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City of Modesto
City of Turlock
POTW SALINITY Contributions to LSJR
NPDES Permitting Determinations
Compliance with Downstream Water Quality Objectives
Recommendations regarding the Implementation of Proposed Objectives in NPDES Permits.
1.0 Introduction

This Report is being submitted on behalf of the LWA Team\(^1\) to fulfill the requirements of Task 4 in the Scope of Work for the Development of a Basin Plan Amendment for Salt and Boron in the Lower San Joaquin River (Workplan). The purpose of Task 4 is to evaluate a range of salinity management alternatives, assess the ability of these alternatives to achieve proposed salinity water quality objectives (WQOs) in Reach 83 of the Lower San Joaquin River (LSJR), and to identify a proposed salinity objective and a program of implementation for that objective. Information generated in Task 4 will be used to support the economic and environmental analyses conducted as a part of subsequent Workplan tasks.

Task 4 includes the following subtasks:

4.1 - Identify the range of potential salinity control measures for the LSJR
4.2 - Develop methods and criteria for screening those control measures
4.3 - Propose three salinity management alternatives for detailed analysis
4.4 - Conduct detailed analyses of three salinity management alternatives selected by the Lower San Joaquin River Committee (LSJRC) that include water quality modeling for compliance assessment
4.5 - Propose a salinity WQO for implementation
4.6 - Develop and define a program of implementation for the proposed salinity WQO

The subtasks listed above have been completed in close coordination with the LSJRC. A summary of the work completed pursuant to Task 4 is presented in this Report.

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\(^1\) The LWA Team consists of the following firms: Larry Walker Associates, Carollo Engineers, Kennedy/Jenks Consultants, Systech Water Resources, PlanTierra, Luhdorff and Scalmanini Consulting Engineers, Ascent Environmental, and Dr. Richard Howitt.
2.0 Project Background

The Task 4 work detailed in this Report builds upon a large body of work previously completed by the LWA Team in accordance with the Workplan. The work completed is documented in the following memoranda noted below:

- Task 8a – Finalize Beneficial Uses Review
  - Memorandum submitted December 5, 2013
- Task 2a – Compile and Update Water Quality and Salt Loading Data
  - Memorandum submitted March 4, 2014
  - Addendum submitted June 19, 2014
- Task 1 – Finalize Draft Agricultural Supply Electrical Conductivity (EC) Objectives
  - Memorandum submitted June 19, 2014
- Task 8b – Finalize Water Quality Criteria Review
- Task 3a – Identifying Potential Ranges of Water Quality Objectives
- Task 3b – Evaluation and Analysis of Existing Water Quality and Compliance with Water Quality Objectives Being Considered in the LSJR
- Task 2b – Update Analysis of Baseline Salt Loading to the LSJR
  - Memorandum submitted November 12, 2014

Brief summaries of the work efforts for each task are presented below to provide context for the Task 4 work.

2.1. FINALIZE BENEFICIAL USE REVIEW (TASK 8A)

The LWA Team reviewed proposed draft language prepared by the LSJRC that described potential changes to the existing and potential beneficial uses designated for Reach 83 (that segment of the LSJR from the Merced River confluence to Vernalis) (Figure 1). The purpose of this work was to determine if any changes to existing and potential beneficial uses for Reach 83 were necessary and/or feasible. The evaluation considered the options of designating a new beneficial use, changing the definition of a beneficial use, and removing or de-designating a beneficial use. The review found that recommended changes to the beneficial uses of Reach 83, as they are currently described in the Sacramento River Basin and San Joaquin River Basin Water Quality Control Plan (Basin Plan), are not essential to the immediate interests of the LSJRC. Furthermore, the evaluation found that the technical, policy and California Environmental Quality Act (CEQA) information required to support beneficial use changes had not been developed, and the time required to develop such information would far exceed the desired time schedule associated with the effort to develop and adopt a salinity WQO for Reach 83. This work identified all existing and potential beneficial uses of Reach 83 that would need to be considered when performing Task 4 and other subsequent tasks of the Workplan.
Figure 1: Overview map of Lower San Joaquin River Project Area
2.2. WATER QUALITY CRITERIA REVIEW (TASKS 8B AND 1)

The LWA Team reviewed/compiled salinity criteria, guidelines, and proposed benchmark values identified in available documents commissioned by CV-SALTS for the Task 8b work effort. Reviews of 11 salinity parameters\(^2\) were conducted for the protection of the following beneficial uses: municipal drinking water, irrigation supply water, stock watering, and aquatic life. The LWA Team identified the AGR irrigation supply water beneficial use as the most sensitive in Reach 83 and proposed a range of potential salinity objectives for this reach of the LSJR. This work identified the beneficial use and parameters that would need to be considered when performing subsequent tasks of the Workplan.

In a parallel effort under Task 1, the LWA Team recommended that almonds be selected as the most sensitive crop requiring protection in Reach 83, based on the CV-SALTS policy that consideration only be given to crops grown on at least 5 percent of the LSJR irrigation use area. The LWA Team worked collaboratively with Central Valley Regional Water Quality Control Board (Regional Water Board) staff in the development of salinity objectives using the Hoffman model that would be protective of almonds. The Regional Water Board staff modeling results indicated that an EC value of 1,550 μS/cm would be protective of almonds under the following CV-SALTS policy: crop yield of 95 percent during a 5th percentile precipitation year using 15 percent leaching fraction. At the request of the LSJRC, the Regional Water Board also derived a theoretical value for almonds using the Hoffman model but with 10% leaching fraction (1,010 μS/cm). This was established to create a range of EC objectives for consideration under the management alternatives to be evaluated in Task 4.

2.3. IDENTIFY POTENTIAL RANGES OF WATER QUALITY OBJECTIVES (TASK 3A)

Based on the work completed in Task 1 and Task 8b, a range of potential salinity objectives for Reach 83 was established. The LSJRC directed the LWA Team to explore various management alternatives required to achieve potential EC objectives ranging from 1,010 to 1,550 μmhos/cm. This range was evaluated in consideration of state and federal regulations, including the Basin Plan (CVRWQCB, 2011), the State’s Sources of Drinking Water Policy (State Water Resources Control Board Resolution 88-63), State and federal drinking water regulations, and other state and federal requirements relevant to drinking water, stock drinking water, aquatic life protection, and agricultural irrigation uses.

Historical ambient water quality data at key locations within Reach 83 of the LSJR were characterized and plotted against the proposed range of EC objectives (1,010 – 1,550 μmhos/cm). Two important historical monitoring locations were selected for further evaluation: (1) Maze Road, used to characterize water quality between the Tuolumne and Stanislaus Rivers, and (2) Crows Landing, used to characterize water quality between the Merced and Tuolumne Rivers. Data collected at an additional location, Patterson Bridge, were used to supplement data gaps at Crows Landing after determining that water quality at the two locations was similar based on a strong linear relationship for EC ($R^2 = 0.92466$)

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\(^2\) EC, total dissolved solids (TDS), sodium, magnesium, calcium, potassium, carbonate, bicarbonate, chloride, sulfate and boron.
Water quality conditions at Maze Road and Crows Landing were characterized on the basis of month, season\(^1\), and water year type\(^4\) for the water years 1977 through 2013\(^5\). These water quality conditions were then utilized in determining the rates of compliance with the proposed range of WQOs. Compliance comparisons of historical 30-day running average EC levels measured at the Maze Road and Crows Landing-Patterson locations were made for the water quality range of 1,000 to 1,600 µmhos/cm, in 100 µmhos/cm increments. These characterizations of historical water quality and their comparisons to a range of potential WQOs showed improved water quality and increasing compliance starting in 1995 with the implementation of the Grassland Bypass Project (GBP). With consideration that the operational conditions and water quality of the LSJR differ from pre-GBP and post-GBP, the LWA Team recommended, and the LSJRC approved, evaluation and modeling that focused on the 1995 – 2013 time period. This decision identified the range of historical salinity loading in Reach 83 that would require future management actions to meet the range of potential EC objectives (1,010 – 1,550 µmhos/cm) and informed the selection of implementation actions that would be modeled under Task 4.

2.4. COMPILE AND UPDATE WATER QUALITY AND SALT LOADING DATABASE (TASK 2A)

Available surface water quality and salt loading data relevant to the LSJR, both within and upstream of Reach 83, were identified, compiled, and added to a comprehensive database, along with the sources from which the data were obtained. The data and data sources were housed within the Watershed Analysis Risk Management Framework (WARMF) and the WARMF database served as the overall database for all data related tasks. While the focus of the project is the development of a salinity WQO that is protective of beneficial uses in Reach 83, the modeling effort also evaluated the salt loads that exist upstream of Reach 83. These upstream loads constitute a significant portion of the salinity measured at Crows Landing and downstream in Reach 83. The project area considered for this effort is shown in Figure 1. This project area is similar to the area in the 2006 Lower San Joaquin River Salt and Boron Total Maximum Daily Load (TMDL).

Surface water quality data and information regarding the project area were compiled and used to update existing data within the WARMF database from 1968 to present. The compiled database developed under Task 2a exists outside of the WARMF framework and serves as the master database for all of the data analysis tasks in the remainder of the work effort. The data compilation effort was needed to allow for a comprehensive evaluation of past and recent salt loading to the LSJR that is necessary in order to identify the locations, magnitudes, and timing of salts loads that will need to be controlled under future salinity management alternatives.

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1 “summer irrigation” (April – August) season or “winter irrigation” season (September – March)

4 The method for determining the San Joaquin Valley Water Year Hydrologic Classifications (e.g., critical, dry, below normal, above normal, wet) is defined in the SWRCB Revised Decision 1641, March 2000, Figure 2, page 189. This method uses the best available estimate of the 60-20-20 San Joaquin Valley water year hydrologic classification at the 75% exceedance level using the best available data published in the California Department of Water Resources’ ongoing Bulletin 120 series.

5 A water year is defined as the period October 1 of a given year through September 30 of the following year.
2.5. UPDATE ANALYSIS OF BASELINE SALT LOADING TO THE LSJR (TASK 2B)

The WARMF model was identified as the best available tool within the resources available for generating the baseline salt loading analysis for the LSJR and was run using historical conditions to establish a “Baseline” model simulation upon which later Management Alternative model simulations could be developed and compared. The WARMF model was used to simulate historic flow and electrical conductivity data collected from the LSJR monitoring stations at Maze Road and Crows Landing. These model results were plotted against the historical ambient water quality to evaluate model performance. The Baseline modeling results for flow compared well to historical flow data at the two monitoring locations along the LSJR. Model EC results compared well to historical data at Maze Road; however, comparisons to historical EC at Crows Landing were not as strong. The effects of discrepancies between historical and WARMF-simulated baseline EC conditions at Crows Landing are further explained in Appendix B.

The Baseline WARMF simulations provided a representative characterization of the significant salt sources in the LSJR basin, quantification of salt loadings from the various sub-watersheds, and descriptions of the timing of salt loading to the river. The results provide information on the regions, sources, and timing of salt loading within the watershed where implementation measures could be employed to provide the greatest reductions in salt loads to the river. Model results showed that the highest salt loads occur from February through May with relatively higher loads present through late August. East side riverine inputs provide dilution flows with low TDS loads relative to upstream sources. Although west side and upstream salt sources have decreased over time, west side salt sources upstream of the Merced River confluence (i.e., upstream of Reach 83) are significant, and are the best targets for implementation of salinity management measures. Reduction of sources upstream of the Merced River have the greatest influence on ambient salinity concentrations observed in Reach 83. This information allowed for selection of the most appropriate location and salinity control measures for modeling under Task 4.
3.0 Development of Salinity Management Alternatives

Pursuant to the Workplan, three salinity management alternatives were evaluated with the WARMF modeling tool to determine the ability of each management alternative to result in water quality within Reach 83 that complied with the range of proposed EC WQOs. Instead of evaluating numerous individual salinity control measures, hereafter referred to as implementation actions, each of the three salinity management alternatives was constructed to constitute a “bundle” of various agricultural, industrial, urban, and/or environmental actions that could be implemented within the project area (Figure 1) as a means of evaluating ambient salinity conditions in Reach 83 with implementation of a management alternative.

The selection of the three salinity management alternatives followed the steps listed below.

4.1 - Identify the range of potential implementation actions to manage salts in the LSJR;
4.2 - Develop methods and criteria for screening those control measures; and
4.3 – With input from the LSJRC, identify appropriate implementation actions to include in three management alternatives selected for detailed modeling and analysis.

The LWA Team worked closely with and solicited a great deal of input from the LSJRC in the selection of appropriate implementation actions to evaluate within each management alternative. Updates and interim work products were provided by the LWA Team at the monthly LSJRC meetings. In addition, a number of supplementary meetings were held with various LSJRC members to specifically identify and discuss the best implementation actions to include within each of the three salinity management alternatives.

Key LSJRC meetings that supported the selection of the three salinity management alternatives included the following (meeting agendas for the October 2014 and January 2015 meetings are included in Appendix A, there were no agendas during the November and December meetings):

- Implementation Planning Workshop #1 (October 2, 2014) – Collaborated with LSJRC members on the selection of the three salinity management alternatives to be modeled by the LWA Team.
- Review of the ‘Planned’ Salinity Management Alternative (November 21, 2014) – Reviewed and agreed upon the modeling approach for the Planned Salinity Management Alternative.
- Review of the ‘Maximum Management Focus’ and ‘Treatment Focus’ Salinity Management Alternatives (December 22, 2014) – Reviewed and agreed upon the modeling approach for the Maximum Management Focus and Treatment Focus Salinity Management Alternatives.
- Implementation Planning Workshop #2: Maximum Management Focus and Treatment Focus Salinity Management Alternatives (January 12, 2015) – Collaborated with LSJRC members on the selection of the Maximum Management Focus and Treatment Focus Salinity Management Alternatives to be modeled by the LWA Team.
3.1. RANGE OF POTENTIAL IMPLEMENTATION ACTIONS

The LWA team coordinated with the LSJRC to identify the suite of available implementation actions that could be employed to control salt loadings to the LSJR. In addition, the following resources were evaluated:

- The Control Program for Salt and Boron Discharges into the Lower San Joaquin River (CVRWQCB, 2011).

The LWA Team identified fifteen implementation actions ranging from large regional controls to more localized actions. These implementation actions could be used to reduce salinity inputs/loadings to the LSJR and/or increase salt exports from the watershed. They are categorized as belonging to one of two classes of salinity control methods:

- Reducing salt and boron loading to the LSJR (Load Reduction)
  - Reduction of salt and boron loads to the LSJR through source control and/or increased salt retention;
- Increasing the amount of salt and boron exported from the LSJR watershed
  - Managing the salt loads via sequestration, transport, and disposal
  - Adaptive water supply management (e.g., SJR water diversions during periods of excess SJR flows)
  - Managing discharges to the LSJR to match available assimilative capacity based on some salinity WQO

The identified implementation actions and the methods under which they are categorized are summarized in Table 1. The implementation actions were pre-screened using input from various LSJRC members with respect to (1) technical feasibility, (2) economic viability, and (3) ability to implement, as a means to gain a general understanding of the utility of a particular implementation action. This “pros and cons” analysis was useful in initially evaluating the effectiveness of potential implementation actions to be included in a management alternative because individual implementation actions could not be evaluated in isolation through modeling once they were bundled together in a management alternative.

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\(^7\) http://www.water.ca.gov/pubs/groundwater/a_management_plan_for_agricultural_subsurface_drainage_and_related_problems_on_the_westside_san_joaquin_valley/rainbowreportintro.pdf
**Table 1: Range of Potential Implementation Actions**

<table>
<thead>
<tr>
<th>METHOD AND IMPLEMENTATION ACTIONS</th>
<th>EXAMPLES</th>
<th>DESCRIPTION OF IMPLEMENTATION ACTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MANAGE SALTS &amp; SOURCES TO THE CURTAIL SALTS</strong></td>
<td><strong>Assimilative Capacity Management</strong></td>
<td>Would take advantage of assimilative capacity in the river to export salt to Lake Ewauna. Requires a proactive program to manage discharges, diversions, and other activities that may increase loads of salts. Also requires real-time monitoring of TDS and EC at selected sites, real-time data link and means of information sharing and dissemination. Those TMDLs that are &quot;sensitive&quot; may include a number of other implementation actions, this and the other actions are bolded and in red within the table so that it is clear they are related.</td>
</tr>
<tr>
<td></td>
<td><strong>Self Realizing Water Management</strong></td>
<td>This program would reduce salt loads from POTWs that have self-regenerating water softeners in their service areas. Would take advantage of salinity water management in the soil. Self-realizing water management may include: (a) integration of land use management and other practices, (b) storage of water and water treatment, (c) storage in the Delta for groundwater recharge or other purposes, (d) groundwater recharge in the Delta for downstream aquifer or river use, (e) storage in brine (water) management projects, and (f) other activities.</td>
</tr>
<tr>
<td></td>
<td><strong>Integrative Drainage Management</strong></td>
<td>This program would reduce salt loads from POTWs by promoting both natural and improved runoff conditions. For specific solutions involving both land source reduction and salinity management, benefits to the river through integration of water management and coordinates the development of a coordinated program to manage discharges, diversions, and river and tributary releases to enable timed release of salinity water. Includes, but is not limited to, product substitutions, process modifications, and other actions.</td>
</tr>
<tr>
<td><strong>MANAGE DISCHARGES TO THE SURFACE WATER</strong></td>
<td><strong>Drainage Water Diversion</strong></td>
<td>Would take advantage of natural evaporation to export salt to the Delta and ocean. Requires a proactive program to manage discharges, diversions, and other activities that may increase loads of salts. Also requires real-time monitoring of TDS and EC at selected sites, real-time data link and means of information sharing and dissemination. Those TMDLs that are &quot;sensitive&quot; may include a number of other implementation actions, this and the other actions are bolded and in red within the table so that it is clear they are related.</td>
</tr>
</tbody>
</table>

*While the table focuses on salt, the implementation actions described will be similar for boron, and other ions.*

*The implementation actions represent a range of potential actions for consideration during the development of three alternative management scenarios. Each alternative management scenario is likely to be a combination of several implementation actions, and it should be noted that none of the actions listed (a) manage or otherwise treat inflows to the Delta, (b) address point sources of salinity or boron, (c) manage other non-salt related water-quality impacts, (d) address other water resources issues, or (e) address other renewable energy impacts.*

**Action considered as a part of SSALTS**

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9 September 2015

**September R:\305**
3.2. METHODS AND SCREENING CRITERIA FOR IMPLEMENTATION ACTIONS

Screening criteria were developed by the LWA Team to help guide the selection of which implementation actions, among those presented in Table 1, should be included in the three salinity management alternatives. The screening criteria were developed to allow for a qualitative evaluation of potential implementation actions and were based upon a review of the approaches and considerations used in the LSJR Salt and Boron TMDL and SSIALTS documents. The criteria needed to allow for the consideration of technical feasibility, economic viability, the ability to implement, and technical details such as the sources and timings of salt loads to the LSJR, as well as be supportive of the overall goals of the Central Valley Salt and Nitrate Management Plan (SNMP) that have been identified by CV-SALTS. The screening criteria include three main categories and several sub-categories as shown in Table 2.

Each of the sub-categories was used to further characterize the relative merits of a particular implementation action. The sub-categories were useful in evaluating the presumed effectiveness and shortcomings of a given action with respect to the quantity and timing of salt loads that the action could reasonably address and the potential costs/impacts that could occur with implementation of the action.

Using the screening criteria and input from the LSJRC, each of the 15 identified implementation actions were evaluated and earmarked for inclusion or exclusion within a salinity management alternative. Implementation actions considered to have numerous poor performing qualitative assessments (e.g. unproven technology, low flexibility, high costs, difficult to model, etc.) were eliminated altogether from inclusion in the salinity management alternatives.

Out of the 15 implementation actions evaluated, the following nine implementation actions were carried forward for potential inclusion in one or more of the salinity management alternatives to be modeled using WARMF:

- 1 – Controlled Timing of Salinity Discharges
- 2c – Reduce Point Sources – existing industrial/food processing sources control and/or pretreatment
- 3a – Reduce Nonpoint Sources – Reduce application of salts in fertilizers and soil amendments
- 5a – Water Treatment – Regional Facility
- 8b – Water Conservation – Optimize Existing Irrigation Efficiency
- 9a – Installation of New High Efficiency Irrigation and Delivery Systems
- 10b – Sequential Reuse and Volume Reduction – Salt Accumulation Area similar to the San Joaquin River Water Quality Improvement Project (SJRIP)
- 12a – Drainage Water Recirculation – Tailwater Recovery
- 12b – Drainage Water Recirculation – Tilewater Recovery
### Table 2: Screening Criteria Used in the Evaluation of Management Alternatives

<table>
<thead>
<tr>
<th>Goal</th>
<th>Criteria</th>
<th>Sub-Criteria</th>
<th>Assessment Range</th>
<th>Suggested Metrics</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Technical Feasibility</td>
<td>a. Technologies are readily available/adaptable</td>
<td>Unproven</td>
<td>Proven, not available and/or not adaptable</td>
<td>Quantitative.</td>
</tr>
<tr>
<td></td>
<td>b. Ability to meet WQOs and load allocations or WQ achieved in near future</td>
<td>Low rate of compliance</td>
<td>Med rate of compliance</td>
<td>High rate of compliance</td>
</tr>
<tr>
<td></td>
<td>c. Provides for flexibility to growers and wetland operators</td>
<td>Low flexibility</td>
<td>Medium flexibility</td>
<td>High flexibility</td>
</tr>
<tr>
<td></td>
<td>d. Flexible/adaptable to climate changes/water year types</td>
<td>Low flexibility</td>
<td>Medium flexibility</td>
<td>High flexibility</td>
</tr>
<tr>
<td>2. Economic Viability</td>
<td>a. Relative Capital and O&amp;M costs</td>
<td>Highest costs</td>
<td>Medium costs</td>
<td>Lowest costs</td>
</tr>
<tr>
<td></td>
<td>b. Potential environmental issues</td>
<td>High issues/ delays</td>
<td>Med issues/ delays</td>
<td>Low issues/ delays</td>
</tr>
<tr>
<td></td>
<td>c. Time period for planning/design/construction</td>
<td>Most time to implement</td>
<td>Medium time to implement</td>
<td>Least time to implement</td>
</tr>
<tr>
<td></td>
<td>d. Legal/regulatory/institutional hurdles</td>
<td>High potential for hurdles</td>
<td>Medium hurdles</td>
<td>Little to no hurdles</td>
</tr>
<tr>
<td>3. Ability to Implement</td>
<td>Time to implement</td>
<td>Most time to implement</td>
<td>Medium time to implement</td>
<td>Least time to implement</td>
</tr>
<tr>
<td></td>
<td>d. Authority within authority of implementing agency</td>
<td>No authority exists</td>
<td>Some authority</td>
<td>Full authority exists</td>
</tr>
</tbody>
</table>
3.3. SELECTION OF SALINITY MANAGEMENT ALTERNATIVES

The LWA Team reviewed the assessment of salt load sources generated by the WARMF Baseline model in Task 2b (LWA 2014d), evaluated available implementation actions using the screening criteria and, with input from the LSJRC, developed three salinity management alternatives for detailed evaluation.

The three alternatives were designed to serve as “book-ends” representing the achievable water quality from a planned management effort and two highly intensive management efforts.

- The planned management effort was designed with the intent that its implementation would achieve the 1,550 µmhos/cm upper EC value identified as protective of AGR irrigation supply beneficial uses in Reach 83 in Tasks 1 and 8b. The planned management effort encompasses existing salinity control activities and those planned for implementation in the project area (Figure 1) within the next 5 – 10 years.

- The two intensive management efforts were designed to demonstrate the level of water quality achievable with implementation of extreme management or engineered treatment of agricultural drainage water. The intent was that implementation would achieve the 1,010 µmhos/cm lower EC value identified.

The three salinity management alternatives are described in additional detail below and summarized in Table 3 (Planned Alternative), Table 4 (Planned Plus Maximum Treatment Focus Alternative), and Table 5 (Planned Plus Maximum Management Focus Alternative).
### Table 3: Planned Management Alternative Implementation Actions

<table>
<thead>
<tr>
<th><strong>PLANNED</strong></th>
<th>3. Controlled Timing of Salinity Discharges <strong>RTM</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Northwest</strong></td>
<td>East Valley Floor</td>
</tr>
<tr>
<td><strong>ASSESSMENT</strong>: It is assumed that some irrigation districts in the Northwest and Grassland Drainage Area subareas, through the use of existing facilities, have the capability to withhold some of the discharge of saline drainage to the LSIR depending on water year. It is also assumed that these subareas would not allow their discharge.</td>
<td></td>
</tr>
</tbody>
</table>

**POST-PROCESSING APPROACH**: The modeling of controlled timing of saline discharges will be handled through post-processing of WARMF simulated results. Assumptions regarding timing differences will be based upon communications with individuals in charge of facility operations. Any assumptions used in post-processing of WARMF simulated results regarding locations and held drainage volumes for existing facilities will be documented in the Task C Technical Memorandum. |

2c. Reduce Point Sources - Existing Industrial/Food Processing Sources Control and/or Pretreatment |

**ASSESSMENT**: The cities of Modesto and Turlock are the only municipalities in the region that discharge treated effluent to the LSIR. At a sensitivity analysis, a 3% reduction in POTW loads is assumed. This is neither a projection of expected reductions nor a statement on future reductions that should be required. |

**MODELING APPROACH**: POTW discharges are included in WARMF. Input values for WWTP salinity loading will be reduced by 3%. |

**Northwest**: East Valley Floor | Grassland Drainage Area | Grassland Bypass | Other |

**ASSESSMENT**: As a sensitivity analysis, a 10% reduction in the application of nitrogen based fertilizers in select subbasins is assumed. No change in the type of or formulation of fertilizer is assumed. This is neither a projection of expected reductions nor a statement on future reductions that should be required. Soil amendments are not anticipated to decrease in their application in the project area. |

**MODELING APPROACH**: Fertilizer application is included in WARMF. The input value for nitrogen-based fertilizer usage in the identified subareas will be reduced by 10%. |

3b. Water Conservation - Optimize Existing Irrigation Efficiency |

**Northwest**: East Valley Floor | Grassland Drainage Area | Grassland Bypass | Other |

**ASSESSMENT**: It is assumed that any water conserved by an irrigation district or individual grower will be used by the entity who conserved the water or will be sold to another entity in the project area who will use the water. It is also assumed that any incremental decrease in salt loading to the LSIR will be small and will result in insignificant changes in ambient water concentrations. |

**MODELING APPROACH**: No change in baseline modeling assumptions. |

**Northwest**: East Valley Floor | Grassland Drainage Area | Grassland Bypass | Other |

**ASSESSMENT**: Similar assumptions as indicated for 3a. |

**MODELING APPROACH**: No change in baseline modeling assumptions. |

10c. Sequential Reuse and Volume Reduction - Soil Accumulation Area (SRIP) **RTM** |

**Northwest**: East Valley Floor | Grassland Drainage Area | Grassland Bypass | Other |

**ASSESSMENT**: There currently exists one soil accumulation area project (SRIP) in the Grassland Bypass Project (GBP) area within the Grassland Drainage Area. There are no other sequential reuse and volume reduction projects planned for the project area within the bundle's planning period (5-10 years). It is assumed that the SRIP project will continue its operation and sequence salts as predicted, resulting in zero discharge of salts from the GBP area. |

**MODELING APPROACH**: WARMF includes inputs from the SRIP area. San Luis Drain Basins will be set to zero (0) in WARMF as the Grasslands Bypass will not contribute any flow or loading to the San Joaquin River. |

**Northwest**: East Valley Floor | Grassland Drainage Area | Grassland Bypass | Other |

**ASSESSMENT**: Titratable can be blended with irrigation supply to result in reduction in tilewater discharge and usage of fresh irrigation water supply. Planned tilewater recovery projects, as reported by irrigation districts and water quality coalitions, will be simulated in WARMF. |

**MODELING APPROACH**: Water "savings" (in AF) resulting from use of recovered tilewater will be modeled in WARMF as a reduction in fresh irrigation water that is applied to those subbasins and a corresponding net increase in irrigation efficiency where irrigation districts or water quality coalitions report planned tilewater recovery projects to the LSIRC that will occur within the bundle's planning period (5-10 years). |

**Northwest**: East Valley Floor | Grassland Drainage Area | Grassland Bypass | Other |

**ASSESSMENT**: Tilewater can be reused directly or blended with irrigation supply to result in volume reduction of tilewater and fresh irrigation water supply. Planned tilewater recovery projects, as reported by irrigation districts and water quality coalitions, will be simulated in WARMF. |

**MODELING APPROACH**: Water "savings" (in AF) resulting from use of recovered tilewater will be modeled in WARMF as a reduction in fresh irrigation water that is applied to those subbasins and a corresponding net increase in irrigation efficiency where irrigation districts or water quality coalitions report planned tilewater recovery projects to the LSIRC that will occur within the bundle's planning period (5-10 years). |
The Planned Alternative (Table 3) builds upon the Baseline model simulation from Task 2b by adding implementation actions that are currently in effect or planned for implementation in the LSJR basin within the next 5-10 years. The Planned Alternative includes the following implementation alternatives:

- **1 – Controlled Timing of Salinity Discharges**

  Although the controlled timing of salinity discharges has the potential to play a significant role in affecting ambient salinity concentrations in the LSJR, especially when implemented at the regional level through a Real-Time Management Program, this action was not considered for modeling within the WARMF model simulation. Instead, the modeling of controlled timing of salinity discharges was determined to be best handled with post-processing of the data using WARMF model output.

  For the purposes of the current project, it was determined that only existing facilities (e.g., Patterson Irrigation District drainage detention pond; Grassland Water District tailwater recovery project) should be considered as having the ability to temporarily hold saline discharges for release to the LSJR. However, based upon communications with individuals in charge of the operations of these facilities and preliminary calculations, it was determined that the current impact of these facilities on LSJR salinity levels is small relative to other implementation actions and model uncertainty. As a result, the effect of the controlled timing of salinity discharges from existing facilities on LSJR water quality was considered in a qualitative manner under the Planned Alternative evaluation.

- **2c – Reduce Point Sources – existing industrial/food processing sources control and/or pretreatment**

  It was determined that the cities of Modesto and Turlock were the only point sources in the region that discharge treated effluent to the LSJR. Both have taken substantial efforts in the past decade to reduce salinity in their effluent which has resulted in lower effluent salinity levels. In the analysis, a 3 percent reduction in publically owned treatment works (POTW) loads was modeled. This is neither a projection of expected reductions nor a statement on future reductions that should be required.

- **3a – Reduce Nonpoint Sources – Reduce application of salts in fertilizers and soil amendments**

  As a sensitivity analysis, a 10 percent reduction in application of nitrogen-based fertilizers in the Northwest, East Valley Floor, and Grassland Drainage Area (Figure 1) was assumed. No change in the type or formulation of fertilizer was assumed. This is neither a projection of expected reductions nor a statement on future reductions that should be required. However, this level of reduction in existing fertilizer application could be achieved through continued precision application of fertilizers on the part of growers. No change in the use of soil amendments was assumed for the project area.

  - **8b – Water Conservation – Optimize Existing Irrigation Efficiency**
  - **9a – Installation of New High Efficiency Irrigation and Delivery Systems**

  While continued water conservation and installation of new high efficiency irrigation and delivery systems is anticipated to occur in the project area within the next 5 – 10 years, no change in the baseline modeling assumptions was made for these two implementation actions. It was assumed that optimizing irrigation efficiency and/or installing new high efficiency irrigation systems...
and delivery systems would not change the amount of salt being applied in the project area. As water is saved, it will be used elsewhere within the project area. In addition, it was assumed that any incremental decrease in salt loading to the river as a result of implementation of these two actions will be small and result in insignificant changes in ambient river concentrations. Furthermore, achieving technical consensus on the assumptions that would need to be made to appropriately model implementation actions 8b and 9a would be challenging and, given the inherent uncertainties in such assumptions and the model results generated, the benefit of modeling these implementation actions was considered to be limited and very minor relative to the salinity control potentials of other modeled implementation actions.

- **10b – Sequential Reuse and Volume Reduction – Salt Accumulation Area (SJIRP)**

There is currently one salt accumulation area project, the Grassland Bypass Project (GBP), located within the Grassland Drainage Area. There are no other sequential reuse and volume reduction projects planned for the project area within the Planned Alternative’s time horizon (5 – 10 years). It was assumed that the GBP will continue its operation, eventually resulting in zero discharge of salts to the San Luis Drain from the Grassland Drainage Area by the end of 2019. This condition was modeled by setting San Luis Drain flows to zero within WARMF to simulate zero flow or loading contributions to the San Joaquin River from the GBP.

- **12a – Drainage Water Recirculation – Tailwater Recovery**
- **12b – Drainage Water Recirculation – Tilewater Recovery**

Tailwater and tilewater recovery projects (existing or planned to be constructed in the project area within the next 5 – 10 years) were considered for modeling based on information regarding such existing or planned projects reported to the LSJRC by irrigation districts and water quality coalitions. As described above, the salinity control potentials of these types of projects that result in the controlled timing of salinity discharges are best estimated through post-processing of WARMF model output. The purpose of modeling these implementation actions is to account for any changes in salinity in the LSJR that would occur as a result of implementing any planned tailwater recovery and tilewater recovery projects. It was determined that the current impact of the Patterson Irrigation District and Grassland Water District tailwater recovery projects on LSJR salinity levels is small relative to other implementation actions and model uncertainty. To this end, the effect of these facilities on LSJR water quality was considered in a qualitative manner under the Planned Alternative evaluation.
### Table 4: Planned Plus Treatment Focus Alternative Implementation Actions

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<tr>
<th>Area</th>
<th>East Valley Floor</th>
<th>Grassland Drainage Area</th>
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#### 3.3.2. Planned Plus Maximum Treatment Focus Alternative

**Assumptions:** It is assumed that some irrigation districts in the northwest and Grassland Drainage Area subbasins, through the use of existing facilities, have the capability to withhold some of the discharge of saline drainage to the SRP depending on water year. It is also assumed that small subbasins would not host both their discharges.

**Post-processing Approach:** The modeling of controlled timing of saline discharges will be based on post-processing of SWATM results. Assumptions regarding timing discharges will be based on communications with individuals in charge of facility operations. Any assumptions used in post-processing of SWATM simulated results regarding locations and held drainage volumes for existing facilities will be documented in the Task 4 Technical Memorandum.

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#### 3.4. Reduce Nonpoint Sources - Existing Industrial/Flood Processing Sources Control and/or Pretreatment

**Assumptions:** The cities of Modesto and Turlock are the only municipalities in the region that discharge treated effluent to the SRP. As a reliability analysis, a 3% reduction in RCITW loads is assumed. This is neither a projection of expected reductions nor a statement of future reductions that should be required.

**Modelling Approach:** SWATM estimates are included in IRWM. Input values for SWATM salinity loading will be reduced by 5%.

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#### 4. Water Conservation - Optimize Existing Irrigation Efficiency

**Assumptions:** It is assumed that any water conserved by an irrigation district or individual grower will be used by the entity who conserved the water or will be sold to another entity in the project area who will use the water. It is also assumed that any incremental decreases in salinity loading to the SRP will be small and will result in insignificant changes in ambient river concentrations.

**Modelling Approach:** No change in baseline modeling assumptions.

**Assumptions:** No change in baseline modeling assumptions.

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#### 5a. Installation of New High Efficiency Irrigation and Delivery Systems Increase Retention of Recoverable Salts

**Assumptions:** No change in baseline modeling assumptions.

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#### 10f. Sequential Releases and Volume Reduction - Salt Accumulation Area (SRP) [Note]

**Assumptions:** There currently exists one salt accumulation area project (SAR) in the Grassland Bypass Project (SBP) area within the Grassland Drainage Area. There are no other sequential release and volume reduction projects planned for the project area within the basin’s planning period (5-10 years). It is assumed that the SBP project will include operation and sequencing salinity as projected, resulting in less discharge of salts from the SBP area.

**Modelling Approach:** SWATM includes inflows from the SBP area. San Joaquin River flows will be set to zero (0) in SWATM so the Grassland Bypass will not contribute any flow or loading to the San Joaquin River.

**Assumptions:** No change in baseline modeling assumptions.

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#### 12a. Drainage Water Recycling - Tailing Recovery [Note]

**Assumptions:** Tailing water can be blended with irrigation supply to result in reduction in tailwater discharge and usage of fresh irrigation supply. Planned tailwater recovery projects, as reported by irrigation districts and water quality coalitions, will be simulated in SWATM.

**Modelling Approach:** Water “tailing” (in-kiln) resulting from use of recovered tailwater will be modeled in SWATM as a reduction in fresh irrigation water that is applied to those subbasins and a corresponding net increase in irrigation efficiency where irrigation districts or water quality coalitions report planned tailwater recovery projects to the BSRP that will occur within the basin’s planning period (5-10 years).

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#### 12b. Drainage Water Recycling - Tailing Recovery [Note]

**Assumptions:** Tailing water can be blended or mixed directly or blended with irrigation supply to result in volume reduction of tailwater and of fresh irrigation supply. Planned tailwater recovery projects, as reported by irrigation districts and water quality coalitions, will be simulated in SWATM.

**Modelling Approach:** Water “tailing” (in-kiln) resulting from use of recovered tailwater will be modeled in SWATM as a reduction in fresh irrigation water that is applied to those subbasins and a corresponding net increase in irrigation efficiency where irrigation districts or water quality coalitions report planned tailwater recovery projects to the BSRP that will occur within the basin’s planning period (5-10 years).

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**Notes:**
- TMR = Real Time Management
- Includes Steinbeck Minor Subbasins located in the East Valley Floor
- SWATM inputs from the Grassland Bypass Project will be set to zero (0) under implementation actions 12a and 12b and are not explicitly considered under the current implementation action.
The Planned Plus Maximum Treatment Focus Alternative (Maximum Treatment Alternative) (Table 4) was designed to estimate resultant LSJR water quality conditions with implementation of intensive drainage treatment necessary to realize the lowest achievable EC in Reach 83 of the LSJR. The Maximum Treatment Alternative includes the same implementation actions as the Planned Alternative plus the addition of the following implementation action:

- 5a – Water Treatment – Regional Facility

The LWA Team developed a preliminary conceptual desalination project designed to control salinity inputs to the LSJR upstream of Reach 83 to a level that would support the achievement of a 1,010 µmhos/cm EC target at Crows Landing. Designing a desalination reverse osmosis (RO) facility to meet a 1,010 µmhos/cm salinity target helped to demonstrate the level of salt removal necessary to meet a 1,010 µmhos/cm EC level at Crows Landing. Crows Landing was chosen as the location for assessing the ability to meet a 1,010 µmhos/cm salinity target because earlier modeling showed that if the target can be met there, then it will be met further downstream in Reach 83 given the diluting flows provided by the Tuolumne and Stanislaus Rivers.

The preliminary conceptual desalination project was designed to pump all 5 drainage water from three sources, Mud Slough, Salt Slough, and the Gustine Area, at two diversion points to a proposed 160 million gallons per day (mgd) RO treatment facility located in the Grassland Drainage Area (outside of the 100-year floodplain). The two diversion points would be located along Mud Slough and Salt Slough just upstream of where each joins the LSJR (Figure 2). The Mud Slough diversion point also receives Gustine Area flows. The project would remove salts from the diverted flows using a RO process, and then pump a low salinity mixture of treated water back to Mud Slough and Salt Slough immediately downstream of the initial diversion points. Approximately 20% of the flows removed from the three drainage sources would be lost in the concentrated brine produced by the RO process. This concentrated brine would be pumped or trucked out of the basin for ultimate disposal.

The LWA Team modeled the estimated changes in LSJR ambient salinity concentrations as a result of the proposed desalination facility by adding points of diversion along Mud Slough and Salt Slough to the WARMF model just upstream of where each joins the LSJR. Two input points were added to the model immediately downstream of the two diversion points to account for the return of RO-treated water to Mud and Salt Sloughs. These treated water discharge points were characterized in terms of their projected flows and TDS concentrations. It was assumed that 80 percent of the diverted flows would be returned to Mud Slough and Salt Slough at the two input points. Additionally, it was assumed that 98% of the salt load diverted would be removed by the RO facility resulting in very high quality treated water being discharged back to Mud and Salt Sloughs and available for diluting salts and other constituents in Reach 83 of the LSJR.

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5 For this planning level analysis, the Maximum Treatment Alternative modeled the diversion of all flows from the downstream reaches of Mud and Salt Sloughs, which during non-critical water years (i.e., wet, above normal, below normal, and dry) resulted in estimated ambient EC levels significantly below the 1,010 µmhos/cm salinity target.
Figure 2: Conceptual Layout of Proposed Facilities for Salinity Control
### Table 5: Planned Plus Maximum Management Focus Alternative Implementation Actions

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<tr>
<th>Planned Plus Maximum Management Focus Alternative</th>
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<tr>
<td><strong>1. Controlled Timing of Salinity Discharges</strong></td>
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<td><strong>2. Reduce Point Sources</strong></td>
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<td><strong>3. Water Conservation - Optimize Existing Irrigation Efficiency</strong></td>
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<td><strong>4. Installation of New High Efficiency Irrigation and Delivery Systems</strong></td>
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<td><strong>5. Sequential Return and Volume Reduction - Salt Accumulation Area (SRIP)</strong></td>
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<td><strong>6. Drainage Water Recirculation - Tiltwater Recovery</strong></td>
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**Notes:**
- RTP = Real Time Management
- * Indicates Steverson Minor Subarea located in the East Valley Floor
- **WARM** inputs from the Grassland Bypass Project will be set to zero (0) under implementation actions 10b and 11b and are not explicitly considered under the current implementation action.

**Table 5:** Planned Plus Maximum Management Focus Alternative Implementation Actions

**Task 4 Report**

September 18, 2015

ASSUMPTIONS:
- It is assumed that some irrigation districts in the Northwheat and Grassland Drainage Area subareas, through the use of existing facilities, have the capability to withhold some of the discharge of saline drainage to the USR, conserving water. It is also assumed that some irrigation districts will not be able to reduce their discharge.

**POST-PROCESSING APPROACH:**
- The modeling of controlled timing of salinity discharge was handled through post-processing of WARM simulated results. Assumptions regarding timed discharges will be based upon communications with individuals in charge of facility operations. Any assumptions used in post-processing of WARM simulated results regarding locations and held drainage volumes for existing facilities will be documented in the Task 4 Technical Memorandum.

**Red Text** indicates those subareas where an implementation action is assumed to occur.
The Planned Plus Maximum Management Focus Alternative (Maximum Management Alternative) (Table 5) was designed to estimate resultant LSJR water quality conditions with implementation of intensive agricultural drainage management necessary to realize the lowest achievable EC in Reach 83 of the LSJR. The Maximum Management Alternative includes the same implementation actions as the Planned Alternative plus the addition of the following implementation action:

- 10b – Sequential Reuse and Volume Reduction – Salt Accumulation Area (SJRIP)

To control salinity inputs to the LSJR through the use of intensive agricultural drainage management, the LWA team developed the concept of implementing a new SJRIP-like project in the Grassland Drainage Area (outside of the 100-year floodplain). The proposed SJRIP-like project would divert all flows from Mud Slough, Salt Slough, and the Gustine Area at the same two diversion points identified in the Maximum Treatment Alternative. Diverted flows would be pumped to one or more locations in the western portion of the Grassland Drainage Area and used in the following phased manner: irrigation of salt tolerant crops, collected in tile drains and processed through initial treatment, and finally processed through RO and selenium biotreatment to produce water and a residual that can be disposed of in an approved waste area. Although specific areas for application of the diverted water were not identified, the modeling of the alternative was useful in showing the effects of the removal of flows from targeted management areas without the return of treated water as modeled under the Maximum Treatment Alternative.

The LWA Team modeled the estimated changes in LSJR ambient salinity concentrations with the implementation of a proposed SJRIP-like project by removing flows from Mud and Salt Sloughs. In WARMF, points of diversion from Mud Slough (this diversion point also receives flows from the Gustine Area) and Salt Slough were added to the model just upstream of where each joins the San Joaquin River and flows from these areas were set to zero. Both the locations of the diversion points and the amount of flow diverted were identical to the Planned Plus Maximum Treatment Alternative; however, the Maximum Management Alternative lacks the clean water return flows. Again, similar to the Maximum Treatment Alternative, Crows Landing was chosen as the location for assessing the ability of the Maximum Management Alternative to meet a 1,010 µmhos/cm salinity target.
4.0 Evaluation of Salinity Management Alternatives

Three management alternatives were modeled in WARMF to determine compliance with a range of potential salinity WQOs (1,010 – 1,550 µmhos/cm). WARMF produces daily output for flow, EC, and TDS. Statistics for the three modeled alternatives for individual water years were calculated using 30-day running average EC values. Individual water year results were generated to compare the three management alternatives with the historical data and the WARMF Baseline based on water year type. Water years are classified as either critical, dry, below normal, above normal, or wet, and are based on the San Joaquin Valley Water Year Index, as defined in SWRCB Revised Decision 1641\(^9\) (D-1641). For each water year type, a 12 month time series of average values was generated. Average values were determined on a daily basis by first classifying each year of model output by water year type and then averaging the 30-day running average values for each day from each modeling run.

Ambient historical results and Baseline model results at Maze Road show a relatively good match when comparing EC levels (Figure 3 and Figure 4). However, Baseline model results at Crows Landing show discrepancies in both the magnitude and timing of peak EC levels when comparing them to historical EC levels in below normal, dry, and critical water years (Figure 5 and Figure 6). Ambient historical results and Baseline model results at Crows Landing show a relatively good match when comparing flow (Figure 7 and Figure 8), indicating that the discrepancy between historical and modeled results is due to differences in the TDS mass loads.

Figure 3: Maze Road Historical Daily Average of 30-day Running Average EC by Water Year Type

Maze Road Historical
Running Average EC by Water Year Type (Oct. 1, 1995 - Sept. 1, 2013)

Figure 4: Maze Road Baseline Daily Average of 30-day Running Average EC by Water Year Type

Maze Road Baseline
Running Average EC by Water Year Type (Oct. 1, 1995 - Sept. 1, 2013)
Figure 5: Crows-Patterson Historical Daily Average of 30-day Running Average EC by Water Year Type

Crows - Patterson Historical
Running Average EC by Water Year Type (Oct. 1, 1995 - Sept. 1, 2013)

Figure 6: Crows Landing Baseline Daily Average of 30-day Running Average EC by Water Year Type

Crows Landing Baseline
Running Average EC by Water Year Type (Oct. 1, 1995 - Sept. 1, 2013)
Figure 7: Crows-Patterson Historical Daily Average of 30-day Running Average Flow by Water Year Type

Figure 8: Crows Landing Baseline Daily Average of 30-day Running Average Flow by Water Year Type
4.1. MODELED ALTERNATIVES RESULTS

The results of each of the modeled alternatives were plotted for critical water years to compare the relative improvements shown by each alternative at Crows Landing. Figure 9 shows raw WARMF output and Figure 10 presents modeled results adjusted to historical output. Critical water year results were chosen because this water year type proved to be the most challenging in terms of meeting the EC targets. For both the raw WARMF model output and the adjusted WARMF model output at Crows Landing, the Maximum Treatment Alternative was observed to provide the lowest EC levels. Details of the results of each of the three modeled management alternatives are described below.

As mentioned earlier, differences in the timing and magnitude of simulated EC levels at Crows Landing were observed when comparing historical results (Figure 5) to Baseline simulation results (Figure 6). Because the modeled management alternatives depict incremental changes from the modeled baseline simulation, the difference in simulated EC between the modeled management alternatives and the baseline was adjusted using a correction factor applied to historical data to predict simulated EC while minimizing the effect of model uncertainty. The methodology for development and application of the correction factor to results at Crows Landing is described in more detail in Appendix B. Figures depicting the raw WARMF output at Crows Landing (Figure 9) for scenario simulations are provided for reference; however, the simulation results adjusted from historical data should be the basis for discussion of the achievability of objectives with implementation of a management alternative as they are more accurate predictions of EC under the conditions represented by each scenario. No adjustments were made to WARMF modeling results for Maze Road due to the good match between historical EC observations and Baseline model results at this location.

To address the effect of management measures in and above Reach 83 on EC conditions at Vernalis, the LWA Team coordinated with Dan Steiner, a modeling expert retained by the San Joaquin Tributaries Authority. Results of WARMF modeling at Maze Road were provided to Mr. Steiner, who then used his calibrated New Melones Operational Model worksheet, which accounts for the complexities of operation of New Melones Reservoir and Goodwin Dam, to predict resultant flow and water quality conditions at Vernalis and to assess changes in required releases from New Melones Reservoir to meet Vernalis EC objectives with implementation of the three management alternatives (Steiner, 2015). The results of the analyses performed by Mr. Steiner are summarized in subsequent sections of the report for each management alternative.
4.1.1. Planned Alternative Results

The Planned Alternative (Table 3) simulates flow and EC conditions expected to occur as a result of implementation of salinity control actions that are currently in effect or planned for implementation in the LSJR basin within the next 5 – 10 years. The highest raw WARMF results for the Planned Alternative at Crows Landing were all under 1,550 µmhos/cm for all water year types (Figure 11). Raw WARMF results for below normal, dry, and critical water years show peaks in EC levels between August and September at around 1,500 µmhos/cm. When the Planned Alternative raw WARMF results at Crows Landing are adjusted to match the timing and magnitude of historical EC levels, modeled results for all water year types again all fall below 1,550 µmhos/cm (Figure 12). Adjusted Planned Alternative WARMF results are actually reduced for below normal, dry, and critical water years, with peak values in EC levels between February and May at around 1,350 µmhos/cm. All adjusted WARMF EC results at Crows Landing for wet and above normal water years fall under 1,010 µmhos/cm.

The New Melones Operational Model was used to estimate potential changes in New Melones Reservoir releases related to compliance with Vernalis WQOs for the 1995-2013 time period. The New Melones Operational Model results for the Planned Alternative showed either no change in some years to a maximum reduction in water quality releases of 56,000 acre-feet of water that would not need to be released from the reservoir to meet current Vernalis EC Objectives\(^\text{10}\) compared to releases estimated by the Baseline model simulation (Table 6) (Steiner, 2015). Results for the Planned Alternative simulation indicate that expected implementation measures, such as full implementation of the GBP, may reduce EC levels in the LSJR to a level that could achieve a potential EC objective of 1,350 µmhos/cm in all water years.

\(^{10}\) EC objectives for the San Joaquin River at Airport Way Bridge, Vernalis, include the following:
From April 1 – August 31 the EC objective is 700 µmhos/cm, and from September 1 – March 31 the EC objective is 1,000 µmhos/cm. The objective is assessed as a 30-day running average of mean daily EC.
Figure 11: Crows Landing Planned Alternative Daily Average of 30-day Running Average EC by Water Year Type - Raw WARMF output

Figure 12: Crows-Patterson Planned Alternative Adjusted to Historical EC by Water Year Type - Adjusted to Historical Output

Table 6: New Melones Project Operation and River Characteristics: Planned minus Baseline (1,000 acre-feet)

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<thead>
<tr>
<th>Year</th>
<th>New Melones Inflow</th>
<th>New Melones Storage</th>
<th>Total Inflow</th>
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4.1.2. Planned Plus Maximum Treatment Focus Alternative Results

The Planned Plus Maximum Treatment Focus Alternative (Maximum Treatment Alternative) (Table 4) simulates the same conditions as those in the Planned Alternative with the addition of a reverse osmosis (RO) treatment facility. The RO facility would treat drainage diverted from Mud and Salt Sloughs and return the high quality treated water back to these water bodies just upstream of their confluence with the San Joaquin River. The treatment facility was designed to support the achievement of a 1,010 µmhos/cm EC target at Crows Landing. The RO facility would have a maximum treatment capacity of 160 mgd and would return 80 percent of diverted flows back to the two diversion points as a low salinity mixture of treated water.

The highest raw WARMF results for the Maximum Treatment Alternative at Crows Landing for all but critical water years were all under 1,010 µmhos/cm (Figure 13). Additionally, raw WARMF results for the critical water year peak at around 1,200 µmhos/cm between August and September. When the Maximum Treatment Alternative raw WARMF results at Crows Landing are adjusted to match the timing and magnitude of historical EC levels, modeled results for all water year types are observed to fall below 1,010 µmhos/cm (Figure 14). Critical water year adjusted average EC levels peak at around 1,000 µmhos/cm in August.

The New Melones Operational Model results for the Maximum Treatment Alternative showed either no change in some years to a maximum reduction in water quality releases of 68,000 acre-feet in the amount of water that would not need to be released to meet the current Vernalis EC objective compared to the Baseline WARMF model simulation (Table 7) (Steiner, 2015). This estimate represents an additional 12,000 acre-feet change in release requirements as compared to the reductions estimated for the Planned Alternative. Results for the Maximum Treatment Alternative simulation indicate that the construction and operation of a 160 mgd RO facility that returns 80 percent of the treated effluent back to the LSJR upstream of Reach 83 may reduce EC levels in Reach 83 to levels that support a potential EC objective of 1,010 µmhos/cm in all water years.
Table 7: New Melones Project Operation and River Characteristics: Maximum Treatment minus Baseline (1,000 acre-feet)

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<th>Year</th>
<th>New Melones Inflow</th>
<th>New Melones Return Flow</th>
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4.1.3. Planned Plus Maximum Management Focus Alternative Results

The Planned Plus Maximum Management Focus Alternative (Maximum Management Alternative) (Table 5) simulates the conditions modeled in the Planned Alternative with the addition of a SJRIP-like project that diverts flows from Mud and Salt Sloughs. Under the Maximum Management Alternative, all flows (and their corresponding salt loads) would be applied to the landscape and would not directly reach the San Joaquin River. The raw WARMF results for the Maximum Management Alternative at Crows Landing were under 1,010 µmhos/cm in dry, wet, and above normal water years (Figure 15). For critical and below normal water years, raw WARMF results indicated EC levels as high as 1,800 µmhos/cm between August and September at Crows Landing.

When the Maximum Management Alternative WARMF results at Crows Landing are adjusted to match the timing and magnitude of historical EC levels, modeled results for all water year types are observed to fall below 1,350 µmhos/cm (Figure 16). Results indicate that the permanent diversion of water from the system, as opposed to putting treated water back into the system as in the Maximum Treatment Alternative, provides little to no additional EC improvement compared to the Planned Alternative. The highest adjusted EC values are estimated to occur during critical and below normal water years when EC levels peak at around 1,350 µmhos/cm from July through September.

The New Melones Operational Model results for the Maximum Management Alternative showed either no change in some years to a maximum reduction in water quality releases of 65,000 acre-feet in the amount water that would not need to be released to meet the current Vernalis EC objective compared to releases estimated by the Baseline WARMF model simulation (Table 8) (Steiner, 2015). This estimate represents an additional 9,000 acre-feet savings as compared to the Planned Alternative. Results for the Maximum Management Alternative simulation indicate that diverting all flows from Mud and Salt Sloughs may reduce EC levels in Reach 83 of the LSJR to levels that support a potential EC objective of 1,350 µmhos/cm for all water years.
Figure 15: Crows Landing Maximum Management Alternative Daily Average of 30-day Running Average EC - Raw WARMF output

Crows Landing Maximum Management Alternative
Running Average EC by Water Year Type (Oct. 1, 1995 - Sept. 1, 2013)

Figure 16: Crows-Patterson Maximum Management Alternative Adjusted to Historical EC - Adjusted to Historical Output

Crows-Patterson Maximum Management Alternative
Adjusted to Historical EC by Water Year Type (Oct. 1, 1995 - Sept. 30, 2013)

Table 8: New Melones Project Operation and River Characteristics: Maximum Management minus Baseline (1,000 acre-feet)

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<th>Water Year</th>
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5.0 Selection of Proposed EC Objectives for Reach 83 of the Lower San Joaquin River

5.1 DEVELOPMENT AND EVALUATION OF POTENTIAL PROJECT ALTERNATIVES

The WARMF modeling of the implementation of the three management alternatives described above provided an indication of the range of ambient salinity levels estimated to be achievable in Reach 83 (from 1,010 to 1,550 µmhos). This information was used to assist in the development of five distinct project alternatives for EC WQOs in Reach 83. Also, a No Action Alternative as required by CEQA (i.e., establish no EC objective in Reach 83) and a year-round 700 µmhos/cm WQO (based on Ayers and Westcot, 1985) were added for a total of seven potential project alternatives for consideration by the LSJRC (see Table 9 and Table 10).

5.1.1 Evaluation Criteria for Potential Project Alternatives

The seven potential project alternatives were evaluated using a set of criteria that were developed specially for this purpose (i.e., specific EC objectives for Reach 83). The evaluation criteria built upon the previous screening criteria (Table 2) and were used to examine the ability of a potential project alternative to satisfy the following attributes, which were determined to be necessary for any project alternative advanced for further consideration (for additional detail see Appendix C):

- Consistent with federal/state laws, plans and policies
- Consistent with other relevant WQOs (e.g., existing boron in Reach 83; seasonal EC objectives at Vernalis)
- Reduces dependency on New Melones Reservoir water quality releases
- Supports salt transport out of basin
- Scientifically Defensible (protects Beneficial Uses)
- Meets CV-SALTS Goals
- Feasible to Implement

The LSJRC utilized the evaluation criteria to identify in a “yes” or “no” fashion whether a given project alternative would be expected to reasonably meet a given criterion.
Table 9: LSJRC Basin Plan Amendment Project Alternative Matrix.

<table>
<thead>
<tr>
<th>Project Alternatives</th>
<th>Technical Basis for the Water Quality Objective</th>
<th>Evaluation Criteria (Rating: Y=Criteria is fully met, N=Criteria is partially or not met)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>A. Consistent with federal, state, and plans and policies</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B. Consistent with other Water Quality Objectives (e.g., Boron, Vernalis EC)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C. Reduced dependency on New Melones Water Quality Releases</td>
</tr>
<tr>
<td></td>
<td></td>
<td>D. Supports salt transport out of basin</td>
</tr>
<tr>
<td></td>
<td></td>
<td>E. Scientifically Defensible (protects Beneficial Uses)</td>
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<tr>
<td></td>
<td></td>
<td>F. Meets CV-SALTS Goals</td>
</tr>
<tr>
<td></td>
<td></td>
<td>G. Feasible to Implement</td>
</tr>
<tr>
<td>1. No EC Objective</td>
<td>Continue to regulate dischargers pursuant to</td>
<td></td>
</tr>
<tr>
<td></td>
<td>the Salt and Boron TMDL</td>
<td>N N N Y N N Y</td>
</tr>
<tr>
<td>2. 1,550 µmhos/cm</td>
<td>Hoffman Model</td>
<td>Y Y Y Y Y Y Y</td>
</tr>
<tr>
<td>Objective</td>
<td>15% leaching fraction</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Protection of 95% of common crop</td>
<td></td>
</tr>
<tr>
<td></td>
<td>95% yield in all of the 5% driest years</td>
<td></td>
</tr>
<tr>
<td>3. Tiered Objective</td>
<td>Hoffman Model</td>
<td>Y Y Y N Y N N</td>
</tr>
<tr>
<td>for Water Year</td>
<td>1,350 µmhos/cm - same technical basis</td>
<td></td>
</tr>
<tr>
<td>Considerations</td>
<td>as WQO option #5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1,550 µmhos/cm - same technical basis</td>
<td></td>
</tr>
<tr>
<td></td>
<td>as WQO option #2</td>
<td></td>
</tr>
<tr>
<td>4. 1,550 µmhos/cm</td>
<td>Hoffman Model</td>
<td>Y Y Y Y Y Y Y</td>
</tr>
<tr>
<td>Objective and a</td>
<td>1,350 µmhos/cm - same technical basis</td>
<td></td>
</tr>
<tr>
<td>1,350 µmhos/cm</td>
<td>as WQO option #5</td>
<td></td>
</tr>
<tr>
<td>EC Performance Goal</td>
<td>1,550 µmhos/cm - same technical basis</td>
<td></td>
</tr>
<tr>
<td>for Seasonal and</td>
<td>as WQO option #2</td>
<td></td>
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<tr>
<td>Water Year</td>
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<td></td>
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<tr>
<td>Considerations</td>
<td></td>
<td></td>
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<td></td>
<td>(see Table 10)</td>
<td></td>
</tr>
<tr>
<td>5. 1,350 µmhos/cm</td>
<td>Hoffman Model</td>
<td>Y Y Y N Y Y N</td>
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<td>Objective</td>
<td>Leaching fraction between 10 – 15%</td>
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<td></td>
<td>Protection of 95% of common crop</td>
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<td></td>
<td>95% yield in all of the 5% driest years</td>
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<tr>
<td>6. 1,010 µmhos/cm</td>
<td>Hoffman Model</td>
<td>N Y Y N Y N N</td>
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<tr>
<td>Objective</td>
<td>10% theoretical leaching fraction</td>
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<td></td>
<td>Protection of 95% of common crop</td>
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<tr>
<td></td>
<td>95% yield in all of the 5% driest years</td>
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<tr>
<td>7. 700 µmhos/cm</td>
<td>Ayers and Westcot</td>
<td>N Y Y N Y N N</td>
</tr>
<tr>
<td>Objective</td>
<td></td>
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Table 10: LSJR Reach 83 EC Objective and Performance Goal for Seasonal and Water Year Considerations (µmhos/cm)

<table>
<thead>
<tr>
<th>Water Year Type</th>
<th>Irrigation Season</th>
<th>Non-Irrigation Season</th>
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<tr>
<td></td>
<td>March – June</td>
<td>July - October</td>
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<tr>
<td>Wet</td>
<td>1350 (Performance Goal(^1))</td>
<td>1550 (WQO(^1))</td>
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<tr>
<td>Above Normal</td>
<td>1350 (Performance Goal(^1))</td>
<td>1550 (WQO(^1))</td>
</tr>
<tr>
<td>Below Normal</td>
<td>1350 (Performance Goal(^1))</td>
<td>1550 (WQO(^1))</td>
</tr>
<tr>
<td>Dry</td>
<td>1350 (Performance Goal(^1))</td>
<td>1550 (WQO(^1))</td>
</tr>
<tr>
<td>Critical</td>
<td></td>
<td>1550 (WQO(^1))</td>
</tr>
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</table>

1. The EC Performance Goal and EC WQO are subject to relaxation during an Extended Dry Period (see definition below).

Alternative #4 includes an EC WQO of 1,550 µmhos/cm and an EC Performance Goal\(^{11}\) of 1,350 µmhos/cm that is recommended to be established throughout the irrigation season for specific water year types. Compliance with the WQO in Reach 83 shall be monitored as a 30-day running average at Crows Landing. The WQO would apply as indicated in Table 10, except during an “extended dry period”. An Extended Dry Period is defined as follows:

An Extended Dry Period is defined using the State Water Resources Control Board’s (SWRCB’s) San Joaquin Valley “60-20-20” Water Year Hydrologic Classification\(^{12}\) included in revised Water Right Decision 1641 to assign a numeric indicator to a water year type as follows (SWRCB 2000):

- Wet – 5
- Above Normal – 4
- Below Normal – 3
- Dry – 2
- Critically Dry – 1

The indicator values will be used to determine when an Extended Dry Period is in effect:

- An Extended Dry Period shall begin when the sum of the current year’s 60-20-20 indicator value and the previous two year’s 60-20-20 indicator values total six (6) or less.
- An Extended Dry Period shall be deemed to exist for one water year (12 months) following a period with an indicator value total of six (6) or less.

\(^{11}\) The Performance Goal will be used to measure progress towards achievement of EC levels during certain water year types and times of the year that are of higher quality than the proposed EC WQO for Reach 83 of the LSJR.

\(^{12}\) The method for determining the San Joaquin Valley Water Year Hydrologic Classifications (e.g., critical, dry, below normal, above normal, wet) is defined in the SWRCB Revised Decision 1641, March 2000, Figure 2, page 189. This method uses the best available estimate of the 60-20-20 San Joaquin Valley water year hydrologic classification at the 75% exceedance level using the best available data published in the California Department of Water Resources’ ongoing Bulletin 120 series.
5.2. SELECTION OF PROJECT ALTERNATIVES

During two meetings held on March 17 and March 26, 2015, the LSJRC considered the seven project alternatives, the evaluation criteria, and the WARMF modeling results for the baseline, Planned Alternative, Maximum Treatment Alternative, and Maximum Management Alternative. As a result, the LSJRC identified a Preferred Alternative and three other alternatives for a more detailed examination and consideration in the Basin Planning process (potential project alternatives #1, #2, #4 and #6; see Table 9).

The primary basis for the selection of the four proposed project alternatives was that each could meet most of the following criteria:

- Provide reasonable protection of the most sensitive AGR use (irrigation of almonds) in Reach 83;
- Less than the upper level of the EC Secondary Drinking Water Standard of 1,600 μmhos/cm;
- Reduce releases from New Melones Reservoir to meet the Vernalis EC Objective;
- Accommodate current and future Real-Time Management Program activities in Reach 83; and
- Can be achieved through reasonable implementation actions (i.e., implementation of planned actions for salinity and selenium control in Reach 83 and upstream tributary areas)

Likewise, the initial screening also resulted in three potential project alternatives being rejected for further consideration in the Basin Planning process for the following reasons:

- Potential project alternative #3 (Tiered Objective for Water Year Considerations - 1,350 μmhos/cm & 1,550 μmhos/cm during critical years) was rejected because its 1,550 μmhos/cm EC objective for critical water years only was thought to severely constrain the ability to export salts out of the basin when available assimilative capacity exists and because it was believed to be over-protective of the AGR (irrigation water supply) beneficial use in Reach 83.
- Potential project alternative #5 (Year-round EC objective of 1,350 μmhos/cm) was rejected for the same reason as noted for #3 because it would even more severely constrain export of salts out of the basin and because it was believed to be over-protective of the AGR (irrigation water supply) beneficial use in Reach 83.
- Potential project alternative #7 (Year-round EC objective of 700 μmhos/cm) was rejected for further consideration because it was believed to be over-protective of the AGR (irrigation water supply) beneficial use in Reach 83 and it would effectively eliminate the ability to export salts out of the basin.

5.3. SELECTION OF PREFERRED PROJECT ALTERNATIVE

Among the four potential project alternatives selected by the LSJRC for consideration in the Basin Planning process, project alternative #4 (Table 9 and Table 10) was selected as the Preferred Alternative because it was determined to best meet the seven evaluation criteria and provide the greatest operational flexibility to export salts out of the basin while protecting the AGR (irrigation supply water) beneficial use in Reach 83.
The three other potential project alternatives did not rank as high as alternative #4 on an aggregate basis for the following reasons:

- Project alternative #1 (No Action Alternative) was not selected as the Preferred Alternative because it would be contrary to the directive of the LSJR Salt and Boron TMDL that requires establishment of a WQO for salinity in Reach 83.

- Project alternative #2 (Year-round EC objective of 1,550 µmhos/cm) was not selected as the Preferred Alternative because it could prevent the achievement of ambient water quality in Reach 83 lower than 1,550 µmhos/cm when such quality may otherwise be attained and can’t work without a real-time river management plan in place.

- Project alternative #6 (Year-round EC objective of 1,010 µmhos/cm) was not selected as the Preferred Alternative because it would require the implementation of a significantly more costly management alternative (RO treatment included in the Maximum Treatment Alternative), as compared to the Preferred Alternative (implementation of the Planned Alternative), and its water quality benefits in terms of protection of the AGR irrigation water supply beneficial use were not considered to be commensurate with its costs.
6.0 Program of Implementation

Implementation provisions describe the actions the Regional Water Board will take to implement a change in water quality standards [a combination of beneficial uses and the corresponding WQOs to protect those use(s)], after those standards are integrated into the Basin Plan. This section describes the proposed program of implementation for the Preferred Alternative identified for the project by the LSJRC.

6.1. PREFERRED ALTERNATIVE

Based on the information developed pursuant to the Task 4 work effort (as described in previous sections of this Report), the proposed action (Preferred Alternative) is to adopt an EC WQO and an EC Performance Goal for seasonal and water year considerations in Reach 83 of the LSJR, as shown in Table 10. The proposed EC WQO and EC Performance Goal are protective of the existing agricultural irrigation supply (AGR) beneficial use and the potential municipal and domestic supply (MUN) beneficial use designated in Reach 83. The WQO and Performance Goal consider agriculture’s seasonal demands for water diverted from Reach 83, while at the same time accounting for the fact that ambient water quality conditions are greatly influenced by the hydrologic conditions, including the presence of return flows, in the San Joaquin River Basin.

The Preferred Alternative includes an EC WQO of 1,550 µmhos/cm. Compliance with the WQO in Reach 83 shall be evaluated as a 30-day running average at Crows Landing. The WQO would apply as indicated in Table 10, except during an “extended dry period”. During an Extended Dry Period (defined in Section 5.1.1), the following shall be taken into consideration to ensure that beneficial uses are protected in Reach 83 of the LSJR (as measured at Crows Landing):

- **Protection of the potential MUN beneficial use**: The EC WQO shall be the Short Term specific conductance secondary MCL level contained in the Water Quality Control Plan (Basin Plan) for the Sacramento River Basin and the San Joaquin River Basin. (Currently incorporated from Table 64449-B of 22 CCR § 64449 at the level of 2,200 µmhos/cm as the average of the previous four (4) consecutive quarterly samples).

- **Protection of the AGR beneficial use**: The EC WQO shall be 2,470 µmhos/cm as a 30-day running average (derived from the Hoffman model results for 75% crop yield for almonds, 5th percentile rainfall, and 15% leaching fraction).

- **Implementation of the Extended Dry Period EC WQO relaxation and/or EC concentrations in Reach 83 above 1,550 µmhos/cm shall not result in requirements for increased water quality releases from New Melones Reservoir to meet Vernalis EC objectives.**

The Preferred Alternative also includes the implementation of an EC Performance Goal\(^\text{13}\) of 1,350 µmhos/cm that is recommended to be established throughout the irrigation season for

\(^{13}\) The Performance Goal will be used to measure progress towards achievement of EC levels during certain water year types and times of the year that are of higher quality than the proposed EC WQO for Reach 83 of the LSJR.
specific water year types (Table 10). Attainment of the EC Performance Goal in Reach 83 shall be monitored using the 30-day running average at Crows Landing. The 1,350 µmhos/cm EC value was established as a Performance Goal because:

- The WARMF modeling of the Planned Bundle (Planned Alternative) indicates that, after full implementation of the key actions underway within the LSJR Basin, the ambient water quality within Reach 83 of the LSJR will not exceed an EC value of 1,350 µmhos/cm. However, due to model uncertainty, the WQO was set at 1,550 µmhos/cm which is the value that is reasonably protective of the AGR (irrigation supply water) beneficial use based on Hoffman modeling results (95% crop yield for almonds, 5th percentile rainfall, 15% leaching fraction).
- Agricultural supply water at 1,350 µmhos/cm or lower would provide a higher level of protection during the irrigation season based on Hoffman modeling results.
- Water quality at 1,350 µmhos/cm or better would also help to maintain the soil salinity balance by flushing salt accumulated below the root zone during Extended Dry Periods.

6.2. PROPOSED PROGRAM OF IMPLEMENTATION FOR THE PREFERRED ALTERNATIVE

The California State Legislature and the Basin Plan recognize that Reach 83 of the San Joaquin River is salinity impaired. The planned salinity management actions modeled by the LSJRC should dramatically improve salinity levels over those previously measured. The Basin Plan should include language in the implementation section that would emphasize that modeling indicated that 1350 µmhos/cm EC at Crows Landing is attainable through implementation of the planned actions, such as completion of the final phase of the Grassland Bypass Project at the end of 2019. However, partially due to model uncertainty, the recommended EC WQO was set at 1550. A re-opener should be established in the Basin Plan ten (10) years after adoption of the amendment to evaluate if an EC value of less than 1550 µmhos/cm as the numeric WQO in Reach 83 can consistently be achieved and is consistent with the screening criteria. As part of the evaluation, the historic EC data should be analyzed to determine if the planned actions assumed for the Planned Bundle modeling have resulted in ambient river EC water quality less than 1550 µmhos/cm. To ensure that planned improvements are not offset by significant new sources of salinity, the Regional Board should consider limiting and, if needed, prohibiting new sources of salt that would significantly increase salinity concentrations in Reach 83 of the San Joaquin River. Based on findings from the evaluation, the Central Valley Water Board may consider the following actions:

- Initiating a Basin Plan amendment effort to establish a new EC WQO.
- Maintaining the current EC WQO with no further planned evaluation.
- Scheduling a future evaluation to allow for additional data collection and analysis.
- Reconvene the LSJRC to assist in developing appropriate actions.

In addition to the actions already being implemented within the San Joaquin River basin, the following are key actions that will assist in meeting the proposed EC WQO:

- **Salinity Management Plan** - The Basin Plan should include language in the implementation section that would emphasize the intent to attain the 1350 µmhos/cm EC
Performance Goal as measured at Crows Landing through implementation of currently planned salinity management actions such as, completion of the final phase of the Grassland Bypass Project. If the planned salinity management actions do not result in the attainment of the EC Performance Goal as expected, Regional Water Board staff will evaluate why the EC Performance Goal was not achieved. Such evaluation may include requesting reports from dischargers in Reach 83, soliciting input from interested parties, or other appropriate actions such as, requesting information from the Real-Time Management Group formed under the 2006 Salt and Boron TMDL for the San Joaquin River.

- **Full Implementation of Components of the Real Time Management (RTM) Program** – RTM facilitates the control and timing of wetland and/or agricultural drainage to the LSJR to coincide with periods when dilution flows are sufficient to meet salinity objectives. It is anticipated that the RTM Program will be fully implemented by 2020.

- **Full Implementation of the Grassland Bypass Project** - It is projected, based on the modeling results for the Planned Alternative (Section 4.1.1), that the Preferred Alternative EC WQO can be consistently achieved after implementation of the Grassland Bypass project. The Grassland Bypass project is currently scheduled to be completed by the end of 2019. As such, the effective date of the Preferred Alternative EC WQO should be established to occur at an appropriate time after the completion of the Grassland Bypass Project.

Upon adoption of the proposed EC WQO, changes to NPDES permits and monitoring programs may be necessary to implement the new WQO. Appendix D and the Task 6 long-term monitoring program memorandum will provide guidance regarding these changes.

- **Wastewater Treatment Plant Effluent Limits** – Appendix D has been prepared to provide guidance to NPDES permit writers regarding the derivation of effluent limits for EC in the permits for the Cities of Modesto and Turlock. As described in the appendix, new effluent limits may not mirror the new WQOs in terms of points of compliance for the averaging period or end of pipe EC concentration. Mass loading analysis, WARMF modeling, and antidegradation considerations should be used, as appropriate, in the derivation of EC effluent limits in these NPDES permits.

- **Water Quality Monitoring** - Routine EC and boron monitoring should be conducted in the LSJR at Crows Landing and EC monitoring at Maze Road in order to assess compliance with the proposed EC and the existing boron WQOs for Reach 83, and to determine the effectiveness of the implementation program\(^\text{14}\).

\(^{14}\) Pursuant to Task 6 a long-term monitoring and reporting program will be developed. The monitoring program will determine compliance with the WQOs as well as the effectiveness of the implementation program. Ongoing monitoring efforts that could be included in the program will also be identified.
REFERENCES


California Regional Water Quality Control Board, Central Valley Region (CVRWQCB), 2004b. Draft Final Staff Report – Amendments to the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins for the Control of Salt and Boron Discharges into the Lower San Joaquin River – Appendix A: TMDL Methods and Data Sources and Appendix B: Geographic Information System Processing Information and Metadata. July 2004.

California Regional Water Quality Control Board, Central Valley Region (CVRWQCB), 2011. The Water Quality Control Plan (Basin Plan) for the California Regional Water Quality Control Board: Central Valley Region, the Sacramento River Basin and the San Joaquin River Basin (Fourth Edition, Revised). October.


Larry Walker Associates (LWA), 2014d. LWA Task 2, 3, and 8b Memorandum, dated November 12, 2014, and other supporting material. Included in December 18, 2014, LSJRC Meeting Agenda Package: pp. 8-80.

### CENTRAL VALLEY SALINITY ALTERNATIVES FOR LONG-TERM SUSTAINABILITY

**Development of a BPA for Salt and Boron in LSJR**

### IMPLEMENTATION PLANNING WORKSHOP

**OCTOBER 2, 2014**  
**9:00 AM – 12:30 PM**

Harvest Hall, Room G  
3800 Cornucopia Way, Modesto

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Lead/ Time for Item</th>
</tr>
</thead>
</table>
| **Welcome and Introductions** | • Welcome & Introductions  
• Review Agenda and Handouts  
• Meeting Purpose  
  o Collaborate with LSJRC members on the selection of the three implementation planning bundles which will be modeled by the LWA team  
• Meeting Outcomes  
  o Provide clear understanding of work efforts to date and how they inform this next step  
  o Obtain agreement on the three bundles that will be modeled  
  o Identify stakeholder questions, concerns, and comments on Task 4 work effort | 9:00–9:20 (Karen Ashby) |

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
</table>
| **Workplan Approach** | • Overall Approach  
  o Key Information and Outcomes to Date  
  o Strategy for Grouping of Implementation Actions  
    o What? - Implementation Actions  
    o Where? Spatial Considerations  
    o How Much? - Intensity of an Action  
  o Review Straw Proposal Bundles  
    o “Planned Plus” – Low  
    o “Planned Plus Treatment Focus” - High  
    o “Planned Plus Maximum Management Focus” – Med | 9:20–12:00 (Mike Trouchon) |

**Key Handouts:**

1. Work Flow for LSJR Basin Plan Amendment for Salt and Boron
### Discussion and Selection of Bundles to Model

**Background Information:**

1. **Range of Potential Implementation Actions**
2. **Screening for Evaluation of Three Management Alternatives**
3. **Draft Salinity Management Bundle #1 – “Planned Plus”**
4. **Draft Salinity Management Bundle #3 – “Planned Plus Treatment Focus”**
5. **Draft Salinity Management Bundle #2 – “Planned Plus Maximum Management Focus”**
6. **Historic and Simulated Analyses**
7. **TDS Loading at Maze Road**

**Key Handouts:**

1. Summary of LSJR Proposed Salinity Management Bundles
2. San Joaquin River Salt Loading Sources
3. Map Worksheet Salinity Management Bundle #1 – “Planned Plus”
4. Map Worksheet Salinity Management Bundle #3 – “Planned Plus Treatment Focus”
5. Map Worksheet Salinity Management Bundle #2 – “Planned Plus Maximum Management Focus”

### Meeting Wrap-up

- **Next Steps**
  - Oct: Review Final Bundles and Propose ‘Intensity’ of the Implementation Actions
  - Oct: Confirm Approach with LSJRC Sub-group
  - Oct 23: Review at LSJRC Meeting
  - Nov: Run Planned Plus and Planned Plus Treatment Focus
  - Nov 20: Review Results at LSJRC Meeting
  - Dec: Confirm Approach with LSJRC Sub-group
  - Dec 2: Run Planned Plus Max Mgmt Focus
  - Dec 18: Review Results at LSJRC Meeting
  - Jan/Feb: Finalize selection of EC objective and program of implementation

- **Meeting Wrap-up Time:** 12:20–12:30
  (Karen Ashby)
CENTRAL VALLEY SALINITY ALTERNATIVES FOR LONG-TERM SUSTAINABILITY
DEVELOPMENT OF A BPA FOR SALT AND BORON IN LSJR

IMPLEMENTATION PLANNING WORKSHOP:
MAXIMUM MANAGEMENT AND TREATMENT FOCUS BUNDLES
JANUARY 12, 2015
9:30 AM – 12:00 PM

Larry Walker Associates
707 Fourth Street, Suite 200 – Davis, CA

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Lead/ Time for Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>Welcome</td>
<td>• Introductions</td>
<td>9:30–9:40 (Karen Ashby)</td>
</tr>
<tr>
<td></td>
<td>• Review Agenda</td>
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<tr>
<td></td>
<td>• Meeting Purpose</td>
<td></td>
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<tr>
<td></td>
<td>• Collaborate with LSJRC members on the selection of the remaining 2 bundles to be modeled</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Meeting Outcomes</td>
<td></td>
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<tr>
<td></td>
<td>• Obtain agreement on the 2 bundles</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Obtain approval to model the bundles</td>
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<tr>
<td>General Discussion</td>
<td>• Use of information derived from modeling bundles</td>
<td>9:40 – 10:00 (LWA Team)</td>
</tr>
<tr>
<td></td>
<td>• Fulfill scope of work and direction from LSJRC</td>
<td></td>
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<td></td>
<td>• Objective setting – need for BPA/Staff Report</td>
<td></td>
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<tr>
<td></td>
<td>• Econ Analysis and CEQA/SED</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Use of WARMF as the modeling tool</td>
<td></td>
</tr>
</tbody>
</table>

**Implementation Planning Bundles**

**Planned**

• Completed Nov/ Presented Dec
• Use of results for other bundles

10:00 – 10:15 (Mike Trouchon)

**Handouts**

1) Planned bundle matrix and summary sheet
2) LSJR WARMF Baseline Average Monthly Source Loads into LSJR
3) 30-day running averages (4 figures)
| Planned + Treatment Focus | • Review proposed approach and rationale  
• Discussion | 10:15 – 11:00 (Mike T.) |
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>Handouts</td>
<td>4) <strong>Planned + Treatment Focus bundle matrix and summary sheet</strong></td>
<td></td>
</tr>
</tbody>
</table>
| Planned + Max Mgmt Focus | • Review proposed approach and rationale  
• Discussion | 11:00 – 11:45 (Mike T.) |
| Handouts                 | 5) **Planned + Max Mgmt Focus bundle matrix and summary sheet** |
| Meeting Wrap-up          | • Next Steps - proposed  
  o Jan 12 - Confirm approach with LSJRC sub-group and receive approval to run model  
  o Jan 13 - 27 – Make WARMF modifications and run WARMF (2 weeks)  
  o Jan 28 - Provide Maze results to Dan Steiner  
  o Jan 30 – Review initial results at LSJRC meeting  
  o Feb 26 – Review results at LSJRC meeting  
  o March-April – Finalize selection of EC objective and program of implementation | 11:45–12:00 (Karen Ashby) |
Appendix B: Accounting for Model Uncertainty when Using WARMF Output at Crows Landing

SOURCES OF MODEL UNCERTAINTY

The WARMF model tracks flow and salinity from its inputs in the watershed through the surface water and shallow groundwater to the San Joaquin River. Between the input and output, there are many processes which the model accounts for, including evapotranspiration, chemical reactions, groundwater recharge, runoff, groundwater accretions, diversions, and channel flow. Although WARMF simulates all these processes, there are multiple sources of uncertainty which cause the simulation output to not match measured data.

Model Input Uncertainty

Time series inputs to the WARMF model include meteorology, air & rain chemistry, boundary inflow flow and water quality, point sources, diversions, irrigation, and groundwater recharge, as shown in Table 11. The “Data Quality” column shows the relative completeness and accuracy of the data available for each model input. The “Model Sensitivity” column shows which model inputs have the largest effect on model outputs. The “Effect on Model Uncertainty” column highlights the greatest potential for variability or uncertainty in model input to translate into uncertainty of model output. The worst case situation for model uncertainty is where inputs have lower data quality and higher model sensitivity. For the WARMF modeling in Reach 83, those inputs include diversion flows from the San Joaquin River, groundwater recharge, and pumped groundwater flow and quality.

Table 11: WARMF Model Time Series Inputs

<table>
<thead>
<tr>
<th>Model Input</th>
<th>Data Quality</th>
<th>Model Sensitivity</th>
<th>Effect on Model Uncertainty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meteorology</td>
<td>High</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Air &amp; Rain Chemistry</td>
<td>Moderate</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Boundary Inflows</td>
<td>High</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Point Sources</td>
<td>Moderate</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Deliveries from DMC</td>
<td>High</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Diversions from SJR</td>
<td>Low</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Irrigation Usage</td>
<td>Moderate</td>
<td>High</td>
<td>Moderate</td>
</tr>
<tr>
<td>Groundwater Recharge</td>
<td>Low</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Groundwater Flow</td>
<td>Low</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Groundwater Quality</td>
<td>Low</td>
<td>High</td>
<td>High</td>
</tr>
</tbody>
</table>
Diversions from the San Joaquin River upstream of Crows Landing are all riparian, so there is no measured flow data. Flows are estimated under the assumption that all crop demand in areas adjacent to the San Joaquin River but not inside any irrigation district will be satisfied with diversions from the San Joaquin River. Groundwater recharge was taken from the WESTSIM model and then scaled to maintain water balance at the various gages on the San Joaquin River and its tributaries. The groundwater pumping rate is assumed to be that necessary to meet the crop demand that is not met by surface water deliveries and diversions. Groundwater quality is estimated from USGS data, but the quality is highly variable between wells so there is a high degree of uncertainty in the model input. Calibration has been performed to reduce these errors, but generally on a spatially averaged basis, so there is little overall bias in simulated flow and electrical conductivity at monitoring locations in the San Joaquin River. To perform the calibration, model parameters were modified uniformly across multiple catchments on the west side or east side of the river to improve the match between simulated and measured flow and EC at the monitoring locations.

**Model Process Uncertainty**

The WARMF model is a simplification of reality, and this introduces inherent uncertainty. Model algorithms include simplifying assumptions. Examples of uncertainty resulting from model algorithms include the assumption of static land use and simulation of irrigation as slow steady application of water instead of simulating actual farm operations (for which adequate data are not available). Uncertainty is also introduced because catchments upstream of Crows Landing are not subdivided by drainage district, only by irrigation district.

**MEASUREMENT OF MODEL ERROR**

There are various methods of measuring model error described in the WARMF Technical Documentation (Chen, Herr, and Weintraub 2001). The two measurements most commonly used are relative error ($E_r$) and absolute error ($E_a$) shown in the equations below. Relative error is the average difference between simulated and observed values where positive and negative values cancel each other out. It is a measure of model accuracy or bias. Absolute error is the average magnitude of the error, so it is a measure of precision. Both can be expressed as a percentage by dividing by the average observed value.

\[
E_r = \frac{\sum (\text{simulated} - \text{observed})}{n}
\]

\[
E_a = \frac{\sum |\text{simulated} - \text{observed}|}{n}
\]

Data for both flow and electrical conductivity has been collected regularly for the San Joaquin River at Crows Landing since 10/1/1995. The WARMF Baseline simulation has relative and absolute errors for the time period 10/1/1995 – 9/30/2013, as shown in Table 2. Calibration goals are to have relative error less than 10% and absolute error less than 20% (Herr and Chen 2012). Exceedances of those objectives are a reflection of the many uncertainties in representation of the diversions, irrigation, groundwater recharge, and groundwater accretions within the watershed upstream of Crows Landing.
Table 12: Error Statistics of WARMF Baseline Simulation, San Joaquin River at Crows Landing
(October 1995-September 2013)

<table>
<thead>
<tr>
<th></th>
<th>Relative Error</th>
<th>Absolute Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow</td>
<td>-330 cfs</td>
<td>412 cfs</td>
</tr>
<tr>
<td>EC</td>
<td>-89 µs/cm</td>
<td>254 µs/cm</td>
</tr>
</tbody>
</table>

ACCOUNTING FOR MODEL UNCERTAINTY

The methods of accounting for model uncertainty depend on how the model will be used. Often, the model is used to answer the question, “What is the benefit of performing a certain action?” To answer this question, the baseline simulation results are compared against simulation of the proposed action. Looking at the difference between model simulations has the advantage of subtracting out the model error which is consistent between the simulations. Thus, if the baseline has a 10% error, it is reasonable to expect the difference between the models to have an error of 10% as well. The error of the difference is thus small compared to the original magnitude of the simulated flow or water quality.

The scenarios run for the Lower San Joaquin River Committee have been run in part to answer the question of what water quality criterion may be achieved if a certain action is taken. The model error introduces significant uncertainty into that direct prediction. To reduce the uncertainty of model prediction, the question to answer can be rephrased as “How much reduction from the historical measured values can be achieved by taking a certain action?” This is the approach that has been used to make adjustments to the modeling results at Crows Landing.

The difference between model Baseline and different management scenario simulations has been applied to the measured historical data for the San Joaquin River at Crows Landing to predict the resulting electrical conductivity if the action simulated by the model scenario were done. The difference between model simulations still contains uncertainty, however. If the model were simulating electrical conductivity 10% too high on a particular day, the median expectation of error between model simulations would be 10% too great a difference. Using the assumption that error of the difference between model simulations is proportional to error of the original model simulation, we can adjust the difference accordingly. For day \( i \) of the simulation, the ratio between the baseline simulation and observed can be described as follows.

\[
\alpha_i = \frac{EC_i(\text{observed})}{EC_i(\text{baseline})}
\]

The predicted EC on each day of the simulation period can then be calculated from the observed value, the simulated baseline value, and the simulated scenario value using the following equation.

\[
EC_i(\text{predicted}) = EC_i(\text{observed}) + \alpha_i \cdot (EC_i(\text{scenario}) - EC_i(\text{baseline}))
\]
Following in Table 13 is an example showing how the predicted EC was calculated over a three day period including both model underprediction and overprediction of measured EC. On June 18, the Baseline simulation predicted 1251.60 µs/cm when the measured value was 1294 µs/cm. $\alpha$ is calculated by $1294/1251.6 = 1.0339$ to correct the model’s bias on that day. Then the difference between the Baseline and Scenario simulation results was applied to the Observed EC to calculate Predicted EC: $1294+1.0339*(782.12-1251.60) = 808.61$.

**Table 13 Example Calculation of Predicted EC**

<table>
<thead>
<tr>
<th>Date</th>
<th>Observed EC µs/cm</th>
<th>Baseline EC µs/cm</th>
<th>Scenario EC µs/cm</th>
<th>$\alpha$</th>
<th>Predicted EC µs/cm</th>
</tr>
</thead>
<tbody>
<tr>
<td>6/18/2013</td>
<td>1294</td>
<td>1251.60</td>
<td>782.12</td>
<td>1.0339</td>
<td>808.61</td>
</tr>
<tr>
<td>6/19/2013</td>
<td>1335</td>
<td>1391.26</td>
<td>924.21</td>
<td>0.9596</td>
<td>886.84</td>
</tr>
<tr>
<td>6/20/2013</td>
<td>1414</td>
<td>1502.09</td>
<td>1031.94</td>
<td>0.9414</td>
<td>971.42</td>
</tr>
</tbody>
</table>

**UNCERTAINTY OF PREDICTED ELECTRICAL CONDUCTIVITY**

The EC predicted using the above method is the median or expected value of EC with the implementation of the actions simulated by the scenario under otherwise historical conditions. The actual value would thus be equally likely to be higher or lower than the predicted value. Differences between actual and predicted EC could be random, seasonal, or systematic.

It would be desirable to know the EC criterion value which would have for example an 80% chance of being met. Carrying out complex calculations in an attempt to determine such a value with precision would have to ignore the sources of uncertainty external to the model.

The implementation of a scenario may end up being different from what was simulated. River operations including reservoir releases and diversions would likely be different from the historical condition as a direct consequence of scenario implementation. The historical condition will also not be repeated again in the future because of random variability and climate change.

The adoption of a water quality criterion should be undertaken with the knowledge that some uncertainty is inevitable. This uncertainty can be managed within the selection of a water quality criterion if there is some flexibility in the means by which it can be attained.
Appendix C: Selection Criteria for Project Alternatives
LSJRC Basin Plan Amendment Project
Selection Criteria for Project Alternatives

The BPA project alternatives were evaluated based on their ability to meet the following criteria:

A. Maintain consistency with applicable federal and state water quality laws, plans and policies\(^{15}\)

Regulations that apply to WQOs

- Federal Regulations and Guidance

  i. **(A-1)** Federal regulations require States to adopt narrative or numeric water quality criteria to protect designated beneficial uses (40 CFR §131.11(a)(1)).

  § 131.11 Criteria.

    (a) Inclusion of pollutants:

      (1) States must adopt those water quality criteria that protect the designated use. Such criteria must be based on sound scientific rationale and must contain sufficient parameters or constituents to protect the designated use. For waters with multiple use designations, the criteria shall support the most sensitive use.


      (a) The State shall develop and adopt a statewide antidegradation policy and identify the methods for implementing such policy pursuant to this subpart. The antidegradation policy and implementation methods shall, at a minimum, be consistent with the following:

      (1) Existing instream water uses and the level of water quality necessary to protect the existing uses shall be maintained and protected.

      (2) Where the quality of the waters exceed levels necessary to support propagation of fish, shellfish, and wildlife and recreation in and on the water, that quality shall be maintained and protected unless the State finds, after full satisfaction of the intergovernmental coordination and public participation provisions of the State’s continuing planning process, that allowing lower water quality is necessary to accommodate important economic or social development in the area in which the waters are located. In allowing such degradation or lower water quality, the State shall assure water quality adequate to protect existing uses fully. Further, the State shall assure that there shall be achieved the highest statutory and regulatory requirements for all new and existing point sources and all cost-effective and reasonable best management practices for nonpoint source control.

      (3) Where high quality waters constitute an outstanding National resource, such as waters of National and State parks and wildlife refuges and waters of exceptional recreational or ecological significance, that water quality shall be maintained and protected.

      (4) In those cases where potential water quality impairment associated with a thermal discharge is involved, the antidegradation policy and implementing method shall be consistent with section 316 of the Act.

---

\(^{15}\) Each item is cross-referenced with information that is provided within a supplemental table (A-1, A-2, etc.)
State Regulations and Guidance

i. (A-3) Water Code section 13050, subdivision (h):

(h) "Water quality objectives" means the limits or levels of water quality constituents or characteristics which are established for the reasonable protection of beneficial uses of water or the prevention of nuisance within a specific area.

ii. (A-4) Water Code section 13241

Each regional board shall establish such water quality objectives in water quality control plans as in its judgment will ensure the reasonable protection of beneficial uses and the prevention of nuisance; however, it is recognized that it may be possible for the quality of water to be changed to some degree without unreasonably affecting beneficial uses. Factors to be considered by a regional board in establishing water quality objectives shall include, but not necessarily be limited to, all of the following:

a) Past, present, and probable future beneficial uses of water.

b) Environmental characteristics of the hydrographic unit under consideration, including the quality of water available thereto.

c) Water quality conditions that could reasonably be achieved through the coordinated control of all factors which affect water quality in the area.

d) Economic considerations.

e) The need for developing housing within the region.

f) The need to develop and use recycled water.

iii. (A-5) Anti-degradation Policy Resolution No. 68-16

1. Whenever the existing quality of water is better than the quality established in policies as of the date on which such policies become effective, such existing high quality will be maintained until it has been demonstrated to the State that any change will be consistent with maximum benefit to the people of the State, will not unreasonably affect present and anticipated beneficial use of such water and will not result in water quality less than that prescribed in the policies.

2. Any activity which produces or may produce a waste or increased volume or concentration of waste and which discharges or proposes to discharge to existing high quality waters will be required to meet waste discharge requirements which will result in the best practicable treatment or control of the discharge necessary to assure that (a) a pollution or nuisance will not occur and (b) the highest water quality consistent with maximum benefit to the people of the State will be maintained.

Regulations to establish an implementation program

1. Federal Regulations and Guidance

i. (A-6) Section 402 of the Clean Water Act requires a permitting system which USEPA addressed by promulgating 40 Code of Federal Regulations, part 122, which are the
regulations pertaining to the NPDES program. The State’s regulations pertaining to NPDES permits must be consistent with the federal regulations.

ii. (A-7) Title 40 Code of Federal Regulations Section 122.44(d)(1)(ii) sets forth the criteria for establishing a procedure for determining whether a discharge has a reasonable potential to cause or contribute to a violation of water quality standards.

(d) Water quality standards and State requirements: any requirements in addition to or more stringent than promulgated effluent limitations guidelines or standards under sections 301, 304, 306, 307, 318 and 405 of CWA necessary to:

(i) Achieve water quality standards established under section 303 of the CWA, including State narrative criteria for water quality.

(ii) When determining whether a discharge causes, has the reasonable potential to cause, or contributes to an in-stream excursion above a narrative or numeric criteria within a State water quality standard, the permitting authority shall use procedures which account for existing controls on point and nonpoint sources of pollution, the variability of the pollutant or pollutant parameter in the effluent, the sensitivity of the species to toxicity testing (when evaluating whole effluent toxicity), and where appropriate, the dilution of the effluent in the receiving water.

2. State Regulations and Guidance

iii. (A-8) Pursuant to Water Code section 13050, subdivision (j)(3), a basin plan amendment must include an implementation program to achieve water quality objectives.

(j) “Water quality control plan” consists of a designation or establishment for the waters within a specified area of all of the following:

(1) Beneficial uses to be protected.
(2) Water quality objectives.
(3) A program of implementation needed for achieving water quality objectives.

iv. (A-9) Water Code section 13242

The program of implementation for achieving water quality objectives shall include, but not be limited to:

a) A description of the nature of actions which are necessary to achieve the objectives, including recommendations for appropriate action by any entity, public or private.

b) A time schedule for the actions to be taken.

c) A description of surveillance to be undertaken to determine compliance with objectives.

v. (A-10) State Water Board Sources of Drinking Water Policy (Resolution 88-63) – monitoring

2 Surface Waters Where:

a. The water is in systems designed or modified to collect or treat municipal or industrial wastewaters, process waters, mining wastewaters, or storm water runoff, provided that the discharge from such systems is monitored to assure compliance with all relevant water quality objectives as required by the Regional Boards; or,

b. The water is in systems designed or modified for the primary purpose of conveying or holding agricultural drainage waters, provided that the discharge from such systems is
monitored to assure compliance with all relevant water quality objectives as required by the Regional Boards.

vi. **(A-11) Recycled Water Policy**

Each salt and nutrient management plan shall include the following components:

(e) Implementation measures to manage salt and nutrient loading in the basin on a sustainable basis.

vii. **(A-12) Water Code section 106.3(a):**

(a) It is hereby declared to be the established policy of the state that every human being has the right to safe, clean, affordable, and accessible water adequate for human consumption, cooking, and sanitary purposes.

B. **Consistent with relevant water quality objectives (e.g., Boron, Vernalis EC objective)**

C. **Reduce dependency on New Melones Water Quality Releases**

D. **Maximize the assimilative capacity of the river to export salt out of the Basin**

E. **Provide scientific analysis to ensure the appropriate protection of beneficial uses**

CV-SALTS Policy Direction

- Use current cropping data as an indicator of future cropping patterns, with updated analyses occurring periodically to reflect future changes.
- Protected (common) crops: protect 95% of crops (by acreage)
- Acceptable yield limitation due to applied water salinity: 95% of maximum relative yield
- Protection furnished during dry years: 95th percentile (1 in 20) dry year (low precipitation)
- Leaching fraction – 15% (or higher, particularly in dry years) for surface and sprinkler irrigated fields

F. **Meets CV-SALTS Goals**

- Sustain the Valley’s lifestyle
- Support regional economic growth
- Retain a world-class agricultural economy
- Maintain a reliable, high-quality water supply
- Protect and enhance the environment

G. **Provide a technically feasible, economically viable, and reasonable solution for the implementation of the water quality standards.**

1. Technically feasible
   a. Technologies are readily available/adaptable
   b. Ability to meet WQOs and load allocations or WQ achieved in river
   c. Provides for flexibility to growers, wetland operators, and POTWs
   d. Flexible/adaptable to climate changes/water year types
2. Economically viable
   a. Relative Capital and O&M costs
3. Implementation achievable
   a. Potential environmental issues
   b. Time period for planning/design/construction
   c. Legal/regulatory/institutional hurdles
   d. Time to implement
   e. Action within authority of implementing agency
LSJRC Basin Plan Amendment Project
Selection Criteria for Project Alternatives

Criterion A – Consistent with Federal/State Laws, Plans, Policies

<table>
<thead>
<tr>
<th>Project Alternatives</th>
<th>EC Water Quality Objective (as measured at Crow's Landing&lt;sup&gt;18&lt;/sup&gt;)</th>
<th>Selection Criteria</th>
<th>Regulations Applicable to WQOs</th>
<th>Regulations Applicable to an Implementation Program</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. No EC Objective</td>
<td></td>
<td>N       N       N       N       N       Y       Y       Y       Y       Y</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. 1,550 µmhos/cm</td>
<td></td>
<td>Y       Y       Y       Y       Y       Y       Y       Y       Y       Y       Y</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Tiered Objective</td>
<td></td>
<td>Y       Y       Y       Y       Y       Y       Y       Y       Y       Y       Y</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>for Water Year Considerations - 1,350 µmhos/cm &amp; 1,550 µmhos/cm during critical years</td>
<td>Y       Y       Y       Y       Y       Y       Y       Y       Y       Y       Y</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Tiered Objective</td>
<td></td>
<td>Y       Y       Y       Y       Y       Y       Y       Y       Y       Y       Y</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>for Seasonal and Water Year Considerations - 1,350 µmhos/cm &amp; 1,550 µmhos/cm</td>
<td>Y       Y       Y       Y       Y       Y       Y       Y       Y       Y       Y</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. 1,350 µmhos/cm</td>
<td></td>
<td>Y       Y       Y       Y       Y       Y       Y       Y       Y       Y       Y</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. 1,010 µmhos/cm</td>
<td></td>
<td>Y       Y       N       N       Y       Y       Y       Y       Y       Y       Y</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. 700 µmhos/cm</td>
<td></td>
<td>N       Y       N       N       Y       Y       Y       Y       Y       Y       Y</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<sup>18</sup> Assumes WQOs are implemented for point sources consistent with Appendix D and the Planned bundle.
### LSJRC Basin Plan Amendment Project
### Selection Criteria for Project Alternatives

#### Criterion G – Feasible to Implement

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>Project Alternatives</strong></td>
<td><strong>EC Water Quality Objective</strong> (as measured at Crow’s Landing)</td>
<td>Types of Required Actions (or Equivalent) Necessary to Meet WQOs</td>
<td></td>
</tr>
<tr>
<td>1. No EC Objective</td>
<td>No Additional Action</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>2. 1,550 µmhos/cm</td>
<td>Planned bundle activities:&lt;li&gt;Controlled timing of salinity discharges (RTM)&lt;/li&gt;&lt;li&gt;3% reduction in POTW loads&lt;/li&gt;&lt;li&gt;10% reduction in application of fertilizers and soil amendments&lt;/li&gt;&lt;li&gt;No releases from Grasslands Bypass Project&lt;/li&gt;&lt;li&gt;Planned Tailwater/tilewater recovery</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>3. Tiered Objective for Water Year Considerations - 1,350 µmhos/cm &amp; 1,550 µmhos/cm during critical years</td>
<td>Same actions as WQO options #2 and #5</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>4. Tiered Objective for Seasonal and Water Year Considerations - 1,350 µmhos/cm &amp; 1,550 µmhos/cm</td>
<td>Same actions as WQO options #2 and #5</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>5. 1,350 µmhos/cm</td>
<td>Same actions as WQO option #2 plus&lt;li&gt;Maximum Management&lt;/li&gt;Same actions as WQO option #2 plus&lt;li&gt;Storage reservoir(s) used for timed releases</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>6. 1,010 µmhos/cm</td>
<td>Same actions as WQO option #2 plus&lt;li&gt;Regional treatment facility</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>7. 700 µmhos/cm</td>
<td>Same actions as WQO options #2 and #6 plus&lt;li&gt;Additional actions as needed</td>
<td>N</td>
<td>N</td>
</tr>
</tbody>
</table>
Appendix D:
Considerations regarding the Implementation of Proposed EC Water Quality Objectives in NPDES Permits Governing Discharges to Reach 83 of the Lower San Joaquin River

If adopted in a Basin Plan amendment (BPA), the proposed EC water quality objectives (WQOs) for Reach 83 of the Lower San Joaquin River (LSJR) as described in the Task 4 Report will be used in the derivation of future NPDES effluent limitations for the Cities of Modesto and Turlock. The LSJR Committee (LSJRC) requested consideration of this issue since it is important to the determination of the economic impacts of the proposed WQOs for these municipalities.

This document provides background information regarding the NPDES-permitted discharges by the Cities of Modesto and Turlock to Reach 83 of the LSJR, the relative magnitude of the salinity loadings associated with those discharges, and recommendations regarding information that should be considered in the derivation of effluent limitations in future NPDES permits for these municipal wastewater treatment facilities.

BACKGROUND ON MUNICIPAL TREATED EFFLUENT DISCHARGES TO REACH 83

Both the Cities of Modesto and Turlock discharge treated wastewater effluent to Reach 83 of the LSJR in the reach between Crows Landing and the confluence with the Tuolumne River as shown in Figure D-1. Agricultural diversions (by Patterson Irrigation District and West Stanislaus Irrigation District) occur in this segment of the LSJR.

**City of Modesto**

The City of Modesto (Modesto) discharges to the LSJR under requirements specified in California Regional Water Quality Control Board, Central Valley Region (Central Valley Water Board) Order R5-2012-0031 (NPDES No. CA0079103). The current permit expires on June 1, 2017. Discharge of secondary effluent is currently only allowed between October 1 and May 31 when the average daily San Joaquin River to effluent flow ratio exceeds 20:1; discharge of tertiary effluent is allowed any time. Modesto’s future plan is to cease all secondary effluent discharge and discharge tertiary effluent year-round at an average dry weather flow (ADWF) of 19.1 million gallons per day (mgd), or 29.6 cubic feet per second (cfs).

**EC Effluent Limitations in Current Modesto NPDES Permit**

The EC effluent limits in the current City of Modesto NPDES permit are as follows:

- **Interim average monthly EC effluent limit** = 1341 µmhos/cm.

- **Final EC effluent limits** are average monthly of 700 µmhos/cm (April 1 through May 31) and 1000 µmhos/cm (October 1 through March 31). The final EC limits in all but
critically dry years will become effective July 2022. In critically dry years, the final EC limits will become effective in July 2026\textsuperscript{16}.  

The Superior Court for Sacramento County entered a judgment and pre-emptory writ of mandate in the matter of the City of Tracy v. State Water Resources Control Board (Case No. 34-2009-8000-392-CU-WM-GDS), ruling that the South Delta salinity objectives shall not apply to the City of Tracy and other municipal dischargers pending reconsideration of the South Delta salinity objectives and adoption of a proper program of implementation that includes municipal dischargers.

A time series plot of EC concentrations for effluent discharged to the LSJR by Modesto for the period January 2006 through January 2015 is shown in Figure D-2\. A trend line of EC concentrations for Modesto effluent discharge is provided in Figure D-3\. This figure shows projected EC concentrations based on historical winter discharges along the trend line at 5 year intervals, for illustrative purposes. Since summer EC levels in the Modesto effluent tend to be higher than winter EC levels, and with the City shifting from a seasonal to a year round discharge in the future, the projected EC levels shown in Figure D-3 could underestimate actual future conditions. Prediction of future effluent concentrations depends on a number of variables (future water conservation, source and quality of water supply, future discharge needs and storage capability, etc.) which are beyond the scope of this analysis. It should be noted that the recent measured increasing concentrations shown in Figure D-2 are the result of decreasing effluent flow rather than increases in salt load.

\textsuperscript{16} These limits will be reconsidered when the Regional Board adopts a renewed NPDES permit for the City of Modesto consistent with the Superior Court decision in the City of Tracy vs. State Water Resources Control Board (Case No. 34-2009-8000-392-CU-WM-GDS).
Figure D-1: Water Quality Monitoring Stations and POTW Discharges within Reach 83 of the Lower San Joaquin River.
Figure D-2: City of Modesto Monthly Average EC Concentration (µmhos/cm) for Effluent Discharged to the LSJR – January 2006 through January 2015.

Figure D-3: Extrapolation of City of Modesto Monthly Average Effluent EC based on Historical Discharge levels through the Year 2030
As required by its current NPDES discharge permit, the City of Modesto has an active Salinity Minimization Program in place, as documented in its annual Salinity Compliance Schedule Progress Report to the Central Valley Regional Water Board. The City has performed a source identification study and continues to monitor its major trunk lines. Modesto has participated in projects to provide access to increased volumes of surface water supplies as part of its efforts to reduce effluent EC levels through decreased reliance on higher EC groundwater supplies.

City of Turlock

The City of Turlock (Turlock) discharges to the LSJR under requirements specified in Central Valley Water Board Order R5-2015-0027 (NPDES No. CA0078948). This order expires May 31, 2020. Turlock operates a tertiary treatment facility and is allowed to discharge continuously to the San Joaquin River. The current ADWF from the City’s treatment facility is approximately 10 mgd, or 15.5 cfs. The City’s NPDES permit allows for a maximum discharge rate of 20 mgd (ADWF), or 31 cfs.

EC Effluent Limitations in Current Turlock NPDES Permit

The EC effluent limitation in the current NPDES permit for the City of Turlock is as follows:

Final = 1250 µmhos/cm as calendar year annual average

A time series plot of effluent EC concentrations for Turlock for the period January 2005 through January 2015 is shown in Figure D-4. A trend line of effluent EC concentrations for Turlock is provided in Figure D-5. This figure shows projected EC concentrations along the trend line at 5 year intervals, for illustrative purposes. Prediction of these future concentrations depends on a number of variables (future water conservation, water supply quality, etc.) which are beyond the scope of this analysis. Similar to the City of Modesto, the recent measured increasing concentrations in salinity depicted in Figure D-4 are the result of decreasing effluent flows rather than increased salt load.

![Turlock Effluent EC, µmhos/cm](image)

Figure D-4: City of Turlock Monthly Average Effluent EC Concentration (µmhos/cm) – January 2005 through January 2015.
The Fact Sheet (page F-62) for Turlock’s permit states that the two major NPDES permittees in the area (Turlock and Modesto) “account for no more than two percent of the total salt load at Vernalis”, according to the Salt and Boron TMDL for the LSJR.

As required in its current NPDES permit, the City of Turlock has an active Salinity Minimization program. The City performed a Phase 1 Salinity study in 2011 and a Phase 2 study in 2013. Turlock has an industrial pretreatment program which addresses multiple constituents, including salinity. The City regularly inspects its Significant Industrial Users and implements an industrial source control program for salinity. The City is currently preparing a Salinity Source Control Work Plan to refine previous salinity source control measures and implement additional measures, as necessary.

![Figure D-5: Extrapolation of City of Turlock Monthly Average EC through the Year 2030 Based on Effluent EC Measured from January 2005 through January 2015.](image)

**POTW SALINITY CONTRIBUTIONS TO LSJR**

As background, and to provide a perspective on the magnitude of the salinity contribution of the Cities of Modesto and Turlock to the LSJR, the salinity loading resulting from maximum permitted flow conditions and an effluent EC quality of 1550 µmhos/cm has been compared to historic salinity loadings in the LSJR at Crows Landing. This POTW salinity loading represents a potential future discharge scenario resulting from the adoption of proposed water quality objectives for Reach 83 of the LSJR. A time series plot of the combined POTW loadings at permitted flows and an effluent EC quality of 1550 µmhos/cm is depicted in Figure D-6. This plot illustrates the small contribution of the POTWs to the historical TDS loading in the LSJR at Crows Landing.

The POTW loading depicted in Figure D-6 is derived as summarized in Table D-1.
For the calculations supporting the values shown in Table D-1, effluent EC concentrations were converted to equivalent TDS concentrations using an assumed TDS/EC ratio of 0.60 to allow for the development of the salinity loadings shown in the table and in Figure D-6.

**Table D-1: Estimated TDS Loadings to the Lower San Joaquin River by the Cities of Modesto and Turlock with Assumed Effluent EC Quality of 1550 µmhos/cm at Permitted Flow.**

<table>
<thead>
<tr>
<th>Flow (cfs)</th>
<th>TDS (tons per day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modesto 1,550 EC</td>
<td>29.6</td>
</tr>
<tr>
<td>Turlock 1,550 EC</td>
<td>31.0</td>
</tr>
<tr>
<td>POTW Totals</td>
<td>60.6</td>
</tr>
</tbody>
</table>

**NPDES PERMITTING DETERMINATIONS**

Three key decisions will be required in future NPDES permitting determinations for Modesto and Turlock related to the establishment of effluent limitations consistent with the proposed EC WQOs in Reach 83:

1. Whether effluent limits will be required
2. If limits are required, what the magnitude and averaging period of the effluent limits will be
3. The monitoring requirements for collecting compliance samples and the location of the compliance sampling points

Under U.S. EPA regulations governing the issuance of NPDES permits, effluent limitations are required for a specific constituent if a discharge is deemed to have a “reasonable potential to cause or contribute to a violation of a water quality objective”. Because the cities of Modesto and Turlock are subject to the wasteload allocation requirements of the Salt and Boron TMDL for the Lower San Joaquin River established in 2006, reasonable potential to cause or contribute to existing EC objectives at Vernalis will likely be deemed to exist and effluent limits for EC will likely be required in the NPDES permits for these discharges.

Given that EC limits will likely be required, the determination of the magnitude and averaging period for the required EC effluent limits, and determination of the compliance sampling requirements (e.g. receiving water monitoring location) will be the next step.

The effluent limitations that will be developed must meet the following requirements:

- Must protect the AGR (irrigation water supply) beneficial use in the LSJR, with particular attention given to the segment between Crows Landing and the Tuolumne River
- Must not adversely impact the attainment of the EC objectives in the LSJR at Vernalis, and
- Must comply with State and federal anti-degradation policies, including consideration of best practicable treatment and control consistent with maximum benefit to the people of the State of California.

As has been discussed in the LSJR Committee meetings, NPDES permitting should consider the relative importance of salinity loadings from the Cities of Modesto and Turlock during different
seasons and water years. The relative importance of the salinity loads from the two cities and the benefit of salinity load reductions on beneficial use protection should be addressed in setting future effluent limitations. NPDES permitting determinations should also account for the continued impact of water conservation, water supply constraints and extended dry period conditions on effluent quality.

As an example of the type of water quality impact analysis that should be considered during future NPDES permitting, a mass balance analysis was performed to determine the minimum concentration at which the combined discharge from the Cities of Modesto and Turlock would be expected to contribute to an exceedance of the proposed 30-day average water quality objective of 1550 µmhos/cm in Reach 83 between Crows Landing and the Tuolumne River. The analysis was based on the following assumptions:

- Modesto and Turlock wastewater treatment plants - each discharging at current permitted ADWF (19.1 mgd and 20 mgd, respectively)
- Effluent EC converted to equivalent TDS using a factor of 0.60
- Historical flows in LSJR at Crows Landing for 1995 through 2013
- Predicted EC levels at Crows Landing based on Planned Bundle simulation
- EC levels in LSJR converted to TDS using a factor of 0.64
- A mass balance was performed and determinations were made with regard to the concentrations at which POTW discharges would cause the LSJR to exceed an EC level of 1550 µmhos/cm.

The following results were obtained (6,575 cases examined):

- POTW concentrations that would cause exceedances of 30-day average 1,550 µmhos/cm EC in LSJR below Crows Landing
  - Single exceedance of 1550 EC: 1994 µmhos/cm
  - 99th percentile not to exceed level: 2672 µmhos/cm
  - 97.5th percentile not to exceed level: 3256 µmhos/cm

The calculations supporting the above results are included in an attached spreadsheet. This example is provided to demonstrate the type of mass balance analysis that should be considered in future NPDES permitting to support the consideration of future effluent limitations.

COMPLIANCE WITH DOWNSTREAM WATER QUALITY OBJECTIVES

Future effluent limitations for Modesto and Turlock must provide beneficial use protection in the LSJR and must not adversely affect compliance with downstream WQOs. To evaluate the specific impact of POTW salinity loadings resulting from a range of alternative effluent limitations on downstream compliance with the proposed EC WQOs at Maze Road Bridge and the EC WQOs at Vernalis, additional modeling would be required.

One option would be to follow the approach used in the LSJR Committee’s approach to development of information supporting the proposed EC WQO for Reach 83. In that work, WARMF modeling results were developed based on specific management scenarios to provide
water quality output at Maze Road Bridge. That information was then communicated to Mr. Dan Steiner, who used his modeling tools to predict effects on WQO compliance at Vernalis as described in the Task 4 report.

For effluent limitation derivation purposes, different salinity loadings from Modesto and Turlock associated with a range of different effluent limitations could be input into the WARMF model. Output from those model runs could be provided as input to Dan Steiner’s models. This would allow a specific evaluation of the water quality impact of different candidate effluent limitations and would help resolve uncertainty regarding these effects.

RECOMMENDATIONS REGARDING THE IMPLEMENTATION OF PROPOSED OBJECTIVES IN NPDES PERMITS

Based on the above considerations, and in conjunction with the salt and boron control program contained in the Basin Plan, the following recommendations are provided regarding the implementation of the proposed EC objectives in the NPDES permits for the cities of Modesto and Turlock. This information is intended to inform and assist Regional Water Board staff in the derivation of future EC effluent limits in these NPDES permits.

- As indicated in the control program for salt and boron discharges into LSJR as incorporated in the Basin Plan, POTW dischargers can comply with water quality objectives at Airport Way Bridge near Vernalis, or participate in a Board-approved Real Time Management Program. The Basin Plan encourages real-time water quality management and pollutant trading of wasteload allocations, load allocations, and supply water allocations as a means for attaining salt and boron water quality objectives, while maximizing the export of salts out of the LSJR watershed. The Basin Plan Amendment should make it clear that point source dischargers have this option for compliance.

- The proposed effluent limitations must protect the AGR (irrigation water supply) beneficial use in the LSJR, must not impact attainment of the Vernalis EC objectives, and must comply with State and federal anti-degradation policies.

- A range of possible effluent limitations and averaging periods, including longer averaging periods and/or limits than the proposed Reach 83 water quality objectives for EC, should be evaluated in the NPDES permitting process.

- Mass balance calculations and modeling should be performed to assess the impact of different POTW salinity discharges on conditions in the river. The relative importance of the salinity loads from the two cities and the benefit of load reductions on beneficial use protection should be addressed in the NPDES permitting process.

- Consistent with the Sacramento County Superior County ruling in the matter of the City of Tracy v. State Water Resources Control Board (Case No. 34-2009-8000-392-CU-WM-GDS), South Delta salinity objectives shall not apply to the City of Tracy and other municipal dischargers pending proper reconsideration in the Bay Delta planning process.

- NPDES permitting determinations should account for the continued impact of water conservation, water supply constraints and extended dry period conditions on effluent quality.
• A re-opener should be provided in the NPDES permit to allow re-evaluation of effluent limitations based on the actual conditions that are observed to occur in the LSJR after full implementation of the Grassland Bypass Project and other planned projects. Also an evaluation should be performed to determine whether water conservation, water supply changes, or other factors caused an increase in effluent EC that would preclude attainment with proposed future effluent limitations.

• In addressing compliance with State and federal anti-degradation policies, a socio-economic analysis should be performed to address the water quality impacts, water management costs, treatment costs and beneficial use protection associated with the range of candidate effluent limitations.

• Modeling work should be performed using available modeling tools to assess the impact of the range of candidate effluent limitations on compliance with downstream water quality objectives at Maze Road Bridge and Vernalis. The extended dry period exception associated with the proposed EC WQOs for Reach 83 should be considered in this evaluation.

• Effluent limitations should be selected based on NPDES permitting requirements at the time of the renewal, results from the above analysis and other considerations (e.g. available dilution, actual and projected effluent quality, ambient conditions in the LSJR, etc.).
Figure D-6.

Stacked Load contributions of permitted POTW flow at Crows Landing (cfs) with 1550 EC discharge

Historical Crows Landing EC data

- Modesto WQCF
- Turlock WWTP
- Crows Landing All Other Load
Memorandum

DATE: September 18, 2015

TO: Michael Johnson, LSJRC Manager

COPY TO: Lower San Joaquin River Committee
Larry Walker Associates (LWA) Team

SUBJECT: Development of a Basin Plan Amendment for Salt and Boron in the Lower San Joaquin River (LSJR):
Task 5 – Economic Analysis

INTRODUCTION

This memorandum is being submitted on behalf of the LWA Team to fulfill the requirements of Task 5 in the Scope of Work for the Development of a Basin Plan Amendment for Salt and Boron in the Lower San Joaquin River (Workplan). The purpose of Task 5 is to conduct a planning level economic analysis showing the costs of implementation of selected project alternatives for various discharge sectors. In addition, the analysis must include the costs of alternative salinity water quality objectives (WQOs) that may provide a higher level of protection. Information generated in Task 4 – Implementation Planning for Proposed Salinity Objectives, September 18, 2015, (Task 4 Report; LWA 2015a) was used to support the economic analyses.

BACKGROUND

The California Water Code and Public Resources Code require that the Central Valley Regional Water Quality Control Board (Regional Water Board) consider economics in adopting new water quality objectives. In considering economics, the Regional Water Board is required to examine

1 The LWA Team consists of the following firms: Larry Walker Associates, Carollo Engineers, Kennedy/Jenks Consultants, Systech Water Resources, PlanTierra, Luhdorff and Scalmanini Consulting Engineers, Ascent Environmental, and Dr. Richard Howitt.
2 Per personal communication with Betty Yee, Central Valley Regional Water Quality Control Board, the economic analysis does not need to include a qualitative cost benefit evaluation (May 15, 2013).
three statutory provisions as they relate to the actions contained in the proposed Basin Plan Amendment (BPA).

These statutory provisions include Water Code § 13241(d), Water Code § 13141, and Public Resources Code § 21159.

1. Water Code § 13241(d) requires that the Regional Water Board consider economics when establishing water quality objectives. This memorandum predicts that no additional cost will be required as a result of adoption of the proposed objectives. As such, it satisfies the subject Water Code requirement. Attachment A provides the Regional Water Board with supplemental information related to costs for specific implementation actions included in the preferred alternative.

2. Water Code § 13141 requires that, prior to the implementation of any agricultural water quality control program, the Regional Water Board must have an estimated cost of such a program, together with an identification of potential funding sources. This memorandum predicts that a new agricultural program will not be required to achieve the proposed electrical conductivity (EC) water quality objective. As such, it satisfies the subject Water Code requirement. Attachment B provides information regarding the overall cost of implementing an alternative EC objective of 1010 µmhos/cm in Reach 83. A portion of those overall costs would be the responsibility of the agricultural community, if the alternative objective was adopted.

3. Public Resources Code § 21159 requires the Regional Water Board, when adopting a BPA that includes installation of pollution control equipment, or a performance standard or treatment requirement, including a rule or regulation that requires the installation of pollution control equipment or a performance standard or treatment requirement pursuant to the California Global Warming Solutions Act of 2006 (Division 25.5 (commencing with Section 38500) of the Health and Safety Code), to conduct an environmental analysis of the reasonably foreseeable methods of compliance. This environmental analysis is required to take into account a reasonable range of environmental, economic, and technical factors, population and geographical areas, and specific sites. This memorandum explains that new pollution control equipment above already planned actions will not be required to implement the proposed water quality objective, and thereby satisfies the requirements of Public Resources Code § 21159 as it relates to the economics of the preferred alternative. Attachment A provides supplemental information regarding economic factors associated with the preferred alternative.

The Watershed Analysis Risk Management Framework (WARMF) modeling of the implementation of the three salinity management alternatives described in the Task 4 Report (Section 4) provides information regarding the actions required to attain a range of ambient salinity levels (from 1,010 to 1,550 µmhos/cm) in Reach 83 of the LSJR (LWA 2015a). WARMF modeling results from one of the three salinity management alternatives, the Planned

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3 (1) Planned Alternative, (2) Planned Plus Maximum Treatment Focus Alternative, and (3) Planned Plus Maximum Management Focus Alternative. See Task 4 Report (Section 3) for a description of the implementation actions included in each alternative (LWA 2015).

4 Reach 83 is defined as that segment of the San Joaquin River from the mouth of the Merced River to Vernalis.
Plus Maximum Management Focus Alternative, which would divert all flows from Mud and Salt sloughs and apply them to land in the Grassland Drainage Area as part of a San Joaquin River Basin Implementation Program-like project, showed that permanent diversion of water from the Lower San Joaquin River provides no significant additional EC improvement compared to the Preferred Alternative. For this reason, the Planned Plus Maximum Management Focus Alternative was eliminated from further consideration as a management alternative.

WARMF modeling information was used to assist in the development of seven distinct EC WQO alternatives in Reach 83 (see Task 4 Report, Tables 9 and 10; LWA 2015a).

The Lower San Joaquin River Committee (LSJRC) considered these seven WQO alternatives, using evaluation criteria and associated WARMF modeling results. Based on that information, the LSJRC identified four project alternatives (#’s 1, 2, 4, and 6) for more detailed examination and consideration in the Basin Planning process. These alternatives are listed below in Table 1. After further consideration, the LSJRC selected Project Alternative #4 as the preferred EC water quality objective (Preferred Alternative) for Reach 83.

### Table 1: Lower San Joaquin River Committee Basin Plan Amendment Project Alternatives.

<table>
<thead>
<tr>
<th>Project Alternatives</th>
<th>Technical Basis for the Water Quality Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. No EC Objective</td>
<td>Continue to regulate dischargers pursuant to the Salt and Boron TMDL</td>
</tr>
<tr>
<td>2. 1,550 µmhos/cm EC Objective</td>
<td>Hoffman Model Results</td>
</tr>
<tr>
<td></td>
<td>• 15% leaching fraction</td>
</tr>
<tr>
<td></td>
<td>• Protection of 95% of the most common crop (almonds)</td>
</tr>
<tr>
<td></td>
<td>• 95% almond crop yield in all but the 5% driest years</td>
</tr>
<tr>
<td>4. 1,550 µmhos/cm EC Objective and a 1,350 µmhos/cm EC Performance Goal for Seasonal and Water Year Considerations (see Table 2)</td>
<td>Hoffman Model Results</td>
</tr>
<tr>
<td></td>
<td>• 1,350 µmhos/cm – Leaching fraction between 10 – 15% with same crop protection and yield as option #2</td>
</tr>
<tr>
<td></td>
<td>• 1,550 µmhos/cm – same technical basis as WQO option #2</td>
</tr>
<tr>
<td>6. 1,010 µmhos/cm EC Objective</td>
<td>Hoffman Model Results</td>
</tr>
<tr>
<td></td>
<td>• 10% leaching fraction</td>
</tr>
<tr>
<td></td>
<td>• Protection of 95% of the most common crop (almonds)</td>
</tr>
<tr>
<td></td>
<td>• 95% almond crop yield in all but the 5% driest years</td>
</tr>
</tbody>
</table>

The Preferred Alternative is to adopt an EC WQO and an EC Performance Goal for seasonal and water year considerations in Reach 83 of the LSJR, as shown in Table 2. The proposed EC WQO and EC Performance Goal are protective of the existing agricultural irrigation supply (AGR) beneficial use and the potential municipal and domestic supply (MUN) beneficial use designated in Reach 83. The WQO and Performance Goal consider agriculture’s seasonal demands for water diverted from Reach 83, while at the same time accounting for the fact that ambient water quality conditions are greatly influenced by hydrologic conditions, including the presence of return flows, in the San Joaquin River Basin.

The Preferred Alternative includes a 30-day running average EC WQO of 1,550 µmhos/cm. Compliance with the WQO in Reach 83 shall be evaluated at Crows Landing. The WQO would
apply as indicated in Table 2, except during an “extended dry period”. An Extended Dry Period is defined as follows:

An Extended Dry Period is defined using the State Water Resources Control Board’s (SWRCB’s) San Joaquin Valley “60-20-20” Water Year Hydrologic Classification\(^5\) included in Revised Water Right Decision 1641 to assign a numeric indicator to a water year type as follows (SWRCB 2000):

- Wet – 5
- Above Normal – 4
- Below Normal – 3
- Dry – 2
- Critically Dry – 1

The indicator values will be used to determine when an Extended Dry Period is in effect:

- An Extended Dry Period shall begin when the sum of the current year’s 60-20-20 indicator value and the previous two year’s 60-20-20 indicator values total six (6) or less.
- An Extended Dry Period shall be deemed to exist for one water year (12 months) following a period with an indicator value total of six (6) or less.

<table>
<thead>
<tr>
<th>Water Year Type</th>
<th>Irrigation Season</th>
<th>Non-irrigation Season</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>March – June</td>
<td>July – October</td>
</tr>
<tr>
<td>Wet</td>
<td>1350 (Performance Goal(^1))</td>
<td>1550 (WQO(^1))</td>
</tr>
<tr>
<td>Above Normal</td>
<td>1350 (Performance Goal(^1))</td>
<td>1550 (WQO(^1))</td>
</tr>
<tr>
<td>Below Normal</td>
<td>1350 (Performance Goal(^1))</td>
<td>1550 (WQO(^1))</td>
</tr>
<tr>
<td>Dry</td>
<td>1350 (Performance Goal(^1))</td>
<td>1550 (WQO(^1))</td>
</tr>
<tr>
<td>Critical</td>
<td>1550 (WQO(^1))</td>
<td></td>
</tr>
</tbody>
</table>

1. The EC Performance Goal and EC WQO are subject to relaxation during an Extended Dry Period (see definition above).

During an Extended Dry Period (defined above), the following shall be taken into consideration to ensure that beneficial uses are protected in Reach 83 of the LSJR (as monitored at Crows Landing):

- Protection of the designated potential MUN beneficial use: The EC WQO shall be the Short Term specific conductance secondary MCL level contained in the Water

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\(^5\) The method for determining the San Joaquin Valley Water Year Hydrologic Classification (e.g., critical, dry, below normal, above normal, wet) is defined in the SWRCB Revised Water Right Decision 1641, March 2000, Figure 2, page 189. This method uses the best available estimate of the 60-20-20 San Joaquin Valley water year hydrologic classification at the 75% exceedance level using the best available data published in the California Department of Water Resources’ ongoing Bulletin 120 series.
Quality Control Plan (Basin Plan) for the Sacramento River Basin and the San Joaquin River Basin. (Currently incorporated from Table 64449-B of 22 CCR § 64449 at the level of 2,200 µmhos/cm as the average of the previous four (4) consecutive quarterly samples).

- Protection of the AGR beneficial use: The EC WQO shall be 2,470 µmhos/cm as a 30-day running average. (Derived from the Hoffman model results for 75% crop yield for almonds, 5th percentile rainfall, and 15% leaching fraction).

- Implementation of the Extended Dry Period EC WQO relaxation and/or EC concentrations in Reach 83 above 1,550 µmhos/cm shall not result in requirements for increased water quality releases from New Melones Reservoir to meet Vernalis EC objectives.

The Preferred Alternative also includes the implementation of an EC Performance Goal of 1,350 µmhos/cm that is recommended to be established throughout the irrigation season for specific water year types (see Table 2). Attainment of the EC Performance Goal in Reach 83 shall be evaluated using the 30-day running average calculated from monitoring data collected at Crows Landing. The 1,350 µmhos/cm EC value was established as a Performance Goal because:

- The WARMF modeling of the Planned Bundle (Preferred Alternative) indicates that, after full implementation of the key actions underway within the LSJR Basin, the ambient water quality within Reach 83 of the LSJR will not exceed an EC value of 1,350 µmhos/cm. However, due to model uncertainty, the WQO was set at 1,550 µmhos/cm which is the value that is reasonably protective of the AGR (irrigation supply water) beneficial use based on Hoffman modeling results (95% crop yield for almonds, 5th percentile rainfall, 15% leaching fraction).

- Agricultural supply water at 1,350 µmhos/cm or lower would provide a higher level of protection during the irrigation season based on Hoffman modeling results.

- Water quality at 1,350 µmhos/cm or better would also help to maintain the soil salinity balance by flushing salt accumulated below the soil root zone during Extended Dry Periods.

The EC Performance Goal and the Extended Dry Period exception included in the Preferred Alternative are advanced in recognition of the existing AGR and potential MUN beneficial uses that must be supported for the water diverted from Reach 83, as well as the seasonal and annual hydrologic conditions that affect both the quantity and quality of the water in the LSJR. The Performance Goal will be used to measure progress toward achievement of EC levels during the irrigation season of non-Extended Dry Periods when EC levels lower than the EC WQO would be beneficial to agriculture and, based on WARMF modeling are considered achievable. The Extended Dry Period exception exists to allow discharges to the LSJR to occur under hydrologic conditions (e.g., low flows and elevated EC levels) when it is anticipated that agriculture may value water availability over then current water quality. A detailed discussion of the project

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6 The Performance Goal will be used to measure progress towards achievement of EC levels during certain water year types and times of the year that are of higher water quality than the proposed EC WQO for Reach 83 of the LSJR.
alternatives considered, including the Preferred Alternative, is provided in Development of a Basin Plan Amendment for Salt and Boron in the Lower San Joaquin River (LSJR): Task 4 – Implementation Planning for Proposed Salinity Objectives (LWA 2015a).

ECONOMIC CONSIDERATIONS OF PROPOSED EC WQO FOR REACH 83

Economic Considerations for Alternative 1 (No Action Alternative)

A decision not to implement a WQO for EC in Reach 83 of the LSJR may eventually require POTWs to implement additional salinity control measures for their discharges to the LSJR as a means to assist in the meeting of San Joaquin River at Vernalis EC objectives. The 2006 Lower San Joaquin River Salt and Boron Total Maximum Daily Load (TMDL) requires POTWs to meet the Vernalis EC objectives as effluent limits by 2022 for most water year types (2026 for critically dry water years), or participate in a Board-approved real-time management program. The Superior Court for Sacramento County entered a judgment and preememptory writ of mandate in the matter of City of Tracy v. State Water Resources Control Board (Case No. 34-2009-8000-392-CU-WM-GDS) ruling that the South Delta salinity objectives shall not apply to the City of Tracy and other municipal dischargers pending reconsideration of the South Delta salinity objectives and adoption of a proper program of implementation that includes municipal dischargers. Additionally, in the TMDL POTWs are considered a low-priority salinity source and waste load allocations and/or implementation measures could be changed as part of the TMDL review.

POTW salinity load reductions to the LSJR have been achieved through acquisition of a new source water supply and other source control measures; other implementation measures such as reverse osmosis (RO) treatment and/or removal of discharges to the LSJR would could be needed to reliably meet the Vernalis objectives at the end-of-pipe. The costs of such additional salinity load reduction strategies beyond those that have already been taken by the Cities of Modesto and Turlock have not been estimated as part of this analysis. The discussion of economic considerations for Alternative 4 does, however, include cost estimates for the Cities of Modesto and Turlock related to annual salinity control program costs and other existing salinity control projects.

Economic Considerations for Alternative 2

The only difference between Project Alternatives #2 and #4 is the inclusion of a 1,350 µmhos/cm EC Performance Goal in the latter alternative. As such, the economic considerations for Alternative #2 are the same as those described below for Alternative #4.

Economic Considerations for Alternative 4 (Preferred Alternative)

Based on WARMF modeling results, the 1,550 µmhos/cm EC WQO associated with Project Alternative #4 (Preferred Alternative) is expected to reliably be met at Crows Landing with implementation of a small number of planned implementation actions that were modeled for the Preferred Alternative (Planned Bundle). The implementation actions included in the Preferred Alternative are listed in Table 3, and described in detail in the Task 4 Report (Section 3; LWA 2015a). The implementation action expected to provide the most significant salinity load reductions to Reach 83 of the LSJR based on WARMF modeling is the completion of the Grassland Bypass Project (GBP). The GBP was initiated in 1995 and is scheduled to be completed at the end of 2019.
Planned salinity management actions for POTWs under this alternative included an sensitivity analysis of a 3% load reduction over current levels of salinity discharges. The analysis was neither a projection of expected reductions nor a statement of future reductions that should be required. Current effluent data trends from the Cities of Modesto and Turlock indicate that neither POTW may be able to reliably comply in the future with the proposed EC WQO and Performance Goal if applied as end-of-pipe effluent limits, as a result of conservation mandates or restrictions on surface water diversions, even with the extensive source control efforts that have been implemented by both cities. Appendix D of the Task 4 Report (LWA 2015a) was prepared to provide an assessment of the overall contribution of these two POTWs to EC in Reach 83 of the LSJR. Appendix D provides recommended considerations that should be used in future permitting decisions to implement permit limits that would still result in compliance with the proposed EC WQO in Reach 83. It is anticipated that implementation of these considerations in the NPDES permitting process would not require significant new salinity control efforts by these POTWs. Therefore, the cost of such additional salinity load reduction strategies have not been estimated as part of this analysis.

The evaluation of compliance with a potential 1,550 µmhos/cm EC objective in Reach 83 is proposed to be accomplished by using water quality data collected at Crows Landing and Maze Road Bridge under existing monitoring programs. Thus, no additional costs are anticipated for a monitoring and surveillance program needed to track compliance with an EC WQO in Reach 83, as described in the Task 6 Memorandum (LWA 2015b). However, because the long-term funding of existing LSJR water quality monitoring programs is unknown, a need could arise in the future to fund water quality monitoring at Crows Landing and Maze Road Bridge specifically to evaluate compliance with Reach 83 WQOs. Furthermore, future monitoring efforts could reveal that additional monitoring, either in location or frequency, is needed to adequately evaluate compliance with Reach 83 WQOs. These future, potential monitoring activities are estimated to require an annual budget of approximately $111,000\(^7\) to accomplish all data collection, instrument maintenance, quality assurance and quality control (QA/QC), data analysis, and report preparation collectively performed by the existing monitoring programs operating in the LSJR.

While the Planned Bundle included controlled timing of salinity discharges as one of its implementation actions, apart from the consideration of two tailwater recovery projects in the project area, controlled timing of salinity discharges as directed by a future Real-Time Management Program was not modeled in WARMF and did not affect modeled EC concentrations estimated in Reach 83 with implementation of the Planned Bundle. To this end, the $110,000 cost estimate for a monitoring and surveillance program noted above does not consider the costs of a cyberinfrastructure, coordination among participating stakeholders, or the forecasting of water quality conditions that will dictate when timed salinity discharges can or cannot occur under a Real-Time Management Program. It should be noted that implementation of the proposed EC WQO in Reach 83 will require coordination with the existing Real-Time Management Program. That program will ultimately include a cyberinfrastructure, salt assimilative capacity forecasting, and data dissemination activities – none of which are fully in place or funded at this time. Currently, the United States Bureau of Reclamation, the California

\(^7\) Monitoring and reporting costs were developed in consideration of EC and boron monitoring at Crows Landing Bridge and EC monitoring at Maze Road (see Appendix A).
Department of Water Resources, and Basin stakeholders are collectively spending in excess of $1,000,000 annually to begin development of the necessary cyberinfrastructure for the Real-Time Management Program. It is anticipated that this level of annual funding, if not greater, from these same stakeholder entities will be required on an ongoing basis to support the Real-Time Management Program when it is fully operational.

All of the implementation actions included in Table 3, with the exception of 2c and 3a, are planned to occur in the project area during the next 5 – 10 years and implementation of the proposed EC WQO and Performance Goal are not expected to result in additional control facilities or actions, and are not expected to result in increased costs to parties in the basin. As such, there are no anticipated additional costs to the primary discharge sectors, POTWs and agriculture\(^8\), within the LSJR basin if the proposed EC WQO and Performance Goal are adopted and implemented.

<table>
<thead>
<tr>
<th>Table 3: Implementation Actions to Manage/Reduce Salinity in Reach 83 of the Lower San Joaquin River included in the Preferred Alternative (Planned Bundle).</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Implementation Action</strong></td>
</tr>
<tr>
<td>1. Controlled Timing of Salinity Discharges</td>
</tr>
<tr>
<td>2c. Reduce Point Sources</td>
</tr>
<tr>
<td>3a. Reduce Nonpoint Sources</td>
</tr>
<tr>
<td>8b. Water Conservation – Optimize Existing Irrigation Efficiency</td>
</tr>
<tr>
<td>9a. Installation of New High Efficiency Irrigation and Delivery Systems</td>
</tr>
<tr>
<td>10b. Sequential Reuse and Volume Reduction – Salt Accumulation Area</td>
</tr>
</tbody>
</table>

\(^8\) Although Industrial Process Supply (PROC) is listed as a beneficial use of LSJR Reach 83, there are currently no uses or diversions of Reach 83 for industrial process supply. In addition, there are no known plans to develop new PROC uses along the river and there are no water right permits or applications pending for industrial process supply use. PROC is not likely to be a use in the future other than incidental use during agriculture field harvest activities.
In the interest of documenting the costs associated with implementation of the various salinity control actions included as part of the Preferred Alternative (Planned Bundle) and planned to occur in the project area during the next 5 – 10 years, project stakeholders were contacted and asked to provide planning level cost estimates for those implementation actions amenable to cost estimate development. The cost of Implementation Action 8b (Water Conservation – Optimize Existing Irrigation Efficiency; see Table 3) was not estimated due to the complexity and information requirements needed to perform such a calculation. The cost of Implementation Action 12b (Drainage Water Recirculation – Tilewater Recovery; see Table 3) was not estimated because no tilewater recovery projects were identified in the project area for consideration in the WARMF modeling effort. The estimated planning levels costs of the implementation actions included in the Planned Bundle are provided in Table 4.

**Economic Considerations for Alternative 6**

Among the four potential project alternatives selected by the LSJRC for consideration in the Basin Planning process, Project Alternative #6 (1,010 µmhos/cm) was the only alternative considered that would require new salinity control measures to attain the water quality objective. Project Alternative #6 would require the construction and operation of a desalination facility in the Grassland Drainage Area in order to meet a 1,010 µmhos/cm EC objective at Crows Landing. This would result in significant, additional costs to the discharge sectors. The planning level cost analysis of Alternative #6 estimates the conceptual desalination facility total project cost at $900 million, the annual operations and maintenance cost at $16.1 million, and the 30-year life-cycle cost at $1.15 billion (see Attachment B). The economic analysis provided for Alternative #6 acts as an evaluation of the costs of an alternative salinity WQO. While the LSJRC has not discussed how such a desalination project would be funded if it were ever to be built, some level of cost-sharing between those entities that discharge to the LSJR, including POTWs, would likely be necessary.

Reverse osmosis (RO) at individual POTW facilities was not considered as part of the Planned Plus Maximum Treatment Focus Alternative as a means for POTWs to meet the 1,010 µmhos/cm EC objective as end-of-pipe effluent limits. Under Alternative #6, POTWs would either require a means to establish attainable effluent limits in implementing a 1,010 µmhos/cm EC objective, similar to the POTW permitting considerations provided in Appendix D of the Task 4 Report (LWA 2015a), or would be required to implement other compliance strategies including RO treatment, improvements to remove discharges from the LSJR on a year-round basis, or development of a specific pollutant trading program.

Similar to the discussion provided for the Preferred Alternative, evaluation of compliance with a potential 1,010 µmhos/cm EC objective in Reach 83 is proposed to be accomplished by using water quality data collected at Crows Landing and Maze Road Bridge by existing monitoring programs. The cost of any future monitoring that may be required to augment those water quality
data collected by existing programs is unknown and thus, not included as part of this analysis. However, it is estimated that a single monitoring and surveillance program would require an annual budget of approximately $110,000 to accomplish all data collection, instrument maintenance, QA/QC, data analysis, and report preparation collectively performed by the existing monitoring programs operating in the LSJR.

Table 4: Cost Estimates of Specific Implementation Actions included in the Preferred Alternative (Planned Bundle).

<table>
<thead>
<tr>
<th>Implementation Action</th>
<th>Cost Basis</th>
<th>Cost Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Controlled Timing of Salinity Discharges</td>
<td>Addressed under Implementation Action 12a as cost of tailwater recovery projects</td>
<td>See 12a</td>
</tr>
<tr>
<td>2c. Reduce Point Sources</td>
<td>City of Modesto – Pretreatment Program costs(^{a})</td>
<td>$964,989(^{(1)}) -----</td>
</tr>
<tr>
<td></td>
<td>City of Modesto – Surface Water Expansion Projects: Phase 1 (top est.) and Phase 2 (bottom est.)</td>
<td>$105,000,000(^{(2)}) $113,000,000(^{(2)})</td>
</tr>
<tr>
<td></td>
<td>City of Turlock – Pretreatment Program costs(^{a})</td>
<td>$20,000(^{(3)}) -----</td>
</tr>
<tr>
<td></td>
<td>City of Turlock – Surface Water Supply Diversification Project</td>
<td>$1,350,000(^{(3)}) $89,000,000(^{(3)})</td>
</tr>
<tr>
<td>3a. Reduce Nonpoint Sources</td>
<td>As a sensitivity(\text{In the analysis, 10% reduction in the application of nitrogen-based fertilizers in the Northwest, East Valley Floor, and Grassland Drainage Area subareas was modeled. (Implementation action would result in a cost savings and hence, a negative number is shown at right)})</td>
<td>-$14,200,000(^{(4)}) -----</td>
</tr>
<tr>
<td>9a. Installation of New High Efficiency Irrigation and Delivery Systems</td>
<td>Retrofitting of existing irrigation systems with high efficiency systems (drip or microspray) in the Northwest, East Valley Floor, and Grassland Drainage Area subareas (includes cotton(^{a}))</td>
<td>$9,600,000(^{(4)}) $26,800,000(^{(4)})</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$21,500,000(^{(4)}) $59,700,000(^{(4)})</td>
</tr>
<tr>
<td>10b. Sequential Reuse and Volume Reduction – Salt Accumulation Area</td>
<td>Total cost of Grassland Bypass Project (completion by December 2019; see Attachment A for cost itemization)</td>
<td>----- $136,388,129(^{(5)})</td>
</tr>
<tr>
<td>12a. Drainage Water Recirculation – Tailwater Recovery</td>
<td>Patterson Irrigation District – Two Drains Project (cost range provided)</td>
<td>----- $4,200,000 – $4,300,000(^{(6)})</td>
</tr>
<tr>
<td></td>
<td>Grassland Water District – North Grasslands Water Conservation and Water Quality Control Project</td>
<td>----- $7,000,000(^{(7)})</td>
</tr>
<tr>
<td>Monitoring and Surveillance Program</td>
<td>Compliance Monitoring and Surveillance Program costs</td>
<td>$111,000(^{(8)}) -----</td>
</tr>
<tr>
<td>Real-Time Management Program</td>
<td>Cost to maintain cyberinfrastructure, salt assimilative capacity forecasting, and data dissemination activities</td>
<td>$1,000,000(^{(9)})</td>
</tr>
</tbody>
</table>
Notes:
^ Implementation of POTW Pretreatment Programs/Salinity Management Plans is what was assumed to provide a possible 3% reduction in POTW salinity loads in the Planned Bundle.

Cost estimates provided by:
2. Thomas Sinclair, Environmental Regulatory Compliance Manager, City of Modesto, Utilities Department Wastewater Division, August 26, 2015.
3. Dan Madden, City of Turlock, Municipal Services Water Quality Control Division, August 18, 2015.
4. Mark J. Roberson, PhD, CPSS, Senior Soil & Water Scientist, Formation Environmental, August 26, 2015 (see Attachment A for additional information).
5. David Cory, San Joaquin Valley Drainage Authority, July 24, 2015 (see Attachment A for additional information).
6. Peter Rietkerk, P.E., General Manager, Patterson Irrigation District, August 18, 2015.
7. Ken Swanson, P.E., District Engineer, Grassland Water District, August 4, 2015 (see Attachment A for additional information).

REFERENCES


Attachment A: Supplemental Information Related to Cost Estimates for Specific Implementation Actions Included in the Preferred Alternative (Planned Bundle)
Attachment B: Cost Estimate for Preliminary Conceptual Desalination Project
Memorandum

DATE: September 18, 2015

TO: Michael Johnson, LSJRC Manager

COPY TO: Lower San Joaquin River Committee
Larry Walker Associates (LWA) Team

SUBJECT: Development of a Basin Plan Amendment for Salt and Boron in the Lower San Joaquin River (LSJR):
Task 6 – Long-term Monitoring and Reporting Program

INTRODUCTION

This technical memorandum (TM) is submitted on behalf of the LWA Team1 to fulfill the requirements of Task 6 in the Scope of Work for the Development of a Basin Plan Amendment for Salt and Boron in the Lower San Joaquin River (Workplan). Task 6 includes the following subtasks:

   Subtask 6.1 Develop goals for a long-term monitoring and reporting program.
   Subtask 6.2 Prepare a monitoring program to evaluate compliance with water quality objectives (WQOs) and the effectiveness of the implementation program.

Information generated in the Task 4 Report, Implementation Planning for Proposed Salinity Objectives, September 18, 2015, (Task 4 Report) was used to support the development of this Lower San Joaquin River Salinity Related Long-term Monitoring Program (LSJR Monitoring Program). Due to the extensive network of existing electrical conductivity (EC) and boron monitoring locations in LSJR (Reach 832), it is anticipated that the LSJR Monitoring Program may be able to rely on these existing programs as the primary source of data.

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1 The LWA Team consists of the following firms: Larry Walker Associates, Carollo Engineers, Kennedy/Jenks Consultants, Systech Water Resources, PlanTierra, Luhdorff and Scalmanini Consulting Engineers, Ascent Environmental, and Dr. Richard Howitt.

2 From the mouth of the Merced River to Vernalis.
California Water Code (CWC) Section 13242 requires implementation programs designed to achieve WQOs to include a description of the surveillance to be carried out in order to determine compliance with the objectives. The information that will be incorporated into Chapter V of the Central Valley Regional Water Quality Control Board’s (Central Valley Water Board) Water Quality Control Plan (Basin Plan) Surveillance and Monitoring section is presented in this TM.

**BACKGROUND**

Based on the information developed pursuant to the Task 4 Report, the LSJR Committee (LSJRC) is proposing an EC WQOs and Performance Goal for seasonal and water year considerations in Reach 83 of the LSJR (the Preferred Alternative)\(^3\), as shown in Table 1. The Preferred Alternative WQO and recommended Performance Goal are protective of the existing agricultural irrigation supply (AGR) beneficial use and the potential municipal and domestic supply (MUN) beneficial use designated in Reach 83. The WQO and Performance Goal consider agriculture’s seasonal demands for water diverted from Reach 83, while at the same time accounting for the fact that ambient water quality conditions are greatly influenced by the hydrologic conditions, including the presence of return flows and reservoir releases, in the San Joaquin River Basin. While this TM includes recommendations for a monitoring program based on the Preferred Alternative, the recommendations would also be applicable to the other alternatives evaluated in Task 4. Additionally, the Basin Plan already has boron WQOs established for LSJR Reach 83.

**Electrical Conductivity**

The Preferred Alternative includes an EC WQO of 1,550 µmhos/cm. Compliance with the WQO in Reach 83 shall be evaluated as a 30-day running average at Crows Landing. The WQO would apply as indicated in Table 1, except during an “extended dry period”. An Extended Dry Period is defined as follows:

An Extended Dry Period is defined using the State Water Resources Control Board’s (SWRCB’s) San Joaquin Valley “60-20-20” Water Year Hydrologic Classification\(^4\) included in revised Water Right Decision 1641 to assign a numeric indicator to a water year type as follows (SWRCB 2000):

- Wet – 5
- Above Normal – 4
- Below Normal – 3
- Dry – 2
- Critically Dry – 1

The indicator values will be used to determine when an Extended Dry Period is in effect:

\(^3\) Section 6.1, Task 4 Report

\(^4\) The method for determining the San Joaquin Valley Water Year Hydrologic Classifications (e.g., critical, dry, below normal, above normal, wet) is defined in the SWRCB Revised Decision 1641, March 2000, Figure 2, page 189. This method uses the best available estimate of the 60-20-20 San Joaquin Valley water year hydrologic classification at the 75% exceedance level using the best available data published in the California Department of Water Resources’ ongoing Bulletin 120 series.
• An Extended Dry Period shall begin when the sum of the current year’s 60-20-20 indicator value and the previous two year’s 60-20-20 indicator values total six (6) or less.

• An Extended Dry Period shall be deemed to exist for one water year (12 months) following a period with an indicator value total of six (6) or less.

Table 1: LSJR Reach 83 EC Objective and Performance Goal for Seasonal and Water Year Considerations (µmhos/cm).

<table>
<thead>
<tr>
<th>Water Year Type</th>
<th>Irrigation Season</th>
<th>Non-irrigation Season</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>March – June</td>
<td>July - October</td>
</tr>
<tr>
<td>Wet</td>
<td>1350 (Performance Goal¹)</td>
<td></td>
</tr>
<tr>
<td>Above Normal</td>
<td>1350 (Performance Goal¹)</td>
<td></td>
</tr>
<tr>
<td>Below Normal</td>
<td>1350 (Performance Goal¹)</td>
<td>1550 (WQO¹)</td>
</tr>
<tr>
<td>Dry</td>
<td>1350 (Performance Goal¹)</td>
<td>1550 (WQO¹)</td>
</tr>
<tr>
<td>Critical</td>
<td>1550 (WQO¹)</td>
<td></td>
</tr>
</tbody>
</table>

1. The EC Performance Goal and EC WQO are subject to relaxation during an Extended Dry Period (see definition above).

During an Extended Dry Period (defined above), the following shall be taken into consideration to ensure that beneficial uses are protected in Reach 83 of the LSJR (as measured at Crows Landing):

• Protection of the potential MUN beneficial use: The EC WQO shall be the Short Term specific conductance secondary MCL level contained in the Water Quality Control Plan (Basin Plan) for the Sacramento River Basin and the San Joaquin River Basin. (Currently incorporated from Table 64449-B of 22 CCR § 64449 at the level of 2,200 µmhos/cm as the average of the previous four (4) consecutive quarterly samples).

• Protection of the AGR beneficial use: The EC WQO shall be 2,470 µmhos/cm as a 30-day running average (derived from the Hoffman model results for 75% crop yield for almonds, 5th percentile rainfall, and 15% leaching fraction).

• Implementation of the Extended Dry Period EC WQO relaxation and/or EC concentrations in Reach 83 above 1,550 µmhos/cm shall not result in requirements for increased water quality releases from New Melones Reservoir to meet Vernalis EC objectives.

The Preferred Alternative also includes the implementation of an EC Performance Goal⁵ of 1,350 µmhos/cm that is recommended to be established throughout the irrigation season for specific water year types (see Table 1). Attainment of the EC Performance Goal in Reach 83 shall be monitored using the 30-day running average at Crows Landing. The 1,350 µmhos/cm EC value was established as a Performance Goal because:

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⁵ The Performance Goal will be used to measure progress towards achievement of EC levels during certain water year types and times of the year that are of higher quality than the proposed EC WQO for Reach 83 of the LSJR.
• The WARMF modeling of the Planned Bundle (Planned Alternative) indicates that, after full implementation of the key actions underway within the LSJR Basin, the ambient water quality within Reach 83 of the LSJR will not exceed an EC value of 1,350 µmhos/cm. However, due to model uncertainty, the WQO was set at 1,550 µmhos/cm which is the value that is reasonably protective of the AGR (irrigation supply water) beneficial use based on Hoffman modeling results (95% crop yield for almonds, 5th percentile rainfall, 15% leaching fraction).

• Agricultural supply water at 1,350 µmhos/cm or lower would provide a higher level of protection during the irrigation season based on Hoffman modeling results.

• Water quality at 1,350 µmhos/cm or better would also help to maintain the soil salinity balance by flushing salt accumulated below the root zone during Extended Dry Periods.

The EC Performance Goal and the Extended Dry Period exception included in the Preferred Alternative are advanced in recognition of the existing AGR and potential MUN beneficial uses that must be supported for the water diverted from Reach 83, as well as the seasonal and annual hydrologic conditions that affect both the quantity and quality of the water in the LSJR. The Performance Goal will be used to measure progress toward achievement of EC levels during the irrigation season of non-Extended Dry Periods when EC levels lower than the EC WQO would be beneficial to agriculture and are considered achievable. The Extended Dry Period exception exists to allow discharges to the LSJR to occur under hydrologic conditions (e.g., low flows and elevated EC levels) when it is anticipated that agriculture will value water availability over water quality. A detailed discussion of the project alternatives considered, including the Preferred Alternative, is provided in Development of a Basin Plan Amendment for Salt and Boron in the Lower San Joaquin River (LSJR): Task 4 – Implementation Planning for Proposed Salinity Objectives (LWA 2015a).

Compliance with the proposed EC WQO is based on a 30-day running average that considers the seasonal components of hydrologic conditions and beneficial uses. Alternatives, including monthly averages and annual averages, were also considered; however, a change in averaging period would not likely change the recommended sample collection frequency considering the availability of high frequency (15 minute) EC measurements throughout the LSJR.

**Boron**

The existing WQOs for boron in Reach 83 are shown in Table 2.

**Table 2. Lower San Joaquin River Boron Water Quality Objectives.**

<table>
<thead>
<tr>
<th>Period of Applicability</th>
<th>Maximum (mg/L)</th>
<th>Monthly Mean (mg/L)</th>
<th>Critical[a] WY Monthly Mean (mg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>March 15th through September 15th</td>
<td>2.0</td>
<td>0.8</td>
<td>1.3</td>
</tr>
<tr>
<td>September 16th through March 14th</td>
<td>2.6</td>
<td>1.0</td>
<td>1.3</td>
</tr>
</tbody>
</table>

[a] – Table IV-3, Basin Plan
Implementation Program

The program of implementation to meet the proposed EC WQO primarily includes the following, already initiated, actions within the San Joaquin River:  

- **Full Implementation of Components of the Real Time Management Program (RTMP)** – RTMP facilitates the control and timing of wetland, agricultural drainage, and/or other discharges to the LSJR to coincide with periods when the LSJR has capacity to assimilate additional salt up to the EC WQO. It is anticipated that the RTMP will be fully implemented by 2020.

- **Full Implementation of the Grassland Bypass Project** – The Grassland Bypass Project prevents discharge of subsurface agricultural drainage water into wildlife refuges and wetlands in central California. The Grassland Bypass Project is scheduled for completion at the end of 2019.

**MONITORING PROGRAM GOALS**

The primary goals of the LSJR Monitoring Program are to evaluate:

1) Compliance with the salinity WQOs and Performance Goal in Reach 83 of the LSJR;
2) The effectiveness of the implementation program.

Based on the information developed in Task 4, these LSJR Monitoring Program goals were expanded into the following, more specific, assessment goals:

- Assess compliance with the EC and boron WQOs in Reach 83 of the LSJR (primary goal No. 1);
- Characterize long-term changes/trends in the ambient EC and boron concentrations within Reach 83 of the LSJR (primary goals No. 1 and No. 2);
- Assess the effectiveness of the implementation program management actions in controlling salt and boron in Reach 83 (primary goal No. 2); and
- Use the LSJR Monitoring Program results to identify potential revisions to the WQOs, Performance Goal, and/or implementation program (primary goals No. 1 and No. 2).

These assessment goals may be modified in the future based on additional information and/or the adaptive management of the implementation program.

**EXISTING MONITORING PROGRAMS**

Existing monitoring efforts in the LSJR are significant and include continuous (typically 15 minute interval) sensors and sample collection at numerous locations within Reach 83 and immediately upstream in the San Joaquin River, Stanislaus River, Tuolumne River, Merced River, Orestimba Creek, Mud Slough, and Salt Slough. The Central Valley Water Board, the United States Geological Survey (USGS), the California Department of Water Resources

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6 Section 6.2, Task 4 Report
7 Primarily electrical conductivity (EC) and boron
8 Section 6.2, Task 4 Report
9 Compliance with the EC WQOs will be based on a 30-day running average
(DWR), and the United States Bureau of Reclamation (USBR) all conduct routine flow and EC and/or boron monitoring that can be used to augment the LSJR Monitoring Program. Upstream tributary sites and diversions were not considered in this evaluation because they do not immediately address the assessment goals. If additional management actions within the upstream tributary drainage areas are identified, these sites may be further considered at that time.

The following monitoring programs are or have collected samples that may be used to address the LSJR Monitoring Program assessment questions:

- **The Central Valley Water Board** previously collected boron and EC samples through the Surface Water Ambient Monitoring Program (SWAMP); however, this monitoring work was completed in 2011.

- **The San Joaquin River Real-time Water Quality Management Program (RTMP)** uses telemetered stream stage and salinity data and computer models to simulate and forecast water quality conditions along the LSJR. Its primary goal is to increase the frequency of maximizing export of salt from the San Joaquin Valley while meeting San Joaquin River salinity WQOs to optimize minimizing high quality releases made specifically for meeting San Joaquin River salinity objectives. DWR, and USBR are cooperating agencies in this program, which has established an extensive network of flow and salinity (EC) continuous (15 minute interval) sensors in the San Joaquin River and all major upstream tributaries. These continuously measured data are reported through the California Data Exchange Center (CDEC).

- Monitoring by the **United States Bureau of Reclamation and the San Luis & Delta-Mendota Water Authority** for the Grassland Drainage discharge to the San Luis Drain is part of the 2010 use agreement (Agreement No. 10-WC-20-2975) that refers to the 2001 Waste Discharge Requirements (Grassland WDR, Order No. 5-01-234) monitoring program. The 2001 WDR was resceded and replaced by Order R5-2015-0094 which requires weekly EC and boron sampling on the San Joaquin River and other upstream tributaries. This WDR monitoring characterizes the effects of the Grassland Bypass Project to reduce selenium and boron loading to surrounding wetlands and refuges, as well as the San Joaquin River.

- **The Irrigated Lands Regulatory Program (ILRP)** requires monitoring through a WDR for agricultural non-point discharges. The **Westside San Joaquin River Coalition 2014 WDR** includes boron and EC monitoring on the San Joaquin River upstream of Reach 83. Other ILRP WDRs includes upstream tributary monitoring.

- **The City of Turlock and City of Modesto** publically owned treatment works (POTWs) monitor EC at locations above and below their discharges between Crows Landing and Maze Road during periods of discharge.

Table 3 and Table 4 summarize the best available data in the mainstem of Reach 83 and the immediate proximity. The data are of high quality and are readily available through the CDEC or the California Environmental Data Exchange Network (CEDEN). Figure 1 identifies the locations of each of these San Joaquin River mainstem sites.

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10 [http://www.water.ca.gov/waterquality/sjr_realtime/map/index.cfm](http://www.water.ca.gov/waterquality/sjr_realtime/map/index.cfm)

11 Receiving water is monitored during periods of POTW discharge.
<table>
<thead>
<tr>
<th>Source Program</th>
<th>Frequency</th>
<th>Location</th>
<th>Flow</th>
<th>EC</th>
<th>Boron</th>
<th>Site ID</th>
<th>Begin Date</th>
<th>End Date</th>
<th>Agency</th>
<th>Real-Time Program</th>
<th>Flow</th>
<th>EC</th>
<th>Boron</th>
<th>Site ID</th>
<th>Begin Date</th>
<th>End Date</th>
<th>Agency</th>
<th>Real-Time Program</th>
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<tr>
<td>CEDEN SWAMP</td>
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<td>Vernalis</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>541SJC501</td>
<td>1995</td>
<td>Present</td>
<td>SJR</td>
<td>VER</td>
<td>VNS</td>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<td>Central Valley Water Board</td>
<td>Weekly</td>
<td>Maze Road</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>541STC510</td>
<td>1995</td>
<td>2007</td>
<td>MRB</td>
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<td>Present</td>
<td>Present</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>USBR Grasslands</td>
<td>Weekly</td>
<td>Patterson</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>541STC507</td>
<td>1995</td>
<td>2000</td>
<td>SJP</td>
<td>Present</td>
<td>Present</td>
<td>Present</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>CDEC Real-Time Program</td>
<td>Continuous</td>
<td>Crows Landing Bridge</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>535STC504</td>
<td>1995</td>
<td>2011</td>
<td>SCL</td>
<td>2004</td>
<td></td>
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<td></td>
<td></td>
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<td></td>
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<tr>
<td>CDEC Real-Time Program</td>
<td>Continuous</td>
<td>Newman [Flow Only]</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>535STC504</td>
<td>1995</td>
<td>Present</td>
<td>NEW [flow]</td>
<td>1995</td>
<td>Present</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: POTW river monitoring currently comprise weekly EC grab samples upstream and downstream of the effluent outfalls during periods of discharge. Both effluent outfalls are between the Merced and Tuolumne rivers. The Regional Board has recently been modifying NPDES permits to include the option of participating in the Delta Regional Monitoring Program in lieu of receiving water monitoring.

12 Flow monitoring is not required by this effort but is useful for assessing the Preferred Alternative WQO and recommended Performance Goal.
Table 4. Electrical Conductivity and Boron Monitoring in the San Joaquin River Upstream of Reach 83.

<table>
<thead>
<tr>
<th>Source Program</th>
<th>Program</th>
<th>Source</th>
<th>Agency</th>
<th>Frequency</th>
<th>Flow</th>
<th>EC</th>
<th>Flow</th>
<th>EC</th>
<th>Flow</th>
<th>EC</th>
<th>Flow</th>
<th>EC</th>
</tr>
</thead>
<tbody>
<tr>
<td>SWAMP Grasslands</td>
<td>CEDEN</td>
<td>CEDEN</td>
<td>CDEC</td>
<td>CDEC</td>
<td>CDEC</td>
<td>CDEC</td>
<td>ILRP</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Central Valley Water Board</td>
<td>UD</td>
<td>USBR</td>
<td>DWR</td>
<td>USBR</td>
<td>USGS</td>
<td>WSJRC</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Frequency</td>
<td>Weekly</td>
<td>Weekly</td>
<td>Continuous</td>
<td>Continuous</td>
<td>Continuous</td>
<td>Monthly</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flow</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EC</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boron</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Location

**Hills Ferry**
- Site ID: 541STC512
- Begin Date: 1985
- End Date: 2007

**Fremont Ford**
- Site ID: 541MER538
- Begin Date: 1995
- End Date: 2011

**Stevenson/Lander Ave.**
- Site ID: 541MER522
- Begin Date: 1995
- End Date: 2011

Note: POTW river monitoring currently comprise weekly EC grab samples upstream and downstream of the effluent outfalls during periods of discharge. Both effluent outfalls are between the Merced and Tuolumne rivers. The Regional Board has recently been modifying NPDES permits to include the option of participating in the Delta Regional Monitoring Program in lieu of receiving water monitoring.

13 Flow monitoring is not required by this effort but is useful for assessing the Preferred Alternative WQO and recommended Performance Goal.
Figure 1. Project Location, Management Action Areas, and Sampling Locations.
Effectiveness Assessment of Management Actions by Other Groups

The Grassland Bypass Project and the RTMP are the most significant implementation actions that will affect EC and boron concentrations upstream and within Reach 83. The effectiveness of the Grassland Bypass Project will be characterized through the WDR monitoring performed by USBR in the San Joaquin River, Mud Slough, and the San Luis Drain. These WDR data are sufficient to characterize loads of salinity and boron from most significant management action areas, thus, no further monitoring is necessary.

The RTMP effectiveness will be assessed through RTMP sensors and ongoing assessments at Vernalis and other locations. Additionally, changes in discharges to Reach 83 will also be assessed through salinity compliance reporting by POTWs and other regulated entities.

PROPOSED LONG-TERM MONITORING AND REPORTING PROGRAM

The availability of existing monitoring program data and the ability to answer the four assessment goals (described above) comprised the criteria considered to develop the proposed monitoring program.

Availability of Existing Monitoring Data

The previous section summarized readily available data (Table 3 and Table 4) in and adjacent to LSJR Reach 83 (Figure 1). The eight San Joaquin River locations and the two POTW data sources were considered for inclusion in the monitoring program. There are other active and inactive monitoring locations that could be included, especially for assessment of the management actions. However, the identified locations consist of established sites with a historic record of monitoring and readily available data through CEDEN, CDEC, and Central Valley Water Board reporting and were chosen to assist in the primary goal of compliance with the salinity-related WQOs and Performance Goal in Reach 83 of the LSJR. The location, type, and frequency of sample collection are further developed through consideration of the four assessment goals.

Assessment Goal Consideration

The proposed monitoring program should address all four of the assessment goals, which support the two primary goals.

Assess Compliance with the EC and Boron Water Quality Objectives

The first LSJR Monitoring Program primary goal is to assess compliance with the proposed EC and existing boron WQOs. The goal will also facilitate the assessment of compliance with the recommended EC Performance Goal. The Preferred Alternative WQO and Performance Goal for EC will require either the use of continuous sensors or daily sample collection to obtain the data necessary to calculate accurate 30-day running averages. To evaluate the existing boron WQOs would initially require sample collection on a weekly basis for comparison to the monthly average, to determine variability, and to determine if existing water quality frequently nears or exceeds the criteria.
Characterize Long-term Changes/Trends in the Ambient EC and Boron Concentrations within Reach 83 of the LSJR

Trends are best assessed with higher frequency data collection, especially if the system experiences changing flow conditions and has a large number of factors that could contribute to the concentration and loading of salinity and boron. Trends in the data collected can be assessed through statistical comparisons that determine if differences over time are random in nature or systematic. Less frequent quarterly or annual sample collection would not adequately characterize the effects of management actions, dam releases, or climate change over time relative to the rate of change and overall variability of flow, weather conditions, and water resource management. While more frequent data collection improves statistical power to identify changes in complex systems, the assessment duration, data variability, and the magnitude of the change in conditions are also considerations when designing sample collection plans. Without specified assessment periods or allowable condition changes, the existing LSJR sensor data collection programs provide reasonable statistical power for future assessments.

Assess the Effectiveness of the Implementation Program Management Actions in Controlling Salt and Boron

The management actions could be considered factors in the system affecting the downstream water quality. In this way assessment of the WQOs attainment measures the effectiveness of these programs, especially if other factors in the system (e.g. stream conditions, groundwater contributions) are well known. Because the existing management actions are expected to have significant benefits to downstream salt loads, attainment of the proposed and existing WQOs and recommended Performance Goal can indicate successful management action implementation. In cases where management actions make only small changes, it may not be possible to statistically identify changes in these downstream “integrator” sites. Future smaller scale studies at the management action locations could provide direct measurement of load reductions and effectiveness of the individual management action. Management actions should be evaluated both on the downstream water quality changes as well as the downstream load changes.

Use the LSJR Monitoring Program Results to Identify Potential Revisions to the WQOs and/or implementation Program

Revisions to WQOs and the implementation program would be based on a number of sources including data collected under the LSJR Monitoring Program. The LSJR monitoring program should provide data sufficient to characterize WQO and Performance Goal attainment, including the duration and magnitude of WQO and Performance Goal exceedances, if any. Data collection should support existing and expected modeling efforts that are used to characterize water flow and quality conditions and evaluate implemented, planned, and proposed management actions. Based on the aforementioned information in this report, it was determined that the recommended LSJR Monitoring Program goals can be met through existing monitoring locations, constituents, and sample collection frequency. Future management actions should include sufficient assessment monitoring to characterize their benefit to both water quality and salt load reductions. The recommended approach is shown in Table 5 and Table 6 and described below.
Electrical Conductivity

The Preferred Alternative EC WQO and Performance Goal would, at a minimum, require daily sample collection on LSJR at Maze Road and Crows Landing. While daily sample collection would be sufficient to calculate a 30-day running average, daily average values capture time-of-day bias and changes that may occur during a day. Daily average values at these locations should be calculated by existing programs based on sensor values that are field calibrated and supplemented with calibration measurements as is done as part of the RTMP. Existing stations at the proposed locations can provide these data. Thus, no additional sample collection would be necessary. **Table 5** summarizes the recommended monitoring locations, collection entity, type, and frequency.

**Table 5. Recommended Electrical Conductivity Monitoring Locations, Collection Approach, and Frequency.**

<table>
<thead>
<tr>
<th>San Joaquin River Location</th>
<th>Sample Collection Entity</th>
<th>EC WQO Assessment</th>
<th>Sample Collection Type</th>
<th>Sample Collection Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maze Road</td>
<td>DWR</td>
<td>30 day running average</td>
<td>continuous sensor</td>
<td>15 minute data to calculate daily average</td>
</tr>
<tr>
<td>Crows Landing Bridge</td>
<td>USGS</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Locations**

The existing USGS and DWR continuous EC sensors within LSJR Reach 83 can be used to characterize compliance at the proposed locations:

- Maze Road - characterizes water quality between the Tuolumne and Stanislaus Rivers, and
- Crows Landing - characterizes water quality between the Merced and Tuolumne Rivers.

Selection of these two sites sufficiently characterizes Reach 83 with respect to the location of major tributaries and point sources, and includes the WQO compliance point for the proposed action (Crows Landing) and a location upstream (Maze Road) of the Vernalis compliance point (see **Figure 1**). The downstream boundary of the LSJR, Vernalis, could also be used to characterize the portion of Reach 83 downstream of the Stanislaus River. This location may be used to characterize the overall condition of the LSJR.

**Frequency**

The RTMP sensors report values every 15 minutes that can be used to calculate a daily average value and the resultant 30-day rolling average or another WQO compliance period that may be identified. Until the variability in the data is determined, the “continuous” data are recommended because of their availability, use within the RTMP, and higher resolution to better characterize variability and trends or the effects of management actions.

**Boron**

Compliance with the existing Basin Plan WQOs for maximum and monthly average boron concentrations can be assessed at Crows Landing Bridge using the weekly Grassland’s sample collection. Apart from Crows Landing Bridge, there are no other active monitoring locations where weekly boron samples are collected within the LSJR Reach 83. **Table 6** summarizes the recommended monitoring locations, collection entity, type, and frequency.
Table 6. Recommended Boron Monitoring Locations, Collection Approach, and Water Quality Objective Assessment.

<table>
<thead>
<tr>
<th>San Joaquin River Location</th>
<th>Sample Collection Entity</th>
<th>Boron WQO Assessment</th>
<th>Sample Collection Type</th>
<th>Sample Collection Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maze Road</td>
<td>None</td>
<td>TBD</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Crows Landing Bridge</td>
<td>Grasslands Project</td>
<td>Calculation of monthly average based on available weekly samples WQO and single sample comparisons to maximum WQO</td>
<td>Discrete grab samples</td>
<td>Weekly</td>
</tr>
</tbody>
</table>

**Locations**

The boron WQO applies to the entirety of Reach 83 and does not specifically identify one compliance point. An assessment program would then ideally consider the three sections above and below the Stanislaus and Tuolumne River as was proposed for EC. However, sample collection at the Crows Landing Bridge can be used to assess beneficial use protection, as it would be expected to have the highest boron concentration. Attainment of the boron objective at this location suggests downstream attainment, where the influence of the Tuolumne and Stanislaus Rivers would improve water quality. Upstream management actions include those upstream of Reach 83, and resultant changes would be adequately characterized by upstream monitoring in coordination with Crows Landing Bridge monitoring. If results exceed the boron Basin Plan WQOs at Crows Landing Bridge, then additional locations at Maze Road and Vernalis may be considered to further characterize LSJR Reach 83.

**Frequency**

Until the Grassland Bypass Project is completed and sufficient time has elapsed to demonstrate continuous compliance, weekly sample collection is recommended for the purpose of calculating a monthly average. Reliable boron continuous sensors are not currently available; however, surrogate relationships between parameters such as EC and boron may be further evaluated to better understand trends and the effect of implementation programs.

Changes to the monitoring program could be made as part of the WQO assessment process and should be targeted to address specific trend changes, characterize specific segments, or better evaluate specific sources or management actions. Design of this additional monitoring would be based on existing data, modeling information, and best professional judgment to meet the monitoring objectives. For example, if an episodic exceedance of boron occurred for unknown reasons at Crows Landing Bridge during the same month in multiple years, additional sample collection of upstream tributaries could be scheduled for that month in the following year(s). Also, additional sample collection in that month at Maze Road and Vernalis would further characterize Reach 83 WQO objective compliance. In many cases data collected by others would be sufficient and additional sample collection might not be necessary.

Finally, the proposed LSJR Monitoring Program and other existing efforts as described above will provide a robust data set that can be used to measure the cumulative effect of all salinity management actions. As a result, no new monitoring to assess the effectiveness of a specific management action is recommended at this time. However, because the monitoring program relies on other external programs, it is important that those efforts are supported and tracked, especially where improvements or changes are proposed.
REPORTING

Data for the RTMP sensors (USBR, USGS and DWR) are reported and archived through CDEC. There is currently no specific SWAMP guidance for continuous sensors; however, the continuous sensor programs used by these agencies follow the intent of the SWAMP Quality Assurance Project Plan (QAPP) approach. Without implementation of continuous data QA computer software, continuous sensor data should be reviewed to identify out-of-range results in the 15 minute interval dataset and the performance of calibration samples should be considered. Boron and EC grab samples reported through CEDEN by the Grassland Bypass Project are collected according to their QAPP requirements and are consistent with SWAMP guidance as approved by the Central Valley Water Board in support of the Grassland Project Revised Monitoring Program document.14

To meet requirements of the Federal Clean Water Act and section 303(c) and Water Code section 13240, the Central Valley Water Board reviews the water quality standards contained in the Basin Plans every three years. However, the Basin Plan section IV LSJR Salt and Boron implementation specifies “The Regional Water Board will review and update the load allocations and waste load allocations by 28 July 2012 and every 6 years thereafter.” While this is specific to the TMDL allocations, it is a more feasible review cycle to observe trends in ambient water quality and the protection of beneficial uses for both the proposed EC WQO and the existing boron WQO. Thus, the six year review cycle tied to TMDL assessment is recommended unless stakeholders initiate or request a more frequent assessment or the Central Valley Water Board identifies another schedule or process to perform this assessment. Establishment of a regional monitoring program as it becomes available could change monitoring regimes in the future.

Adaptive management of the monitoring and assessment program may be necessary based on the Central Valley Water Board’s review of WQO attainment. Recommended monitoring or assessment actions from this review may be performed by other stakeholders or regulated parties. Actions initiated by other regulatory programs (e.g., Grassland Bypass Project, NPDES permits, etc.) should be evaluated in light of the goals and proposed components of this program.

REFERENCES


ENVIRONMENTAL CHECKLIST

The Central Valley Regional Water Quality Control Board (Central Valley Water Board or Board), as a Lead Agency under the California Environmental Quality Act (CEQA), is responsible for evaluating all the potential environmental impacts that may occur because of changes made to the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins (Basin Plan). (Public Resources Code, Section 21000 et seq.) The Secretary of Resources has determined that the Central Valley Water Board’s Basin Planning Process qualifies as a certified regulatory program pursuant to Public Resources Code Section 21080.5 and California Code of Regulations, Title 14, Section 15251(g). This determination means that the Central Valley Water Board’s Basin Planning process needs only to comply with abbreviated CEQA requirements. The Staff Report and this Checklist satisfy the requirements of State Water Board’s Regulations for Implementation of CEQA, Exempt Regulatory Programs, which are found at California Code of Regulations, Title 23, Section 3775 et seq.

PROJECT INFORMATION

1. Project Title: Development of a Basin Plan Amendment for Salt and Boron in the Lower San Joaquin River (LSJR)

   LSJR Reach 83 EC Objective and EC Performance Goal for Seasonal and Water Year Considerations

2. Lead Agency Name and Address: Central Valley Regional Water Quality Control Board

   11020 Sun Center Drive, #200, Rancho Cordova, CA 95670

3. Contact Person and Phone Number: James Brownell, Engineering Geologist

   (916) 464-4675

   Anne Littlejohn, Senior Environmental Scientist

   (916) 464-4840

   Jeanne Chilcott, Environmental Program Manager

   (916) 464-4788

4. Project Location: The project is located within the Lower San Joaquin River watershed, in the Central Valley within portions of San Joaquin, Stanislaus, Merced, Madera, and Fresno Counties. Reach 83 of the Lower San Joaquin River is where proposed salinity objectives would apply and is defined as that segment of the San Joaquin River from the mouth of the Merced River to Vernalis.

5. Project Sponsor’s Name and Address: Lower San Joaquin River Committee through coordination with CV-SALTS

6. General Plan Designation: N/A (multiple jurisdictions)

7. Zoning: N/A (multiple jurisdictions)

8. Description of Project: (Describe the whole action involved, including but not limited to later phases of the project, and any secondary, support, or off-site features necessary for its implementation. Attach
additional sheets if necessary.)

The proposed action (Preferred Alternative) is to adopt an electrical conductivity (EC) water quality objective (WQO) and an EC Performance Goal for seasonal and water year considerations in Reach 83 of the Lower San Joaquin River (LSJR), as shown in Table 1. The proposed EC WQO and EC Performance Goal are protective of the existing agricultural irrigation supply water (AGR) beneficial use and the potential municipal and domestic supply (MUN) beneficial use designated in Reach 83. The WQO and Performance Goal consider agriculture’s seasonal demands for water diverted from Reach 83, while at the same time accounting for the fact that ambient water quality conditions are greatly influenced by the hydrologic conditions, including the presence of return flows, in the San Joaquin River Basin.

The Preferred Alternative includes an EC WQO of 1,550 µmhos/cm. Compliance with the WQO in Reach 83 shall be evaluated as a 30-day running average at Crows Landing. The WQO would apply as indicated in Table 1, except during an “extended dry period”. An Extended Dry Period is defined as follows:

An Extended Dry Period is defined using the State Water Resources Control Board’s (SWRCB’s) San Joaquin Valley “60-20-20” Water Year Hydrologic Classification included in Revised Water Right Decision 1641 to assign a numeric indicator to a water year type as follows (SWRCB 2000):

- Wet – 5
- Above Normal – 4
- Below Normal – 3
- Dry – 2
- Critically Dry – 1

The indicator values will be used to determine when an Extended Dry Period is in effect:

- An Extended Dry Period shall begin when the sum of the current year’s 60-20-20 indicator value and the previous two year’s 60-20-20 indicator values total six (6) or less.
- An Extended Dry Period shall be deemed to exist for one water year (12 months) following a period with an indicator value total of six (6) or less.

During an Extended Dry Period (defined above), the following shall be taken into consideration to ensure that beneficial uses are protected in Reach 83 of the LSJR (as measured at Crows Landing):

- **Protection of the potential MUN beneficial use:** The EC WQO shall be the Short Term specific conductance secondary MCL level contained in the Water Quality Control Plan (Basin Plan) for the Sacramento River Basin and the San Joaquin River Basin. (Currently incorporated from Table 64449-B of 22 CCR § 64449 at the level of 2,200 µmhos/cm as the average of the previous four (4) consecutive quarterly samples).
- **Protection of the AGR beneficial use:** The EC WQO shall be 2,470 µmhos/cm as a 30-day running average (derived from the Hoffman model results for 75% crop yield for almonds, 5th percentile rainfall, and 15% leaching fraction).
- **Implementation of the Extended Dry Period EC WQO relaxation and/or EC concentrations in**

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3 Reach 83 is defined as that segment of the San Joaquin River from the mouth of the Merced River to Vernalis.
2 The method for determining the San Joaquin Valley Water Year Hydrologic Classification (e.g., critical, dry, below normal, above normal, wet) is defined in the SWRCB Revised Water Right Decision 1641, March 2000, Figure 2, page 189. This method uses the best available estimate of the 60-20-20 San Joaquin Valley water year hydrologic classification at the 75% exceedance level using the best available data published in the California Department of Water Resources’ ongoing Bulletin 120 series.
Reach 83 above 1,550 µmhos/cm shall not result in requirements for increased water quality releases from New Melones Reservoir to meet Vernalis EC objectives.

Table 1: LSJR Reach 83 EC Objective and Performance Goal for Seasonal and Water Year Considerations (µmhos/cm).

<table>
<thead>
<tr>
<th>Water Year Type</th>
<th>Irrigation Season</th>
<th>Non-irrigation Season</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>March – June</td>
<td>July – October</td>
</tr>
<tr>
<td>Wet</td>
<td>1350 (Performance Goal)</td>
<td></td>
</tr>
<tr>
<td>Above Normal</td>
<td>1350 (Performance Goal)</td>
<td></td>
</tr>
<tr>
<td>Below Normal</td>
<td>1350 (Performance Goal)</td>
<td>1550 (WQO)</td>
</tr>
<tr>
<td>Dry</td>
<td>1350 (Performance Goal)</td>
<td></td>
</tr>
<tr>
<td>Critical</td>
<td></td>
<td>1550 (WQO)</td>
</tr>
</tbody>
</table>

1. The EC Performance Goal and EC WQO are subject to relaxation during an Extended Dry Period (see definition above).

The Preferred Alternative also includes the implementation of an EC Performance Goal4 of 1,350 µmhos/cm that is recommended to be established during the irrigation season for specific water year types (see Table 1). Attainment of the EC Performance Goal in Reach 83 shall be evaluated as a 30-day running average at Crows Landing. The 1,350 µmhos/cm EC value was established as a Performance Goal because:

- The Watershed Analysis Risk Management Framework (WARMF) modeling of the Planned Bundle (Planned Alternative) indicates that, after full implementation of the key actions underway within the LSJR Basin, the ambient water quality within Reach 83 of the LSJR will not exceed an EC value of 1,350 µmhos/cm. However, due to model uncertainty, the WQO was set at 1,550 µmhos/cm which is the value that is reasonably protective of the AGR (irrigation supply water) beneficial use based on Hoffman modeling results (95% crop yield for almonds, 5th percentile rainfall, 15% leaching fraction).
- Agricultural supply water at 1,350 µmhos/cm or lower would provide a higher level of protection during the irrigation season based on Hoffman modeling results.
- Water quality at 1,350 µmhos/cm or better would also help to maintain the soil salinity balance by flushing the salt accumulated below the root zone during Extended Dry Periods.

The EC Performance Goal and the Extended Dry Period exception included in the Preferred Alternative are advanced in recognition of the existing AGR and potential MUN beneficial uses that must be supported for the water diverted from Reach 83, as well as the seasonal and annual hydrologic conditions that affect both the quantity and quality of the water in the LSJR. The Performance Goal will be used to measure progress toward achievement of EC levels during the irrigation season of non-Extended Dry Periods when EC levels lower than the EC WQO would be beneficial to agriculture and are considered achievable. The Extended Dry Period exception exists to allow discharges to the LSJR to occur under hydrologic conditions (e.g., low flows and elevated EC levels) when it is anticipated that agriculture will value water availability over water quality. A detailed discussion of the project alternatives considered, including the Preferred Alternative, is provided in Development of a Basin Plan Amendment for Salt and Boron in the Lower San Joaquin River (LSJR): Task 4 – Implementation Planning for Proposed Salinity Objectives (LWA 2015a).

Based on Watershed Analysis Risk Management Framework (WARMF) modeling results, the proposed

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4 The Performance Goal will be used to measure progress towards achievement of EC levels during certain water year types and times of the year that are of higher quality than the proposed EC WQO for Reach 83 of the LSJR.
1,550 µmhos/cm EC WQO associated with the Preferred Alternative is expected to reliably be met in the San Joaquin River at Crows Landing with implementation of a small number of planned actions to manage/reduce salts that were modeled for the Preferred Alternative. The planned actions included in the Preferred Alternative, some of which have or will undergo their own environmental review pursuant to CEQA, are listed in Table 2. These planned actions, included as part of the Preferred Alternative, are described in detail in the Task 4 Report (LWA 2015a). All of the actions included in Table 2 are already planned to occur in the project area during the next 5 – 10 years, independent of the establishment of the proposed 1,550 µmhos/cm EC WQO. The planned action expected to provide the most significant salinity load reductions to Reach 83 of the LSJR based on WARMF modeling is the completion of the Grassland Bypass Project (GBP). The GBP was initiated in 1995 and is scheduled to be completed at the end of 2019.

**Table 2: Planned Actions in Reach 83 of the Lower San Joaquin River that Will Assist in Meeting the Preferred Alternative’s Proposed Electrical Conductivity Water Quality Objective.**

<table>
<thead>
<tr>
<th>Planned Action</th>
<th>Subject to CEQA Review?</th>
<th>CEQA Reference Relevant to Preferred Alternative</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Controlled Timing of Salinity Discharges</td>
<td>Yes</td>
<td>See actions 12a and 12b</td>
</tr>
<tr>
<td>2c. Reduce Point Sources of Salinity (Implementation of POTW salinity management plan)</td>
<td>No</td>
<td>------</td>
</tr>
<tr>
<td>3a. Reduce Nonpoint Sources of Salinity (Reduction in nitrogen fertilizer application)</td>
<td>No</td>
<td>------</td>
</tr>
<tr>
<td>8b. Water Conservation – Optimize Existing Irrigation Efficiency</td>
<td>No</td>
<td>------</td>
</tr>
<tr>
<td>9a. Installation of New High Efficiency Irrigation and Delivery Systems</td>
<td>No</td>
<td>------</td>
</tr>
<tr>
<td>12b. Drainage Water Recirculation – Tilewater Recovery</td>
<td>Yes</td>
<td>No tilewater recovery projects currently planned identified in the project area.</td>
</tr>
</tbody>
</table>
As the establishment of future effluent limitations for salinity in the National Pollutant Discharge Elimination System (NPDES) permits issued to the Cities of Modesto and Turlock for operation of their wastewater treatment facilities are not a component of the proposed action, future salinity-related effluent limitations for these facilities will need to consider the proposed EC WQO of 1,550 µmhos/cm, if adopted. The Central Valley Water Board, the entity responsible for developing effluent limitations and issuing NPDES permits, is required to adopt effluent limitations that protect the AGR (irrigation water supply) and MUN (municipal and domestic supply) beneficial uses in the LSJR, that do not impact the attainment of the existing Vernalis EC objectives, and that comply with State and federal antidegradation policies. While future EC effluent limitations for the Cities of Modesto and Turlock cannot be developed at this time (i.e., prior to the expiration of each city’s current NPDES permit), future NPDES permitting determinations, as they relate to the discharge of salts to Reach 83, are a foreseeable outcome of the proposed action and will need to account for the continued effects of water conservation, water supply constraints, and Extended Dry Periods. The proposed EC WQO or Performance Goal for Reach 83 is not expected to result in the need to construct supplementary facilities or additions to the existing wastewater treatment facilities in the Cities of Modesto and Turlock. Considerations regarding the implementation of proposed EC WQOs in NPDES permits governing discharges to Reach 83 are included in Appendix D of the Task 4 Report (LWA 2015a).

Proposed Program of Implementation

In addition to the actions already being implemented within the San Joaquin River Basin (Basin), the following are key actions that would assist in meeting the proposed EC WQO:

- **Full Implementation of Components of the Real Time Management (RTM) Program** - The RTM is an umbrella program to optimize/maximize the export of salt from groundwater, perched zones, and agricultural drain water from the LSJR Basin while ensuring that salinity and boron WQOs are met at Vernalis. The Central Valley Water Board has approved the RTMP in the Basin Plan as an alternative salt management strategy in lieu of monthly salt load allocations enforced by the Central Valley Water Board. RTM facilitates the control and timing of wetland, agricultural drainage, and/or other discharges to the LSJR to coincide with periods when the river has capacity to assimilate additional salts up to a WQO. It is anticipated that the RTM Program would be fully implemented by 2020.

- **Full Implementation of the Grassland Bypass Project** - Initiated in 1996, the Grassland Bypass Project (GBP) has prevented subsurface drainage discharges with elevated levels of selenium, salt and boron from entering channels supplying wetland habitat by consolidating and then discharging the drainage via a portion of the San Luis Drain to Mud Slough and then to the LSJR. In addition, the Grassland Bypass Project has progressively reduced the loads of these constituents entering the San Luis Drain by approximately 80 percent, 63 percent, and 63 percent, respectively, since the project was implemented. Phase I of the GBP was operated under waste discharge requirements (WDRs) issued in 1998 and Phase II was covered by a 2001 WDR update. New WDRs were adopted by the Central Valley Water Board in July 2015 for Phase III of the project, which is located in the Grassland watershed sub-basin of the San Joaquin River Basin. It is projected, based on Watershed Analysis Risk Management Framework (WARMF) modeling results, that the Preferred Alternative EC WQO of 1,550 µmhos/cm should be consistently achieved after full implementation of the GBP. The GBP is currently scheduled to be completed by December 31, 2019. As such, the effective date of the proposed action should be established to coincide with the completion of the GBP.

- **Water Quality Monitoring** - Routine EC and boron monitoring would be conducted in the LSJR at Crows Landing and Maze Road Bridge to assess compliance with the proposed EC WQO and EC Performance Goal and the existing boron WQOs for Reach 83 to determine the effectiveness of the implementation program. A long-term monitoring and reporting program, carried out under either one or more existing ambient water quality monitoring programs or established as a separate entity, will be developed to determine compliance with the EC WQO and Performance Goal in Reach 83, as well as evaluate the effectiveness of the implementation program. The long-term monitoring and reporting program are described in detail in the Task 6 Memorandum written in support of the proposed project (LWA 2015b).
The RTM Program and Grassland Bypass Project have previously been approved by the Central Valley Water Board. Consequently, the environmental checklist is not required to consider the effects of these actions that are identified as helping the Basin meet the proposed EC WQO.

Direct and Indirect Physical Environmental Effects
Implementation of the key actions above, in addition to the actions already being implemented within the Basin, are anticipated to meet the EC WQO that would be promulgated by the proposed action. The proposed action also includes establishment of an EC Performance Goal in Reach 83 and routine EC and boron monitoring in the LSJR at Crows Landing and Maze Road Bridge. The EC and boron monitoring would not result in adverse physical effects to the environment. The proposed action would not result in any direct or indirect environmental effects that have not already been evaluated in other CEQA documents for other approvals.

Comments Received
The Central Valley Water Board hosted a public scoping meeting for the proposed action on March 30, 2009. Public comments were received until April 15, 2009. A list of the commenters and their respective organizations is presented in Table 3. The Central Valley Water Board took into consideration all comments received when selecting the proposed action. Additionally, copies of the letters are attached in Appendix A.

Table 3
List of Commenters

<table>
<thead>
<tr>
<th>Letter Number</th>
<th>Commenter</th>
<th>Date</th>
<th>Agency/Organization</th>
<th>Topic/Concern</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Daniel B. Cozad</td>
<td>3/16/2009</td>
<td>Central Valley Salinity Coalition (CV SALTS)</td>
<td>Coordination amongst CV SALTS and Central Valley Water Board for establishing standards for SJR</td>
</tr>
<tr>
<td>2</td>
<td>Dustin Cooper</td>
<td>4/14/2009</td>
<td>San Joaquin River Exchange Contractors Water Authority</td>
<td>Consistency of the SED under CEQA</td>
</tr>
<tr>
<td>3</td>
<td>Kenneth Petruzzelli</td>
<td>4/14/2009</td>
<td>San Joaquin River Group</td>
<td>Evaluate beneficial uses; CALSIM II modeling; Real Time Management program</td>
</tr>
<tr>
<td>4</td>
<td>Karna E. Harrigfeld</td>
<td>4/15/2009</td>
<td>Stockton East Water District</td>
<td>Timeline; identifying salt sources; reduced flows because of TMDL</td>
</tr>
<tr>
<td>5</td>
<td>Dante John Nomellini, Jr.</td>
<td>4/15/2009</td>
<td>Central Delta Water Agency/South Delta Water Agency</td>
<td>Establishing salinity and boron objectives above Vernalis</td>
</tr>
<tr>
<td>6</td>
<td>Deeanne M. Gillick</td>
<td>4/15/2009</td>
<td>County of San Joaquin/San Joaquin County Flood Control and Water Conservation District</td>
<td>Timeline; reduced flows; protection of beneficial uses; New Melones flow</td>
</tr>
<tr>
<td>7</td>
<td>Michelle Light</td>
<td>4/15/2009</td>
<td>U.S. Bureau of Reclamation</td>
<td>Suggested models and methods of analysis</td>
</tr>
</tbody>
</table>

9. Surrounding Land Uses and Setting: (Briefly describe the project’s surroundings)
Reach 83 of the LSJR is the applicable segment where proposed salinity levels will apply. Reach 83 flows northwest through the San Joaquin Valley, from the San Joaquin River’s confluence with the Merced River to Vernalis. The land surrounding Reach 83 consists primarily of farmland.

10. Other public agencies whose approval is required: (e.g., permits, financing approval, or participation agreement)
No other subsequent approvals are required for the proposed action.
### ENVIRONMENTAL FACTORS POTENTIALLY AFFECTED:

The environmental factors checked below would be potentially affected by this project, involving at least one impact that is a “Potentially Significant Impact” as indicated by the checklist on the following pages.

<table>
<thead>
<tr>
<th>Aesthetics</th>
<th>Agriculture and Forest Resources</th>
<th>Air Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biological Resources</td>
<td>Cultural Resources</td>
<td>Geology / Soils</td>
</tr>
<tr>
<td>Greenhouse Gas Emissions</td>
<td>Hazards &amp; Hazardous Materials</td>
<td>Hydrology / Water Quality</td>
</tr>
<tr>
<td>Land Use / Planning</td>
<td>Mineral Resources</td>
<td>Noise</td>
</tr>
<tr>
<td>Population / Housing</td>
<td>Public Services</td>
<td>Recreation</td>
</tr>
<tr>
<td>Transportation / Traffic</td>
<td>Utilities / Service Systems</td>
<td>Mandatory Findings of Significance</td>
</tr>
<tr>
<td></td>
<td></td>
<td>None With Mitigation</td>
</tr>
</tbody>
</table>
EVALUATION OF THE ENVIRONMENTAL IMPACTS IN THE CHECKLIST

1. The board must complete an environmental checklist before the adoption of plans or policies for the Basin/208 Planning program as certified by the Secretary for Natural Resources. The checklist becomes a part of the Substitute Environmental Documentation (SED).

2. For each environmental category in the checklist, the board must determine whether the project will cause any adverse impact. If there are potential impacts that are not included in the sample checklist, those impacts should be added to the checklist.

3. If the board determines that a particular adverse impact may occur as a result of the project, then the checklist boxes must indicate whether the impact is “Potentially Significant,” “Less than Significant with Mitigation Incorporated,” or “Less than Significant.”
   a. “Potentially Significant Impact” applies if there is substantial evidence that an impact may be significant. If there are one or more “Potentially Significant Impact” entries on the checklist, the SED must include an examination of feasible alternatives and mitigation measures for each such impact, similar to the requirements for preparing an environmental impact report.
   b. “Less than Significant with Mitigation Incorporated” applies if the board or another agency incorporates mitigation measures into the SED that will reduce an impact that is “Potentially Significant” to a “Less than Significant Impact.” If the board does not require the specific mitigation measures itself, then the board must be certain that the other agency will in fact incorporate those measures.
   c. “Less than Significant” applies if the impact will not be significant, and mitigation is therefore not required.
   d. If there will be no impact, check the box under “No Impact.”

4. The board must provide a brief explanation for each “Potentially Significant,” “Less than Significant with Mitigation Incorporated,” “Less than Significant,” or “No Impact” determination in the checklist. The explanation may be included in the written report described in section 3777(a)(1) or in the checklist itself. The explanation of each issue should identify: (a) the significance criteria or threshold, if any, used to evaluate each question; and (b) the specific mitigation measure(s) identified, if any, to reduce the impact to less than significant. The board may determine the significance of the impact by considering factual evidence, agency standards, or thresholds. If the “No Impact” box is checked, the board should briefly provide the basis for that answer. If there are types of impacts that are not listed in the checklist, those impacts should be added to the checklist.

5. The board must include mandatory findings of significance if required by CEQA Guidelines section 15065.

6. The board should provide references used to identify potential impacts, including a list of information sources and individuals contacted.
1 AESTHETICS

<table>
<thead>
<tr>
<th>ENVIRONMENTAL ISSUES</th>
<th>Potentially Significant Impact</th>
<th>Less Than Significant with Mitigation Incorporated</th>
<th>Less Than Significant Impact</th>
<th>No Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. AESTHETICS. Would the project:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) Have a substantial adverse effect on a scenic vista?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☒</td>
</tr>
<tr>
<td>b) Substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☒</td>
</tr>
<tr>
<td>c) Substantially degrade the existing visual character or quality of the site and its surroundings?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☒</td>
</tr>
<tr>
<td>d) Create a new source of substantial light or glare which would adversely affect day or nighttime views in the area?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☒</td>
</tr>
</tbody>
</table>

1.1.1 Discussion

The project area stretches from the Merced River to Vernalis through San Joaquin and Stanislaus counties near the cities of Manteca, Ripon, Modesto, and Turlock. The project site borders lands designated for agricultural activities by both counties. Interstate 5 (I-5) runs though the southwest of Stanislaus County and branches off into Interstate 580 (I-580) which extends along the southwest of San Joaquin County. Caltrans designates these segments as State Scenic Highway (Caltrans 2011a; 2011b).

The proposed action involves establishing a new EC WQO that primarily would be met through the implementation completion of the previously approved RTM Program and completion of the Grassland Bypass Project. The new salinity objective was developed in consideration of State and federal regulations, including the State’s Sources of Drinking Water Policy, the Basin Plan, State and federal water regulations, and other State and federal requirements relevant to drinking water, stock drinking water, agricultural irrigation uses, and aquatic life protection. The proposed action also includes establishment of an EC Performance Goal in Reach 83 and routine EC and boron monitoring in the LSJR at Crows Landing and Maze Road Bridge. The action’s primary objective is to protect the AGR (irrigation supply water) beneficial use in Reach 83 of the LSJR. Implementation would not require any physical disturbance or ground moving activities, or any other physical effect that may affect aesthetic resources. Project operation would not include any new sources of light or nighttime glare nor would implementation affect the integrity of any State Scenic Highway. The project would result in no impact.
II. AGRICULTURE AND FOREST RESOURCES.

In determining whether impacts to agricultural resources are significant environmental effects, lead agencies may refer to the California Agricultural Land Evaluation and Site Assessment Model (1997, as updated) prepared by the California Department of Conservation as an optional model to use in assessing impacts on agriculture and farmland. In determining whether impacts to forest resources, including timberland, are significant environmental effects, lead agencies may refer to information compiled by the California Department of Forestry and Fire Protection regarding the state’s inventory of forest land, including the Forest and Range Assessment Project and the Forest Legacy Assessment project; and forest carbon measurement methodology provided in Forest Protocols adopted by the California Air Resources Board.

Would the project:

a) Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance (Farmland), as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to non-agricultural use? □ □ □ ×

b) Conflict with existing zoning for agricultural use or a Williamson Act contract? □ □ □ ×

c) Conflict with existing zoning for, or cause rezoning of, forest land (as defined in Public Resources Code section 12220(g)), timberland (as defined by Public Resources Code section 4526), or timberland zoned Timberland Production (as defined by Government Code section 51104(g))? □ □ □ ×

d) Result in the loss of forest land or conversion of forest land to non-forest use? □ □ □ ×

e) Involve other changes in the existing environment, which, due to their location or nature, could result in conversion of Farmland to non-agricultural use or conversion of forest land to non-forest use? □ □ □ ×

2.1.1 Discussion

The project area contains several urban areas, such as the cities of Modesto, Turlock, Merced, and Los Banos, as well as other rural communities that are generally situated near regional roadways. These cities and communities are surrounded by agricultural lands, including lands designated as Prime Farmland, Unique Farmland, or Farmland of Statewide Importance (Department of Conservation [DOC] 2015). There are no forest lands within the project area.
The proposed action involves implementing a new EC WQO that primarily would be met through the implementation of the RTM Program and completion of the Grassland Bypass Project, which have previously been approved. The new salinity objective was developed in consideration of State and federal regulations, including the State’s Sources of Drinking Water Policy, the Basin Plan, State and federal water regulations, and other State and federal requirements relevant to drinking water, stock drinking water, agricultural irrigation uses, and aquatic life protection. Additionally, the proposed action includes establishment of an EC Performance Goal in Reach 83, as well as routine EC and boron monitoring in the LSJR at Crows Landing and Maze Road Bridge. The proposed action would set a new EC WQO for water diverted from Reach 83 that is used for irrigation, and was developed to provide reasonable protection for the most sensitive AGR beneficial use (irrigation of almonds). The key actions utilized to meet the new EC WQO would not involve land use changes, ground disturbing activities, or other physical effects. Because the proposed action would not result in the loss of agricultural lands, including those designated as Prime Farmland, Unique Farmland, or Farmland of Statewide Importance or land zoned for agricultural use or lands within a Williamson Act contract there would be no impact.

Because the project area does not contain forest lands, the proposed action would have no impact on forest land.
3 AIR QUALITY

<table>
<thead>
<tr>
<th>ENVIRONMENTAL ISSUES</th>
<th>Potentially Significant Impact</th>
<th>Less Than Significant with Mitigation Incorporated</th>
<th>Less Than Significant Impact</th>
<th>No Impact</th>
</tr>
</thead>
</table>

III. AIR QUALITY.

Where available, the significance criteria established by the applicable air quality management or air pollution control district may be relied on to make the following determinations.

Would the project:

a) Conflict with or obstruct implementation of the applicable air quality plan?
   ☐ ☐ ☐ ☒

b) Violate any air quality standard or contribute substantially to an existing or projected air quality violation?
   ☐ ☐ ☐ ☒

c) Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is non-attainment under an applicable federal or state ambient air quality standard (including releasing emissions which exceed quantitative thresholds for ozone precursors)?
   ☐ ☐ ☐ ☒

d) Expose sensitive receptors to substantial pollutant concentrations?
   ☐ ☐ ☐ ☒

e) Create objectionable odors affecting a substantial number of people?
   ☐ ☐ ☐ ☒

3.1.1 Discussion

The project area is located in San Joaquin and Stanislaus counties. Both counties are within the area regulated for air quality standards attainment by the San Joaquin Valley Air Pollution Control District (SJVAPCD). SJVAPCD is considered an attainment area for the federal 8-hour Carbon Monoxide (CO) standard and an extreme ozone nonattainment area for the federal 8-hour ozone standard.

As previously discussed, the proposed action’s primary objective is to protect the AGR (irrigation supply water) beneficial use in Reach 83 of the LSJR by establishing a new EC WQO. The new salinity objective was developed in consideration of State and federal regulations, including the State’s Sources of Drinking Water Policy, the Basin Plan, State and federal water regulations, and other State and federal requirements relevant to drinking water, stock drinking water, agricultural irrigation uses, and aquatic life protection. The WQO primarily would be achieved through the implementation of the RTM Program and completion of the Grassland Bypass Project. The proposed action also includes establishment of an EC Performance Goal in Reach 83 and routine EC and boron monitoring in the LSJR at Crows Landing and Maze Road Bridge. Implementation and operation of the proposed action would not involve activities that would produce air pollutants. Local air quality plans established by SJVAPCD would not be affected nor would any sensitive receptors in the project area experience an increase in concentrations of air pollutants. There would be no impact.
4 BIOLOGICAL RESOURCES

<table>
<thead>
<tr>
<th>ENVIRONMENTAL ISSUES</th>
<th>Potentially Significant Impact</th>
<th>Less Than Significant with Mitigation Incorporated</th>
<th>Less Than Significant Impact</th>
<th>No Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>IV. BIOLOGICAL RESOURCES. Would the project:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special-status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Wildlife or the U.S. Fish and Wildlife Service?</td>
<td>⬜</td>
<td>⬜</td>
<td>⬜</td>
<td>☒</td>
</tr>
<tr>
<td>b) Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, or regulations or by the California Department of Fish and Wildlife or the U.S. Fish and Wildlife Service?</td>
<td>⬜</td>
<td>⬜</td>
<td>⬜</td>
<td>☒</td>
</tr>
<tr>
<td>c) Have a substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means?</td>
<td>⬜</td>
<td>⬜</td>
<td>⬜</td>
<td>☒</td>
</tr>
<tr>
<td>d) Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursey sites?</td>
<td>⬜</td>
<td>⬜</td>
<td>⬜</td>
<td>☒</td>
</tr>
<tr>
<td>e) Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance?</td>
<td>⬜</td>
<td>⬜</td>
<td>⬜</td>
<td>☒</td>
</tr>
<tr>
<td>f) Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan?</td>
<td>⬜</td>
<td>⬜</td>
<td>⬜</td>
<td>☒</td>
</tr>
</tbody>
</table>

4.1.1 Discussion

Through the establishment of a new EC WQO, the proposed action aims to protect the AGR (irrigation supply water) and MUN (municipal and domestic supply) beneficial uses in Reach 83 of the LSJR. The new salinity objective was developed in consideration of State and federal regulations, including the State’s Sources of Drinking Water Policy, the Basin Plan, State and federal water regulations, and other State and federal requirements relevant to drinking water, stock drinking water, agricultural irrigation uses, and aquatic life protection. The initiation of the previously approved RTM Program and completion of the Grassland Bypass Project would provide the greatest management of salinity loads to achieve the new EC WQO, as well as assist in the protection of wildlife species sensitive to such constituents as selenium. The former project will act to monitor selenium concentrations in the LSJR, along with a number of other water quality parameters, and the latter project will reduce selenium concentrations in the San Luis Drain that ultimately reach the LSJR. Implementation of the proposed action would not result in the physical alteration of a natural environment or have adverse effects on federally- or State-listed species. The proposed action would not
result in adverse physical effects to the environment and would not conflict with any Habitat Conservation Plans, Natural Community Conservation Programs, or local policies designed to protect biological resources. The project would not result in a depletion of biodiversity in aquatic and riparian habitats near the project area. There would be no impact.
5 CULTURAL RESOURCES

<table>
<thead>
<tr>
<th>ENVIRONMENTAL ISSUES</th>
<th>Potentially Significant Impact</th>
<th>Less Than Significant with Mitigation Incorporated</th>
<th>Less Than Significant Impact</th>
<th>No Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>V. CULTURAL RESOURCES. Would the project:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) Cause a substantial adverse change in the significance of a historical resource as defined in Section 15064.5?</td>
<td>☐</td>
<td>☐</td>
<td>☑</td>
<td>☒</td>
</tr>
<tr>
<td>b) Cause a substantial adverse change in the significance of an archaeological resource pursuant to Section 15064.5?</td>
<td>☐</td>
<td>☐</td>
<td>☑</td>
<td>☒</td>
</tr>
<tr>
<td>c) Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?</td>
<td>☐</td>
<td>☐</td>
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</tr>
<tr>
<td>d) Disturb any human remains, including those interred outside of formal cemeteries?</td>
<td>☐</td>
<td>☐</td>
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</tr>
</tbody>
</table>

5.1.1 Discussion

The proposed action requires monitoring and evaluation of salinity levels in Reach 83 of the LSJR. A range of potential salinity levels was reviewed and compared to determine a new EC WQO that is protective of the AGR (irrigation supply water) and MUN (municipal and domestic supply) beneficial uses in Reach 83. The new EC WQO was developed in consideration of State and federal regulations, including the State’s Sources of Drinking Water Policy, the Basin Plan, State and federal water regulations, and other State and federal requirements relevant to drinking water, stock drinking water, agricultural irrigation uses, and aquatic life protection. Achievement of AGR beneficial use protection primarily would occur through the previously approved RTM Program and completion of the Grassland Bypass Project, as well as continued implementation of Basin Plan requirements. The proposed action would not involve physical alterations of existing structures or any ground disturbance. Adverse change or the destruction of significant cultural resources would not result from the monitoring of water quality within Reach 83. There would be no impact.
6 GEOLOGY AND SOILS

<table>
<thead>
<tr>
<th>ENVIRONMENTAL ISSUES</th>
<th>Potentially Significant Impact</th>
<th>Less Than Significant with Mitigation Incorporated</th>
<th>Less Than Significant Impact</th>
<th>No Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>VI. GEOLOGY AND SOILS. Would the project:</td>
<td></td>
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</tr>
<tr>
<td>a) Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:</td>
<td></td>
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</tr>
<tr>
<td>i) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? (Refer to California Geological Survey Special Publication 42.)</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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</tr>
<tr>
<td>ii) Strong seismic ground shaking?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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</tr>
<tr>
<td>iii) Seismic-related ground failure, including liquefaction?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☒</td>
</tr>
<tr>
<td>iv) Landslides?</td>
<td>☐</td>
<td>☐</td>
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</tr>
<tr>
<td>b) Result in substantial soil erosion or the loss of topsoil?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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</tr>
<tr>
<td>c) Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse?</td>
<td>☐</td>
<td>☐</td>
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</tr>
<tr>
<td>d) Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994, as updated), creating substantial risks to life or property?</td>
<td>☐</td>
<td>☐</td>
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</tr>
<tr>
<td>e) Have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water?</td>
<td>☐</td>
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</tbody>
</table>

6.1.1 Discussion

The 2002 Alquist-Priolo Earthquake Fault Zoning Map shows that the project area is not located within any Earthquake Fault Zones; Landslide and Liquefaction Zones; or Fault Zones, Landslide and Liquefaction Zones (DOC 2002). The project site is located within San Joaquin and Stanislaus counties, inland of the San Andreas Fault. The proposed action would establish an EC WQO that is expected to be achieved by approved programs and plans in progress. The proposed action also includes the establishment of an EC Performance Goal in Reach 83, as well as monitoring of salinity levels in Reach 83 of the LSJR. Implementation of the proposed action would not include development of new structures and would not expose people or structures to areas of strong seismic shaking, landslide, or liquefaction. The use or implementation of septic tanks or additional waste water disposal systems is not a component of the proposed action. There would be no impact.
7 GREENHOUSE GAS EMISSIONS

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>VII. GREENHOUSE GAS EMISSIONS. Would the project:</td>
<td></td>
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</tr>
<tr>
<td>a) Generate greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☒</td>
</tr>
<tr>
<td>b) Conflict with an applicable plan, policy or regulation adopted for the purpose of reducing the emissions of greenhouse gases?</td>
<td>☐</td>
<td>☐</td>
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</tr>
</tbody>
</table>

7.1.1 Discussion

The proposed action involves establishing a new EC WQO that primarily would be met through the implementation of the previously approved RTM Program and completion of the Grassland Bypass Project. The proposed EC WQO or Performance Goal for Reach 83 is not expected to result in the need to construct supplementary facilities or additions to the existing wastewater treatment facilities in the Cities of Modesto and Turlock. Considerations regarding the implementation of proposed EC WQOs in NPDES permits governing discharges to Reach 83 are included in Appendix D of the Task 4 Report (LWA 2015a). The new salinity objective was developed in consideration of State and federal regulations, including the State’s Sources of Drinking Water Policy, the Basin Plan, State and federal water regulations, and other State and federal requirements relevant to drinking water, stock drinking water, agricultural irrigation uses, and aquatic life protection. The proposed action also includes the establishment of an EC Performance Goal in Reach 83 and routine EC and boron monitoring in the LSJR at Crows Landing and Maze Road Bridge. Project activities would not include the use of GHG generating equipment or machinery. There would be no release of GHG-related pollutants as a result of project implementation. There would be no impact.
8 HAZARDS AND HAZARDOUS MATERIALS

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>VIII. HAZARDS AND HAZARDOUS MATERIALS. Would the project:</td>
<td></td>
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</tr>
<tr>
<td>a) Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials?</td>
<td>☐</td>
<td>☐</td>
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</tr>
<tr>
<td>b) Create a significant hazard to the public or the environment through reasonably foreseeable upset and/or accident conditions involving the release of hazardous materials into the environment?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☑</td>
</tr>
<tr>
<td>c) Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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</tr>
<tr>
<td>d) Be located on a site which is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5 and, as a result, would it create a significant hazard to the public or the environment?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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</tr>
<tr>
<td>e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project result in a safety hazard for people residing or working in the project area?</td>
<td>☐</td>
<td>☐</td>
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</tr>
<tr>
<td>f) For a project within the vicinity of a private airstrip, would the project result in a safety hazard for people residing or working in the project area?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☑</td>
</tr>
<tr>
<td>g) Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☑</td>
</tr>
<tr>
<td>h) Expose people or structures to a significant risk of loss, injury, or death involving wildland fires, including where wildlands are adjacent to urbanized areas or where residences are intermixed with wildlands?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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</tr>
</tbody>
</table>

8.1.1 Discussion

The proposed action requires monitoring and evaluation of salinity levels within Reach 83 of the LSJR. A range of potential salinity levels was reviewed and compared to determine a new EC WQO that is protective of the AGR (irrigation supply water) and MUN (municipal and domestic supply) beneficial uses in Reach 83. The new EC WQO was developed in consideration of State and federal regulations, including the State’s Sources of Drinking Water Policy, the Basin Plan, State and federal water regulations, and other State and federal requirements relevant to drinking water, stock drinking water, agricultural irrigation uses, and
aquatic life protection. Achievement of AGR beneficial use protection primarily would occur through implementation of the previously approved RTM Program and completion of the Grassland Bypass Project, as well as continued implementation of Basin Plan requirements. Implementation of the proposed action would not create a significant hazard or involve the handling of hazardous materials. There would be no impact.
## 9 HYDROLOGY AND WATER QUALITY

<table>
<thead>
<tr>
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<th>No Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>IX. HYDROLOGY AND WATER QUALITY. Would the project:</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>a) Violate any water quality standards or waste discharge requirements?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☒</td>
</tr>
<tr>
<td>b) Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of pre-existing nearby wells would drop to a level that would not support existing land uses or planned uses for which permits have been granted)?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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</tr>
<tr>
<td>c) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial on- or offsite erosion or siltation?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☒</td>
</tr>
<tr>
<td>d) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in on- or offsite flooding?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☒</td>
</tr>
<tr>
<td>e) Create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☒</td>
</tr>
<tr>
<td>f) Otherwise substantially degrade water quality?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☒</td>
</tr>
<tr>
<td>g) Place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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</tr>
<tr>
<td>h) Place within a 100-year flood hazard area structures that would impede or redirect flood flows?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☒</td>
</tr>
<tr>
<td>i) Expose people or structures to a significant risk of loss, injury, or death involving flooding, including flooding as a result of the failure of a levee or dam?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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</tr>
<tr>
<td>j) Result in inundation by seiche, tsunami, or mudflow?</td>
<td>☐</td>
<td>☐</td>
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</tr>
</tbody>
</table>
9.1.1 Discussion

Through the establishment of a new EC WQO, the proposed action aims to protect the AGR (irrigation supply water) and MUN (municipal and domestic supply) beneficial uses in Reach 83 of the LSJR. The new salinity objective was developed in consideration of State and federal regulations, including the State's Sources of Drinking Water Policy, the Basin Plan, State and federal water regulations, and other State and federal requirements relevant to drinking water, stock drinking water, agricultural irrigation uses, and aquatic life protection. The initiation of the previously approved RTM Program and completion of the Grassland Bypass Project would provide the greatest management of salinity loads to achieve the new EC WQO. The main objective of the proposed action is to protect the AGR (irrigation supply water) beneficial use in Reach 83 of the LSJR. Implementation of the project would set an EC objective to ensure protection of the beneficial uses designated for Reach 83 of the LSJR. An antidegradation analysis would be required when issuing any new or revised NPDES permits, water discharge requirements (WDR), or conditional waivers. Enhanced water quality would be a consequence of the anticipated decreases in salinity levels during certain times of the year with implementation of the EC WQO and Performance Goal. There would be no impact.
10  LAND USE AND PLANNING

<table>
<thead>
<tr>
<th>ENVIRONMENTAL ISSUES</th>
<th>Potentially Significant Impact</th>
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<th>No Impact</th>
</tr>
</thead>
</table>

X. LAND USE AND PLANNING. Would the project:

a) Physically divide an established community? ☒ ☒ ☒ ☒

b) Conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project (including, but not limited to, a general plan, specific plan, local coastal program, or zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect? ☒ ☒ ☒ ☒

c) Conflict with any applicable habitat conservation plan or natural community conservation plan? ☒ ☒ ☒ ☒

10.1.1 Discussion

The proposed action involves implementing a new EC WQO that would be met through the implementation of the RTM Program and completion of the Grassland Bypass Project, which have previously been approved. The new salinity objective was developed in consideration of State and federal regulations, including the State’s Sources of Drinking Water Policy, the Basin Plan, State and federal water regulations, and other State and federal requirements relevant to drinking water, stock drinking water, agricultural irrigation uses, and aquatic life protection. Additionally, the proposed action includes the establishment of an EC Performance Goal in Reach 83 and routine EC and boron monitoring in the LSJR at Crows Landing and Maze Road Bridge. The proposed action would not result in any land use changes and would not result in development of any structures or physical facilities and would therefore not physically divide an established community. The proposed action would also not conflict with any Habitat Conservation Plans or Natural Community Conservation Plans and would comply with local, State, and federal land use policies. There would be no impact to land use and planning.
11 MINERAL RESOURCES

<table>
<thead>
<tr>
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<th>No Impact</th>
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<tbody>
<tr>
<td>XI. MINERAL RESOURCES. Would the project:</td>
<td></td>
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</tr>
<tr>
<td>a) Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☒</td>
</tr>
<tr>
<td>b) Result in the loss of availability of a locally important mineral resource recovery site delineated on a local general plan, specific plan, or other land use plan?</td>
<td>☐</td>
<td>☐</td>
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</tbody>
</table>

11.1.1 Discussion

The proposed action requires monitoring and evaluation of salinity levels within Reach 83 of the LSJR. A range of potential salinity levels was reviewed and compared to determine a new EC WQO that is protective of the AGR (irrigation supply water) and MUN (municipal and domestic supply) beneficial uses in Reach 83. The new EC WQO was developed in consideration of State and federal regulations, including the State’s Sources of Drinking Water Policy, the Basin Plan, State and federal water regulations, and other State and federal requirements relevant to drinking water, stock drinking water, agricultural irrigation uses, and aquatic life protection. Achievement of the action’s objective would occur through implementation of the previously approved RTM Program and completion of the Grassland Bypass Project, as well as continued implementation of Basin Plan requirements. Project implementation and operation would not include changes in existing or planned land use, disturbance of soil, or development of structures or facilities that could impact or reduce the availability of mineral resources. There would be no impact.
12 NOISE

<table>
<thead>
<tr>
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</table>

XII. NOISE. Would the project result in:

a) Exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinance, or in other applicable local, state, or federal standards? □ □ □ ☒

b) Exposure of persons to or generation of excessive groundborne vibration or groundborne noise levels? □ □ □ ☒

c) A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project? □ □ □ ☒

d) A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project? □ □ □ ☒

e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels? □ □ □ ☒

f) For a project within the vicinity of a private airstrip, would the project expose people residing or working in the project area to excessive noise levels? □ □ □ ☒

12.1.1 Discussion

As previously discussed, the proposed action’s main objective is to protect the AGR (irrigation supply water) beneficial use in Reach 83 of the LSJR by establishing a new EC WQO. The new salinity objective was developed in consideration of State and federal regulations, including the State’s Sources of Drinking Water Policy, the Basin Plan, State and federal water regulations, and other State and federal requirements relevant to drinking water, stock drinking water, agricultural irrigation uses, and aquatic life protection. The WQO would be achieved through the implementation of the RTM Program and completion of the Grassland Bypass Project. The proposed action also includes the establishment of an EC Performance Goal in Reach 83 and routine EC and boron monitoring in the LSJR at Crows Landing and Maze Road Bridge. The proposed action would not generate substantial noise and would comply with relevant and applicable local, State, and federal standards. Project activities include monitoring and testing of water quality conditions, and would not involve the use of noise-generating equipment. There would be no impact.
## 13 POPULATION AND HOUSING

<table>
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<tr>
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<tbody>
<tr>
<td>XIII. POPULATION AND HOUSING. Would the project:</td>
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<tr>
<td>a) Induce substantial population growth in an area, either directly (for example, by proposing new homes and businesses) or indirectly (for example, through extension of roads or other infrastructure)?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✗</td>
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<tr>
<td>b) Displace substantial numbers of existing homes, necessitating the construction of replacement housing elsewhere?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✗</td>
</tr>
<tr>
<td>c) Displace substantial numbers of people, necessitating the construction of replacement housing elsewhere?</td>
<td>☐</td>
<td>☐</td>
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<td>✗</td>
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### 13.1.1 Discussion

Through the establishment of a new EC WQO, the proposed action aims to protect the AGR (irrigation supply water) and MUN (municipal and domestic supply) beneficial uses in Reach 83 of the LSJR. The new salinity objective was developed in consideration of State and federal regulations, including the State’s Sources of Drinking Water Policy, the Basin Plan, State and federal water regulations, and other State and federal requirements relevant to drinking water, stock drinking water, agricultural irrigation uses, and aquatic life protection. The initiation of the previously approved RTM Program and completion of the Grassland Bypass Project would provide the greatest management of salinity loads needed to achieve the new EC WQO. The main objective of the proposed action is to protect the AGR (irrigation supply water) beneficial use in Reach 83. The project area currently serves primarily as agricultural land. Implementation of the proposed action would not result in addition or removal of any homes and therefore would not result in an increase in population or in the displacement of people or homes. There would be **no impact** on population and housing.
14 PUBLIC SERVICES

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<thead>
<tr>
<th>ENVIRONMENTAL ISSUES</th>
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</table>

XIV. PUBLIC SERVICES. Would the project:

a) Result in substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, or the need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times, or other performance objectives for any of the public services:

- Fire protection?  
- Police protection?  
- Schools?  
- Parks?  
- Other public facilities?

14.1.1 Discussion

The proposed action requires monitoring and evaluation of salinity levels within Reach 83 of the LSJR. A range of potential salinity levels was reviewed and compared to determine a new EC WQO that is protective of the AGR (irrigation supply water) and MUN (municipal and domestic supply) beneficial uses in Reach 83. The new EC WQO was developed in consideration of State and federal regulations, including the State’s Sources of Drinking Water Policy, the Basin Plan, State and federal water regulations, and other State and federal requirements relevant to drinking water, stock drinking water, agricultural irrigation uses, and aquatic life protection. Achievement of the objective will occur through the previously approved RTM Program and completion of the Grassland Bypass Project. The proposed action also includes the establishment of an EC Performance Goal in Reach 83 and EC and boron monitoring in the LSJR at Maze Road Bridge and Crows Landing. The proposed EC WQO or Performance Goal for Reach 83 is not expected to result in the need to construct supplementary facilities or additions to the existing wastewater treatment facilities in the Cities of Modesto and Turlock. Considerations regarding the implementation of proposed EC WQOs in NPDES permits governing discharges to Reach 83 are included in Appendix D of the Task 4 Report (LWA 2015a). Implementation of the proposed action would not require any physical alterations that would conflict with or reduce access to public services. Monitoring of salinity levels in Reach 83 would not result in the obstruction of service-designated routes or roadways. There would be no impact.
15 RECREATION

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</table>

XV. RECREATION. Would the project:

a) Increase the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be accelerated?

b) Include recreational facilities or require the construction or expansion of recreational facilities that might have an adverse physical effect on the environment?

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15.1.1 Discussion

The proposed action’s main objective is to protect the AGR (irrigation supply water) beneficial use in Reach 83 of the LSJR by establishing a new EC WQO. The new salinity objective was developed in consideration of State and federal regulations, including the State’s Sources of Drinking Water Policy, the Basin Plan, State and federal water regulations, and other State and federal requirements relevant to drinking water, stock drinking water, agricultural irrigation uses, and aquatic life protection. The new WQO would be achieved through the implementation of the RTM Program and completion of the Grassland Bypass Project. The proposed action also includes the establishment of an EC Performance Goal in Reach 83 and routine EC and boron monitoring in the LSJR at Crows Landing and Maze Road Bridge. Implementation of the proposed action would not increase population and would not increase use of existing recreational facilities or demand for new recreational facilities. There would be no impact.
16   TRANSPORTATION/TRAFFIC

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>XVI. TRANSPORTATION/TRAFFIC. Would the project:</td>
<td></td>
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<tr>
<td>a) Conflict with an applicable plan, ordinance or policy establishing measures of effectiveness for the performance of the circulation system, taking into account all modes of transportation including mass transit and non-motorized travel and relevant components of the circulation system, including but not limited to intersections, streets, highways and freeways, pedestrian and bicycle paths, and mass transit?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☒</td>
</tr>
<tr>
<td>b) Conflict with an applicable congestion management program, including, but not limited to level of service standards and travel demand measures, or other standards established by the county congestion management agency for designated roads or highways?</td>
<td>☐</td>
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<tr>
<td>c) Result in a change in air traffic patterns, including either an increase in traffic levels or a change in location that results in substantial safety risks?</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>d) Substantially increase hazards due to a design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment)?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>e) Result in inadequate emergency access?</td>
<td>☐</td>
<td>☐</td>
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</tr>
<tr>
<td>f) Conflict with adopted policies, plans, or programs regarding public transit, bicycle, or pedestrian facilities, or otherwise decrease the performance or safety of such facilities?</td>
<td>☐</td>
<td>☐</td>
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</table>

16.1.1 Discussion

The proposed action involves monitoring and evaluation of salinity levels in Reach 83 of the LSJR. A range of potential salinity levels was reviewed and compared to determine a new EC WQO that is protective of the AGR (irrigation supply water) and MUN (municipal and domestic supply) beneficial uses in Reach 83. The new EC WQO was developed in consideration of State and federal regulations, including the State’s Sources of Drinking Water Policy, the Basin Plan, State and federal water regulations, and other State and federal requirements relevant to drinking water, stock drinking water, agricultural irrigation uses, and aquatic life protection. Achievement of these objectives would occur through implementation of the previously approved RTM Program and completion of the Grassland Bypass Project. The proposed action also includes the establishment of an EC Performance Goal in Reach 83 and EC and boron monitoring in the LSJR at Maze Road Bridge and Crows Landing. The proposed action would not produce an increase in traffic levels or require the construction of new roadways. Project activities would occur in compliance with all applicable plans, policies, and ordinances and would have no effect on air traffic. There would be no impact.
17 UTILITIES AND SERVICE SYSTEMS

<table>
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<tr>
<th>XVII. UTILITIES AND SERVICE SYSTEMS. Would the project:</th>
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<tbody>
<tr>
<td>a) Exceed wastewater treatment requirements of the applicable Regional Water Quality Control Board?</td>
</tr>
<tr>
<td>b) Require or result in the construction of new water or wastewater treatment facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?</td>
</tr>
<tr>
<td>c) Require or result in the construction of new storm water drainage facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?</td>
</tr>
<tr>
<td>d) Have sufficient water supplies available to serve the project from existing entitlements and resources, or are new or expanded entitlements needed?</td>
</tr>
<tr>
<td>e) Result in a determination by the wastewater treatment provider that serves or may serve the project that it has adequate capacity to serve the project’s projected demand, in addition to the provider’s existing commitments?</td>
</tr>
<tr>
<td>f) Be served by a landfill with sufficient permitted capacity to accommodate the project’s solid waste disposal needs?</td>
</tr>
<tr>
<td>g) Comply with federal, state, and local statutes and regulations related to solid waste?</td>
</tr>
</tbody>
</table>

17.1.1 Discussion

The proposed action involves the establishment of a new EC WQO that primarily would be met through the implementation of the RTM Program and completion of the Grassland Bypass Project, which have previously been approved. The new salinity objective was developed in consideration of State and federal regulations, including the State’s Sources of Drinking Water Policy, the Basin Plan, State and federal water regulations, and other State and federal requirements relevant to drinking water, stock drinking water, agricultural irrigation uses, and aquatic life protection. Additionally, the proposed action includes the establishment of an EC Performance Goal in Reach 83, as well as routine EC and boron monitoring in the LSJR at Crows Landing and Maze Road Bridge.

If adopted in a Basin Plan Amendment, the proposed WQO for Reach 83 would be used in the derivation of future effluent limitations contained in NPDES permits for the publically owned treatment works (POTW) operated by the Cities of Modesto and Turlock. The Central Valley Water Board, the entity responsible for developing effluent limitations and issuing NPDES permits, is required to adopt effluent limitations that protect the AGR (irrigation water supply) and MUN (municipal and domestic supply) beneficial uses in the LSJR, that do not impact the attainment of the existing Vernalis EC objectives, and that comply with State and federal antidegradation policies. While future EC effluent limitations for the Cities of Modesto and
Turlock cannot be developed at this time (i.e., prior to the expiration of each city’s current NPDES permit), future NPDES permitting determinations will need to account for the continued effects of water conservation, water supply constraints, and Extended Dry Periods. Additionally, future modeling work may be needed to assess the impact of the POTW discharges over a range of candidate effluent limitations on ambient EC conditions in the LSJR and on compliance with water quality objectives in the LSJR downstream of each POTW. The proposed EC WQO or Performance Goal for Reach 83 is not expected to result in the need to construct supplementary facilities or additions to the existing wastewater treatment facilities in the Cities of Modesto and Turlock. Project implementation would not involve new storm water facilities or the discharge of solid waste or landfill servicing. There would be **no impact**.
XVIII. MANDATORY FINDINGS OF SIGNIFICANCE.

a) Does the project have the potential to substantially degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of an endangered, rare, or threatened species, or eliminate important examples of the major periods of California history or prehistory?

b) Does the project have impacts that are individually limited, but cumulatively considerable? (“Cumulatively considerable” means that the incremental effects of a project are considerable when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects.)

c) Does the project have environmental effects that will cause substantial adverse effects on human beings, either directly or indirectly?

Authority: Public Resources Code Sections 21083, 21083.5.

18.1.1 Discussion

As previously discussed, the proposed action’s main objective is to protect the AGR (irrigation supply water) beneficial use in Reach 83 of the LSJR by establishing a new EC WQO. The new salinity objective was developed in consideration of State and federal regulations, including the State’s Sources of Drinking Water Policy, the Basin Plan, State and federal water regulations, and other State and federal requirements relevant to drinking water, stock drinking water, agricultural irrigation uses, and aquatic life protection. The WQO primarily would be achieved through the implementation of the RTM Program and completion of the Grassland Bypass Project. The proposed action also includes the establishment of an EC Performance Goal in Reach 83 and routine EC and boron monitoring in the LSJR at Crows Landing and Maze Road Bridge. The abovementioned activities do not require the physical alteration of existing structures or habitats and would not result in the loss of an endangered, threatened, or listed species, or any historically significant resources. There would be no cumulatively considerable adverse effects on the environment or human beings. Implementation of the proposed action would improve water quality of the project site for the benefit of biological and human use. There would be **no impact** on notable species, cultural resources, or humans.
19 REFERENCES


Caltrans. See California Department of Transportation.


DOC. See Department of Conservation.


APPENDIX A

COMMENTS RECEIVED BY CENTRAL VALLEY WATER BOARD ON PUBLIC SCOPING MEETING HELD ON MARCH 30, 2009, FOR DISCUSSION OF UPSTREAM SAN JOAQUIN RIVER SALINITY OBJECTIVES/TMDL.