2016
Arizona Drought Preparedness Annual Report

For Water Year 2016: October 1, 2015 – September 30, 2016

ARIZONA DEPARTMENT of WATER RESOURCES EST. 1980

PROTECTING
ARIZONA'S WATER SUPPLIES
for ITS NEXT CENTURY

2016 Arizona Drought Preparedness Annual Report

Acknowledgements

The *Arizona Drought Preparedness Plan* was adopted in 2004 and its continued implementation ordered in 2007 (EO 2007-10). The Arizona Department of Water Resources (ADWR) prepares the report each year based on updates from the Drought Monitoring Technical Committee, Interagency Coordinating Group, Local Drought Impact Groups and others. The 2016 Drought Preparedness Annual Report covers the drought conditions and preparedness activities for the 2016 water year, from October 1, 2015 through September 30, 2016. ADWR acknowledges and thanks all who contributed to this report.

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2016 Arizona Drought Preparedness Annual Report

1. Introduction

Arizona has been in a state of long-term drought for approximately 22 years. Although Arizona's long-term drought status has improved over the last two years, most of the state is still experiencing abnormally dry conditions. Reservoirs for the Salt and Verde Watersheds continue to hover around 50% of capacity and the additional groundwater pumped during the drought has not been recharged. Additionally, moisture deficit is not currently increasing, but it has not recovered from the drought, so long-term conditions are still poor. Due to such conditions, every county, besides Coconino, had a United States Department of Agriculture disaster designation due to the impacts of drought this water year. The enhanced chances for above normal winter precipitation due to El Niño did not materialize for Arizona this water year, though the Upper Colorado River Basin did reasonably well this winter compared to the previous three winters. Arizona's drought preparedness plan activities continue to provide a framework to monitor drought, improve understanding of drought impacts, and determine mechanisms for limiting future vulnerability.

2. Drought Status Summary

A. Winter Precipitation: October 2015 – April 2016

The winter of 2014-15 (**Fig. 1**) was extremely dry on both the Upper Colorado River Basin (Upper Basin) and the Salt and Verde Watersheds. The Colorado Plateau and southeast basins were the wettest areas of Arizona with nearly normal precipitation. By comparison, the winter of 2015-16 was significantly wetter on the Upper Basin and much drier across most of Arizona (**Fig. 2**). Only the northern part of the Colorado Plateau experienced near to above average precipitation in Arizona. The wet conditions on the Upper Basin were welcome as three of the previous four years have been drier than normal. The El Niño that was forecasted failed to produce the expected precipitation across the southwest, but fortunately the wet conditions on the Upper Basin provided much needed inflow to Lakes Powell and Mead. However, due to extensive drought conditions, Lake Mead's elevation levels remain near the first shortage trigger level and there is no indication that the 2016-17 winter will be wetter than normal either on the Upper Basin or the Salt and Verde Watersheds.

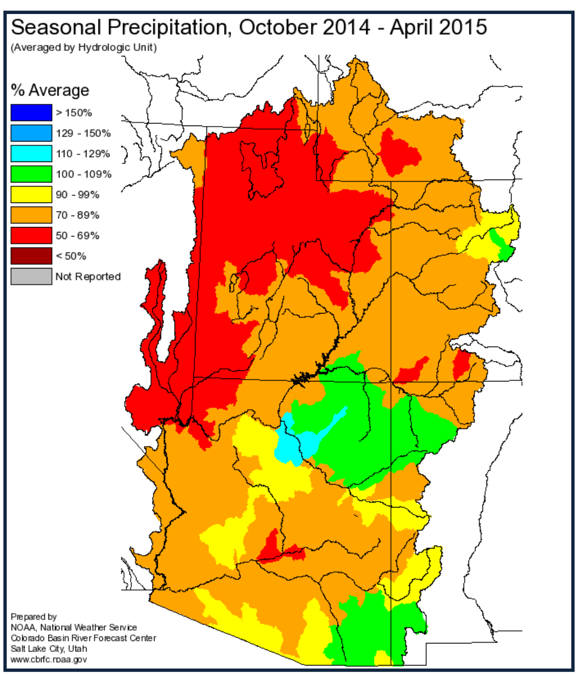


Figure 1. Precipitation Oct. 2014 – Apr. 2015.

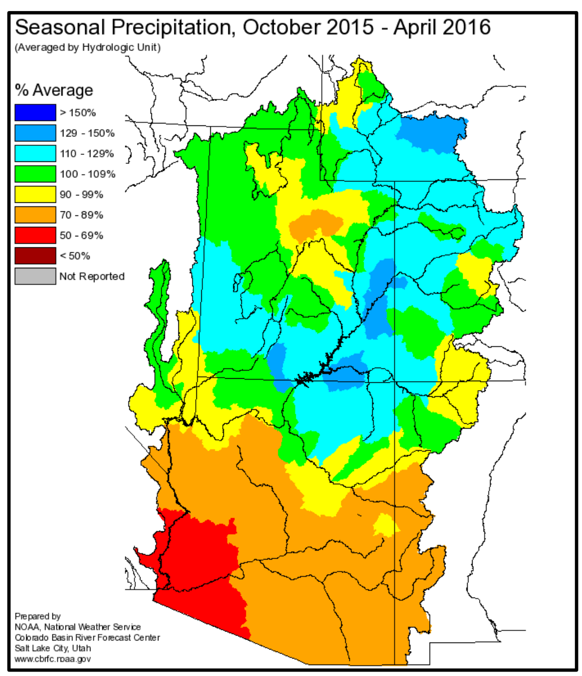


Figure 2. Precipitation Oct. 2015 – Apr. 2016.

Snow accumulation during the winter season (**Fig. 3**) was well below normal across the state. Heavy storms in early January and February brought the snowpack up temporarily. However, very little snow accumulated for the remainder of the season and the statewide snowpack ended up well below the 30-year median.

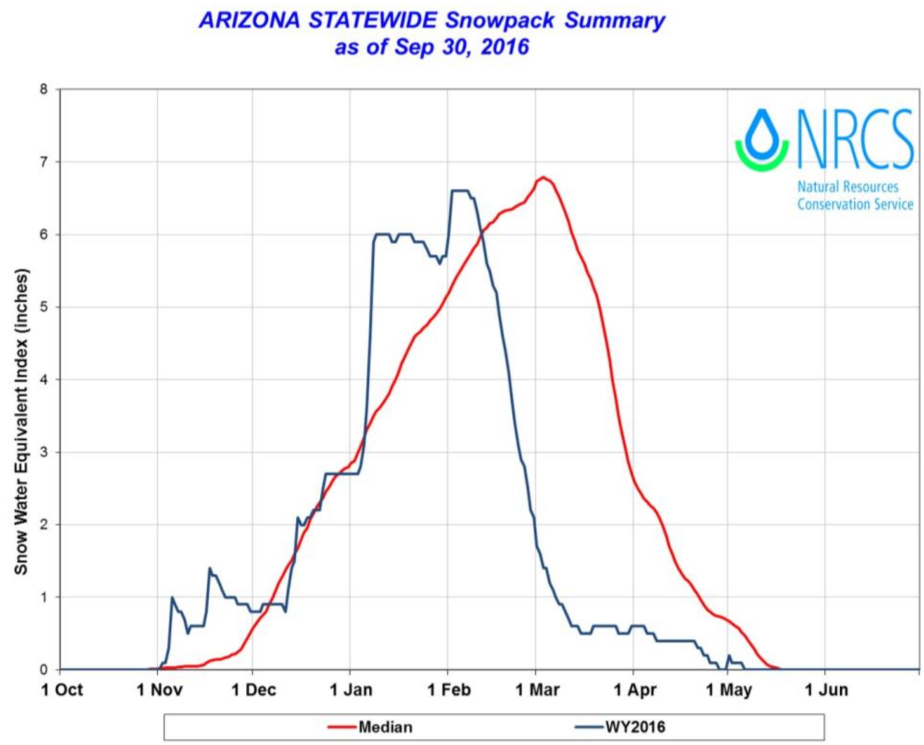


Figure 3. 2016 Snowpack Summary According to Data Collected from the USDA Natural Resources Conservation Service.

B. Monsoon Precipitation: June – September 2016

Rainfall during the 2016 monsoon (**Fig. 5**) was much more consistent than the 2015 monsoon rainfall (**Fig. 4**). Both summers had moisture from eastern Pacific hurricanes drawn into the monsoon circulation. Rainfall in 2015 was more localized with very dry areas adjacent to very wet areas.

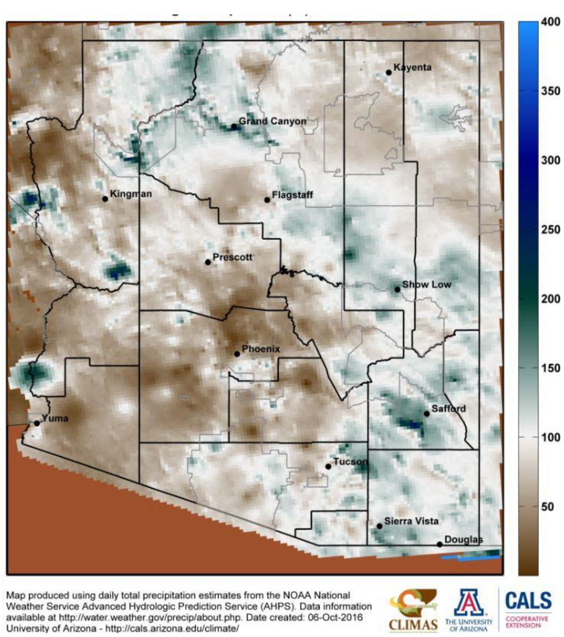


Figure 4. Monsoon 2015 % of Normal Rainfall

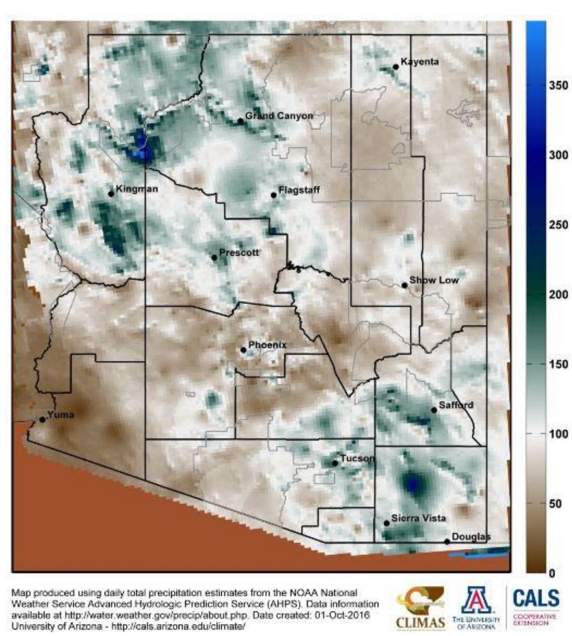


Figure 5. Monsoon 2016 % of Normal Rainfall

Rainfall in 2016 was much heavier in the northwestern and southeastern counties, as much as 200-250% of normal. Much of the rangeland in the state remained green through the summer throughout the Mogollon Rim, the north central Colorado Plateau, and the southeast. Yuma County missed out on most of the activity this year, and central Arizona was also bypassed by most of the storm systems.

C. Cumulative Precipitation and Streamflow Summary

→ *Precipitation*

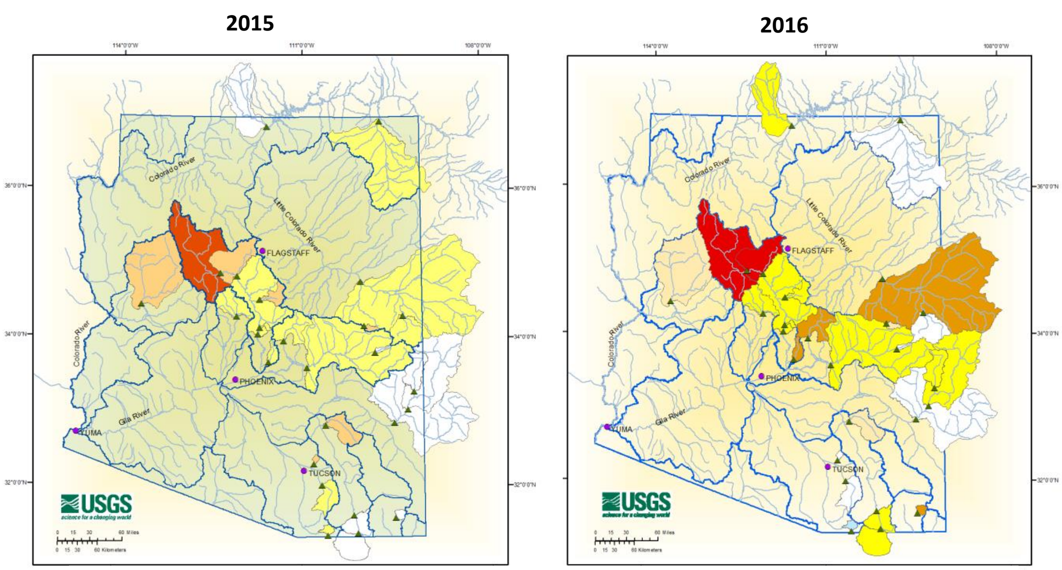
Cumulative precipitation for water year 2016 ended up at below normal levels throughout the mountainous areas of Arizona, ranging from 82% to 94% of average in the major river basins. A well below normal winter was followed by a near normal monsoon which resulted in the below average conditions for the entire water year (**Table 1**).

Table 1. Water Year 2016 Mountain Precipitation (as of September 30, 2016)

Major Basin	Percent of 30-year Average Precipitation
Salt River Basin	85%
Verde River Basin	94%
San Francisco-Upper Gila River Basin	82%
Little Colorado River Basin	90%

→ *Streamflow*

Overall drought status, as indicated by streamflow data, shows an increase in drought severity throughout Arizona from 2015 to 2016 (**Fig. 6**). On the other hand, most basins are still showing no drought to abnormally dry conditions, similarly to 2015 (18 in these two categories in 2015 and 16 in 2016). Basins that increased drought status did so by one to three drought categories; those that decreased did so by one or two categories. Out of the 25 basins; eight remained at the same level, six decreased, and 11 increased in drought severity. The first and second quarter had the basins with the least amount of drought. This condition continued to deteriorate during the spring as little snow pack resulted in below average runoff. In April through June basins gradually increased in the severity of drought. With the arrival of Monsoon precipitation, and continuing through the end of the water year, drought conditions continued to decrease.



Level	Description	Percentile	Color
	No Drought	>30	
D0	Abnormally Dry	21-30	
D1	Moderate	11-20	
D2	Severe	6-10	
D3	Extreme	3-5	
D4	Exceptional	0-2	
	Discontinued		

Figure 6. As determined by USGS stream gages, overall drought condition from 2015 to 2016 improved from Moderate Drought to Abnormally Dry.

D. Drought Index Wells

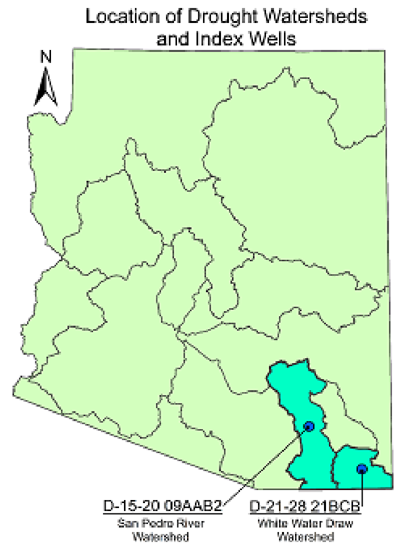


Figure 7. Arizona drought watersheds (WS). Well # D-15-20 09AAB2 is located near the center of the San Pedro River WS. Well # D-21-28 21BCB is located near the center of the White Water Draw WS.

Two ADWR groundwater index wells located in southeastern Arizona serve as qualitative supplements to existing drought indicators (**Fig. 7**). Both wells have been identified as meeting criteria for USGS Climate Response Network observation wells (criteria can be found at http://groundwaterwatch.usgs.gov/Net/OGWNetwork.asp?ncd=crn). Continuous groundwater levels for each well are plotted in figures 8-11, with colored overlays corresponding to historical short- or long-term drought categories (of the watershed if before March 2010, or at the location of groundwater level measurement if after March 2010). The solid blue lines represent historical daily median depth-to-water (DTW) below land surface during the periods of record shown. DTW measurements are recorded near-continuously (four times per day) via a pressure transducer and verified with less frequent manual measurements (four times per year).

→ *San Pedro River Watershed Groundwater Index Well*

Figures 8 and 9 show continuous water level data for ADWR Index Well D-15-20 09AAB2 beginning June 7, 2009 with an initial DTW reading of 32.21 feet. The maximum DTW reading of 33.89 feet was recorded on July 4, 2014, and the minimum DTW reading of 26.1 feet was recorded on September 20, 2014. Water levels at this well are characterized by a relatively large increase in water level (decrease in DTW) around July followed by a sharp decrease in water level through October, then a gradual increase in water level from November through February, followed by a steady decrease in water level through June. This seasonal pattern persists through the entire record. The magnitude of the July or summer water level rise is dependent on precipitation events. Precipitation events in the summer of 2014 appear to have had a mitigating effect on the overall downward-trending water levels at this well (note deviation from historical median from summer of 2011 to summer of 2014, and return to historical median from the summer of 2015 onward). Generally, a drop in DTW is followed by increased severity of drought status (especially for long-term drought status). Long-term, high-resolution records of DTW may prove to be useful qualitative drought-status indicators throughout the state.

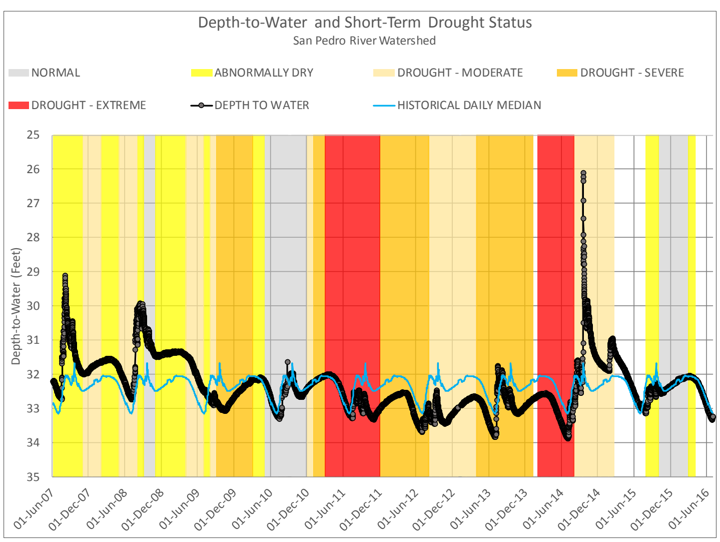


Figure 8. Continuous groundwater levels for drought index well in the San Pedro River Watershed, plotted with *short-term* drought status, and historical daily median depth-to-water.

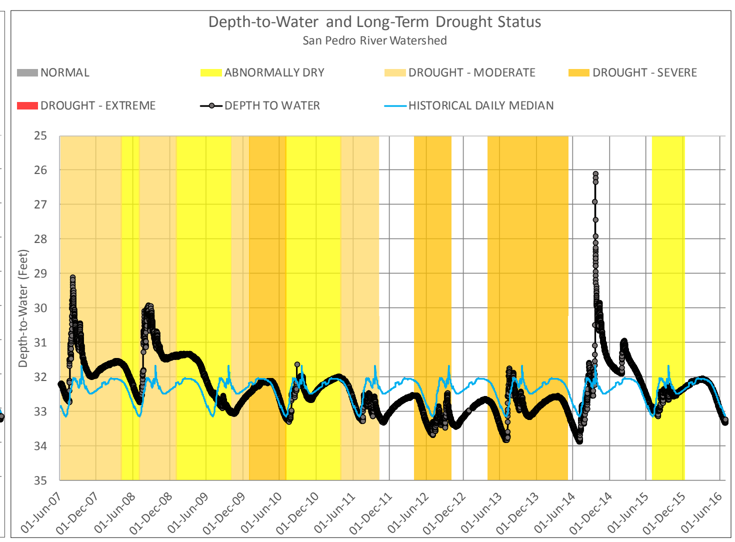


Figure 9. Continuous groundwater levels for drought index well in the San Pedro River Watershed, plotted with *long-term* drought status, and historical daily median depth-to-water.

→ *Whitewater Draw Watershed Groundwater Index Well*

Figures 10 and 11 show continuous water level data for ADWR Index Well D-21-28 21BCB beginning April 9, 2009 with an initial DTW reading of 4.76 feet. The maximum DTW reading of 18.35 feet was recorded on September 13, 2012 and the minimum DTW reading of 1.45 feet was recorded on January 31, 2015. Seasonal water level fluctuations at this well are characterized by a relatively smooth and steady increase (decrease in DTW) from June to December, peaking through January, and decreasing again to June. The amplitude of this pattern varies widely during the observed record, from essentially none in 2011 to over 12 feet in 2013. The trend in water level correlates generally with both short- and long-term drought status; periods of water level increase or decrease are commonly followed by appropriate adjustments of drought category.

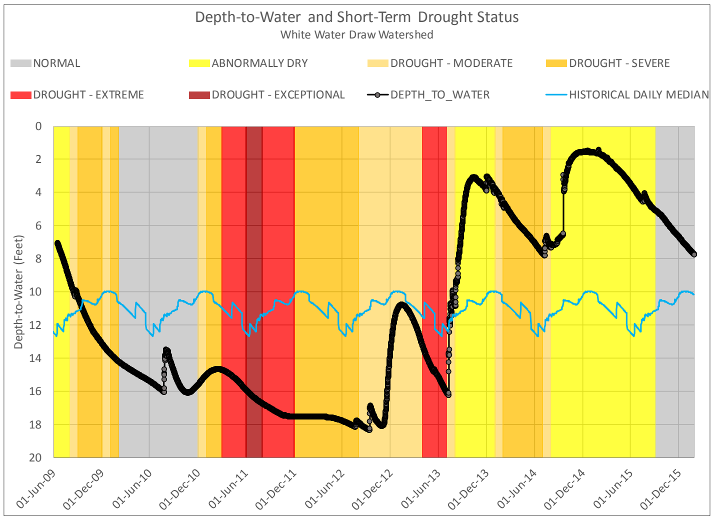


Figure 10. Continuous groundwater levels for drought index well (D-21-28 21BCB) in the Whitewater Draw Watershed, plotted with short-term drought status, and historical daily median depth-to-water.

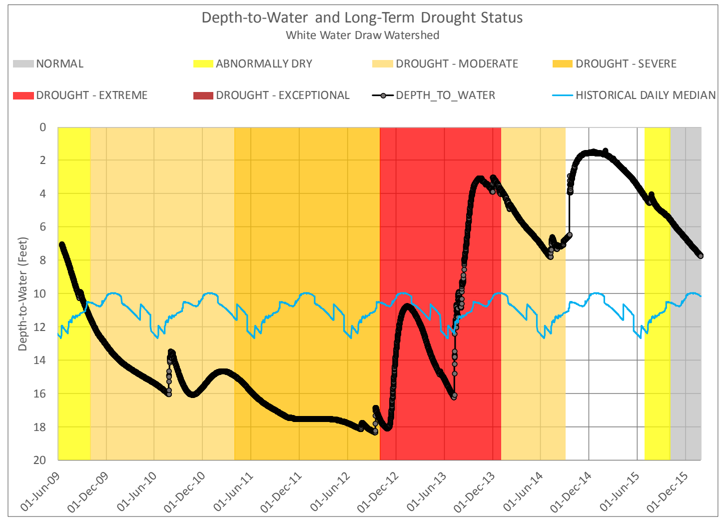


Figure 11. Continuous groundwater levels for drought index well (D-21-28 21BCB) in the Whitewater Draw Watershed, plotted with long-term drought status, and historical daily median depth-to-water.

E. Water Supply Status

→ *2015 Colorado River Basin and Reservoir Status*[1]

Near to below average streamflow was observed throughout much of the Colorado River Basin during water year 2016. Unregulated[2] inflow to Lake Powell in water year 2016 was 9.62 million acre-feet (MAF) or 89% of the 30-year average[3], which is 10.83 MAF. Unregulated inflow to Flaming Gorge, Blue Mesa, and Navajo Reservoirs was 98, 92, and 80 % of average, respectively.

Precipitation in the Upper Colorado River Basin was just below average during water year 2016. On September 30, 2016, the cumulative precipitation received within the Upper Colorado River Basin for water year 2016 was 95% of average.

Snowpack conditions trended near average across most of the Colorado River Basin throughout the snow accumulation season. The basin-wide snow water equivalent measured 97% of average on April 1, 2016.

[1] The source of the information in this section is taken from the United States Bureau of Reclamation's November 2016 draft "Annual Operating Plan for Colorado River Reservoirs 2017." The information has been updated to the end of the 2016 water year, where appropriate and where data was available.

[2] Unregulated inflow adjusts for the effects of operations at upstream reservoirs. It is computed by adding the change in storage and the evaporation losses from upstream reservoirs to the observed inflow. Unregulated inflow is used because it provides an inflow time series that is not biased by upstream reservoir operations.

[3] All unregulated inflow, precipitation, and snowpack statistics are based on the 30-year period 1981-2010.

Total seasonal accumulation peaked at approximately 97% of average on April 3, 2016. On April 1, 2016, the snow water equivalents for the Green River, Upper Colorado River Headwaters, and San Juan River Basins were 107, 109, and 82% of average, respectively.

During the 2016 spring runoff period, inflows to Lake Powell peaked on June 11, 2016 at approximately 58,900 cubic feet per second (CFS). The April through July unregulated inflow volume for Lake Powell was 6.61 MAF, which was 92% of average.

Lower Basin tributary inflows above Lake Mead were below average for water year 2016. Tributary inflow from the Little Colorado River for water year 2016 totaled 0.050 MAF, or 35% of the long-term average. Tributary inflow from the Virgin River for water year 2016 totaled 0.118 MAF, or 65% of the long-term average.

Tributary inflows in the Lower Colorado River Basin below Hoover Dam were below average during water year 2016. Total tributary inflow for water year 2016 from the Bill Williams River was 0.015 MAF, or 16% of the long-term average, and total tributary inflow from the Gila River was 0.006 MAF.

The Colorado River total system storage experienced a net decrease of 0.134 MAF in water year 2016. Reservoir storage in Lake Powell increased during water year 2016 by 0.491 MAF. Reservoir storage in Lake Mead decreased during water year 2016 by 0.235 MAF. At the beginning of water year 2016 (October 1, 2015), Colorado River total system storage was 51% of capacity. As of September 30, 2016, total system storage was 51% of capacity.

At the beginning of calendar year 2016, the probability of Lower Colorado River Basin shortage declaration in 2017 was 37%. Due to the higher than expected runoff into Lake Powell during January through March 2016, United States Bureau of Reclamation's (Reclamation) April 2016 projections for a shortage in 2017 decreased to 10%. Because of the unusually high precipitation in the Upper Colorado River Basin in May, runoff forecasts for unregulated inflow into Lake Powell increased markedly and Reclamation's projection of a Lower Colorado River Basin shortage in 2017 decreased to 0%. The official operational forecast for 2017 made by Reclamation in August shows a 0% chance of shortage in 2017 and 48% chance of a shortage declaration in 2018.

→ *2015 Salt and Verde Reservoirs*

This is the sixth consecutive year that the Salt and Verde watersheds experienced below median winter runoff. Even so, the Salt and Verde reservoirs have remained at the same levels as this time last year, approximately 47% full. This is due to the continued use of groundwater to meet demand, a normal monsoon season and a general decrease in demand over historical norms. If projections for very low inflow hold, this consecutive six-year period, 2011-16, will be the driest six-year period on record (1913-2016). Projections for this winter are uncertain. Weak La Niña conditions are possible in the tropical Pacific and might decrease winter storm precipitation in Arizona.

→ *Rural Areas*

While the most populated areas of the state are subject to stringent groundwater management, have mandatory water conservation requirements and have access to diverse water supply portfolios, most of rural Arizona relies exclusively on groundwater as its primary water source, and lacks comprehensive groundwater management regulation. Lack of targeted groundwater management along with the effects of the ongoing drought can result in water supplies being more stressed in some areas of rural Arizona.

Currently, there are only two water management tools available that were designed to directly manage groundwater withdrawal and use. These tools are Active Management Areas (AMAs) and Irrigation Non-Expansion Areas (INAs). Groundwater withdrawn from inside of an AMA can be subject to withdrawal fees, metering, annual reporting, conservation requirements, and other provisions, while groundwater withdrawn from inside of an INA can be subject to metering and reporting.

As a part of the Planning Area Process portion of the Arizona Water Initiative (**Appendix D**), ADWR has committed additional resources to evaluating water supply and demand imbalances in each of the 22 Planning Areas identified in the Arizona's Strategic Vision for Water Supply Sustainability Report. This process allows local stakeholders to participate in development of better water demand information and a consensus-driven set of solutions for future water supply and demand imbalances.

The West Basins, Cochise, and Northwest Basins Planning Areas have been identified as the focus of the Planning Areas Process for the 2016 calendar year (**Fig. 12**). More information regarding the Arizona Water Initiative and Planning Area Process is available at:
http://www.azwater.gov/AzDWR/Arizona_Water_Initiative/index.htm.

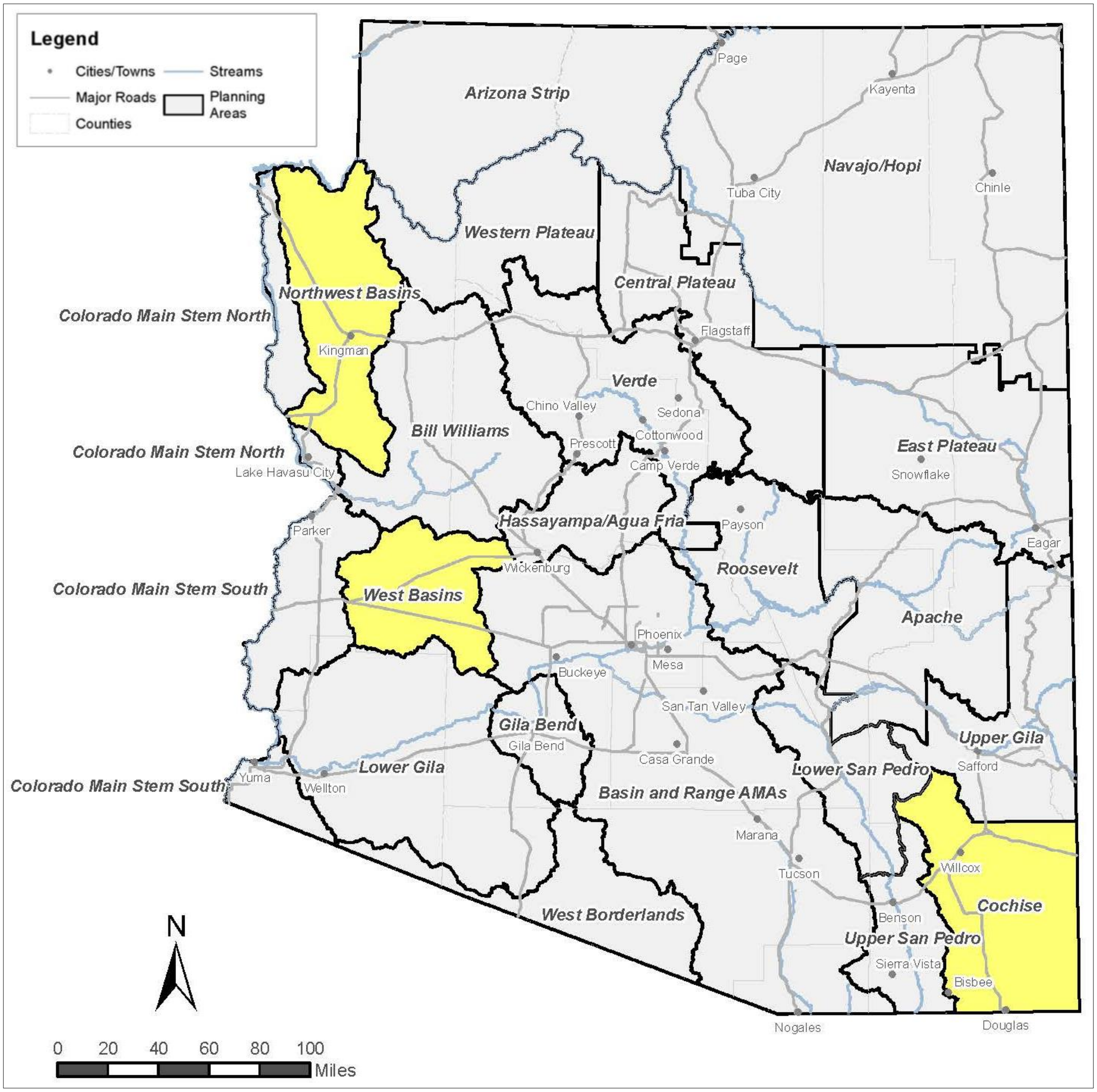


Figure 12. Arizona Water Initiative Plannig Area, including the West Basin, Cochise and Northwest Basin, which are the Planning Area Focus for 2016, highlighted in Yellow.

Planning Area Stakeholder Meetings

The initial meeting in each Planning Area is introductory in nature, and includes presentations regarding the Planning Areas process, Planning Area hydrology, and existing groundwater management tools. Subsequent meetings focus on more detailed discussions of past reports, strategies for updating area water supply and demand data, and ideas for potential solutions, including substantial opportunity for stakeholder information sharing and feedback. ADWR intends to spend about one year meeting with stakeholders in each Planning Area and will publish a report with updated water demand and supply data and recommendations for each area.

West Basins Planning Area

The West Basins Planning Area is located in the central western portion of the state and is comprised of the Butler Valley, McMullen Valley, Ranegras Plain, Tiger Wash, and Harquahala Valley Groundwater Basins. The Planning Area is within portions of La Paz, Yuma, Yavapai, and Maricopa Counties. Communities within the Planning Area include Aguila in the northeast, Brenda in the southwest, and Vicksburg, Hope, Harcurvar, and Salome in the central portion of the Planning Area.

Several stakeholders have expressed their concern that they will not be able to drill new wells fast enough or afford to drill new wells to keep up with the significant pumping occurring on irrigated land. Some residential wells have reportedly gone dry due to increasing water demand and decreasing groundwater levels, requiring residents to haul water or deepen wells. Seasonal residents make up a large proportion of the population, and those who are not registered to vote in Arizona expressed concern that they will not have a say on possible new regulations in the area, even though they own land in the West Basins. Many residents are also concerned about potential pumping related to groundwater transportation regulation in the area, as three out of the five basins in the Planning Area are designated in statute as Groundwater Transportation Basins.

Cochise Planning Area

The Cochise Planning Area is located in the southeast corner of Arizona. It is comprised of the Sulphur Springs, San Simon, and San Bernardino Valleys, covers portions of Cochise and Graham Counties, and consists of the Willcox, Douglas, and San Bernardino Valley Groundwater Basins and the San Simon Valley Sub-basin.

The economy in the Cochise Planning Area is dominated by agriculture, with an emerging wine industry. With minimal surface water availability, agriculture is heavily reliant on pumping groundwater for irrigation. Many parts of the Planning Area have experienced notable declines in groundwater levels and are in a state of overdraft. In some cases, this overdraft has led to declining groundwater levels, which has resulted in land subsidence, earth fissures, and local reports of wells going dry.

Much of the Douglas Basin is within an INA, but the rest of the Planning Area is not subject to similar groundwater regulation. In early 2015, ADWR received a petition for the initiation of procedures to designate an INA for the San Simon Valley Sub-basin. After following required statutory requirements, including conducting a public hearing, ADWR Director issued findings and a decision on October 9, 2015, that the San Simon Valley Sub-basin of the Safford Basin shall not be designated as an INA.

There have been discussions by local stakeholders of creating an INA or an AMA in the Willcox Basin by local initiation. There are those in the area who oppose such a move due to concerns that it might damage property values and harm the local emerging wine industry. There are also concerns that looming regulation is causing a rush to irrigate new land to avoid losing the right to do so. To address those concerns, there has been an effort by some local stakeholders to develop an alternative statutory framework for groundwater management to protect groundwater availability while limiting adverse economic impacts in the Willcox Basin. At this time, draft legislation for such a change has not been presented to the Legislature.

Northwest Basins Planning Area

The Northwest Basins Planning Area is located in the far northwest portion of Arizona and covers an area of approximately 3,882 square miles. The Northwest Basins Planning Area is located solely within Mohave County, Arizona and encompasses close to 29% of the land area within the county. The groundwater basins in the planning area include the Detrital, Hualapai, Meadview and Sacramento Basins.

Most land ownership within the Planning Area is owned and managed by federal agencies including the Bureau of Land Management, which accounts for nearly 50% of land ownership within the Planning Area (1,937 square miles).

Groundwater serves as the primary water source for the Northwest Basins. The largest municipality, the City of Kingman, operates two wastewater treatment plants, which together have a permitted capacity of 5.72 Million Gallons per day (6,407 acre-feet). With the exception of the Colorado River to the north and western borders, the Northwest Basins have no perennial streams within the Planning Area. The Mohave County Water Authority acquired Kingman's entitlement of Colorado River water for use by on-river communities outside the Planning Area.

Some residents are very concerned with the recent large scale agriculture operations along the Stockton Hill Road area of the Hualapai Basin as well as proposed agriculture in the Sacramento Basin.

F. Drought Status Changes

Arizona's drought status is continually monitored and updated. The short-term drought status is updated weekly and monthly. The long-term drought status is updated seasonally at the end of each quarter.

→ *Short-term Drought Status*

Due to the relatively dry winter and localized summer rainfall, the end of the water year short-term drought (**Fig. 15**) is worse than a year ago in the southwestern quarter of the state, but better than a year ago in the northwestern quarter (**Fig. 13**). The change from October 2015 to April 2016 (**Fig. 13 to Fig. 14**) shows the effects of the dry winter in the southern two-thirds of Arizona. The southeastern counties benefitted from a wet monsoon (**Fig. 14 to Fig. 15**), as did Mohave County and much of Coconino County. Northern Navajo and Apache counties had some good winter precipitation, but the summer rainfall stayed to the west, resulting in a return of moderate drought. Severe drought is currently restricted to Yuma County, 22.6% of the state has no drought condition, and no part of the state is in extreme drought in the short-term.

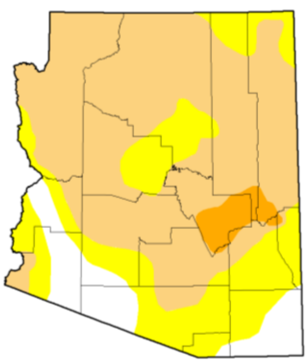


Figure 13. September 29, 2015 short-term drought status.

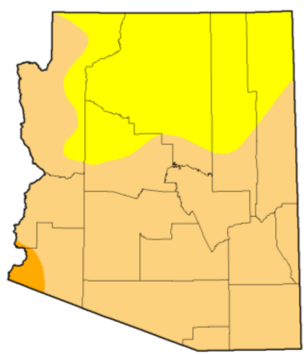


Figure 14. April 26, 2016 short-term drought status.

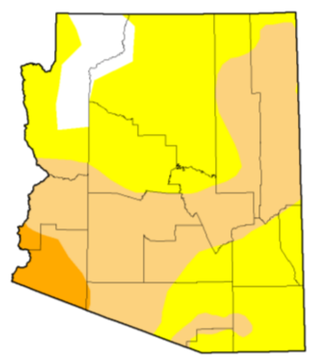


Figure 15. September 27, 2016 short-term drought status.

Level	Description	Percentile	Color
	No Drought	>30	
D0	Abnormally Dry	21-30	
D1	Moderate	11-20	
D2	Severe	6-10	
D3	Extreme	3-5	
D4	Exceptional	0-2	

→ *Long-term Drought Status*

For the long-term, 2016 brought no improvement to any of the watersheds in Arizona, and three watersheds that were not in drought became abnormally dry (**Fig. 16 & Fig. 17**). Currently the Upper Colorado River, Lower Colorado River and the Virgin River watersheds have no drought, while 11 watersheds are abnormally dry (D0) and the Verde River watershed is still in moderate drought (D1). Over the past six years, only the winter of 2014-15 was relatively wet in parts of Arizona, and while the monsoon rainfall in 2014, 2015 and 2016 was greater than average in many parts of the state, the summer rainfall is not effective at improving long-term drought conditions because the moisture demand is very high in summer with high evaporation rates and moisture uptake by vegetation during the growing season. The number of watersheds in each drought category over the last three years, as of October, can be seen in **Table 2**.

Based on our current methodology for assessing drought in Arizona, we have been easing out of drought for the past two years. However, while the drought appears to be easing, it is not over, since the reservoirs are only about 50% full, and the groundwater aquifers have not recovered to their pre-drought levels. Though the long-term maps incorporate streamflow, not all watersheds have sufficient streamflow data to be included, so they are depicted based solely on the standardized precipitation index.

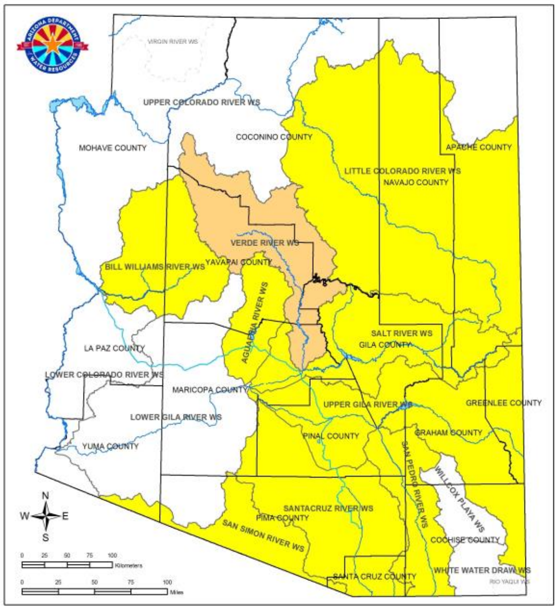


Figure 16. Long-term drought status as of Oct. 2015.

Category
No Drought
D0 - Abnormally Dry
D1 – Moderate Drought
D2 – Severe Drought
D3 - Extreme Drought
D4 - Exceptional Drought

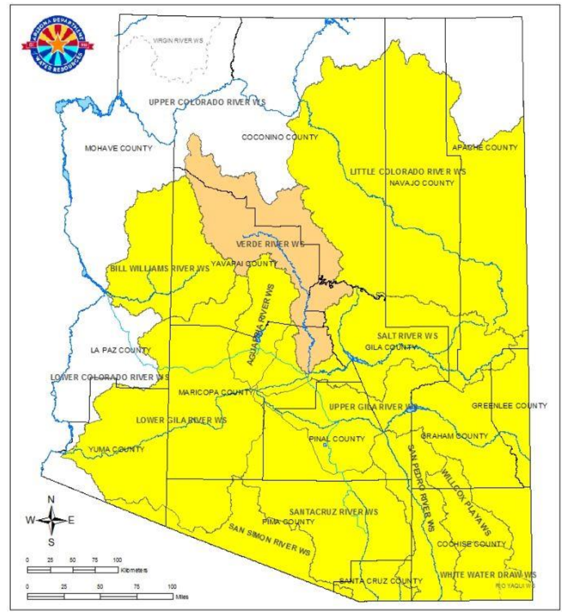


Figure 17. Long-term drought status as of Oct. 2016.

Table 2. Number of Watersheds in Each Drought Category

Category	2014	2015	2016
No Drought	1	6	3
D0 - Abnormally Dry	2	8	11
D1 – Moderate Drought	7	1	1
D2 – Severe Drought	5	0	0
D3 – Extreme Drought	0	0	0
D4 – Exceptional Drought	0	0	0

The Standardized Precipitation Index (SPI) graph (**Fig. 18**) shows the changes in drought over time: Short-term drought conditions (0 – 15 months) are at the bottom, and longer term drought conditions (48 – 60 months) are near the top. The bottom bar graph shows the monthly anomalies with green being wetter than average and brown being drier than average.

Across the top of the SPI graph there are two wet long-term periods, the first from 1981 through spring of 1988, followed by a short abnormally dry period from spring 1990 through the summer of 1992. The second wet period began in the winter of 1992 and continued through the winter of 1994 when the current long-term drought began. The most intense period of the current drought for Arizona was 2002 through 2004, however, the long-term drought continues in the state. There is some easing in the short-term at the bottom right of the graph, and the current long-term drought is also easing slightly. How this translates to aquifer recharge and forest health is uncertain at this time, because the SPI does not differentiate between winter precipitation and summer precipitation; winter precipitation is much more important for aquifer recharge and hydrologic drought recovery while summer rainfall is more important to short-term rangeland conditions, including stock tanks.

For more information about how the graph can be used to correlate precipitation and drought impacts, visit the website: http://cals.arizona.edu/climate/misc/spi/spicontour.png.

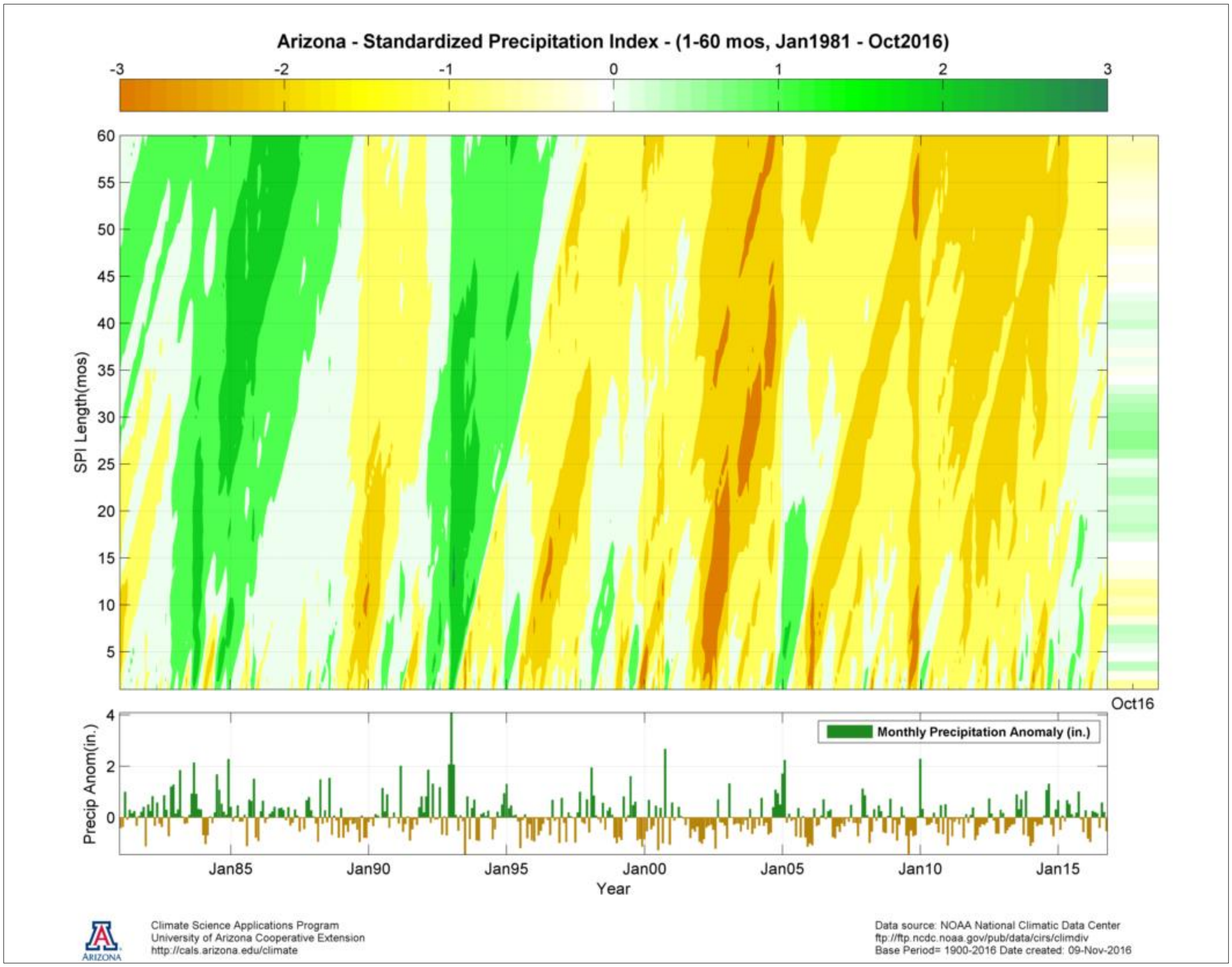


Figure 18. Standardized precipitation index and precipitation anomalies.

G. Outlook for 2016 - 2017

→*Winter 2016-2017*

Winter weather patterns for Arizona can sometimes be dictated by sea surface temperature anomalies across the Pacific basin. This autumn, the Pacific Ocean ranges from slightly cooler than normal across the equator to much warmer than average in the northern latitudes. The most likely outcome for this winter is weak La Niña conditions developing during the late fall and early winter (around a 70% chance) likely trending rapidly towards a more neutral phase later in the winter and early spring (better than 55% chance of a neutral ENSO state after February). These potential outcomes and rapidly changing conditions lead to very limited predictive capability for our local winter climate; and as evidenced by last winter, even strongly forced climate regimes can result in lower probability results.

The official outlooks from NOAA's Climate Prediction Center (**Fig. 19**) indicate the chances of temperatures and precipitation being in an above normal, near normal, or below normal category over a seasonal three-month period. The outlook for January-March 2017 shows a much better chance that average temperature will fall in the above normal category. The precipitation outlook depicts odds tilted towards the drier than average category. These outlooks are supported by a climate multi-model average, minor influence from the forecasted weak La Niña phase, as well as trends in Arizona winters becoming warmer and drier over the past 10-15 years.

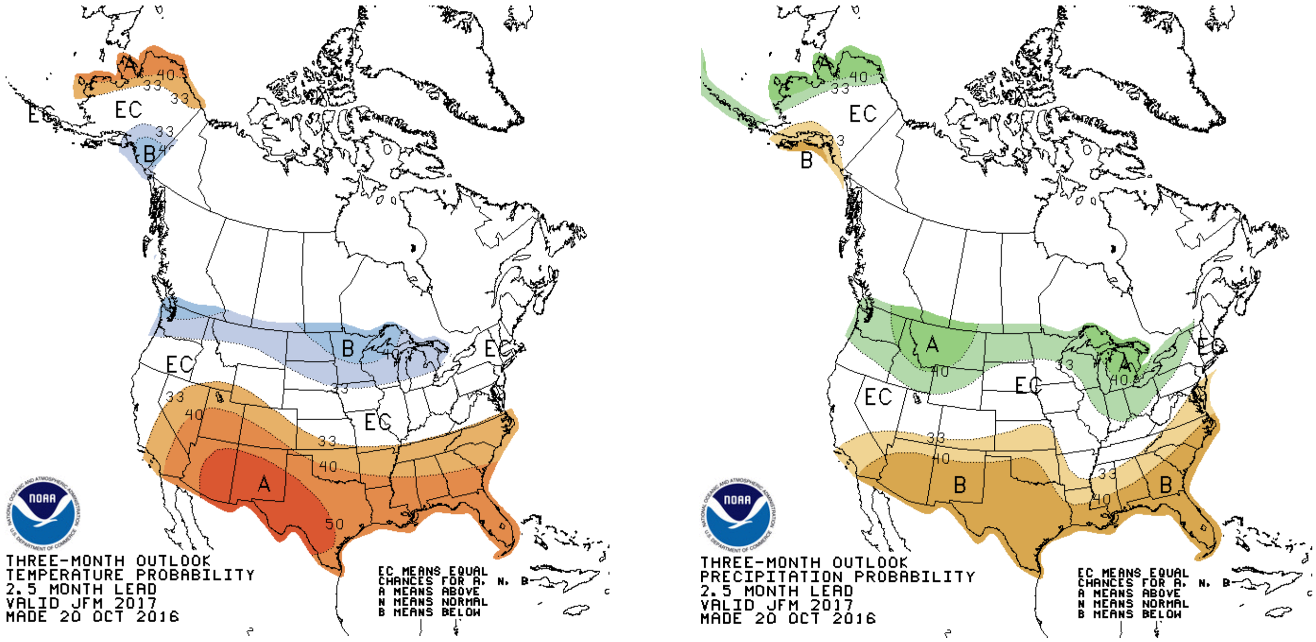


Figure 19. Climate Prediction Center outlooks for temperature (left) and precipitation (right) for January – March 2017. Shading indicates the percentage increased chances of being above or below normal.

→ *Summer 2017*

The Climate Prediction Center's outlook for July-September 2017 (**Fig. 20**) shows somewhat better chances that the average temperature during these three months will be above normal statewide. This outlook is based primarily on distinctive recent trends over the past 10 years (i.e. climate change) versus the longer term 30-year average. The precipitation outlook shows no dependable forecast signal during this period over Arizona. That is, there are equal chances for the 2017 monsoon season to have above, below, or near normal rainfall. This is very common for the Southwest monsoon season where thunderstorm activity is typically very localized and not influenced by larger scale climate signals.

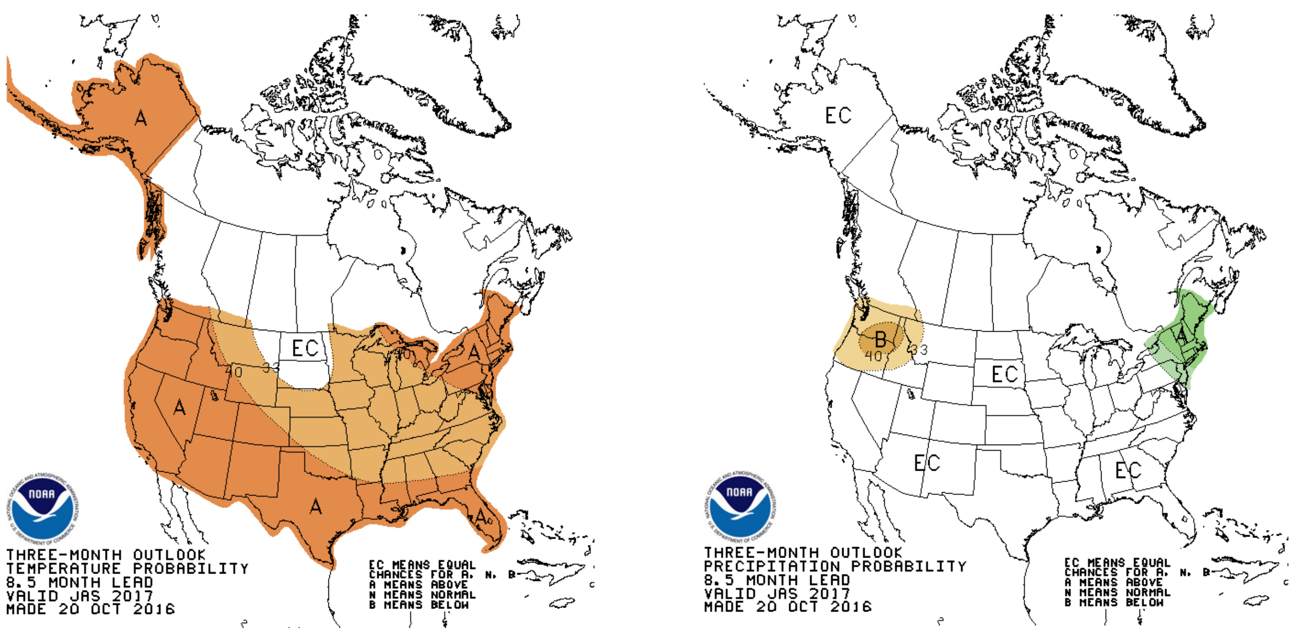


Figure 12. Climate Prediction Center outlooks for temperature (left) and precipitation (right) for July – September 2017. Shading indicates percentage increased chances of being above or below normal.

3. Drought Declarations

A Drought Emergency Declaration has been in effect in Arizona since 1999. The current declaration, PCA 99006, was issued by the Governor in June 1999 and continued by Executive Order 2007-10. The declaration maintains the state's ability to provide emergency response if needed, and enables farmers and ranchers to obtain funding assistance through the Farm Service Agency if they experience significant production losses due to drought. The Drought Interagency Coordinating Group (ICG) is responsible for providing recommendations to the Governor regarding drought declarations based on presentations and discussions at the spring and fall ICG meetings.

4. Disaster Designations

A disaster designation from the Secretary of the U.S. Department of Agriculture (USDA) is necessary for farm operators in both primary and contiguous disaster areas to be considered for assistance from the Farm Service Agency. The USDA uses the U.S. Drought Monitor to help determine designations. Extreme (D3) or Exceptional (D4) drought conditions qualify as automatic designations, while severe (D2) drought for eight consecutive weeks during the growing season qualifies for nearly automatic designation. This "Fast Track" authority designation process delivers fast and flexible assistance to farmers and ranchers.

The following disaster designations by the U.S. Department of Agriculture occurred this water year:

- February 17, 2016: Two counties (La Paz and Mohave) were named as contiguous disaster counties, which was the result of the designation of 47 counties in California as primary disaster counties.
- February 17, 2016: One county (Mohave) was named as a contiguous disaster county, which was the result of the designation of 12 counties in Nevada as primary disaster counties.
- March 2, 2016: Two counties (La Paz and Yuma) were named as contiguous disaster counties, which was the result of the designation of four counties in California as primary disaster counties.
- May 4, 2016: One county (Yuma) was designated as a primary disaster county; the three contiguous disaster counties (La Paz, Maricopa and Pima) also received disaster designations.
- May 18, 2016: One county (La Paz) was designated as a primary disaster county; the four contiguous disaster counties (Maricopa, Mohave, Yavapai and Yuma) also received disaster designations.
- August 10, 2016: Four counties (Cochise, Graham, Pima and Santa Cruz) were designated as primary disaster counties; the seven contiguous disaster counties (Apache, Gila, Greenlee, Maricopa, Navajo, Pinal, Yuma) also received disaster designations.

5. Drought Preparedness Plan Implementation Highlights

A. Drought Planning for Community Water Systems

Drought planning requirements and water use reporting regulations were recommended in the 2004 Arizona Drought Preparedness Plan and established by the state legislature in 2005 to help Community Water Systems (CWS) reduce their vulnerability to drought. These reports provide a means for the state to gather water use data and offer assistance to CWSs that need it.

All CWS in the state (approximately 800) are required to submit a Drought Preparedness Plan to ADWR every five years. The Drought Preparedness Plan is part of the required System Water Plan, which also includes a Water Supply and Conservation plans. The drought plan requires water systems to describe their drought stages and triggers, emergency sources of water, customer communication strategies, and other planning actions.

ADWR provides assistance to water providers in meeting these requirements through web-based resources, online reporting tools and phone or in-person consultations. To date, ADWR has received 671 Initial and 463 Updated System Water Plan. The number of annual water use reports received from systems located outside the state's AMAs can be seen in **Table 3**. (Annual water reports have been required for systems inside the AMAs since the passage of the 1980 Groundwater Act.)

Table 3: Annual Water Use Reports Received from CWS Located Outside Active Management Areas

	2015	2014	2013	2012	2011	2010	2009	2008	2007
Number of reports received out of total CWS for that year:	389/465	383/462	382/468	382/461	394/461	390/469	383/484	396/481	387/463
Percent of population represented by reports received:	96%	97%	96%	93%	97%	96%	95%	96%	97%

B. Colorado River Drought Planning Efforts

The Colorado River system has experienced severe drought conditions for more than 16 years. Further, the Basin runoff during this period is comparable with the lowest 16-year period in the paleo-hydrologic record that dates back over 1,200 years. As a result, water levels in Lake Mead, the primary storage reservoir for the Lower Basin states, and the entire Colorado River System reservoirs have been declining and projections indicate that this will continue into the foreseeable future.

Releases and diversions are made from Lake Mead to meet water deliveries in Arizona, California, Nevada, and Mexico, while Lake Powell is operated to deliver water from the Upper Basin to the Lower Basin. As part of the 2007 Interim Guidelines, water levels in these two reservoirs are coordinated to allow better management of the Colorado River supply.

Lake Mead water levels are important because they determine whether a shortage is declared on the Colorado River. In the 2007 Colorado River Interim Guidelines all the states that share the river, the federal government and Mexico agreed to shortage "trigger levels" resulting in reduced delivery amounts for Lower Basin Shortages and Coordinated Operations for Lake Powell and Lake Mead. These were developed based on data that was available at that time, very early in the Colorado River drought. Now, nearly 10 years later it is apparent that those guidelines are not enough. New river flow projections indicate that Lake Mead levels could drop to the point of seriously impacting power generation and water availability, despite the Shortage Sharing Guidelines.

Lower Basin Drought Contingency Planning

Representatives of the three Lower Basin states, including ADWR, along with Reclamation continue collaborative discussions related to drought contingency planning. The discussions include projections of critical reservoir levels in Lake Mead and how adding volumes of water to the Lake through augmentation or conservation might lessen the risk of reaching or falling below those critical elevations.

The goal is to reduce the risks that were attendant to projections made in the mid-2000s, six years into the current 17-year drought. Representatives of the three Lower Basin states and Reclamation developed a Drought Contingency Proposal (DC Proposal) in December 2015 and agreed to consult with their respective stakeholders regarding possible implementation of the DC Proposal.

Under the DC Proposal, Arizona and Nevada would begin reducing water deliveries earlier than previously agreed. Reclamation would also agree to conserve water in the system. Additionally, California would agree, for the first time, to reduce its deliveries when Lake Mead elevations are below 1050 feet. ADWR is continuing with outreach, in cooperation with Reclamation and Central Arizona Water Conservation

District, in order to educate stakeholders and develop a plan to implement the DC Proposal within Arizona. Link to Colorado River Shortage Preparedness website:

www.azwater.gov/AzDWR/StateWidePlanning/CRM/coloradorivershortage.htm

Bypass Flows

Opportunities for activities to be undertaken in the Yuma area to conserve water in Lake Mead included bypass flows, which are predominantly comprised of drainage pumping from the Wellton-Mohawk Irrigation and Drainage District. The bypass flows, over 100,000 acre-feet (annual average) of pumped agricultural drainage water that bypass the Colorado River due to salinity management constraints, are not included in water deliveries to Mexico and therefore contribute to declining water surface elevations at Lake Mead.

A Bypass Flow Workgroup was convened and co-chaired by ADWR and Reclamation. The group was developed with the goal of aiding in the reduction of further declines of Colorado River reservoirs by identifying, analyzing and recommending a set of options that collectively conserve at least 100,000 acre-feet of water annually in Lake Mead by reducing, replacing or recovering a like amount of the bypass flows in a fiscally, legally, bi-nationally and environmentally responsible manner.

Link to Recommendations of the Bypass Flows Workgroup:
www.azwater.gov/AzDWR/StatewidePlanning/CRM/documents/WorkgroupFinalReportFinal.pdf

C. Local Drought Impact Group Efforts

Local Drought Impact Groups (LDIGs) participate in monitoring, education and local mitigation, mainly through cooperative extension and county emergency management programs. Initial planning efforts included ten LDIGs, and as many as eight LDIGs have been active in the past. Since 2008, LDIG focus has been entirely on drought impact monitoring and reporting in response to local fiscal and staffing limitations. Currently, only Mohave County and Pima County are active. See **Appendix A** for the Mohave County LDIG report and **Appendix B** for the Pima County LDIG Report.

D. State Drought Monitoring Technical Committee Efforts

Arizona Drought Monitoring Technical Committee (MTC) is responsible for gathering drought, climate, and weather data, and disseminating that information to land managers, policy-makers and the public. Specifically, the MTC prepares the short- and long-term drought status reports, briefs the ICG on drought conditions, and provides assistance to Local Drought Impact Groups. The two co-chairs are Nancy Selover, State Climatologist, and Mark O'Malley, National Weather Service, Phoenix Office.

→ *Communicating Drought Status*

The MTC and ADWR coordinate to achieve the primary goal of improving the accessibility of drought information to resource managers, state decision-makers and the public. To further communication, information is updated on the ADWR Drought Status webpage on a weekly, monthly and quarterly basis as follows:

Weekly - The MTC confers weekly with the National Weather Service offices that cover Arizona, Flood Control Districts, LDIGs, water and rangeland managers, agricultural extension and others who observe and report drought impacts, to advise the U.S. Drought Monitor authors on the current conditions in Arizona, and makes recommendations about the position of the drought boundaries for Arizona. The U.S. Drought Monitor is the official record of drought for Federal drought relief claims. Information used by the MTC in advising the Drought Monitor authors includes numerous drought indices, precipitation and stream flow data, and impacts data. Every Thursday, the ADWR Drought Status webpage automatically updates with the latest U.S. Drought Monitor map of Arizona.

Monthly - At the end of each month, the MTC produces a web-based, short-term drought status update based on U.S. Drought Monitor's maps for the past four weeks. An email with the latest map and summary is sent to interested parties.

Quarterly - The MTC meets on a quarterly basis and produces a long-term drought status map and summary report. This report incorporates the 24-, 36- and 48-month precipitation and streamflow percentiles for major Arizona watersheds (i.e., 4-digit U.S. Geological Survey Hydrologic Unit Code (HUC)). Vegetation indices, snowpack, temperature, reservoir levels, and county-scale drought impact information are used to verify or modify the result of the calculations. The long-term drought status reports are posted on the ADWR website and disseminated via email seasonally: in May (for January – March), August (for April – June), November (for July – September) and February (for October – December).

The monthly and quarterly reports serve as an information resource for the public and as a planning tool for resource managers developing mitigation and response strategies.

→ *Arizona DroughtView*

DroughtView, a University of Arizona program that replaced DroughtWatch, is an online tool for collecting drought impact data that incorporates several remote sensing and climate drought monitoring products. The tool can be used to track high-resolution (~250m) changes in remotely sensed 'greenness' (Normalized Differenced Vegetation Index) data collected on a bi-weekly basis from the NASA MODIS satellite. This index can be particularly useful for tracking changes in rangeland conditions related to livestock forage production and forest drought stress which can indicate longer-term drought impacts and wildfire risk. For more information, visit the University of Arizona DroughtView website at http://droughtview.arizona.edu

→ *Community Collaborative Rain Hail and Snow (CoCoRaHS) Network*

The CoCoRaHS network of citizen precipitation observers in Arizona continues to expand. While there is a drought impact reporting tool to allow the 1211 observers in Arizona to efficiently add their drought impact observations to their precipitation observations, the tool has not been used. Many observers do not believe they have enough knowledge to determine drought impacts. The MTC is working to educate observers and increase the use of the reporting tool. The data collected will be important in Arizona's drought monitoring as well as flood warning. Currently the CoCoRaHS network is much more useful for flood warning than for drought.

→ *ADWR Drought Index Wells*

ADWR's Field Services Section collects groundwater levels statewide from approximately 1,800 index wells, including the state's two drought index wells. ADWR also monitors aquifer storage and maintains a statewide network of roughly 120 automated groundwater monitoring sites and an ORACLE database that contains field-verified data including discrete water level measurements, location, and other well specific information.

In 2015, ADWR staff developed a Monitoring Well Network Optimization Plan, which in part will focus on the identification of additional drought monitoring index wells within the state. Water level data from continuous monitoring sites statewide will be reviewed and evaluated with respect to meeting criteria for the USGS Climate Response Network. Drought index wells identified will be integrated with USGS Climate Response Network monitoring sites in Arizona.

→ *Calculating the Standardized Precipitation Index*

The MTC is experimenting with the use of gridded precipitation data to create gridded standardized precipitation index (SPI) maps and a gridded drought status map, using the same calculations for drought status currently used for watershed level mapping. The gridded maps will provide smoother transitions across the state rather than the abrupt watershed boundaries. The results should be more reflective of the Drought Monitor maps and will facilitate internal decision making. Even though drought declarations may be made at the county level, the higher resolution data will provide better information about which parts of individual counties are having the worst drought problems.

→ *Drought Impact Reports from State and Federal Agencies*

Drought impact data is used by the MTC in its efforts to correlate drought conditions with precipitation and streamflow data. Impact information is received from hydrologists, researchers and other field staff from the Bureau of Land Management, United States Geological Survey, U.S.D.A. Natural Resources Conservation Services, Arizona Forestry Division, Arizona Game and Fish Department, Arizona State Parks, Native American Communities and other state and federal groups.

The U.S.D.A. Arizona Natural Resources Conservation Service (NRCS) submits a water year report (**Appendix C**) about the impacts of drought on range and farmland. The 2016 survey sent to all NRCS field offices in the state describes drought impacts on dryland farming, irrigation water supply, rangeland water supply, rangeland forage supply, and rangeland precipitation. Losses of crop production, shortages of water supply, and shortages of forage were reported.

→ *Presentations and Workshops*

WERA 102 - Climate Data and Analyses for Applications in Agriculture and Natural Resources, September 13-14, 2016

Dr. Michael Crimmins, University of Arizona, presented at the WERA 102 meeting at New Mexico State University, Las Cruces. He spoke about his efforts to assist ranchers with rainfall measurements for their pastures and grazing lands. The data will help assess drought conditions in many rural areas.

Intermountain West Drought Early Warning System Meeting (IMW DEWS), September 20, 2016

Dr. Michael Crimmins, University of Arizona, Dr. Nancy Selover, State Climatologist, Charlie Ester, SRP Water Resources Operation Manager and Einav Henenson, ADWR Drought Program Coordinator, presented at the Intermountain West Drought Early Warning Systems (IMW DEWS) meeting at Biosphere II in Oracle, AZ. The IMW DEWS has been piloted in Utah, Colorado and Wyoming and was recently expanded to include Arizona and New Mexico. Dr. Crimmins and Dr. Selover explained how Arizona currently monitors drought and what gaps we have in the current system. Mr. Ester discussed SRP's Drought related operations, and Ms. Henenson provided history and overview of Arizona's Drought Program.

E. Interagency Coordinating Group Efforts

The Interagency Coordinating Group (ICG) has met biannually since 2006 and advises the Governor on drought status, impacts, and any necessary preparedness and response actions. The meetings include a review of statewide monitoring efforts and drought status, water supply updates, rangeland conditions, forest health, and the impacts of drought on wildlife. At both the November 2015 and May 2016 meetings, the ICG recommended continuation of the Drought Declaration for the State of Arizona (Executive Order 2007-10) and the Drought Emergency Declaration (PCA 99006). The presentations and subsequent decisions are on the ADWR ICG website.

F. ADWR Outreach and Assistance

ADWR promotes and encourages efficient use of water throughout Arizona by developing conservation tools and resources, assisting Arizona communities and water providers, presenting on conservation issues and solutions, collaborating with regional and national partners, and participating in outreach activities. Staff provides materials and answers inquiries from the public, businesses, the press, water professionals, students, researchers, and others about water conservation and drought. Staff also administers the Arizona Water Awareness website, www.ArizonaWaterAwareness.com, a central source of information for all Arizonans about water, including current conservation events and activities, regional and seasonal tips, and resources about a variety of conservation topics.

→ *ADWR Director Testimony to U.S. Senate, May 17, 2016*

ADWR Director Tom Buschatzke testified before a Senate Energy and Natural Resources subcommittee seeking Senate support for prioritizing water supplies in the drought-stricken West.

Director Buschatzke testified in support of S. 2902, which identifies five specific areas that may help defend critical water resources in the West. The measure was introduced by Senator Jeff Flake and five other Western senators, including Senator John McCain. A copy of Director Buschatzke's testimony can be found in **Appendix E**.

→ *Colorado River Shortage Preparedness Workshops, May 18 & August 22, 2016*

The Colorado River system has experienced extensive drought conditions for more than 16 years. As a result, water levels in Lake Mead, the primary storage reservoir for the Lower Basin states, and the entire Colorado River System have been rapidly declining and projections indicate that this will continue into the foreseeable future. Lake Mead water levels are important because they determine whether a shortage is declared on the Colorado River.

Arizona is prepared for potential Colorado River shortages because we have implemented innovative water management strategies to secure dependable water supplies. In an effort to provide stakeholders with the most relevant and timely information available related to current Colorado River conditions and possible shortage impacts to Arizona, ADWR and Central Arizona Project co-hosted two Colorado River Shortage briefings. There were hundreds of individuals that participated in the event. Participants included state legislators, tribal leaders, representatives from Reclamation, cities, industrial and agricultural water users, Colorado on-River water users and members of the media and the public. In advance of the briefing ADWR worked with CAP and other stakeholders to develop Colorado River shortage impacts messaging. The briefing was heavily promoted on social media and was picked up by various media outlets.

ADWR created the following webpage dedicated to Arizona's efforts to respond to a potential Colorado River shortage declaration:
www.azwater.gov/AzDWR/StateWidePlanning/CRM/coloradorivershortage.htm

→ *Arizona Water Newsletter*

ADWR's Arizona Water Newsletter, a new weekly newsletter featuring articles regarding the latest in Arizona and Colorado River issues, was launched in March. The newsletter articles allow stakeholders to stay up-to-date on the latest happenings regarding Arizona water. Since launch the Arizona Water News articles have received over 18,000 views. Visit this link to read past Newsletter Articles: www.azwater.gov/AzDWR/ADWR_News/

→ *Arizona Water Facts Website*

On June 1st ADWR launched ArizonaWaterFacts.com. This website is dedicated to promoting Arizona's success in managing its water resources, presenting current water resource challenges, and planning for the future. Arizona Water Facts is intended to build confidence in our water resources – a necessity for fostering a thriving economy and for a healthy livelihood.

→ *Water Awareness Month, April 2016*

ADWR has coordinated Arizona's Water Awareness Month campaign since the Governor's executive order in 2008. In 2016, ADWR conservation personnel participated and exhibited Water Awareness Month and conservation information as well as distributed free educational materials at the Tres Rios Nature Festival on March 5th and 6th. For more information, visit www.waterawarenessmonth.com/.

6. Resource Needs

Incorporate groundwater data for drought status determination

ADWR evaluates groundwater level changes around the state, however, further analysis is needed to determine what role drought plays in these observed changes. Drought index wells serve as a qualitative supplement to existing drought indicators and help establish drought status for watersheds where either precipitation or stream flow data are lacking. The Basic Data Unit of the Field Services Section is exploring the use of groundwater data in a more quantitative manner, perhaps by a modified Palmer index. As the groundwater level signature may include influences other than a climate response, such as pumping or artificial recharge, additional research is needed to determine the suitability of each well site with regards to percentile analysis. The MTC plans on further assessment of statewide groundwater index wells to identify and incorporate data that meet the criteria for drought index wells. Incorporating groundwater level trend data will be critical in determining future drought conditions and impacts on water supply. Funding is needed to implement the Monitoring Well Network Optimization Plan, which was developed last year and integrates many of ADWR ORACLE databases, thus allowing for drought monitoring well identification. *Total cost: $138,000 per year*.

Appendix A

Mohave County
Local Drought Impact Group
2016 Annual Report

MOHAVE COUNTY LOCAL DROUGHT IMPACT GROUP

2016 ANNUAL REPORT

Introduction

This report summarizes the Local Drought Impact Group activities conducted in Mohave County in 2016. The LDIG continues to function as an informal advisory body to the Mohave County Division of Emergency Manager and the County Extension Office.

Due to the demise of the DroughtWatch system, reports received from the drought monitoring network have been compiled by County Emergency Management while awaiting implementation of new reporting protocols. Mike Crimmins with the University of Arizona has recently provided information on new procedures for transmitting county impact reports to the state and NOAA for use in updating the U.S. Drought Monitor status for Mohave County. County Extension Agent Andrew Brischke has been working with Mike Crimmins, NOAA, and the local ranching community to update the impact reporting form and schedule as well as recruit additional impact monitors for the county network.

Drought Status

As of the time of this report (early October, 2016) nearly half of the county has been removed from the Abnormally Dry (D0) category, with the remainder staying in this category. No significant impacts are currently occurring.

Drought Impacts

No severe impacts have been reported from the agriculture sector although there was concern early in 2016 that conditions could potentially worsen. However, several spring precipitation events brought relief to certain areas of the county, particularly around Kingman, in late spring. This rainfall mitigated potential impacts and contributed to a relatively low hazard wildfire season despite two fires in April and May that threatened residences along the Colorado River.

Most areas of the county experienced significant monsoon rainfall which further mitigated the drought. As a result, the U.S. Drought Monitor has removed a large area of the county, including most of the Arizona Strip north of the Colorado River and areas to the north and east of Kingman from the Abnormally Dry category. The remainder of the county, including the western portion along the Colorado River, remains Abnormally Dry.

Due to continued low snowpacks in the Rocky Mountains, the Colorado River has experienced no recovery in streamflow volume. A continuing concern is that Lake Mead water levels will fall below the mandatory threshold for implementation of water conservation measures. Mandatory conservation measures would potentially impact Lake Havasu City, Bullhead City, and unincorporated areas south of Bullhead City, although much of the water supply in these areas comes from wells in aquifers fed by the river rather than the river itself. The populated areas from Wikieup north through Kingman and the Hualapai Mountains and extending northwards to the Arizona Strip and Colorado City are dependent on monsoon and winter rainfall and aquifers generally not associated with the Colorado River.

Drought Related Actions

No drought response or mitigation measures are currently in effect. The Mohave County Alert Flood Warning System, with sensor stations throughout the county, continues to provide near real time precipitation and stream flow information.

Appendix B

Pima County
Local Drought Impact Group
2016 Annual Report

PIMA COUNTY LOCAL DROUGHT IMPACT GROUP

2016 ANNUAL REPORT

The Pima County Local Drought Impact Group (LDIG) has been an active component of County operations since 2006 when the Board of Supervisors adopted the Drought Response Plan and Water Wasting Ordinance (Chapter 8.70). The Ordinance established a four stage trigger category that corresponds to the Arizona Drought Monitor Report and their declaration of a watershed drought condition from “Abnormally Dry” to “Exceptional.” Each “Stage” declaration within the county triggers drought stage reduction measures

Pima LDIG consists of water providers and local, state and federal agencies that have an interest in the cause and effect of drought conditions in Pima County. The Group meets bi-monthly to monitor the short- and long-term drought status, discuss drought impacts and coordinate drought declarations and responses. The Group also explores the impacts of drought on various sectors in Pima County including agricultural water use, ranching, wildfire, hydrology, and flooding. Because many water providers depend on Central Arizona Project water, LDIG also monitors the status of the Colorado River, the El Niño Southern Oscillation (ENSO) and other climate weather patterns in relation to their effect on drought conditions and climate variability in the southwest. LDIG also monitors the status of the summer monsoon season and convenes roundtable discussions of drought and water conservation outreach programs. For a list of presentations and agendas, please visit Pima County LDIG website: http://webcms.pima.gov/cms/one.aspx?portalId=169&pageId=70243.

Weather (National Weather Service)

The year began with a moisture surplus because of a wet fall the previous year (the 14th wettest on record) with more than 2” above normal rainfall mostly from a wet October. The El Niño pattern that had strengthened through 2015 had peaked in November. Weather turned drier and warmer for the winter season, contrasted with above normal precipitation in January. Afterwards, hot and dry conditions continued until respite in April (the 16th wettest on record, with three Pacific storm systems). Interrupting high pressure systems brought alternating cool and warm periods leading to the forth warmest first quarter of the year. May recorded no rainfall at all, which is normal as this time of year is typically dry for the region. June was the second wettest on record, which brought a strong start to the monsoon season and contributed to an above normal wet monsoon season. High pressure systems in June brought extreme heat and several record heat events, with the highest temperatures in two decades. The first half of the year continued as the fourth warmest with above normal rainfall.

Above normal precipitation and temperatures continued through July, both dipping in August. The summer finished as the fourth hottest on record with above average rainfall. Remnants of Hurricane Newton punctuated September providing near average rainfall for the month in one day, which resulted in flooding in the Tucson Metro area, and most southeastern localities reported a surplus of monsoon rainfall.

Drought

→ Short Term

The water year started with most of Pima County drought free with only a central strip of Abnormally Dry (D0) condition, a result of the previous monsoon rain. A wet October bolstered the county through a dry November and December. The county remained mostly out of drought until a dry February when Abnormally Dry condition spread leaving only eastern Pima County free. By March, the county was split with Moderate Drought (D1) in the west and Abnormally Dry condition in the east. Status worsened in April as the entire county experienced Moderate Drought. In May, Severe Drought (D2) crept into the southeast corner of the county. June brought monsoon and heavy rainfall in Tucson, staving off any further drought development. By August, Pima County had returned to mostly Moderate drought with improvement through September to a mixed Abnormally Dry Moderate drought conditions remaining in the west.

→ **Long Term**

The Santa Cruz and San Simon watersheds began and ended the water year in Abnormal Dry condition. Winter precipitation was not sufficient to improve drought status as it remained the same through January and into April. No improvement occurred until the monsoon season as the spring was dry with no rainfall in May.

Colorado River Basin & Central Arizona Project

Several water providers are receiving water from the Central Arizona Project (CAP). Tucson Water has the largest CAP annual municipal allocation in the state; 144,172 acre-feet. Metropolitan Domestic Water Improvement District, the Town of Oro Valley and others have smaller CAP allocations. Agricultural users and the Tohono O'Odham Nation in Pima County also have access to and use CAP water. Consequently, the drought status of the Colorado River and the potential for a shortage declaration is of interest to these sectors.

Unregulated inflow into Lake Powell for water year 2016 was just below average, 94% or 10.17 million acre feet (maf); water year 2016 precipitation for the Upper Colorado Basin was just below average as well, 96%. The April to July 2016 unregulated inflow to Lake Powell was 6.61 million acre-feet, 92% of average.

Every month, Reclamation releases their 24-Month Study which provides operational announcements and near-term projections. The study released in August 2016 stated, most importantly, there will be no shortage in 2017 and that the water release from Lake Powell to Lake Mead for water year 2017 (October 2016 to September 2017) will be 9.0 million acre feet.

Lake Mead elevation is projected to be just above 1075' in 2017 (1079.10') but a significant probability exists for shortage in 2018 (48%) with a projected elevation just below 1075' (1074.50') at this time. On July 1, 2016, the water level elevation of Lake Mead was at its lowest (1,071.61') since being filled in the 1930s.

Significant uncertainty of future snowpack and inflow to Powell is evident in the minimum and maximum probable projections. Next year's inflow could be as high as 17 maf or as low as 6.6 maf. The most probable is 9.53 maf, or 88% of average. Release to Lake Mead is expected to be 9.0 maf in both the minimum and probable inflow projections.

Outflow from Lake Mead has been exceeding the inflow since 2000, except in 2004 and 2010 when there was significant snowpack in the Colorado River Basin. The flow imbalance, referred to as a structural deficit, is lowering the elevation of Lake Mead. At the current rate of decline, Lake Mead's elevation could fall below 1000 feet in five to eight years unless equalization or corrective action is taken. The consequences could reduce diversions of CAP water to municipal and industrial users and Indian users. CAP, ADWR and Colorado River basins states are evaluating options for corrective action to reduce the declining water elevation in Lake Mead.

Drought Impacts in Pima County

The 32 shallow groundwater areas in Pima County are important for riparian areas that are dependent on groundwater. Sustained drought conditions can adversely impact groundwater levels if nearby well owners pump more groundwater to mitigate drought effects on their property. Invasive species, such as buffel grass and tamarisk, as well as fewer native wildlife and birds are being observed in the County.

Cienega Creek, located in eastern Pima County outside of Tucson, is the site of a rare, low-elevation perennial stream that is of regional importance for its environmental and recreational value and has been designated as an "Outstanding Water" by the State of Arizona. This preserve continues to show the impacts of sustained drought though some improvement has occurred this year. Pima Association of Governments' (PAG) drought reporting uniquely depicts the localized drought impacts on this shallow groundwater dependent system, important for habitat and rural residents that are dependent on this water source. Streams and rivers, rare productive systems in the arid landscape of Arizona, are especially sensitive to changes in water availability. With long term support and interest from its member jurisdictions, PAG has consistently monitored the shallow groundwater-dependent riparian area of Cienega Creek Preserve on a monthly and quarterly basis since 1989 and reported the findings to ADWR for compilation into state records. This rich dataset is used by numerous entities to track and evaluate the seasonal, annual and cumulative impacts of drought.

PAG's analysis documented water level trends that indicated marginal improvement in 2015 and further improvement in 2016. This year, creek flows improved to 20% of mapped perennial stretch while last year's survey mapped 9%. The area near Davidson Canyon also showed improvement, recording its first pre-monsoon flows since 2012. Low spring temperatures, El Niño and winter precipitation may have helped maintain shallow groundwater reserves. Despite some improvement however, PAG cautions that long term drought impacts are still apparent given a lack of recovery in Cienega Creek to pre-drought flow levels.

PAG's consistent monitoring of these areas reveals changes in long-term seasonal trends. PAG shares its techniques and protocols with other agencies that may be able to benefit from research into the relationship between increased flow, water use, weather patterns and other climate factors.

Drought Response Actions

Pima County continues its efforts to respond to drought conditions. Several organizations, such as Conserve to Enhance (C2E), urge water conservation that translates into donations to support environmental enhancement. C2E participants have saved 6.9 million gallons (21.35 acre-feet) of water since the program inception in 2011, average gallons per capita savings of approximately 11,474 gallons. C2E has awarded funding to 11 local neighborhood projects totaling approximately $75,000 in investment. School projects also offer an opportunity to engage students in continuing water conservation education.

The Conservation Effluent Pool (CEP) is an effluent allocation set aside pursuant to intergovernmental agreements between the City of Tucson and Pima County for use in riparian restoration projects. In previous years, a CEP taskforce, coordinated by the Community Water Coalition, identified thirteen candidate projects for CEP effluent allocations. The projects are prioritized into three groups: immediate potential, strong potential, and long-term potential. Three projects that have immediate potential have been recommended for implementation.

The first proposed project is a request for several thousand acre feet of reclaimed water to be reserved within the Santa Cruz River along the existing streamflow extent in order to safeguard existing habitat. Both County and City administrations are reviewing the proposal; the request may require some amendments in order to execute within the operational constraints of multiple systems.

In 2010, Pima County and the City of Tucson completed the Water an Wastewater Infrastructure, Supply and Planning Study. An important outcome of the study was the 2011-2015 Action Plan for Sustainability. This final year of the action plan has been implemented, and a final report card itemized successful completion toward shared goals and recommendations. Pima County will continue reporting on water resource management activities that advance the Action Plan and water sustainability efforts.

In addition to the Water and Wastewater Infrastructure as well as the Supply and Planning Study, Pima County prepared the Water Resources Asset Management Plan (WRAMP) in 2012, a distinct water resource planning process to guide the County in maximizing all its water assets. WRAMP, drafted by the County's Water Management Committee, is designed to provide direction in executing County Board of Supervisor Policy F 54.9 Water Rights Acquisition, Protection and Management. WRAMP includes directives to maintain an up-to-date central database of all water rights and wells, map and inspect wells and develop strategic plans for the County's reclaimed water, long term storage credits and surface and groundwater rights. The County has implemented the following:

- Strategic Plan for Use of Reclaimed Water (SPUR) has been developed and accepted by County Administrator; multiple recommendations supporting the objective of maximizing the County's water resources asset value and the production and use of reclaimed water to sustain and protect the natural environment.
- Underground Storage Facility (USF) applications have been planned for two County Water Reclamation Facilities (WRF), Avra Valley and Green Valley, to maximize long term storage credits. Green Valley USF process is pending while Avra Valley WRF has been permitted since September 2015.
- County Regional Wastewater Reclamation Department (RWRD) is cooperating with Cortaro-Marana Irrigation District (CMID), Metropolitan Domestic Water Improvement District (MWDID) and Reclamation to deliver effluent from Tres Rios WRF to CMID agriculture in a Groundwater Savings Facility project.
- Building an accurate baseline of potable and reclaimed water using EnergyCap and other methods. Effort remains underway for formulation of an annual County Water Census detailing each County's meter site and tracking water use trends and an Energy/Water Master Plan for county operations, building upon the County's Sustainability program.
- A well and water rights database has been linked with County GIS mapping and migrated to GIS servers. A springs database (with points of diversion) links ADWR and County springs.
- The Lower Santa Cruz Living River Project, funded by an EPA grant, is a monitoring strategy and reporting tool that evaluates water quality and environmental improvements along the effluent dependent habitat and wetlands, providing better understanding of beneficial impact from upgraded effluent production. Second year report indicates WRF improvements have had the effect of an increase of 12,000 af infiltration, with a decrease in flow extent and habitat. A large reduction in ammonia has removed a barrier to increased aquatic life. These benefits and impacts are a result of ROMP project upgrade

to metropolitan WRF’s. The Living River report will help inform a Lower Santa Cruz River Management Plan.

- Pima County Office of Emergency Management has reviewed all hazard risk profiles to include drought and its impacts in the Multi-Jurisdictional Hazard Mitigation Plan, which establishes a comprehensive county-wide, all-hazards structure to provide for successful and well-organized coordination of Pima County mitigation activities.

As of now, the region’s water providers and other entities with established drought plans are at Drought Stage One or its equivalent (voluntary reductions). Given some incongruity among the various drought plans, Pima Association of Governments has undertaken a local drought plan comparison effort, documenting variances among the plans and issuing a report and recommendations to aid in a more coordinated response and mitigation approach to drought in Pima County. An early draft was presented at the County’s LDIG and a stakeholder comment period is underway.

Appendix C

Arizona Natural Resources Conservation Services (NRCS) 2016 Drought Report

Arizona 2016 Forage Loss Report

USDA-Natural Resources Conservation Service
Phoenix, AZ

Precipitation was highly variable across the state for the year resulting in continuation of drought conditions for most of the state. Winter precipitation patterns resembled a La Niña pattern, rather than a strong El Niño as forecast. Winter and spring were generally dry throughout the state, except for portions of Northern Arizona. Summer monsoons moisture benefited the southeast and northwest parts of the state the most and resulted in slightly improved forage conditions. The driest areas appear to be in the central and southwestern areas (Yuma, Pinal, Maricopa, La Paz, and parts of Pima and Yavapai counties).

NRCS uses Major Land Resource Areas (MLRAs) to differentiate major ecological regions and their climate and vegetation subdivisions within the state. Forage loss estimates for each of the Major Land Resource Areas (**fig.1**) in Arizona are shown in the table to the right. Because of the sample size, the forage loss estimates are generally reliable at the MLRA or State level.

NRCS evaluated 2016 forage losses in Arizona from range study data, inventory and Field Office Drought Reports. NRCS has 24 Field Offices located throughout the state. The District Conservationists and staff from these offices provide the on-the ground knowledge and data collection to support the report. Based on the above information the average forage production across Arizona was approximately 72 percent of normal for 2016.

Arizona Major Land Resources Areas

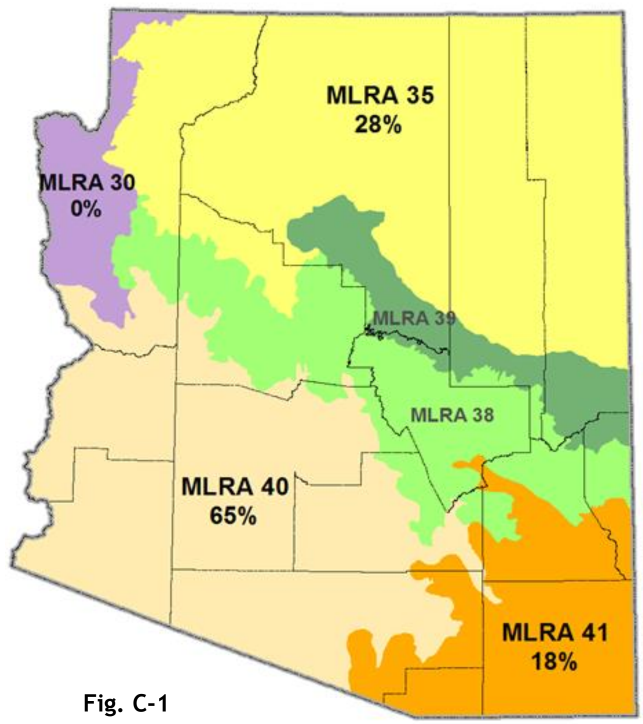


Fig. C-1

Arizona 2016 Forage Loss

MLRA	MLRA Name	% Forage Loss
30	Mohave Basin & Range	0%
35	Colorado Plateau	28%
38	Mogollon Transition	No Report
40	Sonoran Desert	65%
41	Southeastern Basin & Range	18%
39	AZ and NM Mountains	No Report
	Statewide Average	28%

Fig. C- 2. Offices Reporting Livestock Forage Shortages

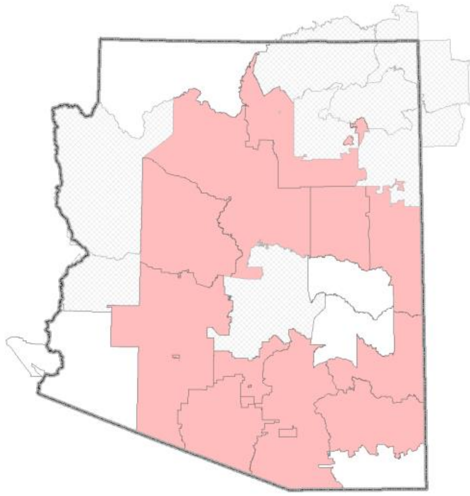


Fig. C-3. Offices Reporting Livestock Water Shortages

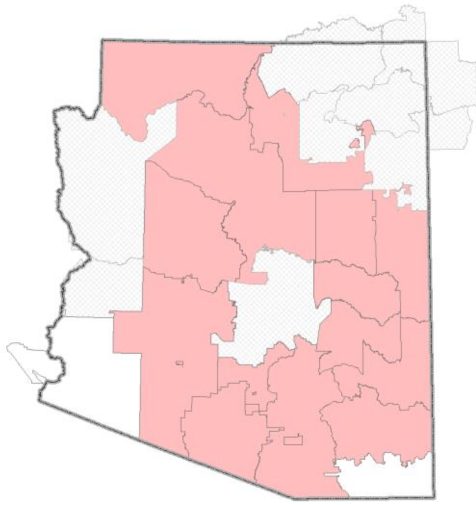
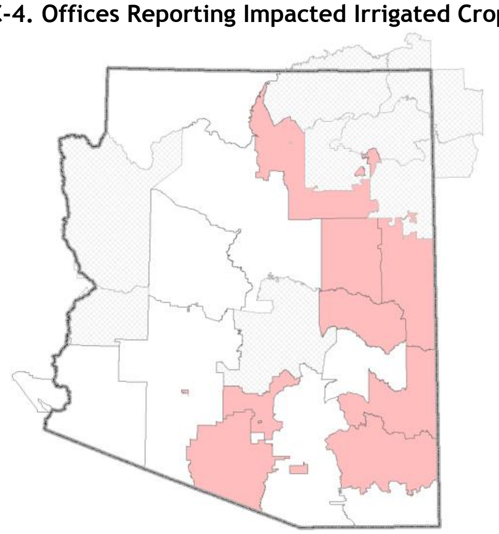


Fig. C-4. Offices Reporting Impacted Irrigated Cropland



2017 Outlook

As part of the report, NRCS Field Offices were asked to assess the outlook for forage production for the 2017 spring season. The offices that reported indicated that below normal forage production would likely occur. With current conditions indicating average or slightly below average precipitation for the winter/spring it is probable that available forage will be average to below average as well.

In addition to reported forage production shortages (**fig.2**), those offices reported reduced livestock numbers with a range of 20-40 percent below established carrying capacities. Livestock water shortages (**fig.3**) were indicated from 14 of 16 offices that reported throughout the state. Field Offices reported an average of 36 percent of the rangeland currently has no livestock water. Dirt ponds, water harvesting catchments, springs, and wells were all impacted by water shortages, although the monsoon did help to replenish some supplies. In some cases about 18 percent of Arizona livestock operators are currently hauling water. Lastly, 9 out of 16 offices reported ranchers kept rainfall gauges. In those nine Field Office areas about 50 percent of ranchers who kept rainfall gauges reported below average precipitation this past year.

Several Field Offices reported irrigation water shortages (**fig.4**) due to drought conditions. Crop production losses ranging from 10 to 70 percent were expected. Crops affected include corn, cotton, wheat, barley, oats, beans, alfalfa, melons, irrigated pasture, and fruit and nut orchards. Affected water sources included wells, direct diversion from streams and reservoirs.

Appendix D

Arizona Water Initiative

ARIZONA WATER INITIATIVE

The Arizona Water Initiative (Water Initiative) was implemented through Executive Order 2015-13 on December 16, 2015, establishing the Governor's Water Augmentation Council (GWAC) and the Planning Area Process. The goal of the Water Initiative is to build on the past work done when creating the Arizona's Strategic Vision for Water Supply Sustainability (Strategic Vision) to continue the Arizona legacy of proactive strategic water planning by working with key stakeholders statewide.

Governor's Water Augmentation Council (GWAC)

The Council will investigate the long-term augmentation strategies for the state, as well as explore additional water conservation opportunities, identify infrastructure needs and, report policy direction or statutory changes to take Arizona into the future.

Council membership consists of a wide array of experts including water providers and leaders in Arizona agriculture, mining, agribusiness, homebuilding, watershed groups and government. ADWR Director Thomas Buschatzke serves as chairman of the Council.

In discussions held during this inaugural year, the GWAC developed a set of recommendations that fall into three categories: recommendations regarding the general tenets of the GWAC; recommendations for discussion topics that will be the focus of the next year of GWAC meetings; and recommendations regarding actions to be taken by ADWR. The recommendations of the GWAC, by category, are presented below.

Recommendations regarding the general tenets of the GWAC:

1. A role of the Council is to provide direction to the Director of ADWR, upon the Director's request, on any issues that the Director determines may impact water management;
2. The GWAC advocates for continued implementation of water conservation measures in all water use sectors throughout the state and makes additional recommendations regarding actions to be taken by ADWR with respect to conservation;
3. Among other things, the GWAC seeks to identify augmentation opportunities as a means to resolve water resource conflicts or improve water supply availability to ensure legal certainty for water users and investors.

Recommendations regarding topics of focus for GWAC discussions in Fiscal Year 2016-2017:

1. Development of a communication plan for the state to accurately convey the status of its water supply resiliency and its efforts to maintain that status moving forward;
2. The potential for augmentation through reuse and the utilization of reclaimed and poor quality water to significantly reduce the future demand and supply imbalance;
3. Funding for augmentation infrastructure;
4. The potential for augmenting groundwater supplies through enhanced natural and constructed recharge and conservation, to include possible incentives and infrastructure needs;
5. Identification of large-scale augmentation opportunities.

Recommendations regarding actions to be taken by ADWR:

1. In recognition of past, present, and proposed investments in water-demand reduction by the state, public and private water providers, as well as the industrial and agricultural

communities, the GWAC recommends that ADWR continue to lead Arizona water conservation efforts and bring applicable conservation concepts to the GWAC for consideration;

2. Assess the potential for additional conservation actions as an element of the Planning Area Process. As ADWR addresses each planning area, it should review existing conservation tools with the stakeholders for inclusion in the solution set that will be created for each area;
3. Identify municipal and private water providers outside Active Management Areas (AMAs) whose water lost and unaccounted for exceeds 10%, and explore with those providers potential actions that may reduce their water lost and unaccounted for to below 10%.

Planning Area Process

The Planning Area Process will focus on analysis of the 22 Planning Areas identified in the Strategic Vision and will allow local stakeholders to participate in development of better water demand information and a consensus-driven set of solutions for future water supply and demand imbalances.

ADWR will work closely with each Planning Area to identify issues that are resulting in demand and supply imbalances and to develop strategies that are likely to be successful in addressing them.

The West Basins, Cochise, and Northwest Basins Planning Areas have been identified as the focus of the Planning Areas Process for the 2016 calendar year. ADWR is currently developing a schedule for the remaining Planning Areas.

Fig. D-1 Strategic Vision Planning Areas

Appendix E

ADWR Testimony to the U.S. Senate Committee of Energy and Natural Resources

Testimony of Director Thomas Buschatzke
Arizona Department of Water Resources
COMMITTEE ON ENERGY AND NATURAL RESOURCES
SUBCOMMITTEE ON WATER AND POWER
United States Senate
May 17, 2016

Chairman Lee, Ranking Member Hirono and Members of the Subcommittee:

Introduction

My name is Tom Buschatzke and I am the Director of the Arizona Department of Water Resources. Thank you for providing me an opportunity to present testimony on behalf of the State of Arizona regarding S. 2902, the Western Water Supply and Planning Enhancement Act. The on-going drought in the western United States demonstrates the need for Congressional action that will allow states to: (1) better plan and manage their existing water resources in a manner that creates greater certainty for water users; (2) leverage existing infrastructure to generate more water supplies; (3) manage watersheds to increase their yield; and (4) protect those watersheds from being degraded by catastrophic fire. If enacted S. 2902 will provide new tools to help achieve those four goals.

Background

The State of Arizona and its water users have a long history of developing water supplies and the necessary infrastructure to deploy those supplies to maximize their benefit to the citizens and businesses in our State. Sound management of those supplies has been a primary focus for our State; the arid nature of Arizona is a constant reminder of the value of every drop of water available to us. Arizona is fortunate to have a diverse portfolio of water supplies. Our State currently uses about seven million Acre-feet of water per year statewide which comes from the following sources: the Colorado River-40 percent; Groundwater-40 percent; in state rivers-17 percent; and reclaimed water reuse- 3 percent.

Arizona has a long history of collaboration and innovation in managing our water supplies. We have participated in interstate and international agreements to protect our Colorado River water supplies, extending from the Colorado River Compact of 1922 to recent agreements with Mexico through Minute 319. Arizona has created institutions over many decades that provide certainty for our water users. Some of those success stories include the Salt River Project, the Gila Project, the Wellton-Mohawk Irrigation and Drainage District, the Yuma County Water Users' Association, the Yuma Mesa Irrigation District, the North Gila Valley Irrigation and Drainage District, the Yuma Auxiliary Project-Unit B, the Central Arizona Project, the 1980 Groundwater Management Act, the Underground Storage and Recovery Act and the Arizona Water Banking Authority. Arizona and its water users have taken proactive measures and made hard choices over many decades to ensure a high quality of life for our citizens and a vibrant economy and will continue to do so in the face of the on-going drought in the West.

Despite the actions and choices made by Arizona, uncertainty remains and the vulnerability of our water supplies to drought is a matter of constant attention among water providers, water users and water managers around the state. Flexibility to manage water supplies and adaptation to drought conditions are part of Arizona's history and will continue to be a key management strategy now and in the future.

In keeping with the long-standing practice of Arizonans stepping up to work together to address challenges to water sustainability, the provisions of S. 2902 that I discuss in my testimony reflect a consensus list of Arizona's federal water priorities. They are the result of comprehensive in-state discussions among a broad group of water users. That process proceeded from a meeting on April 1, 2015 between Governor Ducey, Senator McCain and Senator Flake to discuss the direction that the State would take with its federal delegation on water issues.

Challenges Imposed by the On-Going Drought

Arizona continues to experience drought and 100 percent of the State falls within “Abnormally Dry” to “Severe Drought” conditions. The Salt and Verde River watersheds are in the sixth consecutive year of drought, which has reduced the surface water supplies utilized in the Phoenix metropolitan area by municipal water providers and agriculture. That has resulted in an increase in groundwater pumping to backfill the reduction in those surface water supplies. The Salt and Verde River watersheds are also at increased risk to wildfires, as is the Gila River watershed, the other main source of Arizona’s in-state river supplies. Allocations of surface water from the Gila River have also been reduced as a result of the drought. To address drought conditions and the impact on our water supplies and water users, the Governor’s Drought Interagency Coordinating Group has recommended that a Drought Declaration be adopted by Governor Ducey. That Declaration will allow aid to flow to farmers and ranchers from the United States Department of Agriculture for loss of production and it also raises public awareness regarding drought conditions affecting the State.

The West-wide drought presents some unique challenges for all Colorado River users and the State of Arizona. The Colorado River watershed is in the 16th year of below average runoff due to drought. Arizona stands to lose 320,000 Acre-feet of its 2.8 Million Acre-feet Colorado River allocation when a Tier 1 shortage is triggered by Secretarial order pursuant to the 2007 Colorado River Interim Guidelines for Lower Basin Shortages and The Coordinated Operations for Lake Powell and Lake Mead. Under the Interim Guidelines a projection of the elevation of Lake Mead is made in mid-August for the first day of the next calendar year. If that projection were to show Lake Mead falling below elevation 1,075 feet, a Tier 1 Shortage is then put into place starting on January 1 of that year. Today, Lake Mead is at elevation 1,075.19[4] feet. The probability of a shortage declaration in the Lower Basin of the Colorado River has been steadily increasing during the past few years. The probability of a shortage in calendar year 2017 is 10 percent and that increases to 56 percent[5] for 2017. It is important to note that a Tier 1 shortage triggers reductions for Arizona, Nevada and the Republic of Mexico but not for California. Arizona shoulders the burden of the shortage among the three states and Mexico, about 84 percent of the total.

Deeper shortages will occur if Lake Mead’s elevation continues to decline. Between elevation 1,050 feet and 1,025 feet a Tier 2 shortage results in Arizona suffering a reduction of 400,000 Acre-feet and at elevation 1,025 feet Arizona loses 480,000 Acre-feet, a Tier 3 shortage. The probabilities of Tier 2 and 3 occurring have also been increasing as the drought continues. If Lake Mead’s elevation continues to drop and falls below elevation 1,025 feet, the volume of shortage to Arizona is unknown at this time. This uncertainty creates a difficult task for Arizona: how to plan for a shortage that is unquantified but will undoubtedly be greater than 480,000 Acre-feet. As Lake Mead approaches elevation 1,000 feet, the near-term limit for diversions by Las Vegas, or continues to decline to dead pool at elevation 895 feet, draconian shortages are likely to occur. Reductions in water supply are not the only impacts associated with declining levels at Lake Mead. As Lake Mead elevations decline, the hydropower generating capacity is reduced at Hoover Dam. Hydropower generation at Hoover Dam serves electrical customers in California, Arizona, and Nevada with enough energy to serve 1.3 million people each year. Hoover Dam currently generates about 3,700,000 megawatt hours of electricity each year. The following table illustrates the magnitude of reduction at Hoover Dam:

Lake Mead Elevation	Hoover Dam Capacity[6]	Percent Reduction
1,212 (Jan. 2000- Start of Drought)	~ 2,074 MW	-
1,076 (July 2015 elevation)	~ 1,551 MW	25%
1,050	~ 1,371 MW	33%
1,000	~ 1,046 MW	50%

[4] Based on USBR Lower Colorado River Region's daily reservoir conditions for May 12, 2016.
[5] Based on USBR Lower Colorado River Region's Colorado River April 2016 24 Month Study and resulting projections of Lake Mead elevations.
[6] USBR information August 2013. USBR reports that projected generation capacity is uncertain below elevation 1050 due to unknown impacts of vibration and cavitation on performance at low reservoir elevations.

If a shortage were declared, Hoover Dam could lose as much as 21% of hydropower production from 2015 production levels – a loss equivalent to the electricity needs of 280,000 people. The following table illustrates those reductions:

Lake Mead Elevation	Hoover Dam Generation	Percent Reduction
Current (2015)	3,700,000 MWH	-
1,075 (1st Level Shortage)	3,445,000 MWH	6%
1,050 (2nd Level Shortage)	3,193,000 MWH	13%
1,025 (3rd Level Shortage)	2,915,000 MWH	21%

Impacts on power generation will also occur as Lake Powell's elevations decline. Glen Canyon Dam hydropower production is eliminated if Lake Powell falls below elevation 3,490 feet, and United States Bureau of Reclamation has indicated that impacts to power production could occur at elevation 3,525 feet.

DISCUSSION OF S. 2902

SECTION 101

This Section directs re-evaluation of flood control operations at US Army Corps of Engineers or US Bureau of Reclamation dams to enhance water storage. In Arizona, an opportunity exits at Modified Roosevelt Dam, a facility owned by the Bureau of Reclamation and operated by a local entity, the Salt River Project. The dam was originally completed in 1911. Modifications to the dam were completed in 1996 and 556,000 acre-feet of dedicated flood control space was added along with new water conservation space and safety of dams space (1,223,000 Acre-feet). A Water Control Manual governs the operation of the flood control space behind the dam. Flood control operations are exceedingly safe and conservative. The safety of dams storage space above the flood control space provides protection for the Probable Maximum Flood. There is an opportunity to use the flood control space, moreover, for "temporary storage" when the conservation storage space fills and water remains in the flood control space at the end of the runoff season, typically in April. The water conserved as temporary storage can then be put to beneficial use prior to the next storm season in late fall or early winter. Preliminary modelling by the Salt River Project estimates that an average of about 70,000 Acre-feet per year might be generated under this concept. The model also projects that the yield is highly variable, ranging between zero and 300,000 acre-feet in a year. In fact, water would have been available in 2005, 2008 and 2010 if temporary storage in flood control space has been an option.

The median yield of the Salt River Project system between 1981-2010 is 680,000 Acre-feet and adding an average of 70,000 Acre-feet per year, a 10 percent increase, would be a significant addition to the water supplies delivered by the Salt River Project.

In 2008 Salt River Project representatives and local municipal water providers who receive water from the Salt River Project reached out to the Army Corps of Engineers to discuss this concept. Many hurdles were identified and the effort was set aside for future consideration. Section 101 provides clarity and potentially streamlines the process to creating temporary storage at Modified Roosevelt Dam and the State of Arizona supports the concept.

SECTION 103

This Section requires the National Academy of Sciences conduct a study on the efficiency of controlling tamarisk to increase water supplies and improve riparian habitats and for the Bureau of Reclamation to create a feasible plan that builds upon the 2012 Colorado River Basin Supply and Demand Study to implement tamarisk control. The Colorado River Basin Water Supply and Demand Study contained the following statement: "Estimates of water savings by removal of tamarisk and replacement by other species range from zero and up to 1.5 are-feet (af) per acre (Nagler et al., 2009). A reasonable estimate for planning purposes is 0.54 af per acre (Tamarisk Coalition, 2009)." The Basin Study also made clear that additional information is necessary to understand the water savings potential of removing non-native vegetation such as tamarisk from the Colorado River watershed in a cost-effective and environmentally responsible manner.

In the Lower Basin more than 600,000 Acre-feet of water is lost annually due to evaporation, transmission losses and consumption by non-native vegetation.

Cost effective methods to control tamarisk that create additional flow in the Colorado River system can help to alleviate those losses, reduce impacts of the drought, and can add resiliency to the system. That outcome is consistent with the goals of the State of Arizona and I support these provisions.

SECTION 104

This Section amends Title II of the Energy and Water Development and Related Agencies Appropriations Act, 2015 (division D of Public Law 113-235) by replacing section 206 (43 U. S.C. 620 note; 128 Stat. 2312). It effectively provides authority for the Secretary of the Interior to fund or participate in projects to conserve water for the benefit of the Colorado River system. It also authorizes an appropriation of $10 million each fiscal year 2017 through 2027.

The provisions of this Section build upon the collaborative efforts of the Colorado River Basin States and the Department of the Interior to proactively manage the Colorado River system to improve its health. A major advancement occurred with the approval of the 2007 Colorado River Interim Guidelines for Lower Basin Shortages and The Coordinated Operations for Lake Powell and Lake Mead. That agreement created flexibility for water users in Arizona, Nevada and California to create "Intentionally Created Surplus" by conserving water in one year, storing it in Lake Mead and recovering it for use in a future year. Carefully crafted conditions were attached to this program. One result of this new flexibility was that critical Lake Mead elevations could be protected through the conservation of this water in the Lake. The Basin States continued to seek ways to protect reservoir levels and the health of the Colorado River system.

In July 2014 a pilot system conservation program was created by the Bureau of Reclamation, the Central Arizona Water Conservation District (aka the Central Arizona Project), the Metropolitan Water District of Southern California, the Southern Nevada Water Authority and Denver Water. This program is funded by those partners. In the Lower Basin the program looked to conserve water to benefit Lake Mead and in the Upper Basin to benefit Lake Powell. Unlike Intentionally Created Surplus, this conserved water was dedicated to the system and is not available for future recovery. It was another step forward in management of the River.

That program was followed in December 2014 by the Memorandum of Understanding (MOU) among the United States of America, through the Department of the Interior, Bureau of Reclamation, the Central Arizona Water Conservation District, the Metropolitan Water District of Southern California, the Southern Nevada Water Authority, the Arizona Department of Water Resources, the Colorado River Board of California, and the Colorado River Commission of Nevada for Pilot Drought Response Actions. That MOU was a best efforts agreement that collectively targets a volume of 740,000 Acre-feet to be stored in Lake Mead to protect critical elevations in the Lake. Both Intentionally Created Surplus and system conservation water are accounted to the target.

The creation of system conservation water is a critical component of efforts to protect Lake Mead elevations because Arizona, Nevada and California and their water users all benefit from this system water. In 2014 and 2015 Arizona created about 120,000 Acre-feet of system conservation water. By the end of 2016 we project that approximately an additional 45,000 Acre-feet will be created. The total system conservation water that Arizona expects to be created in 2014-2016 is 165,000 Acre-feet. This is a significant contribution to Lake Mead that benefits Nevada and California as well as Arizona. Additionally, system water can have benefits to the Upper Basin by reducing the probability that low lake levels in Lake Mead will lead to increased Lake Powell balancing releases. Intentionally Created Surplus is also a valuable tool in protecting Lake Mead but that water is intended to be released from the Lake unlike system water.

Absolute certainty that this system water will stay in Lake Mead is a necessity for Arizona to continue its efforts to create these protection volumes. Arizona has the ability to use water solely for the benefit of Arizona. Its robust water banking program can store all of this water in aquifers within Arizona for future use in the State. Recovery of that stored water is a key strategy for minimizing the impacts to Arizona when a shortage is declared by the Secretary of the Interior in the Lower Basin and Arizona and Nevada have their Colorado River allocations reduced. The decision to store conserved water in Lake Mead rather than in aquifers in Arizona relies on some assurances that the conserved water ultimately will go to its intended purpose.

While Arizona appreciates that the Secretary of the Interior has chosen not to release any of the system water created to date, the State of Arizona supports the provisions in Sec. 104 inserting language at Sec. 206 (a) (2), Division D, PL 113-235 to achieve the outcome of absolute certainty that system water will remain as system water to the benefit of the Basin States.

Section 104 of S. 2902 provides incentive for all water users in the Lower Basin to continue to incrementally add to system conservation measures with the knowledge that the conserved water will provide the benefit that was intended.

Sections 111-114

These Sections apply a streamlined permitting process to forest and wildland restoration activities in critical water supply watersheds. The conditions of the national forest system lands, and certain other wildland areas, in the State are presently near a crisis stage, a circumstance that demands the utmost sense of urgency and meaningful and measurable action. The health of our watersheds is one of the biggest environmental challenges for Arizona in the 21st Century. Drought conditions in the West only magnify the challenges. The largest contiguous ponderosa pine forest in North America, an area encompassing approximately four million acres, extends from the Grand Canyon National Park to the Gila National Forest of western New Mexico. This stand, and the other forested and wildland areas in Arizona, supply water to Arizona communities and provide recreational opportunities for our citizens.

The status of vast portions of these forests is distressingly poor due to several factors. The implementation of certain forest management methods, spanning decades, and including well-intentioned yet restrictive administrative and regulatory constraints, have been counterproductive. Among other things, the practices have resulted in over-stocked and even-aged stands of trees. These dense thickets of low value younger trees, combined with ineffective or injurious fire management schemes, have yielded the conditions for catastrophic landscape scale wildfires, endangering people, flora, fauna, and watersheds.

Unhealthy forests and resulting catastrophic wildfires affect the short and long term management, sustainability, and quality of Arizona's water supply. In Arizona and throughout the west, reservoir storage is a critical component of water supply and drought management. Catastrophic wildfires, unlike the low intensity fires seen in healthy forests, cause burn areas that devastate the landscape and produce increased loads of sediment, ash and debris causing reservoirs to fill up faster and reduce the life and storage capacity of reservoirs. In addition, the loss of trees and groundcover can also affect the timing and behavior of runoff, impacting the predictability and management of water supplies. Heavily forested and steep walled watersheds have characteristics that amplify the impact of sedimentation due to wildfire.

In addition, the water quality impact of catastrophic fire and post-fire flooding has both short and long-term impacts, reaching throughout the watershed, and extending far beyond the immediate impact area of the fire and the surrounding communities. The ash and sediment picked up by runoff after a major fire severely impact the taste and purity of drinking water supplies causing an increase in turbidity, and nutrient and organics loads that must be removed during treatment. Runoff events following fires have also resulted in significant changes in the levels of nitrates, sulfates, and chlorides in runoff. Over the longer term, the increased volume of sediment deposited behind reservoirs due to changes in runoff patterns and soil destabilization can impact the taste and odor as dissolved organics increase in the water. In many cases treatment facilities in Arizona have been upgraded by adding carbon filtration to handle the increased levels of organics and sediment at a cost of hundreds of millions of dollars.

In-pre-settlement conditions estimates show that there were less than 50 trees per acre and today those estimates have risen to over 1000 trees per acre. In the Salt and Verde River watersheds the number of acres impacted by fire has steadily increased from 85,000 acres in the 1980s, to 227,000 acres in the

1990s and to almost 2 million acres in the 2000s. According to the Arizona State Forestry and others, approximately 1.8 million acres of timber have burned since 2002.

These data are indicative of the enormity of the need to take immediate action to reduce the risk of fire in our forests and wildlands. Expediting the permit processes that are needed to restore these areas to a healthy condition is critical. I am encouraged by the expansion, enabled by Sections 111-114 of this bill, of categorical exclusion authority along with the "action/no action" evaluation for certain activities. The incorporation of the categorical exclusion provision in the 2014 Farm Bill, though somewhat limited, was a positive earlier step. S. 2902 would significantly increase the scope of this authorization and could result in accelerated forest restoration activities which would assist in the protection of critical watersheds.

In summary, the State of Arizona supports Sections 101, 103, and 111-114 of S. 2902. Collectively those provisions further the efforts of the State to manage their existing water resources in a manner that creates greater certainty for water users, leverages existing infrastructure in our State to generate more water supplies, creates healthy watersheds to increase their water supply yield and protects watersheds from being degraded by catastrophic fire.