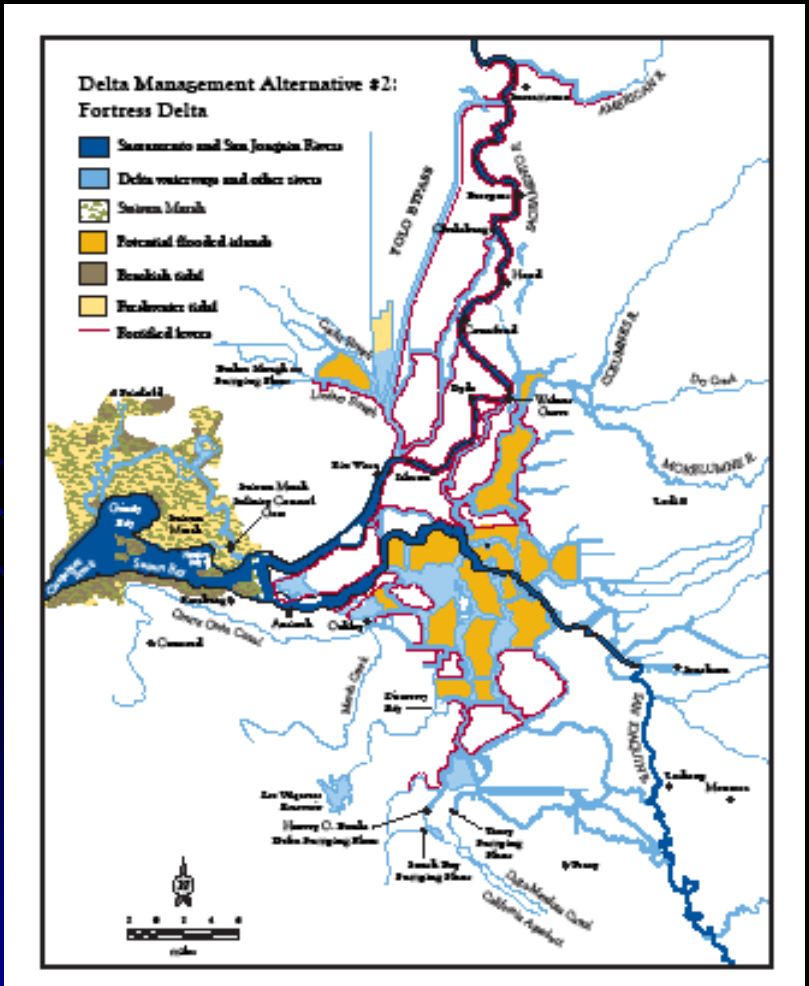
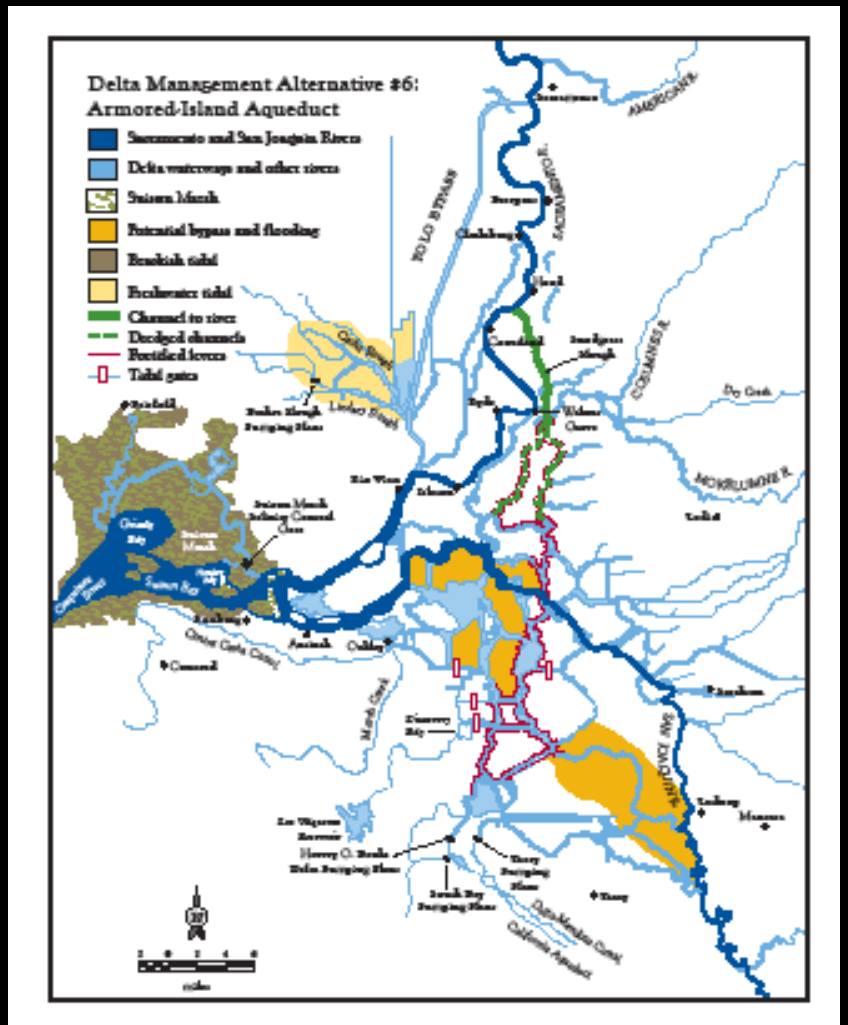
Conveyance Options: Science in an Engineered Environment

Bruce Herbold

US TBA

What ecological considerations cut across conveyance details?

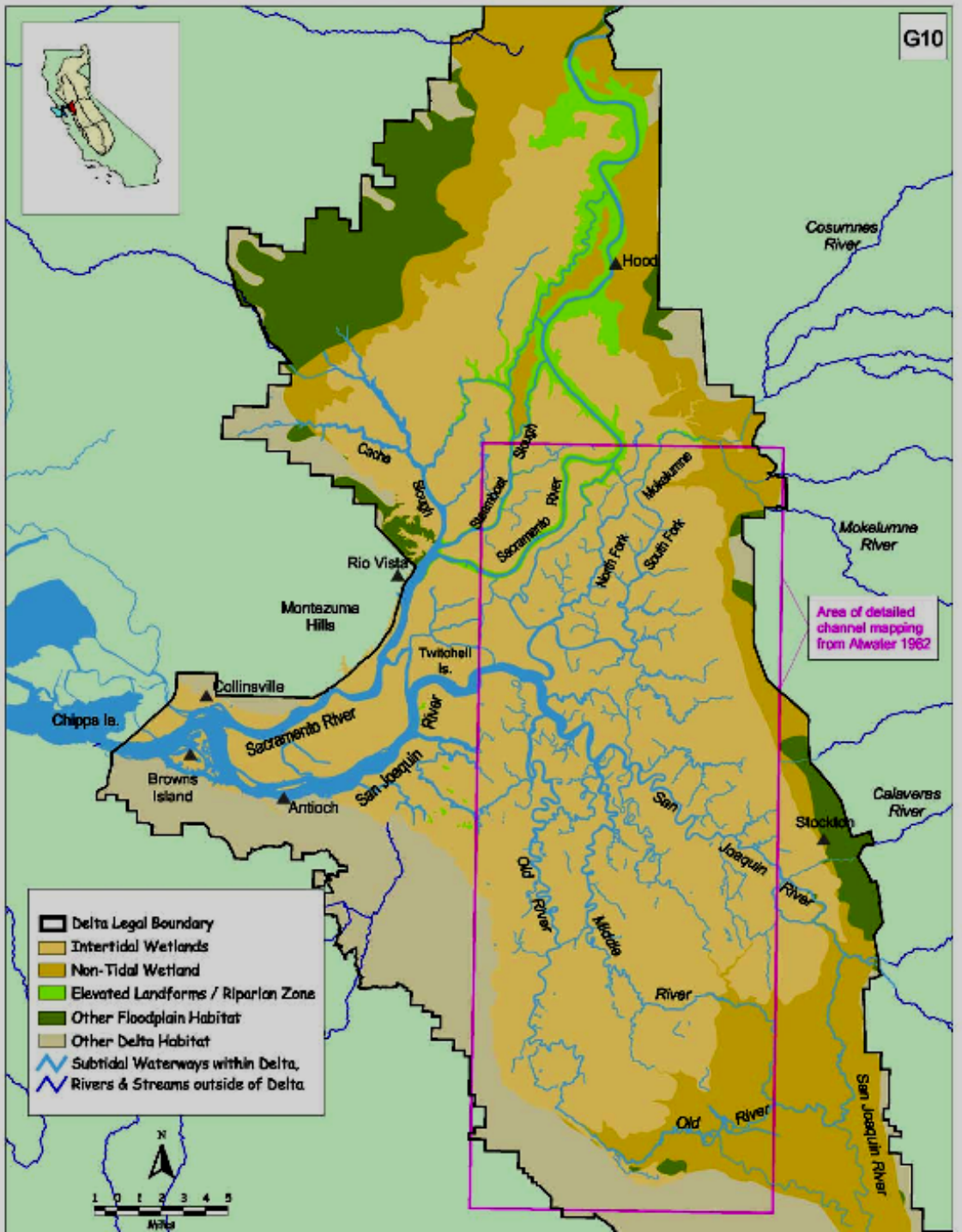


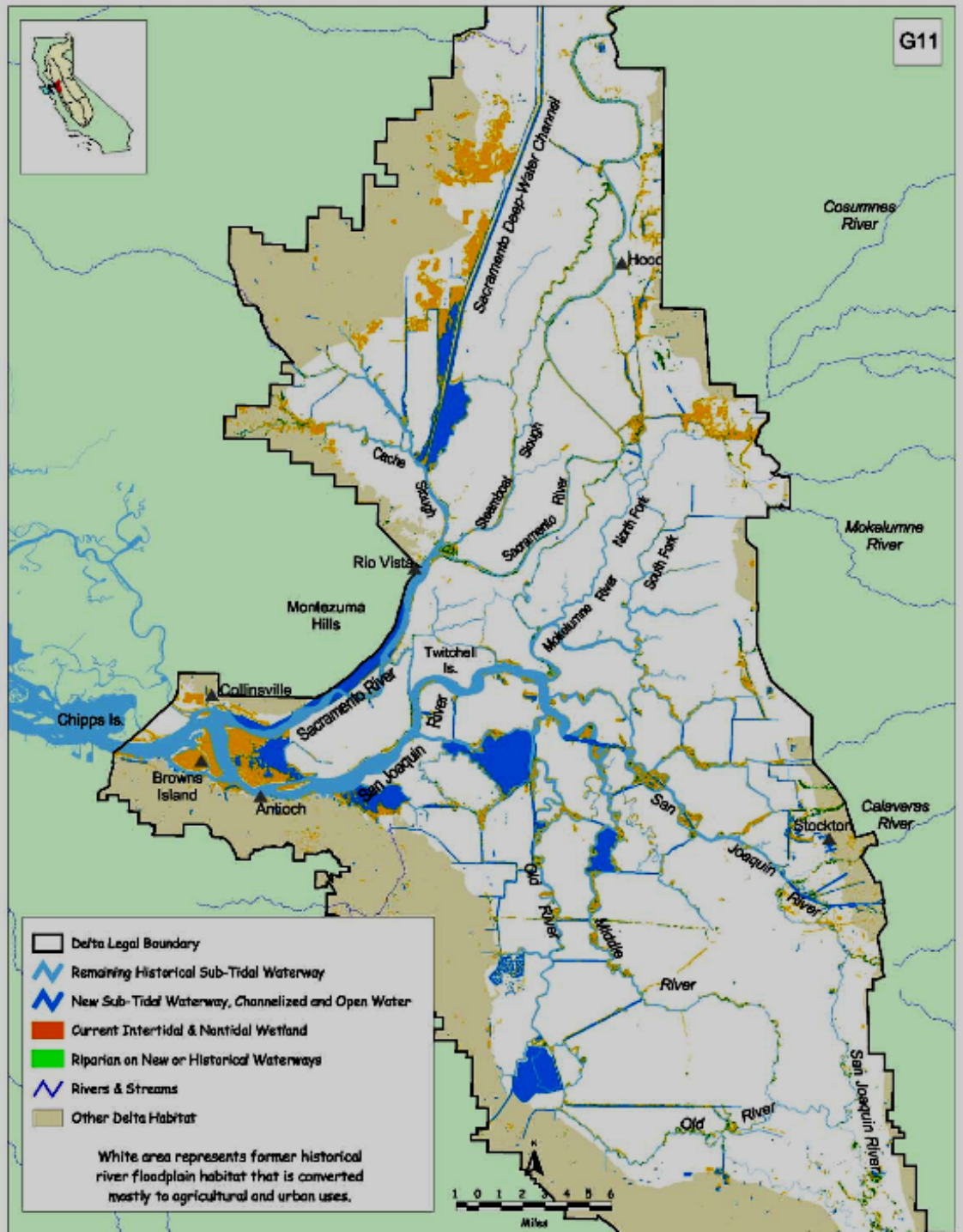


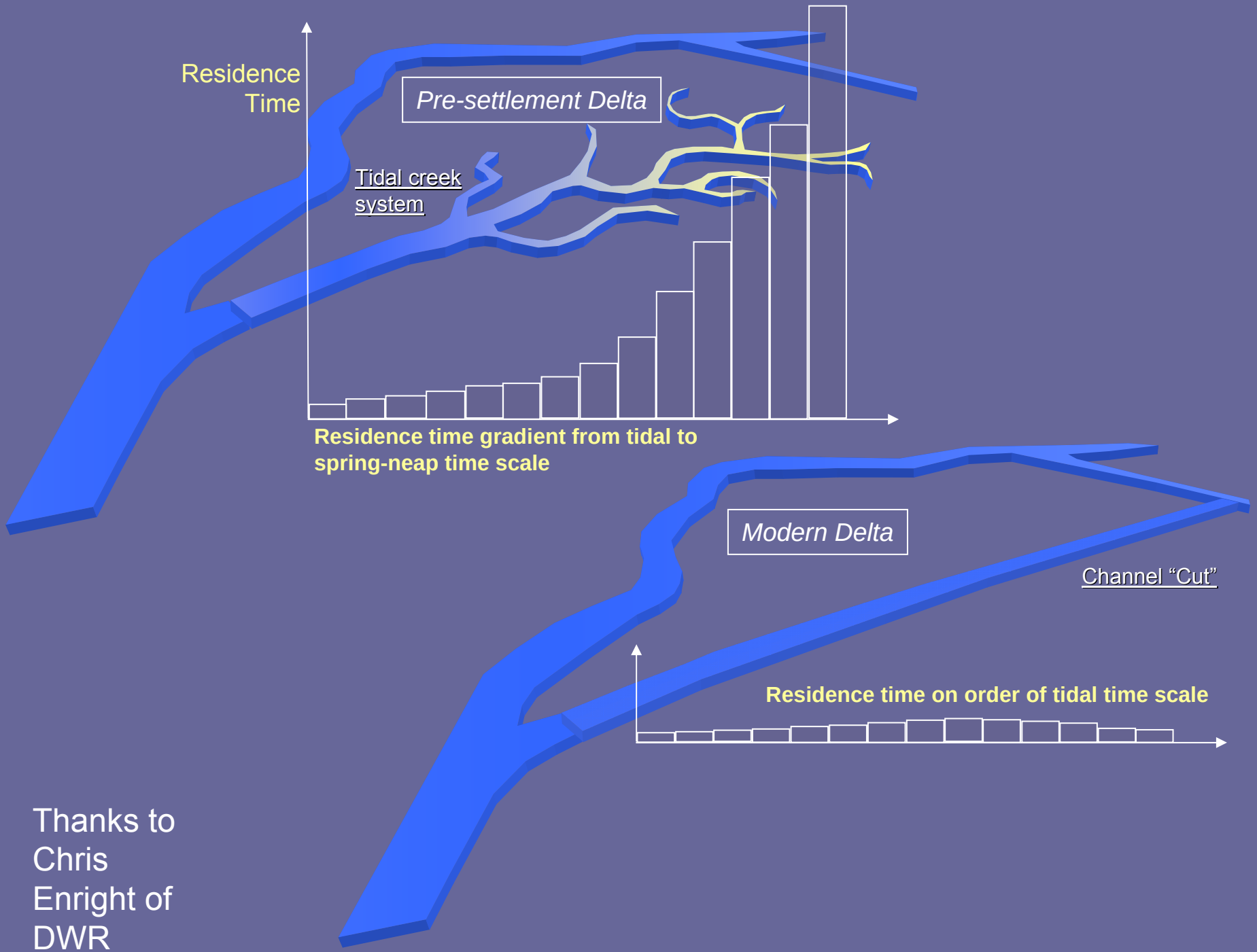
Herbold’s Heresies

- Fragile Ecosystems
- Rivers of All sizes support diverse fish assemblages
- Simple Can be Okay but simpleminded isn’t

SACRAMENTO
Arcade
Davisville
Batavia
Elk Grove
Galt
Rio Vista
Newport
Mokelumne
Vallejo
Benicia
Pittsburgh
Antioch
Summersville
Nortonville
MARTINEZ
SAN RAFAEL
SAN PABLO BAY
SUISUN BAY
NAPA
FAIRFIELD
Suisun
Mt DIABLO MERID.
Mt DIABLO BASE LINE
MONTE DIABLO
OAKLAND
SAN FRANCISCO
REDWOOD
STOCKTON
Farmington
Lathrop
Oak Dale
Knights Ferry
MODESTO
Empire City
Ellis
Banta
San Joaquin City
Grayson
Halsey
Mokelumne
Dry Creek
Willow Slough
Cosumnes
Calaveras
Stanislaus
Tuolumne
Jackson
Lodi
Lockeford
Bridgeport
Latrobe
Yeomet
Fairfield
Drytown
Sutter
Clinton
Lancha Plana
Chili Camp
Cat Camp
Dorado
Lower Lind
Brushville
Millon
Tesco
Mariposa
Mt Diablo
Mt Diablo
Mt Diablo
Mt Diablo

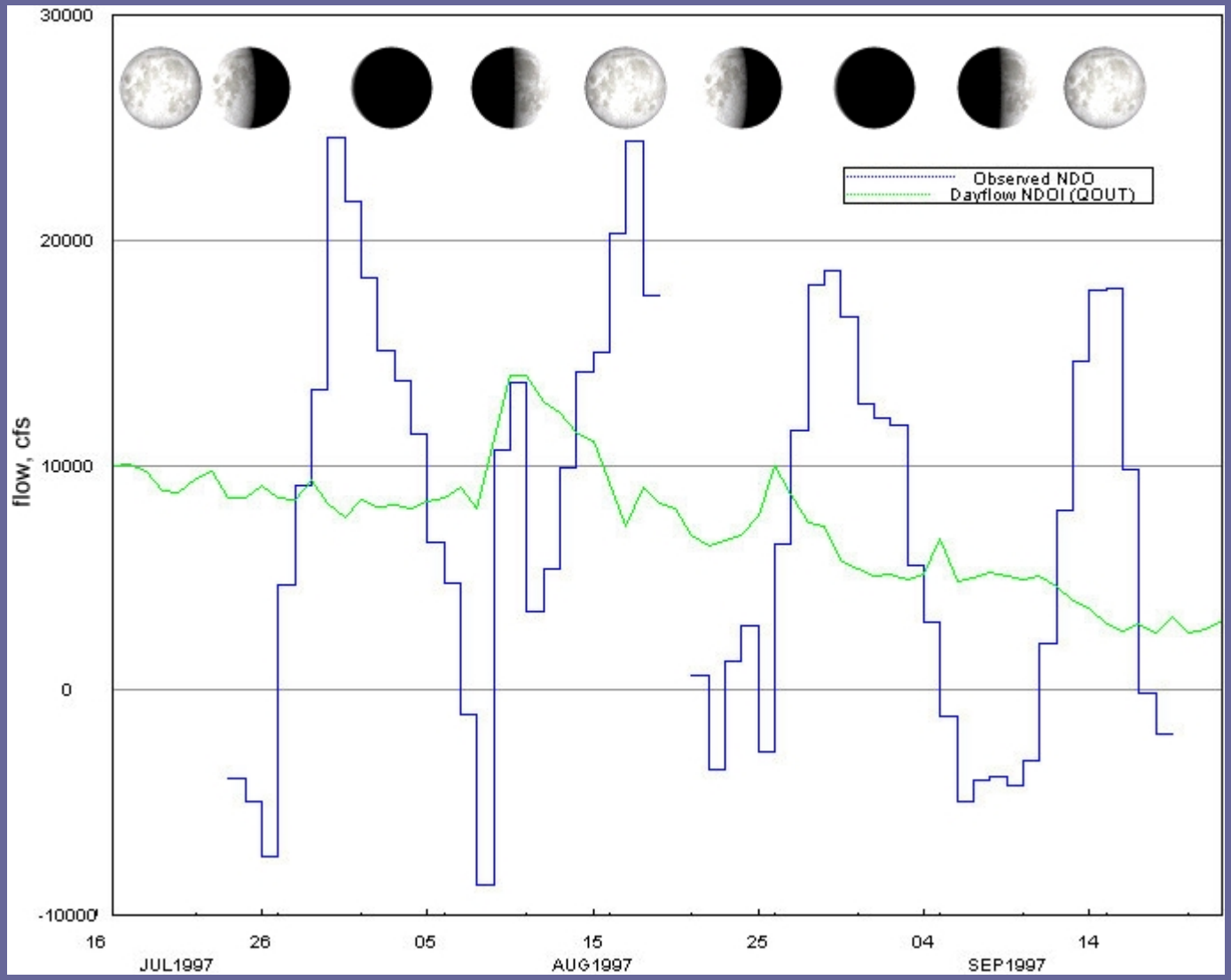

G10
Hood
Cosumnes River
Mokelumne River
Area of detailed channel mapping from Atwater 1962
Cache Slough
Steamboat Slough
Sacramento River
North Fork
South Fork
Mokelumne
Rio Vista
Montezuma Hills
Twitchell Is.
Collinsville
Chipps Is.
Sacramento River
San Joaquin River
Browns Island
Antioch
Stockton
Calaveras River
San Joaquin River
Old River
Middle River
Old River
San Joaquin River
Delta Legal Boundary
Intertidal Wetlands
Non-Tidal Wetland
Elevated Landforms / Riparian Zone
Other Floodplain Habitat
Other Delta Habitat
Subtidal Waterways within Delta,
Rivers & Streams outside of Delta
N
1 0 1 2 3 4 5
Miles


G11
Sacramento Deep Water Channel
Cosumnes River
Hood
Mokelumne River
Cache Slough
Steamboat Slough
Sacramento River
North Fork
South Fork
Mokelumne River
Rio Vista
Montezuma Hills
Twitchell Is.
Collinsville
Chipps Is.
Sacramento River
River
San Joaquin
Browns Island
Antioch
San
Stockton
Calaveras River
Joaquin
River
Old River
Middle
River
Old River
San Joaquin River
Delta Legal Boundary
Remaining Historical Sub-Tidal Waterway
New Sub-Tidal Waterway, Channelized and Open Water
Current Intertidal & Nontidal Wetland
Riparian on New or Historical Waterways
Rivers & Streams
Other Delta Habitat
White area represents former historical river floodplain habitat that is converted mostly to agricultural and urban uses.
1 0 1 2 3 4 5 6
Miles



Thanks to Chris Enright of DWR

Devils Isle
B
White Slough
King Island
Honker Cut
Bishop Cu
onnection Slough
nice Island
Thanks to Chris Enright of DWR
A
Disappointment Slough
Ward Cut
sley Island
Slough
Fern Island
Image © 2004 AirPhotoUSA
©2005 Google
Pointer 38°02'58.08" N 121°27'01.37" W elev 0 ft
Streaming 100%
Eye alt 19332 ft



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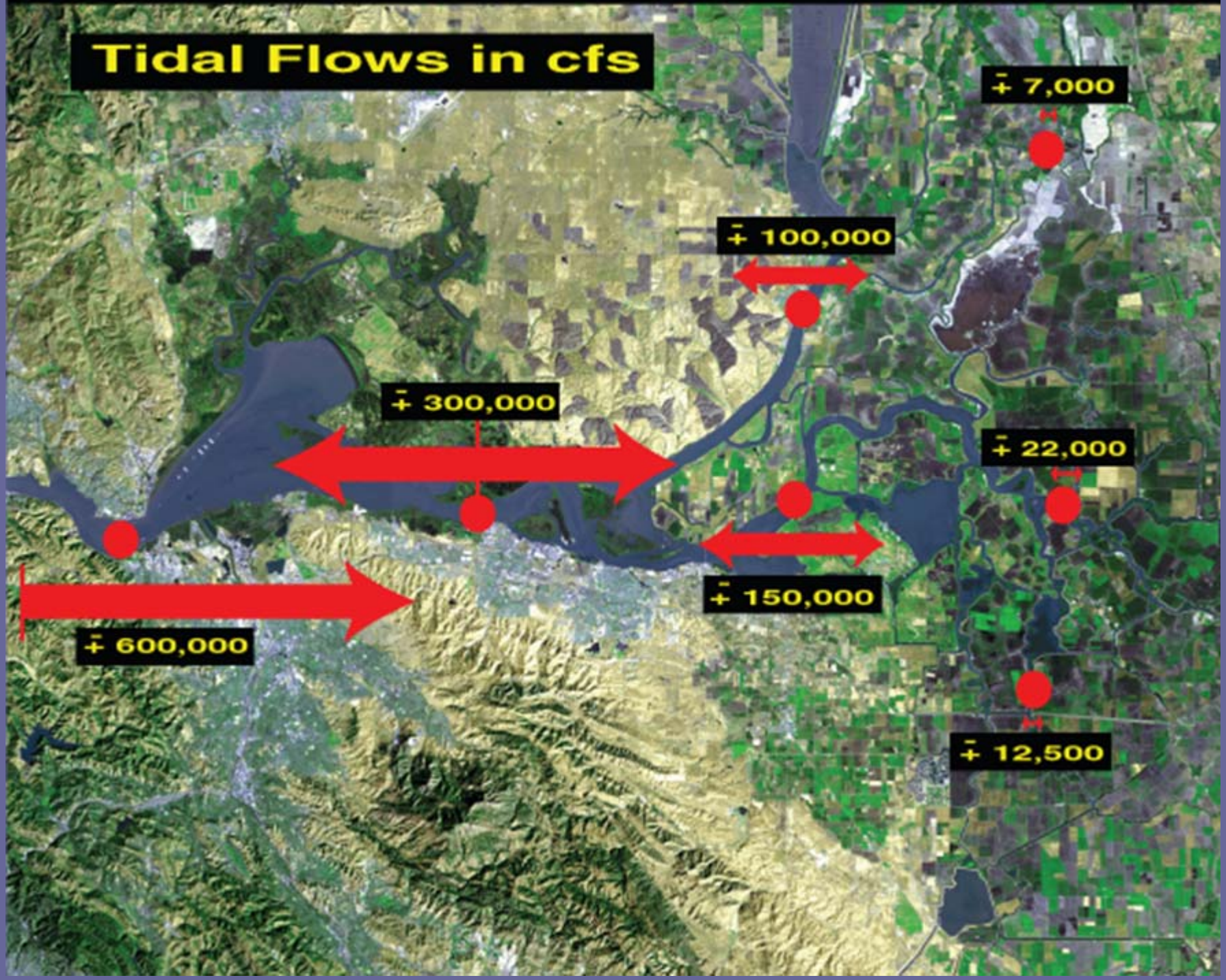
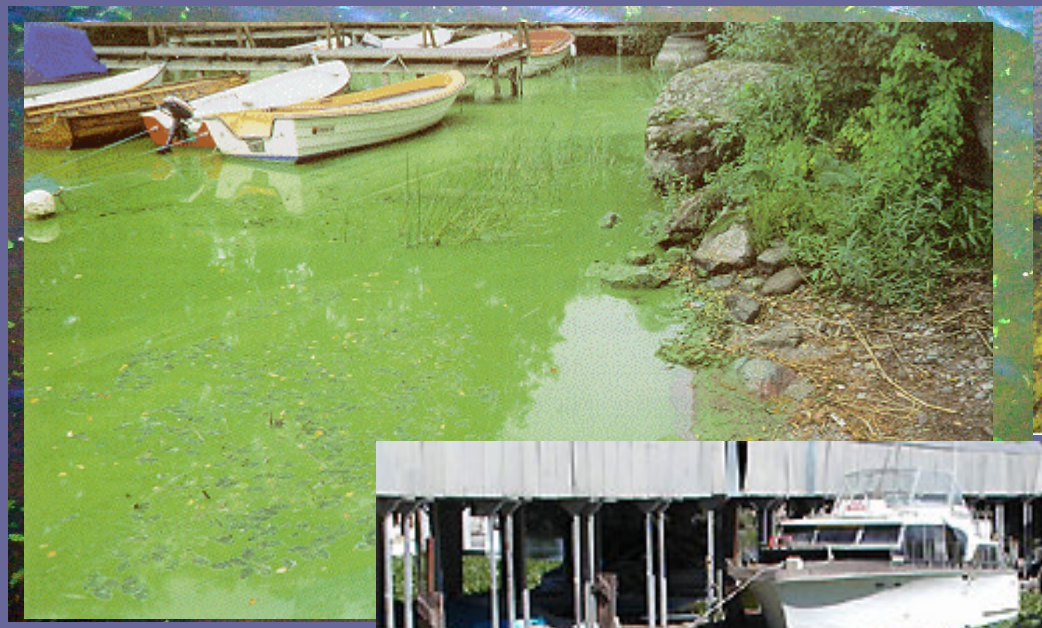

Tidal Flows in cfs
± 7,000
± 100,000
± 300,000
± 22,000
± 150,000
± 600,000
± 12,500

Thanks to Jon Burau USGS and Brad Tom and Chris Enright of DWR

Head of Old River Barrier

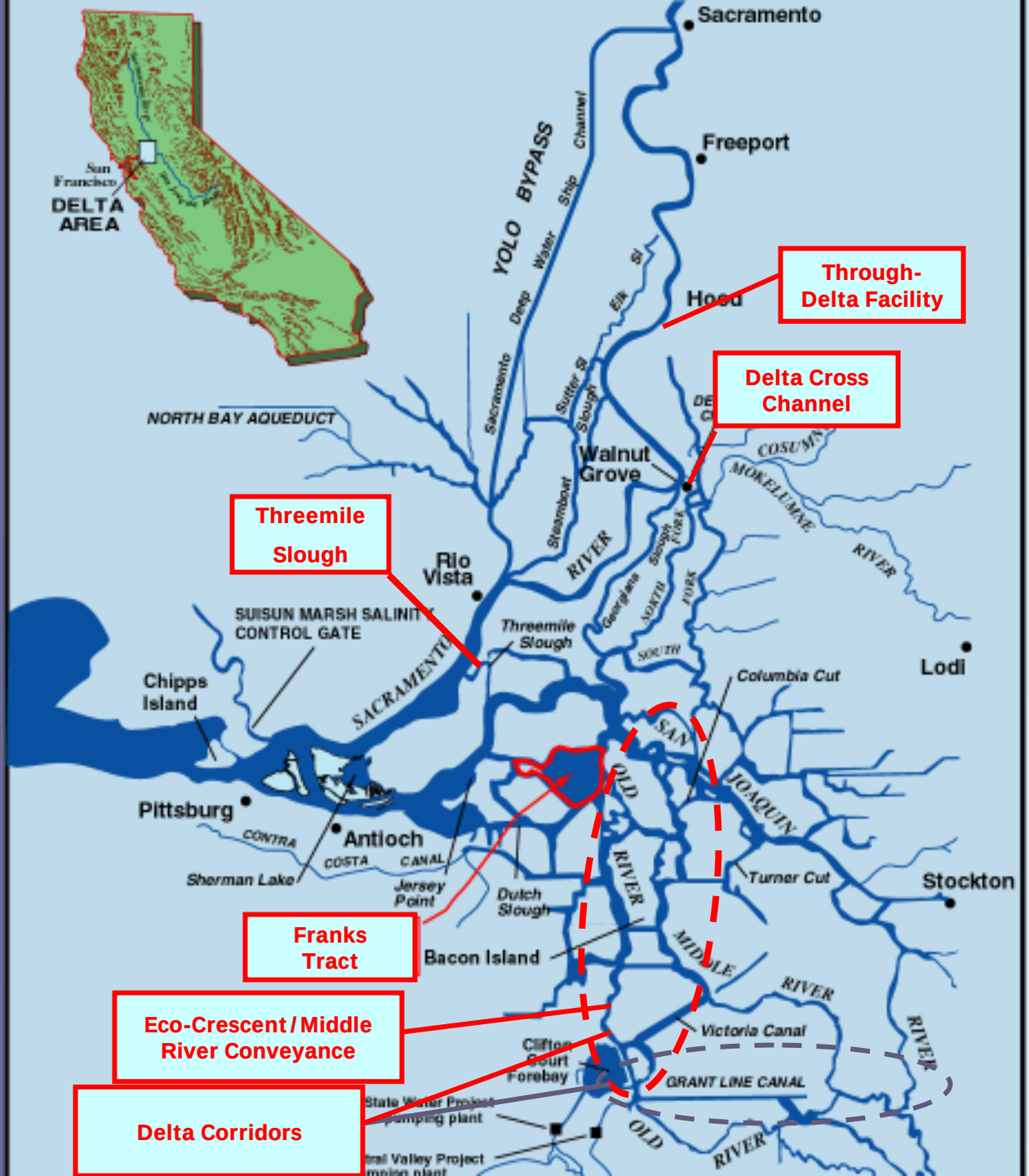
Delta invasive vegetation

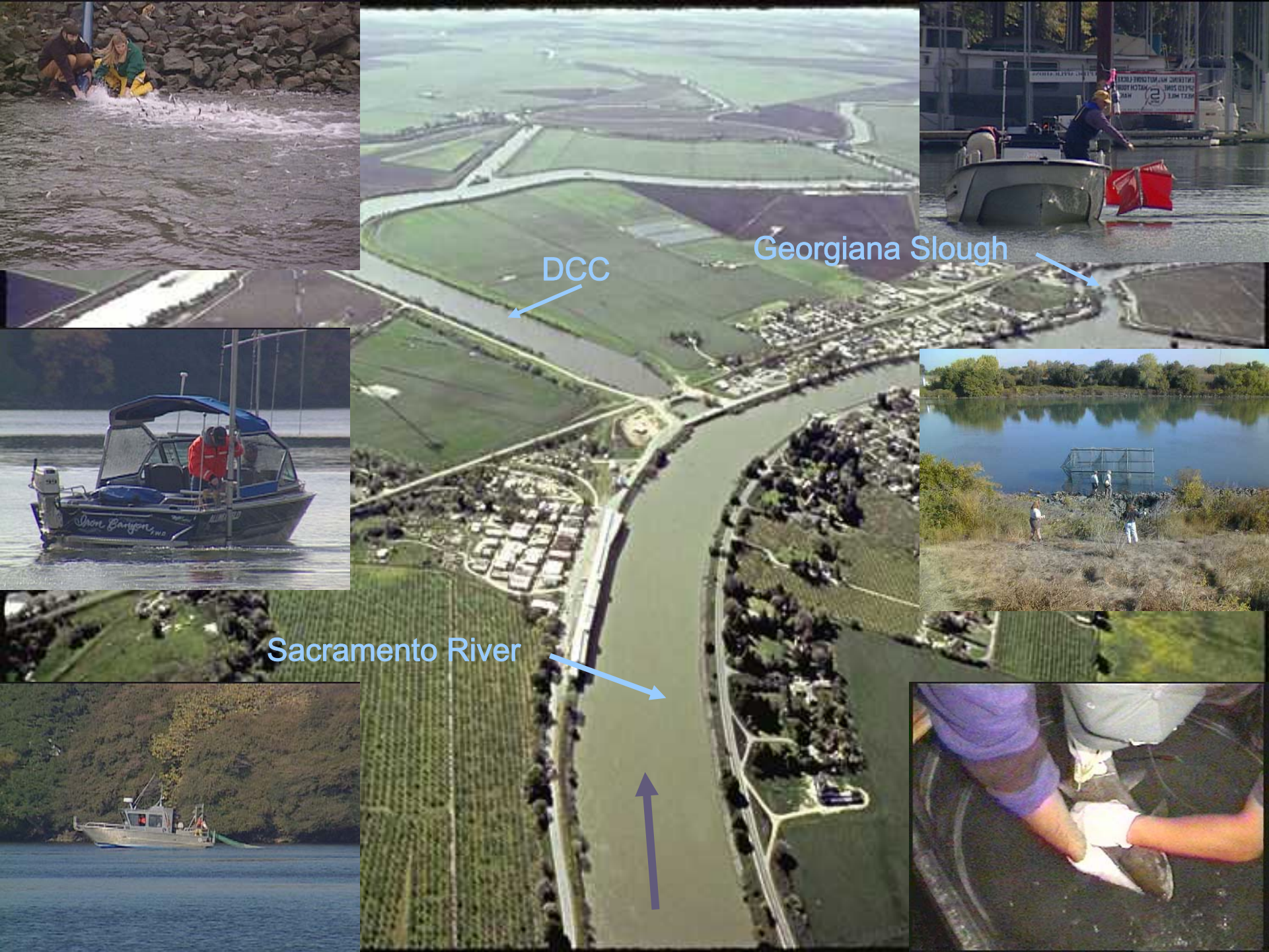


Ott's Diversion Differences

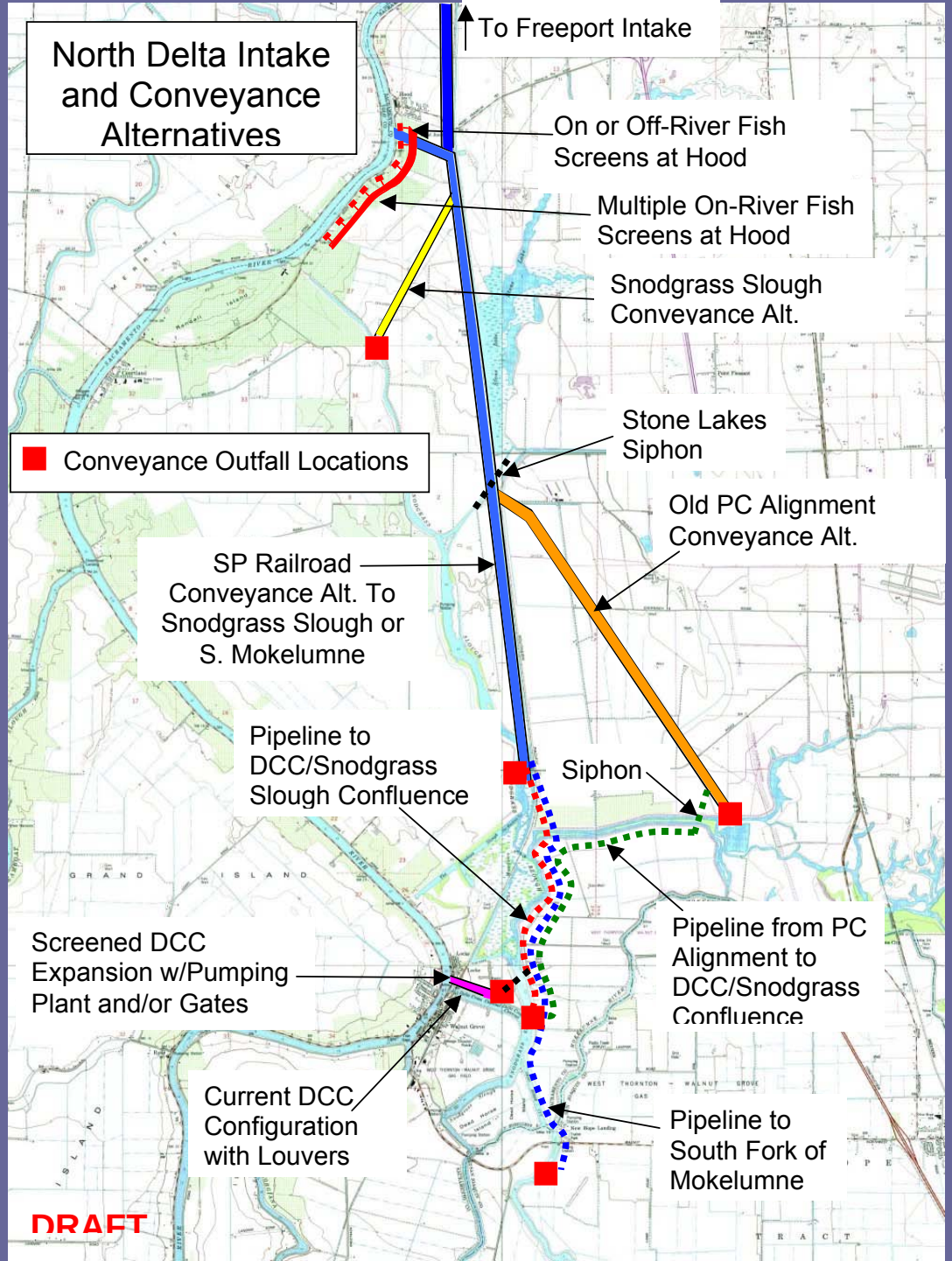
- More flow?
- Less Salt?

- More freshwater/migrant impacts
- Take fewer fish from salt. Always?

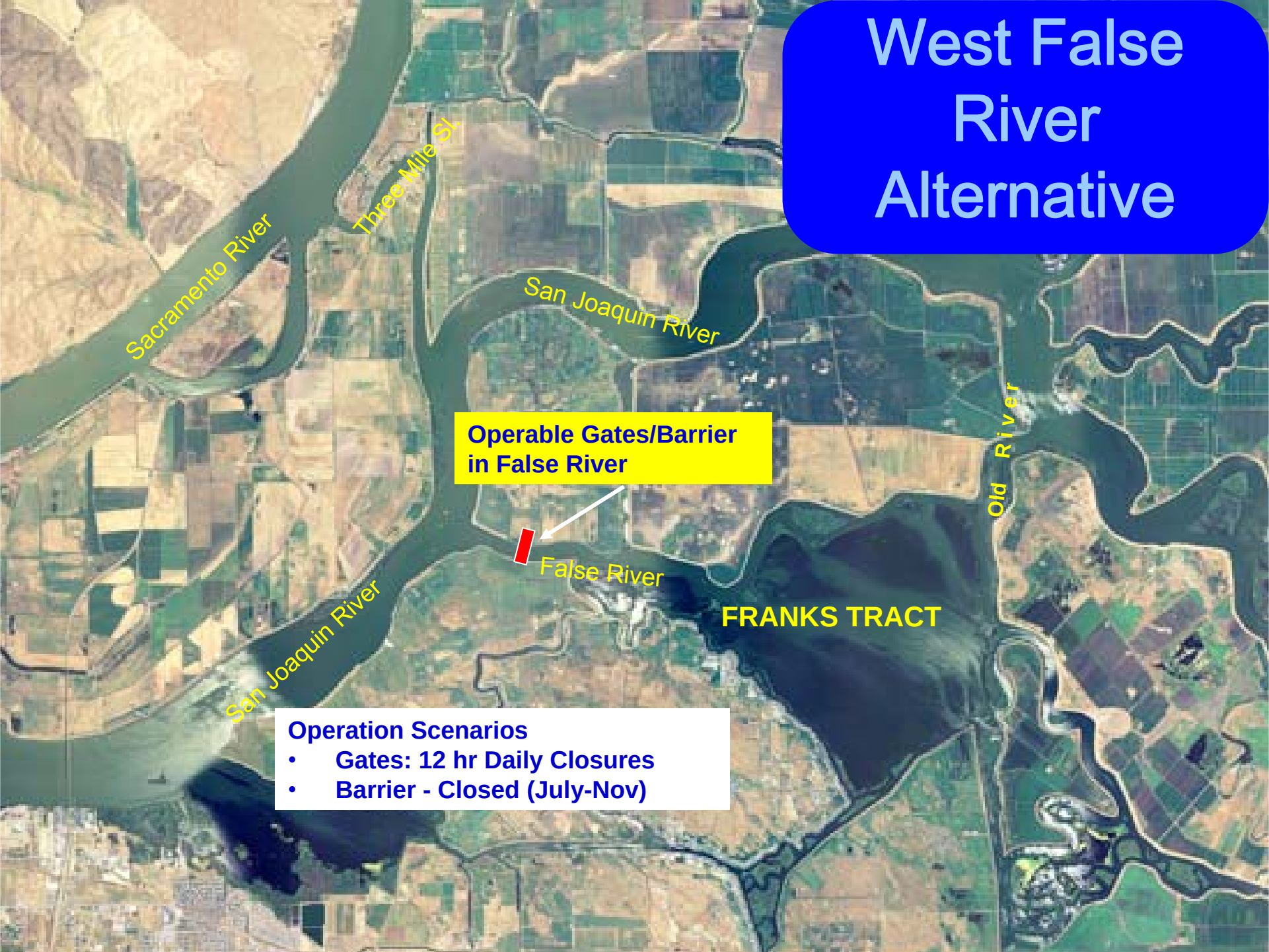

Sacramento
Freeport
Hood
Through-Delta Facility
Delta Cross Channel
Walnut Grove
Threemile Slough
Rio Vista
Lodi
Stockton
Chipps Island
Pittsburg
Antioch
Sherman Lake
Jersey Point
Dutch Slough
Bacon Island
Franks Tract
Eco-Crescent / Middle River Conveyance
Delta Corridors
Clifton Court Forebay
Victoria Canal
GRANT LINE CANAL
Columbia Cut
Turner Cut
SUISUN MARSH SALINITY CONTROL GATE
NORTH BAY AQUEDUCT
YOLO BYPASS
SACRAMENTO RIVER
SAN JOAQUIN RIVER
OLD RIVER
MIDDLE RIVER
CONTRA COSTA CANAL
MOKELUMNE RIVER
COSUMNES RIVER
San Francisco
DELTA AREA


DCC
Georgiana Slough
Sacramento River

TDF Options


North Delta Intake and Conveyance Alternatives
To Freeport Intake
On or Off-River Fish Screens at Hood
Multiple On-River Fish Screens at Hood
Snodgrass Slough Conveyance Alt.
Stone Lakes Siphon
Conveyance Outfall Locations
Old PC Alignment Conveyance Alt.
SP Railroad Conveyance Alt. To Snodgrass Slough or S. Mokelumne
Pipeline to DCC/Snodgrass Slough Confluence
Siphon
Pipeline from PC Alignment to DCC/Snodgrass Confluence
Screened DCC Expansion w/Pumping Plant and/or Gates
Current DCC Configuration with Louvers
Pipeline to South Fork of Mokelumne
DRAFT

West False River Alternative

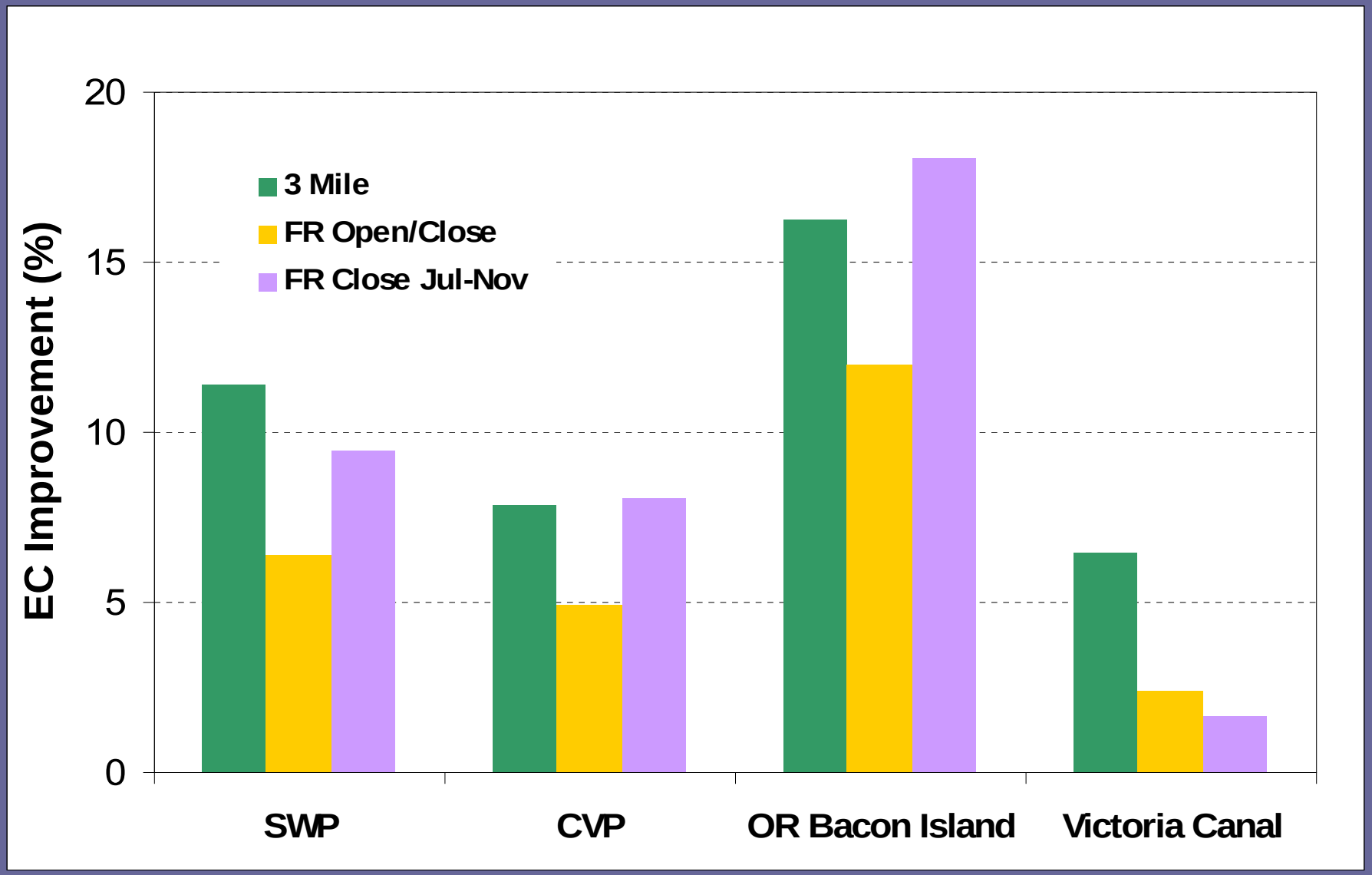


Operation Scenarios

- **Gates: 12 hr Daily Closures**
- **Barrier - Closed (July-Nov)**

Operable Gates in
Three Mile Slough
Sacramento River
San Joaquin River
Operation:
Close 2-6 hrs Daily During Ebb Tide
Old River
False River
FRANKS TRACT
San Joaquin River
Three Mile
Slough
Alternative

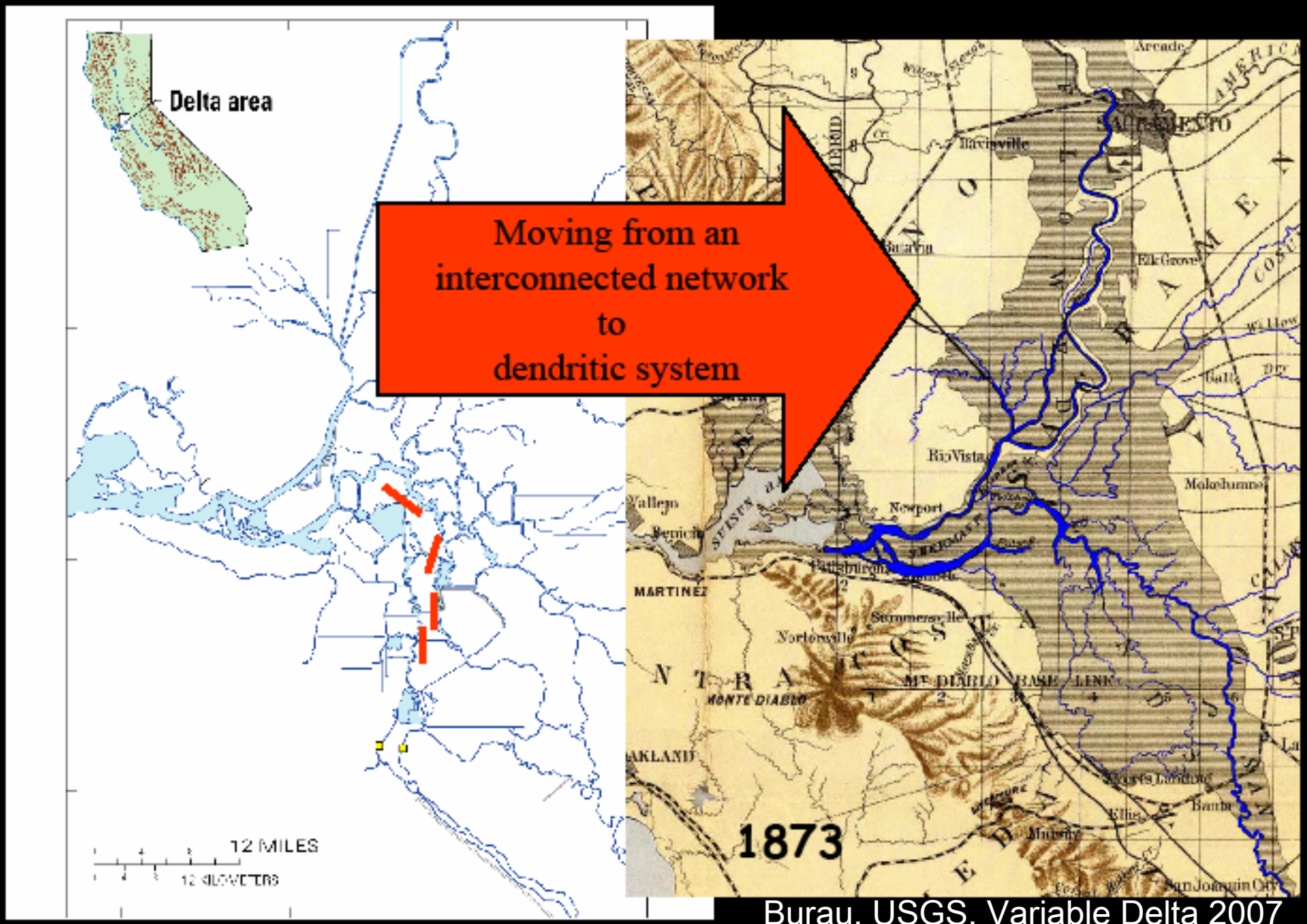
Comparison of Alternatives
Operation: July – November (1976-91)



"Eco Crescent"

Burau, USGS, Variable Delta 2007

Evolution back to natural (historical) geometric form



Burau, USGS, Variable Delta 2007

Reed’s Dicta

- Engineering Ecosystems is Fraught
- Ecosystems function on long timetables
- Needs Change with Time
- Get Out of the Way
- The Unexpected will Happen

Vision ≠ Objectives

- Water supply reliability
  - Enough to do what?
- Water quality
  - To support which use?
- Species recovery
  - Which, where?
- Ecosystem sustainability
  - Desirable characteristics?
- Public safety
  - Define hazard?
- Economic well being……..

United States
Environmental Protection
Agency

Science Advisory Board

EPA-SAB-EPEC-98-003
January 1998
http://www.epa.gov/sab

EPA

Ecological Impacts And Evaluation Criteria For The Use Of Structures In Marsh Management

EPA-SAB-EPEC-98-003

Changes in the 20th Century: The Great Flood of 1927

- 246+ Deaths
- 325,000 Refugees
- 162,000 Homes Inundated
- 16.6 Million Acres Flooded

Mississippi River & Tributaries Project

Marsh Management

…using levees and structures to control water exch

Marsh Management in LA

Landowners

- Drawdown water levels in spring to encourage growth of annual plants
- Maintain water levels in Fall/Winter for waterfowl
- Prevent ‘washing away’ of ‘fragile marsh soils’
- Maintain boundaries around degraded marshes to maintain property rights – surface and subsurface!

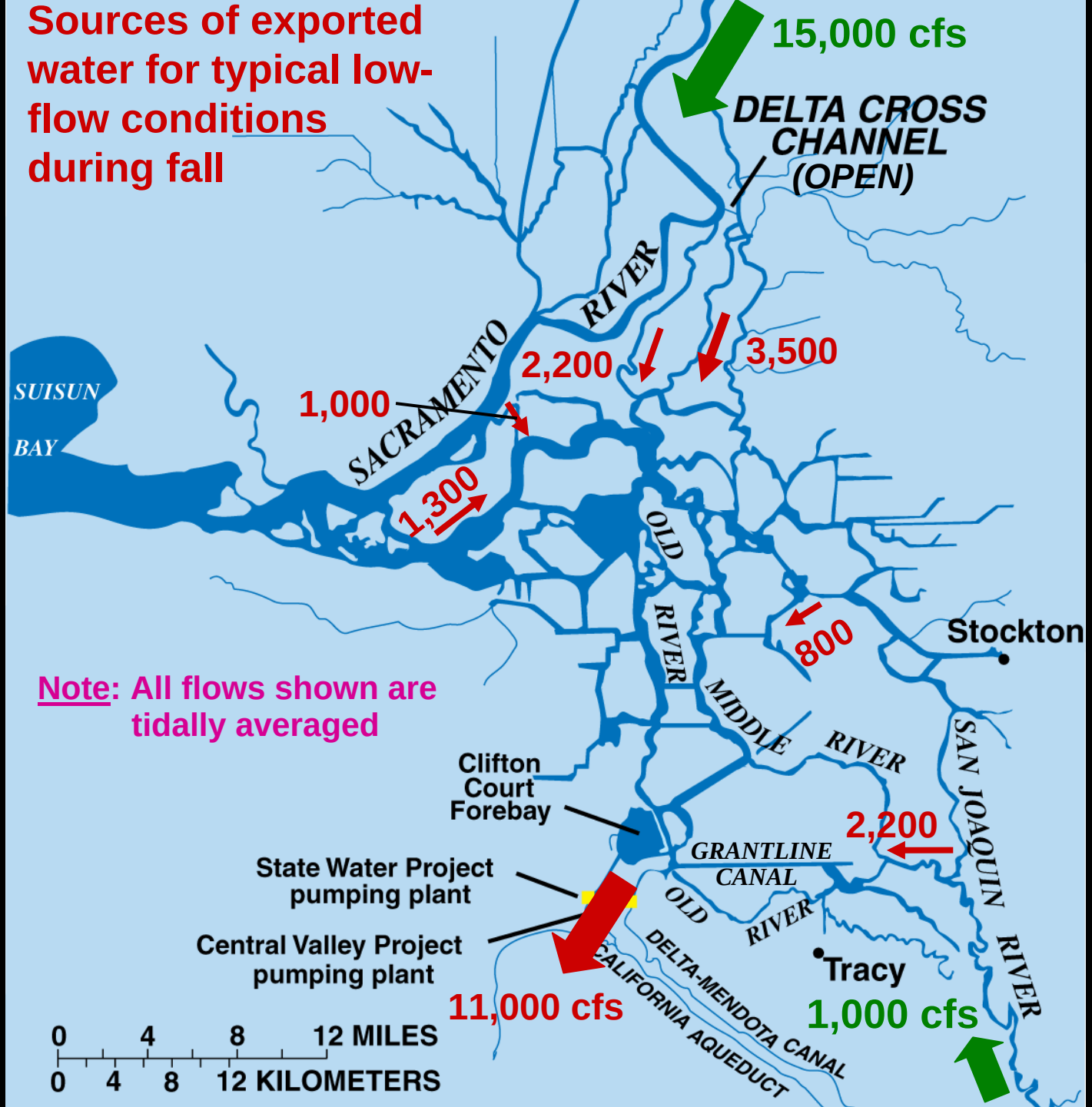
Smith and Stewart's Insights

- WQ is largely a function of SJ inflow
- AND LOCAL GEOCHEMISRTRY!

- We can model particles

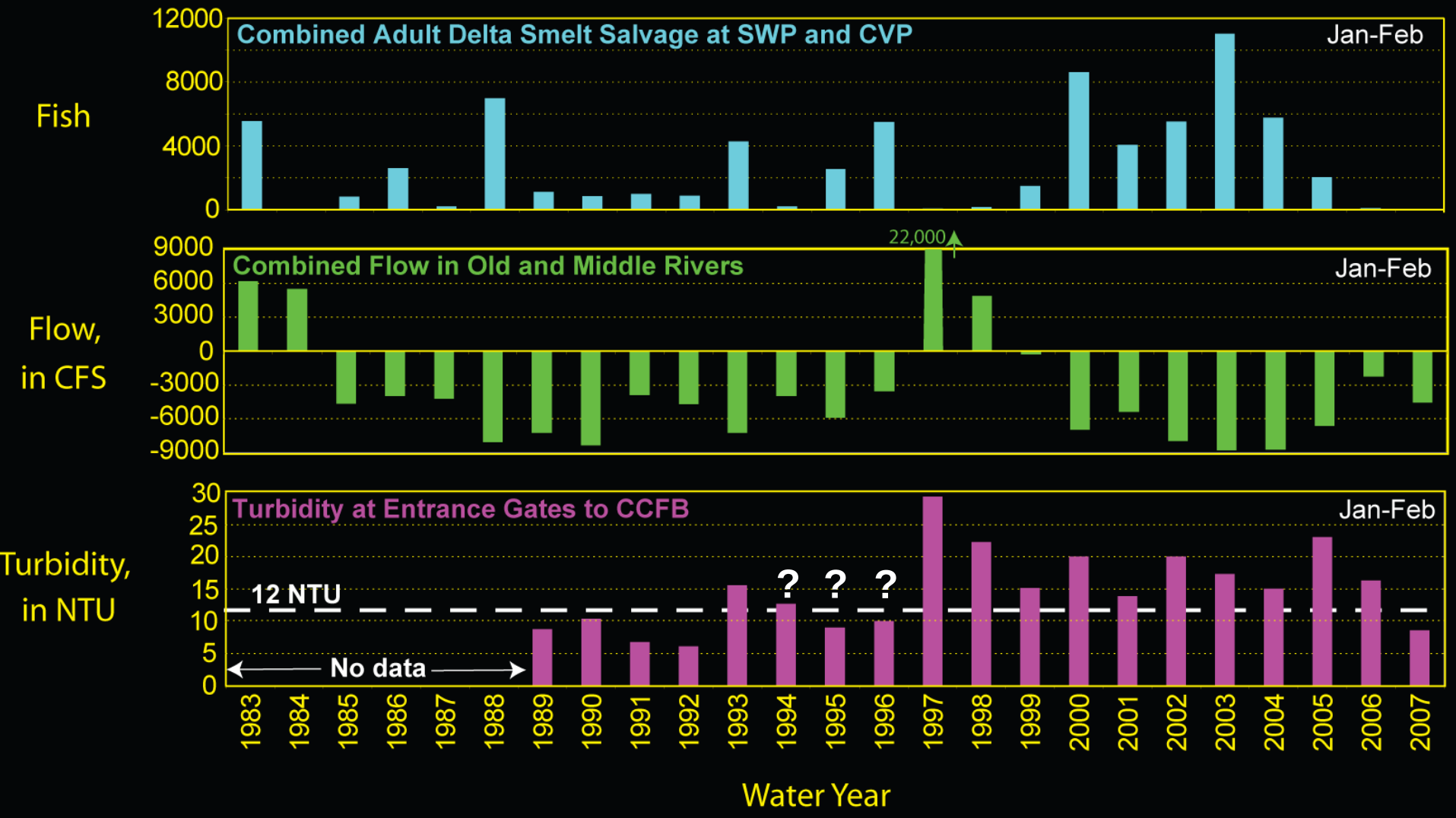
- We can explain and predict entrainment

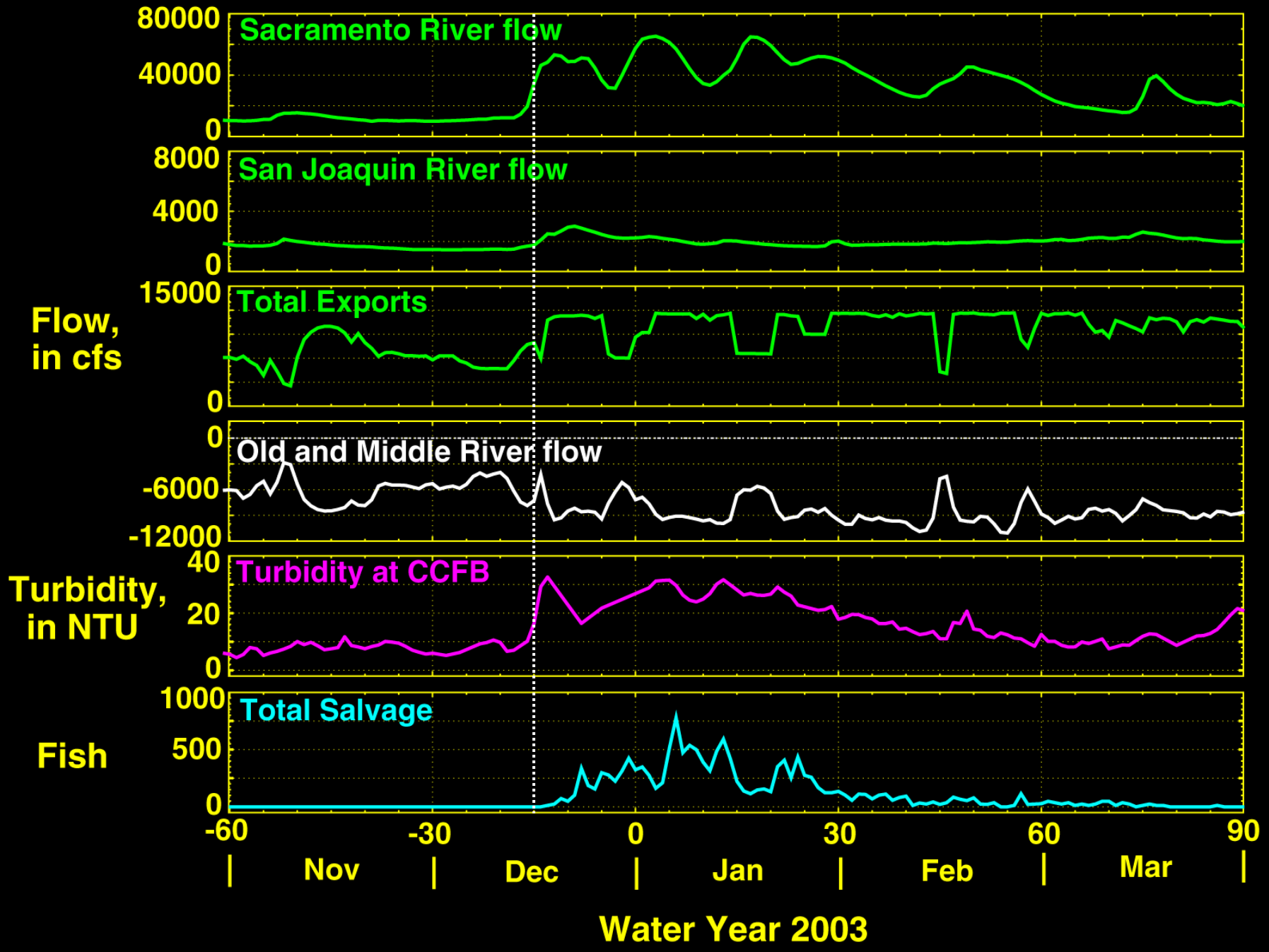
Sources of exported water for typical low-flow conditions during fall



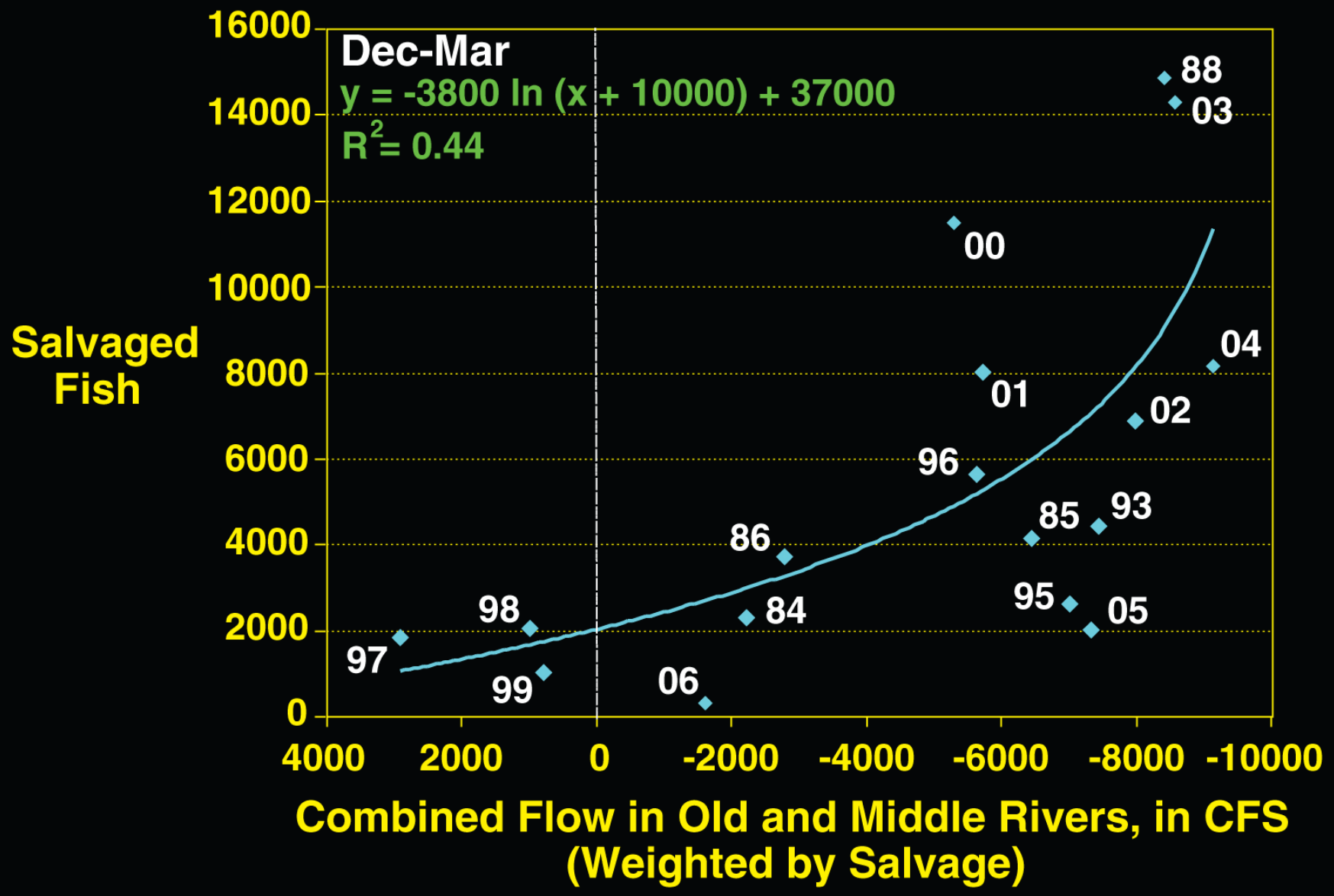
Note: All flows shown are tidally averaged

Adult Delta Smelt Salvage, Flows and Turbidities

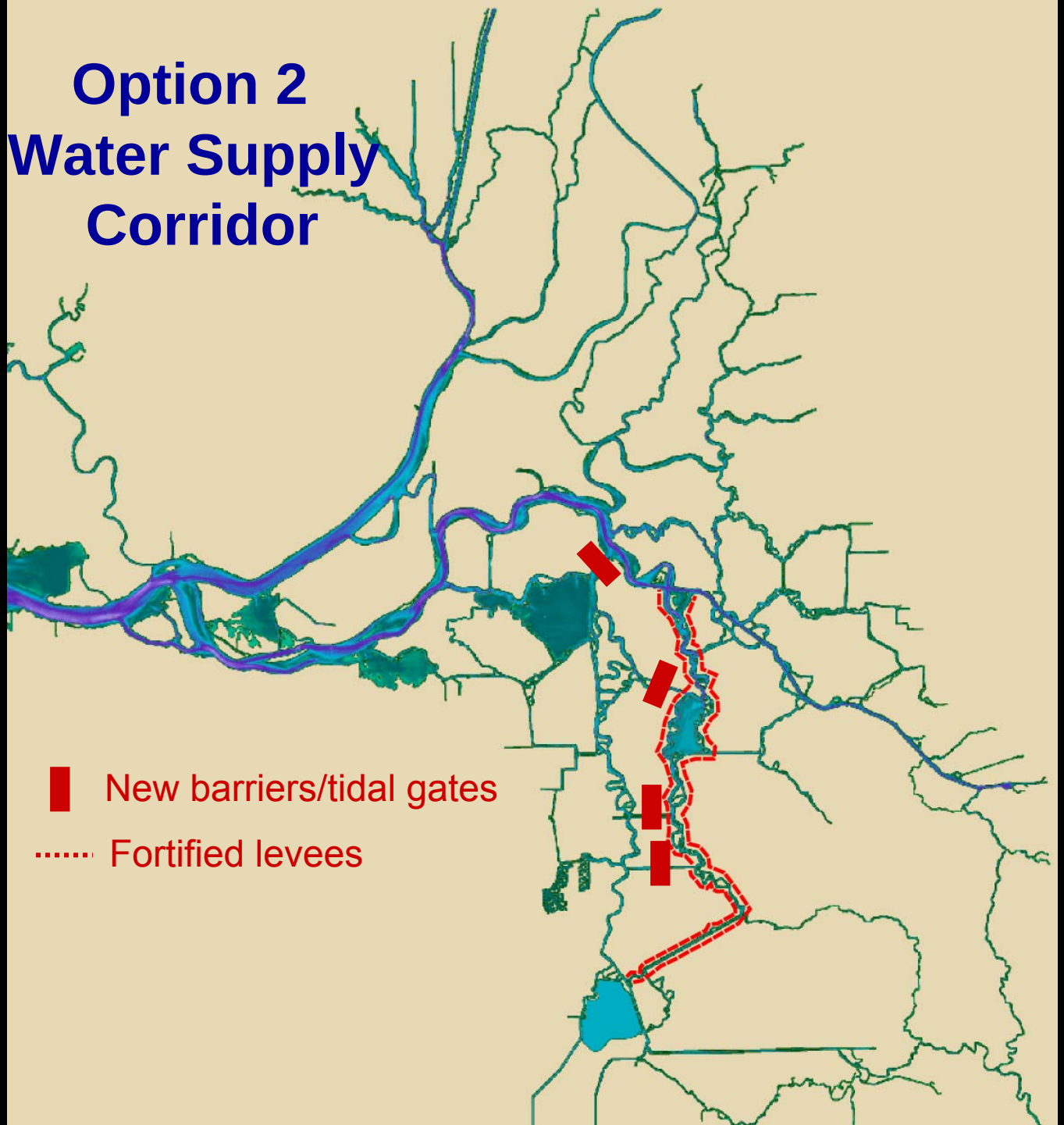



Sacramento River flow
80000
40000
0
San Joaquin River flow
8000
4000
0
Total Exports
15000
0
Flow, in cfs
Old and Middle River flow
0
-6000
-12000
Turbidity at CCFB
40
20
0
Turbidity, in NTU
Total Salvage
1000
500
0
Fish
-60
-30
0
30
60
90
Nov
Dec
Jan
Feb
Mar
Water Year 2003

Regression of Adult Delta Smelt Salvage and Combined Flow In Old and Middle Rivers



Option 2 Water Supply Corridor



The Nobriga Rule of applied ecology:

- If you change the system, the system will change

The Cardinal Rule of exporting water:

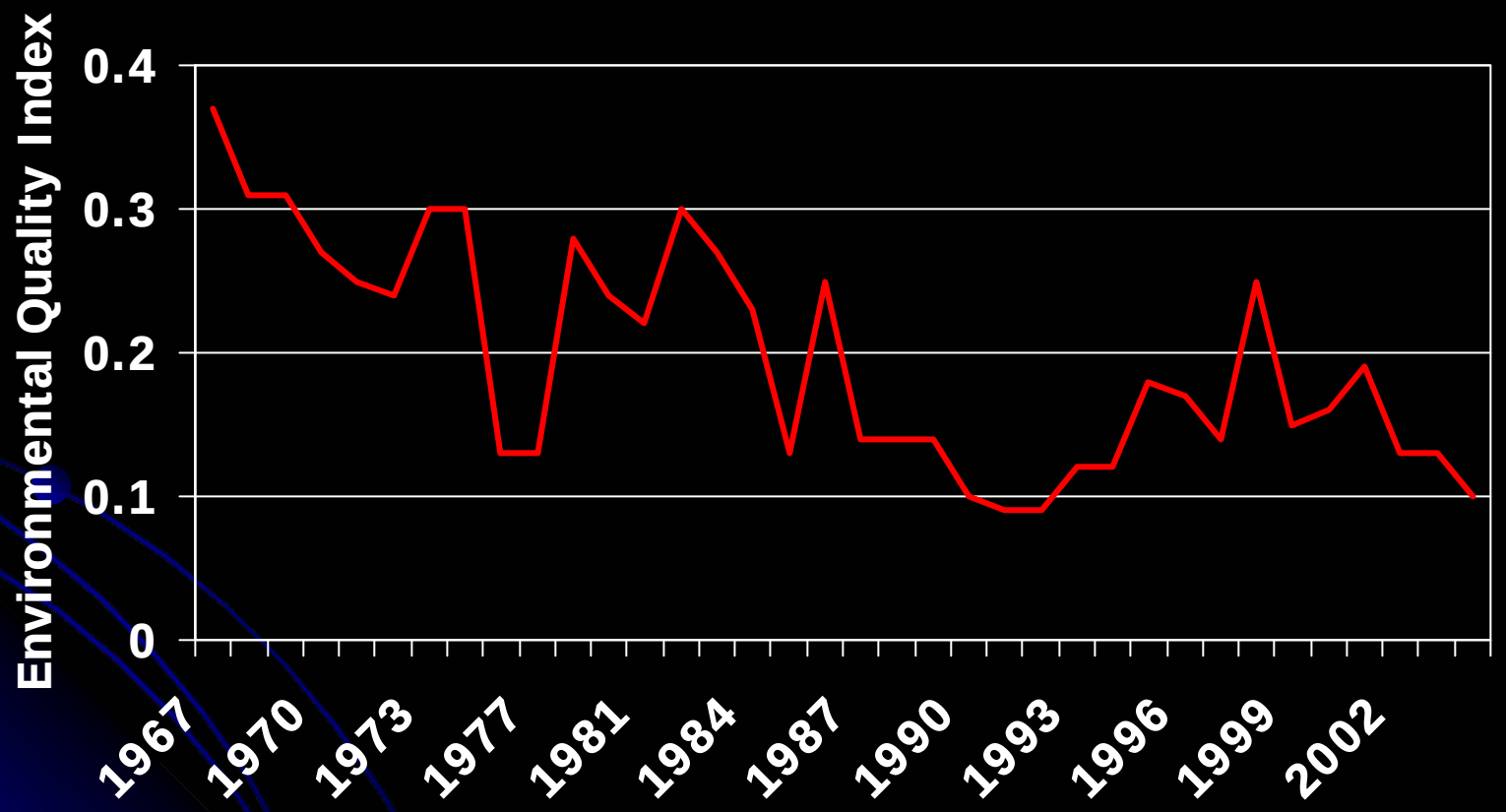
Exporting water will change the system…always

“Freshwater flow defines an estuary.” (Kimmerer 2002)

Three over-arching questions

- How does the conveyance option change the abiotic aspects of fish habitat?
- How does the conveyance option change the flow of energy to target species?
- How does the conveyance option affect migratory fish transport and fate?

The projects influence habitat suitability for delta smelt



Taken from Feyrer et al. (2007)

Conclusions

1. The system will keep changing

2. Think beyond fish passage – See Reed