DEPARTMENT OF WATER RESOURCES
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SACRAMENTO, CA 94236-0001
(916) 653-5791

April 29, 2014

Mr. Thomas Howard, Executive Director
State Water Resources Control Board
1001 I Street
Sacramento, California 95814

Dear Mr. Howard:

The U.S. Bureau of Reclamation (Reclamation) and the Department of Water Resources (DWR) request a modification and extension to the Order Modifying an Order that Approved a Temporary Urgency Change in License and Permit Terms and Conditions Requiring Compliance with Delta Water Quality Objectives in Response to Drought Conditions (dated April 18, 2014) (Order). The CVP and SWP Drought Operations Plan and Operational Forecast, submitted to the State Water Resources Control Board on April 8, 2014 provides a complete description of the hydrologic conditions as of that date and actions proposed to balance multiple needs in a third dry year.

Since the submittal of that document, DWR and Reclamation have updated the hydrologic modeling, and revised our operations plans. As DWR announced on April 18, we do not anticipate needing to install barriers in 2014 to protect water quality and minimize impacts on stored water supplies. This proposed modification and extension reflects the elements of the Drought Contingency Plan that are part of the "without barriers" scenario for the June through November time period. We are requesting that the Order be extended, beginning on July 31, 2014.

The Order currently allows Reclamation and DWR to conserve additional water in the State Water Project/Central Valley Project (SWP/CVP) reservoirs for protection of aquatic species, water quality, and water deliveries by modifying Table 3 of D-1641 such that Delta Outflow must be no less than 3,000 cubic feet per second. The Order provides additional flexibility to export water while Delta inflows remain elevated following precipitation events for the remainder of April that would be in effect while higher Delta inflows persist. Specifically, when precipitation and runoff events occur that allow the Delta Cross Channel (DCC) Gates to be closed and compliance with footnote 10 of D-1641, but the additional Delta Outflow requirements contained in Table 4 of D-1641 are not being met, the Order permits exports of natural and abandoned flows up to the Export Limits contained in Table 3 of D-1641. The use of exported water when D-1641 Delta Outflow or DCC Gate requirements are not being met remains subject to the process requested by the RTDOT on March 18, 2014. The Order also defines the flow requirements on the San Joaquin River at Vernalis during the 31-day pulse flow period in April and May, and defines the restrictions to be applied to exports during that period.

The intent of the proposed modifications to the Order during the June through mid-November period is to continue the focus on conserving as much water as possible in upstream reservoirs in order to protect aquatic species, water quality and water supplies. The conservation of storage will help meet fall Sacramento River temperature requirements and minimize potential impacts from a continuation of drought into 2015, including for the benefit of Chinook salmon. The proposed suite of operational modifications in June through November 15 includes continuation of provisions in the current TUC Order regarding compliance specifications for outflow requirements.

Specifically, Reclamation and DWR request that the Order be modified and extended to allow for the following:

June 1 through November 15, 2014

1. The minimum monthly Net Delta Outflow Index (NDOI) described in Figure 3 of D-1641 during the month of July shall be no less than 3,000 cfs.

2. Modify the critical year D-1641 Agricultural Western Delta Salinity Standard at Emmaton (14-day running average of 2.78 millimhos per centimeter through August 15) by moving the compliance point to Three Mile Slough.

3. The mean monthly Rio Vista flow standard in September, October, and November shall be no less than 2,000 cfs.

4. Vernalis: For June 1 through June 30, no specific minimum flows are required; flows will be maintained sufficient to meet D-1641 San Joaquin River EC requirements.

Urgent Need, Effects on Other Uses, Reasonable Protection of Fish and Wildlife and Protective of the Public Interest

The "urgent need" described in the previous change requests continue to exist. During February, March and April, the State received several precipitation events. Those precipitation events have improved, and continue to improve hydrologic conditions in the Delta and upstream for an interim period. However, it is expected that the additional inflows to the Delta resulting from the earlier storm events will recede very quickly. In addition, while the precipitation events have improved water supply conditions to some extent, San Luis Reservoir and DWR's and Reclamation's reservoirs north of the Delta remain critically low. As a result, the proposed change remains urgent. This Order adds additional measures to help address critically low storage levels in San Luis Reservoir and DWR's and Reclamation's reservoirs north of the Delta and associated water supply needs of those reservoirs.

The attached analyses indicate that legal users of water will not be injured by this action. Delta water quality objectives protective of municipal/industrial and agricultural uses remain in place and the proposed combination of outflows and export levels are expected to continue to provide water quality adequate to meet the needs of beneficial uses. However, as occurs in the South Delta when water quality objectives are met, there may be an exception in achieving the agricultural objective for Old River at Tracy Road. These analyses also provide additional supporting information for the April 9 change request submitted by DWR and Reclamation.

This action should also not have an unreasonable impact to fish and wildlife. Reclamation has concurrence from National Marine Fisheries Service and U.S. Fish and Wildlife Service that these actions are consistent with the federal Endangered Species Act (see attached). DWR has also consulted with the California Department of Fish and Wildlife and has determined that the existing Consistency Determination would remain in effect.

By conserving reservoir storage through the remainder of this year, providing protections for aquatic species, water quality and water supply, and thereby avoiding the severe consequences associated with depletion of reservoir capacity, the proposed changes are in the public interest. This request has been considered and is supported by the Real Time Drought Operations Management Team established to recommend additional changes to the Order necessary to address risks presented by the ongoing and severe drought.

If you have any questions or would like to discuss further, please contact me at (916) 653-7007.

Sincerely,

Mark W. Cowin
Director

Attachments

DWR and Reclamation Request for Modifications and Extension of Temporary Urgency Change Order
April 29, 2014

Review of Potential Impacts on Smelt

This review is for the following proposed modifications: change to the compliance location for the D1641 Agricultural Western Delta Salinity Standard from Emmaton to Three Mile Slough on the Sacramento River; minimum mean monthly Delta outflow in July no less than 3,000 cfs; September-November Rio Vista minimum mean monthly flow of 2,000 cfs; and an EC requirement only for the San Joaquin River at Vernalis in June. These modifications are outline in Scenario 2, section VII of the Drought Operations Plan. These modifications will enable a reduction in upstream reservoir releases and additional preservation of the limited stored water.

PROPOSED ACTIONS

June thru November Period

This period describes D1641 modifications for June through November. The proposed modification to Delta criteria for June-November is a change of the compliance location for the D1641 Agricultural Western Delta Salinity Standard from Emmaton to Three Mile Slough on the Sacramento River; minimum mean monthly Delta outflow June –October of 3,000 cfs; September-November Rio Vista minimum mean monthly flow of 2,000 cfs; and an EC requirement only for the San Joaquin River at Vernalis in June. No modifications to the USFWS BiOp RPA actions are currently proposed under this action. All OMR flow related actions, including determinations based on advice from the Smelt Working Group (SWG) and the Water Operations Management Team (WOMT), remain in place[1]. The OMR Index Demonstration Project as specified in the USFWS concurrence letter continues.

EFFECTS REVIEW

Effects of Proposed Action Specific to Delta Smelt Designated Critical Habitat

Physical Habitat and Water Quality Effects

DSM2 modeling was conducted to assess the potential effects of the proposed modifications on water quality. The modeling adjusted Sacramento River flow so as to meet EC standards at Emmaton and Three Mile Slough, and did not incorporate additional operational or outflow changes. Projected salinity patterns should be considered as reflecting the relative influence of the proposed modifications on salinity patterns, rather than as accurate predictions.

Physical habitat and water quality would be affected by the proposed modifications. The upstream relocation of the compliance point and reduction in outflows will result in salinity moving further upstream on the lower Sacramento and San Joaquin Rivers. Due to the potential for Sacramento River origin water to be transported through the Delta Cross Channel to the San Joaquin River, the upstream tidal excursion of higher salinity water is expected to be more pronounced on the Sacramento River than the San Joaquin. For example, DSM2 modeling estimated that change in conductivity at Rio Vista would be elevated by approximately 50-200 micromhos per centimeter (μmhos/cm) during June-October (Figure 1) over what would likely occur if the Emmaton location was maintained. This would cause an upstream relocation of X2 and given the general decrease in habitat with movement upstream of the low-salinity zone would result in a smaller area of abiotic habitat (Feyrer et al. 2007), thus further constraining the habitat for juvenile Delta Smelt closer to the upstream spawning areas in the lower Sacramento River, San Joaquin River, and the Cache Slough Complex/Sacramento Deep Water Ship Channel. Although these changes will reduce the quantity of available habitat, conductivity within this

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[1] The CDFW 2081 permit criteria associated with longfin smelt remains in place.

habitat will be within the range of salinity generally occupied by Delta Smelt during the summer and fall. Also as Sommer and Mejia (2013) noted, Delta Smelt are not confined to a narrow salinity range and occur from fresh water to relatively high salinity, even though the center of distribution is consistently associated with X2 (Sommer et al. 2011). Nobriga et al. (2008) found that the probability of occurrence of Delta Smelt was highest at low conductivity (1,000-5,000 µmhos/cm), and declines at higher conductivity (Figure 6); conductivity forecasts for Emmaton (figure 5) and locations upstream are within this range during the period modeled. Therefore we conclude that while changes in salinity in the lower Sacramento River are within the physiological tolerances of Delta Smelt, the proposed modifications are expected to shift the Delta Smelt population further upstream.

The upstream shift of Delta Smelt distribution on the Sacramento River will increase the potential for stochastic events to exacerbate mortality and density–dependent effects on the population (Feyrer et al. 2011). As an example of this type of event, there may be water temperature increases during prolonged heat waves that would pose risks to Delta Smelt. In general, summer temperatures are higher in landward channels (Wagner 2012), so reduced inflow is expected to shift the distribution of Delta Smelt into these warmer regions. In addition, with the constriction of X2 above the Sacramento-San Joaquin confluence, salinities may be too high downstream for Juvenile Delta Smelt to move substantially seaward, where the maritime influence and larger water bodies maintain cooler water temperatures.

In the San Joaquin River, modeling suggests that EC at Port Chicago will increase (Figure 2). The modifications would cause slightly higher conductivity changes along some south Delta water supply channels (e.g., Old River near Middle River, figure 3) and higher still on others (e.g., Rock Slough, figure 4), although modeling suggests that EC will be maintained beneath 1000umhos/cm at these locations. From this information it is inferred that there would be little physiological effect on Delta Smelt from changes in conductivity in the lower San Joaquin River, as the ranges are all well within the physiological tolerance ranges for salinity (Nobriga et al. 2008; Figure 6). However, the increase in salinity may alter the distribution of Delta Smelt into less favorable areas within the lower San Joaquin (e.g. Franks Tract).

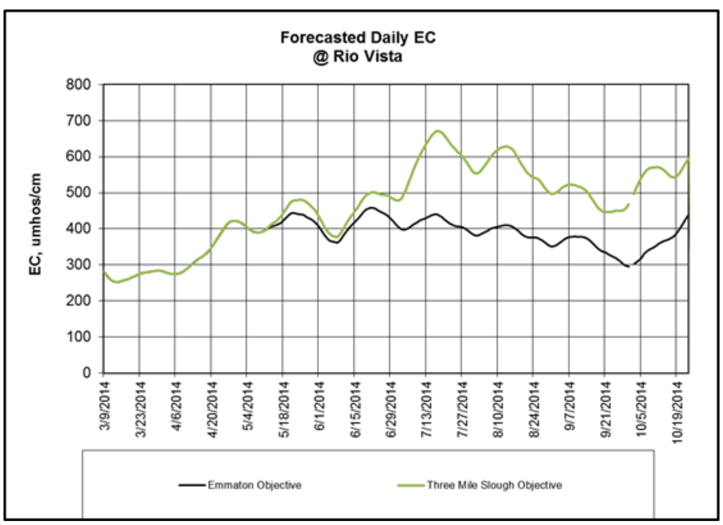


Figure 1, forecasted Daily Electrical Conductivity at Rio Vista, from DSM2 Modeling.

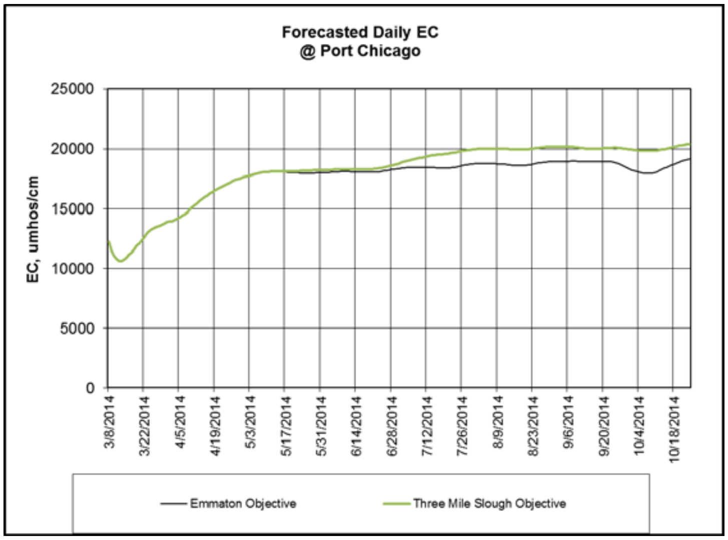


Figure 2, forecasted Daily Electrical Conductivity at Port Chicago, from DSM2 Modeling.

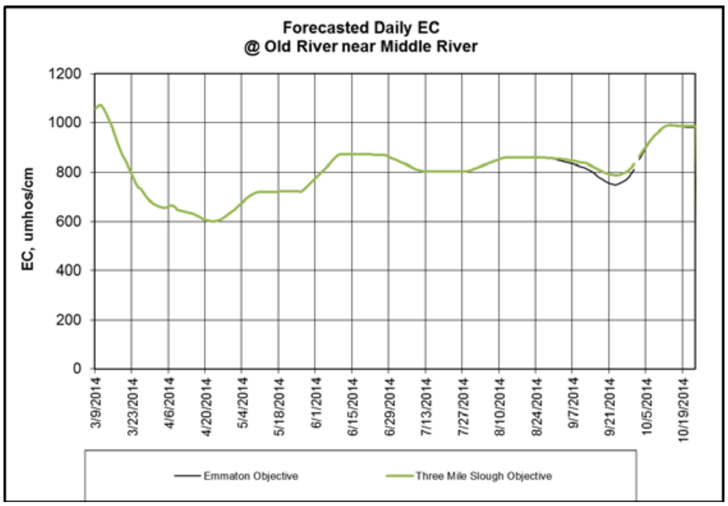


Figure 3, forecasted Daily Electrical Conductivity at Old River near Middle River, from DSM2 Modeling.

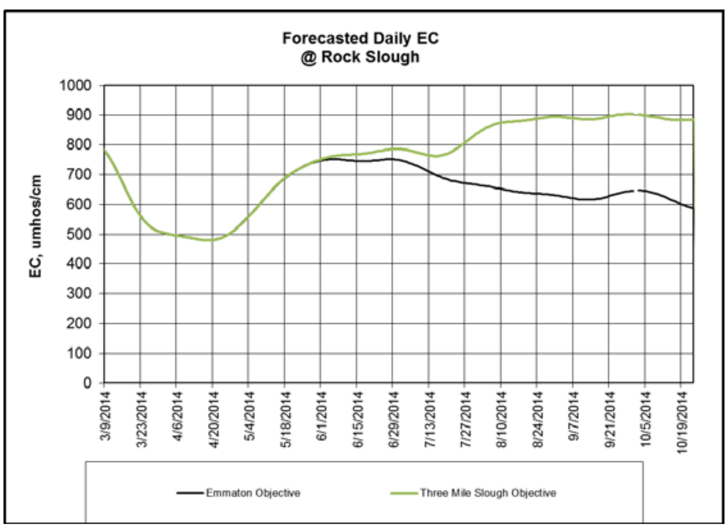


Figure 4, forecasted Daily Electrical Conductivity at Rock Slough, from DSM2 Modeling.

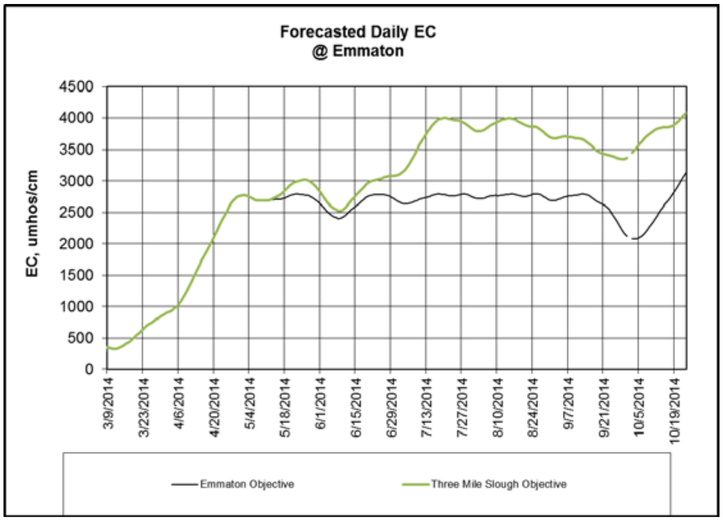


Figure 5, forecasted Daily Electrical Conductivity at Emmaton, from DSM2 Modeling.

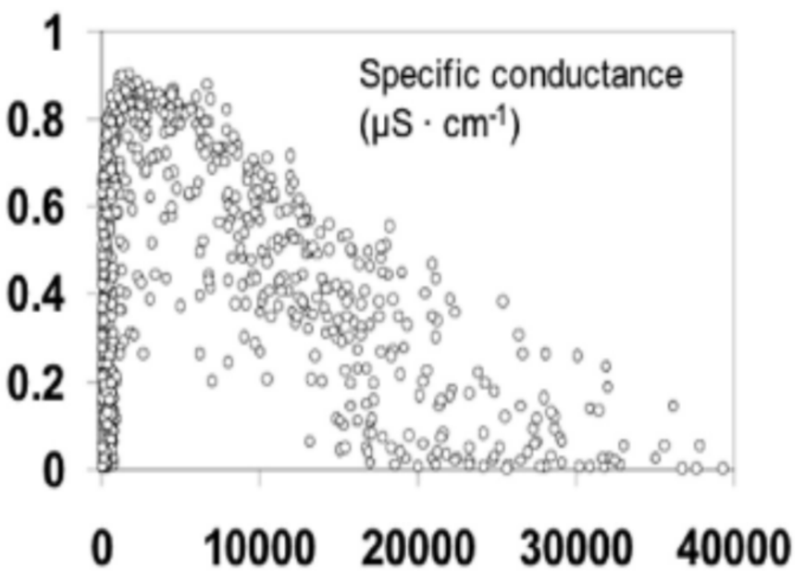


Figure 6, predicted capture probability of Delta Smelt juveniles in 1974-2004 July Summer Townet Surveys from generalized additive modeling in relation to specific conductance, with scatter depicting variation caused by secchi depth and water temperature.[2]

[2] Source: Nobriga et al. (2008).

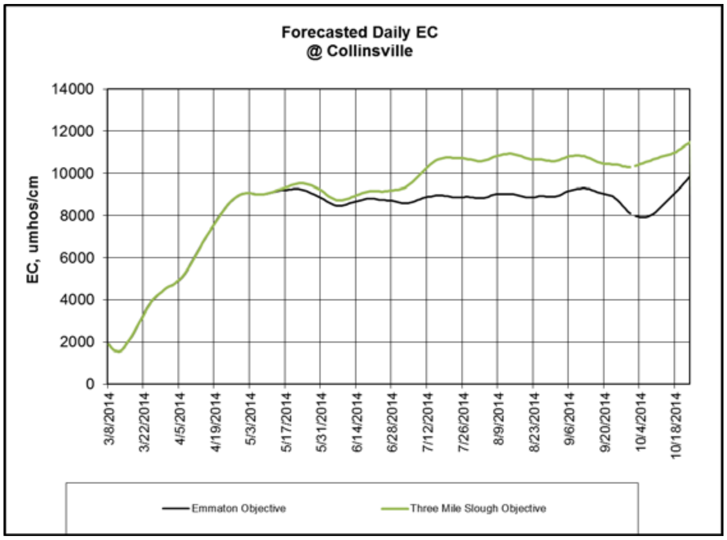


Figure 7, forecasted Daily Electrical Conductivity at Collinsville, from DSM2 Modeling.

Hydrodynamic Effects on Entrainment

The proposed modifications will result in lower outflows that may reduce survival of outmigrating larval smelt that are currently in the Interior Delta. For example, lower flows may expose them to loss at the CVP/SWP export facilities, and increasing their travel time and exposure to degraded habitats and predators. However, the projected OMR flows are less negative than -5000 cfs and therefore are not likely to result in substantial additional impacts over unmodified conditions. For smelt residing in the North Delta, reduced outflow, while limiting the available habitat, is not expected to result in any additional entrainment. There is a low level of uncertainty in this conclusion.

Food Availability

Prey availability is constrained by habitat use, which in turn affects what types of prey are encountered. Larval Delta Smelt are visual feeders. They find and select individual prey organisms and their ability to see prey in the water is enhanced by turbidity (Baskerville-Bridges et al. 2004). Thus, Delta Smelt diets are largely comprised of small invertebrates that inhabit the estuary's turbid, low-salinity, open-water habitats (i.e., zooplankton). Larval Delta Smelt have particularly restricted diets (Nobriga 2002). They do not feed on the full array of zooplankton with which they co-occur; they mainly consume three copepods: *Eurytemora affinis*, *Pseudodiaptomus forbesi*, and freshwater species of the family Cyclopidae. Further, the diets of first-feeding Delta Smelt larvae are largely restricted to the larval stages of these copepods. As the Delta Smelt grow larger their mouth gape increase, and their swimming ability strengthens, enabling them to target larger copepods.

In the laboratory, a turbid environment (>25 Nephelometric Turbidity Units [NTU]) was necessary to elicit a first feeding response (Baskerville-Bridges et al. 2000; Baskerville-Bridges 2004). Successful feeding seems to depend on a high density of food organisms and turbidity, and increases with stronger light conditions (Baskerville-Bridges et al. 2000; Mager et al. 2004; Baskerville-Bridges et al. 2004). The most common first prey of wild Delta Smelt larvae is the larval stages of several copepod species which occur in the North Delta region. The variability of shallow and deep water habitat, and the resuspension of sediment due to wind and tidal action in the North Delta, may buffer the effects of the proposed modifications because much, if not most, of the habitat in this region would remain suitable. The expectations for the North Delta contrast with the lower San Joaquin River where the upstream relocation of X2 may result in a greater proportion of the available habitat encompassing areas of high SAV and associated low turbidities. This could result in lower prey catch efficiencies and also higher predation rates on juvenile Delta Smelt. There is moderate level of uncertainty in this conclusion.

In addition to turbidity effects, changes in flow may affect residence time, which in turn may influence planktonic production. Lower flows are expected to reduce hydraulic residence times, potentially resulting in improved planktonic production (Lucas et al. 2009). However, the specific effect is difficult to predict because benthic grazing can offset these benefits. Hence, the response of the food web to the changes in flow are unclear. There is a moderate level of uncertainty about this conclusion.

Delta Smelt Effects

Current Delta Smelt Distribution

The most recent Spring Kodiak Trawl found that the current distribution of adult Delta Smelt within the estuary is primarily in the Sacramento River system, especially the Sacramento Deep Water Ship Channel (Figure 8). The most recent survey caught only one Delta Smelt (3% of total catch) in the San Joaquin system and this was at the Antioch station near the confluence. In the final week (April 6-10) of supplemental U.S. Fish and Wildlife Service sampling in the lower San Joaquin River (Jersey Point, Figure 9), which consisted of 15 trawls per day and concluded on April 10, 2014, catch of adult Delta Smelt declined precipitously to between zero and two fish per day in the last five days of sampling. This evidence indicates that the majority of the adult population is outside of the influence of the export facilities.

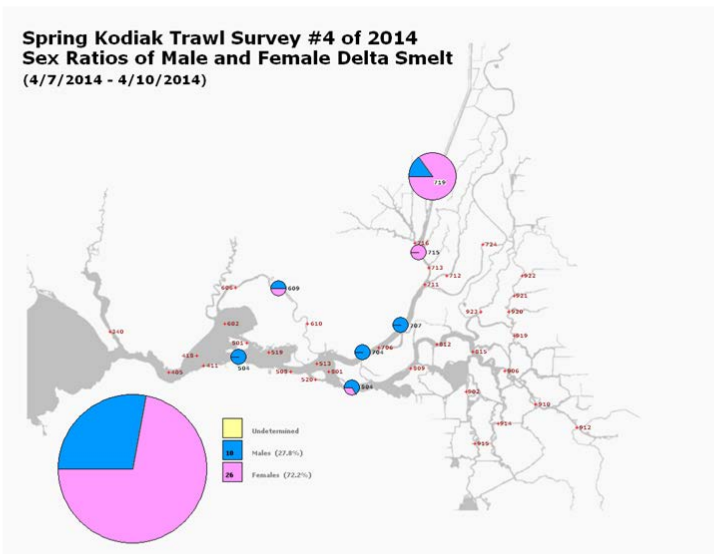


Figure 8, Spring Kodiak Trawl #4 Delta Smelt Catch[3]

[3] Retrieved from http://www.dfg.ca.gov/delta/projects.asp?ProjectID=SKT on 4/24/2014

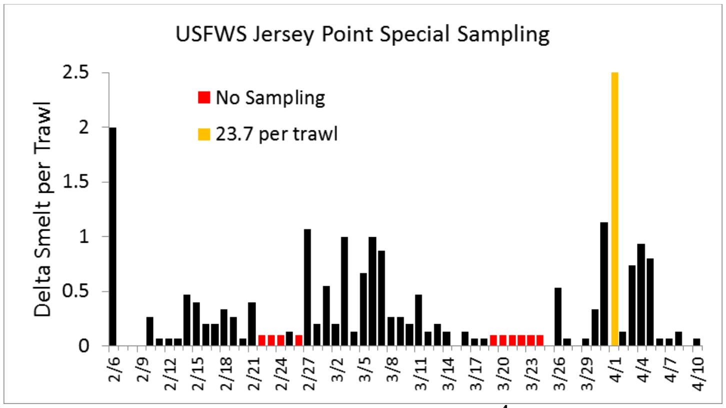
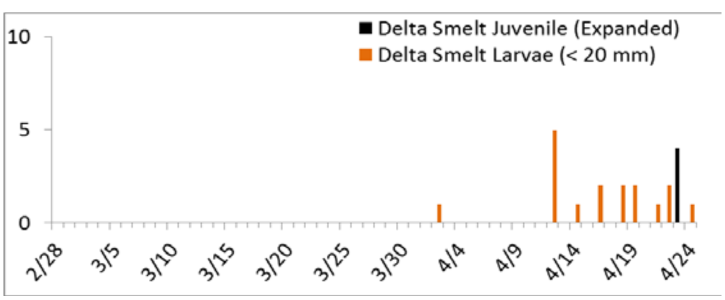


Figure 9, USFWS Jersey Point Special Sampling[4]

Larval Delta Smelt have been detected at the salvage facilities intermittently since April 2, 2014, (figure 10) and a single juvenile Delta Smelt (≥ 20 mm) was collected on April 24, 2014. No adult Delta Smelt have been observed in salvage this water year at the South Delta fish facilities. However, pre-screen loss and entrainment effects (e.g. predation) can occur despite zero observed salvage at the facilities, and these effects are difficult to detect and quantify. In addition, salvage operations at the CVP were sporadically impacted by high levels of debris and outages.

Delta Smelt continue to spawn with larvae detected in the Sacramento River system as of March 3, and larvae were detected in the lower San Joaquin River as of March 17 during the last Smelt Larval Survey of the season (Figure 11). In addition, the most recent 20 mm survey, conducted April 14-17, detected juvenile Delta Smelt in the San Joaquin River at Jersey Point (Figure 11b). Larvae and juveniles in the lower San Joaquin River are potentially susceptible to the effects of South Delta exports. Hatching will likely continue over the next few weeks, although the peak of the spawning season has likely passed. As water temperatures rise, larvae are beginning to recruit to juvenile size, and a broader distribution in the central Delta may become evident. Recent intermittent salvage of larval Delta Smelt indicates at least a limited distribution of larvae in the vicinity of the SWP and CVP pumps that were likely hatched in the central and southern Delta and are being drawn into the pumps at current levels of OMR (Smelt Working Group-notes from 4/21/2014)[5]. The majority of members of the Smelt Working Group expect that larval and juvenile Delta Smelt will be detected in salvage over the next week or so and then decrease as the limited distribution is depleted (Smelt Working Group-notes from 4/21/2014)[5]. A temperature off ramp occurs when water temperatures at Clifton Court reach 25°C for three consecutive days (FWS BO 2008). This off ramp typically occurs in late June, if at all (an alternate, calendar based off ramp is June 30).



[4] Data provided to Smelt Working Group

[5] Smelt Working Group notes 4/21/2014, available at: http://www.fws.gov/sfbaydelta/cvp-swp/smelt_working_group.cfm.

Figure 10, juvenile counts are expanded salvage, larval counts are raw sample numbers, water year 2014[6]

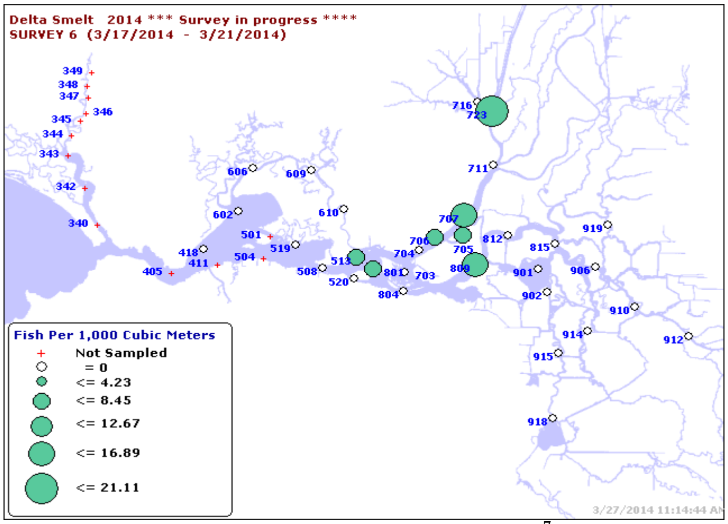


Figure 11, Smelt Larval Survey #6 Delta Smelt catch[7]

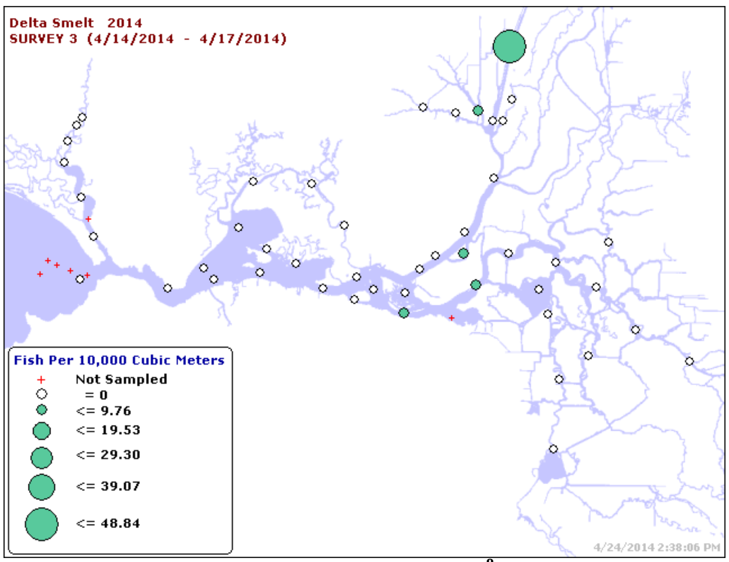


Figure 11b, 20mm Survey #3 Delta Smelt catch[8]

Summary of Delta Smelt Effects

Adult Delta Smelt

If the SKT and USFWS Jersey Point survey results reasonably reflect the current distribution of Delta Smelt, there is a small and diminishing population of adult Delta Smelt in the vicinity of Jersey Point. Entrainment of these adults is unlikely to be a management issue this year. Published analyses of a 13-year dataset of salvage records at the CVP/SWP fish collection facilities indicate that increased salvage of adult Delta Smelt at the CVP/SWP occurs when turbidities increase in the South Delta and Old and Middle River flows are highly negative (Grimaldo et al., 2009). Given the present low turbidity in the

[6] Retrieved from http://www.dfg.ca.gov/delta/apps/salvage/Default.aspx on 3/26/14
[7] Retrieved from http://www.dfg.ca.gov/delta/projects.asp?ProjectID=SLS on 4/24/14
[8] Retrieved from http://www.dfg.ca.gov/delta/projects.asp?ProjectID=20mm on 4/24/14

South Delta, migration of remaining adults into areas of elevated entrainment risk is not expected. The salvage of adult Delta Smelt typically ends by May (Figure 12). After the onset of spawning, salvage of adult Delta Smelt typically diminishes, with the regulatory focus shifting from protection of adults to the protection of larvae/juveniles by the end of March (as determined by water temperatures or biological triggers; FWS BO, 2008).

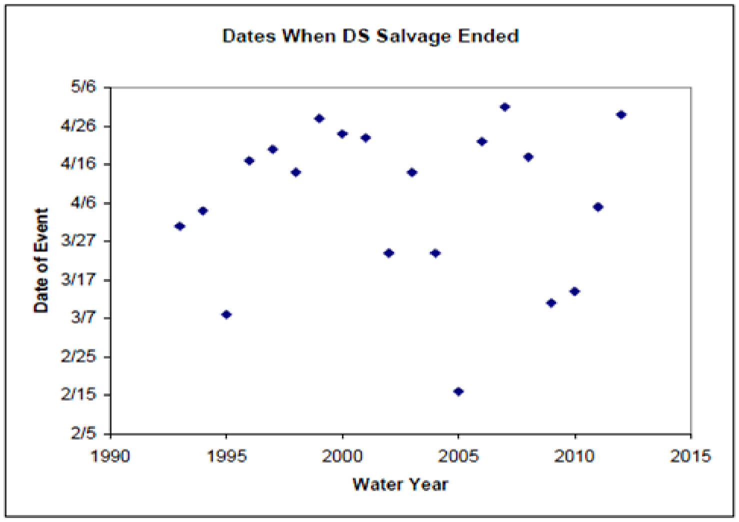


Figure 12: Dates of salvage of last adult Delta Smelt for water year (1993-2012)[9]

Delta Smelt adults and early life stages have historically been collected in the Sacramento River upstream of Georgiana Slough in the Sacramento Trawl and Sacramento area beach seines, as well as in beach seines within Liberty Island and the Yolo Bypass Toe Drain. Therefore Delta Smelt are present in the North Delta. Indeed, Delta Smelt were collected by trawling at Sherwood Harbor during early March (Figure 13). Juveniles and adults in the Northern Delta have a greater area of suitable habitat than populations in the lower San Joaquin. For example, the North Delta includes several potential refuges, such as the Sacramento Deep Water Ship Channel and Liberty Island.

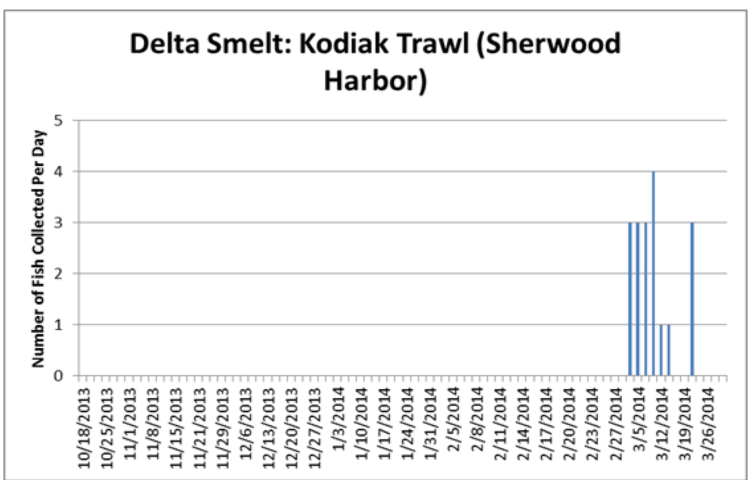


Figure 13, Daily Number of Delta Smelt Collected During Kodiak Trawling at Sherwood Harbor, Sacramento River CA. October 18-March 8, 2014.[10]

[9] Graph provided by Robert Fujimura, CDFW, on 1/14/2013

During the summer, few adult Delta Smelt survive from the previous year. Some two year old fish survive through the summer to spawn the following year, but this is rare (2.3% to 9.3% of population in 2002 and 2003, respectively; Bennett 2005). Although the proportion of fish in this category is typically small, these age 1+ Delta Smelt produce more eggs than age 1 smelt, thus having a disproportionate effect on the population (Bennett 2005). We hypothesize that these age 1+ fish will have a greater ability to move out of areas of poor habitat quality due to their size and broader salinity tolerances, and thus will be more likely to survive compared to juvenile Delta Smelt (discussed below). For these reasons the remainder of our discussion regarding Delta Smelt during the summer will focus on effects on larvae and juveniles.

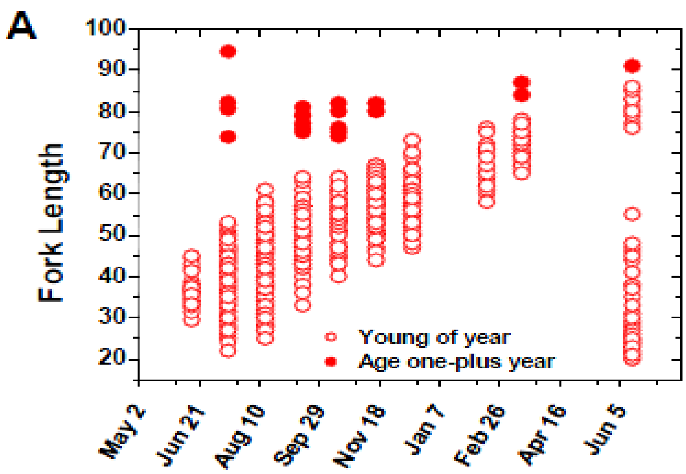


Figure 14, Length of young of year and 1+ adults as determined from Otolith evaluations (n=876) in 1999-2000[11]

Larval-Juvenile Delta Smelt

San Joaquin River: The distribution of newly hatched larval Delta Smelt in the lower San Joaquin River is assumed to be similar to the distribution of adults, which are not currently at a high risk of entrainment. Recent larval survey results further support this assumption (see above). The entrainment risk of larval Delta Smelt produced in the lower San Joaquin River is expected to be moderated by the maintenance of Index OMR flows at -5,000 cfs on a 14 day running average under the proposed action for the duration of the RPA action. There is the potential that undetected larval Delta Smelt are located in the South Delta nearer to the Export facilities and these may be at a higher risk of entrainment. However, based on simulated fates of neutrally buoyant particles (Kimmerer and Nobriga 2008), any Delta Smelt southeast of Jersey Point in the Central/South Delta may well be entrained at the south Delta export facilities even if the proposed modifications are not instituted. There is a low level of uncertainty about this conclusion.

Salvage of juvenile Delta Smelt during the summer and fall months is virtually non-existent (Table 1, CDFW Salvage data), as Delta Smelt do not use the South Delta as habitat during these months (Sommer et al. 2011).

Table 1, Date of last juvenile Delta Smelt salvaged for water year[12]

Facility	2008	2009	2010	2011	2012	2013
CVP	6/20	6/23	5/21	N/A	6/23	6/8

[10] Source: Speegle (pers. comm.). Note that typical daily sampling frequency is ten 20-minute trawls.
[11] Bennett 2005
[12] Data from Robert Fujimura, CDFW, on 4/1/2014

SWP	7/5	6/30	6/8	N/A	6/28	6/17

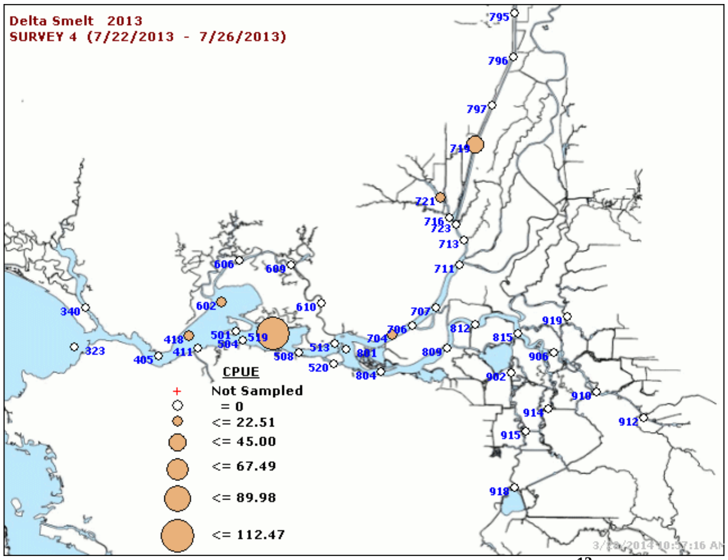


Figure 15, TNS #4 Delta Smelt Distribution in Late July[13]

Sacramento River/North Delta: Juvenile Delta Smelt during the summer period typically reside in the low salinity zone around X2, with a substantial portion of the population remaining in the North Delta (Sommer and Mejia, 2013). The CDFW Summer Townet Survey (TNS) samples the distribution of Delta Smelt throughout the summer and early fall period, and in the summer of 2013 consistently detected Delta Smelt in both of these areas (Figure 15). It is hypothesized that Delta Smelt in the Cache Slough Complex utilize deep water areas of Cache Slough and the Sacramento Deep Water Ship Channel as thermal refuges during high summer temperatures. Delta Smelt continue to feed and grow through the summer months, and begin to move upstream in early winter during periods of increased outflow and high turbidities, which typically do not commence until December. There is no evidence that substantial upstream movement relative to the salt field occurs prior to this period (Sommer et al. 2011).

Juvenile Delta Smelt have the potential to be substantially affected by the proposed actions. The effects of changes in water quality in areas such as Liberty Island, Sacramento Deep Water Ship Channel, Lindsey and Cache Sloughs, are uncertain because the hydrology of this region is strongly driven by tidal effects during the months of the proposed action. However it is relatively likely that reduced inflow will result in a more upstream distribution of Delta Smelt, increasing the risk that they will be exposed to relatively high water temperatures (e.g.>25C). It is hypothesized the Deep Water Ship Channel and Cache Slough may provide key thermal refuges that allow Delta Smelt to persist in the North Delta. Nonetheless, it is not known how long these refuges will persist under conditions of a sustained heat wave.

Delta Smelt have a strong positive association with the position of X2, with more downstream positions providing higher quality habitat (Feyrer et al. 2011). Under the proposed action, it is likely that summer Delta Smelt distributions will not be in areas optimal for growth and survival (Nobriga et al. 2008). In previous low-flow years, when water quality conditions became less tolerable for Delta Smelt in the Cache Slough Complex, the North Delta population appeared to have the capability to move downstream quickly towards the low salinity zone. It is likely, given the strongly tidal nature of the Cache Slough Complex, that Delta Smelt are able to ride these tidal flows and would be capable of quickly escaping unfavorable habitat conditions in the North Delta should they arise. Under the current

[13] Retrieved from http://www.dfg.ca.gov/delta/projects.asp?ProjectID=TOWNET on 3/28/14

proposal, X2 would move further upstream, limiting this potential downstream movement, although conditions without the modifications would also limit this potential downstream movement. The proportion of the total population of Delta Smelt utilizing the North Delta in summer appears to be highly variable (e.g. Dr. James Hobbs, UC Davis, unpublished data), but it can be substantial. There is a moderate level of uncertainty about the expected effects in the North Delta.

Longfin Smelt Effects

Current Longfin Smelt Distribution

Fish surveys and salvage suggest there was limited Longfin Smelt spawning in the Central or South Delta this year, resulting in low densities of larval and juvenile Longfin Smelt in this region. The majority of juvenile Longfin Smelt appear to be distributed in the lower Sacramento and San Joaquin rivers, and the confluence of these rivers, with smaller densities distributed in Suisun Bay, the Cache Slough Complex, and in the South Delta (Figure 16). This water year, no adult Longfin Smelt have been collected in salvage, or in the Central or South Delta during Bay Study sampling, December-March, or in the final Fall Midwater Trawl sampling in December, or in the USFWS special study at Jersey Point.

Longfin Smelt larvae were detected at 8 of 12 Central and South Delta sampling stations during Smelt Larva Survey #3, conducted February 3-5, 2014. However, subsequent Smelt Larva Survey sampling indicated densities of Longfin Smelt larvae in the Central and South Delta rapidly diminished in following weeks. The last Smelt Larva Survey of 2014 (SLS #6), conducted March 17-21, detected larvae at only 2 of 12 Central and South Delta stations, with moderate densities detected only at station 809 situated at Jersey Point. The first detection of age-0 Longfin Smelt in salvage in 2014 occurred on February 24 (Figure 17). Near daily detection of age-0 Longfin Smelt in salvage continued through the first week in March, followed by detection on only five days between March 5 and April 20. It should be noted that larval sampling at the CVP facility did not begin until March 13 and has proceeded on an intermittent schedule due to facility maintenance.

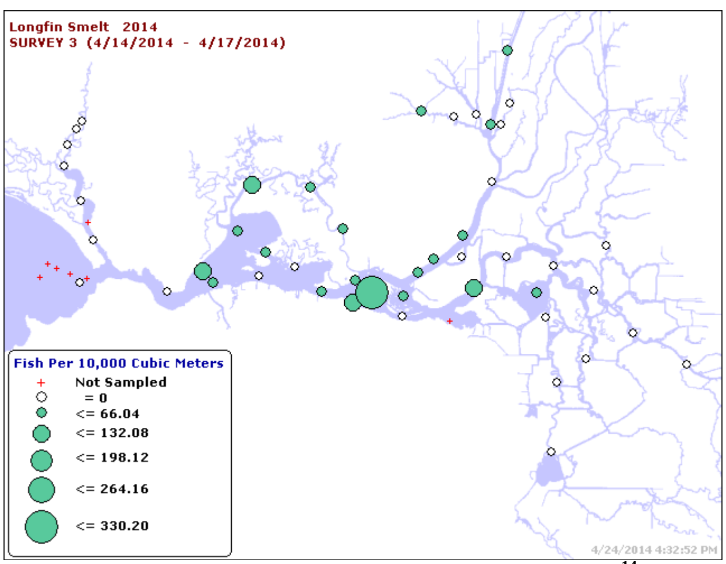


Figure 16, Longfin age-0 distribution from 20 mm survey #3[14]

[14] Retrieved from http://www.dfg.ca.gov/delta/data/ on 3/26/14

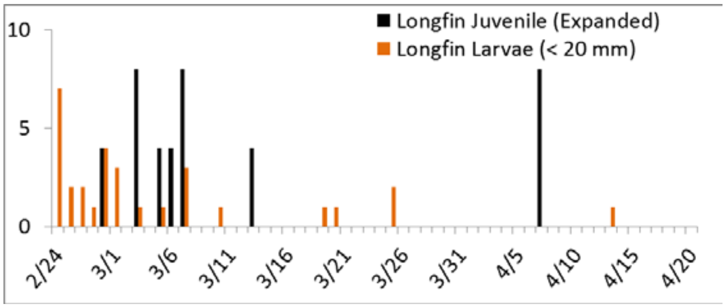


Figure 17, juvenile counts are expanded salvage, larval counts are raw sample numbers, water year 2014[15]

Adult Longfin Smelt Effects

Given their current distribution and the expected downstream shift in distribution over the course of the summer, the proposed actions are not anticipated to affect adult Longfin Smelt.

Larval Longfin Smelt Effects

Given the limited distribution of larvae and juveniles in the Central and South Delta, the proposed action will likely not substantially affect entrainment risk of the Longfin Smelt population. Additionally, larval Longfin Smelt salvage decreases as water temperatures rise in the spring months, so salvage is likely to continue declining through the action period regardless of operations. Overall, potential increased entrainment effects on Longfin Smelt resulting from the proposed actions will be limited, although a demonstrated positive relationship between Longfin Smelt abundance and winter-spring Delta outflow (Kimmerer 2002; Rosenfeld and Baxter 2007) suggests reduced outflow in April under the proposed action will result in some reduction in overall abundance. The modifications proposed are not likely to result in a substantial degradation of rearing habitat for Longfin Smelt over conditions that would be experienced in a dry year. There is a low level of uncertainty about this conclusion.

[15] Retrieved from http://www.dfg.ca.gov/delta/apps/salvage/Default.aspx on 3/26/14

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DWR and Reclamation Request for Modifications and Extension of Temporary Urgency Change Order
April 29, 2014

No Impacts on Other Water Users
Comparison of 2014 Hydrology with Historical Hydrologies

This analysis compares historical hydrology to that projected in 2014, with a proposed change of the salinity compliance location from Emmaton to Threemile Slough. The analysis reviews historical pre-project years similar to this year's hydrology, and shows that salinity intrusion into the Delta would have been significant. These values are greater than what would occur if the Emmaton Objective were moved to Threemile Slough.

The first part of this document shows how the 2014 forecasted stream flows compare to dry pre-project years. The second part of this document shows results from the Delta Atlas on salinity intrusion and DSM2 historical model electrical conductivity results for pre-project years.

Accumulative Simulated Daily Stream flows During Historically Dry years and WY2014

March 23, 2014 Forecast and Historical Accumulative Simulated Daily Stream Flows

Figures 1-3 show the simulated daily stream flows during historically dry years for rivers flowing into Oroville, Shasta, and Folsom. The graphs also show projected stream flows for Water Year 2014 for the one percent (wet), fifty percent, and 99 percent (very dry) hydrology. The graphs were generated using the Soil Water Assessment Tool (SWAT) with a forecast generated from March 23, 2014.

For Feather River flows (Oroville), the dark red line (2014 dry year forecast) and the solid blue line (2014 50% forecast) bracket the pre-project stream flows for 1924 and 1931 (dashed green and dashed blue).

For Shasta Lake, the dark red line (2014 dry year forecast) follows the 1931 stream flow line (dashed blue) with the 2014 50% stream flow being slightly higher, about 100 TAF.

For the American River, the 2014 99% and the 2014 50% stream flows are higher than the 1924 and 1931 except in June when the 1931 stream flows are higher than the 99% hydrology.

April 22, 2014 Forecast and Historical Accumulative Simulated Daily Stream Flows

Figure 4 shows the simulated daily stream flows during historically dry years for the Feather River. The graph also shows projected stream flows for Water Year 2014 for the one percent (wet), fifty percent, and 99 percent (very dry) hydrology. The graph was generated using the Soil Water Assessment Tool (SWAT) with a forecast generated from April 22, 2014.

For Feather River flows (Oroville), the dark red line (2014 dry year forecast) and the solid blue line (2014 50 % forecast) are higher than the 1931 and 1924 stream flow lines during the spring and summer but lower than the 1926 and 1934 lines.

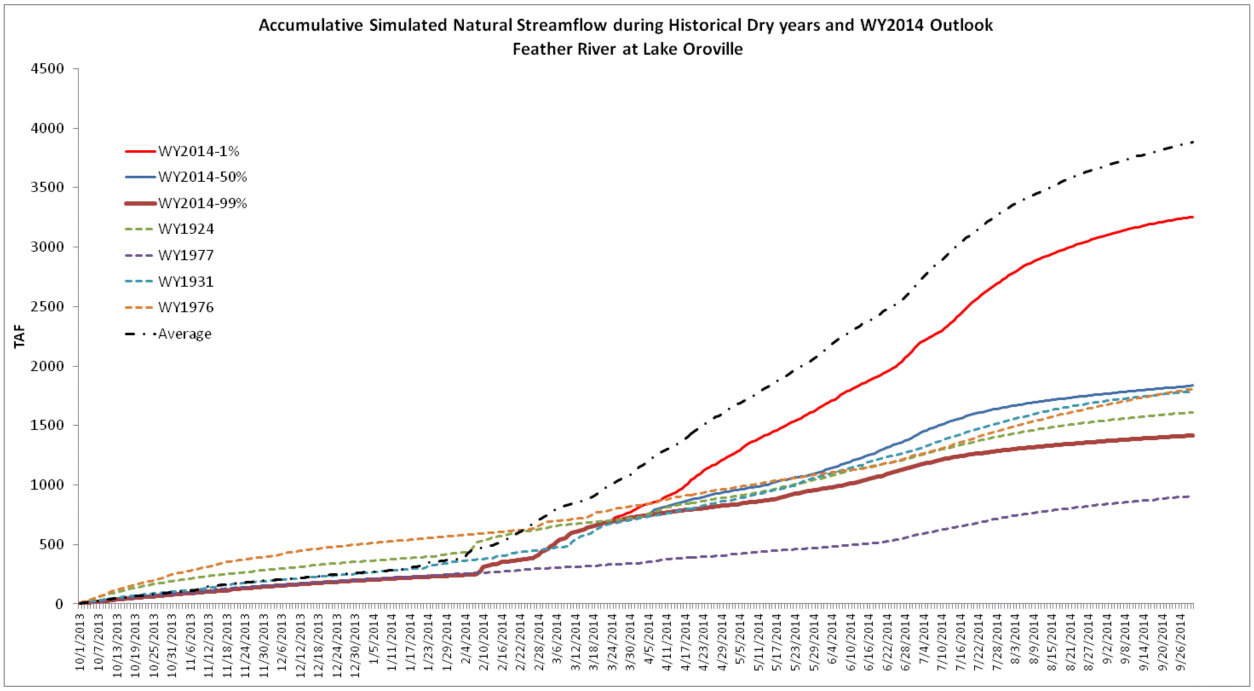


Figure 1: Accumulative Simulated Natural Stream Flow at the Feather River at Lake Oroville – March 23, 2014

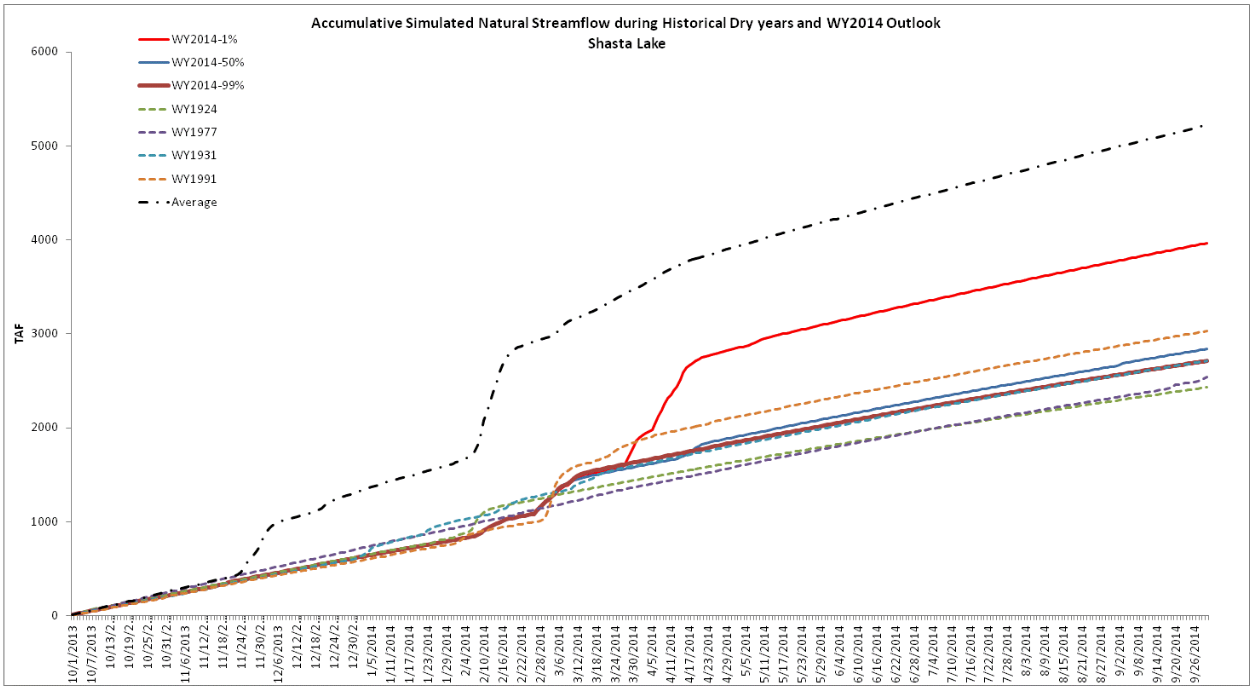


Figure 2: Accumulative Simulated Natural Streamflow at Shasta Lake – March 23, 2014

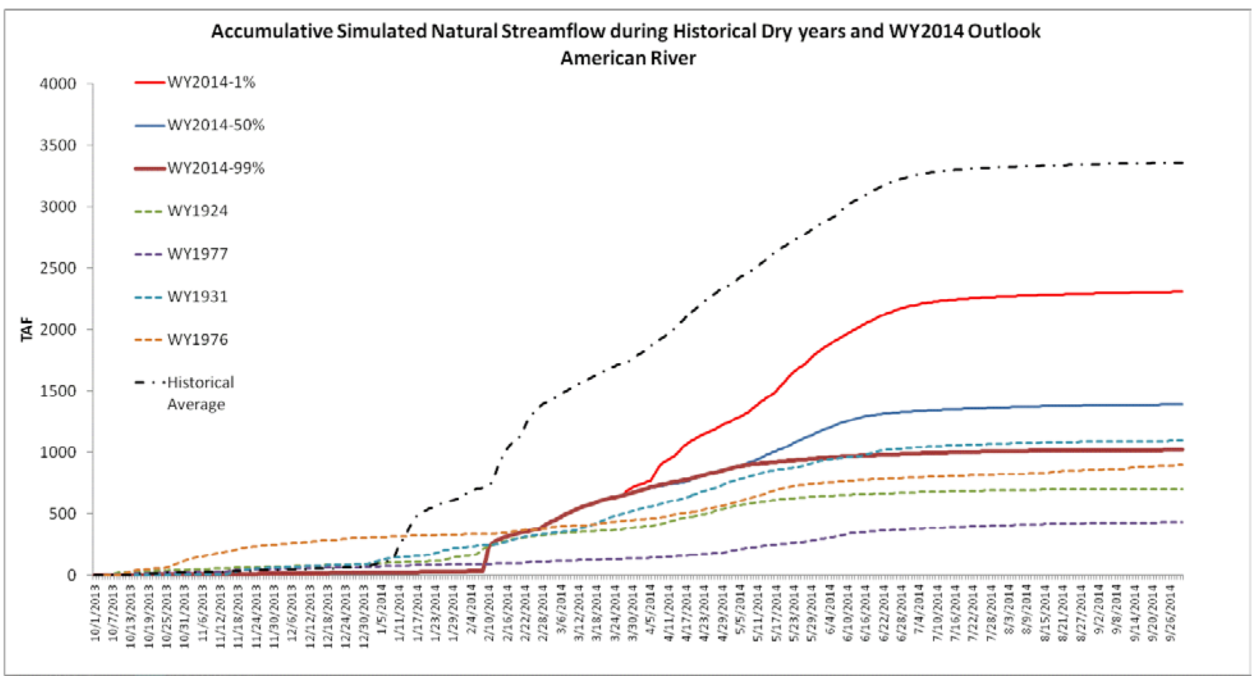


Figure 3: Accumulative Simulated Natural Streamflow at the American River- March 23, 2014

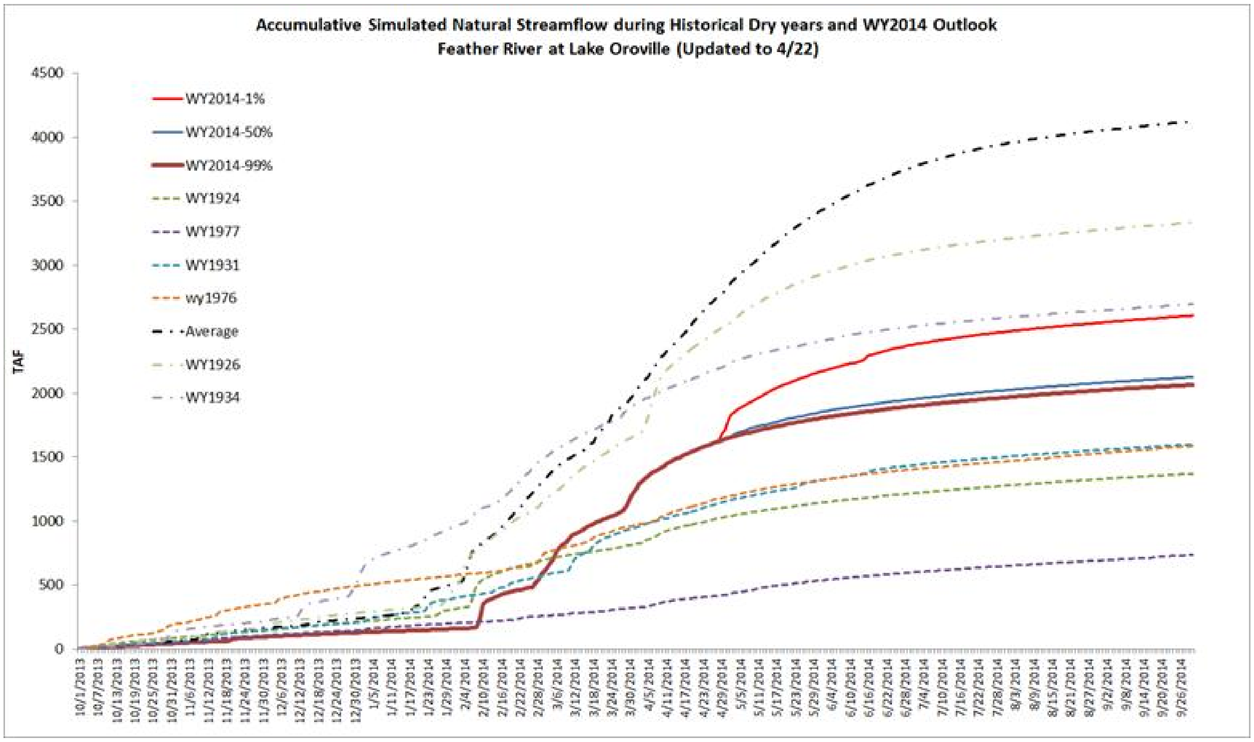


Figure 4: Accumulative Simulated Natural Stream Flow at the Feather River at Lake Oroville – April 22, 2014

Delta Atlas and DSM2 Salinity Intrusion for 1924, 1926, 1931, and 1934

Figure 5 is a graphic from the Delta Atlas showing maximum salinity intrusion, between 1921 and 1943, before the water projects were built. The maximum salinity lines correspond to 1000 parts of Chloride to a million parts of water. This concentration roughly correlates to 4000 umhos/cm at Clifton Court Forebay.

Figure 6 shows the historical DSM2 results for dry years using X2 (2640 umhos/cm). Comparing the Delta Atlas salinity intrusion (Figure 5) with Figures 6, 7 and 8, indicates that DSM2 generally matches the salinity intrusion into the Delta with some under-prediction.

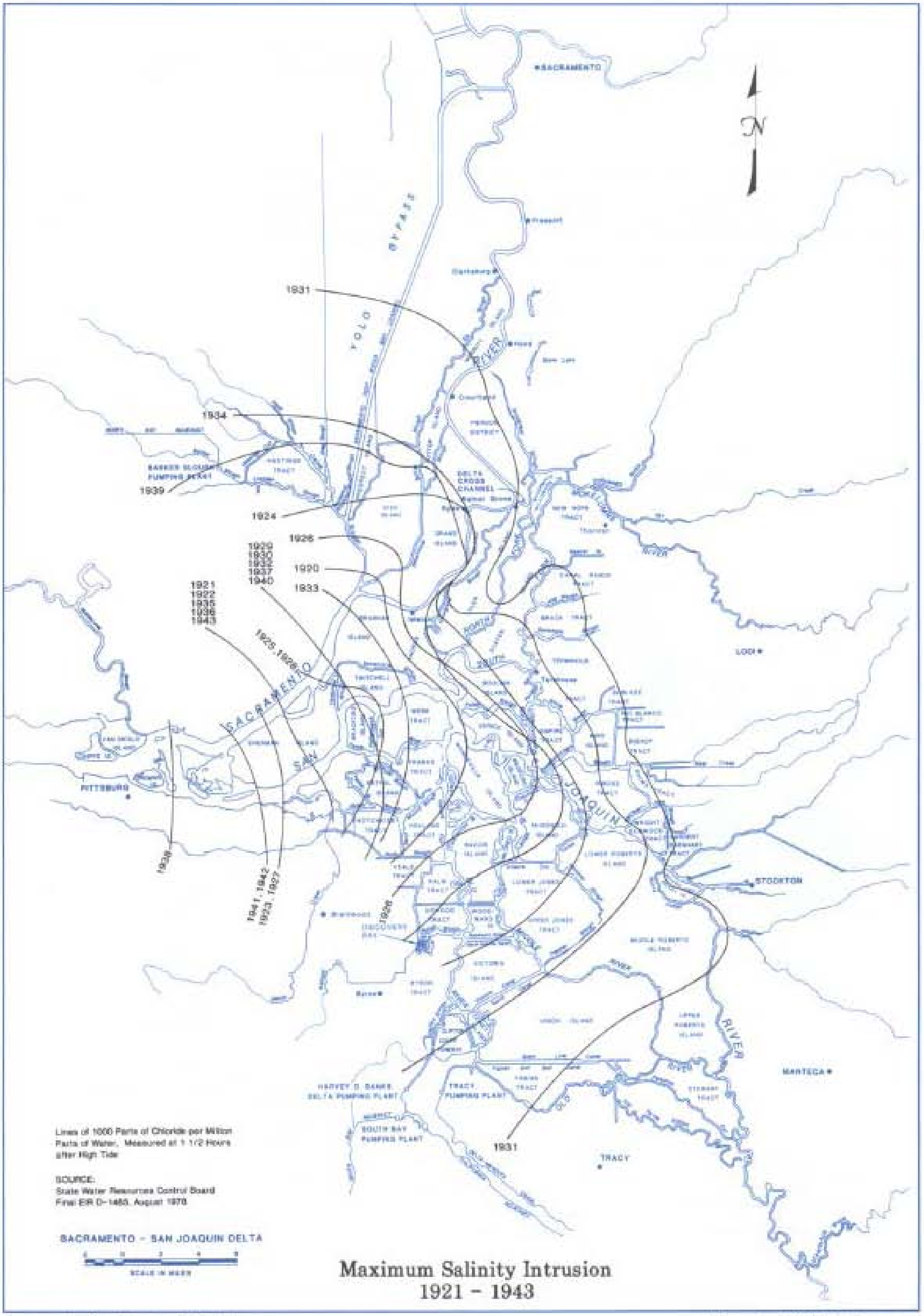
Figure 6, in the purple squares, also shows the maximum fourteen day running average EC for the April Forecast with compliance with the Emmaton salinity objective at Threemile Slough. As seen in that graphic, there is greater salinity intrusion during 1934, 1939, 1924, and 1931 than in the April forecast with compliance at Threemile Slough. The streamflow Figures (1-4) above indicated that the no-project flows into the Sacramento River for 1934 are greater than the flows in 2014 (resulting is less salinity intrusion and fresher water) and the no-project flows for 1924 and 1931 are less than or equal to the flows in 2014.

Figures 7 -10 further illustrate the point that with projects, there is better salinity in the Delta in 2014 with compliance at Threemile Slough Objective than if there were no projects. The Figures show DSM2 EC salinity contours for the maximum intrusion for 1924, 1926, 1931 and 1934. In these years, salinity in most of the Delta exceeded 1000 umhos/cm.

In conclusion, moving the compliance objective to Threemile Slough will not result in greater salinity concentrations than those that occurred in previous years with hydrologies that bracket the project runoff and outflows in 2014. It is important to note that there are no additional downstream agricultural interests protected by a standard at Emmation as compared to Threemile Slough. As a result, other water users will not be impacted by the proposed change. The request to move the D1641 Emmaton salinity standard to Threemile Slough will result in better water quality than what is likely under unimpaired flow conditions, as indicated by historical salinity intrusion.

Further Analysis

As is the common practice of DWR we are continuing to develop new and helpful ways to assess hydrology this year. This effort will result in future analyses that show projections of current hydrology absent the State Water Project and the Central Valley Project. DWR will continue to keep the SWRCB informed of the most current information available.



Sacramento–San Joaquin Delta Atlas *Department of Water Resources*

22

Figure 5: Maximum Salinity Intrusion 1921-1943, Delta Atlas, 1000 parts of Chloride per Million Parts Water

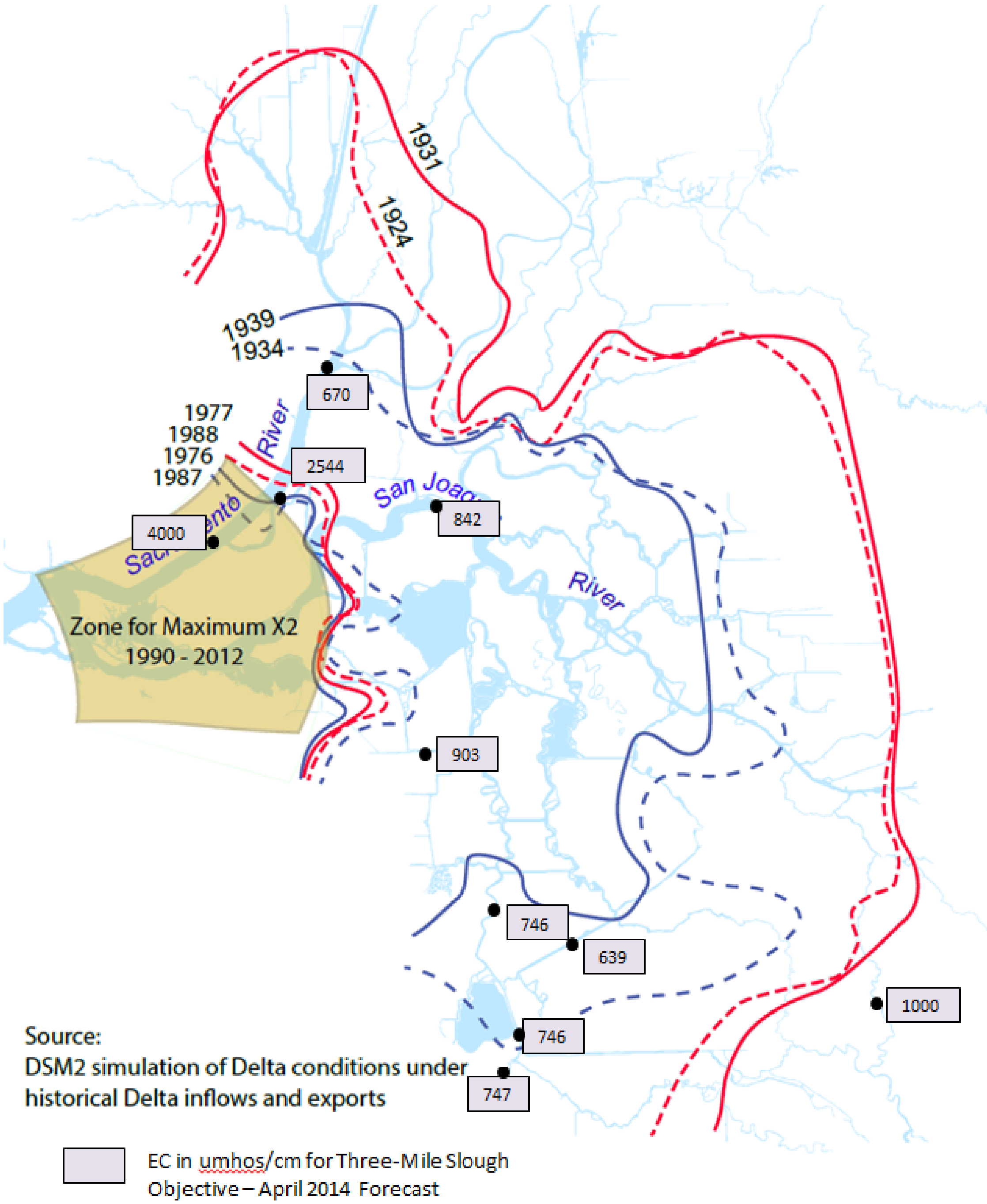


Figure 6: DSM2 Dry Years Maximum Salinity Intrusion, X2 (2640 umhos/cm)

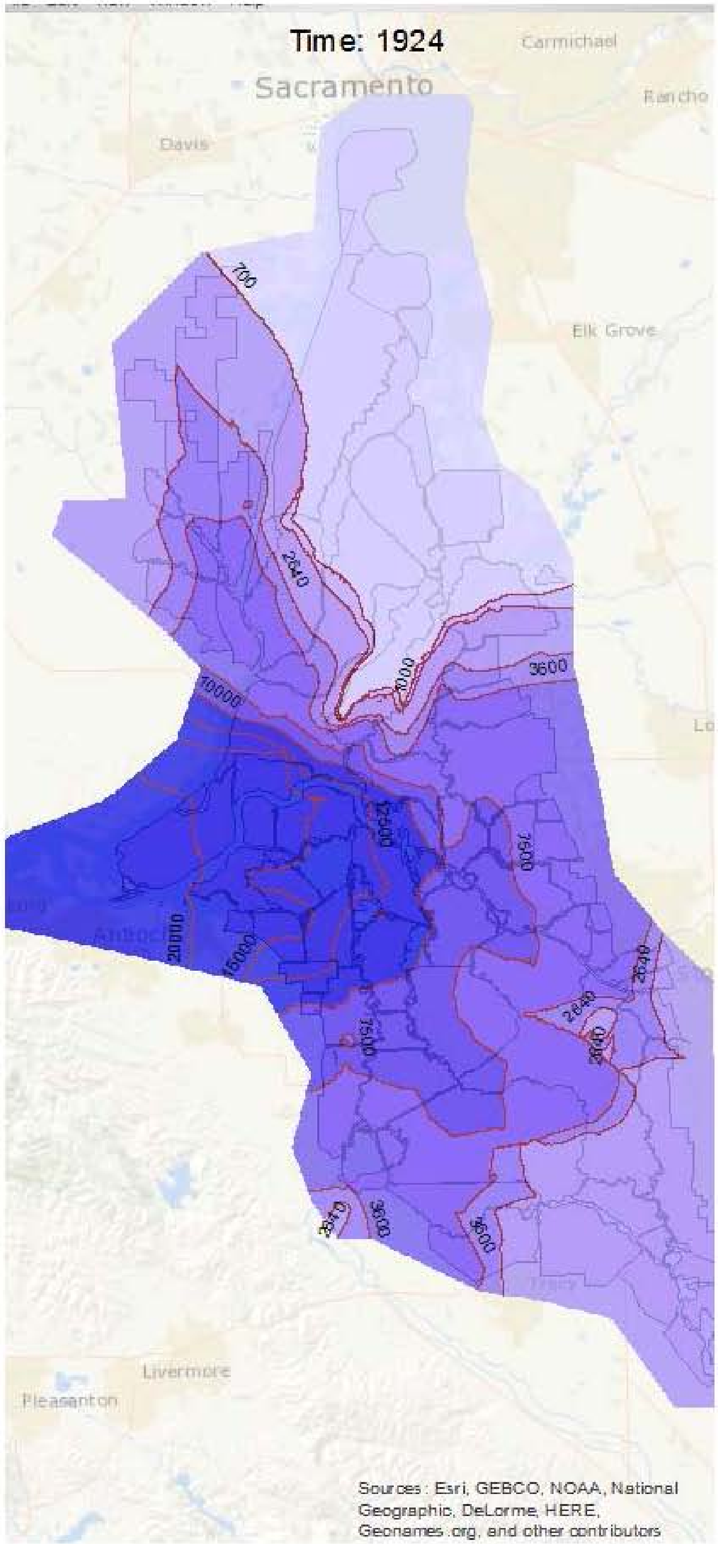


Figure 7: DSM2 1924 Maximum Salinity Intrusion, EC

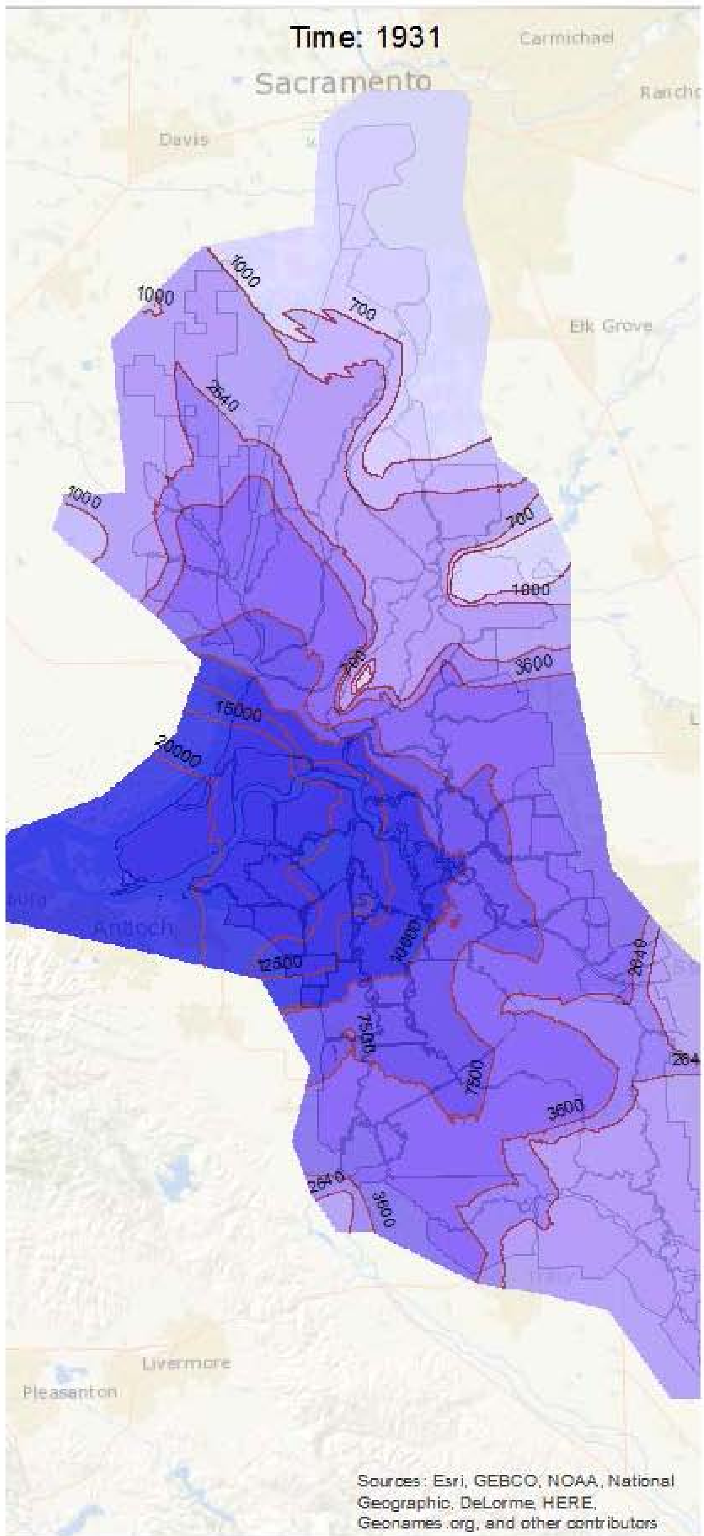


Figure 8: DSM2 1931 Maximum Salinity Intrusion, EC

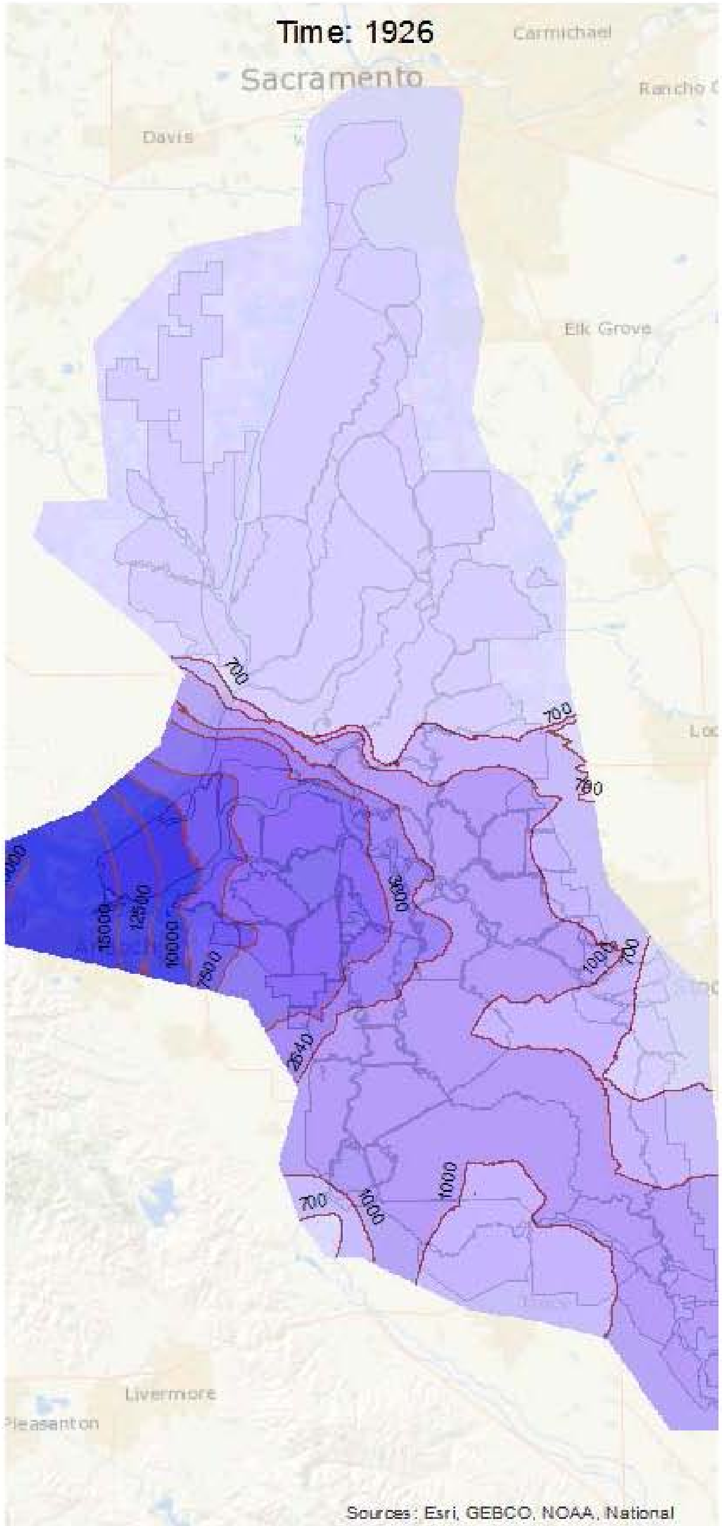


Figure 9: DSM2 1926 Maximum Salinity Intrusion, EC

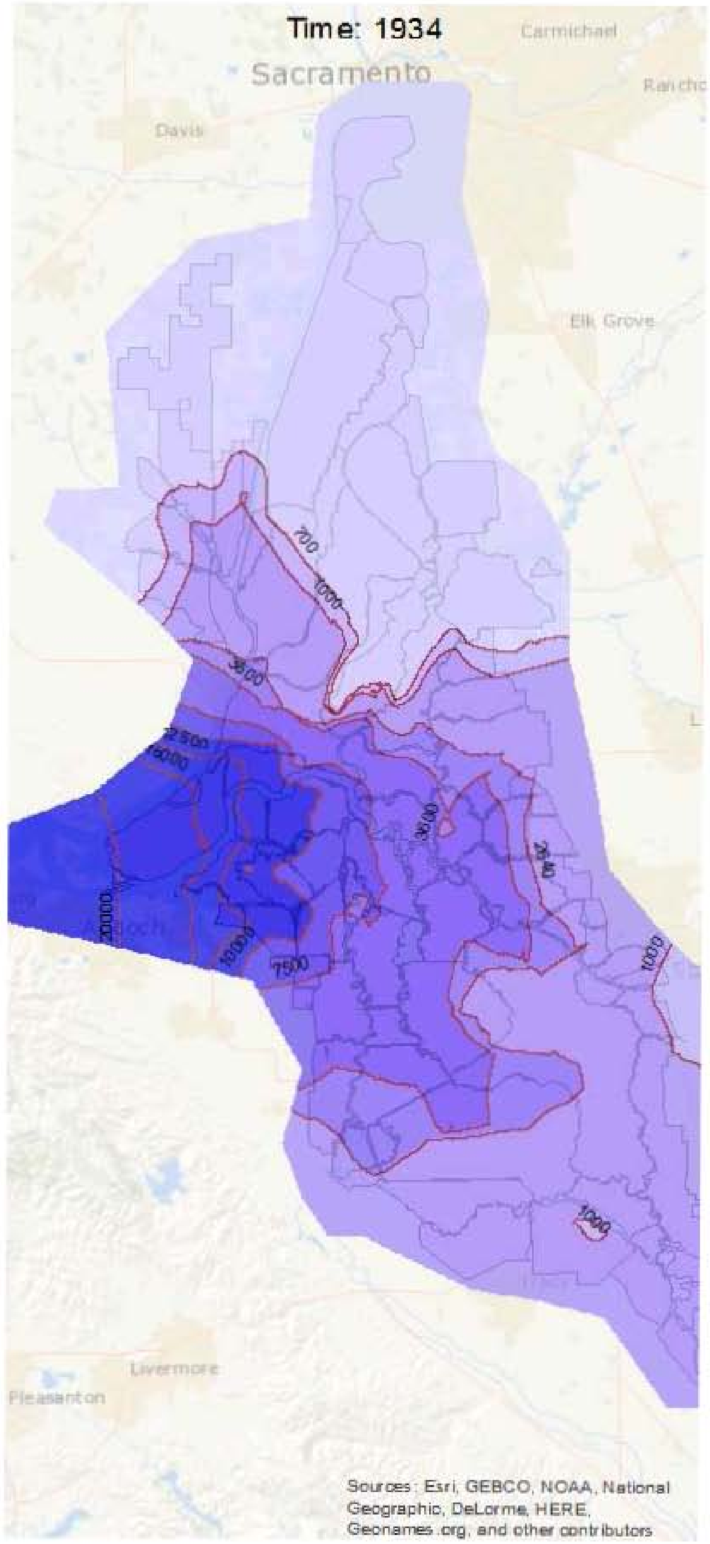


Figure 10: DSM2 1934 Maximum Salinity Intrusion, EC

Optimized April DSM2 Forecast Flow and Electrical Conductivity Plots

Modeling Assumptions

To model the Delta flows, water levels and salinity, Delta Models such as DSM2 need boundary inflows, exports and diversions, water levels and salinity. Up to the point where the forecast begins, DSM2 uses observed historical data. For inflows to and exports from the Delta, DSM2 starts with the forecasted flows from the Delta Coordinated Operations (DCO) model that determine allocations to water contractors. Information that is fed into DCO includes hydrology data, contractor delivery requests, and regulatory and court restrictions on exports. The DCO allocation forecasts that were used for this analysis assumed a 90% hydrology. This represents a forecast for a very dry year. Based on historical data, a 90% hydrology assumes that only one in ten years would be drier than this forecast.

Sacramento flows from the DCO model were further adjusted, using the Minimum Water Quality Cost Compliance Tool (**http://modeling.water.ca.gov/delta/reports/annrpt/2002/2002Ch10.pd**f), so that DSM2 would comply with the water quality objectives listed below.

- Emmaton – 2.78 mmhos/cm
  Or Three Mile
- San Joaquin at Jersey Point – 2.20 mmhos/cm
- South Fork at Terminous - 0.54 mmhos/cm
- San Joaquin at San Andreas Landing - 0.87 mmhos/cm
- West Canal at Mouth of CCFB – 1.0 mmhos/cm
- DMC at Tracy Pumping Plant – 1.0 mmhos/cm
- Rock Slough - 1.0 mmhos/cm

In the simulations the Cross Channel was operated to D1641 objectives and temporary barriers were installed at the end of March.

Electrical Conductivity Plots

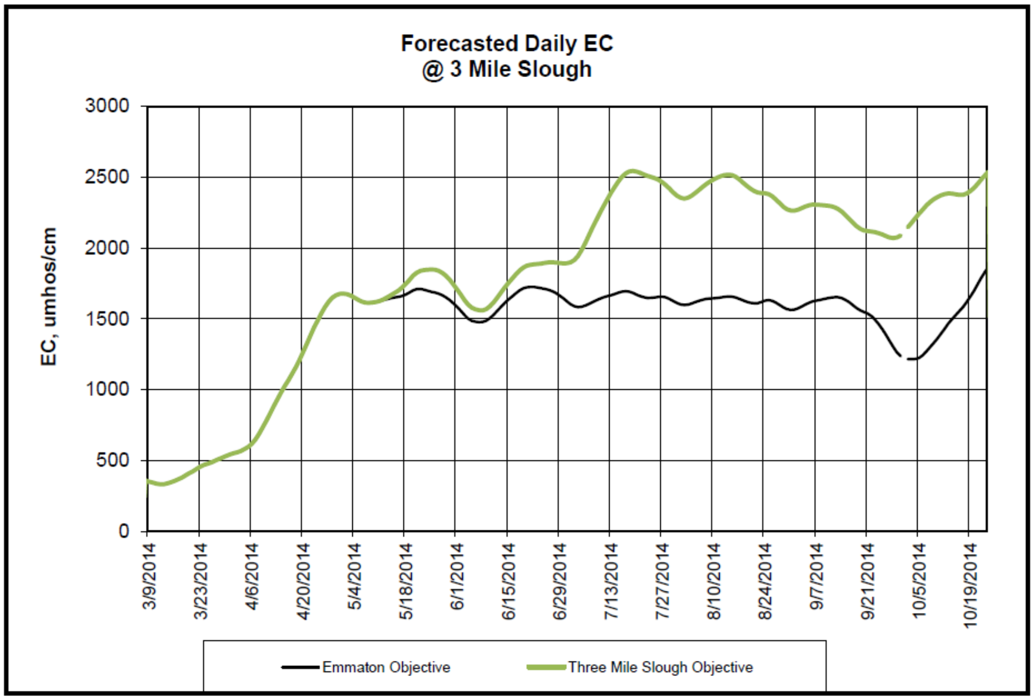


Figure 1: Three Mile Slough EC - Emmaton Objective and Three Mile Objective

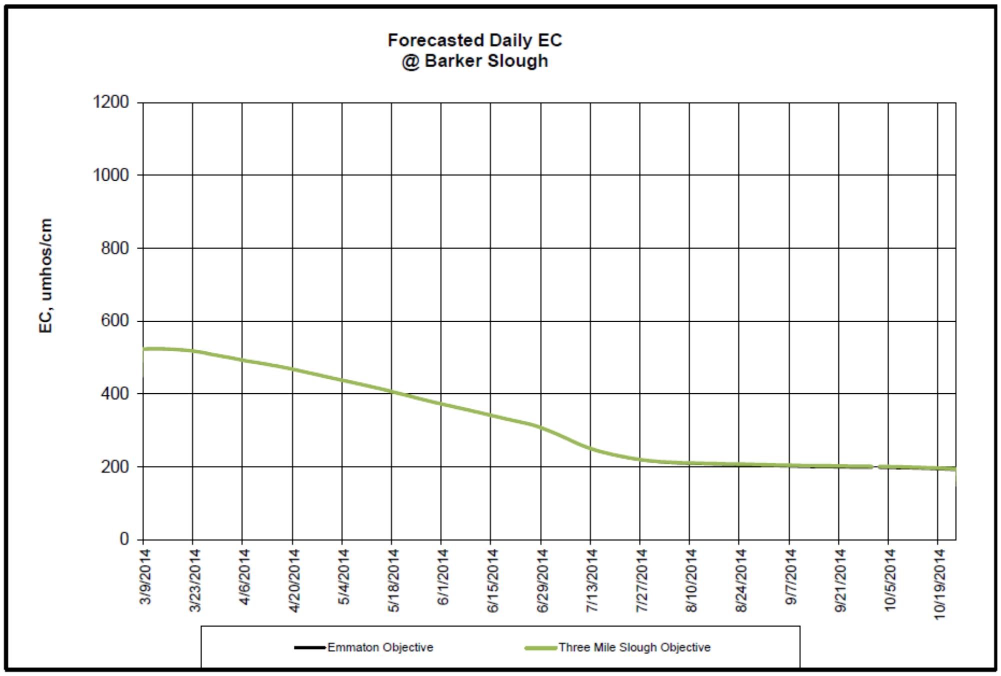


Figure 2:Barker Slough EC - Emmaton Objective and Three Mile Objective

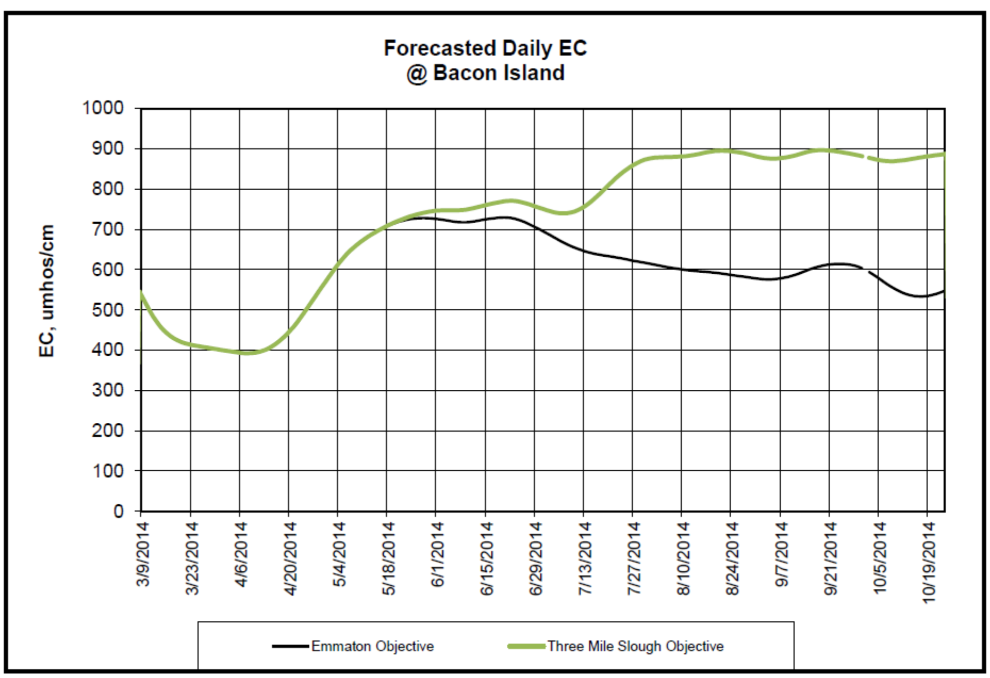


Figure 3: Bacon Island EC - Emmaton Objective and Three Mile Objective

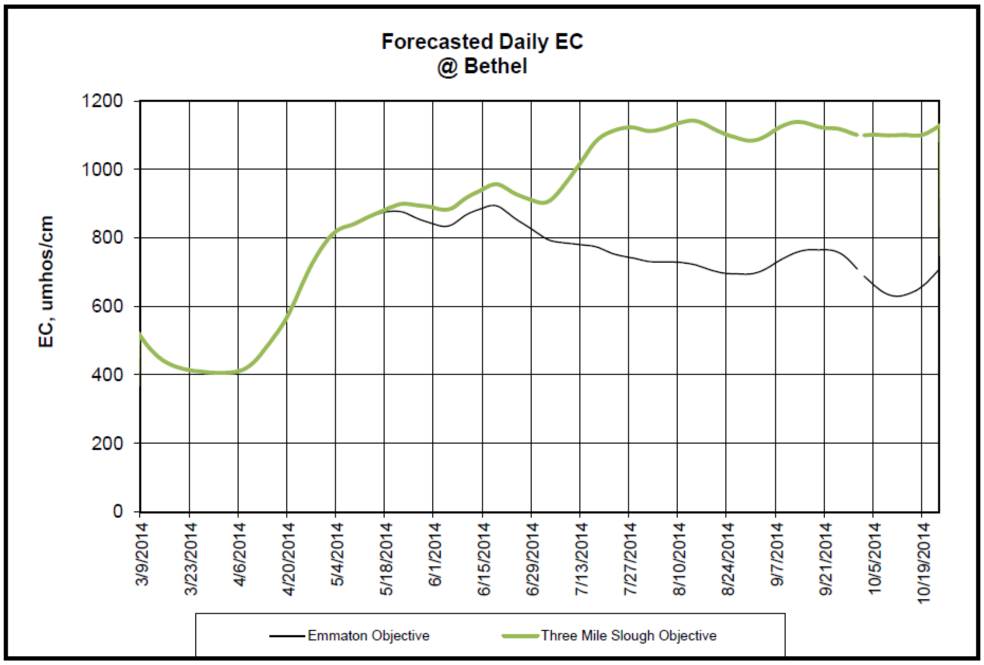


Figure 4: Bethel EC - Emmaton Objective and Three Mile Objective

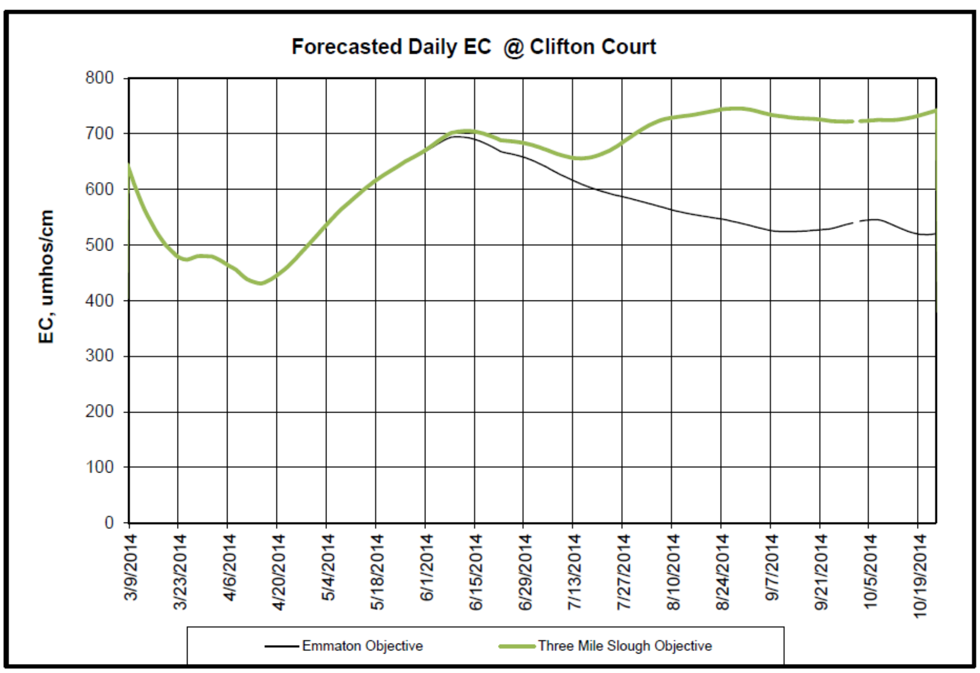


Figure 5: Clifton Court EC - Emmaton Objective and Three Mile Objective

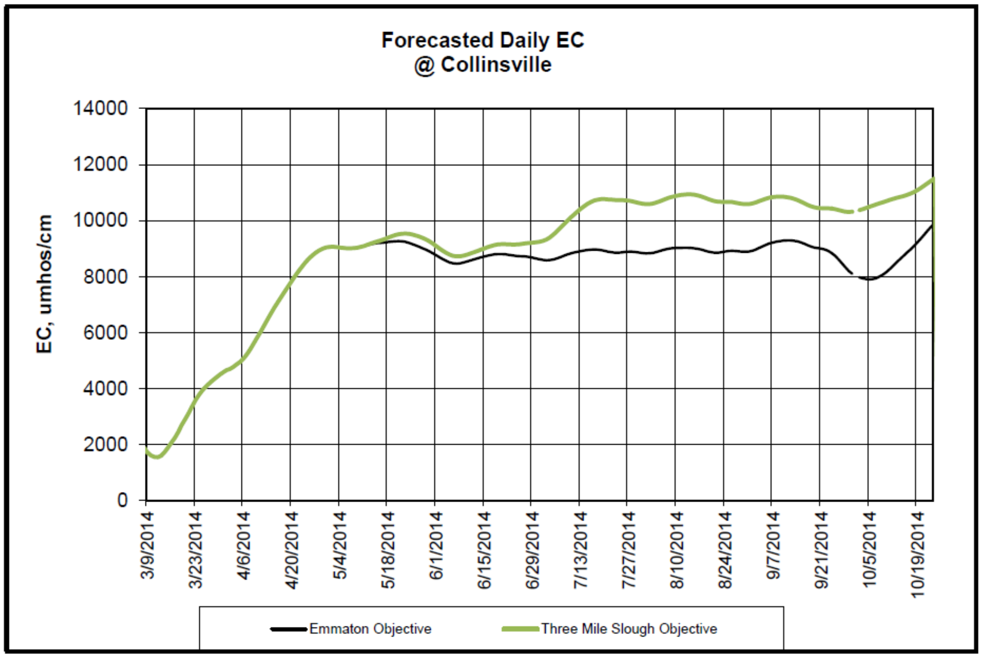


Figure 6: Collinsville EC - Emmaton Objective and Three Mile Objective

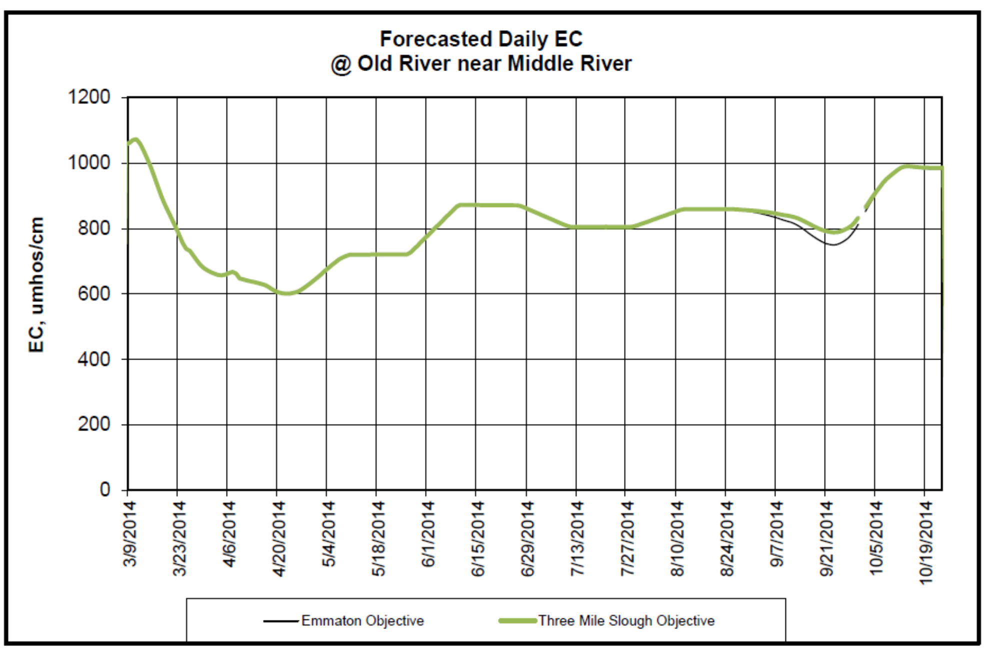


Figure 7: Old River near Middle River EC - Emmaton Objective and Three Mile Objective

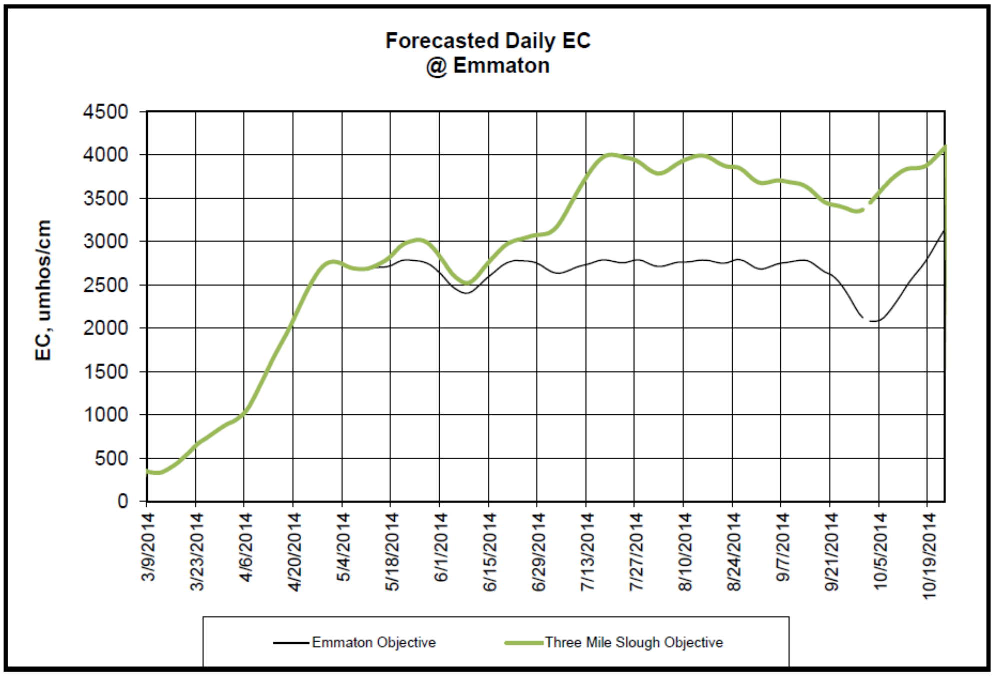


Figure 8: Emmaton EC - Emmaton Objective and Three Mile Objective

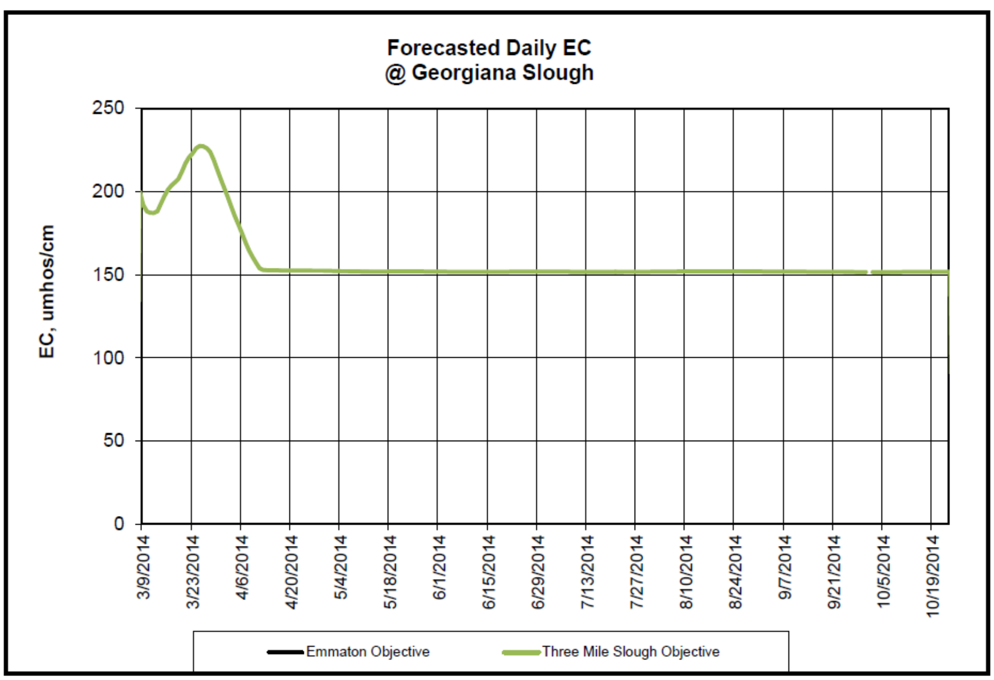


Figure 9: Forecasted DSM2 Georgiana Slough EC - Emmaton Objective and Three Mile Objective

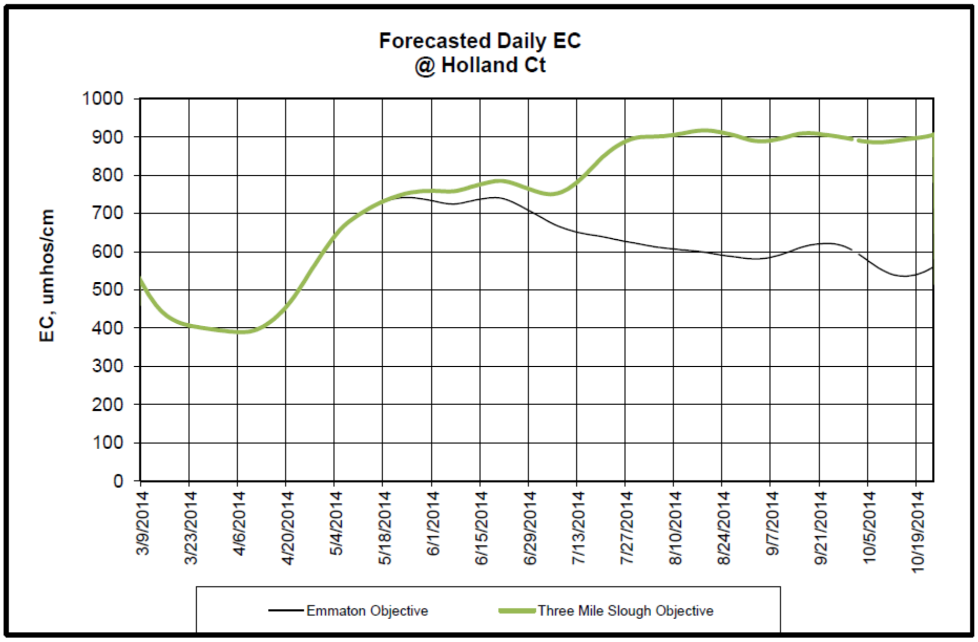


Figure 10: Forecasted DSM2 Holland EC - Emmaton Objective and Three Mile Objective

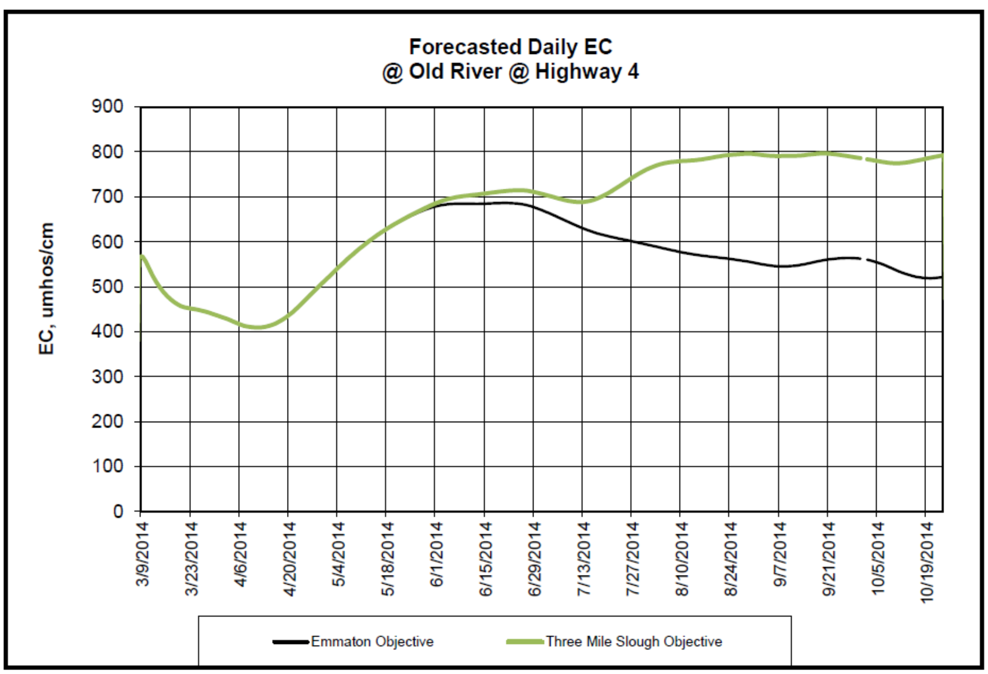


Figure 11: Forecasted DSM2 Old River at Highway 4 EC - Emmaton Objective and Three Mile Objective

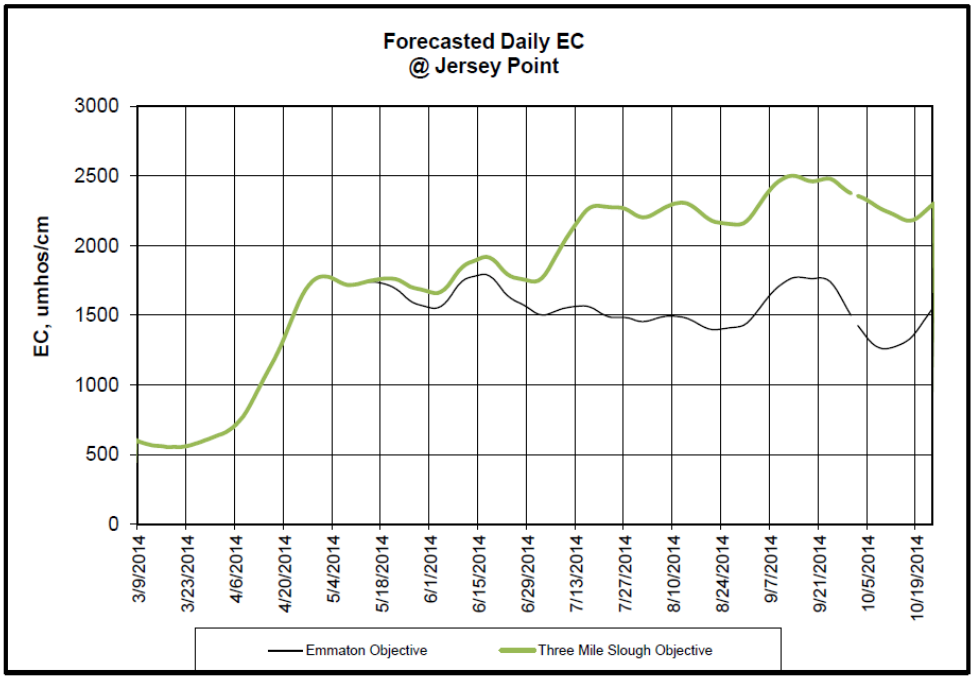


Figure 12: Forecasted DSM2 Jersey Point EC - Emmaton Objective and Three Mile Objective

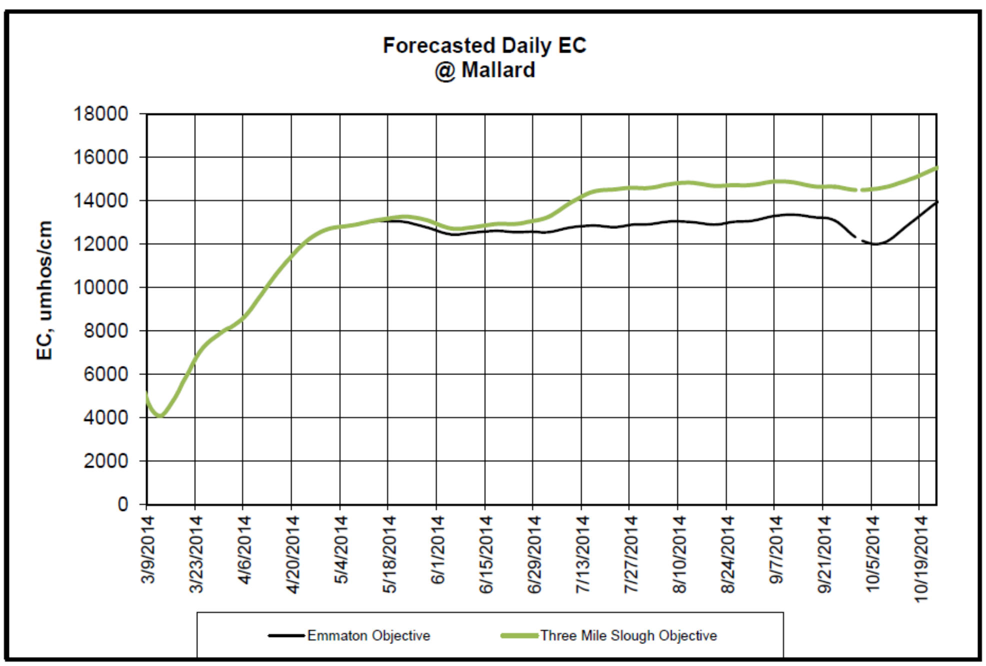


Figure 13: Forecasted DSM2 Mallard EC - Emmaton Objective and Three Mile Objective

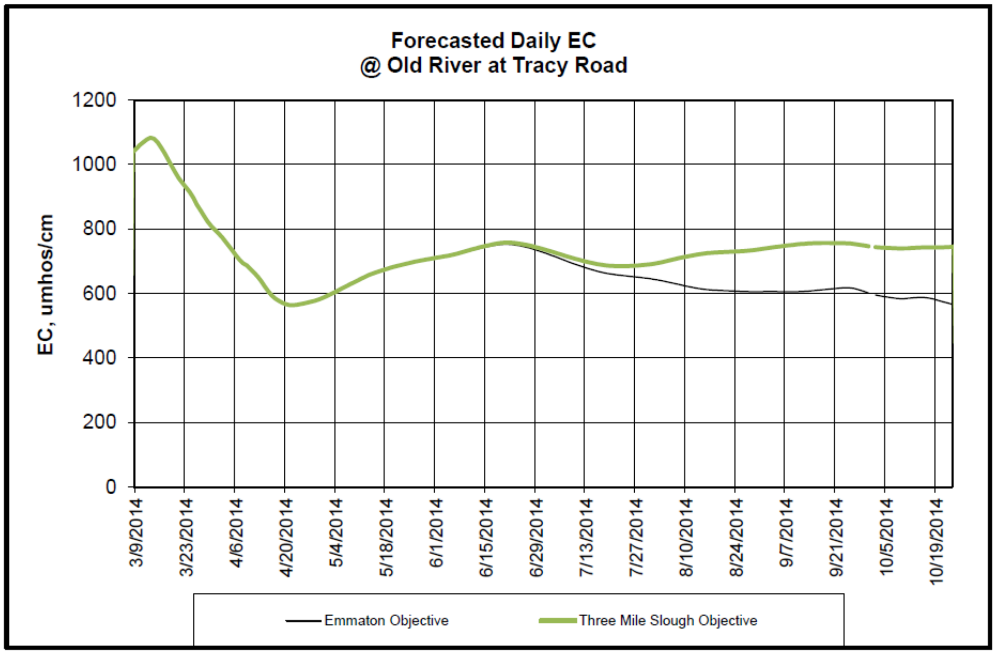


Figure 14: Forecasted DSM2 Old River at Tracy Road EC - Emmaton Objective and Three Mile Objective

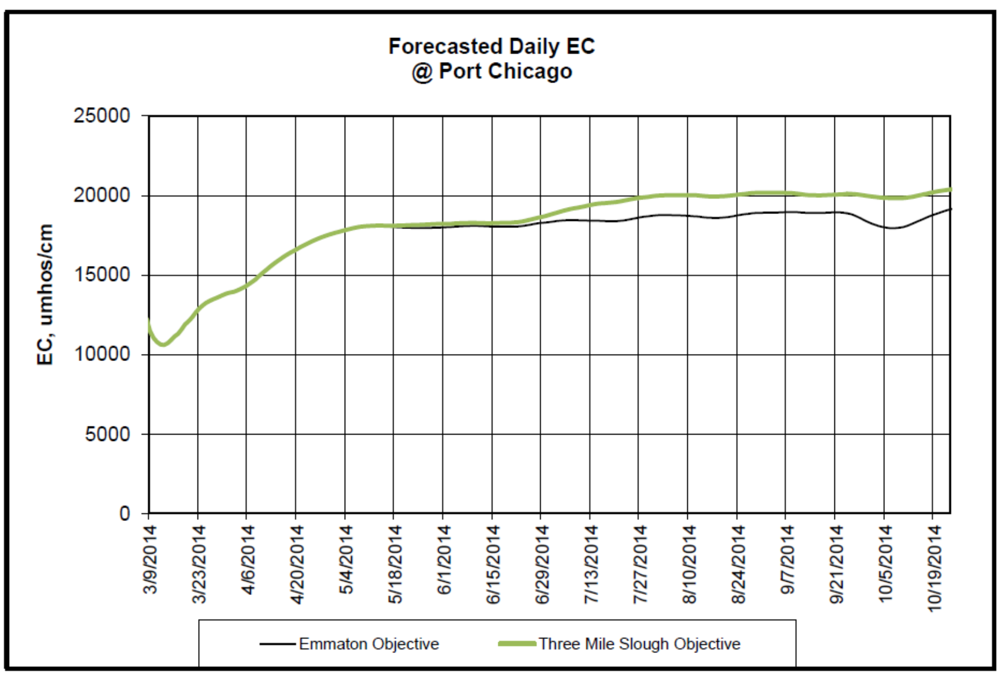


Figure 15: Forecasted DSM2 Port Chicago EC - Emmaton Objective and Three Mile Objective

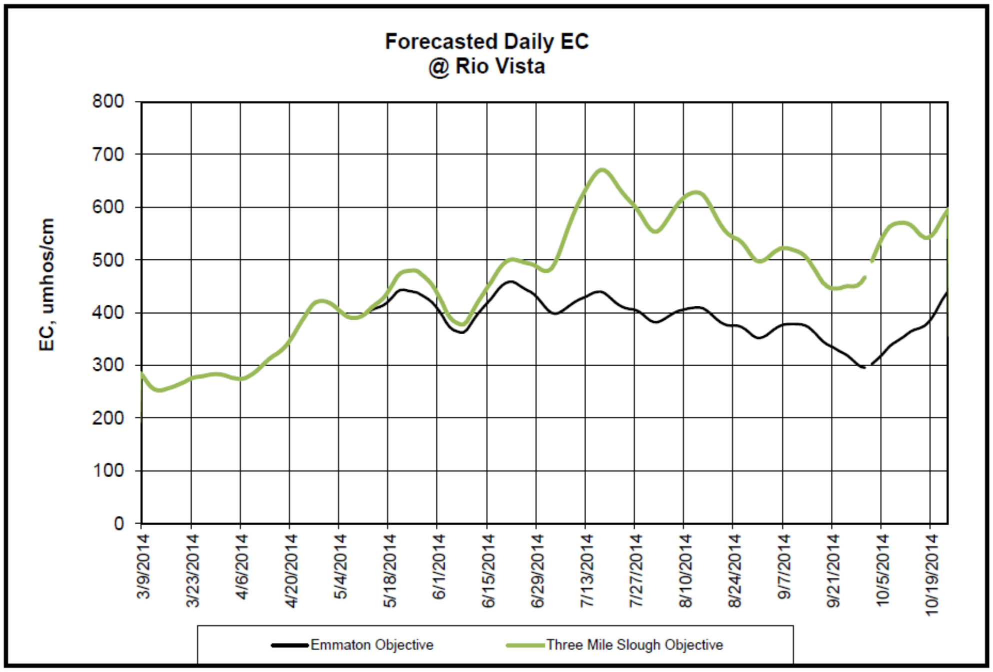


Figure 16: Forecasted DSM2 Rio Vista EC - Emmaton Objective and Three Mile Objective

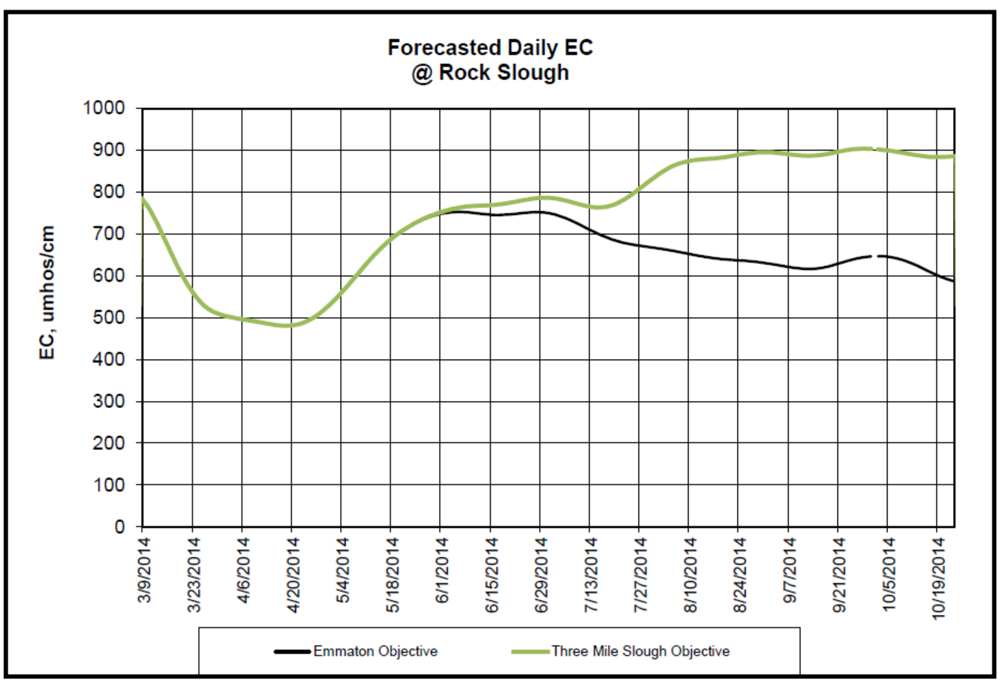


Figure 17: Forecasted DSM2 Rock Slough EC - Emmaton Objective and Three Mile Objective

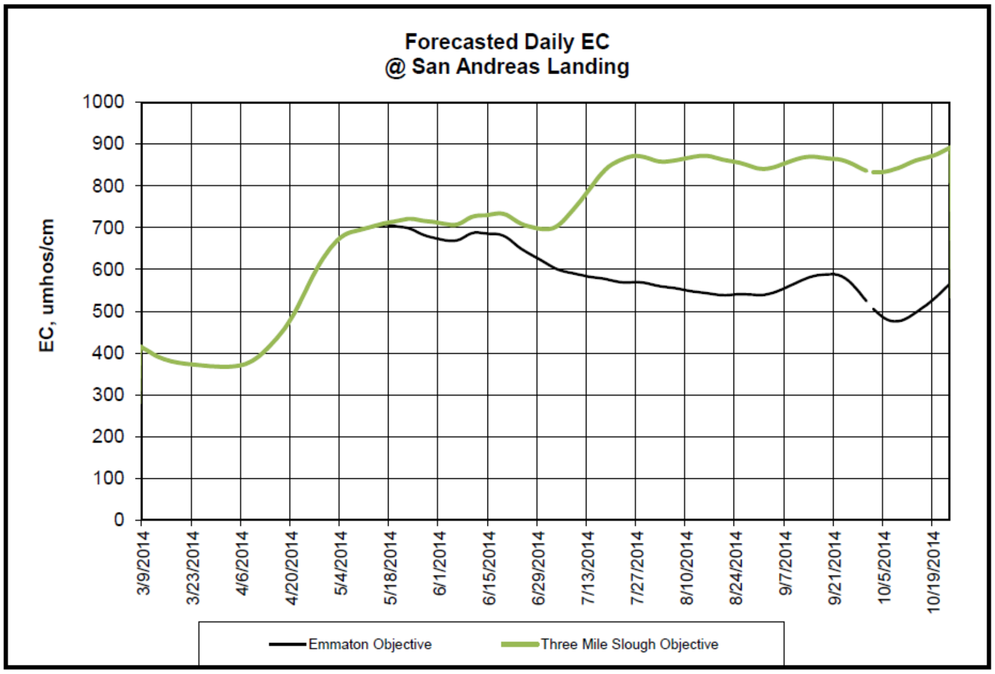


Figure 18: Forecasted DSM2 San Andreas EC - Emmaton Objective and Three Mile Objective

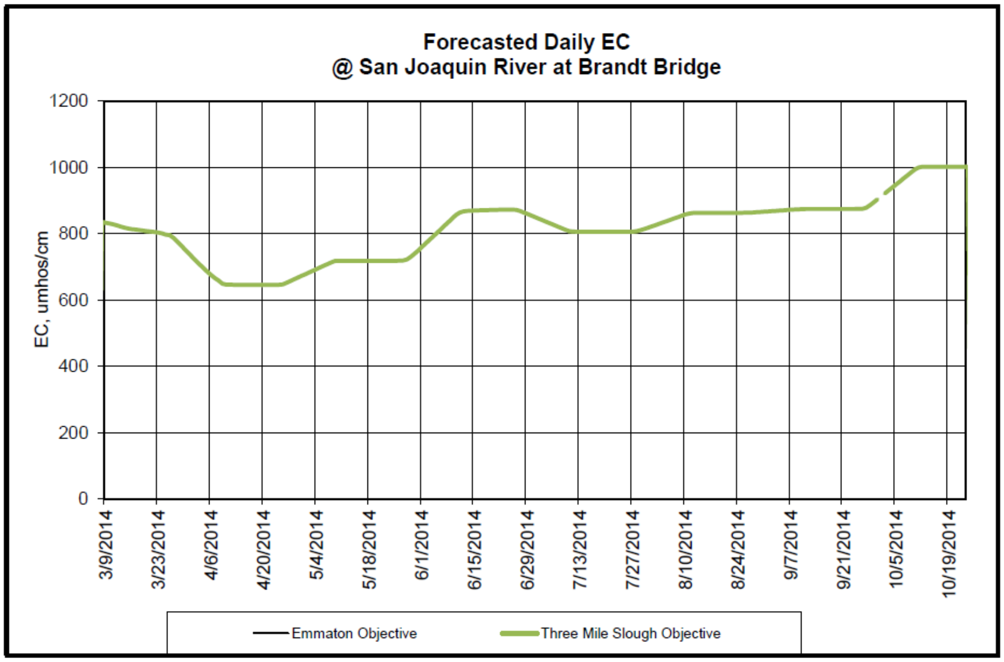


Figure 19: Forecasted DSM2 San Joaquin River at Brandt Bridge EC - Emmaton Objective and Three Mile Objective

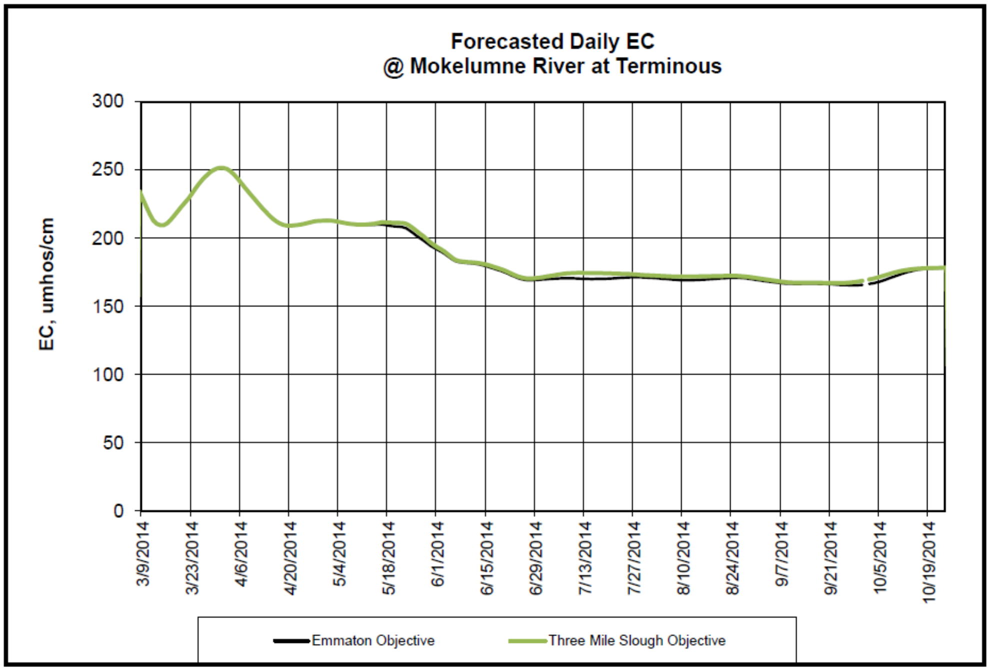


Figure 20: Forecasted DSM2 Mokelumne River at Terminous EC - Emmaton Objective and Three Mile Objective

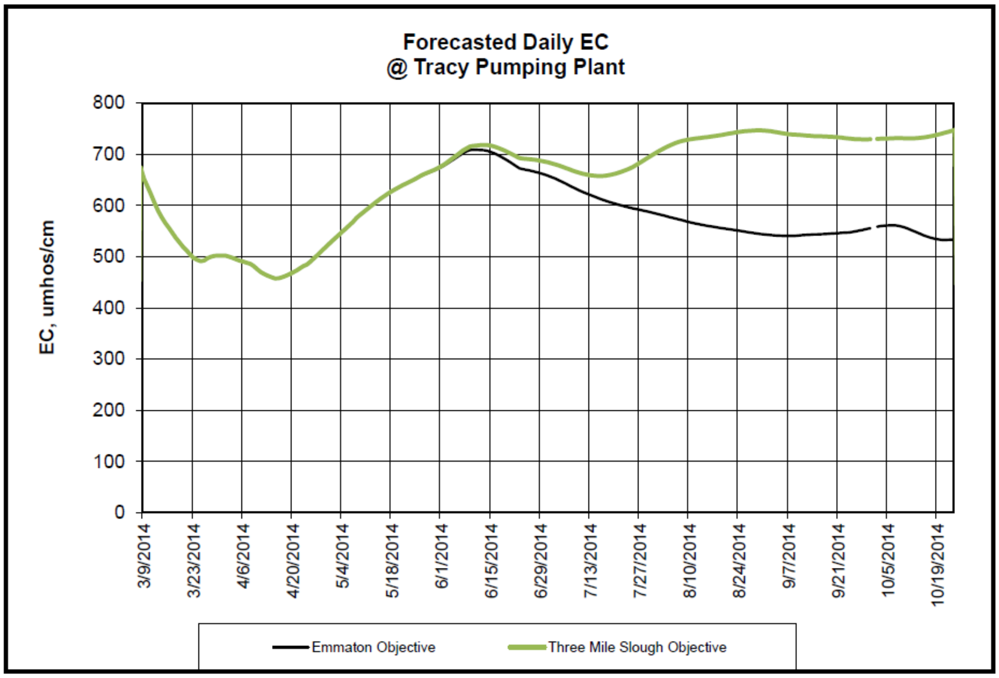


Figure 21: Forecasted DSM2 Jones (Tracy) Pumping Plant EC - Emmaton Objective and Three Mile Objective

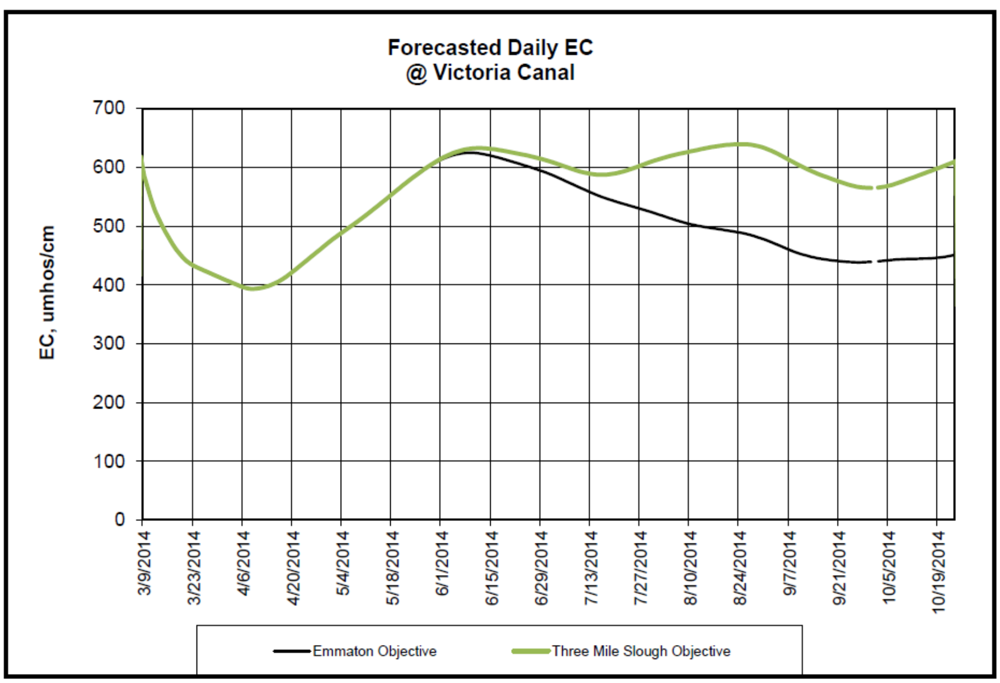


Figure 22: Forecasted DSM2 Victoria Canal EC - Emmaton Objective and Three Mile Objective

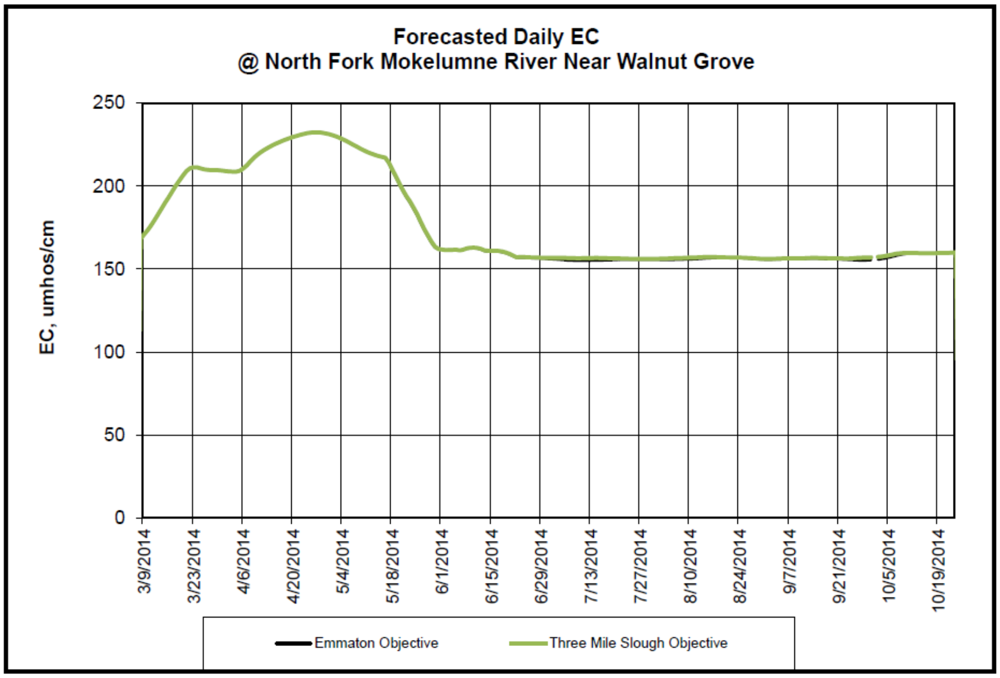


Figure 23: Forecasted DSM2 North Fork Mokelumne EC - Emmaton Objective and Three Mile Objective

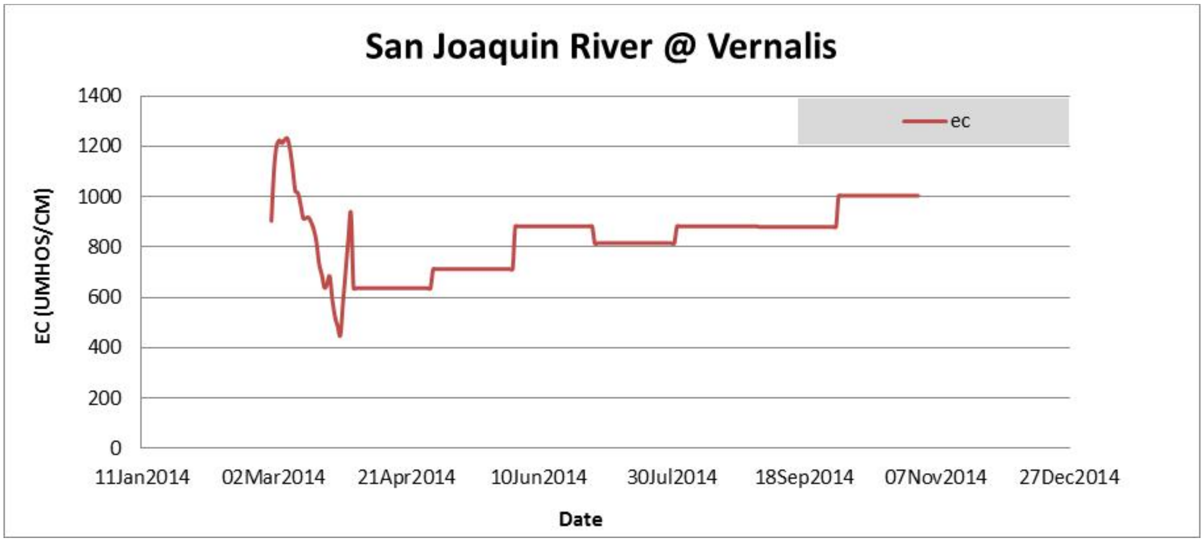


Figure 24: Forecasted San Joaquin River EC

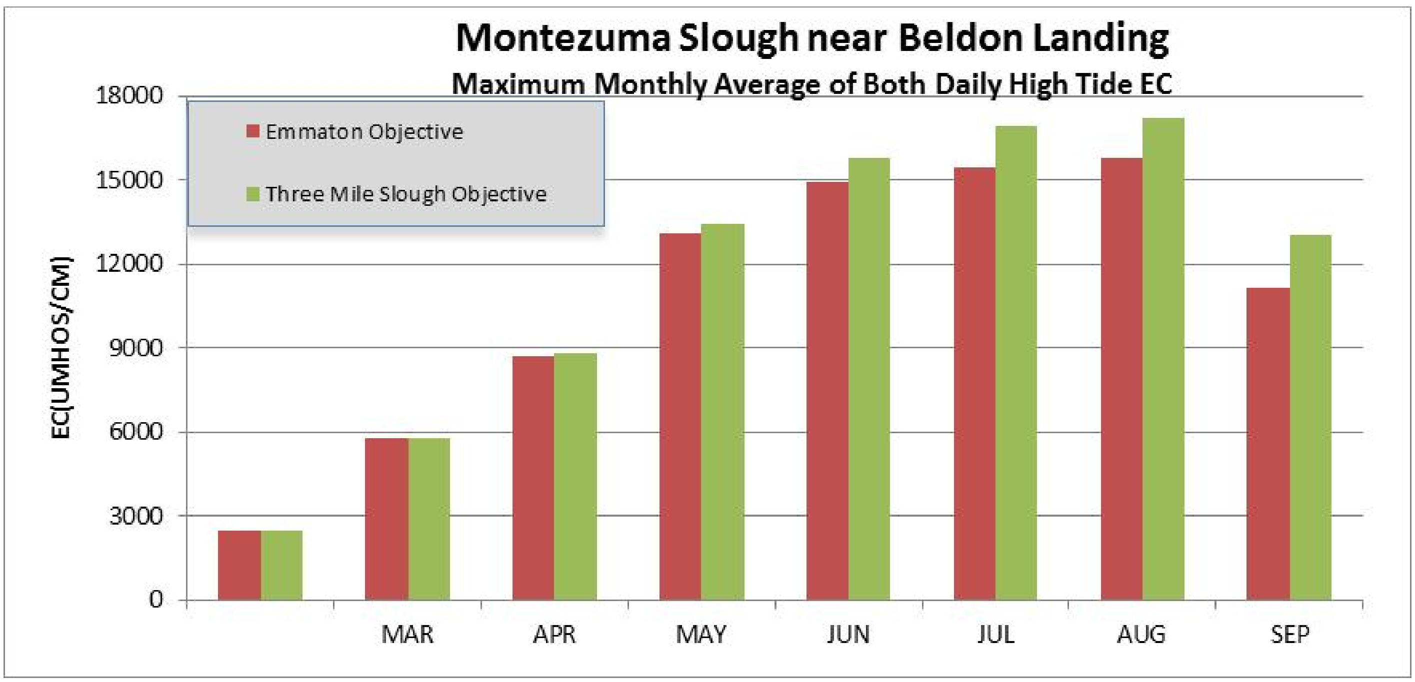


Figure 25: Forecasted DSM2 Montezuma Slough Near Beldon Landing EC - Emmaton Objective and Three Mile Objective

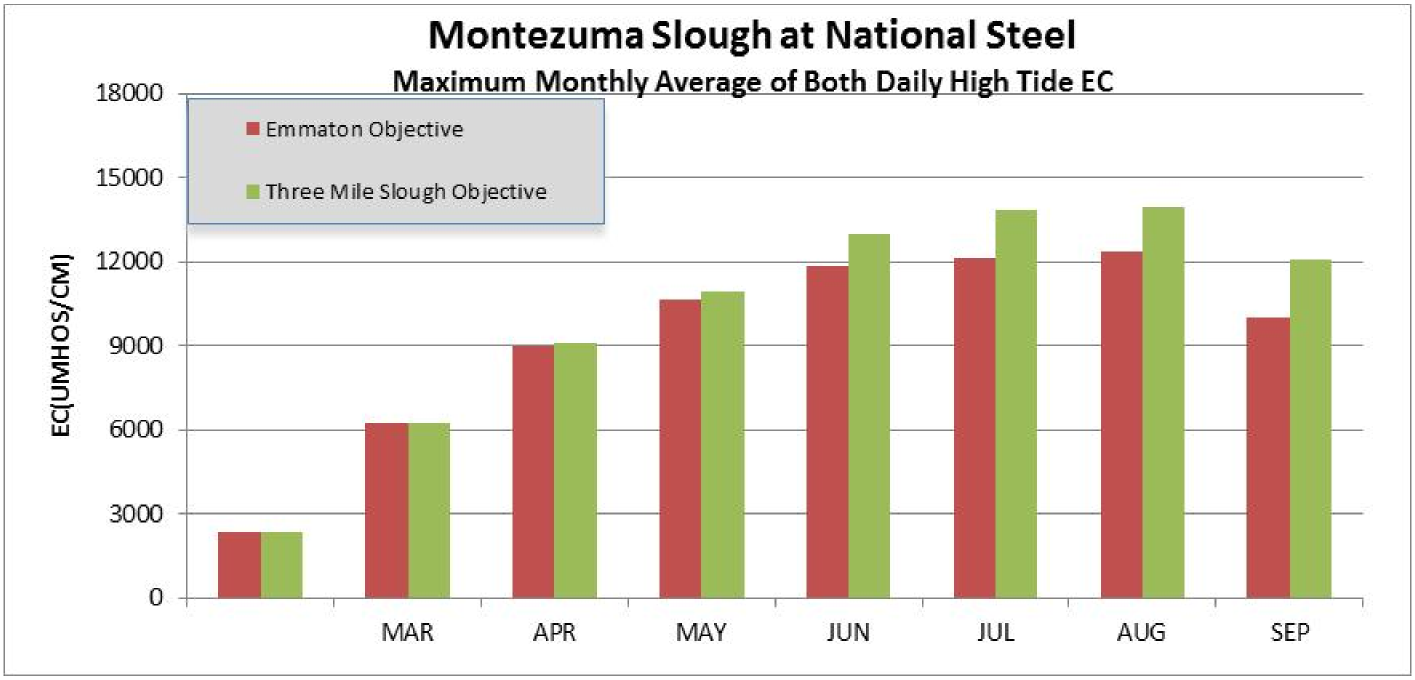


Figure 26: Forecasted DSM2 Montezuma Slough at National Steel EC - Emmaton Objective and Three Mile Objective

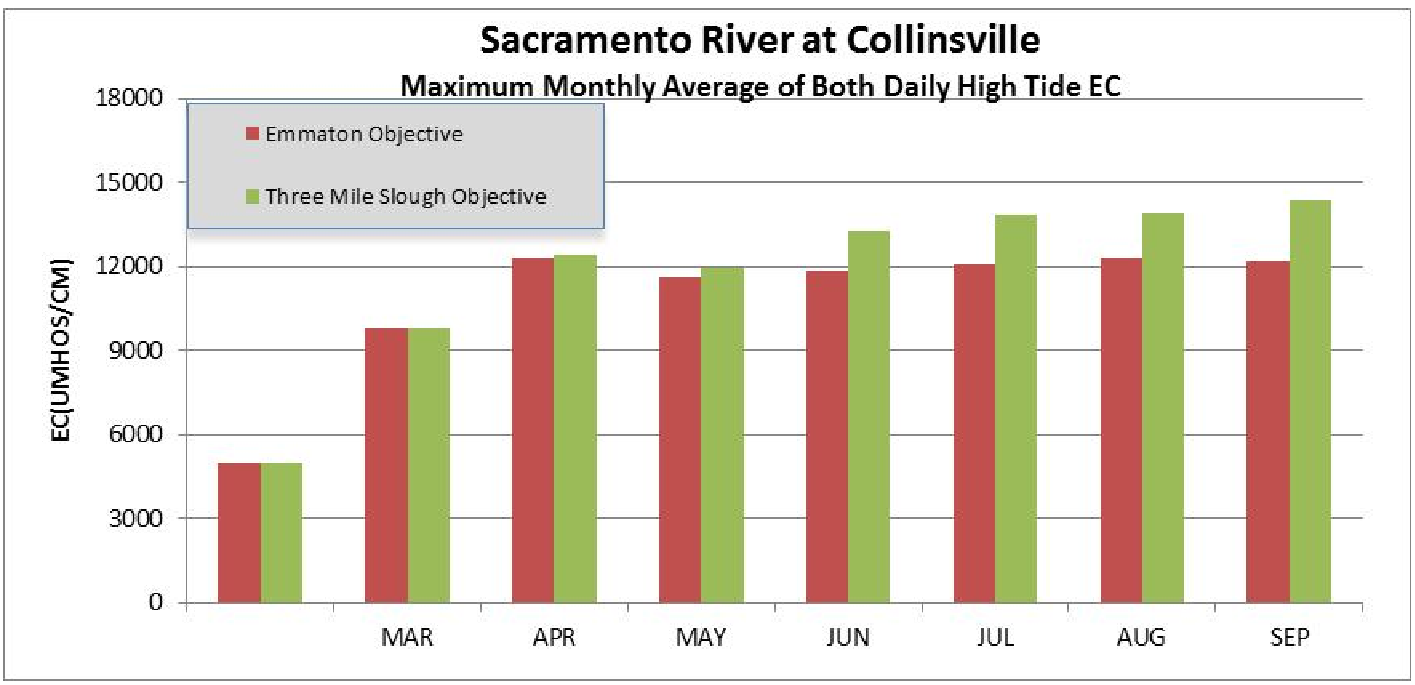


Figure 27: Forecasted DSM2 Sacramento River at Collinsville EC - Emmaton Objective and Three Mile Objective

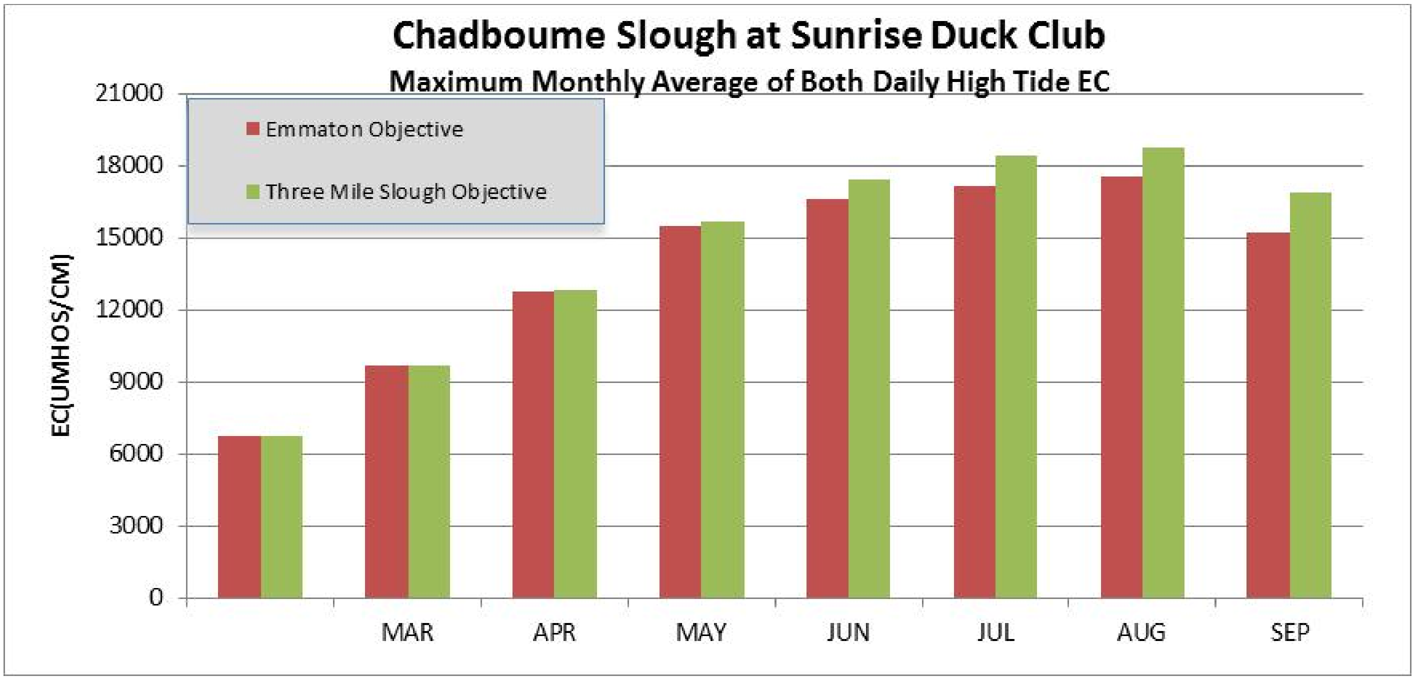


Figure 28: Forecasted DSM2 Chadbourne Slough at Sunrise Duck Club EC - Emmaton Objective and Three Mile Objective

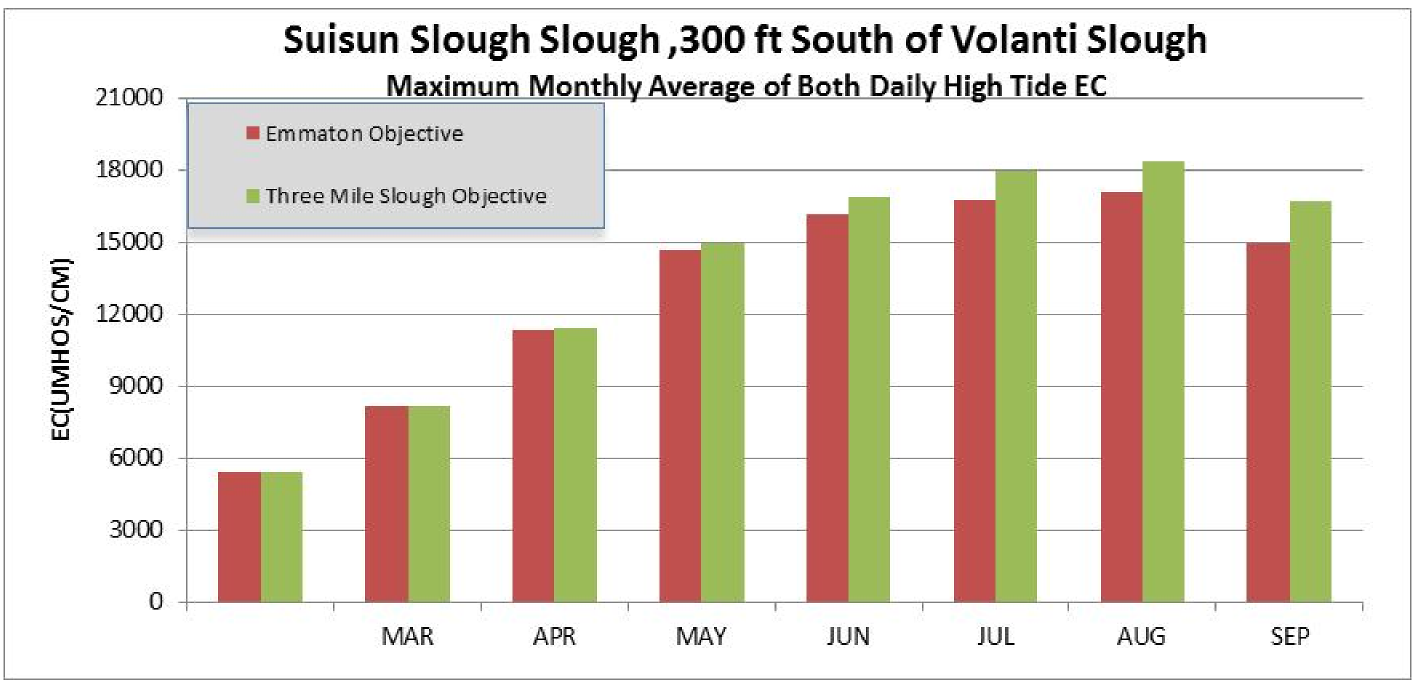


Figure 29: Forecasted DSM2 Suisun Slough EC - Emmaton Objective and Three Mile Objective

Flow Plots

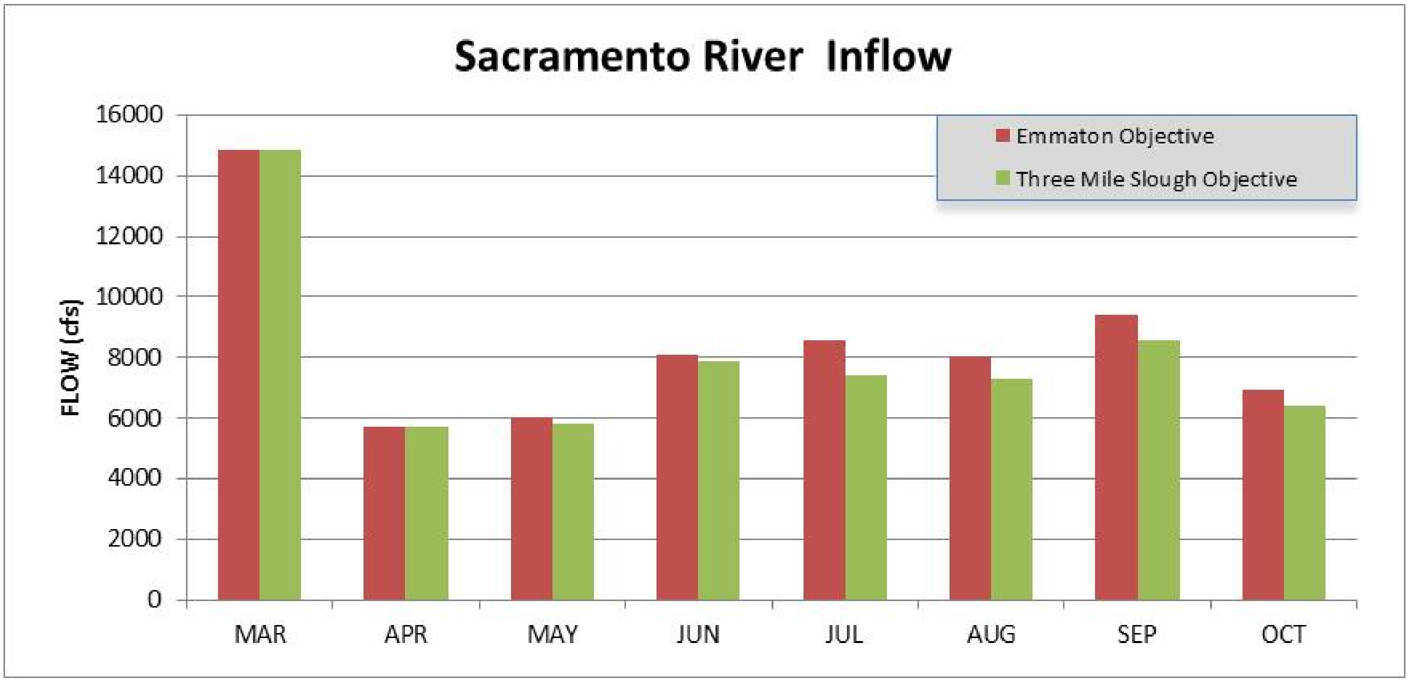


Figure 30: Forecasted Sacramento River Flow - Emmaton Objective and Three Mile Objective

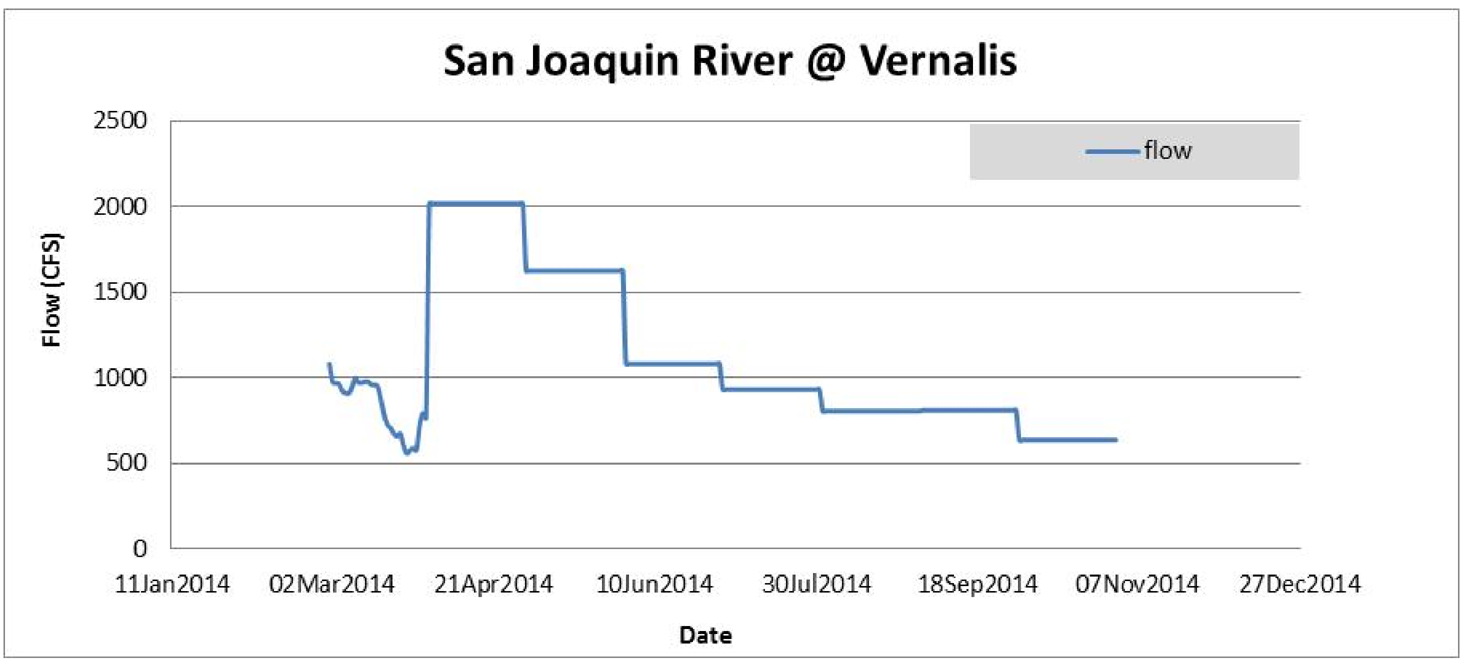


Figure 31: Forecasted San Joaquin River Flow

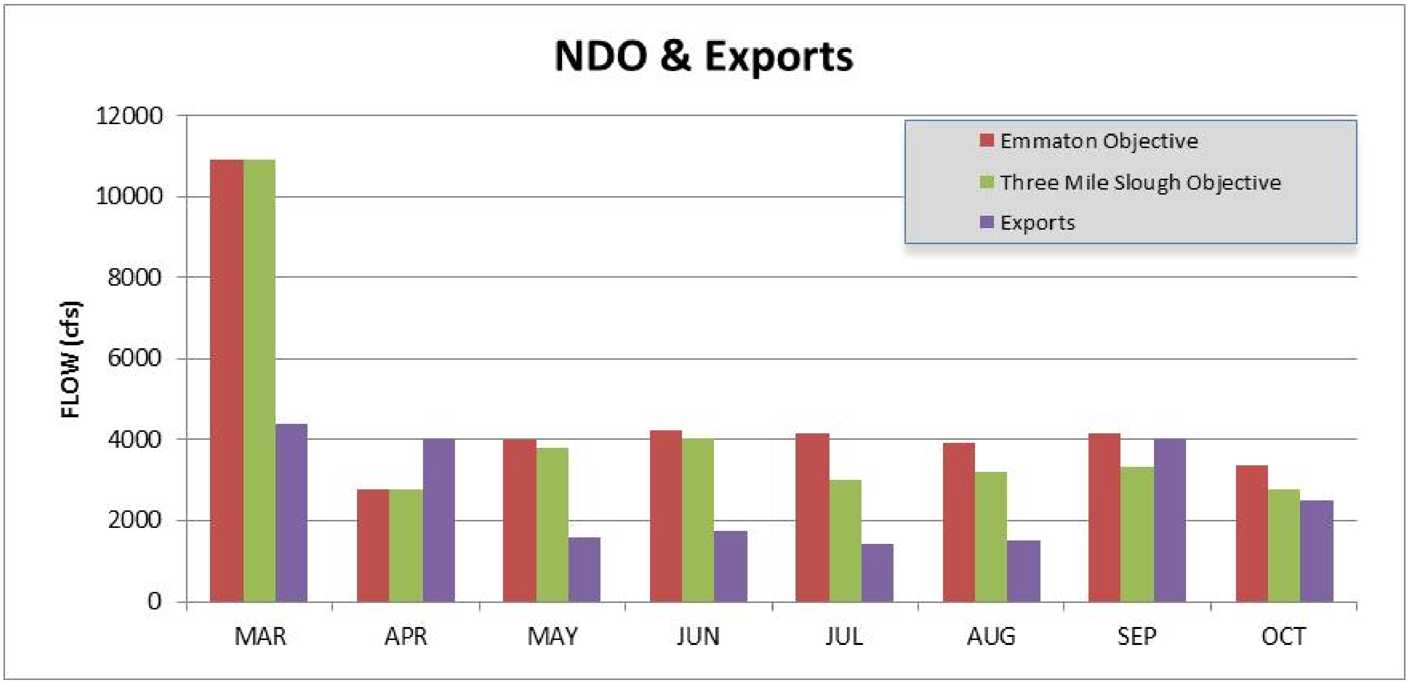


Figure 32: Exports and Net Delta Outflow with Emmaton Objective and Three Mile Objective

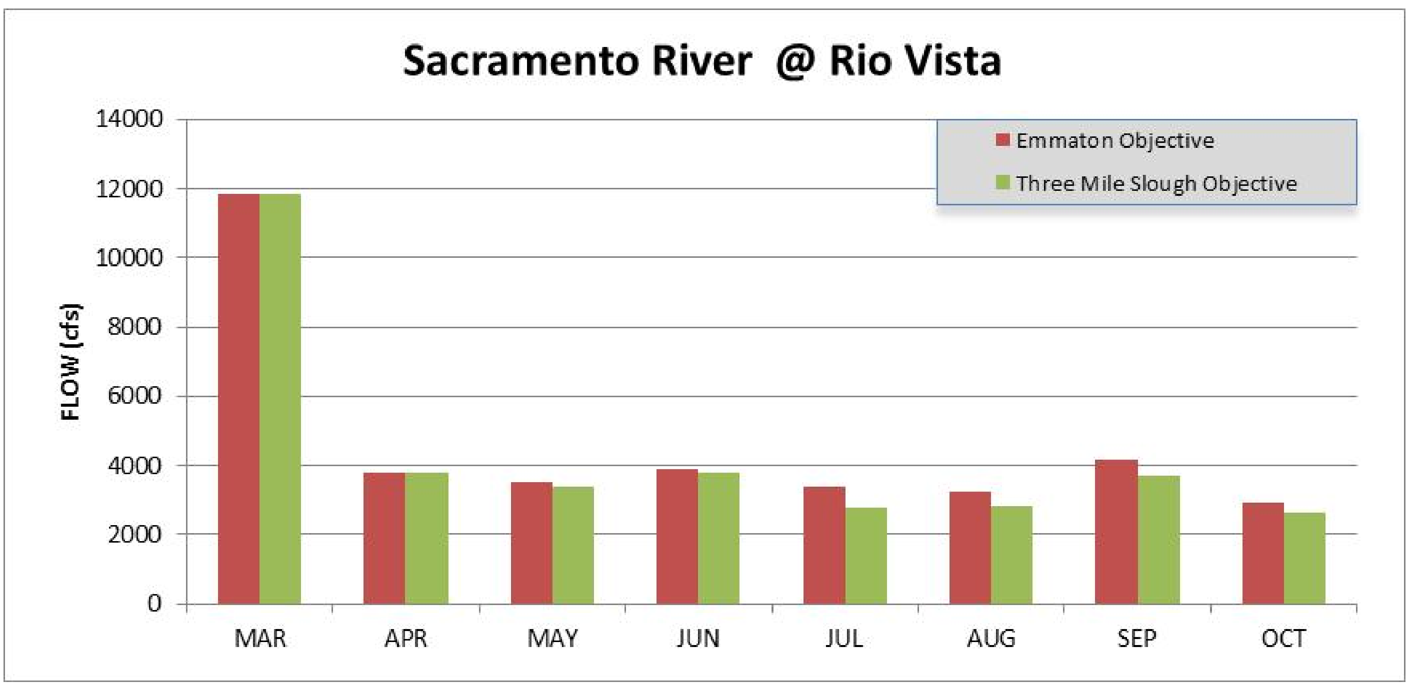


Figure 33: Forecasted DSM2 Sacramento River Flow at Rio Vista - Emmaton Objective and Three Mile Objective

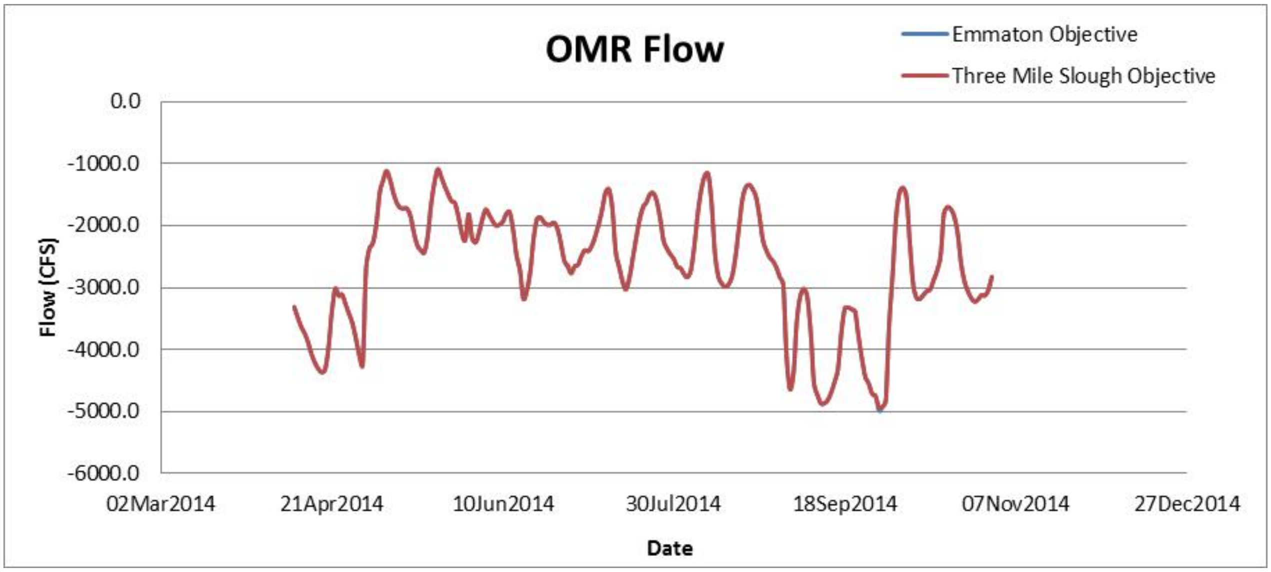


Figure 34: Old and Middle River Flow

DWR and Reclamation Request for Modifications and Extension of Temporary Urgency Change Order

April 29, 2014

No Impacts on Other Water Users
Comparison of Compliance with D-1641 Salinity Standards at Emmaton versus Threemile Slough

This analysis addresses a proposed change of the salinity compliance location from Emmaton to Threemile Slough. The analysis uses DSM2 modeling from hydrology information from mid-April, 2014, which has been optimized to reflect projected operations for the rest of 2014, as described in CVP and SWP Drought Operations Plan and Operational Forecast, submitted to the State Water Resources Control Board on April 8, 2014. The modeling results compare salinity concentrations at various locations in the Sacramento-San Joaquin Delta, comparing results of scenarios in which the Emmaton salinity standard is met at Emmaton versus at Threemile Slough. The results of this modeling are contained in the document entitled Optimized April DSM2 Forecast Flow and Electrical Conductivity Plots, extracts from which are included in this document.

Although DWR and Reclamation are requesting the change in location of the Emmaton objective to Threemile Slough, actual operation would be to attempt to achieve compliance at Emmaton. The reason for the request to move the compliance location is to eliminate the need to operate with a buffer to ensure compliance at Emmaton, as is typically the case. The modification will allow the Projects to operate at higher risk of exceeding the standard at the Emmaton and thereby make more efficient use of the limited upstream water supply this year. Consequently, the forecasted EC levels corresponding to the Threemile Slough objective scenario represent the worst case. Actual EC levels would be expected between the two scenarios and more closely aligned with those forecasted under the compliance at Emmaton scenario (see Figures 3 and 4).

Modeling Assumptions

To model the Delta flows, water levels and salinity, Delta Models such as DSM2 need boundary inflows, exports and diversions, water levels and salinity. Up to the point where the forecast begins, DSM2 uses observed historical data. For inflows to and exports from the Delta, DSM2 starts with the forecasted flows from the Delta Coordinated Operations (DCO) model that determine allocations to water contractors. Information that is fed into DCO includes hydrology data, contractor delivery requests, and regulatory and court restrictions on exports. The DCO allocation forecasts that were used for this analysis assumed a 90% hydrology. This represents a forecast for a very dry year. Based on historical data, a 90% hydrology assumes that only one in ten years would be drier than this forecast.

Sacramento flows from the DCO model were further adjusted, using the Minimum Water Quality Cost Compliance Tool (**http://modeling.water.ca.gov/delta/reports/annrpt/2002/2002Ch10.pdf**), so that DSM2 would comply with the water quality objectives listed below.

- Emmaton – 2.78 mmhos/cm
  Or Three Mile
- San Joaquin at Jersey Point – 2.20 mmhos/cm
- South Fork at Terminous - 0.54 mmhos/cm
- San Joaquin at San Andreas Landing - 0.87 mmhos/cm
- West Canal at Mouth of CCFB – 1.0 mmhos/cm
- DMC at Tracy Pumping Plant – 1.0 mmhos/cm
- Rock Slough - 1.0 mmhos/cm

In the simulations the Cross Channel was operated to D1641 objectives and temporary agricultural barriers were installed at the end of March.

Drinking Water Quality:

The forecast EC concentrations for the Emmaton objective scenario are below the D1641 objective for chloride of 250 mg/L, and has usually been below 150 mg/L since D1641 was approved in 1998. Chloride has a strong correlation to EC and the Clifton Court Forebay chloride concentrations equate to an EC concentration of approximately 1000 uS/cm (see Figure 1). Based on average chloride concentrations, EC concentrations are approximately 700 uS/cm which is below levels that cause drinking water quality concerns.

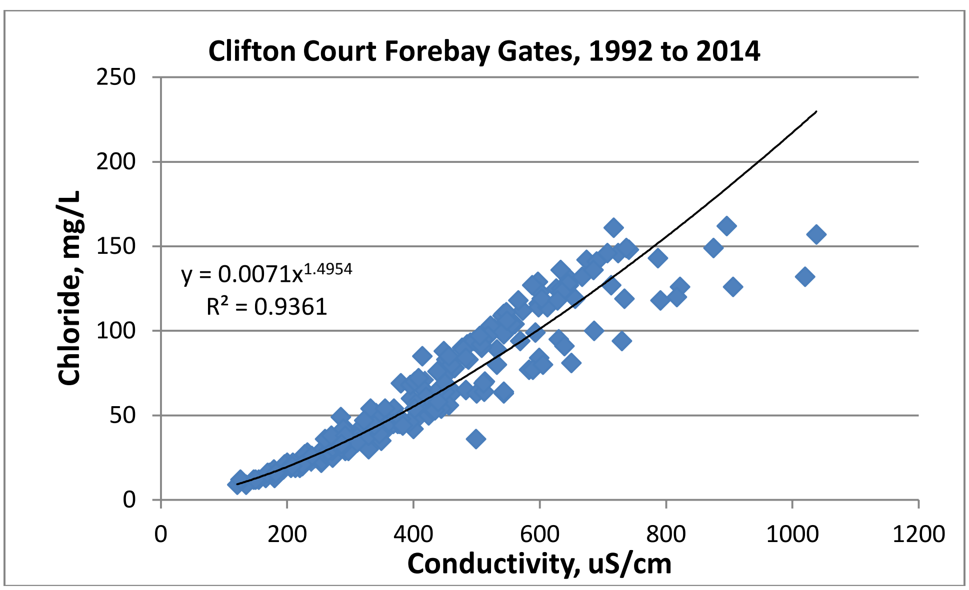


Figure 1: Chloride Correlation to EC

At the Clifton Court Forebay location the EC concentrations are below levels that cause drinking water quality considerations for disinfection byproducts precursors, namely 700 uS/cm EC until July (see Figure 2). If necessary, State Water Project water purveyors may choose to utilize other sources to blend SWP water to meet the CA Drinking Water Standards requirements for disinfection byproducts.

Based on the Water Data Library TOC concentrations at Clifton Court Forebay, the recommended TOC concentration of 4 mg/L would meet the South Bay Contractors' internal trigger. The Dissolved Organic Carbon (DOC) graphs for 1991 at Clifton Court Forebay indicate concentration ranges between 3 – 6 mg/L. Since DOC makes up a good portion of TOC, and TOC usually drops in times with less or no precipitation, it is anticipated that TOC levels during the late spring and summer will be at the no-impact level.

Similar results are projected at both Barker Slough (water quality for the North Bay Aqueduct) and Old River at Tracy Road (water quality for the Delta Mendota Canal). In both of these locations, water quality is projected to be adequate to meet both drinking water and agricultural requirements, despite the higher salinity concentrations projected with compliance at Threemile Slough, versus compliance at Emmaton (see Figures 3 and 4).

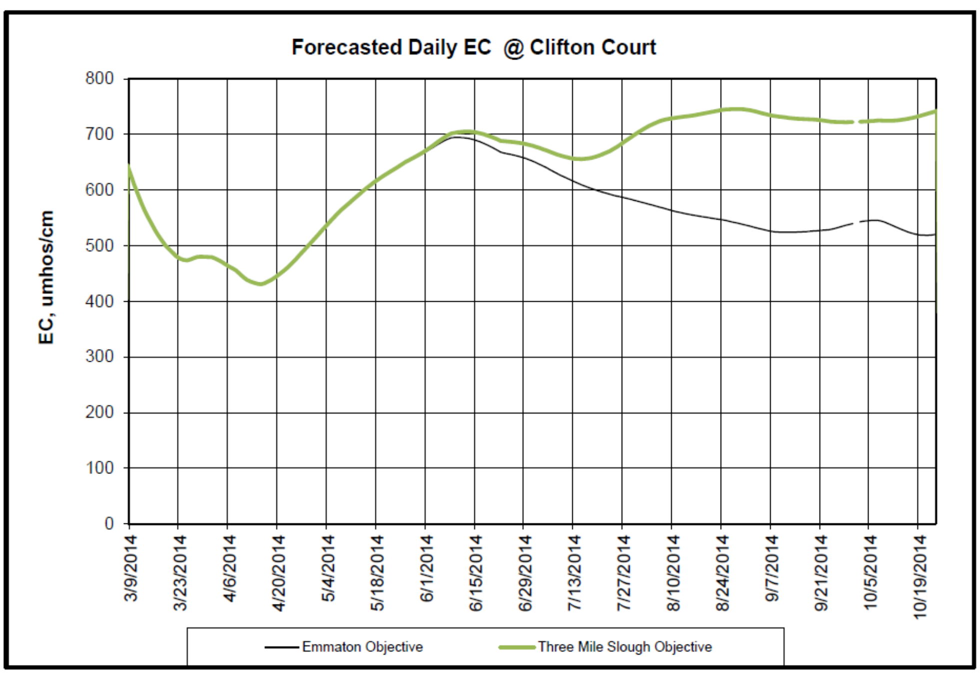


Figure 2: Clifton Court EC - Emmaton Objective and Three Mile Objective

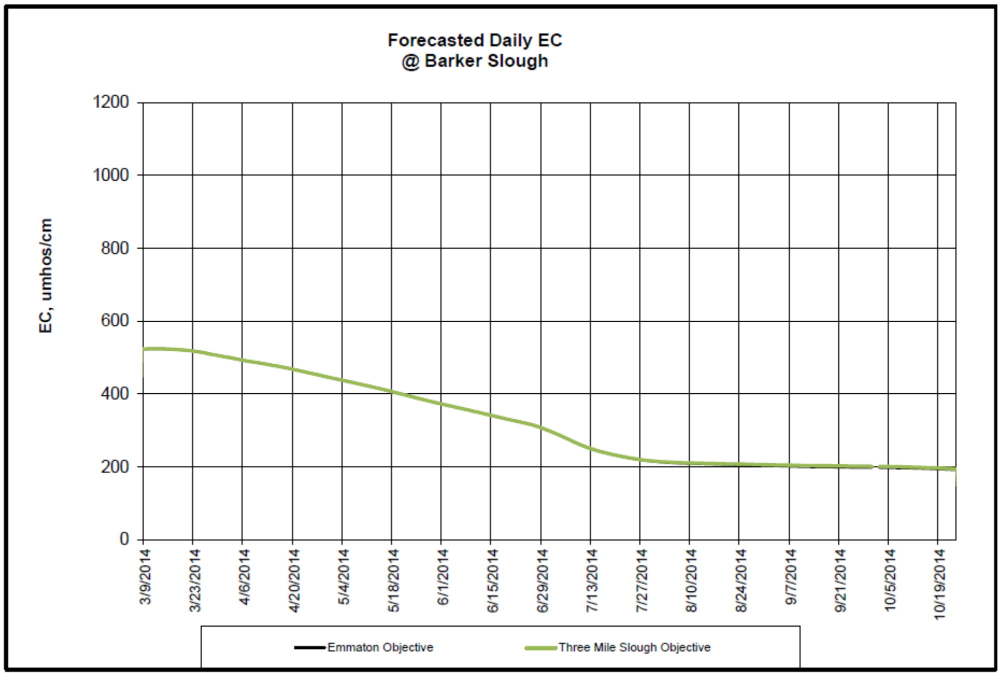


Figure 3: Barker Slough EC - Emmaton Objective and Three Mile Objective

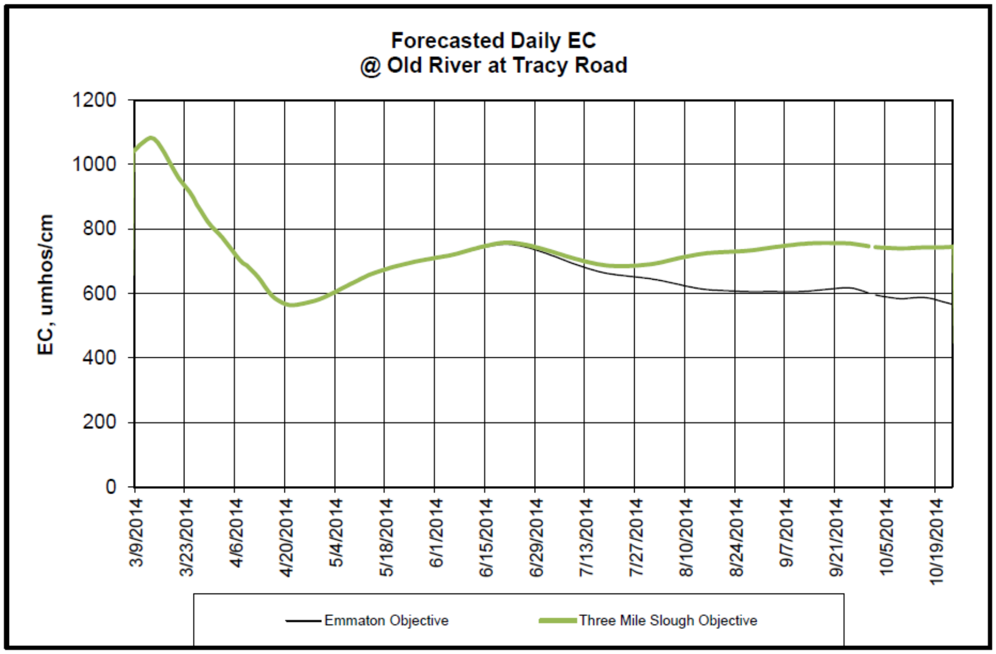


Figure 4: Old River at Tracy Road EC - Emmaton Objective and Three Mile Objective

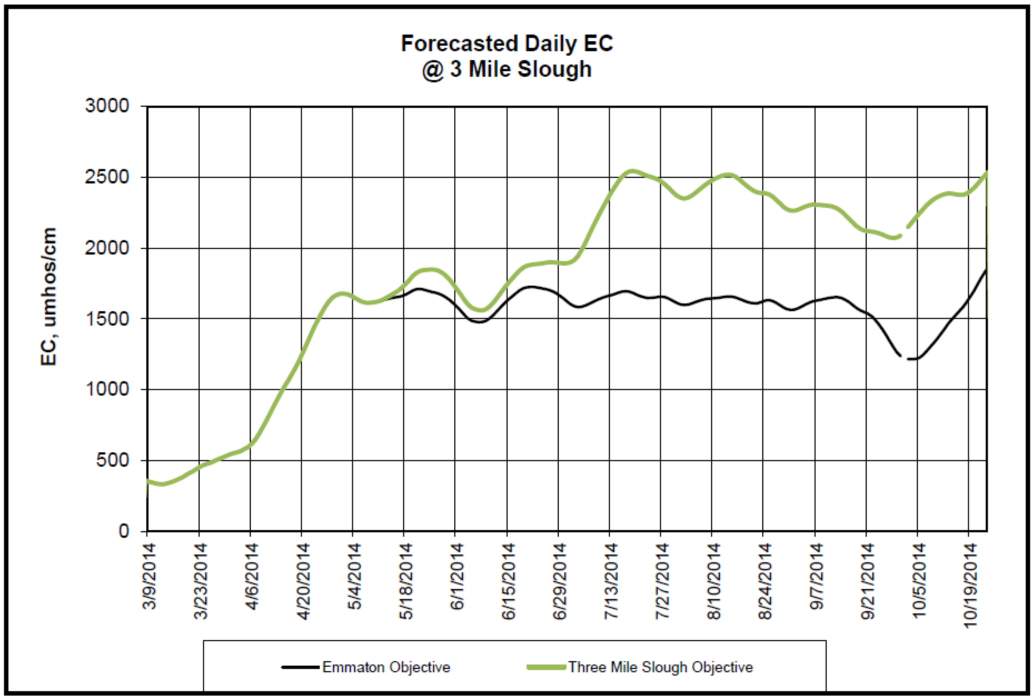


Figure 5: Three Mile Slough EC - Emmaton Objective and Three Mile Objective

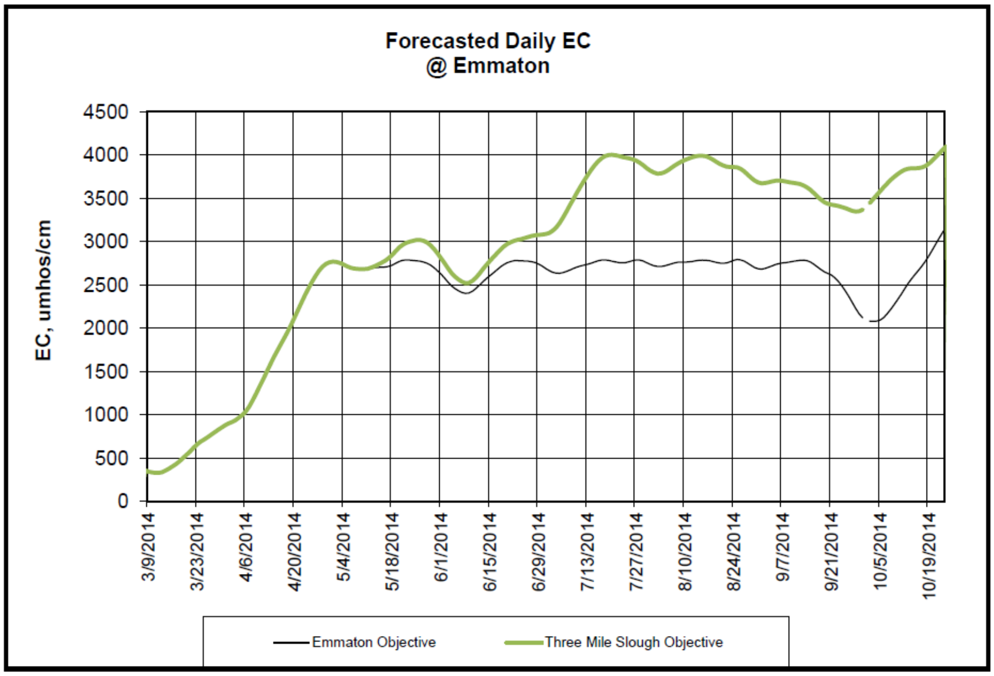


Figure 6: Emmaton EC - Emmaton Objective and Three Mile Objective

Agricultural Water Quality

The agricultural salinity tolerance levels are based on D1641 objectives at various locations, information provided by Kern County Water Agency, and research done by Dr. Glenn Hoffman's report on Salt Tolerance of Crops in the Southern Sacramento San Joaquin Delta (2010).

The forecast EC concentrations for the Emmaton objective scenario are below the D1641 objectives. The recommended EC threshold ranges for no-impact of < 1,000 uS/cm to 1,500 uS/cm consider permanent tree crops such as almonds, walnuts, and pistachios, and grape vines since they are "sensitive" to EC concentration and losses in production yields could have a profound effect on the economic viability of the Southern Sacramento-San Joaquin Delta.

With the modification to allow the Projects to operate at higher risk of exceeding the standard at the Emmaton location EC concentrations during the summer and fall at other Delta locations indicate the levels will be below the recommended EC threshold ranges for no-impact of < 1,000 uS/cm to 1,500 uS/cm for agricultural purposes (see Figures 7 -13).

Soil salinity (EC) measured in the plant root zone is conveniently directly proportional to the salt concentration in the soil water. Crop salinity tolerances are different with each crop ranging from sensitive to tolerant, and are dependent upon the existing soil salinity concentrations, type and age of the crop (more permanent status – trees will experience longer exposures to salt stress than the row crops), type of irrigation used, and susceptibility at different growing stages. For example, salt seems to affect rice during pollination and may decrease seed set and grain yield. Salinity tolerance may also vary throughout the growing season, often increasing with time but although most crops become more tolerant at later stages of growth, there are some exceptions. As expected, crops yields drop with increasing salinity concentrations.

Dr. Glenn Hoffman's report on Salt Tolerance of Crops in the Southern Sacramento San Joaquin Delta focused on the southern Delta area and includes lands and water channels southwest of Stockton, California. The bulk of these lands are included within South Delta Water Agency and encompass nearly 150,000 acres (see Figure 14).

In conclusion, moving the compliance objective to Threemile Slough will not result in adverse impacts on other legal water users. For both agricultural and municipal users, salinity levels in both scenarios analyzed here would be adequate to meet the needs for these beneficial uses. Salinity levels at other locations (e.g., Collinsville, Mallard, Port Chicago) are higher than would be acceptable for these uses in either scenario. It is important to note that there are no additional downstream agricultural interests protected by a standard at Emmation as compared to Threemile Slough. As a result, other water users will not be impacted by the proposed change.

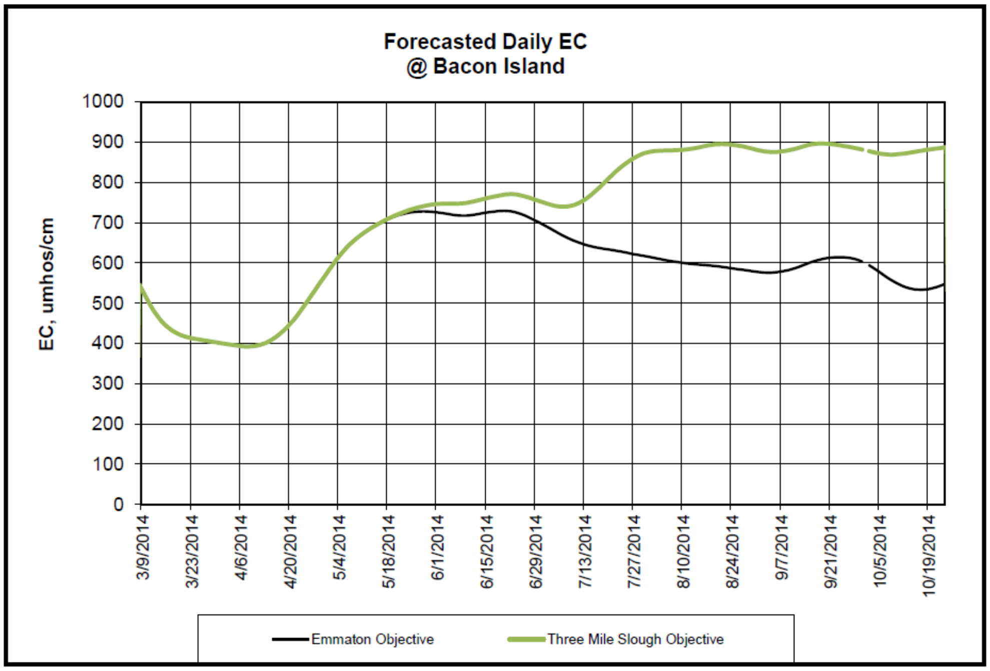


Figure 7: Bacon Island EC - Emmaton Objective and Three Mile Objective

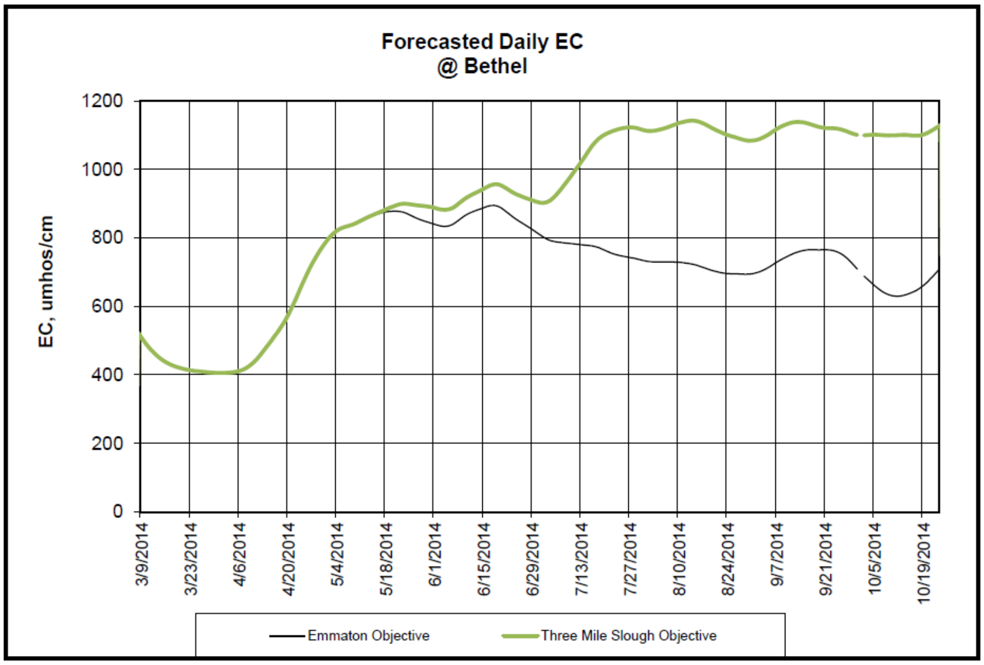


Figure 8: Bethel EC - Emmaton Objective and Three Mile Objective

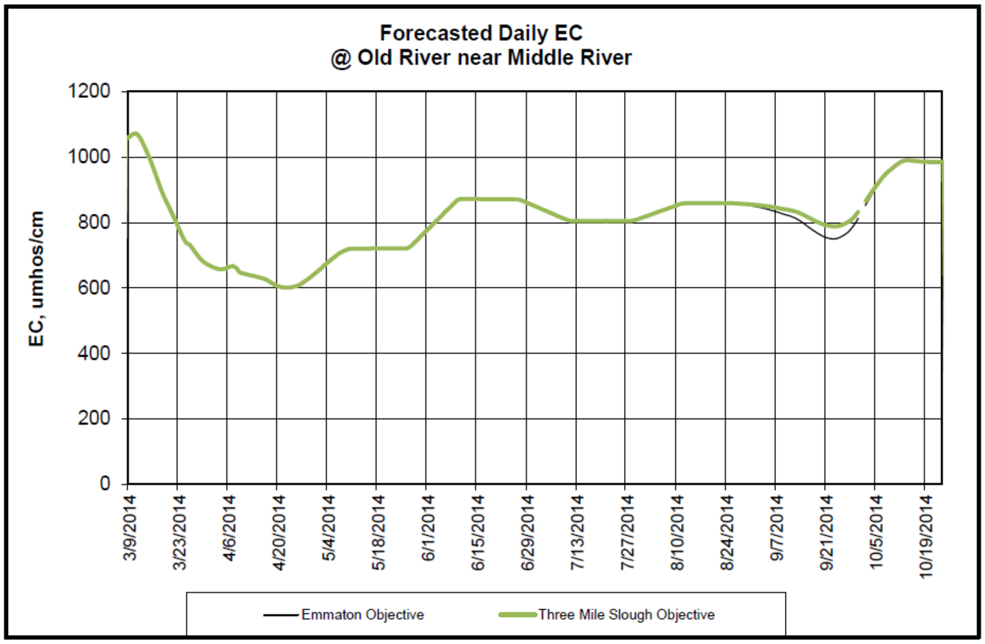


Figure 9: Old River near Middle River EC - Emmaton Objective and Three Mile Objective

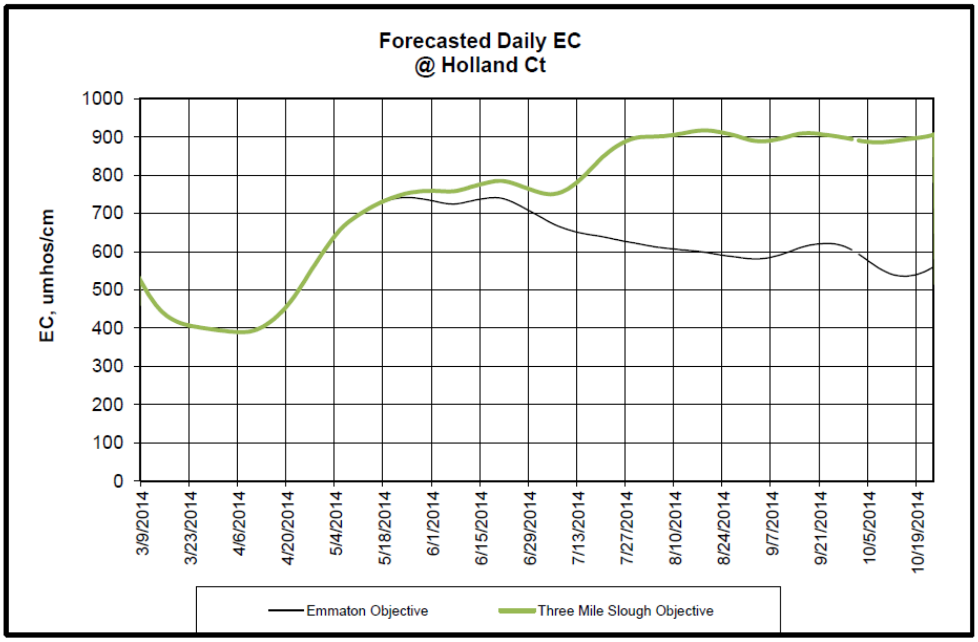


Figure 10: Forecasted DSM2 Holland EC - Emmaton Objective and Three Mile Objective

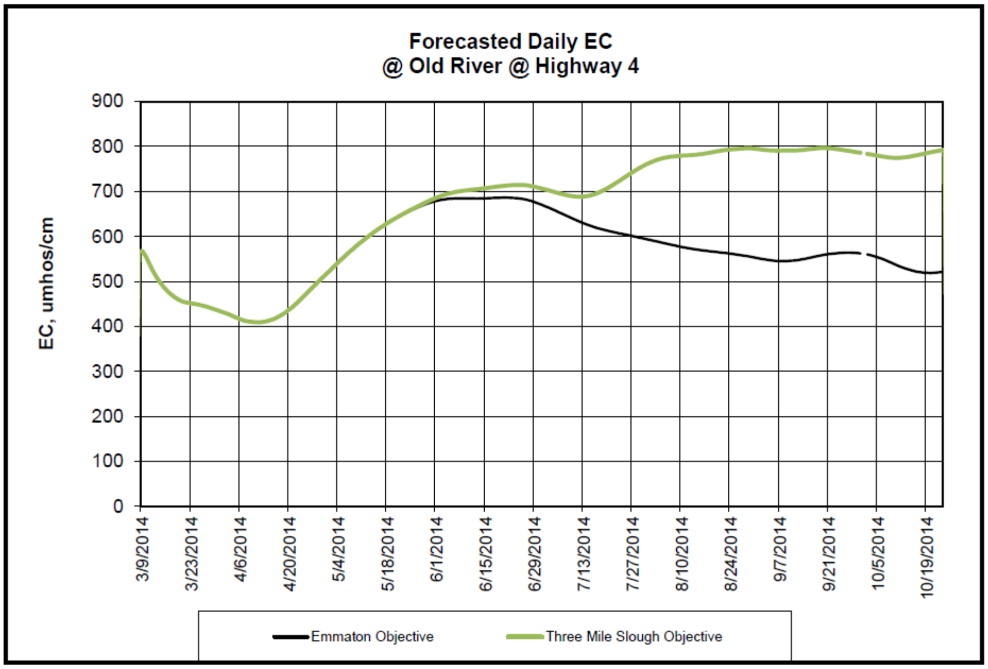


Figure 11: Forecasted DSM2 Old River at Highway 4 EC - Emmaton Objective and Three Mile Objective

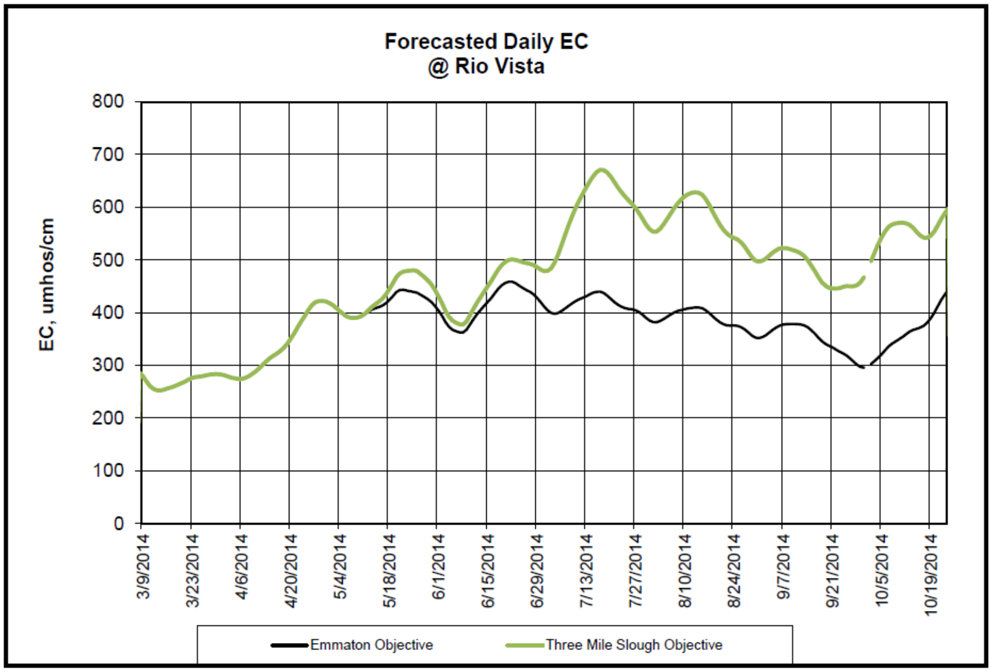


Figure 12: Forecasted DSM2 Rio Vista EC - Emmaton Objective and Three Mile Objective

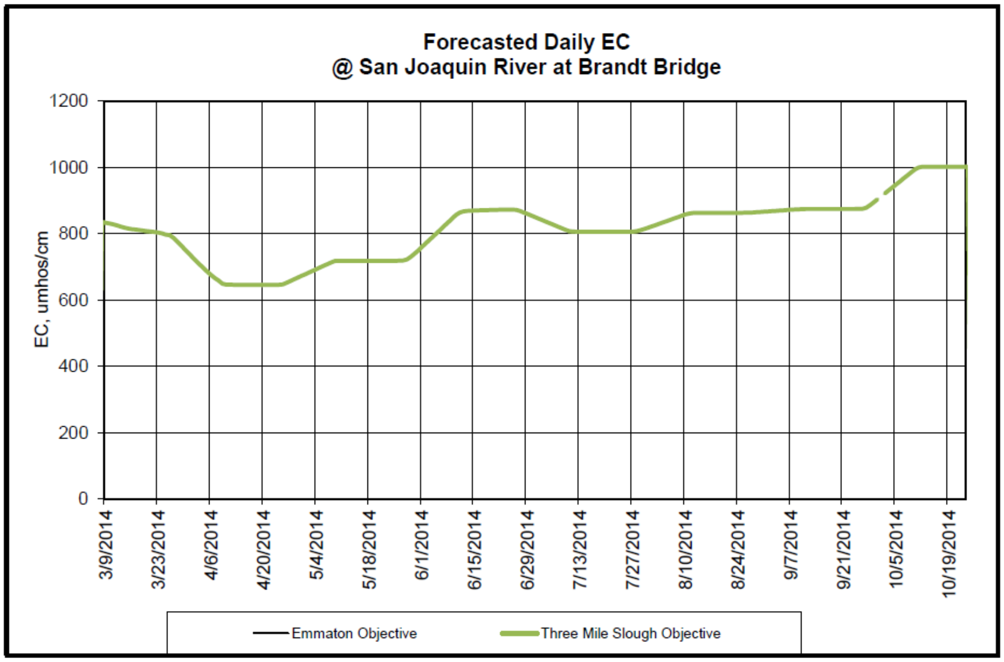


Figure 13: Forecasted DSM2 San Joaquin River at Brandt Bridge EC - Emmaton Objective and Three Mile Objective

Figure 1.1. Map of southern Delta showing boundary of the South Delta Water Agency and salinity compliance stations.

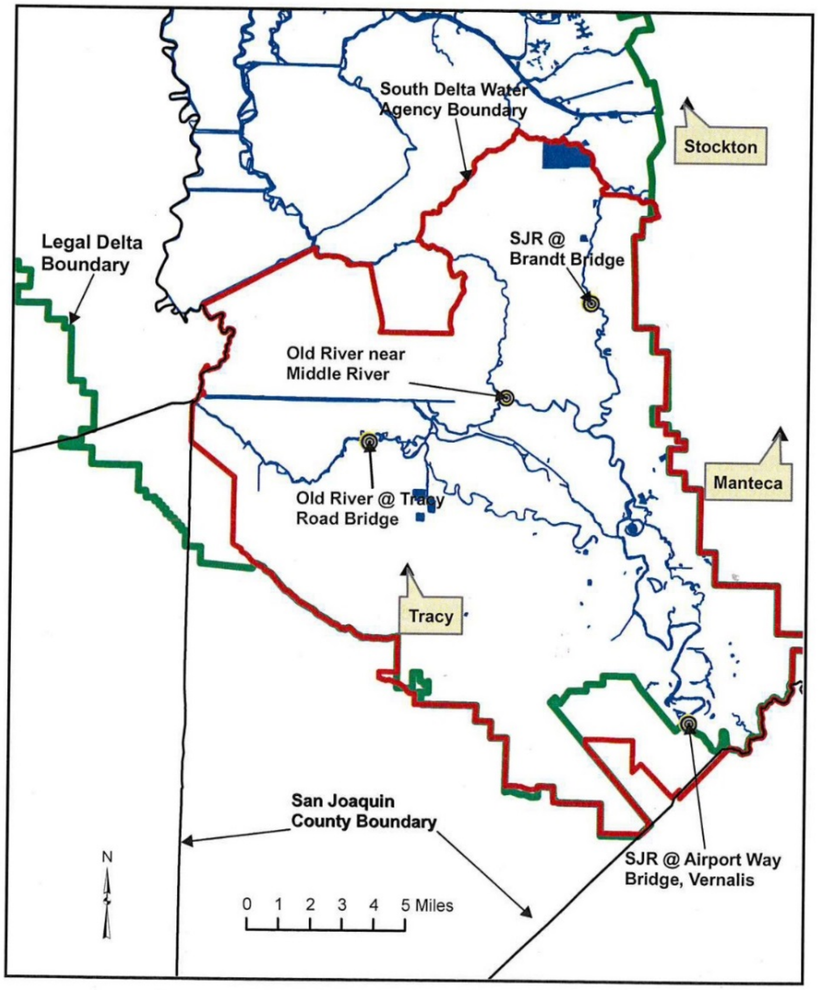


Figure 14: Southern Delta Map