

2011

**Arizona Drought Preparedness
Annual Report**



Arizona Department of
Water Resources

11/16/2011



2011 Arizona Drought Preparedness Annual Report

Acknowledgements

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Introduction

Realizing the need for drought preparedness in Arizona, a Governor's Drought Task Force was created in 2003 and the *Arizona Drought Preparedness Plan* (ADPP) developed. The ADPP was adopted in 2004 and its continued implementation ordered in 2007 (EO 2007-10). The ADPP established a framework to monitor drought, improve understanding of drought impacts, and determine mechanisms for limiting future vulnerability. The Arizona Department of Water Resources coordinates these activities and prepares the *Arizona Drought Preparedness Annual Report* each year. The *2011 Arizona Drought Preparedness Annual Report* covers the drought conditions and preparedness activities for the 2011 water year, from October 1, 2010 through September 30, 2011.

1. Drought Status Summary

Winter Precipitation

The winter of 2011 (Figure 1) was extremely dry across all but the northwestern corner of Arizona due to a La Niña circulation, which forced most winter storms to remain well north of our state. The Verde River watershed received near average precipitation, though it has little storage capacity. The Salt River watershed, which has significant storage capacity, received only 50 to 70% of average precipitation. The southeastern watersheds were exceptionally dry with less than 50% of average winter precipitation. The only good news about the 2011 winter precipitation was the near record run-off from the upper Colorado River basin into Lakes Powell and Mead. The run-off allowed equalizing flows to raise Lake Mead about 41 feet above critical shortage level, while Lake Powell rose 42 feet. This is critical to the Arizona communities that draw on Colorado River water from the Central Arizona Project. Arizona's sparse winter precipitation followed a near average to slightly wetter than average winter in 2010 (Figure 2). The 2010 winter left moisture deficits in the southeastern counties, which became much more critical this winter and through the summer. Temperatures during the winter were generally near average over the northwestern half of the state and two to three degrees warmer than average across the southeastern half of the state. This resulted in a reduction of the snowpack in the White Mountains on the upper Salt River watershed.

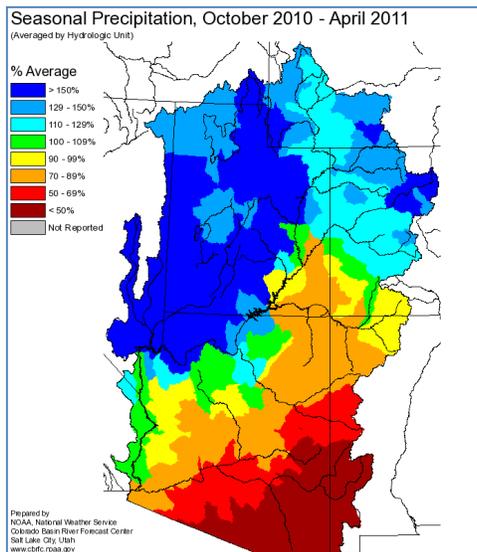


Figure 1. – Winter 2011 Precipitation

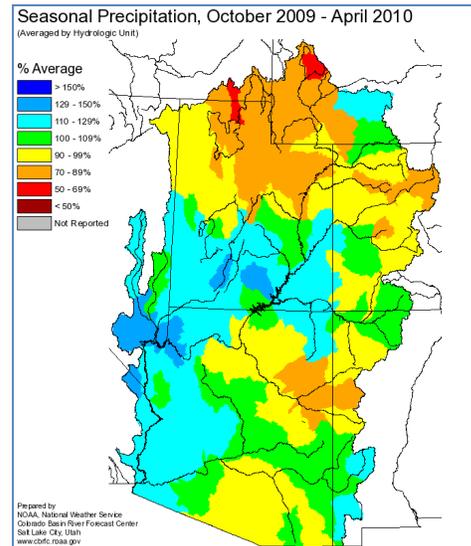
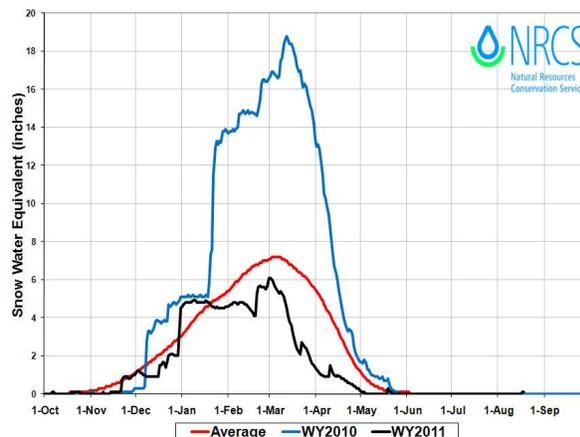


Figure 2. – Winter 2010 Precipitation

At nearly all USDA-Natural Resources Conservation Service (NRCS) automated snow telemetry (SNOTEL) sites, the snowpack (as snow water equivalent) during the winter snow season was well below normal. This is in stark contrast to the snowpack of the previous winter (Figure 3).

Figure 3. Snow water equivalent at high-elevation gages compared to long-term average

Arizona Snowpack Summary



Summer Precipitation

The 2011 summer (Figure 4) was wetter than average on the Little Colorado, San Pedro and Virgin watersheds; much drier than average on the Bill Williams, Agua Fria and San Simon watersheds; and near or slightly drier than average on the other nine watersheds. Summer precipitation was very localized, with individual storms dropping half an inch to an inch of rain in one location and less than a tenth of an inch a few miles away. The southeastern watersheds did not receive enough rainfall this summer to make up for the deficits left by the dry winter. The change from last summer is quite dramatic, particularly in the southwestern deserts and in the eastern watersheds (Figure 5). The monsoon was relatively short, but was augmented by several early fall-type cold fronts that brought much needed rainfall to northern Arizona, leaving Flagstaff with near average precipitation for the water year. Unfortunately, those storms did not bring rainfall to central or southern Arizona. The dry monsoon was largely due to the location of the subtropical high well eastward of its normal location. This persistent high pressure moved the moisture to the eastern border of Arizona, and also created intolerably hot conditions over Texas and Oklahoma.

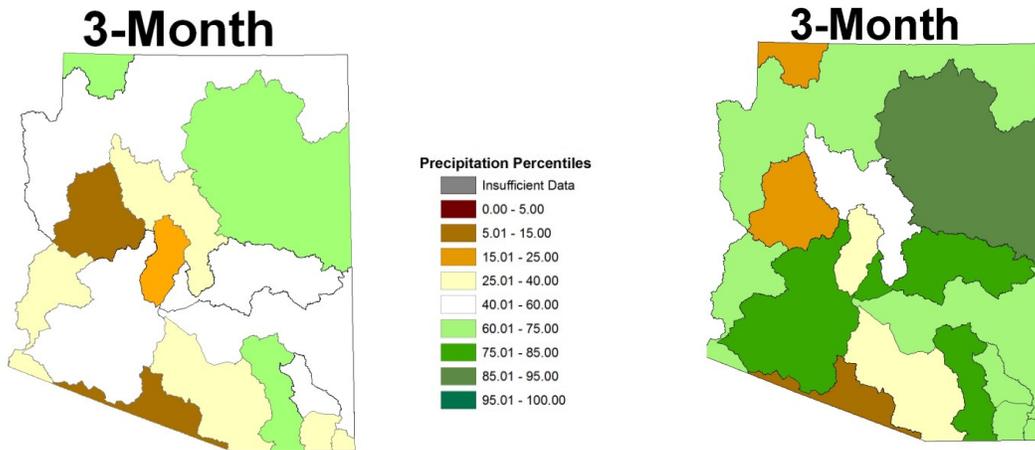


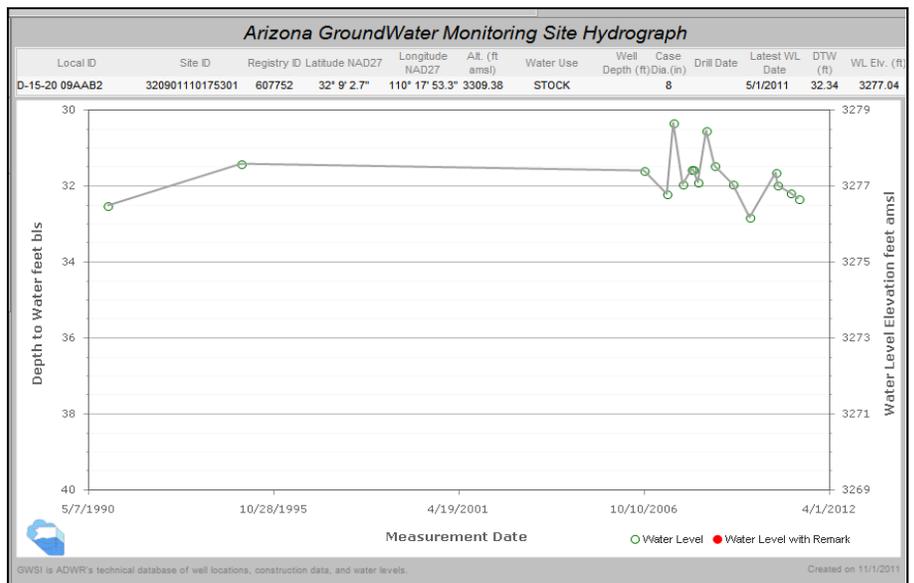
Figure 4. Precipitation Jul - Sep, 2011

Figure 5. Precipitation Jul - Sep, 2010

Drought Index Wells

Two of the Arizona Department of Water Resources' (ADWR) groundwater index wells in the southeastern part of the state have been identified as meeting the criteria for measuring the effects of climate for the purpose of providing an indication of drought status. These wells are located within the Lower San Pedro and Whitewater Draw watersheds. During the 2011 water year, the wells showed a steady decline in groundwater levels that correlated with stream flow and long-term drought conditions, as indicated by the hydrographs in Figure 6 and Figure 7.

Figure 6. Drought index well in the Lower San Pedro watershed



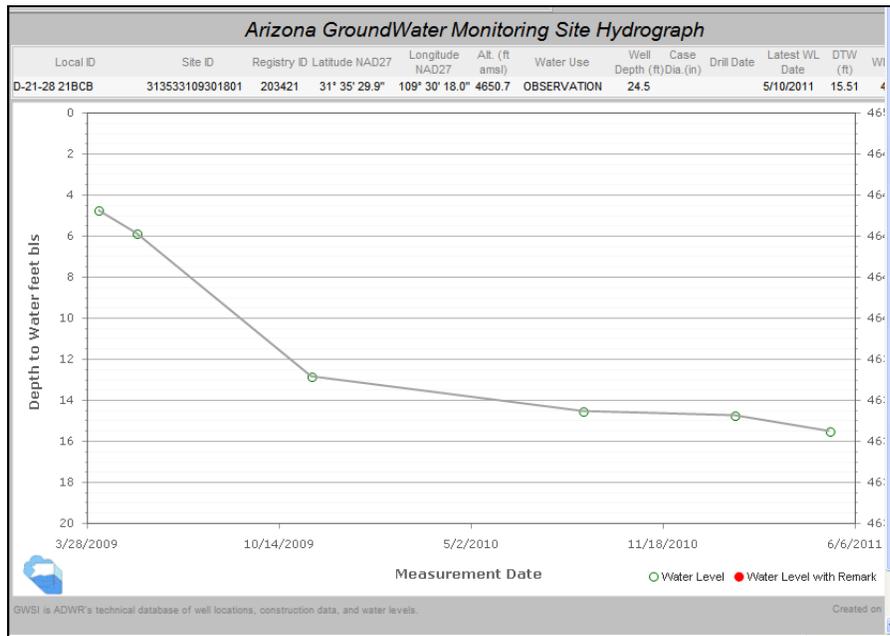
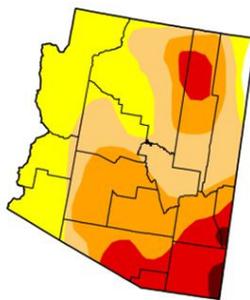


Figure 7. Drought index well in the Whitewater Draw watershed

Drought Status Changes

Arizona’s drought status is updated at the end of each month (short-term drought status) and the end of each quarter (long-term drought status).

-Short-term Drought Status



Intensity:
 D0 Abnormally Dry
 D1 Drought - Moderate
 D2 Drought - Severe
 D3 Drought - Extreme
 D4 Drought - Exceptional

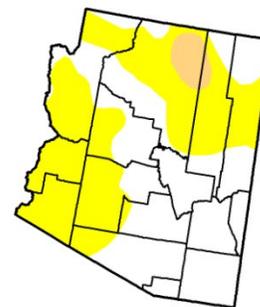


Figure 8. Short-term drought status Oct. 25, 2011

Figure 9. Short-term drought status Oct. 26, 2010

In the short-term, rangeland and forest conditions are in much worse condition than a year ago (Figures 8 and 9). Though summer precipitation was not widespread or uniform, the current status actually is somewhat improved from the mid-summer condition where extreme drought (D3) extended west and north covering all of Graham and Greenlee, southern Gila, and western Pinal and Pima counties, and exceptional drought (D4) covered all of Cochise and southern Graham and Greenlee counties. The current status is a result of both the dry winter and the weak monsoon. In most of the southwestern counties there was no spring green-up. A year ago, over half the state was out of short-term drought condition, but this year 100% of the state is in some drought condition, with 42% in severe drought or worse. So far, there has been no significant fall precipitation, so there may be no winter grasses in many areas. This will be important as we move into a second consecutive La Niña winter for 2011– 2012 that is forecast once again to be drier than normal.

-Long-term Drought Status

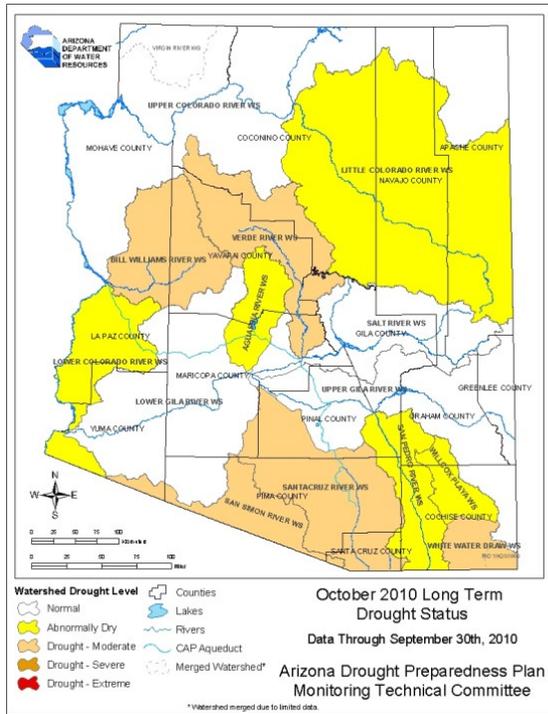


Figure 10. Long-term drought status Oct. 2011

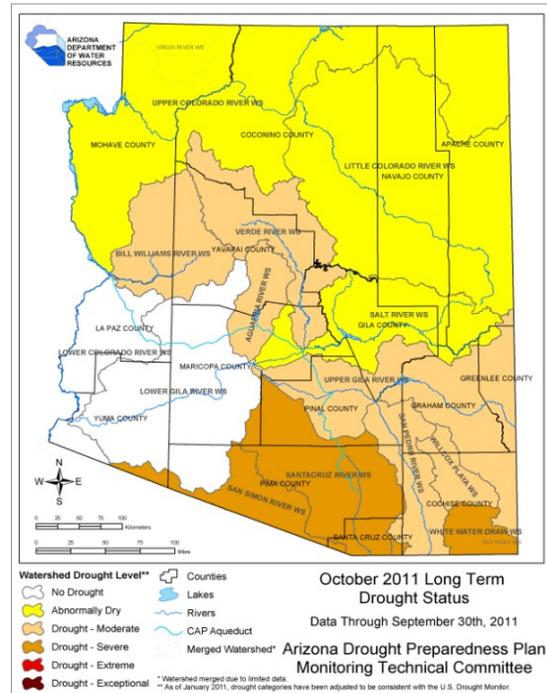


Figure 11. Long-term drought status Oct. 2010

In the long-term, there has been significant degradation from a year ago both in northern Arizona and in the southeastern watersheds (Figures 10 and 11). Last year, due to the extremely wet winter caused by the El Niño circulation pattern, there was significant improvement in the long-term drought status, but the past 12 months have been so dry that many of the long-term gains from the previous year have been erased. The Upper Colorado and Salt River watersheds have moved back to abnormally dry from no drought, and the conditions in the southeastern watersheds have degraded by one or two categories, with the Santa Cruz, Whitewater Draw and San Simon watersheds now in severe drought. On the Drought Monitor, these watersheds and the southeastern counties are in extreme drought. Only the lower Colorado watershed has improved from abnormally dry to no drought. The Lower Gila watershed continues to be without drought. With the current outlook indicating a repeat of La Niña conditions, we anticipate worsening drought conditions this winter.

Table 1. Number of watersheds in each drought category

Category	2011	2010
No Drought	2	4
D0 - Abnormally Dry	3	5
D1 – Moderate Drought	6	6
D2 – Severe Drought	3	0
D3 – Extreme Drought	0	0
D4 – Exceptional Drought	0	0

Water Year Summary

At SNOTEL and other mountain gages, cumulative precipitation for the 2011 water year (ending September 30) was below normal to well below normal in all of the state's major river basins, ranging from 65 to 95% of the 30-year average (Table 2).

Table 2. Mountain precipitation for water year 2011

River Basin	Percent of 30-yr. average Precipitation at NRCS high elevation gages	
	2011	2010
Salt River Basin	75%	109%
Verde River Basin	95%	117%
Little Colorado River Basin	85%	120%
San Francisco-Upper Gila River Basin	65%	104%

Drought status as indicated by streamflow data shows a slight increase in drought from 2010 to 2011. Basins that increased in drought did so by only one or two drought categories. Out of the 26 basins, twelve stayed the same, twelve increased by one drought level and two basins increased by two drought levels. Overall condition for the 2011 water year is moderate drought.

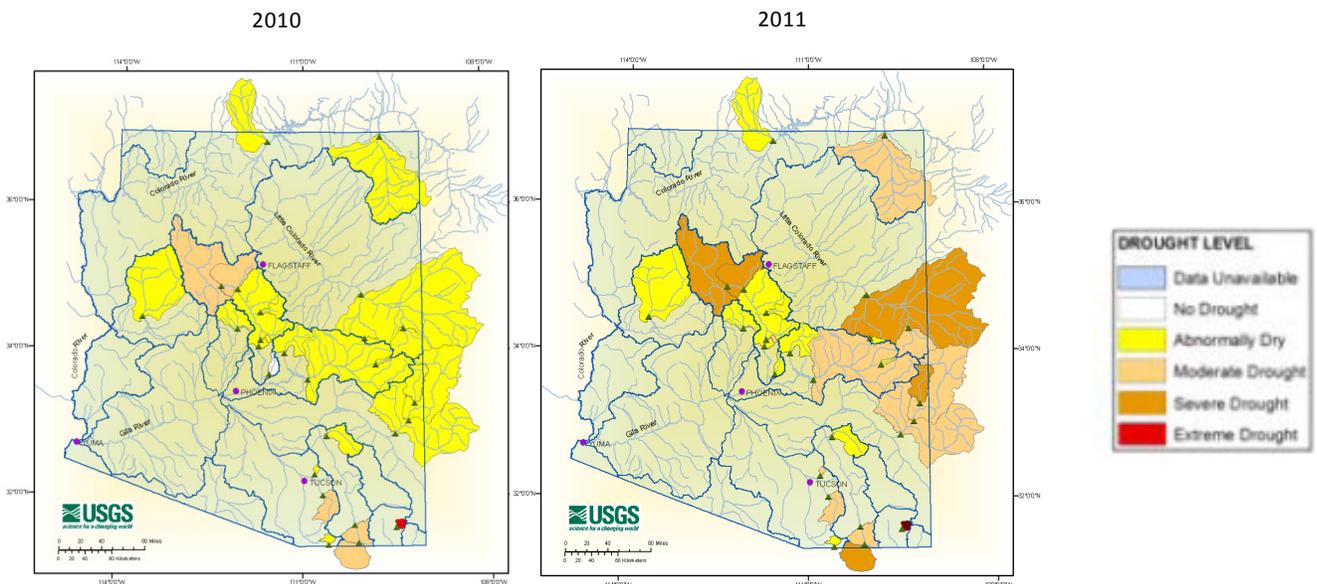


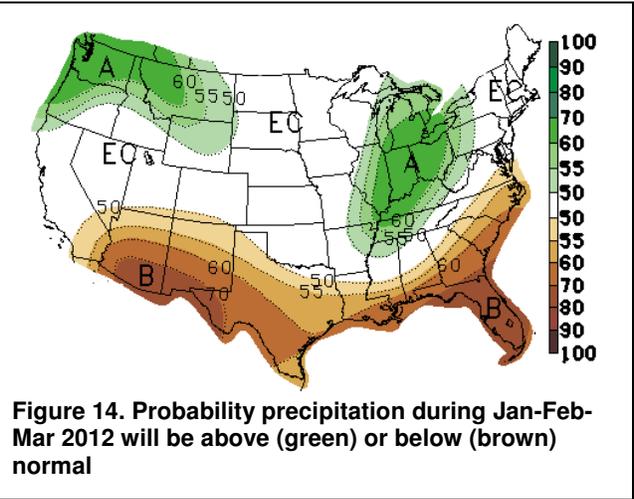
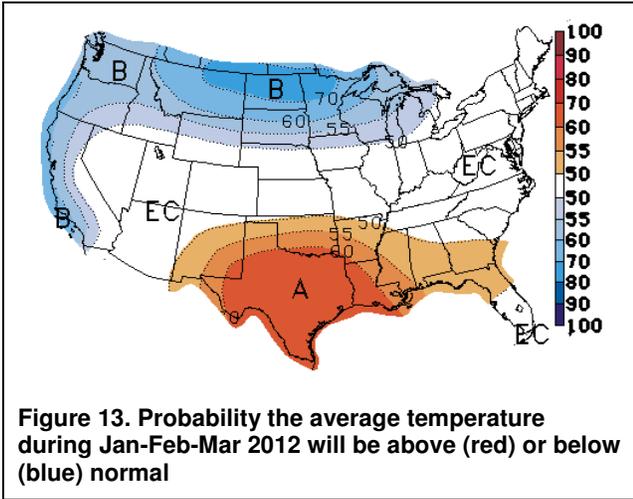
Figure 12. As determined by USGS stream gages, overall drought condition increased one category from 2010 to 2011

Outlook for 2011-2012

-Winter 2011-2012

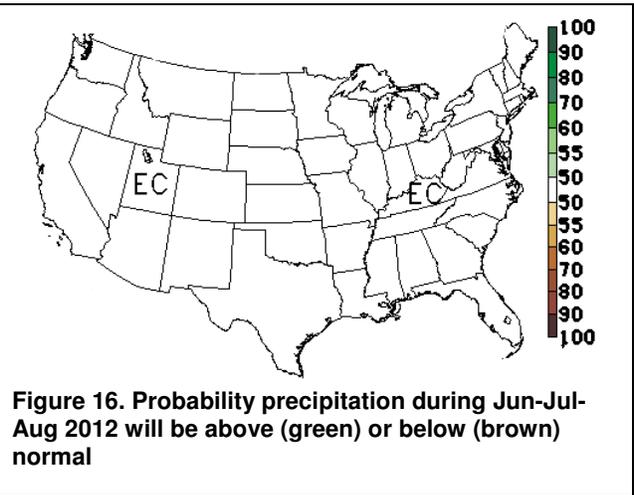
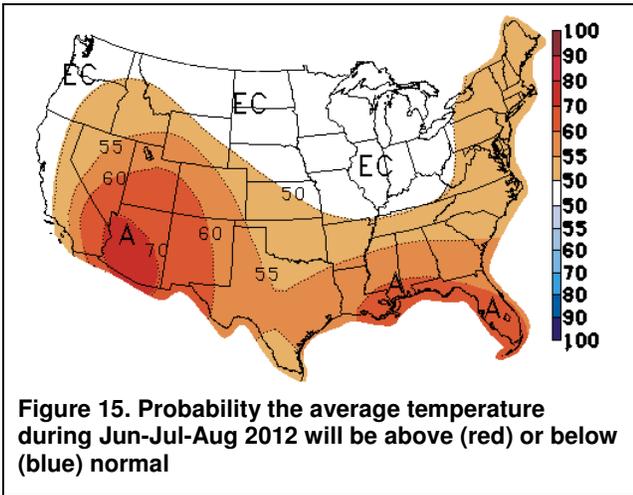
After a strong La Niña event during the 2010-2011 winter, conditions became neutral during the 2011 summer. Since then, the equatorial waters of the Pacific Ocean have slowly but steadily cooled. The majority of climate models now indicate that La Niña conditions will re-emerge during the coming winter months. La Niña conditions *typically* result in below average winter precipitation across the southwestern United States.

Official climate outlooks from the NOAA Climate Prediction Center indicate the chances of temperature and precipitation being either above or below normal. The outlook for January-March 2012 shows an equal chance for the three month average temperature to be above or below normal across Arizona. The precipitation outlook indicates that statewide, below normal precipitation is favored January-March 2012, with the probability ranging from near 55% across far northern Arizona to near 75% across southeast Arizona. This will likely cause existing drought conditions to worsen through the typically wet winter months.



-Summer 2012

The Climate Prediction Center’s climate outlook for June-August 2012 shows a high likelihood that the average temperature during those three months will be above average statewide. The precipitation climate outlook shows no discernable signal during this period. That is, there are equal chances for precipitation during the 2012 monsoon season to be above or below normal.



2. Drought Declarations and Designations

The Arizona Department of Water Resources and the Drought Interagency Coordinating Group participate in the process for Drought Emergency Declarations and Disaster Designations for the state.

Disaster Designations

As of August 2011, nine Arizona counties are designated as disaster areas by the U.S. Department of Agriculture (USDA) as a result of drought, wildfires, and high winds. Once designated, farm operators in the designated counties and contiguous counties may be eligible for assistance (low-interest emergency loans or other federal disaster relief) from the Farm Service Agency (FSA). To become designated, the Governor requests the Secretary of the USDA to issue a disaster designation. This request triggers authorization for the FSA to assemble damage assessment reports for analysis. The reports are then forwarded to the USDA with recommendations for consideration. A disaster designation can occur anytime after a request by the Governor.

Drought Emergency Declarations

A Drought Emergency Declaration has been in effect in Arizona since 1999. The current declaration, [PCA 99006](#), issued by the Governor in June 1999 was continued by [Executive Order 2007-10](#). The Drought Interagency Coordinating Group has been responsible for recommendations to the Governor about drought declarations. 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.

3. Drought Preparedness Plan Implementation Highlights

In early 2011, the part-time coordinator for the statewide drought and community water planning program transferred to another division, resulting in a further reduction of ADWR staff available to help implement and monitor these programs.

Drought Planning for Community Water Systems

Drought planning requirements and water use reporting regulations were recommended in the ADPP and established by the state legislature in 2005 for the purpose of reducing community water systems' drought vulnerability and providing a means for the state to gather water use data. ADWR provides assistance to water providers in meeting these requirements.

-System Water Plans

All community water systems are required to submit a System Water Plan every five years. The System Water Plan includes a Water Supply Plan, Conservation Plan and Drought Plan. The first reporting years were 2007 for large systems and 2008 for small systems. Of approximately 800 community water systems in the state, 644 (80%) have System Water Plans that meet statutory requirements. The System Water Plan forms have been modified for 2012 and 2013 so that they are more user-friendly and will be easier to analyze. A section was added so that community water systems can request the following information to help them determine drought stages:

- precipitation data
- weather forecasts
- regional drought conditions
- range and forage conditions
- aquifer levels
- other drought/conservation information

After the forms are submitted and reviewed, ADWR will determine appropriate ways to provide the requested information.

A vulnerability analysis was conducted in 2011 for 200 community water systems based on information contained in the System Water Plans. The 200 systems analyzed represent 95% of the population outside the state's Active Management Areas. The Vulnerability Analysis will attempt to describe the sustainability of water supplies for planning areas, basins and selected communities. The analysis will be included in Chapter 9 (Arizona Water Sustainability Evaluation) of the Arizona Water Atlas, [ADWR - Statewide Planning / Water Atlas](#).

-Annual Water Use Reports

In 2011, 322 community water systems, representing 85% of the total population outside of the state's Active Management Areas, reported 2010 annual water demand data. (In comparison, 2009 data were received by 358 community water systems, representing 90% of the total population served). ADWR will send a notice at the end of the year to local governing bodies of those providers that have not submitted an Annual Report.

Local Drought Impact Group Efforts

Local Drought Impact Groups (LDIGs) participate in monitoring, education and mitigation on a local level, mainly through cooperative extension and county emergency management programs. Initial planning efforts included ten LDIGs, and eight LDIGs have been active in the past. Since 2008, LDIG focus has been entirely on drought impact monitoring and reporting in an effort to reduce strain on resources, however, only Mohave County and Pima County are currently active.

-Mohave LDIG (see Appendix A for details)

Mohave LDIG meetings were held in January, March, July, and October of 2011, with the March meeting focusing on the visit by the U.S. Drought Mitigation Center. The Mohave LDIG's Drought Impact form is forwarded to the County Emergency Management office, which sends a summary to Arizona DroughtWatch at the first of each month. Opportunities to expand the drought monitoring network to provide more comprehensive coverage are being pursued.

Drought conditions improved in the county in 2011, however, some areas continue to be considerably dryer than others. Conditions across the county as of October varied from normal to unusually dry. Currently, none of the cities have implemented any of their drought plan stages.

The LDIG Mitigation Working Group commenced work on a Drought Mitigation Plan in early 2011. For planning purposes, the county will be divided into zones based on factors such as elevation, topography, vegetation, water sources, and population density. This information will be used to identify trigger points for various drought stages in each of the zones, followed by the identification of potential mitigation measures.

-Pima LDIG (see Appendix B for details)

The Pima County LDIG meets bimonthly to monitor drought conditions, discuss drought impacts and coordinate drought declarations and responses. In 2011, drought conditions persisted in Pima County. The impacts of sustained drought observed include stressed urban landscaping, stressed riparian vegetation, reduced amounts of perennial water available to support wildlife, drying stockponds, and lack of pasture grasses.

However, because the long term status has not worsened appreciably, and increased water levels to Lake Powell and Lake Mead from this winter's snowmelt in the upper Colorado watershed will delay a shortage on the Colorado River by several years, the status of regional drought declarations remains at Stage 1 Alert, unchanged from 2010.

Several water sustainability planning initiatives are underway in Pima County, including updates to the City of Tucson's drought response plan, a climate change mitigation and adaptation plan, and a regional water assessment.

-National Drought Mitigation Center Visit (see Appendix C for details)

In March 2011, staff from the National Drought Mitigation Center along with representatives from the National Weather Service, Arizona State Climate Office and the Drought Watch Program conducted workshops in Kingman, Phoenix and Tucson. The programs were designed to garner feedback from citizens interested in drought conditions, monitoring, online products, and other drought-related issues. The programs covered the following topics:

- Drought monitoring in Arizona and the United States
- Use of citizen drought impact reports by decision makers
- Online drought assessment tools
- U.S.drought-ready communities initiative
- Establishing clear communication channels about current drought impact information.

State Drought Monitoring Technical Committee Efforts

The State 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 (LDIGs). The two co-chairs are Nancy Selover, State Climatologist and Gary Woodall, Meteorologist-in-Charge of the National Weather Service Phoenix Office.

-Short-term Drought Status Reporting

The MTC now confers weekly 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, as 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. The MTC, and particularly Michael Crimmins at the University of Arizona, has worked on improvements to the Arizona DroughtWatch website www.azdroughtwatch.org, where drought impacts can be reported directly into the impacts database, and will be linked automatically to the National Drought Impacts Reporter.

-Arizona DroughtWatch

Arizona DroughtWatch (AZDW) is a pilot, volunteer drought impact monitoring program that has been developed to systematically collect qualitative observations of drought impacts to support drought status determination and local drought vulnerability assessments. Historically, drought monitoring and the calculation of drought status have been based solely on sparse networks of hydroclimatological data collected across the state. Qualitative observations of drought impacts in conjunction with these data offer the promise of a better and more nuanced characterization of drought, given Arizona's complex and highly variable climate. The web-based reporting system allows observers to create accounts and submit impact observations for multiple locations on a monthly basis. These observations are summarized and displayed anonymously in maps and tables on the open website. The beta system, launched in 2009, has collected several hundred individual drought impact observations that have been instrumental in both ground-truthing and adjusting state and national drought status maps. Work is underway to connect Arizona DroughtWatch to the National Drought Impacts Reporter to ensure seamless data sharing in support of national efforts like NIDIS.

-Community Collaborative Rain Hail and Snow (CoCoRaHS) Network

Arizona joined the CoCoRaHS network in 2009 so that our volunteer citizen precipitation observers could communicate their precipitation measurements to the National Weather Service along with over 10,000 observers from other states. The data collected are important in our drought monitoring as well as flood warning. This past year, CoCoRaHS has added drought impacts reporting to their website, enabling our 700-plus observers in Arizona to efficiently add their drought impact observations to their precipitation observations. The data go directly to the Drought Impacts Reporter.

-ADWR Drought Index Wells

The MTC plans on further assessment of statewide groundwater index wells to identify and incorporate data that meet the criteria for drought index wells. Drought index wells serve as a supplement to existing drought indicators and help establish drought status for watersheds where either precipitation or stream flow data are lacking.

-Communicating Drought Status

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

Weekly - On a weekly basis, the ADWR Drought Status webpage (<http://www.azwater.gov/azdwr/StatewidePlanning/Drought/default.htm>) is updated with the

latest version of the Arizona map produced by the U.S. Drought Monitor. The MTC analyzes local hydroclimatic conditions and impacts occurring in Arizona and provides this information to the U.S. Drought Monitor.

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 e-mail with the latest map and summary is sent to interested parties.

Quarterly - On a quarterly basis, the MTC continues to meet and produce a long-term drought status map and summary report, which 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). 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 in May (for January – March), August (for April – June), November (for July – September) and February for October – December.)

See Appendix D for the “Method for Determining Long-term Drought Status.”

These 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.

-Change in Method for Determining Drought Categories

As of January 2011, the MTC changed the percentiles of precipitation and streamflow represented by the drought categories from beginning below the 40th percentile to beginning below the 30th percentile. Since Arizona is an arid state, and precipitation and streamflow frequently fall between the 30th and 40th percentiles, beginning drought in that range caused some watersheds to bounce in and out of drought categories, while conditions on the ground may not have supported the drought condition. Old and new ranges are shown in the table below:

Drought Category	Old percentile range	New percentile range
DO - Abnormally Dry	25-40	21-30
D1 - Moderate Drought	16-25	11-20
D2 – Severe Drought	6-15	6-10
D3 – Extreme Drought	1-5	2-5
D4 – Exceptional Drought	NA	1-2

In addition to better reflecting actual drought rather than our normal precipitation variability, maps will be more consistent with the U.S. Drought Monitor maps that also use these percentile ranges.

- Calculating the Standardized Precipitation Index

The State Climatologist is working on the use of gridded data for calculating the Standardized Precipitation Index and the drought status to improve the resolution and timeliness of the maps produced by the MTC. This is a resource issue as there have been cutbacks on the State Climate Office.

- Funding and Resource Needs

The MTC has identified the following two funding and resource needs, as previously stated in the 2007 through 2010 annual reports:

1. *Development of a strategic plan to identify data gaps and monitoring needs*
 Arizona's current network of meteorological and hydrological observations for drought monitoring lacks sufficient spatial resolution to accurately characterize drought status at the local level requested by stakeholders throughout the state. Improving the spatial, temporal and altitudinal resolution of Arizona's drought monitoring network will improve the Committee's ability to serve the needs of Arizona stakeholders, including the local drought impact groups. In particular, Arizona faces the following conspicuous data gaps:

- Complete lack of soil moisture monitoring
- Few high elevation meteorological monitoring stations
- Constantly decreasing network of streamflow gages

Although the MTC has identified these data gaps in general terms, it is imperative to conduct a systematic evaluation in order to characterize and prioritize these numerous data and observation gaps. A strategic plan, with carefully considered criteria for prioritization, is essential for making state funding requests and for taking advantage of federal funding opportunities. The MTC recommends funding to develop a strategic plan, conduct data and observation gap analyses, and document priority locations using geographic information system technology.

Total cost: \$9,000

2. *Incorporation of groundwater data for drought status determination*

ADWR staff has evaluated groundwater level changes around the state. However, further analysis is needed to determine what role drought plays in these observed changes. Incorporating groundwater level trend data will be critical in determining drought conditions and impacts on water supply. When the state budget allows, the MTC recommends funding for ADWR staff salaries to conduct groundwater analyses.

Total cost: \$38,000 per year

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 2010 and May 2011 meetings, the ICG recommended to the Governor that the state's Drought Emergency Declaration (PCA 99006) and the Drought Declaration for the State of Arizona issued May 2007 (Executive Order 2007-10) be continued. The presentations and subsequent decisions are on ADWR's web site at <http://www.azwater.gov/AzDWR/StatewidePlanning/Drought/ICG.htm>.

4. Conservation Program Highlights

ADWR's Conservation Program provides an integrated approach to water conservation by combining regulations, assistance, outreach and education. ADWR works to achieve the mission of promoting and encouraging the wise and efficient use of water throughout Arizona by developing conservation tools and resources, assisting Arizona communities and water providers, collaborating with regional and national partners, and participating in outreach activities. Although many conservation activities have been curtailed as a result of the 2010 reduction in force and the transfer to another division in 2011 of one of the two staff working on conservation, efforts continue in the areas described below.

Water Conservation Toolkit

The conservation section of ADWR's website (www.azwater.gov/conservation) continues to be maintained, as it provides an assembly of tools developed to assist residents, businesses, communities and water providers in the design and implementation of comprehensive and proven conservation strategies.

ADWR plans to develop new tools for municipal water providers that focus on the best management practices (BMPs) most frequently implemented by the 55 providers in Active Management Areas regulated under the Modified Non-per Capita Conservation Program (MNPCCP). Results of their Conservation Efforts Reports submitted in 2011 indicate that water providers would benefit from additional information about the following BMPs:

- Basic public education on water conservation

- Meter repair and replacement programs
- Customer high water-use inquiry resolution
- Customer high water-use notification.

Information sheets with case studies about these BMPs would serve as a resource for water providers statewide. The October 2011 MNPCCP annual progress report can be found at www.azwater.gov/mnpccp.

Collaboration and Outreach

Another large component of ADWR's Conservation Program is collaboration and outreach to raise public awareness about water efficiency and help create a culture of conservation around the state. To this end, ADWR staff continues to participate in conservation efforts of groups such as the Arizona Municipal Water Users Association (AMWUA) and the Statewide Conservation Information Group. By combining voluntary initiatives with regulatory goals, ADWR is focused on creating a more integrated approach to water conservation. Examples of collaborative efforts include the following:

-Water Awareness Month

Arizona celebrated its 3rd year of Water Awareness Month (WAM) by promoting statewide water conservation activities, events and resources through a collaborative social media campaign. The theme for WAM 2011 was "AWARENESS -- of water conservation issues in our state -- and our call-to-action was for Arizona residents to use water more efficiently, become aware of water conservation activities in their region, and know where to turn for information and resources.



Working in collaboration with AMWUA, an interactive, web-based calendar for April 2011 was developed as a portal (or information hub) with its own independent website, <http://www.waterawarenessmonth.com>. The calendar served as the "landing site" for all WAM inquiries, with connections to activities, resources and tips related to the theme of each day, and a place for people to make a pledge about water conservation. The WAM website also included links to the WAM Facebook and Twitter accounts. Appendix E includes an article about WAM that was published by the University of Arizona Water Resources Research Center.

-LandscapewithStyle.com

ADWR and the AMWUA collaborated on transforming the book *Xeriscape: Landscaping with Style in the Sonoran Desert* into a web-based interactive guide for designing, installing and maintaining a low water-use landscape, making the resource readily available statewide.

www.landscapewithstyle.com



-Summary of Municipal Conservation Programs in Arizona

ADWR updates the *Summary of Municipal Water Conservation Programs in Arizona* as a resource for municipal water providers and other organizations wishing to begin or expand their water conservation programs. In addition to serving as a resource, the summary is an ongoing record of the conservation programs implemented by Arizona municipal water providers.

-Building Water Efficiency (water conservation website for facility managers)

ADWR is participating in the development of the web adaptation of AMWUA's water conservation guide for facility managers. This independent website will provide Arizona-specific information that is searchable and customizable for a variety of commercial and industrial applications, and will be useful statewide.

Appendix A

Mohave County Local Drought Impact Group 2011 Annual Report

Mohave County Local Drought Impact Group Annual Report 2011

Introduction. This report summarizes the Local Drought Impact Group activities conducted in Mohave County in 2011. LDIG meetings were held in January, March, July, and October. The established drought monitoring network provided monthly impact information in an efficient and timely manner. Individual monitors complete the standard Drought Impact form developed by the LDIG's Drought Monitoring Working Group to forward to the LDIG secretary, an employee of the County Emergency Management office, who compiles the report information for transmission to Arizona DroughtWatch at the first of each month. Work is now underway to develop a countywide Drought Mitigation Plan. The Plan concept and outline have been developed, and basic information needed for Plan development is being compiled and analyzed.

Status of Drought. Drought conditions improved in the county in 2011 due to late winter rains and monsoon precipitation. Increased snow pack melting in other states led to higher levels in the Colorado River, which alleviated immediate concerns in the river communities caused by the reduced river flows experienced in recent years. However, the monsoon rains, while heavy at times, were irregular and very spotty, causing some areas to be considerably dryer than others. Conditions across the county as of October varied from normal to unusually dry.

Drought Impacts. Ponds and tanks for livestock and wildlife in some areas have dried up, and some ranchers were on the verge of initiating water hauling as of mid-October. These impacts mostly occurred in the central and northern areas of the county away from the Colorado River. If a normal amount of precipitation is received during the winter, impacts may be somewhat mitigated; otherwise, conditions for wildlife and livestock surface water may worsen.

Drought Related Actions. Currently, none of the cities have implemented any of their drought plan stages. The cities, BLM offices, Arizona Game and Fish, and other agencies continue to provide drought impact reports and in some cases precipitation gauge reports, as do many ranchers and residents. The Mohave County Alert Flood Warning System, composed of 133 sensor sites across the county, continues to provide near real time precipitation and stream flow information. Opportunities to expand the drought monitoring network to provide more comprehensive coverage are being pursued.

The LDIG Mitigation Working Group, which essentially is the LDIG as a whole functioning in work sessions, commenced work in early 2011 on a Drought Mitigation Plan. Due to the considerable variations in elevation, topography, vegetation, water sources, and population density throughout the county, it was decided that for planning purposes the county would be divided into zones based on some of these key factors. Distinct population density/elevation zones were established as starting points, and maps delineating these zones with vegetative overlays have been prepared by the County's Development Services Department for LDIG use. The next step will be to utilize this information to identify trigger points for various drought stages in each of the zones, followed by the identification of potential mitigation measures (mostly drawn for the list of potential measures listed in the Arizona Drought Task Force report) for each drought stage.

In attendance at the March LDIG meeting were representatives from the University of Arizona's DroughtWatch program, the Las Vegas National Weather Service, the Arizona State Climate Office, and the University of Nebraska-Lincoln's U.S. Drought Mitigation Center. This visit was a follow up to teleconferences between the LDIG, DroughtWatch representatives, and the U.S. Drought Mitigation Center that established clear communication channels to ensure that current Mohave County drought impact information is received by all agencies so that informed decisions can be made on the need for drought emergency assistance funding for the ranching and other impacted sectors when conditions warrant.

Appendix B

Pima County Local Drought Impact Group
2011 Annual Report

Pima County Local Drought Impact Group 2011 Annual Report to ADWR

Introduction: Pima County's Local Drought Impact Group (LDIG) consists of water providers and local, state and federal agencies. LDIG meets bimonthly to monitor drought conditions, discuss drought impacts and coordinate drought declarations and responses. During 2011, LDIG meetings included presentations on the winter and summer seasons, a 1,200-year drought perspective in the Southwest based on tree ring research, the Colorado River Basin water supply outlook, Pima County Regional Flood Control District's Automated Local Evaluation in Real Time (ALERT) System and its use for emergency management, and Perennial Water Inventory on Pima County open space lands and the impact of drought on perennial waters.

Staff from the National Drought Mitigation Center also visited Pima County's LDIG to discuss and review the center's approach to drought planning, to present the center's various resources and to discuss drought concerns in Pima County.

Information on LDIG's upcoming meetings, presentations and past meeting summaries can be found on Pima County's [LDIG](#) website.

Status of Drought: In 2011 drought conditions persisted in Pima County. The 2010-11 winter season was typical of a La Niña weather pattern with only two inches precipitation in eastern Pima County, 4.33 inches below normal. Winter temperatures were warmer than normal, especially in January, followed by a deep February freeze.

La Niña storm patterns moved winter precipitation to the northern Rocky Mountains resulting in favorable snowpack and snow melt to the Colorado River Basin. As a result, a shortage declaration on the Colorado River is unlikely until at least 2016. Before the 2011 winter season, a shortage declaration had been projected for 2013. A shortage declaration would result in curtailments to Arizona's CAP deliveries.

The summer monsoon season was hot and dry. In June, the Tucson International Airport recorded 112° for the first time since 1995 and the month ended with eight straight days of temperatures 107° or higher. July and August temperatures were also hot. The summer monsoon season ended with heavy rains in September. As of mid-September, 2.61 inches of rain had fallen at the Airport, making September the 19th wettest on record.

As is typical every ten years, the National Weather Service recalculates normal temperatures based on the previous thirty years. The mandatory recalculation, based on 1981 through 2010, will move our "normal" temperatures slightly higher.

At the beginning of 2011, the short-term drought status in Pima County indicated the western portion at D1- Moderate Drought and the eastern portion at D2 - Severe Drought. Throughout the year the short-term drought status worsened with about half of western Pima County in D3- Severe Drought. This is consistent with the southeastern portion of the State which was designated in Severe Drought and experienced a number of significant wildfires.

The long-term drought status has worsened slightly. Early in the year approximately fifty percent of Pima County was in moderate drought, while most of Pima County is now in moderate drought. Far western Pima County is experiencing no drought although this area is typically dry.

In spite of the worsening short-term drought status, the long-term status has not worsened appreciably. Increased water levels to Lake Powell and Lake Mead from the winter snowmelt in the upper Colorado basin will delay a shortage on the Colorado River by several years. Consequently, Pima County's LDIG recommends Pima County remain at Drought Stage One.

Drought Impacts: The impacts of sustained drought continue to be observed in Pima County:

- The deep winter freeze in February, coupled by the hot dry conditions early in the summer affected urban landscaping, particularly plants intolerant of low temperatures
- The Cienega Creek Natural Preserve exhibited the lowest flow length on record in June 2011, with just 13% flowing. These records began in 1975. Prior to drought, the creek flowed at least 50% of the length or greater
- Stressed riparian vegetation and reduced amounts of perennial water available to support wildlife populations have been observed in unsupplemented and perennial surface waters
- Ranchers continue to be affected by drying stockponds and lack of pasture grasses
- Above average snowpack and snowmelt in the upper Colorado basin resulted in increased water levels at Lake Powell and equalization releases to Lake Mead and delay in projections for declaration of a shortage on the Colorado River
- Aquifer water levels in the Tucson area are rising steadily due, in part, to decreasing water demand, water conservation efforts and increased use of CAP entitlements.

Drought Indicators: Pima County's LDIG continues to use the U.S. Drought Monitor as an indicator of drought severity. Last year's migration to the U.S. Drought Monitor (from CLIMAS) provided continued consistency and timely updates.

Drought-Related Actions: Several water sustainability planning initiatives are underway. Year One of the City/County [Water/Wastewater Study Action Plan](#) is being implemented and includes an update of the City of Tucson's drought response plan.

The City of Tucson's Climate Change Committee is also developing a climate change mitigation and adaptation plan that includes recommendations to achieve greenhouse gas reduction commitments.

A [Regional Water Assessment](#) Task Force is looking to increase collaboration and cooperation in managing water resources at a regional scale by addressing supply, infrastructure, conservation/demand management and reliability/sustainability and aquifer health.

In order to move toward water sustainability and decrease reliance on groundwater, the Town of Oro Valley entered into a wheeling agreement with the City of Tucson to deliver CAP water directly to the town's residents through Tucson Water's CAP infrastructure.

Each of the water providers prepared a drought response plan on file with ADWR. As of October 2011, the status of regional drought declarations remains unchanged from 2010. The status of drought declarations is:

Regional Drought Declarations

Entity	Drought Declaration
Pima County	Stage One Alert
City of Tucson	Stage One
Town of Oro Valley	Stage One
Town of Marana	Stage One Alert
Metropolitan DWID	Stage One Alert
Community Water of Green Valley	Stage One Alert

Appendix C

Arizona and U.S. Drought Monitor
Decision Support
March 22-24, 2011

Arizona and U.S. Drought Monitoring and Decision Support, March 22-24, 2011

Overview

In 2007, the National Drought Mitigation Center (NDMC) garnered funding to work on the development, testing, and promotion of new online drought decision support tools. In 2008, the NDMC sub-contracted with University of Arizona colleagues, who were in the process of developing an online drought impacts reporting system, and who had prior experience in working closely with state and local resource managers on drought planning and monitoring. The major aspects of the research and outreach plan were to learn about the barriers and opportunities associated with citizen drought impact reporting, and a series of workshops to discuss drought monitoring and new online tools, with citizens in several states, including Arizona.

As part of this work, three guests from the National Drought Mitigation Center, Mark Svoboda (Climatologist and Associate Geoscientist), Kelly Helm Smith (Communication & Drought Resources Specialist), and Melissa Widhalm (Climatologist), will visit Arizona in late March, 2011. They will be joined by colleagues from the University of Arizona, including Mike Crimmins (Climate Extension Specialist) and Gregg Garfin (Assistant Professor in Climate Science, Policy & Natural Resources), from the Arizona Department of Water Resources, Susan Craig (Arizona Water Protection Fund), and State Climatologist, Nancy Selover (Arizona State University).

The speakers will discuss drought monitoring in Arizona and the United States, the use of citizen drought impact reports by decision makers, online drought assessment tools, and a U.S. drought-ready communities initiative. The programs of events scheduled for Kingman (March 22), Phoenix (March 23) and Tucson (March 24) are designed to garner feedback from citizens concerned about seasonal and year-to-year drought conditions, regarding drought monitoring, online products, and other drought-related issues. In the spirit of the original collaborative project between NDMC and UA, we do not plan to focus on the potential for extended or severe drought on decade or century-long time scales associated with long-term ocean circulation and global temperature increases. However, we will be prepared to answer questions on such topics, should they arise. The most important point is for us to be attentive and responsive to the drought-related interests of citizens and resource management agency officials.

Goals for the March workshops

- Foster greater awareness of drought monitoring and decision support tools
- Foster greater awareness of connections between state and national drought monitoring
- Foster greater awareness of the role of local drought impacts reports in state and national drought assessment, including:
 - Discussion of the strengths of locally gathered information and how to preserve its integrity as it is aggregated into national tools
 - Examples of applications and the value of local contributions to tools and products that are used by local, state and federal decision makers
 - Demonstrate the impact of local and state drought assessment, through federal relief programs via the Farm Bill, and other mechanisms
- Garner information on AZ drought concerns, monitoring, impacts reporting, policy, NIDIS, NDMC tools

Arizona and U.S. Drought Monitoring and Decision Support, March 22-24, 2011

Agenda for Maricopa County (presentations as stand-alone, followed by workshop)

12:00-2:45 PM (2 hr. 45 min.)

Public Lecture	Presenters	Time Allotted
Drought Monitoring AZ and US <ul style="list-style-type: none"> • Very brief overview of AZ drought – telescoping from paleo, to historical, to March 2011 (Garfin) • Brief overview how local and state information is garnered and incorporated into the U.S. Drought Monitor, the National Integrated Drought Information System (NIDIS) online portal and pilot research projects (Selover, Svoboda) 	Garfin, Selover, Svoboda	20 min.
Impacts monitoring <ul style="list-style-type: none"> • AZ Drought Watch (AZDW evaluation points, where useful) (Crimmins) • CoCoRAHS (Selover) • U.S. Drought Impacts Reporter (NDMC) • Very brief: How are drought impacts reports and other information used by decision makers? How does this affect policy? 	Crimmins, Selover, NDMC	20 min.
NDMC Drought Ready Communities	NDMC	10 min.
Discussion of aforementioned	AZ, NDMC	10 min.
Break		15 min.
Small Meeting: Those Concerned with Drought Monitoring	Presenters	Time Allotted
Goals and Introductions	Garfin	10 min.
Detailed information on NIDIS, U.S. drought monitoring, value of impacts reporting for USDM and policy	Svoboda	20 min.
New NDMC Drought Tools	NDMC	20 min.
Workshop activity: garnering feedback on concerns, products, monitoring, impacts, policy, NIDIS	AZ, NDMC	30 min.
Wrap-up	AZ Local Hosts	10 min.

Arizona and U.S. Drought Monitoring and Decision Support, March 22-24, 2011

Agenda for Mohave County (integrated presentations and workshop) Tentatively 1:00-3:40 PM, (2 hr. 40 min.)

Topic	Presenters	Time Allotted
Goals and Introductions	AZ Local Hosts	15 min.
Drought Monitoring AZ and US <ul style="list-style-type: none"> • Very brief overview of AZ drought – telescoping from paleo, to historical, to March 2011 (Garfin) • Brief overview how local and state information is garnered and incorporated into the U.S. Drought Monitor, the National Integrated Drought Information System (NIDIS) online portal and pilot research projects (Garfin, Svoboda) 	Garfin, Svoboda	25 min.
Impacts monitoring <ul style="list-style-type: none"> • AZ Drought Watch (including brief summary of AZDW evaluation) (Crimmins) • CoCoRAHS (Selover) • U.S. Drought Impacts Reporter (Svoboda? Smith? Widhalm?) • How are drought impacts reports and other information used by decision makers? How does this affect policy? (Svoboda? Smith? Widhalm?) 	Crimmins, Selover, NDMC	30 min.
Break		15 min.
Discussion of monitoring presentations Discussion of Mohave LDIG concerns, with a focus on monitoring, impact reporting contributions, policy	Garfin	20 min.
NDMC Drought Ready Communities NDMC Drought Decision Support Tools	NDMC	20 min.
Workshop activity: garnering feedback on products, monitoring, NIDIS	AZ, NDMC	20 min.
Wrap-up	Garfin	10 min.

Arizona and U.S. Drought Monitoring and Decision Support, March 22-24, 2011

Agenda for Pima County (integrated presentations and workshop) – 10 AM-Noon (2 hr.)

Topic	Presenters	Time Allotted
Goals and Introductions	Garfin	10 min.
Drought Monitoring AZ and US <ul style="list-style-type: none"> • Briefest overview how local and state information is garnered and incorporated into the U.S. Drought Monitor (Garfin) • More time for National Integrated Drought Information System (NIDIS) online portal and pilot research projects and how local reports are used here (Svoboda) 	Garfin, Svoboda	20 min.
Impacts monitoring <ul style="list-style-type: none"> • AZ Drought Watch brief overview and focus on AZDW Evaluation (Crimmins) • CoCoRAHS (Selover) • U.S. Drought Impacts Reporter (Svoboda) • How are drought impacts reports and other information used by decision makers? How does this affect policy? 	Crimmins, Selover, NDMC	30 min.
Break		10 min.
Discussion of monitoring presentations Discussion of Pima LDIG concerns, with a focus on monitoring, impact reporting contributions, policy	Garfin	20 min.
NDMC Drought Ready Communities and Drought Decision Support Tools	NDMC	10 min.
Workshop activity: garnering feedback on products, monitoring, NIDIS	Garfin, NDMC	15 min.
Wrap-up	Garfin	5 min.

Arizona and U.S. Drought Monitoring and Decision Support, March 22-24, 2011

Travel Agenda:

March 21 (Monday)

- NDMC folks arrive in Las Vegas (early afternoon), drive to Kingman, AZ (2 hours)
- Meet in late afternoon/early evening to discuss plans for week

March 22 (Tuesday)

- Meet with Mohave County LDIG (mid-day)
- Drive to Phoenix (3 hours)

March 23 (Wednesday)

- Workshop at Maricopa County Cooperative Extension (mid-day)
- Drive to Tucson (2 hours)

March 24 (Thursday)

- Meet with National Phenology Network scientists (early morning)
- Meet with Pima County LDIG (late morning)
- NDMC folks depart to Omaha (depart late afternoon)

WSP Water Speaker Series in Maricopa County

Monitoring for Drought Ready Communities: A Discussion of Efforts in Arizona and Across the U.S.

On Wednesday, March 23, we will have a special presentation by Mark Svoboda (National Drought Mitigation Center), Kelly Smith (National Drought Mitigation Center), Michael Crimmins (University of Arizona), Nancy Selover (Arizona State University) and Gregg Garfin (University of Arizona). The presentation will take place noon – 1:00 at The University of Arizona Cooperative Extension, Maricopa County, Palo Verde Room at 4341 E. Broadway, Phoenix. Bring your lunch. Following the presentation, there will be a discussion session from 1:15 to 2:15. Please consider staying for the discussion.

Description: In the United States, economic losses from drought match or exceed those from other natural hazards. Anticipating and preparing for drought, predicting the probable magnitude of drought and its impacts, and providing timely emergency management and relief requires superb monitoring, excellent communication, cutting edge science, and forward-thinking policies. This presentation will offer perspectives on the need for citizen drought monitoring, and how citizen and official drought observations are used in determining drought status and by local, state, and federal decision makers. We will showcase some online drought resources and citizen monitoring programs in Arizona and the U.S. We encourage dialogue on these topics, with a focus on community drought preparedness, and welcome participants' perspectives through informal discussions.

Free and open to the public. Please RSVP to Nancy Crocker at 602-827-8200 ext. 335 or NCrocker@cals.arizona.edu. Please indicate if you plan to stay for the discussion.



National Drought Mitigation Center

Drought Impacts and Planning Resources

<http://drought.unl.edu>

About the NDMC

The National Drought Mitigation Center (NDMC) works to reduce societal vulnerability to drought by helping decision makers at all levels:

- implement drought early warning systems.
- understand and prevent drought impacts.
- increase long-term resilience to drought.

The NDMC is a national center founded in 1995 at the University of Nebraska-Lincoln. Mike Hayes has been director of the center since 2007. Its diverse staff of 21 includes faculty and staff with expertise in physical and social sciences and in the humanities. The NDMC conducts basic and applied research.

Drought Early Warning Resources

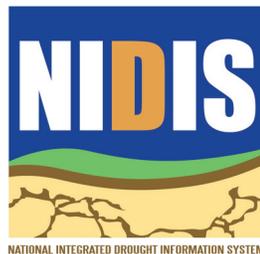
National Integrated Drought Information System (NIDIS) Portal
<http://drought.gov>

U.S. Drought Monitor
<http://drought.unl.edu/dm/monitor.html>

North American Drought Monitor
<http://www.ncdc.noaa.gov/temp-and-precip/drought/nadm/>

U.S. Drought Impact Reporter
<http://droughtreporter.unl.edu/>

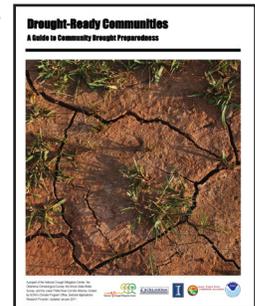
Vegetation Drought Response Index
http://drought.unl.edu/veg dri/VegDRI_Main.htm



Drought Planning Resources

Drought Ready Communities
<http://drought.unl.edu/plan/DRC.htm>

How to Reduce Drought Risk
<http://drought.unl.edu/plan/handbook/risk.pdf>



Drought Impact Reporter Database

The U.S. Drought Impact Reporter has been online since 2005. In November 2008, based on our experience and users' suggestions, we implemented a new database that lets us incorporate more information, such as reports from CoCoRaHS observers, from Arizona Drought Watch (<http://azdroughtwatch.org/>), and from other states' efforts.

Impacts: quantifiable, observable, associated with a place and time (start date required, end date currently optional)

Reports: Drought reports signify awareness but not necessarily what we call an impact, i.e., "Farmers said that it will be a tough year if it doesn't rain soon."

Drought impacts, June 2005-mid-March 2011: about 12,120

Drought impacts affecting Arizona: 214

Media reports, Nov. 2008-mid-March 2011: 9,583
Media reports related to Arizona: 265

User (individual) reports, since 2005: about 1,000
User reports from Arizona: 17

CoCoRaHS reports, since Feb. 10, 2010: 1,162
CoCoRaHS reports from Arizona: 26

Appendix D

Method for Determining Long-Term Drought Status

Method for Determining Long-term Drought Status

The Monitoring Technical Committee uses percentile values for precipitation and streamflow to determine drought status in each of Arizona's watersheds. Arizona's long-term drought status map, updated quarterly, incorporates 24-, 36- and 48-month precipitation *and* streamflow percentiles from multiple gages in each of Arizona's major watersheds. To arrive at these values, precipitation and/or streamflow totals for each period (24, 36, 48 months) are compared to the 30-year historical record. Therefore, only gages with a 30-year record of data are used.

The precipitation and streamflow percentiles are evaluated against the trigger levels shown in the table below to determine drought status for each watershed.

Trigger Levels (based on precipitation & streamflow percentiles)	Drought Status	Possible Impacts
>30	Normal Conditions	
21-30	Abnormally Dry	<ul style="list-style-type: none"> • Measurable reduction in precipitation • Stress to seasonal grasses • Stock pond storage somewhat reduced
11-20	Moderate Drought	<ul style="list-style-type: none"> • Noticeable reduction in precipitation • Some vegetation stress; depending on season, could result in major stress • Stock pond storage reduced • Reduced streamflows • Lower than average reservoir levels
6-10	Severe Drought	<ul style="list-style-type: none"> • Long-term reduction in precipitation • Low snowpack • Reduction in reservoir levels • Vegetation stress affecting trees and shrubs • Habitat and pasture degradation • Stock pond and tinaja storage reduced • Reduced stream- and spring-flows
2-5	Extreme Drought	<ul style="list-style-type: none"> • Multi-year precipitation deficits (including snowpack) • Noticeable reduction in reservoir levels • Measurable reduction in groundwater levels • Near-record low streamflows • Considerable stress on trees

		and rangeland degradation
1-2	Exceptional Drought	<ul style="list-style-type: none"> • Diminished wildlife populations • Significant multi-year precipitation deficits (including snowpack) • Significant reduction in reservoir levels • Drastic reduction in groundwater levels • Record low streamflows • Major stress on trees, rangeland degradation, diminished wildlife habitat and population mortality

For any given precipitation or streamflow total, and any given time period, a percentile value measures how “rare” that precipitation value is as compared with historical values. If precipitation for the period of February - April, for example, is in the 16th percentile based on 30 years of record, then this means that only 16% of all precipitation totals for the period February – April over the last 30 years were lower than the current total (a moderate drought status).

Once the percentile values are determined, drought status is evaluated differently depending on whether the drought status is improving or worsening:

- To avoid premature changes in drought status, and to recognize that drought takes time to develop and to improve in Arizona, precipitation and streamflow percentiles must show improving conditions for at least four consecutive months before a watershed is changed to a less severe drought status.
- Precipitation and streamflow percentiles must show worsening conditions for two consecutive months before moving to a more severe drought status.

After the drought status maps are created, other data are evaluated to verify the calculated drought status. The Committee considers indicators such as vegetation health, reservoir levels, snowpack conditions, and other drought impact data from observers around the state. Based on these other indicators, the Committee may choose to adjust the status of one or more watersheds.

This method of determining long-term drought status was adapted from the Georgia Drought Management Plan (2003). The method has been adapted to account for Arizona’s varied topography and to take into account the considerable contribution of snow to Arizona’s hydrology.

Examples of impacts from recent Arizona droughts (taken, in part, from the U.S. Drought Impact Reporter and AZ DroughtWatch):

Exceptional Drought, in the years 2002-2004, included impacts such as:

- water emergencies in some towns
- reduction of water allocations by Salt River Project
- desiccation of stock ponds, tinajas and springs throughout Arizona
- desiccation of small lakes in northern Arizona
- water hauling to keep large mammal populations in northern Arizona from massive mortality

- extensive conifer mortality
- extensive mortality of Sonoran Desert species, such as palo verde
- extensive reduction in Sonoran pronghorn populations
- large wildland fires
- reduction in tourism at state parks and national recreation areas
- reduction in quail populations

Extreme Drought, in the years 2006-2008, included impacts such as:

- depletion of grass and shrubs for pronghorn in southern Arizona, resulting in the need for water hauling to maintain populations
- wildlife, such as deer, mountain lions, bears, javelina, wandering into urban areas, in search of food
- restrictions on the use of fire or fire-causing activities in National Forests
- USDA declarations of natural disaster areas for agriculture
- loss of lake volume in small-to-medium-sized lakes in central Arizona, to the point where boat ramps are no longer in the water
- lack of snowfall, resulting in loss of winter tourism and recreation, in northern Arizona
- cottonwood mortality along rivers in northeastern Arizona

Severe Drought, in the years 2009-2010, included impacts such as:

- pumping of groundwater to supplement meager spring-flow in a southern Arizona regional park
- use of reclaimed water to irrigate baseball stadium grass, due to a lack of monsoon rain in southern Arizona
- loss of tree foliage in a southern Arizona riparian area, due to failure of monsoon rainfall
- lack of new annual grass growth in northwestern Arizona rangelands, impacting cattle operations and resulting in emergency cattle sales
- reduced planting in southeastern Arizona

Moderate Drought, in 2010, included impacts such as:

- unusually low range productivity, and significant loss of rangeland vegetation due to dry conditions and blowing of sandy soil in northeastern Arizona
- lack of plant health, diminished livestock condition, and reduced surface water availability in northwestern Arizona

Appendix E

Water Resources Research Center Newsletter
Water Awareness Month
April 2011


 ARIZONA
 WATER RESOURCE

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Month Dedicated to Water Awareness

(published 04/20/11)

April is Water Awareness Month (WAM) in Arizona. Arizona's first WAM was proclaimed in April 2008 by the governor's office in order to help create a culture of conservation and reduce the impact of drought on our natural resources, economy, and quality of life. Its goal was to instill a greater awareness of water issues through community education, action and celebration.

The theme for WAM 2011 is "AWARENESS— of water conservation issues in our state." This year, the actions by Arizona residents that organizers hope to motivate are to (1) use water more efficiently, (2) become aware of water conservation activities in their region, and (3) know where to turn for information and resources.

The Arizona Department of Water Resources (ADWR) and the Arizona Municipal Water Users Association (AMWUA) worked collaboratively to expand statewide promotion of Water Awareness Month by creating an interactive website. Water providers and conservation experts around the state contributed information about water-related activities, events, tips, and resources. The WAM web site is full of ideas and activities to help Arizonans learn more about water conservation and become more aware of our state's most precious resource, water.

At the campaign's heart is an interactive, topic-driven calendar—[WaterAwareness-Month.com](#)—that serves as an information hub. Each day has a theme that when clicked on, displays information about activities and events, how-to resources and handy tips that revolve around that theme.

For example:

- April 4th "DIY Landscape Day" focuses on designing and installing a low water use landscape
- April 9th is all about Rebates for water conservation
- April 18th "Grow Green Kids" Day has interactive games and activities
- April 13th "It's Not Rocket Science" features irrigation timers and tips on watering.

Arizona Water Resource Spring 2011

Features

[Transboundary Aquifers: Water Wars or Cooperative Conservation?](#)

News Briefs

[EPA and ADEQ Considering Stricter Standards for Chromium in Drinking Water Correction](#)

Month Dedicated to Water Awareness

[Innovative Educational Program Introduces Middle Schoolers to Water Resources Research](#)

Announcements

[The WRRRC now on Facebook!](#)

New Resources

[Top Water Blogs](#)

[Water Footprint Calculators](#)

Special Feature

[Winners of the Joe Gelt Undergraduate Writing Competition](#)

[Open-Ocean or Land-Based Desalination: Responses to Water Scarcity that Reduce Environmental Impacts](#)

[The Case for Pumping the Big Chino Aquifer](#)

Public Policy Review

[Back to Fundamentals—On Economics and Water Pricing](#) by Sharon Megdal

Or, if one wishes, all of the activities, events, resources, and tips can be seen as comprehensive lists.

In addition to the calendar, the WAM Facebook Page and Twitter can be accessed through the website, and the public is invited to participate in the dialog. There are even places for people to make a pledge about their own water conservation efforts and upload water conservation related photos or videos. Partnering organizations were provided with a turnkey, day-by-day guide to using social media to promote the WAM website to the public, including a website widget, suggested Facebook posts, and Tweets.

To assess the effectiveness of the WAM web-based, social media campaign, organizers plan on conducting several evaluative activities, including:

- Document the number and type of promotional partners and contributors
- Survey partners for their opinions, suggestions, and results
- Track the number and type of pledges
- Track the tweets
- Track the number of requests to receive a water conservation newsletter.

For additional information, contact: Jo Cook, jcook@amwua.org or Ruth Greenhouse, rgreenhouse@azwater.gov.

Attachments: