Central Valley Project and State Water Project
2016 Drought Contingency Plan
For Water Project Operations
February - November 2016

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ATTACHMENTS

I. Introduction of the DCP

California has just ended its fourth consecutive year of below-average rainfall and snowpack, and Water Year (WY) 2015 was the eighth of nine years with below-average runoff. This extended drought has produced chronic and significant shortages to municipal and industrial, environmental, agricultural, and wildlife refuge water supplies and led to historically low groundwater levels. This recent dry hydrology has set many new statewide records, including the driest four-year period of statewide precipitation (2012-2015). In calendar year 2013, many communities recorded their lowest-ever levels of annual precipitation; calendar year 2014 saw record-low water allocations for the Central Valley Project (CVP) and State Water Project (SWP) contractors; and January 2015 was the driest January on record for precipitation Statewide. WY 2015 also produced by far the lowest snowpack in the Sierra Nevada since records have been kept, and by some estimates based on tree-ring analysis, was the lowest over the past five centuries.

The cumulative effect of these sustained dry conditions is demonstrated in reduced natural runoff for streamflow, limited surface water storage in reservoirs, increased groundwater pumping, and significant effects to fish and wildlife populations (both listed and non-listed species, including salmon, smelt, and waterfowl).

Since December 2013, State and Federal agencies that supply water, regulate water quality, and protect fish and wildlife have worked closely together to cope with persistent drought. The U.S. Bureau of Reclamation (Reclamation), California Department of Water Resources (DWR), California Department of Fish and Wildlife (CDFW), State Water Resource Control Board (SWB), U.S. Fish and Wildlife Service (USFWS), and National Marine Fisheries Service (NMFS), (collectively, the State and Federal Agencies) have closely coordinated CVP and SWP water operations to manage reservoir water resources through both forward-thinking and real-time efforts, including through drought operations planning and weekly Real-time Drought Operations Management Team (RTDOMT) meetings. This cooperative environment has allowed the State and Federal Agencies to collectively provide the necessary information to the SWB to support its evaluation of Reclamation and DWR's requests for modifications to operational standards required under Water Rights Decision 1641 (D-1641).

Each successive year of historic drought conditions has brought new management challenges compounded on those we have faced before. The challenge of managing limited reservoir water supplies for multiple uses has never been more difficult. Coordination on drought contingency planning for CVP and SWP water operations is critical for continuation of our drought response efforts, as this process establishes agreed upon goals for Project operations at the beginning of the water year, outlines the potential response actions, and documents the planning process that will inform development of additional response efforts should conditions warrant.

One of the guiding documents for this ongoing planning effort (and for this document) is the *CVP and SWP Drought Contingency Plan for January 15, 2015 through September 30, 2015*, which incorporated additional modeling forecasts informed by DWR's January 2015 prediction

of total annual water year runoff for the major watersheds of the Sacramento and San Joaquin River basins.

This 2016 Drought Contingency Plan (2016 DCP) for CVP and SWP water operations builds on the foundation of the State and Federal Agencies' previous planning work over the last few years and also fulfills the condition of the Order adopted by the SWB on December 15, 2015. This 2016 DCP outlines potential CVP and SWP water operations for February through November 2016 and is prepared under the assumption that dry conditions persist in 2016. In accordance with the December 2015 adopted Order, this 2016 DCP has been prepared by DWR and Reclamation, in coordination with other State and Federal Agencies. In December 2015, the State and Federal Agencies prepared Part I, a working draft of potential CVP and SWP water operations for December 2015-January 2016, before modeled hydrology and projected run-off forecasts were available. Therefore, this 2016 DCP focuses on operations in February through November 2016 based on updated hydrologic forecasts issued by DWR in January 2016.

Longer-term seasonal forecasts for 2016 indicate better than average chances for wetter than average conditions to prevail statewide through March. Although current forecasts indicate the present wet hydrology will continue into spring 2016, there is a potential that dry conditions may return during WY 2016. In addition, precipitation gains observed under our present wet hydrology may not fully alleviate the effects of consecutive years of dry conditions during WY 2016. The State and Federal Agencies are preparing this 2016 DCP based on the January 1, 2016 hydrologic forecast and considering what modifications may be requested under various scenarios. This 2016 DCP provides a framework of potential CVP and SWP water operations actions that may be requested and necessary from February to November 2016 even if California experiences a wetter hydrology.

A. Purpose of the DCP

This 2016 DCP for CVP and SWP water operations from February to November 2016 includes a quantitative analysis of modeled hydrology for 2016 including 50%, 90%, and 99 % exceedence scenarios based on the January 1, 2016 hydrologic scenarios and potential operations based on these analyses (Attachment 1). These quantitative analyses inform this document's list of potential requests for modifications to D-1641 and potential adjustments to Biological Opinions. In addition, this document includes a description of the 2014 and 2015 operations outlining the modifications to standards authorized in 2014 and 2015. The State and Federal Agencies plan to provide an update to this 2016 DCP in February based on the February 1 hydrology in order to determine if changes to CVP and SWP water operations are necessary. In addition, a biological review would be conducted for any Temporary Urgency Change Petition (TUCP) to D-1641 that seeks adjustments to D-1641 or to the Biological Opinions.

Similar to last year, this plan will aid in quantifying the general magnitude of available reservoir water resources under various hydrologic scenarios. For example, the drought actions taken by the CVP and SWP in 2015 followed a rough hybrid of the guidance given under the 90% (dry) and 99% (extremely dry) hydrologic exceedence scenarios identified in last year's January 15,

2015 plan. The TUCPs submitted by the CVP and SWP included modified standards identified in the 90% scenario, with the addition of the installation of the drought barrier at the West False River location as identified in the 99% scenario. Based on the continuing evaluation, the CVP and SWP also identified requests that were not contained in the 2015 DCP, including a request for a mid-step export related to Delta outflow. The actual hydrology after 2015 was indeed somewhat drier than 90% hydrology but not quite as dry as 99% hydrology from January 1 to the remainder of the water year.

Section V provides a summary of potential modified standards for each scenario as a signal for a potential filing of TUCP(s) by the two project agencies later in the year. In addition to these potential modified standards under the various hydrologic scenarios (Attachment 2), Section V discusses potential near term requests for February 2016 informed by real-time conditions that currently exist. Based on current hydrology and near term forecasts, no changes are needed before February 1. If precipitation and hydrology were to change dramatically--for example, if recent precipitation were to cease today--adjusted requirements and operations may be needed as early as February 15. Precipitation and hydrology will continue to be monitored to identify the earliest date at which a change in requirements may be needed in response to a change to drier conditions.

B. 2016 DCP Goals

Economic and environmental challenges continue to mount as our State undergoes consecutive years of drought. If 2016 precipitation results in another dry year, the State and Federal Agencies will need to make difficult decisions to balance reservoir storage to meet water supply needs, such as essential health and safety needs for urban water users, cold water and appropriate flows for fish, and adequate water quality in the Delta. Maintaining sufficient carry-over storage for 2017 to meet essential health and safety needs, and providing for fish and wildlife needs in 2016 are also important considerations for this 2016 DCP. While 2016 is forecasted to be a strong El Nino year, typically characterized by wet conditions, the ability to predict at this time whether 2016 will be wet or dry is limited, highlighting the need to be cautious when planning for 2016 CVP and SWP water operations. The following primary goals are intended to achieve a balance between reservoir storage for water supply and resource conservation (listed in no particular order):

- Ensure, as a first priority, the CVP and SWP will meet essential human health and safety needs, by supplying adequate water supplies throughout their service areas for drinking, sanitation, and fire suppression. Beyond providing for these basic needs, the CVP and SWP will operate in order to lessen economic losses due to water shortages, to the extent possible, through project water deliveries and facilitating voluntary water transfers and exchanges (as the CVP and SWP have done throughout this drought period).
- Manage the intrusion of salt water into the Sacramento-San Joaquin Delta (Delta) through operations of the CVP and SWP. Salt water is driven upstream from the San Francisco Bay into the Delta on a daily basis by tidal actions. In a normal year the CVP and SWP manage this intrusion through water releases from upstream storage, to create a hydrologic barrier of fresh water that holds back

intruding salt water. The CVP and SWP, through discussions with the RTDOMT, will continue to weigh tradeoffs between south of Delta exports, meeting upstream water delivery obligations, cold water pool management for fish and wildlife, and in-Delta water quality, as well as contemplate other management tools, such as installation of physical barriers to manage salinity intrusion.

- Provide and maintain adequate protections for State and Federal endangered and threatened species and other fish and wildlife resources.
  a. The CVP and SWP will implement operational criteria through November 2016 to provide adequate fish protections, including to preserve cold water pools in upstream reservoirs for temperature management for salmon and steelhead. Given consecutive years of poor egg-to-fry survival recorded at Red Bluff Diversion Dam (RBDD), the CVP and SWP will strive to implement temperature management earlier and maintain temperature control throughout WY 2016, which may require tradeoffs with providing habitat, controlling salinity intrusion, and water supply.
  b. In light of the continued declining trend of Delta smelt and Longfin smelt, the CVP and SWP will continue to manage exports in a manner that minimizes entrainment and associated salvage at the export facilities and minimizes effects to habitat for fish species.
  c. The CVP and SWP will continue to manage these tradeoffs through discussions with the State and Federal Agencies using the RTDOMT process. Biological review of the effects of implementing actions will be prepared and provided as part of the formal modification requests. Reclamation and DWR will coordinate with the other State and Federal Agencies to ensure compliance with applicable laws, including the federal and California Endangered Species Acts (FESA and CESA) and the California Water Code.
- Seek and consider water management flexibilities to maximize the benefit of limited water supplies. The CVP and SWP operators will work with their contractors and partners to take advantage of opportunities to shift demands, shift timing of diversions (*e.g.*, working with the Sacramento River Settlement Contractors to shift early spring demand later into the year to conserve water in Shasta Reservoir, if warranted), and facilitate water transfers in order to maximize these benefits. The CVP and SWP, in discussions with the Federal and State Agencies through the RTDOMT, will consider management flexibilities, and if necessary, seek approval for actions such as extending the water transfer window in order to maximize benefits of limited supplies for multiple purposes where possible.

C. Critical Operational Considerations

The exceptionally dry conditions in 2014 and 2015 resulted in low reservoir storages which created a challenge to deliver critical water supplies, provide adequate cold water for instream fisheries resources, and comply with unmodified D-1641 standards. During the last two years, Reclamation and DWR requested the SWB modify the terms of their water rights permits for operation of the CVP and SWP from what is currently provided in D-1641 while still operating

within other existing laws and regulations. The SWB Executive Director approved Orders that modified D-1641 standards which helped Reclamation and DWR balance the delivery of minimum water supplies and operate within the flexibilities of existing Biological Opinions and CESA authorizations.

If dry conditions continue, Reclamation and DWR may need to request the SWB modify certain conditions in D-1641. This DCP provides a framework of potential requests for the period between February 1, 2016 and November 30, 2016. However, the specific requests are not fully developed in this DCP since the hydrologic and biologic conditions are expected to change with the February 1 hydrologic forecast. Any specific requests would be coordinated through the RTDOMT.

i. Health and Safety

Operations of the CVP and SWP must provide for, at a minimum, essential human health and safety needs throughout the CVP and SWP service areas, and we must retain the capability to provide for such minimum needs throughout WY 2016. For clarity, Reclamation and DWR's consideration of these essential human health and safety needs includes adequate water supplies and water quality for drinking water, sanitation, and fire suppression, but it does not extend to other urban water demands such as outdoor landscape irrigation. While most Californian communities have reserve water supplies, some communities will require continued delivery of limited amounts of water through the CVP and SWP systems to meet these basic needs.

At DWR's request, the 29 public water agencies that buy from the SWP quantified their needs to meet demands for drinking, hygiene, and sanitation (collectively 55 gallons per capita per day (gpcd)), plus fire protection. Most SWP contractors have alternative sources of water, including groundwater and local reservoirs. The combined initial estimated need that DWR received from its contractors this past October was approximately 357 thousand acre-feet (TAF) for calendar year 2016. Those needs are expected to fluctuate based on changes in availability from other sources.

Reclamation currently uses public health and safety criteria developed in conjunction with the Municipal and Industrial (M&I) Water Shortage Policy to determine the amount of water to be provided to its M&I contractors in those years where human health and safety needs are considered as part of CVP allocations to M&I contractors. Under these conditions, M&I contractors are required to update population estimates and non-CVP water source information to determine how much water will be needed from the CVP to meet their overall human health and safety demand for that year. In WY 2015, CVP contractors identified a total health and safety need of approximately 600 TAF, which is the best estimate for WY 2016. This amount represents the total M&I demands for all M&I users in the CVP using the baseline 55 gpcd for residential use, and 70% for Commercial, Industrial and Institutional use as typically calculated. Based upon criteria, approximately 200 TAF of all CVP water was allocated to help meet their health and safety needs taking into consideration their other available supplies in WY 2015. For WY 2016, Reclamation intends to again apply the M&I Shortage Policy and concepts

from DWR's Drought Guidebook to determine the amount of CVP water available to meet health and safety needs for CVP customers.

As winter and spring progress and additional hydrologic information is developed for evaluation of projected reservoir water supply and runoff, Reclamation and DWR will continue to evaluate water supply needs for essential health and safety. DWR, through other drought response efforts, plans to continue to work with the Governors Drought Task Force to provide updates on water supply conditions and respond as necessary to meet essential health and safety water supplies.

ii. Economic Considerations

Throughout the continuing drought, CVP and SWP systems will be operated to lessen critical economic losses to agriculture, municipal, and industrial uses due to water shortages through project water deliveries and by facilitating voluntary water transfers and exchanges to the extent possible, while balancing the needs of upstream storage, fishery and wildlife resource protection, and operational flexibility. A key to minimizing water supply shortages for economic purposes will be to take advantage of opportunities to export natural or abandoned flow in the winter and spring. Release of stored water in summer and fall will be managed to concurrently benefit in-stream temperature and wildlife objectives, meet Sacramento Valley in-basin needs, convey water south-of-Delta to meet water supply needs, and preserve system reservoir carry over storage to meet objectives in WY 2016 and WY 2017 if drought conditions continue.

iii. Fishery and Wildlife Protection

The CVP and SWP operations outlined in this 2016 DCP will continue to ensure protections of endangered species and other fish and wildlife resources that are suffering from impacts due to drought and drought-related operations. This document identifies some regulatory requirements that may call for a request for modification of D-1641(Attachment 2) and adjustments to the Biological Opinions. As the regulatory agencies for operations, Reclamation and DWR will develop proposals stemming from this 2016 DCP that comply with applicable laws and requirements. Any changes in operations that are ultimately proposed either through a TUCP or under the ESA will be submitted by Reclamation and DWR for concurrent review under applicable laws, including the FESA, CESA, and the California Water Code.

Based on the goals described above, this 2016 DCP outlines potential actions for CVP and SWP water operations this spring through fall to identify a balanced approach to meeting river temperatures, instream flows, and Delta protective actions. A primary consideration involves the need to conserve enough cold water in Project reservoirs early in the year to maintain cool water temperatures in the Sacramento River and tributaries to support the various runs of Chinook salmon and steelhead. With the loss of two out of three cohorts of endangered wild winter-run Chinook salmon (2014 and 2015), it is critical that we develop cold water pool resources in the winter and spring to support temperature management needed later in the year for this third wild winter run Chinook salmon year class. If conditions shift into a returning dry pattern, these water supplies may need to be evaluated for use in other critical operations throughout 2016.

The timing, flow rate, and rate of any flow changes for instream fishery needs will also vary with storage and hydrologic conditions.

iv. Refuge Water Supplies

One of the requirements of the Central Valley Project Improvement Act (CVPIA) passed by Congress in 1992 included providing water for state, federal and privately managed wetlands in order to maintain and improve wetland habitat areas. The DCP process will continue to evaluate operations and forecasts in an effort to provide adequate supplies to keep conveyance channels charged; to support seasonal, riparian, permanent and semi-permanent wetlands; and to provide critical habitat for ESA-protected species such as the Giant Garter Snake and tri-colored blackbird in both north and south of Delta refuges. Reclamation will continue to work closely with refuge managers and partner agencies on schedules for the delivery of water for summer, fall, and winter needs.

Refuge water supply contracts allow for reallocation of Level 2 supplies between and among refuges to improve supply flexibility, coordination, and management between Reclamation and wetland managers, and to lessen impacts to other water users.

The CVPIA and refuge water supply contracts allow for flexibility to transfer water from refuges both within basin as well as north of the Delta to south of the Delta. Water transfers from north of Delta refuges to south of Delta refuges could occur in WY 2016 to support priority habitat needs of south of Delta refuges given available capacity to facilitate the transfer.

CVPIA refuge managers will be involved regularly throughout the water supply reevaluation and adjustment process. North of Delta Refuge deliveries are directly included in CVP operational scenarios and forecasts, and calculations regarding anticipated reservoir levels into the late fall and early winter. Given the current degree of hydrologic and regulatory uncertainty about likely Delta pumping operations, deliveries (in terms of both quantity and timing) to south of Delta refuges will need to be further refined as the 2016 DCP is further developed in the months ahead.

v. Operational Flexibility

This 2016 DCP seeks to outline potential need for regulatory flexibility of CVP and SWP operations while still remaining within existing law and regulations, given the current status of species and reservoir storage levels. Maximizing such flexibility allows Project operators to adjust quickly to changes in the weather and environment and to maximize the beneficial use of water to the greatest extent possible within the law. This goal of improving water supply through this 2016 DCP includes facilitating water transfers for municipal and industrial, refuge, and agriculture to ensure the most critical supply needs are met throughout the service areas of the CVP and SWP and ensuring flow standards are as flexible as possible in order to capture runoff from multiple storm events under the otherwise dry conditions. Due to the declining status of several ESA-listed fish species, operational flexibility in 2016 may be more limited than in 2014 or 2015.

The description below in Section V highlights potential D-1641 modifications that may be considered through November 2016 and also identifies actions that may be included in future biological opinion adjustments, if necessary. It is important to note that additional actions may evolve as modeled forecasts are developed or if conditions change unexpectedly

II. Initial Status of Conditions

A. Water Quality (Salinity)

Salinity in the western and central Delta reached record high levels in late November 2015 due to record low Delta inflow as a result of low rainfall in fall 2015. December 2015 precipitation was above average and Delta inflows increased slightly. A combination of these increases and maintaining the Delta Cross Channel (DCC) gates in an open position through December 15 resulted in manageable salinity level decreasing, although still elevated. The DCC gates were closed December 16, 2015, and salinity management continued to be the dominating factor for CVP and SWP Project water operations through the end of December and into the first few days of January. Continued wet conditions in early January 2016 and operating to an Old and Middle flow no more negative than -5,000 cfs per the NMFS Biological Opinions resulted in Delta outflows being more than sufficient to control salinity.

Short-term weather forecasts indicate wetter conditions will continue through January 2016. Therefore, it is not anticipated that salinity will govern Delta water operations through the remainder of January.

Despite higher Delta outflows in recent days, X2 remains upstream of Collinsville, 81 km from the Golden Gate. During the February 1-15 period D-1641 requires X2 to move downstream of Collinsville. This requirement is sometimes referred to as the "starting gate" requirement. Based on the short-term Delta outflow forecasts and the forecast for continued precipitation through the end of the month hydrologic modeling suggests that this requirement will likely be met without the need for augmented Delta outflow from upstream reservoirs.

B. Hydrology

i. Precipitation to date

Precipitation to date is near average for the Sacramento River and San Joaquin River watersheds. The Sacramento Valley water year totals trail the cumulative precipitation from last year at this time, but the San Joaquin basin total is trending significantly higher than last year. As of January 1, 2016, the Sacramento Valley 8-station index was 16.7 inches or 94 percent of average for that date. The San Joaquin Valley 5-station index was 15.8 inches or 122 percent of average for that date.

ii. Runoff

Unlike last year, the snow lines (freezing line) associated with the storms this year has been slightly lower than normal. In other words, a higher than normal percentage of precipitation is falling as snow rather than rain in the watersheds. This, coupled with the low soil moisture and

reduced groundwater table due to drought conditions over the past few years, has resulted in significantly below average runoff into the reservoirs and downstream into the Delta.

Sacramento River watershed runoff was 53 percent of average over the first three months of WY 2016. San Joaquin River watershed runoff was 73 percent of average over the same time frame (October 1, 2015 through December 31, 2015).

iii. SWP and CVP Upstream Reservoir Storage

The lack of precipitation in the last several years has contributed to low reservoir storage levels in the Sacramento River and San Joaquin River watersheds. Although storage has somewhat improved from recent precipitation, Folsom Reservoir storage on November 30, 2015 set a new all-time record low storage for the reservoir on any date. On December 31, 2015, Shasta Reservoir on the Sacramento River, Oroville Reservoir on the Feather River, and Folsom Reservoir on the American River were at 31, 29, and 24 percent of capacity, respectively (50, 47, and 50 percent of average for end-of-month December, respectively). Trinity Reservoir on the Trinity River (water from the Trinity system is diverted to the Sacramento River system) was at 20 percent of capacity and 30 percent of the December end-of-month average. In particular, the San Joaquin River watershed has experienced severely dry conditions for the past three years. New Melones Reservoir on the Stanislaus River was at 13 percent of capacity and 22 percent of the December end-of-month average. The Shasta, Oroville, and New Melones storages for this date have only been lower on two or three occasions, and Trinity storage represents a new all-time record low storage for December 31, 2015 in recorded history.

Due to the cumulative effects of consecutive drought years, storage in upstream reservoirs remains at near historic lows and storage conditions for the major project reservoirs are lower than they were last year at this time.

Reservoir	**End of December 2015 Storage (approximately)**	**Storage as of January 13, 2016**
Lake Oroville	1.02 MAF	1.06 MAF
Lake Shasta	1. 43 MAF	1.54 MAF
Lake Folsom	239 TAF	272 TAF
New Melones	310 TAF	335 TAF
Trinity Lake	497 TAF	511 TAF

iv. Snow Pack

Precipitation events to date have been near normal in terms of temperature with slightly greater than average snow pack accumulations to date through most of the Sierra Nevada. As of January 1, 2016, Northern, Central, and Southern Sierra snow pillows were measuring snow water content equivalents that were at 103, 114, and 82 percent of normal to date, respectively (38, 42,

and 27 percent of the April 1 average). April 1 represents the benchmark of when the average yearly maximum accumulation of snowpack occurs.

Additional snowpack accumulation has continued into January. This accumulated percentage to date has continued to increase for the Northern Sierra with 111 percent of normal to date as of January 14, 2016. Slight declines in this accumulation percentage have occurred during the first part of January for the Central and Southern sierra – now at 106 and 88 percent as of January 14, 2016. However, accumulation of snowpack continues to increase through the Sierra with the percent of April 1 averages now standing at 53, 50, and 38 percent for the Northern, Central, and Southern Sierra snow pillows respectively.

C. Biology

i. Salmonids

DWR and Reclamation operate to the 2009 NMFS Biological Opinion. DWR also operates under a consistency determination from CDFW on the Biological Opinion.

Reclamation coordinated closely with State and Federal Agencies throughout the 2015 temperature management season to prevent the elevated water temperatures seen in August and September of 2014 and to provide more suitable temperatures for later arriving spring-run and fall-run Chinook salmon. As described in Reclamation's Sacramento River Temperature Management Plan, the objectives in 2015 included stable releases from Keswick Reservoir to minimize the potential for redd dewatering and targeted a daily average water temperature of 57°F at the Clear Creek temperature compliance point (CCR CDEC station), but allowed increases up to 58°F if they resulted in cold water savings at Shasta Reservoir. Daily coordination among the agencies on fish monitoring and operations resulted in relatively successful implementation of the Sacramento River temperature management plan and ensured that metrics in the plan were met. However, despite all of the coordination, there were three instances where daily average water temperature exceeded 58°F.

Although adult winter-run Chinook salmon returns in 2015 (3,439) surpassed the number of adult returns in 2014 (3,015), the preliminary estimate of brood year (BY) 2015 juvenile winter-run emigration past Red Bluff Diversion Dam is considerably lower than for the same period for BY 2014. As of January 14, 2016, the estimate of natural juvenile winter-run Chinook salmon emigration past the Red Bluff Diversion Dam is 321,113 based on USFWS rotary screw trap monitoring. This estimate follows the low final juvenile winter-run emigration estimate from 2014, both of which are extremely low when compared to the number of juvenile winter-run Chinook salmon estimated to pass Red Bluff Diversion dam in the past six years (below)*.

2015: 321,113*
2014: 411,309
2013: 1,773,886
2012: 1,364,730

2011: 848,980
2010: 1,280,951
2009: 4,401,776

This year the survival from eggs to juveniles reaching RBDD is just 2.1 percent. That is, there was a 97.9% mortality of winter-run Chinook salmon eggs and fry on the upper Sacramento River. This follows on the 95% mortality of winter-run Chinook salmon eggs and fry on the upper Sacramento observed in 2014. This suggests that despite 2015temperature management efforts, Sacramento River winter-run Chinook in BY 2015 have suffered substantial mortality during the egg incubation and emergence periods in the Upper Sacramento River. Since winter-run Chinook salmon spawn every three years, there is a need to conservatively manage for protection of the 2016 winter-run cohort given the year class failures observed in the last two years.

In anticipation of considerable water temperature impacts to incubating winter-run eggs and alevin in WY 2015, the Livingston Stone National Fish Hatchery (LSNFH) again increased its winter-run broodstock collection; this year to 257 adults, or over twice the typical limit of 120. There are currently approximately 420,000 juvenile hatchery winter-run rearing at LSNFH and awaiting release in late January or February. Given consecutive years of poor egg-to-fry survival, Reclamation will strive to implement temperature management earlier in WY 2016 and maintain temperature control until late in the water year.

Through January 14, 2016, the WY 2016 total for combined loss of wild winter-run-sized Chinook is 23. This loss estimate includes winter-run-sized fish according to the length-at-date criteria used at the export facilities to make run assignments. The Delta Operations for Salmon and Sturgeon (DOSS) Team estimated the following distribution of winter-run and spring-run Chinook salmon:

Location	Yet to Enter Delta (Upstream of Knights Landing)	In the Delta	Exited the Delta (Past Chipps Island)
Young-of-year (YOY) winter-run Chinook salmon	10% - 25%	75% - 90%	0-1%
YOY spring-run Chinook salmon	70%	~30%	0-1%

ii. Delta Smelt

DWR and Reclamation are required to protect Delta smelt under the 2008 Delta Smelt Biological Opinion issued by USFWS, as well as those of a consistency determination from CDFW on the Biological Opinion. The Smelt Working Group (SWG) meets weekly from late November onward to evaluate up-to-date biological and technical issues regarding delta and longfin smelt and develop recommendations for consideration in implementation of the Biological Opinions.

Delta smelt field surveys this past WY indicate that relative abundance is at an historical low. The historically low Fall Midwater Trawl (FMWT) index of 9 in 2014 was followed by historically low abundance indices for all field surveys in 2015; the Spring Kodak Trawl index was 13.8 and the 20mm index was 0.3. In the first two months of the 2015 CDFW Summer Tow Net Survey (STN), conducted in June, July, and August, Delta smelt were collected in the Cache Slough-Sacramento Deepwater Ship Channel area and the lower Sacramento River. The resulting abundance index for 2015 is 0.0, the lowest index reported in the history of the STN. The 2015 FMWT followed, resulting in an index reached an historic low of 7.

Similar to 2014, a special Spring Kodiak Trawl survey was completed in December 2015 to more precisely measure the distribution of adult Delta Smelt. Unlike 2014 where 28 fish were caught from several stations, the 2015 December SKT caught only two Delta Smelt at Station 606 (the western portion of Montezuma Slough). Early warning monitoring at Jersey Point and Prisoners Point in the lower San Joaquin River began on November 30, 2015 a regular frequency through December 15 catching only 3 Delta Smelt at Jersey Point. An increase of Delta Smelt was detected at both locations in the latter half of December, indicating that storms in December had stimulated movement of Delta Smelt into the fresher water portions of the estuary. As of January 6, 2016 no Delta Smelt have been observed in salvage at either the Tracy or Skinner Fish Collection Facilities.

iii. Longfin Smelt

DWR operates under the 2009 Longfin Smelt Incidental Take Permit (ITP) issued by CDFW. Entrainment risk for Longfin smelt is highest in drier hydrology when the low salinity zone is farther upstream and adults migrate farther into the Delta to spawn. The 2015 FMWT collected three Longfin Smelt, resulting in an index of four (4), the lowest index in FMWT history. Previous surveys (Bay Study) conducted in the early summer of 2015 detected Longfin Smelt in the Western Delta and the San Francisco Bay with lower densities in Suisun Bay, and in the lower Sacramento River. CDFW, through the SWG, tracks distribution and salvage to assess risk and make appropriate operational recommendations consistent with the Longfin Smelt ITP. No Longfin smelt were detected in the central or south Delta during the December Fall Midwater Trawl or the December and January Spring Kodiak Trawls and as of January 15, 2016 none have been observed in salvage at either the Tracy or Skinner Fish Collection Facilities. The first Smelt Larva Survey of 2016 was completed January 8, 2016 and collected Longfin larvae at two stations in the central and south Delta, no Delta Smelt larvae were detected.

iv. Refuge Water Supply

The CVPIA Refuge Water Supply Program supports 19 managed wetland areas. These areas are strategically located across the Central Valley to provide the core critical wetland habitat for migratory birds and wetland dependent wildlife, including threatened and endangered species such as the Giant Garter Snake and tri-colored blackbird.

The hydrologic conditions will be monitored throughout the spring and if the current projected rainfall pattern decreases, additional measures may be necessary to support refuge conditions in WY 2016.

Proposed Operations and Measures:

- Level 2 represents a baseline of water supply needed by refuges to manage habitat. Level 2 allocations to CVPIA refuges will be maintained, at minimum, consistent with Settlement and Exchange contractor allocations. To maximize the quality and extent of habitat that can be provided and maintained by a limited water supply, system operators will strive to schedule delivery of these refuge supplies at the times requested by refuge and wildlife managers, and in conjunction with deliveries of available Incremental Level 4 water supplies.
- System operators will endeavor to deliver water to refuges from summer through winter, in coordination with refuge manager schedules, and any opportunities to transfer, reallocate, or exchange refuge water supplies to maintain critical seasonal land management and biological needs at public and private refuges and wildlife areas.
- To enable wetland habitat to fully benefit from available storm flows, agencies will encourage water system managers to take advantage of lifted curtailments as much as possible and operate systems to meet the needs of all users within their purview, including refuges, seasonal wetlands and easement lands. Additionally, any storm flows captured by refuges in the absence of curtailments, will not be counted as contracted deliveries.
- Refuge managers will continue to work with fisheries agencies, water districts, non-governmental organizations, and system operators to identify opportunities for delivery flexibility to accommodate the needs of salmon at different life stages while minimizing impacts to refuge operations.

III. Projected Hydrology and Runoff

The DWR's Hydrology and Flood Operations Office within the Division of Flood Management produces estimates of water year runoff for the major watersheds of the Sacramento and San Joaquin River basins beginning in January and updates these as part of the Department's Bulletin 120 update process from February through May of each year. The runoff forecasts utilized for this 2016 DCP are informed by precipitation, snowpack, runoff and other antecedent hydrologic conditions as they existed on January 1, 2016. These forecasts combine runoff associated with antecedent conditions with anticipated runoff resulting from precipitation predicted to occur for the remainder of the year under the 50%, 90%, and 99% hydrologic exceedence scenarios. For example, the 90% exceedence hydrology assumes inflows from rainfall and snowmelt at levels that are likely to be exceeded with a 90% probability, or in other words, there is a 10% or less chance of actual conditions turning out to be this dry or drier from this point forward. The 50% probability is the 50/50 assumption - it is just as likely to be drier or wetter.

Operations forecasts utilize the hydrologic forecasts as inputs to simulate CVP and SWP water operations under various regulatory constraints and produce forecasted reservoir storages,

releases, flows, and deliveries under the same set of hydrologic exceedence scenarios. These operations forecasts provide general guidance for annual water delivery, storage management, and power planning purposes for each exceedence scenario assumption. Actual hydrologic events act in time steps shorter than a month and are often unpredictable more than a few days to a week out. Day-to-day operations are also influenced by operating criteria such as those found in U.S. Army Corps of Engineers flood control manuals, D-1641, and the Biological Opinions. Outputs from forecast models, as provided in this 2016 DCP, represent system responses to the overlay of very specific operating criteria on a generic set of hydrologic scenarios. These operations forecast updates are generally completed by the third week of the month.

IV. Operations Forecasts - Projected Releases and Storage Levels

The operational forecasts are based on a model using 50%, 90% and 99% runoff forecasts based on the hydrologic conditions as they existed on January 1, 2016. These operational scenarios show the likely ranges of hydrology for potential future conditions, and the storage and flows associated with each scenario (Attachment 1). The base assumptions utilize existing storage conditions, actual precipitation and runoff occurred to date, future precipitation based on the historical statistics, projected water supply deliveries, and meeting existing water quality standards and current biological opinion reasonable and prudent alternatives. The 99% hydrology scenario results suggest the installation of a salinity drought barrier will be necessary.

Under all the hydrologic scenarios, the model assumes fulfilling the contractual obligations between DWR and North Delta Water Agency. For the Feather River Settlement contractors, no shortage provision is assumed under the 50% hydrologic scenario, while the contractual 50% shortage provision is assumed to be triggered under the 90% and 99% hydrology. A final determination of the delivery to the Feather River Settlement contractors will be made based on the April forecasts. Deliveries to Sacramento River Settlement contractors and San Joaquin River Exchange contractors are not explicitly identified in these forecasts. Reclamation will be evaluating available supplies to these contractors based on February forecast projections.

In addition to the monthly updates called for the in the December 15, 2015 SWB adopted Order, DWR and Reclamation will do additional modeling scenarios consistent with this 2016 DCP in order to assess ways to improve storage, increase flexibility in the system, and to further define potential operational adjustments.

V. Projected D-1641 TUCP Requests

For context, the 2016 DCP includes a summary of modifications to D-1641 that were granted in 2014 and 2015 (subsection A below). The Summary Table (Attachment 2) outlines the D-1641 Bay-Delta Standards with potential 2016 TUCP requests by month under the 50%, 90%, and

99% hydrologic scenarios. These potential D-1641 modification requests are outlined below (subsection B below) in a narrative format.

A. Summary of TUCP Requests in 2014 and 2015

WY 2014 Hydrology Pattern
Under the 2014 runoff hydrology, DWR and Reclamation would seek to operate the CVP and SWP under modified D-1641 standards with some adjustments to the Biological Opinions. In 2014, although modified D-1641 standards were in effect, the CVP and SWP operated between the modified D-1641 standards and unmodified D-1641 requirements.

The following information highlights the general conditions approved under various Orders issued pursuant to TUCPs filed with the SWB in 2014:

<u>February and March</u>

a) Monthly average Net Delta Outflow Index (NDOI) was no less than 3,000 cfs.
b) Maximum export limited to 1500 cfs when other standards modified.
c) DCC gates could be open to maintain water quality.

<u>April, May and June</u>

a) Monthly average NDOI was no less than 3,000 cfs for April and May.
b) Maximum export limited to 1500 cfs when other standards modified.
c) San Joaquin River flow requirements at Airport Way Bridge no less than 700 cfs during the pulse flow period. Following the pulse flow, the monthly average minimum flow rate no less than 500 cfs.
d) DCC gates could be opened to maintain water quality for April through May 20.
e) Western Delta Sacramento River at Emmaton electric conductivity (EC) compliance location was moved to Threemile Slough for the month of June.

<u>July, August, September, October, and November</u>

a) Monthly average NDOI no less than 3,000 cfs in July.
b) Maximum export limited to 1500 cfs when other standards modified.
c) Sacramento River flow at Rio Vista no less than 2,000 cfs on a monthly average from September to November 15.
d) The Western Delta Sacramento River at Emmaton EC compliance location was moved to Threemile Slough from July through August 15.
e) San Joaquin River flow requirements at Airport Way Bridge no less than 800 cfs on a monthly average for October and November.

WY 2015 Hydrology Pattern
Under a 2015 runoff hydrology, DWR and Reclamation would seek to operate the CVP and SWP under modified D-1641 standards with some adjustments to the Biological Opinions. In

2015, although modified D-1641 standards were in effect, the CVP and SWP operated between the modified D-1641 standards and unmodified D-1641 requirements.

The following information highlights the general conditions approved under various Orders issued pursuant to TUCPs Petitions filed with the SWB in 2015:

February and March

a) Monthly average NDOI no less than 4,000 cfs.
b) Maximum export limited to 1500 cfs when other standards modified.
c) San Joaquin River flow requirements at Airport Way Bridge no less than 500 cfs on a monthly average.
d) DCC gate could be opened in compliance with the DCC gate triggers matrix described in Appendix G of the April 2014 Drought Operations Plan and Operational Forecast.

April, May, and June

a) Monthly average NDOI was to be no less than 4,000 cfs.
b) Maximum export limited to 1500 cfs when other standards modified.
c) San Joaquin River flow requirements at Airport Way Bridge no less than 710 cfs at Vernalis during the pulse flow period from March 25 through April 25. Monthly average minimum flow rate at Vernalis between April 26 and May 31 no less than 300 cfs. For June, monthly average flow rate at Vernalis no less than 200 cfs.
d) DCC gate could be opened between April 1 and May 20 in compliance with the DCC gate triggers matrix described in Appendix G of the April 2014 Drought Operations Plan and Operational Forecast.
e) Western Delta Sacramento River at Emmaton EC compliance location was moved to Threemile Slough.

July, August, September, October, and November

a) Minimum NDOI no less than 3,000 cfs in July.
b) Maximum export limited to 1500 cfs when other standards modified.
c) Average monthly minimum Sacramento River at Rio Vista flow no less than 2,500 cfs during September, October and November.
d) Western Delta, Sacramento River at Emmaton EC compliance location was moved to Threemile Slough July through August 15.

In addition to these modified D-1641 standards, the water transfer period was extended to include October and November. Reclamation implemented a Sacramento River Temperature Management Plan which controlled releases from Keswick Reservoir. Additionally in 2015, DWR installed an Emergency Drought Barrier at West False River to help manage salinity in the interior Delta.

B. Potential 2016 TUCP Requests to Modify Standards

Differences in snowpack distribution, variation among basin and sub-basin hydrologic circumstances, disparity among month to month hydrologic conditions, and other meteorological uncertainties can also effect real-time reservoir and Delta operations and the available water supply at any given time. The 50%, 90% and 99% exceedence scenarios presented here are used to guide potential modifications to D-1641 or potential adjustments to the Biological Opinions. The purpose of this document is to set forth the general foreseeable modifications in 50%, 90% and 99% exceedence scenarios.

The following are potential 2016 TUCP requests to modify D-1641 standards based on the operational forecasts, which are based on a model using 50%, 90% and 99% runoff forecasts based on the hydrologic conditions as they existed on January 1, 2016.

January 1, 2016 50% Hydrologic Scenario

April, May and June

a) San Joaquin River flow requirements at Airport Way Bridge during the pulse flow period (April and May).
b) Following the pulse flow, the monthly average minimum base flow requirement.

January 1, 2016 90% Hydrologic Scenario

March, April, May and June

a) Monthly average NDOI of no less than 4,000 cfs. (April through June).
b) Maximum export limited to 1500 cfs when other standards modified.
c) Modify San Joaquin River base flow and pulse flow requirements at Airport Way Bridge (April through June)
d) DCC gates could be opened to maintain water quality for March through June 15.
e) Western Delta Sacramento River at Emmaton electric conductivity (EC) compliance location move to Threemile Slough April through June.

July, August, September and October

a) Sacramento River flow at Rio Vista no less than 2,000 cfs on a monthly average from September and October.

January 1, 2016 99% Hydrologic Scenario

March, April, May and June

a) Monthly average NDOI of no less than 4,000 cfs.
b) Maximum export limited to 1500 cfs when other standards modified.

c) Modify San Joaquin River base flow and pulse flow requirements at Airport Way Bridge
d) DCC gates could be opened to maintain water quality for March through June 15.
e) Western Delta Sacramento River at Emmaton electric conductivity (EC) compliance location move to Threemile Slough April through June.

July, August, September and October

i. Monthly average NDOI no less than 3,000 cfs in July.
ii. Maximum export limited to 1500 cfs when other standards modified.
iii. Sacramento River flow at Rio Vista no less than 2,000 cfs on a monthly average from September and October.
iv. The Western Delta Sacramento River at Emmaton EC compliance location move to Threemile Slough from July through August 15.
v. Fall San Joaquin River flow requirements at Airport Way Bridge to be determined for a 31-day period.

C. February 2016 Considerations

Due to wet conditions currently being experienced in mid-January and as discussed under Section II.B. Reclamation and DWR do not anticipate any need for modifications to D-1641 standard modifications on February 1. However, if precipitation and hydrology changes dramatically, for example if rain ceases today, adjusted requirements and operations may be needed as early as February 15. Precipitation and hydrology will continue to be monitored to identify the earliest date at which a change in requirements may be needed in response to a change to more dry conditions.

D. RPA Actions in Effect through February 2016

2009 Biological Opinion and Conference Opinion on the Long-term Operations of the Central Valley Project and the State Water Project (NMFS BiOp) Provisions:

i. Delta Cross Channel (DCC) Operation- As per RPA Action IV.1.2 February 1 – May 15 the DCC gates are mandated to be closed. In Previous DCPs, alternative operations have been considered and may be requested in WY 2016 as a means of managing water quality concerns. The DCC gate triggers matrix (as described in Appendix G of the 2014 DOP) has been used to determine operation the DCC gates and in a method that balances water quality and fishery objectives in the Delta. There is a reasonable potential that water quality could be negatively affected by a continuation of the drought into early WY 2016 or by a greater emphasis on achieving upstream storage targets; therefore it is practicable to consider modification to DCC operation as a means of drought contingency planning.
ii. Old and Middle River Flow Management - As per RPA Action IV.2.3 January 1 – June 15 OMR shall be no more negative than -5,000 cfs as a 14-day running average, and no more negative than -6,250 cfs as a 5-day running average (25% more negative). In previous DCPs, drought exceptions to allow more negative OMRs have been requested as needed to capture sporadic storms (increase exports). These past exceptions have been

evaluated based on listed species distribution and risk in the South and Central Delta, and if conditions remain very dry.

iii. Shasta operations: Implementation and Exception Procedures for End of September (EOS) Storage of 1.9 MAF or below - As per RPA Action I.2.2.C, if the EOS storage is at or below 1.9 MAF, then Keswick releases shall be managed to improve storage and maintained at 3,250 cfs unless hydrology improves. Currently Keswick releases are targeting 3,250 cfs as a means of increasing Shasta storage and as part of contingency planning for potential dry hydrology in WY 2016. Depending on system-wide needs and balancing multiple objectives, Reclamation may propose reducing the minimum Keswick releases to as low as 2,750 cfs to further conserve Shasta storage.

2008 Biological Opinion on the Long-term Operations of the Central Valley Project and the State Water Project (USFWS BiOp Provisions):

i. The proposed approach for Delta Smelt in the early winter is focused on avoiding drawing Delta Smelt into areas where adult Delta Smelt and their progeny would be at risk of entrainment. If successful, that approach is intended to minimize the need to take actions for Delta Smelt in the spring that are more restrictive. USFWS is concerned with the ability to find flexibility in the 2008 BiOp for WY 2016, but would consider any requests from the CVP and SWP.

VI. Further Aspects of Potential Operations

A. Instream Flows

i. Trinity River

Spring flows on the Trinity River will be consistent with annual allocations as provided through the Trinity River Main-stem Fishery Restoration Record of Decision. Flows for the remainder of the year will make consistent with SWB Order WR 90-5. Consistent with fish health criteria, releases to augment flows in the Lower Klamath River may be considered.

ii. Sacramento River

Flow releases at Keswick will be maintained at 3,250 cfs or below this winter and spring as much as possible to help conserve storage in Shasta Lake. Procedures consistent with the NMFS Biological Opinion will be applied through this period, and Reclamation will again work closely with the Sacramento River Settlement Contractors in scheduling their river diversions in a manner to help minimize the release of water prior to the start of the temperature management season. Likely starting in late May, flow releases will increase at Keswick to facilitate temperature management along the upper reach of the Sacramento River, and these increased flows will then be used to meet other Project purposes in the system. (More information see Initial Temperature Management Projections below in Section VI.B.i).

iii. Clear Creek

Flows on Clear Creek will be consistent with the NMFS Biological Opinion and RPA actions. The timing of any prescribed pulse flows will be closely evaluated through technical teams to minimize effects on temperature management and/or ability to help meet other system flow needs.

iv. Feather River

DWR anticipates flows on the Feather River will be consistent with flow requirements on the Low Flow Channel and High Flow Channel on the Feather River and all temperature requirements at the Feather River Fish Hatchery and Robinson's Riffle for all periods as designated in the current FERC license which includes consultation by NMFS and USFWS, and the 1983 agreement between DWR and CDFW.

v. American River

Flows on the American River will be consistent with the provisions of the NMFS Biological Opinion and RPA actions. Flows in the winter and spring will generally follow the outline of the "American River Flow Management Standard", with flows in the summer and into the fall intertwined with the temperature plan for Folsom Lake and the American River, flow needs to support Delta operations. Starting in June, flow releases will increase at Nimbus to facilitate temperature management along the American River, and these increased flows will then be used to meet other Project purposes in the system.

vi. Stanislaus River

Flows on the Stanislaus River will be consistent with the provisions of the NMFS Biological Opinion and RPA actions. Generally flows in the winter and spring will follow the "Appendix 2e" schedules (from the NMFS Opinion) as modified through the interagency Stanislaus Operations Group. Given the severely depleted storage at New Melones Lake, minimum flows will be maintained as much as possible. Any potential modifications to flow objectives on the lower San Joaquin River at Vernalis are intended to conserve water in New Melones Lake to help balance the needs of the Stanislaus River and conditions on the lower San Joaquin River.

B. Additional Drought Response Actions

i. Initial Temperature Management Projections

Adult winter-run Chinook salmon returns in 2015 surpassed the number of adult returns in 2014; however, the juvenile winter-run emigration at Red Bluff Diversion Dam for 2015 was

considerably lower than for BY 2014. These data reflect a 97.9% mortality of winter-run Chinook salmon eggs and fry on the upper Sacramento River in 2015.

Given the substantial mortality of Sacramento River winter-run Chinook during the egg incubation and emergence periods in BYs 2014 and 2015, there is a need to conservatively manage for protection of the third of three winter-run Chinook cohorts, which will return to spawn upper Sacramento River beginning in summer of 2016. In the coming months, Reclamation and NMFS will be evaluating different actions to balance fishery needs, water supply, and water quality to develop a greater likelihood of protecting juvenile winter-run from BY 2016. As mentioned previously, any proposed action will require the cooperation of senior water rights holders on the Sacramento River and a system-wide operational approach to prioritize cold-water storage and operations at Shasta Lake.

The current suite of runoff projections based on the January 1, 2016 forecasts suggests a significant range of possible temperature management outcomes for the Sacramento River for the coming year. The range is more pronounced than some of the other aspects of this DCP given that the seasonal inflow to Shasta Lake is the prime driver of temperature performance on the Sacramento River, and the range of the potential inflow to Shasta Lake is sizable this early in the water year. Specifically, the January through April inflow projections currently range from 1.22 MAF in the 99% exceedence forecast, 1.61 MAF in the 90%, and 2.59 MAF in the 50%.

Another important consideration this year is that diversions from the Trinity River basin to the Sacramento River will again be limited given the relatively low storage projections at Trinity Lake and anticipated Trinity River operations this season. Based on forecasted projections, the upper Sacramento River water temperature compliance locations could range from a location upstream of the Clear Creek confluence in a 90% exceedence scenario, to the Ball's Ferry location in a 50% exceedence scenario. As the season progresses, Reclamation anticipates using the procedures outlined in the NMFS Biological Opinion to develop a Drought Contingency Plan (Attachment 3).

Under any hydrologic exceedence scenarios, there is a need to maximize water storage in Lake Shasta to comply with the December 15, 2015 adopted Order and also increase the likelihood of successfully implementing a water temperature management plan to benefit winter run Chinook salmon. The NMFS has prepared some initial concepts to achieve storage and temperature goals (Attachment 4). In general, the proposed concept involves flow release as low as 2750 and 3250 until late May or initiation of a water temperature management plan.

ii. Hatchery Winter-run

Approximately 420,000 juvenile winter-run are currently at Livingston Stone National Fish Hatchery (LSNFH), awaiting release. LSNFH managers will coordinate with DOSS to time the hatchery release of winter-run Chinook with adequate hydrologic conditions. In addition, 570 of the hatchery winter-run will be acoustically-tagged and released at approximately the same time so that their movement down the Sacramento River into and through the Delta can be tracked.

Nine real-time acoustic tag receivers have been deployed at various locations, from Calusa to Middle River, to augment other monitoring and help inform the (real-time) effects of operations and their influence on the timing and distribution of salmonids (and specifically winter-run) as they emigrate down the Sacramento River and into and through the Delta. DOSS will review the real-time acoustic tag data to determine the likely timing and distribution of the hatchery winter-run in the Sacramento River and into the Delta, and advise NMFS and Water Operations Management Team of potential risk of hatchery winter-run to the influences of the hydrodynamic effects of increased exports during sporadic storm events.

iii. Delta Cross Channel Gates

Based on current and projected water quality in the Delta, and at least 3 weeks prior to any need to open the DCC gates, Reclamation and DWR will determine whether adjustments in the timing of the opening of the DCC gates should occur in order to address the prospects of elevated salinities in the Delta (Action IV.1.2). If flexibility in DCC gate operations is warranted, the DCC gate triggers matrix will be likely be proposed to determine risk to species and DCC gate operation in the event the DCC gates are opened to address water quality or supply concerns. The triggers outlined in this matrix provide direction for when the gates may remain open and a method that balances water supply and fishery objectives in the Delta.

iv. Salinity Control Barrier(s)

Typically when saltwater threatens to encroach deeper into the Delta, Project operators repel it either by reducing the amount of water exported from the Delta or by increasing the amount of water flowing into the Delta from upstream reservoirs. With low Delta outflow salinity control barrier(s) is an additional tool to help mitigate a worst-case circumstance in which upstream reservoirs lack sufficient water to repel Delta salinity intrusion.

- West False River Barrier

In 2015, DWR constructed a temporary emergency drought barrier at West False River in the Delta, spanning the approximately 750-foot-wide river between Jersey and Bradford islands to block salt water that tidal action attempts to push eastward from San Francisco Bay into Franks Tract. The barrier was erected in May and June 2015. The trapezoidal barrier was about 120 feet wide at its base and 12 feet wide at its top above the waterline. About 150,000 tons of rocks were dropped from barges with hinged bottoms or lifted from barges and dropped by crane into the river's channel to create the barrier. Water quality monitoring showed localized salinity control benefits from the barrier in critical areas such as Franks Tract. Removal of the barrier began on September 8 and was completed on November 15, 2015.

- Additional Drought Barriers

If winter forecasts show there will not be enough water in upstream reservoirs to repel the saltwater and meet essential health and safety and other critical needs, then installation of additional drought barriers may be considered to lessen water quality impacts. Additional temporary rock (rip-rap) drought barriers may need to be installed at up to two locations in the Delta if drought conditions persist in 2016 to manage salinity in the Delta.

v. Water Transfers

Water transfers outside of the standard July to September water transfer window are typically considered on a case-by-case basis. In 2015, the CVP and SWP received an extension of the water transfer window to November 15, 2015 to assist water management objectives. In 2016, the CVP and SWP may seek an extension of the water transfer window for a similar objective.

VIII. Real Time Monitoring Efforts to Inform Operations

A. Delta Smelt Early Warning Surveys

The current drought has highlighted the need for improved information to support management decisions pertaining to the effect of winter/spring exports on the Delta Smelt population. Reclamation, DWR, and USFWS coordinated in 2014 to develop early warning surveys to provide information on Delta Smelt distribution that would better inform water operations. In January 2014, USFWS implemented a pilot monitoring effort at Jersey Point on the San Joaquin River near Antioch using multiple hauls of a Kodiak trawl to provide an "early warning" tool to assess density changes at that location (Polansky et al. 2014). The 2014 Pilot Study taught us that Delta Smelt were persistently occupying the river near Jersey Point. Data also indicated that catch density changed rapidly and repeatedly in association with storms and associated changes in turbidity. However, no adult Delta Smelt were salvaged in WY 2014, leaving uncertainty about whether Delta Smelt were moving beyond Jersey Point or if environmental conditions resulted in increased catchability of non-dispersing individuals. Starting in December 2014 (WY 2015), supplemental early warning trawls occurred at Prisoners Point, about five river miles upstream from Jersey Point, to provide smelt density information at a point that is more proximal to confluences with the Old and Middle rivers. These multiple station early warning surveys were re-initiated on November 30, 2015 and are on-going in 2016.

The overall intent for early warning surveys is to inform USFWS and others whether substantial numbers of Delta Smelt are moving or being moved, especially during weather events and freshets, into areas of high risk for entrainment into the export facilities. This information collected helps to inform export operational decisions in WY 2015 and is currently helping inform decisions in WY 2016. Last year, the Jersey Point and Prisoners Point sampling data were used as a basis for increasing positive flows in Old and Middle rivers, i.e., making the flows less negative.

Lastly, it was intended that the early warning sampling in WY 2016 would be closely coordinated with USGS SmeltCam surveys at Jersey Point and in the False River (Feyrer et al. 2015). The SmeltCam is an open ended trawl net fitted with an underwater video camera that enumerates and identifies fish species automatically as they pass through the net. The SmeltCam survey is intended to identify the mechanisms influencing the vertical and lateral distribution of Delta Smelt in the water column, particularly during upstream dispersal when Delta Smelt are vulnerable to entrainment. Delays in permitting have delayed deployment of the SmeltCam as of January 8, 2016.

At present, due to conditions in the south Delta which are conducive to upstream movement of Delta Smelt, the early warning trawls are occurring primarily at Prisoners Point and Jersey Point on alternate days, and will continue as such until conditions or circumstances indicate a need to return to weekly sampling.

B. Salmonids Drought Monitoring

Reclamation, NMFS, USFWS, CDFW and DWR have been closely coordinating on long-term and near-term drought monitoring efforts initiated after WY 2013. In WY 2014, various salmonid monitoring efforts (e.g., installation of temperature and dissolved oxygen probes adjacent to winter-run redds, implementation of a DCC gate operations trigger matrix, and increased beach seining and trawling efforts to determine the timing and magnitude of salmonid emigration into the Delta) were implemented in order to determine the effect of the drought and operations on the salmonids and to be able to make real-time management decisions regarding operations and protection of the listed anadromous fish species.

In WY 2015, various salmonid monitoring efforts were continued or expanded. These monitoring efforts were identified in the CVP and SWP Drought Contingency Biological Monitoring Plan for WY 2015 and Beyond[1] (Biological Monitoring Plan), which was intended to cover research and monitoring needs beyond the 2015 water year. Specifically the Biological Monitoring Plan described research and monitoring actions needed to implement changes in Central Valley water operations to best protect threatened and endangered fish species while also providing additional flexibility in operations during periods of prolonged drought. The Biological Monitoring Plan was also intended to highlight the most relevant and existing research and critical science needs that, if better understood, might better inform the decisions made about how to operate the CVP and SWP during critically dry periods.

Much of the increased research and monitoring for Central Valley salmon and sturgeon that began in WY 2014, and continued in WY 2015, will continue in WY 2016 in order to improve scientific understanding of these species. Specifically, the following actions are expected to continue for assessing and managing the effects of continued water scarcity:

Monitoring to Support and Evaluate Old and Middle River Flow Management

[1] http://ca.gov/drought/pdf/DCP-2015-Monitoring-Plan_12-12-14.pdf

In WY 2015, the USFWS implemented the use of additional Kodiak trawl monitoring stations in the central Delta, as a way of assessing salmonid presence and the risk of entrainment into the south Delta. This action was proposed in such a way as to coordinate monitoring efforts in the central Delta already targeting Delta smelt as part of the "early warning" sampling. This monitoring is already underway in WY 2016 providing additional information regarding the distribution of fish in the Delta.

Enhanced Particle Tracking Model (PTM)

The Biological Monitoring Plan directed NMFS to implement a pilot application of the enhanced Particle Tracking Model (ePTM) for real-time operations in 2015 as an initial trial of the collective modeling and analytical efforts and techniques required for rapid response. With increased focus and dedicated staffing at NMFS, the NMFS-SWFSC, and DWR (modeling staff), the ePTM pilot application was implemented in real-time twice in 2015 to allow consideration of two requests to temporarily modify the limit to OMR. Following this initial pilot and its subsequent review by an Independent Review Panel, this tool will be further refined in WY 2016. Additional real-time use of this tool may again occur in WY 2016 should conditions warrant.

Recalibrate Sacramento River Temperature Forecasts

NMFS and Reclamation agreed in early 2015 to organize a technical meeting to discuss the level of effort involved in "recalibrating" the Reclamation temperature model and develop a better understanding of its use and limitations as a temperature/water operations planning tool for fisheries. This effort resulted in a number of technical discussions where the possibility of incorporating the NMFS-SWFSC short-term temperature forecasts for the Sacramento River in real-time offered through the RAFT model and website[2]. The expectations for WY 2016 are to continue to refine the existing Sacramento River Water Quality Management Model (SRWQM) and to incorporate temperature measurements from a newly installed Distributed Temperature System (DTS) which will provide high resolution temperature data.

Monitoring to Support and Evaluate DCC Gate Operations

Similar to the expanded monitoring implemented in 2014, additional monitoring was proposed in 2015 in the Sacramento region to inform the use of the "Matrix of Triggers for Delta Cross Channel Gate Operations" (Attachment G to the 2014 DOP[3]). The 2015 monitoring consisted of continuous 24 hour sampling at Knights Landing RST starting when a flow event at Wilkins Slough occurs, and 3 days prior to a DCC gate opening and throughout the time that the gate is open, trawl sampling at Sherwood Harbor and Sacramento beach seine sampling will be increased to daily. In WY 2016, the Delta Juvenile Fish Monitoring Program (DJFMP) is prepared to expand its sampling efforts in the

[2] http://oceanview.pfeg.noaa.gov/raft/
[3] http://www.ca.gov/drought/pdf/2014-Operations-Plan.pdf

Sherwood Harbor region of the Sacramento River in response to a possible DCC gate opening.

Winter-Run Acoustic Tagging Study

In WY 2015, NMFS-SWFSC continued to implement an acoustic tagging study (begun in 2013) to determine reach survival of hatchery winter-run throughout the Sacramento River and Delta. The WY 2015 Study was successfully implemented with two releases of tagged winter-run from LSNFH (571 total fish released). Funding for continuation of this tagging study in WY 2016 has been secured, and LSNFH, in coordination with NMFS-SWFSC, are set to tag and release 570 winter-run again this year with the rest of the hatchery production.

Butte Creek Spring-run Acoustic Tagging Study

In WY 2015, NMFS-SWFSC proposed to leverage existing acoustic tagging infrastructure and partnerships to explicitly monitor the survival and reach specific movement of wild Butte Creek spring-run Chinook salmon during their outmigration to the ocean. The SWFSC tagged 141 of Butte Creek fish in March of 2015. This study will continue in WY 2016.

Central Valley Salmonid Predation Studies

CDFW selected three projects for funding as part of a $1 million grant solicitation focused on research projects regarding predation on one or more fish species listed under the ESA/CESA. The geographic area of interest includes the Delta and the anadromous reaches of the Sacramento River and San Joaquin River watersheds. Studies funded through the competitive grant will improve the understanding of predator-prey relationships and be considered in adaptively managed efforts to reduce predation effects on populations of listed species and aid in their recovery.

Central Valley Steelhead Monitoring

Under contract with Pacific States Marine Fisheries Commission (PSMFC), CDFW has begun implementation of the Central Valley Steelhead Monitoring Program. In the late summer and early fall of 2015 field equipment testing was conducted and fixed monitoring stations were established to monitor steelhead in the Sacramento River and upper Sacramento River Basin. Actual program trapping started in mid-Oct resulting in low catch, probably due to the lower flows and unusual visibility, but as the flows and turbidity have increased, more fish have been captured. All captured fish are sampled for tissue analysis and tagged with PIT tags, while hatchery fish also get FLOY tags. The tags will used for mark-recapture data analysis when tagged fish are observed in the hatcheries, the CDFW-run angler creel survey, or detected by PIT antenna arrays in the river, upper tributaries, and delta.

Increasing Data Accessibility

In WY 2015, it was recognized that there was a need to establish an internet data hub to house or link to all data sources relevant to delta operations. NMFS, with USFWS, and CDFW, have worked with a number of Water Contractors to establish an online data repository, through the existing web portal Bay Delta Live, and with the web developers,

34north. Although the "Database Dashboard" is not yet up and running, the group expects that the web portal will be available in WY 2016. The ultimate goal is to have a single site for all data related to Delta conditions and ESA/CESA fish.

C. Early Warning Turbidity Monitoring

Real time boat based turbidity transects were initiated in December 2014 in order to more accurately quantify turbidity levels and gain greater spatial resolution that what can be acquired from the continuous, real time, station locations. As listed in the NMFS Salmon and the USFWS Delta Smelt Biological Opinions, turbidity is utilized as an indicator of fish movement.

Drought related boat based turbidity transects were first conducted from December 2014 to March 2015. As the drought continues into the current WY, so does the need for mid-channel turbidity readings to supplement the continuous water quality station network in the Central and South Delta. Method improvements for the upcoming 2015-2016 Turbidity Transects will improve continuity of results between runs and operators. The turbidity transects during WY2014 were relied on for accurate and efficient decision making by water project operational management, and are anticipated to be a continued source of valuable, spatially detailed turbidity data.

The 2015-2016 Turbidity Transects will obtain a finer resolution of turbidity concentration in the South Delta. As turbidity is a key environmental trigger in the USFWS and NMFS Biological Opinions for anadromous fish and Delta Smelt, this mid-channel turbidity monitoring will be an important supplement to the existing continuous water quality station network in the Central and South Delta. Following each transect, results will be distributed within 24-hours as a GIS map and utilized to inform real-time drought operations for the SWP and Interagency Ecological Program stakeholder project teams. These daily turbidity transects will create a necessary 'early warning' system for improved efficiency between SWP operations and Delta Smelt and salmonid trawl efforts. From February 1 through June 30, 2015, it is anticipated that transects will be conducted as necessary to track the changing turbidity conditions and provide operational flexibility for flow management. Supplemental monitoring will be conducted in other regions and outside the project timeline, as deemed necessary.

ATTACHMENT 1

MODELED FORECAST RESULTS

For the 2016 Drought Contingency Plan

January 1 - 50% HYDROLOGY

END OF MONTH STORAGES (TAF)

RESERVOIRS	2016								
	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
Trinity	824	1025	1191	1217	1161	1059	942	835	783
Shasta	2471	2983	3232	3283	3181	2877	2614	2496	2455
Folsom	569	669	795	961	909	699	552	515	486
Oroville	1840	2320	2644	2787	2784	2298	1811	1454	1412
New Melones	418	491	516	574	617	577	531	491	486

MONTHLY AVERAGE RELEASES (CFS)

RESERVOIRS	2016								
	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
Trinity	300	300	460	4230	2530	1100	860	870	370
Sacramento	3250	3250	4500	6000	7200	9000	8100	6000	5000
American	3350	4750	3500	3500	4500	5050	4000	2050	1750
Feather	950	800	800	800	800	7850	8450	7350	1350
Stanislaus	210	200	460	400	150	150	150	150	580

DELTA SUMMARY (CFS)

	2016								
	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
Rio Vista Flows	25000	23300	12750	8900	5450	9400	9600	8750	4000
Sac River at Freeport	29350	27550	15900	12250	10650	18100	18300	16550	8500
SJ River at Vernalis	3150	3100	2500	2900	1100	950	800	900	1550
Computed Outflow	32350	31450	17950	12950	7800	5150	4900	4500	6000
Combined Project Pumping	4350	2550	1400	1550	1300	9850	10800	11000	3500

MODELED FORECAST RESULTS

For the 2016 Drought Contingency Plan

January 1 - 90% HYDROLOGY

END OF MONTH STORAGES (TAF)

RESERVOIRS	2016								
	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
Trinity	668	801	901	920	872	771	685	603	587
Shasta	1829	2109	2168	2033	1765	1454	1174	1059	1013
Folsom	456	628	646	680	539	388	244	200	162
Oroville	1386	1648	1722	1668	1497	1313	1171	1143	1109
New Melones	358	378	353	317	256	195	144	99	85

MONTHLY AVERAGE RELEASES (CFS)

RESERVOIRS	2016								
	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
Trinity	300	300	540	2920	780	450	860	870	370
Sacramento	3250	3250	4750	7000	9000	8850	7500	5000	4150
American	800	800	2850	2050	3750	3500	3500	1750	1250
Feather	950	800	2700	2300	2600	2350	2000	1600	1150
Stanislaus	210	200	460	400	150	150	150	150	580

DELTA SUMMARY (CFS)

	2016								
	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
Rio Vista Flows	12250	10700	7800	5650	5500	2850	3100	3350	2200
Sac River at Freeport	14600	13000	10150	8400	10700	8850	9100	8850	6150
SJ River at Vernalis	1100	1250	1200	1150	550	550	500	550	1300
Computed Outflow	13350	12750	9950	7100	7100	4150	4250	4150	5000
Combined Project Pumping	4200	2500	750	750	800	1050	1750	3100	1300

January 1 - 90% HYDROLOGY - MODIFIED SWRCB WATER RIGHTS D-1641

END OF MONTH STORAGES (TAF)

RESERVOIRS	2016								
	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
Trinity	668	801	901	920	872	771	685	603	587
Shasta	1857	2167	2316	2334	2159	1900	1657	1572	1525
Folsom	456	628	756	736	590	388	244	200	162
Oroville	1386	1648	1833	1826	1705	1489	1348	1319	1286
New Melones	358	378	353	317	256	195	144	99	85

MONTHLY AVERAGE RELEASES (CFS)

RESERVOIRS	2016								
	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
Trinity	300	300	540	2920	780	450	860	870	370
Sacramento	2750	2750	3250	4500	7450	8000	6850	4500	4150
American	800	800	1050	2950	3850	4350	3500	1750	1250
Feather	950	800	800	1550	1800	2900	2000	1600	1150
Stanislaus	210	200	460	400	150	150	150	150	580

DELTA SUMMARY (CFS)

	2016								
	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
Rio Vista Flows	11800	10250	3300	3650	3700	3200	2650	3000	2200
Sac River at Freeport	14100	12500	4950	6050	8400	9350	8450	8350	6150
SJ River at Vernalis	1100	1250	1200	1150	550	550	500	550	1300
Computed Outflow	12850	12250	4000	4000	4000	4150	4250	4150	5000
Combined Project Pumping	4200	2500	1550	1500	1550	1550	1150	2600	1300

ATTACHMENT 1

MODELED FORECAST RESULTS

For the 2016 Drought Contingency Plan

January 1 - 99% HYDROLOGY

END OF MONTH STORAGES (TAF)

RESERVOIRS	2016								
	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
Trinity	554	636	707	720	666	610	550	493	472
Shasta	1654	1855	1927	1686	1176	744	406	305	175
Folsom	363	487	559	491	380	196	91	97	75
Oroville	1248	1266	940	851	800	739	708	695	633
New Melones	324	329	303	265	218	169	116	71	89

MONTHLY AVERAGE RELEASES (CFS)

RESERVOIRS	2016								
	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
Trinity	300	300	600	1500	780	450	450	450	370
Sacramento	2750	2750	3250	7650	11850	9900	8250	4600	5000
American	500	500	1050	2500	2750	3700	2400	500	500
Feather	950	3350	7850	3500	2000	2000	2000	2000	2000
Stanislaus	200	150	150	150	50	50	50	50	50

DELTA SUMMARY (CFS)

	2016								
	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
Rio Vista Flows	7550	7250	7000	6400	5750	2800	2500	1900	2600
Sac River at Freeport	9200	9050	9250	9300	11050	8800	8250	6800	6650
SJ River at Vernalis	700	450	500	450	250	200	200	200	250
Computed Outflow	7100	8050	7950	7100	7100	4050	4200	4000	5000
Combined Project Pumping	3350	1550	650	650	650	600	600	650	650

January 1 - 99% HYDROLOGY - MODIFIED SWRCB WATER RIGHTS D-1641

END OF MONTH STORAGES (TAF)

RESERVOIRS	2016								
	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
Trinity	554	636	707	720	666	610	550	493	472
Shasta	1654	1855	1927	1757	1507	1193	928	863	795
Folsom	363	487	559	491	380	196	91	97	75
Oroville	1248	1422	1331	1240	985	863	832	841	779
New Melones	324	329	303	265	218	169	116	71	89

MONTHLY AVERAGE RELEASES (CFS)

RESERVOIRS	2016								
	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
Trinity	300	300	600	1500	780	450	450	450	370
Sacramento	2750	2750	3250	6500	7450	8000	7050	4000	4000
American	600	500	1050	2500	2750	3700	2400	500	500
Feather	950	800	3900	1550	3250	2850	2000	1650	2000
Stanislaus	200	150	150	150	50	50	50	50	50

DELTA SUMMARY (CFS)

	2016								
	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
Rio Vista Flows	7550	5050	3600	3750	3400	2050	1700	1200	1850
Sac River at Freeport	9200	6500	5300	6200	7950	7700	7050	5800	5650
SJ River at Vernalis	700	450	500	450	250	200	200	200	250
Computed Outflow	7100	5550	4000	4000	4000	3000	3000	3000	4000
Combined Project Pumping	3350	1550	650	650	650	600	600	650	650

ATTACHMENT 2

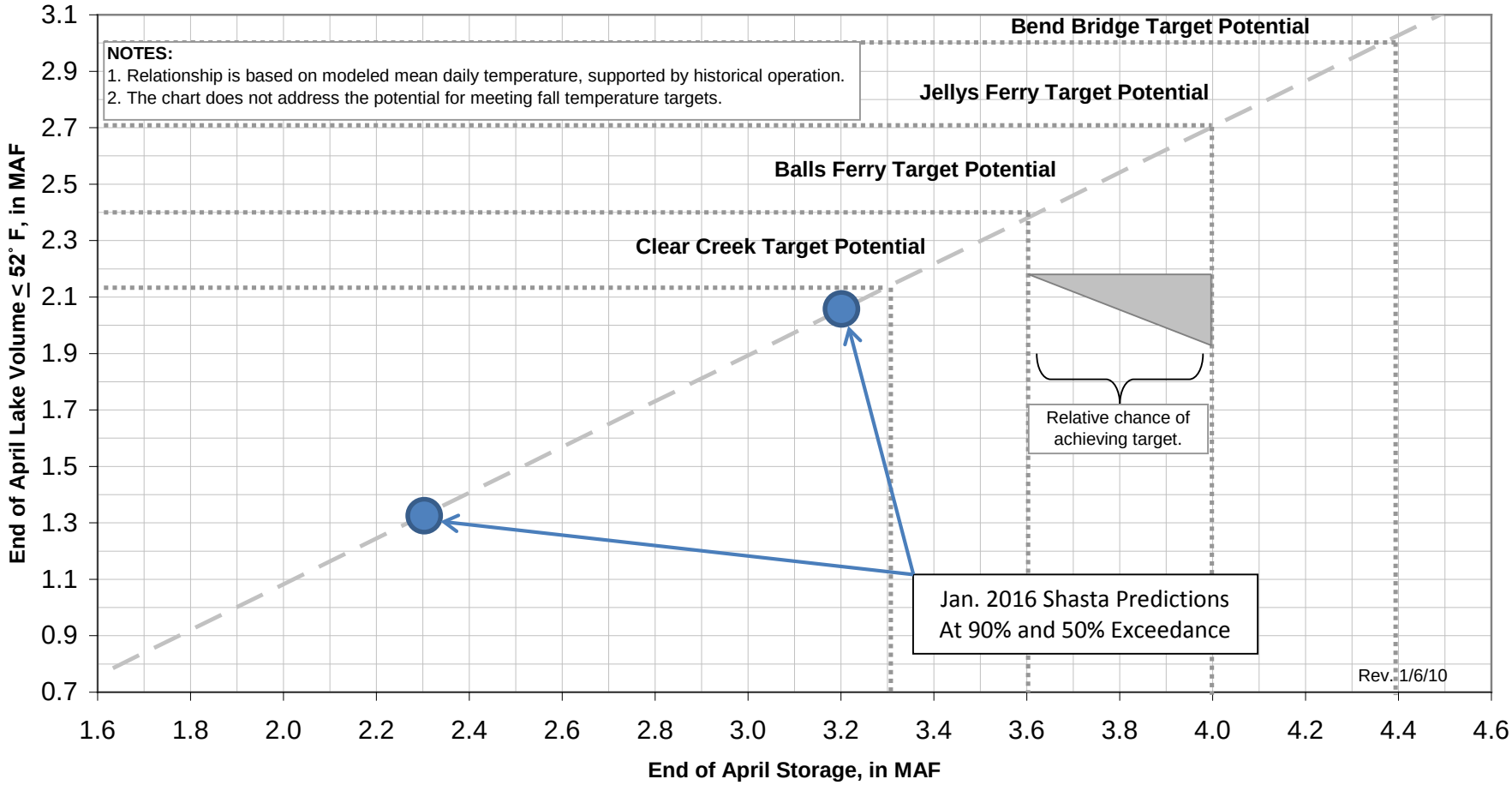
D-1641 Bay-Delta Standards

With Likely 2016 TUCP Requests

CRITERIA	FEB 2016	MAR 2016	APR 2016	MAY 2016	JUNE 2015	JULY 2016	AUG 2016	SEPT 2016	OCT 2016
January 1 - 50% HYDROLOGY									
• Outflow									
Spring X2									
Minimum Outflow - mon.									
• River Flows									
@ Rio Vista - min. mon. avg.									
@ Vernalis: Base -min. mon. avg.					T.B.D.				
Pulse objective			T.B.D.						
• Delta Cross Channel Gates									
• Salinity									
EC - Emmaton									
January 1 - 90% HYDROLOGY									
• Outflow									
Spring X2			4000 cfs	4000 cfs	4000 cfs				
Minimum Outflow - mon.									
• River Flows									
@ Rio Vista - min. mon. avg.								T.B.D.	T.B.D.
@ Vernalis: Base -min. mon. avg.					T.B.D.				
Pulse objective			T.B.D.						
• Delta Cross Channel Gates		Conditional DCC Opening							
• Salinity									
EC - Emmaton			Requirement Moved To Three Mile Slough						
January 1 - 99% HYDROLOGY									
• Outflow									
Spring X2		4000 cfs	4000 cfs	4000 cfs	4000 cfs				
Minimum Outflow - mon.						3000 cfs			
• River Flows									
@ Rio Vista - min. mon. avg.								T.B.D.	T.B.D.
@ Vernalis: Base -min. mon. avg.		T.B.D.			T.B.D.				
Pulse objective			T.B.D.						T.B.D.
• Delta Cross Channel Gates		Conditional DCC Opening							
• Emergency Drought Barriers				Construction	Operational				
• Salinity									
EC - Emmaton			Requirement Moved To Three Mile Slough						

Attachment 3

Lake Shasta End of April Storage
Potential for Meeting Compliance Point Target of 56˚ F (Apr-Sep)



ATTACHMENT 4: NOAA/NMFS Considerations for 2016 Shasta Operations Potential Temperature Criteria Adjustments and Suggested Model Inputs

Potential Adjustments to the Shasta temperature criteria: 2016 will be the third of 3 winter-run cohorts. 2014 and 2015 resulted in very low survival of juvenile winter-run, and therefore, there will be the need to manage very conservatively to protect the third cohort of winter-run in 2016. As such, in the coming months, NMFS will be considering adjustments to the Shasta temperature criteria to provide for greater likelihood of protecting juvenile winter-run from broodyear 2016, as follows:

Criterion	2009 RPA	Implementation through 2015	2016 adjustment
Temperature	Not in excess of 56°F daily average temperature (DAT)		55°F 7-Day Daily Average Daily Maximum (7DADM) or 53°F DAT
Temperature Compliance Point	Between Balls Ferry and Bend Bridge May 15 through October 31 10-year Average: • Clear Creek 95% of the time • Balls Ferry 85% of the time • Jellys Ferry 40% of the time • Bend Bridge 15% of the time	Current 6-year Average (2010-2015): • Clear Creek 66% of the time • Balls Ferry 50% of the time • Jellys Ferry 50% of the time • Bend Bridge 0% of the time	Bonneyview Bridge (CCR)

Temperature modeling scenarios: The following provides for conservative input into the Shasta temperature model, compared to inputs/requirements from the 2009 RPA.

Criterion	2009 RPA	2015	2016 Suggested model inputs
Minimum Keswick Releases (Nov 1 – May 15)	3250 cfs	4250 cfs (Nov 1 – Dec 23) 3250 cfs (Dec 26, 2015 – Jan 31, 2016)	2750 to 3250 cfs (Feb 1 – April 30)
Hydrological Exceedance Forecasts	50%, 70%, and 90%	90%	90%; with additional weight to El Niño hydrological years
Meteorological Forecast	50% local 3-month temperature outlook (L3MTO)	10% L3MTO	2014 or 2015 meteorological data
Shasta Reservoir End of September (EOS) Storage	10-year Average: •87% of years: Min 2.2 MAF •82% of years: Min 2.2 MAF and End of April (EOA) storage of 3.8 MAF •40% of years: Min 3.2 MAF	1.6 MAF Current 6-year Average (2010-2015): • 50% of Years: Min 2.2 MAF • 50% of Years: Min 2.2 MAF and EOA 3.8 MAF • 33% of Years: Min 3.2 MAF	2.2 MAF
Shasta Reservoir Temperature Profile	No Requirement	None	Assume a stratification scenario from the record that shows a steep cold water decline in spring

Shasta Reservoir Cold Water Volume	No Requirement	None	End of May high, medium, and low

Model Run Outputs: Keswick releases, Wilkins Slough flows, Diversions, Folsom & Oroville Releases for Delta, Trinity contribution, SRSC Mitigation options and amounts (groundwater pumping, transfers, other options?)