CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY

REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL VALLEY REGION

AMENDMENTS TO THE WATER QUALITY CONTROL PLAN FOR THE SACRAMENTO RIVER AND SAN JOAQUIN RIVER BASINS

FOR

THE CONTROL PROGRAM FOR FACTORS CONTRIBUTING TO THE DISSOLVED OXYGEN IMPAIRMENT IN THE STOCKTON DEEP WATER SHIP CHANNEL

PEER REVIEW DRAFT STAFF REPORT

March 2004

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Acronyms/Abbreviations

Basin Plan	Water Quality Control Plan for the Central Valley-Sacramento/San Joaquin River Basins
BL	Background Loading
BOD	Biological Oxygen Demand
BPTCP	Bay Protection and Toxic Cleanup Plan
CBOD	Carbonaceous Biological Oxygen Demand
CEQA	California Environmental Quality Act
CFR	Code of Federal Regulations
cfs	Cubic Feet Per Second
CVP	U.S. Bureau of Reclamation, Central Valley Project
CVRWQCB	Central Valley Regional Water Quality Control Board
CWA	Clean Water Act
CWC	California Water Code
Delta	Sacramento/San Joaquin Delta
DMC	Delta-Mendota Canal
DO	Dissolved Oxygen
DWR	California Department of Water Resources
DWSC	Stockton Deep Water Ship Channel
LA	Load Allocation
LC	Loading Capacity
mg/L	Milligrams Per Liter
MLLW	Mean Lower Low Water
MOS	Margin of Safety
NEPA	National Environmental Policy Act
NPDES	National Pollutant Discharge Elimination System
Regional Water Board	Central Valley Regional Water Quality Control Board
RWCF	City of Stockton Regional Wastewater Control Facility
SDIP	South Delta Improvements Project
SJR	San Joaquin River
SJVDP	San Joaquin Valley Drainage Program
State Water Board	State Water Resources Control Board
SWRCB	State Water Resources Control Board
TMDL	Total Maximum Daily Load

Acronyms/Abbreviations (continued)

USACOE	United States Army Corps of Engineers
USBR	United States Bureau of Reclamation
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UVM	Ultrasonic Velocity Meter
WDR	Waste Discharge Requirements
WLA	Wasteload Allocation
WQO	Water Quality Objective

1 Introduction

1.1 Executive Summary

This draft staff report has been prepared in preparation of a Central Valley Regional Water Quality Control Board (CVRWQCB) workshop to be held at their regularly scheduled meeting on April 22 or 23, 2004. The report is a draft description of what will be proposed for adoption at a subsequent public hearing before the CVRWQCB, tentatively scheduled for July 8 or 9, 2004. Staff will make any needed revisions to this draft report and basin plan amendment in response to comments from peer reviewers and the public, prior to consideration for adoption of a revised version of this report. The revised report and proposed BPA will be made available for further public comment prior to the public hearing before the CVRWQCB.

Background

The San Joaquin River experiences regular periods of low dissolved oxygen (DO) concentrations in the first few miles of the Stockton Deep Water Ship Channel (DWSC) downstream from the City of Stockton. These conditions often violate the water quality objectives for DO in the DWSC as contained in the *Water Quality Control Plan for the Central Valley-Sacramento River and San Joaquin River Basins* (Basin Plan). In January 1998, the State Water Resources Control Board (SWRCB) adopted a Clean Water Act (CWA) Section 303(d) list that identified this impairment and ranked it as a high priority for correction.

Inclusion on this list initiated the need under the CWA for the Central Valley Regional Water Quality Control Board (CVRWQCB) to develop a Total Maximum Daily Load (TMDL) that identifies the factors contributing to the DO impairment and apportions responsibility for correcting the problem. It also initiated the need under the Porter-Cologne Water Quality Control Act to develop a program of implementation for the TMDL consisting of actions that the CVRWQCB will take to implement this TMDL and to bring the impaired reach of the DWSC into compliance with the Basin Plan DO objectives. The TMDL and program of implementation must be incorporated as an amendment to the Basin Plan to satisfy both of these requirements. In addition, the SWRCB Water Right Decision 1641 instructed the CVRWQCB to develop a TMDL for this impairment before they would take further water rights actions to implement the DO water quality objectives.

This staff report provides the technical and policy foundation for a proposed amendment to the Basin Plan needed to incorporate the San Joaquin River DO TMDL and phased program of implementation. It also documents the process by which the TMDL and program of implementation were developed in compliance with the California Environmental Quality Act (CEQA) and other applicable state and federal laws and policies. This draft Basin Plan amendment includes the findings and policies described below.

Total Maximum Daily Load

A number of studies performed in recent years have identified three main factors contributing to this DO impairment:

- Loads of oxygen demanding substances from upstream sources react by various mechanisms in the DWSC to reduce DO concentrations

- DWSC geometry intensifies the impact of these various reaction mechanisms such that net oxygen demand exerted in the DWSC is increased
- Reduced flow through the DWSC increases the residence time for these various reaction mechanisms, further increasing net oxygen demand exerted in the DWSC

The total theoretical capacity of the DWSC to assimilate oxygen demand exerted by incoming loads of oxygen demanding substances is a function of flow rate through the DWSC and temperature. Based on equitability and other considerations, this TMDL apportions loading capacity (pounds of oxygen demand exerted in the DWSC per day) less a margin of safety in equal amounts to each of the three main contributing factors.

Wasteload and Load Allocations

As proposed thirty percent of the loading capacity apportioned to sources of oxygen demanding substances is allocated as a wasteload to the City of Stockton RWCF, primarily for its discharge of ammonia. Seventy percent of the loading capacity apportioned to sources of oxygen demanding substances is allocated as a load to sources of algae and its precursors upstream of the DWSC. Current science is insufficient to determine the relative contribution from other wastewater, stormwater and other agricultural sources.

Although there is adequate scientific understanding to support a general apportionment of loading capacity to the three main contributing factors, there is inadequate understanding at this time to support detailed wasteload or load allocations to specific point and non-point sources of oxygen demanding substances and their precursors. As such, this proposed Basin Plan Amendment implements a phased TMDL that will require completion of the scientific studies needed to obtain the information needed for more detailed allocations and eventual implementation of mitigation measures by those responsible for the various sources. This will be achieved by the CVRWQCB taking the following actions:

- Require submission of study plan from entities responsible for the various sources of oxygen demand by February 2005. Studies must identify i) sources of oxygen demanding substances, ii) their transformation between sources and DWSC, and iii) their conversion to oxygen demand in the DWSC by December 2008
- Issue as needed CWC Section 13267 letters, General Waste Discharge Requirements, or modifications to NPDES permits as needed to require completion of required studies
- Develop more detailed wasteload and load allocations to sources of oxygen demanding substances and their precursors, based on the information obtained from these studies.

Non-Load Related Contributing Factors

The two non-load related contributing factors (DWSC geometry and reduced flows through the DWSC) are not loads of a substance for which mass or concentration limits can be assigned. Instead, these factors reduce the capacity of the DWSC to assimilate loads of oxygen demanding substances (loading capacity).

The following actions are proposed to ensure that mitigation measures are implemented to reduce the impact of DWSC geometry on loading capacity to less than the amount apportioned to this factor in the TMDL. The proposed Basin Plan amendment will:

- Require future projects that increase the cross-sectional area of the DWSC geometry to evaluate and fully mitigate potential impacts on oxygen demand loading capacity in the DWSC when obtaining CWA Section 401 Water Quality Certifications.
- Recommend that agencies responsible for existing DWSC geometry evaluate and mitigate the impact on oxygen demand loading capacity to an amount less than that apportioned to these factors in the TMDL

The following actions are proposed to ensure that mitigation measures are implemented to reduce the impact from activities that reduced flow through the DWSC on oxygen demand loading capacity to less than the amount apportioned to these factors in the TMDL. The proposed Basin Plan amendment will recommend:

- SWRCB should amend current water right permits for activities that reduce flow through the DWSC to require that impacts on oxygen demand loading capacity be evaluated and mitigated to less than the amount apportioned to those factors in the TMDL
- SWRCB should require evaluation and full mitigation of the potential impacts of future water right permits or water transfer applications on reduced flow and oxygen demand loading capacity in the DWSC.
- Agencies responsible for existing water resources facilities projects in the watershed that potentially reduce flow through the DWSC should evaluate and mitigate impacts on oxygen demand loading capacity to less than that apportioned to those factors in the TMDL.
- Agencies responsible for future water resources facilities projects in the watershed that potentially reduce flow through the DWSC, and that are not otherwise subject to CWA Section 401 Water Quality Certifications should evaluate and fully mitigate the potential impacts of their projects on oxygen demand loading capacity in the DWSC.

This staff report is in support of an informational CVRWQCB workshop only. The CVRWQCB will consider a resolution to adopt these proposed modifications (including any changes resulting from public comments) at a subsequent public hearing at a regularly scheduled CVRWQCB meeting.

1.2 Organization of Basin Plan Amendment Staff Report

This Basin Plan Amendment staff report begins with a presentation of the proposed Basin Plan language changes for incorporating the TMDL and program of implementation and a discussion of how it relates to applicable CVRWQCB and SWRCB policies. This is followed by a more detailed description of the different elements of the TMDL and program of implementation, and ends with documentation of the process by which the conclusions of this report where reached in compliance with the California Environmental Quality Act and other applicable laws and policies. The report is organized into the following eight sections:

- Section 1 provides an executive summary of the Basin Plan Amendment and outlines the organization of this staff report.
- Section 2 begins with a summary of the proposed changes to the various Basin Plan chapters, followed by specific wording modifications to the Basin Plan language.
- Section 3 provides a review of the existing CVRWQCB and SWRCB policies that pertain to this Basin Plan amendment.
- Section 4 provides a detailed presentation of the TMDL elements and the preferred alternative approach for wasteloads and load allocations and a program of implementation for the TMDL.
- Section 5 begins with a description of the alternatives analysis process that was utilized for selecting the preferred alternative followed by some technical and economic analysis of the preferred alternative.
- Section 6 contains documentation of the required functionally equivalent CEQA review.
- Section 7 provides a description of public participation involved in the CEQA review process.
- Section 8 provides a bibliography of citations to reports and literature used in this report.
- Appendices to this document provide detailed supporting documentation

This staff report is in support of an information workshop only and does not propose specific action to be taken by the CVRWQCB at this time.

2 Proposed Amendments to the Basin Plan

2.1 Summary of Proposed Amendments

The purpose of this Basin Plan amendment is to update the Basin Plan to incorporate a TMDL and Program of Implementation addressing the DO impairment in the San Joaquin River. The Basin Plan amendment staff report presents the needed Basin Plan language (revisions, deletions, and/or additions) and information to support these changes.

The Basin Plan consists of five chapters. The proposed Basin Plan amendment consists of additions and modifications to Chapters 4 and 5 only. This section provides a summary of the proposed amendments to the Basin Plan in the order in which they appear in the Basin Plan. The proposed language modifications are presented in strikeout, underline mode in Section 2.2.

Basin Plan Chapter I: Introduction

Chapter I of the Basin Plan contains a description of the planning area and the major hydrologic features of the basin. The Basin Plan area is subdivided into two major watershed delineations: the Sacramento River and the San Joaquin River watersheds.

This Basin Plan amendment does not propose any modifications, deletions, or additions to Chapter I of the Basin Plan.

<u>Basin Plan Chapter II: Existing and Potential Beneficial Uses</u>

The Basin Plan designates beneficial uses for specific water bodies in the Sacramento and San Joaquin River drainage basins. Beneficial use designations determine the level of protection that a water body receives since water quality objectives must be set to protect the most sensitive beneficial uses.

This Basin Plan amendment does not propose any modifications, deletions, or additions to the designated beneficial uses contained in the current version of the Basin Plan. Those beneficial uses in the DWSC that are impaired by low DO are summarized in Section 4.2

<u>Basin Plan Chapter III: Water Quality Objectives</u>

Water quality objectives are defined in CWC Section 13050(h) as "*… 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.*" In setting water quality objectives the CVRWQCB must consider the requirements of CWC Section 13244, State and federal anti-degradation policies, and other factors. The existing Basin Plan DO water quality objectives applicable to the DWSC are described in further detail in Section 4.2.

No modifications to the Basin Plan DO water quality objectives are proposed as part of this Basin Plan Amendment. If future studies provide information supporting a modification to the DO water quality objectives, a decision can be made by the CVRWQCB at that time as to whether to undertake the Basin Plan amendment that would be required to modify the objectives.

<u>Basin Plan Chapter IV: Implementation</u>

The Porter-Cologne Water Quality Control Act requires that basin plans consist of beneficial uses, water quality objectives and a program of implementation for achieving those water quality objectives [CWC Section 13050(j)]. Chapter IV of the Basin Plan describes considerations and specific actions the CVRWQCB will take to implement the water quality objectives. A number of changes to this chapter of the Basin Plan are summarized below under the headings where they appear. These changes describe specific actions the CVRWQCB will take to implement the DO TMDL.

<u>The Nature of Control Actions Implemented by the Regional Water Board</u>

This section of Chapter IV includes two subsections that describe the SWRCB and CVRWQCB policies, agreements, prohibitions, guidance, and other restrictions or requirements to which CVRWQCB implementation actions must conform.

Under the subheading entitled "*Control Action Considerations of the State Water Board*" this Basin Plan amendment proposes to add a description of Water Right Decision 1641, which was adopted in December 1999 and revised in March 2000 by SWRCB Order WR 2000-02. Also included is a brief statement describing how Water Right Decision 1641 directed the CVRWQCB to prepare a TMDL before the SWRCB would take any further water rights action to implement the DO objectives.

Under the subheading entitled "*Control Action Considerations of the Central Valley Regional Water Board*" this Basin Plan amendment proposes to add a description of how the CVRWQCB will require future DWSC and water resources projects, which need CWA Section 401 Water Quality Certifications, to evaluate and fully mitigate the potential impact of these projects on oxygen demand loading capacity in the DWSC.

Actions Recommended for Implementation by Other Entities

Consistent with the Porter-Cologne Water Quality Control Act, the Basin Plan may identify control action recommended for implementation by agencies other than the CVRWQCB [Water Code Section 13242(a)].

Subheading "*Recommended for Implementation by the State Water Board*" contains recommendations to the SWRCB about specific water quality and water rights actions that would assist in the implementation of the water quality objectives in the Basin Plan. This Basin Plan amendment is adding an item under this subheading, which recommends that the SWRCB use its water rights authority to assign responsibility for mitigating the impact on oxygen demand loading capacity from existing and future activities that reduce flow through the DWSC.

Subheading "*Recommended for Implementation by Other Agencies - Water Resources Facilities*" contains recommendations for other agencies to consider as part of their planning and operation of various water resources facilities in the Sacramento and San Joaquin River basins. This Basin Plan amendment adds an item under this subheading recommending that all federal, state and local agencies responsible for water resources facilities, which may reduce flow through the DWSC, evaluate and mitigate the impact of proposed and existing water resources projects on oxygen demand loading capacity in the DWSC.

This Basin Plan amendment is adding a new subheading entitled "*Recommended for Implementation by Other Agencies – Stockton Deep Water Ship Channel.*" A new item will be added under this subheading recommending that those agencies responsible for the DWSC geometry evaluate and mitigate its potential impact on DO conditions in the DWSC.

Actions and Schedule to Achieve Water Quality Objectives

This heading under Chapter IV provides a description of specific actions the CVRWQCB will implement to achieve the Basin Plan Water Quality Objectives. This Basin Plan amendment is adding a new subheading entitled "*Control Program for Factors Contributing to the Dissolved Oxygen Impairment in the Stockton Deep Water Ship Channel (DWSC).*" Numerous items will be added under this subheading to provide necessary background and to describe the TMDL and specific actions that make up the program of implementation.

Estimated Costs of Agricultural Water Quality Control Programs and Sources of Financing

Water code section 13141 requires that prior to implementation of any agricultural water quality control program, an estimate of the total cost of such a program and identification of sources of funding be included in the Basin Plan. As this Basin Plan amendment involves evaluation of impacts and potential sources controls for agricultural discharges, an estimate of costs and a discussion of the potential funding sources are included under a new subheading, entitled "*Control Program for Dissolved Oxygen in the Stockton Deep Water Ship Channel.*"

Basin Plan Chapter V: Surveillance and Monitoring

CWC Section 13242 requires that a program of implementation for achieving water quality objectives include a description of the surveillance to be undertaken to determine compliance with those objectives. For Basin Plan water quality objectives these descriptions are contained in Chapter V. Surveillance and Monitoring.

As described in detail in Section 4.6 of this report, a phased approach is being proposed for this TMDL and program of implementation. This phased approach provides time for additional scientific and modeling studies to improve our understanding of the linkages between the various contributing factors and the DO impairment. This proposed Basin Plan Amendment adds a description of the goals and schedule of the various studies being allowed for by this phased approach under the Special Studies sub-heading of Chapter V.

2.2 Proposed Amendments

The following are the proposed language modifications to the Basin Plan. Deletions are indicated as strike-through text (~~deleted text~~) and additions are shown as underlined text (<u>added text</u>). All italics text (*Notation Text*) is included to locate where the modifications will be made in the Basin Plan.

Under the Chapter IV heading: "Control Action Considerations of the State Water Board" add the following two paragraphs to item #13 page IV-10

In December 1999 the State Water Board adopted, and in March 2000 per Order WR 2000-02 revised, Water Right Decisions 1641. This decision amended certain water rights by assigning responsibilities to water right holders to help meet flow objectives intended to implement the water quality objectives contained in the 1995 Bay-Delta Plan.

Rather than taking any water right action to meet the dissolved oxygen objectives in the 1995 Bay-Delta Plan, the State Water Board directed the Regional Water Board to first prepare a TMDL to achieve the dissolved oxygen objectives and implement it.

Under the Chapter IV heading: "Control Action Considerations of the Central Valley Regional Water Board" add new paragraph item #12 on page IV-21:

12. Any project that requires a Clean Water Act Section 401 Water Quality Certification from the Regional Water Board and that has the potential to impact dissolved oxygen conditions in the Stockton Deep Water Ship Channel (DWSC) must evaluate and fully mitigate those impacts. This includes, but is not limited to:
    a) Future projects that increase the cross-sectional area of the DWSC
    b) Future water resources facilities projects that reduce flow through the DWSC.

Under the Chapter IV heading: "Recommended for Implementation by the State Water Board" add new sub-heading and items on page IV-28:

Dissolved Oxygen in the Stockton Deep Water Ship Channel (DWSC)

1. The State Water Board should amend water right permits for existing activities that reduce flow through the DWSC to require that the associated impacts on oxygen demand loading capacity be evaluated and mitigated to less than the amount apportioned to flow impacts in the *Control Program for Factors Contributing to the Dissolved Oxygen Impairment in the DWSC.*

2. The State Water Board should require evaluation and full mitigation of the potential impacts of future water right permits or water transfer applications on reduced flow and oxygen demand loading capacity in the DWSC.

Under the Chapter IV heading: "Recommended for Implementation by Other Agencies" and subheading: "Water Resources Facilities" add new item #3 & #4 on page IV-29:

3. Agencies responsible for existing water resources facilities that reduce flow through the Stockton Deep Water Ship Channel (DWSC) should evaluate and mitigate their impacts on oxygen demand loading capacity in the DWSC to less than the amount apportioned to flow factors in the *Control Program for Factors Contributing to the Dissolved Oxygen Impairment in the DWSC.*

4. Agencies responsible for future water resources facilities projects, which potentially reduce flow through the DWSC, should evaluate and fully mitigate the potential impacts on oxygen demand loading capacity in the DWSC.

Under the Chapter IV heading: "Recommended for Implementation by Other Agencies" add sub-heading and paragraph item #1 on page IV-30:

Stockton Deep Water Ship Channel (DWSC)

1. The U.S. Army Corps of Engineers should evaluate the impacts of the existing DWSC geometry on oxygen demand loading capacity in the DWSC and mitigate these impacts to an amount less than that apportioned to DWSC geometry per the *Control Program for Factors Contributing to the Dissolved Oxygen Impairment in the DWSC.*

Under the Chapter IV heading: "Actions and Schedule to Achieve Water Quality Objectives" add a new sub- heading and the following paragraphs beginning on page IV-37:

Control Program for Factors Contributing to the Dissolved Oxygen Impairment in the Stockton Deep Water Ship Channel (DWSC) (Regional Water Board Resolution No. R5-2004-0xxx)

The purpose of this dissolved oxygen TMDL and program of implementation is to achieve compliance with the Basin Plan dissolved oxygen water quality objectives in the DWSC.

The dissolved oxygen impairment in the DWSC is caused by the following main factors:

- Loads of oxygen demanding substances from upstream sources react by various mechanisms in the DWSC to reduce DO concentrations
- The DWSC geometry intensifies the impact of these various reaction mechanisms such that net oxygen demand exerted in the DWSC is increased
- Reduced flow through the DWSC increases the residence time for these various reaction mechanisms, further increasing net oxygen demand exerted in the DWSC

Based on equitability and other considerations, this TMDL apportions total oxygen demand loading capacity less a margin of safety in equal amounts to these three main contributing factors.

Loading capacity (LC_T) is given by the equation:

$$LC_T = \{DO_{sat} - DO_{obj}\} \times Q_{DWSC} \times 5.4$$

where DO_{sat} is the saturation dissolved oxygen concentration, which is itself a function of water temperature, in milligrams per liter; DO_{obj} is the applicable Basin Plan dissolved oxygen objective in milligrams per liter; Q_{DWSC} is the net daily flow rate through the DWSC in cubic feet per second; and 5.4 is a unit conversion factor that provides LC_T, in units of pounds of oxygen demand per day in the DWSC.

A margin of safety equal to 40% of the total loading capacity will be reserved for flow measurement error and technical uncertainty and not apportioned to any of the factors contributing to the impairment.

One-third of the total loading capacity, less the margin of safety, will be allocated to point and non-point sources of oxygen demanding substances and their precursors in the dissolved oxygen TMDL source area as follows:

a) 30% as a wasteload allocation for the City of Stockton Regional Wastewater Control Facility

b) 70% as a load allocation to sources of algae and/or precursors in the watershed.

Further study of the sources and linkages of oxygen demanding substances and their precursors, however, is required before detailed wasteload and load allocations can be developed for specific sources.

Mitigation measures will also need to be implemented to reduce the impact of both the DWSC geometry and reduced flow through the DWSC to less than one-third each of the total loading capacity, less the margin of safety.

The source area for loads of oxygen demanding substances and their precursors being addressed by this TMDL includes the SJR watershed that drains downstream of Friant Dam and upstream of the confluence of the San Joaquin River and Disappointment Slough, with the exception of the western slope of the Sierra Nevada foothills above the major reservoirs of New Melones Lake on the Stanislaus, Don Pedro Reservoir on the Tuolumne, Lake McLure on the Merced, New Hogan Reservoir on the Calaveras, Comanche Reservoir on the Mokelumne, and those portions of the SJR watershed in Mariposa, Tuolumne, Calaveras, and Amador Counties.

The Regional Water Board will take the following actions to implement this TMDL and attain the Basin Plan dissolved oxygen water quality objectives in the DWSC.

1. Water quality studies must be completed no later than December 2008 by the entities responsible for the various point and non-point sources of oxygen demanding substances and their precursors within the TMDL source area. These studies must identify and quantify:

   a) Sources of oxygen demanding substances and their precursors

   b) Growth or degradation mechanisms of these oxygen demanding substances in transit to the DWSC

   c) The impact of these oxygen demanding substances on dissolved oxygen concentrations in the DWSC

2. The Regional Water Board will use its authority under Porter-Cologne Water Quality Act Section 13267 (or alternately by General Waste Discharge Requirements and NPDES permits) as needed to require that the above studies be completed by December 2008. A study plan describing how the information needs will be addressed must be submitted to Regional Water Board staff by February 2005. The study plan and studies may be conducted by individual responsible entities or in collaboration with other entities.

3. The Regional Water Board will develop detailed wasteload and load allocations to sources of oxygen demanding substances and their precursors, based on the findings of these studies and dissolved oxygen conditions in the DWSC at that time.

4. As stated in Basin Plan Chapter IV sub-heading "*Control Action Considerations of the Central Valley Regional Water Board*" any project that requires a Clean Water Act Section 401 Water Quality Certification from the Regional Water Board and that has the potential to impact dissolved oxygen conditions in the Stockton Deep Water Ship Channel (DWSC) must evaluate and fully mitigate those impacts. This includes, but is not limited to:
   a) Future projects that increase the cross-sectional area of the DWSC
   b) Future water resources facilities projects that reduce flow through the DWSC

5. As stated in Basin Plan Chapter IV sub-heading "*Recommended for Implementation by the State Water Board*":
   a) The State Water Board should amend water right permits for existing activities that reduce flow through the DWSC to require that the associated impacts on oxygen demand loading capacity be evaluated and mitigated to less than the amount apportioned to flow factors in this control program.
   b) The State Water Board should require evaluation and full mitigation of the potential impacts of future water right permits or water transfer applications on reduced flow and oxygen demand loading capacity in the DWSC.

6. As stated in Basin Plan Chapter IV sub-heading "*Recommended for Implementation by Other Agencies*" the U.S. Army Corps of Engineers should evaluate the impacts of the existing DWSC geometry on oxygen demand loading capacity in the DWSC and mitigate these impacts to an amount less than that apportioned to DWSC geometry in this control program.

7. As stated in Basin Plan Chapter IV sub-heading "*Recommended for Implementation by Other Agencies – Water Resources Facilities*":
   a) Agencies responsible for existing water resources facilities that reduce flow through the Stockton Deep Water Ship Channel (DWSC) should evaluate and mitigate their impacts on oxygen demand loading capacity in the DWSC to less than the amount apportioned to flow factors in this control program.
   b) Agencies responsible for future water resources facilities projects that potentially reduce flow through the DWSC should evaluate and fully mitigate the potential impacts on oxygen demand loading capacity in the DWSC.

8. The Regional Water Board may consider alternate mitigation measures, as opposed to direct control, of certain contributing factors if these measures adequately address the impact on the dissolved oxygen impairment and do not degrade water quality in any other way.

Under the Chapter IV heading: "Estimated Costs of Agricultural Water Quality Control Programs and Potential Sources of Financing" add new sub-heading and items on page IV-38:

San Joaquin River Dissolved Oxygen Control Program

The dissolved oxygen TMDL and program of implementation requires agricultural and municipal dischargers to perform various studies. The total estimated cost of the studies to be performed as part of the phased TMDL is approximately $15.6 million.

Although dischargers have the ultimate responsibility for funding these studies, nearly $14.4 million of funding has been arranged through the California Bay-Delta Authority from Proposition 13 and 50 bond funds. An additional $1.2 million is being provided from various watershed stakeholders.

The cost of control or mitigation measures that will eventually be required to address the impacts of the various sources of oxygen demanding substances and their precursors cannot be estimated until the studies have been completed and allocations have been established. The costs for compliance with these allocations will be the responsibility of the various dischargers.

Estimating costs for mitigation of existing and future potential impacts from projects that affect DWSC geometry and reduced flow through the DWSC would be speculative until further work on selection of alternative mitigation measures is completed. Construction and operation costs of these mitigation measures would be the responsibility of the facility/project owner

Under the Chapter V, at the end of heading: "Special Studies" add new paragraph and items on page V-2:

As required by the San Joaquin River dissolved oxygen phased TMDL and program of implementation, special studies are required to identify and quantify:

a) Sources of oxygen demanding substances and their precursors

b) Growth or degradation mechanisms of these oxygen demanding substances in transit to the DWSC

c) The impact of these oxygen demanding substances on dissolved oxygen concentrations in the DWSC

3 Policies and Authority

3.1 Central Valley Regional Water Quality Control Board

The following CVRWQCB policies have been identified as being potentially applicable to the development of a Basin Plan Amendment for this DO TMDL and program of implementation.

Controllable Factors Policy

The CVRWQCB Controllable Factors Policy states that:

> *Controllable water quality factors are not allowed to cause further degradation of water quality in instances where other factors have already resulted in water quality objectives being exceeded. Controllable water quality factors are those actions, conditions, or circumstances resulting from human activities that may influence the quality of the waters of the State, that are subject to the authority of the State Water Board or Regional Water Board, and that may be reasonably controlled.*

Evaluation: The Controllable Factors Policy states that controllable water quality factors cannot cause degradation of water quality when water quality objectives are already being exceeded. The proposed Basin Plan amendment is consistent with the Controllable Factors Policy because the DO TMDL and associated program of implementation seek to bring an impaired water body back into compliance with water quality objectives. No additional controllable discharges are being proposed or are expected as a result of the proposed project and the program of implementation will begin to address existing contributing factors to the impairment.

The Water Quality Limited Segment Policy

The CVRWQCB Water Quality Limited Segment Policy states that:

> *Additional treatment beyond minimum federal requirements will be imposed on dischargers to Water Quality Limited Segments. Dischargers will be assigned or allocated a maximum allowable load of critical pollutants so that water quality objectives can be met in the segment.*

Evaluation: The Water Quality Limited Segment Policy indicates that the CVRWQCB will assign or allocate a maximum allowable load to dischargers so that water quality objectives can be met. The proposed Basin Plan amendment will establish a control program that allocates oxygen demand loading capacity to the various contributing factors to the DO impairment. The proposed Basin Plan amendment is, therefore, consistent with the Water Quality Limited Segment Policy.

Watershed Policy

The CVRWQCB Watershed Policy states that:

> *The Regional Water Board supports implementing a watershed based approach to addressing water quality problems. The State and Regional Water Boards are in the*

process of developing a proposal for integrating a watershed approach into the Board's programs. The benefits to implementing a watershed based program would include gaining participation of stakeholders and focusing efforts on the most important problems and those sources contributing most significantly to those problems.

Evaluation: The proposed Basin Plan amendment is consistent with the Watershed Policy. Section 4.3 of this report includes a source analysis, which finds the impairment caused by three key factors: i) loadings of oxygen demanding substances from upstream, ii) altered DWSC geometry, and 3) upstream exports and diversions that reduce flow through the DWSC. Section 4.4 of this report then takes a more comprehensive watershed approach to establishing wasteload and load allocations by taking into account the important impacts on loading capacity caused by DWSC geometry and reduced flow through the DWSC. The phase approach for this TMDL and program of implementation then provides the watershed stakeholders and the CVRWQCB with an opportunity to better identify sources and linkages to the impairment and to study potential mitigation measures.

3.2 State Water Resources Control Board Policies

The following SWRCB policies have been identified as being potentially applicable to addressing the DO impairment in the DWSC.

Antidegradation Implementation Policy

SWRCB Resolution No 68-16, Statement of Policy with Respect to Maintaining High Quality of Water in California, in applicable part states that:

> *…Implementation of this policy [State Water Board Resolution No. 68-16] to prevent or minimize surface and ground water degradation is a high priority for the Board. … The prevention of degradation is, therefore, an important strategy to meet the policy's objectives.* (Notation added)
>
> *The Regional Water Board will apply 68-16 in considering whether to allow a certain degree of degradation to occur or remain. In conducting this type of analysis, the Regional Water Board will evaluate the nature of any proposed discharge, existing discharge, or material change therein, that could affect the quality of waters within the region. Any discharge of waste to high quality waters must apply best practicable treatment or control not only to prevent a condition of pollution or nuisance from occurring, but also to maintain the highest water quality possible consistent with the maximum benefit to the people of the State.*
>
> *Pursuant to this policy, a Report of Waste Discharge, or any other similar technical report required by the Board pursuant to Water Code Section 13267, must include information regarding the nature and extent of the discharge and the potential for the discharge to affect surface or ground water quality in the region.*
>
> *This information must be presented as an analysis of the impacts and potential impacts of the discharge on water quality, as measured by background concentrations and applicable water quality objectives. The extent of information necessary will depend on*

the specific conditions of the discharge. For example, use of best professional judgment and limited available information may be sufficient to determine that ground or surface water will not be degraded. In addition, the discharger must identify treatment or control measures to be taken to minimize or prevent water quality degradation.

Evaluation: The proposed Basin Plan amendment does not specifically authorize any new or existing discharges and therefore it is not expected to result in any further degradation of a water body. The proposed Basin Plan amendment is intended to improve an impaired water body by implementing existing water quality objectives through load reductions.

The State Policy for Water Quality Control

This policy was established by the SWRCB in 1972 and includes general principles for the implementation of "water resources management programs." Key principles that are applicable to this Basin Plan amendment include:[1]

1. *Water rights and water quality control decisions must assure protection of available fresh water and marine water resources for maximum beneficial use.*

2. *Municipal, agricultural, and industrial wastewaters must be considered as a potential integral part of the total available fresh water resource.*

3. *Coordinated management of water supplies and wastewaters on a regional basis must be promoted to achieve efficient utilization of water…*

11. *Water quality criteria must be based on the latest scientific findings. Criteria must be continually refined as additional knowledge becomes available.*

12. *Monitoring programs must be provided to determine the effects of discharges on all beneficial waters uses including effects on aquatic life and its diversity and seasonal fluctuations…*

Water quality control plans and waste discharge requirements hereafter adopted by the State and Regional Boards under Division 7 of the California Water Code shall conform to this policy…

Departures from this policy and water quality control plans adopted by the State Board may be desirable for certain individual cases. Exceptions to the specific provisions may be permitted within the broad framework of well established goals and water quality objectives.

Evaluation: The proposed Basin Plan amendment includes a program of implementation designed to achieve existing DO water quality objectives that have been established for San Joaquin River near Stockton, CA. It includes consideration of the latest scientific information and provides for continued study and monitoring of conditions in the DWSC. This Basin Plan

[1] The numbering is from section II of the policy.

amendment does not propose any new or modified water quality criteria. The proposed Basin Plan amendment is therefore consistent with the State Policy for Water Quality Control.

Statement of Policy with Respect to Maintaining High Quality of Water in California

The policy (SWRCB Resolution No. 68-16) includes the following statements:

> *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 increase 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."*

Evaluation: The San Joaquin River between Stockton and Disappointment Slough is listed on the SWRCB section 303(d) list as an impaired due to low DO concentrations, therefore, the existing water quality in the river is not better than the quality prescribed in the Basin Plan. The proposed Basin Plan amendment is expected to improve DO water quality conditions in the San Joaquin River. No increases in volume or concentration of wastes are being proposed.

Nonpoint Source Management Plan

In 1988, the SWRCB adopted the first Nonpoint Source Management Plan (Resolution 88-123). An update to that plan, required under the Coastal Zone Act Reauthorization Amendments of 1990, was approved by the USEPA and National Oceanic and Atmospheric Administration in July 2000. That plan outlines a three-tiered approach to address non-point source water quality problems.

Tier one, as described in the 2000 update, is "self-determined implementation of management practices." Tier one allows "…landowners and resource managers to develop and implement workable solutions to non-point source pollution control and to afford them the opportunity to solve their own problems before more stringent regulatory actions are taken" (SWRCB/CCC, 2000). Tier two is defined as "regulatory-based encouragement of management practices." The two general approaches described for encouraging adoption of management practices is by waiving adoption of WDRs or by entering into Management Agency Agreements with agencies that have authority to enforce best management practices. Tier three includes the establishment of effluent limitations through WDRs or the application of other CVRWQCB authorities to bring about compliance with water quality objectives.

Evaluation: The proposed Basin Plan amendment is consistent with the Nonpoint Source Management Plan. By taking a phased approach to the TMDL and implementation plan, the time needed to self-determined implementation of management practices, as in Tier One, are being provided. This Basin Plan Amendment is proposing no Tier Two or Three actions. Such action will not be considered until the studies of this phased program of implementation are completed.

3.3 Implementation Authority

The SWRCB and CVRWQCB have the following regulatory authorities and/or obligations to address the DO impairment in the DWSC.

Total Daily Maximum Loads (TMDL)

Section 303(d)(1)(A) of the federal Clean Water Act (CWA) requires that "Each State shall identify those waters within its boundaries for which the effluent limitations are not stringent enough to implement any water quality standard applicable to such waters." The CWA also requires states to establish a priority ranking for waters on the Section 303(d) list of impaired waters and to establish a total maximum daily load (TMDL) for those listed waters. Essentially, a TMDL is a planning and management tool intended to identify, quantify, and control the sources of pollution within a given watershed to the extent that water quality objectives are achieved and the beneficial uses of water are fully protected. A TMDL is defined as the sum of the individual wasteload allocations to point sources, load allocations to non-point sources and background loading. Loading from all pollutant sources must not exceed the loading (or assimilative) capacity of a water body, including an appropriate margin of safety. The loading capacity is the amount of pollutant that a water body can receive without violating the applicable water quality objectives.

The specific requirements of a TMDL are described in the United States Code of Federal Regulations (CFR) Title 40, Sections 130.2 and 130.7 (40 CFR § 130.2 and 130.7), and Section 303(d) of the CWA. In California, the authority and responsibility to develop TMDLs rests with the Regional Water Quality Control Boards. The U.S. Environmental Protection Agency (USEPA) has federal oversight authority for the CWA Section 303(d) program and may approve or disapprove TMDLs developed by the state. If the USEPA disapproves a TMDL developed by the state, the USEPA is then required to establish a TMDL for the subject water body.

In California, the Porter-Cologne Water Quality Control Act (CWC, Division 7, Water Quality) requires a program of implementation for a TMDL to be included into the Basin Plan (CWC § 13050(j)(3)). This program of implementation must include a description of actions necessary to achieve Basin Plan water quality objectives, a time schedule for specific actions to be taken, and a description of monitoring to determine attainment of objectives.

National Pollutant Discharge Elimination System (NPDES) Permits

The Federal Clean Water Act established the National Pollutant Discharge Elimination System (NPDES) to provide a mechanism to regulate point-source waste discharges into surface waters of the United States. In California, the nine Regional Water Quality Control Boards administer the NPDES program. NPDES permits are typically issued to regulate point-source municipal and industrial discharges to surface waters, such as discharges from publicly owned waste water treatment facilities or privately owned facilities that discharge at discrete locations.

Prohibition of Discharge and Waste Discharge Requirements

When necessary, the CVRWQCB can prohibit certain waste discharges (Water Code § 13243). These prohibitions can apply to types of wastes and/or to specific areas. In addition to prohibitions of waste discharges, pursuant to the Porter-Cologne Water Quality Control Act (Water Code § 13260 et seq.) the CVRWQCB has the authority to issue individual or general WDRs, which govern the amount of pollution that can be discharged to a water body. Any person discharging waste or proposing to discharge waste is required to submit a report of waste discharge to the CVRWQCB. The CVRWQCB may also initiate the permit process by requesting a report of waste discharge from an individual or entity. The CVRWQCB also has the authority to require dischargers to prepare technical reports providing information related to a discharge and its impacts (Water Code § 13267).

Unlike NPDES permits, WDRs can be applied to waste discharges to land, groundwater, and from nonpoint source discharges to surface waters, including agricultural drainage. WDRs can be issued to parties discharging wastes, including individuals, agencies such as water districts, or companies. WDRs can specify the volume of discharge and set concentration and load limits on the constituents discharged. They can also set receiving water limits, the allowable concentration of a pollutant in the receiving water downstream of the discharge. The Board can require ongoing discharger compliance monitoring as a permit requirement. Where discharge limits in WDRs cannot be met at the time of adoption, the Board also adopts a Cease and Desist Order that specifies steps that must be taken and a timeline that must be followed to bring the discharge into compliance.

WDRs could have an important role in the implementation of a solution to the DO impairment as they are the primary regulatory mechanism, available to the CVRWQCB that can be used to address nonpoint source discharges.

Stormwater Permits

Provide background…

Clean Water Act, Section 401 Water Quality Certifications

Under the CWA an applicant for a Section 404 permit from the U.S. Army Corps of Engineers for an in-stream activity that may affect water quality also must apply for Water Quality Certification under Section 401 of the CWA. The Section 401 Water Quality Certification is based on the finding that the project will protect beneficial uses and comply with numeric Basin Plan water quality objectives, and uphold SWRCB anti-degradation policy.

Requests Pursuant to Porter Cologne, Section 13267

CWC Section 13267(b) provides that: *In conducting an investigation specified in subdivision (a), the regional board may require that any person who has discharged, discharges, or is suspected of having discharged or discharging, or who proposes to discharge waters within its regions, or any citizen or domiciliary, or political agency or entity of the state who has discharged, discharges, or is suspected of having discharged or discharging, or who proposes to discharge, waste outside of its region that could affect the quality of water within its region shall furnish, under penalty of perjury, technical or monitoring program reports which the regional* *board requires. The burden, including costs, of these reports shall bear a reasonable relationship to the need for the report and the benefits to be obtained from the reports.*

Water Rights Permits

A water right is a legal entitlement authorizing water to be diverted from a specified source and put to beneficial, non-wasteful use. Water rights are property rights, but their holders do not own the water itself--they possess the right to use it. The exercise of some water rights requires a permit or license from the State Water Resources Control Board, whose objective is to ensure that the State's waters are put to the best possible use and that the public interest is served. In making decisions, the Board must keep three major goals in mind: developing water resources in an orderly manner; preventing waste and unreasonable use of water; and protecting the environment.

Water right permits carefully spell out the amounts, conditions, and construction timetables for the proposed water project. Before the Board issues a permit, it must take into account all prior rights and the availability of water in the basin. The Board considers, too, the flows needed to preserve in-stream uses such as recreation and fish and wildlife habitat. The State Board's Division of Water Rights maintains records of water appropriation and use statewide.

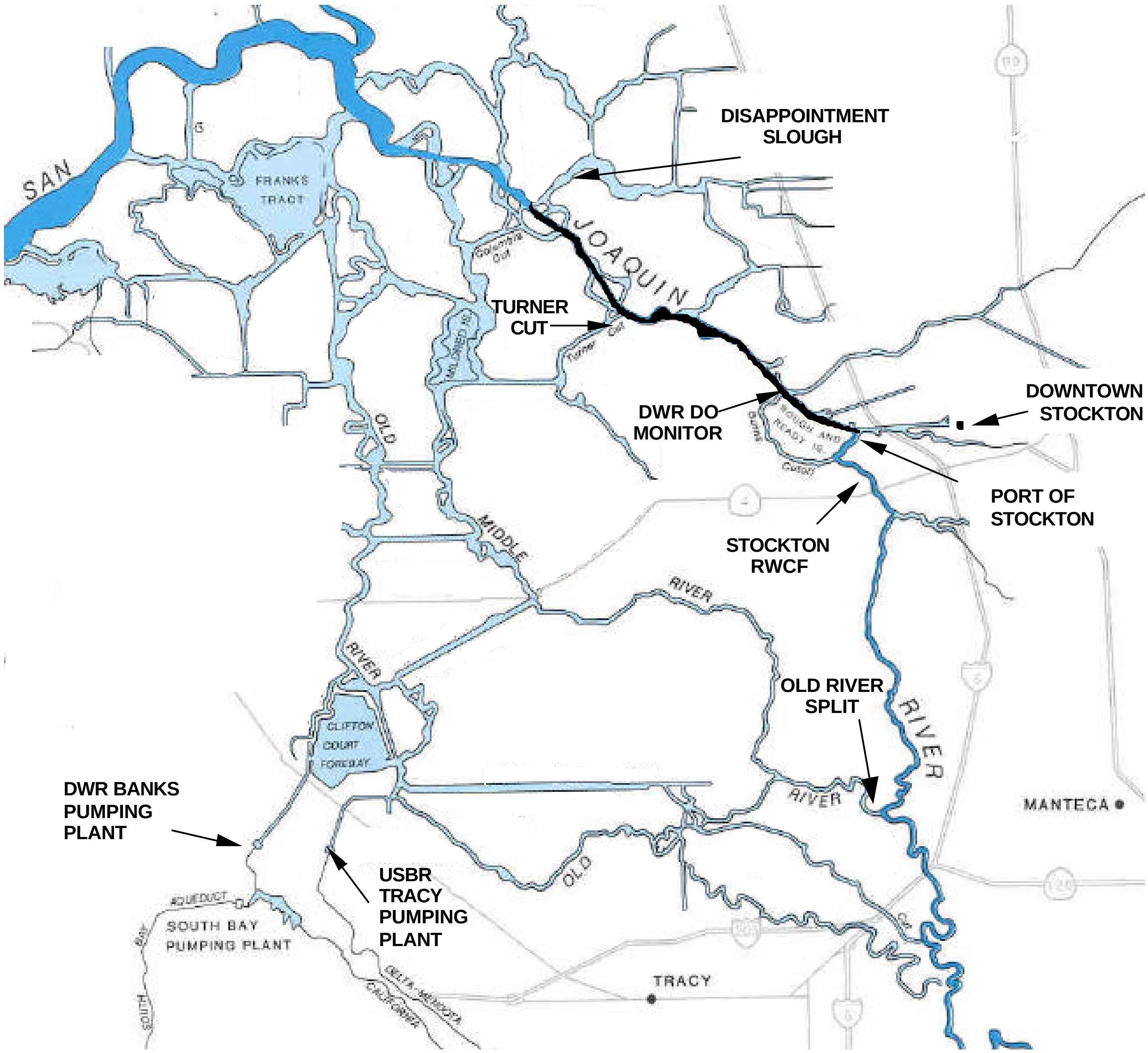
4 TMDL and Program of Implementation

4.1 Problem Statement

The San Joaquin River experiences regular periods of low DO concentrations in the Stockton Deep Water Ship Channel from the City of Stockton downstream to Disappointment Slough (see Figure 4-1). As discussed in more detail in Section 4.1.1, these conditions occur most often during the months of June through October, although severe conditions have occurred in the winter months as well. Data also show that the frequency and severity of violations are generally worse during dryer water years. These conditions often violate the Basin Plan water quality objective for DO in the DWSC, which is 5.0 milligrams per liter (mg/L), with the exception of 6.0 mg/L from September through November between the City of Stockton and Turner Cut. These low DO concentrations may act as a barrier to upstream spawning migration of Chinook salmon and may stress and kill other resident aquatic organisms.

The DWSC is a portion of the San Joaquin River that has been dredged by the U.S. Army Corps of Engineers to a depth of 35 ft. to allow for the navigation of ocean going cargo vessels between San Francisco Bay and the Port of Stockton. Upstream of the DWSC, the San Joaquin River is otherwise about 10 ft. deep. The entire length of the DWSC is within the tidal prism and experiences regular flow reversals.

Figure 4-1: Vicinity Map of Stockton Deep Water Ship Channel



In January 1998, the SWRCB adopted a Clean Water Act Section 303(d) list identifying the DO impairment in this portion of the San Joaquin River / Stockton Deep Water Ship Channel as a high priority. This initiated the need to develop a Total Daily Maximum Load with a program of implementation and incorporate them as an amendment to the Basin Plan.

Numerous monitoring research studies have been performed in recent years by various agencies, academic institutions, and interest groups to better understand the causes of the DO impairment. Most of these studies were peer-reviewed by an independent science panel convened by CALFED in June 2002 and subsequently summarized or referenced in *Synthesis and Discussion of Findings on the Causes and Factors Influencing Low DO in the San Joaquin River Deep*

Water Ship Channel near Stockton, CA: Including 2002 Data prepared by G. Fred Lee and Anne Jones-Lee in March 2003 (Lee and Jones-Lee, 2003), hereafter referred to as the Synthesis Report. Much of the technical basis for this staff report comes from the individual studies that were summarized or referenced in the Synthesis Report.

4.1.1 Nature of Dissolved Oxygen Impairment

Hourly average DO concentrations have been compiled by the California Department of Water Resources (DWR) since 1983 (except for sporadic gaps) from a continuous DO meter installed at the northern end of Rough & Ready Island (see Figure 4-1). The DO monitoring station consists of a continuous reading DO probe installed in a flow-through cell. This cell has an intake located about three feet below the surface inside a perforated pipe that extends seventeen feet below the surface. This configuration was determined to produce a somewhat depth-integrated measurement (Stringfellow, 2001).

Table 4-1 demonstrates that the frequency of violations of the 5.0 mg/L objective measured at this DWR monitoring station since 1983 are highest, on the average, during the months of June through October. Oxygen concentrations less than 5.0 mg/L, however, have occurred during all months of the year. Also, it can be seen that the frequency of violations are worse in dry years, like 1991 through 1993 and less frequent during wet years like 1998.

For each month of the year in Table 4-1, the upper number presented is the percentage of hourly DO measurements below 5.0 mg/L recorded that month. If a cell is blank, there were no DO measurements below 5.0 mg/L that month. If a cell contains “n/a”, no data was recorded at all for that month. The lower italicized number presented for each month is the minimum DO concentration measured that month. The average rate (weighted to account for months with partial data sets) for the 19-year period is shown in the bottom row.

The average monthly excursion rate ranged, on the average, from 4 to 37 percent. The worst months of the year for low DO tend to be June through October with the excursion rate ranging from 23 to 37 percent. This suggests that there is a seasonal influence on the frequency of occurrence of low DO in the DWSC. It can also be observed that as the excursion rate increases in a month, the severity of the DO impairment also increased (Foe, *et al.*, 2002, pg. 6). As discussed in the next section, the DO water quality objective for the impaired portion of the SJR is 6.0 mg/L between 1 September and 30 November and 5.0 mg/L all other months of the year. For the purpose of comparing the relative severity of DO concentrations in different months, Table 4-1 makes comparisons to a constant 5.0 mg/L concentration. The excursion rate above the 6.0 mg/L portion of the DO water quality objective would be higher than those shown in the months of September through November.

Table 4-1: Temporal Distribution of Low Dissolved Oxygen Impairment

Year		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1983	Excursion rate (%) [1]	n/a	n/a	n/a	n/a								
	Minimum [DO] [2]												
1984	:				1	7	84	91	62	2			
	:				*4.4*	*3.9*	*3.0*	*2.8*	*4.0*	*4.7*			
1985	:				6		48	78	15				
	:				*4.4*		*3.3*	*3.5*	*4.2*				
1986	:	29				5		21	9				
	:	*4.4*				*3.1*		*4.5*	*4.8*				
1987	:					44	43	3		29		<1	
	:					*3.5*	*3.6*	*4.6*		*3.9*		*4.9*	
1988	:	51	52	52			3		10	62			
	:	*3.5*	*3.3*	*3.8*			*4.8*		*4.4*	*2.3*			
1989	:			65	<1		37	2		38	14		
	:			*3.7*	*4.9*		*4.1*	*4.8*		*2.4*	*4.2*		
1990	:			1	5	3	11	<1	<1				
	:			*4.8*	*4.6*	*4.7*	*4.5*	*4.8*	*4.9*				
1991	:		<1	8	37	34	1	5	14	55	99		
	:		*4.7*	*4.3*	*4.4*	*4.2*	*4.9*	*4.7*	*4.4*	*1.8*	*0.4*		
1992	:		21	100	60	29	43	39	97	100	77	6	
	:		*3.1*	*2.1*	*1.9*	*3.8*	*3.7*	*3.7*	*2.8*	*0.5*	*1.3*	*4.7*	
1993	:			25	8	2	29	54	87	81	23		1
	:			*3.7*	*4.7*	*4.8*	*3.6*	*3.7*	*2.6*	*2.6*	*1.6*		*4.8*
1994	:		2		<1		61	80	63	16	46		
	:		*4.8*		*4.9*		*4.0*	*3.7*	*3.4*	*4.3*	*3.2*		
1995	:							2	61	6			
	:							*4.8*	*3.0*	*4.6*			
1996	:	15	n/a				8	63	94	89	15	18	
	:	*4.1*					*4.8*	*3.4*	*2.0*	*2.5*	*3.7*	*4.3*	
1997	:						14	74	88	83	44	2	11
	:						*3.6*	*3.1*	*3.3*	*2.4*	*2.2*	*4.7*	*4.5*
1998	:												
	:												
1999	:					n/a	<1	48	20	43	100	93	39
	:						*4.9*	*3.0*	*3.1*	*1.8*	*1.7*	*3.8*	*3.8*
2000	:	4	11				11	61	28	1			12
	:	*4.7*	*3.9*				*2.9*	*2.9*	*2.7*	*4.8*			*4.7*
2001	:	5					69	75	73	61			n/a
	:	*4.7*					*2.5*	*2.3*	*3.0*	*2.9*			
Average [3]	:	5	6	14	6	6	27	34	37	36	23	3	4

1. Excursion rate is the number of hourly average DO measurements from the DWR monitoring station below 5.0 mg/L divided by the total number of such measurements recorded that month, shown as a percent.
2. The minimum hourly average dissolved oxygen measurement for the month in mg/L
3. Average excursion rate is not the simple average of all monthly data-- it is weighted to account for months that had only partial data sets

The DO concentrations in the DWSC as measured at the DWR DO monitor between 1983 and 2001 also show diel variation. The variation between peak DO concentrations during daylight hours versus low DO concentrations during nighttime hours averaged about 1 mg/L in the months of June through September. The variation was less in other months of the year; presumably as algal activity is less during those months (Foe, *et al.*, 2002, Appendix C).

Each year since 1983 DWR has also performed boat cruises in the DWSC sampling DO at 14 locations between Disappointment Slough and the City of Stockton. The boat cruises occur roughly twice a month typically between August and November, but sometimes as early as July and as late as December. Two sets of DO and temperature measurement are taken at each location, one set at three feet below the surface and another near the bottom. The measurements are taken during ebb slack tide using continuous monitoring instruments and Winkler titration. When the stations are sampled, all 14 locations are sampled within about four hours beginning at about 9:00 AM at the downstream station and progressing upstream to the most upstream station (Ralston, personal communication, 2001).

An extensive presentation and analysis of DO data collected by the DWR boat cruises is contained in the Synthesis Report, where the following conclusions were made regarding the spatial extent of DO concentrations in the DWSC:

- DO concentrations less than the Basin Plan objectives occur off Rough & Ready Island and may extend down to Turner Cut.
- The point of greatest DO depletion tends to be shifted downstream toward Turner Cut with increased flow rates through the DWSC.
- DO concentrations below the Basin Plan objectives do not occur downstream of Disappointment Slough, and rarely occur downstream of Turner Cut.
- On the average DO concentrations measured near the bottom were 0.3 mg/L lower than near the surface (Lee and Jones-Lee, 2003, pgs. 23 – 24).

DO concentration profiles in the DWSC appear to follow a sag profile similar to one predicted by a simple Streeter-Phelps model. The location of the low point in the sag profile moved downstream and lessened in severity as flow increased. This analysis also suggested that the severity the low DO concentration is strongly influenced by BOD concentrations entering the DWSC and temperature (Foe, *et al.*, 2002, pgs. 9 – 15).

4.1.2 TMDL Watershed Setting

This section defines the DO TMDL source area and describes the hydrology and land uses in the San Joaquin River watershed.

<u>Dissolved Oxygen TMDL Source Area</u>

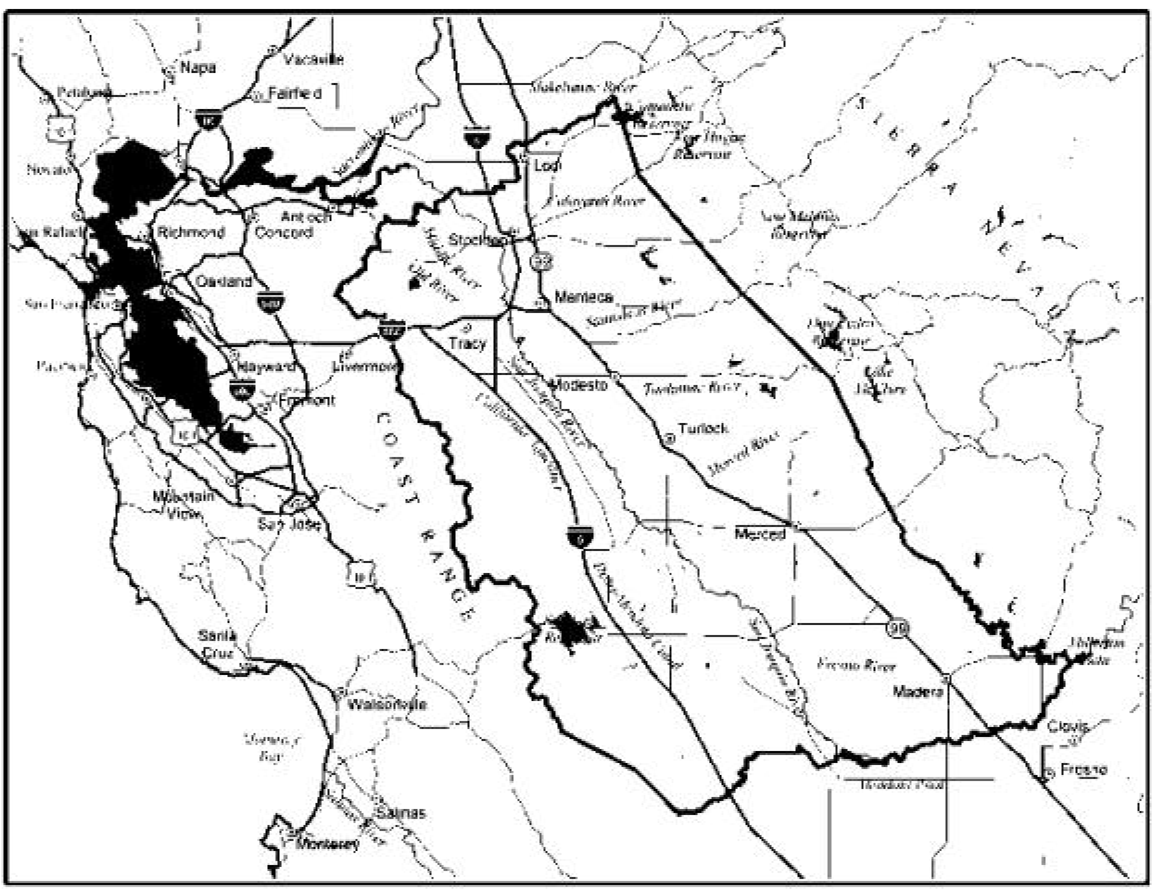
The DO impairment is caused in part by sources of oxygen demanding substances and their precursors that are located upstream in a portion of the San Joaquin River (SJR) watershed. The source area for loads of oxygen demanding substances addressed by this TMDL includes portions of the SJR watershed that drain downstream of Friant Dam and upstream of the confluence of the San Joaquin River and Disappointment Slough. In general, the project area includes the lands draining the eastern slope of the coast range, the western slope of the Sierra

Nevada foothills below the major reservoirs of New Melones Lake on the Stanislaus, Don Pedro Reservoir on the Tuolumne, Lake McLure on the Merced, New Hogan Reservoir on the Calaveras, Comanche Reservoir on the Mokelumne, and the San Joaquin Valley Floor from the Mendota Pool into the Delta at Disappointment Slough.

This source area excludes portions of the SJR watershed in Mariposa, Tuolumne, Calaveras, and Amador Counties. There is little potential for agricultural or wetland inputs of oxygen demanding substances or other contributing factors from these areas, except during very high flows when they would likely not contribute to the DO impairment.

The reach of the SJR downstream of Vernalis, including the entire length of the DWSC, and a portion of this DO TMDL source area are within the jurisdictional boundaries of the Sacramento-San Joaquin Delta (Delta) as defined in CWC Section 12220. Figure 4-2 provides a map of the TMDL source area boundary.

Figure 4-2: Dissolved Oxygen TMDL Source Area



In addition to the DO impairment addressed by this TMDL, the SWRCB has included portions of the SJR watershed on the CWA Section 303(d) list for impairments caused by ammonia, diazinon, chlorpyrifos, selenium, unknown toxicity, DDT, mercury, group A pesticides, electrical conductivity and boron. Though this TMDL focuses exclusively on the DO impairment in the DWSC, there will be coordination with these other TMDLs in the watershed.

Land Use

The San Joaquin Valley has historically been recognized as the leading region for agricultural production in the State of California as well as the nation. Dry conditions make irrigation necessary for nearly all crops grown commercially in the watershed. Surface runoff and subsurface drainage from agricultural activities is either returned to irrigation canals for reuse or is collected in drainage canals and discharged to the SJR or a tributary to the San Joaquin River.

In addition to agriculture, the San Joaquin Valley is known for its high natural resource values. It is estimated that the San Joaquin Valley once contained about 1.1 million acres of permanent and seasonal wetlands, with approximately 731 thousand acres occurring within the SJR watershed. Prior to major water developments, the SJR watershed supported a major Chinook Salmon fishery and tens of thousands of salmon probably spawned in its headwaters (SWRCB, 1987), however, steady declines in fish and wildlife habitat have occurred in connection with large-scale agricultural and urban water development. Approximately 85 percent of the historic seasonal and permanent wetlands in the San Joaquin Valley have been drained and/or reclaimed for agricultural purposes (SJVDP, 1990). The San Joaquin Valley, however, remains a critical habitat for fish and wildlife with as many as twenty-four state or federally listed threatened and endangered species (plant and animal) found in the valley.

SJR flows account for approximately 15 percent of the total flows into the Delta. The Delta provides drinking water for over two thirds of the people in California (more than 20 million people) (SWRCB, 1995). Most of Southern California, a major portion of the San Francisco Bay area, and many Central Valley communities rely on the Delta and its tributaries for their drinking water. The major Sierra Nevada tributaries of the SJR (Stanislaus, Tuolumne, and Merced Rivers) provide drinking water to residents of the San Francisco Bay area and communities in the San Joaquin Valley.

Urban areas within the SJR watershed are expanding and the population of the 13 largest cities in the SJR watershed increased an average of 1.5 percent between 1998 and 1999 (CDF, 1999). Stockton is the largest city in the DO TMDL source area, with a current population of about 250,000. Other urban areas in the DO TMDL source include the cities of Modesto (pop. 200,000), Merced (pop. 62,000), Turlock (pop. 60,000), Ceres (pop. 36,000), Los Banos (pop. 26,000), and Atwater (pop. 23,000).

Hydrology

Precipitation is unevenly distributed throughout the SJR Watershed. About 90 percent of the precipitation falls during the months of November through April. Normal annual precipitation ranges from an average of 8 inches on the valley floor to about seventy inches at the headwaters in the Sierra Nevada. Precipitation at the higher elevations primarily occurs as snow. Potential evaporation on the valley floor is over 50 inches annually (Oppenheimer and Grober, 2002).

The hydrology of the SJR is complex and highly managed through the operation of dams, diversions, and supply conveyances. Water development has fragmented the watershed and greatly altered the natural hydrology of the river. Runoff from the Sierra Nevada and foothills is regulated and stored in a series of reservoirs on the east side of the SJR. Most of the natural flows from the Upper SJR and its headwaters are diverted at the Friant Dam via the Friant-Kern

Canal to irrigate crops outside the SJR Basin. Water is imported to the basin from the southern Delta via the Delta Mendota Canal (DMC) to replace the flows that are diverted out of the basin to the south. Some water in the DMC is delivered directly to the west side of the SJR for agricultural supply, but the majority of DMC water is delivered to the Mendota Pool and distributed from there via irrigation canals to the west side. Water is also released to the SJR from Mendota Pool to meet the needs of various agricultural users between the Mendota Pool and the Sack Dam. Most or all of the remaining flow in the river is diverted at Sack Dam. As a result, the SJR downstream of Sack Dam and upstream of Bear Creek frequently has little or no flow except during flood flows. During non flood-flow periods, this reach of the SJR flows intermittently and is composed of groundwater accretions and agricultural return flows.

The SJR downstream of Bear Creek once again becomes a permanent stream that flows all year. Except during high rainfall and flood flows during wet years, the flow in the reach of the SJR downstream of Bear Creek and upstream of the Merced River confluence is dominated by agricultural and wetland return flows, groundwater accretions, and inflow from Mud Slough and Salt Slough. Mud Slough and Salt Slough drain the 370,000-acre Grassland Watershed. These sloughs contain a mix of agricultural return flows, runoff from managed wetlands, rainfall runoff, and flood flows. Mud Slough discharges to the SJR approximately two miles upstream of the confluence of the SJR and the Merced River. Salt Slough flows into the SJR approximately six miles upstream of the Mud Slough confluence.

The major tributaries to the SJR upstream of the Airport Way Bridge near Vernalis (the legal boundary of the Delta) are on the east side of the San Joaquin Valley, with drainage basins in the Sierra Nevada Mountains. These major east side tributaries are the Stanislaus, Tuolumne, and Merced Rivers. The Cosumnes, Mokelumne, and Calaveras Rivers and French Camp Slough flow into the SJR downstream of the Airport Way Bridge near Vernalis. Several smaller, ephemeral streams flow into the SJR from the west side of the valley. These streams include Hospital, Ingram, Del Puerto, Orestimba, Panoche, and Los Banos Creeks. All have drainage basins in the Coast Range, flow intermittently, and contribute sparsely to water supplies. During the irrigation season, surface and subsurface agricultural return flows contribute to these creeks and sloughs.

Once the SJR reaches Vernalis, tidal stages in the Delta begin to affect its flow. The SJR flow through the DWSC is strongly affected by tidal stage, which can range from about 0.25 feet below mean sea level to about 4.25 feet above mean sea level. The ebb flows are relatively steady for several hours at about 2,500 cfs plus the flow from the SJR. As the flood tide raises water levels, the ebb flows gradually decreases, and after a short period of stagnation, flow reverses. This flood tide flow averages about 2,500 cfs minus SJR river flows. This tidal cycle repeats itself every 24.8 hours and varies in intensity throughout the 28-day lunar cycle (Brown and Renehan, 2001).

4.2 Beneficial Uses and Numeric Targets

No new or modified beneficial uses or water quality objectives are being proposed as part of this Basin Plan Amendment. The numeric targets for this TMDL are simply the numeric DO objectives cited in *The Water Quality Control Plan for the Sacramento River Basin and the San Joaquin River Basin, Fourth Edition*, hereafter referred to as the Basin Plan (CVRWQCB, 1998).

The CWA Section 303(d) listing for low DO in the DWSC is based on impairment to the following fisheries-related beneficial uses:

- warm freshwater species (striped bass, sturgeon, and shad) migration and spawning (WARM MIGR and WARM SPWN)
- cold freshwater species (salmon and steelhead) migration (COLD MIGR)
- warm and cold freshwater species habitat (not including anadromous species) (WARM and COLD)

There are two parts to the Basin Plan DO water quality objectives that apply to the lower San Joaquin River (SJR) for the purpose of protecting these beneficial uses:

- 5.0 mg/L at all times on the SJR within the Delta *(excluding SJR west of Antioch bridge)*
  This objective first appeared for all waters of the Delta in the *Interim Water Quality Control Plans for the Sacramento-San Joaquin Delta* adopted in 1967 (CVRWQCB, 1967). It was adopted again into the first edition of the Basin Plan in 1975 (CVRWQCB, 1975) and remains in the current edition. The SJR west of Antioch is governed by the Basin Plan for the San Francisco Bay Regional Water Quality Control Board and is downstream of the impairment addressed by this TMDL.

- 6.0 mg/L between Turner Cut and Stockton from September 1 through November 30
  This objective was first adopted by the SWRCB in the 1991 *Water Quality Control Plan for Salinity, San Francisco Bay / Sacramento-San Joaquin Delta Estuary* (SWRCB, 1991). This objective was adopted into the third edition of the Basin Plan in 1994 (CVRWQCB, 1994) and remains in the current edition. The objective was adopted by the SWRCB again in their 1995 *Water Quality Control Plan for the San Francisco Bay / Sacramento-San Joaquin Delta Estuary* (SWRCB, 1995). The 5.0 mg/L objective applies at all other times and locations not covered by the 6.0 mg/L objective.

The 1967 Interim Basin Plan stated, "migratory salmonids require at least 5.0 mg/L dissolved oxygen, as do the resident game fishes. Striped bass and other fishes also require at least 5.0 mg/L dissolved oxygen to successfully propagate" (CVRWQCB, 1967). Prior to the latest version, the USEPA Water Quality Criteria suggested a 5.0 mg/L criterion (USEPA, 1976). This criterion was typically interpreted as being applicable at all times and places except for low flow conditions worse than the lowest seven-day flow with a ten-year return frequency (7Q10). Likewise, a study in the San Joaquin River found that the adult salmon migration run upstream past Stockton did not become steady until DO concentrations were above 5 ppm (mg/L) (Hallock, *et al*., 1970). This study did not discuss any time averaging or considerations of spatial variability. In 1986 the USEPA revised its suggested criterion to include a range of values and averaging periods based on life stages present (USEPA, 1986).

The 6.0 mg/L objective included in the 1991 and 1995 SWRCB water quality control plans was intended to protect fall-run Chinook salmon spawning migration. The technical basis for the objective was an agreement reached in 1969 between the California Department of Water Resources (DWR), California Department of Fish and Game, U.S. Bureau of Reclamation

(USBR), and the predecessor to U.S. Fish and Wildlife Service to take specific actions to maintain the DO content in the DWSC above 6 ppm (mg/L). This agreement called for the installation of a temporary rock barrier at the head of Old River to increase San Joaquin River flows past Stockton, thus improving DO levels (SWRCB, 1991,1995).

4.3 Source and Linkage Analysis

Numerous studies over the last several years have provided significant data and information on the causes of the DO impairment. Most of these studies were peer-reviewed in June 2002 by an independent science panel and summarized or referenced in the Synthesis Report (Lee and Jones-Lee, 2003). CVRWQCB staff has concluded from these studies that the three main contributing factors to the DO impairment are as follows:

- Loads of oxygen demanding substances from upstream enter the DWSC where they oxidize and exert an oxygen demand.
- The DWSC geometry reduces the loading capacity of the DWSC for oxygen demanding substances by (i) reducing the efficiency of natural re-aeration mechanisms and (ii) magnifying the effect of oxygen demanding reactions.
- Reduced flow through the DWSC further reduces the loading capacity by increasing the residence time for oxygen demanding reactions in the DWSC.

The following subsections describe each of these three contributing factors in more detail.

4.3.1 Oxygen Demanding Substances

Loads of oxygen demanding substances from upstream enter the DWSC where they oxidize and exert an oxygen demand in the water column. These substances and their sources are categorized into three groups:

- Oxygen demanding substances, primarily ammonia, discharged from the City of Stockton Regional Wastewater Control Facility (RWCF)
- Algae loads from the watershed upstream of the DWSC
- Other oxygen demanding substances potentially originating from agricultural, wastewater, or stormwater sources upstream of the DWSC

As discussed in more detail below, numerous studies have clearly demonstrated the general relationship between loads of oxygen demanding substances entering the DWSC and reduced DO conditions in the DWSC. More studies are required, however, to better understand and quantify the chemical, biological, and physical mechanisms linking upstream sources of oxygen demanding substances to oxygen demand in the DWSC.

City of Stockton Regional Wastewater Control Facility

The primary point source of oxygen demanding substances contributing to the DO impairment is the discharge of oxygen demanding substances from the City of Stockton Regional Wastewater Control Facility (RWCF). Constituents in RWCF effluent that contribute to the DO impairment include, but are not limited to, carbonaceous biological oxygen demand (CBOD), ammonia, and organic nitrogen. These are biodegradable substances that oxidize in the water column of the DWSC and reduce the amount of DO available.

Extensive box model calculations were presented in the Synthesis Report that began to quantify the relative loading of oxygen demand to the DWSC from RWCF constituents versus algae and other substances (Lee and Jones-Lee, 2003, pgs. 44-55). Calculations quantifying the relative contribution from RWCF effluent CBOD and ammonia concentrations were also made (Lee and Jones-Lee, 2003, pgs. 41-53). A more detailed discussion of those calculations appears in Section 4.5.2 of this staff report, where they are used as the basis for a general allocation to the RWCF and to sources of algae in the DO TMDL source area.

Some data and analysis is also available on the rate at which these substances oxidize in the laboratory. The relative rate at which these compounds oxidize in the DWSC, however, and the influence of numerous environmental variables (i.e. flow rates, temperature) on these oxidation mechanisms in the DWSC is not well understood. Additional field studies and detailed modeling of these oxidation mechanisms in the DWSC is required before it can be quantified how much of the ammonia and other oxygen demanding substances discharged from the RWCF actually oxidize and contribute to the DO impairment in the DWSC.

Algae Loads

The primary non-point source of oxygen demanding substances into the DWSC is algae from the SJR watershed upstream of the DWSC. It has been hypothesized that algae grown in the DO TMDL source area flows into the DWSC, where light conditions for sustaining algal growth in the DWSC are not as good as they are in the shallower and more turbulent upstream reaches of the San Joaquin River. This leads to increased oxygen demand in the DWSC from algal respiration and decay of dying algae. (Foe, *et al.*, 2002, pg. 16).

Analysis of data collected between October 1999 and November 2001 has found a strong correlation between indicators of algae biomass (chlorophyll-a and phaeophytin concentrations) and biological oxygen demand (BOD) in samples collected at Maze Blvd., Vernalis and Mossdale on the SJR. The results of this analysis were consistent with those from previous studies that found algae and their byproducts are responsible for most of the oxygen demand in the SJR from (Foe, *et al.*, 2002, pg. 18). Further analyses also found a strong correlation between increased concentrations of chlorophyll-a upstream at Mossdale and decreased DO concentrations in the DWSC upstream (Foe, *et al.*, 2002, pg. 20).

The responsibility for current algae concentrations in the SJR appears to rest with increased use of fertilizers and agricultural activities in the watershed. Data and literature indicate that current average nitrate concentrations in the San Joaquin River at Vernalis have risen dramatically since the early 1950s, while phosphorus and ammonia have not. This increase tracks with the increased use of nitrogen-based agricultural fertilizers, increased cultivation, and increased use of subsurface tile drainage over the same period in the San Joaquin Valley (Kratzer and Shelton, 1998). Concentrations of nitrogen compounds in the San Joaquin River that support algae growth are currently about 10 to 100 times higher than limiting values. With a surplus of nutrients in the San Joaquin River, the algae growth appears to be limited only by the light penetration characteristics of the water (Lee and Jones-Lee, 2003, pg.41).

Statistical analysis and simple growth modeling using chlorophyll-a concentrations at numerous locations along the SJR suggest that the main sources of algae in the SJR are from Salt Slough, Mud Slough, and the San Joaquin River upstream of Lander Ave. These upper watershed tributaries were estimated to account for 80 to 90 percent of the chlorophyll load at Mossdale. The large contributions from these tributaries appear to be related not only to their high initial loads of algae into the SJR, but also the longer residence times that allow algae concentrations to increase as these loads move downstream (Foe, *et al*., 2002, pg. 22 - 26). There remain a number of questions, however, related to algae growth and removal mechanisms that make it difficult to definitively quantify the relative contribution of algae from different sources in the watershed. One question deals with the relative impact of reduced flows from the three main eastside tributaries on algae concentrations and their travel times in the SJR. Of particular uncertainty is the fate of algae in the SJR between Mossdale and the DWSC (Foe, *et al*., 2002, pg. 20 – 22).

Other Potential Sources

Other point or non-point sources of oxygen demanding substances may exist in the watershed upstream of the DWSC. These sources may contribute to oxygen demand in the DWSC, however, further study of their linkages to the impairment are required before wasteload or load allocations can be considered further. Following is a discussion of three potential sources that warrant further investigation.

Municipal wastewater discharges: Wasteloads of oxygen demanding substances (e.g. carbonaceous biological oxygen demand, ammonia, and organic nitrogen) from upstream municipal wastewater discharges, other than the City of Stockton, may contribute to oxygen demand in the DWSC if they are not fully oxidized in the watershed before entering the DWSC. A better understanding of the inputs from these facilities and their upstream oxidation mechanisms is required before an assessment of their impact on the DWSC can be made.

Stormwater discharges: The SWRCB has included five urban waterways in the vicinity of the City of Stockton on the their CWA Section 303(d) list as impaired for low DO. Stormwater discharges containing oxygen demanding substances from adjacent urban and industrial areas have been implicated in these DO impairments. These five waterways are tributary to the impaired portion of DWSC. If not fully oxidized in these waterways, remaining oxygen demanding substances may contribute to the DO impairment in the DWSC. A better understanding of the inputs and oxidation mechanisms in these urban waterways is required before an assessment of their impact on the DWSC can be made. The potential impact of storm water discharges directly into the SJR upstream or within the DWSC must also be considered.

Ammonia from upstream impaired water bodies: Ammonia and oxygen demanding substances from sources other than those discussed above need to be evaluated. For example, the SWRCB has included Avena Drain, Lone Tree Creek and Temple Creek in the French Camp Slough sub-watershed on the CWA Section 303(d) list as impaired for ammonia. Further study of such potential sources is required, and to the extent that there are linkages to the DO impairment, load allocations will be developed.

Animal Wastes: Animal wastes from wetland and agricultural activities in the watershed may be a source of nutrients in the San Joaquin River that contribute to the growth of algae. Further study of such potential sources is required, and to the extent that there are linkages to the DO impairment, load allocations will need to be developed.

4.3.2 Stockton Deep Water Ship Channel Geometry

The DWSC geometry is an important contributing factor because it reduces the assimilative capacity of the DWSC for loads of oxygen demanding substances by reducing the efficiency of natural re-aeration mechanisms and magnifying the effect of oxygen demanding reactions.

The Stockton Deep-Water Ship Channel (DWSC) was constructed in phases beginning in the late 1800s to allow for the navigation of ocean-going vessels upstream on the San Joaquin River to the Port of Stockton for loading and unloading. The Port of Stockton is located on approximately 1,500 acres, just west of the City of Stockton (see Figure 1-1). The channel is approximately 500 feet wide where the San Joaquin River enters the DWSC at the eastern edge of Rough & Ready Island. It increases to a width of approximately 1,000 feet at Turner Cut, approximately seven miles downstream from Rough & Ready Island. The current design depth of the DWSC is 35 feet below mean lower low water (MLLW). Upstream of the DWSC, the San Joaquin River ranges in width from 150 to 250 feet and is relatively shallow, ranging from five to ten feet in depth (Jones & Stokes, 1998).

Any channel deepening or maintenance dredging in the DWSC is performed by the U.S. Army Corps of Engineers (USACOE). The Port of Stockton performs maintenance dredging of the berths at the Port of Stockton and would be the lead agency for any future berth deepening.

There are three mechanisms in the DWSC that are hypothesized to contribute to the DO impairment. The first is that the deeper and wider DWSC cross-section increases water residence time, which allows for more imported organic material to oxidize and exert oxygen demand in the DWSC. Second, the deeper DWSC decreases the relative proportion of the water column in contact with the atmosphere, thereby reducing the efficiency of natural surface re-aeration. Finally, the channel geometry and flow conditions in the DWSC lead to poorer light conditions for the support of algae photosynthesis, which leads to increased oxygen demand in the DWSC from algal respiration and decay of dying algae. (Foe, *et al.*, 2002, pg. 16)

During the summers of 1999 through 2001, the City of Stockton made weekly DO measurements at a series of locations upstream and through the DWSC. Of the 152 samples collected upstream of the DWSC, only one during that period was less than the DO objective. At the same time, 36 percent of 76 samples collected within the DWSC were below DO objectives (Foe, *et al.*, 2002, pg. 16 - 17). A link-node water quality model developed by Systech Engineering was also used to evaluate the relative impact of the DWSC geometry. Using flow and organic loading data from 1999 and 2000, the model predicted no violations of the 5 mg/L DO water quality objective when natural San Joaquin River dimensions were used to replace the modeled DWSC geometry (Chen and Tsai, 2001). These data and modeling results are consistent with the concept that the presence of the altered DWSC geometry is an important contributing factor to the DO impairment.

4.3.3 Reduced Flow Through the Stockton Deep Water Ship Channel

Flow in the DWSC portion of the San Joaquin River may be reduced by i) consumptive use in the San Joaquin River watershed, ii) the diversion of San Joaquin River flows down Old River that result from the operation of the pumping plants at the SWRCB by DWR and the federal Central Valley Project by USBR, and iii) other out of basin transfers. Extensive data supports the connection between flow rates and DO concentrations in the DWSC. Data and studies show a strong relationship between reduced flow in the DWSC and low DO conditions in the DWSC.

Reduced Flow at Vernalis

The hydrology of the San Joaquin River is complex and highly managed through the operation of dams, diversions, and supply conveyances. Annual discharge from the San Joaquin River watershed is considerably lower than the unimpaired runoff that would occur if there were no reservoirs or consumptive use of water. Between 1979 and 1992 the measured runoff in the basin as measured at Vernalis was 2.4 million acre-feet lower than the mean annual unimpaired discharge of 6.1 million acre-feet (USGS, 1997). The difference is due to consumptive use, attributable mostly to water use for agriculture (DWR, 1994).

Based on SJR flow data at Vernalis, the fifteen-year moving average[2] of annual discharge in the late 1990's was approximately 800,000 acre-feet lower than in the late 1940s. Almost all of this reduction in annual watershed discharge occurs during the months of April through August (Oppenheimer and Grober, 2002). Another study found the San Joaquin River flow at Vernalis reduced by 44-56 percent from pre-1944 levels between the months of April through September (Water and Power Resources Service and South Delta Water Agency, 1980).

Flow Split at Head of Old River

The California Department of Water Resources (DWR) and U.S. Bureau of Reclamation (USBR) both operate pumping facilities west of the City of Tracy that have a significant impact on the routing of flow in the Delta and the DWSC. As part of the State Water Project (SWP), DWR operates the Banks Pumping Plant, which supplies water for the South Bay and California Aqueducts. The Banks Pumping plant draws water from Clifton Court Forebay, which is currently permitted to divert an average of 6,680 cubic feet per second (cfs) water from the Delta. DWR is in the process of planning to increase diversions into Clifton Court Forebay from the Delta to an average of 8,500 cfs. As part of the Central Valley Project (CVP), USBR operates the Tracy Pumping Plant to supply flow for the Delta-Mendota Canal. The Tracy Pumping Plant is currently permitted to draw an average of 4,400 cfs water from the Delta.

Water is conveyed to these two pumping plants through the Delta from the Sacramento and San Joaquin Rivers via a network of man-made and natural channels, including Old River. The southeastern reach of Old River diverges from the San Joaquin River just west of Manteca, CA about 14 miles upstream of the DWSC and flows into the south Delta. The northwestern reach of Old River continues north out of the south Delta and rejoins the San Joaquin River near Disappointment Slough. When the SWP and CVP pumps are operating, the northwestern reach

[2] The fifteen-year moving average helps identify long-term trends that may be obscured by annual variability of discharge.

of Old River conveys water from the north and central Delta, while the southeastern reach of Old River conveys water from the San Joaquin River through the south Delta.

One of the effects of SWP and CVP pumping is an increase in the amount of flow that diverges from the San Joaquin at the head of Old River, thereby reducing the flow that continues in the San Joaquin River through the DWSC. As the combined SWP and CVP export rates increase relative to the San Joaquin River flow upstream of the head of Old River, the percentage of flow diverted down Old River (and away from the DWSC) increase. During periods of low flow when SWP and CVP exports are greater than San Joaquin River flows, up to 90 percent of the river flow can be diverted down Old River and away from the DWSC. When combined SWP and CVP exports are less than San Joaquin River flows, Old River flows and SJR flows through the DWSC are nearly equal (Brown and Renehan, 2001).

Beginning in 1969, with an memorandum of understanding between fishery and pumping project agencies, a temporary rock diversion barrier has been installed each fall at the head of Old River in order to increase flow in the SJR past Stockton. When the barrier is in place, an increased percentage of flow remains in the San Joaquin River and flows downstream to the DWSC. Monitoring data show that installation of the barrier in the fall usually improves DO concentrations in the lower SJR, especially in years with relatively low SJR flows. Modeling performed for Water Right Decision 1641 found that significant improvements to DO conditions in the DWSC were not achievable without the temporary barrier (SWRCB, 2000, pg. 77).

Since 1991, as part of its South Delta Temporary Barriers Project, DWR has been collecting performance data on the temporary diversion barriers. This data is being used in their planning for their South Delta Improvement Projects (SDIP). The SDIP is proposing to provide a number of permanent operable flow diversion barriers (including at the head of Old River) and other improvements that will mitigate impacts on water quality and supply from an increase of the average allowable diversion capacity into Clifton Court Forebay from 6,680 to 8,500 cfs. The draft environmental impact report for the SDIP, as required by the California Environmental Quality Act (CEQA), is scheduled for release in the fall of 2003. CVRWQCB staff will be working with DWR to ensure that adequate consideration is given to the impact of this project on the DO impairment in the DWSC.

Effect of Reduced Flow on Dissolved Oxygen Impairment

The nature of the relationship between reduced flow through the DWSC on the severity and spatial extent of the DO impairment is discussed in detail in the *Draft Stawman Source and Linkage Analysis for Low Dissolved Oxygen in the Stockton Deep Water Ship Channel* (Foe, *et al*. 2002). The hypothesis of this report is that as flow at a given DO concentration (oxygen input rate) through the DWSC is reduced, less oxygen demand can be exerted on that flow before DO concentrations drop below the Basin Plan objectives. Also, the increased residence times associated with reduced flows through the DWSC are thought to magnify the affect of chemical, biological and physical mechanisms that oxidize oxygen demanding substances (Foe, *et al*., 2002, pg. 7 - 8). This reduces the assimilative capacity of the DWSC for a given load of oxygen demanding substances.

This relationship between flow and low DO is also clearly demonstrated in Figure 4-3, which plots the daily minimum DO concentrations measured at the DWR DO monitoring station at Rough & Ready Island against the net daily flow rate in the DWSC [3] on the same day. The plot includes 1,168 data points, one for each day between November 1995 and September 2000 that has both a minimum DO reading and a corresponding net daily flow value. For net daily flow above 3,000 cfs, there were no violations of either the 5.0 or the 6.0 mg/L Basin Plan DO objectives. Below 3,000 cfs, the DO concentrations decrease with decreasing flow. At flows below 1,000 cfs, about half of the daily minimum DO concentrations were below 5.0 mg/L.

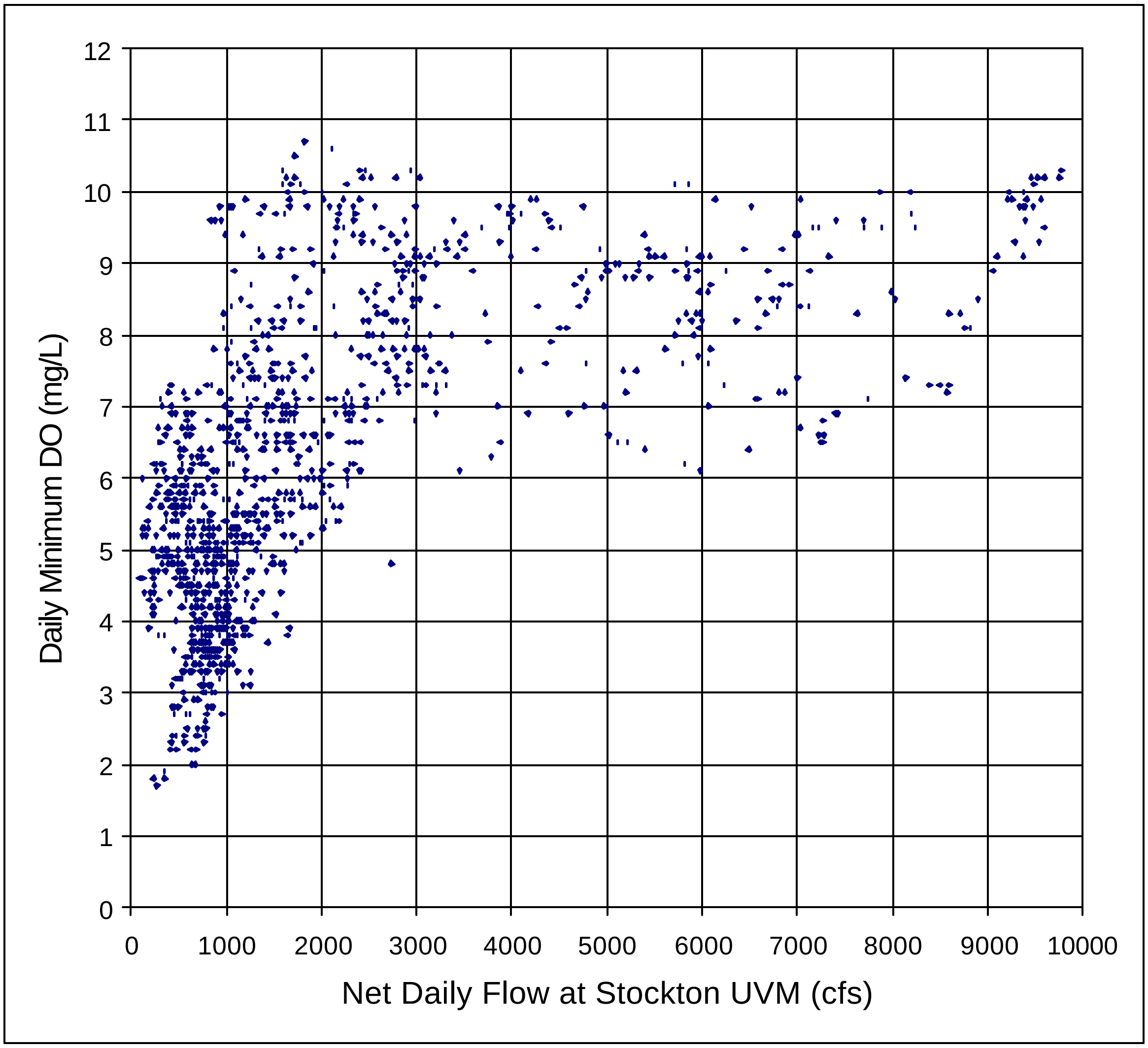
Another analysis of DWR boat cruise data found that DO concentration profiles in the DWSC appear to follow a sag profile similar to one predicted by a simple Streeter-Phelps water quality model. This analysis found the location of the low point in the sag profile moved downstream as flow increased. It also appears that reduced flow tends to increase the BOD concentrations entering the DWSC from upstream, which had the effect of increasing the severity of the impairment at the low point in the sag curve. Some of these observations were based on limited amounts of data and warrant further investigation. More data and detailed modeling in the DWSC is required (Foe, *et al.*, 2002, pgs. 9 – 15).

The rate at which flow is reduced through the DWSC also appears to be of particular concern. This can occur with sudden changes in SJR flow associated with reservoir operations and/or operation of the flow diversion barriers at the head of Old River and in the south Delta. It has been hypothesized that the higher loads of oxygen demanding substances present before a sudden decrease in flow, overload the assimilative capacity present in the DWSC after the loads are decreased. Further study of this phenomenon is needed (Lee and Jones-Lee, 2003, pg. 67).

Even with these relationships, however, more field and laboratory studies are required to better understand and quantify the effects of flow on the various mechanisms that create oxygen demand in the DWSC. Water quality modeling is then needed to understand the net effect of all these mechanisms on DO concentrations and their sensitivity to changing environmental variables (e.g. changes in flow, temperature).

[3] Net daily flow in the DWSC is calculated from tidal flow data collected at the USGS Stockton UVM meter, including consideration of semi-diurnal tidal periods and other tidal variations. See Brown and Renehan, 2001 for detailed description.

Figure 4-3: Dissolved Oxygen Concentrations versus Flow



4.4 TMDL and Loading Capacity

The CWA defines loading capacity as the greatest amount of loading that a water body can receive without violating water quality standards (40 CFR § 130.2 (f)). This is a TMDL for low DO and organic enrichment rather than for a single specific pollutant. The loading capacity in this TMDL is therefore expressed as an allowable rate of oxygen demand at the point of lowest DO concentration in the DWSC, such that the Basin Plan DO objectives are maintained. The loading capacity is calculated as a function of flow through the DWSC and water temperature.

4.4.1 Loading Capacity

The solubility of oxygen in water, at relatively constant atmospheric pressure and salinity, is a function of temperature. At standard atmospheric conditions and with typical San Joaquin River salinity concentrations, the maximum concentration of DO in water ranges from about 10.0 mg/L at 15°C (59°F) to about 7.9 mg/L at 27°C (81°F). This represents a typical range of seasonal low and high temperatures experienced in the DWSC.

Below the saturation concentration, DO concentrations in the DWSC are affected by the relative rate of chemical and physical mechanisms that remove oxygen from the water column (oxygen demand) versus those that add oxygen (re-aeration). At any particular point in the river, when the rate of all oxygen demanding mechanisms are greater than the rate of all the re-aeration mechanisms, DO concentrations decrease (and visa versa). Oxygen demand and re-aeration are expressed in units of mass per unit time, and for this TMDL will be expressed as pounds of oxygen per day.

The total theoretical loading capacity of the DWSC for oxygen demanding substances, LC_T, is the amount of oxygen demand that can be present at any point in the DWSC such that Basin Plan DO objectives are not violated. This does not include consideration of a margin of safety or other factors that reduce loading capacity. In equation form, loading capacity, LC_T, is given by:

$$LC_T = \{DO_{sat} - DO_{obj}\} \times Q_{DWSC} \times 5.4 \qquad (4\text{-}1)$$

where DO_{sat} is the saturation DO concentration, which is itself a function of water temperature, in milligrams per liter; DO_{obj} is the applicable Basin Plan DO objective in milligrams per liter; Q_{DWSC} is the net daily flow rate through the DWSC[4] in cubic feet per second; and 5.4 is a unit conversion factor that provides LC_T, in terms of pounds of oxygen per day. From the above equation, it can be seen that LC_T is a function of flow through the DWSC and temperature (to the extent that temperature affects DO_{sat}). Although temperature will be a factor in determining LC_T, because it is driven primarily by seasonal variation, it will not be a factor that is allocated responsibility for mitigating the DO impairment. Figure 4-4 (a) provides a plot of the LC_T (based on Equation 4-1) as a function of flow at four different temperatures when the 5.0 mg/L DO objective is applicable. Figure 4-4 (b) provides the same plot of LC_T when the 6.0 mg/L objective is applicable.

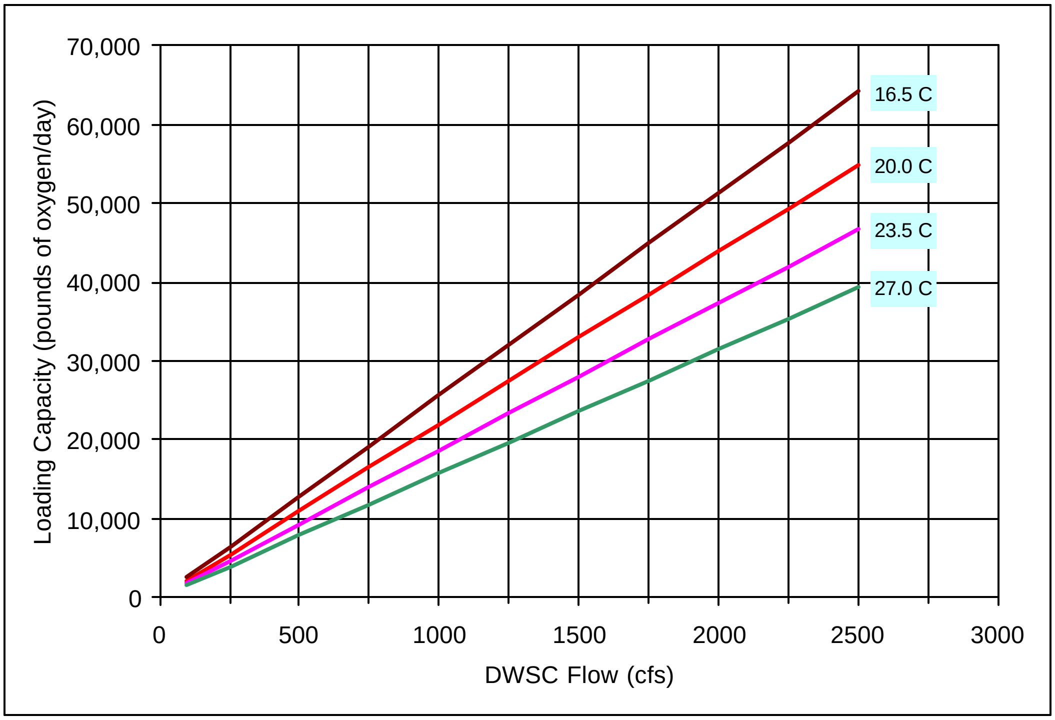
4.4.2 Margin of Safety

The CWA and USEPA regulations require a margin of safety to account for uncertainty concerning the relationship between wasteload and load allocations and water quality. For this TMDL, the margin of safety will be stated explicitly as a percentage of the loading capacity for a given flow rate. The margin of safety will consider both the measurement accuracy of parameters used to determine loading capacity and an estimate of technical uncertainty associated with the current understanding of the various sources and their linkages to the impairment.

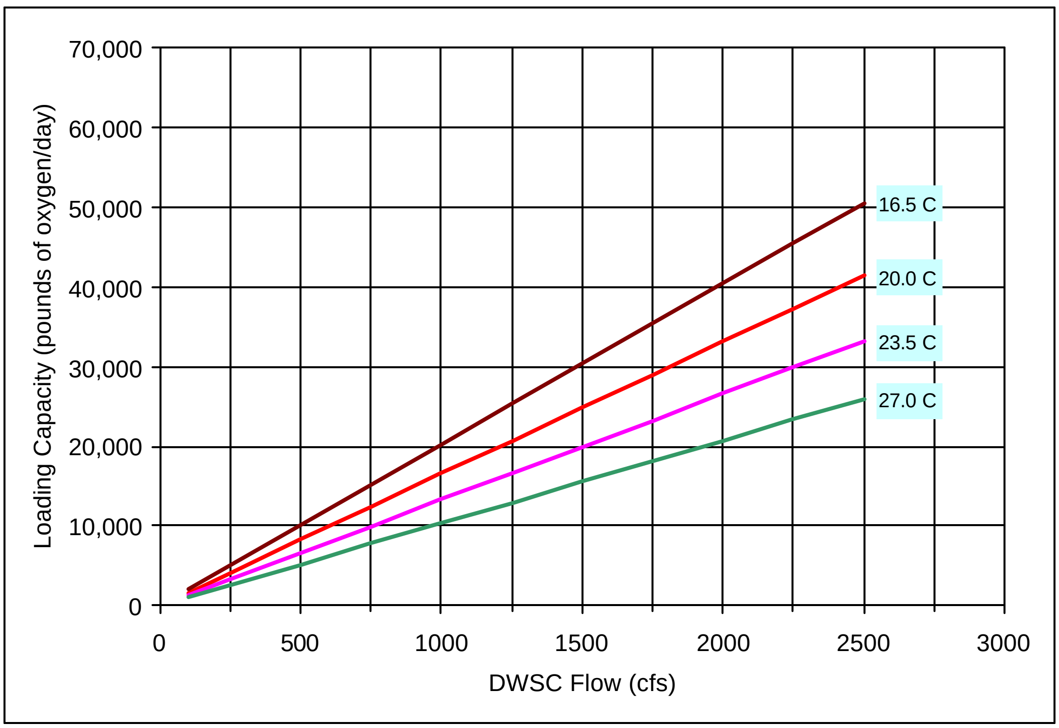
[4] Net daily flow in the DWSC is calculated from tidal flow data collected at the USGS Stockton UVM meter, including consideration of semi-diurnal tidal periods and other tidal variations. See Brown and Renehan, 2001 for detailed description.

Figure 4-4: Loading Capacity (LC_T) Versus Flow and Temperature

(a) with 5.0 mg/l objective and varying temperatures



(b) with 6.0 mg/l objective and varying temperatures



Flow rate through the DWSC is the key parameter needed to determine the total theoretical loading capacity (LC_T) in the DWSC. The only direct measurement of flow through the DWSC occurs at an ultrasonic velocity meter (UVM) and stage recorder installed immediately upstream of the Stockton RWCF, about 1.5 miles upstream of the DWSC. This is a U.S. Geological Survey (USGS) facility that was built in cooperation with the City of Stockton in the summer of 1995. The flow is calculated at this location from the UVM velocity and tidal stage, which is recorded every 15 minutes on a data logger at the facility. Net daily flow is calculated from this data with adjustments made to account for the semi-diurnal tidal period and other tide related variations (Brown and Renehan, 2001).

An estimate of accuracy of the net daily flows determined from measurements at this UVM is believed to be in the range of 20 to 40 cfs. At low flow rates of 200 cfs or less, when the low DO impairment tends to be most severe, the possible error rate for flow measurements is 10 to 20 percent (Lee and Jones-Lee, 2000, pg.26). The only other variable in the determination of loading capacity is temperature (as it affects the DO saturation concentration). Measurement of water temperature is considerably more accurate than measurements of flow and should be adequately addressed by this margin of safety. Therefore, a margin of safety of 20 percent will be used to account for the measurement error of parameters included in the calculation of loading capacity.

Due to the need for further technical study on the sources, linkages, and potential mitigation measures for their impact, there is a significant amount of technical uncertainty surrounding the allocation of wasteloads and loads to sources of oxygen demanding substances and the assumptions regarding the extent to which the impact of non-load related factors can or will be mitigated. Based on professional judgment, a 20 percent margin of safety will be used to account for this technical uncertainty. This margin of safety can be reevaluated for the final phase of the TMDL, based on results of the various studies performed in the initial phase.

To account for flow measurement error and technical uncertainty, a combined 40 percent margin of safety is proposed to determine how much loading capacity may be allocated to loads:

$$MOS = 0.4 \times LC_T \qquad (4\text{-}2)$$

This margin of safety does not include a factor for future growth. Any future project in the watershed that has the potential to contribute loads of oxygen demanding substances, or has the potential to reduce loading capacity in the DWSC, will have to evaluate and mitigate the entire impact of their proposed project as required by applicable State and Federal regulations.

4.4.3 Total Daily Maximum Load

The TMDL is equal to the loading capacity (LC) of the water body. The loading capacity available for this TMDL, however, must be reduced to account for the effects attributable to DWSC geometry and reduced DWSC flow:

$$TMDL = LC = LC_T - [LC_{DWSC} + LC_{Flow}] \qquad (4\text{-}3)$$

where:

LC_T = the total theoretical loading capacity as described in Section 4.2.1,

LC_{DWSC} = loading capacity attributable to the DWSC geometry,

LC_{Flow} = loading capacity attributable to reduced DWSC flow.

Per 40 CFR Section 130.2, the TMDL is also the sum of all wasteload allocations for point sources ($\sum$WLA), plus the sum of all load allocations for non-point sources ($\sum$LA), plus background loads (BL), and the margin of safety (MOS):

$$TMDL = \sum WLA + \sum LA + BL + MOS \qquad (4\text{-}4)$$

Due to the extensively modified and intensively managed nature of water resources within the DO TMDL source area, background loading for oxygen demand in the DWSC is difficult to determine. There is also a lack of historical data about oxygen demand in the DWSC, its various sources, and the related transformation and oxidation mechanisms. The background loading (BL) for determining the TMDL, therefore, will be assumed to be zero. The MOS in Equation 4-4 is equal to 40 percent of the LC_T as described in the Section 4.4.2.

4.5 Wasteload and Load Allocations

As described in Section 4.3 the DO impairment is caused by three main contributing factors: i) loads of oxygen demanding substances from upstream that oxidize within the DWSC, ii) altered DWSC geometry that contributes to this oxidation, and iii) upstream consumptive use and diversions that reduce San Joaquin River flows through the DWSC further contributing to this oxidation. This section describes the method used for determining how loading capacity, and hence responsibility for addressing the DO impairment, will be apportioned between these contributing factors. It will also present the method by which the portion of loading capacity associated with loads of oxygen demanding substances will be further allocated to point and non-point sources of those substances.

4.5.1 Apportioning Loading Capacity to Three Main Contributing Factors

The two contributing factors of DWSC geometry and reduced flows through the DWSC are not loads of a substance for which mass or concentration limits can be assigned. Instead, these factors reduce the oxygen demand loading capacity of the DWSC available to assimilate loads of oxygen demanding substances. To eliminate the DO impairment, a combination of source controls to reduce the oxygen demand from upstream loads, combined with mitigation measures to restore the loading capacity impacted by the two non-load related factors, must be implemented such that total oxygen demand does not exceed its loading capacity in the DWSC.

The relative apportioning of loading capacity between the three contributing factors is complicated by the existence of differing technical arguments for how much each factor is responsible for the low DO impairment. For example, the USACOE has argued that the impairment in the DWSC would not exist if there were no loads of oxygen demanding substances entering the DWSC from upstream (ACOE, 1990). Conversely, it has been observed that the DO impairment does not exists in the San Joaquin River upstream of Channel Point (where the altered DWSC geometry begins) in spite of the presence of these same loads of oxygen demanding substances (Foe, *et al*., 2002, pg. 17). Likewise, under the same DWSC geometry and loading conditions, data and modeling suggest that the impairment could be eliminated if flow through the DWSC were increased (Foe, *et al*., 2002, pg. 8). Each of these arguments provides a reasonable technical basis for why each contributing factor is entirely responsible for the impairment.

Consideration of the above arguments, together with only an empirical understanding of the linkages between the various factors and the impairment, this TMDL apportions theoretical total loading capacity (LC_T), less the margin of safety, equally to the three main contributing factors.

In equation form, this is represented by combining Equations 4-3 and 4-4, and by dropping the term for background loading (which was determined to be zero) to form the following:

$$LC_T - MOS = [\sum WLA + \sum LA] + LC_{DWSC} + LC_{Flow} \qquad (4\text{-}5)$$

Equating the terms for each of the three main contributing factors yields:

$$1/3 \text{ x } (LC_T - MOS) = [\sum WLA + \sum LA] = LC_{DWSC} = LC_{Flow} \qquad (4\text{-}6)$$

This means the oxygen demand exerted in the DWSC from sources of oxygen demanding substances must be less than its apportionment of [$\sum$WLA + $\sum$LA], which is one-third of the total loading capacity less the margin of safety. For non-load related factors this means that the reduction of oxygen demand loading capacity associated with the DWSC geometry must be mitigated to less than LC_{DWSC}. Likewise, the reduction of oxygen demand loading capacity associated with reduced flow through the DWSC must be mitigated to less than LC_{Flow}. Apportioning loading capacity in this way translates into equal responsibility for the three main contributing factors to correct conditions that lead to the impairment.

The above is a general apportionment of loading capacity to each of the three main contributing factors. Further discussion of wasteload and load allocations [$\sum$WLA + $\sum$LA] is described in Section 4.5.2 and the program of implementation for these wasteload and load allocations are presented in Section 4.6.1 and 4.6.2 respectively.

The implementation actions addressing the loading capacity apportioned to DWSC geometry (LC_{DWSC}) and reduced DWSC flow (LC_{Flow}) are described in Sections 4.6.3 and 4.6.4 below.

Measuring Compliance with Apportioned Loading Capacity

Establishing a baseline for measuring the progress of implementing source controls or other mitigation measures is problematic. At any particular time, the impact of a particular contributing factor on the DO impairment is strongly influenced by the impacts from other contributing factors (mainly those related to loading and flow conditions) and numerous other environmental variables (temperature, water year type, sunlight, etc.). The large number of possible combinations of contributing factors and environmental conditions, combined with the uncertainty regarding the specific linkage between these all these factors to the impairment, makes it impractical to establish representative baseline conditions.

Progress in implementation of source controls for this TMDL, therefore, will not be measured against a baseline of current or historical conditions. Instead, source controls and other mitigation measures will be applied according to the apportionment of loading capacity described above (equal distribution to the three contributing factors) until the DO impairment is eliminated. This will require the ability to quantify and tally the amount of mitigation achieved by various source controls and mitigation measures to ensure equitable participation from all responsible entities. Additional studies will be needed before the effect of potential source controls and mitigation measures can be assessed. As discussed further in Section 4.6, these additional studies will be performed as part of the phased program of implementation.

4.5.2 Wasteload and Load Allocations to Point and Non-Point Sources

A number of studies have generated data to evaluate the impact of City of Stockton RWCF effluent and loads of algae on the DO impairment in the DWSC. These studies provide the basis for a preliminary estimate of the relative contribution of ultimate biological oxygen demand (BOD_u) loads from the RWCF and algae to the DWSC.

Evaluation of the relative loads of BOD_u from the City of Stockton RWCF discharge compared to those from upstream loads of algae was performed on 43 sampling runs during the months of August through October 1999 and June through October 2000 and 2001. The average relative contribution was found to be about 25 percent with values as high as 53.5 percent and as low as 5.4 percent (Lee and Jones-Lee, 2003, pg.44). Additional analysis of the relative contribution was performed on samples collected between June 2002 and January 2003, with additional consideration given to flow in the DWSC. The average relative contribution of BOD_u from the RWCF was 26.5 percent, 38 percent, and 58.9 percent at high, average, and low DWSC flow rates respectively during this period. It appears the relative contribution of BOD_u loads from the RWCF increases as DWSC flow, and hence relative loads of BOD_u from upstream, decrease (Lee and Jones-Lee, 2003, pg. 63). It has also been observed that the magnitude of the BOD_u load from the RWCF is seasonally variable with lower loads during the summer and early fall and higher loads during the remainder of the year. This pattern has been attributed to the way the RWCF oxidation ponds are affected by seasonal changes in temperature and duration of daylight. The relative contribution of BOD_u from the RWCF appears to be seasonally variable and affected by flow through the DWSC, however, more analysis of existing data and more extensive future sampling will be required to better define the relative BOD_u loading rates.

The analysis just described, however, only addresses the relative loading of BOD_u and does not address how the BOD_u loads from those different sources actually exert oxygen demand in the DWSC. The complexities of determining the relative contributions to oxygen demand in the DWSC are numerous. Most important is an understanding of the mechanisms by which the various carbonaceous and nitrogenous compounds are oxidized in the DWSC and how these mechanisms are affected by variables such as flow, temperature, and environmental factors. More data and analysis are needed to understand the dynamics of certain mechanisms. Modeling is also needed to evaluate the net effect of these mechanisms on DO concentrations. The specific data needs and the studies being performed to provide this data and analysis are discussed in Section 4.6.

In addition to the relative contributions from algae loads and RWCF loads, there are numerous other possible point and non-point sources of oxygen demanding substances in the watershed. Current information is not conclusive about how much discharges from these other sources are oxidized in the watershed before entering the DWSC. The City of Stockton RWCF, therefore, is the only point source for which a waste load allocation is being specified at this time. Constituents in RWCF effluent with the greatest potential to impact DO in the DWSC are carbonaceous biological oxygen demand (CBOD), ammonia, and organic nitrogen. Other RWCF effluent constituents may, however, exert minor additional oxygen demand.

Based on consideration of the above study findings, 30 percent is allocated as a wasteload allocation to the RWCF; the remaining 70 percent is a load allocation to algae loads. This is a preliminary allocation based on the current relative contribution of BOD_u loads. The allocations between the various point and non-point sources may be modified in subsequent TMDLs based on the finding of future studies regarding the relative impact of these sources on oxygen demand in the DWSC. Other potential sources of oxygen demand may be assigned allocations based on the results of future studies as well.

4.5.3 Summary of Allocations

This TMDL apportions theoretical total loading capacity, less the margin of safety, equally to each of the three main contributing factors; namely i) sources of oxygen demanding substances and their precursors, ii) DWSC geometry, and iii) activities that reduce flow through the DWSC. Source controls and other mitigation measures must be implemented according to this apportionment until the Basin Plan DO objectives are attained in the DWSC.

Of the one-third of loading capacity apportioned to sources of oxygen demanding substances, 30 percent is allocated as a wasteload allocation to the RWCF; the remaining 70 percent is a load allocation to algae loads. Eventually, source controls or other mitigation measures must be implemented to reduce the oxygen demand exerted in the DWSC by these sources to below their associated allocations.

The remaining two-thirds of the loading capacity is apportioned equally to DWSC geometry and reduced flow through the DWSC. Mitigation measures must be implemented to reduce the impact of these contributing factors on load capacity in the DWSC to less than the amount apportioned to each.

Due to the need for a better understanding of the linkages between the various contributing factors and the DO impairment, detailed load limitations or requirements for other mitigation measures are not possible at this time. Based on the findings from future studies, more detailed allocations to specific contributing factors will be developed as part of a subsequent TMDL. Other potential sources of oxygen demand may be assigned allocations based on the results of future studies as well. Section 4.6 presents an outline of the studies to be performed and the specific actions to be taken by the CVRWQCB and other entities to execute these studies and implement the TMDL.

4.6 Program of Implementation

Per Porter-Cologne Water Quality Act Section 13050(j)(3), the proposed Basin Plan Amendment must include a program of implementation for the TMDL. The following provides a description of the actions that will be requested or required of those responsible for the contributing factors identified in the TMDL and the specific actions the CVRWQCB will take to ensure their completion.

4.6.1 Phased Implementation Approach

Although there is adequate scientific understanding to support a general apportionment of loading capacity to the three main contributing factors, there is inadequate understanding at this time to support detailed wasteload or load allocations to specific sources of oxygen demanding substances and their precursors. As such, this Basin Plan Amendment proposes a phased TMDL and implementation approach to provide the needed studies. This implementation plan describes the requirements of the studies to be completed and the actions the CVRWQCB will take to ensure they are completed. The various agricultural drainage and irrigation districts are currently in the process of establishing a contract for the bulk of these studies with the California Bay-Delta Authority. The modeling studies in the DWSC are recently underway.

This program of implementation also describes the actions being taken by various agencies responsible for DWSC geometry and reduced flow through the DWSC to study and then implement mitigation measures to reduce their associated impacts on loading capacity in the DWSC. Also described are actions that the CVRWQCB will take to ensure these mitigation measures are implemented.

Based on the findings of the required studies, and taking into consideration the effect of mitigation measures implemented in the interim, the CVRWQCB will develop detailed wasteload and load allocations to sources of oxygen demanding substances and their precursors in a subsequent revision to this TMDL.

As described in greater detail in Section 7, the Dissolved Oxygen TMDL Steering Committee suggested a phased implementation approach to the CVRWQCB in February 2003. The plan consisted of additional source and linkage analysis and feasibility and demonstration studies of both aeration and non-aeration mitigation measures. The study approach suggested by the DO TMDL Steering Committee provides the framework upon which the study plan for this phased approach was developed. A copy of this stakeholder plan is presented as Attachment A to this report.

<u>Source and Linkage Studies</u>

Additional studies are required to better understand the sources of oxygen demanding substances in the watershed and their linkage to the DO impairment. Specifically these studies must identify and quantify the following:

- Mechanisms, sources of nutrients, and environmental variables that control the creation of algae in the watershed and its transformation before entering the DWSC

- Sources of other oxygen demanding substances in the watershed and the mechanisms and variables that control their transformation before entering the DWSC
- Mechanisms and environmental variables that control how algae and other oxygen demanding substances exert oxygen demand in the DWSC

Numerous watershed stakeholders have proposed and received approval from the California Bay-Delta Authority (CBDA) for a three-year monitoring and analysis program of the upstream sources of oxygen demanding substances and their precursors. This should provide much of the information required to identify and quantify sources and transformation of oxygen demanding substances in the watershed. Two other studies have been started by CBDA to develop multi-dimensional water quality models of the DWSC within two years. Together these studies should provide much of the information needed. Additional monitoring and studies of specific issues will likely be required based on the preliminary findings of these initial studies.

At the same time these studies are taking place, many of the same agencies will also be participating in the CVRWQCB Irrigated Lands Program phased monitoring and reporting program. The study efforts required for this TMDL will be coordinated with and benefit from those of the Irrigated Lands Program. The monitoring and reporting plans for the Irrigated Lands Program will be submitted to the CVRWQCB by July 2004 with Phase 1 and 2 being completed within four years of approval of that plan.

Based on the schedules for completion of the CBDA upstream source and DWSC modeling studies and the Irrigated Lands Program Monitoring Phases 1 and 2, the information needed for more detailed wasteload and load allocations should be available within four years. Therefore, this TMDL program of implementation will identify specific actions that the CVRWQCB will take to see that the needed TMDL studies are completed by December 2008.

Within six months of adoption of this TMDL and implementation plan, those entities responsible for sources of oxygen demanding substances will be required to submit a comprehensive study plan which addresses the information needs of this phased TMDL. Depending on how well the TMDL information needs are addressed by this study plan, who has participated in its development, and the level of assurances that the work will be completed, the CVRWQCB will use its authority under CWC Section 13267 (or alternately by General WDRs and NPDES permits) to require, as needed, all the necessary components of a study plan that delivers the needed information by December 2008. Individual entities may also choose to submit their own plan independent of any collaborative watershed efforts.

Source Control and Mitigation Studies

As the sources of oxygen demanding substances and their linkages to the DO impairment are better understood, those sources linked to the DO impairment will be required to implement mitigation measures. Some of these proposed mitigation measures may directly control the source, and others may provide alternate means of mitigating contributing factors. Studies will be required to evaluate the performance and cost of the most practical and effective mitigation measures. Although some evaluation of these potential mitigation measures could be useful in advance of completing the source and linkage studies, the CVRWQCB will not specifically require the performance of mitigation measure studies until the sources and linkages are better understood.

To the extent that progress can be made in the meantime on studying potential mitigation measures, the California Bay-Delta Authority (on behalf of the watershed stakeholders) has initiated the development of a non-aeration alternatives study program that identifies a broad range of potential source controls and non-aeration mitigation measures that may be applicable to addressing the DO impairment in the DWSC. This non-aeration alternatives study program will provide the basis for determining which mitigation measures can be studied further based on current scientific understanding and those that require a better understanding of the associated sources and linkages before studies are justified.

Study of Mitigation Measures for Non-Load Related Factors

A number of studies will be needed in order to develop mitigation measures as required by CEQA and/or NEPA for future DWSC or water resources projects that have the potential to impact oxygen demand loading capacity in the DWSC. If Clean Water Act Section 401 Water Quality Certifications are required for such future projects, mitigation measures must be implemented before that component of the project, with the potential to impact oxygen demand loading capacity, can proceed. Also, mitigation measures for the impact of existing DWSC geometry and current flow conditions through the DWSC may be initiated in the future, either voluntarily by the responsible entities or as part of future regulatory actions. Until any of these projects are initiated, however, mitigation measures, and the studies needed to develop them, cannot be required by the CVRWQCB.

A number of important DWSC and water resources projects in the watershed are being considered or planned that have the potential to impact DO conditions in the DWSC and would involve the implementation of significant amounts of mitigation before they could begin operation. Some of this mitigation will likely involve mechanical aeration in the DWSC and could begin to improve DO conditions relatively quickly. Recognizing the future need for studies to support the mitigation that will likely be required, the California Bay-Delta Authority (on behalf of their member agencies and the watershed stakeholders) initiated an aeration feasibility and demonstration project.

The aeration feasibility and demonstration project is a two-phased project that starts with a small-scale feasibility study of different aeration technologies that may be effective in the DWSC. This first phase will also include the design and deployment of a monitoring network to measure the impact of aeration on DO concentrations in the DWSC. Once the preferred technologies are identified by the feasibility study, the next phase of the project will be the construction and operation of a large-scale demonstration project using the aeration technologies determined most effective in the DWSC. The purpose of this large-scale project is twofold. First, the purpose is to collect performance and cost data for consideration in development of the final phase of the program of implementation. The second purpose is to begin improving DO conditions prior to development and implementation of the final phase.

The construction of the aeration demonstration project will be financed by Proposition 13 funds as administered by the California Bay-Delta Authority. A group of various agencies in the watershed are currently negotiating an assurance agreement to provide the resources needed to operate, maintain, and monitor the performance of the aerators after construction. The California Bay-Delta Authority will require this assurance agreement be established prior to proceeding with construction of the aerators using Proposition 13 funds.

In addition to the aeration feasibility and demonstration studies, the studies initiated by the non-aeration alternatives study plan discussed in the previous section will also provide an opportunity to study other alternatives for mitigating the impact of non-load related contributing factors to the DO impairment.

4.6.2 Actions Addressing Point Sources

A variety of point sources of oxygen demanding substances or their precursors exist in the DO TMDL source area. The following is a discussion of the actions that will be taken by the CVRWQCB to address the known or potential impacts of these sources on the DO impairment in the DWSC.

City of Stockton Regional Wastewater Control Facility (RWCF)

In the allocation scheme described in Section 4.5, the City of Stockton RWCF will receive a wasteload allocation equivalent to 30 percent of the loading capacity, less the margin of safety, that is apportioned to loads of oxygen demanding substances. The magnitude of this 30 percent allocation is variable depending upon the available loading capacity, which is dependent on flow and temperature in the DWSC. This allocation is for oxygen demand, in units of pounds of oxygen per day, as exerted in the DWSC.

This wasteload allocation of oxygen demand in the DWSC, however, must be converted and expressed in terms of effluent concentration or mass load limits for constituents in the RWCF discharge. This will require understanding the linkage between a given quantity of a oxygen demanding constituent in the RWCF and the corresponding impact on DO concentration in the DWSC. At this point, the RWCF discharge constituent of greatest concern is ammonia, although other constituents may play an important role in the DO impairment as well. Further field and modeling studies are required to understand the specific mechanisms in the DWSC that convert RWCF constituents into oxygen demand and how they are impacted by numerous environmental variables. Of particular interest is how reduced flow through the DWSC influences the amount of oxygen demand that is exerted from the City of Stockton ammonia loads in the DWSC.

In June 2002, a National Pollutant Discharge Elimination System (NPDES) permit for the RWCF was adopted under CVRWQCB Order No. 5-02-083, which included, among other things, effluent limits for ammonia. Although these new ammonia effluent limits were based on the need to protect beneficial uses from acute and chronic toxic effects, once achieved, they will also provide, at times, as much as a ten-fold reduction in the ammonia load to the DWSC and the associated impact on DO.

Based on the fact that this NPDES permit provides for significant reduction in ammonia loading, combined with the uncertainty associated with quantifying the linkage between those ammonia discharges and oxygen demand in the DWSC, more specific wasteload allocations for ammonia are not proposed as part of this TMDL at this time.

Section 4.6.1 outlines the requirements for further studies and modeling, to provide this additional information. In the case of the RWCF ammonia discharges, a better understanding is required of the oxidation rates of different constituents, what percentage of their potential oxygen demand is contributing to the impairment, and the how numerous environmental factors (e.g. flow, temperature, nitrifying bacteria) affect these processes. The City of Stockton may choose to participate in the ongoing CBDA studies to provide this information, provided those efforts adequately address their impacts. The responsibility to perform the studies related to its discharges is ultimately the responsibility of the City of Stockton. The results of these studies, by whatever means, must be provided to CVRWQCB staff by December 2008. Depending on the adequacy of the study plan required by February 2005 and subsequent progress, the CVRWQCB will require its execution, as needed, under CWC Section 13267 or as an amendment to their NPDES permit.

Once adequate understanding of these oxidation mechanisms has been obtained, detailed wasteload allocations will be developed in a subsequent TMDL and revised effluent/load limits incorporated, as needed, into an amended NPDES permit for the City of Stockton RWCF.

Other Municipal Wastewater Treatment Plants

Other municipal wastewater treatment plants in the SJR watershed upstream of the DWSC may also have the potential to contribute oxygen demanding substances or their precursors with the potential to impact the DO impairment. These may include, but are not limited to, the wastewater treatment facilities of the cities of Manteca, Tracy, Modesto, and Turlock.

As for the City of Stockton discharge, more understanding is needed on the way in which oxygen demanding substances in the discharge from these facilities is linked to the DO impairment. As the understanding of the linkages between these types of loads and the DO impairment improves, the need for wasteload allocations to these sources can be assessed. These cities may rely upon the adequacy and schedule of the CBDA funded source and linkage studies discussed above, but ultimately the responsibility for providing the needed information rests with those responsible for the discharge. The results of these studies, by whatever means, must be provided to CVRWQCB staff by December 2008. Depending on the adequacy of the collaborative or individual study plan submitted by February 2005 and subsequent progress in its execution, the CVRWQCB will exercise its authority, as needed, under to CWC Section 13267 or an NPDES permit amendment to require the necessary studies.

Stormwater Discharges

Insert discussion on stormwater and the use of stormwater permits as a vehicle for enforcing the need for study and mitigation of any impacts found.

New or Expanded Discharges

Potential future increases in loads of oxygen demanding substances from new or expanded sources in the watershed shall be accompanied by CEQA and/or NEPA analysis that evaluates and mitigates its entire impact on the low DO impairment. The CVRWQCB will monitor the issuance of CEQA and/or NEPA environmental impact documents and provide comments regarding the project's potential effect on DO conditions in the DWSC.

Depending on the type of project, other State and federal regulations may also require the full potential impact of such a project on DO be mitigated. The CVRWQCB will either exercise its authority to implement these regulations (i.e. NPDES permits, Section 401 water quality certifications) or coordinate with the agencies with jurisdiction to ensure that potential impacts on DO conditions in the DWSC are properly addressed.

4.6.3 Actions Addressing Non-Point Sources

As described in Section 4.5, seventy percent of the available loading capacity apportioned to loads of oxygen demanding substances is allocated to sources of algae. Many mechanisms are known or are suspected of influencing the growth, transport, and decay of algae in the DWSC. Of particular interest are the growth dynamics of algae as it is conveyed downstream through the watershed. Better understanding of these dynamics is needed to determine how specific sources of algae, and specific sources of nutrients that contribute to algal growth, are linked to DO concentrations in the DWSC.

Section 4.6.1 outlines the further study that will be required to understand the sources, transformation, and impact of algae on DO concentrations in the DWSC. Depending on the adequacy of the study plan required by February 2005 and subsequent progress, the CVRWQCB will use its authority under CWC Section 13267 (or alternately by General WDRs) to require, as needed, all the necessary components of a study plan that delivers the needed information by December 2008. Individual entities may also choose to submit their own plan independent of any collaborative watershed efforts.

Once adequate understanding of these linkages has been obtained, specific load allocations for algae and/or its precursors will be assigned to upstream sources by the CVRWQCB in a subsequent TMDL. These load allocations may be implemented through issuance of Conditional Prohibitions of Discharge, General or Individual WDRs, or Conditional Waivers of WDRs.

4.6.4 Actions Addressing Deep Water Ship Channel Geometry

The DWSC geometry reduces the efficiency of mechanisms that supply oxygen to the water column, like natural surface re-aeration and algal photosynthesis. At the same time, the DWSC geometry magnifies the impact of oxygen demanding substances (e.g. ammonia) that reduce DO concentrations in the water column. The net effect is that the DWSC reduces the loading capacity of the DWSC for loads of oxygen demanding substances.

As described in Section 4.5, this TMDL apportions one-third of the total theoretical loading capacity to the existing DWSC geometry (LC_{DWSC}). The USACOE is the primary entity responsible for the existing and any future deepening in the DWSC. The Port of Stockton is the entity responsible for any future berth deepening at its facilities along the DWSC.

Because DWSC geometry does not discharge any substances, however, no wasteload or load allocations can be assigned to entities responsible for the DWSC geometry. Instead, the CVRWQCB will rely upon its authority under Section 401 of the CWA to require that the cumulative effects of reduced loading capacity, caused by future changes in DWSC geometry, be adequately mitigated.

Under CWA Section 404, any project that proposes to discharge fill or dredged material into a water of the U.S. must obtain a permit from the USACOE. If such a project has the possibility to affect water quality, project proponents must also apply for a Water Quality Certification under Section 401 of the CWA. In California, the CVRWQCB is responsible for providing these CWA Section 401 certifications (CWC § 3830-3869), which are enforceable orders under California law. In order to issue a CWA Section 401 certification, the CVRWQCB must find that the project will, in accordance with the Basin Plan, protect beneficial uses, comply with numeric water quality objectives, and not violate the anti-degradation policy of SWRCB Resolution No. 68-16. The CVRWQCB may impose conditions in a CWA Section 401 certification to comply with the CWA, CWC and other applicable law, as necessary. For future projects that propose to alter the DWSC geometry, adequate mitigation for any negative impacts on loading capacity must be demonstrated, including a specific timeline for implementation, before the CVRWQCB will issue a CWA Section 401 certification. In addition to CWA Section 401 certifications, the CVRWQCB can issue WDRs for dredging operations.

The USACOE has already attempted to provide some level of mitigation for past DWSC geometry alterations. Between 1984 and 1987, the DWSC was deepened from 30 feet below mean lower low water (MLLW) to 35 feet MLLW. As part of their National Environmental Policy Act (NEPA) documentation for that project, the USACOE performed modeling that estimated the deepening could reduce loading (assimilative) capacity by as much as 2,500 pounds of oxygen per day (USACOE, 1990). To mitigate this impact, the USACOE constructed and now operates a jet aeration system in the DWSC near where the San Joaquin River enters the DWSC at Channel Point. The jet aeration system installed by the USACOE is designed to diffuse up to 2,500 pounds per day of oxygen into the water column and is operated between 1 September and 30 November each year when DO concentrations measured at the DWR Rough & Ready Island DO monitoring station are at or below 5.0 mg/L (Nichol and Slinkard, 1999). Mitigation of the impact on loading capacity caused by the prior deepening of the DWSC to 30 feet MLLW has not been addressed by the USACOE. This Basin Plan amendment includes a recommendation to the USACOE that it evaluate and mitigate the impact of existing DWSC geometry on oxygen demand loading capacity to less than that apportioned to this impact in the TMDL.

4.6.5 Actions Addressing Reduced Flow Through Deep Water Ship Channel

The impact of reduced flow on the loading capacity of the DWSC has been well documented under current DWSC geometry and variable loading conditions. As flow into the DWSC at a given DO concentration is reduced, less oxygen demand can be exerted before DO concentrations drop below the Basin Plan objectives. It has also been hypothesized that increased DWSC residence times increases how much of the oxygen demand from upstream loads of oxygen demanding substances is exerted in the DWSC. Although relationships between reduced flow through the DWSC and the DO impairment are fairly well understood, further field analysis and modeling studies are required to better understand the specific oxidation mechanisms, and how they are affected by flow, both within the DWSC and upstream.

As described in Section 4.5, this TMDL apportions one-third of the total loading capacity, less the margin of safety, to activities that reduce flow in the DWSC (LC_{Flow}). Because reduced flow does not discharge any substances, no wasteload or load allocations are assigned to responsible entities. Instead, the SWRCB should use its water rights authority and, in some cases, the CVRWQCB will use its CWA Section 401 water quality certification authority to require mitigation for activities that affect flow through the DWSC.

The activities that affect flow in the DWSC fall under three categories: i) consumptive use in the San Joaquin River watershed, ii) the diversion of San Joaquin River flows down Old River that result from the operation of the State Water Project (SWP) by DWR and the federal Central Valley Project (CVP) by USBR and iii) other out-of-basin transfers. Numerous entities are responsible for upstream diversions and consumptive use that reduce flow in the DWSC. Following is a brief discussion of the SWRCB and CVRWQB authorities over different activities in these categories.

Impact of Existing Flow Conditions on Dissolved Oxygen Impairment:
Consumptive use and out-of-basin transfers upstream of the DWSC have the potential to reduce flow through the DWSC. There are currently no minimum required flows in the San Joaquin River past the head of Old River through the DWSC or requirements that water right permit holders provide any mitigation for the DO impairment. The SWRCB adopted Water Right Decision 1641 (D-1641) in December 1999, among other things, to allocate responsibility for achieving water quality objectives contained in the 1995 *Water Quality Control Plan for the San Francisco Bay / Sacramento-San Joaquin Delta Estuary* (Bay-Delta Plan) to water right holders whose diversions affect the beneficial uses in the estuary (SWRCB, 2000). After considering extensive testimony and analysis, the SWRCB decided in Section 9.3 of D-1641 that:

> *"…the SWRCB will not take any water right action to meet the (Bay-Delta Plan) DO objectives at this time. The RWQCB should determine effluent limits based on TMDL results. The SWRCB will wait until the RWQCB has established a TMDL and has implemented it before taking further action to achieve the (Bay-Delta Plan) DO objectives."* (SWRCB, 2000, pg. 79).

It is being proposed that in response to Section 9.3 of D-1641, the CVRWQCB will recommend to the SWRCB that one-third of the loading capacity (and hence responsibility for mitigating the DO impairment) should be assigned using SWRCB water rights authority to entities that are responsible for current activities that reduce flow in the DWSC. The Basin Plan Amendment also includes a recommendation directly to the agencies responsible for activities that reduce flow that they take action on their own to mitigate their impacts on the DO impairment in the DWSC.

Future Projects Potentially Impacting San Joaquin River Flow
The allocations just described are based on flow conditions in the San Joaquin River resulting from existing water project operations. Any future projects proposed in the watershed that have the potential to reduce flows in the San Joaquin River will need to consider the additional potential impact of that reduced flow, and mitigation measures for those impacts, as part of their environmental impact analysis required under CEQA and/or NEPA. Staff will monitor the preparation of CEQA/NEPA environmental impact statements/reports for projects in the watershed that have the potential to impact flow in the San Joaquin River and the DO impairment in the DWSC. The analyses of the potential project impacts will be reviewed for

completeness and technical adequacy and comments will be provided to the project lead agency. The Basin Plan Amendment also includes a recommendation directly to the agencies responsible for future projects that reduce flow that they evaluate and mitigate their impacts on the DO impairment in the DWSC.

Additionally, the CVRWQCB will recommend to the SWRCB that approval of such projects under their water rights or other authorities be contingent upon the effects of any further reduction of flow through the DWSC being properly evaluated and mitigated. The CVRWQCB will provide input on the potential water quality impacts of such projects during SWRCB preparation or modification of the water right permits or other approvals.

<u>South Delta Improvements Project</u>

DWR is in the planning process for their South Delta Improvement Project (SDIP). This project is intended to mitigate the water supply and water quality impacts associated with increasing the maximum allowable diversion capacity into Clifton Court Forebay, from which the State Water Project pumps its water. How this project is designed and operated has the potential for significant impact on flow in the San Joaquin River through the DWSC and hence the DO impairment.

One of the alternatives being considered as mitigation for the effects of increased diversion is the installation of operable flow control barriers at the head of Old River and other locations in the south Delta. These barriers will act to reduce the amount of SJR flow being diverted down Old River towards the pumps and away from the DWSC.

In Section 9.2.1 of D-1641, the SWRCB stated that:

> *"Flow moving past Stockton is the largest single controllable factor that affects DO. Although the 1995 Day-Delta Plan contains flow objectives for the San Joaquin River at Vernalis, modeling shows that implementation of the 1995 Bay-Delta flow objectives alone will not significantly improve DO concentrations at Stockton. A barrier at the head of Old River can increase flows in the San Joaquin River at Stockton by reducing the proportion of flow that enters Old River. If a head of Old River barrier is constructed and is operated in conjunction with implementing the 1995 Bay-Delta flow objective, DO should improve."* (SWRCB, 2000, p. 77).

The SWRCB concluded Section 9.2.1 by stating that:

> *"…this decision does not require the construction of permanent barriers in the southern Delta channels. Nevertheless, the SWRCB encourages the parties involved in constructing and regulating the barriers to consider the effects of the barriers on DO and to make their best efforts to achieve the benefits of the barriers to DO while avoiding or mitigating their adverse effects."* (SWRCB, 2000, p. 78)

In addition to the above, because the SDIP will involve dredging in some South Delta channels and construction of other in-stream structures, a CWA Section 404 permit from the USACOE and a CWA Section 401 certification from the CVRWQCB will be required. In order to obtain this certification the SDIP will need to provide adequate mitigation measures on a specific implementation timeline for the potential impacts of the project on DO conditions in the DWSC (as well as for any other water quality concerns). The CVRWQB will utilize this authority to ensure the potential impacts of this project on oxygen demand loading capacity in the DWSC are properly evaluated and completely mitigated.

4.6.6 Consideration of Alternative Mitigation Measures

Alternate mitigation measures may be needed as a substitute for direct control of certain causative factors if on-going studies show that certain causative factors cannot be successfully mitigated by direct controls. It may also be necessary to rely on short-term alternate mitigation measures as longer-term control measures take more time to implement and become effective. The CVRWQCB will need to consider if alternate mitigation measures that are proposed by those responsible for certain contributing factors are acceptable. In order to be acceptable, any alternative mitigation measures proposed for consideration by the CVRWQCB must adequately address the impact on the DO impairment and must not degrade water quality in any other way. If alternate mitigation measures are selected to address certain impacts, load allocations in a subsequent TMDL will need to be converted and expressed in terms of these alternate mitigation measures or their impact on oxygen demand and/or loading capacity.

After a better understanding of the sources and linkages is obtained by the additional studies described in Section 4.6.1, the CVRWQCB may also consider allowing a portion of wasteload and load allocation to be met through a load-trading program. The details of such a program would need to be developed as part of a subsequent TMDL that establishes more detailed wasteload and load allocations.

5 Basin Plan Amendment Alternatives Analysis

5.1 Basin Plan Alternatives Analysis Process

Since the Basin Plan amendment process is a certified regulatory program pursuant to the California Environmental Quality Act (CEQA), the Basin Plan amendment staff report must serve as a substitute Environmental Document (Environmental Impact Report or Negative Declaration). SWRCB regulations describing the environmental documents required for such planning actions are contained in the California Code of Regulations, Title 23, Section 3720 et seq. The following is a description of the alternatives analysis process by which the TMDL wasteload and load allocations and the program of implementation were developed for the proposed TMDL Basin Plan Amendment.

The process begins with the development of the evaluation criteria in Section 5.2. These criteria will be applied to the various options and alternatives being considered throughout the process. Next, Section 5.3 identifies a number of TMDL and implementation considerations specific to this DO impairment, evaluates different options for addressing them, and considers a preferred option. In Section 5.4 a number of comprehensive alternatives are formulated to address the various options collectively and are then analyzed against the evaluation criteria to select a preferred alternative. Section 5.5 presents an analysis of economic and funding considerations as required by CWC Section 13141.

5.2 Evaluation Criteria

This section presents the evaluation criteria and the scoring methodology for applying those criteria to the TMDL and implementation options in Section 5.3 and the comprehensive alternatives in Section 5.4.

Likelihood of Success

Evaluation of the likelihood of success is based on: 1) the degree to which a given option or alternative has a clearly defined and logical technical and administrative process; and 2) the level of assurance that the various responsible entities will execute the actions defined in the option or alternative.

Scoring: The likelihood of success for each option or alternative is evaluated qualitatively and scored based on best professional judgment. Scoring of this criterion will range from zero to five, with a score of zero representing little likelihood of success and score of five representing a high likelihood.

Flexibility

This criterion evaluates the degree to which a given option or alternative can respond or adapt to new data and information. The criterion also evaluates the degree to which each implementation option provides flexibility to allow the most effective and practical mitigation measures to be implemented by the responsible entities.

Scoring: The flexibility of each option or alternative is evaluated qualitatively and scored based on best professional judgment. Each of the options or alternatives will be evaluated and scored on a scale of zero to five, with zero being the least flexible and five being the most flexible.

Equitability

This criterion evaluates how equitably the wasteload and load allocations and other requirements of this TMDL distribute the responsibility for solving the DO impairment relative to the significance of the corresponding contributing factors.

Scoring: The equitability of each option or alternative is evaluated qualitatively and scored based on best professional judgment. Each of the options or alternatives will be evaluated and scored on a scale of zero to five, with zero being the least flexible and five being the most flexible.

Evaluation Criterion #4: Time to Implement Improvements in Dissolved Oxygen

This criterion will evaluate the relative time it will take to begin physical implementation of mitigation measures aimed at improving DO conditions in the DWSC.

Scoring: The amount of time needed under each option or alternative to physically start implementation of mitigation measures will be evaluated relative to the time needed under other options and alternatives being considered. Scoring for this evaluation criterion will range from zero requiring the most time to implement and five requiring the least time to implement.

Evaluation Criterion #5: Consistency with State and Federal Laws and Policies

Each implementation option is evaluated with respect to whether it complies with or can be implemented under the applicable state and federal laws and policies described in detail in Section 3 of this report.

Scoring: This evaluation criterion will be applied in a pass/fail manner to the options being considered in Section 5.3. If all the options for addressing an issue are consistent with laws and policies and have a reasonable and legal means of implementation, they will proceed to the next step in the alternatives formulation and analysis process in Section 5.4. This criterion will not need to be applied to the alternatives analysis in Section 5.4, as the alternatives are formulated from different combinations of options that already passed this criterion in Section 5.3.

Evaluation Criterion #6: Costs of Implementation

Water code section 13141 requires that prior to implementation of any agricultural water quality control program, an estimate of the total cost of such program and identification of sources of funding be indicated in the Basin Plan. The requirements of CWC Section 13141 apply to this Basin Plan amendment, as the proposed TMDL and program of implementation involve consideration of the potential impact on the DO impairment from agricultural discharges. To the extent possible without speculation, an estimate of cost for each of the alternatives will be prepared and the potential sources of funding will be discussed.

Scoring: The Porter Cologne Act does not specify the weight that must be given to economic considerations nor does it require that a formal cost benefit analysis be performed, therefore, no scoring for this criterion will be applied to the various alternatives. An estimate of cost for each of the alternatives will be presented and the potential sources of funding will be discussed.

5.3 Considerations and Options

Three main considerations, specific to this TMDL and program of implementation, have been identified during the development of this Basin Plan Amendment. This section presents an explanation of these considerations and identifies options for how to address each of them. Each of the options is then preliminarily screened against the evaluation criteria defined in the previous section. If a preferred option for addressing a particular consideration is not selected as part of this preliminary screening, then all the options for a particular consideration are carried forward for further evaluation as part of a comprehensive alternative in Section 5.4.

Consideration #1: Non-Load Related Factors

As described in Section 4.3 there are three contributing factors to the DO impairment; i) loads of oxygen demanding substances, ii) DWSC geometry and iii) reduced flow through the DWSC. Although they are contributing factors, the DWSC geometry and reduced flows through the DWSC are not loads of a substance for which loads can be allocated. Instead, these factors reduce the loading capacity available to sources of oxygen demanding substances. One of the challenges in developing an equitable and effective solution to this impairment is that the CVRWQCB has limited regulatory authority to require control of the impacts caused by the existing DWSC geometry and reduced river flow conditions. The resulting consideration is whether or not, and how, to account for the effect of the two non-load related contributing factors in the determination of wasteload and load allocations to sources of oxygen demanding substances and their precursors.

Option 1a) Consider Loads Only

This option consists of only addressing load-related contributing factors to the DO impairment without consideration of the impact of DWSC geometry and reduced flow through the DWSC on oxygen demand loading capacity in the DWSC. This option would rely upon wasteload and load allocations being implemented through utilization of CVRWQCB authority to issue NPDES permits, WDRs, and other means of controlling surface water discharges.

Option 1b) Account for Non-Load Related Factors

This option will account for the reduction of oxygen demand loading capacity caused by DWSC geometry and reduced DWSC flow as part of developing wasteload and load allocations to sources of oxygen demanding substances and their precursors. This option would rely upon utilization of 401-certification authority over future watershed projects and CVRWQCB coordination with SWRCB authority over water rights to ensure that the impacts of these non-load related factors are properly mitigated.

Evaluation

TMDL regulations and guidance are focused on controlling discharges of pollutants as the means of addressing water quality impairments and do not address how contributing factors such as altered channel geometry or reduced flow should be controlled. Addressing the impact of such non-load related factors in a TMDL and implementing control actions are not inconsistent with applicable laws or regulations as long as such actions are within CVRWQCB jurisdiction. In fact, the CVRWQCB Watershed Policy supports focusing implementation efforts on the most important problems and those sources contributing most significantly to those problems.

Generally speaking Option 1b is more equitable than 1a, because it accounts for the real impact of non-load related factors, rather than placing the burden entirely on sources of oxygen demanding substances and their precursors. There is also a degree of increased flexibility and likelihood of success associated with having more causes and potential solutions to the problem being considered. At the same time, because of the somewhat limited CVRWQCB jurisdiction over non-load related factors, there is some risk associated ensuring implementation of mitigation measures for those factors.

In order to select a preferred option, however, the relative merits of these two options must be evaluated together with the TMDL timing options of Consideration #2. For example, if Option 1a is selected it would be more important that further study be allowed because more emphasis is placed on fewer contributing factors to the impairment; factors for which we also happen to have the most scientific uncertainty. Options 1a and 1b, therefore, will both be forwarded for further evaluation as part of comprehensive alternatives in Section 5.4.

Consideration #2: Phased Approach

As discussed in Section 4.3, one of the contributing factors to the DO impairment are loads of oxygen demanding substances into the DWSC. Some of these oxygen-demanding substances, however, are themselves the result of chemical or biological processes in the watershed that are strongly influenced by the presence of certain conditions or precursor substances. Consideration must be given to whether enough is known about the linkages between the various oxygen demand sources and precursors such that reasonable and effective allocations can be rationalized. Based on uncertainties surrounding our understanding of the various linkages, consideration needs to be given to if, and how quickly, to proceed with the TMDL and program of implementation.

Option 2a) Postpone Development of Basin Plan Amendment

This option consists of postponing development of the TMDL and program of implementation until further studies are completed and more information is available.

Option 2b) Phased TMDL and Implementation Approach

This option consists of proceeding with the development of general allocations to the various contributing factors, but allows for further studies to be completed in a phased manner before detailed wasteload and load allocations are developed for specific sources in the watershed. A phased approach would also allow for aeration demonstration studies to be carried out that would begin to improve DO conditions in the meantime.

Option 2c) Final TMDL and Implementation Based on Current Science

This option consists of developing detailed wasteload and load allocations for specific sources in the watershed based on current understanding of the contributing factors and their linkages to the DO impairment.

Evaluation

In order to be consistent with the Clean Water Act and Porter-Cologne, because the DWSC is not complying with Basin Plan DO objectives, a TMDL and program of implementation must be prepared. The consideration, however, is whether or how far to proceed at this time based on the best available science regarding the causes and potential solutions to the impairment. It is possible to be consistent with laws and policies if, in the technical judgment of the CVRWQCB, the best available science is at an appropriate level of development to support a particular option.

In general, CVRWQCB staff believes the level of science is adequate enough to proceed with establishing general load allocations, which will then drive the execution of further studies in a phased TMDL. The uncertainty surrounding the linkages between the various contributing factors and the impairment make it difficult, however, to rationalize equitable detailed wasteload and load allocations at this time.

A more detailed evaluation of the relative merits of these three options against the evaluation criteria are dependent on which option is selected for Consideration #1. For example, in Option 2C, a detailed TMDL and implementation plan will likely have a greater likelihood of success, if all the non-load related factors are being considered in Option 1b. As a result, all three options for Consideration #2 are forwarded for further evaluation as part of comprehensive alternatives in Section 5.4.

Consideration #3: Alternate Mitigation Measures

For a number of factors contributing to the DO impairment, direct control may not be a practical or effective means of controlling their impacts on the DO impairment. For example, the removal of algae from discharges in the watershed may not be practical or very effective in mitigating DO impacts in the DWSC. Providing the algae concentrations in the discharge do not create other water quality degradation in the San Joaquin River, alternate mitigation measures may be appropriate. For example, restoring riparian habitat to reduce light available for photosynthesis and to reduce temperature may provide a more effective means of mitigating the impact of algae discharges. More study of the linkages between such contributing factors and the benefits and redirected effects of potential mitigation measures is required before specific alternate mitigation measures can be considered.

Option 3a - Consider Alternate Mitigation Measures
This option allows alternate mitigation measures to be considered, but only if such measures, in addition to addressing the DO impairment, will not degrade water quality in any other way.

Option 3b - Do Not Consider Alternate Mitigation Measures
This option would only allow direct control of contributing factors to be considered as mitigation of their impact on the DO impairment.

Evaluation

With regard to consistency with laws and policies, alternate mitigation measures can be considered as long as such measures, in addition to addressing the impairment, will not degrade water quality in any other way. In cases of granting Section 401 water quality certifications, the CVRWQCB may not have the authority to dictate the means and methods by which a proposed project's impacts on water quality are mitigated. Laws and policies are also satisfied if only direct control of contributing factors are considered as mitigation for their impact on the impairment. In the case of NPDES permits or WDRs, direct control of sources of oxygen demanding substances and their precursors can be achieved with load limitations.

Unlike the options in Considerations #1 and #2, which are somewhat dependent upon one another, Options 3a and 3b can be evaluated independent of those other considerations. The relative merits of whether to allow alternate mitigation measures are not significantly influenced by whether non-load related factors are considered in the TMDL or whether a phased TMDL approach is being taken.

For some contributing factors alternate mitigation measures may provide a more effective and practical means of mitigating their impact. If such means exist and they do not degrade water quality in any other way, then this will increase the likelihood of success. The flexibility to consider alternate mitigation measures also may allow more equitable and timely means to address impacts on DO in the DWSC.

Based on this evaluation against the criteria from Section 5.3 and the fact that these considerations are not dependent on other considerations, Option 3a is determined to be the preferred option and will be incorporated into the alternatives analysis in Section 5.4. Option 3b will receive no further consideration. Cost of implementation will be considered as part of the alternatives analysis in Section 5.4.

5.4 Alternatives Analysis

This section presents the methodology used for formulating a set of comprehensive alternatives, evaluating them, and selecting a preferred approach to be incorporated in the Basin Plan Amendment.

5.4.1 Alternatives Formulation

In this section, five alternatives are formulated from different combinations of Options 1a, 1b, 2a, 2b, and 2c described in Section 5.3. Option 3a (Consider Alternate Mitigation Measures) was selected as the preferred option for Consideration #3 and is incorporated as a common element to all of the alternatives formulated below, with the exception of the no-action Alternative V.

Formulation of Alternative I (Consider Loading Factors Only Based on Current Science)

This alternative is a combination of Options 1a, 2c, and 3a. It consists of proceeding now with the development of a TMDL that allocates oxygen demand loading capacity only to sources of oxygen demanding substances and their precursors and is implemented through CVRWQCB authority over the various point and non-point sources. These allocations will not account for the impact of the two non-load related contributing factors of DWSC geometry and reduced DWSC flow. The allocations in this TMDL will be detailed mass load limits assigned to specific sources in the watershed based on current science and data.

The relative distribution of the allocations between the different sources of oxygen demanding substances and their precursors will be proportioned based on the relative current loadings from these sources. Alternate mitigation measures to direct control of the constituent(s) being discharged will only be considered if such measures, in addition to addressing the DO impairment, will not degrade water quality in any other way.

Formulation of Alternative II (Consider Loading Factors Only with Phased Approach)

This alternative is a combination of Options 1a, 2b, and 3a. It consists of proceeding now with the development of a TMDL that allocates oxygen demand loading capacity only to sources of oxygen demanding substances and their precursors and is implemented through CVRWQCB authority over the various point and non-point sources. These allocations will not account for the impact of the two non-load related contributing factors of DWSC geometry and reduced DWSC flow. Detailed mass load limits assigned to specific sources in the watershed will be developed in a phased approach.

The relative distribution of the allocations between the different sources oxygen demanding substances and their precursors will be proportioned based on the relative current loadings from these sources. Alternate mitigation measures to direct control of the constituent(s) being discharged will only be considered if such measures, in addition to addressing the DO impairment, will not degrade water quality in any other way.

Formulation of Alternative III (Consider Non-Loading Factors Based on Current Science)

This alternative is a combination of Options 1b, 2c, and 3a. It consists of proceeding now with the development of a TMDL that allocates oxygen demand loading capacity to point and non-point sources of oxygen demanding substances and their precursors after taking into account the impact of the two non-load related contributing factors of DWSC geometry and reduced DWSC flow.

The loading capacity for oxygen demand in the DWSC will be divided equally between i) sources of oxygen demanding substances and their precursors, ii) DWSC geometry, and iii) reduced flow through the DWSC. The relative distribution of the allocations between the different sources of oxygen demanding substances and their precursors will be proportioned based on the relative current loadings from these sources. The allocations in this TMDL will be detailed mass load limits assigned to specific sources in the watershed based on current science and data.

This TMDL will be implemented through CVRWQCB authority over the various point and non-point sources of oxygen demanding substances and their precursors. To address non-load related contributing factors, the CVRWQCB will utilize its CWA Section 401 water quality certification authority over future projects that may impact DO concentrations in the DWSC and will coordinate with the SWRCB on water right permits or transfer applications that have the possibility to impact flow though the DWSC.

Alternate mitigation measures to direct control of the constituent(s) being discharged will only be considered if such measures, in addition to addressing the DO impairment, will not degrade water quality in any other way.

Formulation of Alternative #IV (Consider Non-Loading Factors with Phased Approach)

This alternative is a combination of Options 1b, 2b, and 3a. It consists of proceeding now with the development of a TMDL that allocates oxygen demand loading capacity to point and non-point sources of oxygen demanding substances and their precursors after taking into account the impact of the two non-load related contributing factors of DWSC geometry and reduced DWSC flow.

The loading capacity for oxygen demand in the DWSC will be divided equally between i) sources of oxygen demanding substances and their precursors, ii) DWSC geometry, and iii) reduced flow through the DWSC. The relative distribution of the allocations between the different sources of oxygen demanding substances and their precursors will be proportioned based on the relative current loadings from these sources. Detailed mass load limits assigned to specific sources in the watershed will be developed in a phased approach.

This TMDL will be implemented through CVRWQCB authority over the various point and non-point sources of oxygen demanding substances and their precursors. To address non-load related contributing factors, the CVRWQCB will utilize its CWA Section 401 water quality certification authority over future projects that may impact DO concentrations in the DWSC and will coordinate with the SWRCB on water right permits or transfer applications that have the possibility to impact flow though the DWSC.

Alternate mitigation measures to direct control of the constituent(s) being discharged will only be considered if such measures, in addition to addressing the DO impairment, will not degrade water quality in any other way.

<u>Evaluation of Alternative V (No Action at this Time)</u>

This alternative consists of Option 2a only and consists of taking no action at this time based on the determination that the current state of knowledge is inadequate to proceed with the determination of any level of wasteload and load allocations. Although, the need for a TMDL and program of implementation would still exist, no actions would be required to obtain the information needed eventually. All other options are not applicable to this alternative, as they are predicated on proceeding with a Basin Plan Amendment.

5.4.2 Evaluation of Alternatives

In this section the five alternatives formulated in the previous section are evaluated and ranked based on the following evaluation criteria from Section 5.2:

- Likelihood of Success
- Flexibility
- Equitability
- Time to Implement

The alternatives are not evaluated against the "Consistency with Laws and Policies" criterion because all the options upon which the alternatives are based were found to satisfy this criterion in the options analysis in Section 5.3.

To address the Cost of Implementation criterion, an estimate of cost for each of the alternatives will be presented and the potential sources of funding will be discussed. The Porter Cologne Act does not specify the weight that must be given to economic considerations nor does it require that a formal cost benefit analysis be performed, therefore, no scoring for the Cost of Implementation criterion will be applied to the alternatives.

<u>Evaluation of Alternative I (Consider Loading Factors Only Based on Current Science)</u>

As described in Section 5.3, this alternative consists of proceeding now with the development of a TMDL that allocates oxygen demand loading capacity only to point and non-point sources of oxygen demanding substances and their precursors. The allocations in this TMDL will be detailed mass load limits assigned to specific sources in the watershed based on current science and data.

<u>Likelihood of Success</u>

Alternative I allocates oxygen demand loading capacity only to sources of oxygen demanding substances and their precursors. This alternative is much less likely to succeed in addressing the impairment than Alternatives III and IV, because they only address one of the contributing factors to the impairment. <u>(Score: 1)</u>

Flexibility

Alternative I develops detailed load allocations now based on current science. It does not provide much flexibility for taking into consideration improved scientific understanding of the linkage between the various sources in the watershed and the DO impairment that will come from future studies. Once detailed load limitations have been adopted into a TMDL and implemented in NPDES permits and other regulatory means, making later modifications will be difficult. In cases where earlier load limitations are found later to be overly stringent, it might not be possible to modify them due to anti-backsliding considerations. Flexibility is further reduced because this alternative only addresses one of the contributing factors to the impairment. (Score: 1)

Equitability

The effects of DWSC geometry and reduced flow through the DWSC on the DO impairment have been found to be significant. If their effect is not considered in the development of wasteload and load allocations, the resulting allocations will not be equitable when compared to their relative contribution to the impairment. Also, without time to further study the relative impacts from different sources of oxygen demanding substances and their precursors, the chances are greater that the allocations resulting from this alternative will not be as equitable if more time to understand the linkages was allowed. (Score 1)

Time to Implement

Relative to alternatives with a phased approach, this alternative will provide a faster path to implementing mitigation measures for sources of oxygen demanding substances and their precursors. To the extent that these allocations will be less effective in addressing the impairment than those based on further study, this alternative may take more time to actually solve the problem than when compared to Alternative II. (Score: 3)

Cost of Implementation:

Under this alternative, regulated point source and non-point source dischargers would be faced with the requirement of implementing either direct controls on their discharge of oxygen demanding substances and their precursors or to provide other means of mitigating their impacts on the DO impairment. Without having developed specific limitations or having identified specific discharges, the cost estimates for implementing this alternative would be speculative. Eventually these discharge controls would need to be funded by the owners of the facility, which would consist primarily of municipalities and agricultural dischargers.

Evaluation of Alternative II (Consider Loading Factors Only with Phased Approach)

As described in Section 5.3, this alternative consists of proceeding now with the development of a TMDL that allocates oxygen demand loading capacity only to point and non-point sources of oxygen demanding substances and their precursors. Detailed mass load limits assigned to specific sources in the watershed will be developed in a phased approach.

Likelihood of Success

For both Alternatives I and II, oxygen demand loading capacity is allocated only to sources of oxygen demanding substances and their precursors. These alternatives are much less likely to succeed in addressing the impairment than Alternatives III and IV, because they only address one of the contributing factors to the impairment. In Alternative II, however, the phased approach will provide a better understanding of which sources to control and how before detailed wasteload and load allocations are developed. This alternative, therefore, will likely be more successful than if allocations were developed now based on current science as in Alternative I. (Score = 2)

Flexibility

The phased approach of this alternative is flexible in that it allows the findings of future scientific studies to be incorporated into the development of detailed wasteload and load allocations to sources of oxygen demanding substances and their precursors. Flexibility is further reduced, however, because this alternative only addresses one of the contributing factors to the impairment. (Score: 3)

Equitability

The effects of DWSC geometry and reduced flow through the DWSC on the DO impairment have been found to be significant. If their effect is not considered in the development of wasteload and load allocations, the resulting allocations will not be equitable when compared to their relative contribution to the impairment. The phased approach of this alternative, however, provides more opportunity for information to be gathered such that a more equitable allocation between the various sources can be developed. (Score: 2)

Time to Implement

As this alternative allows for a phased approach, it may take more time initially to implement than Alternative I. This may likely lead, however, to more effective control of the impairment because more time was provided to identify the most closely linked sources. (Score: 2)

Cost of Implementation:

The total estimated cost of the studies to be performed as part of the phased TMDL in Alternative II is approximately $15.6 million, with nearly $14.4 million coming from Proposition 13 and 50 bond funds and $1.2 million coming from watershed stakeholders. This estimate does not include the cost of data obtained from other study efforts in the watershed, for which funding already exists. A detailed discussion of these costs in presented in Section 5.5.2.

Data from all these studies may lead to more detailed wasteload and load allocations at a later date. The cost of control or mitigation measures that will eventually be required to address the impacts of the various sources of oxygen demanding substances and their precursors cannot be estimated until the studies have been completed and allocations have been established.

Evaluation of Alternative III (Consider Non-Loading Factors Based on Current Science)

As described in Section 5.3, this alternative consists of proceeding now with the development of a TMDL that allocates oxygen demand loading capacity to point and non-point sources of oxygen demanding substances and their precursors after taking into account the impact of the two non-load related contributing factors of DWSC geometry and reduced DWSC flow. The allocations in this TMDL will be detailed mass load limits assigned to specific sources in the watershed based on current science and data.

Likelihood of Success

This alternative is relatively more likely to succeed than either Options I or II, due to the fact that is will address more of the factors contributing to the impairment. Chances are, however, that it will be less likely to succeed than Alternative IV, because it will not allow for consideration of future studies that could increase the effectiveness of the allocations and mitigation measures that are implemented. (Score: 3)

Flexibility

Alternative III develops detailed load allocations now based on current science. It does not provide much flexibility for taking into consideration improved scientific understanding of the linkage between the various sources in the watershed and the DO impairment that will come from future studies. Once detailed load limitations have been adopted into a TMDL and implemented in NPDES permits and other regulatory means, making later modifications will be difficult. In cases where earlier load limitations are found later to be overly stringent, it might not be possible to modify them due to anti-backsliding considerations. Flexibility is slightly better than for Alternative I, however, because the effects of non-load related factors will be considered in the development of the allocations. (Score: 2)

Equitability

This alternative is more equitable than either Alternatives I or II, because it accounts for the significant effect of DWSC geometry and reduced flow through the DWSC in the determination of wasteload and load allocations. The equitability of this alternative is somewhat less than that of Alternative IV, however, because additional time is not provided to better understand the relative impacts from different sources of oxygen demanding substances and their precursors. (Score: 3)

Time to Implement

Relative to alternatives with a phased approach, this alternative will provide a faster path to implementing mitigation measures for sources of oxygen demanding substances and their precursors. Also, aeration is a likely mitigation measure for some of the additional contributing factors (e.g. DWSC geometry) considered in this alternative, and will likely lead to quicker improvements in DO concentrations in the DWSC than for Alternatives I or II. To the extent that these allocations and mitigation measures will be less effective in addressing the impairment than those based on further study, this alternative may take more time to actually solve the problem than when compared to alternatives with a phased approach. (Score: 3)

Cost of Implementation:

Under this alternative, regulated point source and non-point source dischargers and entities responsible for the various non-load related contributing factors would be faced with the requirement of implementing controls to mitigate their impacts on the DO impairment based on current science. Without having developed the specific limitations nor having identified specific contributing factors, the cost estimates for implementing this alternative would be speculative. The discharge controls and other mitigation measures required would need to be funded by the entities responsible for those contributing factors.

Evaluation of Alternative #IV (Consider Non-Loading Factors with Phased Approach)

As described in Section 5.3, this alternative consists of proceeding now with the development of a TMDL that allocates oxygen demand loading capacity to point and non-point sources of oxygen demanding substances and their precursors after taking into account the impact of the two non-load related contributing factors of DWSC geometry and reduced DWSC flow. Detailed mass load limits assigned to specific sources in the watershed will be developed in a phased approach.

Likelihood of Success

This alternative is relatively more likely to succeed than either Options I or II, due to the fact that is will address more of the factors contributing to the impairment. This alternative will likely also be more successful than Alternative III, because it will allow for consideration of future studies that could increase the effectiveness of the allocations and mitigation measures that are implemented. (Score: 4)

Flexibility

The phased approach of this alternative is flexible in that it allows the findings of future scientific studies to be incorporated into the development of detailed wasteload and load allocations to sources of oxygen demanding substances and their precursors. The flexibility of this alternative is enhanced by the fact that other contributing factors to the impairment are being considered as well. (Score: 4)

Equitability

This alternative is more equitable than either Alternatives I or II, because it accounts for the significant effect of DWSC geometry and reduced flow through the DWSC in the determination of wasteload and load allocations. The equitability of this alternative is somewhat greater than Alternative III, however, because additional time is provided to better understand the relative impacts from different sources of oxygen demanding substances and their precursors. (Score: 4)

Time to Implement

As this alternative allows for a phased approach, it may take more time initially to implement than Alternative III, but will likely lead to more effective control of the impairment in the long-term because more time was provided to identify the most closely linked sources and effective mitigation measures. Also, aeration is a likely mitigation measure for some of the additional contributing factors (e.g. DWSC geometry) considered in this alternative, and will likely lead to quicker improvements in DO concentrations in the DWSC than in Alternatives I and II. (Score: 3)

Cost of Implementation:

The total estimated cost of the studies to be performed as part of the phased TMDL in Alternative II is approximately $15.8 million, with nearly $14.6 million coming from Proposition 13 and 50 bond funds and $1.2 million coming from watershed stakeholders. This estimate, however, does not include the cost of constructing an aeration demonstration project.

The cost of constructing the demonstration aerators will be highly variable depending on their yet undetermined scope and design. Based on some preliminary estimates the annual operating costs for the aeration demonstration project, including maintenance and monitoring, could be on the order of $100,000 to $200,000 per year. The cost of operating, maintaining, and monitoring the aerators will be shared by various responsible entities whose contributing factors are determined appropriate for mitigation by aeration.

This estimate does not include the cost of data obtained from other study efforts in the watershed, for which funding already exists. A detailed discussion of these costs in presented in Section 5.5.2.

Data from all these studies may lead to more detailed wasteload and load allocations at a later date. The cost of control or mitigation measures that will eventually be required to address the impacts of the various sources of oxygen demanding substances and their precursors cannot be estimated until the studies have been completed, the allocations have been established, and the appropriate control or mitigation measures have been selected.

Evaluation of Alternative V (No Action at this Time)

As described in Section 5.3, this alternative consists of taking no action to develop a Basin Plan Amendment at this time.

Likelihood of Success

Under this alternative, there will be no requirements that the studies needed for eventual development of a TMDL and program of implementation be performed. (Score: 1)

Flexibility

This alternative provides flexibility in allowing for future studies to be considered in the development of wasteload and load allocations. (Score: 4)

Equitability

No progress will be made towards developing an equitable solution to the DO impairment and the inequitable impact on beneficial uses will continued indefinitely. (Score: 1)

Time to Implement

Without developing wasteload or load allocations or implementing a plan of further study, the length of time to implement this alternative will be very long compared to the other alternatives. (Score: 1)

Cost of Implementation:

There is no direct cost associated with the no-action alternative, although there are potential indirect costs associated with the continuing low DO concentrations and the impact that has on beneficial uses.

5.4.3 Recommended Alternative for Basin Plan Amendment

Based on the ranking of each of the above alternatives against the evaluation criteria, Alternative IV is selected as the preferred alternative. A summary of the rankings is presented in the table below.

Table 5-1: Summary of Alternatives Evaluation Process

Criteria	Alternative I	Alternative II	Alternative III	**Alternative IV**	Alternative V
Likelihood	1	2	3	**4**	1
Flexibility	1	3	2	**4**	4
Equitability	1	2	3	**4**	1
Timeliness	3	2	3	**3**	1
Total:	6	9	11	**15**	7

5.5 Economic Analysis

Water code section 13141 requires that prior to implementation of any agricultural water quality control program, an estimate of the total cost of such program and identification of sources of funding be indicated in the Basin Plan. The requirements of CWC Section 13141 apply to this Basin Plan amendment, as the proposed TMDL and program of implementation involve consideration of the potential impact on the DO impairment from agricultural discharges. The Porter Cologne Act does not specify the weight that must be given to economic considerations nor does it require that a formal cost benefit analysis be performed. Also, there are no requirements to speculate on potential costs as part of this assessment (Attwater, 1994).

Cost of Implementing Alternative I

As described in Section 5.3, this alternative consists of proceeding now with the development of a TMDL that allocates oxygen demand loading capacity only to point and non-point sources of oxygen demanding substances and their precursors. The allocations in this TMDL will be detailed mass load limits assigned to specific sources in the watershed based on current science and data.

Under this alternative, regulated point source and non-point source dischargers could be faced with potentially costly additional controls to remove oxygen demanding substances and their precursors. Without having developed specific limitations and identified specific discharges, the cost estimates for implementing this alternative would be speculative. Eventually these discharge controls would need to be funded by the owners of the facility, which would consist primarily of municipalities and agricultural dischargers.

Cost of Implementing Alternative II

As described in Section 5.3, this alternative consists of proceeding now with the development of a TMDL that allocates oxygen demand loading capacity only to point and non-point sources of oxygen demanding substances and their precursors. Detailed mass load limits assigned to specific sources in the watershed will be developed in a phased approach.

The costs of implementing this alternative are primarily associated with performing the studies required in the phased TMDL. As this alternative will be establishing allocations only to sources of oxygen demand and their precursors, an emphasis will be placed on studies that improve understanding of those particular linkages and associated mitigation measures. The following studies are planned during the phased TMDL:

- A three year field sampling effort is being organized with the purpose of identifying sources of oxygen demanding substances in the San Joaquin River watershed and understanding the mechanisms by which they are created and transformed as they flow downstream to the DWSC. The funding for this study will come in part from Proposition 13 bond funds that have been allocated for study of the DWSC DO impairment. The California Bay-Delta Authority administers contracts utilizing these funds and is currently in the process of establishing a contract for its execution. The total cost of this study is $7.9 million over three years, with $6.8 million coming from Proposition 13 bond funds and $1.1 million of matching funds from local stakeholders and in kind scientific effort on behalf of the principal investigators.

- The California Bay Delta Authority has also proceeded with two efforts to develop multi-dimensional water quality computer models of the DWSC and upstream segments of the San Joaquin River. The models will evaluate the collective impact of numerous mechanisms by which DO concentrations and other water quality parameters are influenced by varying environmental conditions (e.g. flow rates, temperature, seasons, etc.) in the watershed. The total costs of these modeling studies are nearly $1.4 million and are being funded by Proposition 13 bond funds.

- The California Bay Delta Authority has also proceeded with an effort to develop a study plan that identifies and prioritizes the needs for additional scientific studies and demonstration projects. The studies and demonstration projects identified in this study plan will be considered by the California Bay-Delta Authority in the development of their next round of proposal solicitations. This study is focused on understanding and mitigating both load related and non-load related contributing factors. The cost of this effort associated with load related factors only is approximately $50,000. The cost of the studies ultimately funded from this solicitation that will be completed in support of the phased TMDL are uncertain, but could be within the range of $5.0 million.

- A study into the sources of algae and the mechanisms controlling its growth are being undertaken in the San Luis Drain located in the upper San Joaquin River watershed. The funding for this study will come from Proposition 13 bond funds as administered by the SWRCB. The cost of this study is $146,000 over two years, with an additional $45,000 of match funds from the San Luis and Delta Mendota Water Authority.

- Numerous other studies relevant to understanding the sources of oxygen demanding substances and their precursors are being considered for funding as part of a recent SWRCB administered, Proposition 50 grant funding solicitation. Proposals have been submitted and screened, but the schedule for contracting and execution is uncertain at this time. An estimate of $1.0 million should be adequate to cover those relevant studies.

- Data from other studies and monitoring programs may also be useful in better understanding linkages and potential mitigation measures for the DO impairment. One such program is the ongoing Interagency Environmental Program being administered by the California Department of Water Resources per the requirements of SWRCB Water

Right Decision 1641. It collects water quality data at numerous locations in the Sacramento and San Joaquin Rivers and the Delta. Also, CVRWQCB Resolution No. R5-2003-0105 initiated another monitoring and reporting program focused specifically on agricultural discharges in the San Joaquin River watershed in 2003. The costs of data obtained from other monitoring programs (e.g. Irrigated Lands Program) would be at the expense of those programs and are not considered in this analysis.

The total estimated cost of the studies to be performed as part of the phased TMDL in Alternative II is approximately $15.6 million, with nearly $14.4 million coming from Proposition 13 and 50 bond funds and $1.2 million coming from watershed stakeholders. This estimate does not include the cost of data obtained from other study efforts in the watershed, for which funding already exists.

Data from all these studies may lead to more detailed wasteload and load allocations at a later date. The cost of control or mitigation measures that will eventually be required to address the impacts of the various sources of oxygen demanding substances and their precursors cannot be estimated until the studies have been completed and allocations have been established.

Cost of Implementing Alternative III

As described in Section 5.3, this alternative consists of proceeding now with the development of a TMDL that allocates oxygen demand loading capacity to point and non-point sources of oxygen demanding substances and their precursors after taking into account the impact of the two non-load related contributing factors of DWSC geometry and reduced DWSC flow. The allocations in this TMDL will be detailed mass load limits assigned to specific sources in the watershed based on current science and data.

Under this alternative, regulated point source and non-point source dischargers and entities responsible for the various non-load related contributing factors would be faced with the requirement of implementing controls to mitigate their impacts on the DO impairment based on current science. Without having developed the specific limitations nor having identified specific contributing factors, the cost estimates for implementing this alternative would be speculative. The discharge controls and other mitigation measures required would need to be funded by the entities responsible for those contributing factors.

Cost of Implementing Alternative IV

As described in Section 5.3, this alternative consists of proceeding now with the development of a TMDL that allocates oxygen demand loading capacity to point and non-point sources of oxygen demanding substances and their precursors after taking into account the impact of the two non-load related contributing factors of DWSC geometry and reduced DWSC flow. Detailed mass load limits assigned to specific sources in the watershed will be developed in a phased approach.

The costs associated with this alternative are the same as those for Alternative II, with the addition of costs associated with a planned aeration demonstration study. This is a two-phased project that starts with a small-scale feasibility study of different aeration technologies that may be effective in the DWSC. This first phase will also include design and deployment of a monitoring network to measure the impact of aeration on the DO concentrations. Once the preferred technologies are identified by the feasibility study, the next phase of the project will be the construction and operation of a large-scale demonstration project that will provide performance and cost information and begin to improve DO conditions in the DWSC.

The costs for the first phase of the aeration demonstration project are approximately $200,000 and have been initiated and funded by the California Bay-Delta Authority using Proposition 13 bond funds. The scope and design of the second phase of the project will be developed based on the findings of the ongoing feasibility study. The cost associated with the construction of the demonstration aerators will be highly variable depending on their scope and design, therefore, no estimate can be provided at this time.

The cost of operating, maintaining, and monitoring the aerators will be shared by various responsible entities whose contributing factors are determined appropriate for mitigation by aeration. An assurance agreement providing a commitment by these entities to provide the necessary resources is currently being negotiated. Such an agreement would need to be in place before the California Bay-Delta Authority could proceed with construction of the aerators. Based on some preliminary estimates of the magnitude of the oxygen deficits and oxygen and energy costs for a range of aeration technologies (Brown, 2002), the annual operating costs for the aeration demonstration project, including maintenance and monitoring, could be on the order of $200,000 per year.

Cost of Implementing Alternative V

As described in Section 5.3, this alternative consists of taking no action to develop a Basin Plan Amendment at this time.

There is no direct cost associated with the no-action alternative, although there are potential indirect costs associated with the continuing low DO concentrations and the impact that has on beneficial uses.

6 California Environmental Quality Act (CEQA) Review

6.1 Overview

The secretary of resources has certified the Basin Planning process as meeting the requirements of section 21080.5 of the California Environmental Quality Act (CEQA). As such, documents prepared in connection with the basin plan amendment may be substituted in lieu of an environmental impact report. These documents must include either alternatives to the activity and mitigation measures to reduce any significant or potentially significant effect that the project may have on the environment or a statement that the project would not have a significant impact on the environment. This statement must be supported by a checklist or other documentation that shows the possible effects that were considered when reaching the decision.

The following checklist was prepared in compliance with CEQA requirements and to assist in identifying potential impacts and outlining mitigation measures. The checklist is followed by discussion of each of the 17 categories of impact.

6.2 Environmental Checklist Form

1. Project title

Amendment to the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins for the San Joaquin River Dissolved Oxygen TMDL and Program of Implementation.

2. Lead agency name and address

California Regional Water Quality Control Board, Central Valley Region
11020 Sun Center Drive #200
Rancho Cordova, CA 95670-6114

3. Contact person and phone number

Mark Gowdy, Water Resources Control Engineer (916) 464-4717

4. Project location

San Joaquin River Watershed: the San Joaquin River from Friant Dam to Disappointment Slough

5. Project sponsor's name and address

California Regional Water Quality Control Board, Central Valley Region
11020 Sun Center Drive #200
Rancho Cordova, CA 95670-6114

6. General plan designation

Not applicable

7. Zoning

Not applicable

8. Description of project

The Central Valley Regional Water Quality Control Board (CVRWQCB) is proposing to amend the Water Quality Control Plan (Basin Plan) for the Sacramento River and San Joaquin River Basins. The purposes of the proposed amendment are 1) to describe the approach by which wasteload and load allocations for oxygen demanding substances and their precursors will be determined and 2) to describe the actions that will be taken to eventually meet the Basin Plan water quality objectives.

9. Surrounding land uses and setting

The areas impacted by this basin plan amendment include the San Joaquin River watershed downstream of Friant Dam and upstream of the San Joaquin River at the confluence with Disappointment Slough northwest of Stockton. The boundary of this area, clockwise from the confluence with Disappointment Slough, is formed by Disappointment Slough and Pixley Slough to the Thornton Road bridge over Pixley Slough. At this location, the land is near sea level and the boundary becomes a natural drainage formed by Thornton Road north to Eightmile Road. Eightmile Road forms the boundary from this intersection east to its crossing with the Western Pacific Railroad rail. The boundary becomes this rail line northwest for just over a mile to a location where the rail crosses an unnamed canal. The boundary becomes this canal east about two and a quarter miles to West Lane where the canal intersects with Pixley Slough. Here the boundary briefly becomes West Lane to where it crosses Main Canal. Main Canal then becomes the boundary north from that location to the Mokelumne River, from which the canal is diverted. From this location, the boundary becomes the natural topographic drainage divide separating the Mokelumne River upstream of Main Canal from surrounding watersheds to where the divide intersects the San Joaquin County line.

The east boundary of the area of is formed by the eastern edge of the San Joaquin, Stanislaus, and Merced County lines. Where the Merced County line meets the Madera County line, the boundary becomes the CalWater boundary until it reaches the San Joaquin River at Friant Dam.

The southern boundary is formed by the San Joaquin River to the Mendota Pool. Here the boundary becomes the southern edge of Calwater RBUASPW areas 654120000 (Los Banos Hydrologic Area), 654241052, 654241053, and 654241054. Where 654241054 meets San Benito County, the border becomes the county line north of that location.

The eastern boundary of San Benito County and the western edges of Merced, Stanislaus, and a portion of San Joaquin counties forms the western boundary. Though some water in the project area does originate in San Benito County, it is excluded because the water from this region does not significantly impact the affected water bodies. Western Merced and Stanislaus counties and the southwestern boundary of San Joaquin County were chosen because the county lines are coincident with the crest of the Coast Range.

The southern boundary of the Marsh Creek watershed in the northern reaches of the Coast Range near Danville forms the beginning of the northern edge of the boundary of the project area. This drainage boundary forms this region of the project area to the intersection with Contra Costa Canal. At this location, Contra Costa Canal becomes the boundary to where it spills into (diverted from?) Rock Slough. Here the land is below sea level and Rock Slough becomes the boundary to Old River, which then becomes the boundary north to Connection Slough. Connection Slough forms the boundary from this location to Middle River. Middle River then becomes the boundary to Columbia Cut, which forms the boundary between Middle River and the San Joaquin River and empties to the San Joaquin River just across the river from Disappointment Slough. The land uses in the area include agriculture, wetlands, and urban.

10. Other public agencies whose approval is required

State Water Resources Control Board
Office of Administrative Law
U.S. Environmental Protection Agency

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.

- ☐ Aesthetics
- ☐ Hazards & Hazardous Materials
- ☐ Public Services
- ☐ Agriculture Resources
- ☐ Hydrology/Water Quality
- ☐ Recreation
- ☐ Air Quality
- ☐ Land Use Planning
- ☐ Biological Resources
- ☐ Mineral Resources
- ☐ Utilities/Service Systems
- ☐ Cultural Resources
- ☐ Noise
- ☐ Mandatory Findings of Significance
- ☐ Geology/Soils
- ☐ Transportation/Traffic

DETERMINATION:
On the basis of this initial evaluation:

☒ I find that the Proposed Project COULD NOT have a significant effect on the environment, and a NEGATIVE DECLARATION will be prepared.

☐ I find that although the Proposed Project could have a significant effect on the environment, there will not be a significant effect in this case because revisions in the Project have been made by or agreed to by the Project proponent. A MITIGATED NEGATIVE DECLARATION will be prepared.

☐ I find that the Proposed Project MAY have a significant effect on the environment, and an ENVIRONMENTAL IMPACT REPORT is required.

☐ I find that the Proposed Project MAY have a "potentially significant impact" or "potentially significant unless mitigated" impact on the environment, but at least one effect: 1) has been adequately analyzed in an earlier document pursuant to applicable legal standards, and 2) has been addressed by mitigation measures based on the earlier analysis as described on attached sheets. An ENVIRONMENTAL IMPACT REPORT is required, but it must analyze only the effects that remain to be addressed.

☐ I find that although the Proposed Project could have a significant effect on the environment because all potentially significant effects (a) have been analyzed adequately in an earlier EIR or NEGATIVE DECLARATION pursuant to applicable standards, and (b) have been avoided or mitigated pursuant to that earlier EIR or NEGATIVE DECLARATION, including revisions or mitigation measures that are imposed upon the Proposed Project, nothing further is required.

____________________________ ____________________
Signature Date

Dennis Westcot, Environmental Program Mgr.
Printed Name

Cal. Regional Water Quality Control Board
Central Valley Region

EVALUATION OF ENVIRONMENTAL IMPACTS

This Environmental Checklist has been prepared in compliance with the requirements of CEQA relating to certified regulatory programs.

IMPACT	POTENTIALLY SIGNIFICANT IMPACT	POTENTIALLY SIGNIFICANT UNLESS MITIGATION INCORPORATION	LESS THAN SIGNIFICANT IMPACT	NO IMPACT
I. AESTHETICS Would the Project:				
a) Have a substantial adverse effect on a scenic vista?	☐	☐	☐	☒
b) Substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway?	☐	☐	☐	☒
c) Substantially degrade the existing visual character or quality of the site and its surroundings?	☐	☐	☐	☒
d) Create a new source of substantial light or glare which would adversely affect day or nighttime views in the area?	☐	☐	☐	☒
II. AGRICULTURE 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) prepared by the California Department of Conservation as an optional model to use in assessing impacts on agriculture and farmland. 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) Involve other changes in the existing environment which, due to their location or nature, could result in conversion of Farmland, to non-agricultural use?	☐	☐	☐	☒
III. AIR QUALITY – Where available, the significance criteria established by the applicable air quality management or air pollution control the District may be relied upon 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)?	☐	☐	☐	☒

IMPACT	POTENTIALLY SIGNIFICANT IMPACT	POTENTIALLY SIGNIFICANT UNLESS MITIGATION INCORPORATION	LESS THAN SIGNIFICANT IMPACT	NO IMPACT
d) Expose sensitive receptors to substantial pollutant concentrations?	☐	☐	☐	☒
e) Create objectionable odors affecting a substantial number of people?	☐	☐	☐	☒
IV. BIOLOGICAL RESOURCES – Would the Project:				
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 regulators, or by the California Department of Fish and Game or U.S. Fish and Wildlife Service?	☐	☐	☐	☒
b) Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, regulations or by the California Department of Fish and Game or US fish and Wildlife Service?	☐	☐	☐	☒
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?	☐	☐	☐	☒
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 nursery sites?	☐	☐	☐	☒
e) Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance?	☐	☐	☐	☒
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?	☐	☐	☐	☒
V. CULTURAL RESOURCES – Would the Project:				
a) Cause a substantial adverse change in the significance of a historical resource as defined in §15064.5?	☐	☐	☐	☒
b) Cause a substantial adverse change in the significance of an archaeological resource pursuant to §15064.5?	☐	☐	☐	☒
c) Directly or indirectly destroy a unique paleontological resource of site or unique geological feature?	☐	☐	☐	☒
d) Disturb any human remains, including those interred outside of formal cemeteries?	☐	☐	☐	☒

IMPACT	POTENTIALLY SIGNIFICANT IMPACT	POTENTIALLY SIGNIFICANT UNLESS MITIGATION INCORPORATION	LESS THAN SIGNIFICANT IMPACT	NO IMPACT
VI. GEOLOGY AND SOILS – Would the Project:				
a) Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:	☐	☐	☐	☒
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 Division of Mines and Geology Special Publication 42.	☐	☐	☐	☒
ii) Strong seismic ground shaking?	☐	☐	☐	☒
Iii) Seismic-related ground failure,, including liquefaction?	☐	☐	☐	☒
iv) Landslides?	☐	☐	☐	☒
b) Result in substantial soil erosion or the loss of topsoil?	☐	☐	☐	☒
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?	☐	☐	☐	☒
d) Be located on expansive soil, as defined in Table 18-1-B of the Uniform building Code (1994), creating substantial risks to life or property?	☐	☐	☐	☒
VII. HAZARDS AND HAZARDOUS MATERIALS – Would the Project:				
a) Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials?	☐	☐	☐	☒
b) Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment?	☐	☐	☐	☒
c) Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school?	☐	☐	☐	☒
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?	☐	☐	☐	☒
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?	☐	☐	☐	☒

IMPACT	POTENTIALLY SIGNIFICANT IMPACT	POTENTIALLY SIGNIFICANT UNLESS MITIGATION INCORPORATION	LESS THAN SIGNIFICANT IMPACT	NO IMPACT
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?	☐	☐	☐	☒
g) Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan?	☐	☐	☐	☒
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?	☐	☐	☐	☒
VIII. HYDROLOGY AND WATER QUALITY – Would the Project:				
a) Violate any water quality standards or waste discharge requirements?	☐	☐	☐	☒
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 preexisting nearby wells would drop to a level which would not support existing land uses or planned uses for which permits have been granted?	☐	☐	☐	☒
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 erosion or siltation on- or off-site?	☐	☐	☐	☒
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 results in flooding on- or off-site?	☐	☐	☐	☒
e) Create or contribute runoff water which exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff?	☐	☐	☐	☒
f) Otherwise substantially degrade water quality?	☐	☐	☐	☒
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?	☐	☐	☐	☒
h) Place within a 100-year flood hazard area structures which would impede or redirect flood flows?	☐	☐	☐	☒
i) Expose people or structures to a significant risk of loss, injury or death involving flooding,	☐	☐	☐	☒

IMPACT	POTENTIALLY SIGNIFICANT IMPACT	POTENTIALLY SIGNIFICANT UNLESS MITIGATION INCORPORATION	LESS THAN SIGNIFICANT IMPACT	NO IMPACT
including flooding as a result of the failure of a levee or dam?				
j) Inundation by seiche, tsunami, or mudflow?	☐	☐	☐	☒
IX. 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 the 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?	☐	☐	☐	☒
X. MINERAL RESOURCES – Would the Project:				
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?	☐	☐	☐	☒
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?	☐	☐	☐	☒
XI. 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 applicable standards of other agencies?	☐	☐	☐	☒
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?	☐	☐	☐	☒
XII. POPULATION AND HOUSING – Would the Project?				
a) Induce substantial population growth in an	☐	☐	☐	☒

IMPACT	POTENTIALLY SIGNIFICANT IMPACT	POTENTIALLY SIGNIFICANT UNLESS MITIGATION INCORPORATION	LESS THAN SIGNIFICANT IMPACT	NO IMPACT
area, either directly (for example, by proposing new homes and businesses) or indirectly (for example, through extension of roads or other infrastructure)?				
b) Displace substantial numbers of existing housing, necessitating the construction of replacement housing elsewhere?	☐	☐	☐	☒
c) Displace substantial numbers of people, necessitating the construction of replacement housing elsewhere?	☐	☐	☐	☒
XIII. PUBLIC SERVICES				
a) Would the Project result in substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, 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?	☐	☐	☐	☒
XIV. RECREATION				
a) Would the Project 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) Does the Project include recreational facilities or require the construction or expansion of recreational facilities which might have an adverse physical effect on the environment?	☐	☐	☐	☒
XV. TRANSPORTATION/TRAFFIC – Would the Project:				
a) Cause an increase in traffic which is substantial in relation to the existing traffic load and capacity of the street system (i.e., result in a substantial increase in either the number of vehicle trips, the volume to capacity ratio to roads, or congestion at intersections?	☐	☐	☐	☒
b) Exceed, either individually or cumulatively, a level of service standard established by the county congestion/management agency for designated roads or highways?	☐	☐	☐	☒
c) Result in a change in air traffic patterns,	☐	☐	☐	☒

IMPACT	POTENTIALLY SIGNIFICANT IMPACT	POTENTIALLY SIGNIFICANT UNLESS MITIGATION INCORPORATION	LESS THAN SIGNIFICANT IMPACT	NO IMPACT
including either an increase in traffic levels or a change in location that results in substantial safety risks?				
d) Substantially increase hazards due to a design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment)?	☐	☐	☐	☒
e) Result in inadequate emergency access?	☐	☐	☐	☒
f) Result in inadequate parking capacity?	☐	☐	☐	☒
g) Conflict with adopted policies, plans, or programs supporting alternative transportation (e.g., bus turnouts, bicycle racks)?	☐	☐	☐	☒
XVI. UTILITIES AND SERVICE SYSTEMS – Would the Project?				
a) Exceed wastewater treatment requirements of the applicable Regional Water Quality Control Board?	☐	☐	☐	☒
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?	☐	☐	☐	☒
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?	☐	☐	☐	☒
d) Have sufficient water supplies available to serve the Project from existing entitlements and resources, or are new or expanded entitlements needed?	☐	☐	☐	☒
e) Result in a determination by the wastewater treatment provider which 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?	☐	☐	☐	☒
f) Be served by a landfill with sufficient permitted capacity to accommodate the Project's solid waste disposal needs?	☐	☐	☐	☒
g) Comply with federal, state, and local statutes and regulations related to solid waste?	☐	☐	☐	☒
XVII. MANDATORY FINDINGS OF SIGNIFICANCE				
a) Does the Project have the potential to 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 a rare or endangered plant or animal or eliminate important examples of the major periods of California history or prehistory?	☐	☐	☐	☒

IMPACT	POTENTIALLY SIGNIFICANT IMPACT	POTENTIALLY SIGNIFICANT UNLESS MITIGATION INCORPORATION	LESS THAN SIGNIFICANT IMPACT	NO IMPACT
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 probably future projects)?	☐	☐	☐	☒
c) Does the Project have environmental effects which will cause substantial adverse effects on human beings, either directly or indirectly?	☐	☐	☐	☒

THRESHOLDS OF SIGNIFICANCE

For the purposes of making impact determinations, potential impacts were determined to be significant if the proposed project, or its alternatives would result in changes in environmental condition that would, either directly or indirectly, cause a substantial loss of habitat or substantial degradation of water quality or other resources.

6.3 Discussion of Environmental Impacts

Analysis of potential environmental impacts is based on possible changes to water and drainage management practices to comply with the proposed regulations. Potential practices are described in Section 4.4.2 and Appendix 2. Expanded discussion is included only for checklist questions answered Potentially Significant Impact, Less than Significant with Mitigation Incorporation, or Less than Significant Impact.

I. Aesthetics

Possible changes to water and drainage management practices by agricultural and wetland dischargers to comply with the proposed regulations would not alter any scenic vistas, damage scenic resources, degrade the visual character of any site, or adversely affect day or nighttime views.

II. Agricultural Resources

The project would not convert farmland to non-agricultural uses as no changes to land use designations are being sought. Agricultural dischargers may eventually use a variety of water and drainage management practices or other potential strategies to comply with the proposed Basin Plan Amendment. Such practices are unlikely to lead to conversion of farmland to non-agricultural uses. Any facilities constructed to comply with the provisions of the proposed Basin Plan Amendment are considered as appurtenant to agricultural operations and therefore an agricultural use. Furthermore, agricultural dischargers have a wide range of options available to comply with the proposed Basin Plan Amendment. Management practices employed to comply with the proposed Basin Plan Amendment may occur at the farm scale, district scale, or basin-wide scale. Specific projects implemented to comply with the proposed regulation would need to be evaluated by the implementing entity, as necessary.

III. Air Quality

Possible changes to water and drainage management practices would not have any affect on air quality.

IV. Biological Resources

The purpose of the proposed Basin Plan Amendment is implementation of a program to eventually bring San Joaquin River into compliance with existing Basin Plan DO water quality objectives. It is anticipated that the studies needed initially will not have an impact on biological resources and that the eventual mitigation measures employed by the various responsible entities to comply with the proposed TMDL and program of implementation would, in fact, result in improved conditions for aquatic biota in the Stockton DWSC. Before any projects are implemented to improve DO conditions in the DWSC, detailed environmental impact analysis and mitigation of any potential negative impacts on biological resources would need to be performed in conjunction with those projects.

Portions of the TMDL project area are located within the known range of the Fall/Late Fall-run Chinook Salmon; however, adverse impacts to this federal candidate species (also a state Species of Concern) are not expected as a result of the proposed project.

V. Cultural Resources

Implementation of the proposed Basin Plan Amendment would not likely to affect cultural resources.

VI. Geology and Soils

Implementation of the proposed Basin Plan Amendment would not affect the geology of the region and would not expose people to additional geologic hazards. Water and drainage management practices implemented by agricultural dischargers to comply with the proposed regulation may, in fact, reduce soil erosion and loss of topsoil that is occurring in the project area.

VII. Hazards and Hazardous Materials

Implementation of the proposed Basin Plan Amendment would not create hazards or affect handling of hazardous materials.

VIII. Hydrology and Water Quality

The purpose of the proposed Basin Plan Amendment is implementation of a program to eventually bring San Joaquin River into compliance with existing Basin Plan DO water quality objectives. It is anticipated that the studies needed initially will not have an impact on hydrology and water quality and that the eventual mitigation measures employed by the various responsible entities to comply with the proposed TMDL and program of implementation would, in fact, result in improved water quality.

Implementation of the proposed Basin Plan Amendment is not likely to result in violation of water quality standards or waste discharge requirements or deplete groundwater supplies. Implementation of the proposed regulation is unlikely to affect stormwater drainage systems, provide additional sources of polluted runoff, substantially degrade water quality, have an affect on flood flows, or increase the chance of inundation by seiche, tsunami, or mudflow. Specific projects implemented to comply with the proposed regulation would need to be evaluated for its affects on hydrology and water quality by the implementing entity, as necessary.

IX. Land Use and Planning

Implementation of the proposed Basin Plan Amendment should not result in any changes in land use or planning (see section II above for discussion of Agricultural Resources).

X. Mineral Resources

Implementation of the proposed Basin Plan Amendment should have no effect on mineral resources.

XI. Noise

Agricultural and wetland dischargers would likely make changes to their water and drainage management practices to comply with the proposed regulations. These practices, such as those described in Appendix 2 should not lead to any increase in exposure to noise

XII. Population and Housing

Implementation of the proposed Basin Plan Amendment would not directly or indirectly induce population growth in the area, displace existing housing, or displace people.

XII. Public Services

The proposed Basin Plan Amendment would not have an impact on public services.

XIV. Recreation

There should be no increase in use of parks or recreational facilities or the need for new or expanded recreational facilities as a result of this proposed Basin Plan Amendment.

XV. Transportation/Traffic

The proposed Basin Plan Amendment would not have an impact on transportation or traffic.

XVI. Utilities and Service Systems

The proposed Basin Plan Amendment do not include new limits on loads of oxygen demanding substances or their precursors from wastewater treatment plants or stormwater discharges at this time. Likewise, no new limits are proposed at this time for agricultural and wetland dischargers. Studies performed as part of the phased implementation approach, however, may lead to such limitations in future Basin Plan Amendments or other regulatory actions by the CVRWQCB or the SWRCB.

XVII. Mandatory Findings of Significance

The purpose of the proposed Basin Plan Amendment is to implement existing DO water quality objectives through general wasteload and load allocations and a program of additional study and demonstration projects eventually leading to the implementation of mitigation measures. Implementation of the proposed Basin Plan Amendment would therefore likely result in improved quality of the environment with respect to improved DO concentrations in the San Joaquin River. Future Basin Plan Amendments will establish new wasteload and load allocations and other actions as needed. Other Basin Plan Amendments will likely establish new water quality objectives for other pollutants such as pesticides and other control programs to comply with new or existing objectives. The cumulative impacts of these additional regulations will be evaluated at the time of these future Basin Plan Amendments.

STATEMENT OF OVERRIDING CONSIDERATION

A statement of overriding considerations must be made when an agency approves a project that will result in significant impacts. The statement of overriding considerations justifies why the agency is approving the project even though significant impacts have been identified (CEQA Guidelines Section 1603).

The environmental analysis contained in this Basin Plan Amendment staff report and the Environmental Checklist contained therein does not identify any direct significant impacts of the proposed project on the environment.

7 Public Participation and Agency Consultation

Dissolved Oxygen TMDL Steering Committee

In April 1999, the CVRWQCB approved the Regional Bay Protection & Toxic Cleanup Plan (BPTCP), which outlined formation of a Steering Committee consisting of representatives from various agricultural, municipal and environmental stakeholder groups (CVRWQCB, 1999). The BPTCP gave the Steering Committee the opportunity to suggest its own load allocation and implementation plan to CVRWQCB staff for consideration in the development of the TMDL and program of implementation. Staff worked with the Steering Committee to formulate a phased approach that addresses the realistic need for more time to gather additional information on certain sources and linkages to the DO impairment, while at the same time moving forward on making improvements to DO conditions in the DWSC. Also, more information is needed on performance and cost information for possible mitigation alternatives to bringing the DWSC into compliance with the Basin Plan DO objectives. A report summarizing the Steering Committee recommendations for a TMDL program of implementation was submitted to staff on 4 February 2003 (Ploss, 2003). The Steering Committee chose not to recommend a TMDL load allocation.

Basin Plan Amendment Public Process

A technical TMDL report was released for public review in June 2003 and staff solicited informal comments from the public and affected agencies at that time. CVRWQCB staff also held workshop in December 2003 to inform the public and interested parties of the beginning of the public Basin Plan Amendment process for the DO TMDL and to explain the methods and assumptions used to develop the TMDL. This workshops was held to seek public input regarding the development of the TMDL.

This staff report is in support of a CVRWQCB workshop that is being held during the Basin Planning phase of TMDL development to provide additional opportunity for public input. Based on comments received in association with this workshop, a draft final version of the Basin Plan Amendment will be prepared and a formal 30-day comment period on the technical TMDL and the implementing Basin Plan amendment will be provided prior to CVRWQCB consideration of the amendment. The CVRWQCB will ultimately need to consider adoption of the proposed

Basin Plan amendment during a separate public hearing thus, providing another opportunity for public comment.

With regard to agency consultation the SWRCB regulations (23 CFR 3778) state that:

> *Upon completion of the written report, the board shall consult with other public agencies having jurisdiction by law with respect to the proposed activity and should consult with persons having special expertise with regard to the environmental effects involved in the proposed activity. The board may consult with such persons by transmitting a copy of the written report or by other appropriate means.*

Agency consultation shall occur when this staff report is circulated for public review and comment. A written response to any comments containing significant environmental points raised during the evaluation process will be prepared and made available to the public pursuant to the regulations at 23 CFR 3779.

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