

# Appendix A1a

## Methods for Estimating Regional Sacramento/Delta Surface Water Supply for Agricultural and Municipal Use

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### A1a.1 Introduction

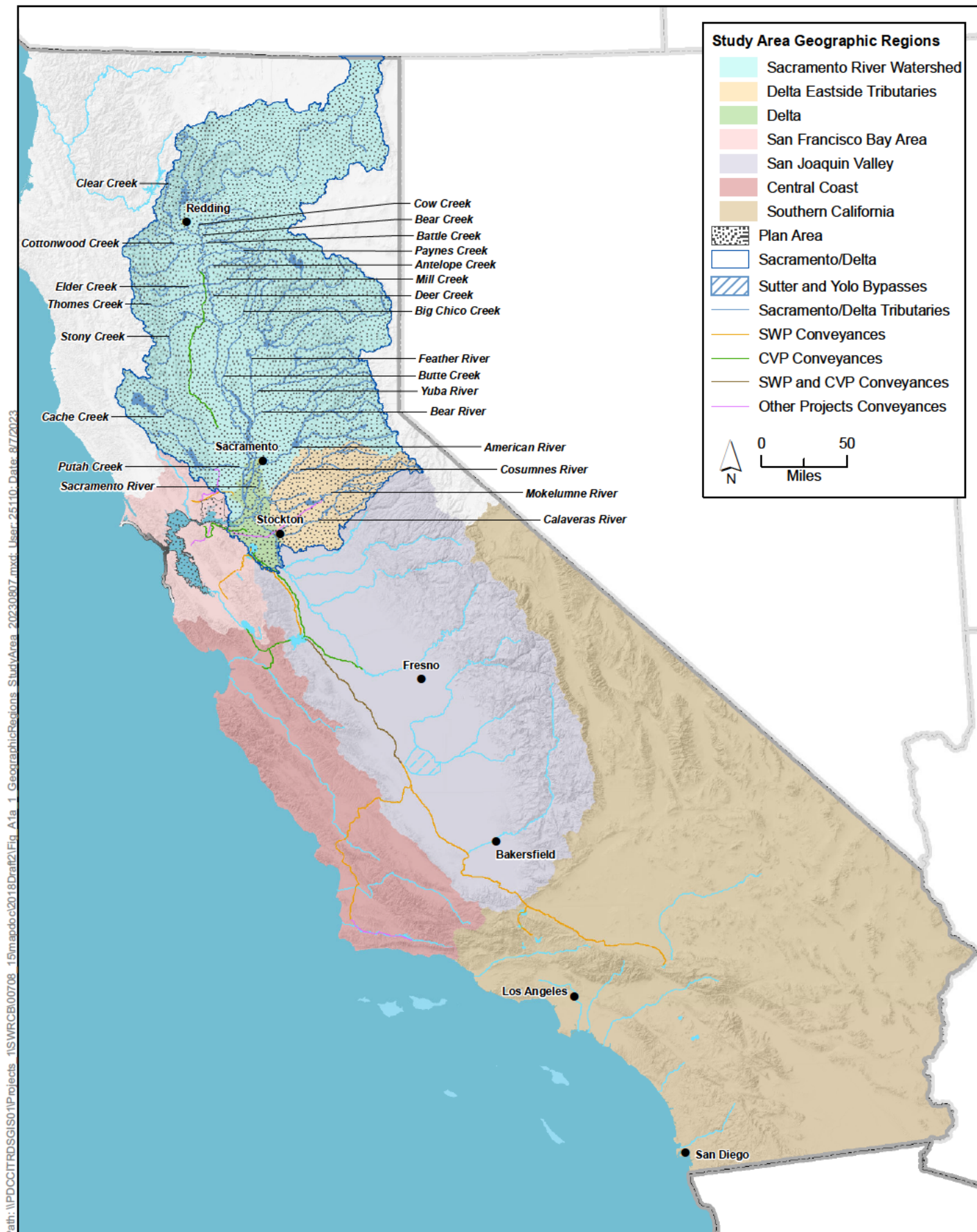
This Staff Report analyzes the potential environmental and economic effects that may result from implementation of proposed changes to the Bay-Delta Plan. Changes in flow requirements could cause changes in hydrology and water supply within the Sacramento/Delta as well as in regions that receive water from the Sacramento/Delta. The Sacramento Water Allocation Model (SacWAM) is used to simulate changes in hydrology and water supply that could result from changes in flow and other water quality objectives. The SacWAM Model Documentation (^SacWAM 2023) provides the methods and assumptions used to develop the SacWAM model. Appendix A1 provides additional assumptions used for the analyses in this report and provides the results of the SacWAM simulations in tables and figures for parameters such as reservoir operations and water supply at SacWAM demand units, and includes modeled changes in CVP and SWP operations and North of Delta and South of Delta contractor deliveries.

The Staff Report uses multiple modeling tools in addition to SacWAM to evaluate the potential effects of proposed changes to the Bay-Delta Plan. SacWAM results, such as river flows, reservoir levels, local runoff, diversions, exports, and other water supplies, are used as inputs to these modeling tools. This sub-appendix provides an overview of the methods for translating SacWAM information into Sacramento/Delta supply estimates for agricultural and urban use in the San Francisco Bay, San Joaquin Valley, Central Coast, and Southern California study regions. The detailed methods are provided in Attachment A1a1, *California Sub-Regional Agricultural Analysis*. Agricultural supply estimates are subtracted from total Sacramento/Delta supply estimates to obtain municipal supply estimates.

Linkages between SacWAM results and models for other resources are discussed in the appendices for those particular models. For example, linkages between SacWAM results and the DSM2 model of the Delta are covered in Appendix A2, linkages between SacWAM results and hydropower calculations are covered in Appendix A5, and linkages between SacWAM results and water temperature modeling are covered in Appendix A6.

### A1a.2 Relationships between SacWAM Results and Study Regions

Effects that could result from actions taken in response to changes in Sacramento/Delta hydrology and surface water supply could occur within a seven-region study area (Figure A1a-1). This includes the Sacramento/Delta and areas that receive Sacramento/Delta supplies, such as the SWP and CVP service areas, and other non-Project service areas (e.g., East Bay Municipal Utility District service area in the San Francisco Bay Area). To provide for a consistent and organized discussion, the effects



**Figure A1a-1**  
**Study Area Geographic Regions**

analysis for agriculture and municipal water supply is organized into the seven regions of the study area.

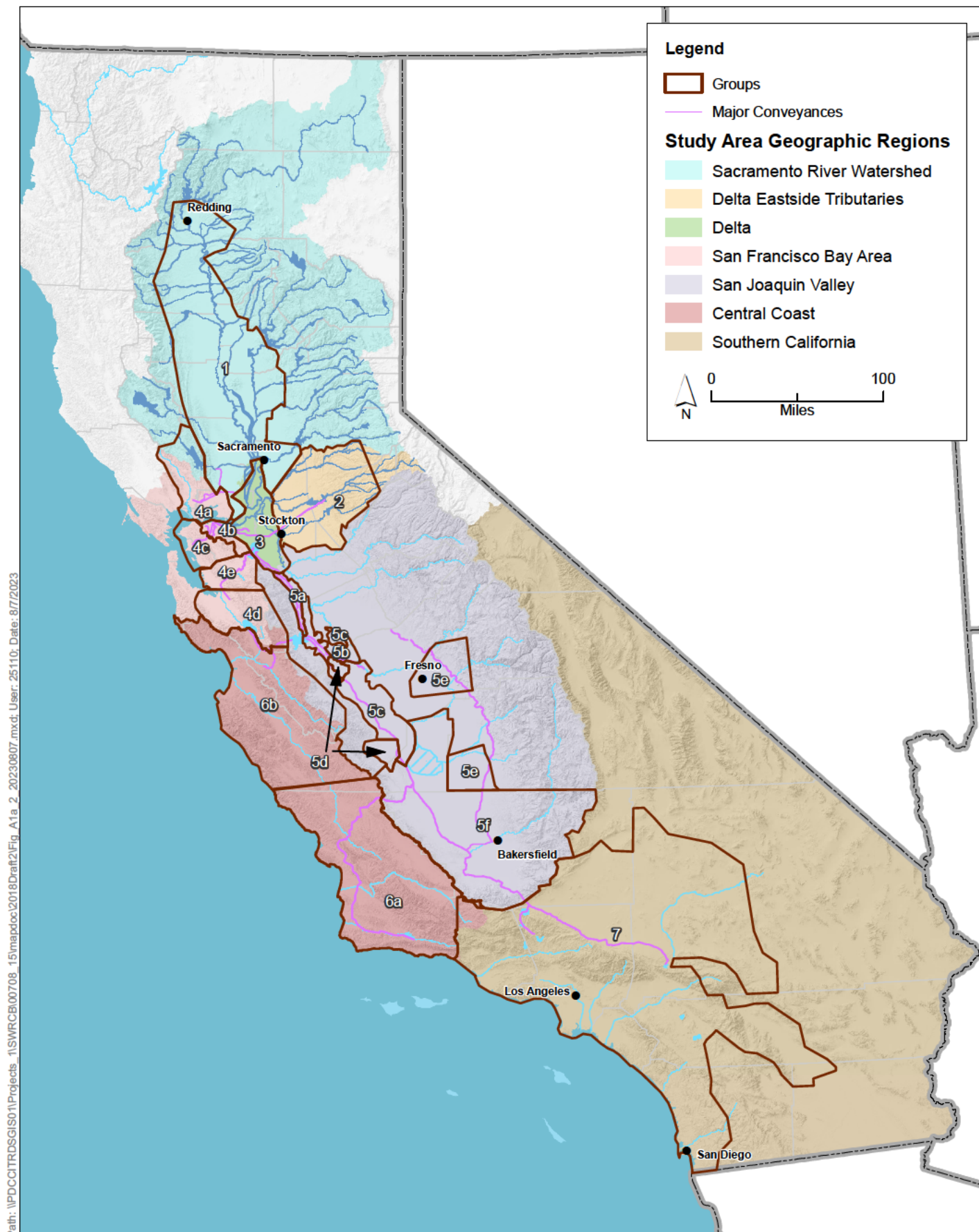
Changes in hydrology and water supply are anticipated to affect both agricultural irrigators and municipal water providers in the study area. The process for determining the effects requires linking several analytical models. The models are connected by using model results from one model as input to another, requiring proper mapping from one to the other and into study regions. The mapping of SacWAM results into the seven study regions is shown in Figure A1a-2.

The SacWAM model provides detailed output of monthly quantities of Sacramento/Delta surface water supplies for a 94-year simulation, which is based on water year 1922 to water year 2015 hydrologic conditions. Monthly output values for the time series are combined into annual averages for use in both the agricultural and municipal effects analyses. Modeling results are compared to baseline condition modeling results to help inform the determination of potential environmental impacts.

Information from a variety of sources was used to estimate Sacramento/Delta supplies for agricultural and municipal use for each study region. For water supplied to CVP contractors, SacWAM provides separate demand nodes for agricultural and urban uses that are based on CVP contract information published by the U. S. Bureau of Reclamation (Reclamation 2016). For water supplied to SWP contractors and non-project users north of the Delta, the type of use was categorized by California Department of Water Resources (DWR) land use data (DWR 1994a-b, 1996, 1997, 1998a-c, 1999a-b, 2000). For water supplied to SWP contractors south of the Delta, the type of use was categorized using DWR published information (DWR 2007) and review of local water management plans.

Within the Sacramento River Watershed, Delta, and Delta Eastside Tributaries regions, the surface water deliveries estimated by SacWAM are used directly in the respective region's agricultural and municipal analysis because SacWAM provides separate agricultural and municipal supply results in these regions. In contrast, the quantity of Sacramento/Delta supply that is exported to the San Joaquin Valley, San Francisco Bay Area, Central Coast, and Southern California regions is estimated within SacWAM but the output is in aggregate form that requires additional data processing before it can be used in the regional agricultural and municipal analyses. For example, SacWAM provides combined agricultural and municipal Sacramento/Delta water supply results for SWP deliveries for parts of the lower San Joaquin Valley and the Central Coast. The mapping of SacWAM results to the individual study regions and smaller subareas within each of the receiving regions relies on a separate process that is based on a more detailed evaluation of SWP and CVP contracts and deliveries. This more detailed mapping of water supply to subregions includes review of local water management plans to develop assumptions regarding the distribution of Sacramento/Delta supply to municipalities and commercial agriculture, which allows changes in agricultural water deliveries and their effects on crop acreage and crop mix to be estimated. Changes in municipal water deliveries are estimated by subtracting agricultural water deliveries from total deliveries. This process is described in more detail in Attachment A1a1, *California Sub-Regional Agricultural Analysis*.

The relationships between SacWAM demand units, types of water supplies, and geographic location in the study region is illustrated in Figure A1a-2, with details in Table A1a-1. Figure A1a-2 superimposes "locator zones" over the study regions which, when combined with Table A1a-1, shows how SacWAM demand units overlay the study regions. Table A1a-1 is organized by locator



**Figure A1a-2**  
**Locator Map Zones of the Study Area**

zones that correspond to regions outlined in Figure A1a-2 that provide a general spatial reference for the locations of the demand units.

Locator Zones 1 contain both urban and agricultural use that are separate outputs from SacWAM, represented by U\_XX and A\_XX demand node structures, respectively. Locator Zone 1 contains water deliveries from the Sacramento River and its tributaries. Locator Zone 2 represents direct diversions in the Delta eastside tributaries. Locator Zone 3 is the Delta and includes both CVP deliveries and direct diversions.

Locator Zones 4a through 4e, in the San Francisco Bay Area, are represented as five subzones. The subzones correspond to delivery canals and adjacent areas, all of which are primarily municipal deliveries to wholesalers. One exception is in Locator Zone 4a, which contains the agricultural delivery to the Solano Project. Some wholesalers ultimately deliver a portion of their Sacramento/Delta supply to irrigation customers. For example, Locator Zone 4e includes South Bay Aqueduct deliveries. Local water management plans indicate that a portion of the Sacramento/Delta supply to Alameda County Flood Control and Water Conservation District (Zone 7) is delivered to agricultural customers. Attachment A1a1, *California Sub-Regional Agricultural Analysis*, provides the methods used for estimating the agricultural supply portion of the South Bay Aqueduct deliveries. CVP deliveries to the San Felipe Division for municipal use are in Locator Zone 4d.

Locator Zones 5a through 5g can all be found in the northern San Joaquin Valley. Locator Zones 5a through 5g are CVP agricultural deliveries distinguished by CVP canal and adjacent use: Upper Delta-Mendota Canal (DMC), Lower DMC, and Mendota Pool; and California Aqueduct SWP agricultural deliveries. Locator Zone 5d contains both urban and agricultural use associated with the CVP San Luis Canal, which are separate outputs from SacWAM. Locator Zone 5f is associated with CVP Cross Valley Canal agricultural use.

Locator Zones 5g and 6b cover the southern San Joaquin Valley and the Central Coast, reflective of SacWAM SWP export deliveries to the area. The San Joaquin Valley portion, Locator Zone 5g, represents SWP deliveries to Tulare County wholesalers. The Central Coast portion, Locator Zone 6b, represents SWP deliveries via the Coastal Aqueduct to San Luis Obispo and Santa Barbara Counties. Attachment A1a1, *California Sub-Regional Agricultural Analysis*, provides the methods used for estimating the agricultural supply portions of these deliveries.

Locator Zone 6a is associated with CVP agricultural deliveries to the San Felipe Division in the northern portion of the Central Coast region.

Locator Zone 7 represents SWP deliveries to Southern California. Attachment A1a1, *California Sub-Regional Agricultural Analysis*, provides the methods used for estimating the agricultural supply portions of these deliveries.

**Table A1a1-1. Legend for Locator Map**

| Study Region                     | Map<br>Locator<br>Group | Municipal Supply               | Irrigation Supply            | Municipal and<br>Irrigation Supply | Example Water Users                                                                                                                                                                                                                                                                                                                                    |
|----------------------------------|-------------------------|--------------------------------|------------------------------|------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Sacramento<br>River<br>Watershed | 1                       | WBAs, U_02<br>through U_26     |                              |                                    | CVP Sacramento River settlement contracts, CVP<br>water service contracts, SWP long-term contracts,<br>Feather River settlements, Redding region,<br>Sacramento region, portions of Placer County Water<br>Agency (PCWA), Yolo County diversions, small<br>communities                                                                                 |
|                                  | 1                       |                                | WBAs, A_02<br>through A_26   |                                    | CVP Sacramento River settlement contracts, CVP<br>water service contracts, SWP long-term contracts,<br>Feather River settlements, Yolo County diversions,<br>South Sutter Irrigation District (ID), Camp Far West<br>ID, Nevada ID (portion), PCWA (portion), Solano<br>Project (portion), Orland Project (portion), individual<br>water right holders |
| Delta Eastside<br>Tributaries    | 2                       | U_AMADR_NU                     |                              |                                    | Amador County Water Agency                                                                                                                                                                                                                                                                                                                             |
|                                  | 2                       | U_JLIND_NU                     |                              |                                    | Calaveras County Water District (WD)                                                                                                                                                                                                                                                                                                                   |
|                                  | 2                       | U_CaCWD_NU<br>U_CPU_NUD        |                              |                                    | Calaveras County WD and Calaveras Public Utilities<br>District (PUD)                                                                                                                                                                                                                                                                                   |
|                                  | 2                       | U_60N_NU2<br>U_60S_NU1         |                              |                                    | Lodi, Galt, Stockton, Rancho Murieta, Rancho Seco,<br>small communities                                                                                                                                                                                                                                                                                |
|                                  | 2                       |                                | A_60N<br>A_60S               |                                    | Jackson Valley ID, North San Joaquin Water<br>Conservation District (WCD), Woodbridge ID,<br>Stockton East WD, Central San Joaquin WCD, riparian<br>and non-district diversions                                                                                                                                                                        |
| Delta                            | 3                       | U_ANTOC_NU                     |                              |                                    | Antioch                                                                                                                                                                                                                                                                                                                                                |
|                                  | 3                       | CVP Upper DMC<br>Urban Demands |                              |                                    | City of Tracy                                                                                                                                                                                                                                                                                                                                          |
|                                  | 3                       |                                | A_50_NA1 through<br>A_50_NA7 |                                    | North Delta Water Agency (WA)<br>Central Delta WA<br>South Delta WA<br>Byron Bethany ID                                                                                                                                                                                                                                                                |

| Study Region              | Map<br>Locator<br>Group | Municipal Supply                                                             | Irrigation Supply                                                      | Municipal and<br>Irrigation Supply    | Example Water Users                                                                                                                                                      |
|---------------------------|-------------------------|------------------------------------------------------------------------------|------------------------------------------------------------------------|---------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| San Francisco<br>Bay Area | 3                       |                                                                              | CVP Upper Delta-<br>Mendota Canal<br>(DMC) Ag<br>Demands<br>(portions) |                                       | Byron-Bethany ID<br>Banta-Carbona ID<br>West Side ID                                                                                                                     |
|                           | 4a                      | U_NAPA_PU<br>U_BNCIA_PU<br>U_FRFLD<br>U_TRAFB_PU<br>U_VLLJO_PU<br>U_20_25_PU |                                                                        |                                       | North Bay Aqueduct: Napa County Flood Control and<br>Water Control District (FC&WCD), Solano County,<br>Vallejo, Benicia, Fairfield, Vacaville, Travis Air Force<br>Base |
|                           | 4a                      |                                                                              | A_SIDSH_NA                                                             |                                       | Solano ID, Solano Project (portion)                                                                                                                                      |
|                           | 4b                      | U_CCWD_PU                                                                    |                                                                        |                                       | Contra Costa WD                                                                                                                                                          |
|                           | 4c                      | U_EBMUD_NU                                                                   |                                                                        |                                       | East Bay Municipal Utility District:<br>Berkeley, Oakland, Richmond, Walnut Creek                                                                                        |
|                           | 4d                      | CVP San Felipe<br>Urban                                                      |                                                                        |                                       | Santa Clara Valley WD<br>San Benito County WD                                                                                                                            |
|                           | 4e                      |                                                                              |                                                                        | SWP SBA Table A<br>SWP SBA Article 21 | Alameda County FC&WCD (Zone 7)<br>Alameda County WD<br>Santa Clara Valley WD                                                                                             |
| San Joaquin<br>Valley     | 5a                      |                                                                              | CVP Upper DMC Ag<br>Demands<br>(portions)                              |                                       | Del Puerto WD<br>Patterson ID<br>West Stanislaus ID                                                                                                                      |
|                           | 5a                      |                                                                              | CVP Upper DMC<br>Water Rights                                          |                                       | Patterson ID                                                                                                                                                             |
|                           | 5a                      |                                                                              | SWP San Joaquin                                                        |                                       | Oak Flat WD                                                                                                                                                              |
|                           | 5b                      |                                                                              | CVP Lower DMC<br>Exchange Demands                                      |                                       | Central California ID (north)                                                                                                                                            |
|                           | 5b                      |                                                                              | CVP Lower DMC Ag<br>Demands                                            |                                       | San Luis WD (north)<br>Eagle Field WD<br>Mercy Springs WD                                                                                                                |

| Study Region | Map<br>Locator<br>Group | Municipal Supply                       | Irrigation Supply                           | Municipal and<br>Irrigation Supply | Example Water Users                                                                                                                                                                          |
|--------------|-------------------------|----------------------------------------|---------------------------------------------|------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|              | 5c                      |                                        | CVP Mendota Pool<br>Exchange Demands        |                                    | Oro Loma WD<br>Central California ID<br>Columbia Canal Company<br>Firebaugh Canal WD<br>San Luis Canal Company                                                                               |
|              | 5c                      |                                        | CVP Mendota Pool<br>Ag Demands              |                                    | James ID<br>Laguna WD<br>Reclamation District 1606<br>Terra Linda Farms<br>Tranquility ID<br>Tranquility PUD<br>Westlands WD (Laguna WD assignment)<br>Westlands WD (Oro Lomo WD assignment) |
|              | 5c                      |                                        | CVP Mendota Pool<br>Water Rights<br>Demands |                                    | Fresno Slough WD<br>James ID<br>Reclamation District 1606<br>Terra Linda Farms<br>Tranquility ID<br>Tranquility PUD                                                                          |
|              | 5d                      | CVP San Luis<br>Canal Urban<br>Demands |                                             |                                    | Avenal<br>Coalinga<br>Huron                                                                                                                                                                  |
|              | 5d                      |                                        | CVP San Luis Canal<br>Ag Demands            |                                    | Pacheco WD<br>Panoche WD<br>San Luis WD (south)<br>Westlands WD                                                                                                                              |
|              | 5f                      |                                        | Cross Valley Canal                          |                                    | County of Fresno<br>Hills Valley ID<br>Kern-Tulare WD<br>Lower Tule River ID<br>Pixley ID                                                                                                    |

| Study Region           | Map<br>Locator<br>Group | Municipal Supply | Irrigation Supply | Municipal and<br>Irrigation Supply                                                                        | Example Water Users                                                                                                                                                                                                                                                                                                                                                         |
|------------------------|-------------------------|------------------|-------------------|-----------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Central Coast          | 5g                      |                  |                   | SWP Central Coast<br>Tulare Table A<br>(portions)<br>SWP Central Coast<br>Tulare Article 21<br>(portions) | Kern-Tulare WD<br>Tri-Valley WD<br>Kings County<br>Dudley Ridge WD<br>Empire West Side ID<br>Kern County WA<br>Tulare Lake Basin WSD                                                                                                                                                                                                                                        |
|                        | 6a                      |                  | CVP San Felipe Ag |                                                                                                           | Santa Clara WD<br>San Benito WD                                                                                                                                                                                                                                                                                                                                             |
|                        | 6b                      |                  |                   | SWP Central Coast<br>Tulare Table A<br>(portions)<br>SWP Central Coast<br>Tulare Article 21<br>(portions) | San Luis Obispo County FC&WCD<br>Santa Barbara County FC&WCD                                                                                                                                                                                                                                                                                                                |
| Southern<br>California | 7                       |                  |                   | SWP South Coast<br>Table A<br>SWP South Coast<br>Article 21                                               | Antelope Valley-East Kern WA<br>Castaic Lake WA<br>Coachella Valley WD<br>Crestline-Lake Arrowhead WA<br>Desert WA<br>Littlerock Creek ID<br>Mojave WA<br>Metropolitan WD of Southern California<br>Palmdale WD<br>San Bernardino Valley Municipal Water District<br>(MWD)<br>San Gabriel Valley MWD<br>San Geronio Pass WA<br>Ventura County Watershed Protection District |

## A1a.3 References Cited

### A1a.3.1 Common References

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- <sup>^</sup>U.S. Bureau of Reclamation (Reclamation). 2016. *Central Valley Project (CVP) Water Contractors*. Bureau of Reclamation Mid-Pacific Region. Revised March 2016.

### A1a.3.2 Section References

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Attachment A1a1

**California Subregional Agricultural Analysis (CASRAA),  
Methods for Estimating Effects on Agriculture in the San  
Francisco Bay Area, Central Coast, and Southern  
California Regions, and in the Upper Watersheds (PPT)**

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# Attachment A1a1

## California Subregional Agricultural Analysis (CASRAA)

Methods for Estimating Effects on Agriculture in the  
San Francisco Bay Area, Central Coast, and  
Southern California Regions,  
and in the Upper Watersheds

September 2023

# Geographic Scope:

The California Subregional Agricultural Analysis (CASRAA) is used to estimate the portion of Sacramento/Delta supply that is used for agriculture, and to analyze the effects of changes in water supply on agriculture in the Upper Watersheds and the San Francisco Bay Area, Central Coast, and Southern California Regions. These are locations that are outside of the geographic domain of the Statewide Agricultural Production (SWAP) model.

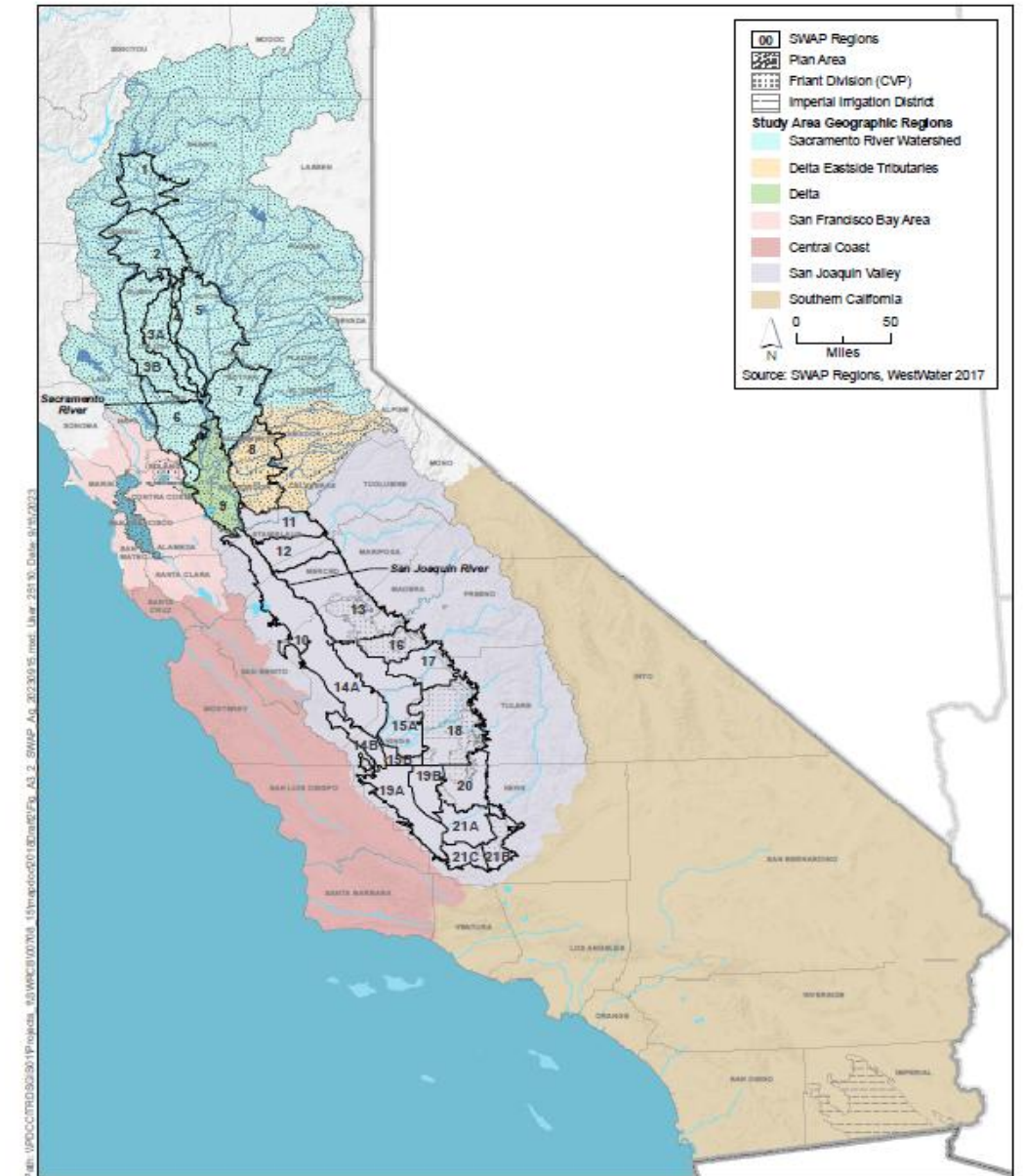


Figure A3-2  
Statewide Agricultural Production (SWAP) Regions in the Study Area

# Features of SWAP and CASRAA

| FEATURES/ATTRIBUTES                                                                      | SWAP | CASRAA |
|------------------------------------------------------------------------------------------|------|--------|
| Utilizes DWR's Detailed Analysis Units (DAUs) for geographic extent of cropping pattern  | X    | X      |
| Utilizes baseline cropping patterns from 2010 DWR land use survey data                   | X    | X      |
| Incorporates site-specific, regional crop water requirements in cropping pattern         | X    | X      |
| Incorporates available water supply in cropping pattern analysis                         | X    | X      |
| Substitutes water supply source under reduced supply conditions                          | X    |        |
| Considers contemporary prices, yields, and cost of production for representative crops   | X    | X      |
| Utilizes UC Cooperative Extension crop enterprise budgets                                |      | X      |
| Incorporates profit-maximizing behavior of farmers within limits of resource constraints | X    | X      |
| Crop substitution within optimization                                                    | X    |        |
| Market constraints on high-profit crops                                                  | X    | X      |
| Utilizes land fallowing as cost-effective response to resource limits                    | X    | X      |

**CASRAA Approach Objectives:** Estimate the effects of changes in Sacramento/Delta supply on agriculture in agricultural production regions that are not included in the SWAP model. Apply an analysis approach that is consistent with SWAP.

| Analytical Approach:   | Step 1                                                                                                         | Step 2                                                                                                            | Step 3                                                                                | Step 4                                         | Step 5:                                                                    |
|------------------------|----------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|------------------------------------------------|----------------------------------------------------------------------------|
|                        | Develop fractioning that can be applied to total Sacramento/Delta supply delivery results obtained from SacWAM | Apply fractions to SacWAM results to estimate agricultural and municipal supplies for baseline and flow scenarios | Representative Crop Types, Crop Applied Water Requirements, and Baseline Crop Acreage | Estimate Reduction in Crop Acres               | Apply UC Crop Budgets to Estimate Reduction in Gross and Net Crop Revenues |
|                        |                                                                                                                |                                                                                                                   |                                                                                       |                                                |                                                                            |
|                        |                                                                                                                |                                                                                                                   |                                                                                       |                                                |                                                                            |
|                        |                                                                                                                |                                                                                                                   |                                                                                       |                                                |                                                                            |
| Source Information:    | Local Water Management Plans (see “References Consulted”)                                                      | SacWAM Results and Results of Step 1                                                                              | ^DWR 2010 land use survey information                                                 | Results of Steps 2 and 3 and crop optimization | Results of Step 4                                                          |
| San Francisco Bay Area | X                                                                                                              | X                                                                                                                 | X                                                                                     | X                                              |                                                                            |
| Central Coast          | X                                                                                                              | X                                                                                                                 | X                                                                                     | X                                              |                                                                            |
| Southern California    | X                                                                                                              | X                                                                                                                 | X                                                                                     | X                                              |                                                                            |
| Upper Watersheds       | Qualitative analysis                                                                                           | Qualitative analysis                                                                                              | X                                                                                     | Qualitative analysis                           | Qualitative analysis                                                       |

## **Section 1: San Francisco Bay Area**

## **Sacramento/Delta Water Supply to San Francisco Bay Area**

- Water that is exported from the Sacramento/Delta to San Francisco Bay Area is accounted for in SacWAM as by demand sites representing deliveries through the North Bay Aqueduct and South Bay Aqueduct; CVP San Felipe Urban demands; and the agricultural demand unit for Putah South Canal (A\_SIDSH\_NA).
- Categories of water deliveries to the San Francisco Bay Area:
  - Direct (non-SWP/CVP Project) Sac/Delta water rights (Antioch, CCWD, EBMUD)
  - Lake Berryessa/Reclamation Solano Project – Putah Creek South Canal
  - SWP contracts, through North Bay Aqueduct
    - Solano County Water Agency: Benicia, CSPA-Solano, Fairfield, Suisun City, Travis AFB, Vallejo, Vacaville
    - Napa County Flood Control and Water Conservation District: American Canyon, Calistoga, Napa, St. Helena
  - SWP contracts, through South Bay Aqueduct
    - Alameda County FC&WD (Zone 7), Alameda County WD, Santa Clara Valley WD –*M&I only*
  - DWR Settlement agreements (Benicia, Fairfield)
  - CVP contracts, through Pacheco Conduit
    - Santa Clara Valley WD and San Benito County WD M&I supplies

# Analysis of San Francisco Bay Area Agricultural Water Use

Reviewed UWMPs to determine which entities deliver water for agricultural uses. All water providers deliver water primarily, or exclusively, for municipal purposes. One SWP contractor (Zone 7) delivers water to agricultural producers. How much Sac/Delta water is relied upon for agricultural irrigation was estimated by applying some reasonable assumptions.

Results of UWMP review:

## North Bay Aqueduct:

Solano County Water Agency: agency serves municipal and agricultural providers in Solano County, but SWP serves only municipal uses.

Napa County FC&WCD: provides interruptible irrigation service to 28 wineries through blended sources. Supply sources far exceed demand and will continue to even with a small reduction in SWP.

Putah South Canal: SacWAM estimates of the reductions in agricultural deliveries to Solano I.D.

EBMUD: Serves no commercial agriculture.

CCWD: Serves a small agricultural operation with treated wastewater only.

## South Bay Aqueduct:

SCVWD: SWP water serves only M&I uses. Local growers in SCVWD service area pump groundwater, about 26K AFY, but this is expected to decline as ag lands are converted to urban use.

ACWD: provides no water to commercial agriculture.

Zone 7: provides mostly urban water, but also 5,600 AF to commercial agriculture. This is expected to increase to 7,800 AF by 2030. Ag demand is for high valued crops: wine grapes, olives, pistachios. Zone 7 relies upon groundwater banking agreements with Semitropic and Cawelo WD, and has offset SWP reductions through substitutions.

Findings and required analyses:

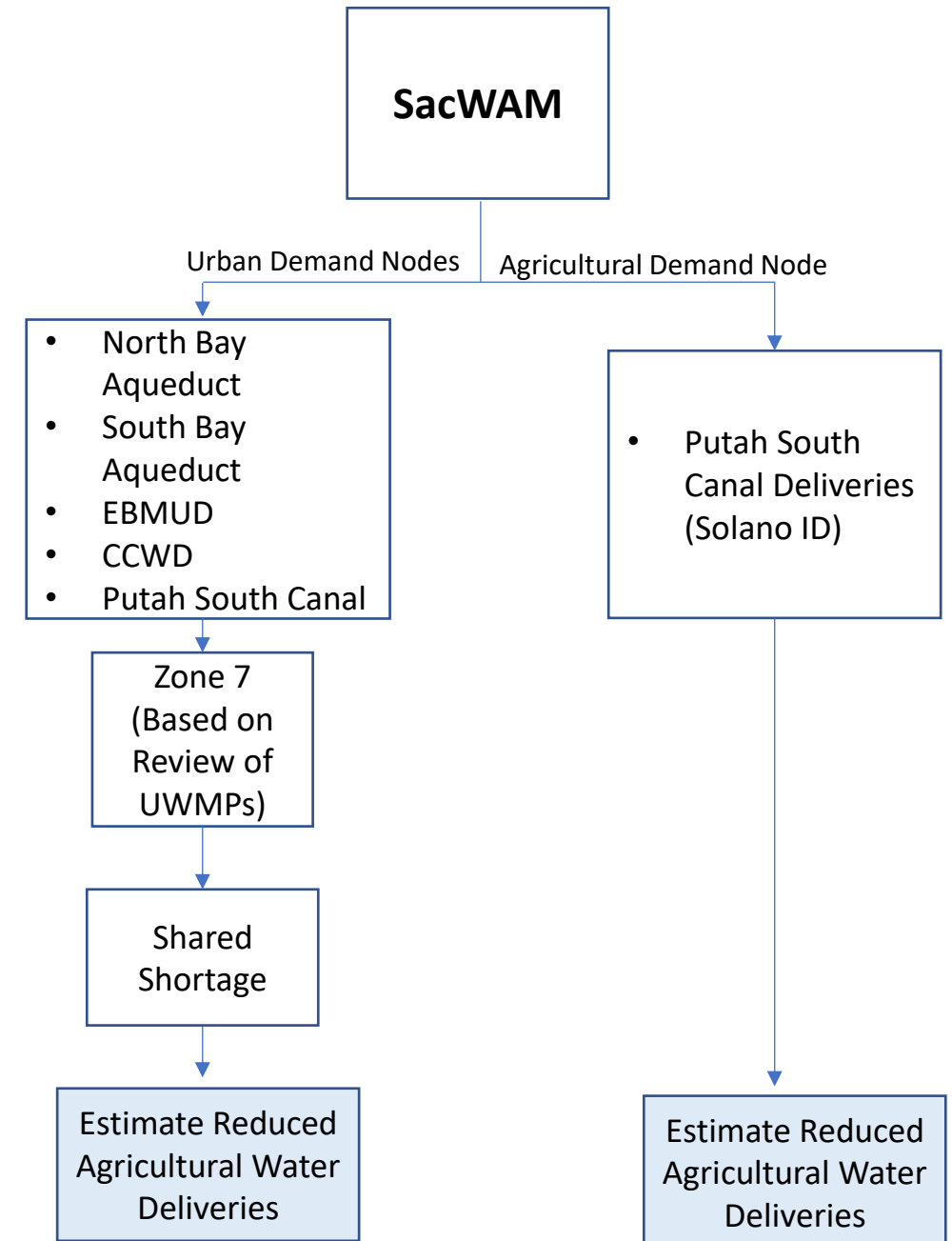
- CASRAA analysis applied to Zone 7
- CASRAA analysis applied to Putah Creek South Canal agricultural water by Solano Irrigation District

# San Francisco Bay Area

Step 1: SacWAM output is apportioned to water users in the Bay Area based on contracts and water rights.

Step 2: Review UWMPs to identify any estimated 2030 agricultural demands that potentially receive water from the Sac/Delta.

Step 3: Estimate the reduction in agricultural water supply for each flow scenario assuming a shared shortage between agricultural and M&I water users.



# San Francisco Bay Area – Putah South Canal

Estimated Reduced Agricultural Water Deliveries:

Putah South Canal agricultural water deliveries.



Putah South Canal Ag Deliveries as Estimated by  
SacWAM (AF) – Demand Unit A\_SIDSH\_NA

| Scenario | Avg    | Dry    |
|----------|--------|--------|
| Baseline | 27,899 | 29,201 |
| 35       | 22,331 | 21,095 |
| 45       | 19,893 | 18,437 |
| 55       | 16,485 | 17,055 |
| 65       | 13,905 | 13,736 |
| 75       | 10,570 | 10,979 |

# San Francisco Bay Area – Zone 7

SWP SBA Total Deliveries (AF) as Estimated by SacWAM for South Bay Aqueduct,  
Table A and Article 21

Total SacWAM SWP deliveries to South Bay Aqueduct Demand Site



| Scenario | Avg     | Dry     |
|----------|---------|---------|
| Baseline | 140,916 | 104,537 |
| 35       | 134,969 | 96,757  |
| 45       | 117,803 | 75,837  |
| 55       | 101,266 | 61,418  |
| 65       | 93,790  | 54,901  |
| 75       | 89,627  | 51,387  |

| Scenario | Avg   | Dry |
|----------|-------|-----|
| Baseline | 535   | 273 |
| 35       | 694   | 293 |
| 45       | 1,106 | 513 |
| 55       | 1,045 | 304 |
| 65       | 995   | 211 |
| 75       | 662   | 97  |

Zone 7's proportion of the total Table A contract amounts among South Bay Aqueduct users (**36.21%**) and Article 21 (**16.67%**)



Zone 7 share of SBA Table A =36.21%

Zone 7 share of SBA Article 21 =16.67%

Total volumes in SWP deliveries to Zone 7 were obtained from SacWAM output using Zone 7's share of SWP deliveries to South Bay Aqueduct, by Table A and Article 21 volumes.



Zone 7 Total Deliveries (AF)

| Scenario | Avg    | Dry    |
|----------|--------|--------|
| Baseline | 51,031 | 37,857 |
| 35       | 48,872 | 35,036 |
| 45       | 42,656 | 27,461 |
| 55       | 36,669 | 22,240 |
| 65       | 33,961 | 19,880 |
| 75       | 32,454 | 18,607 |

| Scenario | Avg | Dry |
|----------|-----|-----|
| Baseline | 89  | 45  |
| 35       | 116 | 49  |
| 45       | 184 | 85  |
| 55       | 174 | 51  |
| 65       | 166 | 35  |
| 75       | 110 | 16  |

Zone 7's projected 2030 SWP agricultural water demand (7,800 AF) was obtained from Zone 7's 2020 UWMP. Calculated share of total baseline deliveries (Table A plus Article 21).



Percentage Share of Zone 7 to Agriculture

7,800 AF of 51,120 AF = 15.26%

## San Francisco Bay Area – Zone 7, Continued

Zone 7 ag deliveries by baseline and flow scenario (sum of Table A and Article 21 from previous slide)



| Scenario | Avg    | Dry    |
|----------|--------|--------|
| Baseline | 51,120 | 37,902 |
| 35       | 48,988 | 35,085 |
| 45       | 42,841 | 27,546 |
| 55       | 36,843 | 22,290 |
| 65       | 34,127 | 19,915 |
| 75       | 32,564 | 18,623 |

Zone 7's ag share of total deliveries (previous slide).



15.26 percent

Estimated Zone 7 reduction in agricultural water deliveries. Shortage shared among all customers multiplies the percentage change in water deliveries to Zone 7 by the 2030 agricultural water demand (7,800 AF) to obtain the change in agricultural water supplies from the Sac/Delta.



### Reduction in Zone 7 Ag Deliveries (AF)



| UF Scenario | Avg   | Dry   |
|-------------|-------|-------|
| 35          | 330   | 436   |
| 45          | 1,283 | 1,605 |
| 55          | 2,213 | 2,420 |
| 65          | 2,634 | 2,789 |
| 75          | 2,877 | 2,989 |

# Crops and Crop Water Requirements

- Representative Crops
  - Putah South Canal:
    - Alfalfa
    - Pasture
  - Zone 7:
    - Vines
    - Deciduous Orchards
- Applied Water Requirements

|            | Acre-Feet / Acre |
|------------|------------------|
| Alfalfa    | 3.05             |
| Pasture    | 3.21             |
| Vines      | 1.05             |
| Pistachios | 2.73             |

Representative crops were selected for the two locations based upon their likelihood to be affected by reduced water supply.

- For Putah South Canal, alfalfa and pasture were selected based on the crop mix in the Solano Irrigation District (^DWR 2010)
- For Zone 7, vines and pistachios were selected as crops identified as receiving SWP water (Zone 7 UWMP 2020)

Crop applied water requirements were obtained from DWR (2010) for the Vacaville and Livermore DAUs (Detailed Analysis Units)

# Effects of Water Supply Changes on Crop Acreage

Effects on crop acreage were calculated as changes in water supply (AF), divided by crop water requirement (AF/Acre), and times crop acreage proportion (^DWR 2010):

For example, *pistachios in the 35 scenario*:

Pistachios:  $325 \text{ AF reduction} / (2.73 \text{ AF/Acre}) * 4.19\% \text{ of acres} = 5 \text{ acres potentially fallowed}$

Vines:  $325 \text{ AF reduction} / (1.05 \text{ AF/Acre}) * 95.81\% \text{ of acres} = 295 \text{ acres potentially fallowed}$

# Estimated Economic Effects of Water Supply Changes

- SWAP Model inputs for Region 9 were used to estimate gross and net revenues for the selected crops to best emulate the SWAP modeling process.
- The reduction in agricultural water supply for each flow scenario was proportionally allocated to the selected crops within each region (Putah South Canal and Zone 7) and divided by the Applied Water Requirement for each crop to estimate the reduction in crop acres.
- The reduction in crop acres was multiplied by the gross and net revenues (\$/acre) shown in the table below to estimate the total change in gross and net revenues by flow scenario.

| Region            | Crops      | Gross Revenue | Net Revenue |
|-------------------|------------|---------------|-------------|
| Zone 7            | Pistachios | \$5,217       | \$599       |
|                   | Vine       | \$6,696       | \$1,184     |
| Putah South Canal | Alfalfa    | \$1,858       | \$485       |
|                   | Pasture    | \$926         | \$420       |

## Change in Gross and Net Revenues, Average Year

| Scenario | Change in Gross Revenue | Change in Net Revenue |
|----------|-------------------------|-----------------------|
| 35       | -\$4,756,300            | -\$1,211,000          |
| 45       | -\$11,751,900           | -\$2,606,500          |
| 55       | -\$19,093,800           | -\$4,129,000          |
| 65       | -\$22,925,300           | -\$4,976,500          |
| 75       | -\$25,420,200           | -\$5,554,600          |

## Change in Gross and Net Revenues, Dry Year

| Scenario | Change in Gross Revenue | Change in Net Revenue |
|----------|-------------------------|-----------------------|
| 35       | -\$6,647,600            | -\$1,712,900          |
| 45       | -\$15,055,000           | -\$3,370,800          |
| 55       | -\$20,703,200           | -\$4,460,100          |
| 65       | -\$24,567,300           | -\$5,361,200          |
| 75       | -\$26,790,700           | -\$5,889,400          |

# References Consulted

- ^California Department of Water Resources (DWR). 2010. Land and Water Use Estimates. Available: <https://water.ca.gov/Programs/Water-Use-And-Efficiency/Land-And-Water-Use/Agricultural-Land-And-Water-Use-Estimates>. Accessed: September 20, 2017.
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## **Section 2: Central Coast**

# Sacramento/Delta Water Supply to Central Coast

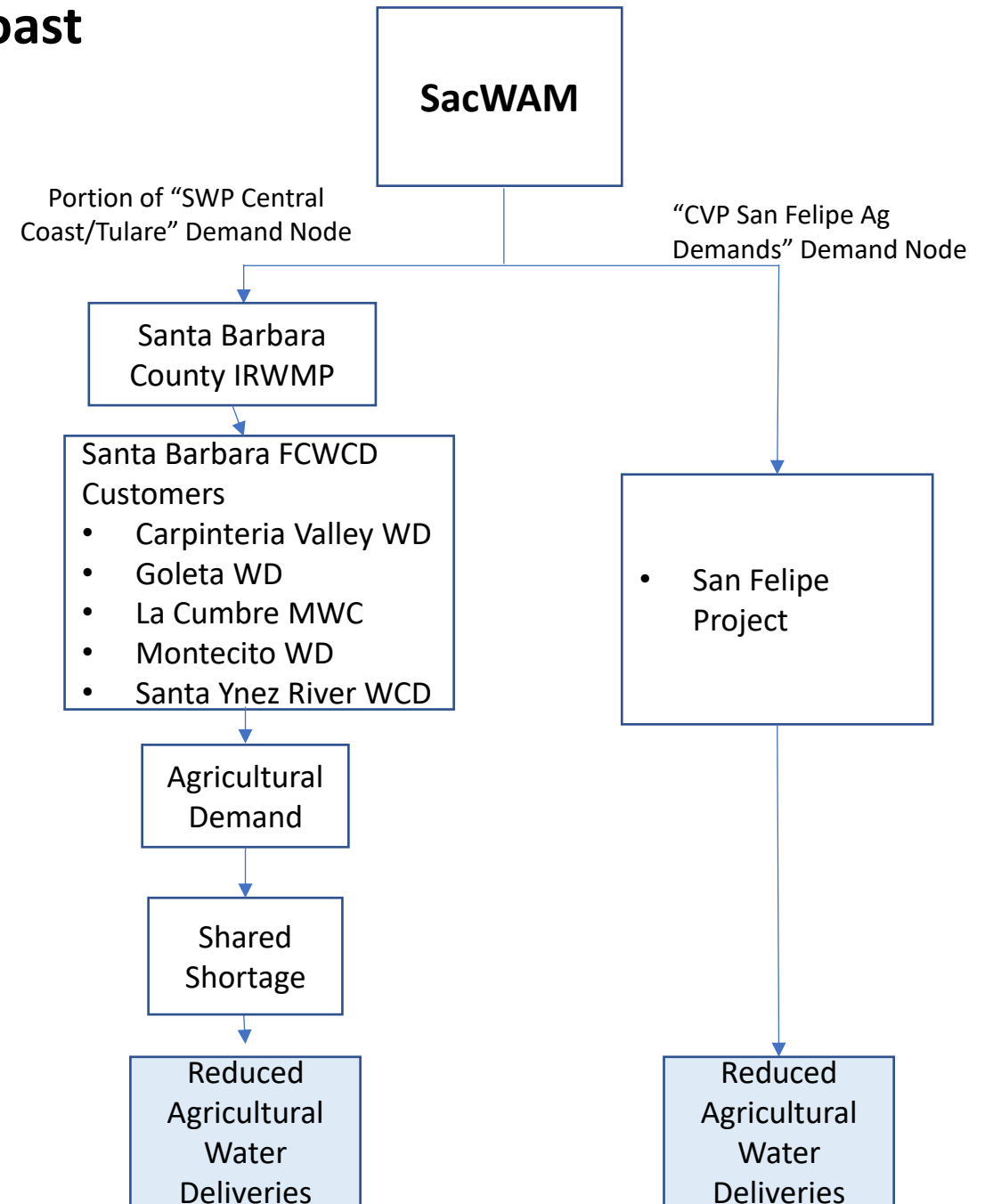
- Water that is exported from the Sacramento/Delta to the Central Coast is accounted for in SacWAM as CVP and SWP exports.
- CVP water for agriculture is delivered to the North Central Coast (San Felipe Unit) via the Pacheco Conduit (“San Felipe Ag Demand” SacWAM Node) to two CVP contractors (ag portion; note that M&I share is in SF Bay Area):
  - Santa Clara Valley WD
  - San Benito County WD
- SWP water is delivered to South Central Coast via the Coastal Aqueduct (portion of “Central Coast/Tulare” SacWAM Node) to two SWP contractors:
  - San Luis Obispo County FC&WCD: No SWP deliveries to agriculture (San Luis Obispo IRWMP 2014)
  - Santa Barbara County FC&WCD: Deliveries of SWP water to 11 cities and water districts in Santa Barbara County, of which five water districts use a portion of their SWP supplies for agricultural irrigation (Santa Barbara IRWMP 2013).
- According to the Santa Barbara County IRWMP, SWP water is commingled with Cachuma Project water in Lake Cachuma. Information from the IRWMP was used to determine the share of SWP water supply to agriculture in the five water districts.
- Findings and required analyses:
  - CASRAA analysis conducted of San Felipe Unit water use.
  - CASRAA analysis conducted on Santa Barbara County FC&WCD water use.

# Central Coast

Step 1: SacWAM output is apportioned to SWP/CVP water users in the Central Coast. San Felipe Project CVP agricultural deliveries are provided through San Luis Reservoir (Pacheco Conduit). Santa Barbara County SWP deliveries are provided through Central Coast Aqueduct and commingled with Cachuma Project supplies.

Step 2: Reviewed Santa Barbara County IRWMP to identify any estimated agricultural demands that receive water from the Sac/Delta.

Step 3: Estimate the reduction in agricultural water supply for each UF scenario assuming a shared shortage between agricultural and M&I water users.



## Central Coast - North

**Deliveries to CVP San Felipe Ag Deliveries as Estimated  
by SacWAM (AF) for Node "CVP San Felipe Ag Demands"**

Estimated Reduction in Agricultural Water Deliveries:



CVP San Felipe Project agricultural water deliveries (from SacWAM).

| Scenario | Avg    | Dry    |
|----------|--------|--------|
| Baseline | 36,666 | 25,830 |
| 35       | 36,122 | 25,180 |
| 45       | 34,311 | 21,971 |
| 55       | 29,559 | 14,974 |
| 65       | 16,690 | 7,443  |
| 75       | 12,710 | 3,102  |

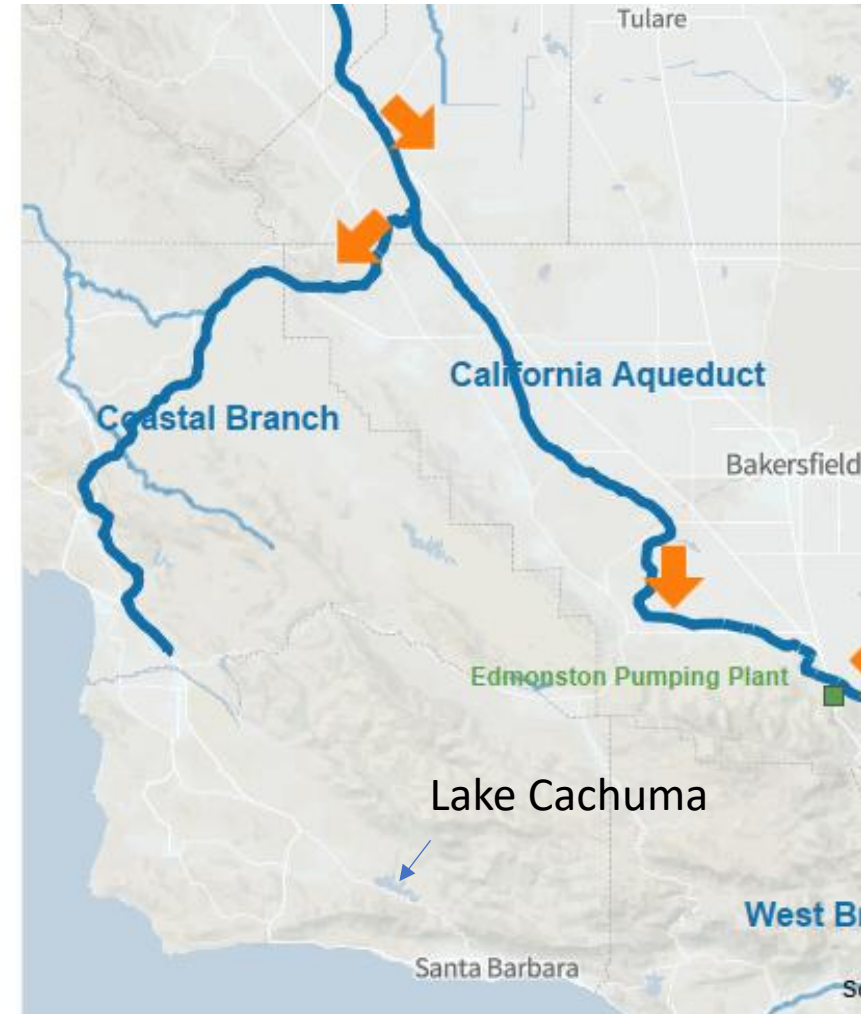
Change in CVP San Felipe Project agricultural water deliveries (from SacWAM).



| Scenario | Average | Dry     |
|----------|---------|---------|
| 35       | -544    | -650    |
| 45       | -2,355  | -3,859  |
| 55       | -7,107  | -10,856 |
| 65       | -19,975 | -18,387 |
| 75       | -23,956 | -22,728 |

## Central Coast, South – SWP Coastal Branch and Lake Cachuma

- Coastal Branch originates at California Aqueduct in Kings County, then traverses San Luis Obispo County and Santa Maria Valley.
- The aqueduct then connects to the Santa Ynez Extension pipeline, which extends southeast and terminates in Lake Cachuma, a USBR project. Lake Cachuma stores both local and SWP water.
- USBR Cachuma Project: 184,000 AF storage reservoir with a 25,714 AF annual yield
  - Project provides about 85% of the municipal water to 250,000 residents plus supplemental irrigation for 12,000 acres
- Facilities connected to Lake Cachuma then transport stored water (Cachuma Project and SWP) south to coastal Santa Barbara County communities and water districts.



# Central Coast – South, SWP Deliveries to SBCFCWCD

Change in Total Central Coast/Tulare SWP Deliveries (AF) as  
Estimated by SacWAM for SWP Central Coast/Tulare Demand Site

Total SacWAM deliveries to Central  
Coast/Tulare demand site.

Santa Barbara County FCWCD's proportion  
of total Table A contracts among supply  
delivered by Central Coast/Tulare Demand  
Node (3.78%)

Total reductions in SWP deliveries to Santa  
Barbara County FCWCD were obtained from  
SacWAM output using Santa Barbara County  
FCWCD's share of Table A deliveries to Central  
Coast/Tulare.

Proportional reduction in Table A deliveries to Central  
Coast/Tulare Demand Node by UF Scenario. Obtained  
by dividing the change in total Santa Barbara County  
deliveries for UF scenarios by the Base delivery  
volume (see table 1).

| UF Scenario | Avg     | Dry     |
|-------------|---------|---------|
| Base        | 782,653 | 619,349 |
| 35          | 691,460 | 518,559 |
| 45          | 626,387 | 468,369 |
| 55          | 534,691 | 379,466 |
| 65          | 436,951 | 278,777 |
| 75          | 355,325 | 203,042 |

SB County share of Central  
Coast Tulare =3.78%

Reduction in Santa Barbara County SWP Deliveries (AF)

| UF Scenario | Avg    | Dry    |
|-------------|--------|--------|
| Base        | 29,584 | 23,411 |
| 35          | 3,447  | 3,810  |
| 45          | 5,907  | 5,707  |
| 55          | 9,373  | 9,068  |
| 65          | 13,068 | 12,874 |
| 75          | 16,153 | 15,736 |

Percent Reduction in Central Coast/Tulare Table A Deliveries

| UF Scenario | Avg    | Dry    |
|-------------|--------|--------|
| 35          | 11.65% | 16.27% |
| 45          | 19.97% | 24.38% |
| 55          | 31.68% | 38.73% |
| 65          | 44.17% | 54.99% |
| 75          | 54.60% | 67.22% |

## Central Coast – South, Continued

### Estimated Santa Barbara County Total Ag Water Use (AF) for Water Providers Receiving SWP

The IRWMP for Santa Barbara County was used to identify agricultural water use. We identified five water providers that deliver water to agriculture. Total ag water demand from all sources for the five water providers is 7,026 AF.



| Water Provider                    | Ag Demand (AF) |
|-----------------------------------|----------------|
| Carpinteria Valley Water District | 1,582          |
| Goleta Water District             | 2,387          |
| La Cumbre Mutual Water Company    | 103            |
| Montecito Water District          | 550            |
| Santa Ynez River WCD, ID #1       | 2,404          |
| Total                             | 7,026          |



The IRWMP does not provide a breakdown of ag and M&I water use by water source. The SWP percentage of total water supply for each water provider was obtained by dividing the IRWMP-reported SWP deliveries by the IRWMP-reported total water deliveries for each water provider.



### SWP Percentage of Total Water Supply for Each Water Provider

| Water Provider                    | % SWP Supply |
|-----------------------------------|--------------|
| Carpinteria Valley Water District | 10%          |
| Goleta Water District             | 7%           |
| La Cumbre Mutual Water Company    | 21%          |
| Montecito Water District          | 10%          |
| Santa Ynez River WCD, ID #1       | 8%           |



The estimated SWP ag water use was estimated by multiplying the total ag demand for each provider (first table) by the percent reliance on SWP supplies (second table) and then summed over the five water providers (586 AF).



Estimated SWP Ag Water  
Use = 586 AF



### Change in Santa Barbara County Ag Deliveries (AF)



| UF Scenario | Avg | Dry |
|-------------|-----|-----|
| 35          | 30  | 47  |
| 45          | 91  | 120 |
| 55          | 163 | 181 |
| 65          | 227 | 223 |
| 75          | 309 | 271 |

Apply the percent reduction in SWP supplies from SacWAM (last table on previous slide) to the SWP ag water use (586 AF) to estimate the change in agricultural water supplies by UF scenario.

# Crops and Effects of Water Supply Changes on Crop Acreage

- Representative Crops and Crop Water Requirement

- San Felipe Unit:

| Selected Crops  | Percent | Applied Water (AF/Acre) |
|-----------------|---------|-------------------------|
| Sweet Cherries  | 6.67%   | 2.04                    |
| Organic Lettuce | 11.20%  | 0.94                    |
| Fresh Tomatoes  | 7.86%   | 1.32                    |
| Bell Peppers    | 21.53%  | 0.94                    |
| Proc. Tomatoes  | 22.62%  | 1.70                    |
| Wine Grapes     | 30.13%  | 0.92                    |

- Santa Barbara County:

| Selected Crops | Percent | Applied Water (AF/Acre) |
|----------------|---------|-------------------------|
| Avocados       | 19%     | 2.52                    |
| Wine Grapes    | 56%     | 1.04                    |
| Lettuce        | 10%     | 1.52                    |
| Strawberries   | 15%     | 1.52                    |

## Average Year

Vegetables  
Deciduous Orchards  
Processing Tomatoes  
Vine  
Alfalfa & Pasture  
Corn and All Silage  
Wheat & Field Crops  
Almonds & Pistachios  
Cotton  
Rice  
TOTAL

|                      | 35   | 45     | 55     | 65      | 75      |
|----------------------|------|--------|--------|---------|---------|
| Vegetables           | -300 | -1,000 | -3,000 | -8,200  | -9,800  |
| Deciduous Orchards   | 0    | -100   | -300   | -700    | -800    |
| Processing Tomatoes  | -100 | -300   | -900   | -2,700  | -3,200  |
| Vine                 | -200 | -800   | -2,400 | -6,600  | -8,000  |
| Alfalfa & Pasture    | 0    | 0      | 0      | 0       | 0       |
| Corn and All Silage  | 0    | 0      | 0      | 0       | 0       |
| Wheat & Field Crops  | 0    | 0      | 0      | 0       | 0       |
| Almonds & Pistachios | 0    | 0      | 0      | 0       | 0       |
| Cotton               | 0    | 0      | 0      | 0       | 0       |
| Rice                 | 0    | 0      | 0      | 0       | 0       |
| TOTAL                | -500 | -2,200 | -6,500 | -18,200 | -21,800 |

## Dry Year

Vegetables  
Deciduous Orchards  
Processing Tomatoes  
Vine  
Alfalfa & Pasture  
Corn and All Silage  
Wheat & Field Crops  
Almonds & Pistachios  
Cotton  
Rice  
TOTAL

|                      | 35   | 45     | 55     | 65      | 75      |
|----------------------|------|--------|--------|---------|---------|
| Vegetables           | -300 | -1,600 | -4,500 | -7,600  | -9,300  |
| Deciduous Orchards   | 0    | -200   | -400   | -600    | -800    |
| Processing Tomatoes  | -100 | -500   | -1,400 | -2,400  | -3,000  |
| Vine                 | -200 | -1,300 | -3,600 | -6,100  | -7,600  |
| Alfalfa & Pasture    | 0    | 0      | 0      | 0       | 0       |
| Corn and All Silage  | 0    | 0      | 0      | 0       | 0       |
| Wheat & Field Crops  | 0    | 0      | 0      | 0       | 0       |
| Almonds & Pistachios | 0    | 0      | 0      | 0       | 0       |
| Cotton               | 0    | 0      | 0      | 0       | 0       |
| Rice                 | 0    | 0      | 0      | 0       | 0       |
| TOTAL                | -600 | -3,600 | -9,900 | -16,700 | -20,700 |

# Estimated Economic Effects of Water Supply Changes

- Published crop budgets from the University of California were used to estimate gross and net revenues for the selected crops.
- The reduction in agricultural water supply for each flow scenario was proportionally allocated to the selected crops within each region (San Felipe Unit and Santa Barbara County) and divided by the Applied Water Requirement for each crop to estimate the reduction in crop acres.
- The reduction in crop acres was multiplied by the gross and net revenues (\$/acre) shown in the table below to estimate the total change in gross and net revenues by flow scenario.

| Region               | Crops           | Gross Revenue | Net Revenue |
|----------------------|-----------------|---------------|-------------|
| San Felipe Unit      | Sweet Cherries  | \$22,156      | \$2,933     |
|                      | Organic Lettuce | \$14,977      | \$2,910     |
|                      | Fresh Tomatoes  | \$8,782       | \$763       |
|                      | Bell Peppers    | \$26,359      | \$9,317     |
|                      | Proc. Tomatoes  | \$5,144       | \$2,096     |
|                      | Wine Grapes     | \$26,689      | \$5,532     |
| Santa Barbara County | Avocados        | \$14,366      | \$1,124     |
|                      | Wine Grapes     | \$26,689      | \$5,503     |
|                      | Lettuce         | \$14,977      | \$2,383     |
|                      | Strawberries    | \$72,934      | \$8,467     |

Change in Gross and Net Revenues (\$), Average Year

| Scenario  | Change in Gross Revenue | Change in Net Revenue |
|-----------|-------------------------|-----------------------|
| <b>35</b> | -\$10,748,600           | -\$2,680,800          |
| <b>45</b> | -\$45,642,700           | -\$11,454,400         |
| <b>55</b> | -\$135,131,100          | -\$34,120,300         |
| <b>65</b> | -\$374,335,800          | -\$94,961,200         |
| <b>75</b> | -\$449,791,700          | -\$114,031,900        |

Change in Gross and Net Revenues (\$), Dry Year

| Scenario  | Change in Gross Revenue | Change in Net Revenue |
|-----------|-------------------------|-----------------------|
| <b>35</b> | -\$13,116,400           | -\$3,250,000          |
| <b>45</b> | -\$74,109,300           | -\$18,652,500         |
| <b>55</b> | -\$204,792,600          | -\$51,840,200         |
| <b>65</b> | -\$344,893,300          | -\$87,465,400         |
| <b>75</b> | -\$426,209,700          | -\$108,096,700        |

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- University of California Cooperative Extension. 2011b. Avocado Sample Establishment and Production Costs and Profitability Analysis for Ventura, Santa Barbara, and San Luis Obispo Counties, 2011. Conventional Production Practices.
- University of California Cooperative Extension. 2012. Sample Costs to Establish and Produce Winegrapes, Cabernet Sauvignon, North Coast Region, Napa County.
- University of California Cooperative Extension. 2013. Costs and Profitability Analysis for Bell Pepper Production, Oxnard Plain, Ventura County, Fresh Bell Pepper Production.

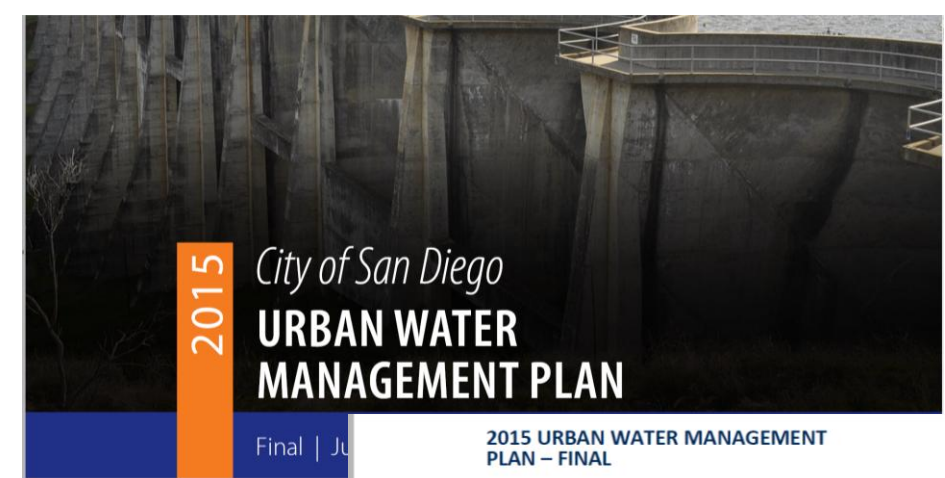
## **Section 3: Southern California**

# Sacramento/Delta Water Supply to Southern California

- Water that is exported from the Sacramento/Delta to Southern California arrives via the State Water Project (SWP) to 12 contractors
- All 12 contractors deliver water primarily, or exclusively, for municipal purposes. Some contractors deliver water that is ultimately used by agricultural producers.
- All 12 contractors receive water from multiple sources.
- Local water management plans, including UWMPs were reviewed to develop reasonable assumptions to estimate the amount of Sacramento/Delta supply that is used for agricultural irrigation.
- This presentation provides an analysis of how Sacramento/Delta water supply for agricultural irrigation is estimated, and how water supply changes to Southern California could affect agricultural producers.

## Southern California Agricultural Water Demand

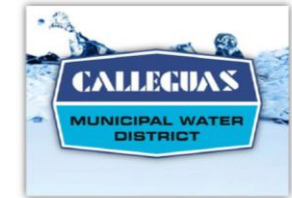
1. Identify the water providers in the Southern California Region that receive water from the SWP. This includes MWD member agencies and SWP contractors.
2. Analyzed spatial data for cropping (2014 DWR data) and water agency boundaries to focus research efforts.
3. Reviewed Urban Water Management Plans (UWMPs) to identify projected 2030 agricultural water demands for each agency.
4. Only considered agricultural water use that is not identified in the UWMPs as being supplied from local sources (groundwater, recycled water, etc.).



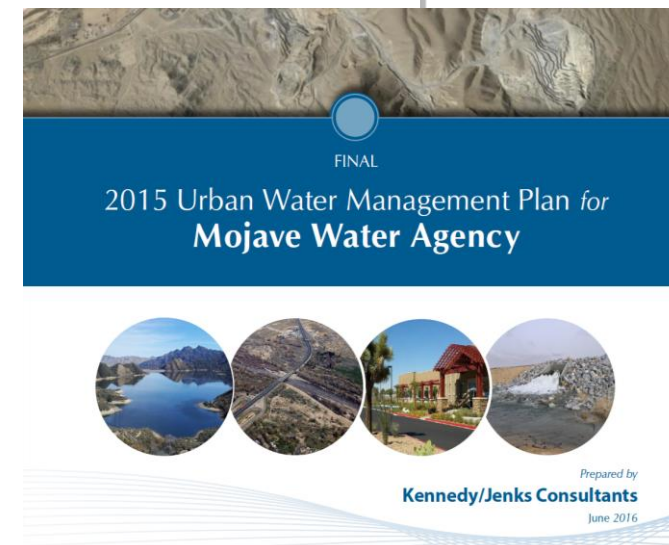
2015 URBAN WATER MANAGEMENT  
PLAN – FINAL

B&V PROJECT NO. 188535

PREPARED FOR



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# SWP Contractor Water Use (Part 1 of 2)

- Agencies with no deliveries for agricultural irrigation
  - Crestline – Lake Arrowhead
  - Desert Water Agency
  - Palmdale Water District
  - San Geronio Pass Water Agency
- Agencies with no SWP deliveries to agriculture
  - Coachella Valley Water District
    - Only Colorado River deliveries to ag
  - Littlerock Creek Irrigation District
- Agencies with minimal agricultural irrigation sales
  - Antelope Valley – East Kern Water Agency
    - 330 of 85,940 AFY
  - Mojave Water Agency
  - San Bernardino Valley Municipal Water District
    - 387 of 82,520 AFY
  - San Gabriel Valley Municipal WC
    - 32 AFY of recycled water,
    - 46,403 AFY total

# SWP Contractor Water Use (Part 2 of 2)

- Agency with agricultural irrigation deliveries
  - Metropolitan Water District
    - Wholesale water agency with 26 member agencies (cities, regional districts, and local wholesalers)
    - Member agencies that provide water for agricultural irrigation:
      - Calleguas Municipal Water Agency
      - Eastern Municipal Water District
      - San Diego County Water Agency
      - Western Municipal Water District
- Other SWP Contractors
  - Castaic Lake Water Agency
    - Accounted for in SWAP through exchange in SJV; no irrigation in service area
  - Ventura County Flood Control District (now Watershed Protection District)
    - Administered by Casitas MWD, allocated 5,000 AF to United WCD, w/ 3,150 AF for recharge

## **Southern California Agricultural Water Supply Effects – General Approach With Focus on Four MWD Member Agencies**

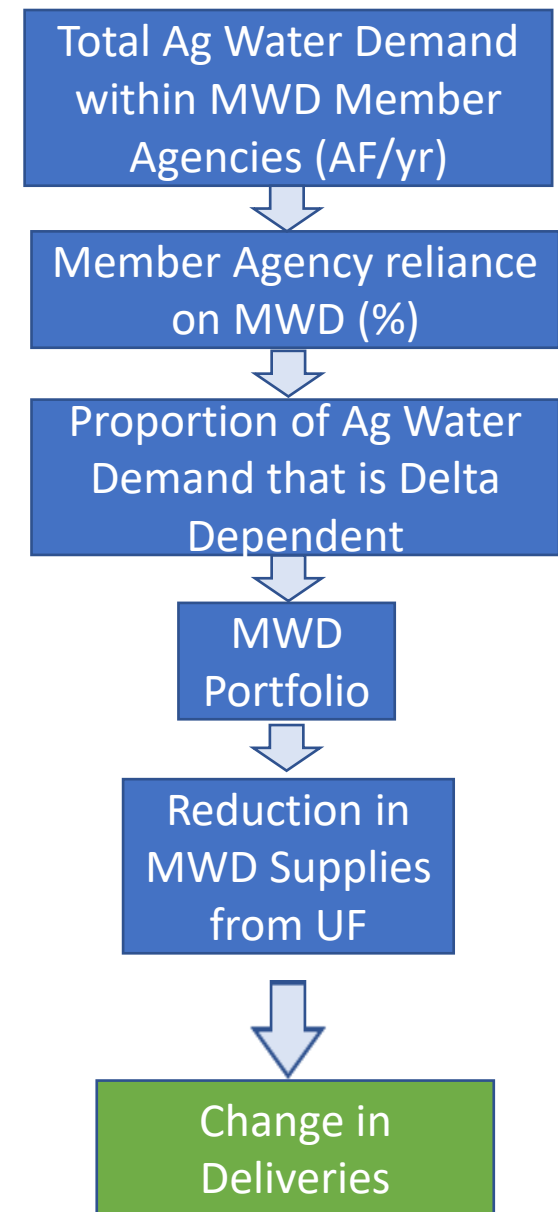
Step 1: Review UWMPs for MWD Member Agencies to identify agricultural water demand from raw or treated surface water supplies (excluding groundwater and recycled water)

Step 2: Review UWMPs for MWD Member Agencies to identify reliance upon MWD imported water. Typically estimated as:  
 $\text{MWD Supply} / \text{Total Water Supply} = \% \text{ from MWD}$

Step 3: Identify the proportion of agricultural water supplied to Member Agencies by MWD that is Delta dependent.

Step 4: Apply SacWAM output to estimate the reduction in MWD's SWP water supplies for each UF scenario. Assume Ag Demand is reduced proportional to reduced water delivery

Step 5: Estimate the reduction in agricultural water supply



**Step 1: Southern California Agricultural Water Demands From Review of References Consulted**

| Water Provider    | Agricultural Demand (AF) |
|-------------------|--------------------------|
| SDCWA             | 49,897                   |
| Calleguas         | 4,848                    |
| Eastern Municipal | 2,900                    |
| Western Municipal | 11,358                   |
| <b>Total</b>      | <b>69,003</b>            |

**Step 2: Identify Member Agency dependence on imported water provided by MWD**

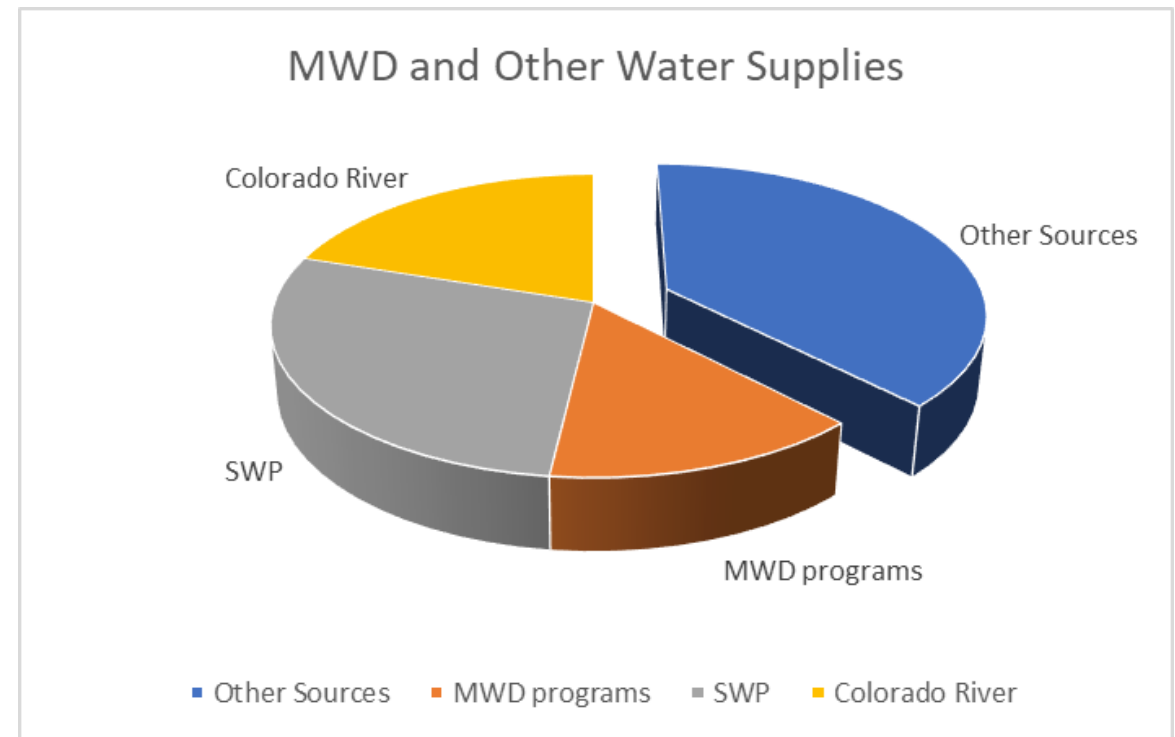
- 1. Reviewed Urban Water Management Plans (UWMPs) to identify projected 2030 water supplies, and the proportion that is purchased from MWD.
- 2. Multiplied the percentage that is supplied from MWD by the total agricultural water demand for each agency to estimate the agricultural water supplied by MWD.

| Water Provider    | Total Ag Demand (AF) | Percent from MWD | Max Ag Supply From MWD (AF) |
|-------------------|----------------------|------------------|-----------------------------|
| SDCWA             | 49,897               | 30.65%           | 15,293                      |
| Calleguas         | 4,848                | 100.00%          | 4,848                       |
| Eastern Municipal | 2,900                | 92.78%           | 2,691                       |
| Western Municipal | 11,358               | 82.98%           | 9,425                       |
| Total             | 69,003               |                  | 32,257                      |

# MWD Managed Supplies Projected Water Portfolio in 2030

## Based on MWD UWMP (2020)

- Projected Demands on MWD in 2030:  
1,388,000 AFY
- Projected MWD Supply in 2030:
  - In-Region MWD Supplies and Programs:
    - 877,000 AFY (22.5% of total)
  - State Water Project, representing MWD's water supply projection:
    - 1,766,000 AFY (45.4% of total)
  - Colorado River
    - 1,250,000 AFY (32.1% of total)
  - TOTAL SUPPLY: 3,893,000 AFY
- MWD receives more water than it delivers to customers. Projected surplus in 2030: 2,505,000 AFY
- Water from supply sources are commingled by MWD before delivery to customers. Customers do not control percent of supply that is Sac/Delta. MWD's UWMPs do not provide information on the composition of the water delivered to customers.



**Step 3: Identify the proportion of imported MWD agricultural water supply that is dependent on Sacramento/Delta supplies.**

1. Reviewed MWD Integrated Water Resource Management Plan to identify projected 2030 SWP water supplies.
2. Divided 2030 SWP water supplies by the total 2030 MWD imported water supply to estimate the proportion of imported MWD agricultural water supply that is Delta dependent – **45.4%**.
3. Applied the MWD SWP % to the Max Ag Water Supply from MWD to develop an estimate of the agricultural water demand potentially affected by the UFs.

| Water Provider    | Total Ag Demand (AF) | Percent from MWD | Max Ag Supply From MWD (AF) | MWD Sac/Delta % | Ag Sac/Delta Supply from MWD |
|-------------------|----------------------|------------------|-----------------------------|-----------------|------------------------------|
| SDCWA             | 49,897               | 30.65%           | 15,293                      | 45.4%           | 6,938                        |
| Calleguas         | 4,848                | 100.00%          | 4,848                       | 45.4%           | 2,199                        |
| Eastern Municipal | 2,900                | 92.78%           | 2,691                       | 45.4%           | 1,221                        |
| Western Municipal | 11,358               | 82.98%           | 9,425                       | 45.4%           | 4,275                        |
| <b>Total</b>      | <b>69,003</b>        |                  | <b>32,257</b>               |                 | <b>14,633</b>                |

**Step 4: Apply SacWAM output to estimate the overall reduction in MWD’s SWP supplies for each UF scenario**

The CASRAA analysis estimates the reductions in water supply to MWD using SacWAM output. To estimate the change in agricultural water supply, the percent reduction in MWD’s SWP supply is applied.

MWD’s SWP Supply (AF)

| UF Scenario | Average   | Dry     |
|-------------|-----------|---------|
| Baseline    | 1,224,891 | 842,612 |
| 35 Scenario | 1,157,370 | 755,143 |
| 45 Scenario | 1,052,417 | 626,241 |
| 55 Scenario | 898,704   | 502,595 |
| 65 Scenario | 747,156   | 395,976 |
| 75 Scenario | 554,336   | 275,647 |

Volume Reduction in MWD’s SWP Supply (AF)

| UF Scenario | Average   | Dry     |
|-------------|-----------|---------|
| Baseline    | 1,224,891 | 842,612 |
| 35 Scenario | 67,521    | 87,469  |
| 45 Scenario | 172,475   | 216,371 |
| 55 Scenario | 326,187   | 340,017 |
| 65 Scenario | 477,735   | 446,636 |
| 75 Scenario | 670,555   | 566,965 |

Percent Reduction in MWD’s SWP Supply (%)

| UF Scenario | Average | Dry    |
|-------------|---------|--------|
| 35 Scenario | 5.51%   | 10.38% |
| 45 Scenario | 14.08%  | 25.68% |
| 55 Scenario | 26.63%  | 40.35% |
| 65 Scenario | 39.00%  | 53.01% |
| 75 Scenario | 54.74%  | 67.29% |

**Step 5: Estimate the reduction in agricultural water supply for each UF scenario assuming that shortages are shared equally by agricultural customers and other municipal uses.**

Multiply the percent reduction in water supply to MWD from the UFs by the Ag Delta Supply from MWD.

| UF Scenario | Average | Dry    |
|-------------|---------|--------|
| 35 Scenario | 5.51%   | 10.38% |
| 45 Scenario | 14.08%  | 25.68% |
| 55 Scenario | 26.63%  | 40.35% |
| 65 Scenario | 39.00%  | 53.01% |
| 75 Scenario | 54.74%  | 67.29% |

(From previous slide)



| UF Scenario | Average | Dry   |
|-------------|---------|-------|
| Baseline    | 14,500  | 9,974 |
| 35 Scenario | 13,700  | 8,939 |
| 45 Scenario | 12,458  | 7,413 |
| 55 Scenario | 10,638  | 5,949 |
| 65 Scenario | 8,844   | 4,687 |
| 75 Scenario | 6,562   | 3,263 |



| UF Scenario | Average | Dry   |
|-------------|---------|-------|
| 35 Scenario | 799     | 1,035 |
| 45 Scenario | 2,042   | 2,561 |
| 55 Scenario | 3,861   | 4,025 |
| 65 Scenario | 5,655   | 5,287 |
| 75 Scenario | 7,938   | 6,711 |

| Ag Delta Supply from MWD (AF) |
|-------------------------------|
| 14,633                        |



# Crops and Effects of Water Supply Changes on Crop Acreage

- Representative Crops and Crop Water Requirement (^DWR 2010)
- Applied to crops in proportion to existing DAU acreage (^DWR 2010):
  - Ventura County (DAU 081)
  - Riverside North (DAU 098)
  - Riverside South (DAU 104)
  - Temecula (DAU 110)
  - San Diego County (DAU 120)



|           | Acre-Feet / Acre |
|-----------|------------------|
| Lemons    | 3.09             |
| Avocadoes | 3.09             |

**Average Year**

|          | 35   | 45   | 55     | 65     | 75     |
|----------|------|------|--------|--------|--------|
| Lemons   | -49  | -126 | -239   | -350   | -491   |
| Avocados | -212 | -541 | -1,024 | -1,499 | -2,104 |

**Dry Year**

|          | 35   | 45   | 55     | 65     | 75     |
|----------|------|------|--------|--------|--------|
| Lemons   | -64  | -159 | -249   | -327   | -415   |
| Avocados | -274 | -679 | -1,067 | -1,402 | -1,779 |

# Estimated Economic Effects of Water Supply Changes

- Published crop budgets from the University of California were used to estimate gross and net revenues for the selected crops.
- The reduction in agricultural water supply for each flow scenario was proportionally allocated to the selected crops and divided by the Applied Water Requirement for each crop to estimate the reduction in crop acres.
- The reduction in crop acres was multiplied by the gross and net revenues (\$/acre) shown in the table below to estimate the total change in gross and net revenues by flow scenario.

| Crops    | Gross Revenue | Net Revenue |
|----------|---------------|-------------|
| Lemons   | \$22,713      | \$4,295     |
| Avocados | \$16,622      | \$629       |

## Change in Gross and Net Revenues (\$), Average Year

| Scenario | Change in Gross Revenue | Change in Net Revenue |
|----------|-------------------------|-----------------------|
| 35       | -\$4,645,800            | -\$425,900            |
| 45       | -\$11,867,000           | -\$1,087,800          |
| 55       | -\$22,443,200           | -\$2,057,300          |
| 65       | -\$32,870,400           | -\$3,013,100          |
| 75       | -\$46,137,300           | -\$4,229,200          |

## Change in Gross and Net Revenues (\$), Dry Year

| Scenario | Change in Gross Revenue | Change in Net Revenue |
|----------|-------------------------|-----------------------|
| 35       | -\$6,018,300            | -\$276,400            |
| 45       | -\$14,887,300           | -\$683,700            |
| 55       | -\$23,394,700           | -\$1,074,300          |
| 65       | -\$30,730,600           | -\$1,411,200          |
| 75       | -\$39,009,800           | -\$1,791,400          |

# Urban Water Management Plans (UWMs) Consulted

- Metropolitan Water District of Southern California. 2021. *2020 Urban Water Management Plan*. June 2021.
- San Diego County Water Authority. 2016. *Final 2015 Urban Water Management Plan*. June 2016.
- Calleguas Municipal Water District. 2016. *2015 Urban Water Management Plan*. Final Report. Prepared by Black & Veatch. June 2016.
- Eastern Municipal Water District. 2016. *2015 Urban Water Management Plan*. Prepared by RMC. June 2016.
- Western Municipal Water District. 2016. *2015 Urban Water Management Plan*. Prepared by RMC. June 2016.
- Crestline Village Water District. 2021. *2020 Urban Water Management Plan*. Prepared by Albert A. Webb Associates. Adopted June 15, 2021.
- Coachella Valley Water District. 2021. *2020 Coachella Valley Regional Urban Water Management Plan*. Prepared for Coachella Valley Water District, Coachella Water Authority, Desert Water Agency, Indio Water Authority, Mission Springs Water District, and Myoma Dunes Mutual Water Company. Prepared by Water Systems Consulting, Inc. June 30, 2021.
- Palmdale Water District. 2021. *2020 Urban Water Management Plan*. Prepared by Kennedy Jenks. June 25, 2021.
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- Mojave Water Agency. 2021. *2020 Urban Water Management Plan*. Final. Prepared by Tully & Young. Adopted May 27, 2021.
- San Bernardino Valley Municipal Water District. 2021. *2020 IRUWMP, Part 2 Chapter 1 Valley District 2020 UWMP*. Prepared by Water Systems Consulting, Inc. June 30, 2021.
- San Gabriel Valley Water Company. 2021. *2020 Urban Water Management Plan and Water Shortage Contingency*. Final. Prepared by Stetson Engineers, Inc. June 2021.

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- ^California Department of Water Resources (DWR). 2010. Land and Water Use Estimates. Available: <https://water.ca.gov/Programs/Water-Use-And-Efficiency/Land-And-Water-Use/Agricultural-Land-And-Water-Use-Estimates>. Accessed: September 20, 2017.
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- University of California Cooperative Extension. 2011b. Avocado Sample Establishment and Production Costs and Profitability Analysis for Ventura, Santa Barbara, and San Luis Obispo Counties, 2011, Conventional Production Practices.

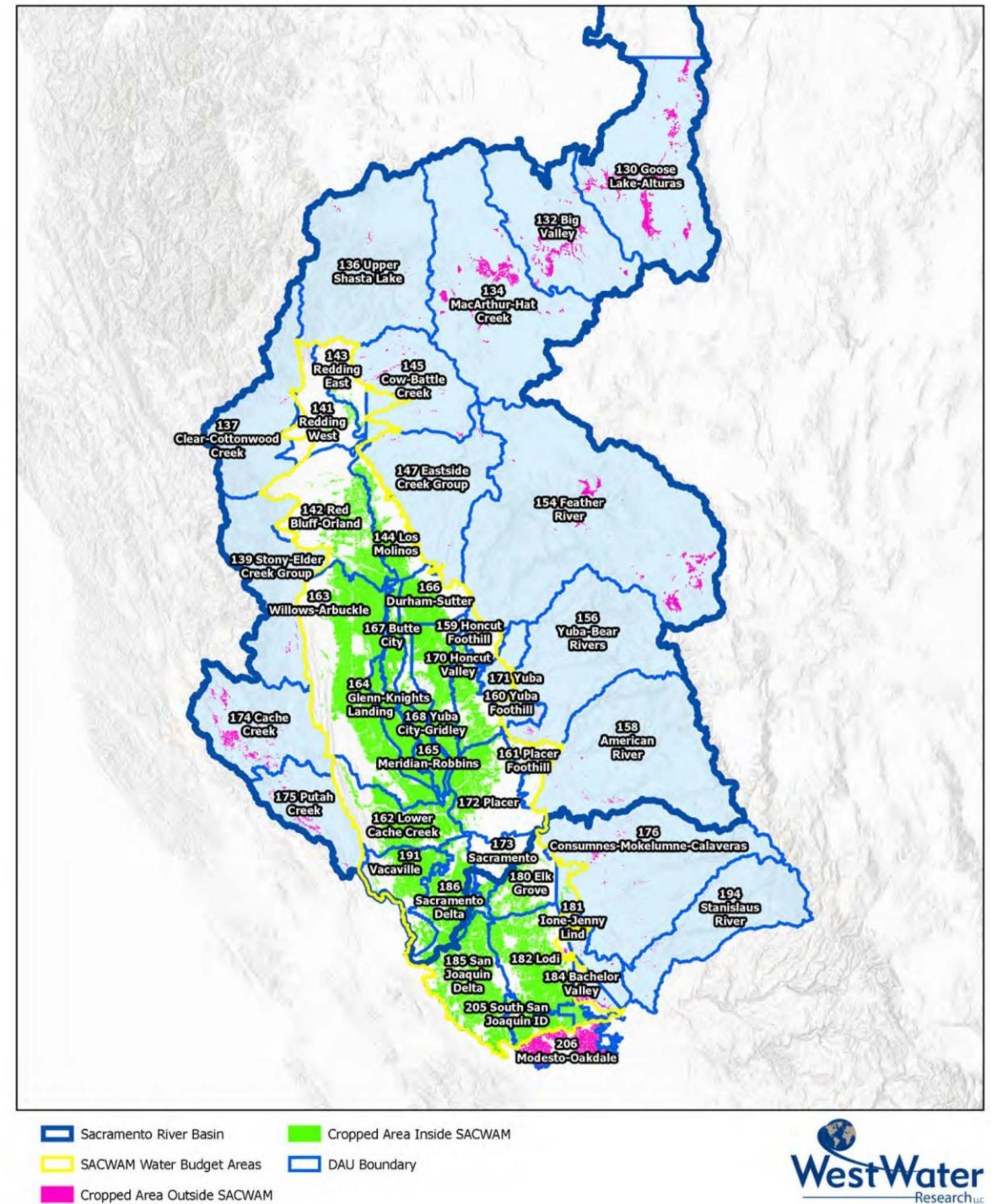
**Section 4: Upper Watersheds**  
**(Upper Sacramento River Watershed & Upper Delta Eastside Tributaries)**

## Upper Watersheds Slides

- The potential effects of the flow scenarios on agricultural production in the Upper Watersheds is dependent upon the relative priorities of surface water rights in the Upper Watersheds and Sacramento Valley, and the estimated effects of reduced water supply.
- These slides provide baseline information on crop types and crop acreage in the Upper Watersheds to inform qualitative analyses of the potential effects of the flow scenarios on agriculture and economics in the region.

## Upper Watersheds Irrigated Agriculture

- The figure at right shows the irrigated crop areas within the SacWAM model region (green) and outside of the SacWAM model region (pink).
- A majority of the irrigated area in the Upper Sacramento Watershed is located within Cache Creek, Putah Creek, Feather River, and above Shasta Lake as represented by DWR's DAU boundaries.
- Cropped areas rely upon a mix of surface water and groundwater supplies.
- Cropped areas within Cache and Putah creeks are primarily planted to wine grapes. Other upper watershed cropped areas include a diverse crop mix but are primarily planted to alfalfa, pasture, and grains according to ^DWR 2010 land use survey data.
- Stoney Creek DAU irrigation is relatively small (less than 4 thousand acres) and mostly consists of pasture.



# Upper Watersheds

- The table at right lists the DWR DAUs included in the CASRAA analysis organized by analysis region.
- Included all Detailed Analysis Units (DAUs) outside of the SacWAM/SWAP model area and in the Sacramento Basin. Also included Delta Eastside tribs (Consumnes, Mokelumne, Calaveras, Stanislaus).
- The selection of analysis regions is based upon the extent of irrigation, crop types, and the proportion of surface water versus groundwater use.
- Subarea include:
  - Cache and Putah DAUs
  - Other Westside Tribs
  - Above Shasta Lake
  - Eastside Creeks
  - Feather, Yuba, American
  - Delta Eastside Tribs

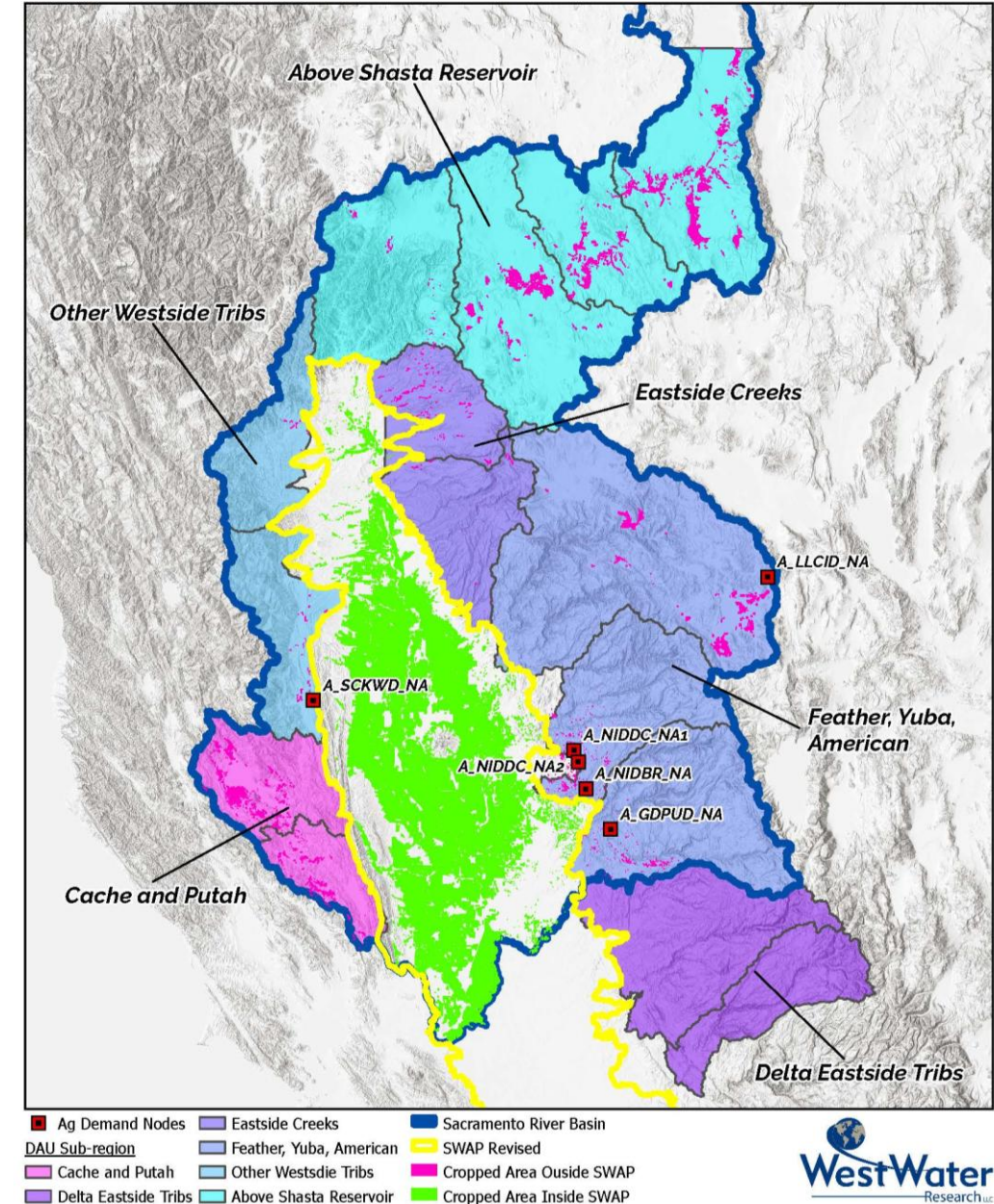


**DWR DAUs by Subarea**

| Subarea                 | DAU Name                      | DAU Number |
|-------------------------|-------------------------------|------------|
| Cache and Putah         | Cache Creek                   | 174        |
|                         | Putah Creek                   | 175        |
| Other Westside Tribs    | Stony-Elder Creek Group       | 139        |
|                         | Clear-Cottonwood Creek        | 137        |
| Above Shasta Reservoir  | Upper Shasta Lake             | 136        |
|                         | MacArthur Hat Creek           | 134        |
|                         | Big Valley                    | 132        |
|                         | Goose Lake-Alturas            | 130        |
| Eastside Creeks         | Cow-Battle Creek              | 145        |
|                         | Eastside Creek Group          | 147        |
| Feather, Yuba, American | Feather River                 | 154        |
|                         | Yuba-Bear                     | 156        |
|                         | American River                | 158        |
| Delta Eastside Tribs    | Consumnes-Mokelumne-Calaveras | 176        |
|                         | Stanislaus River              | 194        |

# Upper Watersheds

| Subarea                    | DAUs               | Irrigated Acres | Notes                                                                                                   |
|----------------------------|--------------------|-----------------|---------------------------------------------------------------------------------------------------------|
| Cache-Putah                | 174, 175           | 22,045          | Contains the largest proportion of high-valued wine grape acreage, potentially largest economic effect  |
| Other Westside Tribs       | 137, 139           | 3,052           | Small acreage, nearly all irrigated pasture                                                             |
| Above Shasta Reservoir     | 130, 132, 134, 136 | 130,852         | Largest subarea in terms of irrigated acreage; half is pasture, most of the remainder alfalfa and grain |
| Eastside Creeks            | 145, 147           | 10,561          | Nearly all (96%) in irrigated pasture                                                                   |
| Feather-Yuba-American      | 154, 156, 158      | 70,142          | Second largest subarea in acreage, half in pasture, most of the remainder alfalfa and grain             |
| Upper Delta Eastside Tribs | 176, 194           | 9,037           | Mix of wine grapes (60%), pasture (32%) and other crops                                                 |
| <b>Total</b>               |                    | <b>245,689</b>  |                                                                                                         |



## Upper Watersheds Irrigated Agriculture – Analysis Subareas

- Cache and Putah: Wine grapes is the primary crop (64% of total acres).
- Other Westside Tribs: Primarily pasture (74% of total acres).
- Above Shasta Reservoir: Primarily pasture, alfalfa, and grains (91%).
- Eastside Creeks: Primarily pasture (96%).
- Feather, Yuba, American: Primarily pasture, alfalfa, and grains (95%)
- Delta Eastside Tribs: Primarily wine grapes (60%)

Crop Acres by Subarea and DAU

| Subarea                 | DAU Name                      | DAU Number | Irrigated Area (Acres) |
|-------------------------|-------------------------------|------------|------------------------|
| Cache and Putah         | Cache Creek                   | 174        | 15,895.0               |
|                         | Putah Creek                   | 175        | 6,150.0                |
|                         | <b>Total</b>                  |            | <b>22,045.0</b>        |
| Other Westside Tribs    | Stony-Elder Creek Group       | 139        | 2,461.0                |
|                         | Clear-Cottonwood Creek        | 137        | 591.0                  |
|                         | <b>Total</b>                  |            | <b>3,052.0</b>         |
| Above Shasta Reservoir  | Upper Shasta Lake             | 136        | 2,720.0                |
|                         | MacArthur Hat Creek           | 134        | 40,967.0               |
|                         | Big Valley                    | 132        | 33,906.0               |
|                         | Goose Lake-Alturas            | 130        | 53,259.0               |
|                         | <b>Total</b>                  |            | <b>130,852.0</b>       |
| Eastside Creeks         | Cow-Battle Creek              | 145        | 9,838.0                |
|                         | Eastside Creek Group          | 147        | 723.0                  |
|                         | <b>Total</b>                  |            | <b>10,561.0</b>        |
| Feather, Yuba, American | Feather River                 | 154        | 61,675.0               |
|                         | Yuba-Bear                     | 156        | 4,661.0                |
|                         | American River                | 158        | 3,806.0                |
|                         | <b>Total</b>                  |            | <b>70,142.0</b>        |
| Delta Eastside Tribs    | Consumnes-Mokelumne-Calaveras | 176        | 6,626.0                |
|                         | Stanislaus River              | 194        | 2,411.0                |
|                         | <b>Total</b>                  |            | <b>9,037.0</b>         |
| <b>Grand Total</b>      |                               |            | <b>245,689.0</b>       |

# Upper Watersheds

DWR land survey data from 2010 was used to estimate the total agricultural water demand.



**Irrigated Crop Acres by Subarea**

| Crop Category | Cache and Putah | Other Westside Tribs | Above Shasta Reservoir | Eastside Creeks | Feather, Yuba, American | Delta Eastside Tribs | Total     |
|---------------|-----------------|----------------------|------------------------|-----------------|-------------------------|----------------------|-----------|
| Grain         | 369             | 0                    | 20,711                 | 0               | 9,117                   | 0                    | 30,197.0  |
| Rice          | 986             | 0                    | 8,528                  | 0               | 0                       | 0                    | 9,514.0   |
| Cotton        | 0               | 0                    | 0                      | 0               | 0                       | 0                    | 0.0       |
| Sgrbeet       | 0               | 0                    | 0                      | 0               | 0                       | 0                    | 0.0       |
| Corn          | 13              | 0                    | 0                      | 12              | 1                       | 0                    | 26.0      |
| DryBean       | 6               | 0                    | 0                      | 0               | 0                       | 0                    | 6.0       |
| Safflwr       | 0               | 0                    | 0                      | 0               | 0                       | 0                    | 0.0       |
| Oth Fld       | 0               | 0                    | 940                    | 0               | 0                       | 0                    | 940.0     |
| Alfalfa       | 84              | 152                  | 23,666                 | 2               | 8,143                   | 0                    | 32,047.0  |
| Pasture       | 2,612           | 2,269                | 75,284                 | 10,115          | 49,645                  | 2,850                | 142,775.0 |
| Pr Tom        | 0               | 0                    | 0                      | 0               | 0                       | 0                    | 0.0       |
| Fr Tom        | 0               | 0                    | 0                      | 0               | 0                       | 0                    | 0.0       |
| Cucurb        | 2               | 0                    | 0                      | 0               | 0                       | 0                    | 2.0       |
| On Gar        | 1               | 0                    | 254                    | 0               | 0                       | 0                    | 255.0     |
| Potato        | 0               | 0                    | 0                      | 0               | 0                       | 0                    | 0.0       |
| Oth Trk       | 52              | 13                   | 1,345                  | 46              | 557                     | 130                  | 2,143.0   |
| Al Pist       | 13              | 50                   | 0                      | 13              | 0                       | 0                    | 76.0      |
| Oth Dec       | 3,869           | 301                  | 124                    | 117             | 1,230                   | 603                  | 6,244.0   |
| Subtrop       | 32              | 264                  | 0                      | 2               | 136                     | 8                    | 442.0     |
| Vine          | 14,006          | 3                    | 0                      | 254             | 1,313                   | 5,446                | 21,022.0  |
| Total         | 22,045.0        | 3,052.0              | 130,852.0              | 10,561.0        | 70,142.0                | 9,037.0              | 245,689.0 |

# Upper Watersheds

Total crop acres by category (shown on the previous slide) were multiplied by the average applied water requirement by crop category shown in the table to the right to estimate total agricultural water demand.



**Average Crop Applied Water Requirements (AF/acre)**

| Crop Category | Cache and Putah | Other Westside Tribs | Above Shasta Reservoir | Eastside Creeks | Feather, Yuba, American | Delta Eastside Tribs |
|---------------|-----------------|----------------------|------------------------|-----------------|-------------------------|----------------------|
| Grain         | 0.4             | 0.0                  | 1.2                    | 0.0             | 2.7                     | 0.0                  |
| Rice          | 5.4             | 0.0                  | 4.7                    | 0.0             | 0.0                     | 0.0                  |
| Cotton        | 0.0             | 0.0                  | 0.0                    | 0.0             | 0.0                     | 0.0                  |
| Sgrbeet       | 0.0             | 0.0                  | 0.0                    | 0.0             | 0.0                     | 0.0                  |
| Corn          | 2.9             | 0.0                  | 0.0                    | 1.9             | 3.3                     | 0.0                  |
| DryBean       | 2.2             | 0.0                  | 0.0                    | 0.0             | 0.0                     | 0.0                  |
| Safflwr       | 0.0             | 0.0                  | 0.0                    | 0.0             | 0.0                     | 0.0                  |
| Oth Fld       | 0.0             | 0.0                  | 1.6                    | 0.0             | 0.0                     | 0.0                  |
| Alfalfa       | 4.6             | 4.0                  | 2.8                    | 3.5             | 2.7                     | 0.0                  |
| Pasture       | 4.7             | 4.0                  | 3.0                    | 2.7             | 3.2                     | 3.5                  |
| Pr Tom        | 0.0             | 0.0                  | 0.0                    | 0.0             | 0.0                     | 0.0                  |
| Fr Tom        | 0.0             | 0.0                  | 0.0                    | 0.0             | 0.0                     | 0.0                  |
| Cucurb        | 0.8             | 0.0                  | 0.0                    | 0.0             | 0.0                     | 0.0                  |
| On Gar        | 1.9             | 0.0                  | 2.6                    | 0.0             | 0.0                     | 0.0                  |
| Potato        | 0.0             | 0.0                  | 0.0                    | 0.0             | 0.0                     | 0.0                  |
| Oth Trk       | 2.5             | 2.0                  | 1.7                    | 1.7             | 1.1                     | 1.1                  |
| Al Pist       | 3.6             | 3.2                  | 0.0                    | 2.3             | 0.0                     | 0.0                  |
| Oth Dec       | 3.3             | 2.7                  | 1.6                    | 2.3             | 1.9                     | 2.6                  |
| Subtrop       | 2.7             | 2.2                  | 0.0                    | 1.7             | 2.0                     | 1.4                  |
| Vine          | 1.8             | 1.7                  | 0.0                    | 1.5             | 0.7                     | 0.6                  |

The total estimated agricultural water demand for all regions is approximately 684 TAF. Highest water demands in Above Shasta Reservoir and Feather, Yuba, American subareas.



**Estimated Annual Total Agricultural Water Demand (AF)**

| Subarea                 | Volume (AF) |
|-------------------------|-------------|
| Cache and Putah         | 56,129      |
| Other Westside Tribs    | 11,334      |
| Above Shasta Reservoir  | 365,532     |
| Eastside Creeks         | 28,137      |
| Feather, Yuba, American | 207,796     |
| Delta Eastside Tribs    | 15,026      |
| Total                   | 683,953     |

# Upper Watersheds

The total estimated agricultural water demand (repeated from prior slide).



**Estimated Total Agricultural Water Demand**

| Subarea                 | Volume (AF) |
|-------------------------|-------------|
| Cache and Putah         | 56,129      |
| Other Westside Tribs    | 11,334      |
| Above Shasta Reservoir  | 365,532     |
| Eastside Creeks         | 28,137      |
| Feather, Yuba, American | 207,796     |
| Delta Eastside Tribs    | 15,026      |
| Total                   | 683,953     |

Total surface water demand was estimated by multiplying the percentage of surface water use for irrigation by the total agricultural water demand. USGS 2010 county-level water use estimates were used to estimate the surface water use percentages. County level estimates were apportioned based upon the overlap of county and DAU boundaries.



**Estimated Irrigation Water Source (%)**

| Subarea                 | Groundwater (%) | Surface Water (%) |
|-------------------------|-----------------|-------------------|
| Cache and Putah         | 43%             | 57%               |
| Other Westside Tribs    | 40%             | 60%               |
| Above Shasta Reservoir  | 28%             | 72%               |
| Eastside Creeks         | 49%             | 51%               |
| Feather, Yuba, American | 29%             | 71%               |
| Delta Eastside Tribs    | 28%             | 72%               |

The total estimated agricultural surface water demand is approximately 477 TAF.



**Estimated Surface Water Demand (AF)**

| Subarea                 | Volume (AF) |
|-------------------------|-------------|
| Cache and Putah         | 32,058      |
| Other Westside Tribs    | 6,841       |
| Above Shasta Reservoir  | 264,877     |
| Eastside Creeks         | 14,462      |
| Feather, Yuba, American | 147,665     |
| Delta Eastside Tribs    | 10,816      |
| Total                   | 476,720     |

# References Consulted

- ^California Department of Water Resources (DWR). 2010. Land and Water Use Estimates. Available: <https://water.ca.gov/Programs/Water-Use-And-Efficiency/Land-And-Water-Use/Agricultural-Land-And-Water-Use-Estimates>. Accessed: September 20, 2017.
- U.S. Geological Survey (USGS). 2010. “Estimated Use of Water in the United States County-Level Data for 2010,” data file “usco2010.xlsx.” Available: <https://water.usgs.gov/watuse/data/2010/usco2010.xlsx>. Accessed December 9, 2021.