# FINAL REPORT

## *Los Molinos Subbasin*

## Sustainable Groundwater Management Act

# Groundwater Sustainability Plan

## (Chapter 2C – Water Budget)

**January 2022, Revised April 2024**

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| | |
|---|---|
| af | Acre-feet |
| AN | Above normal Sacramento Valley water year type |
| AWMP | Agricultural Water Management Plan |
| BMP | Best Management Practice |
| BN | Below normal Sacramento Valley water year type |
| C | Critical (dry) Sacramento Valley water year type |
| CCR | California Code of Regulations |
| CVP | Central Valley Project |
| D | Dry Sacramento Valley water year type |
| DCID | Deer Creek Irrigation District |
| DWR | Department of Water Resources |
| ET | Evapotranspiration |
| GMP | Groundwater Management Plan |
| GSP | Groundwater Sustainability Plan |
| GWS | Groundwater System |
| LMMWC | Los Molinos Mutual Water Company |

| | |
|---|---|
| SVRIC | Stanford Vina Ranch Irrigation Company |
| SWS | Surface Water System |
| taf | Thousand acre-feet |
| Tehama IHM | Tehama Integrated Hydrologic Model |
| TNC | The Nature Conservancy |
| UWMP | Urban Water Management Plan |
| W | Wet Sacramento Valley water year type |
| WMP | Water Management Plan |

# 2. SUBBASIN PLAN AREA AND BASIN SETTING (REG. § 354.8)

## 2.1. Description of Plan Area

## 2.2. Basin Setting

## 2.3. Water Budget (Reg. § 354.18)

An integral component of the GSP is the quantification of the water budget, which is an accounting of water movement and storage between the different systems of the hydrologic cycle (**Figure 2-66**). The Subbasin water budget includes an accounting of all inflows and outflows to the Subbasin. The difference between the volume of inflow and outflow to the Subbasin is equal to the change in storage as illustrated in **Equation 2-1**.

$$\text{Inflows} - \text{Outflows} = \text{Change in Storage}$$

***Equation2-1. Water Budget Equation***

DWR has published guidance and Best Management Practice (BMP) documents related to the development of GSPs, including Water Budget BMPs (DWR, 2016a). The Water Budget BMPs recommend a water budget accounting structure, or conceptual model, that distinguishes the subbasin surface water system (SWS) and groundwater system (GWS). The SWS represents the land surface down to the bottom of plant root zone[1], within the lateral boundaries of the Subbasin. The GWS extends from the bottom of the root zone to the definable bottom of the Subbasin, within the lateral boundaries of the Subbasin. The complete Subbasin water budget is a product of the interconnected SWS and GWS water budgets. The lateral and vertical boundaries of the Subbasin are described in **Section 2.2** of the GSP.

Consistent with these BMPs, this section presents the methodology and results for the historical, current, and projected water budgets of the Los Molinos Subbasin. The water budgets were developed through application of the Tehama Integrated Hydrologic Model (Tehama IHM), a numerical groundwater flow model developed for the Subbasin area that characterizes surface water and groundwater movement and storage across the entire Subbasin, including extending into areas extending outside of the Subbasin. The Tehama IHM is an integrated groundwater and surface water model developed for the purpose of conducting sustainability analyses within Tehama County, including for the Los Molinos Subbasin. The model utilized foundational elements of DWR's SVSim regional model for the Sacramento Valley (DWR, 2021) and was refined locally for improved application in the Subbasin area. Key model refinements made during development of the Tehama IHM include, but are not limited to, extending of the simulation period through water year 2019, refinement of land use conditions based on recent land use mapping information, review and modification to land use crop coefficients based on local remote sensing energy balance data, refinement of surface water supplies and diversions, and enhancements to the sediment textural model used for aquifer parameter. After conducting refinements, the Tehama IHM was calibrated using local groundwater level and streamflow data. The Tehama IHM has a historical simulation period

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[1] The root zone is defined as "the upper portion of the soil where water extraction by plant roots occurs." The depth to the bottom of the root zone varies by crop, but typically ranges from 2-7 feet (ASCE, 2016).

spanning from water year 1985 through 2019, although the calibration period is 1990-2019. Detailed documentation associated with the development of the Tehama IHM is included in **Appendix 2-J.**

This section presents the historical, current, and projected water budget results for the Los Molinos Subbasin. Water budget results for the SWS and GWS are presented individually and as part of a complete water budget for the Subbasin. This section describes the different water budget components and the results of water budget estimates derived from the Tehama IHM. The section includes discussion of the estimated uncertainties associated with the water budget analysis, data sources, and results with additional details related to these topics also described in the model documentation included as **Appendix 2-J**. The water budget results presented in this section are rounded to two significant digits consistent with the typical uncertainty associated with the methods and sources used in the analysis. Water budget component results may not sum to the totals presented because of rounding.

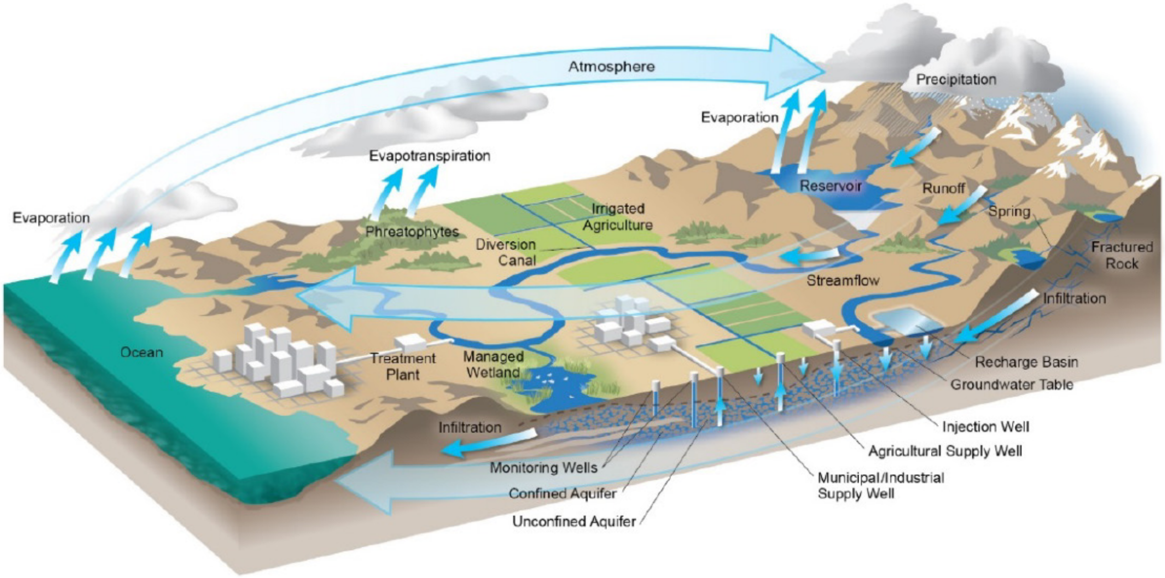

**Figure 2-66. The Hydrologic Cycle (Source: DWR, 2016a)**

### 2.3.1. Water Budget Conceptual Model

A water budget is defined as a complete accounting of all water flowing into and out of a defined volume[2] over a specified period of time. When the water budget is computed for a subbasin, the water budget facilitates assessment of the total volume of groundwater and surface water entering and leaving the subbasin over time, along with the change in volume of water stored within the subbasin.

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[2] Where 'volume' refers to a space with length, width and depth properties, which for purposes of the GSP means the defined aquifer and associated surface water system.

### 2.3.1.1. Water Budget Structure

For accounting purposes, the Subbasin's water budget is divided into the surface water system (SWS) and groundwater system (GWS), described above. These systems are referred to as *accounting centers*. Flows between accounting centers and storage within each accounting center are water budget *components*. A schematic of the general water budget accounting structure is provided in **Figure 2-67**.

The conceptual model (or structure) for the Subbasin water budget is presented in **Figure 2-68**, including presentation of terms used in the following section to describe individual aspects of the water budget. The required components for each accounting center are listed in **Table 2-10**, along with the corresponding section of the GSP Regulations (California Code of Regulations Title 23[3] (23 CCR) §354). Separate but related water budgets were prepared for each accounting center that together represent the overall water budget for the Subbasin.

This section discusses the inflows and outflows from each of the SWS and GWS parts of the Subbasin. The water budgets are calculated using the Tehama IHM, which integrates flows between the SWS and GWS. The GWS water budget incorporates all inflows and outflows from the SWS into an accounting of the net effect of the hydrology and water use on groundwater storage in the Subbasin.

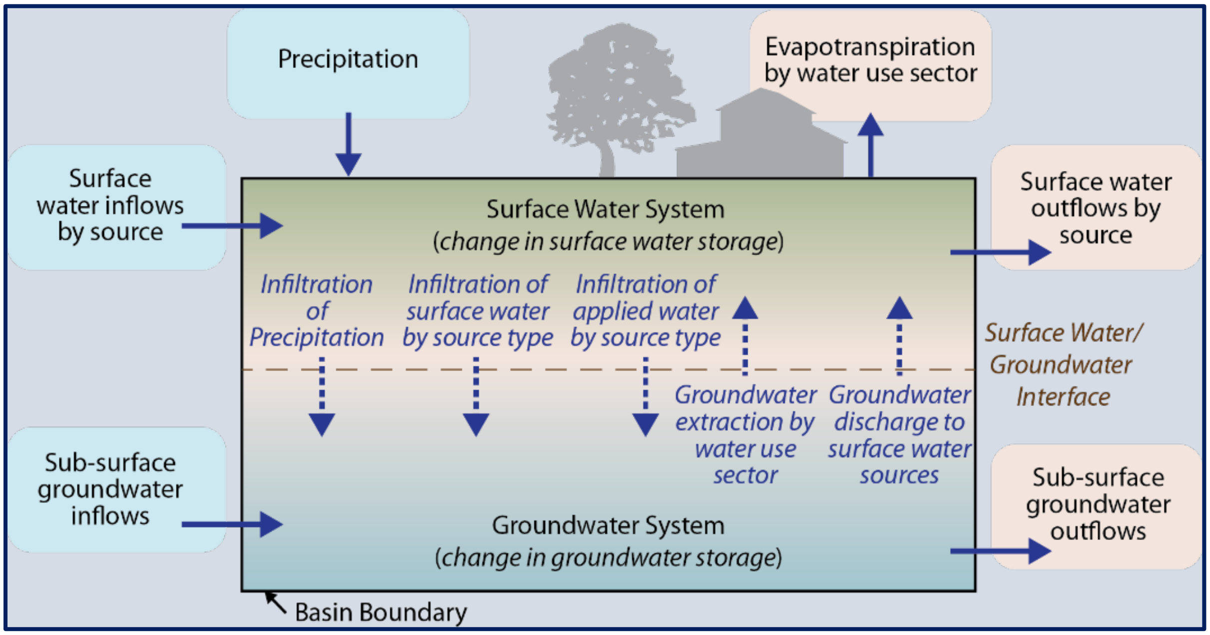

**Figure 2-67. Water Budget Accounting Structure (Source: DWR, 2016a)**

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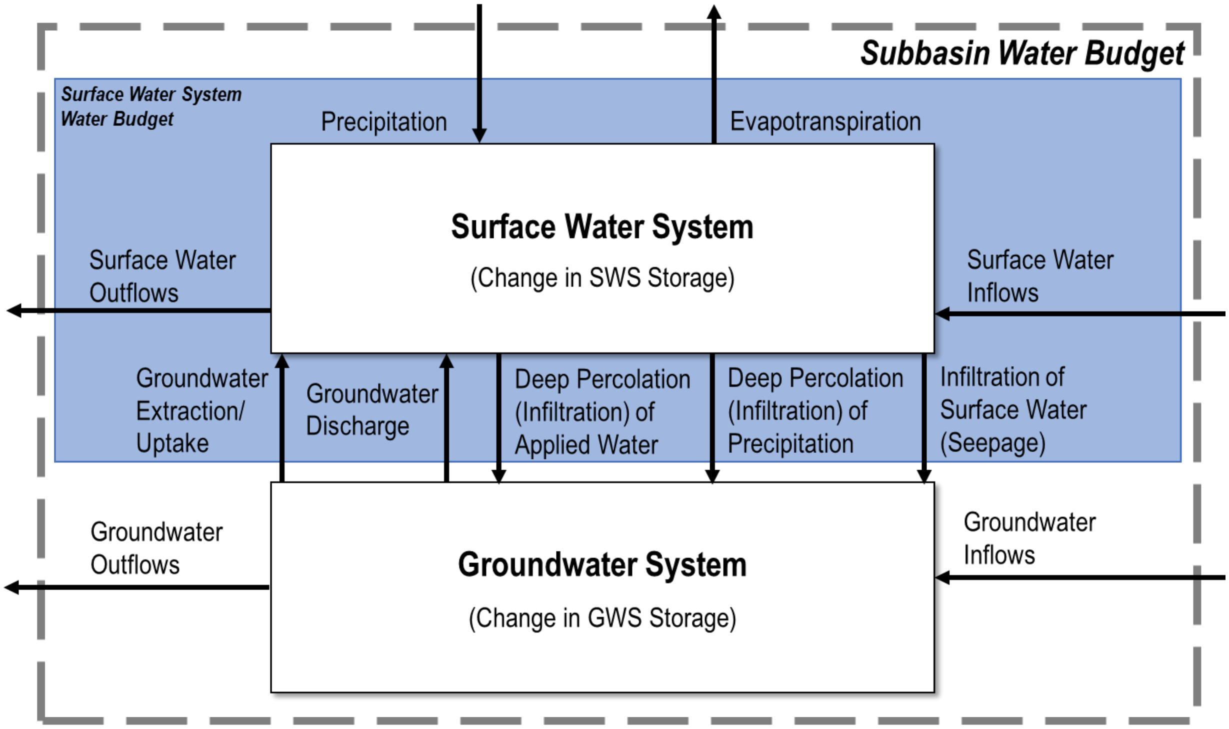
[3] California Code of Regulations, Title 23, Division 2, Chapter 1.5, Subchapter 2 Groundwater Sustainability Plans, Article 5 Plan Contents



Net Recharge from the SWS =
(Deep Percolation of Applied Water + Deep Percolation of Precipitation + Infiltration of Surface Water) – Groundwater Extraction/Uptake

**Figure 2-68. Subbasin Water Budget Conceptual Model**

**Table 2-10. Water Budget Components by Accounting Center and Associated GSP Regulations**

| ACCOUNTING CENTER | WATER BUDGET COMPONENT (FLOW DIRECTION) | GSP REGULATION SECTION1 |
|---|---|---|
| **Basin** | Surface Water Inflow[2] (+) | §354.18(b)(1) |
| | Precipitation (+) | Implied |
| | Subsurface Groundwater Inflow (+) | §354.18(b)(2) |
| | Evapotranspiration[3] (-) | §354.18(b)(3) |
| | Surface Water Outflow[2] (-) | §354.18(b)(1) |
| | Subsurface Groundwater Outflow (-) | §354.18(b)(3) |
| | Change in Storage | §354.18(b)(4) |
| **Surface Water System** | Surface Water Inflow[2] (+) | §354.18(b)(1) |
| | Precipitation (+) | Implied |
| | Groundwater Extraction (+) | §354.18(b)(3) |
| | Groundwater Discharge (+) | §354.18(b)(3) |
| | Evapotranspiration[3] (-) | §354.18(b)(3) |
| | Surface Water Outflow[2] (-) | §354.18(b)(1) |
| | Infiltration of Applied Water[4,5] (-) | §354.18(b)(2) |
| | Infiltration of Precipitation[4] (-) | §354.18(b)(2) |
| | Infiltration of Surface Water[6] (-) | §354.18(b)(2) |
| | Change in SWS Storage[7] | §354.18(a) |
| **Groundwater System** | Subsurface Groundwater Inflow (+) | §354.18(b)(2) |
| | Infiltration of Applied Water[4,5] (+) | §354.18(b)(2) |
| | Infiltration of Precipitation[4] (+) | §354.18(b)(2) |
| | Infiltration of Surface Water[6] (+) | §354.18(b)(2) |
| | Subsurface Groundwater Outflow (-) | §354.18(b)(3) |
| | Groundwater Extraction (-) | §354.18(b)(3) |
| | Groundwater Discharge (-) | §354.18(b)(3) |
| | Change in GWS Storage | §354.18(b)(4) |

1. California Code of Regulations, Title 23, Division 2, Chapter 1.5, Subchapter 2 Groundwater Sustainability Plans, Article 5 Plan Contents
2. By water source type.
3. Evapotranspiration includes total evapotranspiration and evaporation, by water use sector. Total evapotranspiration includes the combined evaporation from the soil and transpiration from plants, resulting from both applied water and precipitation. In this context, evaporation is the direct evaporation from open water surfaces.
4. Synonymous with deep percolation.
5. Includes infiltration of applied surface water, groundwater, and reused water
6. Synonymous with seepage. Includes infiltration of lakes, streams, canals, drains, and springs.
7. Change in storage of root zone soil moisture, not groundwater.

### 2.3.2. Water Budget Analysis Periods

Per 23 CCR §354.18, each GSP must quantify the historical, current, and projected water budget conditions for the Subbasin.

#### 2.3.2.1. Historical and Current Water Budget Periods

The historical water budget for the Subbasin must quantify all required water budget components 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 water budget (23 CCR § 354.18(c)(2)(B)). The historical water budget period effectively represents long-term average historical hydrologic conditions. The current water budget must include the most recent hydrology, water supply, water demand, and land use information (23 CCR § 354.18(c)(1)). The historical water budget enables evaluation of the effects of historical hydrologic conditions and water demands on the water budget and groundwater conditions within the Subbasin over a period representative of long-term hydrologic conditions. The current water budget presents information on the effects of recent hydrologic and water demand conditions on the groundwater system.

The historical and current water budget periods were selected to evaluate conditions over discrete representative periods considering the following criteria: Sacramento Valley water year type; long-term mean annual water supply; inclusion of both wet and dry periods, antecedent dry conditions, adequate data availability; and inclusion of current hydrologic, cultural, and water management conditions in the Subbasin. Water years, as opposed to calendar years, are used as the time unit for defining analysis, following the DWR standard water year period (October 1 through September 30). Unless otherwise noted, all years referenced in this section are water years.

Based on these criteria, the following periods were identified for presentation of historical and current water budgets:

- **Historical Water Budget Period**: Water years 1990-2018 (29 years) using historical hydrologic, climate, water supply, and land use data.
- **Current Water Budget Periods**: Consideration of five different recent water year periods (listed below) using the historical hydrologic, climate, water supply, and land use data over each period.
    - Recent 10 years (2009-2018)
    - Recent 5 years (2014-2018)
    - Recent 3 years (2016-2018)
    - Recent 1 year (2018)
    - Recent 1 year (2019)

For the historical water budget, the period from 1990-2018 was selected to represent long-term average hydrologic conditions following evaluation of precipitation records and DWR Sacramento Valley water year type classification (**Table 2-11**). Further information and discussion of the historical water budget period, including discussion of historical hydrology and the base period selection process, are presented in **Section 2.2** of this GSP. Discussion of the historical water budget water results is included in **Section 2.3.5**

**Table 2-11. Sacramento Valley Water Year Type Classification during the Historical Water Budget Period (1990-2018)**

| SACRAMENTO VALLEY WATER YEAR TYPE | ABBREVIATION | NUMBER OF YEARS, 1990-2018 | PERCENT TOTAL YEARS, 1990-2018 |
|---|---|---|---|
| **Wet** | W | 8 | 28% |
| **Above Normal** | AN | 4 | 14% |
| **Below Normal** | BN | 5 | 17% |
| **Dry** | D | 5 | 17% |
| **Critical** | C | 7 | 24% |
| **Total** | | **29** | **100%** |

For consideration in estimating the current water budget, the results for several recent periods were presented, including recent 1-year, 3-year, 5-year, and 10-year periods. These various periods result in widely varied inflows and outflows, much of which is attributed to varied precipitation and water supplies in individual years (see results in **Section 2.3.6**). Although the model simulations were run for the period 1990-2072, results for 2019 are only shown in the current water budget comparison table for the purpose of considering variability in water budget over different recent time periods. The water budget for year 2019 is not explicitly included in the historical, current, or projected water budgets for the Subbasin although it was simulated in the model to span the years between historical (1990-2018) and projected (2022-2072) water budget periods. Details of model inputs are presented in **Appendix 2-J**. Because of the year-to-year variability in water budget results, the current water budget summarizes results from the various recent periods considered to provide an appropriate and reasonable representation of the current water budget based on recent conditions.

### 2.3.2.2. Projected 50-Year Hydrology and Water Budget Period (§354.18c3)

The projected water budget is intended to evaluate the effects of anticipated future conditions of hydrology, water supply availability, and water demand over a 50-year GSP planning period on the Subbasin water budget and groundwater conditions. The projected water budget incorporates consideration of potential climate change and water supply availability scenarios and evaluation of the need for and benefit of any projects and management actions to be implemented in the Subbasin to maintain or achieve sustainability. The 50-year projected water budget uses hydrologic conditions representative of the most recent 50 years of hydrology in the Subbasin, with adjustments applied in scenarios for evaluating the water budget under climate change and/or altered water supply and demand conditions.

To evaluate projected water budgets, fifty years of future hydrology inputs to the Tehama IHM were developed through consideration of the historical hydrology from 1968 to 2018. Because of the availability of higher quality data and characterization of conditions in the Subbasin during more recent years spanning the historical base period (1990-2018), the projected water budget analyses used surrogate years from the historical period to construct a future hydrology and water budget period representative and consistent with hydrologic conditions over a historical 50-years period from 1968 to 2018. Surrogate years from the historical period were assigned to represent 50 years of future hydrology based on 1) the Sacramento Valley water year index from DWR for each year, 2) mimicking variability (wet and dry) in the historical precipitation conditions in the Subbasin and replicating precipitation consistent with the annual average historical precipitation, and (3) replicating regional streamflow conditions based on flows in the Sacramento River. The frequency of water year types used in the projected hydrology is representative of the 50 years of hydrology for the period 1969-2019 and includes approximately equal proportions of water years with above normal (wet and above normal; 48%) and below normal (below normal, dry, critical; 52%) hydrologic conditions (**Table 2-12**).

The approach and inputs used in development of the projected water budget are described in greater detail in the Tehama IHM documentation included as **Appendix 2-J**.

**Table 2-12. Sacramento Valley Water Year Type Classification Over the Projected Water Budget Period (2022-2072)**

| SACRAMENTO VALLEY WATER YEAR TYPE | ABBREVIATION | NUMBER OF YEARS, 2022-2072 | PERCENT TOTAL YEARS, 2022-2072 |
|---|---|---|---|
| **Wet** | W | 18 | 35% |
| **Above Normal** | AN | 7 | 14% |
| **Below Normal** | BN | 7 | 14% |
| **Dry** | D | 9 | 18% |
| **Critical** | C | 10 | 20% |
| **Total** | | **51** | **100%** |

### 2.3.3. Surface Water System (SWS) Water Budget Description

Water budgets for the SWS were developed to characterize historical and current conditions in the Subbasin relating to the individual inflows and outflows and overall SWS water budget. The general approach used in the SWS water budget calculations is described in **Section 2.3.4.1**. **Section 2.3.6** presents the results of the historical SWS water budgets within the boundary of the Subbasin and **Section 2.3.7** presents results for current SWS water budget analyses. The analyses and results relating to the projected water budget are presented in **Sections 2.3.7** through **2.3.10**. Additional detailed discussion of the procedures and results of the SWS water budgets is included in documentation of the Tehama IHM development and results presented in **Appendix 2-D.**

#### 2.3.3.1. General SWS Water Budget Components and Calculations

SWS inflows and outflows were quantified on a monthly basis, including accounting for any changes in SWS storage, such as changes in water stored in the root zone (**Equation 2-2**).

Total SWS Inflows – Total SWS Outflows = Change in SWS Storage (monthly)

***Equation 2-2. Equation for Los Molinos Subbasin SWS Water Budget Analysis***

As shown in **Figure 2-67** and **Table 2-10**, inflows to the SWS include surface water inflows (in various rivers, streams, and canals), precipitation, groundwater extraction (pumping and groundwater uptake), and groundwater discharge to surface water sources (from areas of high groundwater levels). Outflows include evapotranspiration (ET), surface water outflows (in various rivers, streams, and canals), infiltration of applied water (deep percolation from irrigation), infiltration of precipitation (deep percolation from precipitation), and infiltration of surface water (seepage).

The ET outflow component includes the following: ET of applied water (ET from soil and crop surfaces, of water that is derived from applied surface water, groundwater, and reused water); ET of precipitation (ET from soil and crop surfaces, of water that is derived from precipitation); and evaporation from rivers, streams, canals, reservoirs, and other water bodies. 'ET of applied water' differs from 'applied water' in that applied water is the volume of water that is directly applied to the land surface by irrigators (from all water sources), whereas ET of applied water is the volume of that applied water that is consumptively used by crops, vegetation, and soil surfaces.

Change in SWS storage is also depicted in **Figure 2-68** and **Table 2-10**. This represents the change in root zone soil moisture throughout the year. This is not the same as change in groundwater storage. Net recharge from the SWS is defined as the total groundwater recharge (total infiltration from all sources) minus groundwater outflows to the surface water system, including both groundwater extraction and groundwater uptake by crops and vegetation.[4] Groundwater discharge to the SWS is not included in the net recharge term but is summarized separately as an exchange between the SWS and GWS. Net recharge from the SWS is a useful metric that equates only the impacts of the SWS on recharge and extraction from the GWS, providing valuable insight to the combined effects of land surface processes on the underlying GWS. More information about the net exchanges of surface water and groundwater in the Subbasin is provided in **Appendix 2-K**.

### 2.3.3.2. Detailed SWS Water Budget Accounting Centers and Components

To estimate the water budget components required by the GSP Regulations (**Table 2-10**), the SWS water budget accounting center is subdivided into detailed accounting centers representing the Land Surface System, the Canal System, and the Rivers, Streams, and Small Watersheds System (waterways conveying natural flow and surface water supplies into the Subbasin).

The Land Surface System represents inflows and outflows from irrigated and non-irrigated land. The Canals System represents flows through the canals and conveyance systems of diverters with access to surface water. The Rivers, Streams, and Small Watershed Systems represent inflows and outflows through waterways that convey natural flow, upgradient runoff, and drainage.

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[4] Groundwater discharge to surface water is not included in the calculation of net recharge from the SWS, as groundwater discharge is more dependent on shallow groundwater and soil characteristics along waterways and is much less dependent on the management of the surface layer. Net recharge from the SWS is intended to describe the impacts of the SWS on the GWS, but groundwater discharge is more reflective of the GWS effects on the SWS.

The Land Surface System is further subdivided into water use sectors, defined in the GSP Regulations as "categories of water demand based on the general land uses to which the water is applied, including urban, industrial, agricultural, managed wetlands, managed recharge, and native vegetation" (23 CCR Section 351(al)). Principal water use sectors in the Subbasin include Agricultural (irrigated crop land and idle agricultural land), Native Vegetation (native and riparian vegetation), and Urban (urban, residential, industrial, and semi-agricultural[5]).

### 2.3.3.2.1 *SWS Inflows*

#### *2.3.3.2.1.1 Surface Water Inflow by Water Source Type*

Per the GSP Regulations, surface inflows must be reported by water source type. According to the Regulations (23 CCR § 351(ak)):

> *"Water source type" represents the source from which water is derived to meet the applied beneficial uses, including groundwater, recycled water, reused water, and surface water sources identified as Central Valley Project, the State Water Project, the Colorado River Project, local supplies, and local imported supplies.*

Major surface water inflows to the Los Molinos Subbasin are summarized below according to water source type. Additionally, runoff of precipitation from upgradient areas adjacent to the Subbasin represents a potential source of SWS inflow.

*Local Supplies*

Local supply inflows to the Los Molinos Subbasin predominantly include runoff from upgradient small watersheds adjacent to the Subbasin and surface inflows along Sacramento River, Antelope Creek, little Antelope Creek, Dye Creek, Mill Creek and Deer Creek. A portion of these local supplies are diverted by local water rights users for beneficial use within the Subbasin.

*Central Valley Project*

There are no significant Central Valley Project (CVP) inflows to the Los Molinos Subbasin.

#### *2.3.3.2.1.2 Precipitation*

Precipitation falling on the landscape within the Subbasin is an inflow to the SWS. Precipitation inflows are accounted for by the land use (water use sector) on which they occur.

#### *2.3.3.2.1.3 Groundwater Extraction and Uptake*

Groundwater extraction is an inflow to the SWS (an outflow from the GWS). Groundwater extraction is accounted for by agricultural and urban (urban, residential, semi-agricultural, industrial) water use

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[5] As defined in the DWR crop mapping metadata, semi-agricultural land includes farmsteads and miscellaneous land use incidental to agriculture (small roads, ditches, etc.) (DWR, 2016b).

sectors. Urban groundwater pumping includes domestic well pumping. Groundwater uptake is water taken up by plant roots directly from the GWS.

##### *2.3.3.2.1.4 Groundwater Discharge to Surface Water*

Groundwater discharging to surface water features can occur where groundwater is very shallow and where groundwater levels are higher than the stage in surface water bodies. Groundwater discharge to surface water represents an inflow to the SWS (an outflow from the GWS).

#### 2.3.3.2.2 *SWS Outflows*

##### *2.3.3.2.2.1 Evapotranspiration*

Evapotranspiration (ET) is accounted for by water use sector (urban, agriculture, native) and according to the source water (applied water or precipitation). ET from land includes from applied water and precipitation sources. Evaporation also occurs from rivers, streams, canals, and drains throughout the Subbasin.

##### *2.3.3.2.2.2 Infiltration*

Infiltration (deep percolation) is water that infiltrates below the root zone and recharges the GWS. Infiltration can occur from applied water (e.g., irrigation) or precipitation occurring on the landscape within the Subbasin. Alternatively, infiltration of surface water (stream seepage) can occur from surface water that seeps through the bottom of surface water features and recharges the GWS.

##### *2.3.3.2.2.3 Surface Water Outflow*

In the Los Molinos Subbasin, surface water outflows consist entirely of local supplies that traverse the Subbasin, or that drain from lands within the Subbasin or runoff into the Subbasin from upland areas outside the Subbasin. As described above, substantial local supply volumes enter the Los Molinos Subbasin along Sacramento River and tributary waterways, although much of this water passes through the Subbasin.

### 2.3.3.3. SWS Water Budget Overview

Water budget components are defined for each detailed accounting center in **Table 2-13 through Table 2-16**. Within the Land Surface System accounting center, water budget components are also defined for each water use sector. These detailed water budget accounting centers and components are quantified based on the best available data and science, including information from water management plans (WMPs), groundwater management plans (GMPs), agricultural water management plans (AWMPs), urban water management plans (UWMPs), and other sources.

Each detailed accounting center was computed for the Subbasin. The Subbasin boundary SWS water budget components are identified in **Table 2-16**. The water budget includes the crop demands, available water supplies, and other characteristics specific to the Subbasin, including diversions, evaporation, and infiltration of surface water within the Subbasin.

**Table 2-13. Land Surface System Water Budget Components**

| DETAILED ACCOUNTING CENTER | DETAILED COMPONENT | FLOW DIRECTION | DESCRIPTION |
|---|---|---|---|
| Land Surface System<br>*Water Use Sectors: Agricultural, Native Vegetation, Urban* | Deliveries | Inflow | Deliveries of surface water supply for use within the Subbasin. |
| | Groundwater Extraction | Inflow | Groundwater pumping to meet water demands, and groundwater uptake by crops and vegetation. |
| | Precipitation | Inflow | Direct precipitation on the land surface. |
| | Reuse | Inflow | Reuse of percolated water from the unsaturated zone[1]. |
| | ET of Applied Water | Outflow | Consumptive use of applied irrigation water. |
| | ET of Groundwater Uptake | Outflow | Consumptive use of shallow groundwater uptake. |
| | ET of Precipitation | Outflow | Consumptive use of infiltrated precipitation. |
| | Net Return Flow | Outflow | Net runoff of applied irrigation water, accounting for reuse[2]. |
| | Runoff of Precipitation | Outflow | Direct runoff of precipitation. |
| | Infiltration of Applied Water | Outflow | Deep percolation of applied water below the root zone. |
| | Infiltration of Precipitation | Outflow | Deep percolation of precipitation below the root zone. |
| | Change in SWS Storage | Storage | Change in root zone soil moisture throughout the year; does not represent change in groundwater storage. |

[1] "The unsaturated zone is below the land surface system and represents the portion of the basin that receives percolated water from the root zone and either transmits it as deep percolation to the GWS or to reuse within the land surface system, or both." (DWR, 2016a).

[2] Includes tailwater and pond drainage for ponded crops.

### Table 2-14. Canal System Water Budget Components

| DETAILED ACCOUNTING CENTER | DETAILED COMPONENT | FLOW DIRECTION | DESCRIPTION |
|---|---|---|---|
| Canal System | Diversions | Inflow | Diversions of surface water supply from waterways, a portion of which is delivered and used within the Subbasin. |
| | Deliveries | Outflow | Deliveries of surface water supply for use within the Subbasin. |
| | Infiltration of Surface Water (Seepage) | Outflow | Seepage from canals to the GWS. |
| | Evaporation | Outflow | Direct evaporation from canal water surfaces. |
| | Spillage | Outflow | Spillage from canals used for conveyance. |

### Table 2-15. Rivers, Streams, and Small Watersheds System Water Budget Components

| DETAILED ACCOUNTIN G CENTER | DETAILED COMPONENT | FLOW DIRECTION | DESCRIPTION |
|---|---|---|---|
| Rivers, Streams, and Small Watersheds System | Stream Inflows | Inflow | Surface water inflows at the upstream boundary of waterways that traverse the Subbasin; includes natural flow and spillage, drainage, and runoff from canals and land surfaces upgradient of the Subbasin. |
| | Small Watershed Inflows | Inflow | Surface water inflows of drainage from upgradient small watersheds. |
| | Groundwater Discharge | Inflow | Discharge from shallow groundwater into rivers and streams. |
| | Spillage | Inflow | Spillage from canals used for conveyance. |
| | Stream Outflows | Outflow | Surface water outflows at the downstream boundary of waterways that traverse the Subbasin; includes natural flow and spillage, drainage, and runoff from canals and land surfaces. |
| | Small Watershed Outflows | Outflow | Surface water outflows of drainage from upgradient small watersheds at the downgradient boundary of the Subbasin. |
| | Diversions | Outflow | Diversions of surface water supply from waterways, a portion of which is delivered and used within the Subbasin. |
| | Infiltration of Surface Water (Seepage) | Outflow | Seepage from rivers, streams, and small watershed inflows to the GWS. |
| | Evaporation | Outflow | Direct evaporation from river and stream water surfaces. |

### Table 2-16. Subbasin Boundary Surface Water System Water Budget Components

| DETAILED ACCOUNTING CENTER | DETAILED COMPONENT | FLOW DIRECTION | DESCRIPTION |
|---|---|---|---|
| Rivers, Streams, and Small Watersheds System | Stream Inflows | Inflow | Surface water inflows at the upstream boundary of waterways that traverse the Subbasin; includes natural flow and spillage, drainage, and runoff from canals and land surfaces upgradient of the Subbasin. |
| | Small Watershed Inflows | Inflow | Surface water inflows of drainage from upgradient small watersheds. |
| | Groundwater Discharge | Inflow | Discharge from shallow groundwater into rivers and streams. |
| Canal System | Diversions *(in select cases)* | Inflow | Diversions of surface water supply from waterways *at a point outside or along the boundary of the Subbasin*, a portion of which is delivered and used within the Subbasin |
| Land Surface System *Water Use Sectors: Agricultural, Native Vegetation, Urban* | Groundwater Extraction | Inflow | Groundwater pumping to meet water demands, and groundwater uptake by crops and vegetation. |
| | Precipitation | Inflow | Direct precipitation on the land surface. |
| | ET of Applied Water | Outflow | Consumptive use of applied irrigation water. |
| | ET of Groundwater Uptake | Outflow | Consumptive use of shallow groundwater uptake. |
| | ET of Precipitation | Outflow | Consumptive use of infiltrated precipitation. |
| | Runoff of Applied Water | Outflow | Direct runoff of applied irrigation water[2]. |
| | Runoff of Precipitation | Outflow | Direct runoff of precipitation. |
| | Infiltration of Applied Water | Outflow | Deep percolation of applied water below the root zone. |
| | Infiltration of Precipitation | Outflow | Deep percolation of precipitation below the root zone. |
| | Change in SWS Storage | Storage | Change in root zone soil moisture throughout the year; (not change in groundwater storage) |
| Canal System; and Rivers, Streams, and Small Watersheds System | Infiltration of Surface Water (Seepage) | Outflow | Seepage from canals, streams, and small watershed inflows to the GWS. |
| | Evaporation | Outflow | Direct evaporation from canals, rivers, and streams. |
| Canal System | Spillage | Outflow | Spillage from canals used for interior conveyance. |
| Rivers, Streams, and Small Watersheds System | Stream Outflows | Outflow | Surface water outflows at the downstream boundary of waterways that traverse the Subbasin; includes natural flow and spillage, drainage, and runoff from canals and land surfaces. |
| | Small Watershed Outflows | Outflow | Surface water outflows of drainage from upgradient small watersheds at the downgradient boundary of the Subbasin. |

## 2.3.4. Groundwater System Water Budget Description

Water budgets for the GWS were developed to characterize historical and current conditions in the Subbasin utilizing the Tehama IHM for different historical and current time periods described above. **Sections 2.3.6** and **2.3.7** present the results of the historical and current GWS water budgets within the lateral and vertical boundaries of the Subbasin. Discussion of the general approach used in developing model scenarios to evaluate projected GWS water budgets for the Subbasin with the Tehama IHM and the results from these projected water budget analyses is included in **Sections 2.3.8** through **2.3.8**. More detail related to the procedures and results of the GWS water budgets are also included in documentation of the Tehama IHM development presented in **Appendices 2-J and 2-K.**

### 2.3.4.1. GWS Water Budget Components and Calculations

Inflows and outflows of the GWS were quantified on a monthly basis, including accounting for any changes in GWS storage (**Equation 2-2**).

Total GWS Inflows – Total GWS Outflows = Change in GWS Storage (monthly)

***Equation 2-3. Equation for Los Molinos Subbasin GWS Water Budget Analysis***

As shown in **Figure 2-67** and **Table 2-10**, inflows to the GWS include some of the outflow components from the SWS including infiltration (deep percolation) of precipitation and applied water and infiltration (seepage) of surface water. Additional GWS inflows include lateral subsurface groundwater inflows from adjacent subbasins and from adjacent upland or foothill areas outside the Subbasin (small watersheds). GWS outflows include exchanges with the SWS including groundwater discharge to surface waterways, groundwater extraction through pumping, and root water uptake by plants occurring directly from shallow groundwater. Lateral subsurface groundwater flows to adjacent subbasins represent additional GWS outflows. Water budget components representing exchanges between the GWS and the SWS are also included in discussions and presentations of the SWS conceptual water budget and results.

#### 2.3.4.1.1 *Lateral Subsurface Flows*

Subsurface groundwater flows to and from the Los Molinos Subbasin occur between the Antelope, Red Bluff, Corning Subbasins to the west and the Vina Subbasin to the south. Additional subsurface groundwater inflows occur from the upland (small watershed) areas adjoining the Los Molinos Subbasin.

#### 2.3.4.1.2 *Deep Percolation From the SWS*

Deep percolation from the SWS includes infiltration of water below the root zone (deep percolation) from precipitation and applied water. These two water budget components represent inflows to the GWS and are also included in the SWS water budget as outflows from the SWS.

#### 2.3.4.1.3 *Net Stream Seepage/Groundwater Discharge to Surface Water*

The flow of water between the GWS and SWS through seepage of water from streams and canals and groundwater discharging into streams is discussed as part of the SWS water budget. These components are combined in the GWS water budget as a net volume of stream seepage. Positive total net seepage values represent a net inflow of water from the SWS to the GWS via stream and canal seepage indicating that the overall volume of stream seepage is greater than the volume of any groundwater discharging into surface waterways. Negative net seepage values represent a net outflow of groundwater from the GWS to the SWS through groundwater discharge to surface water. When net seepage is negative, it means that more groundwater is discharging into the surface waterways than is seeping from surface waterways into the GWS.

#### 2.3.4.1.4 *Groundwater Extraction and Uptake*

Groundwater extractions and groundwater uptake are exchanges that occur between the GWS and the SWS and represent an outflow from the GWS. Groundwater extraction from the GWS occurs through groundwater pumping to meet water demands for urban and agricultural needs whereas groundwater uptake occurs through uptake of water by plants directly from the GWS.

### 2.3.4.2. GWS Water Budget Overview

Change in GWS storage as represented by change in groundwater storage is also depicted in **Figure 2-68** and **Table** . The change in groundwater storage represents the total change in the volume of water in storage in the groundwater system as a result of exchanges between the GWS and the SWS and the balance of all inflows and outflows of the GWS. The change in groundwater storage is directly related to changes in water levels in the groundwater system, both of which are sustainability indicators to be considered during development of a sustainable yield for the Subbasin. Each of the detailed components of the Subbasin boundary GWS water budget are identified in **Table 2-17** and were computed for the Subbasin to develop a complete GWS water budget. The HCM discussed in **Section 2.2** identifies two principal aquifers within the GWS: an Upper Aquifer and Lower Aquifer. Vertical groundwater flow does occur between these aquifers and change in storage of the entire GWS and also within each principal aquifer zone are considerations for sustainable groundwater management.

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**Table 2-17. Subbasin Boundary Groundwater System Water Budget Components**

| ACCOUNTING CENTER | DETAILED COMPONENT | FLOW DIRECTION | DESCRIPTION |
|---|---|---|---|
| Groundwater System | Lateral Subsurface Groundwater Flows Between Adjacent Subbasins | Inflow | Lateral subsurface groundwater inflow from adjacent subbasins. |
| | Lateral Subsurface Groundwater Flows Between Adjacent Upland or Foothill Areas | Inflow | Lateral subsurface groundwater inflow from adjacent upland or foothill areas. |
| | Infiltration of Surface Water (Seepage) | Inflow | Seepage from canal, streams, and small watershed inflows from the SWS. |
| | Infiltration (Deep Percolation) of Applied Water | Inflow | Deep percolation of applied water below the root zone from the SWS. |
| | Infiltration (Deep Percolation) of Precipitation | Inflow | Deep percolation of precipitation below the root zone from the SWS. |
| | Lateral Subsurface Groundwater Flows Between Adjacent Subbasins | Outflow | Lateral subsurface groundwater outflow to adjacent subbasins. |
| | Groundwater Extraction | Outflow | Groundwater pumping to meet water demands, and groundwater uptake by crops and vegetation. |
| | Groundwater Discharge | Outflow | Discharge from shallow groundwater into rivers and streams. |
| | Vertical Subsurface Groundwater Flows within the GWS | Storage | Vertical subsurface groundwater flows between the Upper and Lower Aquifers within the GWS |
| | Change in GWS Storage | Storage | Change in volume of water stored within the groundwater system, representative of total accrual or depletion of groundwater storage. |

## 2.3.5. Historical Water Budget

The following section summarizes the analyses and results relating to the historical SWS water budget for the Subbasin. Detailed descriptions and presentation of results for each of the individual water budget components, and the processes and data sources used in their development are included in **Appendices 2-J and 2-K**.

### 2.3.5.1. Land Use

Characterizing historical land use is foundational for accurately quantifying how and where water is beneficially used. Land use areas are also used to distinguish the water use sector in which water is consumed, as required by the GSP Regulations. **Figure 2-69** and **Table 2-18** summarize the annual land use areas over the historical period (1990-2018) in the Los Molinos Subbasin by water use sector, as defined by the GSP Regulations (23 CCR § 351(al)). In the Los Molinos Subbasin, water use sectors include agricultural, urban, and native vegetation land uses. The urban water use sector covers all urban, residential, industrial, and semi-agricultural[6] land uses. See Plan Area section 2.1.1.2, Land Use.

On average, agricultural, urban, and native vegetation land uses covered approximately 18,200 acres, 1,600 acres, and 79,500 acres, respectively, between 1990 and 2018. The total area of each water use sector has remained relatively constant over time, though slight expansion of urban land uses in the 1990s coincided with a similar decrease in agricultural acreage.

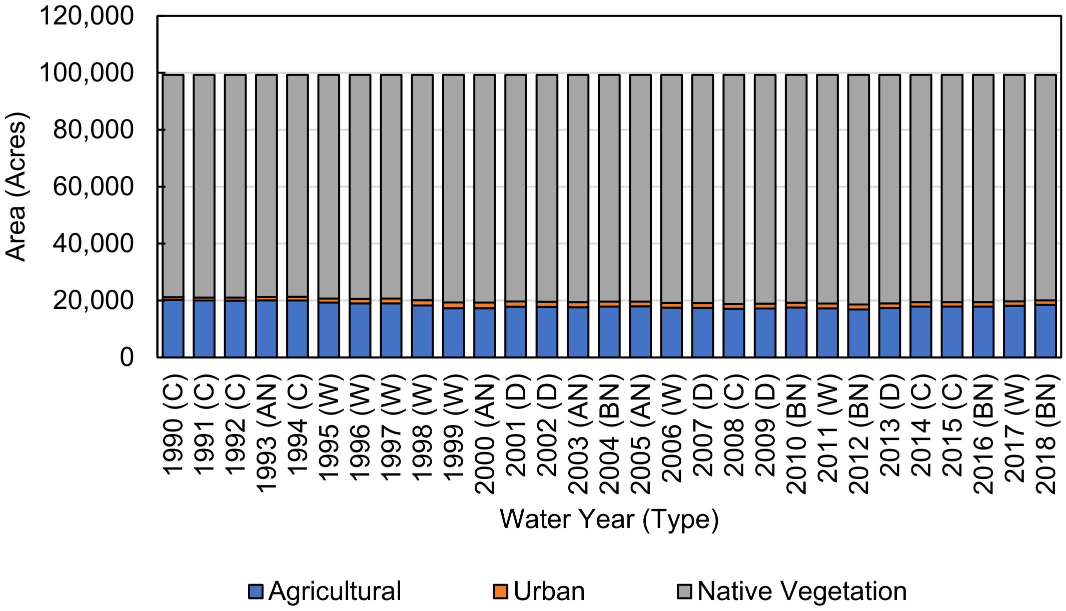

**Figure 2-69. Los Molinos Subbasin Land Use Areas, by Water Use Sector**

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[6] As defined in the DWR crop mapping metadata, semi-agricultural land use subclasses include farmsteads, livestock feed lot operations, dairies, poultry farms, and miscellaneous semi-agricultural land use incidental to agriculture (small roads, ditches, non-planted areas of cropped fields (DWR, 2016b).

**Table 2-18. Los Molinos Subbasin Land Use Areas, by Water Use Sector**

| WATER YEAR (TYPE) | AGRICULTURAL | URBAN[1] | NATIVE VEGETATION | TOTAL |
|---|---|---|---|---|
| 1990 (C) | 20,212 | 951 | 78,123 | 99,286 |
| 1991 (C) | 20,008 | 1,020 | 78,259 | 99,286 |
| 1992 (C) | 19,932 | 1,101 | 78,253 | 99,286 |
| 1993 (AN) | 20,050 | 1,173 | 78,063 | 99,286 |
| 1994 (C) | 20,032 | 1,244 | 78,010 | 99,286 |
| 1995 (W) | 19,281 | 1,396 | 78,609 | 99,286 |
| 1996 (W) | 18,980 | 1,563 | 78,744 | 99,286 |
| 1997 (W) | 18,986 | 1,692 | 78,608 | 99,286 |
| 1998 (W) | 18,272 | 1,842 | 79,172 | 99,286 |
| 1999 (W) | 17,315 | 2,000 | 79,971 | 99,286 |
| 2000 (AN) | 17,300 | 1,965 | 80,022 | 99,286 |
| 2001 (D) | 17,803 | 1,875 | 79,608 | 99,286 |
| 2002 (D) | 17,743 | 1,819 | 79,724 | 99,286 |
| 2003 (AN) | 17,670 | 1,782 | 79,835 | 99,286 |
| 2004 (BN) | 17,855 | 1,733 | 79,698 | 99,286 |
| 2005 (AN) | 17,979 | 1,644 | 79,663 | 99,286 |
| 2006 (W) | 17,494 | 1,696 | 80,096 | 99,286 |
| 2007 (D) | 17,409 | 1,679 | 80,198 | 99,286 |
| 2008 (C) | 17,066 | 1,713 | 80,507 | 99,286 |
| 2009 (D) | 17,220 | 1,692 | 80,375 | 99,286 |
| 2010 (BN) | 17,539 | 1,693 | 80,055 | 99,286 |
| 2011 (W) | 17,257 | 1,696 | 80,333 | 99,286 |
| 2012 (BN) | 16,865 | 1,727 | 80,694 | 99,286 |
| 2013 (D) | 17,360 | 1,657 | 80,269 | 99,286 |
| 2014 (C) | 17,854 | 1,590 | 79,842 | 99,286 |
| 2015 (C) | 17,873 | 1,575 | 79,838 | 99,286 |
| 2016 (BN) | 17,877 | 1,557 | 79,852 | 99,286 |
| 2017 (W) | 18,175 | 1,541 | 79,570 | 99,286 |
| 2018 (BN) | 18,483 | 1,559 | 79,245 | 99,286 |
| Average (1990-2018) | 18,203 | 1,592 | 79,491 | 99,286 |

[1] Area includes land classified as urban, residential, industrial, and semi-agricultural.

Agricultural land uses are further detailed in **Figure 2-70** and **Table 2-19**. Historically, a majority of the agricultural area in the Los Molinos Subbasin has been comprised of pasture and various orchard crops, especially walnuts and prunes. The total area used to cultivate these primary crops has remained relatively constant over time, though the composition of orchard crops has shifted in recent years, with decreased acreage of prunes and increased acreage of walnuts. Slight decreases in agricultural land use have instead resulted from loss of other irrigated crop areas, such as alfalfa, grain, and safflower.

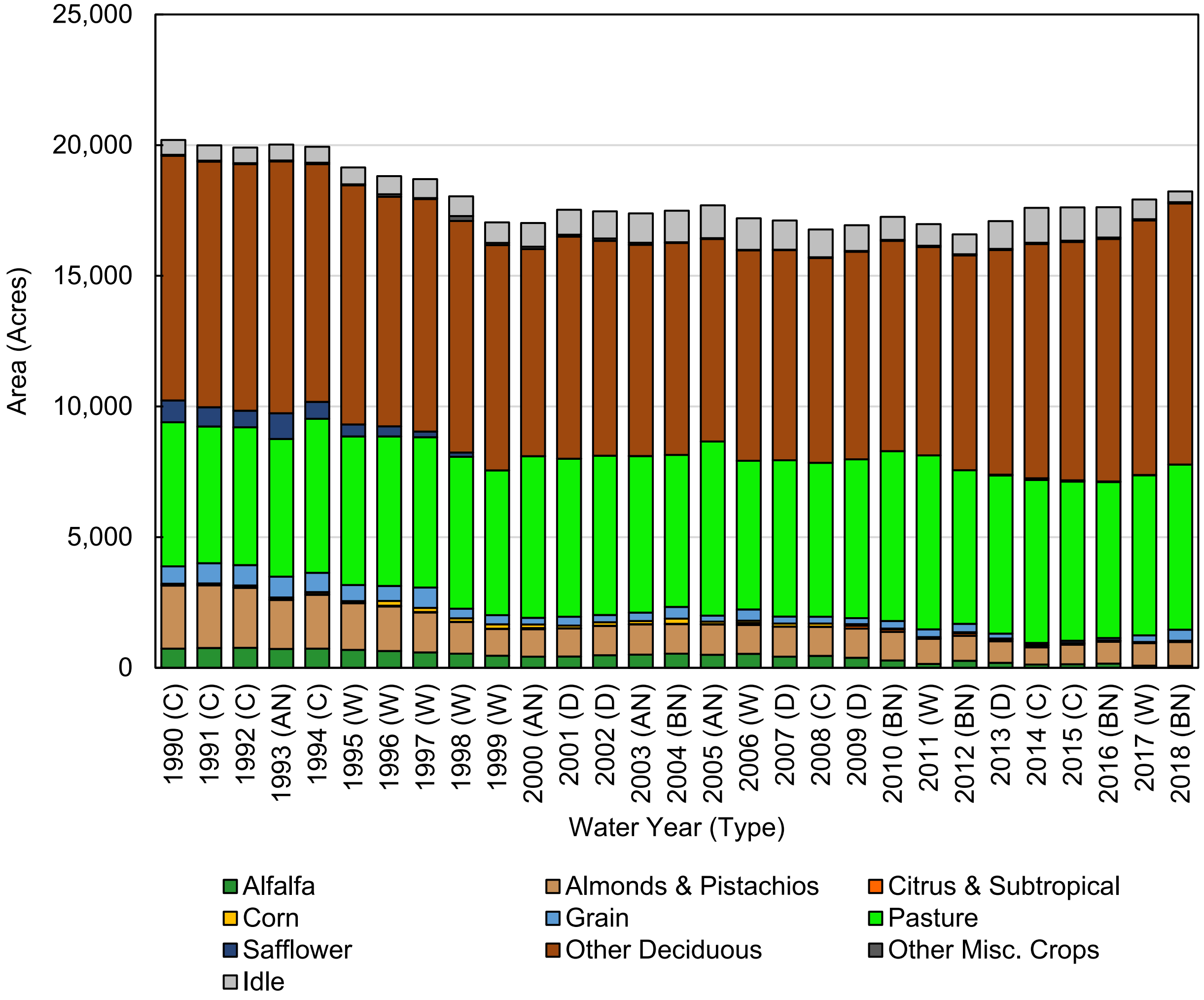


**Figure 2-70. Los Molinos Subbasin Agricultural Land Use Areas**

### Table 2-19. Los Molinos Subbasin Agricultural Land Use Areas (acres)

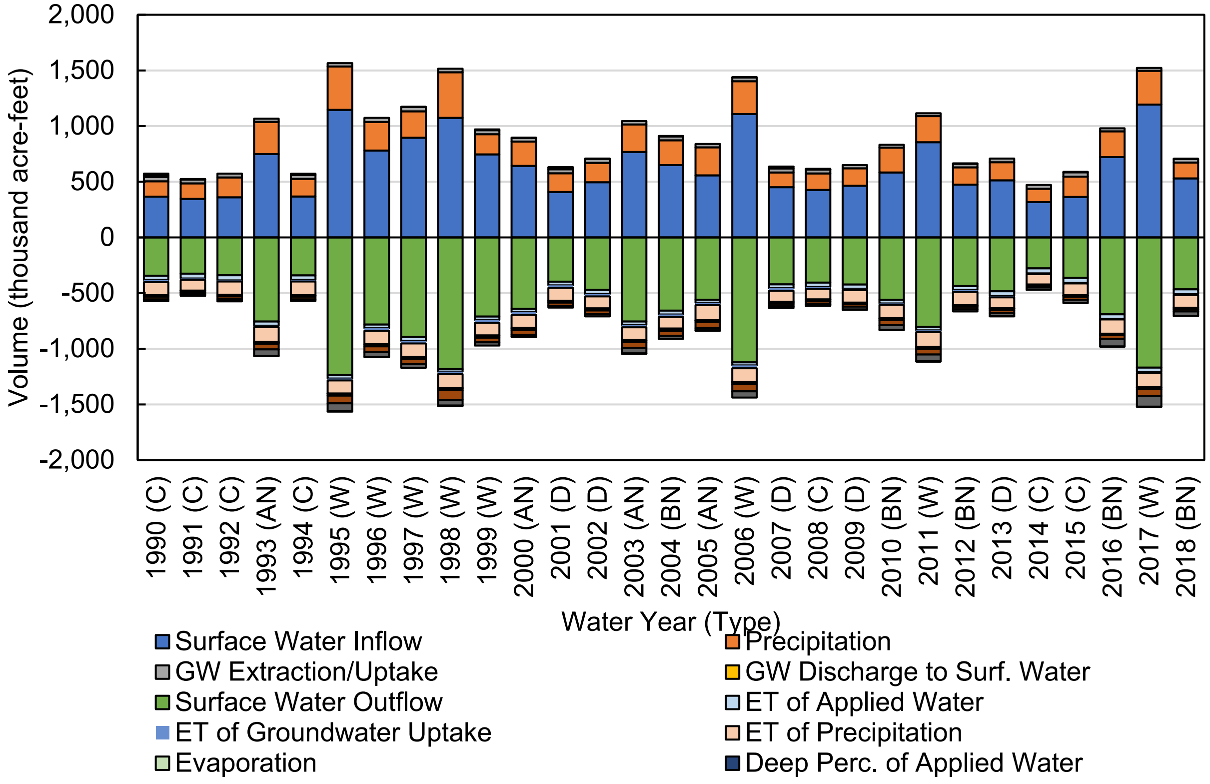
| WATER YEAR (TYPE) | ALFALFA | ALMONDS & PISTACHIOS | CITRUS & SUBTROPICAL | CORN | GRAIN | PASTURE | PONDED (RICE) | SAFFLOWER | OTHER DECIDUOUS[1] | OTHER MISC. CROPS[2] | IDLE | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1990 (C) | 737 | 2,409 | 36 | 37 | 661 | 5,515 | 14 | 833 | 9,367 | 37 | 566 | 20,212 |
| 1991 (C) | 758 | 2,397 | 34 | 44 | 773 | 5,229 | 18 | 738 | 9,399 | 36 | 583 | 20,008 |
| 1992 (C) | 767 | 2,292 | 32 | 63 | 777 | 5,275 | 22 | 632 | 9,435 | 36 | 600 | 19,932 |
| 1993 (AN) | 725 | 1,867 | 30 | 67 | 800 | 5,265 | 27 | 988 | 9,635 | 37 | 609 | 20,050 |
| 1994 (C) | 735 | 2,060 | 25 | 79 | 736 | 5,893 | 95 | 646 | 9,102 | 53 | 608 | 20,032 |
| 1995 (W) | 685 | 1,781 | 21 | 68 | 615 | 5,685 | 132 | 460 | 9,147 | 38 | 649 | 19,281 |
| 1996 (W) | 645 | 1,705 | 28 | 181 | 574 | 5,721 | 164 | 390 | 8,782 | 93 | 697 | 18,980 |
| 1997 (W) | 590 | 1,528 | 19 | 158 | 779 | 5,747 | 288 | 220 | 8,900 | 38 | 721 | 18,986 |
| 1998 (W) | 539 | 1,209 | 12 | 133 | 373 | 5,808 | 233 | 162 | 8,864 | 184 | 754 | 18,272 |
| 1999 (W) | 461 | 1,023 | 12 | 165 | 354 | 5,540 | 268 | 0 | 8,617 | 84 | 789 | 17,315 |
| 2000 (AN) | 424 | 1,056 | 40 | 138 | 254 | 6,185 | 277 | 1 | 7,928 | 89 | 910 | 17,300 |
| 2001 (D) | 436 | 1,072 | 7 | 101 | 340 | 6,045 | 274 | 1 | 8,500 | 71 | 958 | 17,803 |
| 2002 (D) | 482 | 1,122 | 7 | 134 | 277 | 6,093 | 274 | 0 | 8,222 | 92 | 1,041 | 17,743 |
| 2003 (AN) | 504 | 1,162 | 7 | 118 | 322 | 5,995 | 278 | 1 | 8,078 | 81 | 1,124 | 17,670 |
| 2004 (BN) | 539 | 1,133 | 14 | 195 | 450 | 5,819 | 363 | 0 | 8,110 | 24 | 1,208 | 17,855 |
| 2005 (AN) | 499 | 1,160 | 12 | 95 | 235 | 6,662 | 281 | 0 | 7,751 | 26 | 1,260 | 17,979 |
| 2006 (W) | 534 | 1,107 | 81 | 85 | 430 | 5,688 | 290 | 0 | 8,051 | 19 | 1,210 | 17,494 |
| 2007 (D) | 426 | 1,147 | 8 | 115 | 265 | 5,979 | 290 | 0 | 8,039 | 24 | 1,117 | 17,409 |
| 2008 (C) | 456 | 1,110 | 8 | 122 | 262 | 5,886 | 290 | 0 | 7,834 | 33 | 1,065 | 17,066 |
| 2009 (D) | 382 | 1,118 | 113 | 60 | 228 | 6,075 | 283 | 0 | 7,943 | 36 | 983 | 17,220 |
| 2010 (BN) | 284 | 1,090 | 95 | 34 | 290 | 6,498 | 280 | 0 | 8,047 | 36 | 885 | 17,539 |
| 2011 (W) | 149 | 959 | 15 | 53 | 296 | 6,658 | 280 | 0 | 7,971 | 48 | 829 | 17,257 |
| 2012 (BN) | 267 | 958 | 88 | 49 | 322 | 5,879 | 282 | 0 | 8,222 | 41 | 758 | 16,865 |
| 2013 (D) | 191 | 821 | 71 | 37 | 191 | 6,048 | 267 | 34 | 8,597 | 40 | 1,063 | 17,360 |
| 2014 (C) | 122 | 664 | 63 | 32 | 74 | 6,234 | 253 | 68 | 8,962 | 46 | 1,338 | 17,854 |
| 2015 (C) | 138 | 748 | 47 | 19 | 83 | 6,094 | 253 | 46 | 9,121 | 49 | 1,276 | 17,873 |
| 2016 (BN) | 159 | 835 | 47 | 10 | 88 | 5,966 | 253 | 24 | 9,283 | 51 | 1,160 | 17,877 |
| 2017 (W) | 83 | 863 | 40 | 5 | 254 | 6,122 | 256 | 12 | 9,737 | 49 | 755 | 18,175 |
| 2018 (BN) | 77 | 909 | 48 | 2 | 422 | 6,321 | 252 | 0 | 9,990 | 49 | 414 | 18,483 |
| Average (1990-2018) | 441 | 1,286 | 37 | 83 | 397 | 5,928 | 226 | 181 | 8,677 | 53 | 894 | 18,203 |

[1] Includes primarily walnuts and prunes.

[2] Area includes land classified as cotton, cucurbits, dry beans, onions & garlic, potatoes, sugar beets, tomatoes, vineyards, other field crops, and other truck crops.

### 2.3.5.2. Historical Surface Water System Water Budget Summary

Annual inflows, outflows, and change in SWS root zone storage during the historical water budget period (1990-2018) are summarized in **Table 2-20**. Detailed results for the historical SWS water budget are presented in **Appendix 2-K**.


2,000
1,500
1,000
500
0
-500
-1,000
-1,500
-2,000
Volume (thousand acre-feet)
1990 (C)
1991 (C)
1992 (C)
1993 (AN)
1994 (C)
1995 (W)
1996 (W)
1997 (W)
1998 (W)
1999 (W)
2000 (AN)
2001 (D)
2002 (D)
2003 (AN)
2004 (BN)
2005 (AN)
2006 (W)
2007 (D)
2008 (C)
2009 (D)
2010 (BN)
2011 (W)
2012 (BN)
2013 (D)
2014 (C)
2015 (C)
2016 (BN)
2017 (W)
2018 (BN)
Water Year (Type)
Surface Water Inflow
Precipitation
GW Extraction/Uptake
GW Discharge to Surf. Water
Surface Water Outflow
ET of Applied Water
ET of Groundwater Uptake
ET of Precipitation
Evaporation
Deep Perc. of Applied Water

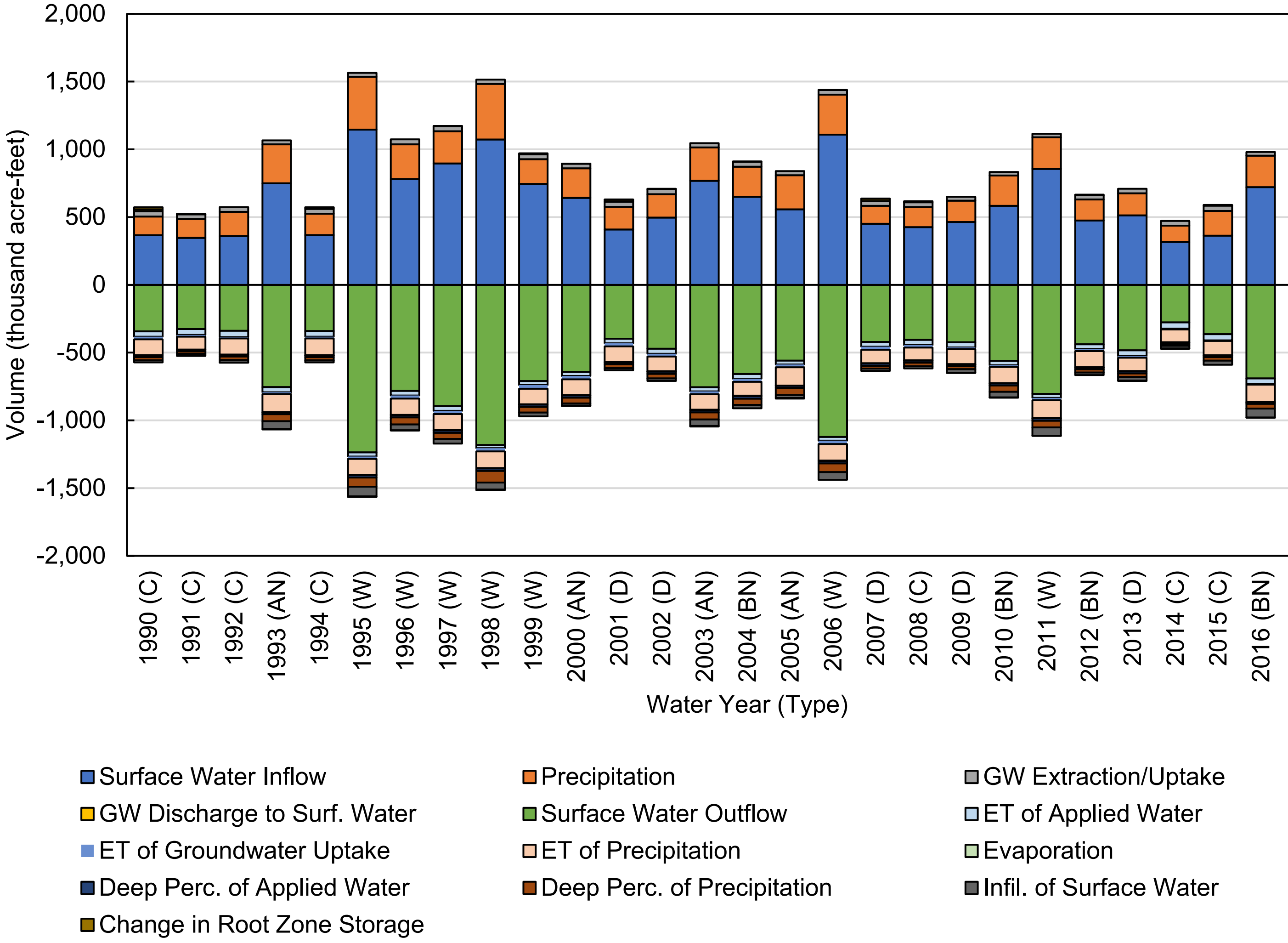


**Figure 2-71. Los Molinos Subbasin Surface Water System Historical Water Budget, 1990-2018**

Table 2-

Inflows in **Figure 2-71** are shown as positive values, while outflows and change in SWS root zone storage are shown as negative values. Review of the variability in component volumes across years provides insight into the impacts of hydrology on the SWS water budget.

Of particular note in the historical SWS water budget results are the volumes of surface water inflows that make up a large part of the Subbasin SWS inflows. Over the historical period, surface water inflows to surface water averaged about 630 taf per year. Precipitation also represents a large SWS inflow component averaging about 210 taf per year. Groundwater extraction and uptake represent a small SWS inflow in the Subbasin averaging about 33 taf per year over the historical water budget period. Groundwater discharge to surface water represents a smaller SWS inflow averaging about 2 taf per year.

Among the outflows from the Subbasin SWS, surface water outflow makes up a large fraction of the total Subbasin SWS outflows. The surface water outflows total about 620 taf per year on average, a value that corresponds with the large volumes of surface water inflow (about 630 taf per year). By comparison, other SWS outflows in the Subbasin are relatively smaller, with values for ET of precipitation about 120 taf per year and ET of applied water totaling about 36 taf per year on average. The outflow of deep percolation of precipitation, infiltration (seepage) of surface water, and deep percolation of applied water are about 39, 35 and 15 taf per year on average, respectively. Together, the outflows from the SWS to the GWS total about 89 taf per year over the historic water budget period. The outflows of ET of groundwater uptake and evaporation from surface water are about 17 and 2.1 taf per year, respectively.

Detailed results for the historical SWS water budget are presented in **Appendix 2-K**.

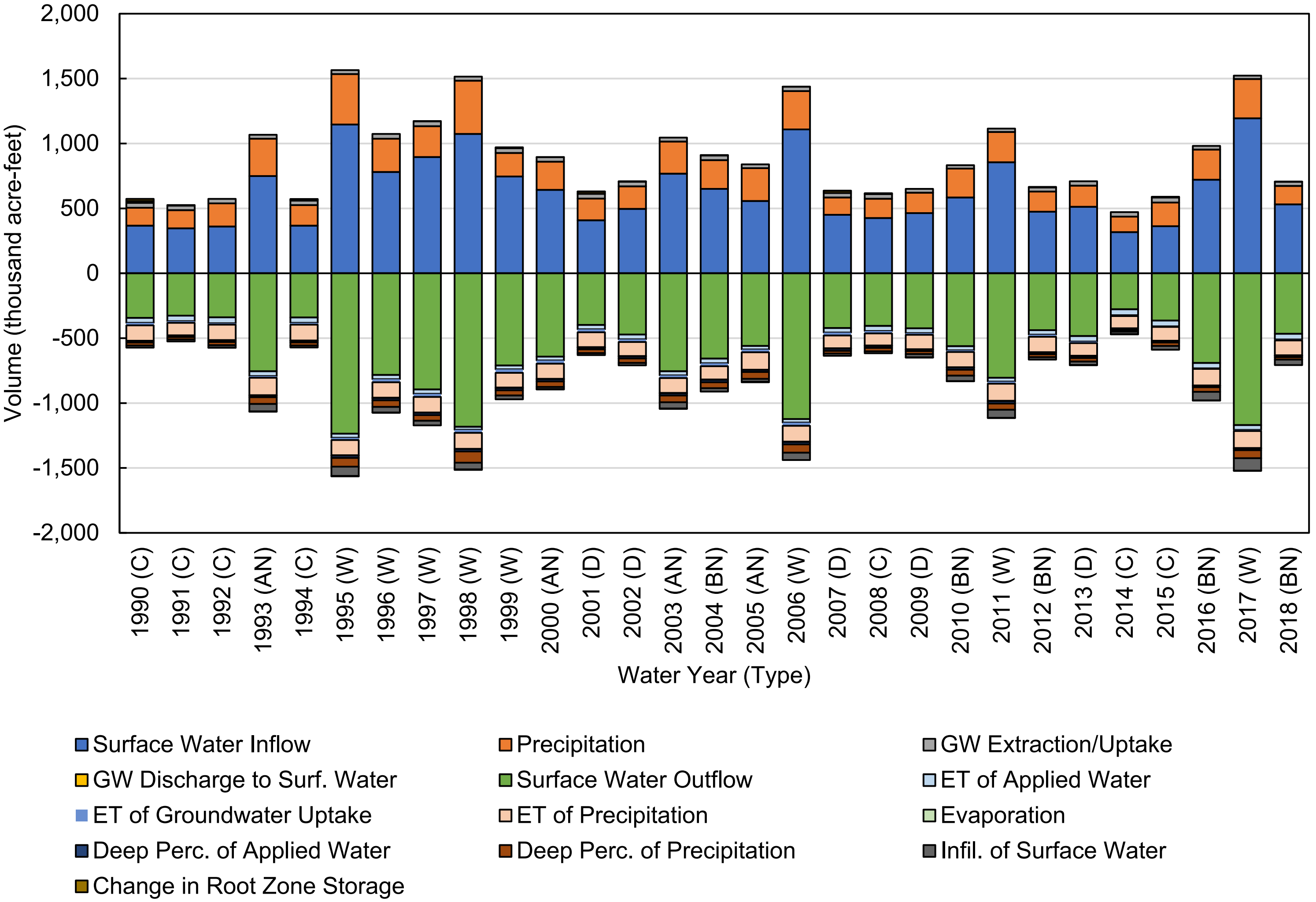


**Figure 2-71. Los Molinos Subbasin Surface Water System Historical Water Budget, 1990-2018**

**Table 2-20. Los Molinos Subbasin Surface Water System Historical Water Budget, 1990-2018 (acre-feet)**

| WATER YEAR (TYPE) | INFLOWS | | | | OUTFLOWS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SURFACE WATER INFLOW | PRECIPITATION | GROUNDWATER EXTRACTION / UPTAKE | GROUNDWATER DISCHARGE | SURFACE WATER OUTFLOW | ET OF APPLIED WATER | ET OF GROUNDWATER UPTAKE | ET OF PRECIPITATION | EVAPORATION | DEEP PERC. OF APPLIED WATER | DEEP PERC. OF PRECIPITATION | INFIL. OF SURFACE WATER | CHANGE IN ROOT ZONE STORAGE |
| 1990 (C) | 370,000 | 140,000 | 38,000 | 14,000 | 340,000 | 38,000 | 20,000 | 120,000 | 910 | 13,000 | 24,000 | 16,000 | -16,000 |
| 1991 (C) | 350,000 | 140,000 | 35,000 | 2,900 | 330,000 | 43,000 | 13,000 | 96,000 | 940 | 13,000 | 18,000 | 15,000 | -1,400 |
| 1992 (C) | 360,000 | 180,000 | 34,000 | 0 | 340,000 | 46,000 | 10,000 | 120,000 | 920 | 13,000 | 25,000 | 19,000 | 100 |
| 1993 (AN) | 750,000 | 290,000 | 30,000 | 0 | 750,000 | 37,000 | 13,000 | 130,000 | 870 | 15,000 | 52,000 | 58,000 | 2,700 |
| 1994 (C) | 370,000 | 160,000 | 35,000 | 8,100 | 340,000 | 41,000 | 14,000 | 120,000 | 850 | 13,000 | 24,000 | 15,000 | -3,600 |
| 1995 (W) | 1,100,000 | 390,000 | 30,000 | 0 | 1,200,000 | 31,000 | 17,000 | 120,000 | 1,100 | 18,000 | 68,000 | 71,000 | 4,000 |
| 1996 (W) | 780,000 | 260,000 | 37,000 | 0 | 780,000 | 33,000 | 23,000 | 120,000 | 1,700 | 17,000 | 52,000 | 43,000 | 400 |
| 1997 (W) | 900,000 | 240,000 | 38,000 | 0 | 890,000 | 34,000 | 24,000 | 120,000 | 2,300 | 17,000 | 44,000 | 35,000 | -420 |
| 1998 (W) | 1,100,000 | 410,000 | 32,000 | 0 | 1,200,000 | 23,000 | 24,000 | 120,000 | 1,600 | 19,000 | 86,000 | 52,000 | 3,900 |
| 1999 (W) | 750,000 | 180,000 | 36,000 | 0 | 710,000 | 29,000 | 27,000 | 110,000 | 3,000 | 17,000 | 41,000 | 28,000 | -7,100 |
| 2000 (AN) | 640,000 | 220,000 | 34,000 | 820 | 640,000 | 29,000 | 25,000 | 120,000 | 2,700 | 17,000 | 42,000 | 16,000 | 3,300 |
| 2001 (D) | 410,000 | 170,000 | 37,000 | 15,000 | 400,000 | 33,000 | 23,000 | 120,000 | 2,900 | 13,000 | 29,000 | 16,000 | -2,800 |
| 2002 (D) | 500,000 | 170,000 | 36,000 | 0 | 470,000 | 37,000 | 21,000 | 110,000 | 3,000 | 16,000 | 34,000 | 18,000 | -3,100 |
| 2003 (AN) | 770,000 | 250,000 | 31,000 | 0 | 760,000 | 31,000 | 21,000 | 120,000 | 2,400 | 17,000 | 52,000 | 48,000 | 4,300 |
| 2004 (BN) | 650,000 | 220,000 | 36,000 | 0 | 660,000 | 35,000 | 23,000 | 100,000 | 2,800 | 19,000 | 45,000 | 26,000 | -3,600 |
| 2005 (AN) | 560,000 | 250,000 | 30,000 | 0 | 560,000 | 27,000 | 21,000 | 140,000 | 1,800 | 15,000 | 53,000 | 21,000 | 4,300 |
| 2006 (W) | 1,100,000 | 300,000 | 34,000 | 0 | 1,100,000 | 27,000 | 25,000 | 120,000 | 2,100 | 18,000 | 64,000 | 56,000 | -890 |
| 2007 (D) | 450,000 | 130,000 | 36,000 | 16,000 | 420,000 | 34,000 | 23,000 | 99,000 | 2,700 | 16,000 | 21,000 | 17,000 | -310 |
| 2008 (C) | 430,000 | 150,000 | 35,000 | 2,200 | 410,000 | 39,000 | 18,000 | 94,000 | 2,900 | 15,000 | 26,000 | 16,000 | -4,600 |
| 2009 (D) | 460,000 | 160,000 | 29,000 | 0 | 420,000 | 37,000 | 13,000 | 110,000 | 2,500 | 12,000 | 22,000 | 26,000 | 2,100 |

| WATER YEAR (TYPE) | | INFLOWS | | | | OUTFLOWS | | | | | | | | CHANGE IN ROOT ZONE STORAGE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | SURFACE WATER INFLOW | PRECIPITATION | GROUNDWATER EXTRACTION / UPTAKE | GROUNDWATER DISCHARGE | SURFACE WATER OUTFLOW | ET OF APPLIED WATER | ET OF GROUND-WATER UPTAKE | ET OF PRECIPITATION | EVAPORATION | DEEP PERC. OF APPLIED WATER | DEEP PERC. OF PRECIPITATION | INFIL. OF SURFACE WATER | |
| 2010 (BN) | | 580,000 | 220,000 | 26,000 | 0 | 560,000 | 32,000 | 13,000 | 120,000 | 2,100 | 16,000 | 46,000 | 42,000 | 1,800 |
| 2011 (W) | | 860,000 | 230,000 | 26,000 | 0 | 810,000 | 29,000 | 17,000 | 130,000 | 2,000 | 19,000 | 48,000 | 62,000 | 1,900 |
| 2012 (BN) | | 470,000 | 160,000 | 31,000 | 0 | 440,000 | 34,000 | 17,000 | 120,000 | 2,400 | 13,000 | 23,000 | 19,000 | -4,400 |
| 2013 (D) | | 510,000 | 160,000 | 33,000 | 0 | 480,000 | 43,000 | 12,000 | 98,000 | 2,800 | 15,000 | 26,000 | 27,000 | 2,300 |
| 2014 (C) | | 320,000 | 120,000 | 34,000 | 0 | 280,000 | 46,000 | 6,400 | 94,000 | 2,800 | 10,000 | 13,000 | 19,000 | 2,200 |
| 2015 (C) | | 360,000 | 180,000 | 39,000 | 0 | 360,000 | 45,000 | 4,200 | 110,000 | 2,500 | 11,000 | 26,000 | 30,000 | -4,900 |
| 2016 (BN) | | 720,000 | 230,000 | 27,000 | 0 | 690,000 | 42,000 | 4,100 | 130,000 | 2,300 | 11,000 | 35,000 | 67,000 | 1,400 |
| 2017 (W) | | 1,200,000 | 300,000 | 26,000 | 0 | 1,200,000 | 36,000 | 8,700 | 130,000 | 2,100 | 14,000 | 61,000 | 96,000 | 2,200 |
| 2018 (BN) | | 530,000 | 140,000 | 32,000 | 0 | 470,000 | 44,000 | 7,800 | 110,000 | 2,500 | 12,000 | 19,000 | 42,000 | -2,300 |
| Average (1990-2018) | | 630,000 | 210,000 | 33,000 | 2,000 | 620,000 | 36,000 | 17,000 | 120,000 | 2,100 | 15,000 | 39,000 | 35,000 | -630 |
| 1990-2018 | W | 970,000 | 290,000 | 32,000 | 0 | 990,000 | 30,000 | 21,000 | 120,000 | 2,000 | 17,000 | 58,000 | 55,000 | 490 |
| | AN | 680,000 | 250,000 | 31,000 | 210 | 680,000 | 31,000 | 20,000 | 130,000 | 2,000 | 16,000 | 50,000 | 36,000 | 3,600 |
| | BN | 590,000 | 200,000 | 30,000 | 0 | 560,000 | 37,000 | 13,000 | 120,000 | 2,400 | 14,000 | 34,000 | 39,000 | -1,400 |
| | D | 470,000 | 160,000 | 34,000 | 6,200 | 440,000 | 37,000 | 18,000 | 110,000 | 2,800 | 15,000 | 27,000 | 21,000 | -360 |
| | C | 360,000 | 150,000 | 36,000 | 3,900 | 340,000 | 43,000 | 12,000 | 110,000 | 1,700 | 13,000 | 22,000 | 19,000 | -4,000 |

### 2.3.5.3. Historical Groundwater System Water Budget Summary

Summarized results for major components of the historical water budget as they relate to the GWS are presented in **Figure 2-72** and **Table 2-21**. The positive net seepage values (on average 29 taf per year) and deep percolation values (on average 54 taf per year) represent the major inflows to the GWS. The net subsurface flows average about -56 taf per year represent the combined net subsurface outflows from the Subbasin to adjacent subbasins. Groundwater (root water) uptake directly from shallow groundwater (on average -17 taf per year) and groundwater pumping (on average -16 taf per year) are somewhat smaller outflows from the GWS. Overall, the water budget results for the 29-year historic period indicate a cumulative change in groundwater storage of about -74 taf, which equals an average annual decrease in groundwater storage of approximately -2.5 taf per year. This change in storage estimates equate to total decreases in storage in the Subbasin of about -0.74 acre-feet per acre over the 29 years and an annual decrease of about -0.03 acre-feet per acre across the entire Subbasin (approximately 99,000 acres). **Figure 2-72** provides a conceptual illustration of the historical water budget. **Figure 2-73** highlights the cumulative change in groundwater storage that has occurred over the 1990-2018 period, with a notable decline in storage over the generally dry period since the mid-2000s. The decrease of groundwater storage during relatively dry years is not an indication of overdraft, but likely due to removal of temporary surplus of groundwater. Temporary surplus removal is the extraction of a volume of aquifer storage to enable the capture of recharge and reduction in subsurface outflow from the subbasin without impacting beneficial users of groundwater creating unreasonable results. In contrast, overdraft is defined as "the condition of a groundwater basin or subbasin in which the amount of water withdrawn by pumping exceeds the amount of water that recharges the basin over a period of years, during which the water supply conditions approximate average conditions. Overdraft can be characterized by groundwater levels that decline over a period of years and never fully recover, even in wet years. If overdraft continues for a number of years, significant adverse impacts may occur, including increased extraction costs, costs of well deepening or replacement, land subsidence, water quality degradation, and environmental impacts" (DWR, 2003).

Additional details on the historical GWS water budget are presented in **Appendix 2-K**.

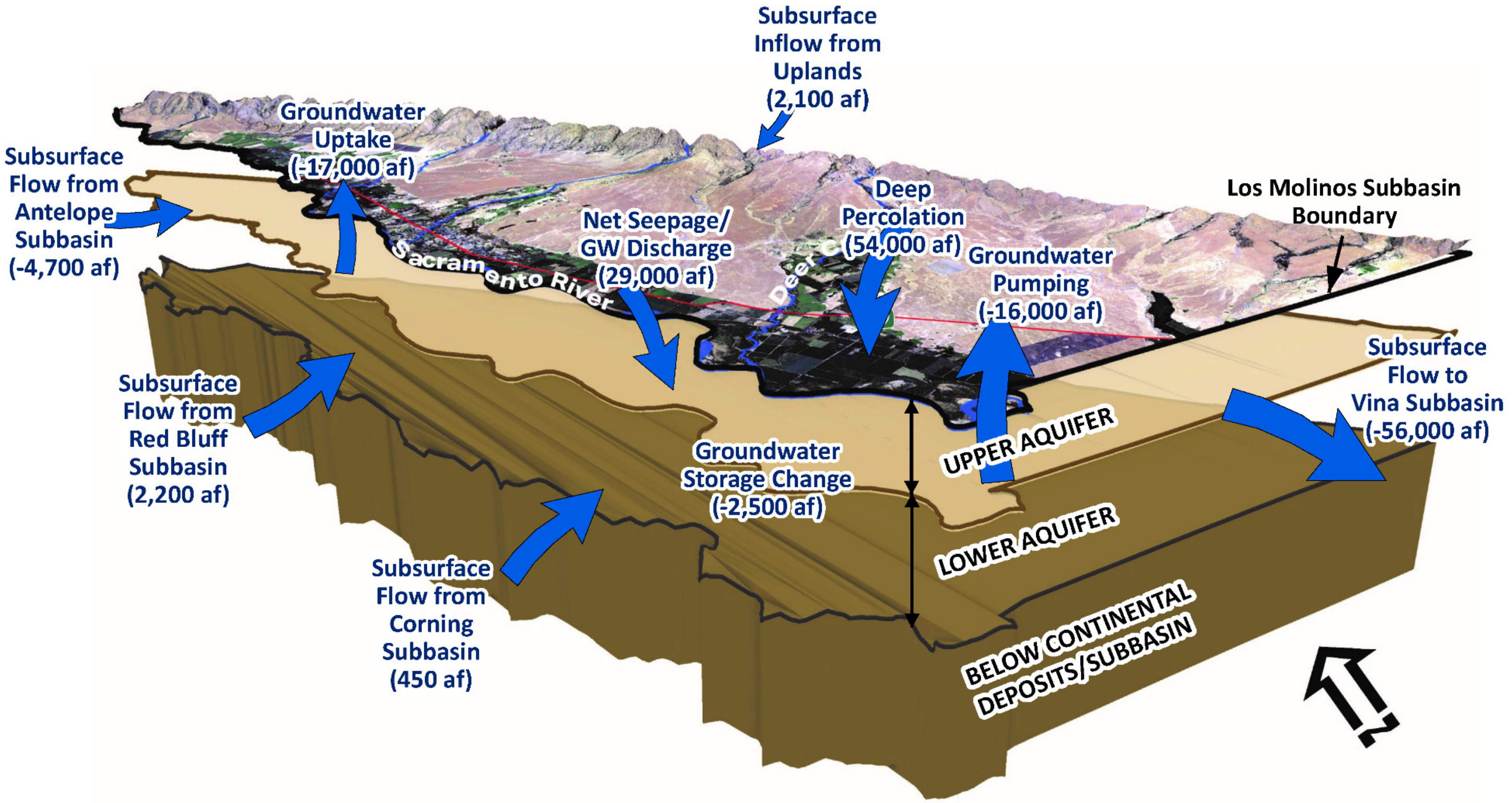


Figure 2-72. Diagram of the Los Molinos Subbasin Historical Average Annual Water Budget (1990-2018)

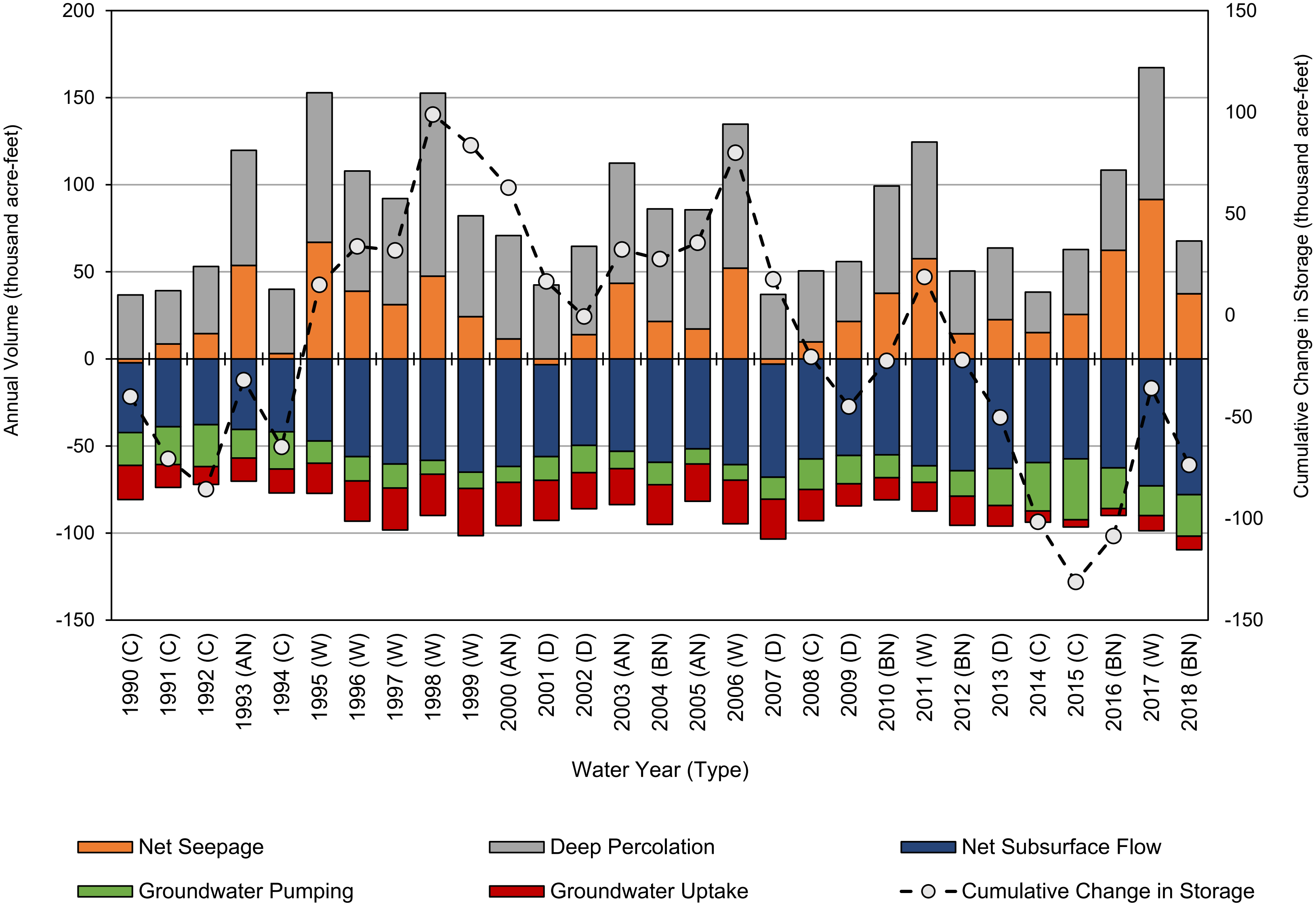


**Figure 2-73. Los Molinos Subbasin Historical Groundwater Budget Summary**

**Table 2-21. Los Molinos Subbasin Historical Groundwater Budget Summary (acre-feet)**

<table>
<tr><th colspan="2">WATER YEAR (TYPE)</th><th>NET SEEPAGE</th><th>DEEP PERCOLATION</th><th>NET SUBSURFACE FLOWS</th><th>GROUND-WATER PUMPING</th><th>GROUND-WATER UPTAKE</th><th>ANNUAL GROUNDWATER STORAGE CHANGE</th><th>CUMULATIVE GROUNDWATER STORAGE CHANGE</th></tr>
<tr><td colspan="2">1990 (C)</td><td>-2,300</td><td>37,000</td><td>-40,000</td><td>-19,000</td><td>-20,000</td><td>-40,000</td><td>-40,000</td></tr>
<tr><td colspan="2">1991 (C)</td><td>8,600</td><td>31,000</td><td>-39,000</td><td>-22,000</td><td>-13,000</td><td>-31,000</td><td>-71,000</td></tr>
<tr><td colspan="2">1992 (C)</td><td>15,000</td><td>39,000</td><td>-38,000</td><td>-24,000</td><td>-10,000</td><td>-15,000</td><td>-86,000</td></tr>
<tr><td colspan="2">1993 (AN)</td><td>54,000</td><td>66,000</td><td>-41,000</td><td>-16,000</td><td>-13,000</td><td>54,000</td><td>-32,000</td></tr>
<tr><td colspan="2">1994 (C)</td><td>3,000</td><td>37,000</td><td>-42,000</td><td>-21,000</td><td>-14,000</td><td>-33,000</td><td>-65,000</td></tr>
<tr><td colspan="2">1995 (W)</td><td>67,000</td><td>86,000</td><td>-47,000</td><td>-13,000</td><td>-17,000</td><td>80,000</td><td>15,000</td></tr>
<tr><td colspan="2">1996 (W)</td><td>39,000</td><td>69,000</td><td>-56,000</td><td>-14,000</td><td>-23,000</td><td>19,000</td><td>34,000</td></tr>
<tr><td colspan="2">1997 (W)</td><td>31,000</td><td>61,000</td><td>-60,000</td><td>-14,000</td><td>-24,000</td><td>-2,000</td><td>32,000</td></tr>
<tr><td colspan="2">1998 (W)</td><td>48,000</td><td>110,000</td><td>-58,000</td><td>-8,000</td><td>-24,000</td><td>67,000</td><td>99,000</td></tr>
<tr><td colspan="2">1999 (W)</td><td>24,000</td><td>58,000</td><td>-65,000</td><td>-9,400</td><td>-27,000</td><td>-15,000</td><td>84,000</td></tr>
<tr><td colspan="2">2000 (AN)</td><td>11,000</td><td>59,000</td><td>-62,000</td><td>-9,100</td><td>-25,000</td><td>-21,000</td><td>63,000</td></tr>
<tr><td colspan="2">2001 (D)</td><td>-3,300</td><td>42,000</td><td>-53,000</td><td>-14,000</td><td>-23,000</td><td>-46,000</td><td>17,000</td></tr>
<tr><td colspan="2">2002 (D)</td><td>14,000</td><td>51,000</td><td>-50,000</td><td>-16,000</td><td>-21,000</td><td>-17,000</td><td>-530</td></tr>
<tr><td colspan="2">2003 (AN)</td><td>43,000</td><td>69,000</td><td>-53,000</td><td>-9,900</td><td>-21,000</td><td>33,000</td><td>32,000</td></tr>
<tr><td colspan="2">2004 (BN)</td><td>21,000</td><td>65,000</td><td>-59,000</td><td>-13,000</td><td>-23,000</td><td>-4,700</td><td>28,000</td></tr>
<tr><td colspan="2">2005 (AN)</td><td>17,000</td><td>68,000</td><td>-52,000</td><td>-8,600</td><td>-21,000</td><td>8,100</td><td>36,000</td></tr>
<tr><td colspan="2">2006 (W)</td><td>52,000</td><td>83,000</td><td>-61,000</td><td>-9,000</td><td>-25,000</td><td>44,000</td><td>80,000</td></tr>
<tr><td colspan="2">2007 (D)</td><td>-3,000</td><td>37,000</td><td>-65,000</td><td>-13,000</td><td>-23,000</td><td>-62,000</td><td>18,000</td></tr>
<tr><td colspan="2">2008 (C)</td><td>9,800</td><td>41,000</td><td>-57,000</td><td>-17,000</td><td>-18,000</td><td>-38,000</td><td>-20,000</td></tr>
<tr><td colspan="2">2009 (D)</td><td>22,000</td><td>34,000</td><td>-55,000</td><td>-16,000</td><td>-13,000</td><td>-24,000</td><td>-45,000</td></tr>
<tr><td colspan="2">2010 (BN)</td><td>38,000</td><td>62,000</td><td>-55,000</td><td>-13,000</td><td>-13,000</td><td>22,000</td><td>-22,000</td></tr>
<tr><td colspan="2">2011 (W)</td><td>58,000</td><td>67,000</td><td>-61,000</td><td>-9,500</td><td>-17,000</td><td>41,000</td><td>19,000</td></tr>
<tr><td colspan="2">2012 (BN)</td><td>14,000</td><td>36,000</td><td>-64,000</td><td>-15,000</td><td>-17,000</td><td>-41,000</td><td>-22,000</td></tr>
<tr><td colspan="2">2013 (D)</td><td>23,000</td><td>41,000</td><td>-63,000</td><td>-21,000</td><td>-12,000</td><td>-28,000</td><td>-50,000</td></tr>
<tr><td colspan="2">2014 (C)</td><td>15,000</td><td>23,000</td><td>-60,000</td><td>-28,000</td><td>-6,400</td><td>-51,000</td><td>-100,000</td></tr>
<tr><td colspan="2">2015 (C)</td><td>25,000</td><td>37,000</td><td>-57,000</td><td>-35,000</td><td>-4,200</td><td>-30,000</td><td>-130,000</td></tr>
<tr><td colspan="2">2016 (BN)</td><td>62,000</td><td>46,000</td><td>-63,000</td><td>-23,000</td><td>-4,100</td><td>23,000</td><td>-110,000</td></tr>
<tr><td colspan="2">2017 (W)</td><td>92,000</td><td>76,000</td><td>-73,000</td><td>-17,000</td><td>-8,700</td><td>73,000</td><td>-36,000</td></tr>
<tr><td colspan="2">2018 (BN)</td><td>37,000</td><td>30,000</td><td>-78,000</td><td>-24,000</td><td>-7,800</td><td>-38,000</td><td>-74,000</td></tr>
<tr><td colspan="2">Average (1990-2018)</td><td>29,000</td><td>54,000</td><td>-56,000</td><td>-16,000</td><td>-17,000</td><td>-2,500</td><td></td></tr>
<tr><td rowspan="5">1990-2018</td><td>W</td><td>51,000</td><td>76,000</td><td>-62,000</td><td>-12,000</td><td>-21,000</td><td>38,000</td><td></td></tr>
<tr><td>AN</td><td>31,000</td><td>66,000</td><td>-54,000</td><td>-11,000</td><td>-20,000</td><td>18,000</td><td></td></tr>
<tr><td>BN</td><td>35,000</td><td>48,000</td><td>-66,000</td><td>-18,000</td><td>-13,000</td><td>-7,700</td><td></td></tr>
<tr><td>D</td><td>10,000</td><td>41,000</td><td>-59,000</td><td>-16,000</td><td>-18,000</td><td>-36,000</td><td></td></tr>
<tr><td>C</td><td>11,000</td><td>35,000</td><td>-50,000</td><td>-24,000</td><td>-12,000</td><td>-34,000</td><td></td></tr>
</table>

Note: positive values indicate inflows/increasing storage, negative values indicate outflows/decreasing storage.

### 2.3.6. Current Water Budget

As described above in **Section 2.3.2**, several recent water budget periods have been considered for use in representing the current water budget. Because the hydrology and land use conditions can vary year to year, estimating the current water budget can be challenging. To evaluate the current water budget, water budget results from the historical model run were summarized for five different recent time periods to evaluate variability and trends. The five different recent water budget periods evaluated include the following:

- Most recent 10 years (2009-2018)
- Most recent 5 year (2014-2018)
- Most recent 3 years (2016-2018)
- Recent single year 2018
- Recent single year 2019

Comparison of these recent water budget periods provides a representation of how water use varies with precipitation and water supply conditions from year to year. Based on these comparisons and consideration of the hydrologic conditions over these recent periods, the recent three-year period from 2016 through 2018 is believed to provide a reasonable representation of the recent water budget conditions. For reporting a current water budget in the GSP, the average water budget for the three-year period between 2016 and 2018 is considered to be representative of the current water budget and representative of current hydrologic and land use conditions. This period incorporates recent land use conditions and spans three years (two below normal years and one wet year) that collectively have precipitation and hydrology similar to the long-term average. Although the 2016 through 2018 period provides a summary of the water budget for recent years that appear to be reasonably representative of recent typical conditions, it is not necessarily representative of any longer-term average conditions. Understanding the recent water budget years is helpful in anticipating longer-term conditions under a scenario where current land uses are maintained in the Subbasin (see section 2.3.7). The results from comparisons of the recent water budget periods evaluated are presented below, including the results and discussion of the selected current water budget period of 2016-2018. The projected water budget with a current land use condition, as described in **Section 2.3.7** also is insightful on the current water budget conditions.

#### 2.3.6.1. Surface Water System Water Budget Summary

The comparison of the different recent SWS water budget periods provides a representation of how individual SWS water budget components vary from year to year depending on water demands, precipitation, and water supply conditions. The SWS water budget results for these different recent time periods are presented in **Table 2-22**. The single year SWS water budget results highlight the high variability between these two years, which included a below normal year in 2018 and a wet year in 2019. The water budget inflows and outflows from the SWS vary by about 500 taf between these two single years. Most of the variability in the total SWS inflows and outflows is a result of variability in precipitation, surface water inflow and surface water outflow. When comparing the average annual water budget results for recent multi-year periods, the variability is considerably reduced with a maximum difference in both inflows and outflows of about 280 taf per year between the three different recent multi-year periods evaluated.

The selected current water budget period of 2016-2018 (highlighted blue in **Table 2-22**) has total SWS inflows and outflows of about 1,100 taf per year, with the largest SWS inflows being surface water inflow (820 taf per year) and the largest SWS outflow being surface water outflow (780 taf per year). Current SWS water budget inflows also include 230 taf per year of precipitation, and nearly 28 taf per year of groundwater extraction and uptake. Other SWS outflows in the current SWS water budget include 120 taf per year ET of precipitation, 68 taf per year infiltration of surface water, 41 taf per year ET of applied water, 38 taf per year deep percolation of precipitation, 12 taf per year of deep percolation of applied water, and additional smaller outflows for ET of groundwater uptake, evaporation from surface water, and change in root zone storage.

**Table 2-22. Comparison of Recent SWS Water Budget Periods (acre-feet)**

| FLOW PATH | | RECENT WATER BUDGET PERIOD | | | | |
|---|---|---|---|---|---|---|
| | | RECENT 10 YEARS | RECENT 5 YEARS | RECENT 3 YEARS | RECENT 1 YEAR | RECENT 1 YEAR |
| | | (2009-2018) | (2014-2018) | (2016-2018) | 2018 | 2019 |
| **Inflow** | Surface Water Inflow | 600,000 | 630,000 | 820,000 | 530,000 | 890,000 |
| | Precipitation | 190,000 | 200,000 | 230,000 | 140,000 | 330,000 |
| | Groundwater Extraction/Uptake | 30,000 | 32,000 | 28,000 | 32,000 | 25,000 |
| | Groundwater Discharge to Surface Water | 0 | 0 | 0 | 0 | 0 |
| | ***Total Inflows***[1] | ***820,000*** | ***850,000*** | ***1,100,000*** | ***700,000*** | ***1,200,000*** |
| **Outflow** | Surface Water Outflow | 570,000 | 590,000 | 780,000 | 470,000 | 910,000 |
| | ET of Applied Water | 39,000 | 43,000 | 41,000 | 44,000 | 37,000 |
| | ET of Groundwater Uptake | 10,000 | 6,200 | 6,800 | 7,800 | 9,300 |
| | ET of Precipitation | 120,000 | 120,000 | 120,000 | 110,000 | 140,000 |
| | Evaporation | 2,400 | 2,400 | 2,300 | 2,500 | 1,900 |
| | Deep Percolation of Applied Water | 13,000 | 12,000 | 12,000 | 12,000 | 16,000 |
| | Deep Percolation of Precipitation | 32,000 | 31,000 | 38,000 | 19,000 | 57,000 |
| | Infiltration of Surface Water (Seepage) | 43,000 | 51,000 | 68,000 | 42,000 | 74,000 |
| | Change in Root Zone Storage | 240 | -280 | 430 | -2,300 | 6,100 |
| | ***Total Outflows*** | ***820,000*** | ***850,000*** | ***1,100,000*** | ***700,000*** | ***1,200,000*** |

### 2.3.6.2. Groundwater System Water Budget Summary

Comparing the different recent water budget periods provides a representation of how the overall GWS water budget components vary from year to year depending on conditions including inflows/outflows between the SWS and subsurface flows. The GWS water budget results for these different recent time periods are presented in **Table 2-23**. As with the results for the current SWS water budget summaries, the single year results for the GWS water budget highlight the high variability between the two individual years of 2018 and 2019, which included a below normal year (2018) and a wet year (2019). Although some of the individual water budget components are relatively stable between the two different recent water budget years, the total change in groundwater storage varied by over 85 taf ranging from a decrease in storage of about -38 taf in 2018 (a below normal year) to an increase in storage of 47 taf in 2019 (a wet year). There is considerably less variability in most of the different water budget components when comparing between the three different recent multi-year periods, although the net seepage and net subsurface flows do show relatively higher differences between the three recent periods. Average annual change in storage varies between -5.3 and -4.7 taf per year for the recent 10-year and 5-year periods, respectively, and indicates an average increase in storage of about 19 taf per year for the recent three-year period. This difference is likely attributable to the drought years consisting of dry and critical years that occurred between 2013 and 2015, which are included in the recent five- and ten-year periods, but not included in the most recent three-year period from 2016-2018.

The selected current water budget period of 2016-2018 (highlighted blue in **Table 2-23**) has total net seepage of about 64 taf per year, indicating net seepage of surface water into the GWS. Deep percolation represents an additional 51 taf per year of inflow to the GWS. Net subsurface flows total -71 taf per year of outflow on average over the current water budget period and groundwater pumping and groundwater uptake account for outflows from the GWS averaging about -21 and -6.8 taf per year, respectively, during the current water budget period.

**Table 2-23. Comparison of Recent GWS Water Budget Periods (acre-feet)**

| GWS WATER BUDGET COMPONENT | RECENT WATER BUDGET PERIODS | | | | |
|---|---|---|---|---|---|
| | RECENT 10 YEARS | RECENT 5 YEARS | RECENT 3 YEARS | RECENT 1 YEAR | RECENT 1 YEAR |
| | (2009-2018) | (2014-2018) | (2016-2018) | 2018 | 2019 |
| Net Seepage | 39,000 | 46,000 | 64,000 | 37,000 | 70,000 |
| Deep Percolation | 45,000 | 43,000 | 51,000 | 30,000 | 73,000 |
| Net Subsurface Flows | -63,000 | -66,000 | -71,000 | -78,000 | -75,000 |
| Groundwater Pumping | -20,000 | -25,000 | -21,000 | -24,000 | -16,000 |
| Groundwater Uptake | -10,000 | -6,200 | -6,800 | -7,800 | -9,300 |
| ***Annual Groundwater Storage Change*** | ***-5,300*** | ***-4,700*** | ***19,000*** | ***-38,000*** | ***47,000*** |

Note: positive values indicate inflows/increasing storage, negative values indicate outflows/decreasing storage.

## 2.3.7. Projected Water Budgets

To evaluate projected water budgets in the future, projected model runs were developed using Tehama IHM. The projected model runs are intended to evaluate the effects of anticipated future conditions of hydrology, water supply availability, and water demand on the Los Molinos Subbasin water budget and groundwater conditions over a 50-year GSP planning period. The projected model runs also incorporate consideration of potential climate change and water supply availability scenarios and evaluation of the need for and benefit of any projects and management actions to be implemented in the Subbasin to maintain or achieve sustainability. The projected model runs use hydrologic conditions representative of the most recent 50 years of hydrology in the Subbasin, with adjustments applied in scenarios for evaluating the water budget under climate change and/or altered water supply and demand conditions. A number of projected future scenarios were simulated in Tehama IHM to compare possible outcomes, including different projected land uses and potential climate change impacts. Additional information about the development of the projected model scenarios is provided in **Appendix 2-J**.

### 2.3.7.1. Projected (Current Land Use) Water Budget

This section presents the results of the Projected (Current Land Use) scenario. The Current Land Use scenario assumes constant land use conditions based on 2018 conditions.

#### 2.3.7.1.1 *Projected (Current Land Use) Surface Water System Water Budget Summary*

Annual inflows, outflows, and change in SWS root zone storage during the projected (current land use) water budget period (2022-2072) are summarized in **Figure 2-74** and **Table 2-24.** Inflows in **Figure 2-74** are shown as positive values, while outflows are shown as negative values. Review of the variability in component volumes across years provides insight into the impacts of hydrology on the SWS water budget.

Of particular note in the projected (current land use) SWS water budget results are the volumes of surface water inflows that make up a large part of the Subbasin SWS inflows. Over the projected (current land use) period, surface water inflows to surface water averaged about 650 taf per year. Precipitation also represents a large SWS inflow component averaging about 220 taf per year. Groundwater extraction and uptake represent a small SWS inflow in the Subbasin averaging about 27 taf per year over the projected (current land use) water budget period. Groundwater discharge to surface water is negligible throughout the projected (current land use) period.

Among the outflows from the Subbasin SWS, surface water outflow makes up a large fraction of the total Subbasin SWS outflows. The surface water outflows total about 610 taf per year on average, a value that corresponds with the large volumes of surface water inflow (about 650 taf per year). By comparison, other SWS outflows in the Subbasin are relatively smaller, with values for ET of precipitation about 120 taf per year and ET of applied water totaling about 41 taf per year on average.

The outflow of infiltration (seepage) of surface water, deep percolation of precipitation, and deep percolation of applied water are about 59, 38 and 14 taf per year on average, respectively. Together, the outflows from the SWS to the GWS total about 110 taf per year over the historic water budget period. The outflows of ET of groundwater uptake and evaporation from surface water are about 7.3 and 2.2 taf per year, respectively. Detailed results for the projected (current land use) SWS water budget are presented in **Appendix 2-K**.

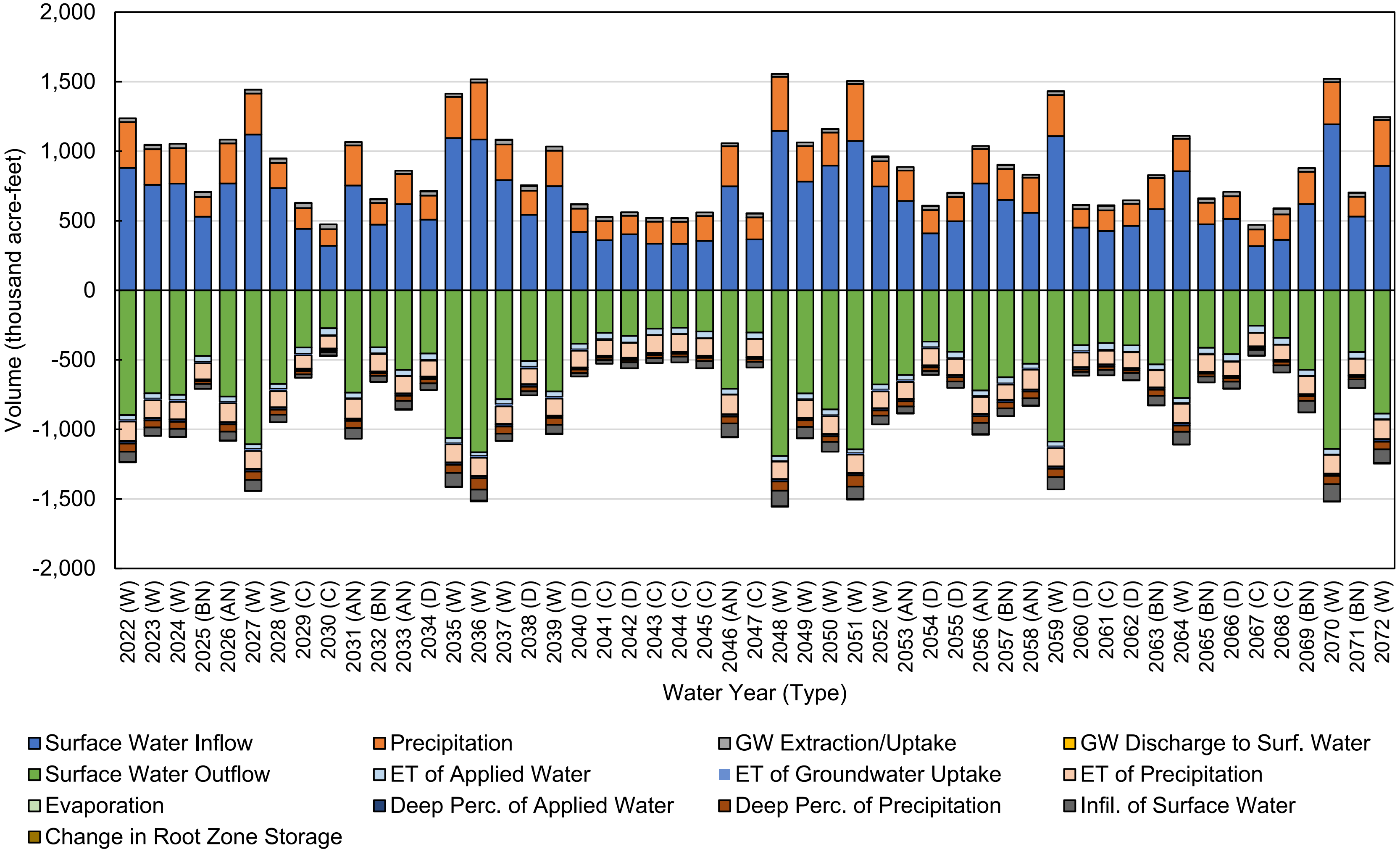


**Figure 2-74. Los Molinos Subbasin Surface Water System Projected (Current Land Use) Water Budget, 2022-2072**

**Table 2-24. Los Molinos Subbasin Surface Water System Projected (Current Land Use) Water Budget, 2022-2072 (acre-feet)**

| WATER YEAR (TYPE) | INFLOWS | | | | OUTFLOWS | | | | | | | | CHANGE IN ROOT ZONE STORAGE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SURFACE WATER INFLOW | PRECIPITATION | GROUNDWATER EXTRACTION / UPTAKE | GROUND WATER DISCHARGE | SURFACE WATER OUTFLOW | ET OF APPLIED WATER | ET OF GROUNDWATER UPTAKE | ET OF PRECIPITATION | EVAPORATION[1] | DEEP PERC. OF APPLIED WATER | DEEP PERC. OF PRECIPITATION | INFIL. OF SURFACE WATER | |
| 2022 (W) | 880,000 | 330,000 | 27,000 | 0 | 900,000 | 37,000 | 9,500 | 140,000 | 1,900 | 16,000 | 58,000 | 75,000 | 1,500 |
| 2023 (W) | 760,000 | 260,000 | 31,000 | 0 | 740,000 | 38,000 | 13,000 | 130,000 | 2,200 | 15,000 | 50,000 | 61,000 | -1,700 |
| 2024 (W) | 770,000 | 260,000 | 31,000 | 0 | 750,000 | 38,000 | 14,000 | 120,000 | 2,200 | 16,000 | 50,000 | 58,000 | 190 |
| 2025 (BN) | 530,000 | 140,000 | 32,000 | 0 | 470,000 | 42,000 | 11,000 | 120,000 | 2,400 | 12,000 | 19,000 | 36,000 | -4,700 |
| 2026 (AN) | 770,000 | 290,000 | 27,000 | 0 | 760,000 | 38,000 | 11,000 | 140,000 | 2,100 | 15,000 | 52,000 | 64,000 | 3,800 |
| 2027 (W) | 1,100,000 | 300,000 | 28,000 | 0 | 1,100,00 | 35,000 | 14,000 | 130,000 | 1,900 | 17,000 | 60,000 | 80,000 | -760 |
| 2028 (W) | 740,000 | 180,000 | 30,000 | 0 | 670,000 | 37,000 | 15,000 | 120,000 | 2,200 | 15,000 | 35,000 | 55,000 | -1,500 |
| 2029 (C) | 440,000 | 150,000 | 35,000 | 0 | 410,000 | 45,000 | 11,000 | 96,000 | 2,700 | 14,000 | 24,000 | 25,000 | -2,800 |
| 2030 (C) | 320,000 | 120,000 | 34,000 | 0 | 270,000 | 50,000 | 5,200 | 90,000 | 2,800 | 10,000 | 12,000 | 24,000 | 6,000 |
| 2031 (AN) | 750,000 | 290,000 | 25,000 | 0 | 740,000 | 40,000 | 5,300 | 140,000 | 2,100 | 15,000 | 52,000 | 77,000 | -1,000 |
| 2032 (BN) | 470,000 | 160,000 | 27,000 | 0 | 410,000 | 43,000 | 5,300 | 120,000 | 2,300 | 10,000 | 20,000 | 43,000 | -3,800 |
| 2033 (AN) | 620,000 | 220,000 | 23,000 | 0 | 570,000 | 41,000 | 5,100 | 120,000 | 2,200 | 14,000 | 37,000 | 60,000 | 5,000 |
| 2034 (D) | 510,000 | 170,000 | 29,000 | 0 | 450,000 | 46,000 | 5,700 | 120,000 | 2,500 | 14,000 | 32,000 | 47,000 | -5,400 |
| 2035 (W) | 1,100,000 | 300,000 | 23,000 | 0 | 1,100,00 | 37,000 | 8,100 | 130,000 | 2,000 | 16,000 | 58,000 | 98,000 | 3,100 |
| 2036 (W) | 1,100,000 | 410,000 | 23,000 | 0 | 1,200,00 | 26,000 | 13,000 | 130,000 | 1,400 | 16,000 | 82,000 | 79,000 | 5,700 |
| 2037 (W) | 790,000 | 260,000 | 33,000 | 0 | 780,000 | 36,000 | 16,000 | 130,000 | 2,200 | 16,000 | 51,000 | 53,000 | -3,200 |
| 2038 (D) | 540,000 | 170,000 | 34,000 | 0 | 510,000 | 41,000 | 14,000 | 110,000 | 2,500 | 15,000 | 33,000 | 29,000 | -5,400 |
| 2039 (W) | 750,000 | 260,000 | 30,000 | 0 | 730,000 | 39,000 | 12,000 | 120,000 | 2,200 | 15,000 | 49,000 | 63,000 | 4,900 |
| 2040 (D) | 420,000 | 170,000 | 29,000 | 0 | 380,000 | 40,000 | 10,000 | 120,000 | 2,300 | 12,000 | 26,000 | 25,000 | -2,700 |
| 2041 (C) | 360,000 | 140,000 | 30,000 | 0 | 310,000 | 45,000 | 5,700 | 110,000 | 2,500 | 11,000 | 17,000 | 26,000 | -30 |

| WATER YEAR (TYPE) | INFLOWS | | | | OUTFLOWS | | | | | | | | CHANGE IN ROOT ZONE STORAGE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SURFACE WATER INFLOW | PRECIPI-TATION | GROUNDWATER EXTRACTION / UPTAKE | GROUND WATER DISCHARGE | SURFACE WATER OUTFLOW | ET OF APPLIED WATER | ET OF GROUND-WATER UPTAKE | ET OF PRECIPI-TATION | EVAPO-RATION[1] | DEEP PERC. OF APPLIED WATER | DEEP PERC. OF PRECIPI-TATION | INFIL. OF SURFACE WATER | |
| 2042 (D) | 400,000 | 130,000 | 25,000 | 0 | 330,000 | 47,000 | 3,200 | 110,000 | 2,600 | 13,000 | 17,000 | 43,000 | 680 |
| 2043 (C) | 340,000 | 160,000 | 28,000 | 0 | 280,000 | 46,000 | 2,300 | 130,000 | 2,200 | 12,000 | 21,000 | 36,000 | -2,100 |
| 2044 (C) | 330,000 | 160,000 | 26,000 | 0 | 270,000 | 46,000 | 1,400 | 130,000 | 2,200 | 12,000 | 20,000 | 42,000 | -60 |
| 2045 (C) | 360,000 | 180,000 | 26,000 | 0 | 300,000 | 48,000 | 1,000 | 130,000 | 2,300 | 12,000 | 23,000 | 52,000 | 150 |
| 2046 (AN) | 750,000 | 290,000 | 22,000 | 0 | 710,000 | 41,000 | 1,900 | 140,000 | 2,200 | 14,000 | 50,000 | 98,000 | 3,200 |
| 2047 (C) | 370,000 | 160,000 | 27,000 | 0 | 300,000 | 45,000 | 2,100 | 130,000 | 2,200 | 12,000 | 21,000 | 40,000 | -3,300 |
| 2048 (W) | 1,100,000 | 390,000 | 21,000 | 0 | 1,200,00 | 37,000 | 3,200 | 130,000 | 1,900 | 16,000 | 65,000 | 110,000 | 3,600 |
| 2049 (W) | 780,000 | 260,000 | 26,000 | 0 | 740,000 | 41,000 | 6,000 | 130,000 | 2,200 | 14,000 | 49,000 | 81,000 | 230 |
| 2050 (W) | 900,000 | 240,000 | 26,000 | 0 | 860,000 | 41,000 | 7,600 | 130,000 | 2,400 | 14,000 | 40,000 | 70,000 | -110 |
| 2051 (W) | 1,100,000 | 410,000 | 21,000 | 0 | 1,100,00 | 27,000 | 11,000 | 130,000 | 1,400 | 15,000 | 82,000 | 90,000 | 3,700 |
| 2052 (W) | 750,000 | 180,000 | 29,000 | 0 | 680,000 | 37,000 | 13,000 | 120,000 | 2,300 | 15,000 | 37,000 | 63,000 | -6,500 |
| 2053 (AN) | 640,000 | 220,000 | 26,000 | 0 | 610,000 | 37,000 | 12,000 | 120,000 | 2,200 | 15,000 | 38,000 | 47,000 | 3,700 |
| 2054 (D) | 410,000 | 170,000 | 29,000 | 0 | 370,000 | 41,000 | 8,600 | 120,000 | 2,300 | 12,000 | 26,000 | 29,000 | -3,200 |
| 2055 (D) | 500,000 | 170,000 | 29,000 | 0 | 440,000 | 46,000 | 6,200 | 110,000 | 2,500 | 14,000 | 31,000 | 47,000 | -2,500 |
| 2056 (AN) | 770,000 | 250,000 | 23,000 | 0 | 720,000 | 39,000 | 6,800 | 120,000 | 2,100 | 15,000 | 48,000 | 80,000 | 4,200 |
| 2057 (BN) | 650,000 | 220,000 | 28,000 | 0 | 630,000 | 44,000 | 8,600 | 110,000 | 2,500 | 18,000 | 42,000 | 56,000 | -3,600 |
| 2058 (AN) | 560,000 | 250,000 | 21,000 | 0 | 530,000 | 34,000 | 8,600 | 140,000 | 1,800 | 13,000 | 49,000 | 51,000 | 3,800 |
| 2059 (W) | 1,100,000 | 300,000 | 27,000 | 0 | 1,100,00 | 35,000 | 12,000 | 130,000 | 1,900 | 16,000 | 60,000 | 89,000 | -860 |
| 2060 (D) | 450,000 | 130,000 | 29,000 | 0 | 390,000 | 43,000 | 9,900 | 100,000 | 2,600 | 14,000 | 18,000 | 26,000 | -480 |
| 2061 (C) | 430,000 | 150,000 | 33,000 | 0 | 380,000 | 49,000 | 5,800 | 99,000 | 2,800 | 14,000 | 23,000 | 39,000 | -3,700 |
| 2062 (D) | 460,000 | 160,000 | 26,000 | 0 | 400,000 | 46,000 | 3,600 | 110,000 | 2,500 | 12,000 | 20,000 | 51,000 | 2,200 |

| WATER YEAR (TYPE) | | INFLOWS | | | | OUTFLOWS | | | | | | | | CHANGE IN ROOT ZONE STORAGE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | SURFACE WATER INFLOW | PRECIPITATION | GROUNDWATER EXTRACTION / UPTAKE | GROUND WATER DISCHARGE | SURFACE WATER OUTFLOW | ET OF APPLIED WATER | ET OF GROUND-WATER UPTAKE | ET OF PRECIPITATION | EVAPORATION[1] | DEEP PERC. OF APPLIED WATER | DEEP PERC. OF PRECIPITATION | INFIL. OF SURFACE WATER | |
| 2063 (BN) | | 580,000 | 220,000 | 21,000 | 0 | 530,000 | 38,000 | 3,800 | 120,000 | 2,100 | 14,000 | 43,000 | 69,000 | 1,900 |
| 2064 (W) | | 860,000 | 230,000 | 20,000 | 0 | 770,000 | 36,000 | 6,100 | 140,000 | 1,900 | 17,000 | 45,000 | 91,000 | 1,900 |
| 2065 (BN) | | 470,000 | 160,000 | 27,000 | 0 | 410,000 | 43,000 | 6,100 | 120,000 | 2,300 | 11,000 | 20,000 | 43,000 | -4,700 |
| 2066 (D) | | 510,000 | 160,000 | 32,000 | 0 | 460,000 | 51,000 | 3,800 | 100,000 | 2,700 | 14,000 | 25,000 | 50,000 | 2,600 |
| 2067 (C) | | 320,000 | 120,000 | 33,000 | 0 | 250,000 | 51,000 | 1,800 | 96,000 | 2,800 | 11,000 | 12,000 | 40,000 | 2,100 |
| 2068 (C) | | 360,000 | 180,000 | 40,000 | 0 | 340,000 | 49,000 | 940 | 110,000 | 2,500 | 11,000 | 25,000 | 51,000 | -5,000 |
| 2069 (BN) | | 620,000 | 230,000 | 27,000 | 0 | 570,000 | 44,000 | 860 | 130,000 | 2,300 | 11,000 | 34,000 | 84,000 | 980 |
| 2070 (W) | | 1,200,000 | 300,000 | 23,000 | 0 | 1,100,00 | 40,000 | 2,700 | 130,000 | 2,100 | 14,000 | 60,000 | 120,000 | 2,000 |
| 2071 (BN) | | 530,000 | 140,000 | 28,000 | 0 | 440,000 | 46,000 | 2,500 | 120,000 | 2,500 | 11,000 | 17,000 | 63,000 | -2,500 |
| 2072 (W) | | 890,000 | 330,000 | 22,000 | 0 | 890,000 | 40,000 | 3,500 | 140,000 | 2,000 | 16,000 | 56,000 | 96,000 | 6,000 |
| Average (2022-2072) | | 650,000 | 220,000 | 27,000 | 0 | 610,000 | 41,000 | 7,300 | 120,000 | 2,200 | 14,000 | 38,000 | 59,000 | 20 |
| 2022-2072 | W | 930,000 | 290,000 | 26,000 | 0 | 910,000 | 36,000 | 10,000 | 130,000 | 2,000 | 15,000 | 55,000 | 80,000 | 1,000 |
| | AN | 690,000 | 260,000 | 24,000 | 0 | 660,000 | 39,000 | 7,100 | 130,000 | 2,100 | 14,000 | 46,000 | 68,000 | 3,200 |
| | BN | 550,000 | 180,000 | 27,000 | 0 | 500,000 | 43,000 | 5,400 | 120,000 | 2,400 | 12,000 | 28,000 | 56,000 | -2,400 |
| | D | 470,000 | 160,000 | 29,000 | 0 | 410,000 | 45,000 | 7,200 | 110,000 | 2,500 | 13,000 | 25,000 | 39,000 | -1,600 |
| | C | 360,000 | 150,000 | 31,000 | 0 | 310,000 | 47,000 | 3,800 | 110,000 | 2,500 | 12,000 | 20,000 | 38,000 | -880 |

1 Diversions for some years were estimated based on average monthly data, resulting in a generally constant evaporation volume for some years.

### 2.3.7.2. Projected (Current Land Use) Groundwater System Water Budget Summary

Summarized results for major components of the projected (current land use) water budget as they relate to the GWS are presented in **Figure 2-75** and **Table 2-25**. The positive net seepage values (on average 55 taf per year) and deep percolation values (on average 52 taf per year) represent the major inflows to the GWS. The net subsurface flows average about -86 taf per year represent the combined net subsurface outflows from the Subbasin to adjacent subbasins.

Groundwater pumping (on average -20 taf per year) and groundwater (root water) uptake directly from shallow groundwater (on average -7.3 taf per year) are somewhat smaller outflows from the GWS. Overall, the water budget results for the 51-year projected (current land use) period indicate a cumulative change in groundwater storage of about -93 taf, which equals an average annual decrease in groundwater storage of approximately -1.8 taf per year. This change in storage estimates equate to total decreases in storage in the Subbasin of about -0.94 acre-feet per acre over the 51 years and an annual decrease of about -0.02 acre-feet per acre across the entire Subbasin (approximately 99,000 acres). **Figure 2-75** provides a conceptual illustration of the projected (current land use) water budget. **Figure 2-76** highlights the cumulative change in groundwater storage that would occur during anticipated multi-year wet and dry periods within the projected period.

Detailed results for the projected (future land use) period GWS water budget are presented in **Appendix 2-K**.

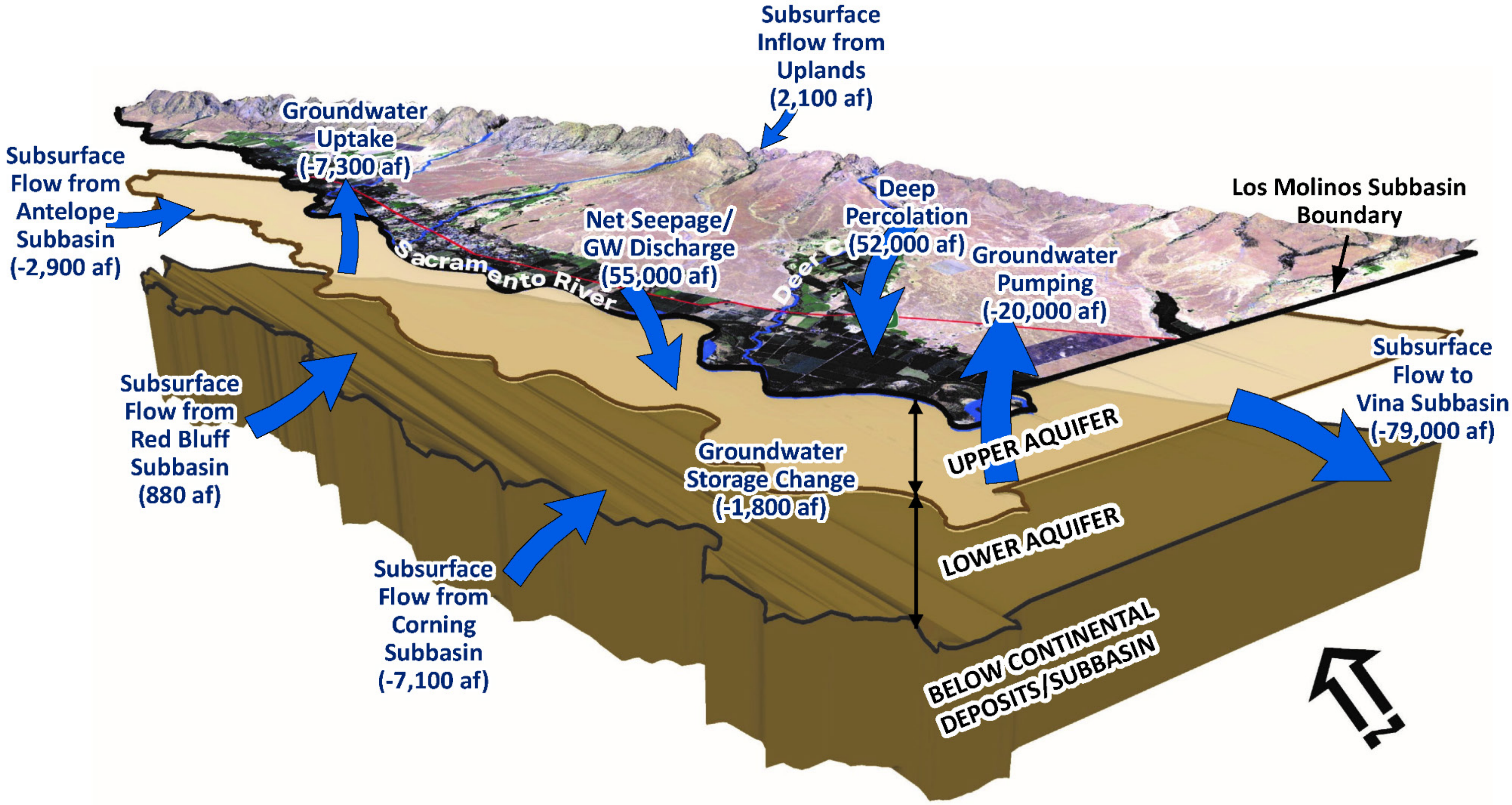


Figure 2-75. Diagram of the Los Molinos Subbasin Projected (Current Land Use) Average Annual Water Budget, 2022-2072

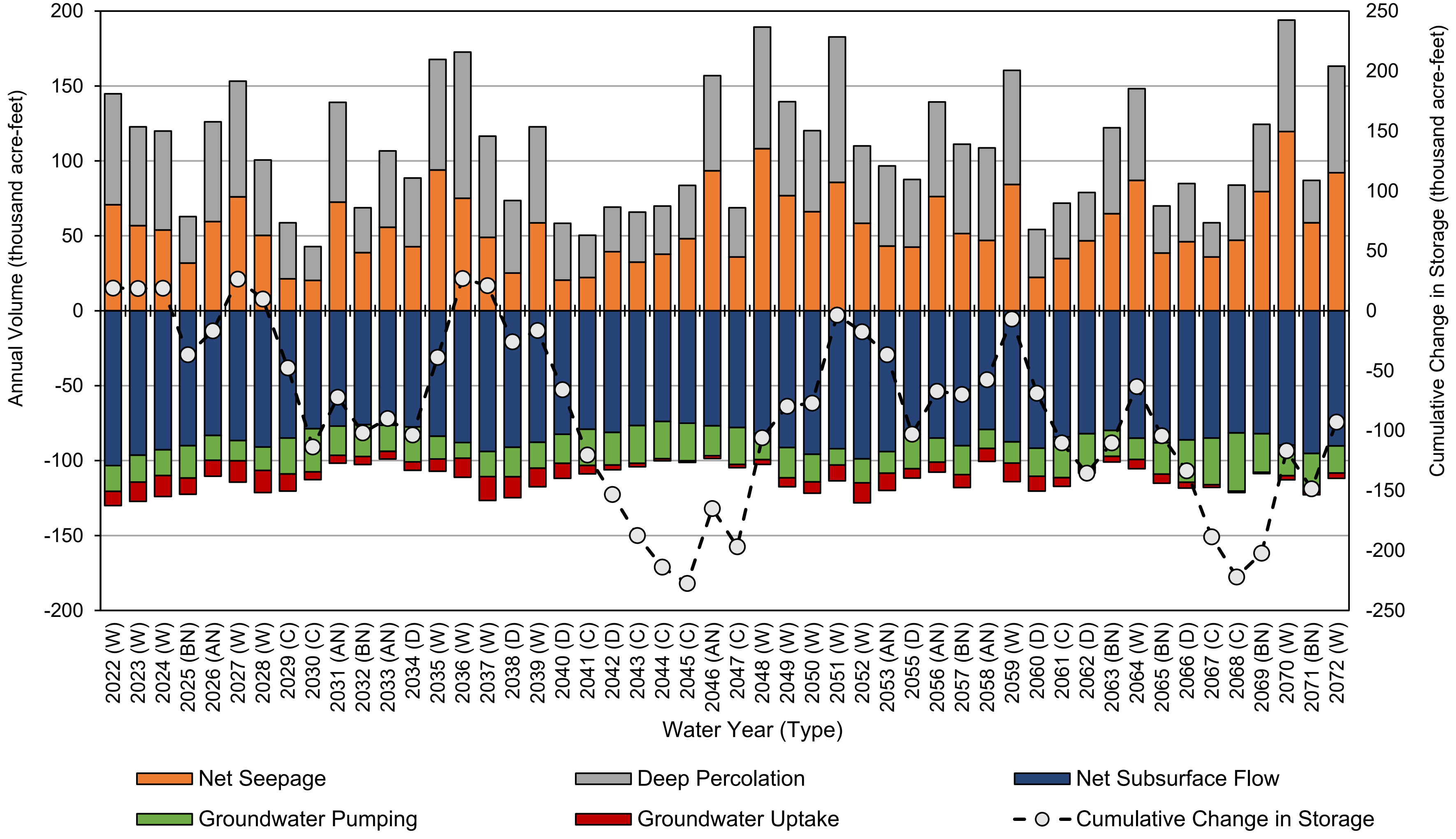


**Figure 2-76. Los Molinos Subbasin Projected (Current Land Use) Water Budget Summary**

### Table 2-25. Los Molinos Subbasin Projected (Current Land Use) Water Budget Summary (acre-feet)

| WATER YEAR (TYPE) | NET SEEPAGE | DEEP PERCOLATION | NET SUBSURFACE FLOWS | GROUND-WATER PUMPING | GROUND-WATER UPTAKE | ANNUAL GROUNDWATER STORAGE CHANGE | CUMULATIVE GROUNDWATER STORAGE CHANGE |
|---|---|---|---|---|---|---|---|
| 2022 (W) | 71,000 | 74,000 | -100,000 | -17,000 | -12,000 | 19,000 | 19,000 |
| 2023 (W) | 57,000 | 66,000 | -96,000 | -18,000 | -9,000 | -310 | 19,000 |
| 2024 (W) | 54,000 | 66,000 | -93,000 | -17,000 | -9,500 | 180 | 19,000 |
| 2025 (BN) | 32,000 | 31,000 | -90,000 | -22,000 | -13,000 | -55,000 | -37,000 |
| 2026 (AN) | 60,000 | 67,000 | -83,000 | -17,000 | -14,000 | 20,000 | -17,000 |
| 2027 (W) | 76,000 | 77,000 | -87,000 | -14,000 | -11,000 | 43,000 | 26,000 |
| 2028 (W) | 50,000 | 50,000 | -91,000 | -16,000 | -11,000 | -17,000 | 9,800 |
| 2029 (C) | 21,000 | 37,000 | -85,000 | -24,000 | -14,000 | -57,000 | -48,000 |
| 2030 (C) | 20,000 | 23,000 | -79,000 | -29,000 | -15,000 | -66,000 | -110,000 |
| 2031 (AN) | 73,000 | 67,000 | -77,000 | -19,000 | -11,000 | 41,000 | -72,000 |
| 2032 (BN) | 39,000 | 30,000 | -76,000 | -21,000 | -5,200 | -30,000 | -100,000 |
| 2033 (AN) | 56,000 | 51,000 | -76,000 | -17,000 | -5,300 | 12,000 | -90,000 |
| 2034 (D) | 43,000 | 46,000 | -78,000 | -23,000 | -5,300 | -14,000 | -100,000 |
| 2035 (W) | 94,000 | 74,000 | -84,000 | -15,000 | -5,100 | 65,000 | -39,000 |
| 2036 (W) | 75,000 | 98,000 | -88,000 | -10,000 | -5,700 | 66,000 | 27,000 |
| 2037 (W) | 49,000 | 68,000 | -94,000 | -17,000 | -8,100 | -5,900 | 21,000 |
| 2038 (D) | 25,000 | 48,000 | -91,000 | -20,000 | -13,000 | -47,000 | -26,000 |
| 2039 (W) | 59,000 | 64,000 | -88,000 | -17,000 | -16,000 | 9,400 | -16,000 |
| 2040 (D) | 20,000 | 38,000 | -82,000 | -19,000 | -14,000 | -49,000 | -66,000 |
| 2041 (C) | 22,000 | 28,000 | -79,000 | -24,000 | -12,000 | -54,000 | -120,000 |
| 2042 (D) | 39,000 | 30,000 | -81,000 | -22,000 | -10,000 | -33,000 | -150,000 |
| 2043 (C) | 33,000 | 33,000 | -77,000 | -25,000 | -5,700 | -34,000 | -190,000 |
| 2044 (C) | 38,000 | 32,000 | -74,000 | -25,000 | -3,200 | -26,000 | -210,000 |
| 2045 (C) | 48,000 | 36,000 | -75,000 | -25,000 | -2,300 | -14,000 | -230,000 |
| 2046 (AN) | 93,000 | 63,000 | -77,000 | -20,000 | -1,400 | 62,000 | -160,000 |
| 2047 (C) | 36,000 | 33,000 | -78,000 | -25,000 | -1,000 | -32,000 | -200,000 |
| 2048 (W) | 110,000 | 81,000 | -82,000 | -18,000 | -1,900 | 91,000 | -110,000 |
| 2049 (W) | 77,000 | 63,000 | -91,000 | -20,000 | -2,100 | 26,000 | -80,000 |
| 2050 (W) | 66,000 | 54,000 | -96,000 | -18,000 | -3,200 | 2,600 | -77,000 |
| 2051 (W) | 86,000 | 97,000 | -92,000 | -11,000 | -6,000 | 73,000 | -3,600 |
| 2052 (W) | 58,000 | 52,000 | -99,000 | -16,000 | -7,600 | -14,000 | -18,000 |
| 2053 (AN) | 43,000 | 53,000 | -94,000 | -14,000 | -11,000 | -19,000 | -37,000 |
| 2054 (D) | 25,000 | 38,000 | -85,000 | -20,000 | -13,000 | -46,000 | -83,000 |
| 2055 (D) | 42,000 | 45,000 | -82,000 | -23,000 | -12,000 | -20,000 | -100,000 |
| 2056 (AN) | 76,000 | 63,000 | -85,000 | -16,000 | -8,600 | 36,000 | -67,000 |
| 2057 (BN) | 51,000 | 60,000 | -90,000 | -19,000 | -6,200 | -2,700 | -70,000 |
| 2058 (AN) | 47,000 | 62,000 | -79,000 | -13,000 | -6,800 | 12,000 | -57,000 |

| WATER YEAR (TYPE) | | NET SEEPAGE | DEEP PERCOLATION | NET SUBSURFACE FLOWS | GROUND-WATER PUMPING | GROUND-WATER UPTAKE | ANNUAL GROUNDWATER STORAGE CHANGE | CUMULATIVE GROUNDWATER STORAGE CHANGE |
|---|---|---|---|---|---|---|---|---|
| 2059 (W) | | 84,000 | 76,000 | -87,000 | -14,000 | -8,600 | 51,000 | -6,900 |
| 2060 (D) | | 22,000 | 32,000 | -92,000 | -19,000 | -8,600 | -62,000 | -69,000 |
| 2061 (C) | | 35,000 | 37,000 | -84,000 | -27,000 | -12,000 | -41,000 | -110,000 |
| 2062 (D) | | 47,000 | 32,000 | -82,000 | -23,000 | -9,900 | -25,000 | -140,000 |
| 2063 (BN) | | 65,000 | 57,000 | -80,000 | -17,000 | -5,800 | 25,000 | -110,000 |
| 2064 (W) | | 87,000 | 61,000 | -85,000 | -14,000 | -3,600 | 47,000 | -63,000 |
| 2065 (BN) | | 39,000 | 31,000 | -88,000 | -21,000 | -3,800 | -41,000 | -100,000 |
| 2066 (D) | | 46,000 | 39,000 | -86,000 | -28,000 | -6,100 | -29,000 | -130,000 |
| 2067 (C) | | 36,000 | 23,000 | -85,000 | -31,000 | -6,100 | -55,000 | -190,000 |
| 2068 (C) | | 47,000 | 37,000 | -82,000 | -39,000 | -3,800 | -33,000 | -220,000 |
| 2069 (BN) | | 80,000 | 45,000 | -82,000 | -26,000 | -1,800 | 20,000 | -200,000 |
| 2070 (W) | | 120,000 | 74,000 | -90,000 | -20,000 | -940 | 85,000 | -120,000 |
| 2071 (BN) | | 59,000 | 28,000 | -95,000 | -25,000 | -870 | -32,000 | -150,000 |
| 2072 (W) | | 92,000 | 71,000 | -90,000 | -18,000 | -2,700 | 56,000 | -93,000 |
| Average (2022-2072) | | 55,000 | 52,000 | -86,000 | -20,000 | -7,300 | -1,800 | |
| 2022-2072 | W | 76,000 | 70,000 | -91,000 | -16,000 | -10,000 | 33,000 | |
| | AN | 64,000 | 61,000 | -82,000 | -17,000 | -7,100 | 24,000 | |
| | BN | 52,000 | 40,000 | -86,000 | -22,000 | -5,400 | -16,000 | |
| | D | 34,000 | 39,000 | -84,000 | -22,000 | -7,200 | -36,000 | |
| | C | 34,000 | 32,000 | -80,000 | -27,000 | -3,800 | -41,000 | |

### 2.3.8. Projected (Future Land Use) Water Budget Summary

This section presents the results of the Projected (Future Land Use) scenario. The Future Land Use scenario assumes a static (held constant over the entire projected period) land use condition reflecting an anticipated future development or land use condition that is expected to exist at the end of the 50-year GSP planning horizon. The future land use condition was developed through discussion with local stakeholders and consultation with the Tehama County Planning Department. The future land use condition includes an increase in urban area reflective of the recent rate of urban increase experienced for the County.

Land use areas are used to distinguish the water use sector in which water is consumed, as required by the GSP Regulations. **Figure 2-77** and **Table 2-26** summarize the annual land use areas over the projected (future land use) period (2022-2072) in the Los Molinos Subbasin by water use sector, as defined by the GSP Regulations (23 CCR § 351(al)). In the Los Molinos Subbasin, water use sectors include agricultural, urban, and native vegetation land uses. The urban water use sector covers all urban, residential, industrial, and semi-agricultural[7] land uses.

Agricultural, urban, and native vegetation land uses covered approximately 18,000 acres, 1,900 acres, and 79,000 acres, respectively, between 2022 and 2072.

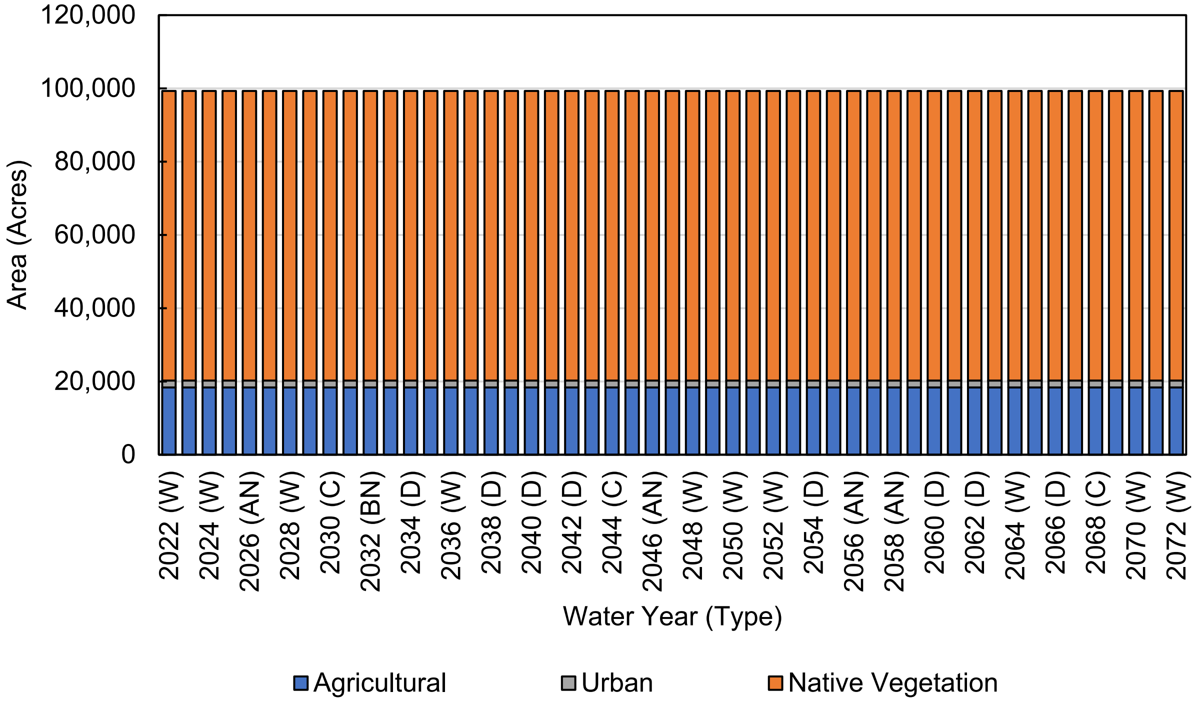


**Figure 2-77. Los Molinos Subbasin Future Land Use Areas, by Water Use Sector**

**Table 2-26. Los Molinos Subbasin Future Land Use Areas, by Water Use Sector (acres)**

| PROJECTED PERIOD (FUTURE LAND USE) | AGRICULTURAL | URBAN[1] | NATIVE VEGETATION | TOTAL |
|---|---|---|---|---|
| 2022 -2072 | 18,360 | 1,860 | 79,070 | 99,290 |

[1] Area includes land classified as urban, residential, industrial, and semi-agricultural.

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[7] As defined in the DWR crop mapping metadata, semi-agricultural land use subclasses include farmsteads, livestock feed lot operations, dairies, poultry farms, and miscellaneous semi-agricultural land use incidental to agriculture (small roads, ditches, non-planted areas of cropped fields (DWR, 2016b).

Agricultural land uses are further detailed in **Figure 2-78** and **Table 2-27**. In the future, a majority of the agricultural area in the Los Molinos Subbasin is projected to consist of deciduous crops and pasture. Irrigated agricultural areas within the Los Molinos Subbasin are projected to remain relatively constant at these acreages during the entire projected period.

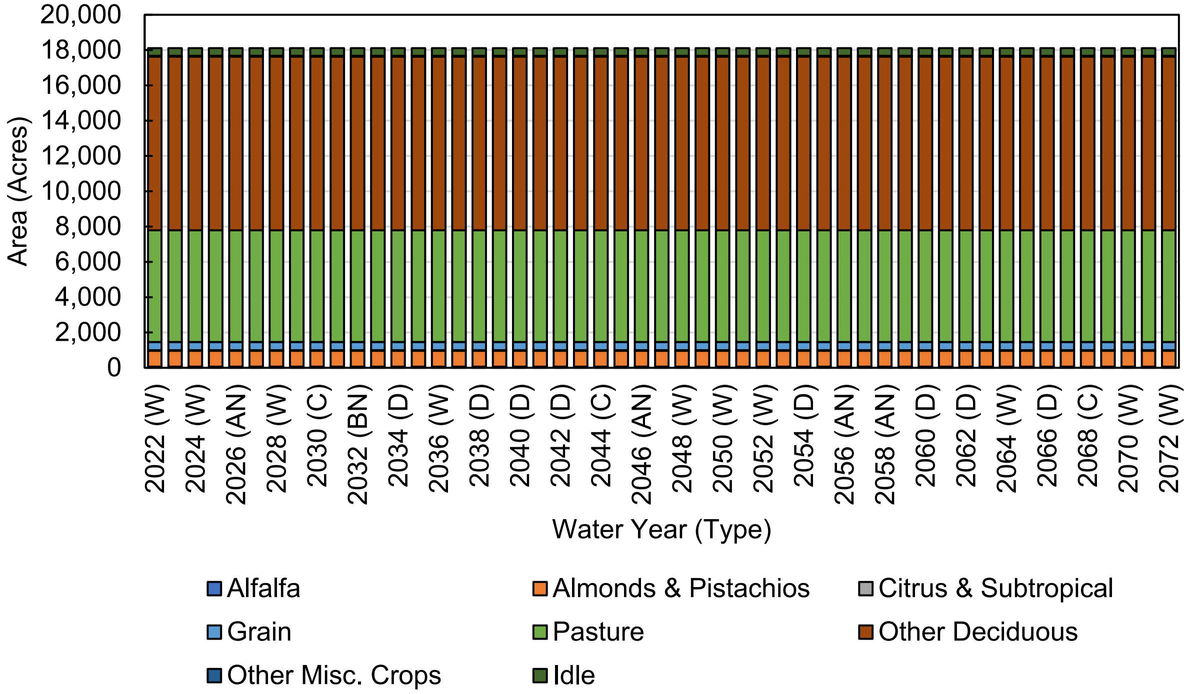

Figure 2-78. Los Molinos Subbasin Projected Agricultural Land Use Areas

Table 2-27. Los Molinos Subbasin Projected Agricultural Land Use Areas (acres)

| PROJECTED PERIOD (FUTURE LAND USE) | ALFALFA | ALMONDS & PISTACHIOS | CITRUS & SUB TROPICAL | GRAIN | PASTURE | PONDED (RICE, REFUGE) | OTHER DECIDUOUS | OTHER MISC. CROPS | IDLE | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|
| 2022 - 2072 | 70 | 890 | 40 | 460 | 6,330 | 250 | 9,840 | 40 | 440 | 18,360 |

### 2.3.8.1. Projected (Future Land Use) Surface Water System Water Budget Summary

Annual inflows, outflows, and change in SWS root zone storage during the projected (future land use) water budget period (2022-2072) are summarized in **Figure 2-79** and Table **2-28**. Inflows in **Figure 2-79** are shown as positive values, while outflows are shown as negative values. Review of the variability in component volumes across years provides insight into the impacts of hydrology on the SWS water budget.

Of particular note in the projected (future land use) SWS water budget results are the volumes of surface water inflows that make up a large part of the Subbasin SWS inflows. Over the projected (future land use) period, surface water inflows to surface water averaged about 650 taf per year. Precipitation also represents a large SWS inflow component averaging about 220 taf per year. Groundwater extraction and uptake represent a small SWS inflow in the Subbasin averaging about 27 taf per year over the projected (current land use) water budget period. Groundwater discharge to surface water is negligible throughout the projected (current land use) period.

Among the outflows from the Subbasin SWS, surface water outflow makes up a large fraction of the total Subbasin SWS outflows. The surface water outflows total about 610 taf per year on average, a value that corresponds with the large volumes of surface water inflow (about 650 taf per year). By comparison, other SWS outflows in the Subbasin are relatively smaller, with values for ET of precipitation about 120 taf per year and ET of applied water totaling about 42 taf per year on average. The outflow of infiltration (seepage) of surface water, deep percolation of precipitation, and deep percolation of applied water are about 63, 38 and 14 taf per year on average, respectively. Together, the outflows from the SWS to the GWS total about 110 taf per year over the historic water budget period. The outflows of ET of groundwater uptake and evaporation from surface water are about 6.1 and 2.3 taf per year, respectively.

Detailed results for the projected (future land use) SWS water budget are presented in **Appendix 2-K**.

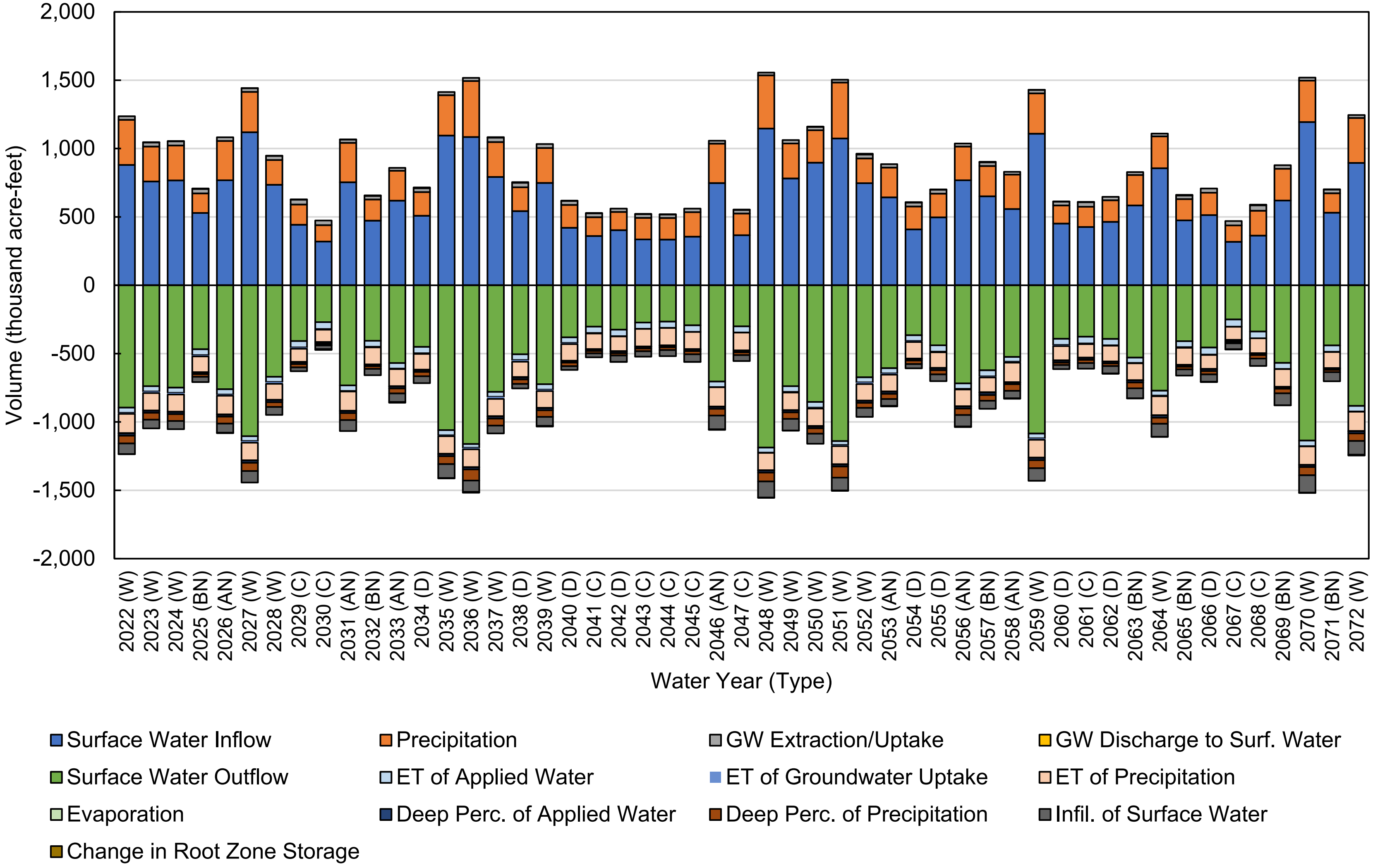

**Figure 2-79. Los Molinos Subbasin Surface Water System Projected (Future Land Use) Water Budget, 2022-2072**

**Table 2-28. Los Molinos Subbasin Surface Water System Projected (Future Land Use) Water Budget, 2022-2072 (acre-feet)**

| WATER YEAR (TYPE) | INFLOWS | | | | OUTFLOWS | | | | | | | | CHANGE IN ROOT ZONE STORAGE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SURFACE WATER INFLOW | PRECIPITATION | GROUNDWATER EXTRACTION/ UPTAKE | GROUNDWATER DISCHARGE TO SURFACE WATER | SURFACE WATER OUTFLOW | ET OF APPLIED WATER | ET OF GROUNDWATER UPTAKE | ET OF PRECIPITATION | EVAPORATION | DEEP PERC. OF APPLIED WATER | DEEP PERC. OF PRECIPITATION | INFIL. OF SURFACE WATER | |
| 2022 (W) | 880,000 | 330,000 | 26,000 | 0 | 890,000 | 38,000 | 8,300 | 140,000 | 1,900 | 16,000 | 58,000 | 77,000 | 1,600 |
| 2023 (W) | 760,000 | 260,000 | 30,000 | 0 | 740,000 | 38,000 | 12,000 | 130,000 | 2,200 | 15,000 | 50,000 | 63,000 | -2,000 |
| 2024 (W) | 770,000 | 260,000 | 31,000 | 0 | 750,000 | 38,000 | 13,000 | 130,000 | 2,200 | 16,000 | 50,000 | 61,000 | -40 |
| 2025 (BN) | 530,000 | 140,000 | 32,000 | 0 | 470,000 | 42,000 | 9,500 | 120,000 | 2,400 | 12,000 | 19,000 | 39,000 | -4,000 |
| 2026 (AN) | 770,000 | 290,000 | 26,000 | 0 | 760,000 | 39,000 | 8,900 | 140,000 | 2,100 | 15,000 | 51,000 | 67,000 | 3,400 |
| 2027 (W) | 1,100,000 | 300,000 | 27,000 | 0 | 1,100,000 | 35,000 | 13,000 | 130,000 | 1,900 | 17,000 | 60,000 | 83,000 | -770 |
| 2028 (W) | 740,000 | 180,000 | 30,000 | 0 | 670,000 | 38,000 | 14,000 | 120,000 | 2,200 | 15,000 | 35,000 | 58,000 | -1,700 |
| 2029 (C) | 440,000 | 150,000 | 35,000 | 0 | 410,000 | 46,000 | 10,000 | 96,000 | 2,700 | 14,000 | 24,000 | 28,000 | -2,600 |
| 2030 (C) | 320,000 | 120,000 | 33,000 | 0 | 270,000 | 50,000 | 4,100 | 90,000 | 2,800 | 10,000 | 12,000 | 27,000 | 5,900 |
| 2031 (AN) | 750,000 | 290,000 | 24,000 | 0 | 730,000 | 41,000 | 4,100 | 140,000 | 2,100 | 15,000 | 51,000 | 80,000 | -990 |
| 2032 (BN) | 470,000 | 160,000 | 26,000 | 0 | 410,000 | 43,000 | 4,200 | 130,000 | 2,300 | 10,000 | 19,000 | 46,000 | -3,800 |
| 2033 (AN) | 620,000 | 220,000 | 22,000 | 0 | 570,000 | 41,000 | 4,000 | 120,000 | 2,200 | 14,000 | 36,000 | 63,000 | 5,000 |
| 2034 (D) | 510,000 | 170,000 | 29,000 | 0 | 450,000 | 46,000 | 4,400 | 120,000 | 2,500 | 14,000 | 32,000 | 50,000 | -5,400 |
| 2035 (W) | 1,100,000 | 300,000 | 23,000 | 0 | 1,100,000 | 38,000 | 6,500 | 130,000 | 2,000 | 15,000 | 58,000 | 100,000 | 3,100 |
| 2036 (W) | 1,100,000 | 410,000 | 22,000 | 0 | 1,200,000 | 27,000 | 12,000 | 130,000 | 1,400 | 16,000 | 81,000 | 83,000 | 5,400 |
| 2037 (W) | 790,000 | 260,000 | 32,000 | 0 | 780,000 | 37,000 | 15,000 | 130,000 | 2,200 | 16,000 | 51,000 | 57,000 | -3,100 |
| 2038 (D) | 540,000 | 170,000 | 33,000 | 0 | 500,000 | 42,000 | 12,000 | 110,000 | 2,500 | 15,000 | 33,000 | 32,000 | -5,300 |
| 2039 (W) | 750,000 | 260,000 | 29,000 | 0 | 720,000 | 39,000 | 11,000 | 120,000 | 2,200 | 15,000 | 48,000 | 66,000 | 4,800 |
| 2040 (D) | 420,000 | 170,000 | 29,000 | 0 | 380,000 | 41,000 | 8,600 | 120,000 | 2,300 | 12,000 | 25,000 | 28,000 | -2,400 |
| 2041 (C) | 360,000 | 140,000 | 29,000 | 0 | 300,000 | 46,000 | 4,400 | 110,000 | 2,500 | 11,000 | 17,000 | 29,000 | -80 |

| WATER YEAR (TYPE) | INFLOWS | | | | OUTFLOWS | | | | | | | | CHANGE IN ROOT ZONE STORAGE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SURFACE WATER INFLOW | PRECIPITATION | GROUNDWATER EXTRACTION/ UPTAKE | GROUNDWATER DISCHARGE TO SURFACE WATER | SURFACE WATER OUTFLOW | ET OF APPLIED WATER | ET OF GROUNDWATER UPTAKE | ET OF PRECIPITATION | EVAPORATION | DEEP PERC. OF APPLIED WATER | DEEP PERC. OF PRECIPITATION | INFIL. OF SURFACE WATER | |
| 2042 (D) | 400,000 | 130,000 | 24,000 | 0 | 320,000 | 48,000 | 2,400 | 110,000 | 2,600 | 13,000 | 16,000 | 47,000 | 680 |
| 2043 (C) | 340,000 | 160,000 | 27,000 | 0 | 270,000 | 46,000 | 1,600 | 130,000 | 2,200 | 12,000 | 21,000 | 40,000 | -2,100 |
| 2044 (C) | 330,000 | 160,000 | 26,000 | 0 | 270,000 | 46,000 | 920 | 130,000 | 2,200 | 12,000 | 20,000 | 45,000 | -50 |
| 2045 (C) | 360,000 | 180,000 | 26,000 | 0 | 290,000 | 48,000 | 670 | 130,000 | 2,300 | 12,000 | 23,000 | 55,000 | 160 |
| 2046 (AN) | 750,000 | 290,000 | 22,000 | 0 | 700,000 | 41,000 | 1,300 | 140,000 | 2,200 | 14,000 | 49,000 | 100,000 | 3,100 |
| 2047 (C) | 370,000 | 160,000 | 26,000 | 0 | 300,000 | 45,000 | 1,400 | 130,000 | 2,200 | 12,000 | 21,000 | 43,000 | -3,300 |
| 2048 (W) | 1,100,000 | 390,000 | 20,000 | 0 | 1,200,000 | 37,000 | 2,500 | 130,000 | 1,900 | 16,000 | 65,000 | 120,000 | 3,600 |
| 2049 (W) | 780,000 | 260,000 | 26,000 | 0 | 740,000 | 42,000 | 4,600 | 130,000 | 2,200 | 14,000 | 48,000 | 85,000 | 220 |
| 2050 (W) | 900,000 | 240,000 | 25,000 | 0 | 850,000 | 42,000 | 6,000 | 130,000 | 2,400 | 14,000 | 40,000 | 74,000 | -120 |
| 2051 (W) | 1,100,000 | 410,000 | 20,000 | 0 | 1,100,000 | 28,000 | 9,200 | 130,000 | 1,400 | 15,000 | 81,000 | 94,000 | 3,400 |
| 2052 (W) | 750,000 | 180,000 | 29,000 | 0 | 670,000 | 37,000 | 12,000 | 120,000 | 2,300 | 14,000 | 37,000 | 66,000 | -6,200 |
| 2053 (AN) | 640,000 | 220,000 | 25,000 | 0 | 610,000 | 38,000 | 10,000 | 120,000 | 2,200 | 15,000 | 38,000 | 51,000 | 3,600 |
| 2054 (D) | 410,000 | 170,000 | 28,000 | 0 | 370,000 | 42,000 | 7,200 | 120,000 | 2,300 | 12,000 | 25,000 | 32,000 | -3,100 |
| 2055 (D) | 500,000 | 170,000 | 29,000 | 0 | 440,000 | 46,000 | 4,900 | 110,000 | 2,500 | 14,000 | 31,000 | 50,000 | -2,400 |
| 2056 (AN) | 770,000 | 250,000 | 22,000 | 0 | 720,000 | 40,000 | 5,300 | 120,000 | 2,100 | 15,000 | 48,000 | 84,000 | 4,100 |
| 2057 (BN) | 650,000 | 220,000 | 27,000 | 0 | 620,000 | 45,000 | 7,000 | 110,000 | 2,500 | 17,000 | 42,000 | 59,000 | -3,500 |
| 2058 (AN) | 560,000 | 250,000 | 21,000 | 0 | 520,000 | 35,000 | 6,900 | 140,000 | 1,800 | 13,000 | 48,000 | 54,000 | 4,100 |
| 2059 (W) | 1,100,000 | 300,000 | 25,000 | 0 | 1,100,000 | 35,000 | 11,000 | 130,000 | 2,000 | 16,000 | 60,000 | 92,000 | -1,200 |
| 2060 (D) | 450,000 | 130,000 | 28,000 | 0 | 390,000 | 44,000 | 8,500 | 110,000 | 2,600 | 14,000 | 18,000 | 29,000 | -290 |
| 2061 (C) | 430,000 | 150,000 | 32,000 | 0 | 380,000 | 50,000 | 4,500 | 99,000 | 2,800 | 13,000 | 23,000 | 42,000 | -3,700 |
| 2062 (D) | 460,000 | 160,000 | 26,000 | 0 | 390,000 | 46,000 | 2,800 | 110,000 | 2,500 | 12,000 | 20,000 | 54,000 | 2,200 |

| WATER YEAR (TYPE) | | INFLOWS | | | | OUTFLOWS | | | | | | | | CHANGE IN ROOT ZONE STORAGE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | SURFACE WATER INFLOW | PRECIPI-TATION | GROUND-WATER EXTRACTION/ UPTAKE | GROUNDWATER DISCHARGE TO SURFACE WATER | SURFACE WATER OUTFLOW | ET OF APPLIED WATER | ET OF GROUND-WATER UPTAKE | ET OF PRECIPI-TATION | EVAPO-RATION | DEEP PERC. OF APPLIED WATER | DEEP PERC. OF PRECIPI-TATION | INFIL. OF SURFACE WATER | |
| 2063 (BN) | | 580,000 | 220,000 | 21,000 | 0 | 530,000 | 38,000 | 3,000 | 120,000 | 2,100 | 14,000 | 43,000 | 73,000 | 1,800 |
| 2064 (W) | | 860,000 | 230,000 | 20,000 | 0 | 770,000 | 36,000 | 4,800 | 140,000 | 1,900 | 16,000 | 44,000 | 95,000 | 1,800 |
| 2065 (BN) | | 470,000 | 160,000 | 26,000 | 0 | 410,000 | 44,000 | 4,800 | 120,000 | 2,300 | 11,000 | 20,000 | 46,000 | -4,700 |
| 2066 (D) | | 510,000 | 160,000 | 32,000 | 0 | 460,000 | 51,000 | 3,000 | 100,000 | 2,700 | 14,000 | 25,000 | 53,000 | 2,600 |
| 2067 (C) | | 320,000 | 120,000 | 33,000 | 0 | 250,000 | 51,000 | 1,200 | 96,000 | 2,800 | 11,000 | 12,000 | 43,000 | 2,100 |
| 2068 (C) | | 360,000 | 180,000 | 40,000 | 0 | 340,000 | 49,000 | 610 | 110,000 | 2,500 | 11,000 | 25,000 | 54,000 | -5,000 |
| 2069 (BN) | | 620,000 | 230,000 | 27,000 | 0 | 570,000 | 44,000 | 580 | 130,000 | 2,300 | 11,000 | 34,000 | 87,000 | 970 |
| 2070 (W) | | 1,200,000 | 300,000 | 23,000 | 0 | 1,100,000 | 40,000 | 2,000 | 130,000 | 2,100 | 14,000 | 60,000 | 130,000 | 2,000 |
| 2071 (BN) | | 530,000 | 140,000 | 27,000 | 0 | 440,000 | 46,000 | 1,700 | 120,000 | 2,500 | 11,000 | 17,000 | 66,000 | -2,500 |
| 2072 (W) | | 890,000 | 330,000 | 21,000 | 0 | 880,000 | 40,000 | 2,700 | 140,000 | 2,000 | 15,000 | 55,000 | 100,000 | 6,000 |
| Average (2022-2072) | | 650,000 | 220,000 | 27,000 | 0 | 610,000 | 42,000 | 6,100 | 120,000 | 2,300 | 14,000 | 38,000 | 63,000 | 30 |
| 2022-2072 | W | 930,000 | 290,000 | 26,000 | 0 | 910,000 | 37,000 | 8,800 | 130,000 | 2,000 | 15,000 | 55,000 | 83,000 | 940 |
| | AN | 690,000 | 260,000 | 23,000 | 0 | 660,000 | 39,000 | 5,800 | 130,000 | 2,100 | 14,000 | 46,000 | 71,000 | 3,200 |
| | BN | 550,000 | 180,000 | 27,000 | 0 | 490,000 | 43,000 | 4,400 | 120,000 | 2,400 | 12,000 | 28,000 | 59,000 | -2,300 |
| | D | 470,000 | 160,000 | 29,000 | 0 | 410,000 | 45,000 | 6,000 | 110,000 | 2,500 | 13,000 | 25,000 | 42,000 | -1,500 |
| | C | 360,000 | 150,000 | 31,000 | 0 | 310,000 | 48,000 | 2,900 | 110,000 | 2,500 | 12,000 | 20,000 | 41,000 | -860 |

#### 2.3.8.2. Projected (Future Land Use) Groundwater System Water Budget Summary

Summarized results for major components of the projected (future land use) water budget as they relate to the GWS are presented in **Figure 2-80** and **Table 2-29**. The positive net seepage values (on average 59 taf per year) and deep percolation values (on average 51 taf per year) represent the major inflows to the GWS. The net subsurface flows average about -89 taf per year represent the combined net subsurface outflows from the Subbasin to adjacent subbasins.

Groundwater pumping (on average -21 taf per year) and groundwater (root water) uptake directly from shallow groundwater (on average -6.1 taf per year) are somewhat smaller outflows from the GWS. Overall, the water budget results for the 51-year projected (future land use) period indicate a cumulative change in groundwater storage of about -100 taf, which equals an average annual decrease in groundwater storage of approximately -2.0 taf per year. This change in storage estimates equate to total decreases in storage in the Subbasin of about 1.0 acre-feet per acre over the 51 years and an annual decrease of about -0.02 acre-feet per acre across the entire Subbasin (approximately 99,000 acres). **Figure 2-80** provides a conceptual illustration of the projected (future land use) water budget. **Figure 2-81** highlights the cumulative change in groundwater storage that would occur during anticipated multi-year wet and dry periods and over the entire projected period.

Detailed results for the projected (current land use) period GWS water budget are presented in **Appendix 2-K**.

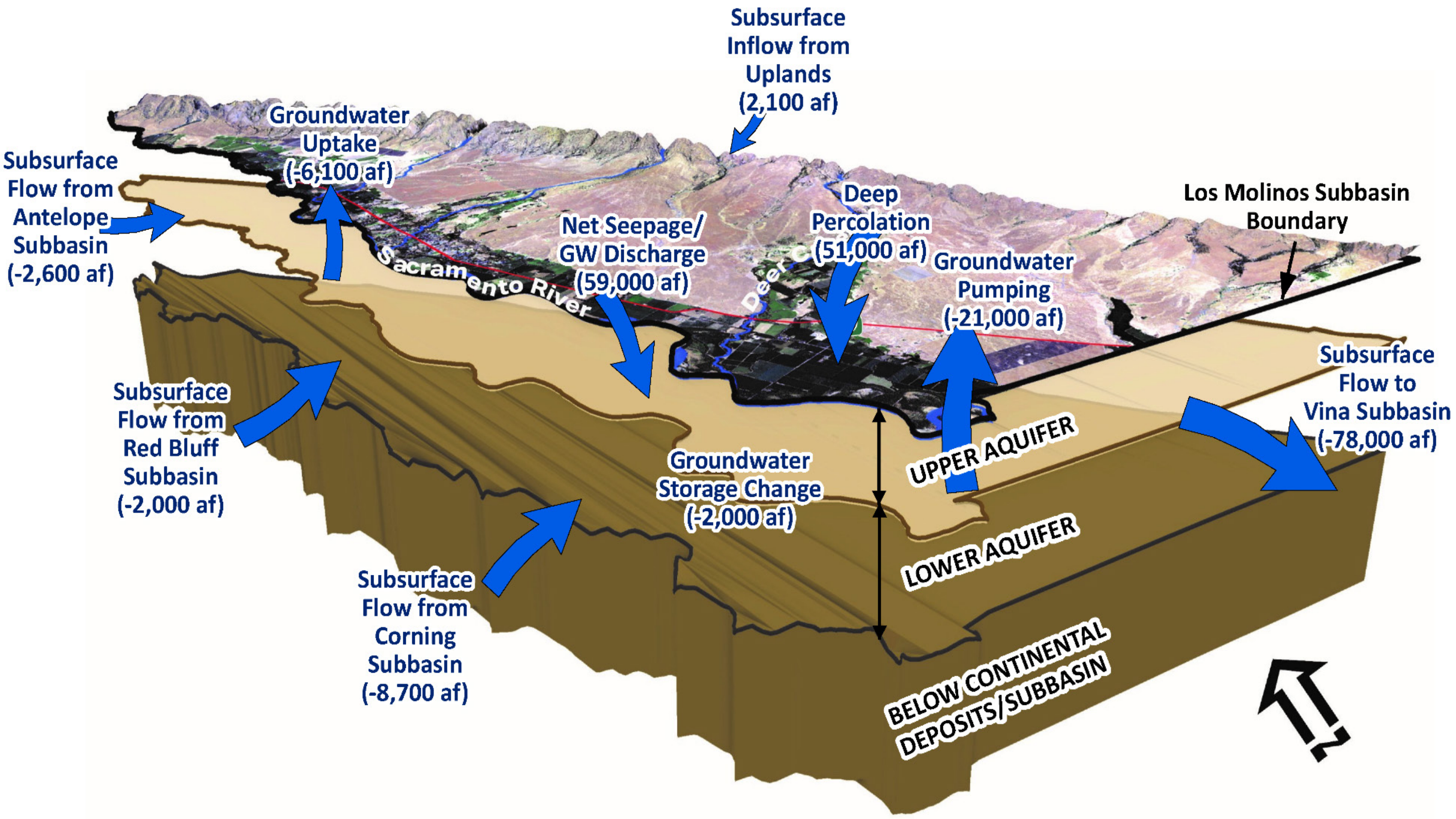

Figure 2-80. Diagram of the Los Molinos Subbasin Projected (Future Land Use) Average Annual Water Budget, 2022-2072

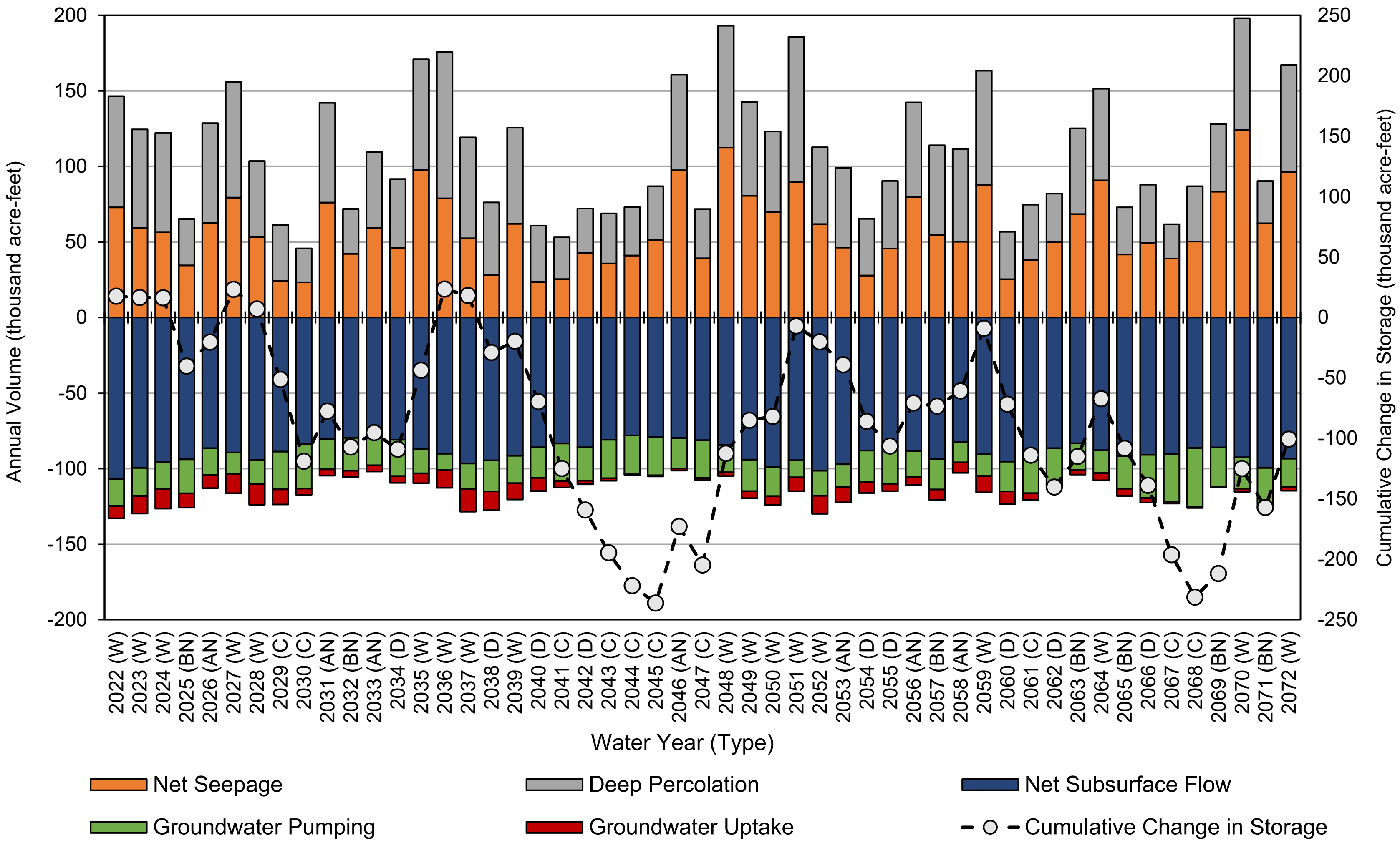

**Figure 2-81. Los Molinos Subbasin Projected (Future Land Use) Water Budget Summary**

**Table 2-29. Los Molinos Subbasin Projected (Future Land Use) Water Budget Summary (acre-feet)**

| Water Year (Type) | Net Seepage | Deep Percolation | Net Subsurface Flows | Ground-water Pumping | Groundwater Uptake | Annual Groundwater Storage Change | Cumulative Groundwater Storage Change |
|---|---|---|---|---|---|---|---|
| 2022 (W) | 73,000 | 74,000 | -110,000 | -18,000 | -8,300 | 18,000 | 18,000 |
| 2023 (W) | 59,000 | 65,000 | -100,000 | -19,000 | -12,000 | -1,100 | 16,000 |
| 2024 (W) | 57,000 | 66,000 | -96,000 | -18,000 | -13,000 | -200 | 16,000 |
| 2025 (BN) | 34,000 | 31,000 | -94,000 | -23,000 | -9,500 | -56,000 | -40,000 |
| 2026 (AN) | 62,000 | 66,000 | -87,000 | -17,000 | -8,900 | 20,000 | -20,000 |
| 2027 (W) | 79,000 | 77,000 | -89,000 | -14,000 | -13,000 | 44,000 | 23,000 |
| 2028 (W) | 53,000 | 50,000 | -94,000 | -16,000 | -14,000 | -16,000 | 7,000 |
| 2029 (C) | 24,000 | 37,000 | -89,000 | -25,000 | -10,000 | -58,000 | -51,000 |
| 2030 (C) | 23,000 | 22,000 | -84,000 | -29,000 | -4,100 | -68,000 | -120,000 |
| 2031 (AN) | 76,000 | 66,000 | -81,000 | -20,000 | -4,100 | 42,000 | -77,000 |
| 2032 (BN) | 42,000 | 30,000 | -80,000 | -22,000 | -4,200 | -30,000 | -110,000 |
| 2033 (AN) | 59,000 | 51,000 | -80,000 | -18,000 | -4,000 | 12,000 | -95,000 |
| 2034 (D) | 46,000 | 46,000 | -81,000 | -24,000 | -4,400 | -14,000 | -110,000 |
| 2035 (W) | 98,000 | 73,000 | -87,000 | -16,000 | -6,500 | 65,000 | -44,000 |
| 2036 (W) | 79,000 | 97,000 | -90,000 | -11,000 | -12,000 | 67,000 | 23,000 |
| 2037 (W) | 52,000 | 67,000 | -97,000 | -17,000 | -15,000 | -5,200 | 18,000 |
| 2038 (D) | 28,000 | 48,000 | -95,000 | -20,000 | -12,000 | -47,000 | -29,000 |
| 2039 (W) | 62,000 | 64,000 | -92,000 | -18,000 | -11,000 | 9,300 | -20,000 |
| 2040 (D) | 23,000 | 37,000 | -86,000 | -20,000 | -8,600 | -50,000 | -70,000 |
| 2041 (C) | 25,000 | 28,000 | -83,000 | -25,000 | -4,400 | -55,000 | -120,000 |
| 2042 (D) | 43,000 | 29,000 | -86,000 | -22,000 | -2,400 | -34,000 | -160,000 |
| 2043 (C) | 36,000 | 33,000 | -81,000 | -26,000 | -1,600 | -35,000 | -190,000 |
| 2044 (C) | 41,000 | 32,000 | -78,000 | -25,000 | -920 | -27,000 | -220,000 |
| 2045 (C) | 51,000 | 35,000 | -79,000 | -25,000 | -670 | -14,000 | -240,000 |
| 2046 (AN) | 97,000 | 63,000 | -80,000 | -20,000 | -1,300 | 63,000 | -170,000 |
| 2047 (C) | 39,000 | 33,000 | -81,000 | -25,000 | -1,400 | -32,000 | -200,000 |
| 2048 (W) | 110,000 | 81,000 | -85,000 | -18,000 | -2,500 | 92,000 | -110,000 |
| 2049 (W) | 81,000 | 62,000 | -94,000 | -21,000 | -4,600 | 27,000 | -85,000 |
| 2050 (W) | 70,000 | 53,000 | -99,000 | -19,000 | -6,000 | 3,100 | -82,000 |
| 2051 (W) | 90,000 | 96,000 | -95,000 | -11,000 | -9,200 | 75,000 | -7,000 |
| 2052 (W) | 62,000 | 51,000 | -100,000 | -17,000 | -12,000 | -13,000 | -20,000 |
| 2053 (AN) | 46,000 | 53,000 | -97,000 | -15,000 | -10,000 | -19,000 | -39,000 |
| 2054 (D) | 28,000 | 38,000 | -88,000 | -21,000 | -7,200 | -47,000 | -86,000 |
| 2055 (D) | 46,000 | 45,000 | -86,000 | -24,000 | -4,900 | -21,000 | -110,000 |
| 2056 (AN) | 80,000 | 63,000 | -89,000 | -17,000 | -5,300 | 36,000 | -71,000 |
| 2057 (BN) | 55,000 | 59,000 | -94,000 | -20,000 | -7,000 | -2,700 | -73,000 |
| 2058 (AN) | 50,000 | 61,000 | -82,000 | -14,000 | -6,900 | 13,000 | -61,000 |

<table>
<tr><th colspan="2">Water Year (Type)</th><th>Net Seepage</th><th>Deep Percolation</th><th>Net Subsurface Flows</th><th>Ground-water Pumping</th><th>Groundwater Uptake</th><th>Annual Groundwater Storage Change</th><th>Cumulative Groundwater Storage Change</th></tr>
<tr><td colspan="2">2059 (W)</td><td>88,000</td><td>76,000</td><td>-90,000</td><td>-15,000</td><td>-11,000</td><td>52,000</td><td>-9,100</td></tr>
<tr><td colspan="2">2060 (D)</td><td>25,000</td><td>32,000</td><td>-95,000</td><td>-20,000</td><td>-8,500</td><td>-63,000</td><td>-72,000</td></tr>
<tr><td colspan="2">2061 (C)</td><td>38,000</td><td>37,000</td><td>-88,000</td><td>-28,000</td><td>-4,500</td><td>-42,000</td><td>-110,000</td></tr>
<tr><td colspan="2">2062 (D)</td><td>50,000</td><td>32,000</td><td>-87,000</td><td>-23,000</td><td>-2,800</td><td>-26,000</td><td>-140,000</td></tr>
<tr><td colspan="2">2063 (BN)</td><td>68,000</td><td>57,000</td><td>-83,000</td><td>-18,000</td><td>-3,000</td><td>25,000</td><td>-110,000</td></tr>
<tr><td colspan="2">2064 (W)</td><td>91,000</td><td>61,000</td><td>-88,000</td><td>-15,000</td><td>-4,800</td><td>48,000</td><td>-67,000</td></tr>
<tr><td colspan="2">2065 (BN)</td><td>42,000</td><td>31,000</td><td>-92,000</td><td>-22,000</td><td>-4,800</td><td>-41,000</td><td>-110,000</td></tr>
<tr><td colspan="2">2066 (D)</td><td>49,000</td><td>39,000</td><td>-91,000</td><td>-29,000</td><td>-3,000</td><td>-31,000</td><td>-140,000</td></tr>
<tr><td colspan="2">2067 (C)</td><td>39,000</td><td>23,000</td><td>-91,000</td><td>-31,000</td><td>-1,200</td><td>-57,000</td><td>-200,000</td></tr>
<tr><td colspan="2">2068 (C)</td><td>50,000</td><td>37,000</td><td>-86,000</td><td>-39,000</td><td>-620</td><td>-35,000</td><td>-230,000</td></tr>
<tr><td colspan="2">2069 (BN)</td><td>83,000</td><td>45,000</td><td>-86,000</td><td>-26,000</td><td>-570</td><td>20,000</td><td>-210,000</td></tr>
<tr><td colspan="2">2070 (W)</td><td>120,000</td><td>74,000</td><td>-93,000</td><td>-21,000</td><td>-2,000</td><td>87,000</td><td>-130,000</td></tr>
<tr><td colspan="2">2071 (BN)</td><td>62,000</td><td>28,000</td><td>-100,000</td><td>-25,000</td><td>-1,700</td><td>-32,000</td><td>-160,000</td></tr>
<tr><td colspan="2">2072 (W)</td><td>96,000</td><td>71,000</td><td>-93,000</td><td>-19,000</td><td>-2,600</td><td>57,000</td><td>-100,000</td></tr>
<tr><td colspan="2">Average (2022-2072)</td><td>59,000</td><td>51,000</td><td>-89,000</td><td>-21,000</td><td>-6,100</td><td>-2,000</td><td></td></tr>
<tr><td rowspan="5">2022-2072</td><td>W</td><td>79,000</td><td>70,000</td><td>-94,000</td><td>-17,000</td><td>-8,800</td><td>34,000</td><td></td></tr>
<tr><td>AN</td><td>67,000</td><td>60,000</td><td>-85,000</td><td>-17,000</td><td>-5,800</td><td>24,000</td><td></td></tr>
<tr><td>BN</td><td>55,000</td><td>40,000</td><td>-90,000</td><td>-22,000</td><td>-4,400</td><td>-17,000</td><td></td></tr>
<tr><td>D</td><td>38,000</td><td>38,000</td><td>-88,000</td><td>-23,000</td><td>-6,000</td><td>-37,000</td><td></td></tr>
<tr><td>C</td><td>37,000</td><td>32,000</td><td>-84,000</td><td>-28,000</td><td>-2,900</td><td>-42,000</td><td></td></tr>
</table>

### 2.3.9. Projected Water Budgets with Climate Change

Additional projected scenarios were developed to model potential climate change scenarios. Climate change scenarios were developed using the DWR guidance for the 2030 and 2070 central tendencies. Additional detail about the development and results of these scenarios can be found in **Appendices 2-J and 2-K**. The climate change scenarios were implemented following DWR's guidance related to the 2030 and 2070 central tendency climate change scenarios and associated adjustment factors applied to model inputs such as precipitation, ET, and surface water inflows. In the Tehama IHM area, the DWR climate change guidance and adjustment factors tend to result in increases in precipitation, ET, and stream flows.

#### 2.3.9.1. Projected (Current Land Use) Water Budget

A comparison of the major components of the projected (current land use) water budget as they relate to the GWS are presented in **Table 2-30**. Net seepage increases under climate change scenarios, indicating greater stream seepage to groundwater. Greater streamflow volumes entering the Subbasin under the climate change scenarios likely results in greater stream seepage although deep percolation and net subsurface flows change little under climate change scenarios. Groundwater pumping increases slightly under climate change scenarios, but the overall water budget results suggest that annual change in storage is only very slightly more negative under the climate change scenarios.

**Table 2-30. Comparison of Annual Projected (Current Land Use) GWS Water Budgets with Climate Change Adjustments (acre-feet)**

| GWS WATER BUDGET COMPONENT | PROJECTED (CURRENT LAND USE) | | |
|---|---|---|---|
| | NO CLIMATE CHANGE ADJUSTMENT | CLIMATE CHANGE (2030) | CLIMATE CHANGE (2070) |
| Net Seepage | 55,000 | 62,000 | 67,000 |
| Deep Percolation | 52,000 | 52,000 | 50,000 |
| Net Subsurface Flows | -86,000 | -87,000 | -88,000 |
| Groundwater Extractions (Pumping and Uptake) | -27,000 | -29,000 | -31,000 |
| ***Annual Groundwater Storage*** | ***-1,800*** | ***-1,900*** | ***-2,100*** |

Note: positive values indicate inflows/increasing storage, negative values indicate outflows/decreasing storage.

### 2.3.9.2. Projected (Future Land Use) Water Budget

A comparison of the major components of the projected (future land use) water budget as they relate to the GWS are presented in **Table 2-31**. Overall, the climate change scenarios to not appear to change the overall Subbasin GWS water budget in a considerable way, at similar magnitudes as in the projected (current land use) conditions. Net seepage increases by about 11 taf per year under climate change scenarios, indicating greater stream seepage to groundwater. Deep percolation and net subsurface flows change little under climate change scenarios. Groundwater pumping increases by about 3.0 taf per year under climate change scenarios; however, overall change in storage is only slightly more negative under the climate change scenarios.

**Table 2-31. Comparison of Annual Projected (Future Land Use) GWS Water Budgets with Climate Change Adjustments (acre-feet)**

| GWS Water Budget Component | Projected (Future Land Use) | | |
|---|---|---|---|
| | No Climate Change Adjustment | Climate Change (2030) | Climate Change (2070) |
| Net Seepage | 59,000 | 66,000 | 70,000 |
| Deep Percolation | 51,000 | 51,000 | 49,000 |
| Net Subsurface Flows | -89,000 | -91,000 | -92,000 |
| Groundwater Extractions (Pumping and Uptake) | -27,000 | -28,000 | -30,000 |
| ***Annual Groundwater Storage Change*** | ***-2,000*** | ***-2,100*** | ***-2,300*** |

Note: positive values indicate inflows/increasing storage, negative values indicate outflows/decreasing storage.

### 2.3.10. Projected Groundwater Storage Change by Aquifer

This section presents the projected groundwater storage change in the Upper Aquifer and Lower Aquifer under Current Land Use and Future Land Use conditions with and without the climate change conditions. Note that the total water budget numbers presented below by aquifer may differ from the sum of the average annual values because of rounding. Additional detail about the development and results of these scenarios can be found in **Appendices 2-J and 2-K**.

#### 2.3.10.1. Projected (Current Land Use) Storage Change

A comparison of the groundwater storage change under the projected (current land use) conditions with different climate change assumptions is presented in **Table 2-32**. The results suggest reduction of storage is only slightly greater under climate chance scenarios, with more of the storage change occurring in the Upper Aquifer. Overall projected storage change in the Subbasin is relatively small and differs little between the various climate change conditions evaluated. The projected average annual storage change decreases range from -1.8 to -2.1 taf per year and are equivalent to very minimal change on a per-acre basis over the 51-year projected period. Projected annual storage changes in the Upper Aquifer range from annual storage decreases of -1.1 to -1.3 taf per year with and without climate change conditions. Storage changes in the Lower Aquifer range from an increase of about -0.73 taf (-730 acre-feet) per year without climate change to -0.9 taf (-900 acre-feet) per year on average with 2070 climate change. The small amounts of change in the entire Subbasin, including individual aquifers, is small and is likely within the range of uncertainty of the water budget results, considering the magnitude of many of the other water budget components. For the projected (current land use) conditions with 2070 climate change factors, storage changes in the Upper and Lower Aquifers equate to annual basin wide storage changes of about -0.02 acre-feet per acre per year on average over the 51 years.

**Table 2-32. Comparison of Projected (Current Land Use) Aquifer-Specific GWS Water Budgets with Climate Change Adjustments**

| PROJECTED (CURRENT LAND USE) | | AVERAGE ANNUAL CHANGE IN STORAGE | | | CUMULATIVE CHANGE IN STORAGE | | |
|---|---|---|---|---|---|---|---|
| | | UPPER AQUIFER | LOWER AQUIFER | TOTAL | UPPER AQUIFER | LOWER AQUIFER | TOTAL |
| No Climate Change Adjustment | acre-feet | -1,100 | -730 | -1,800 | -56,000 | -37,000 | -93,000 |
| | *acre-feet per acre* | *-0.01* | *-0.01* | *-0.02* | *-0.56* | *-0.37* | *-0.94* |
| Climate Change 2030 | acre-feet | -1,100 | -760 | -1,900 | -58,000 | -39,000 | -97,000 |
| | *acre-feet per acre* | *-0.01* | *-0.01* | *-0.02* | *-0.58* | *-0.39* | *-0.98* |
| Climate Change 2070 | acre-feet | -1,300 | -900 | -2,100 | -66,000 | -44,000 | -110,000 |
| | *acre-feet per acre* | *-0.01* | *-0.01* | *-0.02* | *-0.66* | *-0.44* | *-1.1* |

Note: positive values indicate inflows/increasing storage, negative values indicate outflows/decreasing storage.

### 2.3.10.2. Projected (Future Land Use) Water Budget

A comparison of the groundwater storage change under the projected (future land use) conditions with different climate change assumptions is presented in **Table 2-33**. As with the projected (current land use) water budget results, the results suggest reduction of storage is only slightly greater under climate chance scenarios, with more of the storage change occurring in the Upper Aquifer. Overall projected storage change in the Subbasin is relatively small and differs little between the various climate change conditions evaluated. The projected average annual storage change decreases range from -2.0 to –2.3 taf per year and are equivalent to very minimal change on a per-acre basis over the 51-year projected period. Projected annual storage changes in the Upper Aquifer range from annual storage decreases of -1.2 to -1.4 taf per year with and without climate change conditions. Storage changes in the Lower Aquifer range from an increase of about -0.81 taf (-810 acre-feet) per year without climate change to -0.96 taf (-960 acre-feet) per year on average with 2070 climate change. The small amounts of change in the entire Subbasin, including individual aquifers, is small and is likely within the range of uncertainty of the water budget results, considering the magnitude of many of the other water budget components. For the projected (future land use) conditions with 2070 climate change factors, storage changes in the Upper and Lower Aquifers equate to annual basin wide storage changes of about -0.02 acre-feet per acre per year on average over the 51 years.

**Table 2-33. Comparison of Projected (Future Land Use)
Aquifer-Specific GWS Water Budgets with Climate Change Adjustments**

| PROJECTED (CURRENT LAND USE) | | AVERAGE ANNUAL CHANGE IN STORAGE | | | CUMULATIVE CHANGE IN STORAGE | | |
|---|---|---|---|---|---|---|---|
| | | UPPER AQUIFER | LOWER AQUIFER | TOTAL | UPPER AQUIFER | LOWER AQUIFER | TOTAL |
| No Climate Change Adjustment | acre-feet | -1,200 | -810 | -2,000 | -59,000 | -41,000 | -100,000 |
| | *acre-feet per acre* | *-0.01* | *-0.01* | *-0.02* | *-0.59* | *-0.41* | *-1.0* |
| Climate Change 2030 | acre-feet | -1,200 | -850 | -2,100 | -62,000 | -43,000 | -105,000 |
| | *acre-feet per acre* | *-0.01* | *-0.01* | *-0.02* | *-0.62* | *-0.43* | *-1.1* |
| Climate Change 2070 | acre-feet | -1,400 | -960 | -2,300 | -70,000 | -49,000 | -120,000 |
| | *acre-feet per acre* | *-0.01* | *-0.01* | *-0.02* | *-0.71* | *-0.49* | *-1.2* |

Note: positive values indicate inflows/increasing storage, negative values indicate outflows/decreasing storage.

## 2.3.11. Uncertainty in Water Budget Estimates

### 2.3.11.1. Uncertainty in SWS Water Budget

Uncertainties associated with each SWS water budget component have been computed or estimated following the process described by Clemmens and Burt (1997). In summary:

1. The uncertainty of each independently-estimated water budget component (excluding the closure term) is calculated or estimated as a percentage that approximately represents a 95 percent confidence interval for the average annual component volume of the component. Uncertainty percentages are based on the accuracy of measurement devices, the uncertainty of supporting calculations and estimation procedures, and professional judgement.
2. Assuming random, normally-distributed error, the standard deviation is calculated for each independently-estimated component as the average uncertainty on a volumetric basis (uncertainty percentage multiplied by the average annual component volume) divided by two.
3. The variance is calculated for each independently-estimated component as the square of the standard deviation.
4. The variance of the closure term is estimated as the sum of variances of all independently-estimated components.
5. The standard deviation of the closure term is estimated as the square root of the sum of variances.
6. The 95 percent confidence interval of the closure term is estimated as twice the estimated standard deviation.

Estimated uncertainties were calculated following the above procedure for the Subbasin water budget and all GSA water budgets. **Table 2-34** provides a summary of typical uncertainty values associated with major SWS inflows and outflows, along with the sources of these uncertainty values. For surface water flows, deliveries, and diversions, the uncertainty is estimated based on typical accuracy of streamflow gages and measurement devices. For IDC root zone water budget inflows and outflows, the uncertainty is based on typical accuracies given in technical literature and the cumulative estimated accuracy of all inputs used to calculate the components. These uncertainties provide a basis for evaluating confidence in water budget results and help to identify data needs that may be addressed during GSP implementation.

**Table 2-34. Estimated Uncertainty of Major Water Budget Components**

| FLOWPATH DIRECTION (RELATIVE TO SWS) | WATER BUDGET COMPONENT | DATA SOURCE | ESTIMATED UNCERTAINTY (%) | SOURCE |
|---|---|---|---|---|
| Inflows | Surface Water Inflows | Measurement | 5%[1] | Accuracy of USGS streamflow gages, with adjustment for infiltration and evaporation of inflows upstream/downstream of nearest measurement site. |
| | Deliveries | Measurement | 6% | Required delivery measurement accuracy for Reclamation contractors, per the USGS 2017 Standard Criteria for Agricultural Water Management Plans) |
| | Water Rights Diversions | Measurement / Estimate | 10% | Required diversion measurement accuracy, per California Senate Bill 88. |
| | Precipitation | Calculation | 20%[2] | Clemmens, A.J. and C.M. Burt, 1997. |
| | Groundwater Extraction | Calculation | 20% | Typical uncertainty when calculated for Land Surface System water budget closure. The uncertainty of the accounting center closure is a product of the combined uncertainty of all other inflows and outflows, and the relative magnitude of each component. |
| Outflows | Surface Water Outflows | Measurement | 15% | Estimated streamflow measurement accuracy with adjustment for infiltration and evaporation. |
| | Evaporation | Calculation | 20% | Clemmens and Burt, 1997; typical accuracy of calculation based on CIMIS reference ET and free water surface evaporation coefficient. |
| | ET of Applied Water | Calculation | 10% | Clemmens and Burt, 1997; typical accuracy of total irrigation water consumption on irrigated land, parsed into ET of Applied Water and ET of Precipitation by daily root zone water budget component based on reference |

| FLOWPATH DIRECTION (RELATIVE TO SWS) | WATER BUDGET COMPONENT | DATA SOURCE | ESTIMATED UNCERTAINTY (%) | SOURCE |
|---|---|---|---|---|
| | | | | ET, precipitation, surface energy balance crop coefficients, and annual land use. |
| | ET of Precipitation | Calculation | 10%[2] | Clemmens and Burt, 1997; accuracy of total water consumption on irrigated land, parsed into ET of Applied Water and ET of Precipitation by daily root zone water budget component based on reference ET, precipitation, surface energy balance crop coefficients, and annual land use. |
| | Infiltration of Applied Water | Calculation | 20%[2] | Estimated accuracy of daily IDC root zone water budget based on annual land use and NRCS soils characteristics. Similar accuracy anticipated for monthly results. |
| | Infiltration of Precipitation | Calculation | 20%[2] | Estimated accuracy of daily IDC root zone water budget based on annual land use, NRCS soils characteristics, and CIMIS precipitation. |
| | Infiltration of Surface Water | Calculation | 15% | Typical accuracy of daily seepage calculation using NRCS soils characteristics and measured streamflow data compared to field measurements. |

[1] Higher uncertainty of 10-20 percent is typical for estimated surface water inflows, including ungaged inflows from small watersheds into creeks that enter the Subbasin.

[2] IDC root zone water budget inflows and outflows. The uncertainty of these water budget components is based on typical accuracies given in technical literature and the cumulative estimated accuracy of all inputs used to calculate the components.

### 2.3.11.2. GWS Water Budget Uncertainty

Uncertainty associated with the GWS water budget results estimated using the Tehama IHM depends in part on the model inputs relating to the SWS with additional sources of uncertainty associated with model inputs relating to the GWS, including aquifer and streambed properties, specification of boundary conditions, and other factors. The uncertainty estimates associated with SWS water budget components that are also inputs or outputs of the GWS water budget are noted above. The overall uncertainty of other water budget components simulated for the GWS, including subsurface flows, groundwater discharging to surface water, and change in groundwater storage are estimated to be slightly higher, in the range of 15 to 30 percent. These GWS water budget components are subject to higher uncertainty as a result of limitations in available input data and simplification required in modeling of the subsurface heterogeneity. However, the uncertainty in GWS water budget results derived from a numerical model such as the Tehama IHM depends to a considerable degree on the calibration of the model and can vary by location and depth within the Subbasin. The Tehama IHM is a product of local refinement and improvements made to the SVSim model and calibration at a more local scale. The Tehama IHM simulates the integrated groundwater and surface water system and metrics relating to the calibration of the model indicate the model is reasonably well calibrated in accordance with generally accepted professional guidelines and is sufficient for GSP-related applications. The calibration and sensitivity of the model and different model parameters are presented in **Appendix 2-J**.

### 2.3.12. Estimate of Sustainable Yield

GSP Regulations require the GSP quantify the sustainable yield for the Subbasin. Sustainable yield is defined 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 without causing an undesirable result” (CWC Section 10721(w)). Historical and projected model results show that the conditions in the Subbasin under the historical and anticipated future land use conditions and hydrology, including with potential climate change conditions (2030 and 2070), will not cause the occurrence of undesirable results in the Subbasin over the 50-year GSP planning period based on sustainability indicator Minimum Thresholds (MTs) developed for the Subbasin.

Over the historical base period, the average annual volume of groundwater pumping in the Los Molinos Subbasin is estimated to be about 16,000 acre-feet per year. An additional 17,000 acre-feet of groundwater is estimated to be taken up and consumed directly by plants reflecting a total historical groundwater extraction volume of about 33,000 acre-feet per year on average. Observed groundwater level conditions and simulated water budget results suggest there has been little or no historical long-term change in groundwater storage in the Subbasin. Under the projected scenarios (current land use and future land use conditions) without climate change, total groundwater extraction (combination of groundwater pumping and uptake) within the Subbasin decreases overall, although the groundwater pumping component increases by about 4,000 acre-feet per year to about 20,000 acre-feet per year while direct groundwater uptake decreases to between 6,000 and 7,000 acre-feet per year. Under the projected climate change scenarios groundwater pumping ranges from about 22,000 to 25,000 acre-feet per year with groundwater uptake between 5,000 and 7,000 acre-feet per year. The groundwater extraction water budget component is a relatively smaller water budget component in comparison to the net seepage, deep percolation, and subsurface flow water budget components. Notably, projected groundwater extractions are considerably less than the projected GWS inflows of stream seepage and deep percolation which total to between 107,000 and 119,000 acre-feet per year, depending on the water budget land use and climate scenario. Considerable net subsurface outflows to adjacent subbasin of about 76,000 to 92,000 acre-feet per year are also projected to occur. Under all of the projected scenarios, the change in storage is simulated to be very small or practically zero, recognizing typical uncertainty associated with water budget estimates and the magnitude of other water budget components.

Accordingly, for the purpose of the GSP, the sustainable yield is estimated to be 28,000 acre-feet per year, which is equal to the volume of groundwater extracted annually in the Subbasin (by pumping and by uptake) minus the simulated annual decrease in storage under the projected model scenario with future land use and 2070 climate change conditions and considering the level of uncertainty associated with water budget estimates. This volume is well below the annual volume of vertical inflows (stream seepage and deep percolation) occurring within the Subbasin as a result of water infiltrating from the SWS into the

GWS. Assuming a potential uncertainty of 25 percent associated with the water budget estimates, an associated range of values for the estimated sustainable yield would be 21,000 to 35,000 acre-feet per year. It is possible that the true sustainable yield is higher as no model scenarios were developed to test the maximum possible volume of groundwater extraction. The sustainable yield estimate provided here is consistent with the sustainability goal for the Subbasin and will be reviewed as the Subbasin implements the GSP, including through periodic review and updates to the Tehama IHM and water budget results and ongoing monitoring of Subbasin conditions as required by GSP Regulations.

## 2.4. References

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