# CHANGING WATERWAYS

**Stuart Strum**

**Water Resources Planner**

**Los Angeles District**

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# PRESENTATION OUTLINE

California Climate and Waterways
- Drought
- Floods

Water Infrastructure – Water Storage and Transfer

Urban Drainage – Patterns of Development

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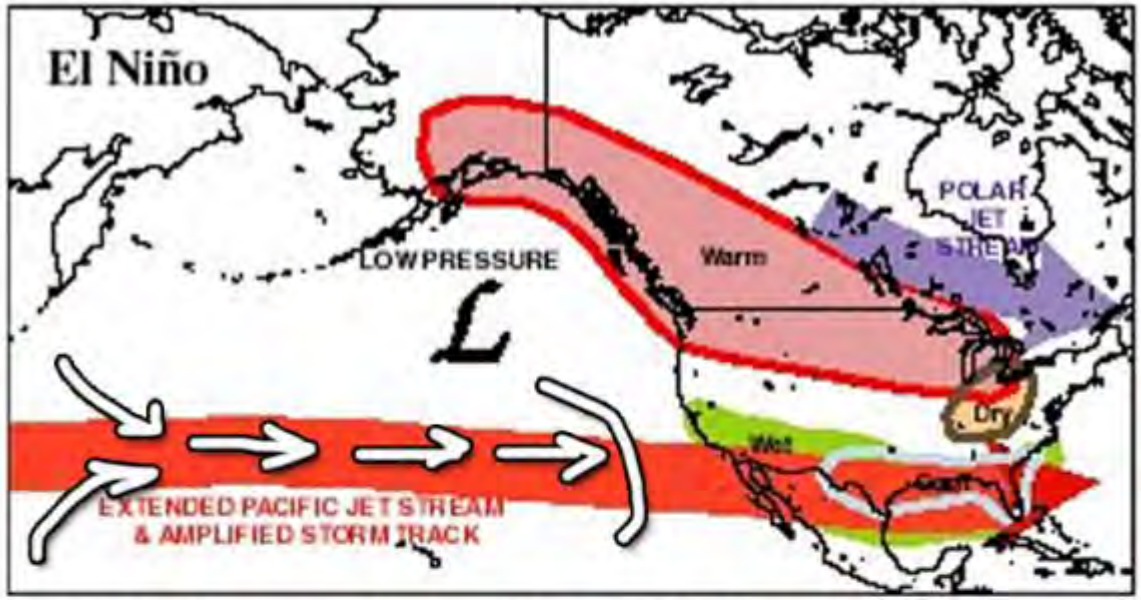
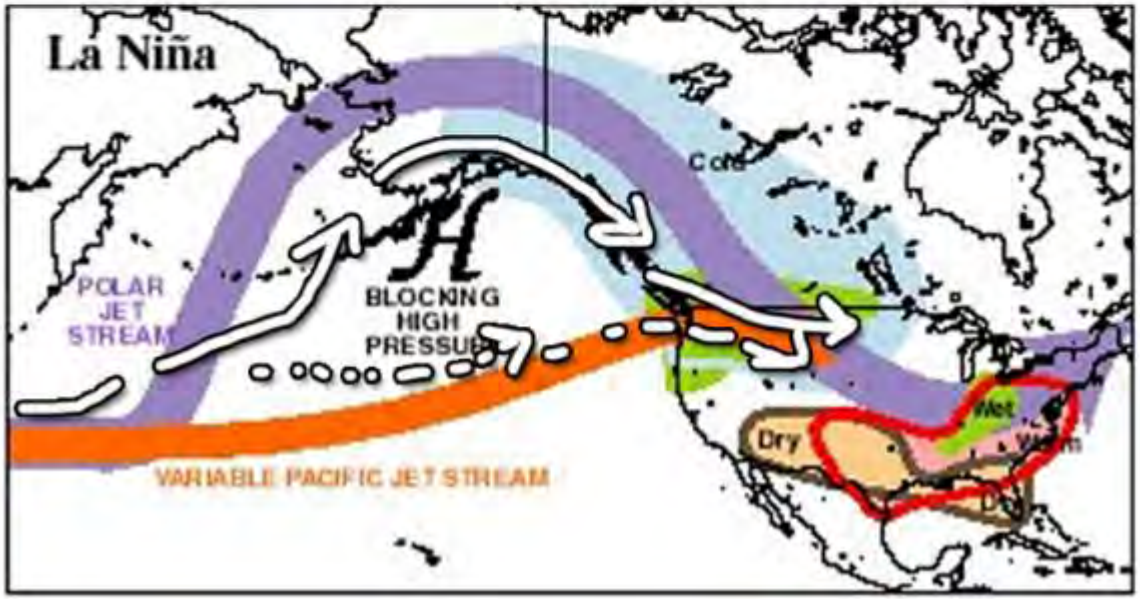
# CLIMATE: EL NINO– SOUTHERN OSCILLATION

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# HISTORIC RECORD OF EL NINO


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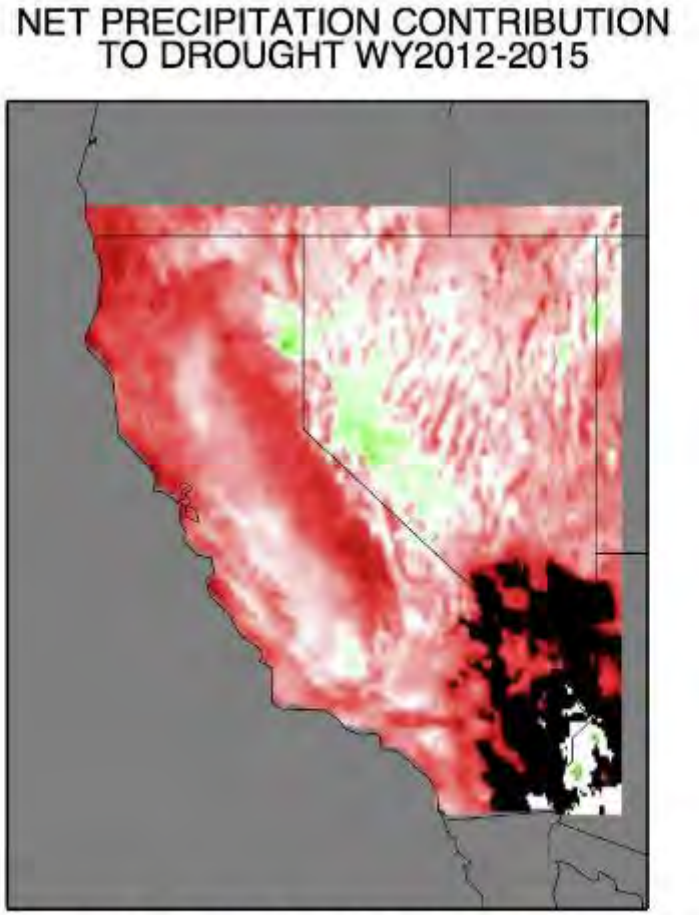
# EXTREME EVENTS: MULTI-YEAR DROUGHT

$\Delta P = \Sigma P - 4 * \langle P \rangle$

$\Delta ETo = \Sigma ET - 4 * \langle ET \rangle$

Plotted here:

$-\Delta P / (\Delta P - \Delta ETo)$




USGS science for a changing world

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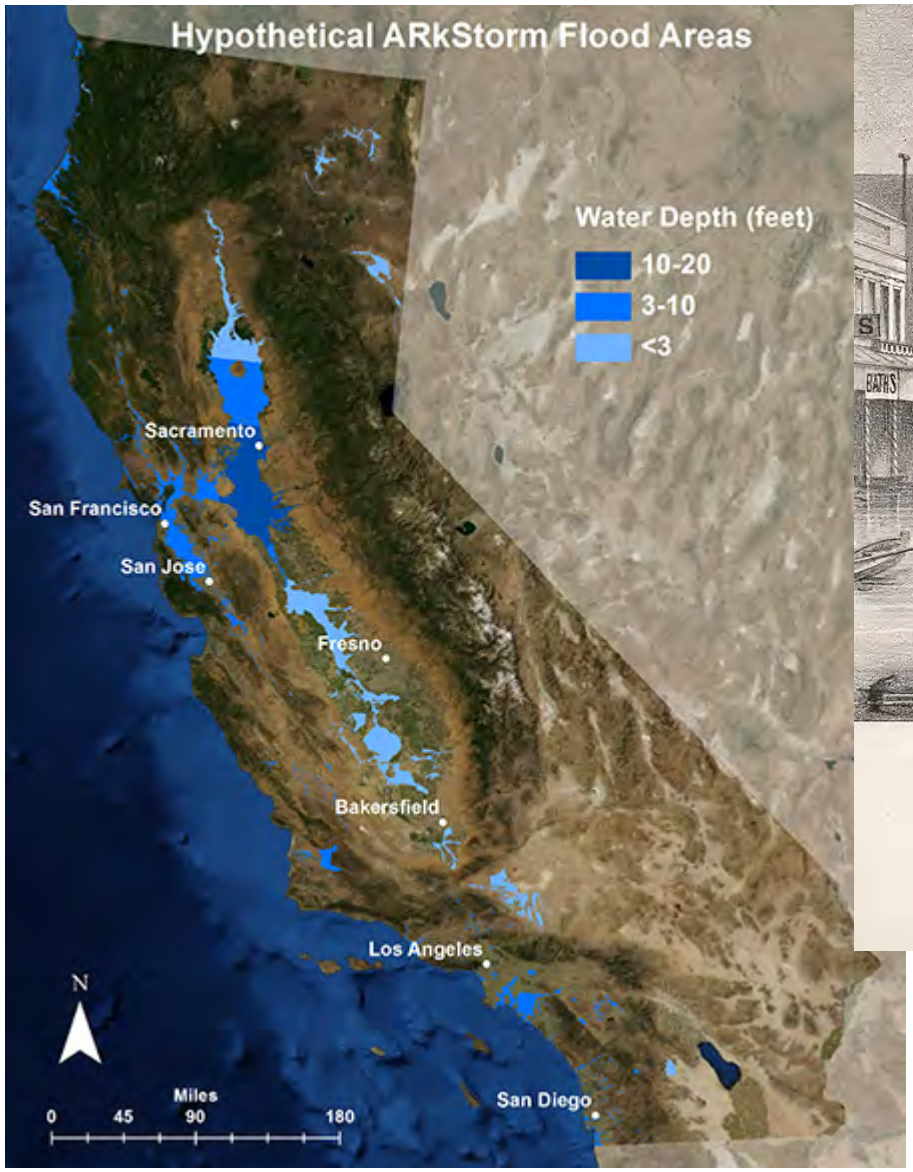
# EXTREME EVENTS: ARKSTORM (HISTORICAL PRECEDENT 1862)





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# CALIFORNIA WATER SYSTEM AND COLORADO RIVER




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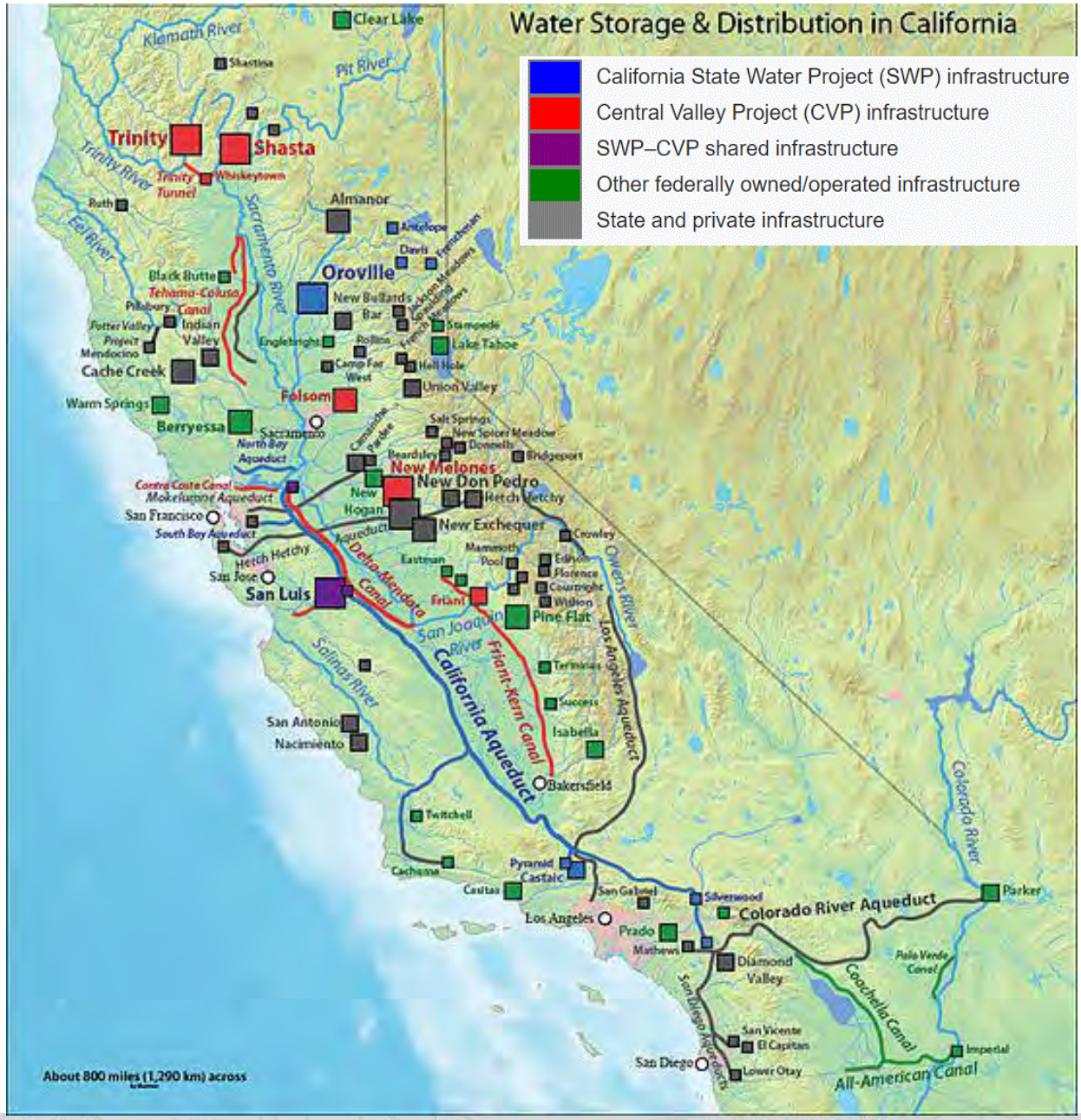
# WATER STORAGE AND DISTRIBUTION IN CALIFORNIA



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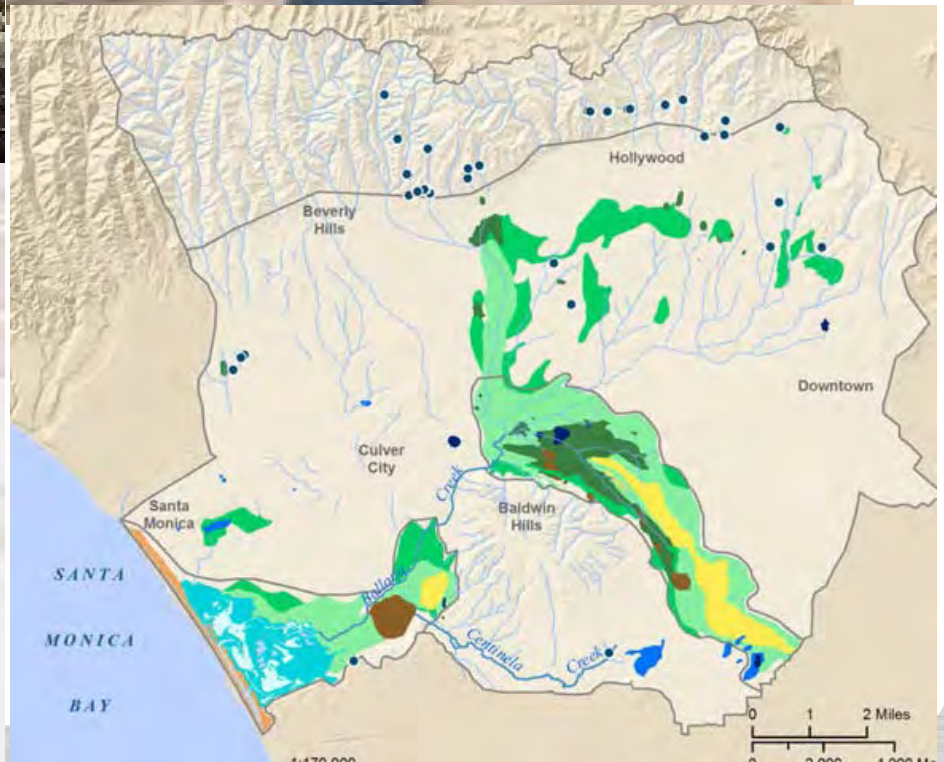
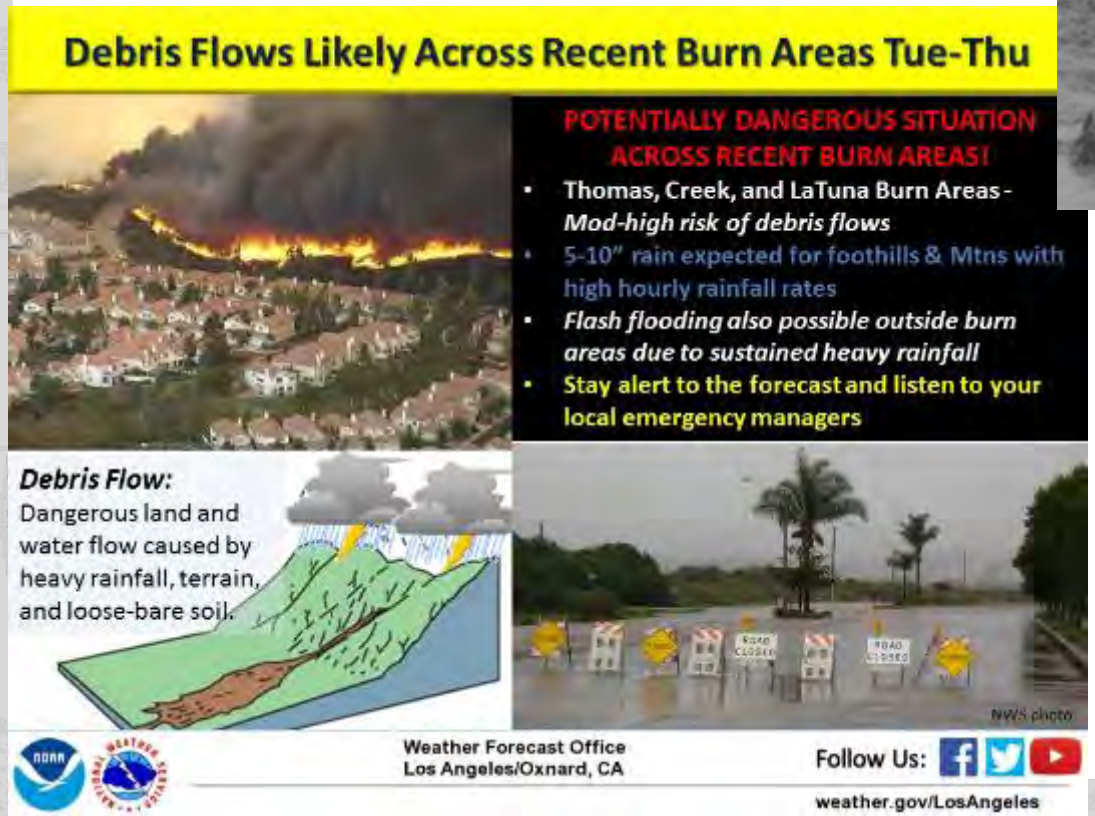
# LOS ANGELES RIVER URBAN DRAINAGE



# HISTORICAL AND RECENT FLOODING

2018




1938

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# FLOOD IMPACTS – NOT JUST WATER

- Landslides and debris flows can cause extensive damage
- Many streams do not have stable banks without engineering control, and bank failure during flood events can damage property and pose a safety hazard
- Factors affecting bank stability
  - Steep slopes and fault-controlled uplift
  - Loose sediment and poorly consolidated formations in stream banks
  - Sudden, high stream flows in flood events
  - Bed load dominated sediment transport

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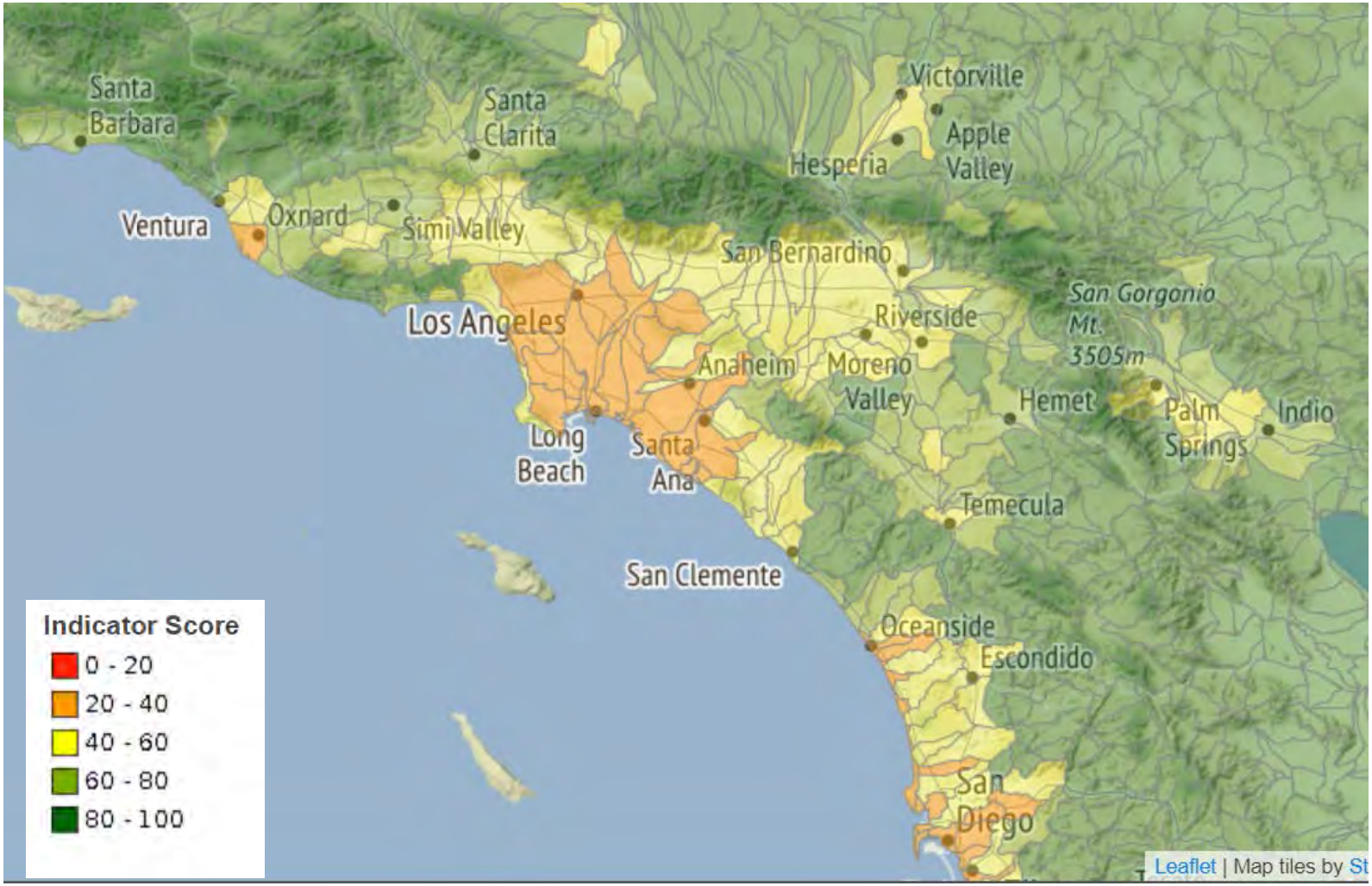
# UC DAVIS STREAM WATER SUSTAINABILITY INDICATORS – GEOMORPHIC CONDITIONS

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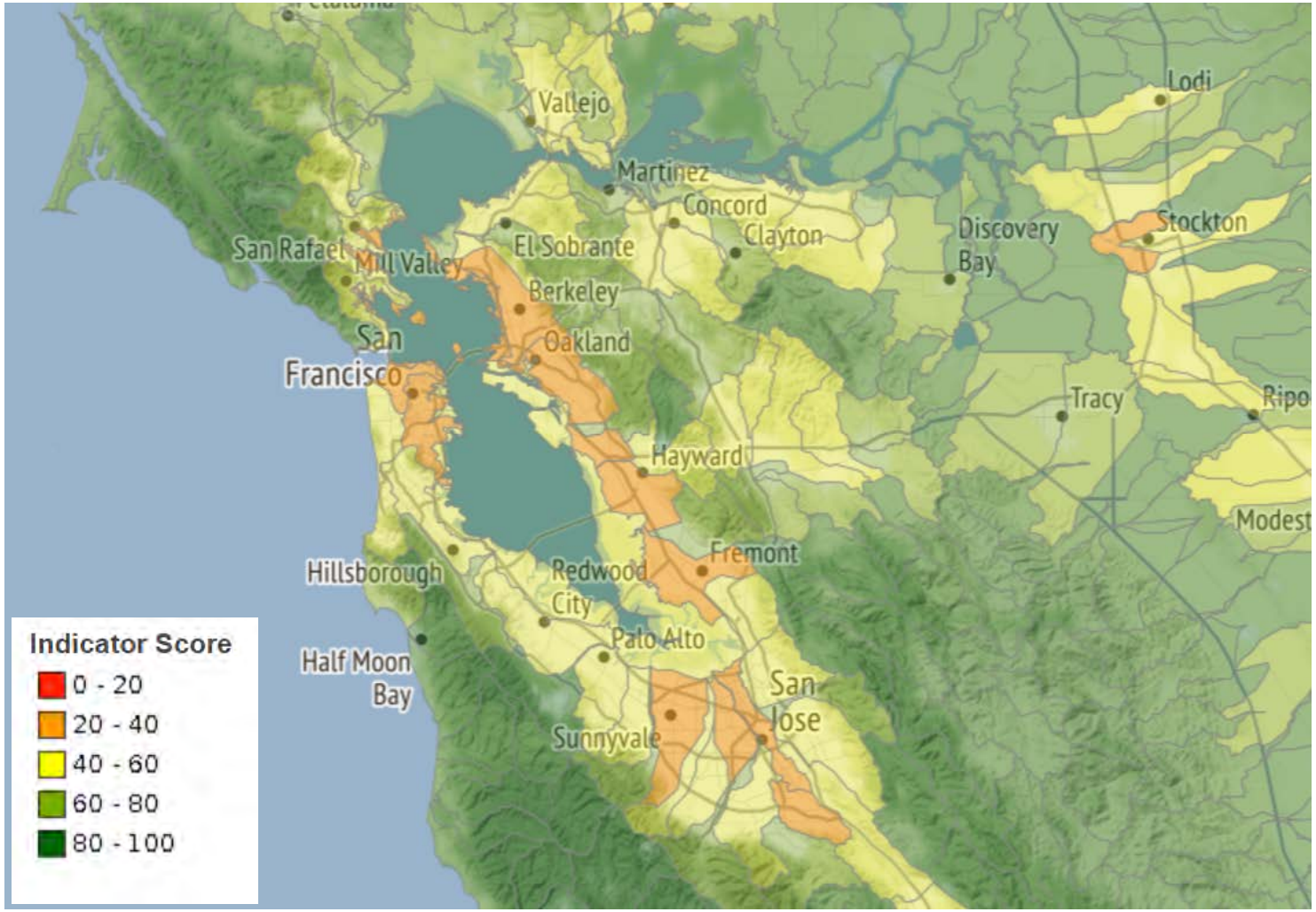


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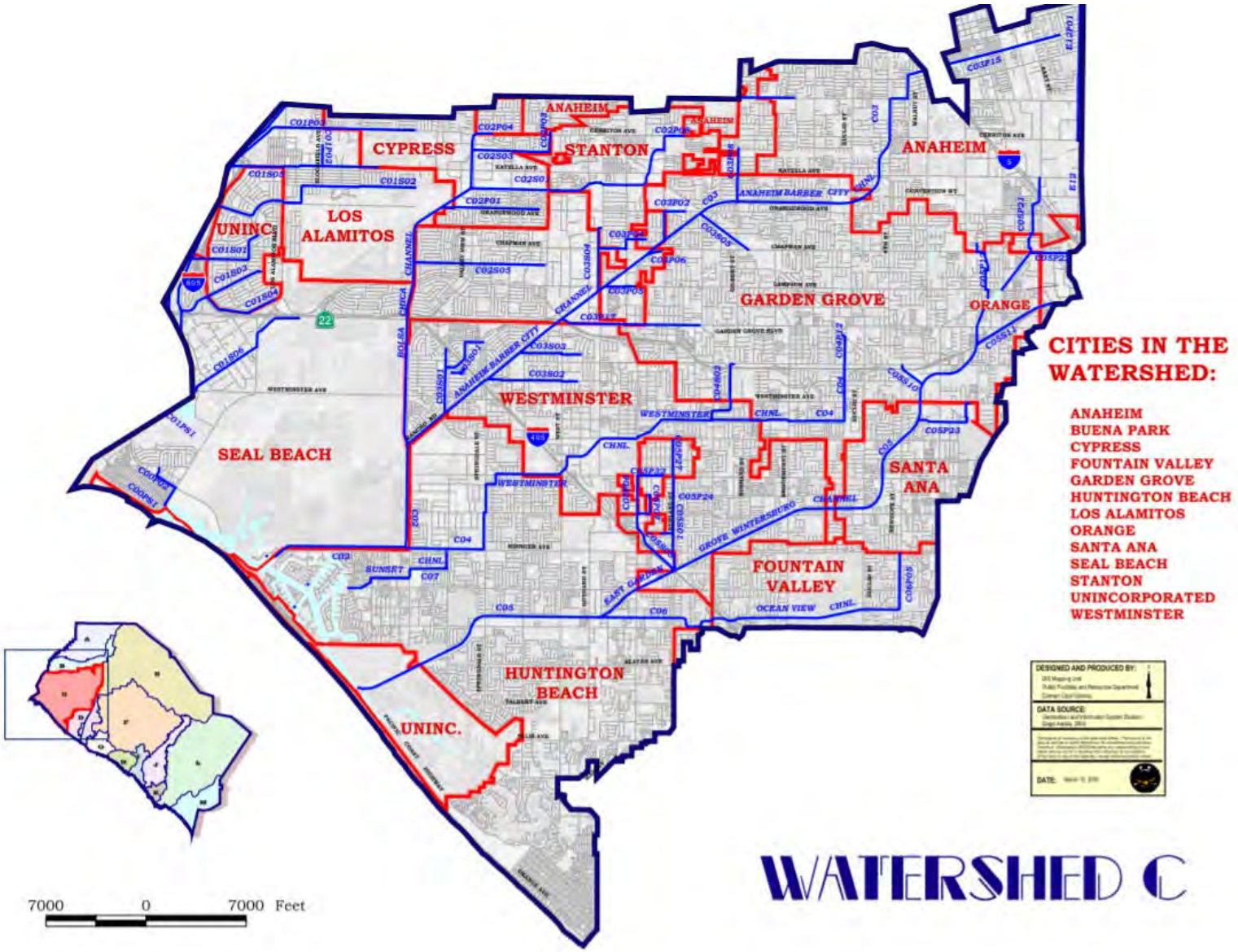
# ORANGE COUNTY: WESTMINSTER—EAST GARDEN GROVE



# WESTMINSTER—EAST GARDEN GROVE SCENARIO

Pre-Development:  Coastal Plain with areas of poor drainage

Initial Settlement and Agricultural Development:  Drainage Districts established to improve drainage, support irrigation. Drainage/irrigation canals constructed, extensive agriculture

Urbanization and Residential Development: Flood control Districts expand existing drainage ditches, typical flood protection at 25-year recurrence interval

Ongoing system upgrades:  improve flood protection with fully engineered channels, goal: 100-year recurrence interval

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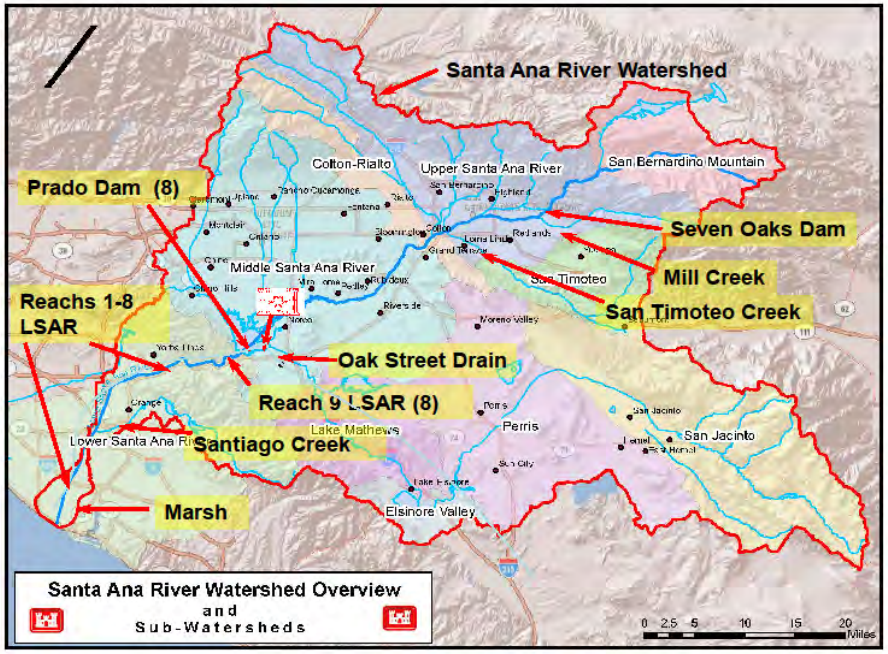
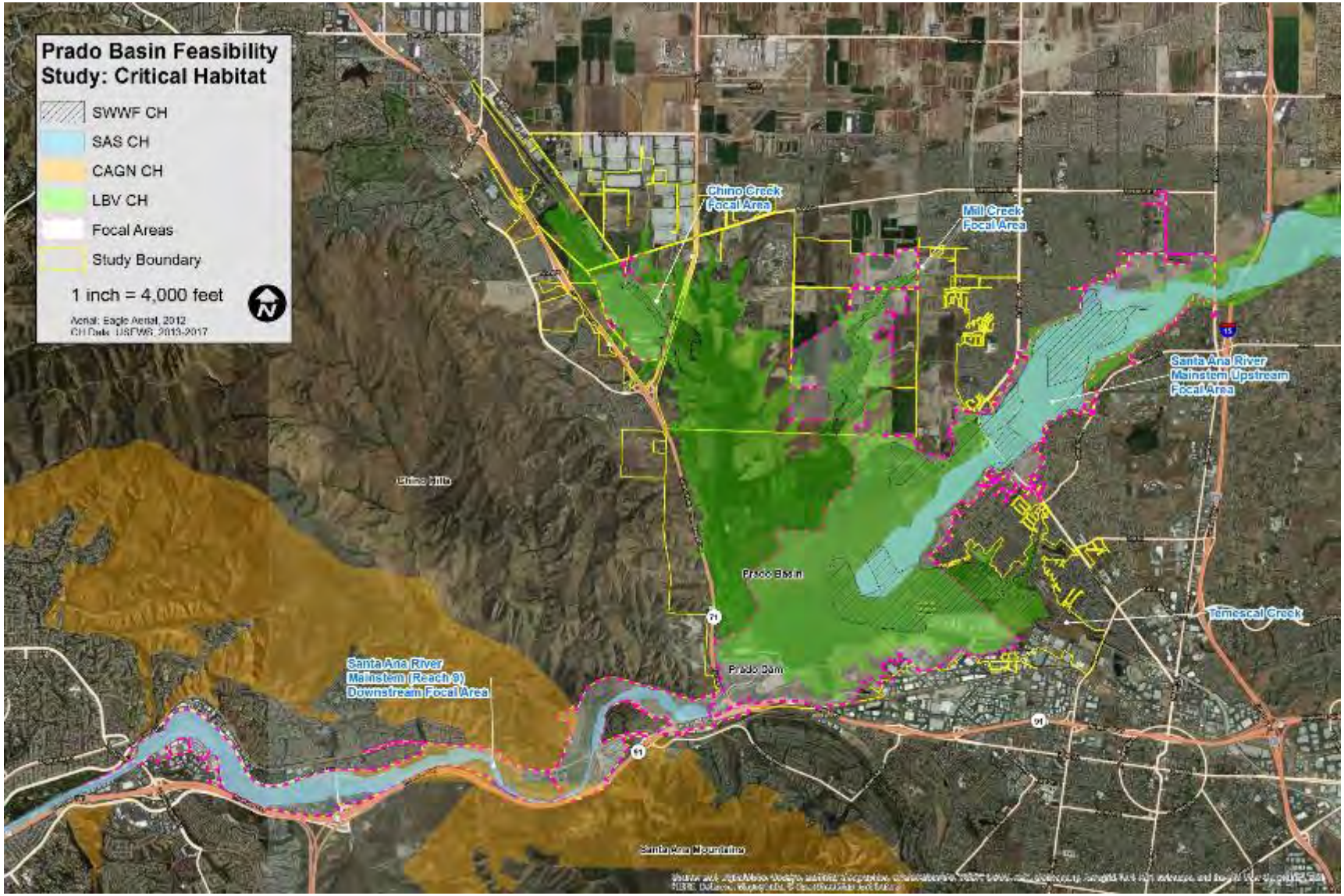
# Santa Ana River Projects






RESOURCE SIGNIFICANCE: Threatened and Endangered Species Critical Habitats

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# Problem: Incised Channels

•Sediment starved flows scour streambeds and streambanks

•Steep sides degrade habitat by reducing the area available for native vegetation and by reducing connectivity

•Incised channel lowers water table beneath the floodplain and reduces floodplain wetlands

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# Problem: Upstream  Sedimentation

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# Problem: Non Native & Highly Invasive Arundo Donax

- Displaces native vegetation
- Consumes 9-25 acre-feet of water/acre/year (2-4 times more than native vegetation)

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# PROBLEM: NON-NATIVE WILDLIFE

## FERAL PIGS, COWBIRDS, CRAWDADS, TURTLES

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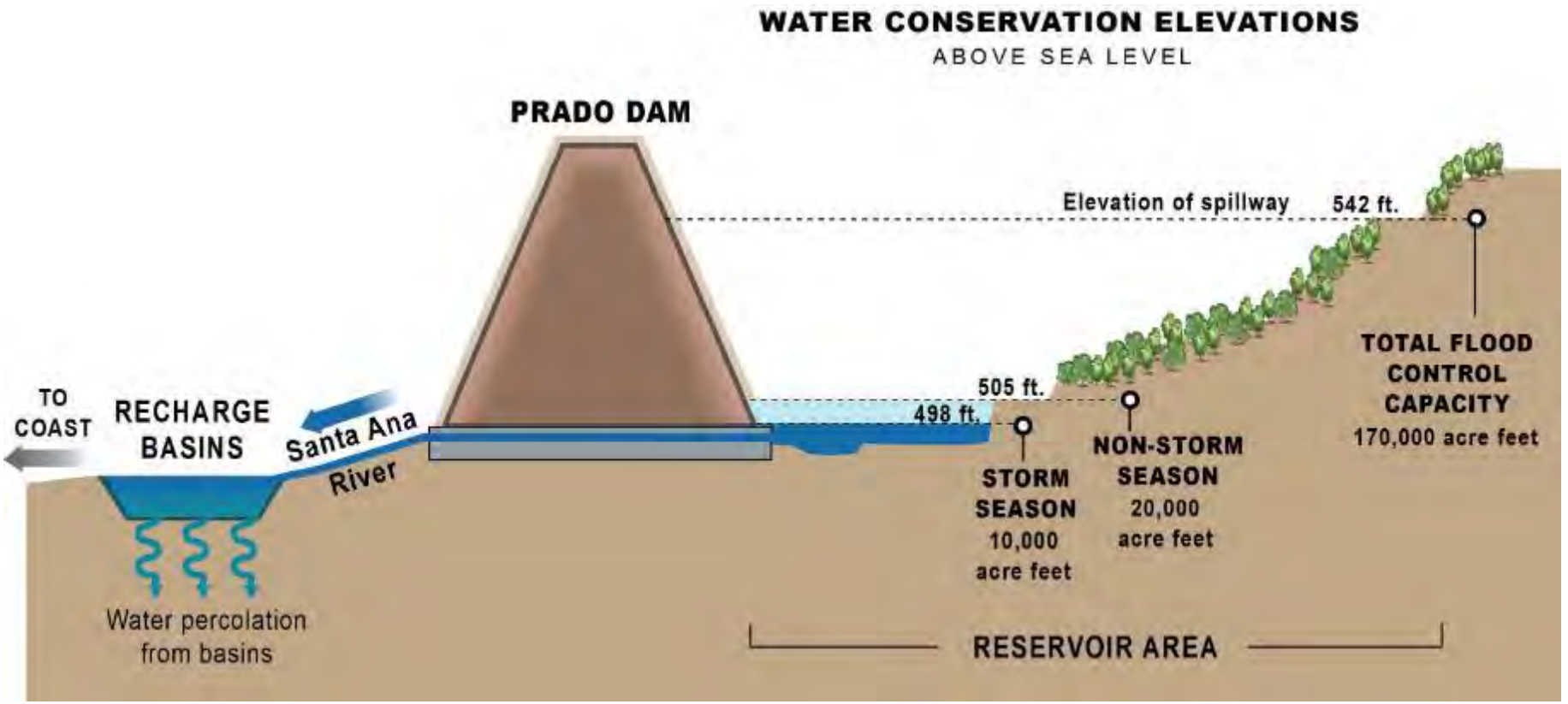
# PRADO DAM OPERATIONS AND WATER CONSERVATION

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# PRADO BASIN RESTORATION TECHNIQUES

- Sediment Management – upstream removal and downstream re-entrainment
- Invasive Vegetation Management
- Invasive Animal Control
- In-stream habitat features – rock groins for mimicking natural flow conditions and habitat
- Channel restoration – channel diversion, bank features and reconnection to floodplain

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# CHANGING WATERWAYS – SUMMARY

- California's climate is inherently conducive to flooding and droughts
- Water supplies are dependent on large-scale long-distance transfers
- Development has incrementally addressed flood risks
- California's terrain means flooding has additional impacts beyond inundation (bank failure, landslides)
- Restoration opportunities do exist
- Greatest limitations on restoration and adaptation are posed by extensive development