The Evolving Landscape of Groundwater Management in California

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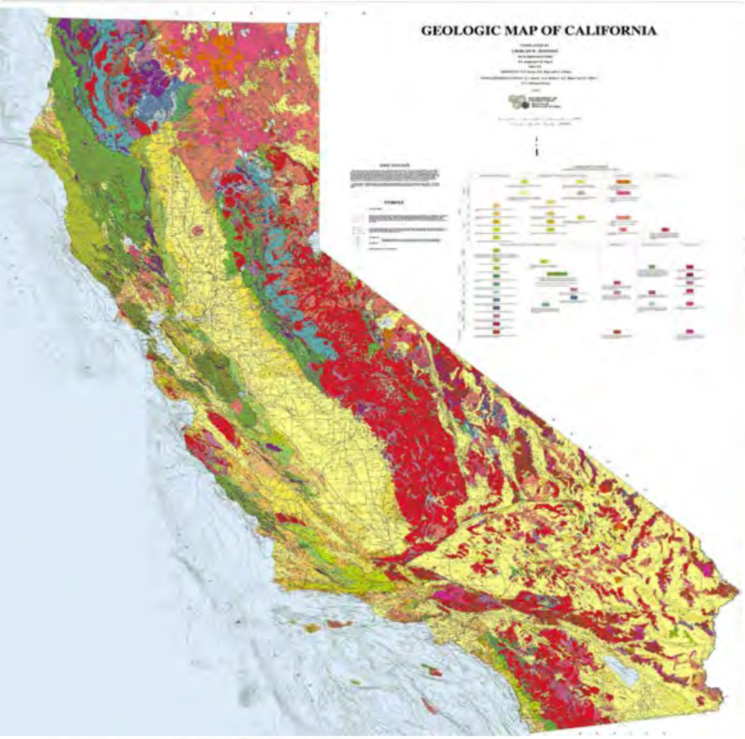
3as Jornadas Technicas

Gestion De Acuiferos Y Recarga Artificial

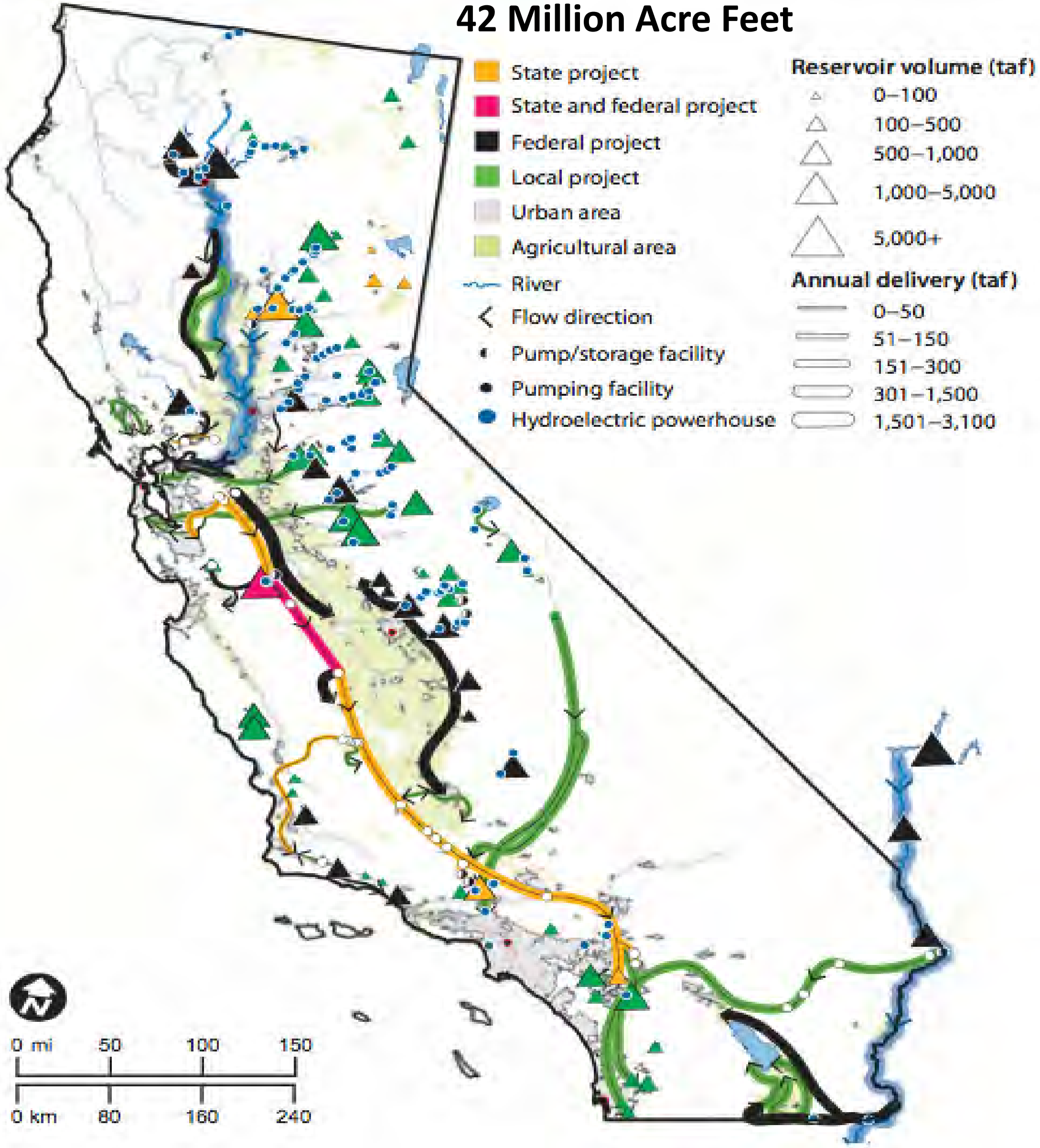
April 26, 2018, Mexico City

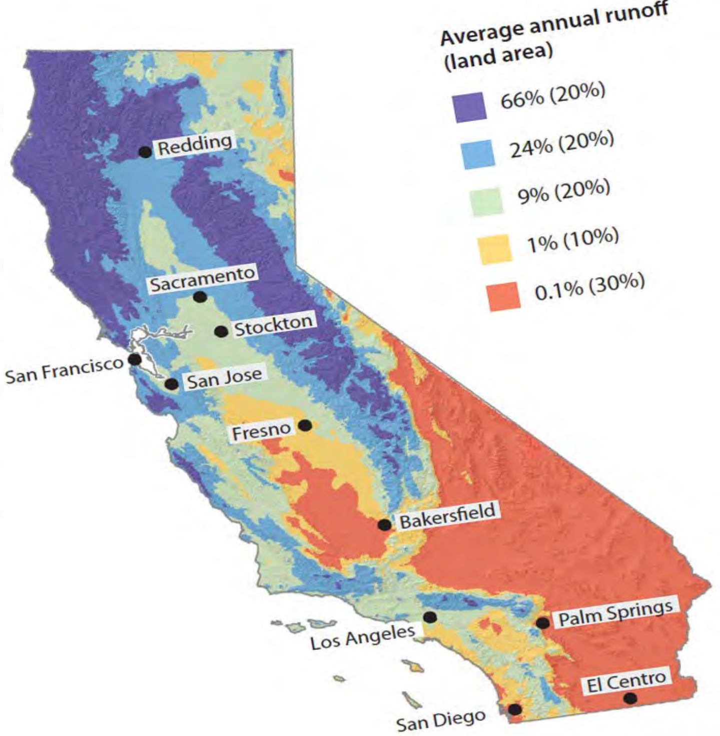
Presentation Overview

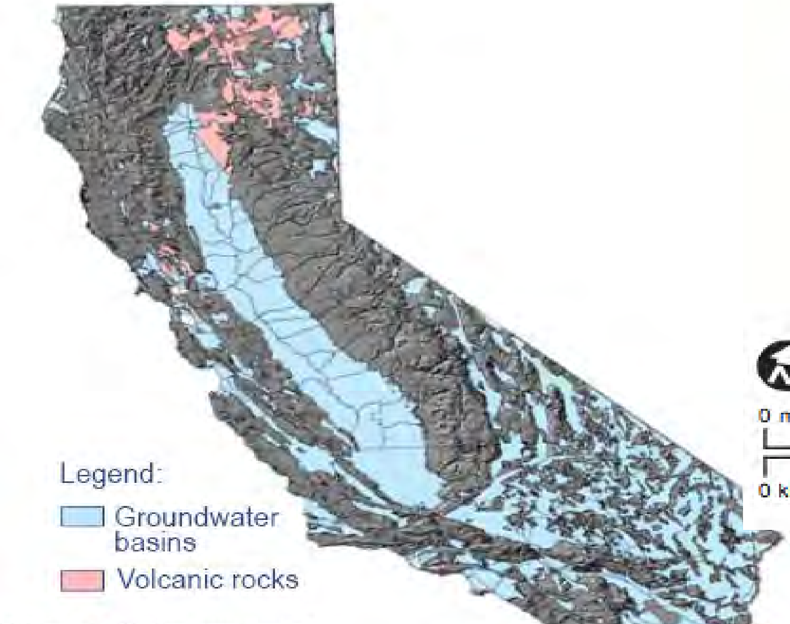
- California Setting
- 2014 Sustainable Groundwater Management Act
- Call to Action to Increase Recharge



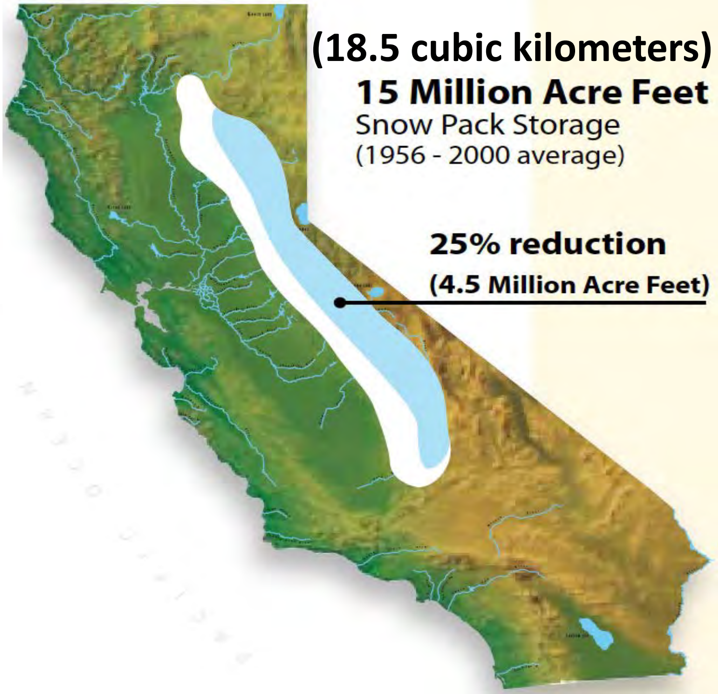
(52.8 cubic kilometers)
42 Million Acre Feet





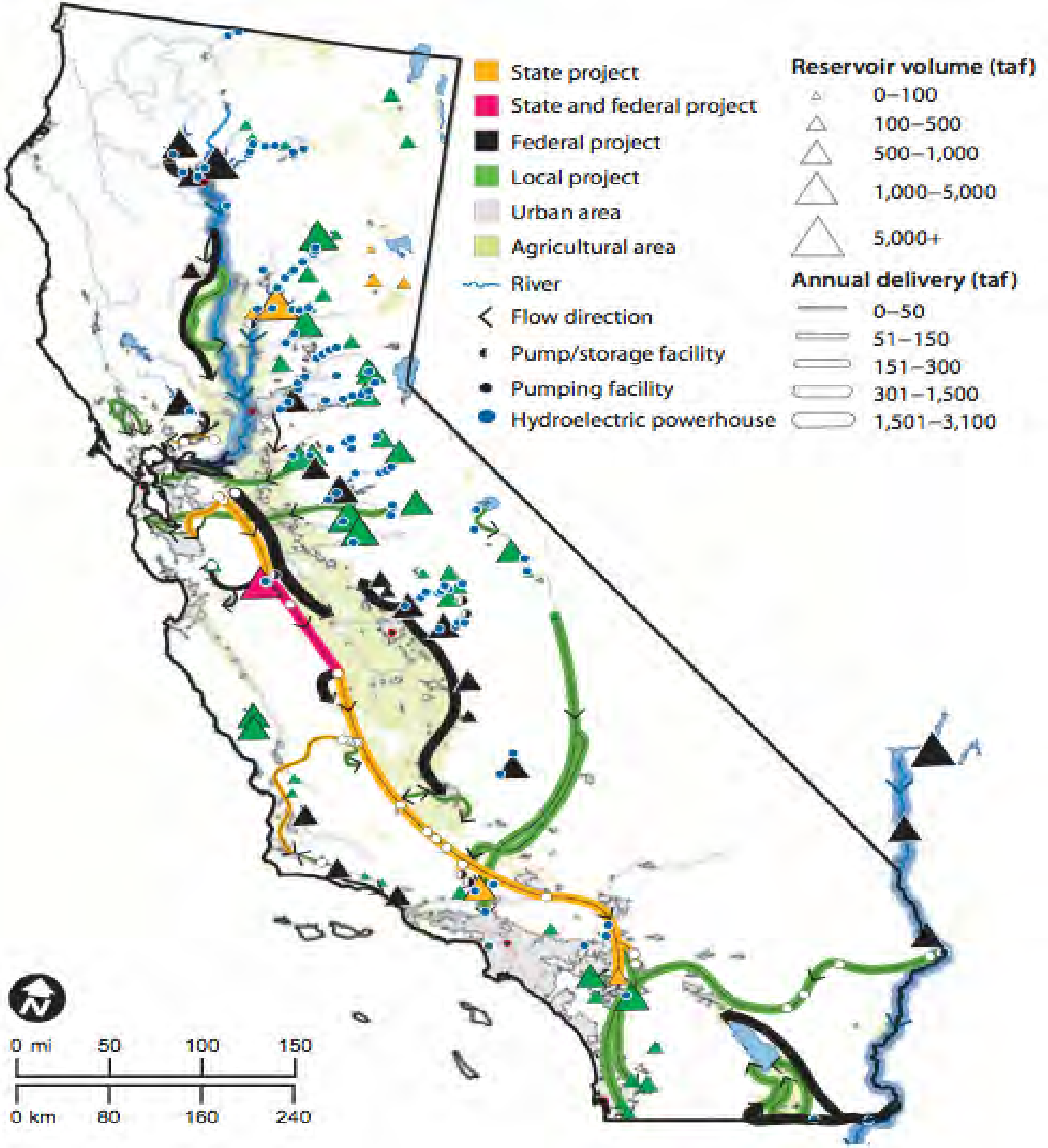


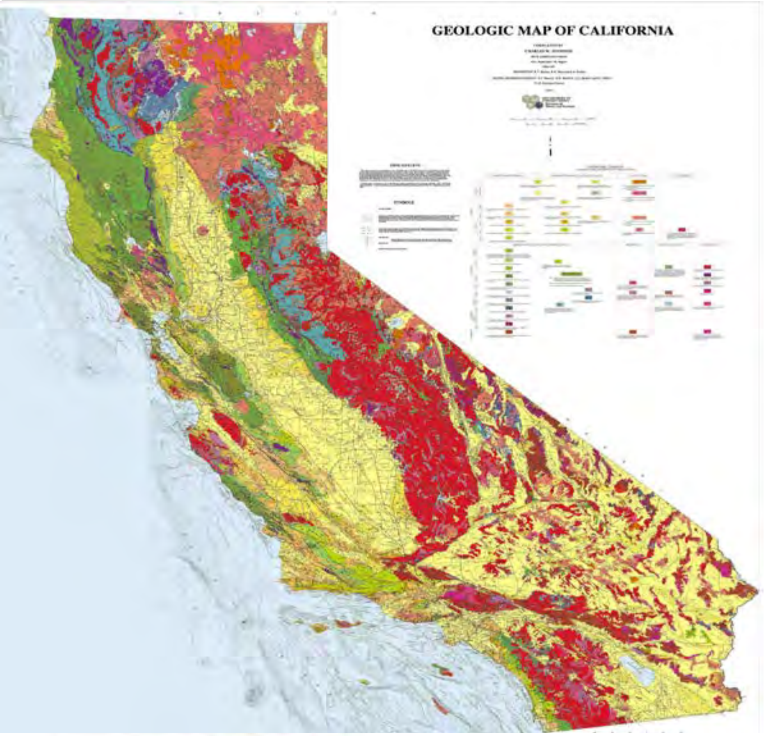
Maps and Photos courtesy of
California Department of Water Resources

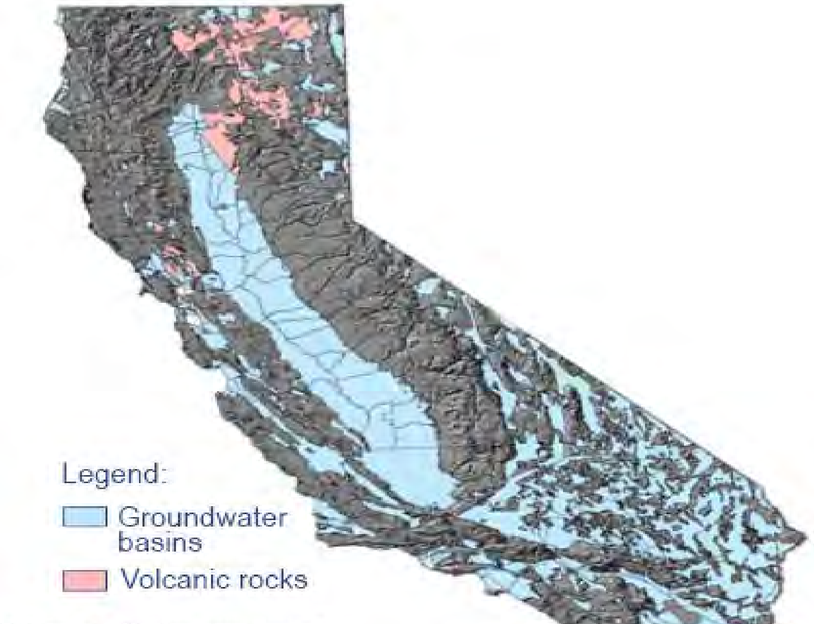


1 acre-foot = 1233.48 cubic meters

- 40 million people
- 5-6 million acres irrigated
  (20,250 – 24,300 km^2)
- 42 MAF (52.8 km^3) Storage in 1,400 Surface Reservoirs (GW 10X)
- ~140 MAF (172.7 km^3) Available Groundwater Reservoir Space
- 200MAF (246.7 km^3)Precipitation/Year
- ~60 Percent Evapotranspiration
- ~75MAF (92.5 km^3) for Use
- Water Use
  - ~62% Agriculture
  - ~16% Urban
  - ~22% Dedicated to Instream Flows
- Groundwater Supply
  - 40% in Normal Years
  - 60% in Dry Years







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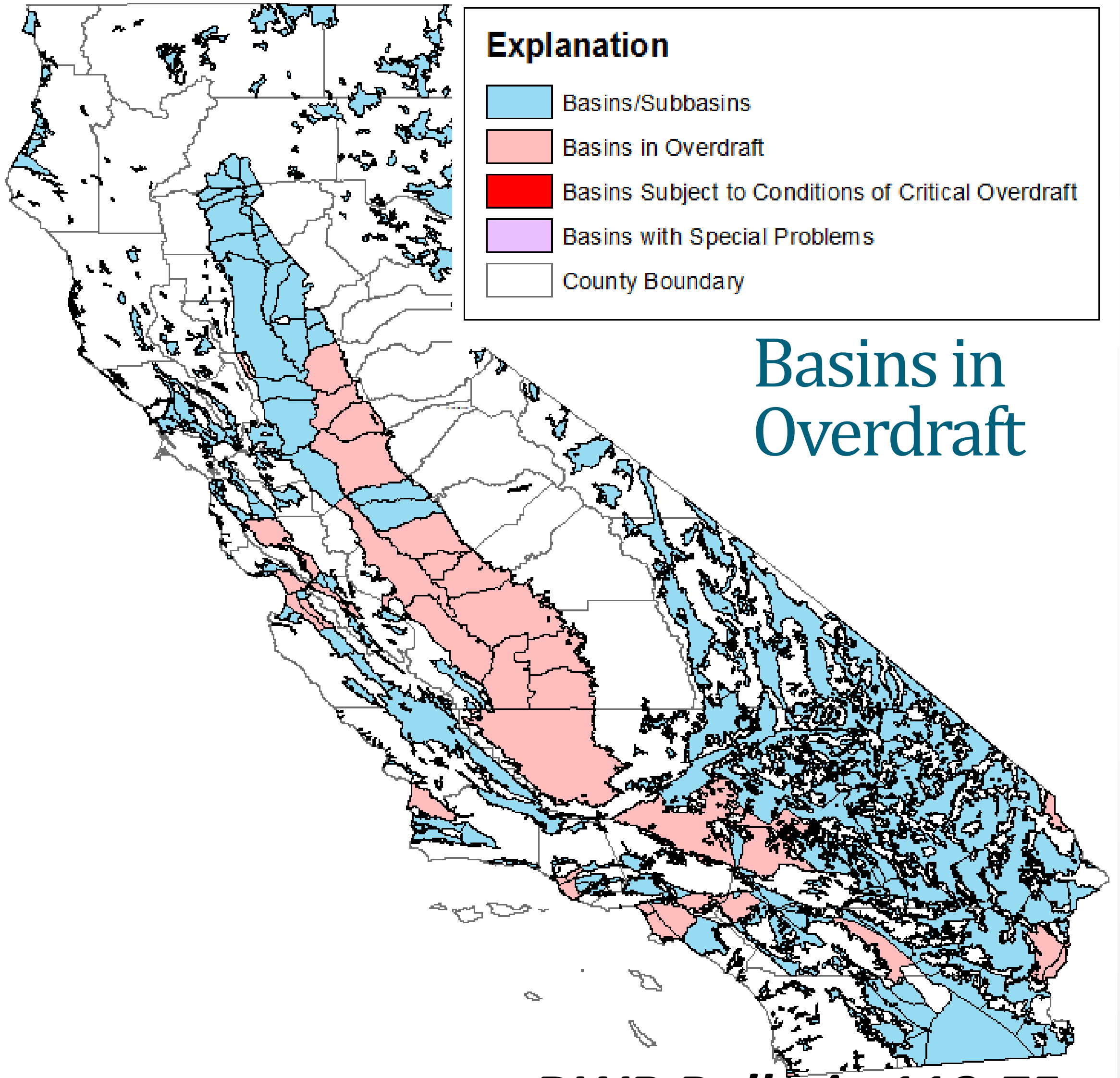
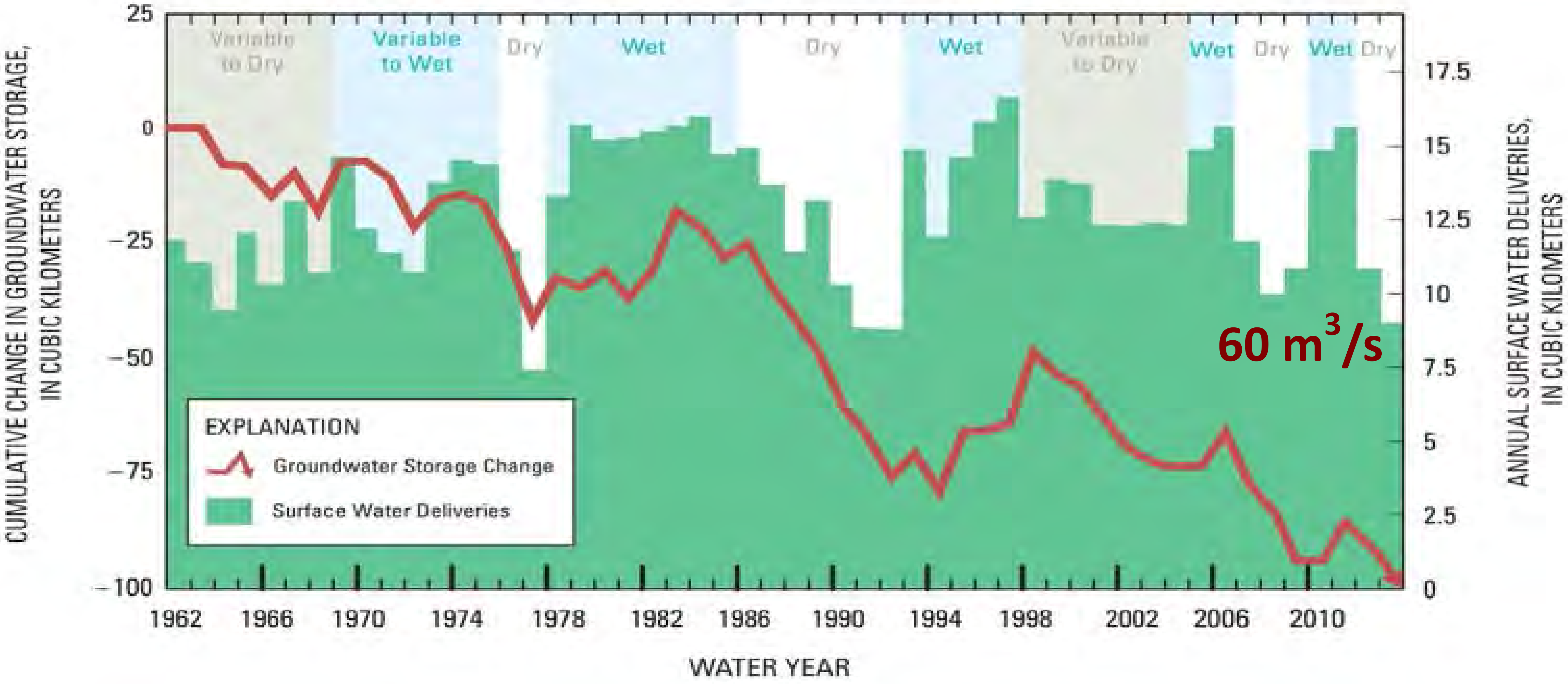
Basins in Overdraft

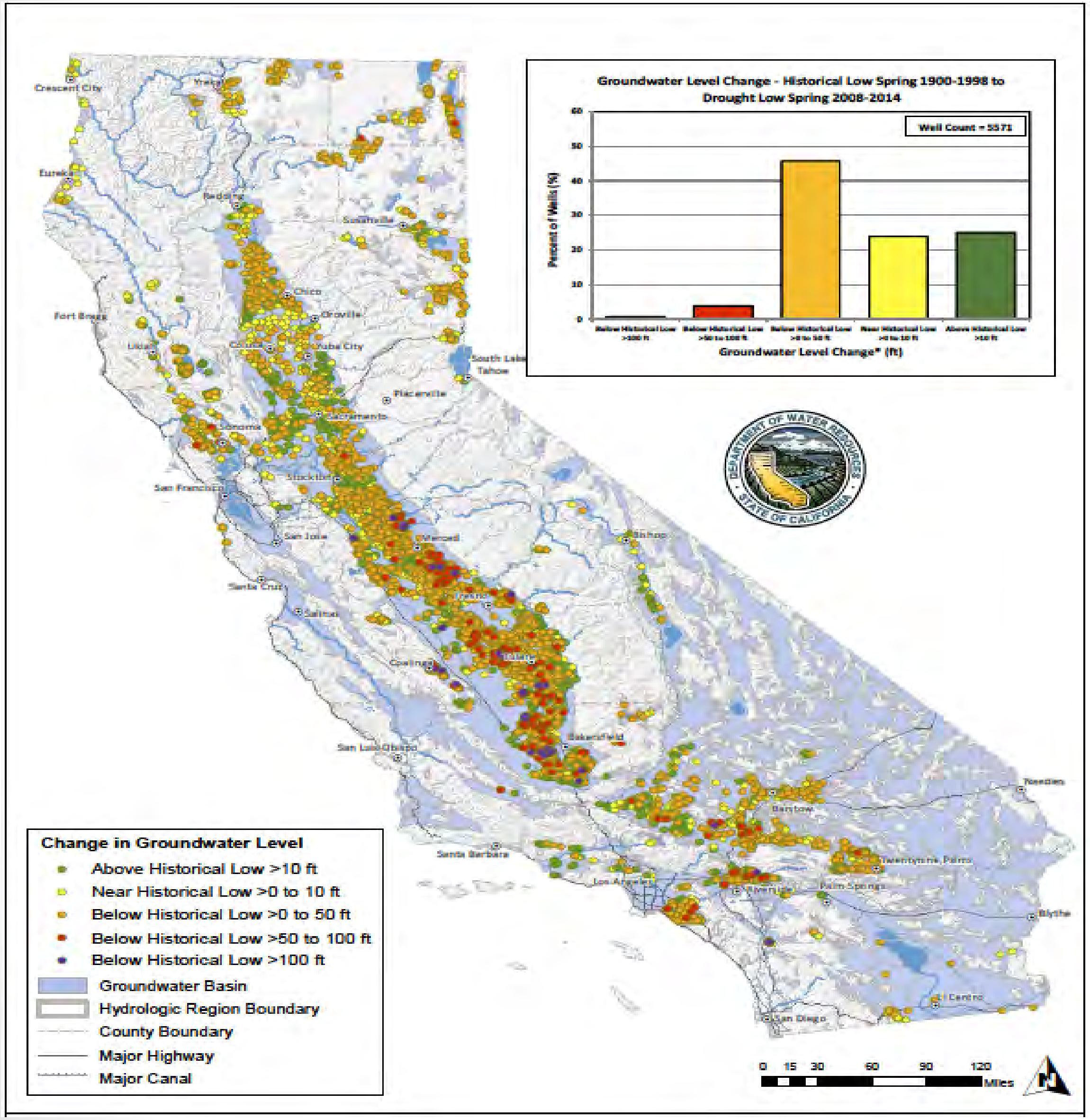


DWR Bulletin 118-75
September 1975

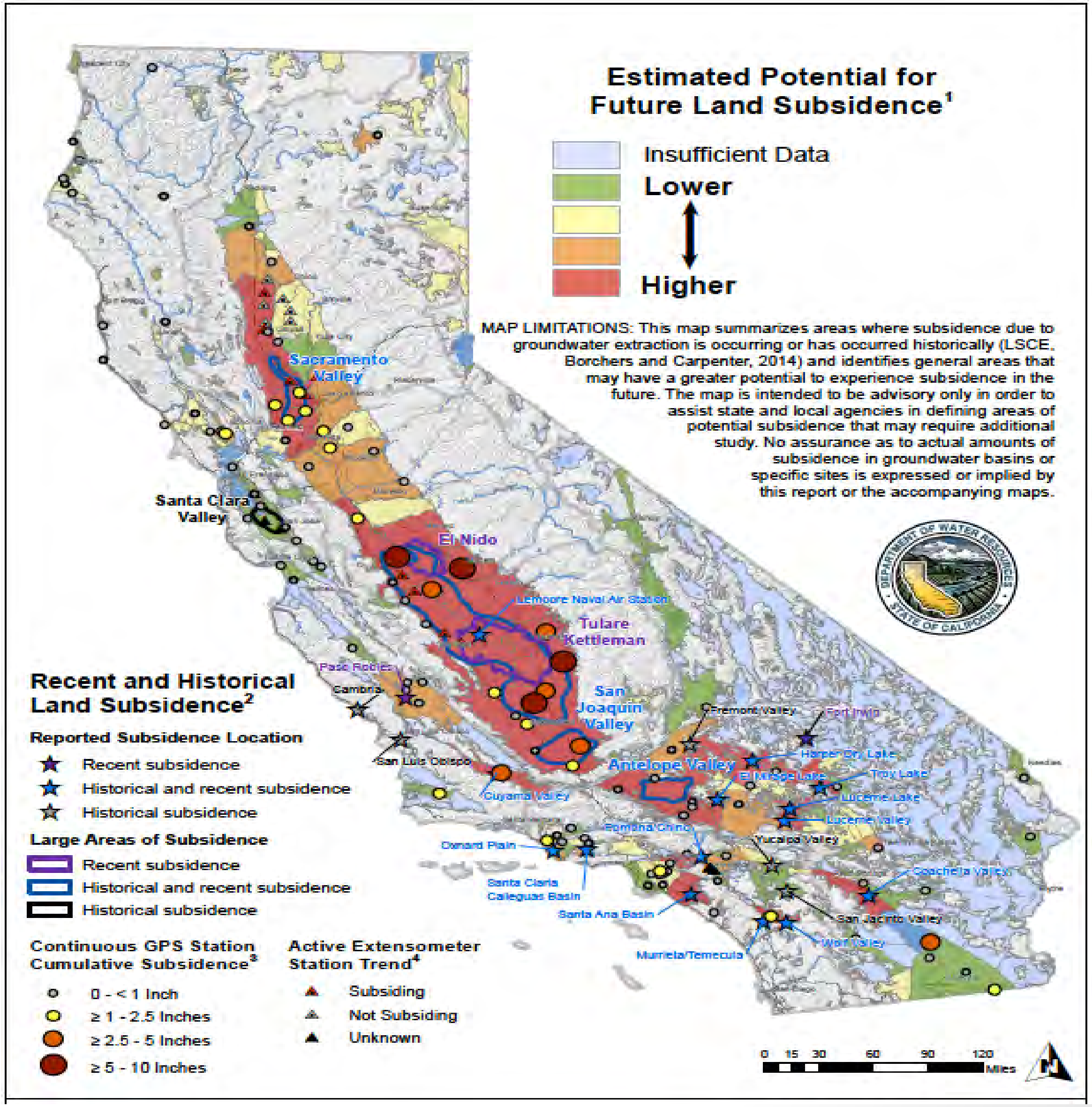
Cumulative Change in Storage
Central Valley 1962-2014



1900-1998 GW Level Change to 2008-2014



Historic to Present Land Subsidence



Summary of Recent, Historical, and Estimated Potential Land Subsidence in California, DWR, 2014

Sustainable Groundwater Management Act (SGMA) Steps to Groundwater Sustainability

Step one
Form Groundwater Sustainability Agency
June 30, 2017

Step two
Develop Groundwater Sustainability Plan
January 31, 2022
January 31, 2020**

Step three
Achieve Sustainability
20 years after adoption of plan*
January 31, 2042
January 31, 2040**

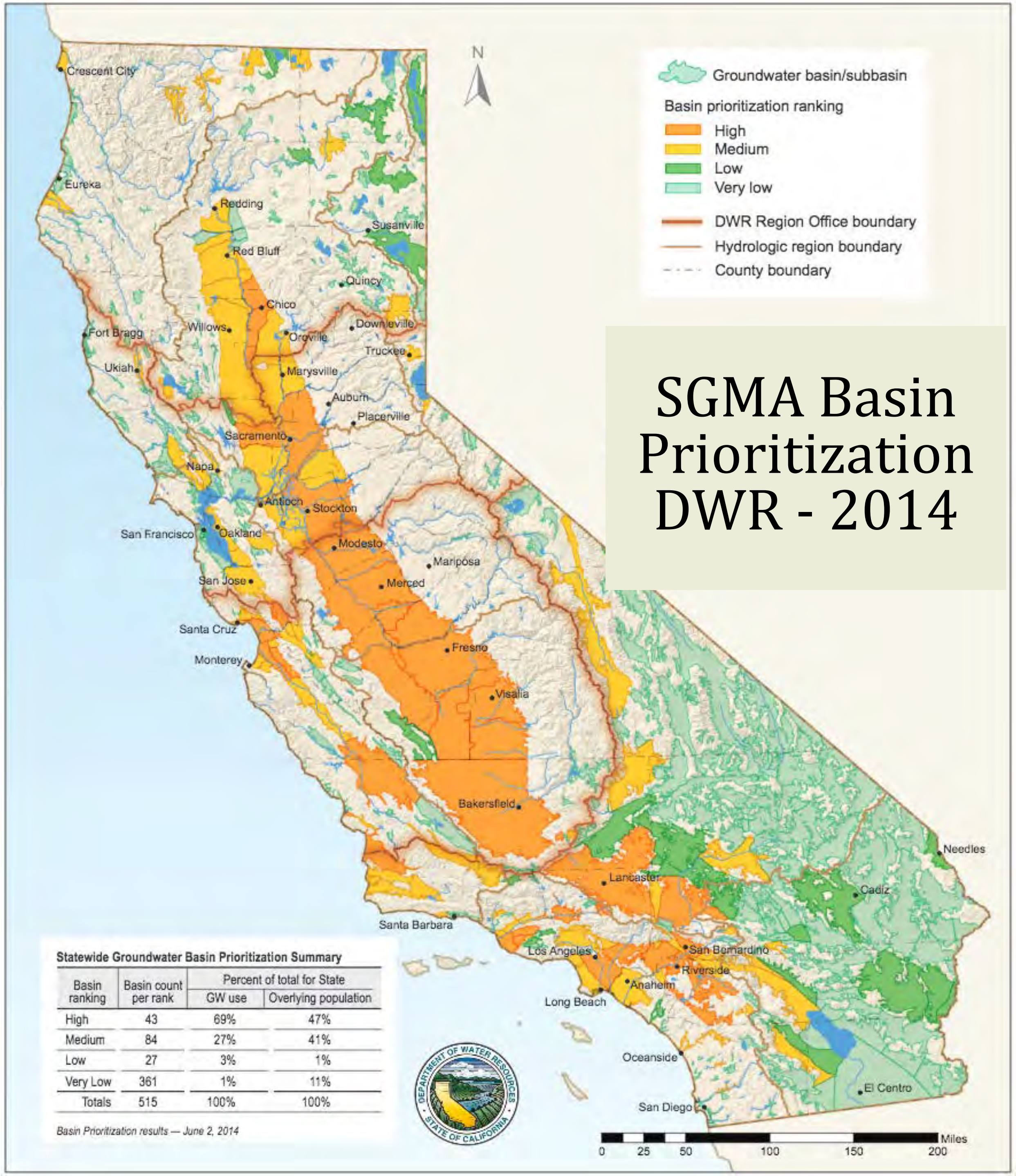
* DWR may grant up to two, five-year extensions on implementation upon showing good cause and progress.

** Critically overdrafted basins have two years less for GSP and to achieve sustainability.

Basin Prioritization

- Current Population
- Projected Growth
- Public Supply Well Density
- Total Well Density
- Irrigated Land Area
- Groundwater Reliance
  - Groundwater use
  - Percentage of Total Use
- Groundwater Impacts
  - Overdraft
  - Subsidence
  - Seawater Intrusion
  - Water Quality Degradation
- Surface Water Depletion from Pumping and Impacts to Groudnwater Dependent Ecosystems

SGMA Basin Prioritization DWR - 2014



Statewide Groundwater Basin Prioritization Summary

Basin ranking	Basin count per rank	Percent of total for State	
		GW use	Overlying population
High	43	69%	47%
Medium	84	27%	41%
Low	27	3%	1%
Very Low	361	1%	11%
Totals	515	100%	100%

Basin Prioritization results — June 2, 2014

Basin Subject to Critical Conditions of Overdraft

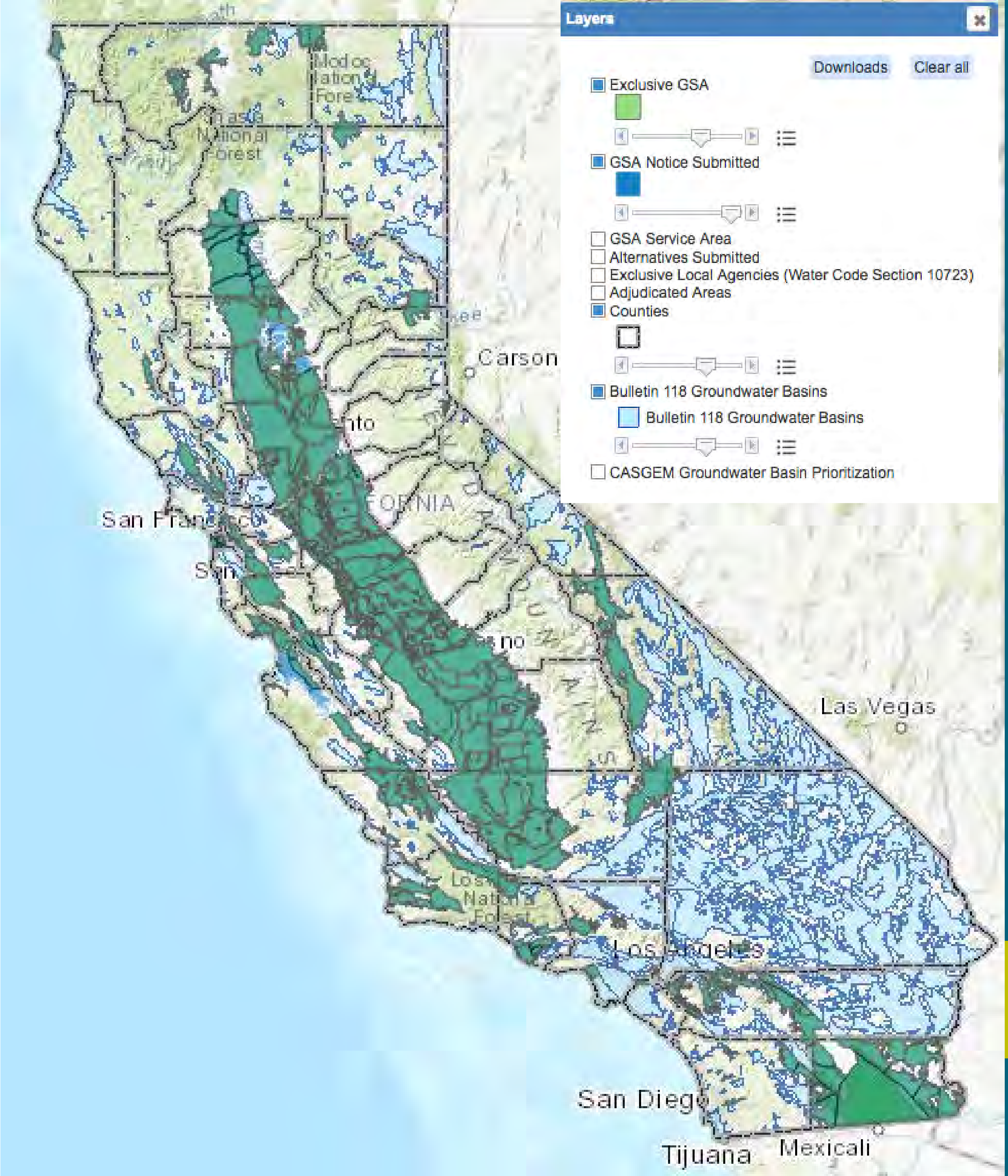
"When continuation of present water management practices would probably result in significant adverse overdraft-related environmental, social, or economic impacts"

- Groundwater Level Trends Over Selected Periods
- Adverse Impacts
  - Land Subsidence
  - Seawater Intrusion
  - Water Quality Degradation
  - Groundwater Level Declines During Normal and Wet Periods

Prepared by California Department of Water Resources for *Bulletin 118, Interim Update 2016.*

GSAs Formed

- Local agency or combination of local agencies
- "Local agency" is any public agency that does one of the following:
  - Supplies water
  - Manages water
  - Controls land use
    - Over 2,000 local agencies have some sort of land use or water authority or responsibility
- Counties are the default GSA in "unmanaged" areas
  - State broken up into 58 counties
- Can be more than one GSA in basin



Groundwater Sustainability Plan (GSP) Requirements

- Describe the basin conditions, using a hydrologic conceptual model
- Describe the basin-specific monitoring network
- Establish numerical thresholds and measurable objectives to avoid undesirable results:

- Identify projects and actions needed to achieve or maintain sustainable conditions within 20 years and 50-year projections

…AND, must be completed by January 31, 2020 or 2022

GSP Components and Process

- Initial Notification
- Community Engagement and Outreach Program
- Plan Area and Basin Setting
- Sustainable Management Criteria
- Monitoring Program and Data Gaps Identified
- Projects and Management Actions
- Implementation and Funding Plan

Plan Area and Basin Setting

- Describe Plan Area
- Evaluate and Describe Basin Setting
  - Hydrogeologic Conceptual Model
  - Water Balance
  - Basin Management Areas
- Update Groundwater Simulator
- Comprehensive Data Management System
- Public Data Portal

Define Sustainability and Metrics

- Develop Sustainable Management Criteria
  - Sustainability Goal
  - Significant and Unreasonable Undesirable Results
  - Minimum Thresholds
  - Measurable Objectives
  - Interim Milestones
  - Assess Data Gaps and Develop Monitoring System
  - Establish Monitoring Program with Protocols to Measure Sustainable Management Criteria

Develop Scope of Projects and Management Actions

- Assemble Potential Projects and Management Actions
  - Groundwater Model Simulations
  - Feasibility Analyses
  - Screening & Prioritization
  - Uncertainty Analysis
- Prepare GSP Implementation Plan
  - Funding and Finance
  - Schedule
  - Reporting and Adaptive Management

Groundwater Resources Association of California
EST. 1992

UC WATER
Security and Sustainability Research Initiative

Call to Action to Recharge Depleted Aquifers in California

Recap of GRA-UC Water Oct 2017 Recharge Roundtable Workshop

Timothy K. Parker

Parker Groundwater & GRA, Sacramento, CA

Graham E. Fogg

Hydrologic Sciences; Land, Air and Water Resources; Earth and Planetary Sciences

University of California, Davis, CA

UC DAVIS
UNIVERSITY OF CALIFORNIA

Background slide from Helen Dahlke

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Recharge Roundtable Participants

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Christina Babbitt	Environmental Defense Fund
Sam Boland-Brien	State Water Resources Control Board
David Bolland	Association of California Water Agencies
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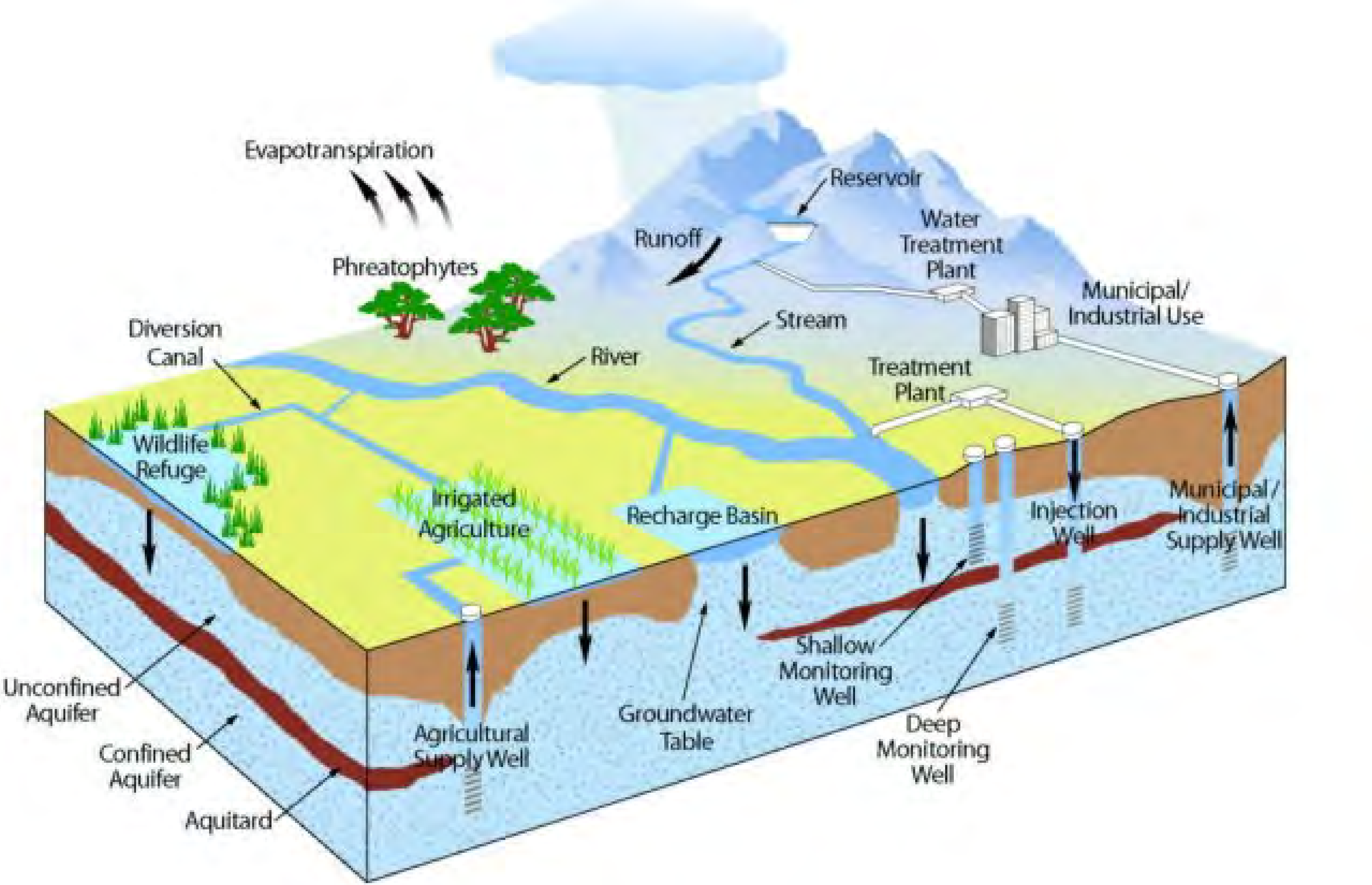
Marcus Trotta	Sonoma County Water Agency
Jim Wieking	California Department of Water Resources


Evapotranspiration
Reservoir
Runoff
Water Treatment Plant
Phreatophytes
Municipal/ Industrial Use
Diversion Canal
Stream
River
Treatment Plant
Wildlife Refuge
Irrigated Agriculture
Recharge Basin
Injection Well
Municipal/ Industrial Supply Well
Shallow Monitoring Well
Unconfined Aquifer
Groundwater Table
Deep Monitoring Well
Agricultural Supply Well
Confined Aquifer
Aquitard

The Challenge and Opportunity

- Central Valley overdraft of 0.5-2.8 MAF **(0.6-3.4 km^3)**
- (Beganskas & Fisher’s [2017] reanalysis of CA Water Plan numbers indicates statewide deficits of 5.1-11.9 MAF **(6.3-14.7 km^3)**
- during 2001-2010).
- Overdraft can only be eliminated by reducing pumping or **increasing recharge**.
- Water theoretically available to recharge, but only during short time spans; and it will get worse.
- Amounts: 2.7 & 1.3 MAF **(3.3-1.7 km^3)** in Sacramento & San Joaquin Valleys during wet years, which occur during 7 and 4.7 years out of 10 years (Kocis & Dahlke, 2017).

The Challenge and Opportunity

- Getting the theoretical water to where you need it.
- How to get the water underground promptly?
- Uncertainty about adequacy of legal basis for diverting, storing and extracting.
- Groundwater quality is degrading. How to stabilize?
- A small number of big projects alone will not fix the problem. How to incentivize 100’s-1000’s of smaller projects?

Available Central Valley Storage Volume

- 140 reservoirs can store 42 MAF **(52.8 cubic kilometers)**
- In Central Valley subsurface, room for another 140 MAF

(172.7 km^3)

RECOMMENDED ACTIONS

1. How much water is hydrologically available for recharge?

- **1.a Find the low-hanging fruit: Determine what high-magnitude (flood) flows are available for recharge and not subject to water rights limitations.**
- **1.b Determine what high-magnitude flows are available above the necessary environmental and functional flows.**
- 1.c Determine likely future changes in timing and magnitude of streamflow due to climate change through integrated modeling of regional climate and regional hydrology.

RECOMMENDED ACTIONS

2. How much recharge can be accomplished based on site conditions – soils and hydrogeology?

2.a Further update soils mapping to identify the best soils for recharge.

2.b Map the subsurface geology with a particular focus on identifying locations where benefits of recharge can spread deeply and regionally. 2.c Continue improving the maps of groundwater levels, including the water table.

2.d Develop maps of recharge favorability based on a combination of soils, geologic, topographic, hydrologic and land use information.

2.e Measure recharge rates in controlled ponding experiments to develop better estimates of recharge volumes in full-scale recharge facilities.

RECOMMENDED ACTIONS

3. What are the legal and regulatory bottlenecks, and how can they be eliminated or reduced?

3.a Conduct a comprehensive review and evaluation of the current "temporary permitting process" to determine whether it is sufficiently effective to support large increases in diversions in the future.

3.b Provide education and guidance, including case studies, to educate local districts on the process of applying for permits to capture high-magnitude flows, and to ensure that applicants engage in the activity sufficiently early to succeed.

3.c Clarify and strengthen the legal foundations related to recharge such that the legal uncertainties do not act as disincentives to large increases in recharge projects and amounts.

RECOMMENDED ACTIONS

4. How to incentivize 100's to 1000's of recharge projects?

4.a Develop short- and long-term funding models for Groundwater Sustainability Agencies (GSAs).

4.b Set a statewide recharge goal determined on the basis of statewide water availability and local and regional needs, including buffers for climate variability and long-term drought resiliency.

4.c Extend knowledge to water stakeholders on consequences of overdraft and benefits of carefully managing both pumping and recharge.

4.d Develop guidance for GSAs and other basin managers on strategies for satisfying the cost and benefit proportionality requirements of Prop 218 and Prop 26, as required by SGMA in Water Code Section § 10730.2(a),(c), thereby assisting proponents of recharge projects to avoid inadvertently triggering an election as a precondition of imposing a groundwater recharge fee or assessment.

5. What changes in reservoir operation and conveyance are needed?

5.a Develop the means of jointly managing the water stores in both surface reservoirs and groundwater.

5.b Revise reservoir operations based on multiple objectives that include flood protection, drought preparedness, groundwater sustainability, and ecosystem restoration.

5.c Develop rehabilitation plans for existing conveyance facilities and assess needs for new conveyance capabilities to fulfill the integrated reoperation of surface and groundwater reservoirs, with particular attention to opportunities offered by high flood flows and high-capacity recharge areas.

Groundwater Resources Association of California

RECOMMENDED ACTIONS

UC WATER Security and Sustainability Research Initiative

6. What are the water quality benefits and concerns of recharge?

6.a Continue the GAMA (California Ambient Monitoring and Assessment Program), but examine whether it is adequate for providing a baseline of both shallow and deep groundwater quality information with which to ascertain water quality effects of recharge.

6.b Estimate through the use of data and models the long-term future changes of groundwater quality under different land and water management strategies that include all the major sources of recharge, including irrigation, ongoing MAR operations, Flood-MAR, and others.

6.c Reexamine California's water quality regulatory system to ascertain whether this system would be compatible with efforts to massively increase recharge.

Yolo Bypass in Flood