WRRC
WATER RESOURCES RESEARCH CENTER

THE UNIVERSITY OF ARIZONA

COLLEGE OF AGRICULTURE & LIFE SCIENCES
COOPERATIVE EXTENSION

Sustainable Water Use in the Arid Southwest

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Renewable Natural Resources Foundation
Congress on Sustaining Western Water
Washington, DC December 1, 2015

wrrc.arizona.edu

The University of Arizona Water Resources Research Center (WRRC)

Mission is to promote understanding of critical state and regional water policy and management through applied research, education, and outreach and engagement.

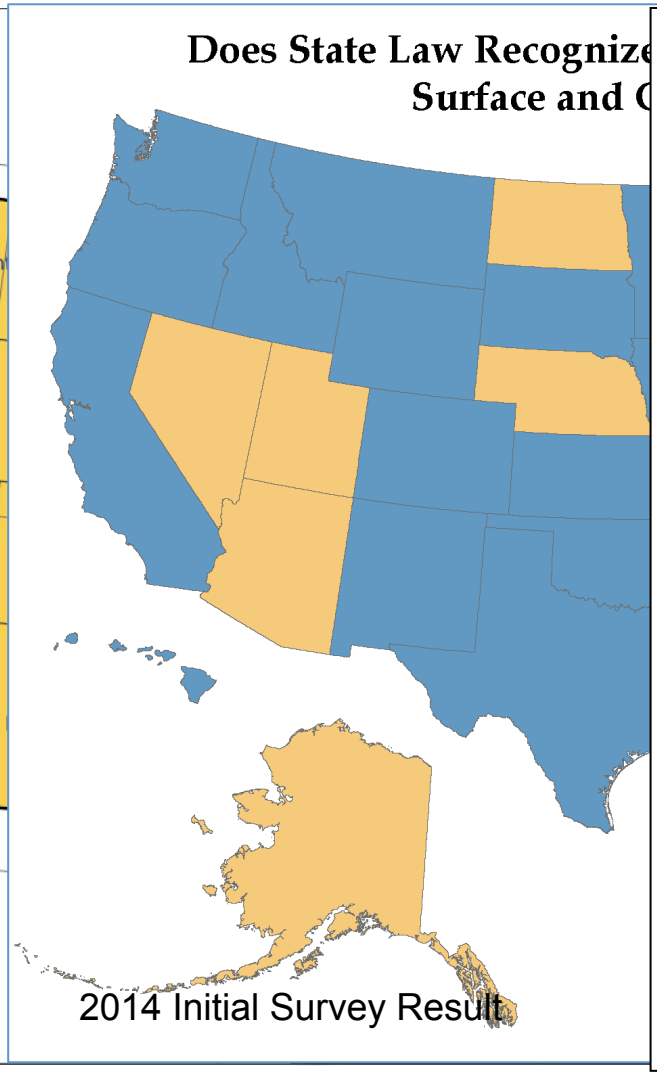
Pathways to Sustainable Water Use Questions Posed by RNRF

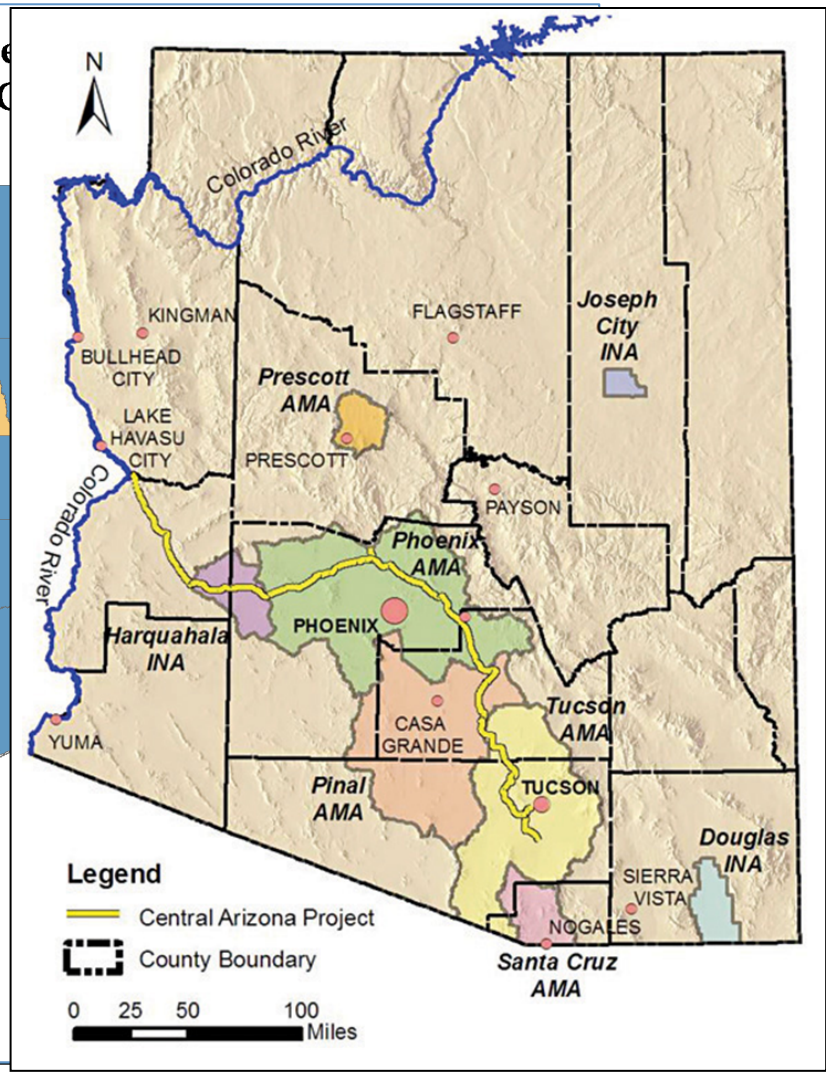
Q1. As we plan for future population growth, water-related infrastructure investments and environmental needs, how are estimates developed to predict how much water will be available for use on a sustainable basis, particularly in light of climate change?

Q2. How can surface water and groundwater be managed in a holistic and sustainable way?

Q3. What monitoring, data and regulatory mechanisms are required for sustainable water use?

Legal/Institutional/Governance Context: Cannot paint US with a single brushstroke – so pathways may differ





Geographic Context: Shared Borders

Map of states participating in the Transboundary Aquifer Assessment Program

US-MX Border Water Governance and Management

- US water governance is decentralized
  - By jurisdiction (federal government versus states)
  - By type of water
- MX water governance is centralized
- History of working two countries working together through the International Boundary and Water Commission (IBWC) www.ibwc.gov
- IBWC Commissioners authorized to approve Minutes to the 1944 treaty governing binational Colorado River management

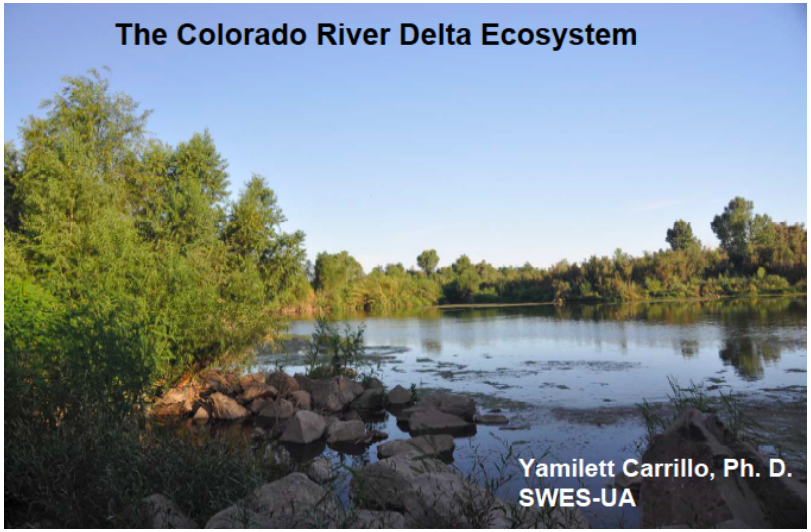
MX Commissioner
Roberto Salmón

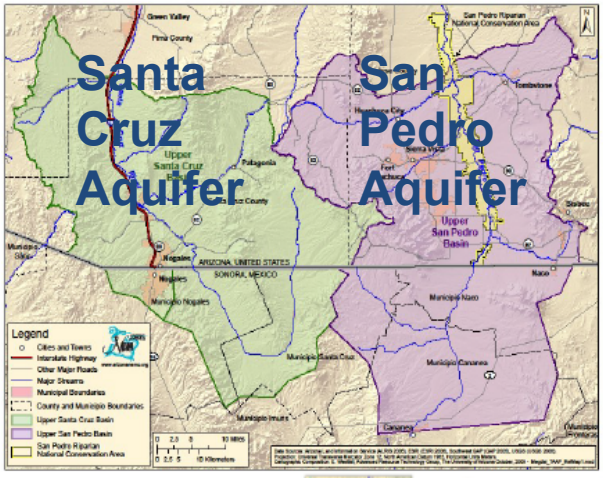
US Commissioner
Edward Drusina

Examples of transboundary efforts between United States and Mexico

Minute 319: Five-year historic agreement signed in November 2012 to share Colorado River shortage and surplus and address Colorado River Delta ecosystem.

Earthquake in April 2010

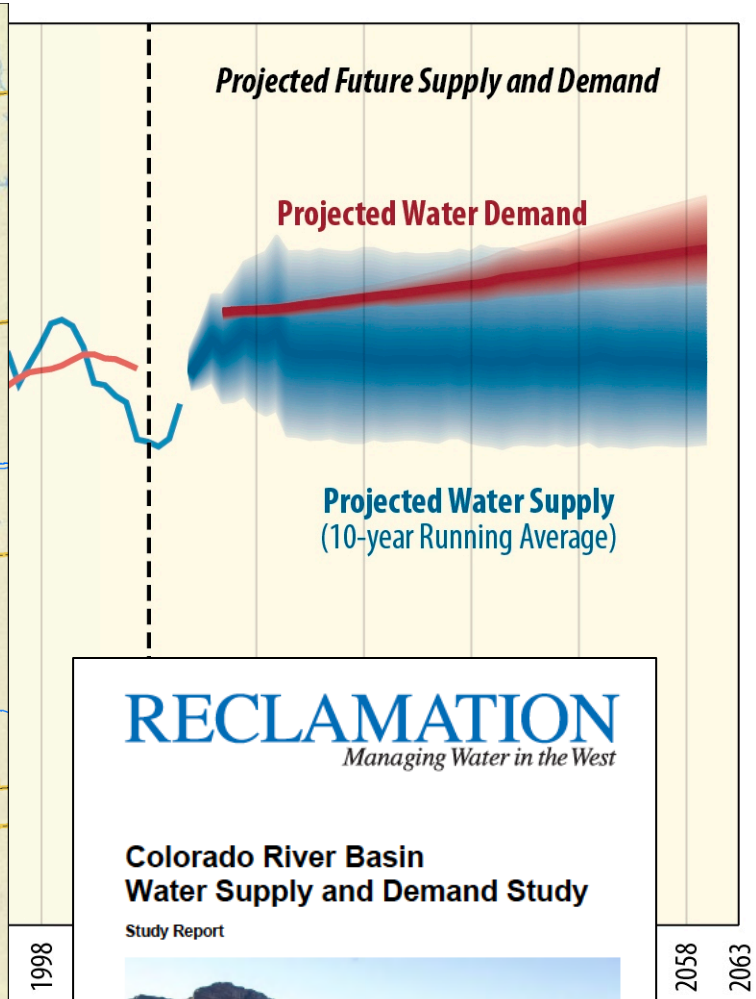


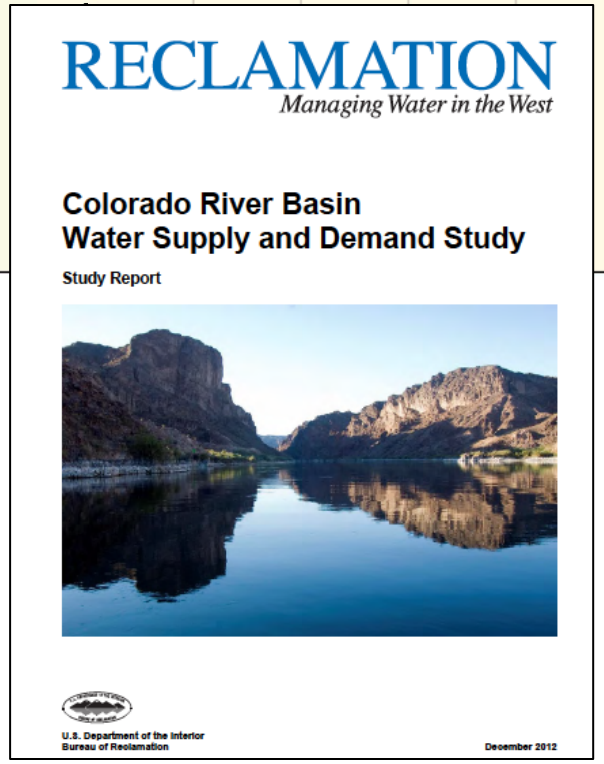


SAN PEDRO RIVER AQUIFER BINATIONAL REPORT

U.S. Public Law 109-448
US-MX Transboundary Aquifer Assessment Program
San Pedro report due out late 2015 or early 2016
Report for Santa Cruz Aquifer under preparation


Legend
Colorado River Basin hydrologic boundary
Areas outside hydrologic basin receiving Colorado River water
Colorado River Watershed
Montana
North Dakota
South Dakota
Oregon
Idaho
Wyoming
Nebraska
Nevada
Utah
Colorado
California
Arizona
New Mexico
Texas
Mexico
Snake River
N. Platte River
S. Platte River
Great Salt Lake
Salt Lake City
Provo
Flaming Gorge Reservoir
Flaming Gorge Dam
Cheyenne
Fort Collins
Boulder
Aurora
Denver
Colorado Springs
Pueblo
Aspinall Unit
Grand Junction
Green River
Colorado River
Arkansas River
San Juan River
Central Utah Project and Strawberry Valley Project
Colorado Front Range
Lake Powell
Glen Canyon Dam
Lee Ferry
Farmington
Navajo Dam
St. George
Las Vegas
Lake Mead
Hoover Dam
Upper Basin
Lower Basin
Davis Dam
Flagstaff
Little Colorado River
Santa Fe
Albuquerque
San Juan-Chama Project
Rio Grande
Colorado River Aqueduct Service Area
Imperial and Coachella Valleys
Los Angeles
Lake Havasu City
Lake Havasu
Parker Dam
Central Arizona Project
Theodore Roosevelt Dam
Phoenix
Salton Sea
Imperial Dam
Gila River
San Diego
Tijuana
Mexicali
Yuma
San Luis Rio Colorado
Tucson
El Paso
U.S.A.
MEXICO
Nogales
Pacific Ocean
Gulf of California
N
W
E
S
0 50 100 200
Miles
U.S. Bureau of Reclamation


Projected Future Supply and Demand
Projected Water Demand
Projected Water Supply
(10-year Running Average)
1998
2058
2063

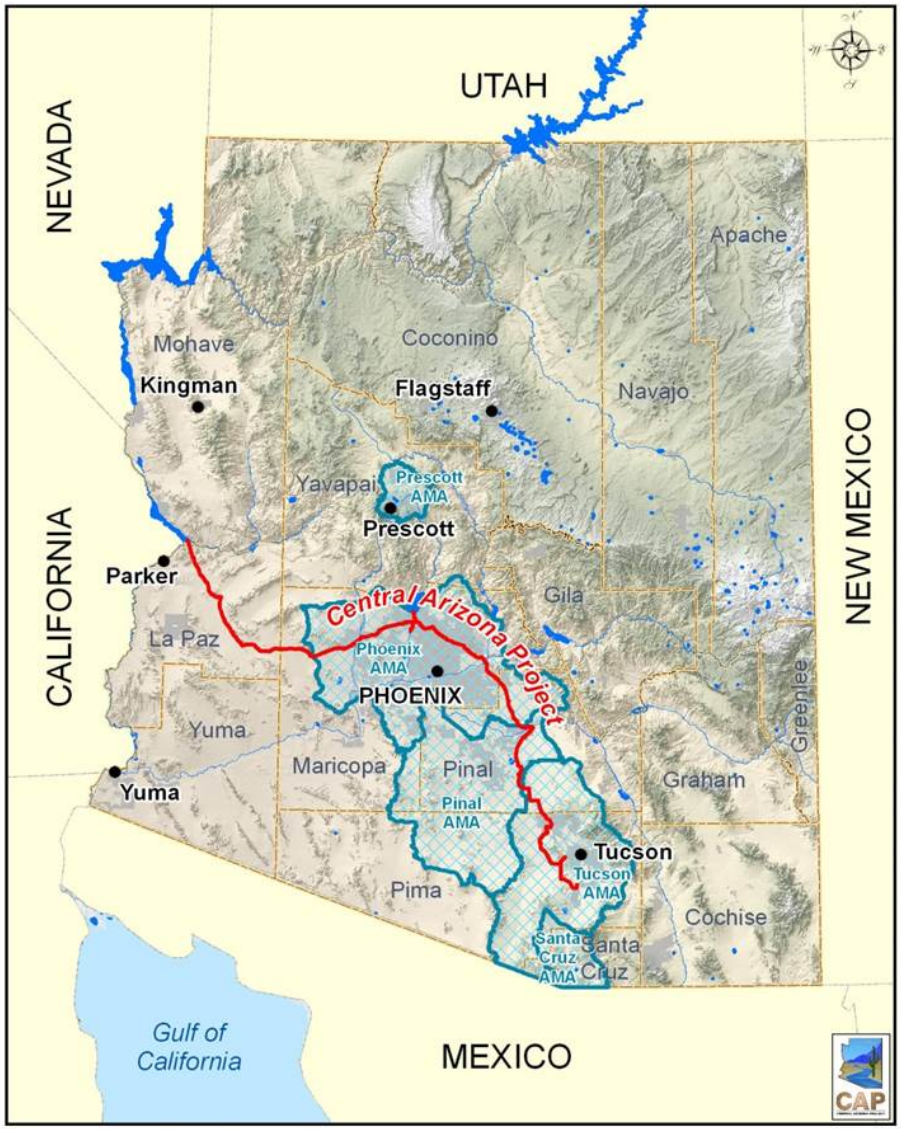

RECLAMATION
Managing Water in the West
Colorado River Basin
Water Supply and Demand Study
Study Report
U.S. Department of the Interior
Bureau of Reclamation
December 2012

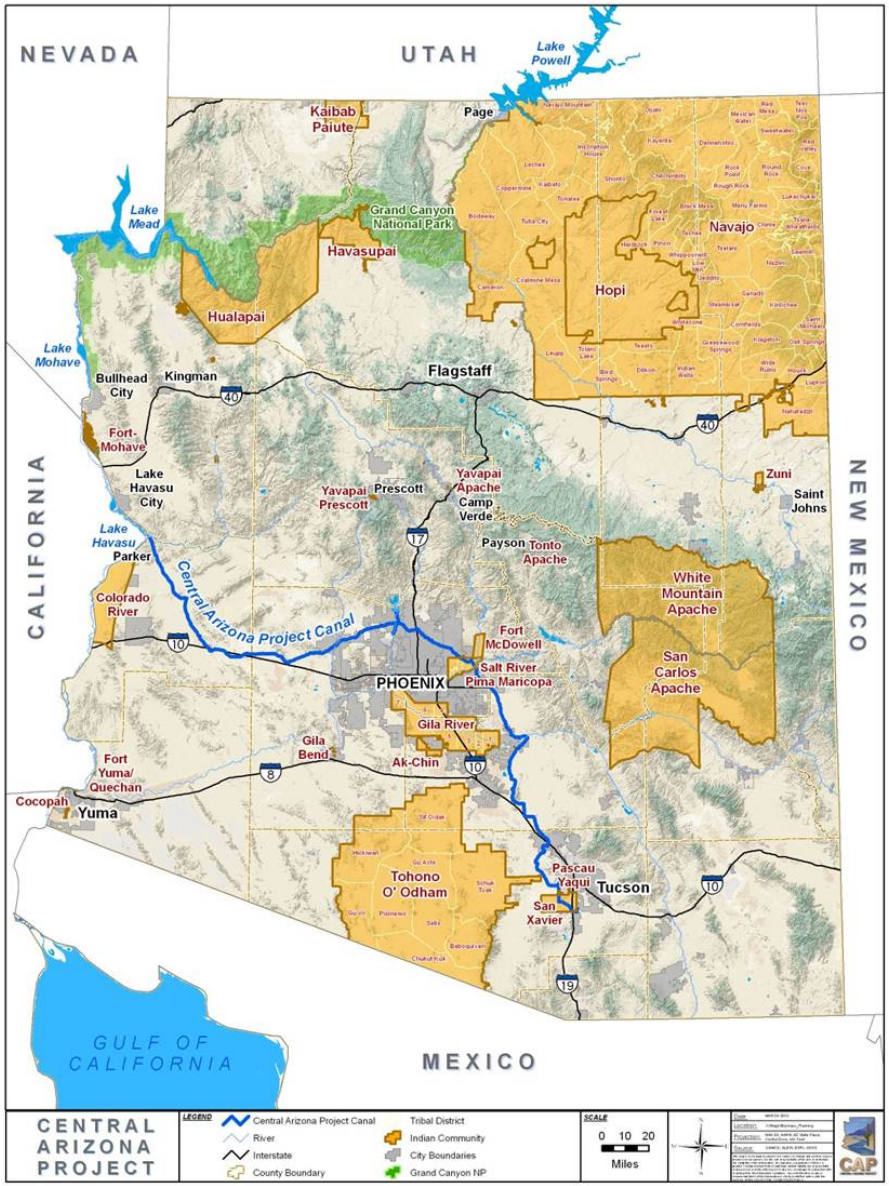
Chapter 5
Environmental and Recreational Flows

This chapter is a product of the Environmental and Recreational Flows Workgroup

May 2016

States and Tribal Nations





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ARIZONA WATER RESOURCE

The Water Resources Research Center Quarterly Newsletter

Volume 23 Number 4 Fall 2015

Special Issue

Indigenous Perspectives on Sustainable Water Practices

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Publications

The Water Resources Research Center produces research reports, outreach materials, and regular publications, including the Weekly Wave e-news digest, the quarterly Arizona Water Resource newsletter and the Arroyo, an annual publication focusing on a single water topic of timely concern in Arizona. **Sign up online to receive WRRC newsletters, event updates and more at: wrrc.arizona.edu/subscribe.**

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Tribal Advisory Committee member, Percy Deal, speaks during a question and answer period at the 2015 WRRC Annual Conference. Source: John Polle

Conference Themes Emerge from a Program of Diverse Perspectives

by Marie-Blanche Roudaut, WRRC Graduate Outreach Assistant and Susanna Eden, WRRC

The Water Resources Research Center 2015 conference, *Indigenous Perspectiv on Sustainable Water Practices*, brought together a unique diversity of perspective to share experience and knowledge about indigenous water management an stewardship. More than 330 people attended the conference, representing si states, 49 cities, and 13 tribal nations. Thirty-three speakers with ties to Nativ American communities across the state presented a variety of viewpoints.

As participants spoke with passion from their different perspectives, sever themes emerged. These themes included the importance of equal and respectfi collaboration on water rights from the community and grassroots to the trib government level, the meaning of sustainability for indigenous people, the lack o water for many tribal people, the importance of youth, and passing on tradition knowledge. The example of the struggles and successes of the Gila River India Community, or GRIC, was prominent. As hosts of the conference, the GRI used the opportunity to celebrate the ten-year anniversary of the Arizona Wate

Conference continued on page

Conference Plants Seeds of Respectful Dialogue

by Governor Stephen Lewis, Gila River Indian Community

The Gila River Indian Community was honored to welcome participants of th conference, *Indigenous Perspectives on Sustainable Water Practices*, to our Communit This conference comes at a critical time for Arizona's Native people. Much ha been accomplished, but much more needs to be done. Change has come becaus of the dedication of our leaders, past and present, and we owe them a debt o thanks. I learned from my mother and my father, Rod Lewis, the life lesson o community service, strength, to give back what you have to your people. We hav a legacy to live up to from people like Richard Narcia, governor at the time o the settlement, and John Echohawk, who fought along with my father and too cases to the Supreme Court. We also owe much to our elders, who are the mor and ethical fiber of our community.

A central theme for tribes was unfortunately loss in many areas: loss of lan culture, language, and human capacity. For the GRIC, it was the loss of ou

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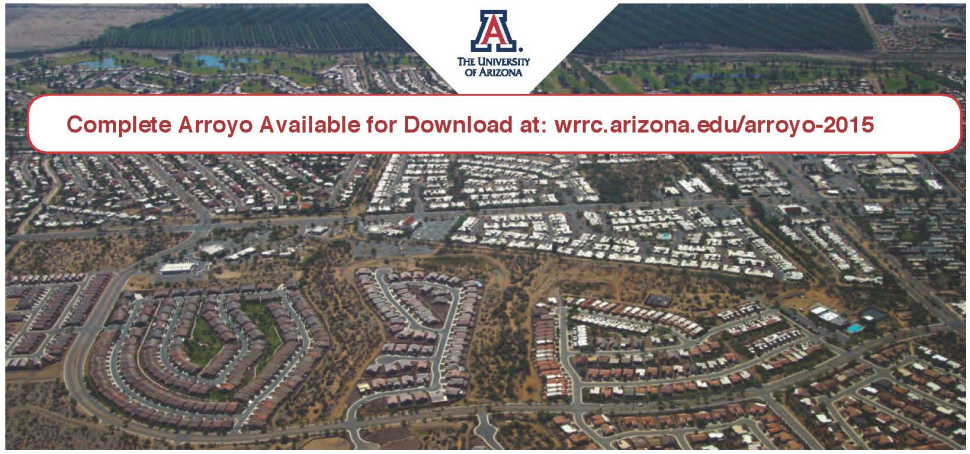

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Complete Arroyo Available for Download at: wrrc.arizona.edu/arroyo-2015

ARROYO 2015

Closing the Water Demand-Supply Gap in Arizona

There is an acknowledged gap between future water demand and supply available in Arizona. In some parts of Arizona, the gap exists today, where water users have been living on groundwater for a while, often depleting what can be thought of as their water savings account. In other places, active water storage programs are adding to water savings accounts. The picture is complicated by variability in the major factors affecting sources and uses of water resources. Water supply depends on the volume that nature provides, the location and condition of these sources, and the amount of reservoir storage available. Demand for water reflects population growth, the type of use, efficiency of use, and the location of that use. In a relatively short time frame, from 1980 to 2009, Arizona's population grew from 2.7 million people with a $30-billion economy to nearly 6.6 million people with a $260-billion economy. Although it slowed since 2007, growth is expected to continue. Growth also varies by location, so projections of water demand for different areas varies from sufficiency to shortage. Legal and political factors, as well as economic and financial factors, play a part in the availability, distribution, and uses of water. As a result, there is no one-size-fits-all solution to closing the water demand-supply gap.

Introduction

Many information sources were used to develop this issue of the *Arroyo*, which summarizes Arizona's current water situation, future challenges, and options for closing the looming water demand-supply gap. Three major documents, however, provide its foundation. All three conclude that there is likely to be a widening gap between supply and demand by mid-century unless mitigating actions are taken.

The first document is the Colorado River Basin Water Supply and Demand Study (http://www.usbr.gov/lc/region/programs/crbstudy.html), a massive report released by the U.S. Bureau of Reclamation (Reclamation) in December 2012. It was compiled with input from the seven Colorado River Basin States (Arizona, California, Colorado, Nevada, New Mexico, Utah, and Wyoming) and other partners and stakeholders. The report projected a median imbalance

Authors: Susanna Eden, Madeline Ryder, Mary Ann Capehart
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Email: wrrc@email.arizona.edu; **Web Site:** wrrc.arizona.edu

Sub-state

Central Arizona Project

Complex Water Management Issues, Challenges, and/or Solutions (Pathways)

- Growth and the need for additional supplies (competition)
- Drought/climate variability – Colorado River Shortage declaration
- Water-energy-food nexus
- Water quantity assessments, flooding
- Water quality
- Desalination
- Use of recycled water for potable and other water needs
- Access to and utilization of renewable supplies
- Transboundary water issues
- The surface water/groundwater interface
- Riparian areas and other environmental considerations
- Water rights, adjudications and settlements
- Conservation programs
- Water storage and recovery (water banking)
- Groundwater replenishment
- Water cost/pricing and financing
- Water Planning

Uncertainty!

Q1. Climate change/variability and drought vulnerabilities

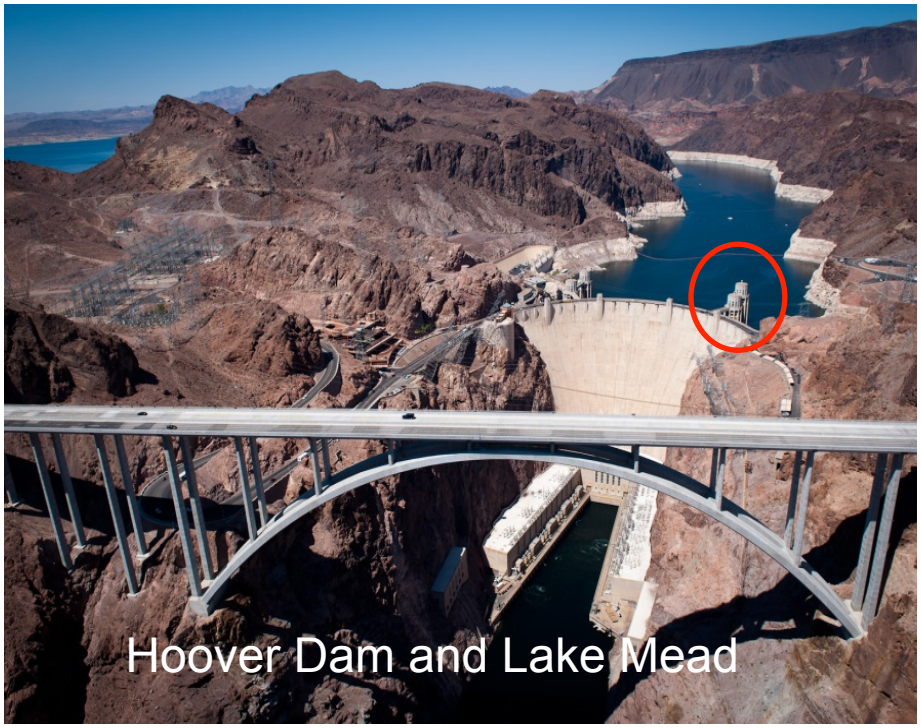
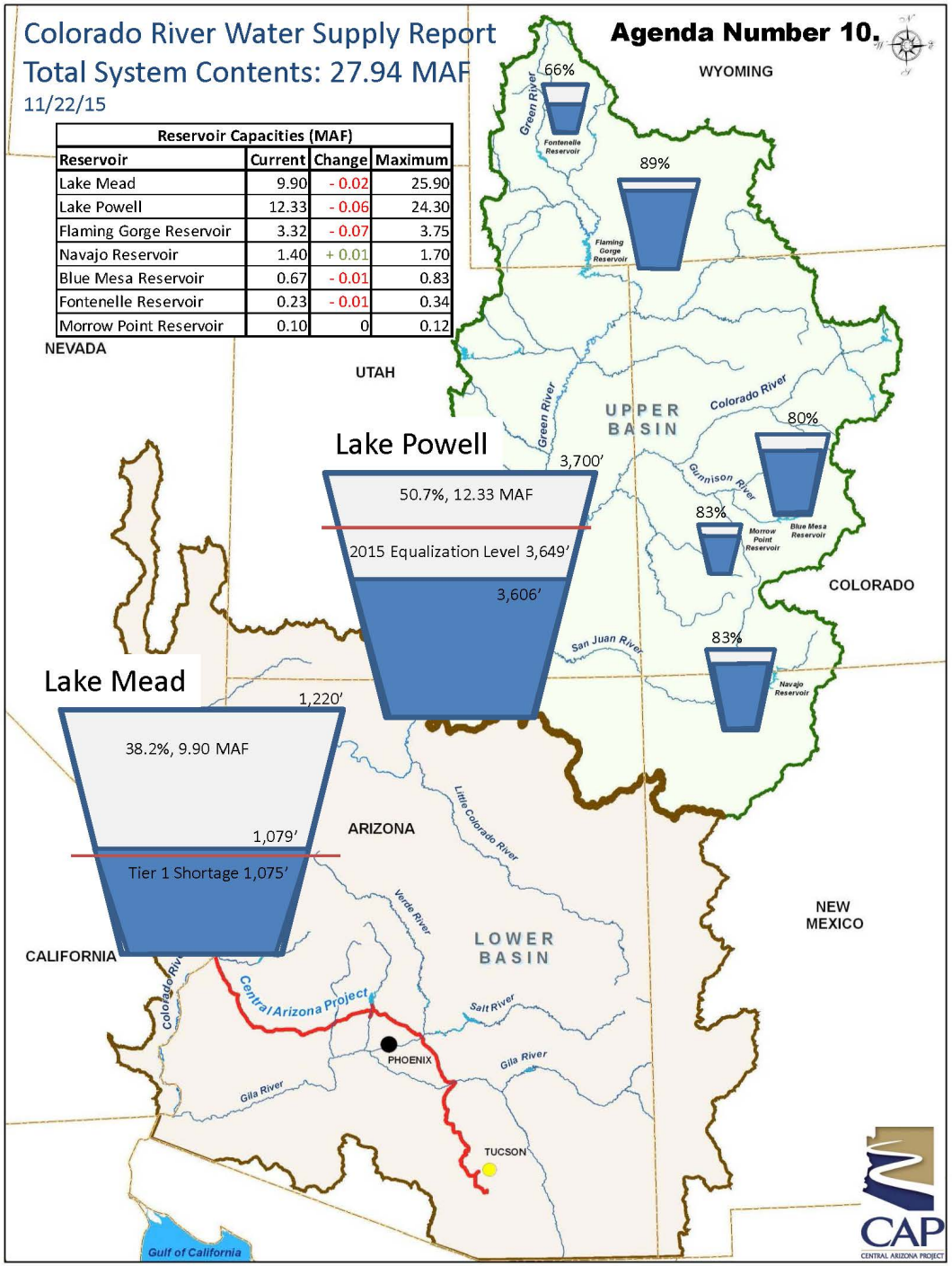


Photo at Hoover Dam by Rodolfo Peón - May 2015

How the states work together

- Example: Developed the 2007 interim shortage sharing guidelines
  - when there will be cutbacks to Lower Basin Colorado River water deliveries
  - How the two large reservoirs, Lake Powell and Lake Mead, will be regulated conjunctively
- 2012 Colorado River Basin Water Supply and Demand Study and follow-on efforts
- The general view is that the states will work together to come up with solutions that do not require changes to the “Law of the River”

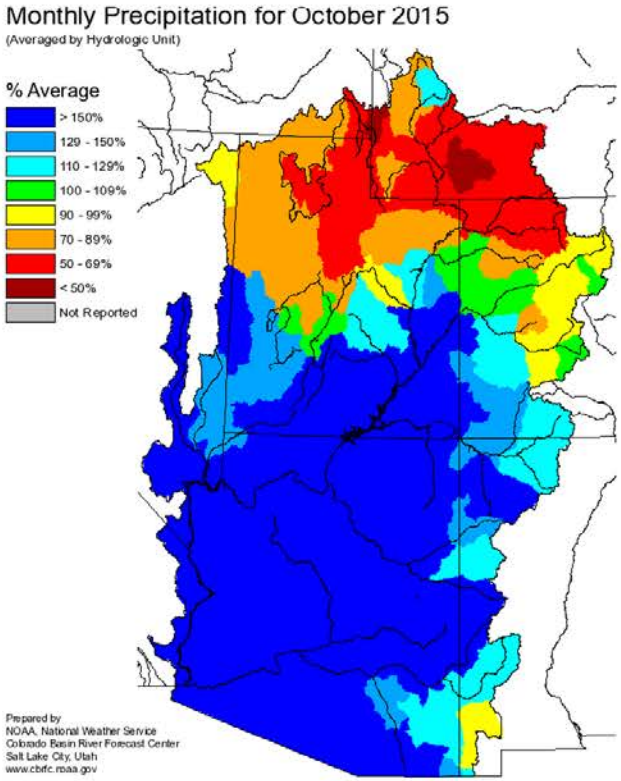


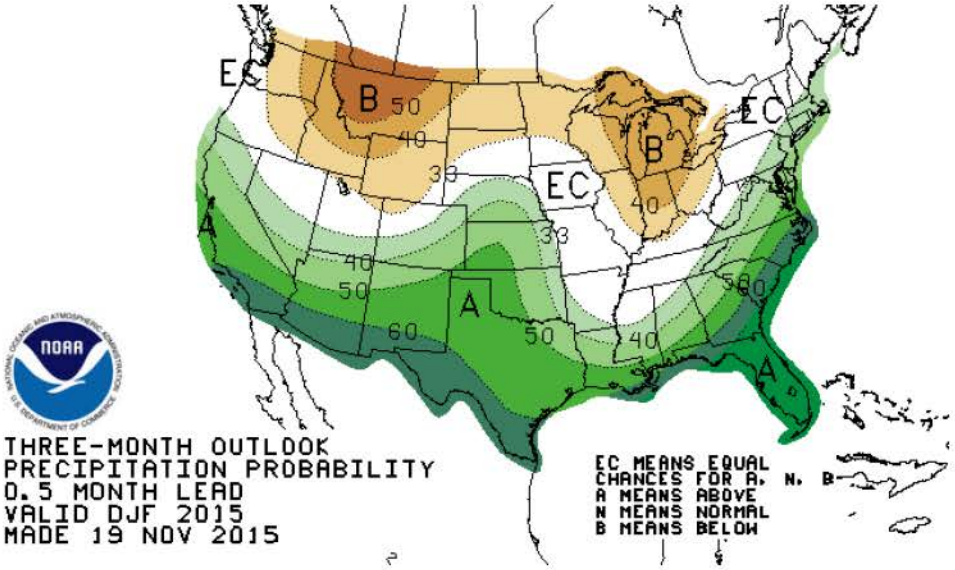
Colorado River flows updated regularly based on models, along with probabilities of shortage declaration for the Lower Colorado River Basin

Monthly Precipitation

The Colorado River Basin experienced an unusually wet May, with 150% of average precipitation. This trend persisted in the Lower Basin and Four Corners area into June. July saw the beginning of a drying trend that resulted in average precipitation for August in the Lower Basin, and a very dry September.

Precipitation was well above the monthly historical average for Arizona, most of the Lower Colorado River Basin, and the headwaters of the Muddy/Virgin Rivers in Utah for October 2015; the 4th warmest October on record. Precipitation was at 150% of the October monthly average in the Lower Basin, which is consistent with the onset of an El Niño-dominated winter. Although still early in the season, low precipitation was recorded for the month in areas near the headwaters of the Green River.



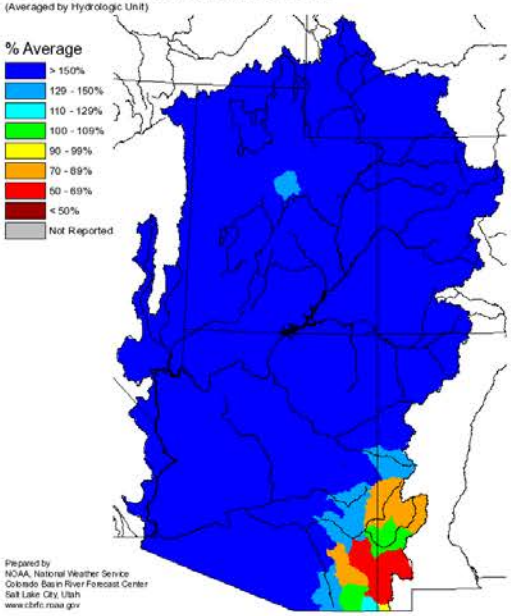


90 Day Precipitation Outlook

The three month precipitation forecast provided by the National Oceanographic and Atmospheric Administration (NOAA) continues to show a higher than normal probability of precipitation over the Southern United States, Southern Rockies, and Central Plains. The precipitation outlook is consistent with a strong El Niño signal, and the Lower Colorado River Basin and part of the Upper Colorado River Basin have a 40-60% chance of above-normal precipitation. A 33-40% chance of below-normal precipitation exists for the headwaters of the Green River in Southwestern Wyoming.

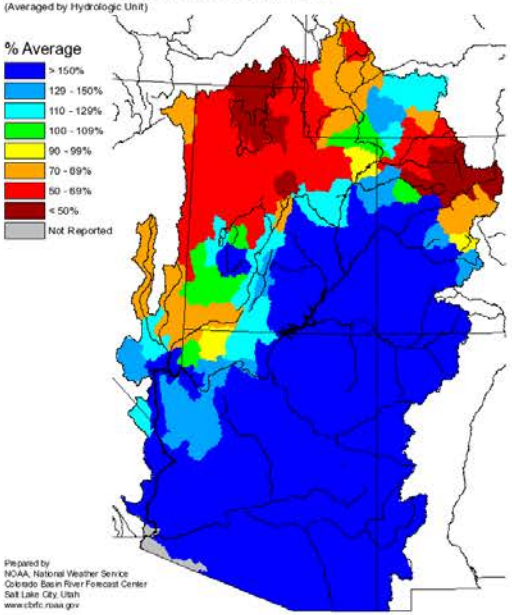
Monthly Precipitation for May 2015

(Averaged by Hydrologic Unit)



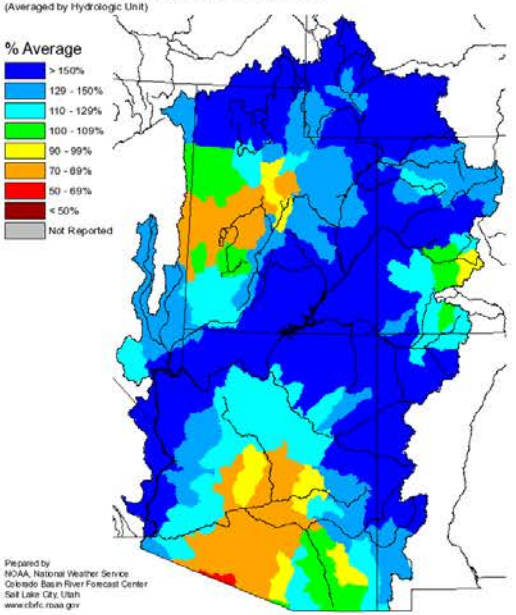
Monthly Precipitation for June 2015

(Averaged by Hydrologic Unit)



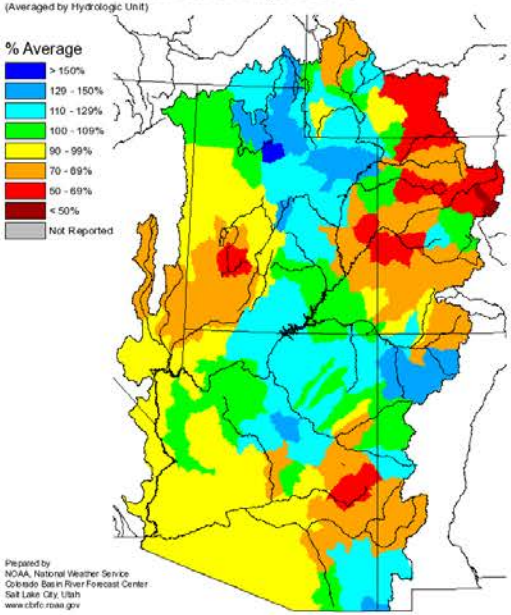
Monthly Precipitation for July 2015

(Averaged by Hydrologic Unit)



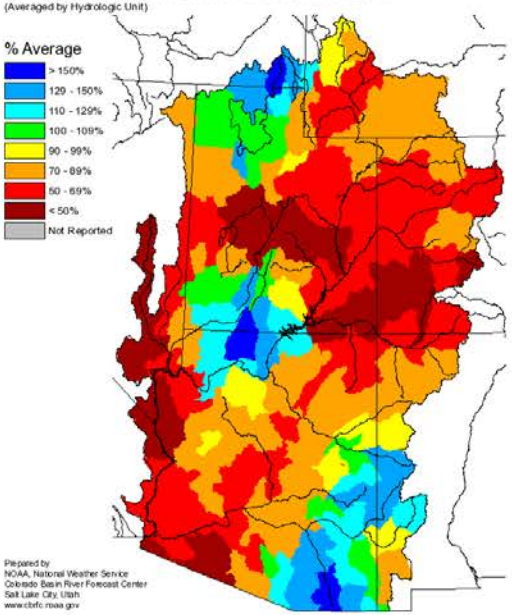
Monthly Precipitation for August 2015

(Averaged by Hydrologic Unit)



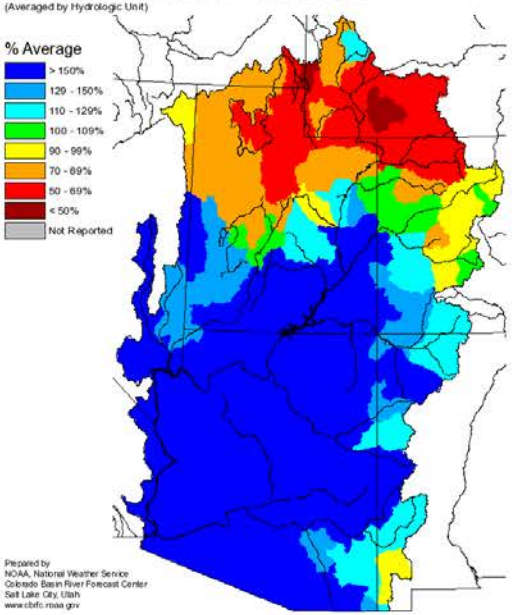
Monthly Precipitation for September 2015

(Averaged by Hydrologic Unit)

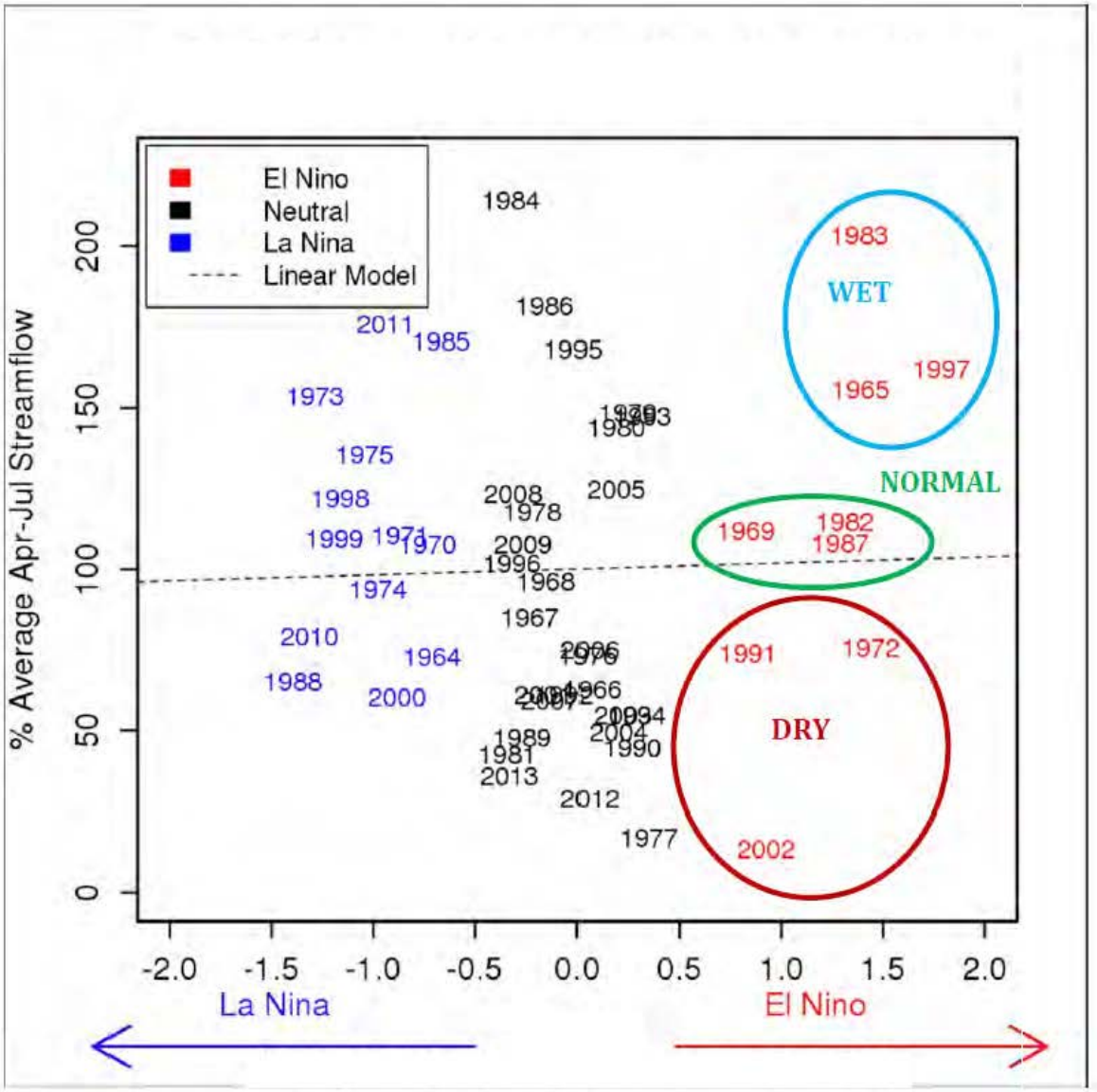


Monthly Precipitation for October 2015

(Averaged by Hydrologic Unit)



What about El Niño and the Colorado River Basin?



Source: Paul Miller, CBRFC (Colorado Basin River Forecast Center)

Innovative agreements to forestall Colorado River shortage declaration:

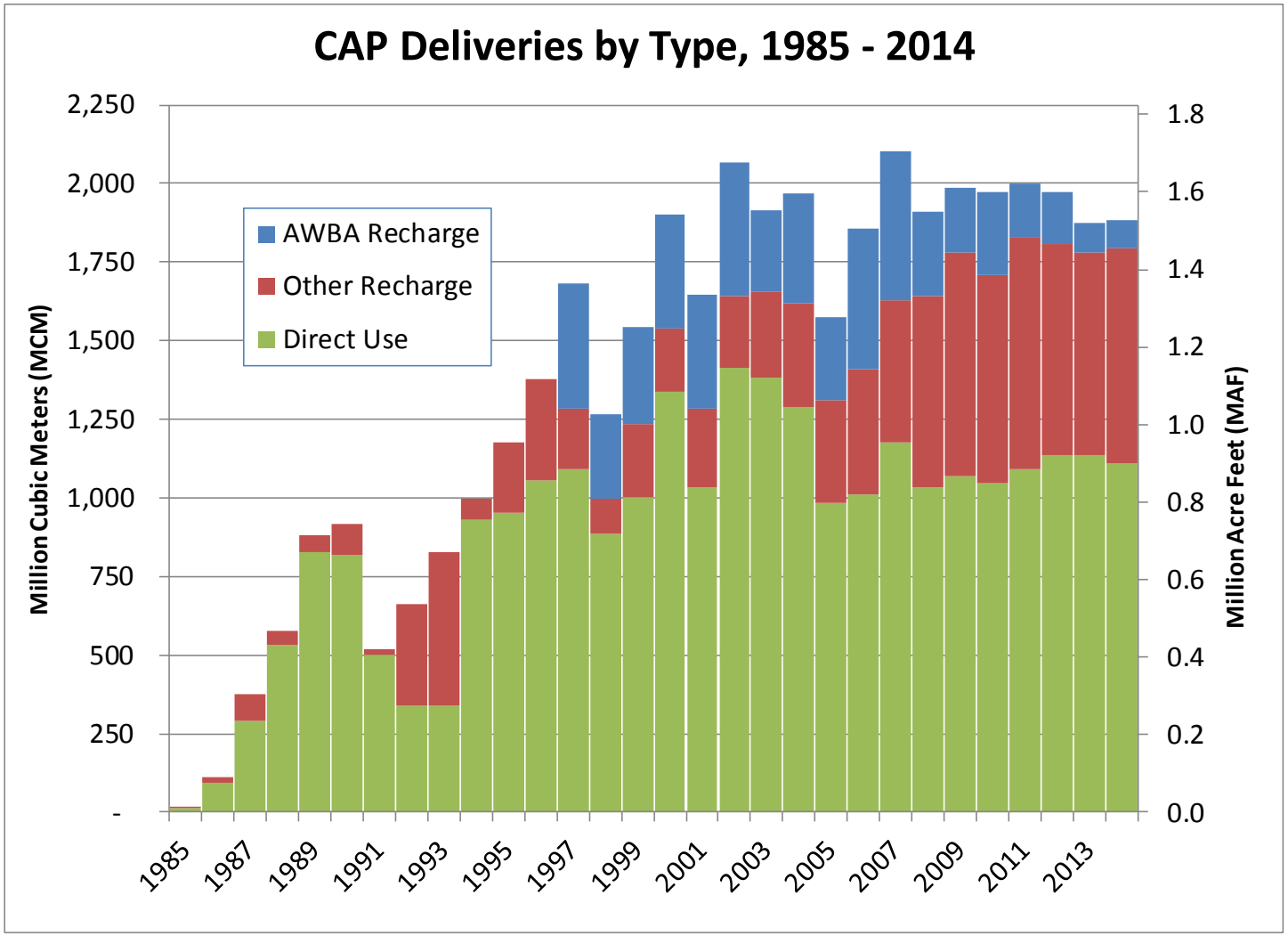
Lower Basin Pilot Drought Responses Action MOU and Pilot System Conservation Agreement

Southern Nevada Water Authority, Metropolitan Water District of Southern CA,and Central Arizona Project all involved

	Lower Basin Pilot Drought Response Actions MOU	Pilot System Conservation Agreement
Goal	RESERVOIR PROTECTION - Store or conserve 740 kaf in Lake Mead	Create SYSTEM WATER in Lake Mead / Lake Powell (est. 75 kaf)
Parties	BOR, ADWR, CAP, SNWA, CRCN, MWD, CRBC	BOR, CAP, MWD, SNWA, Denver Water
Term	2014 – 2017	2015 – 2016, or until funds expended
Scope	Lower Basin Colorado River contractors (AZ, CA, NV) and entitlement holders	Upper Basin, Lower Basin, and Mexico Colorado River contractors and entitlements holders
Commitments	Res. Protection Total = 740 kaf CAP = 345 kaf, MWD = 300 kaf, SNWA = 45 kaf, BOR = 50 kaf ADWR, CRCN, CRBC = 0	Total = $11M BOR = $3M, CAP = $2M, MWD = $2M, SNWA = $2M, Denver Water = $2M
CAP Commitments	Create 345 kaf through conservation/storage in Lake Mead by EOY '17 - ICS Programs: Ag Pool, and Local Supply Replacement - System Water: YMIDD, AZ Unused (Art. II.B.6), Turnback	Contribute funding ($2M)

Arizona has not been waiting for a shortage to be declared

Arizona Water Banking Authority established in 1996



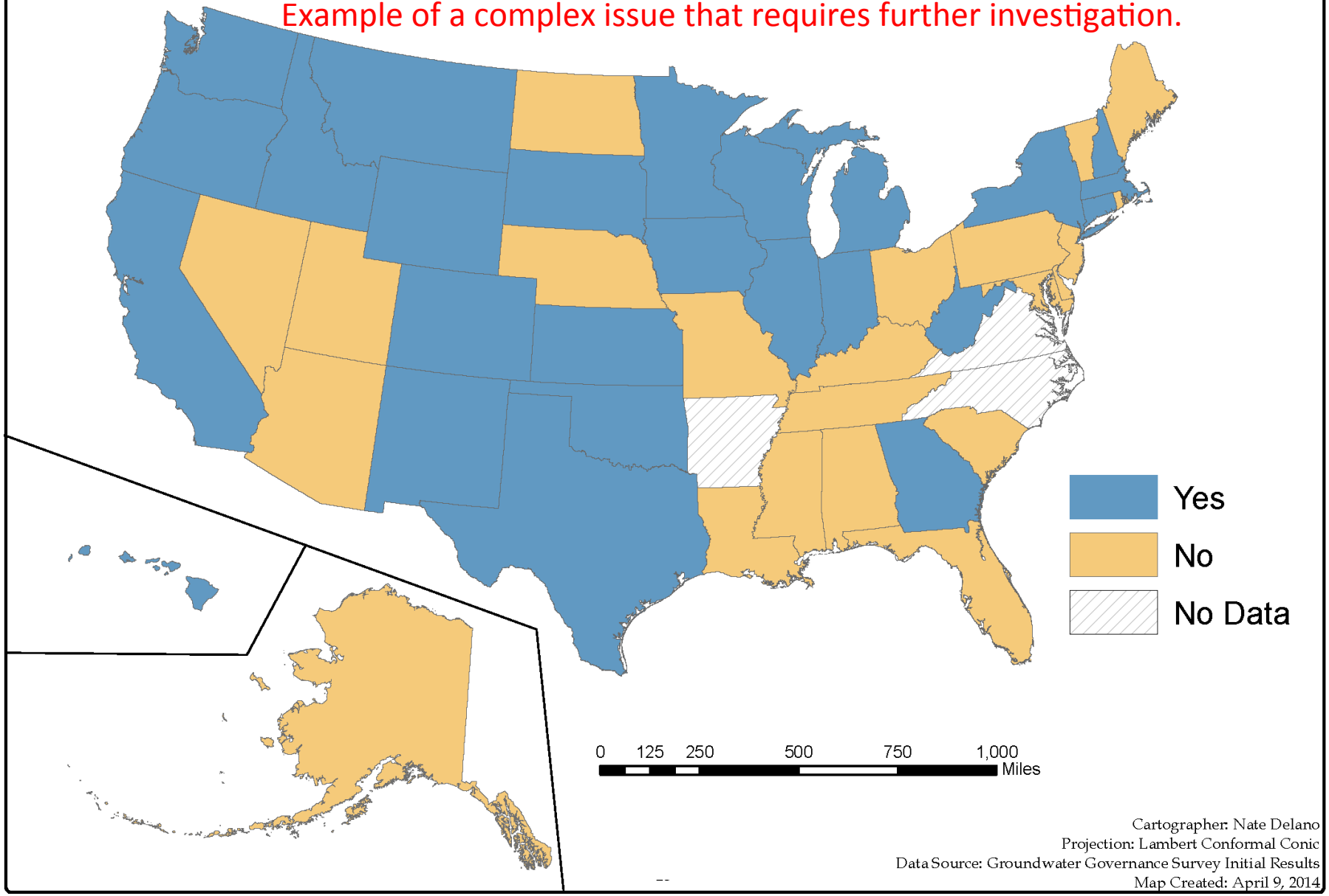
Q2. How can surface water and groundwater be managed in a holistic and sustainable way?

- Difficult issue to address in some areas due to legal frameworks
- Groundwater governance and management
  - Varying laws and frameworks
  - Groundwater in storage and groundwater use may not be measured and monitored
- Water storage and banking
  - Example: Arizona Water Banking Authority

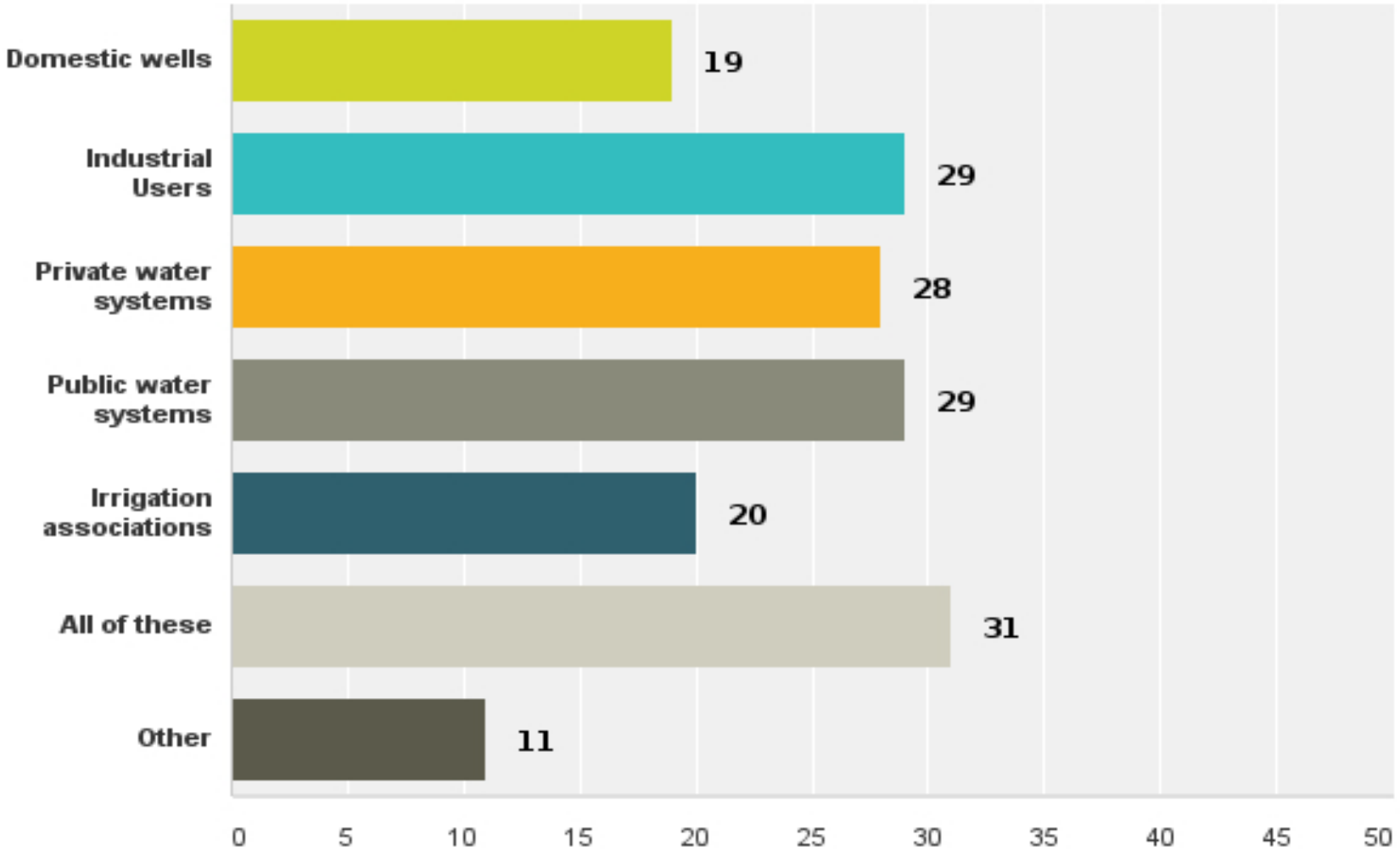
References:
Megdal, S.B., Gerlak, A., Varady, R., and Huang, L. (2015). Groundwater governance in the United States: Common priorities and challenges. *Groundwater 53*(5), pp.677-684. http://dx.doi.org/10.1111/gwat.12294.
Megdal, S.B., Dillon, P., and Seasholes, K. (2014). Water banks: Using managed aquifer recharge to meet water policy objectives. In Megdal, S.B., and Dillon, P. (Eds.), [Special Issue on Policy and Economics of Managed Aquifer Recharge and Water Banking]. *Water 6*(6), pp. 1500-1514. http://dx.doi.org/10.3390/w6061500.

Does State Law Recognize the Connection Between Surface and Groundwater?

Example of a complex issue that requires further investigation.

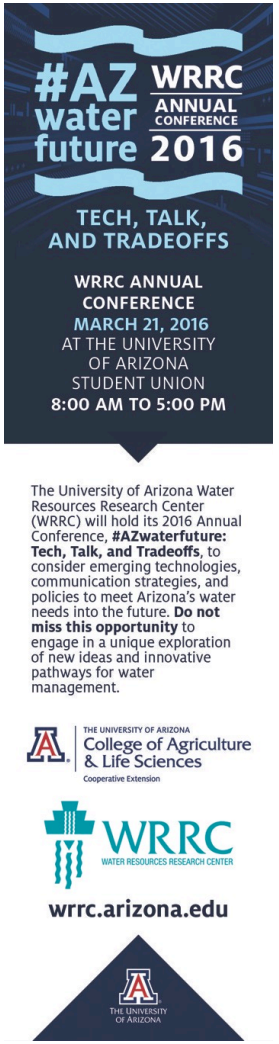


Q18 To which of the following user groups do groundwater regulations apply?



Q3. What monitoring, data and regulatory mechanisms are required for sustainable water use?

A LOT
Also MONEY is needed



Q3. Some Options and Opportunities for Sustainable Water use

- Demand side: Increased conservation and water use efficiencies
  - Revenue implications for utilities
  - Consider how demand estimates are formulated and recognize that land use decisions may affect future demand
- Increase use of reclaimed water, including for potable purposes
- Desalination
  - Brackish water desalination
  - Seawater desalination.
    - Exchanges related to seawater desalination or possible transport
  - Reclaimed water desalination
- Augmentation
  - Importation
  - Storage
  - Weather modification
- Water transactions
- Financing options, including public, private partnerships

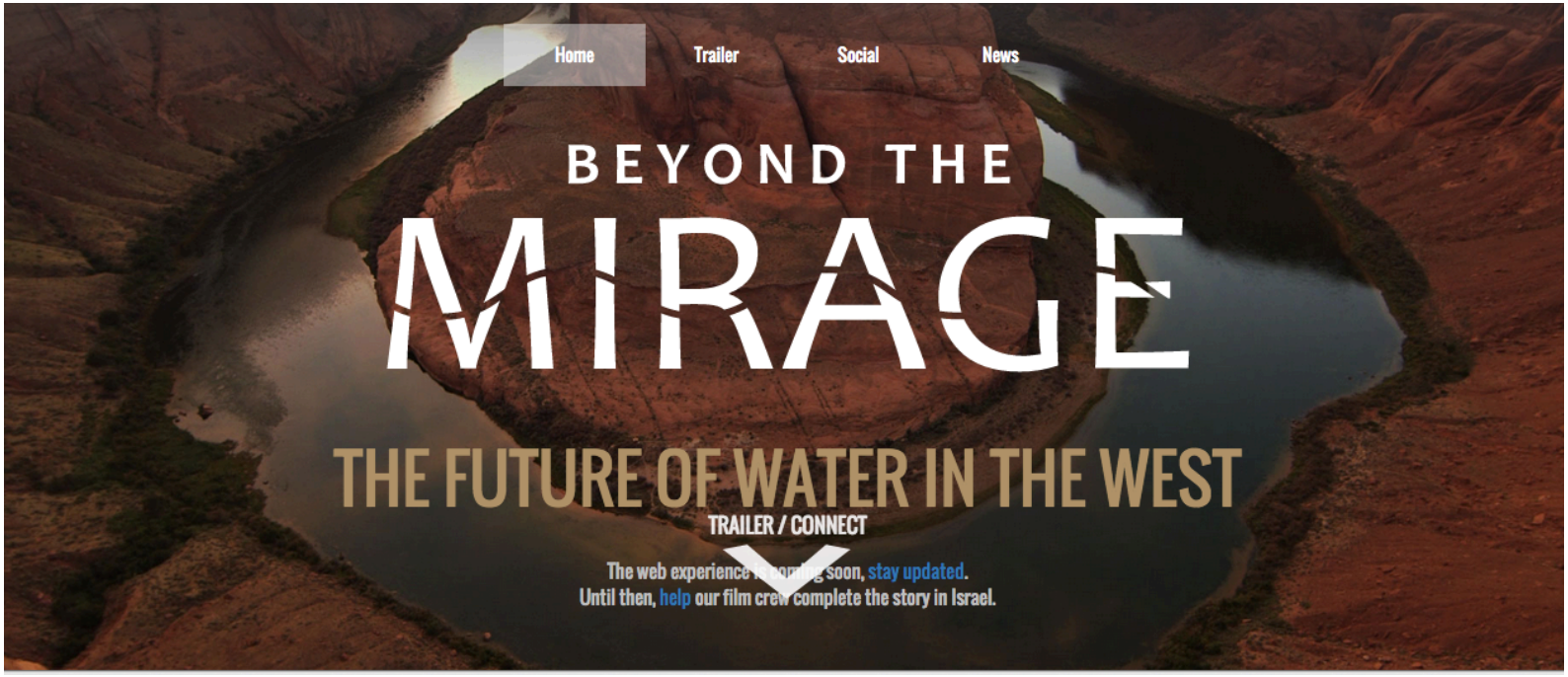
Importance of water rights framework

Agriculture

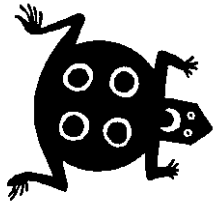
Education and Engagement

- Education and engagement of water stakeholders so that informed decisions can be made for the long term

The conference included a poster session that showcased the work of 25 research projects and programs. Source: Lynn Ketchum



The frog does not drink up the pond in which he lives. – *American Indian (Lakota) Proverb*



Thank you!

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