

DRAFT REVIEW OF APPLIED ADAPTIVE MANAGEMENT
As Implemented through the TUCP Order and
The Central Valley Project and State Water Project
Drought Operations Plan and Operational Forecast

December 12, 2014

Beginning in January 2014 and continuing throughout the remainder of the year, in order to address the effects of the historic drought in 2014, the U.S. Bureau of Reclamation (Reclamation), California Department of Water Resources (DWR), U.S. Fish and Wildlife Service (FWS), National Marine Fisheries Service (NMFS), California Department of Fish and Wildlife (CDFW), and the State Water Resources Control Board (SWRCB) carried out the most coordinated and extensive series of water operations adjustments in the history of the Central Valley Project (CVP) and State Water Project (SWP). This close coordination resulted in adjustments to the existing water quality and Endangered Species Act (ESA) requirements of the SWRCB's Water Right Decision 1641 (D-1641) and the 2009 Biological Opinions of FWS and NOAA that allowed the CVP and SWP to support water deliveries, transfers, and increase upstream water storage while minimizing adverse effects on listed fish species. The six agencies will continue to build on the lessons learned and experiences of Water Year (WY) 2014 as they develop and implement a Drought Contingency Plan for WY 2015.

The Governor issued a drought proclamation on January 17, 2014. On January 29, Reclamation and DWR sought a temporary urgency change to their water rights permits through modification to D-1641. On January 31, 2014, the Executive Director of the SWRCB issued an Order that granted a temporary modification to D-1641 in response to drought conditions. The Order, Drought Operations Plan, and subsequent Federal Endangered Species Act (FESA) and California Endangered Species Act (CESA) actions created flexibility for water operations which conserved water in upstream reservoirs for future beneficial uses. Some of the major elements modified included shifting the Agricultural Western Delta Salinity Standard (EC) compliance from Emmaton upstream to Threemile Slough, adjusting Delta Outflow and Rio Vista flow requirements, adapting OMR flow limits, adapting the San Joaquin inflow to export ratio, varying flow standards at Vernalis, and allowing water transfers before July and after September.

The initial evaluation of information related to water operations and biological conditions in response to operating the CVP and the SWP pursuant to the Order and subsequent biological review are presented below:

- *2014 Summary Information*
- *Collaboration*
- *Key Lessons Learned*
 - *Delta Cross Channel gates*

- *Old and Middle River flow management*
- *Water depletions*
- *Delta Smelt, Longfin smelt and salmon*

Summary Information

The CVP and SWP exported available supplies South of Delta from January through October while complying with the requirements of the Order, CESA and FESA. The CVP facility diverted 688 thousand acre-feet (TAF) while the SWP facility diverted 648 TAF. Additionally, the CVP exported 138 TAF and the SWP exported 143 TAF of water transferred between upstream water right holders to south of delta purchasers.

In a normal year, storage gains in upstream reservoirs are typically released for salinity control, temperature control, and exports later in the year. However in 2014, the critically dry hydrology provided significantly less storage gains than necessary to meet all these beneficial uses later in the summer and fall. Figure 1 below demonstrates the rate at which water was stored, diverted south of Delta, and used to meet the modified D-1641 requirements in the Delta.

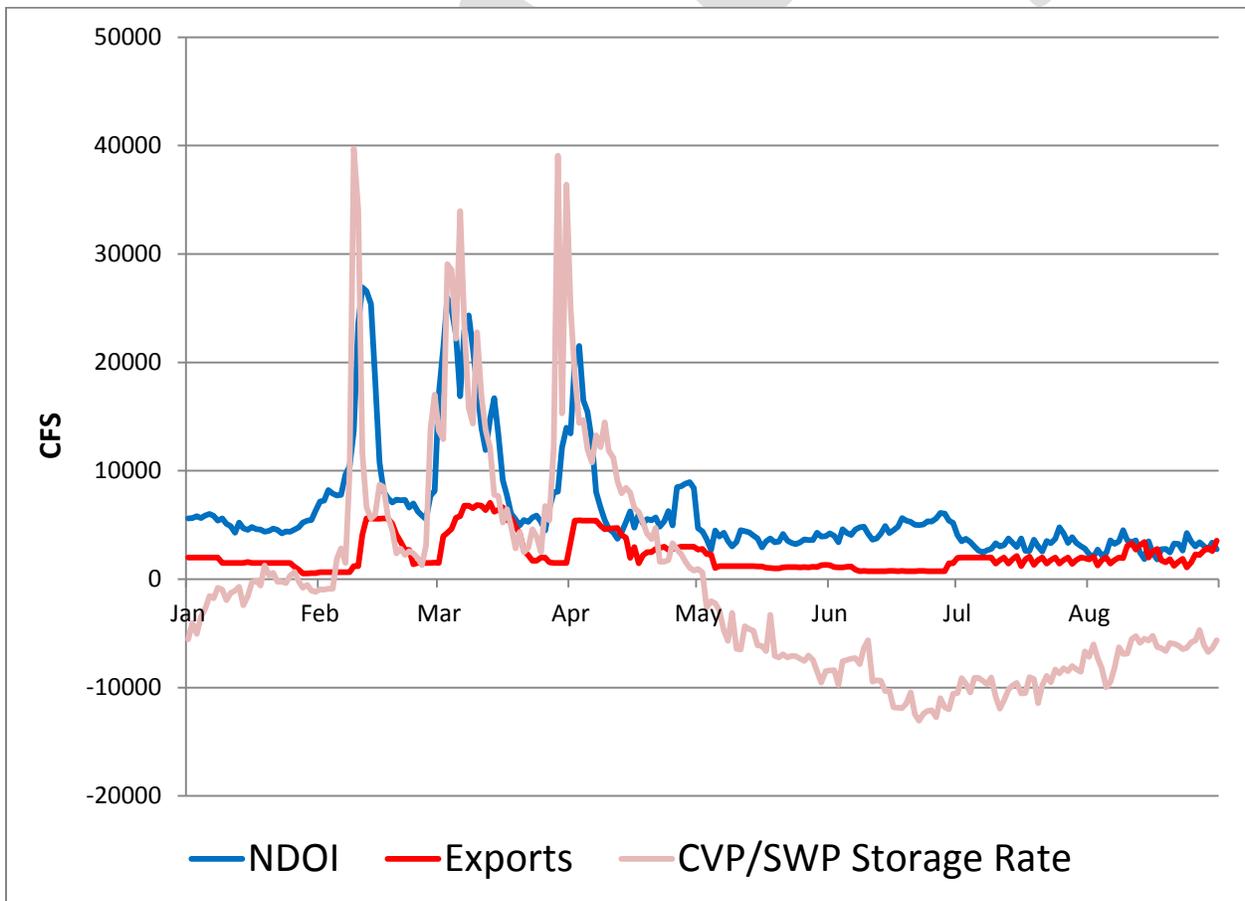


Figure 1: Comparison of Net Delta Outflow Index (NDOI), Exports and Rate of Upstream Storage Changes in 2014

The Order and subsequent FESA and CESA compliance allowed the CVP and SWP flexibility in water operations beginning in February 2014. The modifications provided opportunities to conserve water upstream and increase diversion rates at the South Delta CVP and SWP facilities during periods of high inflow to the Delta. While operating under the modified Order the projects conserved approximately 400 thousand acre-feet of water in upstream reservoirs which would not have been possible otherwise. The conserved water was used throughout the year to provide temperature management, control Delta water quality, and to support and improve water supply during the critically dry 2014 water year.

Collaboration

The Order required Reclamation and DWR to convene a Real Time Drought Operations Management Team (RTDOMT), comprised of representatives from Reclamation, DWR, CDFW, USFWS, NMFS, and the SWRCB. Beginning in February 2014, the RTDOMT met at least once a week in order to proactively review real-time water operation and biological information to assess potential drought response actions for future days or months. This RTDOMT provided state and federal water operators, fish agencies, and the SWRCB with a reliable communication schedule and established points of contact to timely respond to emerging issues. The RTDOMT focused on real-time decision making and mid- and long-term strategic planning.

As with any interagency collaborative group, initial meetings focused on clarifying roles and responsibilities, setting expectations, and defining group norms for working together. The group formation process contributed to perceived time delays in initial proposed water operation changes and subsequent approvals. However, given the importance of the RTDOMT's task, the members quickly established their process for timely assessment of real-time information, seeking operational changes, and rapid review and approval from the SWRCB, CDFW, USFWS, and NMFS.

Reclamation and DWR worked collaboratively to develop and submit proposals for drought response actions to the SWRCB for review and approval between February and October. Many of these proposals required review by CDFW, USFWS, and NMFS. Together, through these subsequent plans and petitions, vetted through the RTDOMT, Reclamation and DWR received modifications to the Order and adjustments in implementation of the smelt and salmonid biological opinions and Longfin Smelt Incidental Take Permit. These adjustments sustained water supply benefits while also providing protection for listed species. For a list of drought related documents submitted to the SWRCB, please

see: (http://www.waterboards.ca.gov/waterrights/water_issues/programs/drought/tucp.shtml).

Key Lessons Learned

On November 18, 2014, the State and Federal fishery agencies presented to the SWRCB the “Effects of Drought and CVP/SWP Operations on Fish - A Fish Agency Overview”, that included summaries of drought and water operations on Delta and Longfin Smelt, Salmonids, temperature management, flow management, operation of the Delta Cross Channel (DCC), and Old and Middle River (OMR) flows and exports. [For the full report and other NMFS specific documents please see: http://www.westcoast.fisheries.noaa.gov/central_valley/water_operations/](http://www.westcoast.fisheries.noaa.gov/central_valley/water_operations/)

A) Delta Cross Channel Gates

RPA Action IV.1.2 of the NMFS 2009 Biological Opinion was temporarily adjusted in 2014 pursuant to RPA Action I.2.3 such that the DCC gate opening was conditionally allowed per the guidelines outlined in a “DCC Trigger Table” which was developed by an interagency technical team. This operation modification to provide for additional flexibility in maintaining the DCC gates open allowed water to be preserved in upstream reservoirs while addressing water quality concerns in the Delta. The DCC Trigger Table was designed with the dual purpose of providing equivalent protection to juvenile salmonids as RPA Action VI.1.2 while providing additional flexibility in gate operations to protect water quality and conserve reservoir storage. Following a review of the monitoring data it appears that the DCC gate operations trigger table adequately protected salmonids in Water Year 2014.

This adaptive management approach to DCC operations was successful due to the interagency cooperation and the ability of the USFWS juvenile fish monitoring program to conduct additional and extended monitoring to collect the prerequisite data necessary for implementation of the “DCC Trigger Table.”

When the DCC Gates were closed during December, 2013, the release of water from upstream storage became the primary mechanism for controlling Delta salinity as exports were already low. SWP water supply contractors which divert water directly from the Delta via Banks Pumping Plant reported elevated bromide concentrations associated with the higher salinity conditions, which resulted in elevated levels of disinfection byproducts (DBPs) at water treatment plants served by this water. In January 2014 due to continued dry conditions, Reclamation requested that the DCC gates be opened, which was not provided for under RPA Action IV.1.2. NMFS and the SWRCB approved a petition by Reclamation and DWR to open the gates on February 1, 2014. A natural flow event occurred at the same time as the opening which rapidly improved conditions.

This experience informs us going into another potentially dry winter that flexibility in opening the DCC may be needed early in the water year given low upstream supplies that will not be available for salinity control operations if needed. As a result, the 2015 drought strategy includes a potential modification to the required DCC gate operations to maintain Delta salinity standards.

B) Old and Middle River (OMR) Flow Management

One of the flexibilities requested by Reclamation, and subsequently granted by the fish agencies, in March 2014, was in OMR flow management. Reclamation requested approval to operate to a 14-day running average OMR of no more negative than -6,000 cfs to capture additional natural flow available in the Delta, because of recent storm events, that would cause up to 7 days of OMR flows more negative than -5,000 cfs, but below -6,000 cfs. The first salvage and loss of older juvenile Chinook salmon, including winter-run, for WY 2014, began during implementation of the this adjustment to the OMR flow requirement of the NMFS Biological Opinion. Although the salvage and loss did not exceed the levels of take permitted at the export facilities in the Biological Opinion, salvage continued throughout the implementation of this flexibility.

Delta Consumption Use Assumptions

CVP and SWP observed Delta water depletions greater than forecasted and modeled estimates. The forecasted operations use DAYFLOW assumptions of Delta consumption use, which are coarse monthly assumptions that do not vary according to hydrology. Actual real-time diversions can vary from those assumptions depending on actual precipitation and ambient temperatures. For example, DWR estimates that Delta consumptive use in January 2014 was much greater than these assumptions, based on the DSM2 model hind cast modeling and observed salinity conditions. There is no direct measurement of Delta diversions, and estimates cannot fully replicate such measurements. Without direct measurement of Delta diversions, the CVP and SWP may release more water from storage than is actually needed to ensure outflow requirements and contract obligations are met, causing reduced storage levels in upstream reservoirs. Similar issues related to Sacramento River depletions complicated upstream reservoir operations and cold water pool management.

C) Fisheries

Delta Smelt

In recent years, Delta Smelt distribution has most often been centered on the Sacramento River side of the estuary. It is better for operations when this occurs as the Smelt are less likely to be entrained by the CVP and SWP pumps in the South Delta. There is a critical period of Smelt movement between December and January during which “first flush” type events have the potential to strongly affect the distribution of adult Delta Smelt.

The low exports and absence of storms during December 2013 and January 2014 prevented hydrological pull towards the Central and South Delta. As a result the adult Delta Smelt ended up distributed in the Sacramento side of the estuary and consequentially there was low entrainment risk throughout the season.

Additional “early warning” monitoring was undertaken at Jersey Point starting in February, to generate information for when Delta Smelt were moving nearer to the South Delta and potentially into the zone of entrainment of the export facilities. The pilot early warning monitoring established that the approach may be effective in providing previously unavailable real-time information about smelt densities at important points in the Delta. The program for WY 2015 is being expanded, as a result of the ongoing drought.

Longfin Smelt

In dry years such as 2014 Longfin Smelt tend to be found farther into the Delta during the spawning period of December through March. This increases their vulnerability to entrainment by the CVP and SWP pumps. In 2014 Longfin distribution was focused primarily on the Sacramento River side of the Delta and in Suisun Bay. This distributional pattern and the low levels of pumping during low inflow periods limited the entrainment risk throughout the season.

Salmonids

In addition to annual real-time monitoring of the Sacramento River system, the April 8, 2014, Drought Operations Plan (DOP) contained a winter-run Drought Contingency Plan that included enhanced monitoring of temperature, flow, and winter-run Chinook salmon egg survival and increased production and capacity at the Livingston Stone National Fish Hatchery.

Using forecast modeling, the water temperature forecast from April 24, 2014, indicated that the daily average water temperature criterion of 56°F would be met at the compliance point on the Sacramento River through mid-September 2014. However, despite the improvement in hydrology after the April forecast, full access to the remaining cold-water pool in Shasta became limited sooner than was initially forecasted, and observed water temperatures were higher than anticipated by late August. The observed water temperatures remained above 56°F throughout the remainder of the winter-run egg incubation season and on into the end of November. Despite best efforts to forecast temperatures, the tools should continue to be improved to capture the full range of drought conditions that we may experience. In addition, the forecasts cannot replace decision-making based on real-time conditions. Temperatures above 56°F result in egg and alevin mortality, with up to 100% mortality at water temperatures greater than 62°F. Winter-run eggs and alevin from broodyear 2014 likely suffered significant mortality resulting from the high water temperatures observed contributing to the observation that the juvenile winter-run passing Red Bluff Diversion Dam through November 4, 2014, had the lowest number of juveniles (less than 200) per female spawner in the last 12 years.

The April 8, 2014 DOP anticipated high mortality of winter-run resulting from high water temperatures for broodyear 2014. Therefore, part of the winter-run Drought Contingency Plan provided for infrastructure improvements in order to increase winter-run Chinook broodstock collection at the Livingston Stone National Fish Hatchery (LSNFH) to 400 adults (actual

broodstock collection was 388 adults), considerably greater than the typical 120 adults. This was an essential action to support the existence of the cohort.

In accordance with the April 8, 2014, winter-run contingency plan, extraordinary measures were implemented to protect winter-run. For example, Reclamation and the fish agencies coordinated on a regular basis on Keswick Dam flow releases and associated monitoring. After each Keswick Dam flow reduction during the summer and fall, CDFW crews monitored known stranding pools, rescuing all salmonids observed, and monitored winter-run redds at risk of dewatering, taking action to remove gravel off the top of the redds to increase the amount and velocity of water over them when necessary.

To plan for 2015 operations based on the lessons of 2014, Reclamation has convened an interagency team of fisheries biologists to conduct a retrospective analysis and assessment of the effects of drought operations on winter-run Chinook salmon. The agencies will continue to push themselves to improve conditions for salmon and other state and Federally-listed fish and wildlife as much as possible while also supporting water supplies.