CALFED Independent Science Board

Water Quality Indicators
February 21, 2007

part 1: Overview
Ecosystem and Human Health

Water Quality Indicators - Overview

Review of draft Phase 1 Report (Sept. 2006)

- Base indicators on Program goals and *quantifiable* objectives
- Cover full range of beneficial uses
- Limited set of outcome indicators

Update: main work plan elements

- Evaluate a suite of water quality parameters
- Select indicators for causal factors (“driver”), intermediate outcomes, and “system outcomes”
- Incorporate monitoring

Questions and discussion

Indicators derive from Program goals and objectives

Provide good water quality for all beneficial uses.

Program Mission Statement

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Program Water Quality Goals for Ecosystem and Human Health

• Eliminate, to the extent possible, toxic impacts to aquatic organisms, wildlife and people.

• Improve and/or maintain water and sediment quality conditions that fully support healthy and diverse aquatic ecosystems in the Bay-Delta estuary and watershed. *Ecosystem Restoration Program, Goal 6.*

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Objectives:

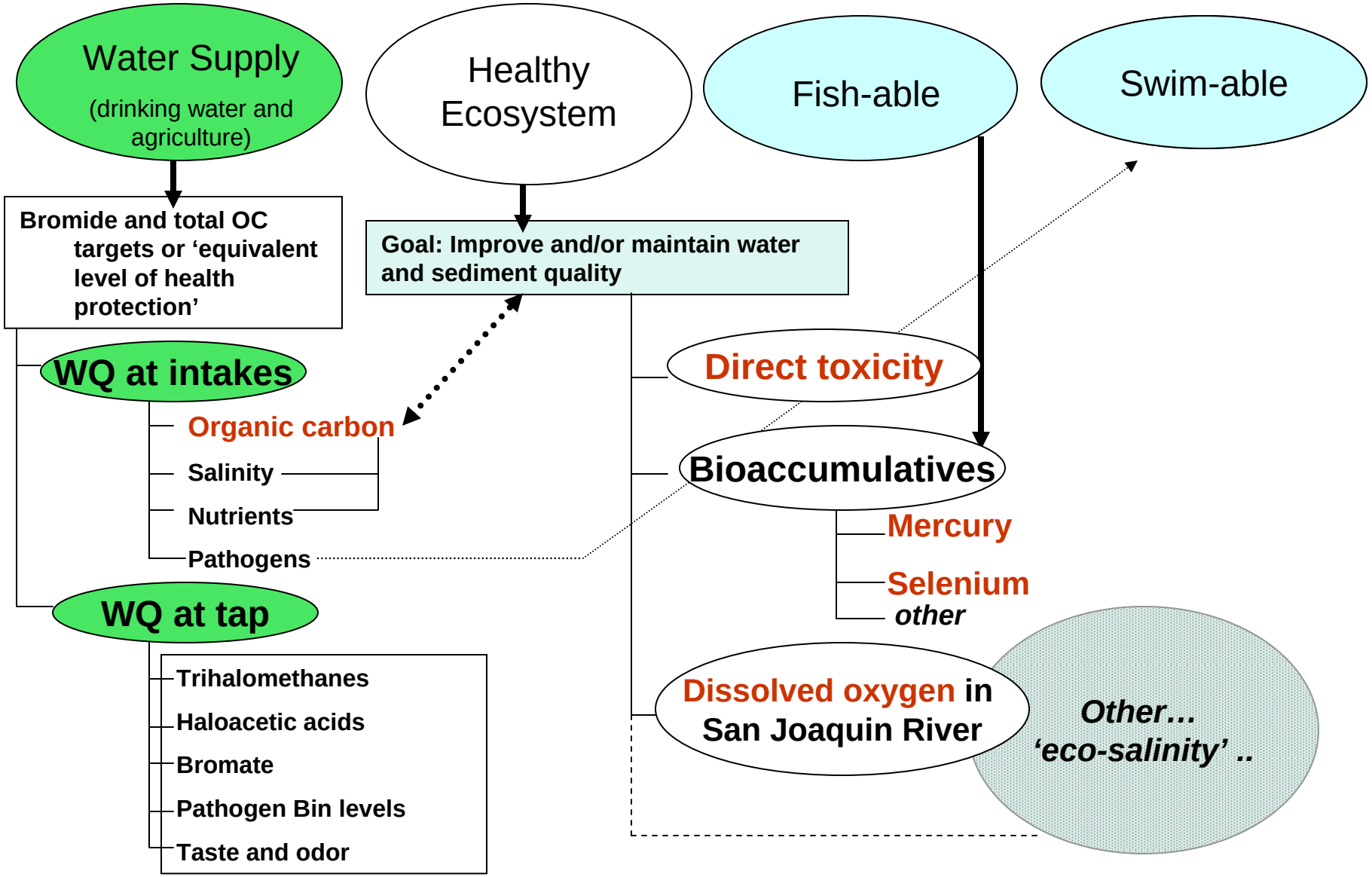
° **Reduce toxic contaminants**

-- Reduce direct toxicity

-- Reduce bioaccumulatives

° **Reduce oxygen-depleting substances**

Range of beneficial uses and water quality parameters



Toxicity objectives:	**Toxicity outcome indicators**:	
• Identify toxic constituents and reduce toxicity to aquatic organisms • Reduce loadings of toxic contaminants • Conduct studies to identify causes of unknown toxicity	• Indications that toxicity can be attributed to known sources • No likely significant aquatic toxicity • Establish if toxicity is a significant factor in POD; if so, identify contaminants and sources	
Mercury objective: • Improve and/or maintain water and sediment quality to levels that do not adversely affect aquatic organisms, humans, and wildlife **Dissolved oxygen objective:** • Reduce oxygen-depleting substances	**Mercury outcome indicators**: • Mercury concentrations in tissue of representative "sport fish" • Public health benefits • Mercury concentrations in tissue of representative biosentinels ***Dissolved oxygen indicators pending***	
Drinking water objectives: • Maintain water quality at the Delta intakes for safe, reliable drinking supplies • Drinking water quality at the tap that meets drinking water targets	**DW outcome indicators**: • Intake water quality: organic carbon, salinity/bromide, nutrients, pathogens • Water quality "at the tap" for Delta providers: salinity, taste/odor, disinfection byproducts, treatment levels	

Proposed ecosystem and human health outcome indicators

from Draft Phase 1 Report

- **Toxicity**
  - Toxicity Identification Evaluations (TIE) indicate that sources of toxicity can be identified
  - Evidence of no likely significant toxicity to aquatic test organisms in water and sediment
  - Establish whether contaminants are a significant factor in the decline of Delta pelagic organisms and if so, identify contaminants and sources
  - *Conduct research on biomarkers*

Proposed outcome indicators, cont.

from Draft Phase 1 Report

Mercury (methylmercury)

- **Tissue concentrations in biosentinel species (birds, small fish, invertebrates)**
- **Mercury tissue concentrations in fish consumed by humans**
- **Metric to measure the effectiveness of outreach to reduce human exposure to mercury from eating contaminated fish**

The tissue concentration indicators track the Regional Water Board's proposed approach to objectives:

- ***Targets are protective values***
- ***Need characterization and control studies to understand methylation processes***

Need intermediate targets, in light of current limited understanding and complexity of management and control measures

Process to develop indicators: Phase 1 work plan (Dec. 2006+)

- ✓ Define a broader array of water quality parameters affecting the Delta *(Plan Activity 2.1).* Add:
  - Selenium
  - Dissolved oxygen in the lower San Joaquin River
  - Organic carbon
  - More specific investigation of toxicity (pyrethroids)

- ✓ Use conceptual models from "Delta Ecosystem Regional Ecosystem Restoration Implementation Plan" *(DRERIP)* to help define important "drivers," processes and intermediate outcomes, and end outcomes– and associated indicators. *(Activity 2.2)*
  - Where possible, identify quantitative targets and/or
  - define reference conditions

- ✓ Link indicator topics to monitoring data *(Activity 3)*
  - Select "informative" topics for preliminary indicator work
  - Identify monitoring gaps

Process to develop indicators:

Phase 1 Work Plan, *cont.*

Work Plan activities should take advantage of complementary projects. For example:

- **Conduct comprehensive review and assessment** based on CALFED mercury projects and related work. Begins spring 2007.

- **Develop monitoring plans**
  - Comprehensive Monitoring, Assessment and Research Program
  - Coordinate with the State and Regional Water Board Programs

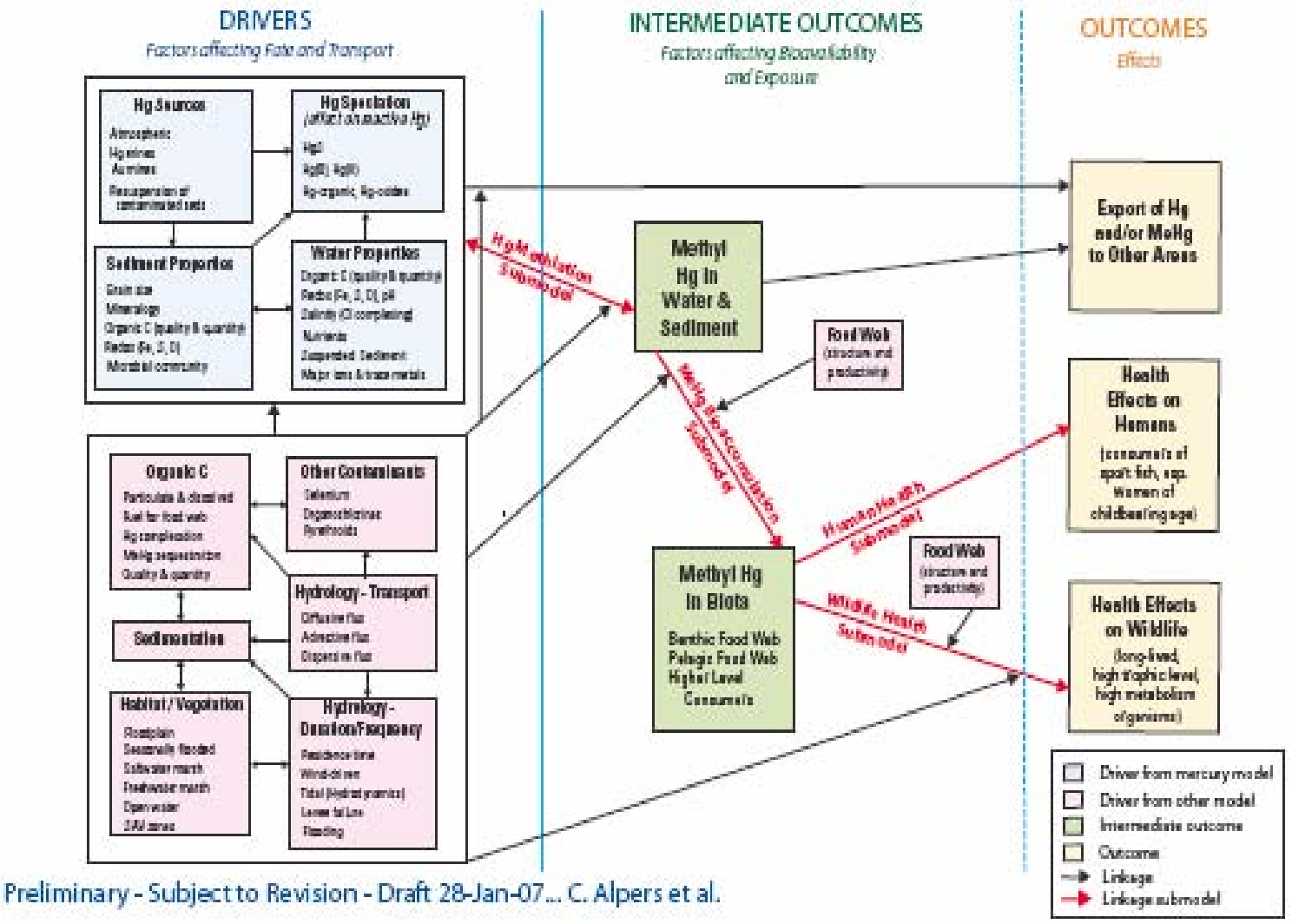
- **Provide guidance for wetland monitoring** and development of mercury management practices through experimental design in CALFED agency and other projects in the Delta.

- **Continue use of information from DRERIP**

Plans for developing mercury indicators

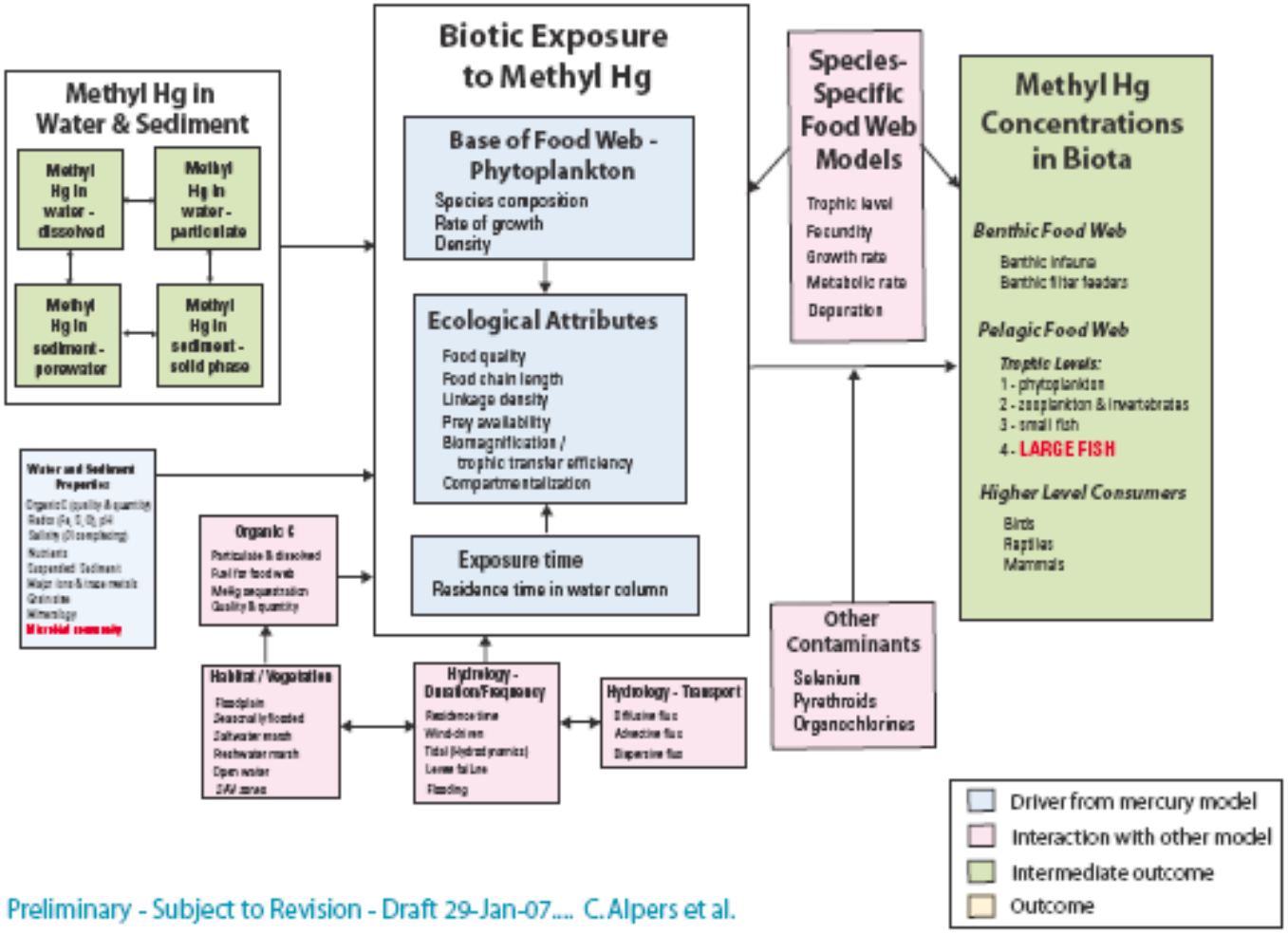
- ✓ **Learn from CALFED-funded mercury projects.**
  - Assessment of ecological and human health impacts of mercury in the Bay-Delta watershed
  - Biogeochemical mercury transformations and trophic transfer
  - Mass balance: transport, cycling and fate of mercury in the Delta and tributaries
  - Mercury cycling and release from wetlands
  - Mercury in birds and fish
  - Fish contamination monitoring, stakeholder involvement and risk communication
- ✓ **Use workshops to launch synthesis of research.**
- ✓ **Coordinate with Regional Water Board Basin Plan amendments/ TMDL to control total and methylmercury.**

Conceptual Model for Mercury in the Sacramento-San Joaquin Delta: Delta Regional Ecosystem Restoration Implementation Plan (DRERIP)



Preliminary - Subject to Revision - Draft 28-Jan-07... C. Alpers et al.

MERCURY CONCEPTUAL MODEL --- SUBMODEL #2 - BIOACCUMULATION



Preliminary - Subject to Revision - Draft 29-Jan-07.... C. Alpers et al.

The future…

- FINISH initial plan by June 2007 (Phase 1) *then*
- Begin development of indicators (Phase 2, *Work Plan activity 3.4 ff*)
  - Data gathering and analysis
  - Preliminary reporting
  - Plan to address data gaps through CMARP and other monitoring programs

….Continuous improvement….

Questions and Discussion

- Do we have an appropriate suite of water quality parameters and associated indicators?
  - In light of potential future changes in Delta management and
  - Uncontrollable factors (e.g., salinity changes with sea level rise)
- Are the selected water quality indicators linked to important ecosystem and other beneficial use effects?
- How do we make/measure connections between management actions and effects?
  - What forms of monitoring?
  - What analytical tools are available, and what are the associated data needs?

Status of Performance Measures for Drinking Water Quality

February 21, 2007

Independent Science Board

Lisa Holm, WQ Program

Water Quality Goals

Beneficial Use Framework for Objectives

Program Mission Statement:

Provide good water quality for all beneficial uses.

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Drinking water

Continuously improve source water quality that allows for municipal water suppliers to deliver safe, reliable, and affordable drinking water that meets and, where feasible, is better than applicable drinking water standards, in a cost effective way.

↓

Achieve either: (a) average concentrations at Clifton Court Forebay and other southern and central Delta drinking water intakes of 50 mg/L bromide and 3.0 mg/L total organic carbon, or (b) *an equivalent level of public health protection* using a cost-effective combination of alternative source waters, source control, and treatment technologies.

Drinking Water Quality

- Performance measures dependent on other ongoing assessment efforts:
  - Central Valley Drinking Water Policy
  - Final Program Assessment
  - Delta Conveyance Studies
  - Funded Projects
- Because of this, progress made on conceptual models, data collection, and assessment

Central Valley Drinking Water Policy

- Prioritization exercise on constituents of concern
- Developed conceptual models for:
  - Organic Carbon
  - Nutrients
  - Pathogens
- Continuing to refine organic carbon model
- Researching drinking water quality goals
- Future work on:
  - Drinking water treatment
  - Controllable sources
- Goal: Development of a Basin Plan Amendment by end of 2009

CALFED WQ “Final” Assessment

- System-wide look at drinking water quality:
  - Background on goals and interpretation
  - Assessment of watershed sources, transport to intakes and experiencing with controlling
  - Assessment of treated water quality, development of representative conceptual models of treated water quality
  - Initial economics evaluation
  - Integration with conveyance and storage studies

Final Assessment Goals

- Inform Stage 1 decision on conveyance by providing drinking water quality context
- Identify priorities for Stage 2 implementation of WQ Program, including initial development of performance measures, monitoring and research needs
- Technical work will also support Central Valley Drinking Water Policy (salinity and treatment conceptual models)

CALFED Conveyance Studies

- Through Delta Facility, Delta Cross Channel and Franks Tract studies focus on drinking water quality and fish impacts
- Primary constituent studied is salinity
- Conveyance Studies have significantly increased our understanding of Delta hydrodynamics

Funded Projects

- USGS assessment of in-Delta water quality, studies of organic carbon in Delta and State Water Project, watershed size investigations
- MWQI real-time (high frequency) samplers at key locations and research projects on urban runoff
- Other non-point source studies and demonstrations of source control

Performance Measure Development Process

- System-level conceptual models
- Tiered basin, watershed-level conceptual models
- Information/Data Assembly and Analysis
- Identification of Critical Performance Indicators
- Gap and Uncertainty Analysis

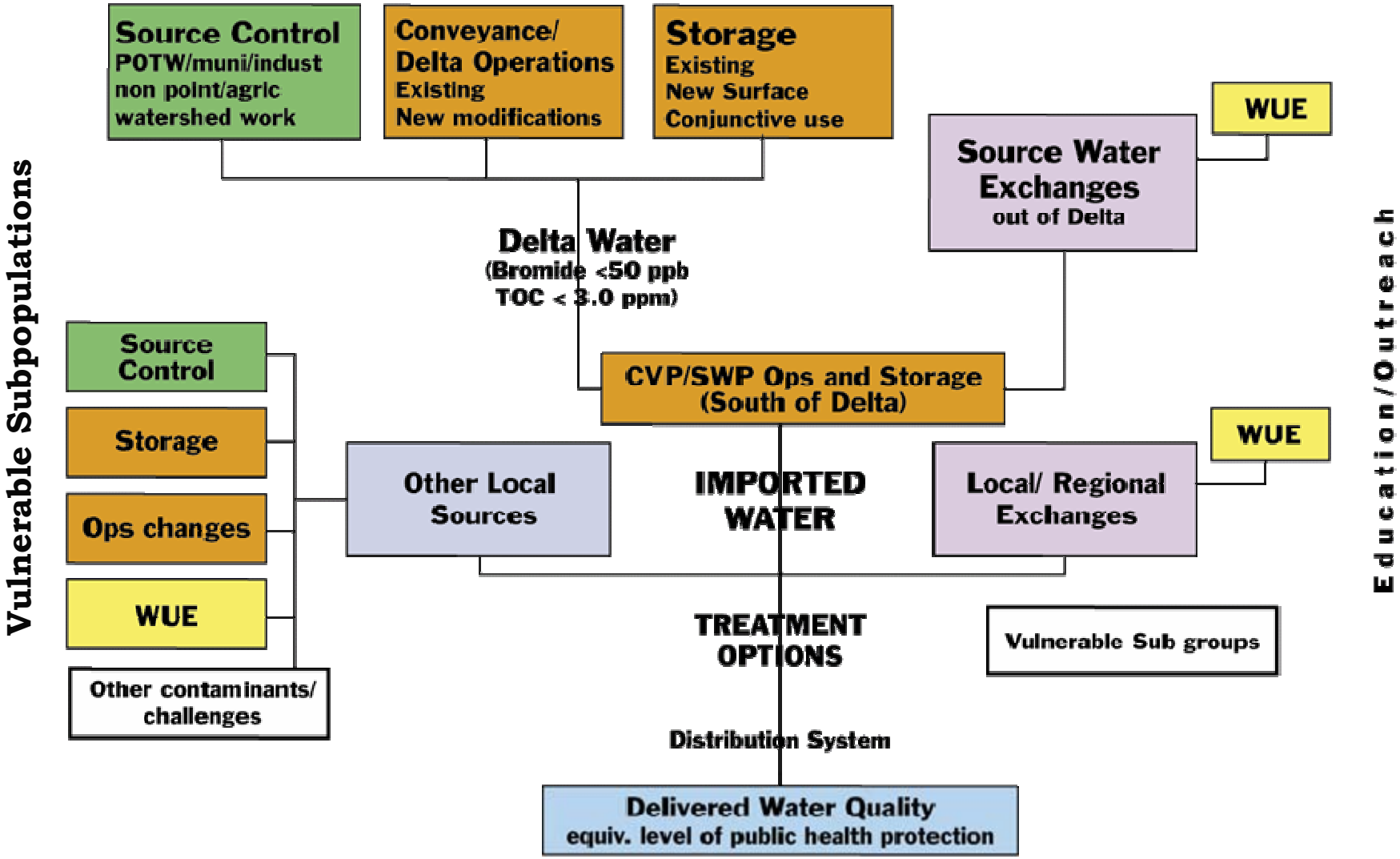
Multiple Barrier Principle

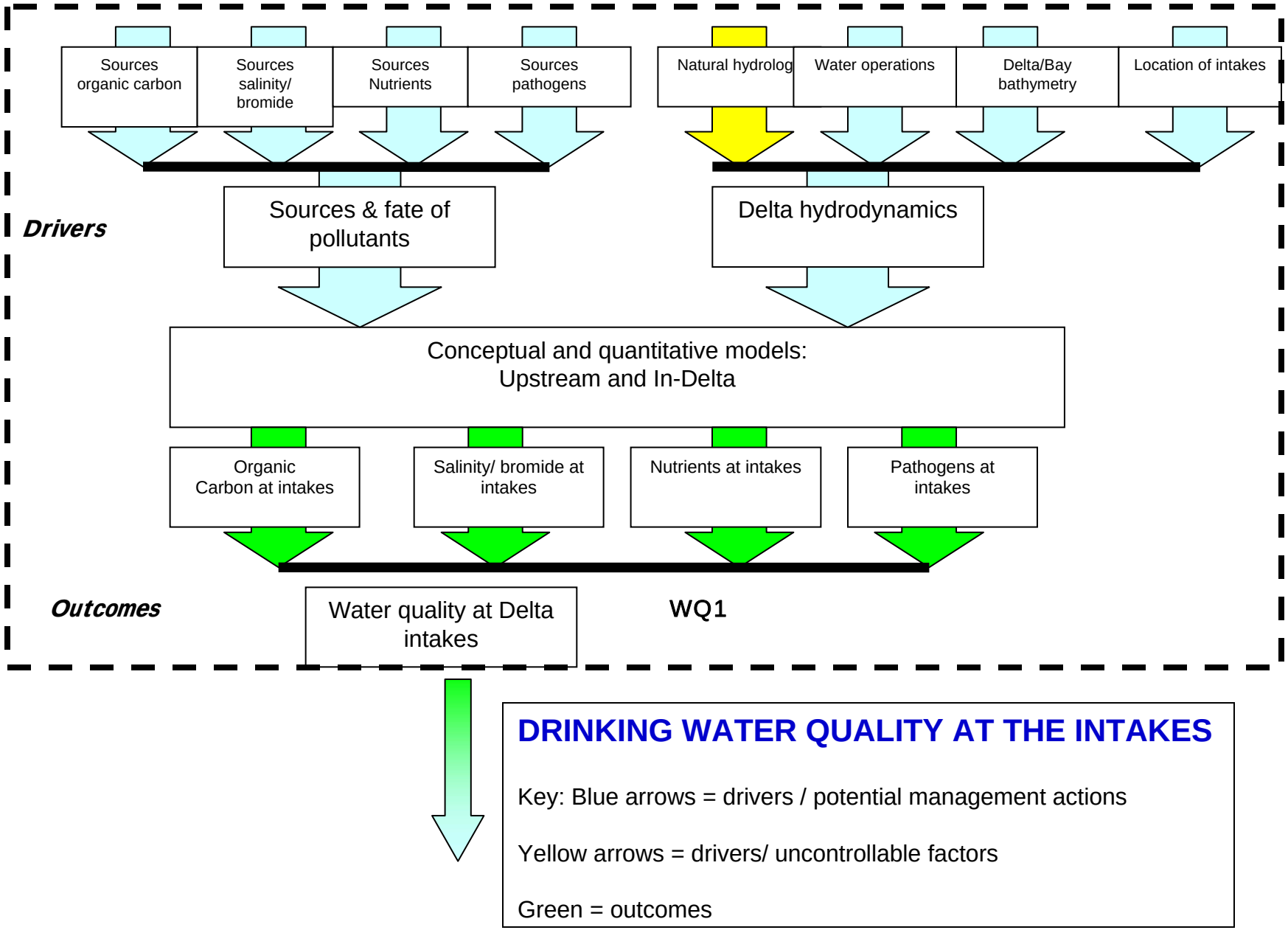
Source Protection

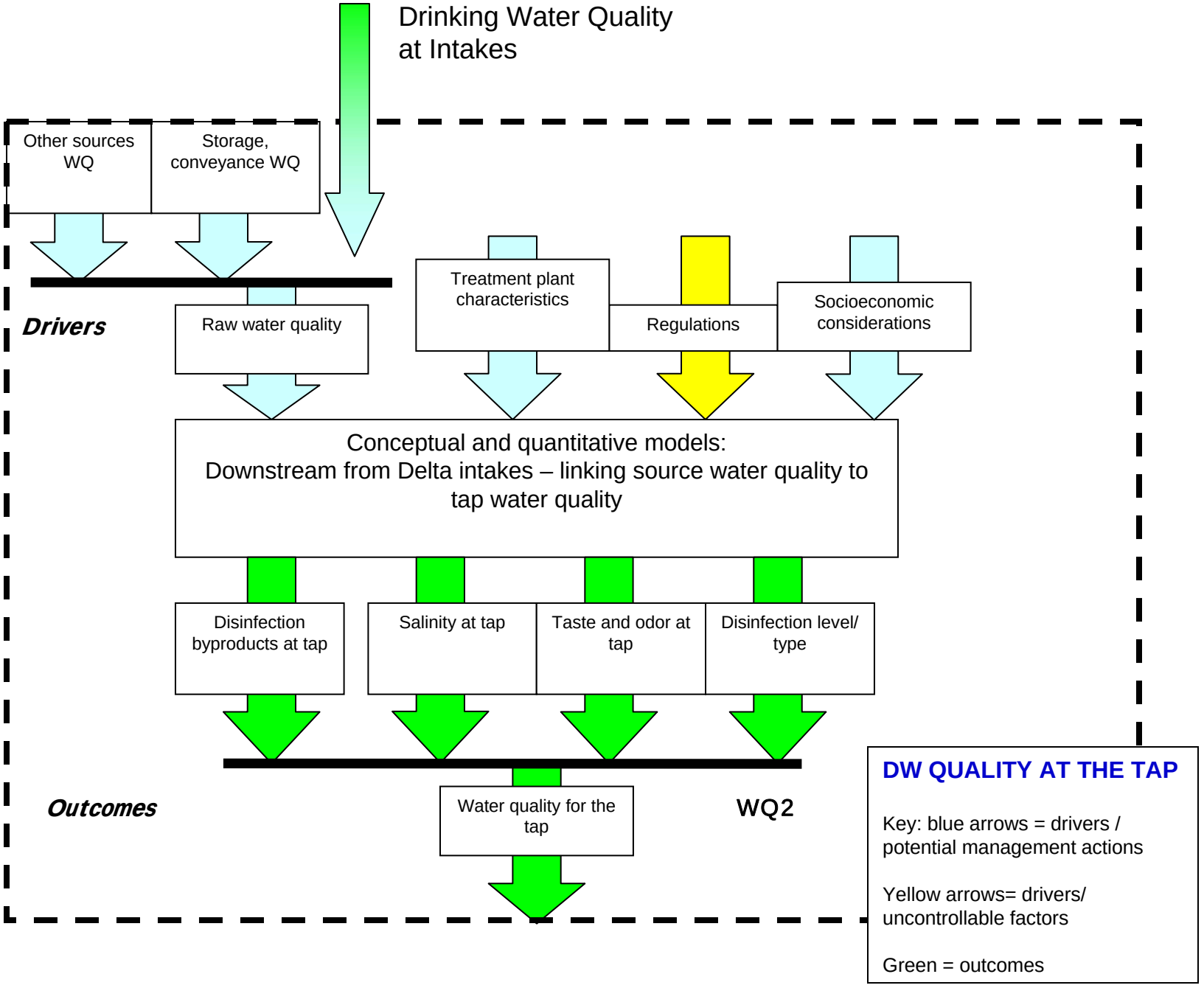
Treatment Effectiveness

Distribution Integrity

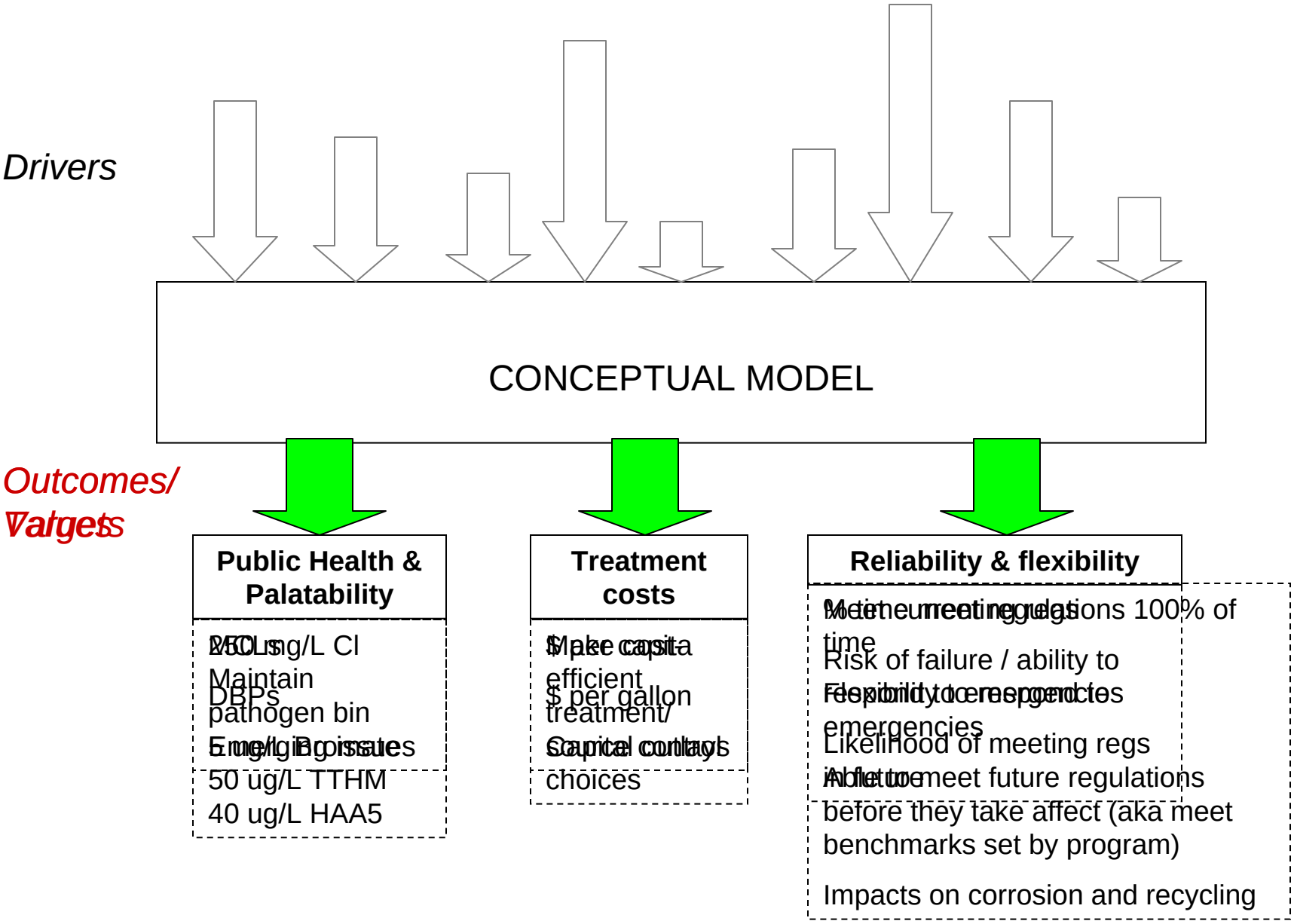
“Equivalent Level of Public Health Protection”




Sources organic carbon
Sources salinity/ bromide
Sources Nutrients
Sources pathogens
Natural hydrolog
Water operations
Delta/Bay bathymetry
Location of intakes
Drivers
Sources & fate of pollutants
Delta hydrodynamics
Conceptual and quantitative models: Upstream and In-Delta
Organic Carbon at intakes
Salinity/ bromide at intakes
Nutrients at intakes
Pathogens at intakes
Outcomes
Water quality at Delta intakes
WQ1
DRINKING WATER QUALITY AT THE INTAKES
Key: Blue arrows = drivers / potential management actions
Yellow arrows = drivers/ uncontrollable factors
Green = outcomes


Drinking Water Quality
at Intakes
Other sources
WQ
Storage,
conveyance WQ
Drivers
Raw water quality
Treatment plant
characteristics
Regulations
Socioeconomic
considerations
Conceptual and quantitative models:
Downstream from Delta intakes – linking source water quality to
tap water quality
Disinfection
byproducts at tap
Salinity at tap
Taste and odor at
tap
Disinfection level/
type
Outcomes
Water quality for the
tap
WQ2
DW QUALITY AT THE TAP
Key: blue arrows = drivers /
potential management actions
Yellow arrows= drivers/
uncontrollable factors
Green = outcomes

Identified desired outcomes/values of treated water

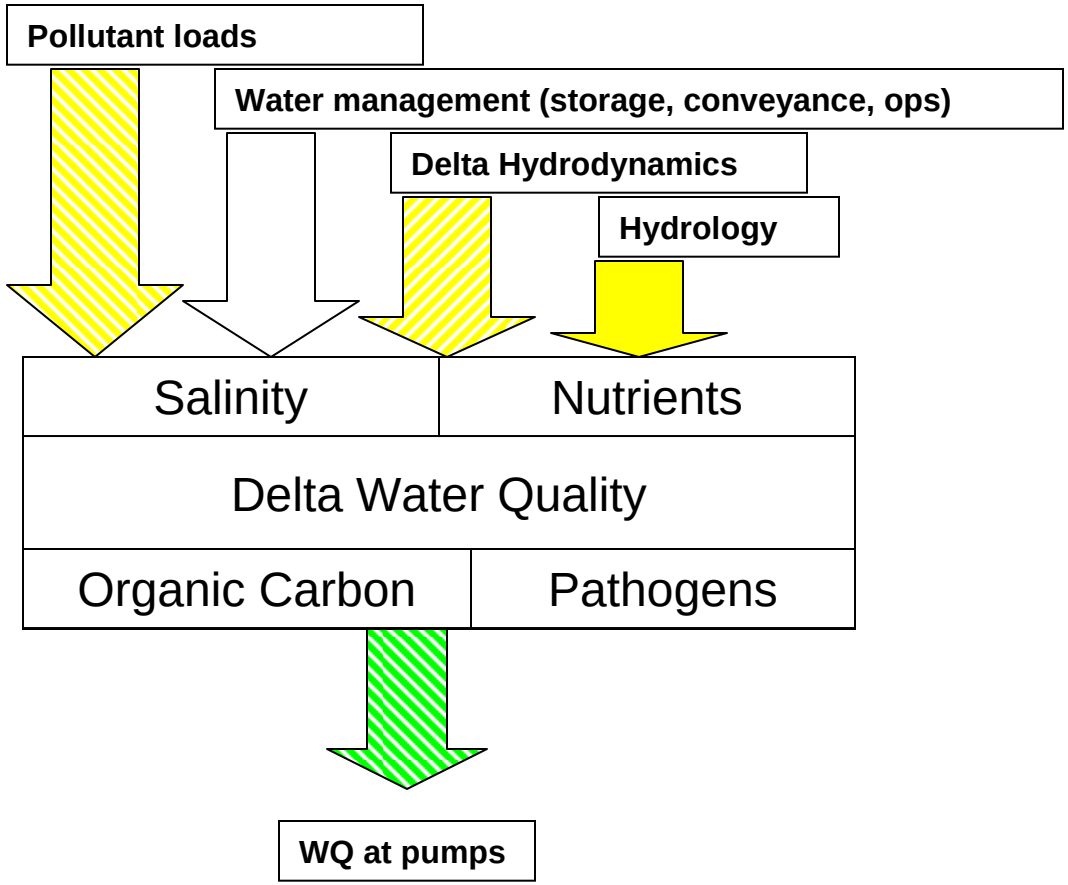


Data Analysis

- Presentation of available data
- Variety of ways to look at data (time series, averaging schemes, geographical, ambient v. sources)
- Using statistical methods and numerical models to analyze and as filter
- Started with San Joaquin organic carbon in 2005, have since also started on Sacramento organic carbon, salinity, and drinking water treatment

Watershed Data Analysis

Drivers



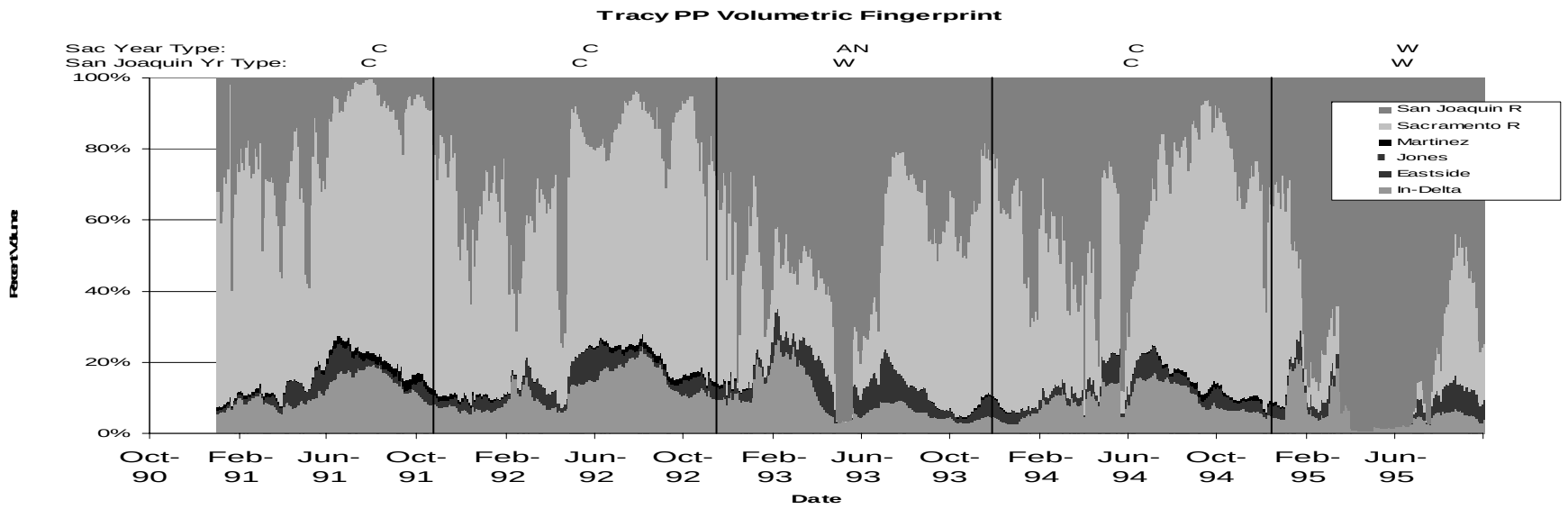
Outcomes

Primary Analyses Questions

- When is export water quality a problem?
- What do we mean by “average”?
- What are the trends at the intakes?
- What is the source of the problems?
- What can we do about the problem?

Hydrodynamics

- Driver of transport to intakes
  - Natural processes (rainfall, tides)
  - Anthropogenic processes (supply operations, structures)
- Conceptual model developing within DRERIP process
- Use of DSM2 to produce 16-year volumetric fingerprints at Delta intakes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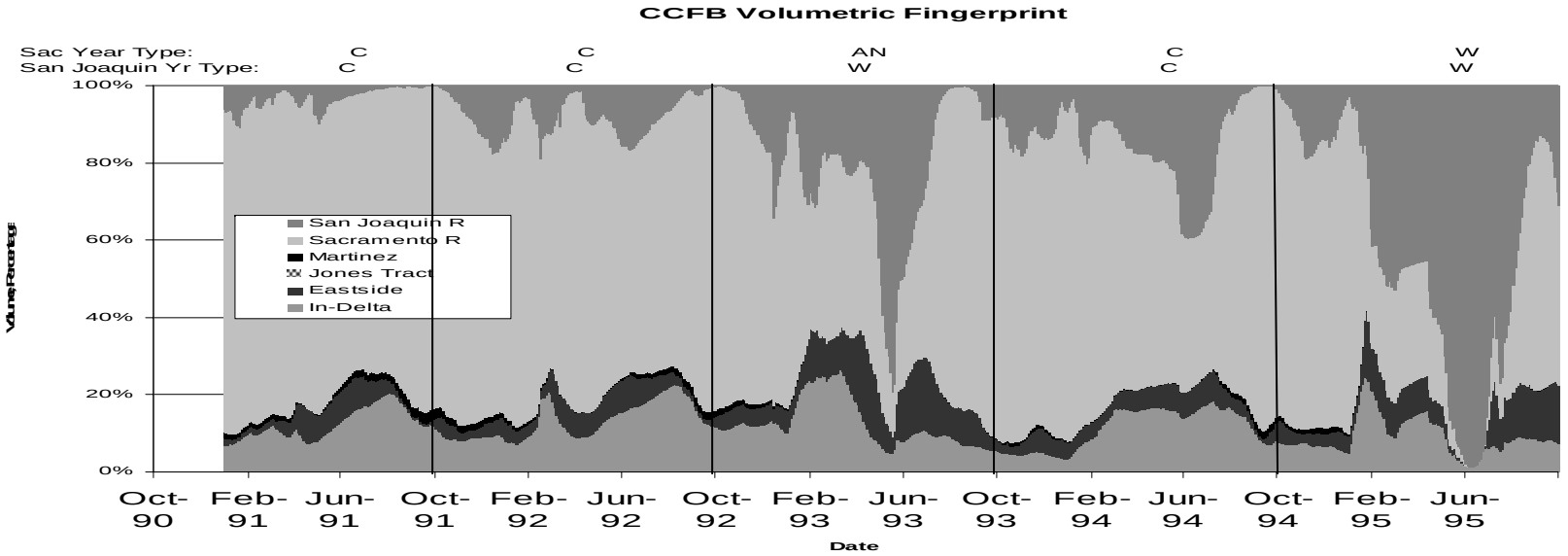
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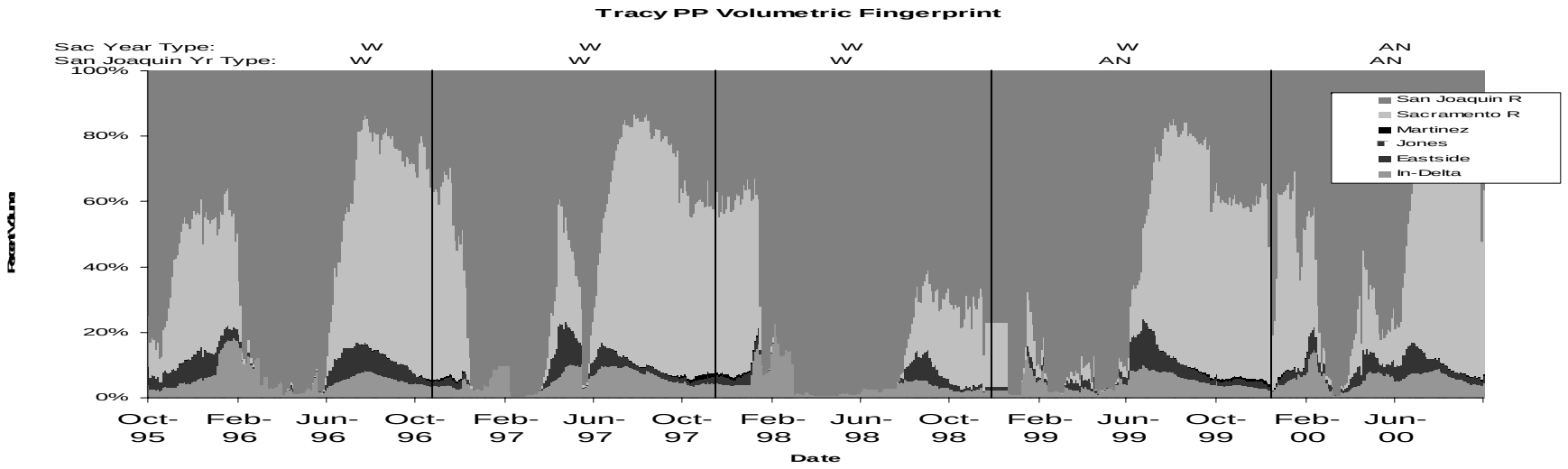
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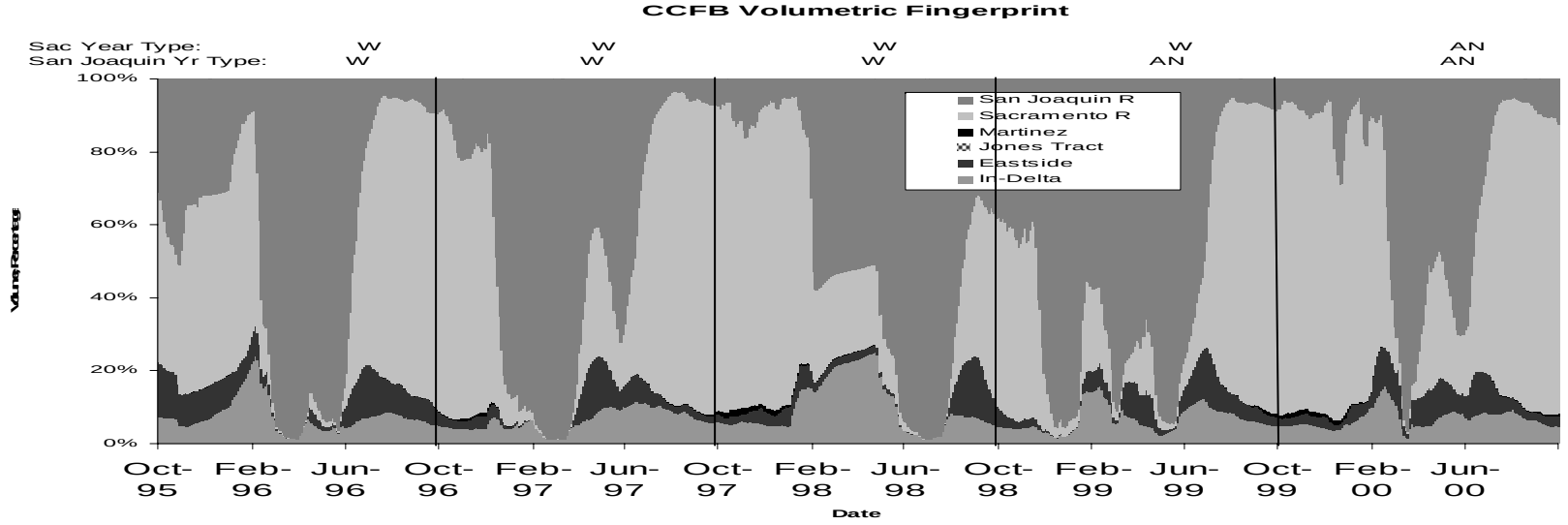
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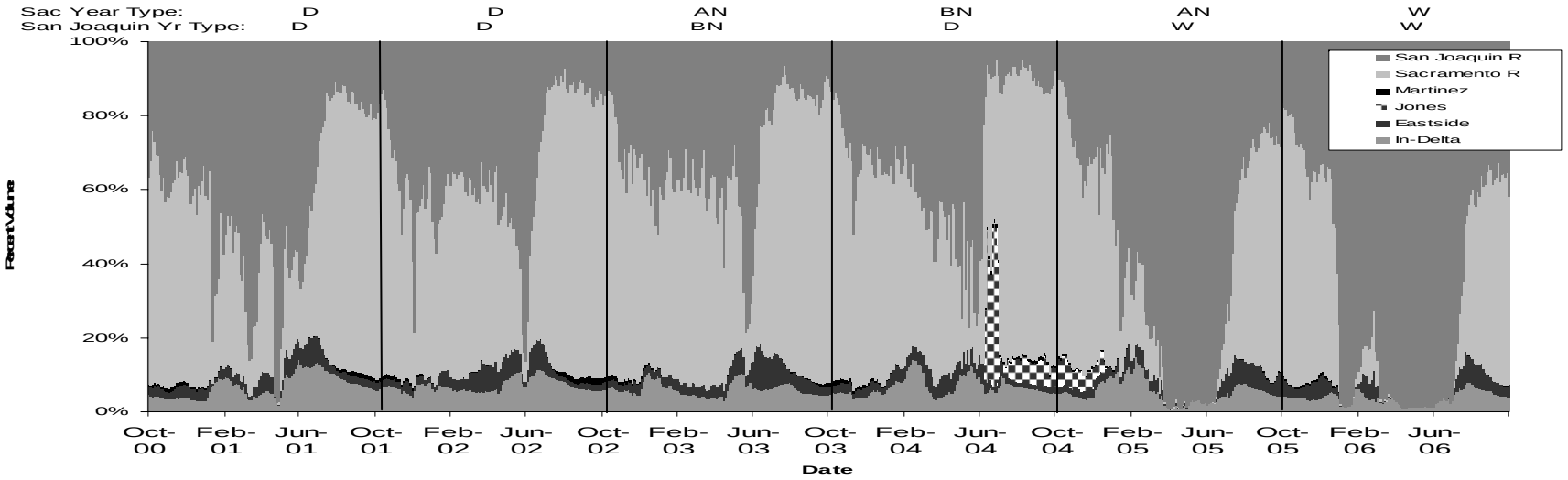

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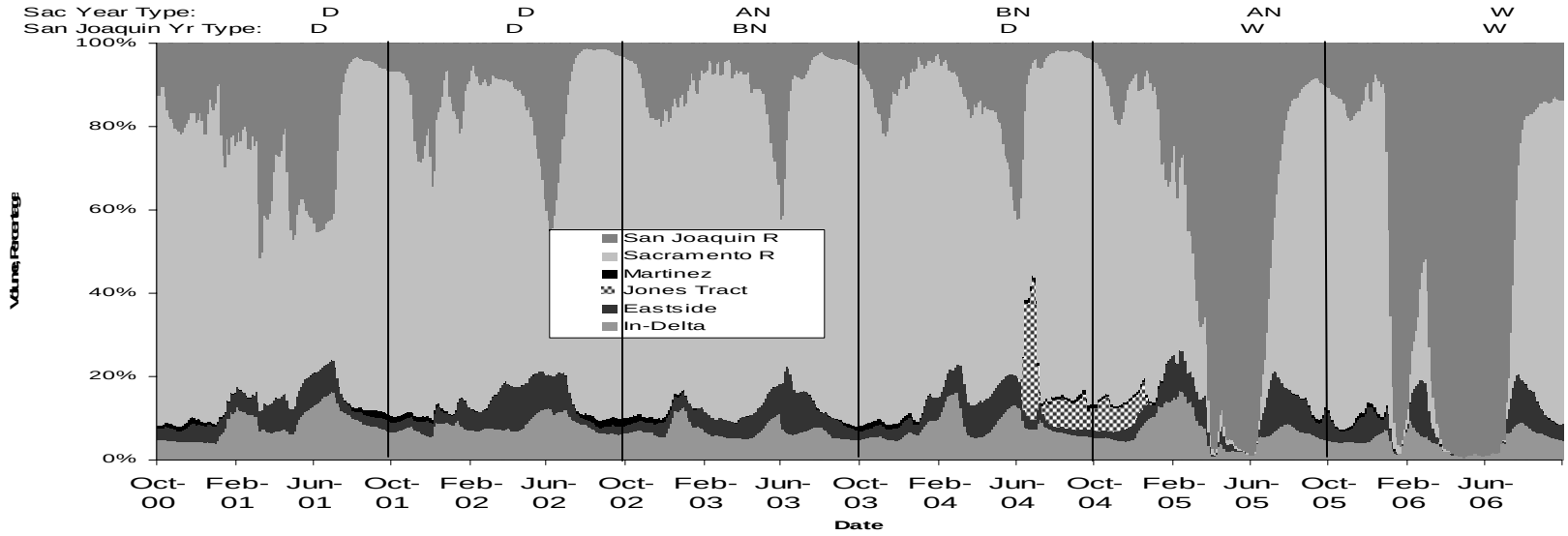

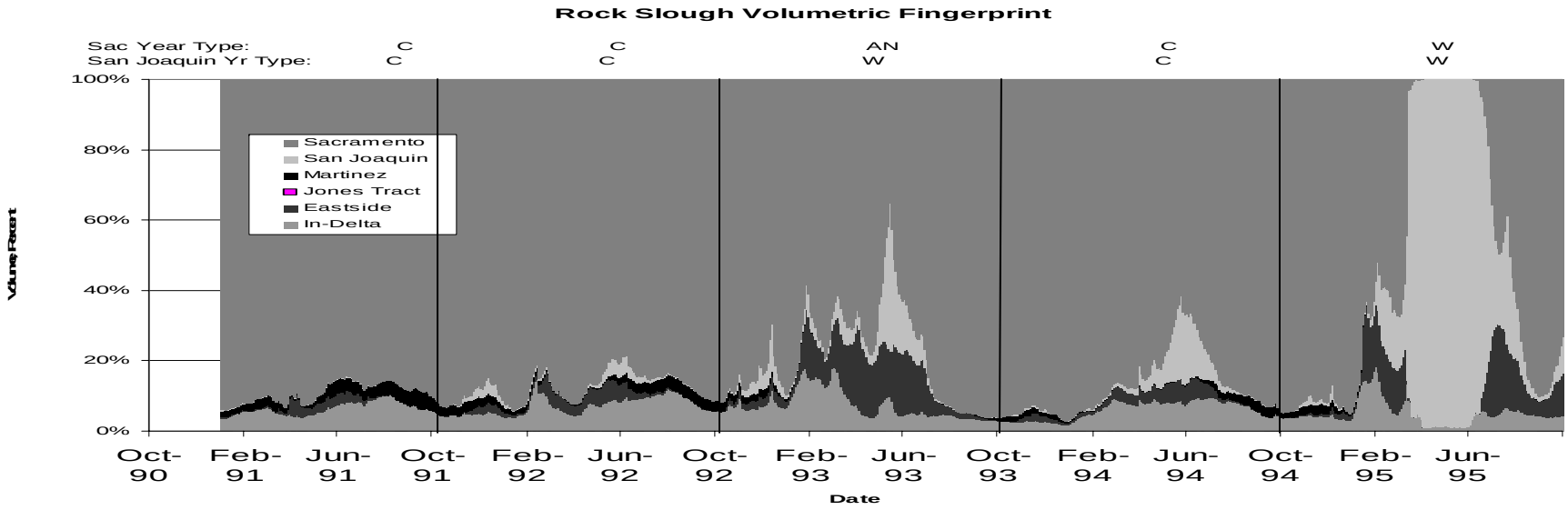
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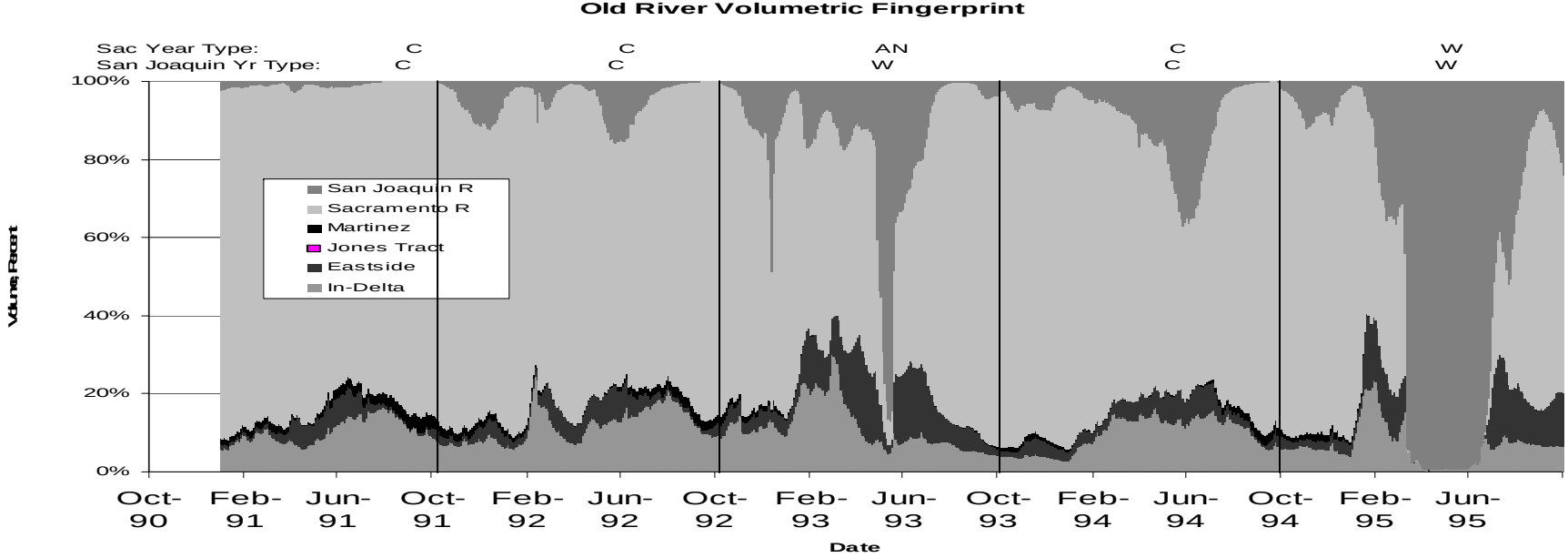
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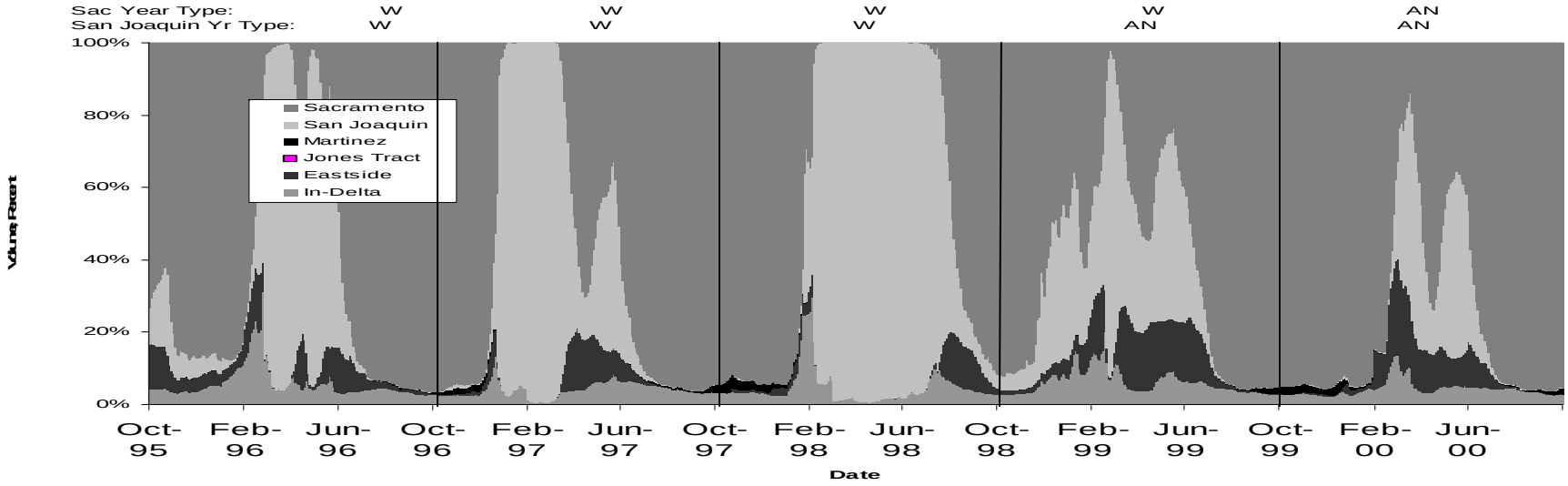
Rock Slough Volumetric Fingerprint



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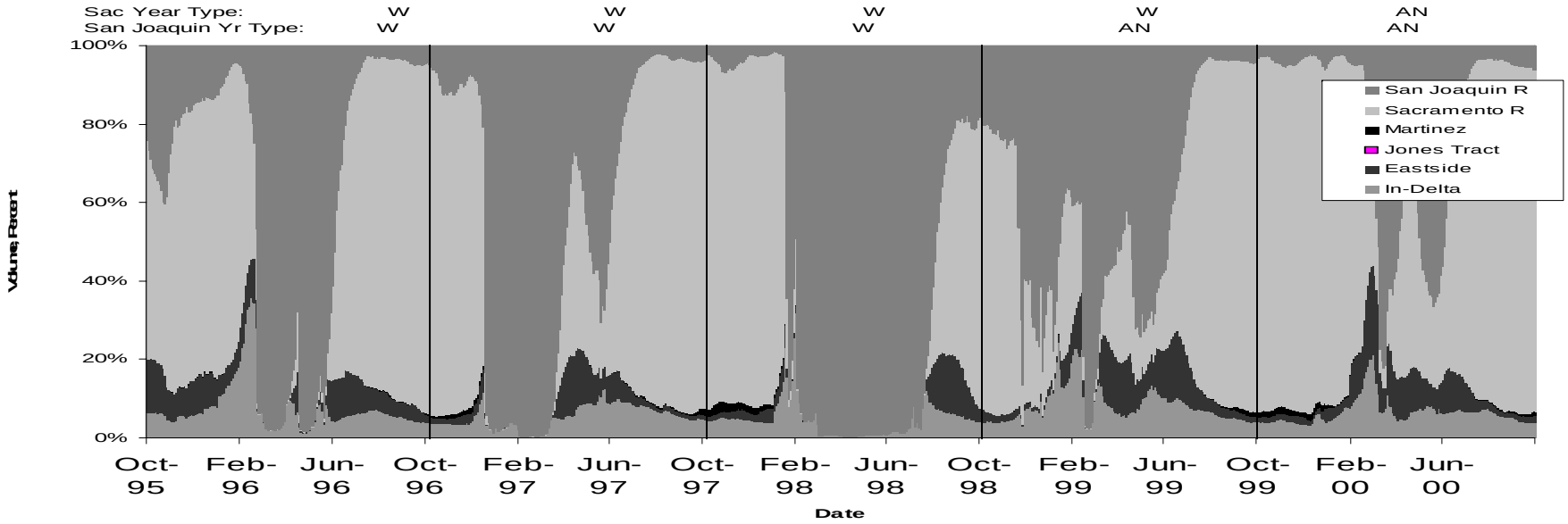

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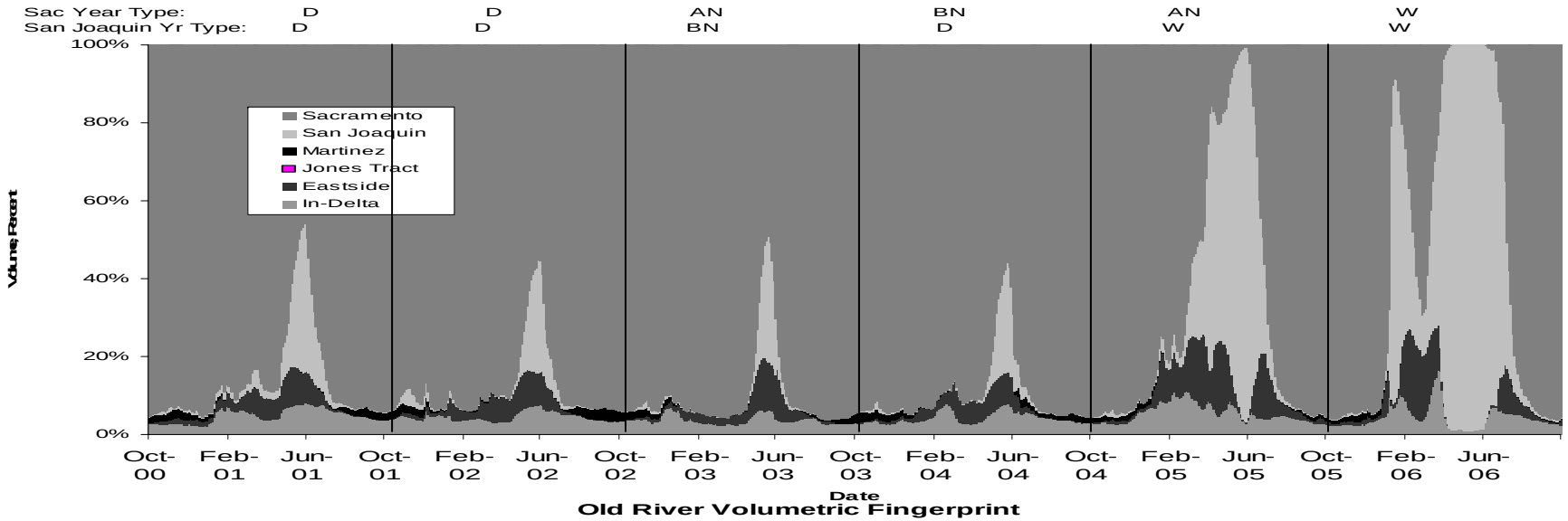

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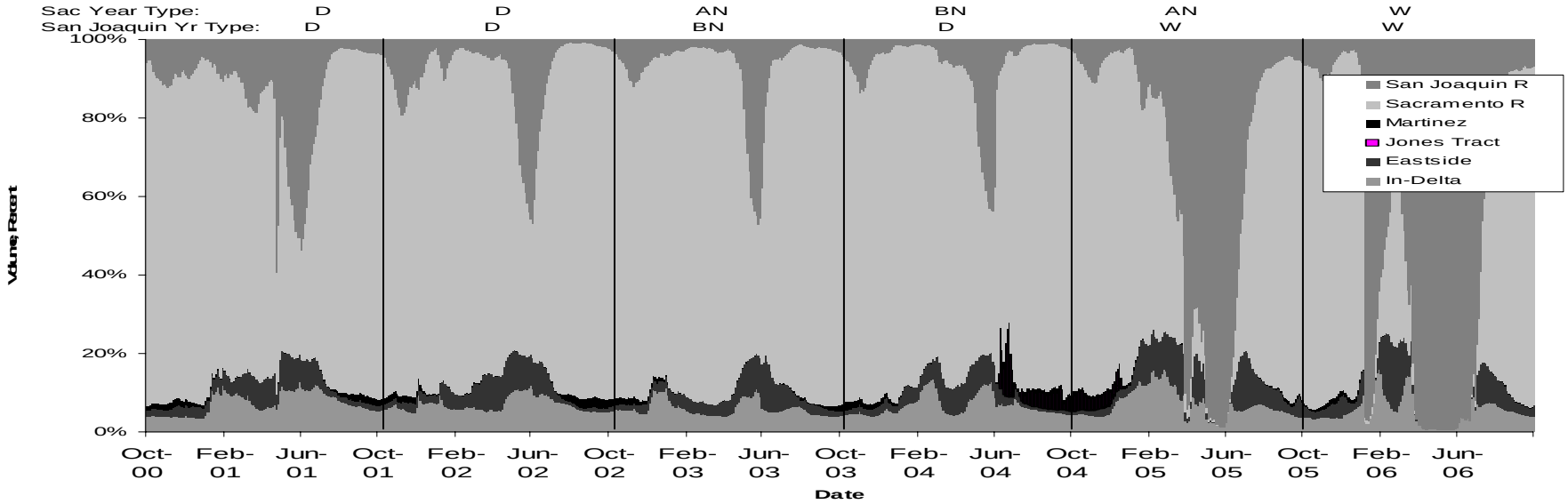

Organic Carbon