Staff Workshop: Modeling Tools Used in Draft Staff Report for Sacramento/Delta Update to the Bay-Delta Water Quality Control Plan (Bay-Delta Plan)

Start time: 9:30 AM
November 2, 2023

CALIFORNIA
Water Boards

State Water Resources Control Board

Workshop Logistics and Purpose

- Workshop is being recorded and will be available on the Sacramento/Delta webpage: bit.ly/sac-delta-update
- **To watch the workshop only:** view the webcast at video.calepa.ca.gov (closed captioning available)
- **To ask questions:** must be on Zoom platform
  - Zoom: submit questions using Q&A function or raise your hand to ask question verbally
  - Phone: press *9 to raise and lower your hand
- Email SacDeltaComments@waterboards.ca.gov for assistance
- Purpose of workshop is to provide information on modeling tools used in the draft Staff Report and to answer questions in advance of public hearing

Submitting Comments on Draft Staff Report

- Participants should reserve comments for public hearing, where Board members will be in attendance, and for the written comment period
- **To provide oral comments:** attend public hearing (scheduled for November 17, December 1, and December 11)
  - Register by November 3: bit.ly/bd-hearing-reg
- **To submit written comments:** email comments to SacDeltaComments@waterboards.ca.gov with the subject "Comment Letter – Sacramento/Delta Draft Staff Report" by December 15, 2023
- Additional information available in September 28 notice: bit.ly/28sep-notice

Additional Resources

- October 19 staff workshop recording and presentation
- Educational video: Overview of Sacramento/Delta Update to Bay-Delta Plan and Draft Staff Report

Available on the Sacramento/Delta webpage: bit.ly/sac-delta-update

Agenda

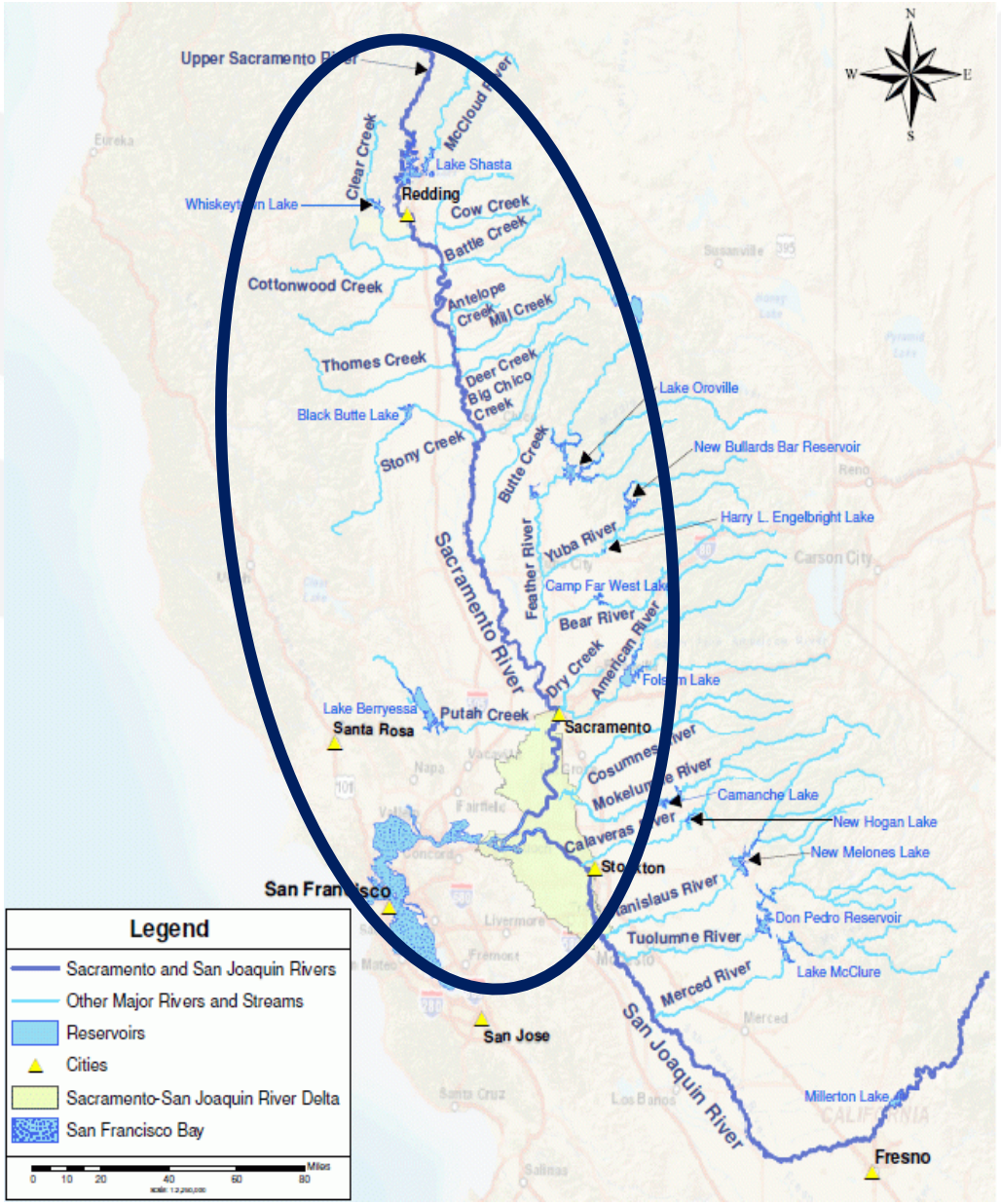
- State Water Resources Control Board (State Water Board or Board) staff presentation
  - Brief introduction of draft Staff Report
  - Overview of models and analytical tools used in draft Staff Report
  - Next steps, schedule, and resources
- Question and Answer Session

Draft Staff Report

- Evaluates potential benefits and environmental/economic impacts of possible alternatives for updating the Sacramento/Delta components of the Bay-Delta Plan
- Assesses a range of alternatives, including proposed Plan amendments, proposed Voluntary Agreements (VAs), and others
- Identifies proposed incorporation of tribal and subsistence fishing beneficial uses to the Plan
- Complies with California Environmental Quality Act, Water Code, and other laws
- Public's opportunity to review and comment on analyses
- Public input will inform the State Water Board's planning process and eventual consideration of adoption of Sacramento/Delta updates

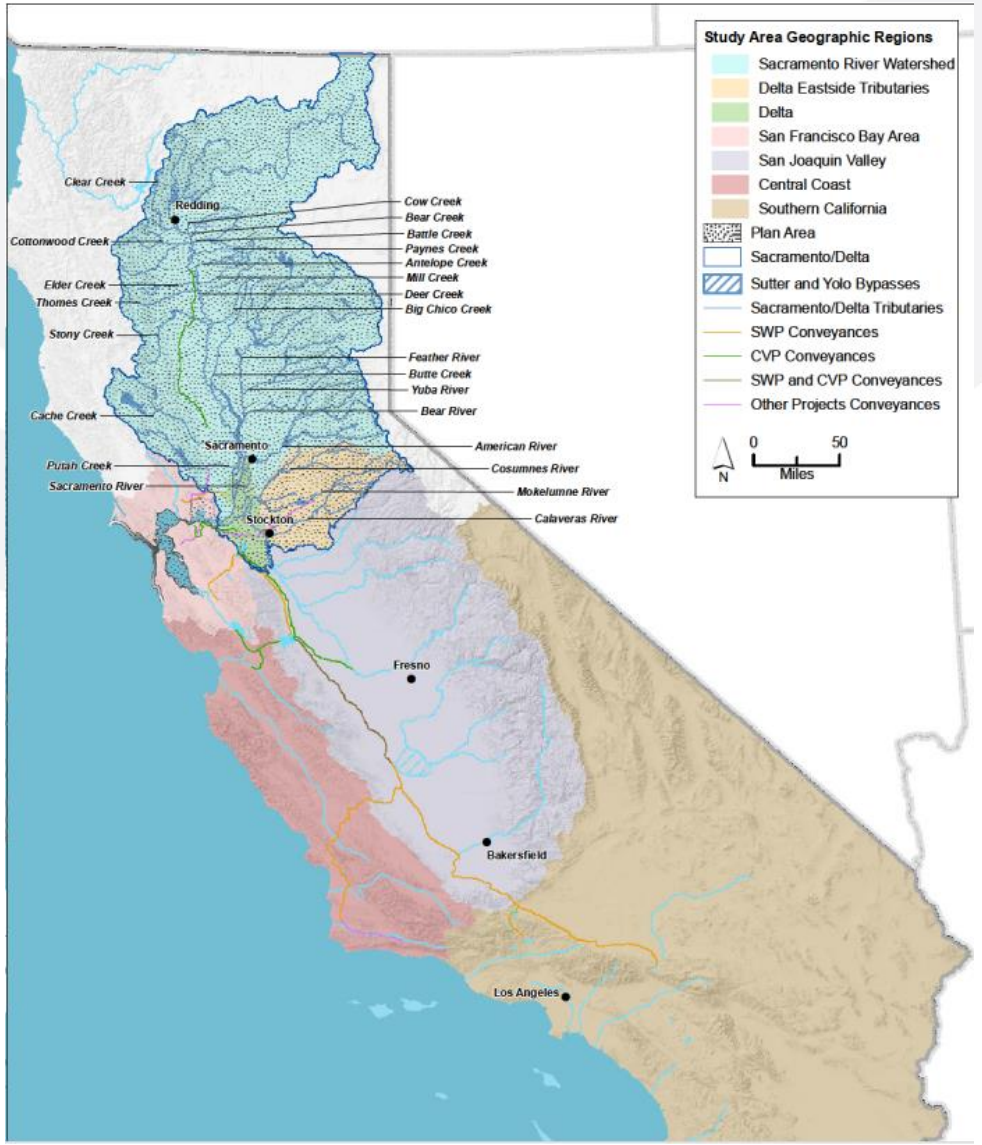
Staff Report Plan Area

- Includes Sacramento/Delta and continues west through Delta, downstream through Suisun Marsh and adjoining bays, out to Pacific Ocean
- Encompasses areas where Sacramento/Delta Plan amendments may apply and the ecosystem that the Plan is intended to protect



Staff Report Study Area

- Larger study area is also defined to ensure that environmental and economic impacts are evaluated in all areas where impacts may occur
- Divided into 7 regions based on geography and water supply
  - Sacramento River watershed, Delta eastside tributaries, Delta, San Francisco Bay, San Joaquin Valley, Central Coast, and Southern California



Organization of the Environmental Analyses

- Changes in hydrology
  - Magnitude and timing of tributary flows, Delta inflows, and Delta outflows; reservoir levels; interior Delta flows
- Changes in water supply
  - Sacramento/Delta supplies
    - Agricultural, municipal, and wildlife refuge supplies
  - Groundwater
  - Other water management actions
    - Groundwater storage and recovery, water transfers, water recycling, and water conservation measures
- Habitat restoration and other ecosystem projects
- New or modified facilities

Models and Analytical Tools

- Sacramento Water Allocation Model (SacWAM)
  - Hydrology and systems operations
- Energy Analyses
- HEC-5Q
  - Water temperature
- Delta Simulation Model II (DSM2)
  - Delta hydrodynamics and water quality
- Statewide Agricultural Production (SWAP) model
  - Agricultural production and economic effects
- IMPLAN
  - Regional economic effects
- Fish Benefits

Appropriate Use of Models

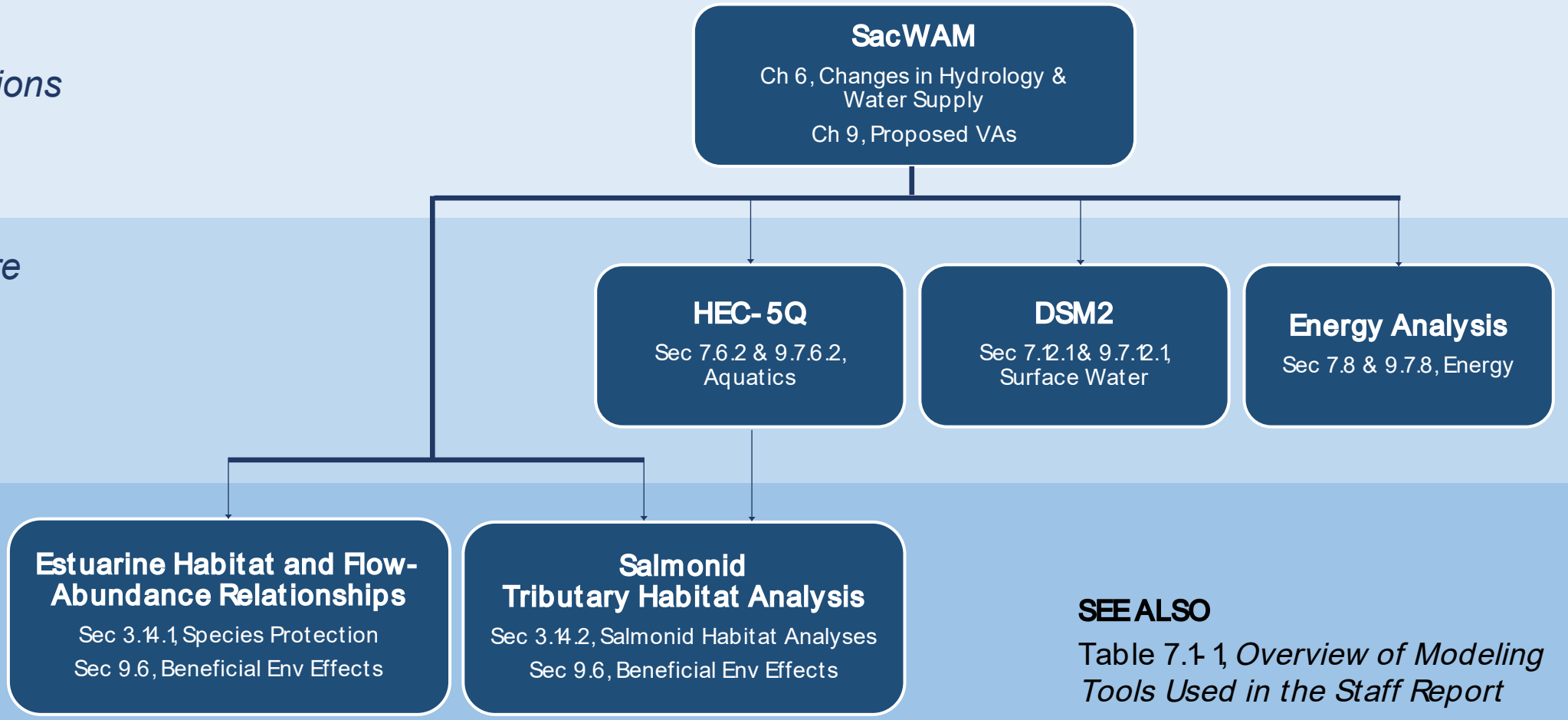
- Model results are used in a comparative manner to assess possible incremental effects of scenarios compared to a baseline
- Model results are not intended to be used in a predictive manner
- Modeling used as an aid for the environmental/economic analyses
- Analysis conclusions could be based on modeling results and additional resource-specific information
- For some topics, comparison of model results used to quantitatively evaluate potential environmental impacts or other effects
- For other topics, changes in hydrologic or water supply conditions are used to infer the potential effects of project-related changes in resource-specific parameters
- Time steps and spatial resolution of analyses limited to resolution of SacWAM

Modeling Tools for Estimating Potential Effects of Changes in Hydrology

Hydrology/Operations

Water Temperature
Water Quality
Hydrodynamics
Energy

Fish Benefits



SEE ALSO

Table 7.1-1, *Overview of Modeling Tools Used in the Staff Report*

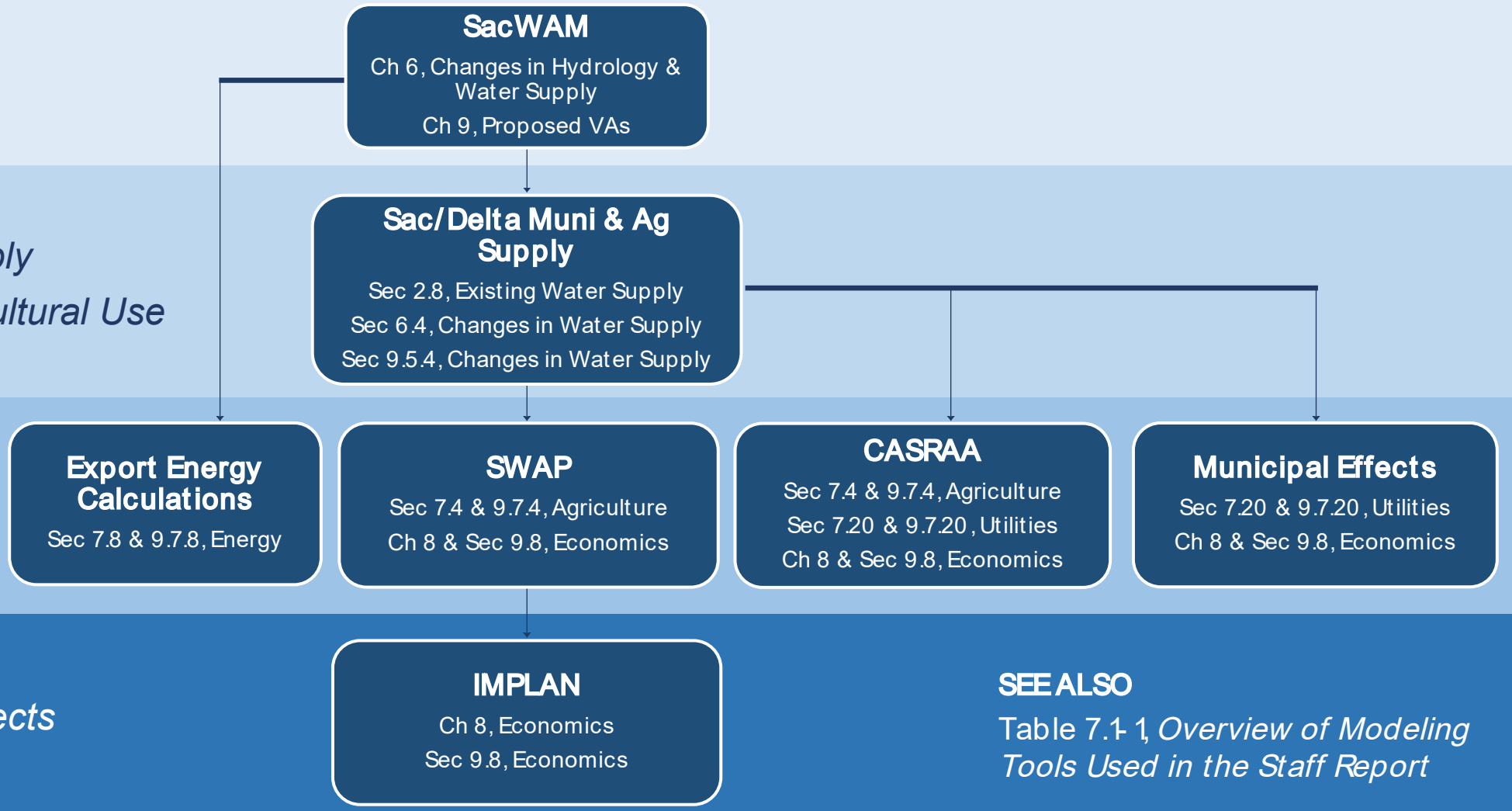
Modeling Tools for Estimating Potential Effects of Changes in Supply

Hydrology/Operations

Sacramento/Delta Supply for Municipal and Agricultural Use

Export Energy
Agricultural Effects
Municipal Effects

Regional Economic Effects



SEE ALSO

Table 7.1-1, *Overview of Modeling Tools Used in the Staff Report*

SacWAM Modeling: Hydrology and Operations

SacWAM Background

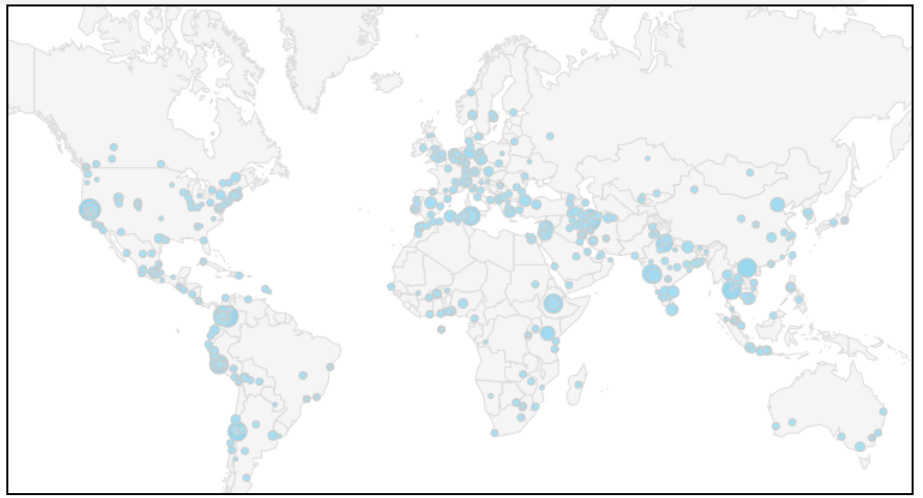
- Developed to assess alternatives for the Sacramento/Delta update to the Bay-Delta Plan
- A hydrology and systems operation model simulating:
  - Streamflows
  - Reservoir operations
  - Diversions
  - Crop demands
  - Soil moisture
  - Groundwater
  - Delta salinity
- Monthly time scale
- 1922–2015 period of simulation
- Built on the Water Evaluation and Planning (WEAP) software platform

SacWAM Development History

- January 2014: Model development began
- September 2016: Beta Version 0.2 released
- October 2016: Peer review
- October 2017: Public release 1.05
- April 2019: Public release 1.2
- November 2019: Public release 2019.11.22
- September 2023: Public release 2023.06.12

WEAP Software

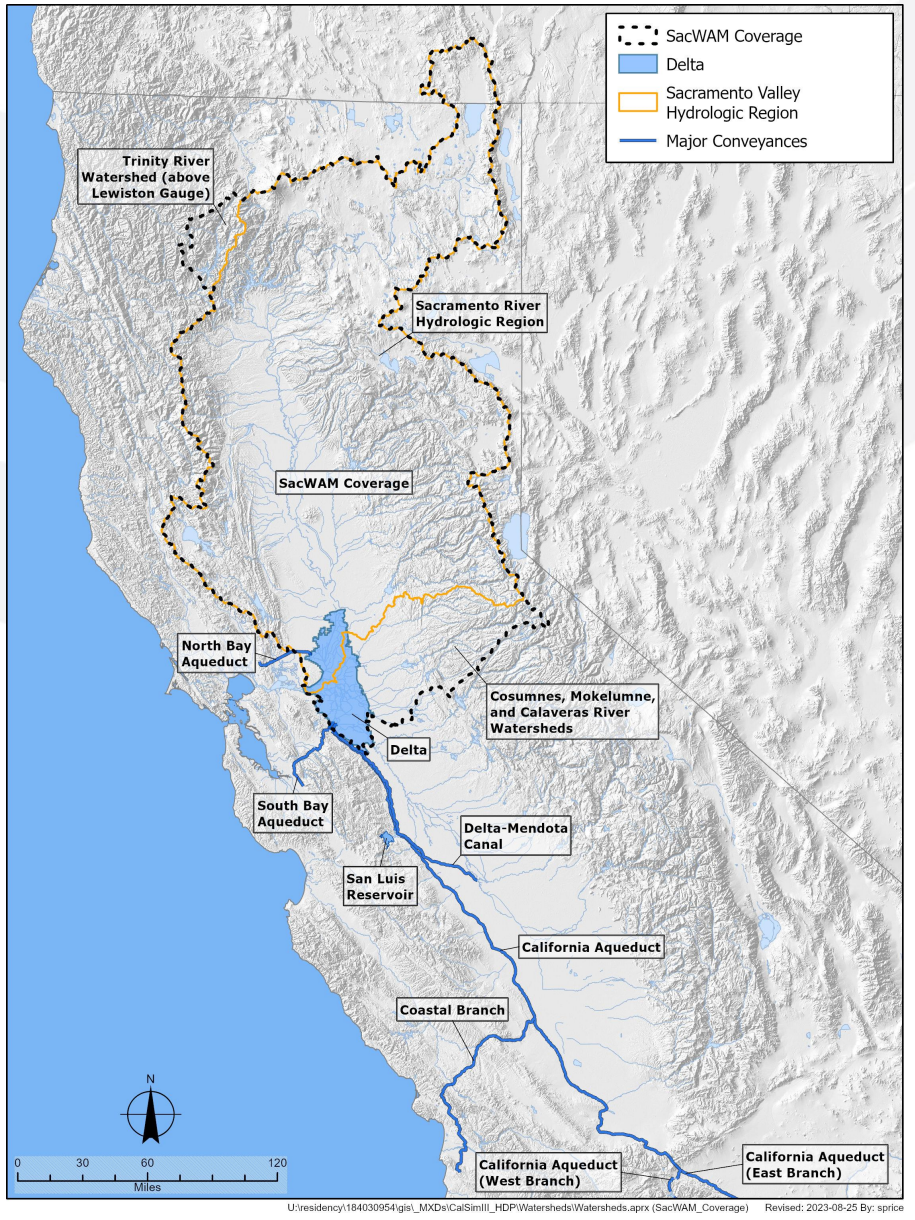
- Widely used
- Under development for 30+ years
- More than 16,000 user members
- Used in hundreds of scientific publications



SacWAM Model Domain

Includes:

- Upper Trinity above Lewiston Reservoir
- Entire Sacramento watershed
- Delta eastside tributaries
- Delta
- California Aqueduct
- Delta Mendota Canal



SacWAM Features

- Complete accounting of water resources representing:
  - Rainfall runoff processes
  - Infrastructure such as dams, canals, diversions, etc.
  - Demands using a range of complexity
- Simulates constant regulatory regime over a historical hydrologic sequence
- Utilizes a priority and preference scheme to allocate water
- Includes an intuitive user interface that provides transparent access to all model assumptions and constraints

Appropriate Use of SacWAM

- Used in comparative analysis
- Regulations in the Delta and throughout the system are constantly changing
- Large scale model – results may not be appropriate at single diversion scale
- Monthly time-step

SacWAM Scenarios

- Baseline (Existing Conditions)
- Unimpaired
- 35–75% Unimpaired Flow (UF) (35%, 45%, 55%, 65%, 75%)
- 2008/2009 Biological Opinions (BiOps) Condition
- 2019 BiOps Condition
- Voluntary Agreements (VA)

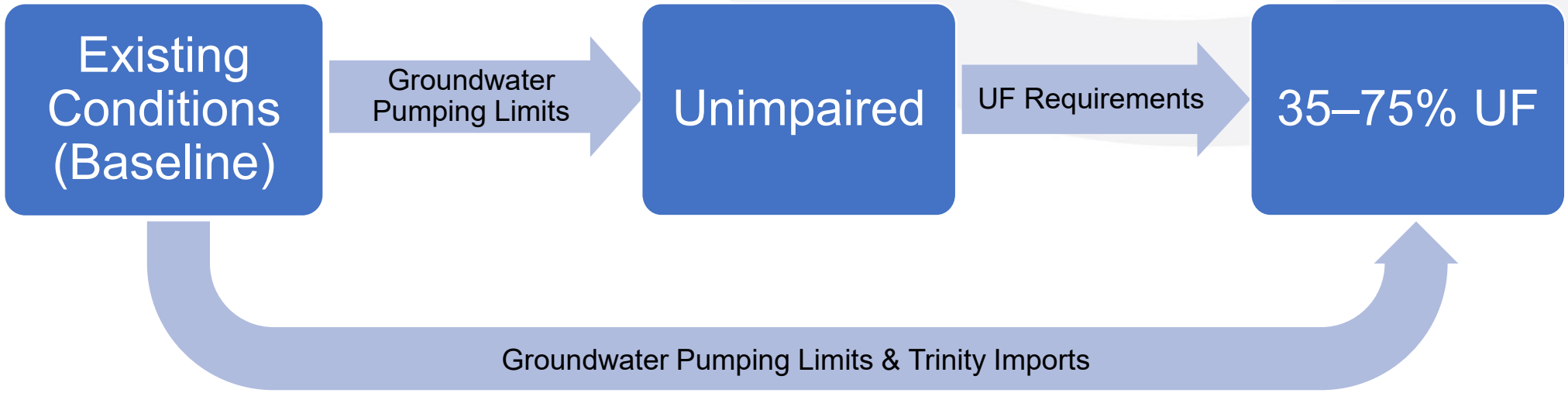
SacWAM Existing (Baseline) Regulatory Assumptions

Table A1-1. SacWAM Baseline Model Assumptions

Regulation	Action/Objective
State Water Board Water Right Decision D-1641	Water quality objectives
	Minimum net Delta outflow index (NDOI)
	Export Limits (E:I)
	Export Limits (SJ I:E)
	Delta Cross Channel (DCC) Closures
	San Joaquin River Vernalis Minimum Flow [a]
	Table 4 (Spring X2)
2019 Biological Opinions	American River Flow Management Standard (FMS)
	Old and Middle Rivers (OMR)
	DCC Closures [b]
	Fall Action (Fall X2)
2020 Incidental Take Permit	Suisun Marsh Salinity Control Gate Operations (Summer)
	Summer Action
	Fall Action (Fall X2)
	OMR
	San Joaquin I:E [c]

[a] Vernalis shoulder flows are assumed to apply for entire pulse period.
[b] The Delta Cross Channel may be closed as early as October pursuant to the 2019 NMFS Biological Opinion.
[c] The 2020 Incidental Take Permit I:E export limit was assumed to apply to SWP *and* CVP.

SacWAM Flow Scenario Development



Unimpaired Conditions

- Measure of total water available to be put to beneficial use
- No reservoir storage
  - Except 840 TAF in Clear Lake because it is a natural lake
- No diversions
  - Except to islands in the Delta that are below sea level
- Existing land cover/land use (however, since no water is being diverted the demands are largely unmet)
- Maximum groundwater pumping limits set from existing conditions
- Unimpaired San Joaquin inflows at Vernalis are developed by DWR

Flow Scenarios

- 35, 45, 55, 65, 75 percent of unimpaired flow evaluated
- Same regulations as existing conditions
- Includes new instream flow requirements throughout the watershed that require a percent of the unimpaired flow calculated at that location
- New requirements were assumed above rim reservoirs, below rim reservoirs, and at bottom of each tributary and for Delta outflow
- Percent UF Delta outflow requirement is based on Delta inflow from all Delta tributaries except the San Joaquin plus the required flow at Vernalis

35–75% Scenario Carryover Storage Targets

Reservoir	End of September Carryover Storage Target (TAF)	Source of Target
Shasta	2,200	2009 NFMS Biological Opinion
Oroville	1,200–1,500	Historical Storage-Temperature Analysis
Folsom	400	Historical Storage-Temperature Analysis
New Bullards Bar	400–550	Historical Storage-Temperature Analysis
Camanche	145	Communications with EBMUD Staff
Lake Berryessa	900	Historical Storage-Temperature Analysis
New Hogan	100	Historical Storage-Temperature Analysis
Camp Far West	20	Historical Storage-Temperature Analysis

Other Flow Scenario Assumptions

- Flow Requirement below Keswick for Water Right Order 90-5
- San Joaquin Inflow at Vernalis
- Groundwater Pumping
- Trinity Imports
- CVP and SWP Operations
- Non-Project Operations

SacWAM VA Scenario Development

VA Scenario Regulatory Assumptions

Table G3a-1. SacWAM Model Assumptions for Each Scenario

Regulation	Project Baseline	2019 BiOps Condition	VA
D-1641	WQ Objectives	WQ Objectives	WQ Objectives
	Min NDOI	Min NDOI	Min NDOI
	Export Limits (E:I)	Export Limits (E:I)	Export Limits (E:I)
	Export Limits (SJ I:E)	Export Limits (SJ I:E)	Export Limits (SJ I:E)
	DCC Closures	DCC Closures	DCC Closures
	SJ Vernalis Min Flow[1]	SJ Vernalis Min Flow[1]	SJ Vernalis Min Flow[1]
	Table 4 (Spring X2)	Table 4 (Spring X2)	Table 4 (Spring X2)
2019 Biological Opinions	American River FMS	American River FMS	American River FMS
	OMR	OMR	OMR
	DCC Closures[2]	DCC Closures[2]	DCC Closures[2]
	Fall Action (Fall X2)	Fall Action (Fall X2)	Fall Action (Fall X2)
2020 ITP	Suisun Marsh Salinity Control Gate Ops (Summer)		
	Summer Action		
	OMR		
	San Joaquin I:E[3]		

[1] Vernalis shoulder flows are assumed to apply for entire pulse period.
[2] DCC may be closed as early as October pursuant to the 2019 BiOps.
[3] The 2020 ITP I:E export limit was assumed to apply to SWP *and* CVP.

VA Flow Assets Modeled In SacWAM

Postprocessed Delta Outflow to Include as Bookend Scenario

Postprocessed Delta Outflow to Include as Bookend Scenario

Explicitly Modeled in SacWAM

Postprocessed Delta Outflow to Include

Table 1: New Contributions to Tributary Flow and Delta Outflows in Thousand Acre Feet by Sacramento River Index[1,2,3] (Adapted from Term Sheet, Appendix 1 and associated amendments)

Source Category	Specific Source	C (15%)[4]	D (22%)	BN (17%)	AN (14%)	W (32%)
San Joaquin River Basin	*Minimum Placeholder Contributions (Stanislaus and Merced)[5]*	*11*	*83*	*101*	*85*	*0*
San Joaquin River Basin	*San Joaquin Basin Portion of Gap[5]*	-	*11*	*2*	*10*	-
San Joaquin River Basin	Tuolumne[15]	37	62	78	27	0
Friant	-	0	50	50	50	0
Sacramento River Basin[6]	Sacramento[7]	2	102	100	100	0
Sacramento River Basin[6]	Feather	0	60	60	60	0
Sacramento River Basin[6]	Yuba	0	60	60	60	0
Sacramento River Basin[6]	American[8]	30	40	10	10	0
Sacramento River Basin[6]	Mokelumne[13]	0	5	5	7	0
Sacramento River Basin[6]	Putah[9]	7	6	6	6	0
CVP/SWP Export Reduction[10]	-	0	125	125	175	0
PWA Water Purchase Program	Fixed Price	3	63.5	84.5	99.5	27
PWA Water Purchase Program	Market Price[11, 14]	0	50	60	83	0
Permanent State Water Purchases[12]	-	65	108	9	52	123
Year 1 New Outflow Above Baseline (Low Target)	-	***155***	***825.5***	***750.5***	***824.5***	***150***

Footnotes to Table 1:

[1] This table reflects status of negotiations as of the date of this Framework. Prior "global gap" to meet adequacy are now reflected as Permanent State Water Purchases.

[2] Outflows additive to baseline and will be provided January through June. A portion of the VAs' flows can be flexibly shaped to other times of year to test biological hypotheses while reasonably protecting beneficial uses. Such shaping will be subject to VAs' governance program. Flows made available through reservoir reoperations will be subject to accounting procedures described in term sheet and all flows will be verified as a contribution above baseline using these accounting procedures.

[3] An assessment based on the accounting procedures to be developed pursuant to Term Sheet section 8.3 will be conducted prior to year 8 of VA to determine if the flows in this table have materialized on average above baseline by water year type. The VA parties acknowledge that, if this analysis does not demonstrate that flows have materialized as shown in this table, then the VAs will be subject to Term Sheet provisions of Section 7.4(B)(ii) or (iii).

Draft VA Strategic Plan 8

VA Delta Outflow Postprocessing

- Delta outflow results for the VA scenario include market price and permanent water purchases, and flow assets from Friant and the Tuolumne River
- Chapter 9 also analyzes two VA scenarios with a CalSim bias correction, as well as:
  - Assumed additional flows from the Merced and Stanislaus with remaining VA San Joaquin River placeholder values, and
  - 2018 Bay-Delta Plan Lower San Joaquin River flow objectives (40% of unimpaired flow February through June)

Other SacWAM VA Modeling Assumptions

- Artificial Neural Network (ANN) Blinding
- Land Fallowing
- San Joaquin River inflow at Vernalis

Where to Find More Information on SacWAM Modeling

- Description of baseline assumptions – **Chapter 6**
- Description of flow scenario assumptions – **Chapter 6**
- Description of VA scenario assumptions – **Chapter 9**
- Methods used to simulate unimpaired conditions – **Appendix A7**
- Methods used to simulate flow scenarios – **Appendix A1**
- Methods used to simulate VA scenario – **Appendix G3a**
- SacWAM model inputs, representation and other details – **SacWAM 2023.06.12 Documentation**
- SacWAM website: waterboards.ca.gov/bay_delta/sacwam/

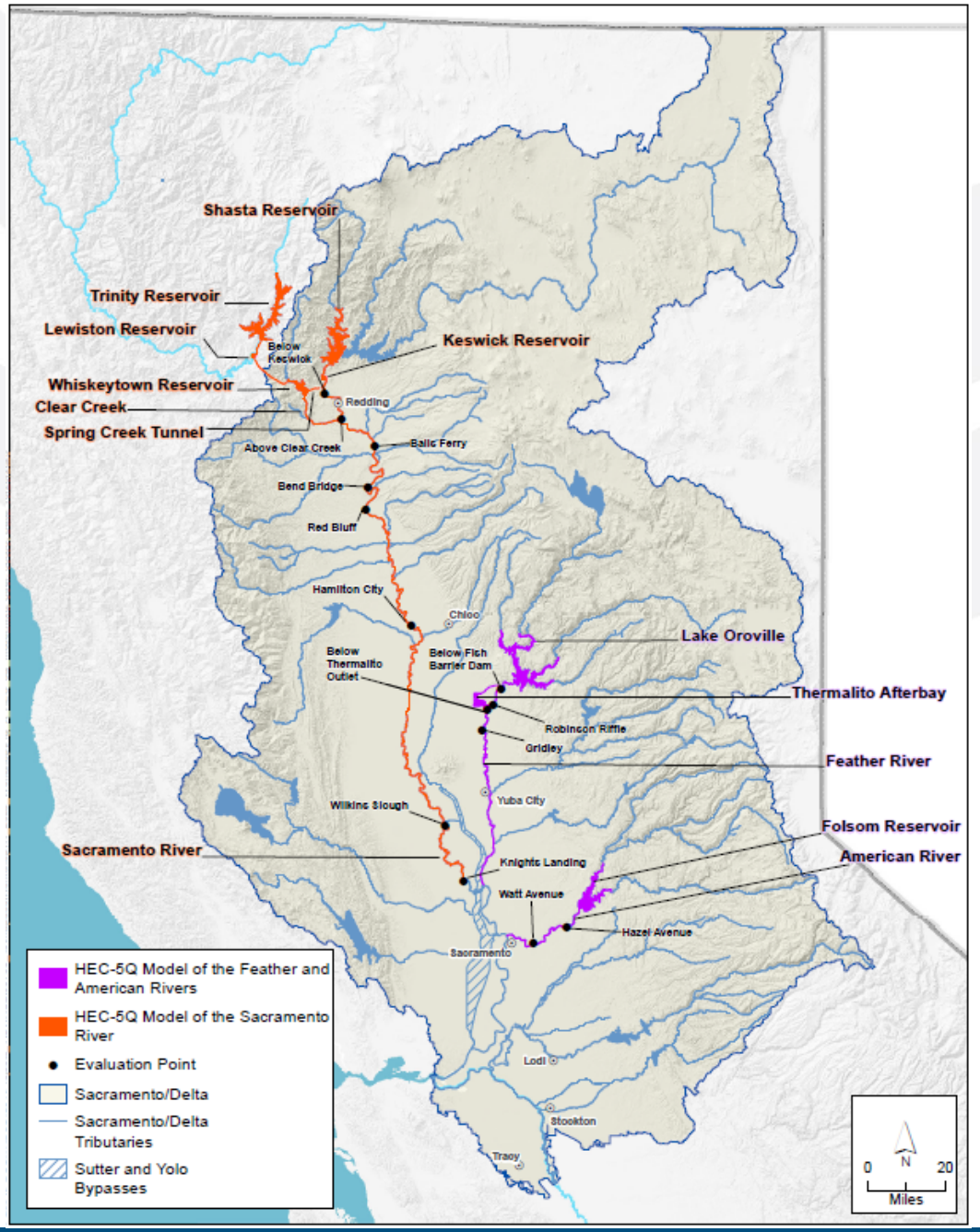
Energy

- Quantitative analysis includes:
  - Hydropower calculations for Sacramento/Delta region
  - Grid reliability assessment using Power Gem's Transmission Adequacy and Reliability Assessment (TARA)
  - Delta export energy calculations
- For more information see:
  - Section 7.8, *Energy*
  - Section 9.7.8, *Energy*
  - Appendix A5, *Hydropower, Energy Grid, and Export Energy Analyses*
  - Appendix G3d, *Hydropower, Energy Grid, and Export Energy Analyses for the Proposed Voluntary Agreements*

HEC-5Q Water Temperature Modeling

- HEC-5Q is a reservoir and stream temperature and water quality modeling tool
- Originally developed by the U.S. Army Corps of Engineers
- Model development started in 1979
- HEC-5Q has been used to simulate water temperature in the Sacramento River system for decades
- Model adapted to take inputs from SacWAM results
- Purpose of the HEC-5Q modeling in the draft Staff Report was to assess potential impacts and benefits of changes to State Water Project and Central Valley Project (Project) reservoir operations on downstream fisheries

HEC-5Q Model Domain and Evaluation Locations



Evaluation of HEC-5Q Results

- Results evaluated for favorable and unfavorable effects on multiple salmonid life history stages by salmonid run:
  - Adult immigration
  - Adult holding
  - Spawning, egg incubation, and alevins
  - Fry and juvenile rearing and emigration
- Favorable/unfavorable changes evaluated for all relevant combinations of month, water year type, and location
- Environmental analysis in Sections:
  - 7.6.2, 9.7.6.2, *Aquatic Biological Resources*
  - 7.12, 9.7.12, *Hydrology and Water Quality*
- Detailed methods and results in Appendices A6 and G3e (note: the November 2, 2023 Staff Report Modeling Workshop presentation included an incorrect reference to Appendix G4)

Caution in Result Interpretation

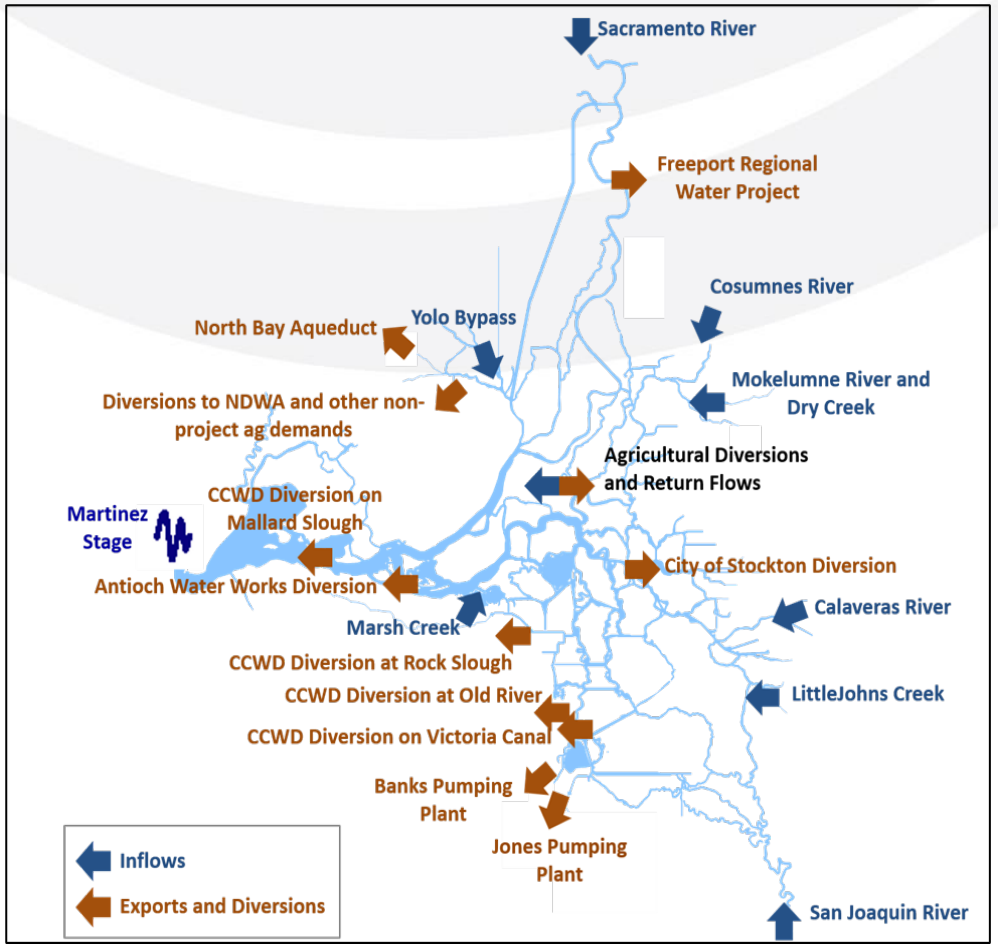
- Flexibility in implementation of cold water habitat narrative objective
- Conversion of monthly results to daily inputs
- Generalized nature of reservoir release temperature target algorithms

DSM2 (Delta Simulation Model 2)

- A one-dimensional mathematical model typically used for simulations of hydrodynamics, water quality, and particle tracking in a network of riverine or estuarine channels
- Used to calculate tidal elevations, flows, velocities, and mixing of salinity in the Delta
- Calculates the tidal flows in each Delta channel and the seawater intrusion effects, which are controlled by the tidal flows and the net Delta outflow
- DSM2 version 8.2.1, which uses the Delta Channel Depletion (DCD) model to estimate Delta agricultural diversions, seepage, and drainage
- Used inputs from SacWAM

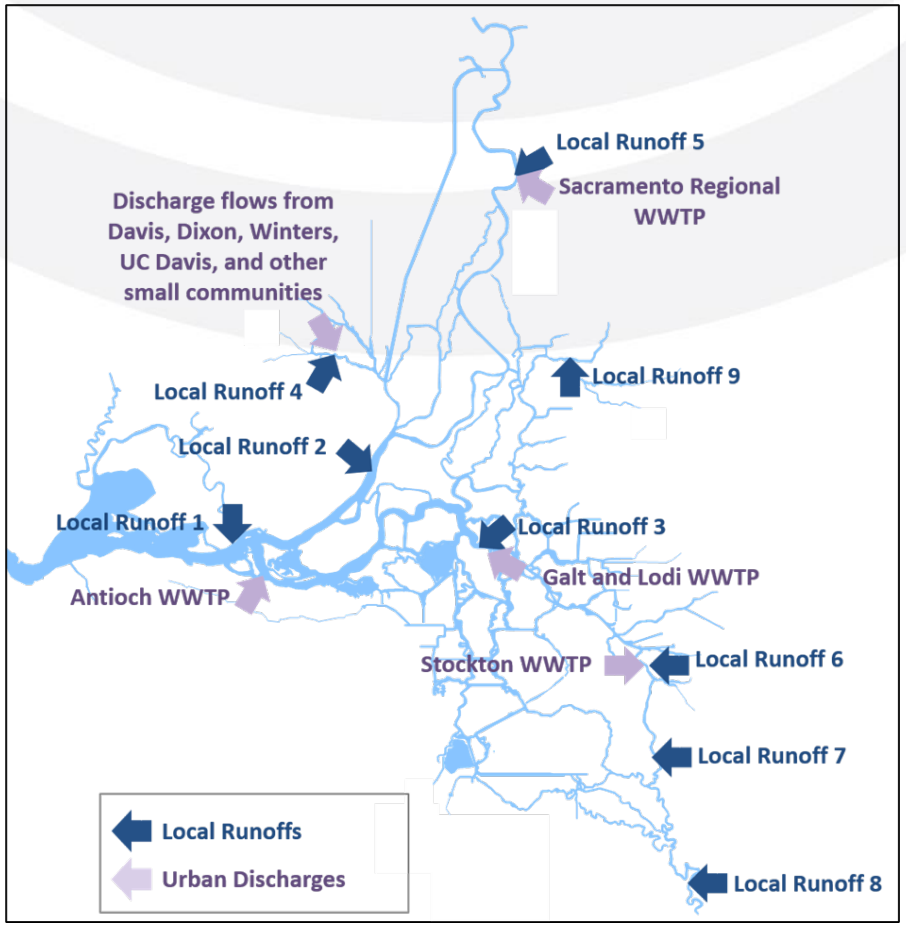
How SacWAM Results Were Incorporated in DSM2

- Flow Boundary Conditions: River Inflows, Exports, Diversions, Local Runoffs and Discharges from WWTP were based on monthly timeseries results from SacWAM



How SacWAM Results Were Incorporated in DSM2 (cont'd)

- Water Quality Boundary: Martinez and Vernalis EC Boundary conditions were from processed SacWAM results
- Facilities and Operations: DCC, Head of Old River Barrier and MSCG were operated based on SacWAM results
- All assumptions are described in Appendix A2



DSM2 Model Results

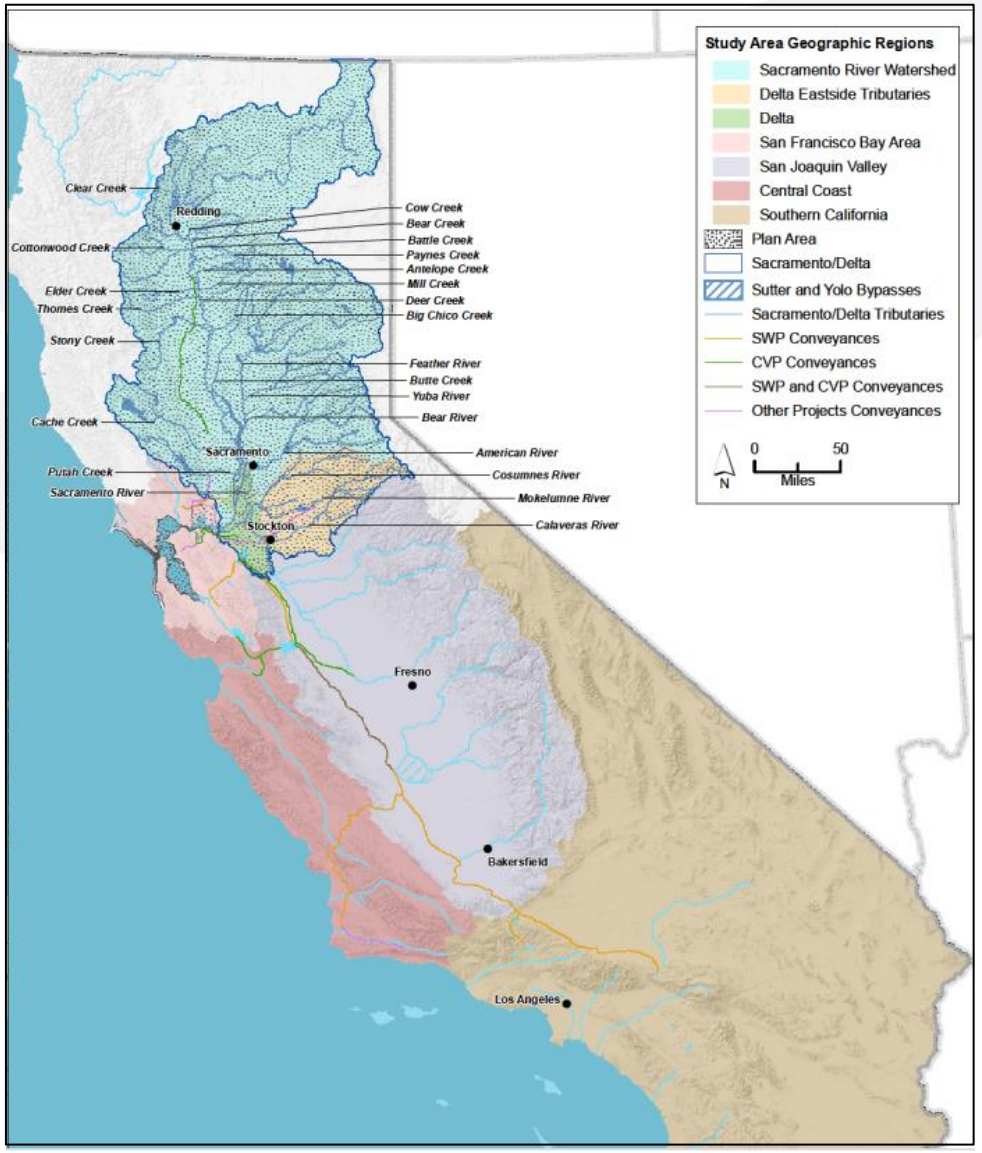
- Model results were analyzed by comparing baseline with Flow Scenarios and VAs
- Analysis focused on:
  - Changes in water quality at water quality compliance locations
  - Seawater intrusion effects
  - Changes in Delta flow that could affect harmful algal blooms (HABs)
- Sections 7.12.1 and 9.7.12.1, *Surface Water*
- DSM2 Methods and Results: Appendix A2 (Baseline and Flow scenarios)
- DSM2 Methods and Results: Appendix G3b (Proposed Voluntary Agreements)

Changes in Supply

- Reduced Sacramento/Delta supply for agricultural and municipal use
- Effects on Agricultural Production, Crop Revenues, and the Regional Economy
- Effects on Municipal Supply and Cost of Replacement Supply

Sacramento/Delta Surface Water Supply

- Originates in Sacramento/Delta watershed
- Comprises a portion of the water supplies to other regions of the study area
- SacWAM results, water contracts, and water planning documents used to estimate Sac/Delta supply for agricultural and municipal use
- Where to find more information:
  - Section 2.8, *Existing Water Supply*
  - Section 6.4, *Changes in Surface Water Supply*
  - Appendix A1a, *Methods for Estimating Regional Sacramento/Delta Surface Water Supply for Agricultural and Municipal Use*
  - Appendix A1b, *Methodology for Estimating Existing Water Supply from Historical Water Deliveries Data*



Effects of Changes in Supply on Agriculture

<u>Agricultural Production</u>
Central Valley: SWAP
Rest of study area: CASRAA

<u>Regional Economy</u>
IMPLAN

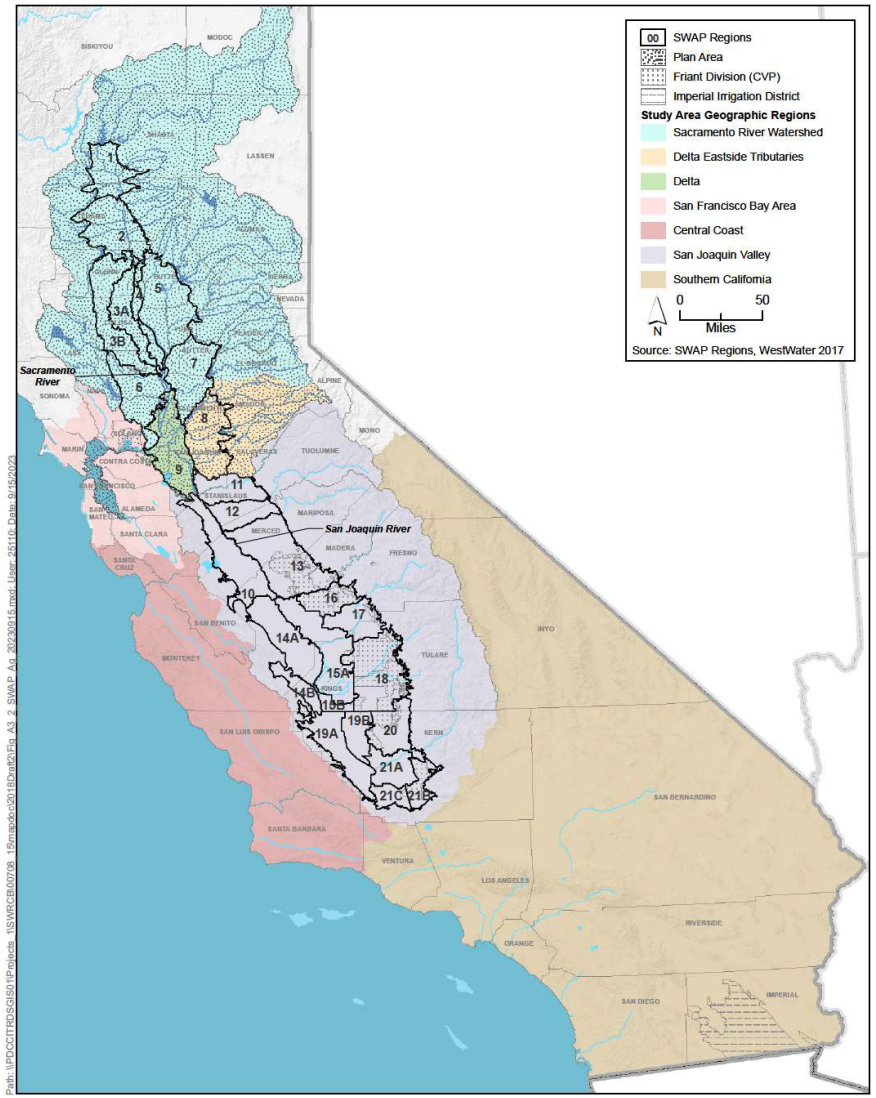
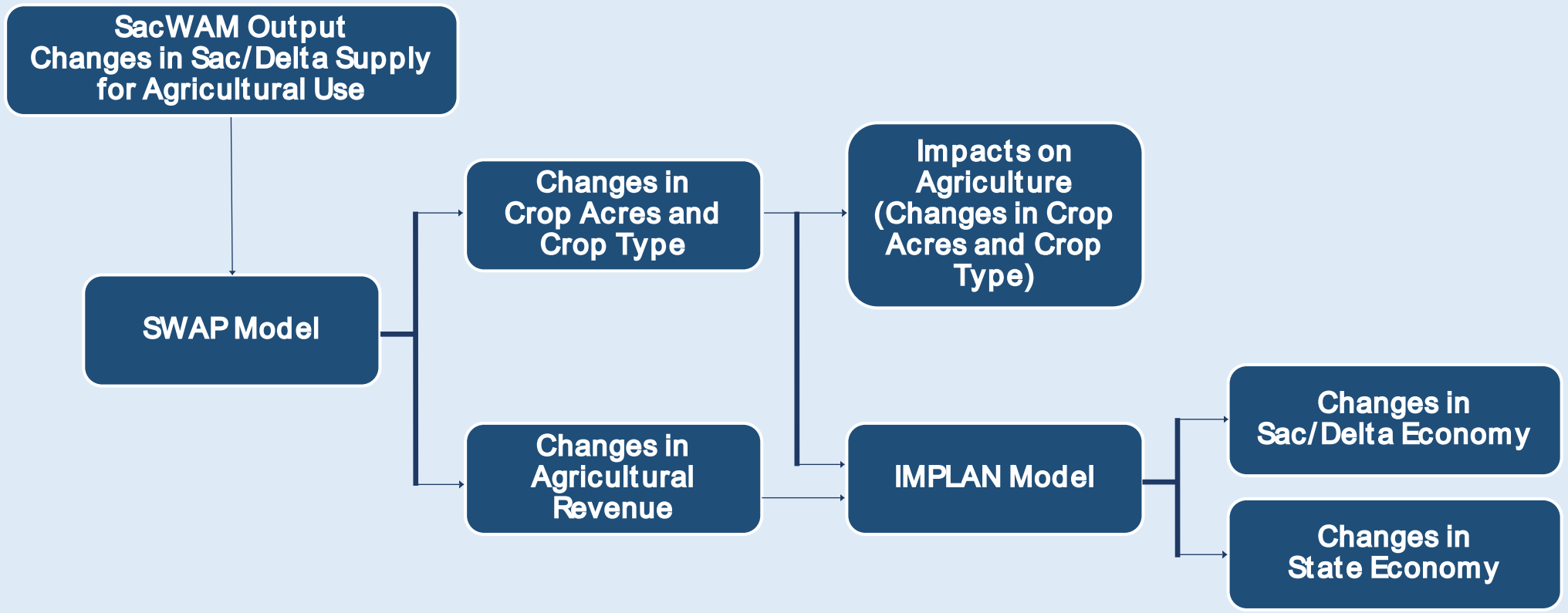


Figure A3-2
Statewide Agricultural Production (SWAP) Regions in the Study Area

Agricultural and Regional Economic Analysis



Statewide Agricultural Production (SWAP) Model

- Regional agricultural and economic optimization model that simulates growers' decisions and responses to changes in water supply in the Central Valley by determining the cropping pattern that maximizes the net returns to agricultural production
- Modeling domain consists of 27 production regions:10 in the Sacramento/Delta and 17 in the San Joaquin Valley
- Includes 21 crop groups representing the majority of Central Valley cropped acreage
- Considers Project supplies, local water supplies, and groundwater
- Considers information on crop water requirements, market constraints, economic factors of prices and yields, and costs for land, water, labor, and other agricultural production inputs
- Optimizes production by adjusting the crop mix, water sources and quantities used, and other inputs, or fallows land when it is the most cost-effective response to resource conditions

Statewide Agricultural Production (SWAP) Model, cont'd

- Annual model, provides point-in-time comparison between baseline and changed flow conditions
- SacWAM results converted to annual volumes for use as SWAP inputs for Project and local supplies
- Average and dry conditions evaluated
  - Average water year inputs developed from SacWAM results averaged over all water years in the simulation period
  - Dry water year inputs developed from SacWAM results averaged over dry and critical years as classified by the Sacramento Index

Statewide Agricultural Production (SWAP) Model, cont'd

- Two groundwater conditions evaluated: no replacement groundwater pumping and maximum replacement groundwater pumping
- Crop applied water requirements in the Sacramento/Delta adjusted to align with SacWAM information
- Deficit irrigation applied in dry year runs, values for some crops modified based on published literature
- Other model adjustments:
  - Added a new crop (corn silage) to the list of crop groups
  - Limited corn silage acreage reductions to no more than 30 percent of baseline
  - Accounted for VA unspecified water purchases by allowing the model to reduce water use associated with the least profitable crop acreage

SWAP Model Caveats

- Developed for large-scale analysis of agricultural water supply or other policy changes, and is not intended to precisely predict the potential future cropping decision of every single grower in an area
- Aids in planning by presenting how irrigated agriculture could respond to estimated reductions in Sacramento/Delta supply, based on reasonable assumptions of grower behavior
- Actual outcome may differ from modeled results because of decisions made by or circumstances facing individual growers
- Does not capture full set of options that growers could pursue to address reduced water supplies, such as groundwater banking, use of recycled water, and water purchases
- Model uses fixed groundwater pumping cost rates even though costs may actually increase if depth to groundwater declines as a result of increased pumping
- Groundwater Use – range of groundwater pumping responses modeled
  - Uncertainty regarding groundwater recharge rates, stream-aquifer interactions, and groundwater pumping in the study area
  - In some areas, groundwater pumping may be subject to other regulatory requirements (e.g., water quality, groundwater adjudications, SGMA)

CASRAA (California Sub-Regional Agricultural Analysis)

- Estimates agricultural production and economic effects for areas outside of SWAP: Bay Area, Central Coast, and Southern California regions
- Similar to SWAP model approach for determining affected crops and water use
- Contracts, urban water management plans, and integrated regional water management plans used to identify providers serving agricultural customers
- Uses UC Extension Service and SWAP crop budgets to estimate reduction in gross and net crop revenues
- Evaluation considers the “no replacement groundwater pumping” condition

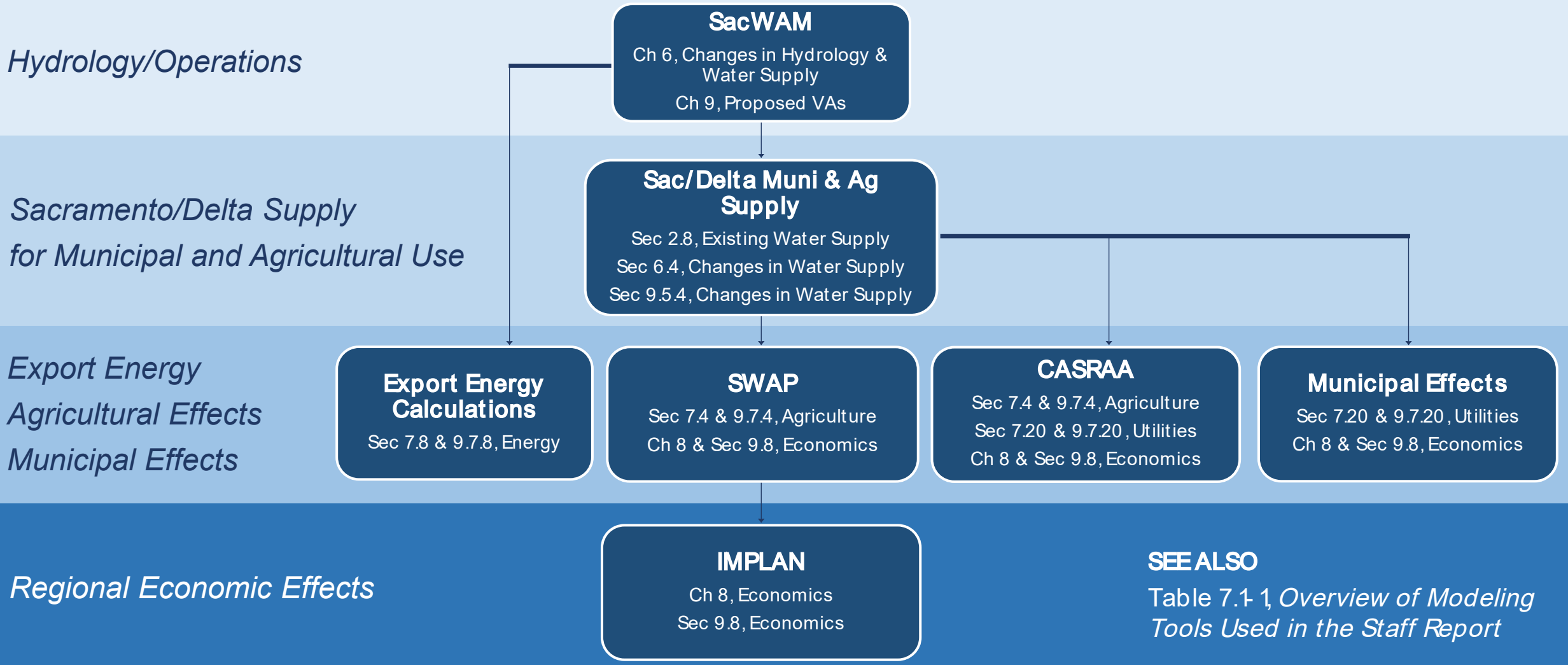
IMPLAN Regional Economic Analysis

- IMPLAN (IMpact analysis for PLANning), originally developed by US Forest Service, now operated privately by IMPLAN, Inc.
- Estimates how changes in agricultural production (crops) could affect agricultural support industries and the regional economy in terms of total industry output (sales), personal income, and employment
- Two IMPLAN modeling regions evaluated
  - Plan Area (Sac/Delta)
  - State of California
  - Results for each scenario compared to the baseline to obtain changes in output, income, and jobs
- Examples of SWAP results used by IMPLAN model
  - Crop production expenditures, including payments for labor
  - Direct payment expenditures to producing industries, transportation sectors, wholesalers and retailers

Where To Find More Information

	SWAP	CASRAA	IMPLAN
Section 7.4, *Agriculture and Forest Resources*	X	X	
Chapter 8, *Economic Analysis and Other Considerations*	X	X	X
Section 9.7.4, *Agriculture and Forest Resources*	X		
Section 9.8, *Economic Analysis and Other Considerations*	X		X
Appendix A1a, *Methods for Estimating Regional Sacramento/Delta Surface Water Supply for Agricultural and Municipal Use* and Attachment A1a1, *California Subregional Agricultural Analysis (CASRAA)*		X	
Appendix A3, *Agricultural Economic Analysis: SWAP Methodology and Modeling Results*	X		
Appendix A4, *Regional Economic Analysis Modeling Procedure*			X
Appendix G3c, *Economic Considerations for the Proposed Voluntary Agreements*	X		X

Modeling Tools for Estimating Potential Effects of Changes in Supply



SEE ALSO

Table 7.1-1, *Overview of Modeling Tools Used in the Staff Report*

Analytical Tools for Evaluating Fish Benefits

- Salmonid Tributary Habitat Analysis (Section 3.14.2, Salmonid Habitat Analyses, Section 9.6, Beneficial Env Effects)
  - SacWAM flows plus physical habitat restoration
  - Suitability Criteria
  - Floodplain Evaluation
- Estuarine Habitat Analysis (Section 9.6, Beneficial Env Effects)
- Flow Abundance Relationships (Section 3.14.1, Species Protection, Section 9.6, Beneficial Env Effects)

Salmonid Tributary Habitat Analysis

- Analytical tool developed by FlowWest
- Described in the Scientific Basis Report Supplement for the VAs (January 2023 draft and September 2023 final draft)
- Expert opinion from each tributary informed flow to suitable habitat relationships for existing (reference condition) and VA spawning and rearing habitat
- Applied to Spring-run and Fall-run Chinook Salmon
- SacWAM flows applied to these flow-suitable habitat relationships
  - Postprocessing used to produce scenarios representing the VA flow flexibility

Suitability Criteria

- Flow to suitable habitat relationships assumed to represent habitat suitable by depth, velocity, and cover criteria
- The resulting suitable acres of habitat were then filtered with temperature criteria
  - Temperature outputs from HEC-5Q for American, Feather, and Sacramento; YWA model for the Yuba River, and EBMUD historical gage data for the Mokelumne
  - Suitable habitat acreage discounted by proportion of days with 7DADM temperatures above criteria (13°C for spawning and 18°C for rearing)

Floodplain Evaluation

- Floodplain habitat additionally evaluated with the Meaningful Floodplain Event (MFE) approach
- MFE defined as the proportion of years in which:
  - For each magnitude of habitat area: 25%, 50%, 75%, and 100% of area needed to support doubling goal or max floodplain habitat area
  - Intra-annual frequency: the given magnitude of suitable habitat is available in 2 of the 5 months of the rearing period
  - Inter-annual frequency: above criteria met 2 out of every 3 years

Estuarine Habitat Analysis

- RMA Bay-Delta model used to estimate salinity, depth, and velocity with CalSim II inputs
- Combined with historical temperature and turbidity
- Suitable habitat calculated from these outputs for Delta Smelt, Longfin Smelt, and Salmonids
- Since RMA model fit to outdated CalSim II inputs, results were postprocessed to SacWAM inputs to estimate suitable habitat area for the SacWAM scenarios

Flow Abundance Relationships

- Methods from 2017 Scientific Basis Report
- Log abundance indices of 4 estuarine species (California Bay shrimp, longfin smelt, Sacramento splittail, and starry flounder) regressed against log outflow
- Regression equations used to estimate percent change in abundance indices for each flow or VA scenario compared to baseline
- Model uncertainty quantified with bootstrapping

Planned Refinements Fish Benefit Modeling

- Updated flow-abundance results for Starry Flounder and Splittail (benefits are greater than portrayed in Chapter 3)
- Updated Mokelumne floodplain habitat results (benefits are smaller than portrayed in Chapter 3)

Upcoming Public Participation

- **November 2023:** Tribal workshop and meeting (tribal representatives only)
- **November 17, 2023:** Board Hearing Day 1 (9:30 am)
- **December 1, 2023:** Board Hearing Day 2 (9:30 am)
- **December 11, 2023:** Board Hearing Day 3 (4:00 pm)
- **December 15, 2023:** Written comments due

Anticipated Timeline

- **Fall 2023:** VA Scientific Basis Report Supplement Report submitted for independent scientific peer review
- **Late 2023:** VA parties submit additional draft components of VA proposal (flow accounting, various agreements, governance charter) to the Board and for public review
- **Early to Mid 2024:** Release specific draft changes to Bay-Delta Plan, including program of implementation language, for public review and comment, and hold public meeting
- **Late 2024:** Develop responses to public comments on draft Staff Report and any needed changes to Staff Report and proposed changes to the Bay-Delta Plan for Board consideration
- **Late 2024:** Board meeting to consider adoption of Sacramento/Delta updates to Bay-Delta Plan and final Staff Report

Resources and Contact Information

Email:

SacDeltaComments@waterboards.ca.gov

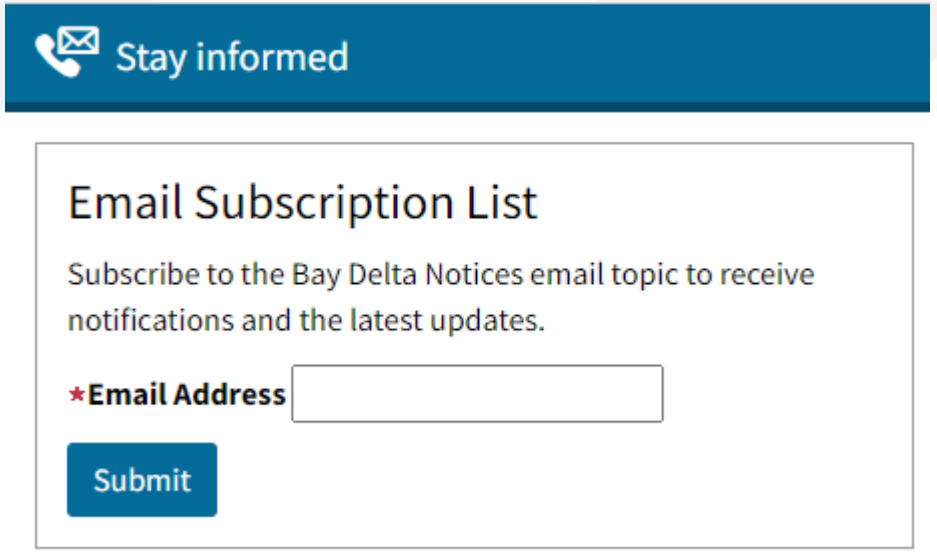
Webpages:

Bay-Delta Watershed:
waterboards.ca.gov/bay_delta/

Sacramento/Delta Update:
waterboards.ca.gov/bay_delta/comp_review.html

SacWAM:
waterboards.ca.gov/bay_delta/sacwam/

Bay-Delta Notices Email List:
waterboards.ca.gov/bay_delta/



Question and Answer Session

- **To ask questions:** must be on Zoom platform
  - Zoom: submit questions using Q&A function or raise your hand to ask question verbally
  - Phone: press *9 to raise and lower your hand
- Email SacDeltaComments@waterboards.ca.gov for assistance

Recap

- Upcoming events and deadline:
  - **November 3, 2023:** Register to provide comments during the public hearing at bit.ly/bd-hearing-reg
  - **November 17, 2023:** Board Hearing Day 1 (9:30 am)
  - **December 1, 2023:** Board Hearing Day 2 (9:30 am)
  - **December 11, 2023:** Board Hearing Day 3 (4:00 pm)
  - **December 15, 2023:** Written comments due
- Contact: SacDeltaComments@waterboards.ca.gov
- Bay-Delta Watershed: waterboards.ca.gov/bay_delta
- Sacramento/Delta Update: bit.ly/sac-delta-update