

# The amazing Delta and models used to manage it

Municipal Water Quality Investigations Meeting  
July 30, 2014

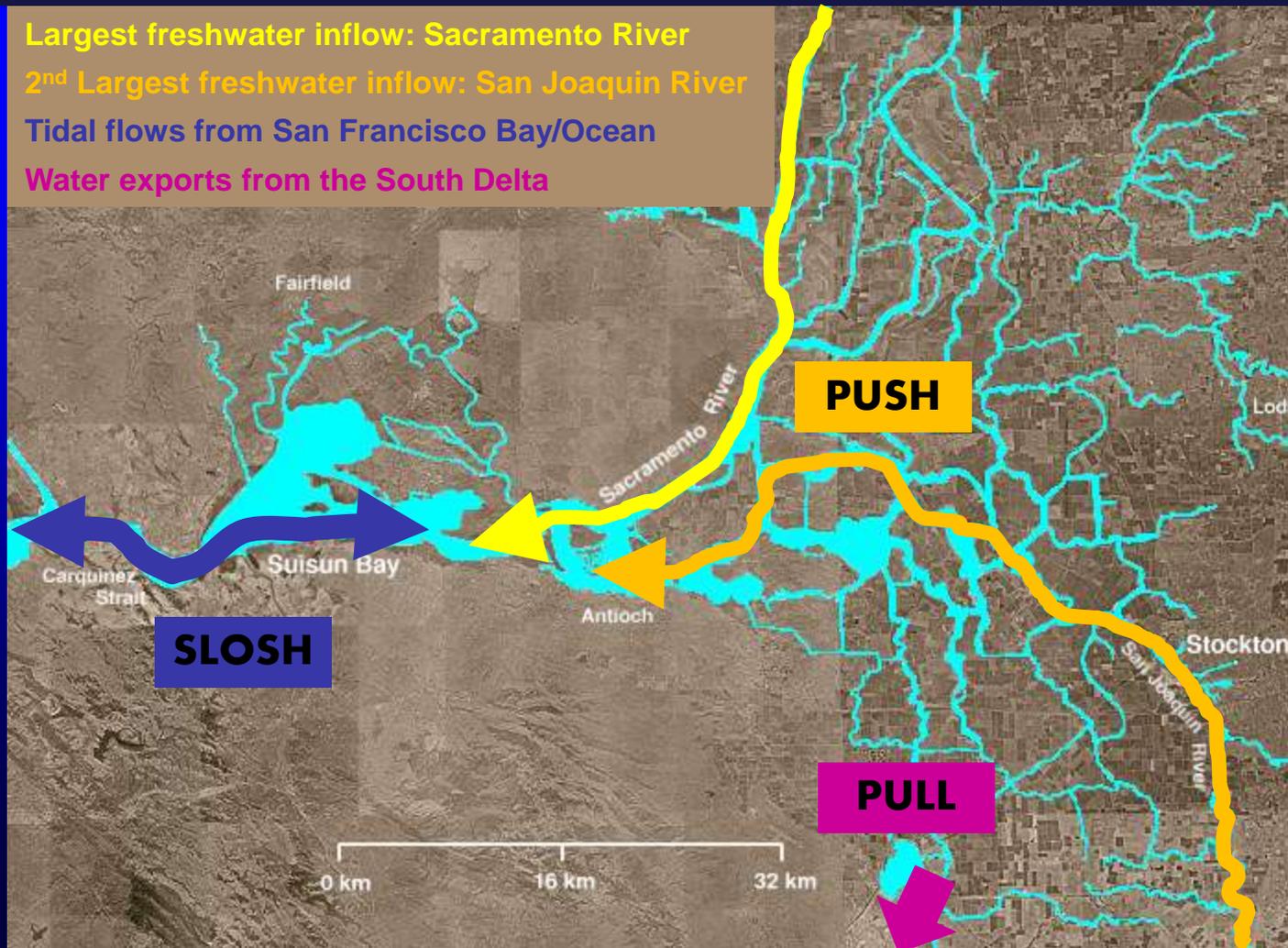
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Modeling Support Branch  
Bay-Delta Office

# The Delta is a **maze** of channels that flow into San Francisco Bay

Largest freshwater inflow: Sacramento River  
2<sup>nd</sup> Largest freshwater inflow: San Joaquin River  
Tidal flows from San Francisco Bay/Ocean  
Water exports from the South Delta





# The amazing Delta



- A **maze** of interconnected channels
- **Hub** of the state & federal water supply systems

# Vital to Economy

- 2/3 of Californians rely on Delta water
- Los Angeles, San Diego, Silicon Valley, Contra Costa depend on Delta water
- 3 million of acres irrigated with Delta water
- Delta water supports about \$400 billion of the California economy



# Vital to Environment



Greater Sandhill Crane



White Sturgeon



Longfin Smelt



Tri-Colored Blackbird



Delta Smelt



Giant Garter Snake



Splittail



Green Sturgeon

- 80% of the state's commercial fish species live in or migrate through the Delta
- The Delta is home to over 700 species of plants and animals
- Several threatened or endangered species

# State & Federal Water Projects

- 54 reservoirs and lakes
- 1,200 miles of canals and pipelines
- 16 hydro facilities

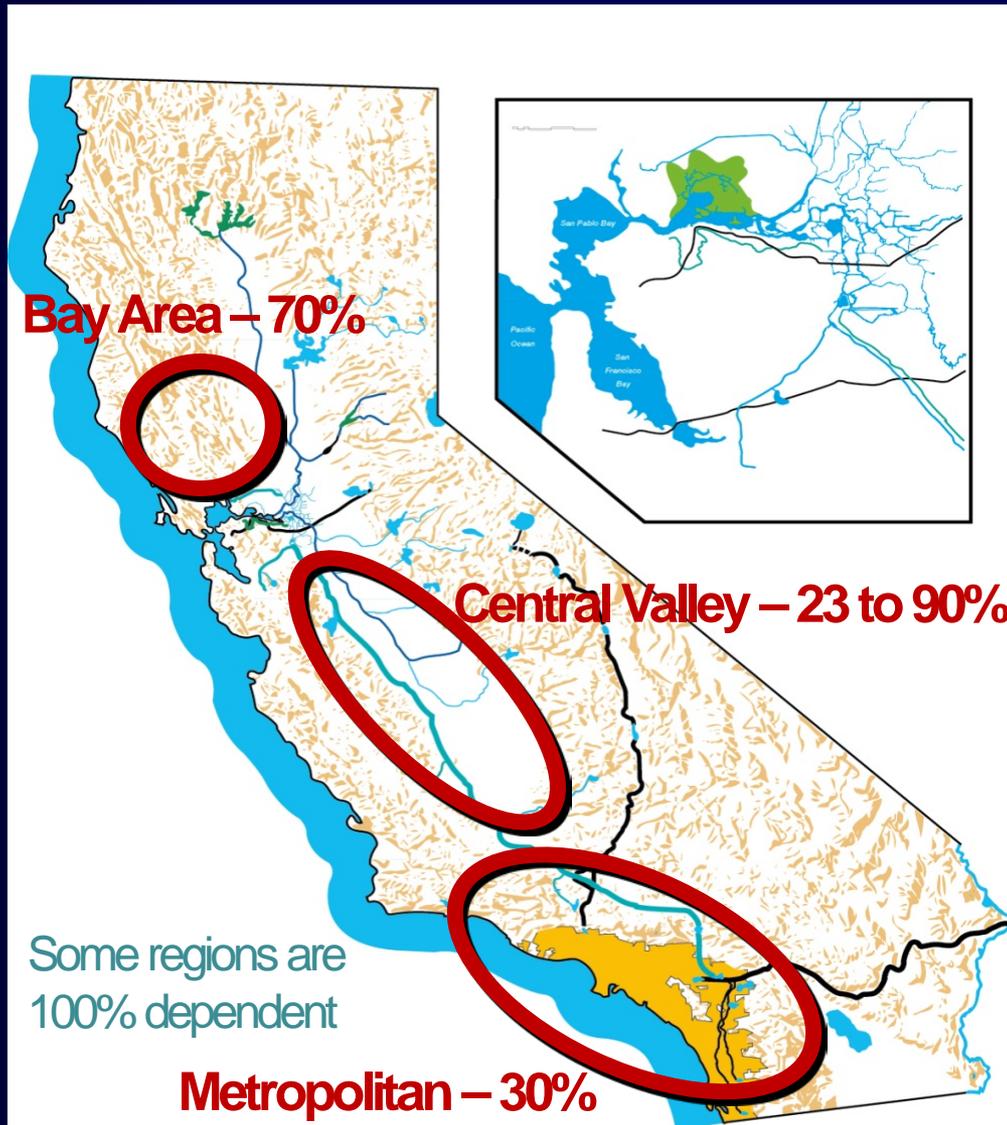


*Largest publically-built and operated water supply project in the world*

*Bay-Delta is the hub of this infrastructure*



# California Relies on Water that Flows Through the Delta





# The amazing Delta



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- Islands are **bowls** surrounded by **levees**



# Delta Islands are bowls

Delta islands are below sea level

1100 miles of levees protect Delta islands from rivers whose water levels are above the island ground levels

Bradford Island

Webb Tract

San Joaquin River

False River

Jersey Island

# Land Subsidence

Due to Farming & Peat Soil Oxidation

- 25 ft.

- 20 ft.

- 15 ft.

- 5 ft.

**Below Sea Level**

-30 -20 -10 -5 ft





# The amazing Delta



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- Salinity is affected by **tides, flows & pumping**

# Delta Inflows

## Sacramento River

~80% Inflow; good quality

## East Side Rivers

~5% Inflow; good quality

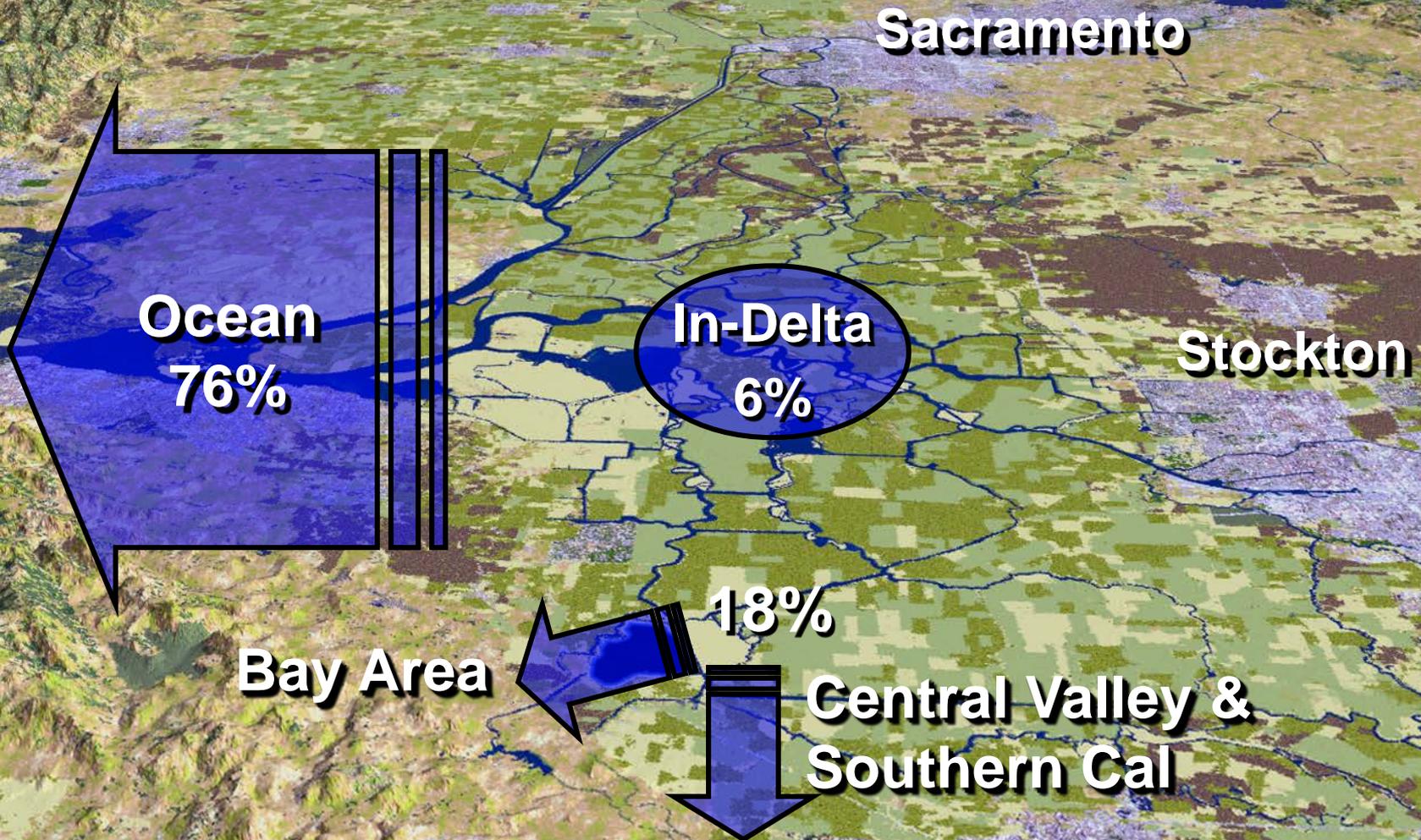
## Ocean/Tidal

High salinity

## San Joaquin River

~15% Inflow; poor quality

# Delta Water Use



# Delta Inflows and Exports

Values on 7-27-14

## Sacramento River

4,000 cfs – 113,000 cfs

8871 cfs

160 uS/cm

## Ocean/Tidal

±330,000 cfs

249 cfs

336 uS/cm

## San Joaquin River

400 cfs – 55,000 cfs

813 cfs

633 uS/cm

## SWP exports

0 cfs – 7180 cfs

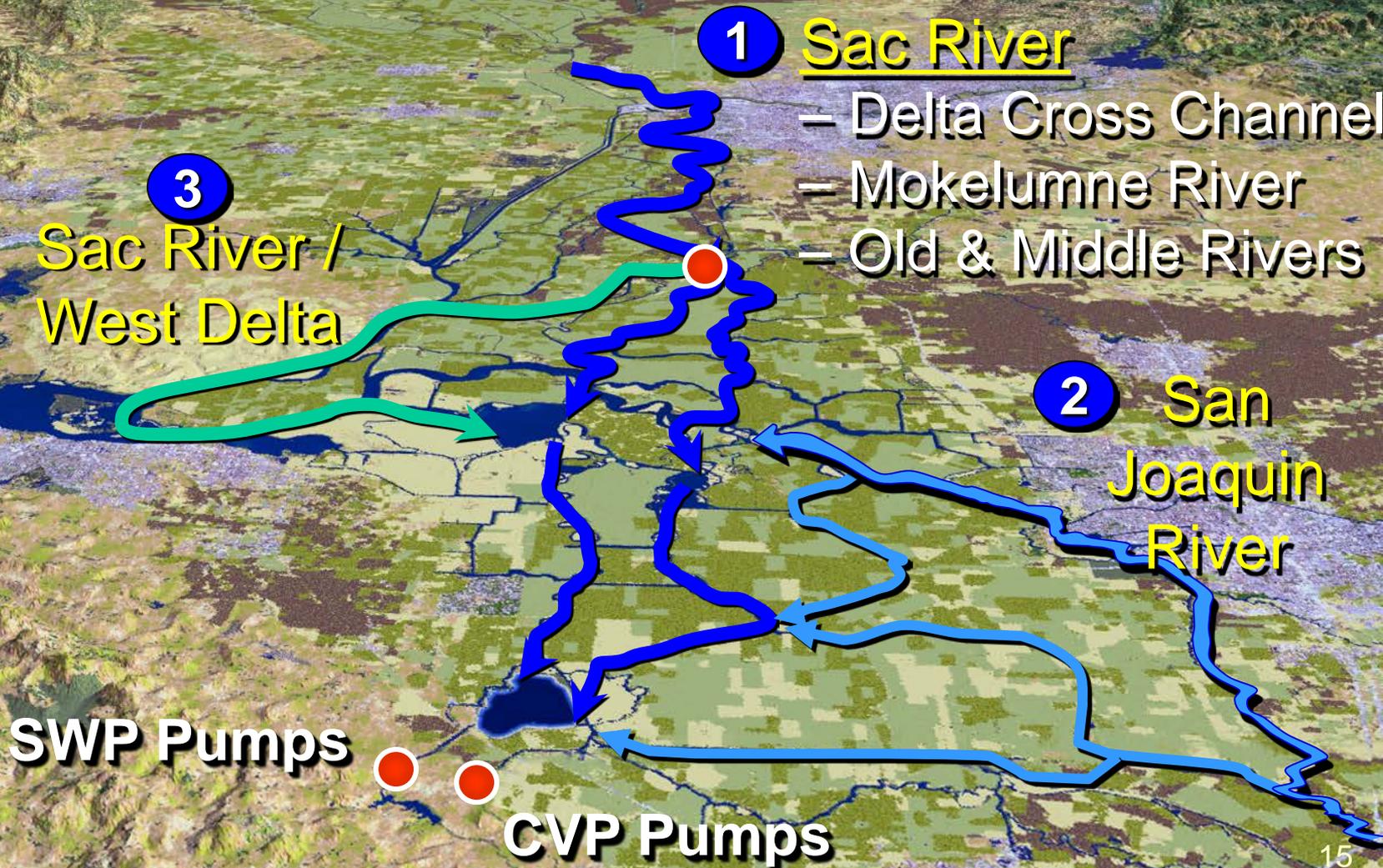
1148 cfs

649 uS/cm

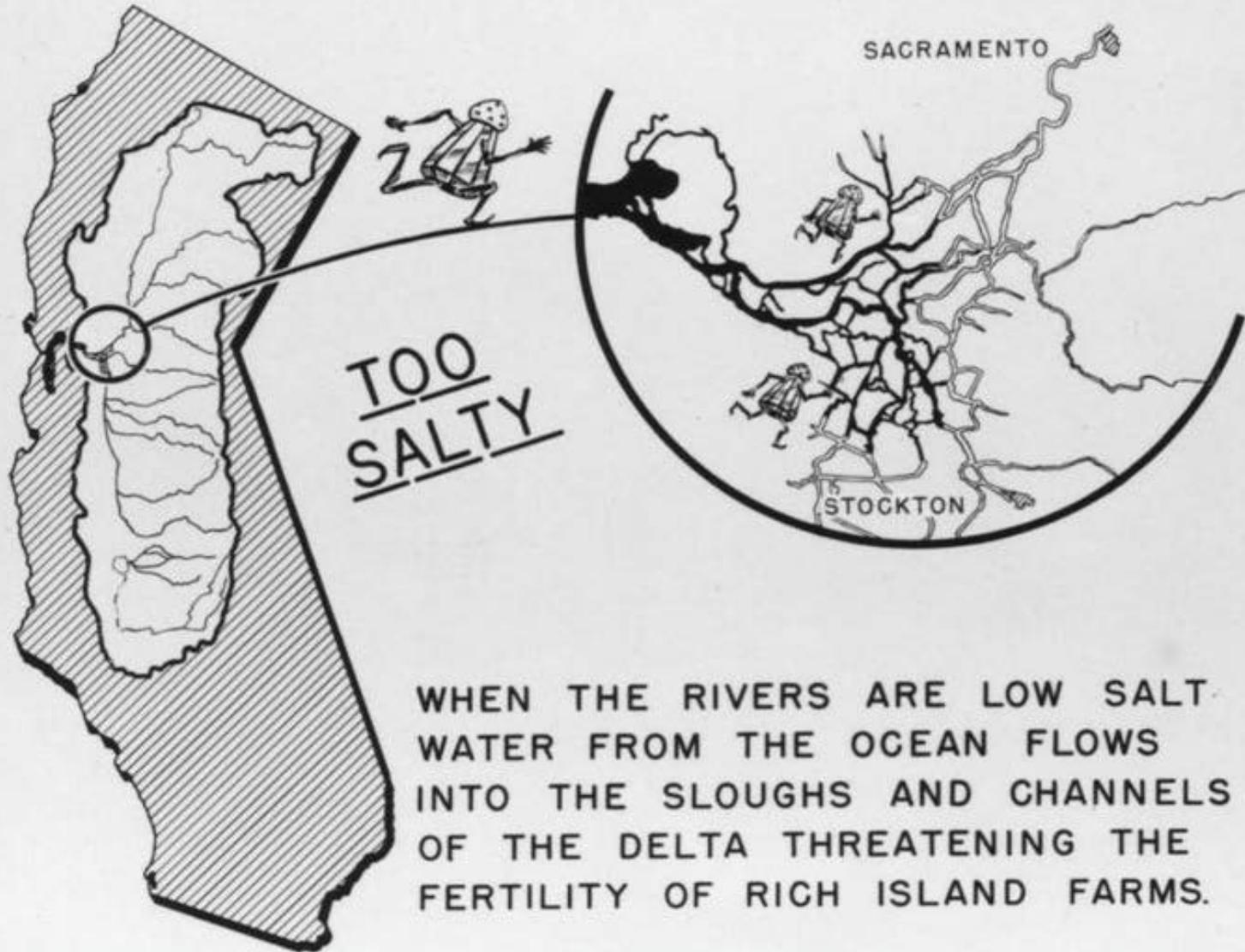
## CVP exports

0 cfs – 4600 cfs

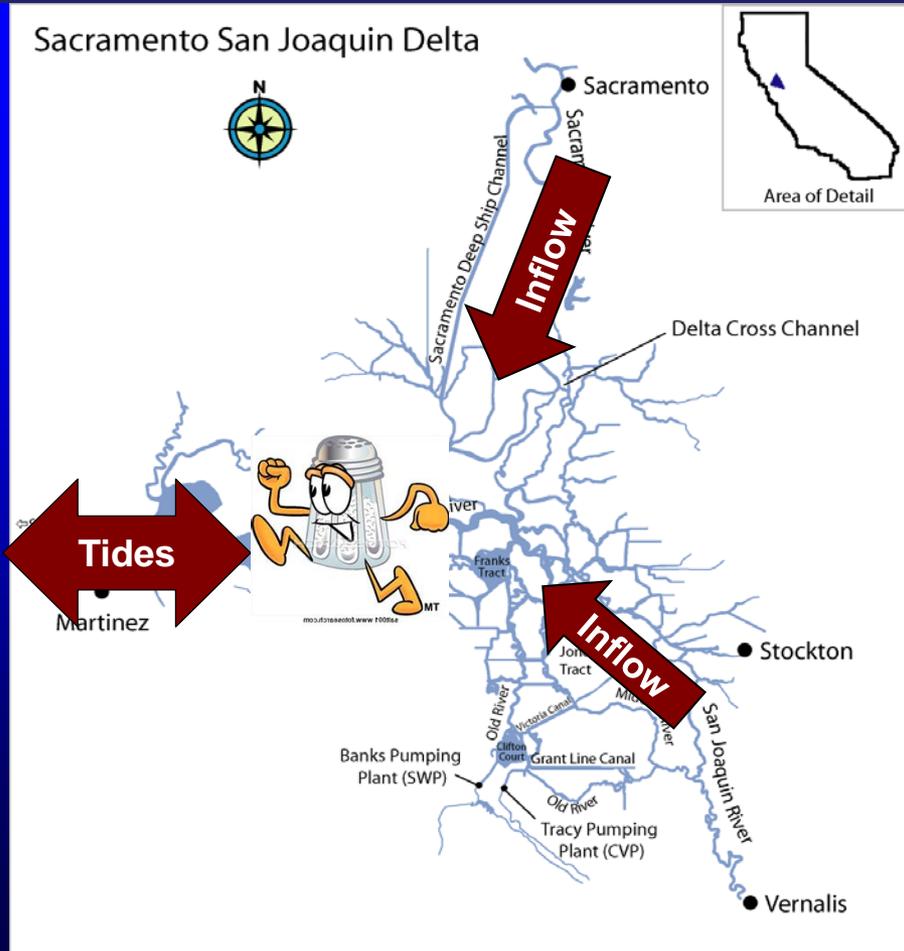
# How Water Gets to State and Federal Pumps



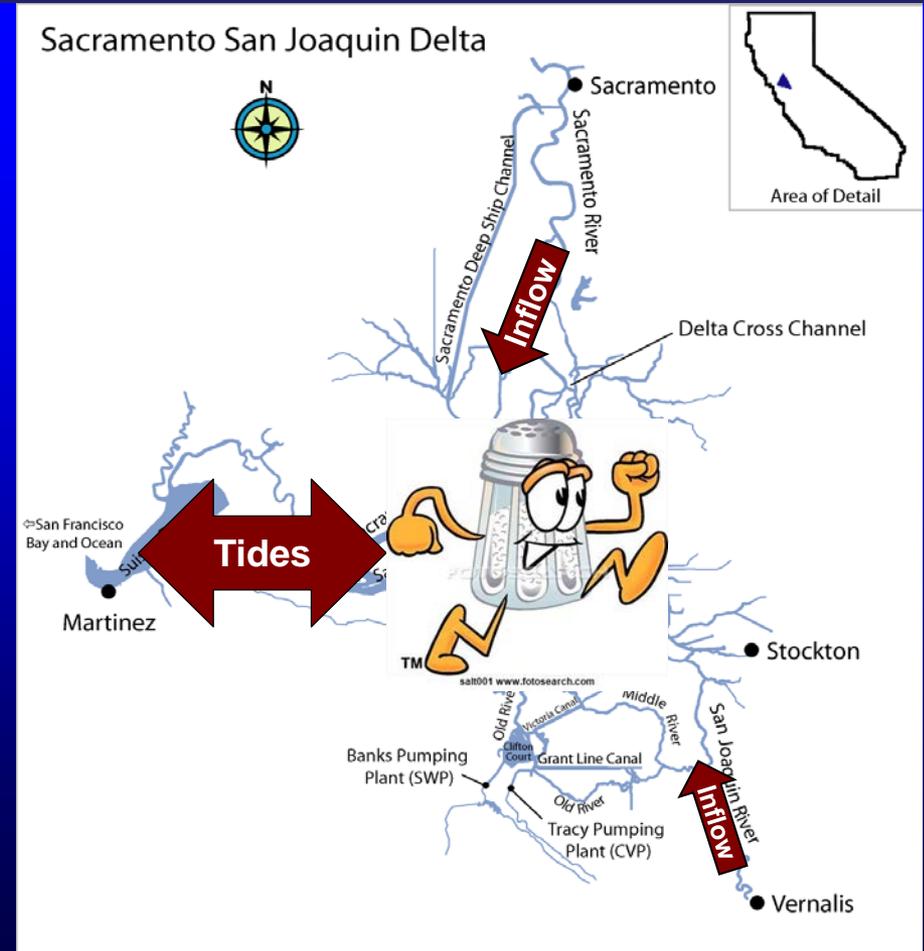
# 1930's Propaganda for CVP



# Delta Salinity & Freshwater Inflows



Higher Inflows Reduce Delta Salinity

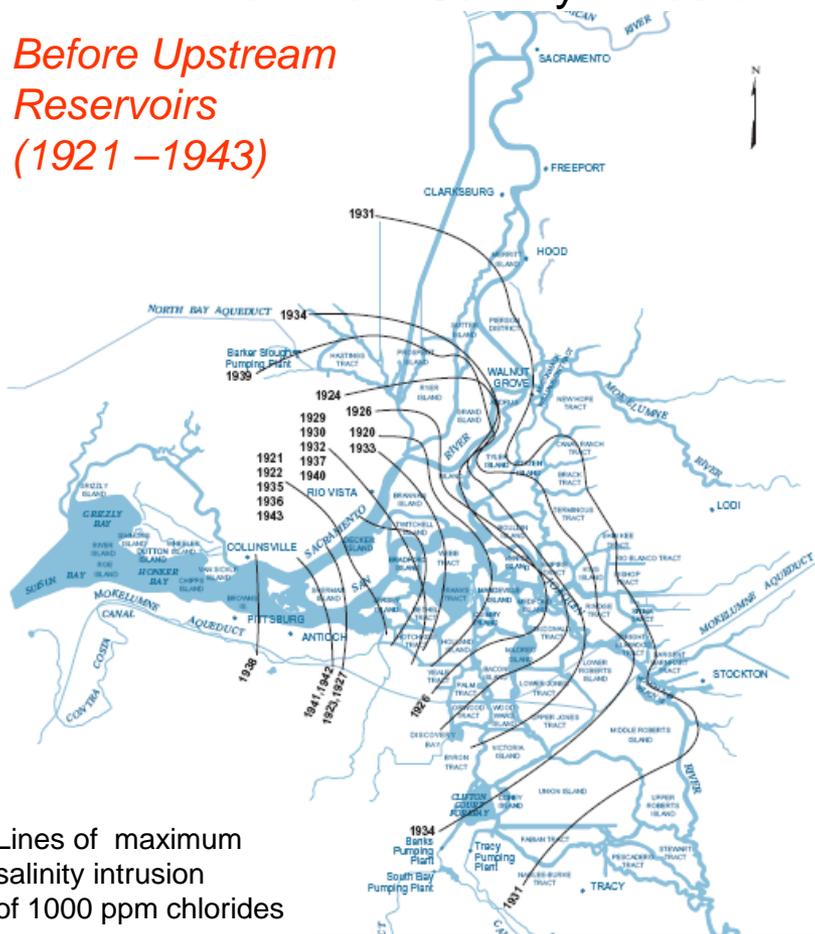


Lower Inflows Increase Delta Salinity

# Salinity Intrusion Before and After Managed Upstream Reservoirs

## Maximum Salinity Intrusion

*Before Upstream Reservoirs (1921 – 1943)*



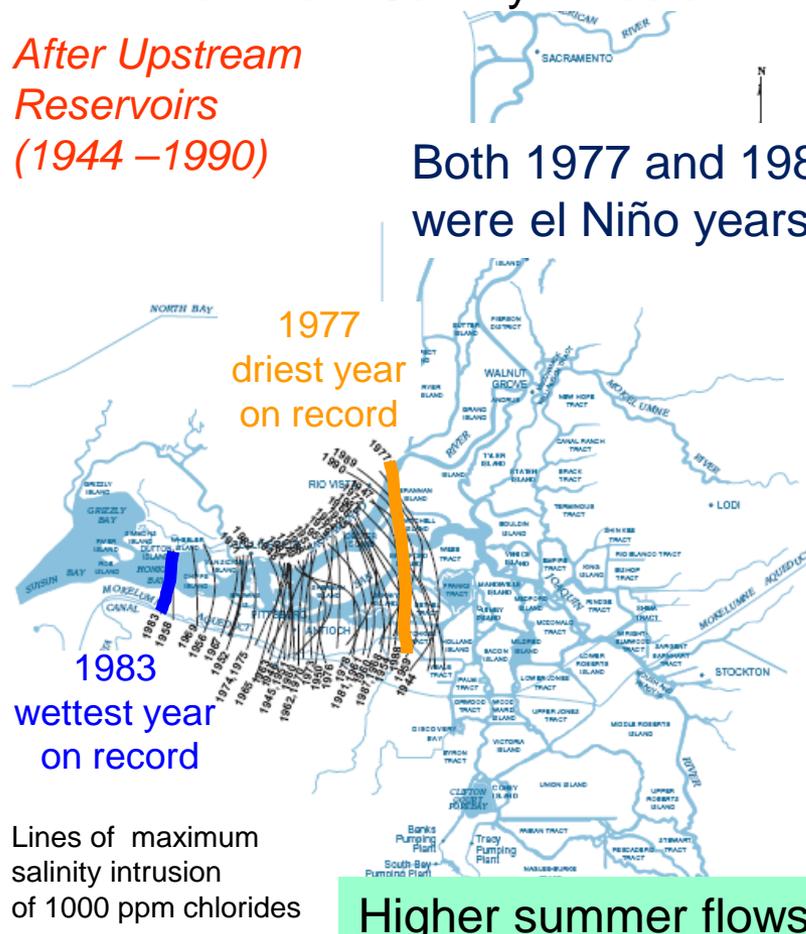
Lines of maximum salinity intrusion of 1000 ppm chlorides



High salinity intrusion during low summer flows

## Maximum Salinity Intrusion

*After Upstream Reservoirs (1944 – 1990)*



Both 1977 and 1983 were el Niño years

1983 wettest year on record

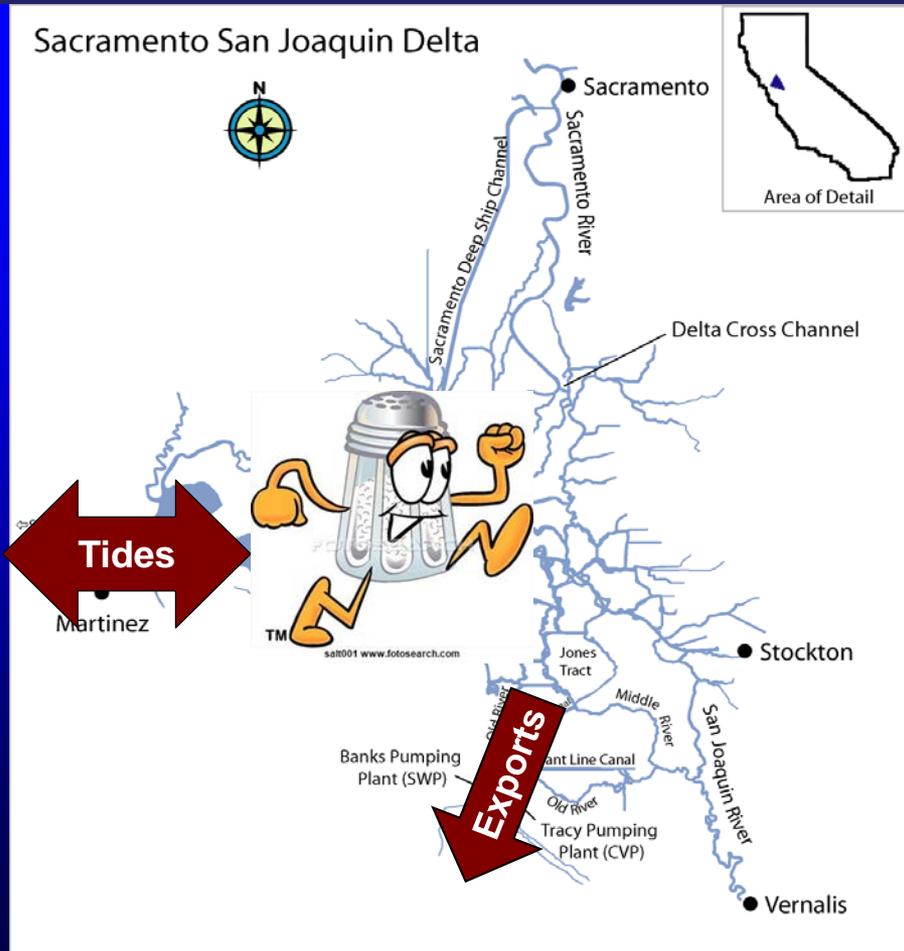
Lines of maximum salinity intrusion of 1000 ppm chlorides



Higher summer flows from reservoir releases reduce salinity intrusion

# Salt Wedge Demo

# Delta Salinity & Export Pumping

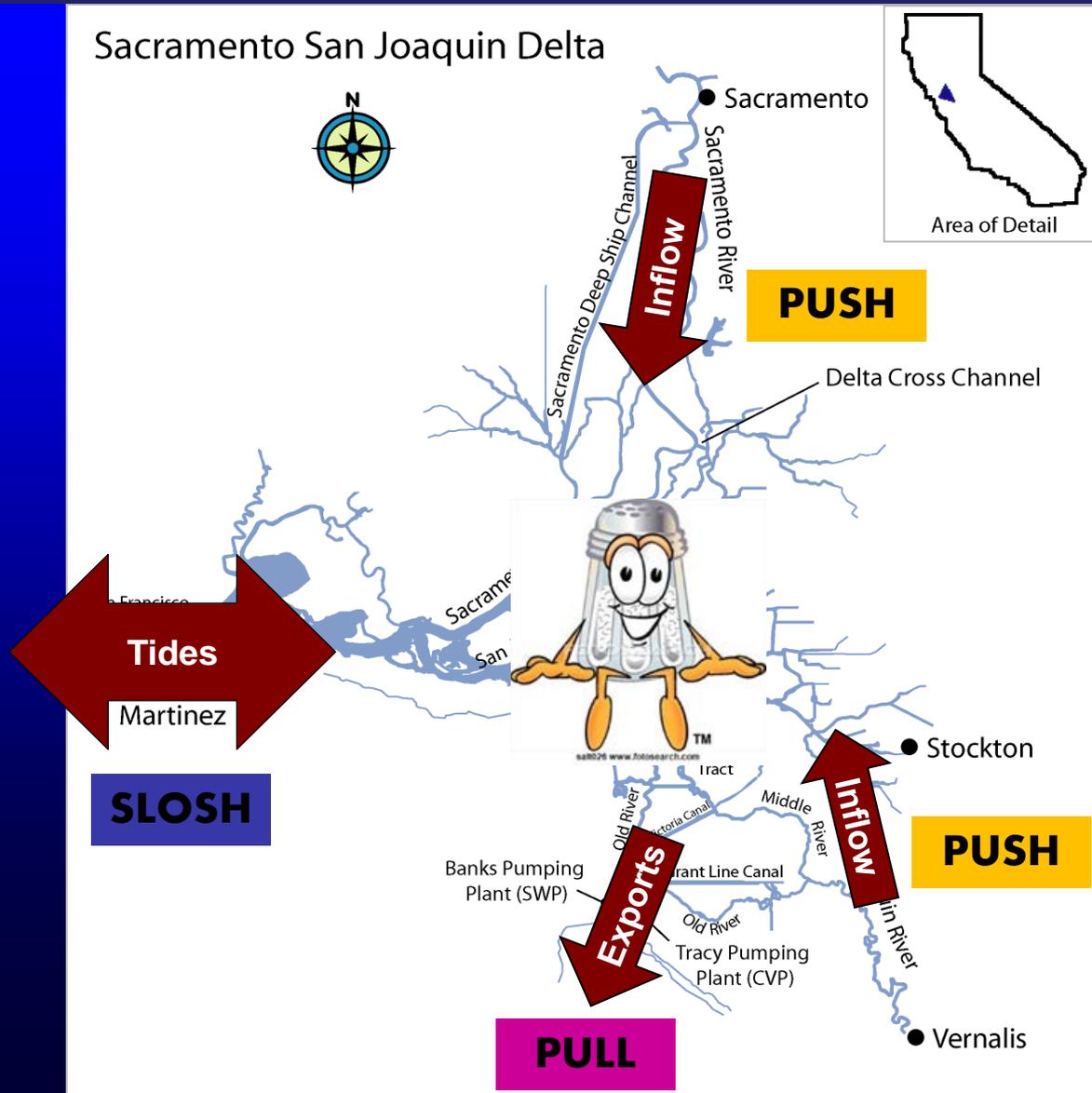


Higher Exports Pull In Delta Salinity

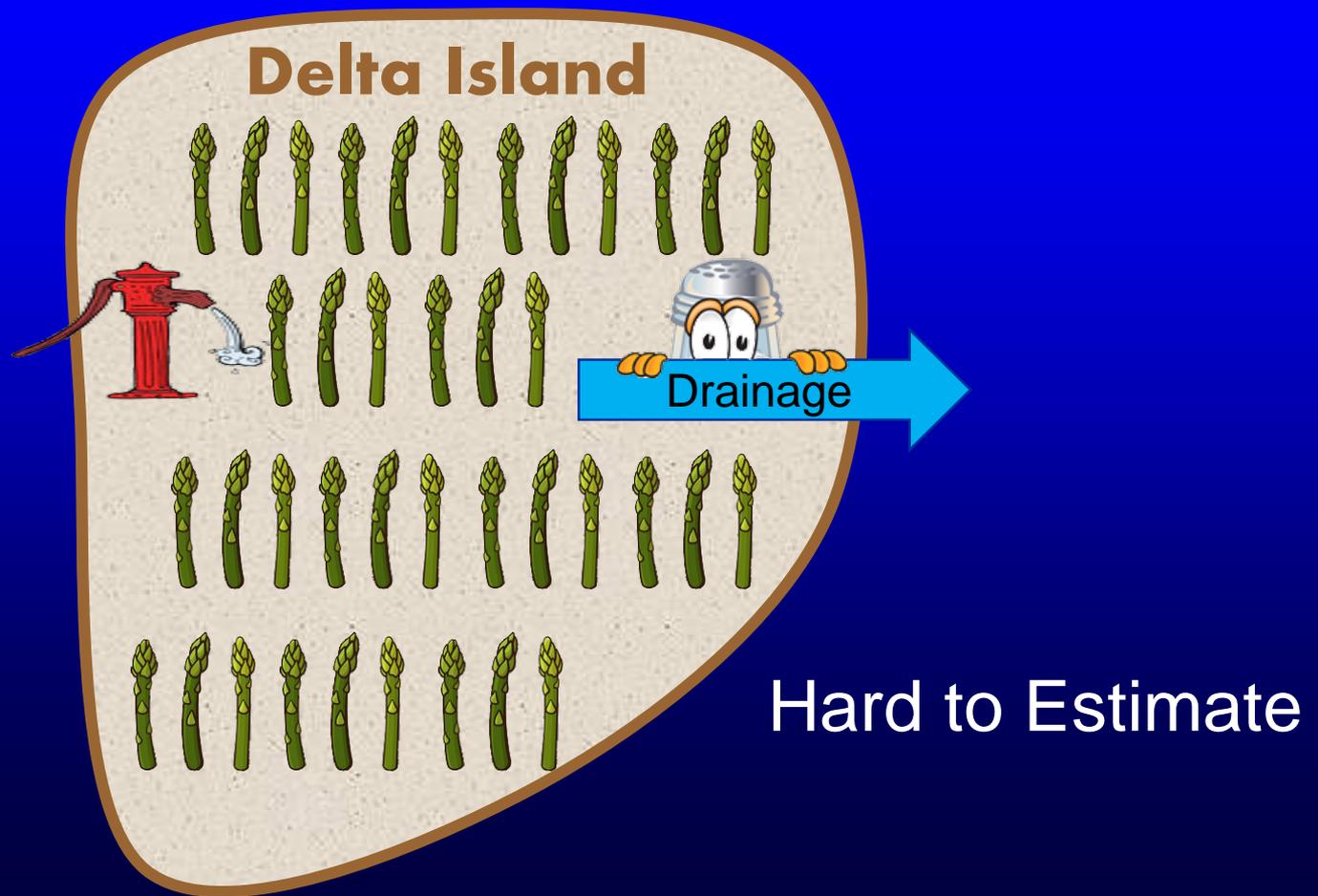


Lower Exports Pull In Less Salinity

# Delta Salinity is determined by the combination of Tides, Inflows and Pumping



# Consumptive Use also affects Salinity



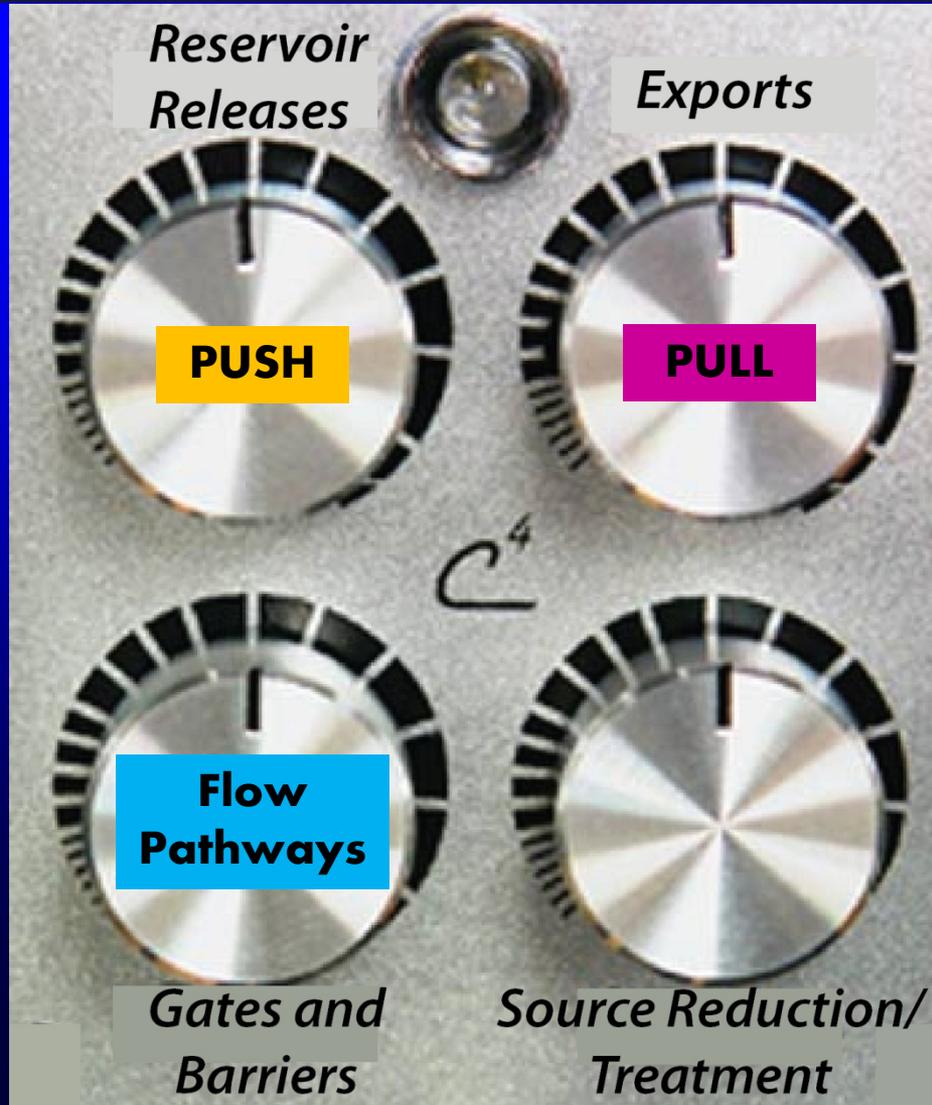


# The amazing Delta



- A **maze** of interconnected channels
- **Hub** of the state & federal water supply systems
- Islands are **bowls** surrounded by **levees**
- Salinity is affected by **tides, flows & pumping**
- “**Knobs**” to change flows and salinity

# Options to help meet Delta Water Quality Standards

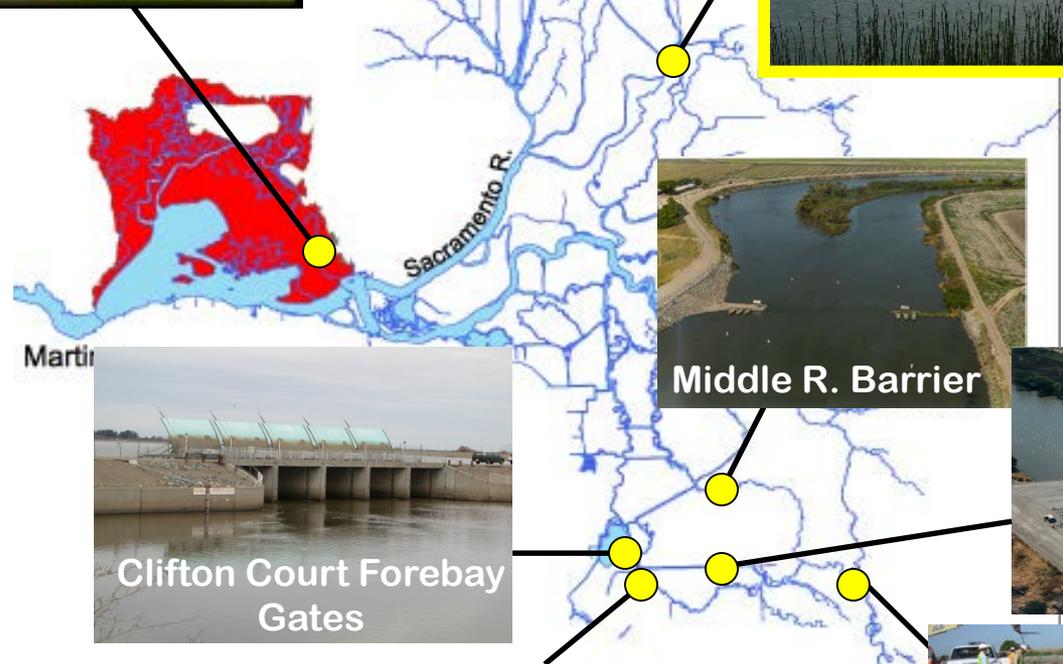




Montezuma Sl. Salinity Control Gates



Delta Cross Channel



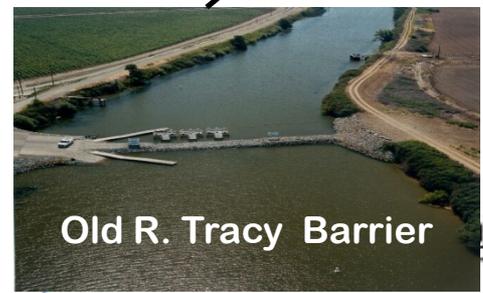
Middle R. Barrier



Clifton Court Forebay Gates



Grant Line Canal Barrier



Old R. Tracy Barrier

6 20



Sound Devices  
Bubblers  
LED Flashing Lights

Head of Old R. Fish Barrier

# Delta Control Structures



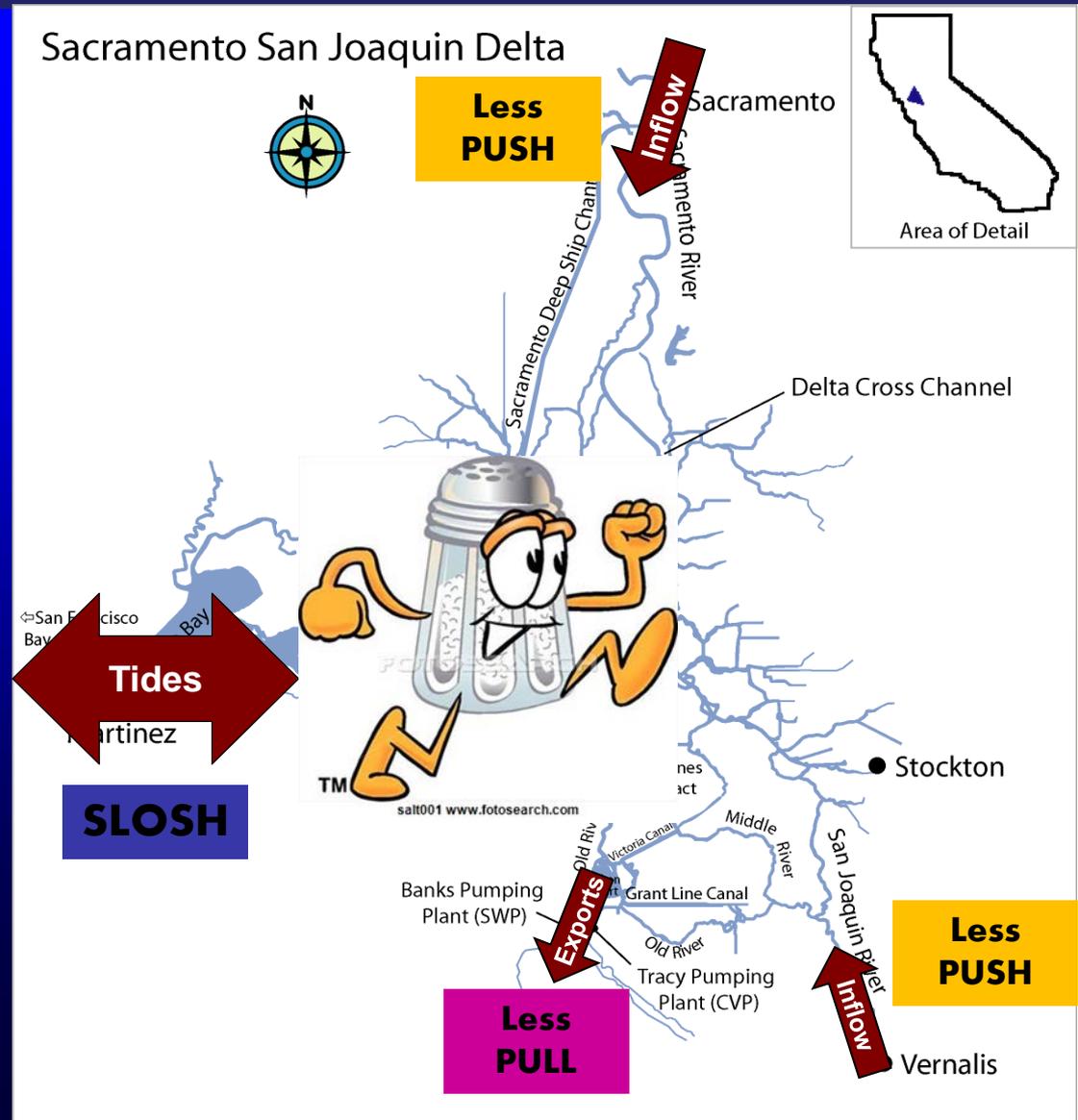
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- Islands are **bowls** surrounded by **levees**
- Salinity is affected by **tides, flows & pumping**
- **“Knobs”** to change flows and salinity
  - Reservoir releases and export pumping
  - Gate/barrier operations
- **Drought**

# Delta Salinity during Droughts

- Lower inflows
- Reduced exports
- Increased salinity intrusion



# During Droughts, Consumptive Use has a larger affect on Salinity

- Low flows in channels
- Consumptive Use is a significant portion of
  - Volume
  - Salinity
- Consumptive Use is hard to estimate



# Drought Reduces Options to Manage Salinity

Less water in storage to release to repel salinity intrusion

*Reservoir Releases*

**PUSH**

*Exports*

**PULL**

Exports reduced  
less water available to export  
try to reduce salinity intrusion

Physically block salty water

Direct freshwater flows into desired channels

**Flow Pathways**

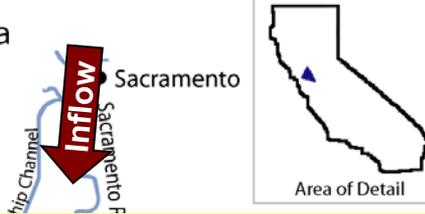
*Gates and Barriers*

*Source Reduction/  
Treatment*

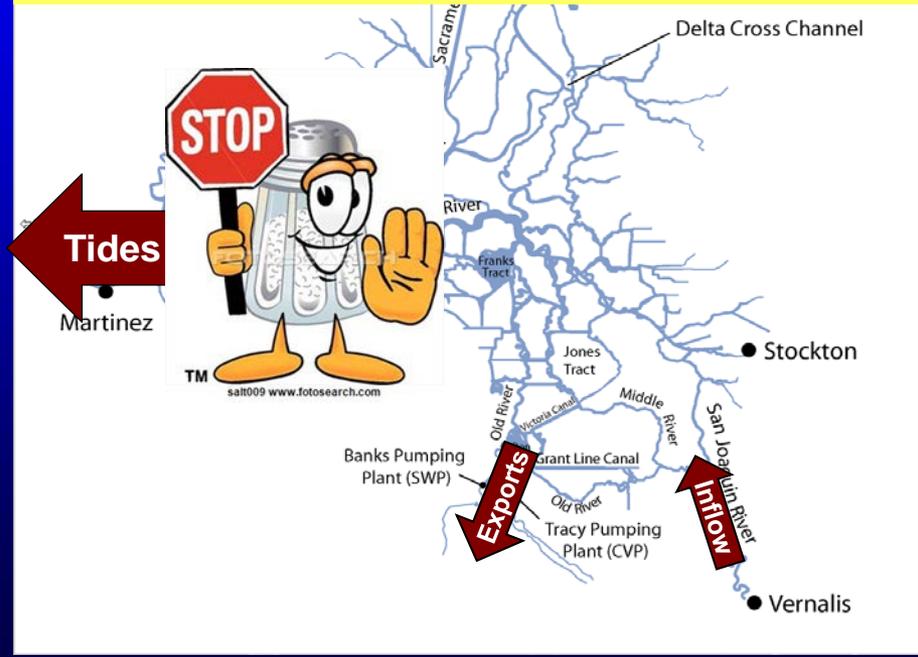
Expensive  
Requires treatment facilities

# Managing Salinity Intrusion in a Drought

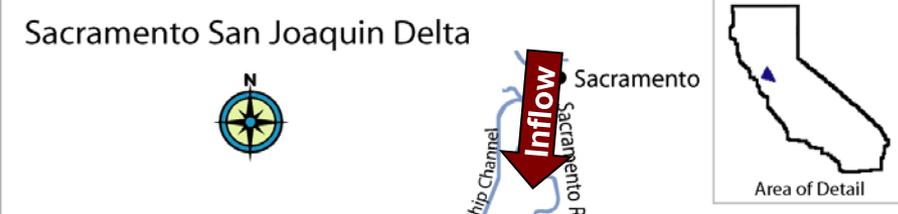
Sacramento San Joaquin Delta



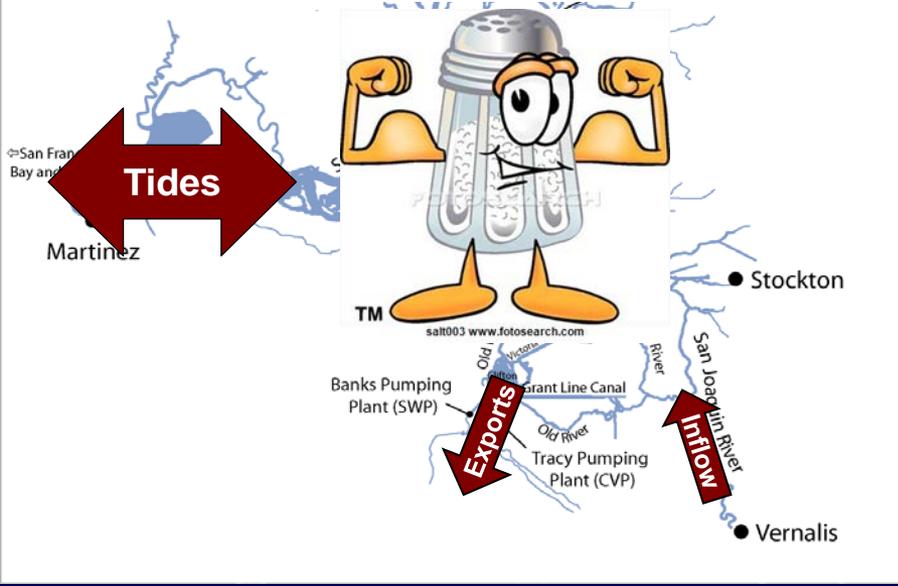
**Goal: STOP/reduce salinity intrusion**



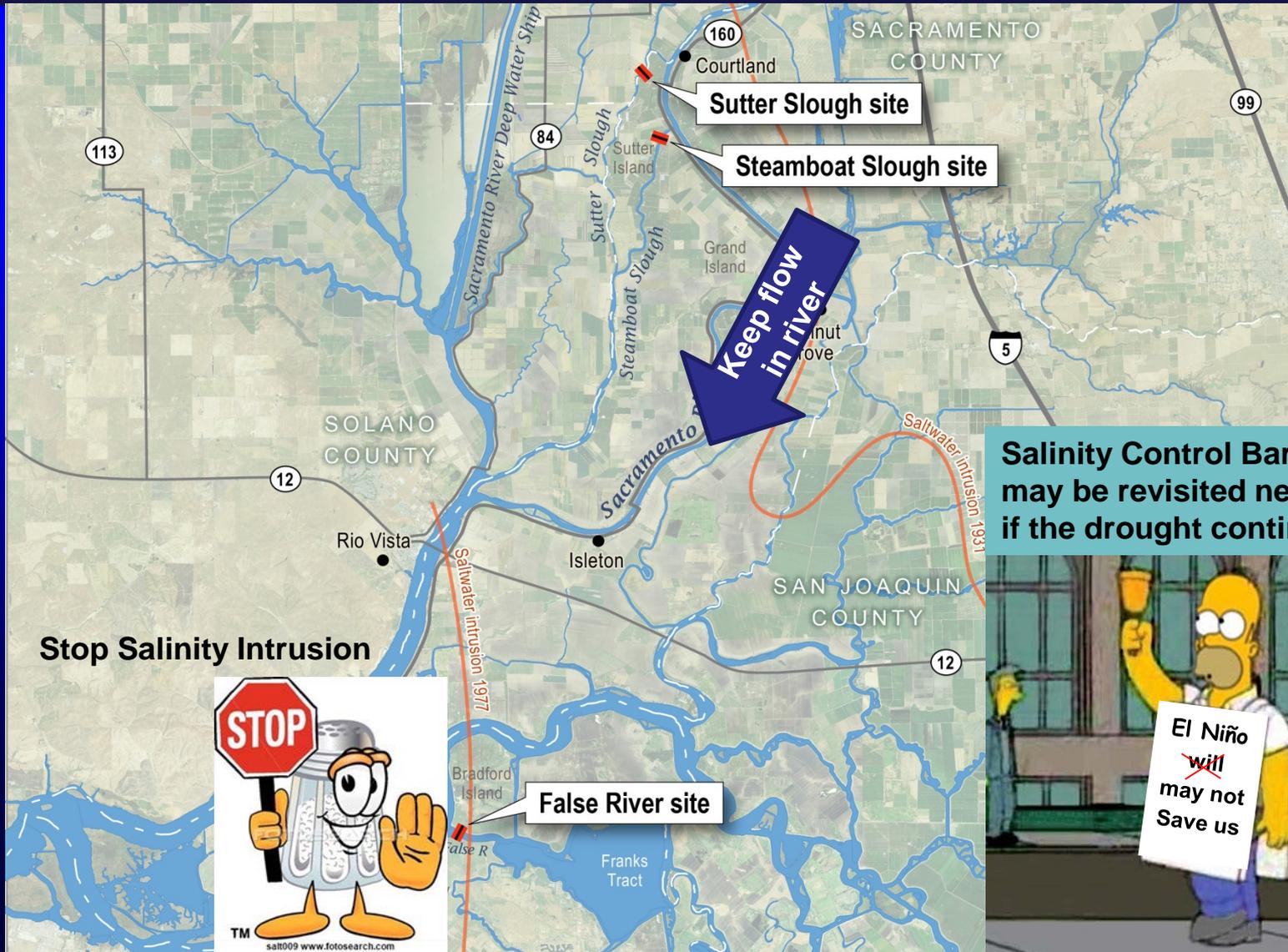
Sacramento San Joaquin Delta



Once salinity intrudes, it is difficult/expensive to dilute/remove



# Proposed Emergency Salinity Control Barriers



**Salinity Control Barriers may be revisited next year if the drought continues**

**Stop Salinity Intrusion**



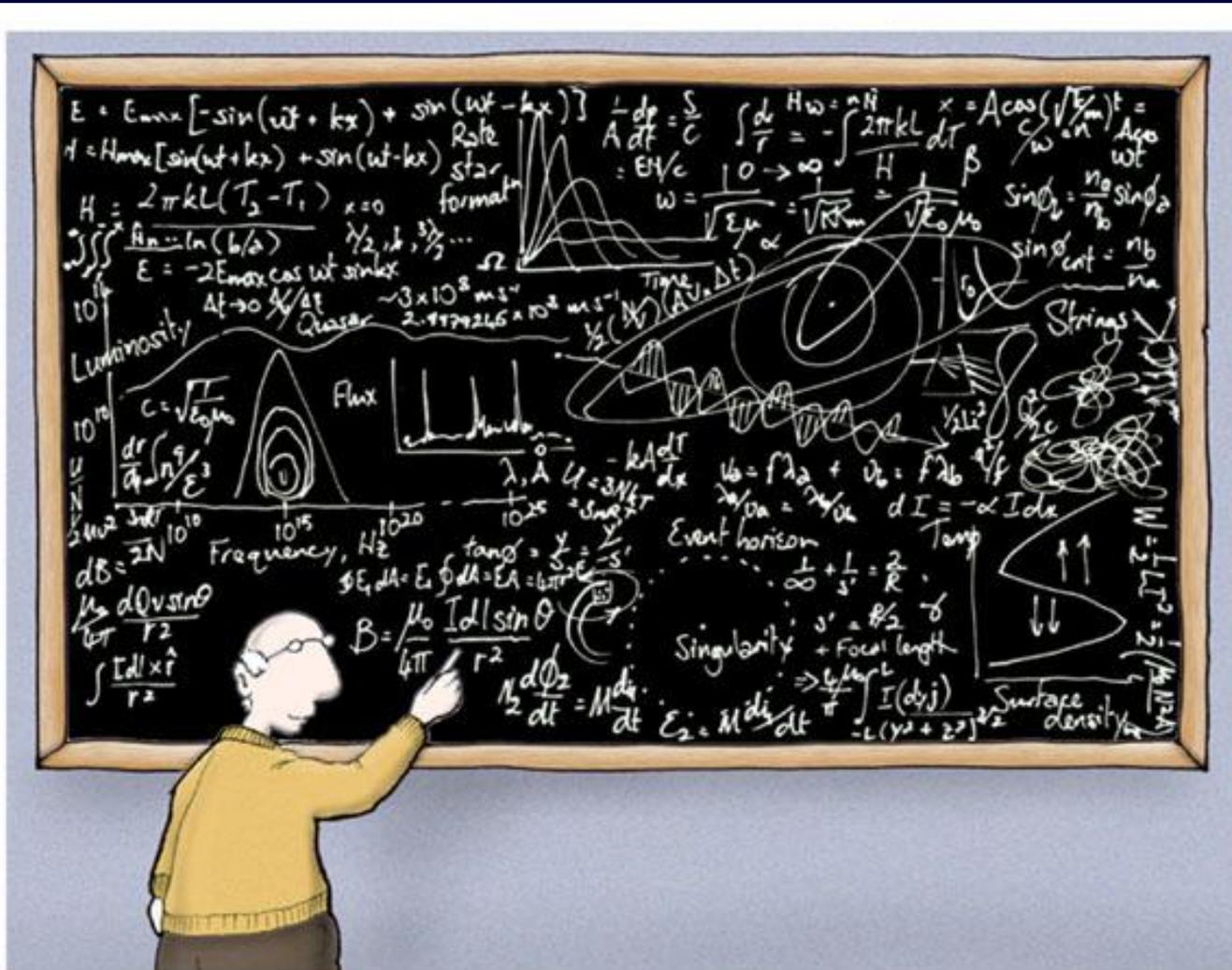


# The amazing Delta



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- Islands are **bowls** surrounded by **levees**
- Salinity is affected by **tides, flows & pumping**
- **“Knobs”** to change flows and salinity
  - Reservoir releases and export pumping
  - Gate/barrier operations
- **Drought**
  - Reduces freshwater inflows
  - Affects amount of water that can be exported
  - Can increase salinity intrusion

# Modeling the Delta

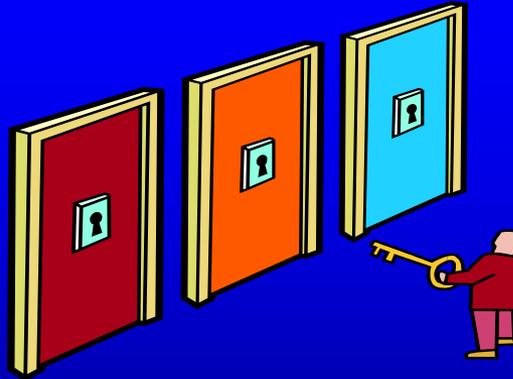


Models help explore complex  
Delta management options

# How do we use models?



Represent  
past conditions



Assess Alternatives



Forecast future  
conditions



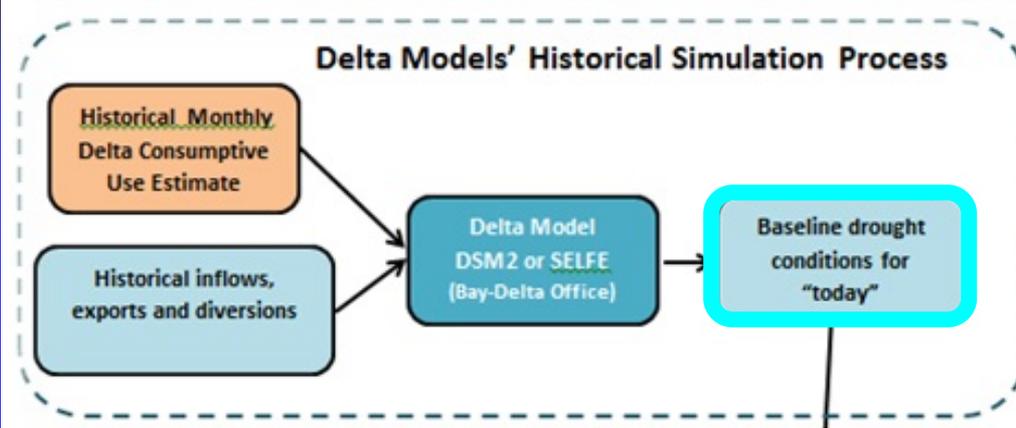
Fill data gaps



**Drought barrier studies  
involved most of these**

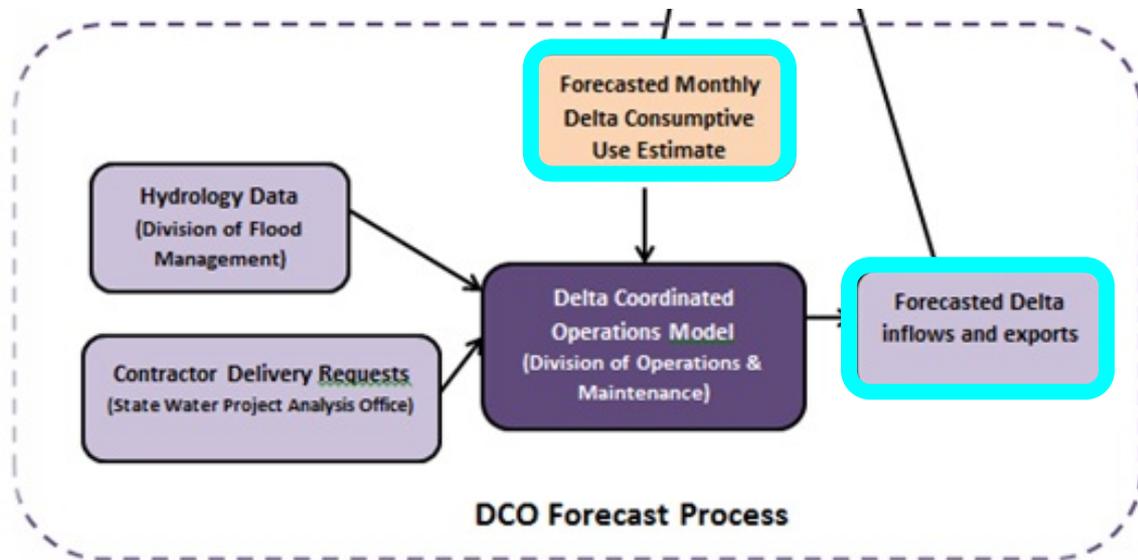
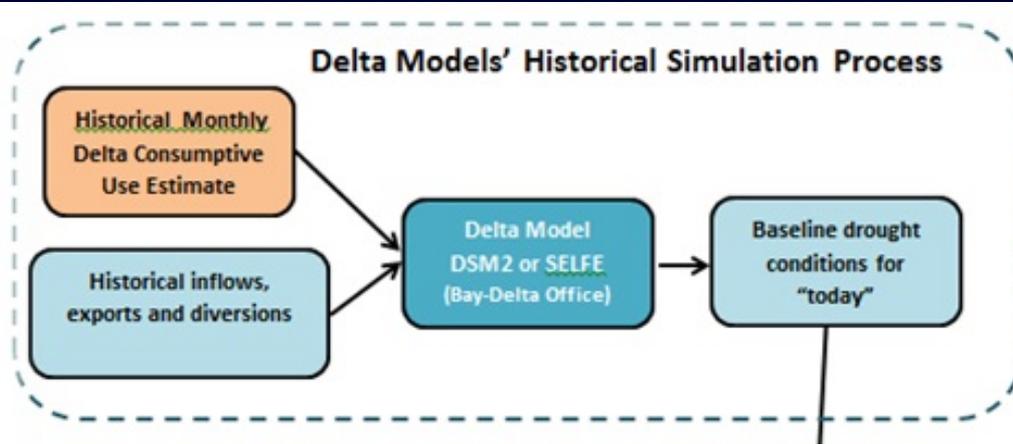
# Drought Barrier Modeling Approach

- Represent historical conditions



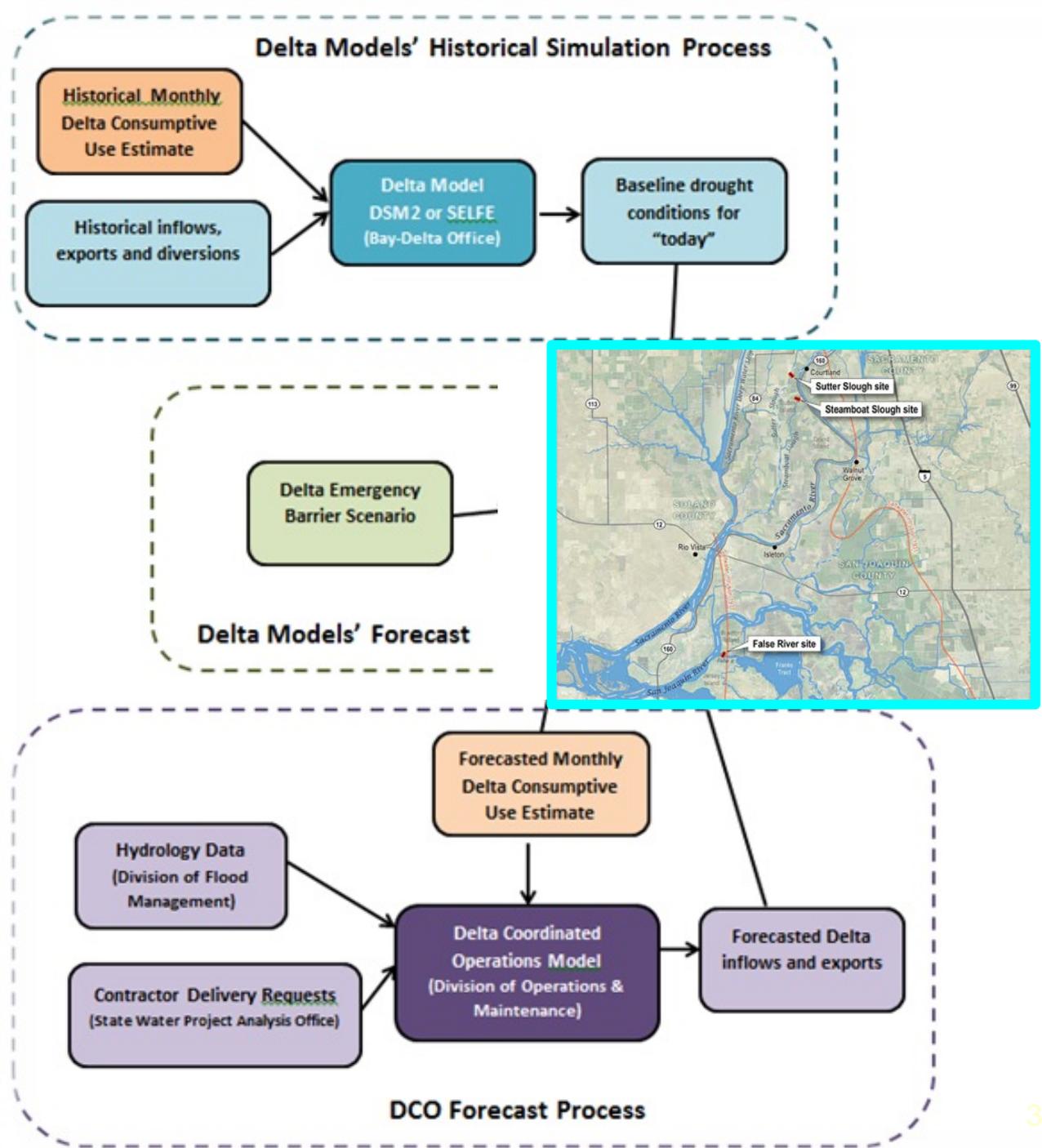
# Drought Barrier Modeling Approach

- Represent historical conditions
- Forecast future conditions



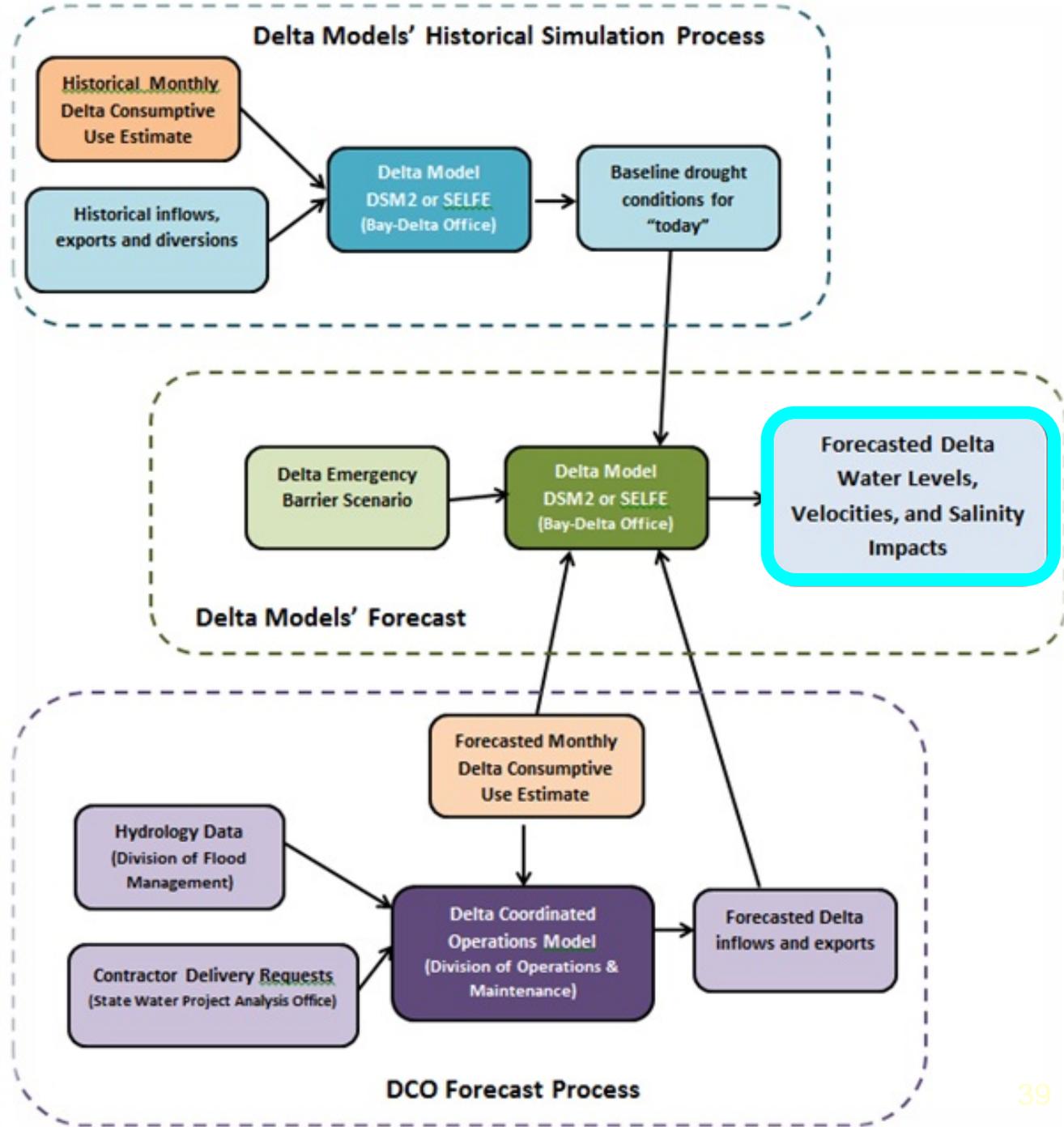
# Drought Barrier Modeling Approach

- Represent historical conditions
- Forecast future conditions
- Select a drought barrier scenario



# Drought Barrier Modeling Approach

- Represent historical conditions
- Forecast future conditions
- Select a drought barrier scenario
- Model potential salinity impacts with & without drought barriers



A sunset scene with a large flock of birds flying in the sky and a building silhouette in the foreground. The sky transitions from a deep blue on the left to a bright orange and yellow on the right. The building in the foreground is dark, with several windows glowing with light. The birds are scattered across the sky, appearing as small dark specks against the lighter background.

# Thank You!

[Jamie.Anderson@water.ca.gov](mailto:Jamie.Anderson@water.ca.gov)

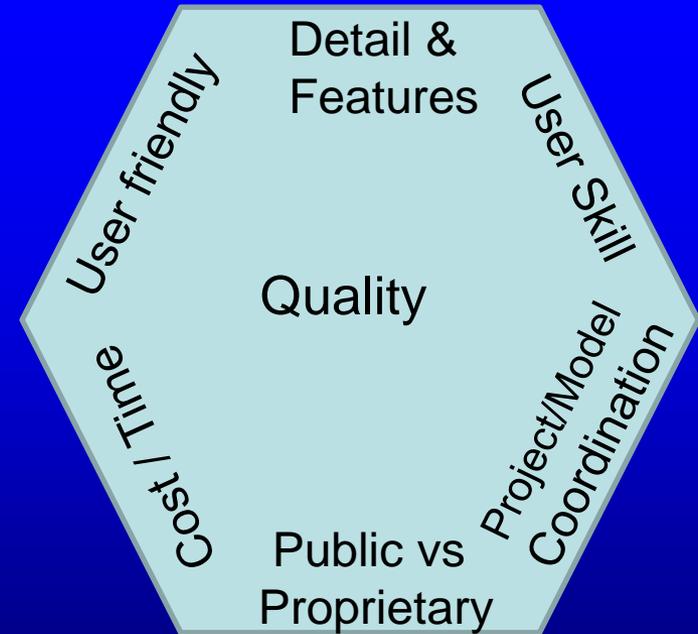
<http://baydeltaoffice.water.ca.gov/modeling/>

# Extra Slides

# Tradeoffs



Project Management  
Triple Constraint

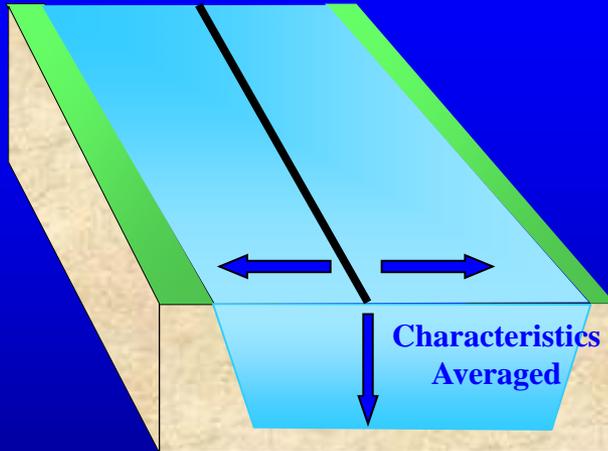


Modeling Tradeoffs  
might be something like this

# Delta Models used in Drought Barrier Studies

**DSM2**

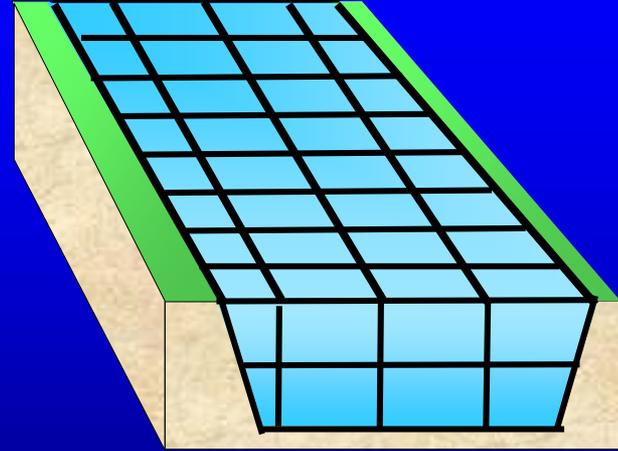
1-D representation



- Flow, velocity, water quality along main flow direction
- Runs faster
- Can simulate long time periods (years)
- Needs field data to tune model
- Long history of use

**SELFE**

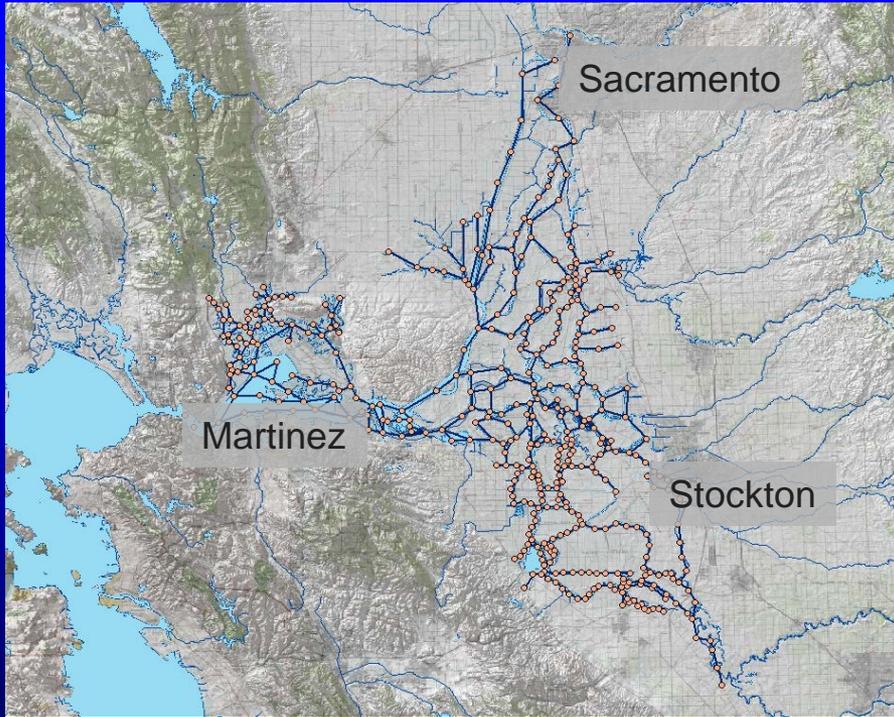
3-D representation



- Flow, velocity, water quality in all directions
- Runs slower
- Typically simulate shorter time periods (months)
- Needs more data to tune model
- New kid on the block

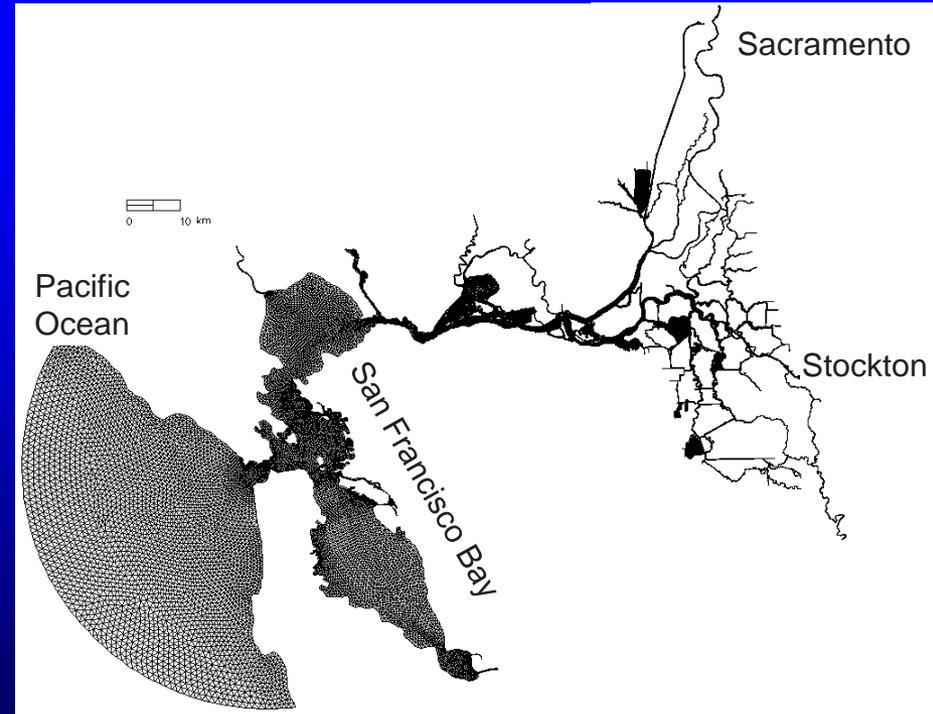
# Delta Models used in Drought Barrier Studies

## DSM2



- Represents Delta
- Used for evaluating large numbers of alternatives

## SELFE



- Represents SF Bay and Delta
- Used for more detail on select alternatives