

2006 Arizona Drought Preparedness Annual Report

DROUGHT HAPPENS



**...what Arizona is doing to be
DROUGHT READY**

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Executive Summary

Drought has affected Arizona for the last decade. In response to growing drought concerns, in March 2003, Arizona Governor Janet Napolitano appointed a Drought Task Force to produce a drought plan for Arizona. As a result of the Task Force's efforts, the *Arizona Drought Preparedness Plan (ADPP)* was developed and the Statewide Drought Program within the Arizona Department of Water Resources (ADWR) was created in late 2005 to coordinate implementation of the ADPP. ADWR's Statewide Drought Program, the State Drought Monitoring Technical Committee and Local Drought Impact Groups made significant progress in 2006 toward meeting the goals identified in the ADPP.

2006 Implementation Highlights

Statewide Drought Program

The Statewide Drought Program began implementation of drought planning requirements for community water systems in 2006. These requirements were created to ensure that the state's water providers reduce their vulnerability to drought impacts and are prepared to respond when drought occurs. Staff coordinated a significant multi-program, multi-agency effort to begin this process in 2006. ADWR has made steady progress on developing report forms, an online reporting tool, and guidance documents. Staff conducted workshops around the state to assist water systems with meeting the new requirements.

A second component of the Statewide Drought Program's work this year focused on education and outreach to raise public awareness about drought and drought preparedness in Arizona. Staff improved web site design, created fact sheets, and conducted workshops. In concert with ADWR's conservation programs, the Statewide Drought Program also promoted water efficiency technology transfer. Programs providing water efficiency technologies to businesses increased in popularity in 2006 and are expected to continue to grow in 2007 and beyond.

ADWR's Statewide Drought Program also began serving in its role as coordinator of the three groups created by the ADPP – the Monitoring Technical Committee, Local Drought Impact Groups and Interagency Coordinating Group. The activities of these groups are summarized below.

Monitoring Technical Committee

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. Throughout 2006, the Monitoring Technical Committee met monthly, closely monitoring the worsening drought conditions throughout the winter and spring months. 2006 activities of the Monitoring Technical Committee included:

- Monitoring and assessing drought conditions
- Producing monthly Drought Monitor Reports

- Briefing the Governor's Drought Task Force Interagency Coordinating Group on drought conditions
- Providing presentations and technical assistance to Local Drought Impact Groups

Local Drought Impact Groups

Since autumn 2005, the Statewide Drought Program has worked to establish Local Drought Impact Groups in three counties (Cochise, Pinal and Santa Cruz), with the others to follow in late 2006 and 2007. All three established Local Drought Impact Groups have set up workgroups within the larger Local Drought Impact Group. The workgroups will address local drought and mitigation response planning, education and outreach, and drought impact monitoring.

Interagency Coordinating Group

The Interagency Coordinating Group met three times during the past year. During these meetings, the group considered presentations on statewide monitoring efforts and drought status, water supply updates, rangeland conditions, forest health and wildlife. The group made the decision to recommend to the Governor that the current Drought Emergency Declaration be maintained. In addition, based on the recommendation of the Interagency Coordinating Group, the Statewide Drought Program put together a series of drought "talking points" for use when speaking to the public or the media about drought in Arizona.

Summary of Drought Conditions

October 2005 - March 2006

Conditions deteriorated as a weak La Niña episode developed causing record low winter precipitation and above-average temperatures. As a result, there was high vegetation stress and fire potential, decreasing water supplies, and deteriorating range and pasture conditions.

March 2006

Precipitation in March brought short-term relief to the drought conditions in the western and central parts of the state.

April – June 2006

Dry conditions resumed after the March rains and remained until June, when some scattered showers again brought slight relief to increasing drought conditions and high vegetation stress.

Late June – September 2006

Monsoon moisture brought ample precipitation to most of Arizona. Summer precipitation improved soil moisture, raised reservoir levels, reinvigorated grass growth, and increased groundwater levels in some locations.

Overall, the water supply for metropolitan Phoenix and Tucson is in good shape at the end of water year 2006. However, many parts of the state are still suffering from long-term precipitation deficits.

Resource Needs

Statewide Drought Program

The following resources are needed to improve drought monitoring, ADPP implementation and response. Funding is needed for:

- Coordination efforts in establishing Local Drought Impact Groups and facilitating drought preparedness activities at the local level
- Drought education
- Drought indicator and trigger tool for community water systems

Monitoring Technical Committee

The funding needs identified below relate directly to the goals of the plan to refine monitoring processes, understand drought impacts, and limit future vulnerability.

Funding is needed for:

- Snow, soil and meteorological monitoring stations
- An integrated hydrologic website and dynamic drought index decision support tool
- Evaluate, revise and update Arizona's drought indicators and triggers system
- Development of a strategic plan
- A drought impact reporting tool
- Incorporation of groundwater level trend data

Local Drought Impact Groups

Funding is needed for:

- An online reporting tool/database for drought impact reporting
- Drought monitoring supplies and training
- Drought education and educational materials

Other needs include:

- Legislation allowing municipalities and water companies to charge water impact fees during extreme drought status levels
- State lobbying and support for federal irrigated agriculture set-aside programs during drought conditions
- Legislation allowing counties to declare moratoriums on building permits or subdivision approvals based on extreme drought conditions

Recommended ADPP Changes

The ADPP provides an excellent foundation for drought planning in Arizona, and no major changes are proposed. All recommendations contained in this report are clarifications and minor procedural changes, such as a change from evaluating drought by climate divisions to evaluation by watershed, and the delegation of the Interagency Coordinating Group annual report writing to the Statewide Drought Program.

Chapter 1 - Introduction

Recognizing the urgent need for drought preparedness in Arizona, Governor Janet Napolitano issued an executive order and established the Governor's Drought Task Force in 2003. This Task Force developed the *Arizona Drought Preparedness Plan* (ADPP), establishing a flexible framework to refine drought monitoring processes, improve understanding of drought impacts, and determine mechanisms for limiting future vulnerability. The group also recommended funding for a Drought Coordinator and two staff persons to be located at the Arizona Department of Water Resources (ADWR).

The Statewide Drought Program was created at ADWR in November 2005. This report is an overview of drought preparedness activities for water year 2006 (October 1, 2005 - September 30, 2006). As recommended in the ADPP, this report includes recommendations to the Governor for improving drought monitoring, implementation and response. The ADPP is intended to be a living document that can be updated and modified to ensure the state's strategies are appropriate and adequate in addressing drought challenges.

The *2006 Arizona Drought Preparedness Annual Report* consists of the following components:

- Report from the Statewide Drought Program
 - Program Development and Plan Implementation Highlights
 - Recommendations for Improving Monitoring, Implementation and Response
 - General Plan Modifications
 - Resource Needs
- Report from Monitoring Technical Committee
 - Monitoring Committee Activities
 - Drought Monitoring Recap
 - Drought Outlook
 - Funding and Resource Needs
 - Recommendations for Revisions to the ADPP
- Report from Local Drought Impact Groups
 - Overview
 - Organizational Structure
 - County Local Drought Impact Group Updates
 - Drought mitigation and response efforts
 - Identification of needs
 - Recommended changes to the ADPP

ADWR's Statewide Drought Program, the State Drought Monitoring Technical Committee and Local Drought Impact Groups made significant progress toward meeting the goals identified in the ADPP. This report highlights the work that was accomplished this year and makes recommendations for improving and expanding the program into the future.

Chapter 2 – Statewide Drought Program Annual Report

PROGRAM DEVELOPMENT AND PLAN IMPLEMENTATION HIGHLIGHTS

The *Arizona Drought Preparedness Plan* outlines a strong program structure and collaborative solutions for implementing drought preparedness activities. Arizona has a proactive plan that emphasizes drought planning and preparedness, innovation and action. In late 2005, ADWR's Statewide Drought Program was created to implement the ADPP. The Statewide Drought Program provides statewide assistance for drought preparedness, mitigation and response. Arizona's drought program structure is being used as a model for other states nationwide.

The newly created Statewide Drought Program coordinates and implements drought preparedness activities and ensures that the state of Arizona is drought ready. Consisting of three full-time employees, the Statewide Drought Program is engaged in daily activities of coordination, outreach, and planning to ensure that the ADPP is implemented. Coordination with ADWR's Statewide Conservation Office and the regional Active Management Area conservation programs is essential to the implementation of the plan. The Statewide Drought Program takes a three-pronged approach to implementing the ADPP:

- 1. Coordination of three structured groups**
- 2. Drought planning for community water systems**
- 3. Education and outreach**

Each of the approaches is explained in detail below.

1. Coordination of Three Structured Groups

First and foremost, the Statewide Drought Program coordinates three groups to implement the ADPP – Monitoring Technical Committee, Local Drought Impact Groups (a.k.a. Local Area Impact Assessment Groups) and Interagency Coordinating Group.

Monitoring Technical Committee

A scientific working group that assesses drought status and impact information provided by citizens, and disseminates information to the public

During the year, the Statewide Drought Program met regularly with the Monitoring Technical Committee to produce monthly drought status maps and Drought Monitor Reports. The Monitoring Technical Committee is made up of hydrologists and climatologists representing local, state and federal agencies and organizations. This group is tasked with monitoring current drought conditions, forecasting future conditions, and communicating that information to resource managers, decision-makers and the public. ADWR relies on this committee for their technical expertise in drought and climate science.

- **Drought Status Maps**
Each month, the Monitoring Technical Committee calculates drought status for each surface watershed in the state using precipitation and streamflow data.

Drought status maps are developed to display statewide drought status – both short term and long term. To provide a “reality check” for the calculated drought status, the Committee also consults vegetation indices, snowpack, temperature, reservoir levels, and drought impacts information before approving the final drought status map.

- **Drought Monitor Report**
The Statewide Drought Program compiles the drought status maps, “reality check” data, and a weather outlook into monthly Drought Monitor Reports. These reports serve as an information resource for the public and as a planning tool for resource managers developing mitigation and response strategies. Throughout the past year, the Statewide Drought Program has worked on redesigning the monthly drought report to improve clarity and now posts the reports online.

For more detailed information, please refer to the *Monitoring Technical Committee Annual Report* (Chapter 3).

Local Drought Impact Groups

County-level citizen groups, coordinated by local representatives of Arizona Cooperative Extension and County Emergency Management, established to develop public awareness about drought, provide impact information, and develop local mitigation and response options

Since autumn 2005, the Statewide Drought Program has coordinated establishment of Local Drought Impact Groups in three of Arizona’s 15 counties – Cochise, Pinal and Santa Cruz. The Program is currently working with Pima and Yavapai County, with Graham, Greenlee and Apache counties next on the agenda. These citizen groups have three major roles:

- reporting local, on-the-ground drought impacts to the Monitoring Technical Committee so that members can more accurately understand and report drought conditions throughout the state
- developing drought mitigation and response strategies tailored to their region’s specific needs to reduce the impact of drought to water users
- educating the public on drought and wise water management

Southeastern Arizona’s Cochise County, the part of the state then most affected by drought, was the first group established and has developed the Local Drought Impact Group model for the rest of the state. Cochise County and others to follow have formed three workgroups – Outreach and Education, Monitoring and Mitigation, and Response.

Throughout the year, the Statewide Drought Program and members of the Monitoring Technical Committee provided technical assistance by presenting information on the ADPP, drought preparedness and climate science. For more detailed information, please refer to the *Local Drought Impact Group Annual Report* (Chapter 4).

Interagency Coordinating Group

An advisory group, comprised of representatives of state, federal, tribal, and non-governmental organizations, that directs state mitigation and response actions and makes recommendations to the Governor regarding ADPP implementation and resource needs

Lastly, the Statewide Drought Program provides direction and recommendations to the Interagency Coordinating Group. The Interagency Coordinating Group's roles are as follows:

- Direct state agency action
- Identify needs for additional resources with input from the Monitoring Technical Committee and Local Drought Impact Groups
- Advise the Governor on drought action
- Review the ADPP and make recommendations for improving monitoring, implementation and response

The Interagency Coordinating Group met three times during the past year, in February, April and October 2006. During these meetings, the group heard presentations on statewide monitoring efforts and drought status, water supply updates, rangeland conditions, forest health and wildlife. The group then considered the information and made the decision to recommend to the Governor that the current Drought Emergency Declaration be maintained.

Furthermore, based on the recommendation of the Interagency Coordinating Group, the Statewide Drought Program put together a series of drought "talking points" (see **Appendix B**) for use when speaking to the public or the media about drought in Arizona. These talking points will provide a starting point for the development of a more comprehensive, interagency communications plan.

2. Drought Planning for Community Water Systems

The Statewide Drought Program is responsible for implementing a new program designed to assist community water systems with drought planning requirements. This was one of the Statewide Drought Program's major tasks this year. These new drought planning requirements were recommended in the ADPP and were adopted through passage of House Bill 2277. This legislation, now established in state statutes, has two goals:

- Reduce community water systems' drought vulnerability and ensure preparedness for drought mitigation and response
- Allow the state to gather water use data to provide drought planning assistance and target assistance efforts to those water providers with the greatest need

Community water systems are now required to complete Annual Water Use Reports and System Water Plans. The Annual Water Use Report will be submitted each year and include information on water pumped or diverted, water received, water delivered to

customers, and effluent used or received. The System Water Plan will be updated and submitted every five years and will consist of three components - Water Supply Plan, Drought Preparedness Plan and Water Conservation Plan.

To implement the new water system requirements, the Statewide Drought Program coordinated a significant multi-program, multi-agency effort. The Arizona Department of Environmental Quality, Arizona Corporation Commission, and ADWR's Active Management Area Program, Adequate Water Supply Program and Statewide Conservation Office all contributed to a successful start-up. ADWR has also made steady progress on developing an online tool that will allow water systems to submit their Annual Water Use report via the internet. This tool is being funded through a grant from the U.S. Bureau of Reclamation.

The Statewide Drought Program conducted a major outreach effort to ensure that water systems were aware of and understood their new requirements. Sixteen community water system workshops were provided across Arizona in 2006 with more than 200 people in attendance. Statewide Drought Program staff also developed a guidance document and form to assist water systems in preparing their System Water Plans.

3. Education and Outreach

Much of the Statewide Drought Program's responsibilities focus on educating the public. Several times throughout the year, the Statewide Drought Program conducted education and outreach efforts to increase public awareness of drought preparedness and ADPP implementation.

Web Site (www.azwater.gov/dwr/drought/)

The Statewide Drought Program web site was created to provide one-stop shopping for Arizona drought information and assistance. Current content includes information on the following:

- Community water systems – guidance documents and forms
- Local Drought Impact Groups – pages for each county to post meeting announcements, accomplishments and other information
- Monitoring Technical Committee – monthly drought status maps and Drought Monitor Report
- Interagency Coordinating Group – updates on drought impacts from government and agency perspectives
- Resources – links to materials on low water use plants and other valuable resources

Fact Sheets

Fact sheets on drought preparedness, community water system requirements and other programs have been developed to help educate the public. These fact sheets were distributed at meetings, conferences, and workshops to help educate the various audiences. **Appendix A** contains a copy of these fact sheets.

Presentations

The Program attended various conferences throughout the year to present information on the Statewide Drought Program and ADPP. During 2006, the Statewide Drought Program presented information at the following conferences:

- Arizona Hydrological Society, 2006 Annual Symposium - *Water & Water Science in the Southwest – Past, Present, & Future*
- Pinal County Board of Supervisors Meeting
- Arizona Association of Conservation Districts
- Arizona Water & Pollution Control Association
- Pima County Drought Task Force
- County Supervisors Association of Arizona
- *Managing Drought and Water Scarcity in Vulnerable Environments: Creating a Roadmap for Change in the United States* conference

A poster presentation was developed for the Geological Society of America's drought conference in Longmont, Colorado. The presentation was created in coordination with the Climate Assessment for the Southwest (CLIMAS) to highlight the ADPP, the roles of the various committees, and drought planning accomplishments in Arizona.

Workshops

The Statewide Drought Program held workshops during the winter and spring of 2006 to provide information on the community water system requirements associated with community water system planning and reporting requirements legislation that was passed in 2005.

Technology Transfer

In concert with ADWR's conservation programs, the Statewide Drought Program is promoting technology transfer. The following water efficiency programs, developed and initiated by the ADWR's Statewide Conservation Office, are designed to provide people with the knowledge to make wise water management decisions and tools to implement water management strategies:

- Rinse Smart
This spray-valve replacement program for restaurants is a component of ADWR's Statewide Conservation Strategy, developed by the Governor's Drought Task Force. The Task Force called for the use of best available technologies to attain water efficiency. Preliminary tests indicate a 40% water savings, or an estimated 50,000 gallons saved per year for a small restaurant.
- Leak Detection Program
With funding now in place from the Bureau of Reclamation, state-of-the-art equipment will be purchased and loaned out to community water systems around the state to detect leaks. Since most utilities report unaccounted losses at 10-20% annually, the Leak Detection Program should result in substantial water savings.

Interviews and Nationwide Assistance

The University of Nebraska and University of Washington conducted research related to drought planning and contacted the Statewide Drought Program for background

information on the ADPP and implementation. During the interviews, the Statewide Drought Program provided information on the State Drought Monitoring Technical Committee and Local Drought Impact Group structure. Based on the information provided during the University of Nebraska's interview, the National Drought Mitigation Center is using Arizona's framework to develop guidelines to assist states with the collection and reporting of drought impact information.



RECOMMENDATIONS FOR IMPROVING MONITORING, IMPLEMENTATION AND RESPONSE

Monitoring

ADWR supports the recommendations of the Monitoring Technical Committee. Refer to the *Monitoring Technical Committee Annual Report* (Chapter 3) for detailed information regarding recommendations to improve monitoring. Recommendations from the Monitoring Technical Committee relate directly to the goals of the plan to refine monitoring processes, understand drought impacts, and limit future vulnerability.

Implementation and Response

The only change related to implementation and response is the shift from climate divisions to watersheds. As stated in the ADPP, drought status was to be calculated by climate divisions. The climate division boundaries frequently split watersheds, separating precipitation from associated streamflow and groundwater. Throughout the course of the year, the Monitoring Technical Committee determined that it was more meaningful from a hydrologic standpoint to calculate short-term and long-term drought status on a watershed basis rather than by climate division. Calculating drought status on a watershed scale should improve integration and analysis of precipitation, surface water and groundwater data. Additionally, in most cases the watersheds are smaller than the climate divisions, providing higher spatial resolution.

GENERAL PLAN MODIFICATIONS

Several general plan modifications are recommended to improve the ADPP:

Additions:

- *Clarify different ways of defining drought*
Information will be added on the different ways of measuring and defining drought and their relationship to one another. Specifically, it is important for the public to understand that the drought stages that each water system develops should be specific to the system and based on *water supply availability*. However, the drought stages determined in the Monitoring Technical Committee's monthly Drought Monitor Reports are based on meteorological conditions as well as impact information such as vegetation health and reservoir levels. The ADPP should make these distinctions clear.
- *Explain drought impact data use and data transmission*
An explanation of how drought impact data will be used and how data should be transmitted will be added. The additional information will help Local Drought Impact Groups and state and federal entities understand the methods of submittal and the beneficial uses of the data.
- *Define declarations and designations*
Declarations and designations will be defined in the ADPP. The purpose of each and the Interagency Coordinating Group's and Monitoring Technical Committee's roles in recommending these to the Governor will be explained.

Clarifications:

- Reporting mechanisms – Annual Report & Drought Monitor Report
 - Annual Report
The ADPP states that the Interagency Coordinating Group should review the ADPP and make recommendations for improving monitoring, implementation, and response, based on information from the Monitoring Technical Committee and the Local Drought Impact Groups. The ADWR Statewide Drought Program will instead assume the responsibility of developing the annual report each year. It is not practical to have the Interagency Coordinating Group submit an annual report when the Statewide Drought Program has the staff to do the work. However, the Interagency Coordinating Group will continue to play an important role in making recommendations and providing feedback on the yearly report.
 - Drought Monitor Report
References to notification of changes in drought status, climate status updates and climate condition reports will be revised to reflect current operating procedures. The monthly Drought Monitor Report emailed each month to the Interagency Coordinating Group provides this notification and satisfies the requirements of the plan. The plan should state that ADWR and

the Monitoring Technical Committee will provide the Drought Monitor Report each month as notification of changes in drought status and climate conditions. A separate notification is not needed.

- **Locally defined mitigation & response**
More explanation will be added to clarify that mitigation and response strategies are locally defined to correspond with drought impacts and drought status maps delineated by watershed.
- **Level of drought stages (watersheds)**
The ADPP will be modified to clarify that drought status, or the stage of drought, is calculated on a watershed basis.

Clarifications will be made throughout the ADPP; any references to the above listed items will be modified as needed, including Appendices.

Change:

All references to Local Area Impact Assessment Groups will be changed to Local Drought Impact Groups. The new name for these county-based groups is more descriptive of the goals and objectives of the groups.



RESOURCE NEEDS

Many resource needs have been identified. In 2006-2007, the Statewide Drought Program, in coordination with the Interagency Coordinating Group, Local Drought Impact Groups and Monitoring Technical Committee, will take action to prioritize and identify funding sources. The following resources are needed to improve monitoring, implementation and response:

Local Drought Impact Groups - \$52,500 (pass through funds)

Funding is needed for coordination efforts (University of Arizona Cooperative Extension, county emergency management, Natural Resources Conservation Districts, etc.) in establishing Local Drought Impact Groups. The Statewide Drought Program requests \$3,500 for each county to initiate and facilitate drought preparedness activities at the local level. The following activities will take place over the next year:

- Providing technical expertise in the form of presentations, meetings, consultations
- Organizing and coordinating meetings
- Developing and sending meeting notices
- Developing meeting notes, presentations and handouts
- Conducting drought outreach and education (see **Drought Education** below)

Drought Education - \$37,500 (pass through funds)

In coordination with the Local Drought Impact Group in each county, funding is needed to provide drought education. The following activities will take place:

- Holding informational meetings on:
 - Local drought impact groups
 - Local drought monitoring efforts
 - Drought monitoring tools available on the Internet
- Conducting workshops for local residents to organize local drought monitoring and planning efforts
- Convening other meetings, technical sessions, and educational outreach activities on drought
- Making materials available or creating displays for the public

Drought Indicator & Trigger Tool for community water systems - \$50,000

A drought indicator and trigger tool is needed for community water systems to use for drought planning purposes. This tool would assist water systems in meeting the requirements outlined in the community water system planning and reporting legislation. The tool will guide local water providers in analyzing their own data with respect to local climatological information and help them develop action plans based on relevant, local data.

Support resource needs of the Local Drought Impact Groups

Each of the Local Drought Impact Groups was asked to identify resource needs, whether legislative or financial, to ensure a sustainable drought planning process and to address the impacts and vulnerabilities within their counties. The Statewide Drought

Program supports the resource needs identified by the Local Drought Impact Groups in the *Local Drought Impact Groups Annual Report* (Chapter 4).

Support resource needs of the Monitoring Technical Committee

The Statewide Drought Program supports funding the recommendations for improving monitoring, identified by the Monitoring Technical Committee in the Funding and Resource Needs section of the *Monitoring Technical Committee Annual Report* (Chapter 3).



Chapter 3 – Monitoring Technical Committee Annual Report

MONITORING COMMITTEE ACTIVITIES

2006 was a year of action for the Arizona Drought Monitoring Technical Committee (hereafter referred to as the “Committee”). Committee members met monthly, closely monitoring the worsening drought conditions throughout the winter and spring months. As the monsoon season progressed, bringing wetter-than-average conditions, the group worked to monitor improvement and determine what impacts still lingered. Although the summer rains brought short-term relief to much of the state, long-term impacts remain a concern. Following is a summary of the Committee’s activities in 2006:

- Compiled data on precipitation, streamflow, temperature, reservoir levels, and vegetation health to assess drought conditions
- Produced monthly drought monitor reports that assessed current conditions and made forecasts for the coming months
- Began posting reports online to provide better access to resource managers and the public
- Improved the clarity and design of the reports
- Expanded its membership to include representatives of the National Weather Service Tucson Weather Forecast Office, Arizona State Land Department, Arizona Meteorological Network (AZMET), and additional specialists from the United States Geological Survey (USGS) and the Arizona Department of Water Resources (ADWR)
- Briefed the Governor’s Drought Task Force Interagency Coordinating Group (ICG) on drought conditions
- Provided numerous presentations and technical assistance to the Cochise, Santa Cruz, and Pinal County Local Drought Impact Groups (LDIGs)
- Presented the Committee’s activities at several technical conferences and workshops as well as via interviews with the media

Innovations, Improvements, Changes

Drought Impact Analysis

During Water Year (WY) 2006, Committee members worked closely with staff from the Statewide Drought Program at ADWR to begin establishing LDIGs, as called for by the *Arizona Drought Preparedness Plan (ADPP)*. These citizen groups will be essential in reporting local, on-the-ground drought impacts to the Committee so that members can more accurately understand and report drought conditions throughout the state.

Committee members and Statewide Drought Program staff worked with stakeholders in Cochise County to develop and refine a drought impact report form and prototype web site for impact data collection.

In WY 2007, the Committee will have sufficient capability to review monthly drought impact reports from counties that have formed LDIGs. In 2007, the Committee plans to consider raw drought impact data and use it as a subjective measure to verify calculated drought status for the monthly Drought Monitor Reports. Pending the necessary funding (see **Funding and Resource Needs** section), the Committee anticipates a multi-year process of developing an online reporting tool and refining

methods for evaluating impact information. The goal is to develop a system for assimilating and displaying this information in the monthly Drought Monitor Reports. The Committee will collaborate with the National Drought Mitigation Center (NDMC) on developing protocols for combining qualitative (impact) and quantitative drought status information. NDMC views Arizona's work as a possible model for the nation.

Watershed-based Drought Analysis

Both short-term and long-term drought status are now calculated on a watershed basis rather than by climate division. The climate division boundaries frequently split watersheds, separating precipitation from associated streamflow and groundwater. Climate divisions made sense for the rapid implementation of Arizona drought monitoring, because climate division data are easy to access and temporally complete. However, Arizona's climate divisions are based on aggregations of single or multiple counties, with no clear connection to climate or hydrology. They are based on a time-varying set of meteorological stations, and they are very cumbersome for calculation of surface streamflow.

Calculating drought status on a watershed scale is more meaningful from both the resource management and hydrologic perspectives. Resource managers in rural Arizona, as well as water providers and managers, are familiar with watershed hydrological units. Moreover, by using surface watersheds, the Committee is able to use a stable set of monitoring stations as well as enhance the spatial resolution of drought depiction. The Committee believes that watershed-based analyses should improve integration and analysis of precipitation, surface water and groundwater data for drought status calculation.

Stream Gage Analysis

Committee members representing the USGS have initiated a rigorous evaluation of streamflow gages used for drought monitoring, with the goal of better classifying the timescale of drought information associated with each gage. Streamflow provides a valuable drought perspective that incorporates precipitation, infiltration, water table interactions and vegetation dynamics. However, these processes cause lag times of varying lengths from the beginning of a precipitation event to a stream response. The stream gage analysis project will allow the Committee to assign certain streamflow gages to characterize short-term drought and others to characterize long-term drought.

Lag Changes

The analytical program used to determine drought status for each watershed incorporates a "lag" time to prevent sudden changes in drought status. The Committee removed the 4-month lag requirement from the short-term drought status calculation, based on preliminary analyses that showed poor agreement between short-term drought status depiction and qualitative assessment of on-the-ground conditions.

Drought Trigger and Indicator System Sensitivity Analysis

Pending the necessary funding (see **Funding and Resource Needs** section), the Committee will conduct an analysis of the drought indicator and trigger system used to calculate drought status.

Groundwater Monitoring

Committee members representing ADWR initiated development of a program for improved groundwater monitoring for drought status evaluation. The program includes systematic inventory and evaluation of groundwater monitoring wells, identification of index wells specifically for drought monitoring, as well as instrumentation of wells for real-time reporting in areas of special concern. Pending the necessary funding (see **Funding and Resource Needs** section), ADWR expects to contribute experimental groundwater assessments to the Committee monthly drought status reports during WY 2007.

Statewide Drought Program Web Site Improvements

Improving the accessibility of drought information to resource managers, state decision-makers and the public is a primary goal of the Committee and Statewide Drought Program. The Committee will continue to work with the Statewide Drought Program to improve the drought-related information and links on the Statewide Drought Program web site. The Committee will also work with developers of the Arizona Hydrologic Information System to incorporate and integrate drought data and decision-support tools (such as the LDIG drought impact reporting system) into a one-stop suite of products, as requested by Arizona stakeholders and Cochise County LDIG members. LDIG members are particularly concerned about having an efficient means to report drought impacts, view drought information, and access drought data, without spending inordinate amounts of their volunteered time and effort trolling through multiple web sites.

Expansion of the Committee and Data Collection Network

As recommended in the ADPP, the Committee will improve drought status reporting through the following actions:

- Renew its invitation to Arizona Indian tribes and nations to participate in monitoring activities
- Formally invite the National Weather Service Flagstaff Weather Forecast Office and Northern Arizona University to participate in monitoring to improve coverage in the northern third of the state
- Expand drought impact data collection through the ICG and its constituent agencies

Strategic Plan to Identify Data Gaps and Monitoring Needs

Arizona can improve the accuracy of monitoring and early drought detection by putting in place a comprehensive observation network. Implementation of the National Integrated Drought Information System (NIDIS) will open up funding opportunities to do this. To be prepared to respond rapidly to NIDIS and other funding sources as they become available, the Committee will develop a strategic plan for expanding and enhancing Arizona's drought observation network. Pending the necessary funding (see

Funding and Resource Needs section), the plan will enumerate key variables and locations, establish priorities for bringing new observing sites online, quantify implementation and maintenance costs, and identify funding opportunities. The Committee will establish priorities based on science and benefit-cost analysis.



DROUGHT MONITORING RECAP

Overall Drought Status

WY 2006 was a year of contrasts in Arizona. WY 2006 began in October 2005, with warmer than average temperatures and little precipitation. Between October 2005 and March 2006, conditions deteriorated as a weak La Niña episode developed in the Pacific Ocean. La Niña brings reliably dry winters to Arizona. Many Arizona locations logged record low winter precipitation, exceedingly low snowpack, above-average temperatures, and low soil moisture. These hydroclimatic conditions led to high vegetation stress, high fire potential, decreasing water supplies, and deteriorating range and pasture conditions. Between mid-October and mid-March, Phoenix experienced a record string of days with no precipitation.

Beneficial precipitation in March brought short-term relief from drought conditions in the western and central parts of the state, which alleviated the drying trend somewhat and greatly delayed a much anticipated serious fire season. However, dry conditions resumed after the March rains and remained until June, when some scattered showers again brought slight relief to increasing drought conditions and high vegetation stress.

Finally, beginning in late June, a monsoon moisture surge brought ample precipitation to most of Arizona; areas not receiving much summer precipitation were western Arizona (Mohave, La Paz, Yuma Counties) and northeastern Arizona (northern Navajo and Apache Counties). Parts of Arizona flooded, and erosion rates were high due to drought-induced vegetation losses from fire and dieback of perennial shrubs. Nevertheless, the summer precipitation improved soil moisture, raised reservoir levels, reinvigorated grass growth, and increased groundwater levels in some locations. However, at present, many parts of the state are still suffering from long-term precipitation deficits, and storage in the Colorado River reservoirs decreased during WY 2006.

The table below summarizes drought monitoring results for WY 2006. See **Appendix C** for a sample Drought Monitor Report, including a list of Committee members.

Indicator/Impact	Water Year 2006 Summary
Precipitation	Winter 2005-06 precipitation was well below average, especially during the months of November and December, when snowpack should be building in the mountain watersheds. March precipitation produced the only major snowfall for the winter of 2006. The dry conditions continued until the monsoon rains began in June, producing above-normal precipitation for most of the state. Overall, precipitation for the year was below average; statewide, WY 2006 ranked as the 24 th driest in 111 years of record.
Streamflow	Streamflow declined from December through June. Despite some limited relief during the spring months, dry soils prevented much of the snowmelt runoff at higher elevations from reaching the tributaries of major rivers. After the summer monsoon rains, the

	majority of gages indicated a return to normal streamflow conditions.
Temperature	Temperatures during water year 2006 were above average, between the 75 th and 95 th percentile.
Reservoir Storage	After a very dry 2005-06 winter, reservoir storage began to increase slightly during the late spring/early summer, but began falling again through the summer months. A relatively wet summer helped to keep the Salt and Verde River reservoirs at 125% of average (66% of capacity) and 105% of average (50% of capacity), respectively, by the end of the water year. Although Colorado River reservoirs are only at 53.5% of capacity, there is no imminent threat of reservoir storage dropping to shortage status.
Vegetation Health	Due to the above-average 2004-05 winter moisture, vegetation health was in good condition at the beginning of WY 2006. By late autumn, vegetation health had deteriorated and continued to exhibit substantial stress. Vegetation stress reached a maximum during mid-May to early June. Monsoon precipitation during the summer months improved soil moisture and reinvigorated grass growth, though other types of vegetation will take longer to recover.

Urban-area Drought Summary

Dry conditions were extreme during the winter of 2005-2006 and included a record run of days without precipitation at the National Weather Service first order observing station at Sky Harbor Airport. However, the water supply for metropolitan Phoenix is in good shape at the end of WY 2006. A wet 2004-2005 winter raised levels in the Salt and Verde River watershed reservoirs, and despite some draw down in reservoir levels during water year 2006, a relatively wet summer helped to keep the Salt and Verde River reservoirs at 125% of average (66% of capacity) and 105% of average (50% of capacity), respectively, by the end of the water year. Although Colorado River reservoirs are only at 53.5% of capacity, there is no imminent threat of reservoir storage dropping to shortage status. Moreover, groundwater levels increased this summer at two-thirds of unofficial drought monitoring wells in the Phoenix metropolitan area.

Tucson suffered through a dry winter and spring, but received copious summer precipitation and notable flooding. Unofficial drought monitoring wells in the southern Tucson basin showed increased groundwater levels following the August storms. The appearance of large mammals (e.g., bears) at the urban fringe and even near the airport appeared to be an interesting delayed effect of winter/spring drought in Tucson. The food supplies for these animals dwindled during the dry winter and spring months; thus, they moved to lower elevations to find food as the summer progressed.

Drought Indicators and Impacts in detail

Overall Precipitation

Precipitation over the past year has been below the long-term average. Almost all areas of the state have had precipitation below the 25th percentile over the last 12 months; percentiles in the southeast region of the state were higher, ranging from the 25th to the 40th percentiles, mostly due to the extremely wet monsoon.

Winter precipitation was well below average, and the precipitation that did fall all came near the end of the season. Spring precipitation in March brought limited relief, but dry conditions returned through April, May and some of June.

The summer precipitation was above average for many areas of the state; however, it was characterized by a few extreme events, leading to widespread flooding in the southeast and central portions of the state. At Alpine, in the White Mountains, the rainfall total for July and August was 13.78 inches, or nearly twice the normal of 7.90. In southeast Arizona, many mountain stations reported very heavy precipitation, with 14.95 inches of rain at Coronado National Monument in the Huachuca Mountains in the month of July alone.

Still, heavy monsoon rainfall was not nearly enough to compensate for the extremely dry winter at most locations across the state. The extreme variability of the precipitation, both summer and winter, is not unusual in this desert climate, and should be expected for the future as well. The extremely wet WY 2005 appears to be the anomaly in a persistent pattern of drought statewide.

Mountain Precipitation

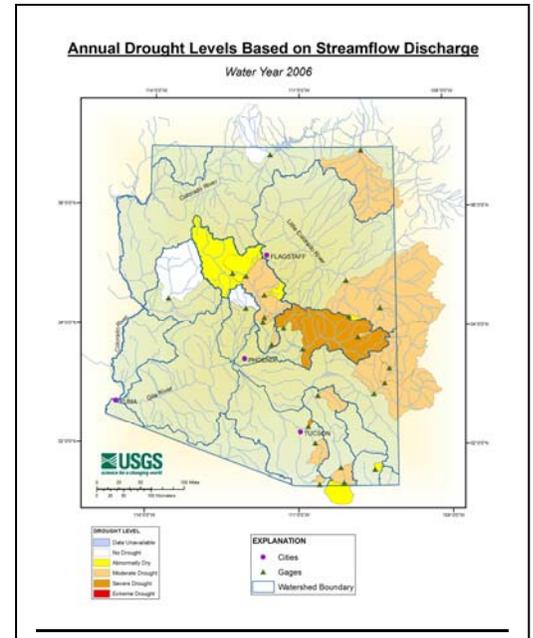
Mountain precipitation for the five-month period October 1, 2005 to February 28, 2006, was well below average in the Salt, Verde, Gila, San Francisco, and Little Colorado River basins. October was generally dry with only three of the Natural Resources Conservation Service's (NRCS) 15 SNOTEL (SNOWpack TELemetry) monitoring sites reporting above average precipitation. November and December were extremely dry, especially at a time when snowpacks should be building in the mountain watersheds.

March precipitation produced the only major snowfall for the winter of 2006, with ten to 30 inches of snowfall throughout the basins. Unfortunately, dry soils prevented much of the snowmelt runoff from reaching the tributaries of major rivers. Although the summer monsoons brought above-average precipitation, cumulative precipitation for the 2006 water year remained below average in all basins, as measured at SNOTEL and other high elevation gages:

<i>River basin</i>	<i>% of 30-year average precipitation at high elevation gages</i>
Salt River	71
Verde River	62
San Francisco-Upper Gila Rivers	89
Little Colorado River	70

Overall Streamflow

The commencement of the 2006 water year began with streamflow gaging stations reflecting the whole range of drought levels across the state, but with very few locations showing “Extreme Drought.” As streamflows continued to decline from December through February, basins began to reflect greater drought severity. By the end of February, only one gage was showing “No Drought.” As the year progressed, streamflow-based drought levels tended to center around “Moderate Drought” and “Severe Drought.” Streamflow-based drought levels reached their greatest severity in June when observations at eleven streamflow gages corresponded with the “Extreme Drought” Arizona drought trigger designation. The month of June has historically been an uneventful month for precipitation, but June 2006 was particularly dry. As monsoon precipitation began to fall throughout the state and especially in southern Arizona at the end of June, an immediate shift in drought levels took place. Starting in July and continuing into September, the majority of observed streamflows at selected drought monitoring gages corresponded to the “No Drought” trigger designation.



Typically, winter runoff is far greater than summer runoff. Only nine times in history has runoff from summer storms surpassed the total runoff produced by the previous winter’s snow in the Salt and Verde Basins. However, this year the opposite was true:

For the Salt, Tonto and Verde Rivers:

- Total streamflow volume Jan-May was 121,400 acre feet.
- Total streamflow volume Jul-Sep was more than double that amount -266,840 acre feet.
- August streamflow volume alone was 175,135 (more than the winter total) .
- The Salt River alone produced 149,165 acre feet, more than all three of the above streams produced during the winter.

Information obtained from Dallas Reigle, Salt River Project

Mountain Streamflow

Observed mountain streamflow levels for October and November 2005 were well below the 30-year median in most basins. December flows remained very low in response to extremely dry conditions throughout the region. Observed streamflow levels during the five month period January-May 2006 were also well below the 30-year median for major rivers in Arizona, as shown in the table below. The low flows during this particular time

period are especially significant, since in Arizona, the majority of the total annual runoff from snowmelt to streams typically occurs during this time.

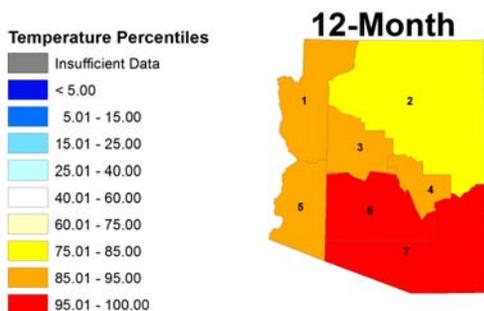
Stream/river	Percent of 30-year median streamflow
Salt River near Roosevelt	14
Verde River above Horseshoe Dam	28
Tonto Creek above Gun Creek near Roosevelt	6
San Francisco River at Clifton	20
Gila River at head of Safford Valley	20
Gila River at Calva	12
Little Colorado River at Lyman Lake	11 (Jan. – June)

The monsoon brought relief with abundant precipitation from late June through September, although the amounts were variable from basin to basin. While the Gila River at Calva ran at 810 percent of median in July, Tonto Creek ran at only nine percent of median. However, most streams remained above median levels through September.

Temperature

For WY 2006, the temperatures have been above the 75th percentile relative to the 112-year record in all areas of the state. In the southern and southeastern areas, temperatures have been above the 95th percentile over the last 12 months.

Higher than normal temperatures increase the demand for water by increasing evaporation, and by lengthening the growing season. Longer growing seasons mean more landscape watering and greater plant transpiration. For rangeland and forests, the higher temperatures lead to greater plant stress when precipitation and soil moisture are insufficient to meet the increased demand. Combinations of elevated temperature, low soil moisture, and high plant stress were associated with lowered resistance to disease and insects during the massive die-off of conifers just a few years ago. Warmer temperatures may also raise the elevation at which mountain precipitation falls as snow, which can reduce snowpack.



Temperature percentiles September 2005 - August 2006

Reservoir Storage

Reservoir storage usually peaks during the late spring or early summer and declines until replenished by melting snow the following spring. This held true in WY 2006, until substantial mid-summer precipitation increased levels in some in-state reservoirs following the early summer decline. Arizona hydrologists noted the late summer storage increases in the Salt, Verde, San Carlos, and Lyman Lake reservoirs as unusual. In the case of San Carlos Reservoir, used chiefly for flood control, storage increased by 16% from the end of July to the end of September.

Despite these increases, overall storage decreased in all of Arizona's in-state and Colorado River reservoirs since the beginning of 2006. As of September 19, 2006, the combined storage in Lake Mead and Lake Powell was 51.2% of total capacity; Mead and Powell began WY 2006 at 53.8% of capacity. Storage in Lake Havasu and Lake Mohave did not change appreciably over the course of WY 2006, due to reservoir management practices in order to meet water delivery obligations to irrigators and others.

Reservoir		Low (Date)		High (Date)		Current
	Storage (1000 af)	Percent of Capacity	Storage (1000 af)	Percent of Capacity	Storage (1000 af)	Percent of Capacity
Powell	10,704	44% (4/1/06)	11,939	49% (10/1/05)	11,930	49% (9/19/06)
Mead	13,930	53% (9/19/06)	15,337	59% (4/1/06)	13,930	53% (9/19/06)
Salt River System	1,325	65% (8/1/06)	1714	85% (10/1/05)	1,379	68% (9/19/06)
Verde River System	125	43% (8/1/06)	165	58% (10/1/05)	140	49% (9/19/06)
San Carlos	74	8% (8/1/06)	232	26% (8/1/06)	213	24% (9/19/06)
Lyman	5	15% (8/1/06)	8	27% (5/1/06)	6	21% (9/19/06)

Vegetation Health

Statewide vegetation health was measured through satellite imaging. Values referred to below are relative to the long-term average of satellite vegetation health index from the National Oceanic and Atmospheric Administration. Note that the satellite measurements used by the Committee cannot distinguish between trees, shrubs, and grasses – thus some of the conditions described below may not apply to all classes of vegetation. Satellite-measured vegetation health typically follows the seasonal cycle, with some autumn stress, winter dormancy, a strong alleviation of stress during the spring green-up period, pre-monsoon stress, and summer green maximum.

At the beginning of WY 2006, vegetation health was good in western Arizona (in response to well above-average winter 2004-05 moisture), and poor-to-fair in eastern Arizona. Vegetation health deteriorated considerably by late autumn, and by the end of December 2005, vegetation throughout southern Arizona exhibited substantial stress, whereas northern Arizona showed fair vegetation condition.

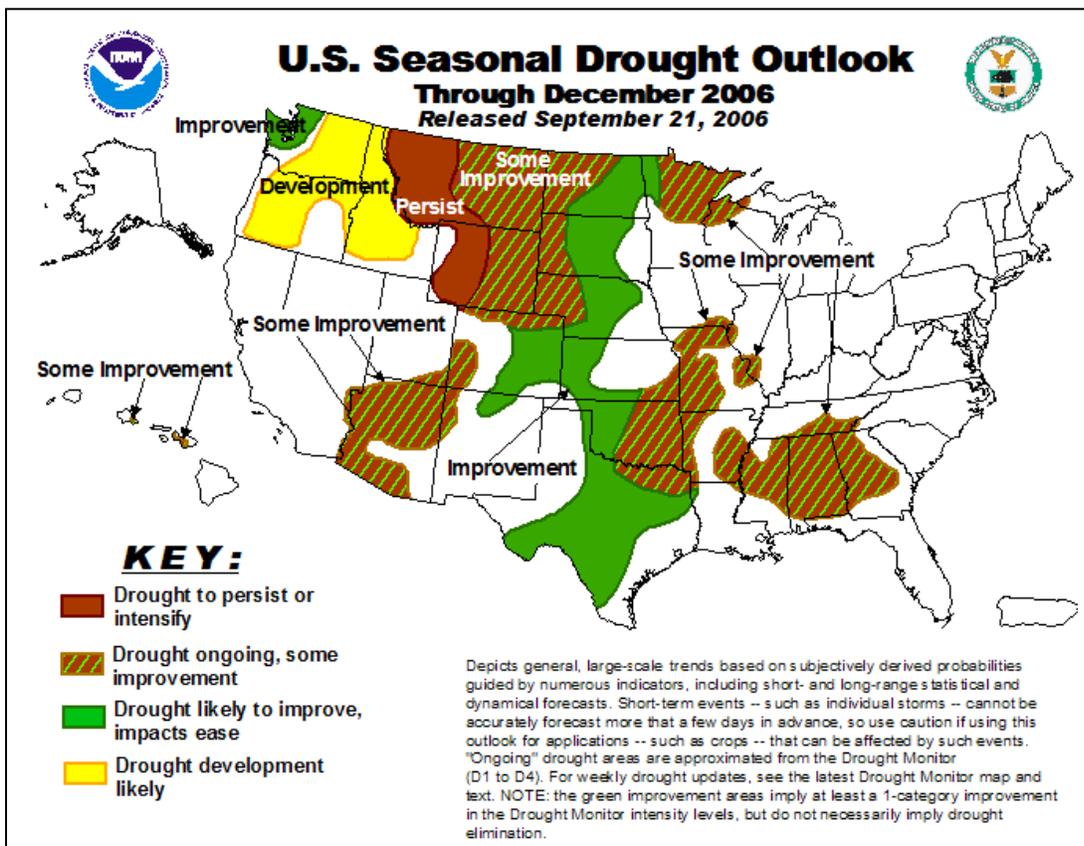
Vegetation health continued to deteriorate, especially from the Mogollon Rim south, during the exceedingly dry 2005-06 winter and spring, precisely when stress should be relieved during the spring green-up period. Vegetation stress reached a maximum during mid-May to early June. Eastern Arizona, and the region from Navajo Nation to Grand Canyon, exhibited substantial stress in June. Stress decreased somewhat in late June and July, except in northeastern Arizona.

Late July and August precipitation, especially in southeastern Arizona, brought relief. By mid-September 2006, vegetation health was as follows: stressed in the Arizona Strip, fair along the Mogollon Rim, and favorable in central and southeastern Arizona. Although the midsummer green-up was too late to make up for vegetation loss and range culling decisions made during the arid spring, the green-up has been substantial.



DROUGHT OUTLOOK

The Committee includes a national drought outlook and seasonal precipitation and temperature forecast in each monthly report. In mid-September, the National Weather Service's Climate Prediction Center announced a weak to moderate El Niño was underway and was expected to continue into the early part of 2007. El Niño typically enhances tropical Pacific moisture flow to the Southwest, resulting in wetter than average winters and springs in a majority of cases. In response, they updated the precipitation outlook for the winter of 2006-2007 to show some confidence precipitation will be above normal, and maintained a moderate to high confidence that temperatures will also be above normal. Therefore, it seems safe to expect that drought conditions are unlikely to worsen and in fact will either stabilize or show some improvement during the 2006-2007 winter. The months beyond that are difficult, if not impossible, to forecast with regard to precipitation; however, there is some confidence in projecting a continuation of above-normal temperatures statewide.



FUNDING AND RESOURCE NEEDS

1. Maintenance of streamflow gage network

Three USGS streamflow gaging stations used to determine long-term drought conditions in the Santa Cruz and Little Colorado River watersheds are losing funding: Sabino Creek near Tucson, Pantano Wash near Vail, and Show Low Creek near Show Low. Funding to support operations and maintenance was lost last year for Show Low Creek near Show Low. Funding for the Sabino Creek and Pantano Wash gages will end in fiscal year 2008. The Committee requests funding to continue operation of these vital drought monitoring stations.

Operation and maintenance for Show Low Creek gage in fiscal year 2007: \$7,500

Cost to fund all three stations in fiscal year 2008: \$23,000

2. 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 LDIGs.

In particular, Arizona faces the following conspicuous data gaps:

- complete lack of soil moisture monitoring
- few high elevation meteorological monitoring stations
- a constantly decreasing network of streamflow gauges

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

3. Improved snow and soil moisture monitoring for Arizona

With regard to the Strategic Plan in #2 above, the Committee has already identified several high priority sites for snow, soil and meteorological monitoring stations in areas of high altitudes. These sites are particularly important because a high percentage of Arizona's runoff and streamflow is generated by snow in Arizona's high country. Monitoring snow, soil moisture, and other meteorological variables at high altitudes is critical to predicting runoff, determining fire danger, and comparing monitoring results with Arizona's more numerous low-elevation meteorological stations. The Committee, in cooperation with NRCS, has prioritized a list of high-quality snow, soil, and meteorological monitoring stations

(twelve high priority sites and three secondary sites) to fill key data gaps in the following areas: northeastern Arizona (Navajo Nation), Little Colorado River watershed, Coconino Plateau, upper Verde River watershed, Santa Cruz watershed, and Willcox Playa watershed.

The Committee is in a good position to fill in key data gaps in northeastern Arizona, because the Navajo Nation has shown tremendous interest in cooperation and data sharing with federal and state agencies. NRCS has offered the Committee an excellent cost sharing arrangement: if the state is willing to purchase the monitoring equipment, then NRCS will install and maintain the equipment and provide data ingestion and quality control services, *in perpetuity*. Current costs are \$25,000 per station for purchase and installation. Annual maintenance (to be covered by NRCS) costs \$2,500. The Committee recommends funding for 12 high priority sites.

Total cost: \$300,000

The Committee also recommends second priority funding for three sites in southeastern Arizona (Pinaleño, Chiricahua, and Huachuca Mountains), and one in northwestern Arizona (Hualapai Mountains) that currently lack snow observations. Agricultural and ranching stakeholders in these regions have made numerous requests for snow observations in these “sky island” mountain ranges. However, these areas are beyond the regular scope of the NRCS SNOTEL program. NRCS would be willing to install and maintain the equipment and provide data ingestion and quality control services, *in perpetuity*, if the state can both purchase the new stations and provide \$2,500 per station for annual maintenance. If the Committee and NRCS can forge alternative maintenance agreements with the USGS or AZMET, then we might be able to reduce annual maintenance costs.

Total cost: \$100,000 for stations; \$10,000/year for maintenance

4. **Drought trigger and indicator system sensitivity analysis**

The current system of determining Arizona drought status is based on a modified version of a method developed for the Georgia Drought Plan. This system has provided a good starting point for Arizona when used in combination with “reality check” data, such as vegetation health and reservoir levels. However, the accuracy and sensitivity of the system to short- and long-term hydroclimatic changes was not systematically evaluated with actual Arizona drought impacts information.

Quantitative verification of the drought status calculation process is essential to ensure the credibility of the Committee’s drought assessments among stakeholders and to ensure appropriate drought mitigation. The Committee proposes to systematically assess the strengths, weaknesses, and usefulness of the current method. Any changes to the current drought calculation method will be evaluated in conjunction with Arizona stakeholders, including representatives of the ICG and other Arizona resource managers and decision makers. Funding

will be used to thoroughly evaluate, revise, and update the system of drought indicators and triggers, pay for research assistants' salaries, and conduct workshops with the ICG and other Arizona stakeholders.

Total cost: \$50,000

5. **Drought Impacts Database and Reporting System**

The ADPP recommended a "state drought impacts database and standardized system to collect regional and sectoral qualitative and quantitative impacts." The Committee recognizes this as a high priority need, based on requests from LDIG volunteers, and recommends a drought impact reporting tool, using web technology, which will serve the following purposes:

- allow LDIGs to easily report drought impact information
- store impact information in a database
- display impact information through online maps that are easy to access and interpret
- allow users to display drought impact history for particular locations
- enable easy evaluation and analysis of impact information through space and time

Also based on feedback from LDIG volunteers (especially ranchers and farmers), for whom an efficient single drought information and impact reporting web site will save valuable time, effort, and good will, the Committee recommends that this system connect with the Arizona Hydrologic Information System described under #7 below. Funding will be used for database and web site development, software development, integration with the Arizona Hydrologic Information System, and testing with stakeholders.

Total cost: \$65,000

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

ADWR staff has evaluated groundwater level changes around the state (**Appendix D**, Groundwater Level Change Map). 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. Funding will be used for ADWR staff salaries.

Total cost: \$38,000 per year

7. **Dynamic drought index decision support web tool**

The Committee, in collaboration with the Arizona Flood Warning System (ADWR, Salt River Project, National Weather Service) and the Arizona Hydrologic Information System (Arizona Water Institute), has initiated a process to include drought information in a new and robust hydrologic web site to give Arizona's decision makers a seamless suite of comprehensive hydrometeorological information.

The plan for the system is to build on software developed by colleagues in South Carolina, which has been successfully used in drought monitoring. The dynamic drought index decision support tool allows users to easily examine a variety of drought data, at a range of spatial scales and aggregations. Users can generate maps, statistics, graphs, and user-defined drought indices tailored to their management needs.

The Committee recommends funding for software adaptation, data transfer (including formatting and quality control), and web design to develop the dynamic drought index decision support tool. A small amount of funding will be needed for a consultant from the University of South Carolina to travel to Arizona to assist with software adaptation.

Total cost: \$25,000.



RECOMMENDATIONS FOR REVISIONS TO THE ADPP

1. Remove references to “climate divisions” and replace with “watersheds” - Both short-term and long-term drought status are now calculated on a watershed basis, rather than by climate division as called for in the ADPP. The climate division boundaries frequently split watersheds, separating precipitation from associated streamflow and groundwater. Calculating drought status on a watershed scale is more meaningful from a hydrologic standpoint and should improve integration and analysis of precipitation, surface water and groundwater data. Additionally, in most cases the watersheds are smaller than the climate divisions, providing higher spatial resolution.
2. Remove references to ADWR as a co-chair of Monitoring Technical Committee - This group has been co-chaired by a climatologist with the University of Arizona’s Climate Assessment for the Southwest program and a meteorologist with the National Weather Service. These committee members are more appropriate co-chairs for a scientific workgroup. However, ADWR’s Statewide Drought Program still serves in a prominent role with the group, acting as group coordinators and advisors.
3. Revise references to “notification of changes in drought status,” and “climate status update.” Clarification should be made that the monthly Drought Monitor Report e-mailed each month to ICG members and posted on ADWR’s web site satisfies the requirements of the plan without need for separate notifications each time a watershed changes drought status. The plan should state that ADWR/Monitoring Technical Committee will provide the report each month as notification of changes in drought status and climate conditions.

Chapter 4 - Local Drought Impact Group Annual Report

OVERVIEW

The establishment of Local Drought Impact Groups (LDIGs) is a key recommendation of the *Arizona Drought Preparedness Plan* (ADPP). These groups were designed to meet three challenges that the state faced when designing a drought plan:

- Engaging the public in drought planning is difficult during wetter periods. The state needed a way to ensure that drought planning remain a high priority at all times.
- Drought impact reporting is critical for assessing costs to the state, but such information is difficult to obtain on a statewide basis.
- Drought preparedness depends on local adaptive capacity. The state needed a means to identify and coordinate region-specific mitigation and response options, conservation measures, and planning needs.

LDIGs provide an answer to these challenges. The group structure established in the ADPP empowers local leaders to collaborate on drought planning for their region, while ensuring statewide coordination and assistance through the Statewide Drought Program. Participants in each county include:

- county and municipal governments
- water providers
- irrigation districts
- tribal governments
- conservation districts
- state and federal resource management agencies
- local non-governmental organizations
- concerned citizens

(Note that the ADPP names these groups “Local Area Impact Assessment Groups.” The name “Local Drought Impact Groups” was chosen upon plan implementation to provide a more descriptive name that is meaningful to the public and other stakeholders that may become involved.)

LDIG Objectives

Assess and report local drought conditions and impacts – The LDIGs will collect and report local drought impact information, including societal impacts and associated losses and costs. This reporting will be critical in demonstrating local needs to the State Drought Interagency Coordinating Group and other local and state decision-makers. It will also provide region-specific corroboration of drought indicator data used by the State Drought Monitoring Technical Committee, enabling more accurate assessments of drought conditions.

Mitigate and respond to drought on a local level – Recommended mitigation and response strategies to reduce the impact of drought to water users will be developed by the LDIGs. Mitigation and response strategies implemented for each drought stage will help reduce the county’s vulnerability to drought.

Educate the public and improve awareness regarding drought - The LDIGs will communicate current drought conditions and reasons that mitigation and response measures are necessary and/or beneficial. Wise water use habits and conservation practices will also be encouraged.

See **Appendix E** for a more detailed vision of how these groups will function.

Group Establishment Process

Since autumn 2005, the Arizona Department of Water Resource’s (ADWR) Statewide Drought Program has facilitated LDIG establishment in three of Arizona’s 15 counties, with the rest slated for establishment in late 2006 and 2007 (see table below). (Note that Pima County had a drought group in place before ADWR’s coordination efforts and Yavapai County is in the planning stages of group establishment.) As outlined in the ADPP, the Statewide Drought Program has partnered with the County Cooperative Extension Offices and the County Emergency Management Offices to develop each county LDIG. The local Natural Resources Conservation Districts (NRCDS) and the County Boards of Supervisors have also been instrumental in the development of the groups.

In the early stages of development, a planning group for each county LDIG has formed to develop the initial invite list and organize the first large group meeting. The Statewide Drought Program and members of the Monitoring Technical Committee provide technical assistance by presenting information on the ADPP, drought preparedness and climate science. After the LDIGs are formed, the Statewide Drought Program continues to provide support and guidance for drought mitigation and response activities.

Schedule for LDIG Development

Estimated timeframe	Counties
<i>In progress</i>	Cochise Pinal Santa Cruz Yavapai Pima
<i>Sept. – Nov. 2006</i>	Graham Greenlee Apache
<i>Jan. – March 2007</i>	Navajo Coconino
<i>April – June 2007</i>	Mohave Maricopa La Paz Yuma
<i>To be determined</i>	Gila



ORGANIZATIONAL STRUCTURE

The LDIGs are encouraged to establish the organizational structure that will best serve their specific local needs. The following represents the organizational structures that have been established by the LDIGs thus far:

Local Drought Impact Group		
Steering Committee or Co-chairs		
Monitoring Workgroup	Mitigation and Response Workgroup	Outreach and Education Workgroup

Note that specific workgroup names may vary by county.

*Note that Pima County formed a local drought group prior to the Statewide Drought Program's coordination efforts. The structure, roles and responsibilities outlined in this section do not all apply to Pima County. See a more detailed description of the county's group and activities in the **County LDIG Updates** section.*

Roles and Responsibilities

Local Drought Impact Group: This refers to the entire group of interested individuals and organizations. The LDIG is responsible for identifying priorities, establishing program direction and approving decisions as needed. Members of the LDIG are encouraged to serve on workgroups to accomplish various tasks. LDIG meetings are open to all interested persons/organizations.

Steering Committee or Co-chairs: Roles of the Steering Committee or Co-chairs within the LDIG include:

- Identifying tasks and making recommendations to the LDIG at large
- Coordinating and monitoring efforts/progress of the LDIG and workgroups
- Recruiting members to workgroups and assuring adequate representation from various areas
- Convening the LDIG when drought conditions warrant and when input or approval is needed
- Determining frequency of LDIG meetings

Cochise County was the first county to formalize a nine-member Steering Committee, which was appointed by the Cochise County Board of Supervisors. Pinal County has also chosen this organizational structure. The Steering Committee provides a county-wide permanent focal group to bring recommendations to and/or to act on direction given by the LDIG. Both counties developed an application process to promote participation on this committee.

Santa Cruz County opted for an organizational structure that consisted of two co-chairs rather than a steering committee. Again, an application process was developed and co-chairs were to be selected by the Santa Cruz County Office of Emergency Management. Unfortunately, no applications were received. The County Emergency Manager and County Extension Office Agent have assumed responsibility for the co-

chair positions at this time. Terms are staggered so that only one vacancy exists at a time.

Workgroups - All three established county groups have set up three workgroups within the larger LDIG. The workgroups will address drought and mitigation response planning, education and outreach, and drought impact monitoring. Specific objectives will vary depending on county needs, and additional workgroups may be formed as needed. See **Appendix E** for a more detailed vision of how these workgroups will function.



COUNTY LDIG UPDATES

Because LDIG establishment is still in the early stages, the three groups that are currently functional have focused this year on building the foundation of their groups. Following is a summary for each county that includes group activities, drought mitigation and response efforts, identification of group needs, and recommendations for changes to the ADPP.

Cochise County

The Cochise County LDIG held its initial meetings in the fall of 2005. It was the first group to form and is commended for leading the path for other counties in the drought preparedness effort. A planning group worked to establish the LDIG and consisted of two representatives from the Cooperative Extension and ADWR staff. The county emergency manager is also now involved with group coordination. To date, Cochise County has held five LDIG meetings, in addition to various steering committee and workgroup meetings. All of these groups are now meeting on a regular basis.

Drought mitigation and response efforts:

As of September 20, 2006, the Steering Committee and workgroups have developed a list of recommended actions to correlate with the drought stage guidelines in the ADPP and are asking for the LDIG's input on the recommended actions. The Steering Committee will review the group's comments and will propose the final recommendations to the LDIG in late 2006. Recommendations include:

- developing a drought plan
- proposing various ordinances
- developing alternative water supplies
- implementing conservation programs
- developing conservation rate strategies

The Monitoring Workgroup is working to establish a network of designated volunteer monitors that will collect drought impact information. The state Monitoring Technical Committee will use this information for more specific analysis of areas impacted by drought and will process the information back to the county so that appropriate action can be determined.

The Education/Outreach Group is working to increase awareness of drought and promote measures to reduce the impact of drought. They are recruiting workgroup members from each community in the county to develop a communication and outreach network. Cochise County currently has a highly successful water conservation program in the Sierra Vista sub-watershed called Water Wise. The Education/Outreach Workgroup will work to utilize and enhance existing organizations/programs such as this one to develop and deliver drought educational materials. Educational programs will be conducted in each community county-wide.

Note that Cochise County received a record amount of rain during this monsoon season, with some areas receiving in excess of 25 inches from July through September

2006. The above-average summer precipitation improved soil moisture, refilled stock ponds, reinvigorated grass growth, and decreased fire danger dramatically. However, impacts still linger after several years of precipitation deficits and one of the driest winters on record. Regardless of current conditions, the LDIGs are taking a proactive approach to drought mitigation and response and will continue drought planning activities during wetter periods.

Identification of needs

- Online reporting tool/database - The Cochise County LDIG strongly supports the Monitoring Technical Committee/ADWR request for funding to develop an online reporting system. A user-friendly database is needed to support both input and processing of data. This system would be invaluable as a resource to disseminate information regarding the status of drought stages and to assist individuals and communities in making appropriate drought mitigation and response decisions. The system should include:
 - User friendly mapping/location id system
 - Capability to summarize area-specific and overall data and provide back to reporter/user
 - Linked rainfall and drought monitoring sites
- Funding for drought impact monitoring - The continued recruitment of drought monitors is needed to establish a network to provide reliable and accurate information. The group requests \$5,000 to equip and train monitors.
- Legislation allowing municipalities and water companies to charge water impact fees during extreme drought status levels.
- State lobbying and support for federal irrigated agriculture set-aside programs during drought conditions.
- Legislation allowing counties to declare moratoriums on building permits or subdivision approvals based on extreme drought conditions.
- Funding for drought education - It is estimated that approximately \$22,000 would be required to provide personnel support to existing organizations and to provide educational materials focused on drought education.

Recommended changes to the ADPP – none at this time

Pinal County

The Pinal County LDIG held its first meeting on July 18, 2006, and has held two LDIG meetings to date. The initial planning team consisted of representatives from:

- Cooperative Extension
- County Emergency Management Office
- Local Natural Resources Conservation District
- County Board of Supervisors
- ADWR Active Management Area
- ADWR Statewide Drought Program

The County Board of Supervisors is scheduled to officially appoint the Steering Committee members this fall.

Drought mitigation and response efforts, county needs, and recommendations for changes to the ADPP have not yet been developed.

Santa Cruz County

The Santa Cruz County LDIG held their first meeting on August 8, 2006, and has held two meetings as of November 2006. The current planning team consisted of representatives from:

- Cooperative Extension
- County Emergency Management Office
- Local Natural Resource Conservation District
- The Nature Conservancy
- La Semilla
- City of Nogales
- Town of Patagonia
- Farm Service Agency
- County Flood Control District
- ADWR Active Management Area
- ADWR Statewide Drought Program
- Friends of the Santa Cruz River
- Santa Cruz County Board of Realtors

Two co-chairs have been assigned and workgroups have been developed.

Drought mitigation and response efforts:

Workgroups will begin meeting in the fall of 2006 to establish goals and tasks. Thus far, the group has determined that the current *Santa Cruz County Multi-Jurisdiction Hazard Mitigation Plan* will be revised and improved, as drought is a natural hazard already addressed in the plan. The following are three goals and objectives from the plan that are related to drought:

- Promote disaster-resistant future development
 - Update, develop, and support the community's general plans, ordinances, and codes to limit development in hazard areas, or build to standards that will prevent or reduce damage
 - Adopt and support codes that protect assets and new development in hazard areas
- Promote public understanding, support, and demand for hazard mitigation
 - Educate the public to increase awareness of hazards and opportunities for mitigation actions
 - Promote partnerships between the state, counties, local and tribal governments to identify, prioritize, and implement mitigation actions
- Reduce the potential level of damage and losses to people, existing and future critical facilities/infrastructure, and other community assets due to drought

- Develop a comprehensive approach to reducing the level of damage and losses due to drought
- Protect existing assets with vulnerability to the effects of drought
- Coordinate with and support existing efforts to mitigate drought (e.g., Arizona Governor's Arizona Drought Task Force)
- Promote water conservation and education

The LDIG will work on developing a drought mitigation and response plan which is consistent with the goals and objectives of the *Santa Cruz County Multi-Jurisdiction Hazard Mitigation Plan*.

Identification of needs - none at this time

Recommended changes to the ADPP - none at this time

Yavapai County

The Yavapai County LDIG is in the early planning stages and has held two meetings to date. On September 26, 2006, the Prescott Active Management Area office, with assistance from the Statewide Drought Program, coordinated a planning meeting for the establishment of the group. The planning team consisted of representatives from:

- University of Arizona Cooperative Extension
- County Emergency Management Office
- County Board of Supervisors Office
- US Department of Agriculture Farm Service Agency and Local Natural Resource Conservation District
- Yavapai County Water Advisory Committee
- ADWR Prescott Active Management Area
- ADWR Statewide Drought Program

The Yavapai County group began developing an invite list and discussed potential agenda items for the first large LDIG meeting. Due to the politics surrounding water issues in this county, the planning team will put a lot of emphasis on educating the public on the LDIG's purpose - drought preparedness, not regulation. A subcommittee was created to begin compiling existing information for a county-wide Drought Mitigation Plan. The group also decided to invite one elected official from each incorporated area to a meeting in January 2007 to discuss the objective and potential structure of the LDIG. The next meeting of the LDIG planning group is in November.

Although the larger Yavapai County LDIG has not yet formed, federal and state agencies along with local ranchers are already submitting drought impact information. The State Drought Monitoring Technical Committee has used this information to corroborate the precipitation and streamflow data evaluated each month to determine drought status.

Because the Yavapai County group is in the early planning stages, drought mitigation and response efforts, county needs, and recommendations for changes to the ADPP have not been developed.

Pima County:

Pima County had already established a Drought Task Force and a Drought Monitoring Committee prior to the Statewide Drought Program's group coordination efforts. The Pima County groups' structure closely resembles the other county groups and provides a good foundation for local-level drought planning needs. Group responsibilities are based on the *Pima County Drought Management Plan*, dated June 2006. The first meeting of the Drought Task Force was held on September 26, 2006 and a second meeting was held on November 3. The Statewide Drought Program will coordinate with this group in a similar capacity to the other county groups.

Drought mitigation and response efforts:

Pima County water providers are in the process of adopting drought response plans. One local provider, Metropolitan Water Improvement District, has a plan in place and is implementing Stage 2 drought response measures. The Drought Task Force will be meeting to develop an overarching response plan that complements the water providers' drought preparedness plans. Coordination of drought response efforts and a consistent public outreach and education effort is needed. Several of the local area drought plans call for coordination with the county to implement ordinances.

Identification of needs – none at this time

Recommended changes to the ADPP – none at this time



SUMMARY

County Activity Summary

Cochise County

- Formed LDIG, steering committee and three workgroups
- Developed a proposed list of recommended actions to correlate with the drought stage guidelines in the ADPP
- Monitoring Workgroup established a network of designated volunteer monitors to collect drought impact information
- Worked to increase awareness of drought and promote measures to reduce the impact of drought

Pinal County

Formed LDIG, steering committee and three workgroups

Santa Cruz County

- Formed LDIG, selected co-chairs and developed three workgroups
- Worked on developing a drought mitigation and response plan consistent with the goals and objectives of the *Santa Cruz County Multi-Jurisdiction Hazard Mitigation Plan*

Yavapai County

- Formed a planning group
- Developed an invite list and discussed potential agenda items for the first large LDIG meeting
- Created a subcommittee to begin compiling existing information for a county-wide Drought Mitigation Plan
- Submitted drought impact information to the state Monitoring Technical Committee

Pima County

- Formed a Drought Task Force
- Coordinated with water providers to develop drought preparedness and response plans

Resource Needs

Funding is needed for:

- An online reporting tool/database for drought impact reporting
- Drought monitoring supplies and training
- Drought education and educational materials

Other needs include:

- Legislation allowing municipalities and water companies to charge water impact fees during extreme drought status levels
- State lobbying and support for federal irrigated agriculture set-aside programs during drought conditions

- Legislation allowing counties to declare moratoriums on building permits or subdivision approvals based on extreme drought conditions

Recommended changes to the ADPP

None at this time



Conclusion

The Governor and the Governor's Drought Task Force are commended for their innovative efforts in developing the *Arizona Drought Preparedness Plan*. The ADPP has provided a strong structural foundation for drought mitigation and response through the creation of three groups: a scientific workgroup, a series of county-level groups, and a state agency advisory group. By funding a Statewide Drought Program to serve in a coordination role for these groups, the plan ensures that actions are occurring at the local, state and federal level and that all parties are communicating and working together. Because of this cooperation, the state has made great strides after just one full year of implementing the ADPP.

As outlined in the ADPP, the Monitoring Technical Committee, Local Drought Impact Groups, Interagency Coordinating Group and the Statewide Drought Program have identified in this report a series of recommendations necessary to continue and improve drought planning activities. Funding is absolutely vital for implementation. Recommendations range from the installation of additional monitoring stations to the development of legislation to help local communities with their drought preparedness efforts. The Statewide Drought Program encourages state leaders to consider all recommendations herein and available sources of funding to improve drought monitoring and limit future vulnerability to drought. Continued - and increased - funding and support is needed for governmental agencies to improve drought preparedness and Arizona's readiness to deal with drought.

Drought is a recurring natural hazard in Arizona, and population growth continues to increase the demand for our scarce water resources. The effects of drought on domestic water supplies, ranching and farming production, vegetation, forest health and wildlife populations can be devastating. The recommendations proposed in this report, if implemented and funded, can equip Arizona to deal with current and future drought and reduce its impacts. Proper drought preparedness will ensure the future vitality of Arizona's natural resources, economy and quality of life.

Appendices

Appendix A

Fact Sheets

Appendix B
Drought Talking Points

Appendix C
Drought Monitor Report

Appendix D

Groundwater Level Change Map

Appendix E

LDIG Roles & Responsibilities – The Vision