

Innovations in Climate Resilience | Columbus, Ohio
Achieving groundwater sustainability in
California in an era of climate uncertainty

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California water

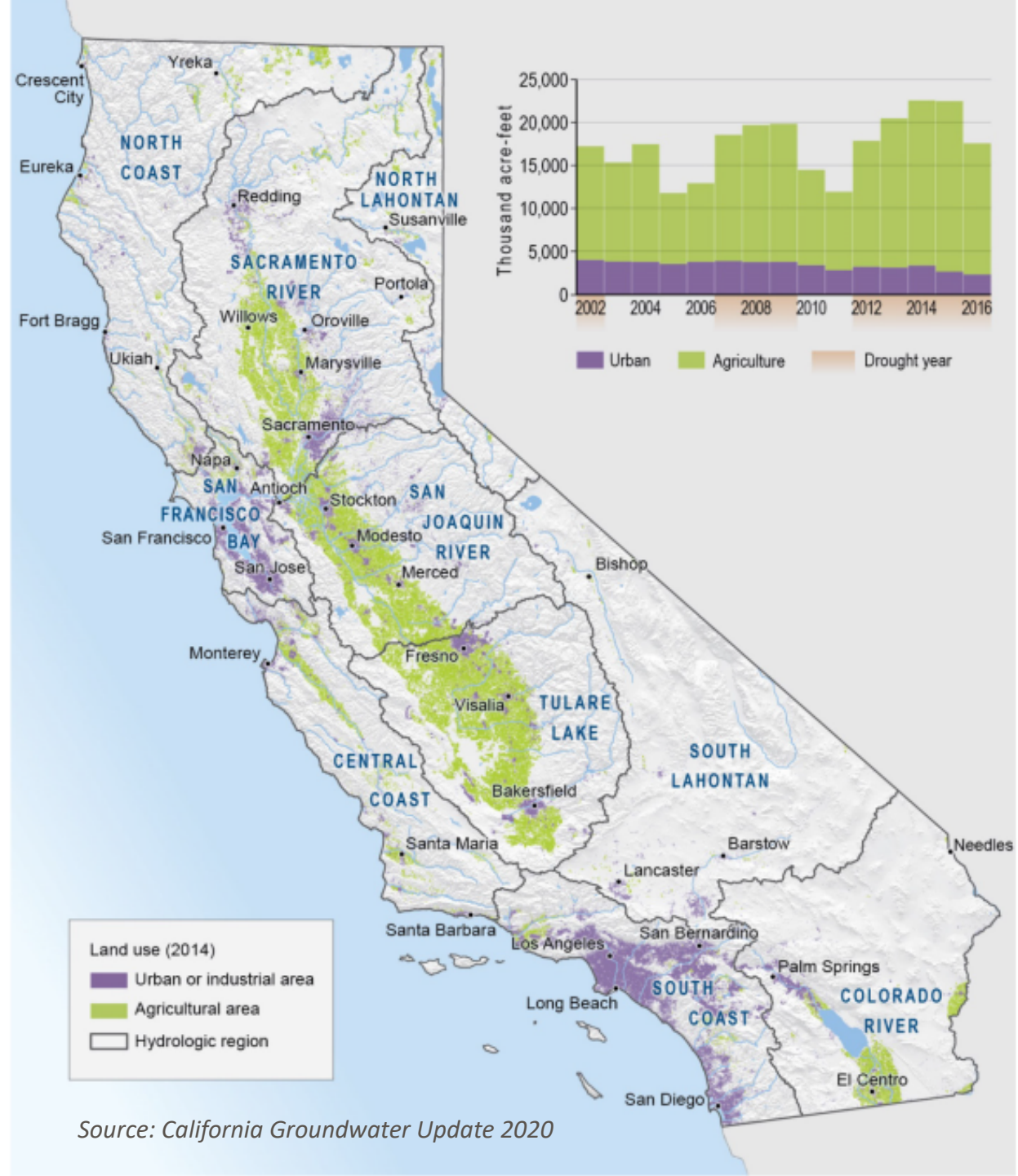
- 75% originates in northern third of the state, 80% of demand is in southern two-thirds
- Atmospheric rivers supply almost half – drought busters
- 40-43 million acre-feet total water use
- State and federal projects
 - multi-purpose network of dams, reservoirs, canals, hydroelectric power plants



Source: California Groundwater Update 2020

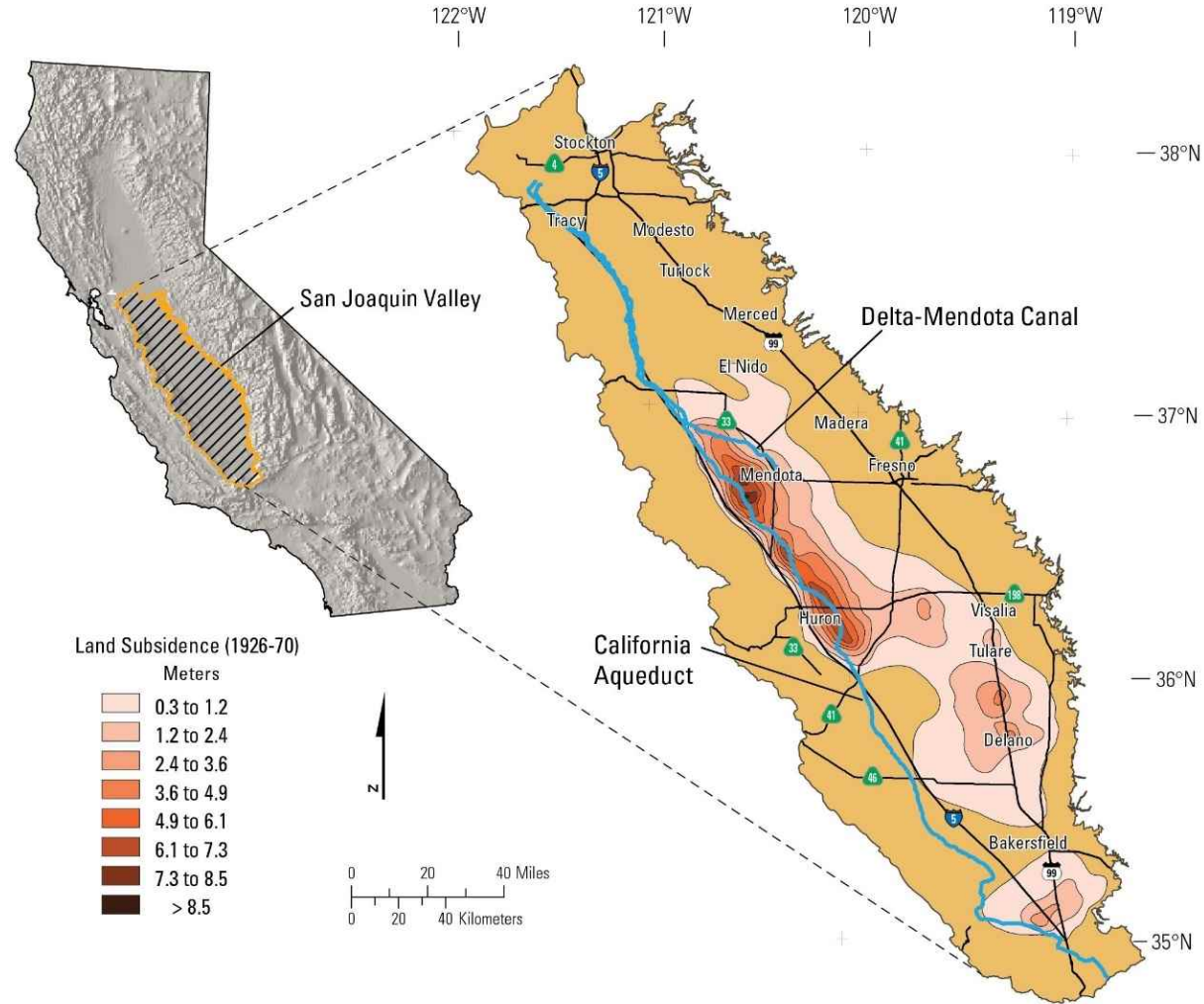
Groundwater use in California

- 515 groundwater basins and subbasins
- Conjunctively used with surface water
 - Above normal to wet years: 30-40%
 - Dry periods: up to ~60%
- Use by sector
 - Agricultural use is more than 75%
 - Productive Central Valley crops
 - \$22.5 billion in exports (almonds, dairy, wine etc)



Source: California Groundwater Update 2020

Droughts and ongoing subsidence



Source: USGS Central Valley Subsidence Map, 2018

Droughts and ongoing subsidence



- Subsidence reduced conveyance capacity by 40%*
- 1,200 square mile subsidence bowl
- 1 ft/year of ongoing subsidence

• 30 feet (1925-1977)

• 6.3 feet (1988-2018)



Indicators of Climate Change in California

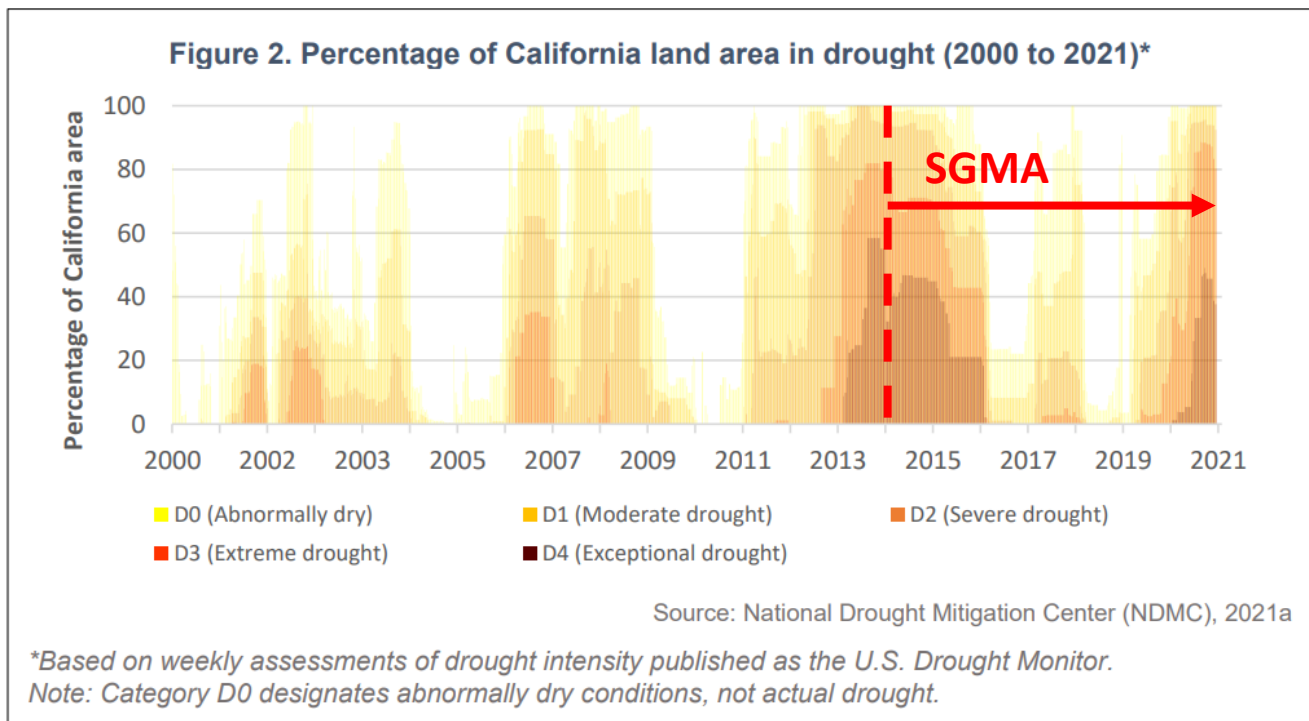
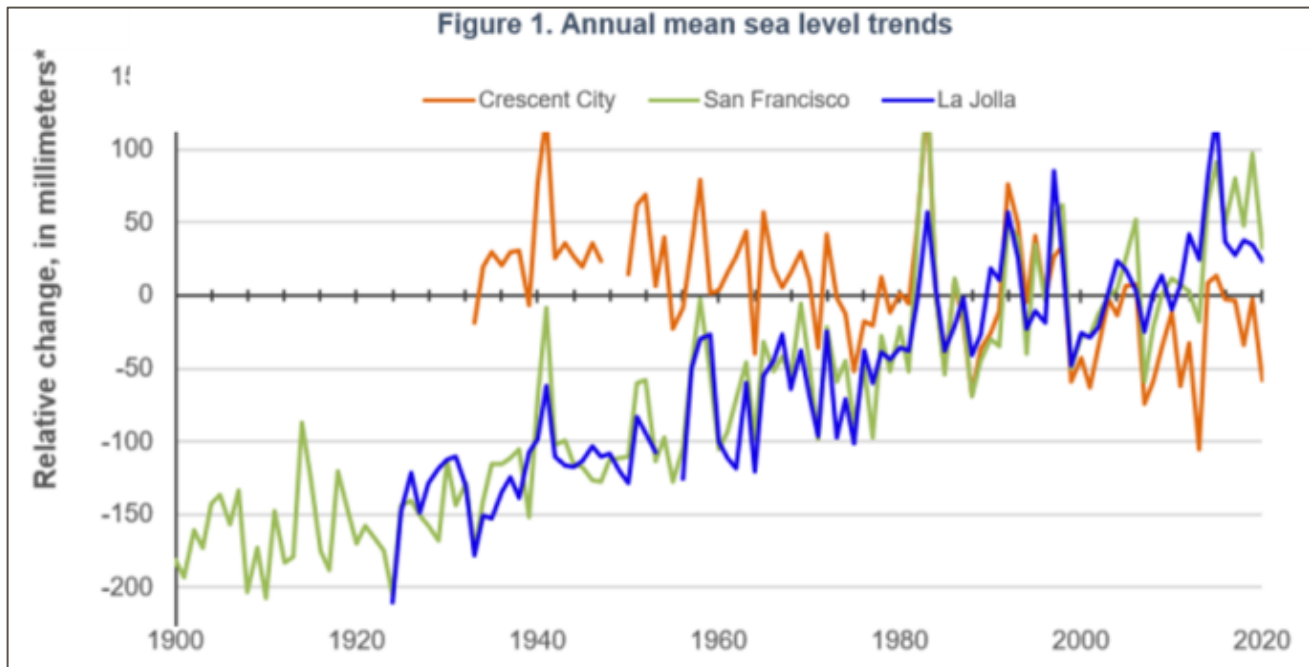
Fourth Edition



Lauren Zeise, Ph.D.
Director, Office of Environmental Health Hazard Assessment

Yana Garcia
Secretary, California Environmental Protection Agency

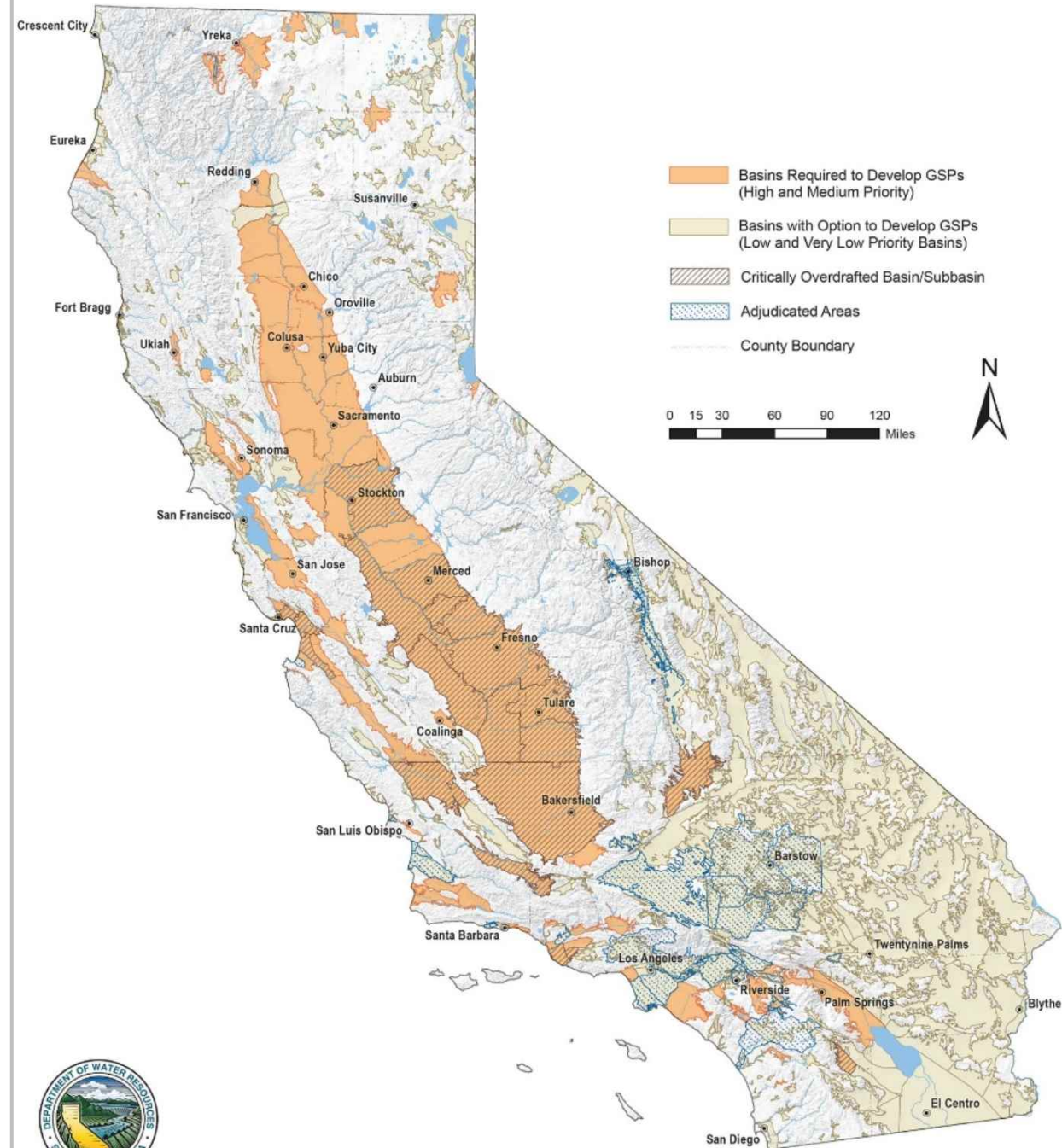
Gavin Newsom
Governor



Sustainable Groundwater Management Act (SGMA)

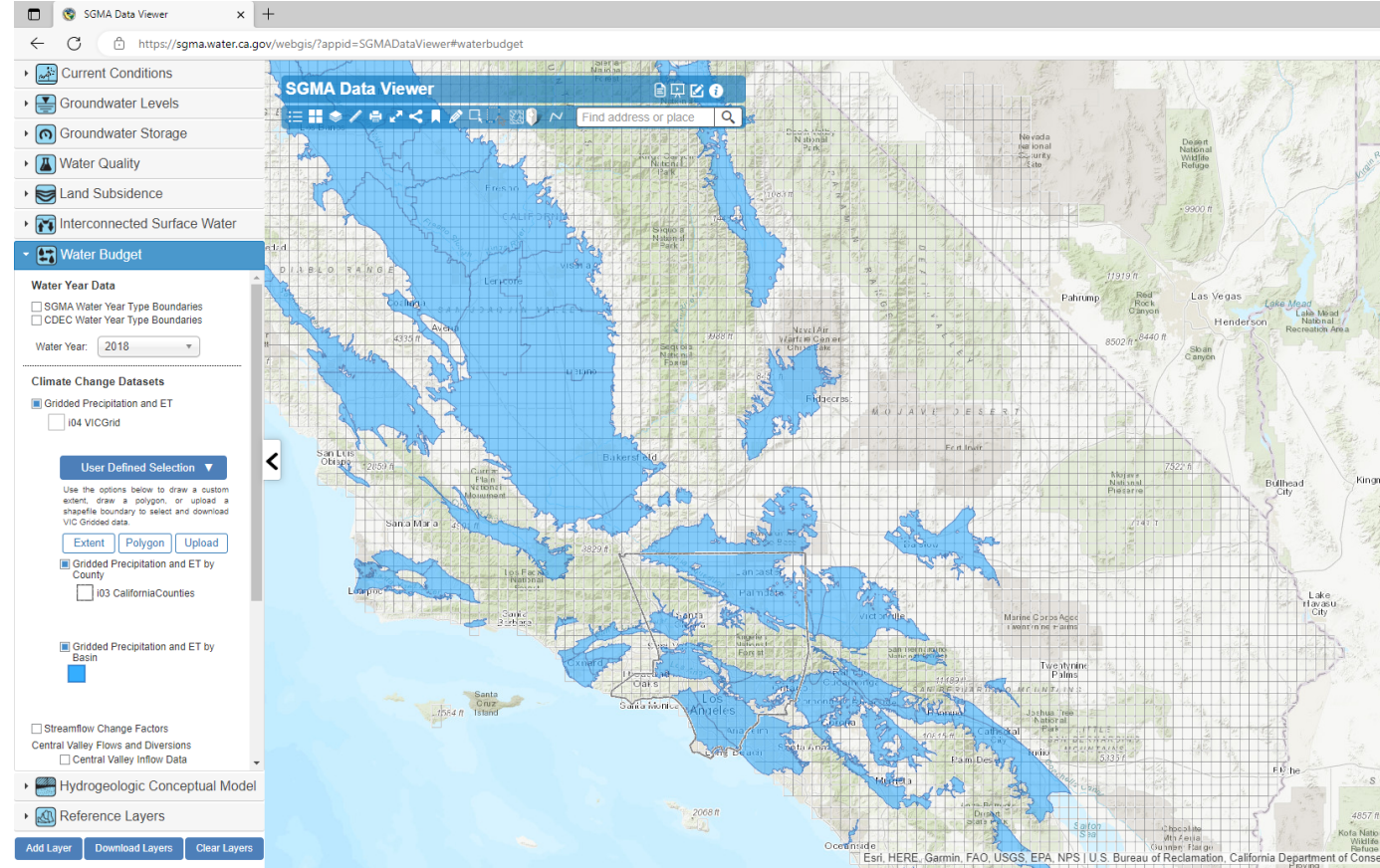
- SGMA framework

- Local planning and implementation, state-level administrative review
- Basin prioritization – high, medium, low
- Groundwater Sustainability Agencies (GSAs), over 260 in 140 basins
- Sustainable Management Criteria
 - Undesirable results
 - Representative monitoring sites
 - Minimum thresholds
 - Measurable objectives
- 2020/2022 timeline for sustainability plans
- 2040/2042 timeline for achieving results
- Adjudicated basins and alternative plans



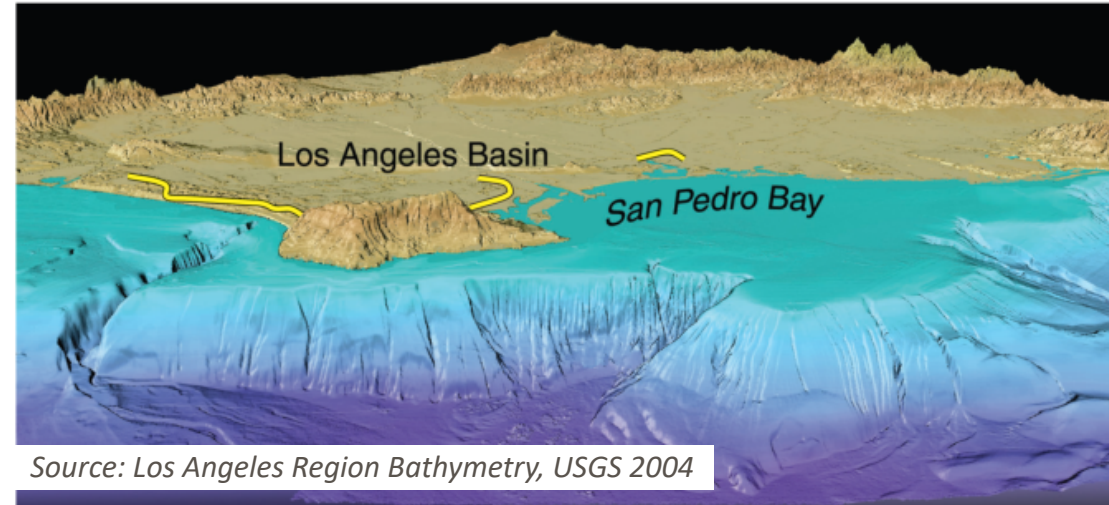
SGMA groundwater sustainability plans (GSPs)

- Water budget requirements
 - Projections of precipitation, evapotranspiration, streamflows, sea-level rise
 - Projected water demand, surface water supplies
- Several critically overdrafted GSPs deemed inadequate
- Adjudicated basins and alternative plans for Southern California basins



Groundwater in Southern California

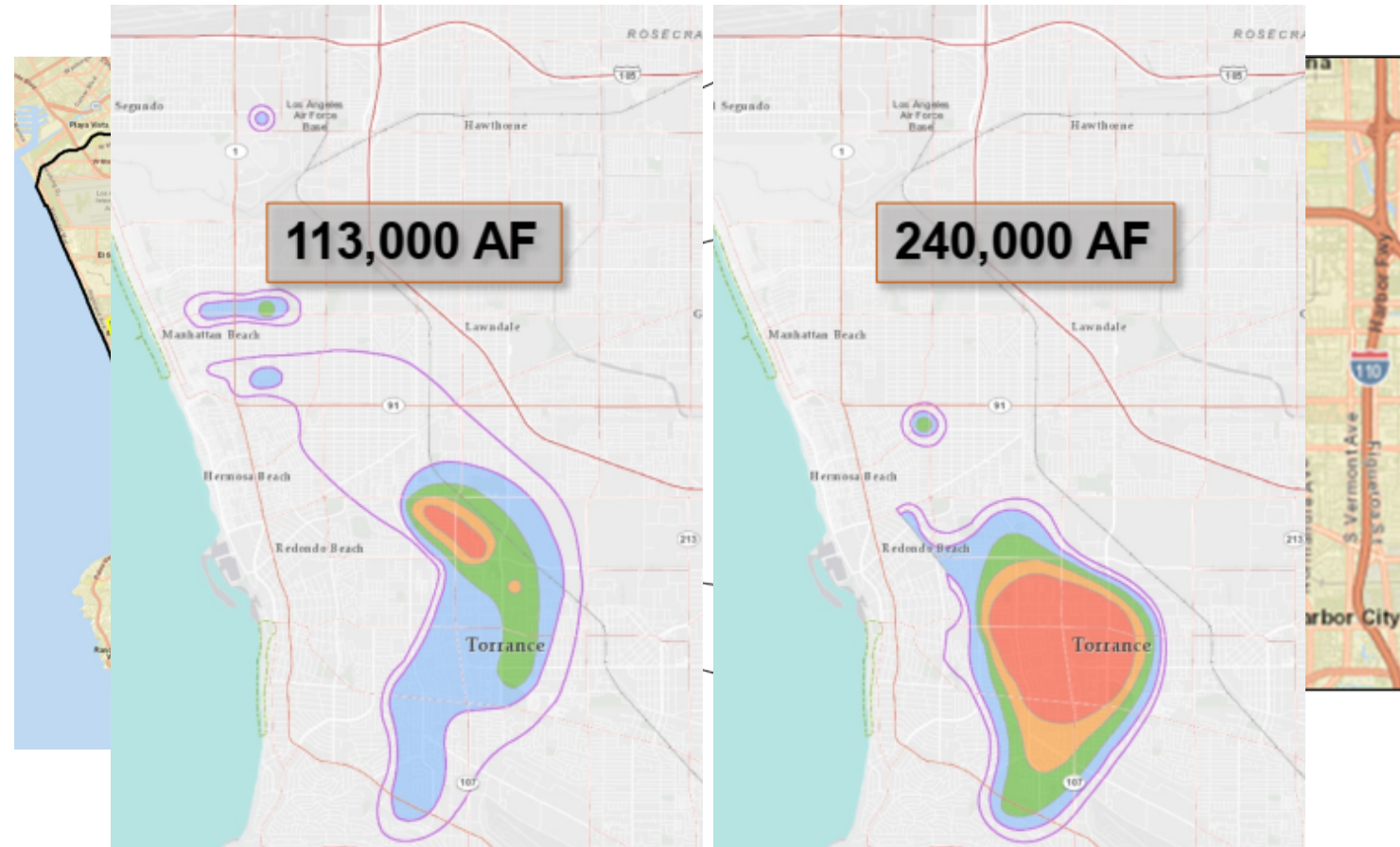
- Historical seawater intrusion due to inland groundwater overdraft
- Adjudication and installation of three seawater barriers
 - Sea-level rise
 - Increase in groundwater demand
 - Water quality degradation
- Drives of vulnerability
 - Sea-level rise
 - Increase in groundwater demand
 - Water quality degradation
- Adaptation solutions – ongoing and planned
 - Regional Brackish Water Reclamation Program
 - City of Los Angeles Operation Next
 - New Sunset Gap seawater barrier



Barrier Project	West Coast	Dominguez Gap	Alamos Gap
Date Started	1953	1969	1964
Overall Length (miles)	9	6	2.2
Number of Injection Wells	153	94	43
Number of Observation Wells	302	232	239
Average Injection (acre-feet/year)	14,800	11,000	6,000

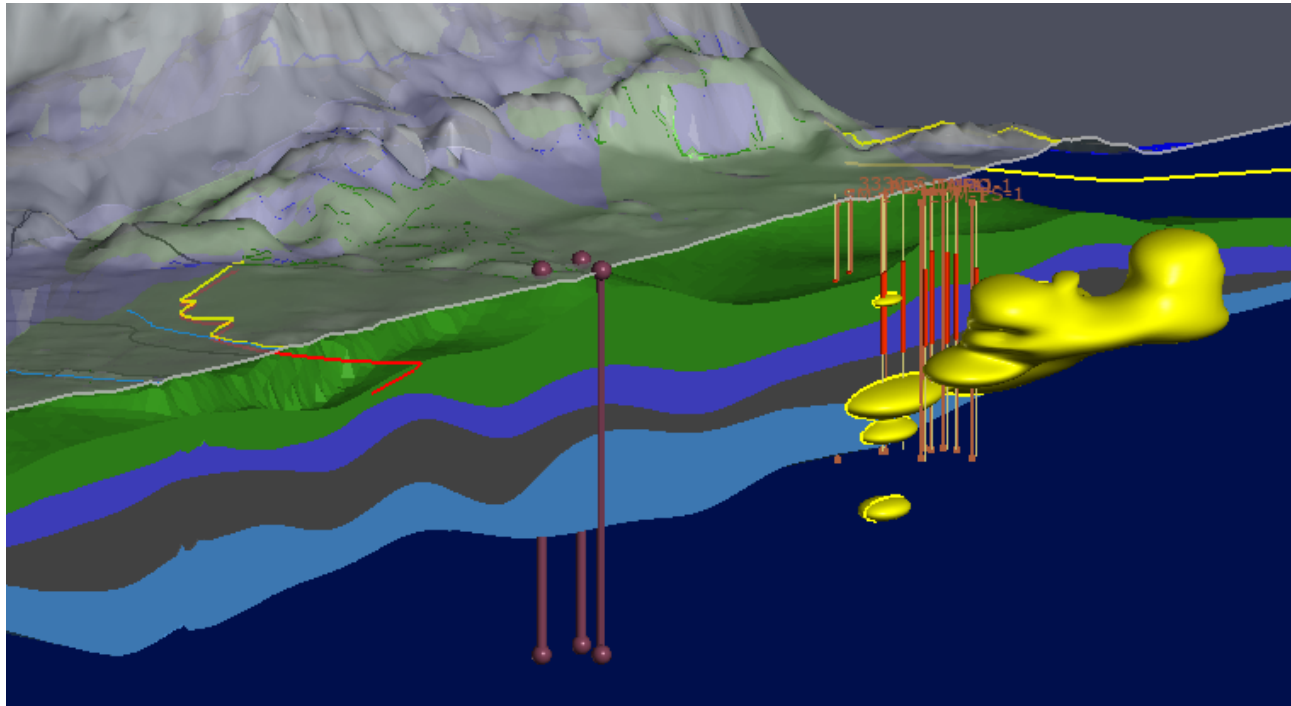
Regional Brackish Water Reclamation Program

- Water Replenishment District of Southern California's Water Independence Now (WIN)
- Extract brackish water, treat and reinject, augment supply
- Additional reinjection at barrier wells, new inland locations
- Determination of optimal locations, volumes, apportionment

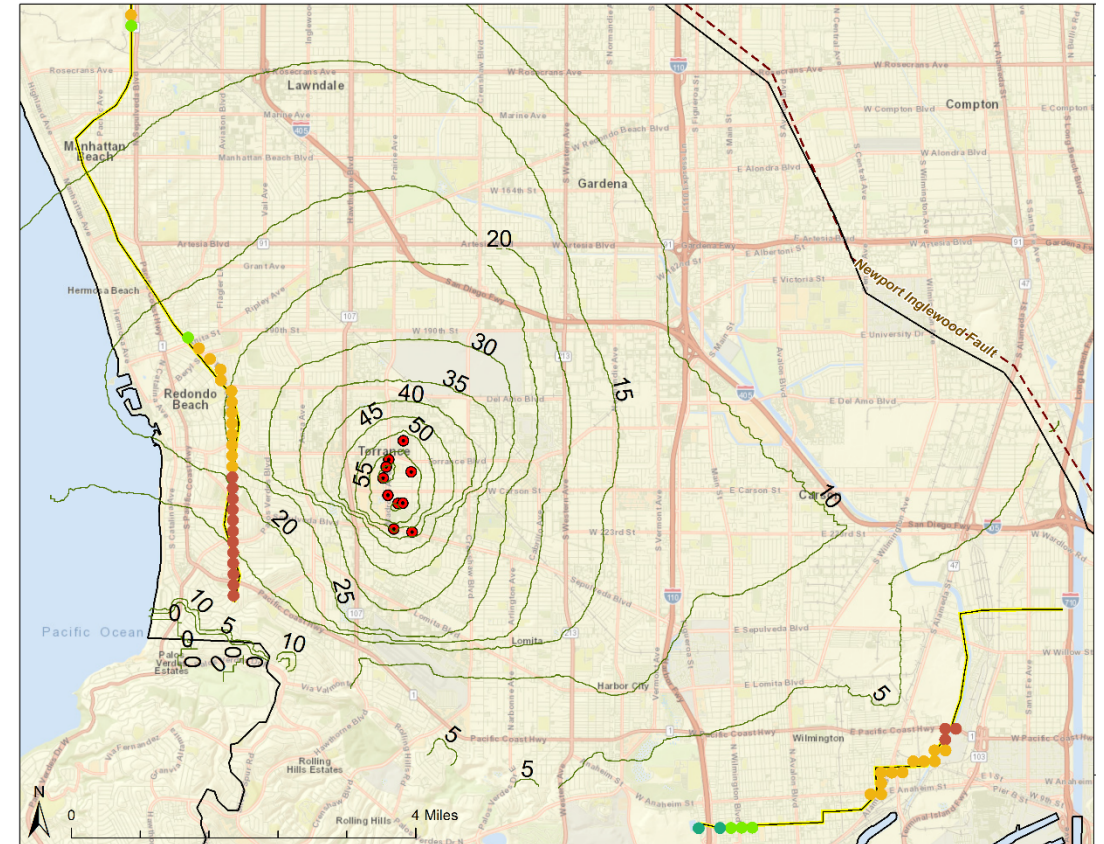


Chloride Plumes in Silverado and Lower San Pedro Aquifers (WRD, 2021)

Simulation of Extraction and Reinjection

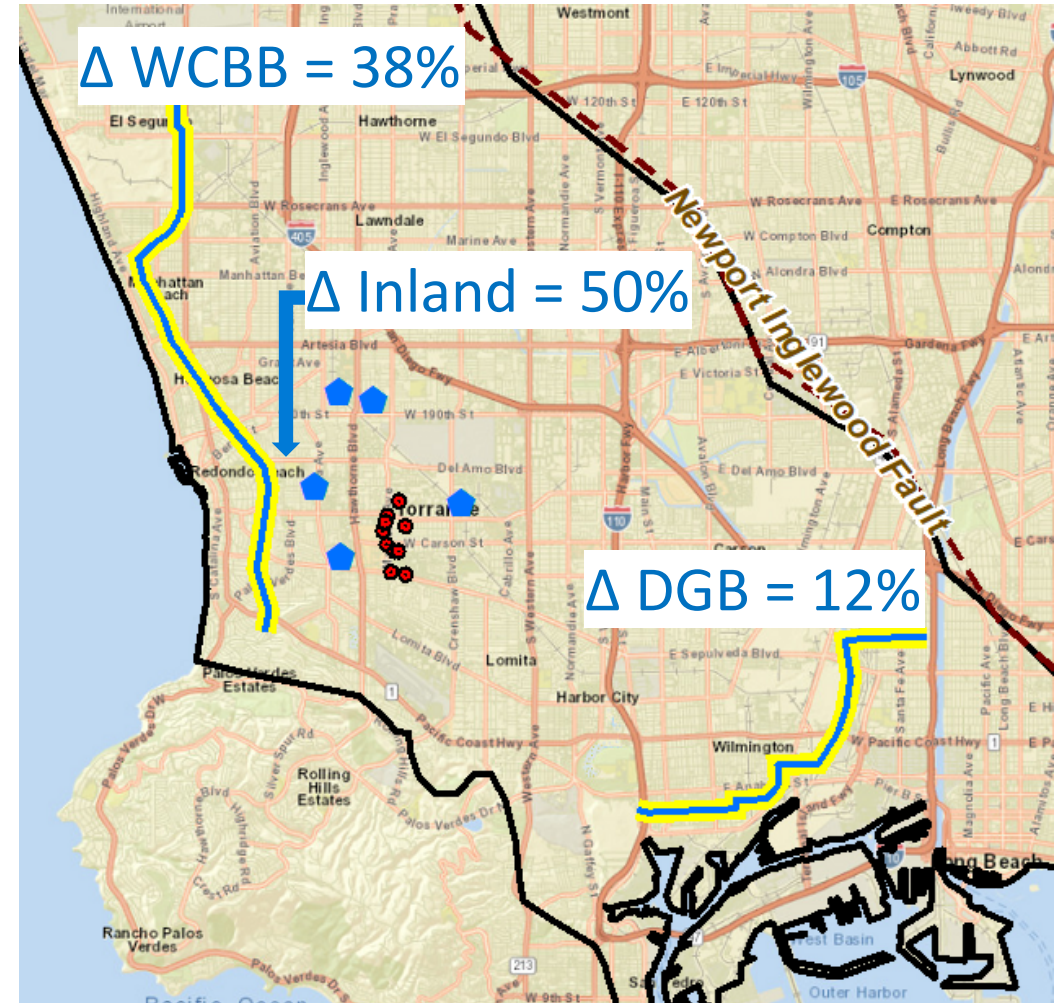
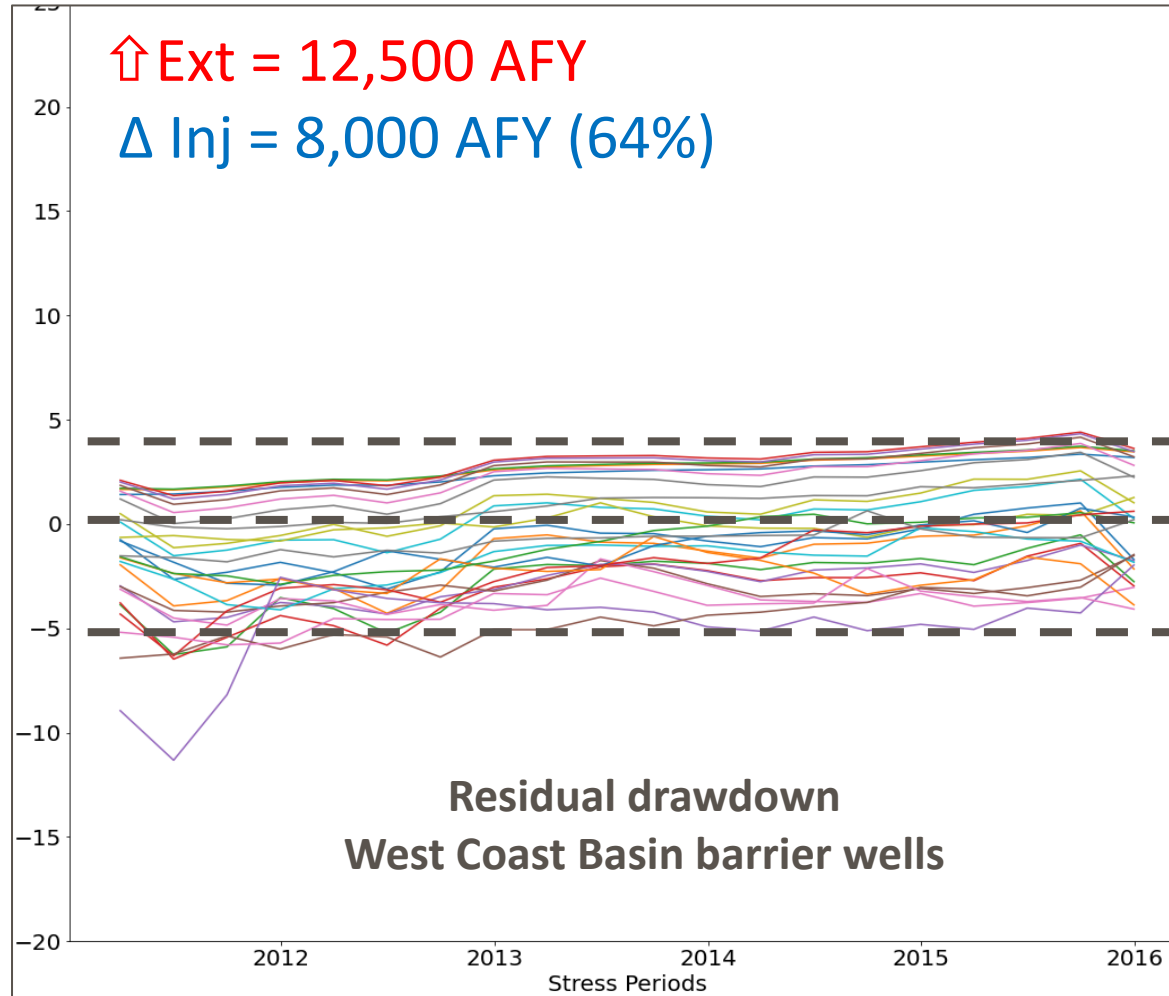


Chloride plume and stratigraphic sequences



Drawdown Contours (12,500 AFY)

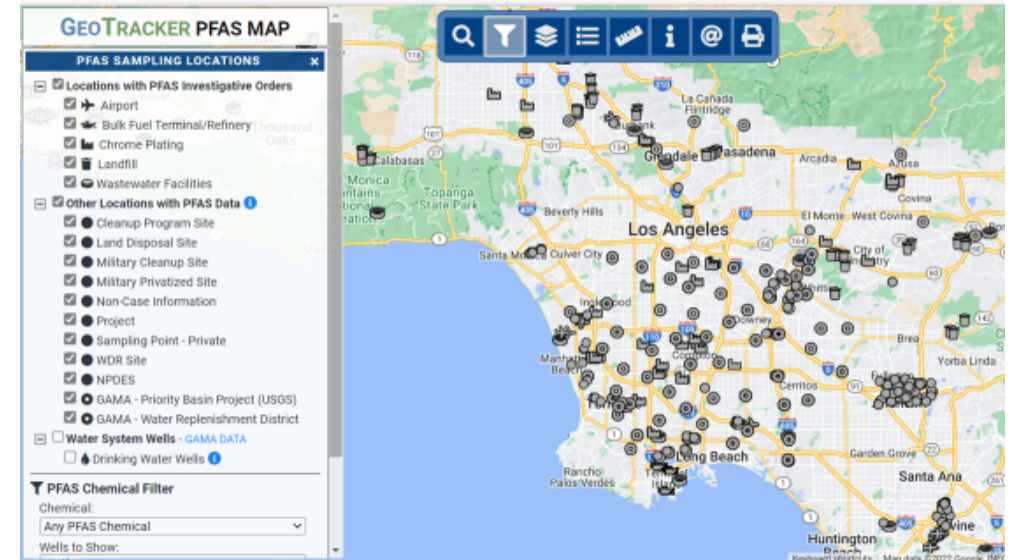
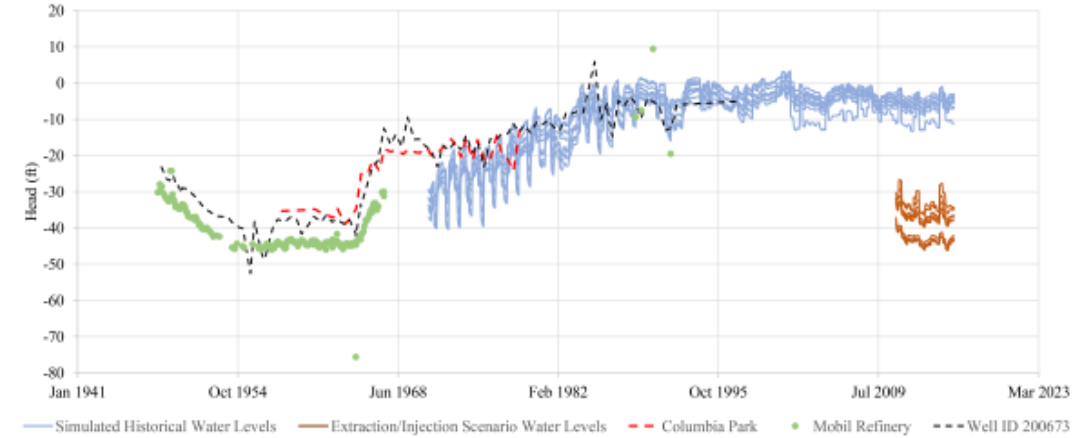
Regional Brackish Water Reclamation Program

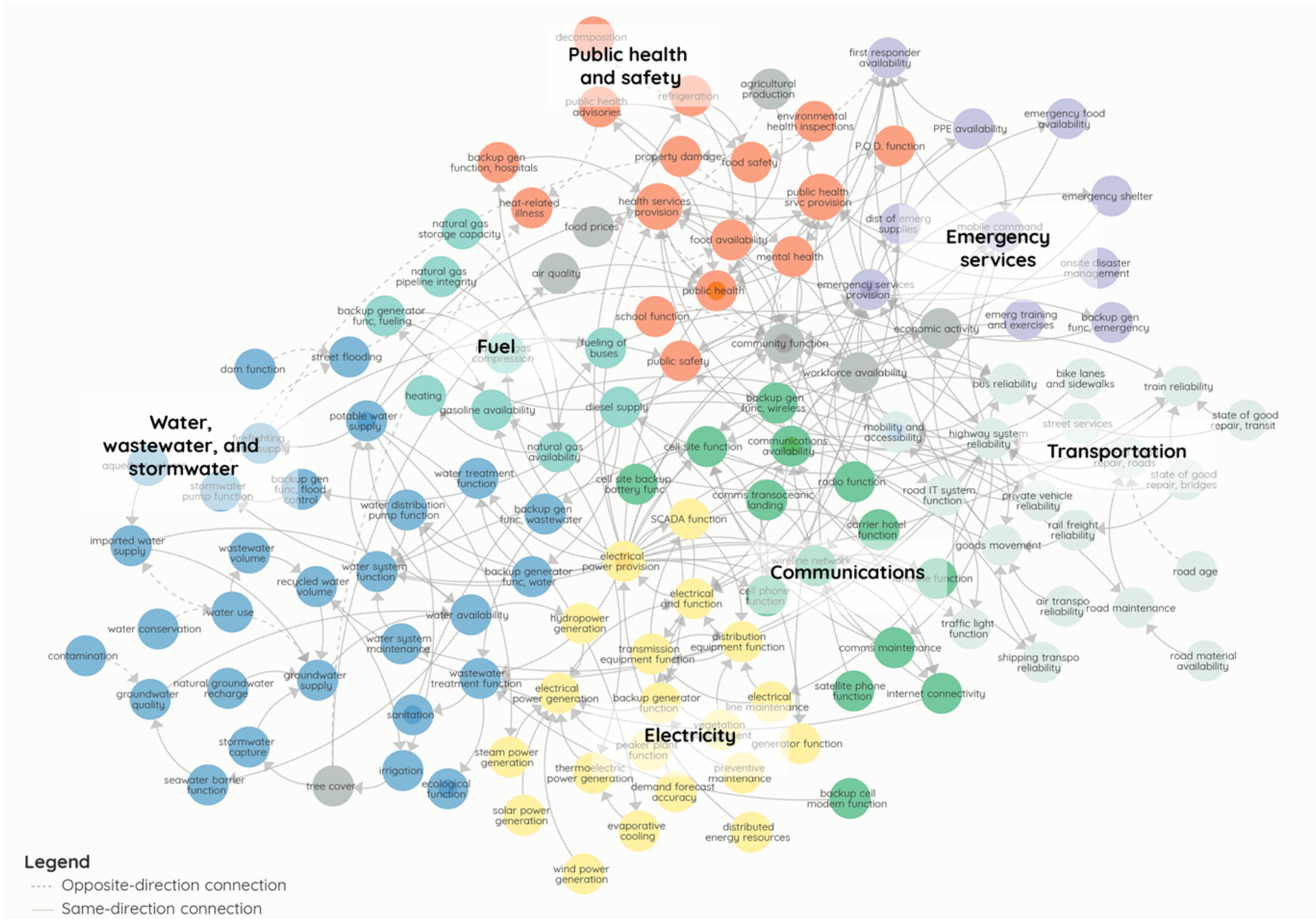


Groundwater Sustainability Under Climate Change

- Mitigation via groundwater recharge
 - potential contaminant mobilization
 - emerging contaminants (PFAS)
 - material and physical harm assessments
- Vulnerabilities to multiple hazards
 - linear superposition may lead to unrealistic risk
 - model-based simulation of combined hazards
 - multiple scenarios for a realistic risk matrix

Potential for subsidence





Infrastructure Interdependencies, Los Angeles County Climate Vulnerability Assessment, 2022