Update on the Sustainable Groundwater Management Act

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http://groundwater.ucdavis.edu

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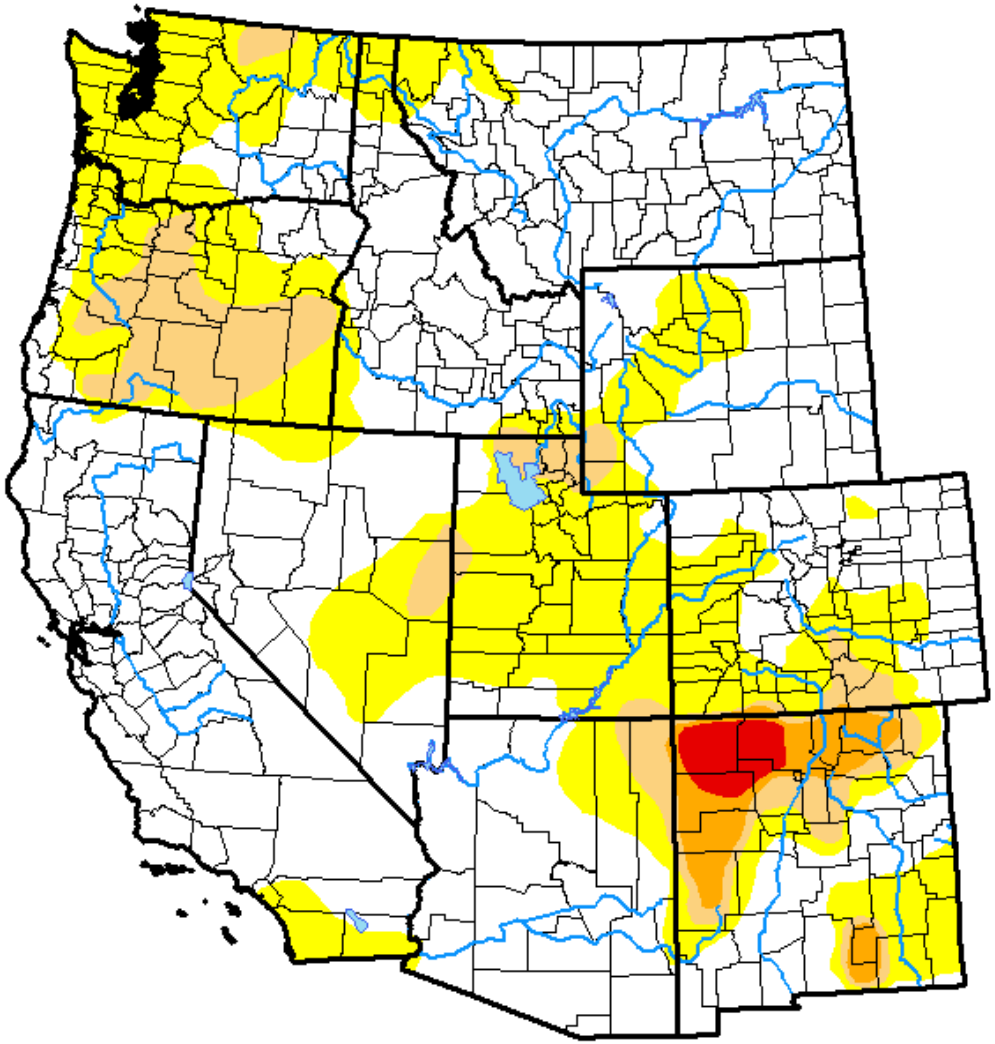
Thomas Harter, UC Davis

U.S. Drought Monitor
West

March 19, 2019
(Released Thursday, Mar. 21, 2019)
Valid 8 a.m. EDT



Intensity:

- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

Author:
Jessica Blunden
NCEI/NOAA

http://droughtmonitor.unl.edu/

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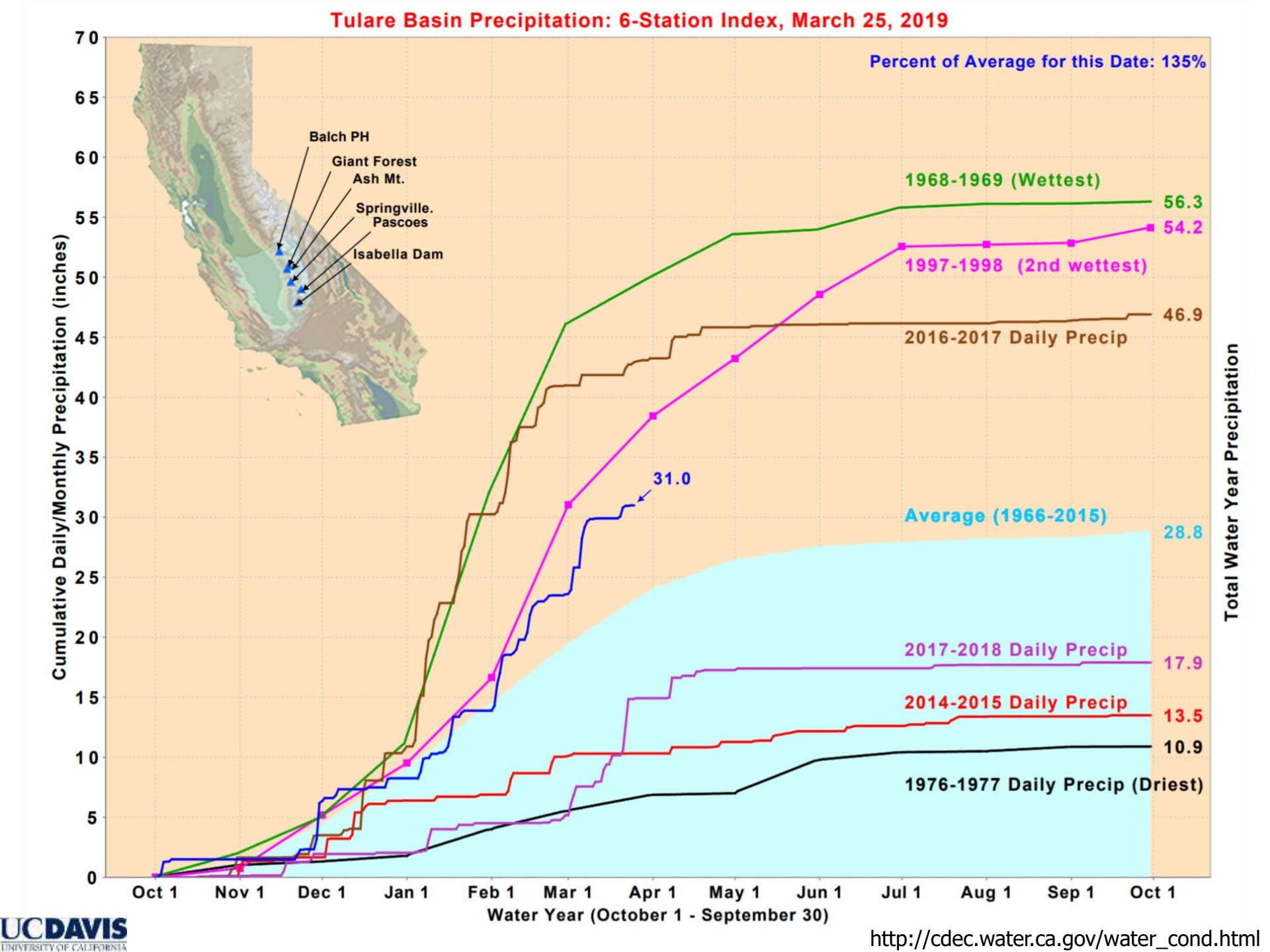

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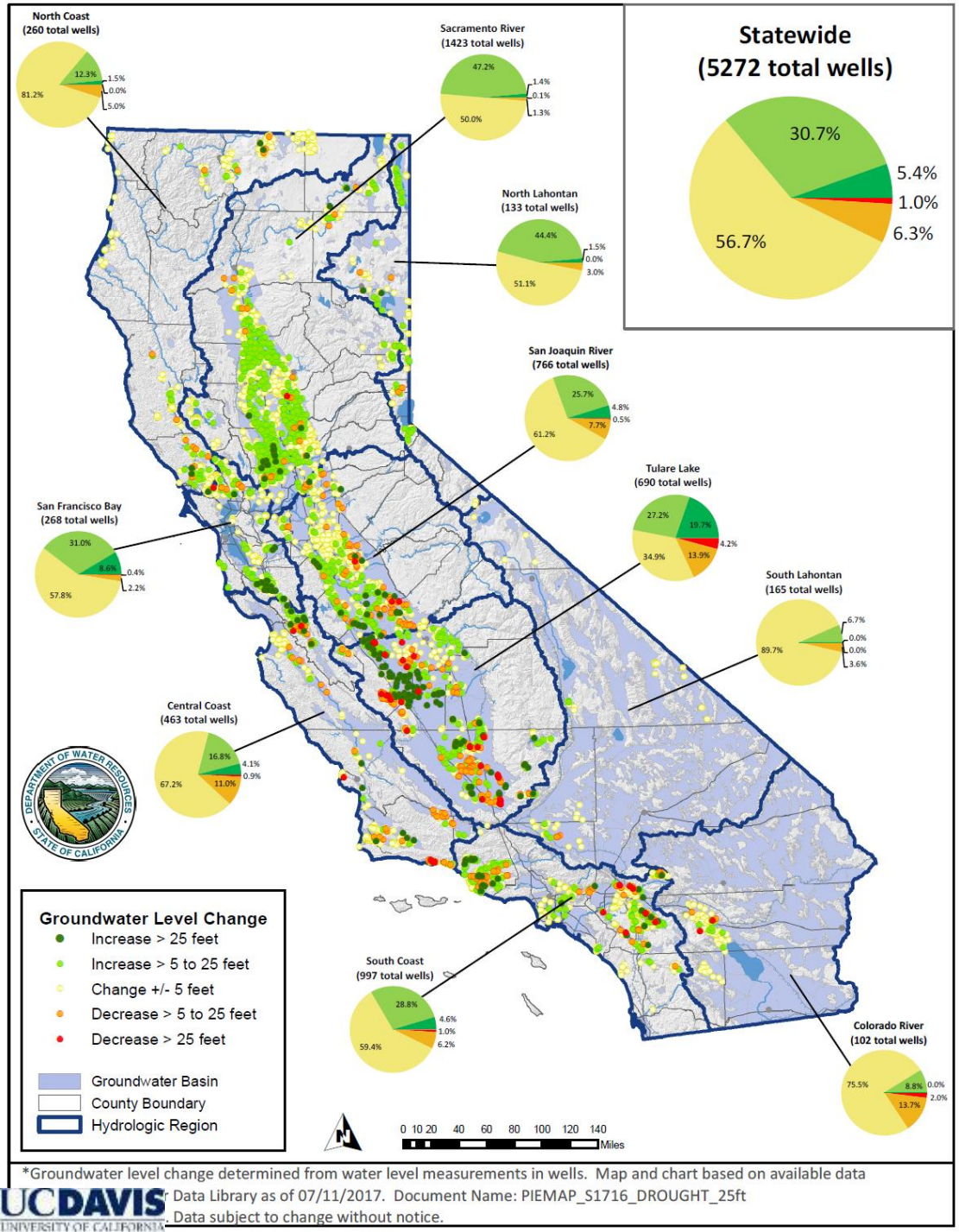
http://cdec.water.ca.gov/water_cond.html

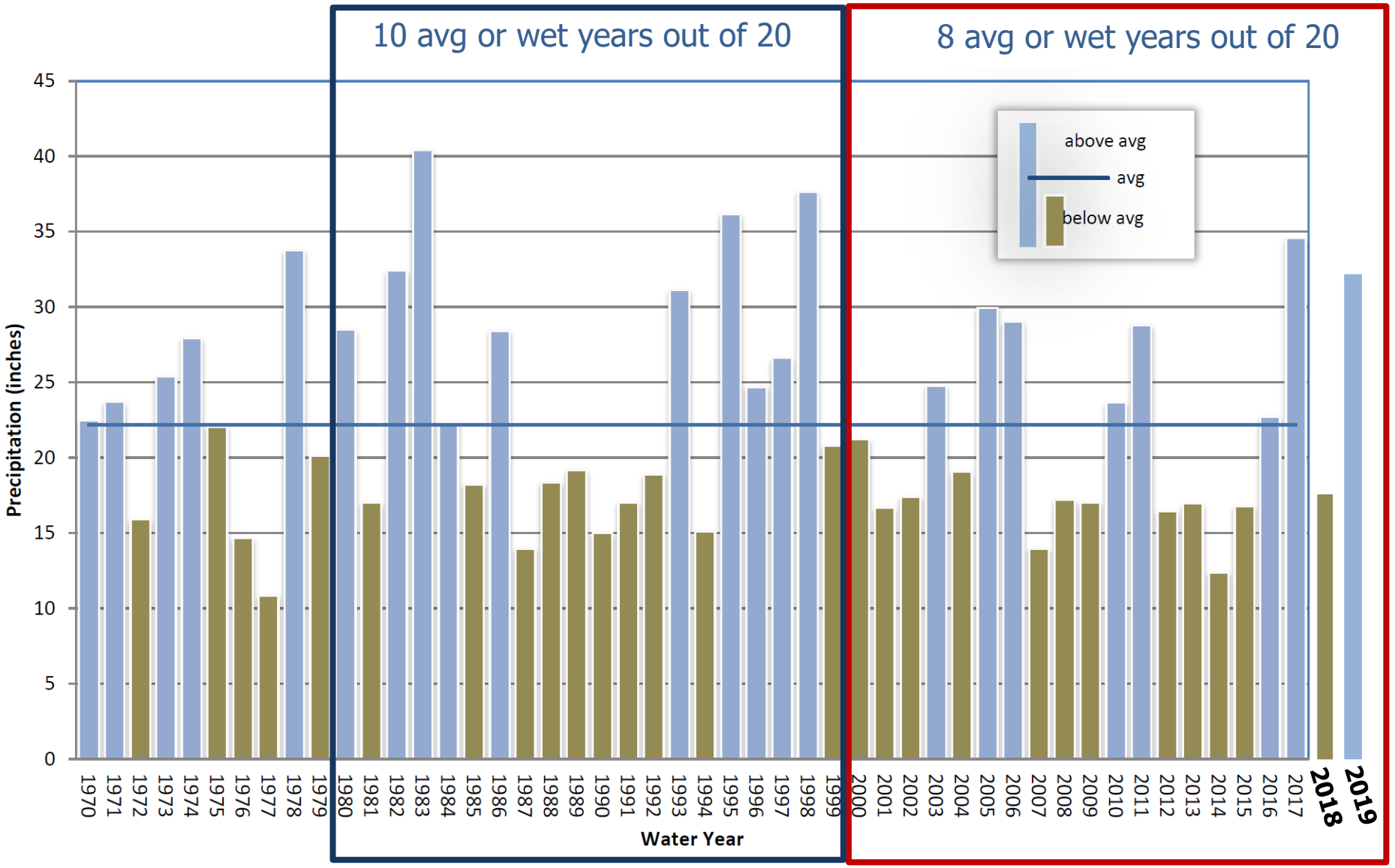


*Groundwater level change determined from water level measurements in wells. Map and chart based on available data
Data Library as of 07/11/2017. Document Name: PIEMAP_S1716_DROUGHT_25ft
Data subject to change without notice.

Groundwater Level Change will be similar to:

Spring 2016 to Spring 2017

Source: DWR 2017



Harter and Brewster, California Water Blog, April 9, 2018; Data from DWR, 2017

https://californiawaterblog.com/2018/04/08/groundwater-recovery-in-california-still-behind-the-curve/

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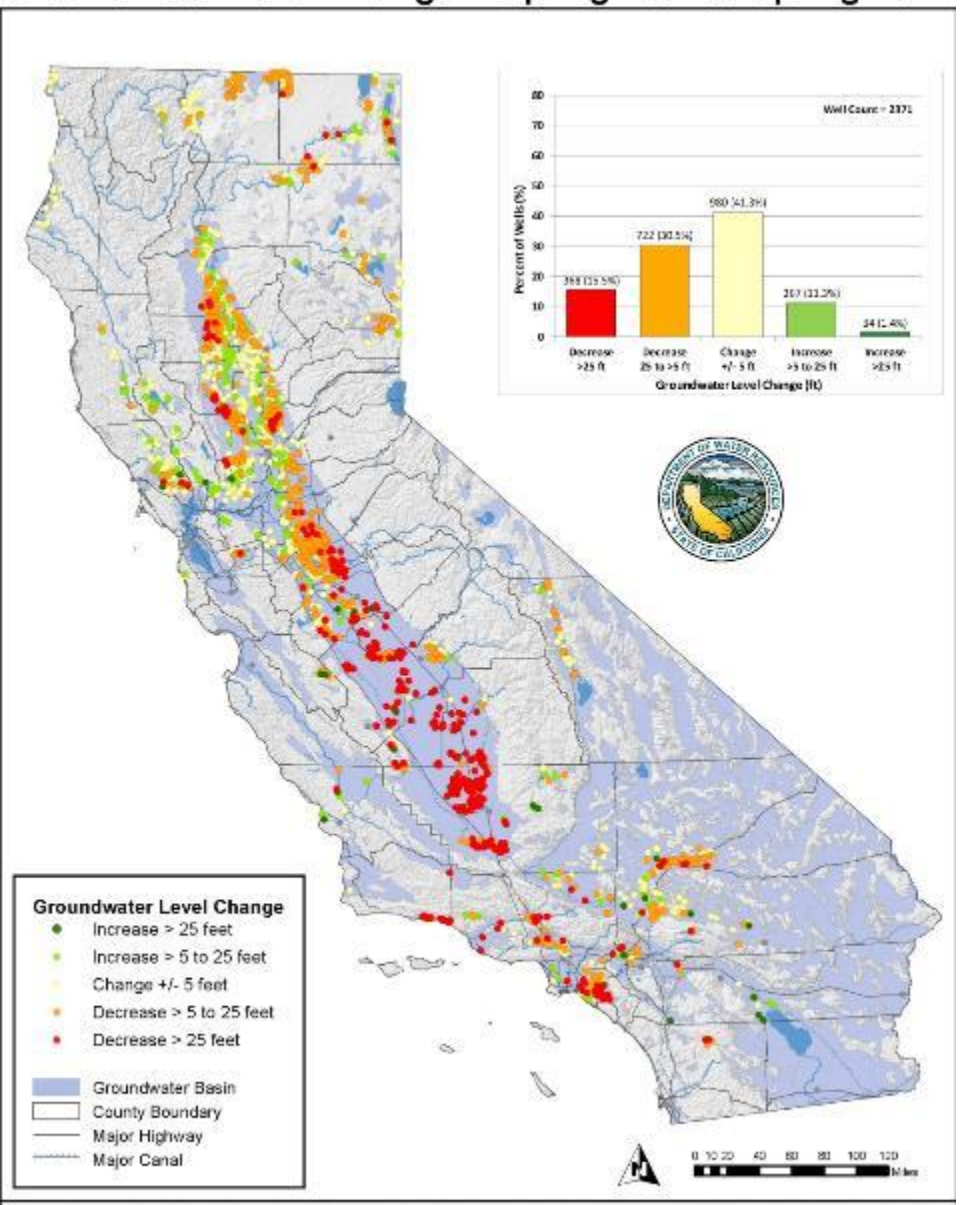
Groundwater Level Change* - Spring 2007 to Spring 2017



*Groundwater level change determined from water level measurements in wells. Map and chart based on available data from the DWR Water Data Library as of 02/21/2018. Document Name: Spring_2007_2017_DOTMAP Updated: 3/21/2018 Data subject to change without notice.

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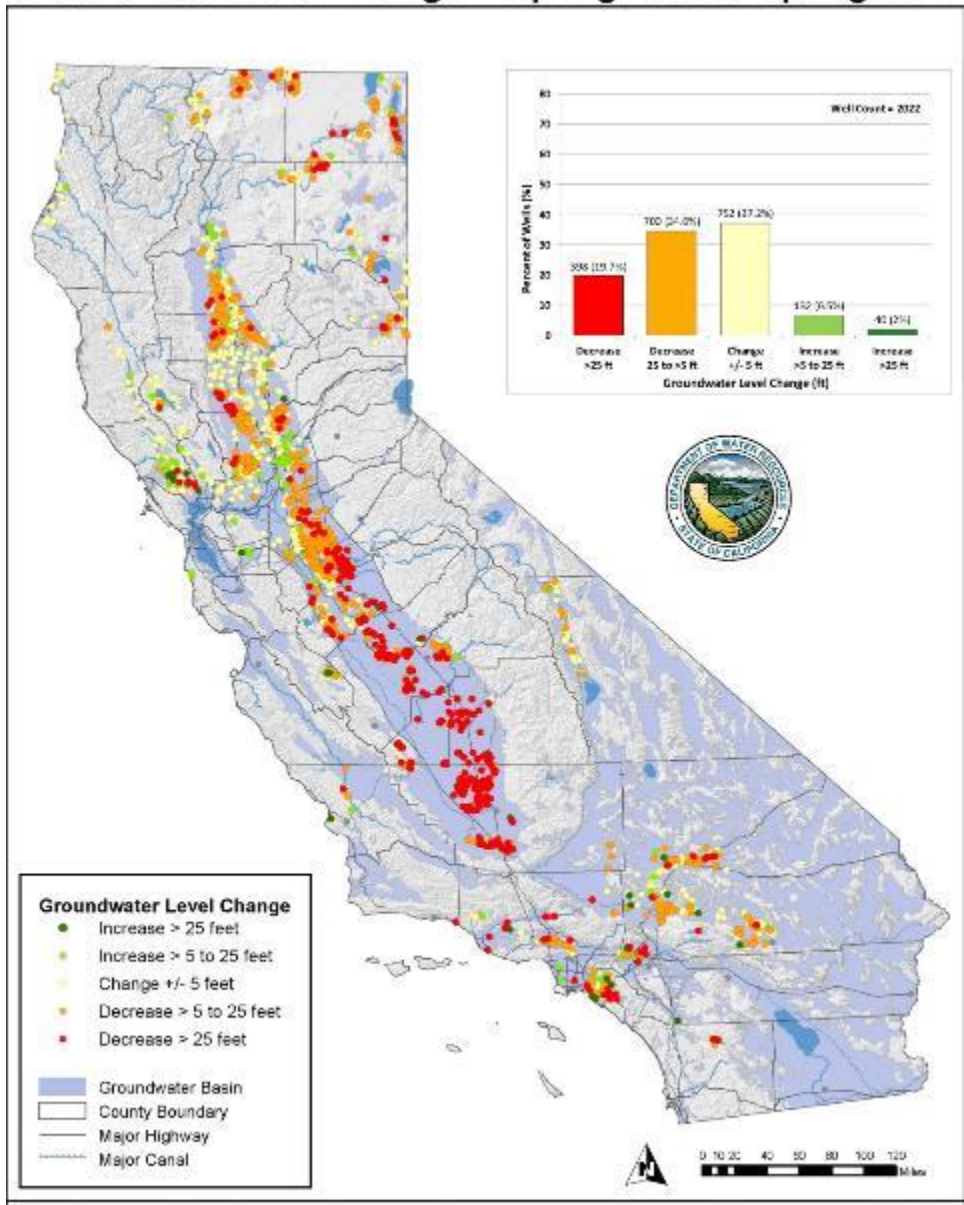
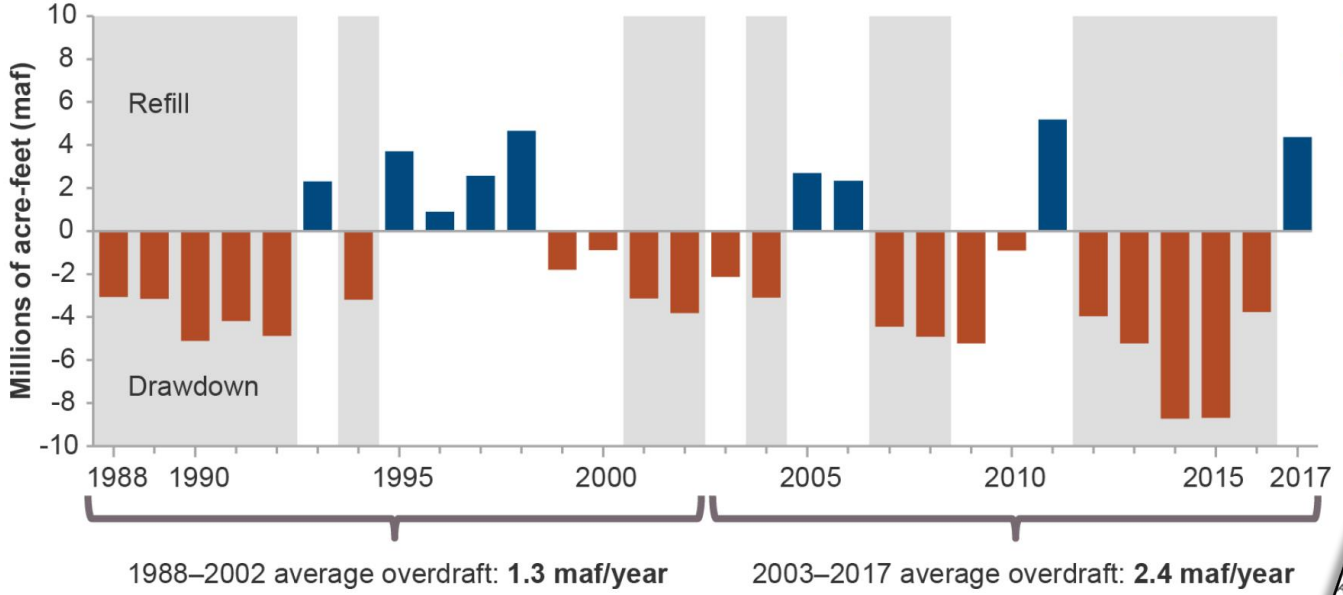
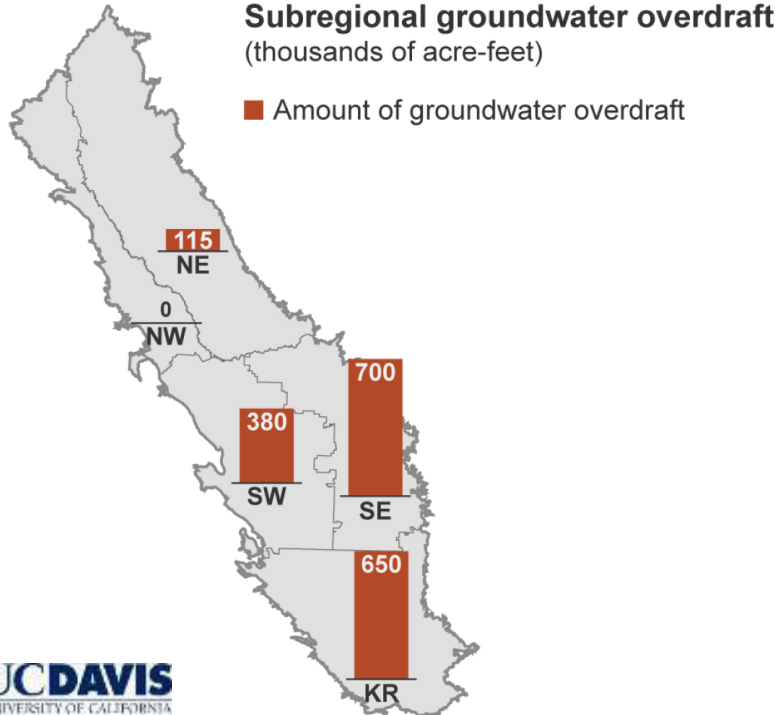
Groundwater Level Change* - Spring 2000 to Spring 2017

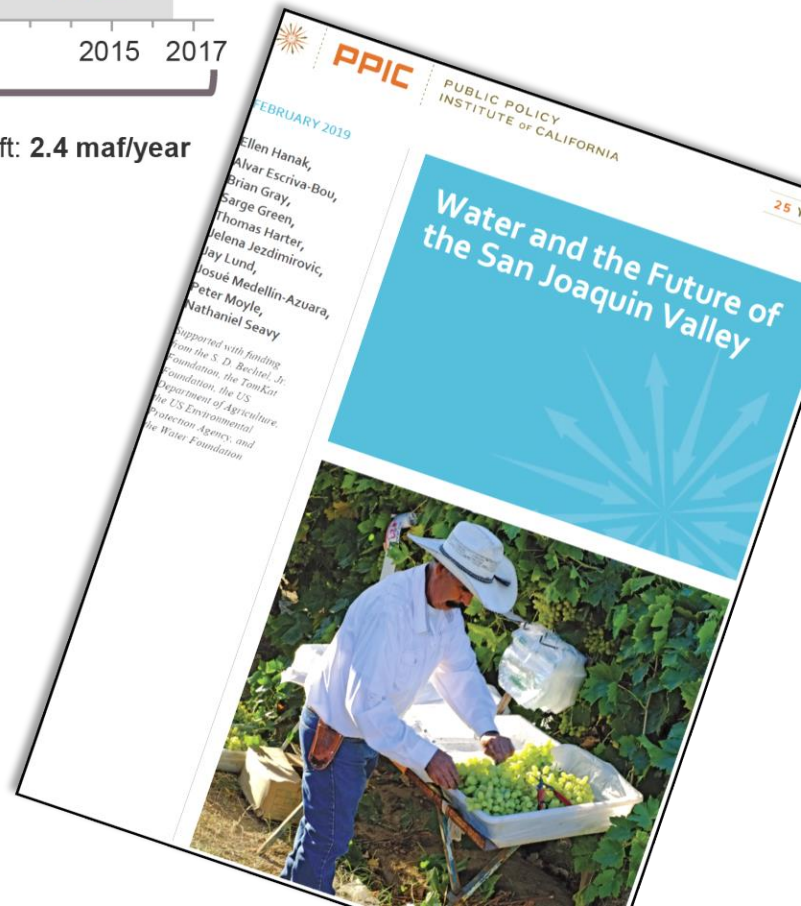


*Groundwater level change determined from water level measurements in wells. Map and chart based on available data from the DWR Water Data Library as of 02/21/2018. Document Name: Spring_2000_2017_DOTMAP Updated: 3/21/2018 Data subject to change without notice.

30-Year Overdraft in the San Joaquin Valley: 1.8 MAF/year







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Sustainable Groundwater Management Act of 2014

SEC. 2.

Section 113 is added to the Water Code, to read:

113.

It is the policy of the state that **groundwater resources be managed sustainably for long-term reliability and multiple economic, social, and environmental benefits** for current and future beneficial uses.

Sustainable groundwater **management is best achieved locally** through the development, implementation, and updating of plans and programs based on the best available science.

[emphasis added]

Sustainability = No "Undesirable Results"

10721. Unless the context otherwise requires, the following definitions govern the construction of this part:

(u) "Sustainable groundwater management" means the management and use of groundwater in a manner that can be maintained during the planning and implementation horizon without causing undesirable results.

(w) **"Undesirable result" means one or more of the following** effects caused by groundwater conditions occurring throughout the basin (Section 10721 (w)):

(1) **Chronic lowering of groundwater levels** indicating a significant and unreasonable depletion of supply if continued over the planning and implementation horizon. Overdraft during a period of drought is not sufficient to establish a chronic lowering of groundwater levels if extractions and recharge are managed as necessary to ensure that reductions in groundwater levels or storage during a period of drought are offset by increases in groundwater levels or storage during other periods.

(2) Significant and unreasonable **reduction of groundwater storage**.

(3) Significant and unreasonable **seawater intrusion**.

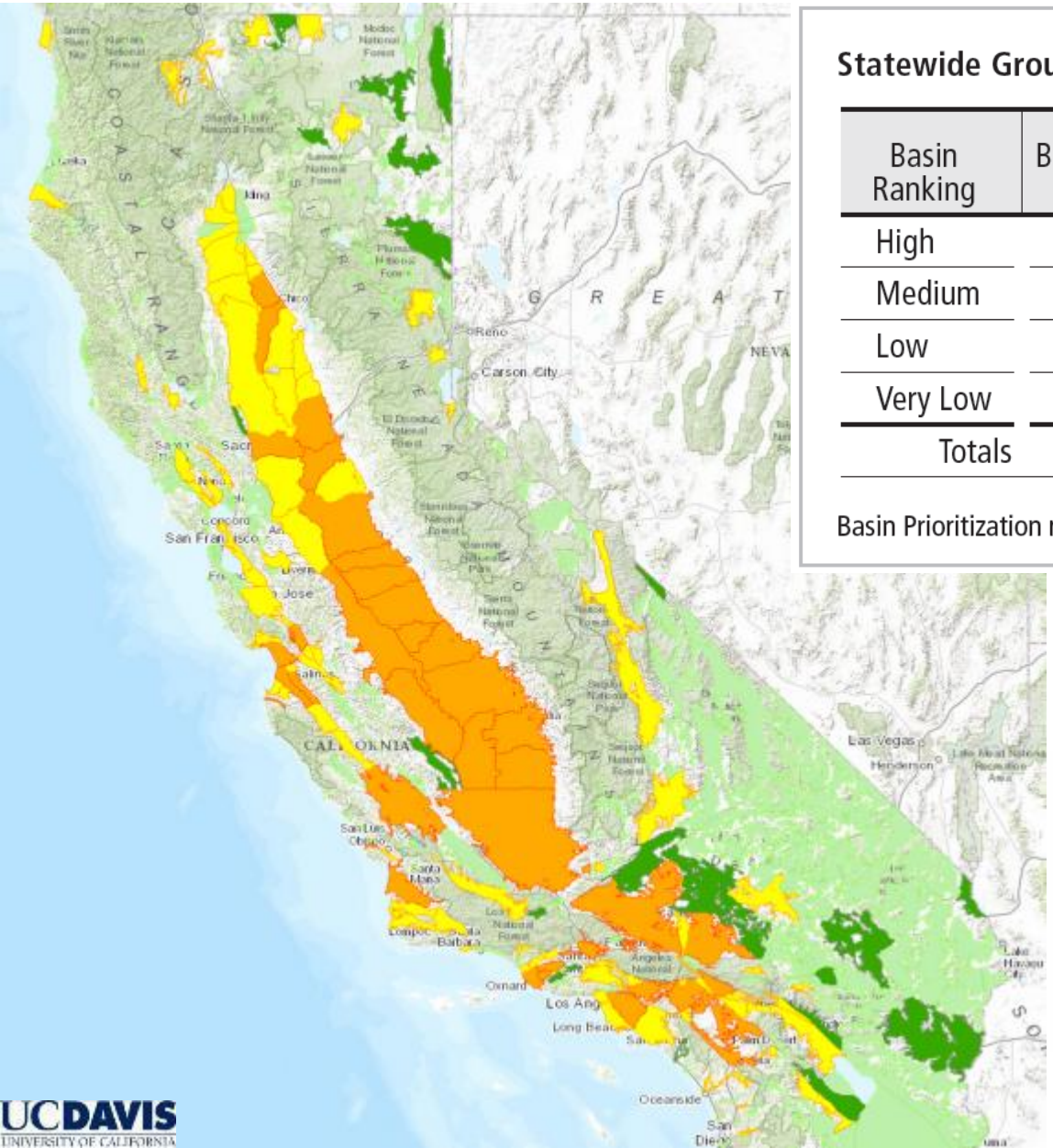
(4) Significant and unreasonable **degraded water quality**, including the migration of contaminant plumes that impair water supplies.

(5) Significant and unreasonable **land subsidence** that substantially interferes with surface land uses.

(6) **Surface water depletions** that have significant and unreasonable adverse impacts on beneficial uses of the surface water.

[emphasis added]

Medium and High Priority Groundwater Basins



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%

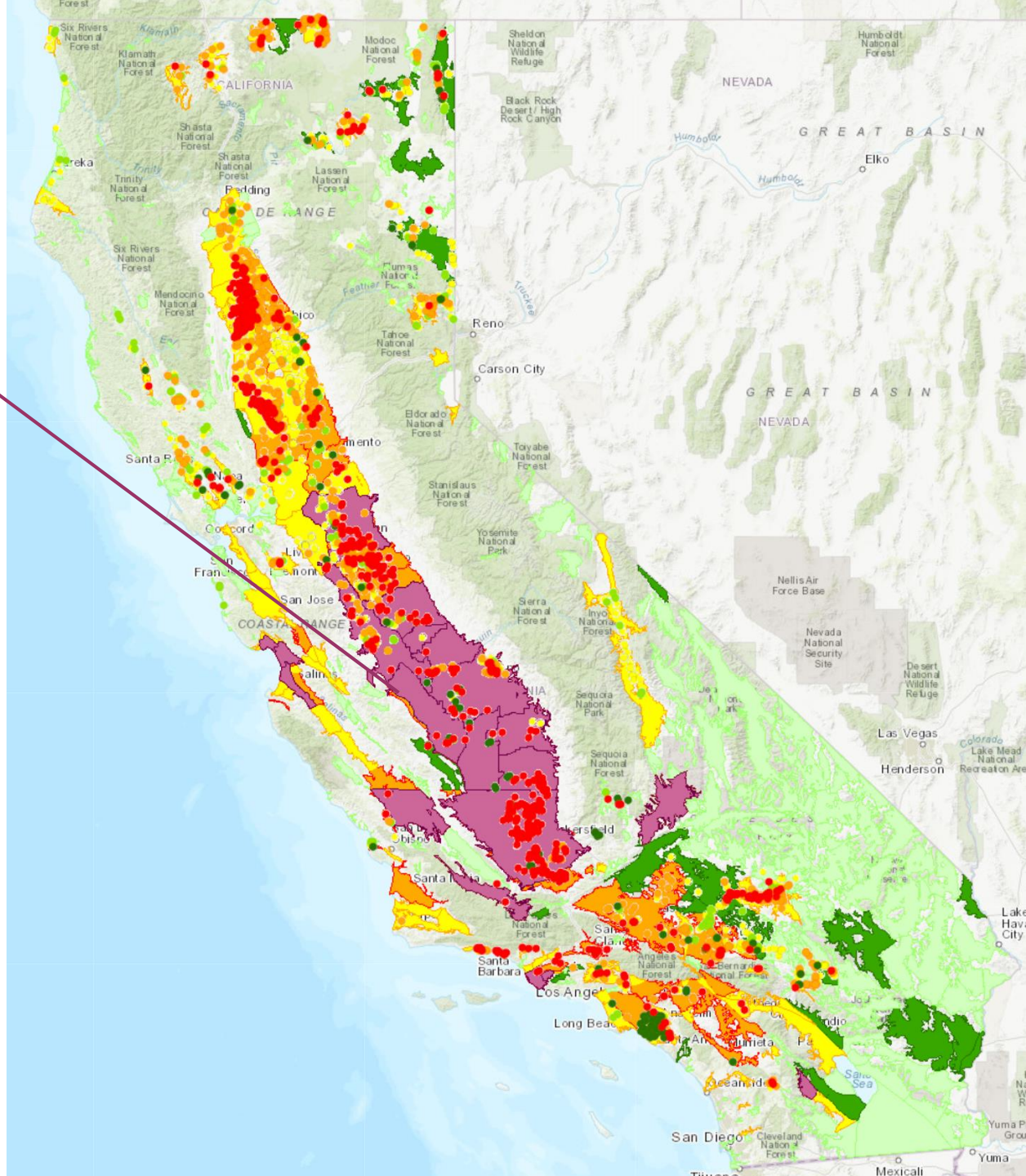
Basin Prioritization results – June 2, 2014

CASGEM Groundwater Basin Prioritization

- High
- Medium
- Low
- Very Low

California Department of Water Resources, 2017

Critically Overdrafted Basins



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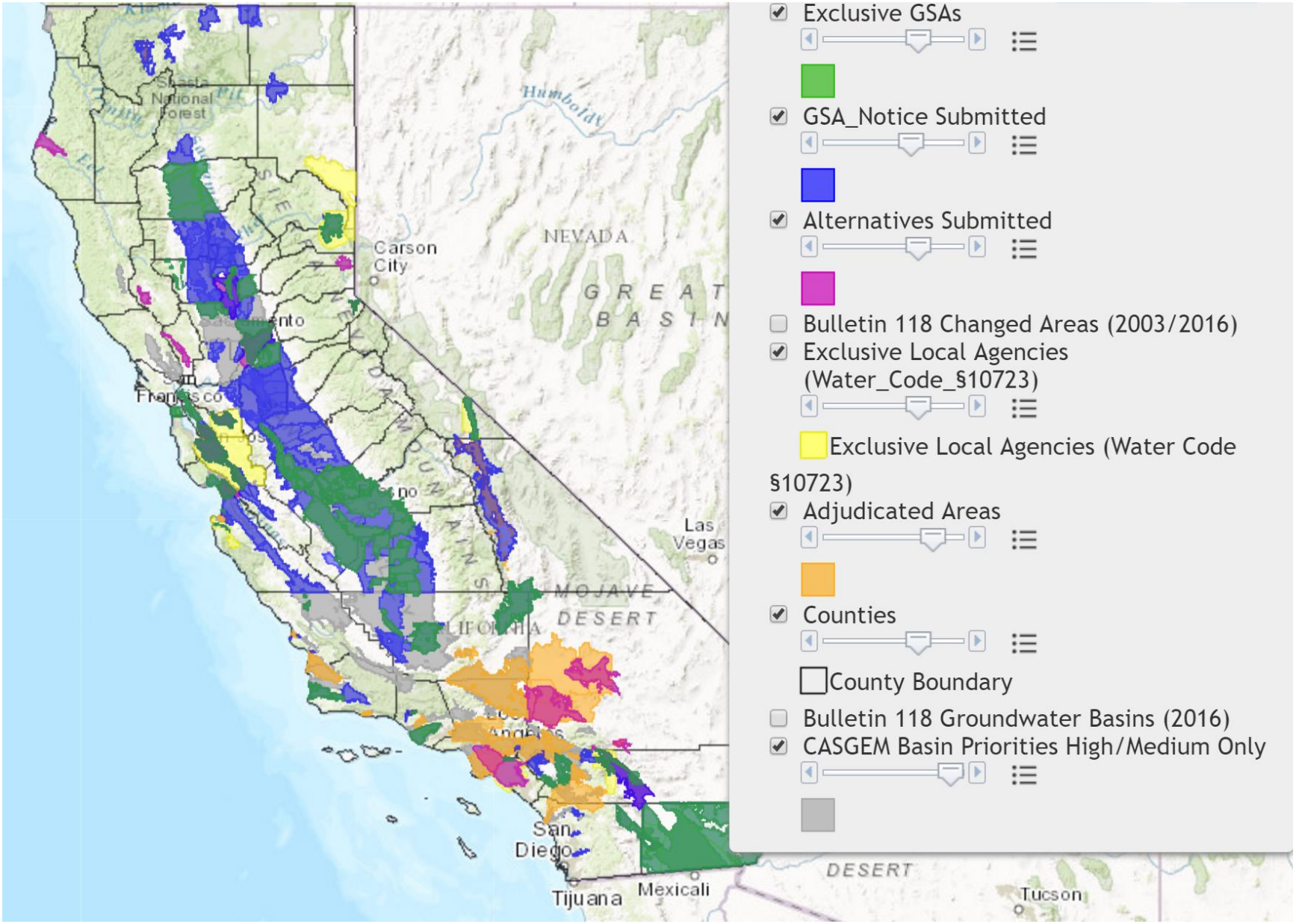
Map of Current GSAs and Other Groundwater Jurisdictions



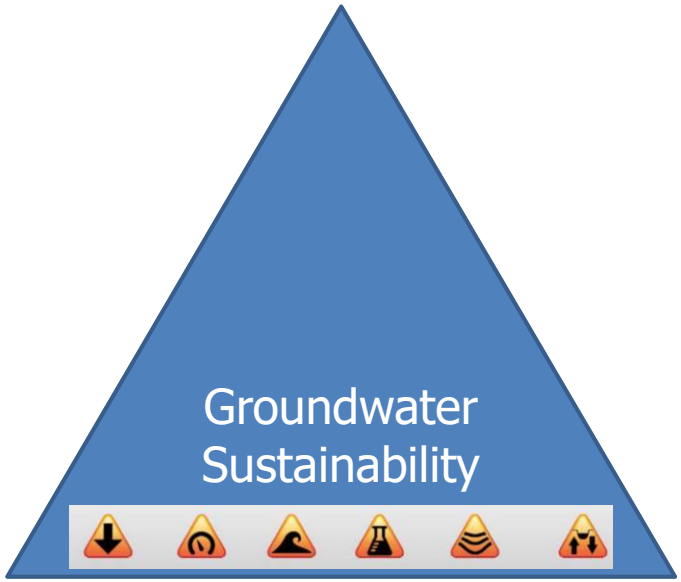
Measure of Groundwater Sustainability: Sustainability Indicators

California Department of Water Resources, 2016

Goal of the GSP:

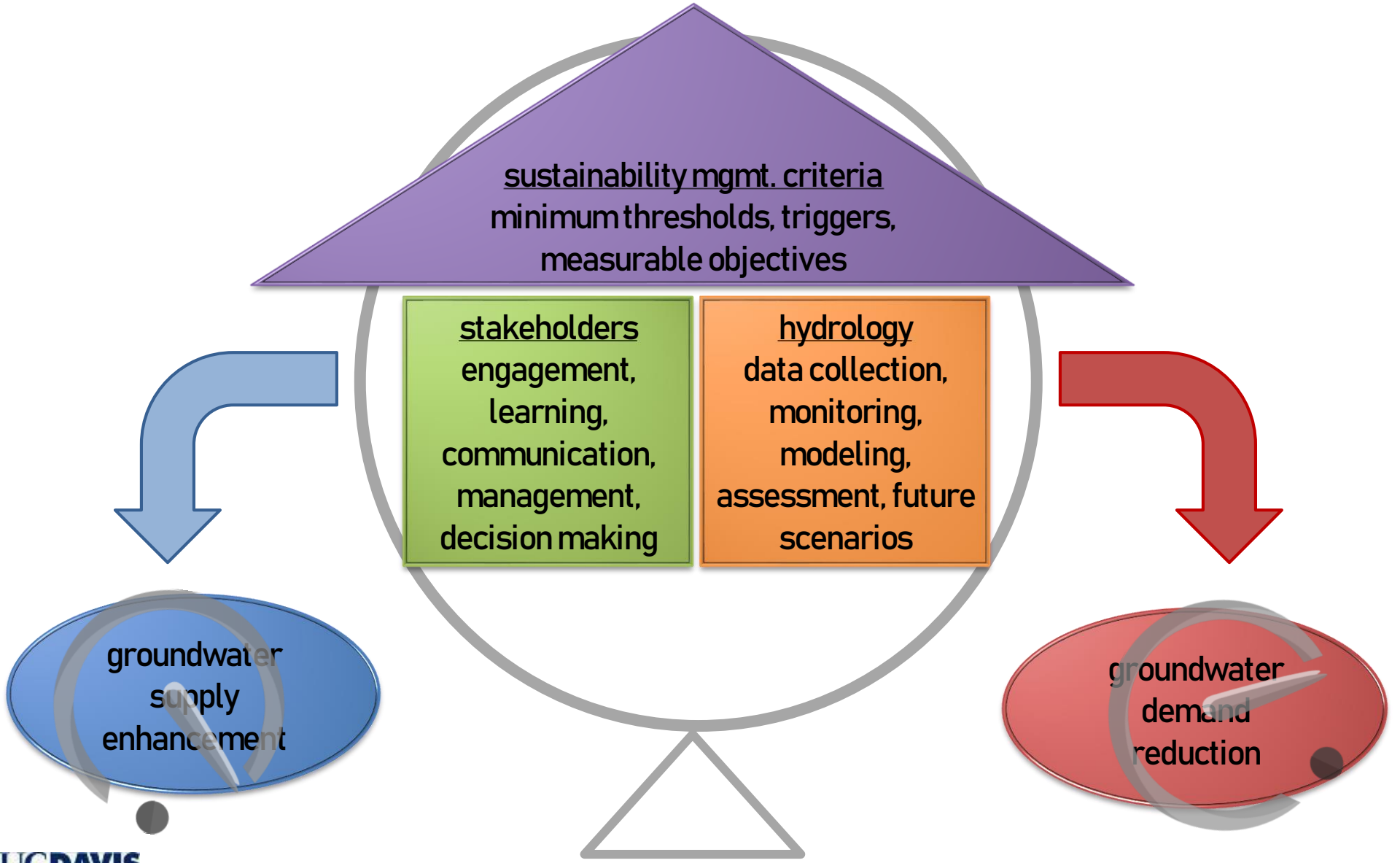
→ maintain sustainability indicators in good status

Developing a GSP – An Optimization Problem

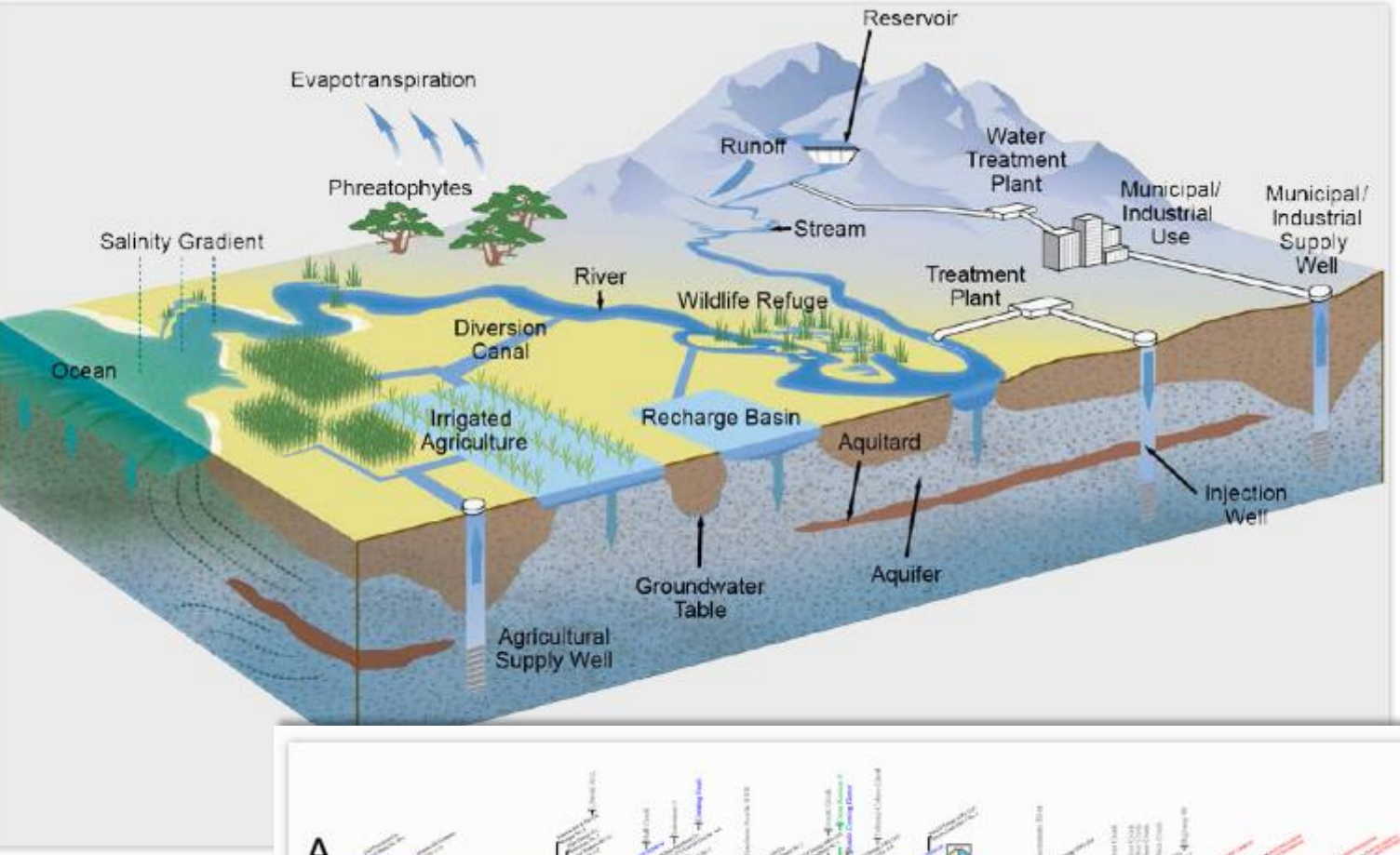


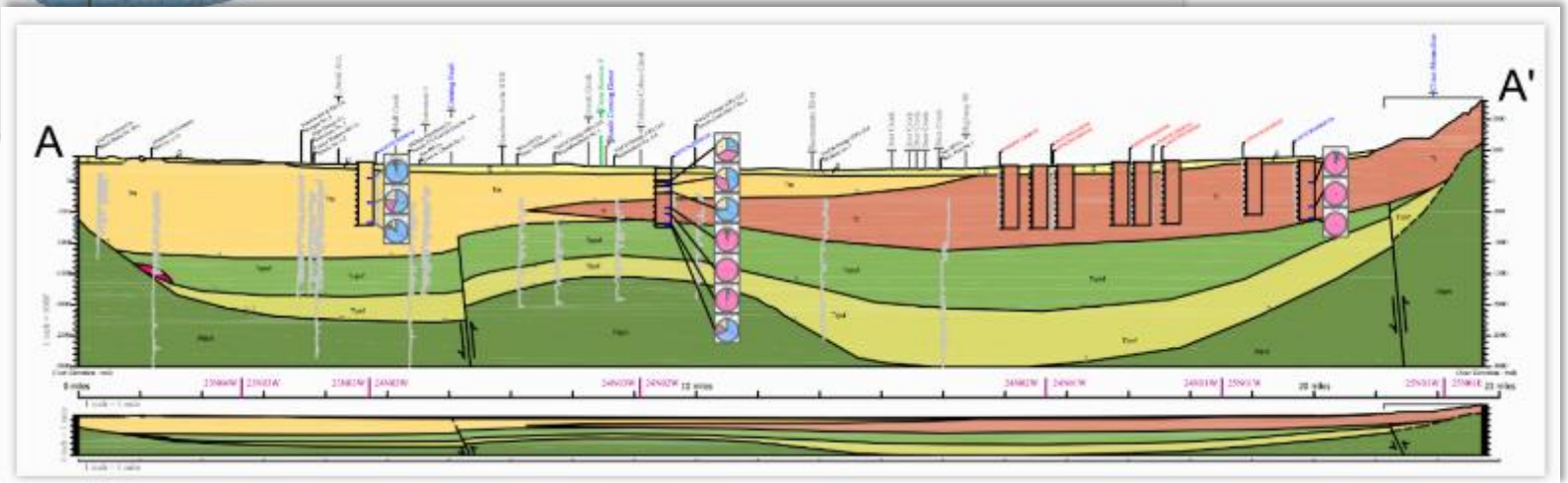
Adopted from: Marylou Shockley, CSU Monterey Bay

The Key Elements of Groundwater Sustainability Plans

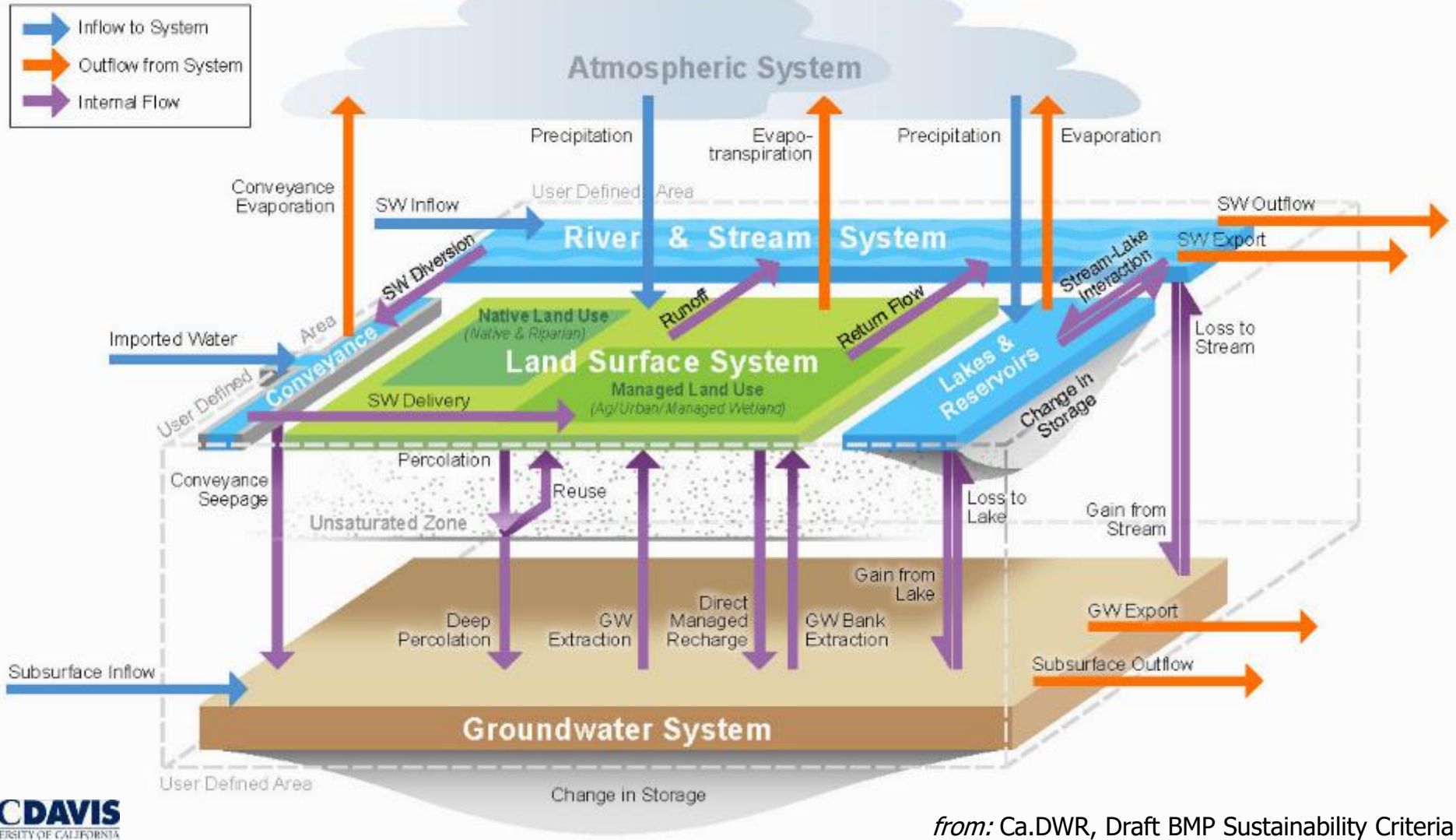


Hydrologic Conceptual Models



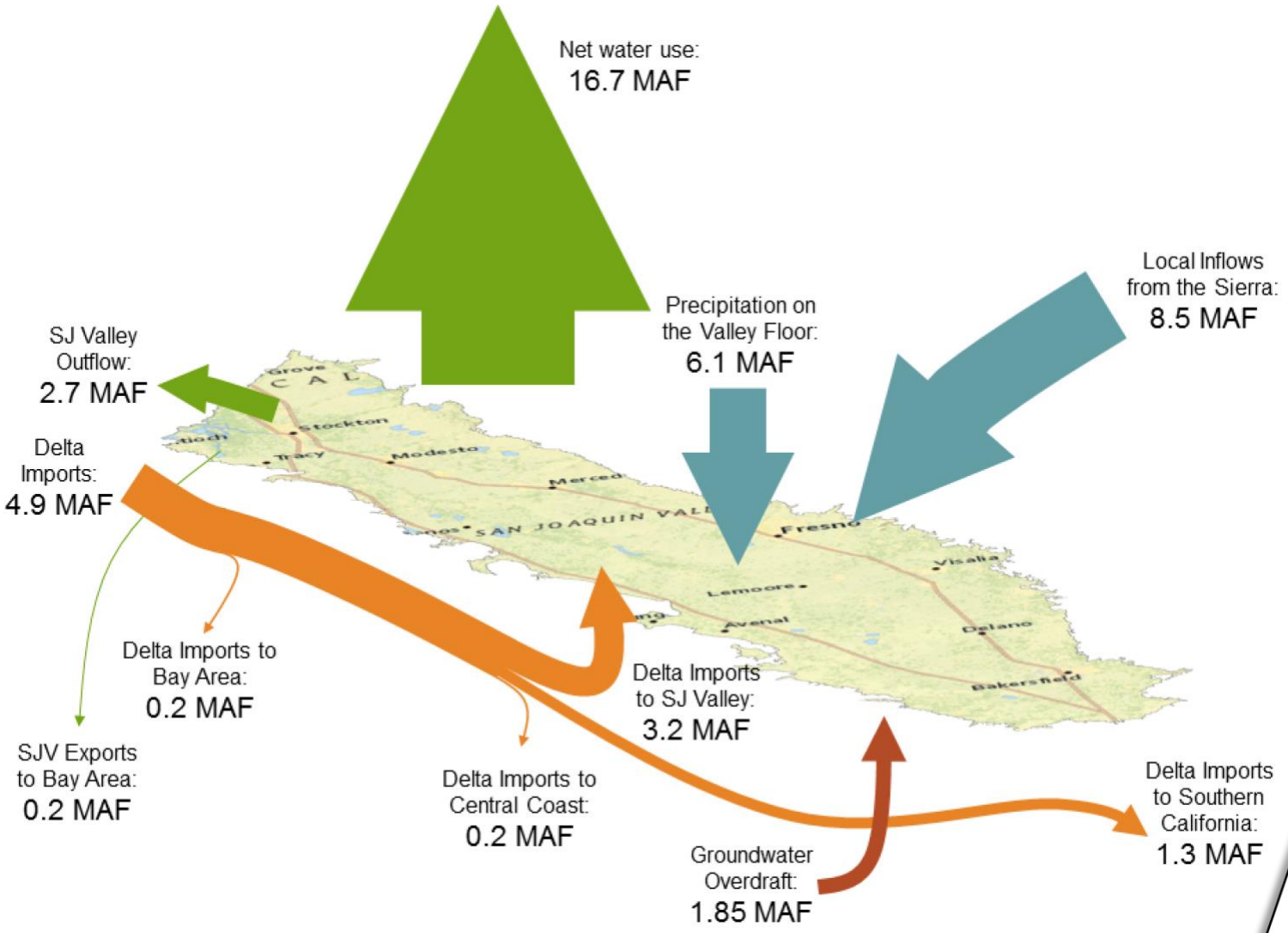


Robust Water Budgets / Integrated Hydrologic Models



from: Ca.DWR, Draft BMP Sustainability Criteria

Water Budget, San Joaquin Valley, 1988 – 2017 Average



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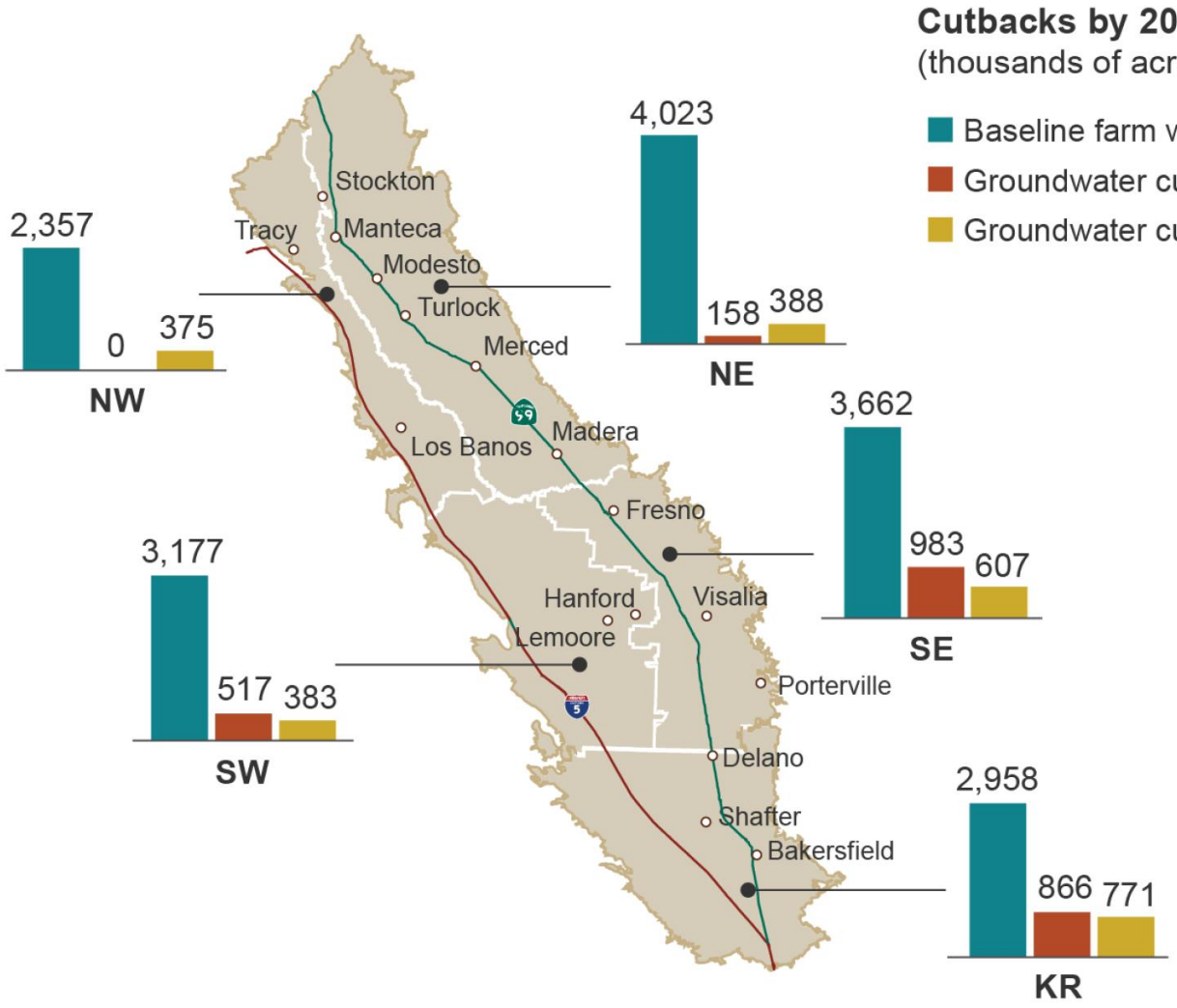
Water Supply and Cutbacks Needed for Balance



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GSP: Monitoring and Managing Sustainability

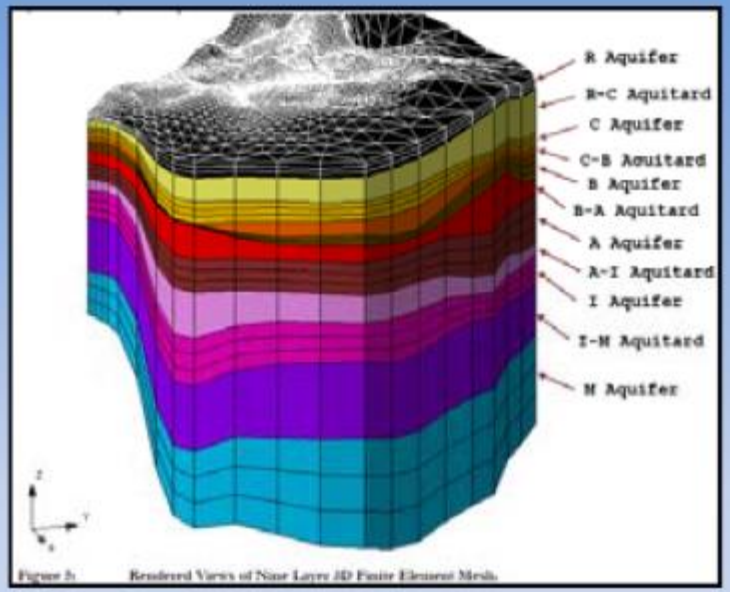
Groundwater Sustainability Agencies have *discretionary* authority to:

- Conduct studies
- Register & monitor wells
- Set well spacing requirements
- Require extraction reporting
- Regulate extractions
- Implement capital projects
- Assess fees to cover costs

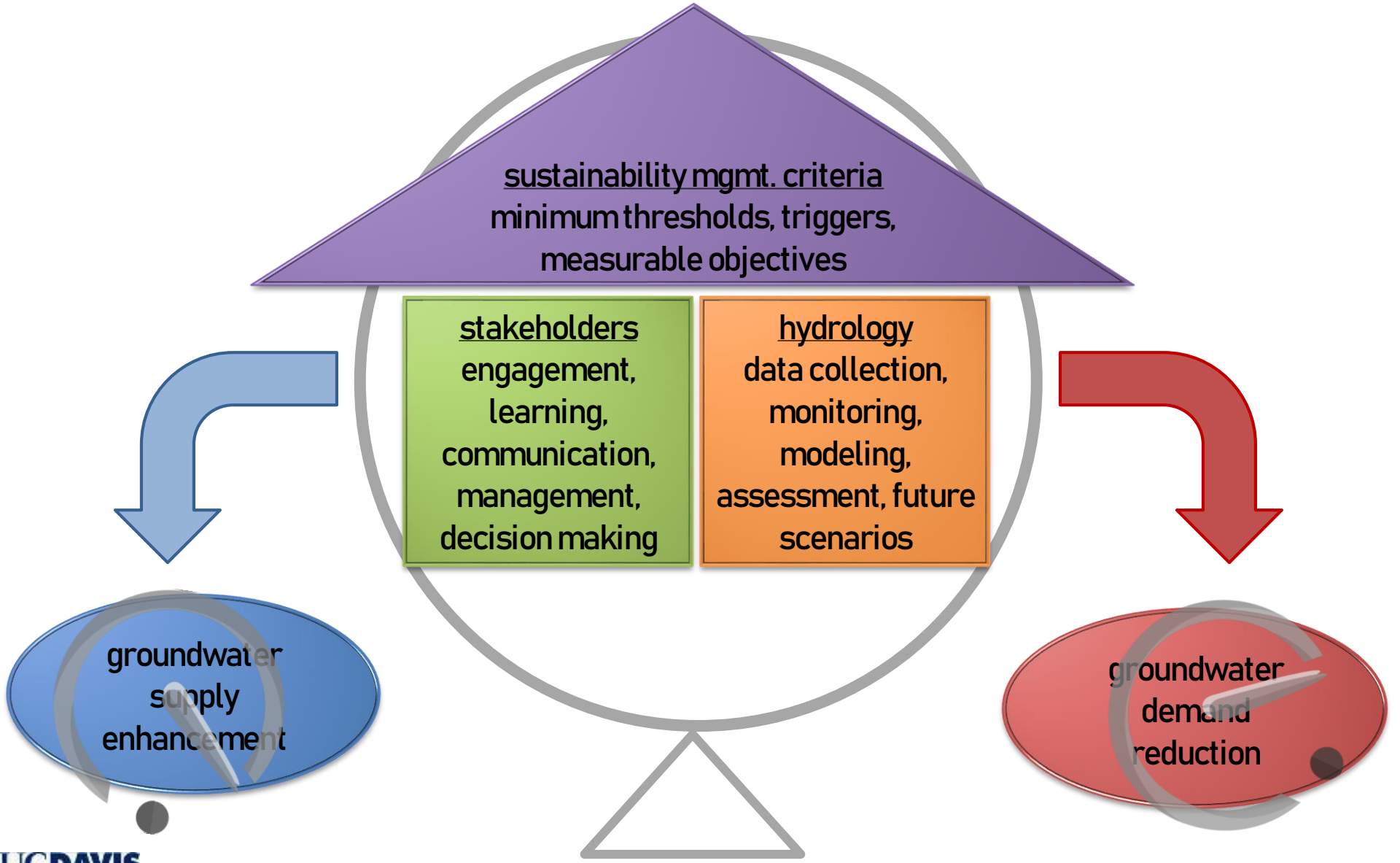
Some exemptions for smaller private well owners

COURTESY - Marcus Trotta, Sonoma County Water Agency, 2015

WRD Monitoring and Modeling Programs



The Key Elements of Groundwater Sustainability Plans



Stakeholder Engagement

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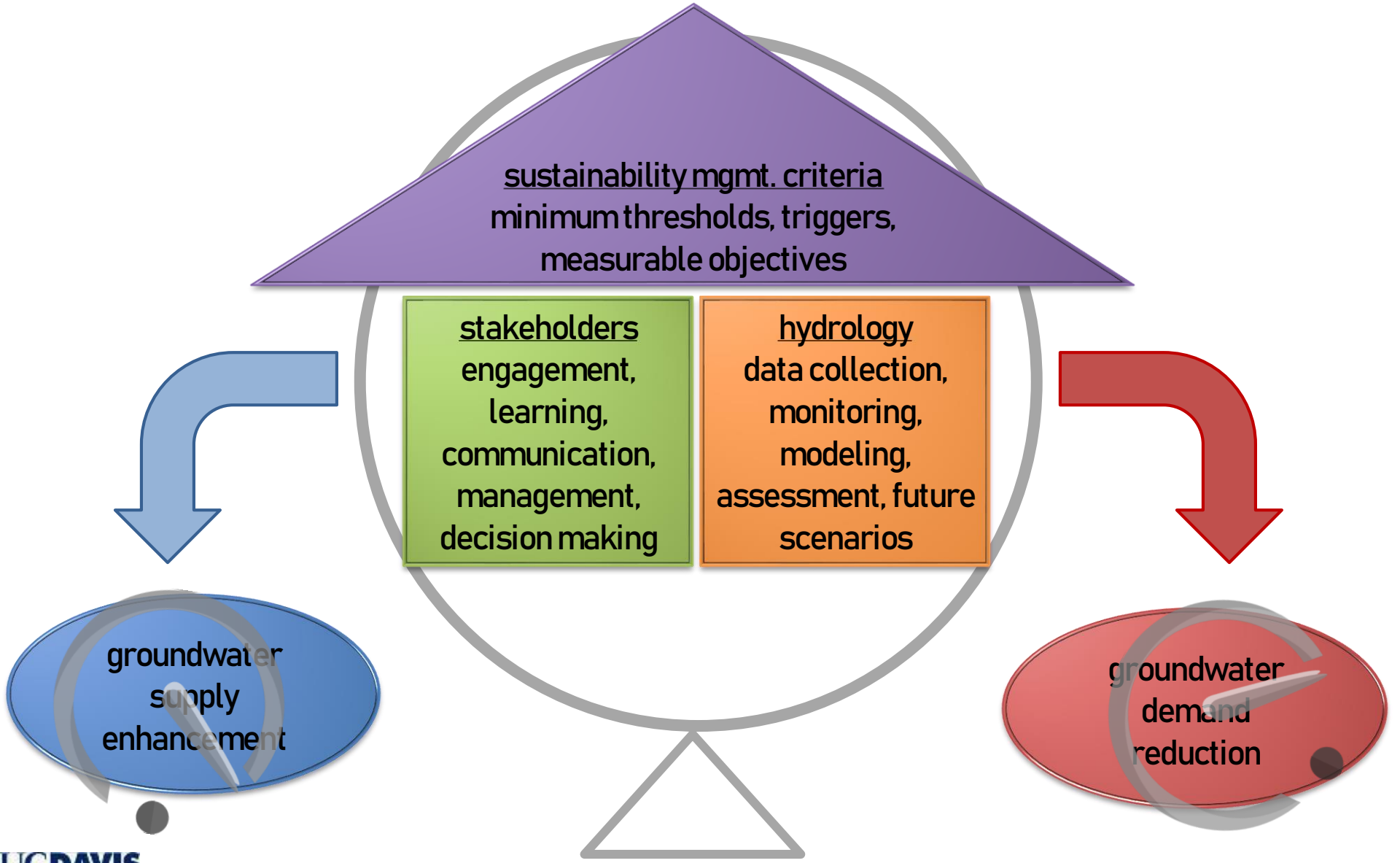
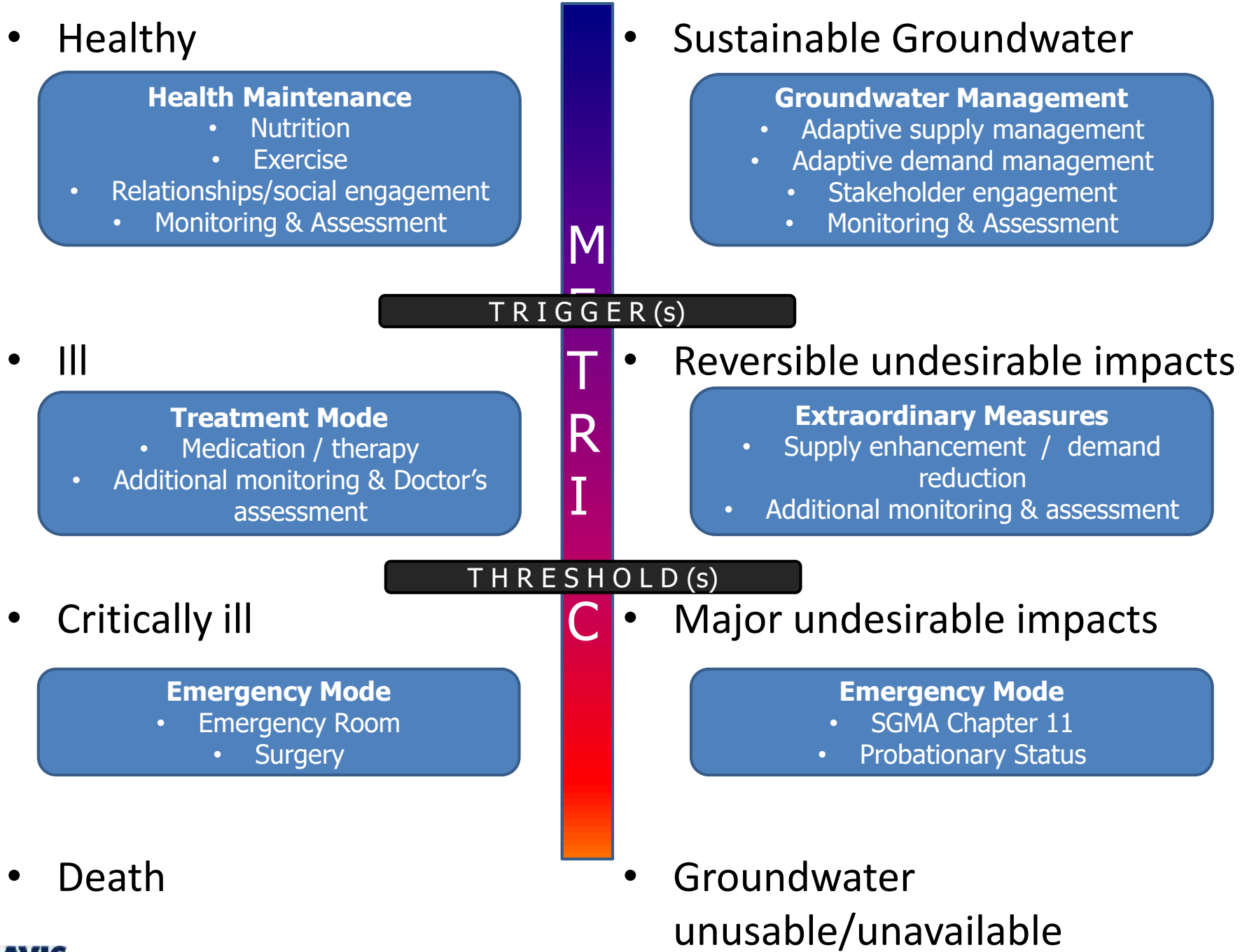
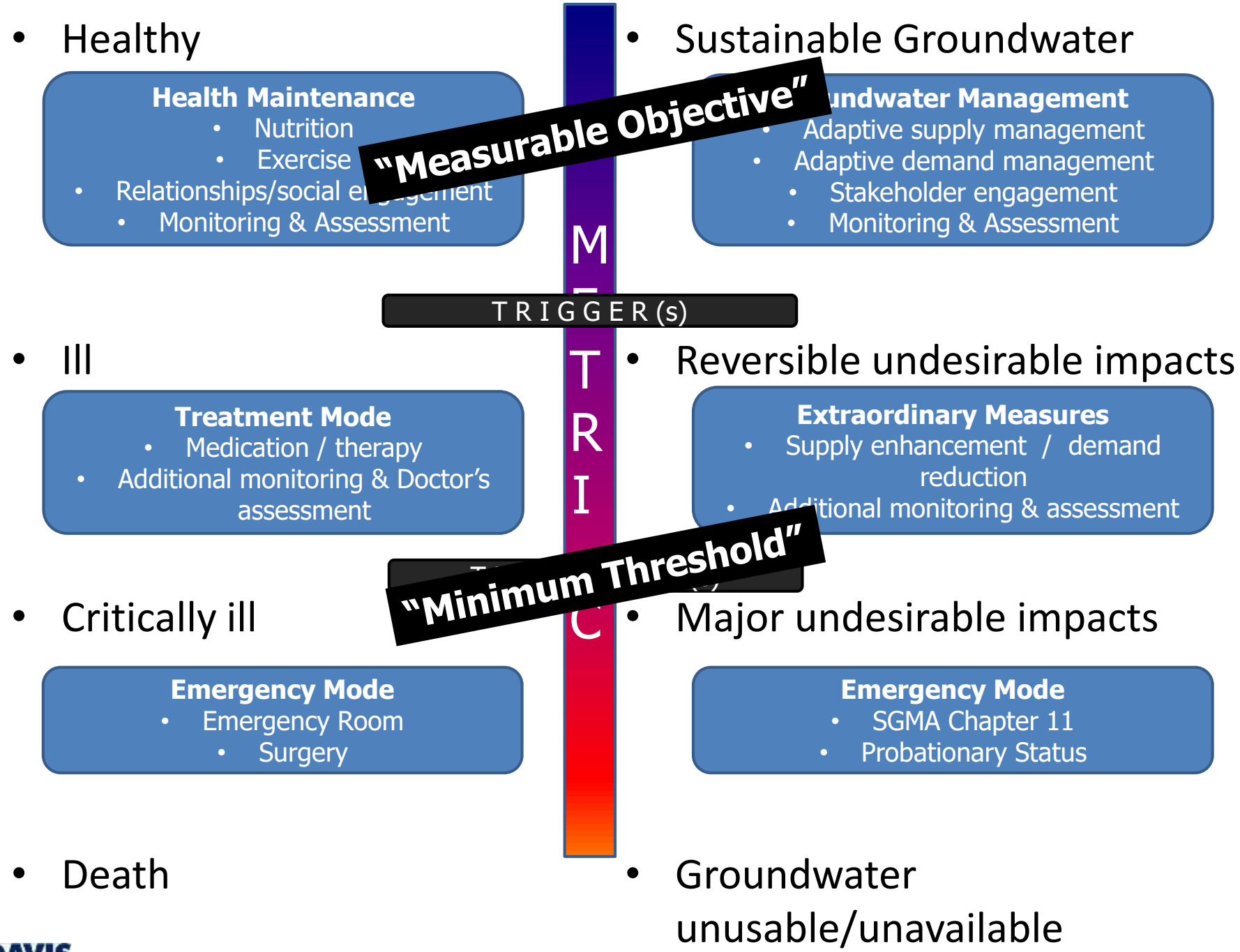
The Key Elements of Groundwater Sustainability Plans




• Healthy
Health Maintenance
• Nutrition
• Exercise
• Relationships/social engagement
• Monitoring & Assessment
• Sustainable Groundwater
Groundwater Management
• Adaptive supply management
• Adaptive demand management
• Stakeholder engagement
• Monitoring & Assessment
M
TRIGGER(s)
• Ill
Treatment Mode
• Medication / therapy
• Additional monitoring & Doctor's assessment
• Reversible undesirable impacts
Extraordinary Measures
• Supply enhancement / demand reduction
• Additional monitoring & assessment
T
R
I
THRESHOLD(s)
• Critically ill
Emergency Mode
• Emergency Room
• Surgery
C
• Major undesirable impacts
Emergency Mode
• SGMA Chapter 11
• Probationary Status
• Death
• Groundwater unusable/unavailable



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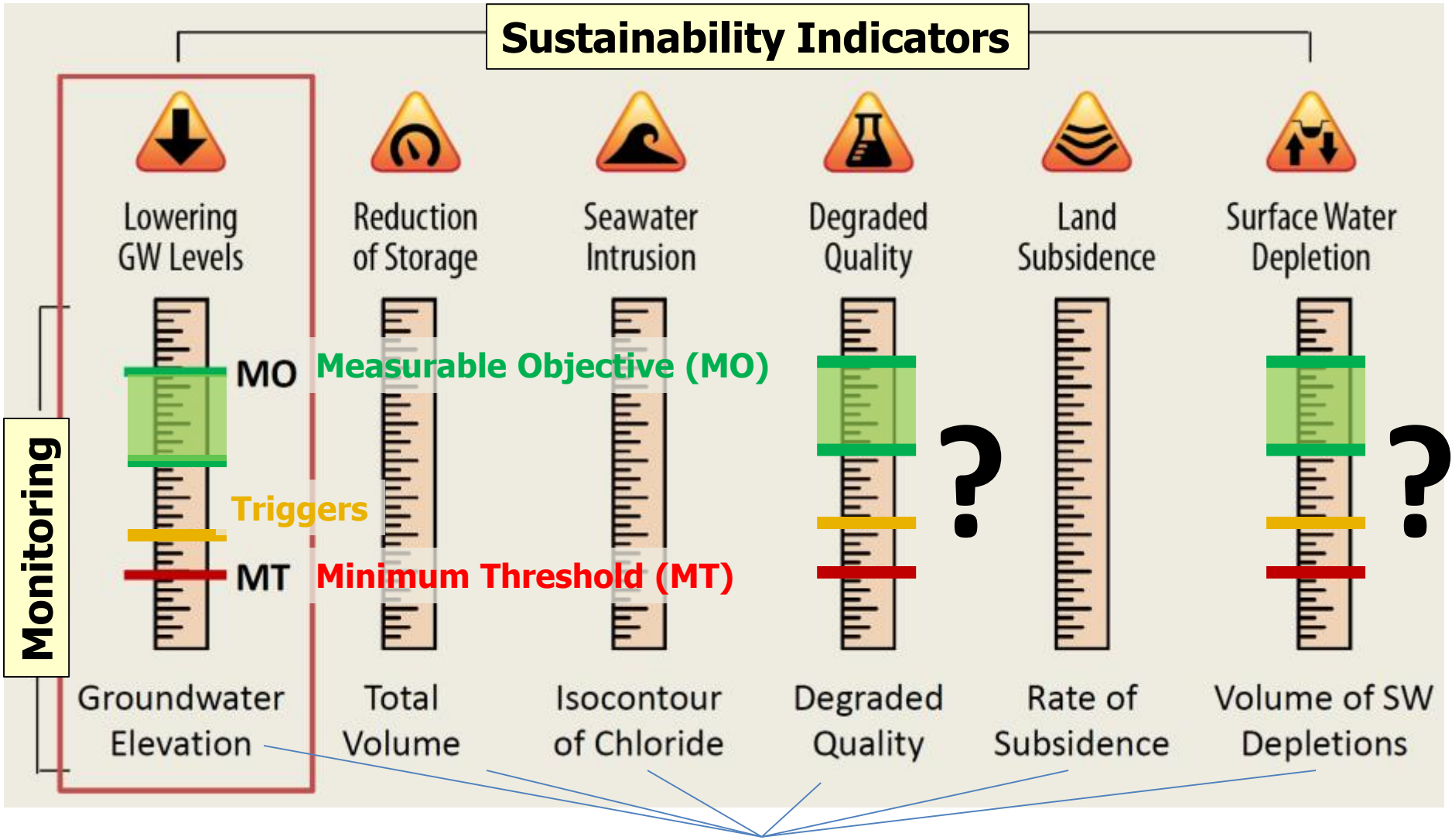
Thomas Harter, Univ. of California, 2017

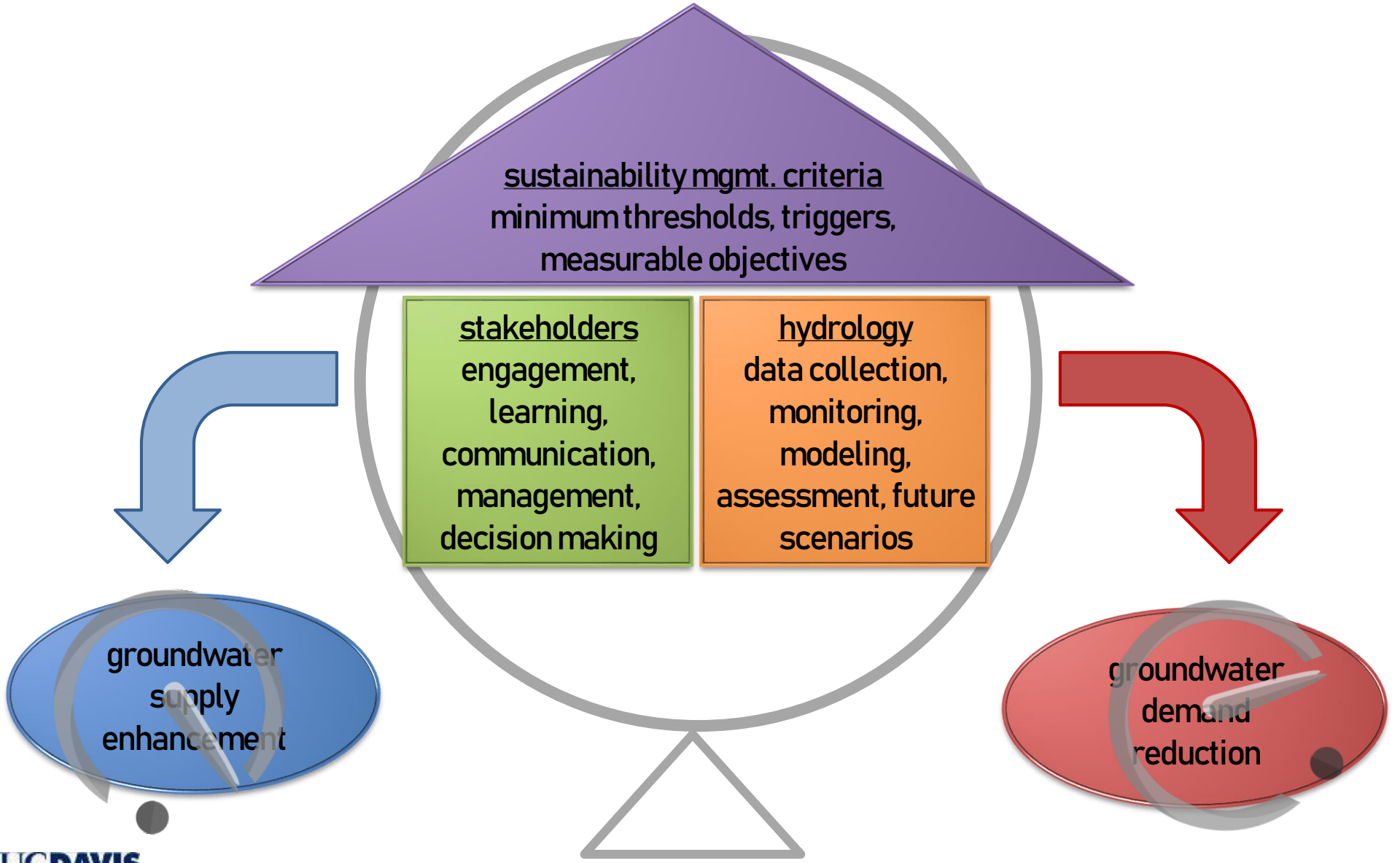
GSP: Monitoring and Managing Sustainability



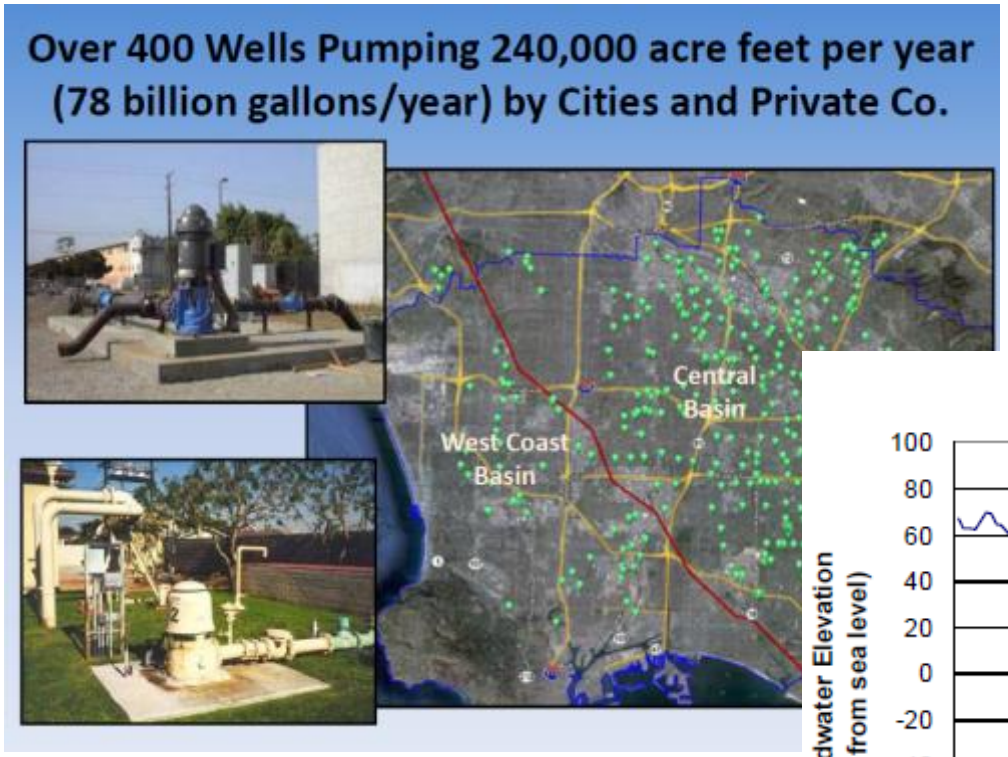
[generalized examples of what to monitor]

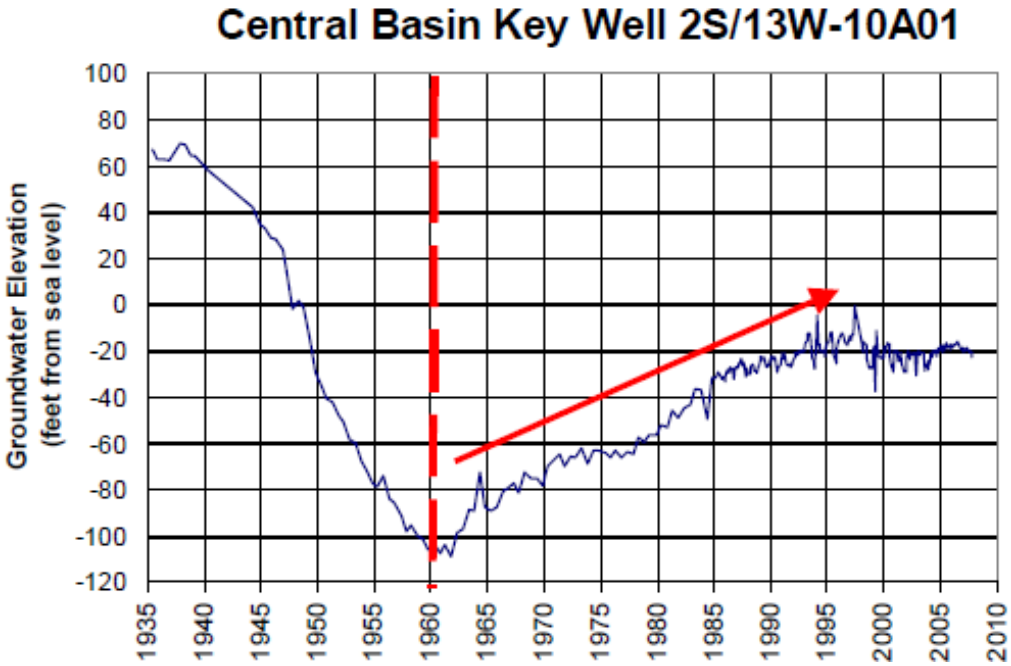
modified from Ca DWR 2016

The Key Elements of Groundwater Sustainability Plans



Storage for Local Use:
Water Replenishment District of So. Cal. (founded in 1959)





=> also to prevent seawater intrusion!

Recycled Water Reuse
- Pajaro Valley -

Photo: Californian Salinas

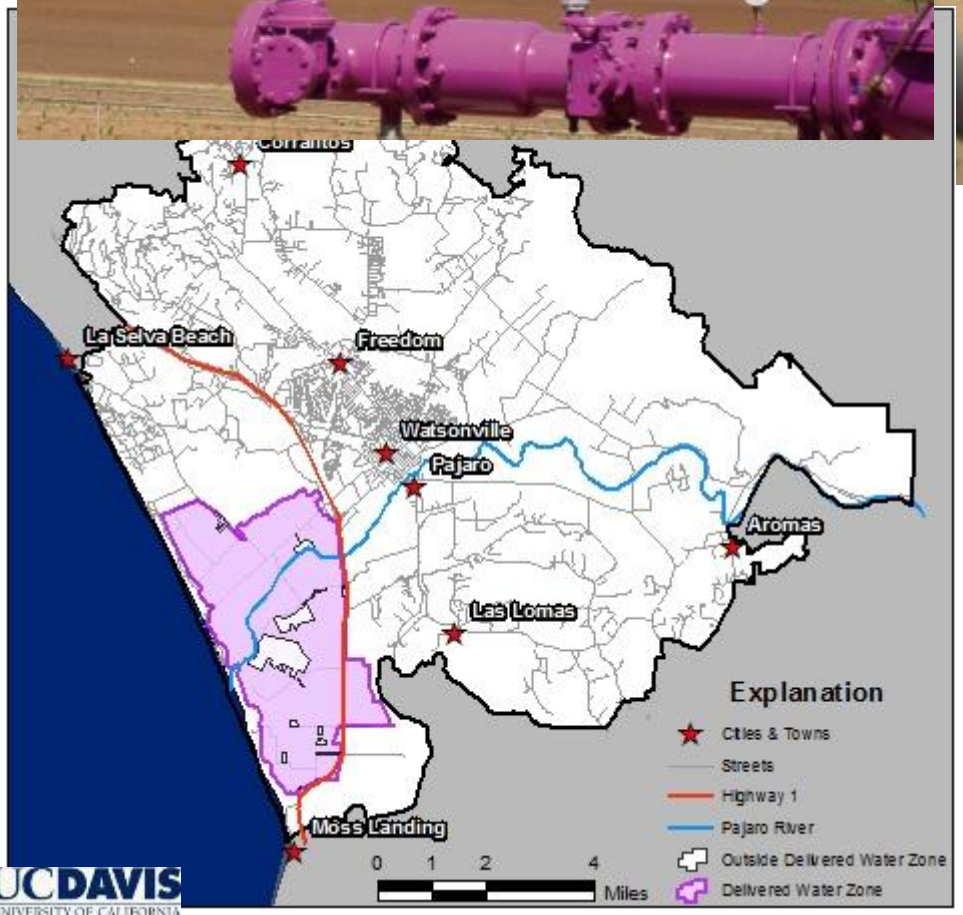


Photo: J.D. Hillard

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Expand Water Storage: Groundwater Banking

From: Ted Johnson, WRD 2013

DWR, California Water Plan Update 2013

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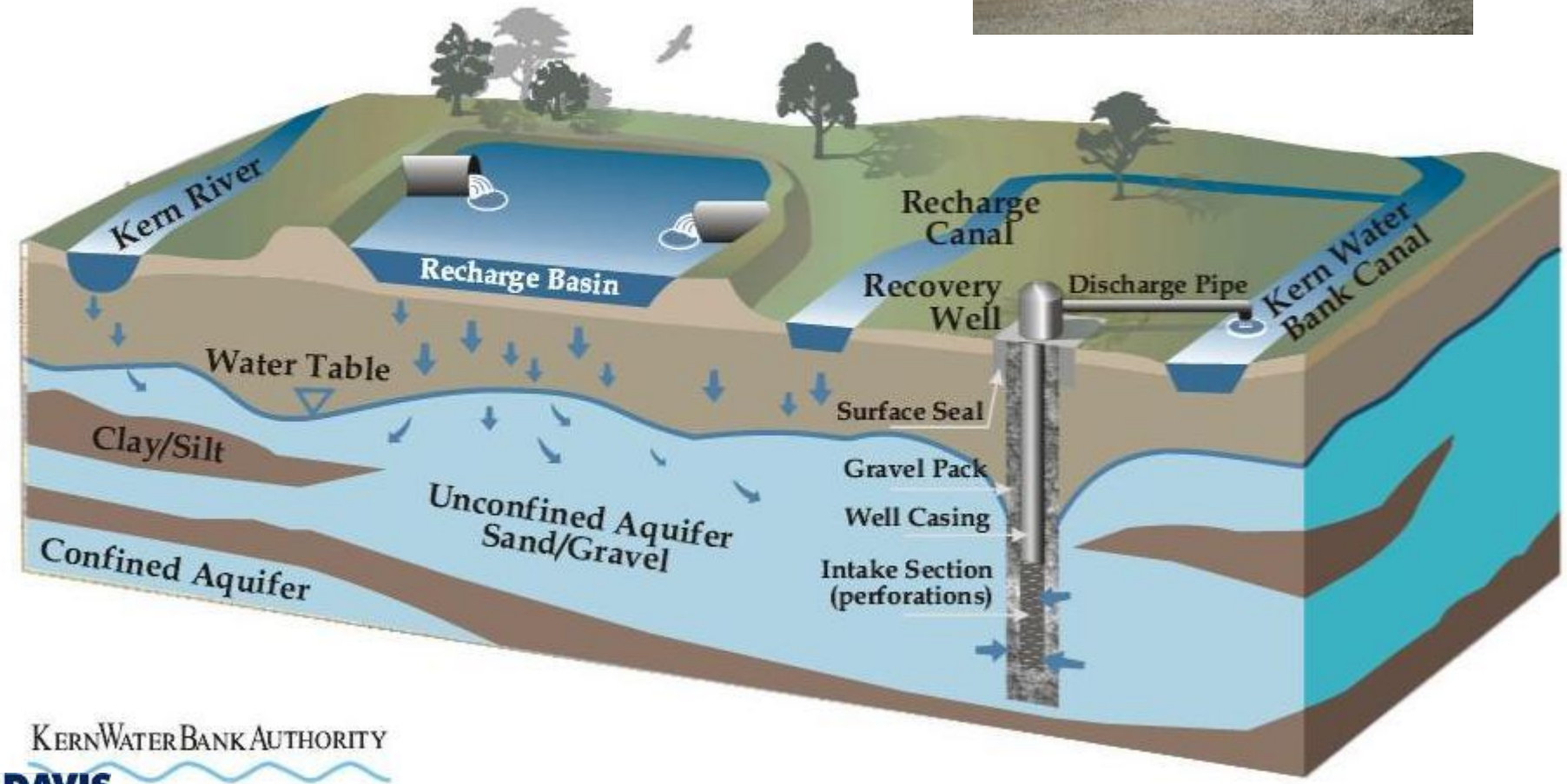

KERN WATER BANK AUTHORITY

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Local Recharge Basins/ Managed Aquifer Recharge

Photo: Kelly M. Grow, Dept Water Resources

Coachella Valley (Colorado River water)

Santa Clara County

Photos : George Sakkestad, Mercury News, 2015

Intentional Winter Recharge in the Agricultural Landscape

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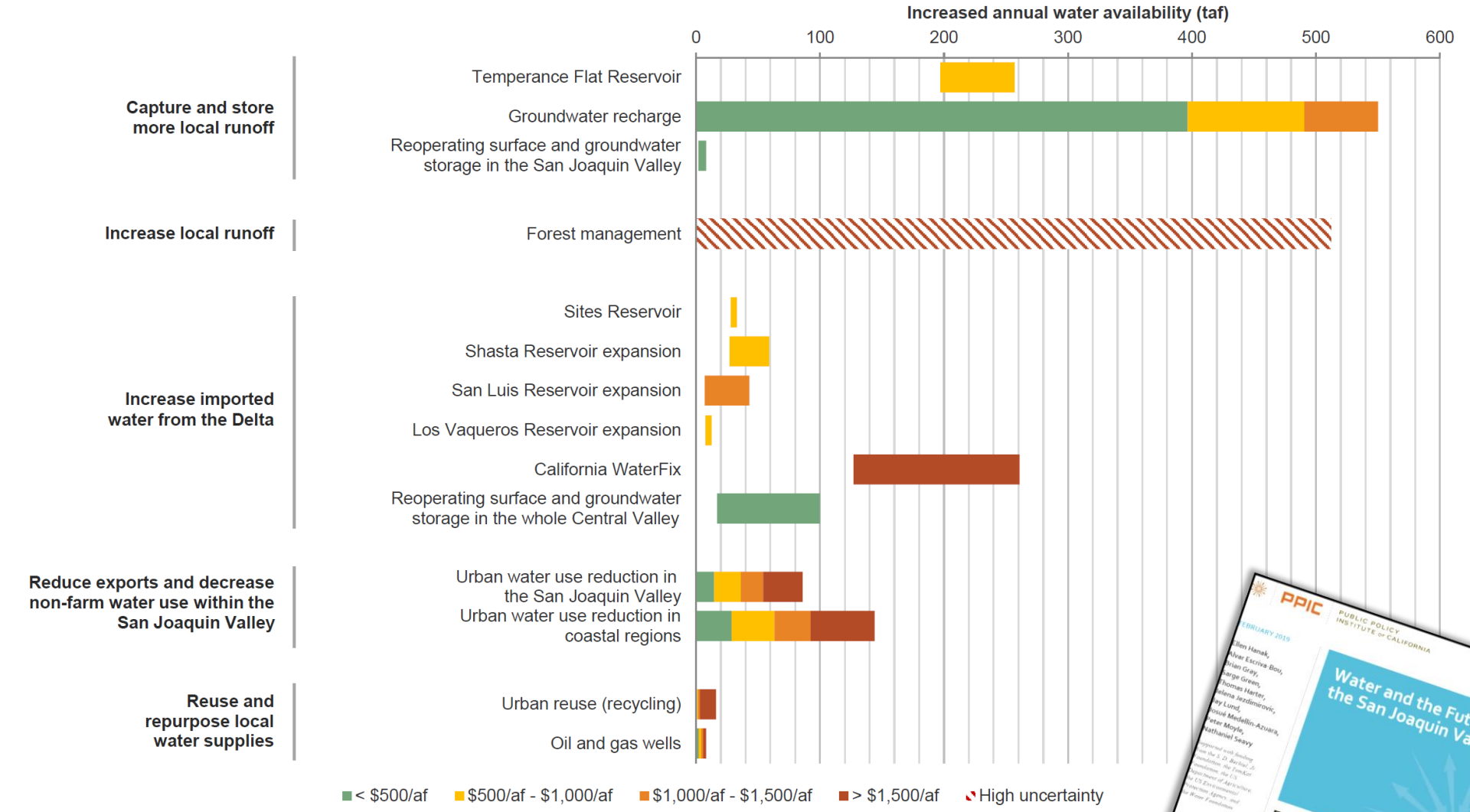
Estimated Additional Water Supply Options



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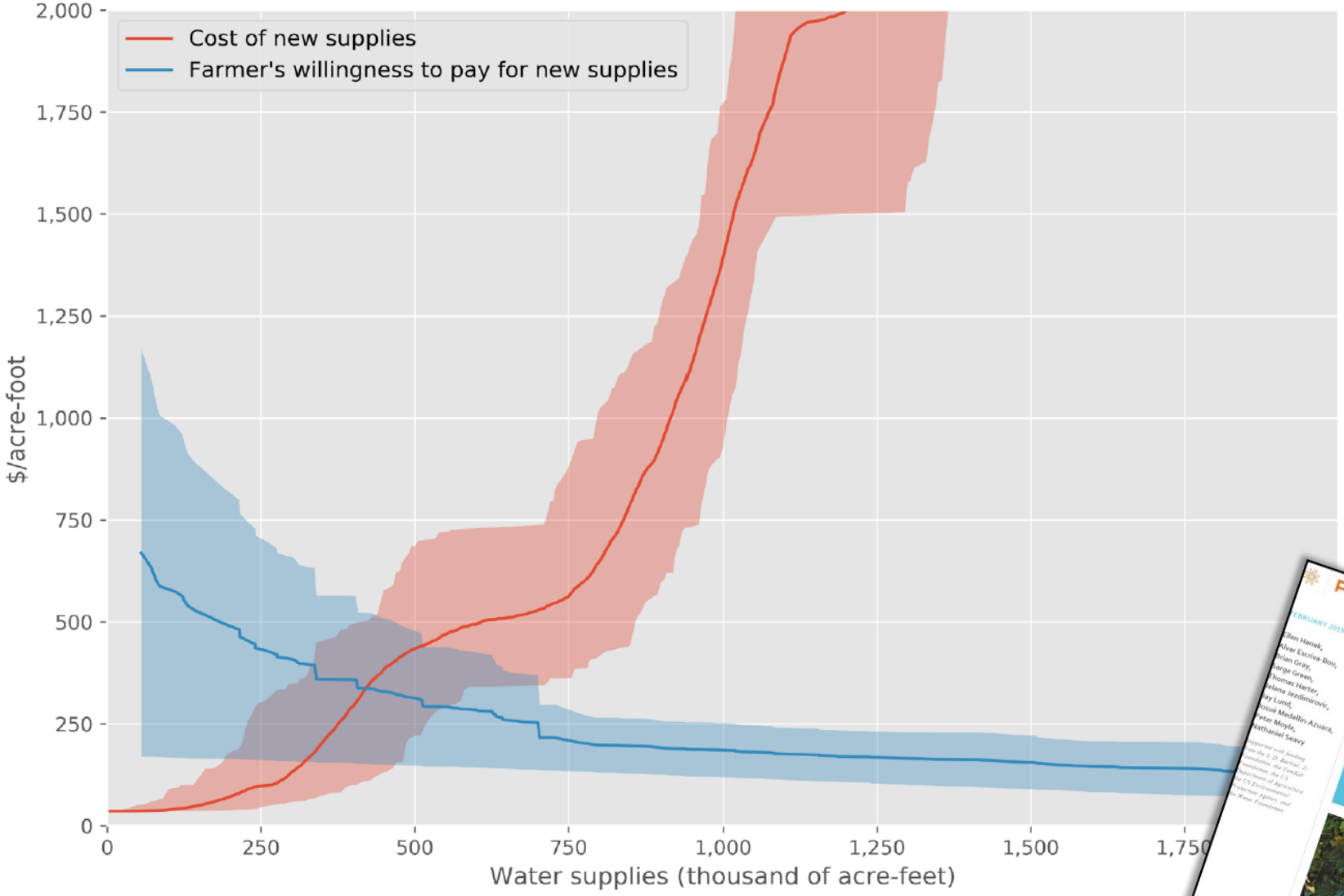
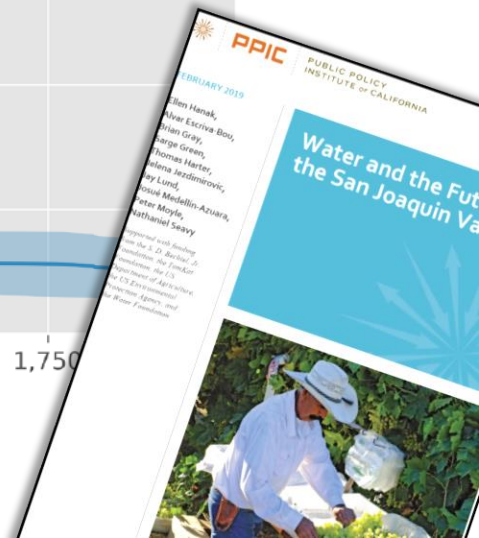
Water Demand and Supply Estimates for SJV





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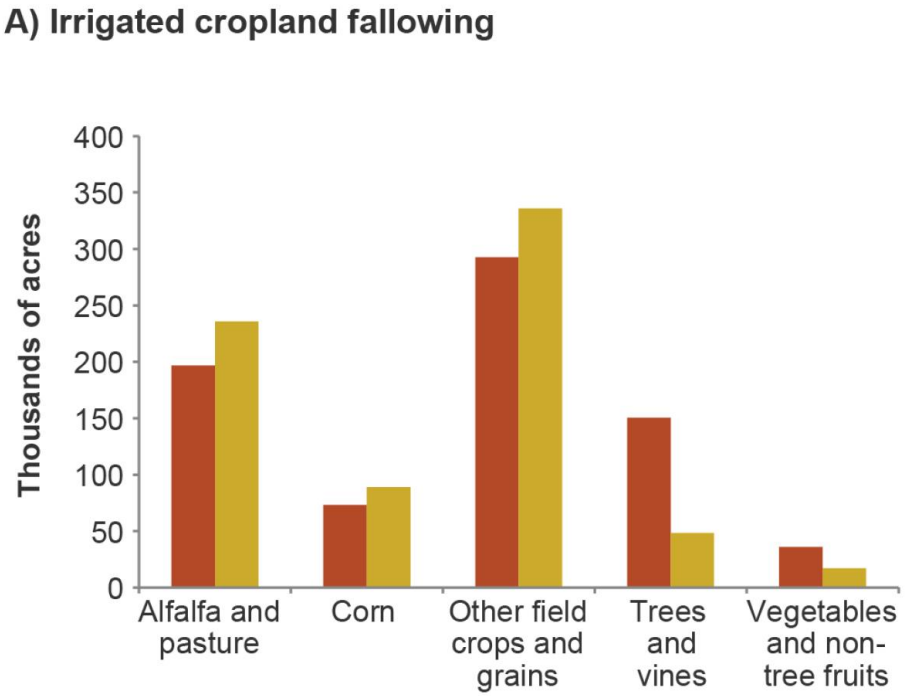
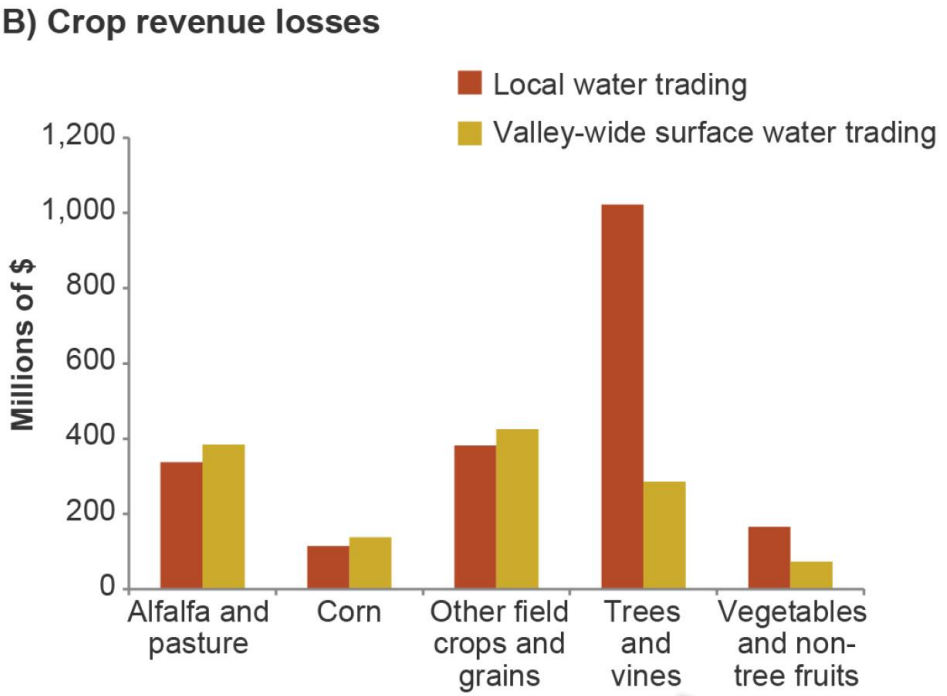
Land Fallowing and Associated Crop Revenue Loss





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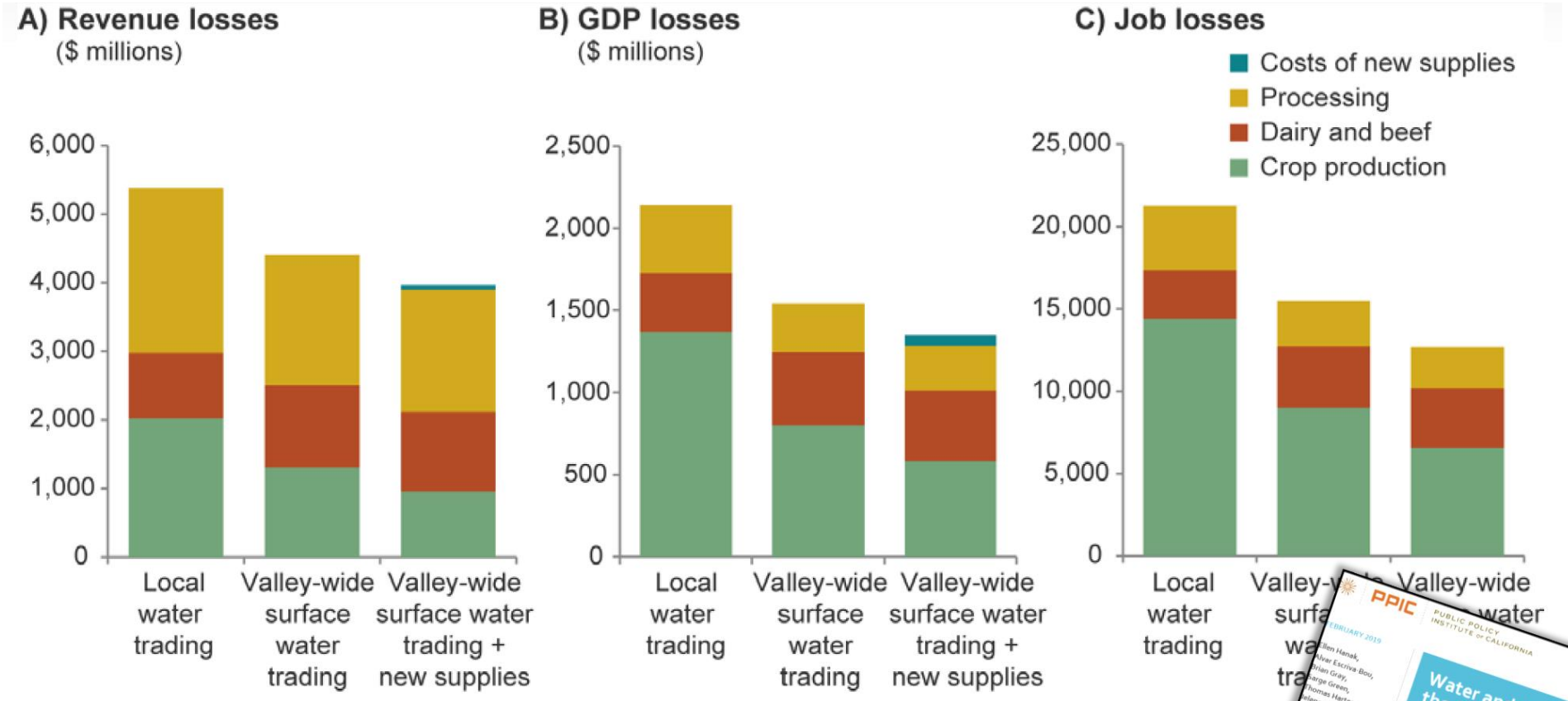
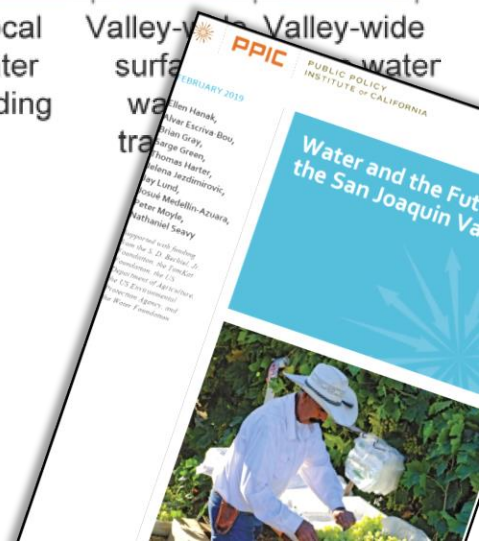
Long-term Economic Impact of Fallowing ~500,000 acres





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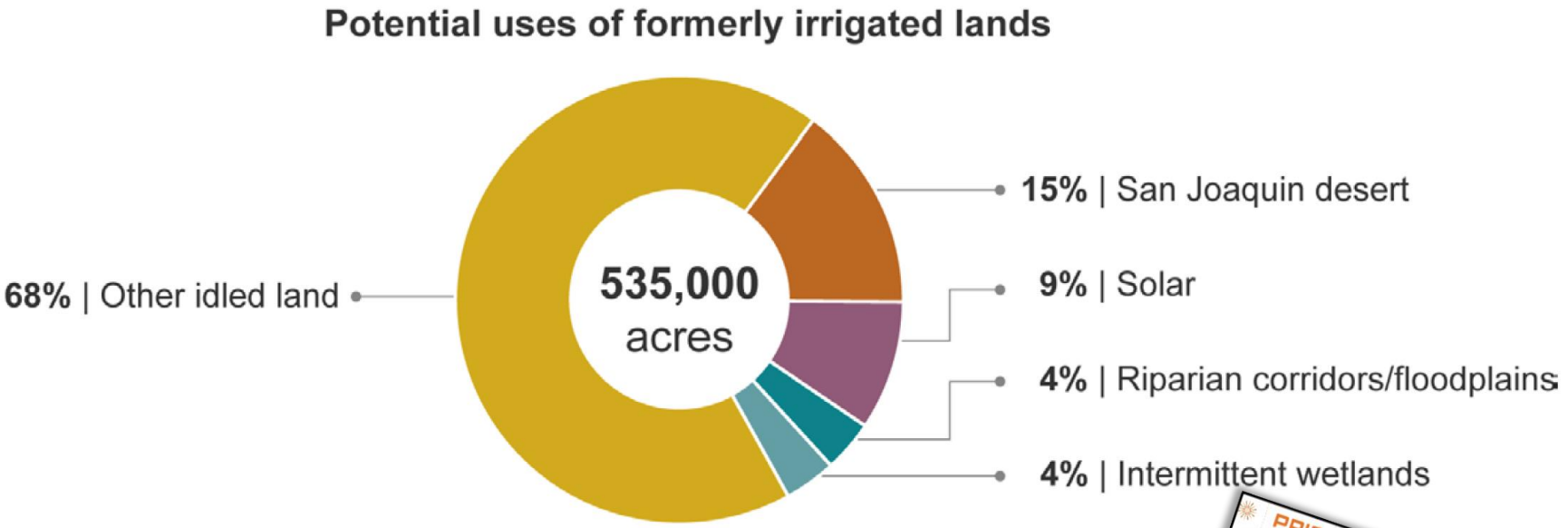
Current planning efforts only account for 1/3 of land likely to be fallowed

- The goal should be to steward all idled lands



PPIC 25 YEARS

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Effective and equitable solutions will require cooperative approaches

- Problems can't be solved farm-by-farm
- Many opportunities to tackle multiple problems at once and get multiple benefits
- Broad-based partnerships will be key
- State, federal agencies can play vital roles

PPIC 25 YEARS

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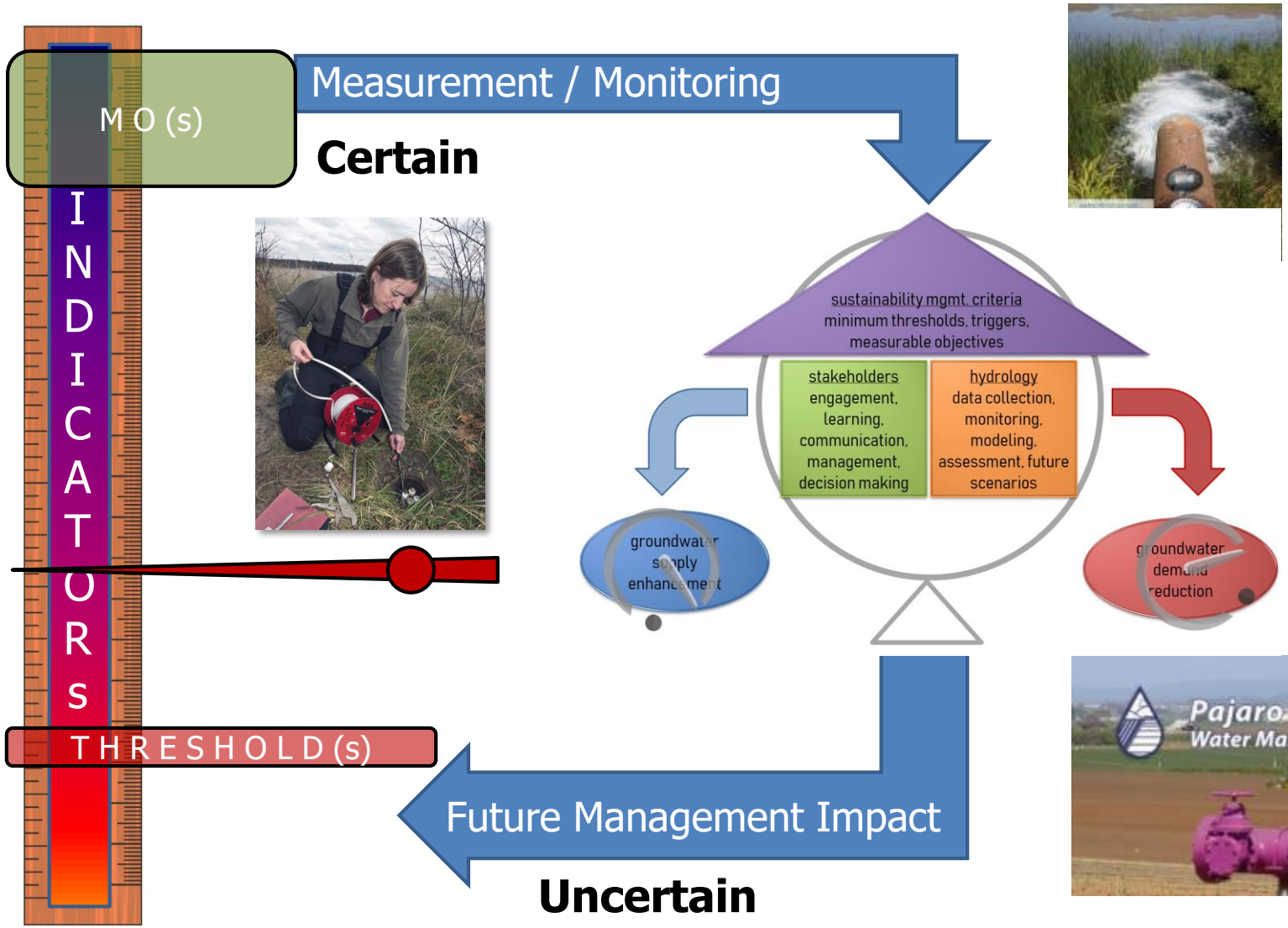
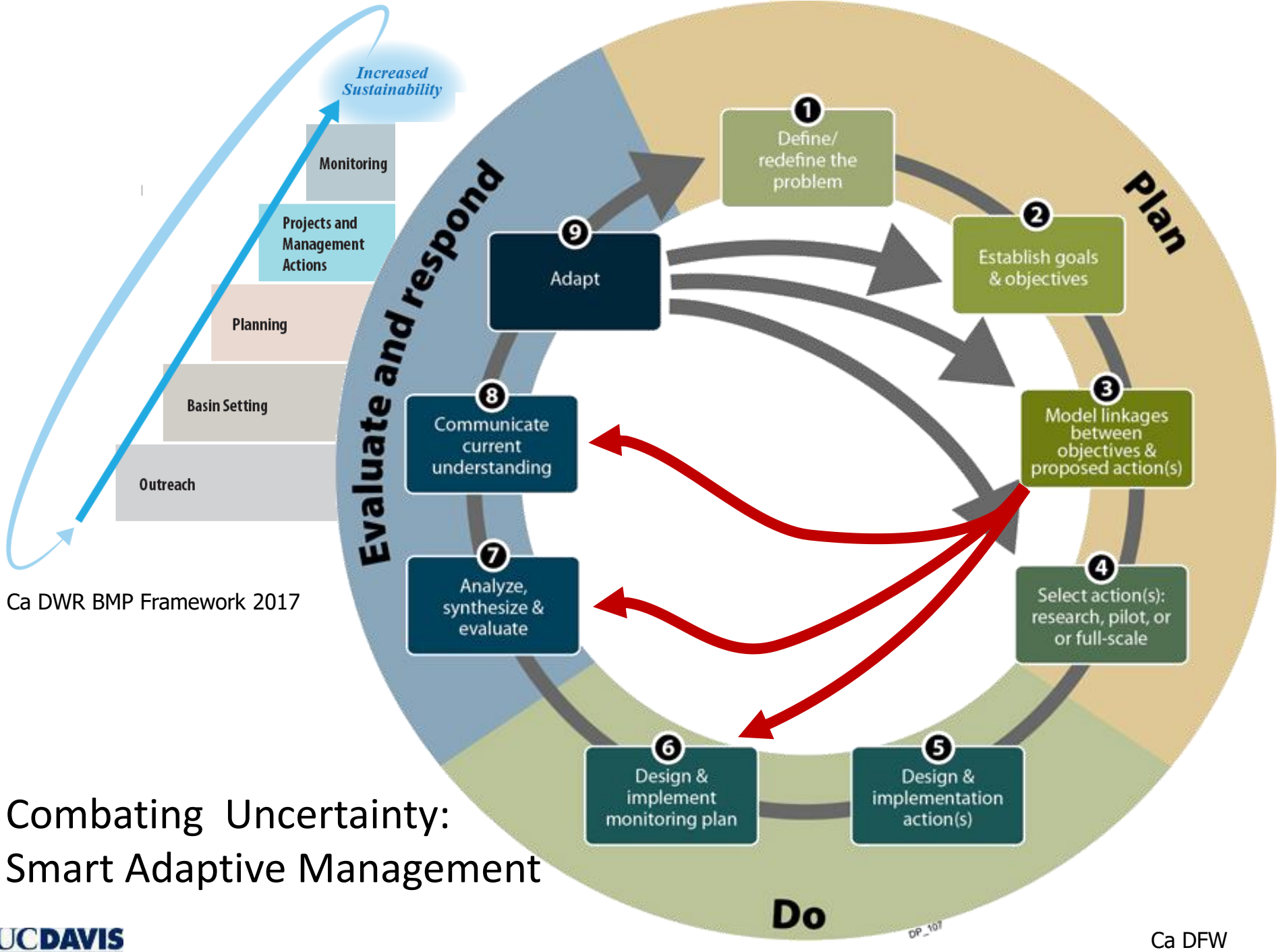
Performance Measures and GSP Implementation





Ca DWR BMP Framework 2017

Combating Uncertainty: Smart Adaptive Management

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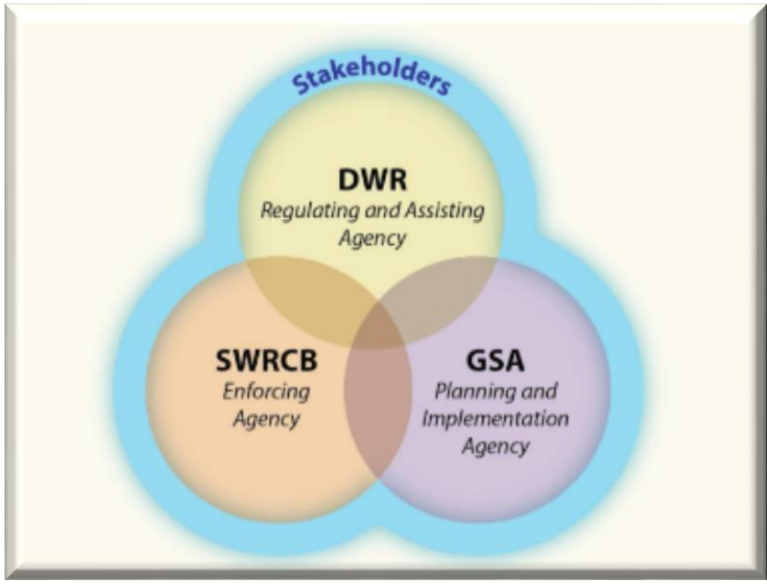
Ca DFW

Role of the State: **Carrot**

- Department of Water Resources has a key role:
  - Technical assistance and funding (Prop 1: $100 million for SGMA) (ongoing)
  - Regulation
    - Groundwater basin boundary adjustments (2016)
    - Minimum regulations and guidelines for appropriate GSP (2016)
  - Control
    - Review and approve GSPs
    - Review implementation

Role of the State: Carrot **& Stick**



California DWR, 2016

- Department of Water Resources has a key role:
  - Technical assistance and funding (Prop 1: $100 million for SGMA)
  - Regulation
    - Groundwater basin boundary adjustments
    - Minimum guidelines for appropriate GSP
  - Control
    - Review and approve GSPs
    - Review implementation
- State Water Resources Control Board:
  - Enforcement where local control fails (after 2017)
    - "probabationary status"
    - Public hearing and 180 days to fix the problem
  - After 180 days: SWRCB poses as interim GSA
    - Groundwater extraction reporting mandatory
    - Possibly temporary control of groundwater extraction
    - Development and implementation of interim GSP
  - When locals are ready: get authority back from state

- http://groundwater.ucdavis.edu/sgma
- http://groundwaternitrate.ucdavis.edu
- Contact Dr. Thomas Harter at ThHarter@ucdavis.edu

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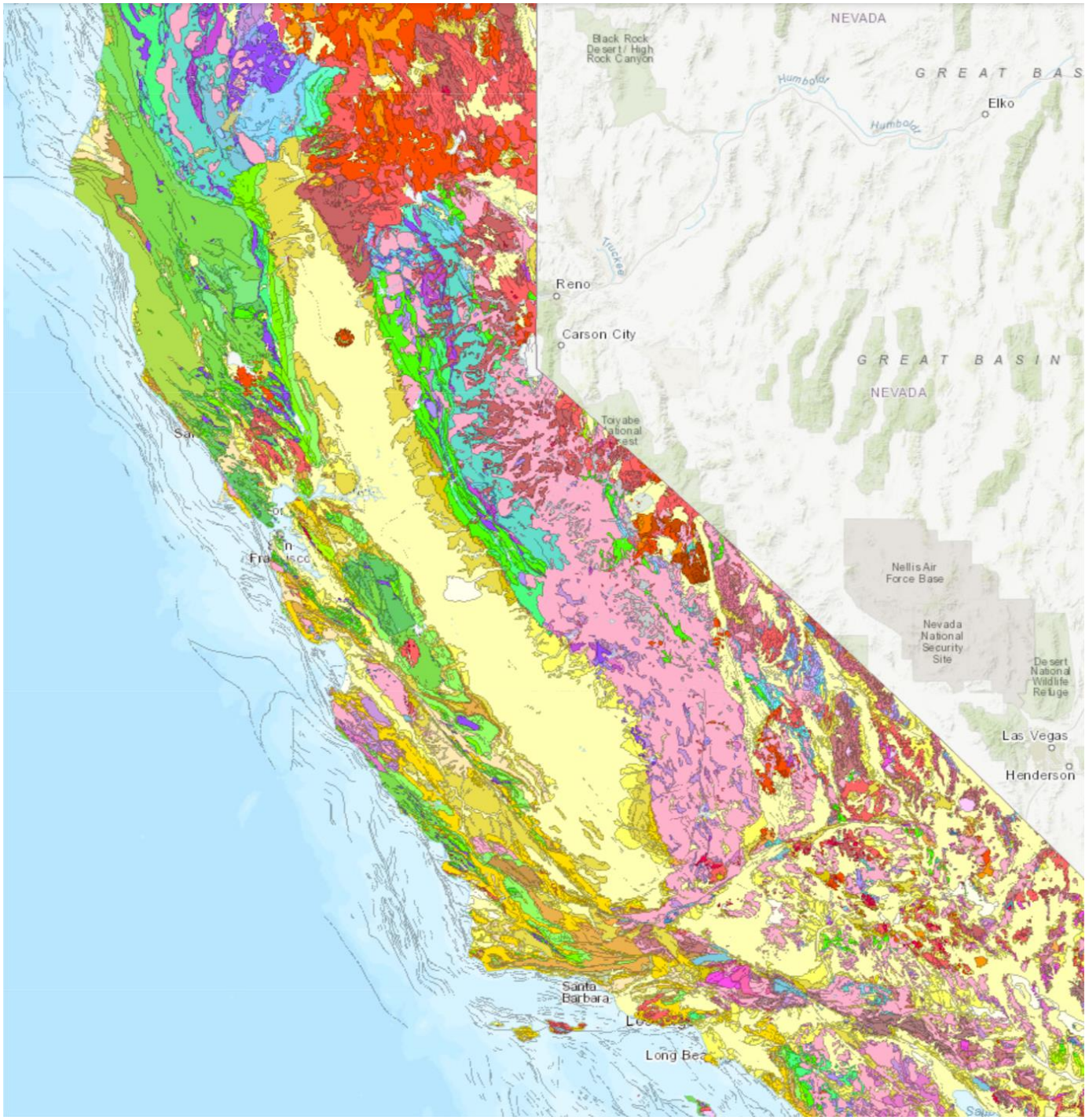
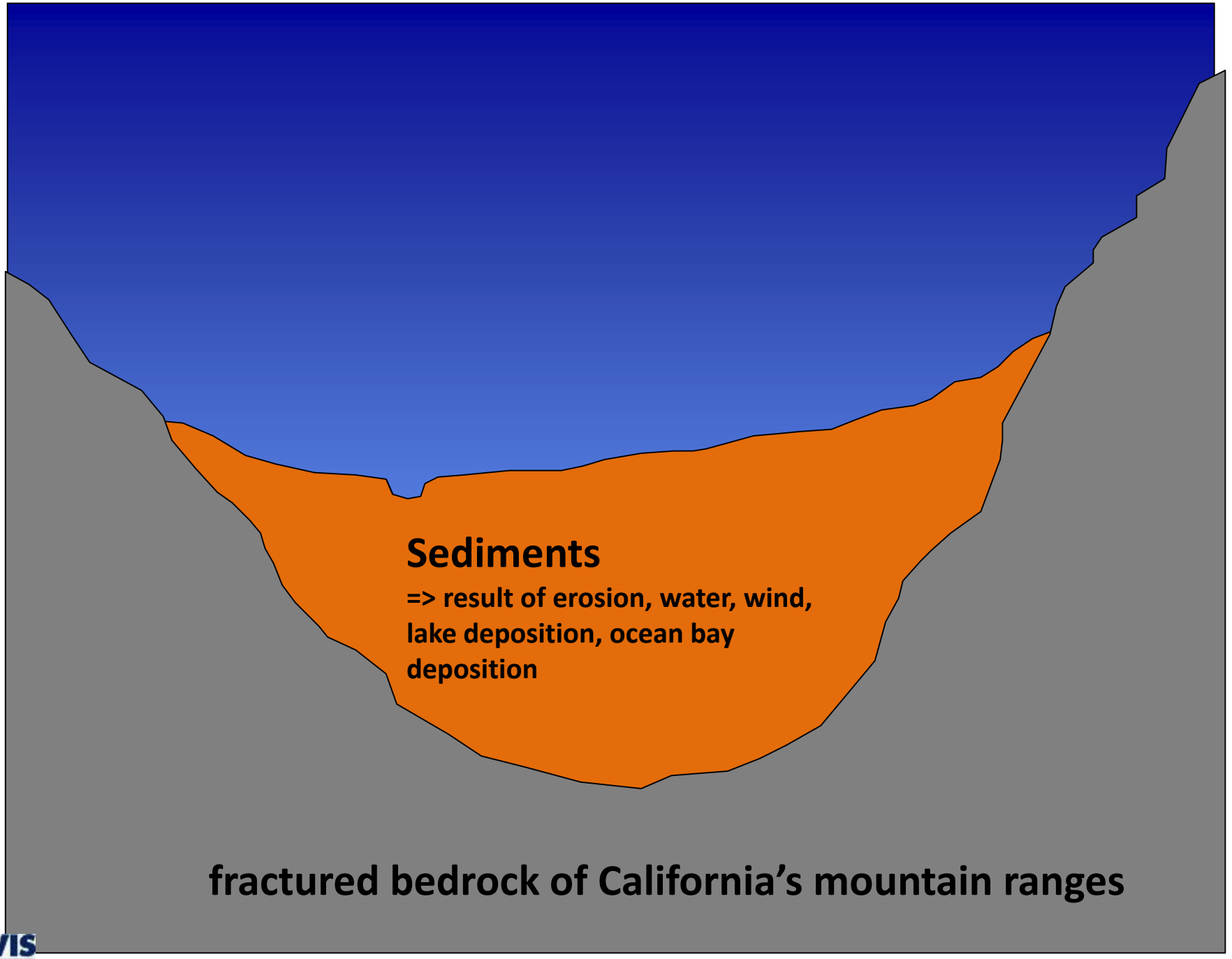
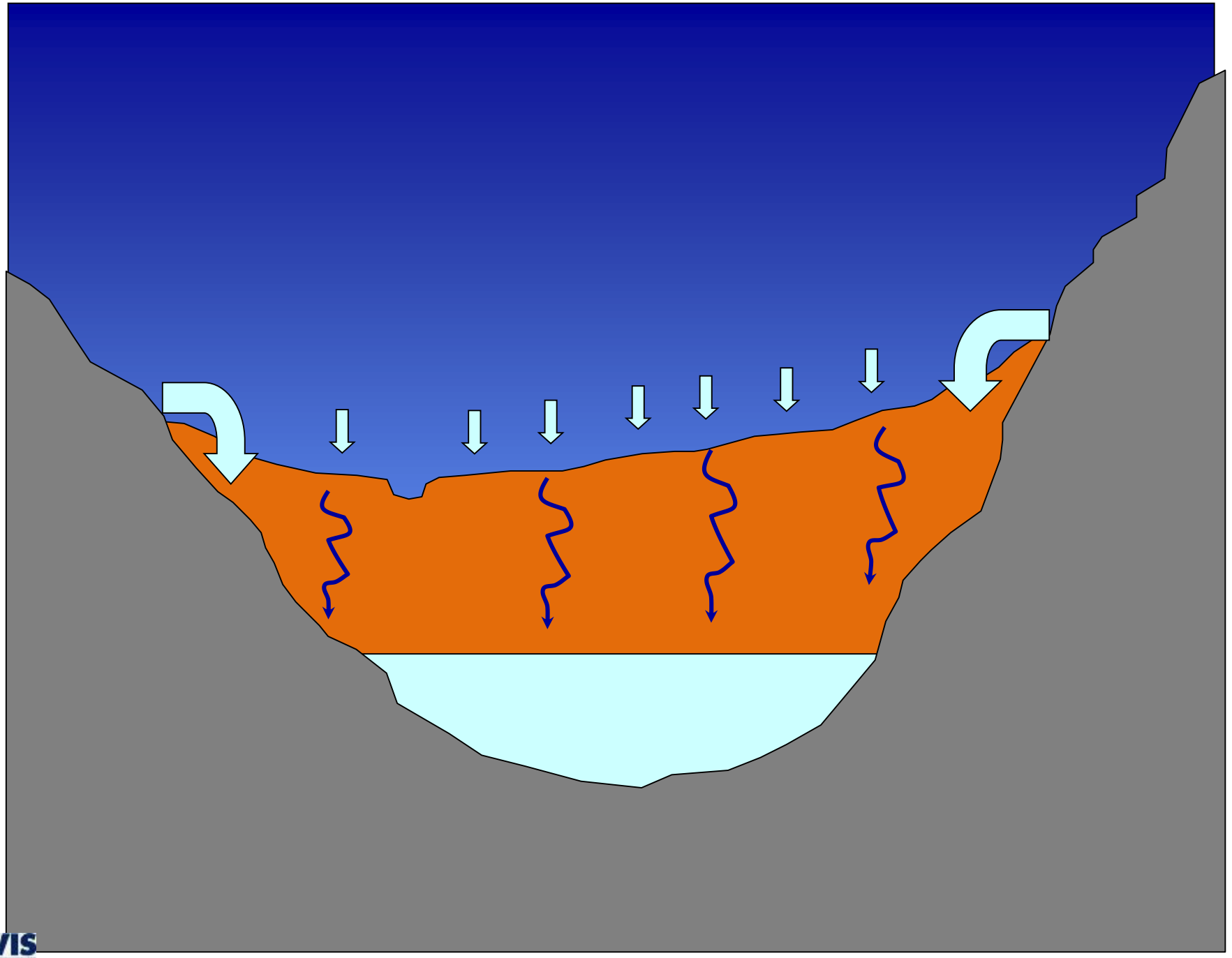
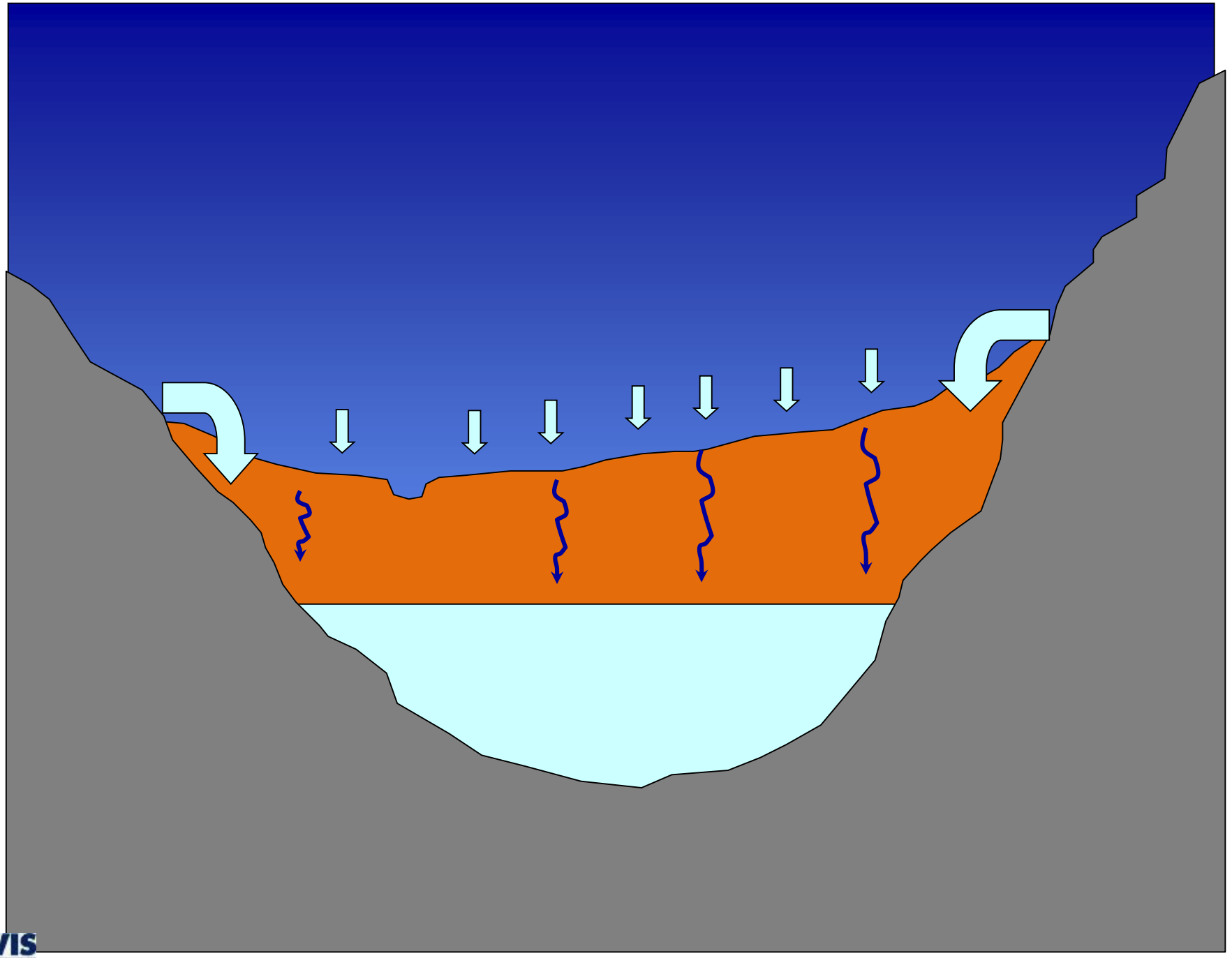
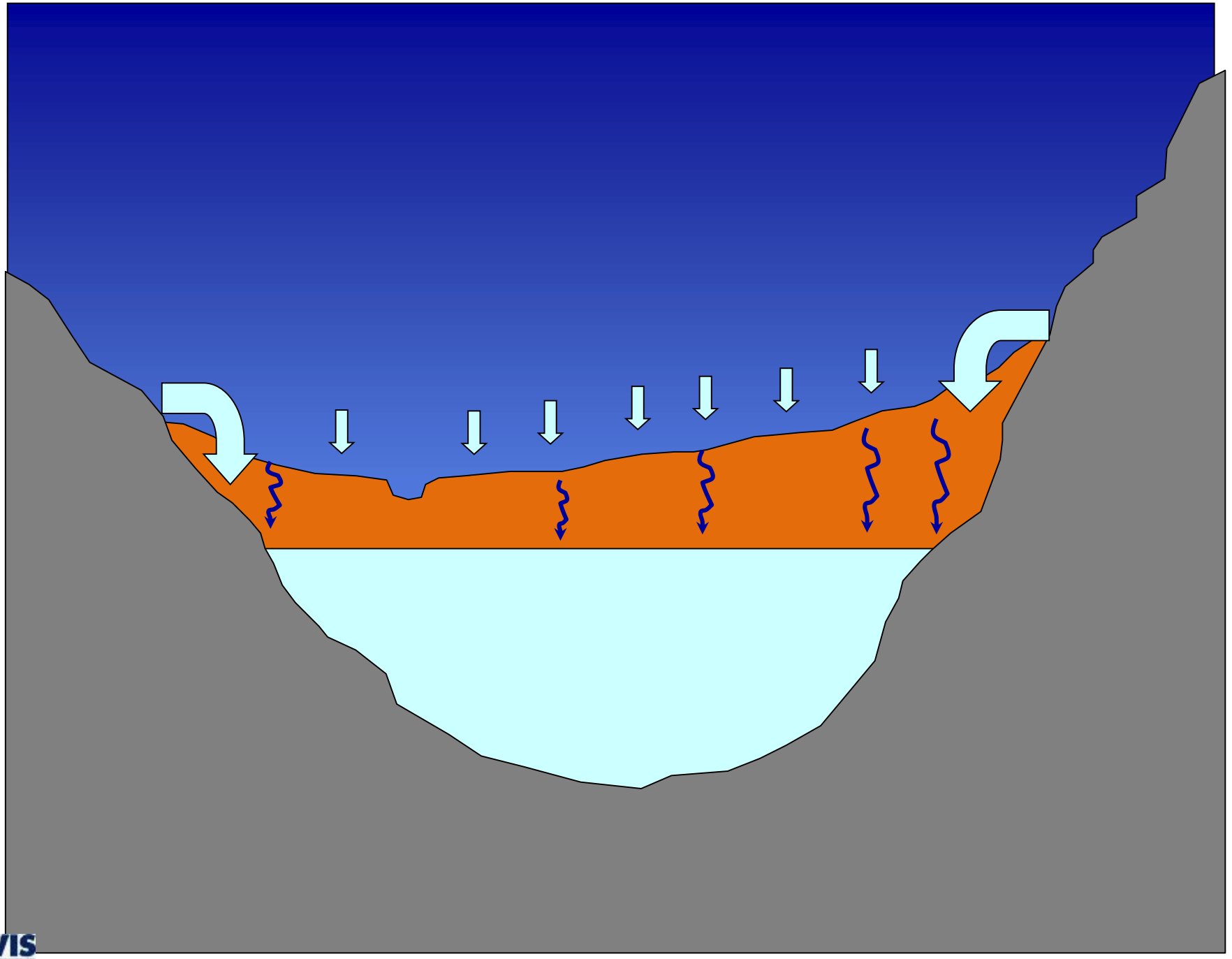
California Geology

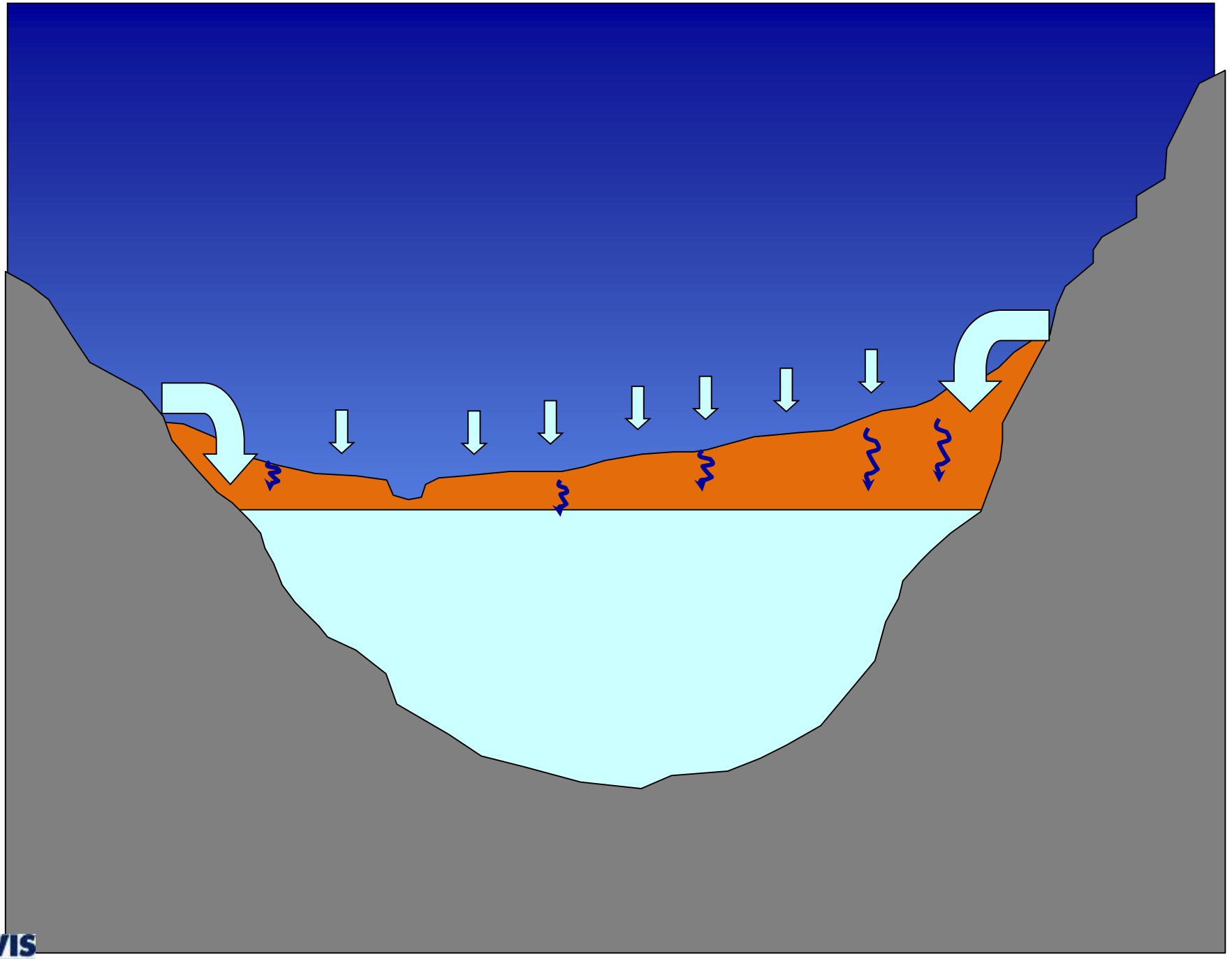



Sediments
=> result of erosion, water, wind, lake deposition, ocean bay deposition
fractured bedrock of California's mountain ranges







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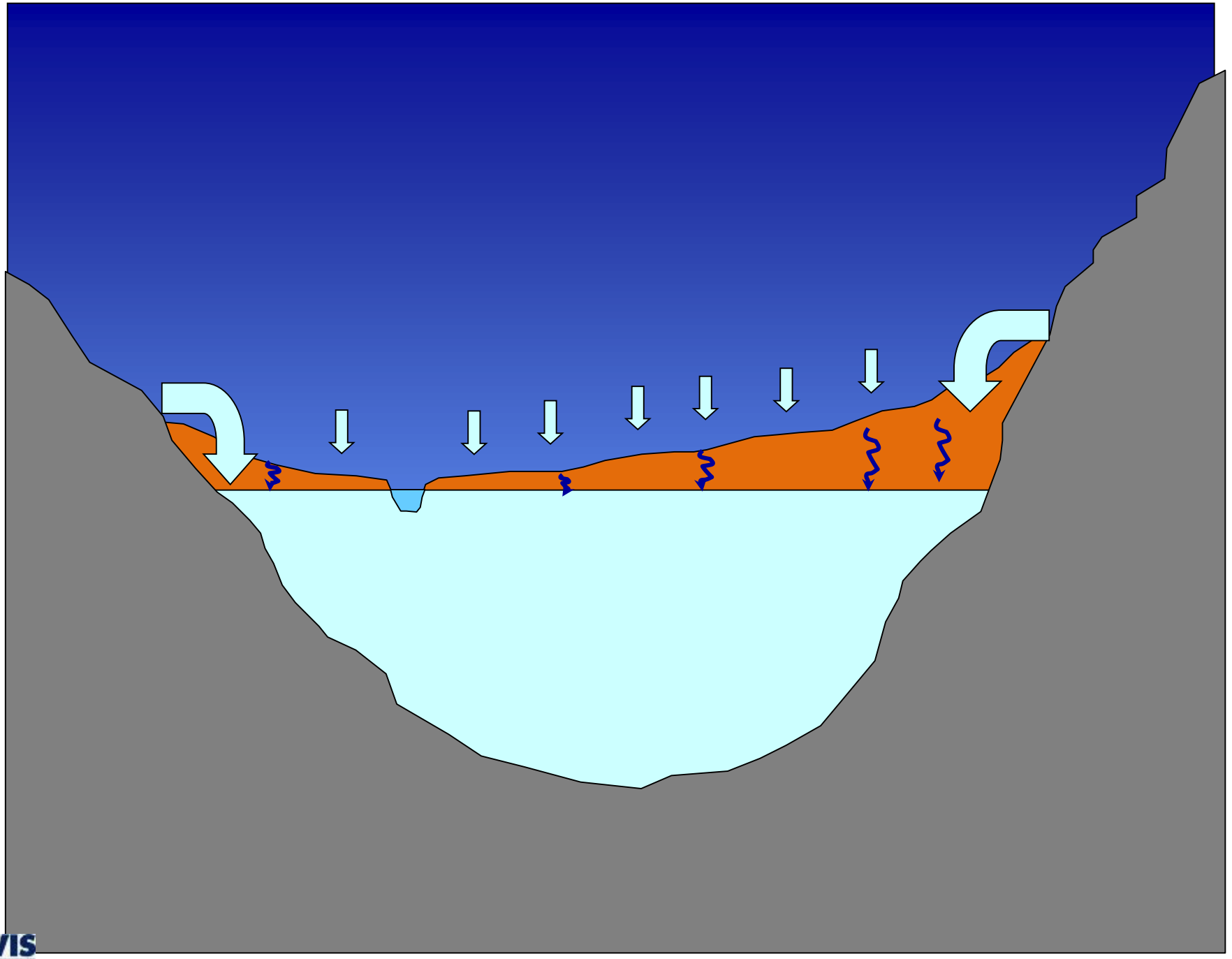

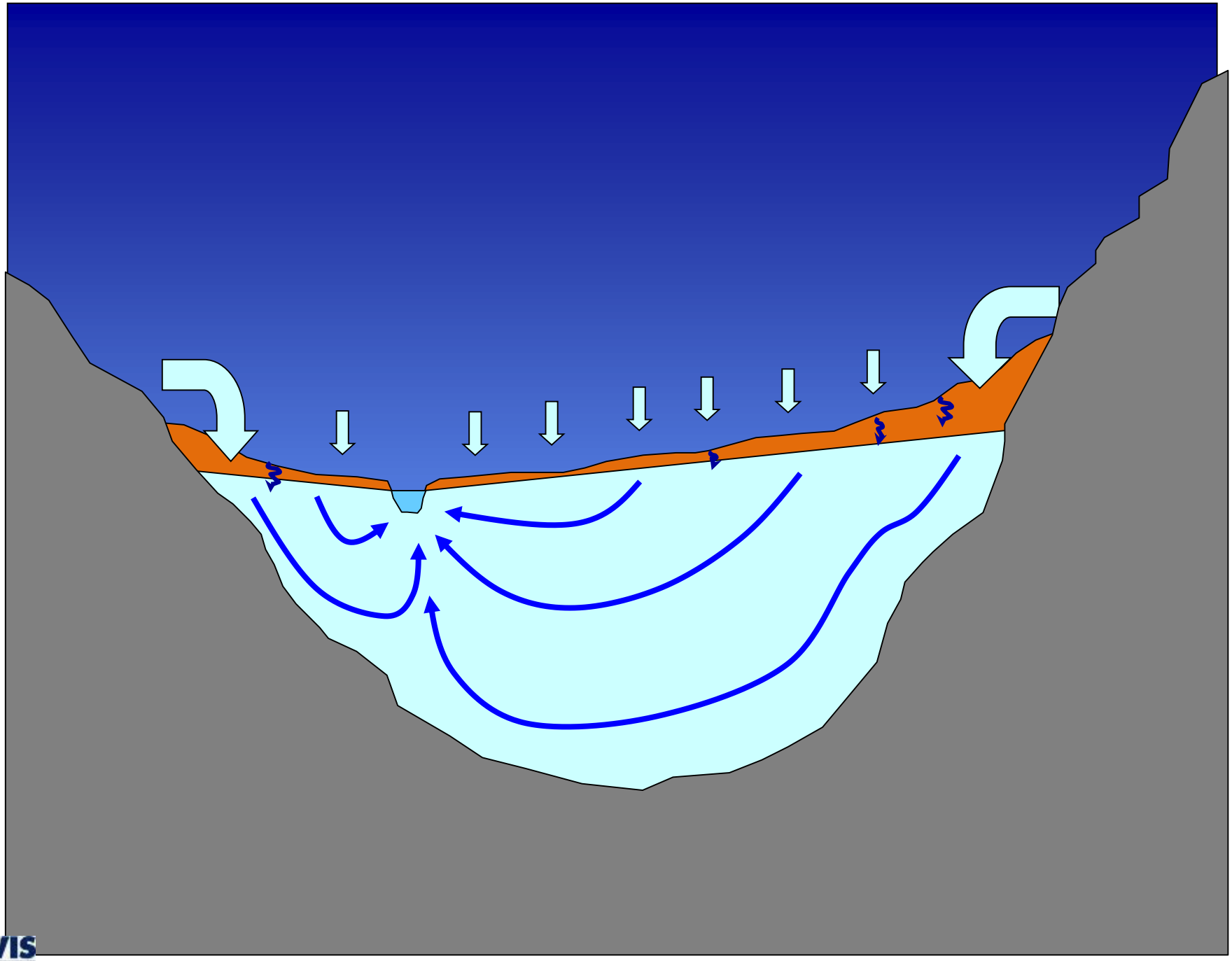

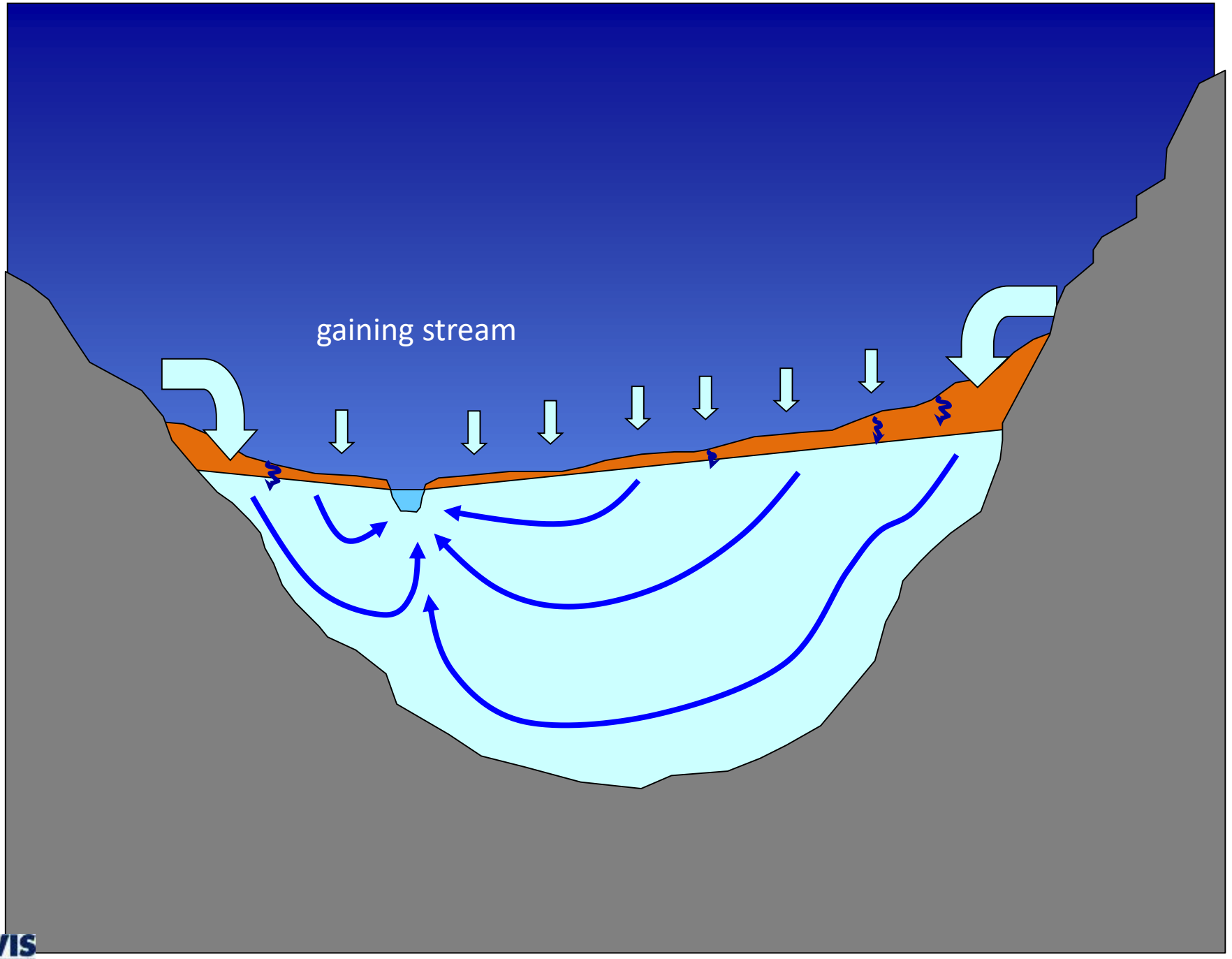


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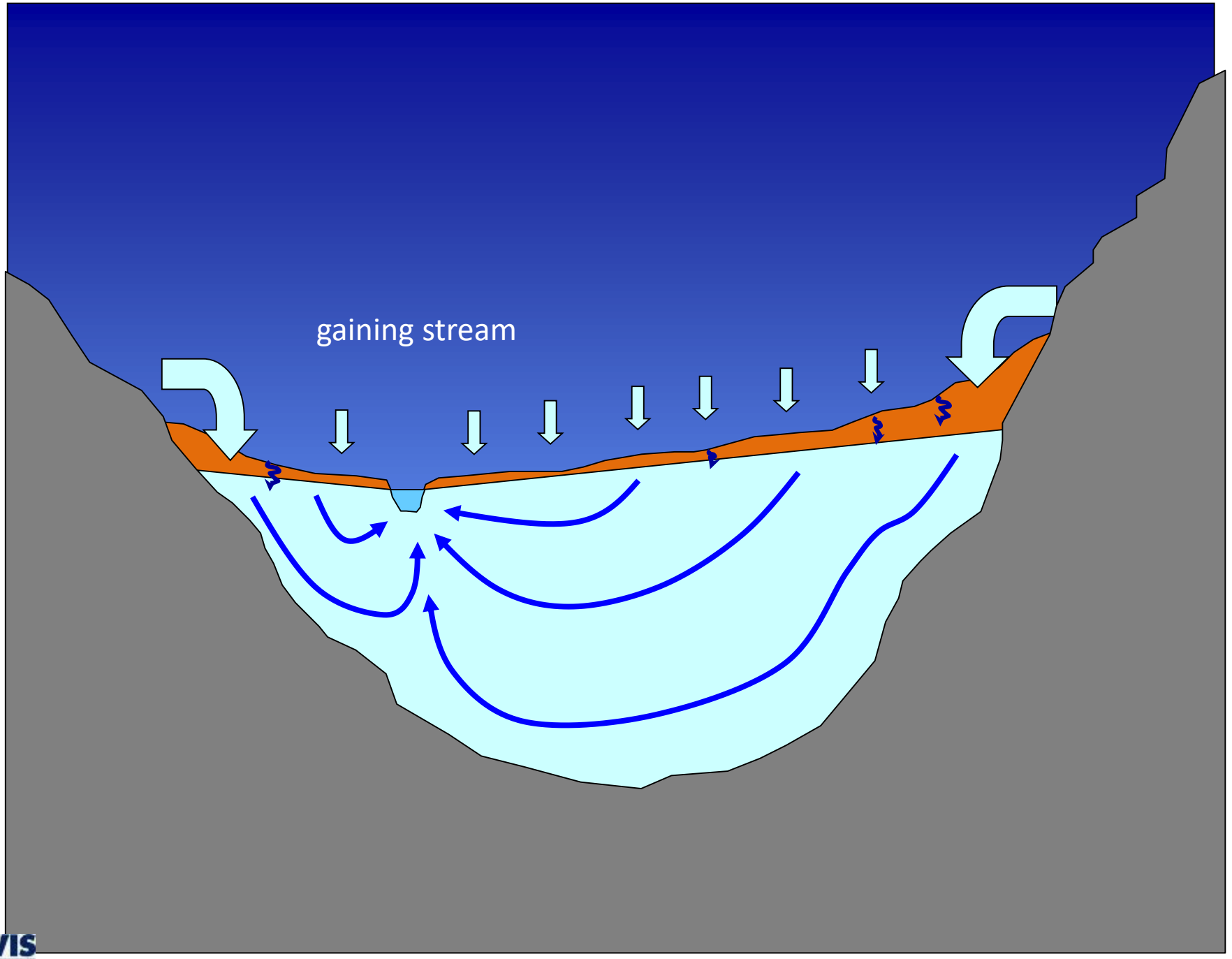
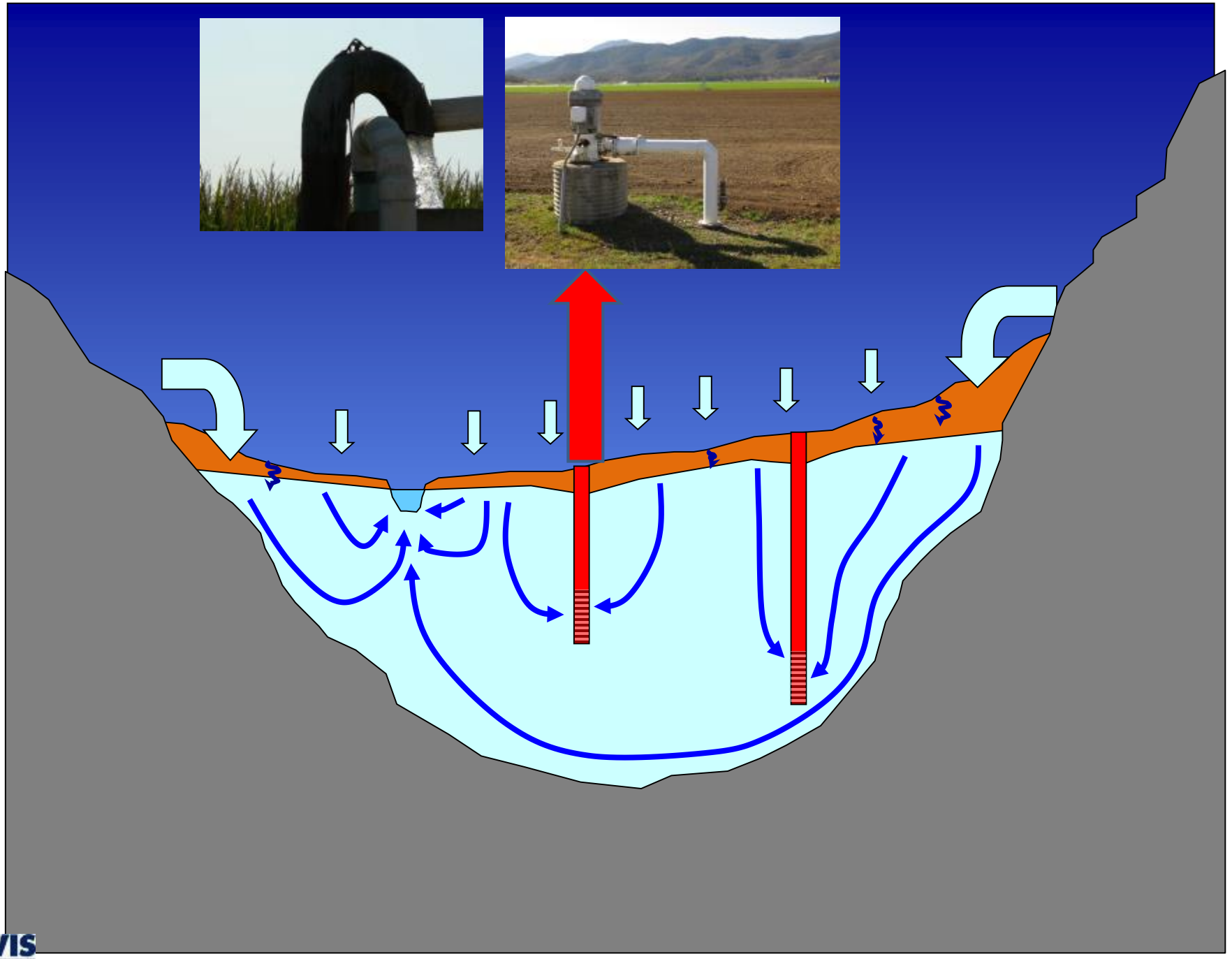
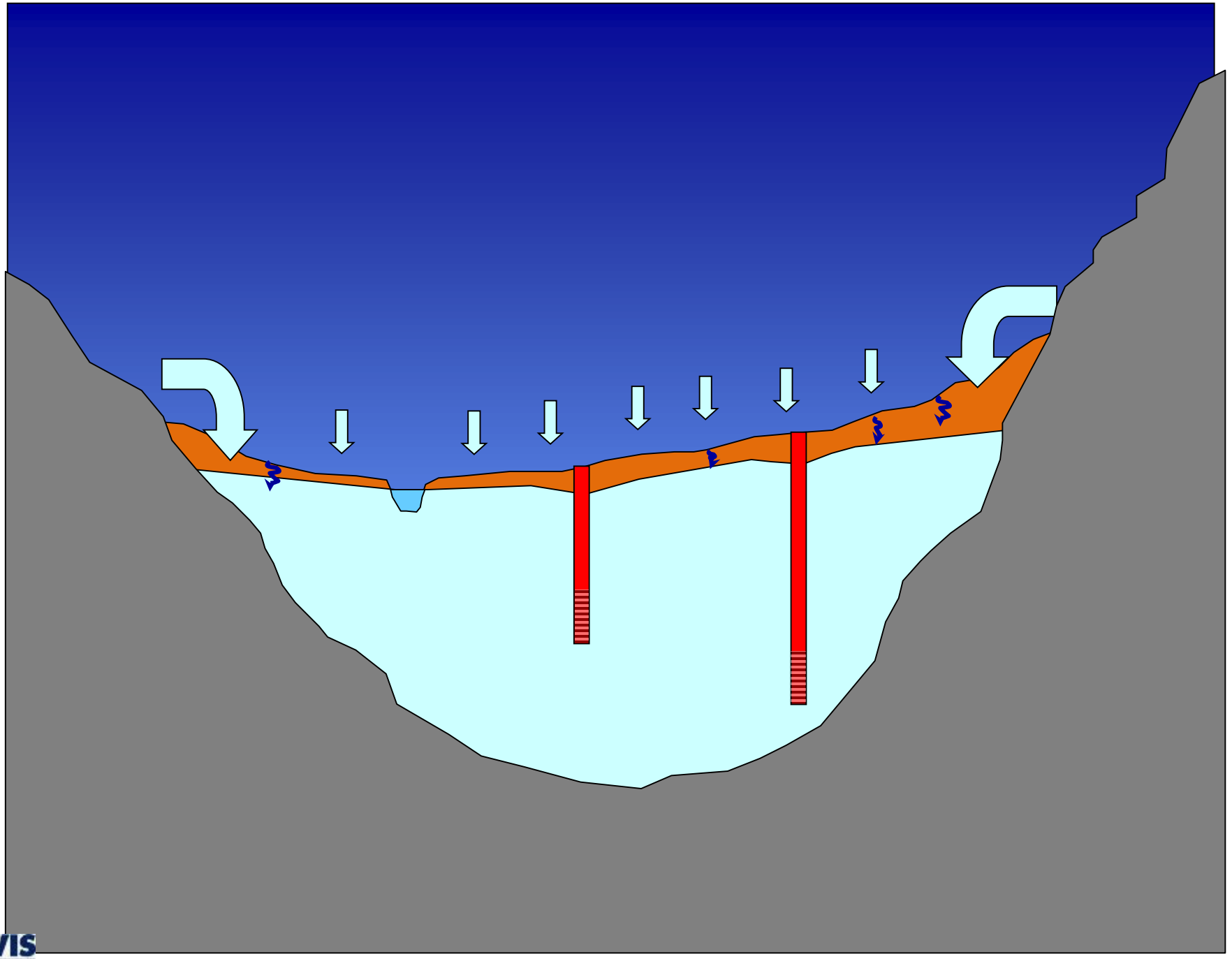
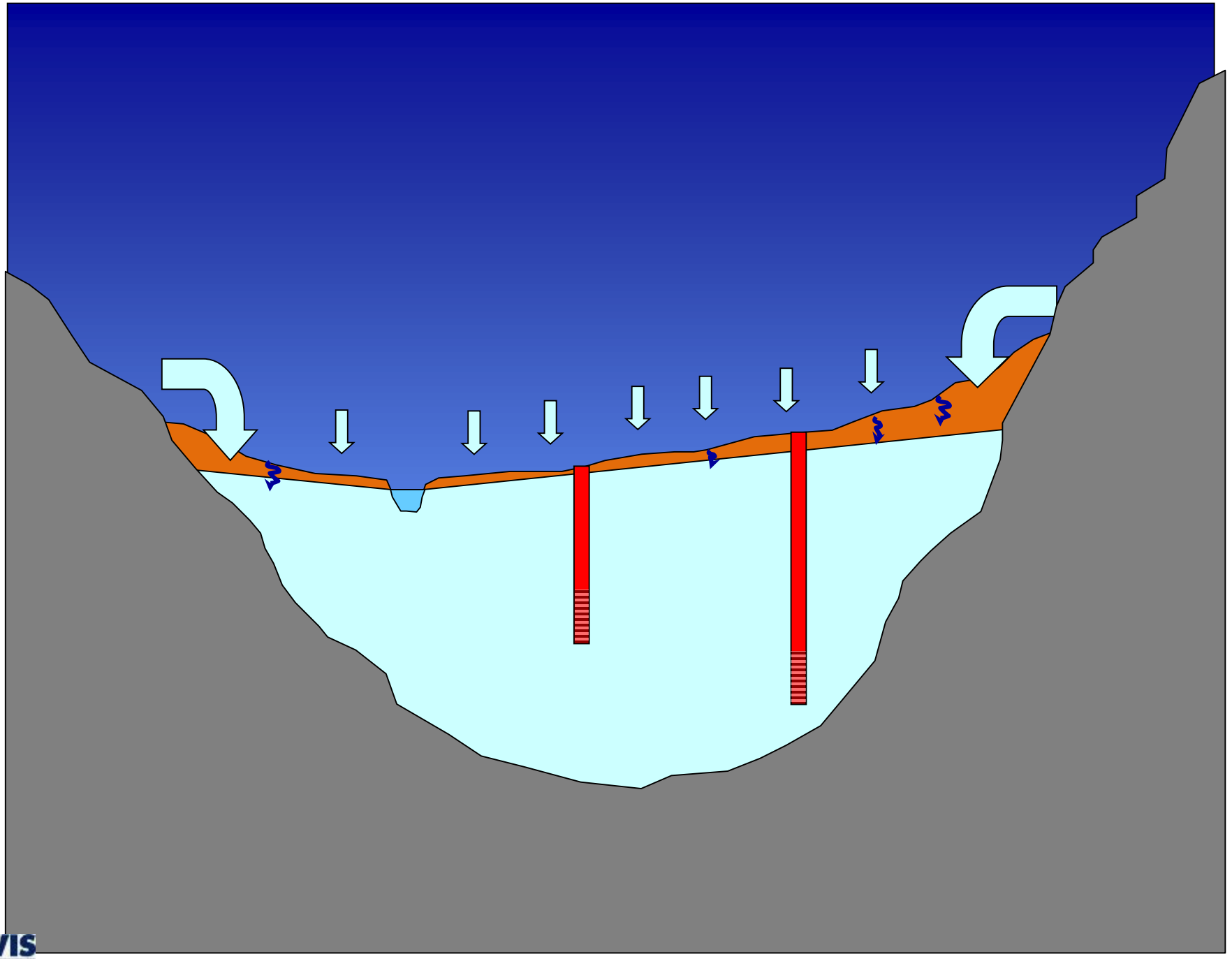
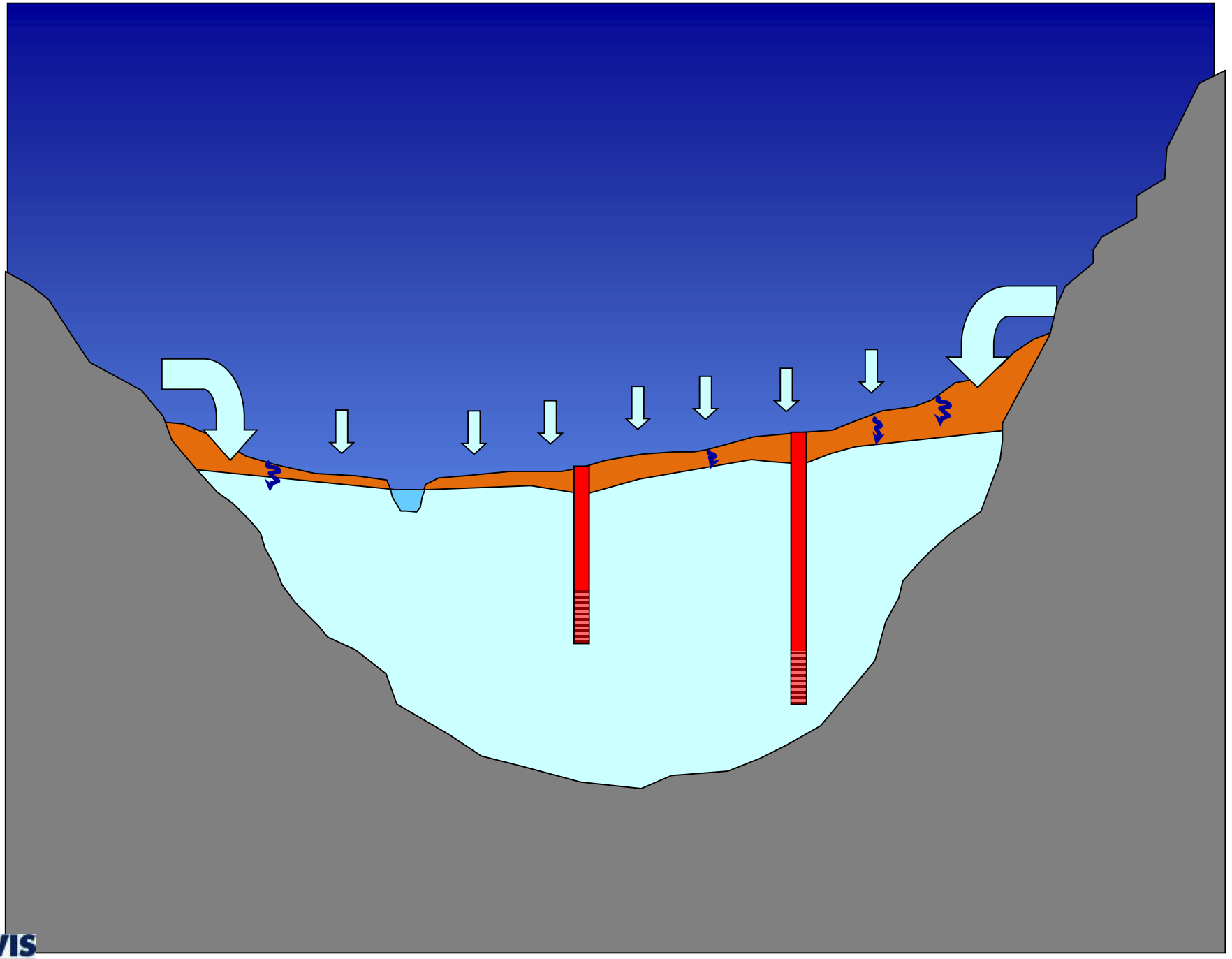
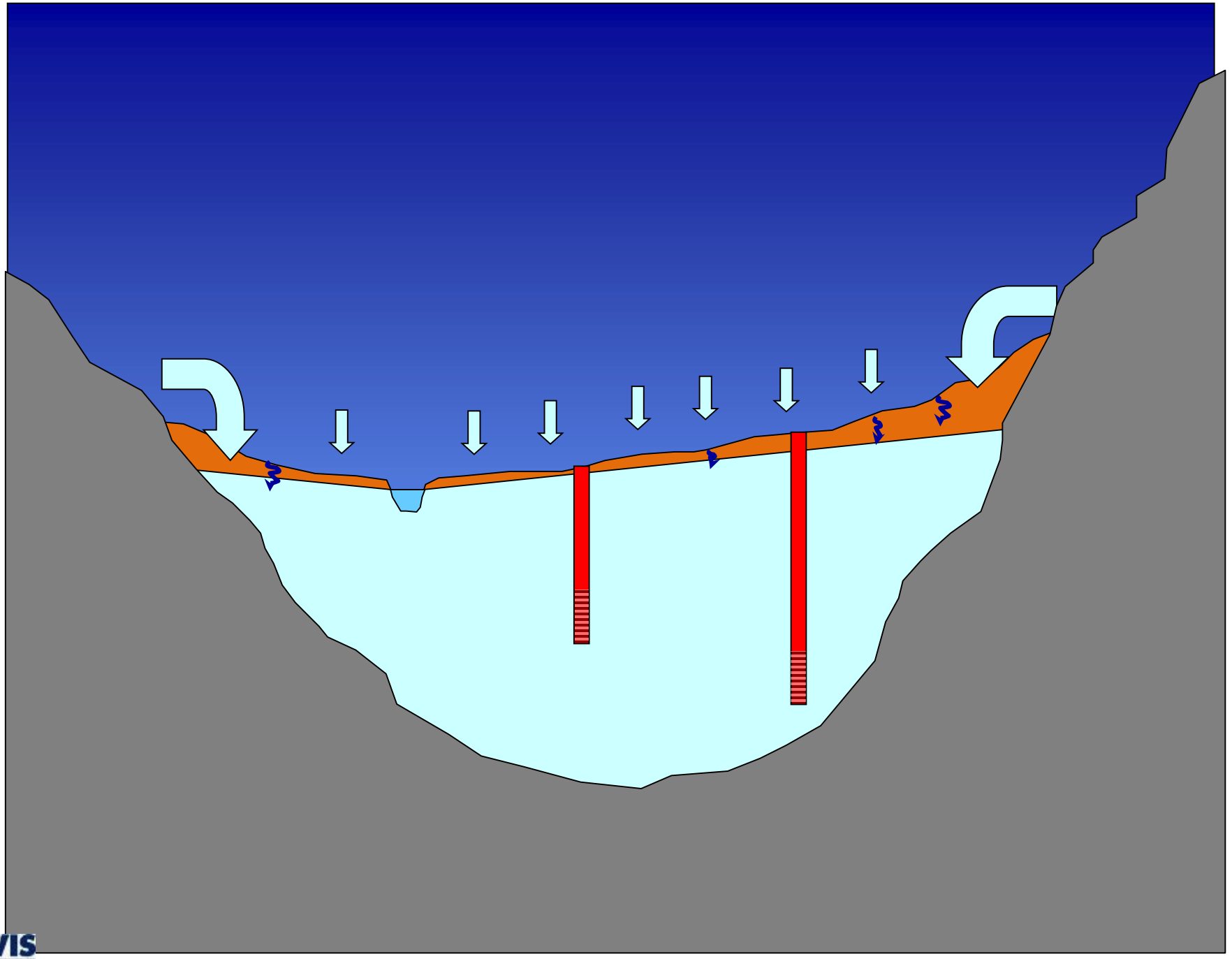


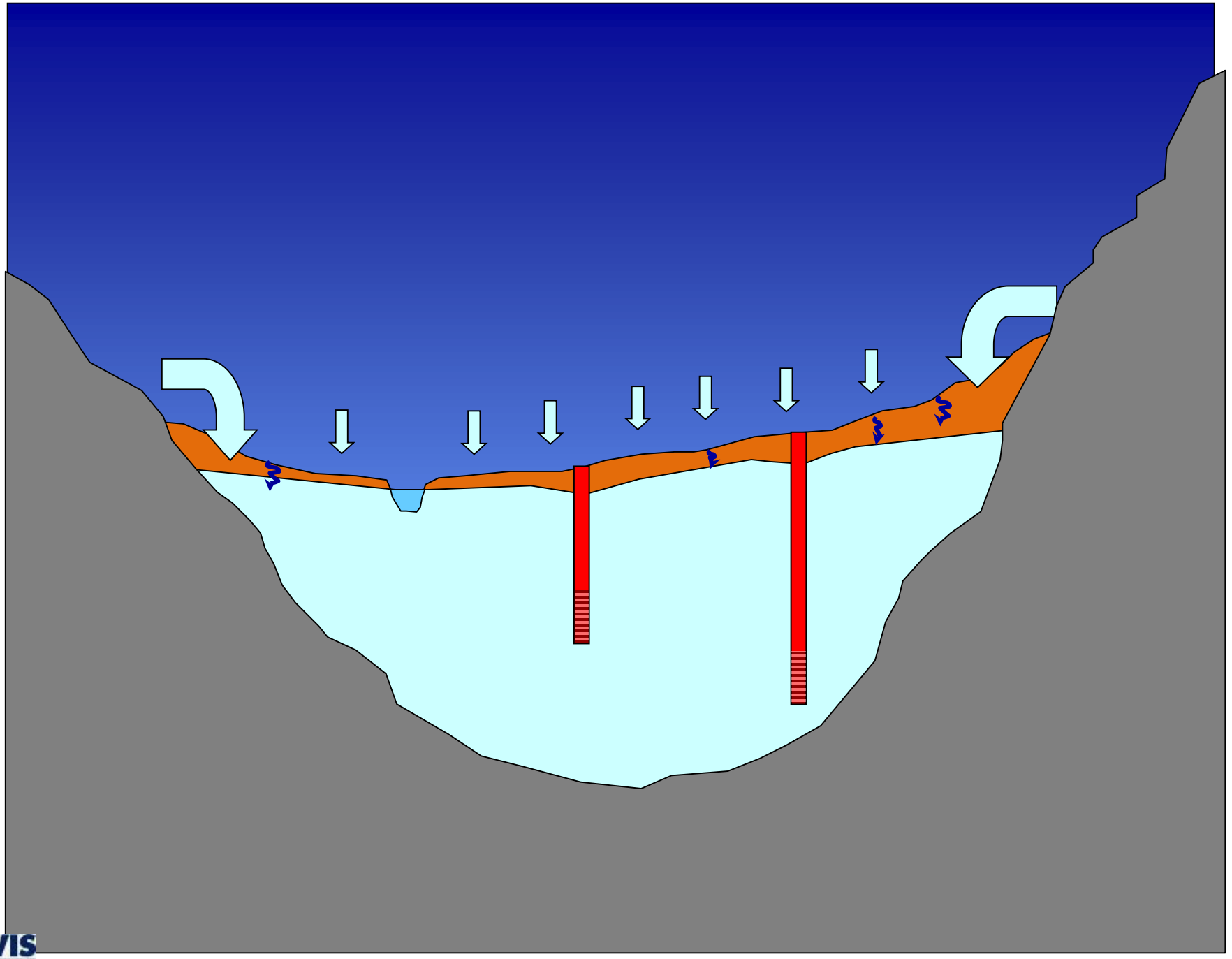


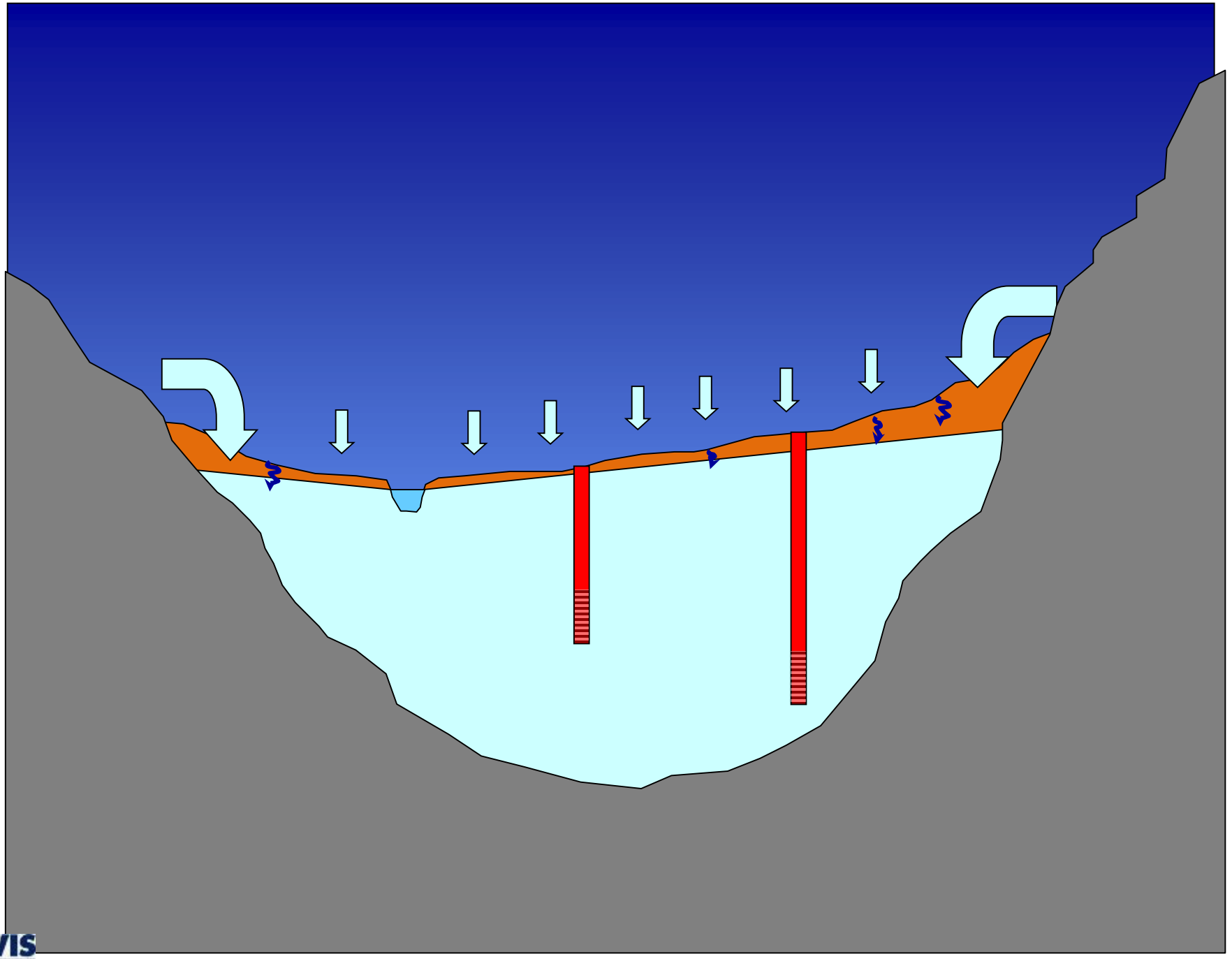


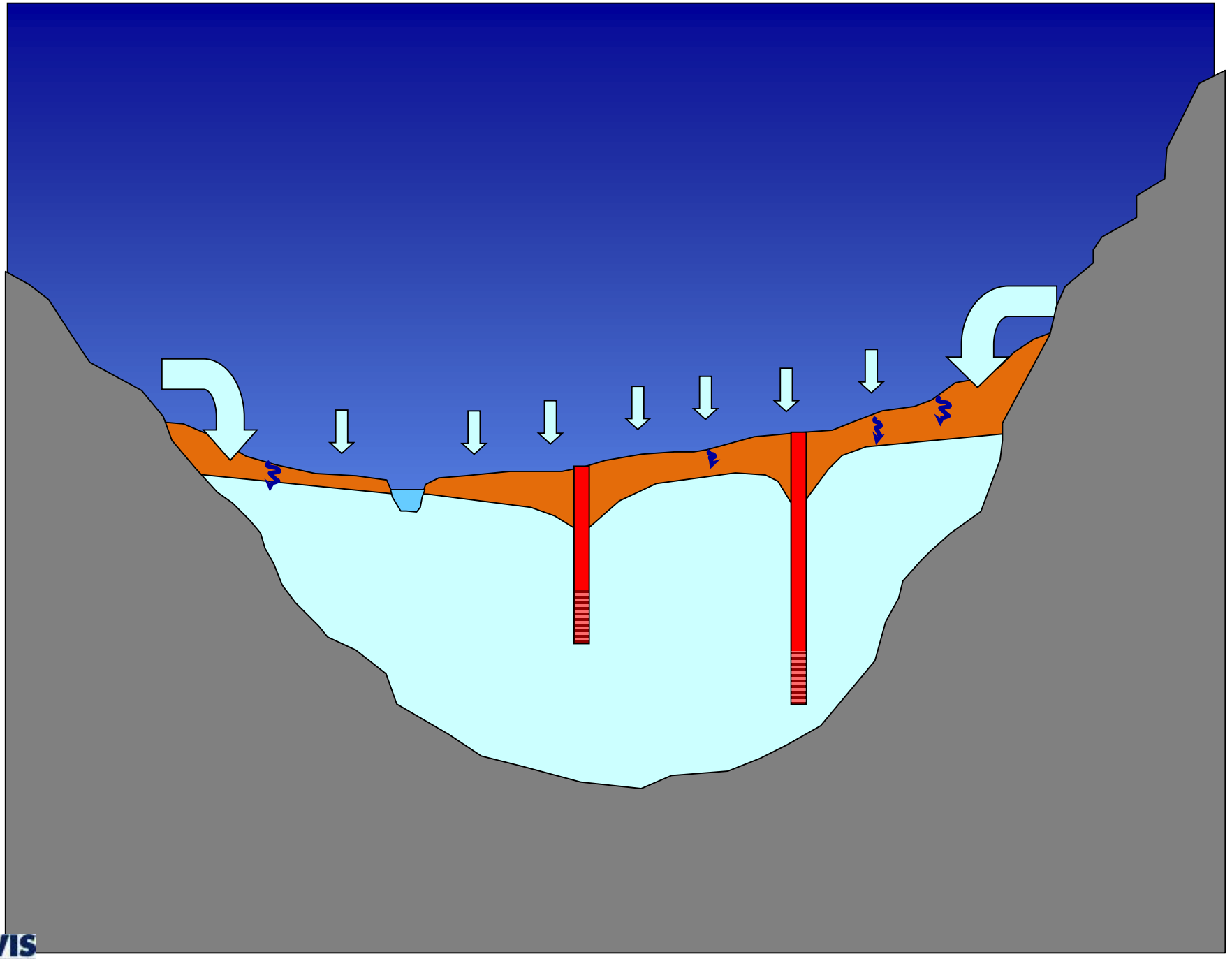


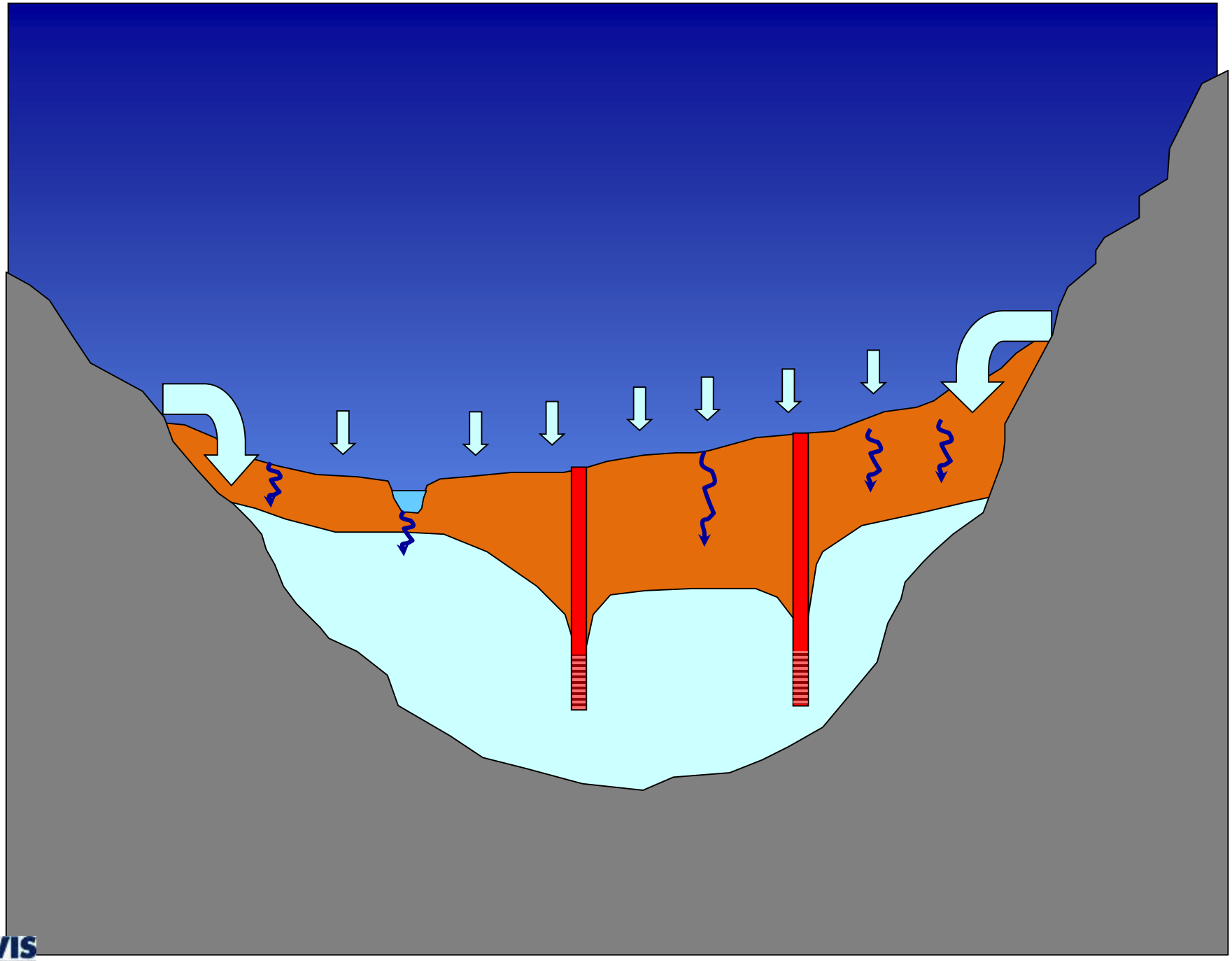


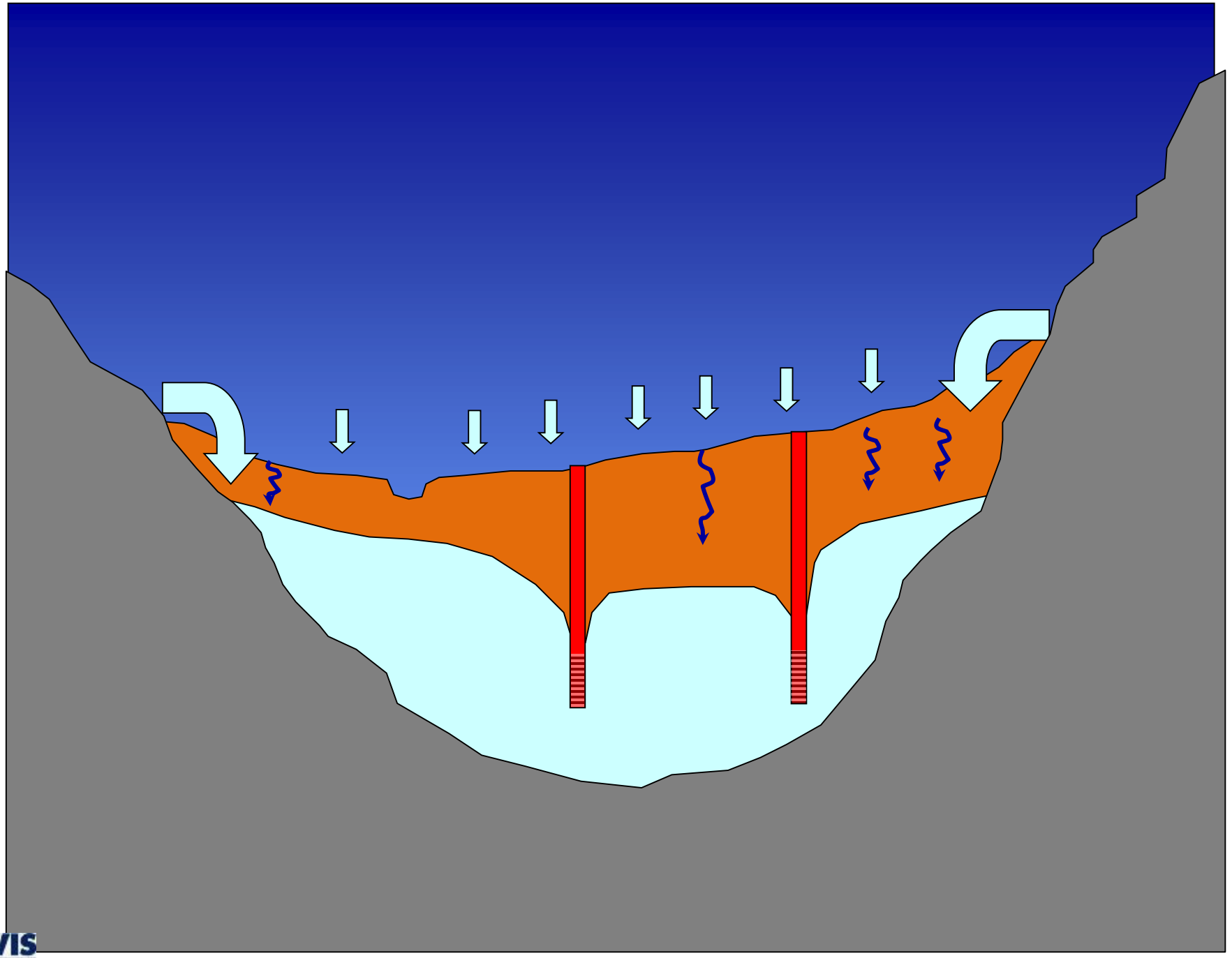










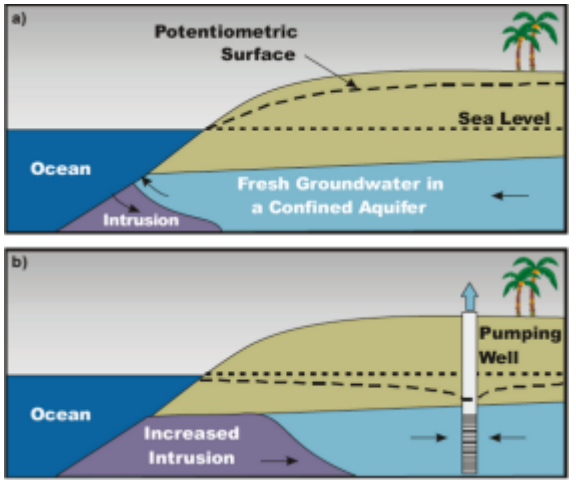


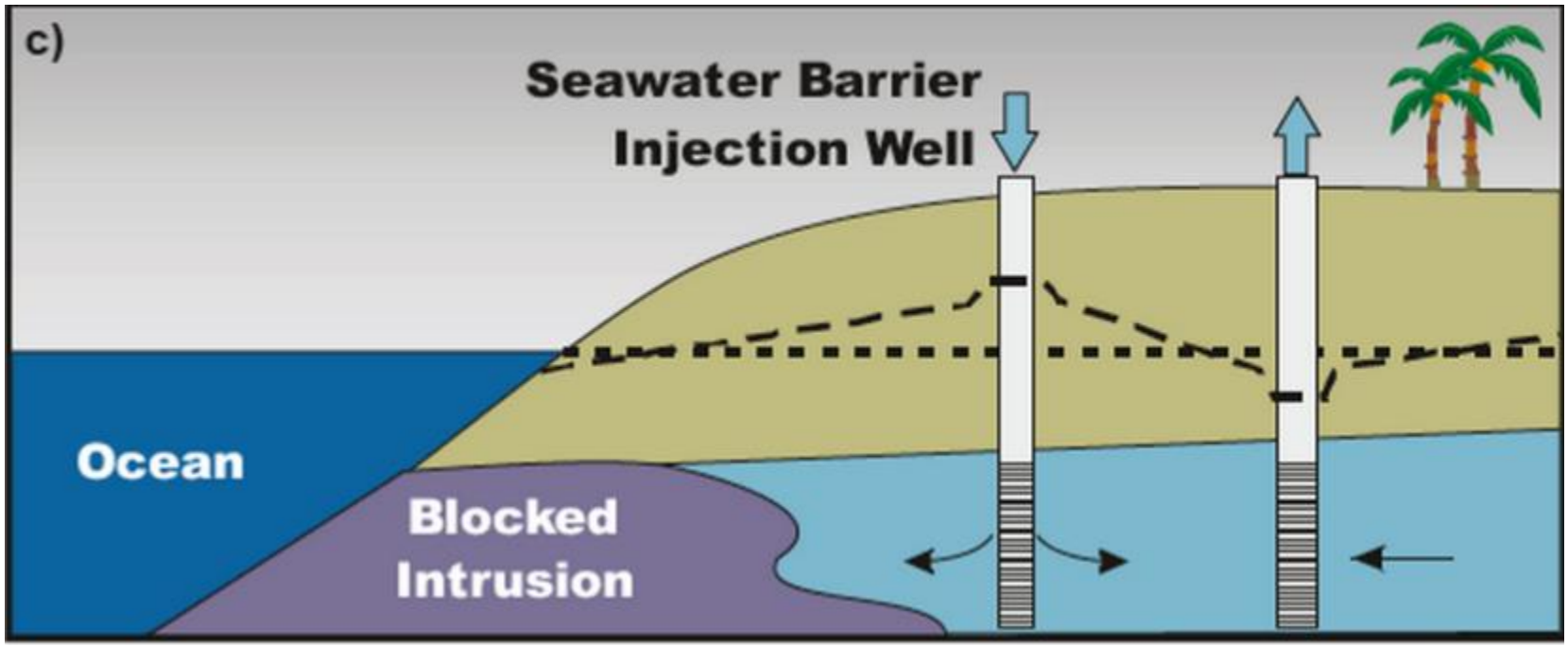
Key Elements of a Groundwater Sustainability Plan

- Introduction
  - Purpose of the GSP
  - Sustainability Goal
  - Agency Information
  - GSP Organization
- Plan Area
  - Plan Area
  - Map of various agencies
  - Water resources monitoring and programs
  - Land use
  - Additional elements (well head protection, well destruction, water quality, contamination sites, GDEs)
  - Communications
- Basin Setting
  - Hydrogeologic Conceptual Model
  - Groundwater Conditions (current and historic)
  - Water budget information
  - Management areas
- Sustainable Management Criteria
  - Sustainability goal
  - Measures to achieve goal
  - Measurable objectives (desirable operating range)
  - Minimum thresholds
  - Undesirable results
  - Monitoring network
- Projects and Mgmt Actions
- Plan Implementation & Reporting

CDWR, 2016: "Groundwater Sustainability Plan (GSP) Annotated Outline"

Prevent Seawater Intrusion: Raising Groundwater Levels





Ted Johnson, Water Replenishment District, 2007

Kern County Groundwater Banks

(Source: mavensnotebook.com; KWBA)

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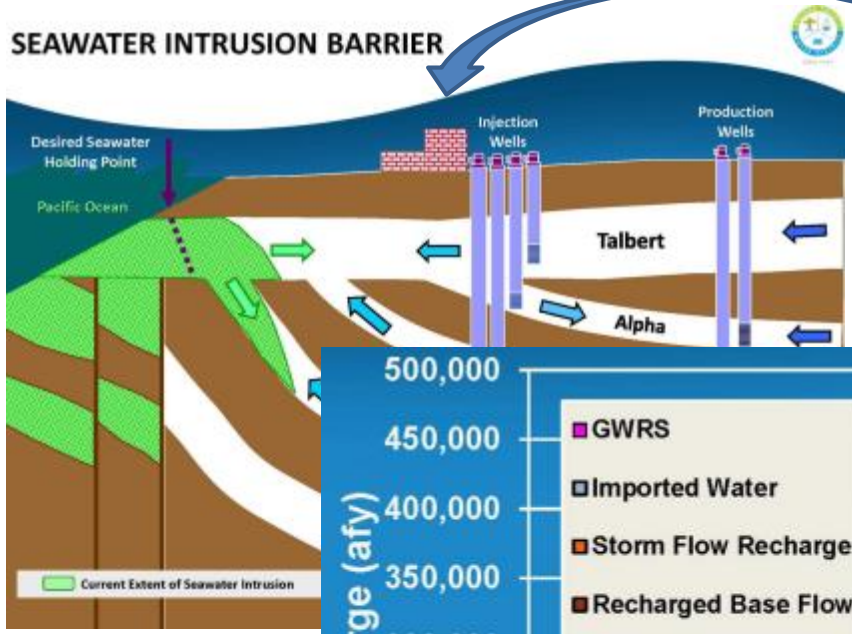
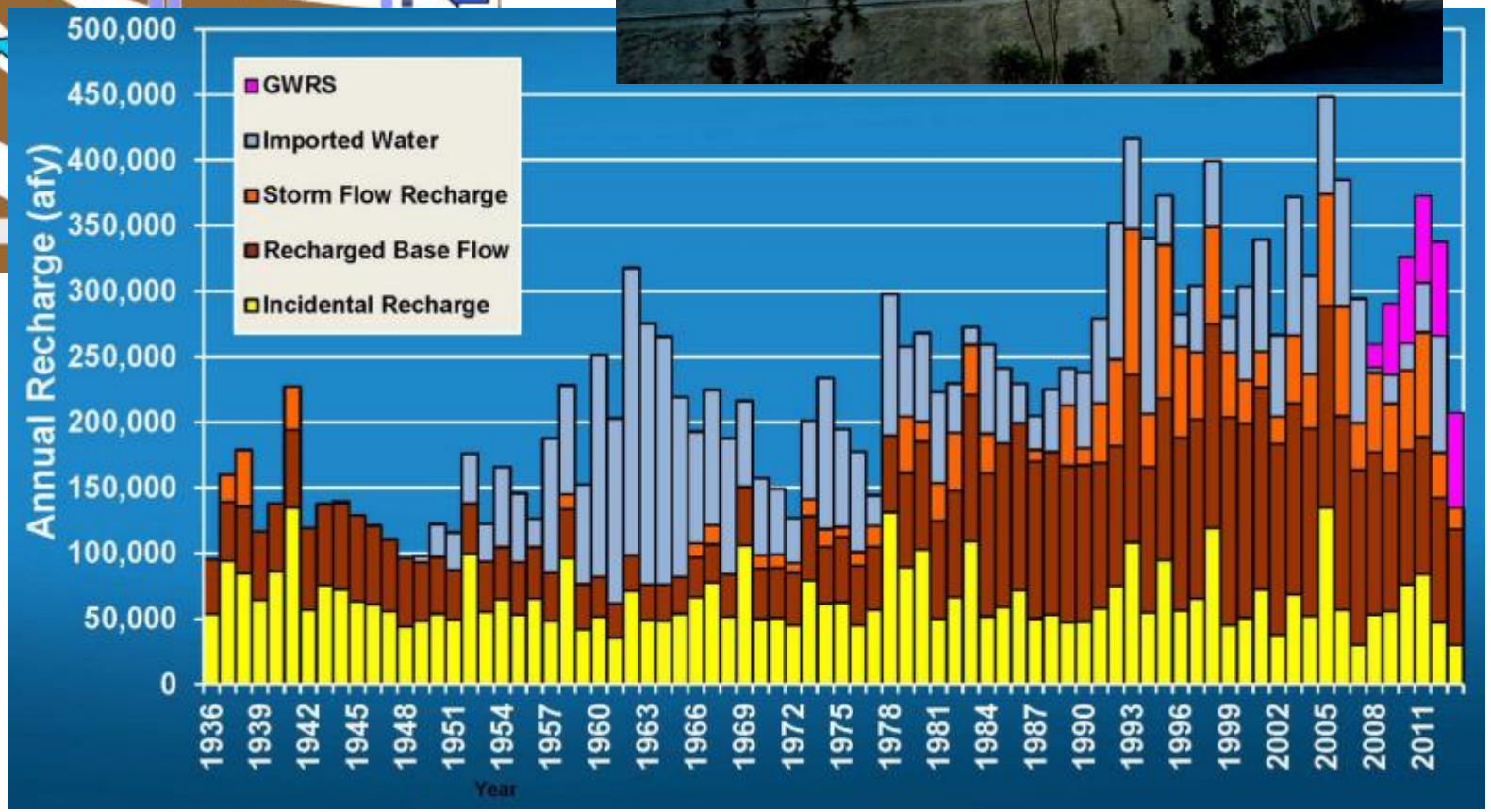
Orange County: Groundwater Recharge Portfolio



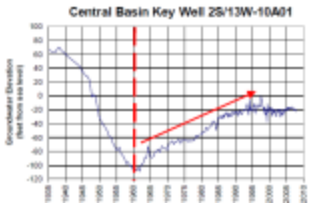


Orange County Water District, 2014

Relationship between
Measurable Objectives (MO) and Management Practices

INDICATORS

THRESHOLD (s)



Measurement / Monitoring

Certainty

Groundwater Sustainability Plan
- Monitoring & Assessment
- Stakeholder engagement
- Adaptive supply management
- Adaptive demand management

Management Impact

Uncertainty

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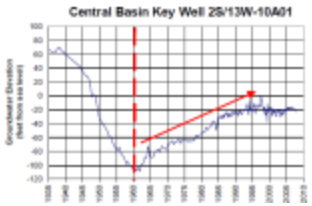
Thomas Harter, Univ. of California, 2015

Relationship between
Measurable Objectives (MO) and Management Practices

State Minimum Regulation

INDICATORS

THRESHOLD(s)



Measurement / Monitoring

Certainty

Groundwater Sustainability Plan
- Monitoring & Assessment
- Stakeholder engagement
- Adaptive supply management
- Adaptive demand management

Local Adaptive & Integrated Regional Water Management

Management Impact

Uncertainty

Management options

Capture and store more local runoff

- Expand local surface reservoirs
  - Temperance Flat Reservoir
- Expand groundwater storage
- Reoperate surface and groundwater storage in the San Joaquin Valley

Increase local runoff

- Increase inflows by managing forests in upper watersheds

Increase imported water from the Delta

- Expand Sacramento Valley storage
  - Sites Reservoir
  - Shasta Reservoir expansion
- Expand Delta and south of Delta storage
  - San Luis Reservoir expansion
  - Los Vaqueros Reservoir expansion
- Increase cross-Delta conveyance capacity
  - California WaterFix
- Reoperate the whole Central Valley system

Reduce exports and increase non-farm water use within the valley

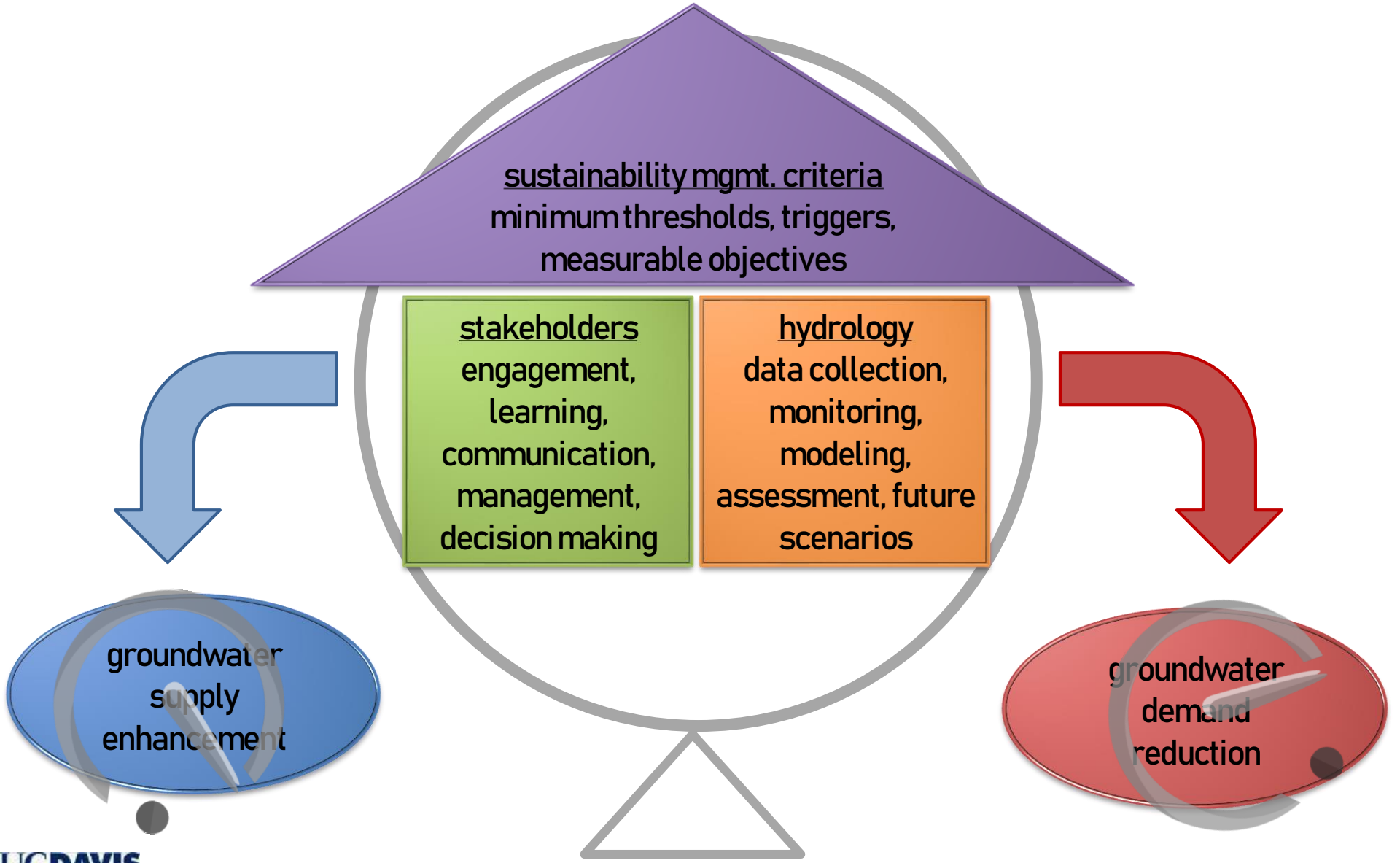
- Urban conservation in the valley
- Urban conservation in coastal regions*

Reuse and repurpose local water supplies

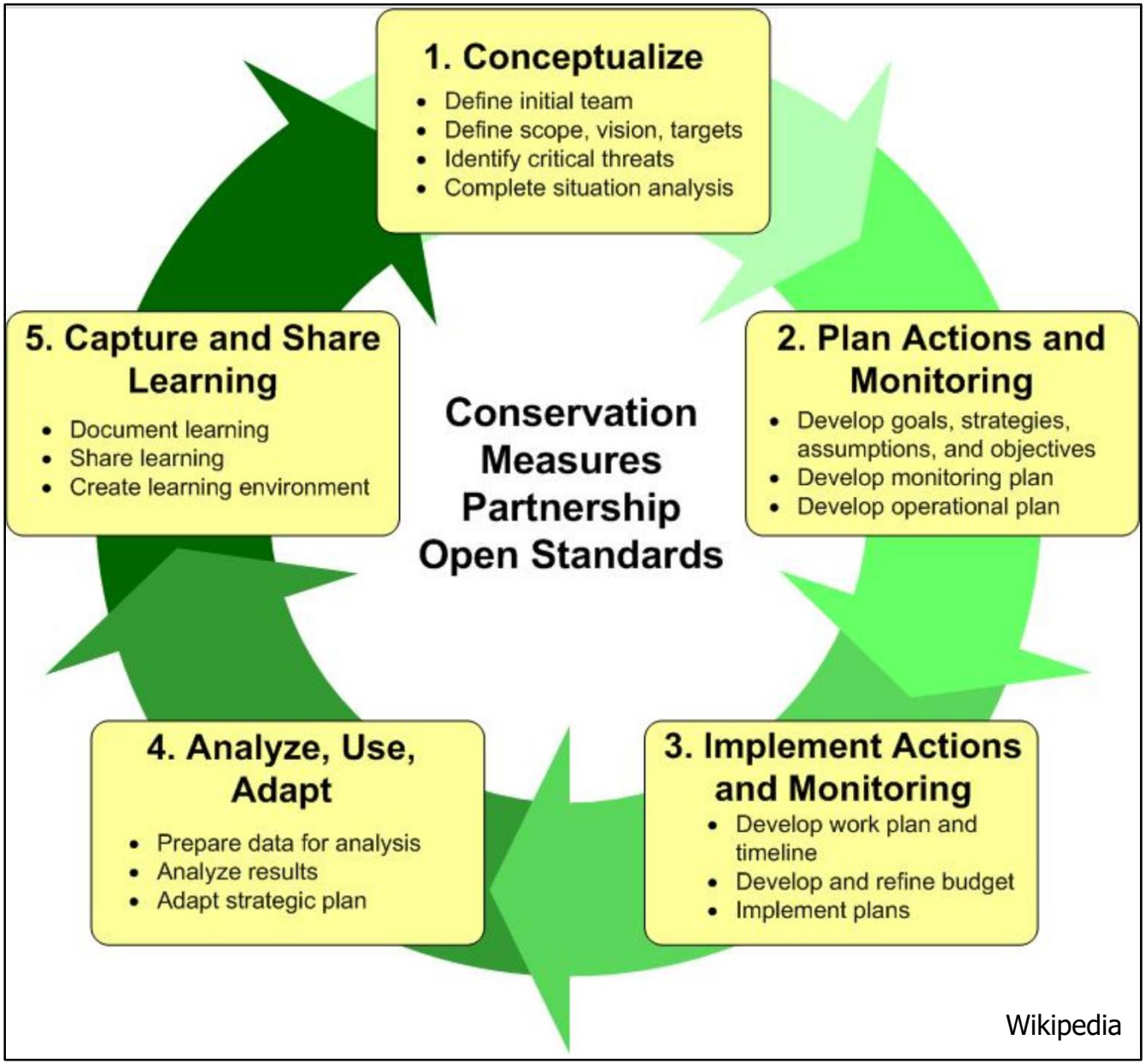
- Urban reuse
- Reuse water produced in oil and gas wells

NOTE: * This option is a way to reduce exports from the valley to coastal regions (Table

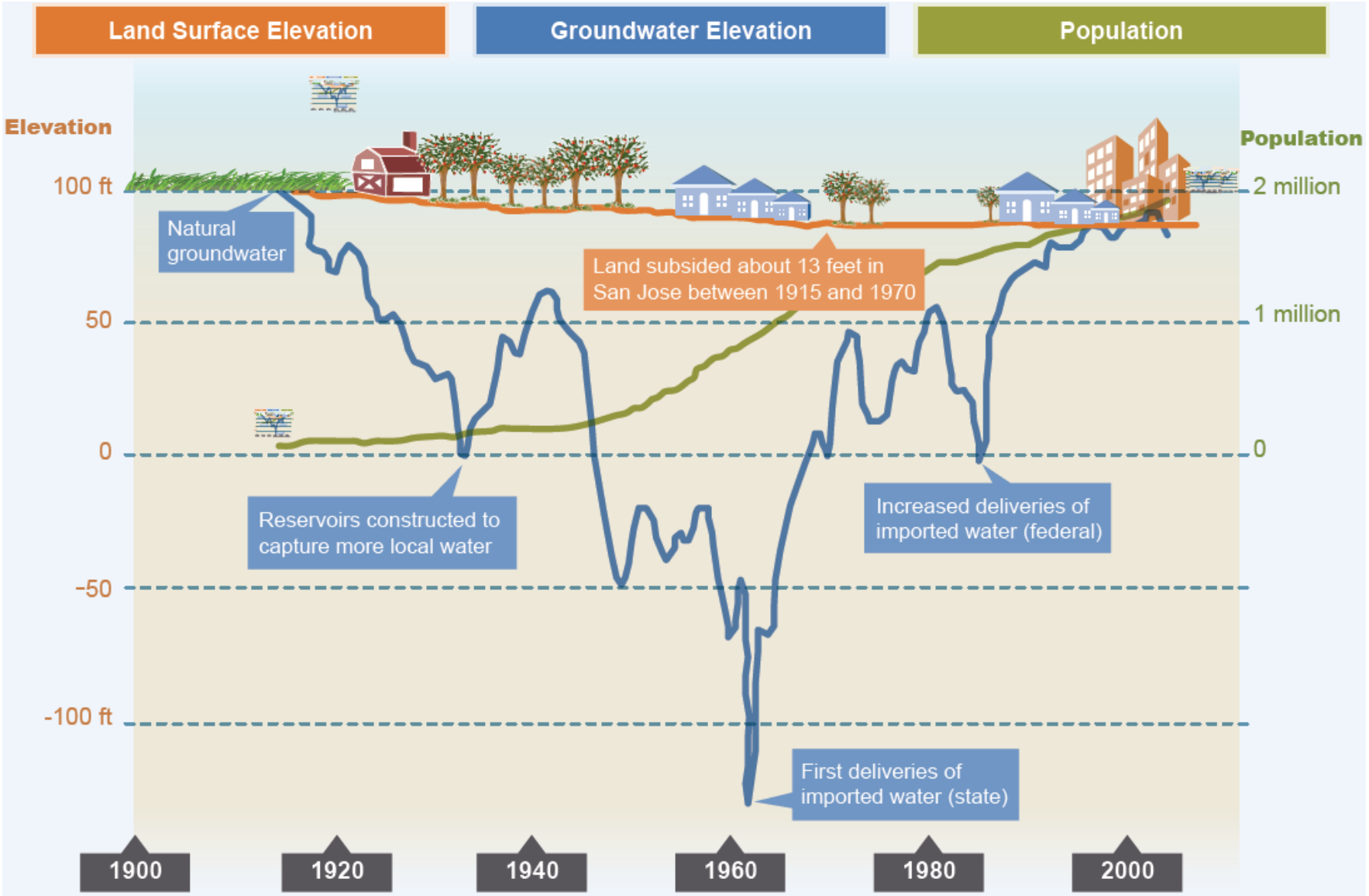
The Key Elements of Groundwater Sustainability Plans



Combating Uncertainty: Adaptive Management



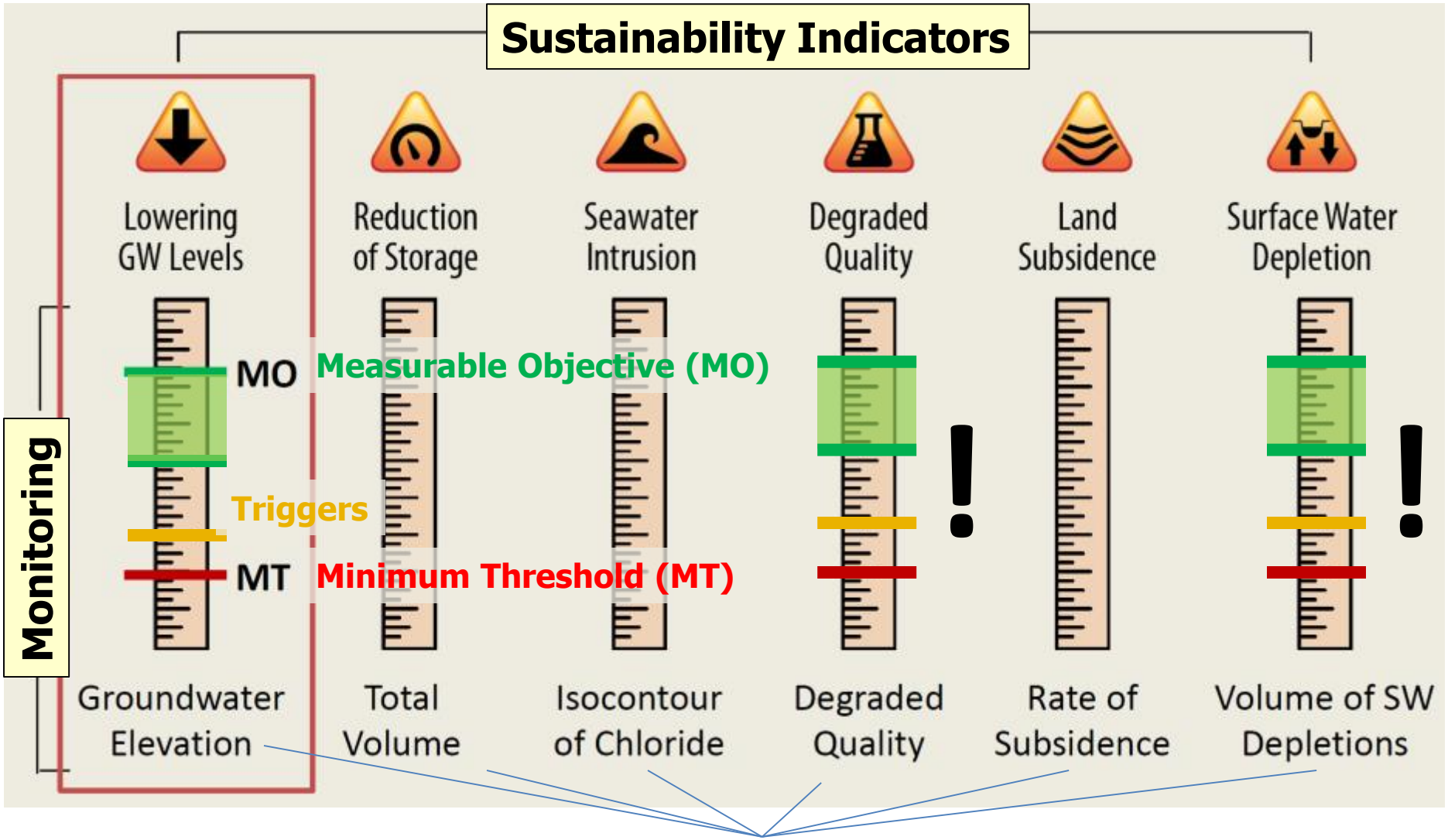
Storage for Local Use: Santa Clara Valley Water District



Note: This graphical representation is not intended as a technical exhibit.

Seawater Intrusion

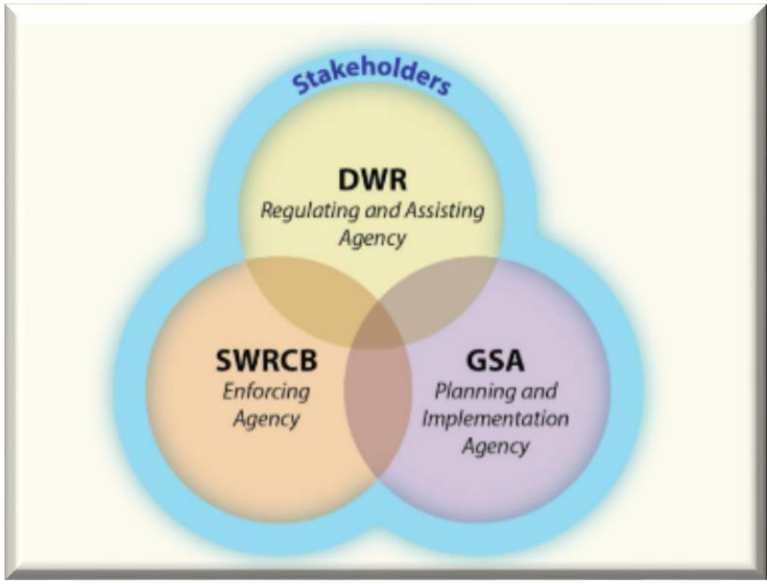
GSP: Monitoring and Managing Sustainability



[generalized examples of what to monitor]

modified from Ca DWR 2016

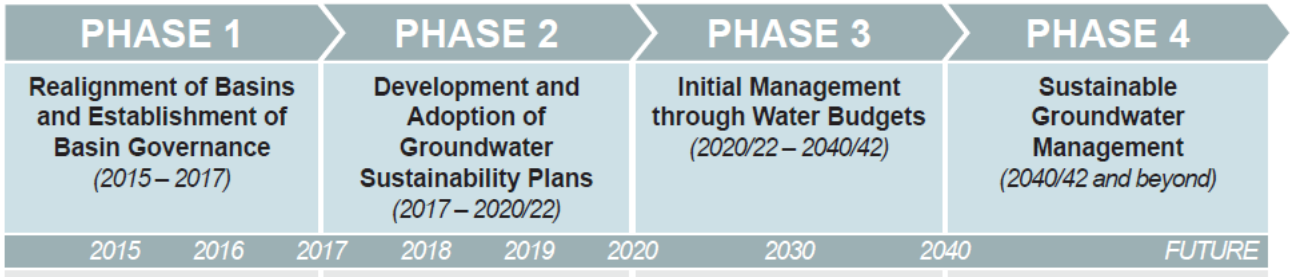
Role of the State: Carrot **& Stick**



California DWR, 2016

- Department of Water Resources has a key role:
  - Technical assistance and funding (Prop 1: $100 million for SGMA)
  - Regulation
    - Groundwater basin boundary adjustments
    - Minimum guidelines for appropriate GSP
  - Control
    - Review and approve GSPs
    - Review implementation
- State Water Resources Control Board:
  - Enforcement where local control fails (after 2017)
    - "probationary status"
    - Public hearing and 180 days to fix the problem
  - After 180 days: SWRCB poses as interim GSA
    - Groundwater extraction reporting mandatory
    - Possibly temporary control of groundwater extraction
    - Development and implementation of interim GSP
  - When locals are ready: get authority back from state

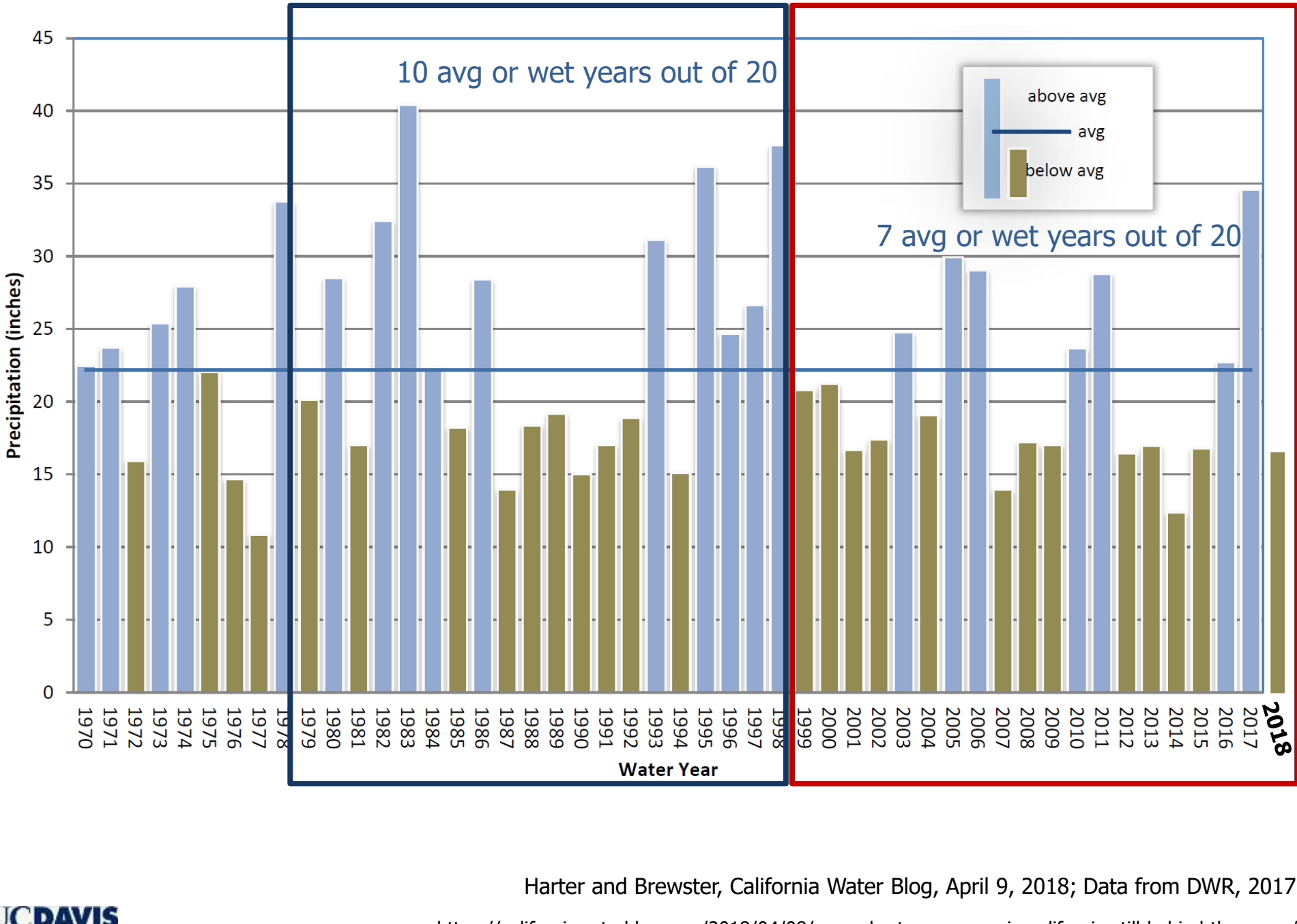
California Timeline Toward Groundwater Sustainability



- First Step: forming a Groundwater Sustainability Agency (GSA)
  - By June 2017
- Second Step: developing a Groundwater Sustainability Plan (GSP)
  - Within 5 years of GSA formation
- **Third Step: implementing Groundwater Sustainability Plan**
  - **achieve sustainable management no later than 2042**
  - DWR may grant up to two 5-year extensions upon showing of good cause and progress

Is the Drought Over?

https://www.wired.com/2017/01/california-flooding-keep-cities-flooding/



Harter and Brewster, California Water Blog, April 9, 2018; Data from DWR, 2017

https://californiawaterblog.com/2018/04/08/groundwater-recovery-in-california-still-behind-the-curve/

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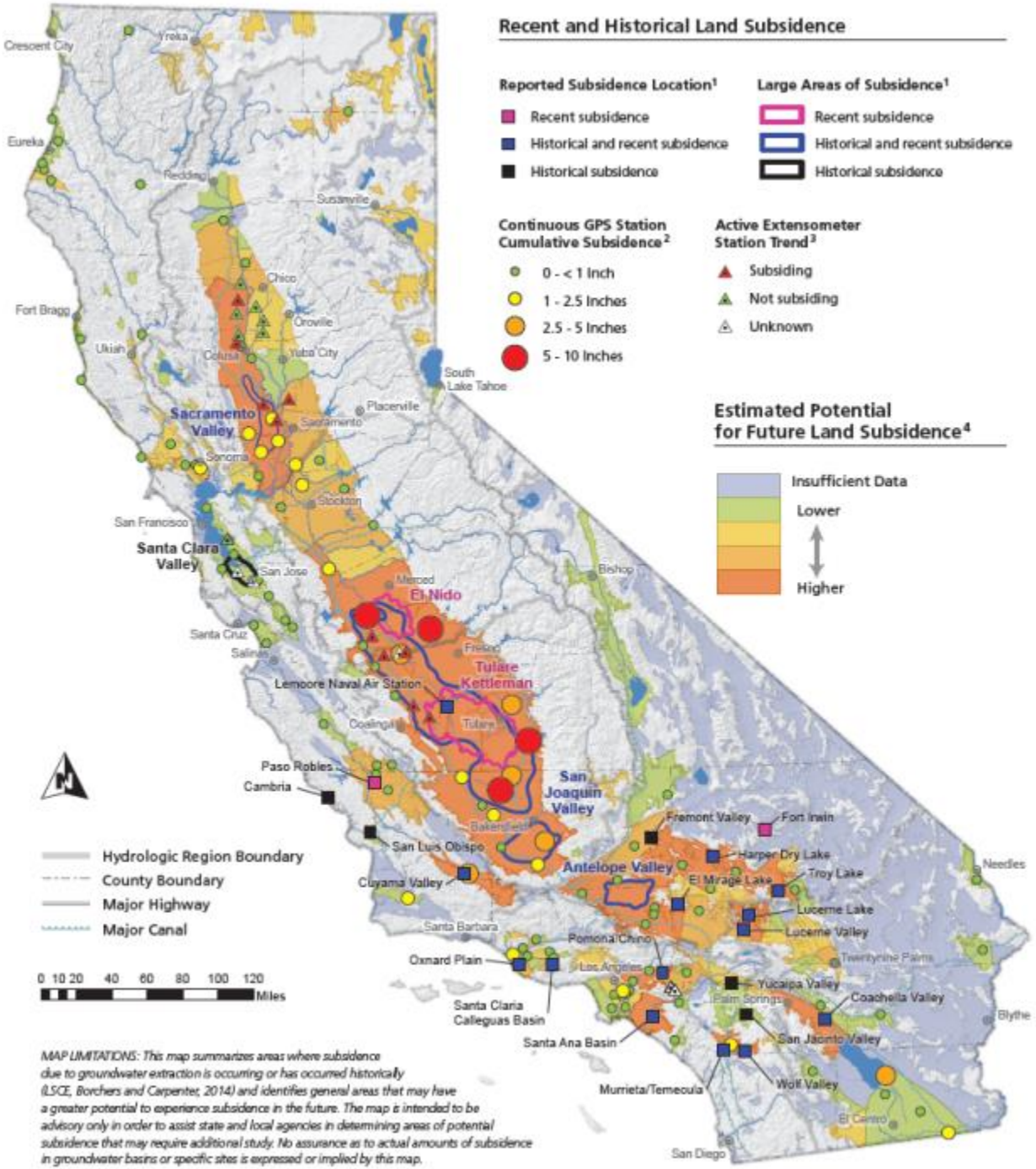
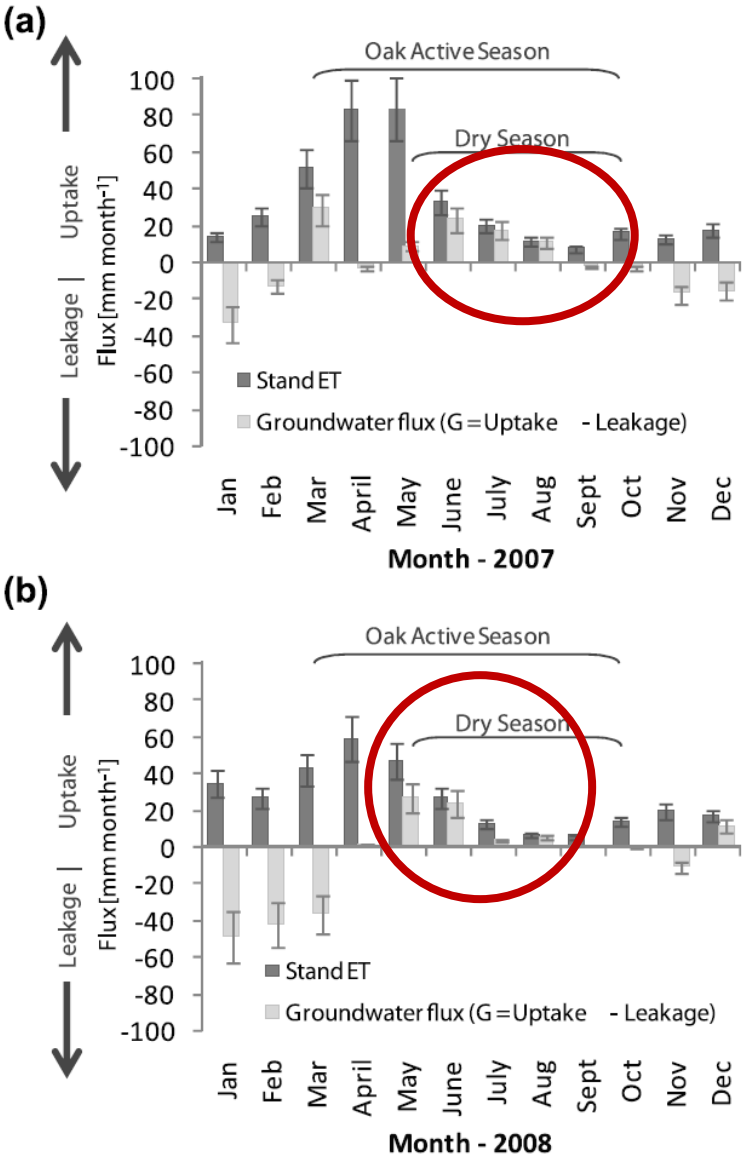
Land Subsidence

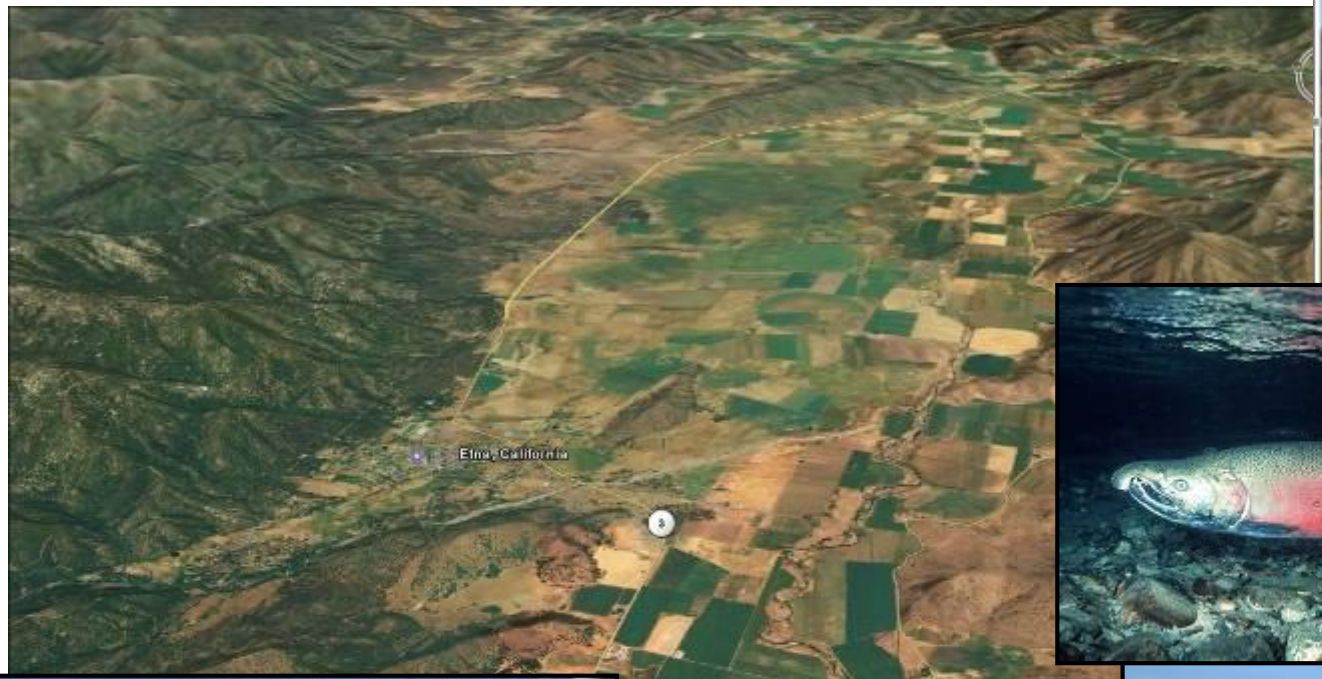


California Department of Water Resources;
Drought Response Update Fall 2014

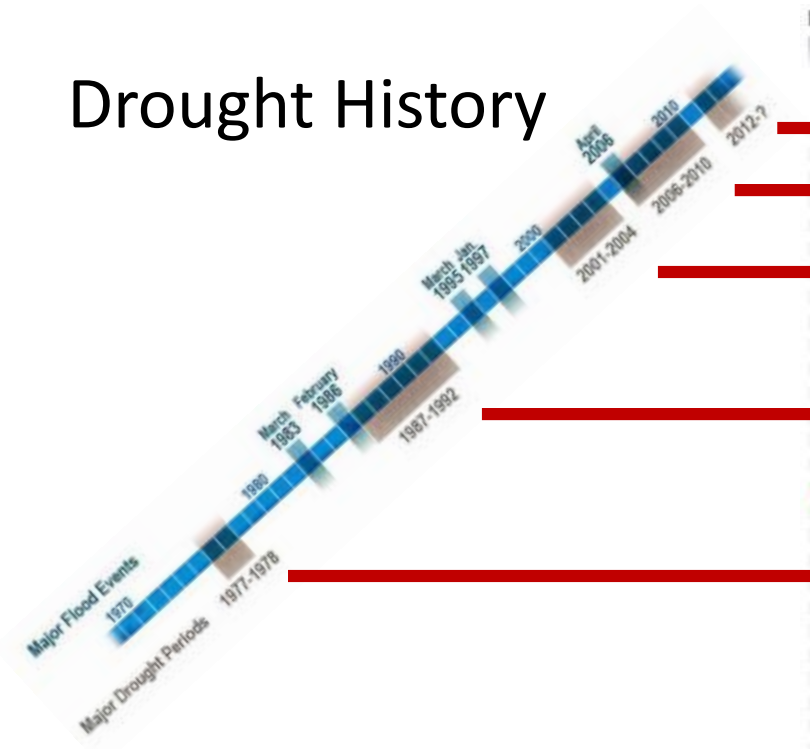


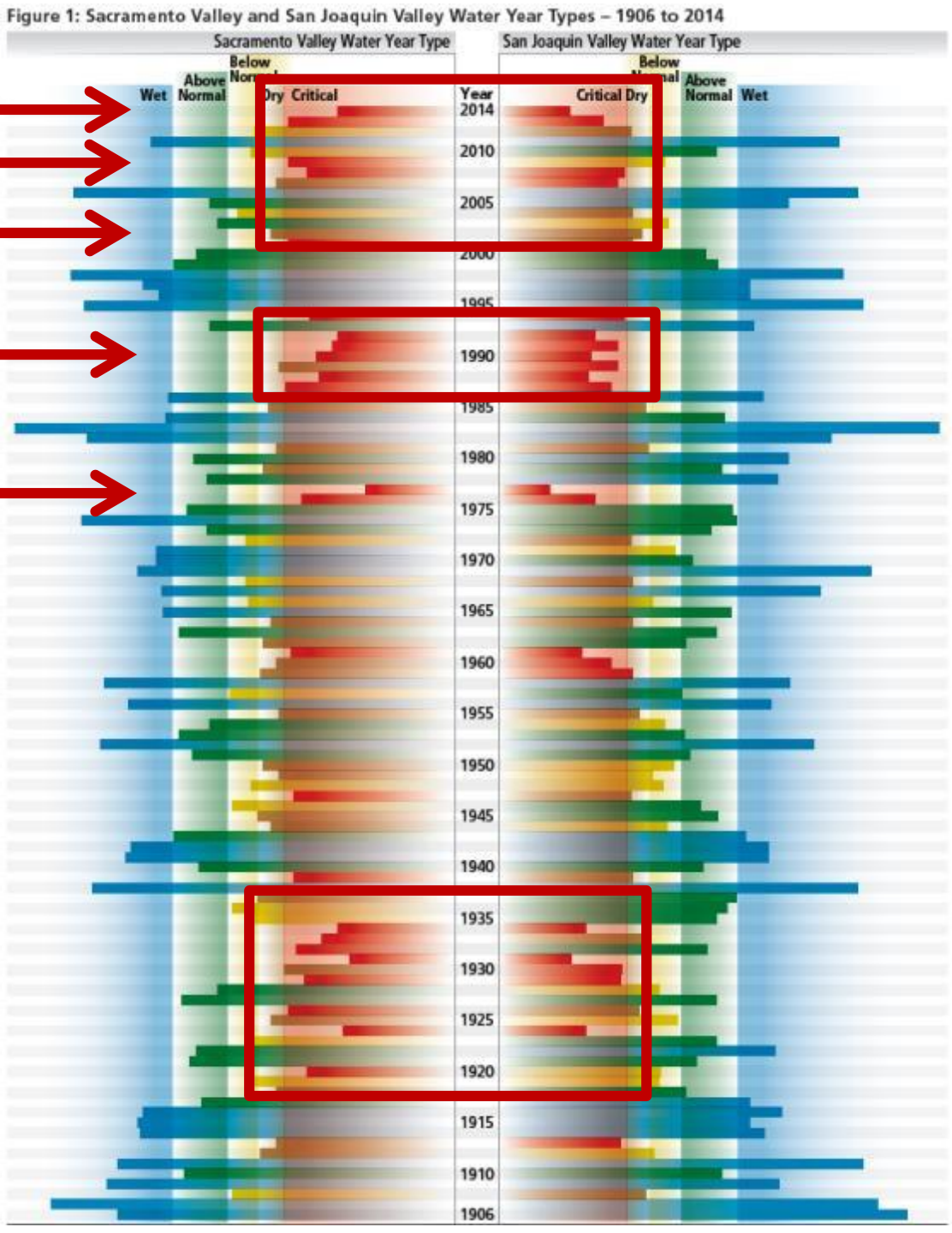
Miller et al., WRR 2010

Key Groundwater Mgmt Challenge in Central/NorCal: Surface Water and Ecosystem Impact



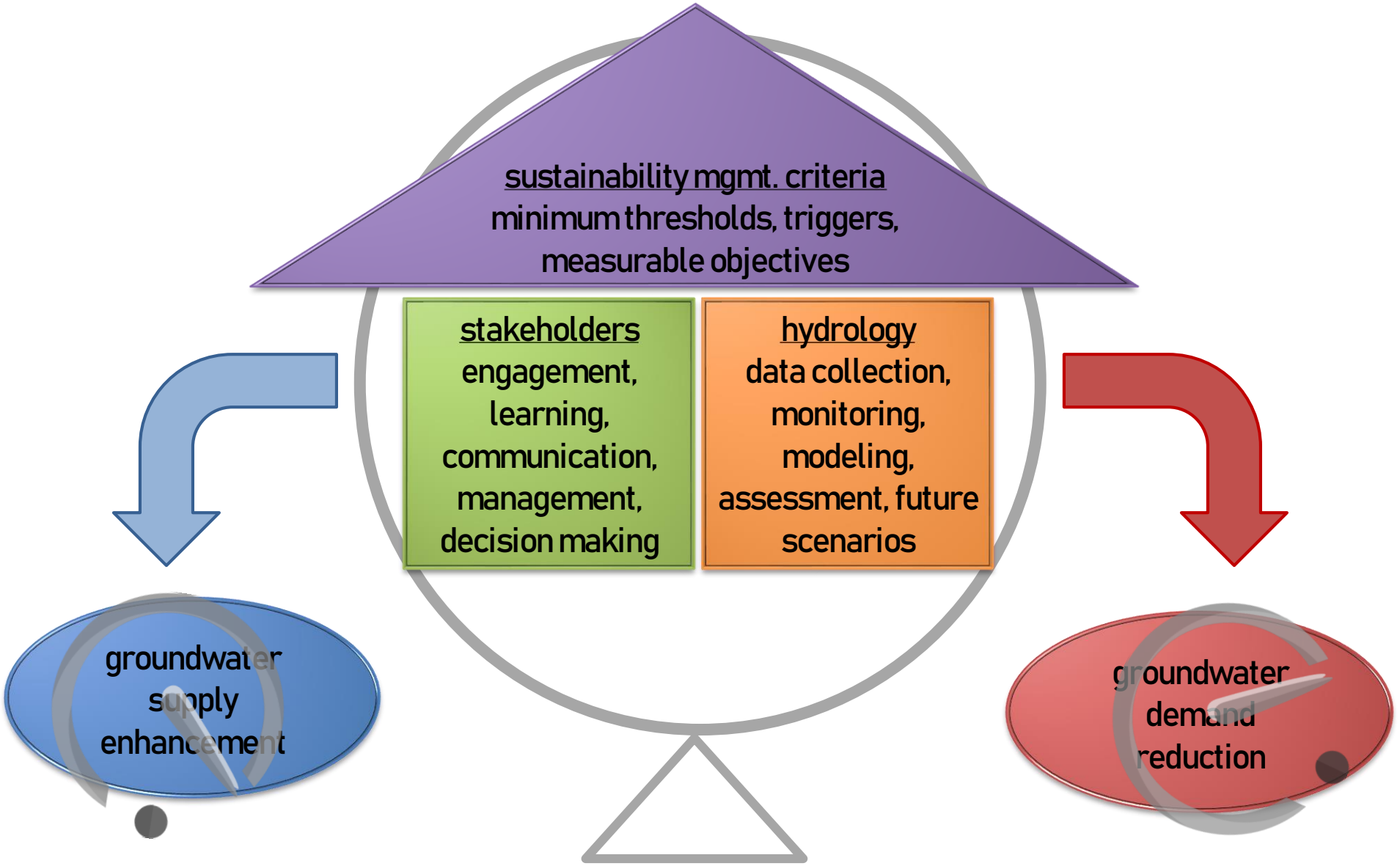
Drought History



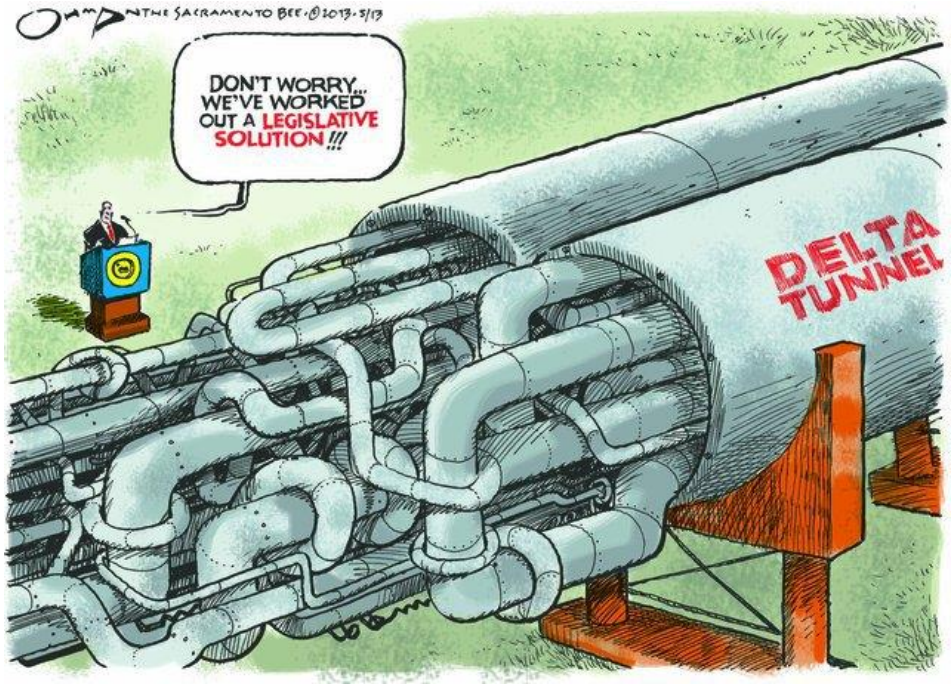


California Department of Water Resources;
Drought Response Update Fall 2014

The GSA world of uncertainty



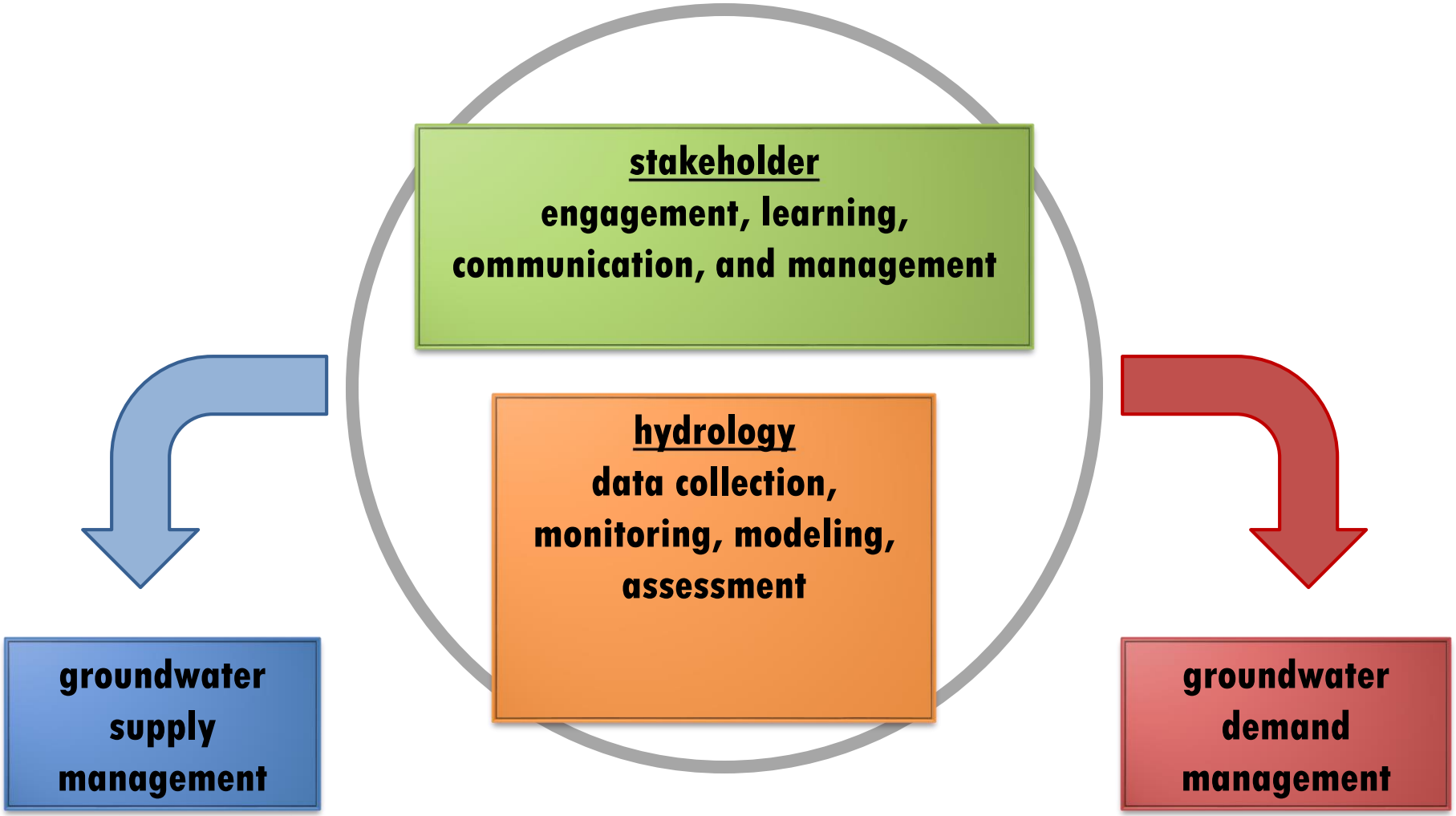
Uncertainty: Project Cost, Funding, Planning, Implementation



from: Sacramento Bee

from: Conservation Corridor

Getting There: GSAs plan & implement GSPs



- **http://groundwater.ucdavis.edu/sgma**
- **http://groundwaternitrate.ucdavis.edu**
- **Contact Dr. Thomas Harter at ThHarter@ucdavis.edu**

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