NCWA
Northern California Water Association

Sacramento River Basin

Improving Conditions for Salmon

PROGRAMS AND PROJECTS IMPLEMENTED SINCE 2000

Photo Credit: Ken Davis

For the past decades, water resources managers have been working with state and federal agencies and conservation partners to implement various programs and projects to improve conditions for viable salmon and other anadromous fish populations in every part of the Sacramento River Basin.

Since the State Water Board's Water Quality Control Plan update and Decision 1641 in 2000, there has been a serious and concerted effort to implement numerous flow arrangements, habitat enhancements, fish passage improvements, fish-food production projects, and studies to advance the science that informs management decisions. These programs and projects collectively address every salmon life-stage and they will be adaptively managed into the future based on lessons learned and better understanding the science.

The recent twenty-year celebration on ***Butte Creek Salmon Recovery*** showed how salmon can recover when conditions improved for every freshwater part of the spring-run salmon life-cycle (Appendix C). It is the comprehensive approach described in this document that will be critical to similar success in other parts of the Sacramento River Basin.

Updated December 8, 2017

Flow Agreements

New instream flow agreements or requirements have been put in place on every major watercourse in the Sacramento River Basin. These requirements, which have all been designed to benefit salmon, are found in State Water Board decisions, biological opinions, streamflow agreements, and other processes.
This includes:

- The agreements/requirements shown on ***Remanaging the Flow,*** *with a more detailed summary,* in Appendix A.
- Various short-term flow arrangements in Appendix B that have been specifically designed to benefit salmon.
- An additional 1.3 million acre-feet (maf) of water has also been redirected annually to dedicated Delta outflow during this time (see ***Retrospective***).

Habitat Enhancement

Numerous habitat improvement projects have been implemented in every part of the Sacramento River Basin to aid adult salmon holding and spawning, juvenile salmon rearing, and protection from predators. This includes spawning gravels, rearing areas and floodplain restoration (Appendix D).

Fish Passage and Migratory Corridors

Various projects have been completed to improve fish passage. This includes fish screens to prevent fish from entering diversions, structures to keep salmon from straying into the Colusa Basin Drain, siphons to keep creeks flowing unimpeded and improving migratory corridors. A complete list is shown in Appendix D.

Sacramento River Basin

Source: Department of Water Resources

Fish Food Production

With the Delta and the major rivers in the Sacramento River Basin currently acting as a food desert, there have been three types of projects to improve fish food production as part of an effort to mimic the natural floodplain:

- bringing fish into rice fields where there is food (i.e., Nigiri Project);
- managing rice fields in the late fall and winter to produce fish food that is then released back into the river system (Fish-Food Pilot Program);
- rerouting flows through the Yolo Bypass to provide additional food production (i.e., Delta Smelt Resiliency Strategy).

These efforts are described in Appendix E.

Science Development

During this time, there also has been a targeted effort to invest in scientific studies, projects and programs that will help to advance our understanding on the actions necessary to improve conditions for salmon in the Sacramento River Basin. This has been a collaborative effort, involving partnerships with state and federal agencies, water management entities and conservation organizations to fund and conduct the scientific work. The scientific efforts have aided in the development of the various flow agreements, habitat enhancement, fish passage, and fish food production that have been implemented in the Sacramento River Basin and new work will further assist and refine these efforts (Appendix F).

For more information on ongoing programs and actions, see the ***Sacramento Valley Salmon Recovery Program***. Parties in the Sacramento River Basin are working closely with the California Natural Resources Agency and its ***Sacramento Valley Salmon Resiliency Strategy***, which should serve as a further catalyst for efforts to help improve conditions for salmon in the Sacramento River Basin; as well as the newly formed Central Valley Salmon Habitat Partnership.

We would welcome any ideas or support for further actions to improve conditions for viable salmon populations in the Sacramento River Basin.

Appendix A

Re-managing the Flow

The major rivers and streams of the Sacramento Valley provide essential pathways for spawning salmon and steelhead. Flow agreements to benefit these fish are on every major watercourse in the Sacramento Valley.

Trinity and **Shasta Lakes** are important sources of cold water storage. Timing the release of this cold water into the rivers is vital if spawning fish are to thrive.

Trinity Lake

Shasta Lake

Whiskeytown Reservoir

Keswick Reservoir

Clear Creek

In May and June, water is pulsed into Clear Creek to attract Spring-run salmon from the Sacramento River. From June through October, water released from Whiskeytown Reservoir keeps water temperatures cool.

Sacramento River Tributaries

Various flow agreements benefit spring run salmon.

Feather River

A water quality certification adopted in 2010 provides for specific flow and temperature requirements to accommodate spawning salmon and steelhead.

Lake Oroville

Sacramento River below Keswick Dam

In 1960, flow objectives were established for the protection of fish and wildlife. In 1990 and 1991 this policy was modified requiring more cold water when warmer temperatures would be harmful to fish.

Sutter Buttes

New Bullards Bar Reservoir

Yuba River

In 2008, the Yuba River Accord increased the streamflow requirements over previous levels, which benefits fish while insuring sufficient water supplies for irrigation and municipal uses.

Sacramento River at Wilkins Slough

The Rivers and Harbors Act of 1935 mandated a specific flow rate at Wilkins Slough be maintained. The primary goals at that time were navigation and flood control. In 1992, Congress made protection of fish and wildlife a secondary goal and this requirement was updated in 2009.

Folsom Lake

American River below Nimbus Dam

In 2000, the Flow Management Standard was developed, which established minimum flow standards to improve the conditions for fall-run Chinook salmon and steelhead. Additionally, releases are adjusted to maintain sufficiently low water temperatures for steelhead rearing in summer and Chinook spawning in the fall.

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For more details visit www.norcalwater.org/efficient-water-management/instream-flows/

July 21, 2017

Instream Flow Requirements in the Sacramento River Hydrologic Region Updated: November 2014

This briefing paper describes the existing instream flow requirements for the major rivers and streams in the Sacramento River hydrologic region. These requirements include provisions in State Water Resources Control Board (SWRCB) decisions, biological opinions, streamflow agreements, and other processes. New processes to develop different flow requirements should be aware of, and take into account, these existing flow requirements.

Upper Sacramento River

1. 1960 MOA between Reclamation and DFG

An April 5, 1960, Memorandum of Agreement (MOA) between Reclamation and the DFG originally established flow objectives in the Sacramento River for the protection and preservation of fish and wildlife resources. The agreement provided for minimum releases into the natural channel of the Sacramento River at Keswick Dam for normal and critically dry years (Table 1, below). Since October 1981, Keswick Dam has operated based on a minimum release of 3,250 cfs for normal years from September 1 through the end of February, in accordance with the MOA. This release schedule was included in Order 90-05 (described below), which maintains a minimum release of 3,250 cfs at Keswick Dam and Red Bluff Diversion Dam (RBDD) from September through the end of February in all water years, except critically dry years.

The 1960 MOA provides that releases from Keswick Dam (from September 1 through December 31) are made with minimum water level fluctuation or change to protect salmon to the extent compatible with other operations requirements. Releases from Shasta and Keswick Dams are gradually reduced in September and early October during the transition from meeting Delta export and water quality demands to operating the system for flood control and fishery concerns from October through December.

2. SWRCB Water Rights Order 90-05 and Water Rights Order 91-01

In 1990 and 1991, the SWRCB issued Water Rights Orders 90-05 and 91-01 modifying Reclamation's water rights for the Sacramento River. The orders stated Reclamation shall operate Keswick and Shasta Dams and the Spring Creek Powerplant to meet a daily average water temperature of 56°F as far downstream in the Sacramento River as practicable during periods when higher temperature would be harmful to fisheries. The optimal control point is the RBDD.

Under the orders, the water temperature compliance point may be modified when the objective cannot be met at RBDD. In addition, Order 90-05 modified the minimum flow requirements initially established in the 1960 MOA for the Sacramento River below Keswick Dam. The water right orders also recommended the construction of a Shasta Temperature Control Device (TCD) to improve the management of the limited cold water resources.

Pursuant to SWRCB Orders 90-05 and 91-01, Reclamation configured and implemented the Sacramento-Trinity Water Quality Monitoring Network to monitor temperature and other parameters at key locations in the Sacramento and Trinity Rivers. The SWRCB orders also required Reclamation to establish the Sacramento River Temperature Task Group (SRTTG) to formulate, monitor, and coordinate temperature control plans for the upper Sacramento and Trinity Rivers. This group consists of representatives from Reclamation, SWRCB, NMFS, the Service, DFG, Western, DWR, and the Hoopa Valley Indian Tribe.

Each year, with finite cold water resources and competing demands usually an issue, the SRTTG devises operation plans with the flexibility to provide the best protection consistent with the CVP's temperature control capabilities and considering the annual needs and seasonal spawning distribution monitoring information for winter-run and fall-run Chinook salmon. In every year since the SWRCB issued the orders, those plans have included modifying the RBDD compliance point to make best use of the cold water resources based on the location of spawning Chinook salmon. Reports are submitted periodically to the SWRCB over the temperature control season defining the temperature operation plans. The SWRCB has overall authority to determine if the plan is sufficient to meet water right permit requirements.

3. June 4, 2009 NMFS Biological Opinion

The National Marine Fisheries Service's (NMFS) June 4, 2009, Biological Opinion and Conference Opinion on the Long-Term Operations of the Central Valley Project and State Water Project (NMFS BiOp) contains numerous terms and conditions addressing instream flows on the Upper Sacramento River.

Table 1 below, as excerpted from the NMFS BiOp (at page 254), identifies the aforementioned MOA and SWRCB order requirements, and Reclamation's proposed flow objectives below Keswick that were analyzed in the NMFS BiOp.

Table 1: Minimum flow requirements and objectives (cfs) on the Sacramento River below Keswick Dam

Water year type	MOA	WR 90-5	MOA and WR 90-5	Proposed Flow Objectives below Keswick
Period	Normal	Normal	Critically dry	All
January 1 - February 28(29)	2600	3250	2000	3250
March 1 - March 31	2300	2300	2300	3250
April 1 - April 30	2300	2300	2300	---*
May 1 - August 31	2300	2300	2300	---*
September 1 - September 30	3900	3250	2800	---*
October 1 - November 30	3900	3250	2800	3250
December 1 - December 31	2600	3250	2000	3250
Note: * No regulation.				

The flow related components of the NMFS BiOp related to the Sacramento River Basin are detailed in the Reasonable and Prudent Alternatives (RPA) section of BiOp at pages 587 through 611. The RPA Actions include flow requirements on Clear Creek; release requirements from Whiskeytown Dam for temperature management; cold water pool management of Shasta Reservoir; development of recommended minimum flows at Wilkins Slough; and restoration of floodplain habitat in the lower Sacramento River basin for protection of certain listed species. A selection of the more specific flow-related requirements are described below.

Clear Creek Operations

RPA Action I.1.1 - Clear Creek Spring Attraction Flows

Reclamation shall annually conduct at least two pulse flows in Clear Creek in May and June of at least 600 cfs for at least three days for each pulse, to attract adult spring-run holding in the Sacramento River main stem. This may be done in conjunction with channel-maintenance flows (Action I.1.2).

RPA Action I.1.2. – Clear Creek Channel Maintenance Flows

Reclamation shall re-operate Whiskeytown Glory Hole spills during the winter and spring to produce channel maintenance flows of a minimum of 3,250 cfs mean daily spill from Whiskeytown for one day, to occur seven times in a ten-year period, unless flood control operations provide similar releases. Re-operation of Whiskeytown Dam should be implemented with other project facilities as described in the EWP Pilot Program (Reclamation 2008d).

RPA Action I.1.5. – Clear Creek Thermal Stress Reduction

Reclamation shall manage Whiskeytown releases to meet a daily water temperature of:

(1) 60 deg. F at the Igo gage from June 1 through September 15; and

(2) 56 deg. F at the Igo gage from September 15 to October 31.

Reclamation, in coordination with NMFS, will assess improvements to modeling water temperatures in Clear Creek and identify a schedule for making improvements.

RPA Action I.1.6. - Adaptively Manage to Habitat Suitability/IFIM Study Results on Clear Creek

Reclamation shall operate Whiskeytown Reservoir as described in the Project Description with the modifications described in Action I.1 until September 30, 2012, or until 6 months after current Clear Creek salmonids habitat suitability (*e.g.*, IFIM) studies are completed, whichever occurs later.

When the salmonid habitat suitability studies are completed, Reclamation will, in conjunction with the Clear Creek Technical Working Group (CCTWG), assess whether Clear Creek flows

shall be further adapted to reduce adverse impacts on spring-run and CV steelhead, and report their findings and proposed operational flows to NMFS within 6 months of completion of the studies. NMFS will review this report and determine whether the proposed operational flows are sufficient to avoid jeopardizing spring-run and CV steelhead or adversely modifying their critical habitat.

Reclamation shall implement the flows on receipt of NMFS' written concurrence. If NMFS does not concur, NMFS will provide notice of the insufficiencies and alternative flow recommendations. Within 30 days of receipt of non-concurrence by NMFS, Reclamation shall convene the CCTWG to address NMFS' concerns. Reclamation shall implement flows deemed sufficient by NMFS in the next calendar year.

Shasta Operations

RPA Action Suite I.2 – Shasta Operations

This suite of actions is designed to ensure that Reclamation uses maximum discretion to reduce adverse impacts of the projects to winter-run and spring-run in the Sacramento River by maintaining sufficient carryover storage and optimizing use of the cold water pool.

RPA Action I.2.1 – Performance Measures

The following long-term performance measures shall be attained. Reclamation shall track performance and report to NMFS at least every 5 years. If there is significant deviation from these performance measures over a 10-year period, measured as a running average, which is not explained by hydrological cycle factors (*e.g.*, extended drought), then Reclamation shall reinitiate consultation with NMFS.

Performance measures for end-of-season ("EOS") carryover storage at Shasta Reservoir:

- 87 percent of years: Minimum EOS storage of 2.2 MAF
- 82 percent of years: Minimum EOS storage of 2.2 MAF and end-of-April storage of 3.8 MAF in following year (to maintain potential to meet Balls Ferry compliance point)
- 40 percent of years: Minimum EOS storage 3.2 MAF (to maintain potential to meet Jelly's Ferry compliance point in following year)

Measured as a 10-year running average, performance measures for temperature compliance points during summer season shall be:

- Meet Clear Creek Compliance point 95 percent of time
- Meet Balls Ferry Compliance point 85 percent of time
- Meet Jelly's Ferry Compliance point 40 percent of time
- Meet Bend Bridge Compliance point 15 percent of time

RPA Actions I.2.2 through I.2.4 – Keswick Release Schedules

Depending on EOS carryover storage and hydrology, Reclamation is mandated to develop and implement Keswick release schedules, and reduce deliveries and exports, as detailed in RPA Actions I.2.2.A through I.2.2C, I.2.3.A through I.2.3.C, and I.2.4. (See NMFS BiOp at pp. 593-603.)

Required Technical Teams for Adaptive Management

The NMFS BiOp requires actions by various Fisheries and Operations Technical Teams whose function is to make recommendations for adjusting operations to meet contractual obligations for water delivery and minimize adverse effects on listed anadromous fish species. The two teams on the Upper Sacramento River are the SRTTG and the CCTWG. Each group must gather and analyze information, and make recommendations, regarding adjustments to water operations within the range of flexibility prescribed in the implementation procedures for a specific action in their particular geographic area.

4. Wilkins Slough Navigation Flow Requirements Under Federal Law

The NMFS BiOp requires the development of certain recommendations regarding the Wilkins Slough navigation flow requirements. Reclamation's compliance with the Wilkins Slough 5,000 cfs navigation flow standard, however, is not discretionary.

In this regard, Congress initially authorized the construction of certain facilities for the Central Valley Project ("CVP") under the Rivers and Harbors Act of 1935 (the "1935 Act"). (49 Stat. 1028, 1038). The 1935 Act mandated in relevant part that "the following works of improvement of rivers . . . are hereby adopted and authorized . . . in accordance with the plans recommended in the respective reports hereinafter designated and subject to the conditions set forth in such documents . . . Sacramento River, California; Rivers and Harbors Committee Document Numbered 35, Seventy-third Congress . . . ." (50 Stat. 1028, 1038.) As such, the 1935 Act incorporates by reference, and expressly requires the implementation of, the recommendations of the Rivers and Harbors Committee Document Number 35. This document is a 1934 report from the Corps' Chief Engineer recommending to Congress that Kennett Dam (predecessor to Shasta Dam) "shall be operated so as to provide a minimum flow of 5,000 cubic feet per second between Chico Landing and Sacramento." (*See* Central Valley Project Documents, Part I, 544, 548 [Committee Doc. 35, 73rd Cong.].)

Congress re-authorized the CVP under the Rivers and Harbors Act of 1937 (the "1937 Act"). (50 Stat. 844, 850.)[1] This re-authorization mandated in relevant part that "the $12,000,000 recommended for expenditure for a part of the Central Valley project, California, in accordance with the plans set forth in Rivers and Harbors Committee Document Numbered 35, Seventy-third Congress, and adopted and authorized by the provisions of section 1 of the Act of August 30, 1935 (49 Stat. 1028, at 1038) . . . shall, when appropriated, be available for expenditure in accordance with the said plans of the Secretary of Interior instead of the Secretary of War."

[1] *See also Stockton East Water District, et al. v. United States*, 583 F.3d 1344, 1349 (Fed. Cir. 2009) [citing to the 1935 and 1937 Acts as Congress' initial authorization and reauthorization of the CVP].

(50 Stat. 844, 850.) As such, the 1937 Act also incorporates by reference, and expressly requires the implementation of, the recommended minimum flow of 5,000 cfs between Chico Landing and Sacramento. There has been no subsequent action by Congress that has "discontinued" or otherwise changed this minimum navigation flow requirement.

The 1937 Act also mandates that CVP "dams and reservoirs *shall* be used, *first*, for river regulation, improvement of navigation, and flood control; second, for irrigation and domestic uses; and, third, for power." (50 Stat. 844, 850, emphasis added; *see also United States v. SWRCB* (1986) 182 Cal.App.3d 82, 135.) In 1992, Congress explicitly amended this hierarchy of use by enacting sections 3406(a) and (b) of the Central Valley Project Improvement Act (Pub. L. No. 102-575 (1992)), which make protection of non-ESA listed fish and wildlife co-equal priorities with irrigation. Even with this amendment, however, Reclamation's first priority remains river regulation, navigation and flood control.

On the Sacramento River, all major diversions have positive barrier flat-plate fish screens installed that provide protection to listed fishery species. These screens have been designed with an approach velocity of 0.33 ft/s as required by NMFS and the Department of Fish and Game. During design, the screens, velocities, and diversion rates were based upon the Wilkins Slough Navigational Flow requirement of 5,000 cfs since this requirement under federal law was controlling.

The NMFS BiOp states that flows could be reduced to 3,250 cfs, which is lower than the Wilkins Slough flow requirement. If the Bureau of Reclamation reduced flows below the Wilkins Slough control point requirement and depending on the diversion rate, some screens may not meet the velocity criteria as designed. The agencies should coordinate with the Sacramento River diverters to develop contingency plans and wells as a coordinated operations plan that would benefit the Sacramento River system for fisheries and water users.

Sacramento River Tributaries

1. Antelope Creek

2014 Voluntary Agreement with Water Users, National Marine Fisheries Service (NMFS) and California Department of Fish and Wildlife (CDFW)

Spring pulse flows: To meet the needs of out-migrating juvenile spring-run Chinook salmon and for the upstream migration of spring-run Chinook salmon for 2014, a pulse flow was conducted using water volunteered by Los Molinos Mutual Water Company and Mr. Jim Edwards, equal to full natural flow in Antelope Creek. The pulse flow was conducted on May 14-16, 2014 for a 48 hour period.

Fall base flows: Once there is a freshet that doubles the full natural flow (measured at a gage above Edward's Dam) after October 15, but prior to November 1, then a base flow of 35 cfs, or full natural flows (measured at Cone Grove Park), whichever is less, will be maintained through December 31, 2014. If there is not a freshet that doubles the full natural flow, then a base flow

of 35 cfs or the full natural flow, whichever is less, will be maintained from November 1 through December 31, 2014.

These were voluntary agreements covering substantially all of the water diverted on Antelope Creek, thus the State Water Resources Control Board emergency regulations did not go into effect.

2. Battle Creek

1998, 2003 and 2006 Agreements with PG&E and the Bureau of Reclamation

For winter-run and spring-run Chinook salmon, the instream flow objective for the North Fork of Battle Creek is 30 cubic feet per second (± 5 cfs). The South Fork of Battle Creek instream flow objective would vary from the Federal Energy Regulatory Commission license condition minimum flow of 5 cfs, to 30 cfs (± 5 cfs). All flows reaching Wildcat Diversion Dam will be released, and no diversion will occur at the main spring collectors at Eagle Canyon. PG&E will block the downstream entrances to fish ladders at the Eagle Canyon and Coleman Diversion Dams unless California Department of Fish and Game, NOAA Fisheries, and US Fish and Wildlife jointly provide PG&E 48 hours advance written notice to open either or both of such downstream entrances.

3. Butte Creek

M&T Ranch and Llano Seco Ranch

In 1997, M&T Ranch and Llano Seco Ranch agreed to dedicate approximately 40 cfs in instream flows from October through June in Butte Creek from Parrott-Phelan diversion to confluence with Sacramento River, for spring-run Chinook and steelhead migration and rearing.

Resource Renewal Institute Court Order

In 1998, the Butte County Superior Court issued an order to change the authorized place of use and point of diversion of 5 cfs of pre-1914 appropriative water rights the Resource Renewal Institute had acquired on Butte Creek, which included the following provisions:

a. The authorized purpose of use in these water rights is now protection of fish and wildlife dependent on instream flows in the portions of Butte Creek that is specified as the place of use;
b. The authorized place of use in these water rights now is Butte Creek between diversion number 54 and the confluence of Butte Creek and Butte Slough (Butte Slough outfall); and,
c. The present authorized point of diversion of these water rights has been eliminated.

4. Deer Creek

2014 Voluntary Agreement with Deer Creek Irrigation District, Grant Leininger, National Marine Fisheries Service (NMFS) and California Department of Fish and Wildlife (CDFW)

For adult spring-run Chinook and juvenile spring-run chinook: From May 30 until June 14, 2014, 50 cubic feet per second (cfs), as measured at the Department of Water Resources (DWR) Gage below Stanford-Vina Ranch Irrigation Company (SVRIC) Diversion Dam, as long as 100 cfs is coming out of the canyon. There will be a proportional reduction in base flow obligation of 1 cfs for each 1 cfs reduction in natural flow below 100 cfs.

June 15 to June 30: 25 cfs, as measured at the DWR Gage below SVRIC Diversion Dam, with Deer Creek Irrigation District (DCID) providing 8.3 cfs during the 25 cfs period.

October 15 to December 31: 50 cfs, as measured at the DWR Gage below the SVIC Diversion Dam, is required for out-migrating yearling juvenile spring-run Chinook and coincidentally Central Valley juvenile and adult steelhead (*Oncorhynchus mykiss*), which are federally listed as Threatened. In the event of a rain freshet, base flows could start on October 1, 2014 if mutually agreed to by NMFS, CDFW and DCID.
Pulse Flows: A minimum of 50 cfs over base flow or full natural flows as recorded at the U.S. Geological Survey (USGS) Stream Gage at the mouth of the canyon above DCID Dam. The duration of the pulse flow in terms of time at which peak flow is maintained will be a minimum of 24 hours but not more than 72 hours. A pulse flow event occurred on May 18-20, 2014 and DCID shall create one more pulse flow event before June 15, 2014. Another pulse flow event may be necessary in June 2014 if monitoring detects fish holding below the SVRIC Diversion Dam.

5. Hat Creek

2002 Federal Energy Regulatory Commission License for the Hat Creek Project

On November 4, 2002, the Federal Energy Regulatory Commission (FERC) issued a new license for the Hat Creek Project. As stipulated in the new license, minimum instream flows in the Hat 1 Bypass Reach were increased from 2 cfs to 8 cfs. In addition, the flow release at the Baum Lake Dam (a minimum of 8 cfs) and accretion flow from the Hat 2 Springs must provide a minimum flow in the lower portion of the Hat 2 Bypass Reach of 43 cfs (measured at the Joerger Diversion Dam).

6. Mill Creek

2014 Voluntary Agreement with Water Users, National Marine Fisheries Service (NMFS) and California Department of Fish and Wildlife (CDFW)

For adult spring-run Chinook and juvenile spring-run Chinook: 50 cubic feet per second (cfs) between April 1 and June 14, 2014, and 25 cfs between June 15 and 30, 2014 for fish passage

through the 2.8 miles of stream between the confluence with the Sacramento River and Ward Dam.

If monitoring and evaluations conducted by CDFW determine that fish are not present in lower Mill Creek or water temperatures are not conducive to fish survival during the period of June 15 to 30, 201, and it is mutually agreed to by CDFW and Los Molinos Mutual Water Company (LMMWC), base flows may be reduced below 25 cfs.

For juvenile spring-run Chinook: For the fall period, 50 cfs is required for out-migrating yearling juvenile spring-run Chinook and coincidentally Central Valley juvenile and adult steelhead (*Oncorhynchus mykiss*), which are federally listed as Threatened. In the event of a rain freshet, base flows could start on October 1, 2014 if mutually agreed to by NMFS, CDFW and LMMWC.

Pulse Flows: A minimum of 50 cfs over base flow or full natural flows as recorded at the U.S. Geological Survey (USGS) Stream Gage at the mouth of the canyon above Upper Dam. The duration of the pulse flow in terms of time at which peak flow is maintained will be a minimum of 24 hours but not more than 72 hours. The pulse flows will occur from April 1 through June 30 at a minimum of once every two weeks. If monitoring and evaluations conducted by CDFW determine that fish are not present in lower Mill Creek or water temperatures are not conducive to fish survival during June, and it is mutually agreed to by NMFS, CDFW and LMMWC, pulse flows may cease prior to June 30, 2014.

These were voluntary agreements covering substantially all of the water diverted on Mill Creek, thus the State Water Resources Control Board emergency regulations did not go into effect.

1990, 1996 and 2007 Flow Agreements with Water Users, Department of Water Resources and Department of Fish and Game

The 1990 Agreement: The Department of Water Resources and Fish and Game paid for the construction, operation and maintenance of wells with a capacity of 25 cubic feet per second (the actual well capacity is closer to 10 cfs) for the purpose of increasing flows in Mill Creek for fisheries transportation in the late spring of some years, during the upstream migration of adult spring-run salmon and downstream migration of juvenile salmon and steelhead.

The 1996 Agreement: Los Molinos Mutual Water Company shall provide a minimum of 10 cubic feet per second in addition to the state's instantaneous capacity (of 10 cfs) for fall-run Chinook immigration and spawning and spring-run Chinook juvenile migration. Los Molinos Mutual Water Company shall release such water upon Fish and Game's request on or after October 15 and allow such water to continue to flow uninterrupted for the remainder of the calendar year.

The 2007 Agreement: Reaffirms and expands and refines the intent of the earlier agreements to provide spring flows (May 1 through June 15) and fall flows (October 15 through November 30) for spring and fall run Chinook salmon.

Lower American River

The American River provides important fish and wildlife habitat, a high-quality water source, a critical floodway, and a spectacular regional recreational parkway. The Bureau of Reclamation (Reclamation) operates Folsom and Nimbus Dams to provide flood control and water for irrigation, municipal and industrial uses, hydroelectric power, recreation, water quality, and the protection of aquatic resources.

In April of 2000, a diverse group of over 40 local business and agricultural leaders, citizen groups, environmentalists, water managers and local governments ended decades of conflict concerning the American River by signing the Water Forum Agreement (WFA). The foundational elements of the WFA are two coequal objectives: to provide a reliable safe water supply for the region and to preserve fishery, wildlife, recreational, and aesthetic values of the lower American River.

Working in cooperation with Reclamation, California Department of Fish and Game, National Marine Fisheries Service, the U.S. Fish and Wildlife Service, the Water Forum developed the Flow Management Standard (FMS) as an alternative to the standards set by the State Water Resources Control Board in 1958's Decision 893 (the current instream flow requirements on the lower American River). The FMS is intended to improve the condition of aquatic resources in the lower American River, particularly fall-run Chinook salmon and steelhead by improving flow-related habitat and water temperature. In addition, the FMS benefits other fish species, the aquatic environment and the riparian ecosystem of the lower American River Corridor. Designed to achieve these benefits over a wide range of hydrologic conditions, the FMS provides a forum through which biologic and ecologic factors are considered in the river management process, and provides for the analysis of hydrologic and biologic information collected though the monitoring and evaluation component.

The lower American River FMS is designed to allocate flow releases from Folsom and Nimbus Dams in consideration of variable hydrology and cold water pool availability in Folsom Reservoir. The FMS includes: (1) minimum flow requirements; (2) water temperature objectives; (3) implementation criteria; (4) an agency group to address river management and operational actions (the American River Group); and (5) a monitoring and evaluation component.

1. Minimum Flow Requirements

The minimum flow requirements prescribe the flows in the lower American River water to meet fishery needs throughout the entire water year. These minimum flow requirements include minimum release requirements (MRR) measured downstream of Nimbus Dam, and downstream flow requirements (250 cfs from January through mid-September and 500 cfs from mid-September through December) between Nimbus Dam and the mouth of the lower American River. The prescribed flows are minimums only and do not preclude Reclamation from making higher releases.

The MRR varies from 800 to 2,000 cfs throughout the year in response to the hydrology of the Sacramento and American River basins and a set of prescriptive and discretionary adjustments. As such, the specified MRR is higher in wet years and lower in dry years. These adjustments are made in response to specific conditions related to the need for spawning flow progressions, fish protection, and reservoir water conservation. The resultant MRR varies throughout the season as shown in Table 1.

Table 1. Seasonal Variation in the Minimum Release Requirement

Time Period	MRR Range (cfs)	Index	Relevance of Index
October	800 to 1,500	Four Reservoir Index (FRI)	Indicates the amount of upstream storage available during the fall and winter months
November and December	800 to 2,000	FRI	
January and February	800 to 1,750	Sacramento River Index (SRI)	Indicates current multi-basin water availability
March through Labor Day	800 to 1,750	Folsom Inflow Index (IFII)	Forecasts water availability for the American River Basin for the remainder of the current water year
Post-Labor Day through September	800 to 1,500	IFII	

The FMS also includes exceptions to the MRR during extreme dry conditions, including:

- **Conference Years:** Occur when the projected March through November unimpaired inflow to Folsom Reservoir is less than 400,000 AF. A minimum flow of 190 cfs is required downstream of the H Street Bridge.
- **Off-ramp Criteria:** Triggered if Folsom Reservoir storage is forecasted to fall below 200,000 AF in the succeeding 12 months. In this case, downstream flow requirements rather than MRR become the minimum flow requirement throughout the lower American River.

2. Water Temperature Objectives

The water temperature objectives of the FMS have been developed to allocate the available lower American River cold water resources for juvenile steelhead rearing in summer, and fall-run Chinook salmon spawning in fall. These objectives are met through use of an Annual Operations Forecast (Operations Forecast) and Annual Water Temperature Management Plan (Temperature Plan).

The Operations Forecast will be prepared by May 1 of each year to describe forecasted American River operations, including flows and water temperatures for the next 12 months, with implementation of the Minimum Flow Requirements and Water Temperature Objectives.

The Temperature Plan will be developed by May 1 of each year to describe how Reclamation will meet the following water temperature objectives for the lower American River:

- 65ºF or less from May 15 through October at Watt Avenue for steelhead juvenile rearing. This objective may be relaxed to 68ºF if Temperature Plan analysis indicates that lower temperature targets will prematurely exhaust the available cold water.
- 60ºF or less as early in October as possible at Hazel Avenue for Chinook salmon spawning and egg incubation.

3. Implementation Criteria

Implementation criteria serve as a tool to determine the conditions by which the FMS Minimum Flow Requirements may be implemented, and to define the method of measuring compliance with the FMS Minimum Flow Requirements. The implementation criteria that are applied for decision-making purposes regarding operational adjustments affecting lower American River flows and water temperatures address the following: (1) end-of-month Folsom Reservoir storage, particularly during May and September; (2) Nimbus Dam releases and flows at the mouth of the lower American River measured over a 5-day averaging period; (3) water conservation adjustments; (4) fish protection adjustments; and (5) other considerations.

4. Lower American River Group

The Lower American River Group (ARG) is an advisory group consisting of agency representatives convened regularly by Reclamation. Through the regularly scheduled ARG meetings, which are open to the public, the ARG provides information to the public and formulates CVP operational recommendations for the protection of fisheries and other in-stream resources consistent with the FMS.

5. Monitoring and Evaluation

Monitoring and evaluation of physical and biological factors are included in the FMS to provide information to support operational decisions and to evaluate operational effects on the aquatic resources of the lower American River including river hydrology, water temperature, salmonid population and downstream movement.

6. Current Status

Sacramento County recently adopted a revised American River Parkway Plan which includes specific policies related to implementing water flows protective of the lower American River ecosystem. The Parkway Plan serves as a guide for other local, state and federal agencies with authority within the American River Parkway under the Wild and Scenic Rivers Act and the Urban American River Parkway Preservation Act. Sacramento County, through the Water Forum, is in the process of preparing a draft environmental impact report to institute the FMS consistent with the American River Parkway Plan and the coequal goals of the Water Forum Agreement by entering into an operations agreement with Reclamation or by seeking to modify Reclamation's Folsom Dam water right permits or other measures.

Reclamation has been operating the Folsom and Nimbus Dams in accordance with the minimum release requirements of the FMS since 2006. In 2009, the National Marine Fisheries Service

(NMFS) included the FMS flow, operational criteria, American River Group, and monitoring requirements in the Reasonable and Prudent Alternatives of the Biological Opinion (BO) for operating the CVP. The NMFS BO also called for an iterative temperature management planning process that is consistent with the water temperature objectives of the FMS.

The Water Forum is currently investigating the potential for an improved Flow Standard for the lower American River that would provide increased protection of salmonid species and improved water supply reliability.

Yuba River

In 2008, the State Water Resources Control Board (the SWRCB) adopted minimum streamflow requirements and related measures proposed by Yuba County Water Agency (YCWA) that implemented the Yuba River Accord Fisheries Agreement, which YCWA developed with the Department of Fish and Game (DFG), the National Marine Fisheries Service (NMFS), the U.S. Fish and Wildlife Service (USFWS) and several conservation groups. The Accord and the SWRCB's related order – Corrected Order WR 2008-14 – resolved 20 years of disputes concerning the Yuba River's minimum streamflows. The Accord streamflow requirements, as implemented by the SWRCB, are depicted in Exhibit A. The SWRCB adopted Corrected Order WR 2008-14, after considering a $6 million environmental impact report that YCWA certified and that was not challenged in court. The Yuba River Accord is summarized below and additional information is available on YCWA's website at http://www.ycwa.com/projects/detail/8.

Disputes concerning the Yuba River's streamflows began in 1988 and continued through a 14-day SWRCB hearing in 1992, a 13-day SWRCB hearing in 2000 and a three-day SWRCB hearing in 2003. In 2003, the SWRCB adopted Revised Water Right Decision 1644 (RD-1644). Many lawsuits, including one by YCWA, were filed to challenge RD-1644.

As an alternative to litigating these disputes to a conclusion, YCWA, DFG, NMFS, USFWS and environmental groups engaged in a collaborative, science-based process to identify and prioritize the key stressors on salmon and steelhead in the lower Yuba River and then to develop streamflow requirements that would address these stressors. The resulting Yuba Accord Fisheries Agreement sets new, substantially-higher streamflow requirements that allocate more water to fishery benefits than RD-1644 would have required. Specifically, the Fisheries Agreement's streamflow schedules include up to more than 174,000 acre-feet of water annually, and more than 100,000 acre-feet in the springtime of about 60% of all years, to fishery benefits than RD-1644 would have required. The Fisheries Agreement allocates these fishery streamflows in a manner that enables YCWA to deliver approximately 350,000 acre-feet of water per year for consumptive use in Yuba County and to transfer water to downstream water users, including Delta-export agencies, for irrigation, municipal and environmental uses.

The Fisheries Agreement is one of four agreements that make up the Yuba River Accord. The other agreements are: (1) Conjunctive Use Agreements with local Yuba County water suppliers; (2) a Water Transfer Agreement with the state Department of Water Resources (DWR); and (3) an agreement with PG&E to allow modified operations at YCWA's New Bullards Bar Reservoir.

Under the Conjunctive Use Agreements, Yuba County water suppliers agreed to pump up to 30,000 acre-feet of groundwater to substitute for surface water deliveries in certain dry years to provide water allocated by the Fisheries Agreement for fishery benefits. Also under the Conjunctive Use Agreements, YCWA agreed to provide funding from its Accord transfer proceeds to assist water suppliers in pumping the necessary groundwater and to monitor local groundwater conditions to ensure that pumping under the Accord does not cause overdrafts. Under the Water Transfer Agreement, YCWA agreed to transfer at least 60,000 acre-feet per year of water to the Environmental Water Account (and successor programs) and potentially 140,000 acre-feet of water in drier years to DWR. In addition to assisting local Yuba County water suppliers in implementing conjunctive use, YCWA has used Accord transfer proceeds to contribute to the funding of setback-levee projects and other flood risk management projects.

The Accord Fisheries Agreement contains several unique elements besides the new streamflow requirements depicted in Exhibit A. The Agreement establishes a River Management Team (RMT), which includes representatives of YCWA, DFG, NMFS, USFWS, PG&E and conservation groups. The RMT may modify flows at certain times for fishery benefits (subject to SWRCB approval). The RMT also is responsible for allocating 50% of the volume of any supplemental surface water transfer by YCWA and up to 20% of the streamflows enabled by implementation of the Accord Conjunctive Use Agreements. The RMT oversees a monitoring and evaluation program that has the goal of determining the efficacy of the Fisheries Agreement's streamflows. That Agreement also establishes a cap on irrigation diversions in extremely dry (1-in-100) "conference years" at about 70% of annual irrigation demands.

Consistent with the Accord agreements, the SWRCB's Corrected Order WR 2008-14 approved water-right permit terms under which, in conference years, YCWA will operate its project to maintain the minimum streamflows required by a 1965 streamflow agreement between YCWA and DFG, but without certain reductions authorized by that agreement and subject to supplemental flow release requirements developed by the RMT's Planning Group under the Fisheries Agreement and approved by the SWRCB's Deputy Director for Water Rights. Under Corrected Order WR 2008-14, if the Planning Group does not make any streamflow recommendations in a conference year by April 1 or if no streamflow requirements are in place by April 11 of such a year, then YCWA must comply with streamflow requirements ordered by the SWRCB after a hearing.

When YCWA operates its facilities, it must comply with the requirements of its existing license for Project No. 2246, which was issued by the Federal Energy Regulatory Commission (FERC). Those FERC license requirements, however, typically are satisfied through implementation of the Accord Fisheries Agreement's streamflow requirements.

The Yuba River Accord has been recognized as a landmark achievement in collaborative water management to achieve water supply reliability and habitat protection. For example, the Accord received the 2008 ACWA Theodore Roosevelt Environmental Award for Excellence in Conservation and Natural Resources Management, the 2009 National Hydropower Association Award for Outstanding Stewards of America's Waters and the 2009 Governor's Environmental and Economic Leadership Award.

EXHIBIT A
Yuba Accord Streamflows, Approved by SWRCB in Corrected Order WR 2008-14

MARYSVILLE GAGE (CFS)																	
Schedule	OCT		NOV	DEC	JAN	FEB	MAR	APR		MAY		JUN		JUL	AUG	SEP	Total Annual
	1-15	16-31	1-30	1-31	1-31	1-29	1-31	1-15	16-30	1-15	16-31	1-15	16-30	1-31	1-31	1-30	Volume (AF)
1	500	500	500	500	500	500	700	1000	1000	2000	2000	1500	1500	700	600	500	574,200
2	500	500	500	500	500	500	700	700	800	1000	1000	800	500	500	500	500	429,066
3	500	500	500	500	500	500	500	700	700	900	900	500	500	500	500	500	398,722
4	400	400	500	500	500	500	500	600	900	900	600	400	400	400	400	400	361,944
5	400	400	500	500	500	500	500	500	600	600	400	400	400	400	400	400	334,818
6	350	350	350	350	350	350	350	350	500	500	400	300	150	150	150	350	232,155

* Indicated flows represent average volumes for the specified time period. Actual flows may vary from the indicated flows according to established criteria.
* Indicated Schedule 6 flows do not include an additional 30 TAF available from groundwater substitution to be allocated according to established criteria

SMARTVILLE GAGE (CFS)																	
Schedule	OCT		NOV	DEC	JAN	FEB	MAR	APR		MAY		JUN		JUL	AUG	SEP	Total Annual
	1-15	16-31	1-30	1-31	1-31	1-29	1-31	1-15	16-30	1-15	16-31	1-15	16-30	1-31	1-31	1-30	Volume (AF)
A	700	700	700	700	700	700	700	700	-	-	-	-	-	-	-	700	-
B	600	600	600	550	550	550	550	600	-	-	-	-	-	-	-	500	-

* Schedule A used with Schedules 1, 2, 3 and 4 at Marysville.
* Schedule B used with Schedules 5 and 6 at Marysville.

Feather River

On December 15, 2010, the SWRCB adopted, as Order WQ 2010-0016, a water quality certification for the Oroville Facilities, FERC # 2100, for the relicensing of the Oroville project by DWR. The water quality certification contains instream-flow and temperature-control requirements for the Feather River's reaches downstream of DWR's Oroville Dam.

In general, the streamflow requirements adopted by the SWRCB in the certification are as follows.

For the Low Flow Channel – which is the reach between DWR's Fish Barrier Dam and the outlet of the Thermalito Afterbay – the certification requires that DWR release into that Channel 800 cfs from September 9 to March 31 of each water year to accommodate spawning anadromous fish and 700 cfs the remainder of the time, with both standards subject to possible revision as recommended by resource agencies under a settlement agreement signed by parties to DWR's relicensing proceeding. The SWRCB's Deputy Director for Water Rights would have to approve changes from the indicated streamflows for the Low Flow Channel.

For the High Flow Channel – which is the reach between the Thermalito Afterbay's outlet and the Feather River's confluence with the Sacramento River – the certification applies the following instream-flow requirements, provided that they, along with project operations, are not projected to cause Oroville

Reservoir to be drawn below elevation 733 feet (approximately 1,500,000 acre-feet of storage):

Preceding April through July unimpaired runoff	Minimum Flow in HFC October-February	Minimum Flow in HFC March	Minimum Flow in HFC April-September
Percent of Normal			
55% or greater	1,700 cfs	1,700 cfs	1,000 cfs
Less than 55%	1,200 cfs	1,000 cfs	1,000 cfs

Under the certification, if applying these requirements would be projected to cause Oroville Reservoir to be drawn below elevation 733 feet, then the minimum streamflows in the High Flow Channel could be reduced by the same percentage as State Water Project deliveries for agricultural use, provided that streamflows would not ever be reduced more than 25 percent below the requirements. In addition, if the highest one-hour streamflow between October 15 and November 30 were to exceed 2,500 cfs because of project operations and not a flood flow, then DWR is required to maintain a minimum flow within 500 cfs of the peak flow.

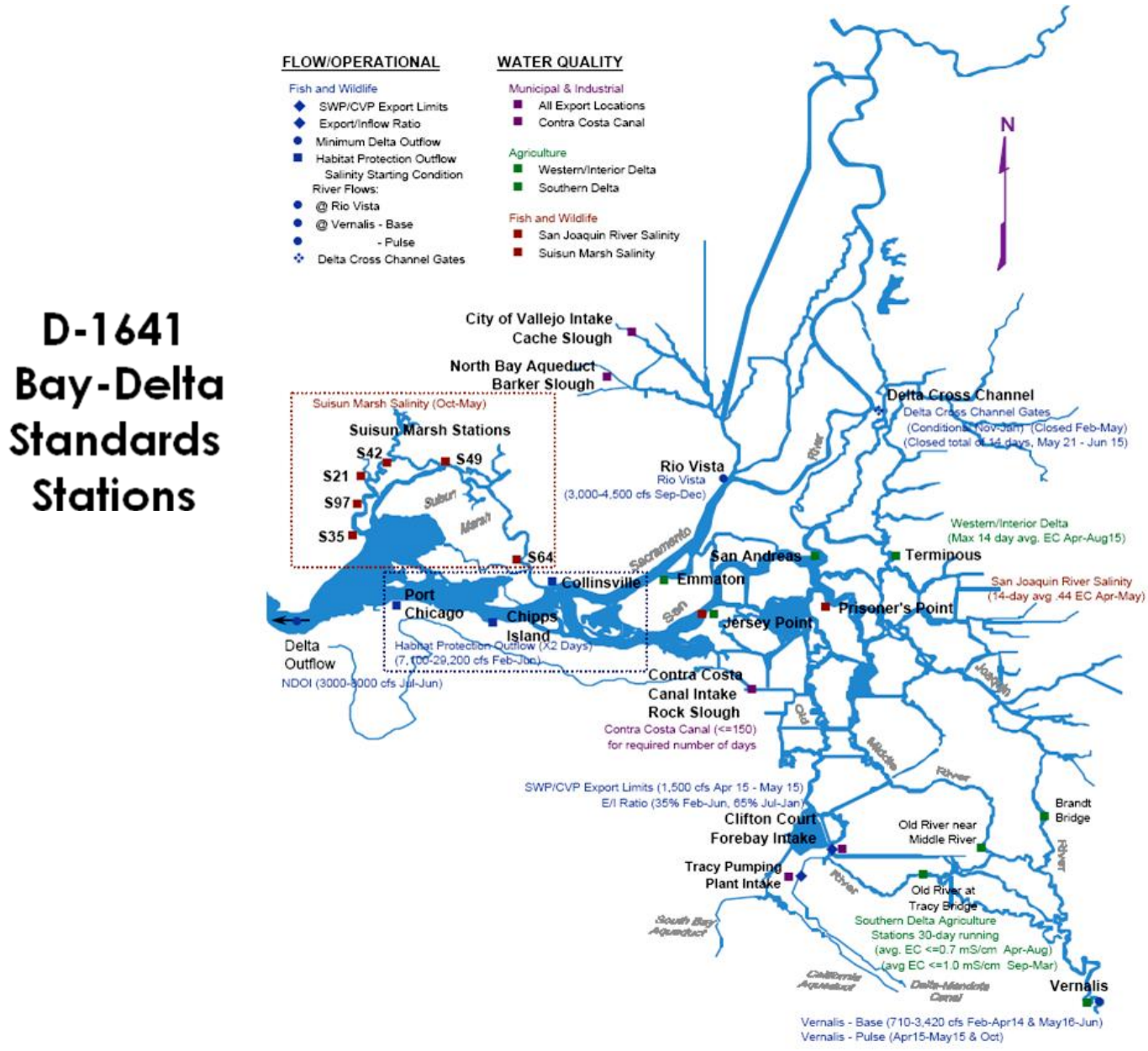
The certification also contains complex terms that require DWR to operate the Oroville project to meet temperature standards in the Low Flow Channel and the High Flow Channel.

For the Low Flow Channel at the Robinson Riffle, the certification sets the following temperature standards: (1) October 1-April 30, 56 degrees F; (2) May 1-15, 56-63 degrees F (as a transition); (3) May 16-August 31, 63 degrees F; (4) September 1-8, 63-58 degrees F (as a transition); and (5) September 9-30, 58 degrees F. If DWR were to demonstrate that it cannot meet these requirements with its current facilities, then the certification would require DWR to submit an interim operations plan to the SWRCB and, within three years of the renewed FERC license's issuance, submit a long-term facility-modification and operations plan to the SWRCB. If after implementing the facility modifications, DWR were to demonstrate that it still cannot meet the above temperature standards, then DWR would be required to propose alternate temperature standards that would provide "reasonable protection of the COLD beneficial use." Upon the approval of the SWRCB's Deputy Director for Water Rights, DWR would be required to operate to the alternate standards.

For the High Flow Channel, DWR is required to operate the project "to protect the COLD beneficial use in [that Channel], as measured in the Feather River at the downstream Project Boundary, to the extent reasonably achievable." Within one year of the renewed FERC license's issuance, DWR would be required to submit an operations plan for the period before facility modifications, which plan would be required to include proposed interim temperature standards and interim measures to reduce temperatures. Within three years of the renewed FERC license's issuance, DWR would be required to submit a long-term facility modification and operations plan, which plan would have to include proposed temperature standards to take effect within 10 years of the renewed license's issuance.

Bay-Delta Standards

The following map shows the existing Bay-Delta standards in SWRCB Decision 1641. Water supplies in the Sacramento Valley are operated to meet these standards.



Appendix B

Sacramento Valley Short-term Flow Arrangements 2000-2017

American River

1. Augmented base flows in the fall and early winter to improve habitat conditions for Chinook salmon and steelhead upstream migration, spawning, egg incubation, and rearing (2005)
2. Augmented low base flows to maintain 1,500-2,000 cfs from Late October to mid-April (2007)

Butte Creek

3. Long-term water right secured for in-stream flows in the west side Sutter Bypass (2004)

Clear Creek

4. Provided an experimental pulse flow in September to minimize hybridization of fall and spring-run Chinook salmon (2002)
5. From October 1, 2004, to June 3, 2005, water releases were maintained at 200 cfs to provide spawning and rearing habitat for Chinook salmon and steelhead. During the summer months, water releases of 90-200 cfs were provided to create cool water temperatures and habitat for threatened spring-run Chinook salmon and steelhead.(2004-2005)
6. Two spring pulse flows to attract spring-run Chinook to Clear Creek (2010)
7. Two spring pulse flows to help attract spring-run Chinook to Clear Creek (2011)
8. Two spring pulse flows to help attract spring-run Chinook to Clear Creek (2012)
9. Two spring pulse flows were provided to help attract spring-run Chinook to Clear Creek (2013)
10. Two spring pulse flows were provided to help attract spring-run Chinook to Clear Creek (2014)

Mill Creek

11. Spring flows (May 1 through June 15) and fall flows (October 15 through November 30) were provided for spring-run and fall-run Chinook Salmon (2007)

Sacramento River

12. Anderson-Cottonwood Irrigation District -- Diversion Dam operation to protect redds (ongoing) (2013)
13. Settlement Contractors – Reduce redd stranding through water project reoperations (ongoing) (2014)
14. Settlement Contractors – Time spring diversion on the Sacramento River to match releases from Shasta to help manage cold water pool (ongoing) (2014)
15. Settlement Contractors – Short-duration pulse flows for wild fish (timed with and without accretion events) (ongoing) (2014)
16. Short-duration pulse flows, linked with release of hatchery fish (ongoing) (2014)

Appendix C

BUTTE CREEK SALMON RECOVERY

A Lesson in Functional Flows

The Butte Creek Fish Passage Improvement projects are located along the middle reach of Butte Creek, a tributary of the Sacramento River in California's Central Valley. The various projects together comprise one of the nation's most significant fisheries restoration efforts, with 90 miles of Butte Creek restored for the benefit of spring-run salmon. These projects also divert water for the benefit of farms, birds and other species along the Pacific Flyway.

BUTTE CREEK FISH PASSAGE IMPROVEMENT PROJECTS:

Water management in the upper reach of Butte Creek provides well-timed functional flows for spawning and holding habitat.

Sutter Bypass

The passage improvements, combined with fish food production and safe rearing habitat for juvenile fish in the lower reach of the creek flowing through the wetlands created by the Sutter Bypass, have provided functional flows and an excellent environment for spring-run salmon and other species to thrive.

Partnerships

Cooperation among the agricultural, urban and environmental communities—with funding partnerships—were essential to the success of the projects. The key stakeholders and participants included:

- **Local water suppliers and farmers (see map), owner and funding partner;**
- **California Urban Water Agencies, funding partner;**
- **U.S. Department of Interior (USFWS and USBR), funding partner;**
- **California Department of Fish and Game**

July 21, 2017

Western Canal Water District

GORRILL RANCH
DURHAM, CA
Est. 1918

NCWA
Northern California Water Association

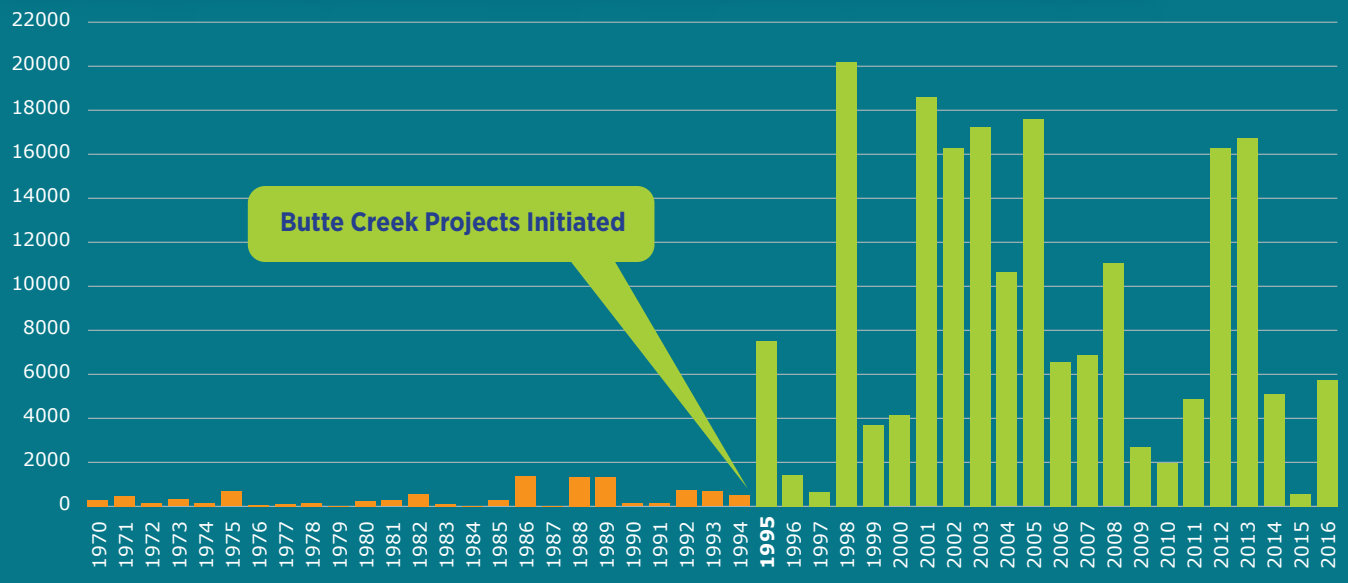
SUCCESS ON BUTTE CREEK

Butte Creek is one of only four Sacramento River tributaries with remaining populations of the endangered spring-run Chinook salmon. Resource agencies and conservation groups value Butte Creek as a keystone in preserving and recovering spring-run salmon, which in some years had dwindled to less than a 100 returning adults from 1970 to the early 1990s. Today, as a result of the Butte Creek Fish Passage Improvement projects, in tandem with a valuable food supply and safe rearing habitat in the Sutter Bypass wetlands, more than 10,000 spring-run salmon return on average to Butte Creek. These projects all provide multiple beneficial uses, serving water for fish, farms, birds and various other species.

Pictured above: Central Valley Spring-Run Chinook Salmon
Illustration by Paul Waters, courtesy of Cal Trout
(Oncorhynchus tshawytscha)

Secretary of Interior Bruce Babbitt tearing down McPherrin Dam in 1998.

BUTTE CREEK SPRING-RUN CHINOOK SALMON POPULATION ESTIMATES



Source: CDFW

Western Canal Water District

GORRILL RANCH
DURHAM, CA
Est. 1918

NCWA
Northern California Water Association

Sacramento Valley Salmon Recovery Program
Completed Projects
2000-2017

American River

1. City of Sacramento Fairbairn Water Treatment Plant fish screen project (2004)
2. Upper Sailor Bar Habitat Enhancement (Water Forum) (2007)
3. Sunrise Side Channel Habitat Enhancement (Water Forum) (2008)
4. Placed of 7,000 tons of spawning gravel at Sailor Bar (2008)
5. Upper Sailor Bar Downstream Habitat Enhancement (Water Forum) (2009)
6. American River Drain Naturalization Project (Water Forum) (2009)
7. Placed 16,000 tons of gravel downstream of Nimbus Dam (2010)
8. Upper Sunrise Habitat Enhancement (Water Forum) (2010)
9. Upper Sunrise Enhancement Phase II (Water Forum) (2011)
10. Cordova Creek Naturalization (Water Forum) (2011)
11. Placed 20,770 tons of gravel at upper Sunrise Park (2011)
12. Placed 5,000 cubic yards of gravel for spawning and side channel habitat (2012)
13. Placed 24,510 tons of gravel and created a 400-foot side channel at lower Sailor Bar -- Lower Sailor Bar Habitat Enhancement (Water Forum) (2012)
14. RM 0.5: Floodplain Connection Project (Water Forum) (2012)
15. Placed 6,000 cubic yards of gravel for additional spawning and side channel habitat (2013)
16. Placed 6,000 tons of gravel and improved a 400-yard long side channel at River Bend Park (2013)
17. Nimbus Basin Habitat Enhancement (Water Forum) (2014)
18. Sacramento Bar Habitat Enhancement (Water Forum) (2016)
19. Placed 10,000 tons of gravel and created 400 yards of side channel habitat in Nimbus Basin, directly below Nimbus Dam (2014)

Antelope Creek

20. Antelope Creek Crossing Repair Project at the Tehama Wildlife Area (2012)
21. Edwards Dam Fish Ladder Replacement (2007)

Battle Creek

22. Battle Creek Conservation Easements Acquisitions, Management, and Restoration Planning (2004)
23. Fish bypass pipe replaced at the Orwick Diversion site (2007)
24. Orwick fish screen improvement project (2008)
25. Wildcat Dam and appurtenant facilities removed (2010)
26. Fish screen and ladder at the Eagle Canyon and North Battle Creek Feeder sites (2011)
27. Battle Creek Wildcat Dam & Canal removal (2012)
28. Fish screen and bypass at Eagle Canyon Dam (2012)

Butte Creek

29. Butte Creek Riparian Protection and Restoration Project (2001)
30. Reclamation District No. 1004 Butte Creek Fish Screen Project (2002)
31. Butte Creek Acquisition and Riparian Restoration (2002)
32. Butte Creek Farms #3 Fish Screen Project (2002)
33. Rancho Caleta #3 Fish Screen Project (2002)
34. Fish ladder, flashboard flow control structure, and fish screen at Weir #5 (2003)
35. Butte Creek/Sanborn Slough Bifurcation Upgrade Project (2003)
36. Three weirs located on the west side of the Sutter Bypass, five water control structures in the Butte Sink and two adult fish barriers were constructed to enhance fish passage on Butte Creek (2004)
37. White Mallard Dam and fish ladder (2008)

Clear Creek

38. Removal of McCormick-Saeltzer Dam and diversion (2000)
39. Phase 2A-Filled in-stream mining pits, constructed and planted 14 acres of floodplain (2000)
40. Phase 2B-Filled in-stream mining pits, constructed and planted 22 acres of floodplain (2001)
41. Phase 3A-Restored 0.25 miles of stream channel, constructed and planted 10 acres of floodplain (2003)
42. Placed 12,000 tons of spawning gravel at four locations: Placer Bridge, City of Redding, Clear Creek Road Bridge and Reading Bar (2003)
43. Approximately 4,768 tons of spawning gravel was injected below Whiskeytown Dam (2004)
44. Approximately 2,000 tons of spawning gravel were injected below Whiskeytown Dam, and 1,000 tons were injected at the NEED Camp site (2005)
45. Phase 3B-Restored 0.8 miles of stream channel, constructed and planted 20 acres of floodplain (2006)
46. Placed 2,700 tons of spawning gravel on Clear Creek (2006)
47. Placed gravel below Dog Gulch (1,000 tons), above Peltier Valley Bridge (770 tons), Paige Bar (1,790 tons), above NEED Camp (980 tons), and below NEED Camp (1,230 tons) for a total of 5,770 tons (2009)
48. Temporary barrier weir to prevent fall-run Chinook salmon from hybridizing with spring-run Chinook salmon on Clear Creek (2009)
49. Placed 8,500 tons of spawning gravel (2010)
50. Understory re-vegetation for the Clear Creek Restoration Program (2010)
51. Placed 10,000 tons of gravel creating more than 21,000 square feet of spawning habitat (2011)
52. Placed 10,000 tons of gravel (2012)
53. Placed 8,000 tons of gravel at four sites (2014)
54. Placed 12,000 tons of spawning gravel (2016)

Cottonwood Creek

55. Anderson-Cottonwood Irrigation District -- Cottonwood Creek Siphon Replacement and Fish Passage Improvement Project (2010)
56. South Fork of Cottonwood Creek Fish Passage Project, Hammer Dam removal (2014)

Feather River

57. Cold Water Settlement between State of California and Feather River Settlement Contractors (2008)
58. Yuba City Fish Screen (2014)
59. Feather Water District Fish Screen (2014)
60. Placed 5,000 cubic yards of spawning gravel (2017)

Mill Creek

61. Stabilization of Potential Sediment Sources within the Deer, Mill, Antelope Creek Watersheds on Lassen National Forest Lands (Phase 1 of 2 Phases) (2001)
62. Anadromous Fish Passage at Clough Dam on Mill Creek (2003)
63. Lower Mill Creek Riparian Restoration (Phase II) (2004)
64. Mill and Deer Creeks Protection and Stewardship (2007)
65. Los Molinos Mutual Water Company Water Management System Modernization and Conservation Program (2011)
66. Voluntary Agreement with Water Users, National Marine Fisheries (NMFS) and California Department of Fish and Wildlife (CDFW) (2014)
67. Water Exchange Agreement with The Nature Conservancy for water right dedicated to fish passage flows (2015)
68. Fish Ladder and Screen improvements at Ward Dam (2015)
69. North and South side comprehensive Water Use Efficiency Study and Recommendations (2016-2017)

Sacramento River

70. Glenn-Colusa Irrigation District Fish Screen Project (2000)
71. Reclamation District 108 Wilkins Slough Fish Screen Project (2000)
72. Anderson-Cottonwood Irrigation District Fish Screen Project (2001)
73. Princeton-Codora-Glenn Irrigation District/Provident Irrigation District Fish Screen Project (2001)
74. Sacramento River Meander Restoration Project (2001)
75. Andreotti #1 & #2 Fish Screen Project (2002)
76. Davis Ranches #6 Fish Screen Project (2002)
77. Tom Ellis Fish Screen Project (2002)
78. Tom Gross Fish Screen Project (2002)
79. Joyce Wells Trust Fish Screen Project (2002)
80. Butte Creek Farms Fish Screen, Sacramento River Consolidation (2002)
81. Sacramento River Floodplain Acquisition and Riparian Forest Restoration (2002)
82. Placed 8,800 tons of salmon spawning-sized gravels on the right bank immediately below the confluence with Salt Creek (2003)
83. Floodplain Acquisition and Sub-reach/Site Specific Management Planning on the Sacramento River (Red Bluff to Colusa) (2003)
84. Tuttle Pump Relocation Project – Maxwell ID Fish Screen (2003)
85. Roberts Ditch Irrigation Company Fish Screen Project (2004)
86. Jerry Forster Fish screen Project (2004)
87. Tisdale Irrigation District Fish Screen Project (2004)
88. A&L Ag Rental and Leasing Fish Screen Project (2004)
89. Davis Ranches Site 1 Fish Screen Project (2004)
90. Ferraro-Locvich Fish Screen Project (2004)
91. City of Sacramento Water Treatment Plant intake replacement and fish screen project (2004)
92. A total of 8,500 tons of spawning gravel was placed; 4,250 tons at the Keswick Dam site; and 4,250 tons at the Salt Creek site (2004)

93. Placed a total of 8,500 tons of spawning gravel—4,250 tons at the Keswick Dam site and 4,250 tons at the Salt Creek site (2005)
94. Place 6,000 tons of spawning gravel at the Keswick Dam site on the Sacramento River (2006)
95. City of Redding Fish Screen Project (2006)
96. Reclamation District 999 Fish Screen Project (2006)
97. Hamilton City Flood Damage Reduction and Ecosystem Restoration (2006)
98. Placed 4,615 cubic yards of spawning gravel (2007)
99. H&L Partnership and Wallace Fish Screen Project (2007)
100. Sutter Mutual Water Company Tisdale Fish Screen Project (2007)
101. Larry Pires Farms Fish Screen Project (2007)
102. Place 8,300 tons of gravel at the Salt Creek site (2008)
103. Reclamation District 108 Poundstone Fish Screen Project (2008)
104. Floodplain restoration on the Sacramento River National Wildlife Refuge (NWR) phase II of the La Barranca unit (2008)
105. Placed 5,500 tons of gravel (2010)
106. Meridian Farms Water Company – Fish Screen Project, Phase I (2010)
107. Sutter Mutual Water Company State Ranch Bend Pumping Plant Fish Screen Project (2010)
108. River Garden Farms Missouri Bend Fish Screen Project (2010)
109. Placed 5,000 tons of gravel just below Keswick Dam (2011)
110. Sutter Mutual Portuguese Bend fish screen (2011)
111. Reclamation District 108 So. Stiener Fish Screen Project (2011)
112. Oji Brothers Farms Kirkville Fish Screen Project (2011)
113. Windswept Land & Livestock fish screen (2011)
114. Placed 15,000 tons of gravel just below Keswick Dam (2012)
115. Bella Vista Water District Fish Screen Project (2012)
116. USBR/TCCA Fish Screen for Tehama-Colusa & Corning Canal Diversions (2012)
117. Placed 14,000 tons of gravel just below Keswick Dam (2013)
118. River Garden Farms #3 -Townsite fish screen (2013)
119. Alamo Farms #1 fish screen (2013)
120. Tisdale Irrigation District #2 fish screen (2013)
121. Cranmore Farms #2 fish screen (2013)
122. Natomas Mutual Water Company – Sankey Diversion Fish Screen Project (2013)
123. USBR/TCCA Red Bluff Diversion Dam Decommissioned: Gates fixed up and stranding/hazards removed (2014)
124. Glenn-Colusa Irrigation District – Restoration of Painter's Riffle (2014)
125. Reclamation District 108 – Eliminate adult salmon passage through Knights Landing Outfall Gates (KLOG) using a physical barrier (2015)
126. Anderson-Cottonwood Irrigation District – North Bank Fish Ladder salmon brood stock fish trap (2015)
127. Anderson-Cottonwood Irrigation District – Fish barrier at Lateral 21 outfall (2015)
128. Natomas Mutual Water Company – Pritchard Lake Pumping Plan Fish Screen Project (2015)
129. Glenn-Colusa Irrigation District – Creation of a spawning riffle near Market Street Bridge (2015)
130. City of Redding Bridge Lighting Program (2015)
131. Reclamation District 2035 / Woodland-Davis Clean Water Agency – Fish Screen Project (2016)
132. Glenn-Colusa Irrigation District – Restoration of a side channel upstream of the Cypress Avenue Bridge (2016)
133. Bullock Bend Floodplain Habitat Project (2016)
134. Reclamation District 108 – Replace Wallace Weir and construction of year-round fish capture facility (2017)
135. River Garden Farms – Salmon Rearing Habitat Project (2017)

Yuba River

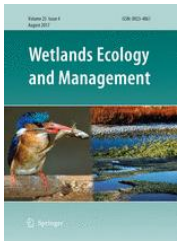
136. Halwood/Cordua Canal Fish Screen Project (2001)
137. Installed two VAKI Riverwatchers at the fish ladders on Daguerre Point Dam (2003)
138. Replaced the existing temporary outlet barrier with a permanent "leaky-dike" barrier to prevent the migration of Yuba River Chinook salmon and steelhead into the Goldfields, which is an active dredger mining operation (2004)
139. Yuba County Water Agency – Narrows 2 Full Flow Bypass (2006)
140. US Army Corps of Engineers – Gravel Augmentation Programs (2007, 2010, 2012, 2013, 2014 and 2016)
141. PG&E Article 404 Narrows Fund, Bureau of Reclamation AFRP and South Yuba River Citizens League – 6,000 cottonwood and willow pole cuttings planted on 5 acres on Hammon Bar on the Yuba River. (2011-2012)
142. Four acres were planted with 4,700 cottonwood and willow pole cuttings to restore riparian habitat on Hammon Bar (2013)
143. U.S. Army Corps of Engineers – Large Woody Material Program (2013)
144. Yuba County Water Agency Narrows 2 Isolation Pool (2014)

Appendix E

Fish Food Production: *Agricultural Floodplain -- Nigiri Project*

"Rearing and migration of juvenile Chinook salmon (Oncorhynchus tshawytscha) in a large river floodplain" analyzed the relationships between residency time, growth, emigration and survival of wild and hatchery fish in off-channel floodplain habitat. The study indicates that increased flooding of the Yolo Bypass would increase off-channel rearing opportunities that could increase the quantity and diversity of Central Valley Chinook salmon.

PLOS ONE published "Floodplain farm fields provide novel rearing habitat for Chinook salmon". The peer-reviewed scientific paper reports the results of the 2012 pilot study at Knaggs Ranch in Yolo Bypass. This scientific paper provides a useful overview of work to integrate floodplain habitats and food web productivity in the management of California river systems.



"Zooplankton ecology and trophic resources for rearing native fish on an agricultural floodplain in the Yolo Bypass California, USA" was published earlier this year in the journal Wetlands Ecology and Management and reported results from one of the 2013 Yolo Bypass experiments. Notably, the paper reports zooplankton densities 300,000% greater on the Yolo Bypass floodplain than in the adjacent Sacramento River channel.

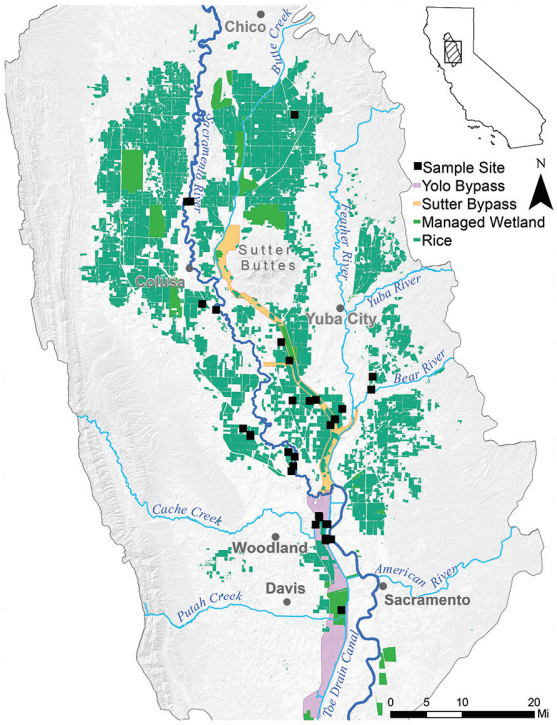
Fish Food on Floodplain Farm Fields

Re-integrating Floodplain Food Resources into the River Ecosystem

In the Central Valley, more than two thousand miles of state and federal levees, along with local flood protection projects, have cut off approximately 95% of historical floodplain wetlands from their river channels. In the 2017 pilot year, the Fish Food on Floodplain Farm Fields Project surveyed existing wetland habitat types over a broad swath of the Sacramento Valley, both inside and outside of the levees. By comparing and contrasting hydrologic conditions and aquatic food web dynamics across the spectrum of existing wetland habitat types (i.e., river channel, managed wetlands, farm fields and bypasses), the project will 1) improve understanding of aquatic food web productivity in the Sacramento Valley and 2) assess the potential for these diverse aquatic habitats, including the hundreds of thousands of acres of floodplain farmland and managed wetlands, to contribute food resources to the river ecosystem, bolster in-river and Delta food webs, and help support recovery of endangered fish populations.

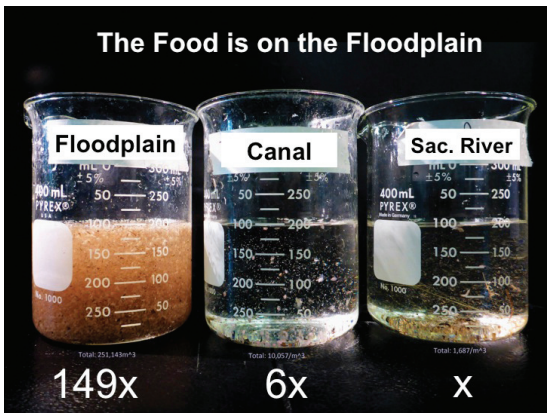
Cultivating Ecological Solutions on Agricultural Lands

Floodplains are the “solar panels” that power aquatic food webs and create abundant populations of fish and wildlife in large river valleys. An explosion of life in winter-flooded floodplain wetlands generates a huge biomass of bugs and zooplankton—the foundation of the aquatic food web. Floodplains make bugs, and bugs make healthy fish. Without hydrologically reconnecting floodplain food factories to river channels, recovery of historical numbers of fish and wildlife will be impossible. But science has shown that it’s possible to mimic natural floodplain productivity by inundating floodplain farm fields in winter when they are not in use by farmers. This project will pioneer on-farm water management practices to re-integrate the flow of floodplain food resources and nutrients back to the river and Delta. Reconnecting floodplain food factories to the river and Delta will help recover historical fish and wildlife populations of California’s Central Valley.



Win-Win

Even during times of drought, California can get far more ***pop per drop*** from water used by putting it to work to create multiple benefits for both fish and people on its way downstream. The innovative water management pioneered in our projects demonstrated that California can have its fish and its farms, and they can work together in harmony.



Reintegrating the Floodplain

"Floodplain Fatties"

More than a hundred years ago, before the Central Valley was leveed and drained, food made on inundated floodplains supported large fish and wildlife populations in the Central Valley and downstream in the Delta. Today, rivers are cut off from their floodplain food factories by levees and thus salmon and smelt populations are starving. The goal of ***F**looding **A**gricultural **T**racts **F**or **I**mproved **S**almon **H**abitat* (dubbed Operation FATFISH) is to better understand aquatic food web productivity on managed agricultural floodplains. The Sacramento Valley has more than 500,000 acres of managed agricultural floodplains on the dry side of the levees. Working with growers and water suppliers, we will develop new farm practices that reintegrate floodplain production into farm and water management. Floodplain fish food will once again connect to the river and contribute to the recovery and resiliency of the river ecosystem, as well as the fish and wildlife populations that the aquatic food web supports.

FATFISH

***F**looding **A**gricultural **T**racts **F**or **I**mproved **S**almon **H**abitat*

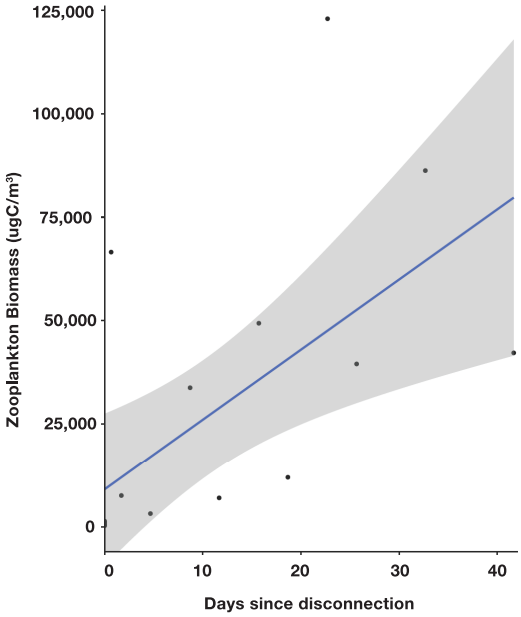
Just like the rest of us, fish need to eat. For California's water system to work effectively, threatened fish populations in the river must have access to the abundant food resources created when winter flood waters spread out and slow down across floodplains. By understanding food web dynamics across multiple wetland habitats on both sides of the levees, Operation FATFISH will establish guidelines for functional integration of agricultural floodplains into the operations and management of California's water system. Remaking and re-operating California's floodplains will help restore salmon and smelt populations, sustain farms, recharge aquifers, improve flood safety, and help deliver water supply security to 25 million Californians.

A Cooperative Partnership

The Fish Food on Floodplain Farm Fields Project represents a private-public partnership with landowners, water districts, government agencies, NGOs, and university researchers all dedicated to finding solutions that work for water supply, agriculture, and the environment. Participants and funders include:

Lundberg Family Farms · Montna Farms · The Metropolitan Water District of Southern California · Cal Marsh & Farm Ventures, LLC · California Rice · San Luis & Delta-Mendota Water Authority · Department of Water Resources, State of California · Center for Watershed Sciences, UC Davis · California Department of Fish & Wildlife · NOAA · SWC State Water Contractors · Reclamation District 108 · NCWA Northern California Water Association · River Garden Farms · SFCWA State & Federal Contractors Water Agency · California Trout Fish-Water-People

Knaggs Ranch **Davis Ranches** **Next Generation Foods**



Bug density in floodplain habitats increases with residence time of water. Longer inundation = more fish food.

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2016 North Delta Food Web Action

Who worked on the project?

-Department of Water Resources led the effort as part of the *Delta Smelt Resilience Strategy*.
-The project was major collaboration with action coordinators (Resources Agency, DFW), fisheries agencies (DWR, NMFS, FWS), diverters (GCID, RD108, Conaway Group), funding sources (DFW, USBR, SFCWA), and scientists (USGS, SFSU, UCD).

Why was there an interest in enhancing the food web?

-Loss of plankton is a major factor responsible for the decline of many fishes including the endangered Delta Smelt, whose status affects water supply reliability in the state.

Why was Yolo Bypass a focus?

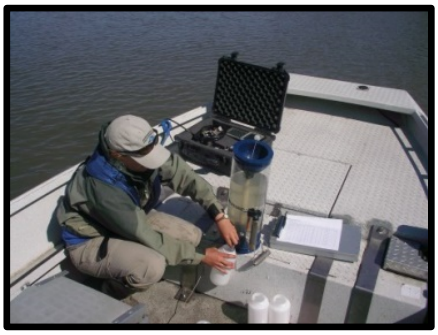
-Yolo Bypass and Cache Slough Complex are known to be relatively richer in plankton than most other parts of the Delta.
-Much of this productivity may not reach the Delta in drier months because local water diversions tend to pull water away from the lower Sacramento River.
-Scientists observed that larger-than-normal fall 2011 and 2012 agricultural flow pulses were followed by downstream Delta plankton blooms. These were the first fall blooms in over 20 years.

What was the basic idea behind the action?

-By routing water through Yolo Bypass instead of the Sacramento River, DWR scientists predicted that a flush of plankton-rich water would provide a "seed" for the downstream Delta, enhancing food resources for Delta Smelt.
-A July 2016 flow pulse was generated with the help of Sacramento Valley water users (See attachment 1).

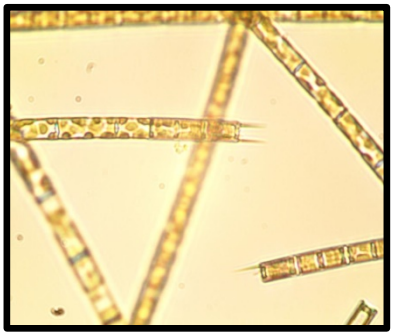
What was measured in the study?

-Water quality, contaminants, plankton, and clams (consumers of plankton) were measured before, during experimental flows at multiple locations.
-Delta Smelt collected during fall will also be analyzed.



2016 North Delta Food Web Action

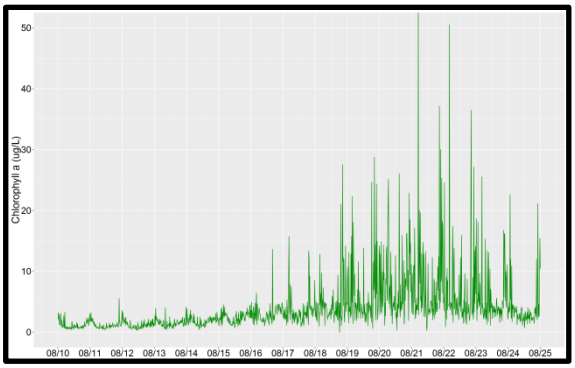
Did the Action Work?



Aulacoseira granulata

-The action generated a substantial flow pulse (12,700 af) for over two weeks in July. However, the flow was less than the target of 24,000 af.
-As predicted, the flow pulse coincided with a wave of phytoplankton (as measured by chlorophyll *a*) through Yolo Bypass.
-<u>The action generated a major increase in phytoplankton in the Delta at Rio Vista.</u>
-The bloom was dominated by a "good" variety, not a harmful species.

Rio Vista Phytoplankton Response

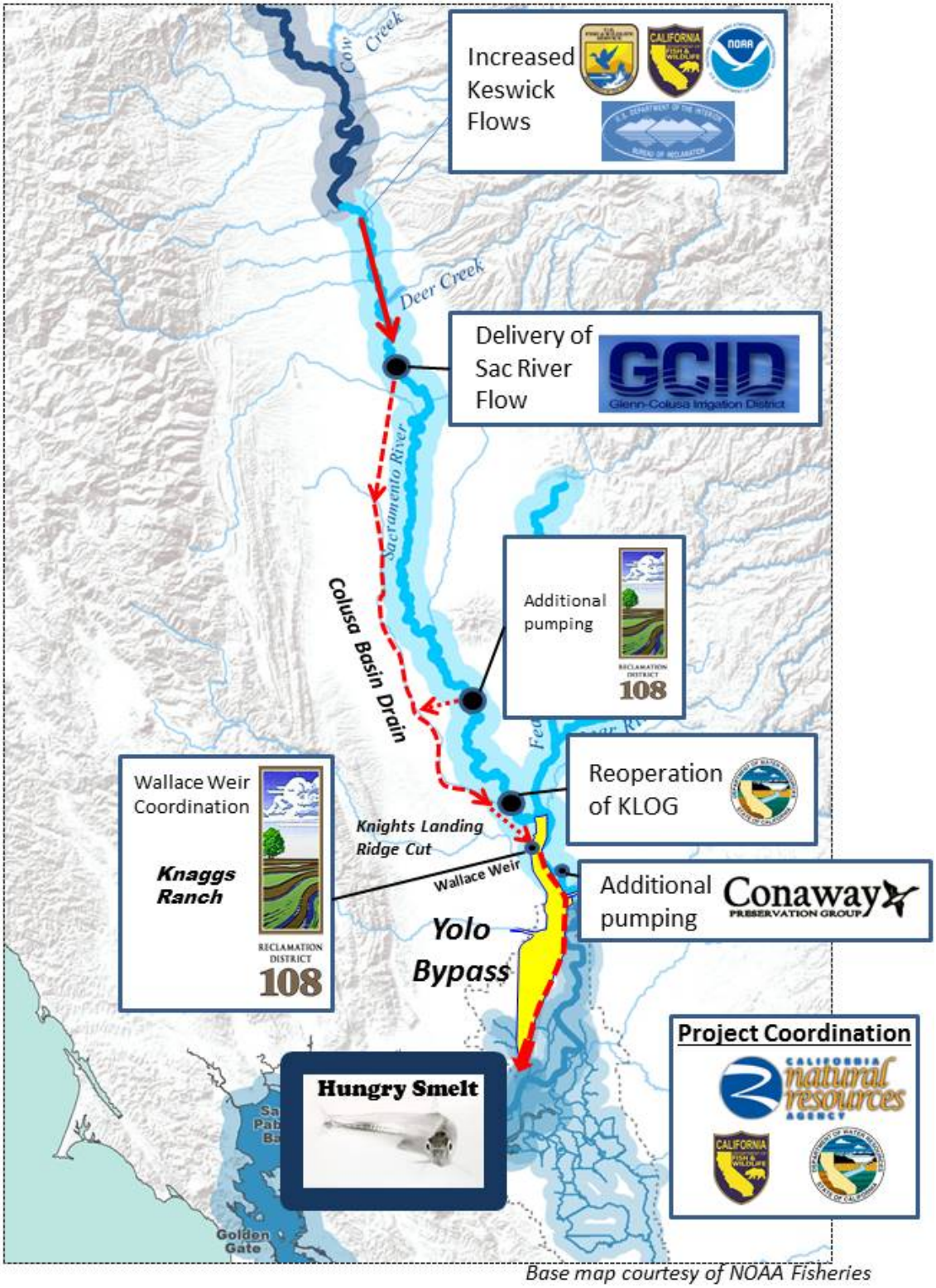


What still needs to be done in 2016?

-There are still many samples that need to be analyzed.
-We are still waiting for data from project partners including USGS and SFSU.
-Of particular interest is whether there is a response in zooplankton and Delta Smelt.
-The results will be presented at the upcoming 2016 Bay-Delta Science conference, and written up for scientific peer-review.

What are future plans?

-Funding is available in the Delta Smelt Resilience Strategy for at least two more years.
-A 2017 action could be considered in other months and with more flow, although careful planning may be needed to work around a new Yolo contruction project ("Ag 4 Crossing).
-Long-term improvements to Yolo Bypass including a proposed notch and fish ladder could make this action easier to implement.
-Improved flows in Yolo Bypass will likely help leverage the efficacy of proposed habitat restoration projects in the north Delta.



Base map courtesy of NOAA Fisheries

Sacramento Valley Salmon Scientific Programs and Projects 2000-2017

American River

1. 1997-2000 flow fluctuation study on the optimal flow rates and flow timing to support fisheries restoration for salmon and Steelhead in the lower American River (2001)
2. American River (North and Middle Forks) Integrated Watershed Plan and Stewardship Strategy (2002)
3. Development of a River corridor Management Plan for the Lower American River (2002)
4. Lower American River final report comparing PHABSIM and 2-D modeling of steelhead and fall-run Chinook salmon spawning (2003)
5. River Corridor Plan for watershed management on the lower American River (2003)
6. Lake Natoma Temperature Model (2006)
7. Iterative Coldwater Pool Management Model (iCPMM) (2010)
8. Structured decision making (SDM) prototype model to assist in selecting the best actions for restoration given existing conditions, e.g., spawning versus rearing habitat. (2012)
9. Folsom Dam Temperature Value Planning Study (2014)
10. LAR Thermal Refugia Study (2015)
11. LAR Otolioth Study (2015)
12. LAR Native Salmonid Genetic Study (2015)
13. Emigrating Salmonid Habitat Estimation (ESHE) Modeling (2015)
14. Real-Time Steelhead Emergence Monitoring and Prediction (Water Forum) (2015)
15. Modified Flow Management Standard (Water Forum) (2015)
16. Update on Salmonid Habitat Relationships (2016)
17. Update Salmon Mortality Model (2016)

Bear River

18. Developed a baseline conditions study for the lower Bear River (2004)

Butte Creek

19. Flow-habitat relationships for spring-run Chinook salmon spawning report (2003)
20. Salmon life history study for Butte and Big Chico Creeks (2006)
21. Butte Creek, Big Chico Creek, and Sutter Bypass Chinook Salmon and Steelhead Evaluation (2006)
22. Butte Creek Spring-run Chinook Salmon Life History Investigation (2010)

Clear Creek

23. The Clear Creek Decision Analysis and Adaptive Management Model improved to evaluate power, sediment, riparian and salmonid impacts from large managed releases of water. (2004)
24. 3-D temperature model for Whiskeytown Reservoir (2004)
25. Spring-run Chinook salmon and steelhead upper reach spawning study (2007)

Cottonwood Creek

26. Cottonwood Creek Watershed Monitoring and Assessment (2003)
27. 2007-2011 Cottonwood Creek salmon video monitoring results report (2012)

Sacramento River

28. Yolo Bypass Fish Habitat Study (2000)
29. Watershed Restoration Strategy for the Yolo Bypass (2002)
30. Spawning Areas of Green Sturgeon in the Upper Sacramento River (2002)
31. Fall, late-fall and winter-run Chinook salmon and steelhead spawning between Keswick Dam and Battle Creek Final Report (2003)
32. Hydraulic modeling of juvenile rearing and macroinvertebrate habitat between Keswick Dam and Battle Creek (2003)
33. Development of the 3-D temperature model for Whiskeytown Reservoir. (2004)
34. Modeling of rearing habitat in the Sacramento River between Keswick Dam and Battle Creek (2005)
35. 2003 and 2004 Biological Evaluation of the Fish Screens at the Glenn-Colusa Irrigation District's Sacramento River Pump Station (2005)
36. Evaluation of Adult Sturgeon Migration at the Glenn-Colusa Irrigation District Gradient Facility on the Sacramento River during 2003 (2005)
37. Flow fluctuation study identifying the relationships between flow fluctuations and redd dewatering and juvenile stranding for Chinook salmon and Steelhead in the Sacramento River between Keswick Dam and Battle Creek (2006)
38. Estimating the Abundance of Sacramento River Juvenile Winter Chinook (2006)
39. Macroinvertebrate flow-habitat Study (2007)
40. Biological Assessment of Green Sturgeon in the Sacramento - San Joaquin Watershed (2007)
41. Redd dewatering and juvenile Chinook and steelhead stranding study (2007)
42. Upper Sacramento River Basin Chinook Salmon Escapement Monitoring Program (USFWS) (2008-2010)
43. Central Valley Chinook Salmon Escapement Monitoring Plan (2012)
44. 2012/2013 redd dewatering and juvenile fish stranding data final report (2013)

Yuba River

45. Implementation Plan for Lower Yuba River Anadromous Fish Habitat Restoration (2003)
46. Upper Yuba River Studies Program - Sediment Studies and Water Quality (2006)
47. River Management Team lower Yuba River comprehensive Monitoring and Evaluation Report (2006)
48. Yuba Salmon Forum North Yuba salmon spawning and rearing habitat studies (2010)
49. Yuba Salmon Partnership Initiative (2013)

50. Yuba River Study Utilizing the Spawning Habitat Integrated Rehabilitation Approach (SHIRA) (2014)
51. Yuba River Ecosystem Feasibility Study (2016)