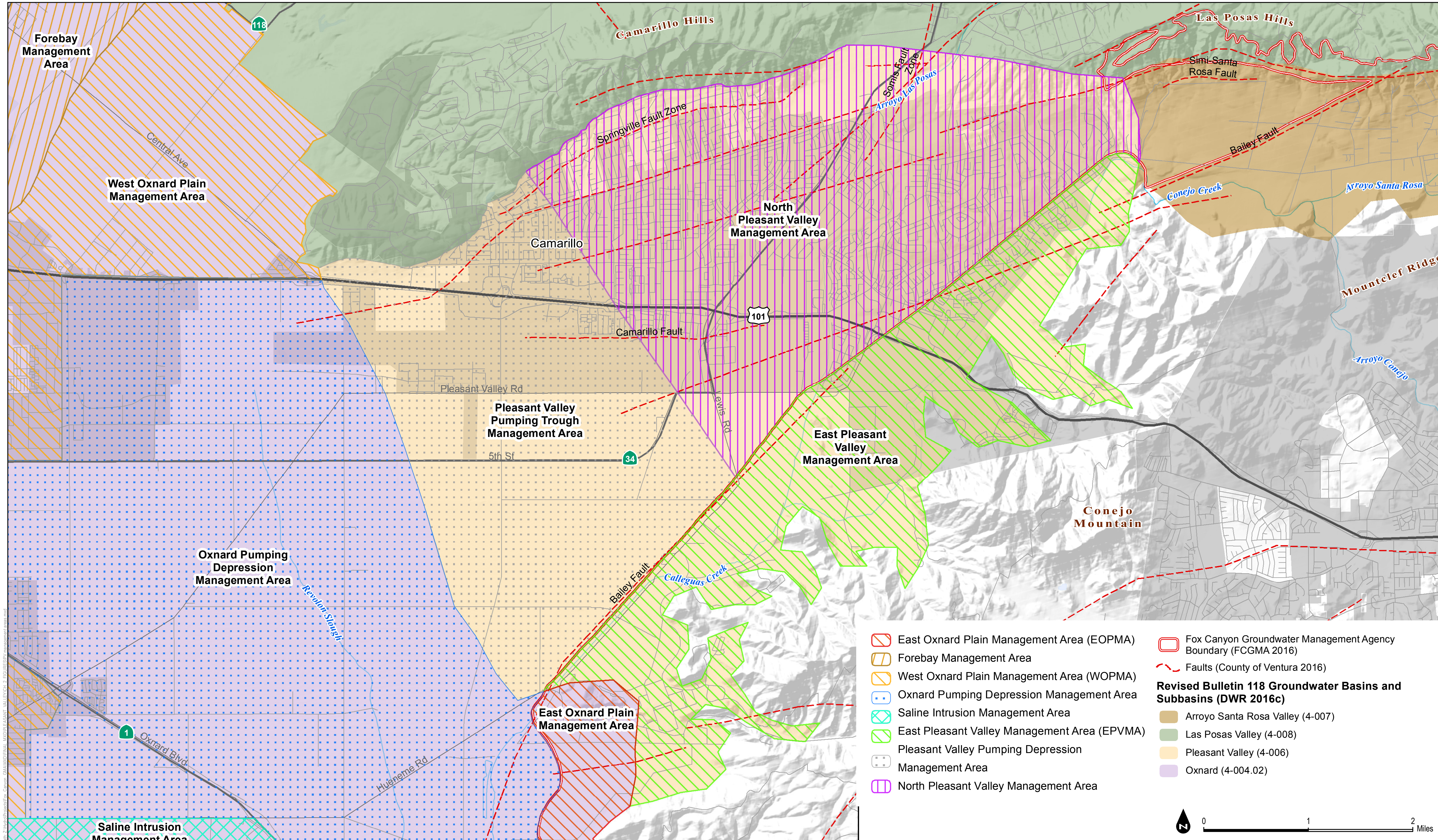
FIGURE 1-1

Vicinity Map for the Pleasant Valley Basin

Pleasant Valley Basin Groundwater Sustainability Plan 2022 Annual Report



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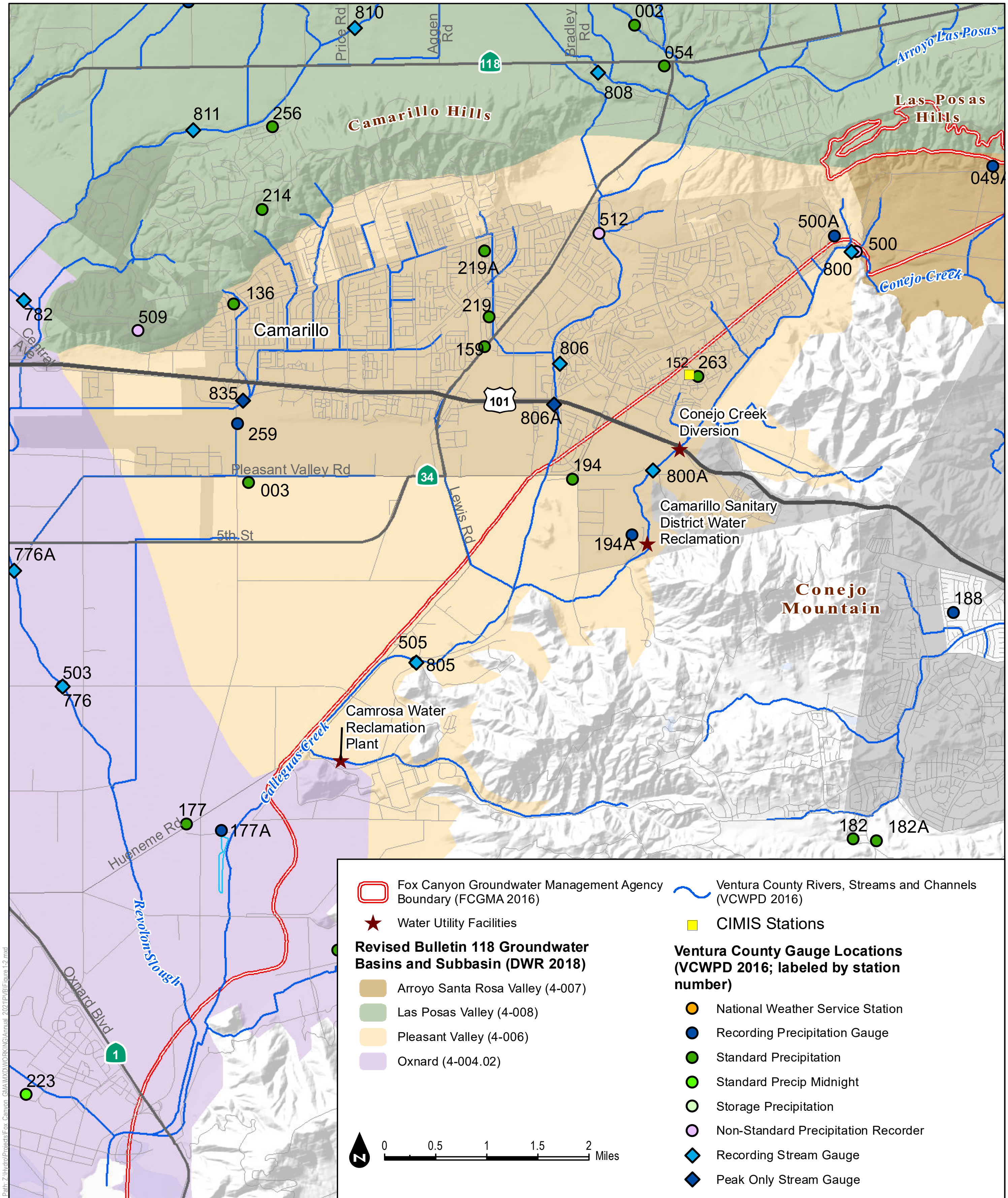
SOURCE: DWR; County of Ventura

FIGURE 1-2

Pleasant Valley Basin Management Areas



SOURCE: DWR; Ventura County; VCWPD

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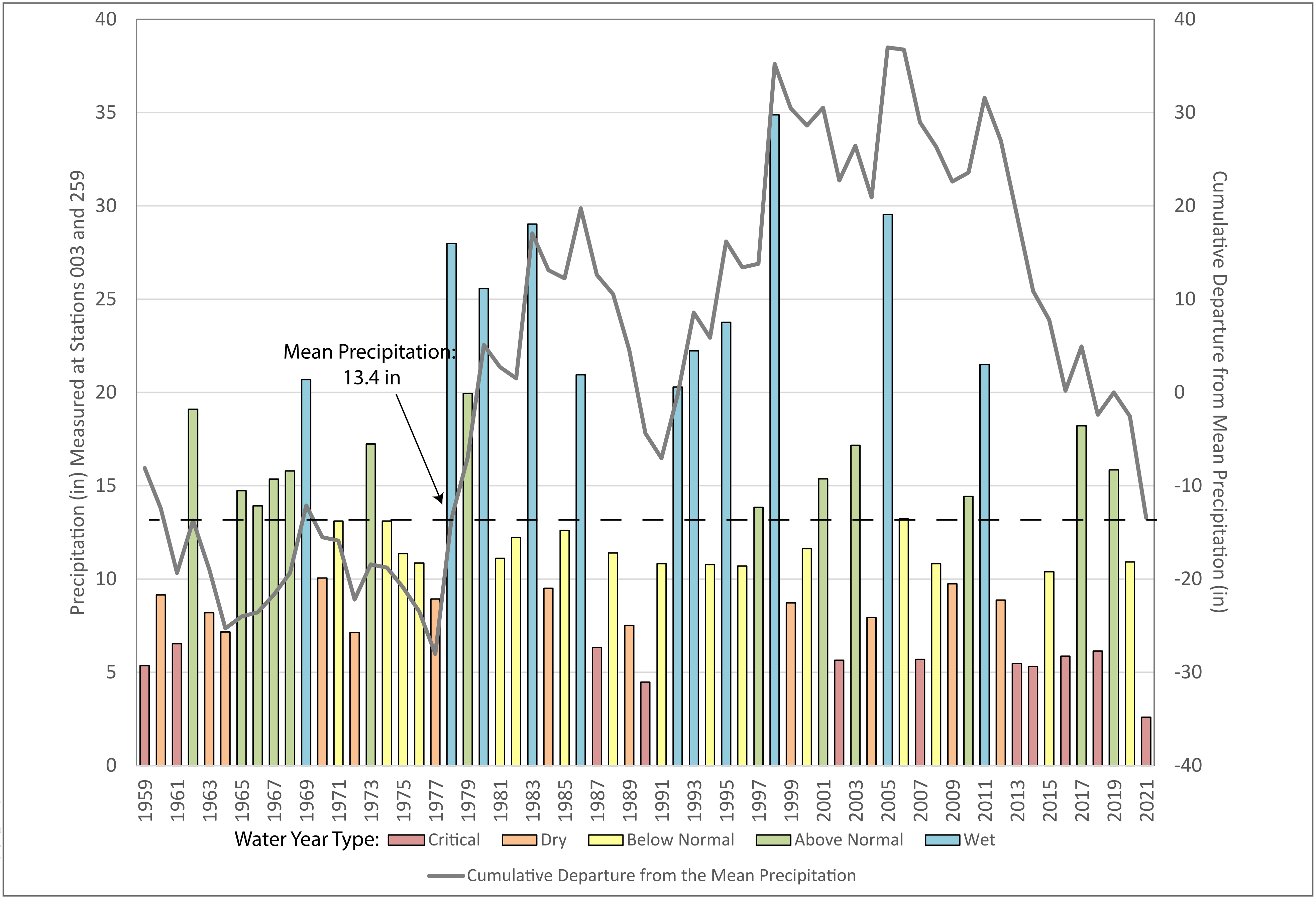
FIGURE 1-3

Pleasant Valley Basin Weather Station and Stream Gauge Locations

Pleasant Valley Basin Groundwater Sustainability Plan 2022 Annual Report



Note: Water year is from October 1 through September 30. Water year type is based on the percentage of the water year precipitation compared to the mean precipitation. Types are defined as: Wet (≥150% of mean), Above Normal (≥100% to <150% of mean), Below Normal (≥75% to <100% of mean), Dry (≥50% to <75% of average), and Critical (<50% of mean)

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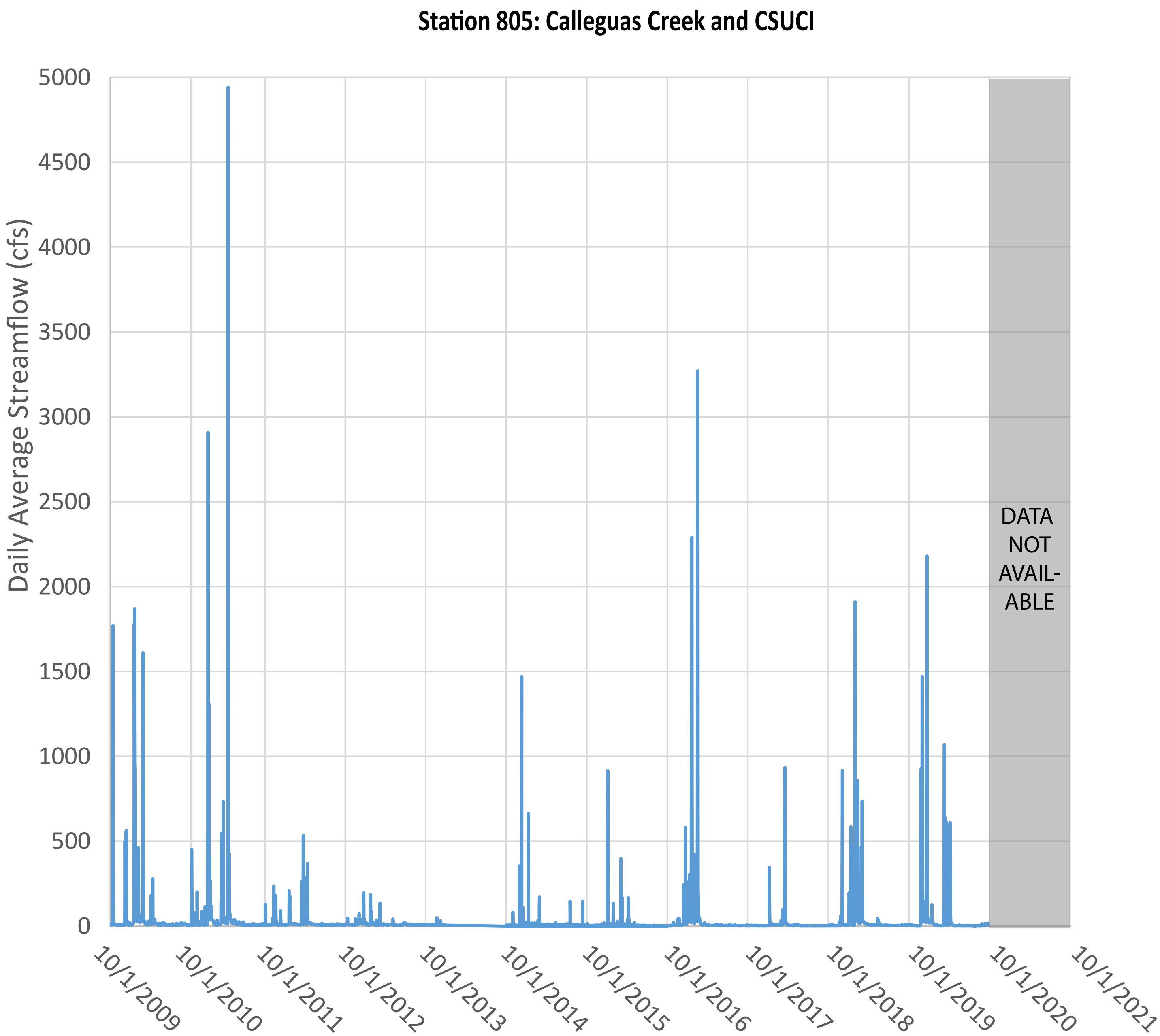
FIGURE 1-4

Pleasant Valley Basin Historical Water Year Precipitation



SOURCE: Ventura County Watershed Protection District (VCWPD) Hydrologic Data Server (https://www.vcwatershed.net/hydrodata/)

FIGURE 1-5

Pleasant Valley Basin Stream Gauge Data

Pleasant Valley Basin Groundwater Sustainability Plan 2022 Annual Report

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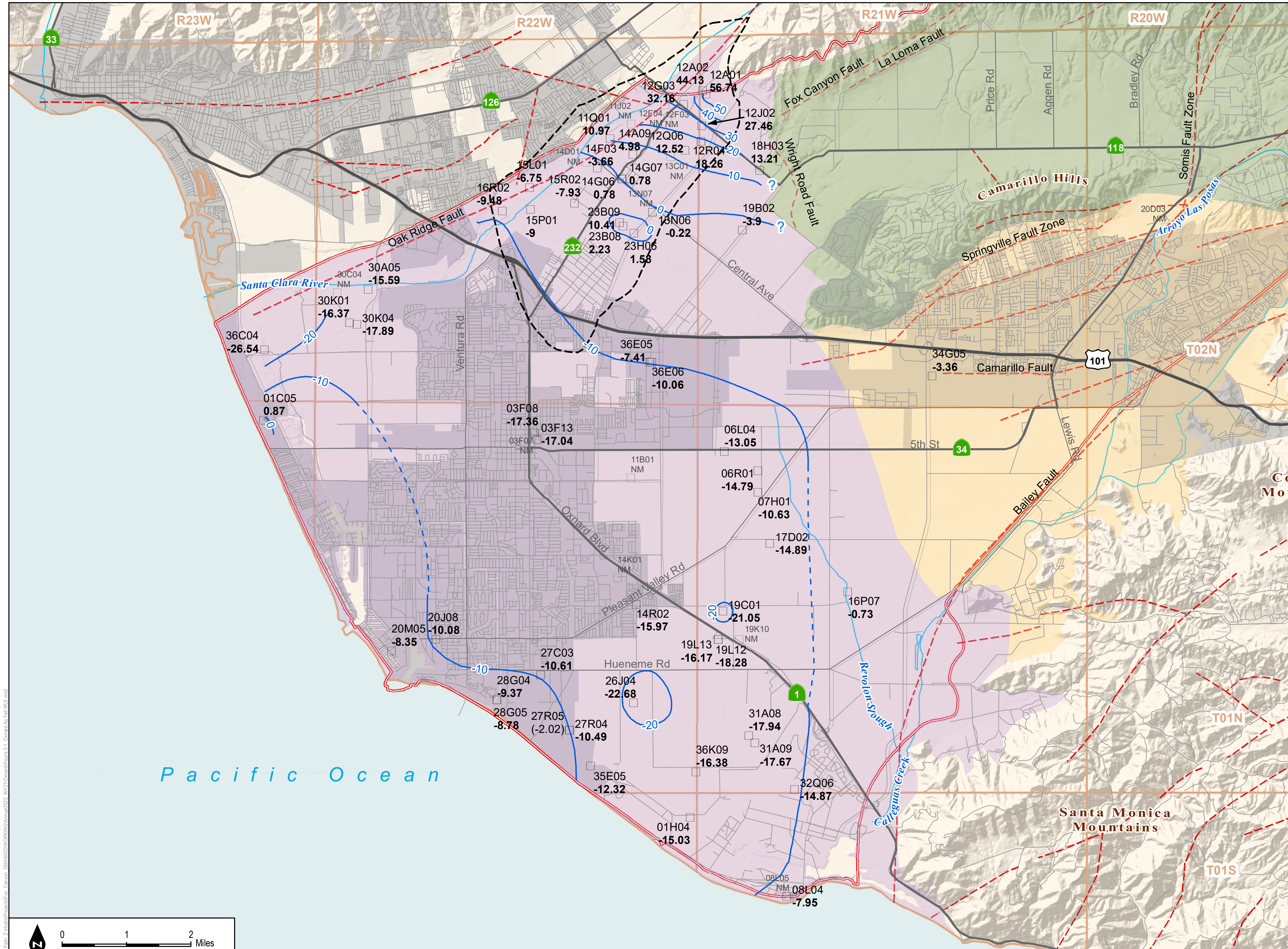


Legend

- Approximate contour of equal elevation (feet amsl) of groundwater. Dashed where approximate; queried where inferred.
- Wells screened in the Oxnard Aquifer
- Forebay Management Area
- *15P01* Abbreviated State Well Number (see notes)
- (-14.7) Groundwater elevations are not used to create contours (see notes)
- **-14.7** Groundwater elevation feet AMSL
- 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 2018)

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

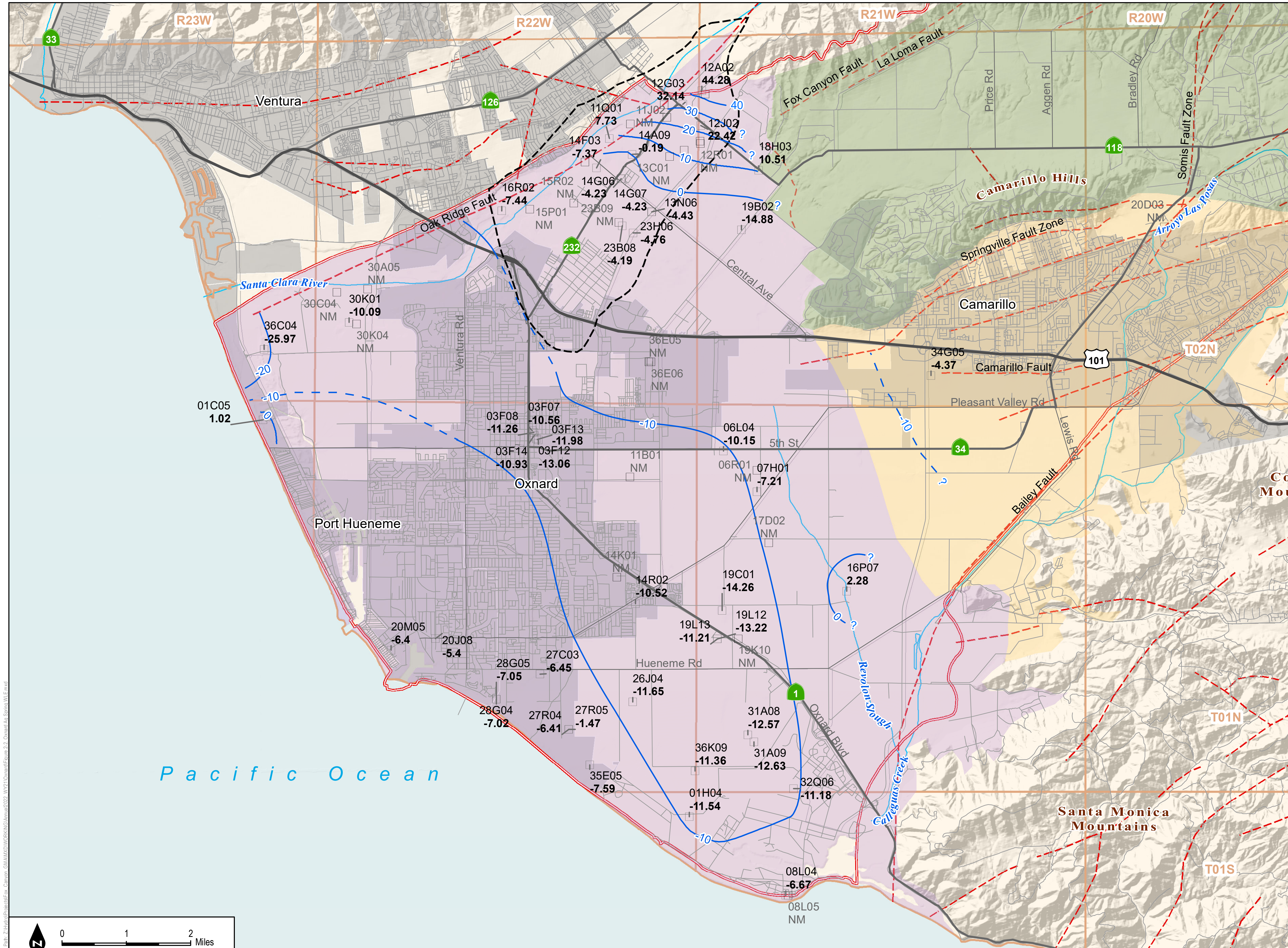
Notes:
1) Well labels consist of an italicized abbreviated State Well Number (SWN) and a groundwater elevation beneath it. SWNs are based on Township and Range in the Public Land Survey System. To construct a full SWN from the abbreviation shown on the map, concatenate the Township, Range, abbreviation, and the letter "S". Example: the SWN for the well labeled "15L01" located in Township 02N (T02N) and Range 22W (R22W) is 02N22W15L01S. Geotracker wells do not have SWN IDs and so are not labeled.
2) "NM" indicates no water level measurement was collected within the specified time window.
3) Groundwater elevations not used to create contours are shown in parentheses.
4) All elevation values are in feet above mean sea level (ft AMSL).
5) Aquifer designation information for individual wells was provided by FCGMA, CMWD and UWCD.

DUDEK

SOURCE: DWR; Ventura County; UWCD; CMWD

FIGURE 2-1

Groundwater Elevation Contours in the Oxnard Aquifer, October 2 to October 31, 2020



Legend

- Approximate contour of equal elevation (feet amsl) of groundwater. Dashed where approximate; queried where inferred.
- Wells screened in the Oxnard Aquifer
- Forebay Management Area
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- Las Posas Valley (4-008)
- Pleasant Valley (4-006)
- Oxnard (4-004.02)

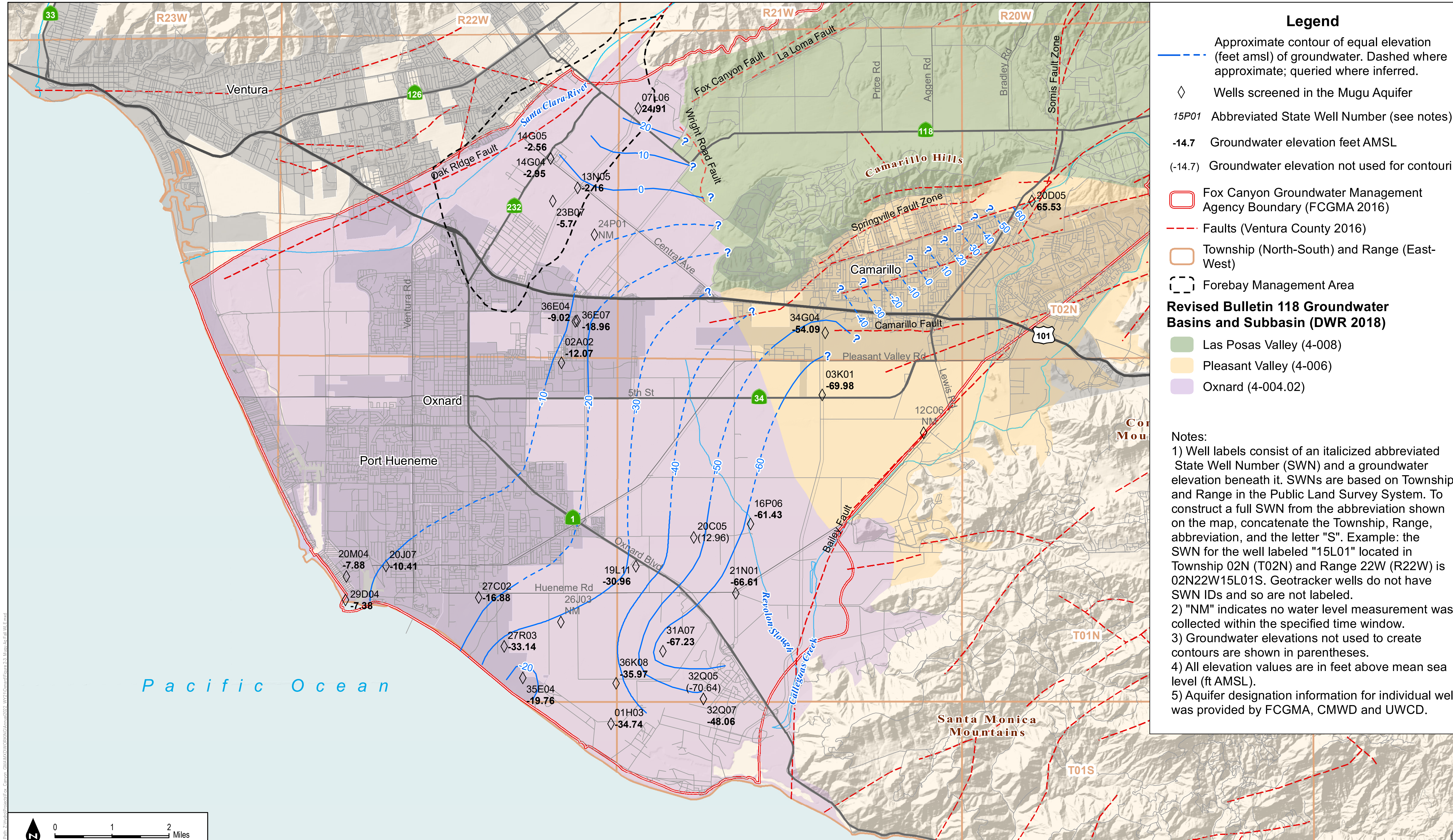
Notes:
1) Well labels consist of an italicized abbreviated State Well Number (SWN) and a groundwater elevation beneath it. SWNs are based on Township and Range in the Public Land Survey System. To construct a full SWN from the abbreviation shown on the map, concatenate the Township, Range, abbreviation, and the letter "S". Example: the SWN for the well labeled "15L01" located in Township 02N (T02N) and Range 22W (R22W) is 02N22W15L01S. Geotracker wells do not have SWN IDs and so are not labeled.
2) "NM" indicates no water level measurement was collected within the specified time window.
3) Groundwater elevations not used to create contours are shown in parentheses.
4) All elevation values are in feet above mean sea level (ft AMSL).
5) Aquifer designation information for individual wells was provided by FCGMA, CMWD and UWCD.

DUDEK

SOURCE: DWR; Ventura County; UWCD; CMWD

FIGURE 2-2

Groundwater Elevation Contours in the Oxnard Aquifer, March 2 to March 29, 2021

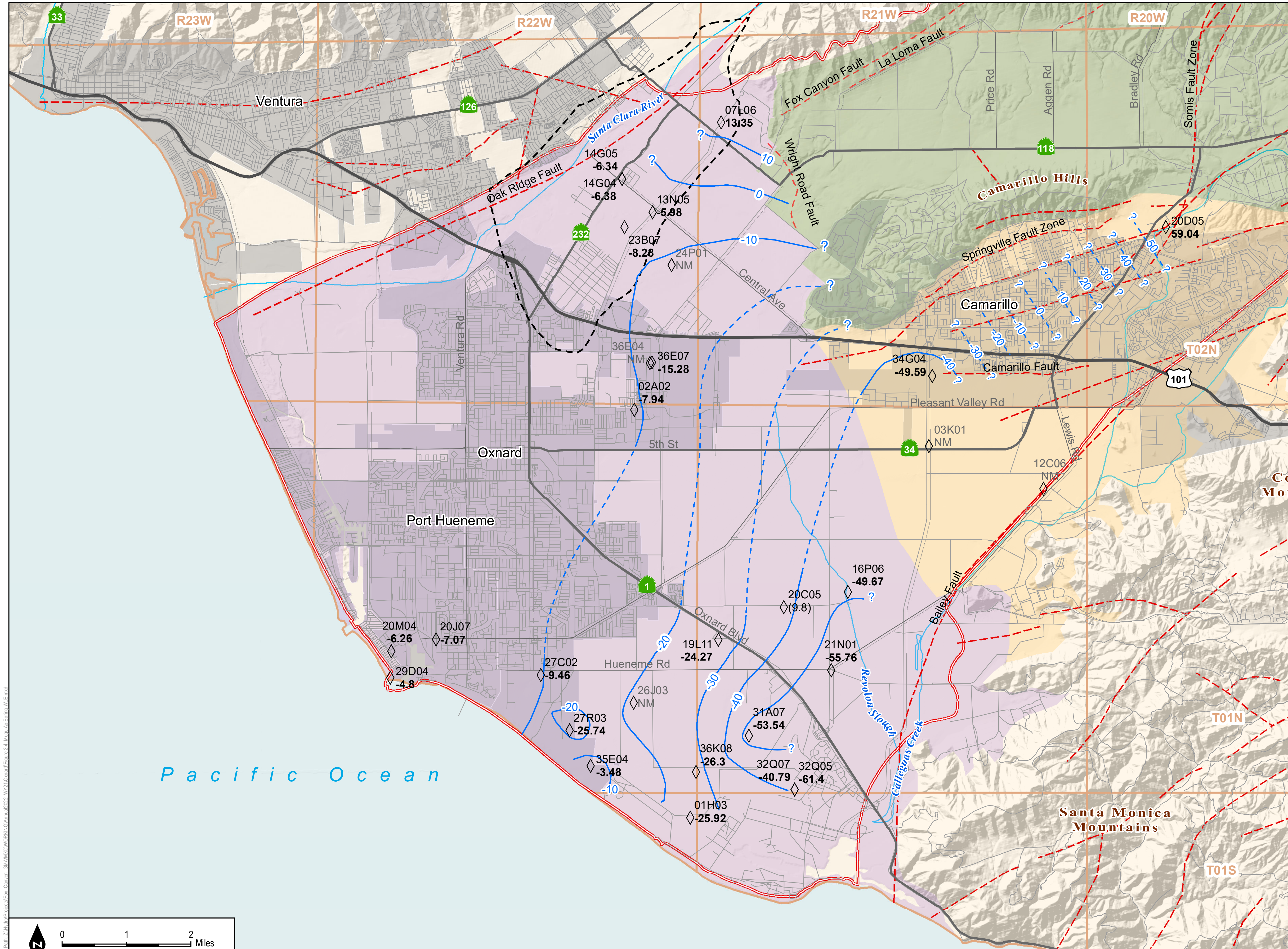


DUDEK

SOURCE: DWR; Ventura County; UWCD; CMWD

FIGURE 2-3

Groundwater Elevation Contours in the Mugu Aquifer, October 2 to October 31, 2020



Legend

Approximate contour of equal elevation (feet amsl) of groundwater. Dashed where approximate; queried where inferred.

◊ Well screened in the Mugu Aquifer

15P01 Abbreviated State Well Number (see notes)

-14.7 Groundwater elevation feet AMSL

(-14.7) Groundwater elevation not used for contouring

Fox Canyon Groundwater Management Agency Boundary (FCGMA 2016)

Faults (Ventura County 2016)

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

Forebay Management Area

Revised Bulletin 118 Groundwater Basins and Subbasin (DWR 2018)

Las Posas Valley (4-008)

Pleasant Valley (4-006)

Oxnard (4-004.02)

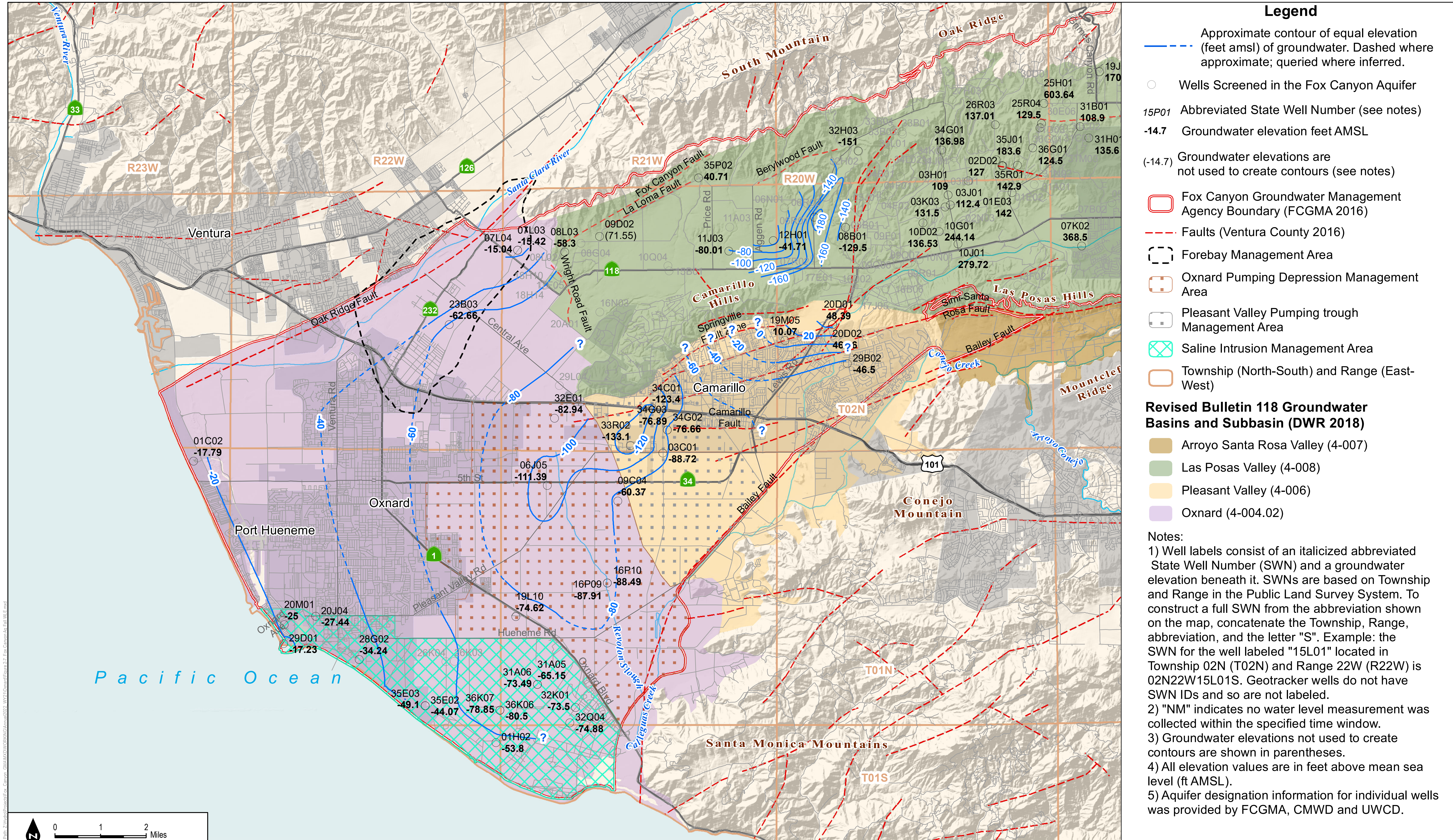
Notes:
1) Well labels consist of an italicized abbreviated State Well Number (SWN) and a groundwater elevation beneath it. SWNs are based on Township and Range in the Public Land Survey System. To construct a full SWN from the abbreviation shown on the map, concatenate the Township, Range, abbreviation, and the letter "S". Example: the SWN for the well labeled "15L01" located in Township 02N (T02N) and Range 22W (R22W) is 02N22W15L01S. Geotracker wells do not have SWN IDs and so are not labeled.
2) "NM" indicates no water level measurement was collected within the specified time window.
3) Groundwater elevations not used to create contours are shown in parentheses.
4) All elevation values are in feet above mean sea level (ft AMSL).
5) Aquifer designation information for individual wells was provided by FCGMA, CMWD and UWCD.

DUDEK

SOURCE: DWR; Ventura County; UWCD; CMWD

FIGURE 2-4

Groundwater Elevation Contours in the Mugu Aquifer, March 2 to March 29, 2021

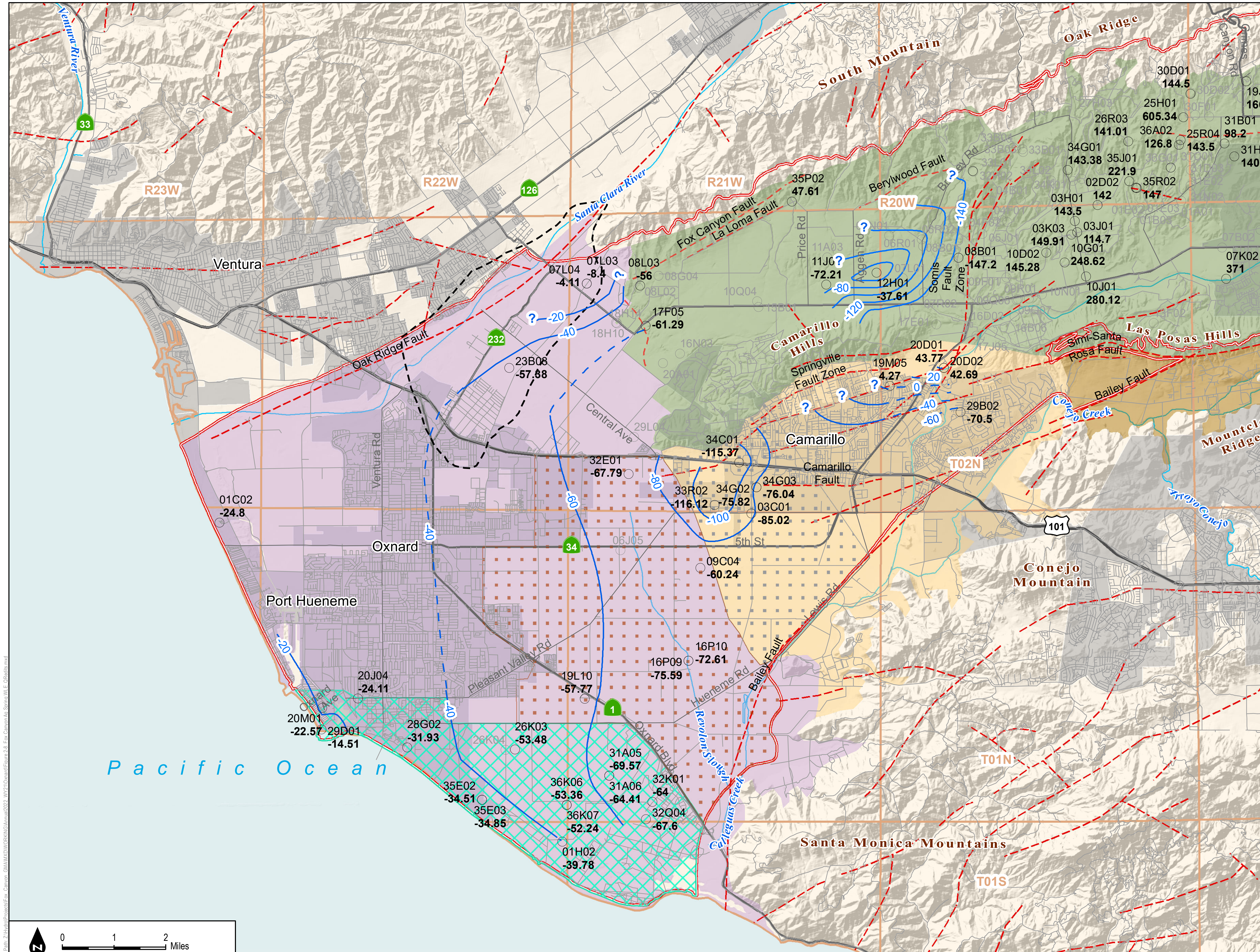


SOURCE: DWR; Ventura County; UWCD; CMWD

FIGURE 2-5

Groundwater Elevation Contours in the Fox Canyon Aquifer, October 2 to October 31, 2020

DUDEK



Legend

- Approximate contour of equal elevation (feet amsl) of groundwater. Dashed where approximate; queried where inferred.
- Wells Screened in the Fox Canyon Aquifer
- *15P01* Abbreviated State Well Number (see notes)
- **-14.7** Groundwater elevation feet AMSL
- (-14.7) Groundwater elevations are not used to create contours (see notes)
- Fox Canyon Groundwater Management Agency Boundary (FCGMA 2016)
- Faults (Ventura County 2016)
- Township (North-South) and Range (East-West)
- Pleasant Valley Pumping trough Management Area
- Oxnard Pumping Depression Management Area
- Saline Intrusion Management Area
- Forebay Management Area

Revised Bulletin 118 Groundwater Basins and Subbasin (DWR 2018)

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

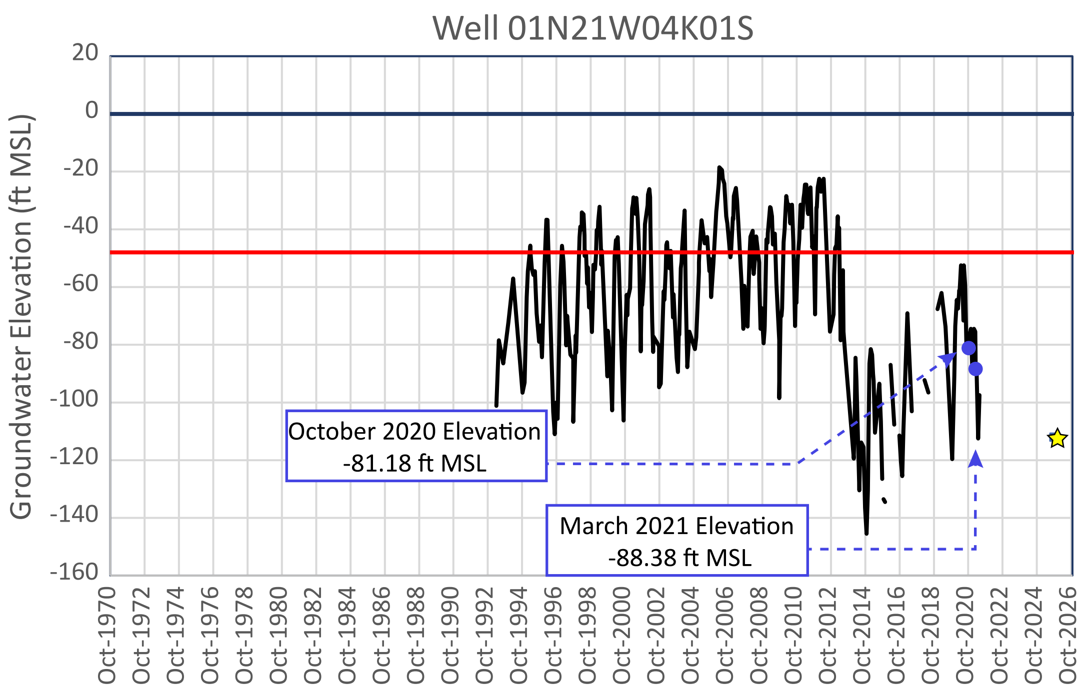
Notes:
1) Well labels consist of an italicized abbreviated State Well Number (SWN) and a groundwater elevation beneath it. SWNs are based on Township and Range in the Public Land Survey System. To construct a full SWN from the abbreviation shown on the map, concatenate the Township, Range, abbreviation, and the letter "S". Example: the SWN for the well labeled "15L01" located in Township 02N (T02N) and Range 22W (R22W) is 02N22W15L01S. Geotracker wells do not have SWN IDs and so are not labeled.
2) "NM" indicates no water level measurement was collected within the specified time window.
3) Groundwater elevations not used to create contours are shown in parentheses.
4) All elevation values are in feet above mean sea level (ft AMSL).
5) Aquifer designation information for individual wells was provided by FCGMA, CMWD and UWCD.

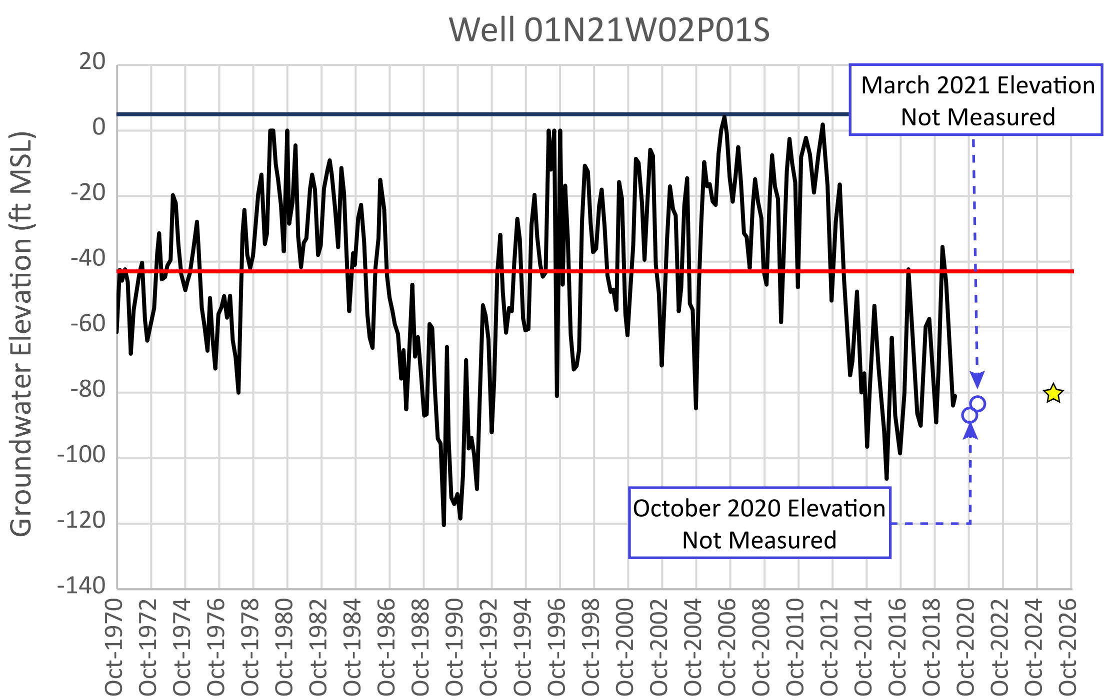
DUDEK

SOURCE: DWR; Ventura County; UWCD; CMWD

FIGURE 2-6

Groundwater Elevation Contours in the Fox Canyon Aquifer, March 2 to March 29, 2021





Groundwater Elevation   Minimum Threshold   Measurable Objective   2025 Interim Milestone for dry climate conditions

Measurement not collected between October 2 and October 31, 2020 or March 2 and March 29, 2021

FIGURE 2-7

Groundwater Elevation Hydrographs for Representative Wells Screened in Multiple Aquifers

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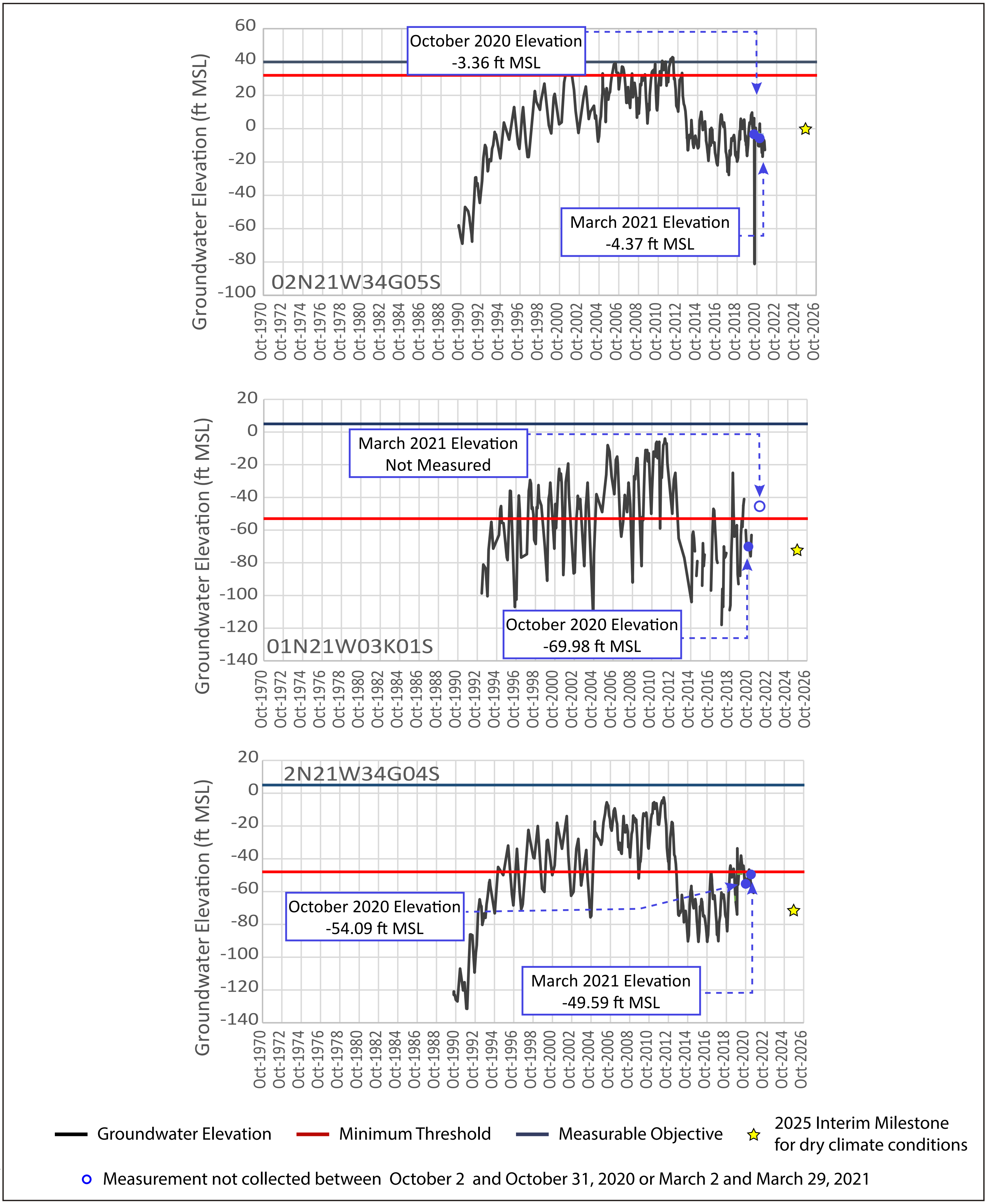

FIGURE 2-8

Groundwater Elevation Hydrographs for Representative Wells Screened in the Older Alluvium

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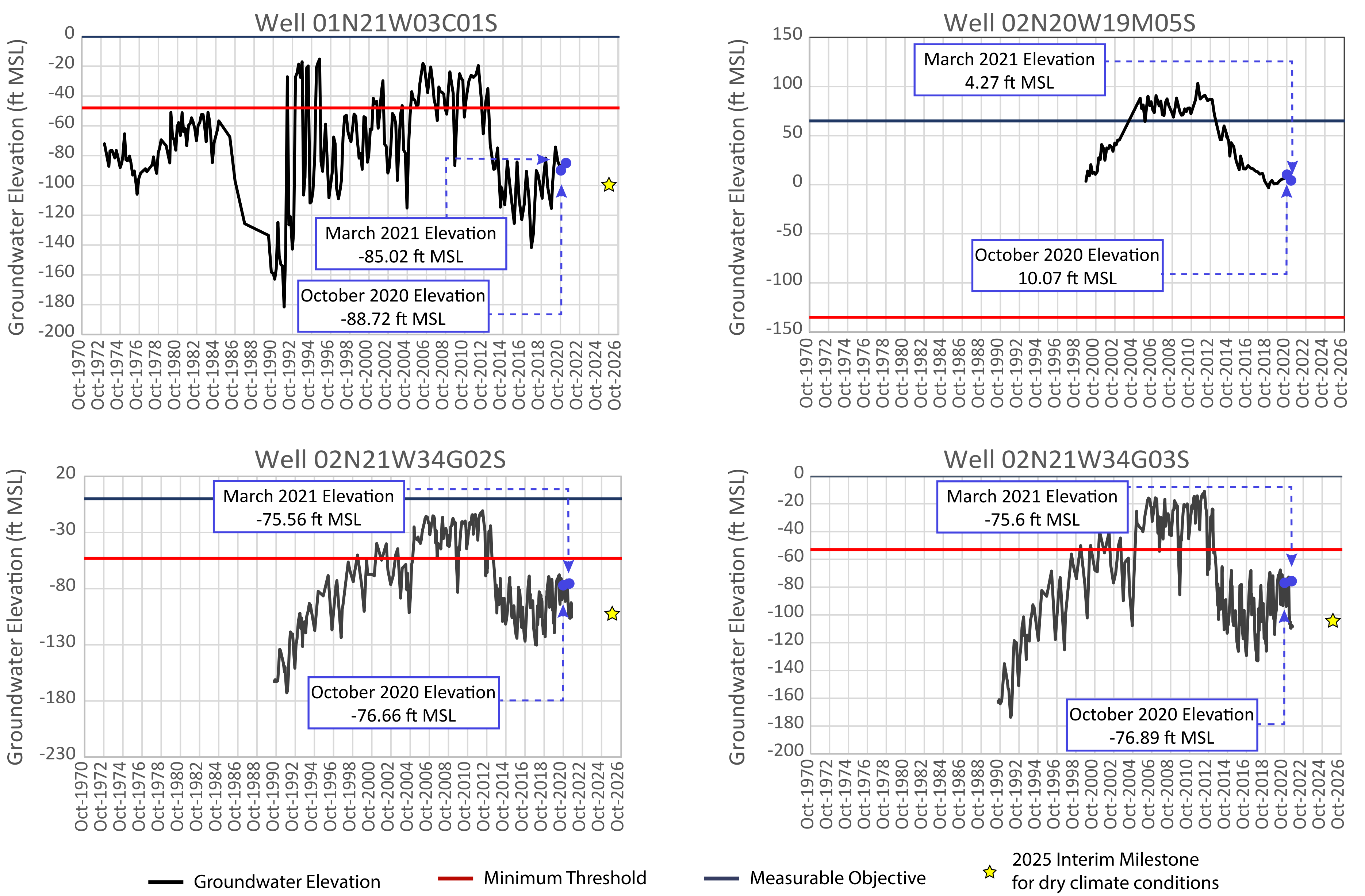

Note: 2025 interim milestone groundwater elevation has not been established for 02N20W19M05S because groundwater elevations are more than 100 feet higher than the established minimim threshold groundwater elevation.

FIGURE 2-9

Groundwater Elevation Hydrographs for Representative Wells Screened in the Fox Canyon Aquifer

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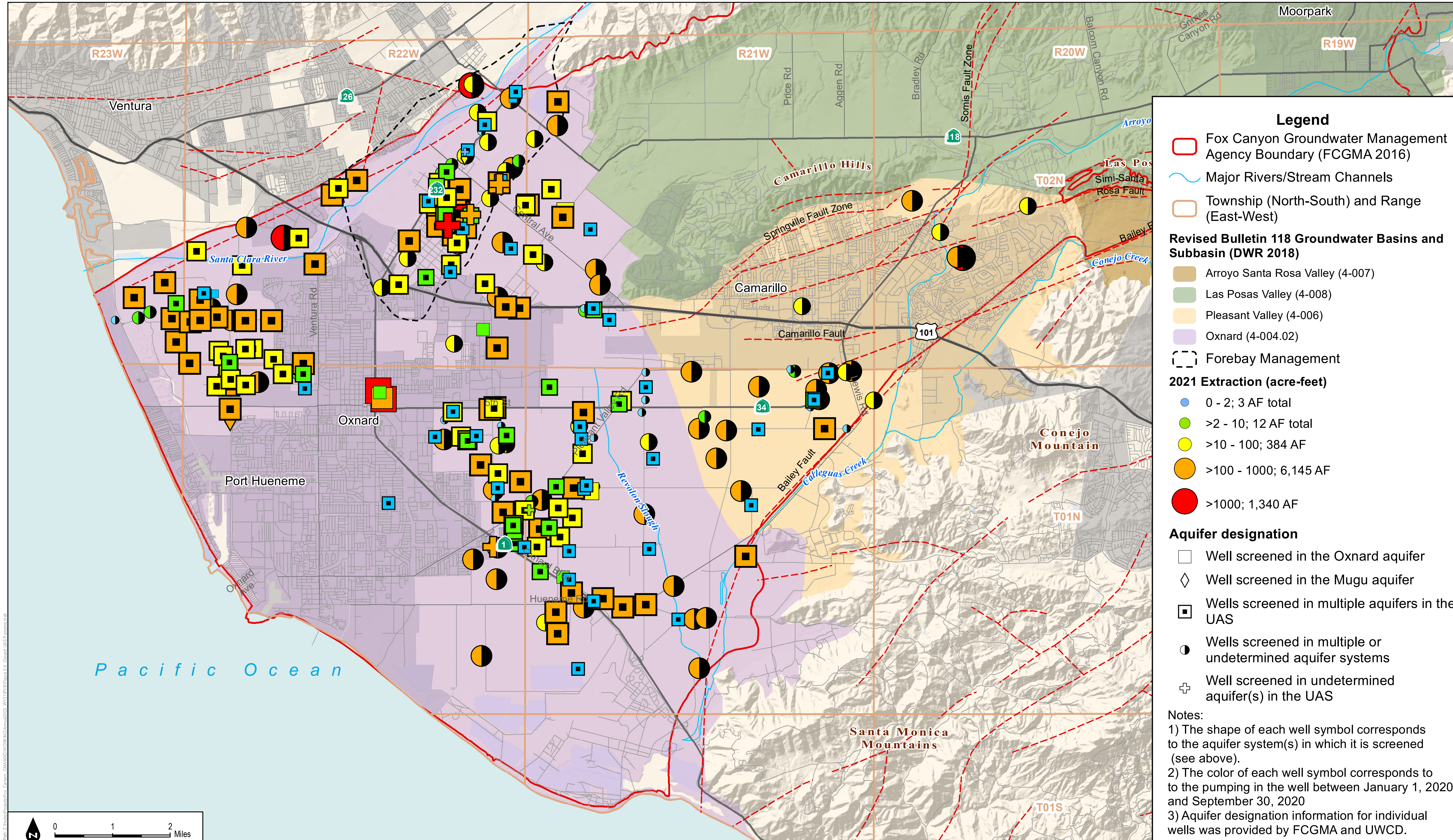
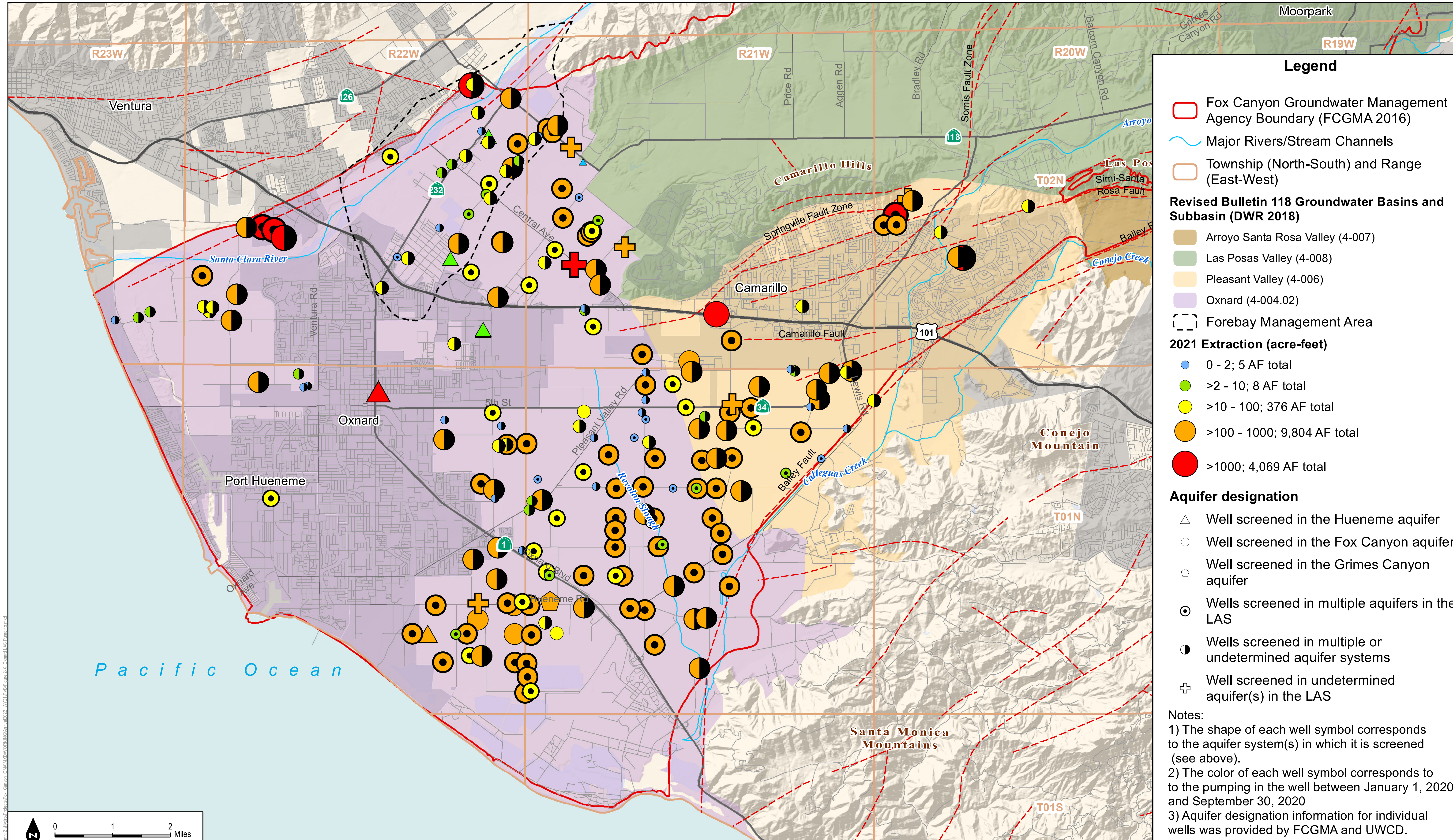


SOURCE: DWR, FCGMA, VCWPD, UWCD

FIGURE 2-10

Groundwater Production from the UAS between October 1, 2020 and September 30, 2021

DUDEK

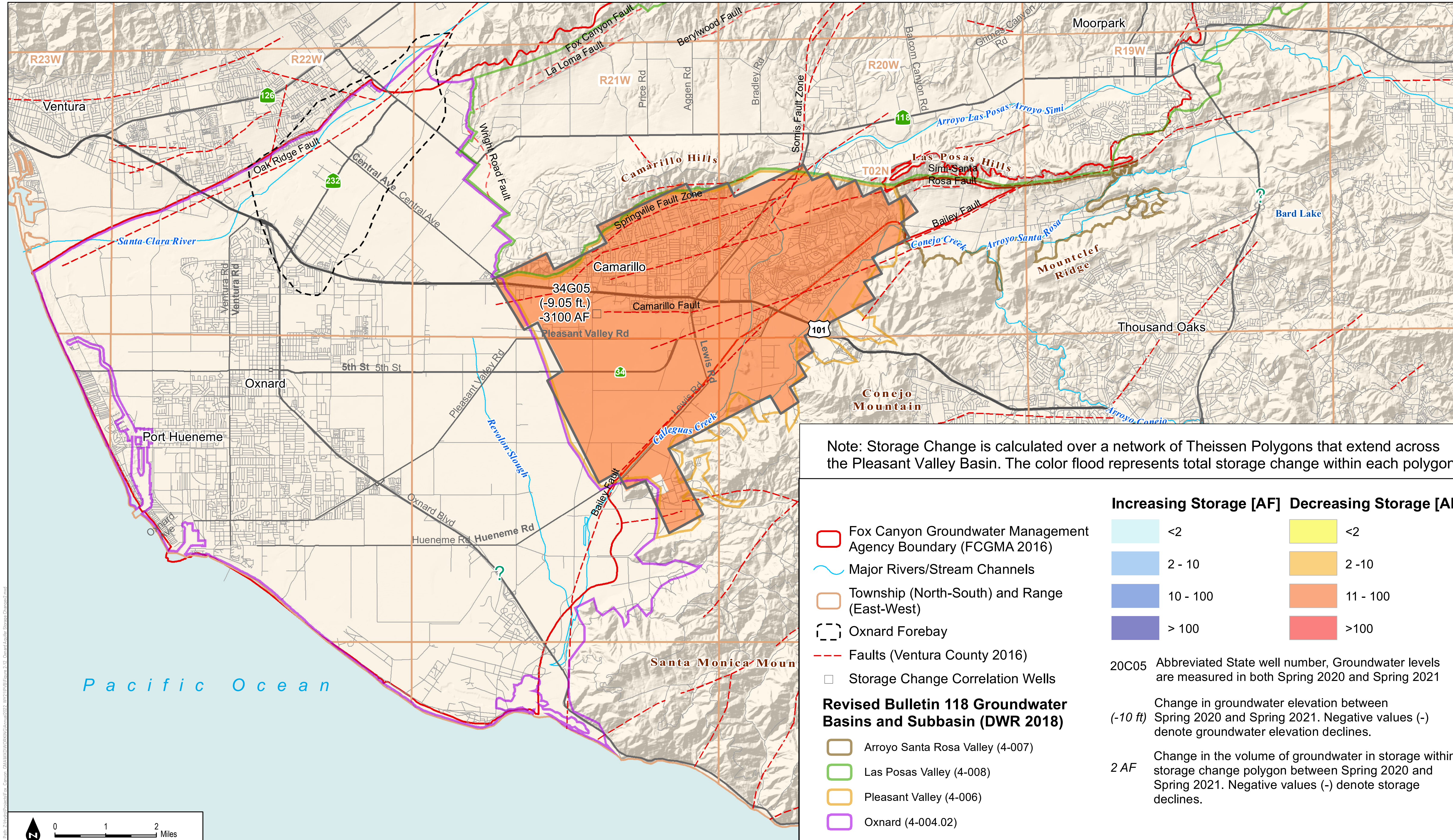


SOURCE: DWR, FCGMA, VCWPD, UWCD

FIGURE 2-11

Groundwater Production from the LAS between October 1, 2020 and September 30, 2021

DUDEK

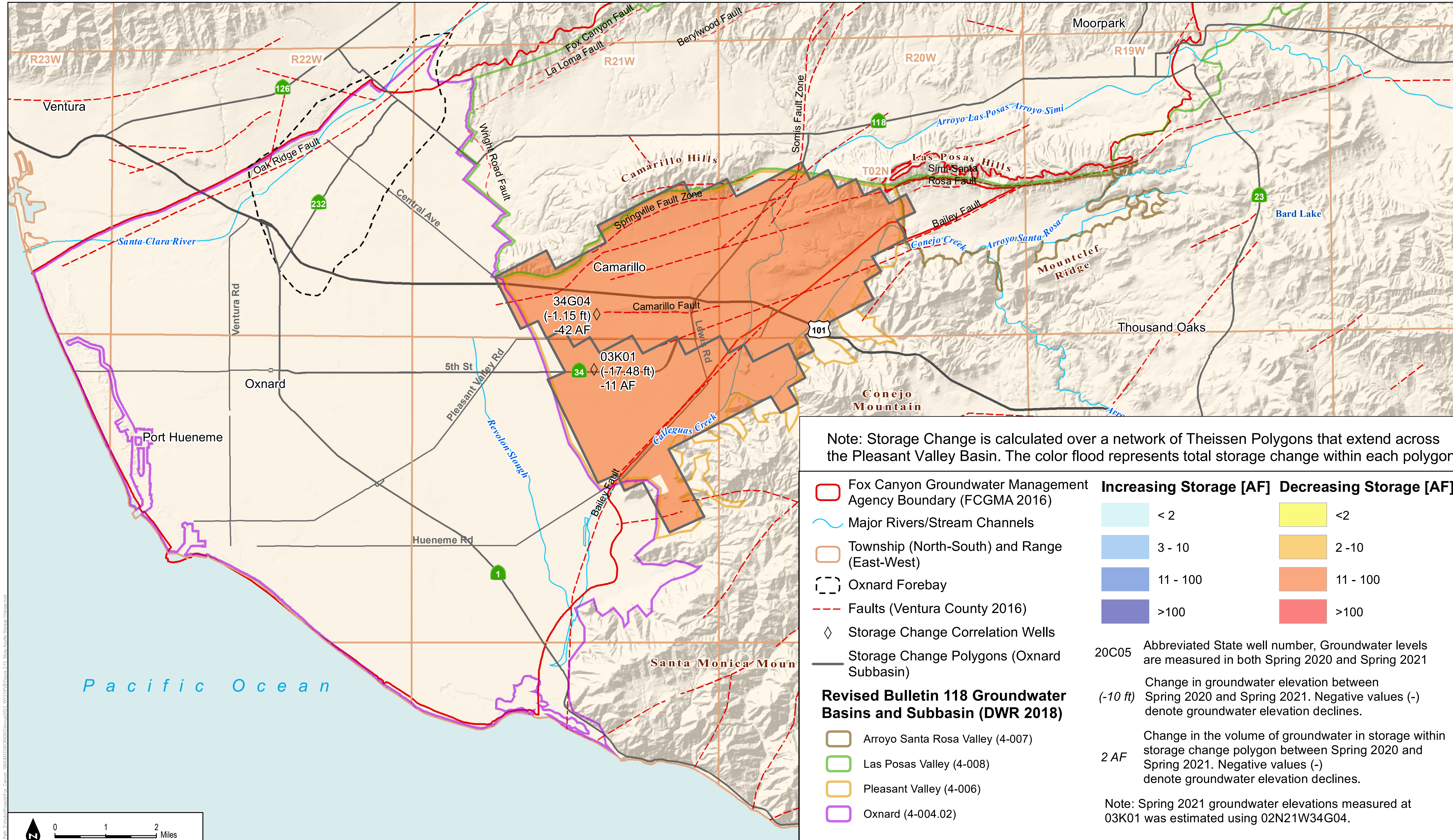


DUDEK

SOURCE: DWR, FCGMA, VCWPD, CMWD, UWCD

FIGURE 2-12

Change in Storage in the Oxnard Aquifer: Spring 2020 to Spring 2021

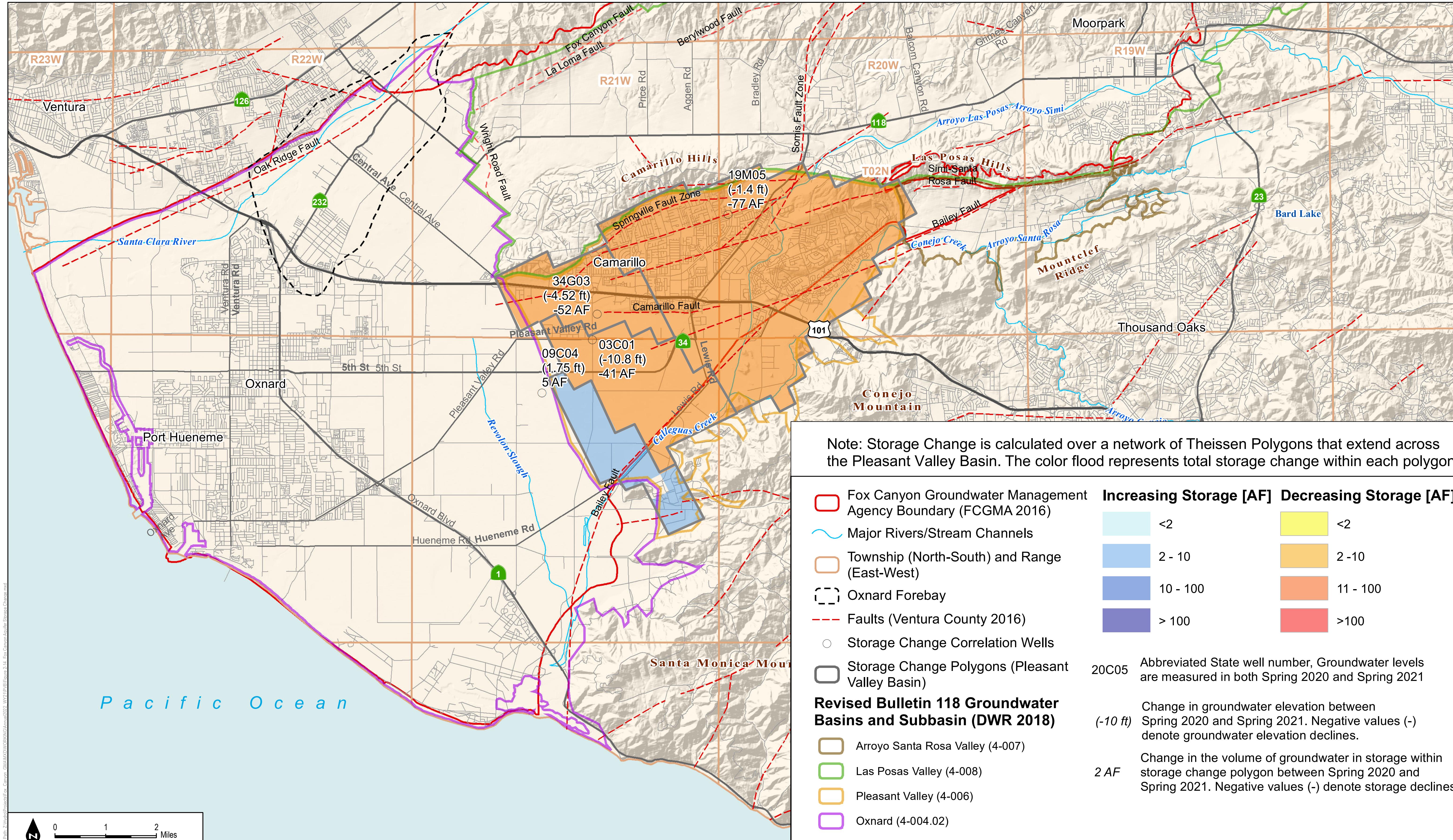


DUDEK

SOURCE: DWR, FCGMA, VCWPD, CMWD, UWCD

FIGURE 2-13

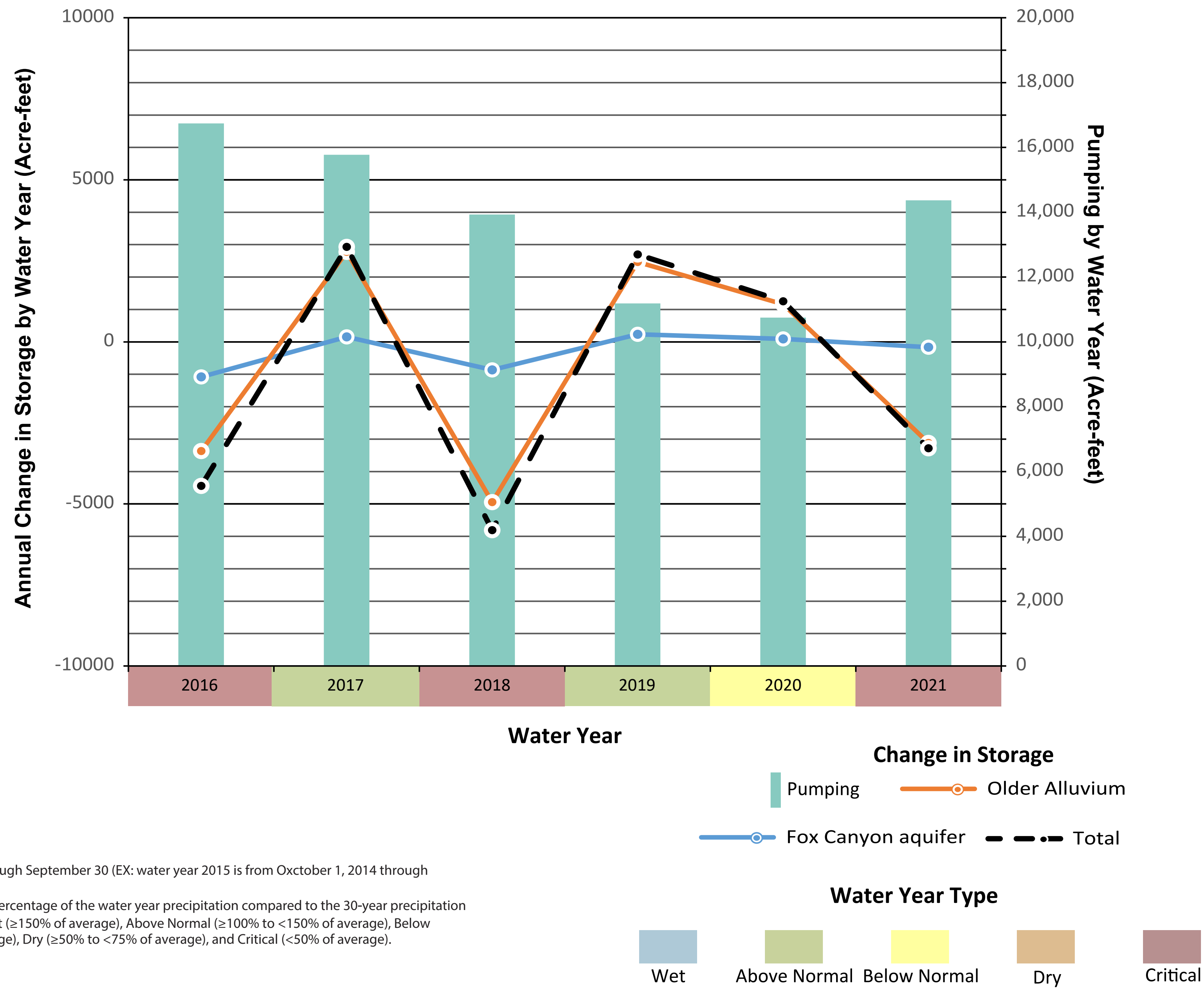
Change in Storage in the Mugu Aquifer: Spring 2020 to Spring 2021



SOURCE: DWR, FCGMA, VCWPD, CMWD, UWCD

FIGURE 2-14

Change in Storage in the Fox Canyon Aquifer: Spring 2020 to Spring 2021

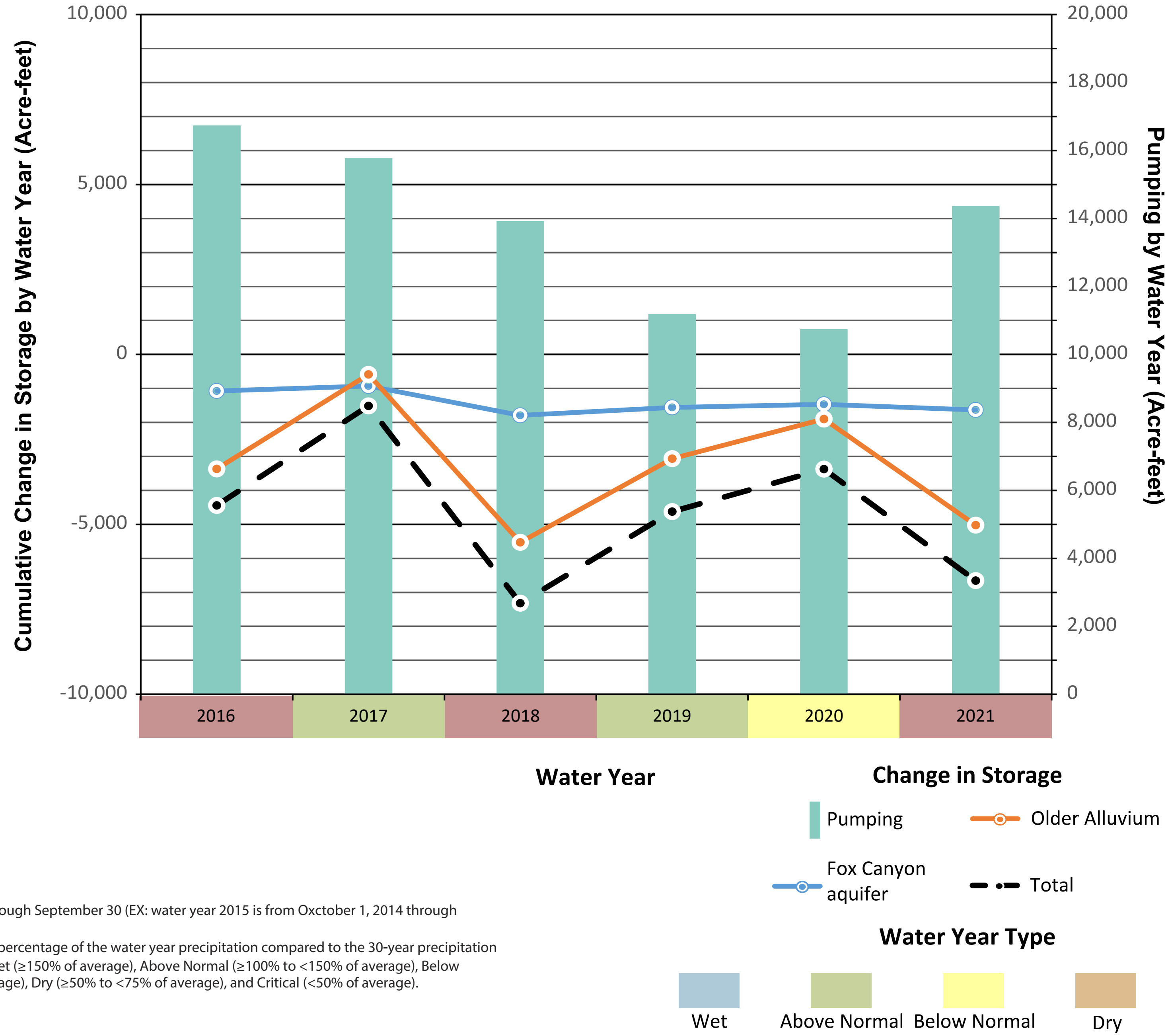


Notes:

1) Water year is from October 1 through September 30 (EX: water year 2015 is from Oxctober 1, 2014 through September 30, 2015).
2) Water year type is based on the percentage of the water year precipitation compared to the 30-year precipitation average. Types are defined as Wet (≥150% of average), Above Normal (≥100% to <150% of average), Below Normal (≥75% to <100% of average), Dry (≥50% to <75% of average), and Critical (<50% of average).

FIGURE 2-15

Water Year Type, Groundwater Use, and Annual Change in Storage in the Pleasant Valley Basin



Notes:

1) Water year is from October 1 through September 30 (EX: water year 2015 is from Oxctober 1, 2014 through September 30, 2015).
2) Water year type is based on the percentage of the water year precipitation compared to the 30-year precipitation average. Types are defined as Wet (≥150% of average), Above Normal (≥100% to <150% of average), Below Normal (≥75% to <100% of average), Dry (≥50% to <75% of average), and Critical (<50% of average).

FIGURE 2-16

Water Year Type, Groundwater Use, and Cumulative Change in Storage in the Pleasant Valley Basin

Appendix A: Change in Storage Technical Memorandum

A.1 Background

The Sustainable Groundwater Management Act's Emergency Groundwater Sustainability Plan Regulations require each Agency to submit an annual report by April 1 of each year characterizing the previous water year groundwater conditions, groundwater usage, and total water supplies (CWC 10733.2). As part of this, each agency is required to quantify the water year change in groundwater storage for each principal aquifer defined in the GSP (§356.2 (5)(A) and §356.2 (5)(B)). The FCGMA has computed annual change in groundwater storage for water years 2016 through 2020 as part of the 2020 and 2021 Annual Reports prepared for the Oxnard Subbasin and Pleasant Valley Basin. These estimates of change in groundwater in storage were computed by mapping spring groundwater elevation contours for each water year onto a uniform grid that covered the areal extent of the Oxnard Subbasin, Pleasant Valley Basin, and West Las Posas Management Area of the Las Posas Valley Basin. The difference in spring groundwater elevation maps was then computed for each consecutive water year and multiplied by the aquifer properties extracted from the Ventura Regional Groundwater Flow Model (UWCD 2018) to calculate localized changes in the volume of groundwater in storage. The total change in groundwater in storage for each principal aquifer was computed by summing the change in groundwater storage values across the entire uniform grid.

As noted in the 2020 and 2021 Annual Reports, this method for estimating storage change is sensitive to the contouring methods, and, importantly, to the network of groundwater elevation monitoring wells sampled each year (FCGMA 2020a, 2020b, 2021a, 2021b). Because the same wells were not consistently monitored during consecutive water years, and data gaps exist that limit the area over which groundwater elevations are measured in the OPV, the estimated change in storage for water years 2016 through 2020 were limited to an area smaller than the entire extent of the Oxnard Subbasin and Pleasant Valley Basin (FCGMA 2020a, 2020b, 2021a, 2021b).

To address these limitations, the FCGMA has revised the approach for estimating storage change as part of the 2022 Annual Report covering the 2021 water year. This revised methodology utilizes a fixed monitoring well network and correlates groundwater elevations measured at each well to simulated change in groundwater storage computed by the Ventura Regional Groundwater Flow Model developed by UWCD (UWCD 2018). This approach expands on method utilized for the 2020 and 2021 Annual Reports by providing estimates of storage change across the entire OPV and largely eliminates the sensitivity to the monitoring well network sampled annually.

This Appendix describes the details of this revised methodology (Section A.2) and provides updated estimates of the change in groundwater storage for water years 2016 through 2021 (Section A.3). A validation of this method is provided in Section A.3).

A.2 Methodology

Estimates of the change in groundwater in storage are based on spring groundwater elevations measured at a fixed set of monitoring wells. Each of these monitoring wells are individually screened within the five principal aquifers in the Oxnard Subbasin (FCGMA 2019a), and three of the principal aquifers in Pleasant Valley Basin GSPs (FCGMA 2019b). These monitoring well networks extend across the Oxnard Subbasin and Pleasant Valley Basin and include the key wells identified in each respective GSP (FCGMA 2019a, 2019b). In addition to the key wells, the storage change monitoring network includes a set of wells that were not designated as key wells but provide localized constraints on groundwater conditions within the Oxnard and Pleasant Valley Pumping Depression Management Areas and the Saline Intrusion Management Area. The storage change well network is shown graphically in Figure 2-18 through Figure 2-22 of the 2022 Annual Report.

To estimate the change in storage corresponding to groundwater elevation changes measured at each well, a series of Thiessen Polygons were first generated using Geographical Information Software (GIS) to define representative areas surrounding each monitoring well. These Thiessen Polygons were extended to the boundary of the Oxnard

Subbasin and Pleasant Valley Basin and were locally constrained by the Management Area boundaries defined in the Oxnard and Pleasant Valley GSPs (FCGMA 2019a, 2019b). The Thiessen Polygons were then mapped onto the Ventura Regional Groundwater Flow Model grid, and model-calculated annual change in storage values were extracted from each polygon area for water years 1986 through 2014[1]. Because storage change for each annual report has been estimated using seasonal high (spring) conditions, the water year storage change extracted from the UWCD numerical model was computed from spring to spring[2].

Linear regression models were then calculated using the spring[3] groundwater elevation measured at each well and the cumulative change in storage extracted from the Ventura Regional Groundwater Flow Model. These linear regression models provide a direct estimate of the cumulative change in groundwater storage since March 1985 within each representative polygon based solely on the corresponding spring groundwater elevation. Differences in the cumulative change in storage between consecutive water years computed using the regression models were then used to calculate the annual change in storage over a given water year.

A.3 Results

1.1 Oxnard Aquifer

Change in groundwater in storage for the Oxnard aquifer was estimated using network of seven monitoring wells, six of which are located in the Oxnard Subbasin and one that is located in the Pleasant Valley Basin (Table A.3.1). The correlation between simulated storage change within each Thiessen Polygon that overlapped the Pleasant Valley Basin and the corresponding spring groundwater elevation measurements are shown in Figures A.3-1 and A.3-2 and summarized in Table A.3.1.

Change in storage in the Pleasant Valley Basin for the age equivalent stratigraphic unit as the Oxnard aquifer is estimated using a single well, 02N21W34G05S, located within the Pumping Depression Management Area near the boundary with the Oxnard Subbasin. The simulated change in storage extracted from the UWCD model follows the same trend in spring groundwater elevations measured at 02N21W34G05S (Figure A.3-1). However, the correlation between the two variables is weaker than the Oxnard Subbasin. This is likely due to the fact that conditions in northern PVB are less similar to conditions measured within the Pumping Depression Management Area. Despite the lower regression statistic, the 2015 water year cumulative change in storage in the Oxnard aquifer estimated by the regression model is within 5% of the cumulative storage change estimated by the UWCD model (Figure A.3-3).

Change in groundwater in storage in the Oxnard aquifer was not previously estimated as part of the 2020 and 2021 Annual reports for the PVB due to limited areal coverage of groundwater elevation contours.

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[1] The Ventura Regional Groundwater Flow Model was designed to simulated conditions in the Oxnard Subbasin, Pleasant Valley Basin, and West Las Posas Management Area of the Las Posas Valley Basin for the period from January 1, 1985 through December 31, 2015. Accordingly, the corresponding complete water years simulated by the model are 1986 through 2014

[2] Water year storage change was calculated as the change in storage between spring conditions. For example, the water year 1986 storage change extracted from the UWCD model corresponded to the 12-month period from March 1985 through April 1986

[3] Spring groundwater elevation was defined as a groundwater elevation measured during March or April of each year.

Table A.3.1 Oxnard Aquifer Storage Change Wells and Correlation Statistics

State Well Number	Key Well?	Basin	Region	Pleasant Valley Basin		
				Avg Annual Change in Storage (AF)	Correlation Coefficient (R^2)	Change in Storage * R^2
02N21W34G05S	Yes	PVB	PDMA	640	0.75	480
Estimated Uncertainty				**25%**		

AF = Acre-Feet; "-NA-" = Not Applicable, "PVB" = Pleasant Valley Basin, "Oxn" = Oxnard Subbasin, "PDMA" = Pumping Depression Management Area, "SIMA" = Saline Intrusion Management Area

1.2 Mugu Aquifer

Change in groundwater in storage for the Mugu aquifer was estimated using a network of eleven monitoring wells, nine of which are located in the Oxnard Subbasin and two that are located in the Pleasant Valley Basin (Table A.3.2). Two groundwater elevation monitoring wells that were not designated as key wells in the Oxnard Subbasin GSP were included in the network of storage change wells: 01N2121N01S and 01S22W01H03S. These wells are located within the Oxnard Subbasin and were added to provide additional characterization of the relationship between groundwater elevations and storage change in the Pumping Depression Management Area and Saline Intrusion Management Area. The correlation between simulated storage change within each Thiessen Polygon that overlapped the Pleasant Valley Basin and the corresponding spring groundwater elevation measurements are shown in Figures A.3-4 and A.3-5 and summarized in Table A.3.2.

In the PVB, change in storage in the age equivalent stratigraphic unit as the Mugu aquifer was estimated using two key wells located in the Pumping Depression Management Area. A comparison of the cumulative change in storage between water year 1986 and 2015 estimated using the Ventura Regional Groundwater Flow Model (Black line and markers) and the linear regression models (Black line, grey symbols) indicates that the regression model is not in strong agreement with model estimates for the Mugu (Figure A.3-6). Accordingly, the storage change estimates for the age equivalent Mugu aquifer provide a general trend in groundwater storage change, rather than a reflection of the magnitude of change between water years.

Change in groundwater in storage in the Mugu aquifer was not previously estimated as part of the 2020 and 2021 Annual reports for the PVB due to limited areal coverage of groundwater elevation contours.

Table A.3.2 Mugu Aquifer Storage Change Wells and Correlation Statistics

State Well Number	Key Well?	Basin	Region	Pleasant Valley Basin		
				Avg Annual Change in Storage (AF)	Correlation Coefficient (R^2)	Change in Storage * R^2
01N21W03K01S	Yes	PVB	PDMA	6	0.46	3
02N21W34G04S	Yes	PVB	PDMA	5	0.77	4
Estimated Uncertainty				**40%**		

AF = Acre-Feet; "-NA-" = Not Applicable, "PVB" = Pleasant Valley Basin, "Oxn" = Oxnard Subbasin, "PDMA" = Pumping Depression Management Area, "SIMA" = Saline Intrusion Management Area; "FMA" = Forebay Management Area

1.3 Hueneme Aquifer

Change in groundwater in storage for the Hueneme aquifer was estimated using a network of four monitoring wells located in the Oxnard Subbasin. The change in groundwater storage in the Hueneme aquifer was not estimated for the Pleasant Valley Basin because there were no monitoring wells screened solely in the Hueneme aquifer with sufficient historical record to develop correlations with model results.

1.4 Fox Canyon Aquifer

Change in groundwater in storage for the Fox Canyon aquifer was estimated using a network of twelve monitoring wells, nine of which are located in the Oxnard Subbasin and three that are located in the Pleasant Valley Basin (Table A.3.3). One groundwater elevation monitoring wells that was designated as key wells in the Pleasant Valley GSP was included in the network of storage change wells: 02N2134G03S (Table A.3.3). This well was added to provide additional characterization of the relationship between groundwater elevations and storage change in the Pumping Depression Management Area. The correlation between simulated storage change within each Thiessen Polygon and the corresponding spring groundwater elevation measurements are shown in Figures A.3-7 and A.3-8 and are summarized in Table A.3.3.

In the Pleasant Valley Basin, the linear regression models sufficiently represent modeled change in groundwater storage (Figure A.3-9). The Ventura Regional Groundwater Flow Model indicates that the largest changes in groundwater storage have historically occurred in northern PVB, where groundwater in storage historically increased at a rate of approximately 290 AFY. The linear regression model developed for this part of the PVB using groundwater elevations measured at 02N20W19M05S accounts for approximately 93% of the simulated cumulative change in groundwater storage (Table A.3.3). Similarly, across the entire PVB, the linear regression models developed account for approximately 96% of the cumulative change in storage simulated by the Ventura Regional Groundwater Flow Model between water years 1986 and 2014 (Figure A.3-12).

The water year 2016 through 2020 change in storage estimates computed using the spring groundwater elevation contour maps are approximately an order of magnitude smaller than values computed using the linear regression models described here. This reflects the limited areal extent of the estimated storage change when using the spring groundwater elevation contours, as well as the 20-foot elevation change resolution introduced by the contour spacing used to prepare groundwater elevation contour maps for the Fox Canyon aquifer (FCGMA 2021a). These limitations of the contour map-estimated storage change values were discussed in FCGMA (2020a) and FCGMA (2019a), and are addressed in the development of the linear regression models.

Table A.3.3 Fox Canyon aquifer Storage Change Wells and Correlation Statistics

State Well Number	Key Well?	Basin	Region	Pleasant Valley Basin		
				Avg Annual Change in Storage (AF)	Correlation Coefficient (R^2)	Change in Storage * R^2
02N21W34G03S	No	PVB	PDMA	-5	0.55	-3
01N21W03C01S	Yes	PVB	PDMA	-44	0.87	-39
02N20W19M05S	Yes	PVB	NPVB	290	0.93	270
Estimated Uncertainty				**5%**		

AF = Acre-Feet; “-NA-“ = Not Applicable, “PVB” = Pleasant Valley Basin, “Oxn” = Oxnard Subbasin, “PDMA” = Pumping Depression Management Area, “SIMA” = Saline Intrusion Management Area; “FMA” = Forebay Management Area, “NPVB” = North PVB

1.5 Grimes Canyon Aquifer

The change in groundwater storage in the Grimes Canyon aquifer was not estimated for the Pleasant Valley Basin because there were no monitoring wells screened solely in the Grimes Canyon aquifer with sufficient historical record to develop correlations with model results.

References

Fox Canyon Groundwater Management Agency (FCGMA). 2019a. Groundwater Sustainability Plan for the Oxnard Subbasin.

Fox Canyon Groundwater Management Agency (FCGMA). 2019b. Groundwater Sustainability Plan for the Pleasant Valley Basin.

Fox Canyon Groundwater Management Agency (FCGMA). 2020a. Oxnard Subbasin Groundwater Sustainability Plan 2020 Annual Report: Covering Water Years 2016 through 2019.

Fox Canyon Groundwater Management Agency (FCGMA). 2020b. Pleasant Valley Basin Groundwater Sustainability Plan 2020 Annual Report: Covering Water Years 2016 through 2019.

Fox Canyon Groundwater Management Agency (FCGMA). 2021a. Oxnard Subbasin Groundwater Sustainability Plan 2021 Annual Report: Covering Water Year 2020.

Fox Canyon Groundwater Management Agency (FCGMA). 2021b. Pleasant Valley Basin Groundwater Sustainability Plan 2021 Annual Report: Covering Water Year 2020.

United Water Conservation District (UWCD). 2018. Ventura Regional Groundwater Flow Model and Updated Hydrogeologic Conceptual Model: Oxnard Plain, Oxnard Forebay, Pleasant Valley, West Las Posas, and Mound Groundwater Basins. Open-File Report 2018-02. July 2018.

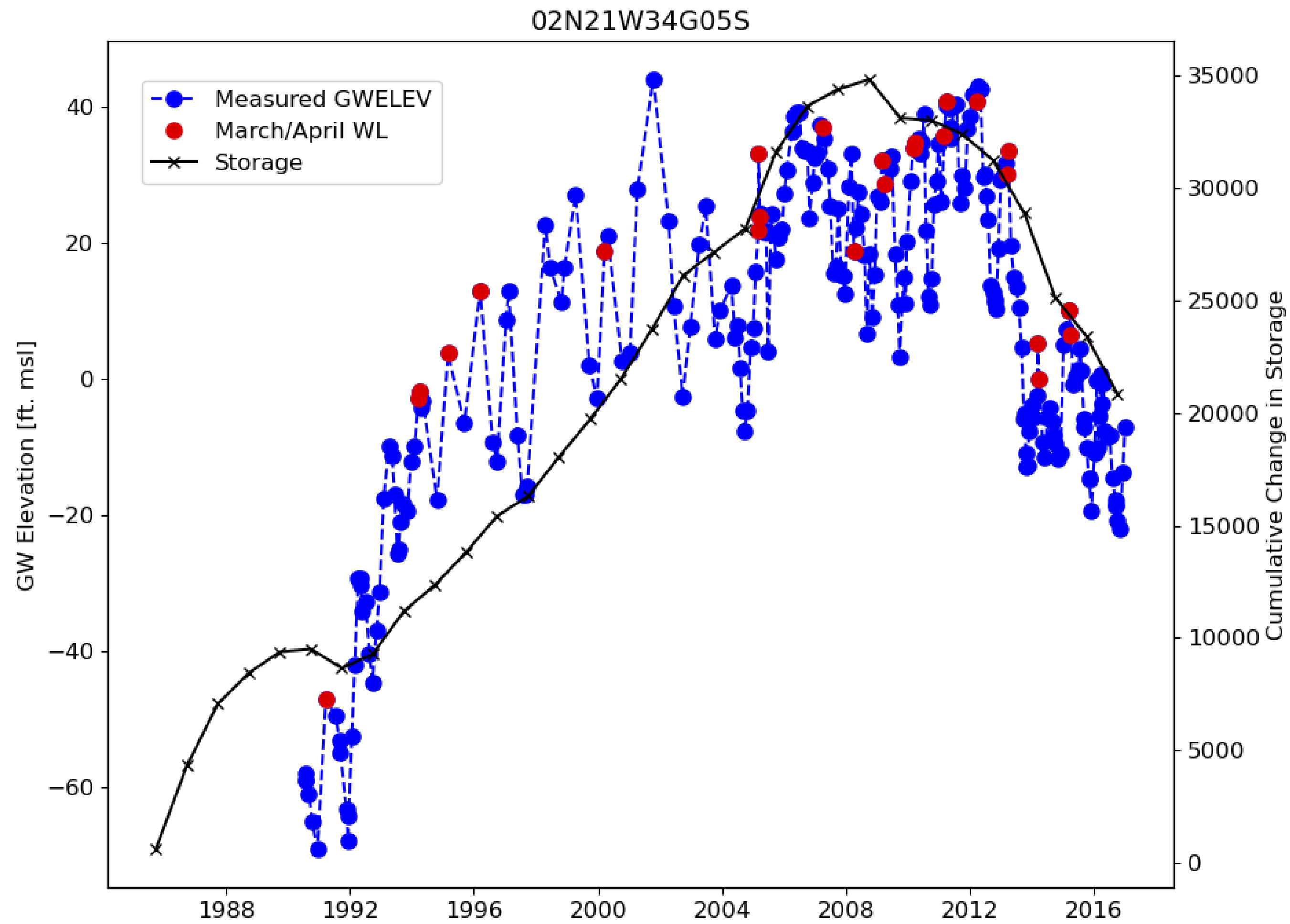

FIGURE A.3-1

Simulated Storage Change and Groundwater Elevation Measured in the Oxnard Aquifer

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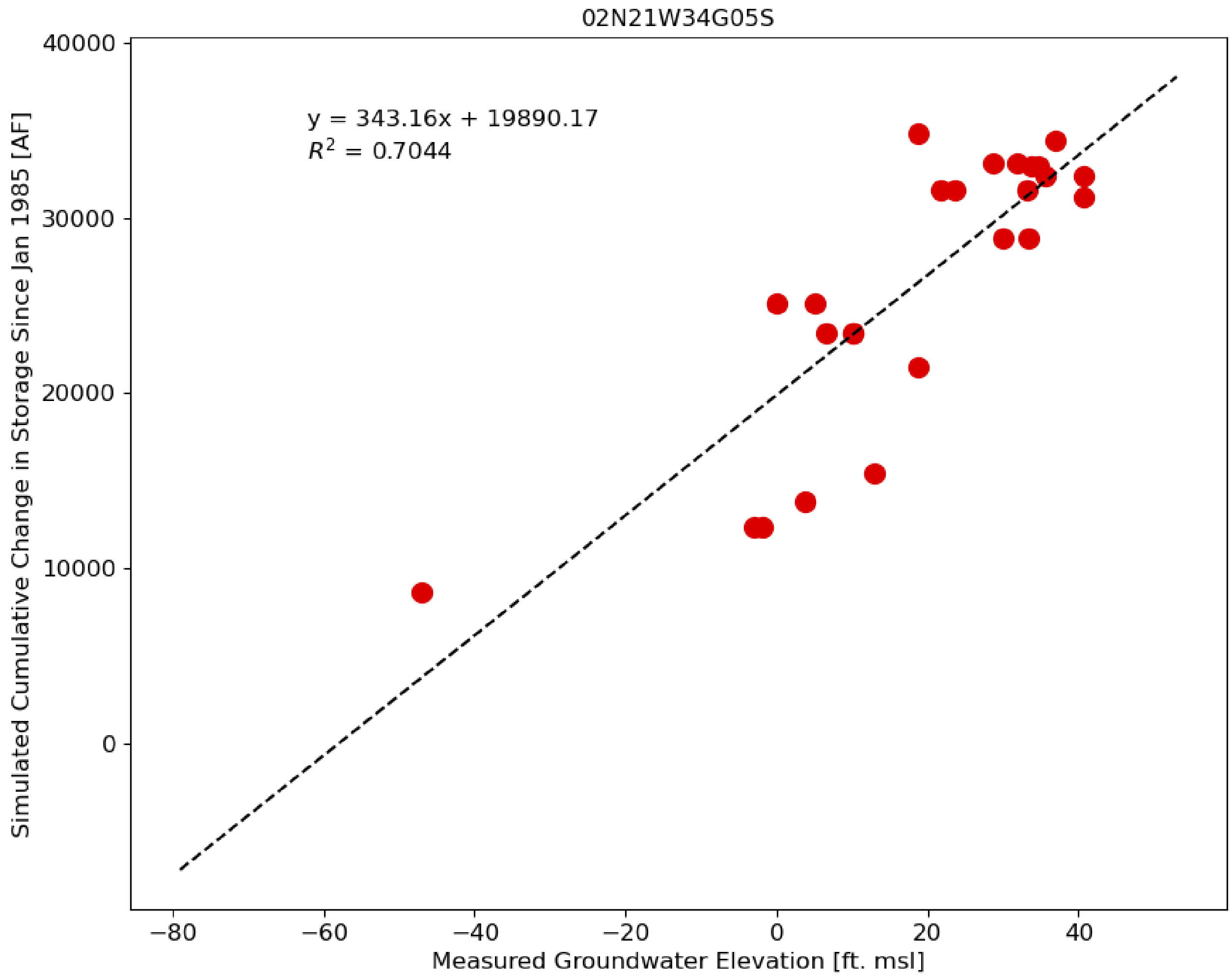

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FIGURE A.3-2

Linear Regression Model Developed for the Oxnard Aquifer

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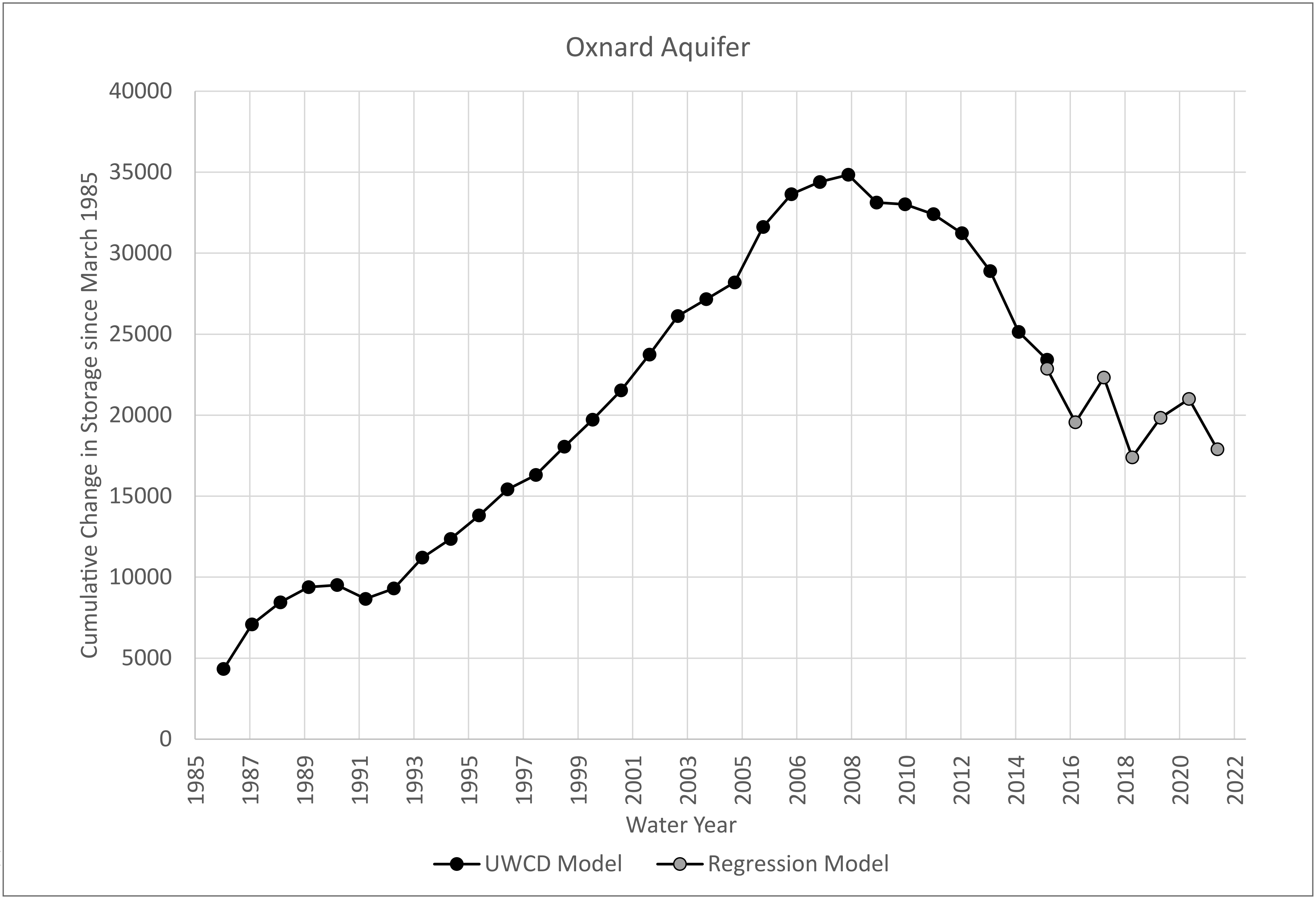

FIGURE A.3-3

Validation of Linear Regression Model - Oxnard Aquifer

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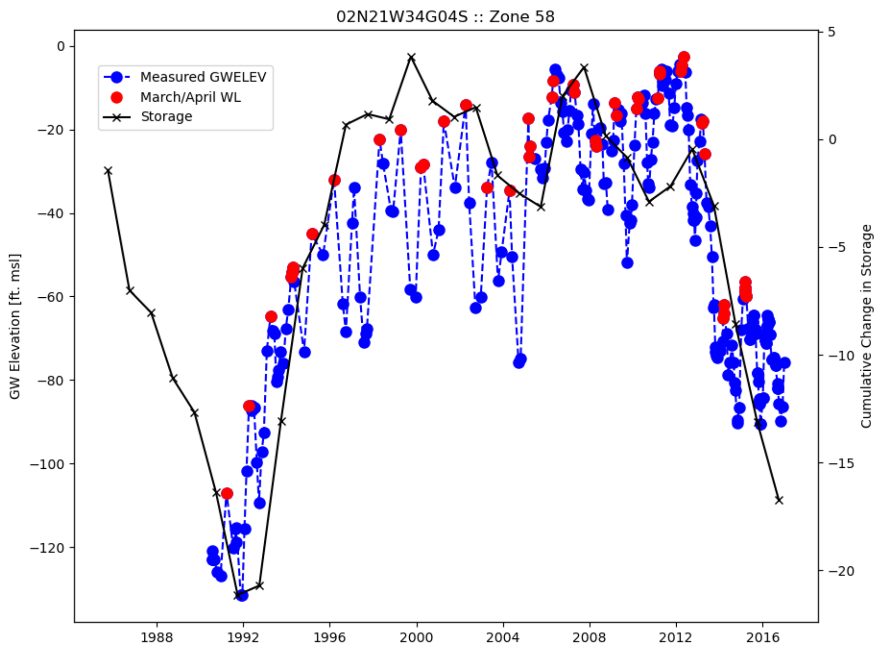

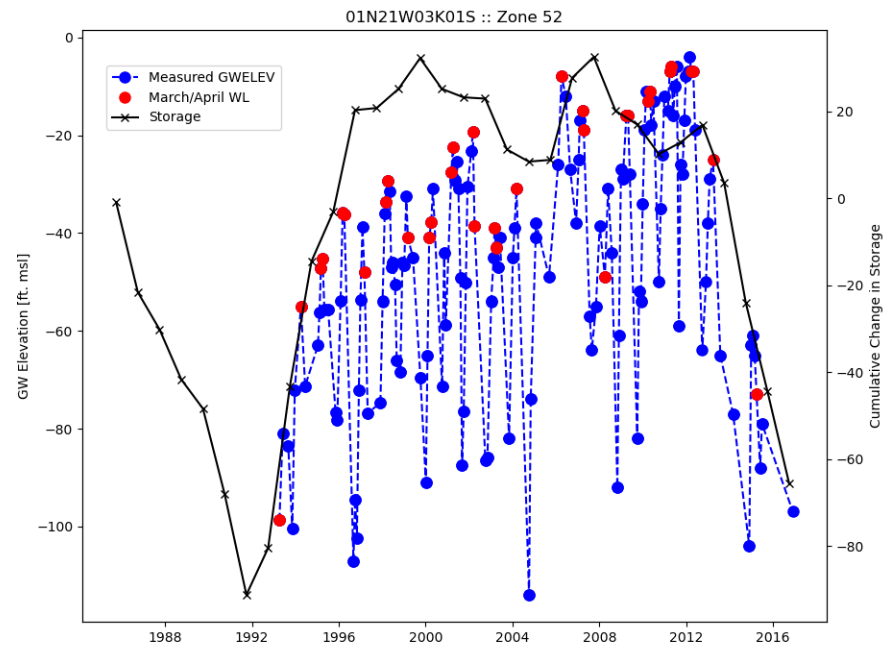

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FIGURE A.3-4

Simulated Storage Change and Groundwater Elevation Measured in the Mugu Aquifer

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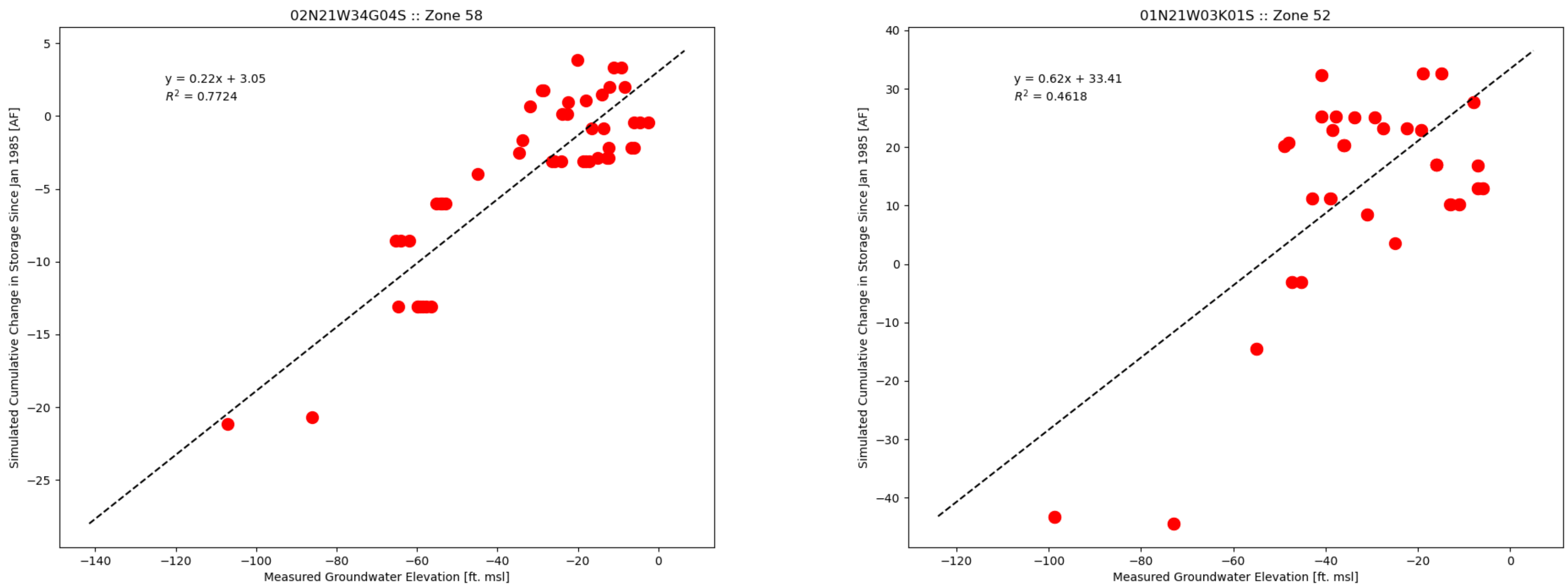

FIGURE A.3-5

Linear Regression Models Developed for the Oxnard Aquifer

Pleasant Valley Basin Groundwater Sustainability Plan 2022 Annual Report

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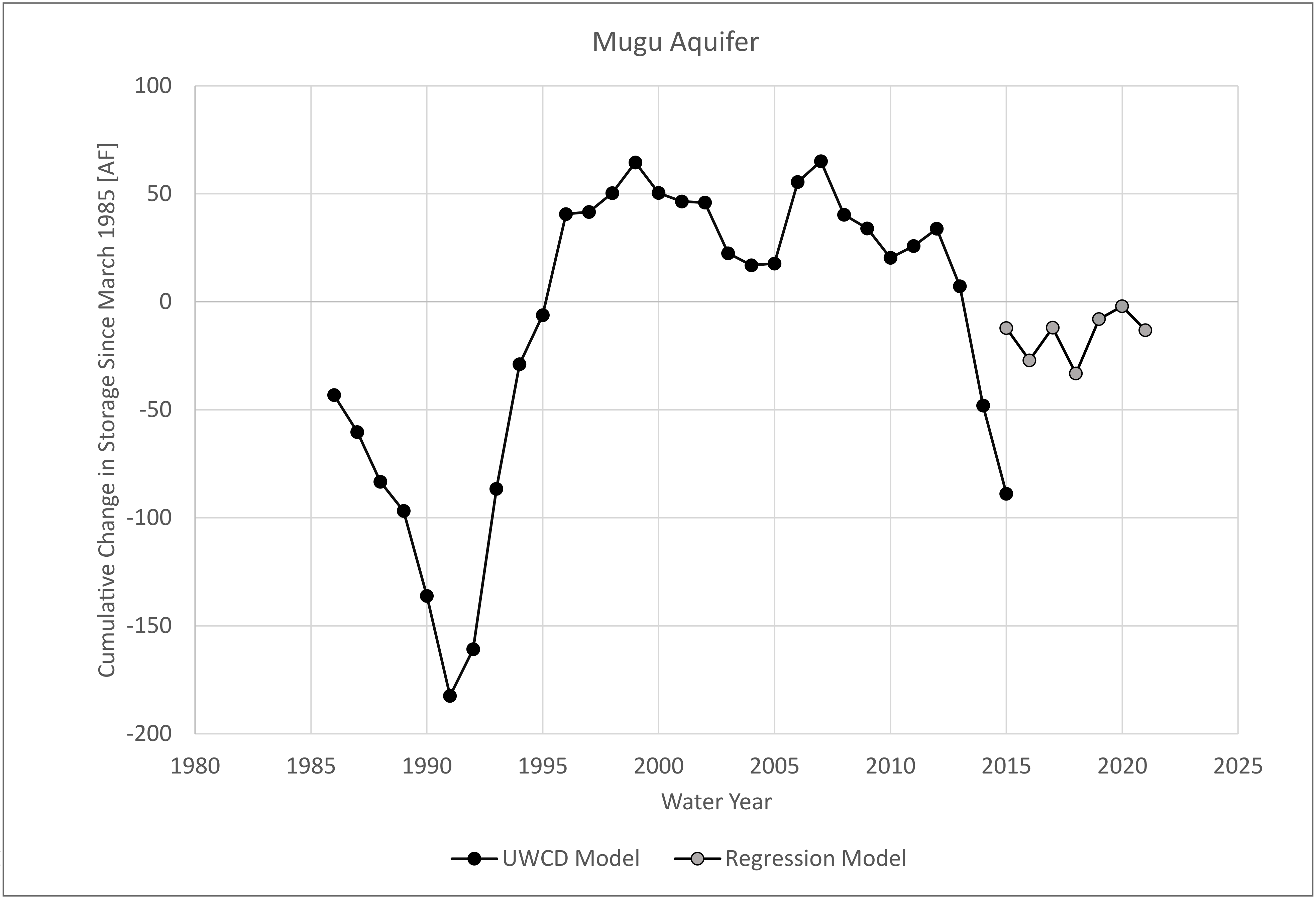

FIGURE A.3-6

Validation of Linear Regression Model - Mugu Aquifer

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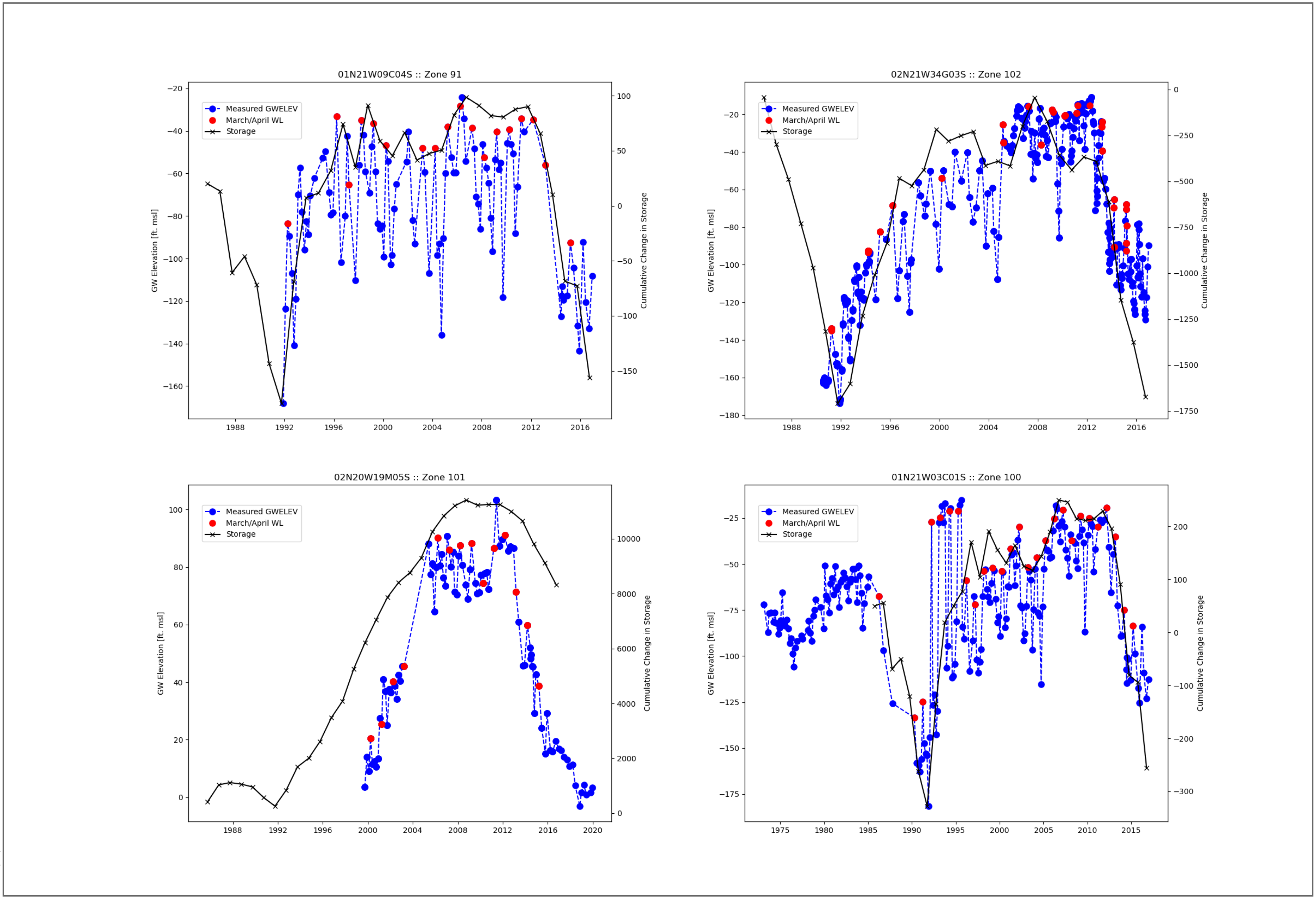

FIGURE A.3-7

Simulated Storage Change and Groundwater Elevation Measured in the Fox Canyon Aquifer

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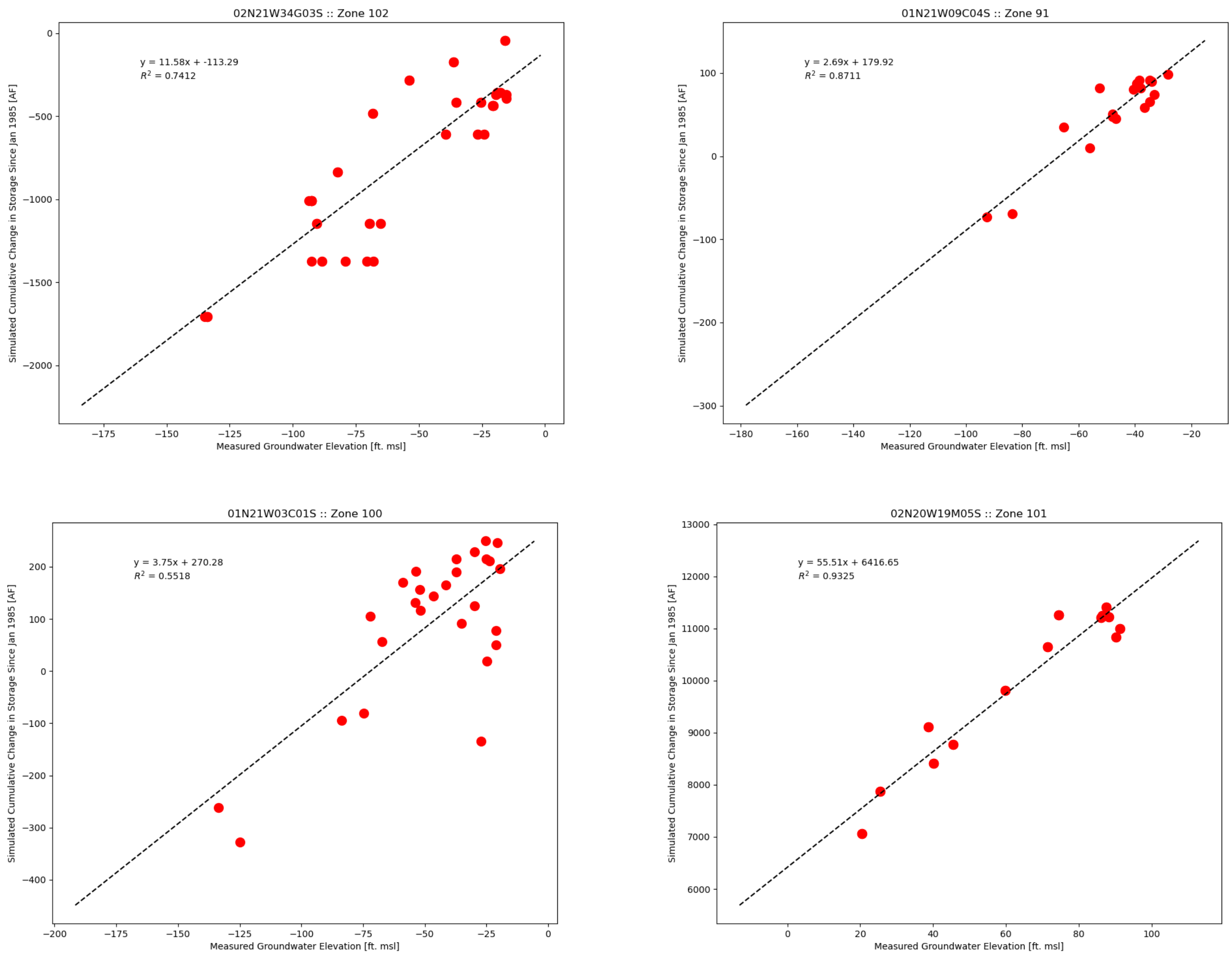

FIGURE A.3-8

Linear Regression Models Developed for the Fox Canyon Aquifer

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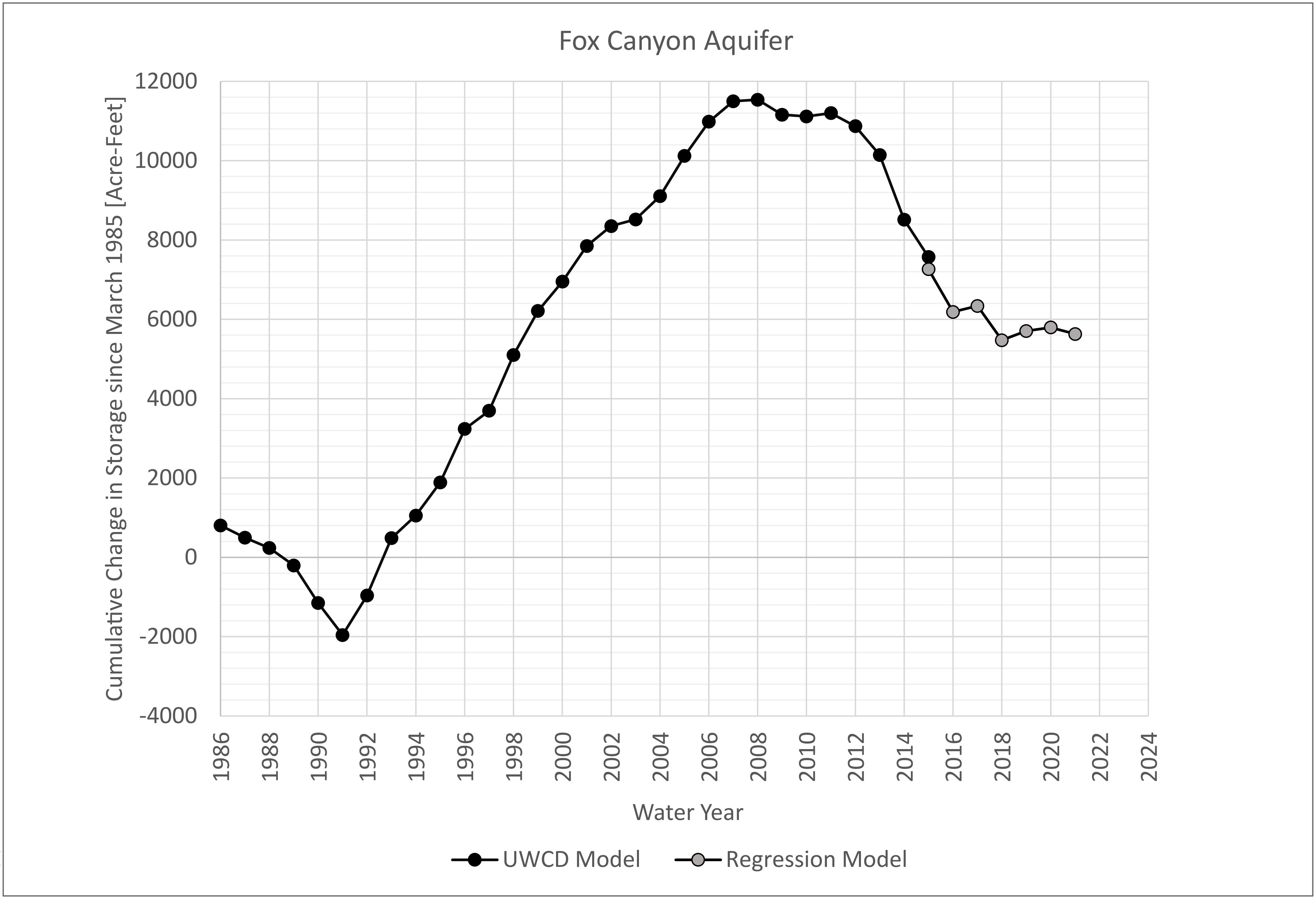

FIGURE A.3-9

Validation of Linear Regression Model - Fox Canyon Aquifer

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Appendix B: Projects to be Appended to the GSP

A1. PVCWD Private Reservoir Program

Description

The Pleasant Valley County Water District (PVCWD) has access to various water sources, including Conejo Creek diversions, that are available during rain events. During these rain events and for a short period directly following them, demand within the PVCWD system is depressed. PVCWD maintains approximately 250 AF of storage. Additionally, a portion of PVCWD pumpers maintain onsite private storage. While a formal accounting of this storage has not been completed, it is estimated to be on the order of 100 AF. To utilize water that is available following rain events, it is necessary to store and retain the water until demands return.

This project seeks to incentivize the utilization of existing and the construction of new privately owned and operated reservoirs for the use of surface water capture during rain events for the purpose of expanding storage capacity within the PVCWD service area. This will increase capture and use of surface waters and reduce groundwater demand, benefitting the entire groundwater basin. In addition to meeting the needs of capturing and utilizing winter flows, the project will also serve a dual purpose of achieving land fallowing. Utilizing a depth of 5 feet, 20 AF of storage corresponds to approximately 4 acres of land. A program target of 200 AF would correspond to approximately 40 acres of land fallowing.

Relationship to Sustainability Criteria

Relationship to Minimum Thresholds

Capturing additional surface water for use following rainfall events will reduce groundwater production demand in the Pleasant Valley Basin. This will allow groundwater elevations to rise. Groundwater elevation minimum thresholds are used as a proxy for other sustainability indicators in the Basin. Therefore, the project will improve groundwater elevations relative to the minimum thresholds.

Relationship to Measurable Objectives

The relationship to the measurable objectives is the same as the relationship to the minimum thresholds. The project will improve groundwater elevations relative to the measurable objective groundwater levels.

Expected Benefits

The project is anticipated to reduce groundwater demand in the Pleasant Valley Basin by providing approximately 500 to 1,000 AFY in supplemental surface water.

Timetable for Implementation

The expected timetable to implement this project is approximately 2 years. This estimate includes outreach, development of a database of existing private storage volume, preparing the program framework, piloting the program, and making any necessary modifications before launching the program to a wider group of PVCWD customers.

Metrics for Evaluation

This program will be evaluated based on the additional volume of surface water stored and used after rain events, in-lieu of groundwater pumping, in the Pleasant Valley Basin.

Economic Factors and Funding Sources

Total capital cost for this project is anticipated to be approximately $590,000 and the capital cost per AF per year produced is approximately $395. Funding for this project may be available through grant opportunities and through PVCWD.

A2. PVCWD Recycled Water Connection Pipeline

Description

This project proposes to connect the east and west zones of PVCWD's distribution system. This will allow PVWD to more effectively distribute up to 4,000 AFY of recycled water from the City of Oxnard's AWPF and an additional 1,000 to 2,000 AFY of surface water from the Conejo Creek. This water will be available to PVCWD and the UWCD PTP system. This project is a complimentary project to the UWCD Laguna Road Recycled Water Pipeline Project. Blending the high-quality recycled water with existing water sources will result in reduced water use within the Basin because the higher quality water will improve uptake by crops and increase crop yields. Better access to and distribution of Conejo Creek water will result in less water stranded due to bottlenecks in the distribution system. This, in turn, will decrease in groundwater demands.

Relationship to Sustainability Criteria

Relationship to Minimum Thresholds

Adding flexibility to the water conveyance facilities in the Pleasant Valley Basin will directly impact groundwater level minimum thresholds, which are used as a proxy for other sustainability indicators, by allowing recycled and surface water to be used, instead of groundwater, when it is available. Reduced groundwater pumping will help groundwater levels, which are currently below the minimum thresholds in much of the Pleasant Valley Basin, rise above the minimum thresholds over the next 18 years.

Relationship to Measurable Objectives

The relationship of the PVCWD Recycled Water Connection Pipeline to the measurable objectives is the same as the relationship with the minimum thresholds. By increasing water levels, the PVCWD Recycled Water Connection Pipeline will help the Pleasant Valley Basin meet the measurable objective groundwater levels.

Expected Benefits

This project should aid with achievement of measurable objectives and minimum thresholds for chronic declines in groundwater elevation, groundwater in storage, and groundwater quality. Higher groundwater levels will also reduce pump lift, and therefore energy consumption, for municipal and agricultural pumpers.

Timetable for Implementation

The timetable for implementation of the PVCWD Recycled Water Connection Pipeline Project is estimated to be on the order of 2 years.

Metrics for Evaluation

Evaluation of the PVCWD Recycled Water Connection Pipeline Project will be based on the quantity of recycled and surface water delivered via the new pipeline, which will be metered by PVCWD.

Economic Factors and Funding Sources

The total capital cost for the PVCWD Recycled Water Connection Pipeline Project is anticipated to be approximately $6.6 million. Funding sources for the project are anticipated to include DWR grant funds for SGMA implementation and potentially funding from FCGMA replenishment fees and PVCWD.

Any action taken by the FCGMA Board, acting as the Groundwater Sustainability Agency for the portion of the Oxnard Subbasin in its jurisdiction, to impose or increase a fee shall be taken by ordinance or resolution. Should the FCGMA Board decide to fund a project through imposition of a replenishment fee, it will need to seek voter approval. This will generally require mailing written notice to the owner of each parcel on which the proposed fee will be imposed and conducting a public hearing at least 45 days after the notice.

A3. Extraction Barrier and Brackish Water Treatment Project

Description

This project is intended to create a seawater intrusion barrier in the Oxnard Subbasin, near Point Mugu, by extracting brackish groundwater in the Oxnard, Mugu, and Fox Canyon aquifers near the coast and maintaining a pumping trough that helps prevent landward migration of seawater. Creation of a barrier to seawater intrusion in the Oxnard Subbasin would also increase the sustainable yield of the Pleasant Valley Basin, which is hydraulically connected to the Oxnard Subbasin. This project will produce treated brackish water for M&I or agricultural use in the Pleasant Valley Basin in addition to the Oxnard Subbasin. Project components include construction of: (1) extraction barrier wells near Mugu Lagoon and possibly Port Hueneme, (2) a reverse-osmosis treatment plant, and (3) a conveyance system for distribution of treated water. The brackish water extracted from the UAS in the Point Mugu area will be treated and delivered to users on the PVCWD system via UWCD's Pleasant Valley Pipeline [PVP].

Construction of injection barriers is being evaluated where the benefit of injection could potentially be greater than that of extraction. The brackish groundwater extracted in the Point Mugu area will be treated for beneficial use, including artificial recharge and/or direct delivery to water users (e.g., Pumping Trough Pipeline [PTP], Pleasant Valley Pipeline [PVP]). Benefits will include limiting further seawater intrusion in the Oxnard Subbasin, raising groundwater elevations primarily, but not exclusively, in the LAS, and improving groundwater quality in the areas served by the PVP.

Some components of this project are currently in preliminary design or permitting phases. The project is envisioned to be advanced in multiple phases. The first phase of the project includes construction of monitoring well clusters and data collection in the vicinity of the proposed project site in order to aid in optimizing the project design. The monitoring well clusters will be used to collect groundwater quality and level data from the aquifers that will be pumped as part of the extraction barrier, as well as the Semi-perched aquifer. The data collected from these wells will be used to: (1) refine understanding of horizontal and vertical conductivity of the aquifers and confining layers, to aid in design of the extraction wellfield; (2) provide additional data regarding geochemistry of the aquifers that will be pumped as part of the extraction; and (3) assess whether contaminants in the Semi-perched aquifer are likely to migrate toward the extraction wells, now or in the future. The second phase of the project includes design and construction of several extraction wells and operation of the extraction wells to verify the efficacy of the extraction barrier. The final phase of the project includes design and construction of more extraction wells, design and construction of the treatment plant and the conveyance system for treated water distribution, and a connection to Calleguas Salinity Management Pipeline for RO brine discharge. Other supporting activities include additional groundwater modeling, geophysical studies, and operation of a pilot-scale extraction/treatment system that will help refine the extent of extraction and treatment needs.

Relationship to Sustainability Criteria

Relationship to Minimum Thresholds

Groundwater elevation minimum thresholds in the Pleasant Valley Basin are used as a proxy for the other sustainability indicators. As a result of this project, water delivered to the Basin will reduce groundwater production in areas served by the PVCWD, which will allow groundwater elevations to recover, particularly in the Lower Aquifer System (LAS). Recovery of groundwater elevations in the LAS may also improve water quality in areas of elevated concentrations of total dissolved solids.

Relationship to Measurable Objectives

As with the minimum thresholds, the project will provide additional water to help groundwater elevations rise to the measurable objective water levels in parts of the Pleasant Valley Basin.

Expected Benefits

This project should aid with achievement of measurable objectives and minimum thresholds for three out of six sustainability criteria by raising groundwater elevations, increasing the volume of fresh groundwater in storage in the aquifers, and improving groundwater quality. The project anticipates increasing the combined annual sustainable yield of the Oxnard Subbasin and Pleasant Valley Basin by approximately 15,000 acre-feet per year, considering both the quantity of treated brackish water supplied by the project and the effects on sustainable yield resulting from mitigating existing and future seawater intrusion. Of this combined increase in the sustainable yield, approximately 20%, or 3,000 acre-feet per year, is estimated to directly benefit the Pleasant Valley Basin, while the remaining increase in the sustainable yield will benefit the Oxnard Subbasin.

Timetable for Implementation

The project design and memorandum of understanding between UWCD and the U.S. Navy are currently in progress; work towards construction of a pilot extraction system is planned to commence in 2022. Construction of the initial phase of the extraction and treatment system is expected to be completed in 2025; and construction of additional extraction wells and treatment plant is expected to be complete in 2027. Potential expansion to larger scale, if needed, could continue to 2035.

Metrics for Evaluation

Evaluation of the Extraction Barrier and Brackish Water Treatment Project will be based on the ability of the project to increase sustainable yield in the Pleasant Valley Basin through delivery of brackish water and the volume by which groundwater pumping in the basin can be increased. Groundwater elevations will continue to be measured at the key wells discussed in the GSP. The volume of brackish water extracted, treated, and served will be measured and reported as part of the GSP annual reporting process.

Economic Factors and Funding Sources

The capital to construct the Extraction Barrier and Brackish Water Treatment Project may be available through UWCD or FCGMA replenishment fees. Additional funding may be available from Defense Community Infrastructure grants, Federal infrastructure grants, EPA low-interest loans, and additional DWR grant funding

Any action taken by the FCGMA Board, acting as the Groundwater Sustainability Agency for the portion of the Oxnard Subbasin in its jurisdiction, to impose or increase a fee shall be taken by ordinance or resolution. Should the FCGMA Board decide to fund a project through imposition of a replenishment fee, it will need to seek voter approval. This will generally require mailing written notice to the owner of each parcel on which the proposed fee will be imposed and conducting a public hearing at least 45 days after the notice.

A4. Freeman Diversion Expansion Project

Description

As described in the GSP, UWCD operates the Freeman Diversion on the Santa Clara River for the purpose of diverting surface flows from the river into groundwater recharge facilities in the Oxnard Forebay and direct surface-water deliveries to growers in the Pleasant Valley Basin via UWCD's and PVCWD's pipelines. The Freeman Diversion Expansion Project proposes to construct facilities capable of diverting surface water at higher flow rates and with higher sediment loads than currently possible. Use of flows with higher sediment loads, which are less conducive to fish migration, has been encouraged by both regulatory agencies and non-governmental organizations (FCGMA 2019). The expansion project has advanced since the GSP was submitted to DWR. This project description reflects the updated understanding of the project based on work that was completed since 2018.

This project requires expansion of the existing intake, conveyance, and recharge facilities associated with Freeman Diversion, in a subsequent phase, and an associated increase in United's right to divert surface water from the Santa Clara River from 375 cfs to 750 cfs instantaneous flow during periods of peak river flow. When constructed, this project will result in additional recharge and conjunctive use of flood/storm flows in both the Oxnard Subbasin and Pleasant Valley Basin. UWCD will improve fish passage and implement the new Multi-Species Habitat Conservation Plan, concurrent with this project.

Increased volume of diverted water will be used for conjunctive use via the PVP in the Pleasant Valley Basin. Benefits will include higher groundwater levels, more groundwater in storage, reduced potential for seawater intrusion and land subsidence, and improved groundwater quality. The areas of the Pleasant Valley Basin served by PVCWD, which receives Santa Clara River water via the PVP, will receive surface-water deliveries for conjunctive use, thereby reducing pumping and increasing groundwater elevations.

Some components of this project have been designed or are constructed already. Next-step project components include expansion of existing conveyance structures (inverted siphon and 3-barrel culvert) and extension of the conveyance system to connect to UWCD's new Ferro-Rose spreading basin via a new undercrossing at Vineyard Ave.

Relationship to Sustainability Criteria

Relationship to Minimum Thresholds

Surface water deliveries via the PVP are a critical component of the water budget in the Pleasant Valley Basin. Groundwater elevations, which are used as a proxy for other sustainability indicators in the Basin, typically rise in years when surface water is available for diversion and fall in years when it is not Increased recharge of a portion of high storm/flood flows in the Santa Clara River will help groundwater levels recover to or remain above the proposed minimum thresholds. The magnitude of the groundwater level rise will depend on the quantity of additional recharge available via the expanded diversion facilities.

Relationship to Measurable Objectives

The relationship of the Freeman Expansion Project to the measurable objectives is the same as the relationship with the minimum thresholds. By increasing water levels in the Basin, the Freeman Diversion Project will help the Pleasant Valley Basin meet the measurable objective groundwater levels.

Expected Benefits

This project should aid with achievement of measurable objectives and minimum thresholds for four out of six sustainability criteria by raising groundwater elevations and the volume of groundwater in storage, improving groundwater quality, and reducing the potential for land subsidence related to groundwater withdrawals. Higher groundwater levels will also reduce pump lift, and therefore energy consumption, for municipal and agricultural pumpers. The project anticipates increasing the annual sustainable yield of the Pleasant Valley Basin by approximately 2,000 AFY.

Timetable for Implementation

The timetable for implementation of the Freeman Expansion Project, which will be constructed in phases, is estimated to be on the order of 3 to 15 years. Securing funding for the project and initiating the first phase of project construction will begin after the fish passage has been selected. UWCD is currently in the process of selecting the fish passage.

Metrics for Evaluation

Evaluation of the Freeman Expansion Project will be based on the increase in surface water diversions relative to recent past diversion rates. UWCD meters diversion from the Santa Clara River and would report these to FCGMA.

Economic Factors and Funding Sources

Improvements to the conveyance system, fish screens, and desilting basin inlet are estimated to cost $50 million. The annual cost, including operations and maintenance, capital, and financing costs is estimated to be $3.1 million. The capital cost per acre-foot per year produced is anticipated to be $100 over the 50+ year expected lifespan of the project. Funding sources for the project are anticipated to include grant money, UWCD rate payers, and replenishment fees from FCGMA.

Any action taken by the FCGMA Board, acting as the Groundwater Sustainability Agency for the portion of the Oxnard Subbasin in its jurisdiction, to impose or increase a fee shall be taken by ordinance or resolution. Should the FCGMA Board decide to fund a project through imposition of a replenishment fee, it will need to seek voter approval. This will generally require mailing written notice to the owner of each parcel on which the proposed fee will be imposed and conducting a public hearing at least 45 days after the notice.

A5. Laguna Road Recycled Water Pipeline Interconnection

Description

This project, which is a complementary project to the PVCWD Recycled Water Connection Pipeline project, is a new pipeline interconnection to allow conveyance of recycled water from Pleasant Valley County Water District's system to UWCD's Pumping Trough Pipeline (PTP) system to allow full utilization of available recycled water. This interconnection will also allow delivery of water from the PTP system to the PVCWD distribution system when such movement would optimize conjunctive use opportunities to improve sustainable yield in the Pleasant Valley Basin. Benefits of using more recycled water in the PTP system include higher groundwater levels, more groundwater in storage, and improved groundwater quality in the Pleasant Valley Basin. The PVCWD service area will receive additional recycled water for agricultural use, reducing pumping and increasing groundwater elevations.

Relationship to Sustainability Criteria

Relationship to Minimum Thresholds

Adding flexibility to the water conveyance facilities in the Pleasant Valley Basin will directly impact groundwater level minimum thresholds, which are used as a proxy for other sustainability indicators by allowing recycled water to be used instead of groundwater when it is available. Reduced groundwater pumping will help groundwater levels, which are currently below the minimum thresholds in much of the Pleasant Valley Basin, rise above the minimum thresholds over the next 18 years.

Relationship to Measurable Objectives

The relationship of the Laguna Road Recycled Water Pipeline Interconnection to the measurable objectives is the same as the relationship with the minimum thresholds. By increasing water levels, the Laguna Road Recycled Water Pipeline Interconnection will help the Pleasant Valley Basin meet the measurable objective groundwater levels.

Expected Benefits

This project should aid with achievement of measurable objectives and minimum thresholds for chronic declines in groundwater elevation, groundwater in storage, and groundwater quality. Higher groundwater levels will also reduce pump lift, and therefore energy consumption, for municipal and agricultural pumpers.

Timetable for Implementation

The timetable for implementation of the Laguna Road Recycled Water Pipeline Project is estimated to be on the order of 2 to 3 years.

Metrics for Evaluation

Evaluation of the Laguna Road Recycled Water Pipeline Project's effects on Pleasant Valley Basin will be based on the quantity of volume of water delivered to the PVCWD system via the new pipeline, which will be metered by UWCD or PVCWD.

Economic Factors and Funding Sources

The total capital cost for the Laguna Road Recycled Water Pipeline Project is anticipated to be approximately $4.2 million. Funding sources for the project are anticipated to include NRCS grant money, USBR water-smart loan, and PTP enterprise fund for recycled-water purchase.

A6. Purchase of Supplemental State Water Project Water

Description

This project proposes purchasing supplemental State Water Project (SWP) water (State Water) for recharge in the Oxnard Subbasin and delivered to users on the PTP and PVCWD systems in years when the State Water is available and willing participants can be found to execute a water transfer. "Supplemental" refers to State Water purchased, exchanged, or transferred for use in the Oxnard and Pleasant Valley basins, in excess of United's Table

A allocation, which is 3,150 AFY[1]. The annual volume of State Water transfers that can be purchased will depend on the volume available and the price that UWCD and other Ventura County agencies are willing to pay. UWCD anticipates that over the long-term approximately 6,000 AFY of supplemental State Water imports will be available at the Freeman Diversion for use within the Oxnard Subbasin and Pleasant Valley Basin.

Relationship to Sustainability Criteria

Relationship to Minimum Thresholds

Surface water deliveries via the PVP are a critical component of the water budget in the Pleasant Valley Basin. Groundwater elevations, which are used as a proxy for other sustainability indicators in the Basin, typically rise in years when surface water is available for diversion and fall in years when it is not. Increased recharge of surface water that currently flows to the Pacific Ocean will help groundwater levels recover to or remain above the proposed minimum thresholds. The magnitude of the groundwater level rise will depend on the quantity of additional recharge available via the expanded diversion facilities.

Relationship to Measurable Objectives

The relationship of the Purchase of Supplemental State Water to the measurable objectives is the same as the relationship with the minimum thresholds. By increasing water levels in the Basin, the purchase of supplemental State Water will help the Pleasant Valley Basin meet the measurable objective groundwater levels.

Expected Benefits

This project should aid with achievement of measurable objectives and minimum thresholds for four out of six sustainability criteria by raising groundwater elevations and the volume of groundwater in storage, improving groundwater quality, and reducing the potential for land subsidence related to groundwater withdrawals. Higher groundwater levels will also reduce pump lift, and therefore energy consumption, for municipal and agricultural pumpers. The project anticipates increasing the combined sustainable yield of the Oxnard Subbasin and Pleasant Valley Basin by approximately 6,000 AFY.

Timetable for Implementation

Implementation of the purchase of supplemental State Water can occur immediately, as long as water and funding are available. In fact, importation of supplemental State Water has already begun; from 2019 through 2021, United and the FCGMA imported approximately 25,000 AF (average of 8,300 AFY) of supplemental State Water for delivery to the Oxnard Subbasin and Pleasant Valley Basin. This water included purchase of Article 21 water (15,000 AF) and exchange or transfer agreements with other SWP contractors (10,000 AF). No additional infrastructure is required to implement this project.

Metrics for Evaluation

Evaluation of the purchase of supplemental State Water will be based on the quantity of surface water delivered at the Freeman Diversion.

Economic Factors and Funding Sources

The cost for supplemental State Water obtained via transfers and exchanges is anticipated to range from approximately $500 per acre-feet to $1,000 per acre-feet based on the Nasdaq Veles California Water (NQH2O)

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[1] In an average year, only about 60 percent of allocated State Water is actually delivered by DWR.

Index value. For Article 21 purchases by SWP contractors (including UWCD), the State charges recipients only the operation and maintenance costs, which totaled approximately $200 per acre-foot for the 15,000 AF purchased by United (on behalf of the FCGMA) in 2019. Funding sources for the project are anticipated to include UWCD rate payers and replenishment fees from FCGMA.

Any action taken by the FCGMA Board, acting as the Groundwater Sustainability Agency for the portion of the Oxnard Subbasin in its jurisdiction, to impose or increase a fee shall be taken by ordinance or resolution. Should the FCGMA Board decide to fund a project through imposition of a replenishment fee, it will need to seek voter approval. This will generally require mailing written notice to the owner of each parcel on which the proposed fee will be imposed and conducting a public hearing at least 45 days after the notice.

A7. Installation of Additional Groundwater Monitoring Wells

Description

This project proposes installation of multi-depth monitoring wells in the Pleasant Valley Basin to assess groundwater conditions in the principal aquifers in areas that lack data. The GSP determined that there were spatial data gaps in the understanding of aquifer conditions and identified six potential new well locations that would help fill the gaps identified. Since the GSP was submitted to DWR, two multi-depth monitoring wells were installed near location PNW-22 in the northern Pleasant Valley Basin. In reviewing the GSP, DWR identified investigation of the groundwater conditions in the Grimes Canyon Aquifer as a recommended corrective action for the next GSP update. The addition of multi-depth monitoring wells, completed in each of the principal aquifers, including the Grimes Canyon Aquifer, will help refine the understanding of aquifer properties, groundwater flow directions and vertical gradients. These wells will also provide information that can be used to determine sustainable management criteria for the Grimes Canyon Aquifer.

Of the locations identified in the GSP, monitoring wells in the vicinity of locations PNW 17, in the East Pleasant Valley Management Area, PNW 21 in the Pleasant Valley Pumping Depression Management Area, and PNW 20 in the North Pleasant Valley Management Area will provide a more complete understanding of groundwater conditions in the various management areas within the Pleasant Valley Basin.

Relationship to Sustainability Criteria

Relationship to Minimum Thresholds

This project does not have a direct influence on the minimum thresholds. It will, however, provide data that can be used to help evaluate and potentially revise the minimum thresholds in the future.

Relationship to Measurable Objectives

This project does not have a direct influence on the measurable objectives. It will, however, provide data that can be used to help evaluate and potentially revise the measurable objectives in the future.

Expected Benefits

The expected benefits of this project lie in the additional data gathered from the well installation process and the ongoing monitoring of the groundwater conditions at the well sites. This data can be used to refine the conceptual and numerical models of the Pleasant Valley Basin. Such refinement may result in reevaluation and adjustment of the minimum thresholds or measurable objectives.

Timetable for Implementation

Installation of monitoring wells will be phased as funding becomes available and the data from the new wells helps define the placement of subsequent wells. Installation of the first three monitoring wells can be completed within a 2-year timeframe with additional wells to follow.

Metrics for Evaluation

This project will be evaluated by the number of new dedicated monitoring wells installed.

Economic Factors and Funding Sources

The cost per new well location is anticipated to be approximately $850,000. Funding sources include DWR TSS or SGM grant funds, as well as potential funding from FCGMA.

A8. Installation of Additional Shallow Groundwater Monitoring Wells

Description

This project proposes installation of shallow monitoring wells to assess groundwater conditions along Arroyo Las Posas, Conejo Creek, and Calleguas Creek in the Pleasant Valley Basin. The GSP determined that there was a data gap in the understanding of how surface water and shallow groundwater interact with the deeper primary aquifers in the Pleasant Valley Basin. DWR also identified "investigation of the hydraulic connectivity of the surface water bodies to the shallow aquifer and principal aquifers" as a recommended corrective action that should be addressed for the 5-year evaluation of the Pleasant Valley Basin GSP. Shallow groundwater wells will be used to help understand the relationship between surface water and groundwater along the stream courses. Data from the construction of the wells will help define aquifer properties in the younger and older alluvium, and data on groundwater conditions in these wells will be used to help assess whether riparian vegetation is accessing groundwater in the Shallow Alluvial Aquifer.

Relationship to Sustainability Criteria

Relationship to Minimum Thresholds

This project does not have a direct influence on the minimum thresholds. It will, however, provide data that can be used to help evaluate and potentially revise the minimum thresholds in the future.

Relationship to Measurable Objectives

This project does not have a direct influence on the measurable objectives. It will, however, provide data that can be used to help evaluate and potentially revise the measurable objectives in the future.

Expected Benefits

The expected benefits of this project lie in the additional data gathered from the well installation process and the ongoing monitoring of the groundwater conditions at the well sites. This data can be used to refine the conceptual and numerical models of the Pleasant Valley Basin. Such refinement may result in reevaluation and adjustment of the minimum thresholds or measurable objectives associated with groundwater dependent ecosystems.

Timetable for Implementation

Installation of the monitoring wells can be completed within a 2-year timeframe.

Metrics for Evaluation

This project will be evaluated by the number of new dedicated monitoring wells installed.

Economic Factors and Funding Sources

The cost per new well location is anticipated to be approximately $165,000. Funding sources include DWR TSS or SGM grant funds, as well as potential funding from FCGMA.

A9. Installation of Transducers in Groundwater Monitoring Wells

Description

This project proposes installation of transducers in seven representative monitoring points, or key wells. The GSP determined that there were often temporal data gaps in the understanding of aquifer conditions in the Pleasant Valley Basin. These data gaps limit the number of wells that can be used to contour spring high and fall low groundwater conditions. The temporal data gaps have persisted in reporting groundwater levels in storage for the annual reports prepared after the GSP was submitted to DWR. Additionally, as most key wells are agricultural irrigation wells, transducers will help assure that measured water levels are actual static water levels unaffected by recovery or potential well interference. The addition of transducers will help ensure that spring high and fall low water levels are collected from the representative monitoring points within a 2-week window, as recommended by DWR and will provide a clearer understanding of groundwater conditions during the spring and fall measurement events. This will allow a better comparison for annual change in storage estimates and will facilitate better management of the Basin.

Relationship to Sustainability Criteria

Relationship to Minimum Thresholds

This project does not have a direct influence on the minimum thresholds. It will, however, provide data that can be used to help evaluate and potentially revise the minimum thresholds in the future.

Relationship to Measurable Objectives

This project does not have a direct influence on the measurable objectives. It will, however, provide data that can be used to help evaluate and potentially revise the measurable objectives in the future.

Expected Benefits

The expected benefits of this project lie in the collection of data from a 2-week window each spring and fall and the ongoing monitoring of the groundwater conditions at the well sites. This data can be used make better management decisions depending on the observed groundwater conditions.

Timetable for Implementation

Installation of transducers can be completed within a 2-year timeframe.

Metrics for Evaluation

This project will be evaluated by the number of transducers installed and the evaluation of annual change in storage that results from the transducer data.

Economic Factors and Funding Sources

The cost is anticipated to be approximately $124,000 for seven well locations. Funding sources include DWR TSS or SGM grant funds, as well as potential funding from FCGMA.

A10. Stormwater Diversion to Camarillo Sanitary District Water Reclamation Plant for Treatment and Reuse Feasibility Study

Description

This project seeks to understand the feasibility of diverting stormwater flows from the City of Camarillo's stormwater collection system to the Camarillo Sanitary District's (CSD) Water Reclamation plant, to be treated and reused for irrigation purposes. The additional irrigation water will reduce groundwater demand in the PVB, and treatment of this stormwater will help with MS4 Permit compliance.

Relationship to Sustainability Criteria

Relationship to Minimum Thresholds

This is a feasibility study, so it does not have a direct influence on the minimum threshold groundwater levels. If the projects are found to be feasible, however, they could provide additional recharge or reduce groundwater production demand, which would help groundwater levels rise above the minimum thresholds in the Pleasant Valley Basin.

Relationship to Measurable Objectives

This is a feasibility study, so it does not have a direct influence on the measurable objective groundwater levels. If the projects are found to be feasible, however, they could provide additional recharge or reduce groundwater production demand, which would help groundwater levels rise above the measurable objectives in the Pleasant Valley Basin.

Expected Benefits

The expected benefits of the feasibility study are to provide a clear understanding of what the impacts may be on groundwater demand, groundwater quality, and groundwater recharge from this project. The project may also help the region comply with the MS4 Permit requirements for TMDL's for the Revolon Slough, Beardsley Wash and other creeks with TMDL limits within the City of Camarillo.

Timetable for Implementation

The feasibility study can be completed in a 2-year timeframe. If the project is found to be feasible, timetables for permitting, construction, and implementation of the project will be developed.

Metrics for Evaluation

Evaluation of the feasibility study will be based on the report produced documenting the data analyzed, work completed, and the findings of the study.

Economic Factors and Funding Sources

The feasibility study is anticipated to cost $350,000. Funding for the study is being sought through a DWR SGM grant.

A11. Camarillo Hills Drain Stormwater Diversion to Camarillo Sanitary District Water Reclamation Plant Feasibility Study

Description

This project seeks to understand the feasibility of diverting a portion of stormwater flows from the Camarillo Hills Drain, near the Camarillo Airport, to the CDS sanitary sewer Pump Station No. 3, near the intersection of Las Posas Road and Pleasant Valley Road. Stormwater would be pumped from Pump Station No. 3 to the CSD Water Reclamation Plant (WRP). Stormwater would be treated at the WRP and the reclaimed water would be used for irrigation in the Camarillo and Camrosa Service areas. The additional irrigation water will reduce groundwater demand in the PVB, and treatment of this stormwater will help with MS4 Permit compliance.

Relationship to Sustainability Criteria

Relationship to Minimum Thresholds

This is a feasibility study, so it does not have a direct influence on the minimum threshold groundwater levels. If the projects are found to be feasible, however, they could provide additional recharge or reduce groundwater production demand, which would help groundwater levels rise above the minimum thresholds in the Pleasant Valley Basin.

Relationship to Measurable Objectives

This is a feasibility study, so it does not have a direct influence on the measurable objective groundwater levels. If the project is found to be feasible, it could provide additional recharge or reduce groundwater production demand, which would help groundwater levels rise above the measurable objectives in the Pleasant Valley Basin.

Expected Benefits

The expected benefits of the feasibility study are to provide a clear understanding of what the impacts may be on groundwater demand, groundwater quality, and groundwater recharge from this project. The project may also help the region comply with the MS4 Permit requirements for TMDL's for the Revolon Slough and Beardsley Wash.

Timetable for Implementation

The feasibility study can be completed in a 2-year timeframe. If the project is found to be feasible, timetables for permitting, construction, and implementation of the project will be developed.

Metrics for Evaluation

Evaluation of the feasibility study will be based on the report produced documenting the data analyzed, work completed, and the findings of the study.

Economic Factors and Funding Sources

The feasibility study is anticipated to cost $300,000. Funding for the study is being sought through a DWR SGM grant.

A12. Camarillo Airport Regional Stormwater Project Feasibility Study

Description

This project seeks to understand the feasibility implementing a regional stormwater capture and infiltration project in the vicinity of the Camarillo Airport. This feasibility study seeks to investigate diverting stormwater flows from the Camarillo Hills Drain to an underground infiltration or detention basin for groundwater recharge. Through a regionally led effort, the study would investigate and propose a suitable location, provide required testing, and other reports as required to fully evaluate project feasibility. The project will also help with compliance of TMDL's for Revlon Slough and Beardsley Wash.

Relationship to Sustainability Criteria

Relationship to Minimum Thresholds

This is a feasibility study, so it does not have a direct influence on the minimum threshold groundwater levels. If the projects are found to be feasible, however, they could provide additional recharge or reduce groundwater production demand, which would help groundwater levels rise above the minimum thresholds in the Pleasant Valley Basin.

Relationship to Measurable Objectives

This is a feasibility study, so it does not have a direct influence on the measurable objective groundwater levels. If the projects are found to be feasible, however, they could provide additional recharge or reduce groundwater production demand, which would help groundwater levels rise above the measurable objectives in the Pleasant Valley Basin.

Expected Benefits

The expected benefits of the feasibility study are to provide a clear understanding of what the impacts may be on groundwater demand, groundwater quality, and groundwater recharge from this project. The project may also help the region comply with the MS4 Permit requirements for TMDL's for the Revolon Slough and Beardsley Wash.

Timetable for Implementation

The feasibility study can be completed in a 2-year timeframe. If the project is found to be feasible, timetables for permitting, construction, and implementation of the project will be developed.

Metrics for Evaluation

Evaluation of the feasibility study will be based on the report produced documenting the data analyzed, work completed, and the findings of the study.

Economic Factors and Funding Sources

The feasibility study is anticipated to cost $300,000. Funding for the study is being sought through a DWR SGM grant.

A13. Infiltration Basin Near Camarillo Sanitary District Water Reclamation Plant Feasibility Study

Description

This project seeks to understand the feasibility of adding stormwater infiltration or detention areas to the west of the existing CSD flood management project near the WRP. This study would investigate and propose a suitable location, provide required testing and other reports as required to fully evaluate project feasibility.

Relationship to Sustainability Criteria

Relationship to Minimum Thresholds

This is a feasibility study, so it does not have a direct influence on the minimum threshold groundwater levels. If the projects are found to be feasible, however, they could provide additional recharge or reduce groundwater production demand, which would help groundwater levels rise above the minimum thresholds in the Pleasant Valley Basin.

Relationship to Measurable Objectives

This is a feasibility study, so it does not have a direct influence on the measurable objective groundwater levels. If the projects are found to be feasible, however, they could provide additional recharge or reduce groundwater production demand, which would help groundwater levels rise above the measurable objectives in the Pleasant Valley Basin.

Expected Benefits

The expected benefits of the feasibility study are to provide a clear understanding of what the impacts may be on groundwater demand, groundwater quality, and groundwater recharge from this project.

Timetable for Implementation

The feasibility studies can be completed in a 2-year timeframe. If the project is found to be feasible, timetables for permitting, construction, and implementation of the project will be developed.

Metrics for Evaluation

Evaluation of the feasibility study will be based on the reports produced for individual projects documenting the data analyzed, work completed, and the findings of the studies.

Economic Factors and Funding Sources

The feasibility study is anticipated to cost $300,000. Funding for the study is being sought through a DWR SGM grant.

A14. City of Camarillo North Pleasant Valley Desalter Expansion

Description

The North Pleasant Valley Desalter Treatment Facility (Desalter) was constructed to treat brackish groundwater that infiltrated from Calleguas Creek between over the past several decades. The Desalter will treat up to 4,500

AFY of brackish water via reverse osmosis filters and produce approximately 3,800 AF of potable water for the City of Camarillo. The Desalter is expected to be fully operational in 2022. This regionally led effort will investigate the feasibility of increasing the volume of groundwater treated by the Desalter for the benefit of regional agencies and multiple basins. The groundwater elevation data collected after the Desalter begins operations and the actual volume of potable water produced by the Desalter will be used to help assess whether there is the potential for additional groundwater production in this area and treatment by the Desalter.

Relationship to Sustainability Criteria

Relationship to Minimum Thresholds

This is a feasibility study, so it does not have a direct influence on the minimum thresholds. The minimum threshold groundwater elevations in the vicinity of the Desalter were selected with the anticipated operational constraints of the Desalter project at the time the GSP was prepared. Changes to the project will need to assess the impact on the minimum thresholds.

Relationship to Measurable Objectives

This is a feasibility study, so it does not have a direct influence on the measurable objectives. As with the minimum thresholds, the measurable objective groundwater elevations in the vicinity of the Desalter were selected with the anticipated operational constraints of the Desalter project at the time the GSP was prepared. Changes to the project will need to assess the impact on the measurable objectives.

Expected Benefits

The expected benefits of this project could include treating additional brackish groundwater in the Pleasant Valley Basin so that it could be used by agencies other than Camarillo, thereby reducing groundwater demand in neighboring areas.

Timetable for Implementation

The feasibility study could be completed within 2-years. The timetable for implementing expansion of the Desalter will not be determined until the project is found to be feasible.

Metrics for Evaluation

Evaluation of the feasibility study will be based on a report produced documenting the data analyzed, work completed, and the findings of the study.

Economic Factors and Funding Sources

The Desalter was funded by the City of Camarillo, State of California grants, including funds from Proposition 84 and Proposition 1, as well as by the U.S. Bureau of Reclamation. The total cost of the Desalter is approximately $70 million. Funding for the feasibility study to expand the Desalter is being sought via a DWR SGM grant. The feasibility study is anticipated to cost approximately $350,000.

A15. Houweling Nursery's Indoor Grow Facility RO Brine Recovery Project – Camarillo CA

Description

Houweling Nursery's indoor grow facility in Camarillo has grown hydroponic tomatoes and cucumbers on approximately 125 acres of land over the last 14 years. This grow operation requires approximately 800 AFY which is supplied by a mix of groundwater and purified / reused hydroponic wastewater returning from the plants. This grow operation desalinates the groundwater and hydroponic waste feed onsite using a dedicated reverse osmosis (RO) system which is capable of recovering approximately 60 to 70% of the influent. Thus, approximately 300 AFY of water is not recoverable through the current system.

This project seeks to recover 99% of the RO effluent processed using zero liquid discharge treatment of RO brine. This project will be sized to process 200 gallons per minute (gpm) of brine, which will give it the ability to generate up to 320 AFY of treated water for re-use. Previously, zero liquid discharge technology has been prohibitively expensive for use in the agricultural industry. New innovations may reduce costs by approximately 80% over previous estimates, thereby making this cost-effective to implement. If this project is successful, it would reduce groundwater demand in the PVB by approximately 320 AFY.

Relationship to Sustainability Criteria

Relationship to Minimum Thresholds

Reduced groundwater demand in the PVB has a direct influence on the minimum threshold groundwater elevations, which are expected to rise with reduced groundwater production in the basin.

Relationship to Measurable Objectives

As with the minimum thresholds, the project will reduce groundwater demand which will help groundwater elevations rise to the measurable objective water levels in parts of the Pleasant Valley Basin

Expected Benefits

The expected benefit of this project is a reduction in groundwater demand in the PVB of approximately 300 AFY.

Timetable for Implementation

The project can be started within 6 months and fully implemented within 1 year of securing funding.

Metrics for Evaluation

Evaluation of the project will be based on the additional volume of water recovered by the zero liquid discharge treatment of the RO brine.

Economic Factors and Funding Sources

The total capital cost for the project is expected to be $3.275 million with an annual cost of $209,000. The capital cost per acre-foot of water produced is approximately $11,000 and the annual O&M cost is $640 per acre-foot. The project is seeking funding from the DWR SGM grant program and also has the potential for private funding from the business owner.