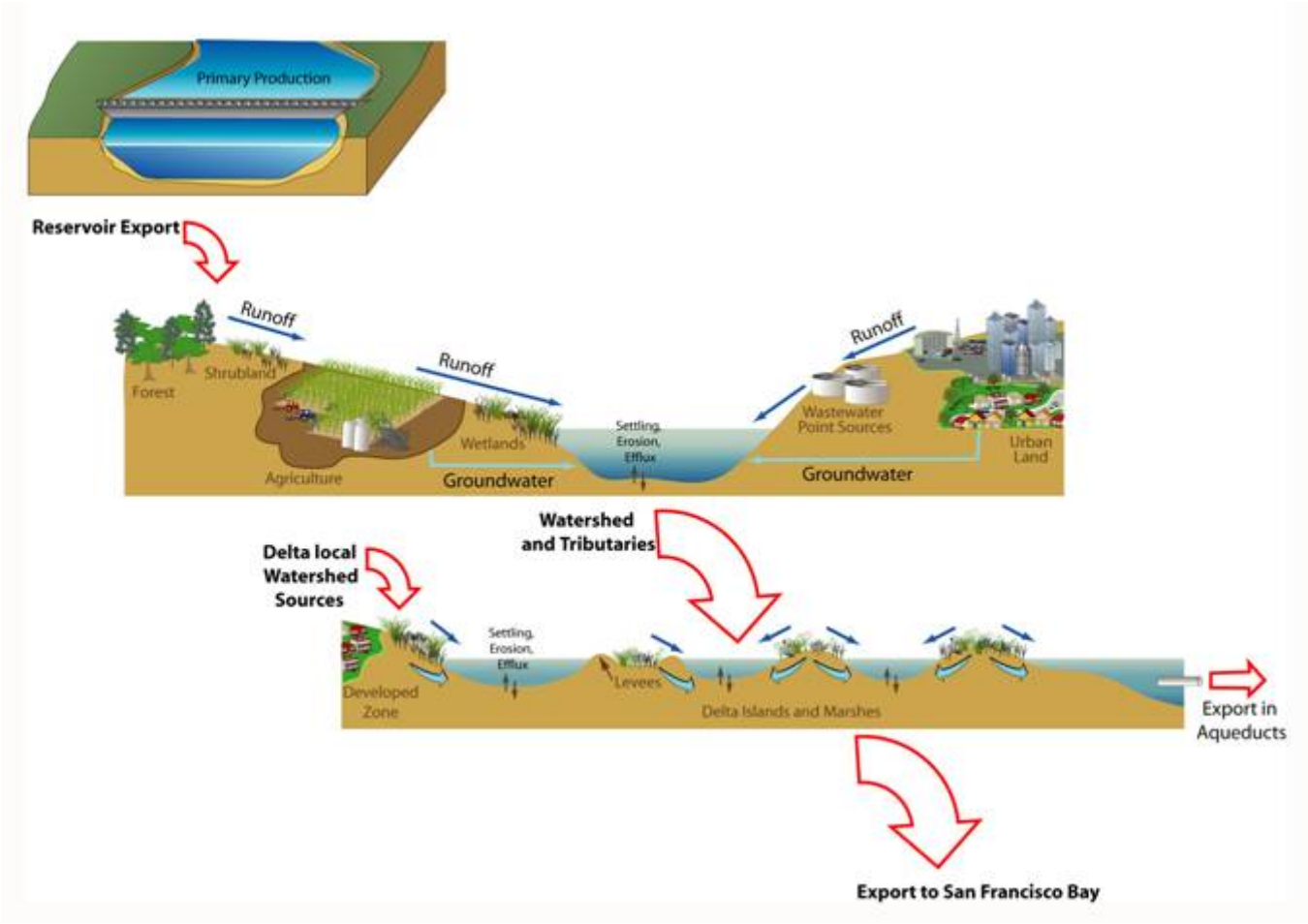
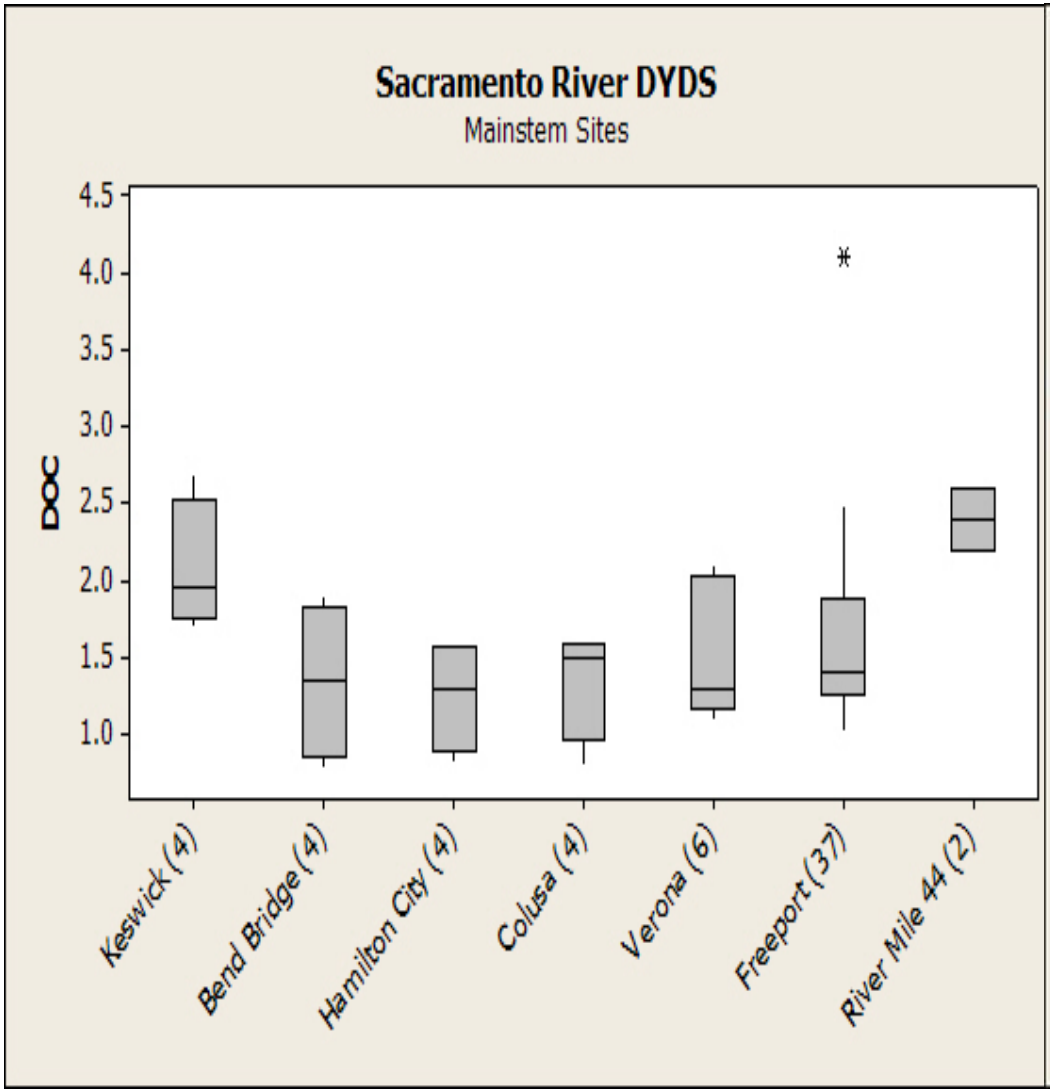
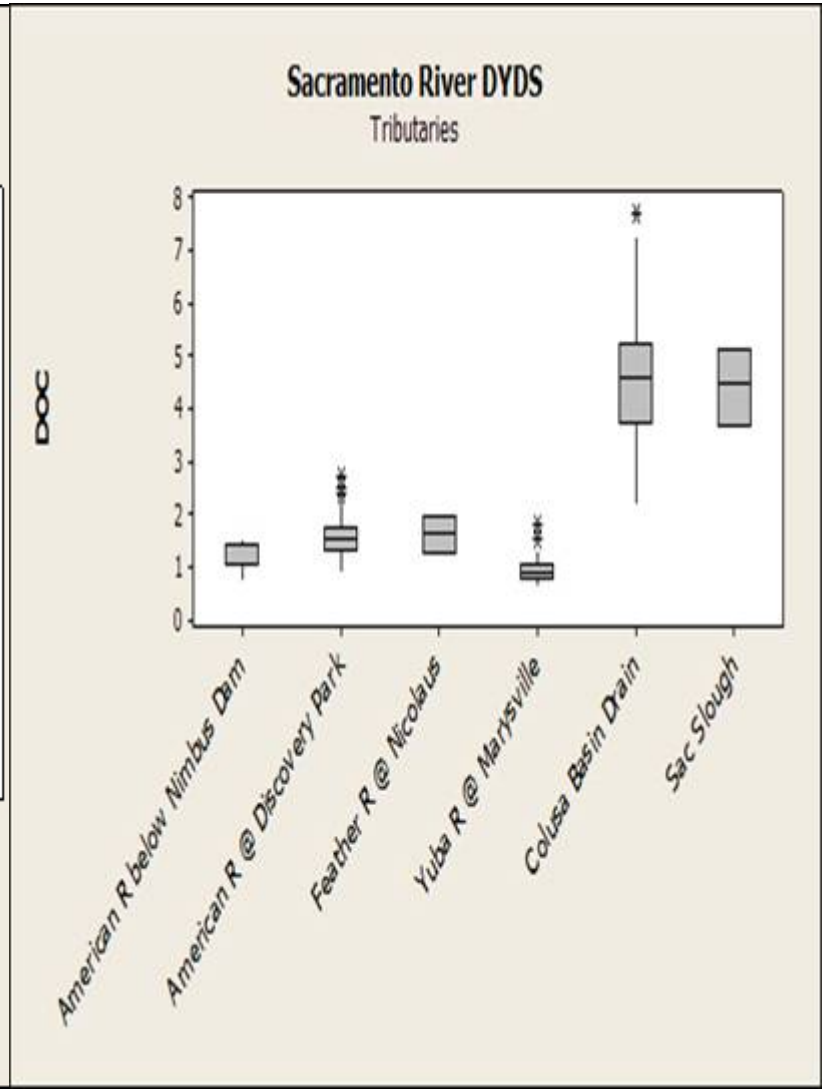
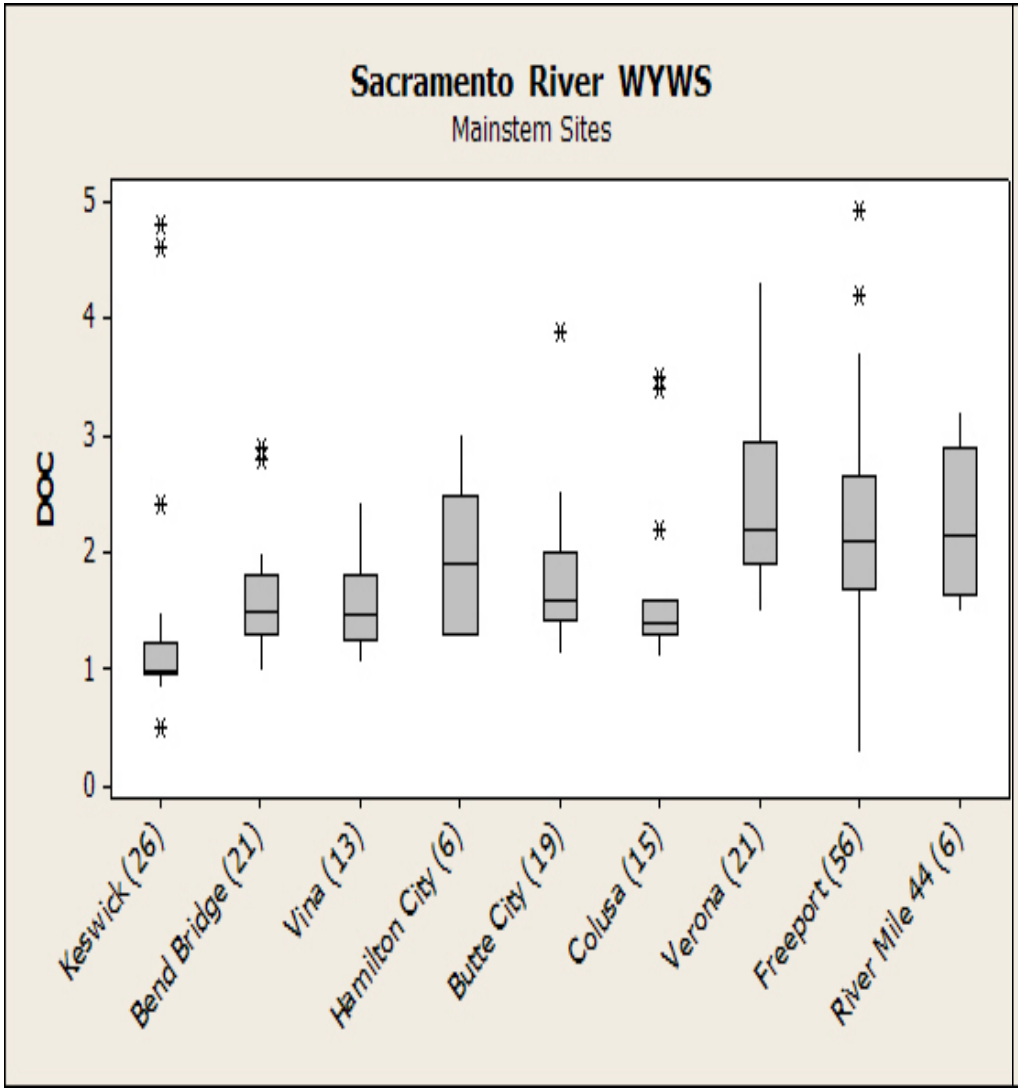
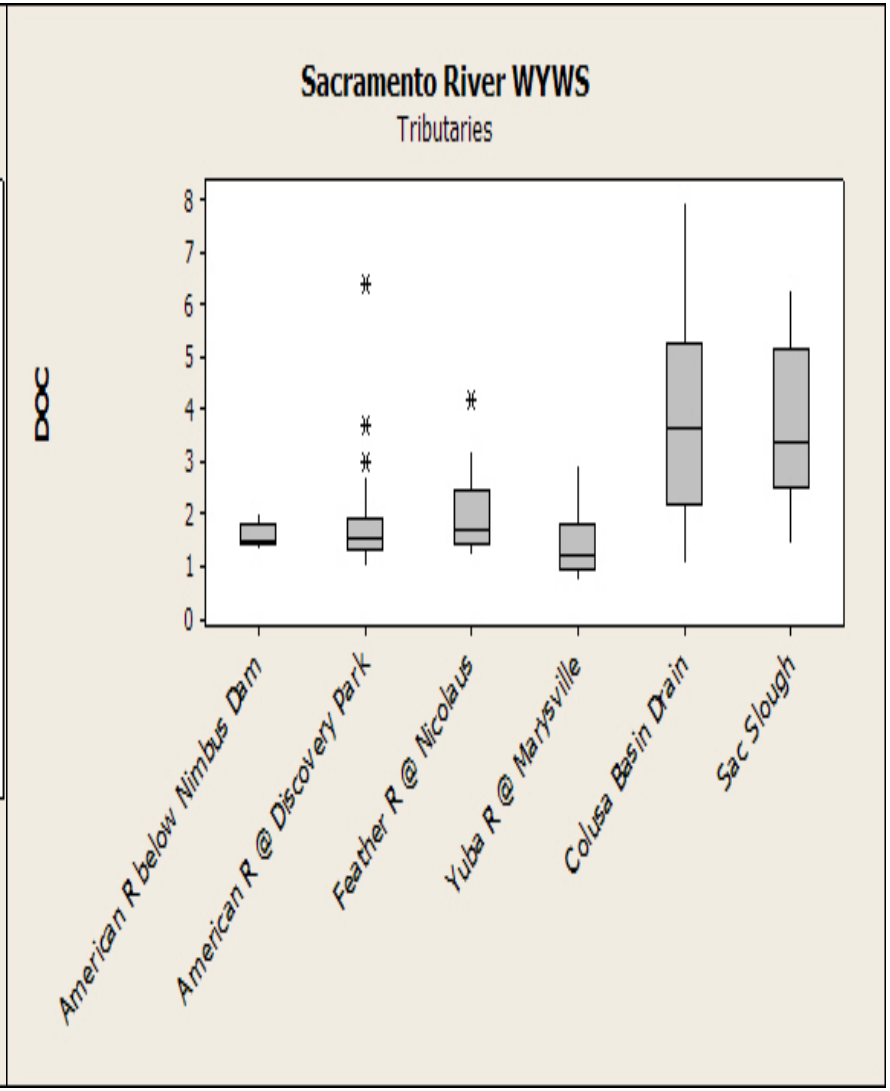
Organic Carbon cycling in the Central Valley, Delta

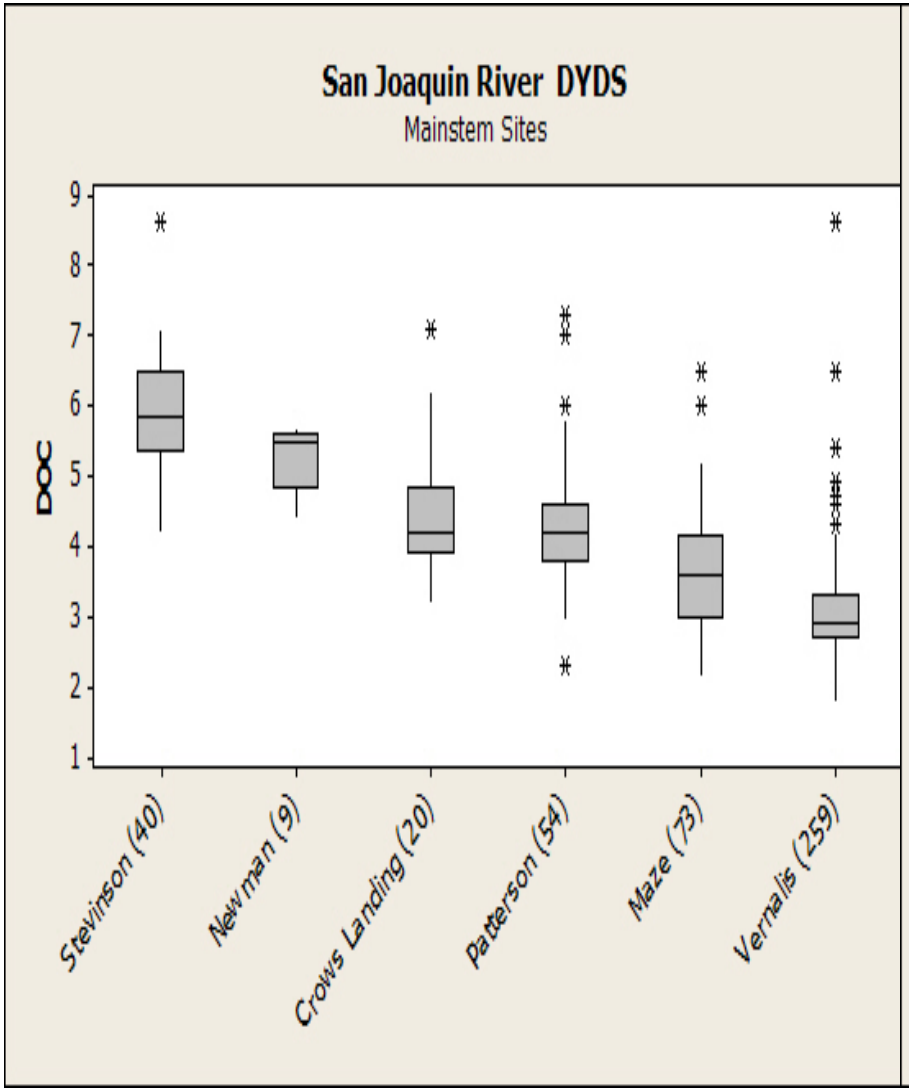


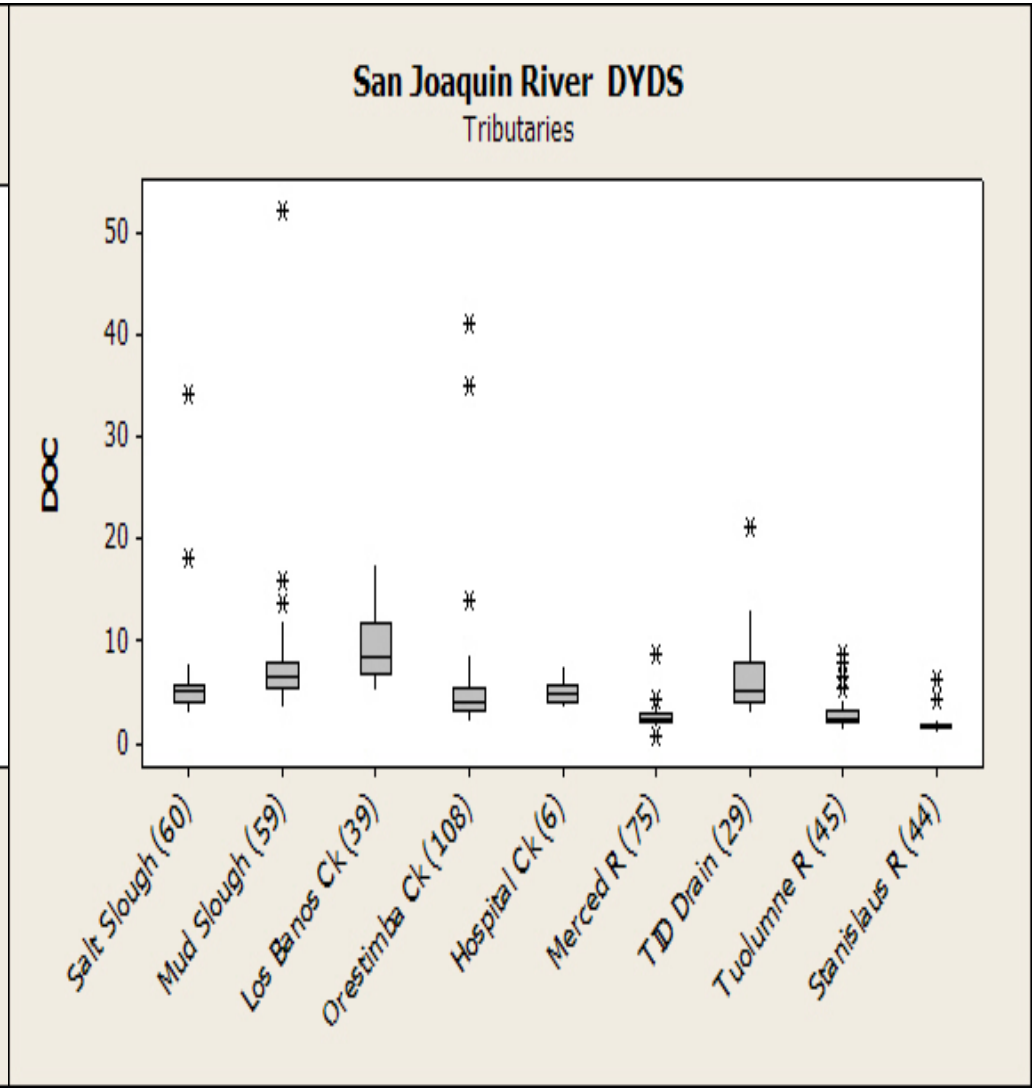

Sacramento River DYDS
Mainstem Sites
DOC
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
Keswick (4)
Bend Bridge (4)
Hamilton City (4)
Colusa (4)
Verona (6)
Freeport (37)
River Mile 44 (2)

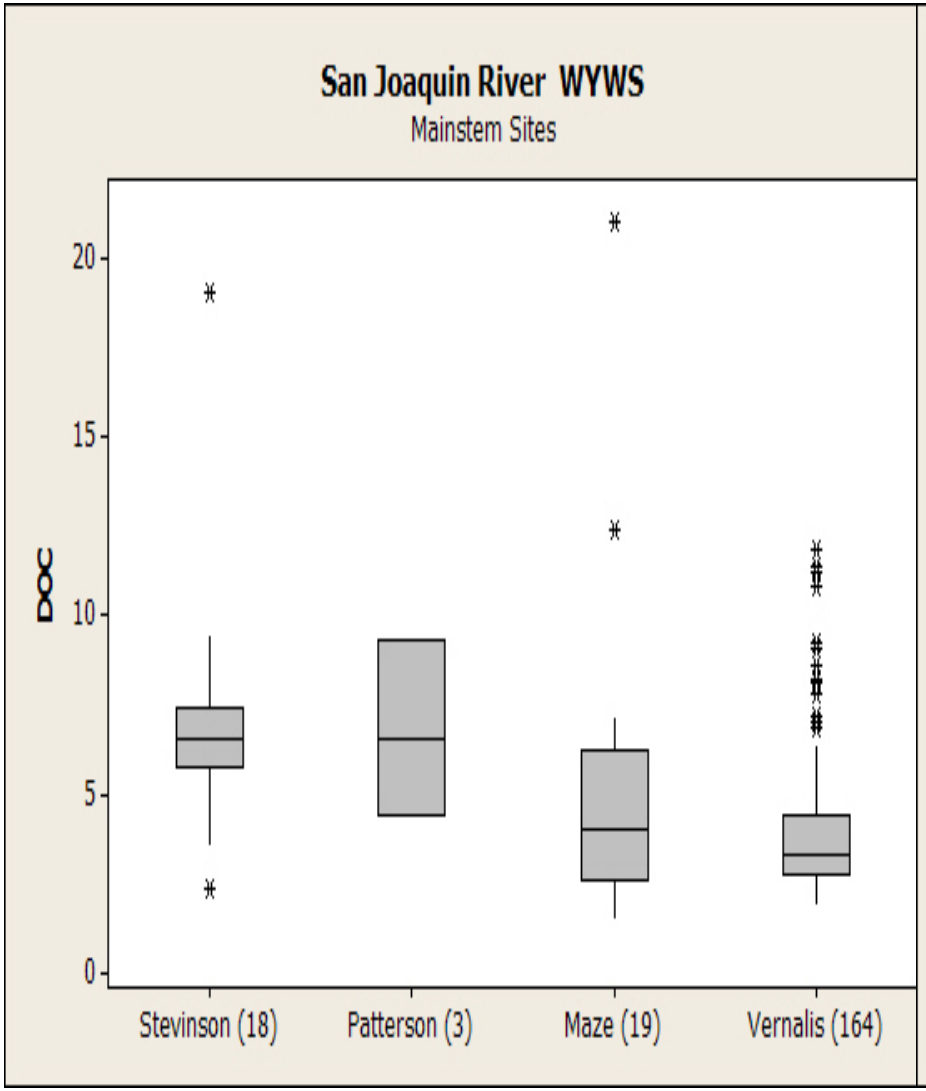

Sacramento River DYDS
Tributaries
DOC
8
7
6
5
4
3
2
1
0
American R below Nimbus Dam
American R @ Discovery Park
Feather R @ Nicolaus
Yuba R @ Marysville
Colusa Basin Drain
Sac Slough

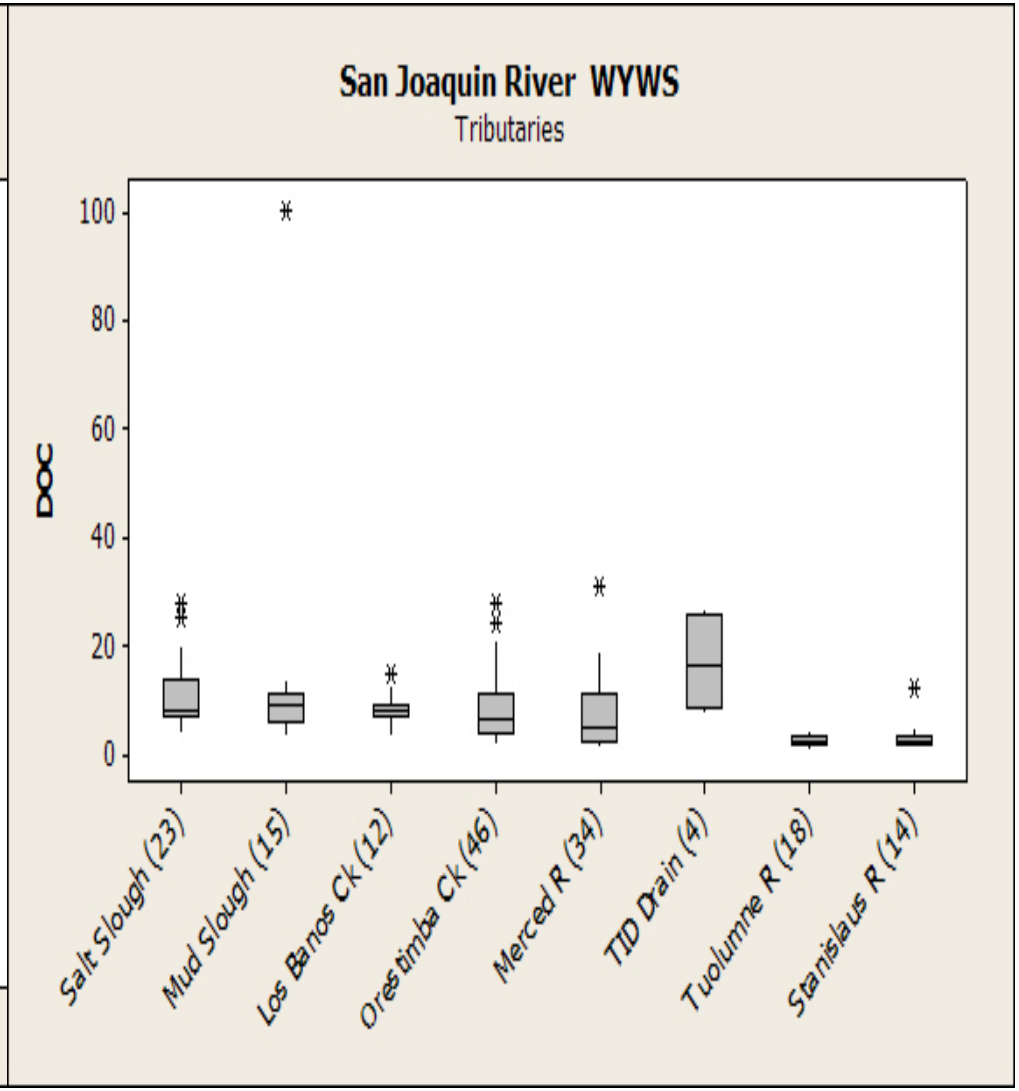

Sacramento River WYWS
Mainstem Sites
DOC
0
1
2
3
4
5
Keswick (26)
Bend Bridge (21)
Vina (13)
Hamilton City (6)
Butte City (19)
Colusa (15)
Verona (21)
Freeport (56)
River Mile 44 (6)


Sacramento River WYWS
Tributaries
DOC
0
1
2
3
4
5
6
7
8
American R below Nimbus Dam
American R @ Discovery Park
Feather R @ Nicolaus
Yuba R @ Marysville
Colusa Basin Drain
Sac Slough

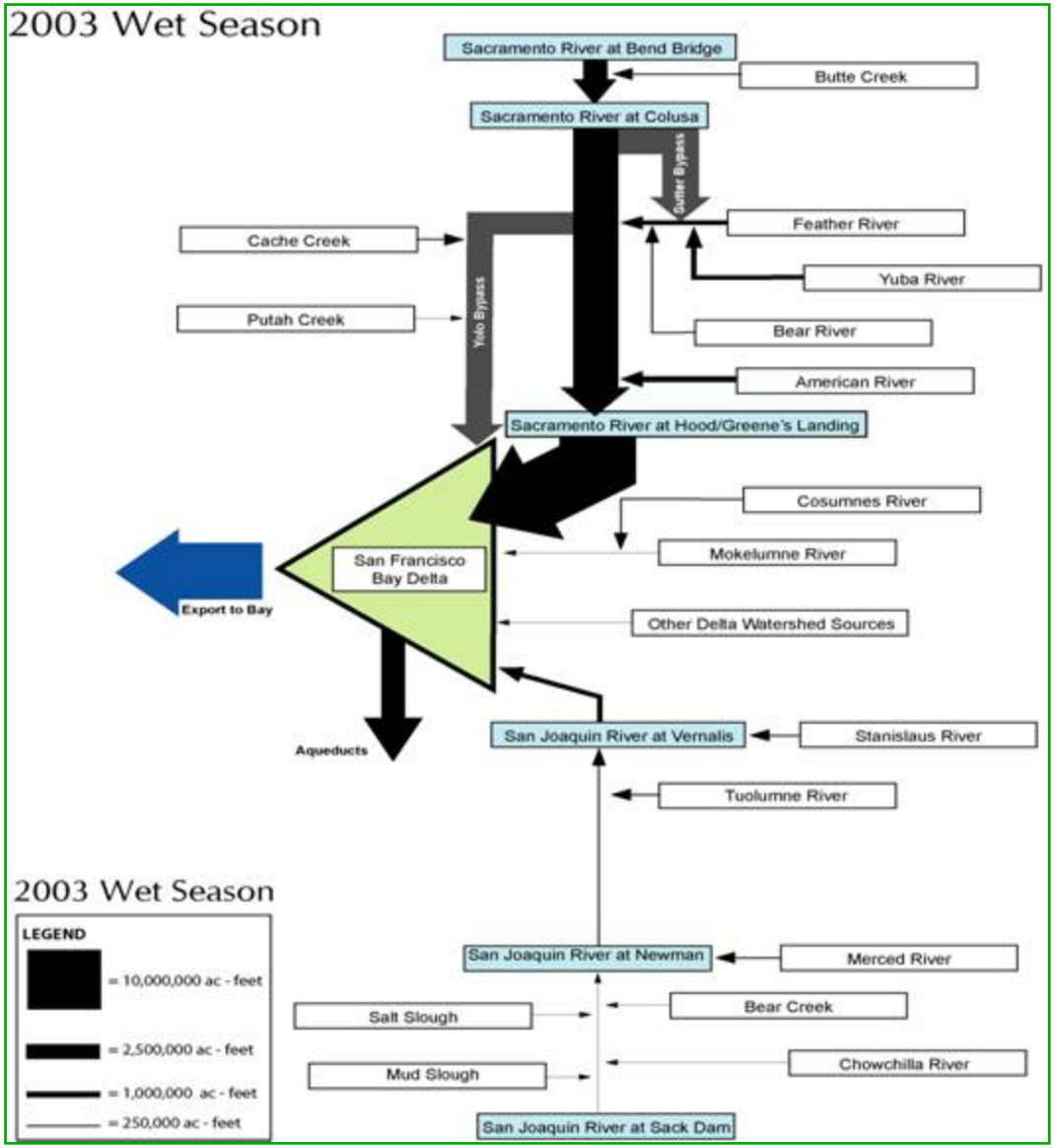

San Joaquin River DYDS
Mainstem Sites
DOC
9
8
7
6
5
4
3
2
1
Stevinson (40)
Newman (9)
Crows Landing (20)
Patterson (54)
Maze (73)
Vernalis (259)

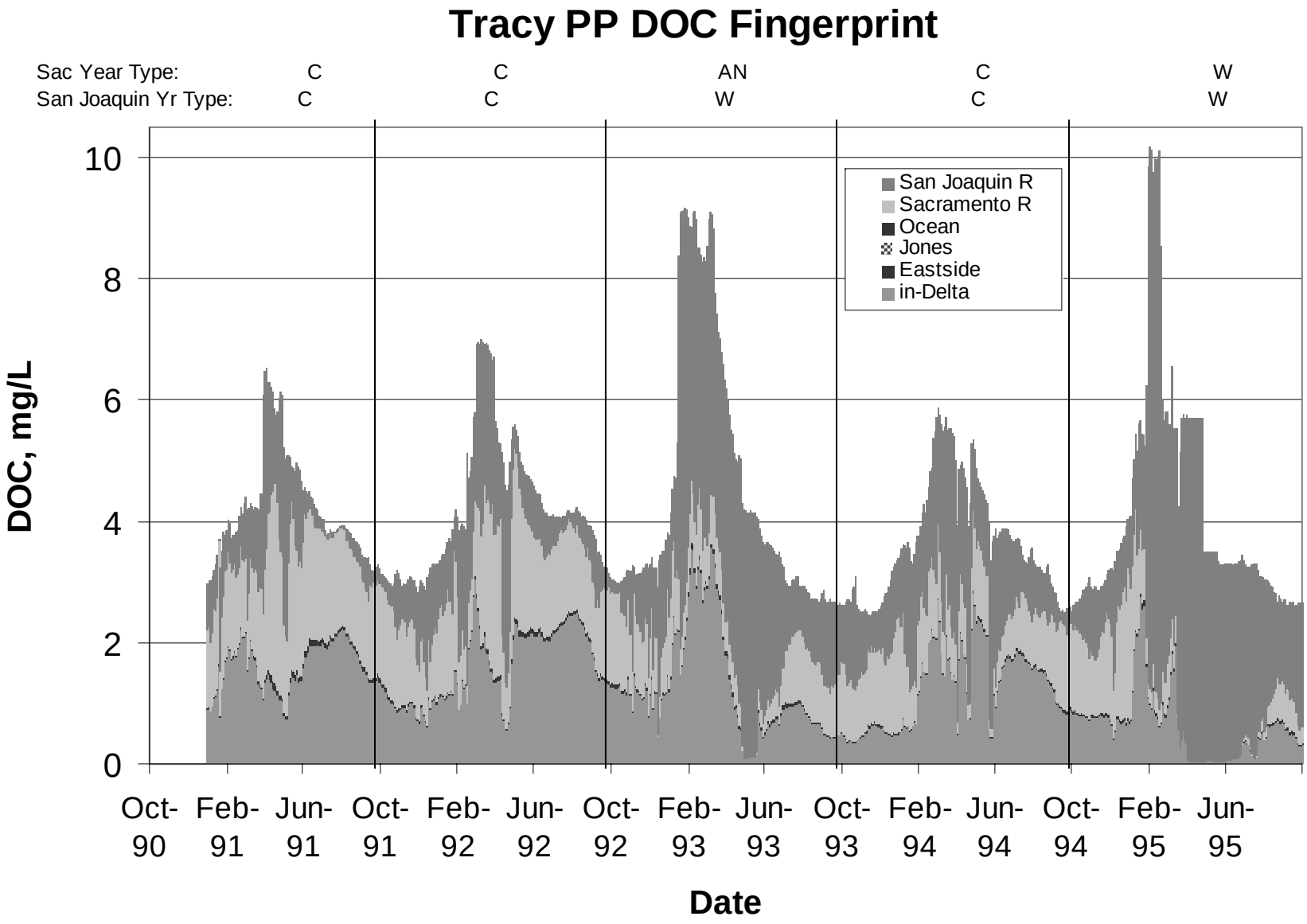

San Joaquin River DYDS
Tributaries
DOC
50
40
30
20
10
0
Salt Slough (60)
Mud Slough (59)
Los Banos Ck (39)
Orestimba Ck (108)
Hospital Ck (6)
Merced R (75)
TID Drain (29)
Tuolumne R (45)
Stanislaus R (44)

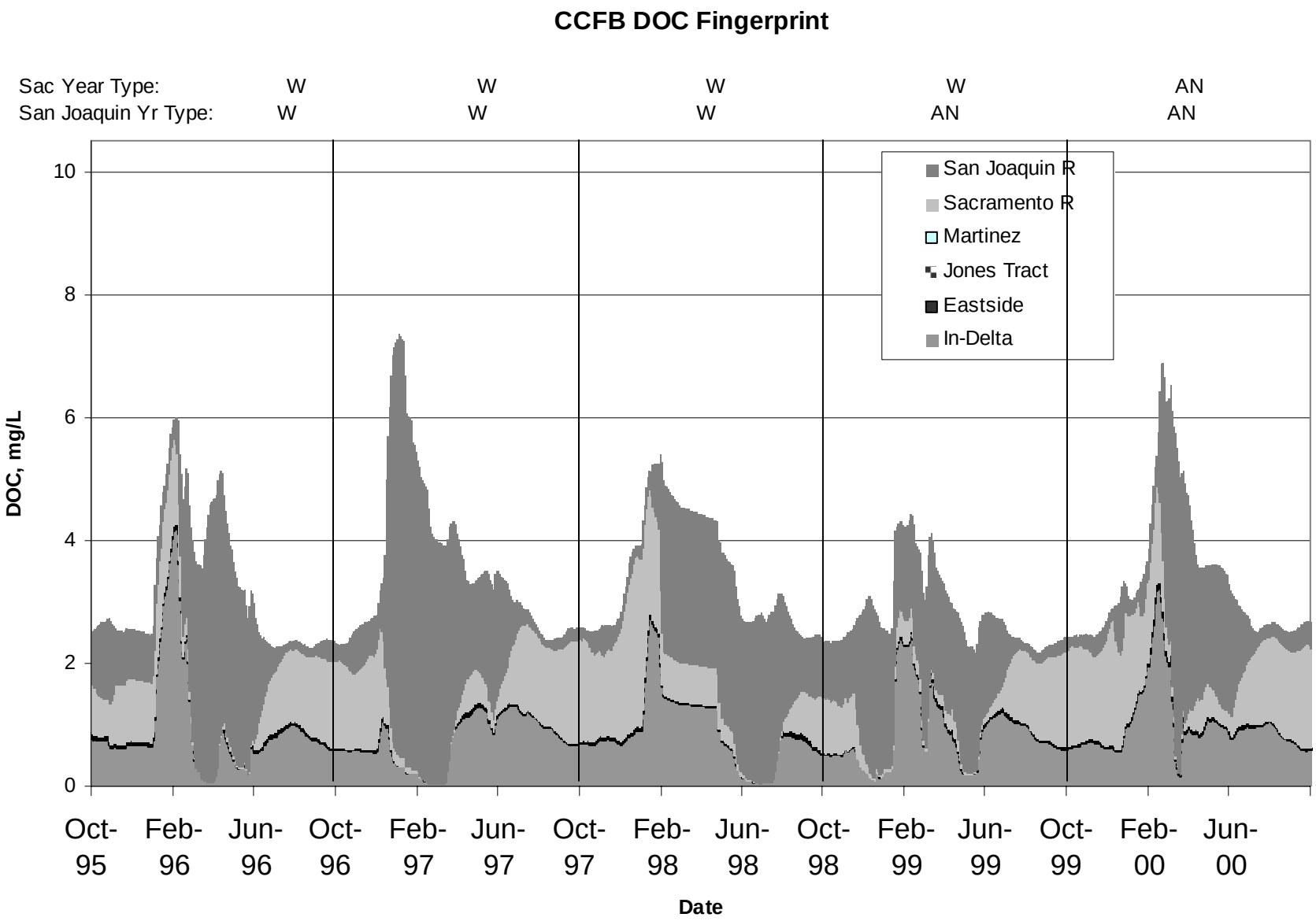

San Joaquin River WYWS
Mainstem Sites
DOC
0
5
10
15
20
Stevinson (18)
Patterson (3)
Maze (19)
Vernalis (164)

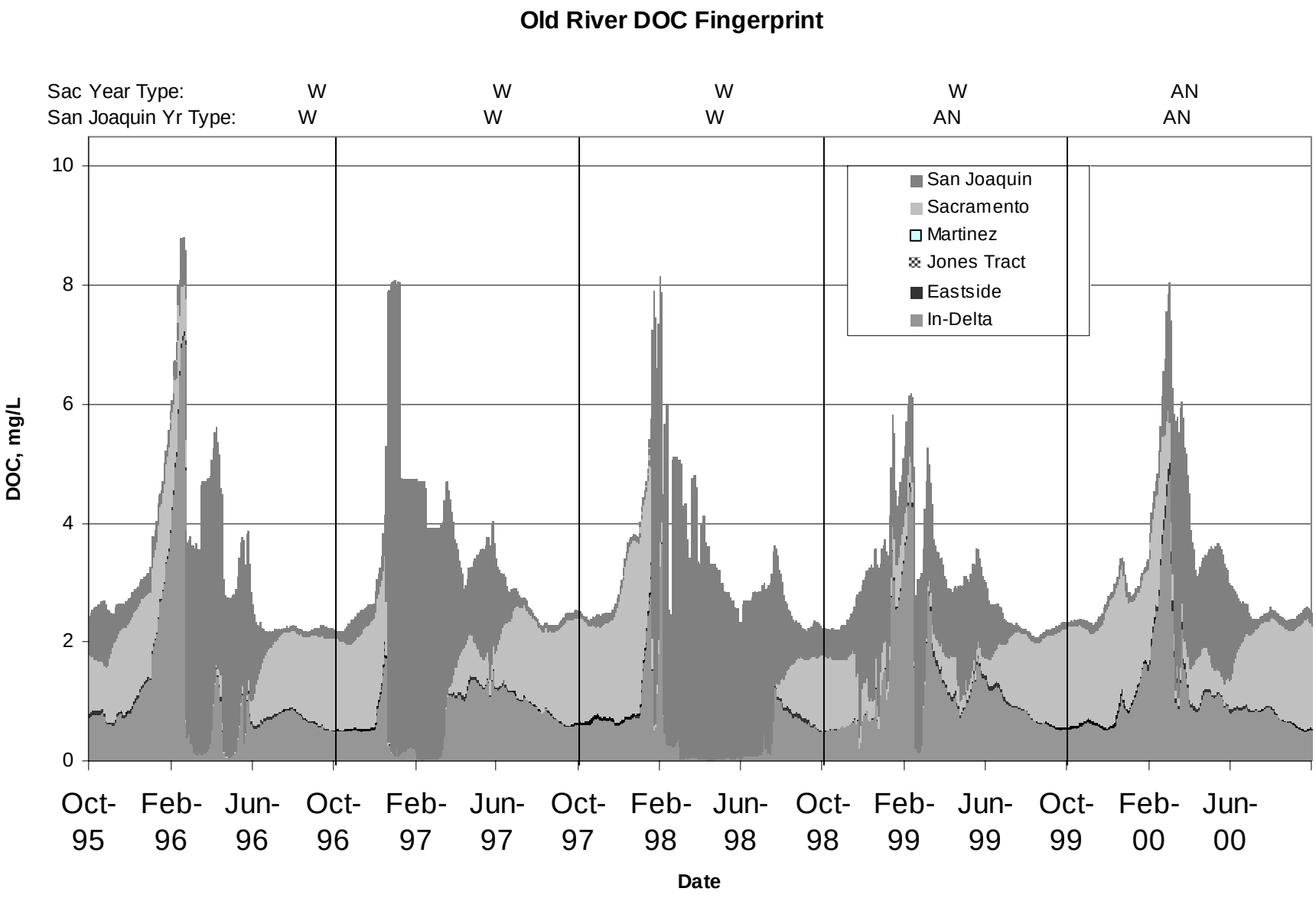

San Joaquin River WYWS
Tributaries
DOC
0
20
40
60
80
100
Salt Slough (23)
Mud Slough (15)
Los Banos Ck (12)
Orestimba Ck (46)
Merced R (34)
TID Drain (4)
Tuolumne R (18)
Stanislaus R (14)

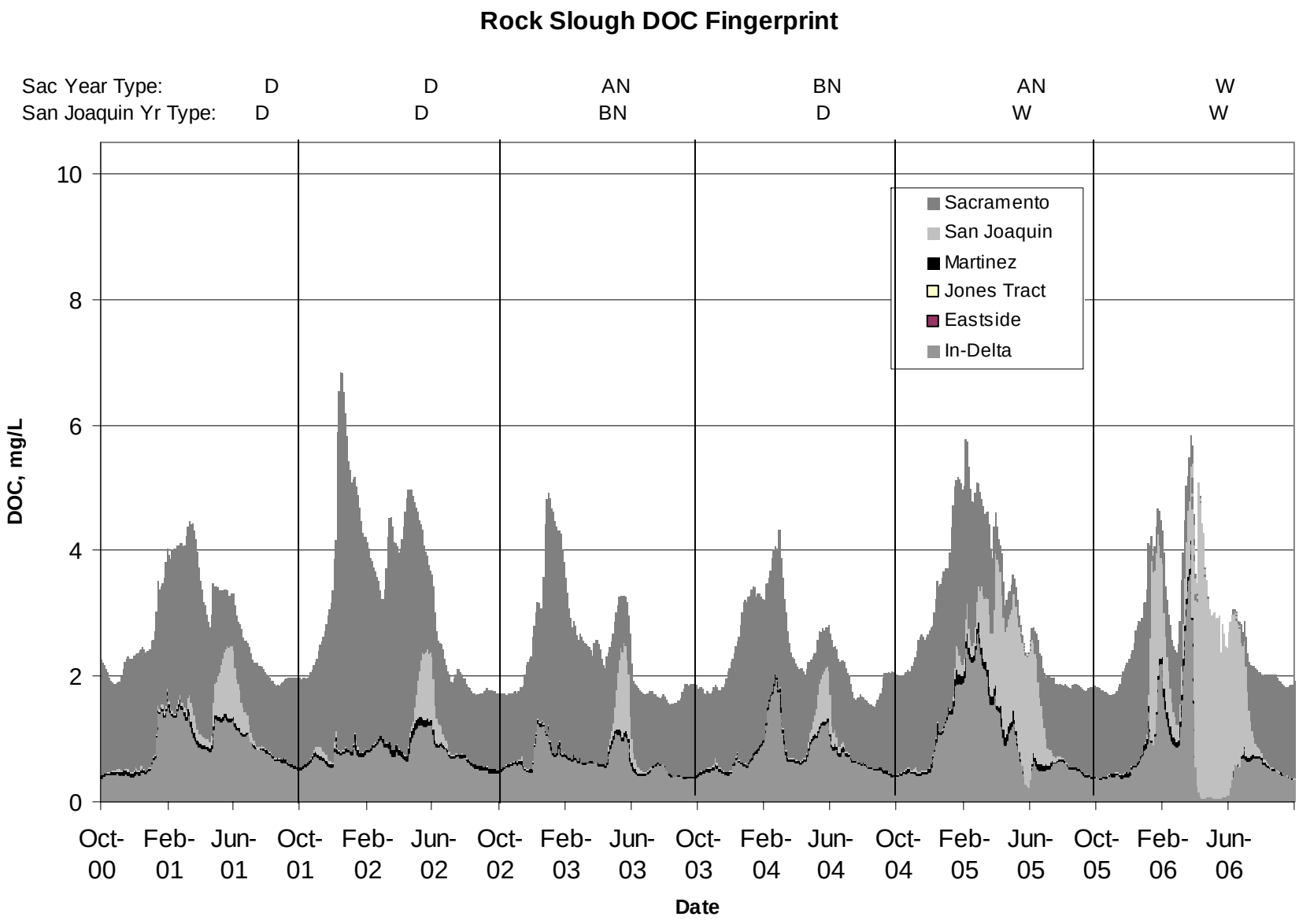
Flows in the Wet Season of 2003




Tracy PP DOC Fingerprint
Sac Year Type: C C AN C W
San Joaquin Yr Type: C C W C W
San Joaquin R
Sacramento R
Ocean
Jones
Eastside
in-Delta
DOC, mg/L
0
2
4
6
8
10
Oct-90
Feb-91
Jun-91
Oct-91
Feb-92
Jun-92
Oct-92
Feb-93
Jun-93
Oct-93
Feb-94
Jun-94
Oct-94
Feb-95
Jun-95
Date


CCFB DOC Fingerprint
Sac Year Type: W W W W AN
San Joaquin Yr Type: W W W AN AN
San Joaquin R
Sacramento R
Martinez
Jones Tract
Eastside
In-Delta
DOC, mg/L
0
2
4
6
8
10
Oct-95
Feb-96
Jun-96
Oct-96
Feb-97
Jun-97
Oct-97
Feb-98
Jun-98
Oct-98
Feb-99
Jun-99
Oct-99
Feb-00
Jun-00
Date


Old River DOC Fingerprint
Sac Year Type: W W W W AN
San Joaquin Yr Type: W W W AN AN
San Joaquin
Sacramento
Martinez
Jones Tract
Eastside
In-Delta
DOC, mg/L
0
2
4
6
8
10
Oct-95
Feb-96
Jun-96
Oct-96
Feb-97
Jun-97
Oct-97
Feb-98
Jun-98
Oct-98
Feb-99
Jun-99
Oct-99
Feb-00
Jun-00
Date


Rock Slough DOC Fingerprint
Sac Year Type: D D AN BN AN W
San Joaquin Yr Type: D D BN D W W
Sacramento
San Joaquin
Martinez
Jones Tract
Eastside
In-Delta
DOC, mg/L
0
2
4
6
8
10
Oct-00
Feb-01
Jun-01
Oct-01
Feb-02
Jun-02
Oct-02
Feb-03
Jun-03
Oct-03
Feb-04
Jun-04
Oct-04
Feb-05
Jun-05
Oct-05
Feb-06
Jun-06
Date

Next steps

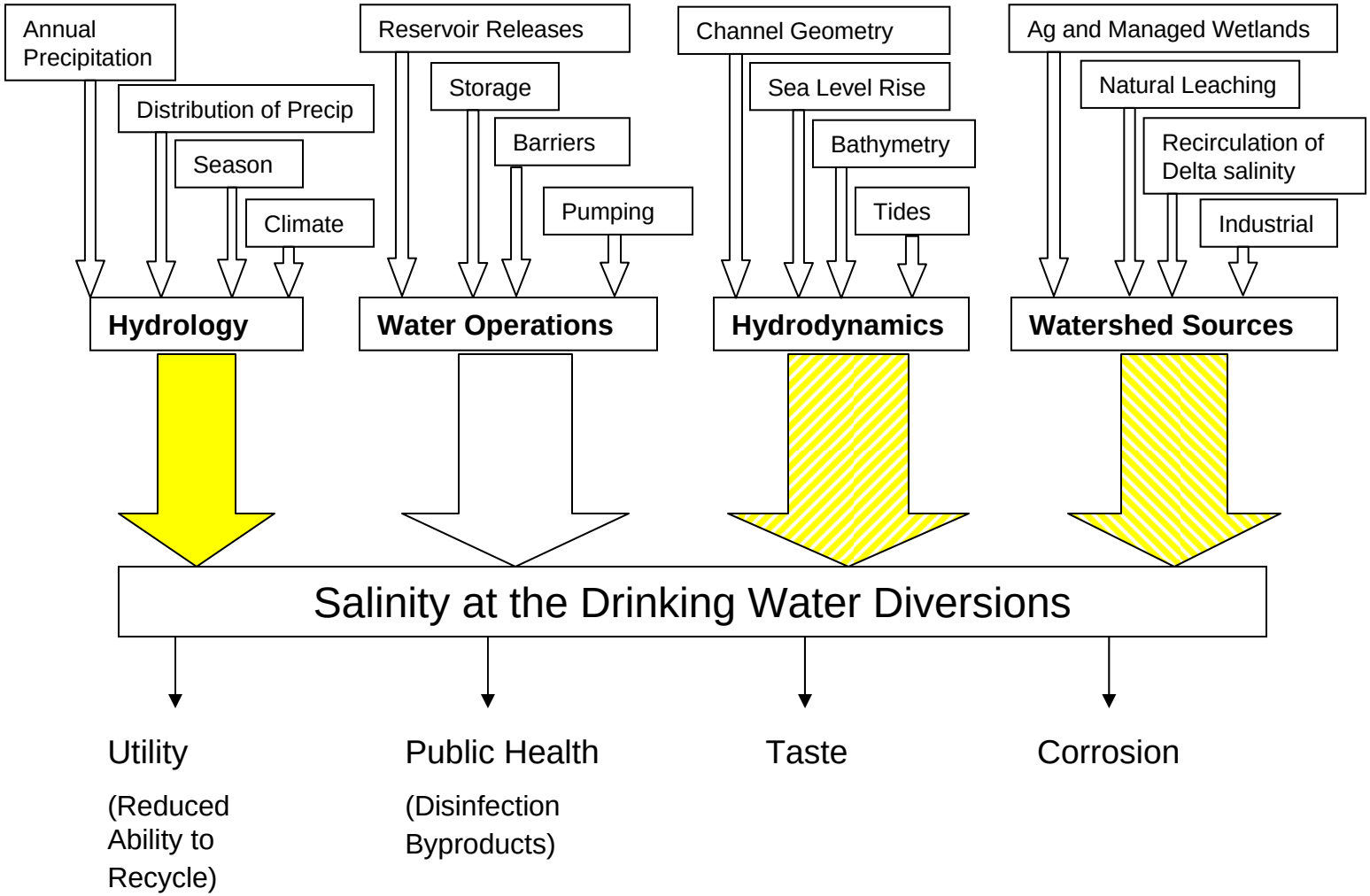
- Significance comparisons between sites to prioritize sub watersheds
- Exploration of drivers
- Investigate data on sources (vs. ambient)
- DWR spreadsheet model of SJ OC, focus on loading at heads of tributaries
- Continue working with DRERIP and funded projects
- CALFED consultant work on controllability

Performance Measures

- Potential locations for all watershed measures:
  - Intakes
  - Tributaries (Hood, Vernalis)
  - Subwatersheds (Smaller river inputs)
  - Identified potential controllable sources

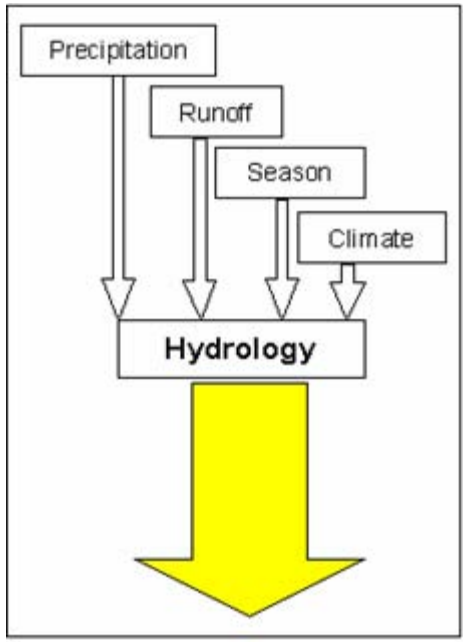
Salinity and Bromide

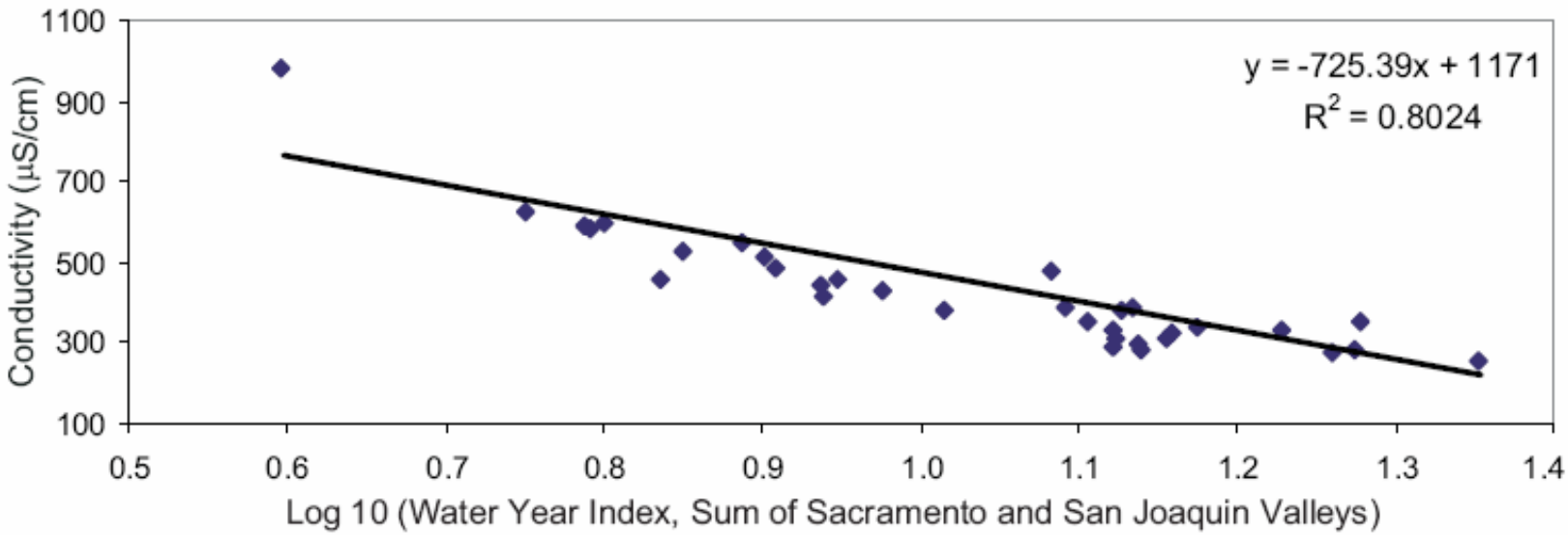
Delta Drinking Water Quality - Salinity



Hydrology

The amount of water flowing into the Delta is the single most important determinant of salinity at the export pumps and the amount of inflow is largely determined by hydrology.

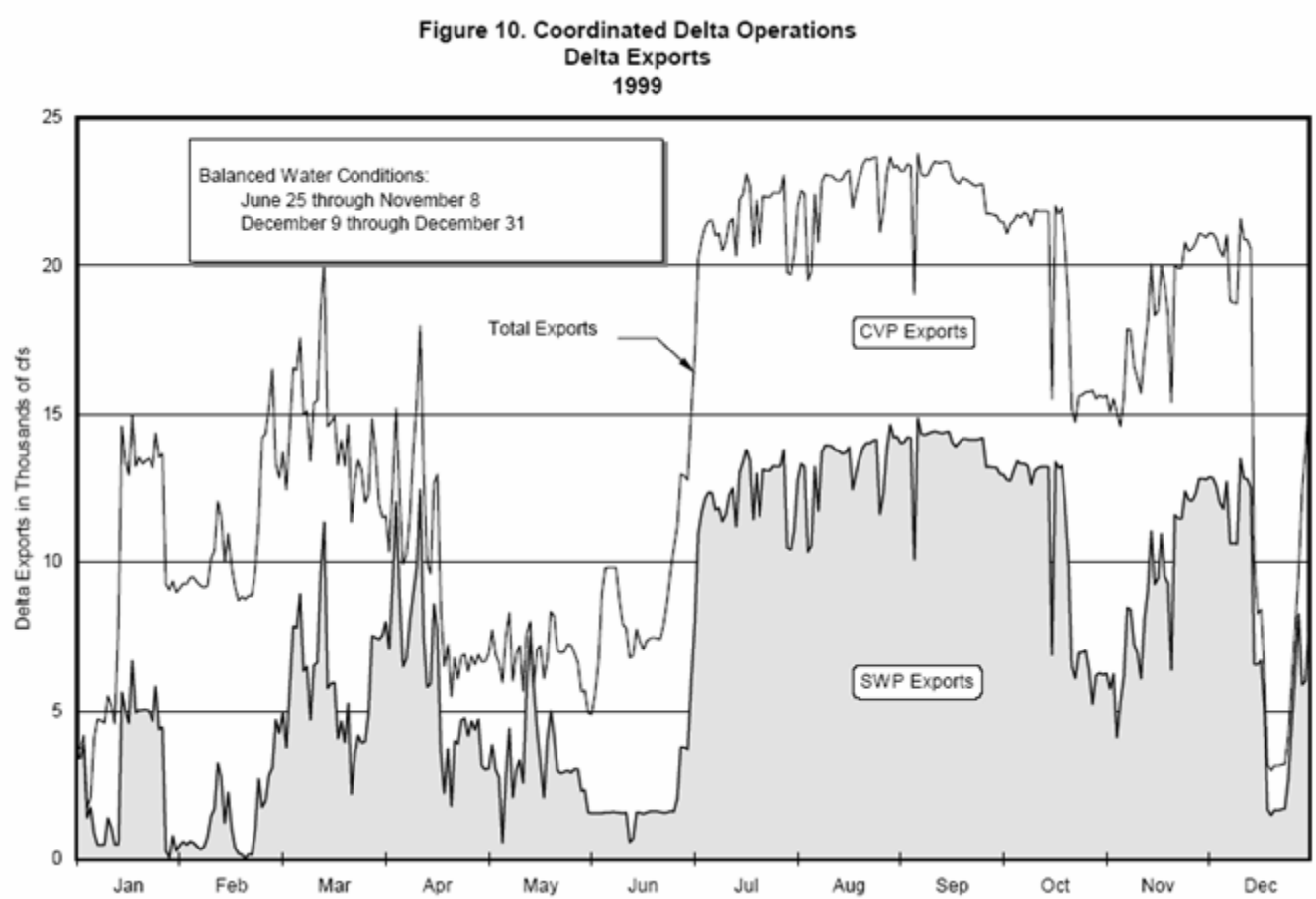


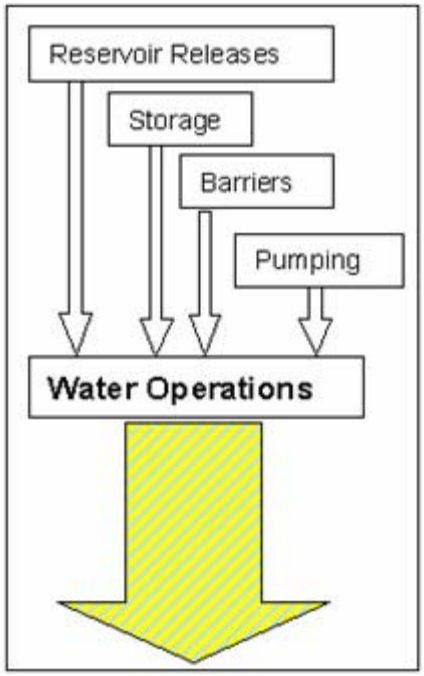


DWR

Water Operations

During periods of low natural inflow, the combination of reservoir releases, barrier operations, and Delta diversion pumping govern salinity.

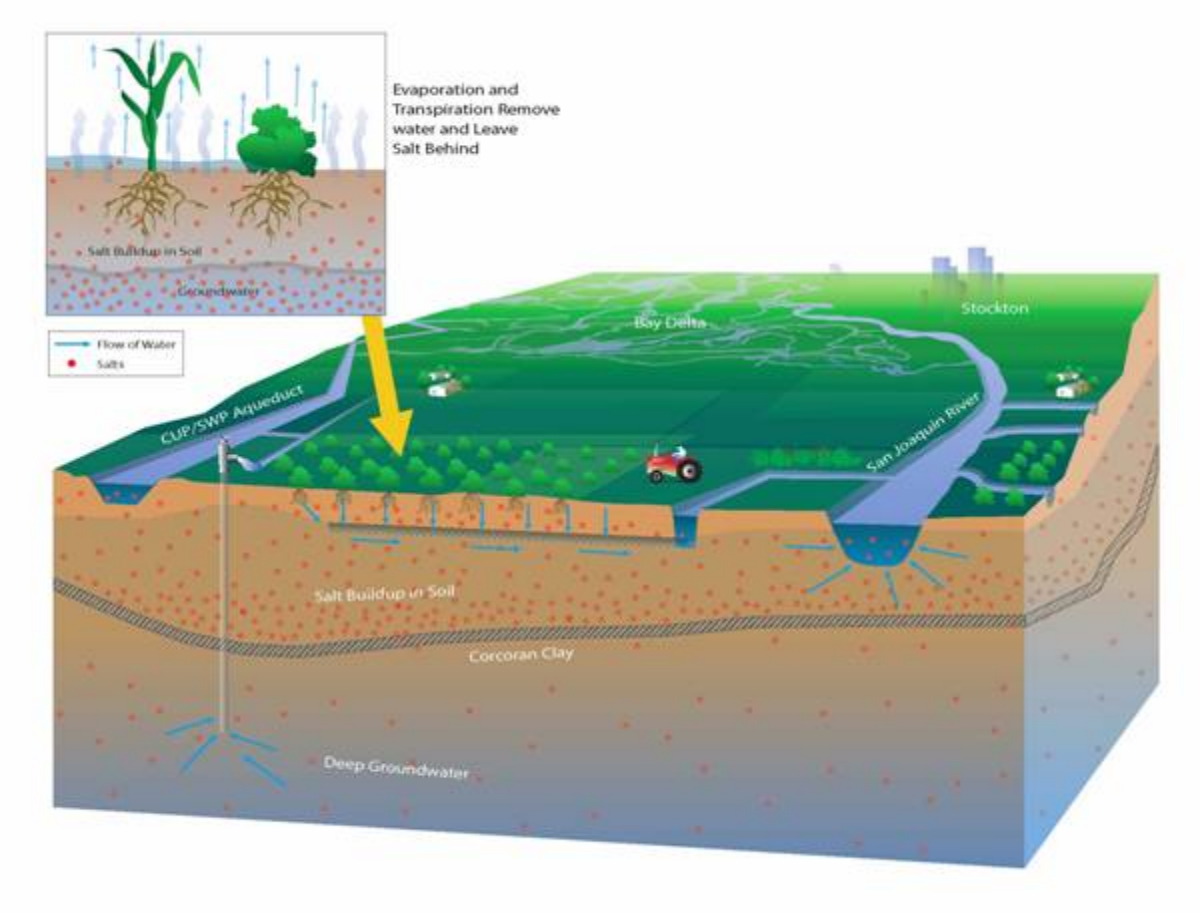


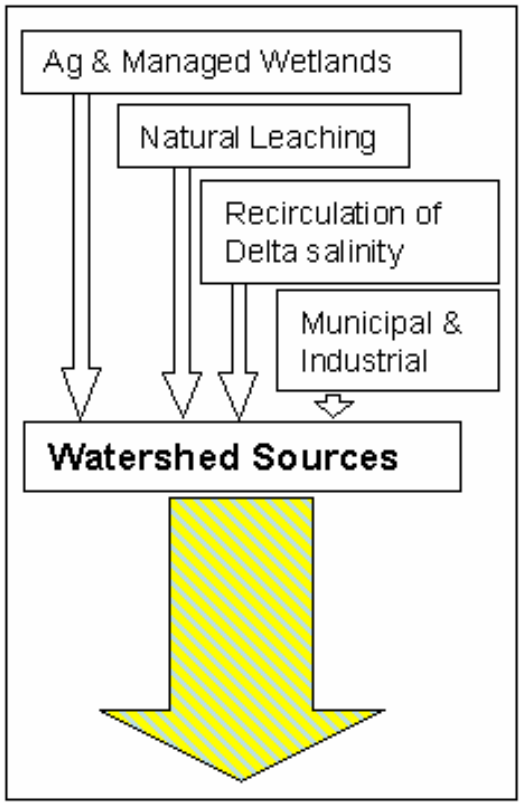


DWR, 2003

Watershed Sources

Included here are salts added through material inputs to agricultural, municipal, industrial, and natural processes.

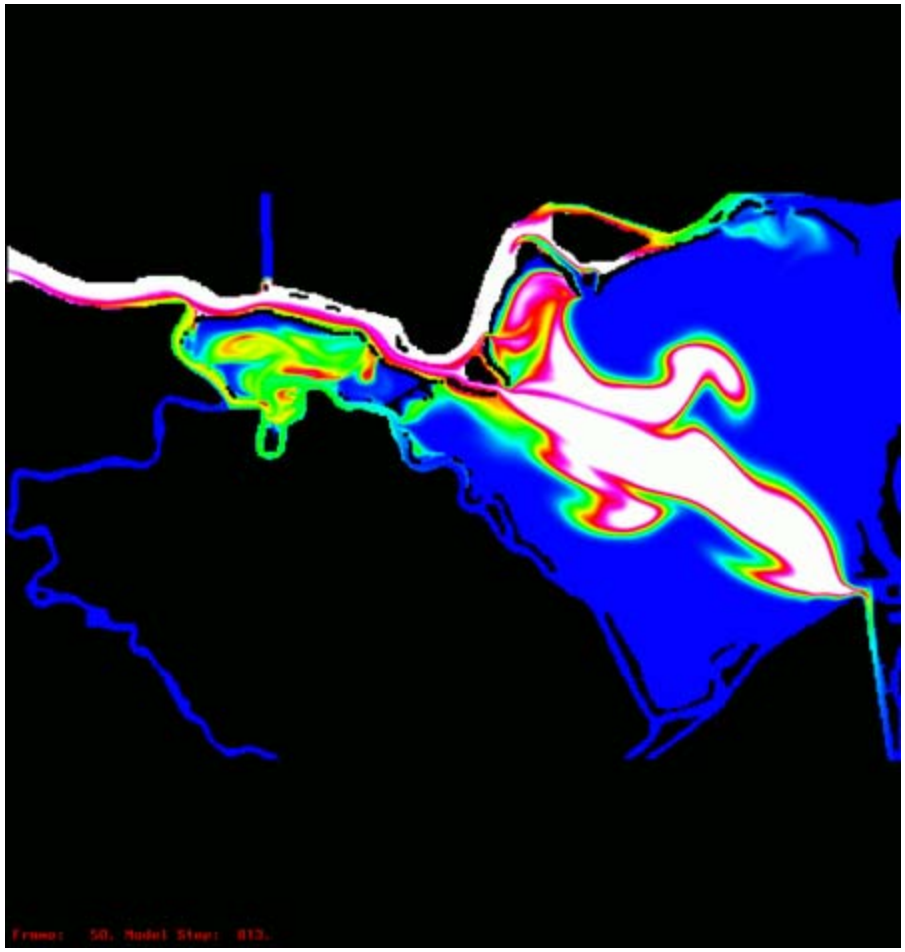


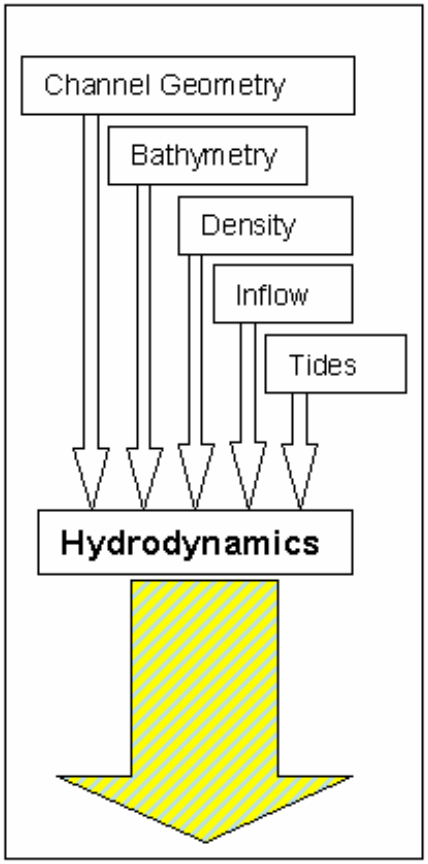


Tetratech, 2006

Hydrodynamics

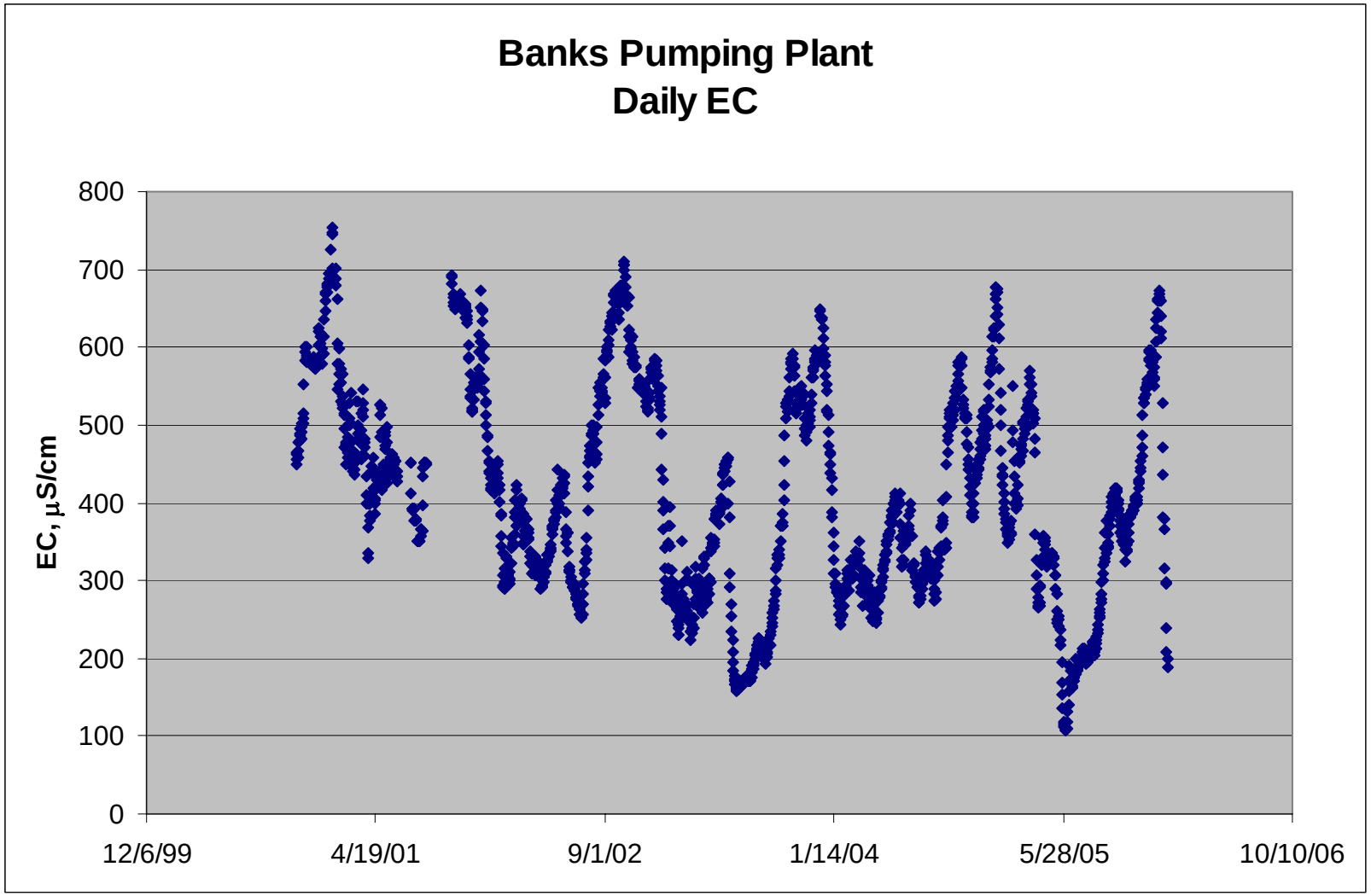
Hydrodynamics includes the major physical features, properties, and processes that govern the movement of water within the Delta and Bay.



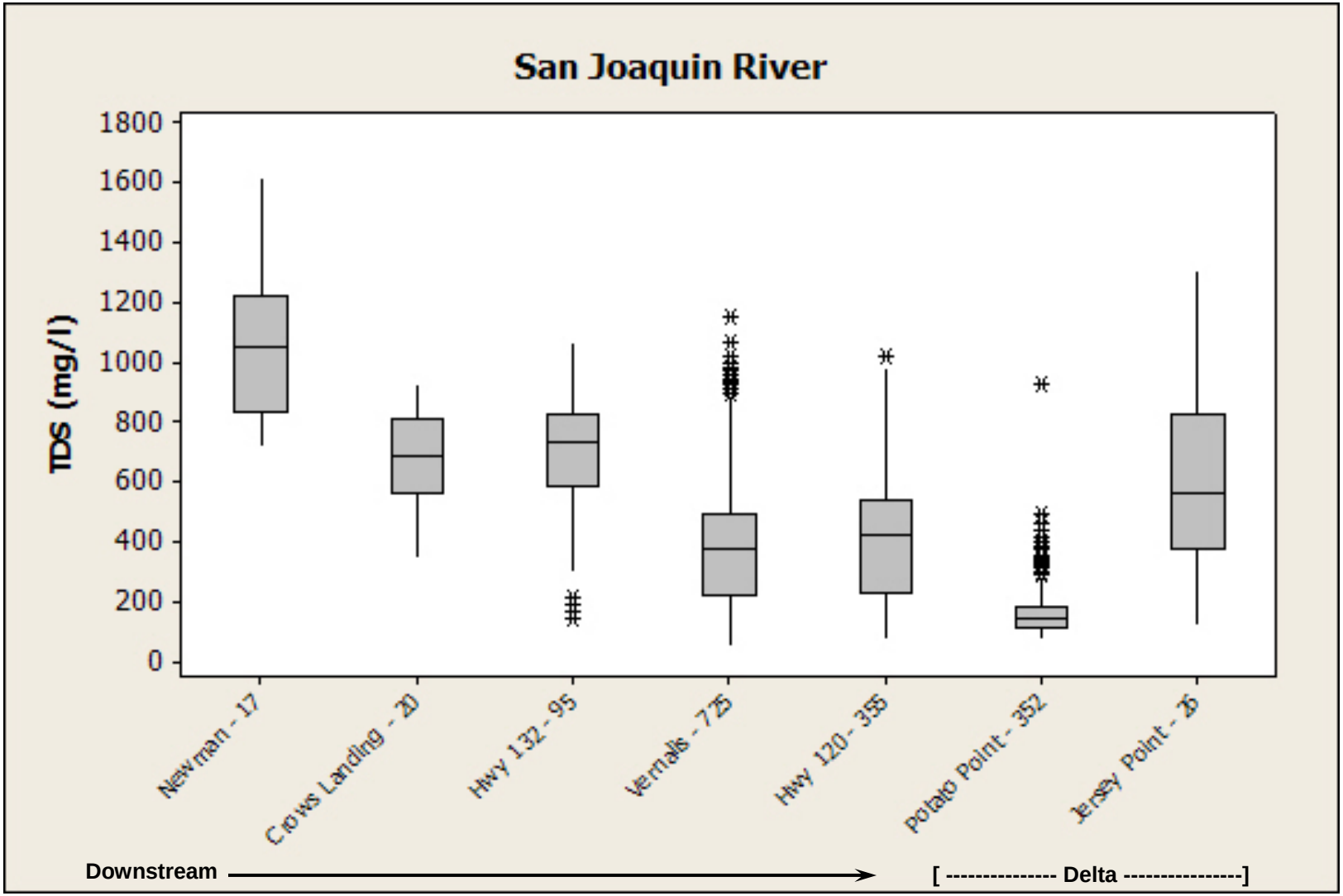


USGS, DWR, and RMA

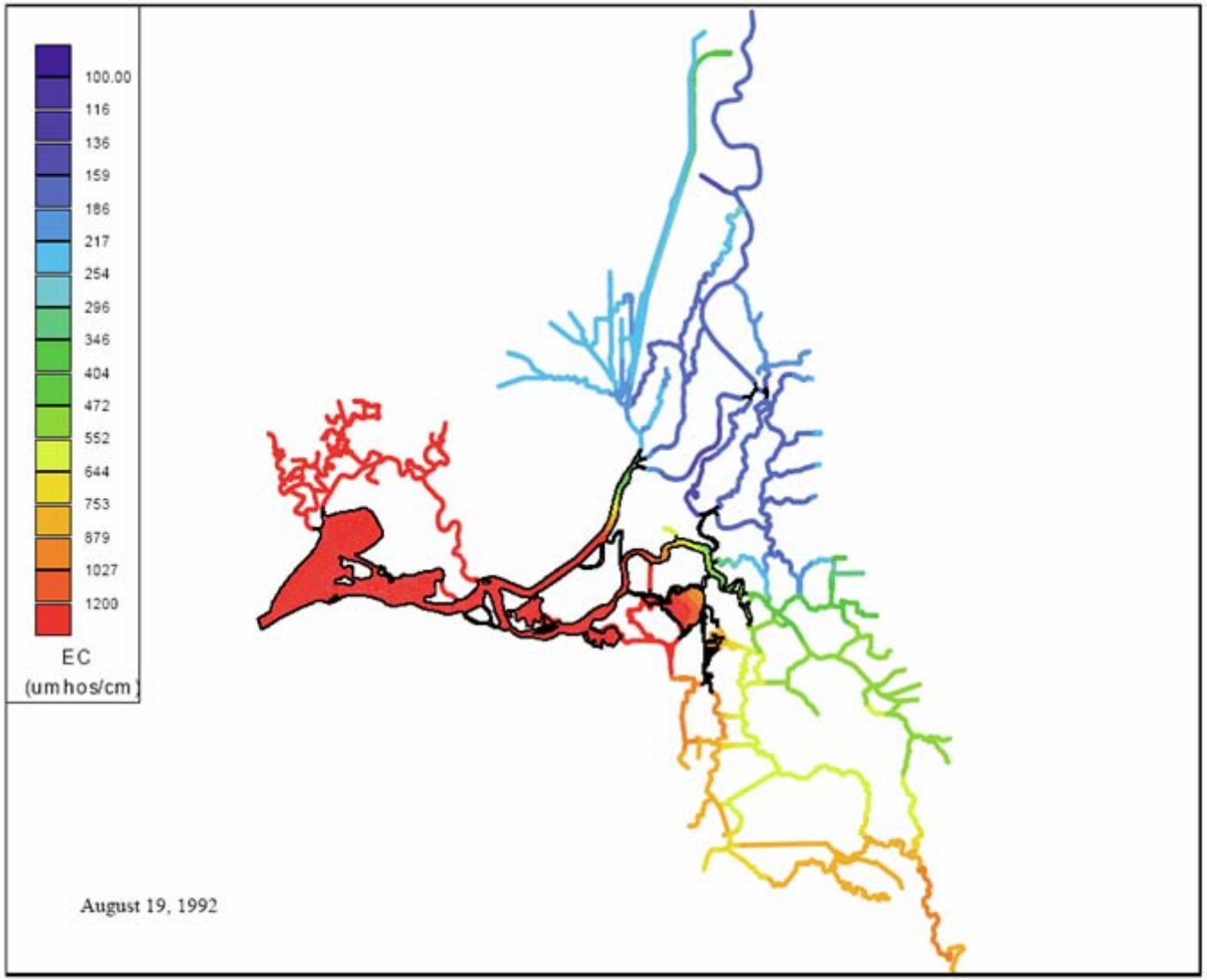
Characterizing salinity



Characterizing salinity



Characterizing salinity



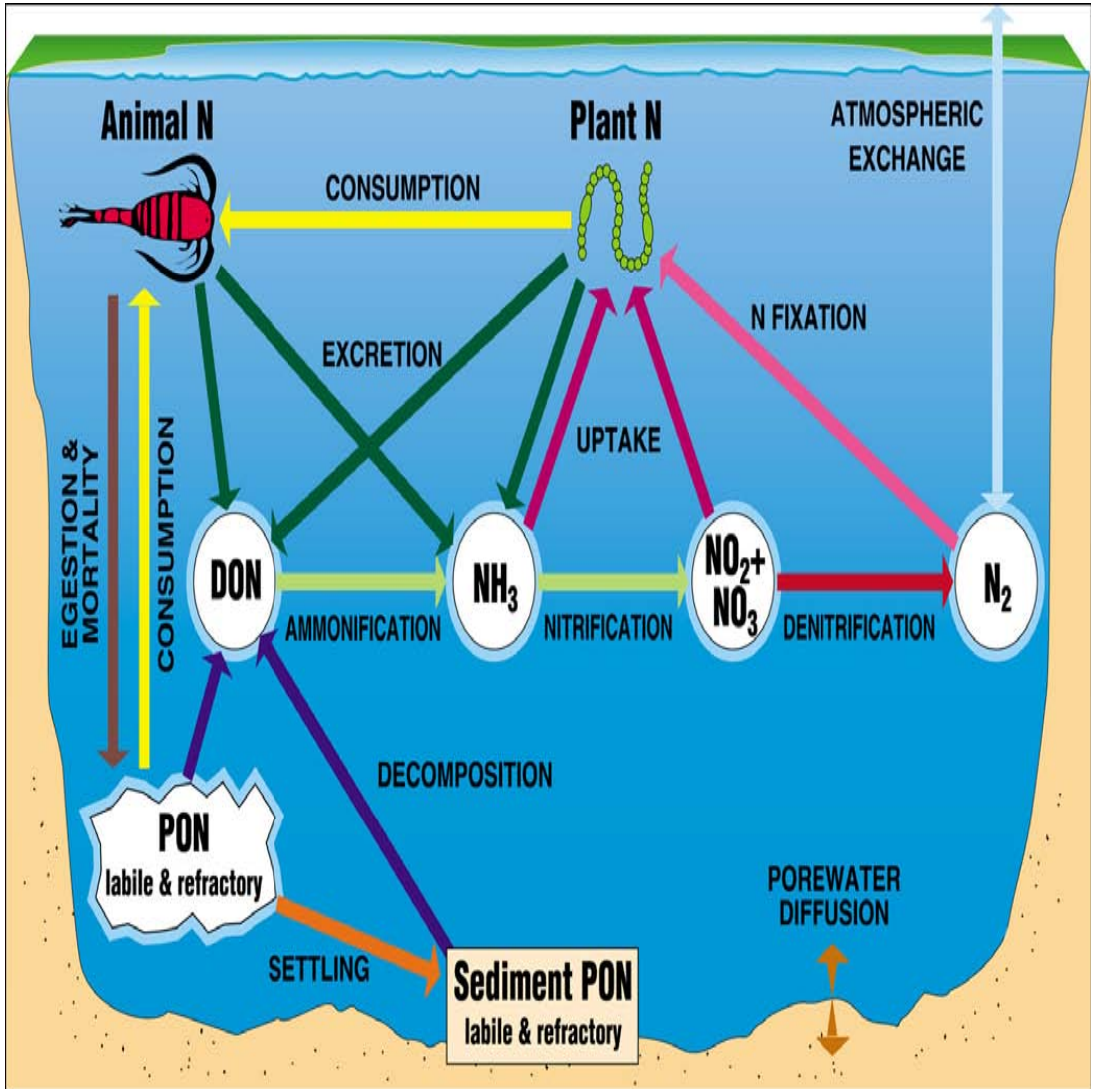
RMA, 2006

Next steps

- Work with DRERIP team on write up of Hydrodynamics/Salinity conceptual models
- Add more explicit bromide analysis
- Solicit input for data analysis direction (in watersheds)
- Investigate data on sources (vs. ambient)
- Finish salinity conceptual model
- Potentially use modeling sensitivity runs to further explore drivers and potential actions

Nutrients

Conceptual Model



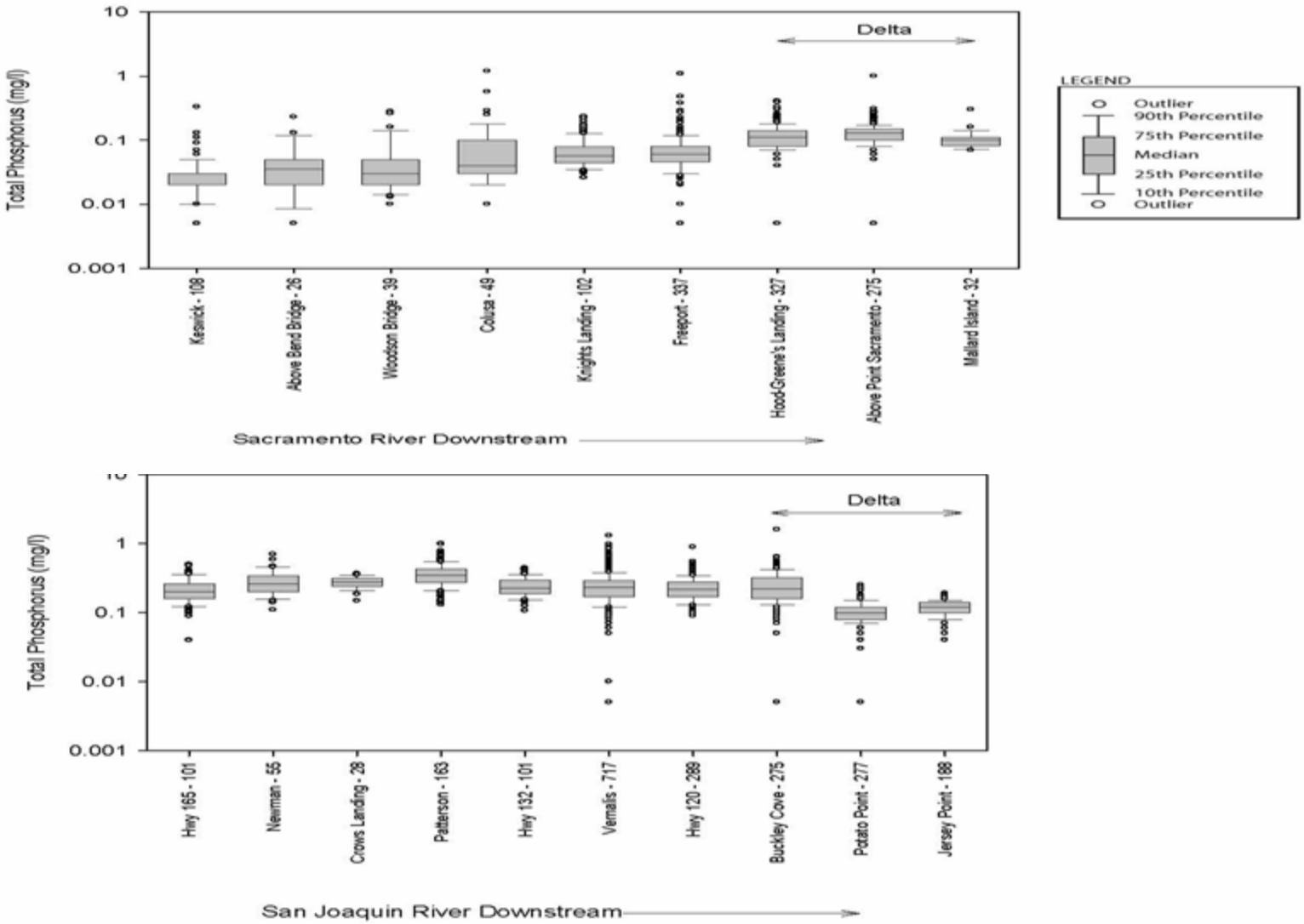
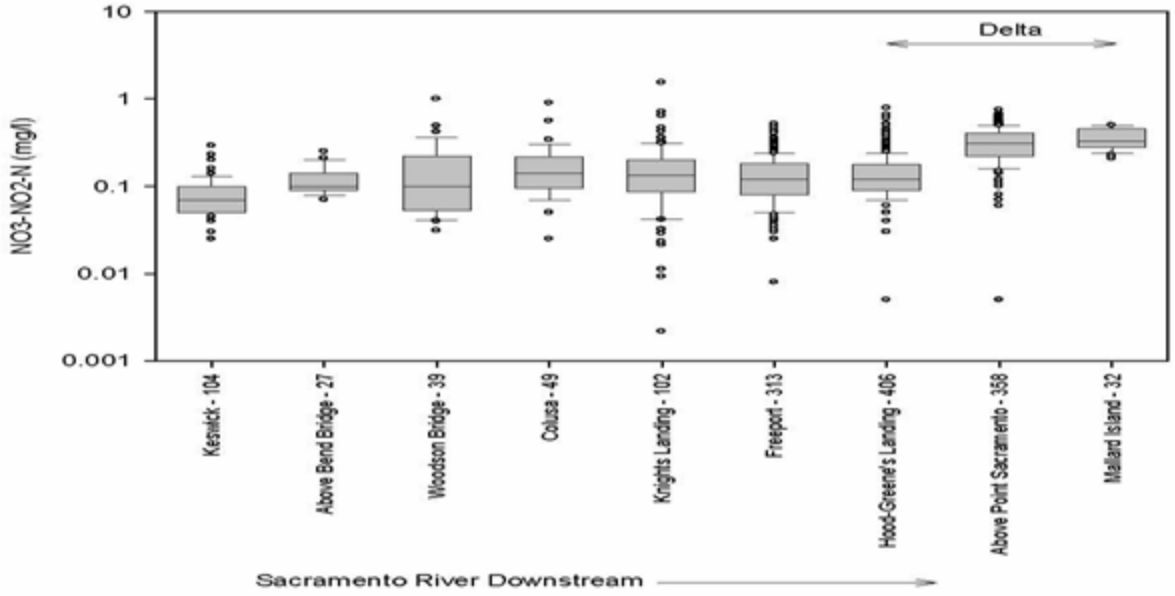
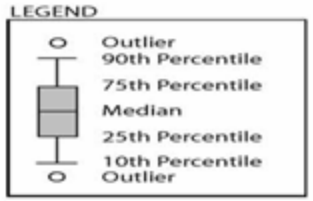
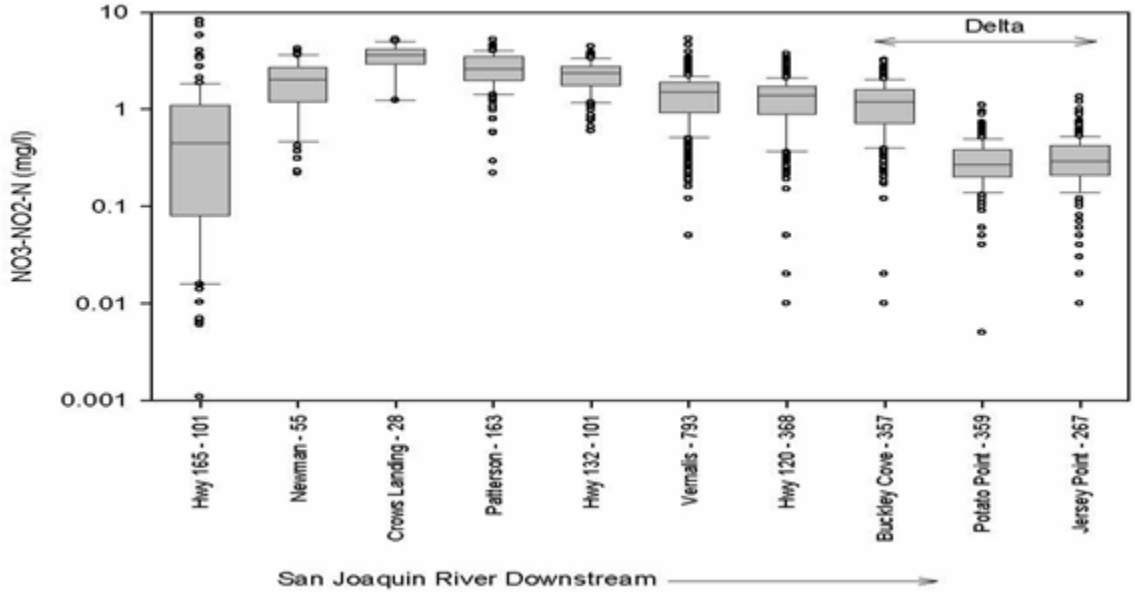
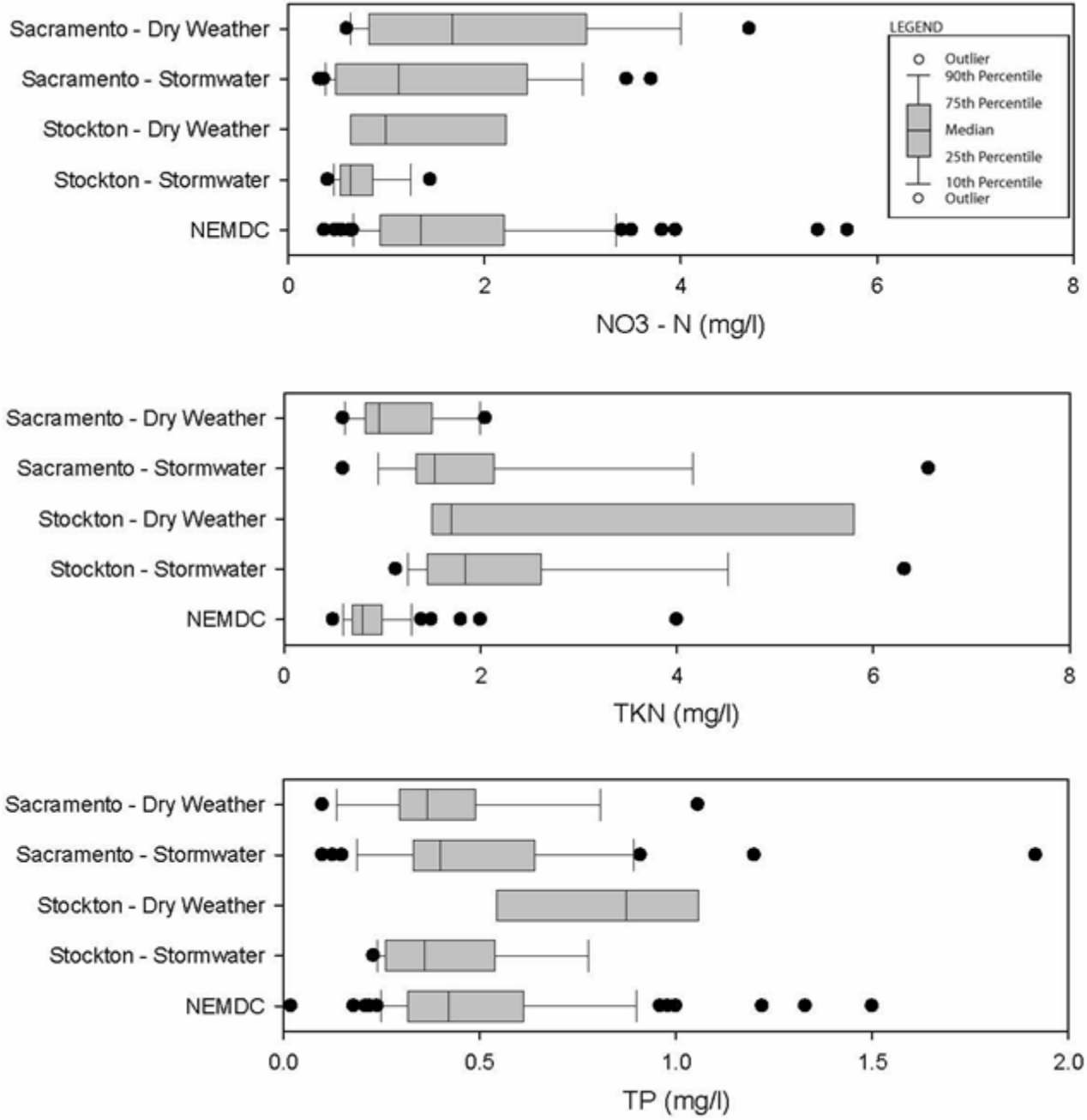


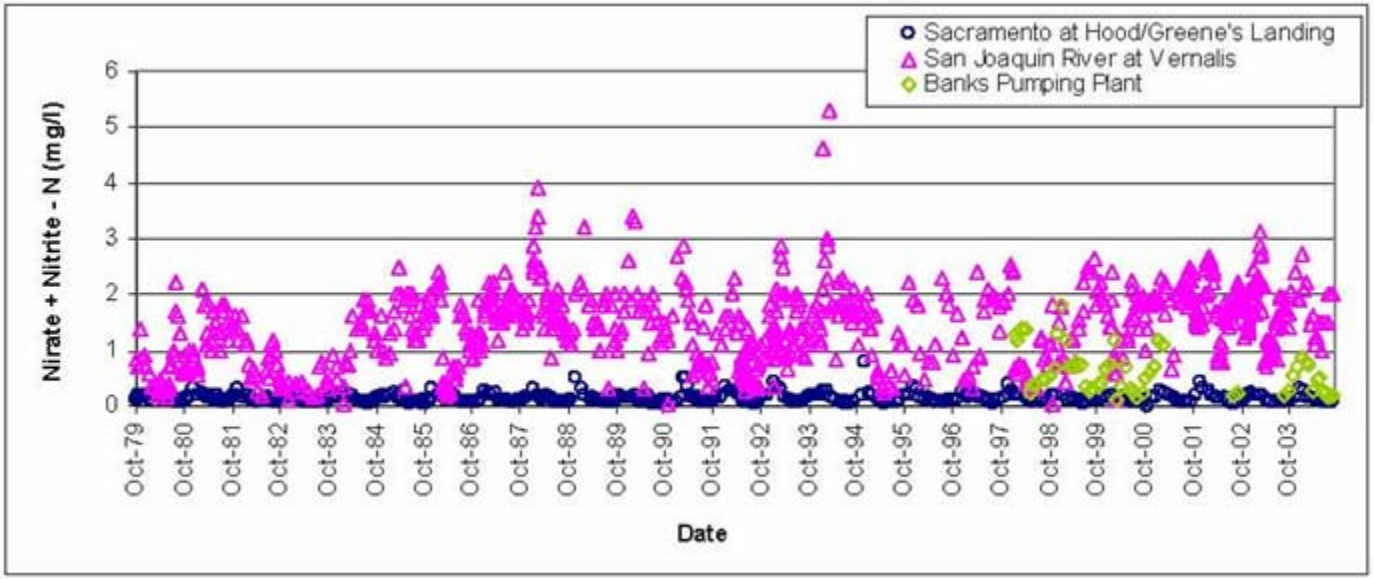
Figure 3-26. TP at various locations in the Sacramento and San Joaquin Rivers. The number of data points is shown after each station name.

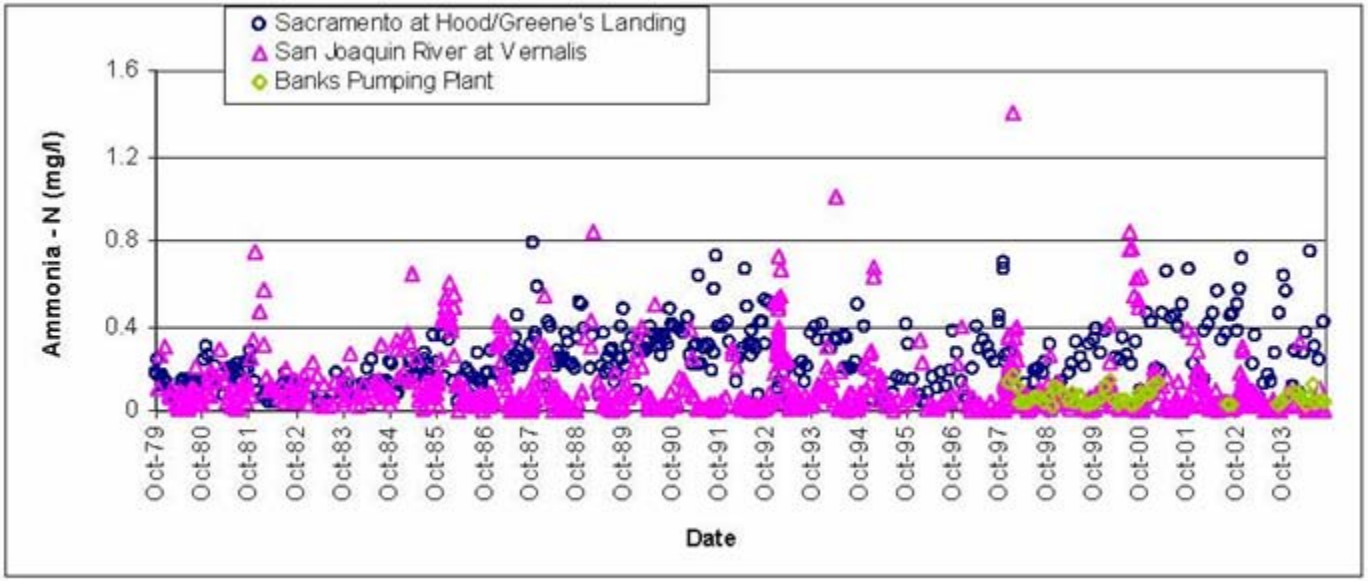

10
1
0.1
0.01
0.001
NO3-NO2-N (mg/l)
Delta
Keswick - 104
Above Bend Bridge - 27
Woodson Bridge - 39
Colusa - 49
Knights Landing - 102
Freeport - 313
Hood-Greene's Landing - 406
Above Point Sacramento - 358
Mallard Island - 32
Sacramento River Downstream


LEGEND
Outlier
90th Percentile
75th Percentile
Median
25th Percentile
10th Percentile
Outlier


10
1
0.1
0.01
0.001
NO3-NO2-N (mg/l)
Delta
Hwy 165 - 101
Newman - 55
Crows Landing - 28
Patterson - 163
Hwy 132 - 101
Vernalis - 793
Hwy 120 - 368
Buckley Cove - 357
Potato Point - 359
Jersey Point - 267
San Joaquin River Downstream


Sacramento - Dry Weather
Sacramento - Stormwater
Stockton - Dry Weather
Stockton - Stormwater
NEMDC
LEGEND
Outlier
90th Percentile
75th Percentile
Median
25th Percentile
10th Percentile
Outlier
0
2
4
6
8
NO3 - N (mg/l)
Sacramento - Dry Weather
Sacramento - Stormwater
Stockton - Dry Weather
Stockton - Stormwater
NEMDC
0
2
4
6
8
TKN (mg/l)
Sacramento - Dry Weather
Sacramento - Stormwater
Stockton - Dry Weather
Stockton - Stormwater
NEMDC
0.0
0.5
1.0
1.5
2.0
TP (mg/l)


Sacramento at Hood/Greene's Landing
San Joaquin River at Vernalis
Banks Pumping Plant
Nirate + Nitrite - N (mg/l)
0
1
2
3
4
5
6
Oct-79
Oct-80
Oct-81
Oct-82
Oct-83
Oct-84
Oct-85
Oct-86
Oct-87
Oct-88
Oct-89
Oct-90
Oct-91
Oct-92
Oct-93
Oct-94
Oct-95
Oct-96
Oct-97
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
Oct-03
Date


Sacramento at Hood/Greene's Landing
San Joaquin River at Vernalis
Banks Pumping Plant
Ammonia - N (mg/l)
0
0.4
0.8
1.2
1.6
Oct-79
Oct-80
Oct-81
Oct-82
Oct-83
Oct-84
Oct-85
Oct-86
Oct-87
Oct-88
Oct-89
Oct-90
Oct-91
Oct-92
Oct-93
Oct-94
Oct-95
Oct-96
Oct-97
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
Oct-03
Date

Next steps

- Work with DO project's work on nutrient modeling
- Determine monitoring and research needs, using treatment work to direct
- CALFED consultant work on controllability (in parallel with organic carbon)

Pathogens

Conceptual Model

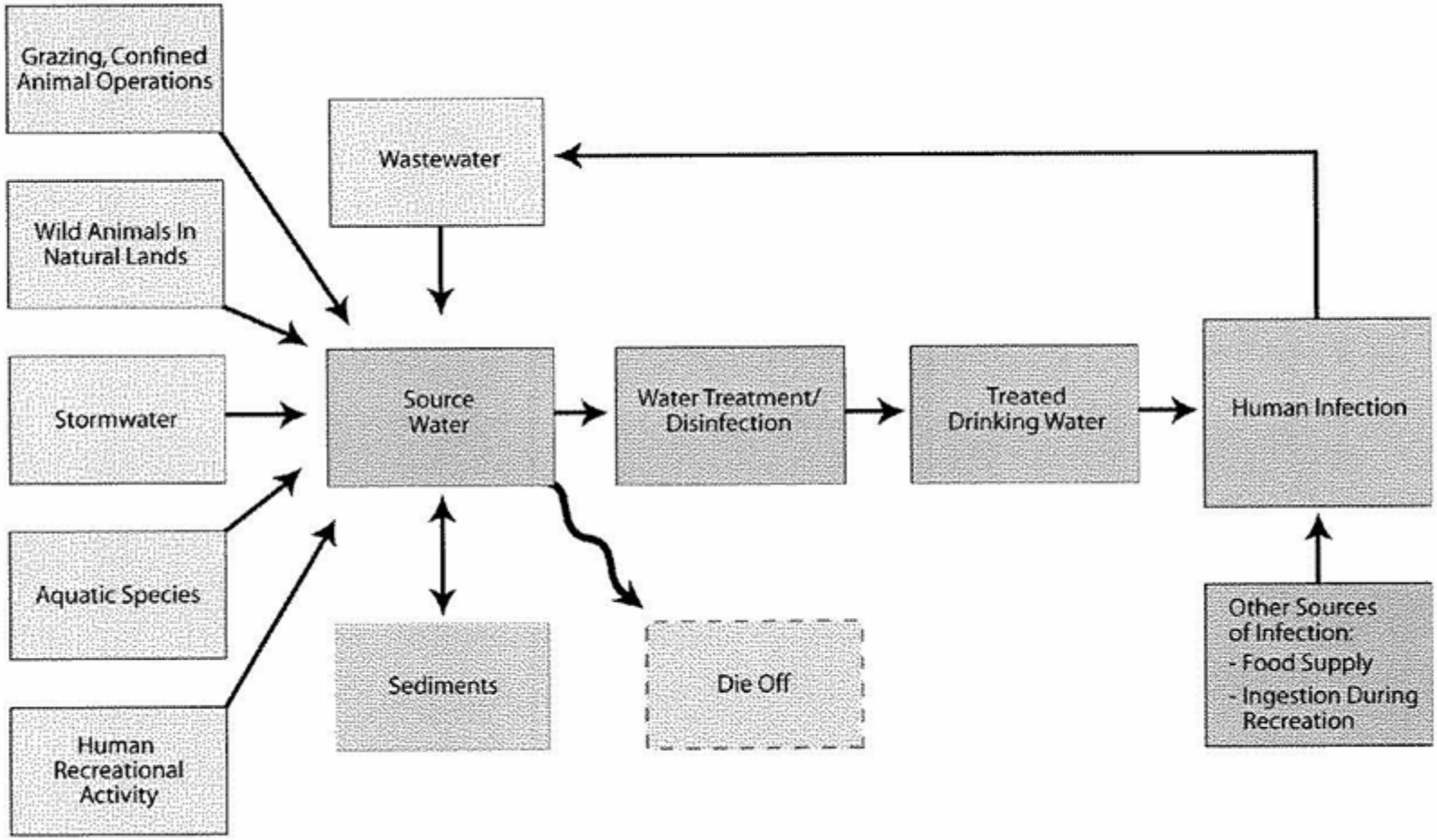
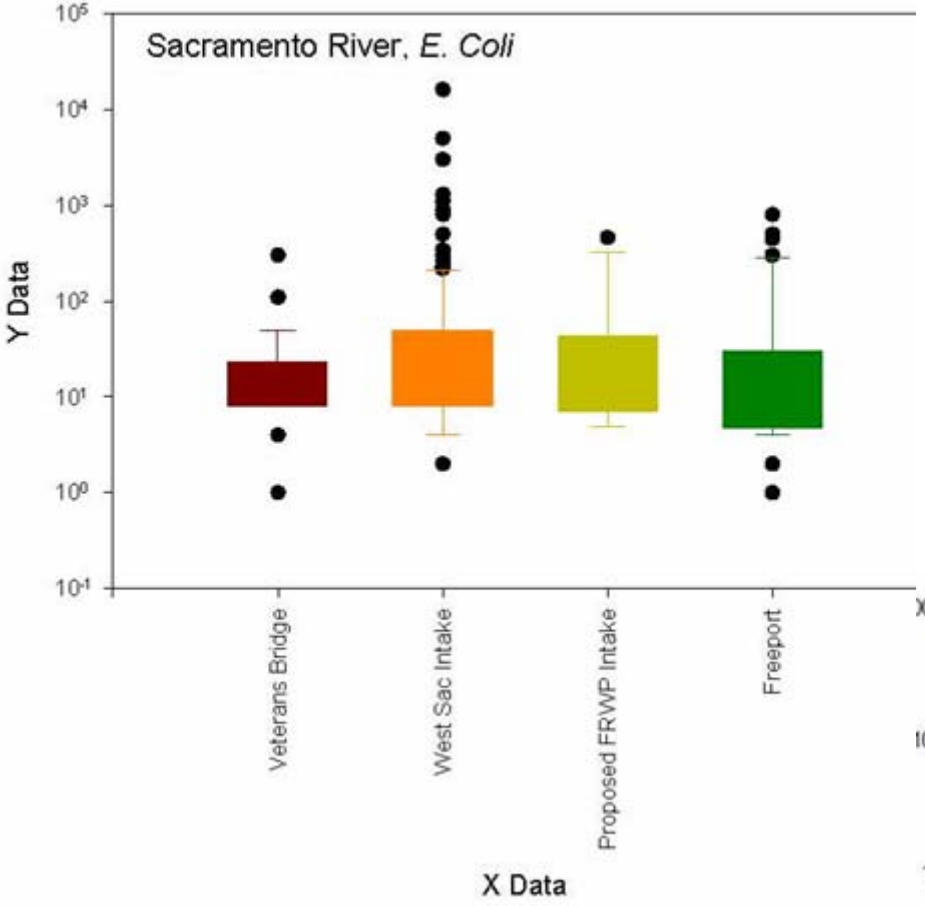
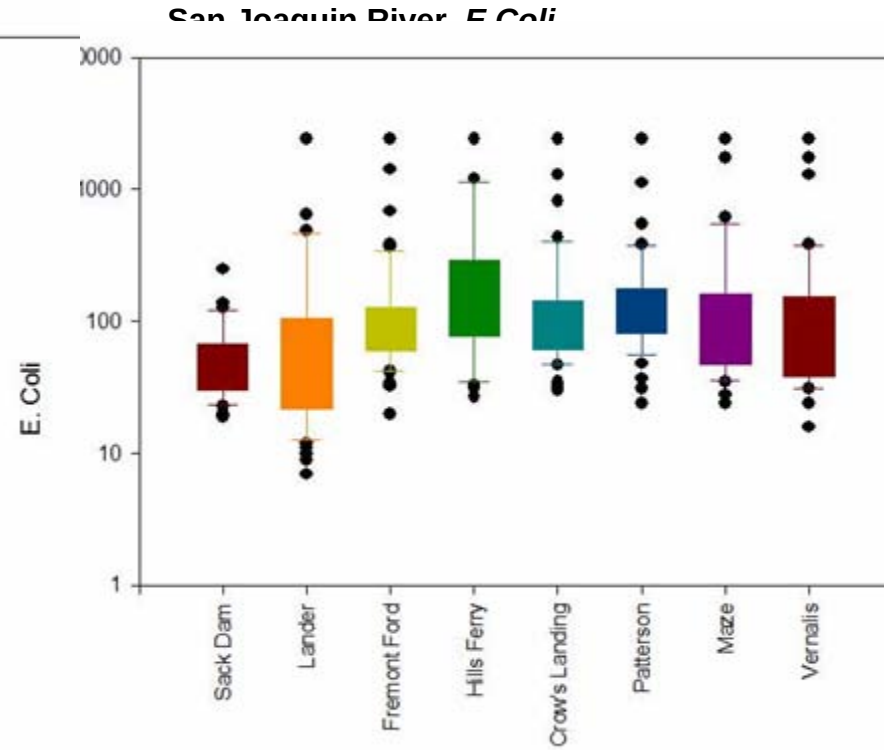


Figure 2-1 Schematic of pathogen contamination of drinking waters.

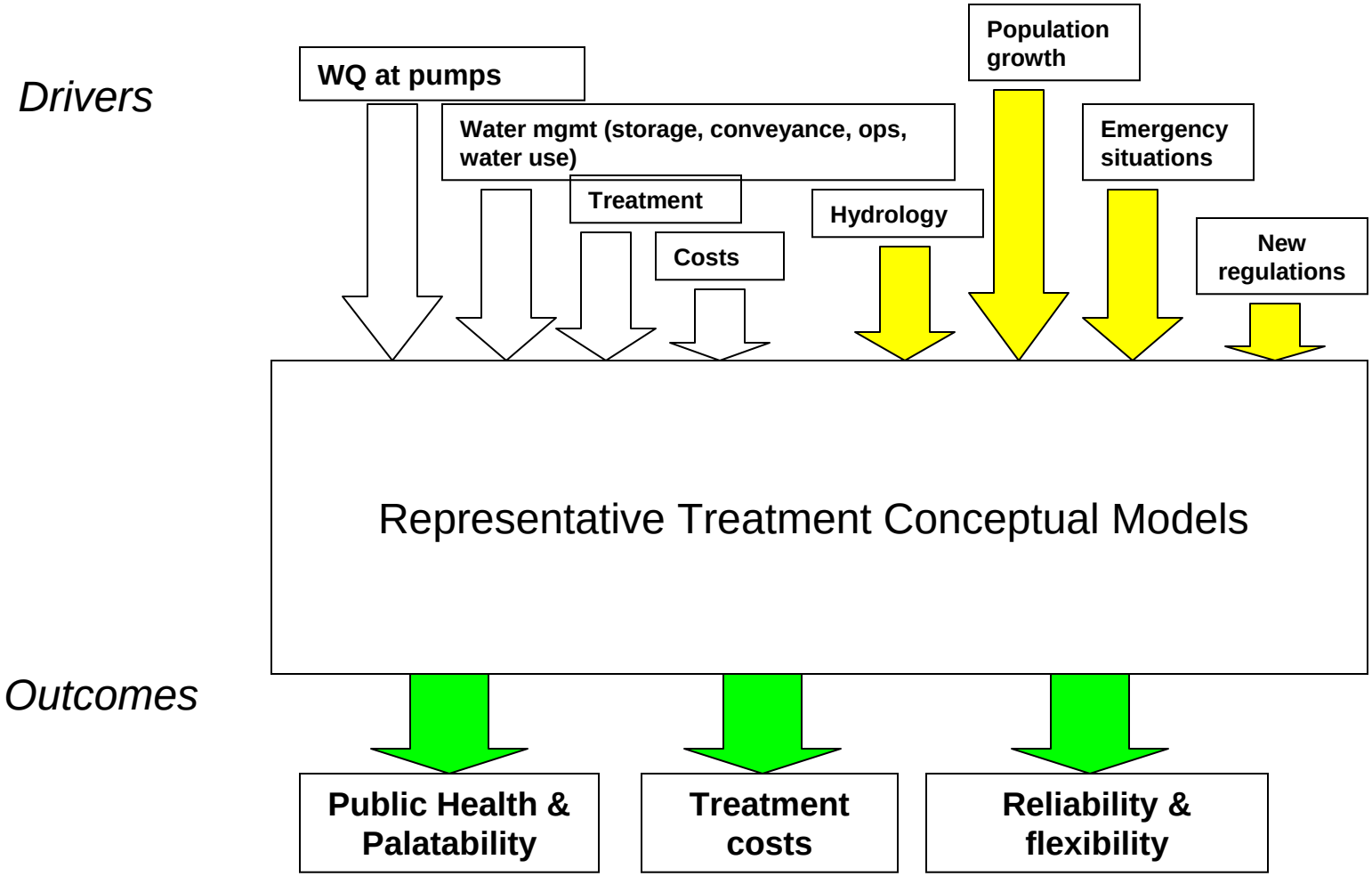
DRAFT


Sacramento River, *E. Coli*
Y Data
10^5
10^4
10^3
10^2
10^1
10^0
10^{-1}
Veterans Bridge
West Sac Intake
Proposed FRWP Intake
Freeport
X Data


San Joaquin River, *E. Coli*
E. Coli
1000
100
10
1
Sack Dam
Lander
Fremont Ford
Hills Ferry
Crow's Landing
Patterson
Maze
Vernalis

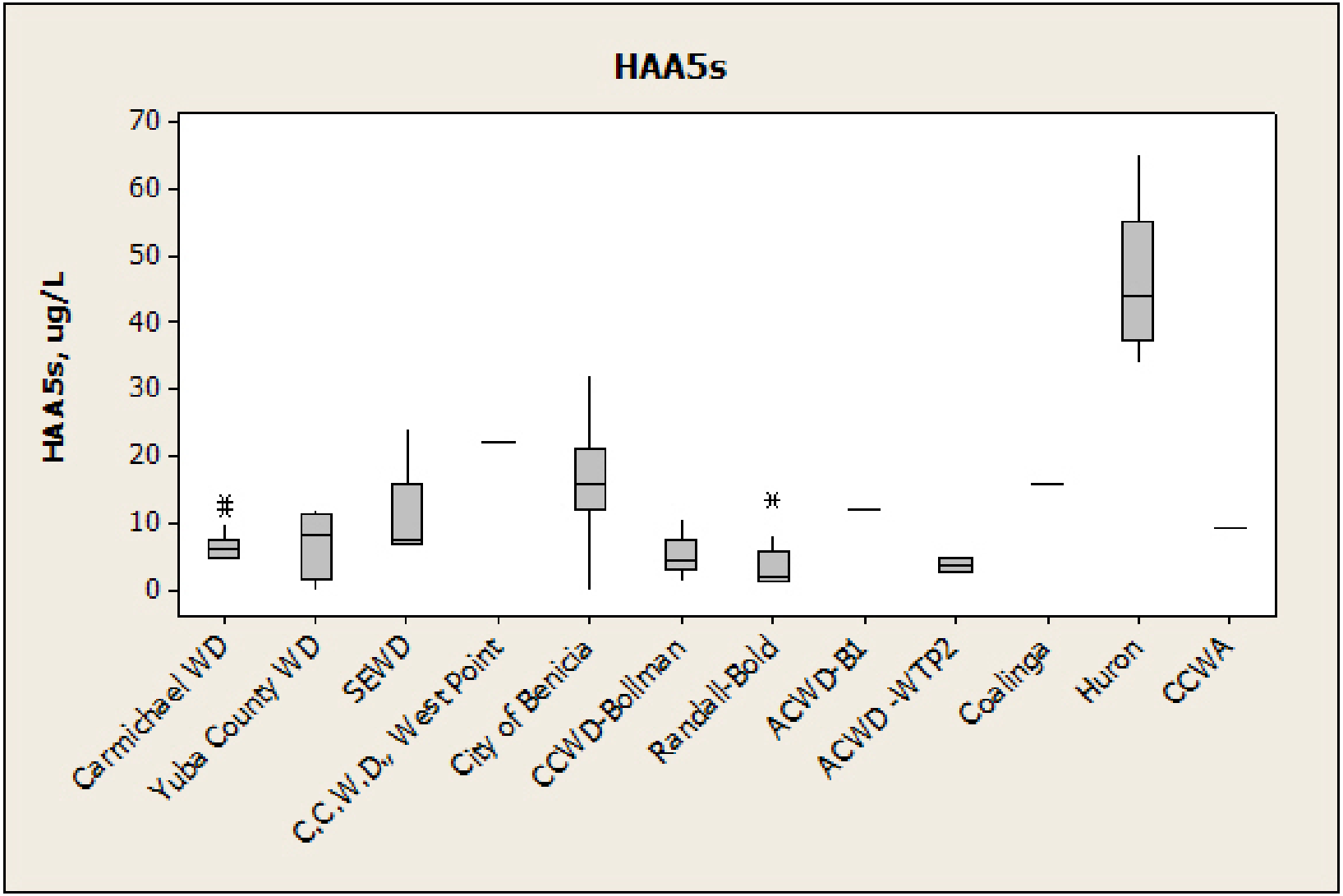
DRAFT

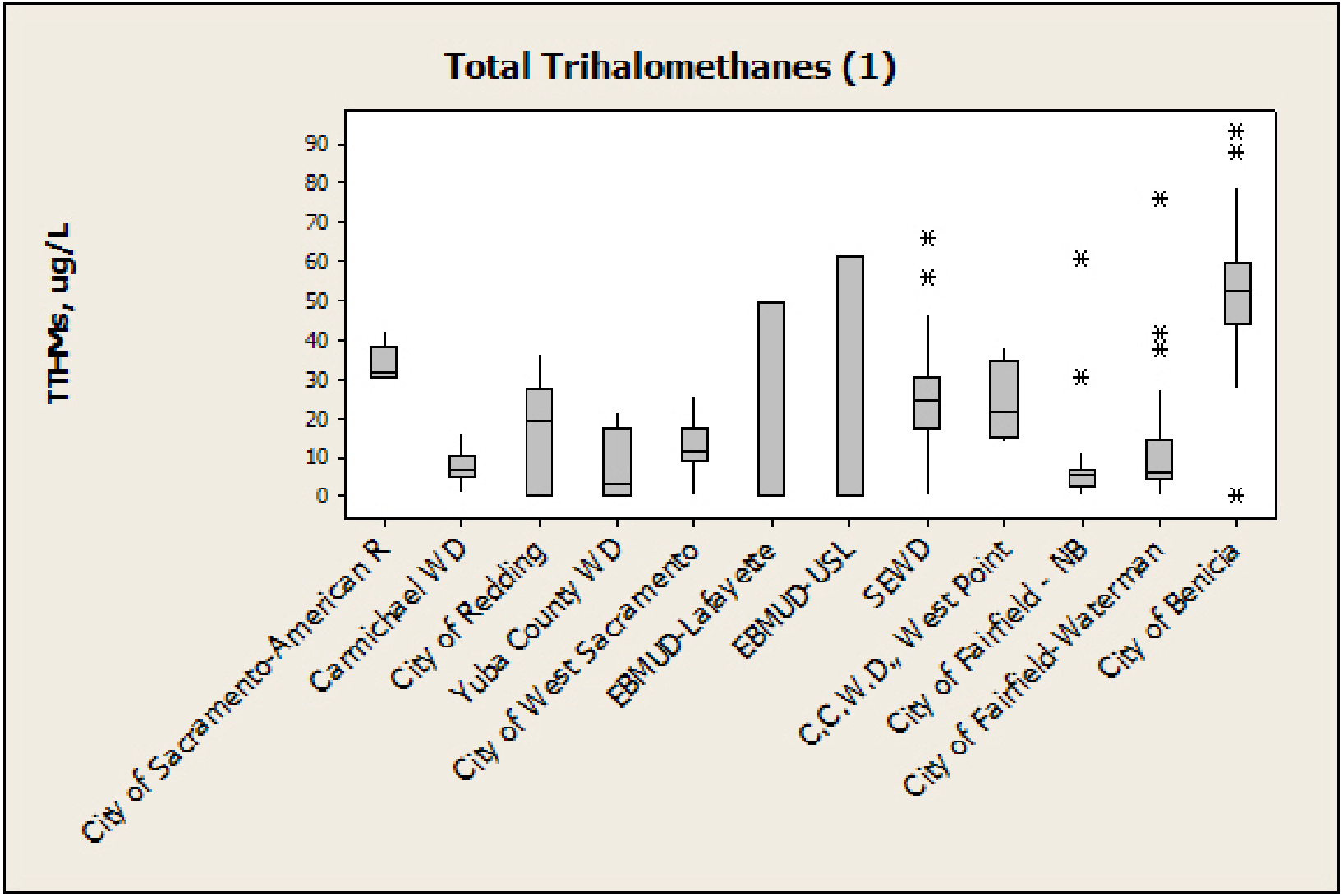
Drinking Water Treatment

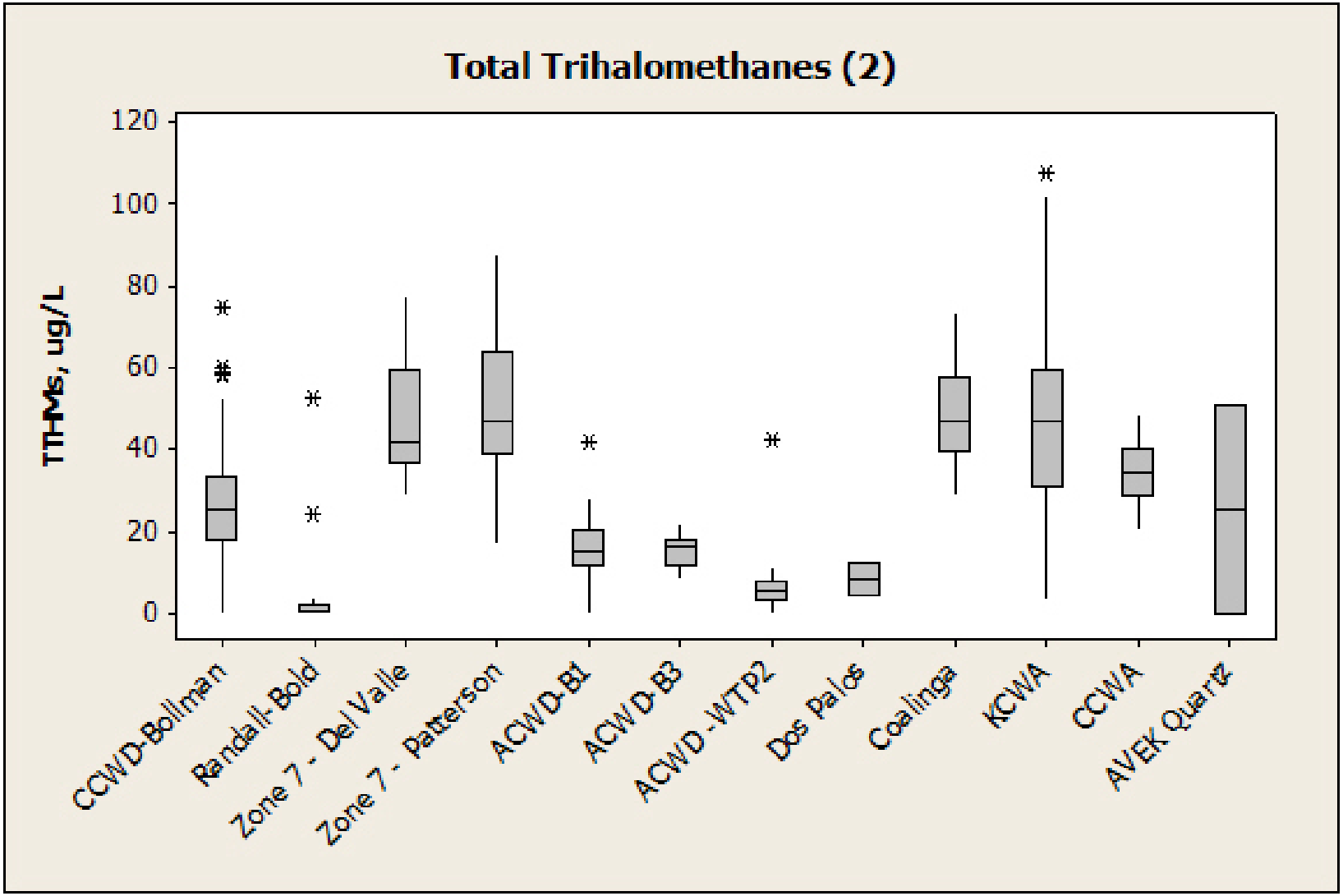

Drivers
WQ at pumps
Water mgmt (storage, conveyance, ops, water use)
Treatment
Costs
Hydrology
Population growth
Emergency situations
New regulations
Representative Treatment Conceptual Models
Outcomes
Public Health & Palatability
Treatment costs
Reliability & flexibility

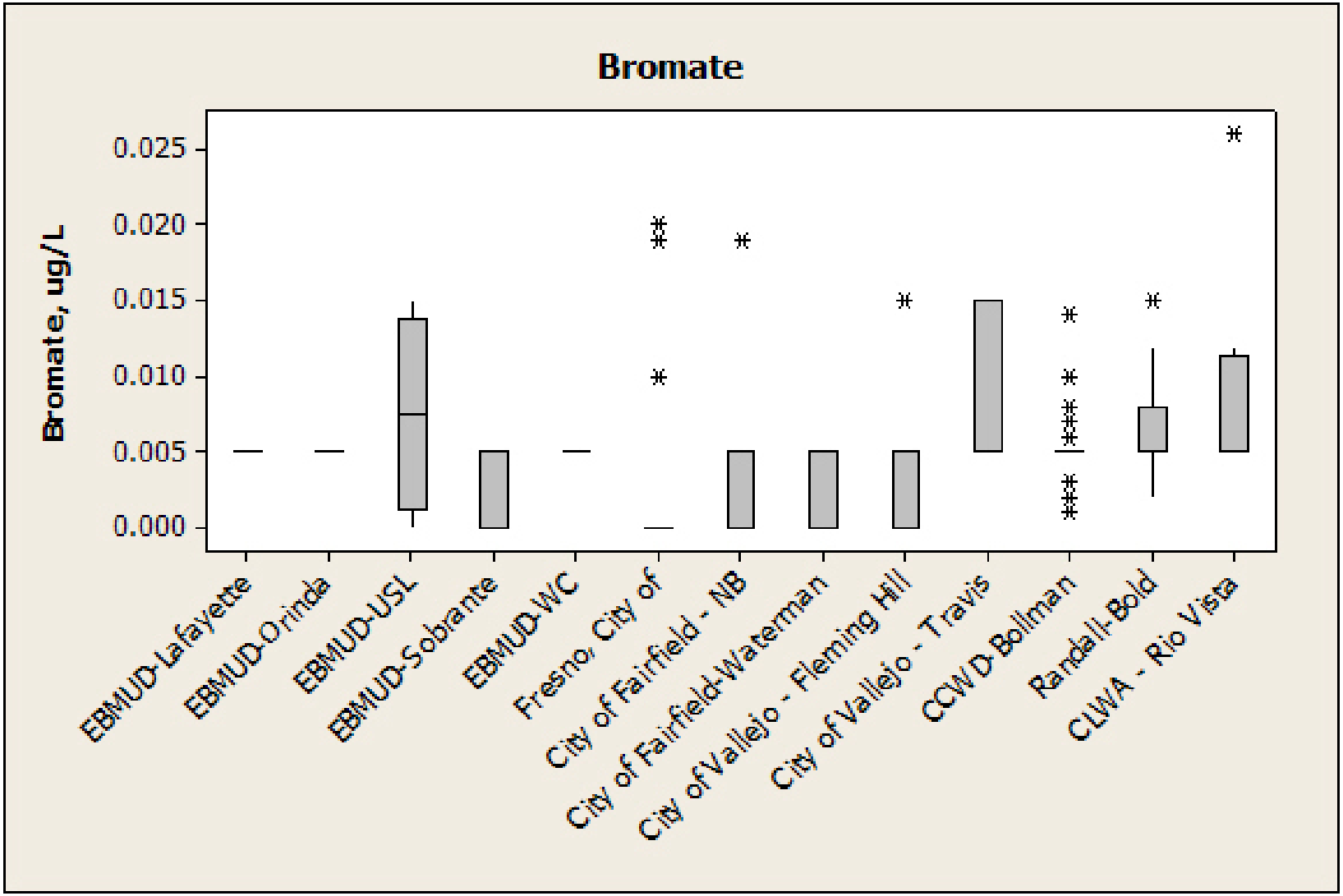
Representative Treatment Plants

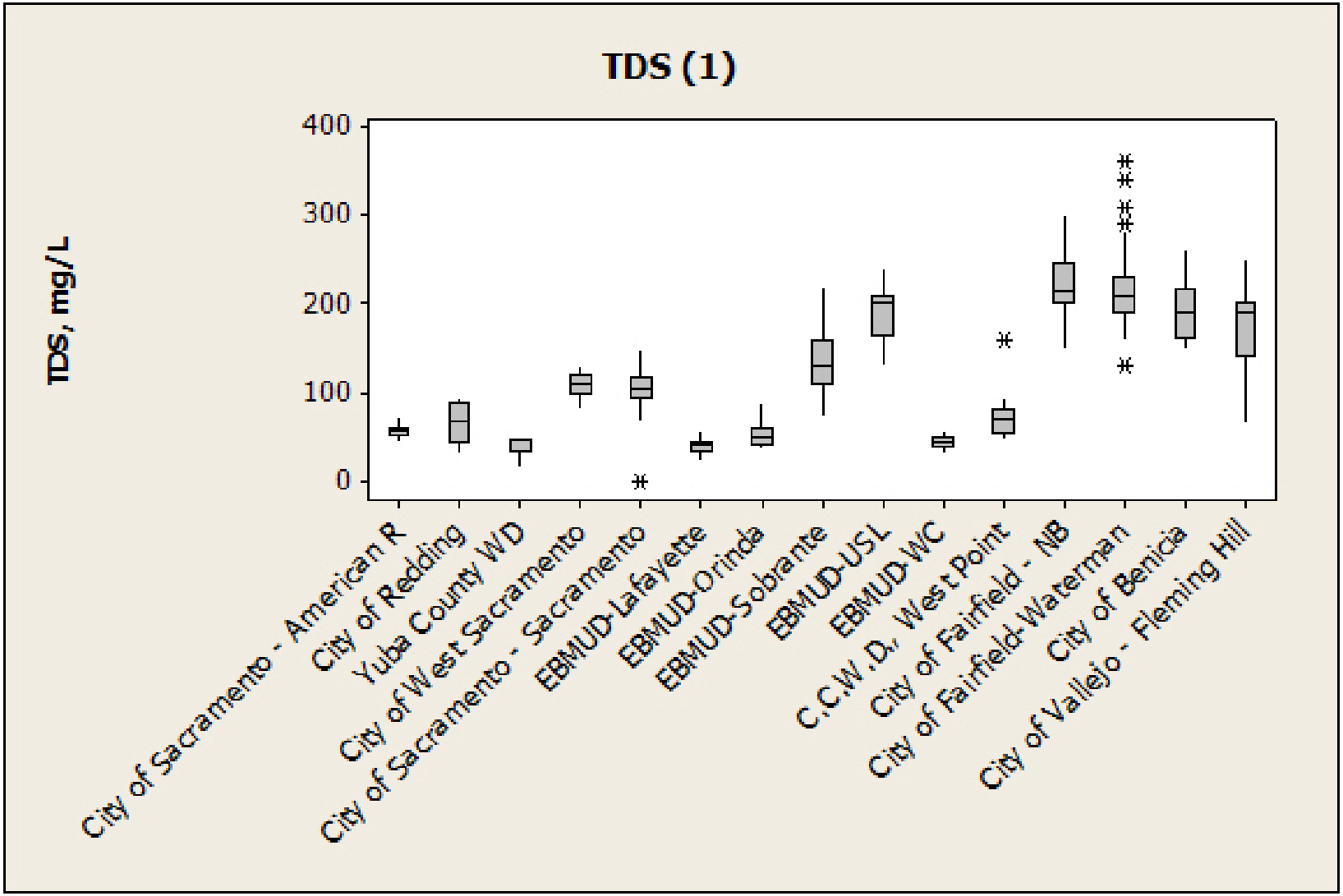
- Identified 62 treatment plants that treat some portion of Delta water, with DHS assistance:
  - 48 conventional treatment
  - 4 direct filtration
  - 1 alternative technology
  - 3 membrane/ultrafiltration
  - 7 not yet categorized
- Disinfection use:
  - 16 employ ozone
  - 21 employ hypochlorination
  - 34 employ chlorination
  - 28 employ chloramines
  - 1 employs MIOX
  - 21 of these are in combination

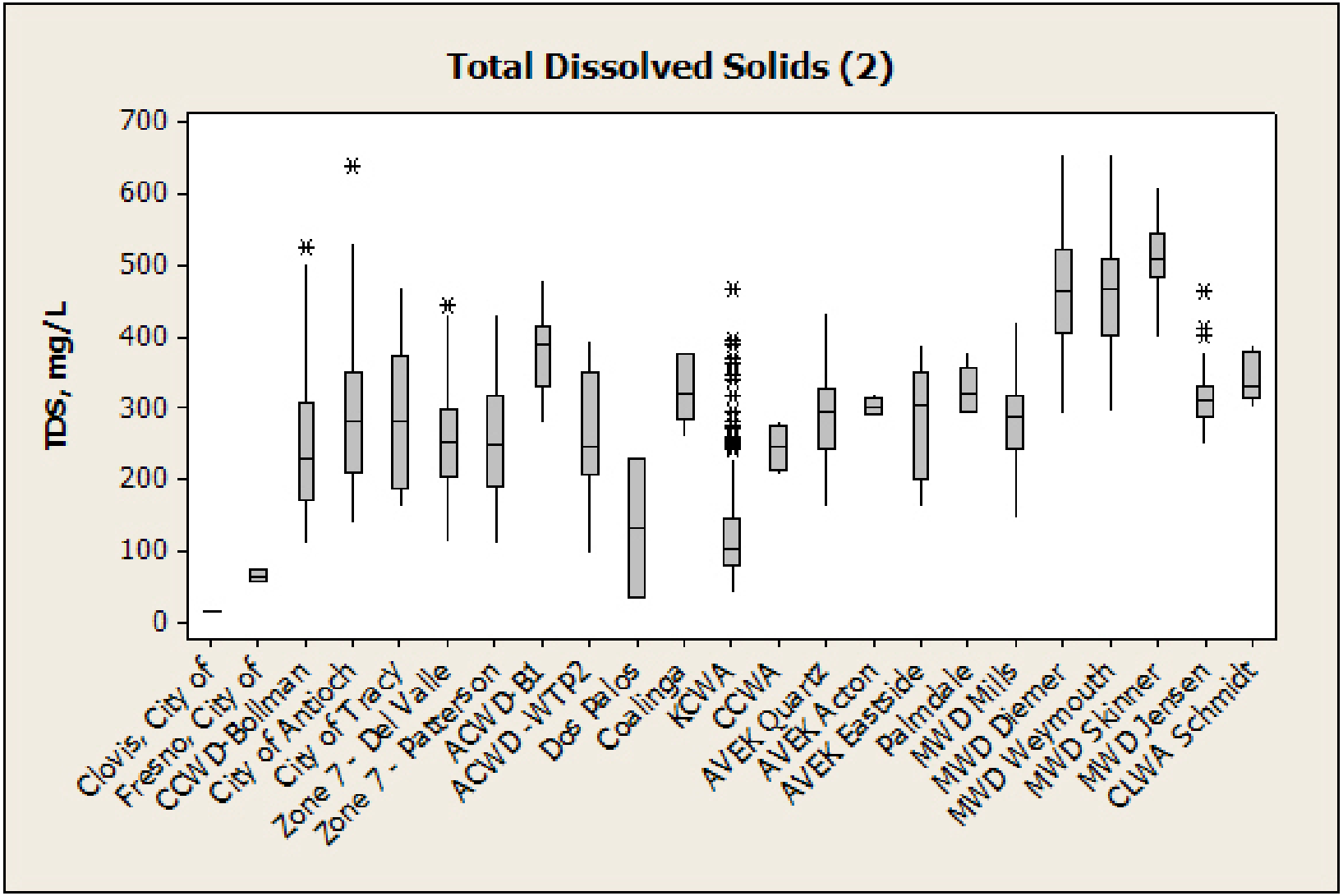

HAA5s
HAA5s, ug/L
70
60
50
40
30
20
10
0
Carmichael WD
Yuba County WD
SEWD
C.C.W.D., West Point
City of Benicia
CCWD-Bollman
Randall-Bold
ACWD-B1
ACWD -WTP2
Coalinga
Huron
CCWA


Total Trihalomethanes (1)
TTHMs, ug/L
90
80
70
60
50
40
30
20
10
0
City of Sacramento-American R
Carmichael WD
City of Redding
Yuba County WD
City of West Sacramento
EBMUD-Lafayette
EBMUD-USL
SEWD
C.C.W.D., West Point
City of Fairfield - NB
City of Fairfield-Waterman
City of Benicia


Total Trihalomethanes (2)
TTHMs, ug/L
120
100
80
60
40
20
0
CCWD-Bollman
Randall-Bold
Zone 7 - Del Valle
Zone 7 - Patterson
ACWD-B1
ACWD-B3
ACWD-WTP2
Dos Palos
Coalinga
KCWA
CCWA
AVEK Quartz


Bromate
Bromate, ug/L
0.025
0.020
0.015
0.010
0.005
0.000
EBMUD-Lafayette
EBMUD-Orinda
EBMUD-USL
EBMUD-Sobrante
EBMUD-WC
Fresno, City of
City of Fairfield - NB
City of Fairfield-Waterman
City of Vallejo - Fleming Hill
City of Vallejo - Travis
CCWD-Bollman
Randall-Bold
CLWA - Rio Vista


TDS (1)
TDS, mg/L
400
300
200
100
0
City of Sacramento - American R
City of Redding
Yuba County WD
City of West Sacramento
City of Sacramento - Sacramento
EBMUD-Lafayette
EBMUD-Orinda
EBMUD-Sobrante
EBMUD-USL
EBMUD-WC
C.C.W.D. West Point
City of Fairfield - NB
City of Fairfield-Waterman
City of Benicia
City of Vallejo - Fleming Hill


Total Dissolved Solids (2)
TDS, mg/L
700
600
500
400
300
200
100
0
Clovis, City of
Fresno, City of
CCWD-Bollman
City of Antioch
City of Tracy
Zone 7 - Del Valle
Zone 7 - Patterson
ACWD-B1
ACWD-WTP2
Dos Palos
Coalinga
KCWA
CCWA
AVEK Quartz
AVEK Acton
AVEK Eastside
Palmdale
MWD Mills
MWD Diemer
MWD Weymouth
MWD Skinner
MWD Jensen
CLWA Schmidt

Next steps

- Continue work with DHS data base (next steps: plant source water data, analysis of treated water data)
- Survey utilities for factors not included in DHS database
- Use data to select representative treatment plants for further investigation, with CALFED consultant
- Develop treatment conceptual model

Final Assessment Schedule

- Draft chapters by the end of July 2007
- Final draft chapters by the end of September 2007
- Final draft document by the end of October 2007
- Peer review process? (Resources not yet identified)

- Performance measure development in parallel with Final Assessment schedule

Questions/Comments/Advice

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