Overview of Recent Efforts to Characterize Natural Delta Outflow

CWEMF-IEP Joint Session

February 26, 2014

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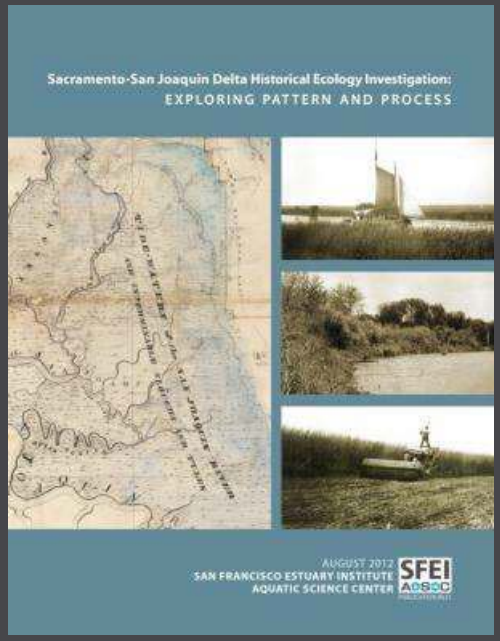
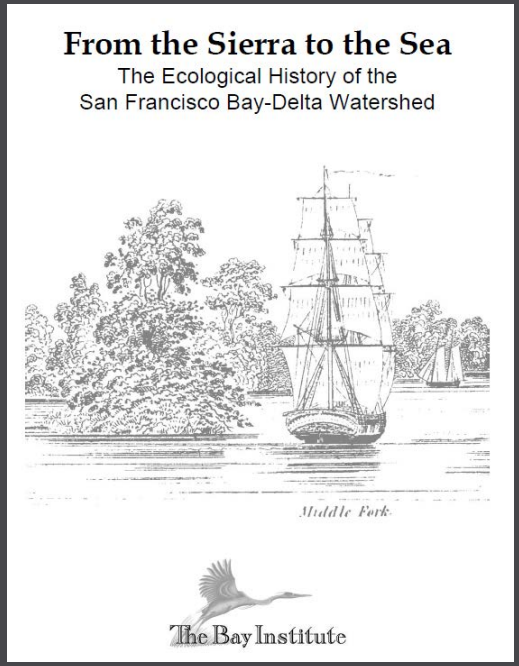
Metropolitan Water District

Purpose

- Gain Insights into Natural Hydrologic Conditions
  - A return to natural conditions is not a realistic goal.
  - However, understanding the biological functions provided under natural conditions is necessary for effective restoration efforts.
- Explore Differences Between “Unimpaired” and “Natural” Delta Outflow





Acknowledgements

Hydrology

Dan Howes, CSU, San Luis Obispo

J. Phyllis Fox, Consulting Engineer

Andy Draper, MWH

Tariq Kadir, DWR

Guobiao Huang, DWR

Funding

San Luis Delta Mendota Water Authority

State Water Contractors

Metropolitan Water District

Independent Collaborators

UC Davis

DWR

Digital Elevation & Hydrodynamics

Robin Grossinger, SFEI

Sam Safran, SFEI

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Bill Fleenor, UC Davis

Alison Whipple, UC Davis

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John DeGeorge, RMA

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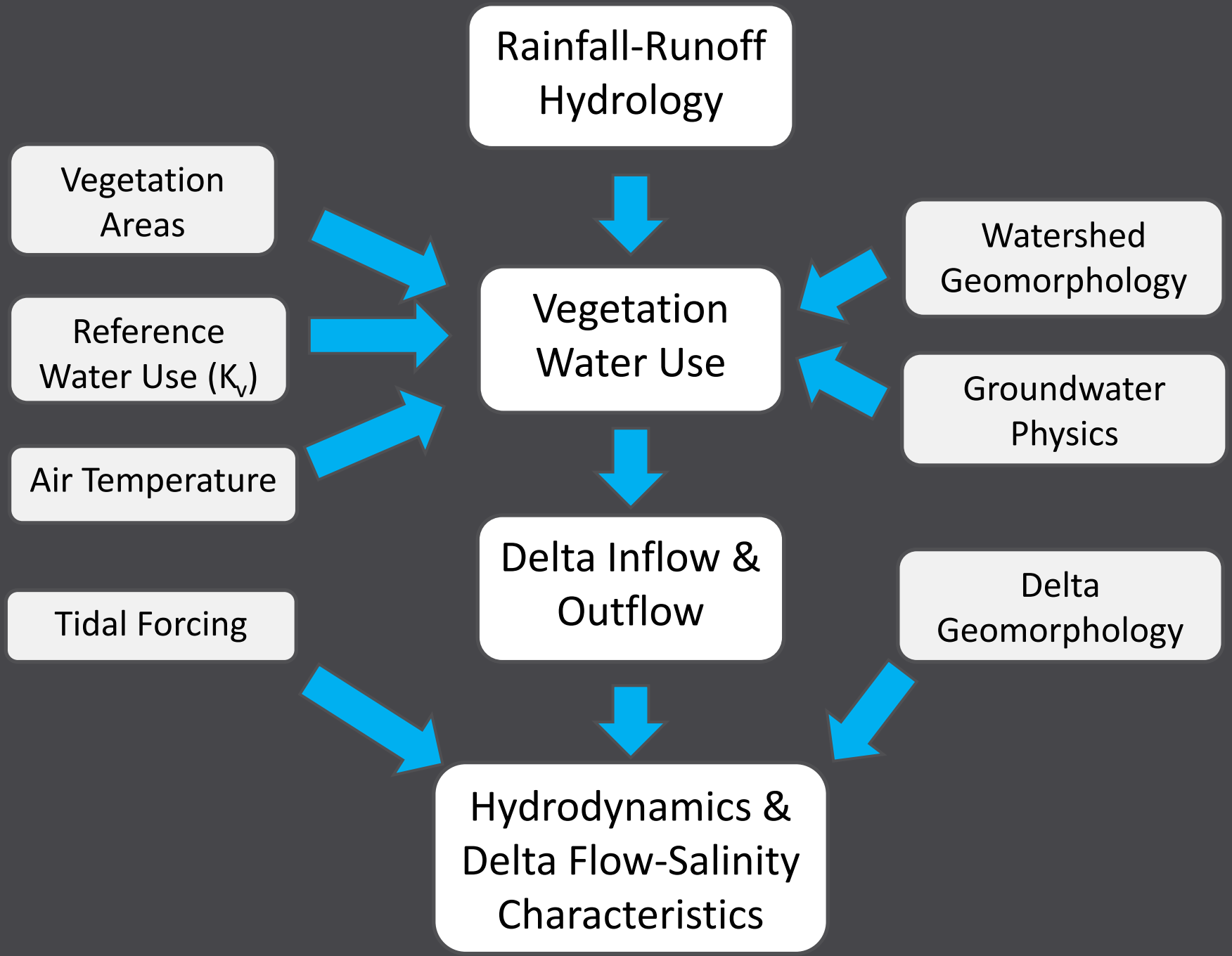
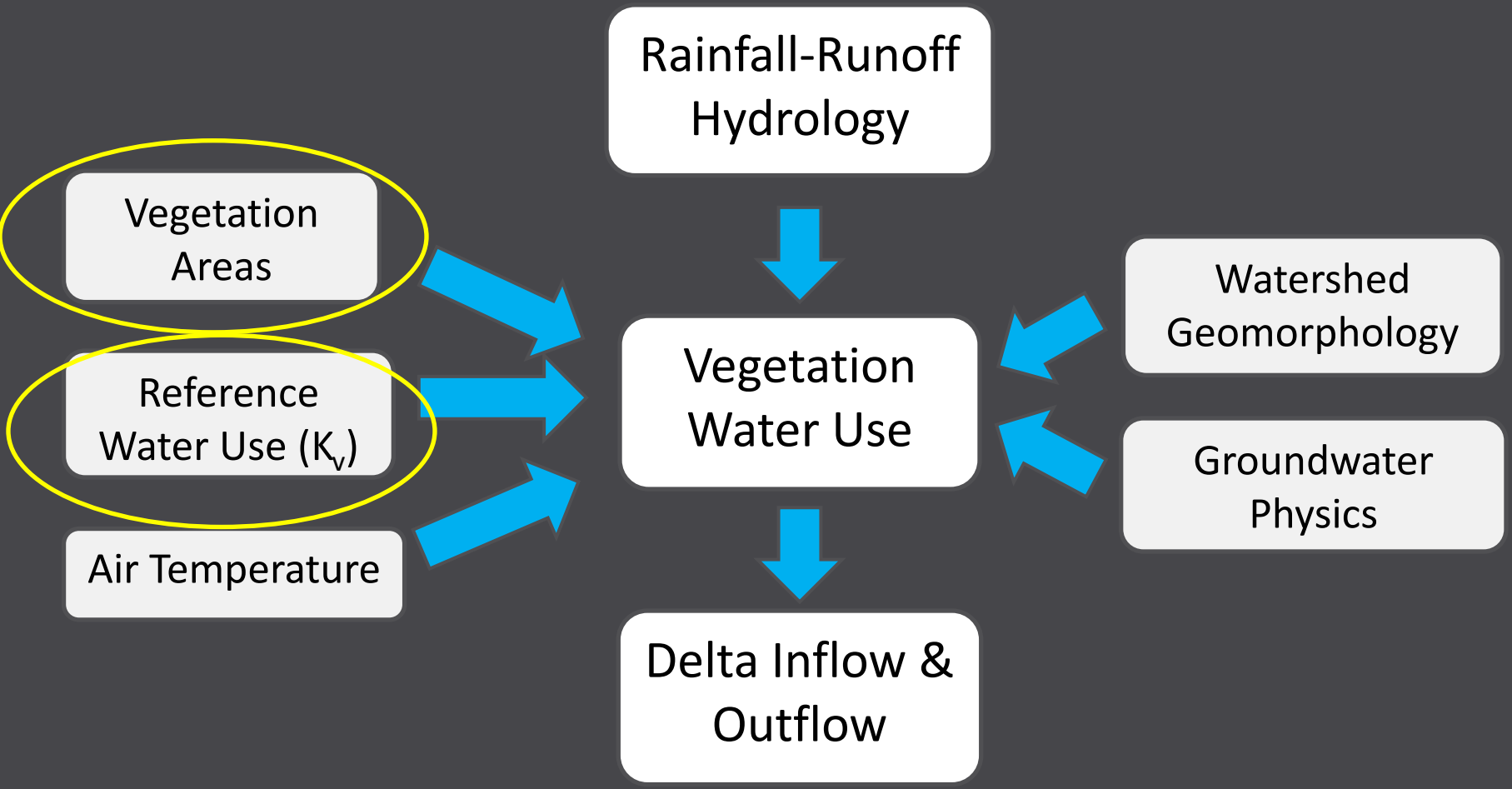
Stephen Andrews, RMA

Stacie Grinbergs, RMA

What do we mean by “natural” conditions?

- Land use and hydrology radically modified since mid-18th century
- Major rivers could not carry normal winter runoff and spring snowmelt
- Natural “level of development”, i.e. natural landscape + contemporary climate


Rainfall-Runoff Hydrology
Vegetation Areas
Reference Water Use (K_v)
Air Temperature
Vegetation Water Use
Watershed Geomorphology
Groundwater Physics
Delta Inflow & Outflow
Tidal Forcing
Delta Geomorphology
Hydrodynamics & Delta Flow-Salinity Characteristics

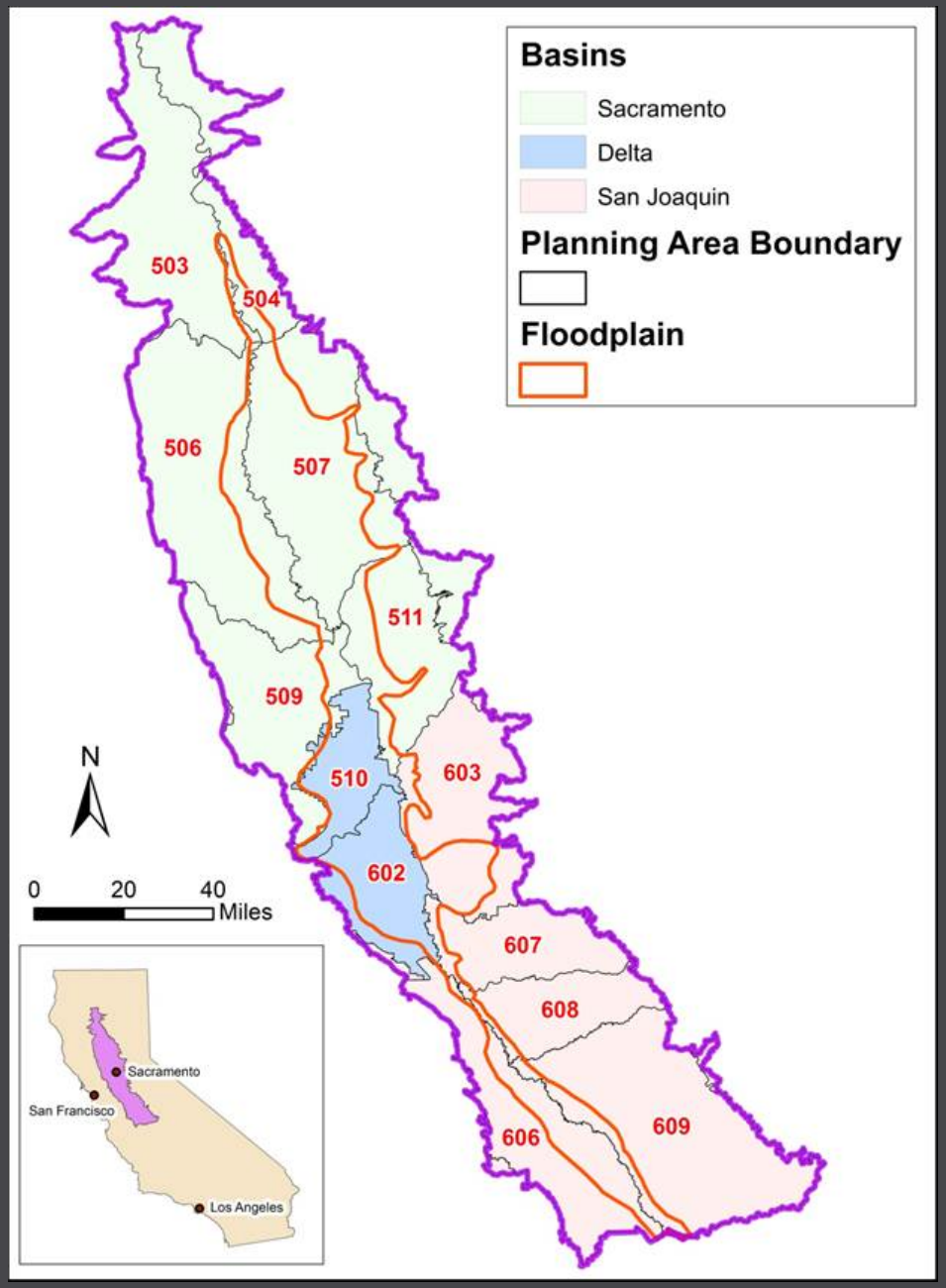


Dan Howes, CSU San Luis Obispo

ET from Natural Vegetation in the Central Valley of California: Monthly Grass Reference Based Vegetation Coefficients and the Dual Crop Coefficient Approach

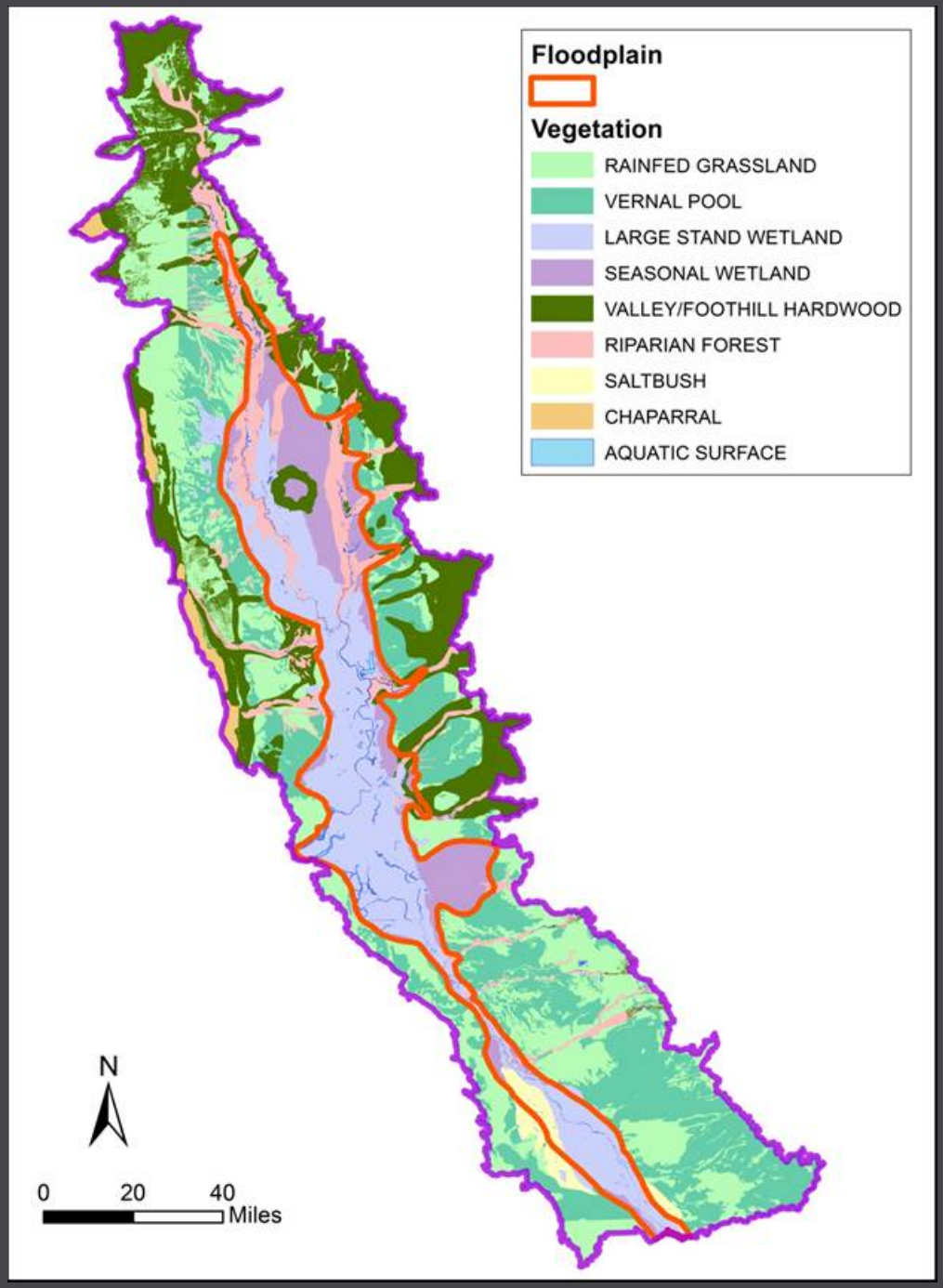
J. Phyllis Fox, Consulting Engineer

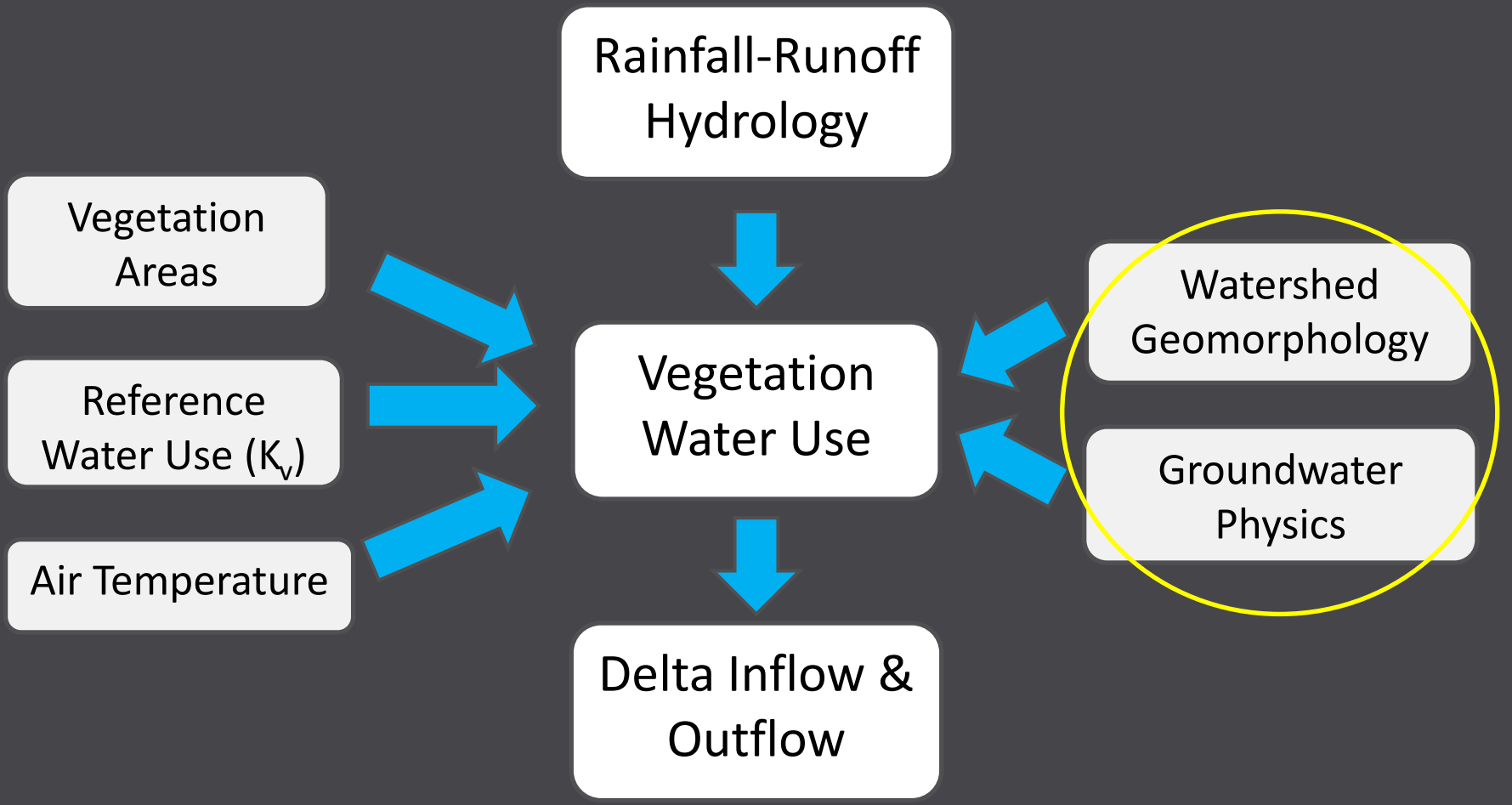
Natural Delta Outflow Water Balance



Vegetation Class	Area (%)	Et_v (ft/yr)
Rainfed Grassland	48	0.9-1.2
Perennial Grassland		3.7-5.0
Vernal Pools		2.2-2.9
Permanent Wetlands	12	4.0-5.4
Seasonal Wetlands	9	3.7-4.9
Foothill Hardwood	19	1.0-1.5
Valley Oak Savanna		1.8-2.4
Riparian Forest	9	3.8-5.1
Saltbrush	3	1.7-2.3
Chaparral		0.6-1.0
Aquatic		3.6-4.9

Vegetation Areas





Andy Draper, MWH

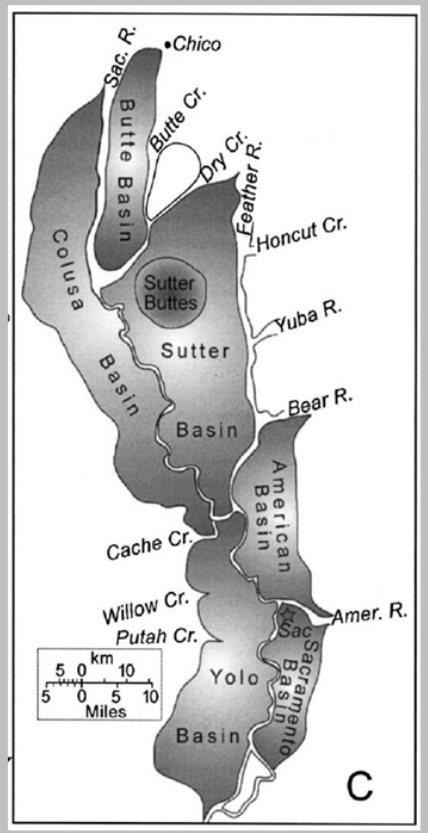
Natural Flow Monthly Routing Model

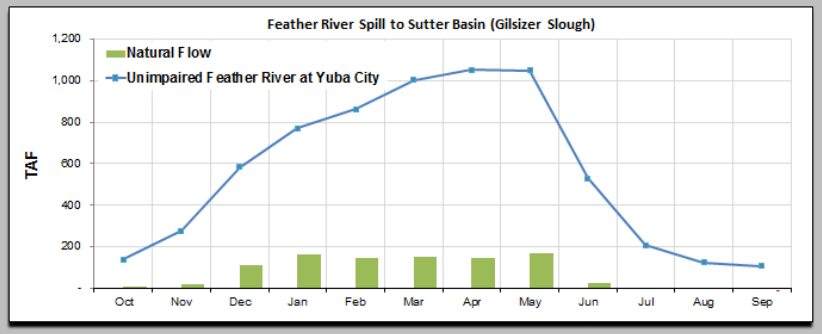
Tariq Kadir, DWR

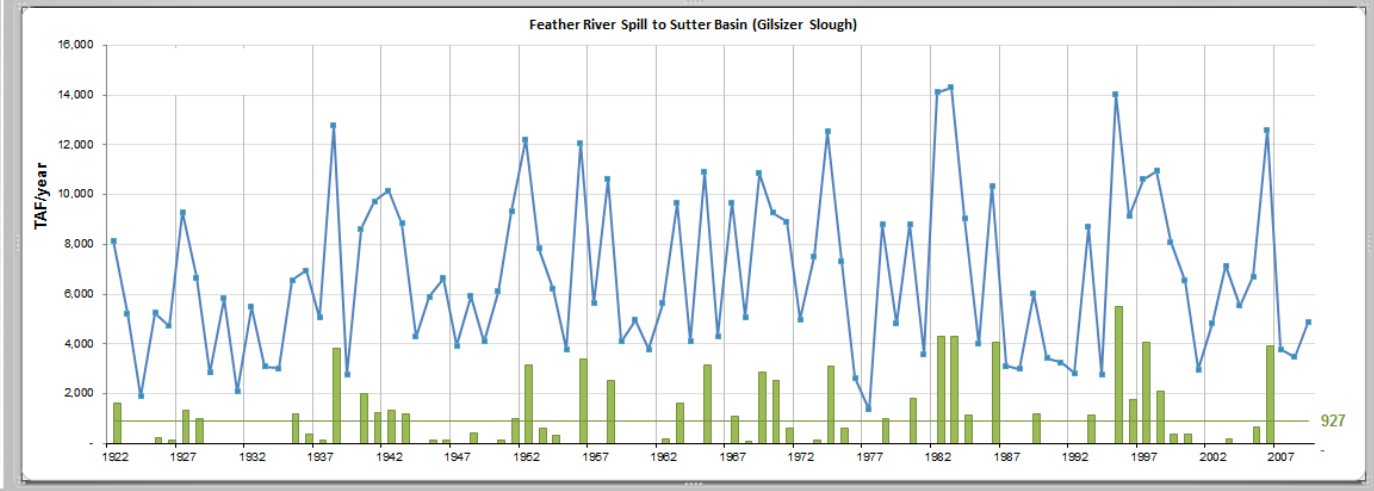
Simulated 1922-2009 Daily Inflows to the Sacramento – San Joaquin Delta under Predevelopment Conditions Using Precipitation-Runoff Models and C2VSIM: Preliminary Results

Monthly Routing Model

Feather River Spill to Sutter Basin (Gilsizer Slough)







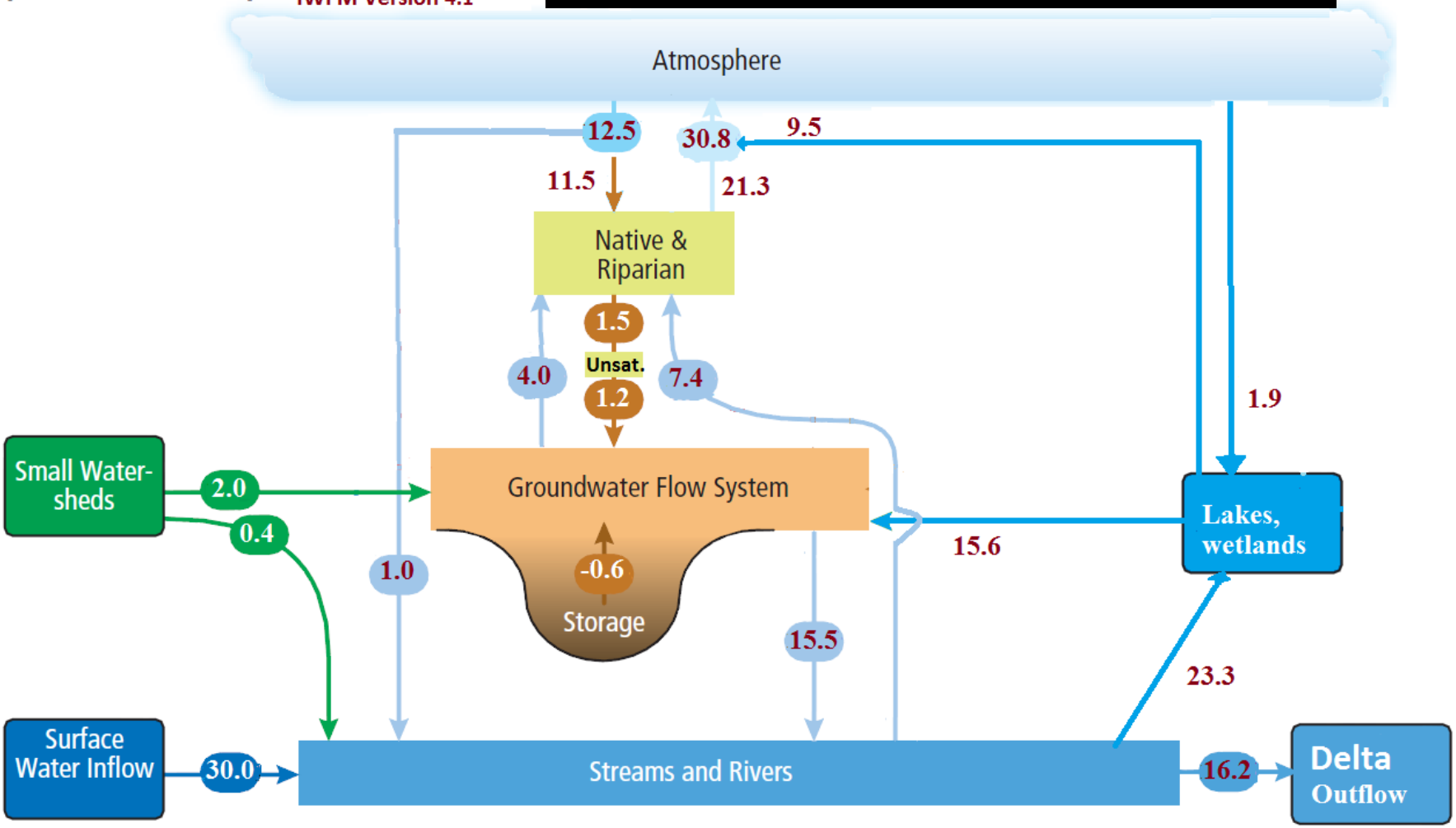
Simulated Annual Water Budget

Pre-Development condition

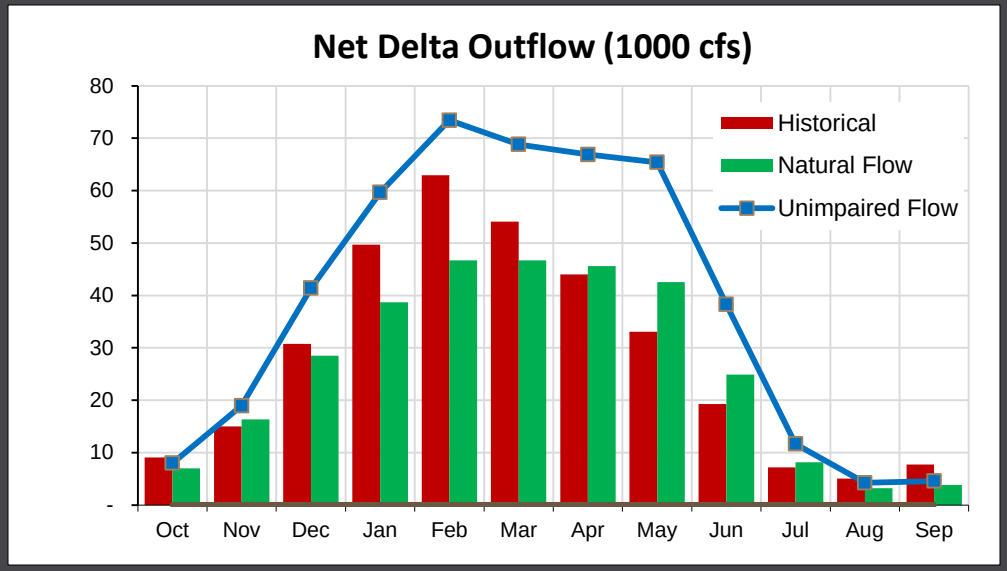
Average Flows for water years **1922-2009**
[Million Acre-Feet/Year]

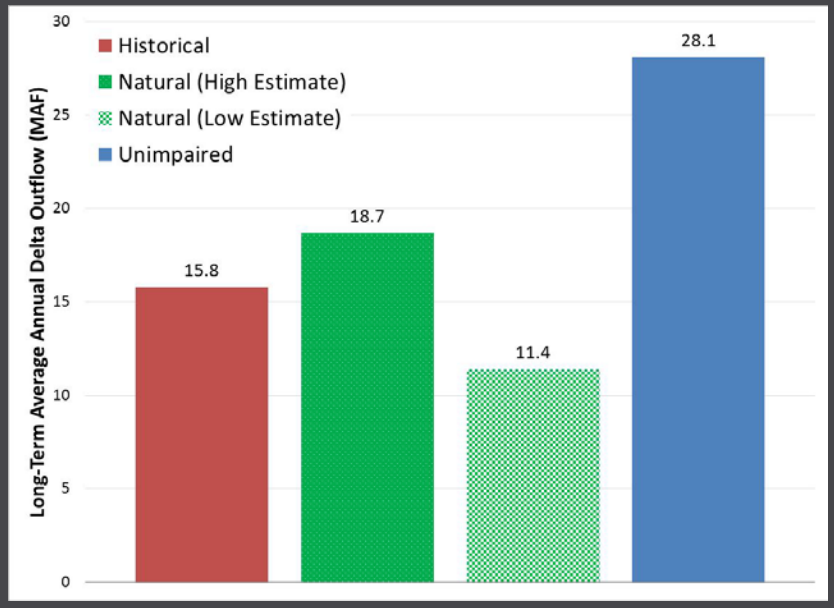
IWFM Version 4.1

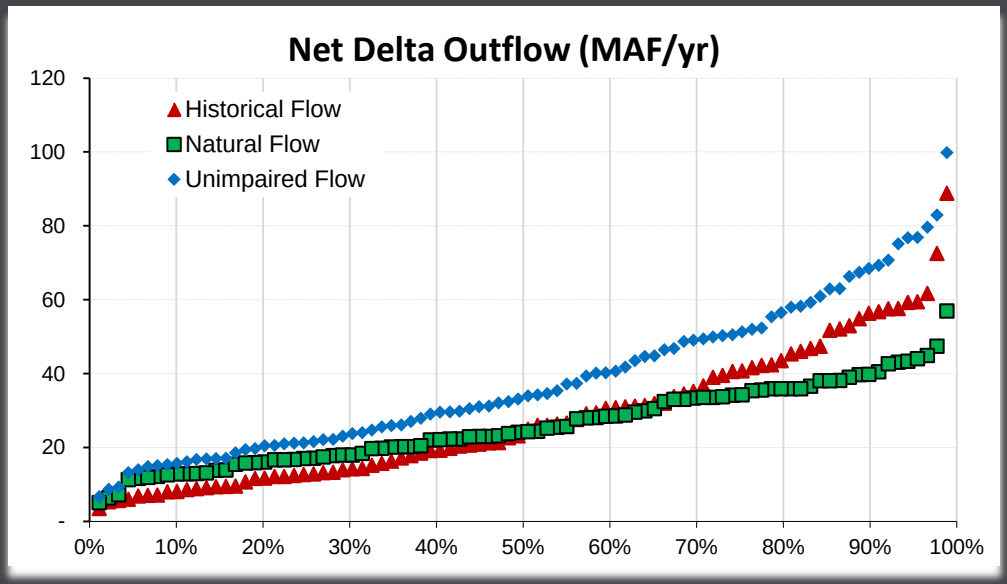
Sacramento-San Joaquin Valley and Delta



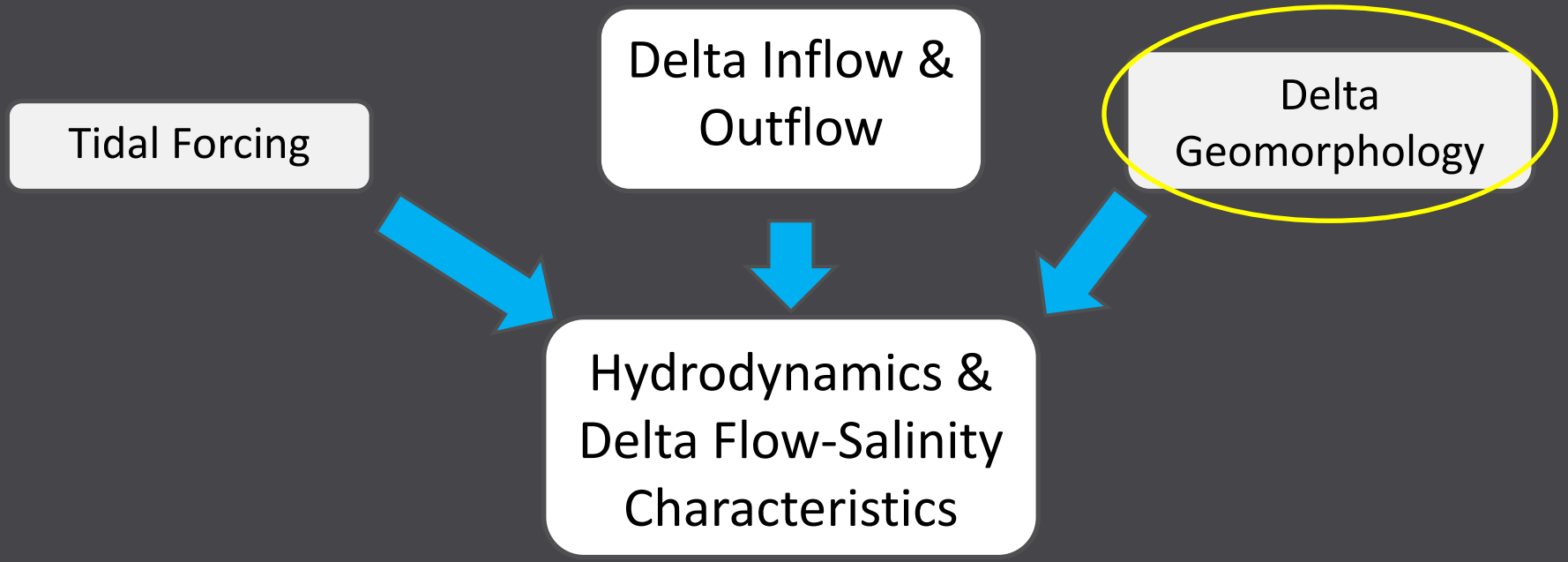
Project Status: Hydrology





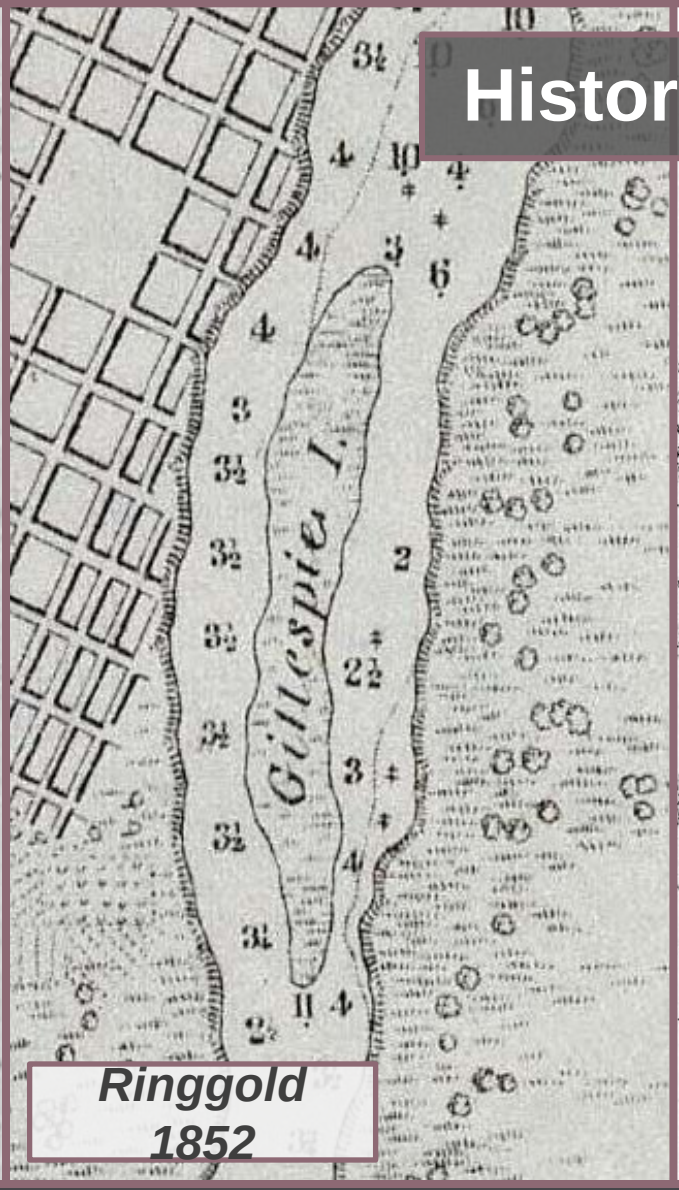


Robin Grossinger, SFEI
Sam Safran, SFEI
Generating a Historical Bathymetric-Topographic Digital Elevation Model (Part 1): Data Collection and Development
Bill Fleenor, UC Davis
Alison Whipple, UC Davis
Generating a Historical Bathymetric-Topographic Digital Elevation Model (Part 2): Data Interpolation

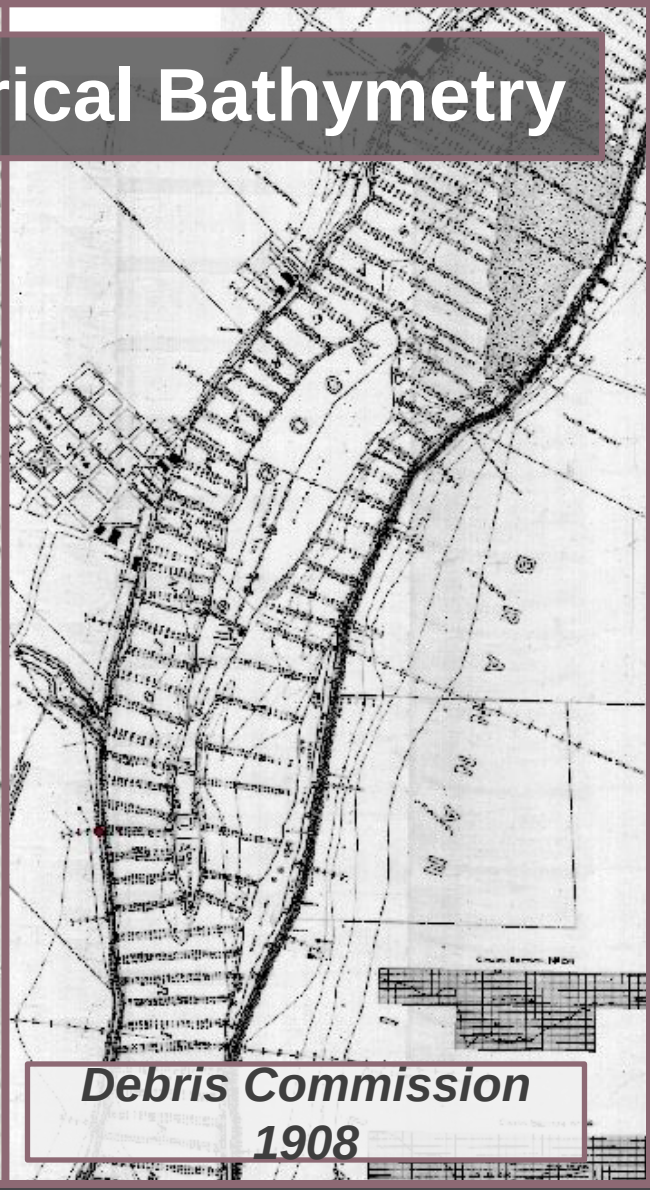


Historical Bathymetry

Gibbes 1850

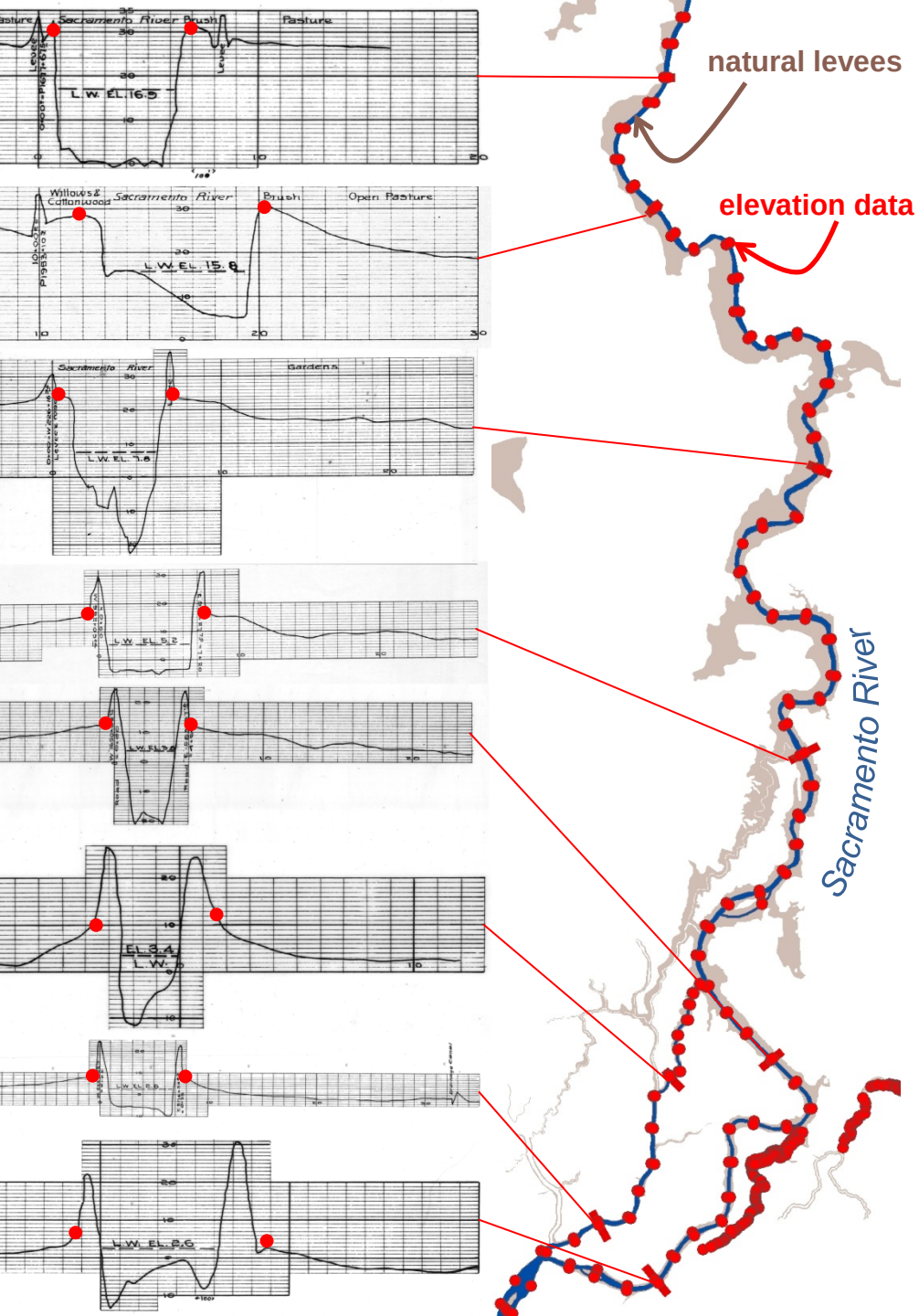


Ringgold 1852



Debris Commission 1908

Historical bathymetry data compiled from **multiple sources** with variation **in time period, spatial accuracy, coverage, and sounding density**



Historical Topography

Natural levees

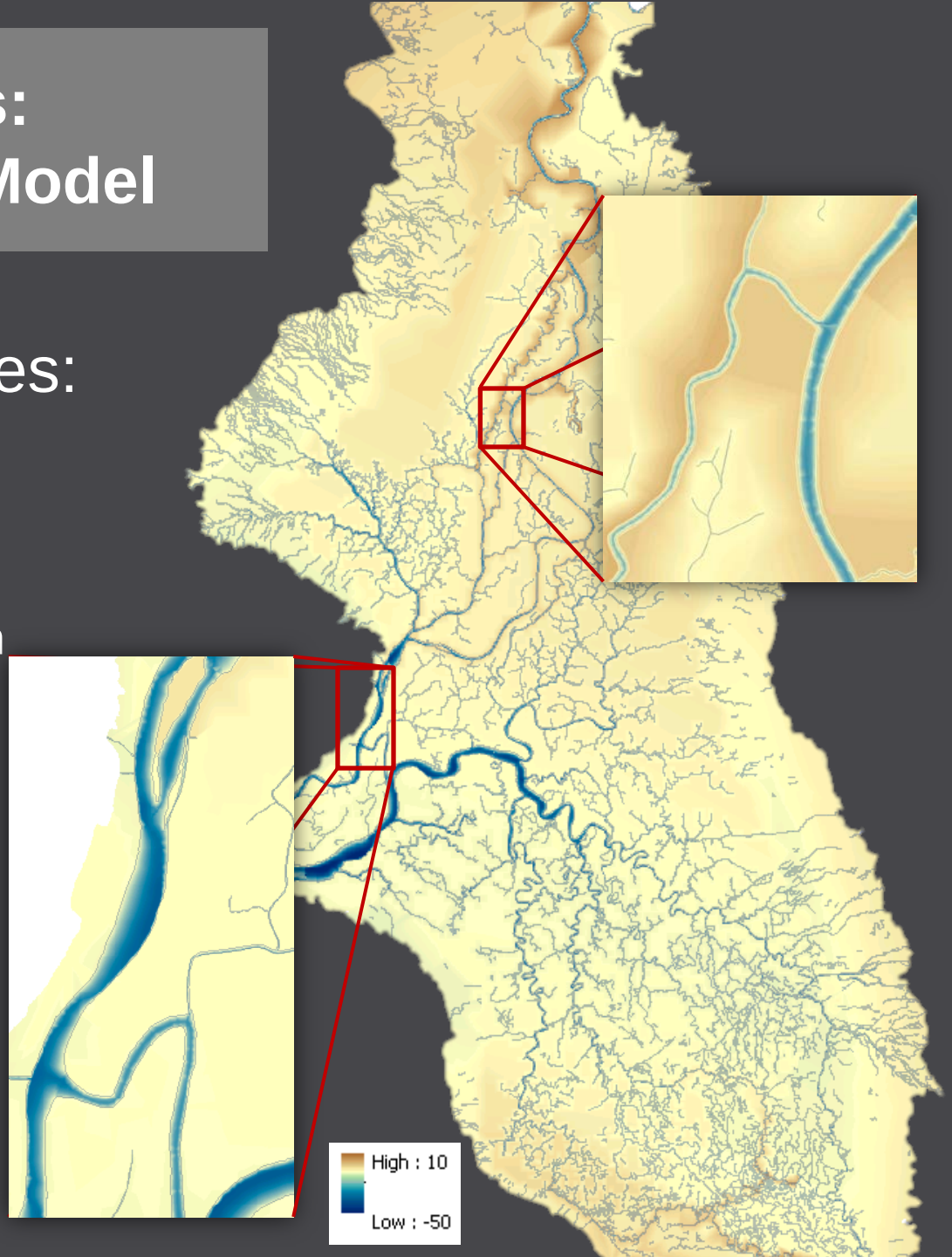
- extent from Historical Ecology layers
- elevations derived from early detailed topographic surveys
- Sacramento River levees ranged from 30 ft. (near Feather River) to 4 ft. NAVD88 (near Rio Vista)
- corroborated with historical written record
- will compare against modern LiDAR

Marsh surface

- extent from Historical Ecology layers
- elevation relative to MSL

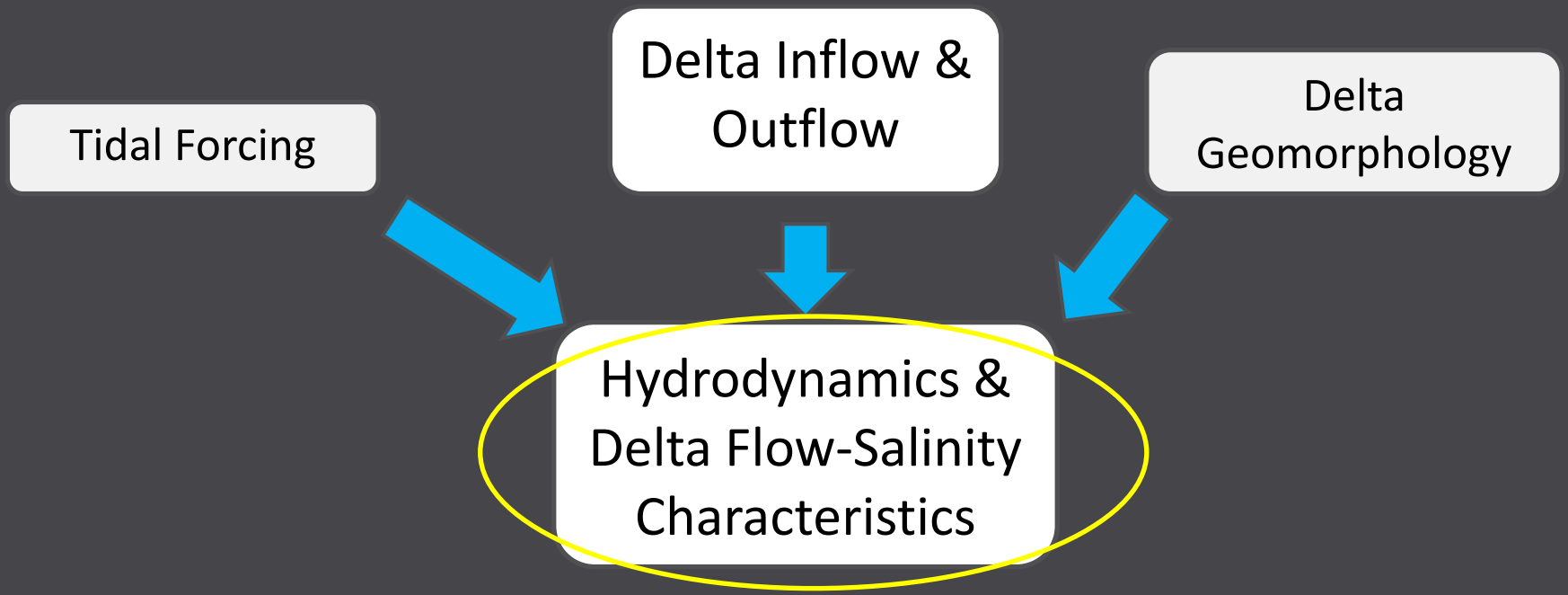
Project Status: Digital Elevation Model

- Interim DEM includes:
  - Channel bathymetry
  - Landscape topography (natural levees & marsh elevations)



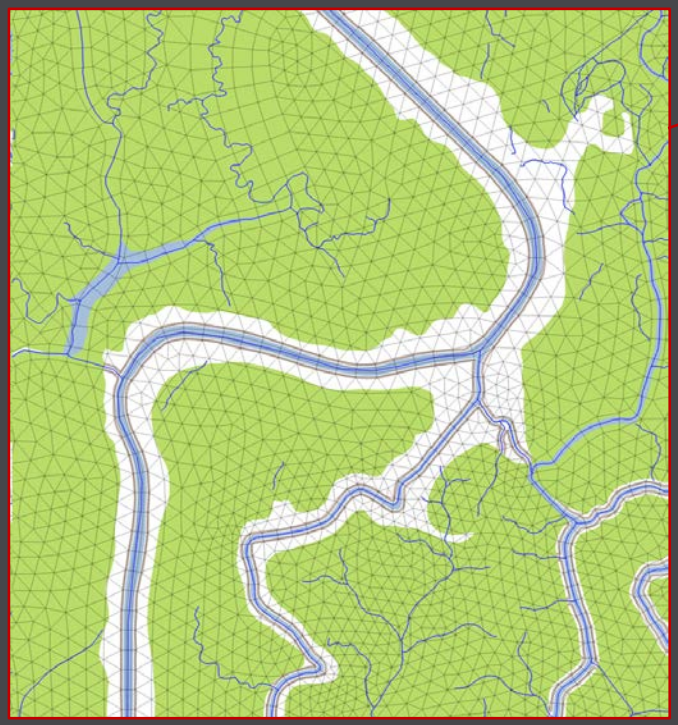
John DeGeorge, RMA
Stephen Andrews, RMA

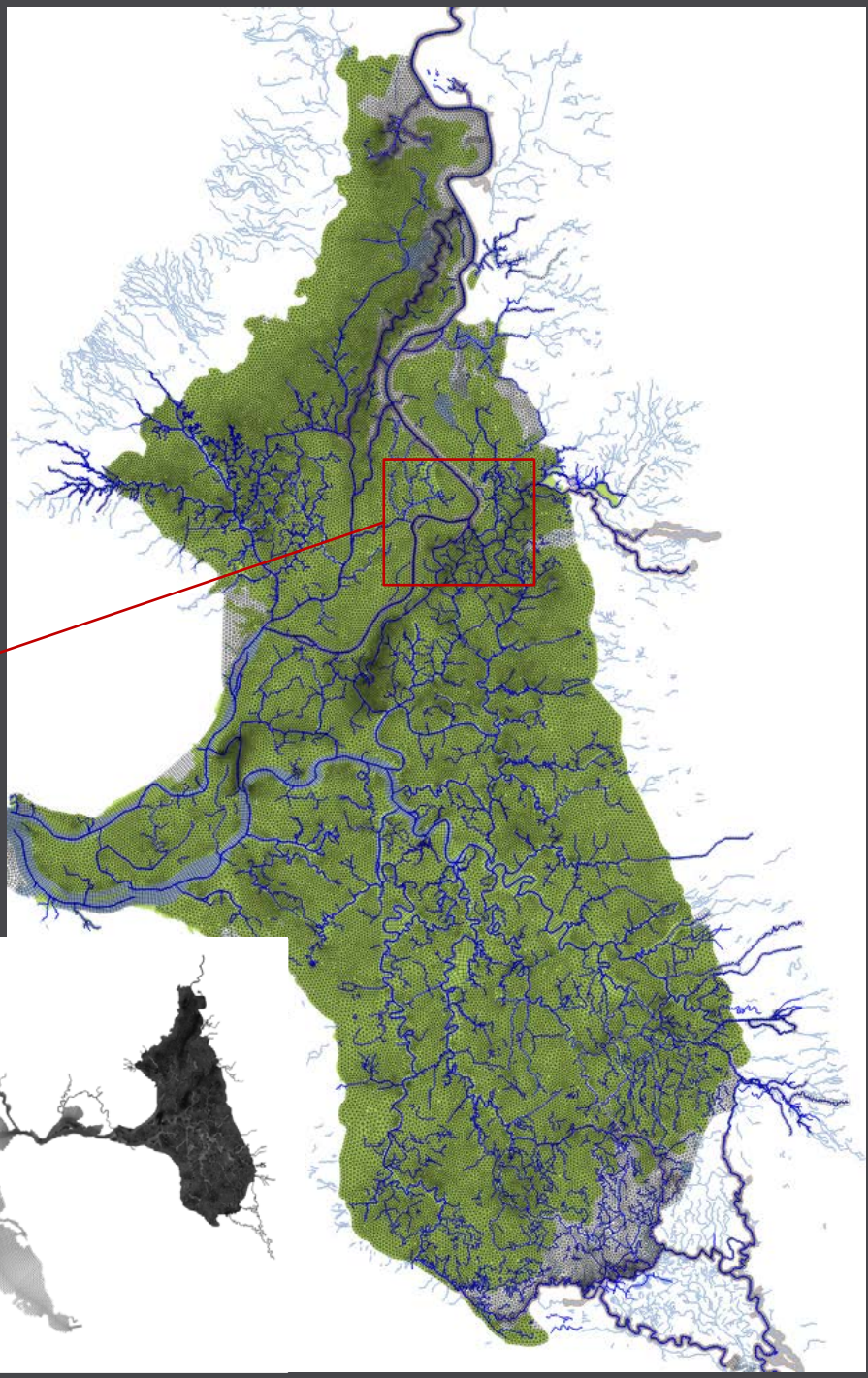
Development of a Three-Dimensional, Stratified Flow Model of the Natural Delta



3D Natural Delta Model

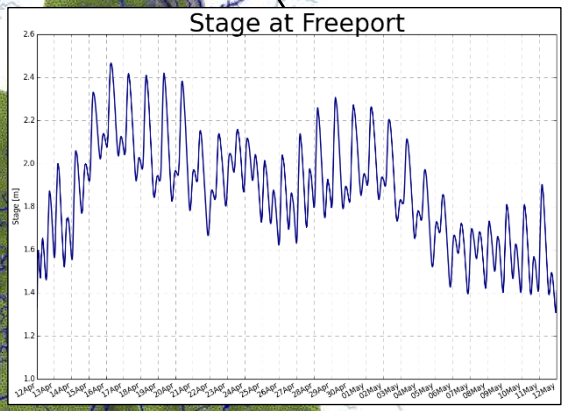
- Developed by RMA in collaboration with UC Davis and SFEI
- Flow aligned quadrilateral elements follow levee crests in main channels
- Triangular elements fill adjacent tidal plains
- Low-order channels captured implicitly using subgrid in 3D model
- ~125,000 elements, 54 vertical layers (max)
- 60:1 ratio of simulation time to run time

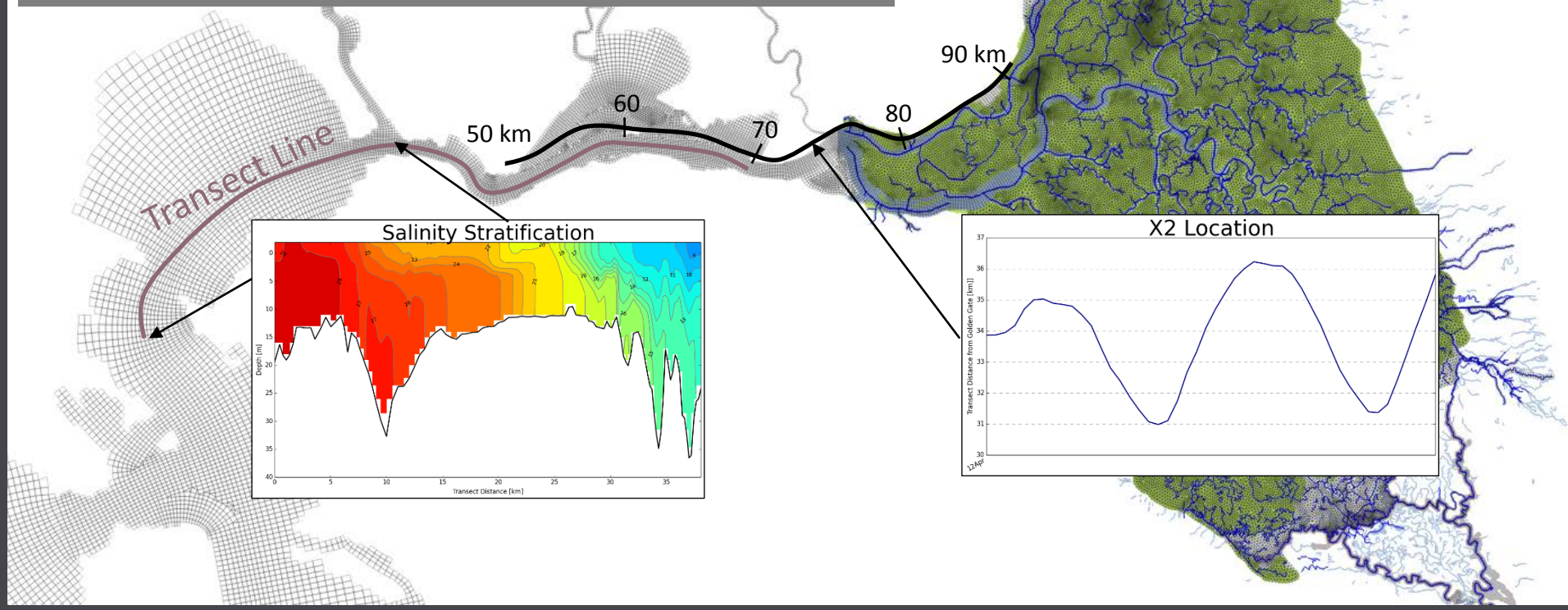




Project Status: Hydrodynamics

- Iterative tuning of DEM and hydrodynamic model to achieve expected tidal range
- Comparison of natural and contemporary Delta using natural hydrology
  - Stratification
  - X2 location
  - Tidal Range





Next Steps

- Hydrology
  - Refinement of watershed and groundwater-surface water modeling by DWR
- DEM & Hydrodynamic Model Development
  - Second phase of model development to be funded by Metropolitan Water District
  - Continued collaboration with UC Davis