

Evaluation of DOC Concentrations From In-Delta Storage Project Island Releases

Water Demand Reduction and Alternative
Supply Possibilities

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Outline

- Organic Carbon in the Delta
- Model Scenarios
- Methodology
- Hydrodynamic Results
- Water Quality Results
- Summary



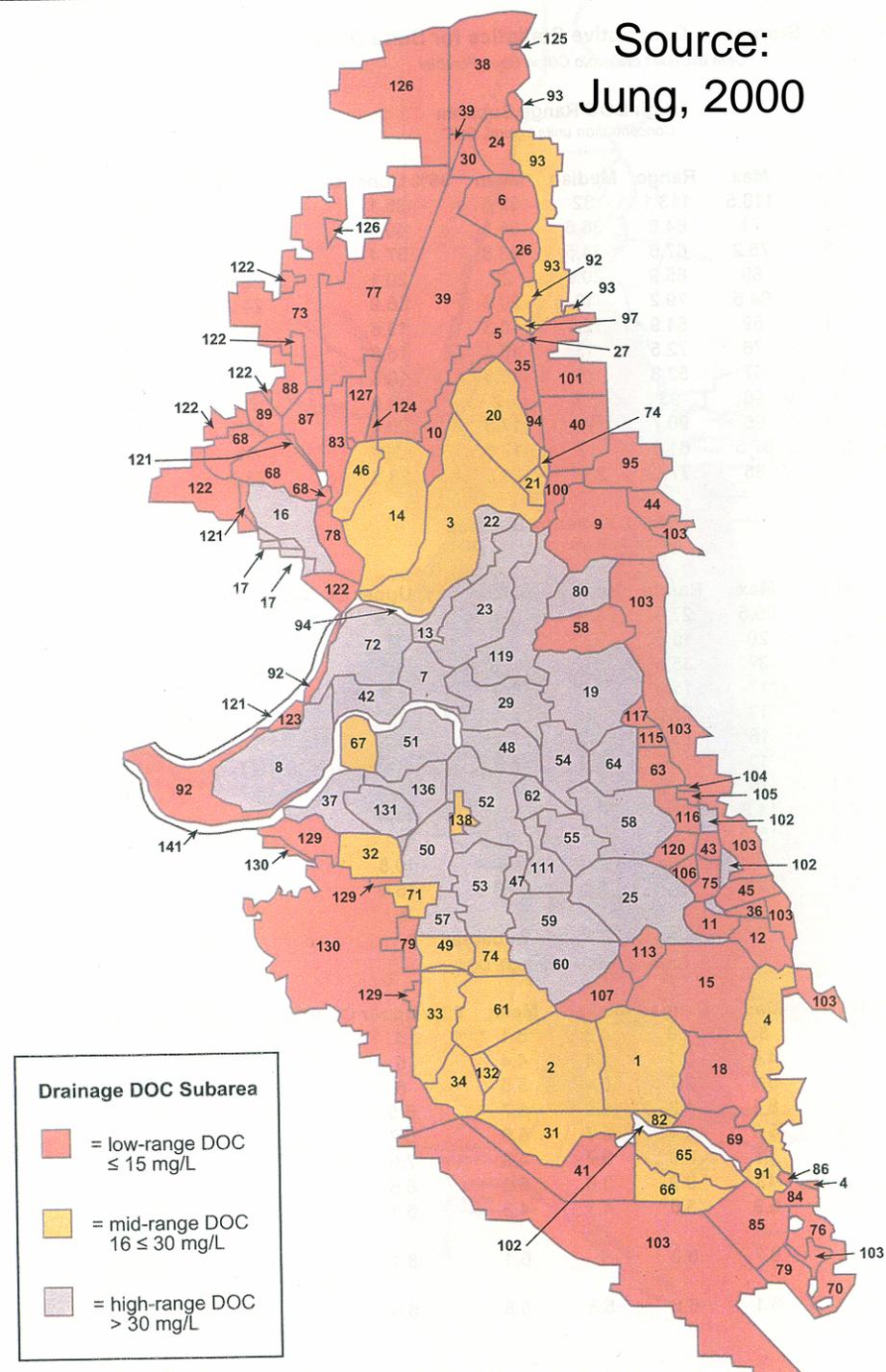
Organic Carbon in the Delta

- Organic carbon reacts with disinfection products to form THMs and other DBPs
- Organic carbon varies seasonally with peaks during the winter
- DOC is easier to measure than TOC
- $\text{DOC} \approx 90\% \text{ TOC}$

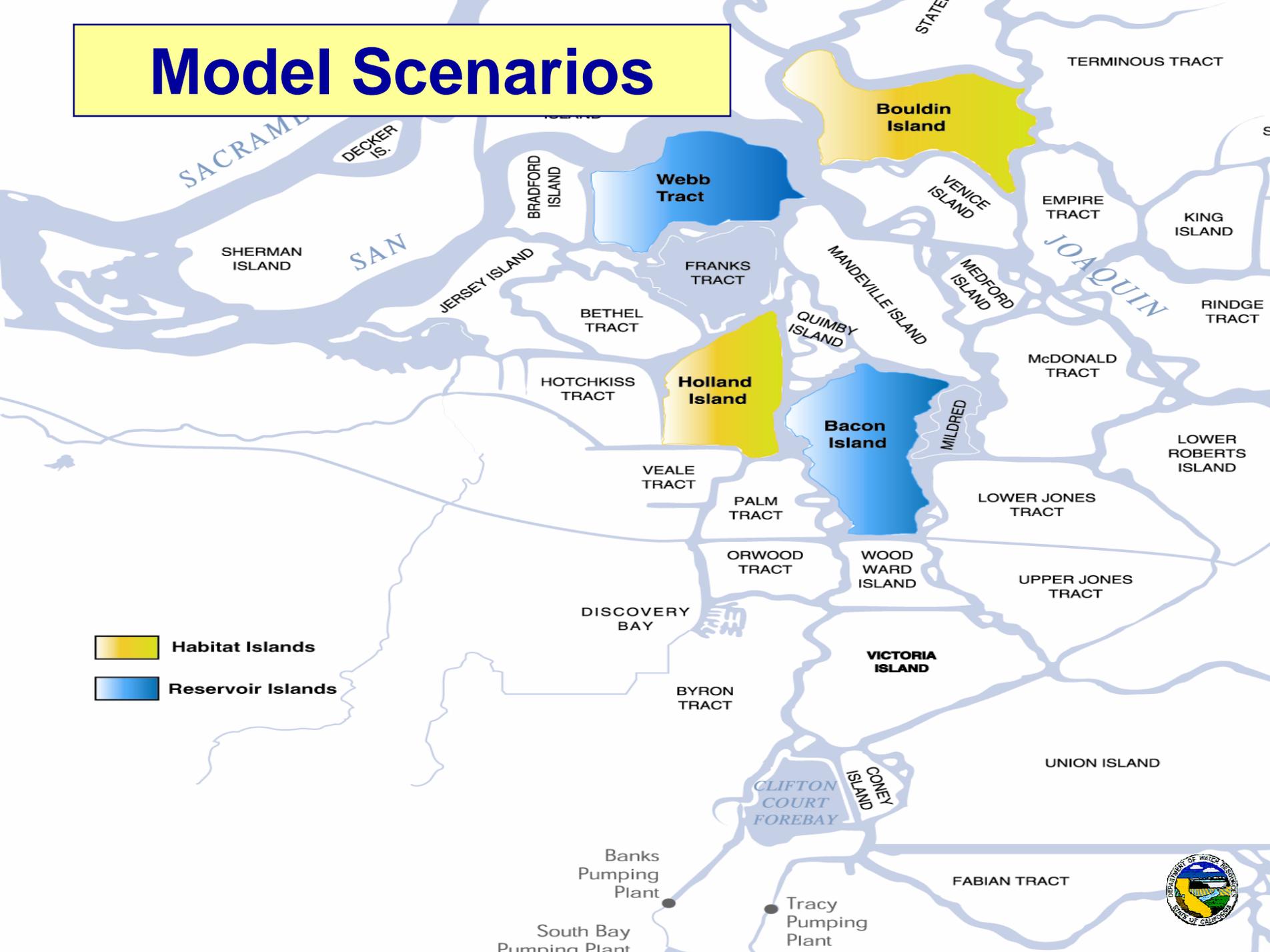


DOC Drainage

- Soil Type :: high DOC from peat soils
- Season :: high DOC in wet months
- Elevation :: high DOC w/ high seepage
- 142 subareas



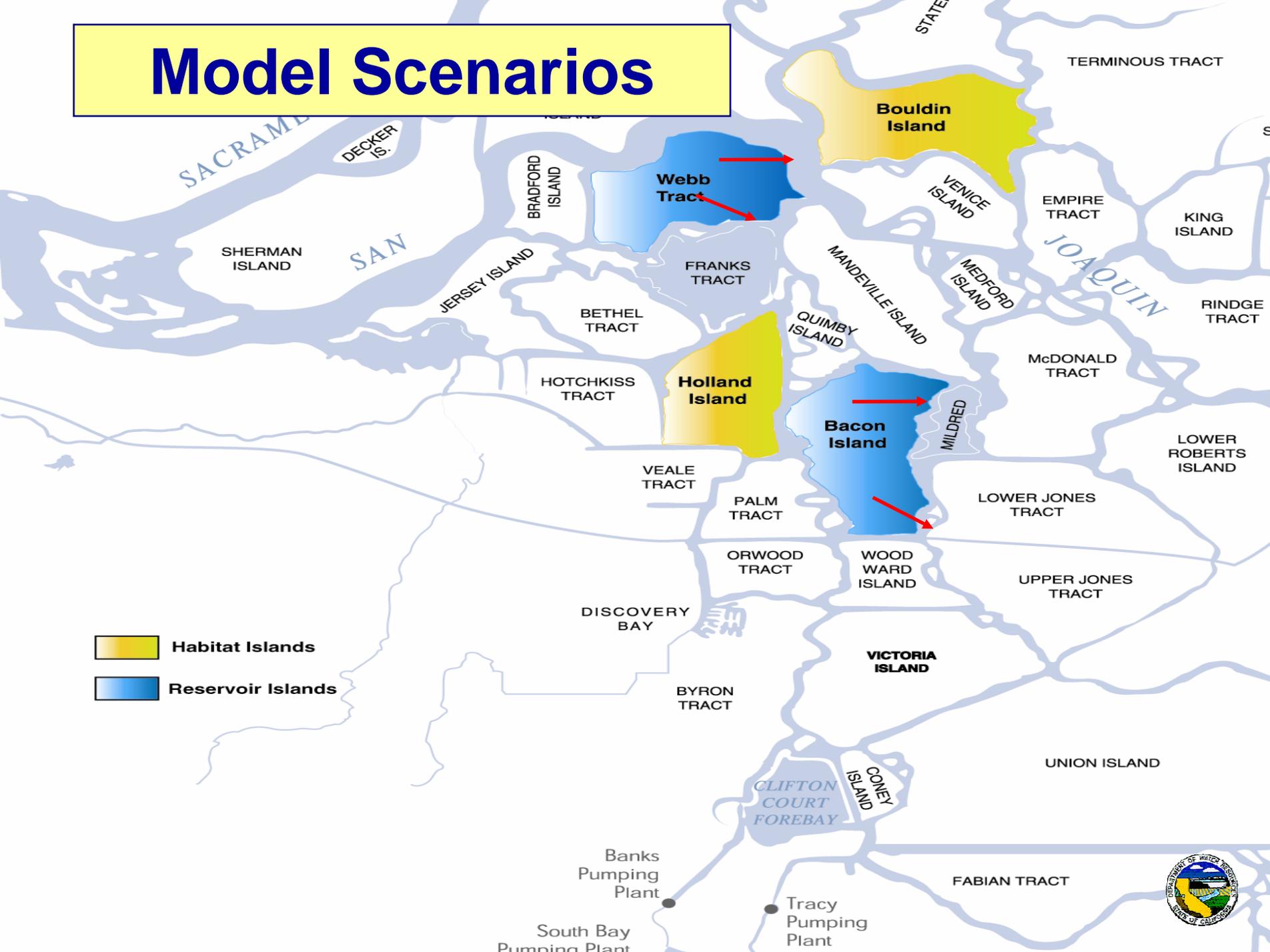
Model Scenarios



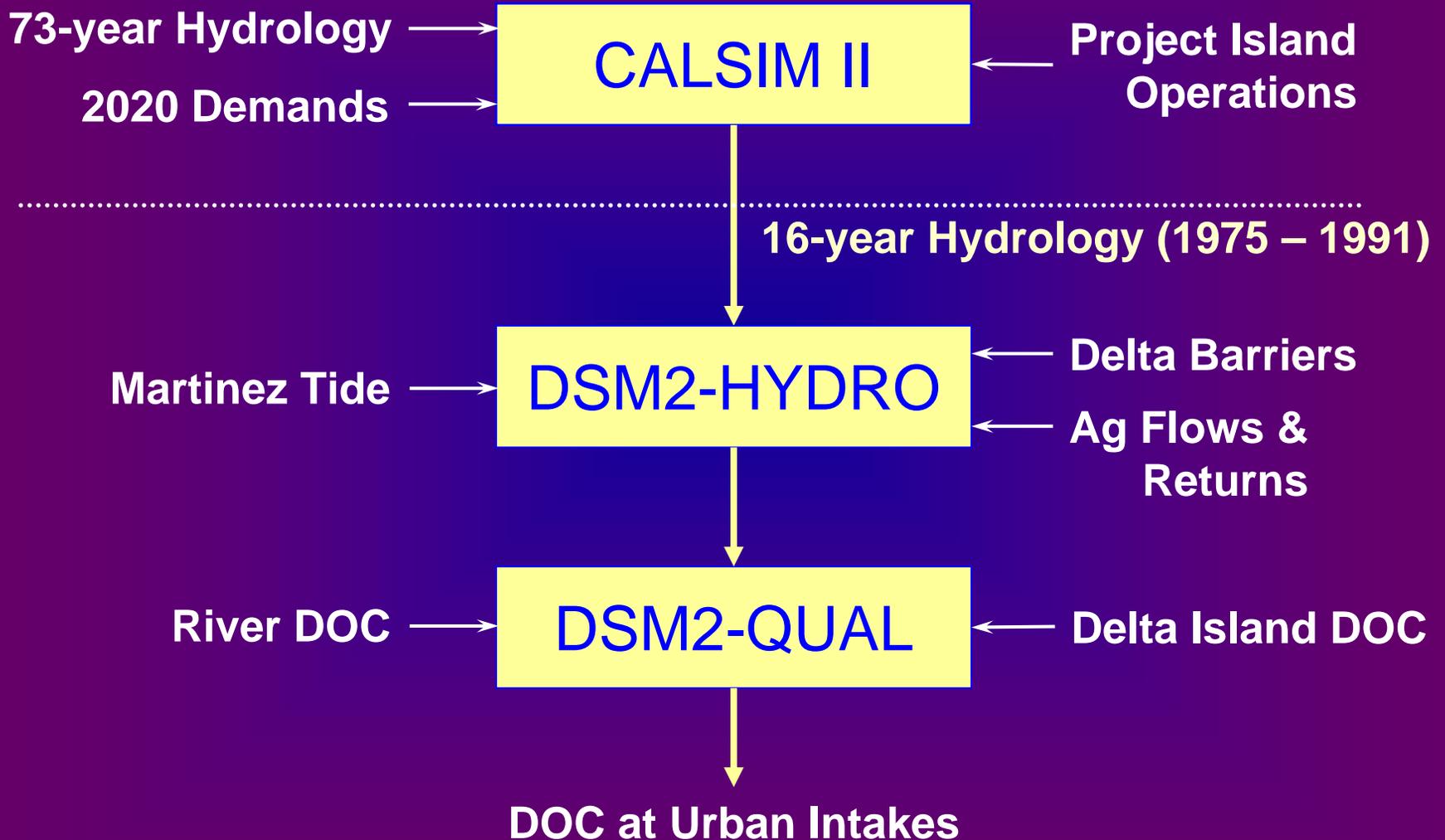
-  Habitat Islands
-  Reservoir Islands



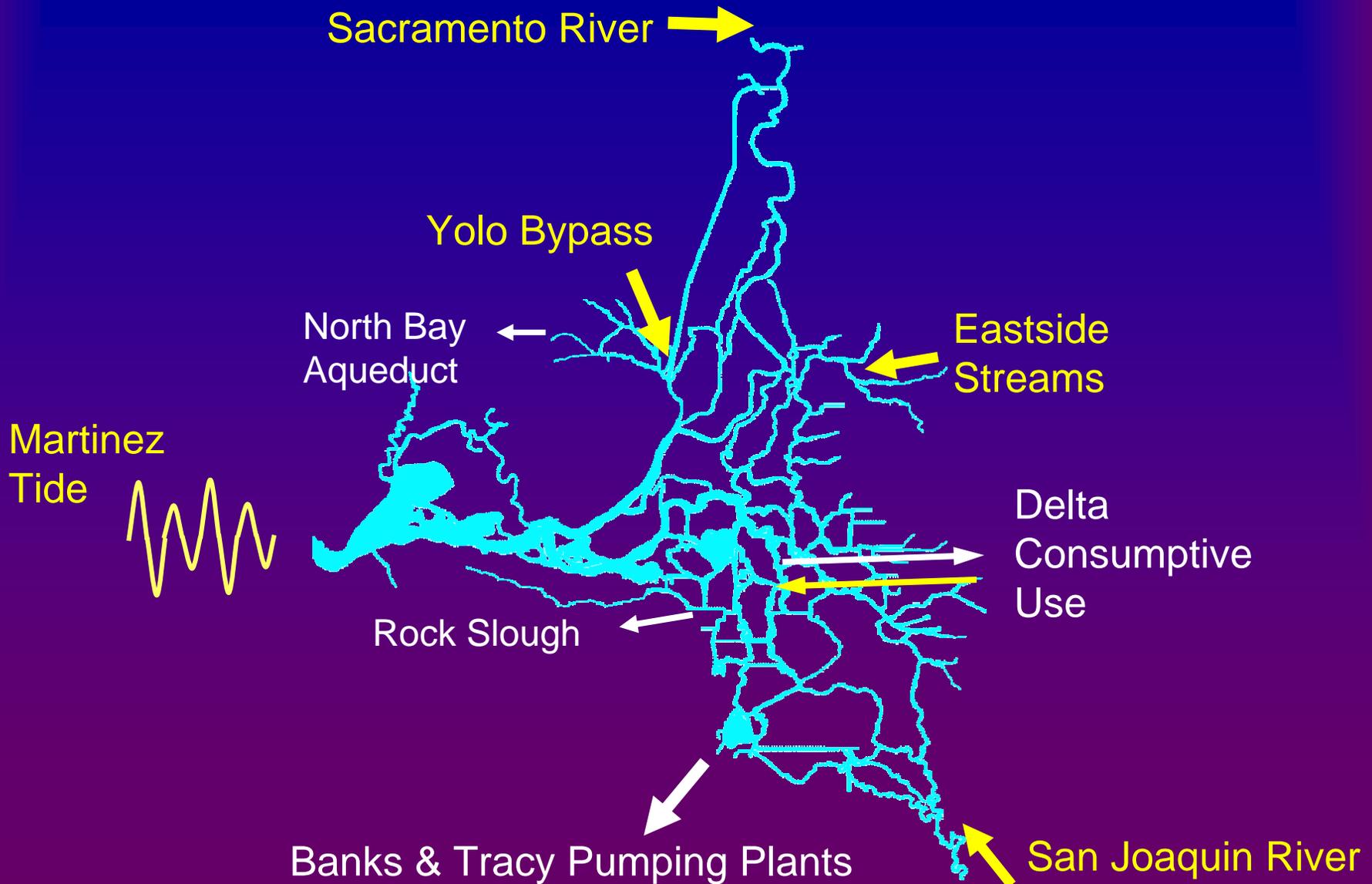
Model Scenarios



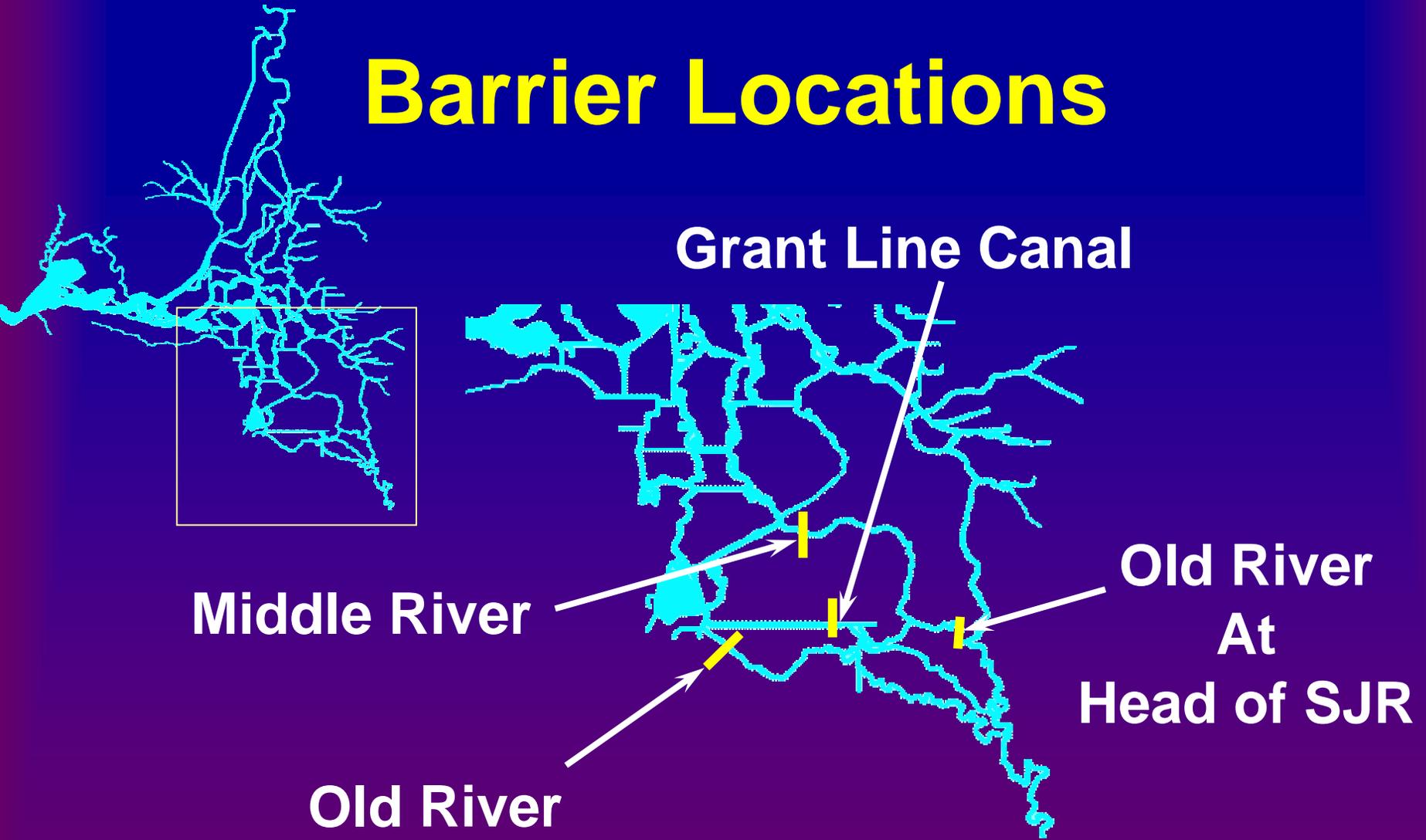
Methodology



Boundary Conditions

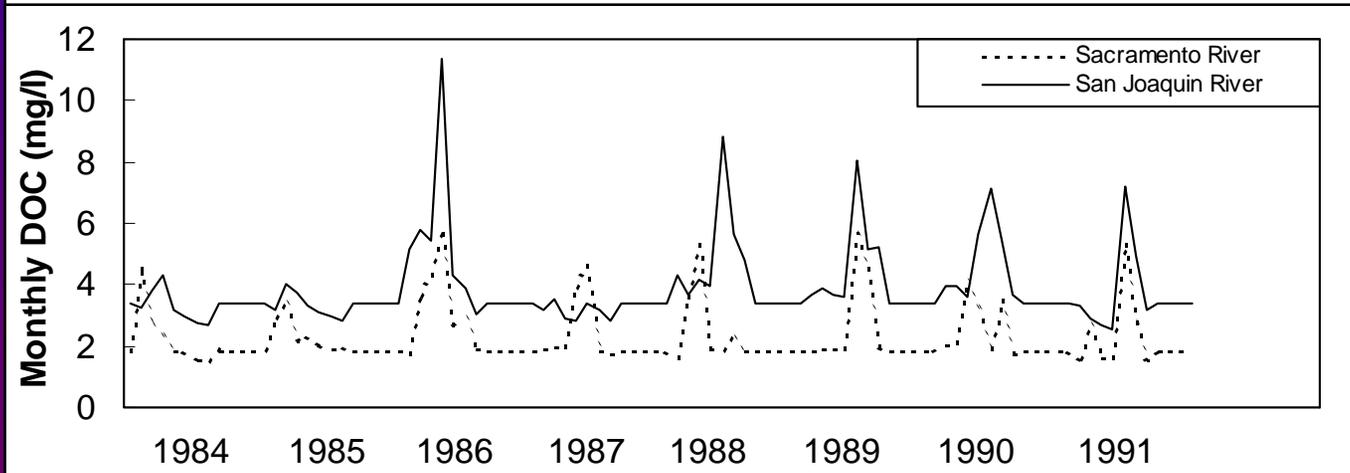
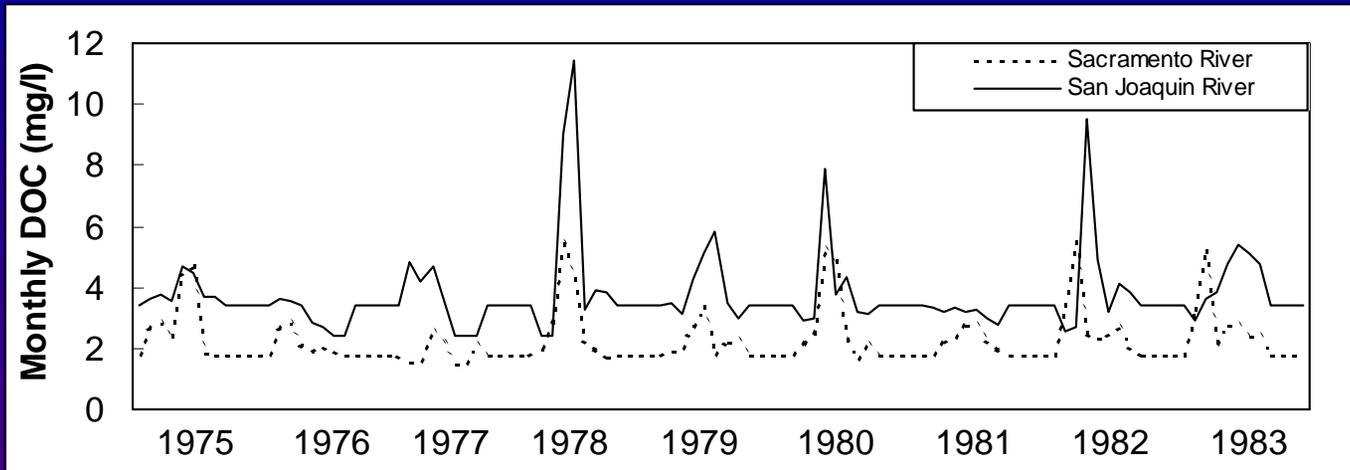


Barrier Locations

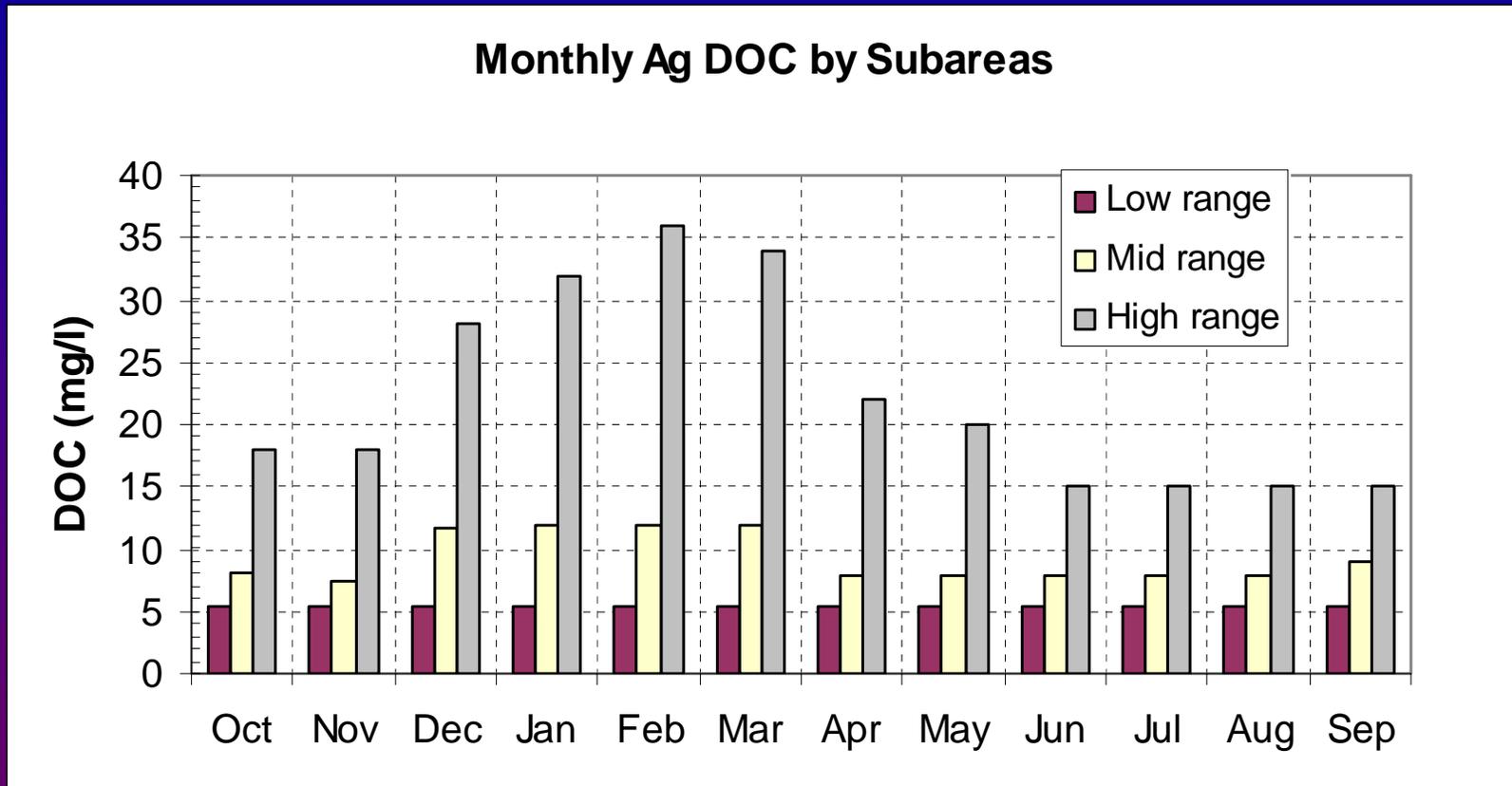


<i>Barrier</i>	<i>Oct</i>	<i>Nov</i>	<i>Dec</i>	<i>Jan</i>	<i>Feb</i>	<i>Mar</i>	<i>Apr</i>	<i>May</i>	<i>Jun</i>	<i>Jul</i>	<i>Aug</i>	<i>Sep</i>
Old River @ Head	■	■						■	■			
Old River @ Tracy	■						■	■	■	■	■	■
Middle River	■						■	■	■	■	■	■
Grant Line Canal									■	■	■	■

Inflow DOC Boundary Conditions



Monthly Ag DOC



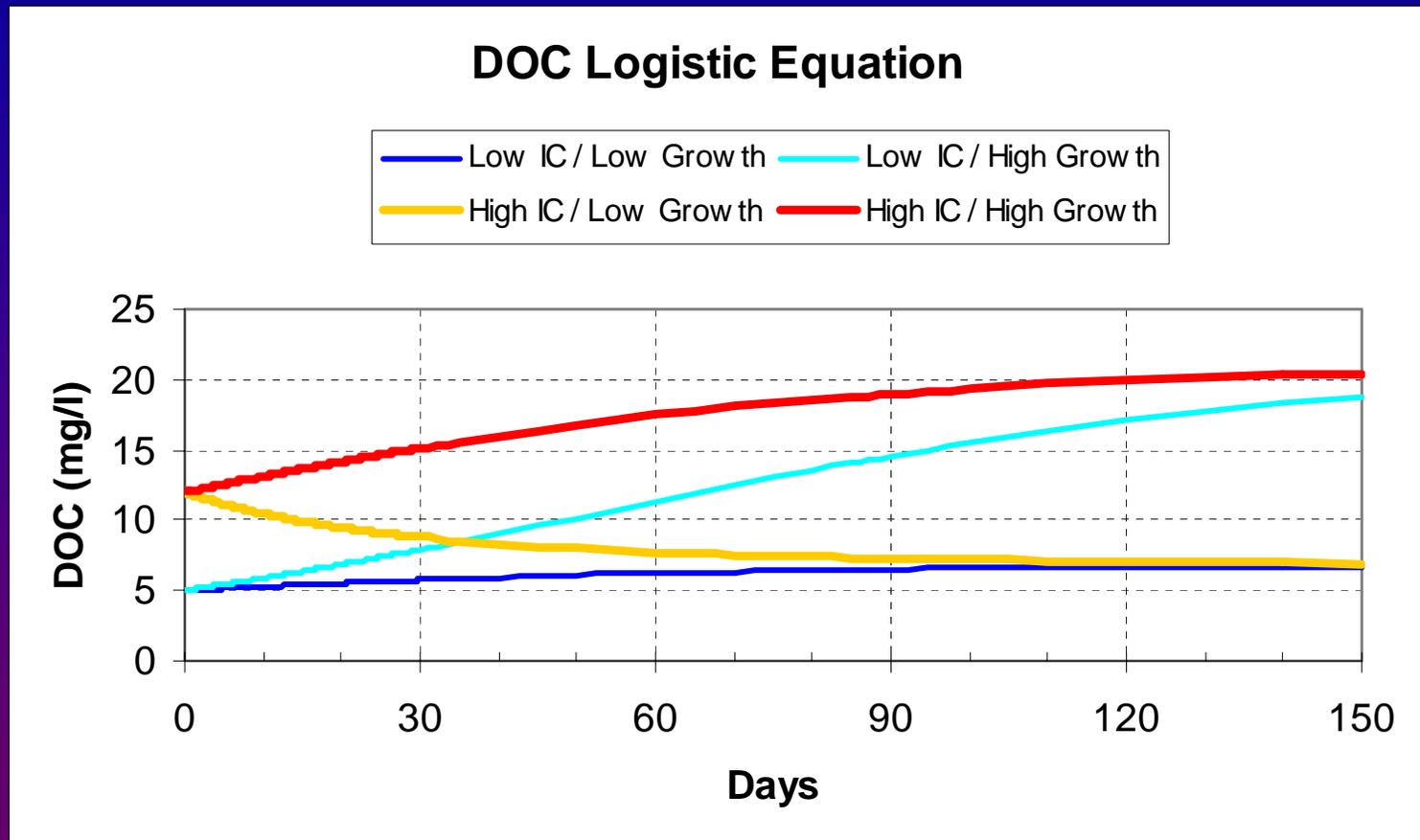
Source: *Revision of Representative Delta Island Return Flow Quality for DSM2 and DICU Model Runs, Municipal Water Quality Investigation Program. (2000)*

Flooded Island Module

$$DOC(t) = \frac{A}{1 + Be^{-kt}}$$

Bookend Scenario	A (mg/l)	k (days ⁻¹)	Ultimate DOC (mg/l)
Low	70	0.022	6.8
High	215	0.022	21.0

Sensitivity of DOC Logistic Equation



For more information see: Jung (2001) and Pandey (2002).



Methodology Summary

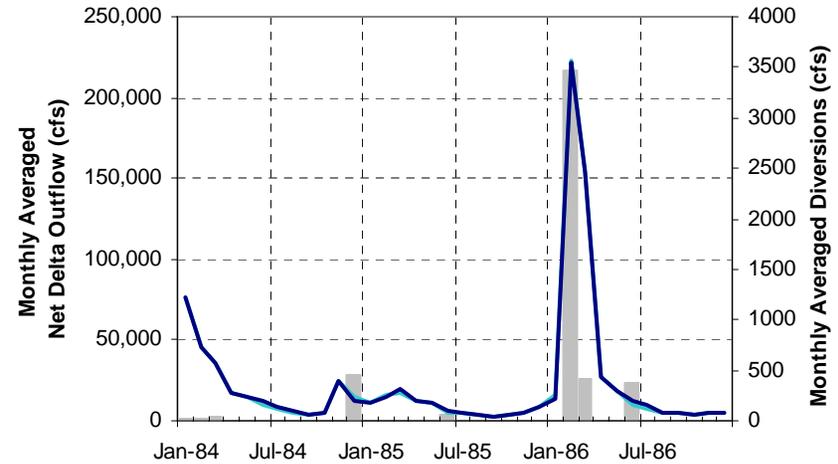
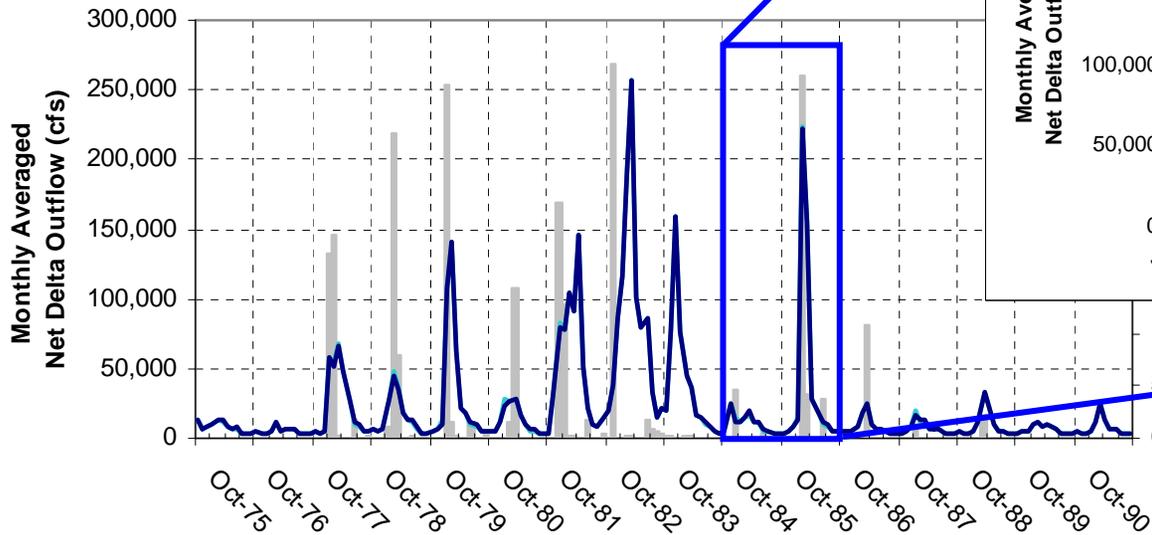
- Daily hydrology from CALSIM II
- Barriers used, but not operational in winter
- Monthly DOC concentrations at boundaries
- DOC concentration increased based on length of time water stored on reservoir
- Two “bookend” growth functions were used to represent ranges of increases of DOC in reservoirs



Hydrodynamic Results

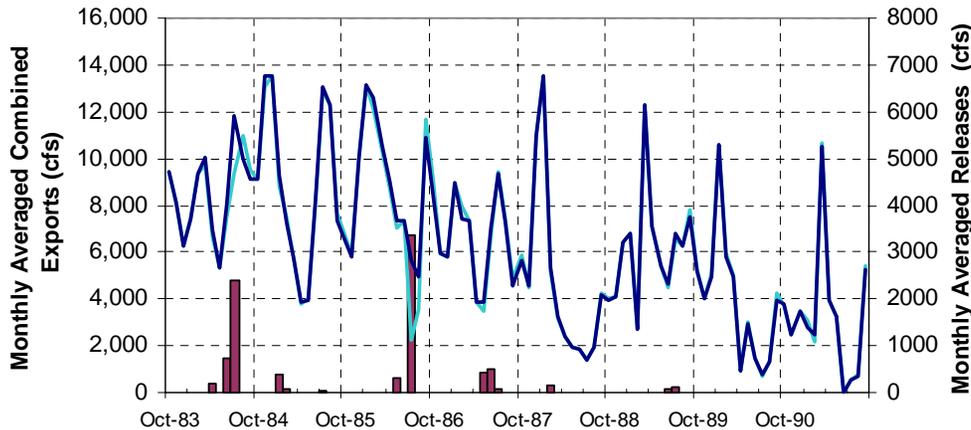
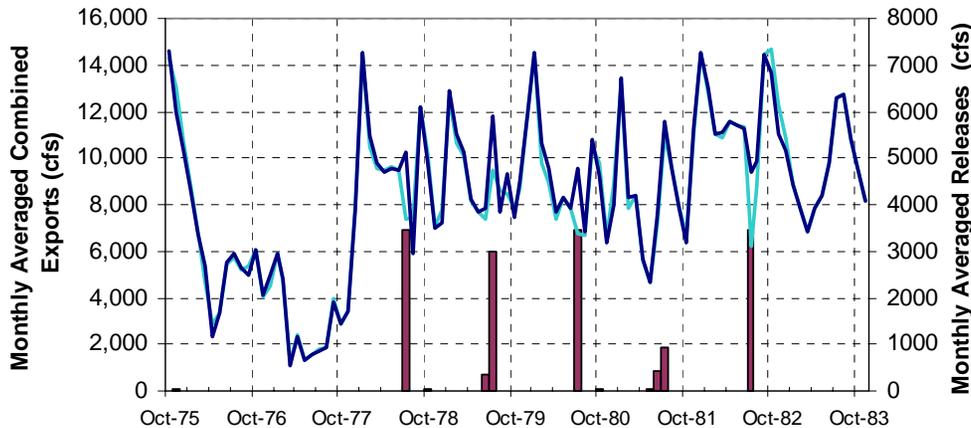
Net Delta Outflow / Project Diversions

■ Diversions — Base — w/ Project Diversions



Combined Exports / Project Releases

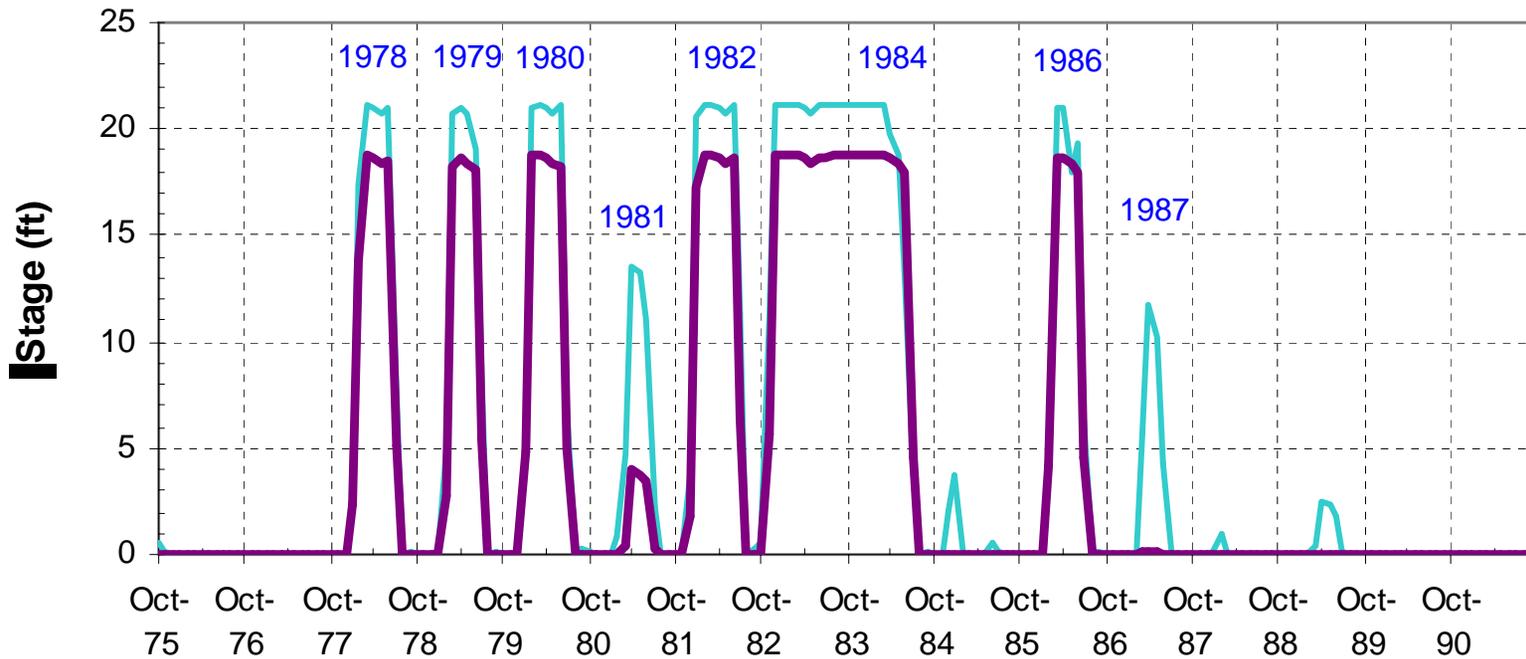
■ Releases — Base — w/ Project Releases



Release Year	Water Year Type	Max Monthly Ave Release (cfs)
1978	AN	3,461
1979	BN	2,973
1980	AN	3,445
1981	D	947
1982	W	3,449
1984	W	2,408
1986	W	3,372
1987	D	517

Stage on Project Islands

— Bacon Island — Webb Tract



Hydrodynamics Summary

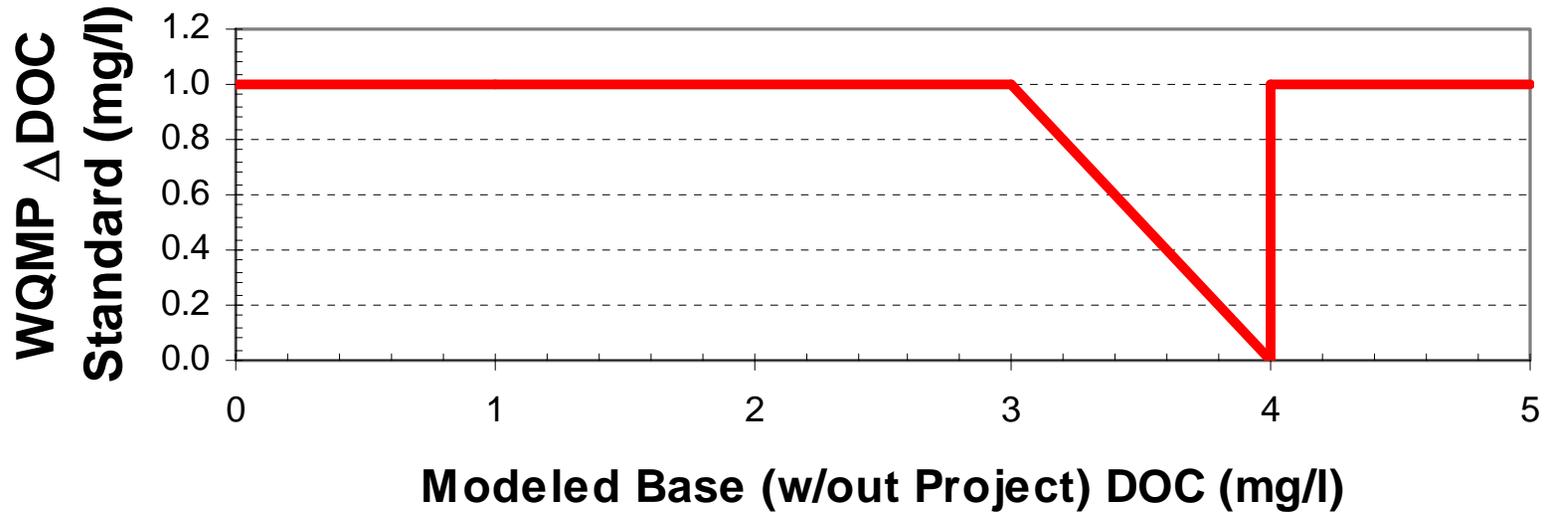
- 16-year run (1975-1991)
- Reservoir evaporation from CALSIM II
- Max stage on islands = 21'
- 8 major summer release periods (where max monthly ave. releases $> 1,000$ cfs)
- 7 major releases in July



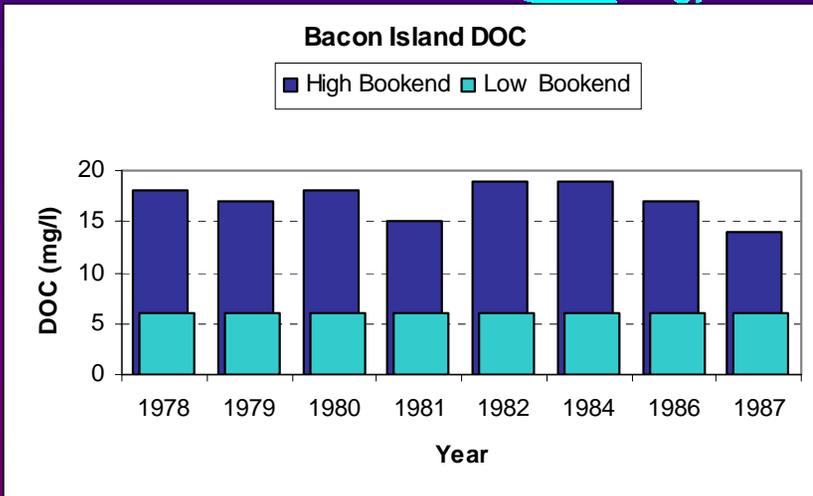
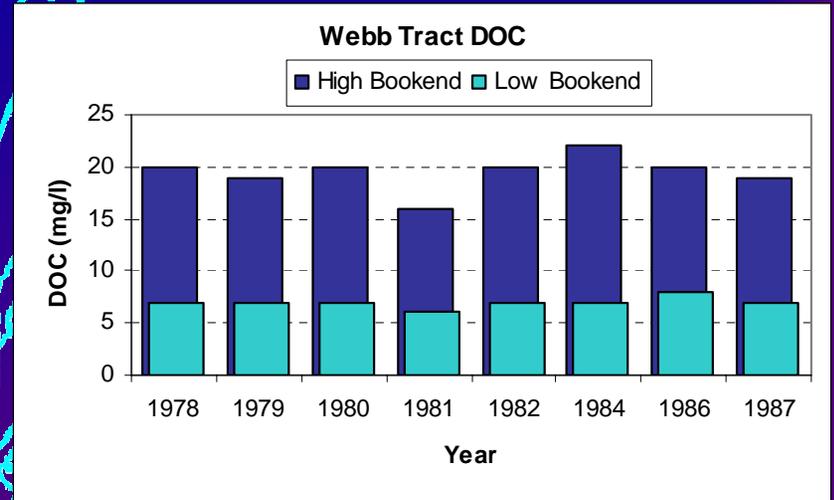
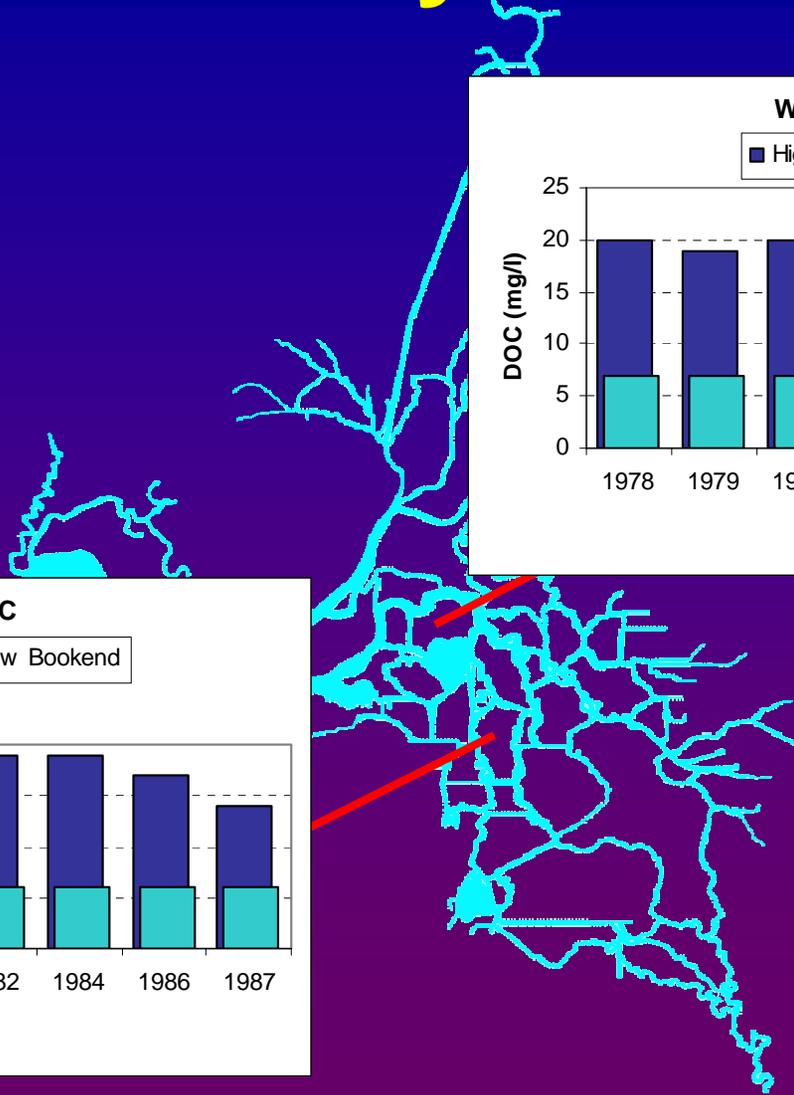
Water Quality Results

DOC Standard

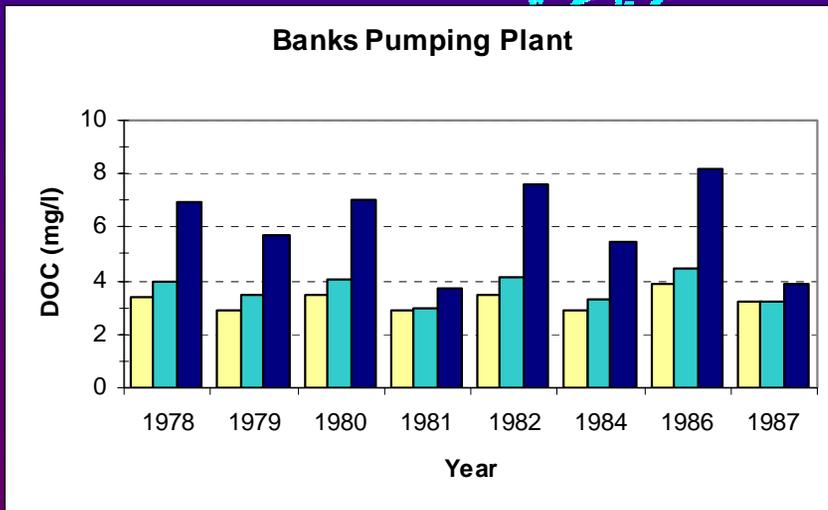
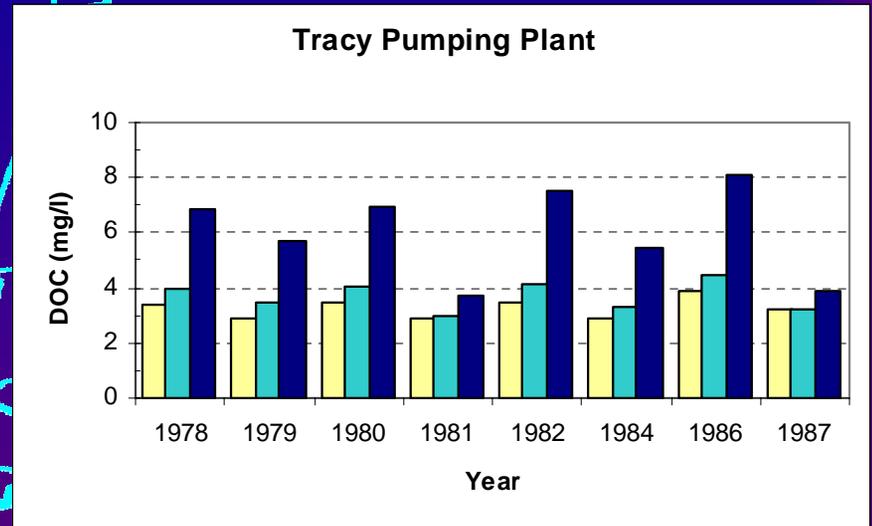
WQMP Incremental DOC Standard



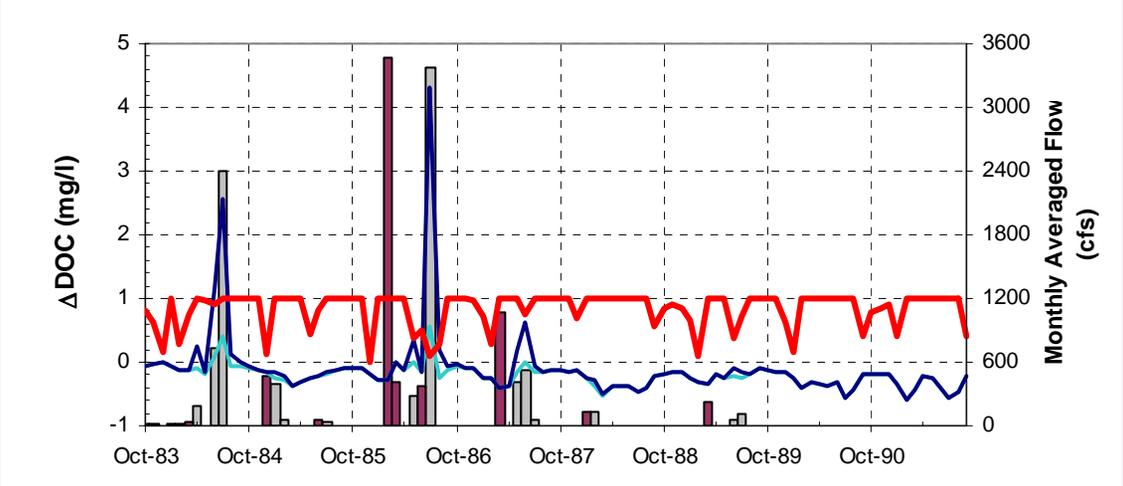
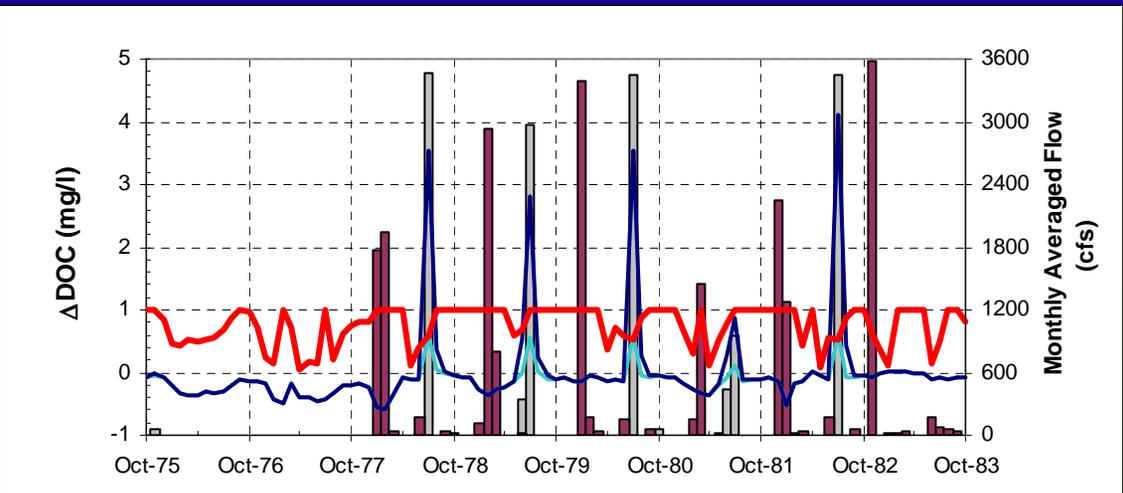
In-Delta Storage Release Water Quality Summary



In-Delta Storage Urban Water Quality Summary

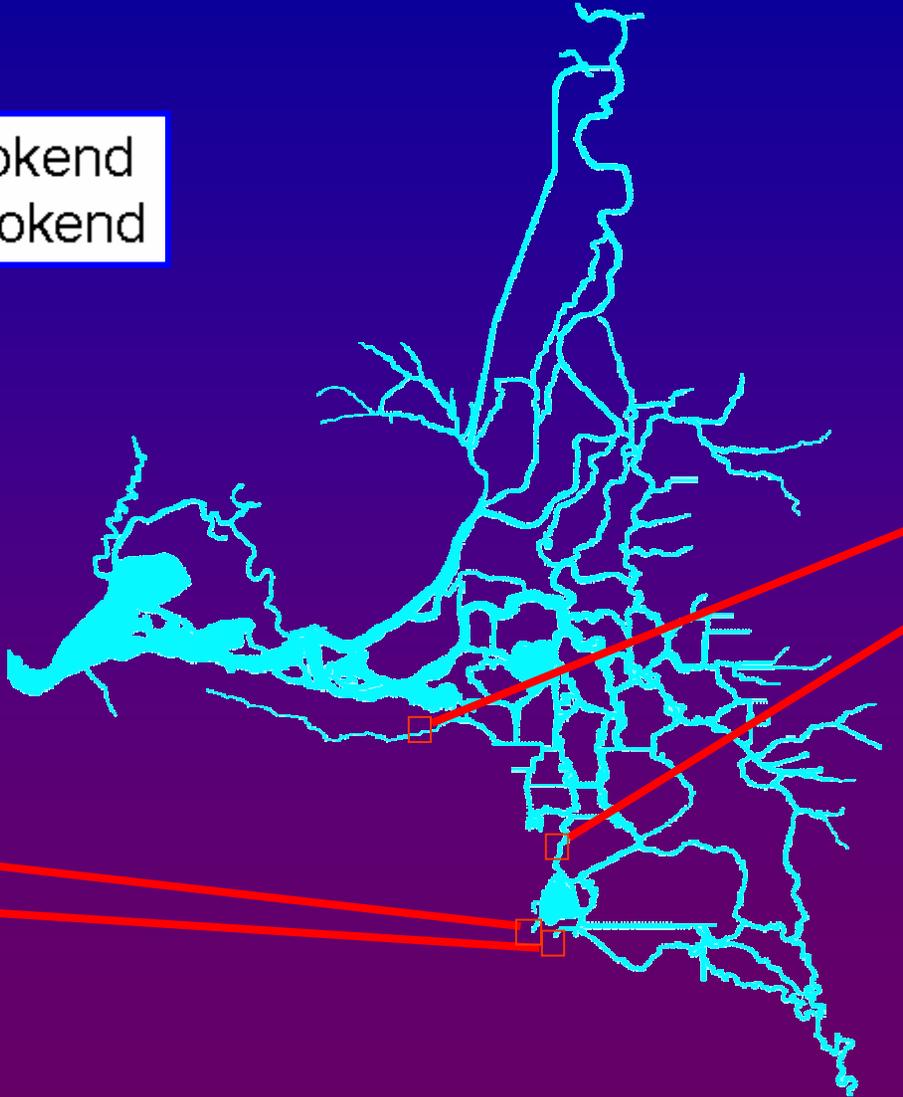


Change in DOC at Banks



WQMP Violations Summary

- Low Bookend
- High Bookend



Banks / Tracy

Release Period	DOC	
1978	•	•
1979		•
1980	•	•
1981		
1982	•	•
1984		•
1986	•	•
1987		

Rock Slough / LVR

Release Period	DOC	
1978		•
1979		•
1980		•
1981		
1982		•
1984		•
1986	•	•
1987		

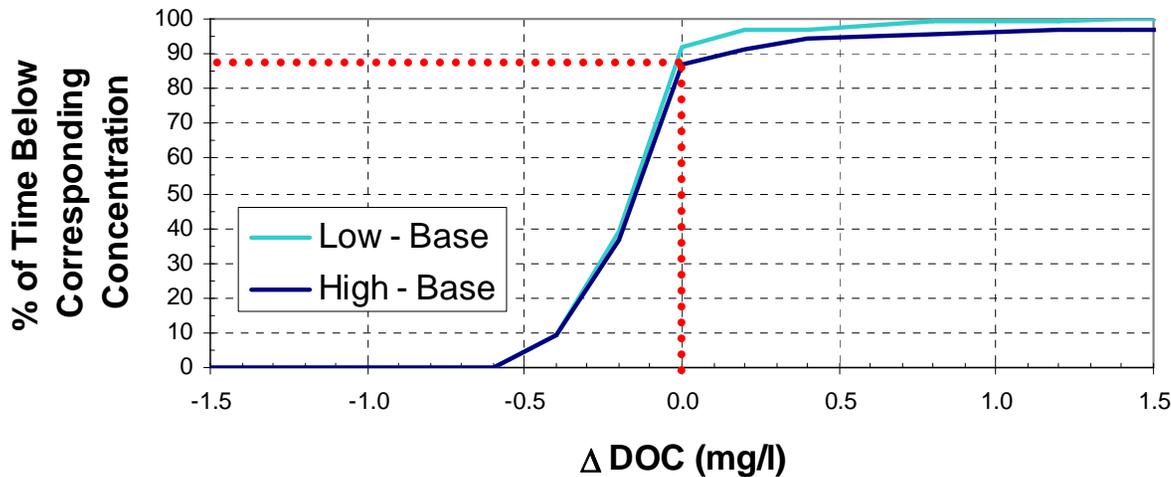


Cumulative Distribution

How frequently is the water quality standard violated?

Percent Time Δ DOC is Less Than X ...

Cumulative Distribution of DOC Change at Banks Pumping Plant



X	Low-Base	High-Base
0 mg/l	91.7	87.0
1 mg/l	99.5	96.4



Water Quality Summary

- Water Quality results based on a specific Project Operation (CALSIM II)
- ≤ 1 mg/l DOC standard assumed
- Significant difference between the low and high bookend DOC concentrations
- Difference between low and base DOC *typically* was less than 1 mg/l



Water Quality Summary (con't)

- 1/2 of the time *low DOC* releases from the Project violated the standard at Banks and Tracy Pumping Plants
- 1 *low DOC* release from the Project violated the standard at Rock Slough and Los Vaqueros
- High DOC release violations were frequent at all 4 urban intakes



Future Directions

- Re-operate CALSIM II to minimize low DOC violations
- Develop and use an improved theoretical model for the growth of DOC in the reservoirs
- Examine daily water quality results
- Continue to look at cumulative distribution frequencies of results



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