



---

## DRAFT TECHNICAL MEMORANDUM

---

2171 E. Francisco Blvd., Suite K • San Rafael, California • 94901  
TEL: (415) 457-0701 FAX: (415) 457-1638 e-mail: sr@stetsonengineers.com

TO: **WMA GSA** DATE: **October 2020**  
FROM: **Stetson Engineers** JOB NO: **2710-03**  
RE: **DRAFT Western Management Area Hydrogeologic Conceptual Model (HCM)**

---

### INTRODUCTION

The Sustainable Groundwater Management Act (SGMA) requires that the Groundwater Sustainability Plan (GSP) include a hydrogeologic conceptual model (HCM). This HCM is part of the Santa Ynez River Valley Groundwater Basin (referred to herein as the “Basin”) setting and “characterizes the physical components and interaction of the surface water and groundwater systems in the basin.”<sup>1</sup>

The Basin is located in Santa Barbara County in the central coast region of California (**Figure 1-1**). The Basin is divided into three management areas: Western Management Area (WMA), Central Management Area (CMA), and Eastern Management Area (EMA). This HCM memorandum is written for inclusion as a chapter in the WMA GSP in accordance with the SGMA.

The HCM provides a written description of the general physical characteristics of the Basin, specifically within the WMA, related to regional hydrology; land use; geology and geologic structures, including the lateral and vertical Basin (or aquifer) limits; introduction of groundwater quality; and definition of principle aquifers and aquitards. Description of these items in the HCM provides context for subsequent technical memoranda (or chapters of the GSP), such as water budgets, numerical groundwater models, and monitoring networks. Future plans and actions, including data collection and evaluation of projects and management actions, are based on the conceptual understanding described by this HCM.

This HCM contains the following sections:

- *Section 1, Western Management Area Extent and Subareas*, provides a general introduction to the Santa Ynez River Valley Groundwater Basin and adjacent basins, including a description of the WMA, subareas of the WMA and their key boundary characteristics, and notable water components.

---

<sup>1</sup> 23 CCR § 354.14 (a)

- *Section 2, WMA and Adjacent Geology*, provides an introduction and overview of the geology of the WMA. This includes a description of the regional geologic structural setting; relevant geologic units; and surface geologic map, including major structural features. A three-dimensional geologic model was developed for the Basin, and cross-sections developed from this model are provided.
- *Section 3, Principal Aquifers and Aquitards*, provides a discussion of geologic units corresponding to aquifers, including the three-dimensional Basin boundaries (lateral and basal boundaries). The physical characteristics of the aquifers in each subarea are summarized.
- *Section 4, Hydrologic Characteristics*, describes physical surface conditions that interact with the groundwater. This section includes topography, soil map, and watershed extent; a description of surface water components, including rivers, and ocean coast; and large anthropogenic alterations to the water environment, including imports, exports, and treated wastewater discharge.
- *Section 5, Uses and Users of Groundwater in the WMA*, discusses the primary use of groundwater in each of the WMA subareas, including a summary of where groundwater pumping occurs, agricultural lands, and groundwater-dependent ecosystems.
- *Section 6, Data Gaps and Uncertainty*, addresses the data gaps at the time that this memorandum was written and uncertainty with respect to certain components of the HCM.

A conceptual diagram showing the components of the surface water and groundwater systems in the Basin is shown in **Figure 1-2**. Sections 2 and 3 review the physical characteristics of the groundwater system shown in **Figure 1-2**. Sections 4 and 5 provides an overview of the water budget and how water moves through the WMA, as shown in **Figure 1-2**.



---

## LIST OF ACRONYMS AND ABBREVIATIONS

3D	three-dimensional
AFY	acre-feet per year (rate of water flow)
Basin	Santa Ynez River Valley Groundwater Basin
CCWA	Central Coast Water Authority
CMA	Central Management Area
CSD	Community Services District
DWR	Department of Water Resources
EMA	Eastern Management Area
FY	Fiscal Year (July 1 through June 30)
GSP	Groundwater Sustainability Plan
HCM	Hydrogeologic Conceptual Model
SGMA	Sustainable Groundwater Management Act
SWRCB	State Water Resources Control Board
USGS	United States Geological Survey
USP	United States Penitentiary - Lompoc
VAFB	VANDENBERG Air Force Base
WMA	Western Management Area

### GEOLOGIC UNITS:

QG	Geologic Unit, River Channel Deposits
QAL	Geologic Unit, Younger Alluvium
QOS	Geologic Unit, Older Dune Sands
QOA	Geologic Unit, Terrace Deposits/Older Alluvium
QO	Geologic Unit, Orcutt Sand
QTP	Geologic Unit, Paso Robles Formation
TCA	Geologic Unit, Careaga Sand
TF	Geologic Unit, Foxen Formation
TSQ	Geologic Unit, Sisquoc Formation



TM                      Geologic Unit, Monterey Formation

---

**APPENDIX**

APPENDIX A                      Geosyntec (2020) “Draft Technical Memorandum on Regional Geology and  
3D Geologic Model for the Santa Ynez River Valley Groundwater Basin”

---

## 1. WESTERN MANAGEMENT AREA BOUNDARIES AND SUBAREAS

### 1.1. BASIN BOUNDARIES AND MANAGEMENT AREAS

The Santa Ynez River Valley Groundwater Basin (Basin) in Santa Barbara County, California, is designated by the California Department of Water Resources (DWR) as Basin 3-15. The extent or boundaries of the Basin in DWR Bulletin 118 are based on regional geology studies and are shown in **Figure 1-1**. The Basin is a mapped “stacked series of aquifers with reasonably well-defined boundaries in a lateral direction, based on features that significantly impede groundwater flow, and a definable bottom.”<sup>2</sup> The Basin extent is generally defined by the location of geologic units of “porous and permeable sediment or sedimentary rock that contains sufficient saturated material to yield significant quantities of groundwater to wells and springs.”<sup>3</sup> DWR Basin 3-15 is bounded by the Purisima Hills to the north, the San Rafael Mountains to the northeast, the Santa Ynez Mountains to the south, and the Pacific Ocean to the west. DWR Basin 3-15 boundaries include areas of Vandenberg Air Force Base (VAFB) that have historically been excluded from regional groundwater studies due to a variety of factors, which are further discussed below.

The Basin is one of several within Santa Barbara County; **Figure 1-3** shows other groundwater basins adjacent to or near the Basin. North of and bordering the Basin is the San Antonio Creek Valley Groundwater Basin,<sup>4</sup> and the Santa Maria River Valley Groundwater Basin<sup>5</sup> is directly adjacent to the north of the San Antonio Creek Valley Groundwater Basin. To the southeast, along the south coast of Santa Barbara County, is the Goleta Groundwater Basin,<sup>6</sup> separated from the Basin by the Santa Ynez mountain range.

As previously discussed in the Outreach and Engagement Plan (chapter of the GSP) and in accordance with the SGMA, separate management areas have been implemented in the Basin, including the WMA, CMA, and EMA (**Figure 1-1**). The remainder of this HCM presents information for the WMA.

### 1.2. WMA BOUNDARIES

The western boundary of the WMA is the Pacific Ocean from Cañada Honda Creek in the south to San Antonio Creek in the north. The northern boundary is at the Purisima Hills and the Purisima Anticline. The eastern boundary of the WMA corresponds to the watershed boundary of the “Santa Rosa Damsite” near Santa Rosa Park.<sup>7</sup> The northeastern boundary is composed of the Santa Rita Upland, around the Santa Rita Valley. The southern boundary of the WMA is

---

<sup>2</sup> 23 CCR § 341(g)(1)

<sup>3</sup> 23 CCR § 341(f)

<sup>4</sup> DWR Basin 3-14

<sup>5</sup> DWR Basin 3-12

<sup>6</sup> DWR Basin 3-16

<sup>7</sup> USGS Site 11131000. “SANTA YNEZ R AT SANTA ROSA DAMSITE NR BUELLTON CA”

complex, including the “narrows” of the Santa Ynez River, characterized by the exposed bedrock defining the river boundaries in this area, as well as the White Hills south of the City of Lompoc (**Figure 1-4**).

### 1.3. WESTERN MANAGEMENT AREA SUBAREAS

The WMA encompasses 134 square miles of complexly folded, faulted, and eroded geologic units that create dynamic topography in the WMA and directly affect the hydrogeologic conditions of the WMA. In addition to natural features, human activity plays an active role in the movement of water into and out of the WMA. Due to the complexity of the various WMA features, it is divided into six subareas,<sup>8</sup> as shown in **Figure 1-4**. The six subareas are listed below, and the following subsections briefly describe key topographic characteristics and surface-ground water interactions that differentiate them.

- Santa Ynez River Alluvium
- Lompoc Plain
- Burton Mesa
- Lompoc Terrace
- Lompoc Upland and
- Santa Rita Upland

The remainder of this document presents details for each of these subareas and summarizes their effects or contributions to the HCM and water environment within the WMA.

#### 1.3.1. Santa Ynez River Alluvium

The Santa Ynez River Alluvium contains the Santa Ynez River from the WMA/CMA boundary near Santa Rosa Park in the east and extends west to where the Santa Ynez River enters the Lompoc Plain, commonly referred to as the Lompoc Narrows at Robinson Bridge (**Figure 1-4**). Groundwater occurs in thin, unconsolidated sedimentary layers of younger alluvium directly over non-water-bearing, consolidated geologic units. Non-water-bearing consolidated geologic units also form the lateral boundaries as exposed bedrock in this area.

Groundwater recharge of the alluvium is primarily received from the surface and underflow of the Santa Ynez River, tributary creek flow, seepage, and irrigation return flows. The Santa Ynez

---

<sup>8</sup> Subareas are similar to and based on the Santa Ynez River Water Conservation District Annual Report subareas, also used for managing pumping in much of the WMA. Extents are adjusted to cover the entire Bulletin 118 basin boundary.



River is governed and regulated by the California State Water Resources Control Board as part of regional surface water rights. The water flowing through the alluvium, in a known and defined channel, is considered surface water by the California State Water Resources Control Board and is not subject to the SGMA.

### **1.3.2. Lompoc Plain**

The Lompoc Plain subarea is composed of the Santa Ynez River floodplain that surrounds and includes the City of Lompoc (**Figure 1-4**). The Santa Ynez River enters the forebay of the Lompoc Plain from the Santa Ynez River Alluvium subarea at the Narrows at the east end of the Lompoc Plain, and terminates in the west where the river flows into the Pacific Ocean. Groundwater in the Lompoc Plain occurs in the unconsolidated units of the Lompoc Plain.

The Lompoc Plain subarea includes substantial agriculture for about 9,000 acres (Bright 1997), the City of Lompoc, the Lompoc Regional Wastewater Reclamation Plant, the Federal Bureau of Prisons facilities, and undeveloped coastline within the VAFB.

### **1.3.3. Burton Mesa**

The Burton Mesa subarea is an upland located northwest of the Lompoc Plain and is bordered on the west by the Pacific Ocean (**Figure 1-4**). The Burton Mesa is characterized by generally thin layer of sediments that overlay the non-water-bearing Monterey Formation. Groundwater in this subarea occurs primarily in a perched condition, largely influenced by annual precipitation. During wet years, high rates of precipitation result in temporary runoff during storm events and perched conditions above non-water-bearing consolidated bedrock and/or above clays that separate the perched water from the regional aquifer system (Arcadis 2016).

The Burton Mesa subarea is almost entirely within the boundaries of VAFB. There is currently no known groundwater pumping for consumptive use in this subarea.

### **1.3.4. Lompoc Terrace**

The Lompoc Terrace subarea is the upland area southwest of the Lompoc Plain and is bordered on the west by the Pacific Ocean. The Lompoc Terrace is similar to the Burton Mesa, with discontinuous, shallow perched groundwater conditions that overlay non-water-bearing, consolidated Monterey or Sisquoc Formations. A small northeastern portion of the Lompoc Terrace includes some Careaga Sand that extends beneath the Lompoc Plain, and is considered one of the principal aquifers within the WMA. The portion of Careaga Sand present in the Lompoc Terrace is a down-faulted wedge, overlain by younger Orcutt Sand deposits.

The Lompoc Terrace subarea is almost entirely within the extent of VAFB. It is relatively undeveloped, with no agriculture and no population centers, and has several buildings related to VAFB. The Lompoc Terrace contains the Space Launch Complexes, which currently get water from the Burton Mesa water supply system.



### **1.3.5. Lompoc Upland**

The Lompoc Upland subarea is north and northeast of the Lompoc Plain (**Figure 1-4**). The northern boundary of this subarea is, in part, a topographic boundary along the top of the Purisima Hills in the north. The Purisima Hills are a result of the Purisima Hill Anticline, a geologic anticline fold that resulted in uplifting and erosional thinning of the water-bearing principal aquifer units in this area.

The Lompoc Upland includes the consumptive water use population centers of Vandenberg Village Community Services District (CSD), Mission Hills CSD, and some agriculture. The Mission Hills Wastewater Treatment Plant contributes to groundwater recharge via return flows in the treatment plant's percolation ponds.

### **1.3.6. Santa Rita Upland**

The Santa Rita Upland subarea is the portion of the Santa Rita Creek watershed that has unconsolidated water-bearing principal aquifer units (**Figure 1-4**). The northern boundary is bound by the Purisima Hills and the southern boundary is bound by the Santa Rita Hills. The water-bearing principal aquifer units are generally located within an east/west-trending geologic syncline fold (**Figure 2-1**).

The Santa Rita Upland subarea includes agriculture uses that comprise approximately 500 acres. Rural residential neighborhoods are served by shared well systems or Mutual Water Companies.



---

## 2. GEOLOGY OF THE WESTERN MANAGEMENT AREA

This section introduces and provides an overview of the regional geology and defining structures within the WMA that control the lateral and vertical extent of groundwater presence, groundwater storage, and groundwater flow. Much of this section provides text from the Draft Technical Memorandum on Regional Geology and 3D Geologic Model for the Santa Ynez River Valley Groundwater Basin, by Geosyntec (2020), which is included as **Appendix A** of this memorandum. **Appendix A** also describes the development of a three-dimensional geologic model based on data collected and analyzed as part of this GSP and references historical reports and studies.

The Basin is located on the Pacific Plate within the Transverse Range geomorphic province of California, which is characterized by east/west-striking, complexly folded and faulted bedrock formations. The Basin is an east/west-trending, linear, irregular structural depression between rugged mountain ranges and hills within the Transverse Range in Santa Barbara County, California. Primary structural features of the Basin include large anticlines and synclines. These large folds are evident in the rocks and deposits in the lowland between the folded and faulted Santa Ynez Mountains to the south, and the faulted San Rafael Mountains to the north (Upson and Thomasson 1951; for all citations provided herein, please see **Appendix A**).

### 2.1. MAPPED SURFACE GEOLOGY

The surface geology of the WMA and the near vicinity have younger geological formations that consist of the younger water-bearing units, and older non-water-bearing formations that constitute the WMA portion of the groundwater basin (**Figure 2-1**). The extent of the geologic units shown in **Figure 2-1** are exports from the three-dimensional model developed by Geosyntec (2020), provided in **Appendix A**. The Geosyntec report cites the extents of the surface geology that were originally mapped by Thomas Dibblee Jr.<sup>9</sup> Faults based on a Quaternary map compilation by the United States Geological Survey (USGS 2020) are also shown on **Figure 2-1**.

#### 2.1.1. Geologic Units

Descriptions of the geologic units that are shown in **Figure 2-1**, in agreement with publicly available literature and as shown in the three-dimensional geological model (**Appendix A**), are provided in the following subsections. The geologic unit descriptions are provided from the surface units (youngest) to deeper underlying units (oldest), as shown in **Figure 2-1**. Detailed descriptions for the geologic units, as excerpted from **Appendix A** (Geosyntec 2020) are provided below:

---

<sup>9</sup> Dibblee conducted field mapping for the following USGS geologic quadrangles: Lompoc Hills and Point Conception Quadrangle, Point Arguello and Tranquillon Mountain Quadrangle, and Lompoc and Surf Quadrangle.

## **Younger Units**

### *River Channel Deposits (Qg)*

Qg occurs within the modern-day Santa Ynez River channel and consists of fine-to-coarse sand, gravels, and thin discontinuous lenses of clay and silt (Upson and Thomasson 1951; Wilson 1959; Miller 1976; Bright et al. 1992). The grain size typically decreases along the river's reach, fining towards the ocean (Upson and Thomasson 1951). The Qg unit thickness ranges from 30-foot (ft) to 40-ft, with observations of localized deposits up to 70-ft thickness 6 miles west of the City of Buellton along the Santa Ynez River, however, these deposits are largely indistinguishable from the underlying alluvium (Upson and Thomasson 1951). The Qg in the geologic model is interpreted using the Dibblee geologic map and from borehole data and is generally thought to be hydraulically connected to the Qal, described below.

### *Alluvium (Qal)*

The geologic unit Quaternary Alluvium (Qal) is composed of a coarse sand upper member and a fine sand lower member which have been previously described by others (Dibblee 1950; Upson and Thomasson 1951; Wilson 1959; Miller 1976; Bright et al. 1992). Qal is composed of unconsolidated, normally graded gravel and medium-to-very coarse sand, which grades upwards into fine to coarse sand with rare gravels, then fines vertically upwards into fine sand, silt and clay (Upson and Thomasson 1951; Wilson 1959; Miller 1976; Bright et al. 1992; Fugro Consultants, Inc. 2007). The thickness of Qal varies from approximately 30 to 90-ft in the Buellton Subarea (Upson and Wilson 1951) to approximately 170-ft to 200-ft in the Lompoc Plain (Dibblee 1950; Upson and Thomasson 1951; Evenson and Miller 1963; Miller 1976; Bright et al. 1992). In sloped areas and drainages, the thickness of Qal varies from less than 10-ft to 50-ft (Fugro Consultants, Inc. 2007). Qal is the principal source of groundwater in the Lompoc Plain (Dibblee 1950; Upson and Thomasson 1951; Evenson and Miller 1963; Miller 1976; Berenbrock 1988; Bright et al. 1992).

### *Terrace Deposits / Older Alluvium (Qoa)*

The geologic unit Quaternary Terrace Deposits and Older Alluvium (Qoa) typically consists of unconsolidated to poorly consolidated sands and gravels with common silt and clay zones (Dibblee 1950; Upson and Thomasson 1951; Miller 1976; Berenbrock 1988; Bright et al. 1992). Qoa thickness varies from 0-50-ft (Bright et al. 1992), up to 150-ft (Upson and Thomasson 1951; Miller 1976; Berenbrock 1988). Qoa underlies alluvium (Qal) in most of the southern Lompoc Plain and caps hilltops, benches and upland areas of the Santa Ynez River and major tributaries (Upson and Thomasson 1951; Miller 1976; Berenbrock 1988; Bright et al. 1992).

### Orcutt Sand (Qo)

The geologic unit Quaternary Orcutt Sand (Qo) consists of unconsolidated, well sorted, coarse to medium sand and clayey sand with scattered pebbles and gravel stringers (Upson and Thomasson 1951; Bright et al. 1992). The top of the formation is locally indurated in Lompoc Valley and Burton Mesa by iron oxides, whereas the basal portion contains well-rounded pebbles of quartzite, igneous rocks, and Monterey chert and shale (Dibblee 1950). Qo thickness varies from 0-300-ft (Upson and Thomasson 1951; Evenson and Miller 1963; Bright et al. 1992).

### Paso Robles Formation (QTp)

The Quaternary-Tertiary Paso Robles Formation (QTp) consists of poorly consolidated to unconsolidated, poorly sorted, gravels, sands, silts and clays (Dibblee 1950; Upson and Thomasson 1951; Wilson 1959; Miller 1976; Berenbrock 1988; Bright et al. 1992; Yates 2010). QTp varies in thickness from 2,800-ft in the Santa Ynez subarea (Upson and Thomasson 1951) 6.5 miles west of the San Lucas Bridge, to 700-ft in Santa Rita Valley (Dibblee 1950; Miller 1976) and thins westward where it pinches out in the eastern Lompoc plain (Dibblee 1950; Upson and Thomasson 1951; Miller 1976).

QTp yields water to wells throughout the study area (Upson and Thomasson 1951; Miller 1976; Berenbrock 1988; Bright et al. 1992) and is the principal water bearing unit in the basin near Lake Cachuma and in the Santa Ynez Upland (Yates 2010).

### Careaga Sand (Tca)

The geologic unit Tertiary Careaga Sand (Tca) yields water and consists of massive, fine-to-coarse sand, with lenses of gravels and fossil shells (Dibblee 1950; Woodring and Bramlette 1950; Upson and Thomasson 1951; Wilson 1959; Evenson and Miller 1963; Miller 1976). Clay and silt beds are characteristically absent, and the uniformity in grain-size and presence of seashells distinguish it from the overlying QTp (Dibblee 1950; Upson and Thomasson 1951). Tca is often differentiated into the upper coarse sand Graciosa Member (Tcag) and the lower, fine sand Cebada Member (Tcac), which have been described in literature (Dibblee 1950; Woodring and Bramlette 1950; Upson and Thomasson 1951; Evenson and Miller 1963; Miller 1976; Berenbrock 1988; Bright et al. 1992). Tca thickness can vary from 450-ft to 1000-ft (Upson and Thomasson 1951), but is typically observed between 500-ft to 800-ft thickness in the Lompoc area, surrounding Lompoc hills, and in the Buellton area (Dibblee 1950; Evenson and Miller 1963; Miller 1976). The Careaga Formation has been previously identified as an important aquifer within the Santa Ynez River Valley Groundwater Basin (Hoffman 2018).

## **Older Units**

Tertiary-Mesozoic Rocks are consolidated non-water bearing units, all of marine origin. They consist of the near-shore marine Foxen (Tf), Sisquoc (Tsq), and Monterey (Tm) Formations. The Foxen Formation consists of light gray or tan massive claystone, siltstone, and/or mudstone (Dibblee 1950; Woodring and Bramlette 1950; Upson and Thomasson 1951). The Sisquoc Formation is massive to very thin bedded, white diatomite and diatomaceous mudstones, with basal massive fine sands (Dibblee 1950; Woodring and Bramlette 1950; Upson and Thomasson 1951). The Monterey Formation, primarily known for its vast oil reserves, consists of variably bedded siliceous shale, diatomaceous mudstone, porcelaneous shale, chert, phosphatic shale, silty shale, limestone, and a basal clay altered tuff (Dibblee 1950; Woodring and Bramlette 1950; Upson and Thomasson 1951).

### **2.2. KEY GEOLOGIC STRUCTURES WITHIN THE WESTERN MANAGEMENT AREA**

Shown on the geologic map of the WMA and the immediate vicinity (**Figure 2-1**) are several geologic fault and fold structures. The existence and orientation of these geologic structures are related to regional movement, generally due to north/south compression. The locations and existence of these features are based on two sources: maps produced by Dibblee (**Appendix A**) and a Quaternary map compilation by the USGS (U.S. Geological Survey 2020).

#### **2.2.1. Synclines and Anticlines**

The Santa Rita Syncline is an east/west-trending fold from the CMA to the WMA. The eastern end of the syncline is in the Buellton Uplands portion of the CMA east of the WMA. The syncline extends westward to the WMA through the Santa Rita subarea to the Lompoc Upland subarea in the WMA (**Figure 2-1**). The unconsolidated sediments in the Santa Rita Syncline form much of the water-bearing principal aquifers in the Santa Rita and Lompoc Upland subareas. Younger Alluvium (Qal) and Orcutt Sand (Qo) overlie much of the Santa Rita Syncline (**Figure 2-1**).

The Purisima Anticline is an approximate east/west-trending fold present in the Purisima Hills forming the northern boundary of the central part of the Lompoc Uplands and Santa Rita Uplands in the WMA. In the east, the anticline is eroded, providing surface exposures of the Sisquoc Formation and the Foxen Formation.

#### **2.2.2. Faults**

Faults with potential to impede groundwater recharge, storage or flow are not currently identified in the WMA. Additional geophysical SkyTEM Aerial Electromagnetic (AEM) survey data collected within the WMA, in conjunction with potential input received from water users and the

public may be used to update current understanding of faults that may affect the water environment within the WMA.

The location of the Santa Ynez River Fault is shown in **Figure 2-1**, consistent with the recent USGS Quaternary fault-and-fold map. The USGS mapped the fault with limited location accuracy (U.S. Geological Survey 2020). Other small fault features are found in the upper reaches of Purisima Canyon and Cebada Canyon in the Lompoc Upland subarea (**Figure 2-1**). These small northwest/southeast-tending thrust faults occur directly south of the western end of the Purisima Anticline (Dibblee 1950).

### 2.2.3 SUBSURFACE GEOLOGIC CONDITIONS

The subsurface geologic conditions within the Basin and WMA are the result of tectonic forces. A detailed subsurface three-dimensional model of the geologic units and structures for the entire WMA and immediate vicinity are provided in **Appendix A**. This effort included compiling new data, collecting recently drilled well completion reports, interpreting and assigning the driller logs to geologic units,<sup>10</sup> and locating them in three-dimensional space. Interpretations of the surface geology in terms of geologic maps, and interpretations of the subsurface from past reports were also pulled into the model. The resulting three-dimensional model is a synthesis of all of these sources and represents the best available three-dimensional understanding of the subsurface geologic units that make up the WMA aquifers.

### 2.2.4 Geologic Cross-Sections

The locations of five cross-sections through the WMA are shown in **Figure 2-2**. Details of the five cross-sectional views are shown in **Figure 2-3a** through **Figure 2-3c**. The locations of the cross-sections represent the structure and shape of the geologic units that underlie the WMA<sup>11</sup>. **Appendix A** includes detailed descriptions of the geology shown in each cross-section.

---

<sup>10</sup> The geologic units included in the geological model, map, cross-sections, and discussion are based on what could be generally recognized from the well drilling logs, which are mostly descriptions of the cuttings as the well is drilled with varying detail. The thinner aquifer units described in the aquifer unit section could not be unambiguously recognized from a majority of these logs.

<sup>11</sup> Cross section E-E' lies near the border of the WMA and CMA and represents the geology at this boundary.

---

### **3 PRINCIPAL AQUIFERS AND AQUITARDS**

Principal aquifers refer to aquifers or aquifer systems that store, transmit, and yield significant or economic quantities of groundwater to wells, springs, or surface water systems. The WMA is characterized by two Principal Aquifers: an Upper Aquifer and a Lower Aquifer. This section relates key geologic units to principal groundwater aquifers within the WMA. Definition of these geologic units and their principal aquifer properties is important in terms of groundwater occurrence, storage, and flow. These properties are also essential during development of the water budget, and evaluation of current groundwater characteristics and conditions, and for the numerical groundwater model employed to quantify groundwater flow in the Basin under historical, current, and projected future conditions. In agreement with the geologic model prepared for the Basin, the lateral and vertical extents of these aquifers, including the definable base of the Basin, are presented and discussed in this section.

#### **3.1 WESTERN MANAGEMENT AREA BASIN EXTENT AND THICKNESS**

The geologic units are categorized in terms of aquifer properties into two broad categories: (1) water-bearing units composed of “unconsolidated” sedimentary deposits and (2) non-water-bearing units composed of “consolidated” sedimentary deposits and crystalline rocks. The “unconsolidated” deposits allow water to infiltrate into them, be stored within them, and flow through them. The “consolidated” deposits impede groundwater infiltration, storage, and flow.

The unconsolidated, water-bearing sediments are those with sufficient permeability and storage potential to both store and convey groundwater. Less consolidated materials allow for greater permeability of water. In terms of the defined geologic units, the unconsolidated sediment applies to the Careaga Sand, Paso Robles, and younger formations.

Non-water-bearing units are consolidated sediments or rock that have low porosity, low hydraulic conductivity, or a combination of the two. Low porosity means there is relatively little space to contain groundwater, and low hydraulic conductivity means groundwater is transmitted relatively slowly. Consolidation such as cementation and compaction of sedimentary units reduces both porosity and hydraulic conductivity. Crystalline units in the area include igneous and metamorphic rocks, which are also significantly older and have no porosity, which is characteristic of their original extrusion. However, crystalline rock formations may have fractures resulting in localized instances of increased storage capability and hydraulic conductivity, which may be suitable for limited use such as domestic water supply, but as a general rule they are considered non-water-bearing. Within the defined geologic units of the WMA, these include the Foxen Formation, Sisquoc Formation, Monterey Formation, and the older formations.

### 3.1.1 Western Management Area Definable Bottom of the Basin

The boundary between the water-bearing and underlying non-water-bearing geologic units form the “definable bottom of the basin”<sup>12</sup> and “lateral basin boundaries,”<sup>13</sup> as defined by the SGMA. Regarding the lateral basin boundaries, the current WMA Basin boundary by DWR is very close to the geologic contact between consolidated deposits (Foxen, Sisquoc, Monterey, and the older Formations) and unconsolidated deposits (formations younger than or equal to Careaga) shown in **Figure 2-1**. However, there are some minor differences with the geology mapped by Dibblee (**Figure 2-1**) and the current WMA boundary. For example, in the area north of Vandenberg Village, the Orcutt Sand is mapped by Dibblee to extend about 2,000 feet north of the current WMA Boundary. However, throughout most of the area, the current WMA boundary lies within a couple 100 feet of the surface geology mapped by Dibblee (**Figure 2-1**).

Based on the three-dimensional geological model (Geosyntec 2020), the *definable bottom of the Basin* was mapped using the contact between the consolidated deposits (Foxen, Sisquoc, Monterey, and the older Formations) and unconsolidated deposits (formations younger than or equal to Careaga) as the base elevation. The Basin bottom elevation has been contoured and is shown on **Figure 3-1**. The lateral Basin boundaries are also shown in **Figure 3-1** as approximated by the WMA Basin Boundary, where the basin bottom intersects the land surface and is analogous to the hard bottom and side that contains an aquifer.

The combined thickness of the Basin unconsolidated deposits is shown in **Figure 3-2**. This is the maximum depth of a groundwater well in an aquifer throughout the Basin. The variation of the thickness of the unconsolidated deposits across the WMA is shown in **Figure 3-2**. The saturated thickness of the aquifer at any particular time, or volume of water, is dependent on current groundwater elevations and other factors.

### 3.2 PRINCIPAL AQUIFERS AND DESCRIPTION FOR EACH WESTERN MANAGEMENT AREA SUBAREA

The aquifers present within the six subareas of the WMA (**Figure 1-4**) are divided into two Principal Aquifers: an upper and a lower unit. An aerial view of the location of two aquifer cross-sections is provided in **Figure 3-3**<sup>14</sup>. Cross-sections of the Upper Aquifer and Lower Aquifer in the Lompoc Plain and Lompoc Upland are provided in **Figure 3-4a** and **Figure 3-4b**. These aquifer cross-sections are from the Lompoc Groundwater Management Plan (West Yost 2013), based on extensive studies conducted by the USGS in the Lompoc area (Bright et al.

---

<sup>12</sup> 23 CCR § 354.14(b)(3)

<sup>13</sup> 23 CCR § 354.14(b)(2)

<sup>14</sup> The zones in Figure 3-3 correlate with management zones used by the Santa Ynez River Water Conservation District (Stetson, 2020), which correlate with five of the six subareas of the WMA. Zone A represents the Santa Ynez River Alluvium. Zone B represents the Lompoc Plain, Lompoc Upland, and Lompoc Terrace. Zone F represents the Santa Rita Upland.

1992; Bright et al. 1997). A description of the Upper and Lower Aquifers in each subarea is provided in the sections below.

### 3.2.1 Upper Aquifer

The Upper Aquifer consist of Santa Ynez River gravels, younger and older alluvial deposits, Orcutt Sand, and other younger alluvial geologic formations that are found throughout the WMA. Most of the extracted groundwater is from the alluvial areas of the Lompoc Plain and the Santa Ynez River Alluvium subarea. The Upper Aquifer is found in the Lompoc Plain, along the Santa Ynez River, and Lompoc Terrace. Additionally the Upper Aquifer is found in Orcutt Sand Deposits throughout the WMA.

#### *Upper Aquifer in the Lompoc Plain*

In the Lompoc Plain subarea, the Upper Aquifer corresponds to the Quaternary alluvium and terrace deposits of the Santa Ynez River. The Lompoc Plain Upper Aquifer is commonly divided into three water-bearing zones<sup>15</sup>: (1) the shallow zone; (2) the middle zone; and (3) the main zone, as described by the USGS (Bright et al. 1992) and adopted locally (West Yost 2013). The three zones in aquifer cross-section A-A' along the Santa Ynez River from east to west are shown in **Figure 3-4a**. This cross-section is from the Lompoc Groundwater Management Plan (West Yost 2013) and agrees with **Figure 2-3a**; geologic cross-section A-A' (Geosyntec 2020), although each focus on different details.

The shallow and middle zones of the Quaternary alluvium are also referred to as the upper member of the alluvium (Upson and Thomasson 1951; Berenbrock 1988). The shallow zone in **Figure 3-4a** includes river-channel deposits and predominately fine-grained sand, silt, and clay deposits of the alluvium that confine or partly confine the underlying deposits in the western, central, and northeastern portions of the subarea. The middle-zone deposits are similar to the shallow zone but contain interbedded lenses of coarse-grained sand and gravel deposits (HCI 1997; Bright et al. 1992). The medium to coarse sand and gravel areas in the upper member of the younger alluvium (shallow and middle zones) are described as follows (Upson and Thomasson 1951, p. 48):

In tributary canyons along the south margin of the Lompoc plain and along the Santa Ynez River the upper member of the younger alluvium is predominantly sand and gravel and contains only thin, discontinuous beds of clay or silt. The coarsest deposits are those penetrated by wells along the river within a few thousand feet downstream from

---

<sup>15</sup> These layers of the younger alluvium are also referred to as the upper and lower members (Upson and Thomasson 1951; Berenbrock 1988) with the lower member correlating with the “Main Zone” in the City of Lompoc Groundwater Management Plan (West Yost, 2013). Note for the purposes of the WMA Groundwater Sustainability Plan, the younger alluvium (Qya) constitutes a Principal Aquifer, the Upper Aquifer, while these layers within the younger alluvium are considered part of this aquifer system.



Robinson Bridge, where very little silt or clay intervenes between the river channel deposits and the lower member of the younger alluvium.

These areas of coarser deposits in the upper part of the younger alluvium, particularly along the Santa Ynez River downstream of Robinson Bridge, are important areas of streamflow infiltration from the Santa Ynez River and tributaries.

The main zone includes the lower member of the alluvium. Medium to coarse sand and gravel comprise this zone. The main zone throughout most of the Lompoc Plain subarea is separated from the middle zone by lenses of silt and clay that result in confined or partially confined conditions in the main zone. However, in the eastern, southern, and northern portions of the Lompoc Plain subarea, the confining deposits are less continuous or absent, allowing movement of groundwater between the shallow, middle, and main zones.

Typical total thickness of the Upper Aquifer in the Lompoc Plain ranges from 160 feet to 200 feet, except in the far eastern portion of the Lompoc Plain east of the Santa Ynez River, where the total thickness ranges from 0 to 100 feet (**Figure 3-4a**). Based on a study by USGS (Bright et al. 1992), the main zone of the Upper Aquifer is absent in the southern portion of the Lompoc Plain (south of Central Avenue in the City of Lompoc) (**Figure 3-4b**).

The divisions of the Lompoc Plain Upper Aquifer are difficult to distinguish in well completion reports. In general, the texture of the three zones is such that the preponderance of coarse-grained textures increases with depth (HCI 1997). The main zone or lower member of the Upper Aquifer has historically been the primary source of water from the Lompoc Plain subarea.

The Upper Aquifer in the southern and eastern portions of the Lompoc Plain is underlain by Careaga Sand. In the western portion of the Lompoc Plain, which includes the estuary adjacent to the Pacific Ocean, the Upper Aquifer alluvium overlies the Sisquoc Formation or the Monterey Formation (**Figure 2-3a**; geologic cross-section A-A').

The intermediate-scale permeability of the younger alluvium ranges from 10 to 400 feet per day within the shallow zone (including the more permeable river channel deposits directly adjacent to the Santa Ynez River), 10 to 20 feet per day within the middle zone, and 300 to 400 feet per day within the main zone (West Yost 2013).

#### *Upper Aquifer in the WMA Portions of the Santa Ynez River Alluvium*

The Upper Aquifer in the WMA Santa Ynez River Alluvium subarea consists of alluvial deposits. As described in terms of geology, this includes relatively thin terrace deposits (Upson and Thomasson 1951) and recent and active river channel deposits overlie bedrock of primarily (Monterey Formation). Non-water-bearing consolidated geologic units also form the lateral boundaries as exposed bedrock in this area (**Figure 2-3c**; geologic cross-section E-E').

The occurrence of water in the WMA Santa Ynez River Alluvium is considered surface water because it flows through a known and defined channel. Surface water is governed by the California State Water Resources Control Board as part of regional surface water rights and is not subject to the SGMA.

The deposits of Santa Ynez River Alluvium consist of fine-to-coarse sand, gravels, and thin discontinuous lenses of clay and silt. Santa Ynez River alluvial deposits are relatively thin, with typical thicknesses of 60 to 80 feet, with local thicknesses of more than 100 feet. Wells completed within these deposits typically yield a few hundred to as high as 1,500 or more gallons per minute. These deposits underlie the floodplain and active river channel. The younger alluvium consists of clay, silt, sand, and gravel beneath the alluvium and floodplain along the Santa Ynez River (Wilson 1959). The permeability of these deposits ranges from 100 to 700 feet per day (Upson and Thomasson 1951).

*Upper Aquifer WMA Orcutt Sand Deposits: Lompoc Upland, Santa Rita Upland, Burton Mesa, and Lompoc Terrace Upper Aquifer*

Orcutt Sand, which is extant in the Lompoc and Santa Rita Uplands, Lompoc Terrace, and Burton Mesa (**Figure 2-1**), is composed of coarse sand, silt, and clay of mostly non-marine origin, with permeability of about 5 feet per day. In the upland and terrace locations, including the Lompoc Terrace, Burton Mesa, Lompoc Upland, and Santa Rita Upland, groundwater is sometimes locally present in “shallow” perched conditions. This occurrence is described as follows (Miller 1976, p. 24):

Beneath the upland and terrace, the Orcutt Sand locally contains perched groundwater. Water levels in wells that tapped perched zones beneath the uplands in 1972 generally were more than 100 ft higher than levels in the underlying Paso Robles Formation and Careaga Sand.

Perched groundwater in the Orcutt Sand deposits on the Burton Mesa subarea is shown on a conceptualized hydrogeologic cross-section in **Figure 3-5** (Arcadis 2016). The shallow groundwater system in the Burton Mesa varies locally, existing either on top of the non-water-bearing shale that underlies the entire mesa, or on top of clay layers within multiple lenses throughout the subarea.

Currently, perched groundwater units, including the Orcutt Sand deposits on the Burton Mesa, have limited storage capacity and are not considered a primary water source in the WMA. The Orcutt Sand deposits of the VAFB are located above the deposits in the Lompoc Plain and separated by Monterey Shale as shown in **Figure 2-3a**, geologic cross-section B-B'. Orcutt Sand has not been included in historical investigations of groundwater in the WMA, most likely due to their perched condition and separation from the regional saturated flow of the Upper and Lower Aquifers in the Lompoc Plain and Upland (SBCWA 1999; Stetson 1992, 2020; Miller 1976;

Bright 1997; West Yost 2013). The thickness of the Orcutt Sand varies in the WMA from 0 to 300 feet (Bright et al. 1992).

Groundwater in Orcutt Sand exists in unsaturated conditions (Bright 1997) and contributes to the recharge of the Lower Aquifer, including the Paso Robles and Careaga Formations in the Lompoc Upland and Lompoc Terrace subareas. Where there is no Lower Aquifer and only older consolidated non-water-bearing formations, as is the case in the Burton Mesa and the southwestern portion of the Lompoc Terrace, water is most likely discharged to local tributaries or springs (Arcadis 2016). This discharge is seen as the interflow component of streamflow hydrographs.

#### Upper Aquifer in WMA Younger Alluvium, Lompoc Terrace Upper Aquifer

Additional small quantities of groundwater are found in the Younger Alluvium in the small coastal drainages that exist in the Lompoc Terrace subarea, including Bear Creek, which is outside of the Santa Ynez River watershed. This area is usually not included in the regional groundwater resources for the Lompoc area due to being outside of the Santa Ynez River watershed. Due to the small size of the drainage, alluvial deposits are estimated to be less than 30 feet thick with low groundwater storage capacity and has been scoured to bedrock in some locations (**Figure 2-1**). Groundwater in bedrock is not subject to SGMA.

### **3.2.2 Lower Aquifer**

The Lower Aquifer consists primarily of the Paso Robles and Careaga Formations. These formations are found in the axis of the Santa Rita Syncline, which trends from the Santa Rita Upland through the Lompoc Upland, and continue under the Lompoc Plain and Lompoc Terrace. The Lower Aquifer is also the main aquifer in the Lompoc Terrace and Lompoc Upland (Bright et al. 1992). Groundwater conditions in the Lower Aquifer range from unconfined to confined in the Lompoc Upland and confined in the Lompoc Plain (Bright et al. 1997).

These Lower Aquifer units are older and more consolidated than younger alluvial formations that make up the Upper Aquifer. The Lower Aquifer units lie unconformably beneath the Upper Aquifer units. The Lower Aquifer locally outcrops on the Lompoc Terrace and along the south side of the Purisima Hills.

The Paso Robles Formation is composed of fine to coarse sand, silt, and clay of non-marine origin, with permeabilities that range from 10 to 100 feet per day. The lower part of the Paso Robles Formation is finer grained than the upper part. Except for parts of the Lompoc Upland and the eastern portion of the Lompoc Plain by the Santa Ynez River, the Paso Robles Formation is either completely unsaturated or not present in the Lompoc area (Bright et al. 1992). The younger Paso Robles Formation conformably overlies the Careaga Formation.

The Careaga Formation has two major components: the upper or Graciosa Member with medium to coarse sand, and the lower or Cebada Member with typically finer sand. The Graciosa Member of the Careaga Sand is the main producer of groundwater in the Lower Aquifer (Bright et al. 1992). Hydraulic conductivity of the Cebada Member ranges from 0.1 to 3 feet per day beneath the plain. Hydraulic conductivity of the Graciosa Member ranges from about 5 feet per day beneath the Lompoc Plain to 90 feet per day beneath the Lompoc Upland (Bright et al. 1992).

#### Lower Aquifer in the Lompoc Plain Subarea

The Lower Aquifer is located under the Upper Aquifer in the Lompoc Plain. The Lower Aquifer is absent in the western portion of the WMA near the Pacific Ocean, but approximately 5 miles inland, the Careaga Formation is present beneath the Upper Aquifer and throughout the rest of the Lompoc Plain, as shown in **Figure 3-4a** and **Figure 3-4b**. The Paso Robles formation is only located east of the Santa Ynez River in the Lompoc Plain. Most of the City of Lompoc has the Lower Aquifer underneath it. Groundwater in the Lower Aquifer beneath the Lompoc Plain is confined or partly confined by the stratified deposits that form this aquifer (Paso Robles Formation and Graciosa Member of the Careaga Sand), and by the overlying fine-grained deposits in the Upper Aquifer (Bright et al. 1992).

#### Lower Aquifer in the Lompoc Upland Subarea

As described above, the Lower Aquifer extends from the Lompoc Plain subarea to the north northeast into the Lompoc Upland). In the Lompoc Upland, the Paso Robles Formation forms part of the Lower Aquifer beneath the Lompoc Upland (**Figure 2-3a**, geologic cross-section B-B'); however, much of the Paso Robles Formation beneath the Lompoc Upland is unsaturated (Bright et al. 1992). The saturated portions of the Lower Aquifer in the Lompoc Upland is primarily the Careaga Formation. Prior to groundwater development, groundwater in the Lower Aquifer of the Lompoc Upland followed the surface topography and flowed into the Lower Aquifer of the Lompoc Plain. During very wet periods, recharge to the Lompoc Upland aquifer can occur from infiltration of the Santa Ynez River (Berenbrock 1988; pg. 15). Under developed conditions, groundwater levels beneath the Lompoc Upland declined, and the exchange of groundwater between the Lompoc Upland and Lompoc Plain is determined by the relative magnitudes of recharge and pumping in the two subareas (West Yost 2013).

#### Lower Aquifer in the Lompoc Terrace Subarea

The Lompoc Terrace subarea, the hilly area adjacent to the southwest part of the Lompoc Plain subarea, is a down-faulted wedge of Careaga Sand overlain by Orcutt Sand. The Lower Aquifer is in the buried syncline that becomes broader and widens to the northeast. Only the lower Cebada Member of the Careaga Sand is present or saturated in the Lompoc Terrace (Bright et al. 1992). The groundwater in the Lower Aquifer of the Lompoc Terrace follows the surface

topography and flows either into the Lower Aquifer of the Lompoc Plain to the northeast or into the adjacent coastal drainage outside of the Santa Ynez River watershed (Bear Creek).

### Lower Aquifer in the Santa Rita Upland Subarea

The Lower Aquifer extends into the Santa Rita Syncline from the Lompoc Upland subarea to the west and continues to the CMA Buellton Upland subarea to the east. The Lower Aquifer is found beneath younger Quaternary alluvial deposits like the Orcutt Sand and Quaternary Terrace deposits, as well as soils with high infiltration rates. Below an unconformity with the Orcutt Sand there is a syncline fold that includes the Paso Robles Formation and Careaga Sand underneath (**Figure 2-3c**, geologic cross-section D-D'). Consolidated rocks (Ts<sub>q</sub> and T<sub>m</sub>) that out-crop out in the Santa Rita Hills to the south of the Santa Rita Valley Aquifer locally separate the Santa Ynez River riparian groundwater basins from the Santa Rita Upland (**Figure 2-3c**, geologic cross-section D-D'; Upson and Thomasson 1951). Groundwater in the Lower Aquifer of the Santa Rita Upland flows westward, partly into the Lower Aquifer of the Lompoc Upland. However, more water level data is needed in the Santa Rita Valley to confirm the direction and rate of movement of groundwater in the Lower Aquifer in this subarea.

Aquifer properties of the Lower Aquifer Formation appear consistent across the Santa Rita Syncline, including the Santa Rita Upland Lower Aquifer. Lower Aquifer deposits consist of fine to coarse sand, with permeabilities that range from 0.1 to 100 feet per day (Upson and Thomasson 1951; Wilson 1959; Bright et al. 1992, 1997).

### **3.3 SUMMARY OF UPPER AND LOWER AQUIFER PROPERTIES**

In the Upper Aquifer in the WMA, the permeability, or hydraulic conductivity, of the alluvial deposits varies widely upon location and depth. The permeability of the river gravel deposits along the Santa Ynez River ranges from 100 to 700 feet per day (Upson and Thomasson 1951). The permeability of the younger alluvium within the shallow zone (including the more permeable river channel deposits directly adjacent to the Santa Ynez River) ranges from 10 to 400 feet per day, 10 to 20 feet per day within the middle zone, and 300 to 400 feet per day within the main zone (West Yost 2013). Similarly storage coefficients range widely in the Upper Aquifer depending upon location and depth. The specific yield of the river gravel deposits along the Santa Ynez River is estimated 30 percent (Bright et al. 1997). The specific yield of the shallow and middle zones of the Upper Aquifer in the Lompoc Plain range from 0.1 to 18 percent (Bright et al. 1997). In the main zone of the Lompoc Plain Upper Aquifer, the storage coefficient has been estimated to range from 0.02 to 0.2 percent.

In the Lower Aquifer in the WMA, the permeability and storage coefficients are generally less than the Upper Aquifer alluvial deposits. Hydraulic conductivity of the Graciosa Member of the Careaga Formation (upper Careaga) ranges from about 5 feet per day beneath the Lompoc Plain to 90 feet per day beneath the Lompoc Upland (Bright et al. 1992). Hydraulic conductivity of



the Cebada Member of the Careaga Formation (lower Careaga) range from 0.1 to 3 feet per day beneath the Lompoc Plain. The Paso Robles Formation has a similar range of hydraulic conductivity as the Careaga. The storage coefficients for the Lower Aquifer has been estimated to range from 0.04 to 0.08 percent (Bright et al. 1997). The specific yield for unconfined portions of the Lower Aquifer have been estimated from 7.5 to 20 percent (HCI, 1997).

The wells in the WMA with available aquifer pump tests were analyzed. The data are from well completion reports from both DWR and the County of Santa Barbara Department of Environmental Health Services, as well as from local water agencies. Most of the data is from the County of Santa Barbara because the County requires a pump test for wells that are permitted as a single parcel and as multiple-parcel water systems, state small water systems, and Public Water Systems with less than 200 service connections. Most of the tests are of short duration and only include one observation of drawdown. Specific capacity data was analyzed for 74 pump tests in the Upper Aquifer with well depths of less 220 feet and for 69 pump tests in the Lower Aquifer with well depths greater than 220 feet.

Using the available pump-test data, the median yield, specific capacity, and hydraulic conductivity were calculated for each aquifer. The hydraulic conductivities were estimated using the methodology from Driscoll (Driscoll, 1986; Appendix 16D). The median yield of the pump tests were estimated to be 1000 and 500 gallons per minute (gpm) for the Upper and Lower Aquifers respectively. The median specific capacity of 25 and 6 gpm per foot of drawdown were estimated for the Upper and Lower Aquifers, respectively. The median hydraulic conductivities of 160 and 10 ft/day were calculated for the Upper and Lower Aquifers, respectively.

### **3.4 WATER QUALITY IN THE WESTERN MANAGEMENT AREA**

Issues related to the degradation of water quality in the WMA most frequently pertain to excessive salinity and hardness (Regional Water Quality Control Board 2017).

In the Upper Aquifer in the WMA, the dissolved-solids concentration of groundwater in the central and western Lompoc Plain has increased from less than 1,000 milligrams per liter in the 1940s to greater than 2,000 milligrams per liter in the 1960s (Bright 1997). Groundwater quality was observed to deteriorate from east to west (Berenbrock 1988). Groundwater conditions in the Lompoc Plain are influenced by the quantity and quality of Santa Ynez streamflow and Cachuma Project operations, and more recent data from water supply wells indicate a decrease in dissolved-solids concentrations (West Yost 2013).

The Upper Aquifer in the WMA also has samples for some wells with water quality concentrations exceeding maximum or secondary contaminant levels for drinking water and impairment for irrigation, including the parameters of sodium, chloride, nitrate, hardness, alkalinity, and iron (Berenbrock 1988). In addition, the parameters of Arsenic and Manganese have exceeded contaminant levels in some well samples in the Lompoc Plain as provided in California's



Groundwater Ambient Monitoring Assessment (GAMA) program (Haas et al. 2019). Data and trends will be described in further detail in the documentation of the groundwater conditions technical memorandum.

In the Lower Aquifer in the WMA, the dissolved-solids concentration of groundwater are generally less than 1,000 milligrams per liter (Bright 1997). The main water quality issue with the lower aquifer is hardness (Allen 2020). In addition, the parameters of Arsenic, Iron, and Manganese have exceeded contaminant levels in some well samples in the Lompoc Upland and on Vandenberg Air Force Base (Haas et al. 2019). Some wells on the Vandenberg Air Force Base also show water quality impairments due to nitrate, sulfate, and hexavalent chromium (Haas et al. 2019).

---

## 4 HYDROLOGIC CHARACTERISTICS

Hydrologic characteristics of the WMA related to groundwater recharge, including aerial precipitation recharge, mountain-front recharge, and streamflow infiltration, are presented in this section, and a generalized representative graphic is included in **Figure 1-2**. Additional details for these topics will be included in the forthcoming water budget technical memorandum, which also will quantify the hydrologic inflows and outflows of the WMA.

### 4.1 TOPOGRAPHY

The topography of the WMA is a major factor on the movement of surface water and groundwater and magnitude of precipitation and groundwater recharge. Groundwater movement in the WMA follows the surface topography. The WMA boundary, topography, and various geographic features within or adjacent to the area are shown in **Figure 4-1**. Ground surface elevations in the WMA vary from sea level (0 feet) at the Santa Ynez River estuary to more than 1,000 feet above sea level in the surrounding hills. The City of Lompoc is about 80 to 100 feet above sea level, and the elevation of the Santa Rita Valley is about 400 to 500 feet above sea level. The terrain south of the Santa Ynez River rises steeply from the river to the Santa Ynez Mountain range. North of the Santa Ynez River the rise in elevation is gradual over upland terraces and toward the Purisima Hills. Burton Mesa and Lompoc Terrace are about 450 and 350 feet above sea level, respectively.

### 4.2 SOILS AND INFILTRATION

Precipitation and agricultural return flows can infiltrate to become groundwater, evaporate into the atmosphere, or run off to become surface water. Soil properties and slope are important controls on infiltration and runoff and indicate the potential for specific agricultural use. The soil characteristics of the WMA in terms of their potential infiltration rates are shown in **Figure 4-2**.

Soils are the combination of minerals, organic matter, living organisms, gas, and water that are located at land surface. Their total composition and elevation greatly affect their infiltration rate and contribution to groundwater recharge, in addition to the types of unconsolidated or consolidated sediments underlying them.

#### 4.2.1 Natural Recharge Areas

The areas of soils with high infiltration rates (**Figure 4-2**) relate to the areas of existing recharge. Key areas for recharge to the lower aquifers include along the Purisima Hills in the Lompoc and Santa Rita Upland subareas, and to a lesser extent in the Lompoc Terrace and Burton Mesa. Additionally, the Lompoc Plain subarea receives most of its substantial recharge from the Santa



Ynez River<sup>16</sup> and much lesser quantities from percolation of runoff in the tributaries in the adjoining subareas. Percolation from the Santa Ynez River channel is therefore the most important source of recharge for the Lompoc Groundwater Basin, and controlled by the magnitude and timing of releases from Cachuma Reservoir (West Yost 2013). The Lompoc Terrace, Lompoc Upland and Santa Rita Upland subareas do not receive recharge from Santa Ynez River infiltration but contain large surface areas of soils with high infiltration rates (**Figure 4-2**).

#### 4.2.2 Potential Groundwater Recharge Areas

In addition to natural recharge, DWR recommends<sup>17</sup> including in the GSP the Soil Agricultural Groundwater Banking Index map (**Figure 4-3**), which is a classification of the suitability of agricultural land for use in groundwater banking conducted by UC Davis. Groundwater banking means using artificial recharge to store water in the aquifer for later withdrawal through pumping.

The Soil Agricultural Groundwater Banking Index ratings are only available for agricultural land and are based on a combination score using the following five factors<sup>18</sup> to ensure that an artificial recharge project would be successful, including limited adverse impact on existing crops.

1. Deep percolation
2. Root zone residence time
3. Topography
4. Chemical limitations
5. Soil surface condition

Potential groundwater banking projects will be described in further detail when projects and management actions are developed for the WMA. Potential areas for artificial recharge have been identified along the Santa Ynez River and in the Santa Rita Upland, and are identified as “excellent” as shown on **Figure 4-3**.

---

<sup>16</sup> In the Lompoc Plain subarea, the green area shown on Figure 4-2 (soil types with high infiltration rates) overlies primarily the Santa Ynez River.

<sup>17</sup> DWR. 2016. *Best Management Practices for Sustainable Management of Groundwater*. Hydrogeologic Conceptual Model.

<sup>18</sup> A.T. O’Geen, Matthew, B.B. Saal, Helen E. Dahlke, David A. Doll, Rachel B. Elkins, Allan Fulton, Graham E. Fogg, Thomas Harter, Jan W. Hopmans, Chuck Ingles, Franz J. Niederholzer, Samuel Sandoval Solies, Paul S. Verdegaal, and Mike Walkinshaw. 2015. “Soil Suitability Index Identifies Potential Areas for Groundwater Banking on Agricultural Lands.” *California Agriculture* 69(2):75–84. doi: 10.3733/ca.v069n02p75.

### 4.3 RUNOFF AND SURFACE FLOWS

The WMA aquifers are recharged by rainfall in the watershed and infiltration of surface flows in the Santa Ynez River and tributaries. Infiltration from the Santa Ynez River is the primary source of recharge to the aquifers that underlie the Lompoc Plain Subarea. These flows are supplemented by water-rights releases into the Santa Ynez River from Bradbury Dam at Lake Cachuma.

#### 4.3.1 Santa Ynez River Watershed

The WMA is primarily composed of the Santa Ynez River watershed, as shown in **Figure 4-4**.<sup>19</sup> Marginal areas in the southwest and northwest of the WMA (**Figure 4-5**<sup>20</sup>) are outside the Santa Ynez River watershed, in the Burton Mesa and Lompoc Terrace subareas. The larger Santa Ynez River watershed is a catchment area for the Santa Ynez River upstream of the WMA, which is a major source of recharge to the WMA, especially within Santa Ynez River alluvium and the Lompoc Plain. Streamflow infiltration of the Santa Ynez River particularly occurs in the eastern Lompoc Plain, from the Lompoc Narrows at Robinson Bridge to V Street.

Precipitation, water imports, and other water sources in the Santa Ynez River watershed outside of the WMA interact with the WMA through a few routes:

- As runoff to surface water streams and rivers, which flows as surface water and subflow into the WMA. Examples are waters of the Santa Ynez River, Salsipuedes Creek, and San Miguelito Creek.
- As mountain front groundwater recharge, which is the subsurface inflow of groundwater to lowland aquifers from adjacent mountains. This likely occurs in upper elevations of the Santa Rita Upland subarea.
- As groundwater flow between management areas. Increasing groundwater pressure as a result of infiltration in the CMA may result in groundwater flowing into the WMA. This may occur along the eastern boundary of the Santa Rita Upland subarea and as subflow through the Santa Ynez River alluvium.

#### 4.3.2 Santa Ynez River and Tributaries

The Santa Ynez River flows west over approximately 90 miles from its headwaters in the San Rafael and Santa Ynez Mountains, to the Pacific Ocean, draining approximately 900 square miles. The Santa Ynez River headwaters originate in the Santa Ynez and San Rafael Mountains

---

<sup>19</sup> Santa Ynez, Hydrologic Unit 18060010: 573,819 acres.

<sup>20</sup> HUC in Figure 4-5 refers to the Hydrologic Unit Code. HUC 8 and 10 are watersheds and sub-watersheds delineated by USGS using a nationwide system.

at an elevation of about 4,000 feet near the eastern boundary of Santa Barbara County, with average annual precipitation of up to 49 inches per year.<sup>21</sup> The Santa Ynez River has three dammed reservoirs upstream of the WMA and the CMA: Jameson Reservoir is the farthest upstream, then Gibraltar Reservoir, and finally Lake Cachuma (**Figure 4-4**). Although reservoir releases do flow into the Santa Ynez River, the reservoirs are also managed to divert water out of the Santa Ynez River watershed via a system of tunnels through the Santa Ynez Mountains for use by the cities located on the Santa Barbara County south coast (i.e., Goleta and Santa Barbara).

Downstream of Bradbury Dam, the dam that forms Lake Cachuma, the Santa Ynez River continues flowing west, with the river subflow entering a bedrock-confined channel in the western portion of the CMA. After entering the WMA, the Santa Ynez River then flows through a series of meanders incised into confining bedrock units (Monterey Formation) until entering the forebay at the Lompoc Narrows. Thereafter, it flows northwest and west across the Lompoc Plain, discharging to the Santa Ynez River estuary and the Pacific Ocean. The flow of the Santa Ynez River is primarily intermittent throughout the Basin, carrying mainly flood flows from tributary watershed land downstream of Bradbury Dam and occasional spills and releases of water from Lake Cachuma. During summer months, water is released from Lake Cachuma to meet downstream water rights and releases for endangered steelhead as specified in the State Water Resources Control Board Order, the Cachuma Project Settlement Agreement, and the National Marine Fisheries Service Biological Opinion.

The two largest tributaries in the watershed join the Santa Ynez River in the WMA: Salsipuedes Creek and San Miguelito Creek (**Figure 4-4** and **Figure 4-5**). Salsipuedes Creek drains a 52-square-mile catchment area and joins the Santa Ynez River upstream of the Narrows. San Miguelito Creek drains an approximate 13-square-mile catchment area before encountering a debris basin at the WMA southern boundary and entering a concrete channel constructed through the western portion of the City of Lompoc before meeting the Santa Ynez River. San Miguelito Creek is the discharge point for tertiary treated water from the Lompoc Regional Wastewater Reclamation Plant, just upstream of the confluence with the Santa Ynez River. The Lompoc Wastewater Reclamation Plant has a design capacity of up to 5.5 million gallons per day<sup>22</sup> and collects effluent from the City of Lompoc, Vandenberg Village, and VAFB.

#### ***4.3.2.1 Downstream Water Rights Releases***

The WMA is recharged by downstream water rights releases from Lake Cachuma as ordered by the Santa Ynez River Water Conservation District (SYRWCD). Water rights releases for users downstream of Lake Cachuma are set forth in the State Water Resources Control Board Order of 1973 (WR 73-37), as amended in 1989 (WR 89-18) and most recently in 2019 (2019-0148).

---

<sup>21</sup> PRISM Climate Group. 2014. *Average Annual Precipitation 1981–2010*.

<sup>22</sup> Dudek. 2019. *Santa Barbara County Integrated Regional Water Management Plan*. Update 2019.

These releases are based on the establishment of two accounts and accrual of credits (storing water) in Lake Cachuma for the above and below Narrows areas. Releases from the Above Narrows Account are made at Bradbury Dam for the benefit of downstream water users between the dam and the Lompoc Narrows. Releases from the Below Narrows Account are conveyed to the Narrows for the benefit of water users in the Lompoc Plain subarea. The SYRWCD designates the riparian flow subarea as Zone A, as shown in **Figure 3-3**. The figure shows the lower part the Above Narrows area, and SYRWCD designated Zone B (Lompoc Plain) in **Figure 3-3** indicates the Below Narrows area.

In addition, the Cachuma Project Settlement Agreement is an important component of downstream water rights releases. Pursuant to the Settlement Agreement between Cachuma Conservation Release Board, SYRWCD, SYRWCD Improvement District No. 1, and the City of Lompoc, relating to operation of the Cachuma Project entered into on December 17, 2002 (2002 Settlement Agreement), State Water Project (SWP)<sup>23</sup> 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.

### 4.3.3 Water Imports

Water is primarily imported to the WMA and VAFB through the Central Coast Water Authority (CCWA) pipeline. Since 1997 this pipeline has delivered water from the State Water Project. Water is delivered at turnouts to specific water distribution systems, as well as to Lake Cachuma. Within the Basin, the receiving entities are VAFB, the City of Buellton, the City of Solvang, and the Santa Ynez River Water Conservation District Improvement District No. 1. CCWA water can also be mixed in with the water rights releases at Lake Cachuma based on the Cachuma Project Settlement Agreement. A map of the water import system in the WMA and upstream in the CMA and EMA are shown in **Figure 4-6**.

Within the WMA, the only importer of water is at VAFB, which imports all of the drinking water it uses. VAFB receives water from the CCWA pipeline at the turnout located in the Burton Mesa area, and additionally has active groundwater wells (the San Antonio Well Field) located in the San Antonio Creek Valley Groundwater Basin (DWR Basin 3-14). The VAFB relies primarily on the CCWA purchased water, which is supplemented by water pumped from the San Antonio Well Field, particularly when the CCWA water delivery system is undergoing maintenance. These imported waters, CCWA and San Antonio groundwater, enter the Santa Ynez River watershed via the domestic and municipal return flows from VAFB. Wastewater sourced from VAFB is collected from the Main Cantonment Area at VAFB and conveyed to the Lompoc Regional Wastewater Reclamation Plant<sup>24</sup> before discharge to San Miguelito Creek, near the confluence with the Santa Ynez River.

---

<sup>23</sup> The State Water Project is the source of water delivered by the Central Coast Water Authority (CCWA).

<sup>24</sup> Dudek. 2019. *Santa Barbara County Integrated Regional Water Management Plan*. Update 2019.



#### 4.3.4 Treated Wastewater Sources

Wastewater treatment plants act as a point source of water flowing into the surface water system and/or where groundwater recharge is occurring.

Wastewater in the WMA is collected by the City of Lompoc, Federal Bureau of Prisons, Mission Hills Community Services District, Vandenberg Village CSD, and VAFB. Wastewater is conveyed to the following treatment facilities before it is discharged as treated effluent.<sup>25</sup>

Locations of the WMA wastewater treatment plants and sewer collection areas are shown in **Figure 4-7**.

	Design Capacity (mgd)	Service Area/Contributors	Current Disposal Method (Permit)	Level of Treatment	Recycled Water Uses
Lompoc Regional Wastewater Reclamation Plant	5.5	City of Lompoc; Vandenberg Village CSD; Vandenberg AFB.	Discharge to Miguelito Creek (tributary to Santa Ynez River) (NPDES)	Tertiary	On-site irrigation and dust control
Mission Hills CSD	0.57	Mission Hills CSD	Percolation ponds (WDR)	Primary	Groundwater recharge
US Penitentiary – Lompoc	—	US Penitentiary	Percolation Ponds WDR	—	Groundwater recharge

Source: CCWA 2011, page 48.

mgd = million gallons per day; WWTP = Wastewater Treatment Plant; NPDES = National Pollutant Discharge Elimination System; WDR = waste discharge requirement; CSD = Community Services District; AFB = Air Force Base

VAFB includes remote areas served by leach fields, septic tanks, and package treatment plants. In addition to VAFB, there are domestic users located outside of the sewer collection areas, also on septic systems.

<sup>25</sup> Dudek. 2019. *Santa Barbara County Integrated Regional Water Management Plan*. Update 2019.

---

## 5 USES AND USERS OF GROUNDWATER IN THE WESTERN MANAGEMENT AREA

This section discusses the primary uses of groundwater in the WMA, and presents a summary of locations where groundwater pumping occurs. In addition, this section describes water use on agricultural lands, and discusses water use by phreatophytes.

### 5.1 PRIMARY USE OF GROUNDWATER

Groundwater production within the WMA for both the Upper and Lower Aquifers is for agricultural, domestic, municipal, and industrial uses including mining operations (wells utilized by the Imery mining operation). Outside of the municipal users, including the City of Lompoc, Vandenberg Village CSD, Mission Hills CSD, VAFB, and the United States Penitentiary-Lompoc (USP or Penitentiary), most of the WMA is a mixture of rural areas with agriculture and some suburban development.

Groundwater production is reported by the Santa Ynez River Water Conservation District (SYRWCD) Annual Report (District Annual Report)<sup>26</sup> and includes the CMA and parts of the EMA. The Water Conservation District reports on average for the period 1982-2018 that the use of groundwater in the District was 71% “Agricultural Water,”<sup>27</sup> 3% “Special Irrigation Water,”<sup>28</sup> and 26% “Other Water.”<sup>29</sup>

#### 5.1.1 Water Use in the Lompoc Plain, Lompoc Upland, and Lompoc Terrace Subareas

The Lompoc Plain subarea, combined with the Lompoc Terrace subarea and Lompoc Upland subarea, forms the District Annual Report’s Zone B. Prior to fiscal year (FY) 1993–1994, this also included the Santa Rita Upland subarea (Zone F). For this combined area, overall annual average water production has ranged from 13,632 acre-feet per year (AFY) in FY<sup>30</sup> 1979–1980 to 29,815 AFY in FY 2012–2013. For this zone, agricultural water has ranged from 7,233 AFY to 21,257 AFY. Special irrigation water has ranged up to 1,205 AFY, and other water has ranged from 5,778 to 9,407 AFY.

Water use in the Lompoc Plain subarea is primarily agriculture, but also includes domestic usage by the City of Lompoc and the Penitentiary (USP). The City of Lompoc, currently and for the planned future (through 2035), relies entirely on groundwater resources (Lompoc UWMP 2015)

---

<sup>26</sup> Stetson Engineers.2020. *Forty-Second Annual Engineering And Survey Report On Water Supply Conditions Of The Santa Ynez River Water Conservation District 2019–2020.*

<sup>27</sup> Water first used on lands in the production of plant crops or livestock for market (CA WAT § 75508).

<sup>28</sup> Water used for irrigation purposes at parks, golf courses, schools, cemeteries, and publicly owned historic sites.

<sup>29</sup> Water used for purposes not including agriculture or irrigation at parks, golf courses, schools, cemeteries, and publicly owned historic sites. Generally, refers to municipal, industrial, or domestic uses of pumped or produced water.

<sup>30</sup> Santa Ynez River Water Conservation District’s fiscal year is July 1 through June 30.

and pumps from the Upper Aquifer. The USP relies on CCWA imported water for the municipal prison facilities, and, in addition, the USP uses water for a prison farm by using the VAFB's wells located in the Plain.

Water use in the Lompoc Upland subarea is primarily domestic and municipal use, including the population centers and urbanized areas of Vandenberg Village CSD and Mission Hills CSD. Both Vandenberg Village CSD and Mission Hills CSD pump from the Lower Aquifer.

The Lompoc Terrace subarea is relatively undeveloped with no agriculture and no population centers, but has several buildings related to VAFB. The Lompoc Terrace contains the Space Launch Complexes which has industrial and municipal water use (i.e. water for sound suppression and military buildings). The Lompoc Terrace currently gets water from the VAFB water supply system (imported water from CCWA and San Antonio well fields).

### **5.1.2 Santa Rita Upland Subarea**

The Santa Rita Upland subarea forms the District Annual Report's Zone F. This zone was split off from Zone B in FY 1993–1994. Overall annual average water production has ranged from 722 AFY in FY<sup>31</sup> 1993–1994 to 2,423 AFY in FY 2015–2016. For this zone, agricultural water has ranged from 644 AFY to 2,313 AFY. There has been no special irrigation water, and other water has ranged from 50 to 160 AFY.

The Santa Rita Upland subarea has rural and agricultural groundwater uses. Rural residential communities are located in the Santa Rita Upland and are served by small, shared wells or mutual water companies, such as the Vista Hills Municipal Water Company (MWC), Santa Rita MWC and the Tularosa MWC.

### **5.1.3 Santa Ynez River Alluvium Subarea**

Agriculture occurs in the Santa Ynez River Alluvium subarea, but there are no population centers in this subarea. There is some rural residential single and some shared wells, especially along Santa Rosa Road.

The WMA Santa Ynez River Alluvium subarea comprises a portion of the District Annual Report's Zone A, which extends through all of the Santa Ynez River Alluvium in the CMA and EMA.<sup>32</sup> For this larger Zone A area, overall annual average water production has ranged from 8,178 AFY in FY<sup>33</sup> 1979–1980 to 15,571 AFY in FY 2014–2015. In this zone, agricultural water has ranged from 6,363 to 12,677 AFY. Special irrigation water has ranged up to 1,059 AFY, and other water has ranged from 1,355 to 2,806 AFY. Major pumpers for Zone A include

---

<sup>31</sup> Santa Ynez River Water Conservation District's fiscal year is July 1 through June 30.

<sup>32</sup> Stetson Engineers. 2020. *Forty-Second Annual Engineering and Survey Report On Water Supply Conditions of the Santa Ynez River Water Conservation District 2019–2020*.

<sup>33</sup> Santa Ynez River Water Conservation District's fiscal year is July 1 through June 30.



Santa Ynez River Water Conservation District Improvement District No. 1, the City of Buellton, and the City of Solvang, all of which are located outside of the WMA.

#### **5.1.4 Burton Mesa Subarea**

The Burton Mesa subarea is almost entirely within the extents of VAFB and is the location of the base Cantonment Area which includes most of the facilities. However, the VAFB public water system, which supplies drinking water, does not produce water from the Burton Mesa subarea, and relies on imports, either from the CCWA or a well field in San Antonio Creek Valley Groundwater Basin.

Part of the Burton Mesa subarea is within the District Annual Report's Zone C but has no major groundwater pumping.

### **5.2 AGRICULTURAL LANDS**

In the WMA, a majority of agricultural lands are located in the Santa Ynez River Alluvium, the Lompoc Plain, and the Santa Rita Upland subareas. Some minor agriculture uses are present in the Lompoc Upland subarea. The distribution of crops within the WMA for a representative year, 2016, based on the California LandIQ database, is provided in **Figure 5-1**.

Planted crops in the area have changed over the years according to the United States Department of Agriculture.<sup>34</sup> Major crops include grapes, strawberries, raspberries, dry beans, walnuts, alfalfa, barley, herbs, peaches, cut-flowers, lettuce, and broccoli. Based on this United States Department of Agriculture source, dry beans were more common around 2010; since then, strawberries have become a common crop in the Lompoc Plain subarea, and grapes have become common in both the Santa Ynez River Alluvium and Santa Rita Upland subareas. The newest crop type in the WMA is cannabis.

Crop types affect the amount of water in demand and the timing of water use. Additionally, crops have varying tolerance for degraded water quality, and may require extra water to flush salts from soils. Finally, certain crops, such as leafy vegetables, are associated with fertilizer practices that result in high-nitrate return flows.

### **5.3 WATER EXPORTS**

Water is exported from the Santa Ynez River watershed from three reservoirs on the Santa Ynez River upstream of the WMA, Jameson and Gibraltar Reservoirs and Lake Cachuma, through a series of tunnels to supply cities located on the Santa Barbara County south coast. No groundwater exports occur within the boundaries of the WMA.

---

<sup>34</sup> USDA (United States Department of Agriculture). "National Agricultural Statistics Service. CropScape - Cropland Data Layer." Accessed July 20, 2020. <https://nassgeodata.gmu.edu/CropScape/>.



## 5.4 POTENTIAL GROUNDWATER DEPENDENT ECOSYSTEMS

DWR recommends (DWR 2016) classification of potential groundwater-dependent ecosystems as (1) wetland features commonly associated with the surface expression of groundwater under natural, unmodified conditions, and (2) vegetation types commonly associated with the sub-surface presence of groundwater (phreatophytes) (**Figure 5-2**). The source of this dataset is a working group consisting of DWR, the California Department of Fish and Wildlife, and The Nature Conservancy.

Phreatophytes are plants that depend on, and obtain, groundwater that lies within reach of their roots. These include plants grown within the riparian zone of a river, and some agricultural crops, such as alfalfa. Historical estimates of phreatophytes water use indicate up to 6,000 AFY is used in the WMA (Bright 1997).

### 5.4.1 DISCHARGE AND SPRINGS AREAS

Groundwater discharges are described in terms of springs, seeps, and known areas of groundwater discharge. Active springs and seeps within and adjacent to the Basin are shown in **Figure 5-2**. Six active springs and seeps have been identified in the WMA including: four springs/seeps are located in the Lompoc Upland; one in the Burton Mesa, and one in the Lompoc Terrace subarea (**Figure 5-2**). The quantity of water discharging from these six springs located within the WMA is currently a data gap.

Groundwater in the WMA also discharges to the Santa Ynez River when the groundwater elevation is higher than the streamflow thalweg. Groundwater discharge to the Santa Ynez River will occur during wet winter and spring months, but during the summer and dry winter months, the streamflow loses water to the groundwater aquifers in the Lompoc Plain and Santa Ynez River Alluvium subareas. The Santa Ynez River is perennial downstream of the wastewater discharge from the Lompoc Regional Wastewater Treatment Plant to the Santa Ynez River estuary and Pacific Ocean.

Additionally, groundwater discharge to the Pacific Ocean is occurring as subflow. Approximately 150 to 400 AFY of underflow or discharge to the Pacific Ocean from groundwater was estimated by the USGS (Bright 1997).

---

## **6 DATA GAPS AND UNCERTAINTY**

This HCM section describes data gaps and uncertainty in the conceptual understanding of the groundwater and the interaction with surface water. Overall, there are many existing ground water studies and data for the WMA, including two previous ground water models developed by the USGS (Bright 1997; Bright et al 1992) and the City of Lompoc (HCI 1997). However, the following data gaps below are currently identified for the WMA Hydrogeologic Conceptual Model:

### **6.1 INFLUENCE OF FAULTS ON GROUND WATER MOVEMENT**

Faults with potential to impede groundwater recharge, storage or flow are not currently identified in the WMA. Additional geophysical SkyTEM AEM data collected within the WMA, in conjunction with potential input received from water users and the public may be used to update current understanding of faults that may affect the water environment within the WMA.

### **6.2 PERCHED GROUNDWATER CONDITIONS OF THE BURTON MESA AND LOMPOC TERRACE SUBAREAS**

The Burton Mesa and Lompoc Terrace are almost entirely contained within the boundaries of Vandenberg Air Force Base. Only a few wells logs were reviewed in the Burton Mesa area for the three-dimensional understanding of the Basin (Geosyntec 2020). Additionally, geophysical and other data was not available to adequately evaluate perched groundwater conditions in the Burton Mesa and Lompoc Terrace. Based on available data and reports provided by VAFB (Arcadis 2016), perched groundwater in these areas is not connected to the saturated flow of the Santa Ynez River Basin. Therefore, it is unclear if additional data or study are necessary or needed.

### **6.3 SANTA RITA SUBAREA GROUND WATER MOVEMENT**

Additional water-level data are needed to evaluate the hydraulic conditions between several subareas of the WMA including: 1) the Santa Rita subarea and the Lompoc Upland subarea; 2) the Santa Rita subarea and the Santa Ynez River Alluvium subarea; and 3) the Santa Rita subarea and the Buellton Uplands subarea of the CMA. Existing groundwater models in the WMA (Bright 1997 and HCI 1997) assume there is sub-flow between the Santa Rita and Lompoc Upland, but the exact quantity is not well known or quantified.

Additional data is needed to understand the role of perched aquifers that occur in the Santa Rita Upland. Current understanding for this area is constrained due to small areal extent.



#### 6.4 DISCHARGE QUANTITIES OF IDENTIFIED SPRINGS IN THE WMA

The quantity of water discharging from the six springs located within the WMA (**Figure 5-2**) is currently a data gap. Additional data is needed to understand how discharge from these springs changes over seasons and during wet and dry years.

---

## 7. REFERENCES

- 2002 Settlement Agreement. 2002. *Settlement Agreement between Cachuma Conservation Release Board, Santa Ynez River Water Conservation District, Santa Ynez River Water Conservation District Improvement District No. 1, and the City of Lompoc, relating to Operation of the Cachuma Project.*
- Allen, C. Email communications with Stetson Engineers, April 17, 2020.
- Arcadis. *Project Management Plan – 2016 Annual Update. Performance-Based Remediation Vandenberg Air Force Base, California.* October 2016.
- A.T. O’Geen, Matthew, B.B. Saal, Helen E. Dahlke, David A. Doll, Rachel B. Elkins, Allan Fulton, Graham E. Fogg, Thomas Harter, Jan W. Hopmans, Chuck Ingles, Franz J. Niederholzer, Samuel Sandoval Solies, Paul S. Verdegaal, and Mike Walkinshaw. 2015. *Soil Suitability Index Identifies Potential Areas for Groundwater Banking on Agricultural Lands.* California Agriculture 69(2):75–84. doi: 10.3733/ca.v069n02p75.
- CCWA (Central Coast Water Authority). 2011. Central Coast Water Authority 2010 Urban Water Management Plan. Brady John.
- Berenbrock, C. 1988. *Ground-water quality in the Lompoc Plain, Santa Barbara County, California, 1983.* Water-Resources Investigations Report 87-4101.
- Bright, D.J., C.L. Stamos, P. Martin, and D.B. Nash. 1992. *Ground-Water Hydrology and Quality in the Lompoc Area, Santa Barbara County, California, 1987–88.* USGS Water-Resources Investigations Report 91-4172. doi: 10.3133/wri914172.
- Bright, D.J., D.B. Nash, and P. Martin. 1997. *Evaluation of Ground-Water Flow and Solute Transport in the Lompoc Area, Santa Barbara County, California.* USGS Water-Resources Investigations Report 97-4056. doi: 10.3133/wri974056.
- Dibblee, T. 1950. *Geology of Southwestern Santa Barbara County California. Point Arguello, Lompoc, Point Conception, Los Olivos, and Gaviota Quadrangles.* State of California Department of Natural Resources.
- Dibblee, T. 2009. *Geologic map of the Lompoc Hills and Point Conception quadrangles, Santa Barbara County, California.* Dibblee Geology Center Map #DF-18.
- Driscoll. 1986. *Groundwater and Wells*

- Dudek. 2019. *Santa Barbara County Integrated Regional Water Management Plan*. Update 2019.
- DWR (California Department of Water Resources). 2016. *Best Management Practices for Sustainable Management of Groundwater*. Hydrogeologic Conceptual Model.
- Evenson and Miller. 1963. *Geology and Ground-Water Features of Point Arguello Naval Missile Facility Santa Barbara County California*. USGS Water-Supply Paper 1619-F.
- Fugro Consultants. 2007. *Geophysical and Geotechnical Study Sewer Force Main Crossing Santa Ynez River Solvang, California*. Fugro Job No. 3568.001.
- Geosyntec. 2020. *Draft Technical Memorandum on Regional Geology and 3D Geologic Model for the Santa Ynez River Valley Groundwater Basin*.
- Haas, R.; Kolb, H; Bishop, James. 2019. *Santa Barbara County Groundwater Characterization Project: Santa Ynez River Valley Groundwater Basin*. Heal the Ocean and Central Coast Regional Water Quality Control Board. June 18, 2019.
- Hydrologic Consultants, Inc. (HCI). 1997. *Development of a System of Models for the Lompoc Ground-Water Basin and Santa Ynez River for the City of Lompoc*.
- Hoffman. 2018. *Water Well Completion Report - Fire Station #51 Test Well for Vandenberg Community Services District*. Rick Hoffman and Associates.
- Miller 1976. *Ground-water resources in the Lompoc area, Santa Barbara County, California*. USGS Open-File Report 76-183. Miller, G.A. USGS. California Water Resources Control Board.
- National Marine Fisheries Service (NMFS). 2000. Biological Opinion. U.S. Bureau of Reclamation operation and maintenance of the Cachuma Project on the Santa Ynez River in Santa Barbara County, California, September 8, 2000.
- PRISM Climate Group. 2014. *Average Annual Precipitation 1981–2010*.
- Regional Water Quality Control Board, Central Coast Region State Water Resources Control Board, California Environmental Protection Agency. 2017. *Water Quality Control Plan for the Central Coastal Basin*.
- Santa Barbara County Water Agency. *Santa Barbara County 1999 Groundwater Report*. Santa Barbara County Public Works Water Resource Department Water Agency Division.
- Stetson Engineers. 1992. *Santa Ynez River Water Conservation District, Water Resources Management Planning Process, Phase I: Baseline Data and Background Information*. Prepared for Santa Ynez River Water Conservation District.



Stetson Engineers. 2020. *Forty-Second Annual Engineering and Survey Report On Water Supply Conditions of the Santa Ynez River Water Conservation District 2019–2020*. Prepared for Santa Ynez River Water Conservation District.

Upson, J.E., and H.G. Thomasson Jr. 1951. *Geology and Water Resources of the Santa Ynez River Basin, Santa Barbara County, California*. USGS Water Supply Paper 1107. doi: 10.3133/wsp1107.

USDA (United States Department of Agriculture). 2020. National Agricultural Statistics Service. CropScape – Cropland Data Layer. Accessed July 20, 2020. <https://nassgeodata.gmu.edu/CropScape/>.

USGS (United States Geological Survey). 2020. Quaternary Fault and Fold Database for the Nation. Accessed June 15, 2020. [https://earthquake.usgs.gov/static/lfs/nshm/qfaults/Qfaults\\_GIS.zip](https://earthquake.usgs.gov/static/lfs/nshm/qfaults/Qfaults_GIS.zip).

West Yost Associates. 2013. *City of Lompoc Groundwater Management Plan*.

Wilson, H.D. Jr. 1959. *Ground-Water Appraisal of Santa Ynez River Basin, Santa Barbara County, California, 1945–52*. USGS Water Supply Paper 1467. doi: 10.3133/wsp1467.

Woodring and Bramlette. 1950. *Geology and Paleontology of the Santa Maria District California*. Geological Survey Professional Paper 222. Department of the Interior.

Yates. 2010. *Assessment of Groundwater Availability on the Santa Ynez Chumash Reservation*. Yates, Gus. Tetra Tech. Santa Ynez Band of Chumash Indians.