





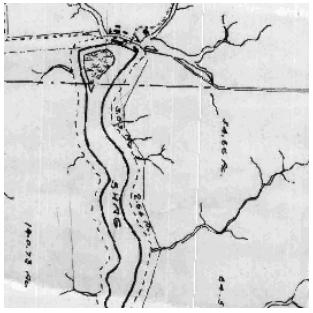


# Historical Perspectives on the Estuarine Gradient

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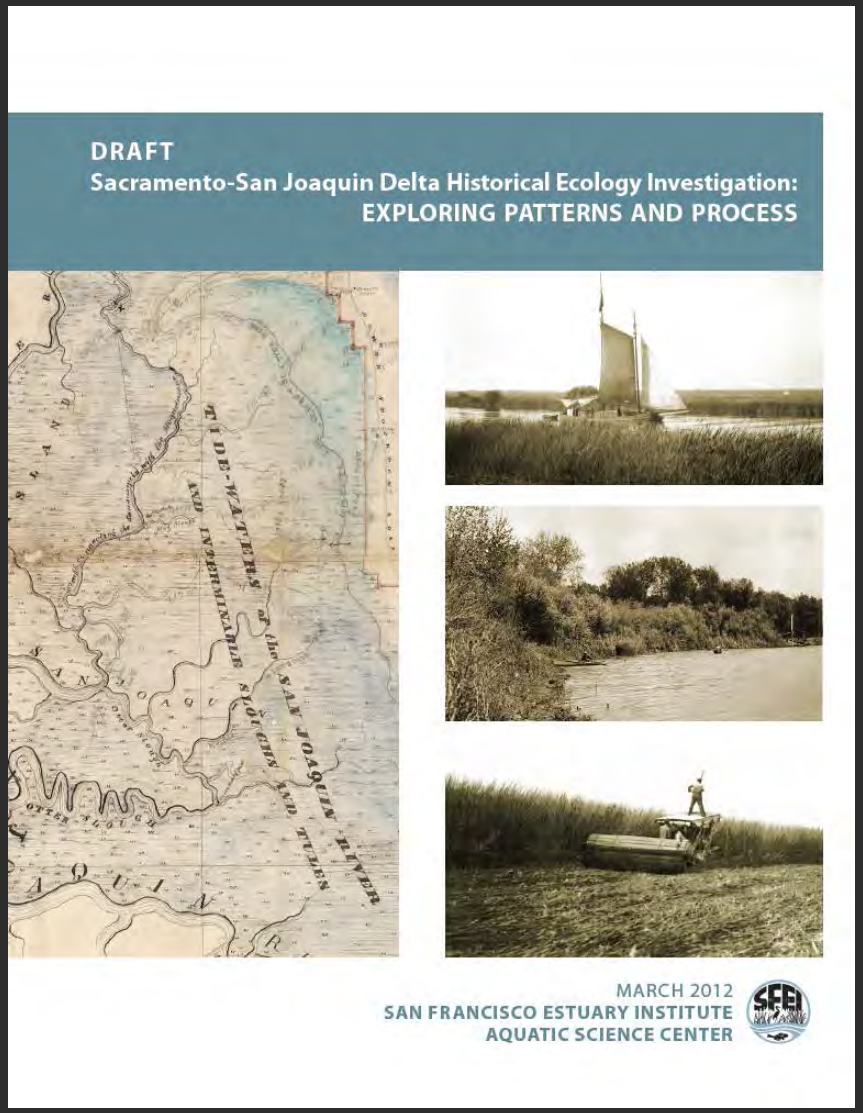
Senior Scientist
San Francisco Estuary Institute-Aquatic Science Center

**Co-authors: Alison Whipple, Daniel Rankin[1]**
[1]California Department of Fish and Game

*March 27, 2012*

AQUATIC SCIENCE CENTER




## Sacramento-San Joaquin Delta Historical Ecology Investigation: *Exploring Patterns and Process*

- Whipple et al. in review
- SFEI-ASC in collaboration with and funding from CDFG and the Ecosystem Restoration Program
- Currently in Technical Review
- Final Report/GIS Available: August 2012

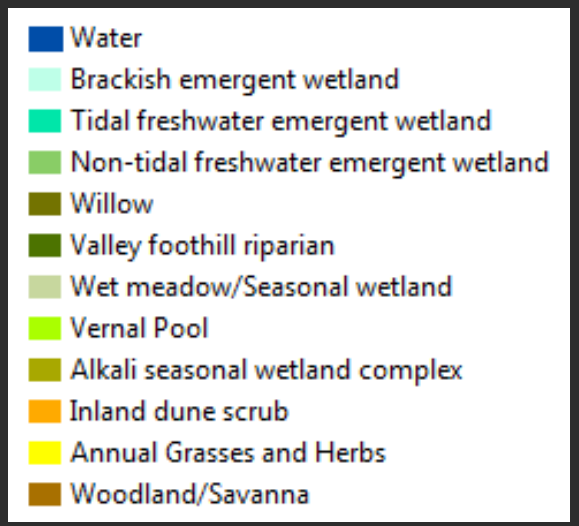
# Why look at the historical Bay-Delta landscape?

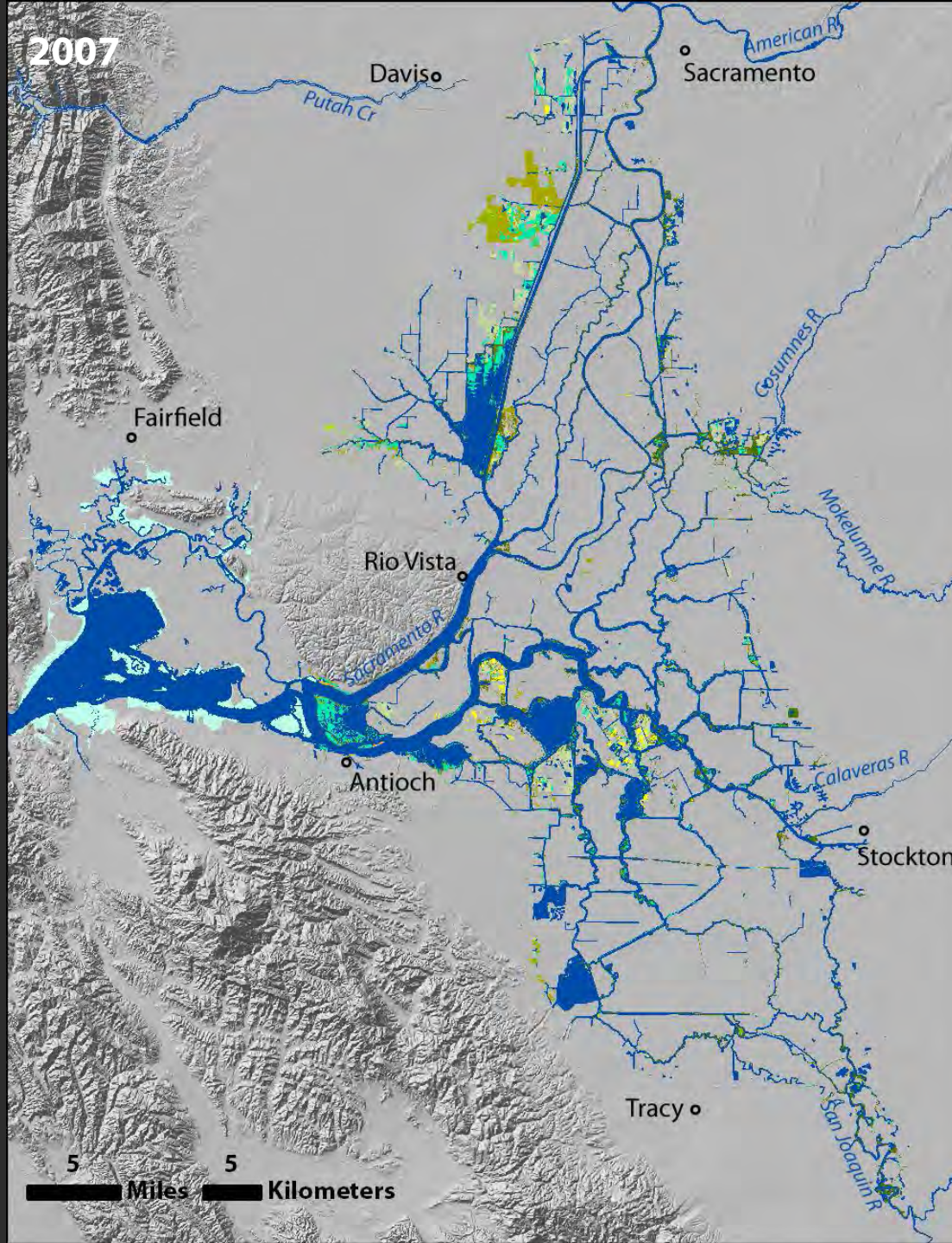
1. Loss of habitat as stressor (Atwater 2011)

2. Combination of water and geographic features (“landscape”) is responsible for the value of LSZ

3. Historical Delta landscape likely affected location of the LSZ

4. Relationship to restoration scenarios


Water
Brackish emergent wetland
Tidal freshwater emergent wetland
Non-tidal freshwater emergent wetland
Willow
Valley foothill riparian
Wet meadow/Seasonal wetland
Vernal Pool
Alkali seasonal wetland complex
Inland dune scrub
Annual Grasses and Herbs
Woodland/Savanna


2007
Davis
Putah Cr
American R
Sacramento
Cosumnes R
Fairfield
Mokelumne R
Rio Vista
Sacramento R
Antioch
Calaveras R
Stockton
Tracy
San Joaquin R
5
Miles
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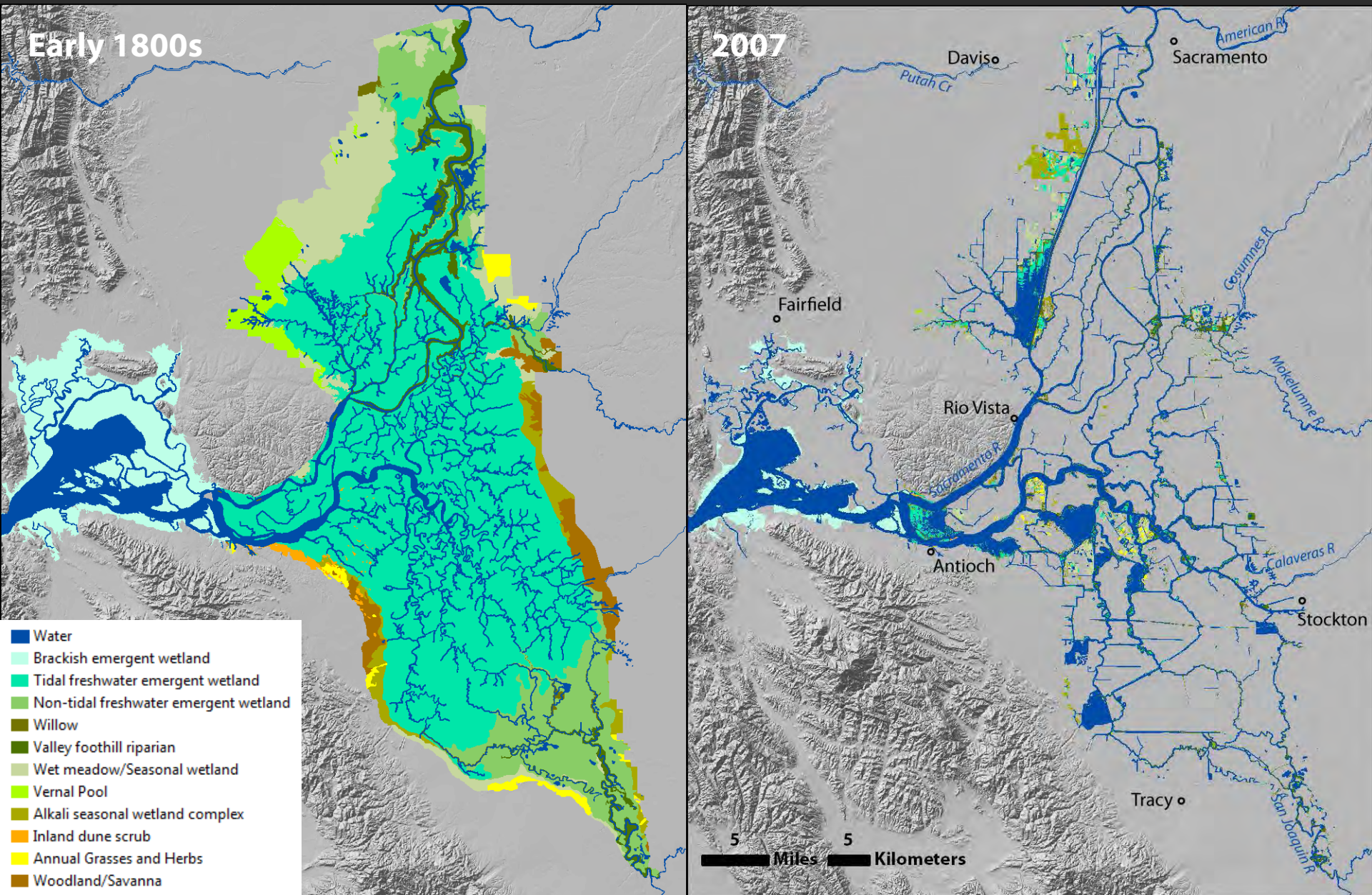
Kilometers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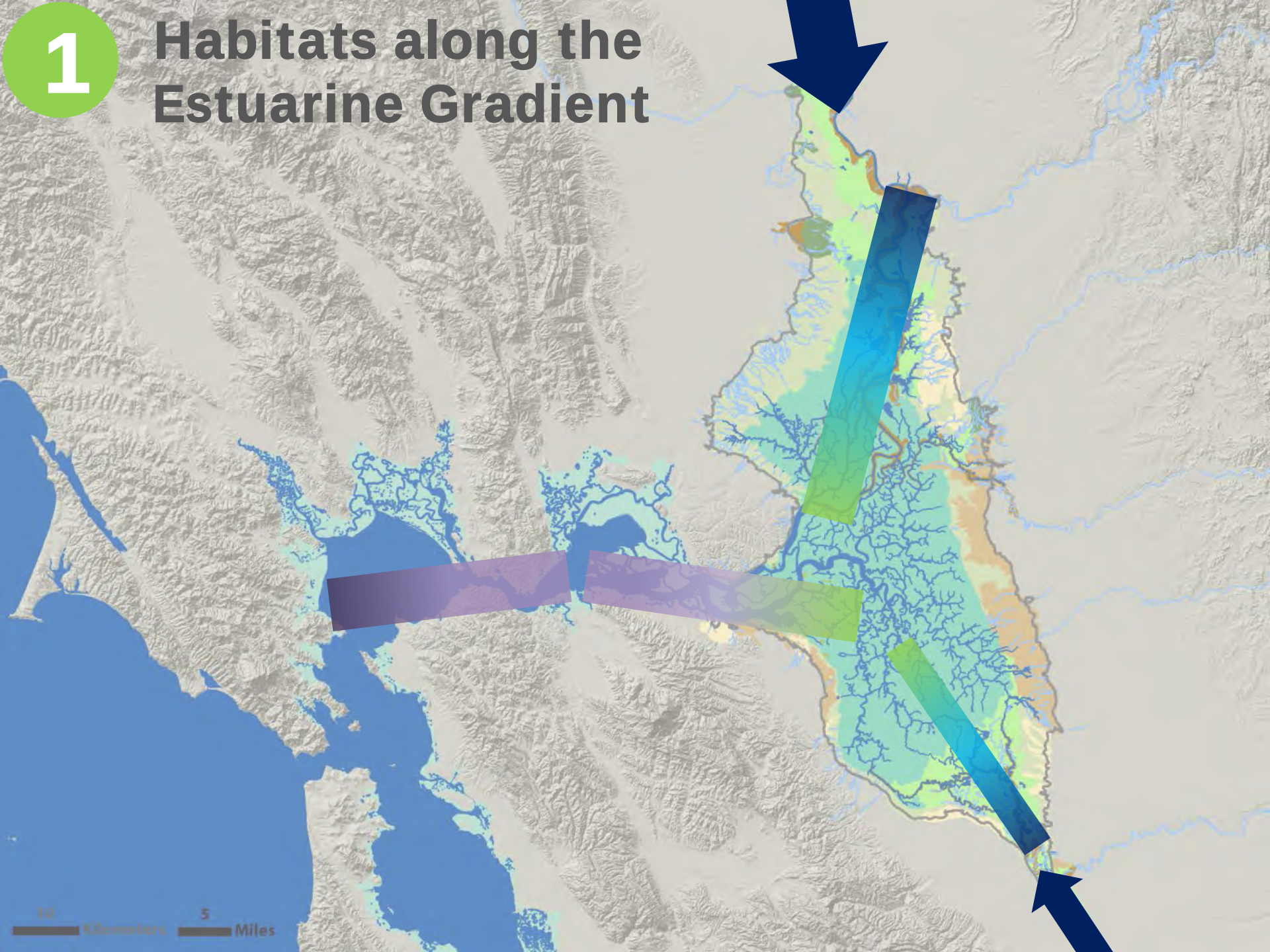
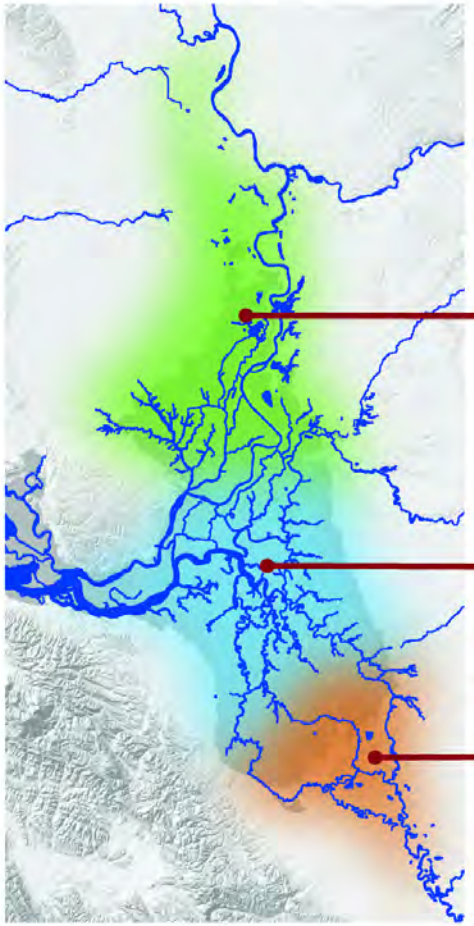
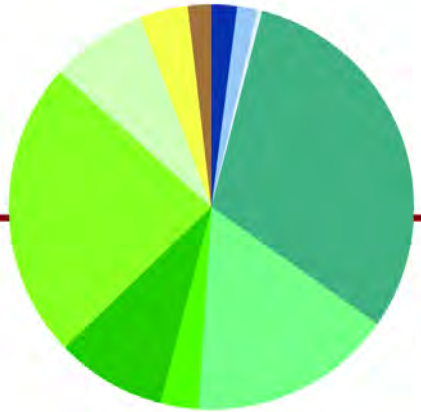
# 1 Habitats along the Estuarine Gradient



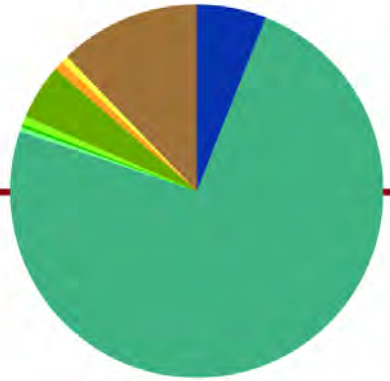
# Conceptual models of historical landscapes



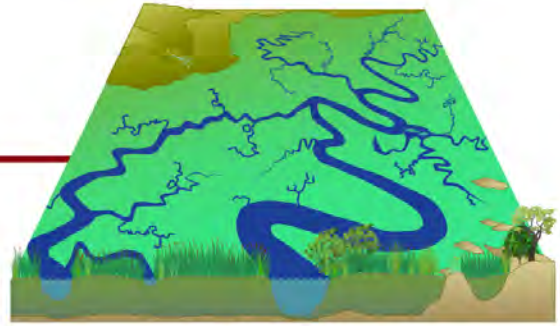


360,000 acres

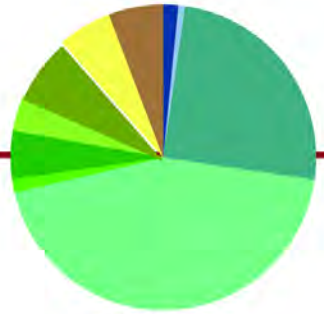
North Delta: flood basins



300,000 acres



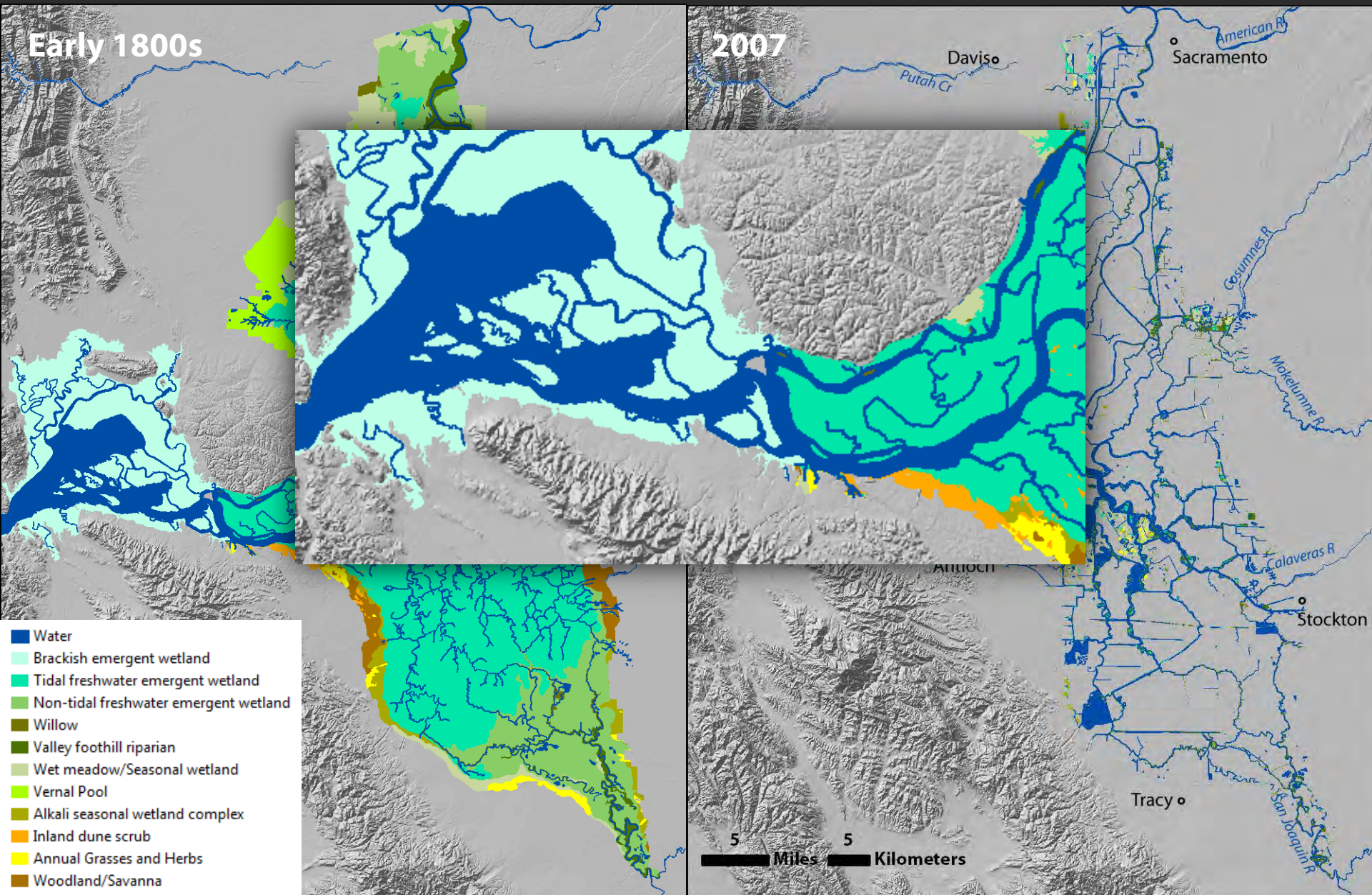
Central Delta: tidal islands



120,000 acres

South Delta: distributary rivers

- waterway
- pond/lake
- seasonal pond/lake
- tidal freshwater emergent wetland
- nontidal freshwater emergent wetland
- willow
- valley foothill riparian
- wet meadow/seasonal wetland
- vernal pool complex
- alkali seasonal wetland complex
- inland dune scrub
- grassland
- woodland/savanna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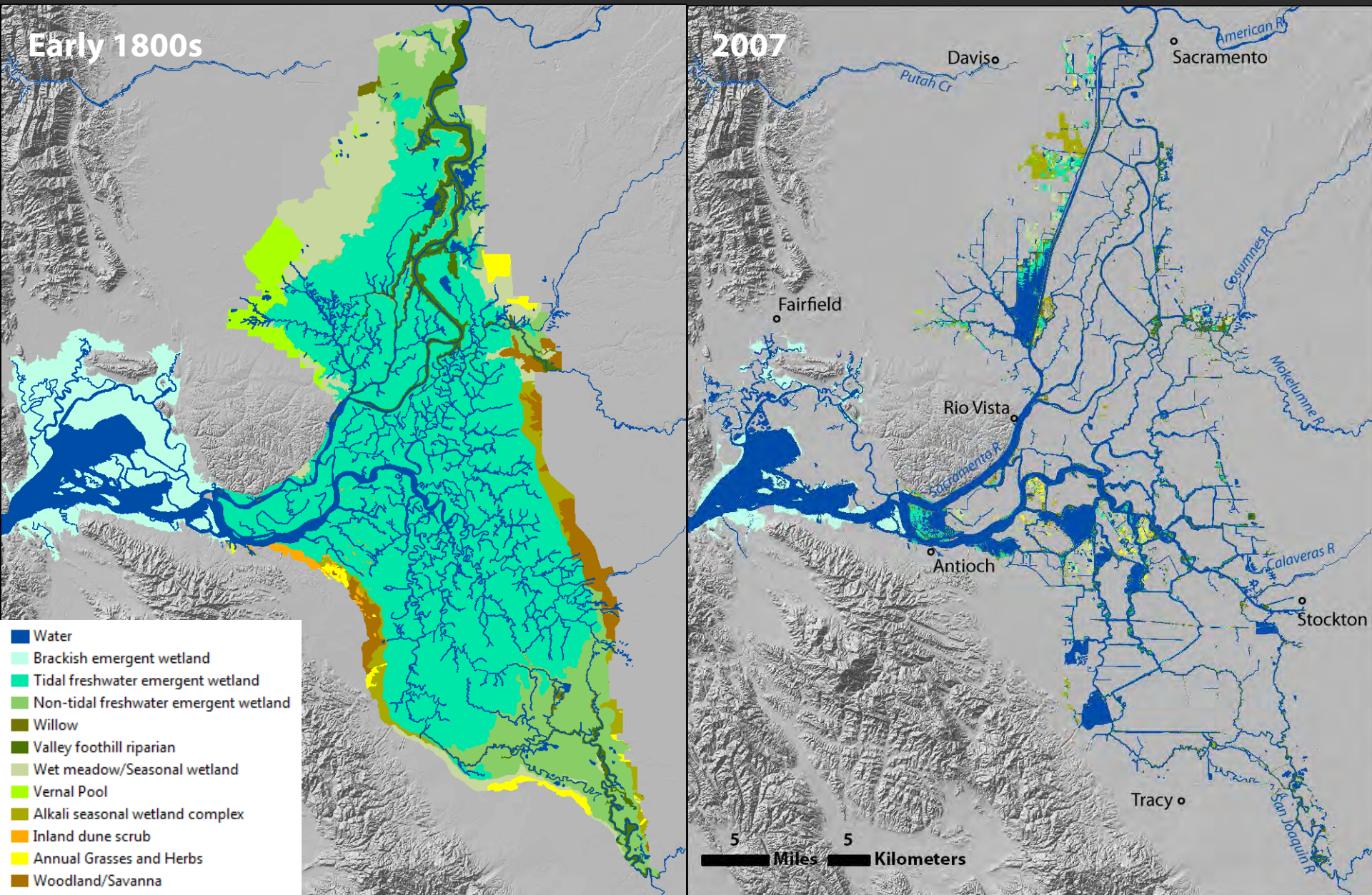
| Quote | Date | Flow | Location | Reference |
|---|---|---|---|---|
| "finding the water fresh and still" | 1772, March 30 | 19.5 | from Willow pass, likely west of Antioch | Crespi and Bolton 1927 |
| "where some rivers empty and take the saltiness of the water which there becomes sweet, the same as in a lake" | 1775 | 18.7 | mouth of the Delta | de Cañizares et al. 1909 |
| "it was now very fresh, but we noted that it was changeable" | 1776, April 3 | 9.1 | near Antioch | Anza and Brown 1998 |
| "we found the water perfectly sweet" | 1837, Oct 26 | 14.1 | where the Sacramento "becomes a narrow stream" | Belcher et al. 1979 |
| "camped, without water, that of the river being still brackish" | 1841, Aug | 5.56 | likely near Antioch | Wilkes 1845 |
| "the water being fresh here all the year" | 1847 | 19.8 | Rio Vista | Californian 1847 |
| "It is such as is peculiar to both salt and fresh water marshes—Some tule and some salt grass…Sometimes fresh sometimes salt [water]. In summer season high tide would be salt" | 1865 | 18.5 | vicinity of New York [Pittsburg] and Antioch | Taylor 1865 |
| "The line of brackish water is at the lower end of Sherman Island" | 1869 | 14.9 | foot of Sherman Island | Alexander 1869 |
| "The water along the San Joaquin frontage is fresh for ten months out of the twelve, and, in most years, is fresh the entire year; even in very dry seasons it is fresh at low water" | 1879 | 15.4 | vincinity of Antioch | Smith & Elliot [1879]1979 |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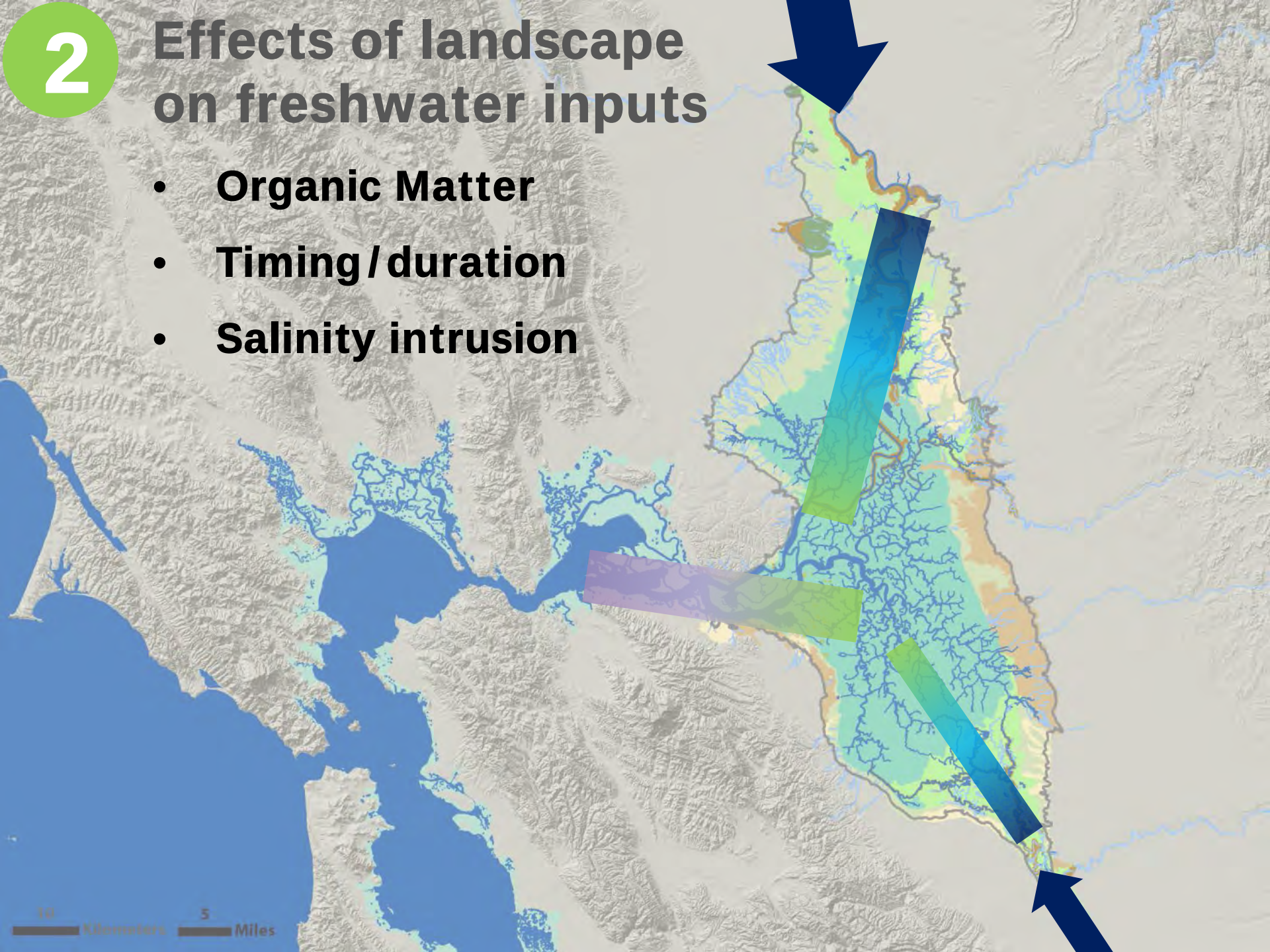
# 2 Effects of landscape on freshwater inputs

- **Organic Matter**
- **Timing / duration**
- **Salinity intrusion**



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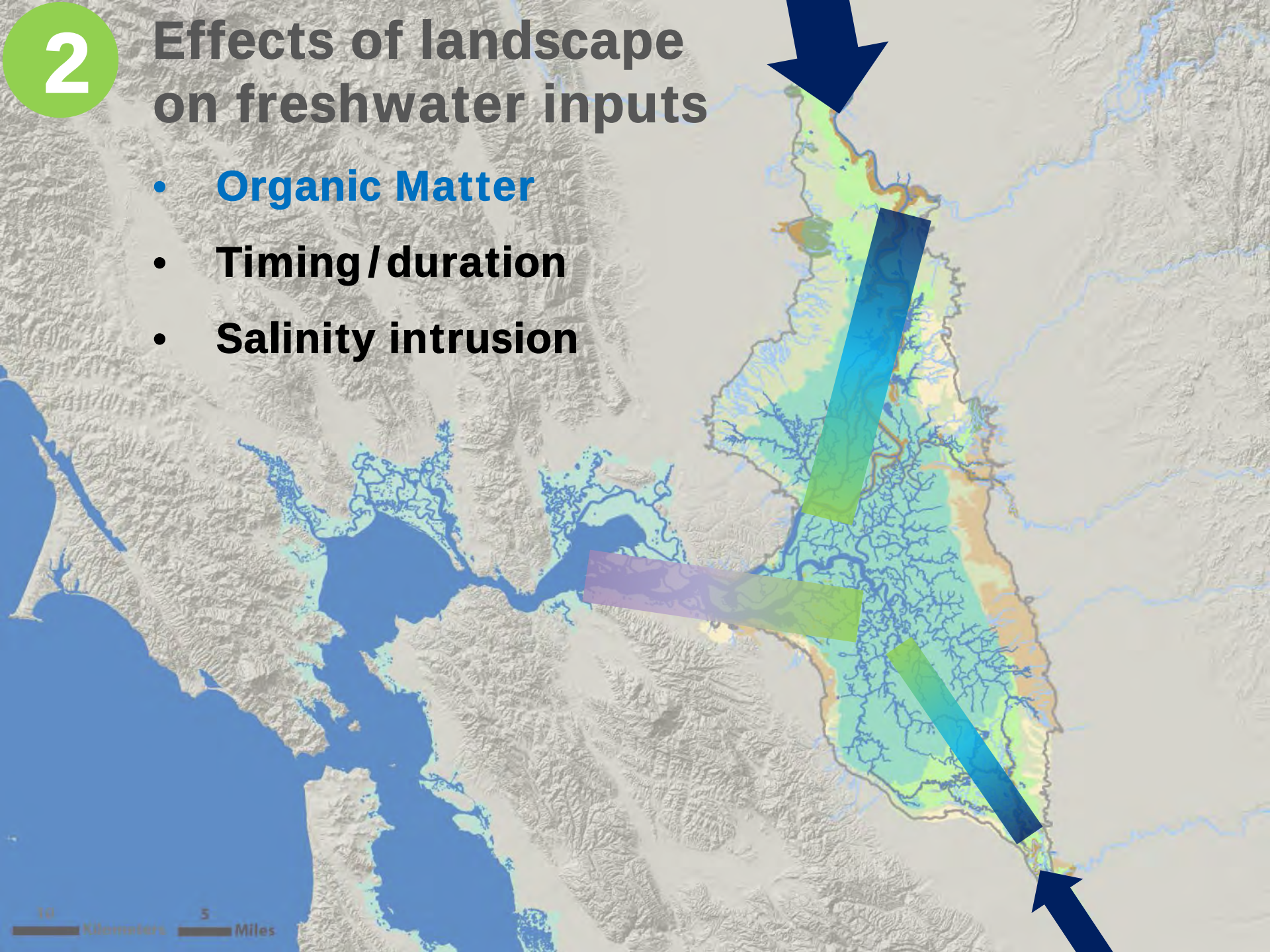
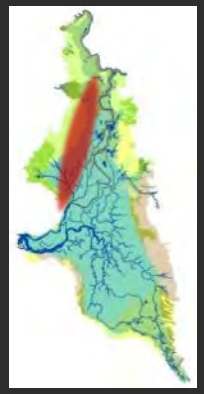




**Tule marsh water:**

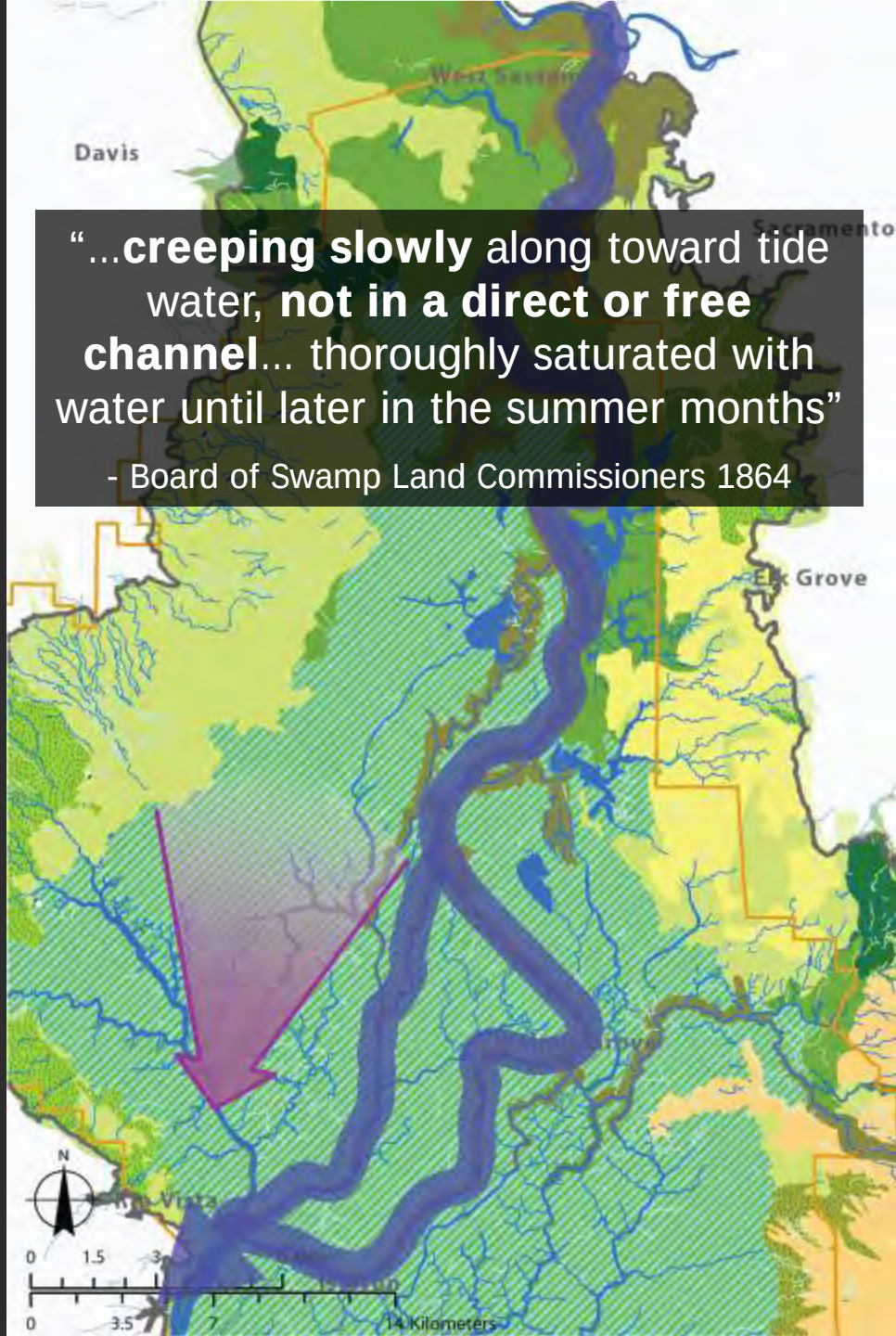
"so thoroughly impregnated with decaying vegetable matter that **it looked more like sherry than water…**we had before us for study **a whole universe of animalcules**." (Wright ca. 1850)

GRAPHIC REMOVED DUE TO COPYRIGHT STATUS

*Browning 1851, Courtesy of The Bancroft Library*

**In-stream flows**: inorganic sediment, short residence time

**Tidal marsh discharge**: organic material, zooplankton, longer residence time, capacity for nutrient exchange, warmer termperatures



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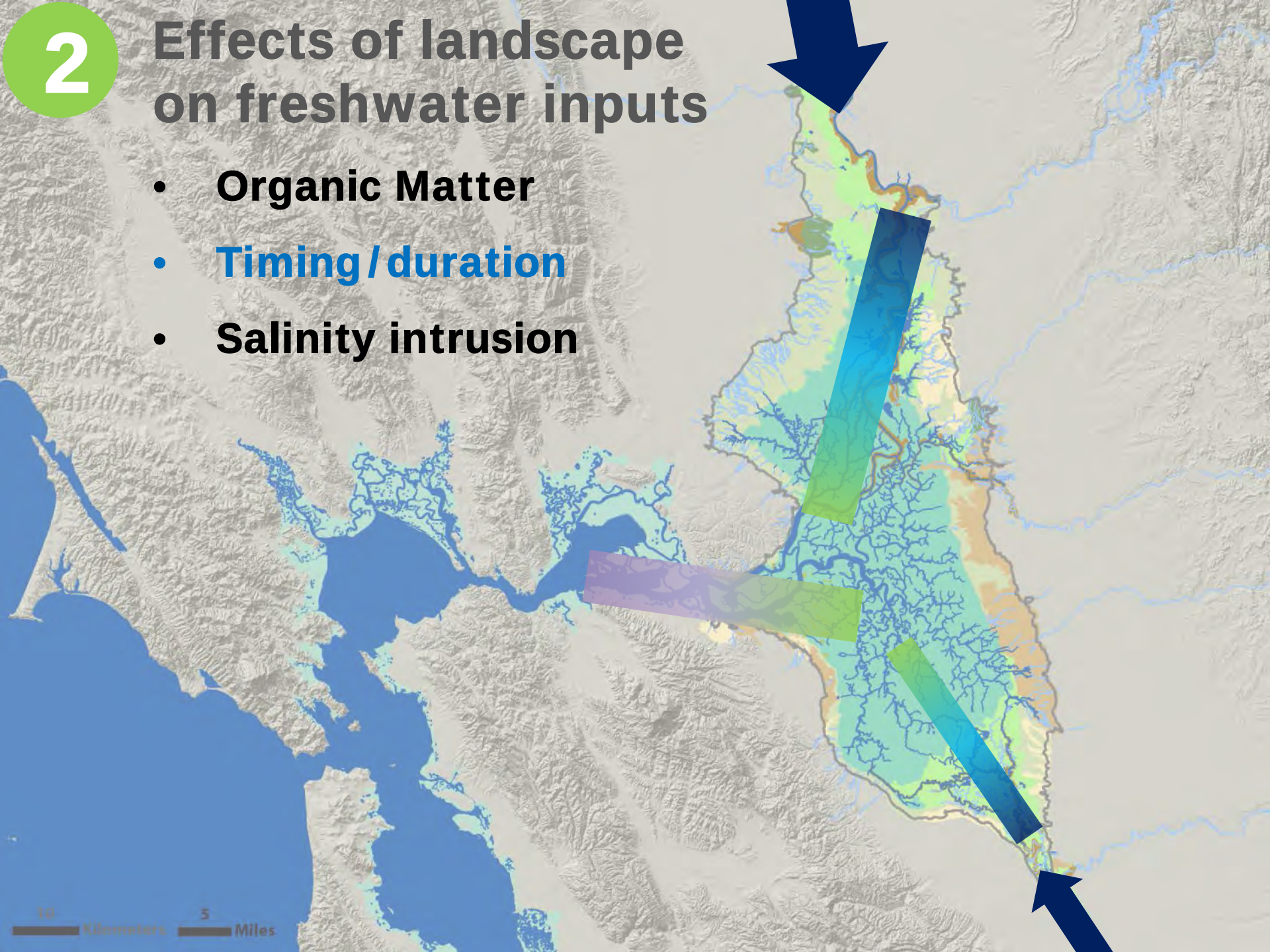


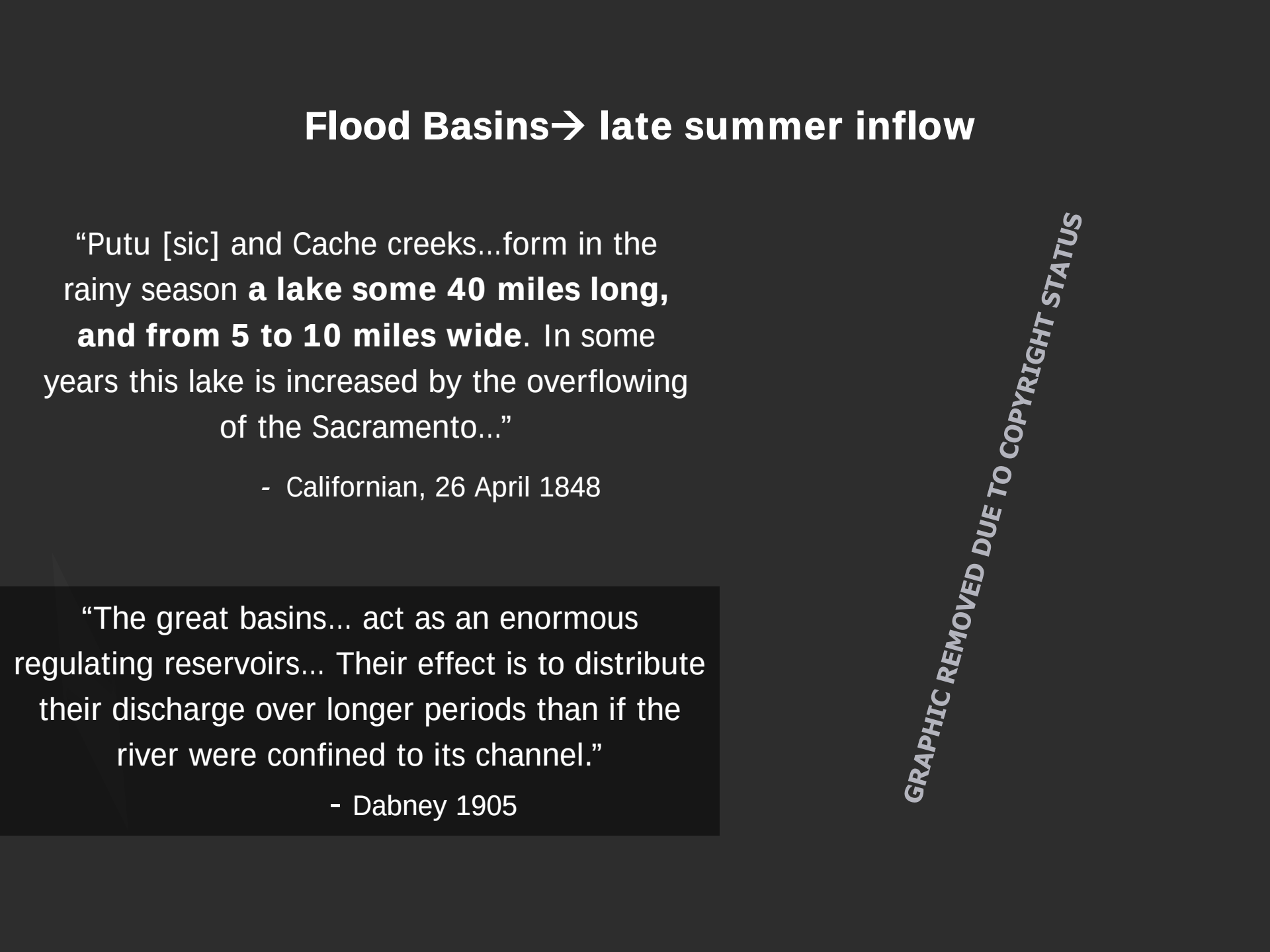
# Flood Basins→ late summer inflow

"Putu [sic] and Cache creeks…form in the rainy season **a lake some 40 miles long, and from 5 to 10 miles wide**. In some years this lake is increased by the overflowing of the Sacramento…"

- Californian, 26 April 1848

"The great basins… act as an enormous regulating reservoirs… Their effect is to distribute their discharge over longer periods than if the river were confined to its channel."

- Dabney 1905



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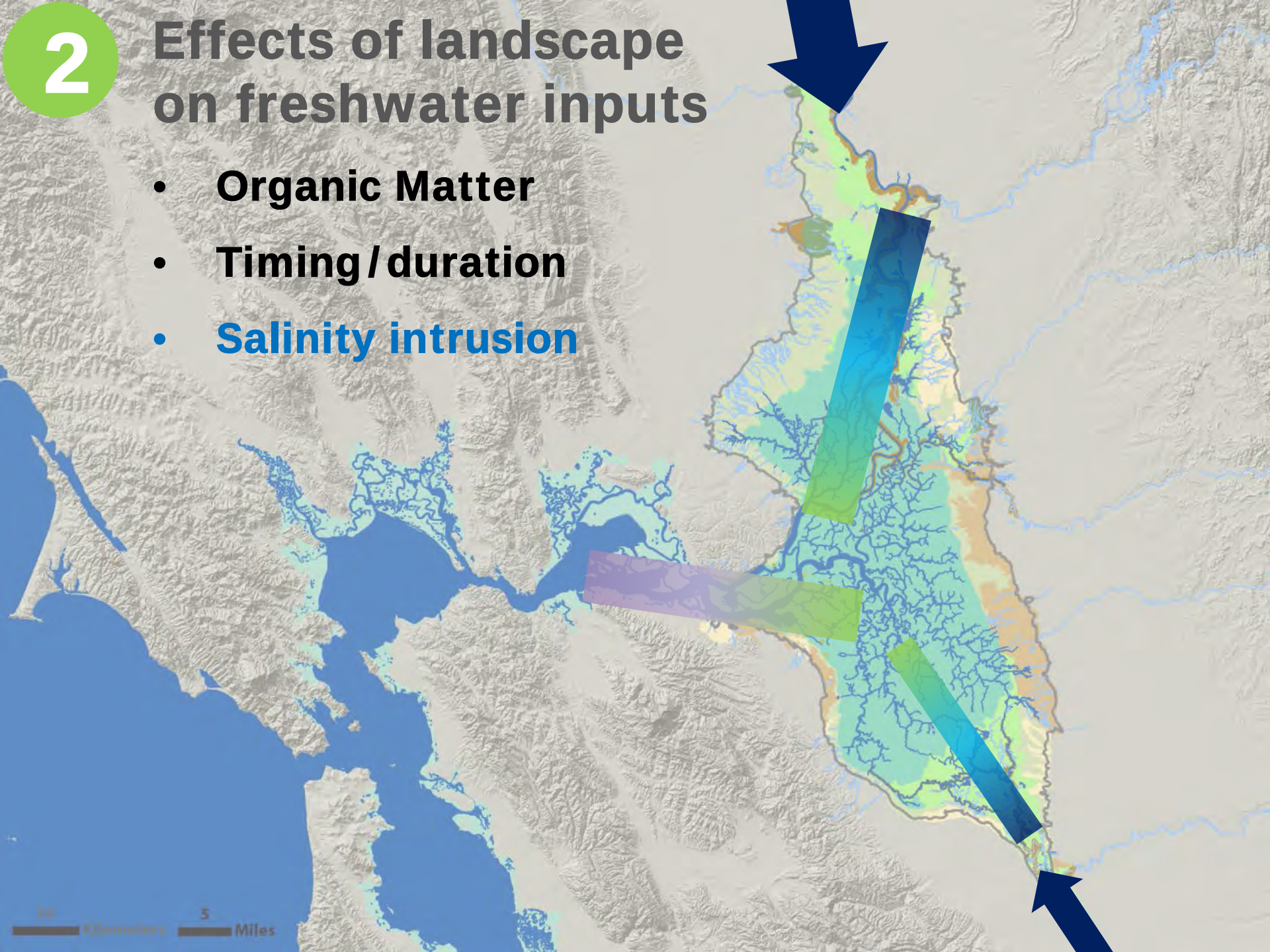
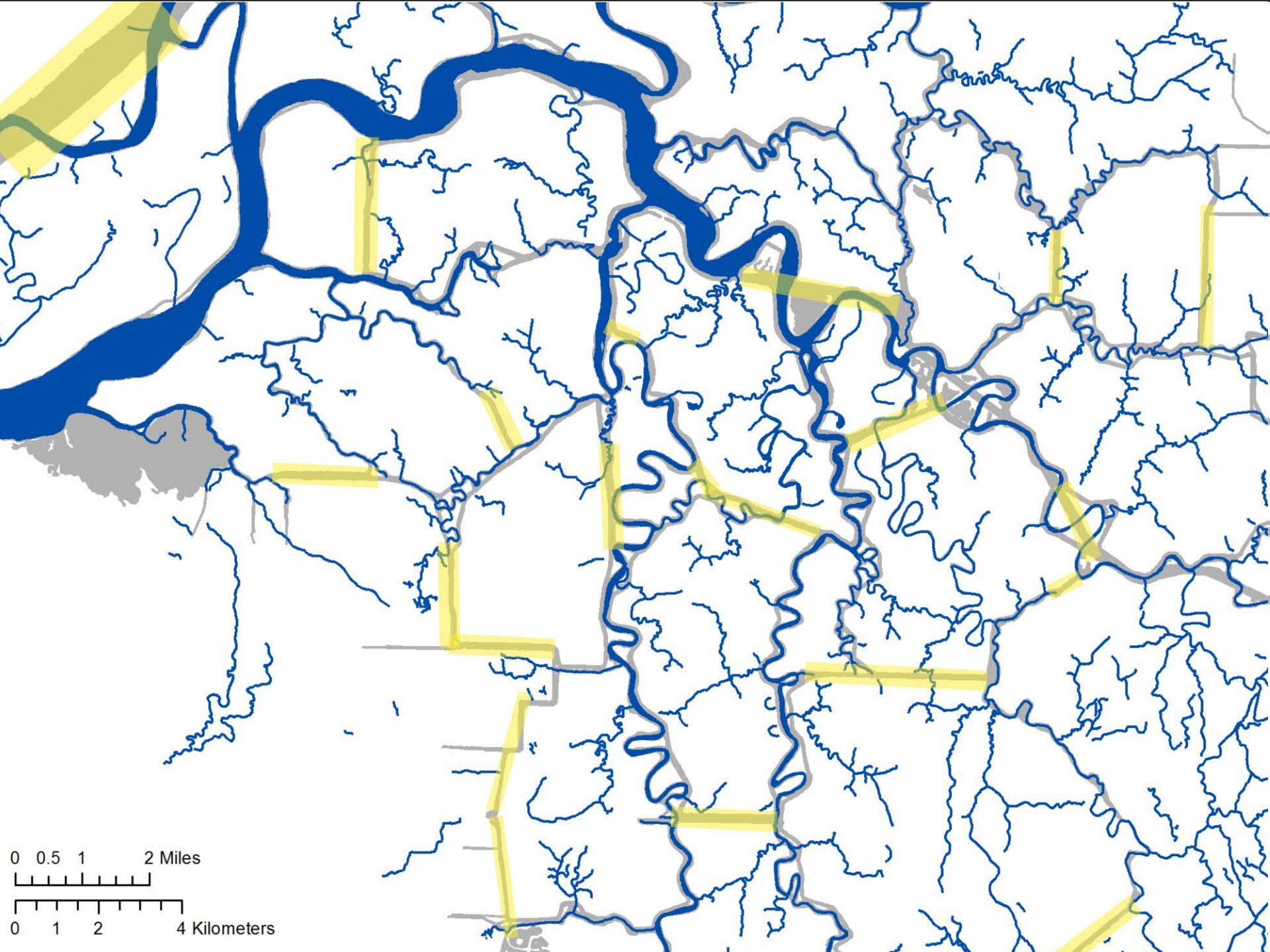



0 0.5 1 2 Miles
0 1 2 4 Kilometers

# TIDAL ISLANDS: channel characteristics

## CAUSED BY "CUTS".

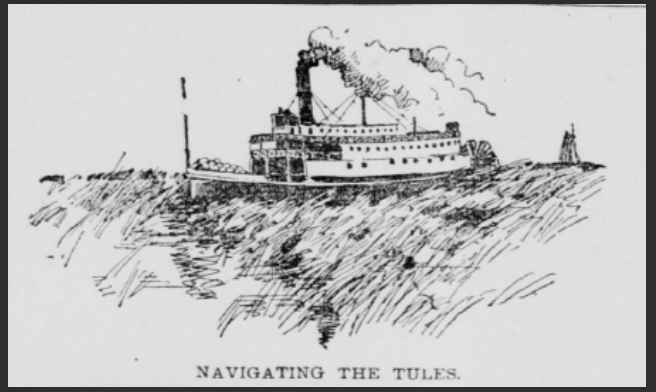
### The San Joaquin Almost Unnavigable.

### EXCEPT AT HIGH TIDE.

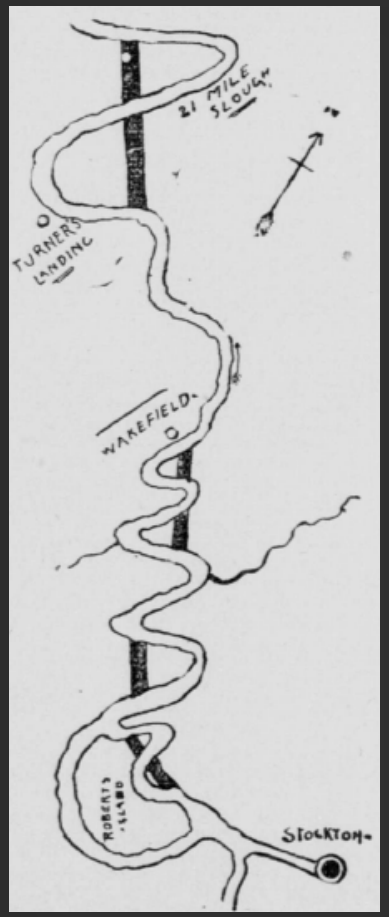
### Unexpected Result of Shortening the River.

In the old days, when the river twisted like a snake, the rise and fall of the tide in the bay did not make a difference in the San Joaquin between Stockton and Twenty-one Mile Slough of more than two feet. The reason of this was that the many curves in the stream prevented the water running out as fast as the tide fell. By the time the tide had fallen six feet in the bay the water fell only two feet in the river, and when the tide rose in the bay it caught the flood and the river commenced to rise again. By this natural phenomenon the river was navigable at all hours.

"But now things have changed," said Pilot Arthur Robinson yesterday, "and the water runs through those cuts at low tide as it would out of a tin pan. The tide



NAVIGATING THE TULES.



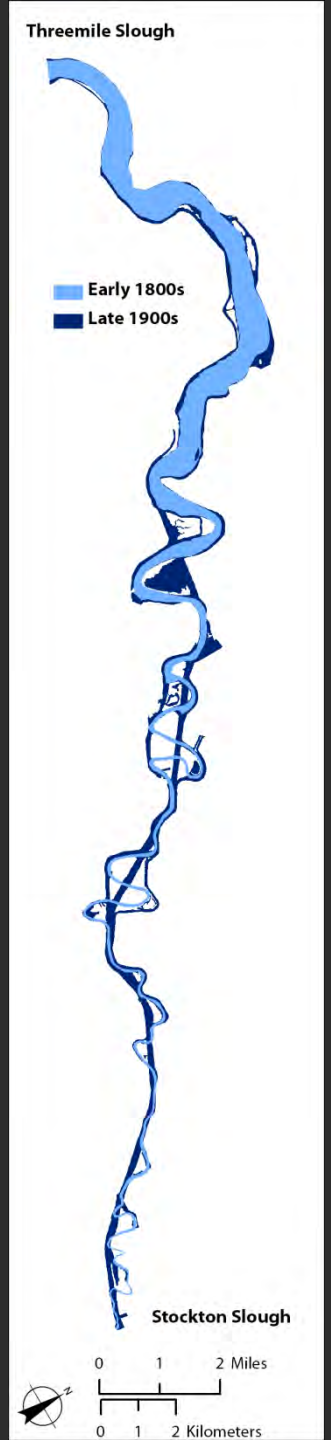

"In the old days, when the river twisted like a snake, the rise and fall...did not make a difference...of more than two feet."

"...the many curves...prevented the water running out as fast as the tide fell."

"...the river was navigable at all hours."

"...now things have changed...the water runs through those cuts...as it would out of a tin pan."

The Morning Call, September 19, 1894



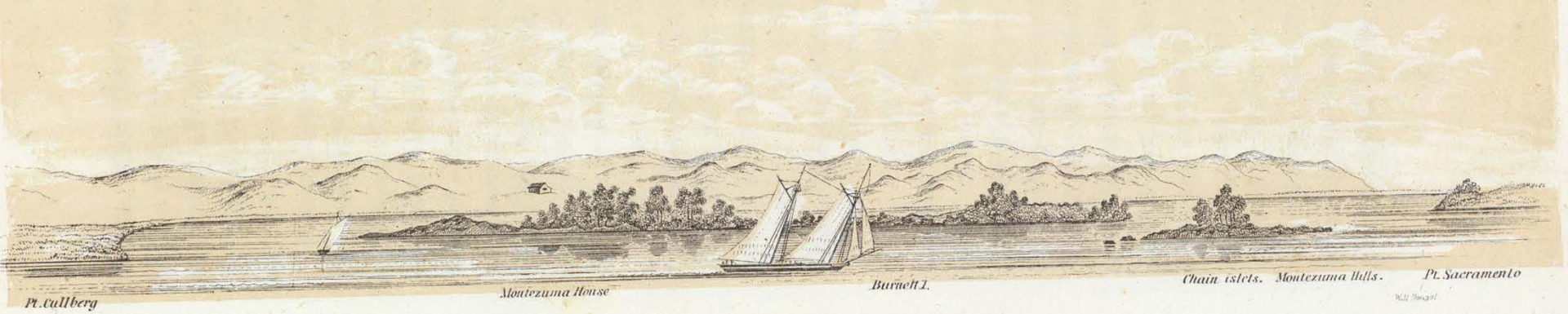

## Length

35 mi (56 km) to 25 mi (41 km)

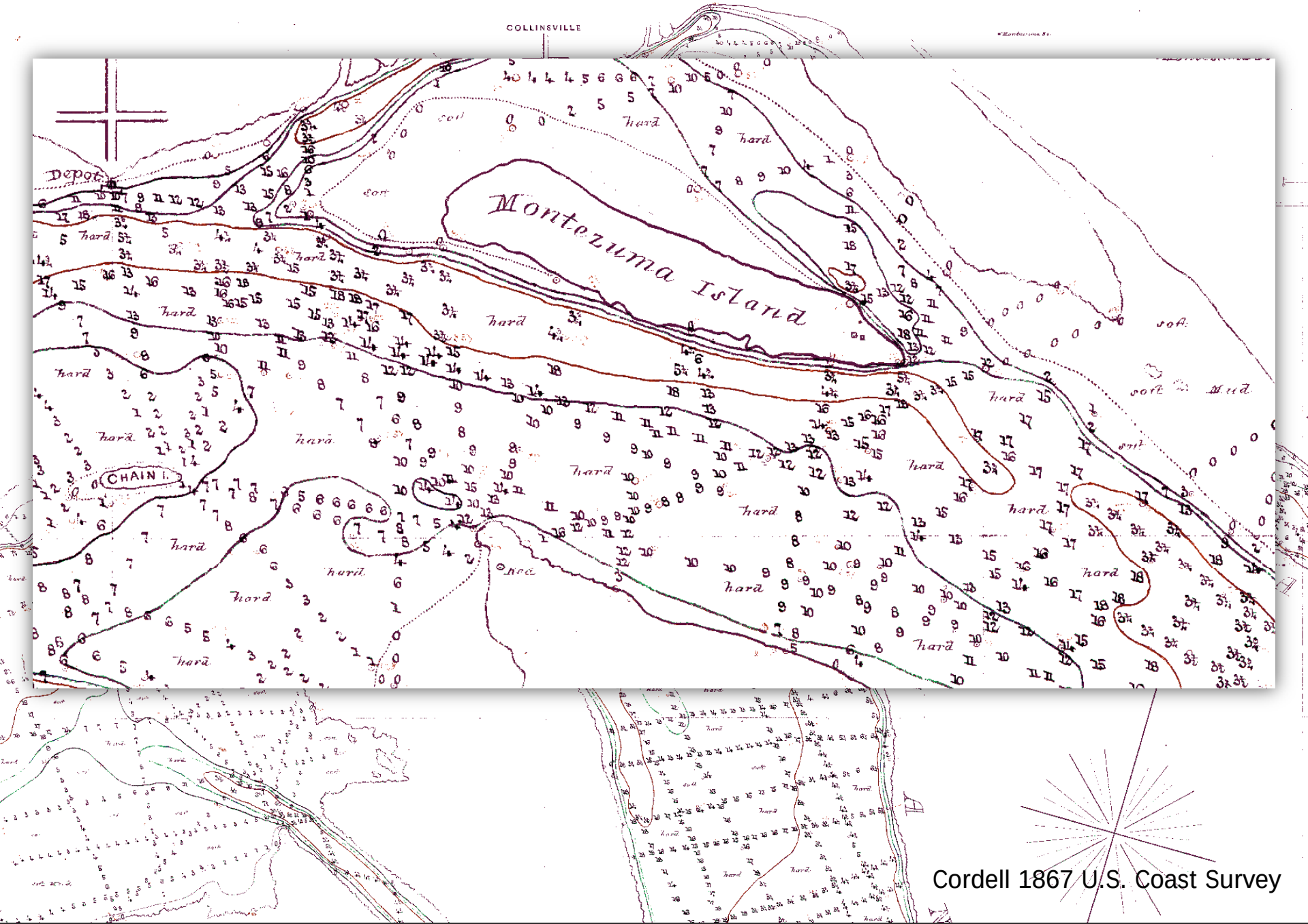
## Width

On the order of 350 ft (100 m)

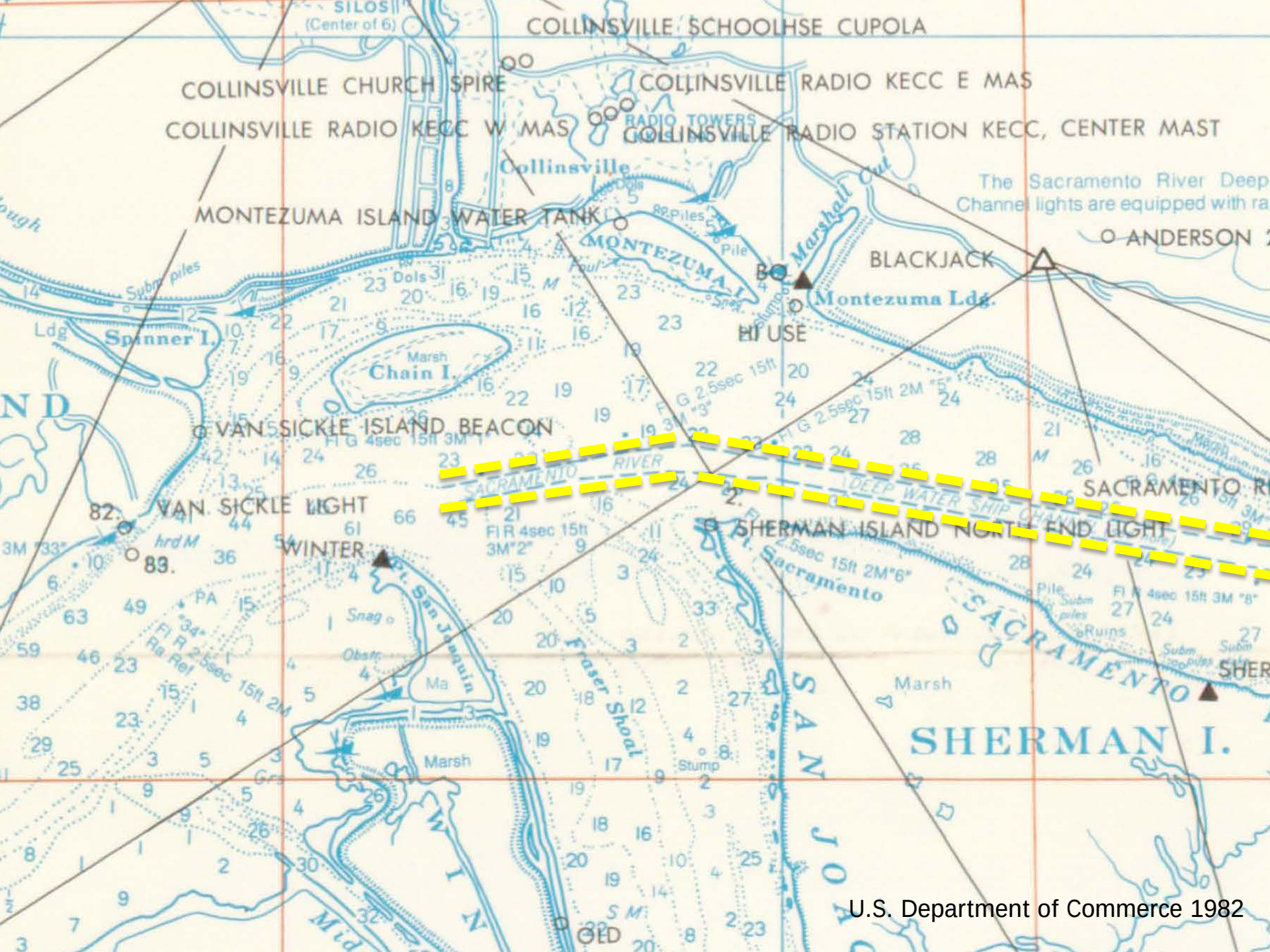

SLOUGH
DISAPPOINTMENT
R I
T R
Camp 21
Dredger Cut
RINDGE NAVIGATION + CANAL CO
uncultivated
WHISKEY SLOUGH
HEAD REACH
GUN CLUB
uncultivated
RINDGE NAVIGATION + CANAL CO
uncultivated
150 m or 500 ft
N
0
0.125
0.25
0.5 Miles
0
0.25
0.5
1 Kilometers


Entrance to the Sacramento River




Cordell 1867 U.S. Coast Survey




U.S. Department of Commerce 1982

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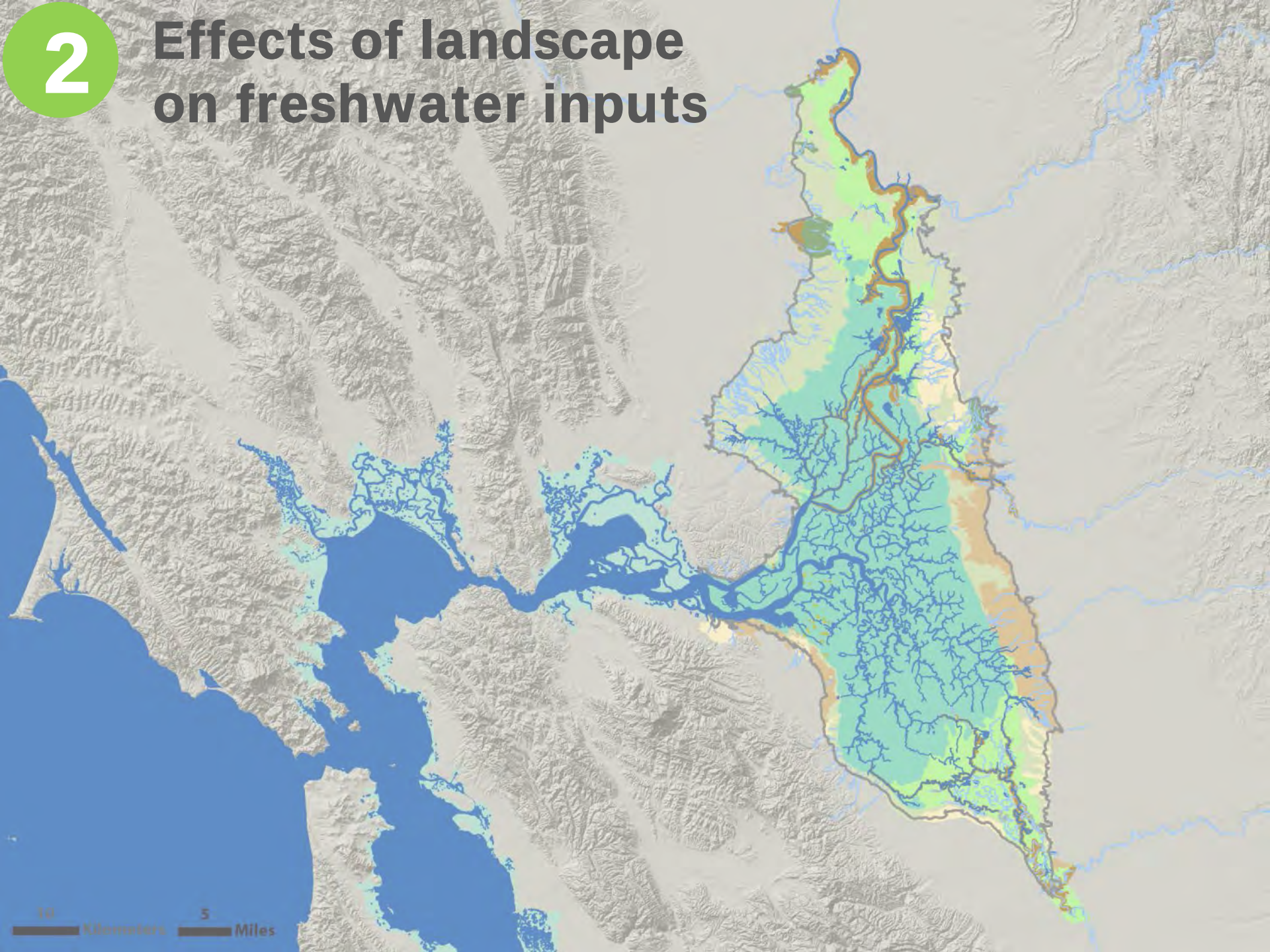

## SUMMARY POINTS

Bay-Delta *landscape* integral to the value of the LSZ

Landscape affects not just area/volume of LSZ but also location (and probably quality)

Historical Delta a lot more resistant to salinity intrusion

These effects could be modeled using new GIS of historical Delta geometry (plus bathymetry, hydrograph)

# Questions?