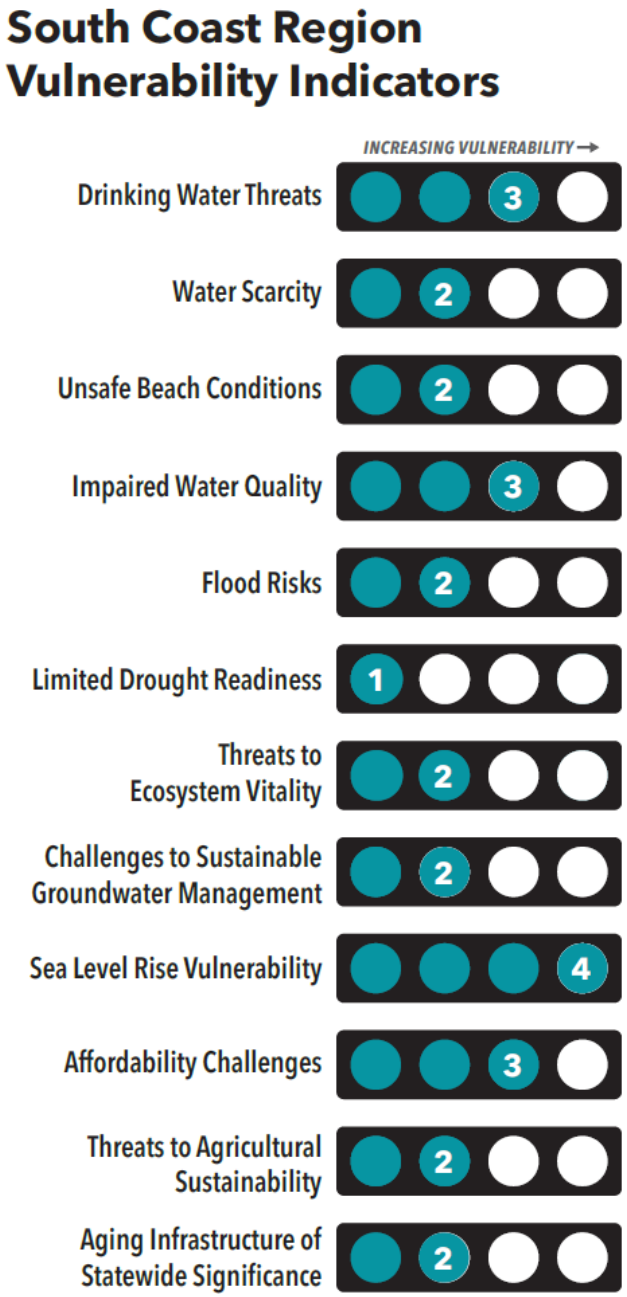
PRIORITIES FOR CLIMATE ADAPTATION

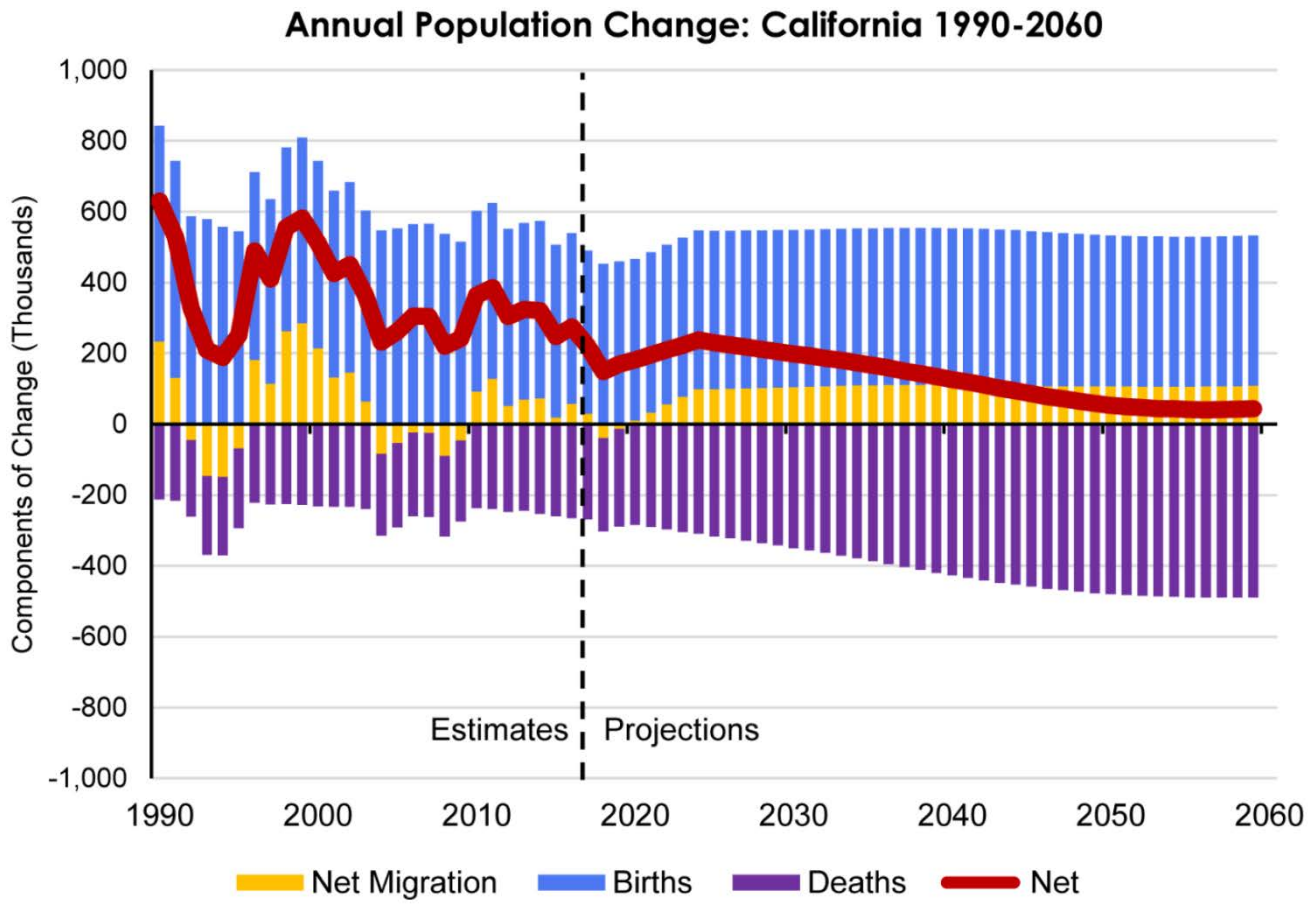
DEIRDRE DES JARDINS / CALIFORNIA WATER RESEARCH

Water Resilience Portfolio Climate vulnerabilities



POPULATION GROWTH

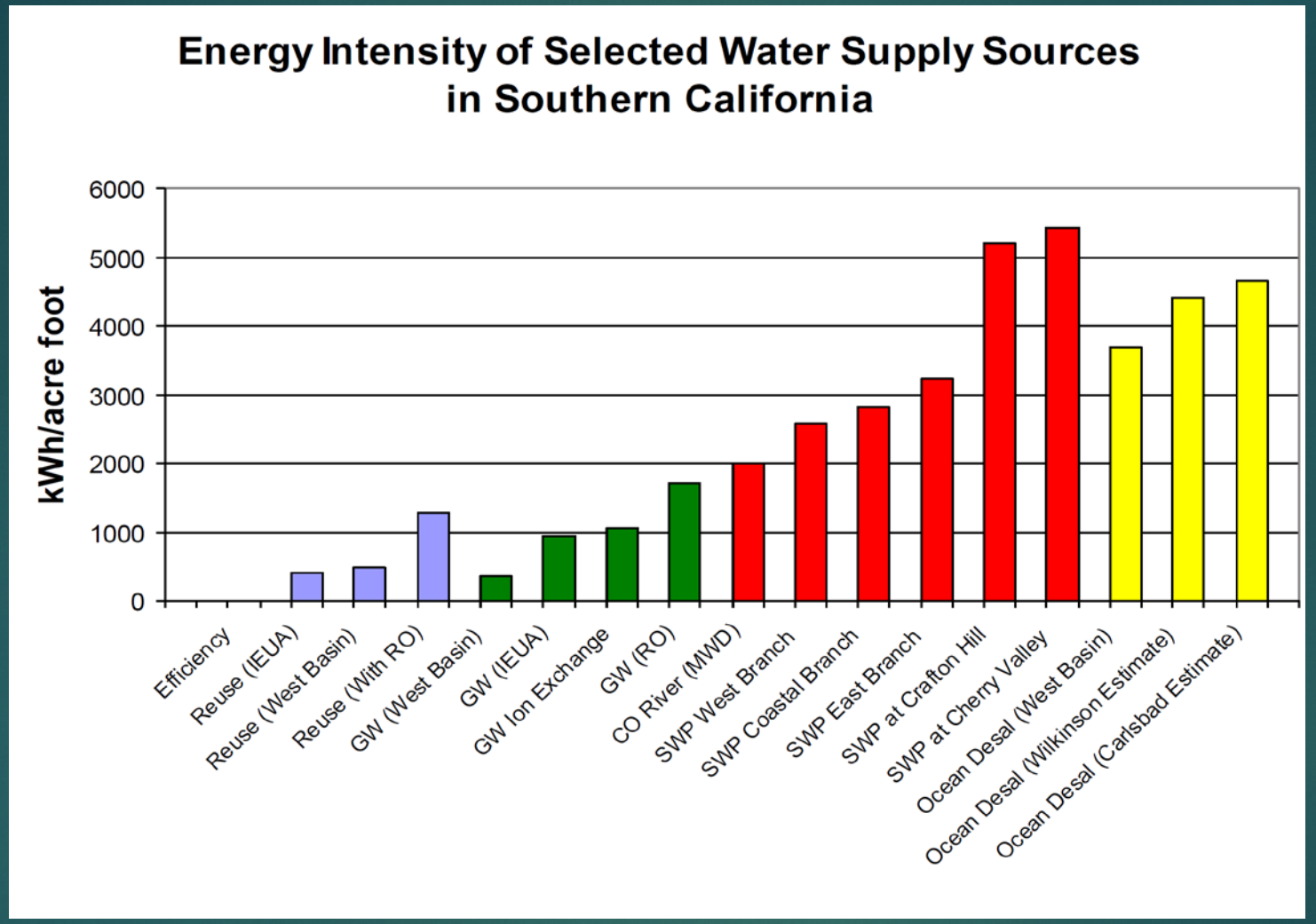
- **Draft Water Resilience Portfolio**
- California is projected to add another 10 million residents by 2050. This growth could increase water demand in communities in that period by one to six million acre-feet, according to state estimates.
- **Department of Finance (2020-21 Budget)**
- The net annual population increase is expected to fall to less than 100,000 by 2045, and close to zero net growth by 2060. Fewer births lead to fewer adults, which compounds the slowing growth over time. The current projections series reach a total population of 45 million by 2060, rather than 50 million in the previous iteration.



DOF Population Change projections (2020)

STATE RESILIENCE PRINCIPLES

- Adopted by the State of California's Integrated Climate Adaptation and Resiliency Program (OPR.)
- First principle:
- Prioritize integrated climate actions, those that both reduce greenhouse gas emissions and build resilience to climate impacts, as well as actions that provide multiple benefits.



Source: Dr. Robert Wilkinson

RECYCLED WATER

- **Draft Water Resilience Portfolio**
- Goal: recycle or reuse 2.5 million acre-feet by 2030

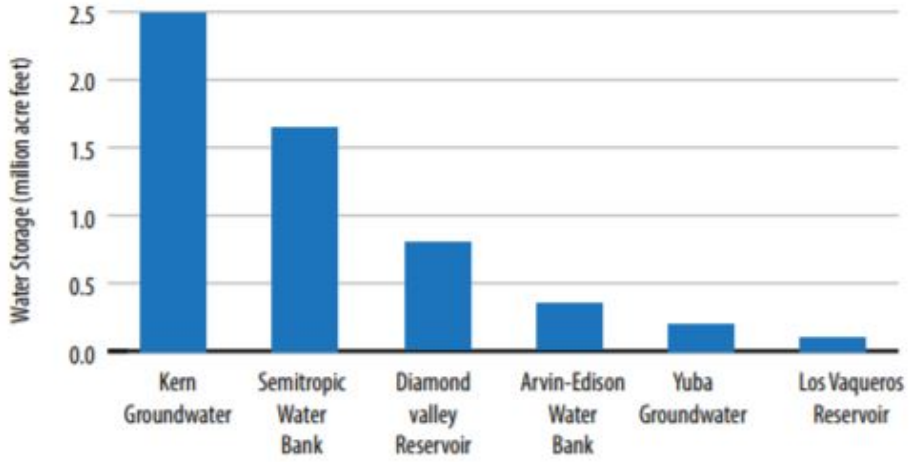
STORAGE

In the past few decades, California has added nearly 6 million acre-feet of new water storage capacity, with the biggest gains being realized from groundwater storage projects.

"The idea that surface storage is a silver bullet for the state's water problems is a myth founded on the erroneous notion that large, unregulated amounts of water are available to fill new storage at a reasonable cost. It persists because most people do not recognize the technical limitations and because a few local interests stand to gain from state subsidies for new facilities.…Surface storage is a costly way to expand water supplies in part because most favorable reservoir locations already have large dams."

—ELLEN HANAK ET AL., *CALIFORNIA WATER MYTHS*, PUBLIC POLICY INSTITUTE OF CALIFORNIA, 2009

Figure 4: Recently Developed California Water Storage

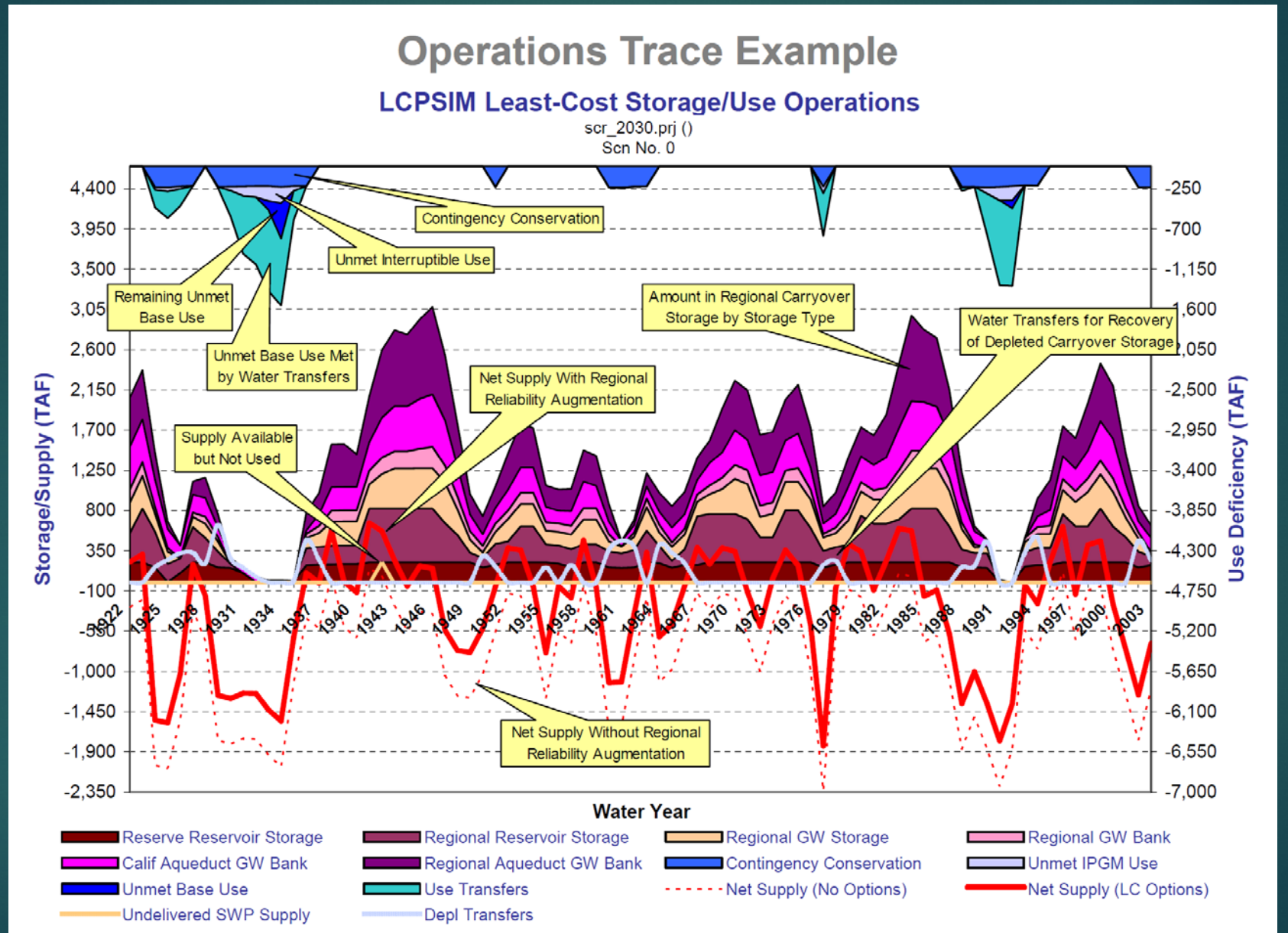


Source: Environmental Defense Fund, 2007, deltavision.ca.gov/DV_Committee/Nov2008/Handouts/Item_5_Spreck_Rosekrans_Comment.pdf

RESERVOIR OPERATIONS FOR CLIMATE CHANGE

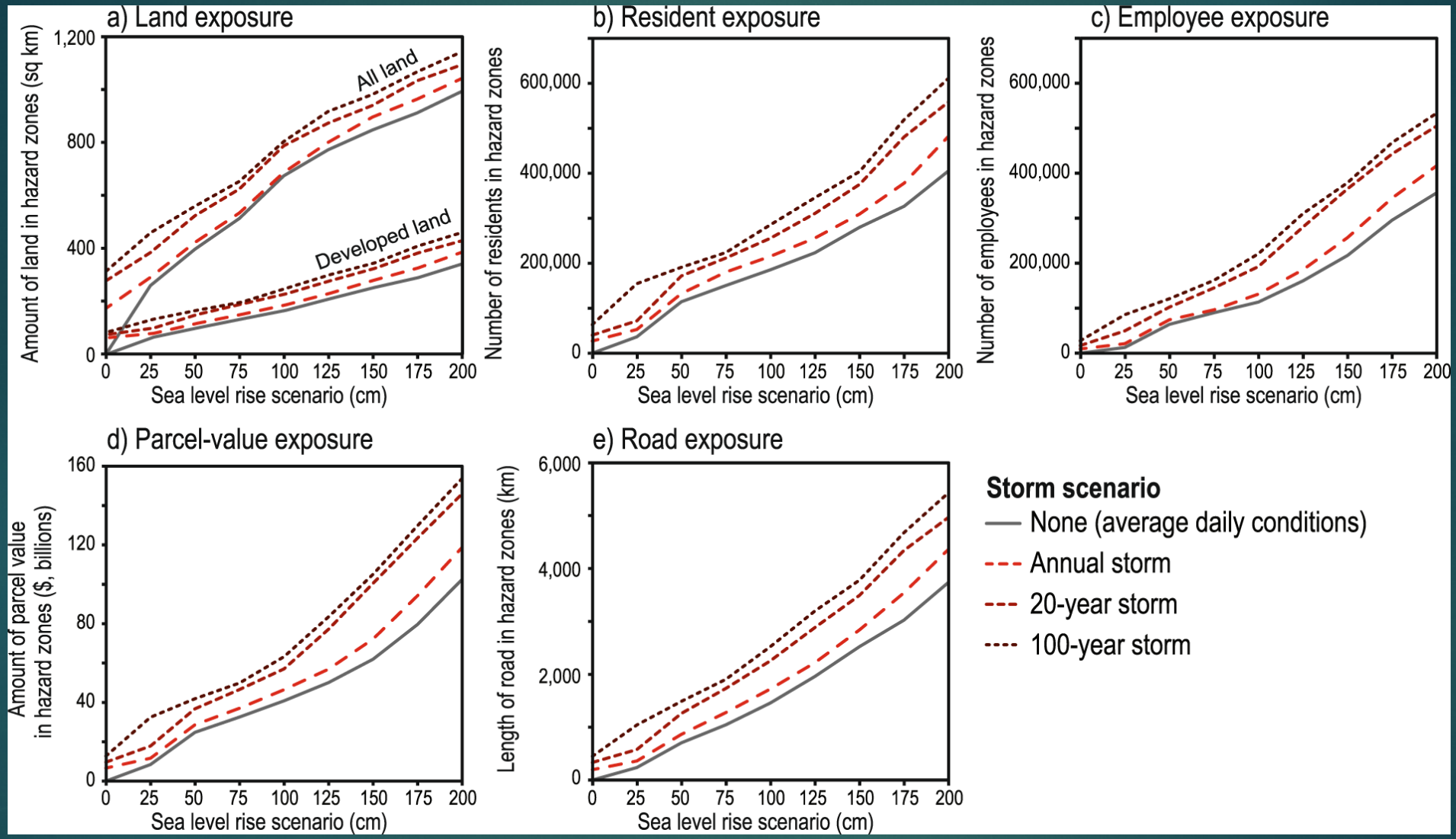
- **Aris Georgakakos, 2012**
- *… the current policy, which is tuned to the historical hydrologic regime, is unable to cope effectively with the more variable future climate. As a result, the water supply, energy, and environmental water uses cannot be effectively satisfied during future droughts, exposing the system to higher vulnerabilities and risks.*
- **Francis Chung, 2009**
- *We recommend that DWR develop a reoperation strategy for the CVP and SWP that includes modified operations scenarios to mitigate the effects of dead storage during climate change conditions prior to release of any studies (either these or BDCP) that include climate change.*

Operations Trace Example

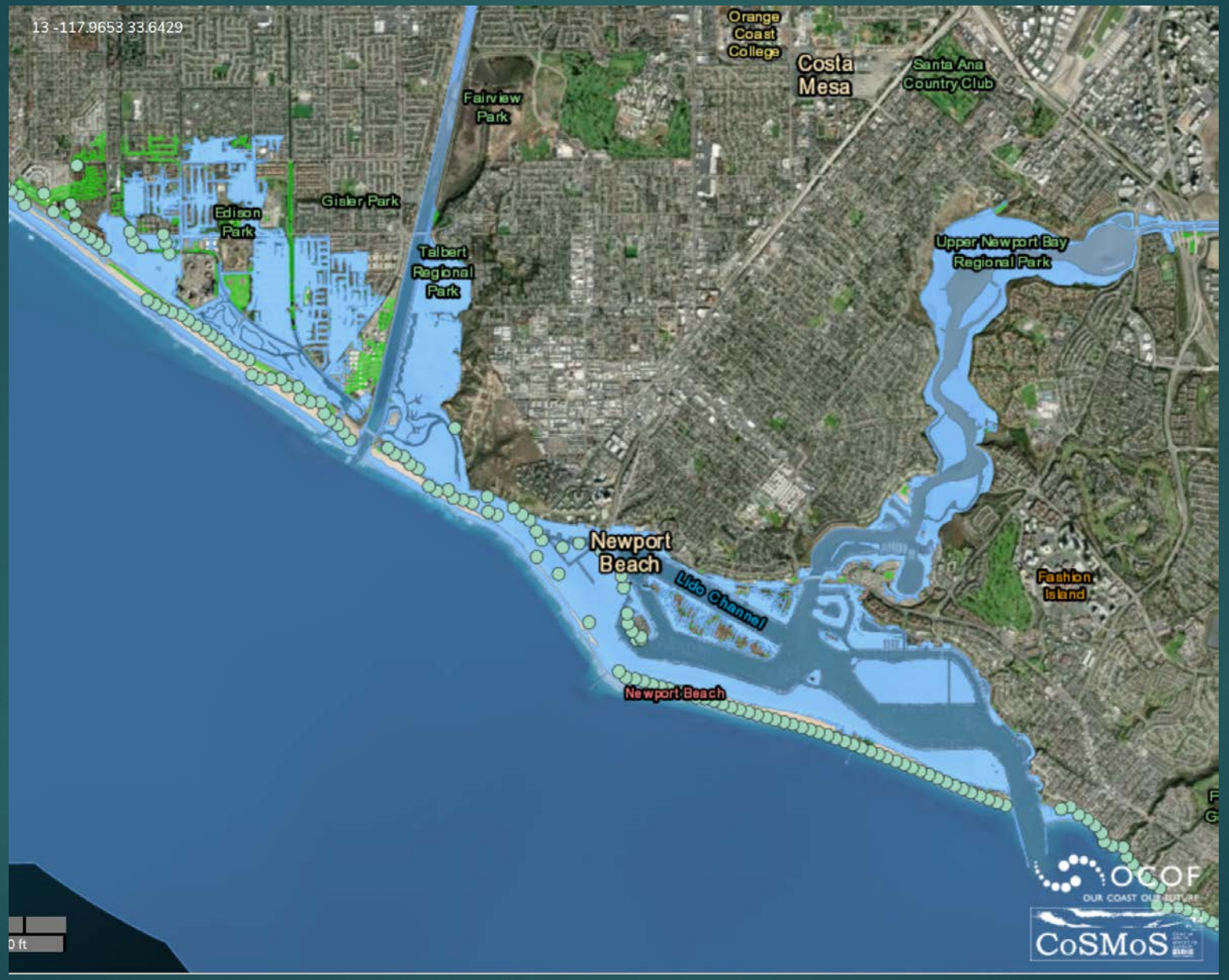


Sea Level Rise

- **US Geological Survey**
- **Barnard et. al. *Dynamic flood modeling essential to assess the coastal impacts of climate change* (Nature, March 2019)**
- Dynamic modeling integrating the effects of SLR, tides, waves, storms, and coastal change (i.e. beach erosion and cliff retreat)
- Estimated over $150 billion of property equating to more than 6% of the state's GDP and 600,000 people could be impacted by dynamic flooding by 2100


a) Land exposure
Amount of land in hazard zones (sq km)
1,200
800
400
0
All land
Developed land
0 25 50 75 100 125 150 175 200
Sea level rise scenario (cm)
b) Resident exposure
Number of residents in hazard zones
600,000
400,000
200,000
0
0 25 50 75 100 125 150 175 200
Sea level rise scenario (cm)
c) Employee exposure
Number of employees in hazard zones
600,000
400,000
200,000
0
0 25 50 75 100 125 150 175 200
Sea level rise scenario (cm)
d) Parcel-value exposure
Amount of parcel value in hazard zones ($, billions)
160
120
80
40
0
0 25 50 75 100 125 150 175 200
Sea level rise scenario (cm)
e) Road exposure
Length of road in hazard zones (km)
6,000
4,000
2,000
0
0 25 50 75 100 125 150 175 200
Sea level rise scenario (cm)
Storm scenario
None (average daily conditions)
Annual storm
20-year storm
100-year storm


Wilmington
Long Beach
Port
of Long Beach
West Basin
San Pedro
Outer Harbor
San Pedro Bay
Long Beach
Outer Harbor
Los Angeles
Harbor
Orange
Naval Weapons
Station
Seal Beach
Seal Beach
Sunset Beach
OCOF
OUR COAST OUR FUTURE
CoSMoS


13 -117.9653 33.6429
Orange Coast College
Costa Mesa
Santa Ana Country Club
Fairview Park
Gisler Park
Edison Park
Talbert Regional Park
Upper Newport Bay Regional Park
Newport Beach
Lido Channel
Fashion Island
Newport Beach
OCOF
CoSMoS

CALIFORNIA OCEAN PROTECTION COUNCIL

2018 SEA LEVEL RISE GUIDANCE

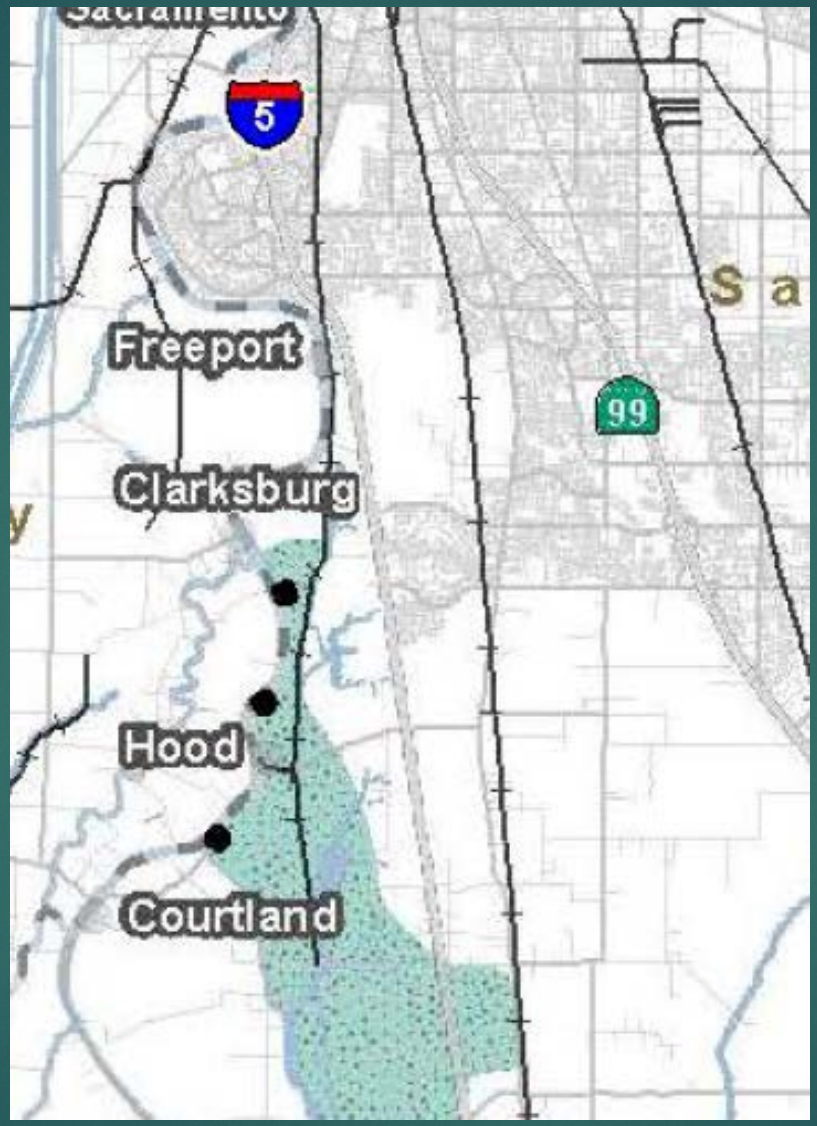
Sea Level Rise at Santa Monica (Feet) High GHG emission scenario			
	median	high (95%)	max (99.9%)
2050	0.8	1.3	1.9
2060	1.1	1.8	2.6
2070	1.3	2.3	3.4
2080	1.7	2.9	4.4
2090	2.0	3.5	5.5
2100	2.3	4.3	6.9

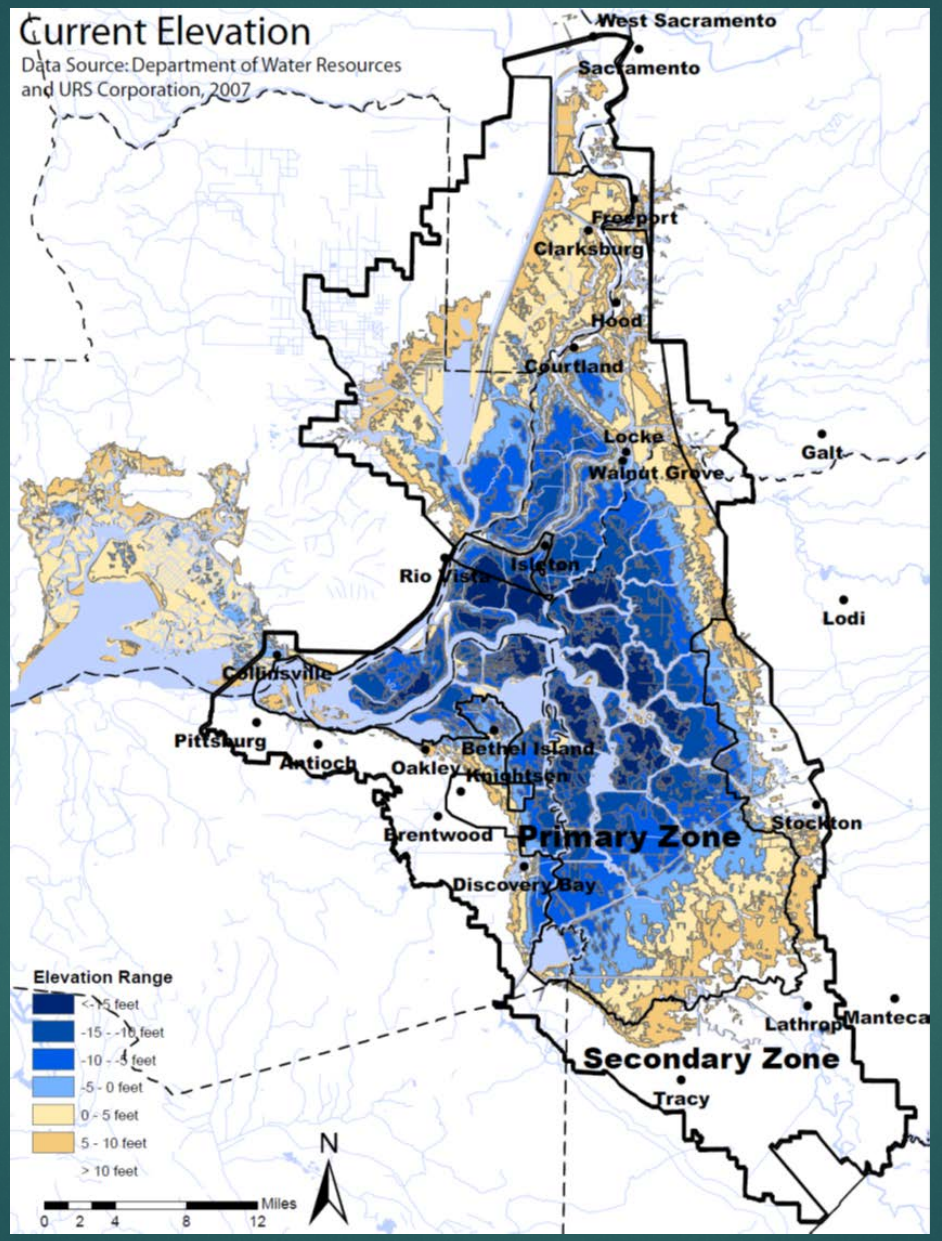
THE “RESILIENT” DELTA TUNNEL

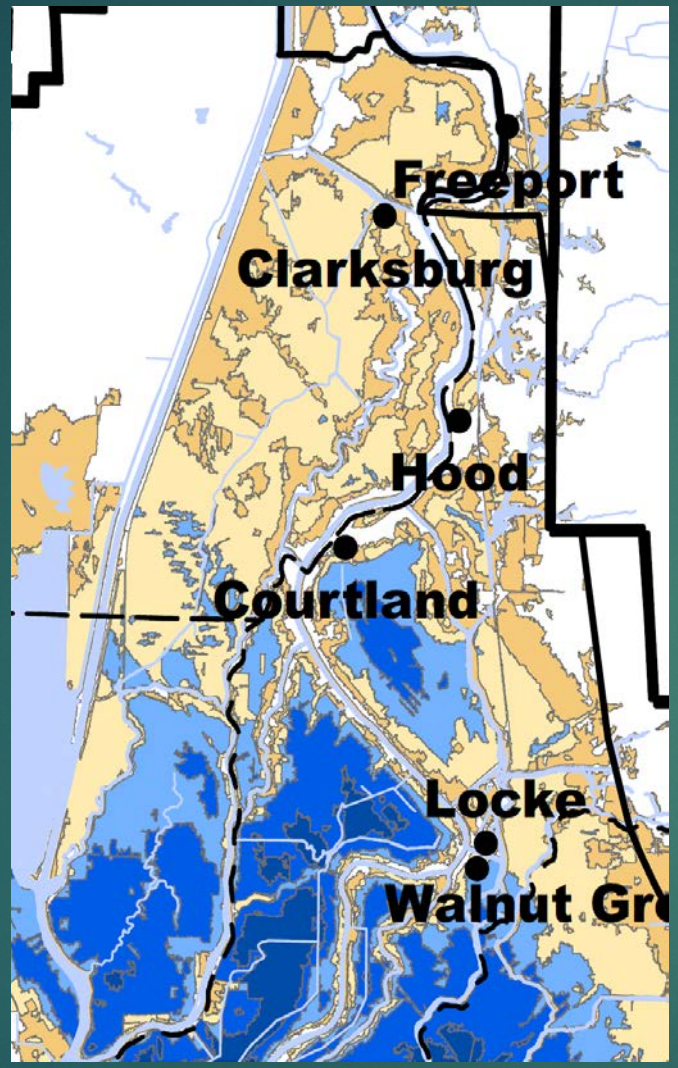
North Delta Intakes

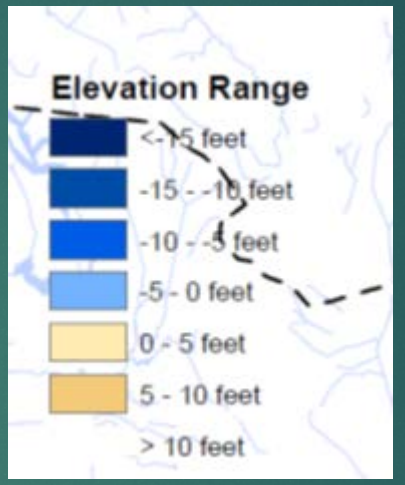
Delta Conveyance Design and Construction Authority has decided to keep intakes in same location as twin tunnels project.

For the twin tunnels project, only one analysis of performance of intakes with high sea level rise was done in 2010 (55 inches.) The simulation did not consider potential levee failure or island flooding in the North Delta.


5
Freeport
99
Clarksburg
Hood
Courtland


Current Elevation
Data Source: Department of Water Resources and URS Corporation, 2007
West Sacramento
Sacramento
Freeport
Clarksburg
Hood
Courtland
Locke
Walnut Grove
Galt
Rio Vista
Isleton
Lodi
Collinsville
Pittsburg
Antioch
Bethel Island
Oakley
Knightsen
Brentwood
Primary Zone
Stockton
Discovery Bay
Lathrop
Manteca
Secondary Zone
Tracy
Elevation Range
< -15 feet
-15 - -10 feet
-10 - -5 feet
-5 - 0 feet
0 - 5 feet
5 - 10 feet
> 10 feet
N
Miles
0 2 4 8 12


Freeport
Clarksburg
Hood
Courtland
Locke
Walnut Gr


Elevation Range
<-15 feet
-15 - -10 feet
-10 - -5 feet
-5 - 0 feet
0 - 5 feet
5 - 10 feet
> 10 feet

MODEL GRID FOR 2010 SIMULATION OF PERFORMANCE WITH SEA LEVEL RISE AND ISLAND FLOODING

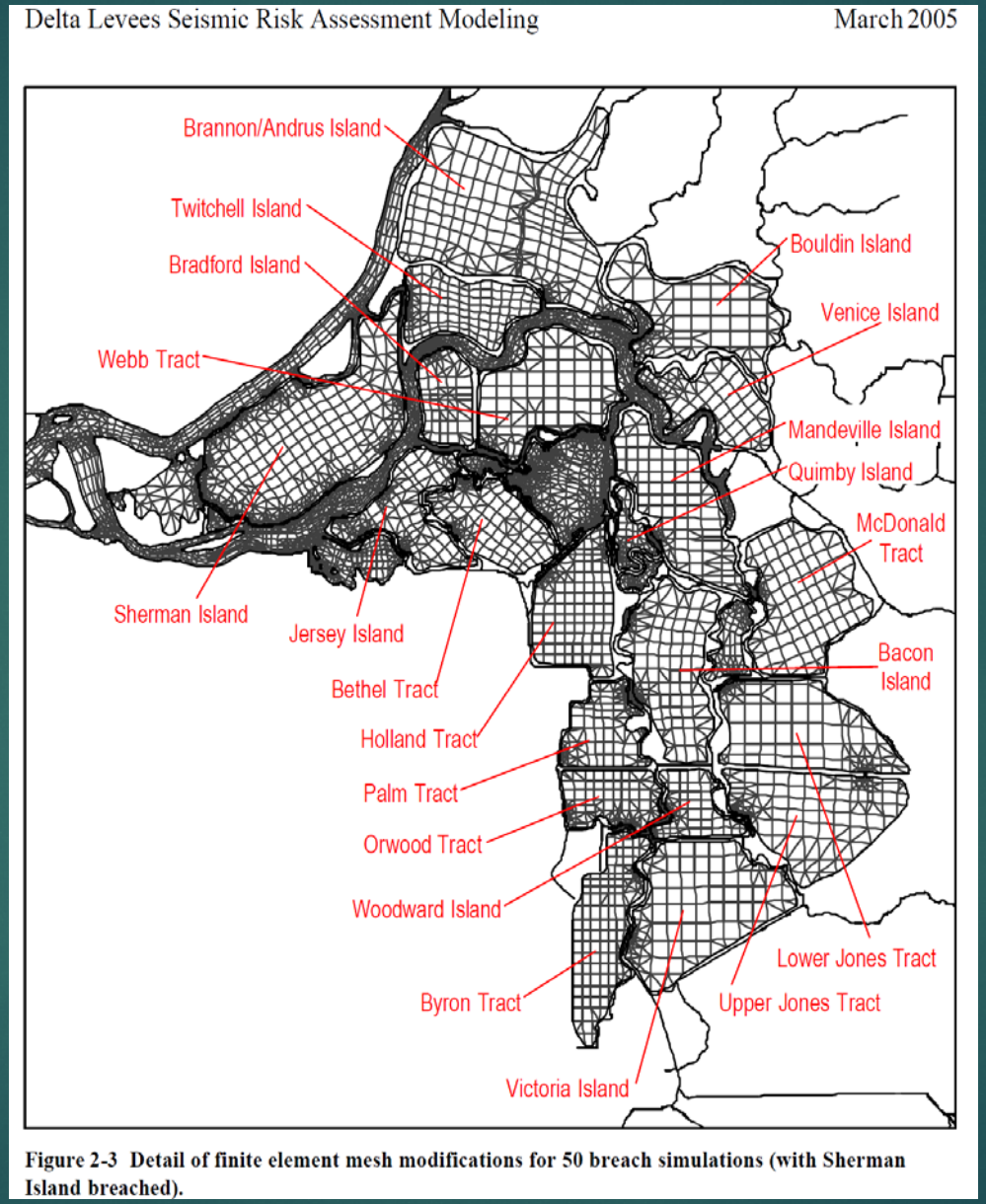
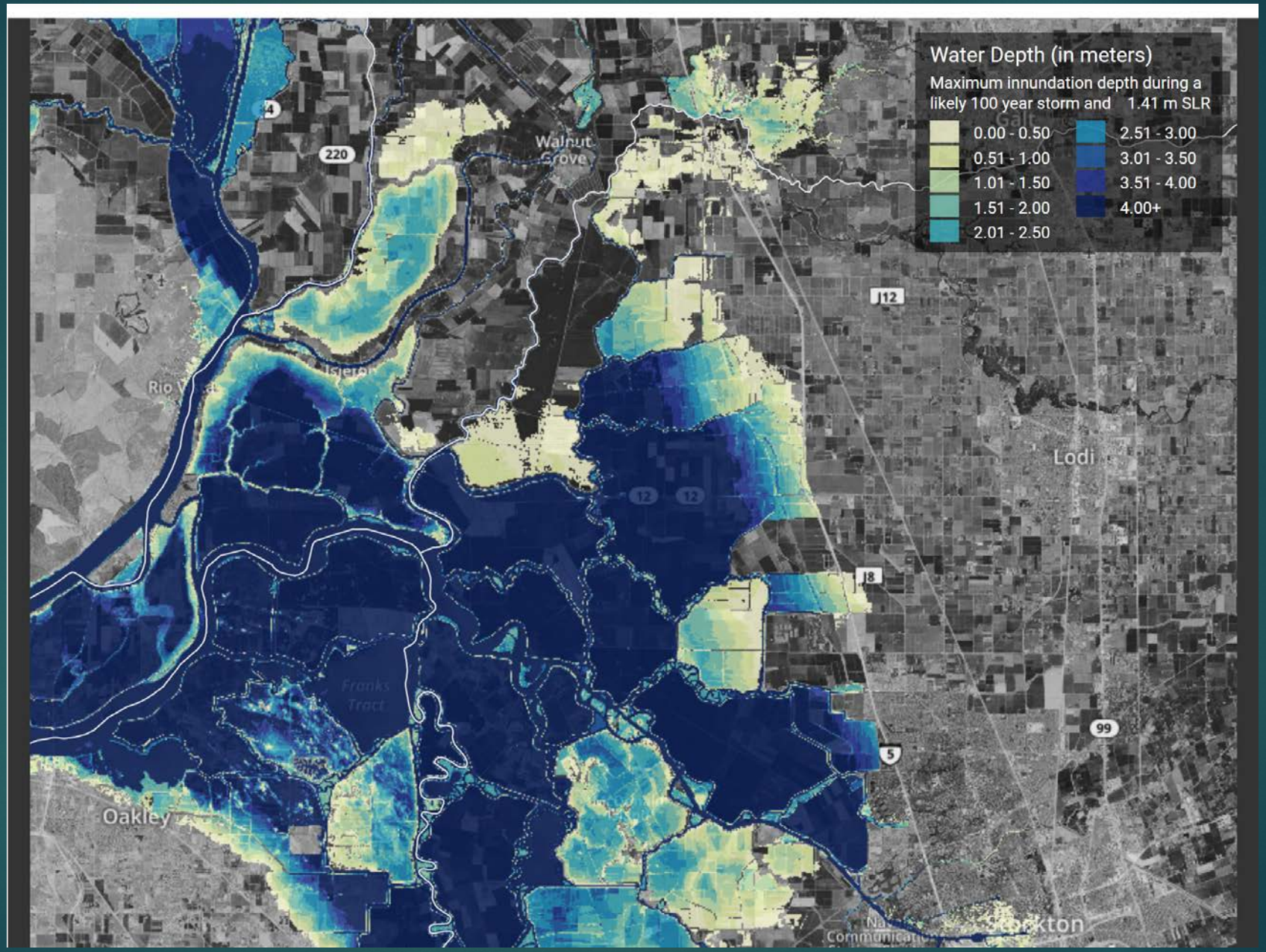


Figure 2-3 Detail of finite element mesh modifications for 50 breach simulations (with Sherman Island breached).


Water Depth (in meters)
Maximum innundation depth during a likely 100 year storm and 1.41 m SLR
0.00 - 0.50
0.51 - 1.00
1.01 - 1.50
1.51 - 2.00
2.01 - 2.50
2.51 - 3.00
3.01 - 3.50
3.51 - 4.00
4.00+
Walnut Grove
Lodi
Oakley
Stockton
Franks Tract
220
12
99
5

ADAPTATION CONSIDERATIONS

- “Resilient” tunnel is a hard adaptation that will start to be affected by salinity intrusion with high sea level rise
- Degradation likely to be experienced between 1.5-2 m of sea level rise
- Coastal flooding will become major issue at same point in time.
- Could overwhelm capacity to adapt for some areas

CONCLUSION

- For long term sea level rise, only truly “resilient” investments are local supplies

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