Salinity
Real-Time Management Program
Framework

DRAFT

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ABBREVIATIONS AND ACRONYMS

Basin Plan	Water Quality Control Plan for the Sacramento and SJR Basins
BFMM	Best Feasible Management Measures
CDEC	California Data Exchange Center
CVP	Central Valley Project
CV-SALTS	Central Valley Salinity Alternatives for Long-term Sustainability
CVSC	Central Valley Salinity Coalition
Central Valley Water Board	Central Valley Regional Water Quality Control Board
CVPIA	Central Valley Project Improvement Act
DMC	Delta Mendota Canal
DWR	California Department of Water Resources
EC	electrical conductivity
GBP	Grassland Bypass Project
GRCD	Grassland Resource Conservation District
GWD	Grassland Water District
ILRP	Irrigated Lands Regulatory Program
LSJR	Lower San Joaquin River
LSJRC	Lower San Joaquin River Committee
MAA	Management Agency Agreement
MOU	Memorandum of Understanding

Reclamation	United States Department of the Interior, Bureau of Reclamation
RTMP	Real Time Management Program
SJR	San Joaquin River
SJRIP	San Joaquin River Improvement Program, a reuse area as part of the Grassland Bypass Project
State Water Board	California State Water Resources Control Board
TMDL	total maximum daily load
TRT	Technical Research Team
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WARMF	Water Analysis Risk Management Framework
WDR	Waste Discharge Requirement
µS/cm	microSiemens per centimeter

1.0 Introduction

This document lays out the framework for a Real Time Management Program (RTMP) that will maximize salt exports from the lower San Joaquin River (LSJR) Basin while ensuring that salinity water quality objectives are met at Vernalis (the boundary of the Sacramento-San Joaquin Delta). Operation under a Central Valley Regional Water Quality Control Board approved RTMP is an alternative to enforced monthly salt load allocations as specified in the Control Program for Salt and Boron Discharges into the LSJR [also known as the Salt/Boron Total Maximum Daily Load (TMDL)] that was adopted into the Sacramento-San Joaquin Water Quality Control Plan (Basin Plan) in 2004.

The purpose of this framework is to provide a roadmap for implementing the RTMP. This document outlines a suite of actions for salinity management as part of the RTMP that when implemented will meet the following objectives:

- Meet salinity water quality objectives at Vernalis
- Allow export of salt loads in accordance with the provisions in the Basin Plan from surface waters during times of river assimilative capacity
- Reduce the reliance on New Melones Reservoir for meeting water quality objectives for salinity at Vernalis[1]
- Establish an organizational approach for the continuing development, implementation and coordination of RTMP activities

In order to develop the components of a fully functioning RTMP that would be able to meet the desired objectives, a thorough understanding of the hydrology of the basin and the history of water management activities is needed as well as a coordinated, systematic approach to allow collaboration from a multitude of diverse stakeholders.

This document provides:

- Description of the project area
- Summary of salinity water quality concerns
- Requirements under the Control Program for Salt and Boron Discharges to the LSJR
- Description of activities under a phased approach to reach full RTMP implementation
- Status to date
- Additional ongoing activities related to salinity management in the LSJR

[1] In accordance with Public Law 108-361

Attachment A is a Memorandum of Understanding (MOU) between agencies/individuals that have agreed to fully participate in the phased implementation of the RTMP. Attachment B is a Management Agency Agreement between the US Bureau of Reclamation (Reclamation) and the Central Valley Regional Water Quality Control Board (Central Valley Water Board) documenting agreed upon activities to mitigate salt loading into the LJSR through the Central Valley Project (CVP) and specifically imports via the Delta Mendota Canal. These attachments may be updated as necessary, however any updates will be provided to the Executive Officer of the Central Valley Regional Water Quality Control Board within 30-days of finalization.

As long as salt and boron water quality objectives at Vernalis are met, those participating in the Central Valley Water Board approved RTMP will be considered in compliance with the Salt and Boron Control Program. As the RTMP is being developed and implemented, Reclamation will continue to meet that salinity objectives at Vernalis through fresh water releases from New Melones Reservoir as specified in the operation requirements in Water Rights Decision 1641.

2.0 Background

2.1 The San Joaquin River Basin

The SJR Basin drains an area of approximately 13,500 square miles. Runoff in the Basin is dominated by snowmelt and rainfall from the Sierra Nevada Range and its foothills on the east side of the Basin (Figure 1). The LSJR which is the section of the river between the the Mendota Dam and the boundary of the Sacramento-San Joaquin Delta, and its tributaries are highly developed, with upstream dams capturing and diverting much of the natural flow under most conditions. Three tributaries on the east side of the Basin, the Merced River, the Tuolumne River, and the Stanislaus River, provide most of the natural freshwater flow into the basin. Flows within the east side tributaries are regulated to a large degree by upstream reservoirs which, in turn, are operated according to predetermined rules and release schedules. These rules and release schedules are followed to provide flood protection and flows to benefit fish and wildlife, contract and water rights, water supplies, hydropower, water quality control; and recreation. Ephemeral streams on the west side of the basin provide seasonal flow.

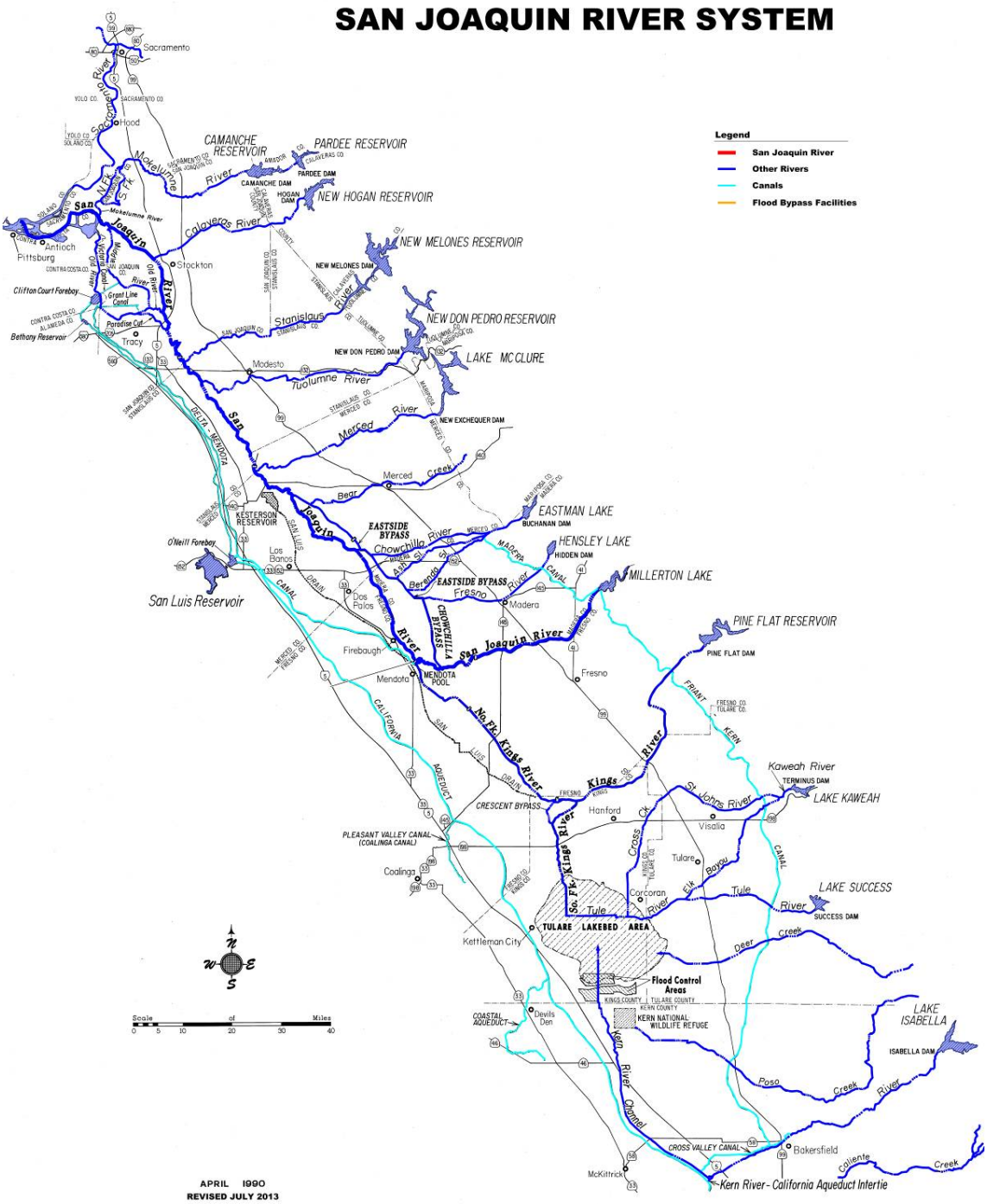
The predominant land use in the SJR Basin is irrigated agriculture although there are also discharges from managed wetlands, municipalities and industry. An important source of irrigation water on the west side of the valley is imported water from the Sacramento-San Joaquin Delta delivered through the Delta-Mendota Canal. The east side tributaries and groundwater provide the majority of the irrigation water supply to the east-side of the San Joaquin Valley. Drainage discharges and operational spills from agricultural lands, irrigation districts and wetlands, together with accretions, are

conveyed through a system of canals, creeks and sloughs to the SJR. Dilution of drainage from the west side tributaries is provided by the east side tributary rivers – the Merced, Tuolumne and Stanislaus.

The San Joaquin River serves as the natural drain for the San Joaquin Valley Basin with flows entering the Sacramento-San Joaquin Delta at Vernalis. As a result of the hydrologic modifications, the quality of water in the LSJR during the irrigation season is dominated by agricultural practices, irrigation water supplies, and naturally occurring groundwater containing salts that return water to the River. The relative timing of agricultural and wetland salt loading and reservoir releases from east side tributaries affect the ability of the LSJR to meet salinity objectives of 700 µS/cm during the irrigation season (April – August) and 1,000 µS/cm during the non-irrigation season(September – March) at the boundary of the Sacramento-San Joaquin Delta (at Vernalis).

Managed wetland areas in the Basin can contribute between 8% and 12% of the salt loading to the SJR, as measured at the Vernalis compliance monitoring station, depending on water year type. Discharges originating from irrigated agriculture in the Basin have historically contributed up to 65%. However, actions since the adoption of the TMDL by the Grassland Bypass Project (GBP) have reduced the total salinity load at Vernalis by approximately 17% and recent programs in the Grassland Resource Conservation District (GRCD) have led to further reductions.

Figure 1. San Joaquin River System Map



2.2 History of Salinity Impairment and Adoption of a Control Program

Water quality degradation of the San Joaquin River by salinity was recognized in the Central Valley Water Board's 1975 Water Quality Control Plan for the Sacramento River Basin, Sacramento-San Joaquin Delta Basin and the San Joaquin Basin (Central Valley Water Board, 1975). In 2004, the Central Valley Water Board adopted a Control Program for Salt and Boron Discharges into the LSJR (Control Program, also known as the Salt/Boron TMDL) into the Sacramento-San Joaquin Basin Plan in order to insure that salinity water quality objectives were met at Vernalis, the boundary of the Sacramento-San Joaquin Delta. As context for the adoption of the TMDL, the 2004 TMDL Staff Report described effects of salinity within the basin, as follows:

"Since the 1940s, mean annual salt concentrations in the SJR at the Airport Way Bridge near Vernalis have doubled and boron levels have increased significantly. Water quality monitoring data collected by the Regional Board and other governmental agencies including the United States Geological Survey (USGS), Department of Water Resources (DWR), and Reclamation indicates that water quality objectives for salinity and boron are frequently exceeded during certain times of the year and under certain flow regimes. Consequently, the river no longer supports all of its designated beneficial uses.

The salinity and boron water quality impairment in the river has occurred, in large part, as a result of water development coupled with agricultural land use and associated agricultural discharges in the watershed. Upstream river flows have been diminished by the construction and operation of dams and diversions. Diverted natural river flows have been replaced with poorer quality (higher salinity) imported water that is primarily used for irrigating crops. Surface and subsurface agricultural discharges are the largest sources of salt and boron loading to the river. During the irrigation season, the river is heavily influenced by irrigation return flows. Water quality generally improves downstream as better quality tributary flows dilute salt and boron concentrations."[2]

The Control Program established an implementation program and a compliance schedule to meet salinity and boron objectives at Vernalis. The salinity water quality objectives for the SJR at Vernalis, measured as electrical conductivity (EC), are 700 µS/cm and 1000µS/cm during irrigation and non-irrigation seasons, respectively.

The Control Program presented four means to achieve compliance. Non-point source dischargers (e.g. agricultural drainage dischargers) may comply with the proposed control program by meeting any one of the following conditions:

[2] Excerpt from Appendix 1: Technical TMDL Report for Salt and Boron in the Lower San Joaquin River, September 2004 Final Draft Staff Report, Section 1.0

•Cease discharge to surface waters

•Discharges must not exceed 315 µS/cm electrical conductivity

•Operate under a waste discharge requirement (WDR) for salt

•Operate under a waiver of waste discharge by participating in a

The implementation of the Control Program also recognized the impact of salt loads from imported CVP deliveries and required that the Reclamation either enter into a Management Agency Agreement with the Central Valley Water Board clarifying how it would mitigate imported salt loads or also adhere to load allocations specified in WDRs.

The Central Valley Water Board developed a timeline for implementation with initial control actions on the most significant sources of salt and boron discharges to the LSJR (See Figure 2 and Table 1). Priority for implementation of load allocations to control salt and boron discharges were given to subareas with the greatest unit area salt loading (tons per acre per year) to the LSJR. The priority compliance schedule from the TMDL is shown in Table 1.

Figure 2. TMDL Project Area

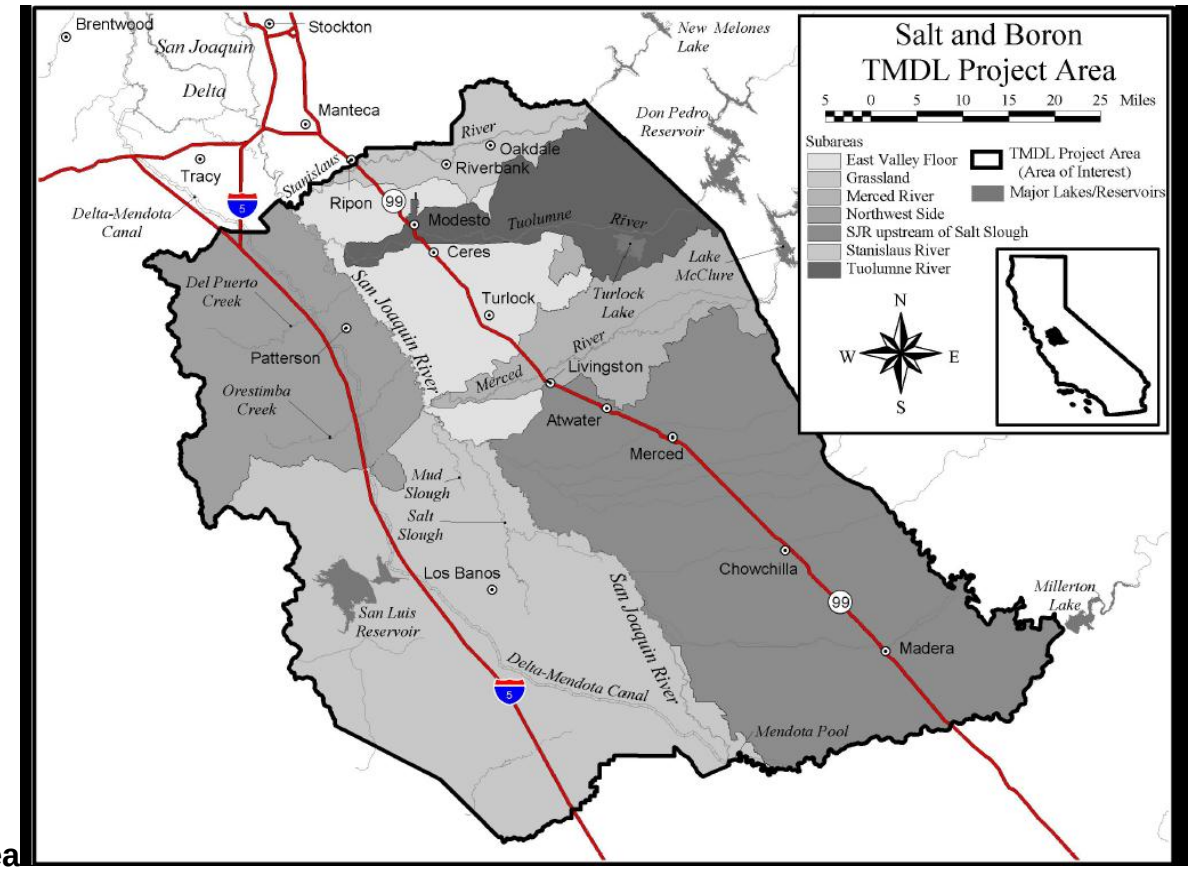


Table 1. Priorities for Compliance with Salt and Boron TMDL

Subarea ID	Name of Subarea	Subarea Priority 2006[1]	Date of Compliance Wet and Dry Years	Date of Compliance for Critical Years
1	SJR Upstream of Salt Slough	Low	July 2022	July 2026
2	Grassland	High	July 2014	July 2018
3	East Valley Floor	Low	July 2022	July 2026
4	Northwest Side	High	July 2014	July 2018
5	Merced River	Low	July 2022	July 2026
6	Tuolumne River	Medium	July 2018	July 2022
7	Stanislaus River	Low	July 2022	July 2026
NA	Delta Mendota Canal[2]	High	July 2014	July 2018

Source: 2008 TMDL Amendment
[1]Implementation priority- number of years after effective date to comply: High 8-14 years; Medium14 -16 years; Low 16-20 years.
[2]DMC is not a subarea, but is operated by Reclamation who is a supplier of water.

Salt loads were identified in the TMDL for each of the 7 subareas and Delta Mendota Canal (DMC) shown in Table 1. Within given subareas there are multiple entities. For example in the Grassland subarea there are multiple water agencies including federal and exchange water contractors and public and private wetlands areas. The proportion of allocated salt loads in the TMDL is by acreage. The components to the salt loads include a base load allocation, CVPIA supply water relaxation and a consumptive use allowance.

The Vernalis objectives are currently set as a 30-day running average concentration: 700 µS/cm from April 1 – August 31 and 1,000 µS/cm from Sept 1 – March 31. Figure 3 shows the 30-day running average EC at Vernalis from 1985 through 2012. Since there are two seasons for the Vernalis objective, the first data point for the 30-day average starts 30 days after the beginning of the season. For example the first data point for the April 1 – August 31 season is April 30 and the last data point is August 31. There are no data points from April 1 through April 29 because a 30 day average cannot be calculated.

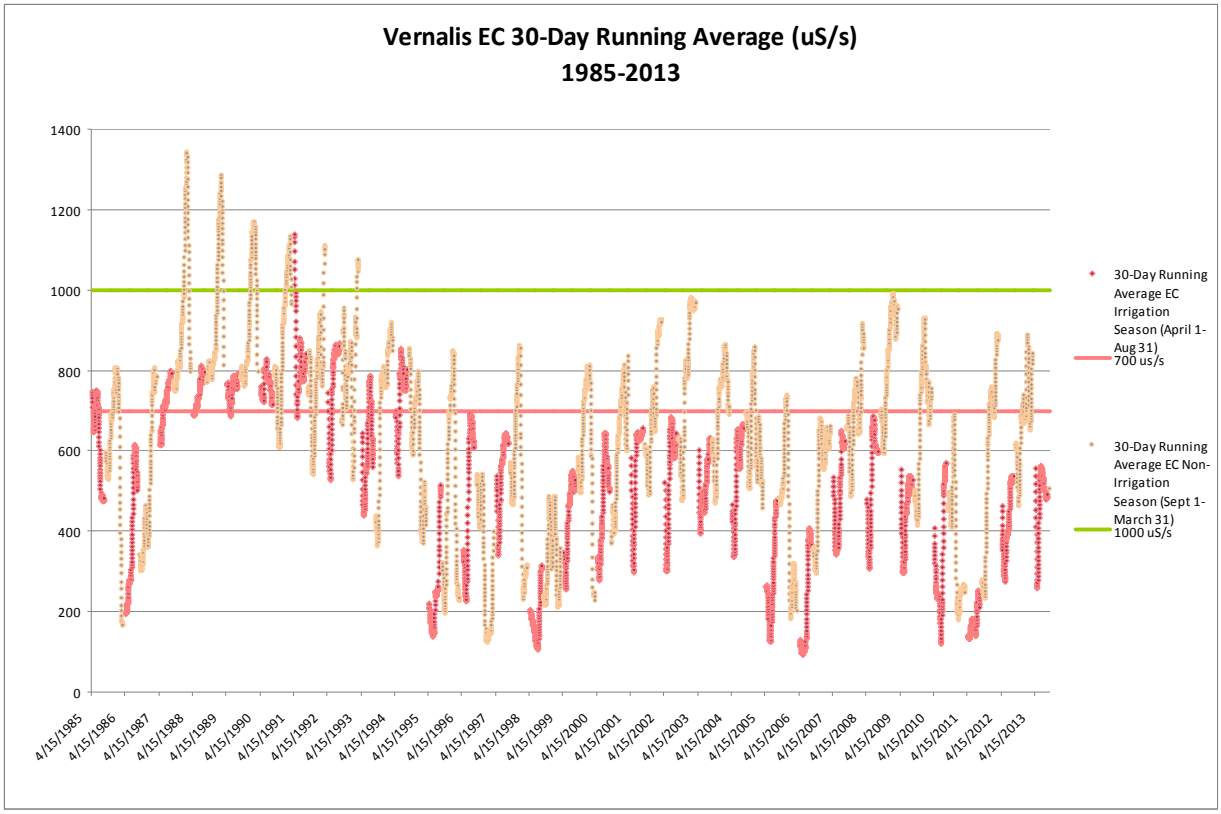


Figure 3. 30-day Running Average EC for the SJR at Vernalis.

The salinity objective at Vernalis has been met since 1994, in part through additional releases of fresh water by Reclamation from New Melones Reservoir into the Stanislaus River upstream of the Vernalis compliance point as well as through decreased discharges such as the GBP and the Irrigated Lands Regulatory Program. The goal under a real-time management program is to continue to meet the irrigation and non-irrigation season salinity water quality objectives by managing salt loads so they are discharged when there is assimilative capacity in the river, rather than be constrained by mandated monthly load allocations in WDR's. Managing the use of assimilative capacity is also anticipated to reduce reliance on fresh water releases from New Melones Reservoir to meet the salinity objectives at Vernalis and to provide a mechanism to maximize salt exports from the SJR Basin.

The Westside San Joaquin River Watershed Coalition, stakeholders, and Reclamation recognize that by partnering, sharing technical resources, and developing the RTMP for salinity they can maximize their ability to control their discharges and meet the salt and boron water quality objectives prescribed by the Central Valley Water Board.

Stakeholders have shown their support for the development of a RTMP that provides technical assistance for monitoring and database management, forecasting river assimilative capacity, and identifying best feasible management measures (BFMM) for the management of SJR salinity. A successful RTMP requires the commitment by stakeholders for further development, implementation and management of sensor monitoring networks, forecast modeling tools, and program planning and coordination.

3.0 Real Time Management Program

The Central Valley Water Board Basin Plan for the Sacramento and SJR made a provision for real-time control of salinity in the SJR:

> "*3. The Regional Water Board will adopt a waiver of waste discharge requirements for salinity management, or incorporate into an existing agricultural waiver, the conditions required to participate in a Regional Water Board approved RTMP. Load allocations for nonpoint source dischargers participating in a Regional Water Board approved RTMP are described in Table IV-4.4. Additional waiver conditions will include use of Regional Water Board approved methods to measure and report flow and electrical conductivity. Participation in a Regional Water Board approved RTMP and attainment of salinity and boron water quality objectives will constitute compliance with this control program."* [3]

Stakeholders within the San Joaquin Basin can choose to participate in the RTMP or operate under WDR from the Water Board.

A fully functioning RTMP requires development of specific components, including but not limited to the following:

- Organization Structure for Participants
- Monitoring Network
- Data Management
- Modeling/forecasting
- Physical infrastructure and changes in management practices, as needed
- Funding base

[3] Water Quality Control Plan (Basin Plan) for the Sacramento River and San Joaquin River Basins, Actions and Schedule to Achieve Water Quality Objectives, Agricultural Drainage Discharges in the San Joaquin River Basin, Control Program for Salt and Boron Discharges into the Lower San Joaquin River, pg. IV-32.01

The sections below document the organizational structure for the effort and a phased approach to incorporate all the necessary RTMP components in a systematic fashion. As the program develops, it is important to note that Reclamation will continue to operate its New Melones releases under the State Water Board Water Rights Decision 1641, to meet salinity objectives at Vernalis.

3.1 RTMP Framework MOU

Parties participating in the RTMP Framework will be organized under MOU. The initial participants are expected to be the Westside San Joaquin River Watershed Coalition on behalf of participating agencies and individuals within its boundaries and the Grassland Basin Drainers on behalf of all of its participants, along with Reclamation and other Cooperating Agencies that wish to participate. The MOU will allow for participation by districts, coalitions, or individuals in each of the other identified sub-basins, who may join at the outset or later on. These parties are collectively referred to as the "RTMP Participants" or the "Stakeholders." The MOU will be executed by July 28, 2014.

A copy of the MOU will be incorporated as Attachment A into the final RTMP Framework. When participants sign on to or depart from the MOU, Attachment A of the RTMP Framework will be updated and a copy of the revision provided to the Central Valley Water Board within 30-days of the signed revision.

Reclamation is continuing to participate and support the effort and has entered into a Management Agency Agreement (MAA) with the Central Valley Water Board documenting their future activities. A copy of the MAA is included as Attachment B.

3.2 RTMP Phased Approach

An important concept for development of real time management is "assimilative capacity." Assimilative capacity can be defined as the mass load of a pollutant that can be safely discharged to receiving water without exceeding the water quality objective or standard for that pollutant. A RTMP is a set of water monitoring and management actions coordinated in conjunction with real time forecasts of river water quality to time salt discharges during optimum assimilative capacity. Proper phasing of the effort is critical to insure that management can be adapted based on changes in water quality, water supplies, flow regimes and other ongoing regulations and potential projects. The following phased approach provides a logical platform to move into a fully functioning RTMP.

3.2.1 Phase 1 –Initiation Phase

- Completed prior to first compliance date of July 28, 2014

- Identify the monitoring stations necessary for the River Forecast Model.
- Develop a River Forecast Model approach for the RTMP.
- Determine the appropriate forecasting interval.
- Develop operation and maintenance requirements for the monitoring stations (for the forecasting model) along with costs and funding for the monitoring stations.
- Complete pilot studies on: tracking discharge salinity that includes existing activities and monitoring in the Mud Slough drainage area (including the drainage of the GRCD and the GBP); and salt control techniques at GBP.
- Develop a MOU to organize participants and provide a mechanism for additional participants.
- Develop Management Agency Agreement between Reclamation and the Central Valley Water Board that identifies Reclamation activities supporting a RTMP.

3.2.2 Phase 2 Development Phase

- Begin at first compliance date and complete in 12 months.
- Stakeholders participating in the RTMP will demonstrate and refine salinity management methods. Stakeholders can evaluate the GRCD demonstration project networked monitoring and control system and the GBP salinity control techniques for useful program development information.
- Participants throughout the program will as necessary improve the existing monitoring stations, install additional stations, and cooperate to further develop a model to be used to forecast SJR assimilative capacity.
- Initial participants in the RTMP will cooperate under the MOU including developing approaches for funding the necessary activities.
- Develop the data platform to support the River Forecast Model.
- Outreach will continue for additional stakeholders.

3.2.3 Phase 3 – Early implementation Phase

- Complete 36 months from first compliance date.
- One or more cooperating agencies or other entities will conduct programmatic weekly forecasting of assimilative capacity in the SJR. Data sharing is of utmost importance to the successful implementation of the RTMP; key stakeholders will be asked to share flow and water quality information throughout the basin.

- The RTMP participants will analyze the need for additional infrastructure and identify necessary funding requirements through the MOU.
- Develop and recommend specific additional management practices needed to better coordinate the real time operation of discharges to the San Joaquin River.
- Continue outreach for additional stakeholders.

3.2.4 Phase 4 Implementation Phase

- Completed 60 months from first compliance date.
- RTMP Participants will be implementing monitoring, data networking, management practices and utilizing the forecast model to coordinate the timing of discharges.
- RTMP participants will be addressing long-term funding and management needs.
- Additional parties would join by their Basin Plan compliance date. The future level of participation by additional regulated parties in the real time management program is difficult to predict. It is anticipated, however, since the alternative will be fixed load allocations, the coordinated and collaborative approach envisaged under a RTMP would be more cost-effective in the long term.
- It is further anticipated that during Phase 4 continuous implementation will bring about improvements to data processing, quality assurance and the river assimilative capacity forecast modeling.

3.3 Status of Phase 1

Phase 1 is ongoing and is anticipated to completed by of July 2014. Status products of the various elements are listed below.

3.3.1 Identify the monitoring stations necessary for the River Forecast Model

The key initial monitoring stations for the RTMP are listed below. A map is shown in Figure 4. These stations were installed at various times, the installation and maintenance supported by different agencies. The River stations have been established the longest and were installed and maintained by the California Department of Water Resources and the US Geological Survey (under a service agreement with Reclamation).

3.3.1.1 River Sites

Prior to 1985 most stations reported just flow. EC sensors were added to the majority of River stations in the 1990's. The Maze Road monitoring station was the last to be upgraded to measurement of continuous EC in the early 2000's by DWR. In the case of the Newman Bridge flow monitoring station it was determined, given its proximity to the Merced River confluence, that it would not be a suitable location for continuous EC measurement. Hence a new station was established at the Crows Landing Bridge. Although the station was not ideal for flow measurement, given its location immediately downstream from a bend in the San Joaquin River, its location is sufficiently downstream of the Merced River confluence from the east side of the River and the Orestimba Creek confluence from the west side of the River to provide meaningful EC measurements. The Vernalis monitoring station was upgraded about 8 years ago and the site moved a short distance downstream with the installation of a new gauge house and access ramp. The new station allows easier access and the deployment of additional continuously recording water quality instruments. The river stations include:

- San Joaquin River near Crows Landing
- San Joaquin River near Patterson
- San Joaquin River at Maze Rd Bridge
- San Joaquin River at Vernalis

3.3.1.2 Tributary Sites

Tributary monitoring stations were located along the lower reaches of the Merced, Tuolumne, and Stanislaus Rivers at stations that are mostly upstream of backwater conditions when the San Joaquin River is at flood stage. The tributary stations include:

- San Joaquin River at Hwy 165 (near Stevinson)
- Merced River near Stevinson
- Tuolumne River at Tuolumne City
- Stanislaus River at Koetitz Ranch

Figure 4. Monitoring Station Location Map

3.3.1.3 Discharge Sites

Westside Locations

Mud Slough near Gustine (GBP Site D) and Salt Slough at Highway 165 (Lander Avenue) are long established sites that are monitored by the USGS under contract initially to the State Water Board and now by Reclamation. Likewise Orestimba Creek (the largest of the west side drainages) has been measured continuously since the late 1980's. The San Luis Drain was monitored by the GBP at Site B starting in 1996 until the flow measurement site was moved to the Drain terminus. Site B measures the combined subsurface drainage from the 100,000 acre Grasslands Bypass Project area. Mud Slough at Gun Club Rd., Fremont Canal at Gun Club Rd., Hollowtree Drain, S. Lake Drain (Collectively GBP Site C) and Los Banos Creek at Hwy 140 sites were installed over a decade ago by Berkeley National Laboratory in cooperation with Grassland Water District (GWD) and the U.S. Fish and Wildlife Service (USFWS). The sites have been upgraded and continue to be operated by GWD as part of their monitoring commitment under the Irrigated Lands Regulatory Program. The eight west side tributary discharge sites were installed by Berkeley National Laboratory in cooperation with Patterson Irrigation District and West Stanislaus Irrigation District using funds allocated by the Central Valley Water Board. The stations were utilized for the Stockton Dissolved Oxygen TMDL and have been maintained by the University of the Pacific under contract with the Westside San Joaquin River Watershed Coalition. These eight discharge stations are in the process of being re-established on CDEC. All other discharge stations with the exception of Newman Wasteway are telemetered. The Westside stations include:

- Salt Slough at Hwy 165 (near Stevinson)
- Mud Slough near Gustine (GBP Site D)
- Mud Slough above San Luis Drain Confluence (GBP Site C)
- San Luis Drain at Outlet (GBP Site B)
- Los Banos Creek at Highway 140
- Newman Wasteway
- Marshall-Spanish-Moran Drains
- Ramona Lake
- Orestimba Creek near Crows Landing
- Westley Wasteway
- Del Puerto Creek
- Hospital Creek
- Ingram Creek

Eastside Locations

The Eastside monitoring sites are flow gauging sites within Modesto and Turlock Irrigation Districts that were upgraded by Berkeley National Laboratory in 2005 in cooperation with District personnel to measure EC. The data is telemetered internally to each district on their SCADA networks. At the time of the Stockton Dissolved Oxygen TMDL (Upstream Studies) Project data were sent to Berkeley Lab via FTP transfer every month. The data was QA checked and relayed to Systech Water Resources Inc. for inclusion in the WARMF-SJR model. A collaborative effort will need to be made in concert with Modesto and Turlock Irrigation Districts to automate data delivery from the east side stations draining into the San Joaquin River. The Eastside stations include:

- Modesto ID Lateral 4 Spill
- Modesto Irrigation District Lateral 5 Spill
- Modesto Irrigation District Lateral 6 Spill
- Modesto Irrigation District Main Drain to Stanislaus River
- Turlock Irrigation District Harding Drain
- Turlock Irrigation District Lateral 2 Spill
- Turlock Irrigation District Lateral 6 & 7 at levee
- Turlock Irrigation District Westport Drain

3.3.1.5 Diversion Sites

Of the three major diversions, Patterson Irrigation District, West Stanislaus Irrigation District and El Solyo Water District, reliable diversion gauging only exists at Patterson and West Stanislaus Irrigation Districts. In the late 1990's Berkeley National Laboratory installed a new monitoring station along the First Lift Canal at West Stanislaus Irrigation District allowing real-time flow and EC data acquisition using a shared phone line in the pump house. Data was downloaded daily from this site until 2003 when grant funding that supported this activity ran out. During this same period the General Manager at Patterson Irrigation District provided access to the District's internal FTP site into flow data from the Replogle Flume installed in the First Lift Canal and EC data from an environmental monitoring station along the same reach was exported daily. This allowed real-time access to the diversion data. New agreements will need to be developed with both Districts to re-establish data access. At El Solyo Water District the District will require the installation of reliable continuous flow and EC sensors to provide reliable diversion information.

The diversion sites include:

- Patterson ID
- West Stanislaus ID

3.3.1.6 Wastewater Treatment Plants:

The Modesto wastewater treatment plant is the only facility where data are available to characterize direct discharge into the San Joaquin River. There has been no attempt to date to obtain real-time data from this facility.

3.3.2 River Forecast Model Approach for the RTMP

The SJR Forecast Model for assimilative capacity in the LSJR will undergo changes before the regulatory deadline in 2014. Reclamation has funded a contractor to update the US EPA's Watershed Analysis Risk Management Framework (WARMF) model. In order to provide a successful RTMP, cooperating agencies and stakeholders agreed to participate in a Technical Research Team (TRT). The TRT is committed to the development of WARMF River Forecast Model, Management Module, WARMF on-line application, and visual tools in support of meeting water quality objectives in the LSJR at Vernalis. The TRT includes experienced model developers and managers experienced with establishing milestones and metrics to assess progress of the project.

The WARMF River Forecast Model will serve to present assimilative capacity forecasts using real-time data, as well as simulating forecasts from one to two weeks in the future.. This vital information can be utilized by the real-time management group, in conjunction with visualization tools, to plan and coordinate discharges into the SJR at times when assimilative capacity is available. Initially, three agencies have volunteered to run this model during start up, and provide the information every week on a rotational basis: Reclamation, the CA Department of Water Resources, and the Central Valley Water Board.

When fully developed, the model will be used by the real time management program stakeholders in the following basic salinity management process: the sensor network will provide real time data, visualization tools will present real-time water EC and flow data, and SJR forecast model will present real-time and simulated river assimilative capacity for water discharge planning.

3.3.2.1 Determine the Forecasting Interval

The TRT in association with the water masters and the RTMP stakeholders will determine the forecasting requirements and reporting intervals that will be needed for an operational RTMP. It is expected that forecast needs may change seasonally.

3.3.2.2 Develop Operation and Maintenance Requirements for the Monitoring Stations

Reclamation, Central Valley Water Board, DWR, and Westside Stakeholders (due to 2014 compliance deadline) will develop the RTMP WARMF SJR Forecasting Tool, Management Module, and WARMF On-line Application. The CDEC and USGS stations will be maintained by the associated agency. Each watershed or District will manage their on-site sensor and water management systems. Future management and funding plans will be developed as needed for the RTMP.

3.3.3 RTMP Pilot Studies

The following projects demonstrate the feasibility of a real time monitoring program. The technical part of real time monitoring and data management has been addressed and that part of the process only needs to be scaled up which is relatively simple (compared to other aspects) given the large data storage capabilities of modern computers. The GRCD program can be used as a pilot for developing a monitoring strategy and the GBP as a pilot of a variety of salinity control techniques.

3.3.3.1 Grassland Resource Conservation District Wetland Areas

The real-time water quality monitoring program within the GRCD has provided water quality and flow data to the U.S. Fish and Wildlife Service, CA Department of Fish and Wildlife and the private wetland managers for over a decade. The network has been publically available since 2005, has expanded to over 45 monitoring stations, and characterizes water quality and quantity both entering, within, and leaving the Grassland Wetland Complex. The network has also proven to be a tremendous resource for decision support and water accounting within the wetland areas.

A Quality Assurance/Quality Control protocol was developed in collaboration with the Reclamation to maintain the integrity of the monitoring network and data. The Quality Assurance protocol for continuous data collection and processing was based on the protocol adopted for the Grasslands Bypass Project and previous assessments administered by GWD including the Irrigated Lands Regulatory Program (ILRP), and a State Water Board funded project, *Adaptive, Coordinated Real-Time Management of Wetland Drainage* (Agreement # 04-312-555-1).

This project has improved upon these protocols by utilizing real-time data (15 minute) through the YSI EcoNet commercial website and the NIVIS Data Center. This allowed more frequent assessment of sensor performance at each of the monitoring stations and rapid response to problems identified through the continuous inspection of the data. Given the highly variable flow conditions at these monitoring stations and the high susceptibility for fouling by algae, sediment or vegetation, the web enablement has helped to reduce station “down-time” and resulted in more representative and

comprehensive data sets than has been observed during previous efforts. Currently the program, under a cooperative agreement with USBR, is transitioning to WISKI, an improved time series management platform from KISTERS, which will provide for improved quality assurance and data management ultimately resulting in more representative real time data and time savings. WISKI's mass data calculation, optimized database and transfer capabilities will enable the storage, visualization and analysis of data more efficiently for the program.

In addition to providing monthly progress reports on operations, GWD provides semi-annual reports on the dynamics of water and salt load entering and leaving the wetland complex. The network has proven to be a tremendous decision support resource for minimizing salt load to the SJR without compromising the productivity of the wetland complex. With cooperation from private landowners, CDFW and USFWS management staff, the project has moved forward smoothly. Many of the private landowners, CDFW and USFWS management staff, as well as GWD water management staff now utilize the monitoring network acknowledging its utility to assist in water conservation and water quality management decision support. The utilization of the monitoring network by the local wetland community has been instrumental in advancing the concept of real-time water quality monitoring based decision support in this region. Management and Stakeholder adoption of the monitoring network emphasizes the importance of a publicly accessible web enabled real-time water quality monitoring data.

Wetland water tenders and managers now utilize the real time monitoring network continuously to maximize water conservation and monitor water quality within the wetland complex and discharges to the SJR.

Reclamation is completing development of a visualization tool for GRCD. The visualization tool utilizes a Geographic Information System to help the GRCD understand the spatial distribution of water flow, salt discharges and river flows (assimilative capacity). This tool technology will be available for adaptation if stakeholders wish to visualize the salt movement within their watershed; the GRCD pilot project serves as an example of how real-time monitoring tools can be used to manage water discharges.

The GRCD real-time study serves as an example to stakeholders within the Basin of the information and sensor technologies that may be required to implement a RTMP. GRCD can offer guidance to those who are implementing similar programs. Costs associated with this program, including equipment acquisition, installation, quality assurance, and data management are currently in excess of $5 million. Approximate annual programmatic costs are currently in the range of $500,000.

3.3.3.2 Grassland Bypass Project and Panoche Drainage District

Reclamation has invested more than $33 million since 2001 in systematic data-gathering, research, and development of the San Joaquin River Improvement Project (SJRIP) that is part of the GBP and is owned and operated by Panoche Drainage District and Firebaugh Canal Water District. In addition approximately $107 million in Federal, State and farmer funds has been invested in the GBP and the SJRIP. Other types of drainage management investments include landowner, district, and state supported investments in the conversion of 70% of the irrigated acres to drip irrigation, installation of tailwater recirculation systems, installation of District recirculation systems, and projects to reduce system losses at the District level. These investments have resulted in a long-term reduction in the amount of saline agricultural drain water that is discharged to the SJR estimated to be 17% of the total average annual salt load at Vernalis. Federal and match funds have built infrastructure to apply most of this drain water to salt tolerant crops within the SJRIP, and provide mitigation for environmental effects.

The metric for success has been the significant reduction in the loads of salts that are discharged to the river that can be attributed to the drainage management activities, including the SJRIP. The diminishing monthly and annual load objectives have been specified in the 2009 Use Agreement[4], with the goal of full elimination of these discharges by 31 December 2019 and incentives for earlier full elimination. As discussed above, participants in the Grasslands Bypass Project implemented agricultural best management practices and area wide measures to reroute drainage and reduce the total selenium load discharged to the SJR. The measures were initially implemented to control selenium; reduced salt loads are an additional benefit. The Grasslands Bypass Project has resulted in the following actions:

- Rerouting of agricultural subsurface drainage water around wetlands to the SJR via the San Luis Drain, a concrete-lined bypass.
- Improved management practices to achieve selenium objectives in the main stem of the SJR below the Merced River.
- Through the Use Agreement achieved selenium load reductions.

Reclamation and the San Luis and Delta-Mendota Water Authority entered into a Use Agreement that states that the San Luis Drain will be closed if annual load targets are exceeded by more than 20 percent and no acceptable explanation is provided. The Central Valley Water Board adopted three selenium TMDLs, developed a Waste

[4] U.S. Bureau of Reclamation and the San Luis and Delta-Mendota Water Authority, December 22, 2009. Agreement for Continued Use of the San Luis Drain for the Period January 1, 2010 to December 31, 2019. Agreement No. 10-WC-20-3975

Discharge Requirement permit that required Grasslands Area Farmers to reduce the discharge of selenium below pre-GBP levels, and established a plan to guide coordinated implementation of these requirements.

The Grasslands Bypass Project was instrumental in improving cooperation between federal, state and local agencies to address regional water quality issues. The oversight committee includes the USBR, USFWS, US Environmental Protection Agency (USEPA), California Department of Fish and Wildlife, and the Central Valley Water Board. The Contra Costa Water District helped to negotiate terms of the San Luis Drain Use Agreement. In addition, the San Luis and Delta-Mendota Water Authority represent the Grasslands Area Farmers, the USGS provided technical support and Environmental Defense provided support in developing the project.

3.3.4 MOU Development

The RTMP Framework and associated MOU will allow for participants to join the RTMP prior to their compliance deadline. Additionally, the Central Valley Water Board adopted Resolutions will present options for dischargers for meeting the compliance requirements for salinity.

3.3.5 Management Agency Agreement Development

Reclamation and the Central Valley Water Board agreed to collaborate and develop the 2014 MAA. The 2014 MAA will outline commitments over a five-year term. The agencies will develop an annual workplan that will be completed a year in advance to prioritize needs and funding.

4.0 Additional Information on Program Implementation

The RTMP Framework developed by the stakeholder group when approved by the Central Valley Water Board will serve as program guidance for salinity management and compliance with the TMDL. Stakeholders throughout the watershed have implemented projects to reduce salinity within the SJR. These actions will be coordinated through participation in the Steering Committee as outlined under the MOU for the real-time management participants.

The techniques required collecting and transmitting flow and stage data are well established and will be utilized in the RTMP. State and Federal agencies such as the DWR, Reclamation and USGS measure flow and stage routinely for a variety of applications. Only the California Data Exchange Center (CDEC), a separate operations division within the DWR, provides river stage and flood warning information on a real time basis. Agencies, such as the U.S. Army Corps of Engineers, utilize this information to determine reservoir release schedules during high runoff periods.

4.1 Real-Time Management Framework

Reclamation entered into a MAA with the CV Water Board in 2008. In this agreement Reclamation agreed to lead the effort to develop stakeholder interest in a real time management program. Actions performed by Reclamation to achieve this goal include participation in CV-SALTS, conducting public meetings, supporting real-time monitoring station development and developing a SJR salinity forecasting model. Reclamation and stakeholders have also collaborated to draft the Real Time Management Framework, which will serve as a reviewed and approved program guideline for the real-time management program within the watershed.

Stakeholders from the western San Joaquin watershed have worked in collaboration with Reclamation and DWR to develop the RTMP for the SJR. The Framework document will be released for public comment through the CV-SALTS LSJR committee. A phased approach was chosen after consultation with Central Valley Water Board staff to provide flexibility to develop and implement the most appropriate methods.

4.2 Central Valley Salinity Alternatives for Long-term Sustainability

In July 2008, after approval of the salt and boron TMDL for the SJR, the Central Valley Water Board and San Joaquin Valley stakeholders created the Central Valley Salinity Coalition (CVSC), a legal non-profit organization. CVSC signed a Memorandum of Agreement (MOA) with the Central Valley Water Board and the State Water Resources Control Board. Its purpose is to organize, facilitate and fund efforts needed to fulfill the goals of the Basin Plan. This coalition created the Central Valley Salinity Alternatives for Long-term Sustainability (CV-SALTS) program to give Central Valley stakeholders a forum for participation in the creation of a Valley-wide salt and nutrient management plan. The CV-SALTS program subsequently created the Lower San Joaquin River Committee (LSJRC) to accomplish the task of determining upstream water quality objectives and compliance points in accordance with the Basin Plan. CVSC coordinates the meetings of the CV-SALTS committees, maintains an independent web site, and manages the projects originating from this effort. Information and materials regarding the stakeholder committees and other activities, including the meeting schedule, are posted on their website: www.cvsalinity.org.

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4.3 Future Activities that will Affect Salinity

Most planned activities within the San Joaquin Basin have the potential to affect salinity concentrations within the river. The San Joaquin River Restoration Program, San Joaquin River flow requirements, Vernalis flow objective, Irrigated Lands Regulatory

Program, likely cropping patterns and changes, timing of tributary reservoir releases, and other activities will all affect salinity within the SJR.

4.4 Ongoing Water Quality Regulatory Activities

4.4.1 Management Agency Agreement

Reclamation entered into a MAA with the Central Valley Water Board in December 2008 as a result of the Regional Board Staff Report and TMDL identifying significant contribution to salinity in the SJR watershed from Reclamation's delivery of CVP water imported through the Delta Mendota Canal. Reclamation included an Action Plan which lists the activities Reclamation planned to implement to meet water quality objectives in the SJR at Vernalis, including the facilitation of a real-time management program. Virtually all of the activities within that Action Plan have been completed. A Phase II 2014 MAA will be the mechanism that will document Reclamation's ongoing compliance with the TMDL. The draft 2014 MAA is being developed and is expected to be available in early 2014.

4.4.2 Irrigated Lands Regulatory Program

Agricultural stakeholders within the San Joaquin Valley have formed coalitions to comply with the Irrigated Lands Regulatory Program. The Westside San Joaquin River Watershed Coalition and the East San Joaquin Water Quality Coalition represent the majority of lands within the TMDL Project area. These Coalitions have been required to implement TMDL's within their respective areas.

4.4.3 Grassland Bypass Project

The Grassland Basin Drainers are organized to implement the GBP subject to waste discharge requirements issued by the Central Valley Water Board. Updated requirements will include the obligation to implement TMDL's applicable within the area served by the GBP. It should be noted that reductions of discharges from agricultural lands in the Grasslands subarea participating in the GBP are already at or very near load requirements.