



CITY OF TUCSON WATER DEPARTMENT ANNUAL DROUGHT MONITORING REPORT

July, 2011





MEMORANDUM

DATE: August 4, 2011

TO: Mike Letcher
City Manager

FROM: Andrew Quigley
Interim Director
Tucson Water (TW)

SUBJECT: Continuation of Stage 1 Drought Response for TW Service Area

Background

The City of Tucson Drought Preparedness and Response Plan (Plan) was adopted by Mayor and Council November 28, 2006, as required by A.R.S. §45-342. An implementation ordinance (No. 10380) was approved March 20, 2007. The Plan recognizes that drought impacts do not occur suddenly or without warning, and acknowledges that with proper planning and review it is unlikely the community will find itself in an emergency situation caused solely by drought. The Plan calls for annual reporting on local and regional indicators to be monitored as triggers for implementing or rescinding various stages of drought response that may be required to ensure the Utility's resources and system characteristics are not compromised by drought impacts.

The Plan triggers for escalating drought response stages meet the statutory requirement for drought response indicators to be directly tied to a water provider's water resource availability and the ability to deliver those resources. For TW, water resource availability requires review of both regional (Colorado River) and local conditions that may impact supplies, whereas evaluation of infrastructure reliability primarily requires review of the potable and reclaimed water distribution systems (local system indicators).

The Plan establishes four drought response stages, outlines an action plan for responding to potential drought-related impacts on TW's system and water supplies, and addresses the issue of emergency supplies. The Plan also demonstrates the success of the long-term financial investment the community has made in securing and implementing use of renewable water resources, which has provided considerable ability to withstand the impacts of sustained drought on TW's supplies.

TW's regional indicators are severe or sustained drought on the Colorado River watershed, including declared shortages on the Colorado River; or a drought status "above normal" declared by the Arizona Department of Water Resources (ADWR) for the Santa Cruz Watershed, which includes the City of Tucson. Local system drought impact indicators for TW include measures of aquifer storage, potable and reclaimed water production capability (i.e.: measures of water supplies and the ability to deliver them where needed), and gallons per capita per day (GPCD) use. While GPCD is not a "drought indicator" per se, monitoring GPCD allows the Utility better assess, whether drought response measures previously implemented are having the desired affect.

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TW's declining GPCD in the face of long-term drought, indicates both the responsiveness and general drought awareness of our customers.

Recommendation to Continue Stage 1 Drought Response; Drought Response Indicators

The attached drought monitoring report summarizes the results of staff review of both regional and local system indicators of potential impacts from drought on the Utility's water supplies, system and service area. For the fifth consecutive year since the Plan was adopted, the Utility's recommendation is a continuation of the response measures outlined in the Plan for a Stage 1 Drought Response (See Table 1: Stage 1 Drought Response Measures). The focus of the Stage 1 response measures from a community perspective is to communicate information about drought to our customers and emphasize water use efficiency. The 2011 report includes, a table reflecting specific Stage 1 Response Measures and the actions taken to date to implement these measures.

Plan Review and Update

TW's drought preparedness planning is an ongoing process closely linked with long-range water resource planning. All successful planning requires periodic updates of any written plans to incorporate new data and adjust planning scenarios to reflect real-life conditions. Experience gained through the first five years of the City's Drought Preparedness and Response Plan, indicates the need to revise various response strategies, especially within Stage 1 response.

In addition, TW's ability to adapt to climate variability must also be considered in any long-term planning effort. Arizona statute (A.R.S. §45-342) also requires an updated drought response plan every five years. The original plan was submitted to ADWR in December 2006; therefore an update is due to ADWR by the end of 2011. Review and revision of the adopted Plan is currently underway and will include integration of climate adaptability planning. Staff will work with the Citizens' Water Advisory Committee as revisions proceed and present an updated Plan to Mayor and Council later this year.

AHQ/lr

Attachment: Annual Drought Monitoring Report - 2011

cc: Honorable Mayor and Council Members
Richard Miranda, Deputy City Manager
Sean McBride, Assistant City Manager

CITY OF TUCSON
TUCSON WATER DEPARTMENT
ANNUAL DROUGHT MONITORING REPORT
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Outside sources: Staff thanks the University of Arizona, Institute of the Environment, Climate Assessment for the Southwest (CLIMAS); U.S. Drought Monitor, National Drought Mitigation Center, University of Nebraska, Lincoln; U.S. Department of Agriculture; U.S. Department of Commerce, National Oceanic and Atmospheric Administration; U.S. Department of the Interior, Bureau of Reclamation; Arizona Department of Water Resources (ADWR), Drought Monitoring Technical Committee (DMTC).

TUCSON WATER (TW) ANNUAL DROUGHT MONITORING REPORT July 2011

This report provides the outcome of staff's assessment of drought impact indicators, followed by a drought response stage recommendation for 2011. In addition, this year's report includes a brief discussion of the plan review and update process currently underway to meet a statutory requirement to update the plan every five years. The updated plan will include an element on climate variability and adaptability, and its importance to TW's scenario planning process for long range water resources planning (see Appendix A).

Status of Regional Indicators

- **Colorado River Status**

The Colorado River water delivered through the Central Arizona Project (CAP) is a vital resource to the TW service area. More than 70% of TW's annual water demand is met through this renewable surface water resource, and Colorado River water will provide even more of the water supply to meet this demand in future years. TW will purchase its full CAP allocation in fiscal year 2012.

Snow melt and runoff from the Upper Colorado River Basin provide supplies to Lakes Powell and Mead, the reservoirs most critical to Arizona Colorado River deliveries (Figure 1).



Figure 1: The Colorado River System in Arizona with Lakes Mead and Powell and the CAP Canal

The Natural Resources Conservation Service (NRCS) monitors nearly 2,000 stations in the Western United States, using automated and manual snow telemetry (SNOTEL) stations. Stations provide precipitation, snow depth, snow water content (defined as ‘snow water equivalent’, the amount of water contained in the snowpack if the snowpack at the SNOTEL site melted all at once), and air temperature data. More than 100 SNOTEL sites are monitored above Lake Powell for the Upper Colorado River Basin.

Figure 2 depicts snow conditions in the upper Colorado snowshed. As of early May, most of the snowshed water content was well above normal, a substantial change from this same period in 2010. According to CLIMAS, current dry conditions in the Southwest are the result of a moderate to strong La Niña event. At the same time, the La Niña weather pattern has also been responsible for the above average snows further north in the upper Colorado River Basin (as shown in Figure 2). CLIMAS states that “spring streamflow forecasts for Lake Powell predict a 50-percent chance that inflow into the reservoir will be about 120 percent of the 1971–2000 average.”

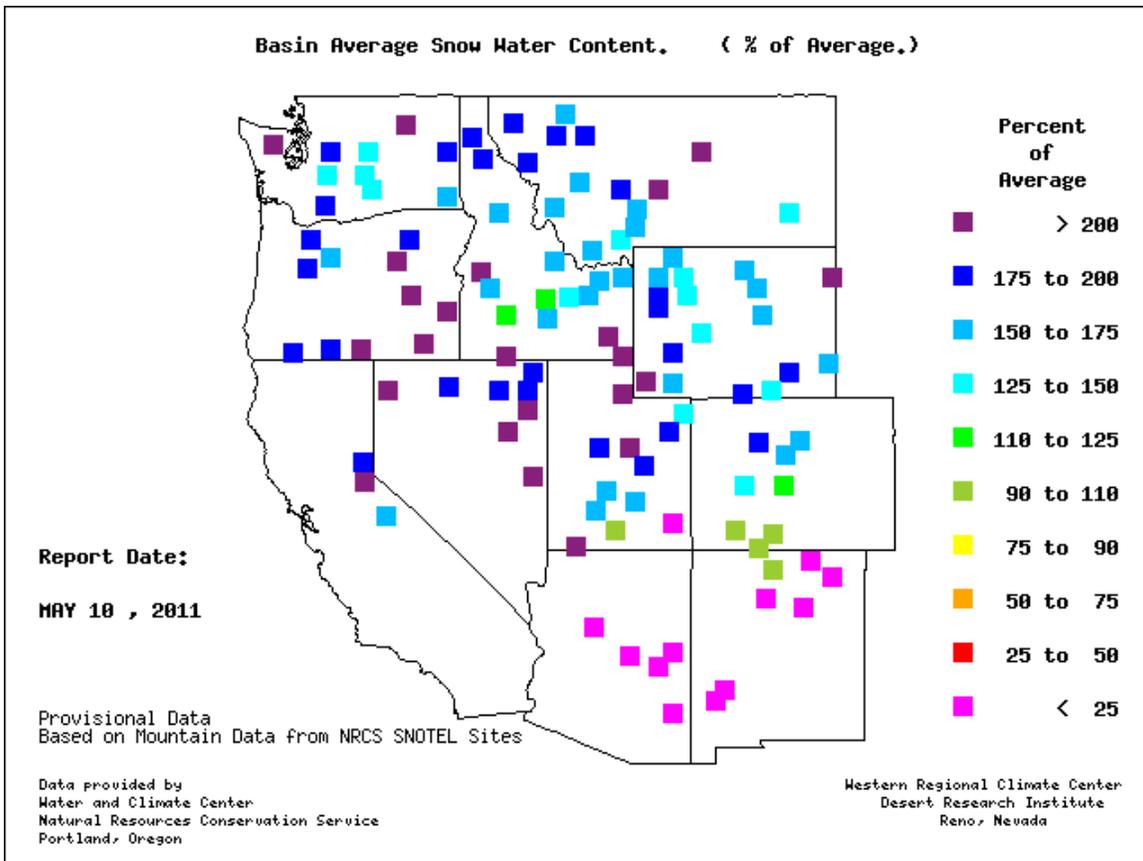


Figure 2: SNOTEL – River Basin Snow Water Content as of May 10, 2011
<http://www.wrcc.dri.edu/snotelanom/basinswe.html>, Western Regional Climate Center
 Desert Research Institute; Reno, Nevada

Using this and other data, the Secretary of the Interior, through the U.S. Bureau of Reclamation, annually determines the condition of the Colorado River for the coming water year as surplus, normal (or average), or that the river is in a shortage. In its 2010 Annual Operating Plan, the Bureau considered the river normal or average and did not declare a shortage on the river for the 2010 water year (Annual Operating Plan for Colorado River Reservoirs, U.S. Bureau of Reclamation, December 2010).

How much water is ultimately available for release to the Lower Colorado River Basin is determined by multiple governing documents and an intricate process of projecting various river-flow scenarios for successive (or “rolling”) 2-year projections. The April forecast for July flows into Lake Powell was 9.5 million acre-feet (Maf), which is about 120% of average. The releases from Lake Powell for 2011 are projected to total 11.56 Maf, or enough water to raise the elevation of Lake Mead to 1,105 feet above sea level, which is 30 feet above the shortage-trigger elevation of 1075 feet. As of May 11, 2011, Lake Powell elevation was 3614 feet, or about 54% of its full-pool capacity of 24.3 Maf (Figure 3).

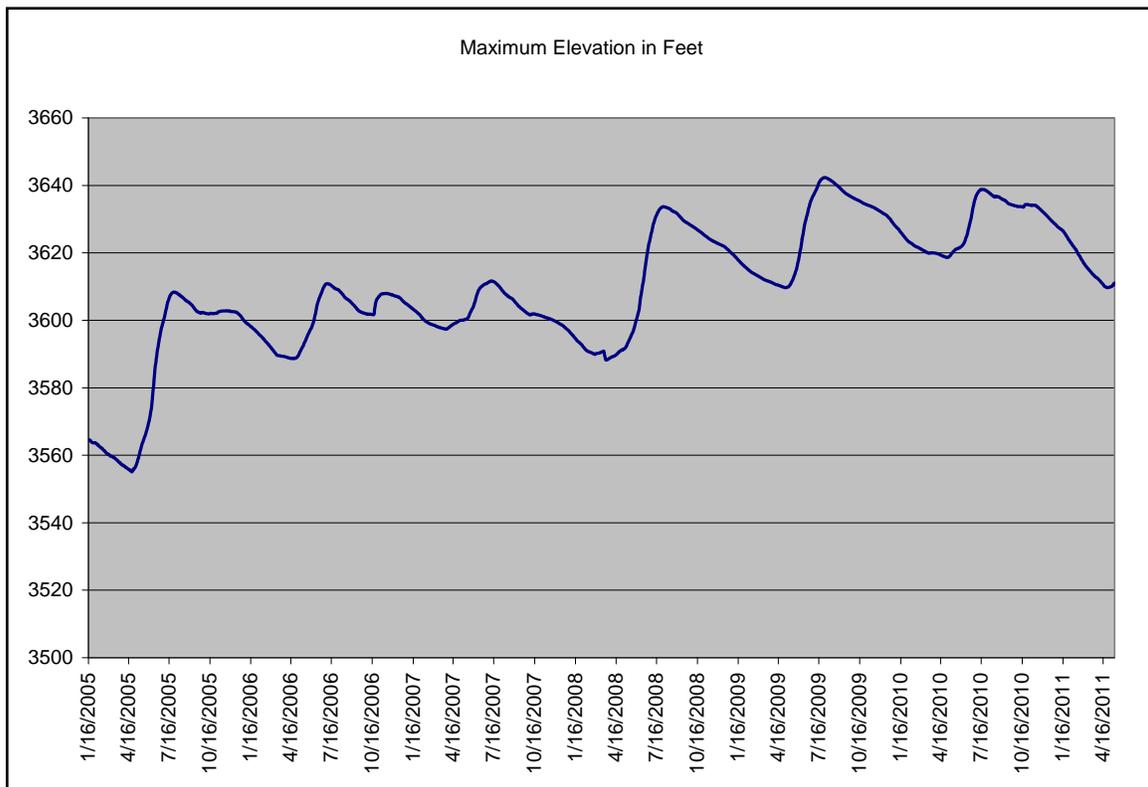


Figure 3: Lake Powell Daily Water Levels: 2005 to present (Source data from U.S. Bureau of Reclamation)

• **Santa Cruz Watershed Drought Status**

Another regional indicator TW staff reviewed is the drought status for the Santa Cruz watershed, as determined by ADWR, DMTC. This information appears in the DMTC’s monthly Drought Monitoring Report on the ADWR website as well as in the *Southwest Climate Outlook* newsletter produced by CLIMAS. A poor showing of winter storms left most of the Tucson Active Management Area in a state of “extreme drought” for the short term (Figure 4).

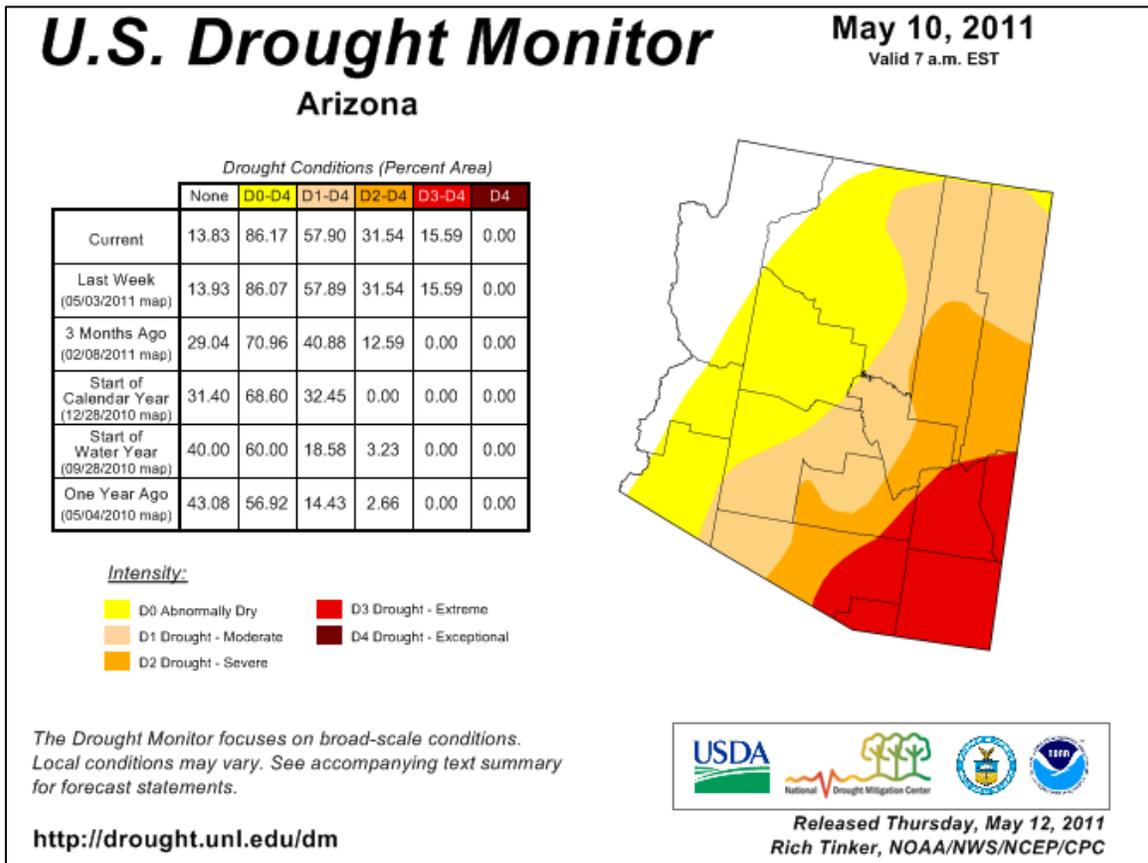


Figure 4: Arizona Short-Term Drought Status. U.S.

(<http://drought.unl.edu/DM/monitor.html> National Drought Monitor Mitigation Center, a joint effort with National Oceanic and Atmospheric Administration and the U.S. Department of Agriculture).

The technical committee monitors long-term drought as well, and evaluates data from three periods (2, 3, and 4 years), along with stream flows. The technical committee’s evaluation for Tucson’s Active Management Area (AMA) for the current long-term evaluation shows a state of “moderate drought” throughout the same area (Figure 5).

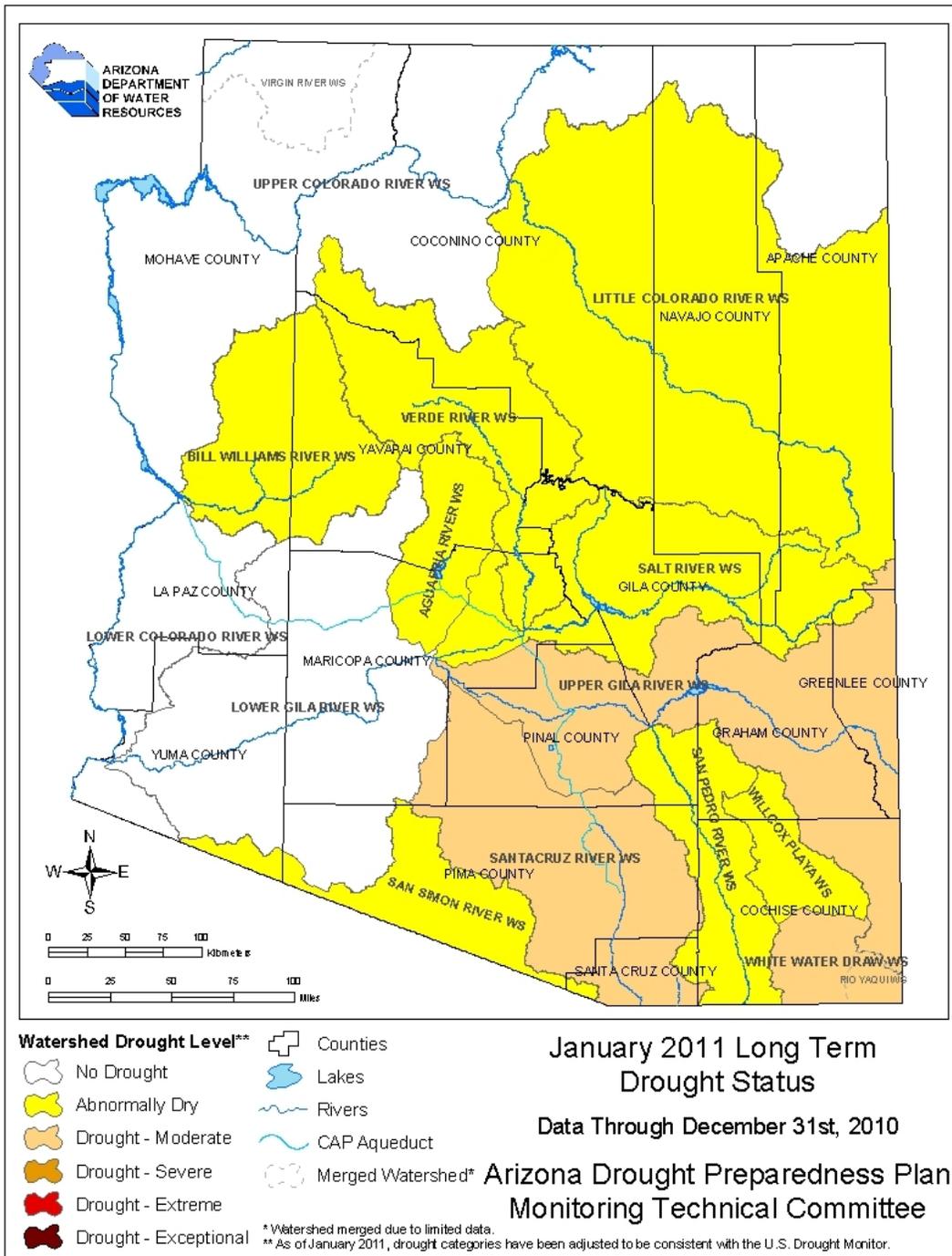


Figure 5: Arizona Long-term Drought Status as of January 2011.
<http://www.azwater.gov>, Arizona Department of Water Resources

Status of Local System Indicators

- **Aquifer Storage Index**

The Aquifer Storage Index (ASI) captures the net effects on water table levels from pumping and from natural and artificial recharge. It is a measure of the change in water storage volume relative to a base year of 2000. TW’s production wells are grouped into 11 regions of hydrologic similarity for this calculation. Each region is represented by one average water level, simplifying water level change comparison (Figure 6).

2010 Aquifer Storage Index

The ASI has continued its dramatic improvement since 2003. This is due to continued increases in storage at the Central Avra Valley Storage and Recovery Project (CAVSARP), storage at Southern Avra Valley Storage and Recovery Project (SAVSARP) and falling demand for potable water, resulting in less use of mined groundwater as a percent of all potable demand.

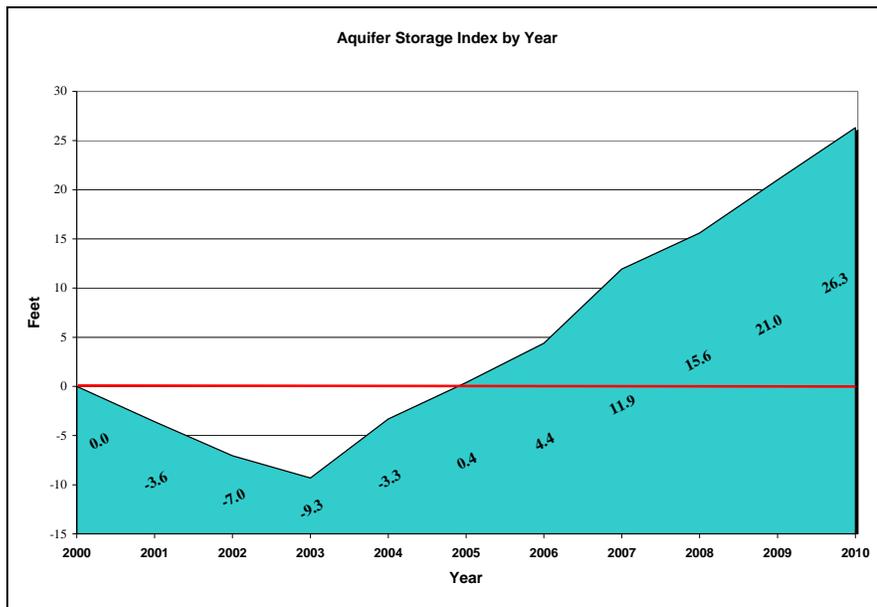


Figure 6: ASI by Year

- **Potable Production Capacity Index (PPCI)**

The Potable Production Capacity Index (PPCI) is a ratio of potable production capacity available for the coming year (in millions of gallons per day or mgd) divided by the predicted maximum 30-day demand period for the upcoming year (in mgd). Data from TW’s Well Status Report is the primary information source for the PPCI. An index score of “1.1” or higher is considered good; lower than 1.1 indicates some degree of system stress; less than one indicates that demand is expected to be greater than capacity and that excess demand will be met with storage.

Further expected declines in the peak 30-day demand period and stable production capacity has resulted in the PPCI forecast increasing to 1.40 for this annual update. Over the last two years the maximum 30-day demand has come in well below the forecasted volume. Due to continued underlying weakness in the local economy and TW's strong water conservation programs, the maximum 30-day demand could once again fall below the forecasted volume. As such, the forecasted PPCI of 1.49 represents a conservative estimate (Figure 7).

Year	Forecast Production Capacity in Million Gallons	Forecast Maximum 30-Day Demand in Million Gallons	Forecasted PPCI	Actual Maximum 30-Day Demand in Million Gallons	Actual PPCI
2008	171.5	150.0	1.14	137.2	1.25
2009	184.2	148.1	1.24	126.5	1.46
2010	196.7	141.0	1.40	132.6	1.48
2011	201.7	135.0	1.49		

Figure 7: Table of Potable Production Capacity Index by Year

- **Gallons Per Capita Per Day** (134 and trending downwards)

Gallons Per Capita per Day (GPCD) is the total potable water produced by TW for the previous year divided by the estimated service area population for that year.

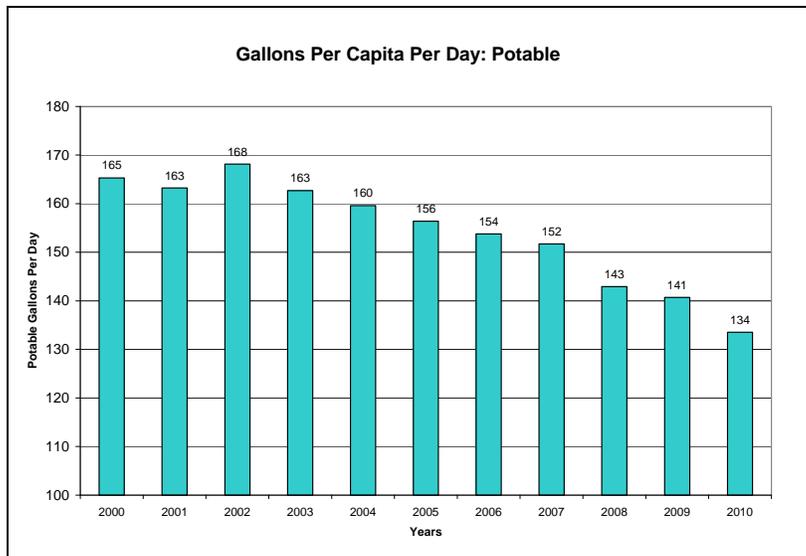


Figure 8: Potable Gallons Per Capita Per Day Usage By Year

The source for potable water produced is the annual pumpage report prepared every March by TW staff for submission to ADWR; the report submitted in March 2011 reports the total pumpage for calendar year 2010.

ADWR and TW agreed on a new methodology for estimating population. As a result of the new population estimates, the per capita water use is higher than reported for 2010 and for other years prior (Figure 8). Note that the 2010 per capita number was much lower than in 2009 because of a long period of very cool and wet weather in the spring of 2010.

- **Reclaimed Production Capacity Index**

The Reclaimed Production Capacity Index (RPCI) is the ratio of maximum reclaimed water production capacity for the upcoming year to the peak day forecast for reclaimed water demand for the upcoming year. An index score of “1.1” or higher is considered good and an index above 1.0 is considered acceptable, (Figure 9).

Forecast Year	Production	Forecasted Peak Day	RPCI
2008	34.2	31.3	1.09
2009	33.5	31.8	1.05
2010	29.8	29.3	1.02
2011	32.2	31.0	1.04

Figure 9: Reclaimed Production Capacity Index by Year

Staff Recommendation on Drought Response Stages

A Stage 1 Drought Response was declared for the TW Service Area in April 2007 based on the indicators in the adopted plan. Regional rather than local indicators triggered the response stage with continuing drought in the Colorado River Basin being the primary factor. Stage 1 was continued in years 2008-2010 based on staff’s annual assessments of regional and local indicators and water system indexes.

Based on the 2011 annual review of regional and local system indicators, it is recommended that a Stage 1 Drought Response be continued in the TW service area.

Stage 1 Response Measures and Actions Taken

TW’s Drought Preparedness and Response Plan includes four response stages, with Stage 1 Response being the least stringent in terms of restrictions on customers, with a focus on public education, and Stage 4 being the most stringent with significant water use restrictions as drought response measures.

The primary focus of Stage 1 response measures is to increase community awareness of drought and promote water use efficiency through continuation of TW’s conservation programs. A summary of the response measures for Stage 1 and the actions taken by the City follows in Table 1 on pages 14 and 15.

While many of the actions described are on-going programs of the TW Conservation office, some activities listed have both a water use efficiency goal as well as the specific focus of educating water customers to better prepare for potential future escalation of the City’s Drought Response Stage should drought impacts worsen.

Table 1: Stage 1 Drought Response Measures

Who the measure targets:	Drought Response Measure included in the adopted Drought Preparedness Plan for Stage 1:	Actions taken since original declaration of Drought Stage 1 in April 2007:
City of Tucson	<ul style="list-style-type: none"> Require City departments to monitor their own water use through self-audits and identify conservation potential outside of existing water-efficient practices. TW continues or accelerates ongoing operations such as well drilling and well maintenance and other system maintenance programs to reduce system losses (meter replacement, leak detection). 	<ul style="list-style-type: none"> TW and Office of Conservation and Sustainable Development (OCSD) staff received training on conducting indoor and outdoor water audits; completed in March 2011. TW and OCSD staff and a contracted water auditor completed 45 outdoor sites (parks) and 20 indoor City buildings. TW has expedited the meter replacement program. <i>Contractor will now identify conservation potential and upgrades on audited sites; create a database to track water savings and then re-audit after upgrades installed (Fall 2011 – Spring 2012).</i>
Residential Water Customers	<ul style="list-style-type: none"> Continue baseline conservation program (Appendix B). Public notification through local media and/or water bill inserts. Implement an education program designed to specifically address the drought situation and need for voluntary water reductions. 	<ul style="list-style-type: none"> Information on TW’s Drought Response stages has been included in the water bill inserts and in public presentations since 2008. A brochure on the City’s Drought Response Plan was completed in April 2011 to be used as a hand-out at public events. <i>Current projects include water-wise landscaping publications for distribution through local nurseries and development of a water conservation and water budget calculator through the TW Website (expected to be completed in the fall of 2011).</i>
Multi-Family Water Customers	<ul style="list-style-type: none"> Implement Stage 1 measures for residential customers and to include: Conducting voluntary self-audits and develop water budgets for possible exemptions from mandatory restrictions in Stage 2. 	<ul style="list-style-type: none"> Businesses receive a free water audit as part of the WaterSmart Business Certification Program (71 participants and 19 audits performed to date), and irrigation audits through the Irrigation Upgrade Rebate program (34 irrigation audits were performed during fiscal years 2010 and 2011). WaterSmart Business Certification Program includes training for property managers on conducting water audits and creating water budgets and provides incentives for future drought response stages.

Who the measure targets:	Drought Response Measure included in the adopted Drought Preparedness Plan for Stage 1:	Actions taken since original declaration of Drought Stage 1 in April 2007:
Commercial Water Customers	<ul style="list-style-type: none"> • Implement Stage 1 measures for multi-family customers and may include: • Encouraging customers to implement business-specific voluntary measures (Examples: encourage restaurants to serve water only upon request or ask plant nurseries to promote the sale of low-water-use vegetation). 	<ul style="list-style-type: none"> • The WaterSmart Business Program is marketed to the largest water users in this class of customers (those users exceeding 325 Ccf/month). • Approximately 5,500 “table tents” have been provided to the Arizona Restaurant Association for distribution to the 250 Tucson area members; table tents inform participating restaurants’ customers that water is served only on request. • <i>Development of hotel signage to educate Tucson visitors to be water efficient will be completed in Spring 2012.</i>
Industrial Water Customers	<ul style="list-style-type: none"> • Implement Stage 1 measures for commercial customers. 	<ul style="list-style-type: none"> • The programs listed for Commercial Water Customers target this class of water customers also.
Reclaimed Water Customers	<ul style="list-style-type: none"> • Continue customer education on efficient-water-use especially related to drought conditions. • Voluntary self-audits and developing water budgets to potentially gain exemptions from mandatory reductions in advanced drought response stages. • TW staff prepares a methodology to monitor wastewater treatment plant flows and calculate reclaimed water customer reductions for later drought stages if approved water budgets are not implemented. 	<ul style="list-style-type: none"> • <i>Development of a letter or educational information specifically targeting activities Reclaimed Water customers can do to better prepare for or respond to Drought Response Measures implemented by the City is expected in FY 2012.</i>

Drought and Climate Variability

In its October 2007 newsletter, the National Weather Service (NWS — part of the National Oceanic Atmospheric Organization, NOAA) defines climate variability as *a long-term shift in the statistics of the weather* (including its averages). The NWS states that the last decade of the 20th century and the beginning of the 21st century have been the warmest period since instrumentation began recording global temperatures in the mid-19th century.

Climate variability is normal, and large-scale climate changes have occurred in the Earth's past. But human-induced change also is a likely cause of the more recent climate shifts. Naturally occurring gases such as carbon dioxide and water vapor trap heat in the atmosphere. This is generally referred to as the greenhouse effect and these gases are often called “greenhouse gases”. The current level of these gases is the highest it has been in the past 650,000 years. Burning of fossil fuels such as oil, coal, and natural gas add carbon dioxide, as well as other greenhouse gases, to the atmosphere. The 2007 Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) stated most of the observed increase in the globally averaged temperature since the mid-20th century is very likely due to human-caused greenhouse gas concentrations.

In addition, the U.S. Global Change Research Program in its 2009 report “Global Climate Change Impacts in the United States” wrote that climate variability in the Southwest is among the most rapidly occurring in the nation, and is more than the global average in some areas. Climate variability in the Southwest is especially troublesome, the report states, because this region continues to lead the nation in population growth. One result has been a trend toward less spring snowpack and snowmelt to augment the Colorado River, a water resource the City of Tucson depends on.

Climate variability inevitably affects the environment over time. The increased sedimentation and turbidity from more intense flood events may cause reservoirs to become shallower, warmer, and more prone to the growth of biological organisms. These unwanted results may require planning for invasive species management (e.g., quagga mussels), protecting threatened and endangered species, and assuring water quality. These environmental concerns will also have impacts on people and their quality of life.

Although climate variability is normal, new understanding of its current implications from such credible sources as those mentioned above suggests it will likely be more severe in the future. These implications have been considered in recent planning efforts at Tucson Water, and will become formalized in the 2011 update to Tucson Water's *Drought Preparedness and Response Plan*.

The City of Tucson continues to prepare for the possibility of climate change. The Climate Change Advisory Committee, a group of citizen stakeholders, meets monthly to advance the City's readiness for climate change adaptation and mitigation. One of its principal functions is the development of a Climate Change Mitigation and Adaptation Plan for the City of Tucson.

Tucson Water is involved in regional climate-change studies coordinated through various universities, including the University of Arizona and Arizona State University. Tucson Water is a cooperator in a project known as “Knowledge to Action: An Assessment of the Transfer of Climate Science to Decision Making.” This program is funded by the Climate Program Office of NOAA. The University of Arizona is the principal investigator, and one of the products of the program will be a set of guidelines for integrating climate science with decision making.

In addition, Tucson Water is a workshop partner in “Planning for Climate Change through an Integrative Approach to Water-planning, Climate Downscaling, and Robust Decision-Making.” This effort is also aimed, in part, at making climate science accessible and useful for water utilities. Additional workshop partners include the U.S. Bureau of Reclamation, Arizona Water Institute, CLIMAS (University of Arizona), City of Phoenix, Central Arizona Project, Arizona State University’s Decision Center for a Desert City, and others.

Tucson Water has also begun the process of developing a “Climate Change Preparedness Plan” which will be integrated with Tucson Water’s existing Drought Preparedness and Response Plan. Within the past year, the Utility established a project team to coordinate with climate scientists, other water providers, and federal, state and local government agencies to articulate the practical resource and supply implications associated with climate change. The project team is comprised of representatives from pertinent areas of the Utility and also includes members from local government and climate science researchers at the University of Arizona. A critical goal of this project is the development of an *Integrated Drought Preparedness and Response/Climate-Change Adaptability Plan* for the Utility.

Working from the existing *Drought Preparedness and Response Plan*, the integrated plan will continue to be revised at a minimum of every five years as required by Arizona Revised Statute (A.R.S. §45-342) or as new information becomes available and planning factors and assumptions are revised. It is expected that the Utility will benefit from added flexibility and adaptive capacity to respond to climate-change uncertainties by integrating climate change preparedness into its planning and operational functions.

Ultimately, Tucson Water is integrating climate science into the broader water resource planning program. Much of the focus of Tucson Water’s planning efforts is intended to mitigate for future uncertainty, whatever the cause. To the extent that climate science can be applied to that goal, it will be an important tool for assuring the community of a sustainable water supply for the future.



Photo Tucson Mountains by Karen LaMartina



The *City of Tucson Drought Preparedness and Response Plan* and prior Annual Drought Reports can be found at: <http://cms3.tucsonaz.gov/water/drought-intro>

