DRAFT

Eastern Management Area Groundwater Sustainability Agency

Santa Ynez River Valley Groundwater Basin – Eastern Management Area Groundwater Sustainability Plan

PUBLIC DRAFT Section 3 – Basin Setting: Groundwater Budget

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EMA

Santa Ynez River Valley Groundwater Basin
Eastern Management Area
Groundwater Sustainability Agency

Prepared by:

GSI Water Solutions, Inc.
418 Chapala Street, Suite H, Santa Barbara, CA 93101

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Abbreviations and Acronyms

AF	acre-feet
AFY	acre-feet per year
AW	applied water
BCM	Basin Characterization Model
Casino	Chumash Casino
CMA	Central Management Area
CCWA	Central Coast Water Authority
DWR	California Department of Water Resources
EMA	Santa Ynez Groundwater Basin Eastern Management Area
EP	effective precipitation
ET	evapotranspiration
ETAW	evapotranspiration of applied water
ETc	crop evapotranspiration
ETo	reference evapotranspiration
Ep	pan evaporation data
EVT	Existing Vegetation Type
HUC	hydrologic unit code
GSI	GSI Water Solutions, Inc.
GSP	Groundwater Sustainability Plan
ID No. 1	Santa Ynez River Water Conservation District ID No. 1
m	meter
M&I	municipal and industrial
OWTS	onsite wastewater treatment system
SGMA	California Sustainable Groundwater Management Act
SWP	California State Water Project
SWRCB	State Water Resources Control Board
SYRWCD	Santa Ynez River Water Conservation District
USBR	U.S. Bureau of Reclamation
USGS	U.S. Geological Survey
VIC	variable infiltration capacity
WMA	Western Management Area
WWTP	wastewater treatment plant

SECTION 3: **Basin Setting [Article 5, Subarticle 2]**

§354.12 Introduction to Basin Setting. This Subarticle describes the information about the physical setting and characteristics of the basin and current conditions of the basin that shall be part of each Plan, including the identification of data gaps and levels of uncertainty, which comprise the basin setting that serves as the basis for defining and assessing reasonable sustainable management criteria and projects and management actions. Information provided pursuant to this Subarticle shall be prepared by or under the direction of a professional geologist or professional engineer.

This section describes the physical setting and characteristics of the Eastern Management Area (EMA) of the Santa Ynez River Valley Groundwater Basin (Basin), including the Basin boundaries, geologic formations and structures, and principal aquifer units. Accurate understanding of the Basin is central to sustainable management of the groundwater resource.

This section is principally based upon a body of published literature, primarily consisting of geologic and hydrogeologic investigations; annual groundwater planning reports, which have been prepared for a large portion of the EMA for over 40 years; and Basin-specific geologic and hydrogeologic data. The compiled literature, reports and data relied upon for this report constitute the best available information relevant to EMA. This Basin Setting section of the Groundwater Sustainability Plan (GSP) provides a foundation for sustainable groundwater management, and, to that end, will be updated as warranted to maintain this goal.

3.3 Water Budget [§354.18]

> **§354.18 Water Budget.**
>
> **(a) Each Plan shall include a water budget for the basin that provides an accounting and assessment of the total annual volume of groundwater and surface water entering and leaving the basin, including historical, current and projected water budget conditions, and the change in the volume of water stored. Water budget information shall be reported in tabular and graphical form.**
>
> **(b) The water budget shall quantify the following, either through direct measurements or estimates based on data:**
>
> **(1) Total surface water entering and leaving a basin by water source type.**
>
> **(2) Inflow to the groundwater system by water source type, including subsurface groundwater inflow and infiltration of precipitation, applied water, and surface water systems, such as lakes, streams, rivers, canals, springs and conveyance systems.**
>
> **(3) Outflows from the groundwater system by water use sector, including evapotranspiration, groundwater extraction, groundwater discharge to surface water sources, and subsurface groundwater outflow.**
>
> **(4) The change in the annual volume of groundwater in storage between seasonal high conditions.**
>
> **(5) If overdraft conditions occur, as defined in Bulletin 118, the water budget shall include a quantification of overdraft over a period of years during which water year and water supply conditions approximate average conditions.**
>
> **(6) The water year type associated with the annual supply, demand, and change in groundwater stored.**

A water budget is the key integrating aspect of the Basin Setting. For the EMA, the Hydrogeologic Conceptual Model (Section 3.1) and water budgets (this section) together form the basis for the numerical flow model to be used for quantitatively evaluating the management alternatives to be considered in the GSP.

This section summarizes the estimated water budget for the EMA, including information required by California Sustainable Groundwater Management Act (SGMA) regulations and information that is important for developing an effective GSP that achieves groundwater sustainability. In accordance with the SGMA Regulations Section 354.18, the GSP must include a water budget that provides an accounting and assessment of the annual volume of groundwater and surface water entering and leaving the basin, including historical, current, and projected hydrologic conditions, and the change in the annual volume of groundwater in storage. The regulations require that the water budget be reported in graphical and tabular formats.

3.3.1 Overview of Water Budget Development

> **§354.18 Water Budget.**
>
> **(d) The Agency shall utilize the following information provided, as available, by the Department pursuant to Section 353.2, or other data of comparable quality, to develop the water budget:**
>
> **(1) Historical water budget information for mean annual temperature, mean annual precipitation, water year type, and land use.**
>
> **(2) Current water budget information for temperature, water year type, evapotranspiration, and land use.**
>
> **(3) Projected water budget information for population, population growth, climate change, and sea level rise.**
>
> **(e) Each Plan shall rely on the best available information and best available science to quantify the water budget for the basin in order to provide an understanding of historical and projected hydrology, water demand, water supply, land use, population, climate change, sea level rise, groundwater and surface water interaction, and subsurface groundwater flow. If a numerical groundwater and surface water model is not used to quantify and evaluate the projected water budget conditions and the potential impacts to beneficial uses and users of groundwater, the Plan shall identify and describe an equally effective method, tool, or analytical model to evaluate projected water budget conditions.**
>
> **(f) The Department shall provide the California Central Valley Groundwater-Surface Water Simulation Model (C2VSIM) and the Integrated Water Flow Model (IWFM) for use by Agencies in developing the water budget. Each Agency may choose to use a different groundwater and surface water model, pursuant to Section 352.4.**

This section presents an overview of the data sources used for development of the water budget from a variety of publicly available data. As noted above, this water budget refers to the EMA portion of the Basin, as defined in Section 1.2 and depicted on Figure 1-1. This section presents a water budget as required by the regulations, which accounts for and assesses the annual volume of groundwater and surface water entering and leaving the EMA, including historical, current, and projected water budget conditions, each of which present both surface water and groundwater components.

The balance of the inflow and outflow components as well as the sustainable yield are presented following the water budgets. The sustainable yield of a groundwater basin is the volume of groundwater that can be extracted from a basin on a long-term basis without creating chronic and continued lowering of groundwater levels and a significant and unreasonable reduction of groundwater in storage. The sustainable yield is not a fixed constant value, but can fluctuate over time as the balance of the groundwater inflows and outflows change; thus, the calculated sustainable yield within the EMA can be estimated and likely modified with each future update of the GSP.

The water budget analysis is inextricably tied to the requirement of SGMA to ensure the basin is operated within its sustainable yield. Sustainable yield is defined in SGMA as “the maximum quantity of water, calculated over a base period representative of long-term conditions in the basin and including any temporary surplus that can be withdrawn annually from a groundwater supply <u>without causing an</u>

undesirable result." An undesirable result is one or more of the following effects caused by groundwater pumping occurring throughout the basin:

- Chronic lowering of groundwater levels in the aquifer(s) indicating a significant and unreasonable depletion of supply if continued over the planning and implementation horizon. Overdraft during a period of drought is not sufficient to establish a chronic lowering of groundwater levels if groundwater extractions and recharge are managed as necessary to ensure that reductions of groundwater levels or storage during a period of drought are offset by increases of groundwater levels or storage during other periods.
- Significant and unreasonable reduction of groundwater in storage.
- Significant and unreasonable degradation of water quality, including the migration of contaminant plumes that impair water supplies.
- Seawater intrusion.
- Significant and unreasonable land subsidence that substantially interferes with surface land uses.
- Depletion of interconnected surface water that has significant and unreasonable adverse impacts on beneficial uses of surface water.

Defining sustainable yield of a groundwater basin based upon a water budget provides a starting point that may be adjusted by considering whether there are undesirable results associated with any of the six sustainability indicators described above. Consideration of the sustainability indicators for defining sustainable yield is discussed in Section 4.

Section 354.18 of the SGMA regulations requires development of a water budget that includes both groundwater and surface water components to provide an accounting of the total volume of water entering and leaving the basin. To satisfy the requirements of the regulations, a water budget was prepared for the EMA for each water budget period. A general schematic diagram of the hydrologic cycle, each component of which is included in the water budget, is presented on Figure 3-41.

The Santa Ynez River and associated underflow within the Santa Ynez River Alluvium is included in the surface water system that is summarized in the budget. As surface water, the Santa Ynez River Alluvium is not considered a principal aquifer because the water within this geological unit is present within the defined bed and banks of the channel and thus is not considered groundwater in accordance with Water Code, Section 10721(g). The surface water system is managed under the jurisdiction of the California State Water Resources Control Board (SWRCB) and is not within the purview of SGMA. Therefore, water both above ground and belowground within the Santa Ynez River, defined as the Santa Ynez River Water Conservation District's (SYRWCD's) Zone A portion of the EMA, is quantified as surface water. The extent of the Santa Ynez Uplands (groundwater area) and Santa Ynez River (surface water area) are shown on Figure 3-1.

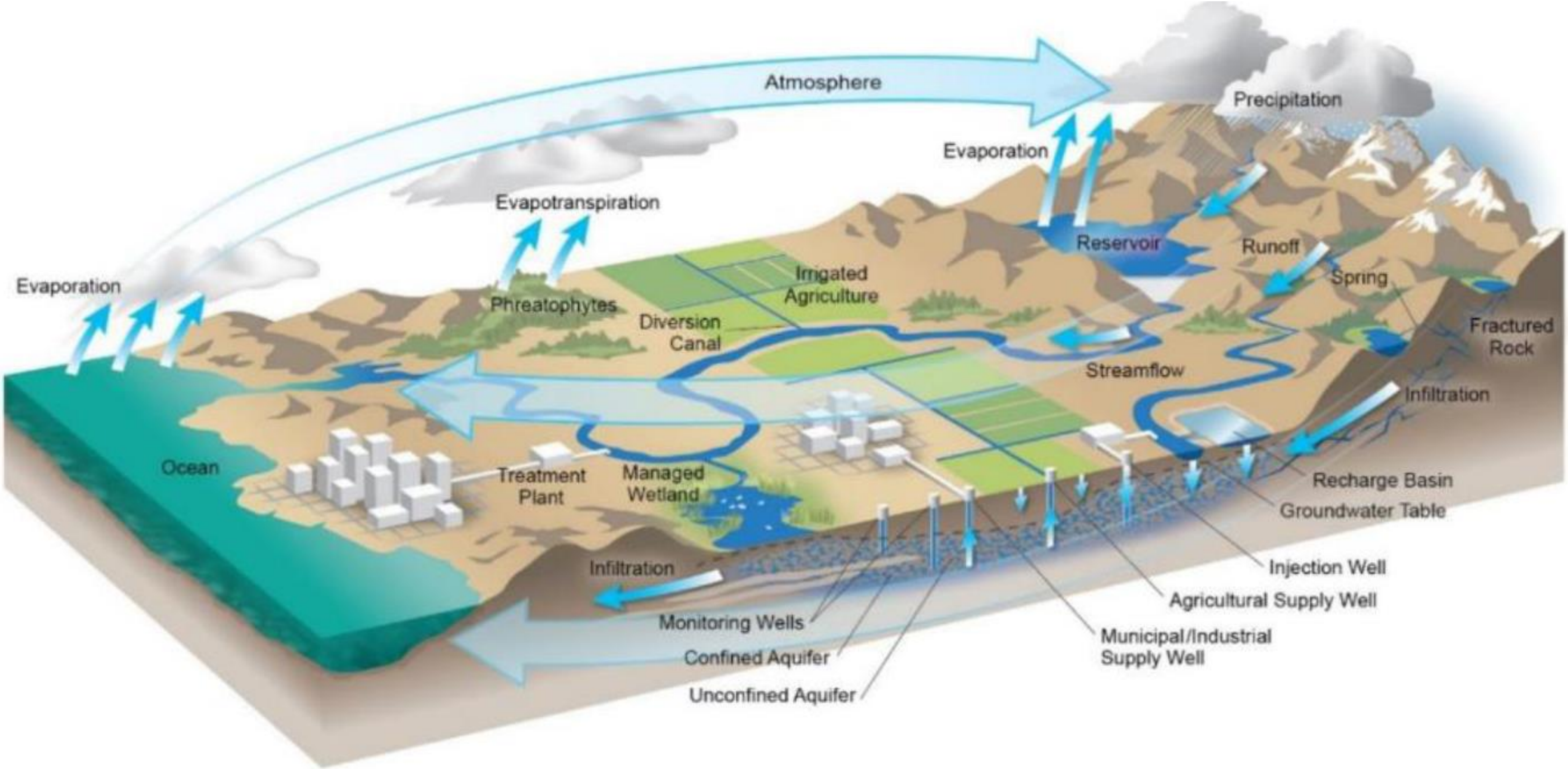

Figure 3-41. Hydrologic Cycle

(Source: DWR, 2016a)

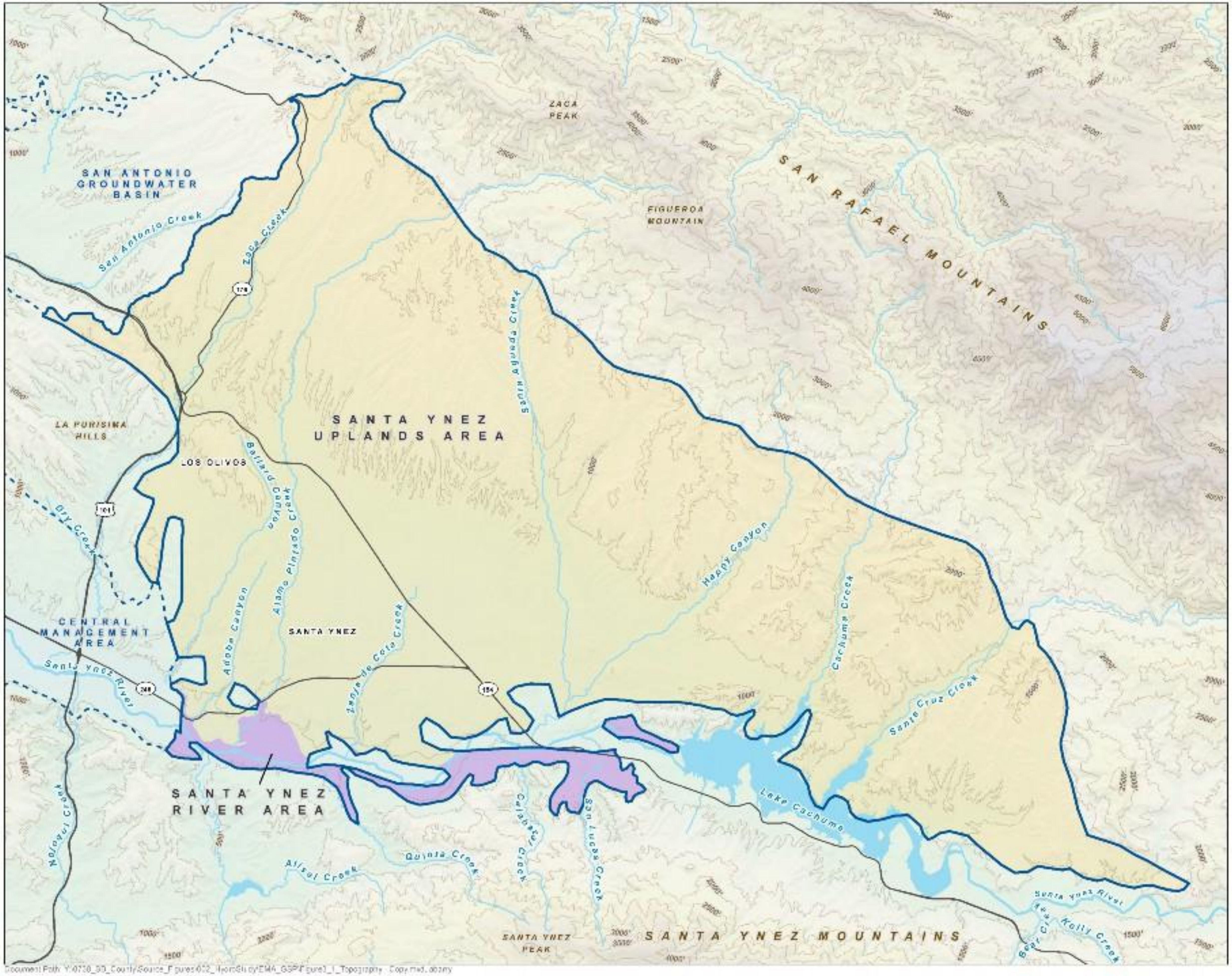

FIGURE 3-1

Topographic Map

Groundwater Sustainability Plan
Eastern Management Area

Date: March 10, 2021
Data Sources: ESRI, USGS, Maner 2015

GSI Water Solutions, Inc.

Document Path: Y:\0730_SB_County\Source_Figures\002_HydroStudy\EMA_GSP\Figure3_1_Topography - Copy.mxd, dbairy

A few components of the water budget, such as streamflow at a gaging station or groundwater pumping from a metered well, can be measured directly. Other components of the water budget, such as recharge from precipitation or unmetered groundwater pumping, are estimated. The water budget is an inventory and accounting of total surface water and groundwater inflows (recharge) and outflows (discharge) from the EMA, including the following:

Surface Water Inflows (Santa Ynez River):

- Streamflow and subsurface inflow into the Santa Ynez River Alluvium from both the upstream Santa Ynez River and Santa Ynez Uplands tributaries
- Runoff of precipitation into streams and rivers or diversion structures that enter the EMA from the surrounding watershed
- Irrigation return flow to the Santa Ynez River Alluvium
- Return flows from septic systems
- Imported surface water (e.g., from the California State Water Project [SWP])

Surface Water Outflows (Santa Ynez River):

- Streamflow exiting the EMA through the Santa Ynez River and Zaca Creek
- Subsurface flow through the Santa Ynez River Alluvium into the downstream Central Management Area (CMA)
- Pumping from river wells completed in the Santa Ynez River Alluvium
- Phreatophyte evapotranspiration (ET)

Groundwater Inflows:

- Recharge from precipitation
- Percolation of tributary flows to groundwater
- Subsurface groundwater inflow, including mountain front recharge
- Irrigation return flow (water not consumed by crops/landscaping)
- Percolation of treated wastewater
- Septic tank return flows

Groundwater Outflows:

- Groundwater pumping
- ET
- Subsurface groundwater outflows to adjoining groundwater system
- Groundwater discharge to surface water

The difference between inflows to and outflows from the groundwater system in the Santa Ynez Uplands is equal to the change of groundwater in storage.

The historical water budget period was selected to be water years 1982 through 2018. The current water budget period was selected to be water years 2011 through 2018. The projected water budget extends to 2072 (43).

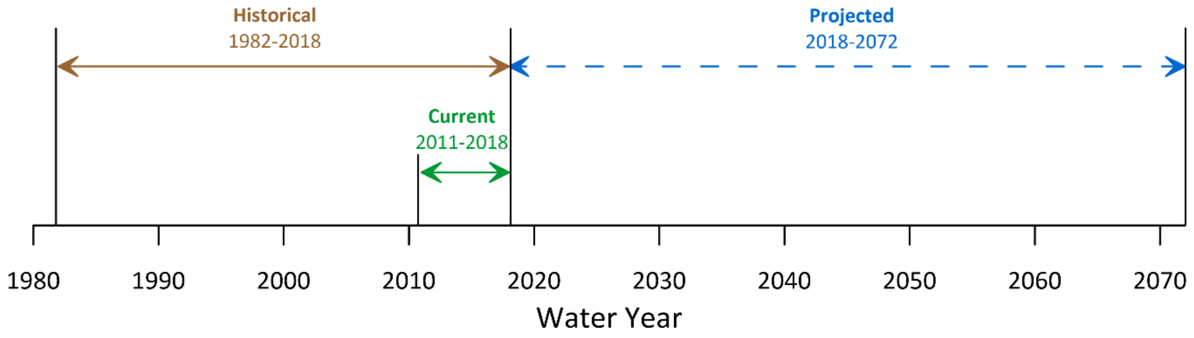

Figure 3-42. Historical, Current, and Projected Water Budget Periods

As within the entire GSP, historical water budget period discussion refers to water years, which run between October 1 and September 30 of the following year. For example, the period between October 1, 2017, and September 30, 2018, constitutes water year 2018.

The 37-year period between water years 1982 and 2018 (inclusive) has been selected for the historical water budget to comply with the California Department of Water Resources (DWR) regulatory requirements, which require the following:

> "a quantitative assessment of the historical water budget (be prepared) starting with the most recently available information and extending back a minimum of 10 years, or as sufficient to calibrate and reduce the uncertainty of the tools and methods used to estimate and project future water budget information and future aquifer response to proposed sustainable groundwater management practices over the planning and implementation horizon."

The historical period selected also includes "the most recently available information." The 37-year period selected for the historical water budget includes two wet and two dry hydrologic cycles, recent changes in imported water supply availability, changes to water demand associated with cropping patterns, and associated land use.

The historical water budget period was set to define a specific period over which elements of recharge and discharge to the basin may be compared to the long-term average. This period allows for the identification of long-term trends in basin supply and demand, water level trends, changes of groundwater in storage, and estimates of the annual components of inflow and outflow to the zone of saturation. This information is fundamental to development of the EMA groundwater model (discussed in Appendix X).

Further, the SGMA regulations require that the historical water budget provide a "quantitative evaluation of the availability or reliability of historical surface water supply deliveries" … based on the most recent 10 years of surface water supply information (Section 354.18[c][2]).

A representative historical water budget period should do the following:

- Be representative of long-term hydrologic conditions (precipitation and streamflow)
- Include wet, dry, and average (normal[1]) years of precipitation
- Span a 20-to-30-year period (Mann, 1968)

---

[1] Normal: average precipitation over a long period, sometimes 30 years

- Have its start and end years preceded by comparatively similar rainfall quantities (DWR, 2002)
- Preferably start and end in a dry period (Mann, 1968), which minimizes water draining (in transit) through the vadose zone
- Include recent cultural conditions (DWR, 2002)

Determination of an appropriate historical water budget period included consideration of data availability, surface water inflows to the basin, and the historical development of water supplies imported from outside of the Basin and the EMA.

This historical water budget period selection also helps inform the projected water budget which utilizes "50 years of historical precipitation, ET, and streamflow information as the baseline condition for estimating future hydrology (SGMA Regulations Section 354.18(c)(3))." Notably, the selection of both the historical and current water budget periods are based on this requirement. The historical water budget period (base period) closely approximates long-term hydrologic conditions based on precipitation. While the historical water budget period selection may include consideration of streamflow, the flow in the Santa Ynez River upstream of the EMA is highly regulated by three upstream dams. Because of this, the consideration of streamflow in the Santa Ynez River is neither meaningful nor useful for the selection of the historical period. Therefore, precipitation data are used as the principal recharge component for the selection of the historical period.

In addition to the consideration of precipitation and streamflow variability, the historical period selected must include high-quality, reliable data with regard to all of the principal components of the water budget. The historical period generally includes reliable data for most, but not all, of the water budget components. For components for which reliable data were not readily available, additional analysis was conducted to provide reliable estimates of the components. Many of these components were verified by numerical groundwater modeling, which will be discussed in a later section (prepared under separate cover).

The historical period was determined based on review of long-term precipitation records from 12 precipitation stations located in, and adjacent to, the EMA (discussed in Section 2). Of the 12 stations, eight were chosen for this analysis based on approximately representing the historical record (based on both geographic distribution and period of record). A map of these stations, with the exception of the upstream stations to the west, is presented as Figure 2-1.

The four stations excluded from the analysis were either located too far from the EMA (Los Alamos) or had limited available data (Foxen Canyon, Midland School, and Happy Canyon). The eight precipitation stations used for the analysis are summarized on Table 3-1.

Table 3-1. Precipitation Stations Used for Historical Period Selection

Station No.	Station Name	Beginning of Record	Location	Elevation (Feet)	Period Average (Inches)
218	Santa Ynez Fire Station	1951	Within EMA	600	15.7
393	Solvang PW Water	1965	Within EMA	485	18.3
233	Buellton Fire Station	1955	Surrounding	360	17.2
421	Figueroa Mountain	1961	Surrounding	3,200	21.3
332	Cachuma	1953	Adjacent EMA	800	19.7
204	Los Alamos Fire Station	1910	San Antonio Basin	580	15.3
230	Gibraltar Reservoir	1920	Upstream	1,500	26.2
232	Jameson Dam	1926	Upstream	2,230	28.7

Graphs showing the cumulative departure from mean precipitation for the eight precipitation stations were created. The climatic trends (which exhibit wet, average [normal], and dry periods) determined from the stations are presented on all hydrographs and water budget graphs in this GSP.

The precipitation station with the longest period of record (more than 100 years) is the Los Alamos Fire Station, located 6 miles west of the EMA in the adjacent San Antonio Groundwater Basin. For the five precipitation stations within or immediately surrounding the EMA, precipitation averages approximately 18 to 19 inches per year. These five stations each have at least 53 years of reliable precipitation data: Santa Ynez, Solvang, Buellton, Figueroa Mountain, and Cachuma. The Santa Ynez Fire Station is the principal precipitation station for this analysis.

Based on review of precipitation data from these stations, the initial year for a suitable historical period could be 1976, 1978, 1981, or 1982, all of which start in a dry year preceded by at least one dry year. The ending year of 2018 is a dry year in an overall dry period. The period between 1982 and 2018 (inclusive) is the most balanced period. In consideration of the availability of high-quality data, especially reported groundwater pumping data, this period will be used for the EMA groundwater modeling and for the historical water budget analysis. The historical water budget information is presented in Section 3.3.3.

The current water budget period was selected to be between 2011 and 2018. This period represents a very dry period overall, which—although not hydrologically balanced as was the historical period—is considered representative of the current drought conditions. Precipitation at the Santa Ynez Fire Station during this period averaged 12.5 inches, which is just 79 percent of the historical period. The current water budget information is presented in Section 3.3.4.

The projected water budget between 2018 and 2072 extends 50 years past the 2022 submittal of this GSP for a total of 55 years. The projected water budget information is presented in Section 3.3.5.

3.3.2 Water Budget Data Sources

The historical and current water budget analysis was developed using various publicly available data sets in a tabular accounting by water year. The projected water budget analysis was developed in part using the EMA groundwater model, further described below. The groundwater inflow and outflow components of the water budget pertain to the principal aquifers, the Paso Robles Formation and the Careaga Sand, which are located within the Santa Ynez Uplands portion of the EMA. The surface water inflow and outflow components generally refer to the SWRCB-regulated Santa Ynez River (aboveground and underflow within the Santa Ynez River Alluvium) and the surface flow through the tributaries in the Santa Ynez Uplands, which flow to the Santa Ynez River.

Table 3-2 provides a summary of the data sources employed for developing the historical and current water budget analyses and a description of each data set's qualitative data rating. Each of these data sets is described in further detail in the following sections.

A qualitative discussion of the estimated level of uncertainty associated with each data source is described in the table below and for each water budget term. This discussion focuses on the level of uncertainty and our confidence in the data, assumptions, and interpretations of the information used to develop the water budgets. The level of uncertainty can significantly affect the GSA's ability sustainably manage the EMA. While the data associated with the EMA is generally excellent, any large uncertainty in the data could limit the GSA's ability to effectively develop sustainable management criteria, select appropriate projects and management actions, and determine whether the Basin is being sustainably managed.

Table 3-2. Water Budget Data Sources

Water Budget Component	Data Source(s)	Comment(s)	Qualitative Data Rating
Surface Water Inflow Components			
Bradbury Dam Releases	U.S. Bureau of Reclamation	Data provided by Stetson Engineers	Metered - High
Cachuma Project	U.S. Bureau of Reclamation	Data provided by SYRWCD, ID No.1	Metered - High
Native Streamflow	USGS BCM Runoff, gage data	BCM calibrated to gage data	Calibrated Model - Medium
Imported: State Water Project	Central Coast Water Authority	Data provided by SYRWCD, ID No. 1	Metered - High
Groundwater Inflow Components			
Deep Percolation of Precipitation	USGS BCM Recharge	BCM calibrated to Basin met station data	Calibrated Model - Medium
Tributary Percolation	Santa Ynez RiverWare Model, USGS BCM	Collaborative Modeling effort: Stetson and GSI	Calibrated Model - Medium
Subsurface groundwater inflow: Mountain Front Recharge	USGS BCM Recharge	BCM calibrated to SYRB met station data	Calibrated Model - Medium
Irrigation Return Flows	Land Use Surveys, SYRWCD crop-specific water duty factors, self-reported pumping data	Methods described in text	Estimated – Medium/Low
Percolation of Treated Wastewater	Chumash Casino WWTP Operations Manager	Verbal, described in text	Estimated – Medium/Low
Percolation from Septic Systems	RWQCB data set, census data	Methods described in text	Estimated - Low
Surface Water Outflow Components			
Santa Ynez River Outflow	U.S. Bureau of Reclamation, USGS BCM Runoff, gage data	Methods described in text	Estimated – Medium/Low
Pumping from River Wells[1]	City of Solvang, ID No. 1, SYRWCD self-reported pumping data	Methods described in text	City of Solvang: High, SYRWCD, ID No. 1: High, self-reported: Medium/Low
Groundwater Outflow Components			
Agricultural Irrigation Pumping	Land use surveys, SYRWCD crop-specific water duty factors, self-reported pumping data	Methods described in text	Estimated – Medium/Low
Municipal Pumping[1]	City of Solvang, ID No. 1, SYRWCD self-reported pumping data	Methods described in text	City of Solvang: High, SYRWCD, ID No. 1: High, self-reported: Medium/Low
Rural Domestic Pumping (outside SYRWCD)	RWQCB data set, census data	Methods described in text	Estimated - Low
Small Public Water Systems Pumping (outside SYRWCD)	DRINC, census data	Methods described in text	Estimated – Medium/Low
Phreatophyte ET	LandFire	Methods described in text	Estimated – Medium
Subsurface Outflow	Darcian Flux Calculations, Groundwater Model	Methods described in text	Estimated - Low

Notes

[1] Includes all self-reported domestic pumping that occurs within the SYRWCD area.

BCM = Basin Characterization Model

DRINC = Drinking Water Information Clearinghouse

ET = evapotranspiration

GSI = GSI Water Solutions, Inc.

RWQCB = Regional Water Quality Control Board

Stetson = Stetson Engineers

SYRWCD = Santa Ynez River Water Conservation District

SYRWCD, ID No.1 = Santa Ynez River Water Conservation District, Improvement District No. 1

USGS = U.S. Geological Survey

WWTP = wastewater treatment plant

3.3.2.1 Surface Water Inflow Components

Surface water inflows to the EMA include runoff in the Santa Ynez River main stem that is attributable to precipitation, releases from the Cachuma Reservoir (also referred to as Lake Cachuma), and rainfall runoff in various tributaries to the Santa Ynez River within the EMA. Surface water inflows also include water imported into the EMA via the SWP.

The individual components of surface water inflows are described below.

3.3.2.1.1. Bradbury Dam Releases

Downstream releases and spillway flows from Lake Cachuma are controlled and monitored by U.S. Bureau of Reclamation (USBR) at Bradbury Dam (the dam). Flows in the Santa Ynez River below the dam are a combination of volumes released through the Bradbury Dam outlet works, the Hilton Creek Watering System, and occasional releases over the dam spillway. Except for releases over the spillway, releases from the Cachuma Reservoir are governed by both a State Water Rights Order 2019-0148 and a National Marine Fisheries Service Biological Opinion to support fish migration, spawning, and habitat maintenance in the Lower Santa Ynez River.[2] These releases satisfy downstream water rights and ensure protection of public trust resources downstream of Bradbury Dam. The USBR monthly release and spillway flow data for Bradbury Dam were provided by Stetson Engineers for the 1982 through 2018 water year period. These data were used as provided for EMA surface water inflows.

The uncertainty associated with the data from Bradbury Dam releases provided by the USBR is considered low and does not limit the GSA’s ability to sustainably manage the Santa Ynez Uplands groundwater within the EMA.

3.3.2.1.2. Native Streamflow

Native streamflow in the Santa Ynez River main stem and in tributary creeks to the Santa Ynez River downstream of Bradbury Dam (see Table 3-3) were estimated using a combination of USGS Basin Characterization Model (BCM) for California (Flint & Flint, 2017), runoff data, and stream gage data (as available). The BCM data are provided statewide on a 270 by 270-meter grid. As a quality assurance check on the BCM data, the gridded BCM monthly precipitation data were compared to the monthly precipitation reported at weather stations across the entire Santa Ynez River Basin. On average, over the 37-year period of record, from October 1981 through September 2018, the BCM precipitation across all of these stations was 1.4 percent higher than the weather station reported values. For month-to-month comparisons, however, weather stations reported more discrepancies between the BCM values for individual locations. A correction was applied to the BCM values for each monthly time step such that the adjusted BCM data exactly matched all recorded weather station monthly precipitation values. These monthly adjustments were also applied to the BCM-generated runoff and recharge data sets. These adjusted BCM runoff and recharge data sets were then compared to tributary stream flow gage data, where available, and calibrated to fit the gage data.[3]

The native streamflow in tributary creeks where they enter the Basin were determined using the adjusted and calibrated BCM recharge and runoff data sets summed over the contributing watershed areas outside the Basin.

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[2] Biological Opinion, U.S. Bureau of Reclamation Operation and Maintenance of the Cachuma Project on the Santa Ynez River in Santa Barbara County, California, issued September 11, 2000.

[3] The adjusted BCM runoff data were calibrated to match stream gage data (where available) by routing excess or deficit volumes to/from recharge (discussed further in Section 3.3.2.2 as Streamflow Percolation, Mountain Block Recharge, and/or Deep Percolation of Precipitation).

The Santa Ynez River and underflow is accurately gauged and highly regulated. Therefore, the level of uncertainty of these data is low. The flow from the tributary creeks, however, is ungauged and estimated based on BCM and SYRHM data outputs. The uncertainty of these data are considered high because large scale regional models are being used to estimate these water budget terms. In our opinion, the uncertainty associated with estimated tributary flow does not limit the GSA's ability to manage the Santa Ynez Uplands groundwater system because the tributary flow terms are relatively small when compared to the other water budget terms.

Table 3-3. Tributary Creeks to the Santa Ynez River Downstream of Bradbury Dam

Creek Name	Contributing Watershed Area
Santa Agueda Creek	San Rafael Mountains (north from Santa Ynez Uplands)
Zanja de Cota Creek	San Rafael Mountains (north from Santa Ynez Uplands)
Alamo Pintado Creek	San Rafael Mountains (north from Santa Ynez Uplands)
Zaca Creek	San Rafael Mountains (north from Santa Ynez Uplands)
Hilton Creek	Santa Ynez Mountains (south)
San Lucas Creek	Santa Ynez Mountains (south)
Calabazal Creek	Santa Ynez Mountains (south)
Alisal Creek	Santa Ynez Mountains (south)

3.3.2.1.3. Cachuma Project / Imported State Water Project Supplies

As described in Section 3.3.2.1.5, Santa Ynez River Water Conservation District, Improvement District No. 1 (ID No. 1) receives a portion of its water supply via the USBR Cachuma Project. Prior to 1997, Cachuma Project water was delivered directly to ID No. 1 via pipeline. Since the Coastal Branch of the SWP came online in 1997, ID No. 1 has received its Cachuma Project water through the 1993 Santa Ynez River/State Water Project Exchange Agreement (Exchange Agreement) with the South Coast Cachuma Project Member Units, whereby the South Coast Members take ID No.1's portion of Cachuma water and ID No. 1 takes an equivalent amount of SWP water at the ID No. 1 turnout. As a member agency of the Central Coast Water Authority (CCWA), ID No. 1 imports additional SWP water through its contractual entitlement to SWP Table A supplies, a portion of which ID No. 1 has contractually allocated to the City of Solvang. USBR monthly Cachuma Project water delivery data were provided by ID No. 1 for the 1981 to 1997 water year period. CCWA monthly SWP water delivery data (for both ID No. 1 Exchange Agreement deliveries and Table A deliveries to ID No. 1 and Solvang) were provided by ID No. 1 for the period from 1997 to present.

The level of uncertainty of these data is low because they are measured values and thus, does not limit the GSA's ability to sustainably manage the Santa Ynez Uplands groundwater within the EMA.

3.3.2.1.4. Subsurface Inflow: Mountain Front Recharge to Surface Water

The southern portion of the EMA along the Santa Ynez River is bounded by the Santa Ynez Mountains (Figure 2-2). Water enters the basin around the edges of the EMA where water-bearing deposits abut Monterey Formation and underlying bedrock on the mountain slopes. This component of inflow is called mountain front recharge. This recharge component occurs both from the north via the San Rafael Mountains, which contribute groundwater recharge to the Santa Ynez Uplands, and from the south via the Santa Ynez Mountains, which contribute recharge to the Santa Ynez River both above and belowground. Mountain front recharge from the Santa Ynez Mountains that flows directly into streams and the Santa Ynez River Alluvium (considered to be surface water) was calculated using the adjusted and calibrated BCM model as described in Section 3.3.2.1.2.

The uncertainty of these data are considered moderate because large scale regional models are being used to estimate this water budget term. We do not have other reliable methods for estimating this term and so are applying best available science. However, we have attempted to constrain this term through the groundwater model calibration process. We do not believe that uncertainty associated with estimates of mountain front recharge limit the GSA's ability to manage the Santa Ynez Uplands groundwater system because the overall water budget is consistent with the calibrated groundwater flow model.

3.3.2.1.5. Imported Water: State Water Project

As noted above, monthly volumes of imported SWP water were provided by ID No. 1 for September 1997 through to the present. These volumes include imported SWP water received by ID No. 1 in exchange for Cachuma Project water. Prior to 1997, no water was imported into the Basin. The level of uncertainty of these data is low because they are measured values and do not limit the GSA's ability to sustainably manage the Santa Ynez Uplands groundwater within the EMA.

3.3.2.2 Groundwater Inflow Components

The data sources used for inflows to the groundwater system of the Santa Ynez Uplands are described below. Note that the groundwater system includes only the aquifers in the Santa Ynez Uplands portion of the EMA and specifically excludes all water within the Santa Ynez River Alluvium, which is managed as surface water under the jurisdiction of the SWRCB.

3.3.2.2.1. Deep Percolation of Precipitation

Precipitation falling on the land surface of the EMA represents the principal source of inflows to the groundwater within the Santa Ynez Uplands. Precipitation varies spatially and exhibits a strong seasonal variability (GSI, 2020). The precipitation that falls on the ground surface within contributing watersheds to the Basin either runs off into stream channels that eventually discharge to the Santa Ynez River or infiltrates into the soil zone.

Recharge to groundwater from deep percolation of precipitation was determined using the USGS BCM gridded recharge data set. As described in Section 3.3.2.1.2, the BCM recharge data set has been adjusted, based on comparison to monthly precipitation records at weather stations, across the entire Santa Ynez River Basin. The adjusted BCM recharge data set was then further adjusted in conjunction with comparisons to tributary stream flow gage data as described in Section 3.3.2.1.2. As a result of these adjustments[4] in the water budget, approximately 14 percent of the BCM recharge volume (not the total precipitation volume) was routed to streamflow and the remaining 86 percent was input as deep percolation of precipitation. That is, of the volume of precipitation that initially infiltrates, 86 percent percolates deeply to groundwater, while the small remainder of 14 percent flows laterally and subsequently discharges to nearest stream channel as baseflow.[5]

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[4] The adjustments to the BCM data were conducted in conjunction with consultants who are preparing the GSPs for the Central Management Area (CMA) and Western Management Area (WMA) within the Basin. Adjustments similar to those made for the EMA were made for the CMA and WMA, based on the same data. Similar adjustments were also made for the adjacent San Antonio Creek Valley Groundwater Basin. Furthermore, these adjustments were verified by the numerical groundwater flow model created for the EMA.

[5] These percentages pertain to the historical period (water years 1982 through 2018).

The level of uncertainty of these data is considered moderate. These data are based on a calibrated analytical methods and calibrated groundwater flow model and are within the range of values commonly applied to similar geologic settings.

3.3.2.2.2. Tributary Percolation

Tributary percolation, the deep percolation of surface water to groundwater through the tributary streambeds, was estimated using the adjusted BCM model. Portions of the adjusted BCM runoff and recharge data sets routed to tributary streamflow percolation were determined in conjunction with comparisons to tributary stream flow gage data as described in Section 3.3.2.1.2. The level of uncertainty of these data is moderate. These data are based on a calibrated analytical methods and calibrated groundwater flow model and are within the range of values commonly applied to similar geologic settings.

3.3.2.2.3. Subsurface Inflow: Mountain Front Recharge

The EMA is surrounded by the San Rafael Mountains to the north and east, as shown on Figure 2-2. Groundwater enters around the edges of the EMA where water-bearing deposits abut the Monterey Formation and underlying bedrock on the mountain slopes; this groundwater inflow is called mountain front recharge.

Mountain front recharge was calculated using the adjusted and calibrated BCM model as described in Section 3.3.2.1.2. Mountain front recharge was calculated as the sum of the adjusted and calibrated BCM recharge data set over the contributing watershed areas outside the EMA minus the portion routed to native streamflow and the Santa Ynez River Alluvium.

The uncertainty of these data are considered moderate because large scale regional models are being used to estimate this water budget term. We do not have other reliable methods for estimating this term and so are applying best available science. However, we have attempted to constrain this term through the groundwater model calibration process. We do not believe that uncertainty associated with estimates of mountain front recharge limit the GSA's ability to manage the Santa Ynez Uplands groundwater system because the overall water budget is consistent with the calibrated groundwater flow model.

3.3.2.2.4. Irrigation Return Flows

Irrigation return flow is the water applied to crops in excess of crop ET demand, which percolates below the root zone and back to groundwater. The proportion of applied water that is utilized to satisfy crop ET demand is equivalent to the irrigation efficiency, expressed as a percentage. The remaining percentage of applied water is equivalent to the irrigation return flow. Return flows can reenter the hydrologic system as deep drainage and recharge to groundwater, or water that leaves the cropped field as surface flow tail water and discharges to a nearby stream. It is assumed that most of the irrigation return flow percolates to groundwater within the EMA. For irrigated agriculture in the EMA, an irrigation efficiency of 80 percent is assumed for all crops except vineyards, which are generally irrigated using a drip system at an efficiency of 90 percent.[6] The urban landscape irrigation efficiency is assumed to be 70 percent[7]. These irrigation return flow proportions were estimated by a method used within all three management areas in the Basin based on published values and personal communications with a Citizen's Advisory Committee member, who agree with the estimates, and representatives from the CMA, WMA, and the adjacent San Antonio Creek Basin GSA. These irrigation return flows were used throughout the Basin. Irrigation return flow volumes have been

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[6] Irrigation efficiencies within vineyards have increased from 70 percent in the 1970s to 80 percent in the 1980s, and to 90 percent more recently, based on Tetra Tech 2010 and DWR 1994, and personal conversations with local irrigators including Kevin Merrill and Kris Beal.

[7] Irrigation return flows estimated based in part on data provided in Tetra Tech, 2010 *Assessment of Groundwater Availability on the Santa Ynez Chumash Reservation* and DWR 1994, *California Water Plan Update.*

calculated using these efficiencies multiplied by the calculated annual volumes of irrigation water applied to each crop type (based on land use surveys within the EMA in 1985, 1996, 2014, 2016 and 2018), assigned crop-specific water duty factors, and self-reported irrigation pumping data. These applied water volumes are discussed further in Section 3.3.2.4.

Since 1997, ID No. 1 has imported SWP water for use in the EMA. A portion of the water that ID No. 1 serves its customers is used for agricultural irrigation, which is derived in part from imported (SWP) sources. Water from imported and native surface water sources is commingled with other sources of water within ID No. 1's distribution system and used throughout ID No. 1's service area for agricultural, municipal, domestic, commercial, and industrial uses. As noted above, ID No. 1 also produces surface water (underflow) from the Santa Ynez River main stem pursuant to licenses issued by the SWRCB. Those waters are applied for domestic, agricultural, commercial, and institutional uses in portions of the Santa Ynez Uplands groundwater system.

For agricultural uses, ID No. 1 delivered an estimated 1,364 AFY from imported sources (SWP Table A, Exchange Agreement, and Cachuma) and another 620 AFY of surface water produced from river wells located within the Santa Ynez River main stem during the historical period. In total, 1,984 AFY was derived from these sources and used for irrigation in both the Santa Ynez Uplands and the Santa Ynez River Alluvium. The proportion of this return flow that occurs within the Santa Ynez Uplands was based on an analysis of irrigated acreage of agricultural areas within ID No. 1's service area and within the Santa Ynez River Alluvium (Zone A) area (Figure 3-1). Of this applied irrigation water derived from imported and surface water sources, a total of 317 AFY (16 percent[8]) returned to the ground; 287 AFY of which returned to the upland groundwater system, and 67 AFY of which returned to the Santa Ynez River (Zone A).

These groundwater recharge components were estimated based on published values for irrigation efficiency, which were used throughout both the entire Basin and adjacent basins. Therefore, the level of uncertainty of these data is relatively low. The variability and magnitude of this recharge component are included in the calibrated numerical groundwater model provided in Appendix E, using best available science and industry-standard methods.

3.3.2.2.5. Percolation of Treated Wastewater

There are two wastewater treatment plants (WWTPs) in the EMA: a small treatment plant for the Chumash Casino (Casino) and a larger municipal treatment plant, which serves the City of Solvang.

Discharge of treated wastewater from the Casino was estimated based on verbal communication with Casino WWTP operator Kevin McKennon, as well as details of plant operation specified in the *Assessment of Groundwater Availability on the Santa Ynez Chumash Reservation* report (Tetra Tech, 2010). Prior to 2003, all Casino wastewater was transmitted to the Solvang WWTP. Beginning in 2003, upon completion of the Chumash WWTP for the Casino, between 40 AFY and 120 AFY of effluent have been discharged from the Casino WWTP into Zanja de Cota Creek. This discharge subsequently flows into the Santa Ynez River underflow. There has been a trend of increasing wastewater reuse by the Casino, causing a reduction in discharge to the creek over time. The Santa Ynez Community Services District maintains the Chumash wastewater treatment and collection system.

The residences and businesses in the City of Solvang and much of the eastern portion of the town of Santa Ynez, west of Highway 154, are connected to sewer service. Wastewater flows from these properties are collected by the Santa Ynez Community Services District, and are transmitted to the Solvang WWTP and subsequently discharged to the percolation ponds located adjacent to Santa Ynez River downstream of the

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[8] Based on weighted average irrigation efficiency.

western EMA border near the Santa Ynez River. These WWTP discharges occur within the CMA and do not contribute to the EMA water budget.

This groundwater recharge component of this flow term was estimated using a range of industry accepted values for soils in this region. The volume of flow is relatively small and so uncertainties in this estimate do not appreciably affect the overall water budget.

3.3.2.2.6. Percolation from Septic Systems

Outside of the sewer service areas in the EMA, domestic, commercial, and institutional wastewater is discharged to on-site wastewater treatment systems (OWTSs, formerly referred to as septic tank – leach field systems). Return flows from these OWTS provide recharge to the groundwater in the Santa Ynez Uplands. The locations and distribution of these OWTS were estimated by identifying residences not served by a sewer system using Google Earth and then comparing OWTS data to data provided by Heal the Ocean (HTO, 2019). Within the EMA, the total number of OWTS in 2018 was multiplied by an estimated return flow rate of 0.11 AFY per unit (Tetra Tech, 2010). This was then scaled through time using a compilation of census data for nearby communities.

The water used within the service areas of ID No. 1 and the City of Solvang are derived in part from native and imported surface water sources (Section 3.3.2.1.5) and from groundwater pumped from upland wells completed in the Paso Robles Formation and Careaga Sand. Water for ID No. 1 from imported and native surface water sources is commingled with Santa Ynez Uplands groundwater within its distribution system and used throughout the ID No. 1 service area for agricultural, potable domestic, commercial, and institutional uses. On average, ID No. 1 delivered a total of 2,587 AFY for non-agricultural uses of which 1,117 AFY of water was delivered from imported (SWP, Exchange and Table A) and another 539 AFY of which was from surface water sources. The remainder of 931 AFY the water was delivered from groundwater pumped from the Santa Ynez Uplands groundwater sources.

A portion of the water from these sources is used for exterior landscaping on domestic parcels (60 to 65 percent on average) and a portion of which is used for indoor use (35 to 40 percent)[9]. Where the indoor water use is not located within a sewered area, the indoor water is delivered to septic systems, the vast majority of which ultimately percolates to groundwater. Assuming a wastewater generation rate of 0.4 AFY per dwelling unit, a total 900 AFY of septic system percolation flows returned to the groundwater basin on average during the historical period.

These groundwater recharge components were estimated based primarily on published values for municipal water and wastewater deliveries, estimated return flow rates, and indoor and outdoor water use proportions. The level of uncertainty of these data are considered moderate because they are estimated from published literature and not measured; however, this component of the water budget is relatively small compared to the rest of the area and so will not have a significant effect on the GSAs ability to manage the basin.

3.3.2.3 Surface Water Outflow Components

The data sources used for surface water outflows are described below.

3.3.2.3.1. Santa Ynez River Outflow

Santa Ynez River surface water outflows were quantified based on gaged flow as measured near Solvang and from Zaca Creek from a gauge near the intersection of Highways 154 and 101. The location of the streamflow gauges is shown on Figure 2-11.

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[9] 1992 Stetson *Water Resources Management Plan* for the Santa Ynez River Water Conservation District.

The Santa Ynez River is accurately gauged and, therefore, the level of uncertainty of this data is low.

3.3.2.3.2. Subsurface Outflow

Subsurface outflow from the Santa Ynez River is accounted for in the water budget as surface water outflows. This outflow occurs at the downstream end of the EMA along the border with the CMA. The magnitude of this flow has been calculated using Darcy's law with estimated values for hydraulic conductivity, the average hydraulic gradient, and the outflow plane cross-sectional area (based on saturated thickness estimates). This estimate was made in coordination with Stetson Engineers for the downstream CMA, which accounts for this same volume of outflow as inflow into the CMA. Furthermore, these flow volumes have been verified by the numerical groundwater models being created separately for the CMA and EMA.

The quantity of subsurface outflow through Santa Ynez River alluvium was estimated using industry standard methods and a calibrated surface water model prepared by Stetson Engineers. The level of uncertainty of this water budget term is considered low.

3.3.2.3.3. Pumping Extractions

Pumping extractions occur from the Santa Ynez River Alluvium for municipal, industrial, and agricultural uses, including water used for urban landscape irrigation. Pumping data from this area of the EMA are provided by the City of Solvang, ID No. 1, and from SYRWCD as "self-reported" pumping data from landowners within the District. These data from ID No. 1 and the other self-reported pumping records lump uses together into three categories: (1) agricultural; (2) "other" water, which includes municipal, industrial, small public water systems, and domestic use; and (3) "special" irrigation water, which refers to urban landscape and golf course irrigation. These pumping volumes have been compiled on a water year basis and are reported annually on a calendar year basis in SYRWCD's annual reports, which have been prepared for 42 years. These data include all of the agricultural and non-agricultural groundwater pumping that occurs within the SYRWCD. ID No. 1 and the City of Solvang produce surface water from the underflow of the Santa Ynez River main stem pursuant to a pending permit (City of Solvang) and licenses (ID No. 1) issued by the SWRCB.

Pumping volumes provided by the City of Solvang and ID No. 1 are from metered pumping and are considered highly reliable. Likewise, some of the self-reported pumping data provided by SYRWCD annual reports are also from metered pumping records. These data sets have low uncertainty. A large portion of the self-reported SYRWCD pumping data outside of the municipal providers is estimated from self-reported records utilizing crop specific water duty factors. Pumping estimates based on self-reported records is of medium quality with moderate uncertainty due to the uncertainty of standardized crop water duty factors and reliability of self-reporting.

3.3.2.3.4. Phreatophyte ET

Phreatophyte ET, also referred to as riparian ET, was calculated using the LandFire Existing Vegetation Type (EVT) spatial data set[10] to determine acreages of riparian vegetation types occurring within the Santa Ynez River Alluvium portion of the EMA between the base of Bradbury Dam, through the EMA to the shared border with the CMA near the City of Solvang. The LandFire EVT data set was constrained to the lateral extent of SYRWCD's Zone A to avoid including acreage on adjacent hillsides and riparian vegetation within the tributaries that are part of the groundwater budget, which is accounted for there as a groundwater outflow component. Because flows within the Santa Ynez River are carefully managed and subject to the conditions

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[10] LandFire is a shared program between the wildland fire management programs of the U.S. Department of Agriculture Forest Service and U.S. Department of the Interior, providing landscape scale geo-spatial products to support cross-boundary planning, management, and operations (https://landfire.gov).

of the 2020 Biological Assessment, the National Marine Fisheries Service Biological Opinion, and SWRCB's 2019 Cachuma Project Order, it is assumed that the riparian acreage in the EMA did not change significantly during the historical period.

The riparian acreage determined from the LandFire EVT analysis was then multiplied by a variable riparian water duty factor (determined by the LandFire EVT), which varied based on water year type. The riparian water duty factor used in the water budget is 4.5 AF per acre per year, on average. Phreatophyte ET is a major component of surface water outflow and thought to decrease surface water flow in the tributary alluvium and reduce infiltration into the upland groundwater basin.

The acreage and water use factors utilized to estimate phreatophytes extractions are based on authoritative sources. The acreage, however, has been collected by remote-sensing methods and has not been field-verified to confirm the presence of the indicated plants. In addition, there is considerable uncertainty associated with the phreatophyte ET because this term is not directly measured and there is likely to be considerable variability. Therefore, the uncertainty associated with this data source is considered to be high.

3.3.2.4 Groundwater Outflow Components

The data sources used for groundwater outflows are described below.

3.3.2.4.1. Agricultural Irrigation Pumping

To satisfy the crop irrigation demand, groundwater is pumped and subsequently applied to the cropped land throughout the Santa Ynez Uplands portion of the EMA. The bulk of water used to irrigate crops in the EMA is sourced by pumping groundwater from the Santa Ynez Uplands. To a lesser degree, imported and native surface water is applied for agricultural irrigation purposes within the service area of ID No. 1, which overlaps and is within the boundaries of SYRWCD. Within its system, water from imported and native surface water is commingled with pumped groundwater from wells located in the Santa Ynez Uplands.

In the absence of metered pumping records, individual groundwater pumpers located within the SYRWCD boundaries area are required to self-report to SYRWCD their estimated pumping volumes for each 6-month period. These estimates are based on planted acreages and crop-specific water duty factors specified in SYRWCD's *Groundwater Production Information and Instructions* pamphlet (SYRWCD, 2010). The groundwater users specify which type of water they are using (agricultural, special [parks, schools, and golf courses], or other [municipal and industrial]). The self-reported agricultural irrigation volumes, categorized as Agricultural Water, were provided by SYRWCD for inclusion in the water budget.

Groundwater produced by ID No. 1 and the City of Solvang, which is reported to SYRWCD, is based on metered production.

For areas of the EMA outside of the SYRWCD boundaries area (the SGMA-designated "white area"[11] shown on Figure 2-4), agricultural pumping is not metered or reported. Therefore, the agricultural irrigation pumping was estimated using periodic land use surveys provided by DWR to determine crop types and acreages and then applying the same crop-specific water duty factors specified in the SYRWCD pamphlet. The land use surveys for the EMA were available for the periods 1985, 1996, 2014, 2016, and 2018 from DWR-provided sources, as well as a land and water use analysis for the area prepared by Dudek Consultants for Santa Barbara County (Dudek, 2016).

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[11] "White areas" under SGMA refer to areas that are not served by a water district and which depend solely on groundwater supplies.

The spatial distribution of six main crop groups for the four land use survey periods between 1985 and 2014 are presented as Figure 3-43 through Figure 3-46. The crops presented on these maps are combined into six groups: deciduous fruit and nuts; field crops; ornamentals; pasture; truck, nursery, and berry crops; and vineyards, A summary of the total area of irrigated crops in the past 20 years within the Santa Ynez Uplands (outside of the SYRWCD) are presented on Table 3-4.

Table 3-4. Summary of Irrigated Acres Outside of Santa Ynez River Water Conservation District
(Values in acres)

Crop Group	1996	2014	2016	2018
Deciduous Fruit and Nuts	37	93	93	74
Field Crops	267	273	812	1,090
Ornamentals	5	29	21	3
Pasture	1,350	839	858	747
Truck, Nursery, And Berry Crops	141	714	675	498
Vineyards	944	1,804	1,932	1,828
Cannabis	0	0	0	0
Total	**2,743**	**3,752**	**4,390**	**4,241**

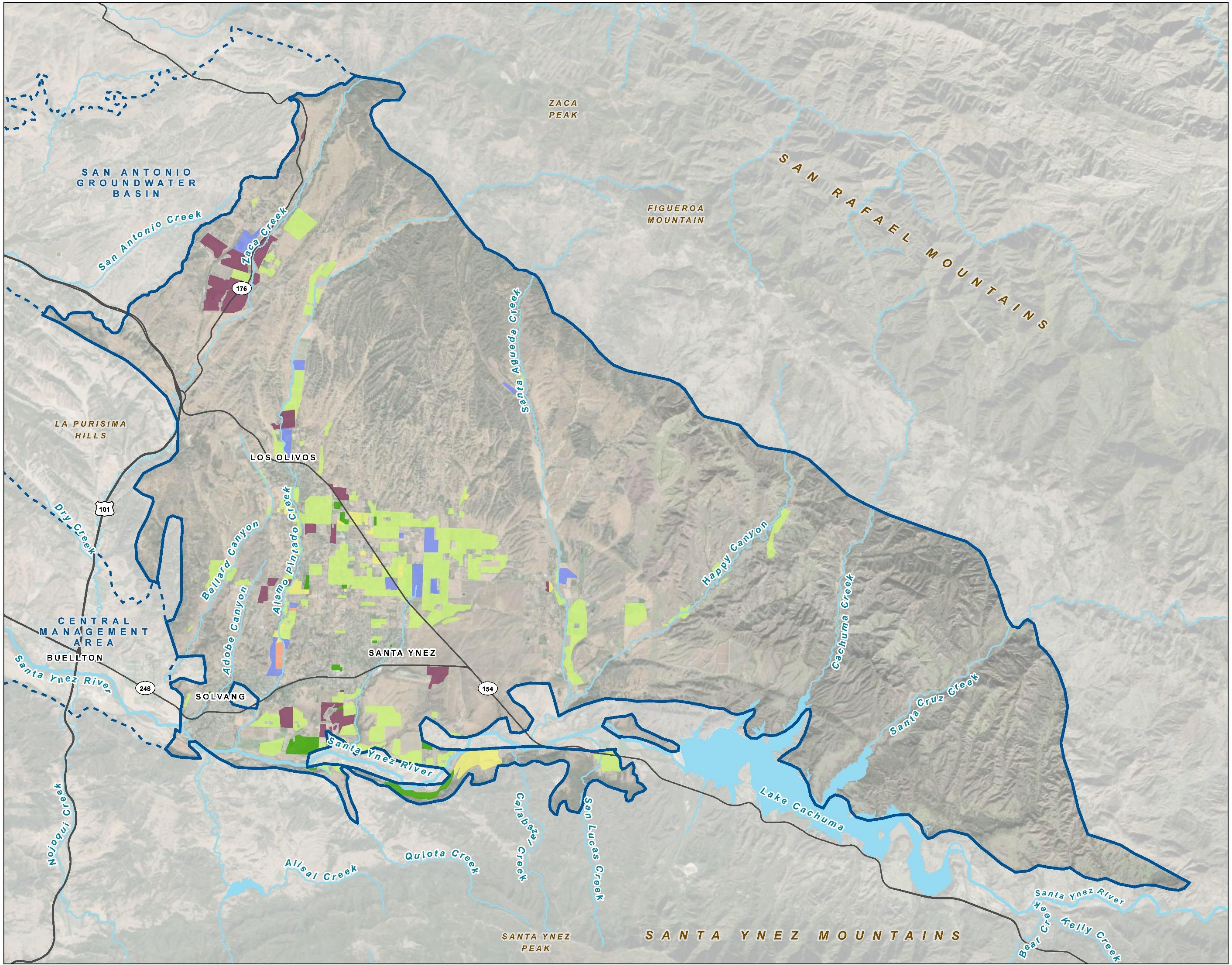
The total irrigated area outside of the SYRWCD was 4,241 acres in 2018, the period of the most recent land use survey. In the 22 years between 1996 and 2018, a total of 1,678 acres of irrigated acres were added within the EMA area outside of the SYRWCD boundaries. As of 2018, a total of 1,828 acres of vineyards were planted. While a further discussion of the projected trends in irrigated acreages is included in the Projected Water Budget Section 3.3.5, a brief discussion of the trends in individual crops is also warranted here. The expansion of vineyard acreage has slowed considerably in recent years, compared to the rapid growth that occurred between during the late 1990s and early 2000s. Between 1996 and 2014, vineyards were growing at an average rate of approximately 3.7 percent per year, which since 2014 has moderated to near zero growth.

The acreages of the crop groups presented on Table 3-4 show significant variability and slight reduction in acreages in the most recent years. While deciduous fruit and nuts, as well as ornamentals were relatively unchanged, field crops experienced a large increase in recent years, which added an average of 28 acres per year since 1996. Meanwhile, the acreage of truck, nursery, as well as pasture land, have declined significantly, as shown on Figures 3-43 through 3-47. Truck, nursery, and berry crops increased from 171 acres in 1996 to 714 acres in 2014, which has since declined significantly, losing over 50 acres per year on average. The acreage of pasture has likewise declined, declining by approximately 23 acres per year on average since 2014 (Figure 3-45).

FIGURE 3-43

Crop Distribution 1985

Groundwater Sustainability Plan
Eastern Management Area



LEGEND

▭ Eastern Management Area Basin Boundary

Crop Type

- 🟩 Field Crops
- 🟩 Pasture
- 🟨 Deciduous Fruit and Nuts
- 🟧 Ornamentals
- 🟦 Truck, Nursery, and Berry Crops
- 🟪 Vineyards

All Other Features

- Major Road
- Watercourse
- Waterbody

N

0 5,000 10,000 15,000
Feet

GSI Water Solutions, Inc.

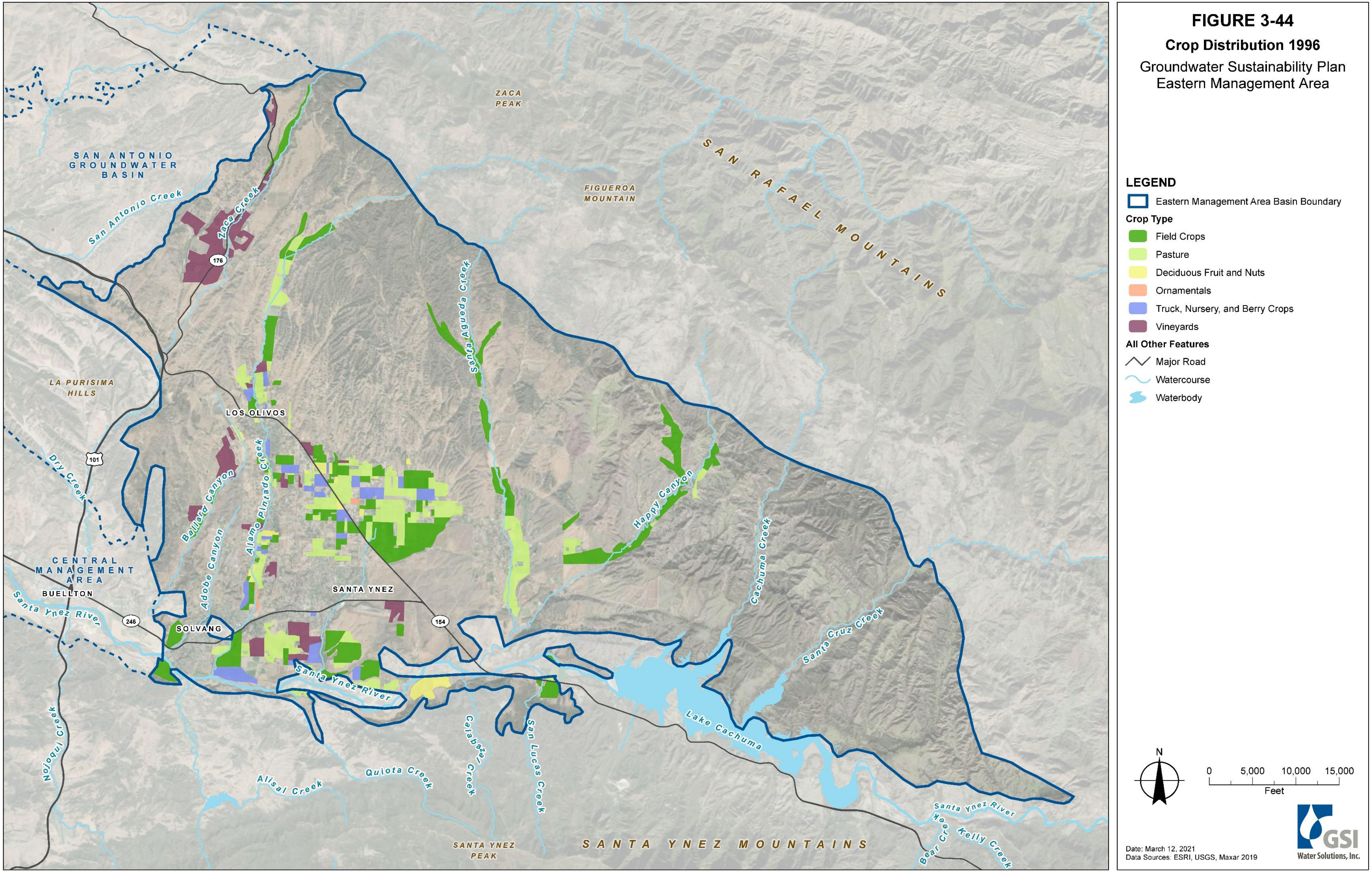
Date: March 12, 2021
Data Sources: ESRI, USGS, Maxar 2019, DWR

Document Path: Y:\0738_SB_County\Source_Figures\002_HydroStudy\EMA_WaterBudget\Figure3-43_Crop_Dist_1985.mxd, TNicely

FIGURE 3-44

Crop Distribution 1996

Groundwater Sustainability Plan
Eastern Management Area



Date: March 12, 2021
Data Sources: ESRI, USGS, Maxar 2019

Document Path: Y:\0738_SB_County\Source_Figures\002_HydroStudy\EMA_WaterBudget\Figure3-44_Crop_Dist_1996.mxd, TNicely

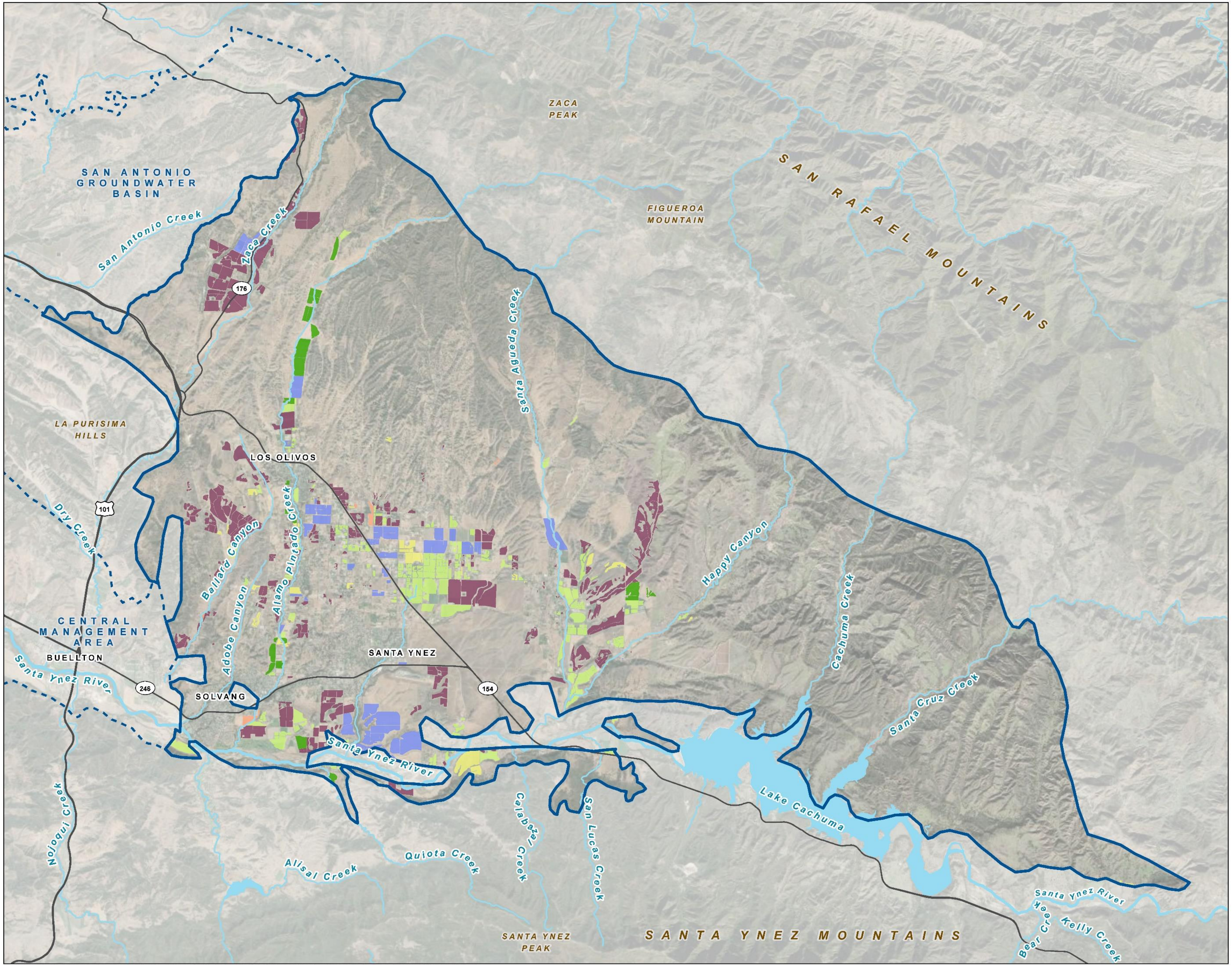


FIGURE 3-45

Crop Distribution 2014

Groundwater Sustainability Plan
Eastern Management Area

LEGEND

▢ Eastern Management Area Basin Boundary

Crop Type

- 🟩 Field Crops
- 🟩 Pasture
- 🟨 Deciduous Fruit and Nuts
- 🟧 Ornamentals
- 🟦 Truck, Nursery, and Berry Crops
- 🟪 Vineyards

All Other Features

- ╱╲ Major Road
- ∿ Watercourse
- ▬ Waterbody

Date: March 12, 2021
Data Sources: ESRI, USGS, Maxar 2019

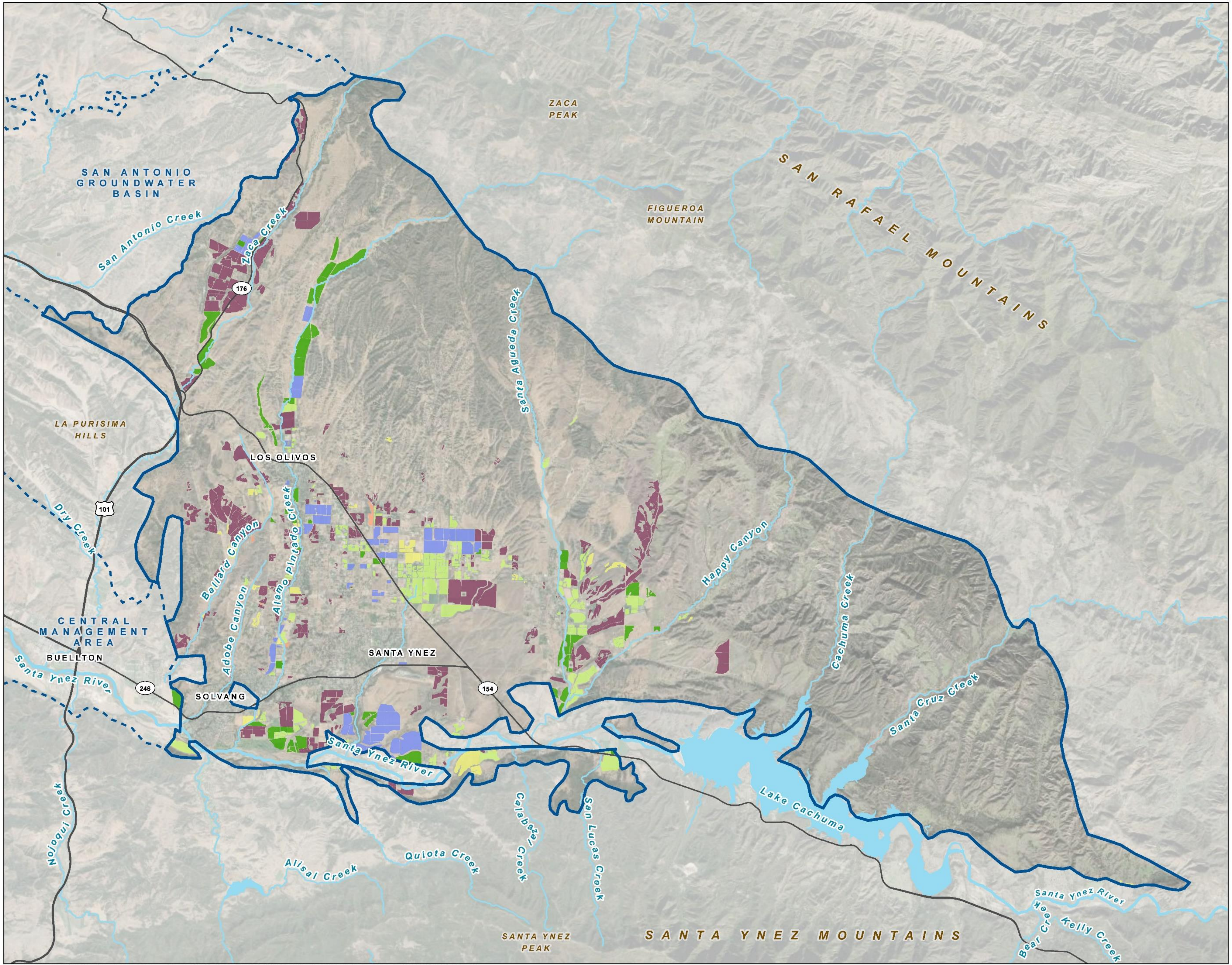
GSI Water Solutions, Inc.

Document Path: Y:\0738_SB_County\Source_Figures\002_HydroStudy\EMA_WaterBudget\Figure3-45_Crop_Dist_2014.mxd, TNicely

FIGURE 3-46

Crop Distribution 2016

Groundwater Sustainability Plan
Eastern Management Area



LEGEND

▭ Eastern Management Area Basin Boundary

Crop Type

- 🟩 Field Crops
- 🟩 Pasture
- 🟨 Deciduous Fruit and Nuts
- 🟧 Ornamentals
- 🟦 Truck, Nursery, and Berry Crops
- 🟪 Vineyards

All Other Features

- Major Road
- Watercourse
- Waterbody

N

0 5,000 10,000 15,000
Feet

Date: March 12, 2021
Data Sources: ESRI, USGS, Maxar 2019

GSI Water Solutions, Inc.

Document Path: Y:\0738_SB_County\Source_Figures\002_HydroStudy\EMA_WaterBudget\Figure3-46_Crop_Dist_2016.mxd, TNicely

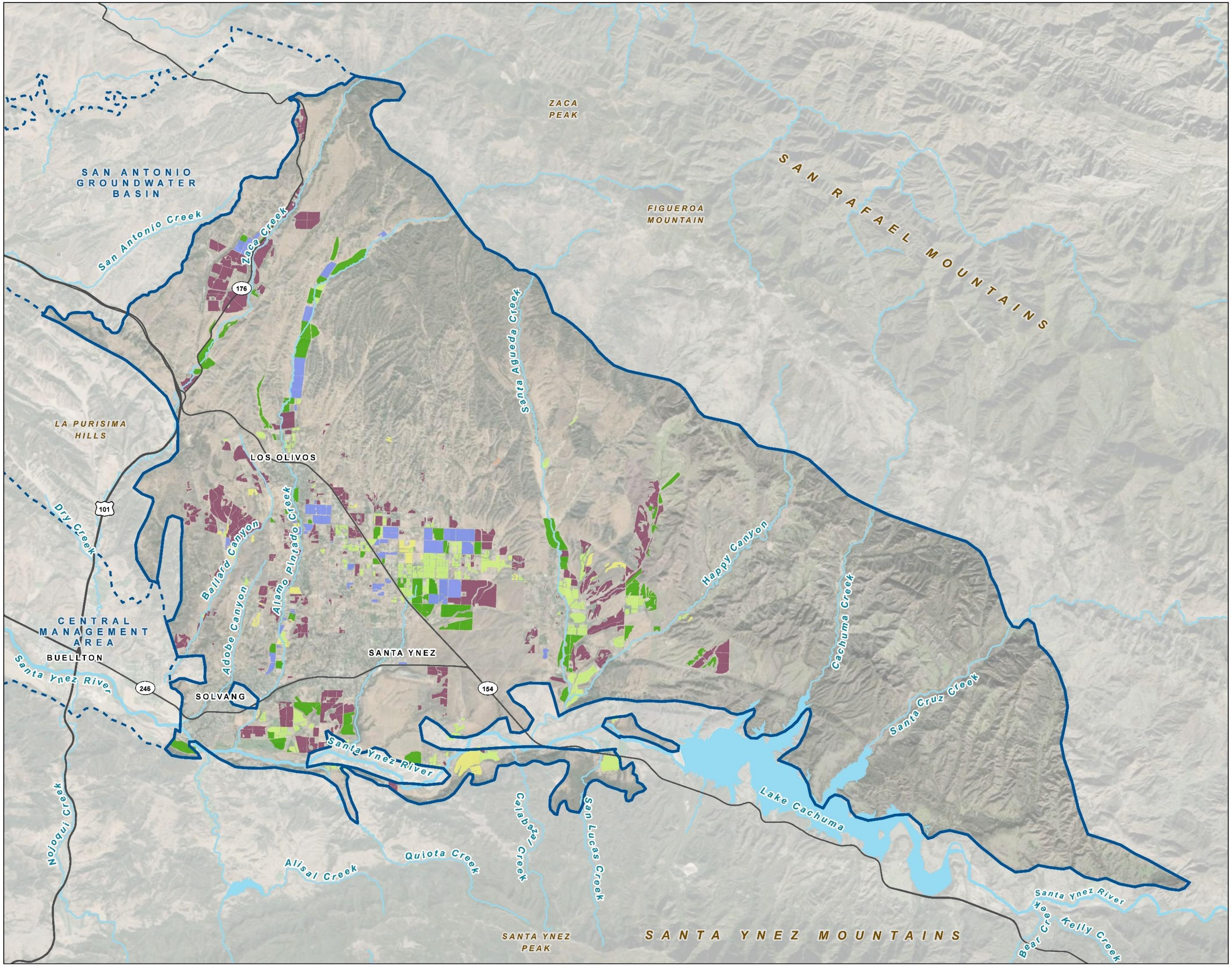


FIGURE 3-47

Crop Distribution 2018

Groundwater Sustainability Plan
Eastern Management Area

LEGEND

- ▭ Eastern Management Area Basin Boundary

Crop Type

- 🟩 Field Crops
- 🟩 Pasture
- 🟨 Deciduous Fruit and Nuts
- 🟧 Ornamentals
- 🟦 Truck, Nursery, and Berry Crops
- 🟪 Vineyards

All Other Features

- Major Road
- Watercourse
- Waterbody

N

0 5,000 10,000 15,000
Feet

Date: April 2, 2021
Data Sources: ESRI, USGS, Maxar 2019

GSI Water Solutions, Inc.

Document Path: Y:\0738_SB_County\Source_Figures\002_HydroStudy\EMA_WaterBudget\Figure3-47_Crop_Dist_2018.mxd, TNicely

The land use surveys provide estimates of irrigated crop acreages, crop evapotranspiration (ETc), evapotranspiration of applied water (ETAW), effective precipitation (EP), and applied water (AW) for 20 crop categories each year the survey was performed. These values are estimated from reference evapotranspiration (ETo) or pan evaporation data (Ep), crop development over time (crop coefficients), soil characteristics, rooting depths, and the quantity and timing of precipitation. ETAW estimates include adjustments for irrigation efficiencies as well as the amount of water required for specific agricultural practices, such as the ponding of water in rice fields or extra water applied to leach accumulated salts from the soil. Spatial-temporal interpolations were made between the land use surveys for the intervening years.

The 2014, 2016 and 2018 land use data, prepared by Land IQ and provided to DWR, are the most recent data sets pertaining to the historical and current water budget time periods. For these recent years, the data represent a statewide, comprehensive, field-scale assessment of agricultural land use, as well as urban and managed wetland boundaries. The data were delineated from imagery provided by the National Agriculture Imagery Program.[12] The data are derived from a combination of remote sensing, agronomic analysis, and ground verification. The data set provides information for resource planning and assessments across multiple agencies throughout the state and serves as a consistent base layer for a broad array of potential users and multiple end uses.

While the accuracy of the land use mapping of irrigated crops for the recent years is high, uncertainty remains in the estimates of water use from these irrigated lands and hence the assumed amount of pumping needed to meet the crop water requirement. The volume of groundwater pumping needed to satisfy these agricultural crop water demands are presented below.

3.3.2.4.2. Municipal and Other Reported Pumping

Groundwater pumping in the Santa Ynez Uplands serves municipal, industrial, and agricultural uses, including urban landscape irrigation. Pumping data were provided by the City of Solvang, ID No. 1, and the SYRWCD (as self-reported pumping data). The City of Solvang provides water only for municipal and potable uses. The SYRWCD, summarizes pumping within their boundaries into three categories: (1) agricultural; (2) "other" water, which includes municipal, industrial, small public water systems, and domestic use; and (3) "special" irrigation water, which refers to urban landscape (parks, schools, golf course) irrigation. These pumping volumes have been compiled on a water year basis from data reported annually on a calendar year basis in SYRWCD's annual reports, which have been prepared for 42 years. These data include all of the agricultural and non-agricultural (other and special) groundwater pumping that occurs within the SYRWCD. Pumping from all of Zone E (Santa Ynez Uplands) and the portion of Zone C (Other Areas) that are within the EMA are derived from the two principal aquifers: the Paso Robles Formation and the Careaga Sand.

Pumping volumes from the City of Solvang and ID No. 1 are from metered pumping and are considered highly reliable. Likewise, some of the self-reported pumping data provided by SYRWCD annual reports to estimate this use are also from metered pumping records. A large portion of the self-reported SYRWCD pumping data outside of the municipal providers is estimated from self-reported acreage of irrigated crops multiplied by District-provided water use factors. The data derived from the metered pumpers are considered to be of very high quality with a low level of uncertainty. However, the water use estimates based on self-reported acreage for irrigated crops is of medium quality with moderate uncertainty due to the uncertainty of standardized crop water duty factors and reliability of self-reporting. In addition, there is uncertainty about whether the crop water duty factors should be adjusted downward during periods of above-normal rainfall.

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[12] Data are available at https://www.fsa.usda.gov/programs-and-services/aerial-photography/imagery-programs/naip-imagery/. (Accessed February 15, 2021.)

3.3.2.4.3. Rural Domestic Pumping (Outside of SYRWCD)

Rural domestic pumping is considered to be all non-agricultural pumping that occurs outside of SYRWCD that is not associated with a small public water system. This area includes all of the rural areas of the EMA that are not served by a water district or mutual water company and are solely reliant on groundwater supplies. These areas constitute unincorporated lands outside of the SYRWCD, ID No. 1, and the City of Solvang boundaries, where all groundwater pumping is considered rural domestic. This area (Figure 2-4) is not within the boundaries of any water agency and therefore falls under the jurisdiction of Santa Barbara County. Rural domestic pumping was estimated based on a review of the potential rural domestic parcels outside of SYRWCD from 2018 satellite imagery and parcel data provided by the County of Santa Barbara.[13] The domestic water demand for each of these land parcels was estimated using variable demand factors based on parcel acreage, as estimated by Tetra Tech (Tetra Tech, 2010) (see Table 3-5). The calculated 2018 rural domestic demand was then scaled through time for other years included in the water budget using a compilation of census data for nearby communities.

Table 3-5. Rural Domestic Demand Factors Based on Lot Size

Lot Size (Acres)	Annual Water Use (AFY per lot)
0.16	0.14
0.5	0.52
1	0.82
5	0.98
10	1.15

Note

Source: Tetra Tech (2010)

While the accuracy of the rural domestic pumping is roughly estimated, the overall magnitude of this pumping is small. Therefore, the relatively moderate uncertainty does not adversely affect the GSA's ability to sustainably manage the groundwater resource.

3.3.2.4.4. Small Public Water Systems Pumping (Outside of SYRWCD)

Reported pumping data was compiled from California Drinking Water Information Clearinghouse[14] for a limited number of years for most of the small public water systems within the EMA. These small water systems located outside of SYRWCD are listed on Table 3-6.. Small public water systems production volumes reported for 2018 were scaled through time using a compilation of census data for nearby communities. While additional small water systems have been identified in the EMA, the systems listed in Table 3-5 are those for which production data were available.

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[13] Data are available at https://countyofsb.org/mapping.sbc. (Accessed March 12, 2021.)

[14] Available at https://drinc.ca.gov/drinc/. (Accessed February 15, 2021.)

Table 3-6. Small Public Water Systems Outside of SYRWCD

Small Public Water System Name
Midland School Corporation
Oak Trail Estates Mutual Water Company
Oak Trail Ranch Mutual Water Company
Rancho Ynecita Mutual Water Company
Santa Ynez Rancho Estates Mutual Water Company
Woodstock Property Owners Association
Cachuma Village
Bridlewood Winery
San Lorenzo Seminary

The estimates of small public water system pumping is roughly estimated. Because the overall magnitude of this pumping is small, the relatively moderate uncertainty does not adversely affect the GSA's ability to sustainably manage the groundwater resource.

3.3.2.4.5. Phreatophyte ET

Phreatophyte ET outflow from the underlying groundwater within the Santa Ynez Uplands was calculated using the LandFire EVT spatial data set to determine acreages of riparian vegetation types occurring within the EMA. The LandFire EVT data set was constrained to the extent of the tributary (younger) alluvium located outside of the main stem of the Santa Ynez River. It is assumed that the riparian acreage in the EMA did not change significantly and therefore was kept constant for the historical period. The riparian acreage determined from the LandFire EVT analysis was multiplied by a variable riparian water duty factor determined by the LandFire EVT, which varied based on water year type. The riparian water duty factor used in the water budget is 4.5 AF per acre per year, on average. Phreatophyte ET is a major component of outflow from the tributary alluvium and is thought to decrease infiltration and reduce groundwater recharge.

The acreage and water use factors utilized to estimate phreatophytes extractions are based on authoritative sources. The acreage, however, has been collected by remote-sensing methods and has not been field-verified to confirm the presence of the indicated plants. In addition, there is considerable uncertainty associated with the phreatophyte ET because this term is not directly measured and there is likely to be considerable variability. Therefore, the uncertainty associated with this data source is considered to be high.

3.3.2.4.6. Subsurface Groundwater Outflow

A relatively small volume of subsurface groundwater outflow occurs to the west through the shallow alluvial canyons along Ballard Canyon, near the Purisima Hill and through the alluvium of Zaca Creek. For the annual water budget, the magnitude of this flow has been calculated using Darcy's law with estimated values for hydraulic conductivity, the average hydraulic gradient, and the outflow plane cross-sectional area (based on saturated thickness estimates). This estimate was made in coordination with Stetson Engineers for the downstream CMA. Ultimately, these values have been verified by the numerical groundwater model.

Limited groundwater level data and numerical modeling results indicate that neither subsurface inflow nor outflow occurs along the shared boundary with the San Antonio Creek Valley Groundwater Basin on the northwest boundary of the EMA. The USGS is developing a groundwater flow model for the San Antonio Creek Basin and has characterized this boundary as a no-flow boundary. This boundary has also been investigated by Santa Barbara County using aerial electromagnetic geophysical methods (SkyTEM); however, the results of this work are not yet available. If additional information indicates that the possibility exists for there to be communication between the basins, then the water budget and groundwater model will be updated accordingly.

The quantity of subsurface outflow through shallow alluvial canyons was estimated using industry standard methods and terms associated with the calibrated surface water model prepared by Stetson Engineers. The level of uncertainty of this water budget term is considered low and is not considered a substantial part of the water budget that affects management of the basin. .

3.3.3 Historical Water Budget (Water Years 1982 through 2018)

§354.18 Water Budget.

(c) Each Plan shall quantify the current, historical, and projected water budget for the basin as follows:

(2) Historical water budget information shall be used to evaluate availability or reliability of past surface water supply deliveries and aquifer response to water supply and demand trends relative to water year type. The historical water budget shall include the following:

(A) A quantitative evaluation of the availability or reliability of historical surface water supply deliveries as a function of the historical planned versus actual annual surface water deliveries, by surface water source and water year type, and based on the most recent ten years of surface water supply information.

(B) A quantitative assessment of the historical water budget, starting with the most recently available information and extending back a minimum of 10 years, or as is sufficient to calibrate and reduce the uncertainty of the tools and methods used to estimate and project future water budget information and future aquifer response to proposed sustainable groundwater management practices over the planning and implementation horizon.

(C) A description of how historical conditions concerning hydrology, water demand, and surface water supply availability or reliability have impacted the ability of the Agency to operate the basin within sustainable yield. Basin hydrology may be characterized and evaluated using water year type.

The SGMA regulations require that a historical water budget be based on at least the most recent 10 years of data. The period for water years 1982 through 2018 was selected as the historical water budget period because it is long enough to capture typical climate variations (with two wet and two dry hydrologic cycles) and includes recent changes in imported water supply availability, changes to water demand associated with cropping patterns, and associated land use.

Estimates and assumptions of the surface water and groundwater inflows and outflows and changes in total water and groundwater in storage for the historical period are provided below.

3.3.3.1 Surface Water Inflows

3.3.3.1.1. Local Surface Water Inflow

Local surface water inflows include (1) surface water flows that enter the EMA from precipitation runoff within the watershed and (2) Santa Ynez River inflow to the EMA, regulated by SWRCB as release outflows from Lake Cachuma. Also included in the local surface water inflow totals is water delivered from the Cachuma Project directly to ID No. 1 via pipeline prior to 1997. Prior to 1997, ID No. 1 received an average of 2,200 AFY from the Cachuma Project. As noted in the next section, Cachuma Project deliveries to ID No. 1 after 1997 are derived from imported SWP supplies under the Exchange Agreement. The Cachuma Project deliveries after 1997 are similar volumes to those prior to 1997 (2,500 AFY).

The estimated average annual total inflow from these sources, including surface flows, over the historical period is about 93,000 AFY. The largest component of this average inflow is due to releases from Bradbury Dam and subsequent flow in the Santa Ynez River. The surface water flow into the EMA during this historical period averaged 60,800 AFY as measured from Bradbury Dam outflow. This outflow into the Santa Ynez River below the dam is a combination of volumes released through the Bradbury Dam outlet works, the Hilton Creek Watering System, and occasional releases over the dam spillway. A more complete discussion of the outflow from Bradbury Dam is presented in Section 3.1.1.3.

The annual average, minimum, and maximum volumes of local surface water sources (natural and imported) during the historical period of 1982 through 2018 are presented on Table 3-7. The large difference between the minimum and maximum inflows reflects the climatic variability and the difference between dry and wet years in the EMA and contributing watershed.

3.3.3.1.2. Imported Surface Water from State Water Project

As described in Section 3.3.3.1.1, imported surface water through the SWP became available after completion of the Coastal Branch pipeline in 1997. As a member agency of the CCWA, ID No. 1 has an annual contractual SWP Table A allocation of 2,000 AFY and a drought buffer of 200 AFY. Of this total, 1,500 AFY per year are contractually committed for use by the City of Solvang. The annual amount of SWP Table A supplies available to ID No. 1 (and Solvang) depends on the yearly SWP allocation issued by DWR.

Separate from the SWP Table A supplies utilized by ID No. 1 and the City of Solvang, additional SWP supplies are used by ID No. 1 pursuant to the Exchange Agreement between ID No. 1 and the South Coast Cachuma Project Member Units (SYRWCD and SYRWCD ID No. 1, 1993). Prior to the SWP coming online, ID No. 1 received its Cachuma Project supplies by direct delivery via the Santa Ynez Valley pipeline. Between 1982 and 1997, this averaged 2,223 AFY.

Since completion of the SWP Coastal Branch in 1997, ID No. 1 has been receiving its Cachuma Project supplies in accordance with the Exchange Agreement whereby the South Coast Cachuma Member Units take ID No. 1's portion of Cachuma Project water and ID No. 1 takes an equivalent amount of SWP water at the ID No. 1 turnout. Under a full allocation of Cachuma Project supplies, ID No. 1's 10.31 percent share is 2,651 AFY. Based on Cachuma Project allocations during the period 1998 through 2018 period, approximately 2,100 AFY on average has been delivered to ID No. 1 in the form of exchanged SWP deliveries.

Imported surface water from the SWP has been utilized at times as supplemental water supply, in lieu of groundwater pumping, for domestic and agricultural purposes. The annual average, minimum, and maximum volumes of imported SWP water during the historical period are presented in Table 3-7. The imported water supply provides approximately 4.6 percent of the total volume of surface water that enters the EMA. Natural inflow from tributaries from the Santa Ynez Uplands and the Santa Ynez Mountains contributes 29 percent of the total surface water inflow.

Table 3-7. Annual Surface Water Inflow, Historical Period (1982 through 2018)

(Values in acre-feet per year)

Surface Water Inflow Component	Average	Minimum[1]	Maximum[1]
Santa Ynez River Inflow	61,600	3,100	397,600
Santa Ynez River Tributary Inflow[2]	27,000	1,000	147,800
Mountain Front Recharge	4,200	0	10,200
Precipitation Recharge	200	0	800
Septic Return Flow	10	10	10
Agriculture Irrigation Return Flows	70	40	110
Cachuma Project (Imported)[3]	960	0	5,050
SWP Exchange (Imported)[3]	1,230	0	3,240
SWP Table A (Imported)[4]	720	0	1,350
Local	**93,070**		
Imported	**2,910**		
Total	**95,980**		

Notes

[1] Minimum and maximum values are not totaled because the values for each component may have occurred in different years.

[2] Tributaries include Hilton, San Lucas, Calabazal, Alisal, Santa Agueda, Zanja de Cota, Alamo Pintado, and Zaca Creeks.

[3] Since 1998, ID No. 1 exchanged its Cachuma Project entitlement supplies for an equivalent amount of SWP water that is delivered to the ID No. 1 turnout, referred to as “SWP Exchange” water.

Cachuma average 1982 to 1997: 2,223 AFY.
Exchange average 1998 to 2018: 2,165 AFY.

[4] SWP Table A includes 426 AFY Table A water for Solvang and 291 AFY Table A water for ID No. 1.

SWP = State Water Project

3.3.3.2 Surface Water Outflows

The estimated annual average total historical surface water outflow from the EMA (as above ground and below ground flow) in the Santa Ynez River is summarized in Table 3-8.

Table 3-8. Annual Surface Water Outflow, Historical Period (1982 through 2018)

(Values in acre-feet per year)

Surface Water Outflow Component	Average	Minimum[1]	Maximum[1]
Santa Ynez River Outflow (including Zaca Creek)	85,700	600	655,500
Pumping (River Wells)	5,000	1,900	9,000
Subsurface Outflow	1,800	1,800	1,800
Phreatophyte Evapotranspiration	4,100	4,000	4,300
Total	**96,600**		

Note

[1] Minimum and maximum values are not totaled because the values for each component may have occurred in different years.

The estimated average annual total outflow from these surface water sources over the historical period is about 96,600 AFY. The largest component of this outflow is gaged surface flow within the Santa Ynez River near Solvang and flow through Zaca Creek near the intersection of Highways 101 and 154, which together total 89 percent of the total surface water outflow. The remainder of the surface water outflow, or 11 percent of the total, leaves the EMA through the Santa Ynez River Alluvium either as subsurface outflow near the City of Solvang; pumping by the City of Solvang, ID No. 1, and other users; or phreatophyte ET. The large difference between the minimum and maximum outflows reflects the difference between dry and wet years in the EMA and contributing watershed.

3.3.3.3 Groundwater Inflows and Outflows

During the historical period from water year 1982 through water year 2018, groundwater supplied a vast majority of the water used in the EMA from both of the two principal aquifers, which includes production from the Paso Robles Formation and the Careaga Sand. This section presents a summary of estimated groundwater inflows, groundwater outflows, and a change of groundwater in storage under historical conditions.

3.3.3.4 Groundwater Inflow

Groundwater inflow components include stream percolation, agricultural irrigation return flow, deep percolation of direct precipitation, subsurface groundwater inflow (including mountain front recharge), percolation of treated wastewater, and domestic/urban septic return flow. The annual groundwater inflows during the historical period are summarized in Table 3-9.

Table 3-9. Groundwater Inflow, Historical Period (1982 through 2018)

(Values in acre-feet per year)

Groundwater Inflow Component	Average	Minimum[1]	Maximum[1]
Deep Percolation of Direct Precipitation	11,300	100	25,500
Tributary Percolation	700	300	1,600
Subsurface Groundwater Inflow[2]	3,100	0	7,200
Agricultural Irrigation Return Flow	2,600	2,100	3,400
Domestic/Urban Irrigation Return Flow	130	10	260
Septic Return Flow	900	700	1,100
Wastewater Effluent Percolation	40	0	120
Total	**18,770**		

Notes

[1] Minimum and maximum values are not totaled because the values for each component may have occurred in different years.

[2] Subsurface Inflow includes mountain front recharge.

During the historical period, an average of 18,770 AFY of groundwater inflow occurred. During this time, the groundwater inflow ranged from 4,060 to 53,200 AFY. This large variation was due primarily to variations in precipitation over the historical period. The largest groundwater inflow component was percolation of direct precipitation, which accounts for approximately 60 percent of the total annual average inflow.

3.3.3.5 Groundwater Outflows

Groundwater outflow components include groundwater pumping from all water use sectors, subsurface groundwater outflow to tributaries and the adjacent management area, and phreatophyte ET. Groundwater discharges to surface water are included as discharges that ultimately flow to surface water in the Santa

Ynez River. This volume was estimated using the EMA numerical modeling in consultation with consultants within the adjacent management areas. The estimated annual groundwater outflows for the historical period are summarized in Table 3-10.

Table 3-10. Annual Groundwater Outflow, Historical Period (1982 through 2018)

(Values in acre-feet per year)

Groundwater Outflow Component	Average	Minimum[1]	Maximum[1]
Total Groundwater Pumping	14,700	13,280	16,680
Subsurface Groundwater Outflow	2,800	100	17,600
Phreatophyte Evapotranspiration	3,100	3,000	3,200
Total	**20,600**		

Note

[1] Minimum and maximum values are not totaled because the values for each component may have occurred in different years.

The estimated annual groundwater pumping by water use sector for the historical period is summarized in Table 3-11.

Table 3-11. Annual Groundwater Pumping by Water Use Sector, Historical Period (1982 through 2018)

(Values in acre-feet per year)

Water Use Sector	Average	Minimum[1]	Maximum[1]
Agricultural[2]	11,700	10,600	13,100
Municipal/Reported Domestic[3]	1,950	800	3,920
Rural Domestic[4]	300	200	300
Small Public Water Systems[4]	820	650	950
Total	**14,770**		

Notes

[1] Minimum and maximum values are not totaled because the values for each component may have occurred in different years.

[2] Includes all metered and estimated agricultural irrigation pumping, both inside and outside of the SYRWCD.

[3] Includes all metered and self-reported domestic pumping that occurs within the SYRWCD.

[4] Includes only pumping that occurs outside of the SYRWCD.

SYRWCD = Santa Ynez River Water Conservation District

Of all pumping, agricultural production was the largest component, followed by municipal production, accounting for about 79 percent and 13 percent of total pumping over the historical period, respectively. Agricultural pumping fluctuated over time, but only slightly increased overall during the historical period. Municipal pumping, which includes all metered domestic pumping that occurs within the SYRWCD area, generally increased through 1997 when imported SWP became available; the rate of pumping has since remained approximately constant. Rural-domestic and small water system pumping occurring outside of the SYRWCD account for 2 percent and 6 percent of total pumping, respectively, during the historical period.

3.3.3.6 Changes of Groundwater in Storage

Annual variations in the volumes of groundwater in storage were calculated for each year of the historical period. The changes of groundwater storage for the 37-year period were used to (1) evaluate conditions of water supply in storage, surplus, and/or deficiency and (2) identify long-term groundwater overdraft.

A summary of the average inflows and outflows associated with each component of the water budget within the EMA for the historical period are presented graphically on Figure 3-47. The average inflow of approximately 18,770 AFY is less than the average total outflow of 20,600 AFY. This indicates that on average, there has been a reduction of groundwater in storage with an average overdraft of 1,830 AFY over the historical period 1982 through 2018.

Average inflow and outflow components of the water budget are presented for each year of the historical period on Figure 3-48. Inflow components are shown above the zero line and outflow components are shown below the zero line. The figure also presents the cumulative change of groundwater in storage during each year and the overall historical period. Note that this section refers to changes of groundwater in storage, which not the same as “dewatered storage.” Increases of groundwater in storage indicate that more water is present in the ground, while increases in “dewatered storage,” used outside of the SGMA context, refers to a decrease of water present in the ground. The data are also presented on Table 3-12.

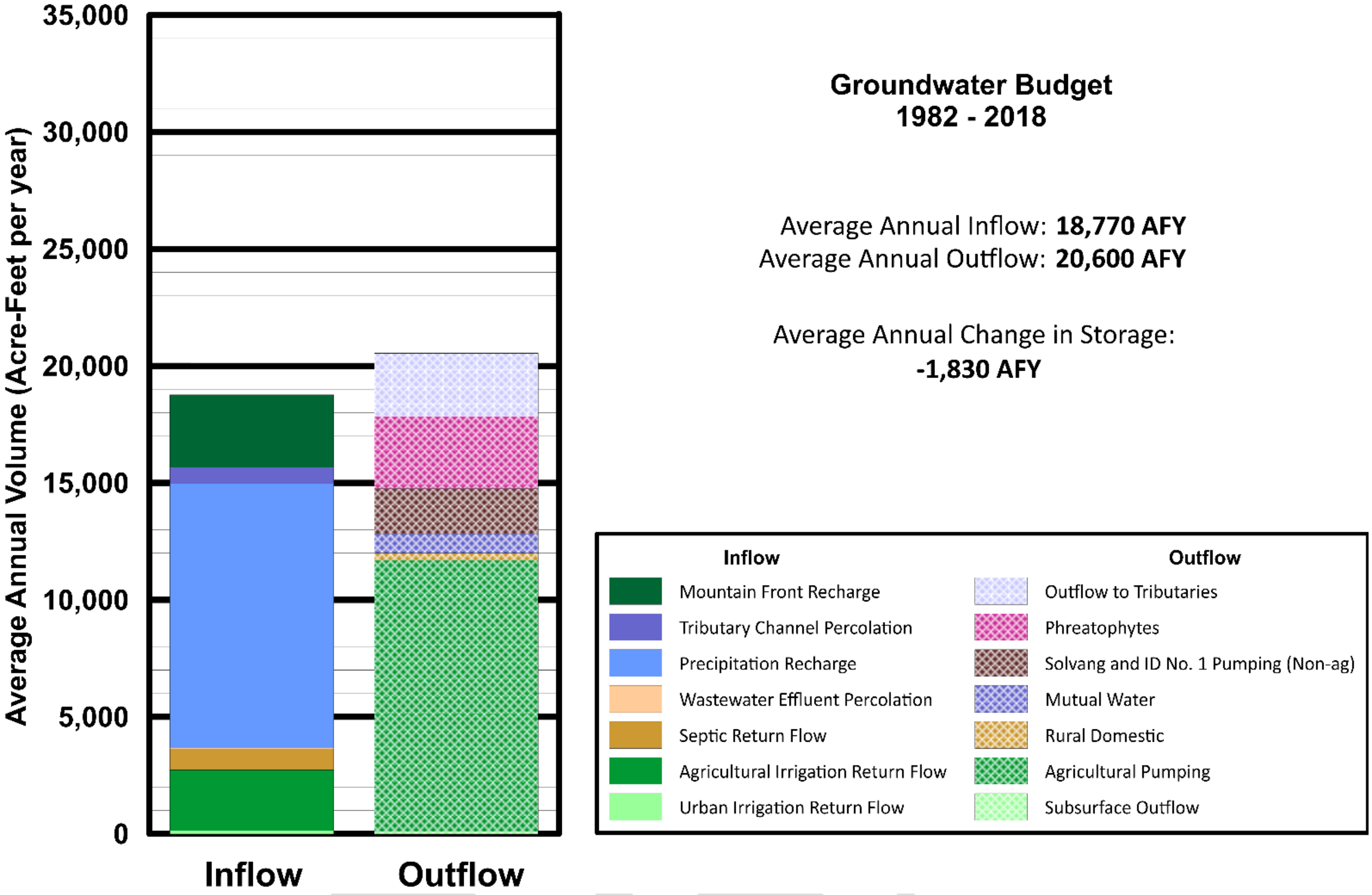


Figure 3-48. Average Groundwater Budget Volumes, Historical Period (1982 through 2018)

Table 3-12. Santa Ynez River Groundwater Basin Eastern Management Area Historical and Current Water Budget Summaries

Values in acre-feet

Water Budget	Water Year	Rainfall		Surface Water Inflow							Groundwater Inflow							Total Inflow
		Inches	% of Average	Santa Ynez River Inflow	Tributary Inflow	Mountain Front Recharge (River)	Precipitation Recharge	Ag Irrigation Return Flows	Imported	Septic Return Flows	Mountain Front Recharge	Tributary Percolation	Precipitation Recharge	Chumash WWTP Effluent	Septic Return Flows	Ag Irrigation Return Flows	Urban Irrigation Return Flows	
Historical	**1982**	15	92%	4,000	11,100	4,000	100	90	3,000	10	3,300	600	6,600	0	700	3,000	60	36,560
	1983	35	219%	366,200	147,800	8,700	800	70	1,500	10	7,000	700	41,900	0	700	2,800	60	578,240
	1984	7	46%	20,100	3,800	3,900	100	110	5,100	10	1,900	1,600	7,200	0	700	3,400	50	47,970
	1985	11	68%	5,400	2,100	400	0	90	2,700	10	700	300	1,400	0	800	3,200	20	17,120
	1986	17	106%	8,100	21,200	5,700	200	90	2,700	10	4,900	500	10,500	0	800	3,200	30	57,930
	1987	9	56%	4,200	1,700	500	0	100	3,800	10	700	800	2,500	0	800	3,300	40	18,450
	1988	17	105%	4,900	9,700	3,500	200	90	2,800	10	3,800	400	9,800	0	800	3,200	30	39,230
	1989	7	46%	6,700	1,300	500	0	80	2,800	10	400	800	1,200	0	900	2,900	50	17,640
	1990	6	40%	4,800	1,000	0	0	70	800	10	100	300	100	0	900	2,700	40	10,820
	1991	17	105%	5,600	21,000	3,200	100	90	1,700	10	3,100	300	5,500	0	900	3,000	30	44,530
	1992	25	155%	14,800	42,200	6,700	300	80	900	10	6,200	800	14,800	0	900	2,800	40	90,530
	1993	28	174%	284,000	74,400	8,800	500	70	2,000	10	7,200	1,100	27,200	0	900	2,700	10	408,890
	1994	14	84%	9,600	5,200	2,500	100	60	1,800	10	1,700	1,200	6,000	0	900	2,400	10	31,480
	1995	30	187%	360,200	117,200	9,500	500	50	100	10	4,500	600	26,700	0	900	2,300	10	522,570
	1996	12	76%	11,800	5,700	3,500	100	70	2,100	10	1,900	1,300	6,800	0	900	2,500	10	36,690
	1997	12	73%	15,700	13,000	5,800	200	60	2,000	10	5,600	500	11,200	0	900	2,400	10	57,380
	1998	36	226%	397,600	144,000	10,200	700	50	3,500	10	5,900	500	33,500	0	900	2,500	30	599,390
	1999	12	76%	3,100	7,100	3,300	200	70	4,000	10	2,200	1,600	8,700	0	900	2,800	120	34,100
	2000	15	95%	12,900	16,500	7,800	300	70	3,200	10	4,200	500	14,100	0	1,000	3,000	260	63,840
	2001	26	159%	117,900	59,900	8,400	500	70	2,700	10	6,300	700	25,800	0	1,000	2,900	240	226,420
	2002	8	49%	13,700	1,700	100	0	60	2,600	10	200	1,100	1,400	0	1,000	2,600	250	24,720
	2003	17	103%	4,700	14,100	6,900	300	70	5,000	20	4,600	300	12,700	120	1,000	2,700	260	52,770
	2004	10	64%	16,300	5,100	3,000	100	60	3,600	20	1,800	700	6,200	120	1,000	2,500	240	40,740
	2005	35	219%	266,500	108,900	9,600	700	50	4,600	20	6,900	500	34,900	120	1,000	2,400	240	436,430
	2006	18	109%	71,200	20,600	7,900	300	60	4,600	20	5,200	1,600	15,900	120	1,000	2,400	180	131,080
	2007	7	42%	14,300	1,000	0	0	60	4,300	20	0	800	800	120	1,000	2,400	200	25,000
	2008	16	98%	33,300	20,800	6,600	300	60	4,200	20	5,600	300	13,600	120	1,000	2,400	240	88,540
	2009	13	82%	8,700	4,300	900	100	50	3,100	20	1,200	700	3,400	120	1,000	2,300	260	26,150
	2010	21	132%	14,400	19,400	6,200	300	40	4,200	20	4,300	600	12,800	120	1,000	2,100	240	65,720
	2011	26	164%	93,700	54,100	8,900	600	40	5,000	20	7,000	900	30,000	110	1,000	2,100	170	203,640
	2012	12	74%	6,900	4,200	700	100	60	4,400	20	800	1,200	2,700	40	1,000	2,300	190	24,610
	2013	7	42%	16,600	1,600	600	0	60	3,500	20	400	500	700	40	1,000	2,400	210	27,630
	2014	8	49%	10,200	1,200	0	0	60	2,100	20	0	300	100	40	1,100	2,300	220	17,640
	2015	8	50%	14,800	1,800	100	0	70	2,100	20	100	400	100	40	1,100	2,600	170	23,400
	2016	10	62%	13,500	2,500	400	0	50	400	20	300	400	200	40	1,100	2,300	160	21,370
	2017	21	128%	10,100	28,300	5,700	300	60	3,000	20	5,900	400	14,200	40	1,100	2,500	170	71,790
	2018	8	49%	14,200	2,700	600	200	50	1,800	20	500	900	8,200	40	1,100	2,300	200	32,810
	Minimum	6.5	40%	3,100	1,000	0	0	40	100	10	0	300	100	0	700	2,100	10	10,820
	Maximum	36.4	226%	397,600	147,800	10,200	800	110	5,100	20	7,200	1,600	41,900	120	1,100	3,400	260	599,390
	Average	**16.1**	**100%**	**61,600**	**27,000**	**4,200**	**200**	**70**	**2,900**	**10**	**3,100**	**700**	**11,300**	**40**	**900**	**2,600**	**130**	**115,000**
			% of Total:	54%	23%	4%	0.2%	0.1%	2.5%	0.0%	3%	1%	10%	0.0%	1%	2%	0.1%	
Current	**2011**	26.3	164%	93,700	54,100	8,900	600	40	5,000	20	7,000	900	30,000	110	1,000	2,100	170	203,640
	2012	11.9	74%	6,900	4,200	700	100	60	4,400	20	800	1,200	2,700	40	1,000	2,300	190	24,610
	2013	6.8	42%	16,600	1,600	600	0	60	3,500	20	400	500	700	40	1,000	2,400	210	27,630
	2014	7.9	49%	10,200	1,200	0	0	60	2,100	20	0	300	100	40	1,100	2,300	220	17,640
	2015	8.1	50%	14,800	1,800	100	0	70	2,100	20	100	400	100	40	1,100	2,600	170	23,400
	2016	10.0	62%	13,500	2,500	400	0	50	400	20	300	400	200	40	1,100	2,300	160	21,370
	2017	20.6	128%	10,100	28,300	5,700	300	60	3,000	20	5,900	400	14,200	40	1,100	2,500	170	71,790
	2018	7.9	49%	14,200	2,700	600	200	50	1,800	20	500	900	8,200	40	1,100	2,300	200	32,810
	Minimum	6.8	42%	6,900	1,200	0	0	40	400	20	0	300	100	40	1,000	2,100	160	17,640
	Maximum	26.3	164%	93,700	54,100	8,900	600	70	5,000	20	7,000	1,200	30,000	110	1,100	2,600	220	203,640
	Average	**12.4**	**77%**	**22,500**	**12,100**	**2,100**	**200**	**60**	**2,790**	**20**	**1,900**	**600**	**7,000**	**50**	**1,100**	**2,400**	**200**	**52,900**
			% of Total:	43%	23%	4%	0.4%	0.1%	5.3%	0.0%	4%	1%	13%	0.1%	2%	5%	0.4%	

Table 3-12. Santa Ynez River Groundwater Basin Eastern Management Area Historical and Current Water Budget Summaries

Values in acre-feet

Water Budget	Water Year	Rainfall		Surface Water Outflow						Groundwater Outflow												Total Outflow	Change of Groundwater in Storage	Cumulative Change in Storage
				Subsurface Outflow	Surface Outflow	Pumping Extractions			Phreatophyte ET	City of Solvang Pumping	ID No. 1 and SYRWCD Self-Reported Pumping			"White Area" Pumping [1]			Total Pumping	Outflow to Tributaries	Phreatophyte ET	Evaporative Losses	Subsurface Outflow			
		Inches	% of Average			City of Solvang	ID No. 1	SYRWCD			"Agricultural Water" Pumping	"Other Water" Pumping	"Special Irrigation Water" Pumping	Ag Irrigation Pumping	Mutual Water Companies	Rural Domestic Pumping								
Historical	1982	15	92%	1,800	3,900	1,100	300	2,700	4,100	90	4,300	1,000	0	7,200	650	200	13,440	900	3,000	0	100	31,400	-3,180	-3,180
	1983	35	219%	1,800	511,200	1,200	400	2,400	4,100	90	4,400	1,100	0	7,200	670	200	13,660	17,500	3,100	0	100	555,300	18,800	15,620
	1984	7	46%	1,800	24,900	1,200	1,000	2,700	4,200	90	4,100	1,000	0	7,200	690	200	13,280	400	3,100	0	100	52,700	-2,030	13,590
	1985	11	68%	1,800	2,700	1,300	700	2,900	4,100	100	4,800	1,200	0	7,200	710	200	14,210	0	3,100	0	100	30,900	-10,990	2,600
	1986	17	106%	1,800	12,300	1,300	500	3,000	4,100	110	4,700	1,100	0	7,700	730	200	14,540	1,700	3,100	0	100	42,500	490	3,090
	1987	9	56%	1,800	1,900	1,300	700	3,300	4,100	100	4,000	700	0	7,800	740	200	13,540	0	3,100	0	100	29,700	-8,600	-5,510
	1988	17	105%	1,800	4,100	1,400	700	3,100	4,100	30	4,600	1,100	0	7,800	740	200	14,470	1,300	3,100	0	100	34,400	-940	-6,450
	1989	7	46%	1,800	1,800	1,300	600	3,500	4,100	20	4,100	2,900	0	7,800	750	200	15,770	0	3,100	0	100	32,000	-12,720	-19,170
	1990	6	40%	1,800	600	1,400	700	3,300	4,200	20	4,100	3,900	0	7,700	760	200	16,680	0	3,100	0	100	31,700	-15,740	-34,910
	1991	17	105%	1,800	12,400	1,100	1,600	2,900	4,100	150	4,800	1,200	0	7,600	770	200	14,720	700	3,000	0	100	42,500	-5,690	-40,600
	1992	25	155%	1,800	40,100	1,200	1,200	3,000	4,200	130	5,000	1,300	0	7,600	780	200	15,010	3,700	3,100	0	100	73,400	3,630	-36,970
	1993	28	174%	1,800	364,100	400	1,400	2,000	4,200	470	4,200	2,100	0	7,400	780	200	15,150	8,300	3,100	0	100	400,600	12,460	-24,510
	1994	14	84%	1,800	9,400	600	2,000	1,800	4,200	350	3,300	1,800	0	7,300	790	300	13,840	200	3,100	0	100	36,800	-5,030	-29,540
	1995	30	187%	1,800	533,900	500	800	2,100	4,100	490	3,900	2,400	0	7,200	800	300	15,090	6,000	3,000	0	100	567,400	10,820	-18,720
	1996	12	76%	1,800	15,900	1,000	1,100	2,100	4,200	310	4,500	3,000	0	7,100	810	300	16,020	400	3,100	0	100	45,700	-6,210	-24,930
	1997	12	73%	1,800	15,300	1,000	100	2,400	4,200	480	3,600	2,300	0	7,700	810	300	15,190	2,100	3,100	0	100	45,300	120	-24,810
	1998	36	226%	1,800	655,500	900	0	2,300	4,100	500	3,000	1,800	60	8,300	820	300	14,780	10,900	3,000	0	100	693,300	14,550	-10,260
	1999	12	76%	1,800	11,000	900	1,500	3,000	4,000	480	3,300	1,900	20	9,000	830	300	15,830	600	3,000	0	100	41,700	-3,210	-13,470
	2000	15	95%	1,800	24,200	700	2,000	4,200	4,200	560	3,400	1,800	10	9,700	830	300	16,600	2,500	3,100	0	100	59,500	760	-12,710
	2001	26	159%	1,800	157,900	300	3,100	4,100	4,100	740	3,100	1,400	10	9,200	840	300	15,590	5,800	3,100	0	100	196,000	12,350	-360
	2002	8	49%	1,800	8,500	300	900	4,000	4,100	370	2,900	1,100	20	8,700	840	300	14,230	0	3,100	0	100	36,900	-10,880	-11,240
	2003	17	103%	1,800	7,700	200	2,700	3,700	4,100	200	2,900	1,200	10	8,700	850	300	14,160	2,200	3,100	0	100	39,700	2,120	-9,120
	2004	10	64%	1,800	10,100	300	1,000	3,700	4,200	180	2,800	1,300	20	8,800	860	300	14,260	300	3,100	0	100	38,900	-5,200	-14,320
	2005	35	219%	1,800	373,600	100	1,000	3,200	4,100	140	2,300	1,200	20	8,800	860	300	13,620	13,400	3,000	0	100	413,800	15,940	1,620
	2006	18	109%	1,800	96,500	100	1,500	3,000	4,200	100	2,500	1,400	20	8,700	870	300	13,890	3,200	3,100	0	100	127,200	6,110	7,730
	2007	7	42%	1,800	10,900	200	1,500	3,100	4,100	140	3,100	1,800	20	8,500	880	300	14,740	0	3,100	0	100	39,500	-12,620	-4,890
	2008	16	98%	1,800	49,600	200	1,700	3,300	4,100	190	3,300	2,100	30	8,300	880	300	15,100	2,900	3,100	0	100	81,800	2,060	-2,830
	2009	13	82%	1,800	4,800	200	1,600	3,600	4,200	160	2,900	1,800	20	8,300	890	300	14,370	100	3,100	0	100	33,700	-8,690	-11,520
	2010	21	132%	1,800	18,600	200	400	3,300	4,100	140	2,700	1,300	20	8,200	890	300	13,550	2,000	3,000	0	100	46,900	2,510	-9,010
	2011	26	164%	1,800	120,400	100	500	2,600	4,100	0	2,800	1,500	20	8,100	900	300	13,620	10,000	3,000	0	100	156,300	14,560	5,550
	2012	12	74%	1,800	4,900	100	1,100	3,900	4,100	110	3,200	2,200	30	8,000	910	300	14,750	0	3,100	0	100	33,800	-9,720	-4,170
	2013	7	42%	1,800	11,500	200	1,400	3,900	4,200	180	3,600	2,400	20	8,000	910	300	15,410	0	3,100	0	100	41,700	-13,360	-17,530
	2014	8	49%	1,800	6,100	200	1,700	4,000	4,200	290	3,400	2,200	20	8,100	920	300	15,230	0	3,100	0	100	36,500	-14,370	-31,900
	2015	8	50%	1,800	9,500	300	2,200	4,100	4,300	230	3,300	1,800	10	8,600	930	300	15,170	0	3,200	0	100	40,500	-13,960	-45,860
	2016	10	62%	1,800	8,000	400	600	3,800	4,200	290	3,200	1,600	10	9,000	930	300	15,330	0	3,100	0	100	37,200	-14,030	-59,890
	2017	21	128%	1,800	18,700	300	1,400	4,500	4,200	190	3,000	1,700	10	9,000	940	300	15,140	3,000	3,100	0	100	52,100	2,970	-56,920
	2018	8	49%	1,800	9,300	300	1,200	3,300	4,200	370	2,900	1,700	10	9,000	950	300	15,230	0	3,100	0	100	38,500	-5,190	-62,110
	Minimum	6.5	40%	1,800	600	100	0	1,800	4,000	0	2,300	700	0	7,100	650	200	13,280	0	3,000	0	100	29,700	-15,740	
	Maximum	36.4	226%	1,800	655,500	1,400	3,100	4,500	4,300	740	5,000	3,900	60	9,700	950	300	16,680	17,500	3,200	0	100	693,300	18,800	
	Average	**16.1**	**100%**	**1,800**	**85,700**	**600**	**1,200**	**3,200**	**4,100**	**230**	**3,600**	**1,700**	**10**	**8,100**	**820**	**300**	**14,700**	**2,700**	**3,081**	**0**	**100**	**117,200**	**-1,830**	
			% of Total:	2%	73%	1%	1%	3%	3%	0.2%	3%	1%	0%	7%	1%	0%		2%	3%	0%	0%			
Current	2011	26.3	164%	1,800	120,400	100	500	2,600	4,100	0	2,800	1,500	20	8,100	900	300	13,620	10,000	3,000	0	100	156,300	14,560	14,560
	2012	11.9	74%	1,800	4,900	100	1,100	3,900	4,100	110	3,200	2,200	30	8,000	910	300	14,750	0	3,100	0	100	33,800	-9,720	4,840
	2013	6.8	42%	1,800	11,500	200	1,400	3,900	4,200	180	3,600	2,400	20	8,000	910	300	15,410	0	3,100	0	100	41,700	-13,360	-8,520
	2014	7.9	49%	1,800	6,100	200	1,700	4,000	4,200	290	3,400	2,200	20	8,100	920	300	15,230	0	3,100	0	100	36,500	-14,370	-22,890
	2015	8.1	50%	1,800	9,500	300	2,200	4,100	4,300	230	3,300	1,800	10	8,600	930	300	15,170	0	3,200	0	100	40,500	-13,960	-36,850
	2016	10.0	62%	1,800	8,000	400	600	3,800	4,200	290	3,200	1,600	10	9,000	930	300	15,330	0	3,100	0	100	37,200	-14,030	-50,880
	2017	20.6	128%	1,800	18,700	300	1,400	4,500	4,200	190	3,000	1,700	10	9,000	940	300	15,140	3,000	3,100	0	100	52,100	2,970	-47,910
	2018	7.9	49%	1,800	9,300	300	1,200	3,300	4,200	370	2,900	1,700	10	9,000	950	300	15,230	0	3,100	0	100	38,500	-5,190	-53,100
	Minimum	6.8	42%	1,800	600	100	0	1,800	4,000	0	2,800	1,500	10	8,000	900	300	13,280	0	3,000	0	100	33,800	-14,370	
	Maximum	26.3	164%	1,800	655,500	1,400	3,100	4,500	4,300	370	3,600	2,400	30	9,000	950	300	16,680	10,000	3,200	0	100	156,300	14,560	
	Average	**12.4**	**77%**	**1,800**	**23,600**	**200**	**1,300**	**3,800**	**4,200**	**210**	**3,200**	**1,900**	**20**	**8,500**	**920**	**300**	**15,000**	**1,600**	**3,100**	**0**	**100**	**54,600**	**-1,700**	
			% of Total:	3%	43%	0%	2%	7%	8%	0.4%	6%	3%	0%	16%	2%	1%		2.9%	6%	0%	0%			

Table 3-12. Santa Ynez River Groundwater Basin Eastern Management Area Historical and Current Water Budget Summaries

Notes

[1] White areas under SGMA refer to areas that are not served by an irrigation district, which depend solely on groundwater supplies.

ag = agriculture

ET = evapotranspiration

ID No. 1 = Santa Ynez River Water Conservation District ID No. 1

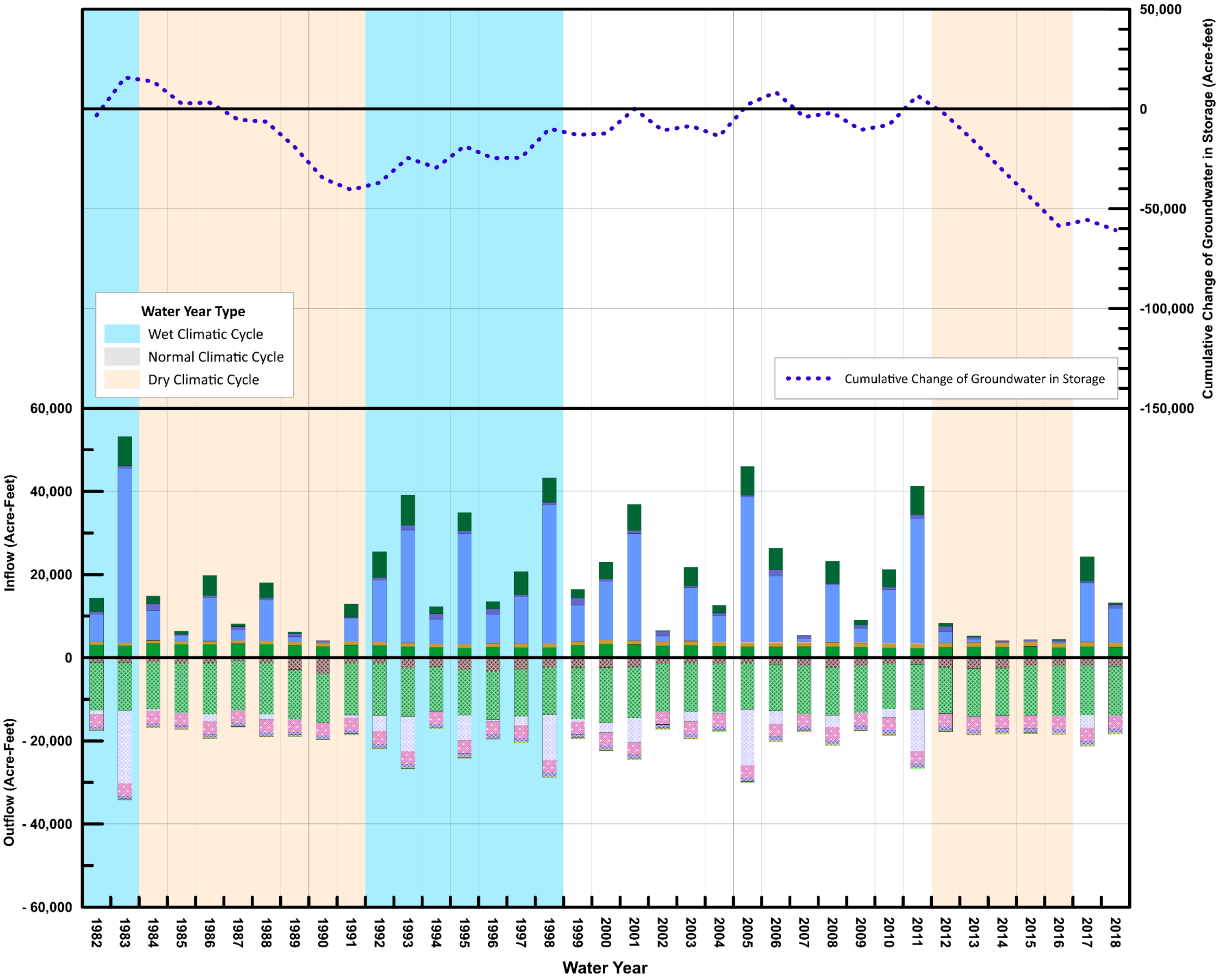
SGMA = Sustainable Groundwater Management Act

SYRWCD = Santa Ynez River Water Conservation District

WWTP = wastewater treatment plant

Figure 3-49
Historical Groundwater Budget

Groundwater Sustainability Plan
Santa Ynez River Valley Groundwater Basin
Eastern Management Area



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Variability of the components of the water budget are directly influenced by annual variations in climatic conditions, as shown on Figure 3-49. During the historical period, two full periods of wet and dry climatic cycles were evident. Dry climatic conditions (drought) prevailed from 1984 through 1991 and again from 2012 through 2016, as depicted by the peach-colored areas on Figure 3-49. During these dry climatic periods (drought), the amount of recharge was relatively low. For example, during the drought between 2012 and 2016, recharge from precipitation and mountain front recharge were reduced significantly to near zero. The graph indicates that the drought resulted in a net reduction of groundwater in storage.

In contrast, wet conditions prevailed in the early 1980s, again between 1992 and 1998 (as shown by blue areas on Figure 3-49), as well as during occasional single alternating wet/dry years. During otherwise normal (average) periods (indicated by gray areas on Figure 3-49) and during the wet periods, the amount of recharge and streamflow percolation was relatively high. The net result during these periods was a gain of groundwater in storage.

The water budget for the historical period is also influenced by the amount of groundwater pumping that occurs. Over the historical period, the total amount of groundwater pumping decreased in the early 1990s, corresponding with a period when irrigation of alfalfa and pasture acreage (high water use factors) declined and irrigated vineyard acreage (a low water use factor) increased. The transition from alfalfa and pasture to vineyards resulted in an estimated net decrease of groundwater pumping because the irrigation demand per acre of vineyards is significantly less than the per-acre demand for alfalfa and pasture. This decrease in pumping contributed to an increase of groundwater in storage during the 1990s.

Over the 37-year historical period, a total net decline of groundwater in storage of about 62,100 AF occurred. The average annual groundwater storage decline during the historical period—or the difference between inflow and outflow to groundwater within the EMA—is approximately 1,830 AFY. This estimate of the groundwater deficit is similar to the deficit projected by the County of Santa Barbara, who in 2003 estimated the then-future demand in 2020 of 1,600 AFY would exist. It was projected that this shortfall would continue at approximately this level through 2040.

3.3.3.6.1. Sustainable Yield Estimate of the Basin

The water budget during the historical period of 1982 through 2018 indicates that total groundwater outflow exceeded the total inflow in the EMA by an average of 1,830 AFY. Long-term withdrawals in excess of sustainable yield can lead to undesirable results. It should be recognized that the concepts of safe yield, sustainable yield, and overdraft reflect conditions of water supply and use over a long-term period. Given the importance of the conjunctive use of both surface water and groundwater in the EMA, short-term water supply differences are satisfied largely by groundwater pumping, which, in any given year, often exceed the sustainable yield of the groundwater within the EMA. The EMA, however, has a very large amount of groundwater in storage that can be used as carryover storage during years when there is little natural recharge. The large amount of groundwater in storage can be replenished in future years by reduced pumping and increased surface water use, or from various types of projects, including, for instance, artificial recharge.

The sustainable yield within the EMA is difficult to estimate due to some degree of uncertainty inherent in the estimates of some of the recharge and discharge components of the water budget. Several methods are available to estimate the sustainable yield under the conditions of water supply and use that prevailed during the 37-year historical period. Use of these methods requires acknowledgment of the inherent uncertainties in the estimates of recharge and discharge.

Total groundwater pumping averaged approximately 14,700 AFY during the historical period (Table 3-10).

The sustainable yield within the EMA was estimated by subtracting the average groundwater storage decline of 1,830 AFY from the estimated total average amount of groundwater pumping of 14,700 AFY for the historical period. This results in a sustainable yield of about 12,870 AFY. This estimated value reflects balanced historical climatic and hydrologic conditions and provides insight into the amount of groundwater pumping that can be sustained in the EMA to maintain a balance between groundwater inflows and outflows.

As the development of sustainable management criteria proceeds, this estimate of sustainable yield will be refined through the planning and implementation phase of the SGMA process with the forthcoming predictive numerical groundwater model scenarios to reflect a sustainable yield value that avoids undesirable results.

The sustainable yield estimate includes recharge and discharge estimates from a combination of imported and native local sources. Of the groundwater recharge components, which averaged 18,770 AFY during the historical period, approximately 287 AFY is derived from percolation of irrigation water into the Santa Ynez Uplands from imported sources and another 339 AFY from septic return flow from imported sources. Together, these two components add 626 AFY, or 3 percent of the groundwater recharge from imported sources.

3.3.3.7 Reliability of Historical Surface Water Supplies

§354.18 Water Budget.

(c) Each Plan shall quantify the current, historical, and projected water budget for the basin as follows:

(2) Historical water budget information shall be used to evaluate availability or reliability of past surface water supply deliveries and aquifer response to water supply and demand trends relative to water year type. The historical water budget shall include the following:

(A) A quantitative evaluation of the availability or reliability of historical surface water supply deliveries as a function of the historical planned versus actual annual surface water deliveries, by surface water source and water year type, and based on the most recent ten years of surface water supply information.

The historical reliability of surface water supply has been a function of the availability of local and imported surface water. The long-term reliability of the surface water from the local sources, including Bradbury Dam outflow releases and tributary runoff from the Santa Ynez Uplands, is subject to climatic variability and is subject to requirements for dam releases to meet in-stream habitat and water rights requirements. Releases from Cachuma Reservoir for these purposes have maintained a stable surface water supply within the EMA. Flow in the Santa Ynez River main stem will continue to be regulated and determined by terms of the State Board Order and National Marine Fisheries Service Biological Opinion.

3.3.4 Current Water Budget (Water Years 2011 through 2018)

§354.18 Water Budget.

(c) Each Plan shall quantify the current, historical, and projected water budget for the basin as follows:

(1) Current water budget information shall quantify current inflows and outflows for the basin using the most recent hydrology, water supply, water demand, and land use information.

SGMA regulations require that a water budget under current conditions be developed based on the most recent hydrology, water supply, water demand, and land use information. For the GSP, the period selected to represent current conditions is water years 2011 through 2018. This period is a subset of the historical period described above in Section 3.3.3.

The current water budget period is dominated by a drought period when annual precipitation averaged about 78 percent of the historical average and percolation of direct precipitation averaged about 62 percent of the historical average. As a result, the current water budget period represents drought conditions and is not representative of long-term, balanced conditions needed for sustainability planning purposes.

Estimates of the surface water and groundwater inflow and outflow, and changes of groundwater storage for the current water budget period are provided below.

3.3.4.1 Surface Water Inflows

Similar to the water budget under historical conditions, the current water budget includes two surface water source types: local supplies and SWP.

3.3.4.1.1. Local Surface Water Supplies

Current local surface water supplies include surface water flows that enter the EMA from precipitation runoff within the watershed and Santa Ynez River inflow to the EMA, regulated as releases from Lake Cachuma at Bradbury Dam. The annual average, minimum, and maximum values for these inflows for the current period are shown on Table 3-13. Both ID No. 1 and the City of Solvang produce local surface water from the Santa Ynez River main stem (including underflow) for applied use in the Santa Ynez Uplands area of the EMA.

Table 3-13. Annual Surface Water Inflow, Current Period (2011 through 2018)

(Values in acre-feet per year)

Surface Water Inflow Component	Average	Minimum[1]	Maximum[1]
Santa Ynez River Inflow	22,500	6,900	93,700
Santa Ynez River Tributary Inflow[2]	12,100	1,200	54,100
Mountain Front Recharge	2,100	0	8,900
Precipitation Recharge	200	0	600
Septic Return Flow	20	20	20
Agricultural Irrigation Return Flow	60	40	70
Cachuma Project (Imported)[3]	0	0	0
SWP Exchange (Imported)[3]	1,570	0	3,126
SWP Table A (Imported)[3]	1,220	69	2,330
Local	**36,980**		
Imported	**2,790**		
Total	**39,770**		

Notes

[1] Minimum and maximum values are not totaled because the values for each component may have occurred in different years.

[2] Tributaries include Hilton, San Lucas, Calabazal, Alisal, Santa Agueda, Zanja de Cota, Alamo Pintado, and Zaca Creeks.

[3] ID No. 1 exchanged its Cachuma Project entitlement supplies for an equivalent amount of SWP water that is delivered to the ID No. 1 turnout.

SWP = State Water Project

The estimated average annual total inflow from these sources during the current water budget period was about 39,770 AFY, or about 41 percent of the average annual inflow during the historical period of 95,980 AFY. Inflow of surface water from the Santa Ynez River and contributing tributaries during the current period was significantly lower than during the historical period. The reduction in surface water inflows reflects the drought conditions that prevailed during the current water budget period.

3.3.4.1.2. Imported Surface Water from State Water Project

Imported SWP water has been used by ID No. 1 and the City of Solvang during the current water budget period, as described in Section 3.3.2.1.5. The annual average, minimum, and maximum values for the imported SWP water use during the current water budget period are summarized in Table 3-13.

3.3.4.2 Surface Water Outflows

The estimated annual surface water outflow leaving the EMA as flow in the Santa Ynez River and subsurface flow over the current water budget period is summarized in Table 3-14. Reductions in surface water outflow for the current water budget period were similar to those for the surface water inflows.

Table 3-14. Annual Surface Water Outflow, Current Period (2011 through 2018)

(Values in acre-feet per year)

Surface Water Outflow Component	Average	Minimum[1]	Maximum[1]
Santa Ynez River Outflow (including Zaca Creek)	23,600	4,900	120,400
Pumping (River Wells)	5,300	3,200	7,100
Subsurface Outflow	1,800	1,800	1,800
Phreatophyte Evapotranspiration	4,200	4,100	4,300
Total	**34,900**		

Note

[1] Minimum and maximum values are not totaled because the values for each component may have occurred in different years.

3.3.4.3 Groundwater Inflows and Outflows

The water budget for the current period includes a summary of the estimated groundwater inflows, groundwater outflows, and change of groundwater in storage. Groundwater supplied most of the water used in the EMA during the current water budget period.

3.3.4.3.1. Groundwater Inflows

Groundwater inflow components include streamflow percolation, agricultural irrigation return flow, deep percolation of direct precipitation, subsurface groundwater inflow (including mountain front recharge), percolation of treated wastewater, and domestic/urban septic return flow. The annual groundwater inflows during the historical period are summarized in Table 3-9. Groundwater inflows during the current period are summarized in Table 3-15.

Table 3-15. Groundwater Inflow, Current Period (2011 through 2018)

(Values in acre-feet per year)

Groundwater Inflow Component	Average	Minimum[1]	Maximum[1]
Deep Percolation of Direct Precipitation	7,000	100	30,000
Tributary Percolation	600	300	1,200
Subsurface Groundwater Inflow[2]	1,900	0	7,000
Agricultural Irrigation Return Flow	2,400	2,100	2,600
Domestic/Urban Irrigation Return Flow	200	160	220
Septic Return Flow	1,100	1,000	1,100
Wastewater Effluent Percolation	50	40	110
Total	**13,250**		

Notes

[1] Minimum and maximum values are not totaled because the values for each component may have occurred in different years.

[2] Subsurface groundwater inflow includes mountain front recharge.

For the current period, estimated total inflow to the groundwater of the Santa Ynez Upland ranged from 4,060 to 41,300 AFY, with an average inflow of 13,250 AFY. Notable observations from the summary of groundwater inflows for the current period include the following:

- Average total inflow during the current water budget period was about 70 percent of the average total inflow for the historical period.
- Total annual average recharge from direct precipitation for the current period was about 62 percent of the recharge from direct precipitation for the historical period.

3.3.4.3.2. Groundwater Outflows

Groundwater outflow components include groundwater pumping from all water use sectors, subsurface groundwater outflow to tributaries and the adjacent management area, and phreatophyte ET. Groundwater discharges to surface water are included as discharges that ultimately flow to surface water in the Santa Ynez River. This volume was estimated using the EMA numerical modeling in consultation with consultants within the adjacent management areas. The estimated annual groundwater outflows for the current period are summarized in Table 3-16.

Table 3-16. Annual Groundwater Outflow, Current Period (2011 through 2018)

(Values in acre-feet per year)

Groundwater Outflow Component	Average	Minimum[1]	Maximum[1]
Total Groundwater Pumping	15,000	13,620	15,410
Subsurface Groundwater Outflow	1,700	100	10,100
Phreatophyte Evapotranspiration	3,100	3,000	3,200
Total	**19,800**		

Note

[1] Minimum and maximum values are not totaled because the values for each component may have occurred in different years.

Groundwater pumping was the largest groundwater outflow component, totaling 76 percent of all of the groundwater outflow. The estimated annual groundwater pumping by water use sector for the current period is summarized in Table 3-17.

Table 3-17. Annual Groundwater Pumping by Water Use Sector, Current Period (2011 through 2018)

(Values in acre-feet per year)

Water Use Sector	Average	Minimum[1]	Maximum[1]
Agricultural[2]	11,700	10,900	12,200
Municipal/Reported Domestic[3]	2,100	1,500	2,600
Rural Domestic[4]	300	300	300
Small Public Water Systems[4]	900	900	950
Total	**15,000**		

Notes

[1] Minimum and maximum values are not totaled because the values for each component may have occurred in different years.

[2] Includes all metered and estimated agricultural irrigation pumping, both inside and outside of the SYRWCD.

[3] Includes all metered and self-reported domestic pumping that occurs within the SYRWCD.

[4] Includes only pumping that occurs outside of the SYRWCD.

SYRWCD = Santa Ynez River Water Conservation District

Pumping for municipal uses accounts for 14 percent of total pumping over the current period. Agricultural pumping fluctuated over time, but is estimated to have increased only slightly during the current period. As noted above, agricultural pumping outside SYRWCD is not metered or reported. Rural-domestic and small water system pumping occurring outside of the SYRWCD boundaries area account for 2 percent and 4 percent of total pumping, respectively, during the current period. Overall, the total average groundwater outflows during the current period were very similar to those during the historical period.

3.3.4.4 Changes of Groundwater in Storage

Average groundwater inflows and outflows within the EMA for the current period are presented on Figure 3-50, and a summary of annual groundwater inflows and outflows are presented on Figure 3-51.. Inflow components are graphed above the zero line and outflow components are graphed below the zero line on Figure 3-51.. The cumulative change of groundwater in storage during the current period on Figure 3-51. indicates that the average inflow of approximately 13,250 AFY is less than the average total outflow of 19,800 AFY. On average, there has been a reduction of groundwater in storage with an average overdraft of approximately 6,580 AFY over the current period of 2011 through 2018. The total reduction of groundwater in storage during the current period was approximately 52,800 AF. As stated previously, the current water budget was developed during a severe drought period and is not representative of long-term basin conditions.

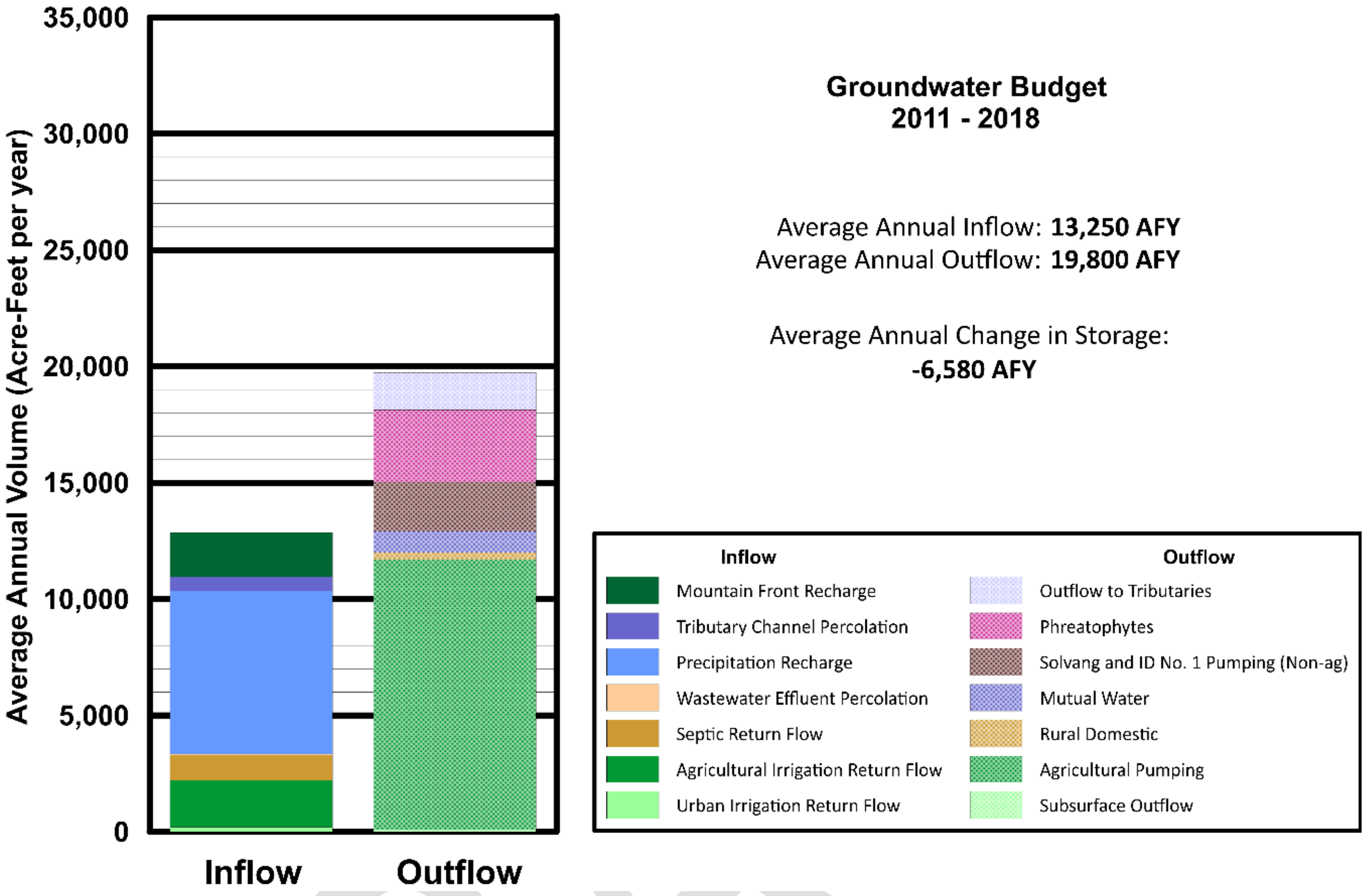
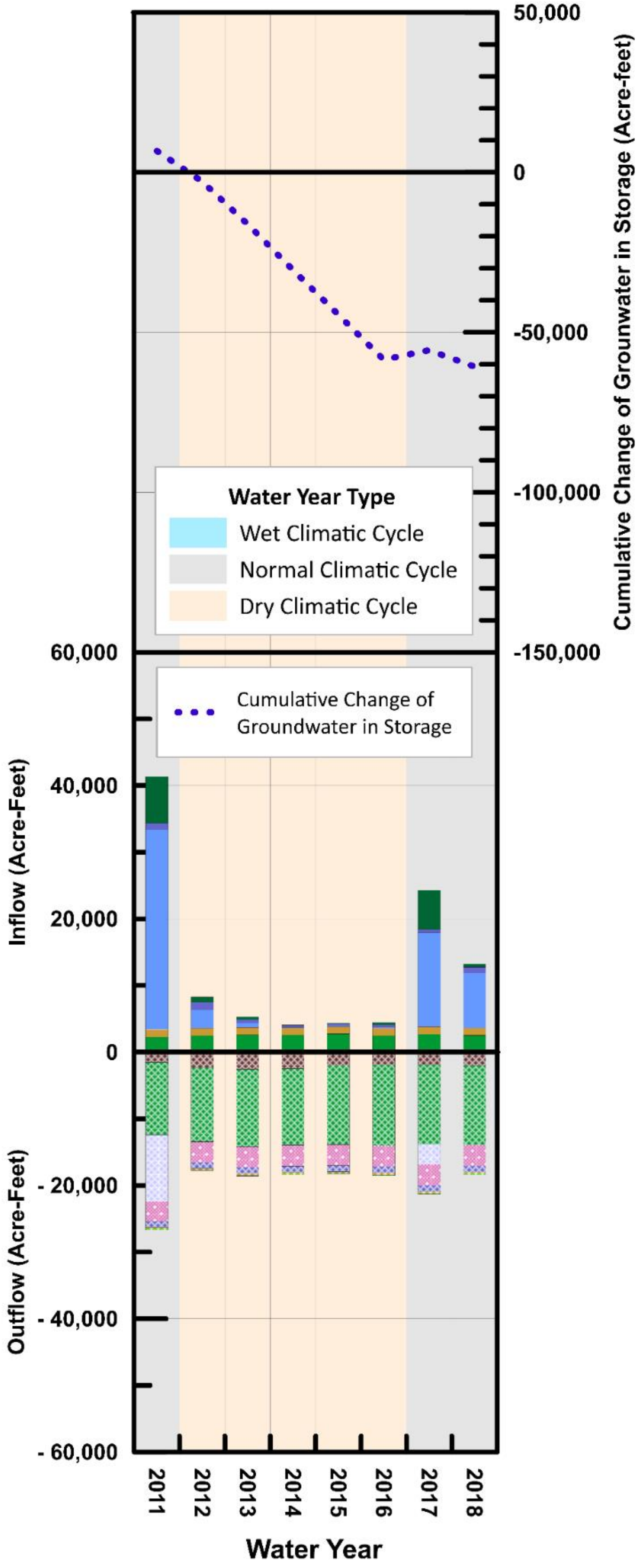


Figure 3-50. Average Groundwater Budget Volumes, Current Period

Figure 3-51
Current Groundwater Budget

Groundwater Sustainability Plan
Santa Ynez River Valley Groundwater Basin
Eastern Management Area



GSI
Water Solutions, Inc.

3.3.5 Projected Water Budget

§354.18 Water Budget.

(c) Each Plan shall quantify the current, historical, and projected water budget for the basin as follows:

(3) Projected water budgets shall be used to estimate future baseline conditions of supply, demand, and aquifer response to Plan implementation, and to identify the uncertainties of these projected water budget components. The projected water budget shall utilize the following methodologies and assumptions to estimate future baseline conditions concerning hydrology, water demand and surface water supply availability or reliability over the planning and implementation horizon:

> (A) Projected hydrology shall utilize 50 years of historical precipitation, evapotranspiration, and streamflow information as the baseline condition for estimating future hydrology. The projected hydrology information shall also be applied as the baseline condition used to evaluate future scenarios of hydrologic uncertainty associated with projections of climate change and sea level rise.
>
> (B) Projected water demand shall utilize the most recent land use, evapotranspiration, and crop coefficient information as the baseline condition for estimating future water demand. The projected water demand information shall also be applied as the baseline condition used to evaluate future scenarios of water demand uncertainty associated with projected changes in local land use planning, population growth, and climate.
>
> (C) Projected surface water supply shall utilize the most recent water supply information as the baseline condition for estimating future surface water supply. The projected surface water supply shall also be applied as the baseline condition used to evaluate future scenarios of surface water supply availability and reliability as a function of the historical surface water supply identified in Section

3.3.5.1 Projected Water Budget Calculation Methods [§354.18(d)(1),(d)(2),(d)(3),(e), and (f)]

The SGMA regulations require the following regarding projected water budgets:

> "Projected water budgets shall be used to estimate future baseline conditions of supply, demand, and aquifer response to Plan implementation, and to identify the uncertainties of these projected water budget components."
>
> "Projected hydrology shall utilize 50 years of historical precipitation, evapotranspiration, and streamflow information as the baseline condition for estimating future hydrology…"
>
> "Projected water demand shall utilize the most recent land use, evapotranspiration, and crop coefficient information as the baseline condition for estimating future water demand…"
>
> "Projected surface water supply shall utilize the most recent water supply information as the baseline condition for estimating future surface water supply. The projected surface water supply

The subsurface groundwater inflow and outflow components of the future water budget in the EMA were estimated utilizing estimated future land uses from the Santa Barbara County Association of Governments, related pumping volumes, and repeating factors associated with the historical climatic conditions projected forward in time through 2032 and 2072. The effects of climate change were also evaluated using DWR-provided climate change factors. This section briefly describes the estimated components of the future water budget that include (1) the effects of changing land use and water demand and (2) effects caused by climate change.

The 2030 and 2070 precipitation and ET climate change factors are available on 6-kilometer resolution grids. The climate data sets have also been analyzed with a soil moisture accounting model known as the Variable Infiltration Capacity (VIC) hydrology model and routed to the outlet of subbasins defined by 8-digit Hydrologic Unit Codes (HUCs). The resulting downscaled hydrologic time series are available on the SGMA Data Viewer[15] hosted by DWR. Precipitation and ET data used in this analysis were downloaded from the SGMA Data Viewer for climate grid cells covering the EMA within HUC 18060010, which covers the entire Santa Ynez River Valley Groundwater Basin. Monthly time series change factors were then developed for the EMA. Monthly time series change factors for inflow in the Santa Ynez River—which will continue to be regulated by the State Board Order and National Marine Fisheries Service 2000 Southern California Biological Opinion—were similarly retrieved from the SGMA Data Viewer. Mean monthly and annual values were computed from the time series to show projected patterns of change under 2030 and 2070 conditions.

3.3.5.1.1. Projected Hydrology [§354.18(c)(3)(A)]

§354.18 Water Budget.

(c) Each Plan shall quantify the current, historical, and projected water budget for the basin as follows:

(3) Projected water budgets shall be used to estimate future baseline conditions of supply, demand, and aquifer response to Plan implementation, and to identify the uncertainties of these projected water budget components. The projected water budget shall utilize the following methodologies and assumptions to estimate future baseline conditions concerning hydrology, water demand and surface water supply availability or reliability over the planning and implementation horizon:

(A) Projected hydrology shall utilize 50 years of historical precipitation, evapotranspiration, and streamflow information as the baseline condition for estimating future hydrology. The projected hydrology information shall also be applied as the baseline condition used to evaluate future scenarios of hydrologic uncertainty associated with projections of climate change and sea level rise.

DWR's Water Budget and Modeling Best Management Practices (DWR, 2016c) (DWR, 2016e) (DWR, 2020b) describe the use of climate change data to estimate projected hydrology. DWR has also provided SGMA Climate Change Data and published a Guidance for Climate Change Data Use for Groundwater Sustainability Plan Development (DWR, 2018) as the primary source of technical guidance used in this analysis.

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[15] Available at https://sgma.water.ca.gov/webgis/?appid=SGMADataViewer#currentconditions. (Accessed February 15, 2021.)

The DWR-provided climate change data are based on the California Water Commission's Water Storage Investment Program climate change analysis results, which used global climate models and radiative forcing scenarios recommended for hydrologic studies in California by the Climate Change Technical Advisory Group. Climate data from the recommended General Circulation Model models and scenarios have also been downscaled and aggregated to generate an ensemble time series of change factors that describe the projected change in precipitation and ET values for climate conditions that are expected to prevail at midcentury and late century, centered around 2030 and 2070, respectively. The DWR data set also includes two additional simulation results for extreme climate scenarios under 2070 conditions. Use of the extreme scenarios, which represent Drier/Extreme Warming (2070DEW) and Wetter/Moderate Warming (2070WMW) conditions in GSPs is optional.

This section describes the retrieval, processing, and analysis of DWR-provided climate change data to project the impact of climate change on precipitation, ET, upstream inflow, and imported flows under 2030 and 2070 conditions. The precipitation and ET change projections are computed relative to a baseline period of 1981 to 2010, due to the availability of the data beyond 2010. For upstream inflow into Lake Cachuma and imported water from the SWP, change projections are estimated using a baseline period of 1981 to 2003. The baseline period was selected based on the historical period (which includes water years 1982 through 2018), the availability of concurrent climate projections (calendar years 1915 to 2011), and derived hydrologic simulations (water years 1922 through 2011) from the SGMA Data Viewer.

Projected Changes in Streamflow. Within the entire Basin, and therefore the EMA, streamflow is projected to increase slightly, by 0.5 percent in 2030 and 3.8 percent in 2070, based on climate change and other factors in the VIC analyses for the Basin. Notably, the projection of changes of local surface water flow into the Santa Ynez River portion of the EMA is complicated and subject to significant error with (1) the impoundment of the flow in the Santa Ynez River behind three reservoirs, (2) diversions through three tunnels to communities along the coast, and (3) requirements for regulated releases to the river. The projected changes to streamflow do however apply through the tributaries that flow through the Santa Ynez Uplands and ultimately into the Santa Ynez River.

Projected Changes in Evapotranspiration. Crops require more water to sustain growth in a warmer climate, and this increased water requirement is characterized in climate models using the rate of ET. Under 2030 conditions, the EMA is projected to experience average annual ET increases of 3.8 percent relative to the historical period. The largest monthly changes would occur in winter and early summer with projected increases of 4.3 percent to 4.8 percent in January and 3.8 percent to 4 percent in June. Under 2070 conditions, annual ET is projected to increase by 8 percent relative to the historical period. The largest monthly changes would occur in December with projected increases of between 12.8 percent and 13.5 percent. Summer increases peak at approximately 8 percent in May and June.

Projected Changes in Precipitation. The seasonal timing of precipitation in the EMA is projected to change. Sharp decreases in early fall and late spring precipitation accompanied by increases in winter and early summer precipitation are projected to occur. Under 2030 conditions, the largest monthly changes would occur in May with projected decreases of 14 percent, while increases of approximately 9 percent and 10 percent are projected in March and August, respectively. Under 2070 conditions, decreases of up to 31 percent are projected in May while the largest increases are projected to occur in September (25 percent) and January (17 percent). The EMA is projected to experience minimal changes in total annual precipitation. Annual precipitation increases by 0.8 percent or less are projected under 2030 conditions relative to the historical period. Under 2070 conditions, small decreases in annual precipitation are projected, with changes of less than 1 percent.

3.3.5.1.2. Projected Water Budget [§354.18(c)(3)(B)]

§354.18 Water Budget.

(c) Each Plan shall quantify the current, historical, and projected water budget for the basin as follows:

(3) Projected water budgets shall be used to estimate future baseline conditions of supply, demand, and aquifer response to Plan implementation, and to identify the uncertainties of these projected water budget components. The projected water budget shall utilize the following methodologies and assumptions to estimate future baseline conditions concerning hydrology, water demand and surface water supply availability or reliability over the planning and implementation horizon:

(B) Projected water demand shall utilize the most recent land use, evapotranspiration, and crop coefficient information as the baseline condition for estimating future water demand. The projected water demand information shall also be applied as the baseline condition used to evaluate future scenarios of water demand uncertainty associated with projected changes in local land use planning, population growth, and climate.

Based on the conditions documented in the historical water budget, the inflow and outflow from the EMA were estimated into the future, extending through the GSP implementation period through 2042 as well as for 50 total years after this GSP is submitted, through 2072. This section describes the methods and results to estimate the groundwater inflow and outflow components in the Santa Ynez Uplands through 2042 and 2072. Obviously, uncertainty exists in the estimates for current and future water supply and demand. The level of uncertainty is compounded as the forecast time horizon extends from 20 to 50 years. To minimize the uncertainty that will always exist, this projected water budget is based the best available data and compiled in coordination and collaboration with water users within the EMA, entire Basin, and adjacent groundwater basin.

Agricultural Acreage. Between water years 1982 and 2018, irrigated agricultural pumping within the Santa Ynez Uplands averaged 11,700 AFY. During 2018, the year of the most recent crop survey, there was an estimated 6,818 acres of irrigated land within the Santa Ynez Uplands. Of this area, a total of 4,241 acres were planted in irrigated crops in the areas outside of the SYRWCD boundaries, for which a total of 8,976 AFY was pumped. This is equal to an application rate of average of 2.11 acre-feet per acre per year.

The available crop survey data from 1985, 1996, 2014, 2016 and 2018 indicate that groundwater pumping occurred in areas outside of the SYRWCD boundaries is used to satisfy a variety of crops, the acreages of which vary from year to year. A summary of the land use trends for the recent years is presented on Table 3-18. The crop types presented are combined into six groups of similar crops.

Table 3-18. Summary of Historical and Projected Irrigated Agricultural Acreage, Outside of Santa Ynez River Water Conservation District

(Values in acres)

Crop Group	Recent Trend	1996	2014	2016	2018	2042 (Projected)	2072 (Projected)
Deciduous Fruit and Nuts	Modest increase	37	93	93	74	130	199
Field Crops	Rising (+ 4.5% / year)	267	273	812	1,090	1,752	2,581
Ornamentals	Unchanged	5	29	21	3	14	28
Pasture	Declining	1,350	839	858	747	500	500
Truck, Nursery, and Berry Crops	Declining	141	714	675	498	300	300
Vineyards	Very modest increase	944	1,804	1,932	1,828	1,900	1,990
Cannabis	Large increase expected	0	0	0	0	500	1,000
	Total	**2,743**	**3,752**	**4,390**	**4,241**	**5,096**	**6,598**
	Change since 2018					**+ 856**	**+2,357**

The total irrigated area outside of the SYRWCD was 4,241 acres in 2018, the period of the most recent land use survey, which consisted principally of vineyards and field crops, as well as lesser acreages of pasture and also truck, nursery, and berry crops. The projection of estimated changes of irrigated crop acreages into the future were considered individually for the six crop groups in consultation with GSA staff and local irrigators.[16]

Based on the available data, only field crops exhibited an upward trend in recent years, which was rising at 4.5 percent per year. This projection was projected into the future at this rate, which would add approximately 28 acres of field crops on average per year. By 2042, the number of acres of field crops outside of the SYRWCD is projected to increase from 1,090 acres in 2018 to 1,752 acres. This may increase further to 2,581 acres by 2072 based on these projections.

The data indicated that the area of truck, nursery, and berry crops has declined significantly. Truck, nursery, and berry crops have lost an average of 50 acres per year since 2014, and covered 498 acres in 2018. For the sake of the projection, we have estimated that a total of 300 acres of these crops will remain within the basin for the foreseeable future (through 2042 and 2072).

Likewise, pasture, which covered 747 acres in 2018, has been declining recently, losing over 20 acres per year on average. For the sake of the projection of this crop type, we have assumed that this decline will continue, but will not drop below a total of 500 total acres within the area outside of the SYRWCD.

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[16] Based on personal conversations with local irrigators, including Kevin Merrill, and feedback from board members and public comments collected during a public meeting held February 25, 2021. Considerations for projection of individual crop groups included market conditions and projected changes in water availability and cost.

The expansion of vineyard acreage has slowed considerably in recent years, compared to the rapid growth that occurred during the late 1990s and early 2000s. Between 1996 and 2014, vineyards were growing at an average rate of approximately 3.7 percent per year, and since 2014 has moderated to near zero growth, which is included in the projection less than 0.2 percent per year annual growth. This is equal to an increase of approximately 3 acres per year on average.

While not included as a crop category in the recent crop surveys, cannabis production is projected to enter the Santa Ynez Valley and the EMA in the coming years. The County of Santa Barbara has placed an upper limit on the maximum number of acres county-wide allowed to be planted with cannabis. The assumption for the EMA is that cannabis production will reach a limit for the Santa Ynez Valley over the next several years and will increase beyond the current limit. Review of the four current cannabis permit applications suggest that a total of approximately 350 acres of cannabis production are being considered within the EMA. The estimated acreage of this crop projected through 2042 and 2072 are only estimates and are subject to much uncertainty.

The estimated projected total acreages of the ornamentals and deciduous fruit and nuts remained relatively unchanged on the whole based on the crop surveys and are not projected to increase significantly during the future water budget period.

Overall, the summation of the individual cropping changes result in a projected increase in irrigated acreage outside of SYRWCD from 4,241 acres in 2018 to 5,259 acres in 2042 at an annual growth rate of approximately 0.8 percent per year. Between 2042 and 2072, the total irrigated acreage is projected to increase further relative to 2018 to 6,598 acres at the same average annual growth rate. This growth is expected to occur mostly due to increases in field crops and cannabis acreage.

Agricultural Pumping. Projected future ET values were derived for each of these crop groups for 2042 and 2072 by multiplying the acreage of each crop by historical crop ET and the DWR climate change factors. The water use of each crop group varies between 1.05 acre-feet per acre per year for field crops to 3.11 acre-feet per acre per year for truck, nursery, and berry crops, as shown on Table 3-19.

Table 3-19. Water Duty Factors for Crop Groups

Crop Group	Annual Crop Demand (acre-feet per acre per year)
Deciduous Fruit and Nuts	2.14
Field Crops	1.05
Ornamentals	3.00
Pasture	3.50
Truck, Nursery, And Berry Crops	3.11
Vineyards	1.60
Cannabis[17]	1.50

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[17] From Battany, 2019, *An initial estimate of a water duty factor for field-grown CBD hemp in the Paso Robles area.* The University of California working in cooperation with San Luis Obispo County and the USDA. April 22, 2019.

The agricultural demand was estimated throughout the Santa Ynez Uplands both within and outside of the SYRWCD. In 2018, a total of 2,900 AFY was pumped within the SYRWCD to satisfy agricultural demands. Agricultural pumping data from within the SYRWCD were based on metered production from ID No. 1 and Solvang, and other self-reported pumping records of the total volume of water pumped, but lacking information about which crops will be irrigated. Throughout the historical period, agricultural pumping within the SYRWCD has been declining slightly such that, before 2000, agricultural pumpage averaged 4,113 AFY, which has since declined to an average of 2,984 AFY for the period since 2000. This moderate decline is equal to an average reduction of 51 AFY of agricultural pumping over the historical period within the SYRWCD. To estimate agricultural pumping within the SYRWCD, we assume that a modest decline will continue from 2,900 AFY in 2018 to 2,497 AFY in 2042, as summarized on Table 3-20.

Based on results of the projection, the overall agricultural pumping within the Santa Ynez Uplands will increase. In 2018, agricultural pumping in the entire Santa Ynez Uplands was 11,301 AFY, which was similar to the average for the entire historical period of 11,700 AFY. Together with the declining agricultural pumping trend within the SYRWCD and conversion of crop acreages throughout the Santa Ynez Uplands to lower water use crops, pumping to satisfy crop demands is projected to decrease slightly to 11,129 AFY in 2042 and 10,584 AFY in 2072. These projections indicate that irrigated agricultural demand, not accounting for climate change, will decline by approximately 1.5 percent by 2042 and 6.3 percent by 2072, as summarized on Table 3-20.

Table 3-20. Summary of Projected Irrigated Agricultural Pumping (not including climate change), Santa Ynez Uplands

(Values in acre-feet per year)

Crop Group	2018	2042 (Projected)	2072 (Projected)
Deciduous Fruit and Nuts	159	277	425
Field Crops	1,143	1,838	2,707
Ornamentals	10	43	85
Pasture	2,615	1,750	1,750
Truck, Nursery, And Berry Crops	1,550	933	933
Vineyards	2,925	3,040	3,184
Cannabis	0	750	1500
SYRWCD	2,900	2,497	2,270
Total	**11,301[1]**	**11,129**	**10,584**
	Change	**- 172**	**- 717**
	Change, Percent	**- 1.5 %**	**- 6.3 %**

Note

[1] Agricultural pumping from Santa Ynez Uplands between 1982 and 2018 averaged 11,700 AFY

SYRWCD = Santa Ynez River Water Conservation District

Climate Change. The effects of climate change are projected to increase ET and therefore groundwater pumping for agriculture. Consideration of climate change factors are required by DWR to be consistent with DWR guidance for future water budget projections. By 2042, the EMA is projected to experience average annual ET increases of 5.1 percent relative to the baseline historical period, and 8.2 percent by 2072. To satisfy these increases in ET, the total pumping for agriculture is projected rise, at similar magnitudes as the decreases due to cropping changes. Precipitation is projected to change slightly as a result of climate change in the future, increasing by 0.8 percent in 2042 and decreasing by 1 percent in 2072.

As presented on the table below, climate change may increase pumping demand for agriculture by 568 AFY by 2042 and further by 868 AFY by 2072. Together with the projected decrease in agricultural demand due to changes in cropping patterns and increase in demand due to climate change, the net effect is a slight increase in agricultural water demand of 3.5 percent in 2042 and a lesser increase of 1.3 percent in 2072.

Table 3-21. Summary of Projected Irrigated Agricultural Pumping including Climate Change

(Values in acre-feet per year)

Crop Group	2018	2042 (Projected)	2072 (Projected)
Agricultural Demand	11,301	11,129	10,584
Climate Change	--	+ 568 (+5.1%)	+ 868 (+8.2%)
Ag + Climate Change	11,301	11,696	11,452
Change since 2018		**+ 395**	**+ 151**
Change since 2018, Percent		**+ 3.5 %**	**+ 1.3 %**

Notes

Ag = Agricultural

Municipal and Industrial Pumping. Future municipal and industrial (M&I) demands were estimated based on records of current demand for non-agricultural uses for the City of Solvang, ID No. 1, mutual water companies, and rural domestic users. To estimate future these M&I demands, GSI Water Solutions, Inc. (GSI) reviewed historical demand records from the City of Solvang and ID No. 1, along with population projections for the City of Solvang and unincorporated communities in the EMA based on pumping records from several mutual water companies, Santa Barbara County Association of Governments Regional (population) Growth Forecasts (SBCAG, 2012), the California Department of Finance Population and Housing Estimates (DOF, 2020) and discussions with agency staff. Based on these data sources, it was determined that the City of Solvang anticipates a population increase of approximately 1 percent per year while ID No. 1 and the unincorporated areas of the EMA including Los Olivos, Ballard, the Chumash Reservation, and other areas are not expected to increase in population through 2042 and 2072.

Together, the growth estimates from these sources were used to project overall changes in municipal demand as presented on Table 3-22. The minor expansion of municipal and industrial pumping within the Santa Ynez Uplands is equal to a 5 percent overall increase by 2042 and an 11 percent increase by 2072 compared to the historical period. This component of the water budget was applied to the projected growth of M&I; mutual and rural demands (outflow components); and Chumash WWTP effluent flow, septic return flow and urban irrigation return flows (inflow components).

Table 3-22. Summary of Projected Municipal, Industrial and Domestic Pumping

(Values in acre-feet per year)

Water Budget Component	Historical Average	2042 (Projected)	2072 (Projected)
Solvang and ID No. 1 (non-agricultural)	1,940	2,040	2,150
Mutual Water Companies	820	860	910
Rural Domestic	300	320	330
Total	**3,060**	**3,220**	**3,390**
Change, AFY	**–**	**+ 160**	**+ 330**
Change, Percent	**–**	**+ 5 %**	**+ 11 %**

Other Groundwater Inflow Components. All of the components of the groundwater budget were projected forward into the future for the 2042 and 2072 periods. In addition to changes to both agricultural and M&I pumping discussed above, the other components were adjusted to reflect the projected climate and hydrological changes, which are presented on Table 3-23.

The water budget components related to agricultural pumping (agricultural return flow) were adjusted by the same magnitude as the adjustments to agricultural pumping described above. That is, increasing pumping for irrigated agricultural pumping in turn increases agricultural return flow by the same amount.

Water budget components related to streamflow include tributary percolation (inflow) and outflow of groundwater to these tributaries. Both of these were varied based on guidance by DWR, which projected that streamflow would increase in EMA by 1 percent in 2042 and 4 percent in 2072. These changes are incorporated into the projected water budget on Table 3-23.

Precipitation recharge is projected to change slightly in the future, increasing by 0.8 percent in 2042 and decreasing by 1 percent in 2072. These adjustments were applied to projected change in precipitation recharge and mountain front recharge, which are both inflow components.

The only component that did not change in the projected water budget was the subsurface outflow, which is minor and not significantly affected by the hydrologic changes projected to occur.

Within the Santa Ynez Upland, agricultural and M&I demands in the EMA are projected to increase.

Table 3-23. Summary of Historical, Current, and Projected Water Budget with Climate Change, Santa Ynez Uplands

(Values in acre-feet per year)

Water Budget Component	Historical	Current	2042 (Projected)	2072 (Projected)
Inflow Components				
Mountain Front Recharge	3,100	1,900	3,110	3,070
Tributary Percolation	700	600	710	730
Precipitation Recharge	11,300	7,000	11,330	11,190
Chumash WWTP Effluent	40	50	40	40
Septic Return Flows	900	1,100	950	1,000
Ag Irrigation Return Flows	2,600	2,400	2,660	2,630
Urban Irrigation Return Flows	130	200	140	140
Groundwater Inflow	**18,770**	**13,250**	**18,940**	**18,800**
Outflow Components				
Solvang and ID No. 1 Pumping (non-agricultural)	1,940	2,130	2,040	2,150
Agricultural Pumping	11,700	11,700	11,960	14,850
Mutual Water	820	900	860	910
Rural Domestic	300	300	320	330
Outflow to Tributaries	2,700	1,600	2,740	2,800
Phreatophytes	3,081	3,100	3,240	3,330
Subsurface Outflow	100	100	100	100
Groundwater Outflow	**20,641**	**19,800**	**21,260**	**21,470**
Groundwater Change in Storage	**-1,830**	**-6,580**	**-2,320**	**-2,670**

The M&I and agricultural demands are satisfied with both groundwater pumping (Santa Ynez Uplands summarized above) and surface water from local and imported water sources. Imported SWP water became available to the City of Solvang in 2002, which caused groundwater pumping demand to decrease compared to previous years. M&I demand is projected to increase by 5 percent) in 2042 and 11 percent in 2072. Agricultural demand with climate change is projected to increase by 3.5 percent in 2042 and only just over 1 percent in 2072. A summary of the projected pumping from the Santa Ynez Uplands is presented as Table 3-24.

Table 3-24. Summary of Projected Pumping with Climate Change

(Values in acre-feet per year)

Pumping Component	Historical Average	2042 (Projected)	2072 (Projected)
Agricultural	11,700	11,960	11,850
Municipal and Industrial	3,060	3,220	3,390
Total Pumping	**14,760**	**15,180**	**15,240**
Change	**–**	**+ 420**	**+ 480**
Change, Percent	**–**	**+ 3 %**	**+ 3 %**
Average Annual Change, Percent	**–**	**+ 0.12 %**	**+ 0.06 %**

At the end of the GSP implementation period in 2042 and further into 2072, the total pumping in the EMA is projected to increase modestly by 3 percent relative to the historical period in response to a combination of agricultural and M&I demands, along with climate change projections. This increase represents an annual growth of projected pumping of approximately 0.1 percent per year through 2042 and 2072. The increase in demand in 2042 is presented graphically on Figure 3-52. and in 2072 on Figure 3-53.

3.3.5.1.3. Projected Surface Water Supply [§354.18(c)(3)(C)]

§354.18 Water Budget.

(c) Each Plan shall quantify the current, historical, and projected water budget for the basin as follows:

(3) Projected water budgets shall be used to estimate future baseline conditions of supply, demand, and aquifer response to Plan implementation, and to identify the uncertainties of these projected water budget components. The projected water budget shall utilize the following methodologies and assumptions to estimate future baseline conditions concerning hydrology, water demand and surface water supply availability or reliability over the planning and implementation horizon:

(C) Projected hydrology shall utilize 50 years of historical precipitation, evapotranspiration, and streamflow information as the baseline condition for estimating future hydrology. The projected hydrology information shall also be applied as the baseline condition used to evaluate future scenarios of hydrologic uncertainty associated with projections of climate change and sea level rise.

Now and in the future, surface water is expected to be supplied to the EMA for use both in the Santa Ynez River and Santa Ynez Uplands. The surface water supplies from local and imported sources have been approximately 2,900 AFY through the historical period. Notably, the water supply available to the EMA was significantly lower between 2012 and 2016, when supplemental surface water supplies from the SWP were reduced due to drought conditions statewide.

Based on planning guidance from the CCWA and DWR's Delivery Capability Report (DWR, 2020), a 58 percent delivery allocation of SWP water to the EMA is the minimum projected volume of imported water that may be available. This would suggest that the volume of imported water supply that will be available to serve ID No. 1 (including the City of Solvang) for the foreseeable future may be between 58 percent and 100 percent of their historical deliveries, or between 1,682 and 2,900 AFY.

Water supply from local surface water sources (diversion from the Santa Ynez River) was estimated based on climate-based adjustments to Santa Ynez River streamflow, which indicate that streamflow will increase by a total of 0.5 percent by 2030 and 3.8 percent by 2072. Together, pumping from the Santa Ynez River, managed as surface water diversions, averaged 5,000 AFY during the historical period, which is projected to increase to 5,520 AFY by 2042 and 5,550 AFY by 2072, or up to the pumping volume allowed by the SWRCB for individual water rights. These calculations indicate that downstream surface water production by ID-1, City of Solvang, and other river water right holders and riparian landowners will likely be maintained.

3.3.5.2 Summary of Projected Water Budget

Overall, groundwater outflows from the Santa Ynez Uplands are projected to exceed inflow in the future. At the end of the implementation period in 2042, the groundwater outflows will exceed the groundwater inflows (deficit) by 2,320 AFY as presented on Figure 3-52..

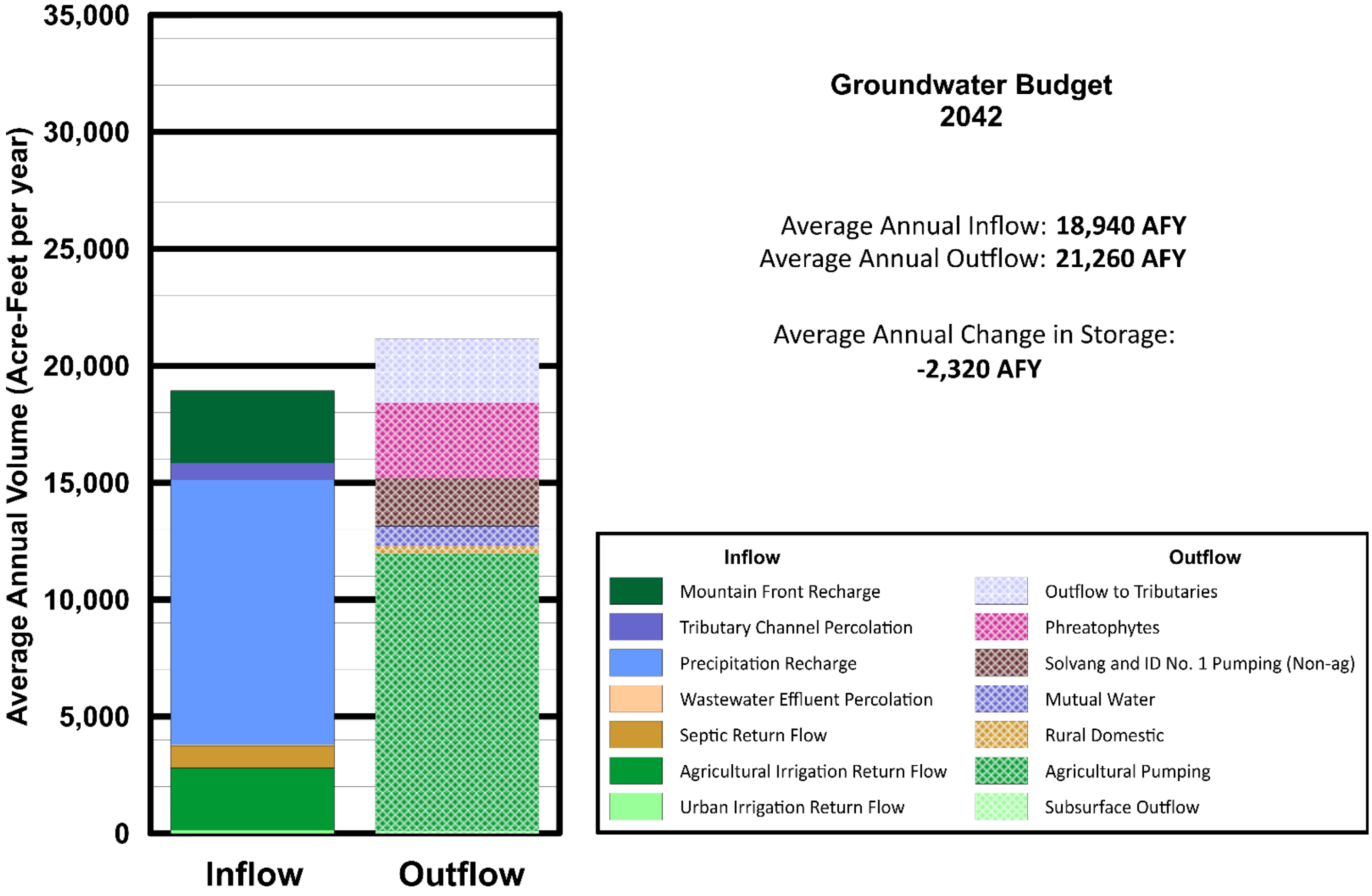

Figure 3-52. Projected Groundwater Budget, 2042

In 2072, groundwater outflows from the Santa Ynez Uplands are projected to exceed inflow components (deficit) by 2,670 AFY as presented on Figure 3-53.

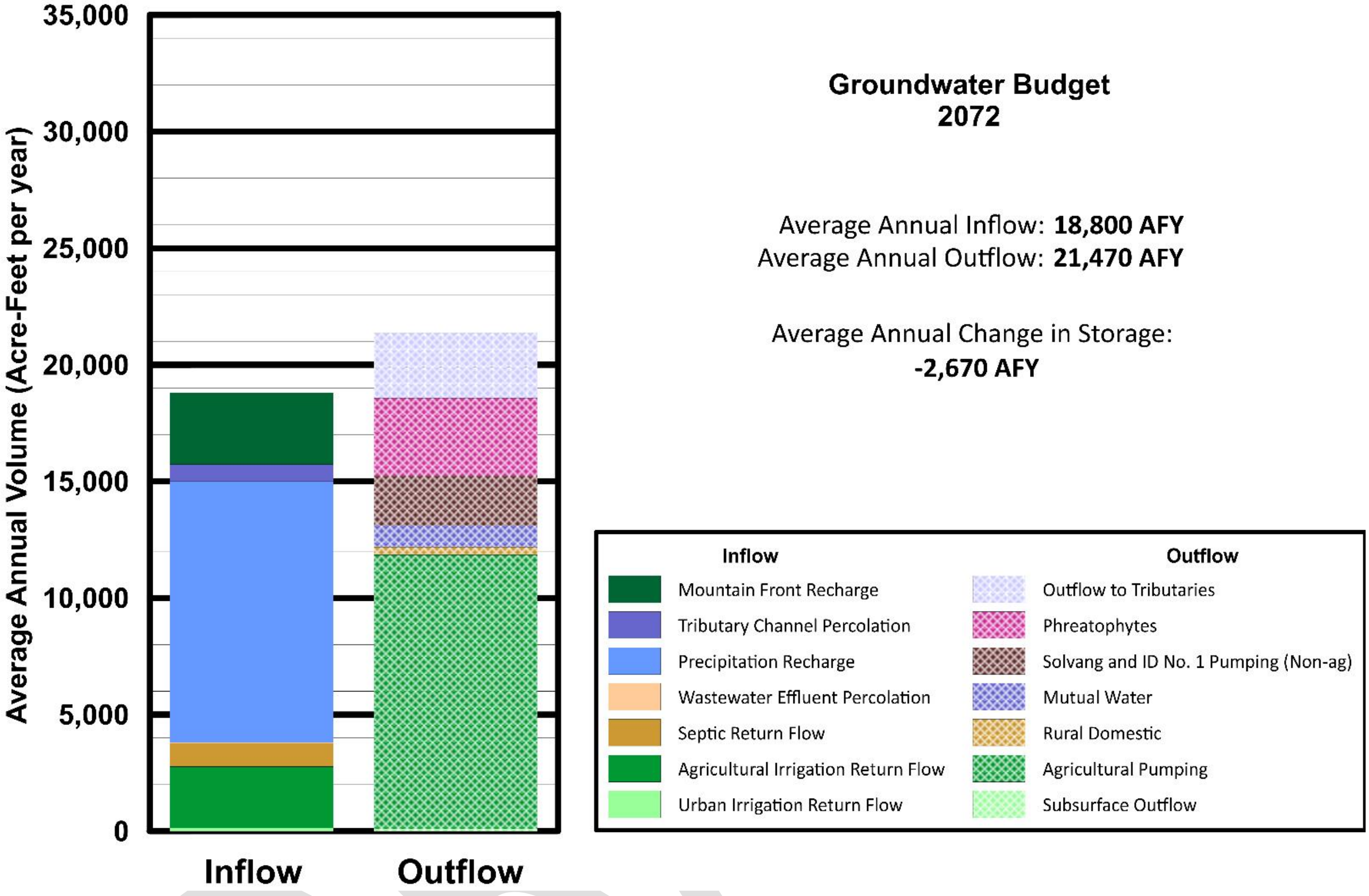

Figure 3-53. Projected Groundwater Budget, 2072

During the historical period, production from wells in the Santa Ynez Uplands served increasing demands for areas that that did not have access to surface water supply. In addition, where surface water was not available, increased groundwater pumping (almost 20,000 AFY) made up for variations in surface water supply. In the future, it is assumed that a majority of the increased demand from M&I uses will be supplied by a combination of local groundwater and imported supplies, and that increased demand from agricultural uses will be supplied by local groundwater.

The combined effects of these changes in supply and demand are that total groundwater pumping in the EMA may increase by approximately 3 percent from 14,760 AFY under historical conditions to 15,180 AFY under 2042 conditions and to 15,240 AFY by 2072 unless measures are implemented to increase supply or reduce demand. The water budget calculations indicate that the current deficit (outflows exceeding inflows) could increase to an average of 2,320 AFY in 2042 and further to 2,670 AFY in 2072.

This analysis points out that, if demand for groundwater increases in the future, projects and management actions may need to be developed to address the current and projected deficit projected to remain in 2042, the year that DWR expects the Basin to be balanced and sustainable without undesirable results.