



DRAFT TECHNICAL MEMORANDUM

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TO: **WMA GSA** DATE: **February 2021**
FROM: **Stetson Engineers** JOB NO: **2710-03**
RE: **DRAFT Western Management Area Groundwater Conditions**

INTRODUCTION

This Memorandum describes groundwater conditions within the Western Management Area (WMA) of the Santa Ynez River Valley Groundwater Basin, herein referred to as the “Basin.” The Sustainable Groundwater Management Act (SGMA) requires the Groundwater Sustainability Plan include “a description of current and historical groundwater conditions in the basin”¹ as presented in this Groundwater Conditions Technical Memorandum (Memorandum). As required by SGMA, the Basin setting is summarized in the following three related technical memoranda:

1. Hydrogeologic Conceptual Model
2. Groundwater Conditions
3. Water Budget

The Hydrogeologic Conceptual Model characterizes the WMA extent and management areas, subareas, topography, geology, principal groundwater aquifers, and primary sources, uses, and users of groundwater. This Groundwater Conditions Technical Memorandum presents the available data evaluated, provides an assessment of current WMA groundwater conditions as observed in the period 2015-2020, and describes historical conditions using available data from the period 1924 through 2020. The Water Budget Technical Memorandum will quantify groundwater flows into and out of the WMA, including natural conditions (precipitation, groundwater flow, etc.) and human-made conditions (dam releases, groundwater pumping, etc.).

In accordance with SGMA, groundwater sustainability is determined from historical trends, water year type, current groundwater conditions, and projected water use in the Basin. Groundwater use and management within the WMA is determined unsustainable if available data indicate “significant and unreasonable” effects caused by groundwater conditions based on six sustainability indicators specified in the regulations. Accordingly, as required by SGMA, the

¹ 23 CCR 354.16.

following indicators were evaluated within the WMA to document their past and current conditions and support future development of related Sustainable Management Criteria (SMC).

1. Chronic lowering of groundwater levels
2. Reduction of groundwater storage
3. Degraded groundwater quality
4. Seawater intrusion
5. Land Subsidence
6. Depletion of interconnected surface water

The remainder of this Memorandum presents results from the review and evaluation of available data for the WMA. If the data indicate undesirable results may be occurring, or have the potential to occur, the WMA Groundwater Sustainability Agency (GSA) Committee, with input from the Citizen Advisory Group and the public, shall establish SMC thresholds for the relevant sustainability indicators. The SMC thresholds determine when effects are considered “significant and unreasonable,” and can be utilized by the WMA GSA Committee to define sustainability.

The SMC thresholds and definitions for undesirable results will be memorialized in a separate Technical Memorandum. Following establishment of SMC thresholds, projects and management actions will be identified as needed in subsequent technical studies to mitigate undesirable results, if any are occurring, and facilitate sustainable groundwater management within the WMA portion of the Basin.

This Memorandum is organized as follows.

- *Section 1. Groundwater Elevation.* This section evaluates the first of the six sustainability indicators, chronic lowering of groundwater levels, and can provide a framework to evaluate some or all of the remaining sustainability indicators. This section includes groundwater elevation data and hydrographs, groundwater flow directions and maps, lateral and vertical groundwater gradients, regional groundwater pumping patterns, and changes in groundwater elevations over time.
- *Section 2. Groundwater Storage.* This section evaluates the second sustainability indicator, reduction of groundwater storage. It includes data on changes in groundwater storage data over the available period of record (roughly 1980–2020).
- *Section 3. Water Quality.* This section addresses, degraded groundwater quality. Beneficial uses are described, and suitability of water quality for each is discussed. Areas



of known groundwater contamination and existing contaminant plumes are documented. Water Quality conditions for recent water years 2015-2018 were evaluated using published water quality objectives for groundwater.

- *Section 4. Seawater Intrusion.* This section addresses seawater intrusion, which could occur at the westernmost margin of the WMA where the aquifer interfaces with the Pacific Ocean. This section evaluates available data and provides the required maps and cross-sections of chloride concentrations for the relevant principal aquifers.
- *Section 5. Land Subsidence.* This section addresses the rate and extent of land subsidence. The section includes available data related to current and historical ground surface elevations, potential for subsidence, and summarizes historical extent, cumulative total, and annual rate of detected land subsidence within the WMA.
- *Section 6. Interconnected Surface Water and Groundwater Dependent Ecosystems.* This section addresses depletion of interconnected surface water. It identifies potential interconnected surface waters, evaluates potential depletions of those waters, and describes the general relationships between surface water, groundwater, and depletions to potential Groundwater Dependent Ecosystems within the WMA.



LIST OF ACRONYMS AND ABBREVIATIONS

AFB	Air Force Base
Basin	Santa Ynez River Valley Groundwater Basin
DDT	dichloro-diphenyl-trichloroethane
GDE	Groundwater Dependent Ecosystem
GSA	Groundwater Sustainability Agency
GSP	Groundwater Sustainability Plan
HCM	Hydrogeologic Conceptual Model
InSAR	Interferometric Synthetic Aperture Radar
mg/L	milligrams per liter
SGMA	Sustainable Groundwater Management Act
SMCL	secondary maximum contaminant level
SWRCB	State Water Resources Control Board
USGS	United States Geological Survey
WMA	Western Management Area
µg/L	micrograms per liter

APPENDICES

APPENDIX A	HISTORICAL WELL HYDROGRAPHS.
APPENDIX B	Dudek. 2020. <i>Land Subsidence, West and Central Management Areas – Santa Ynez River Valley Groundwater Basin</i> . October 30, 2020.



1 GROUNDWATER ELEVATION

This section addresses the first of the six sustainability indicators, chronic lowering of groundwater levels. Groundwater elevation data, lateral and vertical groundwater gradients, inferred groundwater flow directions, maps showing lines of equal groundwater elevations (contours), regional groundwater pumping patterns, and graphical changes in groundwater elevations over time (hydrographs) are described and evaluated in the following subsections. These descriptions include both historical seasonal and longer-term trends, and documentation of current conditions in the WMA. This section also provides a framework for data presentation and reporting on the five remaining sustainability indicators.

1.1 GROUNDWATER ELEVATION DATA

Groundwater data were made available by the WMA Groundwater Sustainability Agency (GSA) member agencies. The data are collected by the agencies to monitor and manage their respective groundwater jurisdictions. Data provided by the WMA GSA member agencies include groundwater well names and/or identifying labels, groundwater well locations, static groundwater elevation data, and groundwater pumping or production data. Five sources of groundwater elevation data made available for this evaluation are summarized in **Table 1-1**.

**TABLE 1-1
WMA GROUNDWATER ELEVATION DATA SOURCES**

Type	Summary	Description
Monthly	City of Lompoc	Static water level measurements provided by the City of Lompoc.
Monthly	United States Bureau of Reclamation (USBR)	Groundwater elevation data reported in the USBR Cachuma project monthly reports. The vertical datum of the source data was converted from National Geodetic Vertical Datum of 1929 (NGVD29) to North American Vertical Datum of 1988 (NAVD88). ¹
Monthly	Vandenberg Village Community Services District (CSD)	Static water level measurements provided by Vandenberg Village CSD.
Semiannual	United States Geological Survey (USGS) National Water Information System (NWIS)	Groundwater level data available from the USGS NWIS (entire Santa Ynez Valley).
Semiannual	County of Santa Barbara	Groundwater level data collected by the County of Santa Barbara.

Note: ¹ 23 CCR 352.4 requires that groundwater elevations be reported in NAVD88. Vertical datum is the zero-elevation from which all other elevations are referenced. In the Basin, depending on location, the difference between NGVD29 and NAVD88 is approximately 2.5–2.6 feet.



The groundwater elevation data were previously incorporated into the Data Management System as described in the Data Management Plan. The Data Management System was utilized to evaluate these data and prepare groundwater elevation hydrographs for the principal groundwater aquifers within the WMA based on well depth, well-casing perforated intervals, geologic conditions, and measured water level responses to recharge and pumping.

1.2 GROUNDWATER ELEVATION CONTOUR MAPS

In accordance with the Sustainable Groundwater Management Act (SGMA), “groundwater elevation contour maps depicting the groundwater table or potentiometric surface associated with the current seasonal high and seasonal low for each principal aquifer within the basin”² are to be prepared for the WMA. Contours were developed for those portions of the WMA having sufficient number and distribution of groundwater wells. Groundwater elevation contour maps for seasonal high (spring 2020) and seasonal low (fall 2019) conditions within the WMA are included as **Figures 1-1** and **1-2**.

As described in the companion Hydrogeologic Conceptual Model (HCM) Technical Memorandum, the WMA has two principal aquifers, the Upper Aquifer and Lower Aquifer, whose names are derived from the Lompoc Plain subarea of the WMA where both aquifers are located.

- Upper Aquifer consists primarily of older and younger alluvial deposits and river gravels of the Santa Ynez River; and,
- Lower Aquifer consists of Careaga Sandstone and the Paso Robles Formation in a broad syncline structure.

Two subareas, the Burton Mesa and south Lompoc Terrace, are uplifted marine terraces and not included in the WMA groundwater elevation contour maps because of existing data gaps (they are not part of current monitoring programs), and because they are considered mostly disconnected from the principal aquifers cited above. Groundwater in these two subareas is typically perched, and therefore not representative or correlative to the principal groundwater aquifers above.

1.2.1 Seasonal High and Seasonal Low Groundwater Elevation Contour Maps

Seasonal High – Spring 2020

Seasonal high groundwater elevations represented by Spring 2020 measurements are presented on **Figure 1-1**. Shown on this map are the locations of wells with groundwater monitoring data,

² 23 CCR 354.1(a)(1).

color-coded to identify wells with screened intervals within the Upper Aquifer and wells screened within the Lower Aquifer.

Upper Aquifer seasonal high groundwater elevations were available at wells located across the Santa Ynez Alluvium and Lompoc Plain. The groundwater elevation data were used to calculate groundwater gradient and flow direction inferred from the contours. In the Upper Aquifer, groundwater generally flows from east to west, in alignment with the Santa Ynez River channel. Adjacent to the Lompoc Narrows is an area with a relatively steep groundwater gradient, as the groundwater at higher elevations in the Santa Ynez Alluvium disperse across the Lompoc Plain toward the Pacific Ocean.

Lower Aquifer seasonal high groundwater elevations are shown on **Figure 1-1** for the Lompoc Terrace, Lompoc Plain, Lompoc Upland, and Santa Rita Upland subareas. Groundwater elevations are highest along the base of the Purisima Hills in the Santa Rita Upland and Lompoc Upland, and lowest in the westernmost portions of the Lompoc Plain where the Santa Ynez River discharges to the Pacific Ocean. Groundwater generally flows east to west from the Santa Rita and Lompoc Uplands to the adjacent Lompoc Plain and continues toward the Pacific Ocean.

Groundwater elevations are greater in wells representing the Lower Aquifer than in the Upper Aquifer, indicating an upward vertical gradient. The upward vertical gradient is consistent with previous studies (Bright et al. 1997), which concluded that groundwater flow is upward from the Lower Aquifer to the Upper Aquifer.

Seasonal Low – Fall 2019

Seasonal low groundwater levels are represented by Fall 2019 groundwater elevations, and contours based on available data from wells located across the Santa Ynez Alluvium and Lompoc Plain are shown on **Figure 1-2** (the wells are color-coded to correspond to the Upper Aquifer and Lower Aquifer, similar to **Figure 1-1**). Fall 2019 Upper Aquifer and Lower Aquifer groundwater elevation data are slightly lower in elevation with respect to the Spring 2020 seasonal high; however, horizontal flow directions and vertical gradients are consistent with the Spring 2020 conditions described above.

1.2.2 Evaluation of Seasonal High and Low

As expected, seasonal low Upper Aquifer groundwater elevations are generally lower than those measured in Spring 2020, and the groundwater gradient from the western Lompoc Plain to the Pacific Ocean is generally flatter.

Groundwater levels in the Lower Aquifer show less variation between the Fall 2019 seasonal low and Spring 2020 seasonal high, with the largest difference occurring along the Santa Ynez River in the western portion of the Lompoc Plain.



1.3 GROUNDWATER HYDROGRAPHS

SGMA requires preparation of “hydrographs depicting long term groundwater elevations, historical highs and lows, and hydraulic gradients between principal aquifers.”³ Hydrographs using data from select WMA wells are shown on **Figure 1-3**. Hydrographs were also prepared for other wells located within the WMA but are not shown on **Figure 1-3** because of their relatively short period lengths or limited value to assess WMA groundwater because of their locations. The hydrographs for these additional wells are provided in Appendix A, and are generally organized from west to east within each WMA subarea.

The wells shown on **Figure 1-3** were utilized to prepare representative hydrographs for the WMA subareas. The colors of hydrograph data points correspond to their data source noted in the figures and described in Section 1.1, “Groundwater Elevation Data”. The hydrographs show the measured groundwater elevation on the left y-axis (vertical axis) and the corresponding depth to groundwater on the right y-axis. Grid lines depicting Calendar Year are provided at the top x-axis (horizontal axis) and the bottom x-axis shows the Water Year which spans October through September, annually. Vertical columns for the water year are colored to represent water year index based on precipitation (wet, dry/critically dry, or above/below normal).

The following subsections discuss the hydrograph data presented in **Figure 1-4A-H**. In general, the hydrograph data show visible but slight increases in groundwater elevations during the relatively wet 1990-2000 period and decreases in groundwater elevations during the relatively dry 2005-2020 period.

1.3.1 Lompoc Plain

Groundwater elevation trends across the Lompoc Plain are variable and reflect differences in land and water use. The western margin of the Lompoc Plain, where the Santa Ynez River discharges to the Pacific Ocean, is characterized by the Santa Ynez River Estuary, which is a brackish natural environment with little to no groundwater pumping. Moving eastward, the western portion of the Lompoc Plain is characterized by abundant agricultural groundwater use. The eastern portion of the Lompoc Plain encompasses the City of Lompoc, and groundwater use in this area is primarily used to meet municipal and industrial demands for water with some limited agricultural use. Eight representative hydrographs have been prepared for these general portions of the WMA and are reported in **Figures 1-4AB** through **Figure 1-4GH** and reveal groundwater elevation trends for the Upper and Lower Aquifers.

Santa Ynez River Estuary

In the WMA, the Santa Ynez River Estuary is located at the westernmost margin of the Lompoc Plain where the Santa Ynez River discharges to the Pacific Ocean. The Lower Aquifer is missing

³ 23 CCR 354.1(a)(2).

in this area, and the Upper Aquifer lies non-conformably on top of the non-water-bearing Monterey Formation.

The location of well 7N/35W-17M1 is shown on **Figure 1-3**, and it is considered representative of the eight current and historical groundwater monitoring wells in the Santa Ynez Estuary area. The hydrograph for 7N/35W-17M1 is shown on **Figure 1-4A** and indicates seasonal groundwater elevations vary by approximately 5 feet; water levels have been relatively stable, and no long-term water level trend is discernable in the data record which began in 1965. Stable groundwater elevations may be due to approximately stable Santa Ynez River subflows and long-term water levels in the adjacent Pacific Ocean.

Western Lompoc Plain

There is significant agricultural groundwater use in this area, and as such water level measurements in the wells can be influenced by pumping from nearby wells. Hydrographs for three Upper Aquifer wells representative of the western portion of the Lompoc Plain are shown on **Figure 1-4B, C and D**. Additional hydrographs for wells in this area are included in Appendix A. The hydrograph for well 7N/35W-22J1 (**Figure 1-4B**) shows typical seasonal variation and an approximate 10 feet decline in groundwater elevation since about 1950; average groundwater elevation has been approximately stable since 2010. Well 7N/35W-23E6 (**Figure 1-4C**) is constructed within the deeper parts of the Upper Aquifer and exhibits larger seasonal high and low groundwater elevation changes than measured in 7N/35W-22J1 and other nearby wells. There is no long-term trend visible in the hydrograph from this well. The hydrograph for well 7N/35W-26F4 (**Figure 1-7D**) shows seasonal variations that can exceed 20 feet. Groundwater elevations appeared to respond to climatic conditions, showing declines during dry periods within 1985-1990 and 2000-2010, but have recovered since around 2015 despite the dry climatic conditions. As a result, there is no visible net long-term trend.

Well 7N/35W-26L4 is located in the western portion of the Lompoc Plain where both the Upper Aquifer and Lower Aquifer are present (**Figure 1-3**). The hydrograph for this well (**Figure 1-4E**) shows up to 15 feet of seasonal variation in groundwater elevations. Longer term trends are similar to other wells, where there is a visible increase in groundwater elevations during characteristically normal and wet years in the period 1990- 2000, followed by groundwater elevation decreases during dry years. Overall, there has not been a significant net change in groundwater levels since the late 1980's.

Eastern Lompoc Plain

The east-central portion of the Lompoc Plain is bound by the Lompoc Narrows to the east and San Miguelito Creek to the west. In this area, both the Upper Aquifer and Lower Aquifer are present. Groundwater is used to meet a mix of municipal, industrial, and limited agricultural demands for water. Hydrographs were prepared using data from two representative Upper

Aquifer wells and one Lower Aquifer well (**Figure 1-3**). Additional hydrographs for other wells in the area are included in Appendix A.

The hydrograph for Upper Aquifer well 7N/34W-27P5 (**Figure 1-4F**) shows seasonal variation up to 10 feet, and longer-term declines of about 30 feet during characteristically dry conditions during the late 1980's to early 1990's, and after 2010. Water levels increase during the relatively wet periods. Overall, there has been no significant net change in groundwater elevations in the Upper Aquifer since the mid 1960's except during extended drought periods.

The hydrograph for Upper Aquifer well 7N/34W-35K9 (**Figure 1-4G**) is likely influenced by recharge from the Santa Ynez River and exhibits oscillating groundwater elevations associated with seasonal conditions and river discharge. Groundwater elevations exhibit seasonal variations of up to 20 feet, typically returning to a relatively stable elevation. Groundwater elevation declines are visible during the extended drought period between 2010 and 2019.

The Lower Aquifer well 7N/34W-24N1 (**Figure 1-4H**) hydrograph visibly shows a consistent, long-term groundwater elevation decline since approximately 1925. Temporary increases in groundwater elevations are observed during characteristically wet periods between 1990 and 2000, consistent with other wells in the area, but are followed by continued groundwater elevation declines during relatively dry periods. The seasonal variation in groundwater elevations is approximately 5 feet.

1.3.2 Lompoc Terrace

The Lompoc Terrace is geologically similar to the tectonically uplifted Burton Mesa (Geosyntec 2020); however, the Lompoc Terrace does have geologic units corresponding to both the Upper and Lower Aquifers present in the Lompoc Plain. The Lompoc Terrace Orcutt Sand forms the corresponding Upper Aquifer but it is hydrogeologically disconnected from the Lompoc Plain. Where groundwater is observed in the Orcutt Sand it is considered perched. The corresponding Lower Aquifer geologic units present in the Lompoc Terrace may be hydrogeologically connected to the Lompoc Plain; however, due to data gaps from the limited number of wells and available groundwater elevation data, confirmation of this connection is not possible.

A representative hydrograph for the Lompoc Terrace 7N/35W-27P1 (**Figure 1-5**) shows annual seasonal water level variations on the order of several feet but approximately no net change in groundwater elevation since the late 1960s. Consistent with other WMA subareas, there were periods of extended groundwater elevation decreases and increases during relatively dry and wet climatic periods. For example, slight increases in groundwater elevations are observed between 1990 and 2000 after a period of normal and wet years, followed by groundwater elevation declines between approximately 2010 through 2019 in response to long-term drought conditions.

1.3.3 Burton Mesa

The Burton Mesa (**Figure 1-3**) is a tectonically uplifted marine terrace, as previously discussed and presented in the Geologic Model Technical Memorandum (Geosyntec 2020). The Burton Mesa is characterized by the non-conformable deposition of the Orcutt Sand directly over the non-water-bearing Monterey formation. In the WMA, the Orcutt Sand is typically associated with the Upper Aquifer, however the Burton Mesa is not hydrogeologically connected to the Upper Aquifer and the presence of groundwater in this area is considered perched. Vandenberg Air Force Base (AFB), the current landowner and primary water user in the Burton Mesa subarea, confirmed the lack of groundwater and groundwater use. Hydrographs for wells constructed in the Burton Mesa wells are included in Appendix A.

1.3.4 Lompoc Upland

In the Lompoc Upland, groundwater is used to meet municipal and agricultural demands for water. The Upper and Lower Aquifers are both present in the Lompoc Upland, however groundwater monitoring occurs only in the Lower Aquifer (**Figure 1-3**). Hydrographs for the Lompoc Upland are provided in **Figure 1-6**.

The hydrograph for Lower Aquifer well 7N/34W-15E1 (**Figure 1-6A**) represents groundwater conditions in the western portion of the Lompoc Upland. Since the late 1960's, groundwater levels have experienced an overall net decline of about 10 feet, but most of that decline has occurred since approximately 2005 to the present. The data indicate groundwater elevations were relatively stable between 1975 through 1990, fluctuating within a range of approximately 5 feet to 10 feet. Slight increases in groundwater elevation are observed after 1990 during normal and wet years and continued through 2000. Groundwater elevations declined during the recent drought periods that began after 2005.

The hydrograph for Lower Aquifer well 7N/34W-12E1 (**Figure 1-6B**) represent groundwater conditions in the eastern portion of the Lompoc Upland. This hydrograph shows a fairly steady, long-term decline in groundwater elevation since 1950. Minor groundwater elevation increases are observed between 1990 and 2000 following normal and wet years, followed by continued decline since approximately 2010. The long-term net decline in this well was about 30 feet.

1.3.5 Santa Rita Upland

In the Santa Rita Upland, groundwater is used to meet a mix of agricultural and domestic demands for water. The Upper and Lower Aquifers are both present in the Santa Rita Upland, but groundwater monitoring is primarily conducted in Lower Aquifer wells with limited data available for the Upper Aquifer. Hydrographs for both aquifers are provided on **Figures 1-7AB** and **1-7CD**.

In the central-western portion of the Santa Rita Upland, groundwater elevations in Lower Aquifer well 7N/33W-21N1 (**Figure 1-7A**) show seasonal variations of a few feet. However, an approximately 20 feet decline in water levels occurred during the period 1970-1995, and after 1995 water levels have been relatively stable with no apparent net change in groundwater elevations. Hydrographs for Lower Aquifer wells in the northern portion of the Santa Rita Upland 7N/33W-21G2 (**Figure 1-7B**) and south-central portion of the Santa Rita Upland 7N/33W-27G1 (**Figure 1-7C**) both show consistent groundwater elevation declines. In the northern area, the net decline in groundwater elevation has been about 50 feet since approximately 1988. Similarly, in the south-central area the net decline in groundwater elevation has been more than 40 feet since about 1968. During normal and wet years, minor groundwater elevation increases are measured in these wells, but these increases do not have a substantial influence on the longer-term trends.

In the eastern portion of the Santa Rita Upland, the elevation of groundwater in Upper Aquifer well 7N/33W-27J01 (**Figure 1-7D**) is hundreds of feet higher than in Lower Aquifer well 7N/33W-27G1 (**Figure 1-7**) located less than one quarter mile to the west. Groundwater in the Upper Aquifer at this well is only about 20 feet below ground surface, whereas groundwater in the Lower Aquifer is several hundred feet or more below land surface. These groundwater elevations suggest that groundwater in the Upper Aquifer is likely underlain by an unsaturated zone, and the water table is perched above the Lower Aquifer.

1.3.6 Santa Ynez River Alluvium

In the WMA upstream of the Lompoc Narrows, as discussed in the HCM, the Santa Ynez River Alluvium is considered part of the subflow of the river, which is regulated by the SWRCB. Because subflow is considered surface water, the Santa Ynez River Alluvial deposits upstream of the Lompoc Narrows would not be classified as a principal aquifer or managed by a GSP under SGMA. The hydrograph for a well screened within this subflow of the Santa Ynez River, well 6N/33W-8E2 (**Figure 1-8**), indicates water level elevations are relatively stable to slightly declining, following periods of prolonged drought in the late 1990s and late 2010s. Seasonal variations up to 10 feet are observed annually. These seasonal and longer-term trends are determined primarily by managed releases from Cachuma Reservoir and extractions of the subsurface water from wells in the river alluvium.

2 GROUNDWATER STORAGE

This section addresses the second sustainability indicator, reduction of groundwater storage. In the WMA, the change in groundwater storage in the Basin was evaluated in this technical memorandum with respect to baseline conditions established in 1982, using data reported annually by the SYRWCD (Stetson, 2020). Groundwater storage data for the WMA is evaluated and the cumulative changes in groundwater storage over time are discussed below. In accordance with SGMA, the section also includes “a graph depicting estimates of the change in groundwater in storage, based on data, demonstrating the annual and cumulative change in the volume of groundwater in storage between seasonal high groundwater conditions, including the annual groundwater use and water year type.”⁴ Graphs were created for the WMA subareas that show changes to groundwater in storage since the established baseline (1982) and are included as **Figure 2-1**. Groundwater storage under future scenarios will be analyzed and refined with the groundwater budget and groundwater model being developed for the GSP.

2.1 CUMULATIVE CHANGE IN GROUNDWATER STORAGE

Accumulated change of groundwater in storage for the WMA is shown on **Figure 2-1** in acre-feet (AF). This annual and cumulative change in the volume of groundwater in storage is from the annual groundwater reports produced by the SYRWCD (Stetson, 2020). From 1982 through 2018, the data indicate a net decline of groundwater storage in the WMA of about 15,000 AF.

The annual reporting of changes in groundwater storage (Stetson, 2020) is based on changes in groundwater levels in representative monitoring wells. For the Lompoc Plain, the United States Bureau of Reclamation (USBR), in connection with SWRCB Order No. 2019-148, determines on a monthly basis the quantity of dewatered storage beneath the forebay on the Lompoc Plain and in the Santa Ynez River alluvial deposits. The District uses a similar methodology with representative monitoring wells to estimate the changes in groundwater storage for the Lompoc Upland, Lompoc Terrace, and Santa Rita Upland (Stetson, 2020).

The Burton Mesa subarea is not included in **Figure 2-1** as it has perched groundwater conditions that are not hydrogeologically connected to the principal aquifers of the WMA. In contrast, the Lompoc Terrace is included in **Figure 2-1** because it may be hydrogeologically connected to the Lower Aquifer. Both the Burton Mesa and the Lompoc Terrace have limited pumping and groundwater use, and therefore experience relatively minimum changes in groundwater storage.

2.2 CLASSIFICATION OF WET AND DRY YEARS

The four wettest water years (water-year defined as October through September, annually) based on precipitation in the period of record at Lompoc (Water Year 1911-2020)⁵ are 1998 (36.42

⁴ 23 CCR 354.16(b).

⁵ Lompoc City Hall, Gauge 439, Santa Barbara County Flood Control & Water Conservation District.

inches precipitation), 1941 (32.71 inches), 1983 (32.46 inches), and 1995 (31.39 inches). The four driest water years in the period of record based on precipitation correspond to 2007 (5.32 inches), 1989 (6.35 inches), 1934 (6.45 inches) and 1924 (6.49 inches).

To characterize all water years as either wet, above/below normal, or dry/critically dry as shown on **Figure 2-2**, the Salsipuedes Creek streamflow gauge (U.S. Geological Survey [USGS] gauge 11132500) was selected as a proxy to classify each water year. The Salsipuedes Creek streamflow gauge is located in Salsipuedes creek just below the confluence with El Jaro Creek, representing a 47.1-square-mile⁶ drainage area. The 79-year dataset for the gauge spans 1942 through 2020 and represents unimpeded runoff due to the absence of upstream water diversion and storage.

Discharge in acre-feet per year for Salsipuedes Creek gauge is shown on **Figure 2-3** for the period of record. The data are presented as a power law distribution, meaning the highest recorded flows in acre-feet have occurred in a minority of the total years recorded. Classification into a water year type followed the State Water Resources Control Board order WR 2019-0148 methodology. Years were classified based on the rank in the period of record in one of five categories: “critically dry” (bottom 20 percentile), “dry” (20th to 40th percentile), “below normal” (40th to 60th percentile), “above normal” (60th to 80th percentile), and “wet” (80th to 100th percentile).

Using the robust dataset from the Salsipuedes Creek gauge (**Figure 2-2**) the period of record was classified as wet, above/below normal, or dry/critically dry. The cumulative departure from mean graph at the bottom indicates that the period 1993–2006 was relatively wet, while the period 2012–2018 has been relatively dry.

2.3 GROUNDWATER USE AND EFFECTS ON STORAGE

Total annual reported groundwater use for the WMA is compared to cumulative groundwater storage loss on **Figure 2-4**. Groundwater use was relatively constant from the late 1987 through 2012. For years 2013 through 2019 (current), total annual groundwater use has declined from about 31,000 to 25,000 acre-feet per year. The observed decline in groundwater use has occurred during a period with relatively dry water years. Cumulative groundwater storage loss indicates that during dry periods the groundwater storage decreased (i.e. 2012-2018), and conversely, during wet periods the groundwater storage increased (i.e. 1993-2006).

⁶ USGS NWIS (2020) USGS 11132500 SALSIPUEDES C NR LOMPOC CA

3 WATER QUALITY

In accordance with SGMA, “Groundwater quality issues that may affect the supply and beneficial uses of groundwater, including a description and map of the location of known groundwater contamination sites and plumes”⁷ are described in this section. Water quality objectives vary depending on the beneficial use and users of groundwater being evaluated. To determine existing or future potential water quality issues within the WMA, the beneficial uses of groundwater must first be established.

This section is divided as follows:

- *Section 3.1, Beneficial Uses.* This subsection describes the various beneficial uses for groundwater within the Basin and provides context for water quality objectives for those beneficial uses.
- *Section 3.2, Suitability for Beneficial Use,* includes discussion of major beneficial uses.
- *Section 3.3, Existing Groundwater Contamination Sites and Plumes.* This section describes the known existing groundwater contaminant sites and plumes that are currently managed by other State of California regulatory bodies responsible for protecting groundwater quality and quantity.
- *Section 3.4, Recent Groundwater Quality,* includes data for selected major diffuse or natural constituents for the period water year 2015 through 2018.

3.1 BENEFICIAL USES

The Central Coast Basin Water Quality Control Plan herein referred to as the Central Coast Basin Plan (Central Coast Regional Water Quality Control Board [CCRWQCB], 2019), which includes the SYRGB, identifies 18 beneficial uses of surface and groundwater in the Santa Ynez River basin below Cachuma Reservoir (CCRWQCB, 2019 Table 2-1), which are briefly listed and described below.

The following four beneficial categories apply to both groundwater and surface water in the WMA.

- **Municipal and Domestic Supply (MUN).** Uses of water for community, military, or individual water supply systems including, but not limited to, drinking water supply.

⁷ 23 CCR §354.16 (d)



- Agricultural Supply (**AGR**). Uses of water for farming, horticulture, or ranching including, but not limited to, irrigation, stock watering, or support of vegetation for range grazing.
- Industrial Process Supply (**PROC**). Uses of water for industrial activities that depend primarily on water quality (i.e., waters used for manufacturing, food processing, etc.).
- Industrial Service Supply (**IND**). Uses of water for industrial activities that do not depend primarily on water quality including, but not limited to, mining, cooling water supply, hydraulic conveyance, gravel washing, fire protection, or oil well repressurization.

For surface water, the 2019 Basin Plan has identified an additional 14 beneficial uses in the SYRVGB below Cachuma Reservoir⁸. The importance of groundwater quality on these beneficial uses depends on the discharge of groundwater to surface water which is described further in Section 6.

3.1.1 Median Groundwater Quality Objectives

The Central Coast Regional Water Quality Control Board (CCRWQCB) 2019 Basin Plan includes median groundwater objectives for several major water quality constituents specifically for portions of the WMA. These are shown in **Table 3-1** along with the secondary maximum contaminant levels (SMCL), a national federal drinking water standard for guidance regarding water for potential public supply. These “objectives are intended to serve as a water quality baseline for evaluating water quality management in the basin” (CCRWQCB, 2019) and represent an average value in each subarea.

TABLE 3-1
MEDIAN GROUNDWATER OBJECTIVES IN MG/L FOR THE WESTERN MANAGEMENT AREA

Basin/Subarea	Salinity as Total Dissolved Solids (TDS)	Chloride (Cl)	Sulfate (SO ₄ ²⁻)	Boron (B)	Sodium (Na)	Nitrogen (N)
Lompoc Plain	1,250	250	500	0.5	250	2
Lompoc Upland	600	150	100	0.5	100	2
Lompoc Terrace*	750	210	100	0.3	130	1
Santa Rita	1,500	150	700	0.5	100	1
<i>SMCL</i>	<i>500</i>	<i>250</i>	<i>250</i>	-	-	-

Note: * 2019 Basin Plain map of the Lompoc Terrace only includes areas where the Lower Aquifer is present.

⁸ See “Table 2-1. Identified Uses of Inland Surface Waters (continued)”, page 20, 2019 Basin Plan

3.2 SUITABILITY FOR BENEFICIAL USE

Groundwater quality in the WMA is suitable for potable and agricultural uses. Key water quality parameters in the WMA in relation to the primary beneficial uses and primary users are summarized below.

3.2.1 Municipal Supply

Municipal supply is the best documented water quality in the WMA, as all public water systems of significant size are required to collect and report water quality to the State Water Resources Control Board (SWRCB) as part of the Safe Drinking Water Information System. Because the major public water systems treat the groundwater in the WMA including the City of Lompoc and the Vandenberg Village and Mission Hills Community Services Districts (CSDs), the majority of the water quality issues are constituents likely related to the distribution system and do not indicate general groundwater quality impairing this beneficial use. The exception is the elevated nitrate found by the Vista Hills Mutual Water Company and Tularosa Mutual Water Company, both located in the Santa Rita Upland, who have reported problems to the SWRCB in 2019 and 2020.

3.2.2 Agricultural Supply

Agricultural beneficial use is the primary beneficial use in the WMA. Different crops have different sensitivities to water quality constituents, and water quality is one of many considerations in terms of crop selection. Section 5.2 of the HCM identified major crops in the WMA, including wine-grapes, strawberries, raspberries, dry beans, walnuts, alfalfa, barley, herbs, peaches, cut-flowers, lettuce, and broccoli. These include crops that are sensitive to high total dissolved solids (TDS), chloride, and boron. Agricultural water is generally untreated before use; however, poor water quality (high TDS) often can be mitigated by increased water application (increased leaching fraction).

Historical water quality in the WMA was reviewed relative to the 2019 Basin Plan general water quality objectives for agricultural water use. In parts of the Lompoc Plain, boron is above the reference value of 0.75 milligrams per liter (mg/L) and iron has measurements above the reference of 5.0 mg/L. Manganese has several values above 0.2 mg/L in the Santa Ynez River Alluvium and Lompoc Plain. Molybdenum has values above 0.01 mg/L in the Lompoc Terrace and Lompoc Plain.

3.2.3 Domestic Supply

Impaired beneficial use for domestic supply was reviewed using the SWRCB Needs Analysis GAMA Tool. This tool identifies the location of domestic wells by section and indicates if groundwater is adversely affected by nitrate, arsenic, hexavalent chromium, perchlorate, 1,2,3-



trichloropropane, and uranium. Unlike municipal supply, domestic supply is less likely to involve water treatment and so groundwater quality is more likely to have a direct negative impact on this beneficial use. Domestic suppliers are not required to take and submit water quality samples.

In the WMA, nitrate exceedances occurred in sections with domestic supply wells in the Lompoc Plain, Lompoc Terrace, Santa Rita Upland, and the Santa Ynez Alluvium. Arsenic exceedances only occurred in sections in the eastern Lompoc Plain, although it was detected below action levels in the Lompoc Upland. No issues were identified related to hexavalent chromium, perchlorate, 1,2,3-trichloropropane, and uranium in the WMA.

3.3 GROUNDWATER CONTAMINATION SITES AND PLUMES

Publicly available databases maintained by various State of California regulatory agencies, including the State Water Resources Control Board GeoTracker GAMA site⁹, and the California Department of Toxic Substances Control EnviroStor site¹⁰ were reviewed and evaluated. In accordance with SGMA, the available data were used to identify sites that could potentially affect groundwater quality within the WMA. Identification of existing groundwater contamination sites are mapped on **Figure 3-1** and the historical extents of contaminant plumes in groundwater are mapped on **Figure 3-2**. These sites are regulated and under the oversight authority of their respective State of California agencies responsible for ensuring the contamination is mitigated in-place and directing appropriate actions to protect groundwater quantity and quality. The SGMA requires that sustainable groundwater management not influence plume migration and negatively influence groundwater quality. Hence, discussion of these sites is for information purposes, and all management, monitoring, compliance and reporting activities related to these sites remain under their respective State of California agencies.

A summary of the identified sites within the WMA is provided in **Table 3-2**. Most of the sites within the City of Lompoc are located along Highway 246 (Ocean Avenue) and Highway 1 (H Street). The sites are primarily related to historical fueling station operations and the contaminants are related to leaking underground storage tank sites. The Vandenberg AFB Cantonment Area is currently regulated under the oversight of the Central Coast Regional Water Quality Control Board (CCRWQCB). Although the site has multiple contaminants of concern¹¹,

⁹ <https://geotracker.waterboards.ca.gov/>

¹⁰ <https://www.envirostor.dtsc.ca.gov/public/>

¹¹ Identified contaminants of concern at the VAFB Cantonment area include: heavy metals (hexavalent chromium, arsenic, nickel, lead, cadmium, antimony, selenium, beryllium, thallium, vanadium, and barium), DDT and byproducts (4,4'-DDT, 4,4'-DDD, and 4,4'-DDE), degreasing solvents (1,2,3-trichloropropane, 1,1-dichloroethylene, vinyl chloride, and acetone), petroleum products (methyl-tert-butyl ether (MTBE), tert-butyl alcohol (TBA), and benzene), dieldrin and heptachlor. Vandenberg AFB Space Launch Complexes have identified groundwater contamination from trichloroethene (TCE), vinyl chloride, and groundwater contamination related to rocketry, including perchlorate, an oxidizer.



they are currently considered compliant with applicable regulatory orders and the contaminants are being effectively monitored and managed in place or remediated to reduce future potential to impair groundwater quality.

TABLE 3-2
COUNT OF POTENTIAL POINT SOURCES OF GROUNDWATER CONTAMINATION
SHOWN ON FIGURE 3-1 BY WMA SUBAREA

Basin/Subarea	SWRCB Cleanup Program		LUST Cleanup		Military Cleanup		DTSC Cleanup		Total	
	Open	Total	Open	Total	Open	Total	Open	Total	Open	Total
Lompoc Plain	3	12	5	43	4	9	4	6	16	70
Lompoc Upland	1	5	0	9	5	7	2	3	8	24
Lompoc Terrace	0	0	0	0	8	20	0	0	8	20
Burton Mesa	0	1	0	0	48	288	4	5	52	294
Santa Rita Upland	0	1	0	0	0	0	0	0	0	1
Santa Ynez River Alluvium	0	0	0	0	0	0	0	0	0	0
Total	4	19	5	52	65	324	10	14	84	409

Note: LUST = leaking underground storage tank; DTSC = Department of Toxic Substances Control.

3.4 Current Groundwater Quality (2015-2018)

The distribution and concentration of selected naturally occurring or diffuse groundwater constituents are discussed in the following subsections. The constituents in this section correspond to the same constituents used for the 2019 Basin Plan groundwater quality objectives (Table 3-1). Averages for the recent 4-year period of water years 2015 through 2018 are shown. Water quality data was primarily evaluated from three primary data compilation sources:

- Water Quality Portal, a cooperative service from USGS, the U.S. Environmental Protection Agency, and the National Water Quality Monitoring Council, which in addition to these federal sources includes some state, tribal, and local data. This is the primary source for USGS water quality data. Water quality data collected by the Santa Barbara County Water Agency is submitted to the USGS and included here.

- Safe Drinking Water Information System, which is a compilation service from SWRCB that compiles mandated water quality reports from California public water systems. Public water systems include the WMA agency members of City of Lompoc, Vandenberg Village Community Services District, and Mission Hills Community Services District.
- Irrigated Lands Regulatory Program (ILRP), an SWRCB program that tracks discharges from irrigated agricultural lands. Participants submit water quality sampling results for selected constituents. The IRLP is made available through the Safe Drinking Water Information System GeoTracker GAMA website.

The Data Management System, described in the Data Management Plan, was configured to automatically update the database with data from these three sources of water quality data. The sections below provide a snapshot of current groundwater conditions in the WMA, based on the best available data from January 1, 2015, through 2018. The spatial distribution of water quality is assessed using maps, and average concentrations are compared to the 2019 Basin Plan water quality objectives and summarized in tables.

3.4.1 Salinity (Total Dissolved Solids)

Salinity, as measured by total dissolved solids (TDS), is the dry mass of constituents dissolved in a given volume of water. There are two measurements of salinity: TDS, which is a measurement of the total mass of the mineral constituents dissolved in the water, and electrical conductivity, which is a measurement of the conductivity of the solution of water and dissolved minerals.

The Secondary Maximum Contaminant Level (SMCL) includes a recommended standard of 500 mg/L, an upper limit of 1,000 mg/L, and a short-term limit of 1,500 mg/L (SWRCB 2017). The 2019 Basin Plan for irrigation does not provide a TDS guidance for salinity. Major crops in the WMA sensitive to salinity are beans, strawberries, raspberries, and peaches (Hanson 2006).

Average TDS concentrations in groundwater during water years 2015–2018 for 437 measurements at 110 wells in the WMA are shown on **Figure 3-3**, and a summary of the data is provided in **Table 3-3**. As shown in **Table 3-3**, the average constituent concentrations in most wells located in the Lompoc Upland, Santa Rita Upland and Santa Ynez River Alluvium were below the 2019 Basin Plan Water Quality Objective (WQO); -whereas only 43-percent of the wells located in the Lompoc Plain were below the WQO. The average concentrations were generally lower in the Santa Rita Upland and Lompoc Upland, and relatively higher in the Santa Ynez River Alluvium and the Lompoc Plain. The highest salinity was measured in the central and western portions of the Lompoc Plain (**Figure 3-3**).



TABLE 3-3
SUMMARY OF SALINITY AS TOTAL DISSOLVED SOLIDS (TDS) IN THE WMA DURING WATER YEARS 2015–2018

Subarea	TDS Average (mg/L)	TDS Minimum (mg/L)	TDS Maximum (mg/L)	TDS WQO (mg/L)	Wells Below WQO (count)	Wells Above WQO (count)
Lompoc Plain	1,600	ND	5,450	1,250	32	42
Lompoc Upland	756	390	1,970	600	4	5
Lompoc Terrace	-	-	-	750	0	0
Santa Rita Upland	583	340	1,050	1,500	12	0
SYR Alluvium	1,276	840	2,590	1,500	12	3

3.4.2 Chloride

Chloride (Cl⁻) is a mineral anion and a major water quality constituent in natural systems. Chloride is characteristically retained in solution through most of the processes that tend to separate out other ions (Hem 1985). The circulation of chloride ions in the hydrologic cycle is largely through physical processes. For example, chloride is a chemical indicator commonly used to evaluate seawater intrusion, as high chloride concentrations are characteristic of seawater and it remains dissolved in solution in most surface water conditions (see Section 4, Seawater Intrusion).

For general municipal and domestic beneficial uses the SMCL is a recommended standard of 250 mg/L, an upper limit of 500 mg/L, and a short-term limit of 600 mg/L. For agricultural beneficial use, the 2019 Basin Plan indicates chloride levels that exceed 106 mg/L cause increasing problems for crop irrigation. Major crops grown in the WMA sensitive to chloride in irrigation water include strawberries (tolerance of 100–180 mg/L) and raspberries (tolerance of 100 mg/L) (Hanson et al. 2006).

Average chloride groundwater concentrations during water years 2015–2018 for 357 measurements at 112 wells are shown on **Figure 3-4**, and a summary of the data is provided in **Table 3-4**. The average concentration in samples from most wells were below the 2019 Basin Plan WQO. Highest chloride concentrations were in samples from the central and western portions of the Lompoc Plain (**Figure 3-4**).



TABLE 3-4
SUMMARY OF CHLORIDE (CL⁻) CONCENTRATIONS IN THE WMA DURING
WATER YEARS 2015–2018.

Subarea	Cl ⁻ Average (mg/L)	Cl ⁻ Minimum (mg/L)	Cl ⁻ Maximum (mg/L)	Cl ⁻ WQO (mg/L)	Wells Below WQO (count)	Wells Above WQO (count)
Lompoc Plain	285	77	2,710	250	48	27
Lompoc Upland	157	72	364	150	6	4
Lompoc Terrace	-	-	-	210	-	-
Santa Rita Upland	95	53	203	150	11	1
SYR Alluvium	122	61	270	150	13	2

3.4.3 Sulfate

Sulfate (SO₄²⁻) is a naturally occurring anion and a major water quality constituent. The SMCL includes a recommended standard of 250 mg/L, an upper limit of 500 mg/L, and a short-term limit of 600 mg/L. The 2019 Basin Plan does not indicate a specific sulfate guideline for irrigation water.

Average sulfate concentrations in groundwater during water years 2015–2018 were determined from 349 samples collected at 111 WMA wells, and the results are mapped on **Figure 3-5**, and a summary of the data is provided in **Table 3-5**. The average concentration in most wells were above the 2019 Basin Plan WQO. Sulfate concentrations were generally lower in the Santa Rita Upland and Lompoc Upland, and relatively higher in the Santa Ynez River Alluvium and the Lompoc Plain. The highest sulfate concentrations were measured in samples from the central Lompoc Plain (**Figure 3-5**).

TABLE 3-5
SUMMARY OF SULFATE CONCENTRATIONS IN THE WMA DURING WATER YEARS 2015–2018

Subarea	SO ₄ ²⁻ Average (mg/L)	SO ₄ ²⁻ Minimum (mg/L)	SO ₄ ²⁻ Maximum (mg/L)	SO ₄ ²⁻ WQO (mg/L)	Wells Below WQO (count)	Wells Above WQO (count)
Lompoc Plain	518	ND	1,800	500	9	66
Lompoc Upland	174	31	736	100	4	5
Lompoc Terrace	-	-	-	100	-	-
Santa Rita Upland	149	34	490	700	6	6
SYR Alluvium	474	189	1,060	700	0	15



3.4.4 Boron

Boron (B) is a trace water quality constituent, and plants have specific tolerance limits for boron concentrations in irrigation water. The 2019 Basin Plan’s general guidance regarding boron toxicity from irrigation water increases from 500 to 2,000 micrograms per liter (µg/L). Major crops in the WMA considered sensitive to boron are beans (750–1,000 µg/L), grapes (500–750 µg/L), peaches (500–750 µg/L), strawberries (750–1,000 µg/L), and walnuts (500–750 µg/L) (Hanson et al. 2006). Concentrations above 10,000 µg/L may be toxic to fish.

Average boron groundwater concentrations during water years 2015–2018 for 146 measurements in 40 wells in the WMA are shown on **Figure 3-6**, and a summary of the data is provided in **Table 3-6**. Averages concentrations in most wells located in the WMA were below the 2019 Basin Plan WQO. Boron concentrations were generally lower in the Santa Rita Upland and Lompoc Upland, and relatively higher in the Lompoc Plain. The highest concentrations were in samples from wells located in the central portions of the Lompoc Plain (**Figure 3-6**).

TABLE 3-6
SUMMARY OF BORON CONCENTRATIONS IN THE WMA DURING WATER YEARS 2015–2018

Subarea	B Average (µg/L)	B Minimum (µg/L)	B Maximum (µg/L)	B WQO (µg/L)	Wells Below WQO (count)	Wells Above WQO (count)
Lompoc Plain	666	99	6,340	500	26	16
Lompoc Upland	290	ND	550	500	4	1
Lompoc Terrace	-	-	-	300	-	-
Santa Rita Upland	248	73	520	500	2	1
SYR Alluvium	-	-	-	500	0	0

Note: Non-Detect (ND) Values are Treated as Zero in Calculations.

3.4.5 Sodium

Sodium (Na⁺) is a mineral cation and a major water quality constituent in natural systems. The 2019 Basin Plan indicates the primary concern for sodium in irrigation water is the sodium absorption ratio (SAR). The sodium absorption ratio is the relative concentration of sodium to calcium and magnesium and is managed to maintain soil permeability.

Average sodium groundwater concentrations during water years 2015–2018 for 359 measurements at 113 wells in the WMA are shown on **Figure 3-7**, and a summary of the data is provided in **Table 3-7**. The average concentrations in most wells were below the 2019 Basin Plan WQO. Sodium concentrations were generally lower in the Santa Rita Upland and Lompoc



Upland, and highest in the Lompoc Plain. The highest concentrations were in samples from wells located in the central and western Lompoc Plain.

TABLE 3-7
SUMMARY OF SODIUM CONCENTRATIONS IN THE WMA DURING WATER YEARS 2015–2018

Subarea	Na ⁺ Average (mg/L)	Na ⁺ Minimum (mg/L)	Na ⁺ Maximum (mg/L)	Na ⁺ WQO (mg/L)	Wells Below WQO (count)	Wells Above WQO (count)
Lompoc Plain	190	61	2,000	250	65	11
Lompoc Upland	89	49	150	100	7	3
Lompoc Terrace	-	-	-	130	-	-
Santa Rita Upland	68	40	110	100	12	0
SYR Alluvium	99	1	578	100	9	6

3.4.6 Nitrate

Nitrogen is the primary atmospheric gas, however its presence in water is related to the breakdown of organic waste. Total nitrogen in groundwater is the sum of organic nitrogen and the three inorganic forms: nitrate (NO₃⁻), nitrite (NO₂⁻), and ammonia (NH₄⁺). These forms are ubiquitous in nature and come from fixation by microbes in soil and water and by lightning. Sources for high concentrations in water sources include fertilizers, animal and human waste streams, and explosives. Nitrogen and phosphorus are key for life and are found in many fertilizers.

The maximum contaminant limit (MCL) and public health goal is 10 mg/L for combined nitrate plus nitrite as nitrogen (Banks et al. 2018). The 2019 Basin Plan indicates increasing problems for irrigation of sensitive crops if nitrate as nitrogen is between 5 and 30 mg/L, and problems for livestock watering if nitrate plus nitrite as nitrogen exceeds 100 mg/L.

Nitrate concentrations are reported either as nitrate (the full mass of the nitrate anion), or as nitrogen (the mass of the nitrogen). For this study all values have been converted to nitrate as nitrogen. The best available data and coverage for nitrogen within the WMA for recent years is from ILRP, which measures and reports combined nitrate-nitrite values. In the WMA, measurements of nitrate concentrations are significantly greater than nitrite, so combined nitrate-nitrite are approximately equal to nitrate alone.

Average nitrate groundwater concentrations during water year 2015-2018 for 304 measurements at 117 wells in the WMA are shown on **Figure 3-8**, and a summary of the data is provided in



Table 3-8. Nitrate concentrations that exceeded the MCL occur in the WMA, but average concentrations of samples from most of the wells are below the MCL. The highest concentrations of nitrate are measured in samples from wells located in the Santa Ynez River Alluvium and the Lompoc Plain.

**TABLE 3-8
SUMMARY OF NITRATE AS NITROGEN IN IN THE WMA DURING WATER YEARS 2015–2018**

Subarea	NO₃ as N Average (mg/L)	NO₃ as N Minimum (mg/L)	NO₃ as N Maximum (mg/L)	NO₃-NO₂ as N WQO (mg/L)	Wells Below WQO (count)	Wells Above WQO (count)
Lompoc Plain	9.9	ND	150	2	44	31
Lompoc Upland	1.9	ND	6.7	2	8	4
Lompoc Terrace	-	-	-	1	-	-
Santa Rita Upland	1.5	ND	9.4	1	7	8
SYR Alluvium	4.0	100	37.7	1	8	7

3.4.7 Historical Trends

Historical water quality trends in the WMA have been analyzed with available historical data from 1980 to present in California’s Groundwater Ambient Monitoring Assessment (GAMA) program (Haas et al. 2019). Mixed trends, both increasing and decreasing, were noted for the identified constituents in the 2019 Basin Plan (TDS, sulfate, and nitrate) and additional constituents (arsenic, hexavalent chromium, iron and manganese)¹². The mixed nature of these trends is most likely to various natural and manmade sources (Haas et al. 2019).

Salinity measured as TDS has historically been an issue of concern for the Upper Aquifer in the Lompoc Plain (Bright, 1997). The salinity conditions in the Lompoc Plain are influenced by the quantity and quality of Santa Ynez streamflow and Cachuma Project operations. Pursuant to a Settlement Agreement entered into on December 17, 2002 (2002 Settlement Agreement) between Cachuma Project Member Units and downstream local interests, State Water Project (SWP) supplies are commingled with water rights releases. The objective of such commingling operations is to maximize delivery of SWP supplies to lower the salinity in the Lower Santa Ynez River at the Narrows. As a result, data from water supply wells showed a decrease in dissolved-solids concentrations (West Yost 2013). However, in more recent years the mixing of reservoir and imported water has been limited owing to conflicting purposes for the dam penstock operations, biological opinion restrictions, and other operational conflicts.

¹² Figures 20-26 (Haas et al. 2019)



These baseline water quality data are provided as a snapshot of current conditions. The responsibility of regulating water quality lies with other existing agencies and programs, and a goal of the WMA GSP will be to not significantly and unreasonably influence existing (background) water quality conditions as part of GSP implementation (which will be discussed further under Sustainable Management Criteria, SMCs). Hence, future groundwater management actions implemented by the WMA will not adversely affect groundwater quality, nor will they interfere with other agencies objectives or responsibility to manage, maintain, or improve water quality.

4 SEAWATER INTRUSION

The fourth sustainability indicator, seawater intrusion, is addressed in this section through presentation of “seawater intrusion conditions in the basin, including maps and cross-sections of the [potential] seawater intrusion front for each principal aquifer.”¹³ The potential undesirable result from seawater intrusion is degraded water quality (third sustainability indicator) from increased salt and mineral content from seawater, which is orders of magnitude higher (saltier) than freshwater. Seawater salinity (total dissolved solids) is approximately 35,000 mg/L, seawater chloride is about 19,000 mg/L, and seawater sodium is 10,500 mg/L (Hem 1985). Estuary environments, like the Santa Ynez River Estuary, occur naturally where rivers meet and mix with seawater and are characterized by changing salinity concentrations affected by tidal influence from the ocean, and discharge influence from the river.

Chloride is a chemical indicator commonly used to evaluate seawater intrusion, as chloride concentrations are typically much greater than measured in inland waters and it remains dissolved in solution in most surface water conditions. Chloride concentrations for seawater, the Santa Ynez River Estuary and inland wells in the WMA are shown in aerial and cross-section view on **Figures 4-1, 4-2, and 4-4**. In the WMA, chloride concentrations in samples from Upper Aquifer wells range from 50 mg/L¹⁴ to more than 650 mg/L in the Lompoc Plain.¹⁵ As indicated in Section 3 of this Memo, the Basin Plan objectives for median groundwater use in the Lompoc Plain is 250 mg/L. Historically measured chloride concentrations in Santa Ynez River water samples, a primary source of recharge to the Lompoc Plain, range from 14.0 mg/L to 270 mg/L. Currently seawater intrusion is not an issue of concern in the WMA as discussed in more detail in the section below.

4.1 WESTERN MANAGEMENT AREA SUBAREAS ADJACENT TO PACIFIC OCEAN

4.1.1 Lompoc Plain

In the Lompoc Plain subarea, the Santa Ynez River meets the Pacific Ocean in the Santa Ynez River Estuary. In the inter-tidal zone seawater mixes with Santa Ynez River water. The land in the lower Santa Ynez River is within the inter-tidal zone is shown in **Figure 4-1** and is located almost entirely within federal lands of Vandenberg AFB. The tidal fluctuation was mapped by the Pacific Marine and Estuarine Fish Habitat Partnership (2018) using high resolution elevation data, and results show that these areas are almost entirely located within federal lands of Vandenberg AFB. The tidal zone extends 3.1 miles inland from the coast and covers 588 acres.

Figure 4-2 is a conceptual model of mixing in the estuary at low and high tides. Higher chloride groundwater is associated with proximity to the Pacific Ocean, and lower chloride groundwater

¹³ 23 CCR 354.16(c).

¹⁴ 52.1 mg/L USGS 343830120065001 007N031W35K004S measured on 2014-08-07.

¹⁵ 663 mg/L USGS 344043120322407 007N035W23E007S measured on 2018-08-21.

is associated with the Santa Ynez River. Seawater mixes with fresh water within the tidal zone of the estuary (**Figure 4-2**), creating a mixed saline environment both spatially and temporally, depending upon the condition of high or low tides.

The locations of historical and current chloride monitoring and the extents of the estuary are shown on **Figure 4-3**. Approximate lines of equal chloride concentrations in groundwater (isochlors) were constructed from this dataset to approximate conditions in 2020¹⁶, and the contours show the relative influences of seawater near the coast and mixing of different waters and water qualities that influence groundwater conditions beneath the estuary.

The estuary is located geologically in an alluvium-filled channel cut into the non-water-bearing Monterey formation. The only aquifer unit is the Upper Aquifer comprised of the alluvial sediments of the Santa Ynez River. Groundwater in the Upper Aquifer is hydraulically connected to the overlying estuary, and the absence of the Lower Aquifer in this area near the coast as shown in cross-section **Figure 4-4** impedes the potential inland advancement of seawater.

Graphs of salinity (TDS), chloride, and sodium concentrations in water from regularly monitored wells located in the Lompoc Plain are shown in **Figure 4-5**. One of the wells (7N/35W-17K20) is located about 1.2 miles inland from the ocean and near the Santa Ynez Estuary; the comparison wells (7N/35W-26F4, 26F5) are located about 3.5 miles farther inland in the Lompoc Plain. Concentrations in the estuary well (7N/35W-17K20) are elevated relative to those measured further inland (7N/35W-26F4, 26F5), but are significantly less than the concentrations measured in seawater. Long-term trends of all three constituents in samples from the estuary well have been relatively stable, suggesting that there has been no significant movement of the natural interface between seawater in the subsurface and the relatively fresh groundwater in the Lompoc Plain.

Figure 4-6 is a piper diagram showing the relationships between the major cations and anions measured in samples from selected wells and surface water gauges in the lower Santa Ynez River. The water quality in samples from two inland wells (7N/35W- 17K20 and 7N/35W- 18H1) is similar to Santa Ynez River water, whereas the samples from wells located further west (7N/35W- 26F4 and 7N/35W- 21G2) and toward the coast and in the estuary show an increasing influence of seawater.

Chloride concentrations that exceed 650 mg/L occur in samples from wells located in the Santa Ynez River Estuary (**Figures 4-2** through **4-4**), consistent with estuary environments where fresh water mixes with seawater. The Santa Ynez River Estuary is an established estuarine environment, known for its connection to the Pacific Ocean and associated tidal influences, and therefore elevated chloride concentrations observed in groundwater in this part of the Lompoc

¹⁶ An airborne geophysics survey was conducted in late 2020 over the Santa Ynez River Estuary, with results expected in mid-2021. The results are expected to provide a basis for improved resolution of the chloride isocontours shown in Figure 4-3.



Plain is likely a natural condition and not indicative of active sea water intrusion. Moreover, previous studies concluded there is a net outflow of relatively fresh groundwater to the Pacific Ocean from the principal aquifers in this part of the Basin. For example, Bright et al. (1992) indicated up to 400 AFY of net groundwater outflow in the Upper Aquifer from the Lompoc Plain to the Pacific Ocean (**Figure 4-4**).

4.1.2 Lompoc Terrace

The Lompoc Terrace subarea consists of an Upper Aquifer of water bearing Orcutt Sand deposits and a Lower Aquifer consisting of Careaga Sand along the trace of the syncline. Along most of the coast, the land surface elevation is well above sea-level and as a result the Orcutt Sand deposits are physically separated from the ocean, which prevents seawater intrusion from occurring. In the Lower Aquifer, the water level elevations along the coast in the Lompoc Terrace are 100 feet higher than sea level and there is no groundwater pumping in this area (Ken Domako, VAFB, personal communication 2020), so seawater intrusion is not an issue of concern. Furthermore, VAFB is federal facility and not subject to SGMA.

4.1.3 Burton Mesa

In the Burton Mesa subarea, water-bearing sediments are physically separated from the Pacific Ocean by the low permeability Monterey formation. The perched sand deposits in this area are not hydraulically connected to the ocean, and therefore seawater intrusion is not an issue of concern.

5 LAND SUBSIDENCE

The fifth sustainability indicator, land subsidence, is evaluated within the WMA in this section. SGMA requires evaluation of the “extent, cumulative total, and annual rate of land subsidence, including maps depicting total subsidence,”¹⁷ with the overall goal of avoiding the undesirable result of “significant and unreasonable land subsidence that substantially interferes with surface land uses” as a result of changing groundwater conditions throughout the Basin.¹⁸ Land subsidence is not an issue of concern in the WMA as discussed in more detail below.

Land subsidence may result from tectonic forces or the extraction of oil, gas and water. Land subsidence resulting from groundwater use and aquifer deformation (the action or process of changing in shape or distorting, especially through the application of pressure) may be of two kinds: *elastic or inelastic*.

Elastic deformation occurs from the compression and expansion of sediments due to pore pressure changes that occur with fluctuations in groundwater elevations (Borchers and Carpenter 2014). Therefore, elastic deformation may be cyclical in nature corresponding to seasonal groundwater recharge or groundwater discharge or extraction. Elastic deformation does not result in permanent loss of pore space or land subsidence.

Inelastic deformation may result in irreversible land subsidence and is commonly related to groundwater discharge or extraction from fine grained sediments within clay or silt aquitards (Borchers and Carpenter 2014). Permanent land subsidence related to groundwater withdrawal generally occurs in an aquifer when groundwater elevations and changes in groundwater storage consistently decrease falling below historical seasonal and longer-term ranges. The resulting combination of increased pressure from the weight of the overlying sediments (overburden stress) and reduction in hydraulic pressure within the aquifer (pore pressure) essentially squeezes the water out of the compressible clay beds within the aquifer system. This type of deformation is irreversible and represents a permanent loss in aquifer storage.

¹⁷ 23 CCR §354.16(e). The extent, cumulative total, and annual rate of land subsidence, including maps depicting total subsidence, utilizing data available from the Department, as specified in Section 353.2, or the best available information.

¹⁸ CA WAT §10721(x)(5). Significant and unreasonable land subsidence that substantially interferes with surface land uses.

5.1 GEOLOGIC SETTING

The companion HCM introduces the geologic setting, units, and extents, which are discussed relative to their potential influence on land subsidence. Generally, fine-grained sediments are susceptible to inelastic deformation. Inelastic compaction of coarse-grained sediment is usually negligible (Borchers and Carpenter 2014). The principal aquifers of the WMA and CMA are primarily coarser material and not subject to a significant risk of land subsidence. Previous studies of well logs in the WMA indicate 40 to 70 percent coarse grained material in the Upper Aquifer (HCI, 1997).

5.1.1 Tectonic Movement

Tectonic movement is a potential source for land surface elevation changes within the WMA. The Basin is within the Transverse Range geomorphic province of California, a tectonically active region of California. Rapid uplift is occurring in places within the Transverse Range, such as in the Santa Ynez Mountains, where uplift is estimated at approximately 2 millimeters per year (Hammond et al. 2018). Likewise, in tectonically active areas where uplift is occurring, subsidence may also be observed in response to fault motion. However, this type of subsidence is not influenced by groundwater use or water resource management actions in the WMA.

5.2 HISTORICAL RECORDS

There is little or no documentation of physical evidence of subsidence such as well casing failure, infrastructure disruption, or earth fissures within the WMA. According to the 2013 City of Lompoc Groundwater Management Plan, there has been no evidence of land subsidence resulting from groundwater-level declines within the Lompoc Groundwater Basin portion of the WMA. The risk of future significant impacts is low because long-term groundwater levels have been mostly static.

The Solvang Public Works Department, Caltrans (District 5), Department of Water Resources (DWR), and Santa Ynez River Water Conservation District have not observed or reported infrastructure failures due to land subsidence within the Basin for the past 100 years (Appendix B, Dudek, 2020). The Solvang Public Works do not recall any land subsidence issues throughout the Santa Ynez Valley (M. van der Linden, personal communication, August 12, 2020; Appendix B, Dudek, 2020). John Brady of the Central Coast Water Authority (CCWA) engineering department reported that since the 27-mile long CCWA pipeline (see HCM tech memo Figure 4-6 for reference) was built in 1990, there have been no triggers of the isolation valves and in his opinion, that there has been no groundwater related land subsidence in the area (Appendix B, Dudek, 2020).



5.3 REMOTE SENSING DATA

Remote sensing data from InSAR (Interferometric Synthetic Aperture Radar) for January 2015 through September 2019 is available. Over this time period, land surface elevation changes have ranged from an estimated increase of 0.5 inches to a decrease of 1 inch. The distribution of these elevation changes is mapped in **Figure 5-1** and shows the greatest land surface declines generally occurred in the upland areas that surround the Lompoc Plain, and in areas where there is little to no reported groundwater use. Appendix B includes detailed maps of the remote sensing dataset.

6 INTERCONNECTED SURFACE WATER AND GROUNDWATER DEPENDENT ECOSYSTEMS

The sixth sustainability indicator, depletion of interconnected surface water, is addressed in this section. The various beneficial uses of surface water and groundwater are presented in Section 3 and include various natural environments that rely on surface water and groundwater.

In accordance with SGMA, “interconnected surface water” is defined as “surface water that is hydraulically connected at any point by a continuous saturated zone to the underlying aquifer and the overlying surface water is not completely depleted” (DWR 2016). In this section, surface waters within the WMA that potentially meet this definition are identified. In addition, SGMA requires Groundwater Dependent Ecosystems (GDEs) be identified as part of the description of groundwater conditions. GDEs are ecological communities or species that depend on groundwater emerging from aquifers or rely on groundwater occurring near the ground surface. Hence, GDEs are considered and discussed below because they could be influenced by chronic lowering of groundwater levels (second sustainability indicator) and depletions of interconnected surface water.

6.1 INTERCONNECTED SURFACE WATER FOR THE SANTA YNEZ RIVER

The portion of the Santa Ynez River between the Lompoc Narrows and the Pacific Ocean is identified as seasonally interconnected surface water because at times surface water in this reach is hydraulically connected to the underlying water table in the principal aquifer. The reach is considered seasonally interconnected because the Santa Ynez River is dry for significant periods of time during the year, and as a result is not “hydraulically connected” to the underlying water table.

6.1.1 Santa Ynez River Alluvium Subarea

In the WMA upstream of the Lompoc Narrows, as discussed in the HCM, the Santa Ynez River Alluvium is considered part of the underflow of the river, which is regulated by the SWRCB. Because the underflow is considered part of the surface water, the Santa River Alluvial deposits upstream of the Lompoc Narrows would not be classified as a principal aquifer under SGMA. Underneath and to the sides of the Santa Ynez River Alluvium are the non-water bearing sediments of the consolidated Monterey Shale and Sisquoc Formations. As such, there is no underlying aquifer in this reach upstream of Lompoc Narrows in the WMA, and consequently no interconnected surface water with groundwater.

6.1.2 Lompoc Plain Subarea

In the Lompoc Plain subarea, the Upper Aquifer is seasonally hydraulically connected to the Santa Ynez River. As discussed in the HCM (GSP Section 3), in the eastern and northern portions



of the Lompoc Plain subarea, particularly along the Santa Ynez River, the confining deposits are less continuous or absent, allowing movement of groundwater between the river and the entire depth interval of the Upper Aquifer (Bright et al. 1992).

Under SGMA, part of the criteria for interconnected surface waters requires identification of the reaches that are “not completely depleted.” As discussed in the HCM, the Santa Ynez River dries up completely in the WMA each year due primarily to the seasonal rainfall and runoff patterns. The USGS gauging stations in the WMA are shown in **Figure 6-1**, and the seasonality of the flows for measured gauges is shown in **Figure 6-2**. High flows can exist from December through May due to rainfall but flow quickly subsides for the remainder of the year. The gauges show that the streambed is typically dry during the summer and early fall months of the year. For example, the surface flow at the USGS H Street gauge (ID No. 11134000) indicates that annual minimum flows are zero and the river has dried up every year, including wet years, for the past 20 years (**Figure 6-1** and **Table 6-1**).



**TABLE 6-1
ANNUAL MINIMUM GAGED FLOWS OF THE SANTA YNEZ RIVER IN THE WMA**

Water Year	Minimum Flow at Lompoc Narrows (USGS Gage 11133000) cubic-feet/second	Minimum Flow at H Street (USGS Gage 11134000) cubic-feet/second	Spill from Cachuma Reservoir acre-feet/year	Hydrologic Year Type¹
2001	1.3	0	112,313	Wet
2002	0	0	0	Dry
2003	0	0	0	Below Normal
2004	0	0	0	Dry
2005	1.5	0	260,078	Wet
2006	0.5	0	62,869	Above Normal
2007	0	0	0	Critical
2008	0	0	22,994	Above Normal
2009	0	0	0	Dry
2010	0	0	0	Below Normal
2011	1.8	0	85,755	Wet
2012	0	0	0	Dry
2013	0	0	0	Critical
2014	0	0	0	Critical
2015	0	0	0	Critical
2016	0	0	0	Dry
2017	0	0	0	Above Normal
2018	0	0	0	Dry
2019	0	0	0	Above Normal
2020	0	0	0	Below Normal

Note: ¹ Based on Hydrologic Year Type Classification in SWRCB Order 2019-0148, based on Lake Cachuma inflow, which also correspond to the classification using Salsipuedes Creek gauge. Water Year 2010 is classified Below Normal in the lower watershed (Salsipuedes Creek gauge) and Above Normal in the upper watershed (Lake Cachuma inflow).

Cachuma Inflow acre-feet/year (afy)	Classification
<4,550 afy	Critical
4,551 - 15,366 afy	Dry
15,367 - 33,707 afy	Below Normal
33,708 - 117,842 afy	Above Normal
>117,842 afy	Wet

There are some exceptions to dry conditions in the Santa Ynez River besides seasonal runoff patterns and releases from Lake Cachuma (**Figure 6-2**), including the following:

- Spills from Lake Cachuma
- Water rights releases from Bradbury Dam
- Discharge from the Regional Lompoc Wastewater Treatment Plant

Surface flow entering the Lompoc Plain (Lompoc Narrows gauge 11133000) can exist year-round (perennial) in wet and above normal hydrologic years in which Cachuma Reservoir spills, as shown in **Table 6-1**. However, in 2008, the flow at the Lompoc Narrows still dried up even though Cachuma Reservoir spilled about 23,000 acre-feet. Surface flows will also exist at the Lompoc Narrows gauge during water rights releases made for the Below Narrows Account as described in the HCM Section 4.3. Water rights releases for the Below Narrows Account are typically made during the months of July through October when flows at the Lompoc Narrows would otherwise not exist. Hence, river flows are substantially influenced by dam and reservoir operations.

Another exception for interconnected surface water status is the reach below the Lompoc Regional Wastewater Treatment Plant to the Pacific Ocean (HCM Figure 4-7). The Lompoc Regional Wastewater Treatment Plant treats effluent for the City of Lompoc, Vandenberg Village Community Services District, and Vandenberg AFB before discharging to San Miguelito Creek, near the confluence with the Santa Ynez River. The average discharge from 1981 to present has been about 5 cubic feet per second (CFS), which has created perennial surface flow conditions downstream of the discharge. This is another example of where river flows are substantially influenced by human activities. The Upper Aquifer in this western portion of the Lompoc Plain contains more clay deposits, such that the main pumping zone of the Upper Aquifer is not hydraulically connected to the river (Bright et al. 1992).

The quantity and timing of depletions of the surface water in the Lompoc Plain is complex due to the seasonality of surface flows in the Santa Ynez River. In addition, surface flows in the Lompoc Plain are managed by water rights releases from Cachuma Reservoir as regulated by the SWRCB for the Below Narrows Account (HCM Section 4.3).

6.2 INTERCONNECTED SURFACE WATER FOR TRIBUTARIES TO THE SANTA YNEZ RIVER

All of the tributaries within the WMA (Figure 6-1) are ephemeral. Several small streams flow year-round in canyons outside of the WMA and south of the Lompoc Plain (Bright et al. 1997). Once these flows reach the unconsolidated alluvial deposits within the boundary of the WMA, all of the flow infiltrates and recharges the groundwater. Thus, the perennial flows in these tributaries are not influenced by groundwater management actions in the WMA and would not be

classified as having interconnected surface water under SGMA because they are disconnected from the water table in the primary aquifer and completely depleted as sources of groundwater recharge in the WMA.

One possible exception are the springs identified in the WMA (HCM Figure 5-2). There are no available data that relate spring flow, the source of water to these springs, groundwater levels, and groundwater use. The relationship between these springs and underlying groundwater is therefore poorly understood and represent a data gap to address as part of GSP implementation.

6.3 GROUNDWATER DEPENDENT ECOSYSTEMS IN THE WESTERN MANAGEMENT AREA

SGMA defines GDEs as “ecological communities of species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface” (DWR 2016). In some settings, groundwater can be critical to sustaining springs, wetlands, and perennial flow (baseflow) in streams, as well as to sustaining vegetation such as phreatophytes that directly tap groundwater through long and extensive root systems.

Mapping of California Department of Water Resources’ Natural Communities Commonly Associated with Groundwater dataset indicates the vast majority of GDEs within the WMA are located along the Santa Ynez River (HCM Figure 5-2). The recent SWRCB Order 2019-148 states (pg. 2):

The Santa Ynez River provides habitat for the Southern California Distinct Population Segment (DPS) of steelhead trout (*Oncorhynchus mykiss*) (steelhead), which is listed as an endangered species under the federal Endangered Species Act (ESA). (16 U.S.C. §§ 1531-1544.) The Cachuma Project has adversely affected the steelhead fishery by blocking access to the majority of suitable spawning and rearing habitat upstream, and by modifying flows in the mainstem of the lower Santa Ynez River (mainstem) below Bradbury Dam to the point that the survival of the species is uncertain. (E.g., NOAA-12, p. 6.) Currently, Reclamation operates and maintains Bradbury Dam on the Santa Ynez River in accordance with a Biological Opinion issued by the National Marine Fisheries Service (NMFS) on September 11, 2000 (2000 Biological Opinion) pursuant to section 7 of the federal ESA. (16 U.S.C. § 1536.)

SWRCB Order 2019-148 requires additional releases from Cachuma Reservoir beyond the 2000 Biological Opinion (NMFS 2000) to protect steelhead. In addition to the endangered steelhead trout species, riparian habitat along the lower Santa Ynez River also supports a great diversity of aquatic non-fish and terrestrial wildlife species (SWRCB 2019).

Historical impacts to GDEs along the Santa Ynez River were evaluated as part of the SWRCB Cachuma Project Water Rights hearings (Jones and Stokes 2000). The SWRCB Final Environmental Impact Report (SWRCB 2011) summarized the findings as follows:



Jones & Stokes (2000) observed that, even in dry years, groundwater levels in the basin remained less than 10 feet below the channel thalweg along most of the river and remained at relatively constant depths below the ground surface on the banks of the river. The groundwater has been maintained at depths suitable to support mature phreatophytic plants (such as willows and cottonwoods), in combination with winter flows. Jones & Stokes (2000) concluded that the operations of the Cachuma Project since 1973 have not altered groundwater conditions in a manner that adversely affects riparian vegetation.

Based on this study by Jones and Stokes (2000), GDEs located along the Santa Ynez River are not currently considered vulnerable due to groundwater pumping in the Upper Aquifer, due in part to water rights releases under the SWRCB Order for the Cachuma Project (currently Order 2019-0148) and the resulting stable groundwater levels.

Additional potential GDEs have been mapped by the California Department of Water Resources, the California Department of Fish and Wildlife, and The Nature Conservancy along the tributaries of the WMA (HCM Figure 5-2), including the following:

- The same tributaries north of the Lompoc Plain with identified springs, including Santa Lucia Canyon Creek, Davis Creek, Purisima Canyon Creek and Cebada Creek
- Additional creeks south of the Lompoc Plain, including Lompoc Canyon, La Salle Canyon, and Sloane Canyon Creeks

There are no available data that establish whether these potential GDEs in the WMA tributaries are connected through a continuous saturated zone to any principal aquifer, upper or lower. Their relationship to underlying groundwater is therefore poorly understood and represent a data gap to address as part of GSP implementation.

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