United States Department of the Interior

BUREAU OF RECLAMATION
Central Valley Operations Office
3310 El Camino Avenue, Suite 300
Sacramento, California 95821

IN REPLY
REFER TO:

CVO-100
ENV-7.00

APR 12 2016

Doc #00791

VIA ELECTRONIC MAIL

Ms. Maria Rea
Assistant Regional Administrator
California Central Valley Area Office
National Marine Fisheries Service
650 Capitol Mall, Suite 5-100
Sacramento, CA 95814

Subject: Reasonable and Prudent Alternative (RPA) Action IV.2.1 of the National Marine Fisheries Service (NMFS) 2009 Coordinated Long-term Operation of the Central Valley Project (CVP) and State Water Project (SWP) Biological Opinion (NMFS 2009 BiOp) – Request for Flexibility in San Joaquin River Inflow to Export Ratio

Dear Ms. Rea:

As you are aware, drought conditions in the San Joaquin River basin have continued well into the spring of 2016, which has limited San Joaquin River flows at Vernalis and into the Sacramento-San Joaquin Delta. Although conditions have improved somewhat in the month of March, the snow water content in the Central Sierra Nevada is below average, and major reservoir storage levels remain well below historical levels throughout the San Joaquin Valley. For much of the winter and spring, the official San Joaquin Valley Index has oscillated between a "critical" and "dry" water year classification.

These dry conditions have contributed to a low base flow on the San Joaquin River entering the Delta and are suppressing available sources to build an ample pulse flow this spring. We believe that San Joaquin River salmonids, including California Central Valley steelhead, would benefit from additional pulse flows to aide their outmigration from the Stanislaus and San Joaquin Rivers. To advance this purpose, U.S. Bureau of Reclamation (Reclamation), in conjunction with Oakdale Irrigation District (OID) and South San Joaquin Irrigation District (SSJID), proposes the following action:

> Reclamation and the local districts will augment the currently scheduled Stanislaus River Appendix 2(e) flow releases with an additional 75,000 acre feet (af) during the pulse flow period this April and May. We propose that the Stanislaus Operations Group evaluate these augmented flows and recommend to NMFS and Reclamation the pattern and timing of the releases, which may include a recommendation on the timing of the initial increases in CVP/SWP pumping, to provide the best biological benefit. The 75,000 af of

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additional pulse flow will be accounted for as part of the annual water supplies available to OID and SSJID consistent with their senior water rights. Without these augmented releases, we estimate that the 31-day pulse flow at Vernalis will only average about 2,000 to 2,200 cubic feet per second (cfs) this spring, but the added release will increase that average flow to approximately 3,100 to 3,300 cfs.

The senior water rights holders have agreed to the release of the augmented flows provided that the incremental flow can be re-diverted in the Delta to supplement water supplies south of the Delta. To achieve this objective, Reclamation requests flexible implementation of RPA Action IV.2.1 to allow Reclamation and the California Department of Water Resources (DWR) to make full use of the added release.

The March 2016 San Joaquin Valley Index indicated a "critical" water year type, which provided for a San Joaquin River inflow-to-export ratio of 1:1, or minimum health and safety combined CVP/SWP pumping of 1,500 cfs, at the onset of RPA Action IV.2.1 on April 1, 2016. The April 2016 San Joaquin Valley Index now indicates a "dry" water year type, under which RPA Action IV.2.1 prescribes a Vernalis flow-to-combined CVP/SWP export ratio (San Joaquin River I:E ratio) of 2:1, based on a 14-day running average, through May 31. Given the current dry year designation, Reclamation proposes to modify CVP/SWP pumping prescribed by RPA Action IV.2.1 to allow the additional incremental release of district water to be pumped at a ratio of 1:1 (i.e., Scenario 3 as further described in the enclosed Biological Review). Meanwhile, Reclamation and DWR will also continue to pump the minimum health and safety level (1,500 cfs) for an overall resulting San Joaquin River I:E ratio of approximately 1.3:1 during the period of the augmented pulse flow.

RPA Action IV.2.1 does include a drought exception for multiple dry years, and in late February, it appeared that the criteria to invoke this exception would likely be met. This exception procedure allows for a San Joaquin River I:E ratio of 1:1 when both a combination of multiple critically dry years and a projected New Melones Index of 1.0 million acre feet (maf) or less are realized. Although the criterion for the multiple critically dry years is met, the current estimate of the New Melones Index for 2016 is now 1.1 maf. The slight improvement in projected New Melones supply, coupled with the San Joaquin Valley Index classification of "dry," has prompted Reclamation to evaluate the proposed flexible implementation of RPA Action IV.2.1 for this year. During the proposed flexible implementation, Reclamation expects all other provisions of the NMFS 2009 BiOp and the 2008 U.S. Fish and Wildlife Service Biological Opinion for the coordinated long-term operation of the CVP and SWP (FWS 2008 BiOp) to remain in effect, specifically NMFS's RPA Action IV.2.3 and Action 3 of the FWS 2008 BiOp. To help conserve storage in New Melones Reservoir to preserve the cold water pool through this summer and provide for cool water releases later this fall, Reclamation has also submitted a Temporary Urgency Change Petition to the State Water Resources Control Board requesting modification of the San Joaquin River flow criteria at Vernalis included in Water Rights Decision 1641 (D-1641); and modification of the Ripon Dissolved Oxygen Compliance Point on the Stanislaus River included in Water Rights Decision 1422 (D-1422).

Reclamation has reviewed the effects of this proposal for the period of April 15 through May 15 on listed species (see enclosed Biological Review). Based on this review, Reclamation concludes that the benefit of the proposed augmented pulse flow outweighs the increase in entrainment risk in the south Delta. Reclamation has further concluded that the requested flexibility in implementation of RPA Action IV.2.1 from April 15 through May 15 is consistent with the effects that were analyzed in the NMFS 2009 BiOp, and does not jeopardize the continued existence of these listed species or adversely modify or destroy their designated critical habitats. Any incidental take resulting from this request is consistent with the existing incidental take limits in the NMFS 2009 BiOp. Reclamation seeks NMFS' concurrence in this determination.

We look forward to working with you and your staff as we find innovative ways to operate through another challenging water year and we appreciate your willingness to work with us on this time sensitive matter.

Sincerely,

Ronald Milligan
Operations Manager

Enclosure

cc: Mr. Tom Howard
Executive Director
State Water Resources Control Board
1001 I Street
Sacramento, CA 95814

Mr. Chuck Bonham
Director
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Sacramento, CA 95814

Mr. Mark Cowin
Director
California Department of Water Resources
1416 Ninth Street
Sacramento, CA 95814

Continued on next page.

cc: Continued from previous page.

Ms. Kaylee Allen
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2800 Cottage Way
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(w/encl to each)

Biological Review of Requested Flexible Implementation for Spring 2016

Reasonable and Prudent Alternative (RPA) Action IV.2.1

National Marine Fisheries Service Biological Opinion
2009 Coordinated Long-term Operation of the Central Valley Project - State Water Project

April 2016

Overview of Related Actions

Proposed Action to Augment Stanislaus and San Joaquin River Pulse Flow

The continued dry conditions in the San Joaquin Valley have contributed to a low base flow on the San Joaquin River entering the Delta and are suppressing available sources to build an ample pulse flow this spring. We believe that San Joaquin River salmonids, including California Central Valley steelhead, would benefit from additional pulse flows to aide their outmigration from the Stanislaus and San Joaquin Rivers. To advance this purpose, Reclamation, in conjunction with Oakdale Irrigation District (OID) and South San Joaquin Irrigation District (SSJID), proposes to augment the currently scheduled Stanislaus River Appendix 2(e) flow releases with an additional 75,000 af during the pulse flow period this April and May. We propose that the Stanislaus Operations Group then recommend to NMFS and Reclamation the pattern and timing of the releases to provide the best biological benefit. Without these augmented releases, we estimate that the 31-day pulse flow at Vernalis will only average about 2,000 to 2,200 cfs this spring, but the added release will increase that average flow to 3,100 to 3,300 cfs.

The senior water rights holders have agreed to the release of the augmented flows provided that the incremental flow can be fully diverted from the Delta to supplement water supplies south of the Delta. To achieve this objective, Reclamation requests flexible implementation of RPA Action IV.2.1 to allow Reclamation and the California Department of Water Resources (DWR) to make full use of the added release.

Request for Flexible Implementation of RPA Action IV.2.1

The proposed flexible implementation of RPA Action IV.2.1 treats the allowable pumping in two parts; 1) the current RPA Action is applied to the estimated base Vernalis flows that would occur absent the 75,000 af augmented Stanislaus River release (resulting in combined Project pumping at the greater of a 2:1 San Joaquin River I:E ratio or 1,500 cfs), and 2) allow the additional incremental release of district water to be pumped at a San Joaquin River I:E ratio of 1:1. Reclamation estimates that the overall resulting San Joaquin River I:E ratio would be approximately 1.3:1 during the period of the augmented pulse flow.

To evaluate the relative effects of the proposed flexible implementation, Reclamation have formulated three scenarios to analyze. Various estimated daily flow and pumping information for these scenarios are presented in Tables 1 through 3 below.

Scenario 1 represents the base flow conditions than would likely occur absent the 75,000 af flow augmentation. This base condition includes the Appendix 2(e) pulse flows, the minor pulse flow contributions from the Tuolumne and Merced Rivers, and anticipated accretions from the San Joaquin River. The Head of Old River Barrier is installed and there is no change to implementation of RPA Action IV.2.1. In this case, the combined CVP/SWP pumping is at the minimum health and safety level of 1,500 cfs throughout the pulse flow period.

Scenario 2 includes all the flows from Scenario 1 plus the additional 75,000 af flow augmentation on the Stanislaus River. The Head of Old River Barrier is also installed. For this scenario, combined CVP/SWP pumping was set at a 1:1 ratio for the entire estimated Vernalis flow.

Scenario 3 includes all the flows from Scenario 1 plus the additional 75,000 af flow augmentation (totaling the same as Scenario 2), and the Head of Old River Barrier is installed. For this scenario, the combined CVP/SWP pumping rate was set at 2,600 cfs, which combines the 1,500 cfs pumping in Scenario 1 (implementing the 2:1 San Joaquin I:E ratio) and an additional 1,100 cfs of pumping (implementing the 1:1 San Joaquin I:E ratio that is the subject to the flex request) to capture the 75,000 af flow augmentation in the Delta.

This Biological Review is based on a comparison of conditions estimated in Scenario 1 (base case) to conditions estimated in Scenario 2 and Scenario 3 (RPA flex options).

Relationship to RPA IV.2.1 Drought Exception Criteria

RPA Action IV.2.1 contains a drought exception for multiple critically dry years, and in late February, it appeared that the criteria to invoke this exception would likely be met. The exception procedure outlines that if: 1) the previous two years plus current year of San Joaquin Valley "60-20-20" Water Year Hydrologic Classification and Indicator (as defined below) is 6 or less and 2) the New Melones Index is less than 1 million acre feet (maf), then total combined CVP/SWP pumping shall be limited to a 1:1 ratio with San Joaquin River inflow as measured at Vernalis, or minimum combined pumping of 1,500 cfs, whichever is greater.

Exception procedure for multiple dry years: If the previous 2 years plus current year of San Joaquin Valley "60-20-20" Water Year Hydrologic Classification and Indicator as defined in D-1641 and provided in following table, is 6 or less, AND the New Melones Index is less than 1 MAF, exports shall be limited to a 1:1 ratio with San Joaquin River inflow, as measured at Vernalis.

San Joaquin Valley Classification	Indicator
Critically dry	1
Dry	2
Below normal	3
Above normal	4
Wet	5

In this current situation, the 2014 and 2015 San Joaquin Valley "60-20-20" Indicators were both critically dry, and the 2016 forecast most likely will be defined as dry. But although storage levels remain very low at New Melones Reservoir, the forecasted New Melones Index this year will most likely be about 1.1 maf – just slightly more than the 1.0 maf criterion.

The slight improvement in projected New Melones inflow, coupled with a likely San Joaquin Valley classification of "dry", has prompted Reclamation to evaluate the proposed flexible implementation of RPA Action IV.2.1 for this year. And while Reclamation expects all other provisions of the NMFS and the U.S. Fish and Wildlife Service Biological Opinions to remain in effect, Reclamation has petitioned the California Water Resources Control Board with a Temporary Urgency Change for modification of the D-1641 San Joaquin River flow criteria at Vernalis; and potential modification of Ripon Dissolved Oxygen Compliance Point on the Stanislaus River (D-1422).

Methods and Modeling

DSM2 Model

Delta Simulation Model II (DSM2) simulations were performed and evaluated for three operational management scenarios (Tables 1-3). These simulations were designed to evaluate potential effects of the Project Description's increased San Joaquin River flow at Vernalis and reduced I:E ratio on potential Delta hydrodynamics during a portion of April and May when listed salmonids from the San Joaquin River basin are most likely to be present in the San Joaquin River and Delta and hydrology forecasts are operationally implementable. A baseline scenario (Scenario 1) represents an unmodified hydrology (Vernalis flows not augmented by additional Stanislaus flows) and an unmodified Action IV.2.1 I:E ratio. Scenario Hydrologies' 2 and 3 included modified Vernalis flows (augmented by 75TAF of additional Stanislaus flows) and modified I:E ratio (1:1).

Input values for the modeling reflected the best information available to California Department of Water Resources (DWR) modelers when models were run on March 24, 2016. Modeled flows do not necessarily reflect current forecast information and realized flows at Vernalis will likely differ from the modeled scenarios depending on actual accretions and depletions during April

and May. Recent data suggest modeled Vernalis flows under the Project Description are likely greater than what will actually be observed, which influences the interpretation of any possible impacts on fishes resulting from the Project Description, although relative comparisons should still apply. These issues increase the uncertainty of assessments of impacts to all species reviewed.

Particle Tracking Model

For the purposes of the biological review, particle "entrainment" was considered to evaluate hydrologic alteration under the three considered Scenarios (Tables 1-3). The DSM2 particle tracking model does not currently incorporate a behavioral component and particles are not an accurate proxy for juvenile salmonids, but do reflect the influence of variation in modeled hydrodynamics. The NOAA-SWFSC ePTM modeling, which does include a behavioral component, has not been used for this biological review as that model continues to be developed. Daily entrainment flux fate at the CVP/SWP projects at the end of the model period (May 31) was considered and graphed for cumulative daily flux (Figure 2). Combined entrainment at the Projects was highest in both scenarios for particles inserted at Railroad Cut. The flux of particles past Chipps Island from all injection points are shown in Figures 3-5 for all three modeled scenarios.

DOSS Weekly Assessment

Potential effects to winter-run Chinook salmon (O*ncorhynchus tshawytscha*) and spring-run Chinook salmon and green sturgeon (*Acipenser medirostris*), originating from the Sacramento River are considered by reviewing the Delta Operations for Salmon and Sturgeon April 5, 2016 assessment of distribution and entrainment risk.

Table 1. Hydrologic input data for Scenario 1.

		Hydrology 1: No OID/SSJID water, no SJR I:E flex									
Date	Freeport	Total Vernalis (cfs)	Vernalis Base (cfs)	Vernalis Flow Augment (cfs)	Delta Outflow (cfs)	Daily OMR (cfs)	Combined Exports (cfs)	Export Vernalis Base (cfs)	Export Vernalis Base (%)	Export Vernalis Augment (cfs)	Export Augment Vernalis (%)
4/15/2016	26,950	2202	2202	0	26,655	-1605	1500	1500	68%	0	0%
4/16/2016	26,450	2202	2202	0	26,155	-1605	1500	1500	68%	0	0%
4/17/2016	25,950	2202	2202	0	25,655	-1605	1500	1500	68%	0	0%
4/18/2016	25,450	2202	2202	0	25,155	-1605	1500	1500	68%	0	0%
4/19/2016	24,950	2202	2202	0	24,655	-1605	1500	1500	68%	0	0%
4/20/2016	24,450	2202	2202	0	24,155	-1605	1500	1500	68%	0	0%
4/21/2016	23,950	2202	2202	0	23,655	-1605	1500	1500	68%	0	0%
4/22/2016	23,450	2202	2202	0	23,155	-1605	1500	1500	68%	0	0%
4/23/2016	22,950	2202	2202	0	22,655	-1605	1500	1500	68%	0	0%
4/24/2016	22,450	2202	2202	0	22,155	-1616	1500	1500	68%	0	0%
4/25/2016	21,950	2202	2202	0	21,605	-1616	1500	1500	68%	0	0%
4/26/2016	21,450	2202	2202	0	21,105	-1616	1500	1500	68%	0	0%
4/27/2016	21,450	2202	2202	0	21,105	-1616	1500	1500	68%	0	0%
4/28/2016	21,450	2202	2202	0	21,105	-1628	1500	1500	68%	0	0%
4/29/2016	21,450	2202	2202	0	21,055	-1628	1500	1500	68%	0	0%
4/30/2016	21,450	2202	2202	0	21,055	-1628	1500	1500	68%	0	0%
5/1/2016	21,450	2142	2142	0	20,995	-1633	1500	1500	70%	0	0%
5/2/2016	21,450	2081	2081	0	20,933	-1638	1500	1500	72%	0	0%
5/3/2016	21,450	2021	2021	0	20,871	-1654	1500	1500	74%	0	0%
5/4/2016	21,450	2021	2021	0	20,820	-1666	1500	1500	74%	0	0%
5/5/2016	21,450	2021	2021	0	20,768	-1666	1500	1500	74%	0	0%
5/6/2016	21,450	2021	2021	0	20,767	-1666	1500	1500	74%	0	0%
5/7/2016	21,450	2021	2021	0	20,765	-1678	1500	1500	74%	0	0%
5/8/2016	21,450	2021	2021	0	20,714	-1678	1500	1500	74%	0	0%
5/9/2016	21,450	2021	2021	0	20,714	-1690	1500	1500	74%	0	0%
5/10/2016	21,450	2021	2021	0	20,664	-1690	1500	1500	74%	0	0%
5/11/2016	21,450	2021	2021	0	20,664	-1701	1500	1500	74%	0	0%
5/12/2016	21,450	2021	2021	0	20,614	-1713	1500	1500	74%	0	0%
5/13/2016	21,450	2021	2021	0	20,564	-1713	1500	1500	74%	0	0%
5/14/2016	21,450	2021	2021	0	20,564	-1725	1500	1500	74%	0	0%
5/15/2016	21,450	2021	2021	0	20,514	-1725	1500	1500	74%	0	0%

Table 2. Hydrologic input data for Scenario 2.

Hydrology 2: 75 TAF of OID/SSJID water, I:E flex for all water arriving at Vernalis during pulse period											
Date	Freeport	Total Vernalis (cfs)	Vernalis Base (cfs)	Vernalis Flow Augment (cfs)	Delta Outflow (cfs)	Daily OMR (cfs)	Combined Exports (cfs)	Export Vernalis Base (cfs)	Export Vernalis Base (%)	Export Vernalis Augment (cfs)	Export Augment Vernalis (%)
4/15/2016	26,950	3302	2202	1100	26,055	-3116	3200	2100	95%	1100	100%
4/16/2016	26,450	3302	2202	1100	25,555	-3116	3200	2100	95%	1100	100%
4/17/2016	25,950	3302	2202	1100	25,055	-3116	3200	2100	95%	1100	100%
4/18/2016	25,450	3302	2202	1100	24,555	-3116	3200	2100	95%	1100	100%
4/19/2016	24,950	3302	2202	1100	24,055	-3116	3200	2100	95%	1100	100%
4/20/2016	24,450	3302	2202	1100	23,555	-3116	3200	2100	95%	1100	100%
4/21/2016	23,950	3302	2202	1100	23,055	-3116	3200	2100	95%	1100	100%
4/22/2016	23,450	3302	2202	1100	22,555	-3116	3200	2100	95%	1100	100%
4/23/2016	22,950	3302	2202	1100	22,055	-3116	3200	2100	95%	1100	100%
4/24/2016	22,450	3302	2202	1100	21,555	-3128	3200	2100	95%	1100	100%
4/25/2016	21,950	3302	2202	1100	21,005	-3128	3200	2100	95%	1100	100%
4/26/2016	21,450	3302	2202	1100	20,505	-3128	3200	2100	95%	1100	100%
4/27/2016	21,450	3302	2202	1100	20,505	-3128	3200	2100	95%	1100	100%
4/28/2016	21,450	3302	2202	1100	20,505	-3139	3200	2100	95%	1100	100%
4/29/2016	21,450	3302	2202	1100	20,455	-3139	3200	2100	95%	1100	100%
4/30/2016	21,450	3302	2202	1100	20,455	-3139	3200	2100	95%	1100	100%
5/1/2016	21,450	3242	2142	1100	20,395	-3144	3200	2100	98%	1100	100%
5/2/2016	21,450	3181	2081	1100	20,333	-3149	3200	2100	101%	1100	100%
5/3/2016	21,450	3121	2021	1100	20,271	-3165	3200	2100	104%	1100	100%
5/4/2016	21,450	3121	2021	1100	20,220	-3177	3200	2100	104%	1100	100%
5/5/2016	21,450	3121	2021	1100	20,168	-3177	3200	2100	104%	1100	100%
5/6/2016	21,450	3121	2021	1100	20,167	-3177	3200	2100	104%	1100	100%
5/7/2016	21,450	3121	2021	1100	20,165	-3189	3200	2100	104%	1100	100%
5/8/2016	21,450	3121	2021	1100	20,114	-3189	3200	2100	104%	1100	100%
5/9/2016	21,450	3121	2021	1100	20,114	-3201	3200	2100	104%	1100	100%
5/10/2016	21,450	3121	2021	1100	20,064	-3201	3200	2100	104%	1100	100%
5/11/2016	21,450	3121	2021	1100	20,064	-3212	3200	2100	104%	1100	100%
5/12/2016	21,450	3121	2021	1100	20,014	-3224	3200	2100	104%	1100	100%
5/13/2016	21,450	3121	2021	1100	19,964	-3224	3200	2100	104%	1100	100%
5/14/2016	21,450	3121	2021	1100	19,964	-3236	3200	2100	104%	1100	100%
5/15/2016	21,450	3121	2021	1100	19,914	-3236	3200	2100	104%	1100	100%

Table 3. Hydrologic input data for Scenario 3

Hydrology 3: 75 TAF of OID/SSJID water, I:E flex only for OID/SSJID water arriving at Vernalis during pulse period											
Date	Freeport	Total Vernalis (cfs)	Vernalis Base (cfs)	Vernalis Flow Augment (cfs)	Delta Outflow (cfs)	Daily OMR (cfs)	Combined Exports (cfs)	Export Vernalis Base (cfs)	Export Vernalis Base (%)	Export Vernalis Augment (cfs)	Export Augment Vernalis (%)
4/15/2016	26,950	3302	2202	1100	26,655	-2552	2600	1500	68%	1100	100%
4/16/2016	26,450	3302	2202	1100	26,155	-2552	2600	1500	68%	1100	100%
4/17/2016	25,950	3302	2202	1100	25,655	-2552	2600	1500	68%	1100	100%
4/18/2016	25,450	3302	2202	1100	25,155	-2552	2600	1500	68%	1100	100%
4/19/2016	24,950	3302	2202	1100	24,655	-2552	2600	1500	68%	1100	100%
4/20/2016	24,450	3302	2202	1100	24,155	-2552	2600	1500	68%	1100	100%
4/21/2016	23,950	3302	2202	1100	23,655	-2552	2600	1500	68%	1100	100%
4/22/2016	23,450	3302	2202	1100	23,155	-2552	2600	1500	68%	1100	100%
4/23/2016	22,950	3302	2202	1100	22,655	-2552	2600	1500	68%	1100	100%
4/24/2016	22,450	3302	2202	1100	22,155	-2564	2600	1500	68%	1100	100%
4/25/2016	21,950	3302	2202	1100	21,605	-2564	2600	1500	68%	1100	100%
4/26/2016	21,450	3302	2202	1100	21,105	-2564	2600	1500	68%	1100	100%
4/27/2016	21,450	3302	2202	1100	21,105	-2564	2600	1500	68%	1100	100%
4/28/2016	21,450	3302	2202	1100	21,105	-2575	2600	1500	68%	1100	100%
4/29/2016	21,450	3302	2202	1100	21,055	-2575	2600	1500	68%	1100	100%
4/30/2016	21,450	3302	2202	1100	21,055	-2575	2600	1500	68%	1100	100%
5/1/2016	21,450	3242	2142	1100	20,995	-2580	2600	1500	70%	1100	100%
5/2/2016	21,450	3181	2081	1100	20,933	-2585	2600	1500	72%	1100	100%
5/3/2016	21,450	3121	2021	1100	20,871	-2601	2600	1500	74%	1100	100%
5/4/2016	21,450	3121	2021	1100	20,820	-2613	2600	1500	74%	1100	100%
5/5/2016	21,450	3121	2021	1100	20,768	-2613	2600	1500	74%	1100	100%
5/6/2016	21,450	3121	2021	1100	20,767	-2613	2600	1500	74%	1100	100%
5/7/2016	21,450	3121	2021	1100	20,765	-2625	2600	1500	74%	1100	100%
5/8/2016	21,450	3121	2021	1100	20,714	-2625	2600	1500	74%	1100	100%
5/9/2016	21,450	3121	2021	1100	20,714	-2637	2600	1500	74%	1100	100%
5/10/2016	21,450	3121	2021	1100	20,664	-2637	2600	1500	74%	1100	100%
5/11/2016	21,450	3121	2021	1100	20,664	-2648	2600	1500	74%	1100	100%
5/12/2016	21,450	3121	2021	1100	20,614	-2660	2600	1500	74%	1100	100%
5/13/2016	21,450	3121	2021	1100	20,564	-2660	2600	1500	74%	1100	100%
5/14/2016	21,450	3121	2021	1100	20,564	-2672	2600	1500	74%	1100	100%
5/15/2016	21,450	3121	2021	1100	20,514	-2672	2600	1500	74%	1100	100%

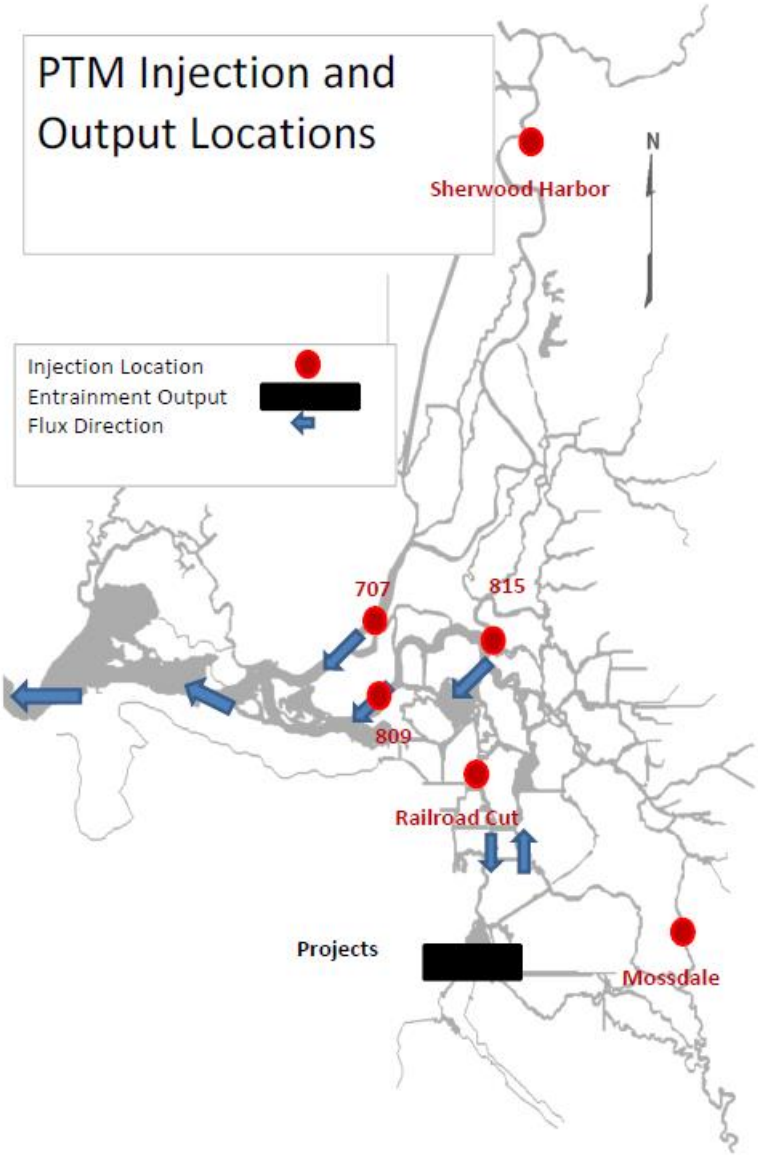

Figure 1. PTM model injection and output locations.

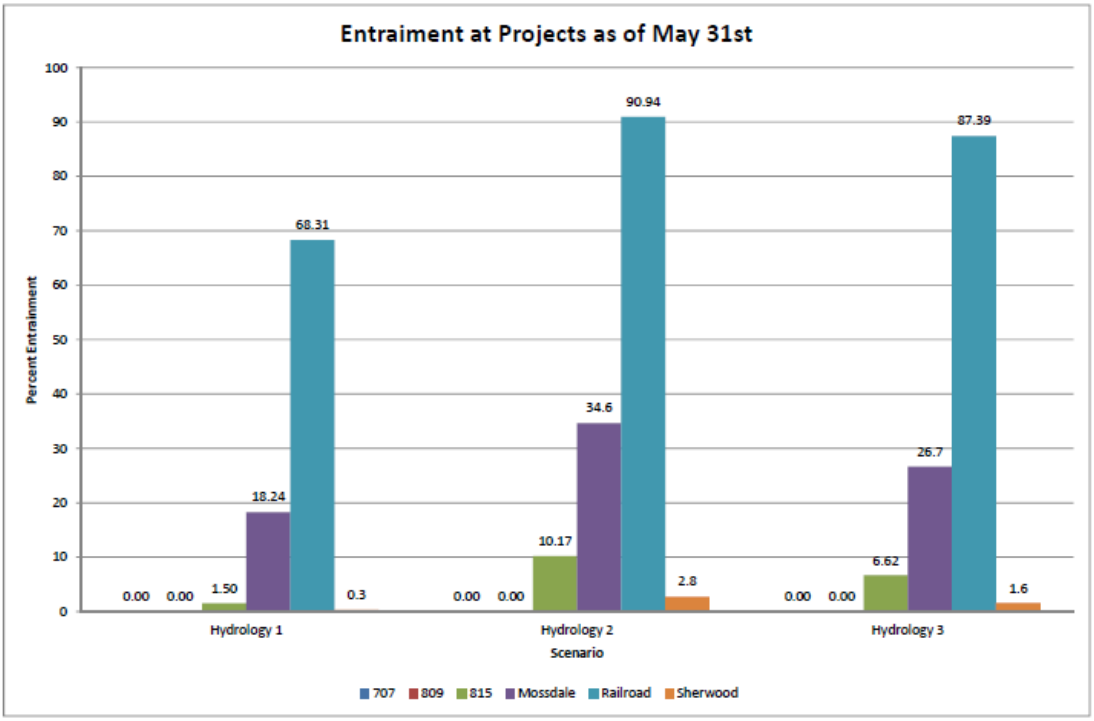

Figure 2. Entrainment at Projects from multiple injection locations under three modeled scenarios.

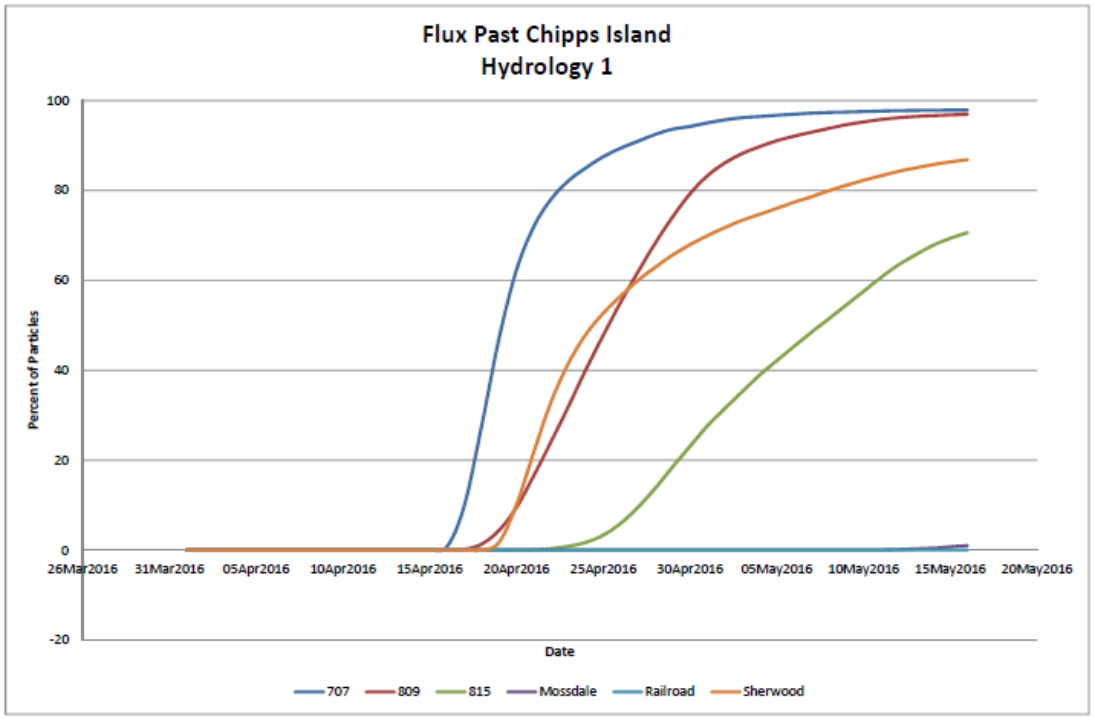

Figure 3. Flux Fate past Chipps Island under modeled Hydrology 1 scenario.

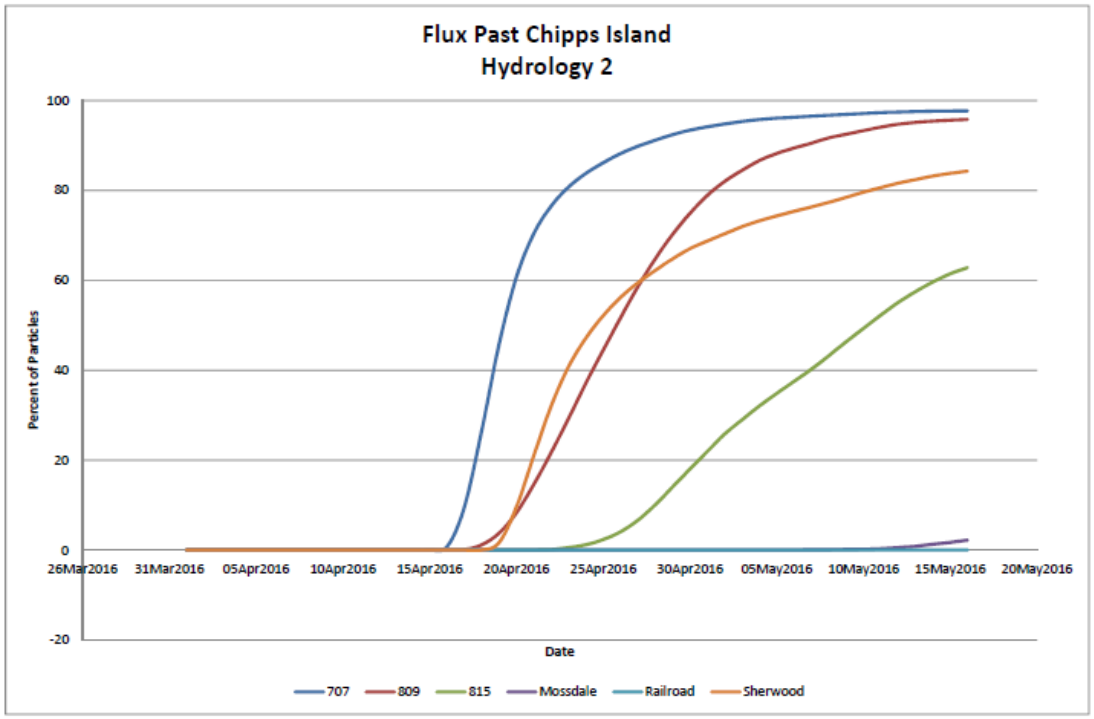

Figure 4. Flux Fate past Chipps Island under modeled Hydrology 2 scenario.

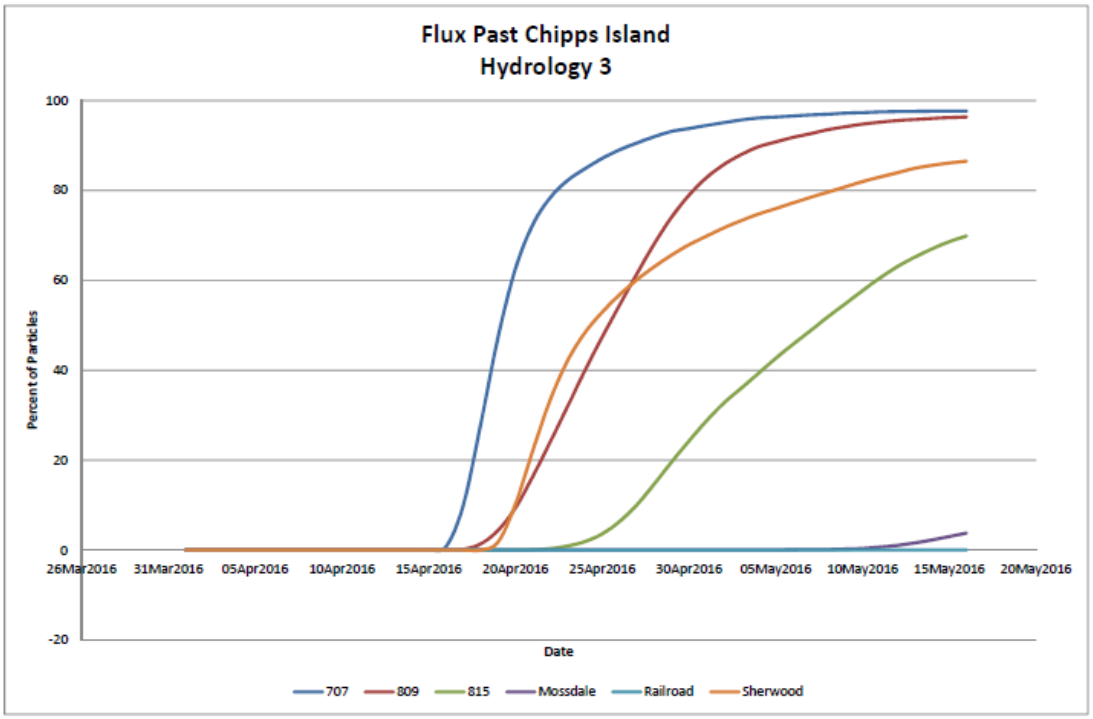

Figure 5. Flux Fate past Chipps Island under modeled Hydrology 3 scenario.

Status of the Species

The Status portion of this section focuses on NMFS species of concern in the San Joaquin River basin. Effects of the Project Description are also considered for winter-run Chinook salmon, spring-run Chinook salmon, and Green sturgeon (*Acipenser medirostris*).

Central Valley Steelhead

Steelhead, *O. mykiss*, emigration timing from the Stanislaus occurs throughout the winter and spring months based on rotary screw trap catches at Oakdale and Caswell (Figures 6 and 7). As of March 31, 2016 two juvenile steelhead have been captured in the Caswell trap on March 9 and March 16. Although rotary screw trap efficiencies are low for steelhead smolts, the low observations in the juvenile monitoring and adult escapement monitoring programs indicate a small component of the *O. mykiss* population in the Stanislaus out migrates in comparison with the relatively high populations residing in the river. The in-river population rears in the approximately ten miles of habitat immediately downstream of Goodwin Dam. Observations of rearing *O.mykiss* in late 2015 in the Goodwin Canyon area indicated below normal densities.

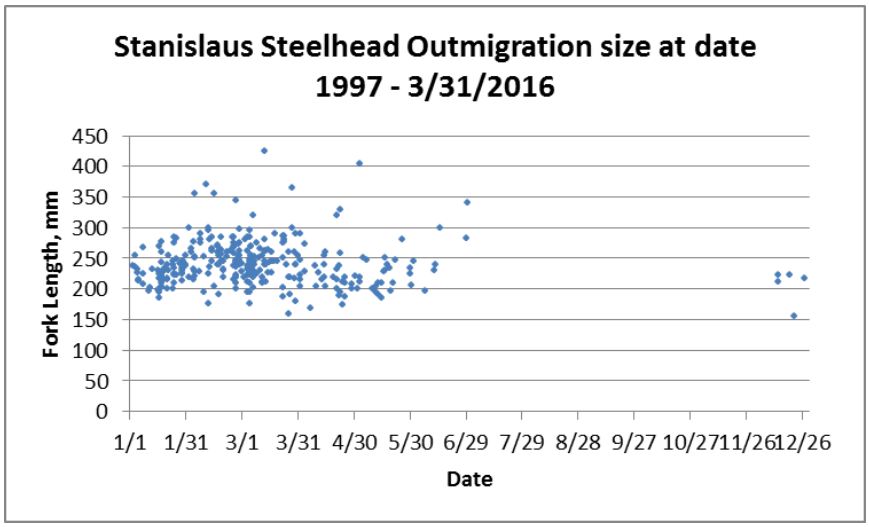

Figure 6. Steelhead smolt outmigration timing and size. Includes only fish >150 mm. Oakdale data cover cover 1998–2006 and Caswell data covers 1997–2016.

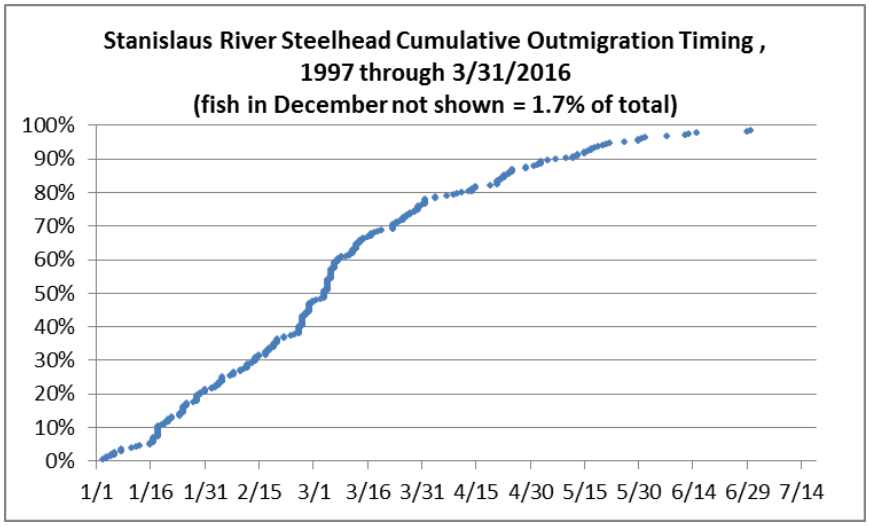

Figure 7. Cumulative Stanislaus steelhead outmigration past rotary screw traps at Oakdale and Caswell. Oakdale data cover 1998–2006 and Caswell cover 1997–2016. Includes only fish > 150 mm.

Outmigrating steelhead move past the screw traps predominantly during flow peaks such as those provided during the RPA prescribed flows and with rain events. Upstream passage of O. mykiss at the Stanislaus River weir in the 2015-2016 included two adult steelhead (>16 inches) and three *O.mykiss* < 16 inches. Comprehensive steelhead monitoring does not occur on the Stanislaus but the observations at the weir for the year were below normal.

As of March 27, 2016, an expanded salvage of 94 natural origin and 1252 adipose-clipped steelhead have been estimated at the state and federal fish collection facilities at the South Delta CVP/SWP export pumps. Of these, 38 natural origin and 694 adipose-clipped fish were salvaged at the SWP and 56 natural origin and 558 adipose-clipped fish were salvaged at the CVP fish collection facilities. Most steelhead have been salvaged during the past month. The high ratio of clipped to unclipped steelhead (13:1) likely indicates a low abundance of naturally-produced steelhead compared to the number of hatchery steelhead.

Fall-run Chinook Salmon

A record 12,657 Chinook salmon passed the Stanislaus River weir during the 2015-2016 escapement season. The next highest escapement year based on weir counts was 2012 when 7,134 were counted. The weir has operated annually since 2003. Escapement estimates for the Tuolumne and Merced are not yet available but based on carcass counts the escapements were below average and well below the number in the Stanislaus. Flow conditions and dense aquatic vegetation in the San Joaquin River due to drought conditions may have limited successful migration of Chinook into the Tuolumne and Merced in fall 2015. The large Stanislaus escapement should result in a high juvenile rearing density in the Stanislaus River. These fish spawned later than normal, which may have increased survival above what would have occurred with a normal timing. However, water temperatures higher than the preferred range in the early part of the Chinook spawning season may have been responsible for the later than average adult return and spawning timing that was observed. Water temperatures dropped to a suitable egg incubation temperature range by around the last part of November. The late spawning timing and warmer water temperatures early in the incubation season may have truncated the normal early emerging fish. Chinook salmon screw trap catches to date have not been high in the Stanislaus, potentially indicating many rearing Chinook salmon remain in the river. Most of the catch occurred in conjunction with the flow peaks during rain events. These flow peaks had a greater magnitude in the lower reaches of the river.

Summary of Effects of Project Description

Central Valley Steelhead

Stanislaus River flows under Appendix 2E of the 2009 BO and the proposed flow increase are being coordinated with the Stanislaus Operations Group to provide the best conditions as feasible under the current conditions in the San Joaquin basin. The proposed increase in flow on the Stanislaus will enable rearing steelhead to more successfully emigrate out of the Stanislaus and lower San Joaquin River towards the ocean. As higher flows increase habitat, it is hypothesized to reduce predator densities and increase migratory speed for steelhead moving past locations where predators may congregate. Additional rearing habitat and feeding opportunities for the in-river steelhead will be provided as additional vegetation is wetted along the banks and floodplain releasing food in the form of invertebrates and allowing additional food production to occur from the additionally wetted organic material. These flows, above what is required in Appendix 2E of the 2009 NMFS biological opinion, will be a net benefit to steelhead in the Stanislaus River and the San Joaquin River. The amount of certainty regarding increased flows effects in the river is moderate, while the effect of these flows in the Delta is less certain.

Central Valley steelhead migrating through the lower San Joaquin River will traverse the Central and Southern Delta, where PTM model entrainment analysis suggests a greater proportion of particles will reach the facilities under the modified hydrology scenarios (Scenarios 2 and 3) compared to the baseline scenario (Scenario 1). The hydrologic influence of the modified I:E ratio is greater in the South Delta (i.e. Railroad Cut and Mossdale) than Central Delta (i.e. station 815) suggesting that hydrologic conditions in the Delta under the modified scenarios are affected regionally and likely is also affected by tidal conditions. Similar to winter-run Chinook salmon, overall entrainment risk into the Interior Delta and CVP/SWP facilities is low for steelhead, although greater (low to medium) if steelhead are observed in the Mossdale trawl monitoring.

An evaluation of each injection point's flux past Chipps Island may provide addition insight into how specific Delta regions are influenced by the modeled scenarios. For Station 815 on the lower San Joaquin River, Scenarios 1 and 3 show similar trends and total particles past Chipps Island, while Scenario 2 results in fewer particles passing Chipps after 45 days. The two Sacramento River injection sites (707 and 809) and Railroad Cut show very small differences in total particles passing Chipps. No difference is observed in the trend or total particles passing Chipps from the Sherwood injection point until after approximately 30 days and Mossdale injection point until after approximately 50 days (Figure 8). The migration of steelhead through the Delta does not typically take 30 days, and is hypothesized to be faster under the higher Vernalis flow hydrologic scenarios (2 and 3).

The Head of Old River Barrier (HORB) closed on April 1 and should reduce entrainment of steelhead into the South Delta. While the coordinated Vernalis flows increases and HORB likely provide a benefit through the Delta, these benefits are reduced as these flows reach the tidal interface in the Central Delta, and in this region, fish are unlikely to be affected by the proposed action. PTM entrainment modeling is not a reasonable surrogate for fish behavior and there is considerable variation in the nascent relationship between reach-specific steelhead survival and reach-specific Delta flows, thus the amount of certainty regarding the biological effects of Delta hydrologic effect on steelhead from the Scenarios is low.

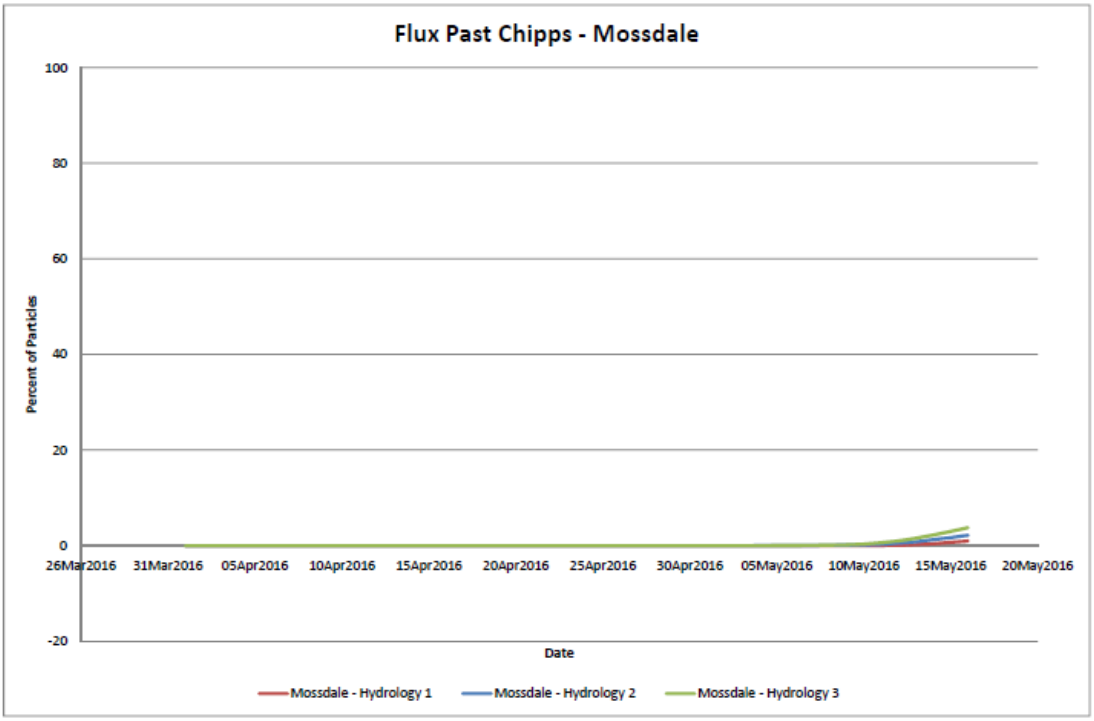

Figure 8. Flux past Chipps Island from Mossdale for the three hydrology scenarios.

In summary, an effect of the proposed action is to improve outmigration survival by reducing transit time through the Stanislaus, lower San Joaquin River, and into the Delta and increasing migration corridor habitat accessibility for Central Valley steelhead. Deployment of the Head of Old River barrier will increase survival through increase outflow further downstream along the San Joaquin River and reduced entrainment into Old River towards the CVP/SWP fish facilities for fish entering the south Delta. Migrating steelhead through the Delta have the lowest survival in the predominantly tidal reaches, where the daily inflow differences between the baseline and either modified hydrology scenarios are insignificant compared to the daily volume of tidal flows. Thus, the flow differences in the Delta due to the Project Description due to increased inflow and exports are unlikely to increase entrainment into the Interior Delta, entrainment and loss at the CVP/SWP export facilities, or increase mortality of migrating steelhead through the Delta.

Fall-run Chinook Salmon

A substantial benefit of the increased flows will be the potential for enhanced growth for rearing habitat availability for Chinook salmon in the Stanislaus River and as they move down the San Joaquin River. Similar to the benefits for steelhead an increase in food resources will be provided as additional riparian area is wetted resulting in increased rearing habitat in proximity to the food sources. The higher flows will result in increased thalweg water velocities providing the opportunity for outmigrating juveniles to move more quickly past predator hotspots. These flows, above what is required in the RPA appendix 2E, will be a net benefit to fall-run Chinook salmon in the Stanislaus River and the San Joaquin River. Effects on fall-run Chinook salmon in the Delta are likely similar to steelhead. PTM entrainment modeling is not a reasonable surrogate for fish behavior and there is considerable variation in the nascent relationship between reach-specific Chinook survival and reach-specific Delta flows, thus the amount of certainty regarding the biological effects of Delta hydrologic effect on Chinook is low.

Winter-run and Spring-run Chinook Salmon

Flows in the Sacramento River influence winter-run and spring-run Chinook juvenile migration survival, Delta rearing survival and entrainment into the south Delta, and adult migration timing. The three hydrodynamic scenarios modeled do not vary regarding Freeport flows, and thus the proposed action is not likely to affect these biological responses. Juvenile winter-run and spring-run are distributed in the Delta and the modeled OMR reverse flows under scenario one through three remain less than -3,500 cfs. DOSS's assessment of the factors influencing entrainment risk suggest no difference in exposure or routing risk for salmonids present in the Delta at this level of OMR (DOSS April 5, 2016 notes). When OMR reverse flows are between -2,500 cfs to -3,500 cfs, DOSS's risk criteria are considered low for juvenile salmonid present in the Interior Delta and close to the CVP/SWP facilities. Scenarios one through three have OMR flow averages during the project of -1,646 cfs , -3,157 cfs, and -2,593 cfs, respectively, and thus the modeling suggests overall entrainment risk through the Interior Delta and at the CVP/SWP facilities is low. The amount of certainty we have regarding the modeled risk is low.

Green Sturgeon

Flows in the Sacramento River influence adult green sturgeon migration. The three hydrodynamic scenarios modeled do not vary regarding Freeport flows, and thus the proposed action is not likely to affect influence this biological response. It is unknown, but possible, that 1+ green sturgeon are present in the Delta. Scenarios one through three have OMR flow

averages during the project of -1,646 cfs , -3,157 cfs, and -2,593 cfs, respectively, and thus the modeling suggests overall entrainment risk through the Interior Delta and at the CVP/SWP facilities is low. This assumes juvenile green sturgeon behave similar to juvenile salmonids. The amount of certainty we have regarding the modeled risk is low.