Groundwater-Surface Water Interface Webinar

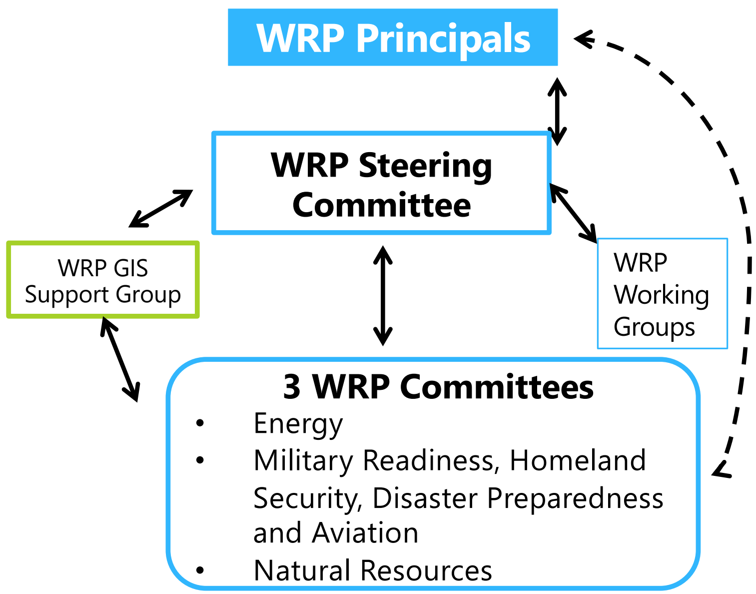
Hosted by the WRP Natural Resources Committee

October 2021

WRP Mission

WRP provides a proactive and collaborative framework for **senior-policy level Federal, State and Tribal leadership** to identify common goals and emerging issues in the states of **Arizona, California, Colorado, Nevada, New Mexico and Utah** and to develop solutions that support WRP Partners and protect natural and cultural resources, while promoting sustainability, homeland security and military readiness.

WRP Structure



WRP NATURAL RESOURCES COMMITTEE CO-CHAIRS

- **Melanie Barnes**, **Ph.D**., Deputy State Director, Bureau of Land Management, New Mexico
- **Thomas M. Finnegan**, Colonel (Retired), Arizona Military Affairs Commission
- **Kevin Kinsall,** Natural Resources Intergovernmental Coordinator Arizona Game and Fish Department
- **Priscilla Pavatea,** Interim Director, Department of Natural Resources, The Hopi Tribe
- **Steve Pennix**, Branch Head, Range Sustainability Office, Naval Air Warfare Center, Weapons Division, China Lake Ranges
- **Matt Wunder, Ph.D**., Chief, Ecological and Environmental Planning Division, New Mexico Department of Game and Fish

WRP Natural Resources Committee GIS Liaison: Mike Dick, Biologist, U.S. Fish and Wildlife Service, Region 2 Regional Office

Brief Background on WRP Water Security Deep-Dive

- **Current WRP Priority:**
  - *Building Resilience in the West for America's Defense, Energy, Environment and Infrastructure through Enhanced Collaboration among Federal, State and Tribal Entities.*
    - **Explore** tools and resources needed to build resilience to **support** the diverse missions of Federal, State and Tribal entities in the WRP Region
- **Phase one: Survey of WRP Leadership identified four deep-dives**
  - Resiliency of Airspace in the WRP Region
  - Water Security
  - Disaster Mitigation
  - Resilient Energy Infrastructure

Background on WRP Water Security Deep-Dive
(continued)

Desired End State:

- Brief overview of water security (what does “water security” mean for the WRP Region)
- Highlights of Water Security Deep-Dive Efforts (info on each “bucket”)
  - Case studies/vignettes to assist efforts
- Identify areas of commonality and recommendations (enforcement; water quality and quantity; financing/funding; resources, areas of potential WRP partner commonality to address water security efforts; recommendations)

Started a collection of water security resources; agency definitions of “water security”; and Case Study Vignettes

WRP Water Security working definition:

For the WRP Region, "Water Security" means having a reliable supply of water of suitable quality. Elements that assist in the establishment or recognition of water security include: having adequate data on water availability and infrastructure; appropriate planning, policies, laws and regulations to promote water security; and the identification of best practices and implementation of new technologies to reduce water demand and increase and protect water quality and quantity.

Water Security "Buckets"

LAWS and REGULATIONS:
Develop understanding of water quality and quantity laws and regulations in the context of water security practices

POLICY PLANNING and IMPLEMENTATION:
How statutes, regulations, policy, and guidance are implemented to promote planning for water security

Each will explore their interdependencies with each other, including enforcement, water quality and quantity as well as financing/funding

RESOURCE MANAGEMENT STRATEGIES:
Identify best practices and new technologies for implementing water resource management strategies to reduce water demand, increase supply reliability, improve quality, reduce flood risk, restore ecosystems, and ensure equity

DATA:
Develop understanding of the scientific data to support water availability and infrastructure capacities in the WRP Region and identify gaps and best practices

Groundwater - Surface Water Interface Webinar Speakers

- **CA: Dr. Maurice Hall**, PE, Associate VP, Ecosystems – Water, Environmental Defense Fund
- **AZ: Jennifer Heim**, Deputy Counsel, Arizona Department of Water Resources
- **CO: Tracy Kosloff**, Deputy State Engineer, Colorado Division of Water Resources
- **NM: Dr. Bruce M. Thomson**, Regents Professor of Civil Engineering at the University of New Mexico
- **NV:**
  - **Jon Benedict**, Hydrogeologist, Nevada Division of Water Resources, Department of Conservation and Natural Resources
  - **Micheline Fairbank,** Deputy Administrator, Nevada Division of Water Resources
- **UT: Jim Reese**, Assistant State Engineer for our Technical Services Section, Department of Natural Resources, Division of Water Rights

Dr. Maurice Hall, PE,
Vice President, Water
Environmental Defense Fund

- Oversees EDF's work to revitalize working rivers and groundwater basins and their ability to provide a resilient water supply for people and nature. Focuses on developing collaborative water management approaches to meet ecosystem needs alongside the needs of farms and cities. Approaches include shaping water transaction programs that achieve resilient water supplies while protecting the environment and vulnerable communities, improving information systems to inform smart management of water resources, and shaping water governance that proactively considers multiple objectives and responds to climate change.
- Previously served as the water program lead for the Water Funder Initiative, a collaborative effort to identify and activate promising water solutions through strategic philanthropic investments in the United States, starting in the American West, and The Nature Conservancy (TNC), including serving as California Director and Science and Engineering Lead for the California Water Program.
- Expertise includes water resources systems and governance, relationships between hydrology and water-dependent ecosystems, integrated water management strategies, and agricultural water management.
- Previously served on the Board of Directors for the Shasta Land Trust in Shasta County, California and for the Water Education Foundation. Selected as a 2019 David Keith Todd Distinguished Lecturer by the Groundwater Resources Association of California.
- B.S., Chemical Engineering, University of Tennessee Chattanooga; PhD, Earth Resources, Watershed Sciences, Colorado State University.

Resilience from Below

Sustaining communities and nature through proactive groundwater management

WRP Groundwater-Surface Water Interface Webinar

October 24, 2021

Maurice Hall, PhD, PE

Vice President, Resilient Water Systems

Environmental Defense Fund

EDF ENVIRONMENTAL DEFENSE FUND®

Finding the ways that work

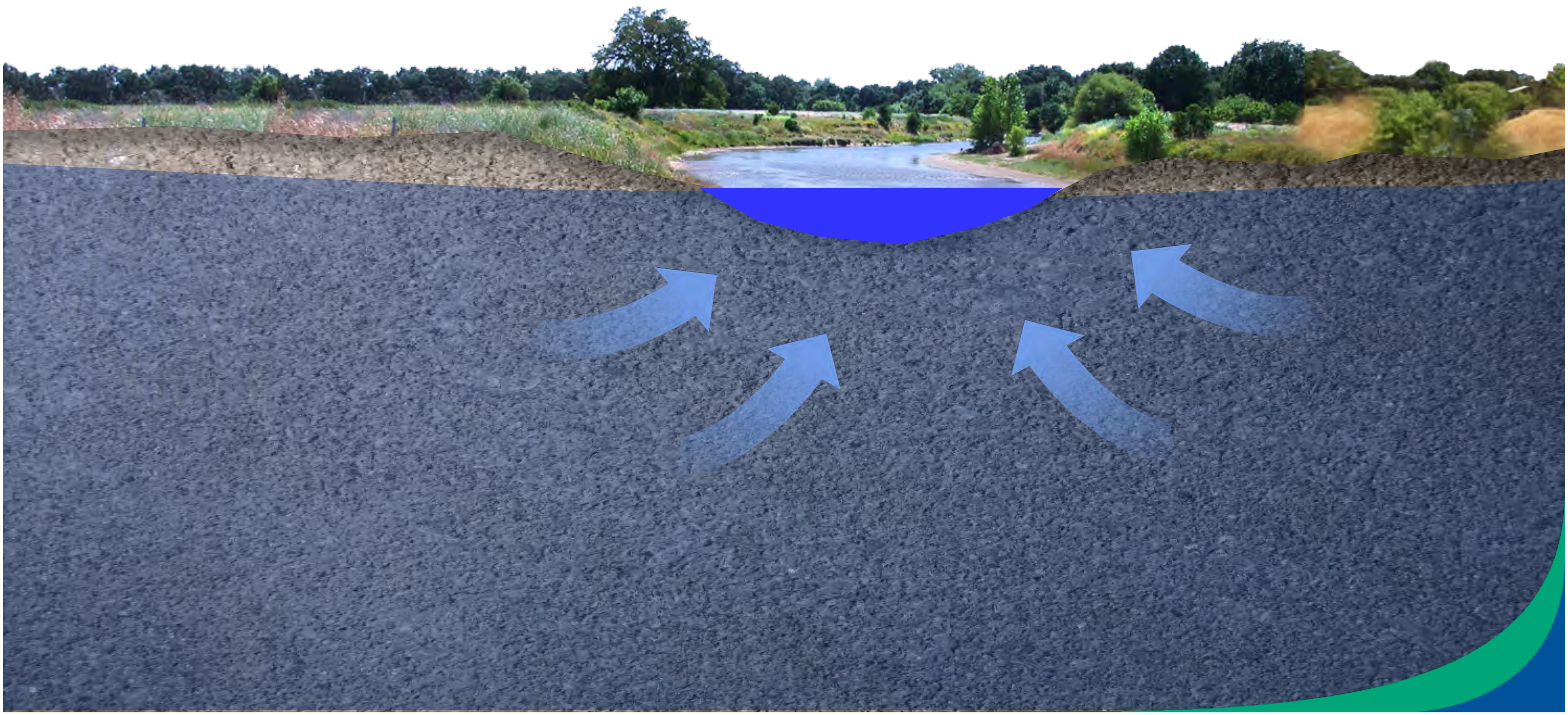
EDF and Water Management

Building the multiple needs of people and nature into the everyday business of managing water

Groundwater – Surface Water Connection

An Important Linkage in Water Supply Resilience

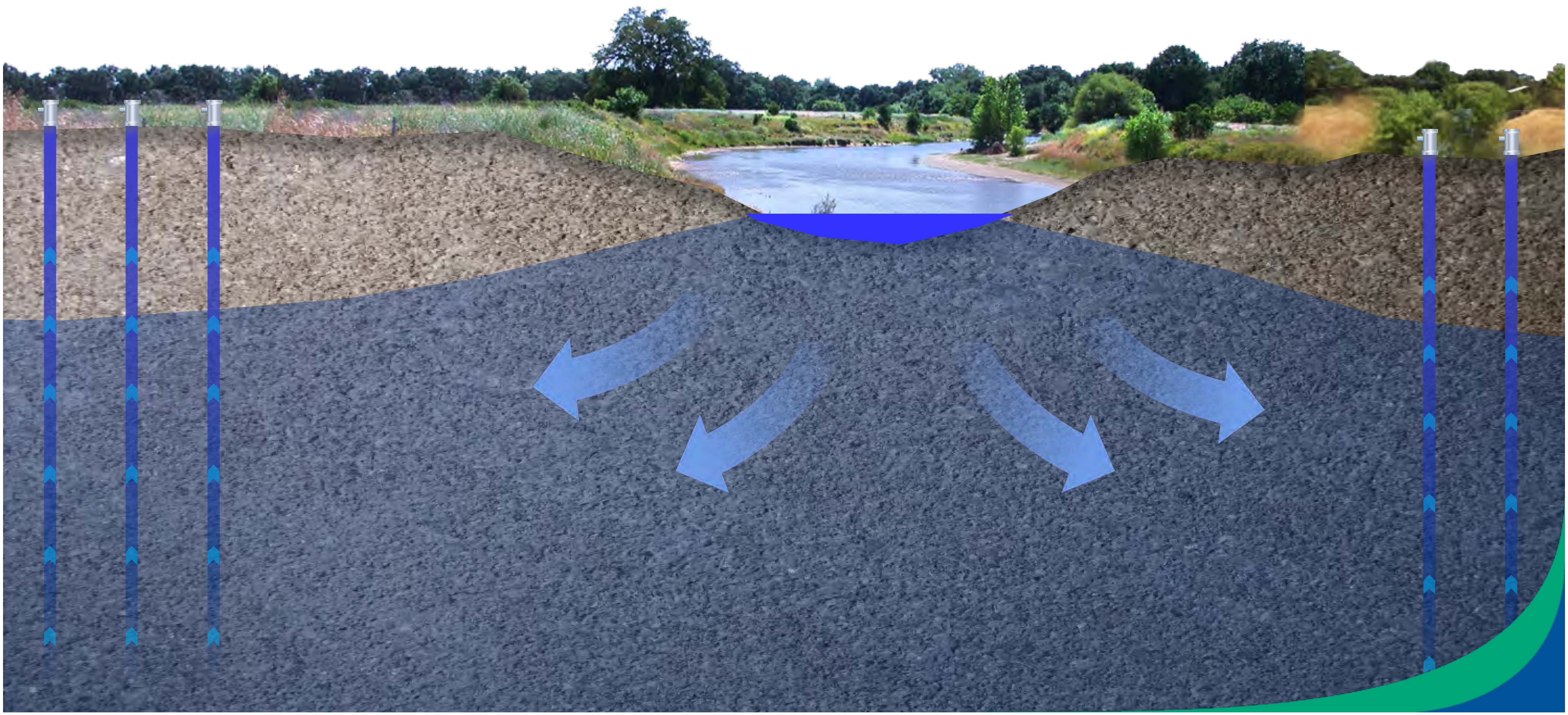
Gaining Stream



Groundwater – Surface Water Connection

An Important Linkage in Water Supply Resilience

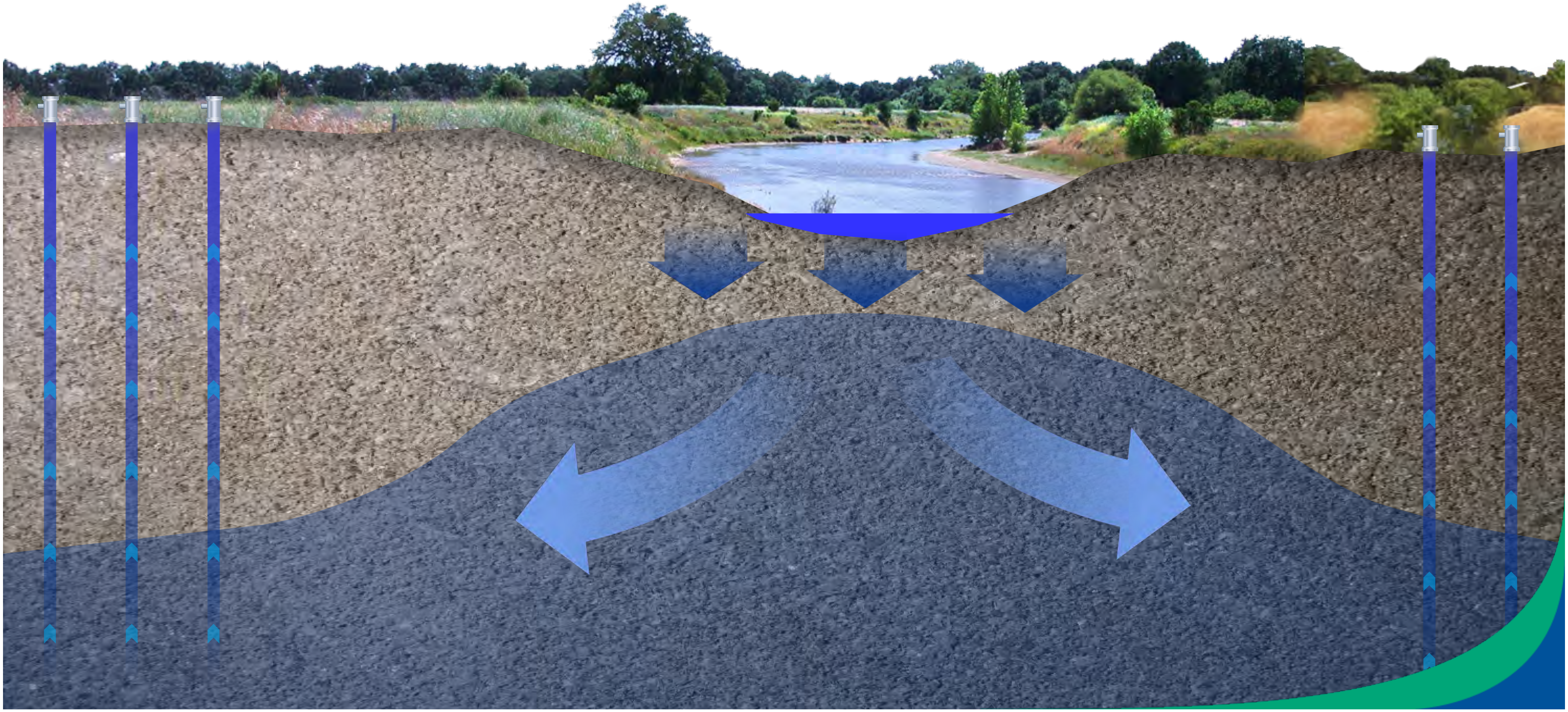
Losing Stream



Groundwater – Surface Water Connection

An Important Linkage in Water Supply Resilience

Losing & Disconnected Stream

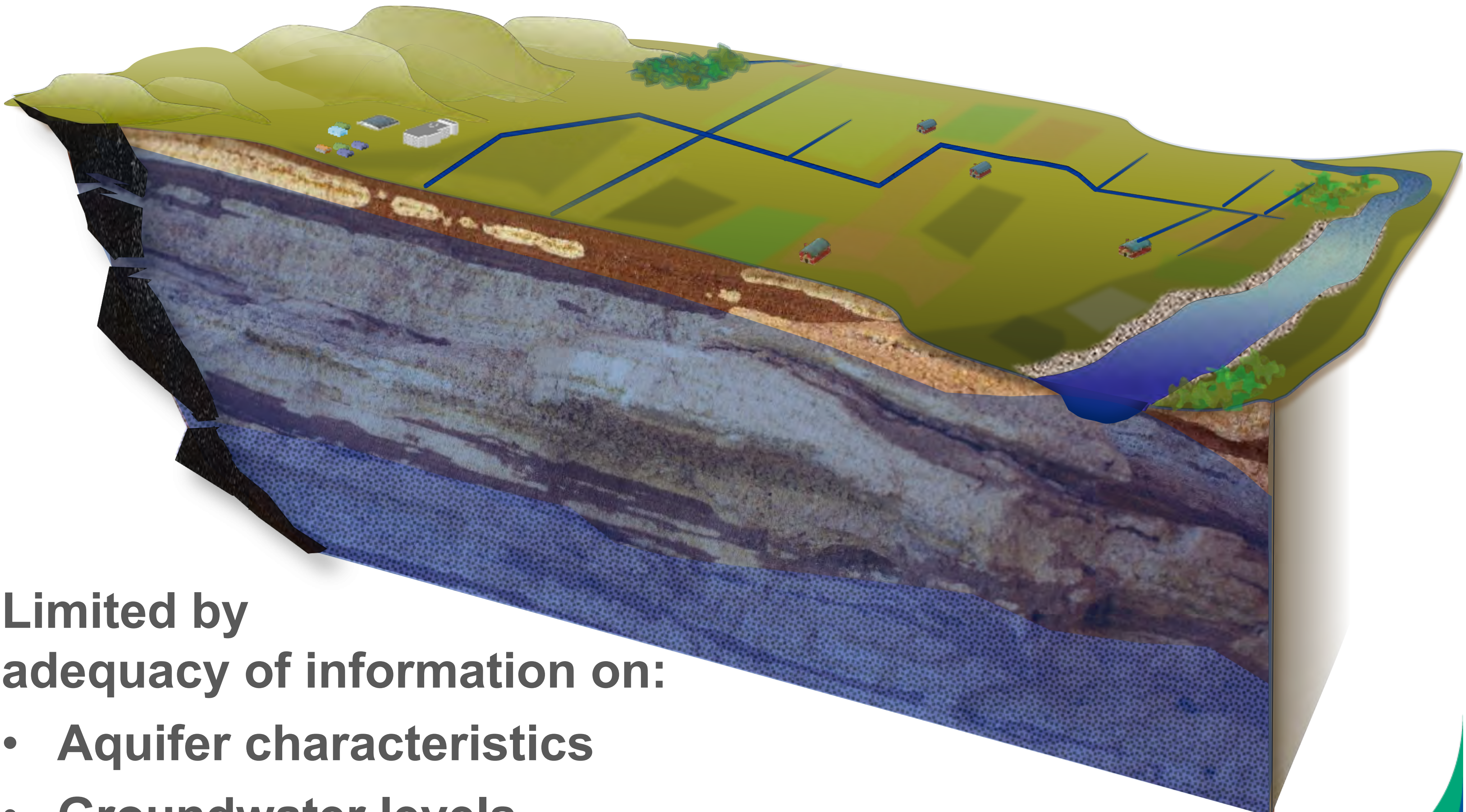


Groundwater – Surface Water Connection

An Important Linkage in Water Supply Resilience

Dry Stream

Myth: We Don't Understand Groundwater



Limited by adequacy of information on:

- Aquifer characteristics
- Groundwater levels
- Management activities

California Backdrop: Pre-SGMA

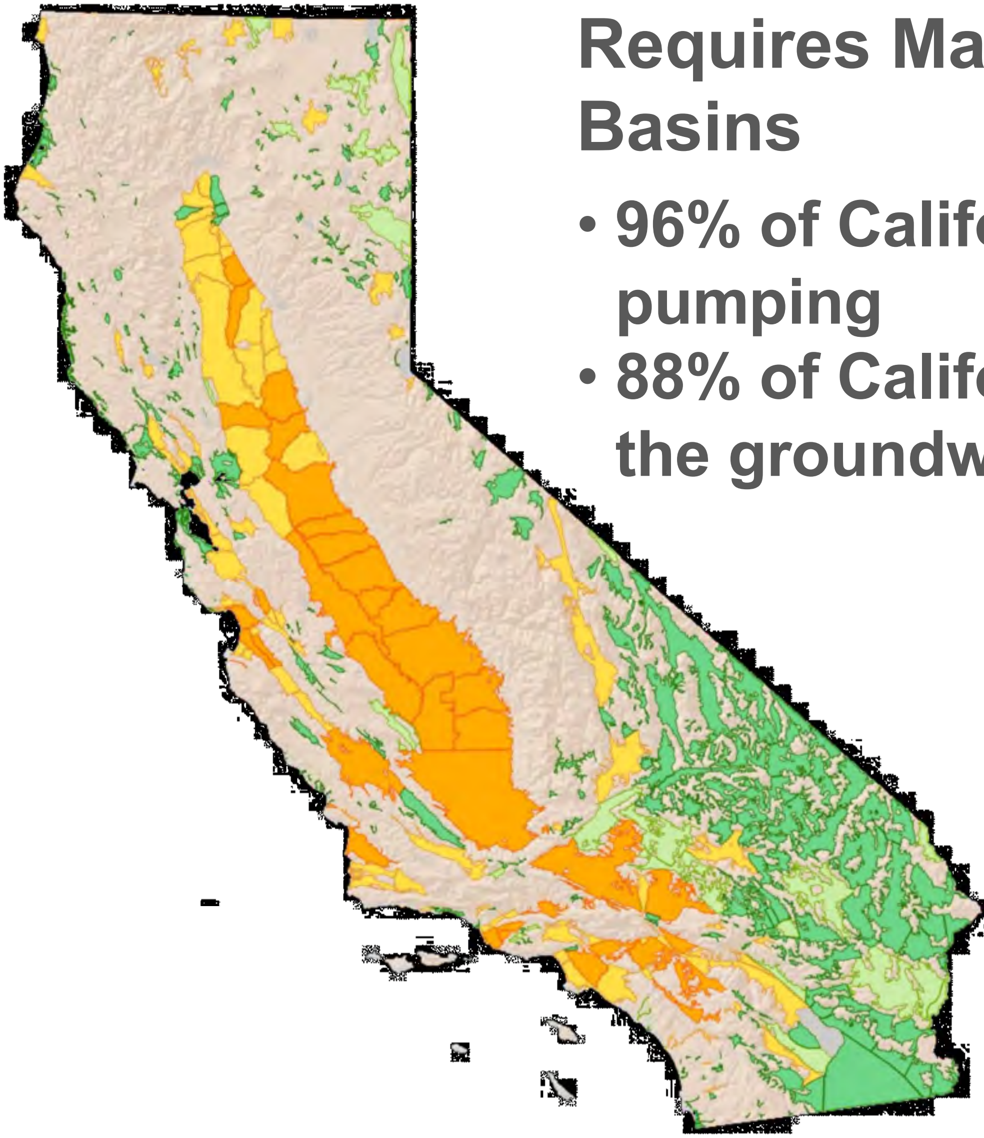
Well-developed groundwater management in some areas

- Out of necessity
- Desperate water supply conditions
- Conflicts/adjudications
- Often – after conditions highly degraded

Remainder of the State

- Limited oversight

California Backdrop: SGMA (2014)



Requires Management of 127 Priority Basins

- 96% of California's annual groundwater pumping
- 88% of California's population (overlying the groundwater basins area)

Local Control

- Form Sustainability Agency
- Develop Sustainability Plan
- Avoid Undesirable Results

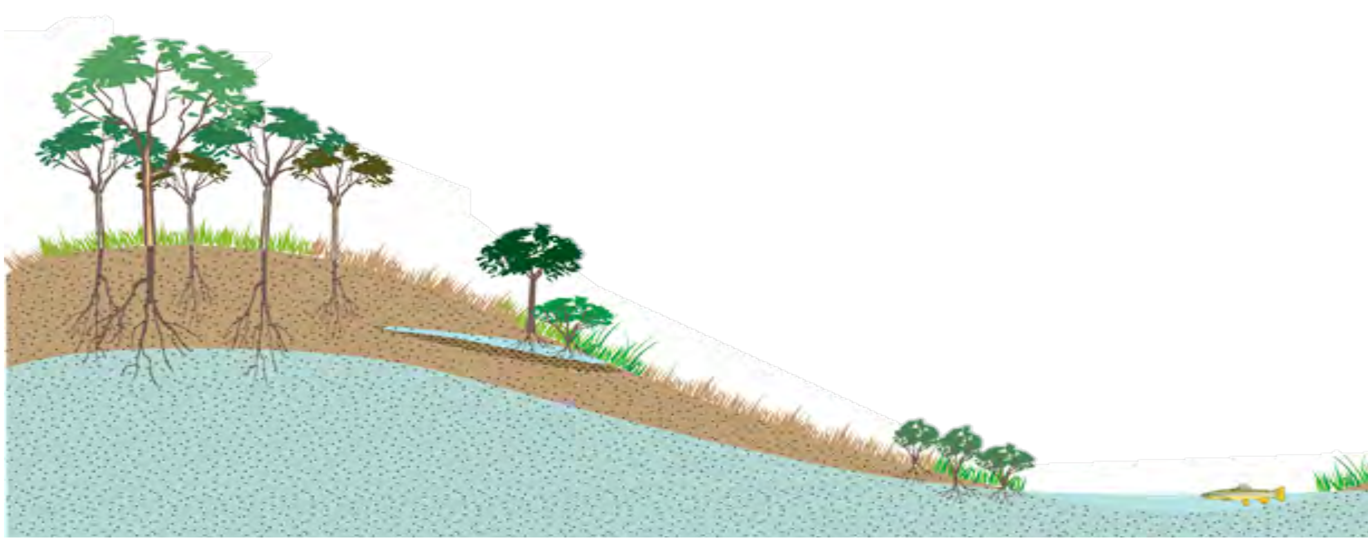
Defining “Sustainable” in SGMA

Undesirable Results

- **“undesirable results” = “impacts”**
- **Do not have to address undesirable results that occurred prior to Jan 1, 2015**

Defining “Sustainable” in SGMA

Avoiding undesirable results…

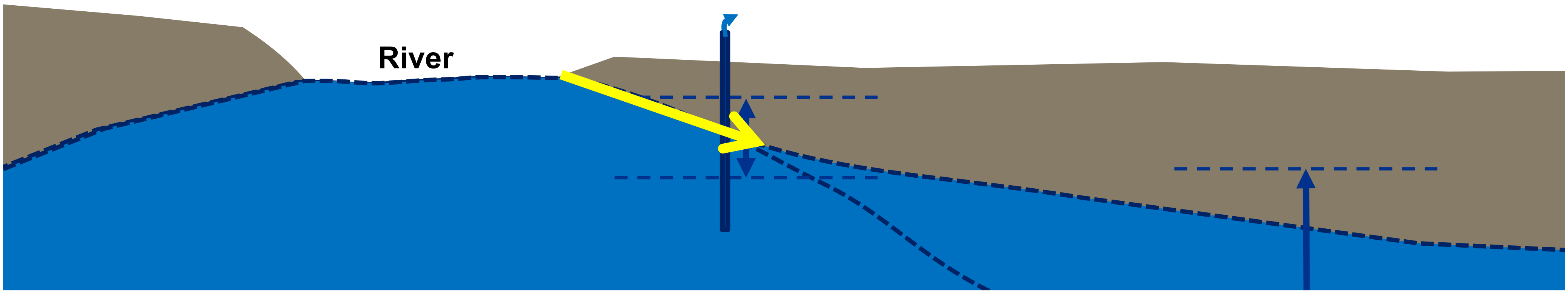


A Proposed Approach to Addressing Streamflow Depletions

Maintain Groundwater **Gradient** Near the Stream at or above pre-2015 Levels

1. Assume stream levels are the same in the future as in the past
2. Set minimum threshold for groundwater levels in the vicinity of streams
3. Manage to maintain levels at or above the threshold levels

SGMA-focused Approach, but general principles applicable elsewhere



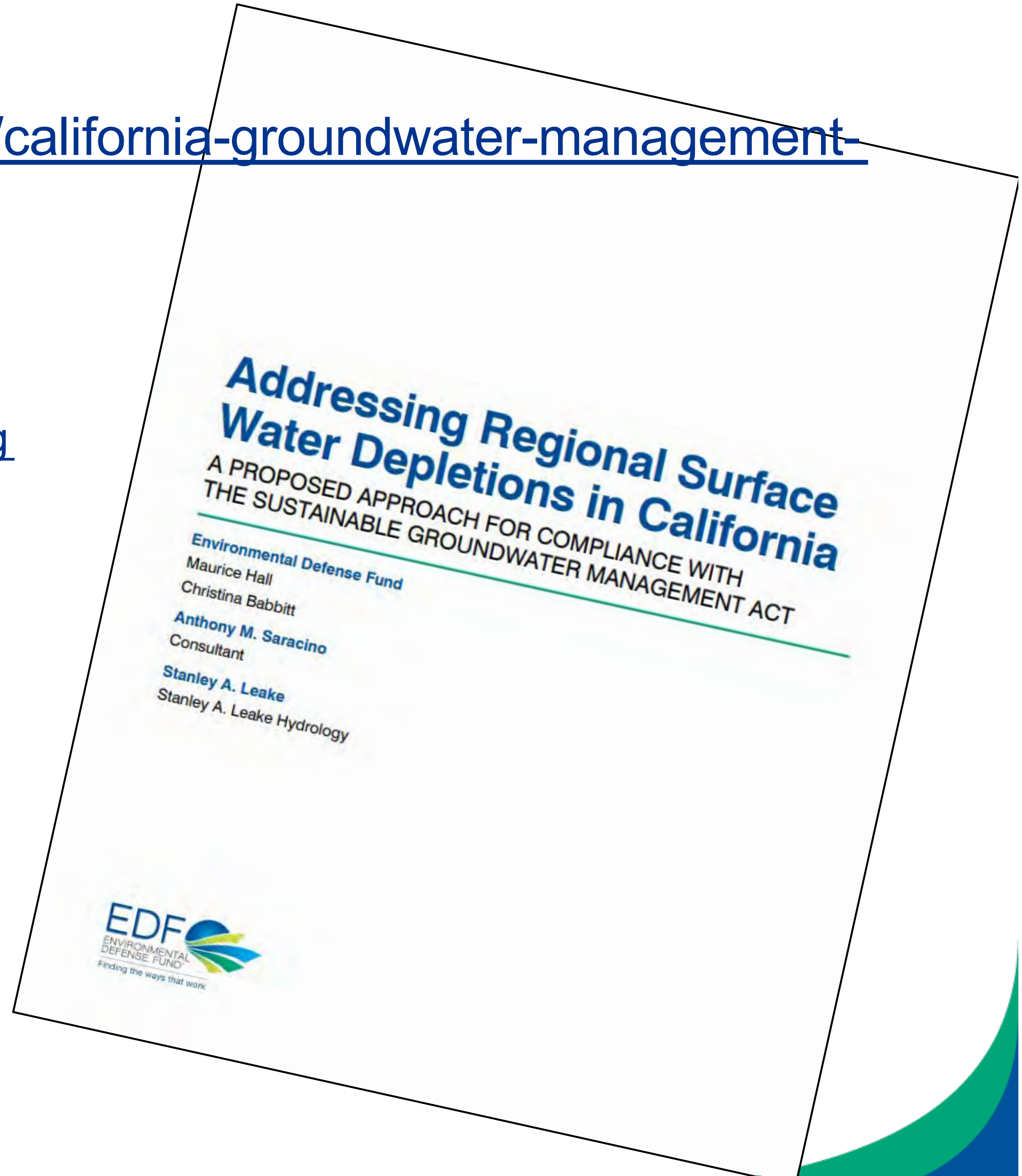
A Proposed Approach

Download the report at:

https://www.edf.org/ecosystems/california-groundwater-management-resources

For further information, contact:

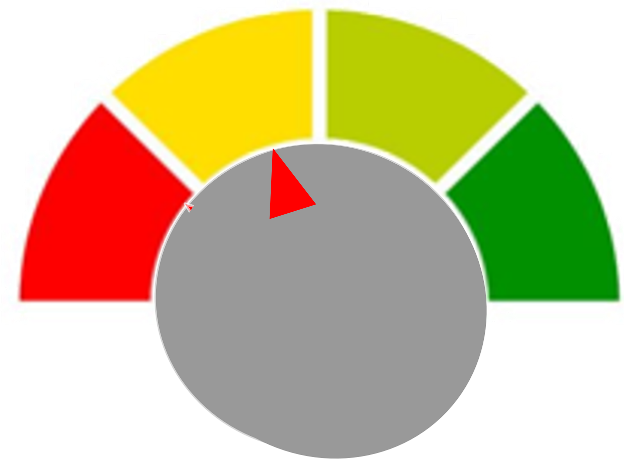
- Maurice Hall - mhall@edf.org
- Christina Babbitt - cbabbitt@edf.org



Groundwater Basins are Underutilized

Groundwater Management of the Past:

- Passive/Reactionary
- Under-monitored
- Under-funded



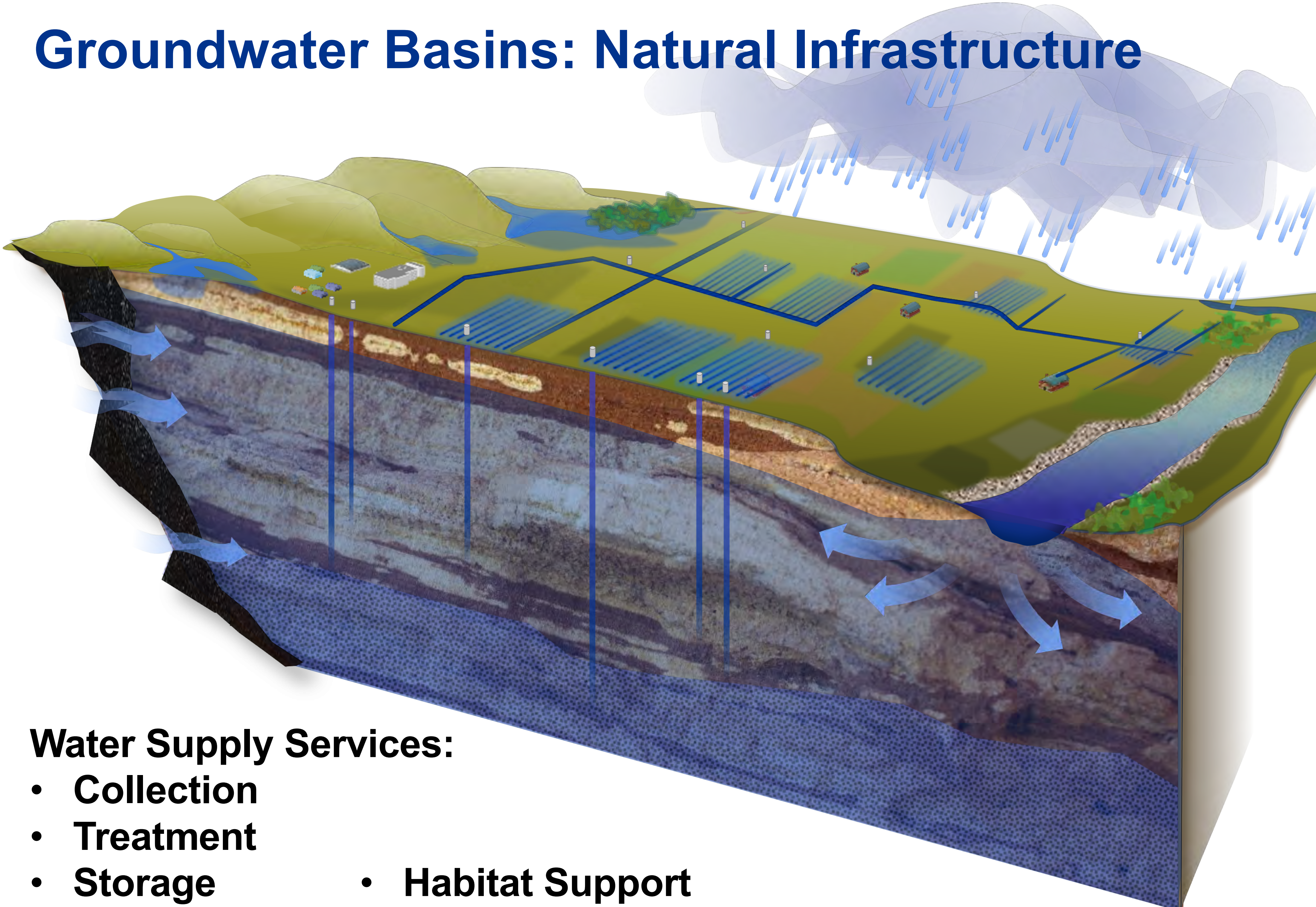
Resilience Meter

SGMA (Basic Requirements)

- Primarily defensive
- “Avoid undesirable Results”
- But…. Now you have ability to manage

Groundwater Basin

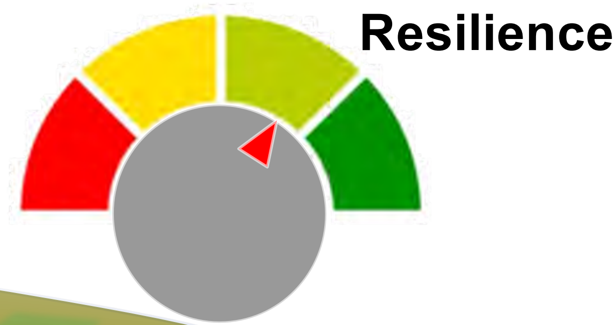
Groundwater Basins: Natural Infrastructure

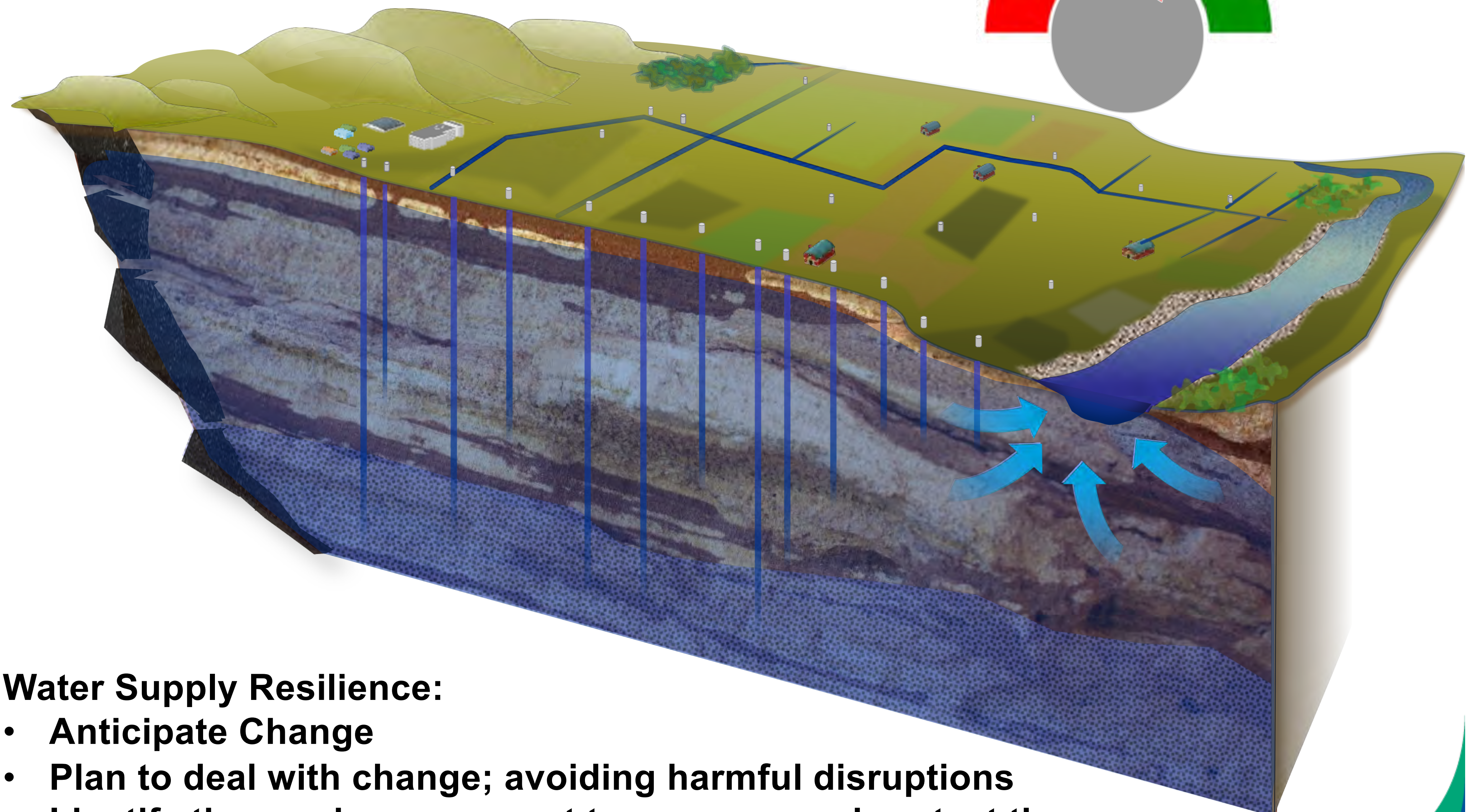


Water Supply Services:
- **Collection**
- **Treatment**
- **Storage**
- **Conveyance**
- **Habitat Support**
- **Streamflow Support**

Illustrative cross section, not to scale

Managing For Resilience





Water Supply Resilience:

- **Anticipate Change**
- **Plan to deal with change; avoiding harmful disruptions**
- **Identify the services you want to preserve and protect them**

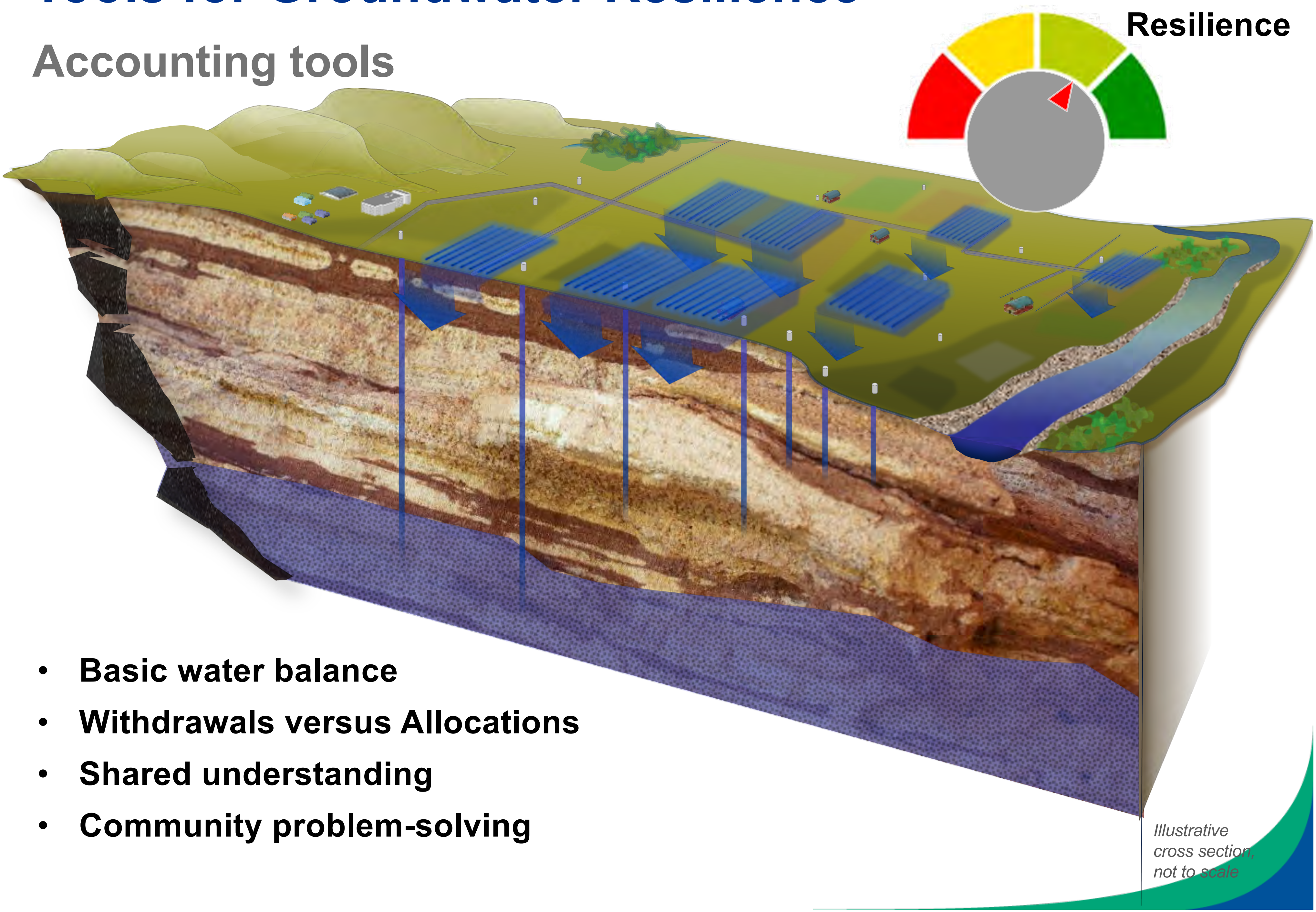
Tools for Managing for Resilience

Community Engagement

- Identify ALL the Services You Want to Support
- Transparency and Information Exchange
- Increased accountability
- Political Durability

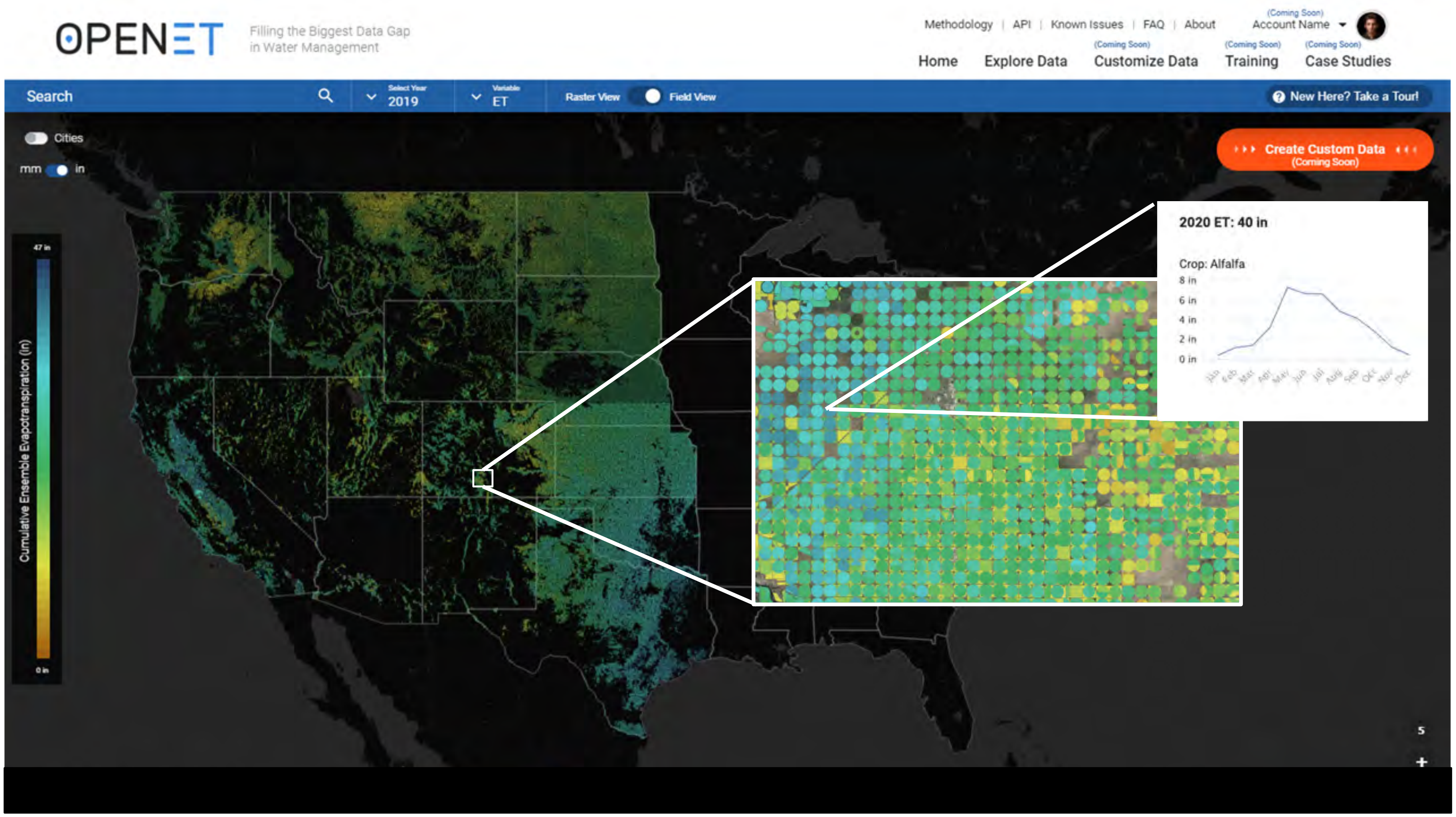
Tools for Groundwater Resilience

Accounting tools



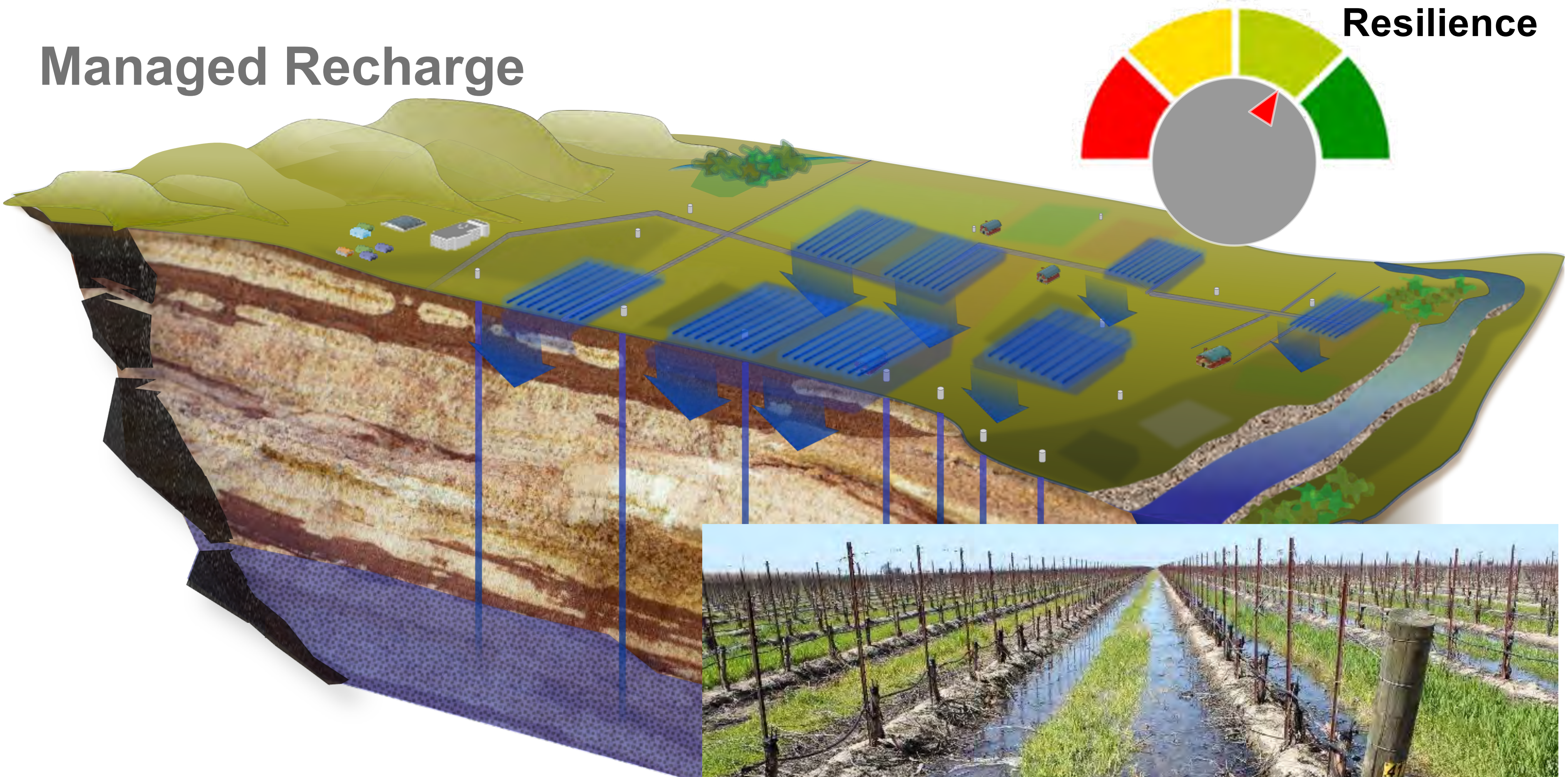
- **Basic water balance**
- **Withdrawals versus Allocations**
- **Shared understanding**
- **Community problem-solving**

OpenET: Reliable, accurate water data



Tools for Groundwater Resilience

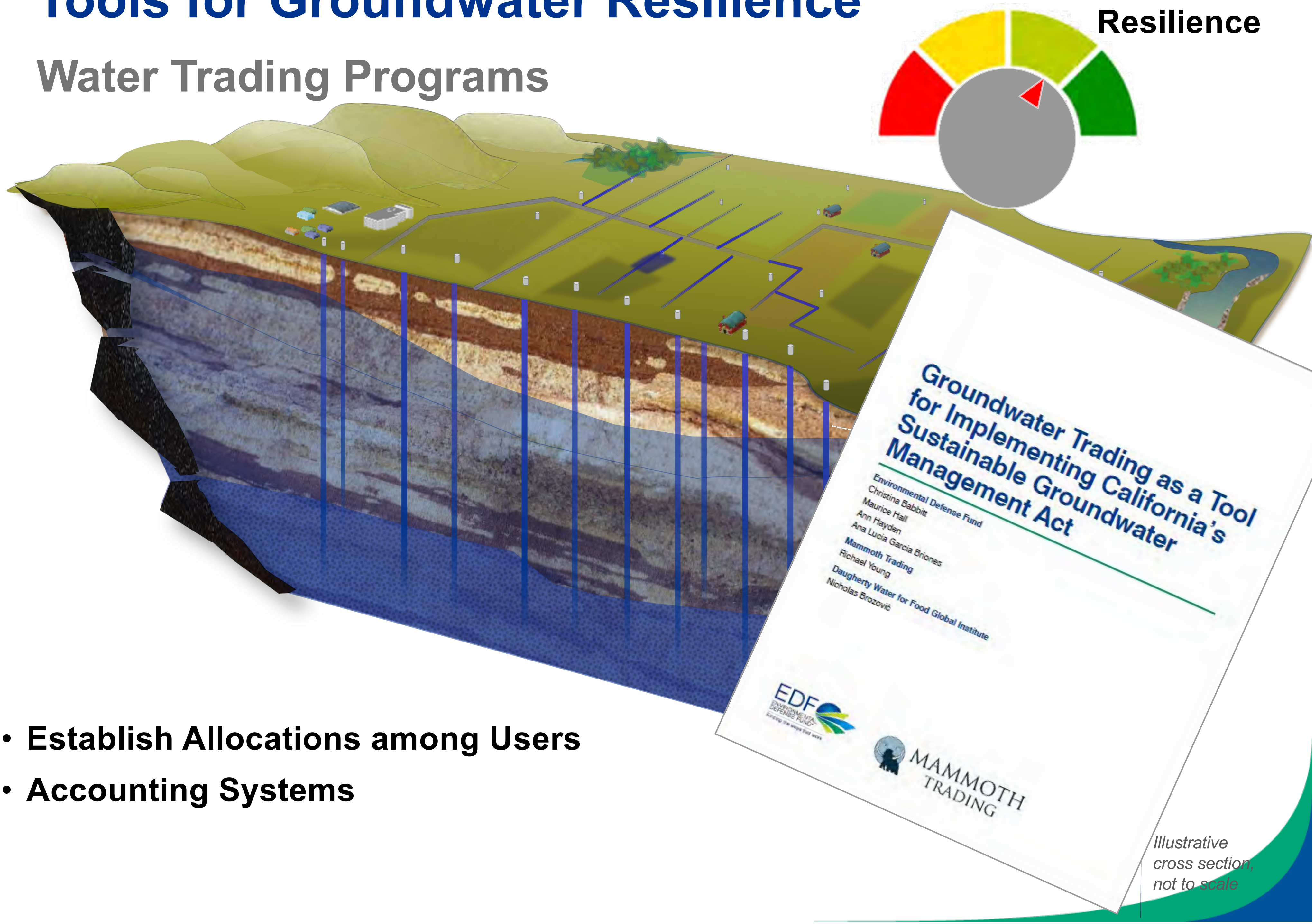
Managed Recharge



- Dedicated Recharge Basins
- On-Farm Recharge
- In-Lieu
- Floodplain Inundation
- Other Methods

Tools for Groundwater Resilience

Water Trading Programs

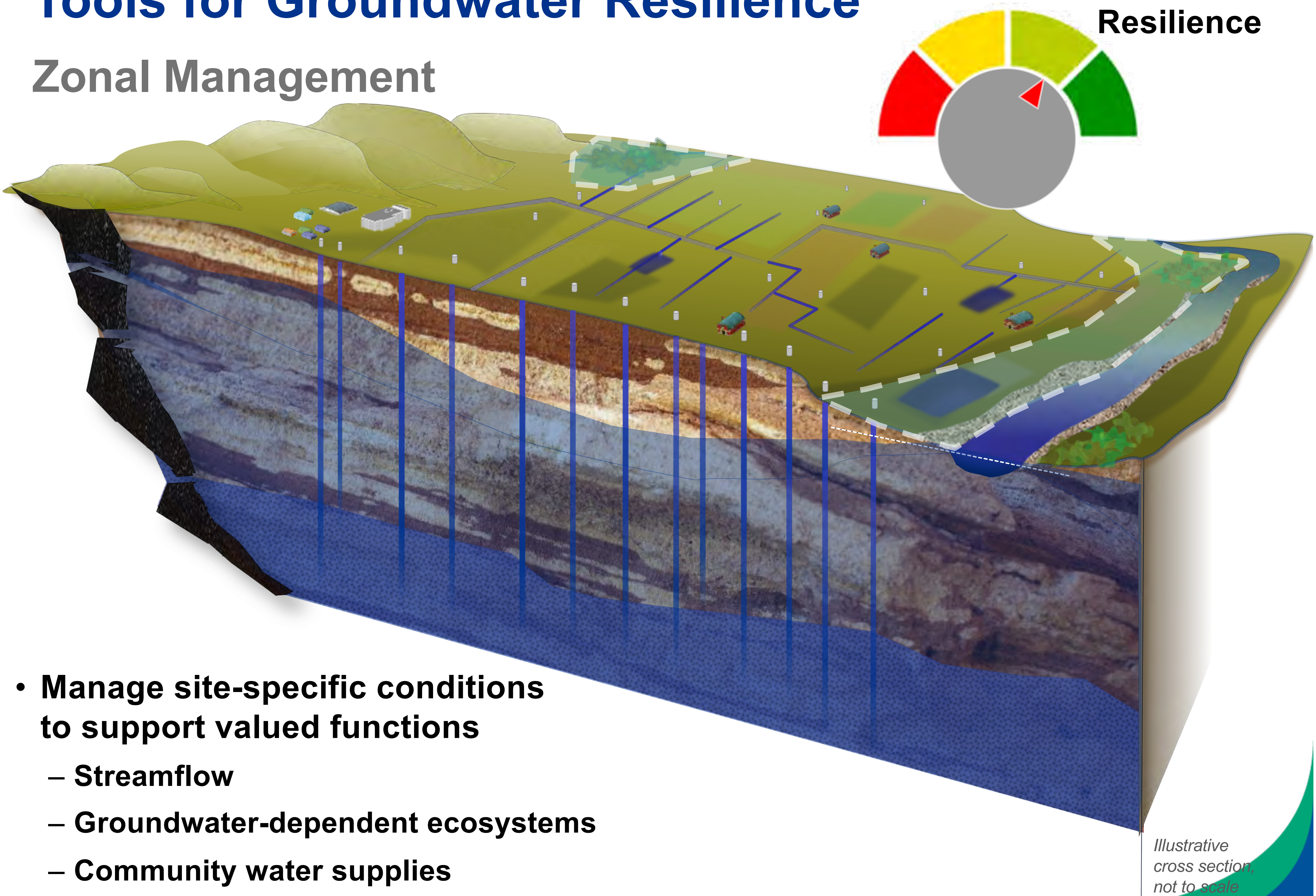


- **Establish Allocations among Users**
- **Accounting Systems**

Illustrative cross section, not to scale

Tools for Groundwater Resilience

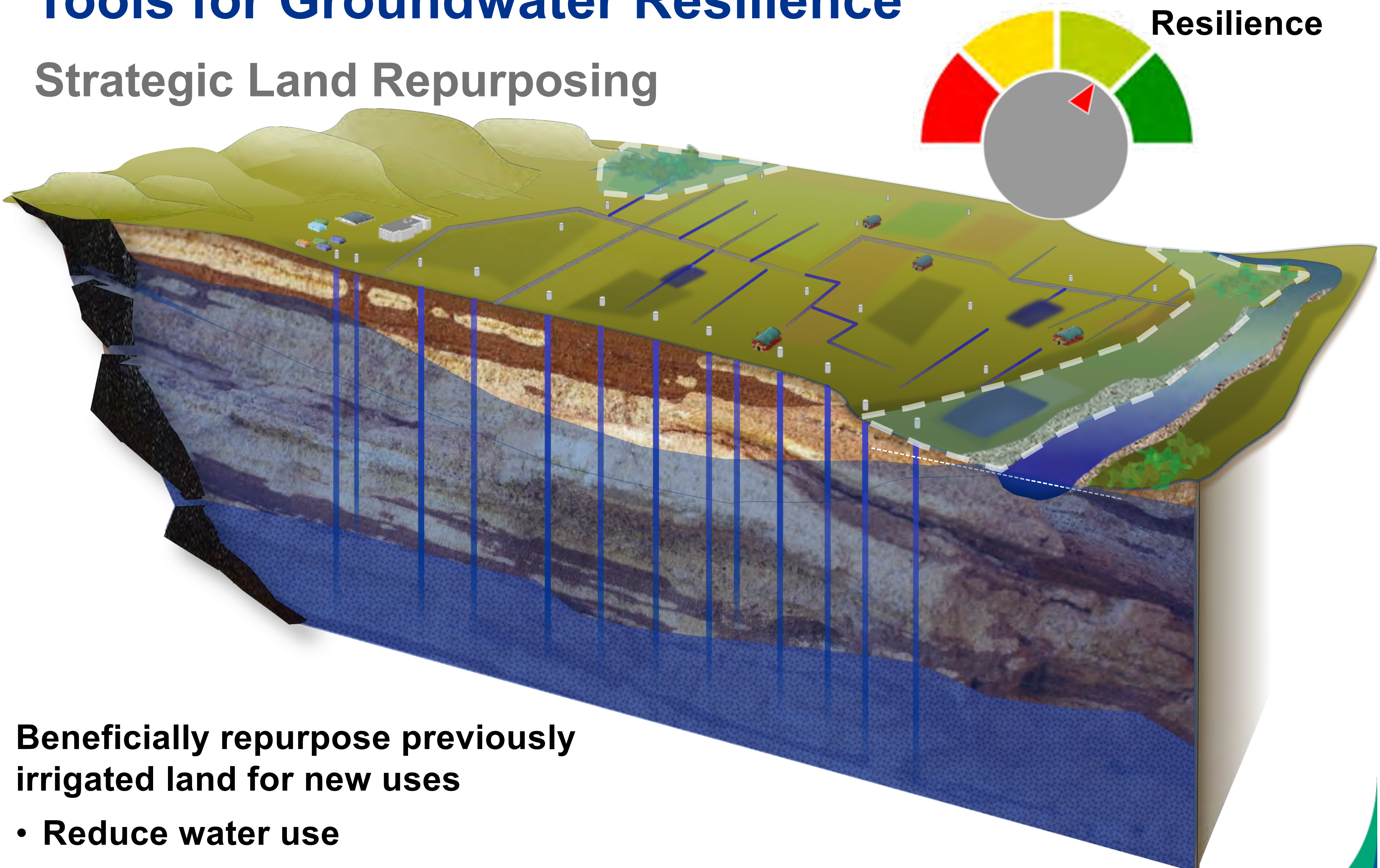
Zonal Management



- **Manage site-specific conditions to support valued functions**
  - **Streamflow**
  - **Groundwater-dependent ecosystems**
  - **Community water supplies**

Tools for Groundwater Resilience

Strategic Land Repurposing



Beneficially repurpose previously irrigated land for new uses

- **Reduce water use**
- **Provide other benefits, such as dryland farming, groundwater recharge, managed rangeland, habitat restoration**

Illustrative cross section, not to scale

Jennifer Heim
Deputy Counsel
Arizona Department of Water Resources

- Served in this capacity for more than four years.
- Work for ADWR has largely focused on groundwater and Colorado River issues.
- Previously a litigation attorney in the private sector.
- B. A., Texas Christian University;
  J.D., University of Minnesota Law School.

SURFACE WATER/GROUNDWATER RELATIONSHIP IN ARIZONA

JENNIFER HEIM

DEPUTY COUNSEL

ARIZONA DEPARTMENT OF WATER RESOURCES

Presentation for Western Regional Partnership Webinar

October 26, 2021

Arizona's Bifurcated System

Arizona has a bifurcated system of managing surface water and groundwater.

Surface Water

Surface water:

- Water flowing in streams, canyons, ravines or other natural channels, or in definite underground channels, and of lakes, ponds and springs on the surface.
- "Subflow" – Waters that find their way through the sand and gravel constituting the bed of the stream, or the lands under or immediately adjacent to the stream, and are themselves a part of the surface stream. (*Southwest Cotton*, 1931)

Surface Water

- Surface water is subject to the doctrine of prior appropriation ("first in time, first in right") and doctrine of beneficial use.
- A right to appropriate surface water may be obtained by applying to ADWR for a permit to appropriate the water.

Groundwater

- Groundwater: All water underground except subflow.
- Groundwater is not subject to doctrine of prior appropriation – groundwater may be pumped by the overlying landowner, subject to regulations imposed by statute and federal reserved water rights.
- The extent to which groundwater is regulated in Arizona depends on the location of the withdrawal.

1980 Groundwater Management Act

The 1980 Groundwater Management Act imposes three levels of groundwater regulation in the state:

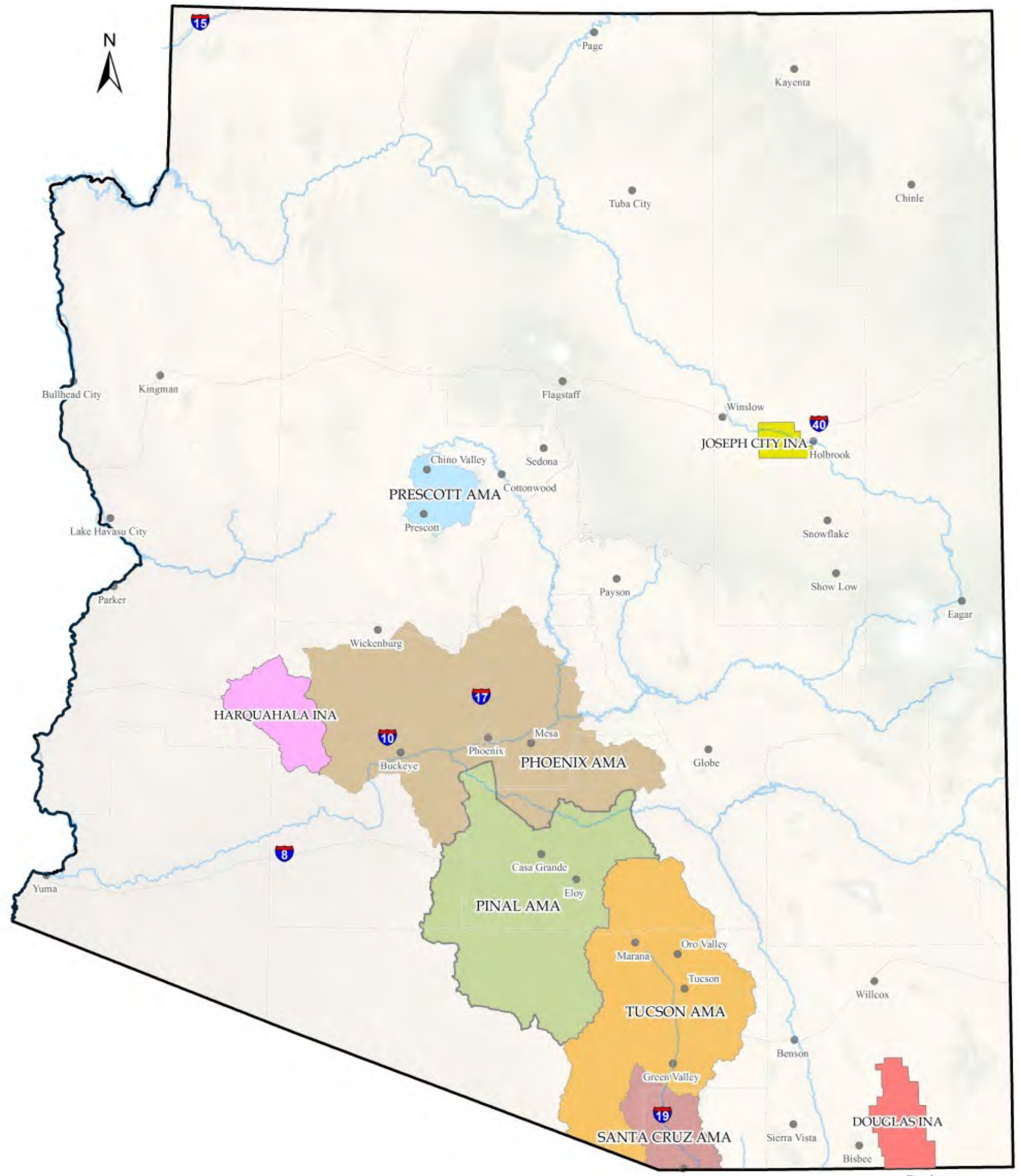
- State-wide regulations.
- Regulations within the three Irrigation Non-Expansion Areas (“INA”).
- Regulations within the five Active Management Areas (“AMA”).

Active Management Areas (AMAs)

* *Phoenix (1980)*
* *Pinal (1980)*
* *Prescott (1980)*
* *Tucson (1980)*
* *Santa Cruz (1994)*

Irrigation Non-Expansion Areas (INAs)

* *Douglas (1980)*
* *Joseph City (1980)*
* *Harquahala (1981)*



Distinguishing Groundwater from Surface Water

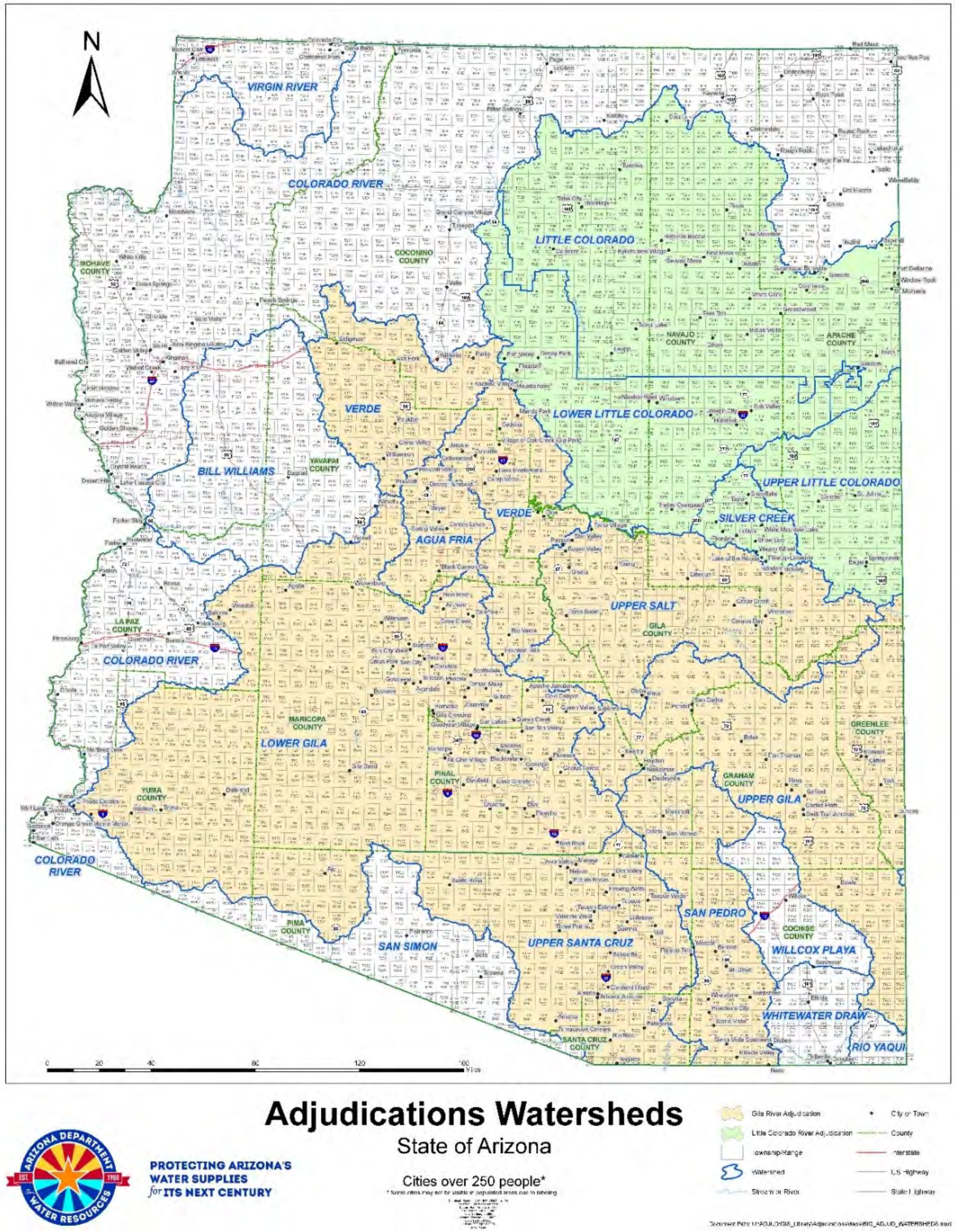
This bifurcated system of water rights was not unique to Arizona. It was typical of western states until around the turn of the twentieth century. At that time, scientific investigation was revealing that most underground water is hydraulically connected to surface water. As scientific knowledge progressed, most states revised their water laws to provide for unitary management of hydraulically connected underground and surface water. Arizona, however, did not, and continues to adhere to a bifurcated system of water rights, with compelling implications for general stream adjudications.

In re Gen. Adjudication of All Rights to Use Water in Gila River Sys. & Source, 175 Ariz. 382, 386, 857 P.2d 1236, 1240 (1993)

General Stream Adjudications

General stream adjudications are judicial proceedings to determine the extent and priority of all surface water rights in an entire river system. Arizona is undertaking a general stream adjudication of both the Gila River and the Little Colorado River systems. A river system means all water appropriable by law and all water subject to claims based upon federal law.

The final decrees will establish the existence and ownership of claimed water rights as well as important attributes of the water rights including location of diversions, water uses, quantity of water used, and date of priority of water rights.


N
VIRGIN RIVER
COLORADO RIVER
LITTLE COLORADO
COCONINO COUNTY
MOHAVE COUNTY
NAVAJO COUNTY
APACHE COUNTY
VERDE
LOWER LITTLE COLORADO
BILL WILLIAMS
YAVAPAI COUNTY
UPPER LITTLE COLORADO
SILVER CREEK
AGUA FRIA
UPPER SALT
GILA COUNTY
LA PAZ COUNTY
COLORADO RIVER
MARICOPA COUNTY
LOWER GILA
GREENLEE COUNTY
GRAHAM COUNTY
PINAL COUNTY
YUMA COUNTY
UPPER GILA
COLORADO RIVER
SAN PEDRO
PIMA COUNTY
SAN SIMON
UPPER SANTA CRUZ
COCHISE COUNTY
WILLCOX PLAYA
WHITEWATER DRAW
SANTA CRUZ COUNTY
RIO YAQUI
Adjudications Watersheds
State of Arizona
Cities over 250 people*
PROTECTING ARIZONA'S WATER SUPPLIES for ITS NEXT CENTURY

Distinguishing Groundwater from Surface Water

"[W]e recognize that the line between surface and groundwater drawn by the *Southwest Cotton* court and reaffirmed by this court today is, to some extent, artificial and fluid.… . however, we do not feel free to redraw or erase that line."

In re Gen. Adjudication of All Rights to Use Water in Gila River Sys. & Source, 175 Ariz. 382, 392, 857 P.2d 1236, 1246 (1993)

Challenges

- Size of the proceedings/number of claimants
- Technical complexities/efforts to reconcile hydrologic realities with legal framework.
- Federally reserved water rights are not necessarily limited to surface water, but may also include groundwater.

Successes

- 2017 ADWR's delineation of subflow zone in the San Pedro watershed was accepted by the adjudication Court.
- De Minimis Use Determinations – ADWR proposes methodology for determining whether a use qualifies as de minimis. Parties can object to methodology. ADWR recommends date and locations, but quantity is uniform.

Arizona Recharge and Recovery

As of October 2021:

- **110 permitted recharge projects in AZ**
  - 94 Underground Storage Facilities (USFs)
  - 16 Groundwater Saving Facilities (GSFs)
- **Almost 13 MAF stored for future use**

Recharge Program Goals

- To encourage the use of renewable water supplies (surface water and effluent) instead of non-renewable water supplies (groundwater) by allowing for the underground storage and recovery of the renewable water supplies
- To provide for the efficient use of renewable water resources by allowing renewable water supplies to be "transported" by storing the supplies underground in one location and recovering a like quantity elsewhere in the same groundwater basin
- To utilize underground storage to accommodate seasonal demand for water
- To augment the water supply

Regulation of Recharge in Arizona

Underground water storage and recovery is regulated by state law.
The laws are administered by the Arizona Department of Water Resources ("ADWR")

Basic requirements:

- A permit must be obtained from ADWR to store water underground or to recover stored water through a well.
- A person who stores or recovers water during a year must report the amount of water stored or recovered to ADWR.
- ADWR maintains accounts of the volume of water stored and recovered to ensure that recovery does not exceed storage.

Constructed USF

A facility designed, constructed and maintained to recharge water into an aquifer. Examples include injection wells and infiltration basins.

Managed USF

A recharge project in which water is artificially discharged into a natural stream channel for infiltration into the aquifer.

The water to be recharged may not include water that naturally flows in the stream channel.

Groundwater Savings Facility

A project for the delivery of a renewable water supply to a facility (typically a farm) to replace groundwater that would otherwise be used at the facility, resulting in groundwater savings.

The groundwater saved through the project is considered to be stored by the person delivering the renewable water supply to the facility.

Recovery

Requires a recovery well permit

* The applicant must hold long-term storage credits earned from the storage of water at a USF or GSF <u>or</u> the applicant must recover stored water in the same year that it is stored.

* If the recovery well is a new well (and in some cases an existing well), ADWR must determine that recovery of stored water from the well will not cause unreasonably increasing damage to surrounding land and other water users.

Restrictions On Recovery Of Stored Water

If the recovery well will be located outside the area of hydrologic impact of the stored water:

- The recovery well must be located in same groundwater basin or active management area in which water was stored.
- If the recovery well will be in an active management area, ADWR must determine that recovery of the water at the proposed location is consistent with the management goal and management plan for the active management area.
- If the recovery well will be located in the service area of a water provider, the water provider must consent .
- If the recovery well will be located within three miles of the service area of a water provider, the closest water provider must consent.

Long-Term Storage Credits

ADWR maintains a long-term storage account for each person storing water.

Each person with a water storage permit is required to report to ADWR the amount of water stored during a year.

If a person stores water during a year and does not recover the water during that year, ADWR registers a credit to the person's long-term storage account (The credit is called a long-term storage credit).

One credit is registered for each acre-foot of water stored (with certain exceptions).

Tracy Kosloff
Deputy State Engineer
Colorado Division of Water Resources

- Oversees the Intrastate Water Supply Development and Litigation Section & the Hydrogeology Section. Directs and supervises the review and engineering evaluation of substitute water supply plans, water court applications, well permit applications, subdivision water supply plans, & other water supply-related activities and critical hydrogeological investigation activities. Also provides general support to the State Engineer in water administration matters around the state and a point of contact for the Colorado General Assembly on legislative matters related to water administration.
- Previously worked as a consulting engineer in the water supply planning field, originally focused on water supply regulation in the South Platte River Basin and Colorado's eastern plains. Now in a statewide role dealing with Well Permitting, Surface Water Use Approvals, State Legislation, Water Law, and whatever else is necessary.
- B.S. and M.S, Engineering, UCLA.

Colorado Legal Surface & Groundwater Interaction

October 26, 2021

Tracy Kosloff
Deputy State Engineer

Topics

A. Background
B. Legally Connected Unless Shown Otherwise
C. Exceptions
   a. Nontributary
   b. Designated Groundwater
D. ASR - Two Types

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Colorado Background

- ➢Prior appropriation
- ➢Water courts adjudicate surface and groundwater rights
- ➢Water use administered by DWR
- ➢Well permits issued by DWR

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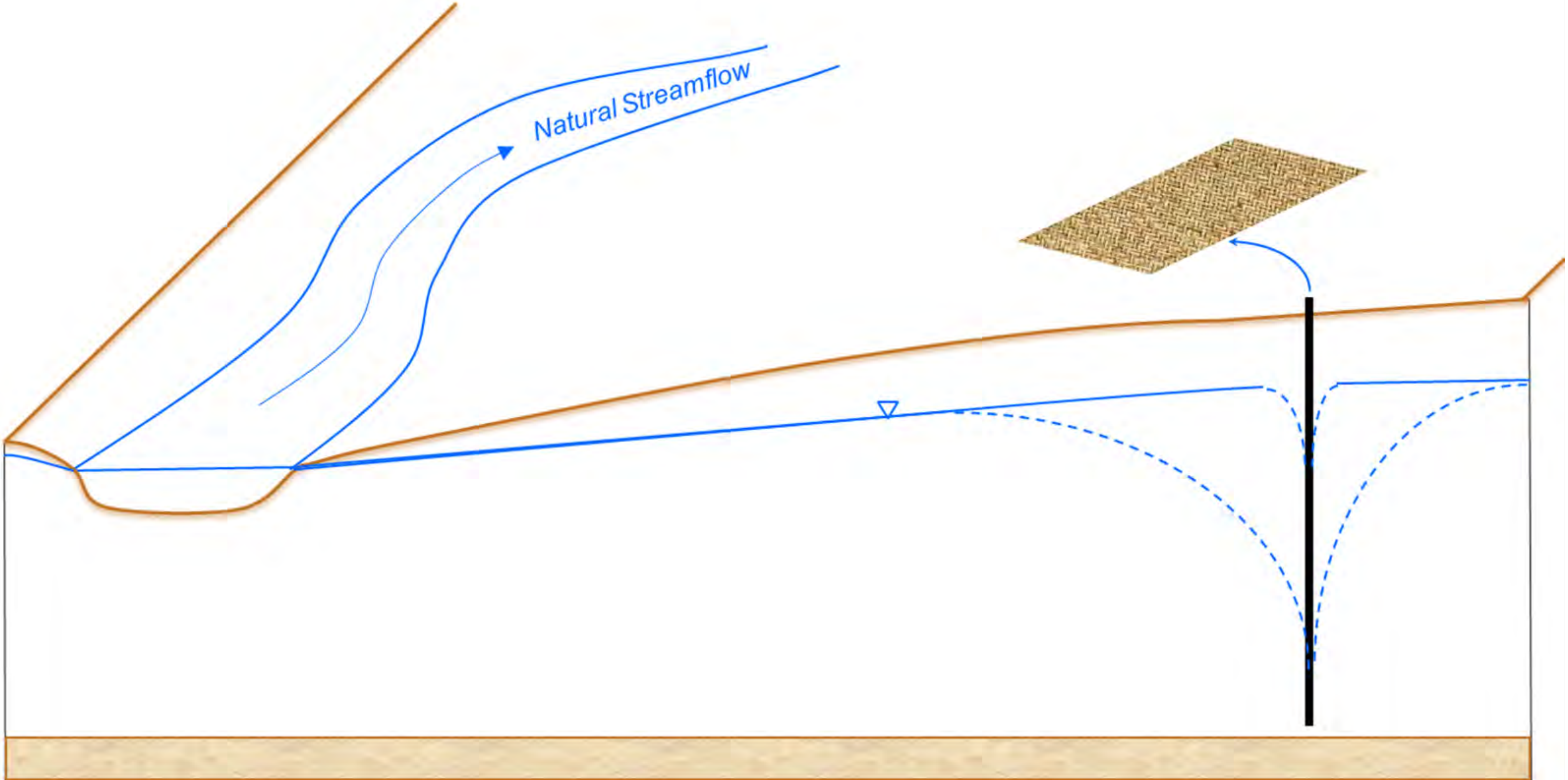
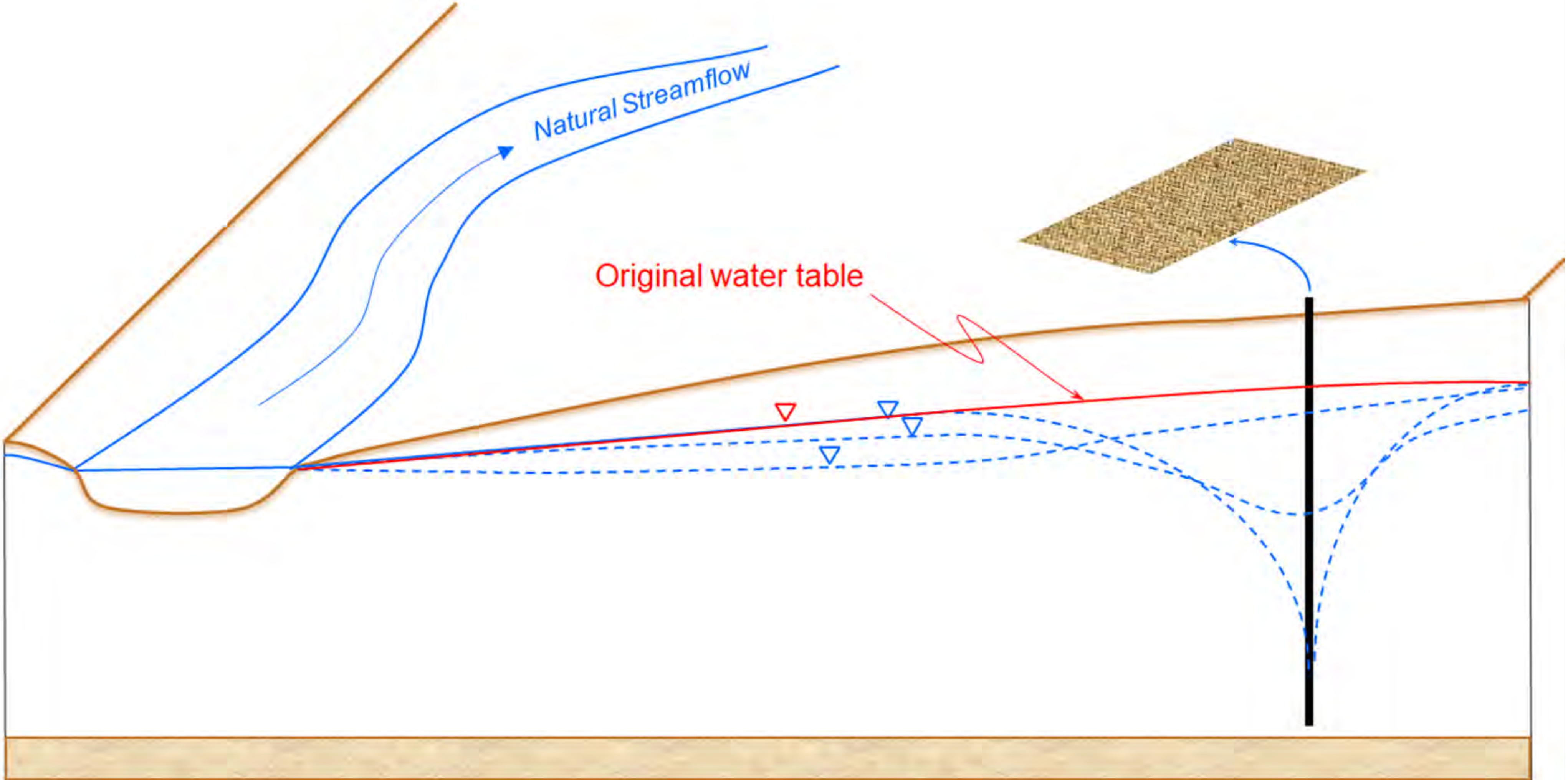
Legally Connected - Unless Shown Otherwise

Colorado's surface and groundwater administration integrated per statute since 1969



Example - irrigation well pumping



At the end of the season, the pumping stops and the aquifer begins to recover near the well.

The aquifer is depleted compared to its state had there been no pumping.

How to prevent injury to senior surface water rights?

Allow well pumping but prevent injury to senior water rights

- Court approved plans for augmentation
- Require replacement of depletions
  - Time
  - Place
  - Amount
- DWR can issue a 1-year temporary approval for these operations

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How?

- ➢ Determine time, place & amount
  - Glover analysis or groundwater modeling
- ➢ Provide replacement water
  - Reservoir releases
  - Leases of effluent
  - Recharge accretions (more on this later)

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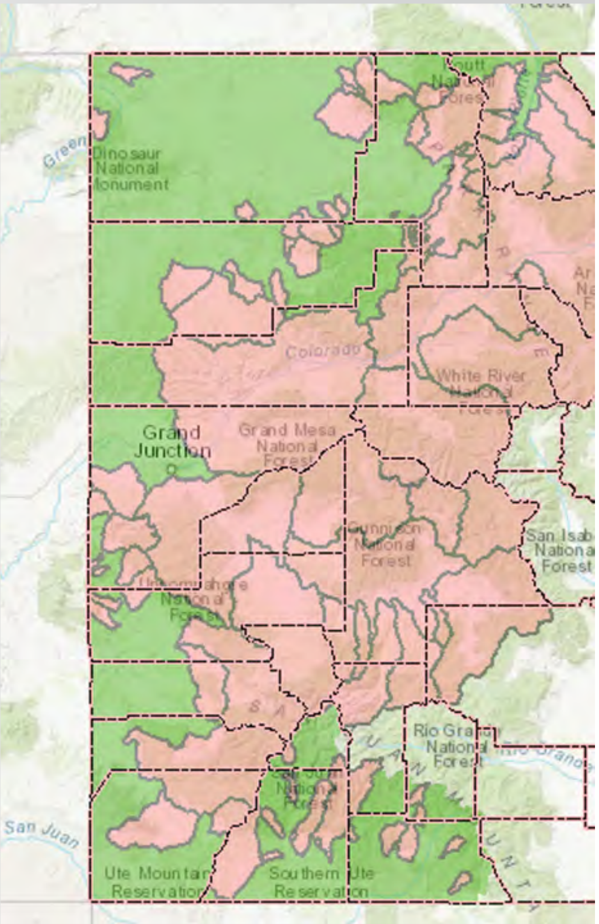
Where is augmentation of well pumping required?

- ➢Overappropriated Areas
  - Need an augmentation plan before getting a new well permit
  - Most of Colorado
- ➢Overappropriated Areas with Well Rules
  - New wells & older wells need an augmentation plan to keep pumping
  - About half of Colorado



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Exceptions

- ➢Nontributary Groundwater
- ➢Designated Groundwater

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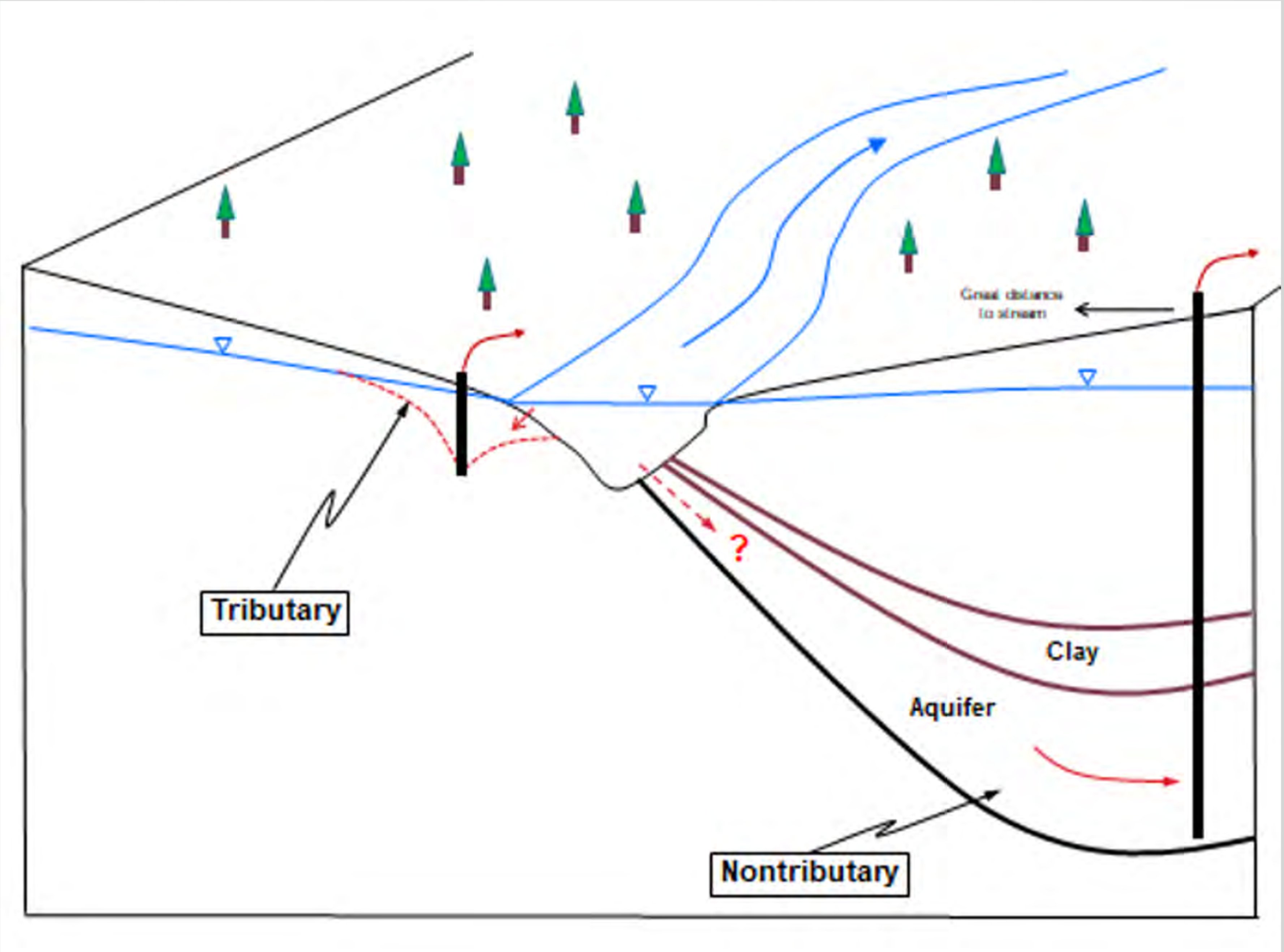
Tributary
?
Clay
Aquifer
Nontributary

Nontributary

Must prove:

... after one hundred years of continuous withdrawal... natural streamflow is depleted at less than 0.1% of the annual pumping amount

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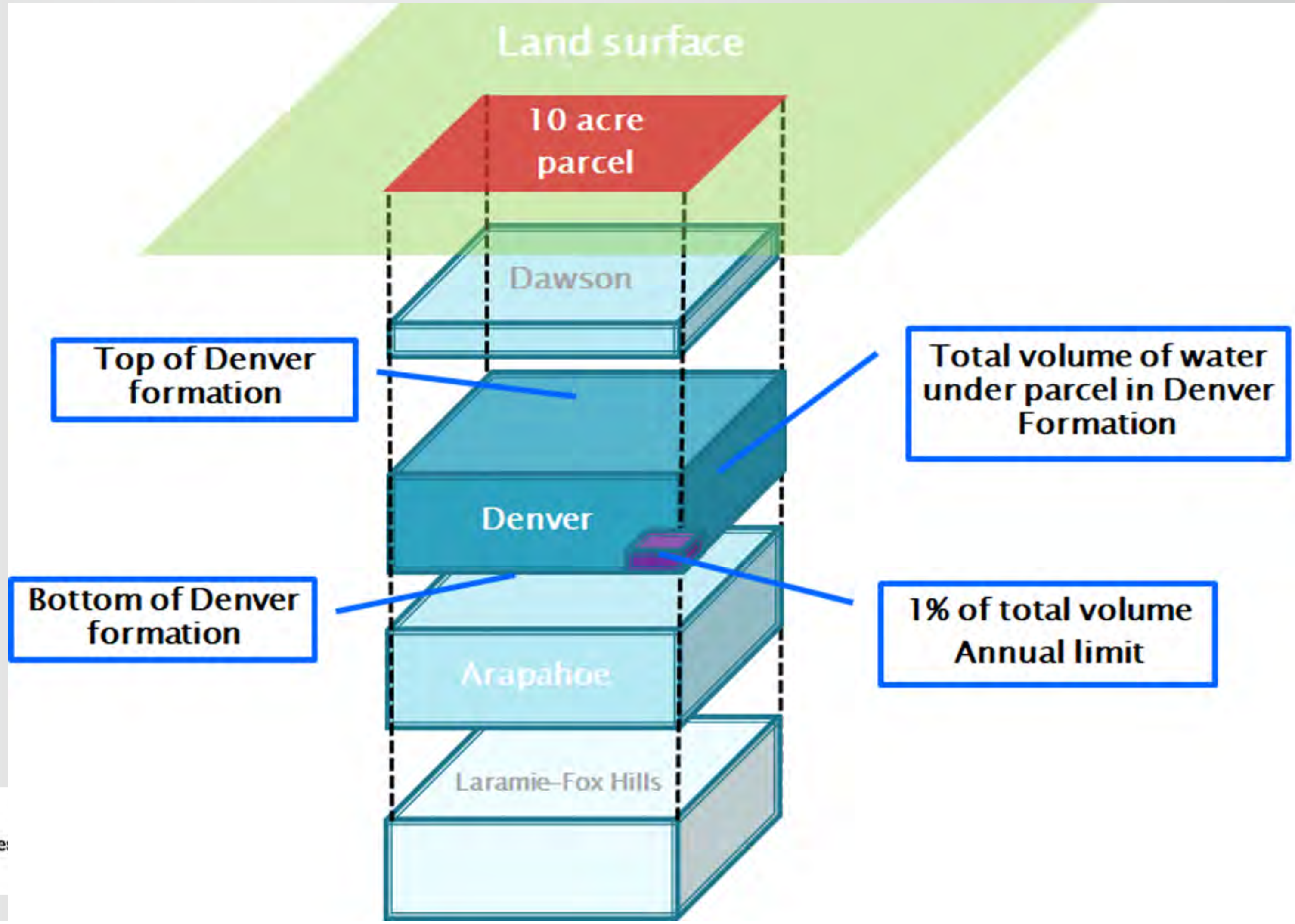
Nontributary

Use - limited to underlying quantity

1% per year



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Designated Groundwater

- ➢Areas far from streams
- ➢Reliance on groundwater
- ➢Modified priority system
  - Minimal consideration of surface waters

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Exceptions - Mapped

Denver Basin and Designated Ground Water Basins

Crow Creek & Camp Creek Basins

Irrigation and Domestic water is from both **Alluvial and Bedrock Aquifers. No surface water supply.**

Lack of precipitation may result in increased pumping and lowing of the water table. This would lead to higher energy and production costs.

Kiowa-Bijou

Irrigation water supply is from the **Alluvial Aquifer, No surface water supply.** Domestic supply from both **Alluvial and Bedrock Aquifers.**

Lack of precipitation may result in increased pumping and lowing of the water table. This would lead to higher energy and production costs.

Lost Creek

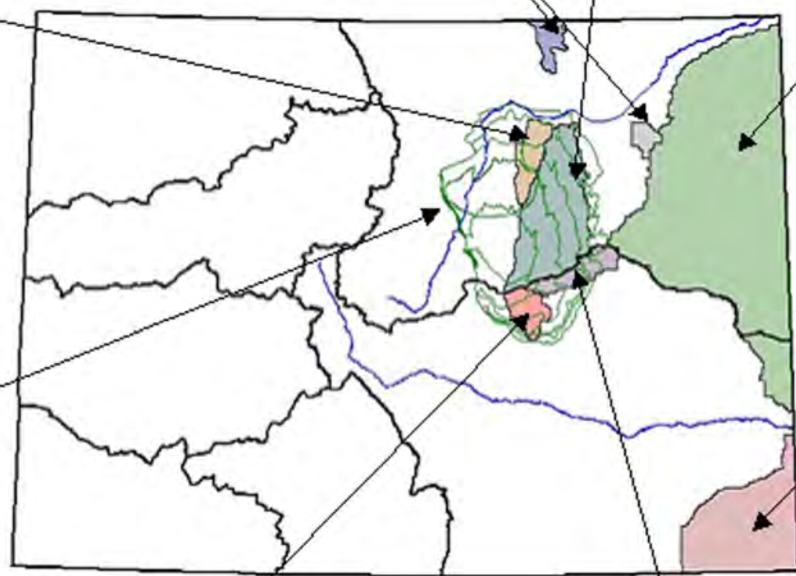
Irrigation and Domestic water is from both **Alluvial and Bedrock Aquifers. No surface water supply.**

Lack of precipitation may result in increased pumping and lowing of the water table. This would lead to higher energy and production costs.

Northern High Plains

Irrigation and domestic water supply is from the **Ogallala Aquifer. No surface water supply.**

Lack of precipitation may result in increased pumping and lowering water levels. This would lead to higher energy and production costs.



Denver Basin

Ground water supply is from the four major Denver Basin Bedrock Aquifers, **Dawson, Denver, Arapahoe and Laramie-Fox Hills.** The aquifers are not part of the surface system and are not affected by drought conditions. However, in times of shortages in the surface water supply, increased use of ground water from the basin can result in accelerated water level declines

Southern High Plains

Irrigation and domestic water supply is from the **Ogallala, Dakota, Cheyenne and Docum Aquifers. No surface water supply**

Lack of precipitation may result in increased pumping and lowering water levels. This would lead to higher energy and production costs.

Upper Black Squirrel

Irrigation water supply is from the **Alluvial Aquifer, No surface water supply.** Domestic water supply from **Denver Basin Aquifers**

Lack of precipitation may result in increased pumping and lowing of the water table. This would lead to higher energy and production costs.

Upper Big Sandy

Irrigation water supply is from the **Alluvial Aquifer, No surface water supply.** Domestic supply from **Alluvial and Bedrock Aquifers.**

Lack of precipitation may result in increased pumping and lowing of the water table. This would lead to higher energy and production costs.

ASR - Two Types

- Recharge - Alluvial
- ASR into nontributary aquifers

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ASR - Recharge Alluvial

- ➢Junior surface water diversions to recharge ponds → returns to stream
- ➢Use for augmentation / replacement
- ➢Model or calculate accretion timing to river
- ➢Requires crystal ball...

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ASR - Recharge Alluvial

- Water court
  - Junior surface diversions - “recharge rights”
  - Timing and use of accretions

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ASR - Nontributary Aquifers

- Largely a permit system
- Injection
  - Permitted by EPA - Underground Injection Control Program (water quality)
  - Administratively - water right must allow for ASR
- Extraction
  - Permitted by DWR
  - Largely to track accounting

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Dr. Bruce M. Thomson

Regents Professor Emeritus, Department of Civil, Environmental and Construction Engineering, University of New Mexico

- Previously, Director of UNM's Water Resources Program.
- Research has focused on the chemistry and treatment of metals and metalloids in water, water resources of the southwestern US, and the relationship between energy development and water. Has published over 70 journal articles, several book chapters and papers in over 150 conference proceedings.
- Has served on many federal, state and local committees involved with management and protection of water resources.
- Elected member and current Chair of the Board of Directors of the Albuquerque Metropolitan Arroyo Flood Control Authority (AMAFCA).
- Licensed Professional Engineer in the State of New Mexico and is among the last practicing engineers in the state who knows how to use a slide rule.
- B.S., Civil Engineering, University of California at Davis; M.S. and Ph.D., Environmental Science and Engineering, Rice University.

Surface & Ground Water Interactions in NM: The Good, The Promising, & The Ugly

(Title courtesy of Mike Hightower)

Bruce Thomson

Civil, Construction & Environmental Engineering

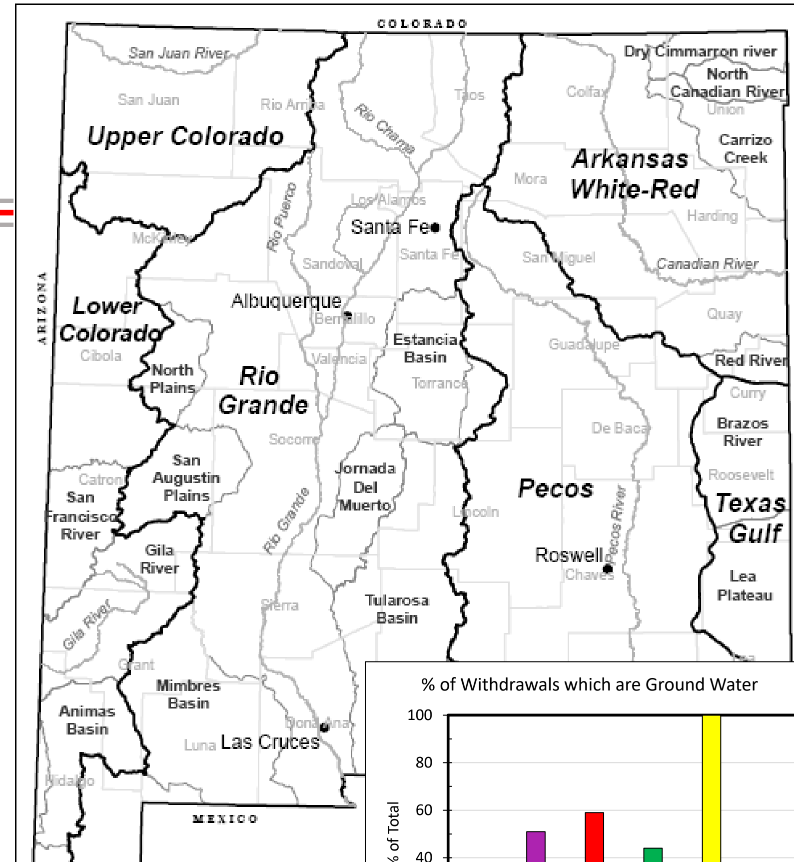
University of New Mexico

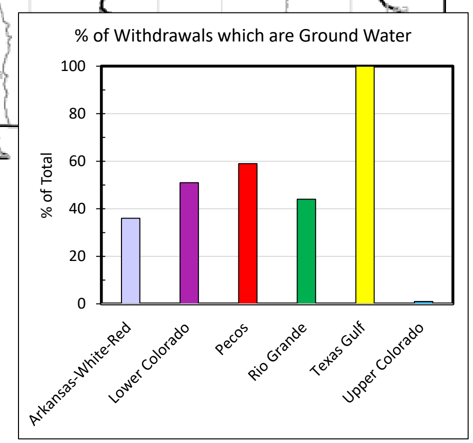
(bthomson@unm.edu)

THE UNIVERSITY of NEW MEXICO

Introduction

- Challenges of Surface water as source of supply
  - Limited storage in most watersheds
  - Highly variable source of supply
  - High evaporation losses
  - Susceptible to drought
  - Likely decreased supply due to climate warming
    - Smaller snow pack, hence spring runoff
    - Longer growing season
    - Increased evapotranspiration losses
- Ground water is important source of supply in NM
  - 48% of total water withdrawals in NM (1.5 MAF of 3.1 MAF total)
  - 72% of public & domestic water supply is ground water (225 KAF)
- Need to understand relationship between surface and ground water

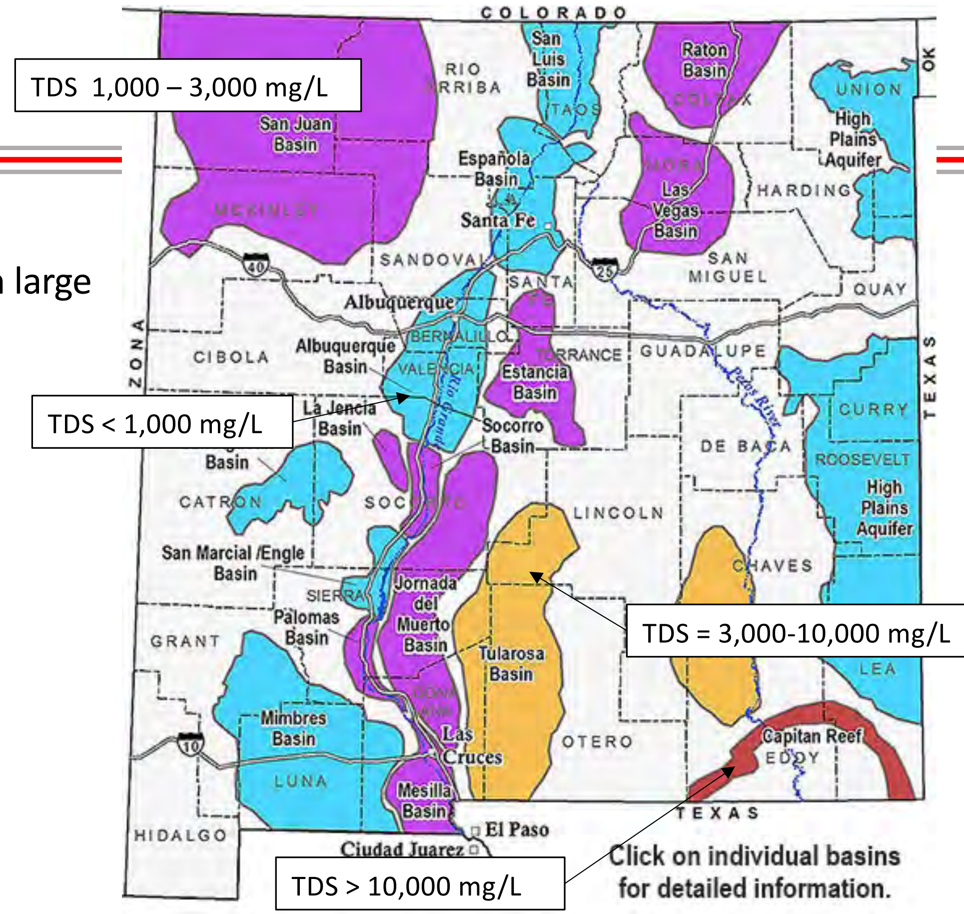




Major Aquifers of NM

(https://geoinfo.nmt.edu/resources/water/amp/home.html)

- Focus of this talk is on aquifers in Rio Grande basin
- Caution: Water quality is variable & difficult to summarize in large 2-D plot



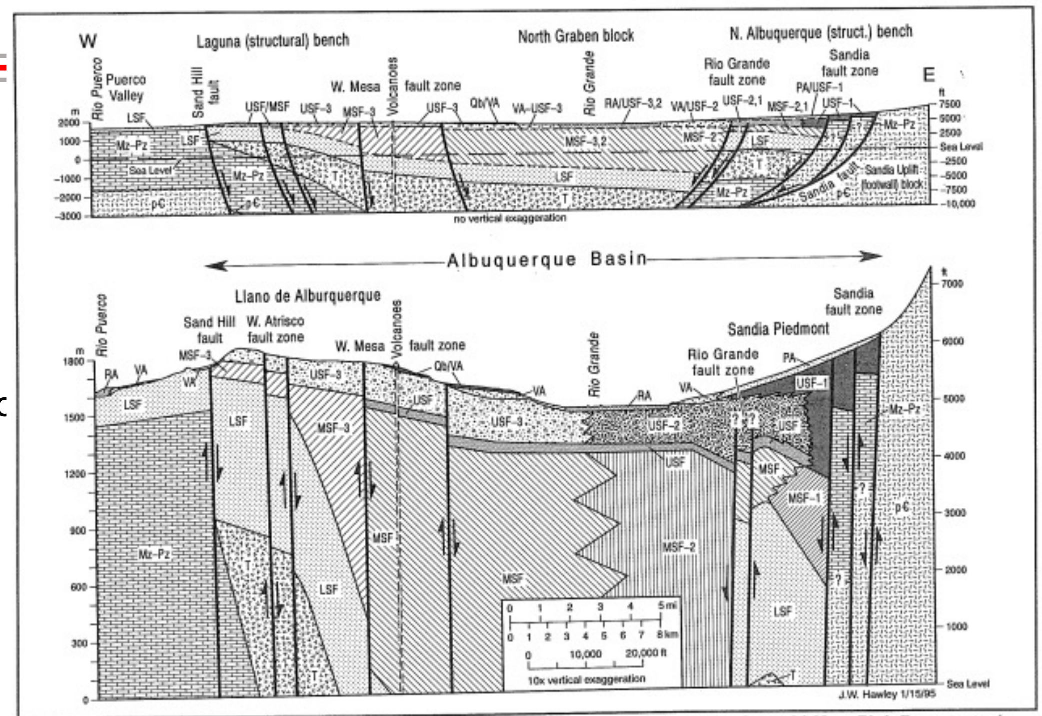
Organization – 3 Short Case Studies

- The Good – Aquifer recovery in middle Rio Grande due to:
  - Switching to surface water as main source of supply in Albuquerque
  - Water conservation
- The Promising – Improving sustainability of ground water resources through aquifer storage & recovery (ASR)
  - Successful projects
  - Remaining challenges
- The Ugly – TX v NM challenge in the US Supreme Court for under delivery of surface water according to the Rio Grande Compact
  - Claimed due to excessive ground water pumping in Lower Rio Grande

The Good:
Aquifer Recovery in the Middle Rio Grande

Until 2008 All Water Utilities in Rio Grande Watershed Relied on Ground Water for Supply

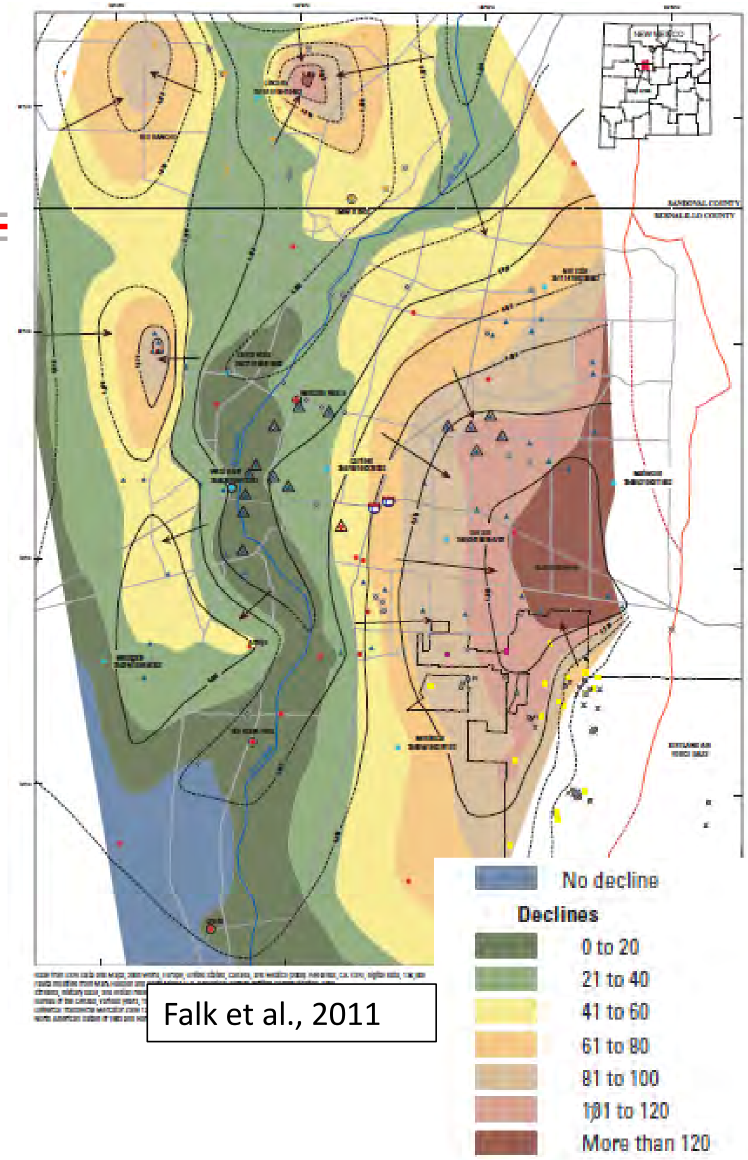
- Santa Fe Formation in Middle Rio Grande – Alluvium & colluvium to depths > 15,000 ft
  - Water quality & hydraulic properties decrease with depth
- City of Albuquerque supplied by ~90 large diameter wells
  - Large production wells located at depths from ~500' to 1,000' below top of aquifer
- Recognition by ~1990 that aquifer was being depleted
- City collaborated with USGS & NM Bureau of Mines & Mineral Resources to study aquifer
  - Geology
  - Water use
  - Ground water model



Hawley & Haase, 1992

Middle Rio Grande Piezometric Surface Decline

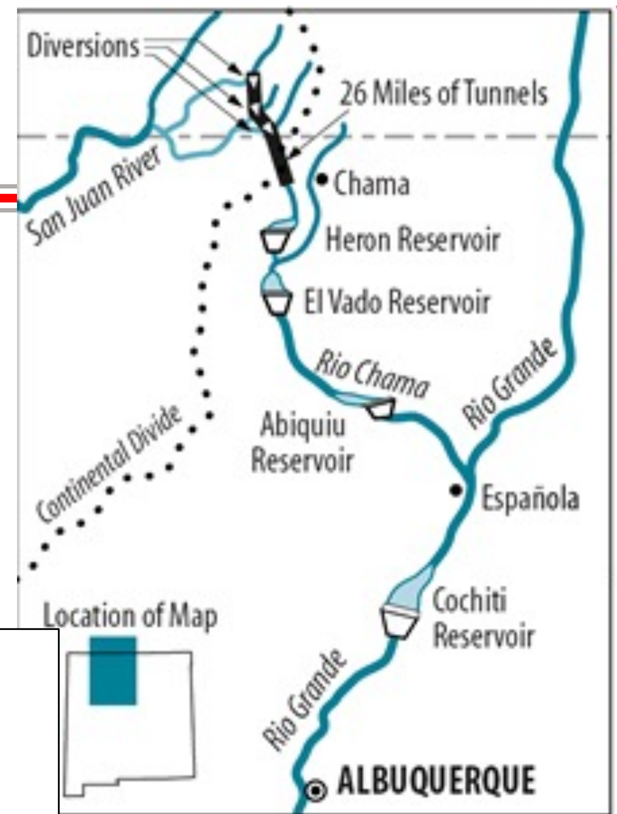
- USGS installed network of nested piezometers throughout basin
- Falk et al. (2011) mapped piezometric surface decline in production zone
- CABQ started planning to directly use surface water from San Juan Chama Project
- CABQ started aggressive voluntary conservation program
- CABQ subsequently became regional Albuquerque Bernalillo County Water Utility Authority (ABCWUA)

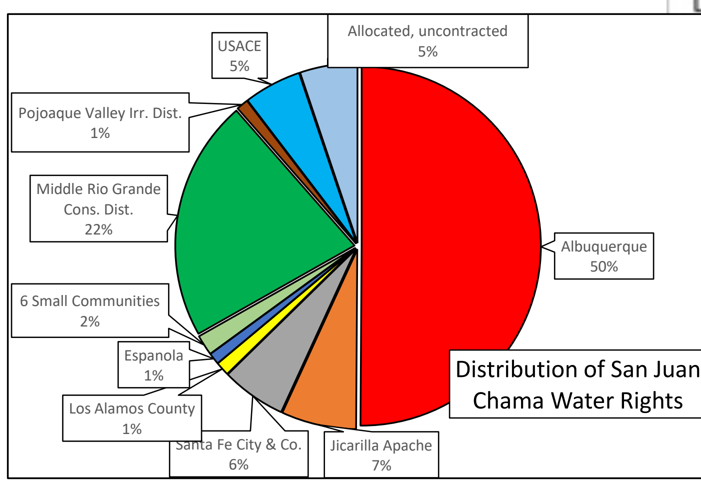


Falk et al., 2011

San Juan Chama Project

- First surveys in 1933
- Authorized in 1962
- Azotea tunnel completed in 1970
  (26 miles of tunnels)
- Rio Blanco, Little Navajo R. & Navajo R.
- Diversions began in 1971
  - 1/3 for agriculture & environment
  - 2/3 for public supply
- ABCWUA diversion dam, treatment plant & pipeline project completed in Dec. 2008
- Total cost ~$500 M



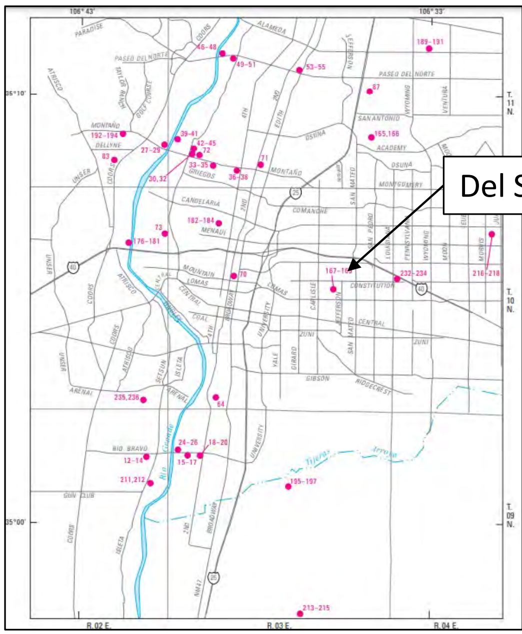


Azotea Tunnel Entrance

Diversion Dam & Pump Station

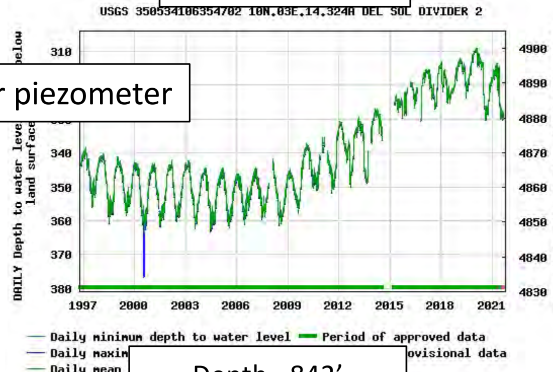
Treatment Plant

Aquifer Recovery
(https://waterdata.usgs.gov/nm/nwis/rt

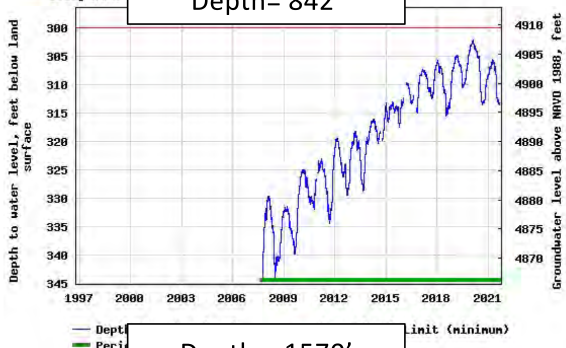


Del Sol Divider piezometer

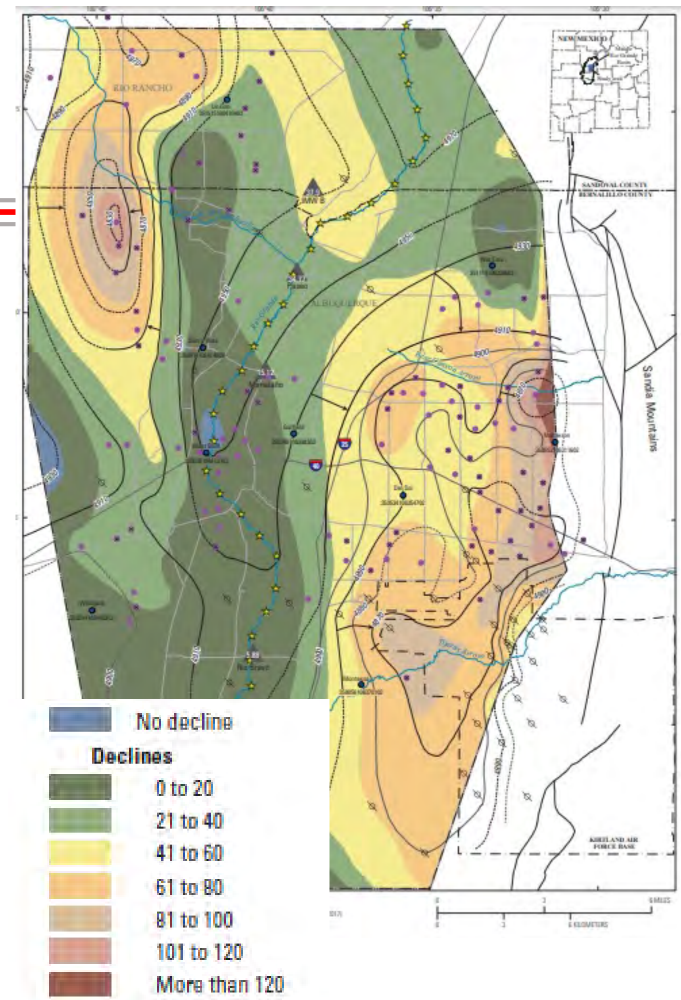
Depth = 425’



Depth= 842’



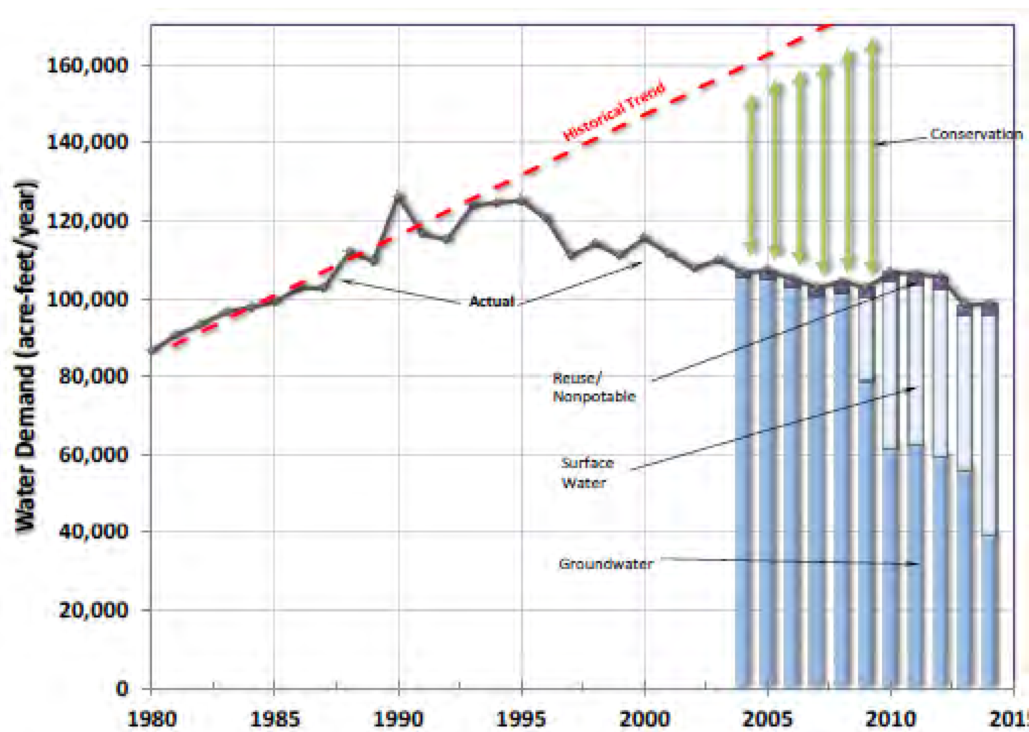
Depth = 1570’



Piezo Surface Drawdown in 2016
Galanter & Curry, 2019

Causes of Aquifer Recovery – Due Primarily to Rebound & Redistribution

- Surface water is ~75% of supply
- Per capita use is currently ~125 gpcd down from 250 gpcd
- Less total water use now than in 1995 – benefits of conservation
- Recharge not well quantified



ABCWUA Water 2120

The Promising:
Aquifer Storage & Recovery in NM

Regulatory Complications of Aquifer Storage & Recovery (ASR)
(Managed Aquifer Recovery (MAR))

- Benefits of ASR
  - Secure underground storage with no ET losses
  - Limit regional drawdown
  - Limit subsidence
  - Promote water conservation
- Complications
  - How to quantify water stored in aquifer
  - Who has rights to water once it reaches the aquifer?
  - Water quality issues
  - Methods of recharge
- Groundwater Storage and Recovery Act of 1999 (72-5A, NMSA) – Underground Storage & Recovery (USR)
  - Regulations in 19.25.8 NMAC
  - Office of the State Engineer – Underground Storage & Recovery Permit
  - NM Environment Department (Ground Water Quality Bureau) – Ground water discharge Permit

Regulations for USR – Burden of Proof
(Steve Finch, JSAI, 2019)

- Organization has the technical and financial capability to construct and operate the project
- Project is hydrologically feasible
- Project will not impair existing water rights or the state's interstate obligations
- Project will not be contrary to the conservation of water within the state
- Project will not be detrimental to the public welfare of the state
- A valid water right for the recharge water has been quantified

Also requires Ground Water Discharge Permit from NM Environment Department (NMED)

- Injected water has drinking water quality

Notable ASR Projects in NM (All near ABQ)

- Bear Canyon (ABCWUA)
- Rio Rancho Direct Injection Project (Rio Rancho)
- Mariposa Infiltration Project (Rio Rancho)
- ABCWUA Large Scale Direct Injection

Notable ASR Projects in NM – Bear Canyon Arroyo

- Permitted for up to 3,000 AF/yr, actual ~500 AF/yr
  - Limited in part by downstream golf cart crossing
- Source of water – Bank filtered & chlorinated Rio Grande water
- Infiltration through bottom of Bear Canyon Arroyo
- First ASR project in NM
  - Demonstration 2008-2009
  - Full scale operation in 2014
- Extensively instrumented to document performance

Notable ASR Projects – Rio Rancho Direct Injection ASR System

- Permitted to 1,120 AF/yr
- Source of water –Municipal wastewater
    - Treated to drinking water standards
- Direct injection in 1,700 ft well
- Concerns about PFAS, PFOAA

Notable ASR Projects – ABCWUA Large Scale ASR Project

- Permitted to 4,500 AF/yr
- Source of water –Treated drinking water
  - Treated to drinking water standards
- Direct injection in 1,240 ft well, 32” dia

Engineering Challenge of Ground Water Recharge

- Rule of Thumb: Hydraulic conductivity is determined by d_{10}, diameter of smallest 10% of soil (remember Fair-Hatch eqn?)

$$k = \frac{1}{B}\left[\frac{(1-\alpha)^2}{\alpha^3}\left[\frac{A}{100}\sum\frac{P_m}{d_m}\right]^2\right]^{-1}$$

- Clay in watershed will settle in pond bottom & impede infiltration. (Farm ponds in NM hold water for weeks following storm events)
- Recharge options:
  - Ponds – don't work unless bottom is cleaned frequently
  - Injection wells – require VERY clean water (no suspended solids)
  - Sand bottom channel – works well but storms are short

Bear Canyon ASR Project, ABCWUA

Farm Pond, 12/16/17, >70 d without rain

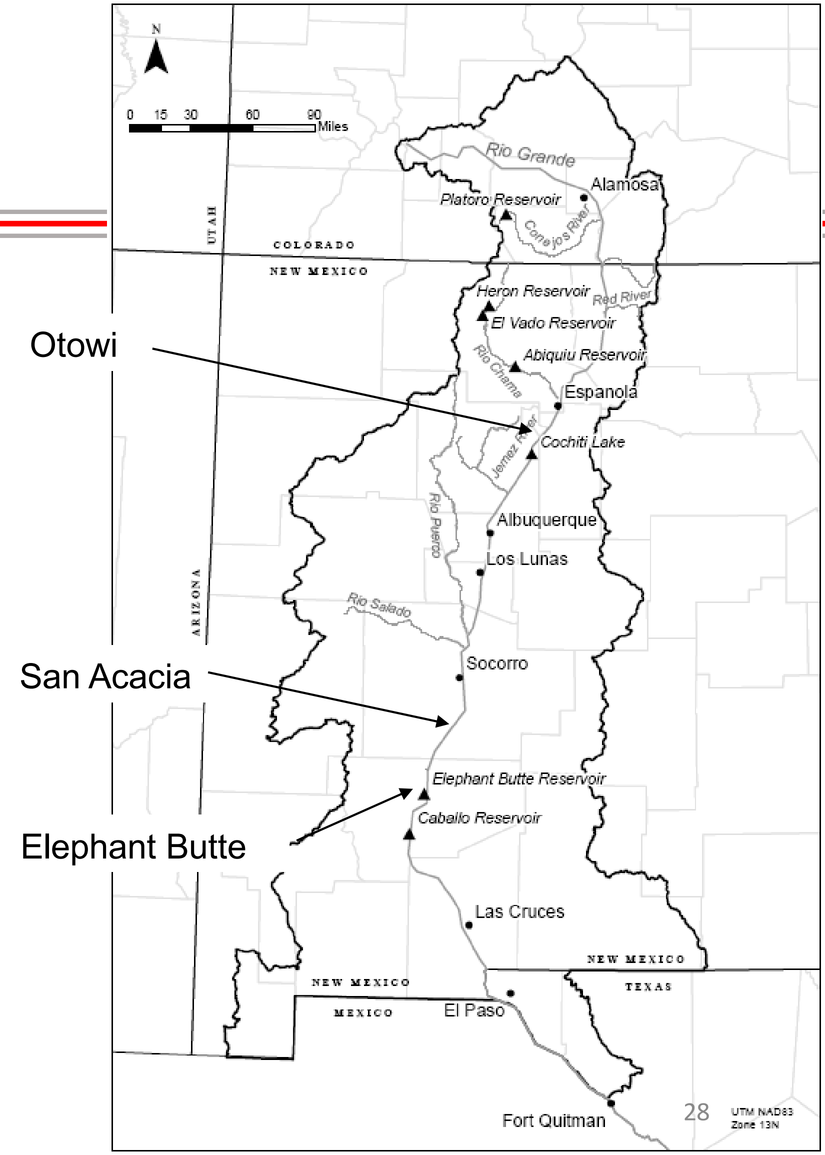
Challenges of ASR Projects in NM

- ~10 proposed projects throughout state – most not actively pursuing permitting at present
- Challenges
  - Injected water must meet drinking water standards
    - Recent issues raised by concerns about PFAS & PFOAAs
  - Uncertainties with water rights
  - Requirement to demonstrate project before approval
  - Costs of project

The Ugly:
Texas v. New Mexico (and Colorado)

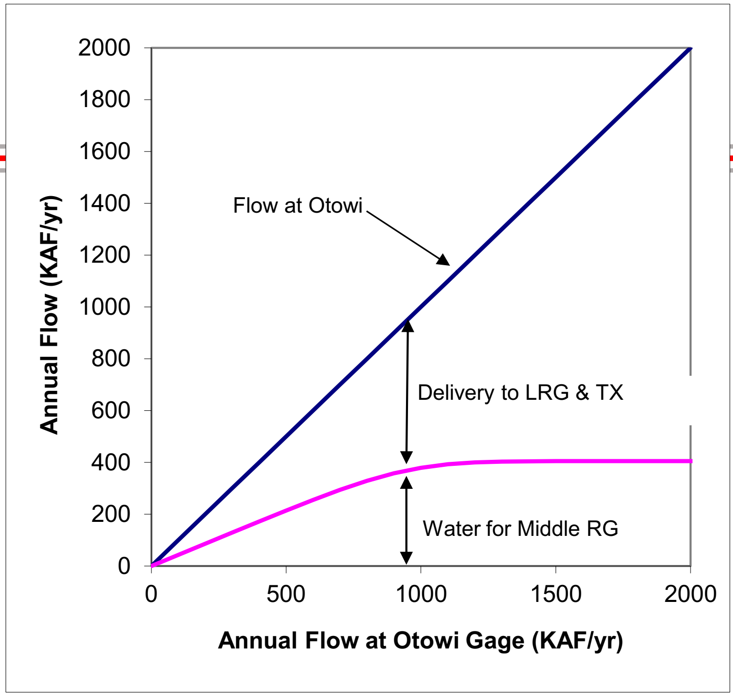
Rio Grande Basin

- 4^{th} longest river in US
  - Really 2 rivers – upper & lower
- River disappears below Ft. Quitman, TX
  - Watershed >30,000 mi^2
- Middle Rio Grande is between Cochiti Reservoir & San Acacia
- Rio Grande Compact:
  - Otowi gage is index gage
  - Deliveries are made at Elephant Butte dam
- Note: LRG (below El. Butte) is in Compact TX but political NM
  - 57% of water to LRG
  - 43% of water to TX



Summary of the Rio Grande Compact – 1938

- Rio Grande Project was initiated in 1906 by Bureau of Reclamation to include dams, canals, drains & other infrastructure to provide water for Lower Rio Grande (LRG) & TX
- Interstate compact between CO, NM and TX to provide "equitable apportionment" of waters of the Rio Grande Basin
  - Approved by Congress
  - Disagreements over Compact almost since it was signed
- Deliveries to Lower Rio Grande (LRG) & TX is determined by flows at Otowi gage in northern NM
  - Average annual flow at Otowi ~1 M AF/yr
- Distribution of water between LRG & TX is governed by Operating Agreement – signed by irrigation districts but not State of NM
  - Multiple parties in disputes – Compact Commission, NM OSE, Bureau of Reclamation, irrigation districts (Elephant Butte Irrigation District, El Paso County Water Improvement District 1)

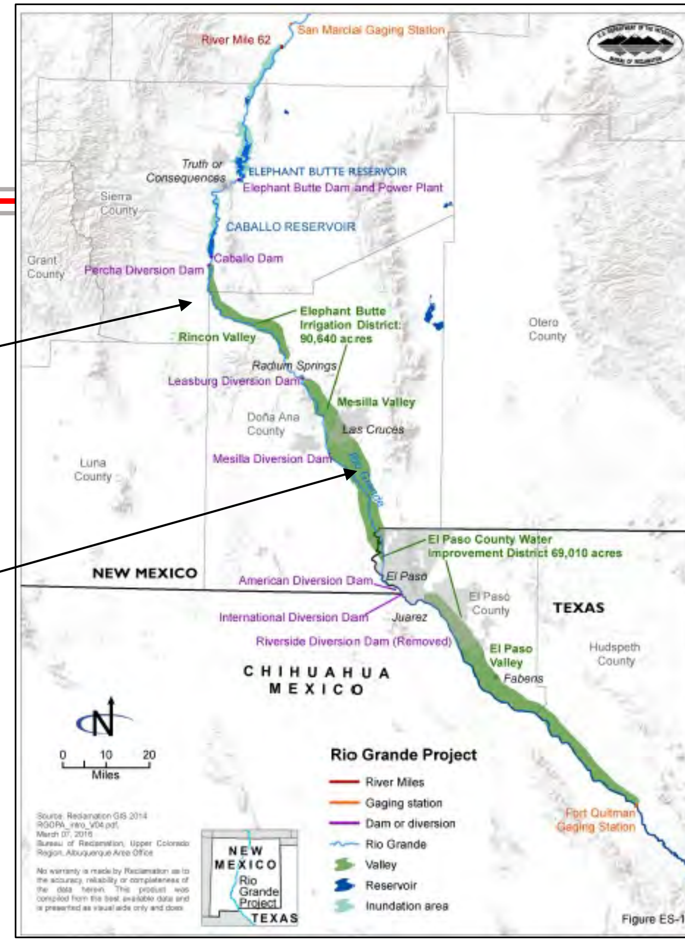


Lower Rio Grande

- Several sub-regions
  - Hatch Rincon Valley – 16,200 acres
  - Mesilla Valley – 73,050 acres
  - El Paso-Juarez – 56,000 acres + 12,200 acres in Mesilla Valley

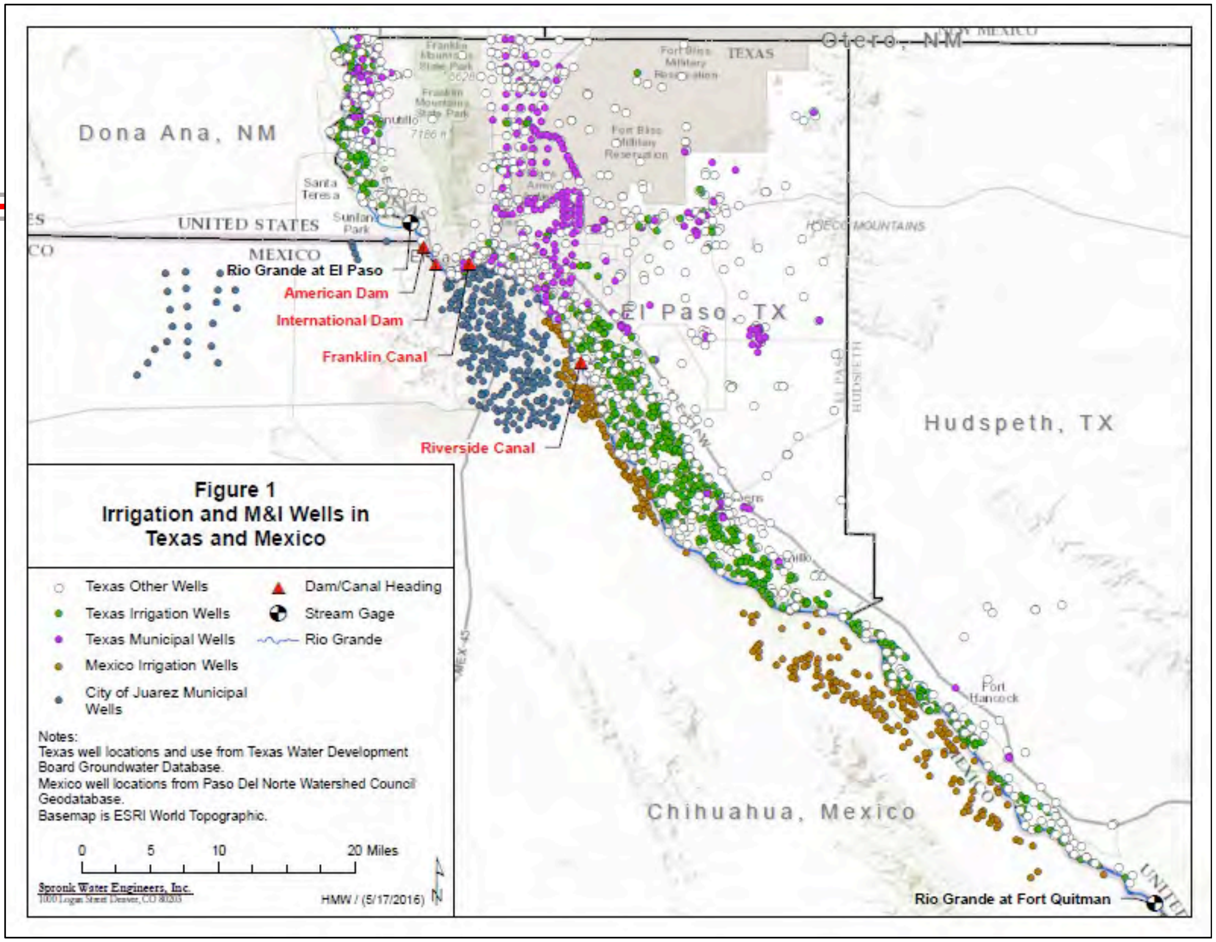
Percha Dam & Diversion

EBID Gate



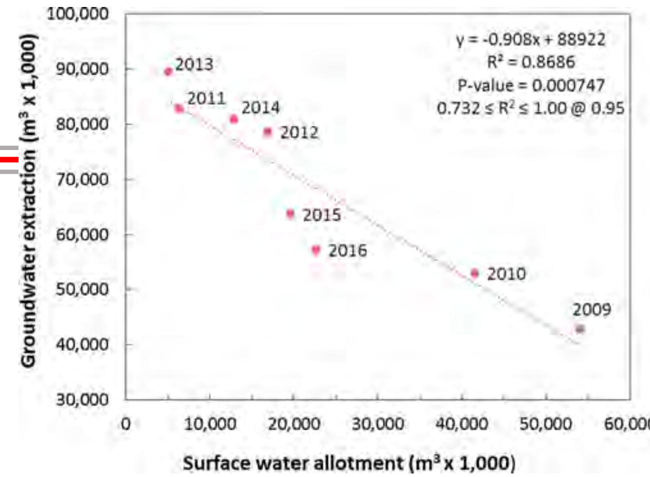
Wells in Lower Rio Grande & Adjacent Areas

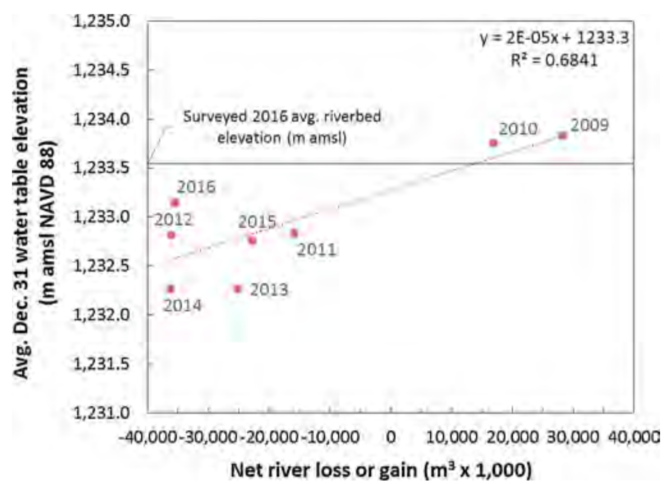
- NM Wells are metered. Most TX wells are not
- NM is concerned about TX impacts on aquifer

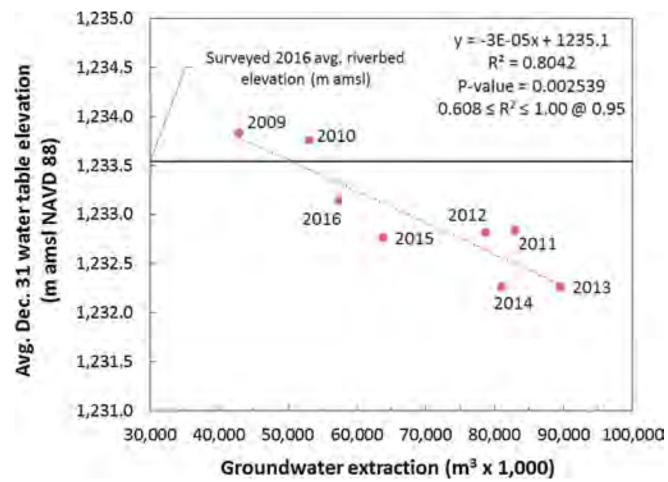


Ground Water Pumping in Lower Rio Grande
(Fuchs et al., 2018)

- Study of surface water-ground water interactions in Rincon Valley
- GW extractions increased during low flow years
- Results
  - Decreased GW in storage
  - Decreased river flow due to increased infiltration







Ground Water Pumping in Lower Rio Grande Basin: The Operating Agreement

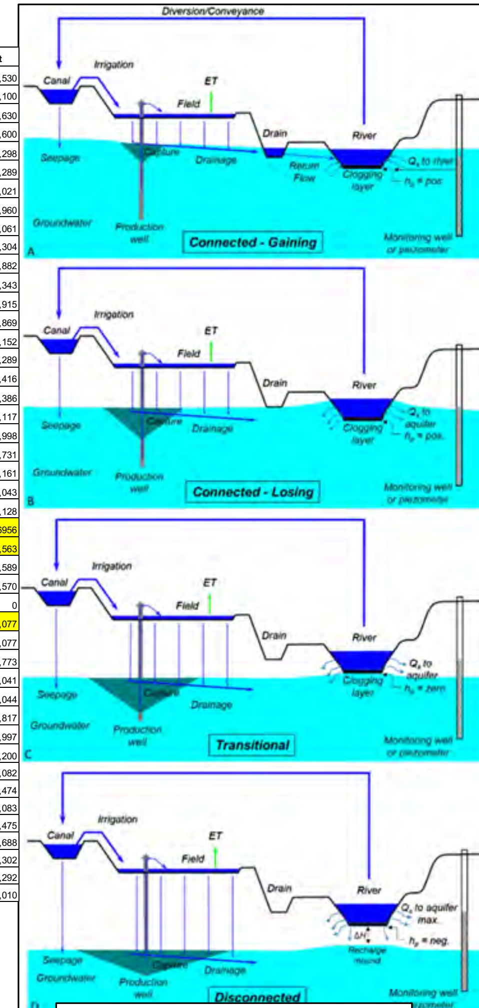
- Complicated water accounting procedures – Dueling spreadsheets, EBID vs EPWD1
- NM position is compact requires delivery of surface water at El. Butte

Row	Description	Source of Value	Equation
1	Rio Grande Project Diversion Allocations	NA	NA
2	Elephant Butte Reservoir Storage	USBR	NA
3	Caballo Reservoir Storage	USBR	NA
4	Total Rio Grande Project Storage	Calculated	[2]+[3]
5	Estimated Rio Grande Compact Credit Waters	USBR	NA
6	Estimated San Juan-Chama Water	USBR	NA
7	Water Released from Storage	USBR	NA
8	Total Usable Water Available for Release	Calculated	[4] + [5] + [6] + [7]
9	Carryover Obligation using Estimated Diversion Ratio	Calculated	([11] + [12]) / [26] (MAX([12],[11],(+[11]+[12])))/[26]
10	Total Usable Water Available for Current Year Allocation	Calculated	MIN(790000,[8] - [9])
11	EBID Allocation Balance (Previous Year)	EPCWID, EBID, USBR	NA
12	EPCWID Allocation Balance (Previous Year)	USBR	NA
13	EBID Estimated Allocation Balance (End-of-Year)	EBID	NA
14	EPCWID Estimated Allocation Balance (End-of-Year)	EPCWID	NA
15	Storage for EBID and EPCWID Estimated Allocation Balance (End-of-Year)	Calculated	([14]+[13]) / [26]
16	Estimated Release of Current Usable Water	USBR	[10] + [9] - [15]
17	Estimated End-of-Year Release for Diversion Ratio	USBR	NA
18	D1 Delivery	Calculated	MAX(0,([17]*0.8260932) - 102305)
19	Mexico's Current Diversion Allocation	Calculated	MIN(60000,[18]*0.113486)
20	Gross D2 Diversion Allocation	Calculated	MIN(763842,[10])*1.3377994-89970+MAX(0,[16]-763842)
21	EPCWID ACE Conservation Credit	USBR	NA
22	Net D2 Diversion Allocation for EBID and EPCWID	Calculated	[20] - [19]
23	D2 Diversion Allocation for EPCWID	Calculated	[22] * 67 / 155
24	EPCWID Diversion Allocation (w/o Conservation Credit)	Calculated	[23] + [12]
25	EPCWID Diversion (w/o Conservation Credit or 67/155ths of Row 30)	Calculated	[24] - [14]
26	Diversion Ratio	Calculated	0.00000042113634*[17]+0.6946382
27	Diversion Ratio Adjustment	Calculated	([26] - 1) * [16]
28	Sum of Release and Diversion Ratio Adjustment	Calculated	[16] + [27]
29	EBID D2 Diversion Allocation	Calculated	[22] * 88 / 155
30	Difference between EBID Diversion Ratio Allocation and D2 Diversion Allocation	Calculated	IF([16]<600000,MAX(0,[31]-[29]),0)
31	EBID Diversion Ratio Allocation	Calculated	[28] - [25] - [19] - [11] - [21] =IF([11]<0,0,[11])+[28]-[25]-[19]-[21]
32	EBID Diversion Allocation	Calculated	IF([16]<600000,MIN([29],[31]),[31])
33	Total EBID Diversion Allocation (includes 88/155th of Value in Row 30)	Calculated	[32]+[11]+88/155*[30]
34	Total EPCWID Allocation (includes Row 21 and 67/155th of Value in Row 30)	Calculated	[24]+[30]*67/155+[21]
35	Total EBID, EPCWID, and Mexico Allocation	Calculated	[34]+[33]+[19]

EPCWID Diversion Allocation Charges for May 2014

Diversion Location	Metered Volume	Adjustment for Conveyance Losses for NM Deliveries	Normal Diversion Allocation Charges for Month	Beginning-of-Month Totals	End-of-Month Totals
	ac-ft	ac-ft	ac-ft	ac-ft	ac-ft
L U E Canal - TX	415	95%	394	0	394
L U W Canal - TX	0	95%	0	0	0
Three Saints Lateral	0	100%	0	0	0
Total Mesilla Valley (Texas)			394	0	394
Umbenhauer/Robertson Water Treatment Plant	123	100%	123	0	123
Franklin Canal	75	100%	75	0	75
United States - Ysleta del Sur Agreement	0	100%	0	0	0
United States Section - IBWC (Construction Water)	0	100%	0	0	0
Jonathan W. Rogers Water Treatment Plant	0	100%	0	0	0
Riverside Canal	591	100%	591	0	591
Haskell R. Street WWTP Effluent	-107	100%	-107	0	-107
Credit for Diversions greater than Orders (El Paso Valley)	0	100%	0	0	0
Totals					1,077
Total Allotment Diversions Charges					**0**
Diversion Allocation					
Est. Annual Conservation Credit Diversion Allocation					
Accrued Conservation Credit Diversion Allocation					
Total Diversion Allocation					
District Allotment Balance					
EOY Estimated Allocation Balance					

1	**Rio Grande Project Diversion Allocations (EOM OCT 2009 Project Data)**	**ac-ft**
2	Elephant Butte Reservoir Storage	454,530
3	Caballo Reservoir Storage	26,100
4	Total Rio Grande Project Storage	480,630
5	Estimated Rio Grande Compact Credit Waters	-126,600
6	Estimated San Juan-Chama Water	-37,298
7	Water Released from Storage	693,289
8	Total Usable Water Available for Release	1,010,021
9	Carryover Obligation using Estimated Diversion Ratio	235,960
10	Total Usable Water Available for Current Year Allocation	774,061
11	EBID Allocation Balance (Previous Year)	-4,304
12	EPCWID Allocation Balance (Previous Year)	232,882
13	EBID Allocation Balance (End-of-Year)	40,343
14	EPCWID Allocation Balance (End-of-Year)	232,915
15	Storage for EBID and EPCWID Allocation Balance (End-of-Year)	276,869
16	Current Usable Water	733,152
17	End-of-Year Release for Diversion Ratio	693,289
18	D1 Delivery	470,416
19	Mexico's Current Diversion Allocation	53,386
	Gross D2 Diversion Allocation	942,117
	EPCWID ACE Conservation Credit	17,998
	Net D2 Diversion Allocation for EBID and EPCWID	888,731
	D2 Diversion Allocation for EPCWID	384,161
	EPCWID Diversion Allocation (w/o Conservation Credit)	617,043
	EPCWID Diversion (w/o Conservation Credit or 67/155ths of Row 30)	384,128
	Diversion Ratio	0.986956
	Diversion Ratio Adjustment	-9,563
	Sum of Release and Diversion Ratio Adjustment	723,589
	EBID D2 Diversion Allocation	504,570
	Difference between EBID Diversion Ratio Allocation and D2 Diversion Allocation	0
	EBID Diversion Ratio Allocation	268,077
	EBID Diversion Allocation	268,077
	Total EBID Diversion Allocation (includes 88/155th of Value in Row 30)	263,773
	Total EPCWID Allocation (includes Row 21 and 67/155th of Value in Row 30)	635,041
	District to District Allocation Transfer (OA 1.11 Excess Carryover Balance)	82,044
	Total EBID Diversion Allocation (After Transfer)	345,817
	Total EPCWID Allocation (After Transfer)	552,997
	Total EBID, EPCWID, and Mexico Allocation	952,200
	EPCWID 2009 Allocation Charges (calculated)	320,082
	EBID 2009 Allocation Charges (calculated)	305,474
	EPCWID 2009 Allocation Charges (actual)	320,083
	EBID 2009 Allocation Charges (actual)	305,475
	Mexico 2009 Allocation Charges (actual)	58,688
	Difference in Mexico's Charges and Allocation	-5,302
	EPCWID Share	-2,292
	EBID Share	-3,010



Fuchs et al, 2019

Texas v. New Mexico

- Filed in 2013 claiming under delivery of water
  - BOR also filed suit - Can US intervene in dispute between states?
  - Special Master recommended (2017) recommended that BOR doesn’t have enforcement powers under the Operating Agreement
  - Supremes unanimously disagreed (2018)
  - Appointed new Special Master in 2018 – Circuit Judge Michael Melloy
  - Hearing before Special Master in October 2021

- 643 filings listed on the official docket between 11/13/14 and 10/21/21 (https://www.ca8.uscourts.gov/texas-v-new-mexico-and-colorado-no-141-original)

Concluding Thoughts

- The Good: Remarkable progress in achieving recovery of aquifer in Middle Rio Grande Basin
  - Utilizing surface water for up to 75% of municipal supply
  - Extraordinary voluntary water conservation program that reduced per capita water use from 250 gpcd in 1995 to <130 gpcd in 2021
- The Promising: NM has been slow to implement Aquifer Storage and Recovery but recent projects may lead the way for future projects
  - Difficult regulatory challenges for ASR projects that require a large amount of up front engineering & hydrologic analyses.
  - Requires pilot demonstration
  - Stringent water quality standards for ground water injection
- The Ugly: Interstate Compact disputes are:
  - Very expensive (full & generous employment for selected water lawyers & their experts)
  - Very lengthy proceedings
  - Results are highly uncertain

Thank You

Bruce Thomson
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University of New Mexico
(bthomson@unm.edu)

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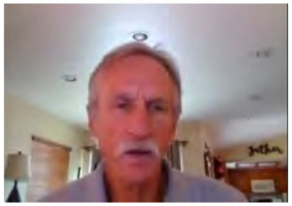
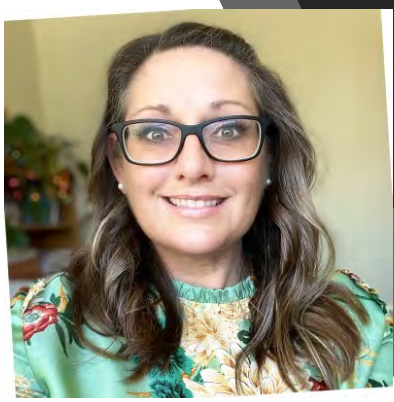
- U.S. Bureau of Reclamation (2013). Supplemental Environmental Assessment Implementation of Rio Grande Project Operating Procedures, New Mexico and Texas, Appendices, Rio Grande Project Operating Agreement (2008) and Operations Manual (2012). https://www.usbr.gov/uc/albuq/envdocs/ea/riogrande/op-Proced/Supplemental/Appdx.pdf

Jon Benedict

Hydrogeologist, Nevada Division of Water Resources, Department of Conservation and Natural Resources

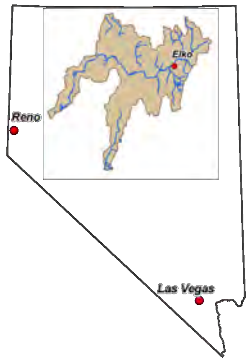
- With NDWR since 2014. Responsibilities include conducting hydrologic assessments for water right conflict analysis and using groundwater models to evaluate projects for their potential impact on water resources. Managed NDWR's Aquifer Storage and Recovery program and oversaw mine monitoring plans for the Division. Also in-house technical lead for evaluating water right applications for pit lake evaporative loss and for NDWR's Humboldt River Basin capture study and conjunctive management effort.
- Previously an exploration geologist in Nevada. In 2000, transitioned into the field of hydrogeology focused on seeking technically driven solutions to groundwater contaminant and water resource problems.
- Graduate of Dartmouth College and the University of Wyoming.





Micheline Fairbank
Deputy Administrator, Nevada Division of Water Resources

- Works with the Nevada State Engineer in administering Title 48 of the Nevada Revised Statutes in the management of water rights and the State's water resources.
- More than seventeen years of practice experience handling a broad spectrum of civil matters, including extensive trial and appellate practice experience and a practice focused on water and natural resource law. Experience handling legislative matters and before the Nevada State District Courts, Federal District Courts in Nevada and California, the Ninth Circuit Court of Appeals, the National Labor Relations Board, the Equal Opportunity and Employment Commission, and state administrative agencies.
- Licensed in Nevada, California and Colorado.
- J.D., Williamette University College of Law. B.A., Political Science, Biology, Environmental Studies, Western Colorado University



NEVADA DIVISION OF WATER RESOURCES | Nevada Department of CONSERVATION & NATURAL RESOURCES

Conjunctive Management, Water Rights and the Groundwater-Surface Water Interface: *A Nevada Perspective*

Humboldt River Wet and Dry

Western Regional Partnership Webinar
October 26, 2021

Presented by:
Jon Benedict, Senior Hydrogeologist
and
Michelle Fairbank, Esq, Deputy Administrator
NDWR

Photos from USGS,
SIR 2005-5199

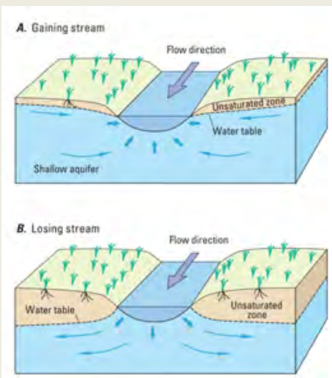
water.nv.gov | @NevDCNR

GW-SW INTERFACE: DEEP DIVE?

- WRP Objective
- Water Security Deep Dive

Overview

- Nevada Context
- GW-SW “Capture” Concepts
- Humboldt Case Study
- Legal Framework



NEVADA HYDROGEOLOGY

Basin and Range Topo/Geology

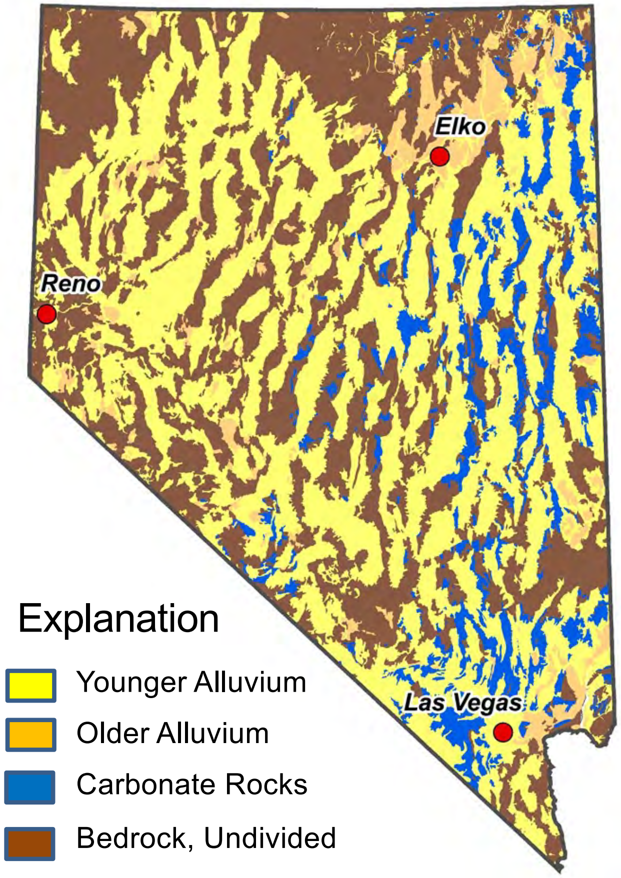
Multiple basin-fill aquifers separated by elongate bedrock mountain ranges with up to 6,000 feet of relief

Basin-fill as deep as mountains high

Carbonate rock aquifers in east

Most groundwater development takes place in the basin-fill aquifers, which receive their recharge mostly through winter snowpack in the adjacent mountains

GW discharge principally via evapotranspiration (ET)



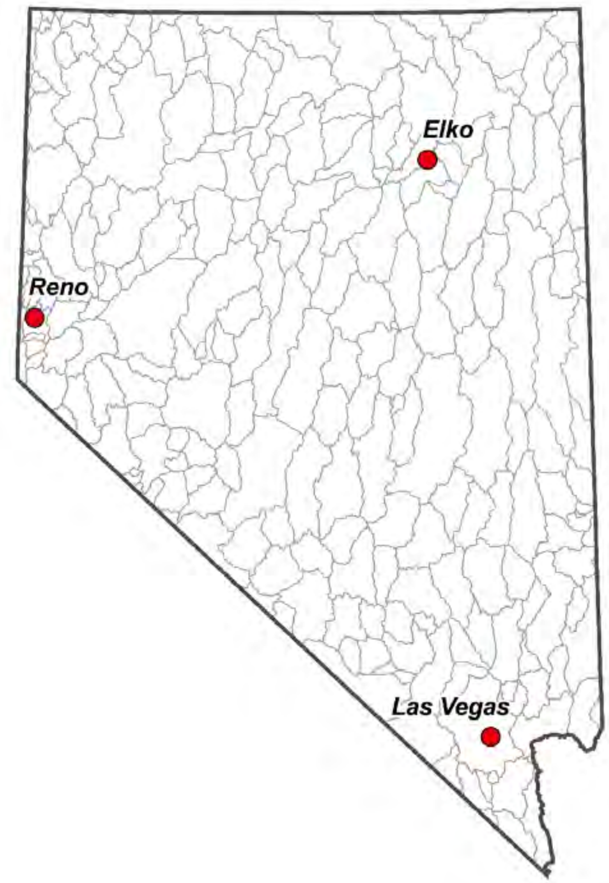
NEVADA GROUNDWATER BASINS

GW availability is based on Perennial Yield concept.

"Perennial yield is the maximum amount of groundwater that can be salvaged each year over the long term without depleting the groundwater reservoir."

Ultimately limited to the maximum amount of natural discharge that can be put to beneficial use.

Groundwater Resource ~ 2 million acre-feet



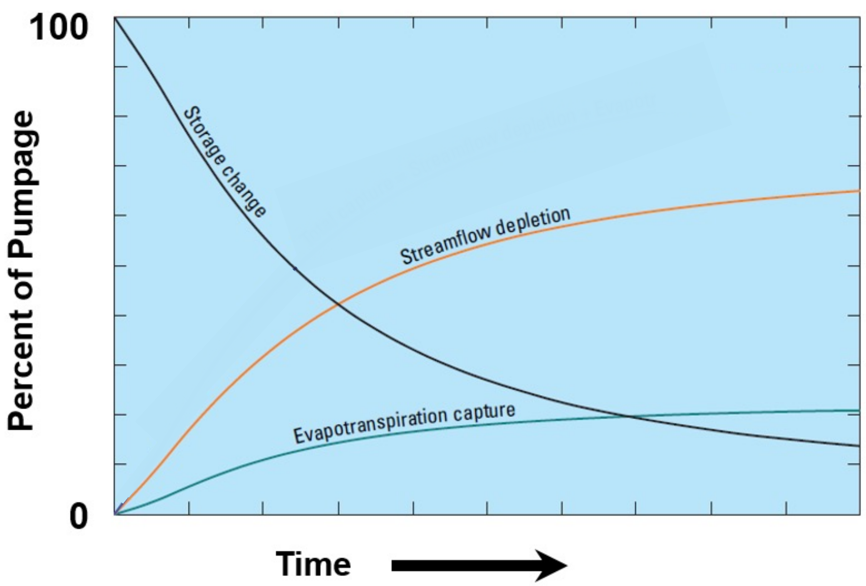
NEVADA'S REALITY

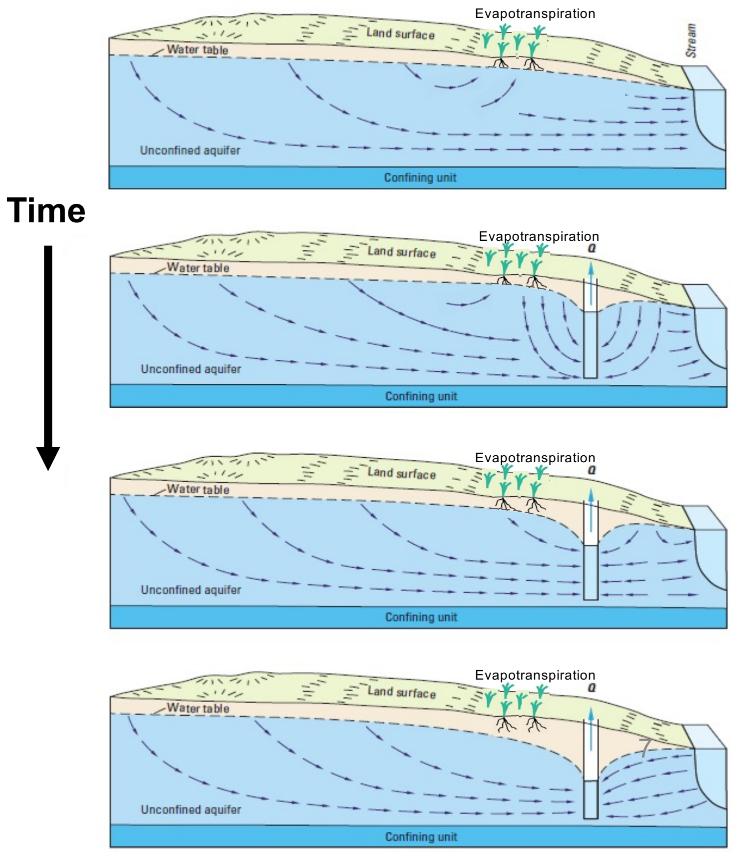
- ✓ Driest state in U.S.
- ✓ Prior Appropriation Doctrine
- ✓ GW management by P.Y.
- ✓ SW fully appropriated; GW right junior to SW rights

In reality, water sustainability issues from a water rights perspective tend to be localized on the SW side of GW-SW interface.

GW-SW Interaction Concepts

Capture caused by a pumping well

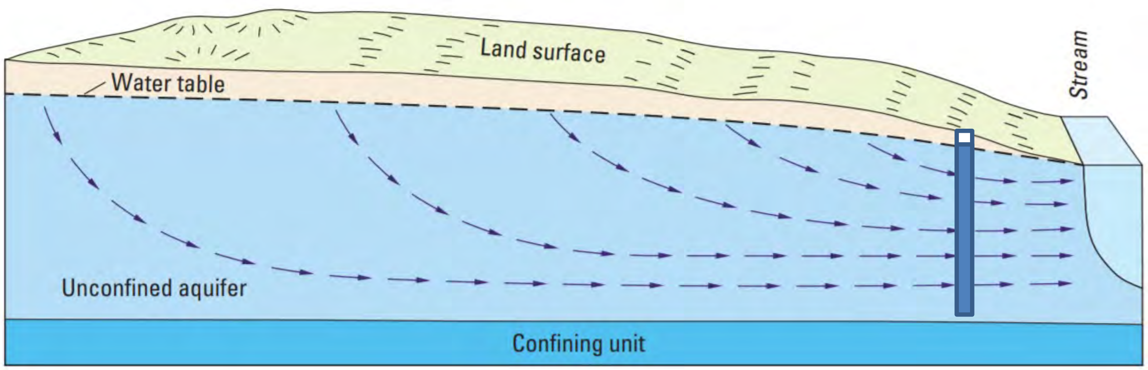


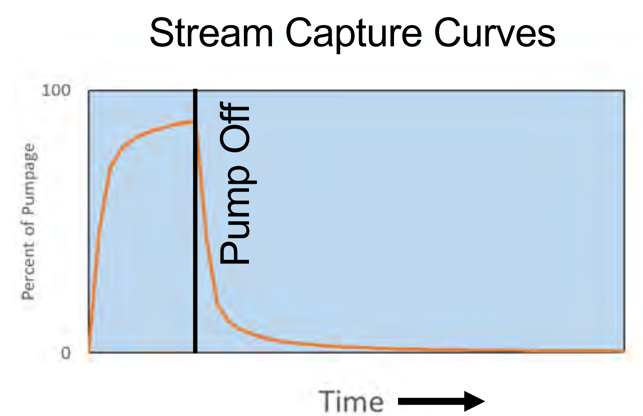


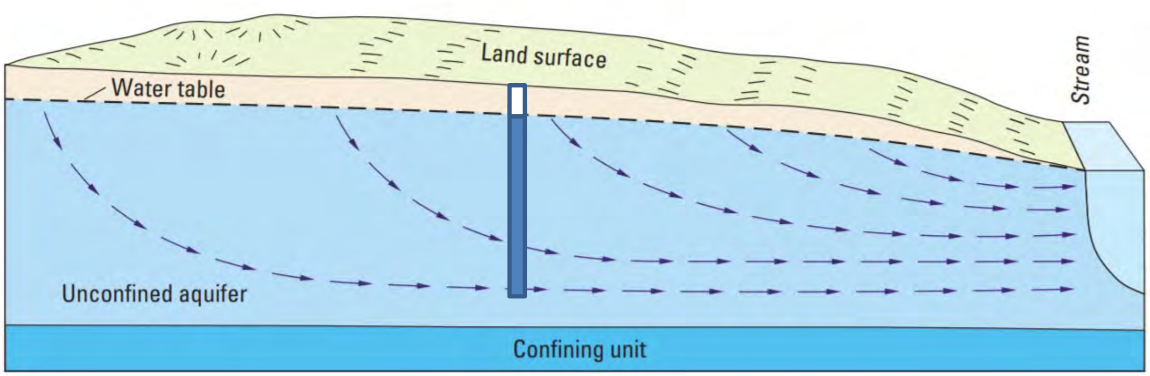
Stream Capture = Streamflow Depletion

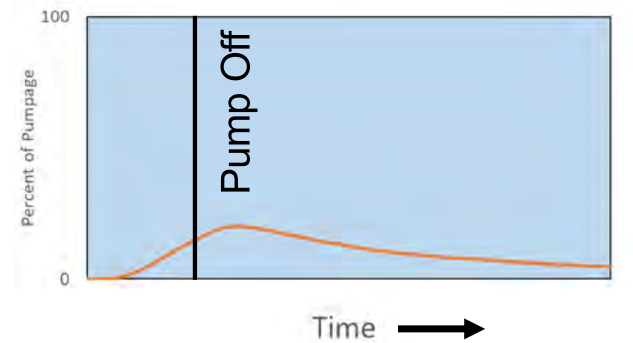
Barlow and Leake, USGS CIR 1376, 2012

GW-SW Interaction Concepts









Barlow and Leake, USGS CIR 1376, 2012

HUMBOLDT RIVER BASIN

15% of State by area
~17,000 square miles
Size of New Hampshire and Massachusetts combined

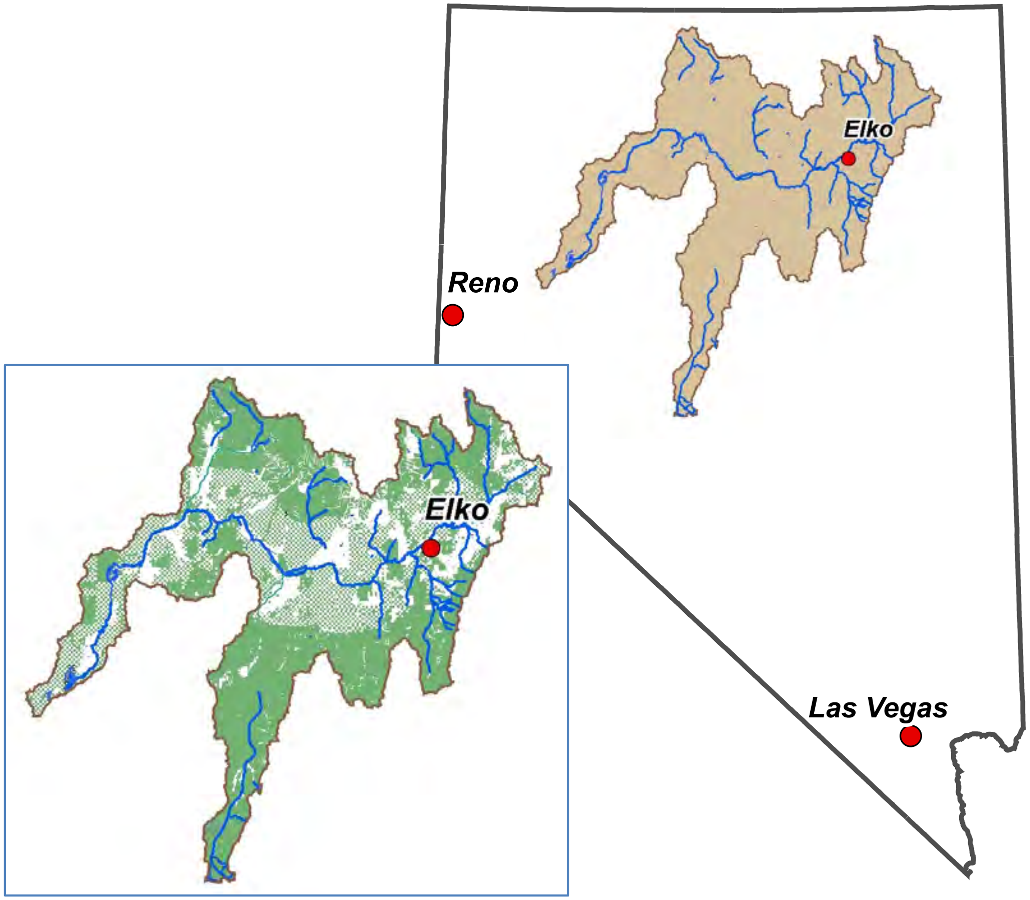
25% => State's surface water irrigation
Humboldt River: Fully decreed at 661,000 acre-feet, No headwater reservoir capacity

30% => State's groundwater irrigation
280,000 acre-feet pumped

3% => State's population
~ 85,000 people

Agriculture and Mining-based Economy

Majority of land is Federally Owned

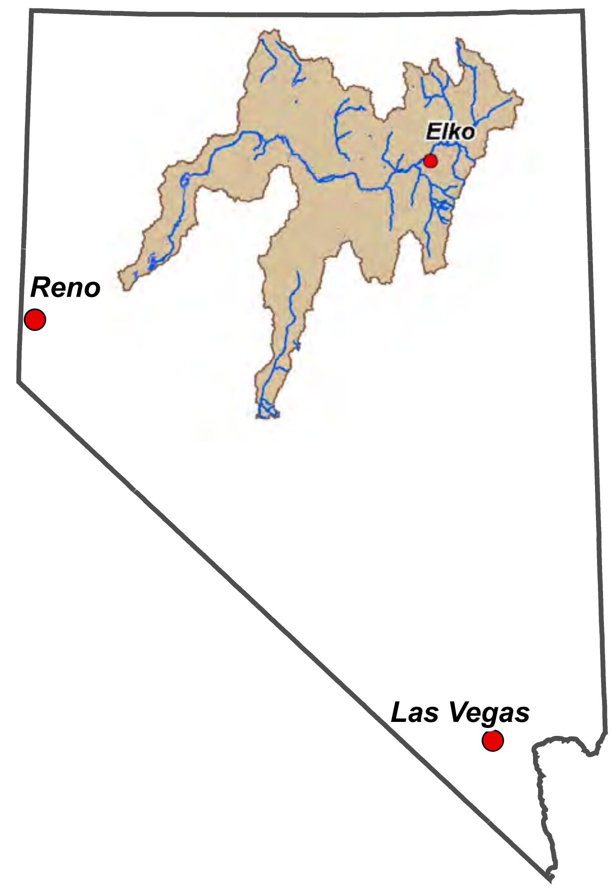


HUMBOLDT RIVER BASIN

- 2012-2015 drought, senior SW users did not get their scheduled deliveries while junior GW pumpers continued to pump seemingly contrary to prior appropriation doctrine
- Humboldt River and tributaries are part of a hydrologically-connected system
- State Engineer recognized potential for conflict

BUT,

- Deemed curtailment to be futile
- Recognized need for tools to understand SW/GW system and quantify pumping impacts



Actions

2015 Humboldt River Region curtailment deemed futile
- -Capture Modeling
- -Meter Order

2016 Evaluation of all new GW right applications for conflict to SW

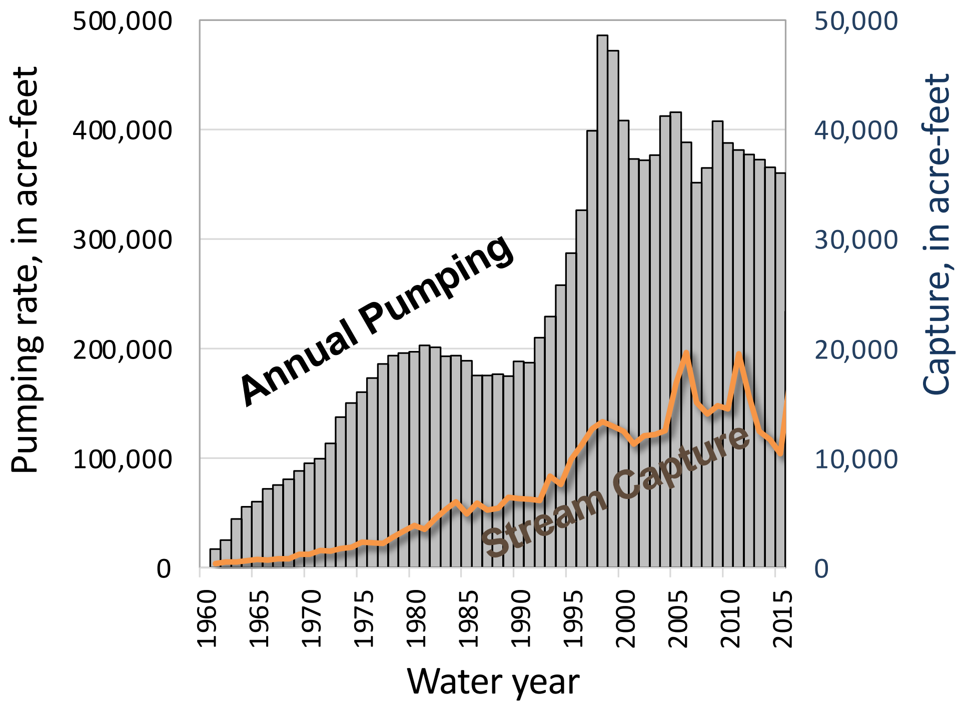
2017 Conjunctive Management policy

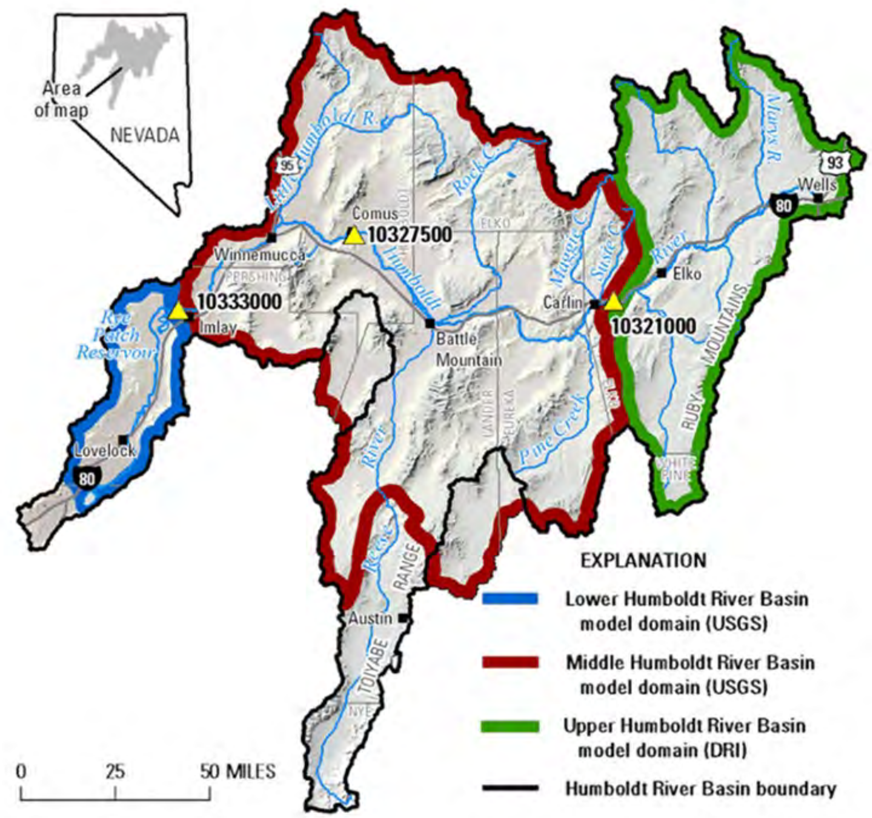
2019 Humboldt River Mitigation Regulations Failed
(“Money for Water”)

2021 Interim Order to prevent additional conflict

2022 Modeling Results

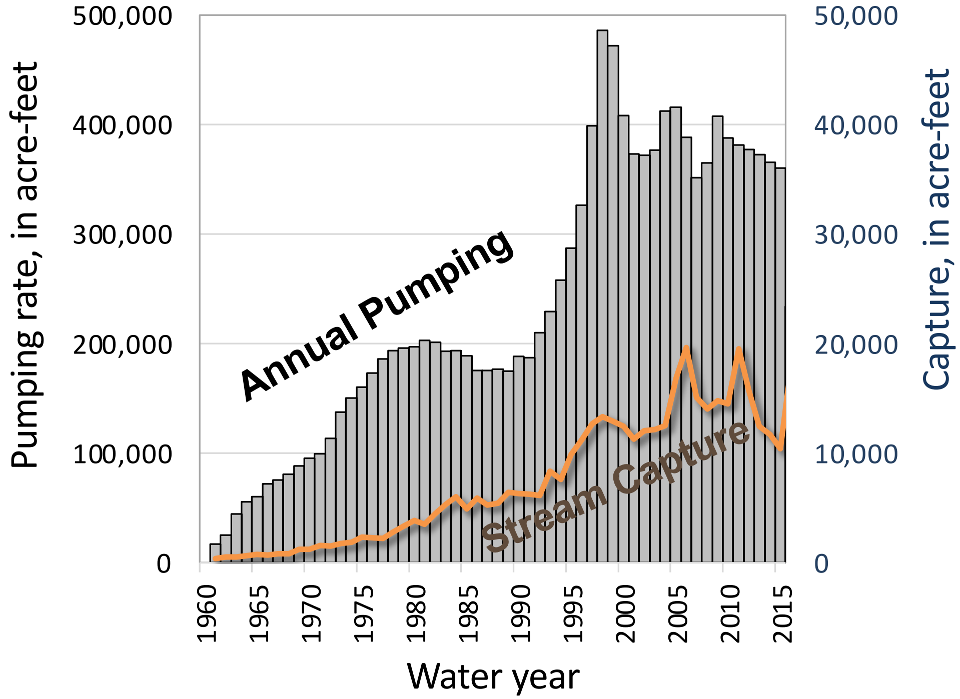
MODELING

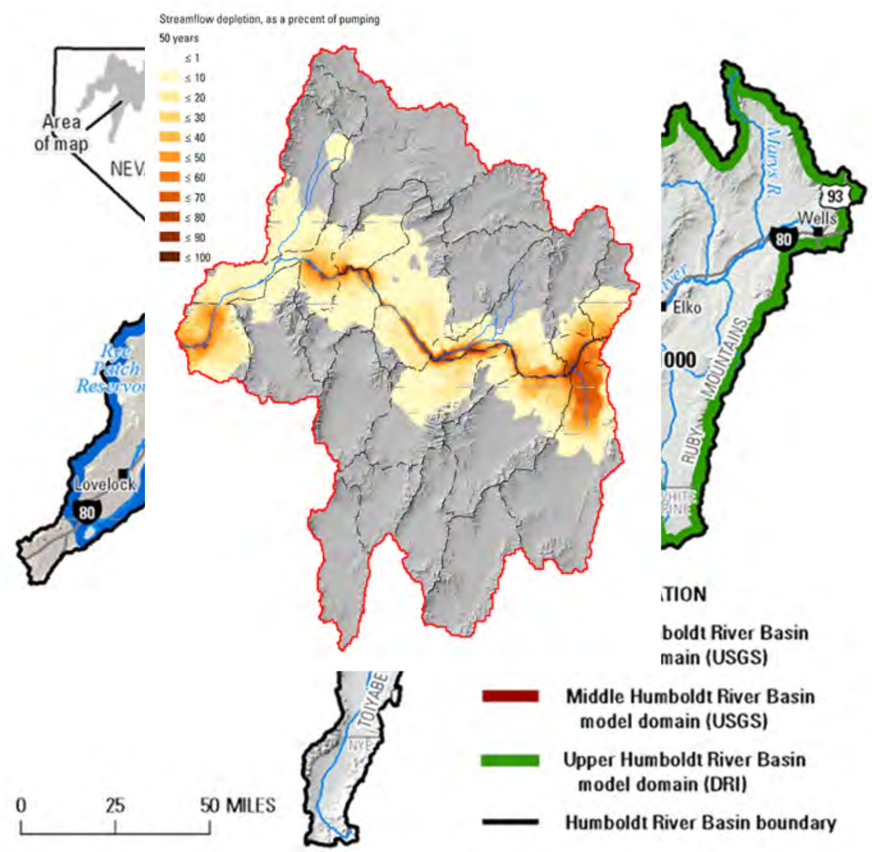




USGS, 2021, Provisional Information

MODELING





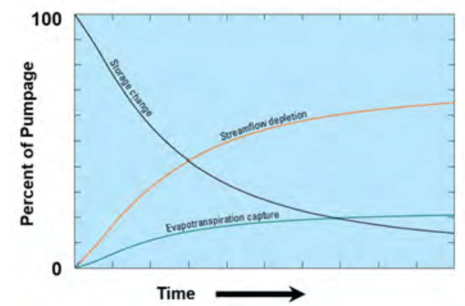
USGS, 2021, Provisional Information

Perennial Yield / Water Rights / Conjunctive Management

The Conundrum

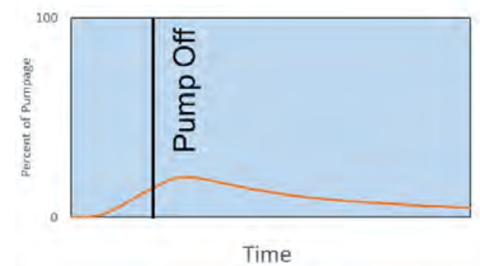
Perennial Yield Approach

–ET and stream capture intertwined



Prior Appropriation

-Curtailment of almost all GW rights and would not eliminate stream capture for decades



Conjunctive Management

-can't occur without GW use, but under prior appropriation doctrine, GW use can't occur without conflict.

STRATEGIES AND SOLUTIONS WITH A LIMITED TOOLBOX

- ✓ Prevent additional capture impacts
- ✓ Reassess Perennial Yield amounts
- ✓ Stakeholder/User Involvement
- ✓ Supply Enhancement: Floodwater ASR, GW to supplement SW
- ✓ Demand Reduction: Efficiency, Conservation, Buy and Dry,
- ✓ Fee Assessments?: $ to implement Supply/Demand strategies
- ✓ Targeted Curtailment

Historic Resource Management

Operated with a Legal Fiction in Resource Management

Nevada Revised Statutes (NRS) Chapter 533 – Surface Water (generally)

NRS Chapter 534 - Groundwater

2017 – Everything Changed, Or Did It?

The Nevada Legislature declared the policy of the State in NRS 533.024(e):

To manage conjunctively the appropriation, use and administration of all waters of this state, regardless of the source of the water.

New Legislative Policy Declaration – What does it mean?

- No additional guidance beside the policy declaration.
- Left to manage within existing statutory structure:
  - ❖ Doctrine of Prior Appropriation – First in time, first in right
  - ❖ Beneficial use is the basis, the measure and the limit of the right to the use of water
  - ❖ Use it or lose it

Legal Toolbox

Statutory options are limited & draconian.

- Utilize "best available science"
- Informed decision making
- Targeted curtailment
- Critical Management Area Designation NRS 533.110(7).
- Community based collaborative solutions

Questions?

Contact

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Jim Reese

Assistant State Engineer, Technical Services Section, Department of Natural Resources, Utah Division of Water Rights

- Manages the Division's Technical Services section, which has responsibility over commissioning hydrologic studies and providing support in hydrology and groundwater modeling, developing groundwater management plans, the Division's website and database, reviewing ASR projects, GIS, and water use reporting.
- Previously an engineer for the Utah Division of Water Rights, also in the Technical Services section, and worked in the private sector as an engineer for water rights projects in southeastern New Mexico.
- B.S. and M.S., Civil and Environmental Engineering, Brigham Young University

Water Right Permits for Aquifer Recharge and Recovery in Utah

Utah Division of Water Rights

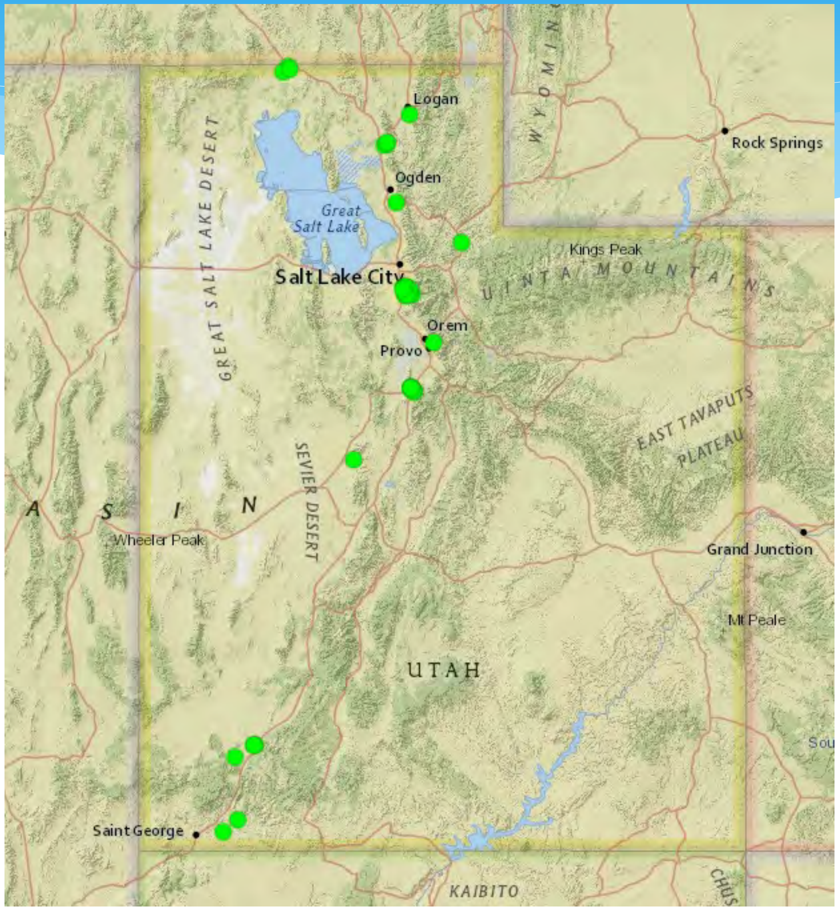
10/26/2021

Overview

- Current Projects
- Recharge Permit Requirements
- Recovery Permit Requirements
- Storage Accounting

Current Projects

- Jordan Valley WCD
- Brigham City
- Washington County WCD
- Leamington Town
- Weber Basin WCD
- Santaquin City
- Summit Creek Irrigation and Canal Company
- Central Iron County WCD
- Cedar City
- RFL Deep Creek, LLC
- Sandy City
- Provo City



Legislation

73-3b Groundwater Recharge and Recovery Act

- Recharge Permit
- Recovery Permit

Recharge Application

- Applicant information
- Detailed description of the project
- Evidence of water quality permits
- Plan of operation
- Valid water right
- Fee

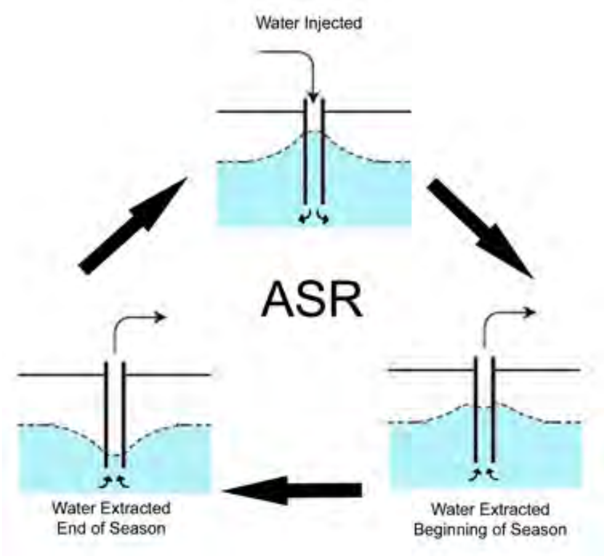
FEE SCHEDULE				
Flow-CFS		Acre-Feet		FEE
More Than	Not to Exceed	More Than	Not to Exceed	
0	0.1	0	20	$ 150
0.1	0.5	20	100	$ 200
0.5	1.0	100	500	$ 250
1.0	2.0	500	1,000	$ 300
2.0	3.0	1,000	1,500	$ 350
3.0	4.0	1,500	2,000	$ 400
4.0	5.0	2,000	2,500	$ 430
5.0	6.0	2,500	3,000	$ 460
6.0	7.0	3,000	3,500	$ 490
7.0	8.0	3,500	4,000	$ 520
8.0	9.0	4,000	4,500	$ 550
9.0	10.0	4,500	5,000	$ 580
10.0	11.0	5,000	5,500	$ 610
11.0	12.0	5,500	6,000	$ 640
12.0	13.0	6,000	6,500	$ 670
13.0	14.0	6,500	7,000	$ 700
14.0	15.0	7,000	7,500	$ 730
15.0	16.0	7,500	8,000	$ 760
16.0	17.0	8,000	8,500	$ 790
17.0	18.0	8,500	9,000	$ 820
18.0	19.0	9,000	9,500	$ 850
19.0	20.0	9,500	10,000	$ 880
20.0	21.0	10,000	10,500	$ 910
21.0	22.0	10,500	11,000	$ 940
22.0	23.0	11,000	11,500	$ 970
23.0	and above	11,500	and above	$1000

Water Quality Permits

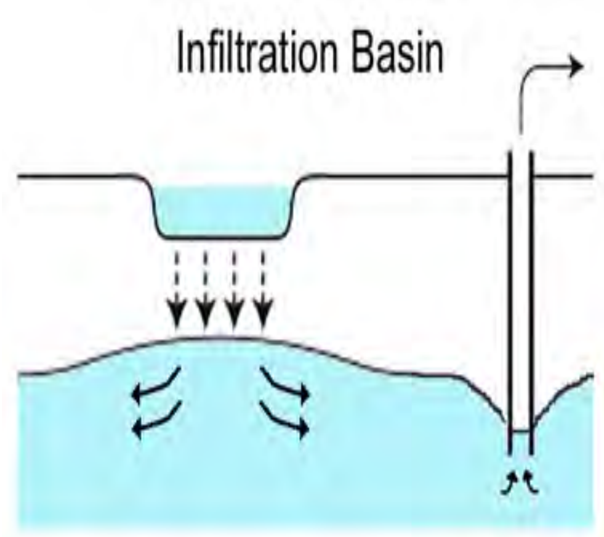
* Underground Injection Control (UIC) program
* Safe Drinking Water Act (SDWA)

Types of Projects

Injection Wells

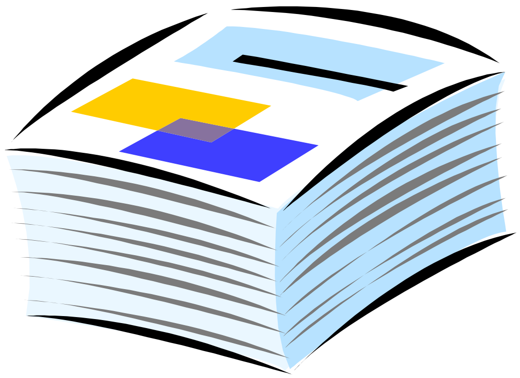


Infiltration Ponds



Plan of Operation

* Detailed description of the project
* Design capacity
* Monitoring program
* Duration of the project
* Groundwater study
    * Area of hydrologic impact
    * Hydrologic feasibility
    * Harm to land or existing water rights
    * Recoverable water
    * Financial and technical capability



Valid water Right

73-3b-106. Water right for recharged water -- Change of use of recovered water.

(1) A person proposing to artificially recharge water into an aquifer must have:

(a) a valid water right for the water proposed to be recharged; or

(b) an agreement to use the water proposed to be recharged with a person who has a valid water right for the water proposed to be recharged.

(2) A person who holds a recovery permit may use or exchange recovered water only in the manner in which the water was permitted to be used or exchanged before the water was artificially recharged, unless a change or exchange application is filed and approved pursuant to Section 73-3-3 or 73-3-20, as applicable.

Recovery Application

- Applicant Information
- Consent from Owner of Recharge Permit
- Recovery Well Description
  - Location
  - Depth and Diameter
  - Design Pumping Capacity
- Fee ($2,500.00)
- Storage Account Parameters

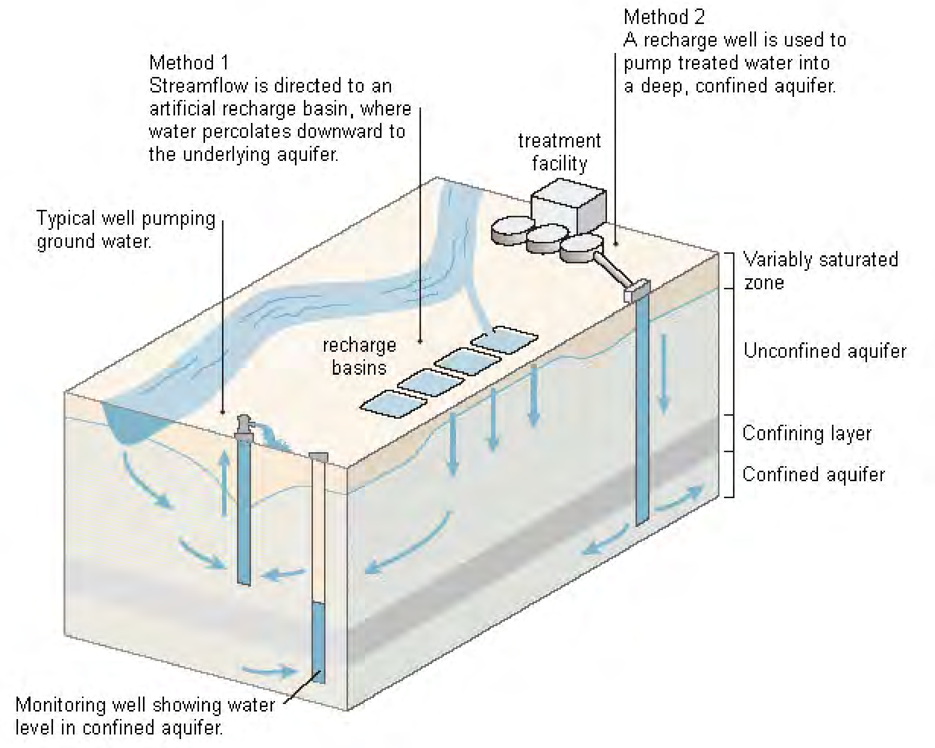
Permit Conditions

- Proof Time Frame– 5 years
- Monitoring Program
- Reports on Water Stored and Recovered
- Reports on Water Quality
- Storage Accounts
- Annual Fee
- Modification of recharge or recovery permits

Storage Accounts

Parameters:

- Initial Wait Period
- Loss Factor
- Month Of Loss



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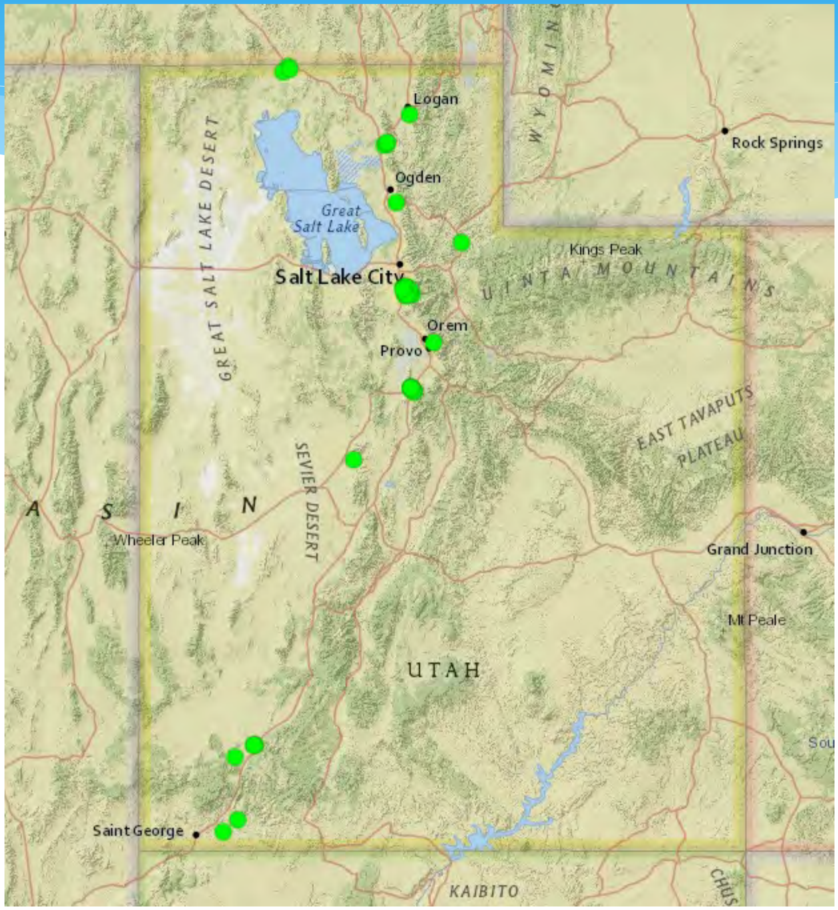
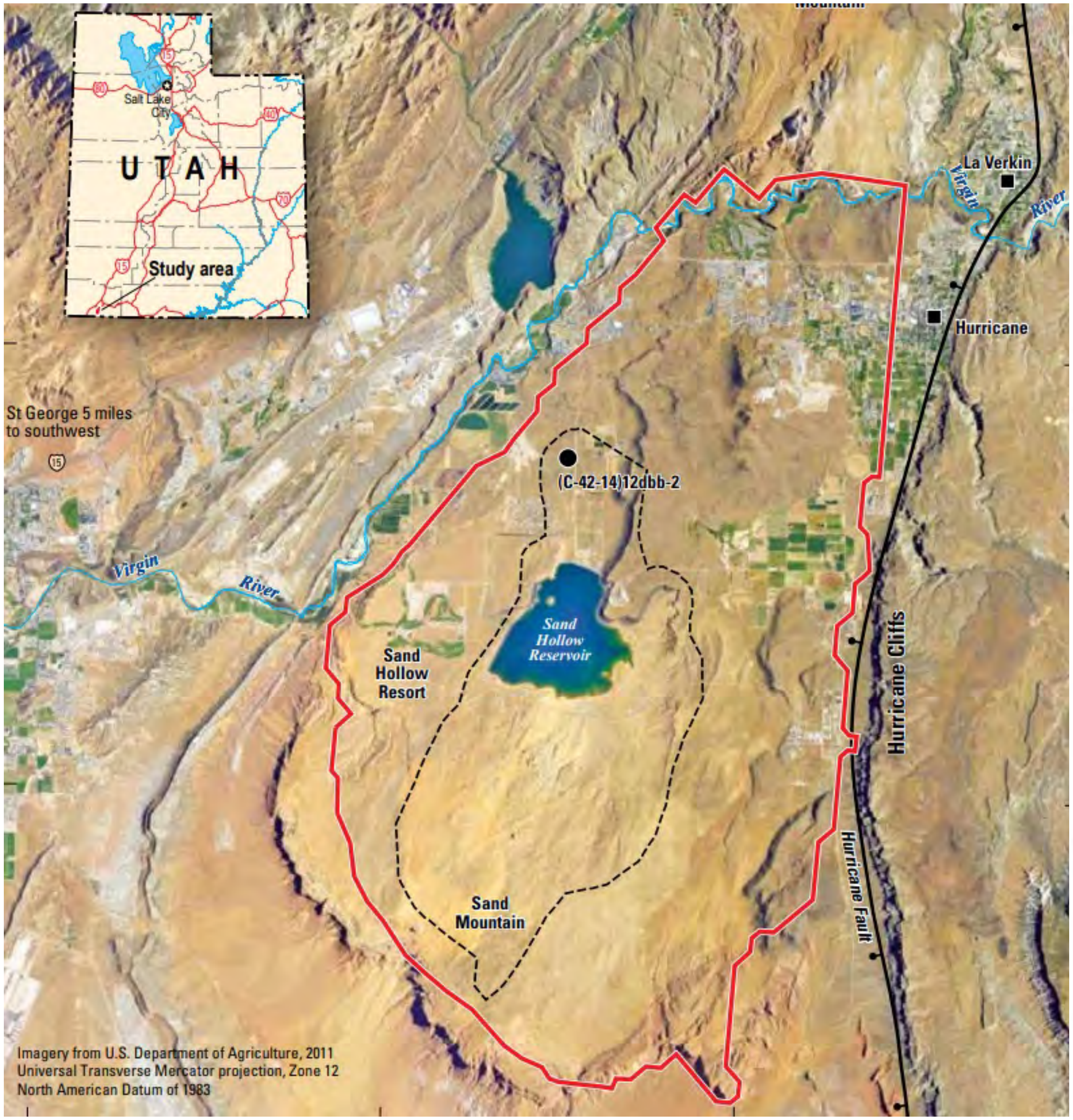
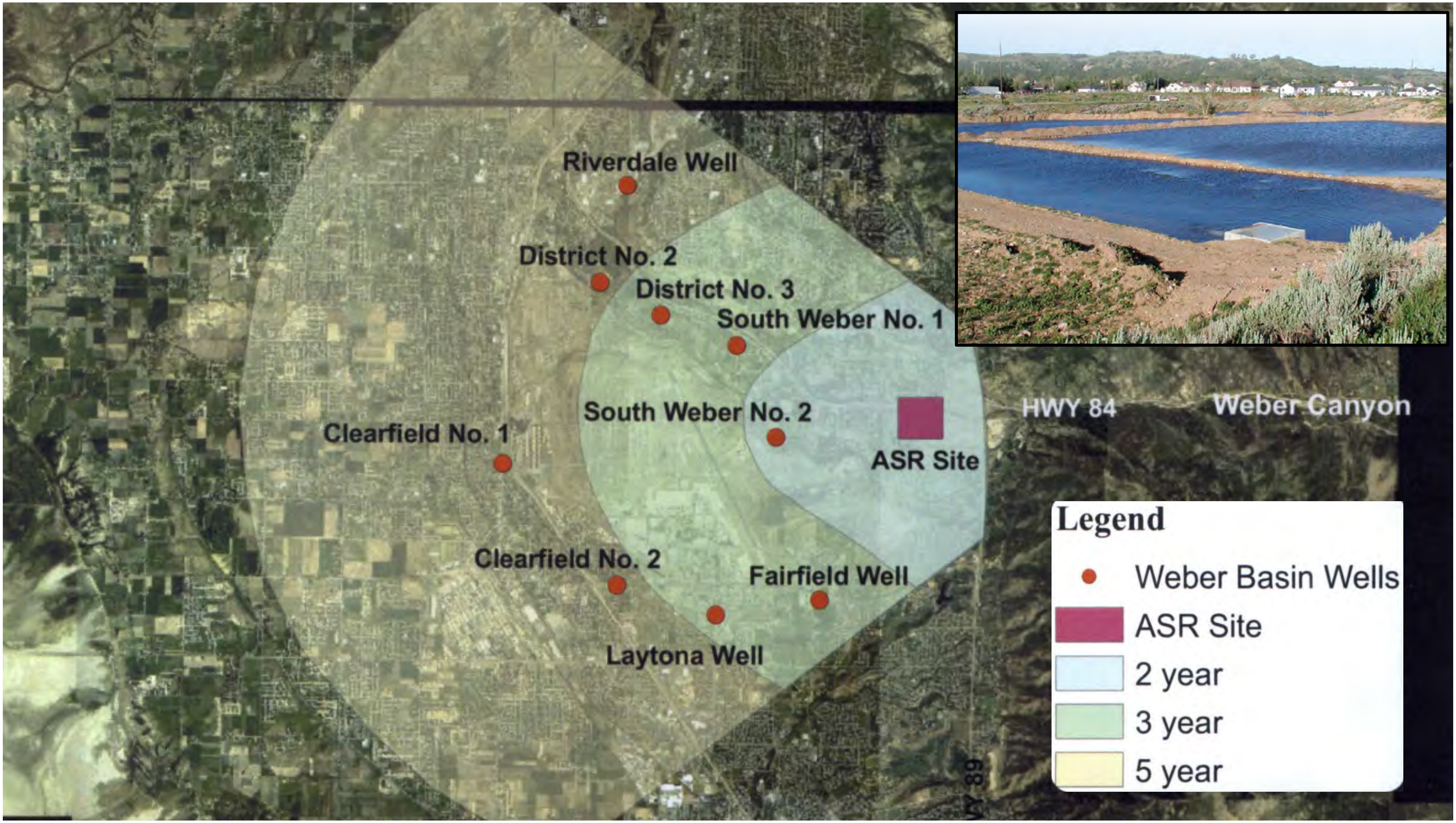




Base from NAIP 1-meter aerial photography, 2016
Universal Transverse Mercator projection, Zone 12
North American Datum of 1983


Riverdale Well
District No. 2
District No. 3
South Weber No. 1
South Weber No. 2
Clearfield No. 1
ASR Site
HWY 84
Weber Canyon
Clearfield No. 2
Fairfield Well
Laytona Well
Legend
Weber Basin Wells
ASR Site
2 year
3 year
5 year


Questions
www.waterrights.utah.gov

Western Regional Partnership

Reliable Outcomes for America's Defense, Energy, Environment and Infrastructure in the West

wrpinfo.org