2010 ARIZONA DROUGHT PREPAREDNESS ANNUAL REPORT

Drought Status Summary

The winter of 2010 (Figure 1) was a very wet El Niño winter in most Arizona locations, with only the Little Colorado watershed receiving near-average precipitation. Northern and western Arizona were much wetter than average, and the Salt-Verde watershed was also quite wet. The southeastern quarter of the state was only slightly wetter than average, which was not enough to recover from the deficit left by the dry 2009 monsoon. Statewide drought conditions were much improved over the previous year (Figure 2) when the northern half of the state had near-average precipitation and southern Arizona was much drier than average. Arizona's wet winter improved drought conditions for much of the state, but deficits continued to exist in the southern counties. Temperatures during the winter were also cooler than average, allowing snow levels (the elevation at which snow turns to rain) to be somewhat lower than average, thereby increasing the snowpack. The Salt-Verde watershed had a very good winter for filling the reservoir system.

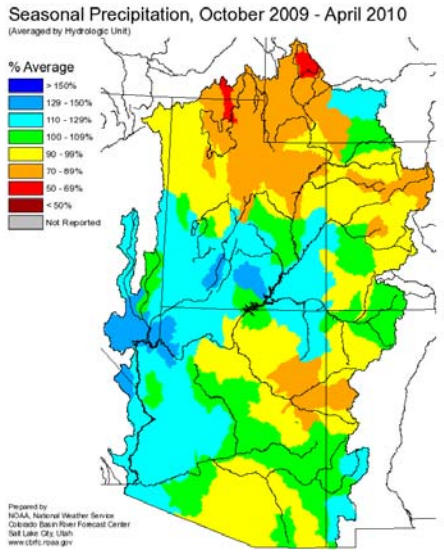

Figure 1. – Winter 2010 Precipitation

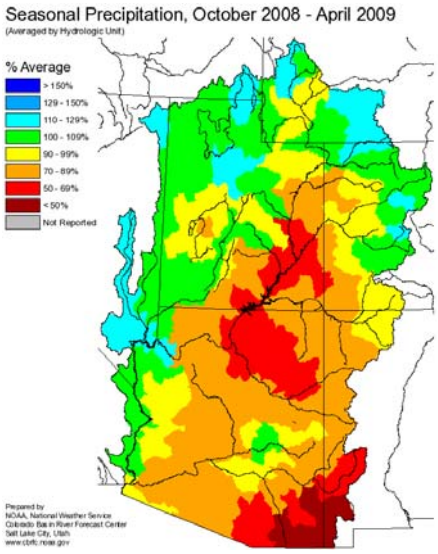

Figure 2. – Winter 2009 Precipitation

At nearly all USDA-Natural Resources Conservation Service (NRCS) automated snow telemetry (SNOTEL) sites, precipitation catch during the winter snow season (December through March) was well above normal in all basins (Figure 3). One major storm system occurring on January 21-23 produced over one-third of the snowpack accumulations for the entire winter. Additional storms in February and early March brought the statewide snow water equivalent to more than 250 percent of the 30-year average by mid-March.

Mountain precipitation during the spring period (April through June), however, was well below average in all basins.

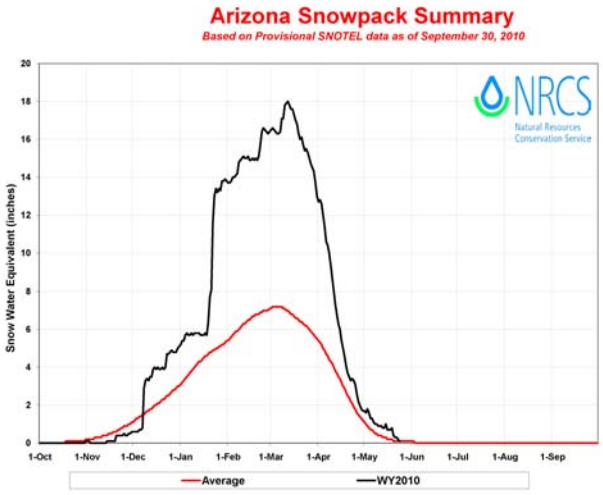

Figure 3. Snow water equivalent at high-elevation gages compared to long-term average.

Summer Precipitation

The 2010 summer (Figure 3) was wetter than average in nine Arizona watersheds, and near or slightly drier than average in six, especially in the Virgin, Bill Williams in west central Arizona and the San Simon along the southern border. This is a marked improvement over the 2009 summer (Figure 4) when only the lower Gila received above average rainfall. The Salt-Verde watersheds were wet enough to provide some inflow into the central Arizona reservoir system, which is unusual for summer when demand generally exceeds precipitation. The monsoon was relatively short, due to a late start and an early finish. The moisture circulation was generally south to north, and was pushed toward the eastern half of the state, bringing frequent thunderstorms to the southeast and the higher elevations along the Mogollon Rim and White Mountains. The central and southwest deserts had fewer than normal thunderstorm days, but the storms were generally quite intense, with large rainfall totals. The rain increased streamflow in many watersheds, particularly in the southeast.

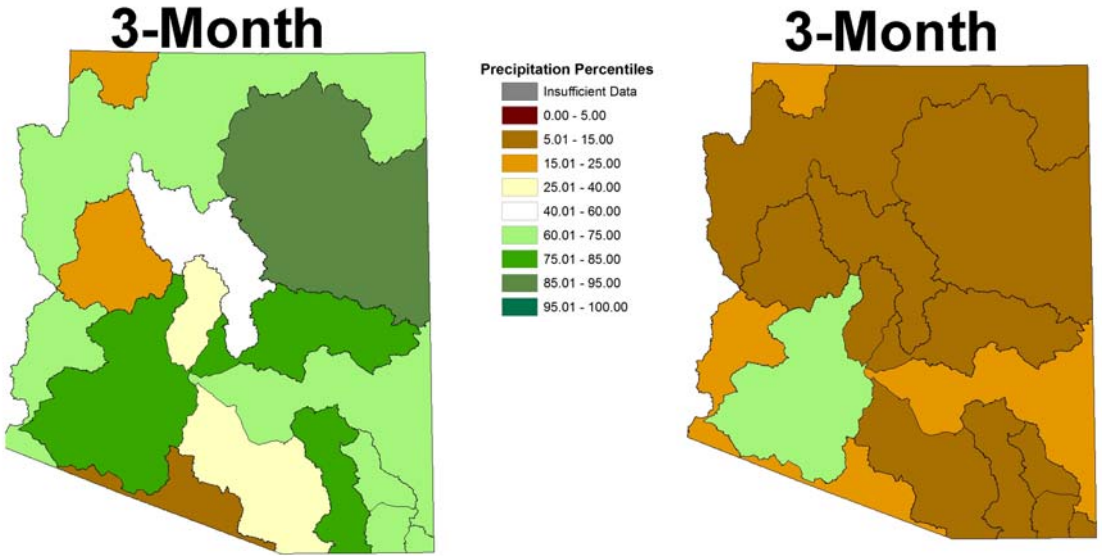

Figure 3. Precipitation Jul - Sep, 2010

Figure 4. Precipitation Jul - Sep, 2009

Drought Status Changes

Short-term Drought Status

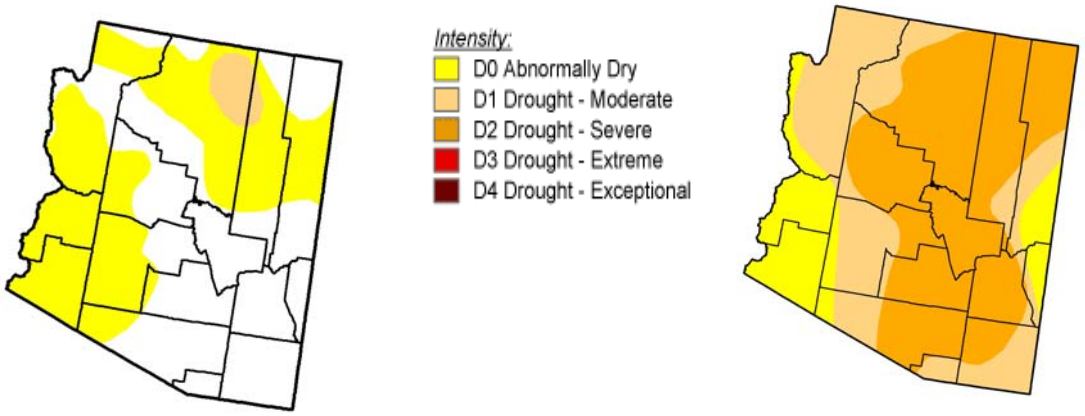

Figure 5 Short-term drought status Oct. 26, 2010

Figure 6 Short-term drought status Oct. 27, 2009

In the short-term, rangeland and forest conditions are much improved over last year across most of the state, due to both a wet winter and an active monsoon (Figures 5 and 6). The eastern half of Arizona benefitted the most from the wet monsoon, and the late-spring, early summer precipitation in southeastern Arizona was very important to spring green-up. Currently more than half of Arizona is not in short-term drought. The early October precipitation was too late to help rangeland, but should have helped to fill stock tanks across Mohave County. This will be important as we move into a La Niña winter in 2010 – 2011 that is forecast to be drier and warmer than normal.

Long-term Drought Status

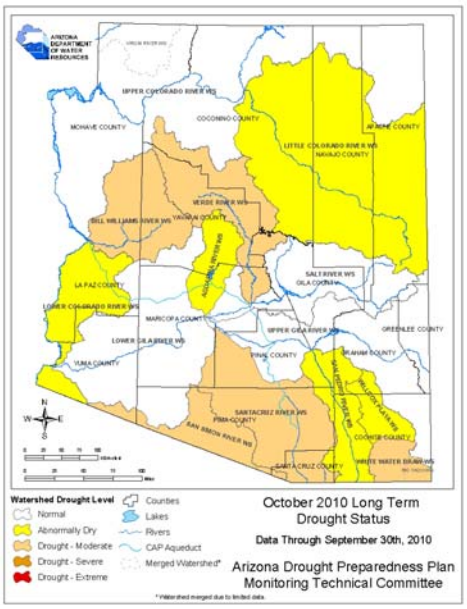

Figure 7. Long-term drought status Oct. 2010

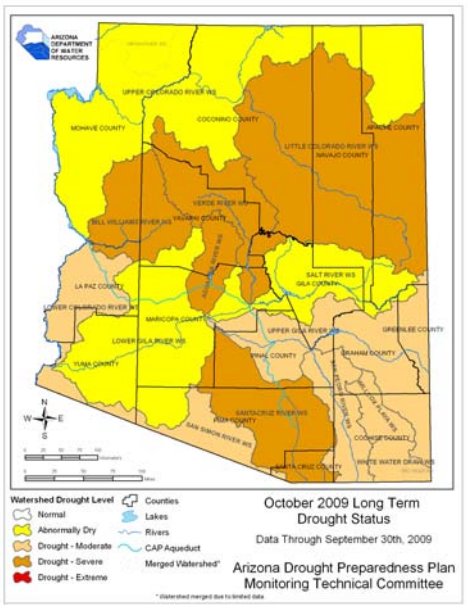

Figure 8. Long-term drought status Oct. 2009

In the long-term, there was also significant improvement from a year ago (Figures 7 and 8). All watersheds improved by one or two categories, except the San Simon and White Water Draw in southern Arizona. The Little Colorado and Agua Fria improved two categories from severe drought to abnormally dry, the Salt, Virgin, upper and lower Gila and upper Colorado improved to no drought, and six other watersheds improved one category. Currently four watersheds have no drought, six watersheds are abnormally dry, and five watersheds are in moderate drought. Most of the improvement is due to the wet winter, as this summer was wetter than average in many watersheds, but not all.

Water Year Summary

At SNOTEL and other mountain gages, cumulative precipitation for the water year ending September 30 was at or above normal in all of the state's major river basins, ranging from 104 to 120 percent of the 30-year average (Table 1).

River Basin	Percent of 30-yr. average Precipitation at NRCS high elevation gages	
	2010	2009
Salt River Basin	109%	89%
Verde River Basin	117%	81%
Little Colorado River Basin	120%	79%
San Francisco-Upper Gila River Basin	104%	88%

Table 1. Mountain precipitation for water year 2010 and 2009.

Considering drought status as indicated by streamflow, average drought values based on USGS streamflow measurements for the 2010 water year show that drought conditions stayed fairly consistent from 2009 (Figure 9). Overall, streamflow conditions remain abnormally dry.

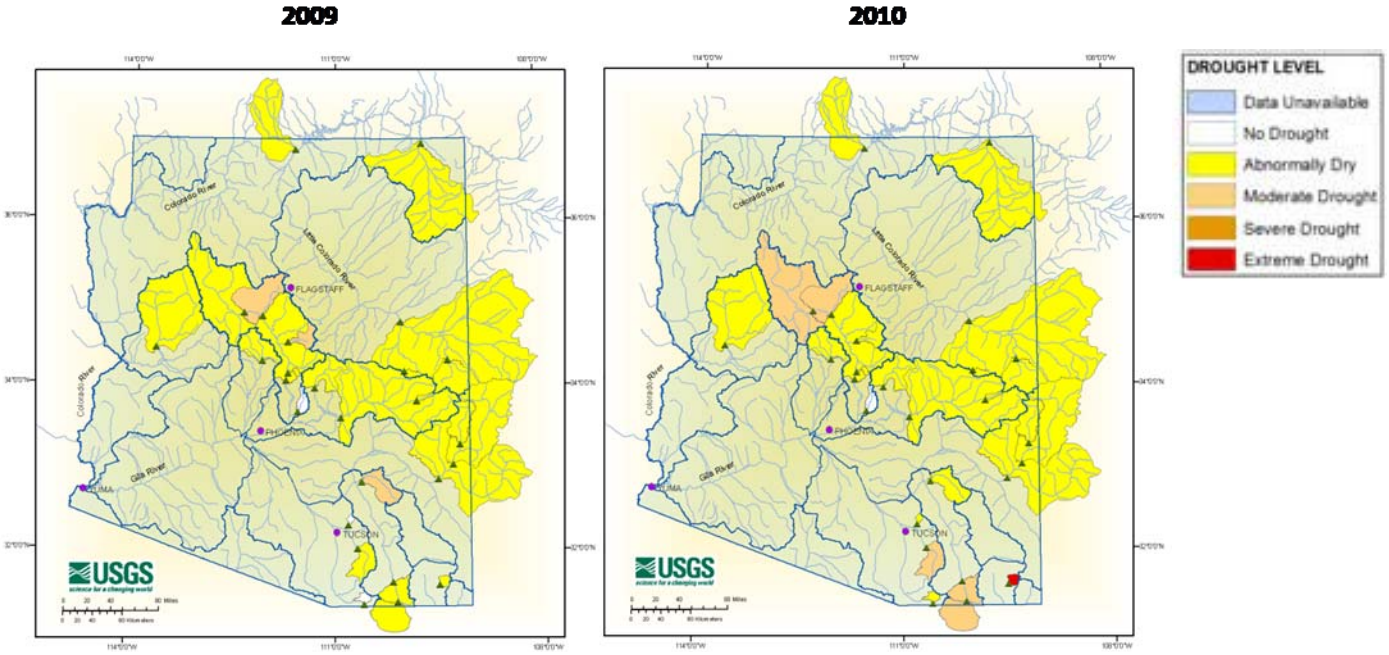

Figure 9. As determined by USGS stream gages, drought conditions have stayed fairly consistent from 2009 to 2010.

Outlook for 2011

Winter 2010-2011

During the first eight months of 2010, the large-scale atmospheric and oceanic patterns experienced a dramatic shift. The strong El Nino, which affected Arizona in the winter of 2009-2010 dissipated, and was replaced by strong La Nina conditions. Climate models overwhelmingly suggest that strong La Niña conditions will persist well into Spring 2011.

Official outlooks from the NOAA Climate Prediction Center indicate the chances of temperature and precipitation being above or below normal. The temperature outlook for January-March 2011 shows an increased chance for above-normal temperatures across Arizona, with the greatest probability over the southeastern quarter of the state. The precipitation outlook indicates enhanced chances for below-normal precipitation statewide, with a greater than 50 percent probability over

southern Arizona. Specifically, there is an 83 percent chance that southern Arizona will receive average-to-below average precipitation, and a 17 percent chance of above-average precipitation. This will likely cause drought conditions to expand and worsen through the typically wet winter months.

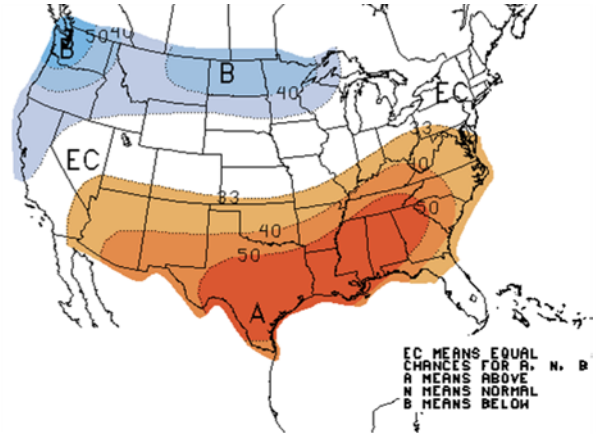

Figure 10. Probability the average temperature during Jan-Feb-Mar 2011 will be above (red) or below (blue) normal.

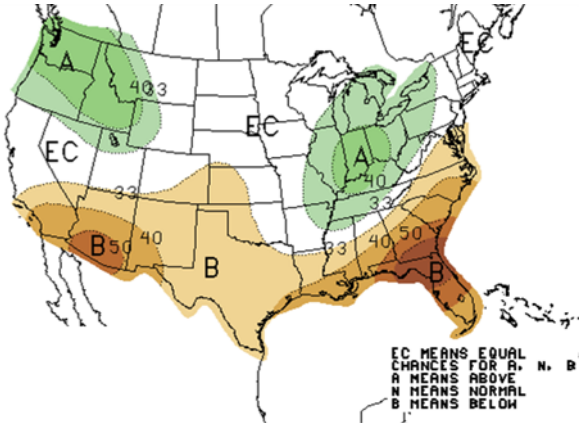

Figure 11. Probability precipitation during Jan-Feb-Mar 2011 will be above (green) or below (brown) normal.

Summer 2011

The Climate Prediction Center's temperature outlook for June-August 2011 shows a signal for above-normal temperatures over all of the state. The precipitation outlook shows no discernable signal during this period. That is, there are equal chances for precipitation during the 2011 monsoon season to be below normal, near normal, or above normal.

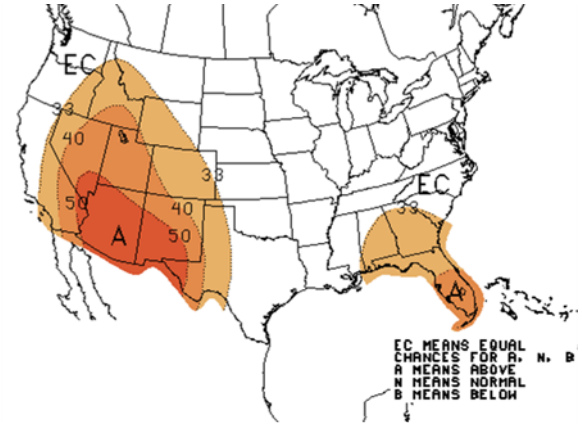

Figure 12. Probability the average temperature during Jun-Jul-Aug 2011 will be above (red) or below (blue) normal.

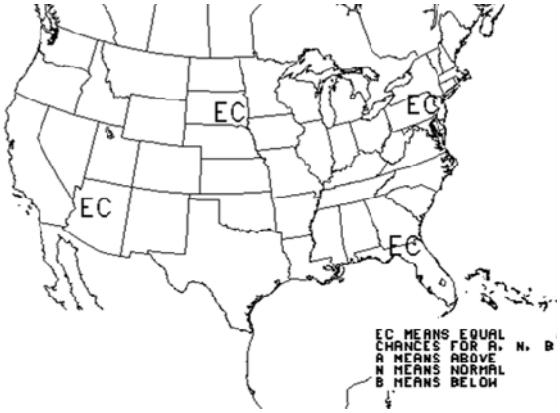

Figure 13. Equal chances of above, near or below normal precipitation during Jun-Jul-Aug 2011.

Drought Preparedness Plan Implementation Highlights

In April, during ADWR's reduction in force, the Community Water Planning – Drought and Water Conservation Programs were impacted significantly. Currently, ADWR has one part-time staff working to implement the community water system program and coordinate the local drought impact groups, State Drought Monitoring Technical Committee and Governor's Drought Interagency Coordinating Group.

Drought Planning for Community Water Systems

Drought planning and water use reporting regulations were established by the state legislature in 2005. ADWR provides assistance to water providers in meeting these requirements.

System Water Plans – As stated in previous reports, water providers need assistance in securing emergency supplies and preparing for potential water shortage conditions. To this end, ADWR is working to assess water resource vulnerability and sustainability conditions using the information provided in the plans. Water-use, supply, conservation and drought information will be entered into a database and utilized for the vulnerability determination.

Annual Water Use Reports - There was a 2 percent decrease in the number of reports received this year compared to last year. In 2010, 358 community water systems, representing 90 percent of the total population served, reported 2009 annual water demand data. Of those water providers who reported this year, 59 percent reported online, a 5 percent increase from last year.

ADWR will send a notice at the end of the year to local governing bodies of those providers that have still not submitted a system water plan or submitted a plan that does not meet statutory requirements (22 percent currently). The notice will also include those providers that have not submitted an annual water use report (28 percent currently). ADWR will continue making efforts to assist these systems.

Local Drought Impact Group Efforts

There are only two local drought impact groups that are currently active, the Mohave and Pima County groups. Throughout the year, ADWR provided coordination and technical assistance to these groups by attending meetings and assisting with coordination of impact data.

Local Highlights

Both Mohave and Pima County provided 2010 highlights and these reports are included in **Appendix A**. Despite the shift in 2008 to focus entirely on drought impact reporting, which was designed to require fewer resources, Mohave and Pima County are the only groups that continue to meet regularly. The other local drought impact groups that have been established or planned for have remained inactive during 2010. Resources, both at the state and local level, continue to be a problem.

Mohave - The Mohave County local drought impact group meets quarterly. In 2010, a monthly impact reporting procedure was formalized through the Mohave County Emergency Management office and is operational. In October, the group initiated discussion on the establishment of a Mitigation Working Group and countywide Mitigation Plan. Efforts to date have been focused exclusively on establishing and building the Monitoring Workgroup, which will continue as work commences on mitigation planning. Drought impact monitoring efforts in Mohave County are a huge success, as demonstrated by the numerous monthly reports to Arizona DroughtWatch (http://azdroughtwatch.org/), a drought impact reporting system developed by the University of Arizona, in conjunction with ADWR.

Pima - In Pima County, local drought impact group participants meet bimonthly to monitor drought conditions, discuss drought impacts and coordinate drought declarations and responses. Potential climate change impacts on water resources are being assessed in a 26-member climate change committee being led by the City of Tucson. Groundwater levels in three wells on Cienega Creek are worth noting - water levels dropped as much in 2010 as they have in the previous 15 years combined.

Regional drought declarations remain unchanged from 2009 – all providers are at stage one. During the year, the City of Tucson and Pima County completed Phase 2 of a water/wastewater infrastructure study, which establishes a framework for sustainable water resources planning. On June 1, the City of Tucson began implementing a rainwater-harvesting ordinance that requires new commercial properties to provide a minimum 50 percent of their landscaping water budget from harvested rainwater. In addition, the ordinance requires all new one- and two-family dwellings to have gray water stub-outs for laundry drains. New single-family dwellings will be required to have separate drain lines for toilets, showers and bathtubs to allow for future installation of distributed gray water systems. The ordinance is a positive move toward reaching Arizona's water conservation goals.

State Drought Monitoring Technical Committee Efforts

The Monitoring Technical Committee is responsible for gathering drought, climate, and weather data and disseminating that information to land managers, policy-makers, and the public. The two co-chairs are Gary Woodall, Meteorologist-in-Charge of the National Weather Service Phoenix Office, and Nancy Selover, State Climatologist.

New Short-term Drought Status Reporting Approach

The State Drought Monitoring Technical Committee (Committee) decided on a new approach to reporting short-term drought status for the purpose of providing more current information. Previously, Arizona's monthly short-term drought status map incorporated 3-month, 6-month, and 12-month average percentile values from multiple precipitation gages in each of the state's major watersheds. There were two major drawbacks with our short-term drought status methodology:

1. It took approximately four weeks for the Committee to obtain data from all of the precipitation gages; therefore, when the map was produced, it was already one month old.
2. Due to the outdated data and other variables, the Arizona short-term drought status map frequently differed substantially from the U.S. Drought Monitor map (http://drought.unl.edu/DM/MONITOR.html), a weekly publication that synthesizes multiple drought indices and impacts, and represents a consensus of federal and academic scientists. Note that the U.S. Drought Monitor is the official record of drought for Federal drought relief claims.

To reconcile these issues, the Committee now provides coordinated weekly analysis of local hydroclimatic conditions and impacts occurring in Arizona to the U.S. Drought Monitor's weekly maps. Weekly analysis includes input from Arizona's local drought impact groups, and impact reports from Arizona DroughtWatch. Beginning this year, the Committee utilizes the U.S. Drought Monitor to report short-term drought status in Arizona. The U.S. Drought Monitor is well-known and, with the ongoing support and resources of two federal agencies for over 10 years, is the authoritative system for reporting drought status to the nation. U.S. Drought Monitor status assessments are timely, and therefore more useful to Arizonans. Additionally, eligibility for many funding and assistance programs, including USDA relief and low interest loans to ranchers and farmers, is based on the drought status depicted by the U.S. Drought Monitor.

The expertise of the Committee in understanding drought conditions in Arizona is critical to guiding the U.S. Drought Monitor map authors; consequently, the Committee has improved direct communication with U.S. Drought Monitor map authors by providing weekly input. The Committee believes that stakeholders' interests are best served by the Committee putting their efforts into ensuring that the U.S Drought Monitor (map) accurately reflects Arizona conditions.

Communicating Drought Status
Improving the accessibility of drought information to resource managers, state decision-makers and the public is a primary goal of the Committee 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 a version of the latest U.S. Drought Monitor map that focuses on Arizona.

Monthly - At the end of each month, the Committee 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 Committee continues to meet and produce a long-term drought status map, 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). Additionally, vegetation indices, snowpack, temperature, reservoir levels, and county-scale drought impact information are used to verify or modify the result of the calculations. A comprehensive quarterly report (Drought Monitor Report) is no longer produced. Instead, the Committee:

- develops a long-term drought status summary to accompany the map
- updates the ADWR Drought Status webpage
- sends an e-mail with the web-based drought status summary, which includes:
    - latest U.S. Drought Monitor map and monthly update
    - long-term drought status map and summary

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.

Funding and Resource Needs
The Committee has identified the following two funding and resource needs, as previously stated in the 2007 through 2009 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 Committee 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 Committee 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 Committee recommends funding for ADWR staff salaries to conduct groundwater analyses.
   Total cost: $38,000 per year

Lastly, as resources permit, the State Climatologist will be shifting to near real-time gridded precipitation data for calculating the Standardized Precipitation Index and drought status, which will allow finer resolution of dry areas, rather than basin-wide averages, and should reduce the time-lag to a week or less.

Interagency Coordinating Group Efforts
The Interagency Coordinating Group met two times during the past year to review and consider statewide monitoring efforts and drought status, water supply updates, rangeland conditions, forest health and wildlife. As a result, the group recommended to the Governor that both 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.

Conservation Program Highlights

ADWR's Conservation Program provides an integrated approach to water conservation by combining regulations, assistance, outreach and education. By developing conservation tools and resources, assisting Arizona communities and water providers, collaborating with regional and national partners, and participating in outreach activities, ADWR works to achieve the mission of promoting and encouraging the wise and efficient use of water throughout Arizona.

In April 2010, ADWR's conservation program was drastically impacted by the reduction in force. Over the course of the past year, staffing of the conservation program has been reduced by 80 percent, and only two staff remain on the conservation team. Although many conservation activities have been curtailed as a result, efforts continue in the following areas:

Water Conservation Toolkit

ADWR completed its water conservation toolkit (www.azwater.gov/conservation), an assembly of tools developed to assist residents, businesses, communities and water providers in the design and implementation of comprehensive and proven conservation strategies. Toolkit categories include:

Water Planners & Providers - Tools to establish and implement effective water conservation strategies, including: water waste ordinances, water rate structures, metering, leak detection, and conservation planning. See **Appendix B** for example water conservation tools on water rate structures and metering.

Residential - Tools to assist in using water efficiently around the home; indoor and outdoor use, landscapes, irrigation, low water-use plants, rainwater harvesting and gray water reuse.

Landscape Professionals - Resources to assist with planning, installing and maintaining water-efficient landscapes, low water-use plants, training opportunities and certification programs.

Commercial, Industrial & Institutional - Water-saving equipment and strategies for kitchens, laundries, fleet and vehicle washing, and medical facilities. Tools on inventorying water use, and developing and implementing a facility water management plan.

Agriculture - Water-efficiency information, strategies, programs and practices to enhance water management; regulations, best management practices, computer-based tools, education, and links to agriculture-related resources and organizations.

Technologies- Information on equipment, heating and cooling processes and technologies to modify and reduce water use; leak detection equipment, plumbing fixtures, water treatment, and irrigation.

Education - Conservation, education and outreach materials for adults, students and educators, including: workshops, presentations, water festivals, activities and games.

Modified Non-Per Capita Conservation Program

The Modified Non-Per Capita Conservation Program is a performance-based program that requires participating providers to implement water conservation measures that result in water use efficiency in their service areas. All large municipal providers (cities, towns and private water companies serving more than 250 acre-feet per year) that do not have a Designation of Assured Water Supply and that are not regulated as a large untreated water provider or an institutional

provider are required to participate. Staff continues to administer this program, including conservation-related activities such as:

- Documentation of best management practices (BMPs) being implemented
    - See the *June 2010 Report: Modified Non-Per Capita Conservation Program* for details about the number of providers in the program, active management areas and BMP selection – www.azwater.gov/mnpccp
- Planning for an effectiveness evaluation of the program
- Assistance/outreach to water providers enrolled in the program

Community-based Social Marketing Effort

In December 2009, EPA's WaterSense Program and ADWR jointly offered a community-based social marketing workshop to Arizona water providers, municipalities and water-efficiency professionals. Since that time, with financial support from EPA, ADWR has been leading a community-based social marketing effort and working collaboratively with 16 regional partners to foster water-efficient behavior among Arizona residents. The goal of the project is to reduce outdoor water use and objectives of the community-based social marketing effort include:

- Increase appropriate watering on landscapes
- Increase the percentage of households with appropriate landscapes
- Keep water used on landscapes off streets

Currently, four behaviors are being researched in an effort to hone the campaign down to one behavior:

- Adjust your sprinklers/irrigation systems seasonally
- Find and fix irrigation leaks
- Turn off irrigation system when it rains
- Adjust sprinklers/irrigation system so you don't water the sidewalk/street

A volunteer researcher from Arizona State University is assisting the group with the research component. A web-based survey was created and conducted to obtain quantitative data - over 1,400 Arizonans took the survey. Following that analysis, intercept surveys will be developed and conducted. The qualitative data obtained through the intercept surveys and the quantitative data obtained through the web-based survey will help the team determine barriers and benefits to each of the behaviors. One behavior will be selected, and then a message framework will be created, incentives identified and an implementation plan developed. Resources permitting, a pilot strategy will be conducted in 2011.

Water Awareness Month

A major Water Awareness Month (WAM) campaign occurred in 2010 to educate, celebrate and take action to save water. ADWR developed a theme for the 2010 campaign – Plants Don't Waste Water, People Do. The idea was to remind all Arizonans about the importance of using water efficiently outdoors. To support the theme, a WAM webpage was developed that provided information on how to design, water and maintain a beautiful and water-efficient landscape: www.azwater.gov/WAM. A WAM logo was also developed (Figure 14).

Figure 14. Water Awareness Month promotional logo.

Throughout the month of April, ADWR promoted WAM and the new-and-improved conservation website. Efforts included distribution of brochures and bookmarks; outreach via Twitter, e-mail, press releases, and radios spots (national public radio during the week of April 5th); and participation in water-related education events. An e-newsletter (**Appendix C**) and WAM logo was sent to all partners.

Water Provider Vulnerability Assessment
As part of the water provider vulnerability assessment discussed in the Drought Planning for Community Water Providers section above, ADWR will evaluate conservation plans provided by water providers. This assessment will aid in development of recommendations to reduce system vulnerability and support development of sustainable water supplies. If resources allow, ADWR conservation staff will work with high priority systems to help them develop and improve their system water plans, including the conservation plan component.

Collaboration and Outreach
Another large component of ADWR's Conservation Program is collaboration and outreach to raise public awareness about water efficiency. Using water more efficiently is a critical element in Arizona's long-range plan for securing a sufficient water supply. And, through collaboration and partnerships, ADWR is working to create a culture of conservation around the state. ADWR staff continues to participate in conservation efforts of groups such as Arizona Municipal Water Users Association, the Statewide Conservation Information Group, and the Blue Ribbon Panel, and to support conservation events such as Fix-a-Leak Week. By combining voluntary initiatives with regulatory goals, ADWR is focused on creating a more integrated approach to water conservation.

APPENDIX A
LOCAL DROUGHT IMPACT GROUP UPDATES

LOCAL DROUGHT IMPACT GROUP UPDATES

(as submitted by group coordinators with minor edits)

Mohave County

Introduction. This report summarizes the Local Drought Impact Group activities conducted in Mohave County in 2010. Quarterly LDIG meetings were held in January, April, July, and October. Drought Status reports and informational presentations were provided at the meetings by various agencies and groups, including the Bureau of Land Management, the Las Vegas National Weather Service Office, the University of Arizona, Arizona Department of Water Resources, Mohave County Flood Control, local ranchers, and others. The Monitoring Workgroup worked throughout the year to revise the Drought Impact report form into a standard version for all monitors and improve the Drought Monitor reporting system. It was apparent early in the year that the U.S. Drought Monitor was not accurately tracking drought impacts in the county, and despite the fact that Mohave was one of the Arizona counties to receive a 2009 drought emergency declaration, local ranchers were not eligible for U.S.D.A. drought relief loans. Subsequent discussions with ADWR, Arizona DroughtWatch, and the U.S. Drought Monitor resulted in impact reporting improvements and enhanced communication and coordination between the U.S. Drought Monitor, the state, and the county. A monthly impact reporting procedure was formalized through the Mohave County Emergency Management office, and the LDIG identified geographical gaps in the monitoring network and recruited individuals to fill many of those gaps.

Status of Drought. Drought conditions continued in the county throughout the year, although conditions were not as severe as during the last four months of 2009. Comparisons of 2010 precipitation amounts in various areas of the county from the county Alert Flood Warning System records indicate that most areas have received rainfall amounts comparable to the 2008 amounts, rather than those of 2009. The exceptions are the Lake Havasu City, Truxton, and Wikieup areas, which have experienced rainfall similar to the very dry 2009 amounts. Unusual October storms have produced precipitation providing temporary drought relief after a light and spotty monsoon season.

Drought Impacts. Water tanks and washes in the Arizona Strip area were reported dry through the end of September, with some ranchers hauling water and up to 40% forage loss reported. October storms in the western part of the Strip have put water in some previously dry reservoirs. However, in the part of the county north of the Cerbat and Black Mountains, including the Strip, the October rains have helped increase forage but are probably not putting enough water into tanks and reservoirs to alleviate long-term concerns for livestock and wildlife. In the southern part of the county south of the Cerbat and Black Mountains, drought impacts continue in those areas such as Lake Havasu City that experienced several months without rain in late 2009 and early 2010. With a relatively dry winter being projected, any relief from the October rainfall will likely be short-lived. Lake Mead's water elevation is currently the lowest in 75 years and only 8 feet above the level which will trigger incremental rationing for Colorado River water users, although the Bureau of Reclamation plans to utilize Lake Powell releases to generate higher water levels at Lake Mead in the next year.

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, In October, the LDIG initiated discussion on the establishment of a Mitigation Working Group and countywide Mitigation Plan. Efforts to date have been focused exclusively on establishing and building the Monitoring Workgroup and network, which will be maintained and expanded as work commences on mitigation planning.

Pima County

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 2010, LDIG meetings included presentations on the winter and summer seasons from the National Weather Service, an overview of the U.S. Drought Monitor from the Climate Assessment for the Southwest, Tucson Water's annual drought assessment and a status report on the Colorado River and reservoir levels at Lake Mead and Lake Powell from the Central Arizona Water Conservation District.

Status of Drought In 2010 drought conditions eased somewhat in Pima County. January was the 8th wettest month on record, while February was the 11th wettest. Winter temperatures were cooler. However, the summer monsoon season was the 2nd warmest on record. Rainfall was above average; 4.75 inches compared with the average 4.61 inches. Also notable was the average low temperature which was 74.7º F or 3.4º F higher indicating nighttime temperatures were warmer this summer. The summer monsoon precipitation was variable throughout Pima County with some areas in eastern Pima County receiving as much as 8 inches of precipitation while some areas in western Pima County received less than an inch of rainfall.

At the beginning of 2010, the short-term drought status in Pima County ranged from severe drought to moderate drought, while the long-term drought status was moderate, except in the far western portion of Pima County that was abnormally dry. As the year comes to a close, the short-term drought status is improved; abnormally dry in western Pima County and no drought conditions throughout the rest of Pima County. However, the long-term drought status shows moderate drought in eastern Pima County, abnormally dry in central Pima County and normal in western Pima County.

Although drought conditions have eased somewhat, the consensus of the Pima County LDIG is that it will take several years of above average precipitation for the long term drought status to improve and LDIG recommends Pima County remain at Drought Stage One.

Drought Impacts The impacts of sustained drought were observed in several sectors throughout Pima County:

- At Cienega Creek, groundwater levels in three wells have dropped as much in the last year as they have in the last 15 years. Stream reaches are also shorter and the surface water volume is lower.
- Despite the warm, wetter summer weather patterns in eastern Pima County, water utilities continue to see a change in the peak high demand day. Usually occurring in mid- to late-June, the peak high water use day occurred in August and the peak was lower than in previous years.
- For ranchers, impacts to stock ponds and grasses continue to indicate drought conditions.

Drought Indicators In 2010, ADWR began using the U.S Drought Monitor instead of the monthly ADWR Drought Monitor Report (DMR). The U.S Drought Monitor is a web-based reporting system and is now used because:

- It provides more timely information
- In some cases, drought conditions can change rapidly
- The ADWR DMR was reporting conditions that were at least one month old
- The US Drought Monitor has better and more timely input
- The US Drought Monitor is a more sustainable process in light of the ADWR budget cuts

LDIG is now using the US Drought Monitor to monitor drought conditions in Pima County.

Drought-Related Actions During the year, the City of Tucson and Pima County completed Phase 2 of a water/wastewater infrastructure study. Phase 2 establishes a framework for sustainable water resources planning through the implementation of 19 goals and 56 recommendations. Phase 1 was completed in 2009 and consisted of an infrastructure inventory. With respect to drought, the Phase 2 report recommends the City and County pursue adaptive, flexible, multi-pronged preparedness strategies, including diversification of water supplies and improved demand management, such as increased reliance on water harvesting. To track and measure the plan's progress, an action plan implementing the goals and recommendation of Phase 2 is being completed. More information can be obtained at http://www.tucsonpimawaterstudy.com

In 2010, the City of Tucson published its Annual Drought Monitoring Report that recommended continuation of the Stage 1 Drought Response. The report is available at http://www.pima.gov/drought/PDFs/2010_Drought_Rpt.pdf

On June 1, 2010, the City of Tucson began implementing a rainwater-harvesting ordinance that requires new commercial properties to provide a minimum 50 percent of their landscaping water budget from harvested rainwater. Also on June 1, the City of Tucson began requiring all new one- and two-family dwellings to have gray water stub-outs for laundry drains. New single-family dwellings will be required to have separate drain lines for lavatories, showers and bathtubs to allow for future installation of distributed gray water systems.

Should drought conditions persist and curtailments of CAP water be declared, water providers have several response strategies in place. The first and second CAP curtailment levels will not affect deliveries to municipal water providers. However, drought response plans are in place and more restrictive drought response measures can be taken if a shortage is declared. The Arizona Water Bank Authority has stored unused CAP allocations at recharge facilities in the Tucson Active Management Area on behalf of Tucson Water and other CAP subcontractors in the region. This water can be recovered during shortage periods. Potential climate change impacts on water resources are also being assessed in a 26-member climate change committee being led by the City of Tucson.

Each of the water providers has prepared a drought response plan on file with ADWR. As of September 2010, the status of regional drought declarations remains unchanged from 2009. 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 B
EXAMPLE WATER CONSERVATION TOOLS

Arizona Department of Water Resources
Conserving Water Today for Arizona's Tomorrow

Water Metering

Arizona Department of Water Resources

Conservation Program
(602) 771-8585

Long Distance within Arizona
(800) 352-8488

3550 N Central Ave.
Phoenix, AZ 85012

www.azwater.gov/conservation

Revised November 2010

Introduction

To ensure effective water-resource planning, water providers and planners must have a clear understanding of water-use practices.

The best way to measure water use, including the amount produced (supply) and amount delivered (demand), is with water meters.

Whether at the point of receipt or source, metering offers a variety of water system benefits. It is essential in evaluating actual volume used, associated costs, infrastructural soundness and accounting errors.

Metering all service connections offers an opportunity to advise customers of the actual costs and volume of water used; otherwise, customers have little incentive to use water efficiently.

Metering also provides a direct method of identifying high water users who can then be targeted in conservation efforts. Further, meters help establish average water use by type of user (residential, multi-family, commercial, etc.), providing data that can be used to direct conservation programs.

Meter Regulation in Arizona

The State of Arizona requires that a large provider located inside an Active Management Area (AMA) meter water deliveries to all municipal service connections on its system except connections to fire services, dwelling units in individual multifamily units, mobile homes in a mobile home park with a master meter, and construction users. While providers outside of the AMAs are not required by the state to meter their water delivery, they may be subject to regulations by the city, town, or county in which they are located.

Please see www.azwater.gov for questions regarding specific regulatory requirements for municipal, industrial and agricultural water users.

General Information

Water meters are devices used to measure the volume of water used in a water supply system.

Meters are located at the water source, well, or throughout a water system to determine flow through that portion of the system. The type of meter selected is based on different flow measurement methods, the type of end user, the required flow rates, and accuracy requirements.

Meters are typically designed for cold, potable water. Specialty meters include hot water meters, which are designed to withstand higher

temperatures and meters for reclaimed water, which have purple register covers to signify that the water is non-potable.

Meters generally measure and display total usage in gallons or cubic feet.

In North America, standards for the manufacturing of water meters are determined by the American Water Works Association (AWWA). AWWA publications cover all aspects of water meters, including meter types, selecting the right meters for various customer classes, installation, testing, and maintenance. For more information, please visit www.awwa.org.

The use of water meters is considered an essential practice in effective water supply management.

Metering is considered a good practice in water supply management because it encourages:

- Accurate accounting of water produced and delivered
- Calculation of unaccounted-for water
- Enhanced detection of leaks and waterline breaks
- Charging for water based on actual use
- Identification of high water users who may need assistance in reducing overall water use
- Monitoring water system efficiency and potentially postponing the need for system expansion

Selecting a Meter

Proper meter selection involves consideration of both the size and type of meter.

Meter Size
Meter size is described in terms of the size of pipe for which the meter was originally intended. Often meters are sized to match the diameter of the service line but this may not be the best practice as actual flows tend to be lower than the maximum flows the service lines are designed to accommodate.

Proper meter sizing depends on the types of flows and water demands, as well as variations in daily and season flows.

Meters should be the right size for the application and in the right location. Meters should be sized for the flow rate, not the pipe size.

Meter Types
The type of meter chosen should be based on the expected range of flow rates, allowable pressure loss and local safety requirements, such as maintaining fire-service flows.

There are two basic types of water meters: Positive Displacement and Velocity; each type has several variations.

Positive Displacement Meters operate by directing water through compartments of known volume which are repeatedly filled and emptied. The flow rate is calculated based on the number of times this process occurs.

Positive Displacement meters are sensitive to low flow rates and are typically used for houses and small businesses. These meters are available 2”and smaller and are not generally practical in large applications requiring high flow rates or low pressure loss.

The types of Positive Displacement meters include: Nutating Disc and Oscillating Piston.

Velocity Meters operate by directing water through a known cross-sectional area with a measured velocity that can be equated into a volume of flow. Velocity meters are typically good for high flow applications and are available 2" and larger, with the exception of the Multi-jet which is available ⅝"–2".

The types of Velocity meters include: Turbine, Multi-jet, Propeller, Ultrasonic, Venturi, Magnetic and Orifice.

Compound Meters typically have Positive Displacement and Velocity meters installed together to measure high and low flows. Compound meters are typically 2" and larger.

Metering is a valuable tool in directing a community's conservation efforts.

Master Meters are those that deliver water to an entire distribution system and are typically a type of Velocity Meter. The main meter at a commercial building, apartment building or mobile home park is referred to as the master meter for that complex and can be a Positive Displacement or Velocity meter.

Metering Large Flows

Velocity and Compound meters are normally chosen for large flows such as those at treatment plants. Propeller meters, a type of Velocity meter, are often used on large main lines or pump stations. Compound meters are used if accurate measuring at low flows is important but large flows also have to be measured. Utilities often use magnetic flow meters to measure untreated water and wastewater as there is no mechanical measuring element to get clogged or damaged by debris. Magnetic meters usually have the ability to measure flow in either direction. Turbine meters are commonly used for large flows when minimum flows are generally above 10–12% of maximum rating and maintaining high pressure is necessary.

Metering Medium Flows

For medium flows, such as apartment buildings, businesses and public buildings, 1"–2" Positive Displacement meters are normally used. In sizes of 2"–3", Positive Displacement, Multi-jet or Turbine meters are common. In sizes of 3"– 4", the meter type depends on the average flow rate. Multi-dialed meters are common at large industrial and commercial meters.

Metering Small Flows

Positive Displacement meters are usually used in residential and small commercial applications.

Submeters

All water use should be metered. Although not usually a water provider's primary function, promoting separate metering has proven to lower water use.

Submetering water delivered to individual tenants and/or for specific uses such as separate commercial applications or outdoor and landscape use is an important tool in effective water management.

Submetering is important as it creates awareness of water use and efficiency as tenants pay for actual use and leaks.

Submetering can save costs by allowing property managers and customers to identify and address specific inefficiencies. Submetering of separate applications may also save costs if discounted sewer fees are available for the water that is not returned to the sewer system (landscape uses and cooling tower evaporation).

A submetered system typically includes a master meter for the complex (multifamily or commercial) that is owned by the utility supplying the water. Additional meters, publically or privately owned, are installed to measure water use of individual tenants or particular uses.

Maintenance

Water meters get damaged and deteriorate with age. This may lead to inaccurate readings and most often the under registering of consumption. Inaccurate readings provide incorrect information regarding usage, make leak detection more difficult, and may result in lost revenue for the water provider. All meters should be tested for accuracy on a regular basis.

After determining accuracy, water providers should create a schedule and process to correct meter deficiencies. Meters should be recalibrated on a regular basis to ensure accurate water accounting and billing.

When considering repair or replacement, AWWA suggests that it may be more sensible to measure the life of a meter based on total consumption and not time.

Water quality and mineral content are also factors in the deterioration of meters, and local water quality conditions should be taken into account when developing a maintenance and replacement schedule.

It may not be desirable or even feasible to repair outdated designs; however, newer, modular models are easier and more cost effective to repair. Some water providers replace meters on a regular basis regardless of the functionality of the individual meters.

Determining the cost per meter repaired and purchased is important in establishing a maintenance and replacement program.

Cost

The cost associated with metering includes the investment costs to purchase and install meters, as well as the recurrent costs to read, test, maintain and replace meters. The price of meters varies considerably based on size and type.

Purchasing

There are a number of businesses and manufacturers that sell water meters in Arizona. Please refer to your local yellow pages or search the Internet using the key words “water flow meters.”

References

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United States Environmental Protection Agency, *Water Conservation Plan Guidelines*, 1998

Vickers, Amy. *Handbook of Water Use and Conservation*. Amherst, MA: Waterplow Press, 2001

Arizona Department of Water Resources

Conserving Water Today for Arizona's Tomorrow

Conservation-based Water Rate Structures

For More Water Conservation Information Contact:

Conservation Program
(602) 771-8585

Long Distance within Arizona
(800) 352-8488

3550 N Central Ave.
Phoenix, AZ 85012

www.azwater.gov/conservation

Introduction

Water rate structures play an essential role in communicating the value of water to customers. And since price influences the perceived value of a product, rate structures can be an important instrument in promoting long-term efficient use of water.

The appropriate rate structure is important in communicating the value of water and encouraging customers to use it responsibly.

Conservation Water Rate Structures

Conservation-based rate structures are those that encourage the efficient use of water by charging customers more as water use increases.

There are two types of conservation-based rate structures:

Inverted or Increasing structures have increasing rates – customers who use higher volumes pay more per unit of water.

Seasonal or Off-peak structures have increasing rates per unit of water during the peak demand season (for example, during the summer, a customer may pay more due to the increased demand).

Other types of rate structures exist that may actually encourage high water use and run contrary to conservation efforts as they provide no price incentive to use water efficiently:

Uniform rate structures have a flat rate per unit of water regardless of the volume used.

Declining rate structures have decreasing rates per unit of water as more water is used.

Rate structures are generally referred to as block or tier structures, where a uniform per unit fee is assigned to a specific volume range of water. Many variations and regional-specific considerations can be applied to setting each block volume.

Example of an Increasing Block Rate Structure

Numbers used in these tables are hypothetical and used only to illustrate different methodologies.

Gallons Used Block/Tier	Monthly Service Charge ($)	Metered Water Rates ($ / Kgal)
0 – 4,200	9.90	3.00
4,201 - 19,200	9.90	4.50
19,201 - 28,200	9.90	5.00
28,201 - 33,000	9.90	6.50
33,001 – 39,000	9.90	9.00
39,001 – 49,000	9.90	12.50
Over 49,000	9.90	15.00

Example of a Seasonal or Off-peak Block Rate Structure

Monthly Service Charge	Metered Water Rate ($ / Kgal)	
($)	Oct – May	Jun – Sep
9.90	4.50	6.50

Detailed information on establishing conservation-based rate structures is available through the Environmental Protection Agency at www.epa.gov and the American Water Works Association at www.awwa.org. Many private firms that specialize in water planning also offer assistance with rate studies and implementation.

Benefits of Conservation Rate Structures

Conservation-based rate structures are an effective way for water providers to encourage water conservation while offsetting the costs sometimes associated with implementing other types of water conservation programs.

The benefits of conservation-based rate structures include:

- Reducing peak usage
- Reducing seasonal usage
- Reducing total system demand
- Communicating an overall conservation consciousness
- Rewarding efficient users
- Surcharging for nonessential and non-efficient water uses

Conservation Fees

Providers may also want to consider establishing a water-conservation fee, which could be collected per customer per billing period and used to help fund water conservation programs.

Effectiveness of Conservation Rate Structures

A review of over 100 studies showed that for residential demand, a 10 percent increase in price lowers demand by 2 to 4 percent; and for industrial demand, a 10 percent increase in price lowers demand by 5 to 8 percent (Beecher, 1994).

Evaluating Effects of Water Rate Changes

Evaluating existing rate structures in comparison to conservation-based rate structures is a valuable first step when considering a change in rates.

Below is a table that will help determine how revenue will be effected if a conservation-rate structure is implemented. This exercise should be done for each customer class (residential, multifamily, commercial, etc.).

Line	Item	Value
1	Current price per gallon	$
2	Current revenue-producing gallons (or cubic feet)	gallons
3	Current annual revenues (line 1 multiplied by line 2)	$
4	Conservation goal (reduction in water use)	gallons
5	Conservation goal as percentage of current annual revenue-producing gallons (line 4 divided by line2)	%
6	Estimate price elasticity of demand (by customer class and/or type of use if applicable)	%
7	Percentage change in price needed to induce conservation (line 5 divided by line 6)	%
8	Calculate revised price level (line 1 multiplied by (1.00 plus line 7))	$
9	Revised annual water usage (line 1 less line 4)	gallons
10	Revised revenues (line 8 multiplied by line 9)	$
11	Annualized fixed costs	$
12	Annual variable costs for revised water usage	$
13	Revised revenue requirements	$
14	Net revenue effect (line 10 less line 13)	$

Source: USEPA Water Conservation Plan Guidelines, Appendix A, Water Conservation Measures

Issues to Consider when Implementing Conservation Rate Structures

- In most Arizona communities, rates are significantly lower than the true cost of acquiring water (pumping, treatment, delivery, replenishment, and obtaining new supplies), which may create customer resistance to paying higher rates.
- An effective rate structure should be designed so that water used for basic and essential needs costs less than water used for discretionary or non-essential needs.
- Rate changes should be publicized and explained so that customers understand why the change is necessary. It is important to show customers how much money could be saved by lowering water use to a less expensive block.
- Water providers have a natural reluctance to initiate conservation programs since revenue streams are based on water used.

- If water rates are designed appropriately, reduced water use should not necessarily result in reduced revenue. Rates should be adjusted so that the price of water reflects the cost of getting it to the customer.
- Some water providers are reluctant to initiate conservation programs since revenue streams are based on water used. If rates are established correctly, the rates paid by customers in high-water-use blocks may actually offset revenue loss from those in lower-water-use blocks.
- If rate structures are implemented properly, utilities should be able to balance their revenue stream to cover operation and maintenance and any increased costs associated with implementation of water conservation programs. A long-term conservation program can result in significant cost savings to the water system; it can extend the life of existing infrastructure and delay the costs associated with building new facilities or retrofitting old facilities to handle larger capacities.
- For private water companies, cost recovery for water conservation programs through a rate increase must be approved by the Arizona Corporation Commission (ACC). For more information, contact the ACC: www.azcc.gov or (800) 222-7000.

"Tiers should be designed in a manner that customers who conserve will recognize cost savings, while high water users will pay a greater portion of the costs that increased usage places on the water system."
Arizona Corporation Commission

The Need for Conservation Rate Structures in Arizona

The use of rate structures as an incentive to save water is not new. While several cities in Arizona do have seasonally adjusted or inverted block rates and conservation programs in place, data suggests that rate structures in Arizona have a wide variability in both pricing and opportunities for rate restructuring.

This variability was demonstrated through a comprehensive study that was commissioned by the Arizona Water Infrastructure Finance Authority (WIFA). The study, Rate Structure Survey Summary for 2003, evaluated the rates of 400 Arizona water providers and showed that the average monthly charge for a standardized study use of 7,750 gallons/month is $30.16. The range of costs for this same gallon usage across the study sample was from a low of $5.61 to a high of $99.60.

Conclusion

Arizona's water resources are limited and aggressive conservation measures must be adopted to protect this valuable resource. Perhaps one of the most effective ways to accomplish this is by making sure the cost of water reflects its value and encourages customers to use it efficiently.

"Rate structures have the advantage of avoiding the costs of overt regulation, restrictions, and policing while retaining a greater degree of individual freedom of choice for water customers."
USEPA How to Conserve Water and Use It Effectively

APPENDIX C
WATER AWARENESS MONTH E-NEWSLETTER

April 2010

Plants don't waste water, people do.

What's planted in your yard?

Stick with Arizona-appropriate landscapes.

Are your plants thirsty? Probably not.

Determine your plants' water needs.

Where is your water going?

Fix leaks and only water your landscape – not the pavement!

Save water and reduce maintenance by selecting plants that are suitable for Arizona's climate.

Then, water appropriately.

Your plants don't waste water, neither should you!

Learn how to design, water, and maintain a beautiful and water-efficient landscape by visiting ADWR's Water Awareness Month web page.

ARIZONA DEPARTMENT OF WATER RESOURCES

EPA WaterSense PARTNER

CHOOSE HOW YOU USE

Executive Order 2008-19 designates April as Water Awareness Month. Thank you for doing your part to educate, celebrate and take action to save water - in April and every month.