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COOPERATIVE EXTENSION

WATER RESOURCES RESEARCH CENTER

Arizona Groundwater Management Past, Present and Future

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WATER RESOURCES RESEARCH CENTER

GREATER DEPTH, BROADER PERSPECTIVE FOR A CLEAR WATER FUTURE

We tackle key water policy and management issues,
empower informed decision-making,
and enrich understanding through engagement, education,
and applied research.

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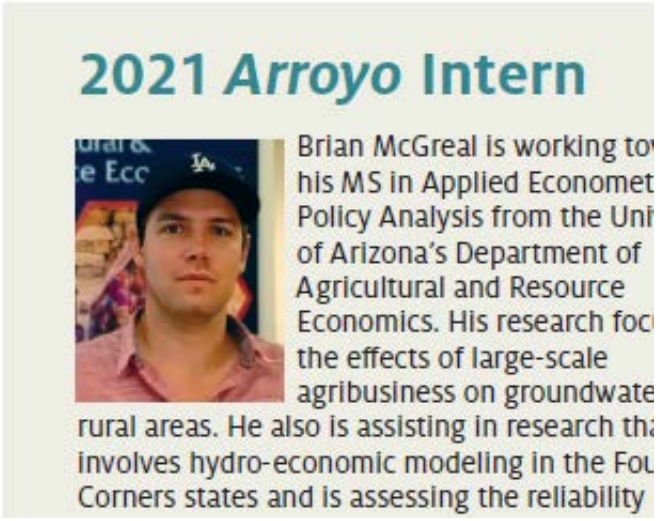
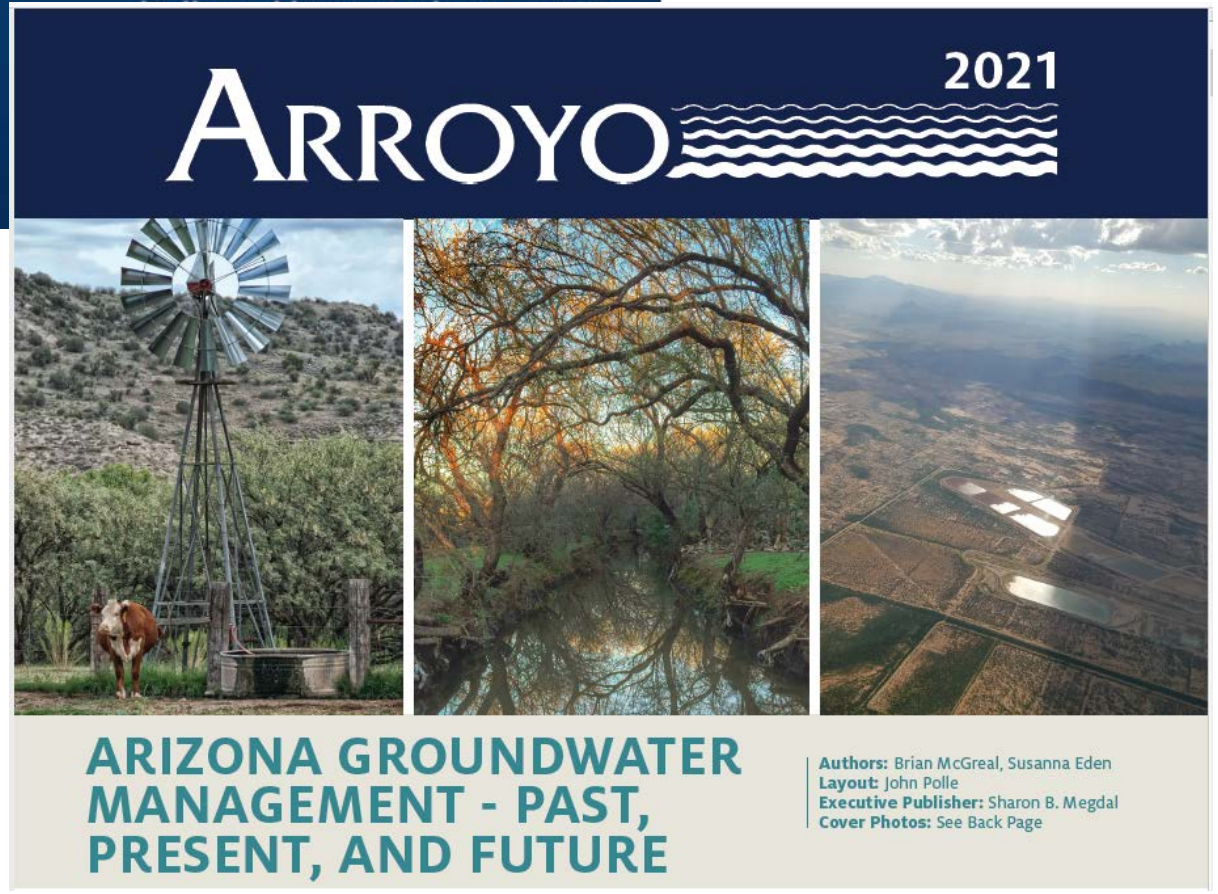
ARROYO

Annual WRRC publication on a single topic of timely interest for Arizona



2021 *Arroyo* Intern

Brian McGreal is working to
his MS in Applied Economet
Policy Analysis from the Uni
of Arizona's Department of
Agricultural and Resource
Economics. His research foc
the effects of large-scale
agribusiness on groundwate
rural areas. He also is assisting in research tha
involves hydro-economic modeling in the Fou
Corners states and is assessing the reliability



2021 ARROYO BACKGROUND

Taking its inspiration from the WRRC's 2020 Annual Conference, "Water at the Crossroads: The Next 40 Years," this *Arroyo* covers the history of the GMA and the mechanisms through which the act made groundwater use in Arizona more sustainable. It examines some of the state's broader water use issues that impact groundwater management and explores innovative solutions policymakers, managers, and stakeholders are developing to address these issues.

2021 ARROYO BACKGROUND

Pre-Columbian Era – Post-WWII

Water development limited to surface water and shallow groundwater

Late 1800s saw water diversions to support mining operations

Photo Credit: Arizona Archaeological Society

2021 ARROYO BACKGROUND

20th Century before 1980

High-speed centrifugal turbine pump developed

Groundwater used in large-scale agriculture

Rapid municipal expansion in Central Arizona

Aquifer overdraft becomes a major issue by 1970s

Photo Credit: US Geographic Survey

2021 ARROYO BACKGROUND

Central Arizona Project 1968-1984

Colorado River water to be delivered to Central Arizona

Approved by US Congress as part of Colorado River Basin Project Act of 1968

Funding became contingent on replacing rather than augmenting groundwater use

Photo Credit: Arizona Municipal Water Users Association

2021 ARROYO BACKGROUND

1980 Arizona Groundwater Management Act

Act established Arizona Department of Water Resources

Instituted system of groundwater management areas

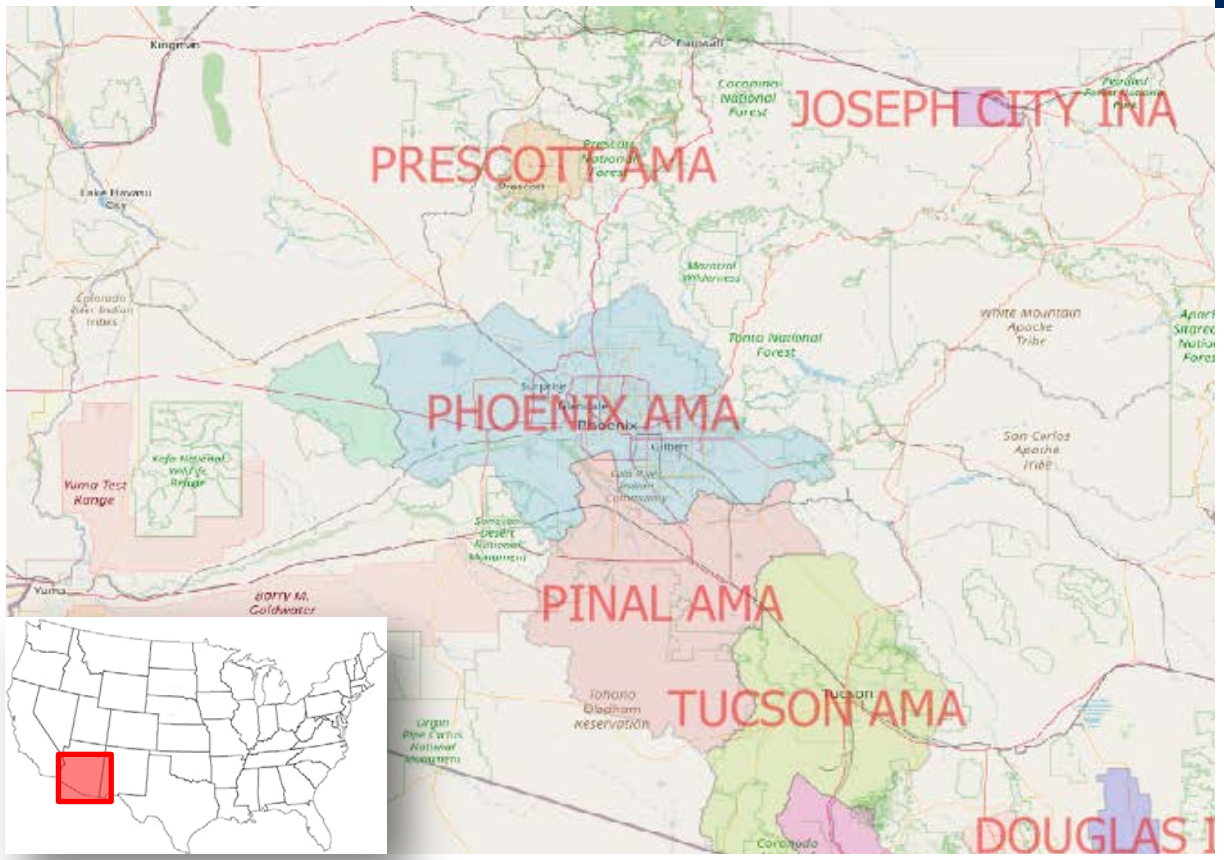
Act addressed 3 key issues:

1) **Reducing Arizona's groundwater overdraft**
2) **Allowing transport of groundwater away from overlying lands**
3) **Substituting CAP water for groundwater use**

Photo Credit: Arizona Department of Water Resources

2021 ARROYO BACKGROUND

Management Areas



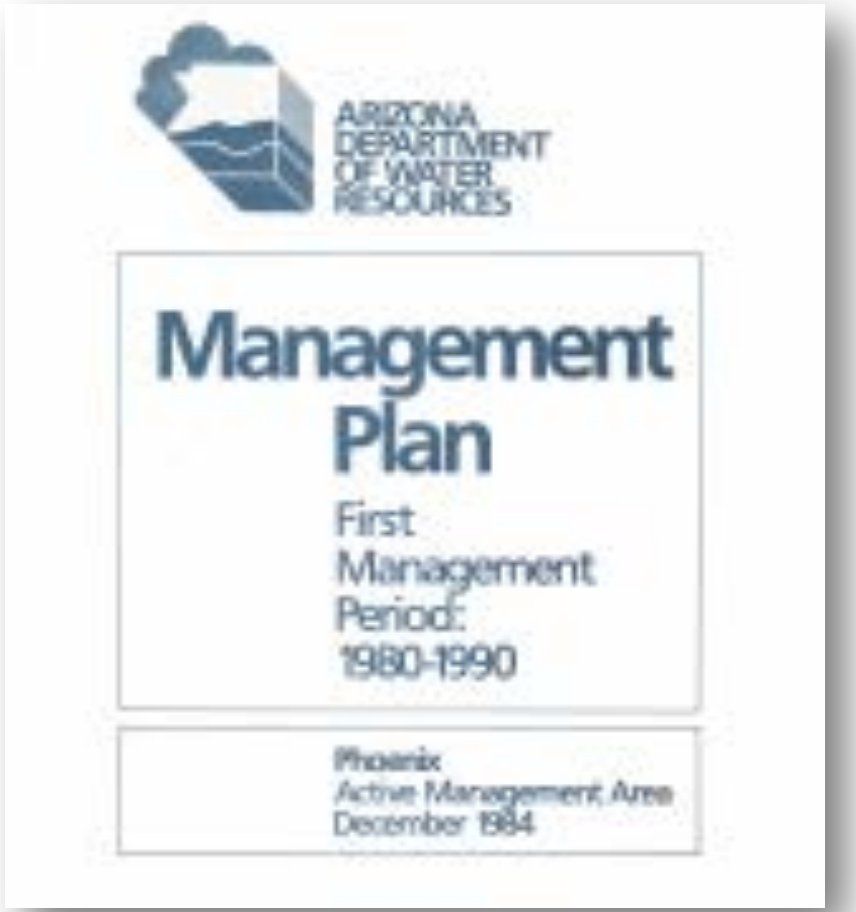
The AZ Groundwater Management Act established:

- **Active Management Areas**
- **Irrigation Non-Expansion Areas**

Designed to limit groundwater use where aquifers were most distressed in 1980

Photo Credit: QGIS w/ data from ADWR

2021 ARROYO BACKGROUND



Management Areas

AMAs

- **No groundwater may be extracted without a water right or permit**
- **Conservation mandated through a series of 10-year plans**

INAs

- **No new acres may be irrigated with groundwater**

Photo Credit: ADWR

2021 ARROYO BACKGROUND

Assured Water Supply

GMA requires proof of a 100-year Assured Water Supply for housing development in AMAs

1993: Assured Water Supply rules enacted

Central Arizona Groundwater Replenishment District established to facilitate compliance

Photo Credit: Business Insider

2021 ARROYO BACKGROUND

Central Arizona Groundwater Replenishment District

CAGRD finds, acquires, and recharges renewable water supplies

Housing developments and other water users enroll and pay dues to CAGRD

CAGRD facilitates members' demonstrable 100-year water supply

Photo Credit: JSTOR

2021 ARROYO BACKGROUND

Legislation in 1986 and 1994 created a framework for aquifer storage and recovery of renewable water

Underground Water Storage and Recovery Acts

Regulates recharge facilities

Establishes accounting system of water storage credits

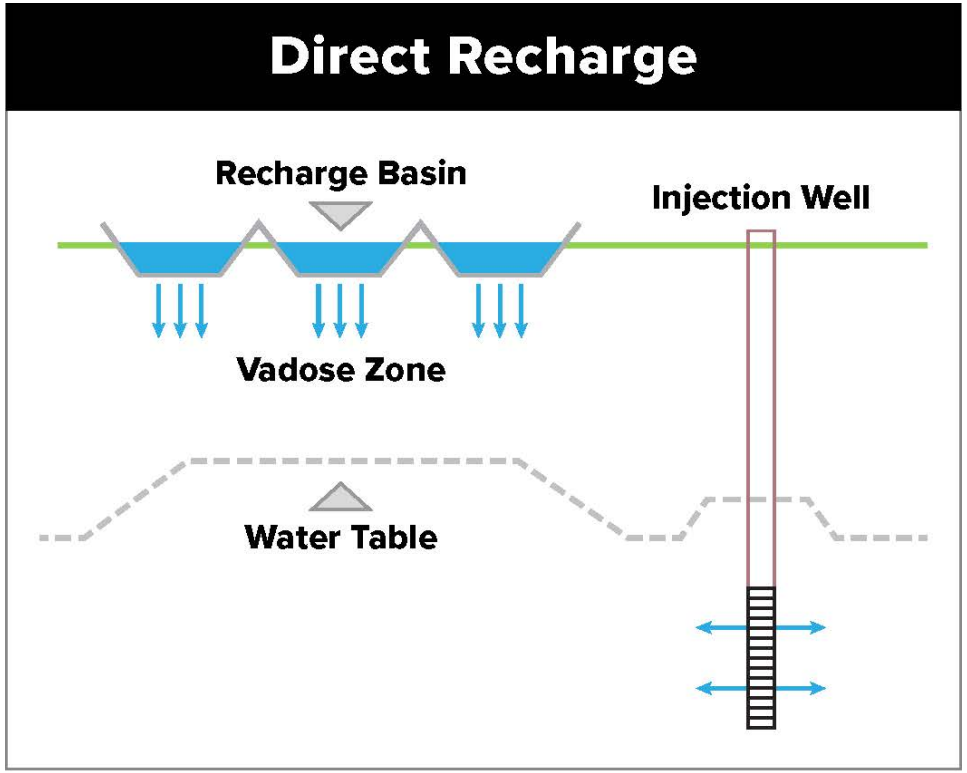
Permits storage amounts and recovery wells

Allows for direct and indirect storage

Photo Credit: CAP

2021 ARROYO BACKGROUND

Aquifer Storage Direct and Indirect



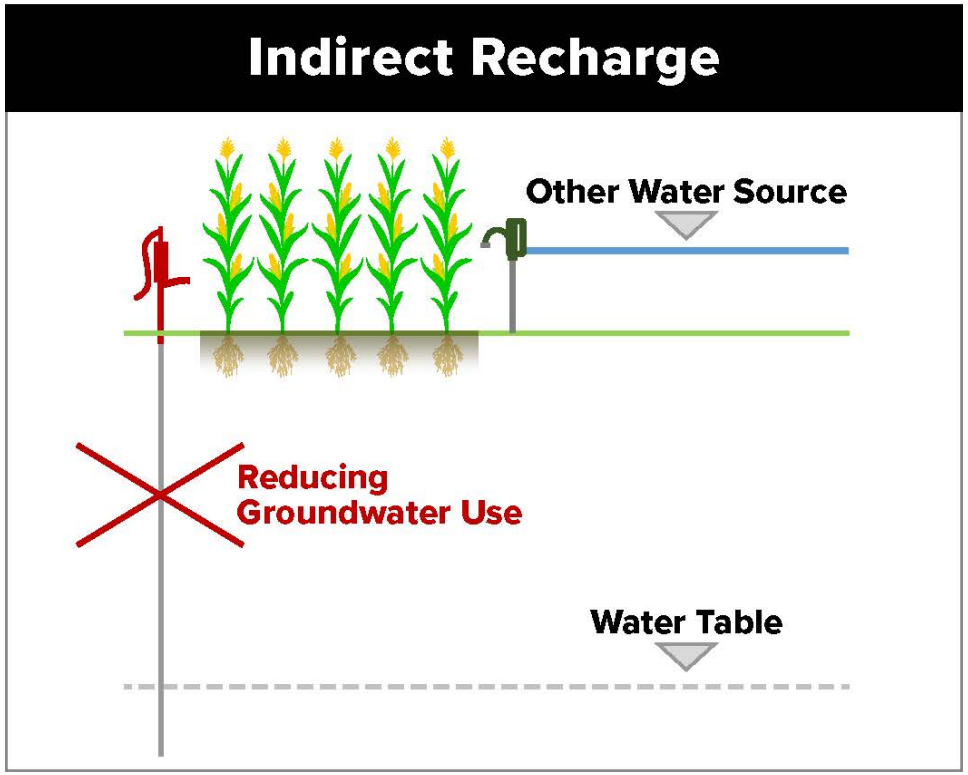


Photo Credit: WRRC

2021 ARROYO BACKGROUND

Arizona Water Banking Authority

Established in 1996

“Banks” excess CAP water

Allows interstate water storage

“Firms” M&I supplies against Colorado River shortages

Helps AMAs reach groundwater goals

Photo Credit: Association of California Water Agencies

2021 ARROYO ISSUES

Despite the accomplishments of the 1980 Groundwater Management Act and related legislation, Arizona continues to face a diverse array of challenges related to managing water resources.

2021 ARROYO ISSUES

Climate Change

A hotter and drier Southwest

Increased water demand

Uncertain and highly variable rain, snow, and runoff

Increasingly frequent and intense drought

Photo Credit: KPNX

BREAKING NEWS

Climate Change

Photo Credit: KPNX

For those interested:

Brad Udall - free webinar tomorrow March 9, 11:00 AM (1:00-2:00 EST)
Renewable Natural Resources Foundation
Washington Round Table on Public Policy
rnrf.org

Water Solutions for Our Warmer World free webinar series
#1 - Wednesday, March 17, 2021, 4 to 5:30 PM
environment.arizona.edu/water-series-2021

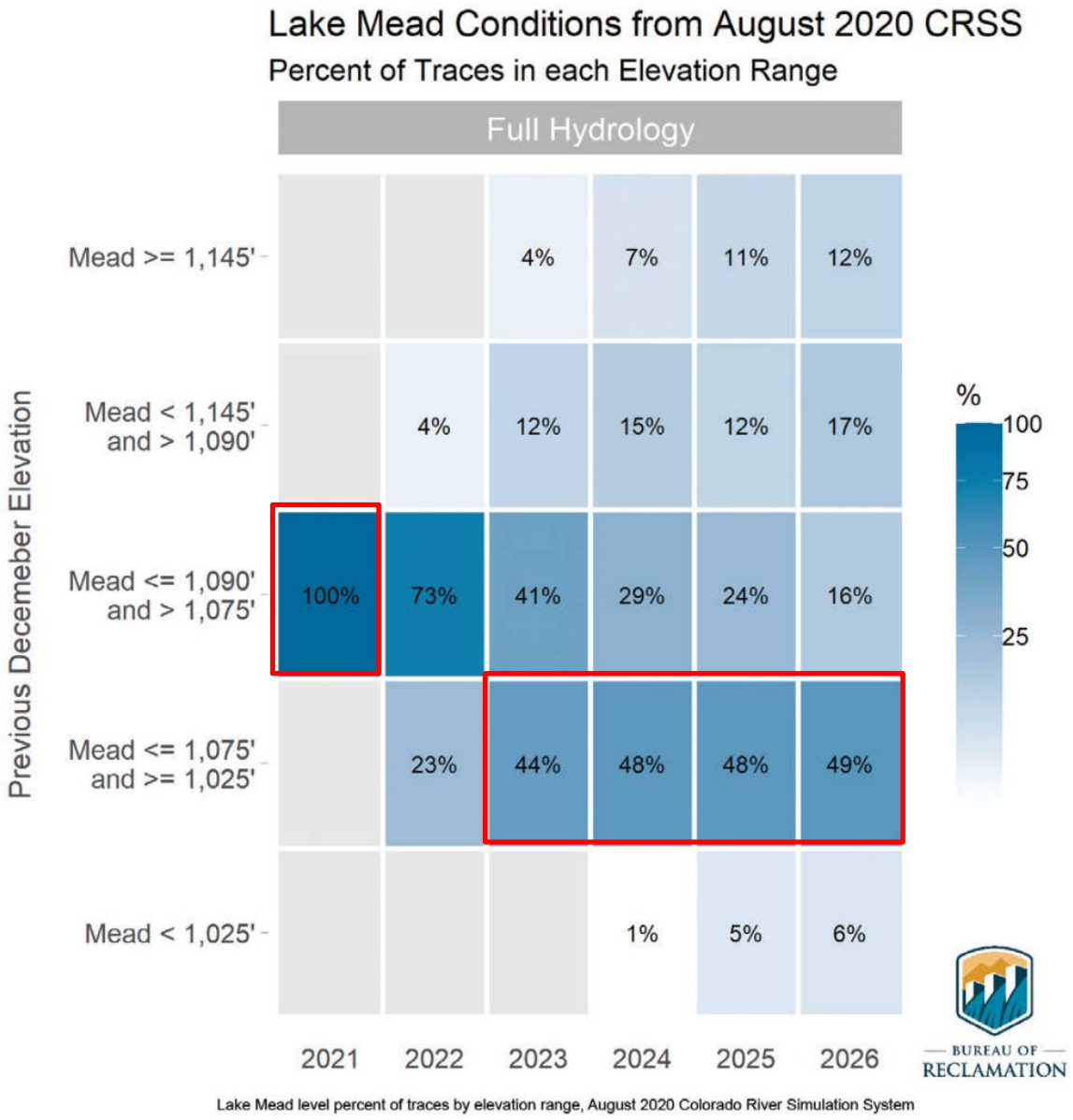
2021 ARROYO ISSUES

Colorado River Supply Reliability

Implications for groundwater

- **Substituting groundwater for reduced CAP water**
- **Less recharge and replenishment**
- **Undermining conjunctive management of water resources**

Photo Credit: National Geographic



Colorado River Supply Reliability

Reliability concerns

- **Drought and climate change reduce inflows**
- **“Structural deficit” lowers Lake Mead**
- **Shortage sharing requires demand management**
- **Basin states negotiate new shortage sharing guidelines**

Photo Credit: US Bureau of Reclamation

2021 ARROYO ISSUES

Colorado River Water Transfers

On-river farms and communities hold high-priority water rights

Transfers could bolster supply for Central AZ water users

On-river communities oppose transfers as threats to their economies

Photo Credit: Arizona PBS

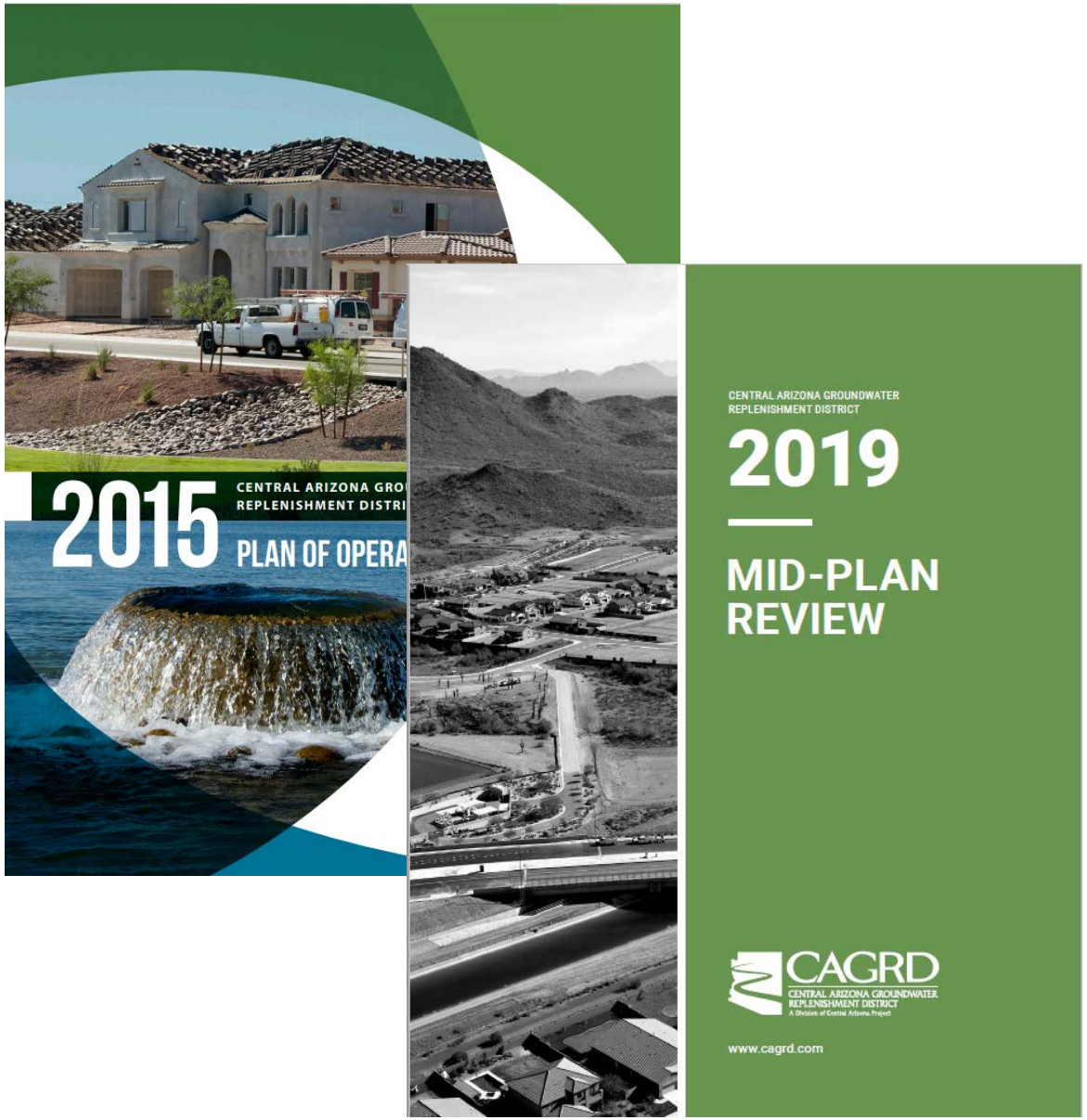
2021 ARROYO ISSUES

CAGRD Replenishment Obligations

Sustainability concerns

- **Unlimited membership**
- **Competition for diminishing replenishment supplies**
- **Hydrologic disconnect**

Photo Credit: Cronkite News



CAGRD Replenishment Obligations

Membership

2015 Plan of Operation

- 63,600 new; 327,300 total projected ML housing units by 2019
- 44,800 AF/Y in 2020; 86,900 AF/Y by 2034 projected replenishment obligation

2019 Mid-Plan Review

- 23,800 new; 286,000 total ML housing units
- 30,000 AF/Y replenishment obligation – relatively steady 2009-2018

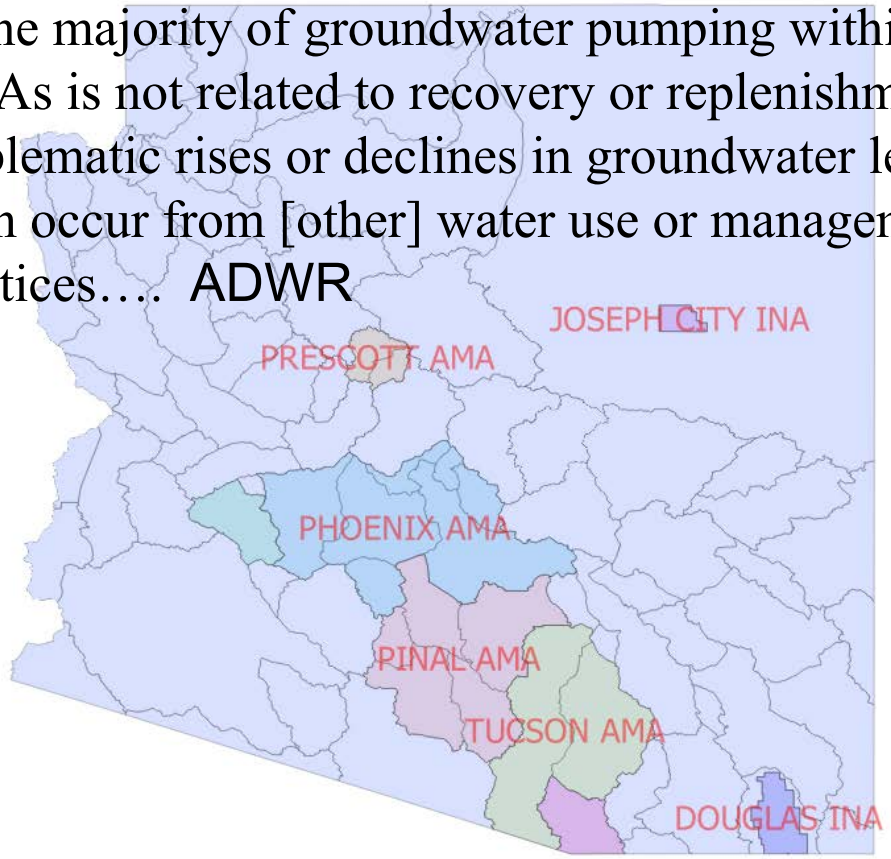
Replenishment supplies

- 420,000+ acre-feet of water storage credits
- 44,000 AF/Y

2021 ARROYO ISSUES

Hydrologic Disconnect

… the majority of groundwater pumping within AMAs is not related to recovery or replenishment, and problematic rises or declines in groundwater levels often occur from [other] water use or management practices…. ADWR



Extraction and replenishment can take place in different parts of an AMA

AMA Aquifers are not uniform and continuous

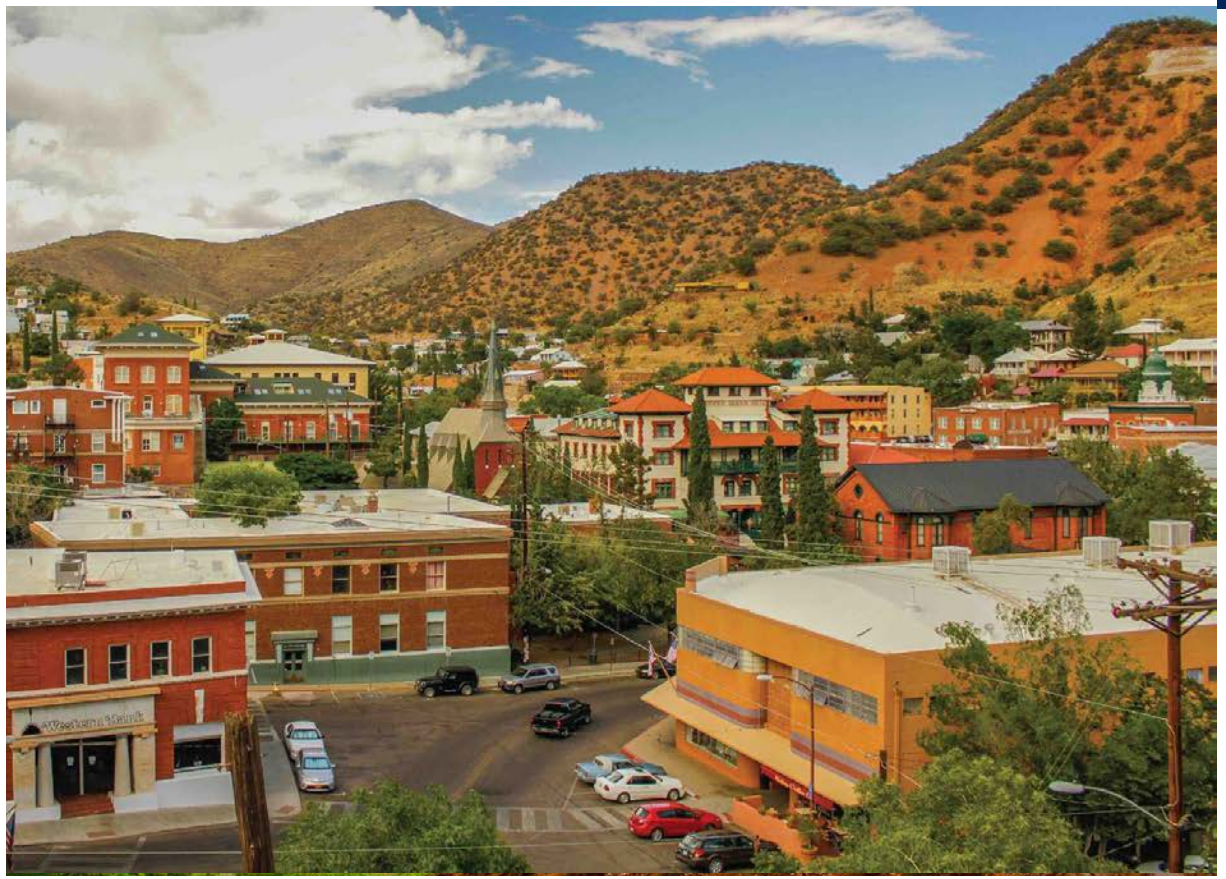
Localized overdraft may threaten water security

Subsidence and fissuring may occur

Photo Credit: QGIS w/ groundwater sub-basin data from ADWR

2021 ARROYO ISSUES

Water for Rural Communities



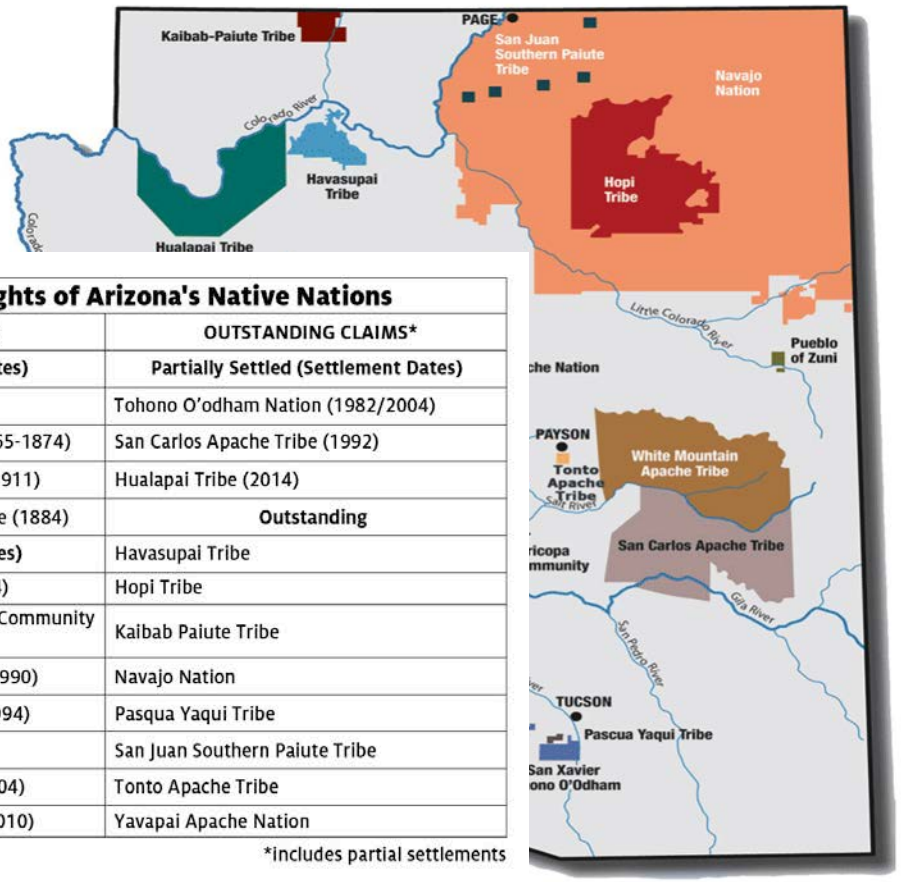
Common challenges

- **Dependent on groundwater**
- **Spatially dispersed**
- **Low incomes and limited economic diversity**
- **Vulnerable domestic wells**
- **Lack of water management authority**

Photo Credit: AZ Office of the Governor

2021 ARROYO ISSUES

Tribal Water



2020 Water Rights of Arizona's Native Nations	
QUANTIFIED RIGHTS	OUTSTANDING CLAIMS*
Adjudicated (Priority Dates)	**Partially Settled (Settlement Dates)**
Cocopah Tribe (1917)	Tohono O'odham Nation (1982/2004)
Colorado River Indian Tribes (1865-1874)	San Carlos Apache Tribe (1992)
Fort Mojave Indian Tribe (1890-1911)	Hualapai Tribe (2014)
Fort Yuma (Quechan) Indian Tribe (1884)	**Outstanding**
Settled (Settlement Dates)	Havasupai Tribe
Ak Chin Indian Community (1984)	Hopi Tribe
Salt River-Pima Maricopa Indian Community (1988)	Kaibab Paiute Tribe
Fort McDowell Yavapai Nation (1990)	Navajo Nation
Yavapai-Prescott Indian Tribe (1994)	Pasqua Yaqui Tribe
Zuni Indian Tribe (2003)	San Juan Southern Paiute Tribe
Gila River Indian Community (2004)	Tonto Apache Tribe
White Mountain Apache Tribe (2010)	Yavapai Apache Nation

*includes partial settlements

Water rights of many Tribes are not quantified

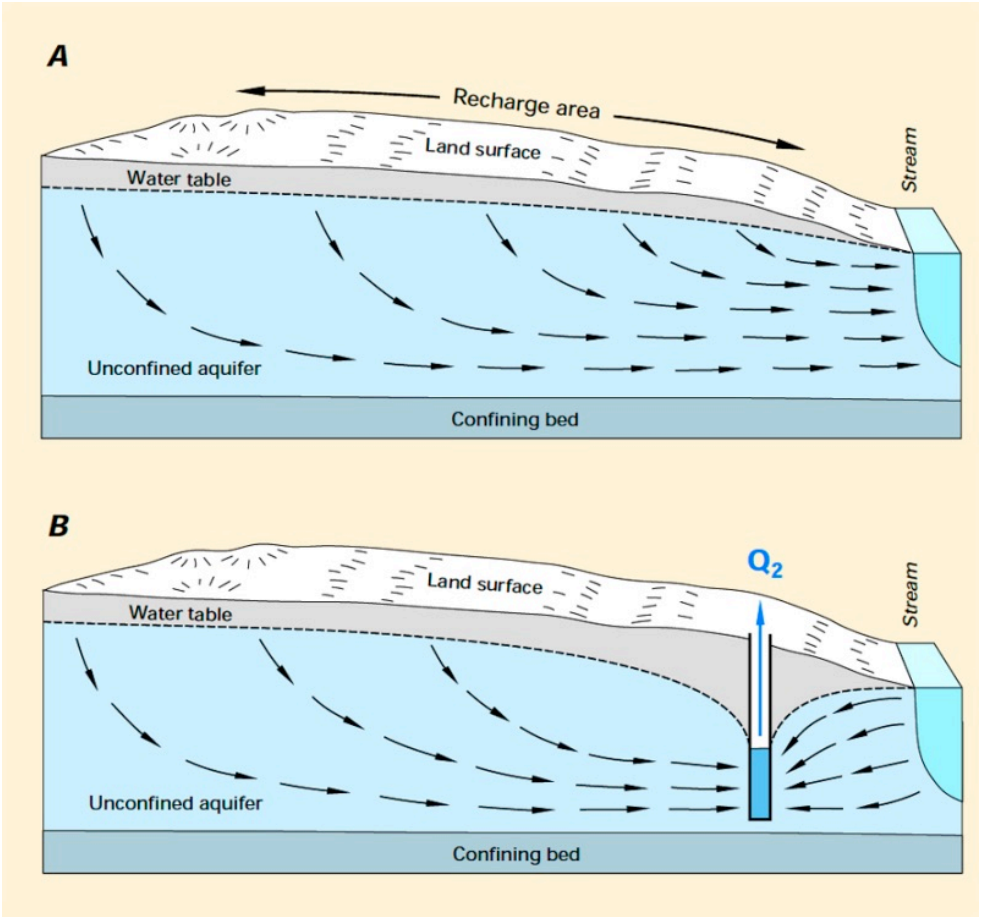
Tribes lack infrastructure to access and deliver water

Trust is lacking between Tribes and non-tribal entities

Photo Credit: Mel and Enid Zuckerman College of Public Health – University of Arizona

2021 ARROYO ISSUES

Environmental Water Needs



Preservation of aquatic and riparian ecosystems requires baseline flows

Arizona water law rarely protects instream flows

Surface water law discourages conservation

Groundwater pumping can drain surface water even from senior water rights holders

Photo Credit: USGS

BREAKING NEWS

ARIZONANS' ATTITUDES AND OPINIONS ABOUT ENVIRONMENTAL ISSUES

In March 2017 and in January 2020, the Nina Mason Pulliam Charitable Trust enlisted the independent Morrison Institute for Public Policy at ASU to survey a representative sample of registered Arizona voters to gauge attitudes toward and beliefs about the environment and environmental protection.

64%

of Arizonans say, "Protecting the environment should be given priority, even at the risk of slowing economic growth."

TOP POLICY PRIORITIES

Arizonans rank the **environment** among their **top three priorities** for the governor and legislature to address.

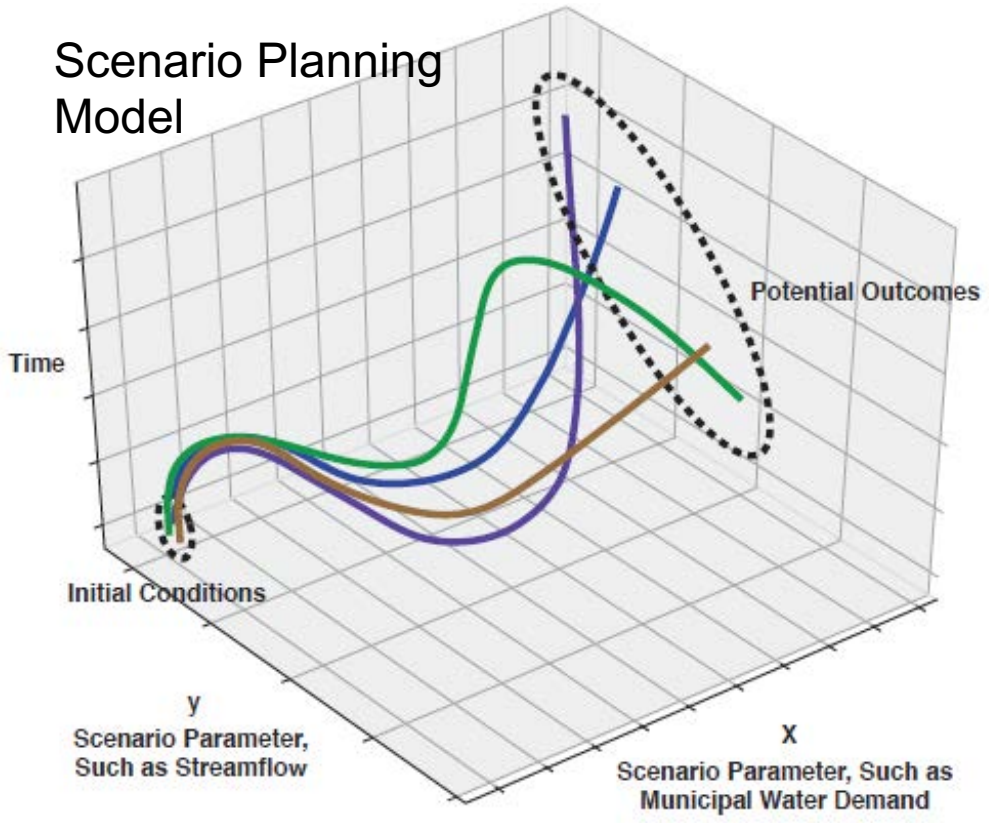
Photo Credit: ASU Morrison Institute

2021 ARROYO SOLUTIONS

From central Arizona's sprawling population centers to small rural communities, Arizona's policymakers, water managers, and stakeholders face numerous water challenges. In response, a variety of innovative solutions are in various stages of development.

2021 ARROYO SOLUTIONS

Modeling Arizona's Water Future



CAP projects water use in CAP service area through 2060

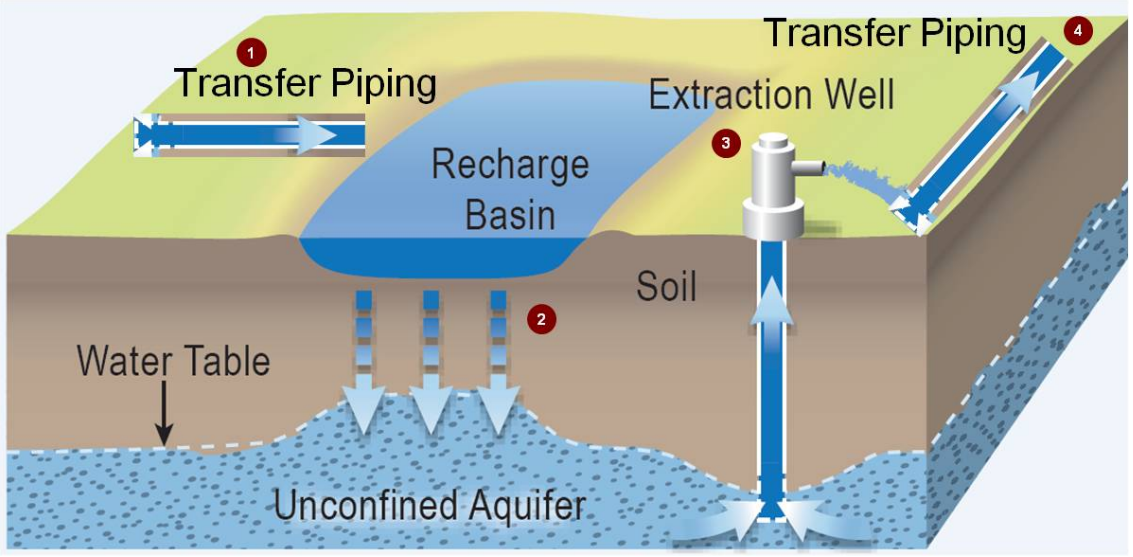
US Bureau of Reclamation publishes forecasts of water levels in Lake Powell and Lake Mead

ADWR has developed multiple groundwater models to inform management and policy

Photo Credit: WRRC

2021 ARROYO SOLUTIONS

Recovering Water Banked in the AMAs



Banked water is crucial to Arizona's future water supply

Recovery plan defines 3 ways to recover banked water
Direct via CAP canal
Indirect via agreements between water users
Exchanges

Interstate recovery will be accomplished indirectly

Photo Credit: Willow Springs Water Bank

2021 ARROYO SOLUTIONS

Augmenting Arizona's Water Supply

Desalination

- **Ocean water from California or the Sea of Cortez delivered indirectly**
- **Brackish groundwater**

Desalination is expensive, energy intensive, and creates highly saline brine

Photo Credit: ThoughtCo

2021 ARROYO SOLUTIONS

Augmenting Arizona's Water Supply

Reclaimed wastewater

- **Already applied to non-potable uses**
- **Regulations permit potable reuse**
- **Scottsdale Water's DPR program is first in Arizona**

Water treatment costs and public opinion may slow adoption for potable use

Photo Credit: City of Scottsdale

2021 ARROYO SOLUTIONS

Augmenting Arizona's Water Supply

Phreatophyte Control

Weather Modification

Rainwater harvesting

Extreme long-distance water transfers

Photo Credit: Discover Magazine

2021 ARROYO SOLUTIONS

Water Solutions for Rural Communities

Cooperative infrastructure projects between entities

Potential for additional AMAs or INAs (often unpopular)

Legislation to create alternative groundwater management tools

Photo Credit: ADWR

2021 ARROYO SOLUTIONS

Tribal Water Solutions

Better tribal water infrastructure for economic security and public health

Financial and technical support for water infrastructure may be included in water rights settlements

Cooperative water projects have proven successful

Photo Credit: TakePart

2021 ARROYO SOLUTIONS

Tribal Water Solutions

Tribes are demanding representation in high level water discussions

Tribes with quantified water rights can contribute to problem solving

Gila River Indian Community and Colorado River Indian Tribes both played significant roles in recent agreements

Photo Credit: Indianz News

2021 ARROYO SOLUTIONS

Environmental Water Use

Potential legal tools to protect environmental resources:

- **Invoke Public Trust Doctrine**
- **Establish mandatory minimum streamflows**
- **Recognize surface water – groundwater links**

Photo Credit: The Nature Conservancy

BREAKING NEWS

No Forfeiture

On February 25th, 2021 the "Water Conservation Notice; No Forfeiture" bill was signed into law

Law allows water users to conserve water with no threat of losing their water rights

Encourages wise water use and leaving water in streams

Photo Credit: Audubon Society

Thank you

QUESTIONS?

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