



Groundwater Security: Banking for the Future

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(with Rebecca Nelson, Stanford Law School)

A large, clear, conical fountain of water spraying upwards from a central point in a field, with a smaller fountain visible in the background. The water is bright blue and creates a misty spray at the top. The background shows a vast, open landscape with rolling hills, a body of water, and a line of trees under a clear sky. The foreground is filled with green grass and some small plants.

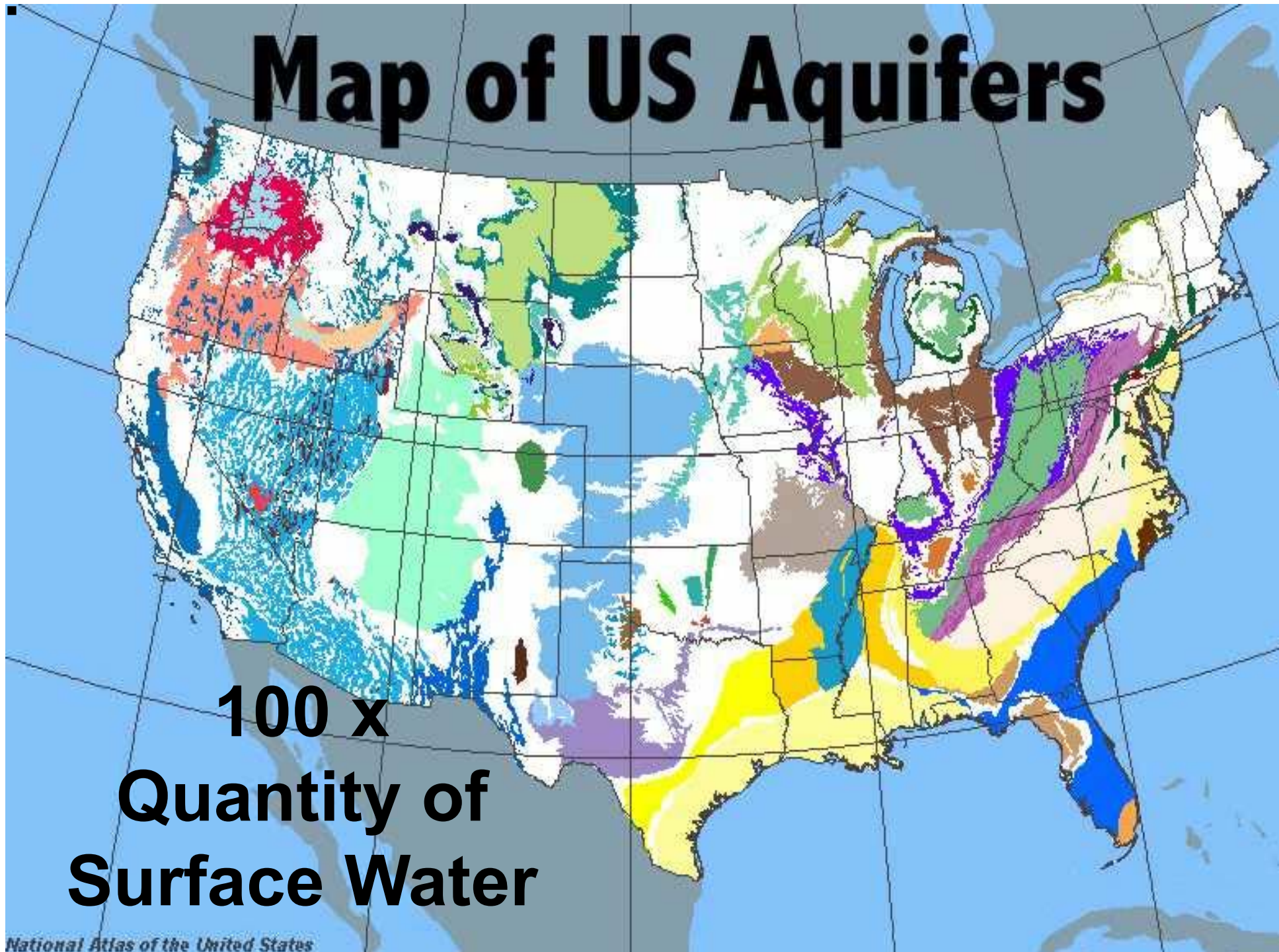
**An Exceptionally
Valuable Resource –
Particularly in the West**



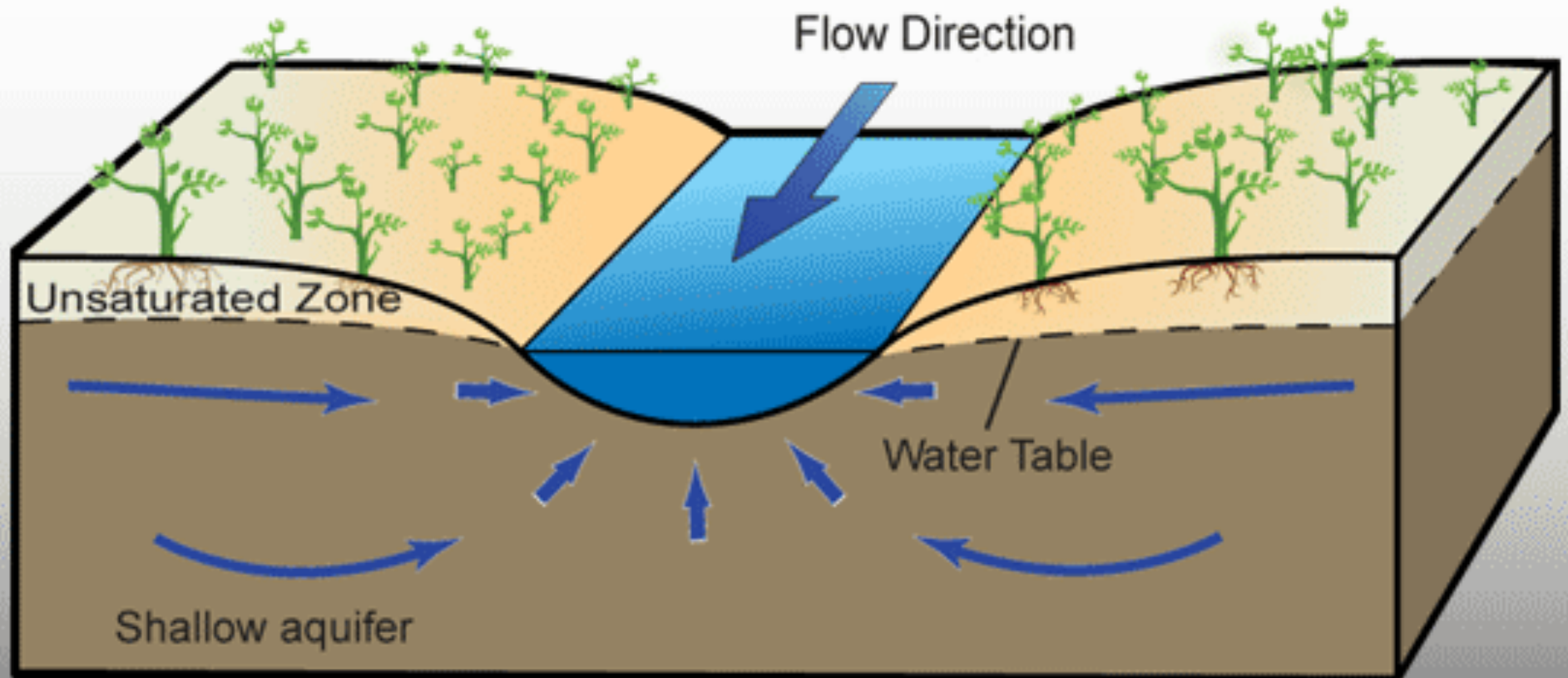
Only 0.3%!

Map of US Aquifers

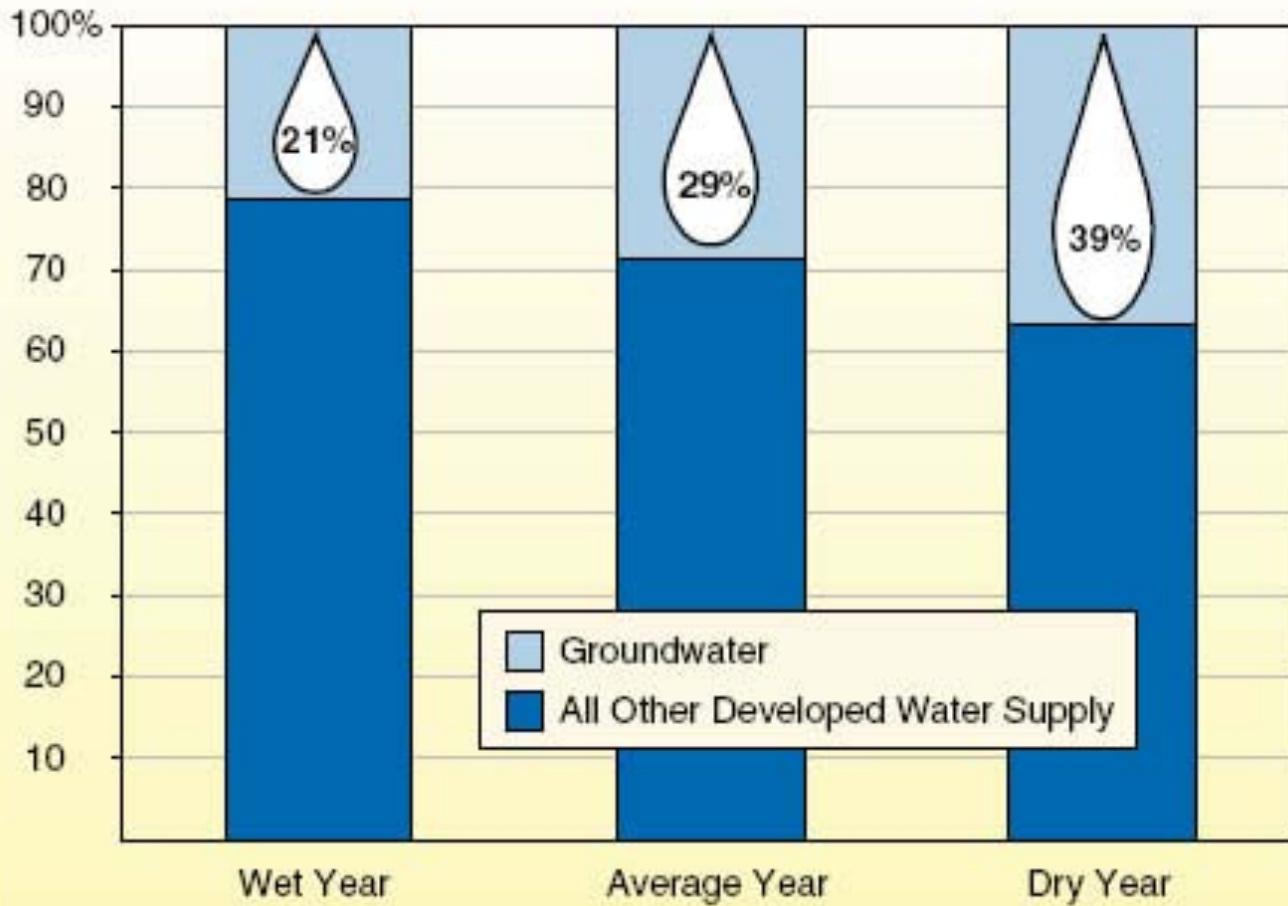
100 x
Quantity of
Surface Water



Gaining Stream







Drought Insurance

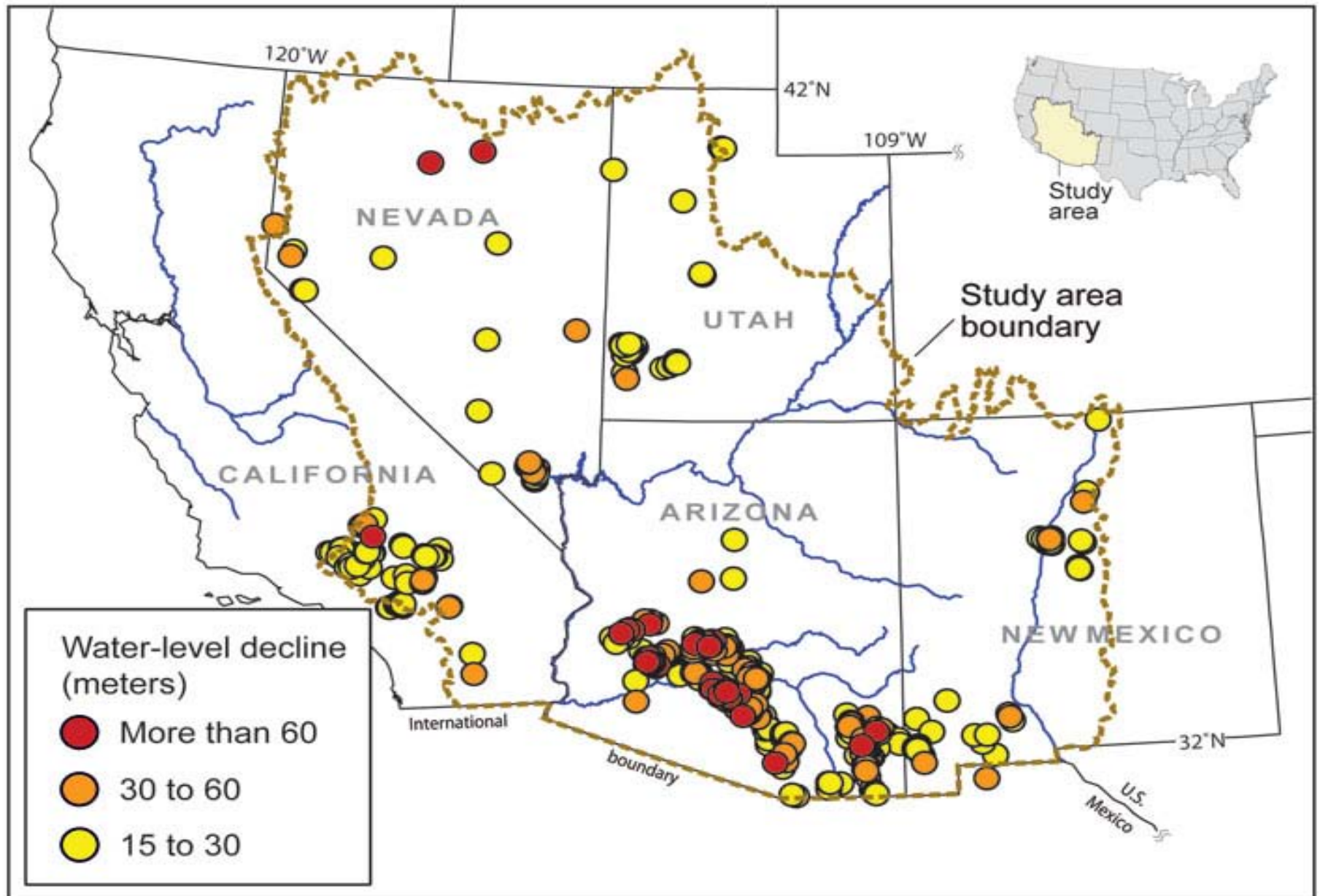


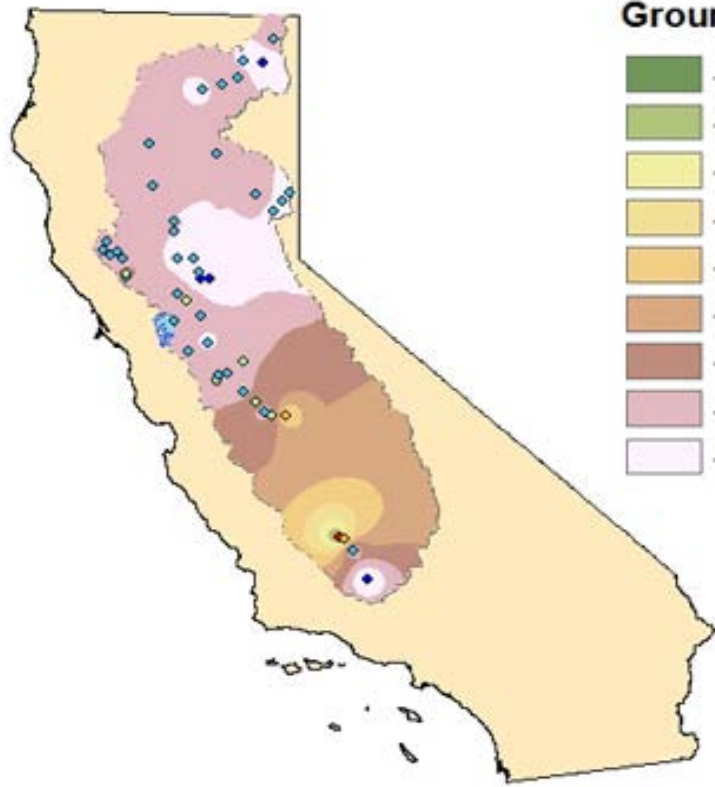
Flowing ground water



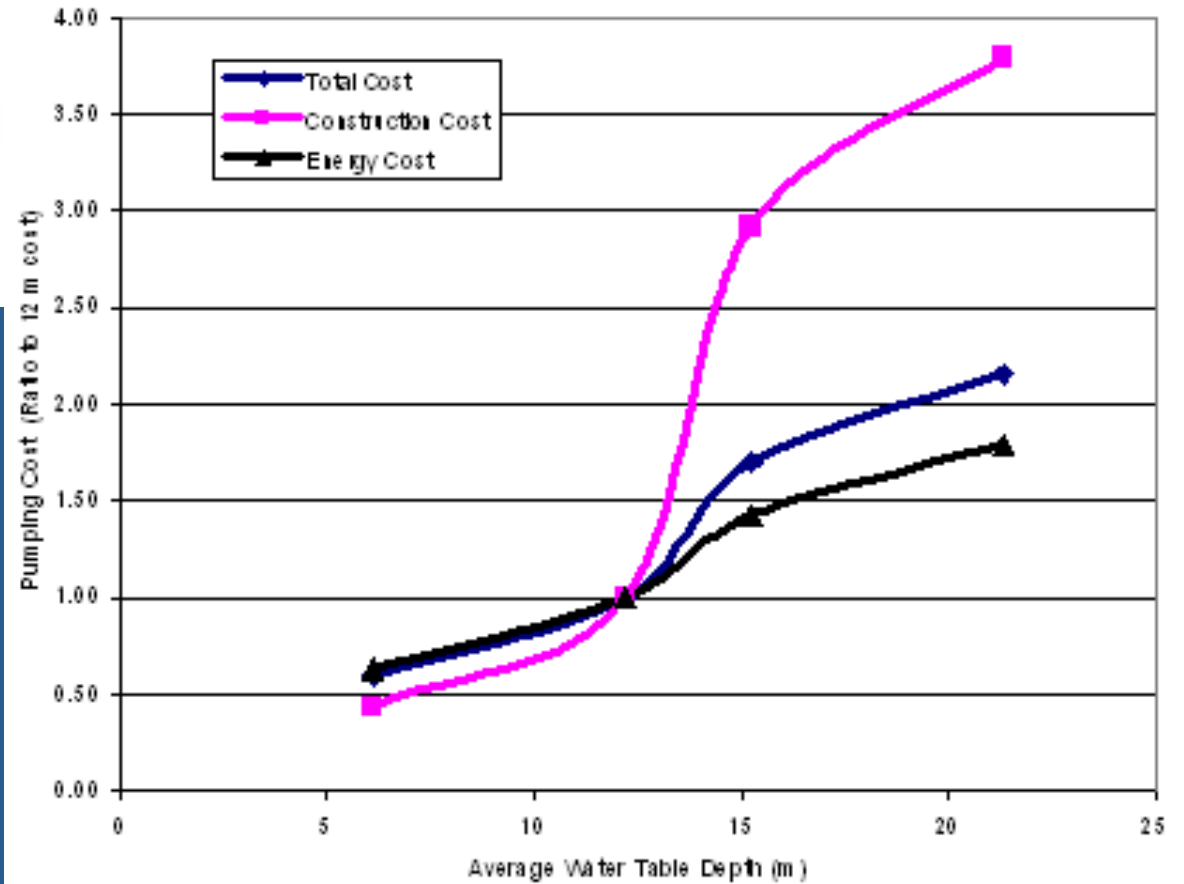
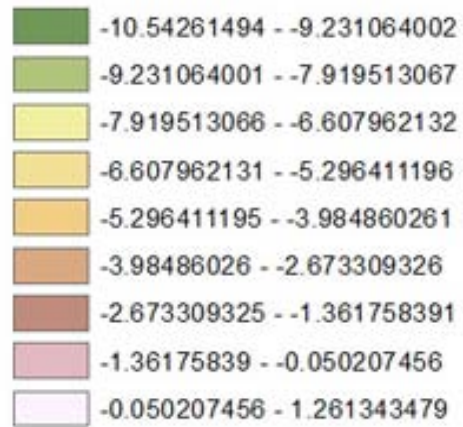
Storage Capacity

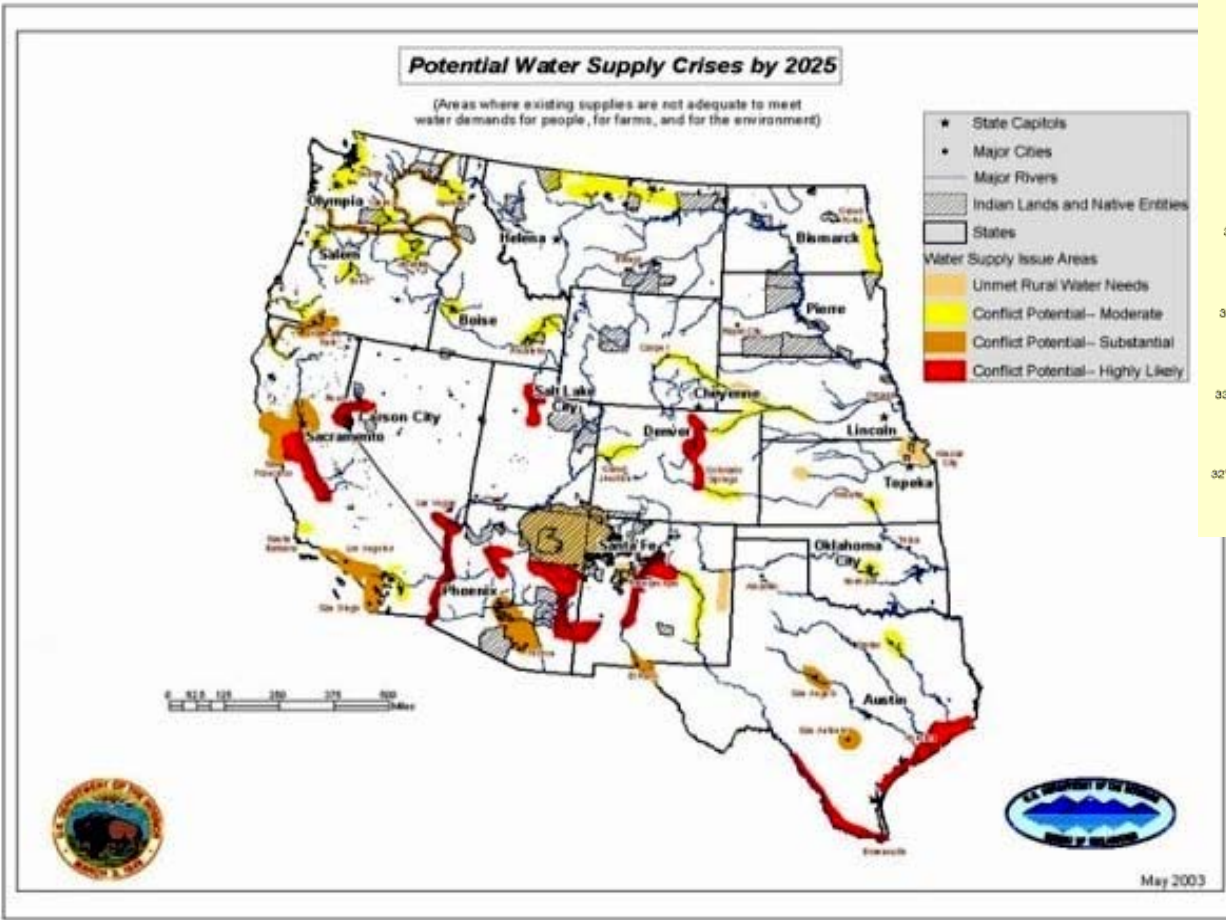
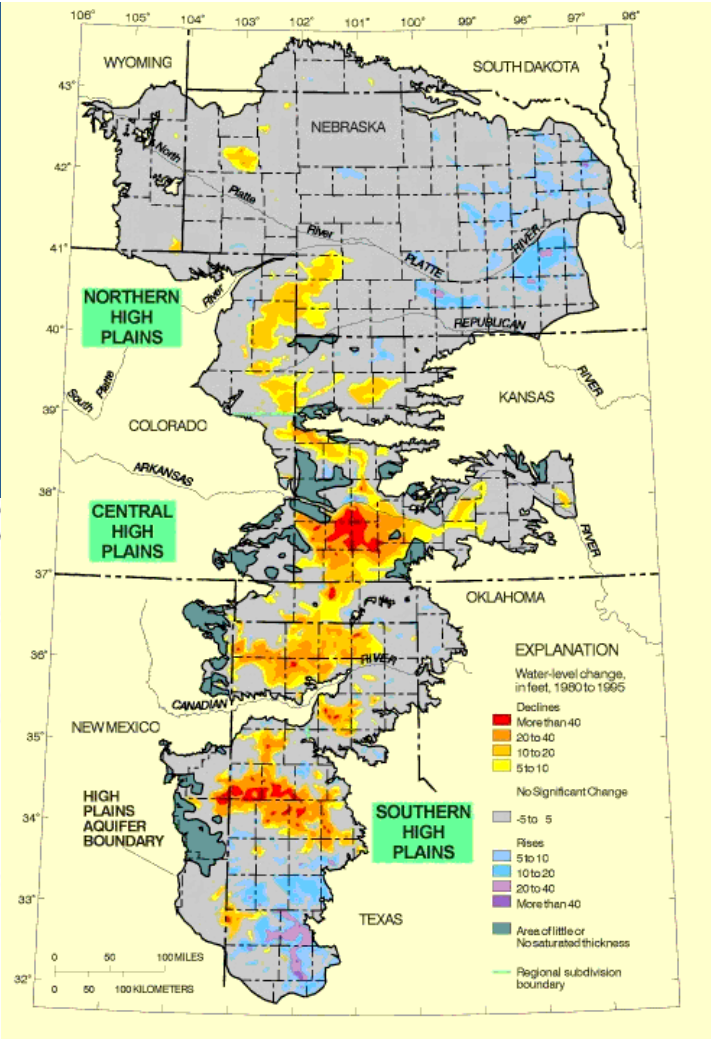
Historic Aquifer Water-Level Declines in the Southwest





Ground Water Trends ft/yr





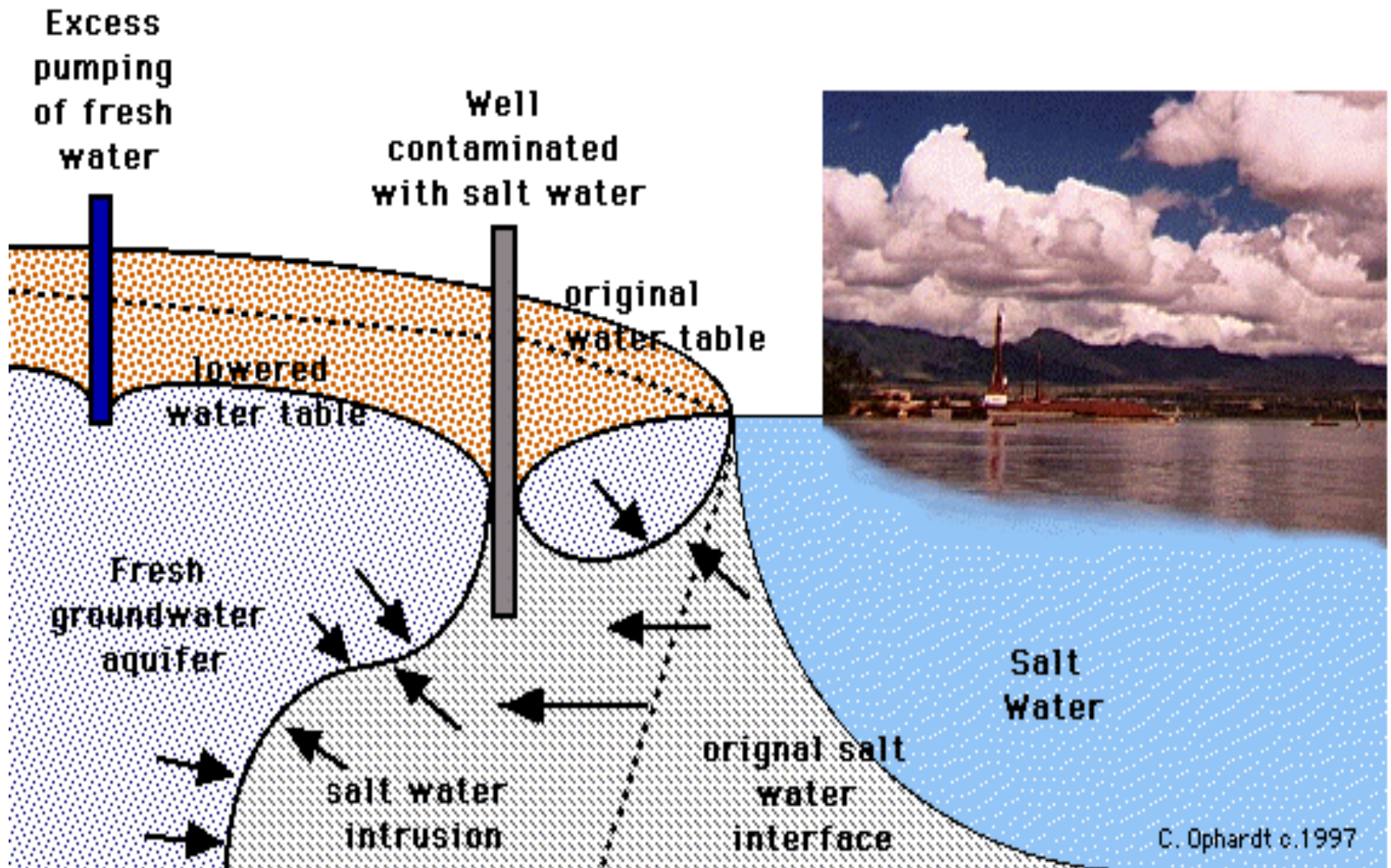


Sign warning motorists of subsidence hazard was erected after an earth fissure damaged Snyder Hill Road in Pima County, Arizona, 1981.



Areas where subsidence has been attributed to groundwater pumpage (Land Subsidence in the United States, USGS Circular 1182)

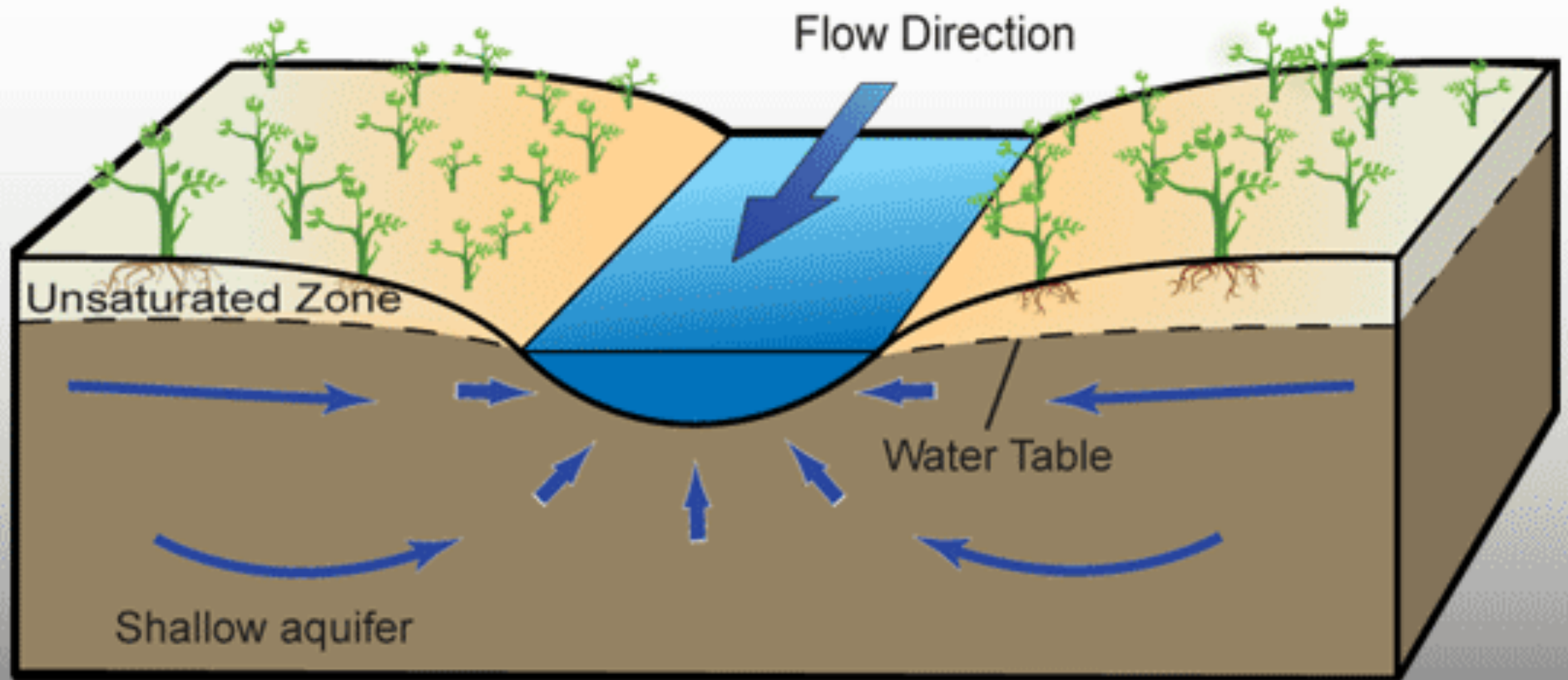
Salt Water Intrusion in Coastal Areas



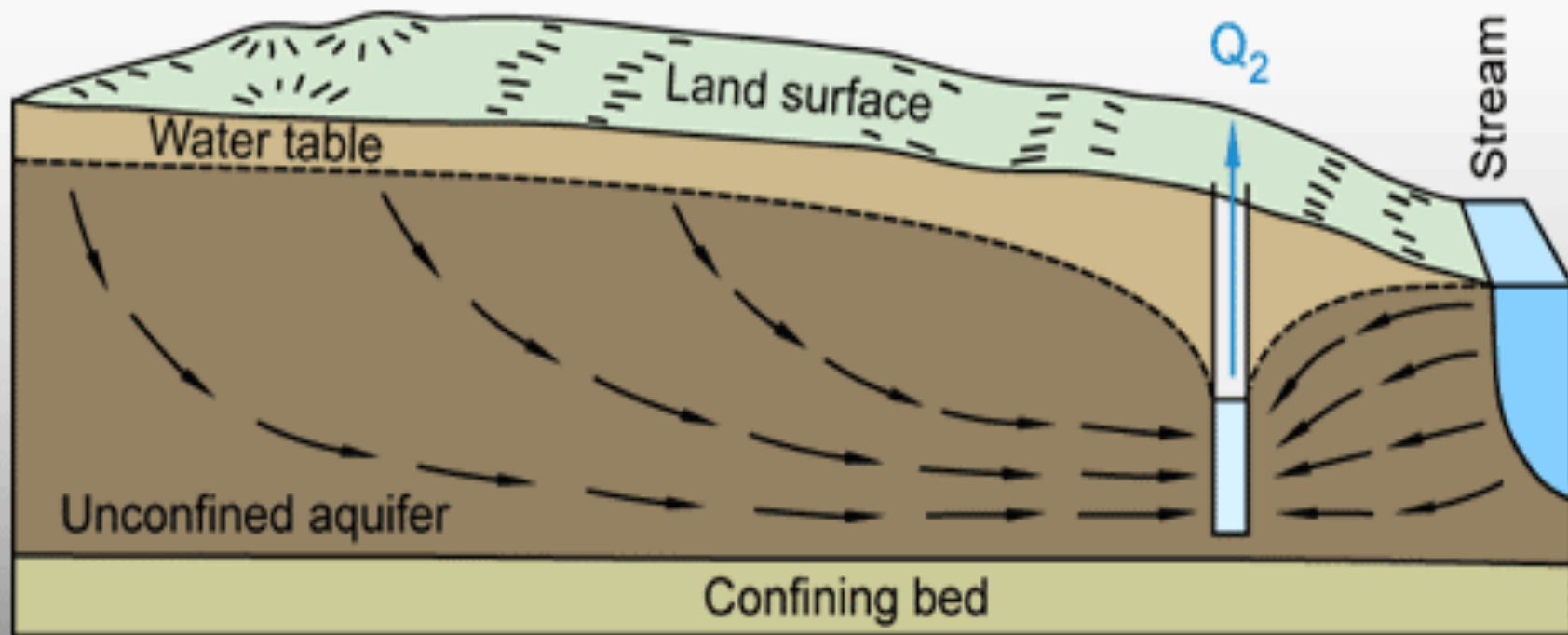
Desertification



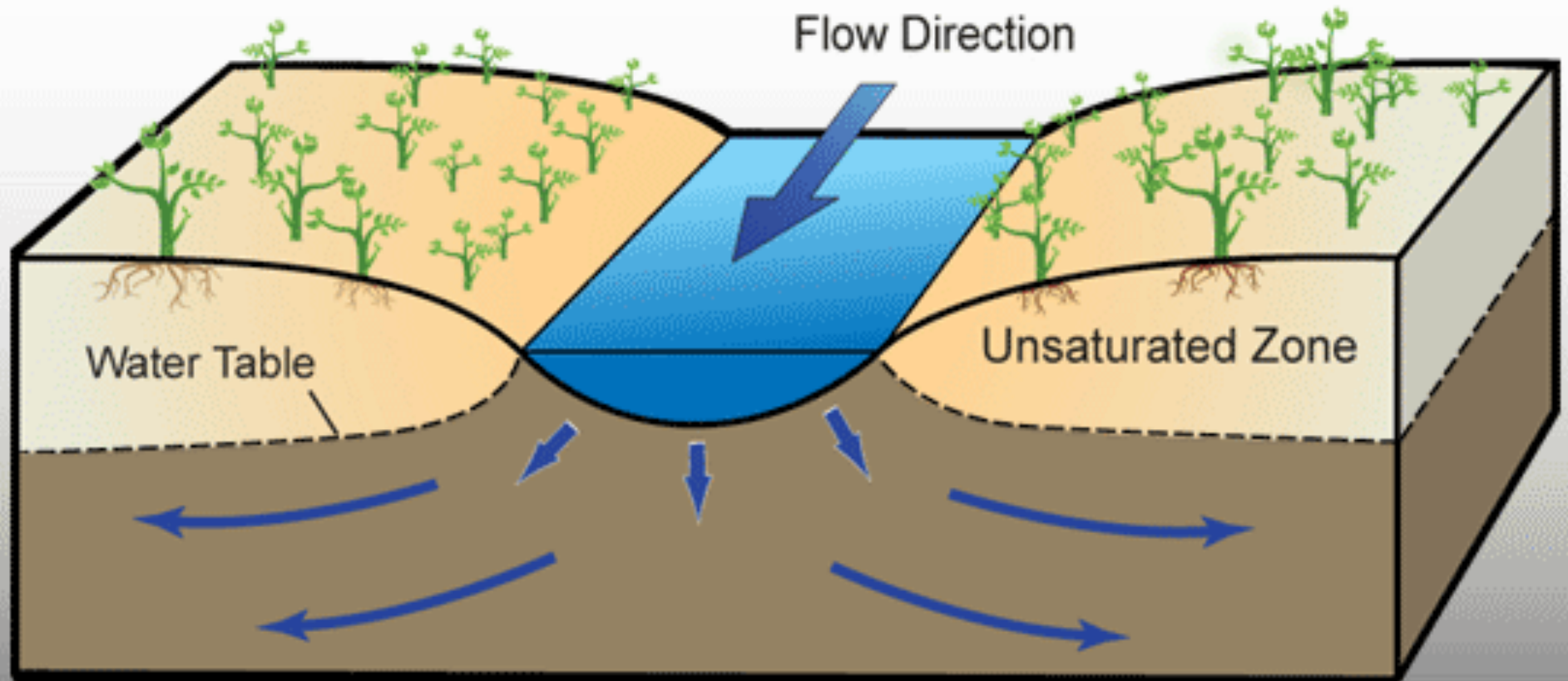
Gaining Stream



C



Losing Stream





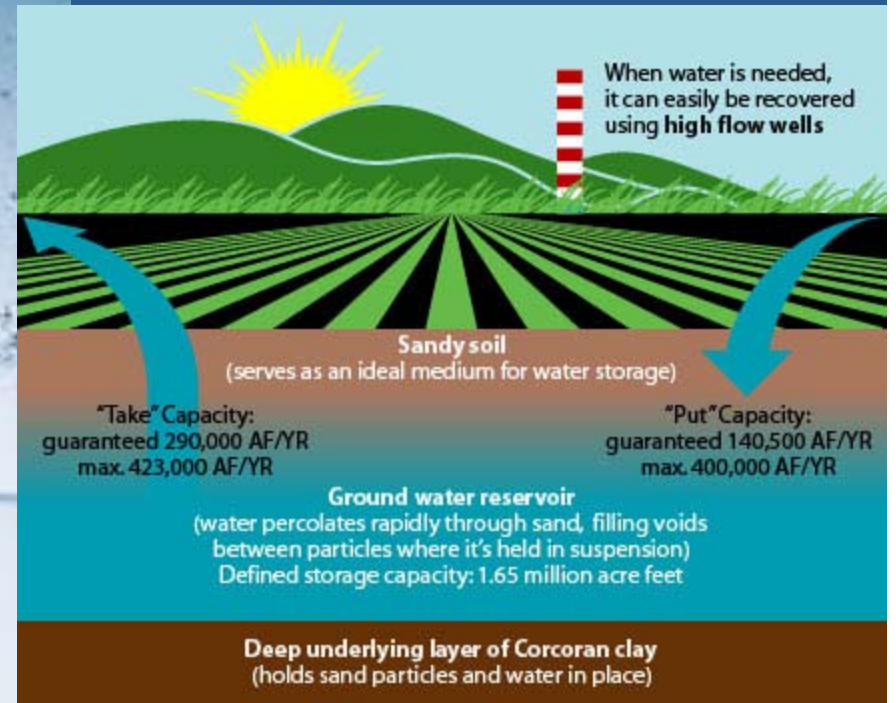
July/August 2018

WESTERN WATER

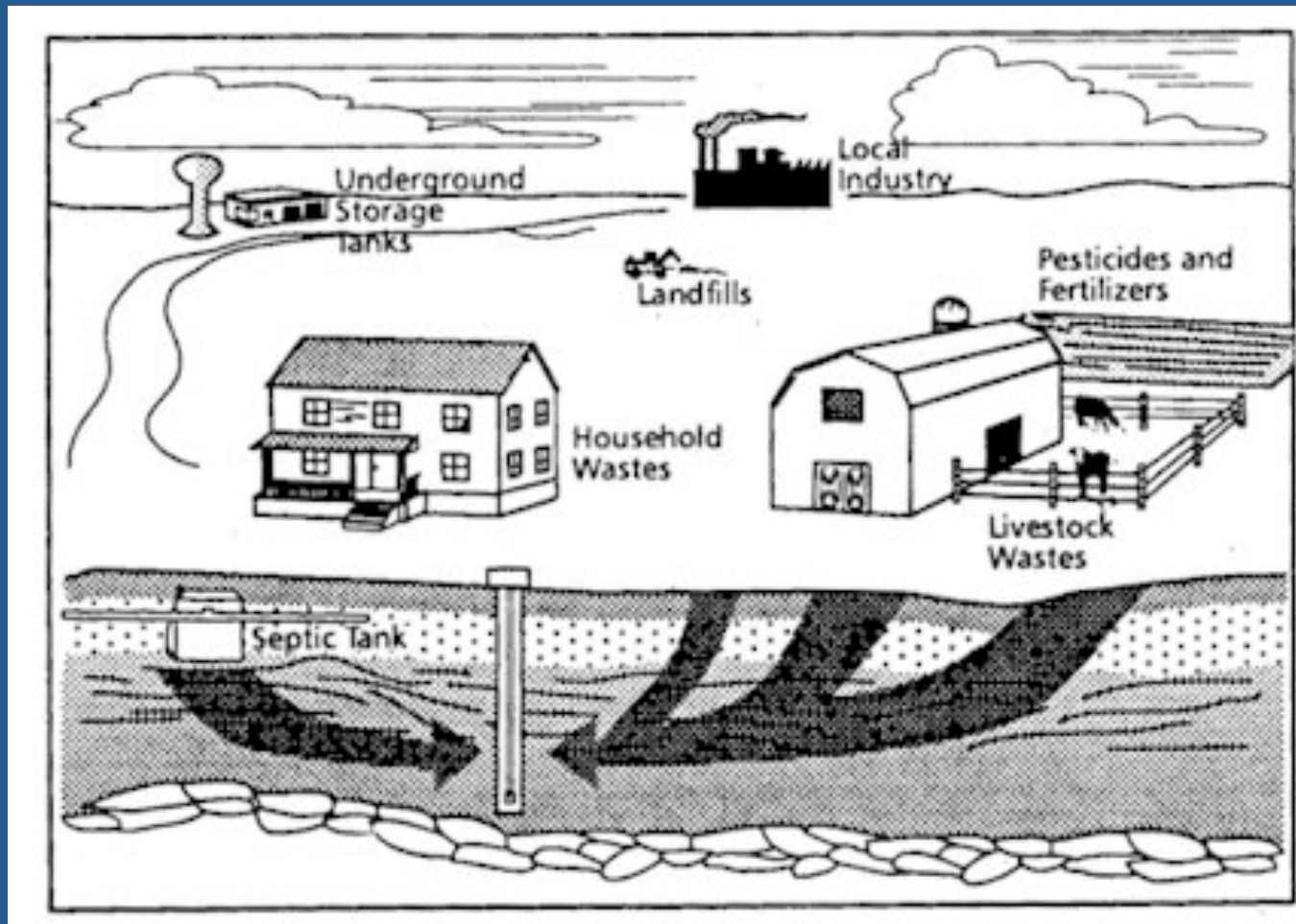


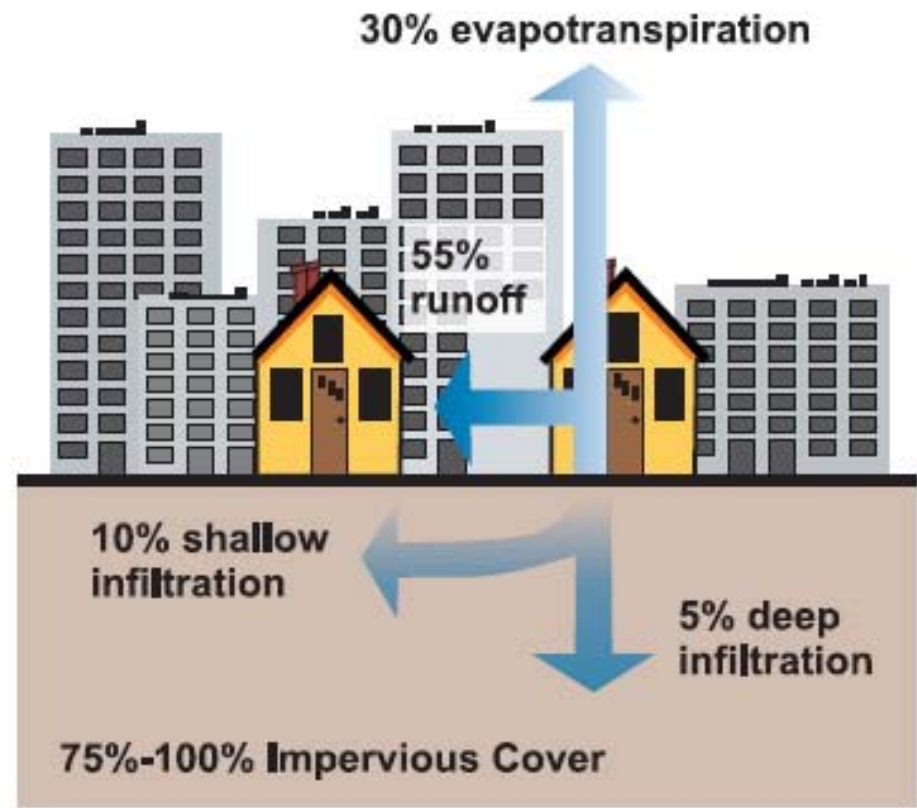
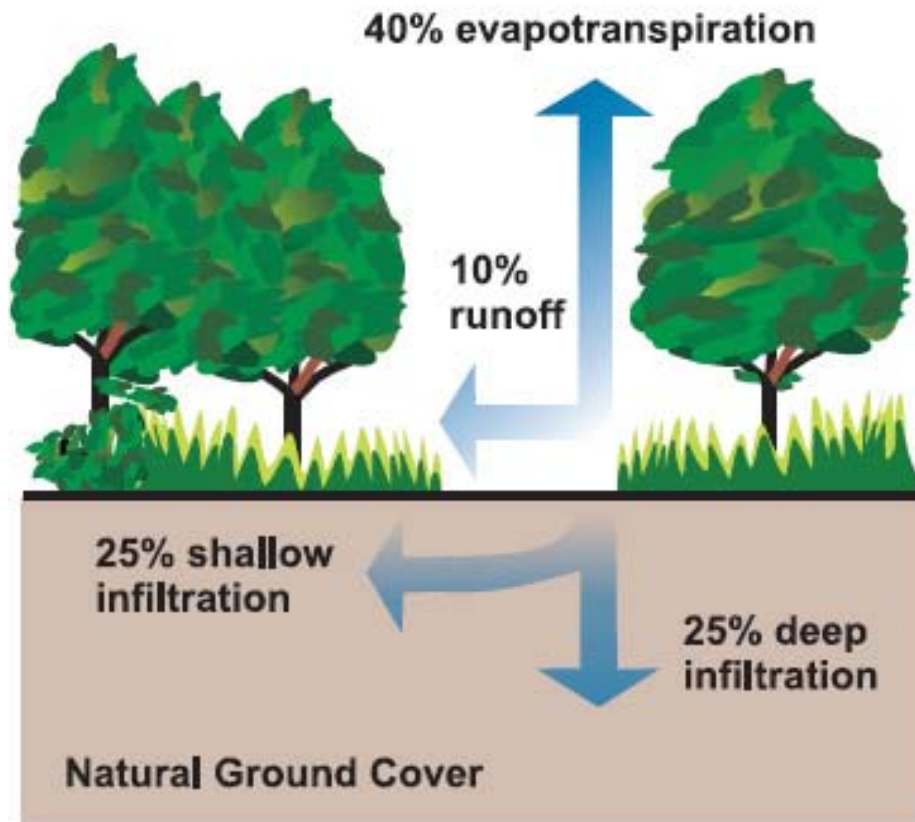
**Saving it For Later:
Groundwater Banking**

Published by the Water Education Foundation



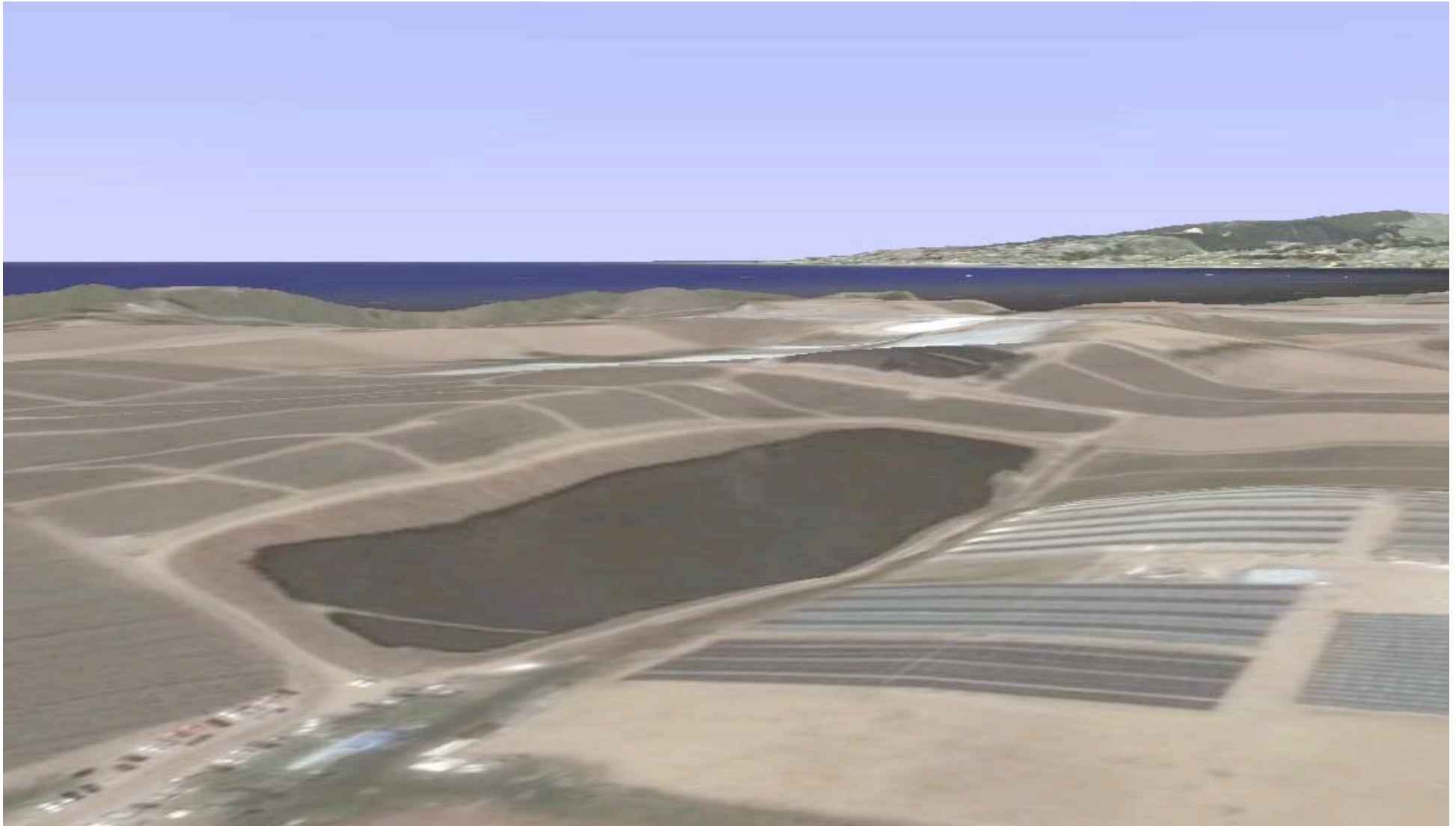
External Threats to Groundwater





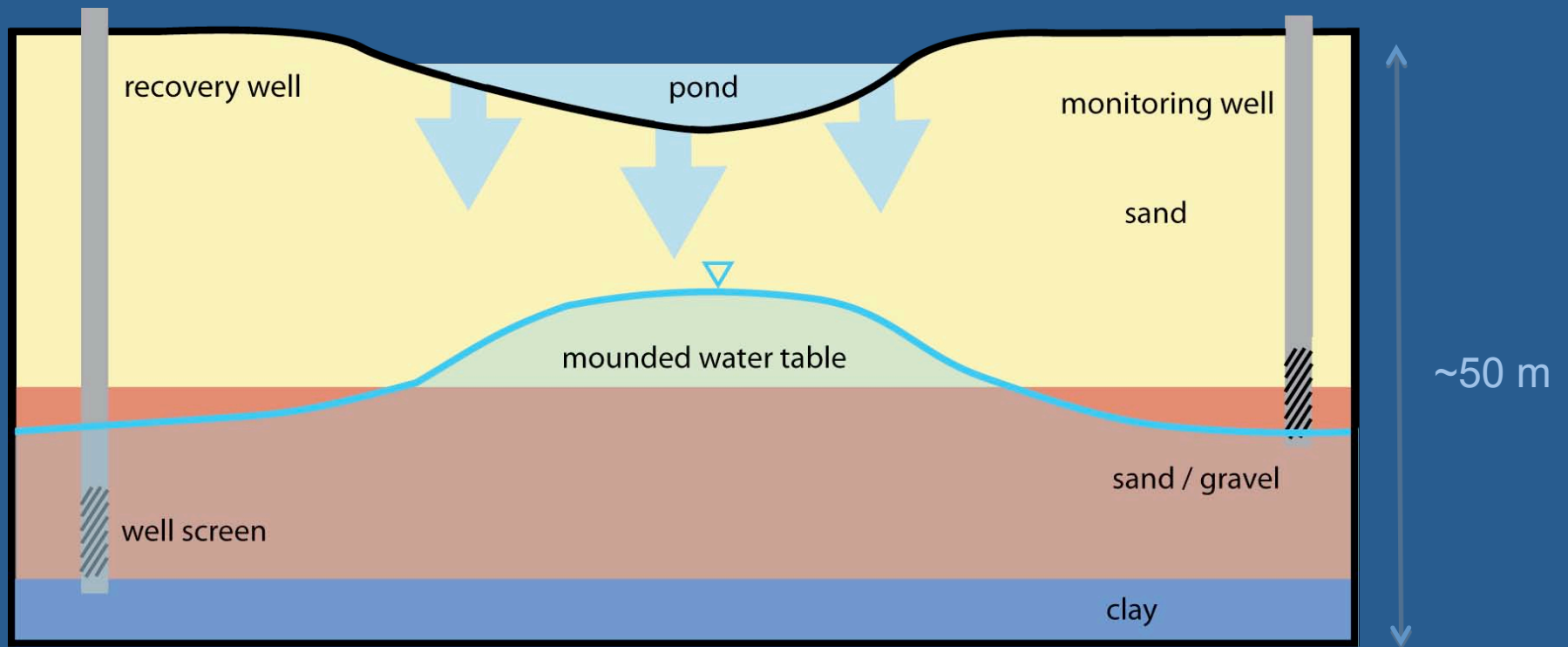
A large, circular, blue-tinted water fountain is the central focus, spraying water upwards and outwards in a wide, shallow basin. The fountain is situated in a field of dry, golden-brown grass. In the background, a calm lake reflects the sky, and rolling hills with sparse trees are visible under a clear blue sky. The overall scene is bright and open.

Working to Find Solutions

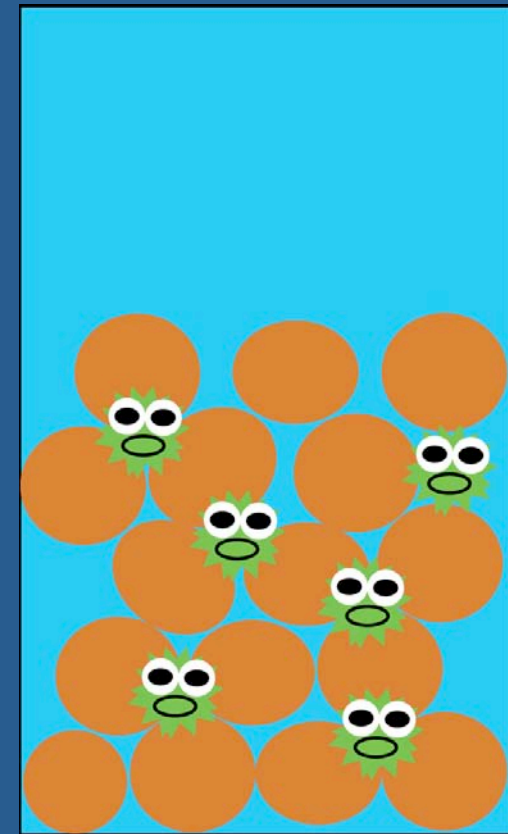
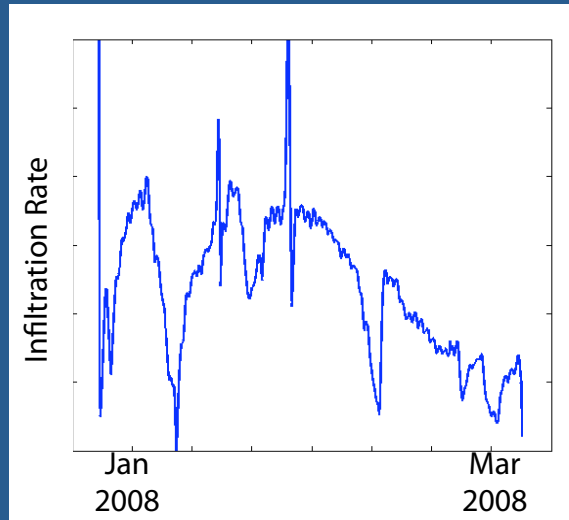
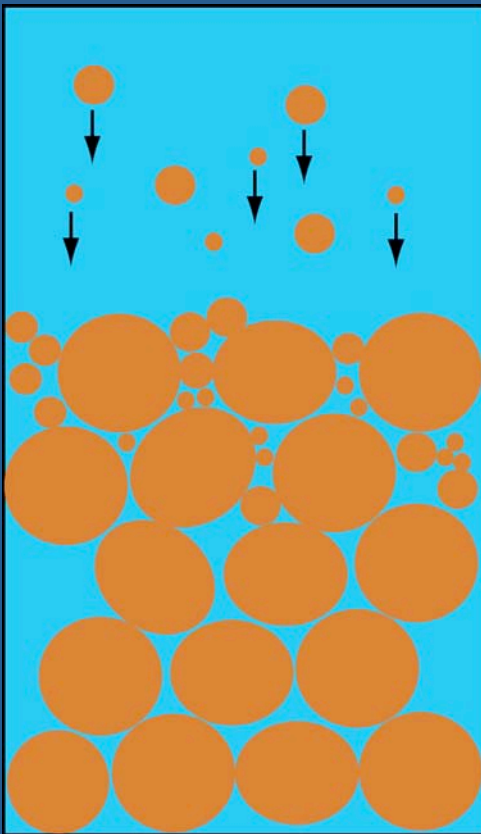


**Step 1:
Better Information & Science**

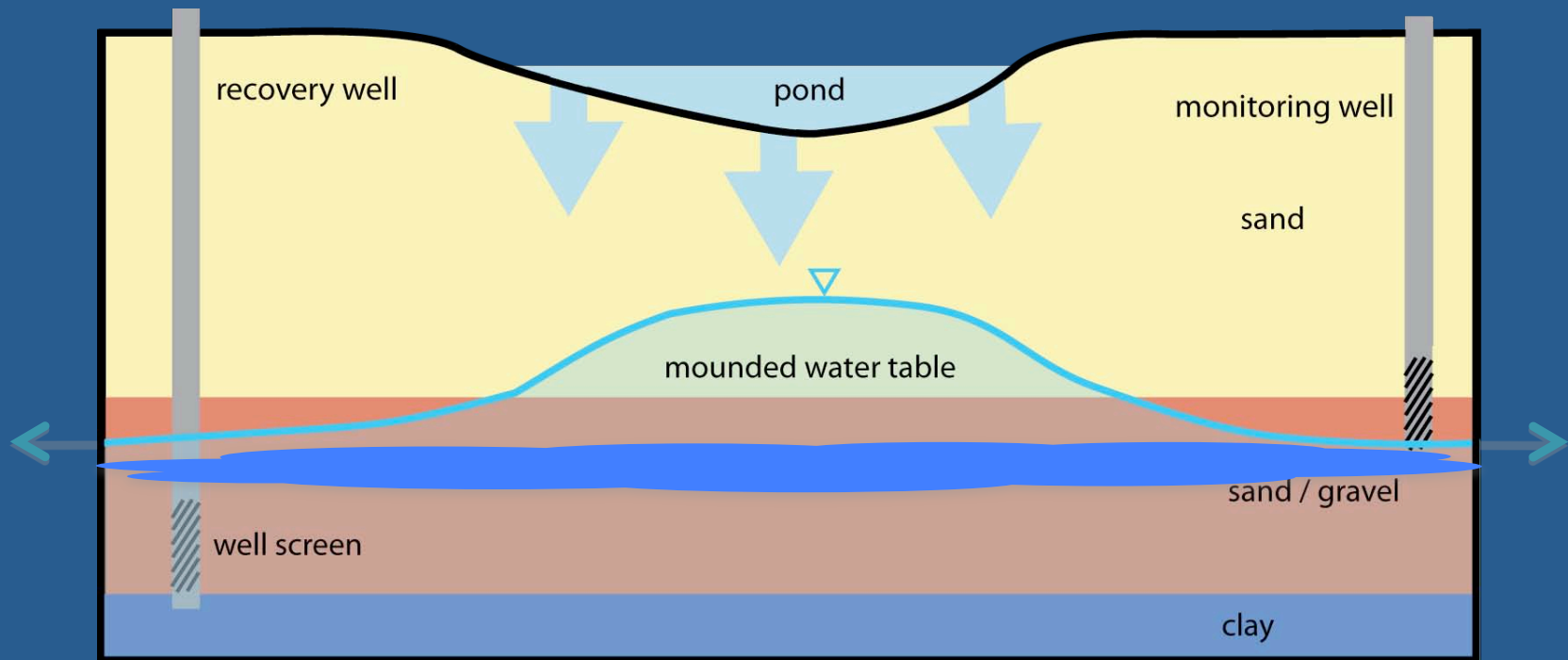
Initial Conceptual Model



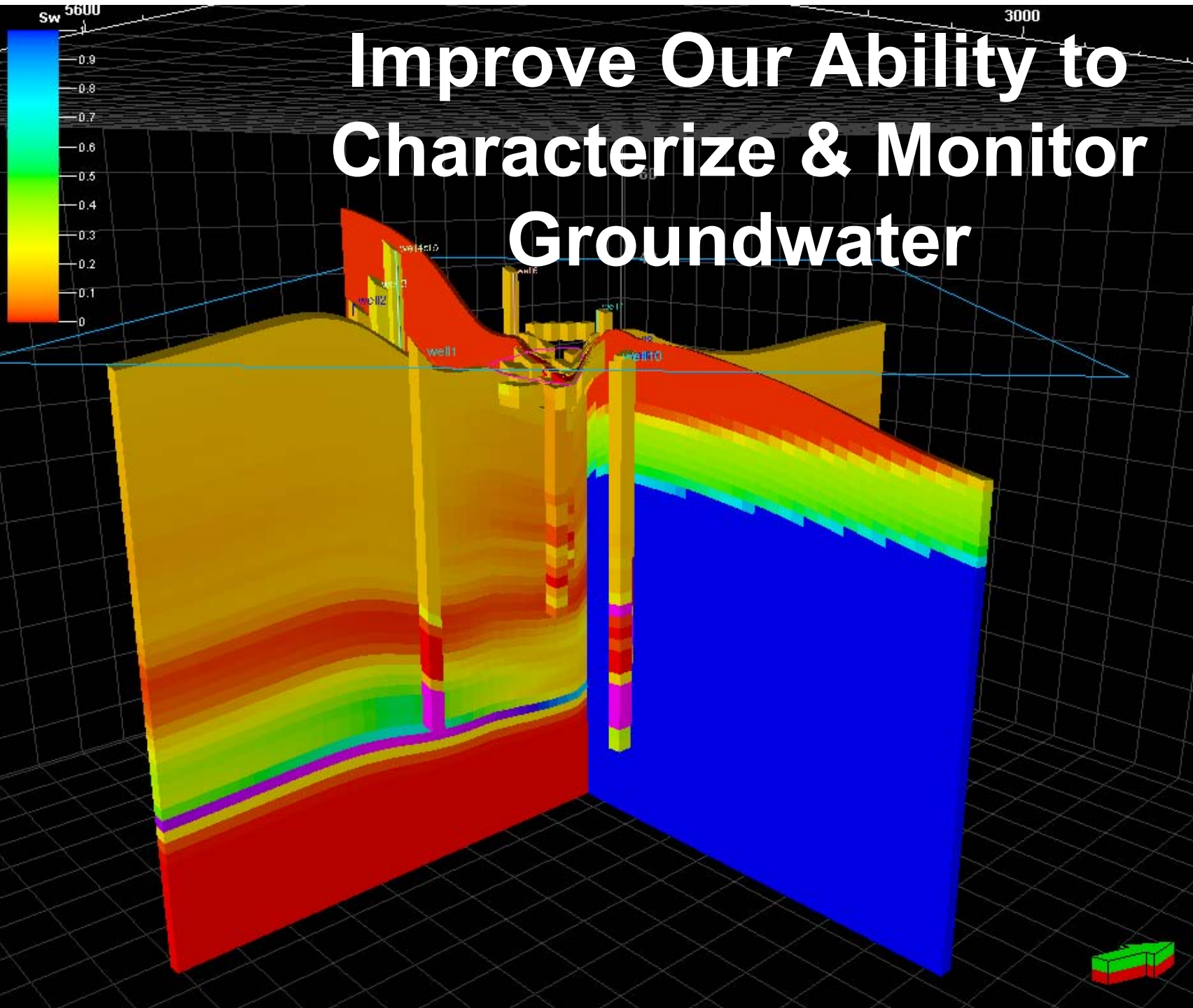
Falling Infiltration Rates



30% Recovery Rate

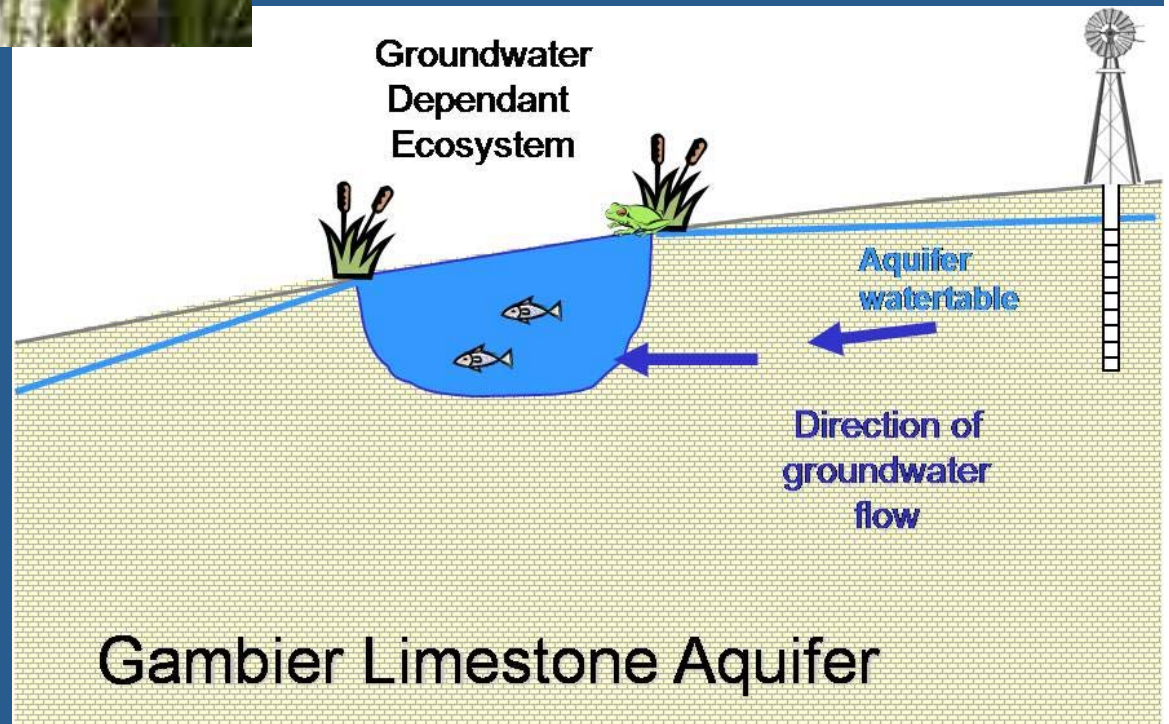


Improve Our Ability to Characterize & Monitor Groundwater





Improve Our Understanding of Groundwater-Dependent Ecosystems



Farmington

Groundwater Recharge Seasonal Habitat Study



Final Report
August 2001

*Making Water a Crop for
Eastern San Joaquin County's Future*

Help Optimize Groundwater Banking





Step 2: Identify Best Policy Practices

Elements of Successful Programs

- Integration
 - “Integrated Regional Water Management”



Elements of Successful Programs

- **Integration**
 - “Integrated Regional Water Management”
- **Careful Planning & Stakeholder Involvement**



Elements of Successful Programs

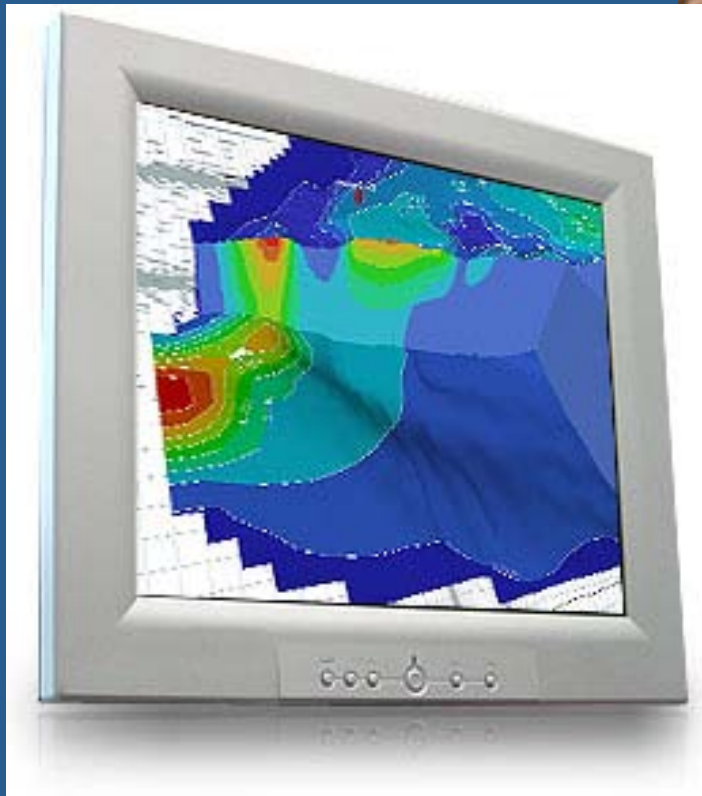
- **Integration**
 - “Integrated Regional Water Management”
- **Careful Planning & Stakeholder Involvement**
- **Multiple Goals & Strategies**



Elements of Successful Programs

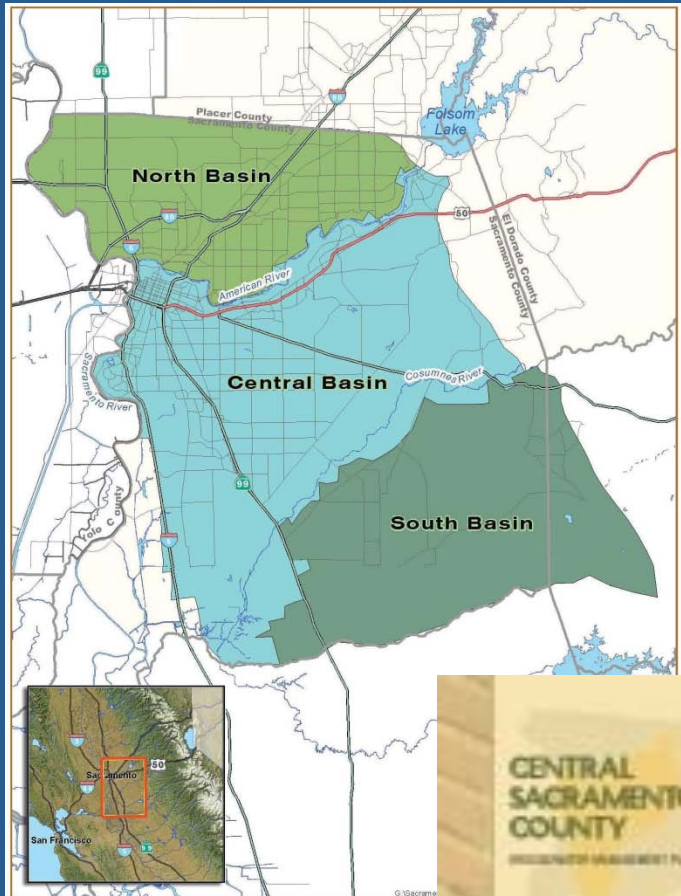
- Integration
 - “Integrated Regional Water Management”
- Careful Planning & Stakeholder Involvement
- Multiple Goals & Strategies
- Markets





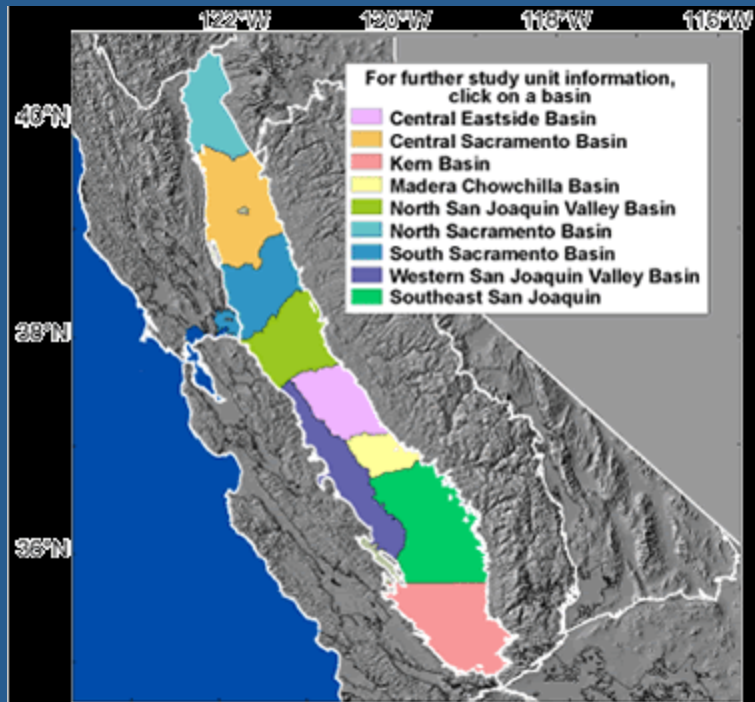
Step 3: Promote Action and Reform

Action-Promoting Information



- Pumping costs
- Water quality degradation
 - Value of lost water
 - Clean-up costs
 - Damage to appliances
- Subsidence damages
- Visualization of future
 - Impact
 - Timing

Third Party Pressure State-Mandated Goals



- “Cooperative Federalism”
 - State determines goal
 - Local regions implement
- Examples
 - Australia
 - Utah

Legal Mandates

- **Endangered Species Act**
 - Edwards Aquifer
- **Public Trust Doctrine**
 - Hawaii
 - California lawsuit in progress





Step 4: Convening & Educating

A large, circular, blue-tinted water fountain in a rural landscape. The fountain is the central focus, with water spraying upwards and then cascading outwards in a wide, shallow pool. The background shows rolling hills, a body of water, and a clear sky. The overall scene is peaceful and scenic.

Discussion

1. Are these the right four steps?
2. Where should we focus?
3. Other solution ideas?
4. Other advice?