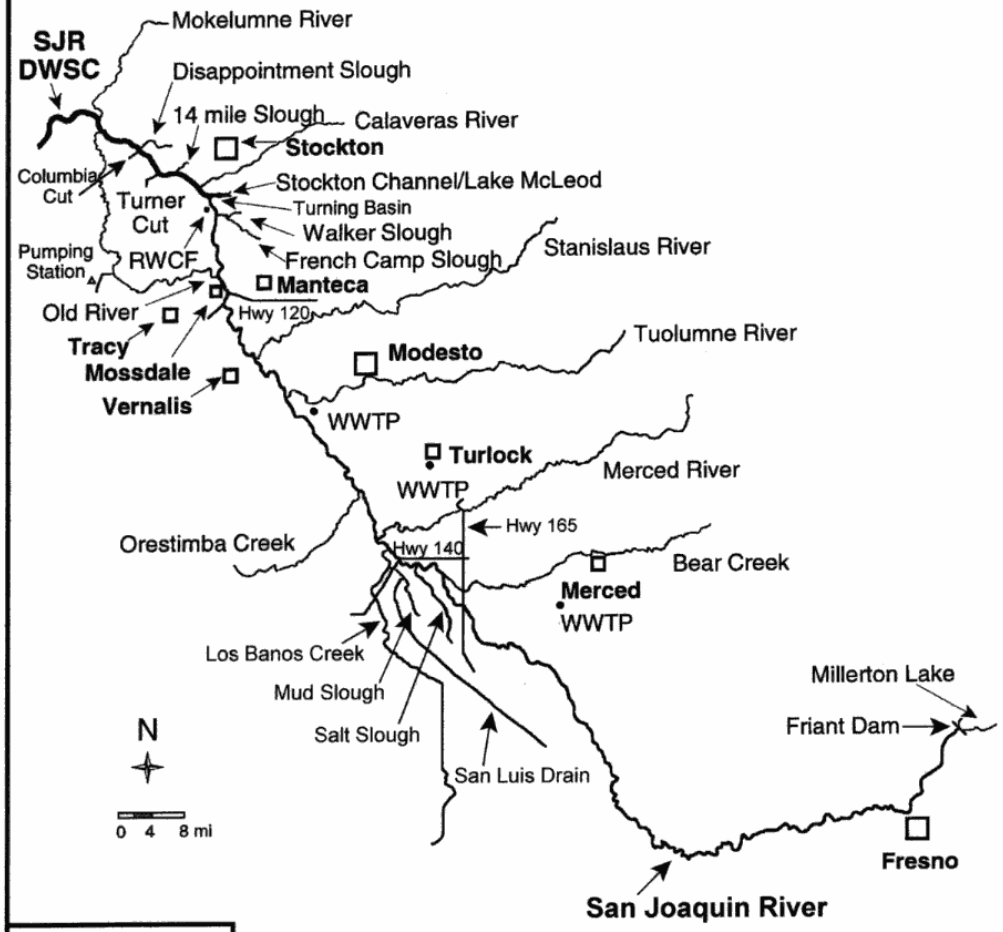
An Integrated Approach for TMDL Development for Agricultural Stormwater Runoff, Tailwater Releases & Subsurface Drainwater Discharges

G. Fred Lee, PhD, PE, DEE & Anne Jones-Lee, PhD
G. Fred Lee & Associates
El Macero, CA
(www.gfredlee.com)

Topics

- Irrigated Agriculture in the San Joaquin River Watershed Faces Achieving Compliance with about 15 TMDLs
- Review Characteristics of These TMDLs
  - Issues That Should Be Considered in Implementation
    - Appropriate Listing and TMDL Targets
  - Integrated Sampling
  - Evaluation of Water Quality Significance of Exceedance of Water Quality Objectives
- Recommended Approach for Addressing TMDLs

San Joaquin River Deep Water Ship Channel Watershed



(Anne Jones-Lee, 2000)

San Joaquin River Watershed TMDLs

- Current TMDLs
  - Selenium
  - Salinity, Total Dissolved Solids
  - Boron
  - OP Pesticides (Diazinon, Chlorpyrifos)
  - Oxygen-Demanding Substances
    (BOD, Ammonia, Organic N)

San Joaquin River Watershed TMDLs

- Pending TMDLs
  - Organochlorine Pesticides (DDT, Chlordane, Dieldrin, Toxaphene, etc.)
  - PCBs
  - Mercury
  - Unknown-Caused Toxicity
  - Toxicity to Algae (Herbicides)

San Joaquin River Watershed TMDLs

- Potential Future TMDLs
  - Nutrients, Excessive Fertilization (Nitrogen & Phosphorus Compounds)
  - High pH, Low DO Caused by Excessive Fertilization (Photosynthesis)
  - Alternative Pesticides to OP Pesticides
  - Total Organic Carbon, Trihalomethanes in Domestic Water Supplies
  - Excessive Sediment, Erosion, Turbidity
  - Pathogen-Indicator Organisms, E. coli
  - Sediment Toxicity, Pesticides, Nutrients / Algae / Sediment Ammonia
  - Temperature (?)
  - Dioxins / Furans, Combustion Residues (?)

Origin of TMDLs

- 1972 Revisions of the Federal Water Pollution Control Act (“Clean Water Act” - CWA) Required US EPA to Develop Water Quality Criteria (WQC) to Protect Beneficial Uses of the Nation’s Waters
- US EPA WQC to Be Used by States as Basis for State Water Quality Standards (WQS, WQO)
- Exceedance of a WQS in Ambient Waters Leads to CWA 303(d) Listing of Waterbody as “Impaired”
- Must Eliminate the Violation of the WQS through TMDL Process

Purpose of CWA Water Pollution Control Program

- Enhance Designated Beneficial Uses Where They Are Degraded
- Protect Designated Beneficial Uses of Waters

- Beneficial Uses of Waterbodies Designated in the 1970s
  - Domestic Water Supply
  - Agricultural Water Supply
  - Recreation
  - Fish & Aquatic Life (Numbers, Types & Characteristics of Aquatic Life in Water Column & Sediment)

Approach to Regulating Water Quality

- US EPA Adopted Chemical-Concentration-Based Approach for Regulating Water Quality
  - Exceedance of a Chemical Concentration WQS
    - No More Than 1 Exceedance of a WQS by Any Amount in 3-yr Period
  - Often Poor Relationship between Exceedance of WQS / WQO and Impairment of Beneficial Use

Approach to Regulating Water Quality

- Chemical Concentration-Based Regulatory Approach
  - Easy to Administer
  - Frequently Overly Protective Resulting in Unnecessary Expenditure for Unnecessary Control of Chemical Constituents
  - Can Also Provide Inadequate Protection
- Should Focus on Impacts of Chemicals on Beneficial Uses Rather Than on Concentrations
  - Potential Pollutants vs Real Pollutants (Cause Beneficial-Use Impairment)
  - Should Distinguish between “Potential” and “Real” Pollutants to Avoid Over-Regulation

First Step in TMDP Process
Should Be Evaluation of Reliability of 303(d) Listing

- US EPA WQC Designed to Be Protective under All Conditions
- US EPA WQC & State WQS / WQO Based on Worst-Case (Most Adverse) Assumptions
  - 100% Availability of Forms of Potential Pollutants
  - Extended Duration of Exposure to Chemical
- Many Chemicals Exist in Aquatic Systems in Variety of Chemical Forms, Only Some of Which Are Adverse to Water Quality / Beneficial Uses
  - Especially True for Agriculture-Derived Chemicals
  - Toxicity / Availability of Potential Pollutant Depends on Characteristics of Source & Receiving Water
  - Need to Incorporate Current Information on Aquatic Chemistry, Toxicology & Biology into Implementation of CWA

Site-Specific Adjustment

- In 1980s, US EPA Understood & Provided Opportunity for Site-Specific Adjustment of WQCs and WQSs
  - Failure to Make Such Adjustments Leads to Inappropriate 303(d) Listing of Waterbodies & Unreliable TMDL Targets
    - Over-Regulation & Unnecessary Expenditures for Control of Chemical Constituents
  - Site-Specific Adjustment of WQC / WQS Needs to Be Funded by Regulated Community with Possible Support from Federal & State Governments

Example Areas of Potential Over-Protection in San Joaquin River (SJR) TMDLs

- OP Pesticides (Diazinon / Chlorpyrifos)
  - Toxicity to Limited Types of Lower Forms of Aquatic Life (Some Zooplankton)
    - What Effect Does the Killing of Water Fleas over Short Duration Associated with Stormwater Runoff Event Have on Game Fish Production?
    - Alternative Pesticides More Toxic
- Toxicity to Algae
  - What Is Water Quality Significance of Algal Toxicity Caused by Herbicides?
  - What Is Significance of Algal Toxicity in SJR Watershed & Delta to Water Quality / Beneficial Uses?
    - Excessive Algae Present in SJR

Example Areas of Potential Over-Protection in San Joaquin River (SJR) TMDLs

- Nutrients – Nitrogen & Phosphorus Compounds
  - No Evidence of Adverse Impacts of Nutrients in SJR Watershed Upstream of DWSC
  - Application of US EPA Nutrient Criteria Could Cause Agriculture to Spend Large Amounts of Money for Nutrient Control with Little Improvement in Water Quality
    - Detrimental to Delta Fisheries
- Total Organic Carbon (TOC) – Drinking Water THMs
  - May Be More Cost-Effective to Treat Drinking Water at Treatment Works to Control TOC / THMs Than To Try to Control TOC in Agricultural & Wetlands Runoff / Discharges

San Joaquin River Water Waterbodies with Excessive OCl Residues in Fish

Based on 1997 – 2000 Organism Tissue Data
& OEHHA Screening Values

Location	DDT	Dieldrin	Chlordane	Toxaphene	PCBs
San Joaquin River @ Hwy 99	?	?	?	?	?
San Joaquin River @ Lander Ave	?	X	?	?	?
Mud Slough	X	X	?	X	X
Salt Slough	x?	x?	?	x?	?
Merced River	X	X	?	X	X
San Joaquin River @ Crow's Landing	?	?	?	?	?
Orestimba Creek	x?	x?	?	x?	?
Spanish Grant Drain	x?	?	?	x?	x?
Olive Avenue Drain	--	--	--	--	--
Turlock Irrigation District, Lateral #5	?	?	?	?	?
Del Puerto Creek	x?	?	?	?	?
Ingram Creek	--	--	--	--	--
Hospital Creek	--	--	--	--	--
Lower Tuolumne River	X	X	?	X	X
Stanislaus River	X	x?	?	x?	X
San Joaquin River @ Vernalis	X	X	X	X	X

◄ KEY ►		X	Exceedance
?	Lower Analytical Detection Limit Greater Than Screening Value	x?	Past Exceedance; No Recent Data
--	No Measurement Made but High Concentration in Water	?	No Exceedance

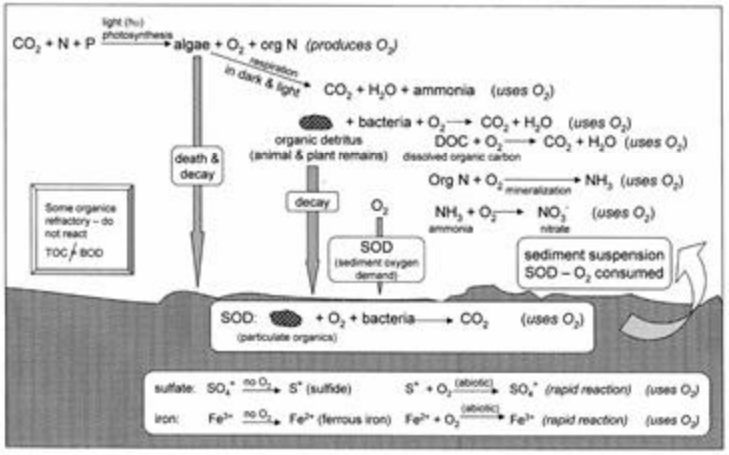
Example Areas of Potential Over-Protection in San Joaquin River (SJR) TMDLs

- SJR Deep Water Ship Channel (DWSC) DO Issues
  - Low DO in DWSC
  - Oxygen Demand Sources Include
    - City of Stockton Ammonia
    - Nutrients (N&P) That Grow Algae in SJR Watershed That, in Turn, Are Transported into DWSC Where They Die & Then Decompose and Consume Oxygen
  - Only Small Part of N & P Discharged in Agricultural Tailwater & Subsurface Drains Becomes Algae That Exert an Oxygen Demand in DWSC

Synthesis of Findings on the Causes and Factors Influencing Low DO in the San Joaquin River Deep Water Ship Channel near Stockton, CA

G. Fred Lee, PhD, DEE & Anne Jones-Lee, PhD
G. Fred Lee & Associates
El Macero, CA

Report to SJR Steering Committee and CALFED
October 2002



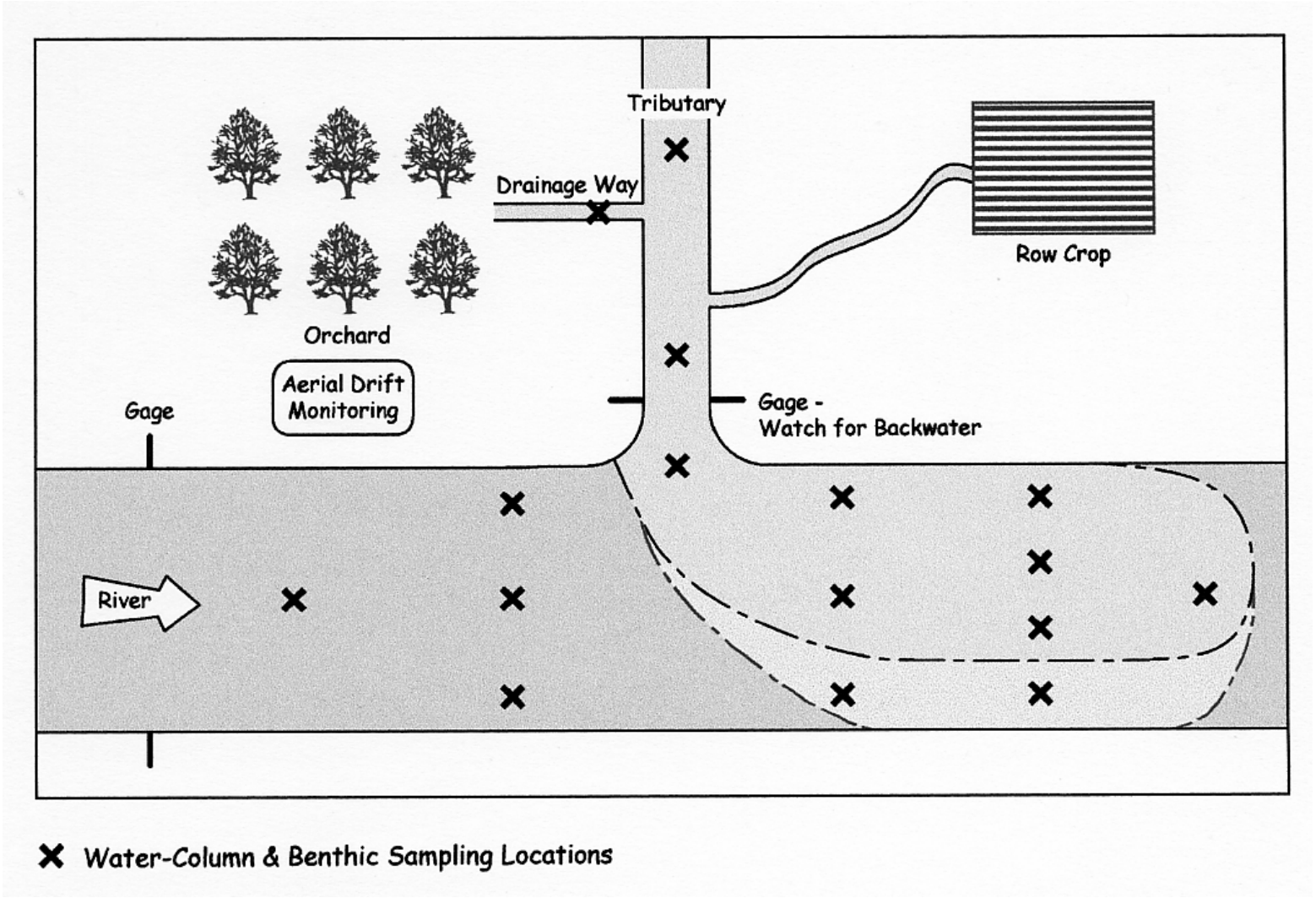
Conceptual Model of DO Depletion Reactions in SJR DWSC

Agricultural Waiver Issues

CVRWQCB September 7, 2001 Resolution No. 5-01-236 *"Control of Discharges from Irrigated Lands"*

- Increased Water Quality Monitoring of Agricultural Drains & Agriculture-Dominated Waterbodies
  - Will Focus on:
    - Aquatic Life Toxicity / Pesticides
    - Nutrients
    - Suspended Sediments / Turbidity

Agriculture Issues



Agricultural Waiver Issues

- Monitoring Agricultural Drain Mouth vs Edge of Field
  - Agricultural Drain Beneficial Uses?
    - Tributary Rule
  - “Waters of the State”
- Agricultural Waiver Water Quality Monitoring Could Lead to Designation of Large Number of New “303(d)-Listed” Waterbodies for Agricultural Derived Chemical Constituents

Recommended Approach

- Should Use Evaluation Monitoring to Define Impact of Chemicals Derived from Agricultural Activities on Beneficial Uses of Waterbodies
- Agricultural Communities Should Work with Regulatory Agencies, Environmental Groups & Public to Properly Implement TMDLs That Are Designed to Control Chemical Constituents in Irrigated Agricultural Runoff / Discharges
- Need to Develop Cooperative, Integrated Program of Water Quality Monitoring & Water Quality / Beneficial Use Impact Assessment
  - Will Require Funding from Federal and/or State Government