

**Evolution and Evaluation of the  
Active Management Area Management Plans**

**FINAL  
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## EXECUTIVE SUMMARY

More than half-way into the 45-year period for meeting the goals of the Arizona Groundwater Management Act (GMA), the Arizona Department of Water Resources (ADWR) will be developing the fourth of five management plans for each of the Active Management Areas (AMAs), as mandated by the Act. In each of the AMAs, tremendous effort by ADWR staff, those regulated by ADWR and other water stakeholders is devoted to the development of the management plans. This report provides an examination of the intended functions/purposes of the management plans relative to legislative intent, an evaluation of the management plan provisions to date from the perspective of ADWR staff and the regulated community, an assessment of the effectiveness of the management plans in meeting their goals, and suggestions of what stakeholders would like to see in future management plans. It concludes with several key recommendations based on the implications of the study results. This project will assist ADWR as it moves forward with the development of the Fourth Management Plans. This evaluation provides a foundation for change in the approach and content of the final two management plans.

To gain perspective on the original intent of the GMA's management plan provisions, interviews were conducted with people directly involved in the drafting of the GMA as it was enacted in 1980. Most of the individuals interviewed were members of the Arizona Groundwater Management Study Commission, although other stakeholders involved in the development of the GMA were also interviewed. The decision to include management plans in the GMA was the result of an acknowledged need for some degree of centralized control to ensure groundwater conservation. Participants in the development of the GMA agreed on the management goal for each AMA and realized the importance of providing time for groundwater users to adjust to the new paradigm of water management in the AMAs and related regulations. Management periods were developed allowing for progress toward management goals over time through conservation, augmentation, reduction in the amount of groundwater used for irrigation, and use of the best available industrial technology. After specific requirements for the first three management periods, the requirements for the Fourth and Fifth Management Periods were left vague to allow maximum flexibility.

An important goal of this study was to determine the effectiveness of the management plans to date through use of the data included in the management plans themselves. Unfortunately, the effectiveness of the conservation programs cannot be determined from information available in the management plans to date. Careful thought should be given to the kind of water use information that will be needed for quantifying program effectiveness going forward. For example, the collection and reporting of individual municipal provider GPCD, individual farm use, and industrial user data should be done regularly and consistently. Measuring effectiveness will also require development of a methodology to isolate the impacts of conservation on water use from other factors such as weather, the economy, changes in customer base (such as more commercial), water rates, and demographics. In addition, there are some influencing factors that are difficult to measure, such as the implications of media attention to drought and climate change. In order to account for the variables beyond the control of the conservation programs and isolate the effects of the regulations, a multivariate statistical analysis is needed.

Despite the inability to quantify the effectiveness of the management plan conservation programs to date, stakeholders have strong opinions about the conservation programs and the process used to develop them. Only the industrial sector was generally satisfied with the management plan development process and the regulations resulting from it. Other sectors had mixed views, but generally expressed some dissatisfaction with the conservation regulations over time and especially the process used to develop the management plan conservation programs. Overall, there was a general opinion that the time has come to shift the focus of the management plan development process away from regulation towards collaborative, long-term water planning.

As such, stakeholders would like to see a shift toward using the management plans or a companion document for regional water resource planning, not just regulation. While ADWR may seem like the logical entity to facilitate long-range planning, there are several things to consider. First, planning of the type envisioned by many of those interviewed goes beyond what has been included to date in management plans. This type of planning would have to incorporate

the individual plans of water providers and large users, much like a regional transportation plan must include planning elements at the discretion/choice of the local entities. It would require sufficient levels of trust so that individual users/providers would willingly share information not normally reported to ADWR. It would necessarily require that data collected by ADWR be available in a useful format. It is likely some shared governance or oversight of the process would have to be agreed upon. Long-term planning would require ADWR to act not only as a regulatory agency for the AMAs, as it has done on many occasions.

In order to facilitate the implementation of the findings of this study relating to determining the effectiveness of the conservation programs and initiating long-term regional water planning, the authors offer the following recommendations:

**Recommendation 1:** *ADWR should provide water use data for all sectors on at least an annual basis. These data must be reported in a consistent format over time and across AMAs.*

**Recommendation 2:** *State of the AMA reports should be produced on a yearly or biennial basis.*

**Recommendation 3:** *ADWR should shift its focus to long-term water planning, but still maintain the current conservation programs.*

**Recommendation 4:** *The Augmentation and Recharge Program and the Central Arizona Groundwater Replenishment District rules need to be reviewed and updated to ensure fairness.*

## INTRODUCTION

In 1980, the State of Arizona enacted the Groundwater Management Act (GMA) to provide for long-term water management and conservation of its overdrafted groundwater supply. The GMA established the Arizona Department of Water Resources (ADWR) and four Active Management Areas (AMAs) centered on the major urban and agricultural centers of the state: Pinal, Phoenix, Prescott, and Tucson. Later the Tucson AMA was split to form a fifth AMA, Santa Cruz. The GMA included a management goal for each AMA, mandated an assured water supply program, limited the expansion of agriculture, and required a series of management plans. The management plans include conservation programs for each of the major water using sectors.

The primary purpose of the management plans is to establish the regulatory framework for conservation in the agricultural, industrial, and municipal sectors to contribute to the achievement of the management goal of each AMA. Three of the AMAs, Prescott, Phoenix, and Tucson have a management goal of reaching safe-yield by 2025 or earlier. The Santa Cruz AMA has the goal of maintaining safe-yield and preventing further decline of local water tables. The predominately agricultural Pinal AMA has the goal of protecting the agricultural economy for as long as feasible, while preserving water supplies for future non-agricultural purposes. The GMA mandates the development of a new management plan for each AMA every ten years through 2025. There are a total of five management periods; the first management period began in 1980, with a new management period beginning each decade. Now, more than half-way into the 45-year period for meeting the goals of the GMA, ADWR will soon be developing the Fourth Management Plans. In each of the AMAs, tremendous effort by ADWR staff, the regulated community, and other water stakeholders is devoted to the development of a management plan.

This report evaluates the effectiveness of the management plans' conservation programs relative to legislative intent and stakeholder expectations. It has several components. First, the methodology for conducting the research is presented. The purpose and intent of the GMA and the management plans based on interviews conducted with individuals involved in the drafting of the original language of the GMA are then discussed. This discussion sets the stage for the consideration of the contents of the

current management plans and looking forward to future management plans.

This is followed with a summary of the provisions of the management plans over time. In many cases, the contents of the management plans have been directly affected by legislative changes to the GMA, and it is important to consider their contents in this light. The next section addresses stakeholder input on the process for developing the management plans and includes summaries of the stakeholder input as well as analysis.

The analysis of stakeholder perspectives on the conservation programs is followed by a discussion of challenges associated with measuring the effectiveness of the management plans' conservation programs and with additional policy analysis. Key interview findings about what future management plans should contain are then discussed and analyzed. As the ADWR undertakes development of the Fourth Management Plan, these findings are useful indicators of stakeholders' hopes for the plan. Finally, we offer some brief concluding remarks.

## METHODOLOGY

Research was carried out over the course of eight months beginning in January 2007. Two separate groups of interviews were conducted. An extensive review of the past and current management plans for each of the AMAs, as well as the statutory language of the GMA relevant to the management plans, was performed. The project was carried out through an incremental process with each step informing the work done for the next. The following tasks were completed:

- Review of the GMA management plan provisions and of legislative changes to the GMA over time;
- Interviews with key participants involved in drafting the GMA;
- A comprehensive review of all of the management plans for each AMA;
- Stakeholder interviews with current and former ADWR staff and members of the regulated community across AMAs, including representatives of the agricultural, industrial, and municipal sectors, from each AMA; and
- Analysis of the information.

The review of the management plan provisions of the GMA and subsequent legislative changes was performed by the ADWR legal staff on behalf of the project. This review resulted in two reports: *Groundwater Management Plan Legislative Summary*, provided as Appendix D to this report, and the free-standing report, *Groundwater Management Plan Legislative Changes Since 1980*. The latter report provides the actual text of all Management Plan-related statutory changes to the GMA since 1980. The former summarizes the statutory changes into a shorter, more readable format. The purpose of these reports is to provide information on the original legislative intent of the management plans, as well as the current legal requirements for content. The review presents the original management plan requirements of the GMA for each management period and then traces the changes and additions to the original provisions made over time. It also tracks the development of the underground water storage provisions of the GMA, to the extent that they relate to the management plans.

To gain perspective on the original intent of the GMA's management plan provisions, interviews were conducted with people directly involved in the drafting of the GMA as it was enacted in 1980. Most of the individuals interviewed were members of the Arizona Groundwater Management

Study Commission, although other stakeholders involved in the development of the GMA were also interviewed. Participants represented diverse interests, including the agricultural, municipal, and industrial sectors. Interviews were conducted by Dr. Zachary Smith and Research Assistant Carol Johnson of Northern Arizona University during the first half of 2007.

All interviewees were asked three questions specific to the management plan component of the GMA:

1. How did the management plans for the AMAs become part of the GMA?
2. Was there much debate on the management plans prior to adoption of the GMA?
3. What goals were the management plans designed to accomplish?

These questions were followed by an open-ended discussion about the management plans. The majority of interviews were conducted in person and lasted about one hour. All participants were promised anonymity to ensure candid, unrestrained responses to the questions asked. Therefore, the names of the interview subjects are not provided in this report. Thirteen interviews were conducted. The results of the interviews were synthesized and analyzed for recurring themes. The results of this synthesis are presented in a separate report, *AMA Reform: A Political Analysis*, included here in Appendix F. This report compares findings on the intent of the management plan provisions of the GMA from the interviews with the statutory language from the legislative summary provided by ADWR.

A comprehensive review of the existing management plans for each AMA was conducted during the spring of 2007 by Dr. Sharon Megdal and Research Assistant Aaron Lien of The University of Arizona. The purpose of this review was to track the evolution of the regulatory portions of the management plans, over time, in each AMA. The effort focused on the regulatory portions of the management plans – principally the conservation programs for the municipal, agricultural, and industrial sectors – because these are the sections of the management plans required by statute. The other, non-regulatory sections of the management plans (e.g. the water use and future directions chapters) help set the context for the plans, but are not formally required.

The initial approach to tracking management plan changes over time was to consider each sector within each AMA separately. For example, in the Tucson AMA the municipal conservation program was traced over the three

existing management plans and a summary of the changes over time was developed. When this was completed for each AMA, a combined summary by sector and a matrix of regulatory provisions was developed. This task therefore, tracked the content of the management plans relative to legislative intent. It provided essential background for the stakeholder interviews. The body of the text, as well as Appendix E, includes summary information on the provisions of the management plans over time.

A key component of the project was a series of stakeholder interviews conducted during the summer of 2007. A total of 33 interviews were conducted. The interviews provided the primary source of information on 1) the content of past and current management plans, 2) the process for management plan development, and 3) perspectives on what future management plans should accomplish.

Stakeholders from all AMAs were interviewed. More interviews were conducted in the Phoenix and Tucson AMAs because they are the largest AMAs by population and, as a result, have the largest diversity and population of stakeholders (Chart 1). Participants included representatives of all of the sectors regulated by the management plans. More interviews were conducted with stakeholders from the municipal sector than any other sector (Chart 2). The municipal sector is growing quickly and will become the dominant water user in the AMAs over time. Therefore, the conservation programs affecting the municipal sector are likely to be of most interest going forward.

In order to learn stakeholder opinions about the development of past management plans, an effort was made to interview people who had been involved in the development of past management plans. The majority of interviewees were involved in the development of at least one management plan (Chart 3). Many were involved in the development of multiple management plans. Because the First and Second Management Plans were developed in the early and late 1980s, fewer interviewees were available who had been involved in the development of those early plans.

All interview participants were asked the same nine questions. The questions covered four general topics:

- A baseline question about past involvement in management plan development;
- Opinions about the management plan development process;
- Opinions about the content of past and current management plans; and

- Opinions about the content and structure of future management plans.

The questions were provided to all participants prior to the interview so they would know what to expect and could, if they wished, prepare answers in advance. The questions were used as a guide; the interviews themselves generally took the form of an open discussion based on the topics raised by the questions. While a point was made to ensure all of the questions were answered during each interview, each session did not necessarily go through the questions in a linear fashion. Interviewees were also encouraged to raise related issues and not feel constrained by the specific topics raised by the provided questions. Interviews typically lasted about one hour. Participants were ensured anonymity in an effort to garner maximum candor. Therefore, direct quotes and the name of participants are not included in this report.

The results of the interviews conducted for this report were synthesized by themes and analyzed. The analysis is divided into three categories: 1) opinions about the current status of the management plans, 2) opinions about the process used to develop the management plans, and 3) opinions about the structure and content of future management plans. The results of the analysis of these thematic areas, along with the analysis of legislative intent, provide the basis for the findings of this report.



## MANAGEMENT PLAN PURPOSE AND INTENT

To assist in meeting the management goals of the AMAs, as described in the introductory section, the GMA requires the director to adopt a series of five management plans for each AMA. Except for the Fifth Management Plan, each plan covers a 10-year management period. The management plans must be developed according to the guidelines set forth in the GMA and must contain a continuing mandatory conservation program for persons withdrawing, distributing and receiving groundwater in an AMA (ARS §45-563).

For each management period there are specific guidelines set forth in the GMA describing what must be included in the management plans. See Appendix D for a summary of the statutory language of the GMA as it relates to the management plans. For all management periods the following must be included:

- The requirements for conservation programs for the agricultural, municipal, and industrial sectors;
- Requirements to reduce lost and unaccounted for water from water distribution systems; and
- Monitoring and reporting requirements (ARS §45-563).

The GMA also defines the promulgation dates of each of the management plans. Beginning with the second management period, each management plan must also include an augmentation program to provide incentives for

artificial groundwater recharge. Beginning with the third management period, the management plans must include an assessment of groundwater quality and may include a purchase and retirement program for grandfathered rights. From the First to the Third Management Plans, the GMA generally calls for the conservation regulations to become stricter. For the Fourth and Fifth Management Plans, little guidance is included in the statute, providing for greater flexibility (ARS §45-564 to ARS §45-568).

Following the development of a summary of the original provisions of the GMA, a series of interviews were conducted with individuals involved in the development of the GMA to identify legislative intent specifically related to the management plans. Interviews focused on members and staff of the Groundwater Management Study Commission. This Commission was created by the state legislature in 1977. Members of the Commission played a pivotal role in the development of the GMA and were selected to represent the primary groundwater stakeholders in the GMA development process. The purpose of the interviews was to determine the motivations and intent behind the management plan provisions of the GMA. The following summarizes the insights gained from the interviews.

The concept of management plans was the reflection of a clear need for some method of implementation, at the discretion of the ADWR Director and by AMA, of the goals of any groundwater management related legislation.

Chart 1: Number of Interviews by AMA

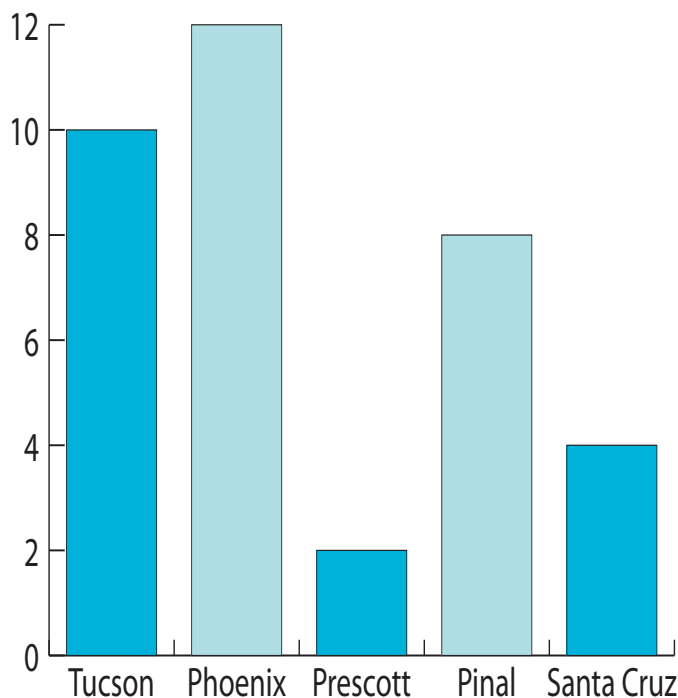
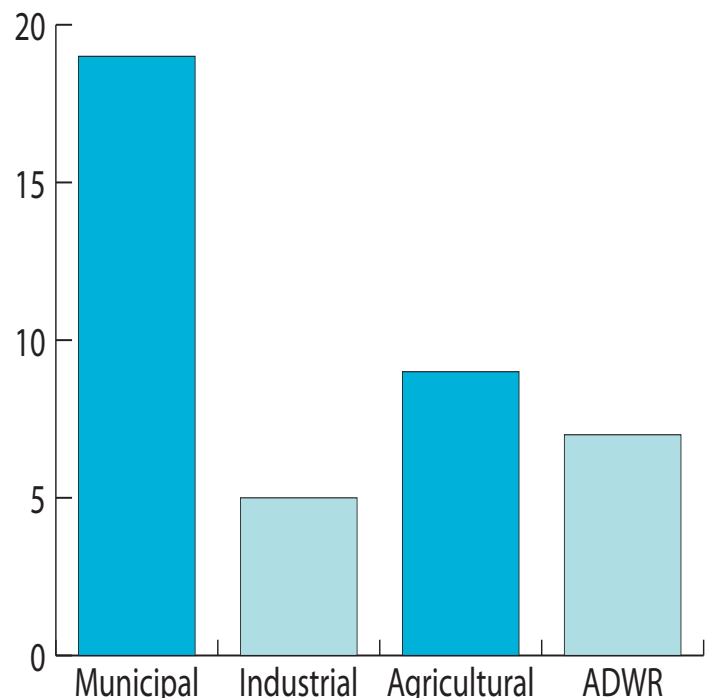


Chart 2: Number of Interviews by Sector



If no larger structure was provided to develop a plan for implementing the goals of the legislation, then no real change was occurring from the reasonable use doctrine. The management plans were the enforcement tool adopted for the implementation of the conservation programs agreed upon during the negotiation of the GMA.

Stakeholders agreed that the overall goal of the GMA, and the management plans as the tool for implementing and enforcing the conservation provisions of the GMA, was to achieve safe-yield within the AMAs. The Pinal AMA was unique because of its groundwater dependent agricultural economy. As a result, a goal of maintaining the agricultural economy by managing the depletion of groundwater was adopted. The management plans were designed to give ADWR and water users incremental goals. The framers of the Act wanted to improve the groundwater situation, but also did not want to disproportionately harm water users by requiring rapid reductions in water use. The management plans provided a means for a gradual transition.

Interview participants also noted that there was some reluctance to development of strict management plan requirements for the later management periods. The Fourth and Fifth Management Plans were 30 and 40 years away when the GMA was drafted. With such a long planning horizon, the drafters felt it was prudent to leave the requirements for the Fourth and Fifth Plans ambiguous. It was impossible to know then what changes in technology may be affecting the water demands of

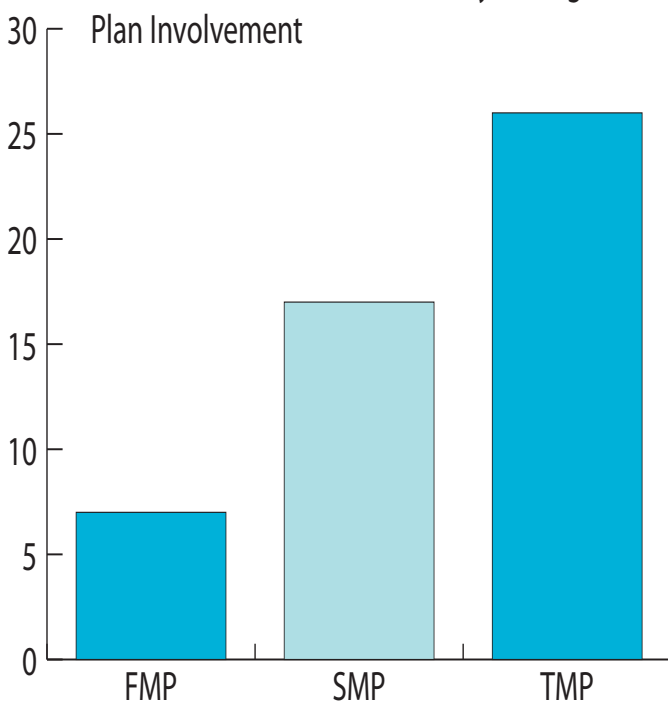
industry or how much progress towards safe-yield would have been made, given growth in municipal demand from larger populations. The drafters wanted to provide flexibility for the later management plans.

These intentions are clearly reflected in the structure of the GMA itself. The management plan guidelines require regulatory programs for the reduction of water use within the AMAs. The statutory language requires stricter conservation requirements through the third management period, increasing the level of conservation. The language also provides for intermediate goals within the second and third management periods, emphasizing the goal of moving toward the management goal of each AMA in small steps (ARS §45-564 to §45-566). The guidelines for the Fourth and Fifth Management Plans, however, are quite vague. They note only that the director of the ADWR *may* establish new conservation requirements for each sector, but do not require anything specific. In fact, all of the language for the Fourth and Fifth Management plans except for the promulgation dates uses “may” statements (ARS §45-567 to ARS §45-568). Therefore, there is no requirement for change to the management plans from the third to the fourth management period.

Interviewees recalled that there was quite a bit of debate about how far the groundwater management legislation should go in constraining groundwater use. There was agreement that in order to reduce groundwater withdrawals, gallons per-capita-per-day use by municipal providers had to be reduced. But the conservation approach for agriculture was subject to much more debate. Many agriculture representatives felt that reduction in the quantity of allowable groundwater use was a taking meriting compensation. Other sectors felt that agriculture was not efficient in its water use and wanted to shift some of its use to other sectors. The compromise was the limitation on irrigation acres. In the industrial sector, there was concern about not being able to predict technological changes. It was agreed that industry would be constrained by the latest available, economically feasible conservation technology. The intent of each of these decisions was to do the most possible to reduce groundwater use over time in order to achieve safe-yield.

In summary, the decision to include management plans in the GMA was the result of an acknowledged need for some degree of centralized control to ensure groundwater conservation. Participants in the development of the GMA agreed on the management goal for each AMA – safe-

Chart 3: Number of Interviews by Management



yield for Phoenix, Prescott, and Tucson and maintenance of the agricultural economy in Pinal. They also realized the importance of providing time for groundwater users to adjust to the new paradigm of water management in the AMAs and related regulations. Therefore, management periods were developed allowing for progress to safe-yield over time through conservation, augmentation, reduction in the amount of groundwater used for irrigation, and use of the best available industrial technology. After specific requirements for the first three management periods, the requirements for the Fourth and Fifth Management Periods were left vague to allow maximum flexibility.

## EVOLUTION AND EVALUATION OF THE MANAGEMENT PLAN REGULATORY PROGRAMS

The management plans have evolved to include increasingly complex conservation programs over the course of the first three management periods. In addition, the Second and Third Management Plans include detailed augmentation and recharge chapters. This section presents the content of the conservation and augmentation programs of the management plans over time. Stakeholder perspectives on the regulatory provisions of the management plans are also summarized.

### Municipal Conservation Program

A key component of the management plans is the Municipal Conservation Program. This program regulates municipal water providers, defined by the GMA as, “all non-irrigation uses of water supplied by a city, town, private water company or irrigation district” (ARS §45-561). As the state continues to grow, municipal water use will become a larger component of total water use. Therefore, the Municipal Conservation Program is a critical component of the effort to achieve and maintain safe-yield in the AMAs.

The purpose of the Municipal Conservation Program is to require reasonable reductions in per capita water use by municipal providers during each of the first three management periods (ARS §§45-564 to 45-566). As noted in the statutory language and intent section above, the fourth and fifth management plans do not provide specific goals (ARS §§45-457 and 458). Per capita use is the total amount of water used divided by the population in the service area of a municipal provider. It is expressed in gallons per capita per day (GPCD). Per capita calculations include all water that is supplied by a municipal provider for all uses, including lost and unaccounted for water.

While the approach to the Municipal Conservation Program in the First Management Plans was remarkably simple, by the Third Management Plans, the municipal program had developed into a complex set of regulations. The simplicity of the First Management Plans is due to its lack of options – providers are not given a choice of how they will be regulated. With a few minor exceptions, the same regulations are applied to each provider regardless of size or any special circumstances that may exist.<sup>1</sup>

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<sup>1</sup> Unless otherwise noted, the source of information on

When the Second Management Plans were developed, ADWR realized there was a need for flexibility in the regulations. Therefore, the department revamped the base conservation program, the Total Gallons Per-Capita Day (GPCD) Program, tailoring it more specifically to the individual conditions of particular providers and separating out small providers. Small providers were defined as water providers supplying less than 100 acre-feet of water per year. The Second Management Plans also include a second, parallel regulatory system, the Alternative Conservation Program, to increase the choices available to providers. The Third Management Plans built on the changes of the second management period and introduced a third parallel set of regulations, the Non-Per Capita Conservation Program, to allow even more flexibility. Recently enacted legislation requires ADWR to replace the current Non Per-Capita Conservation Program with a Best Management Practices (BMP) Program. During the fourth management period, the BMP Program will replace the Total GPCD Program as the default conservation program for municipal water providers (ARS §45-566 to §45-558). Table 1 provides a summary of the general requirements of all elements of the Municipal Conservation Program and notes major changes over time.

### Current Status

Nearing the end of the Third Management Period, the Municipal Conservation Program has been dramatically altered by Senate Bill 1577, passed during the 2007 legislative session. See Appendix A for a summary of the bill and its provisions as they relate to the Municipal Conservation Program. For the remainder of the third management period, the Total GPCD Program will be replaced as the base conservation program for municipal providers (ARS §45-566 to §45-568). ADWR is currently preparing a modification of the Third Management Plan that will implement a Municipal Best Management Practices (BMP) Program (a modified NPCCP), and eliminate the Alternative Conservation Program (ADWR 2007). These changes will have a significant impact on how municipal providers are regulated for the remainder of the third management period and in the fourth and fifth management periods. For the fourth and fifth management periods, the BMP program will be mandatory for all the management plans is the management plans themselves. The First through Third Management Plans for the Pinal, Phoenix, Prescott, and Tucson AMAs and the Third Management Plan for the Santa Cruz AMA were used in the development of this report. The Third Management Plan for each AMA is available on the ADWR website at: <http://www.azwater.gov>.

non-designated municipal water providers. Designated providers will be allowed to choose between the Total GPCD Program and the BMP program. It is unclear what effect the changes in regulatory structure will have on conservation and attainment of the goals of each AMA, though stakeholders did offer opinions during the interview segment of the project based on the draft structure of the BMP Program.

The Municipal BMP program is similar in concept to NPCCP, but with important modifications. The NPCCP was optional and only available to providers who met certain requirements, including status as a designated water provider under the assured water supply rules (ARS §45-565 to §45-567). The BMP program, beginning with the Fourth Management Plan, is mandatory for all providers except designated providers, who may opt out. The goals of the BMP program are to create a culture of conservation within the AMAs through implementation of conservation practices and to address private water company's ongoing concerns about existing conservation regulations (ADWR 2007). Private water companies have long argued that conservation was difficult to implement because they do not control the actions of their customers and they are not guaranteed cost recovery for conservation expenses. All participants in the program will submit a provider profile when they enroll in the program outlining provider characteristics and BMPs that have been or will be implemented. Providers select BMPs based on their characteristics and the number of service connections in their system. A tiered system has been developed so that providers with more service connections must implement more BMPs. Although providers are no longer assigned a target GPCD under the BMP program, GPCD will still be calculated based on annual reporting requirements to determine the effectiveness of the implemented BMPs (ADWR 2007).

### Stakeholder Perspectives

Stakeholder opinions of the municipal conservation program regulations were mixed. Key trends include:

- No consensus on the fairness or effectiveness of the conservation programs;
- Mixed feelings about the new Municipal Best Management Practices Program;
- Agreement that standardization of conservation programs across AMAs is not advisable; and

- Enforcement has been inconsistent, but conservation is an essential part of water provider practices with or without enforcement.

There was very little agreement between municipal providers about the current conservation requirements. Some believe that the regulations are fair and effective, focusing mostly on the Gallons Per-Capita Day program (GPCD). However, calculating GPCD is considered cumbersome and time consuming. Others, mostly from fast growing cities, feel that the regulations, especially the GPCD program, are too burdensome and too difficult for growing cities to comply with. Some indicated that there was inflexibility in the administration of the GPCD Program. They believe that staff should have allowed adjustments to target maximum GPCD numbers to reflect changes in the mix of water customers, such as growth in industrial water use. Others felt that the GPCD program was not a "real" conservation program, just a measure of water use, and that it should be changed to place a greater emphasis on management. Finally, some municipal providers, particularly private water companies, felt it is unfair to place such a large conservation burden on water providers because there are limited things they can do to impact the water use habits of their customers.

Enforcement of the GPCD program has not occurred for a number of years as a result of legal proceedings. Many stakeholders felt that, because conservation continued in the absence of enforcement, it is clear municipal providers will implement conservation programs with or without regulation. Despite the lack of enforcement, providers stated that they have still been working to increase conservation and comply with the conservation program requirements. This indicates that the management plans and conservation requirements are only one part of a larger set of factors driving conservation by municipal providers. Nevertheless, many stakeholders pointed out that, although a regulatory program may not be required to make conservation happen in the AMAs, politically it is very important. Arizona needs to show other states in the Colorado River Basin that it is doing its part to conserve and using water wisely. Many felt Arizona is a leader in its approach to water management and needs to work to maintain this position and ensure others know what is happening in the state.

Participants in the NPCCP felt the program has been unnecessarily cumbersome. The program requires participants to negotiate a series of reasonable conservation

measures with the ADWR. Participants report this process has been difficult, requiring too much time to reach a conclusion. Once agreement on conservation measures has been reached, participants are reluctant to seek changes because they do not want to go through the process again.

The complaints about the implementation of the NPCCP carry over to concerns about how the new BMP program will be administered. The BMP program will have a much larger group of participants because all non-designated providers are required to participate in the fourth and fifth management periods. There is concern that, if the department follows a similar approach for selecting BMPs as has been followed in the past for selecting reasonable conservation measures, the administrative burden could be overwhelming and significantly slow implementation of the program. The BMP program also requires continued calculation of GPCD for participants, another significant administrative burden for the department. Some of those who advocated for changes to the NPCCP and were at one time expected to be participants in the new BMP program indicated that they are planning to remain in the Total GPCD Program. These providers advocated for retaining the Total GPCD Program as an option during the 2007 legislative process.

There are also divided opinions about the potential effectiveness of the BMP program. About half of the municipal representatives interviewed feel the new program is a step in the right direction. They feel it will result in similar amounts of water conservation as the current GPCD program and will provide more flexibility to meet the challenges of changing service area characteristics. It is also a step in the direction of water management and planning, and away from the standard regulatory approach. The other half feels the program is a step backwards. They are not confident the new program will result in the same amount of conservation or ease the administrative burden of participating providers or the Department of Water Resources.

The standardization of conservation requirements across the AMAs is not generally supported. Most felt the conditions in each AMA are just too different to expect the same conservation requirements to be effective. For example, there is an explicit difference in conditions between the Phoenix AMA, where there is surface water available, and the Prescott AMA, where no surface water is available. Most agree standardization makes regulation administratively easier for the department, but do not

think this is a good enough reason to not create unique programs for different AMAs. When standardization does occur, the department needs to make sure the regulations are enforced in the same way across AMAs.

Discussions with ADWR staff about the municipal conservation program centered on the Gallons Per-Capita Day (GPCD) Program and the new municipal BMP program. Some acknowledged that the GPCD Program as originally conceived was not fair and did not take into account factors unrelated to conservation that may affect GPCD usage. However, many feel the addition of flexibility credits and other changes to the program have addressed its shortcomings. Flexibility accounts were developed to address changes in water demand caused by factors beyond the control of water providers like weather variations from year to year. If a provider achieves a total GPCD rate under its target for a year, the provider is given a credit for this amount. The credit can then be used in a future year when the provider is unable to meet its total GPCD target. Others feel the GPCD Program is unfair because of the restrictions it places on communities with changing development patterns. Finally, some think the GPCD Program is inadequate because it does not allow one to determine where water savings are coming from or why. Because GPCD only measures water use over time and does not monitor the actions taken to achieve reductions, it is impossible to determine the exact cause of reductions (or increases) in water use. This limits ADWR's ability to determine the effectiveness of particular conservation measures.

The municipal BMP program also received mixed reviews from department staff. Many feel it is an improvement because it is a step towards conservation planning as opposed to basic conservation regulation. However, there is serious concern about the administrative burden the program will place on the department. Others also worry about the loss of the quantitative measure of water use represented by GPCD. The BMP program requires calculation of GPCD for participants, however, so this may not be a meaningful concern.

### Analysis

Interviewees from the municipal sector suggested that the conservation programs have reached their maturity and it is appropriate for focus to move away from a measure of per capita water use as a metric for conservation. However, designated water providers, who requested the opportunity

to participate in a non-per-capita program in the 1990s as a means to move away from GPCD and toward policy regulations, now wish to retain the option of participating in the GPCD program. In fact, they are the only ones who have the ability to do so. In addition, all participants acknowledged that there has been no enforcement of the Municipal Conservation Program for many years and that calculations of GPCD rates have not been performed.

It is not necessary to have agreement on conservation program effectiveness measures to infer from viewpoints shared that water providers would prefer programs that are less binding on them. Several water providers indicated that “we have squeezed as much blood out of the turnip” as we can through the conservation programs. But, have we? The metrics offered through the Management Plans are of limited utility for determining if there have been conservation gains from implementation of different or more extensive/stringent conservation measures.

Perspectives shared by the interviewees did reflect concerns about ADWR’s ability to fairly and efficiently implement and enforce the Municipal Conservation Program. At this point in time, there is considerable uncertainty regarding whether ADWR has sufficient staff or expertise for these tasks. Experience with development of the GPCD program over time and implementation of the Non-per-capita program were cited as evidence. Within the AMAs, staff has focused on matters other than enforcement of the Municipal Conservation Program. Also, ADWR has dedicated additional staff resources to statewide programs, where conservation programs are not mandatory.

The BMP Program has the potential to address concerns about standardization of the Municipal Conservation Program across the AMAs if it has enough flexibility. All agreed more uniformity of conservation programs across the AMAs is more efficient for ADWR staff. However, AMA circumstances differ tremendously. The GMA did establish a partially decentralized approach with the formation of AMA offices, each with a Director and a Governor appointed Groundwater Users Advisory Council. The AMA offices provide ADWR staff with the ability to craft programs designed to reflect local conditions and meet local needs, within the framework of the GMA’s requirements. Going forward, it is important to continue to take advantage of this capability.

**Table 1: Municipal Conservation Program**

	Total Gallons Per Capita Day Program			Alternative Conservation Program		
	<i>First Management Plan</i>	<i>Second Management Plan</i>	<i>Third Management Plan</i>	<i>First Management Plan</i>	<i>Second Management Plan</i>	<i>Third Management Plan</i>
<b>Tucson AMA</b>	Uniform base of 140 GPCD; required reduction of 25% of the amount over; if under base, no requirement	Individual targets based on conservation potential; flexibility accounts	Component method for base; population estimates done yearly; flexibility accounts	N/A	Same in 2nd and 3rd plans; intended for providers with disproportion-ate non-residential use	3 Components: groundwater withdrawal limitations, residential GPCD rate, non-residential RCMs
<b>Phoenix AMA</b>	Uniform base of 140 GPCD; required reduction based on GPCD rate; if under base, no requirement	Individual targets based on conservation potential; flexibility accounts	Component method for base; population estimates done yearly; flexibility accounts	N/A	Same in 2nd and 3rd plans; intended for providers with disproportion-ate non-residential use	3 Components: groundwater withdrawal limitations, residential GPCD rate, non-residential RCMs
<b>Pinal AMA</b>	Individual targets based on conser. potential; if under 140 GPCD, no requirement	Under 125 GPCD, no requirement; use 3 year average for base and conservation. potential	Component method for base; pop. estimates done yearly; flexibility accounts	N/A	Same in 2nd and 3rd plans; intended for providers with disproportion-ate non-residential use	3 Components: groundwater withdrawal limitations, residential GPCD rate, non-residential RCMs
<b>Prescott AMA</b>	Uniform base of 130 GPCD; required reduction based on GPCD; if under base, no requirement	Uniform base of 120 GPCD; all large providers under the 120 GPCD requirement at start of SMP	Component method for base; pop. estimates done yearly; flexibility accounts	N/A	Same in 2nd and 3rd plans; intended for providers with disproportion-ate non-residential use	3 Components: groundwater withdrawal limitations, residential GPCD rate, non-residential RCMs
<b>Santa Cruz AMA</b>	N/A (See Tucson)	N/A (See Tucson)	Component method for base; population estimates done yearly; flexibility accounts	N/A	Same in 2nd and 3rd plans; intended for providers with disproportion-ate non-residential use	3 Components: groundwater withdrawal limitations, residential GPCD rate, non-residential RCMs

Note: A complete summary of the evolution conservation program requirements is available in Appendix E, Summary of the Conservation Programs for the Active Management Areas



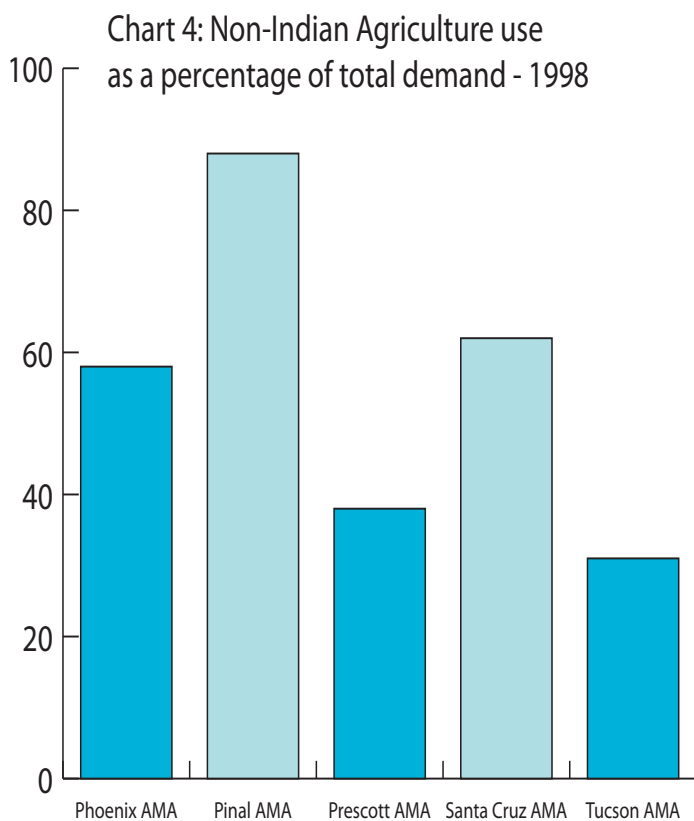
	Non-Per Capita Conservation Program			Institutional Provider Program		
	<i>First Management Plan</i>	<i>Second Management Plan</i>	<i>Third Management Plan</i>	<i>First Management Plan</i>	<i>Second Management Plan</i>	<i>Third Management Plan</i>
Tucson AMA	N/A	Added in 2nd modifications; See 3rd Plan for explanation.	No GPCD requirements; Providers select RCMs to limit use; ground-water limitation requirements for eligibility	Special provider program for providers with 60% use for non-residential purposes; special conserve. requirements	Eligible if 90% of water supplied to institutions; individual mandatory conservation requirements assigned	Identical to 2nd Management Plan. Include residential GPCD requirements
Phoenix AMA	N/A	Added in 2nd modifications; See 3rd Plan for explanation.	No GPCD requirements; Providers select RCMs to limit use; ground-water limitation requirements for eligibility	Special provider program for providers with 60% use for non-residential purposes; special conserve. requirements	Eligible if 90% of water supplied to institutions; individual mandatory conservation requirements assigned	Identical to 2nd Management Plan. Include residential GPCD requirements
Pinal AMA	N/A	Added in 2nd modifications; See 3rd Plan for explanation.	No GPCD requirements; Providers select RCMs to limit use; ground-water limitation requirements for eligibility	Special provider program for providers with 60% use for non-residential purposes; special conserve. requirements	Eligible if 90% of water supplied to institutions; individual mandatory conservation requirements assigned	Identical to 2nd Management Plan. Include residential GPCD requirements
Prescott AMA	N/A	Added in 2nd modifications; See 3rd Plan for explanation.	No GPCD requirements; Providers select RCMs to limit use; ground-water limitation requirements for eligibility	Special provider program for providers with 60% use for non-residential purposes; special conserve. requirements	Eligible if 90% of water supplied to institutions; individual mandatory conservation requirements assigned	Identical to 2nd Management Plan. Include residential GPCD requirements
Santa Cruz AMA	N/A	Added in 2nd modifications; See 3rd Plan for explanation.	No GPCD requirements; Providers select RCMs to limit use; ground-water limitation requirements for eligibility	N/A (See Tucson)	Eligible if 90% of water supplied to institutions; individual mandatory conservation requirements assigned	Identical to 2nd Management Plan. Include residential GPCD requirements

## Agricultural Conservation Program

The Agricultural Conservation Program provides the regulatory conservation requirements for all agricultural users within the AMAs. Among the AMAs, Phoenix and Pinal have the largest agricultural sectors. In Prescott, Santa Cruz, and Tucson, the agricultural sector is a smaller, but still important water user, as seen in Chart 4. While urbanization is replacing agriculture to a varying extent in each of the AMAs, it still accounts for more than half of the total water use in the Pinal, Phoenix, and Santa Cruz AMAs.

According to projections included in the Management Plans, agricultural use is expected to remain an important component of total groundwater use in all AMAs except Prescott through 2025. Because the agricultural sector uses such a large percentage of the groundwater in the AMAs, the conservation program is of critical importance.

The agricultural conservation programs of the AMAs have experienced an accelerating rate of evolution leading up to the third management period. The program began during the first management period with a single regulatory approach. The same regulations continued into the second management period with little change. During the third management period, however, significant changes and additions have taken place. The agricultural conservation



program now provides farms with a variety of options for meeting the conservation goals of the AMAs.

The GMA provides a system for the establishment of irrigation rights for farms irrigated with groundwater at the time the GMA was passed. These irrigation rights are called Irrigation Grandfathered Rights (IGFRs).

To be eligible for an IGFR, the land to which the right is tied must have been irrigated at some point between 1975 and 1979 or significant investment must have been made during this time to bring the land into irrigated use. Land that can be irrigated with an IGFR are designated “irrigation acres” (A.R.S. §45-452.A). Land without an established IGFR cannot be brought into irrigation use unless it qualifies for one of the following exceptions:

- New acreage may be irrigated in place of old acreage (on a one-for-one basis) to allow irrigation with CAP water instead of groundwater;
- State universities may irrigate up to 320 new acres per year with up to 5 acre-feet of water per acre for educational and research purposes. This does not establish a IGFR, however;
- Irrigation acres damaged by flooding may be replaced on a one-for-one basis with new acreage;
- Irrigation acres may be traded on a one-for-one basis to make it easier or more efficient to irrigate because of the shape of a farm or characteristics of the land;
- If an appropriated right existed prior to June 12, 1980, surface water may be used to irrigate new acres (Third Management Plan addition);
- Acreage currently irrigated using surface water may be replaced on a one-for-one basis with new acreage as long as the surface water right is permanently transferred to the new acreage (Third Management Plan addition);
- The Department of Corrections may irrigate up to 10 acres of new land per year with not more than 4.5 acre-feet of water per acre per year in order to produce food for prisoners or as a part of a prison work program (Third Management Plan addition)(ARS §45-452).

The base conservation program of the First and Second Management Plans of each of the AMAs used assigned irrigation efficiency targets, water duties, and water duty acres as the primary conservation tools. Irrigation efficiency is a way of measuring how effectively irrigation water is applied to crops. For example, an irrigation efficiency of 50% indicates that 50% of the irrigation water applied to a field is used in some way by the crop growing in the field, while the remainder is lost to percolation or runoff.

The irrigation efficiency is used to calculate water duties. Water duties are calculated for each farm unit. A farm unit consists of one or more farms irrigated with groundwater and in close proximity to or contiguous with one another with similar soil conditions, crops, and cropping patterns. A farm unit usually has a single IGFR, but could have more than one. The water duty for a farm unit is calculated in several steps. First the total irrigation requirement of the farm unit is calculated. The total irrigation requirement is divided by the total planted acres for the farm unit. Total planted acres are determined by summing the total acres planted from 1975 to 1979 (double cropped acres are counted only once). The result of this calculation is then divided by the assigned irrigation efficiency for the farm unit, resulting in the water duty. The water duty is the maximum amount of water that may be reasonably applied to land with an IGFR each year (ARS §45-465).

The final step in calculating the amount of groundwater that may be applied to a farm unit in a given year is determining the water duty acres. Water duty acres are the maximum number of acres irrigated in any one year from 1975 to 1979. The water duty acres are multiplied by the water duty for the farm unit. The result is the total groundwater allowance (ARS 45-465). Table 2 provides a summary of the evolution of the Agricultural Conservation Program over the course of the first three management periods.

### Current Status

Significant changes to the Agricultural Conservation Program occurred during the third management period. Because of disputes between ADWR and IGFR holders about a reasonable level of irrigation efficiency, the base conservation program was not included in the Third Management Plan when it was promulgated. Instead, the Second Management Plan requirements were carried forward with the addition of a new alternative program, the Historic Cropping Program, and the department worked with stakeholders to arrive at an agreed upon maximum irrigation efficiency of 80%. The base conservation program, along with a new BMP program, was then included in a modification to the Third Management Plan issued in 2003. The Historic Cropping Program was included in the Third Management Plan as the result of legislation passed in 1998 adding the program to the GMA (ARS §45-566.02 and §45-567.02). The Historic Cropping Program is similar in structure to the base program, but sets irrigation efficiency at 75% and limits the accumulation of flexibility credits. No farms have enrolled in the program. The BMP

program was developed to provide an additional option to IGFR holders who were having difficulty complying with their irrigation water duty. Participants are required to select a combination of management practices from each of four categories. The management practices are assigned points and a minimum number of points must be attained to be admitted to the program.

### Stakeholder Perspectives

Agricultural sector stakeholders disagree about the fairness of the base conservation program. Key trends include:

- General agreement about the effectiveness and problems with the conservation program but disagreement about its fairness.
- Agreement that the Agricultural Best Management Practices Program is a step in the right direction.
- Comfortable with standardization across AMAs.

Some stakeholders expressed concern that the department was placing a disproportionate share of the conservation burden on the agricultural sector. While they have learned to work within the system, they are not necessarily happy with the regulations. Others felt that the conservation programs largely did not make a difference because farmers have been able to accumulate so many flexibility credits and alternative conservation programs are now available.

A point of agreement within the agricultural sector interviewees is that the conservation program historically has not provided the flexibility necessary for farmers to respond to changes in the agricultural economy. Because the water allotments for the base conservation program are based on historic irrigation acres and crop mix, it has been difficult for some farmers to adjust crop mix to meet the demands of the shifting agricultural economy. In addition, the program did not differentiate between those that were already operating efficiently versus those with greater conservation potential. Stakeholders also felt flexibility is needed in the process of conversion of agricultural lands to other uses in order to allow for irrigation to continue until development actually begins. The new agricultural BMP program has addressed some of these issues by providing farmers with the flexibility of not being tied to a specific groundwater allocation.

Agricultural stakeholders also agree that the BMP program is a step in the right direction. In addition to providing farmers with flexibility, it is also a step towards a long-term management approach rather than a regulatory approach.

However, some feel the program may be too little too late. Farms near urbanizing areas that anticipate conversion to other uses in the near future are unlikely to enroll because of the investment required to implement management practices. Farms enrolling in the program may have to implement new practices to achieve compliance. If a farm is in an urbanizing area, the time horizon of agricultural use in that area may be too short to recover the investment in new management practices. Though not directly stated by stakeholders, it is also likely that many farms are not participating in the BMP program because they are comfortable with their ability to continue complying with the base agricultural program. Many farms have been able to accumulate a large amount of flexibility credits under the base program, providing a significant cushion for compliance. Appendix B provides a brief summary of the current participation in the BMP program and the program's requirements.

Standardization of conservation requirements is favored by the agricultural sector. Agriculture is facing similar issues in each of the AMAs with significant farming economies. Standardization ensures equity of requirements across AMAs. The agricultural economy is interconnected; cropping patterns in one AMA will affect cropping patterns in the other AMAs. Because of this, a level regulatory playing field is needed.

There was limited discussion with department staff about the agricultural conservation program in the interviews except to say that many felt the flexibility credits have rendered the program ineffective. Most farmers now have enough flexibility credits that they do not have a realistic worry of violating the conservation requirements. There is also a feeling that the agricultural BMP program may be requiring resources out of proportion to its impact on water use because it is used by such a small segment of the regulated community.

## Analysis

A limited number of agricultural stakeholders was interviewed. Some interviews could not be conducted due to lack of response or scheduling difficulties. Therefore, it may be that additional interviews could have affected this summary and analysis. Nevertheless, it is possible to make some observations. Like the municipal sector, the agricultural sector has influenced the modifications to the agricultural conservation programs. As noted in the description of the program, an expensive and

expensive effort resulted in development of an alternative conservation program for agriculture for which there were no takers. That is, despite concerns about the base program and involvement in development of an alternative program, all agricultural entities remained in the base program. This suggests the base program was not as binding or problematic as suggested. Clearly, the flex credits have equipped farmers with significant flexibility. The relatively new BMP program, which is undergoing review, provides even greater flexibility. It was adopted by statute, along with a freeze on the base program efficiency requirement, with the strong support of the sector. Although the original legislation adopting the agricultural BMP program required an assessment prior to its inclusion in the Fourth and Fifth Management Plans, Senate Bill 1557 made the agricultural BMP program a permanent option for the agricultural sector.

A thorough review of the BMP program is needed. Associated with moving away from a water quantity-based program to a best practices approach was the Legislature's recognition that there had to be some assessment of the program relative to water used. Assessment efforts are currently underway. The results of this effort were not available for this study. Finally, it should be noted that due to retirements and staff reassignments, the staff expertise regarding the agricultural sector has changed since the development of the Third Management Plan. However, because the basic framework for the Agricultural Conservation Program is established for the fourth and fifth management periods, this may not be problematic. However, staffing levels could affect efforts to enforce existing programs and/or provide analysis going forward.

**Table 2: Agricultural Conservation Program**

	Base Conservation Program			Historic Cropping Program	Best Management Practices Program
	<i>First Management Plan</i>	<i>Second Management Plan</i>	<i>Third Management Plan</i>	<i>Third Management Plan and Modifications</i>	<i>Third Management Plan and Modifications</i>
<b>Tucson AMA</b>	Base program established. IGFRs assigned an irrigation efficiency of 70% for most farms. Irrigation efficiency assumes reasonable conservation measures and is used to calculate the groundwater allotment for each farm. Flexibility accounts established.	Updated efficiency requirements based on farm management techniques, econ. feasibility, farming conditions and farming practices. New irrigation efficiency was 85% with few exceptions. Assigned efficiency achieved by end of management period with two intermediate periods. Flex accounts.	85% efficiency determined to be unachievable. ADWR worked with the regulated community to establish an assigned irrigation efficiency of 80%. Exceptions permitted for orchards and difficult farming conditions. Flex accounts unchanged.	Optional replacement for the Base Program. Assigns an irrigation efficiency of 75% but limits flex credits. Developed as a result of legislative action. Requires careful farm management to meet efficiency and flex credit standards.	Eliminates water duties and irrigation efficiency for regulated IGFRs. A minimum number of BMPs must be implemented. BMPs must result in water savings equivalent to the base program. Provides farmers with flexibility while still achieving conservation goals. Implemented as a trial program during the 3rd management period to determine if water savings equivalent to the base program could be achieved. Legislation in 2007 made it permanent.
<b>Phoenix AMA</b>	Base program established. Irrigation efficiency requirement assigned based on historic water use by a IGFR. Minimum efficiency was 55%, intermediate efficiency standard was 70% and maximum standard was 85%. Flexibility accounts established.	Updated efficiency requirements based on farm management techniques, econ. feasibility, farming conditions and farming practices. New irrigation efficiency was 85% with few exceptions. Assigned efficiency achieved by end of management period with two intermediate periods. Flex accounts.	85% efficiency determined to be unachievable. ADWR worked with the regulated community to establish an assigned irrigation efficiency of 80%. Exceptions permitted for orchards and difficult farming conditions. Flex accounts unchanged.	Optional replacement for the Base Program. Assigns an irrigation efficiency of 75% but limits flex credits. Developed as a result of legislative action. Requires careful farm management to meet efficiency and flex credit standards.	Eliminates water duties and irrigation efficiency for regulated IGFRs. A minimum number of BMPs must be implemented. BMPs must result in water savings equivalent to the base program. Provides farmers with flexibility while still achieving conservation goals. Implemented as a trial program during the 3rd management period to determine if water savings equivalent to the base program could be achieved. Legislation in 2007 made it permanent.

Note: The Historic Cropping Program was promulgated with the Third Management Plans. The Best Management Practices Program was first added to the Third Management Plans through a modification. A complete summary of the evolution conservation program requirements is available in Appendix E, Summary of the Conservation Programs for the Active Management Areas

<p style="writing-mode: vertical-rl; transform: rotate(180deg);"><b>Pinal AMA</b></p>	<p>Base program established. Minimum assigned irrigation efficiency of 60% assigned to each farm unit. Up to 85% efficiency assigned to farms with more efficient practices already in place. Efficiency target based on economic feasibility. Flexibility accounts established.</p>	<p>Updated efficiency requirements based on farm management techniques, econ. feasibility, farming conditions and farming practices. New irrigation efficiency was 85% with few exceptions. Assigned efficiency achieved by end of management period with two intermediate periods. Flex accounts.</p>	<p>85% efficiency determined to be unachievable. ADWR worked with the regulated community to establish an assigned irrigation efficiency of 80%. Exceptions permitted for orchards and difficult farming conditions. Flex accounts unchanged.</p>	<p>Optional replacement for the Base Program. Assigns an irrigation efficiency of 75% but limits flex credits. Developed as a result of legislative action. Requires careful farm management to meet efficiency and flex credit standards.</p>	<p>Eliminates water duties and irrigation efficiency for regulated IGFRs. A minimum number of BMPs must be implemented. BMPs must result in water savings equivalent to the base program. Provides farmers with flexibility while still achieving conservation goals. Implemented as a trial program during the 3rd management period to determine if water savings equivalent to the base program could be achieved. Legislation in 2007 made it permanent.</p>
<p style="writing-mode: vertical-rl; transform: rotate(180deg);"><b>Prescott AMA</b></p>	<p>Base program established. Minimum assigned irrigation efficiencies were 50%. Low efficiency requirements were the result of difficult farming conditions. Higher efficiency could be assigned to farms with practices already in place. Flexibility accounts established.</p>	<p>Updated efficiency requirements based on farm management techniques, econ. feasibility, farming conditions and farming practices. New irrigation efficiency was 75% with few exceptions. Assigned efficiency achieved by end of management period with two intermediate periods. Flex accounts</p>	<p>85% efficiency determined to be unachievable. ADWR worked with the regulated community to establish an assigned irrigation efficiency of 80%. Exceptions permitted for orchards and difficult farming conditions. Flex accounts unchanged.</p>	<p>Optional replacement for the Base Program. Assigns an irrigation efficiency of 75% but limits flex credits. Developed as a result of legislative action. Requires careful farm management to meet efficiency and flex credit standards.</p>	<p>Eliminates water duties and irrigation efficiency for regulated IGFRs. A minimum number of BMPs must be implemented. BMPs must result in water savings equivalent to the base program. Provides farmers with flexibility while still achieving conservation goals. Implemented as a trial program during the 3rd management period to determine if water savings equivalent to the base program could be achieved. Legislation in 2007 made it permanent.</p>
<p style="writing-mode: vertical-rl; transform: rotate(180deg);"><b>Santa Cruz AMA</b></p>	<p>N/A (See Tucson)</p>	<p>N/A (See Tucson)</p>	<p>85% efficiency determined to be unachievable. ADWR worked with the regulated community to establish an assigned irrigation efficiency of 80%. Exceptions permitted for orchards and difficult farming conditions. Flex accounts unchanged.</p>	<p>Optional replacement for the Base Program. Assigns an irrigation efficiency of 75% but limits flex credits. Developed as a result of legislative action. Requires careful farm management to meet efficiency and flex credit standards.</p>	<p>Eliminates water duties and irrigation efficiency for regulated IGFRs. A minimum number of BMPs must be implemented. BMPs must result in water savings equivalent to the base program. Provides farmers with flexibility while still achieving conservation goals. Implemented as a trial program during the 3rd management period to determine if water savings equivalent to the base program could be achieved. Legislation in 2007 made it permanent.</p>

## Industrial Conservation Program

The GMA defines industrial use of water as “a non-irrigation use of water not supplied by a city, town, or private water company, including animal industry use and expanded animal industry use.” A.R.S. §45-561(5). Industrial groundwater users have a grandfathered right to withdraw groundwater from a non-exempt well if they own a Type 1 or Type 2 industrial water right or a general industrial use permit. The basis of the volume of groundwater available under Type 2 rights is established in the GMA; generally it is based on the highest year of groundwater pumpage between 1975 and 1979 for a non-irrigation use. Groundwater withdrawals associated with Type 1 rights may increase over time as agricultural rights are extinguished and converted into non-irrigation grandfathered rights (ARS §45-463-464). General industrial use permits may be issued when a new industrial user cannot receive water from a municipal provider, surface water, effluent, or a retired irrigation grandfathered right. These permits are issued for a specific time period (ARS §45-515). Industrial users may also receive a quantity of groundwater from an irrigation district equal to the amount it was entitled to from the district on June 12, 1980. Finally, “individual users” established under the Municipal Conservation Program (these are specific categories of industrial users served by municipal water companies) are also subject to the rules of the Industrial Conservation Program.

The Industrial Conservation Program divides industrial users into a number of different categories based on the activity pursued by the user. As of the Third Management Plan, the categories include:

- Turf Related Facilities ( $\geq 10$  acres)
- Sand and Gravel Facilities ( $> 100$  acre-feet/year)
- Metal Mining Facilities ( $> 500$  acre-feet/year)
- Large-Scale Power Plants ( $> 25$  megawatts)
- Large-Scale Cooling Facilities ( $> 1,000$  tons)
- Dairy Operations (monthly average  $\geq 100$  lactating cows/day)
- New Large Landscape Users ( $> 10,000$  square feet of water intensive landscape)
- New Large Industrial Users ( $>100$  acre-feet/year)
- Cattle Feedlot Operations
- Other Industrial Users

None of the AMAs contains a user from all of the industrial categories. Each AMA has a unique combination of industrial users present; the Phoenix AMA has the most industrial use by volume and the most categories represented while the Prescott AMA has the least industrial use by volume, as seen in Table 3.

### Current Status

Unlike the municipal and agricultural sectors, the Industrial Conservation Program does not provide a base program for industrial water users. Instead, there is a specific conservation program either requiring the use of specific technologies and management practices or establishing an allocation based on the use of those technologies and practices for each industrial sub-sector, as noted above. The conservation requirements for each sub-sector are summarized in Table 4.

**Table 3: Total Industrial Demand by AMA**

	Phoenix	Tucson	Pinal	Prescott	Santa Cruz
1985	73,485 ac-ft		4,801 ac-ft		1,393 ac-ft
1987		40,872 ac-ft			
1990	73,767 ac-ft	48,743 ac-ft	5,596 ac-ft	444 ac-ft	1,328 ac-ft
1992				443 ac-ft	
1995	83,088 ac-ft	60,204 ac-ft	6,704 ac-ft	555 ac-ft	1,363 ac-ft
1997				626 ac-ft	
1998		57,500 ac-ft	8,292 ac-ft		
1999					1,469 ac-ft
2000	126,333 ac-ft				
2005		54,200 ac-ft			

## Stakeholder Perspectives

Because of the diversity of water users in this sector and the fact that some are located in some AMAs but not others, only some sectors were interviewed. This summary, therefore, cannot be considered broadly representative. The stakeholders interviewed stated that their industries had considerable input into the regulations and, consequently, they considered the conservation program generally fair. Key trends include:

- Agreement that the regulations are generally fair;
- Feel limitations of commodity driven economies not fully considered; and
- Feel caught between ADWR and the Department of Environmental Quality.

Stakeholders noted that the department had very limited expertise in most industrial sub-sectors. This has been an impediment to an ADWR-led effort to develop effective conservation programs for different industrial users. In most cases the industrial sub-sector has guided the department in the development of the conservation regulations, resulting in relatively easy to satisfy conservation requirements. Stakeholders feel the department will need to develop expertise in the various sub-sectors if they hope to have more effective conservation programs in the future.

Concerns were expressed in two areas. First, stakeholders noted that it can be difficult for commodity-based industries to pass additional conservation costs on to customers. The commodity markets define the price received for products; therefore, they cannot simply add the incremental cost of conservation onto the cost of their product. This is especially a concern during economic downturns when the incremental cost of conservation increases. Second, industrial users at times find themselves caught between ADWR regulations and Arizona Department of Environmental Quality regulations. Interviewees would like to see these departments work together to ensure their regulations are complementary.

The comments by ADWR staff regarding the industrial conservation program mirrored the comments of the industrial sector stakeholders. Staff indicated that the industrial requirements, with the exception of turf, are lenient and that the expertise does not exist within the department to strengthen them. Because of the industrial sector's near-exclusive reliance on groundwater and its growth, this deficiency needs to be addressed.

Growth in the industrial sector is a particular area of concern not only for ADWR staff, but also for representatives of the municipal and agricultural sectors. The concern is centered on the rules governing the issuance of General Industrial Use (GIU) permits. Generally, new industrial water users that do not have an existing industrial water right, are outside the service area of a municipal provider, and do not have access to surface water or effluent shall be issued a GIU permit (ARS §45-515). The GIU permit allows the industrial user to pump groundwater. There is no limit on the number of GIUs that may be issued in an AMA and there is no discretion regarding permit issuance if the criteria are met. Many stakeholders worry that as industrial use in the AMAs grows, GIU permits could impede progress toward achieving safe-yield.

## Analysis

The industrial sector is diverse. Effective conservation programs require knowledge of the sub-sector. There is a wide disparity of industries in this sector, making it difficult for ADWR to have the technical expertise related to industry best management practices. Development of conservation programs, therefore, requires reliance on expertise from the regulated industry or, at times, from consultants. Regulations for most industrial sub-sectors take a best management practices approach. This appears to have resulted in regulations that are less binding for some sub-sectors than for others. The turf sub-sector regulations are volumetric and water users, especially golf courses, have found conservation program constraints binding.

Because the industrial sector has the ability to expand its groundwater pumping over time, it is extremely important that it be given sufficient attention during the management plan development process as well as via enforcement. An example that came up in one interview related to cooling systems for electric power generation. Currently, wet cooling is less expensive and therefore the mechanism of choice. However, changes in the economics of dry cooling may make it a feasible option for some types of power generation. Likewise, technological changes in other sub-sectors may change the economic feasibility of lower water use technologies. Discussion of other issues that were raised, particularly relating to the issuance of General Industrial Use permits, are beyond the scope of this study.



**Table 4: Industrial Conservation Program**

	All Industrial Users			Turf-Related Facilities >10 acres			Sand and Gravel >100 acre-feet of water		
	<i>First Management Plan</i>	<i>Second Management Plan</i>	<i>Third Management Plan</i>	<i>First Management Plan</i>	<i>Second Management Plan</i>	<i>Third Management Plan</i>	<i>First Management Plan</i>	<i>Second Management Plan</i>	<i>Third Management Plan</i>
<b>Tucson, Phoenix, Pinal, Prescott, and Santa Cruz AMAs</b>	Avoid waste and make diligent efforts to recycle water, conservation requirements on latest commercially conservation technology consistent with reasonable economic return. Prohibited from using single-pass cooling or heating. Waiver provision.	Single-pass cooling or heating is not allowed unless water is reused. Low-flow plumbing fixtures codes were adopted by state and local governments.	Modified waiver language. Deleted waivers for prohibiting new water features within publicly owned rights-of-way. Monitoring and reporting requirements revised based on more technical information.	Maximum annual water allotment. Application rates were developed. Adjustment of turf application rates if effluent was used.	For golf courses, application rates adjusted to reflect 23.8 acre-foot per hole limitation for new golf courses after 1984. Annual or 3-year average compliance basis. New limits on water-intensive landscaped area within new cemeteries. Effluent use incentives.	Flexibility accounts for both credit and debit limits set at 20 percent of the maximum annual water allotment. Discounted all direct effluent use by 30 percent. All turf-related facilities are required to prepare and maintain a water conservation plan.	Conservation requirements to recycle wash water using disposal ponds or clarifiers. Divert to the max. extent possible runoff water to ponds for reclamation. Alternative conservation methods allowed to be submitted to ADWR Director for consideration.	Same as first management plan plus required to submit a conservation plan identifying specific water-saving methods.	Same as Second Management Plan with the requirement to implement two additional conservation measures.

Note: A complete summary of the evolution conservation program requirements is available in Appendix E, Summary of the Conservation Programs for the Active Management Areas.

	Large-Scale Cooling Facilities >250 tons			New Large Landscape Users		
	<i>First Management Plan</i>	<i>Second Management Plan</i>	<i>Third Management Plan</i>	<i>First Management Plan</i>	<i>Second Management Plan</i>	<i>Third Management Plan</i>
<b>Tucson, Phoenix, and Prescott AMAs</b>	No requirements	Required to have 2,000 mg/l of total dissolved solids in recirculating water before blowing it down for new facilities in operation after January 1, 1990. Monitoring and reporting requirements.	Total dissolved solids standard changed to silica-and hardness-based standards. Same monitoring and reporting requirements. Added all facilities, not just “new “ facilities with an aggregate cooling capacity of 1,000 tons or more.	No requirements	Non-residential facilities that are hotels or motels or Non-residential facilities that are not hotels or motels. Water usage based on square footage of landscaped areas. Conservation requirements.	Excluded schools, parks, cemeteries, golf courses, common areas of housing developments and public recreational facilities from the conservation requirements for new large landscape users. Added more limits on percentage of water-intensive landscaped area.

	Large-Scale Power Plants > 25 mgwatts			Dairy Operations>100 cows		
	<i>First Management Plan</i>	<i>Second Management Plan</i>	<i>Third Management Plan</i>	<i>First Management Plan</i>	<i>Second Management Plan</i>	<i>Third Management Plan</i>
<b>Tucson, Phoenix, and Pinal AMAs</b>	Conservation requirements for cooling towers, makeup water.	Same as First Management Plan	Minor revisions on cycles of concentration requirements. Technical terms clarified. Monitoring and reporting requirements revised to allow water quality data terminology.	No requirements	Maximum annual water allotment based on no. of cows.	Alternative conservation program allowed: best management practices

	New Large Industrial Users >100 ac-ft water/year after 1/1/1990			Cattle Feedlot Operation >100 beef cattle per day during a calendar year		
	<i>First Management Plan</i>	<i>Second Management Plan</i>	<i>Third Management Plan</i>	<i>First Management Plan</i>	<i>Second Management Plan</i>	<i>Third Management Plan</i>
<b>Phoenix and Pinal AMAs</b>	No requirements.	New large industrial users in excess of 100 acre-feet of water commencing after 1/1/2000. Submit a water conservation plan identifying opportunities for conserving water.	Same requirement as 2nd MP. No new large industrial users identified in AMA in 3rd MP	No requirements.	Maximum annual water allotment.	No changes.

	Metal Mining Facilities		
	<i>First Management Plan</i>	<i>Second Management Plan</i>	<i>Third Management Plan</i>
<b>Tucson and Pinal AMAs</b>	For facilities built after 1984, transport of tailing densities 40 percent solids by weight. Prepare long-range conservation densities plans. Best management practices. Install new wells to intercept tailings seepage.	Tailing densities increase to 45 percent for existing facilities and 50 percent for new facilities. Long-range conservation plan	Deleted requirement to install wells to intercept tailings seepage. Provision added to address possible conflict between water conservation requirements and other environmental regulations. Transport tailings at an average density of 48 percent solids by weight.

## Augmentation and Recharge Program

Beginning with the second management period, all Active Management Areas (AMAs) have been required to develop an Augmentation and Recharge Program. The purpose of this program is “to encourage the development, delivery, storage, and use of water supplies now and in the future.” In 1986, provisions were added to the GMA requiring that recovery projects outside the area of impact of storage and within an AMA be consistent with the management plan and management goal of the AMA where the recovery is taking place (ARS §45-807). In 1994 the statute was amended to require that persons recovering water other than the storer must obtain a determination that recovery is consistent with the management plan, even if the recovery is within the area of impact (ARS §45-834.01). The statute was amended a third time in 2004 to allow for recovery of Colorado River water within the area of impact by anyone without a determination of consistency (ARS §45-834.01). Non-recoverable storage is required to be consistent with the augmentation program of the AMA where storage is occurring (ARS §45-652; later replaced with identical language by ARS §45-833.01).

The requirements for consistency with the management plans provide the basis for including the Augmentation and Recharge Program regulations in the management plans and enforcing their provisions. One of the most significant regulatory requirements of the program is the draw-down criterion for recovery wells outside the area of impact of storage. In order to be considered consistent with the management plan, recovery wells outside the area of impact must be sited in an area where the average decline in groundwater level is not greater than four feet per year.

Augmentation through recharge is an important component for all of the safe-yield AMAs efforts to achieve and maintain safe-yield by 2025 and beyond. The Augmentation and Recharge Program is intended to

help balance withdrawals and recharge through activities that augment natural recharge. Thus, the program is complementary to the industrial, agricultural, and municipal conservation programs, which attempt to reduce overall demand for groundwater.

The Augmentation and Recharge Program is supported by groundwater withdrawal fees in all of the AMAs. A withdrawal fee of \$1.50 per acre-foot pumped was charged in the Tucson and Phoenix AMAs during the second management period. Prior to this, the Tucson AMA had charged a fifty cent groundwater withdrawal fee to fund the pilot Alamo Wash/Rillito Creek Recharge Project. By the Third Management Plan, the groundwater withdrawal fee in these AMAs had increased to three dollars per acre-foot (of this, \$2.50 goes to fund the Arizona Water Banking Authority). In the Prescott AMA, the withdrawal fee was \$1.00 during the second management period. In the Pinal AMA, the withdrawal fee started at \$0.25 in 1990, increased to \$0.35 in 1991, and was increased again in 1994 to \$0.50. When the Santa Cruz AMA was created in 1994 a withdrawal fee of \$0.50 was imposed (Table 5).

Early in the program, additional funding for the Augmentation and Recharge Program comes from enforcement actions for non-compliance with the conservation programs and surcharges for the temporary use of groundwater to fill artificial lakes. Decisions regarding specific augmentation programs and allocation of funding were left to the individual AMAs. Table 6 below shows the status of the Augmentation and Recharge Programs of each of the AMAs over time.

### Stakeholder Perspectives

There were only a few comments from stakeholders during the interviews about the current status of the Augmentation and Recharge Program. Most of the comments about augmentation, recharge, and recovery focused on changes

**Table 5: Maximum Groundwater Withdrawal Fees**

	<i>First Management Plan</i>	<i>Second Management Plan</i>	<i>Third Management Plan</i>
<b>Tucson AMA</b>	\$0.50	\$1.50	\$3.00
<b>Phoenix AMA</b>	N/A	\$1.50	\$3.00
<b>Pinal AMA</b>	N/A	\$0.25 increased to \$0.50	\$0.50
<b>Prescott AMA</b>	N/A	\$1.00	\$1.00
<b>Santa Cruz AMA</b>	N/A	\$0.50	\$0.50

needed in the future and are considered in the next section. Remarks about the current recharge and recovery regulations focused on the equity of the regulations and the Central Arizona Groundwater Replenishment District (CAGRDR).

The municipal sector is very concerned about recharge and recovery well regulations and the operations of the CAGRDR. Most do not feel that the current regulations are fair because the pumping and replenishment regulations governing the CAGRDR and its members differ substantially from the storage and recovery regulations governing the use of renewable supplies by municipal providers. Many municipal providers feel addressing these differences is a critical issue for the AMAs, although management plans may not be the vehicle to do so. Use of the recharge and recovery program is essential to achieving safe-yield. Both CAGRDR membership and the Augmentation and Recharge Program provide flexibility in use of renewable supplies. However, it is believed by some that the water management considerations associated with management plan restrictions on recovery of stored water should be extended to excess groundwater pumping by CAGRDR members.

The agricultural sector also has concerns about the provisions of the Assured Water Supply rules, including the role of the CAGRDR. One of the perceived incentives for agriculture under the GMA was the ability to convert irrigation water rights into rights that could be used by developers. This would increase the value of agricultural land when sold for conversion because the land would come with otherwise unavailable water rights. However, much development is occurring without converting irrigation rights, limiting the value of irrigation rights. The agricultural sector would like to see changes to the rules to increase the value of their irrigation water rights.

## Analysis

The stakeholder interview summary adequately addresses the main concern raised, which is a significant one. The issue is the divergence between the regulations associated with use of renewable water supplies through recharge and recovery versus groundwater pumping and replenishment by the CAGRDR. All of these regulations fall outside of the management plans except for the draw-down regulation for recovery wells. Groundwater pumping by CAGRDR members can be from any and all wells available to the water providers that are either CAGRDR Member Service

Areas or serving water to CAGRDR Member Lands. Except for wells permitted to recover stored water, there is no individual well decline criterion. As long as development is not projected to depend on groundwater below the "feet below land surface" limitation of the Assured Water Supply Rules, pumping can occur regardless of the rate of groundwater draw-down at individual wells. The CAGRDR replenishes its members' excess groundwater use after the fact. There is no official recovery of renewable water supplies when renewable water supplies are used through the CAGRDR replenishment mechanism. However, for those water providers, such as many holders of CAP subcontracts, that that rely on before-the-fact storage and later recovery as a mechanism to utilize renewable water supplies, the four-foot draw-down criterion for permitting recovery wells applies. This issue is perceived not only as an equity issue but, depending on storage and well locations, one that has potentially significant groundwater availability implications. There are related equity issues with groundwater pumpage by undesignated water providers that serve pre-1995 demand.

Another issue related to the management plan recovery well regulations relates to the standardization across the AMAs – or even within AMAs. Water management considerations may indicate the need for differential draw-down regulations.

Lack of additional discussion of recharge and recovery in this report reflects the limited direct nexus of this program to the management plans.

**Table 6: Recharge and Recovery Program**

	Program Goals and Objectives			Program Funding		
	<i>First Management Plan</i>	<i>Second Management Plan</i>	<i>Third Management Plan</i>	<i>First Management Plan</i>	<i>Second Management Plan</i>	<i>Third Management Plan</i>
<b>Phoenix AMA</b>	N/A	Maximize CAP and surplus water use, maximize recharge, explore inter-regional water transfers, overcome obstacles for alternative supplies, research.	Focus on “critical areas,” maximize use and storage of renewable supplies, address localized water supply problems, focus AWBA storage in critical areas.	N/A	\$1.50 per acre-foot withdrawal fee charged to fund programs. Additional funding from enforcement actions.	\$3.00 per acre-foot withdrawal fee, of which \$2.50 goes to AWBA. Additional funding from enforcement.
<b>Pinal AMA</b>	N/A	Maximize CAP and surplus water use, maximize recharge, explore inter-regional water transfers, overcome obstacles for alternative supplies, research.	Focus on “critical areas,” maintain use of CAP water, encourage muni. providers to use CAP, create and implement an AMA augmentation plan	N/A	Withdrawal fee started at \$0.25 and went up to \$0.50 per acre-foot. Additional funding from enforcement	Withdrawal fee remains \$0.50. Additional funding from enforcement actions.
<b>Prescott AMA</b>	N/A	Maximize CAP use, maximize recharge, explore inter-regional water transfers, overcome obstacles for alternative supplies, research.	Focus on “critical areas,” create a replenishment district, develop a regional recharge plan, other goals similar to Second Management Plan.	N/A	\$1.00 per acre-feet withdrawal fee charged to fund programs. Additional funding from enforcement.	\$1.00 per acre-foot withdrawal fee charged to fund programs. Additional funding from enforcement.
<b>Santa Cruz AMA</b>	N/A	N/A	Maintain existing water resources, secure renewable supplies, prevent long-term groundwater declines, explore augmentation and recharge options	N/A	In 1994 when AMA was created, a \$0.50 per acre-foot withdrawal fee was imposed.	\$0.50 per acre-foot withdrawal fee continues. Additional funding from enforcement
<b>Tucson AMA</b>	Small demonstration project conducted in Rillito River.	Maximize CAP and surplus water use, maximize recharge, explore inter-regional water transfers, overcome obstacles for alternative supplies, research.	Focus on “critical areas,” increase renewable water use, maximize CAP storage, increase storage by AWBA in the AMA	\$0.50 per acre foot withdrawal fee charged to fund Rillito River demonstration project.	\$1.50 per acre-foot withdrawal fee charged to fund programs. Additional funding from enforcement actions.	\$3.00 per acre-foot withdrawal fee, of which \$2.50 goes to AWBA. Additional funding from enforcement.

<b>Underground Water Storage, Savings, and Replenishment Program</b>			
	<i>First Management Plan</i>	<i>Second Management Plan</i>	<i>Third Management Plan</i>
<b>Phoenix AMA</b>	N/A	Storage should take place where groundwater is in use or needed in the future or to help with mitigation; recovery where it will help with mitigation or where there is a less than 4 foot decline in groundwater level	Statutorily defined storage and recovery criteria; introduces long and short term credit concepts; regulations for non-recoverable water; storage targeted to where it can be used directly
<b>Pinal AMA</b>	N/A	Storage should take place where groundwater is in use or needed in the future or to help with mitigation; recovery where it will help with mitigation or where there is a less than 4 foot decline in groundwater level	Statutorily defined storage and recovery criteria; introduces long and short term credit concepts; regulations for non-recoverable water; storage targeted to where it can be used directly
<b>Prescott AMA</b>	N/A	Storage should be up gradient of active wells, contribute to mitigation, or in an are experiencing a 1.5 foot groundwater decline; recovery where it will help with mitigation or where there is a less than 1.5 foot decline in groundwater level	Statutorily defined storage and recovery criteria; introduces long and short term credit concepts; regulations for non-recoverable water; storage targeted to where it can be used directly
<b>Santa Cruz AMA</b>	N/A	N/A	Statutorily defined storage and recovery criteria; introduces long and short term credit concepts; regulations for non-recoverable water; storage targeted to where it can be used directly
<b>Tucson AMA</b>	N/A	Storage should take place where groundwater is in use or needed in the future or to help with mitigation; recovery where it will help with mitigation or where there is a less than 4 foot decline in groundwater level	Statutorily defined storage and recovery criteria; introduces long and short term credit concepts; regulations for non-recoverable water; storage targeted to where it can be used directly

Note: A complete summary of the evolution conservation program requirements is available in Appendix E, Summary of the Conservation Programs for the Active Management Areas.

## THE MANAGEMENT PLAN DEVELOPMENT PROCESS

### Overview

The management plan development process is marked by extensive stakeholder involvement. The stated purpose of this process is to understand stakeholders' perspectives on the conservation programs in order to create reasonable but effective plans. The primary vehicles for facilitating stakeholder involvement and input into the development of the management plans are the Groundwater Users Advisory Councils (GUACs) and the Technical Advisory Committees (TACs). The role of the GUAC with respect to the management plans as defined by the GMA, is to advise the AMA director on the management plans and their provisions before the plans are promulgated (ARS §45-421). The TACs operate as advisors to the AMAs on the specific provisions of the conservation programs. All AMAs have GUACs, while only the larger AMAs have relied on TACs in the management plan development process. Generally, the GUACs have been more involved in management plan development in AMAs where TACs are not used.

### Stakeholder Perspectives

Stakeholders and department staff expressed a number of opinions about the management plan development process, including:

- Most stakeholders were disappointed with the results of the stakeholder process, especially leading up to the Third Management Plan.
- Department staff felt the Third Management Plan was a missed opportunity to make substantive changes to the conservation programs and were also disappointed with the process.
- The process was too narrowly focused and too slow.

Only the stakeholders interviewed from the industrial sector felt the management plan process was as effective as it could have been.

While most stakeholders acknowledged the efforts the Department of Water Resources made to solicit stakeholder opinions and participation in the development of the plans, many felt very limited in what they were able to comment on. This feeling is especially strong in reference to the Third Management Plan. After being told that "everything is on

the table," even changes that would require action by the legislature, the department retreated and made only minor changes to the conservation programs. Many people felt this was a missed opportunity to make meaningful changes to address the flaws of existing conservation programs. People were discouraged because they felt that the department had "changed the rules of the game" in the middle of the process. Many saw this as a breach of trust that contributed to undermining stakeholder confidence in the department.

Staff acknowledged this was an issue, and many were disappointed that changes requiring legislative action could not be made. At the beginning of the process, they did not realize significant changes requiring legislative action would not be possible. Moving from an "everything is on the table" mode to only making small changes to the plans after so much time had been invested caused an acknowledged degradation of trust between the department and stakeholders and also a decline in morale at the department. The intention of staff was not to deceive stakeholders. But as the process progressed it became clear that a number of factors would prevent anything more than minor changes, including: political pressure, lack of time to make legislative changes before the management plan was due, and fear of "opening a can of worms" and losing more in the process than was gained. As a result, only small adjustments to existing conservation programs were possible.<sup>2</sup>

The development of the Third Management Plan was marked by a very long stakeholder process. Many stakeholders described it as painful and slow and recall

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<sup>2</sup> Instead of addressing legislative changes through the Third Management Plan development process, the department initiated a process that led to the June 2000 formation of the Governor's Water Management Commission. Task forces were formed at the AMA level to consider the status of water management. Their analysis and information then fed into the work of the Governor's Water Management Commission. The Commission was formed to evaluate the Groundwater Management Act's progress toward achieving its goals, consider additional approaches to reducing groundwater use in the AMAs, and to recommend changes required to allow the AMAs to reach their goals. The Commission pursued its mandate through an extensive public process. The Commission ultimately produced approximately 50 recommendations, including many that would require statutory change. There has been little follow-up on most of the recommendations included in the Commission's December 2001 Final Report. Although many of the recommendations are pertinent to current-day discussions regarding achievement of the management goals of the AMAs, few of the recommendations have been actively debated in recent years.



being burnt out by the end of the process. While each sector expressed the same general concern about the stakeholder process leading up to the management plans, each also had specific concerns related to their experience.

The municipal sector was the most disillusioned with the process. They felt they were not listened to during the process and serious concerns about the conservation programs were ignored. The process was often described as formulaic and many felt the department knew what it wanted from the beginning and was only conducting a stakeholder process because it felt it had to for credibility. The municipal sector also felt that the process was too narrowly focused on specific details of the conservation programs at the expense of the big picture. Representatives of this sector also felt that the Groundwater Users Advisory Councils (GUACs) were only marginally effective, particularly in the larger AMAs. In the larger AMAs the Technical Advisory Committee process performed the advisory role that the GUACs served in the smaller AMAs.

The agricultural sector felt they were listened to only after they fought to be heard. This is exemplified by the challenge to the agricultural base conservation program of the Third Management Plan. Only after this challenge did the department sit down with representatives of the sector and listen to their concerns. Though agricultural sector representatives were involved throughout the development of the management plans, because the department proposed a conservation standard the sector felt was impossible for them to comply with, it was clear to them that they were not being listened to.

The industrial sector was most satisfied with the results of the management plan development process. This is largely a result of the very specific nature of the conservation program requirements for different industrial sub-sectors. Because the department did not have expertise in all of the industrial sub-sectors, the stakeholders had a great deal of influence over the regulations. However, stakeholders did express concerns with the process moving too slowly, lacking a clearly articulated goal, and being problem oriented instead of solution oriented.

Dissatisfaction with the management plan development process is not limited to stakeholders. Many of the Department of Water Resources employees interviewed expressed similar concerns about the process. They too were disappointed with the process leading to the Third Management Plan and felt it was a missed opportunity

to make larger changes to the conservation programs. However, Department of Water Resources' employees do generally feel that they listen to and act on stakeholder comments to a greater degree than other regulatory agencies.

## Analysis

ADWR undertakes an intensive process to gather stakeholder input as part of the development of the management plans. The frustration surrounding the process may stem from different expectations regarding what should come out of the process rather than the process itself. The ADWR Director has a statutory responsibility to adopt the management plans, the requirement portions of which are regulatory. The process, however, is different from the traditional rule-making process common at the state level. Nevertheless, the management plans include several regulatory programs, as well as information providing the context for them. The management plan *process* tends to have considerable flexibility and opportunity for stakeholder input, both informal and formal, built into it. All agree that the plans to date were developed with significant stakeholder input. But regulatory programs are not usually written by those regulated. In the early years when ADWR staff was finding its way and forging new programs, the process may in fact have been more open than in later years, when a more mature agency was refining its programs.

As the water community sets to embark on the development of the Fourth Management Plans, the process and content are both of high interest. As noted, the statutory requirements for the fourth and fifth management periods are vague. Recent statutory changes requiring a municipal BMP program as the base conservation program and making permanent the optional agricultural BMP program remove some of the uncertainty about the underlying framework. The required modifications to the Third Management Plans resulting from these statutory changes are underway as this report is being prepared. The industrial sector conservation framework is unlikely to change much given current staffing levels and lack of data to suggest changes are necessary. Therefore, what remains of central interest is the content of the Fourth Management Plans themselves.

Key to any determination of future approach is evaluation of the effectiveness of the management plan regulatory programs to date. This is considered in the next section.

## **DETERMINING EFFECTIVENESS OF THE CONSERVATION PROGRAMS BASED ON MANAGEMENT PLAN INFORMATION**

When undertaking this study, the study team anticipated that it would discuss “the performance of the Management Plans relative to the anticipated effectiveness based on the research done in the prior tasks.” It was expected that through examining reported and projected reductions in groundwater use, as reflected in ADWR-prepared water budgets and Chapter Three of the management plans on the water use characteristics of each AMA, an effectiveness measure or proxy could be developed.

Quantifying reductions in water use that result from the Management Plan regulatory provisions is a difficult and complex task. This is especially true if the source of information is the Management Plans themselves. While the Management Plans contain considerable characterization of water use in the AMAs and include the details of the regulatory programs, they include little consistent information on actual water usage by individual water providers/users, over time. The lack of reported data makes it difficult to assess savings due to the conservation programs. Because the conservation programs and characteristics of each of the regulated sectors – municipal, agricultural, and industrial – vary, the challenges for determining the effectiveness of the regulations for each sector are unique. However, the common theme is that the Management Plans do not contain information that enables measurement of water savings due to the conservation programs.

### **Municipal**

Through the first three management periods, the Total GPCD Program has been the base conservation program for the municipal sector. This program requires large municipal providers to reduce total GPCD water use, including both residential and non-residential water use. It is difficult to determine any clear municipal conservation trends as a result of the Total GPCD Program, both at the AMA level and at the individual provider level, from the management plans.

Perhaps the most significant challenge to determining the effectiveness of the Municipal Conservation Program is the general lack of provider-by-provider trends in GPCD rates. Each of the management plans provides a GPCD

rate for all the large providers within the AMA in order to establish a base rate for ongoing conservation targets. This data are very limited and inconsistent, however. With the exception of the Prescott AMA, only three data points are available for each large provider. There are not enough data to allow for a meaningful or conclusive analysis.

These limited data show that only the Phoenix AMA has seen a decline in GPCD rate for most large providers. However, the Phoenix AMA also has the highest average use by a large margin, indicating that there is perhaps greater conservation potential. The Prescott AMA Third Management Plan provides yearly data for its two large providers. Unfortunately, the data show a consistent upward trend in GPCD rates for both providers. This could indicate that the Total GPCD Program is ineffective in the Prescott AMA, but the overall number may be affected by the addition of customers, such as commercial or industrial customers, that skew the data upward. The plans do not contain data sufficient for sorting out the source of the upward trend. A problem with using a total GPCD rate is that the numbers can show trends that depend on the mix of customers rather than the water use trends of a particular class of customers.

The data available over time for the Tucson and Santa Cruz AMAs are inconsistent, hampering attempts at analysis. The First Management Plan for the Tucson AMA reports a total GPCD rate for each large provider, the Second Management Plan reports residential GPCD rates, and the Third Management Plan reports separate GPCD rates for single family residential, multi-family residential, non-residential, turf, and lost water. To the extent that Santa Cruz AMA data are available for the first and second management periods, they are reflected in the Tucson AMA data. No trends are apparent for large providers in the Pinal AMA. Finally, the change in definition of large providers has led to data gaps for some providers.

Table 7 shows overall GPCD rates for each of the AMAs over time. The figures in Table 7 represent all water uses associated with municipal water provision, including residential, commercial and some industrial uses. While the figures can be used to examine gross trends over time, they do not provide insight into the effectiveness of the conservation programs. Only the Phoenix AMA shows a consistently downward trend over time in the AMA-wide GPCD rate.

**Table 7 : Municipal Sector Gallons Per Capita Day by AMA over Time**

	Phoenix AMA	Pinal AMA	Prescott AMA	Santa Cruz AMA	Tucson AMA
<b>1985</b>	308	220	131	178	176
<b>1990</b>	301	228	141	199	169
<b>1995</b>	282	225	147	189	172
<b>1998</b>	278	214	N/A	N/A	172

Notes: Pinal AMA data includes only larger providers. All others include all providers.

Lack of a consistent downward trend does not lead to a conclusion of ineffectiveness, however. There are a number of factors that affect GPCD rates. An ongoing factor has been weather variation. Over time, the regulations of the Total GPCD Program have been adjusted to better account for variations in water use as a result of weather. It is difficult to disentangle the effect of weather from the impacts of conservation efforts. In addition, growth of population, changing demographics, and changes in the water use characteristics, including the extent of commercial and industrial water provided by municipal water providers, can have an impact on GPCD rates.

It is also impossible to know what GPCD rates would have been within the AMAs without the regulatory municipal conservation programs. Without the conservation programs, it is possible GPCD rates would have increased, and that the management plans have been effective by holding rates below what they would have otherwise been. Alternatively, new technologies, concerns over drought, and other factors may have contributed more to stable or declining GPCD rates than the conservation programs themselves.

In summary, the data necessary to develop even simple metrics for the effectiveness of the municipal conservation programs are not included in the management plans. Furthermore, a quantitative study that controls for several important factors is necessary to quantify the effectiveness of the conservation programs to date. Data for intervals more frequent than every 10 years would be useful to such a study. Such a data collection and analysis effort was clearly beyond the scope of this study. The scope of the study did not include (1) original, quantitative research on measuring the effectiveness of conservation programs nor (2) scrutiny of documents internal to ADWR and stored on an AMA-by-AMA basis.<sup>3</sup>

3 Gustafson et. al. conducted a study of municipal providers in the greater Phoenix area using the Phoenix AMA

### Agricultural

As with the municipal sector, there are no consistent trends in agricultural water use reported in the management plans specifically attributable to the agricultural conservation program. The management plans provide basic information about agricultural water use at the AMA level and at the irrigation district level. Based on this information alone, there is no discernable trend in agricultural water use, as can be seen in Table 8.

The lack of a clear trend in the agricultural sector and the resulting inability to determine the effectiveness of the agricultural conservation program is the likely result of a number of factors. Stakeholders frequently noted that weather plays a large role in the irrigation demands of farms. In addition, the management plans themselves acknowledge the difficulty in determining the effectiveness of the agricultural conservation program because of the impact of the agricultural economy on water use. The mid-1990s’ spike in water use by the agricultural sector seen in Table 8 may be the result of an increase in planted acres due to new agricultural incentives and a strong economy. Continued conversion of agricultural land to municipal uses results in a reduction in agricultural water use independent of conservation.

Finally, very few farms actually use their full irrigation allotment. The amount of planted and irrigated acres during the baseline period of 1975 to 1979 was very high relative to average conditions. As a result, agricultural Irrigation Grandfathered Rights are generous. The agricultural sector has accumulated a huge amount of

Third Management Plan and other data. This study reached similar conclusions about determining the effectiveness of the municipal conservation program, stating, “A myriad of factors may influence patterns of residential water consumption and conservation programs including land-use history, water portfolios and infrastructure, population density and growth rates”(Gustafson et.al. 2007).

**Table 8: Agricultural Demand by AMA (acre-feet) over Time**

	Pinal AMA	Phoenix AMA	Prescott AMA	Santa Cruz AMA	Tucson AMA
<b>1985</b>	754,888	1,363,530		8,960	
<b>1987</b>					104,075
<b>1990</b>	757,376	1,023,970	6,932	11,603	90,849
<b>1995</b>	840,750	1,109,105	9,217	12,884	93,816
<b>1997</b>			7,572		
<b>1998</b>	803,674	1,021,155			94,800

flexibility credits and has generally not struggled to comply with the conservation program. One interpretation of this is that the agricultural conservation program has not been particularly effective over the first three management periods.

### Industrial

There are essentially no indicators available to determine the effectiveness of the industrial conservation program. Industrial use has been increasing in all of the AMAs except for the Tucson AMA. This increase is the result of new industrial users. With the exception of mining data from the Tucson AMA, no information is provided in the management plans at the individual user level. As a result, there is no way to determine if the conservation program is actually affecting the behavior of individual industrial users. Even in the Tucson AMA where data on individual mines water use are provided, no conservation trends are evident, as seen in Table 9. Similar data for other sectors would be useful to evaluate trends at the user level.

Industrial users do not generally think the industrial conservation program is restrictive. The conservation program was developed with the assistance of industry representatives and is generally based on the existing best

practices of individual industrial sectors (the turf industry is a significant exception to this statement). Because of this, one could argue the industrial conservation program is not highly effective outside of the turf industry.

Like the agricultural sector, industrial users in existence when the Groundwater Management Act was passed were given grandfathered rights based on the highest year of water use between 1975 and 1979. Industrial users with grandfathered rights generally do not use their full water allocation. This cushion could be an indicator that the conservation program is not very restrictive or effective. However, because the conservation regulations for most of the industrial sub-sectors are based on best practices, not usage, it is possible the underutilization of grandfathered rights is a result of the conservation regulations. Unfortunately, it is impossible to determine the relationship between water use and the conservation regulations from the information provided in the management plans.

Water use by the industrial sector is also highly influenced by the economy. Water use by the mines in the Tucson AMA, for example, fluctuates based on increases and decreases in copper prices and resultant changes in production levels. Due to these fluctuations it is difficult

**Table 9: Groundwater Withdrawals by Metal Mines in the Tucson AMA**

	ASARCO Mission	ASARCO Silver Bell	Cyprus Sierrita	Cyprus Twin Buttes
<b>1995</b>	13,753	214	22,066	5,324
<b>1994</b>	14,722	182	22,674	5,946
<b>1993</b>	13,690	80	18,880	6,071
<b>1992</b>	12,728	234	16,953	6,920
<b>1991</b>	9,391	437	23,900	5,877
<b>1990</b>	8,514	406	17,887	5,636
<b>1989</b>	8,883	532	18,684	3,499
<b>1988</b>	6,855	262	16,566	205
<b>1987</b>	6,054	351	15,838	60

to discern long-term conservation trends indicating an effective conservation program.

## Water Budgets

Apart from the Tucson AMA, up-to-date water budget information is not readily available. Even there, the format has changed from the Third Management Plan and similar historical test year data are unavailable for the different formats. Generally, the format of the water budgets from one management plan to the next has changed, making them difficult to compare. Their format differs by AMA as well. In addition, the water budgets incorporate changes in water use due to growth, implementation of the Assured Water Supply Rules, weather and other factors. Water budgets cannot provide the necessary information to measure conservation program effectiveness.

Despite the inability to determine a causal relationship between conservation regulations and actual reductions in per capita water use, the water budgets do provide interesting information about general water use trends in the AMAs. The Third Management Plans for each AMA provide two water budgets project water use through 2025. The first budget, the Current Use Projection, assumes continuation of water use rates at mid-1990s levels. The second budget, the Conservation Model Projection, assumes implementation of the conservation programs of the Third Management Plans (the water budgets for the Pinal AMA are somewhat different). For the reasons discussed above, the effectiveness of the conservation programs cannot be determined from the data currently available in the management plans. Therefore, it is unclear which model, the Current Use Projection or the Conservation Model Projection, is a more accurate description of the future.

The Tucson AMA provides the most up to date water budget information, having developed a water budget in 2006. The updated water budget provides interesting insights relative to the Third Management Plan water budgets. Both the Third Management Plan and 2006 water budgets and show a clear increase in municipal demand over time, reflecting the growing Tucson metro population. However, groundwater use by the municipal sector has declined significantly due to the introduction of Central Arizona Project water to the AMA. The 2006 water budget shows municipal demand in 2006 was roughly equivalent to the projected demand in the Third Management Plan Current Use Projection. As of the 2006, water use in the Tucson AMA is consistent with mid-1990s use trends and does

not reflect implementation of the Third Management Plan conservation programs. This implies that, to date, the Third Management Plan conservation programs have not had a significant impact on municipal demand.

The situation is different for the industrial and agricultural sectors in the Tucson AMA. The water demand of the industrial sector, projected to increase by the Third Management Plan, has actually been declining, leading to a decline in groundwater use. However, there has been little actual shift away from groundwater use by the industrial sector. The Tucson AMA projects that the industrial sector will continue to meet nearly all of its demand from groundwater. This indicates that the management plan conservation programs have done little to effect a change in the industrial sector's preference for groundwater. This same trend holds true for the agricultural sector in the Tucson AMA, which continues to use groundwater to meet most of its needs. While overall water use by the agricultural sector has declined sooner than originally projected, this is likely attributable to conversion of agricultural land to other uses. Overall, because of the shift of the municipal sector away from groundwater to CAP water, overdraft in the Tucson AMA is projected to decline. Even so, the AMA is not projected to reach safe-yield by 2025. Importantly, the 2025 water use projections in the 2006 Tucson AMA water budget reflect the Conservation Model Projection from the Third Management Plan. To date, actual municipal water demand has tracked the Third Management Plan's Current Use Projection – water use consistent with mid-1990s levels, not Third Management Plan conservation program levels. If this trend continues, overdraft may be slightly higher than the 2006 Tucson AMA water budget suggests.

In each of the other AMAs, the Third Management Plan water budgets are the most recent available. The Phoenix AMA has perhaps the most complex water budgets because the AMA has a diversity of water sources not present in many of the other AMAs. The Conservation Model Projection shows the implementation of Third Management Plan conservation programs are expected to slow the increase in demand from the municipal sector and decrease overall demand from the agricultural sector. Industrial sector demand decreases slightly. The Conservation Model Projection water budget also shows increased use of renewable supplies by the municipal sector and decreased use of groundwater by all sectors. Even with successful implementation of conservation programs, the Phoenix AMA is not expected to reach safe-yield by 2025.

The Prescott AMA Third Management Plan water budgets are unique in that both the Current Use Projection and the Conservation Model Projection water budgets project the same water demand for all sectors. While the description of the water budgets in the Management Plan states that the Conservation Model Projection takes into account implementation of Third Management Plan conservation programs for municipal providers and turf facilities, no change in total demand is seen in the municipal or industrial sectors. The significant difference between the water budgets is not the results of implementing conservation programs, but the impacts of importation of groundwater from the Big Chino Watershed and effluent recovery. The Prescott AMA has essentially no surface water, so the only way to achieve safe-yield is through recovery of effluent and water importation.

The Santa Cruz and Pinal AMAs are somewhat different in that they are not safe-yield AMAs. This difference is reflected in their water budgets. The Santa Cruz AMA is currently in a state of safe yield. As a result, the sources of water to meet the water demand of each sector – groundwater, surface water, etc. – are not reported in the water budgets as they are in the other AMAs. The Third Management Plan water budgets show only the affect of the Third Management Plan conservation programs on water use, independent of the source of water. The Conservation Model Projection water budget projects slower growth in municipal demand relative to the Current Use Projection water budget as a result of Third Management Plan conservation programs. There is no change, however, in agricultural and industrial demand. This implies that the conservation programs for these sectors are not expected to have an impact on water use.

In the Pinal AMA the management goal is to maintain the agricultural economy while preserving water for future municipal use. It is assumed that the AMA will not achieve safe-yield. The water budgets for the Pinal AMA reflect only a slight decrease in GPCD between 2000 and 2010 as a result of the Third Management Plan conservation programs. Instead of focusing on conservation, the Pinal AMA water budget models reflect two different CAP water use scenarios – minimum supply and maximum supply. Under the Minimum Supply Projection, CAP use decreases over time while groundwater use increases. Under the Maximum Supply Projection, CAP use also decreases, but to a lesser degree. In both scenarios, groundwater overdraft continues to increase over time.

## Other Considerations

It could be argued that effectiveness could be defined in terms of the program design itself and not necessarily in quantification of results. Therefore, an “indirect” source of information on the effectiveness of the management plan conservation programs could be the frequency of changes to them. ADWR has worked with stakeholders over time to adopt various modifications to the agricultural and municipal conservation programs. Working with stakeholders can be seen as indicative of a desire to develop and implement effective conservation programs. Many interviewees, both external and internal to ADWR, believe that there is little more to be gained with refinement of current conservation programs. While very indirect, this almost-universal perspective can be considered evidence that the Management Plan provisions have been effective in their conservation focus to date. The less sanguine interpretation of this position is that water providers would prefer to get out from under the grips of conservation regulations. However, the position was supported by the fact that conservation activity was quite robust throughout the period of time during which enforcement of the municipal GPCD program was very limited.

In addition, it might be possible to glean additional information on conservation program effectiveness from information on enforcement actions themselves. Compliance actions related to violations could provide some gross indication of the stringency of the conservation programs as well as their enforcement. If water users or providers never have difficulty complying with conservation programs, then it could be suggested that the programs are not affecting behavior. Alternatively, lack of violations could be reflective of good program design. Frequent violations, on the other hand, could indicate program design difficulties – or that the regulations are in fact binding and some are not complying. This discussion is speculative at this time because summary information on compliance was not available to the study team. Lack of data was due in part to the lack of compliance monitoring while a major challenge to the municipal GPCD program was pending. In addition, access to compliance documents over time and across the AMAs proved difficult.

## Future Research Needs

An accurate determination of the effectiveness of the management plan conservation programs will likely

require an intensive research effort. Effectiveness of the conservation programs cannot be determined from information available in the management plans to date. The Third Management Plans are undergoing modification, with a Best Management Practices program replacing the GPCD program as the base municipal conservation strategy. Best Management Practices are not grounded in quantified water reductions. However, achieving the management goals for the three safe-yield AMAs require additional reductions in groundwater utilization. Careful thought should be given to the kind of water use information that will be needed for quantifying program effectiveness going forward. For example, the collection and reporting of individual municipal provider GPCD, residential water use, individual farm use, and industrial user data should be done regularly and consistently. Measuring effectiveness will also require development of a methodology to isolate the impacts of conservation on water use from other factors such as weather, the economy, changes in customer base (such as more commercial), water rates, the differences in conservation technologies present in old housing stock versus new homes, and demographics. In addition, there are some influencing factors that are difficult to measure, such as the implications of media attention to drought and climate change. In order to account for the variables beyond the control of the conservation programs and isolate the effects of the regulations, a multivariate statistical analysis is needed.<sup>4</sup> However, because not only ADWR, but stakeholders of many types would like to know how conservation programs are affecting water use, it would be useful for the Fourth Management Plan conservation programs to include reporting requirements and protocols for water providers and users – and for ADWR – that

would enable the extent of conservation effort to be documented and available.

The management plans are regulatory documents. While they provide some information beyond the core regulatory framework of the conservation programs, this information is limited. The purpose of the management plans is to provide a framework for the regulations and the supporting information required to understand the regulations. To date, they have not provided the data and analysis needed to determine the effectiveness of the regulations over time. Such a determination would require a separate effort as outlined above. The results of an effectiveness study may not fit into the current management plan framework. However, an effectiveness study is a critical effort needed to understand how well the regulations have performed in the past and where we are headed in the future. As will be seen in the following section, stakeholders from both the regulated community and ADWR are interested in the results of such an effort.

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4 The Evaluation and Cost Benefit Analysis of Municipal Conservation Programs Study, conducted by the Water Conservation Alliance of Southern Arizona (Water CASA), evaluates the effectiveness of specific conservation measures implemented by individual utilities. The conservation measures evaluated by the study, unlike the Total GPCD Program, are specific actions, not an overall program: washing machine rebates, device giveaways, toilet rebates, etc. Effectiveness was determined by comparing residential units implementing a given program with a control group. It is unlikely that a similar effort would be successful for the Total GPCD Program because it does not require specific provisions of the type evaluated by Water CASA. However, it may be applicable to evaluating the effectiveness of individual Best Management Practices Program practices for both the municipal and agricultural sectors. Water CASA emphasizes that regular and consistent record keeping of water use by individual customers is required to conduct evaluations of the effectiveness of a given provider's conservation efforts.

## KEY FINDINGS FOR FUTURE MANAGEMENT PLANS

The level of agreement across sectors and between the department and the regulated community about what direction the management plans should take in the future was striking but requires analysis. After reporting on the common themes from the interviews, analysis is provided. The following themes emerged in nearly all of the interviews:

- Future management plan efforts should be focused on long-term planning;
- A meaningful and well thought out stakeholder process is critical to the success of future planning efforts;
- Issues with recharge and recovery and Assured Water Supply must be addressed; and
- Water budgets and other types of water use tracking should be done on a more regular basis.

### Emphasis on Long-term Planning

A consensus developed among stakeholders and ADWR staff alike that future management plans should look very different from the current and past management plans. Rather than focusing energy on refining the conservation programs of the management plans, nearly everyone felt the focus of the management plan process should now shift to long-term water planning. Many noted that, while they are called “management plans,” what exists now is really a regulatory document with embellishment around the edges. The documents are not roadmaps to achieving statutory management goals. The first three management plans have focused on the regulatory conservation programs and augmentation components required by statute. Now that the conservation regulations are well established and relatively well refined, stakeholders believe the focus should shift to planning in the true sense of the word. By planning, most stakeholder mean going beyond the regulatory framework and the information needed to inform the regulations to non-regulatory, policy-driven planning that seeks to address critical issues in the AMAs, many of which require actions beyond the reach of management plan regulations. A “roadmap” to achievement of management goals is needed. What needs to be done in addition to regulatory conservation programs to reach safe-yield in the AMAs? What are the impediments restricting achievement of safe-yield and how can they be overcome? What about regional drought planning? Most see the Fourth Management Plan process

as an opportunity to address these types of questions. The roadmap could include recommendations for legislative changes not necessarily limited to the management plans themselves.<sup>5</sup>

Two different models for achieving this goal emerged. The first includes carrying forward into the Fourth Management Plan the Third Management Plan conservation regulations as they are now (or are being modified) with no or only minor changes, thereby avoiding a long, drawn-out process to refine the conservation programs for each sector. Instead, the focus would be on creating a second document that would serve as a long-term water planning document for each AMA. These documents could take the form of a State of the AMA report or something similar and would be tailored to each individual AMA. The second option would take a similar approach with the conservation programs, but would include long-term planning to achieve AMA statutory management goals in the Fourth Management Plan itself.

The management plan language of the GMA allows for this shift in focus. As noted in the statutory intent section above, the statutory language is intentionally non-specific about what should be contained in the management plans for the fourth and fifth management periods. Unlike with the first three management periods, there is no requirement to continue to tighten conservation requirements (ARS §§45-567 – 45-568). While conservation programs are still required, the statute provides ADWR the flexibility to maintain the current programs with little or no change and focus its efforts elsewhere.

Reasons given for pursuing this type of planning vary across sectors. Some feel that much of what can be achieved from conservation has been achieved and, while there is additional conservation potential, the effort required to achieve greater conservation from regulatory programs will be disproportionate to the level of increased conservation achieved. Most believe that conservation efforts, as long as there is a baseline regulatory framework, will continue without new or more stringent regulations. All sectors understand the importance of water conservation for the future of the state. Conservation will occur out of necessity and economy regardless of how much tighter the regulatory screws are turned.

<sup>5</sup> Although the background information considered in 2000 and 2001 by the Governor’s Water Management Commission is somewhat dated, review of the identified challenges to meeting AMA management goals could be a useful part of a roadmapping exercise.



There is also a general attitude of ambivalence toward the conservation programs. As noted above in the summary of comments on the contents of the management plans, there is little agreement on the effectiveness of the conservation programs or the direction they have been taken by recent legislation. As a result of the legislative changes, the conservation programs for the municipal and agricultural sectors are largely decided for the next management period. The municipal program will be focused on BMPs while the agricultural program will include BMPs as an option. Because most feel the regulatory framework for the future is in place regardless of stakeholder opinions, it makes sense to accept it and shift focus to other issues.

Some believe that overlaying a long-term planning component will result in focus on the critical actions needed to achieve statutory AMA goals. One example of this could be a shift to “critical area management,” focusing resources and programs where the need is greatest. Critical area management looks at an AMA to determine where the greatest need for action lies. For example, in the Santa Cruz AMA, there are shallow aquifers warranting management at a finer scale than the regional AMA approach. In the Phoenix AMA the water supply situation is different between the West Valley and the East Valley. In the Tucson and Pinal AMAs, recharge efforts could be focused on areas with the highest risk of subsidence. The Third Management Plans acknowledge the need for critical area management in all of the AMAs but lack the capacity to undertake it in a meaningful way.

Many stakeholders believe the statute does not provide justification for intra-AMA differences in conservation programs. But some believe critical area planning may be possible if undertaken as part of a long-term planning process outside of the conservation program framework. By conducting planning on an AMA-by-AMA basis, the specific issues facing each AMA could be addressed and the problems with standardization of regulations overcome.

## Scope

Stakeholders also felt the management plan process could be a forum for the ADWR to facilitate long-term planning in the AMAs that goes beyond the regulatory efforts of the department. Many of the actions required to reach safe-yield in the AMAs are likely to be beyond the mandate of the department and require collaboration among and actions by local planning entities, water providers, etc. It is unlikely the AMAs will be able to reach their respective

statutory management goal through regulation alone. A regional effort is required to identify and address through a collaborative process the remaining impediments to goal achievement.

When discussing the content of the conservation programs, many stakeholders noted that the regulations exist at the macro level – they provide conservation requirements for all water users within the AMA, regardless of location. The regulations fail at the micro level – addressing the things that are important to safe-yield at the sub-regional level. Addressing these issues is the key to implementation of critical area management and will require the participation of local communities in the planning effort, not because it is required by law, but because it is what is needed for the future of the region.

Examples given by interviewees of issues that are at least in part outside the scope of ADWR’s authority, but need to be addressed are (1) severe drought and (2) the consequences of not reaching safe-yield. Drought planning is becoming a more important issue as a result of uncertainty associated with climate change. It is also closely tied to the issue of safe-yield; long-term drought has obvious consequences for the ability of the AMAs to reach safe-yield. ADWR does not have the authority in the statute to implement drought specific conservation measures, so coordination with local governments on this issue is essential. It is also important to distinguish conservation programs that are targeted at short term drought emergencies from long-term conservation that may result in greater water supplies for new growth (among other consequences)

The question of safe-yield is critical for the Phoenix, Tucson, and Prescott AMAs. If there is local consensus that the goal is worth achieving, moving forward with the programs necessary to achieve the goal is more likely. At this point, almost 30 years since the passage of the GMA, most feel that reaching safe-yield in the Phoenix, Tucson, and Prescott AMAs by 2025 is not likely. It is recognized that the conservation programs alone are unable to facilitate achievement of the goal. Consequently, each safe-yield AMA needs to hold an open community dialogue about the consequences of not reaching safe-yield. What are the economic consequences? What are the quality of life implications? This discussion will inform the community, motivate collaborative action, and identify what can be done by both the ADWR and local governments and water providers to contribute to achieving safe-yield sooner rather than later. Several stakeholders suggested that ADWR

could serve as the facilitator of discussions about both safe-yield and drought planning and that the resulting plans would include actions required on the part of all involved.

## **Stakeholder Process – Overcoming the Past**

Critical to achieving the vision of a planning focused process advocated by so many stakeholders is an effective stakeholder process. Many noted the need to overcome the weaknesses of the public process from past management plans and meaningfully engage stakeholders. This point was acknowledged both by department staff and stakeholders. Many noted that the department has become more bureaucratic over time. This tendency must be overcome during the fourth management period planning process. If a planning process is undertaken by ADWR, the stakeholder involvement process will be critical to acceptance of the results. Some stakeholders pointed to the process used to develop the Assured Water Supply rules for the Pinal AMA as a model.

Acknowledged challenges facing the department going forward are lack of (1) expertise and experience with the management plan process and (2) trust of the regulated community. Over time, the department has lost many of the staff members who were involved in the development of past management plans. The department is currently working on building staff expertise to conduct long-term planning during the Fourth Management Plan development process. However, many expect this to remain a challenge as they struggle to meet the obligations of the current conservation programs with present staffing levels. Suggestions for building trust include empowering planning staff so it is clear to stakeholders that the stakeholders are influencing the decision-making process.

## **Recharge, Recovery, and Assured Water Supply**

Many stakeholders, especially municipal providers, expressed concern about the existing Augmentation and Recharge Program. There are concerns that pumping by CAGR members may interfere with the recovery of stored water by municipal water providers. Some see an inequity in the regulations that favors CAGR members. Many see long-term planning as an opportunity to address these concerns. They feel that the recharge and recovery rules, CAGR operations, the Assured Water Supply rules, and other water regulations should be fully integrated with

the management plan regulations to ensure consistency. This will help close loopholes and make the regulations fairer.

Going forward, most stakeholders believe recharge and recovery and the Assured Water Supply rules are the primary tools for achieving safe-yield in the AMAs. As has been noted previously, the regulated community is ambivalent towards the conservation programs and uncertain about their ability to make a measurable and significant contribution to reaching safe-yield. They believe a coordinated application of revised Assured Water Supply, recharge and recovery rules, and CAGR operations, however, will make a difference. In addition, many see a need for addressing groundwater use by non-designated water providers. Non-designated providers are able to mine groundwater, potentially undermining the safe-yield goal. Some stakeholders would like to see this loophole addressed.

## **Keeping Score – AMA Water Budgets**

Finally, many stakeholders and department staff expressed a need for regular accounting of water use in the AMAs. Currently water budgets are created for each AMA in conjunction with the planning process for each management plan. In order to get a clear picture of water use over time and encourage greater responsiveness to change and flexibility, water budgets should be created on a rolling basis.

Currently, the most recently available full calculation of water budgets for the AMAs is contained in the Third Management Plans. The statistics used to construct these water budgets are from the mid to late-1990s. As a result, now almost a decade later, these water budgets are essentially useless for determining the current state of the AMAs relative to their management goal. ADWR indicated staff is working on updating water budgets, but only the Tucson AMA has a publicly available update to the Third Management Plan water budget.

In order to meaningfully pursue a long-term planning approach to the Fourth Management Plans, consistent, detailed and regularly updated information about water in the AMAs will be needed. Water budgets help identify sectors where water use is growing or shrinking, may provide indicators of why water use characteristics are changing (e.g. an increase in population or decrease in irrigation acres), and can help to identify where focused conservation

efforts are needed. Water budgets also provide a critically important overview of the AMA-wide water balance.

Several people suggested developing a simplified water budget for the AMAs that could be revised on an annual or biennial basis. A full water budget involves a tremendous amount of work and data to complete. But a simplified version showing only basic water use characteristics by sector and current over-draft would be easier to create and easier for the community to digest. Such a model could help with engaging the larger community in water issues and keep people informed of the current status of their AMA. The Tucson AMA has recently produced just such a water budget (Appendix C); this budget could serve as a model for implementation of regular water use accounting in all of the AMAs.

## Analysis

The development of the Fourth Management Plans provides ADWR with an opportunity to take stock of where the AMAs are in terms of water conservation and water management more generally and chart direction for moving forward. The Fourth Management Plans will become effective 30 years after adoption of the GMA and only 15 years from when achievement of the GMA's goals was expected. With the construction of the CAP canal ensured and the expected adoption of conservation programs and assured water supply rules, 45 years must have seemed like a long time. Yet, almost 30 years later, the safe-yield AMAs are not projected to achieve their management goals.

As reported earlier, the management plans were seen as an important but not the only tool for reaching water management objectives.. As written to date, the management plans are not plans or roadmaps to achieve the statutory management goals of the GMA. They are regulatory programs, the elements of which must be implemented by individual water suppliers and users. Stakeholders would like to see a shift toward using the management plans or a companion document for regional water resource planning, not just regulation. While ADWR may seem like the logical entity to facilitate long-range planning, there are several things to consider. First, planning of the type envisioned by many of those interviewed goes beyond what has been included to date in management plans. This type of planning would have to incorporate the individual plans of water providers and large users, much like a regional transportation plan

must include planning elements at the discretion/choice of the local entities. It would require sufficient levels of trust so that individual users/providers would willingly share information not normally reported to ADWR. It would necessarily require that data collected by ADWR be available in a useful format. It is likely some shared governance or oversight of the process would have to be agreed upon. Long-term planning would require ADWR to act not only as a regulatory agency for the AMAs, as it has done on many occasions.

Timing would also be of paramount importance. All the AMAs are experiencing growth pressures. Stakeholders, including many who heretofore have not been involved in ADWR processes, are asking questions about sufficiency of water supplies and the connections between land-use planning and water planning. Can ADWR and stakeholders work together on a timeframe that is workable to all? Can ADWR staff accommodate all the demands on their time, including important ones coming from outside the AMAs? Should/can the AMAs adopt the approach of the San Pedro River and Verde Valley areas and ask to be empowered to develop their own plans? These and other questions cannot be answered by this study team. We can only suggest that time is of the essence and that ADWR must be an active participant in these important planning efforts, whether or not it is the facilitator/leader.

## Political Science Analysis by Zachary Smith and Carol Johnson

A Political Science-based policy analysis is included in Appendix F. The analysis explains that there are three possible paths for the development and implementation of future management plans: a) minimal effort will be undertaken by the ADWR and AMA staff to meet their current statutory obligations; b) efforts will be undertaken to further the goals of the Act which may include greater stakeholder involvement, pursuing current conservation measures and perhaps the introduction of new conservation initiatives; or c) a serious effort will be undertaken to significantly change the programs, methods and enforcement of a new and aggressive approach to implementation of the Act.

Scenario "b", which most closely resembles the implementation strategy to date, is the most likely to play out, but that the third option, scenario "c", is the most desirable future. Scenario "a" is possible but unlikely. This is because this option has the best chance of accomplishing

the original goals of groundwater reform efforts in Arizona (as articulated by the creators of the Act) and because it is in the long-term interest of both water managers and the citizens of the State of Arizona (interests that are not always identical).

It was not the intention of this study to rigorously measure success or failure of the GMA. The existing data are inadequate to draw conclusions with any amount of certainty about the specific role of the Act or the management plans in any specific decline in groundwater use. For example, we know that per capita water consumption has declined in some cases in central Arizona over the last few decades but we do not know if this is due to conservation brought about by the management plans or some combination of other socio-economic considerations that also impact water use.

Measured by the intent of its authors, however, the Act has not been a success. Arizona is still a long way from achieving safe yield in groundwater management. Many of the people involved in the creation of the Act do not think it has achieved the goals they had in mind. At the same time many, though by no means all of the people currently involved in the implementation of the Act, are satisfied with the status quo. These facts lead us to believe that a major overhaul of the management plan process, in conjunction with other water management efforts, is necessary to protect Arizona's water future.

## RECOMMENDATIONS

This study has considered many issues relating to the regulatory conservation programs included in the management plans. Before concluding, we offer four recommendations that are important to the timely assessment of conservation programs going forward and more effective planning relative to the management goals of the Groundwater Management Act.

**Recommendation 1:** *ADWR should provide water use data for all sectors on at least an annual basis. These data must be reported in a consistent format over time and across AMAs.*

Data availability is essential to determining the effectiveness of the management plan conservation programs. The unavailability of data and lack of consistency of data over time are problematic. It is likely that the department already collects much of the data, but the data are not generally readily available to the public. Availability of data through the ADWR website would be useful.

Inconsistency of data format over time is also an impediment to conducting an analysis of the conservation programs. Because the format of the data that are available often changes from one management plan to the next, it is difficult to conduct analysis over time. This problem is seen in the variation of reporting format of GPCD rates for municipal providers in the Tucson AMA. The study team was not able to conduct even a basic analysis of the data because the reporting format changed from the First to the Second to the Third Management Plans.

By reporting data more frequently and consistently, a statistically sound analysis of effectiveness of the management plans would be possible. Such an analysis would allow ADWR to see where it has been most successful and where conservation programs may need adjustment. In addition, the public would see where conservation is and is not working and which providers are conserving more or less, informing open debate of water conservation issues.

**Recommendation 2:** *State of the AMA reports should be produced on a yearly or biennial basis.*

Closely related to our first recommendation, we believe State of the AMA reports would be an effective tool for reporting water use data for the AMAs and facilitating

frequent community dialogue on water issues.<sup>6</sup> At minimum, a State of the AMA report should include:

- An accounting of water use data over the previous year by sector and at the provider/user level;
- Updated water use trends incorporating the most recent year's data;
- Updated water budgets in a consistent format across AMAs to show progress toward safe-yield (or maintenance of the AMA goal if it is not safe-yield);
- Comparison of projected water use based on implementation of conservation measures and actual water use, by sector; and
- Updated projected water use incorporating the implications of the previous year's data.

The regular production of State of the AMA reports would be a significant undertaking. It necessarily requires staff and data systems capacity. However, regular analysis of water use data in the AMAs will result in greater awareness of water conservation and more effective conservation programs in the future.

**Recommendation 3:** *ADWR should shift its focus to long-term water planning, but still maintain the current conservation programs.*

While the regulatory conservation programs are still necessary to ensure ongoing conservation efforts in the AMAs, it is clear that there is a desire for the ADWR to involve itself in regional water planning, with a focus on achievement of statutory management goals. Projections indicate that none of the safe-yield AMAs is likely to reach their management goal by the 2025 deadline set by the GMA. Conservation alone will not get the AMAs to safe yield. Most stakeholder feel that additional focus on conservation programs will yield diminishing returns, although enforcement must be an ADWR function. ADWR, in conjunction with stakeholders, needs to shift the focus of its efforts to long-term water planning issues that go beyond water conservation. This should be the focus of the up-coming Fourth Management Plan development process and should be an ongoing priority of the department.

In order to be successful in such an effort, ADWR will need to successfully re-brand itself with stakeholders as a partner first and a regulator second. This could be a

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<sup>6</sup> The authors are aware that Water Atlas information for the AMAs is being compiled. Inquiries about this effort were not part of the research performed for this study.

difficult process. However, in areas outside the AMAs, where ADWR does not have direct regulatory authority, it has been successful working as a partner and resource for local communities. The department can borrow from these experiences and other experiences to inform its approach to building trust with the regulated community within the AMAs.<sup>7</sup> We envision the department fulfilling the role of facilitator of regional water planning, where policy and programmatic solutions may involve locally or regionally based responsibilities. Because the department does not have the statutory authority to conduct this type of planning, it would need the voluntary participation of all stakeholders.

**Recommendation 4:** *The Augmentation and Recharge Program and the Central Arizona Groundwater Replenishment District rules need to be reviewed and updated to ensure fairness.*

Stakeholder work on issues related to the membership and operations of the CAGRDR should include discussion of the regulations regarding recovery wells. This discussion is necessarily related to development of the Fourth Management Plans.

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<sup>7</sup> An example of a successful and voluntary regional effort led by ADWR was the development of a Regional Recharge Plan for the Tucson AMA in the late 1990s.

## CONCLUSION

The management plans were envisioned as an important component of Arizona's approach to reducing groundwater overdraft in the Active Management Areas by the framers of the Groundwater Management Act. Statutory language provides significant guidance on the required elements of the management plans through the third management period, which ends in 2010. The opinions expressed by the crafters of the original language of the GMA indicate that the lack of specificity for the later management periods was intentional; flexibility for the Fourth and Fifth Management Plans was desired. The framers were unsure what the AMAs would need 30 years in the future in order to meet their management goals, so they left the language in the statute vague so it could be adapted to present needs.

Stakeholders and the ADWR can take advantage of this statutory flexibility to realize their desire for a meaningful, collaborative effort to conduct long-term water planning in the AMAs. Such an effort will require a well-structured public process that reaches out to all the players involved in water management in the AMAs. Effective long-term planning will require cooperation to address issues outside the ADWR mandate. The broad agreement between stakeholders and the department about approaching the development of the Fourth Management Plans is a hopeful sign that a successful collaborative effort is possible.

## REFERENCES

- Arizona Department of Water Resources. 2007. *Program Framework: Modified Non-Per Capita Conservation Program*. Phoenix, AZ.
- Arizona Department of Water Resources. 1999. *Third Management Plan for the Pinal Active Management Area, 2000-2010*. Phoenix, AZ. Available at: <http://www.azwater.gov>
- Arizona Department of Water Resources. 1999. *Third Management Plan for the Phoenix Active Management Area, 2000-2010*. Phoenix, AZ. Available at: <http://www.azwater.gov>
- Arizona Department of Water Resources. 1999. *Third Management Plan for the Prescott Active Management Area, 2000-2010*. Phoenix, AZ. Available at: <http://www.azwater.gov>
- Arizona Department of Water Resources. 1999. *Third Management Plan for the Santa Cruz Active Management Area, 2000-2010*. Phoenix, AZ. Available at: <http://www.azwater.gov>
- Arizona Department of Water Resources. 1999. *Third Management Plan for the Tucson Active Management Area, 2000-2010*. Phoenix, AZ. Available at: <http://www.azwater.gov>
- Arizona Department of Water Resources. 1991. *Second Management Plan for the Pinal Active Management Area, 1990-2000*. Phoenix, AZ.
- Arizona Department of Water Resources. 1991. *Second Management Plan for the Phoenix Active Management Area, 1990-2000*. Phoenix, AZ.
- Arizona Department of Water Resources. 1991. *Second Management Plan for the Prescott Active Management Area, 1990-2000*. Phoenix, AZ.
- Arizona Department of Water Resources. 1991. *Second Management Plan for the Tucson Active Management Area, 1990-2000*. Phoenix, AZ.
- Arizona Department of Water Resources. 1985. *First Management Plan for the Pinal Active Management Area, 1980-1990*. Phoenix, AZ.
- Arizona Department of Water Resources. 1984. *First Management Plan for the Phoenix Active Management Area, 1980-1990*. Phoenix, AZ.
- Arizona Department of Water Resources. 1984. *First Management Plan for the Prescott Active Management Area, 1980-1990*. Phoenix, AZ.
- Arizona Department of Water Resources. 1984. *First Management Plan for the Tucson Active Management Area, 1980-1990*. Phoenix, AZ.



## APPENDIX A: SENATE BILL 1577 SUMMARY

### Bill Summary

SB 1557 requires the Director of the Department of Water Resources to replace the Non-Per Capita Conservation Program (NPCCP) for municipal water providers in the third, fourth, and fifth management periods with a municipal Modified Non-Per Capita Conservation Program (MNPCCP; also known as the Municipal BMP Program) and to extend the Agricultural Best Management Practices (BMP) into the fourth and fifth management periods.

### Bill Provisions

Municipal Best Management Practices Program (the modified NPCCP program)

- Applies to the third, fourth, and fifth management plans.
- Allows a provider with an assured water supply designation to choose to participate in either the Total GPCD program or the BMP Program. Requires a provider without an assured water supply to participate in the BMP Program.
- Requires implementation of a public education program relating to water conservation and metering of service area connections, with certain listed exceptions.
- Requires providers regulated under the BMP Program to report their water rate structure to ADWR.
- Requires BMP participants to submit a “provider profile” that describes water use patterns, BMPs that have been or will be implemented, and an explanation of how each conservation measure described in the provider profile is relevant to the municipal provider’s existing service area characteristics or water use patterns. The number of BMPs that must be implemented is dependant on the number of water connection a provider serves. Providers serving more connection are required to implement more BMPs
- Provides a specific time period for the Director to approve or disapprove the Provider Profile (90 days) and establishes a method to appeal the Director’s decision.
- Requires the Director, based on input from the municipal providers, to prepare a guidance document that outlines the BMP Program and explains how the program will be implemented.

- Exempts large untreated water providers from the BMP Program.
- Exempts small municipal water providers, although small water providers are required to comply with conservation requirements set forth in the management plans.

Agricultural Best Management Practices Conservation Program

- Extends the agricultural BMP program into the fourth and fifth management plans.
- Requires the BMP program to achieve conservation that is equivalent to the irrigation efficiencies and maximum annual groundwater established for the fourth and fifth management periods.

Performance Evaluation

- Requires the DWR Director to periodically evaluate the effectiveness of the Municipal and Agricultural BMP Programs.
- Authorizes the DWR Director to modify the programs if the changes are consistent the intent of the GMA. Modifications inconsistent with the GMA require notification of the Governor, President of the Senate and Speaker of the House of Representatives.
- Allows the DWR Director to establish an advisory committee to provide assistance with evaluation of the Municipal BMP Program and to contract with an independent researcher to assist with the evaluation.

### Conclusion

SB 1557 addresses the specific issues that private water companies have raised in legal disputes with the ADWR and recognizes the regulatory obligations of these providers to the Arizona Corporation Commission. Private water companies have raised two arguments over the Total GPCD program. First, they argue that they cannot control the actions of their customers. Second, they feel that they will not be able to recover costs in the form of higher rates as a result of costs incurred for actions not specifically required by regulations. The BMP program overcomes the former by allowing water companies to implement practices on the supply side instead of at the user. The latter is addressed because water companies will be required to implement the BMPs they agree to with the ADWR, increasing the likelihood of recovering costs.

There has been concern raised in the past that the current GPCD program may not be a valid indicator of water use efficiency. GPCD does not allow one to determine the reason for water savings; conservation may be the cause of reduced GPCD use or the cause could be weather, changing community characteristics, or some unknown cause. The BMP Program is a departure from the GPCD program in that it emphasizes water conservation practices over a single conservation measure. Therefore, while causality of reduced water use relative to conservation efforts may still be difficult to establish, it will be clear exactly what types of conservation efforts are taking place and the conservation goals the efforts are meant to achieve. Some stakeholders feel the BMP Program is a step towards a planning approach to water conservation by allowing municipal providers to focus on practices instead of use.

The Agricultural BMP Program is already a component of the Agricultural Conservation Program in all of the AMAs. The new legislation extends the program, which was set to reach the end of its evaluation period at the end of the third management period, through the fourth and fifth management periods. Stakeholder opinions about the program are discussed in the main body of this report. A summary of the program components is included below in Appendix B.

## APPENDIX B: AGRICULTURAL BMP PROGRAM SUMMARY

The BMP program is a complete departure from the structure of the base agricultural program. It does not use irrigation efficiency or water duties as a method of forcing conservation. Instead, it functions much like the Non-Per Capita Conservation Program/BMP Program of the Municipal Conservation Program. The Agricultural BMP Program was developed to provide farmers with maximum flexibility and addresses other weaknesses of the agricultural base program while still achieving reasonable groundwater conservation. Weaknesses of the base program include difficulty measuring conservation as a result of the management plans and the administrative burden of the base program for both the ADWR and farmers. There was also recognition that farmers needed the ability to respond to fluctuating market conditions from year to year; fixed allotments based on historical conditions made this difficult (Governor’s Water Management Commission 2001).

A collection of BMPs have been developed by the ADWR in conjunction with stakeholders. These practices are grouped into four categories: water conveyance system improvements, farm irrigation systems, irrigation water management, and agronomic management. Each of the management practices is assigned a different number of points. Users regulated under the BMP program are required to select a group BMPs resulting in a score of at least ten points, subject to the following conditions:

- a maximum of three points can be scored in any one category,
- at least one point must be scored in each category,
- at least two points must be scored from the farm irrigation systems category,

- credit for water conveyance system improvements and farm irrigation systems practices is only available for practices that were implemented at the time of application to the program, and
- credit for irrigation water management and agronomic management practices is only available if the practices will be implemented on a yearly basis.

Farms also may receive credit for practices not listed in the BMPs as long as they demonstrably result in water savings equivalent to the approved management practices.

Water savings resulting from the implementation of the BMP Program should be equivalent to the savings that would be achieved if the same user was regulated under the base program. Farms must apply to ADWR to be included in the program. The application must include a map of the farm and, if the land is leased, permission from the owner to take part in the program. Once an application is approved, the farm unit is regulated under the BMP program for the remainder of the management period. A single application may include more than one IGFR as long as all the IGFRs are for the same farm unit.

The BMP Program, with the passage of SB 1557, has been extended to the fourth and fifth management periods. The ADWR is also currently in the process of conducting a review of the program to determine its effectiveness to date. The results of this review are expected sometime next year. Until this review is complete, it is impossible to meaningfully judge the effectiveness of the program. However, the general feeling of interviewees who are familiar with the program is that its effect on water use is neutral – while no additional water savings are achieved, it has not resulted in more water use either.

**Table 1: BMP Participation in the Pinal and Phoenix AMAs**

BMP Participation (as of August 2007)				Total Number of IGFRs (As of the Third Management Plans)			
Pinal		Phoenix		Pinal		Phoenix	
IGFRs	Acres	IGFRs	Acres	IGFRs	Acres	IGFRs	Acres
92	30,559.5	52	6,919.19	N/A	281,200	3,575	308,681

Sources: Third Management Plans of Pinal and Phoenix AMAs and personal communication with Michael Hanrahan, ADWR employee.

A small number of IGFRs relative to the total number of IGFRs in all of the AMAs are currently enrolled in the program. All participants in the program are located in either the Pinal or the Phoenix AMAs, with the largest number of participants located in the Pinal AMA (Table 1). There are no participants in the Tucson, Santa Cruz, Prescott AMAs. During the interview process, agricultural water users noted two reasons why more farms have not enrolled in the program. First, many farms have an excess of flexibility credits and are having no trouble complying with the current regulations. For these IGFR holders, it is easier to stay in the base program because they are familiar with its requirements and how to work within them. Second, some feel that farms located on the urban fringe are unwilling to enroll because they anticipate conversion to urban use in the near-term. Enrollment in the BMP program would not make sense for these farms because they may not have a long enough farming horizon to recoup the cost of investing in management practices that were not already in place. This concern may explain the lack of participants in the Tucson AMA, where agriculture is located near the Tucson Metropolitan area and the limited participation in the rapidly urbanizing Phoenix AMA.

**Reference:**

Governor's Water Management Commission. 2001. *Conservation Subcommittee Report: Agricultural BMPs Summary*. Phoenix, AZ.

**APPENDIX C: TUCSON AMA 2006 WATER  
BUDGET**

Tucson AMA		DRAFT, SUBJECT TO REVISION		
		1998	2006	2025
<b>MUNICIPAL</b> (includes exemptwells)				
DEMAND		160,500	193,400	247,100
SUPPLY	Groundwater	150,800	91,100	63,000
	CAP (direct use; recovery; replenishment)	200	86,100	146,400
	Effluent	9,500	15,900	37,700
INCIDENTAL RECHARGE		56,100	14,200	13,100
<b>INDUSTRIAL</b>				
DEMAND		57,500	54,600	75,400
SUPPLY	Groundwater	56,800	52,500	70,700
	CAP (direct use & credit recovery)	0	100	0
	Other surface water	0	400	
	Effluent	700	1,600	4,700
INCIDENTAL RECHARGE		6,900	6,500	7,600
<b>AGRICULTURAL</b>				
DEMAND		94,800	87,600	57,200
SUPPLY	Groundwater	70,900	63,300	44,200
	Groundwater (in lieu )	22,900	18,800	10,000
	CAP (direct use; no in lieu )	0	5,500	0
	Effluent	1,000	0	3,000
INCIDENTAL RECHARGE		19,000	17,500	8,700
<b>INDIAN</b>				
DEMAND		100	11,400	16,000
SUPPLY	Groundwater	100	800	200
	CAP (direct use; no in lieu )	0	10,600	15,800
	Effluent	0	0	0
INCIDENTAL RECHARGE		0	2,200	3,200
<b>OTHER</b>				
DEMAND	Riparian	3,700	3,700	3,700
SUPPLY	Cuts to the aquifer	2,300	16,600	45,200
	Net natural recharge	62,000	62,000	62,000
<b>OVERDRAFT</b>				
TOTAL		158,900	111,200	52,000
<b>ADDITIONAL RECHARGE FOR FUTURE USE *</b>				
OTHER	Net artificial recharge	22,700	68,400	13,500

\* Includes storage for Colorado River drought, and interstate storage on behalf of Nevada

**APPENDIX D: GROUNDWATER  
MANAGEMENT PLAN LEGISLATIVE  
SUMMARY**

**GROUNDWATER MANAGMEENT PLAN  
LEGISLATIVE SUMMARY**

Groundwater management plan legislative changes since 1980 as of March 23, 2007 (including changes to A.R.S. § 45-467 relating to flexibility accounts for farms and changes to underground water storage provisions)

Prepared by the Arizona Department of Water Resources  
for the Water Resources Research Center

**Management Plan Requirements in the  
Original Groundwater Management Act of  
1980**

**I. General Provisions**

The 1980 Groundwater Management Act (“Act”) created four active management areas (“AMA”) in the state and established a management goal for each AMA.<sup>8</sup> The management goal for the Phoenix, Prescott and Tucson AMAs is safe-yield by 2025 or such earlier date as the director of water resources (“director”) determines. The management goal of the Pinal AMA is to allow development of non-irrigation uses as provided in the Act and to preserve existing agricultural economies in the AMA for as long as feasible, consistent with the necessity to preserve future water supplies for non-irrigation uses. A.R.S. § 45-562.

To help meet the management goals of the AMAs, the Act requires the director to adopt a series of five management plans for each AMA after holding public hearings. Except for the fifth management plan, each management plan covers a 10-year management period. The management plans must be developed according to the guidelines set forth in the Act and must contain a continuing mandatory conservation program for persons withdrawing, distributing and receiving groundwater in the AMA.<sup>9</sup>

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<sup>8</sup> A fifth AMA, the Santa Cruz AMA, was created in 1994 from a portion of the Tucson AMA. The management goal of the Santa Cruz AMA is to maintain a safe-yield condition and to prevent local water tables from experiencing long-term declines.

<sup>9</sup> For the Santa Cruz AMA, the management plans must contain a continuing mandatory conservation program for persons

A.R.S. § 45-563. The guidelines for each management period are described in section II below.

**II. Management Plan Guidelines Set Forth in  
the Act**

First Management Period, 1980-1990 (A.R.S. § 45-564)

*Promulgation dates:* The director is required to promulgate a management plan for the first management period for the Phoenix, Prescott and Tucson AMAs by January 1, 1983 and for the Pinal AMA by July 1, 1985.

*Irrigation uses<sup>10</sup>:* The director must establish in the plan an irrigation water duty for each farm unit in the AMA. The director is required to calculate the irrigation water duty for a farm unit as the quantity of water reasonably required to irrigate the crops historically grown in the farm unit assuming conservation methods being used in the state that would be reasonable for the farm unit, including lined ditches, pump-back systems, land leveling and efficient application practices, but not a change from flood irrigation to drip irrigation or sprinkler irrigation.

*Municipal uses<sup>11</sup>:* For municipal uses, the plan must require reasonable reductions in per capita use and use of such other conservation measures as may be appropriate for individual users.

*Industrial uses<sup>12</sup>:* For industrial uses, the plan must require the use of the latest commercially available conservation technology consistent with reasonable economic return.

*Distribution requirements:* The plan must include economically reasonable conservation requirements for the distribution of groundwater by cities, towns, private water companies and irrigation districts.

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withdrawing, distributing and receiving water, other than stored water, from wells in the AMA.

10 “Irrigation use” is defined as the use of groundwater on two or more acres of land to produce plants or parts of plants for sale or human consumption, or for use as feed for live stock, range livestock or poultry.

11 “Municipal use” is defined in A.R.S. § 45-561 as “all non-irrigation uses of water supplied by a city, town, private water company or irrigation district.”

12 The term “industrial use” was not defined in the Act. In 1981, A.R.S. § 45-561 was amended to include the following definition of the term: “Industrial use” means a non-irrigation use of water not supplied by a city, town or private water company, including animal industry use and expanded animal industry use.

*Notice requirements:* Within thirty days after the management plan is adopted, the director must give written notice of the irrigation water duties and conservation requirements adopted in the management plan as follows:

- The director must give written notice of the irrigation water duty for a farm unit to each person in the farm unit who is entitled to withdraw or receive groundwater pursuant to an irrigation grandfathered right (“IGFR”) and to each person distributing groundwater pursuant to an IGFR.
- The director must give written notice of the municipal conservation requirements to each person who is entitled to withdraw or distribute groundwater for municipal use in the AMA.
- The director must give written notice of the industrial conservation requirements to persons entitled to withdraw or receive groundwater for an industrial use in the AMA.
- The director must give written notice of the conservation requirements for distribution of groundwater to each city, town, private water company and irrigation district in the AMA.

*Compliance:* A person notified of an irrigation water duty or conservation requirement must comply with the water duty or conservation requirement within two years from the date of the notice, unless the person obtains a variance pursuant to A.R.S. § 45-574. Compliance with irrigation water duties is determined pursuant to A.R.S. § 45-467. That statute requires the director to establish an operating flexibility account for each farm. The director must register a credit to a farm’s flexibility account if the farm uses less water than allowed by its irrigation water duty and register a debit to the account if the farm uses more water than allowed by its irrigation water duty.<sup>13</sup> A person using groundwater on a farm is out of compliance with the farm’s irrigation water duty if the farm’s flexibility account is in arrears at any time in excess of fifty percent of the farm’s current irrigation water duty.

Second Management Period, 1990-2000 (A.R.S. § 45-565)

*Promulgation date:* The director is required to promulgate

<sup>13</sup> Spill water is treated differently than other water sources in calculating debits to a farm’s flexibility account. If a farm’s use of spill water during a year would cause a debit to be registered to the farm’s flexibility account, the amount of the debit is reduced by the amount of spill water used. “Spill water” is surface water released from a storage facility into a surface water distribution system to avoid spilling.

a management plan for each AMA for the second management period by January 1, 1988.

*Irrigation uses:* The director must establish in the plan a new irrigation water duty for each farm unit to be reached by the end of the second management period and may establish one or more intermediate water duties to be reached at specified intervals during the management period. The director is required to calculate the water duty for a farm unit as the quantity of water reasonably required to irrigate the crops historically grown in the farm unit, assuming the maximum conservation consistent with prudent long-term farm management practices within areas of similar farming conditions, considering the time required to amortize conservation investments and financing costs.

*Municipal uses:* For municipal uses, the plan must require additional reasonable reductions in per capita use to those required for the first management period and use of such other conservation measures as may be appropriate for individual users. The plan must include a schedule for compliance with the requirements.

*Industrial uses:* For industrial uses, the plan must require the use of the latest commercially available conservation technology consistent with reasonable economic return. The plan must include a schedule for complying with the requirements.

*Distribution requirements:* The plan must include additional economically reasonable conservation requirements for the distribution of groundwater by cities, towns, private water companies and irrigation districts.

*Augmentation program:* The plan must include a program for augmentation of the water supply of the AMA including incentives for artificial groundwater recharge. A.R.S. § 45-611 requires the director to levy a groundwater withdrawal fee in each AMA for augmentation of the water supply of the AMA.

*Groundwater quality:* The plan must include an assessment of groundwater quality in the AMA and any proposed program for groundwater quality protection. Any such program must be submitted to the legislature for any necessary enabling legislation or coordination with existing programs of the Department of Health Services (“DHS”). The director must consult with DHS in making the assessment and developing any program for groundwater quality protection.

*Notice requirements:* Same as for first management period.

*Compliance:* A person notified of an irrigation water duty or conservation requirement must comply with the water duty or conservation requirement not later than January 1, 2000, unless the person obtains a variance pursuant to A.R.S. § 45-574. If intermediate irrigation water duties are established, a person entitled to withdraw or receive groundwater pursuant to an IGFR must comply with the intermediate water duty by the compliance date specified in the management plan, unless the person obtains a variance pursuant to A.R.S. § 45-574. Compliance with irrigation water duties is determined pursuant to A.R.S. § 45-467.

#### Third Management Period, 2000-2010 (A.R.S. § 45-566)

*Promulgation date:* The director is required to promulgate a management plan for each AMA for the third management period by January 1, 1998.

*Irrigation uses:* The director must establish a new irrigation water duty for each farm unit to be reached by the end of the third management period and may establish one or more intermediate water duties to be reached at specified intervals during the management period. The water duties must be calculated in the same manner as for the second management period. In setting the irrigation water duties, the director may adjust the highest twenty-five per cent of the water duties within the sub-basin to more clearly reflect the average of the middle fifty per cent of the water duties within the sub-basin.

*Municipal uses:* For municipal uses, the plan must require additional reasonable reductions in per capita use to those required for the second management period and use of such other conservation measures as may be appropriate for individual users. The plan must include a schedule for compliance with the requirements.

*Industrial uses:* For industrial uses, the plan must require the use of the latest commercially available conservation technology consistent with reasonable economic return. The plan must include a schedule for complying with the requirements.

*Distribution requirements:* The plan must include additional economically reasonable conservation requirements for the distribution of groundwater by cities, towns, private water companies and irrigation districts.

*Augmentation program:* The plan must include a program for additional augmentation of the water supply of the AMA, if feasible, including incentives for artificial groundwater recharge.

*Groundwater quality:* The plan must include an assessment of groundwater quality in the AMA and any proposed program for groundwater quality protection. Any such program must be submitted to the legislature for any necessary enabling legislation or coordination with existing programs of DHS. The director must consult with DHS in making the assessment and developing any program for groundwater quality protection.

*Purchase and retirement of grandfathered rights:* The plan may include a program for the purchase and retirement of grandfathered rights by the Department to begin no earlier than January 1, 2006. A.R.S. § 45-611 requires the director to levy a groundwater withdrawal fee of up to two dollars per acre-foot per year in an AMA for purchasing and retiring grandfathered rights in the AMA beginning in the first year in which the director develops and implements a program for the purchase and retirement of grandfathered rights for the AMA, but not earlier than January 1, 2006.

*Notice requirements:* Same as for first management period.

*Compliance:* A person notified of an irrigation water duty or conservation requirement must comply with the water duty or conservation requirement not later than January 1, 2010, unless the person obtains a variance pursuant to A.R.S. § 45-574. If intermediate irrigation water duties are established, a person entitled to withdraw or receive groundwater pursuant to an IGFR must comply with the intermediate water duty by the compliance date specified in the management plan, unless the person obtains a variance pursuant to A.R.S. § 45-574. Compliance with irrigation water duties is determined pursuant to A.R.S. § 45-467.

#### Fourth Management Period, 2010-2020 (A.R.S. § 45-567)

*Promulgation date:* The director is required to promulgate a management plan for each AMA for the fourth management period by January 1, 2008.

*Irrigation uses:* The director may, where feasible, establish a new irrigation water duty or intermediate water duty.



*Municipal uses:* The director may, where feasible, establish additional conservation requirements for municipal uses and a schedule for compliance with the requirements.

*Industrial uses:* The director may, where feasible, establish additional conservation requirements for industrial uses and a schedule for compliance with the requirements.

*Distribution requirements:* The director may, where feasible, establish additional economically reasonable conservation requirements for the distribution of groundwater by cities, towns, private water companies and irrigation districts.

*Augmentation program:* The director may, where feasible, establish a program for additional augmentation of the water supply of the AMA including incentives for artificial groundwater recharge.

*Groundwater quality:* The director may, where feasible and in cooperation with DHS, include in the plan an assessment of groundwater quality in the AMA and any proposed program for groundwater quality protection. Any such program must be submitted to the legislature for any necessary enabling legislation or coordination with existing programs of DHS.

*Purchase and retirement of grandfathered rights:* The director may, where feasible, establish a program for the purchase and retirement of grandfathered rights by the Department.

*Notice requirements:* Same as for first management period.

*Compliance:* A person notified of an irrigation water duty or conservation requirement must comply with the water duty or conservation requirement not later than January 1, 2020, unless the person obtains a variance pursuant to A.R.S. § 45-574. If intermediate irrigation water duties are established, a person entitled to withdraw or receive groundwater pursuant to an IGFR must comply with the intermediate water duty by the compliance date specified in the management plan, unless the person obtains a variance pursuant to A.R.S. § 45-574. Compliance with irrigation water duties is determined pursuant to A.R.S. § 45-467.

### Fifth Management Period, 2020-2025 (A.R.S. § 45-568)

*Promulgation date:* The director is required to promulgate a management plan for each AMA for the fifth management period by January 1, 2019.

*Guidelines:* The director is required to follow the guidelines for the fourth management period in adopting the management plans for the fifth management period.

*Compliance:* A person notified of an irrigation water duty or conservation requirement must comply with the water duty or conservation requirement not later than January 1, 2020. Compliance with irrigation water duties is determined pursuant to A.R.S. § 45-467.

### **III. Modification of Management Plans (A.R.S. § 45-572)**

After a management plan is adopted, the director may modify the plan, after public hearing, except that the director may modify an irrigation water duty or conservation requirement only if the director determines that extraordinary circumstances justify the modification. Within thirty days after a conservation requirement is modified, the director must give written notice of the modification to the persons originally given notice of the requirement.

### **IV. Variance (A.R.S. § 45-574)**

A person who requires additional time to comply with an irrigation water duty or conservation requirement because of economic circumstances may apply to the director for a variance from the water duty or requirement within ninety days from the date the person received notice of the requirement. The director may grant a variance of up to five years upon a showing of compelling economic circumstances. The director may require a person granted a variance to comply with a schedule of intermediate water duties or conservation requirements at specified intervals during the variance period.

### **V. Administrative Review (A.R.S. § 45-575)**

An aggrieved party may request an administrative review of an irrigation water duty or conservation requirement not later than ninety days from the date of notice of the water duty or requirement.

## Significant Legislative Changes to the 1980 Groundwater Management Act

### Significant Changes for 1984

A.R.S. § 45-564 was amended to permit the director to include in the first management plan for the Tucson AMA a program for the augmentation of water supply of the AMA including incentives for artificial groundwater recharge. This provision was already required for the second, third, fourth, and fifth management plans for all AMAs. A.R.S. § 45-611 was also amended to require the director to levy a groundwater withdrawal fee in the Tucson AMA of up to 50 cents per acre-foot per year for augmentation in the AMA beginning in the first year that the director adopts a specific augmentation project as part of the management plan.

### Significant Changes for 1985

Amendments to A.R.S. §§ 45-564, 45-565 and 45-566 authorize the director to establish in the management plans water allotments for industrial users (golf courses, dairies, etc.) based on the use of the latest commercially available conservation technology consistent with reasonable economic return. Previously, the director could only require industrial users to use the latest commercially available conservation technology consistent with reasonable economic return.

Amendments to A.R.S. §§ 45-565, 45-566 and 45-567 authorize the director to establish in the second, third and fourth management plans intermediate conservation requirements to be complied with prior to the end of the second, third or fourth management periods respectively.

A.R.S. § 45-568 added the requirement that persons subject to fifth management plan conservation requirements are to remain in compliance with the requirements until the legislature determines otherwise (previously there was no mention of how long persons were required to remain in compliance with the requirements).

### Significant Changes for 1986

Amendments to A.R.S. §§ 45-561, 45-565 and 45-566 exempted small municipal providers from the requirements to achieve reasonable reductions in per capita use and required the director to establish reasonable conservation requirements for small municipal providers. “Small

municipal provider” was defined as “a city, town, private water company or irrigation district that supplies water for non-irrigation use, serves less than five hundred people and supplies less than one hundred acre feet of water for non-irrigation use during a calendar year.”

Amendments to A.R.S. §§ 45-565, 45-566, 45-567 and 45-569 reflect the establishment of the Department of Environmental Quality (“DEQ”). Responsibility of water quality regulation was transferred from the DHS to the DEQ. The director must coordinate with the DEQ in areas where previously the director coordinated with the DHS.

Chapter 13, “Artificial Recharge,” was added to the Groundwater Code and provides for the issuance of permits for recharging water into an aquifer with no ability to recover the water later (now known as non-recoverable water storage). The article contains section 45-652, which sets forth the criteria for obtaining a recharge project permit. This section authorizes the director to issue a recharge project permit if the director determines, among other things, that “if the recharge project is in an active management area, the project is not inconsistent with the active management area’s augmentation program.”

Chapter 3, “Underground Water Storage,” was added to title 45, A.R.S., and provides for the issuance of permits to construct underground storage and recovery projects. This chapter includes section 45-807, which sets forth the criteria for obtaining a recovery well permit to recover stored water. This section authorizes a holder of an underground storage and recovery project permit to recover the water stored at the project from wells located outside the area of hydrologic impact of the project and within an AMA, “if the director determines that recovery at the proposed location is consistent with the management plan and achievement of the management goal for the active management area.”

### Significant Changes for 1987

Amendments to A.R.S. §§ 45-565, 45-566, 45-567 and 45-568 require the director to notify persons of their conservation requirements two years before they become effective (in addition to the notice given within 30 days after the management plan is adopted).

A.R.S. § 45-571.01 was added and authorizes the director to give notice of conservation requirements to persons who

obtain grandfathered rights under the late application procedures. The notice is to be given at the time the grandfathered right is issued (even though it is more than 30 days after the management plan was adopted). A person notified of an irrigation water duty or conservation requirement pursuant to this section must comply with the requirement beginning January 1 of the calendar year following the first full year after the date of the notice. The person may request a variance or administrative review as provided in A.R.S. §§ 45-574 and 45-575.

A.R.S. § 45-575 was amended to provide that an application for administrative review of an irrigation water duty or conservation requirement must be filed no later than 90 days from the date of the notice of the requirement given within 30 days after adoption of the management plan.

#### Significant Changes for 1988

A.R.S. § 45-561 added the definition of municipal provider. Municipal provider “means a city, town, private water company or irrigation district that supplies water for non-irrigation use.” A.R.S. § 45-571.02 was added and A.R.S. §§ 45-564, 45-565, 45-566, 45-567 and 45-568 were amended to make an individual user (i.e. a customer of a municipal provider) responsible for complying with a conservation requirement established for its water use if the director gives written notice of the requirement to the individual user within 30 days after the management plan is adopted. Prior to this time, municipal providers were responsible for complying with the conservation requirements established for individual users. The amendments require the director to give written notice of an individual user conservation requirement that is substantially identical to an industrial conservation requirement (e.g. a golf course allotment) directly to the individual user if the municipal provider serving the individual user identifies the individual user to the director in writing at least 90 days before the management plan is adopted.

A.R.S. § 45-571.01 was amended to authorize the director to notify new water users of management plan conservation requirements (even though it is more than 30 days after the management plan was adopted). A person given notice of an irrigation water duty or conservation requirement pursuant to this provision must comply with the requirement beginning on the date specified in the notice. The person may request a variance or administrative review pursuant to A.R.S. §§ 45-574 and 45-575.

A.R.S. § 45-575 was amended to allow a person subject to a conservation requirement to apply for an administrative review of the requirement more than 90 days after receiving the initial notice of the requirement if the person claims that the requirement should be modified because of extraordinary circumstances not in existence when the notice was received. Prior to this amendment, a person subject to a conservation requirement could apply for an administrative review of the requirement only within 90 days after receiving the initial notice of the requirement.

#### Significant Changes for 1990

Amendments to A.R.S. §§ 45-467 and 45-561 exclude spill water use from consideration when determining compliance with agricultural and municipal conservation requirements. “Spill water” is surface water released from a storage facility to avoid spilling.

Amendments to A.R.S. §§ 45-565, 45-566 and 45-567 require the director to include in a management plan a program for conservation assistance to water uses in the AMA. A.R.S. § 45-611 authorizes the director to levy a groundwater withdrawal fee in each AMA for conservation assistance in the AMA.

#### Significant Changes for 1991

A.R.S. § 45-467 was amended to allow farmers in irrigation districts to sell or convey credits in their flexibility accounts to other farmers in the same irrigation district (up to the amount of credits they received in the previous year). The section was also amended to exclude effluent use from consideration when calculating debts to a farm’s flexibility account.

Amendments to A.R.S. §§ 45-561, 45-565, 45-566 and 45-567 exempted deliveries of untreated water by large untreated water providers from conservation requirements requiring reasonable reductions in per capita use. “Large untreated water provider” was defined as a municipal provider serving untreated water to at least 500 persons as of January 1, 1990, or serving at least 100 acre-feet of untreated water as of that date. Instead of reductions in per capita use, large untreated water providers are required to comply with conservation requirements or rate of use requirements based on the use of the latest commercially available conservation technology consistent with reasonable economic return.

## Significant Changes for 1992

A.R.S. § 45-467 was amended to place an additional restriction on the ability of a person to sell or convey credits in a farm's flexibility account - the farm must have been capable of being irrigated as of the end of the previous year. The effect of this amendment is that credits cannot be sold or conveyed from a farm's flexibility account if the farm was developed as of the end of the previous year.

A.R.S. § 45-561 was amended and A.R.S. §§ 45-565.01, 45-566.01, 45-567.01 and 45-568.01 were added to require the director to include in the management plans an optional alternative conservation program for large municipal providers, called the non-per capita conservation program. A large municipal provider is eligible to be regulated under this program if: 1) the provider agrees to reduce its mined groundwater use to zero by 2010 or is a member of a groundwater replenishment district, and 2) the provider agrees to implement specific conservation measures in its service area that the director determines will result in a water use efficiency equivalent to the efficiency assumed by the director in establishing the provider's conservation requirements under the program requiring reasonable reductions in per capita use. A large municipal provider regulated under the non-per capita conservation program is exempt from the requirement to achieve reasonable reductions in per capita use.

Amendments to A.R.S. §§ 45-566, 45-567 and 45-568 authorize the director to reduce the highest 25 percent of the irrigation water duties in an area of similar farming conditions up to 10 percent (but not lower than the highest water duty in the lowest 75 percent of the water duties in the area of similar farming conditions). Previously, the director was authorized to reduce the highest 25 percent of the water duties in a sub-basin to more clearly reflect the average 50 percent of the water duties in the sub-basin.

## Significant Changes for 1994

A.R.S. § 45-561 was amended to change the definition of "small municipal provider" from a municipal provider serving less than 500 people and less than 100 acre-feet of water for non-irrigation use during a year to a municipal provider serving 250 acre-feet or less of water for non-irrigation use during a year.

A.R.S. § 45-563.02 was added and A.R.S. §§ 45-565, 45-566, 45-567 and 45-568 were amended to provide an

exemption from the irrigation water duties established in the management plans for farms that have ten or fewer irrigation acres and that are not part of an integrated farming operation with more than 10 irrigation acres. Instead of complying with irrigation water duties, persons using groundwater on these farms are required only to prevent groundwater from running off the surface of the farm unless the groundwater will be put to a beneficial use.

Amendments to A.R.S. §§ 45-565.01, 45-566.01 and 45-567.01 changed the non-per capita conservation program to provide that large municipal providers designated as having an assured water supply are eligible to enroll in the program.

A.R.S. §§ 45-467, 45-562, 45-563, 45-566 and 45-567 were amended as part of the legislation creating the Santa Cruz AMA. The amendment to A.R.S. § 45-562 established the management goal of the AMA, which is to maintain a safe-yield condition and prevent local water tables from experiencing a long-term decline. The other amendments: (1) provide that the conservation requirements in the Santa Cruz AMA apply to all water withdrawn from a well other than stored water; and (2) require that the management plans for the Santa Cruz AMA contain criteria for the location of new non-exempt wells consistent with the management goal of the AMA and an evaluation of the potential impact of the plan on the Tucson AMA.

Article 13 of the Groundwater Code, "Artificial Recharge," and Title 45, Chapter 3, A.R.S., "Underground Water Storage," were repealed and replaced with Chapter 3.1, Title 45, A.R.S., "Underground Water Storage, Savings and Replenishment." This had the effect of consolidating the statutory provisions governing non-recoverable water storage, underground storage facility permits, water storage permits and recovery well permits into one chapter and reorganizing and renumbering the statutes. Section 45-833.01 sets forth the criteria for obtaining a non-recoverable water storage permit. Subsection A of that section provides that if the water storage occurs within an AMA, the director may designate the water storage permit as storing non-recoverable water "only if the storage is consistent with the active management area's augmentation program." Section 45-834.01(A) contains criteria for obtaining a recovery well permit. Under that section, if the recovery well will be located within an AMA and outside the area of impact of the stored water (or within the area of impact if the person recovering the water is not the water

storer), the director must determine “that recovery at the proposed location is consistent with the management plan and achievement of the management goal for the active management area.”

### Significant Changes for 1996

Amendments to A.R.S. §§ 45-566 and 45-567 require the director to include in the management plans for the Phoenix, Tucson and Pinal AMAs recommendations to the Arizona Water Banking Authority regarding water storage and extinguishment of long-term storage credits.

### Significant Changes for 1998

A.R.S. § 45-467 was amended to allow an owner of a farm located outside of an irrigation district to sell or convey credits in the farm’s flexibility account to a farm located outside of an irrigation district, but in the same groundwater sub-basin. Only the credits registered to the account during the previous year can be conveyed. Previously, only farms located within irrigation districts could convey or purchase flexibility account credits.

A.R.S. §§ 45-566.02 and 45-567.02 were added and require the director to include in the third, fourth and fifth management plans an optional alternative conservation program for agricultural water users, called the historic cropping program. The historic cropping program is similar to the irrigation water duty program included in the 1980 Groundwater Management Act (“base irrigation water duty program”) except that under the historic cropping program: 1) irrigation water duties are calculated using an assumed irrigation efficiency of 75 percent, 2) there is a limit on the credits that can be registered to the farm’s flexibility account, and 3) the farmer cannot buy or sell credits. These sections also authorize, but do not require, the director to establish additional optional alternative agricultural conservation programs equivalent to the base irrigation water duty program, including a cropped acreage program in which the maximum annual groundwater allotment is calculated using the crops actually grown during the year instead of the crops historically grown.

### Significant Changes for 2002

A.R.S. § 45-467 was amended to relax the restriction on selling or conveying credits in a farm’s flexibility account by allowing credits to be sold or conveyed from a farm outside of an irrigation district to a farm located within

an irrigation district and vice versa, but only if the owner or lessee of the farm from which the credits are conveyed is the owner or lessee of the farm to which the credits are conveyed. Only the previous year’s credits may be conveyed.

A.R.S. § 45-566 was amended to require the director to establish irrigation water duties for farmers in the base irrigation water duty program using an assumed irrigation efficiency of 80 percent. Prior to the amendment, the Department had calculated water duties for the second management period using an assumed irrigation efficiency of 85 percent. An irrigation efficiency lower than 80 percent may be used for farms with limiting soils or excessive slopes.

A.R.S. §§ 45-566, 45-567 and 45-568 were amended for the third, fourth and fifth management periods to limit the amount by which the director may reduce the highest 25 percent of irrigation water duties in an area of similar farming conditions. The amendments provide that no water duty may be reduced below a water duty calculated using an assumed irrigation efficiency of 80 percent.

A.R.S. § 45-566.02 was amended to require the director to modify the third management plan to include an agricultural best management practices (“BMP”) program for farms as an additional optional alternative to the base irrigation water duty program. The BMP program must be designed to achieve conservation that is at least equivalent to the base irrigation water duty program. A farmer who chooses to be regulated under the BMP program must implement specific agricultural conservation practices on the farm and is exempt from irrigation water duties and a maximum annual water allotment. The farm’s flexibility account is frozen while the farm is regulated under the BMP program (no credits or debits may be registered to the account and credits in the account cannot be sold to another farm).

A.R.S. §§ 45-567.02 and 45-568.02 were amended to authorize, but not require, the director to include the optional agricultural BMP program in the fourth and fifth management plans. If the BMP program is included in those management plans, it must have the same requirements as in the third management plan BMP program (described in the preceding paragraph).

Amendments to A.R.S. §§ 45-571.02 and 45-575 allow the director to notify an individual user (i.e. a customer

of a municipal provider) of a municipal conservation requirement that is substantially identical to an industrial conservation requirement (e.g. a golf course allotment) more than 30 days after the management plan is adopted if the municipal provider serving the individual user failed to notify the director of the identity of the individual user at least 90 days before the management plan was adopted.

#### Significant Changes for 2004

A.R.S. § 45-834.01, which contains criteria for obtaining a recovery well permit, was amended to provide that in an AMA, the recovery of Colorado river water within the area of impact of storage by a person other than the storer of the water no longer requires a determination by the director that the recovery is consistent with the management plan and achievement of the management goal of the AMA.

#### Significant changes for 2007 (Bill has been introduced, but not yet enacted into law)

Amendments to A.R.S. §§ 45-566, 45-566.01, 45-567, 45-567.01, 45-568 and 45-568.01 will change the municipal conservation program for large municipal providers. Under these amendments, beginning January 1, 2010, all large municipal providers not designated as having an assured water supply and not regulated as a large untreated water provider will be regulated under the non-per capita conservation program in the applicable management plan instead of the program requiring reasonable reductions in per capita use. Large municipal providers designated as having an assured water supply will continue to be regulated under the program requiring reasonable reductions in per capita use unless they elect to be regulated under the non-per capita conservation program. The amendments make several changes to non-per capita conservation program. The director must modify the management plan for the third management period by January 1, 2008 to include the changes. The following are the major changes:

- A large municipal provider regulated under the non-per capita conservation program must implement specific conservation measures within its service area, chosen from a list of conservation measures approved by the director. The director may prescribe the number of conservation measures that a provider must implement based on the number of service connections within its service area.
- Prior to the effective date of the non-per capita conservation program in a management plan, a large

municipal provider that will be regulated under the program must submit to the director a provider profile describing the provider's existing service area characteristics and water use patterns, the conservation measures the provider intends to implement while regulated under the program and an explanation of how each conservation measure is relevant to the provider's service area characteristics or water use patterns. The director must review a large provider's provider profile and approve the profile if the profile demonstrates that the provider will implement the required number of conservation measures and that the measures are relevant to the provider's service area characteristics or water use patterns. If the director disapproves a large provider's provider profile, the provider will be given one opportunity to revise the profile and resubmit it to the director for approval. A provider is regulated under the non-per capita conservation program after the director approves the provider's provider profile.

- Large municipal providers regulated under the non-per capita conservation program are no longer required to limit or reduce their groundwater use, but the director is required to design the program so that it achieves water use efficiency within the service areas of providers regulated under the program equivalent to the water use efficiency assumed by the director in establishing the program requiring reasonable reductions in per capita use.
- The director will be required by a session law to periodically review the non-per capita conservation program adopted in a management plan to evaluate the effectiveness of the program. If the director determines that changes to the program are appropriate to improve the effectiveness of the program, the director must modify the program if the changes are consistent with the relevant statutes or, if not, give written notice of the appropriate changes to the speaker of the House of Representatives, the president of the senate and the governor.

Amendments to A.R.S. §§ 45-465, 45-567.02 and 45-568.02 will require the director to include in the management plans for the fourth and fifth management period an optional agricultural BMP program that requires the owner of an irrigation grandfathered right and any person using groundwater pursuant to the right to implement specific agricultural conservation practices for water use in lieu of complying with an irrigation water duty and a maximum annual groundwater allotment. The program must be designed to achieve conservation that is at least

equivalent to that required under the base irrigation water duty program. Currently, the agricultural BMP program is required to be included in the management plan for the third management period and the director is authorized, but not required, to include the program in the management plans for the fourth and fifth management periods. The director will be required by a session law to periodically review an agricultural BMP program adopted in a management plan to evaluate the effectiveness of the program. If the director determines that changes to the program are appropriate to improve the effectiveness of the program, the director must modify the program if the changes are consistent with the relevant statutes or, if not, give written notice of the appropriate changes to the speaker of the House of Representatives, the president of the senate and the governor.

# **APPENDIX E: SUMMARY OF THE CONSERVATION PROGRAMS FOR THE ACTIVE MANAGEMENT AREAS**

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## SUMMARY OF THE EVOLUTION OF THE MUNICIPAL CONSERVATION PROGRAM

### Highlights

- First Management Plan programs were very different than future plans
- Despite little time for learning between first and second plans, significant changes did take place
- There is a dramatic increase in complexity over time
- Rather than adapting the same program over time, the ADWR has instead added new programs to address unique needs
- A modified Non-Per Capita Conservation Program was recently adopted by the state legislature. Significantly, the modified program is mandatory for municipal providers without an AWS.

### Introduction

A key component of the management plans is the Municipal Conservation Program. This program regulates municipal water providers – water providers such as cities, towns, and irrigation districts that deliver groundwater for non-irrigation uses. Private water companies are also regulated as municipal providers. As the state continues to grow, municipal water use will become a larger component of total water use. Therefore, the Municipal Conservation Program is critical component of the effort to achieve safe-yield in the AMAs. This summary traces the evolution of the Municipal Conservation Program across the three management plans to determine the information used to develop the regulatory programs and ADWR’s approach

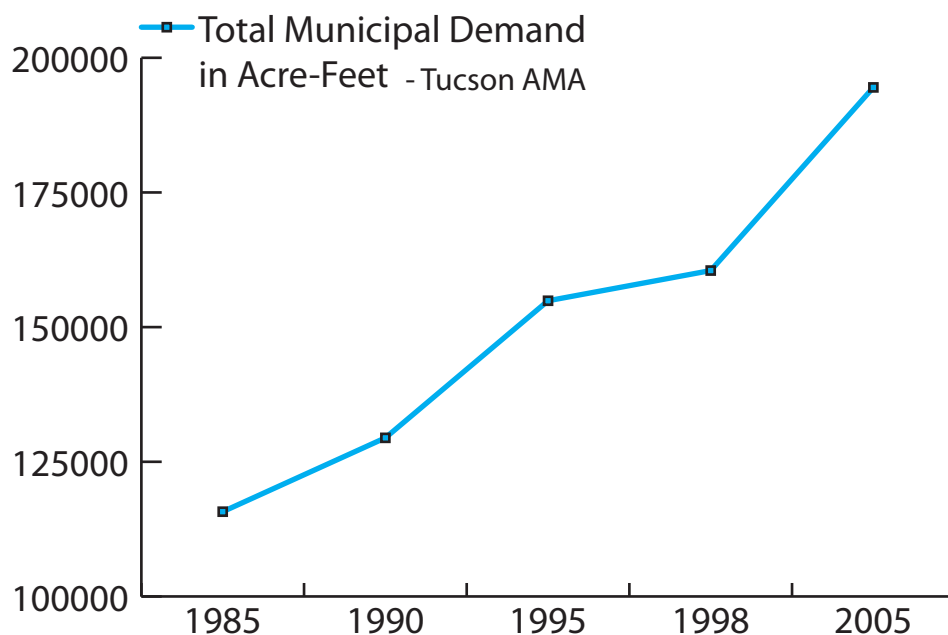
to regulating municipal water providers.

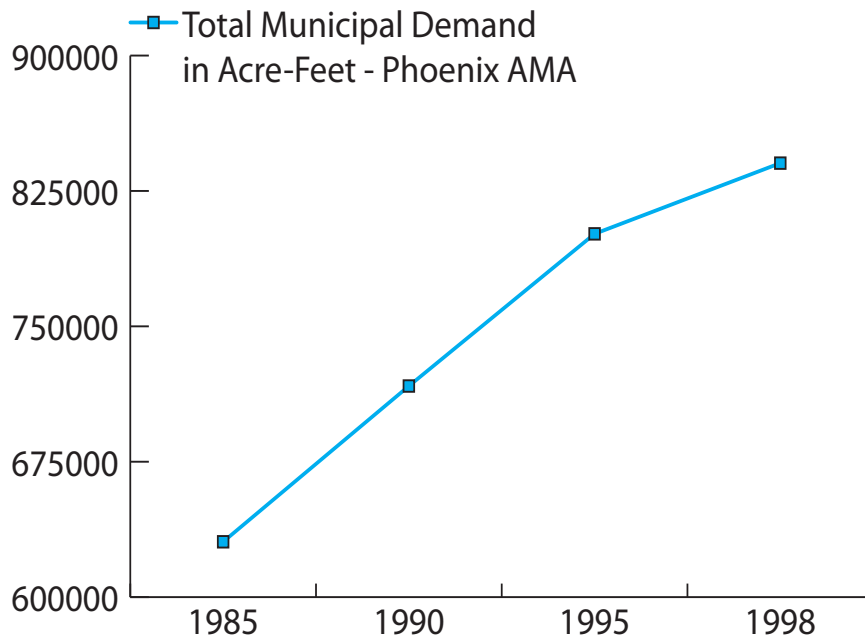
### Water Use 1980 – 1995

#### Tucson AMA

Total municipal water use in the Tucson AMA has been steadily increasing since the First Management Plan was developed in the mid-1980s. Municipal providers used approximately 115,000 acre-feet of water in 1985, 129,000 acre-feet in 1990, and 163,000 acre-feet in 1996. It is important to note that increases in water use were driven by a growing population within the AMA. This growth has continued. By 2005, total municipal use in the AMA had increased to 194,500 acre-feet.

The ADWR also uses gallons per-capita day (GPCD; the number of gallons used for each person in a service area per day) to track municipal water usage. This measure is a more accurate reflection of the effects of conservation measures because it does not need to be adjusted for population growth. The GPCD for municipal uses in the Tucson AMA has fluctuated over the management periods. In 1985, 176 GPCD was used by municipal providers. In 1990, the number had dipped to 169 GPCD. By 1995, the usage had rebounded to 172. The fluctuation highlights a recognized problem with the use of GPCD as a conservation measure: water use varies with the weather. This problem is a major cause of the reforms introduced across management periods.





### Phoenix AMA

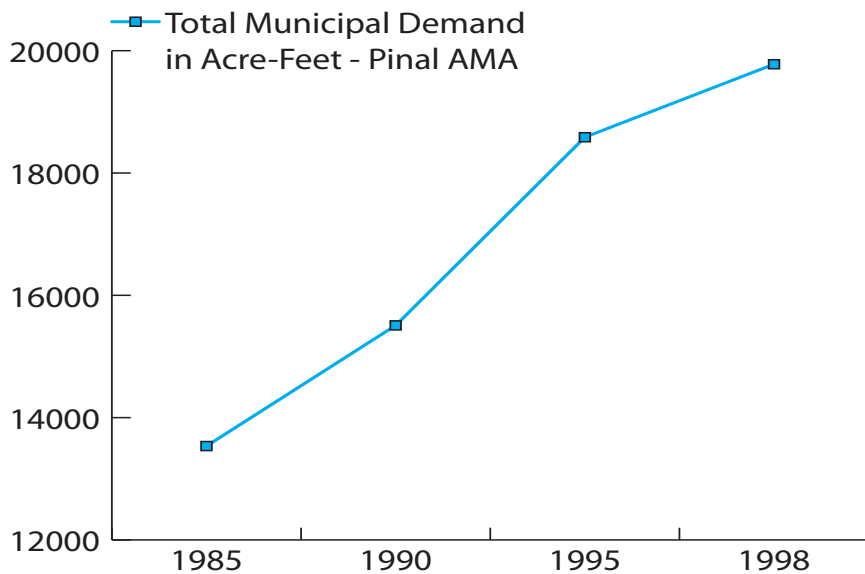
The Phoenix AMA has been successful in reducing the average GPCD between 1985 and 1995. Prior to the first management period, the AMA had a high average GPCD rate of 243 GPCD for large providers and 371 GPCD for small providers. These rates had gone down to 235 and 223, respectively, by 1995. In 1995, large providers made up 82% of total municipal use while small providers represented only 1% of municipal use. The remaining 17% was accounted for by untreated water delivered for urban irrigation. The Phoenix AMA makes greater use of effluent and untreated water proportionally than the other AMAs.

Despite the progress made over the first two management periods to reduce total GPCD rates and groundwater

overdraft, there is still a significant groundwater mining problem within the AMA. Groundwater mining is expected to continue beyond 2025. The municipal sector's contribution to groundwater overdraft was approximately 193,000 acre-feet in 1995 (ADWR 1999a). Overdraft will change depending on the rate of population growth and the success of future conservation efforts.

### Pinal AMA

There have been significant changes in the distribution of water use in the Pinal AMA over the course management periods. The agricultural sector continues to be the largest water user in the AMA, but the municipal sector is growing at an accelerating pace. In 1980, at the beginning of the first management period, 91% of the water used in the AMA was used by agriculture. Only 2% was used by the



municipal sector. By 1995, agriculture represented 74.7% of total water use and municipal use had increased to 2.4%. Projected water budgets for the Pinal AMA reflect the continued growth of the municipal sector. Because these water budgets use inaccurate population estimates for the AMA (the 2025 population is projected at 145,000, while the population of Pinal County already well exceeds 200,000), the shift from agriculture to municipal will be even more pronounced than expected by the management plans. This shift has important implications for water use in the AMA because of the very different water demands of the agricultural and municipal sectors and the AMA's unique management goal.

Because of the increasing size of the municipal sector in the Pinal AMA, it is important to consider the effectiveness of the municipal conservation programs. As of the Third Management Plan there is no clear trend towards a reduction in GPCD use for the municipal sector. Because of this, it is difficult to determine the effectiveness of the conservation programs or actual water savings as a result of the programs.

### Prescott AMA

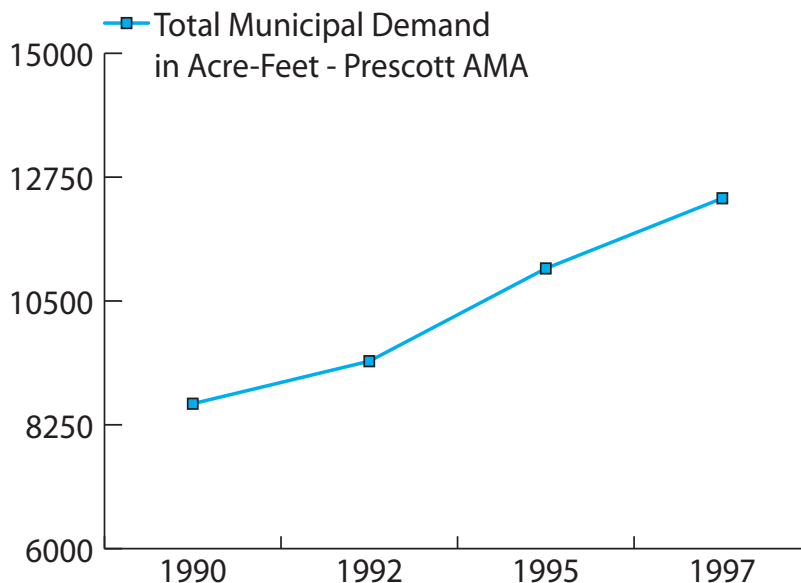
Tracking water use by the municipal sector in the Prescott AMA over time is more difficult than in the other AMAs. During the first and second management periods, service area populations were calculated differently than in the other AMAs. The unique calculation method in the Prescott AMA led to an artificially low GPCD rate because it failed to properly account for residential vacancies. For the third management period, the population calculation

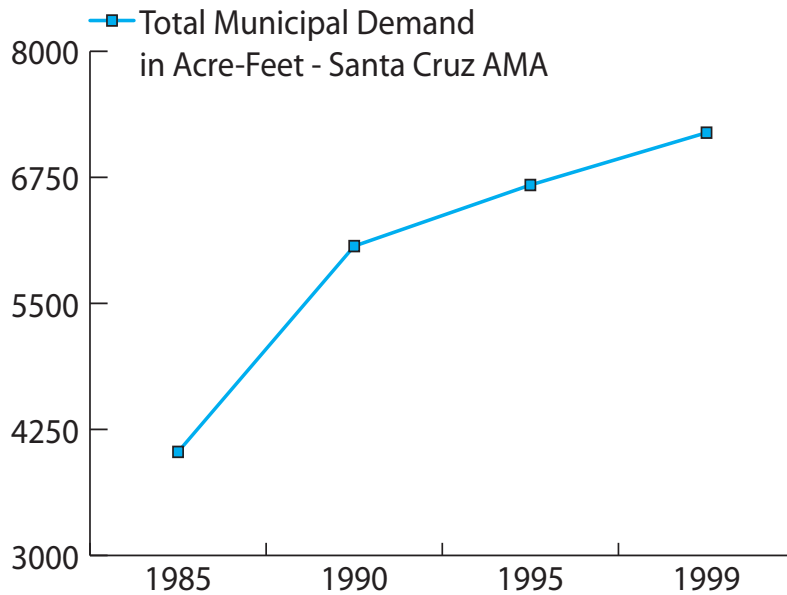
method was changed to bring it into conformance with that of the other AMAs. This change resulted in a jump in GPCD making it difficult to compare GPCD rates from the first two management periods with the GPCD targets in the third management period (ADWR 1999b). However, an evaluation of the GPCD trend by the ADWR indicates an upward trend in GPCD rate for the municipal sector over the three management periods (ADWR 1999b).

The reasons for this increase in GPCD rates are not entirely clear. It may be related to rapid growth and a general change in the character of development within the AMA. It is clear, however, that there is reason to be concerned about increasing water use by the municipal sector. The municipal sector made up 60% of total water demand in 1997. The sector's share of total demand has been increasing rapidly and this trend is expected to continue. The increase in municipal demand is being fed by groundwater, not renewable sources. Between 1985 and 1997 there was a 57% increase in population but a 95% increase in groundwater use. Because of the municipal sector's overwhelming dependence on groundwater and the general scarcity of renewable supplies in the AMA, the Municipal Conservation Program of the management plans is of critical importance to achieving the AMA's safe-yield goal.

### Santa Cruz AMA

The Santa Cruz Active Management Area (AMA) is unique. It was created out of the Tucson AMA in the mid-1990s because of unique characteristics of the Santa Cruz County portion of the Tucson AMA. Municipal water use in the AMA has generally increased from 1985





to 1999. The growth in municipal water use is consistent with population growth within the AMA. On a per-capita basis, municipal water use in the AMA has fluctuated from 1985 to 1995. In 1985 total GPCD use was 178 gallons. In 1990 the GPCD rate had increased to 199 only to decline to 189 GPCD by 1995. The population, and with it water use, of the Santa Cruz AMA is expected to continue to grow during future management periods.

### Municipal Conservation Programs – Increasing Complexity

While the approach to the Municipal Conservation Program in the First Management Plans was remarkably simple, by the Third Management Plans the municipal program had developed into a complex set of regulations. The simplicity of the First Management Plans is due to its lack of options – providers are not given a choice of how they will be regulated. With a few minor exceptions, the same regulations are applied to each provider regardless of their size or any special circumstances that may exist.

When the Second Management Plans were developed, ADWR realized there was a need for flexibility in the regulations. Therefore, the department revamped the entire Total GPCD Program, tailoring it more specifically to the individual conditions of particular providers and separating out small providers. The Second Management Plans also include a second, parallel regulatory system, the Alternative Conservation Program, to increase the choices available to providers. The Third Management Plans built on the changes of the second management period and introduced a third parallel set of regulations,

the Non-Per Capita Conservation Program, to allow even more flexibility. Recent legislative changes have replaced the Total GPCD Program with a modified version of the non-per capita program. The evolution of the three regulatory programs under the umbrella of the Municipal Conservation Program is described in the following sections.

### Total GPCD Program – The Heart of the Management Plans

The Total Gallons Per-Capita Day (GPCD) Program is the only regulatory portion of the Municipal Conservation Program that is present in each of the three management plans in all AMAs. It is the core of the municipal conservation effort – all municipal providers are by default regulated by the Total GPCD program. Regulation under any of the alternative programs developed in the Second and Third Management Plans is optional and by application.

#### First Management Period

During the first management period, each of the AMAs had different requirements under the Total GPCD program, though the method of determining the requirements was similar. The First Management Plans prescribed a uniform GPCD standard for all municipal providers using a base year of 1980. With the exception of the Pinal AMA, the standard was based on what was required for the AMA to reach safe-yield given its Central Arizona Project (CAP) allocation and the projected population growth within the AMA. The conservation potential of individual providers was not considered in developing the standard. In the

Pinal AMA, in addition to a minimum standard, a specific GPCD target for each provider based on conservation potential was developed. This was made possible by the unusually small number of municipal providers present in the AMA. In the other AMAs, it was reasonable to use the CAP estimate to project safe-yield because it was assumed that a large portion of the municipal demand within the four AMAs would be met by direct delivery of CAP water to municipal customers. However, due to delivery and water quality problems, direct delivery of CAP water is no longer an option within the Tucson Water service area. In addition, the City of Prescott in the Prescott AMA sold its CAP allocation due to the impracticalities of using the allocation (ADWR 1999b).

The base requirement was 140 GPCD in the Tucson, Phoenix, and Pinal AMAs and 130 GPCD in the Prescott AMA. Providers who met the base requirement at the time enforcement of the management plans began were not required to implement additional conservation measures. They were required to maintain their existing GPCD consumption. Providers who exceeded the GPCD requirement were expected to reduce their consumption in order to begin to move towards the base GPCD standard. The specific reduction in total water use by providers exceeding the base requirement varied from one AMA to the next depending on what the ADWR felt was reasonable in a given AMA.

#### Tucson AMA

Providers who exceeded the 140 GPCD requirement were expected to reduce their consumption by 25% of the difference between their actual consumption and 140 GPCD by the end of the management period. Twenty-five percent was selected as the standard because a 25% reduction in each of the management periods would result in all providers meeting the 140 GPCD requirement by 2025. Assuming full utilization of their CAP allotment, municipal providers would achieve a per capita consumption level compatible with the safe-yield goal of the AMA by the target year of 2025.

#### Phoenix AMA

Providers who exceeded the 140 GPCD requirements, but used less than 350 GPCD were considered “moderate per capita providers” and expected to reduce their consumption

by 6%. Providers with usage exceeding 350 GPCD were considered “high per capita providers” and required to cut consumption by 11%. Greater GPCD reductions were expected from providers with higher GPCD rates because they were expected to have a larger overall conservation potential.

#### Prescott AMA

If a provider exceeded the 130 GPCD standard, it was required to implement conservation measures resulting in a 6% reduction in GPCD rate. The City of Prescott was the only large provider that exceeded the 130 GPCD threshold.

#### Pinal AMA

To determine an individual provider’s conservation requirement under the Total GPCD program, ADWR began by undertaking an analysis of conservation potential for the provider. This analysis considered the types of users supplied by the provider and the measures the provider could undertake to reduce user’s GPCD usage. Based on the results of this analysis, providers were divided into four groups, each with a different requirement for percentage decrease in GPCD based on conservation potential. If a provider’s total GPCD usage was under 140 GPCD, they were not required to implement conservation measures.

#### Second Management Period

Although the Total GPCD Program requirements were in effect for only two years when the Second Management Plan was adopted, the program was dramatically modified. The changes were motivated by a desire to increase the flexibility of the program. One major flaw of the First Management Plan approach is that it did not consider the conservation potential of individual providers (ADWR 1991a, 1991b, 1991c, 1991d). The Second Management Plan, except in the Prescott AMA, addressed this problem by tailoring conservation targets for individual large providers. Any municipal provider that supplies more than 100 acre-feet of water per year is considered a large provider. The GPCD requirement for an individual provider was based on that provider’s conservation potential, not on a blanket standard required to meet safe-yield. The Second Management Plan eliminated the base standard altogether – every provider with conservation potential was expected to make reasonable reductions in their GPCD consumption. The new requirements applied only to large providers as defined

by statute. The Prescott AMA retained the methodology used in the First Management Plan with lower Total GPCD targets. The First Management Plan approach was used in the second management period because generally lower water demand in the Prescott AMA relative to the other AMAs allowed providers to reach the uniform target more easily.

Also new in the Second Management Plan was the creation of flexibility accounts for large municipal providers. If a large provider was able to reduce its GPCD consumption below the conservation requirement, it was given a credit for the number of GPCD below the target amount. These credits could then be drawn on if the provider ever exceeded its GPCD target. The maximum number of annual flexibility account credits and debits varied from one AMA to the next:

- Tucson AMA: A maximum of 30 GPCD of credits and 10 GPCD of debits
- Phoenix AMA: A maximum of 60 GPCD of credits and 20 GPCD of debits
- Prescott AMA: A maximum of 30 GPCD of credits and 10 GPCD of debits
- Pinal AMA: A maximum of 45 GPCD of credits and 15 GPCD of debits; added in the Third Management Plan

This provision was developed to address a second flaw of the Total GPCD approach – water usage in the AMAs is correlated with weather. In hot, dry years, people use more water. In cool wet years, people use less water. The flexibility account allows for these variations (ADWR 1991a).

### Third Management Period

The Third Management Plan provisions are currently in effect. The Total GPCD Program provisions in the Third Management Plans are nearly identical to those of the second plans. New in the Third Management Plans is a great deal more background information on the management philosophy of the plans. The Third Management Plans are also more complex. The third management period is also the first complete period with fully implemented Assured Water Supply (AWS) rules, which were originally adopted in 1995.

The three most important changes in the Total GPCD Program in the third management period are the new definition of a large provider, the change in the way the GPCD target is calculated, and a change in the way population projections are used in setting GPCD

compliance. The first change is the result of statutory change – the GMA now defines a large municipal provider as a water provider that supplies more than 250 acre-feet per year for non-irrigation uses. This change reduced the number of large providers in all of the AMAs. As the state absorbs additional growth, most of the providers that became small providers as a result of the change are expected to shift back to large provider status (ADWR 1999a, 1999b, 1999c, 1999d).

The change in the GPCD target calculation is a result of lingering problems with structuring a Total GPCD program that is insulated from weather induced water use fluctuations (ADWR 1999a). In the third plan, the GPCD target is calculated a multiple year average to account for yearly fluctuations in climate. The resulting average, when coupled with flexibility account credits and debits, is expected to be achievable in any given year.

Finally, the method of calculating population for GPCD use rates was changed in the third management period. In the Second Management Plans, population estimates from the Arizona Department of Economic Security were used to project the population of the AMAs for each year throughout the management period. These projections proved to be inaccurate and led to problems with accurately and fairly calculating GPCD for water providers with populations growing faster than projected. In addition, the Prescott AMA's unique method of calculating current population within the AMA failed to properly account for residential vacancies, resulting in artificially low GPCD rates.

Compliance with GPCD standards are now calculated using a base year population from the 2000 US Census and then adding each year the estimated number of new users (households, commercial, etc.). A provider is assigned a base GPCD for its 2000 population based on the conservation potential of the provider. All new development is assigned a fixed conservation standard. The total population is calculated at the end of each year and then divided by the total water delivered to determine GPCD compliance for the year.

### Alternative Conservation Program – An Unused Alternative

The Alternative Conservation Program (ACP) was first included in the Second Management Plans. It was developed to give providers flexibility. Prior to the development of

the ACP, the only option available to municipal providers was the Total GPCD program. If a provider felt it could not comply with the Total GPCD program, it had no other options. The ACP is especially well suited to municipal providers supplying a service area with rapidly changing water use patterns. Such changes could lead to distortions in Total GPCD. For reasons that are unclear from the management plan language, the ACP has been adopted by only one municipal provider, the City of Eloy in the Pinal AMA.

The ACP rules have remained relatively constant from the Second to the Third Management Plans. There are three basic components to the ACP:

- Groundwater withdrawal limitations
- A residential GPCD requirement
- A non-residential conservation requirement

The groundwater withdrawal limitation limits the amount of groundwater a provider can use to a specific amount. In the Second Management Plans, the amount was determined by the highest annual groundwater withdrawal from 1980 to 1989. In the third management period, this requirement was amended to set the withdrawal limitation at the AWS limit if a provider has a designated assured supply or to 50% of the largest annual groundwater withdrawal from 1990 to 1999 if the provider did not exist before 1990 and is not a designated provider.

The residential GPCD requirement in both the Second and Third Management Plans is identical to that of the Total GPCD Program. Because only residential uses are accounted for using the GPCD method, the flexibility account provisions are also modified. The specific credit and debit allowances are different in each AMA because of different water use patterns, but in every case the allowed credit and debit is reduced from the standard amount under the Total GPCD program.

The non-residential requirement has seen the most modification from the Second to the Third Management Plans. In the second management period, a small set of conservation requirements for non-residential users were specified. These conservation requirements were unique to the ACP. In the Third Management Plans, the non-residential conservation requirements are drawn directly from the Reasonable Conservation Measures (RCMs) of the Non-Per Capita Conservation Program (NPCCP), which is discussed below. As a result, the number of required conservation measures has increased.

## **Non-Per Capita Conservation Program**

The NPCCP was adopted in 1995 at the midpoint of the second management period. It was amended to the Second Management Plans of each AMA; the Third Management Plans are the first to include it as an alternative from the beginning of the management period. The NPCCP is a significant departure from both the Total GPCD Program and the ACP in that it does not have specific GPCD requirements for any user categories. Therefore, it is the most complete alternative to the Total GPCD Program.

The NPCCP is a close approximation to a best management practices program. Instead of monitoring and regulating the total amount of water used by sector, it requires municipal providers to adopt a series of Reasonable Conservation Measures (RCMs) that collectively limit water use by the same amount as required by the Total GPCD program. There are a large number of RCMs to select from. Providers are required to implement a certain number for each sector; the individual RCMs selected are at the discretion of the provider. The NPCCP includes yearly reporting requirements to ensure that the program is being implemented and the selected RCMs are achieving the intended level of water savings. The monitoring and reporting requirements are developed by a steering committee of ADWR staff and stakeholders. To be eligible for the program a provider must have an AWS designation, be a member of a groundwater replenishment district, or plan to completely eliminate groundwater mining by 2010.

## **Future Directions**

The ADWR is has undertaken a review of the Municipal Conservation Plan provisions of the third management period. This review was focused on concerns about the overall usefulness of the Total GPCD program as a conservation tool and the impacts of the municipal conservation framework as a whole on the unique needs of private water companies. There was also concern among ADWR staff that the program is becoming too administrative burdensome relative to the results achieved.

The Total GPCD program, despite the revisions undertaken after each management period, is still questioned as an accurate measure of conservation. Despite efforts to insulate GPCD base requirements from the effects of weather

variations, this is still a concern. GPCD usage is much more responsive to weather than conservation measures, making it difficult for providers to meet GPCD requirements in hot, dry years. There is also a disparity between providers who serve primarily residential service areas and providers with large non-residential populations. Municipal providers in areas with primarily residential growth have had a much easier time meeting GPCD requirements than those in areas with strong non-residential growth, independent of the conservation measures undertaken (ADWR 1999a).

Private water companies are in a unique position. Unlike government owned utilities, private water companies are regulated by the Arizona Corporation Commission (ACC). Because of the ACC rules, it is difficult for private water companies to recover costs for conservation measures that are not specifically mandated by law. Because the ACP and NPCCP are optional as of the Third Management Plans, private water companies may not be able to recoup conservation expenses if the costs are higher than they would be under the Total GPCD Program. This makes it difficult for a private water company to apply for regulation under the ACP or the NPCCP, even if one of the alternative programs would be more appropriate for the company's service area characteristics (ADWR 1999a).

The Municipal Conservation Plan review process has addressed these concerns by developing a modified NPCCP. The modified NPCCP was adopted by the Arizona legislature and signed by the Governor in April 2007. The modified program functions more like a pure best management practices program and replaces the Total GPCD Program as the base program for the AMAs. Regulation of providers under the modified NPCCP rules begins January 1, 2008. All municipal providers within the AMAs will be regulated by the modified NPCCP except for providers with a designation of AWS. For these providers, participation in the modified NPCCP is optional; they can elect to be regulated by the Total GPCD Program instead. The ACP has been eliminated. Under the modified NPCCP program, all providers are required to implement an education program and, depending on the number of hook-ups in their service area, a certain number of best management practices.

This program addresses the Total GPCD Program problems by making that program voluntary rather than mandatory. Providers with an AWS designation who are well suited to GPCD regulation can elect to be regulated under the Total GPCD Program's provisions. Private water companies'

ability to recover costs is improved because the modified NPCCP is mandatory, not optional.



## SUMMARY OF THE EVOLUTION OF THE AGRICULTURAL CONSERVATION PROGRAM

### Highlights

- The First and Second Management Plans of each AMA are virtually identical.
- The Third Management Plan and third plan modifications provide the first significant changes to the Agricultural Conservation Program. The Third Management Plan includes the Best Management Practices Program and the Historic Cropping Program.
- The Agricultural Conservation Program has not resulted in any identifiable decline in groundwater use or overall water use by the agricultural sector in any of the AMAs.
- The passage of SB1557 ensures the Best Management Practices Program will continue into the fourth and fifth management periods.

### Introduction

The Agricultural Conservation Program provides the regulatory conservation requirements for all agricultural users within the active management areas (AMAs). Among the AMAs, the Phoenix and Pinal AMAs have the largest agricultural sectors. In the Prescott, Santa Cruz, and Tucson AMAs, the agricultural sector is a smaller, but still important water user. While urbanization is replacing the agriculture to a varying extent in each of the AMAs, it

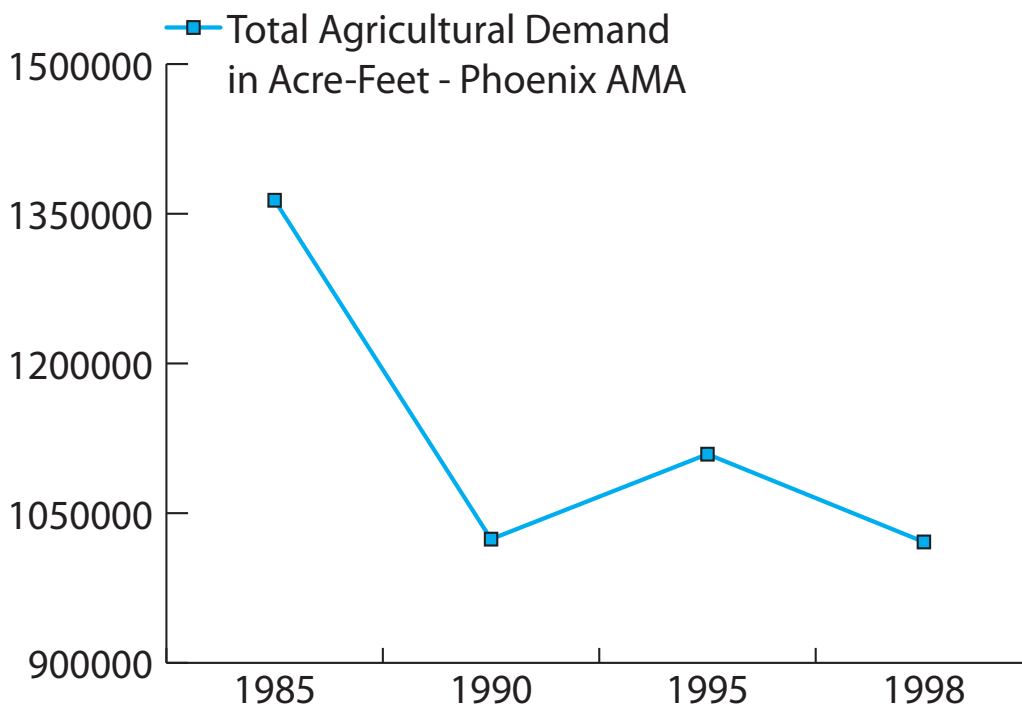
still accounts for more than half of the total water use in the Pinal, Phoenix, and Santa Cruz AMAs.

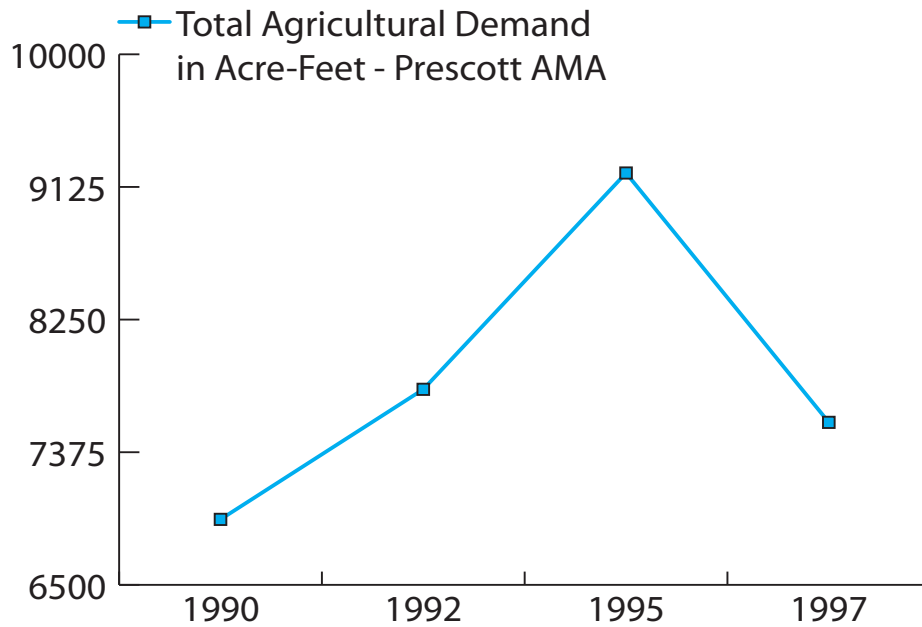
Agricultural use is expected to remain an important component of total groundwater use in the AMAs through 2025. Because the agricultural sector uses such a large percentage of the groundwater in the AMAs, the conservation program is of critical importance and will make a significant difference in efforts to achieve safe-yield (in the Phoenix, Prescott, Santa Cruz, and Tucson AMAs) and maintain the agricultural economy (in the Pinal AMA). This summary provides a brief history of water use by the agricultural sector in each of the AMAs and traces the evolution of the regulatory conservation programs from the first to the third management period.

### Water Use 1980 – 1995

#### Pinal and Phoenix AMAs

Historically, the agricultural sector has been the dominant water user in both the Phoenix and Pinal AMAs. In the Phoenix AMA, the agricultural sector accounted for 69% of total water use in 1985 (1,622,039 acre-feet). Of the total water used, 70% was groundwater (772,632 acre-feet). In the Pinal AMA, agricultural water use has been an even larger portion of total water use. In the 1980s between 95 and 98% of total water use in the AMA was for agricultural purposes. Of this, about 74% was from groundwater and only 24% was from surface water.





By 1995, total agricultural demand in the Phoenix AMA had declined. The factors contributing to this decline are not obvious. There has been a general reduction in the number of acres irrigated in the Phoenix AMA, with about 60,000 acres converting from agricultural to some other use (usually urbanization). In addition, varying economic conditions over the years and incentives to leave fields fallow have resulted in fluctuations in the actual amount of acreage planted and irrigated. In 1995 only 49% of the total acreage with irrigation rights were planted. Finally, while consistent declines irrigation water use were seen through the late 1980s and early 1990s, by the mid-1990s irrigation use began to increase, despite the smaller amount of total acreage available for irrigation. Therefore, it is clear that the number of acres available for irrigation and the total amount of water used for irrigation do not necessary have a direct relationship. It is also impossible to assess the effectiveness of the agricultural conservation program due to a lack of clear trends.

Similar conditions are present in the Pinal AMA. While there has been some increase in municipal use relative to agricultural use, there is no clear trend toward a decline in total agricultural use. In 1995, agriculture represented 93.5% of the total water use in the AMA (1,055,928 acre-feet). Agricultural use has also fluctuated in a pattern similar to the Phoenix AMA, with declines in the late-1980s and early-1990s and increases thereafter. This mirroring emphasizes the impacts of the agricultural economy and weather conditions on agricultural water needs.

One encouraging trend, however, is that in both the Phoenix and Pinal AMAs groundwater now makes up

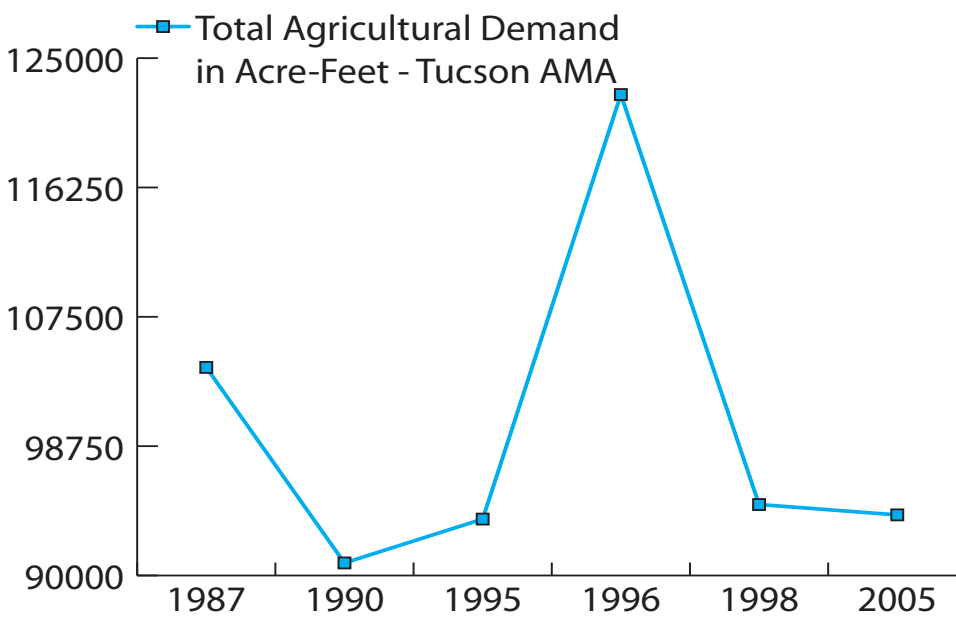
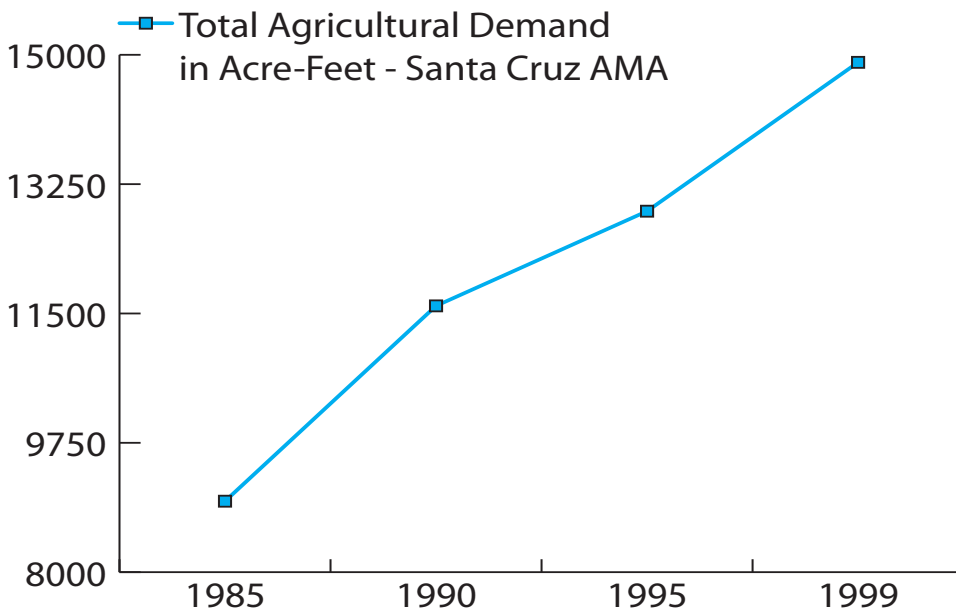
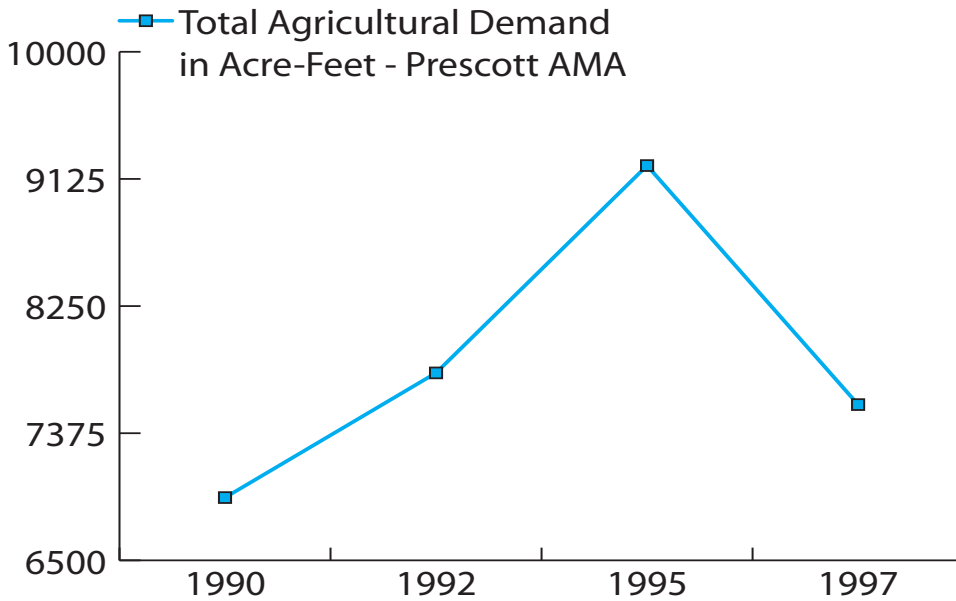
a much smaller portion of total agricultural water use. This is the result of new surface water supplies from the Central Arizona Project (CAP). In the Phoenix AMA, the groundwater portion of total water use has declined from 48% (772,632 acre-feet) to 43% (573,183 acre-feet). In the Pinal AMA groundwater use as a percentage of total demand has declined from 76% to 51%. In addition, in irrigation districts served with CAP water, groundwater makes up only 42% of total demand.

#### Prescott, Tucson, and Santa Cruz AMAs

While the agricultural sector is not the dominant groundwater user in the Prescott and Tucson AMAs, agricultural use is still an important component of total water use in these AMAs. In the Santa Cruz AMA, the agricultural sector is the largest overall water user, though total water use and agricultural use are on a much smaller scale than the other AMAs. In addition, agricultural users in the Santa Cruz AMA meet some of their irrigation needs with surface water rights.

The Prescott AMA's agricultural sector used approximately 7,572 acre-feet (ac-ft) of water from all sources in 1997. This represents 37 percent of the total reported water use in the Prescott AMA. Of the 7,572 acre-feet used by the agricultural sector, about 1,000 acre-feet came from surface water sources.

There has been a general decline in water use by the Prescott AMA's agricultural sector throughout the 1990s as urbanization has begun to replace agricultural uses. This decline is expected to continue throughout the



third management period. By 2010, the agricultural sector is expected to account for only a trivial portion of total groundwater use in the AMA.

The Tucson AMA is also experiencing a general decline in total water use by the agricultural sector, though it is unclear if this decline will continue. Between 1985 and 1995, agricultural water use declined by approximately 20,000 acre-feet. However, there was a spike in water use in 1996 to pre-1985 levels, indicating that agricultural incentives and market conditions may play an important role in agricultural water demand in the Tucson AMA. At the time the Third Management Plan was published, urbanization in the AMA was not threatening the agricultural center of the AMA around Marana (ADWR 1999a). However, since then, urbanization has increased, with the potential to result in significant declines in agricultural water use in the AMA.

In the Santa Cruz AMA, there are no clear long-term agricultural water use trends. Total water use fluctuates from year to year depending on factors such as weather. Groundwater users that also hold surface water rights are required to exercise their surface rights from time to time in order to maintain their claims, resulting in fluctuations in groundwater use. As the trend toward conversion of agricultural land to residential uses continues, agricultural water demand is expected to decline.

### Agricultural Conservation Program

The agricultural conservation programs of the AMAs have experienced an accelerating rate of evolution during the third management period after two decades of relative stagnancy.

The program began during the first management period with a single regulatory approach. The same regulations continued into the second management period with little change. During the third management period, however, significant changes and additions have taken place. The agricultural conservation program now provides farms with a variety of options for meeting the conservation goals of the AMAs.

The Groundwater Management Act (GMA) provides a system for the establishment of irrigation rights for farms irrigated with groundwater at the time the act was passed. These irrigation rights are called Irrigation Grandfathered Rights (IGFRs). To be eligible for an IGFR, the land to which the right is tied must have been irrigated at some point between 1975 and 1979 or significant investment must have been made during this time to bring the land into irrigated use. Land that can be irrigated with an IGFR are designated “irrigation acres” (A.R.S. §45-452.A). Land without an established IGFR cannot be brought into irrigation use unless it qualifies for one of the following exceptions:

- New acreage may be irrigated in place of old acreage (on a one-for-one basis) to allow irrigation with CAP water instead of groundwater;
- State universities may irrigate up to 320 new acres per year with up to 5 acre-feet of water per acre for educational and research purposes. This does not establish a IGFR, however;
- Irrigation acres damaged by flooding may be replaced on a one-for-one basis with new acreage;
- Irrigation acres may be traded on a one-for-one basis to make it easier or more efficient to irrigate because of the shape of a farm or characteristics of the land;
- If an appropriated right existed prior to June 12, 1980, surface water may be used to irrigate new acres (Third Management Plan addition);
- Acreage currently irrigated using surface water may be replaced on a one-for-one basis with new acreage as long as the surface water right is permanently transferred to the new acreage (Third Management Plan addition);
- The Department of Corrections may irrigate up to 10 acres of new land per year with not more than 4.5 acre-feet of water per acre per year in order to produce food for prisoners or as a part of a prison work program (Third Management Plan addition).

The base conservation program of the First and Second Management Plans of each of the AMAs used assigned irrigation efficiency targets, water duties, and water duty

acres as the primary conservation tools. Irrigation efficiency is a way of measuring how effectively irrigation water is applied to crops. For example, an irrigation efficiency of 50% indicates that 50% of the irrigation water applied to a field is used in some way by the crop growing in the field.

The irrigation efficiency is used to calculate water duties. Water duties are calculated for each farm unit. A farm unit consists of one or more farms irrigated with groundwater and in close proximity to or contiguous with one another with similar soil conditions, crops, and cropping patterns. A farm unit usually has a single IGFR, but could have more than one. The water duty for a farm unit is calculated in several steps. First the total irrigation requirement of the farm unit is calculated. The total irrigation requirement is divided by the total planted acres for the farm unit. Total planted acres are determined by summing the total acres planted from 1975 to 1979 (double cropped acres are counted only once). The result of this calculation is then divided by the assigned irrigation efficiency for the farm unit, resulting in the water duty. The water duty is the maximum amount of water that may be reasonably applied to land with an IGFR each year.

The final step in calculating the amount of groundwater that may be applied to a farm unit in a given year is determining the water duty acres. Water duty acres are the maximum number of acres irrigated in any one year from 1975 to 1979. The water duty acres are multiplied by the water duty for the farm unit. The result is the total groundwater allowance.

The minimum irrigation efficiency in the Pinal AMA was set at 60% for the first management period. The 60% efficiency target was selected because the ADWR determined it was the maximum efficiency achievable without imposing a significant economic burden on irrigators in the AMA. Higher irrigation efficiencies were assigned to farms that already had more efficient irrigation practices – modified sloop, drip, sprinkler, or basin leveled systems – in place at the start of the management plan. These efficiencies were assigned on a case by case basis, but never exceeded 85%.

In the Phoenix AMA irrigation efficiency requirements were assigned based on historic efficiency of farm units. Farms with a historic efficiency under 60% were placed in one group and those with a historic efficiency over 60% were placed in another. Farms in the under 60% group were assigned an irrigation efficiency of 55%. Farms in

this group were required to increase efficiency to 55% or reduce water use by 6%, whichever yielded the lower water duty. Farms in the second group were assigned a minimum efficiency of 60%. If a farm in this group had an irrigation efficiency over 60%, it was required to increase efficiency to 70% or reduce water use by 6%, whichever yields the lower water duty. A farm with an efficiency over 70% did not have to increase its efficiency but was required to maintain its current efficiency level. No farms were required to maintain an irrigation efficiency above 85%. The high level of detail in assignment of irrigation efficiencies in the Phoenix AMA was possible because most farms received metered water from irrigation districts. This allowed the ADWR to develop accurate calculations of water use, irrigation efficiency, etc.

The First Management Plan of the Tucson AMA assigned an irrigation efficiency of 70% to farms within the AMA. This target was the result of what the ADWR determined could be achieved through use of reasonable conservation measures by individual farm units. Reasonable conservation measures included lined ditches, pump-back systems, land leveling, and efficient water application practices. Farms with more sophisticated irrigation systems already in place were assigned a higher efficiency requirement based on the expected efficiency of the specific irrigation practice. In addition, if a farm had a historic irrigation efficiency higher than 70%, the historic level of efficiency was used. The ADWR determined that 85% was maximum irrigation efficiency achievable within the AMA.

Due to the unique characteristics of irrigated farmland within the Prescott AMA, the First Management Plan irrigation efficiency requirement was lower than in the other AMAs. Grandfathered right holders were required to achieve an irrigation efficiency of at least 50% during the first management period. The requirement was lower than other AMAs because of difficult soil conditions and steeply sloped farming areas, limiting the effectiveness of existing irrigation practices and restricting the implementation of more efficient practices such as land leveling. Farms with sophisticated irrigation systems (e.g. sprinklers, drip irrigation, etc.) at the time the GMA was passed were assigned a higher irrigation efficiency based on the expected efficiency of the specific irrigation method.

The ADWR revised the irrigation efficiency targets for each AMA during the second management period. Updated efficiency requirements were based on a detailed analysis of farm management techniques, economic feasibility, areas

of similar farming conditions, and prudent long-term farming practices. Irrigation grandfathered right holders were required to attain an irrigation efficiency of 85% by the end of the management period, except in the Prescott AMA. A few minor exceptions were made for orchards and farms with difficult soil or slope conditions. In the Prescott AMA, IGFR holders were required to attain an irrigation efficiency of 75%. The water duty for farms decreased over two intermediate periods during the management plan – 1992-1994 and 1995-1999. By 2000, all farm units were expected to meet the management goal. The ADWR felt that most farms could achieve the management goal by converting fields to basin leveled systems, which are much more efficient than traditional sloped systems.

It is clear from the Third Management Plans of each AMA that the 85% irrigation efficiency goal was unreasonable. As a result, the base program was initially suspended upon the adoption of the Third Management Plans to allow for more time to determine a reasonable standard for the third, fourth, and fifth management periods. More information on the Third Management Plan programs is provided in the next section.

Each of the management plans also included flexibility account provisions. The accounts are designed to accommodate fluctuations in weather and the agricultural economy that result in more or less demand for water. Farms are allowed to earn credits for the portion of their groundwater allowance they do not use in a given year. These credits may then be drawn upon in unusually hot and dry years or in years of high commodity prices when additional water is needed. There is no limit on the number of credits that may be accrued. A farm may borrow up to 50% of its total groundwater allotment from the flexibility account in any one year and may use excess groundwater up to the flexibility account's credit balance at any time.

### **The Third Management Plan**

Significant changes to the Agricultural Conservation Program have taken place during the Third Management Period. As mentioned above, the base program was initially suspended to provide more time to research a reasonable irrigation efficiency target for each AMA. Ultimately, the program was reinstated in 2003 in a modification to the Third Management Plans with an irrigation efficiency target of 80% - 5% lower than the Second Management Plan target. Special exemptions were again provided for orchard crops and farms with unique conditions. In

addition to the base program, a Historic Cropping Program and a Best Management Practices (BMP) program were also instituted. The Historic Cropping Program became available to users at the beginning of the management period, while the BMP program was not instituted until 2003.

The Historic Cropping Program is very similar to the base program. It was developed in response to legislation passed in 1998 (A.R.S §45-566.02). Participation in the program is voluntary and by application to the ADWR. In order to qualify for the program an IGFR owner must meet the following criteria:

- Have a flex account debt of no more than 25% of the maximum yearly groundwater allotment,
- Have a flex account credit of no more than 75% of the maximum yearly groundwater allotment,
- Provide documentation showing an irrigation efficiency of 75% has or will be met on a yearly basis.

Once an IGFR owner has applied to and been accepted into the Historic Cropping Program, they are subject to its requirements for the remainder of the third management period. The requirements of the program are:

- Maintain an irrigation efficiency of at least 75%,
- Accrue a flex account debt of no more than 25%,
- Accrue a flex account credit of no more than 75%.

Credits may not be accumulated over the 75% cap and excess credits may not be sold to other IGFR owners. Because of the reduced flex account requirements and the fairly high irrigation efficiency, the Historic Cropping Program requires sophisticated farm management.

The BMP program is a complete departure from the structure of the base program. It does not use irrigation efficiency or water duties as a method of forcing conservation. Instead, it functions much like the Non-Per Capita Conservation Program of the Municipal Conservation Program. The program was developed to provide farmers with maximum flexibility and address other weaknesses while still achieving reasonable groundwater conservation. Weaknesses of the base program include difficulty measuring conservation as a result of the management plans and the administrative burden of the base program for both the ADWR and farmers. There was also recognition that farmers needed the ability to respond to fluctuating market conditions from year to year; fixed allotments based on historical conditions made this difficult (Governor's Water Management Commission 2001).

A collection of BMPs have been developed by the ADWR in conjunction with users. These practices are grouped into four categories: water conveyance system improvements, farm irrigation systems, irrigation water management, and agronomic management. Each of the management practices is assigned a different number of points. Users regulated under the BMP program are required to select a group BMPs resulting in a score of at least ten points, subject to the following conditions:

- a maximum of three points can be scored in any one category,
- at least one point must be scored in each category,
- at least two points must be scored from the farm irrigation systems category,
- credit for water conveyance system improvements and farm irrigation systems practices is only available for practices that were implemented at the time of application to the program,
- credit for irrigation water management and agronomic management practices is only available if the practices will be implemented on a yearly basis.

Farms are also able to receive credit for practices not listed in the BMPs as long as they demonstrably result in water savings equivalent to the approved management practices.

Water savings resulting from the implementation of the BMP Program should be equivalent to the savings that would be achieved if the same user was regulated under the base program. Farms must apply to ADWR to be included in the program. The application must include a map of the farm and, if the land is leased, permission from the owner to take part in the program. Once an application is approved, the farm unit is regulated under the BMP program for the remainder of the management period. A single application may include more than one IGFR as long as all the IGFRs are for the same farm unit.

The BMP Program, with the passage of SB 1557, has been extended to the fourth and fifth management periods.

### **Distribution System Requirements**

During the first management period, the AMAs did not have strong regulations for reducing distribution systems' lost and unaccounted for water. The first plan required irrigation districts to submit a plan to reduce system losses by the beginning of 1989. The plans went into effect July 1, 1989.

The Second and Third Management Plans provided more specific criteria. Beginning with the Second Management Plan, all water providers delivering 20% or more of their total water for irrigation purposes were required to comply with the Agricultural Conservation Program's distribution system requirements. Providers were required to reduce total lost and unaccounted for water to 10% or less and concrete-line all canals.

The Third Management Plans contains requirements identical to the Second Management Plans.

# SUMMARY OF THE EVOLUTION OF THE INDUSTRIAL CONSERVATION PROGRAM

## Introduction

The Groundwater Management Act defines industrial use of water as “a non-irrigation use of water not supplied by a city, town, or private water company, including animal industry use and expanded animal industry use.” A.R.S. §45-561(5). Industrial groundwater users are allowed to withdrawal groundwater from their own well if they own a Type 1 or Type 2 industrial water right or a general industrial use permit. The volume of groundwater available under Type 2 rights is established in the GMA; groundwater withdrawals associated with Type 1 rights may increase over time as agricultural rights are extinguished and converted into non-irrigation grandfathered rights. General industrial use permits are issued when an industrial user cannot receive water from a municipal provider, surface water, effluent, or a retired irrigation grandfathered right. These permits are issued for a specific time period. Industrial users may also receive a quantity of groundwater from an irrigation district equal to the amount it was entitled to from the district on June 12, 1980. Finally, “individual users” established under the Municipal Conservation Program are also subject to the rules of the Industrial Conservation Program.

The Industrial Conservation Program divides industrial users into a number of different categories based on the activity pursued by the user. As of the Third Management Plan, the categories include:

- Turf Related Facilities ( $\geq 10$  acres)
- Sand and Gravel Facilities ( $> 100$  acre-feet/year)

- Metal Mining Facilities ( $> 500$  acre-feet/year)
- Large-Scale Power Plants ( $> 25$  megawatts)
- Large-Scale Cooling Facilities ( $> 1,000$  tons)
- Dairy Operations (monthly average  $\geq 100$  lactating cows/day)
- New Large Landscape Users ( $> 10,000$  square feet of water intensive landscape)
- New Large Industrial Users ( $>100$  acre-feet/year)
- Cattle Feedlot Operations
- Other Industrial Users

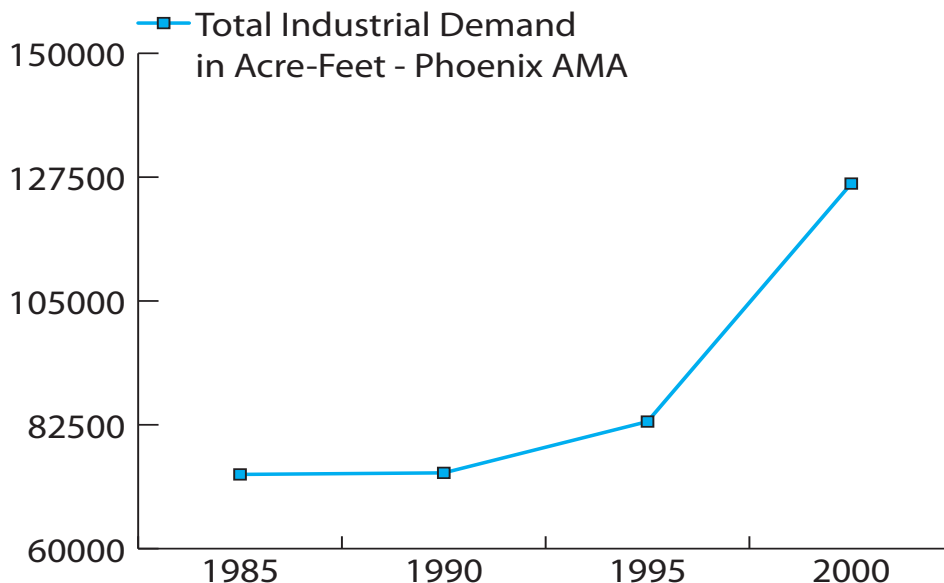
None of the AMAs contain a user from each of the industrial categories. If a type of industrial user not currently present in a given AMA were to begin operation, the management plan for the AMA may be modified to include standards for the new industrial user category. Each AMA has a unique combination of users present; the Phoenix AMA has the most industrial use by volume and the most categories represented while the Prescott AMA has the least industrial use by volume.

This summary traces industrial groundwater use and the development of the Industrial Conservation Program across the first three management periods in each AMA. It examines the information used to develop the regulatory programs as presented in the management plans, identifies significant changes over time, and discusses future directions.

## Water Use 1980 - 1995

### Phoenix

Industrial water use in the Phoenix AMA has been gradually increasing since 1985 when the First Management Plan was





developed. In 1985, the industrial sector used a total of 73,485 acre-feet of water. By 1990, water use had increased only slightly to 73,767 acre-feet and by 1995 total water use had jumped to 83,088 acre-feet. As a percentage of total use, the industrial sector is still using about the same amount of groundwater as it did in 1985. These statistics include only industrial users who withdraw water pursuant to a Type 1 or Type 2 non-irrigation right or a groundwater withdrawal permit. Industrial users receiving water from municipal suppliers are accounted for as municipal demand.

Although total water use by the industrial sector has been increasing, this is not necessarily an indication that the management plans have failed to increase conservation within the AMA by industrial users. The Phoenix area has also seen rapid growth over the period of the first three management plans. Growth is accompanied by new industrial users who increase total water use by the sector even if individual users may be using less water. For this reason, industrial water use is expected to continue to grow in the AMA.

The most common type of industrial users in the Phoenix AMA are turf-related facilities. Water demand by this sector is primarily related to irrigation and is therefore closely related to weather. Turf-related facilities had a total water demand of approximately 50,000 acre-feet in 1995. While there was a decline in demand from this sector in the late-1980s and early-1990s, the 1995 demand and 1985 demand are nearly identical. Other major industrial users include dairies and sand and gravel facilities. Both dairies and sand and gravel facilities had significant increases in demand from 1985 to 1995.

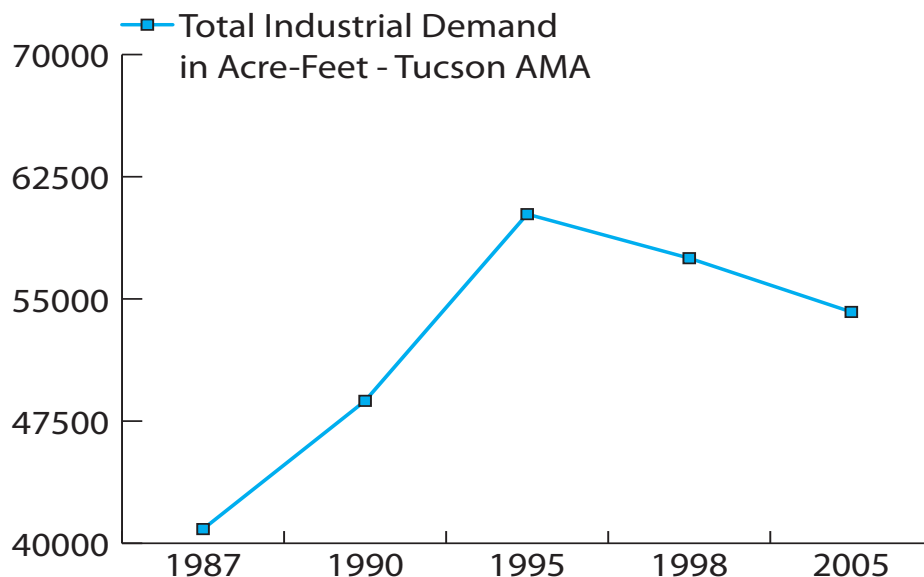
The following sectors were regulated in the Phoenix AMA as of the Third Management Plan:

- Turf-Related Facilities
- Sand and Gravel Facilities
- Large-Scale Power Plants
- Large-Scale Cooling Facilities
- Dairy Operations
- Cattle Feedlot Operations
- New Large Landscape Users
- New Large Industrial Users

### Tucson

While industrial water use has fluctuated over time, there has been a general trend towards increased industrial use over time in the Tucson AMA. In 1987, the industrial sector accounted for 40,872 acre-feet of total water use. In 1995, use had increased to 60,204 acre-feet. Nearly all industrial sector demand is met with groundwater. The increase in total use represented a four percent increase in the industrial sector's portion of total AMA demand to 19 percent, up from 15 percent. The increase in water demand and fluctuations in demand over time are the result of a number of factors including the economy, weather, and urbanization. Industrial use is expected to continue to increase as the Tucson metropolitan area continues to grow.

Unlike the other AMAs, turf-related facilities are not the largest industrial user in the Tucson AMA. Rather, metal mining is the dominant water user, representing nearly two-thirds of all industrial demand. The water demand of the metal mining sector is met exclusively with groundwater. The sector's water demand nearly doubled



from 1987 to 1995 and is expected to continue to increase over time. However, mining demand is also very dependant on market conditions. Use of alternative supplies such as CAP water or effluent is not practical because of the expense of infrastructure development to deliver the water, the cost of these alternative supplies, and concerns about water quality for use in milling processes.

Other major industrial users in the Tucson AMA include turf-related facilities and sand and gravel facilities. Total demand from users in these categories has also increased from 1987 to 1995, but not at nearly the same magnitude as metal mining. Most of the turf-related facilities are older and are not expected to expand. Most of the water demand from turf-related facilities is met with groundwater, though a limited amount is met by effluent. Demand from the sand and gravel facilities is expected to increase to meet the needs of the rapidly growing Tucson metropolitan area.

The following sectors were regulated in the Tucson AMA as of the Third Management Plan:

- Turf-Related Facilities
- Sand and Gravel Facilities
- Metal Mining Facilities
- Large-Scale Power Plants
- Large-Scale Cooling Facilities
- Dairy Operations
- New Large Landscape Users
- New Large Industrial Users

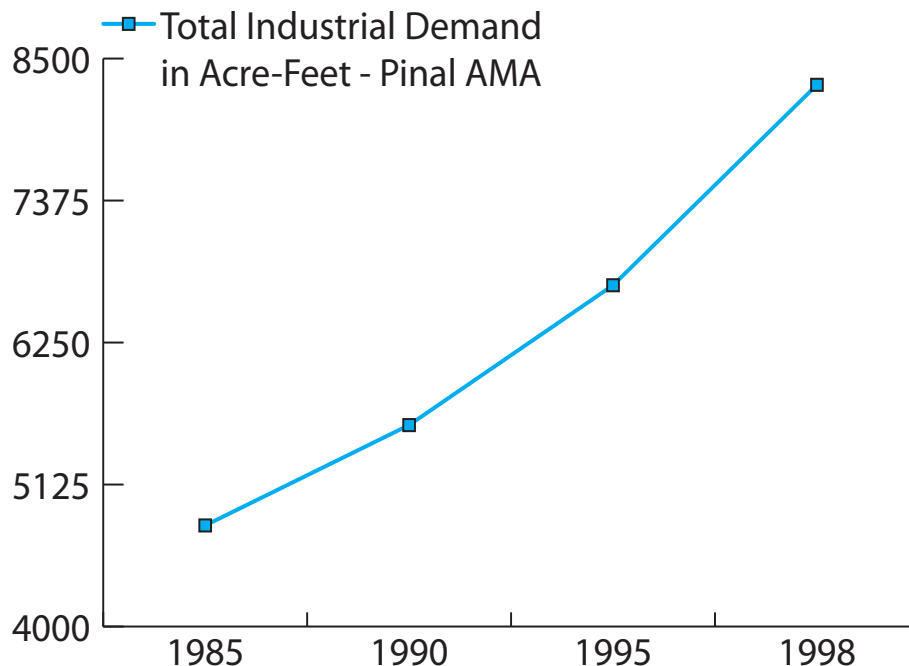
## Pinal

Industrial users account for a very small portion of total water use in the Pinal AMA. The AMA has been dominated by the agricultural sector since the first management period. It is expected that agriculture will remain the primary water user in the AMA through 2025. In part, this is a reflection of the unique mission of the Pinal AMA. Unlike the other AMAs, Pinal's mission is to preserve the agricultural economy for as long as possible while still reserving groundwater for future non-agricultural groundwater users.

In 1995, industrial water use in the Pinal AMA totaled 7,693 acre-feet. This represents less than one percent of the total water use within the AMA. The largest water users are cattle feedlots, turf-related facilities, dairies. With the exception of the turf-related facilities (golf courses) water use by the industrial sector has been relatively stable since the First Management Plan was implemented. Turf-related facilities have increased in number and size, resulting in an increase in total water use.

The following sectors were regulated in the Pinal AMA as of the Third Management Plan:

- Turf-Related Facilities
- Sand and Gravel Facilities
- Large-Scale Power Plants
- Large-Scale Cooling Facilities
- Metal Mining Facilities
- Dairy Operations
- Cattle Feedlot Operations



- New Large Landscape Users
- New Large Industrial Users

### Prescott

In the Prescott AMA, industrial water use is extremely small, but increasing over time with increased urbanization of the AMA. All industrial demand within the AMA is met using groundwater.

In 1985, total industrial water use was only 77 acre-feet. In 1990, use had grown to a total of 444 acre-feet of groundwater. By 1997, groundwater use increased to 626 acre-feet or 3 percent of the AMA’s total water use. Turf-related facilities make-up the majority of industrial water demand.

The following sectors were regulated in the Prescott AMA as of the Third Management Plan:

- Turf-Related Facilities
- Sand and Gravel Facilities
- Large-Scale Cooling Facilities
- New Large Landscape Users
- New Large Industrial Users

### Santa Cruz

Industrial water use in the Santa Cruz AMA has been stable across the first three management periods. Industrial use in between 1985 and 1995 averaged approximate 1,300 acre-feet per year. Fluctuations in water use have occurred over time as a result of weather patterns from one year to the next. As in the other AMAs, the majority of industrial demand comes from turf-related facilities. The only other

major industrial user in the AMA is a sand and gravel operation. All industrial water demand in the AMA is met with groundwater.

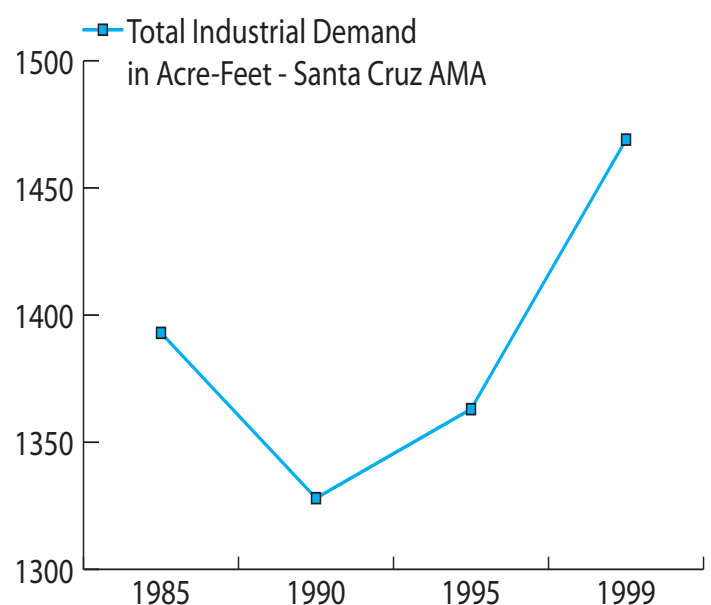
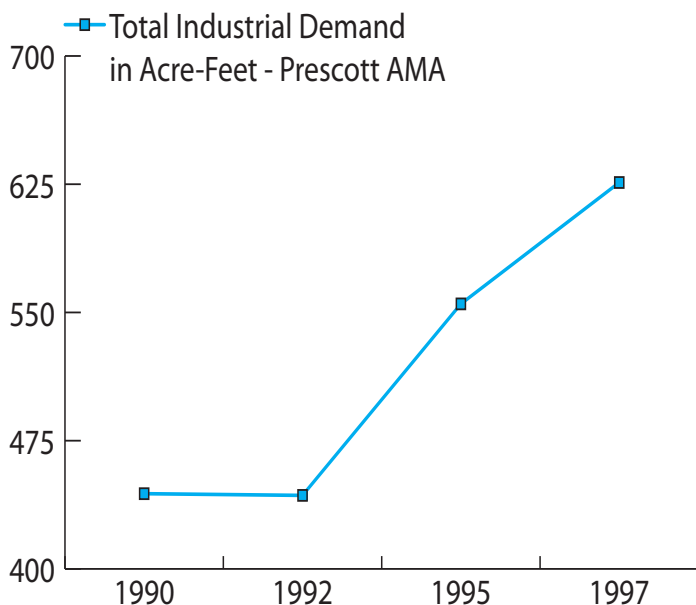
The following sectors were regulated in the Phoenix AMA as of the Third Management Plan:

- Turf-Related Facilities
- Sand and Gravel Facilities
- New Large Landscape Users
- New Large Industrial Users

### Industrial Conservation Program

The conservation requirements of the Industrial Conservation Programs of each AMA have been largely identical throughout the first three management periods. The primary difference between the industrial programs of the different AMAs has been the differences in what industries are present in a given AMA. If a particular industry is not present, conservation requirements for that industry are not included in the management plan for the AMA (e.g. while the Tucson AMA has a large metal mining sector, this industry is not present in any other AMAs. In contrast, turf-related facilities are present in all AMAs and therefore each AMA includes regulations for this sector in its management plan).

Over the course of the first three management plans, the Industrial Conservation Program did not see major changes on the scale of what occurred with the Municipal and Agricultural Conservation Programs. Instead, the industrial program went through a steady evolution, adding additional and more specific requirements for



regulated users and adding new user categories to allow for more comprehensive regulation of industrial users.

The Industrial Conservation Program contains both overarching and sector specific regulatory requirements. The overarching requirements apply to all industrial users. The sector specific requirements apply only to the industrial users within that category. This approach allows for the development of baseline conservation requirements and specific requirements tailored to the specific needs and conservation potential of a given industrial sector. Industrial users that do not fall into any of the regulated categories are only required to meet the general conservation requirements for all industrial water users. The conservation requirements for all industrial users and specific sectors are presented below.

### All Industrial Users

General conservation requirements for all industrial users were not developed until the second management period and were updated for the third management period. The regulations are identical in each of the AMAs. The requirements for all industrial users also replaced the “other industrial users” category from the First Management Plans. The intention of these regulations is to provide general guidelines to encourage conservation by all industrial water users. Because of the diversity of the industrial sector in the AMAs, it is impossible to formulate specific regulations for every type of user. These regulations ensure that all industrial sector users at least have some basic conservation requirement. The all industrial users requirements include:

- A general requirement to avoid waste and make efforts to recycle water (2<sup>nd</sup> and 3<sup>rd</sup> plans)
- Single-pass heating and cooling systems (systems that do not recirculate water more than once) are prohibited (2<sup>nd</sup> and 3<sup>rd</sup> plans)
- State and local plumbing codes requiring low-flow fixtures must be followed (2<sup>nd</sup> and 3<sup>rd</sup> plans)
- Use of low water use/drought tolerant plants and efficient irrigation systems (3<sup>rd</sup> plan)
- Landscaping in the public right of way may not be irrigated unless the vegetation is on the low water use/drought tolerant plant list for the AMA (3<sup>rd</sup> plan)
- Water groundwater cannot be used for water features constructed in the public right-of-way after January 1, 2002 (3<sup>rd</sup> plan)
- Conduct water conservation education programs for employees (2<sup>nd</sup> plan)

- Develop water conservation plans for large facilities (2<sup>nd</sup> plan)

In addition, the Second Management Plans included specific conservation requirements for cooling towers and landscaping as part of the all industrial users category. In the Third Management Plans, separate categories were created for these user types. The conservation requirements for cooling towers and landscape users are presented below.

### Turf Related Facilities (≥10 acres)

Turf-related facilities are the most common industrial user in the AMAs. The category includes a diverse group of water users including golf courses (the largest user type in the category), schools, parks, cemeteries, common areas (e.g. landscaped areas owned by a home owners association, and other miscellaneous users. Water used for turf-related facilities for landscape watering is not considered irrigation by the ADWR. Irrigation is limited to water used to grow crops and is regulated by the Agricultural Conservation Program. Turf-related facilities have been regulated in each AMA beginning with the First Management Plan. Over time the regulations for turf-related facilities have become more specific and restrictive.

During the first management period, regulations for most types of turf-related facilities were based on a water allotment system. For cemeteries, the conservation requirements did not mandate a total water allotment, but did limit the extent of landscaped area to 75 percent of the land area used by the cemetery. All other turf-related facilities were required to comply with the allotment system. The total water allotment for a given facility was calculated by multiplying the turfed area by the statutorily defined water application rate. Different water application rates were developed for existing turf-related facilities, expansion of existing facilities, new facilities (those that came into existence after the First Management Plan became effective), expansion of new facilities, and large new golf courses. The water allotment determined through this process was the maximum amount of water that could be applied to the turf-related facility in a given year. Facilities using effluent for landscape watering were allowed to apply for a modification of their allotment if they could show that the use of effluent created a difficulty in meeting their water allotment.

The Second Management Plans also use an allotment approach to encourage water conservation. The allotment

approach has been expanded to all turf facilities, including cemeteries, and the total allotment for all users has been reduced from first management period levels. The allotment calculations are relatively simple for most users. This approach has been continued through the Third Management Plan for all turf related facilities. While golf courses are also regulated using the allotment approach, the regulations are much more complicated.

Golf courses are the largest water users in the turf-related facilities category and the largest water user in most of the AMAs. The number of golf courses is expected to continue to grow through 2025. For these reasons, more specific regulations for golf courses were developed for the Second Management Plan. Golf courses are now divided into three categories – new and existing non-regulation golf courses, existing regulation golf courses, and new regulation golf courses. Regulation golf courses are “championship” courses and are typically larger than non-regulation golf courses. For new and existing non-regulation courses, a water application rate is assigned for planted acres, newly turfed area within the existing planted acres, historic turfed acres, historic low water use landscaped area, and water surface area. The application rates are multiplied by the number of acres in each category to determine the total water allotment for a given golf course.

The conservation requirements for regulation golf courses are more specific. For both existing and new regulation golf courses, a water application rate is developed and assigned just as with non-regulation courses. However, limitations are applied to the total allotment for calculating the total area of water surface and the total amount of water that may be used per hole for planted areas. Generally, there can be no more than five acres of turf per hole. Areas in excess of five acres have a lower water application rate. Adjustments to the total allotment are available for revegetation, filling a water body, use of effluent, and leaching of salts from the root zone of the soil. Compliance with the water allotment may be measured on a yearly basis or using a three year total for water use and allotment.

The development of the Third Management Plan conservation requirements for golf courses was contentious. Many in the golf industry argued that the standard water allotments from the Second Management Plan were too restrictive. Because of the limitations on total allotment and turf per hole, course managers felt they were forced into creating shorter, more technical courses and limited from creating longer courses that could attract major

tournaments. At the same time, some in the golf industry as well as independent studies of the watering needs of regulation length golf courses endorsed the Second Management Plan approach. These parties felt the total water allotment from the second plan was adequate. However, it did require additional creativity on the part of golf course designers and managers.

Ultimately, the ADWR elected to retain the water allotment approach from the first management plan with minor adjustments and made additions to the conservation program to increase the flexibility of the program. Golf courses may receive additional allotments for reducing the number of turfed acres, newly planted turf during the year it is planted, revegetation with low water use plants, initial filling of water bodies, and leaching of salts from the root zone. The incentive for effluent use has also been increased so that effluent is accounted for at only 60 percent of actual use (e.g. 1 acre-foot of effluent is accounted for as .60 acre-feet when calculating water use for the total water allotment of a golf course). Finally, a flexibility account has been added to address the challenges posed by fluctuating weather patterns.

#### **Sand and Gravel Facilities (>100 acre-feet/year)**

The conservation requirements for sand and gravel facilities during the first and second management periods were nearly identical. Regulations required sand and gravel facilities to use disposal ponds and clarifiers to recycle wash water. In the Second Management Plans, an additional requirement was added to develop a conservation plan and evaluate specific water saving methods that could be implemented at a given facility.

The requirements from the First and Second Management Plans have been carried through into the Third Management Plan. An additional requirement to implement two additional conservation practices has also been included. One of the conservation practices must be related to reducing water use for dust control and the other must be related to reducing water use for cleaning sand and gravel. The management plan provides a list of conservation practices for each category. In a sense, this portion of the sand and gravel facilities’ conservation requirements operates like a mini best management practices program. Sand and gravel facilities may apply to the ADWR for permission to implement alternative conservation practices not included in the management plan, but they must result in water savings equivalent to the listed practices.

## **Metal Mining Facilities (>500 acre-feet/year)**

The conservation requirements for metal mining facilities have seen a stepwise increase in rigor over the course of the first three management plans. The increasing level of conservation required in each subsequent management plan is the result of the belief that there is additional capacity for conservation by the metal mining sector.

The conservation requirements of the First Management Plan form a foundation that has been built on in the Second and Third Management Plans. Most of the regulations focus on tailings solutions and how they are handled. Tailings are the fine grain material left over after the processing of ore. They are typically disposed of in tailings ponds – the tailings are transported in a solution with water and then released into a pond to settle out of the water. The water in the tailings pond is eventually reused in the ore milling process after the tailings have settled out of the tailings solution. Large amounts of water in tailings ponds is lost to evaporation before it can be reused, resulting in the focus on reducing water use for tailings disposal.

The First Management Plan contained conservation requirements for existing and new metal mining facilities. Existing metal mining facilities are defined as mines in operation prior to 1984. New facilities are those which commence operations after 1984. There are no new metal mining facilities regulated under the management plan. Requirements for both existing and new facilities include:

- Tailings must have an average density of at least 40 percent solids by weight
- Minimize seepage of tailings water by compacting soils lining tailings ponds or installing interceptor wells down gradient of ponds
- Minimize surface area and maximize depth of tailings ponds to reduce evaporation
- Recover water from tailings ponds for reuse in mill processes
- Minimize the need for dust control by capping abandoned tailings impoundments
- comply with specific monitoring and reporting requirements

In addition, an optional requirement asked facilities to submit a conservation plan to decrease water use. New users were required to meet additional requirements including: the highest economically feasible tailings density, installing wells to intercept seepage, and using decant towers to limit evaporation of tailings water.

Only minor changes were made to the conservation requirements in the Second Management Plan. Tailings density requirements were increased to 45 percent for existing mines and 50 percent for new mines. In addition, the optional conservation plan of the First Management Plan became a mandated requirement. Conservation plans were required to include an approach for increasing tailings density to 55 percent. Both the First and Second Management plans had provisions for alternative conservation plans for unique circumstances and stays from the conservation requirements when a mine was using less than 50 percent of its historic average water use for a year.

With the Third Management Plan came significant additions to the metal mining facilities conservation requirements. Tailings density requirements remain a core component of the regulations. Currently, existing mines are required to achieve a three year rolling average tailings density of 48 percent. New mines are required to achieve a yearly average tailings density of 50 percent. The goal of an average density of 55 percent from the conservation plan requirement of the Second Management Plan was abandoned because it is seen as infeasible. Other conservation requirements are similar to the Second Management plan, with the following additions or modifications:

- reduce water loss from tailings ponds due to seepage
- minimize the surface area of tailings ponds in order to minimize evaporation
- minimize water use for leaching
- select and implement 3 of the 8 possible conservation measures listed in the management plan

The requirement to implement three additional conservation measures from a list of eight options is the most significant change to the metal mining conservation requirements from the Second to the Third Management Plans. The additional conservation measures relate to specific aspects of mine operation and are intended to promote conservation in areas not addressed by the generally applicable regulations.

## **Large-Scale Power Plants (>25 megawatts)**

The conservation requirements for this category of industrial users are based on the concentration ratio of dissolved solids in the water re-circulating in power plants' cooling towers. The concentration ratio is the ratio of the concentration of dissolved solids in the re-circulating water to the concentration of dissolved solids in the replacement

water. This ratio is also referred to as the “cycles of concentration.” If there is a four to one ratio of dissolved solids between the cooling tower water and the replacement water before the water is replaced, the tower is operating at four cycles of concentration.

The First and Second Management Plans contained the same conservation requirements for large-scale power plants. Power plants that existed at the beginning of each management period were required to achieve seven cycles of concentration before cooling tower water was replaced. Power plants built after the beginning of the management period were required to achieve a stricter standard of 15 cycles of concentration. Power plants were also required to reuse waste water as feasible for cooling purposes. A power plant can propose the use of an alternative water saving technology to the director of the ADWR, but the water savings resulting from the alternative must be equivalent to the savings achieved through cycles of concentration. Finally, a waiver from the conservation requirements is available to power plants that establish a plan for the reuse of cooling water after it is discharged from the cooling towers.

The Third Management Plan largely retains the requirements from the First and Second Management Plans, but updates and modernizes them. Power plants are still required to achieve the same number of cycles of concentration as in earlier management plans. However, the new regulations are sensitive to the fact that not all power plants operate year-round. When a power plant is dormant, it is still necessary to run water through cooling towers to keep surfaces wet and in working order. This water is likely to become stagnant and in need of replacement before the appropriate number of cycles of concentration is reached. An exception to the conservation requirements is provided for this situation. Exceptions from conservation requirements are also available to users when high levels of contaminants are present in replacement water for cooling towers.

### **Large-Scale Cooling Facilities (>1,000 tons)**

Specific regulations for large-scale cooling facilities were developed for the first time for the Third Management Plans. Large-scale cooling facilities include cooling facilities with a minimum aggregate cooling capacity of at least 1,000 tons. Cooling towers must have an individual capacity of at

least 250 tons to be included in the aggregate calculation of the total capacity of a facility. The Second Management Plans included requirements for new cooling facilities built after January 1, 1990 with an aggregate capacity over 250 tons. The Second Management Plan regulation proved difficult to implement due to difficulty identifying new cooling facilities. Therefore, the regulations have been replaced in their entirety in the Third Management Plans. The new conservation requirements apply only to larger facilities, but are not limited to new facilities. All cooling facilities with a capacity in excess of 1,000 tons in an AMA must comply with the conservation requirements.

The purpose of cooling towers is to absorb heat generated by industrial processes with water and dissipate that heat through evaporating a portion of the heated water. Because evaporation is essential to the operation of cooling towers, they will always use significant amount of water. The majority of the water in the cooling tower system, however, is re-circulated and reused a number of times. The same water cannot be perpetually re-circulated in a cooling tower because as water evaporates, dissolved minerals become concentrated, disrupting the operation of the cooling tower and potentially causing damage. Therefore, water must periodically be discharged from the cooling tower and replaced by fresh water. The conservation requirements for large-scale cooling facilities focus on how many times water is re-circulated in the system before it is discharged and replaced.

During the second management period, new cooling facilities had to achieve a concentration of dissolved solids of at least 2,000mg/liter before water could be discharged from the tower and replaced with fresh water. The concentration standard was based on total dissolved solids and did not focus on any particular solids. As long as a cooling facility reached a concentration of 2,000mg/liter before discharging water from a tower, it did not matter how many times that water had been re-circulated.

Instead of simply measuring total dissolved solids, the Third Management Plans consider only the concentration of silica and total hardness (which measures the concentration of calcium and magnesium salts). These were selected because they have the most potential to harm a cooling tower from over-concentration. Cooling facilities must reach a average minimum silica concentration of 120mg/liter or total hardness of 1,200mg/liter before discharging and replacing circulating water.

The Third Management Plans also contain a number of exceptions to the concentration standards in order to encourage cooling facilities to reuse discharged water and to use effluent instead of freshwater in cooling towers. Any cooling facility that makes beneficial reuse of 100 percent of the water discharged from its cooling towers in a given year is exempt from the concentration requirements. In addition, a cooling facility that uses at least 50 percent effluent for 12 consecutive months is exempt from the concentration standards for the 12 month period. After the initial 12 month period, the cooling facility may apply for an alternative concentration standard if a non-regulated dissolved solid resulting from the use of effluent prevents the facility from reaching the regulatory requirements. Cooling facilities may also apply for an alternative concentration standard if it is shown that compliance with the regulatory standard will result in damage to a facility.

#### **Dairy Operations (monthly average $\geq$ 100 lactating cows/day)**

Conservation requirements for dairies did not appear until the Second Management Plan. The Second Management Plan established an allotment based approach, assigning an allotment of water to a dairy based on the average number of cows present in a given year. Water is used by dairies for washing and cleaning machinery, surfaces, and cows; to cool cows in the summer month; and for drinking water. Cows produce more milk when kept cool, so cooling water is important to dairies in the summer months. An individual dairy was required to meet its yearly allotment or, alternatively, have a three year average water use below its allotment. Exceptions from the standard allotment were available under special circumstances (e.g. needed to meet health standards, milk more times a day than average, etc). Dairies were required to meet their allotment beginning in 2000.

For the Third Management Plan the conservation requirements of the Second Management Plan are retained. These requirements are also supplemented by an optional best management practices (BMP) program. The BMP program was created because there was concern from the dairy industry that new cooling technologies are incompatible with the allotment levels provided in the Second and Third Management Plans. The BMP program requires implementation of standard conservation measures at all stages of the production process. The list of standard conservation measures is provided in the Third Management Plan. If a dairy can demonstrate that an

alternative conservation measure will result in equivalent water savings, they may apply to implement the alternative measure in place of a standard measure. A dairy may also apply for waivers from a limited number of standard BMPs if it can show the BMP cannot be implemented. Dairies regulated under the BMP program will be evaluated after five years to determine the effectiveness of the program.

#### **New Large Landscape Users (>10,000 square feet of water intensive landscape)**

The conservation requirements for large landscape users are nearly identical in the Second and Third Management Plans. Large landscape users are facilities that use groundwater to irrigate large landscaped areas. Examples include business and industrial parks and hotels. Excluded from this category are users classified as turf-related facilities and regulated by the turf-related facilities conservation requirements.

During the second management period, water intensive landscaped area was limited to 20 percent of the landscapable area over 10,000 square feet for facilities that were not hotels or motels. For hotels and motels, water intensive landscaped area was limited to 20 percent of the landscapable area over 20,000 square feet (p. 145). Facilities using 100 percent wastewater generated on site (greywater, water from cooling towers, etc.) were exempt from the conservation requirements.

The Third Management Plan requirements are largely identical, with the same percentage requirements for water intensive landscaping for general facilities and for hotels and motels. The wastewater exemption is also still present. The only change is that the conservation requirements now include bodies of water in the accounting of water intensive landscaping. Bodies of water exclude swimming pools and include ponds, fountains, etc.

#### **New Large Industrial Users (>100 acre-feet/year)**

New large industrial users were not separated into a distinct user group until the Third Management Plans. During the second management period, new industrial users were included in the "all industrial users" category. Despite this change from the Second to the Third Management Plans, the actual conservation requirements are identical for each management period.

Each new large industrial user is required to submit a conservation plan outlining opportunities for water



conservation at the industrial facility. The plan must contain a description of:

- the achievable level of water conservation
- how the facility uses water and conservation opportunities
- a water conservation education program for employees
- the implementation schedule for the conservation plan

### **Cattle Feedlot Operations**

The First Management Plan established an allotment system for cattle feedlot operations. A total water allotment of 30 gallons per animal unit day (GAUD) was assigned. Maximum annual water allotments were based on reasonable maximum requirements for animal drinking, dust control, and miscellaneous water use needs. In addition, the First Management Plan contained specific conservation requirements for reducing water use for dust control and required users to submit a plan detailing management practices used for dust control. The Second and Third Management Plans carried forward these requirements, but allowed individual feedlots to achieve their maximum allotments by using a three year average.

It is possible that more stringent air quality standards may require the use of more water for dust control by feedlots.

### **Other Industrial Users**

The other industrial users category is the First Management Plan equivalent of the current “all industrial users” category. The primary difference between the two is that the other industrial users category does not apply to industrial users that fall into other user categories. The Second and Third Management Plan all industrial users category applies to users with specific requirements and users with no specific requirements.

The other industrial users category was intended to provide basic conservation requirements for industrial users that did not fall into any of the specifically regulated sectors. The reason a industrial user is not subject to specific requirements could be because no requirements for a particular sector were developed or the user was too small of a water user to be regulated under the categorical requirements that would otherwise apply. The requirements of other industrial users category include a requirement to avoid waste and a ban on single-pass cooling. Users falling into this category are also required to submit annual water use reports.

## **AUGMENTATION AND RECHARGE PROGRAM SUMMARY**

### **Introduction**

Beginning with the second management period, all Active Management Areas (AMAs) are required to develop an augmentation and recharge program. The purpose of this program is “to encourage the development, delivery, storage, and use of water supplies now and in the future” (ADWR 1999). Augmentation and recharge is of critical importance for all of the safe-yield AMAs if they are to achieve safe-yield by 2025 and beyond. The augmentation and recharge program is intended to help balance withdrawals and recharge through policies that augment natural recharge. Thus, the program is complementary to the industrial, agricultural, and municipal conservation programs, which attempt to reduce overall demand for groundwater.

### **Program Funding**

The augmentation and recharge program is supported by groundwater withdrawal fees in all of the AMAs. During the second management period a withdrawal fee of \$1.50 per acre-foot pumped was charged in the Tucson and Phoenix AMAs. Prior to this, the Tucson AMA had charged a fifty cent groundwater withdrawal fee to fund the pilot Alamo Wash/Rillito Creek Recharge Project. By the Third Management Plan, the groundwater withdrawal fee had increased to three dollars per acre-foot (of this, \$2.50 goes to fund the Arizona Water Banking Authority). In the Prescott AMA, the withdrawal fee was \$1.00 during the second management period. In the Pinal AMA, the withdrawal fee started at \$0.25 in 1990, increased to \$0.35 in 1991, and was increased again in 1994 to \$0.50. When the Santa Cruz AMA was created in 1994 a withdrawal fee of \$0.50 was imposed. Additional funding comes from enforcement actions for non-compliance with the conservation programs and surcharges for the temporary use of groundwater to fill artificial lakes. Specific augmentation programs and allocation of funding are left to the individual AMAs.

### **Second Management Plan Augmentation and Recharge Programs**

The augmentation and recharge programs began in the Second Management Plan. For each of the AMAs, the augmentation program was virtually identical, with

only small differences from one plan to the next. The augmentation program had a single, general goal of developing additional water supplies and maximizing the use of renewable supplies to reach safe-yield (in Pinal the goal was to slow use of groundwater because safe-yield is not the stated goal of the AMA). This goal was supported by a series of objectives:

- Maximize the use of Central Arizona Project (CAP) Water
- Use the CAP canal to deliver surplus Colorado River Water if available (absent in Prescott AMA)
- Maximize the recharge of effluent within the AMA
- Explore and initiate inter-regional water transfers
- Overcome the technical, legal, and institutional impediments to developing alternative supplies
- Research and identify future augmentation opportunities (In the Pinal AMA, the final two objectives are combined)

### **Assessment of the Success of the Second Management Plan**

#### **Tucson AMA**

The Third Management Plan provides a useful analysis of AMA’s success in achieving the Second Management Plan objectives. Generally, the results are mixed. The attainment of the first goal, increasing use of CAP water, was impaired by delivery and water quality problems within the AMA. Many providers are located too far from the CAP canal to make economical use of the water. In addition, the City of Tucson experienced significant problems with delivering CAP water to customers served by older pipes. These problems resulted in the passage of the Water Consumer Protection Act (WCPA), which prevents the direct delivery or injection recharge of CAP water. For similar reasons, the second objective – delivering surplus Colorado River water using CAP – was also largely unsuccessful, although some surplus water was used by groundwater savings facilities (GSFs).

The third objective, to maximize recharge of effluent in the AMA, was somewhat more effective. Several pilot recharge projects were initiated. In addition, a regional planning effort was started in 1995 to identify the geographical, political, institutional, legal, and technical issues associated with effluent recharge. In 1997 the Regional Effluent Planning Process was initiated.

The fourth objective was a total failure – no inter-regional water transfers were initiated in the watershed.

The fifth objective of the Second Management Plan's augmentation program – to remove technical, institutional, legal, environmental constraints – saw the most work during the second management period. A number of legislative changes improved the environment for pursuing recharge and augmentation programs, including:

- The establishment of the Arizona Water Banking Authority (AWBA). The AWBA's purpose is to store unused portions of Arizona's Colorado River allotment for future use. It can also pursue interstate water storage arrangements with California and Nevada.
- The Underground Water Storage, Savings, and Replenishment Act provided a unified legal framework for recharge and augmentation projects.
- The Central Arizona Groundwater Replenishment District was established.
- The Water Exchange Act allows for the exchange of different water supplies between users
- The Groundwater Transportation Act provided a legal framework for interbasin water transfers, although transfers from rural to urban areas are severely restricted
- Legislation was passed to encourage the use of CAP water by moving up the compliance date for AWS designations.
- A Regional Recharge Committee and Regional Recharge Plan was developed to encourage augmentation within the AMA.
- In 1991, the Santa Cruz Valley Water District (SCVWD) was created to help coordinate AMA wide augmentation and recharge projects and increase use of renewable supplies. The SCVWD was abolished in 1993 at the end of its pilot period.

The sixth objective, to research and identify future augmentation opportunities, was not addressed in the second management period.

### **Phoenix AMA**

Unlike the Tucson AMA, the Third Management Plan for the Phoenix AMA does not provide a detailed assessment of the successes and failures or the Second Management Plan's policies. Instead, it provides a general overview of the program.

On the whole, the success of the augmentation program of the Second Management Plan was mixed. The regulatory incentives provided by the augmentation program were largely a failure because they failed to address the actual cost or availability of water, the largest determinate of water use. Incentives for effluent use failed in previously urbanized areas of the AMA because it was too expensive to add an effluent distribution system; in recently developed areas, effluent systems are being integrated from the start.

The ADWR was more successful in providing technical assistance to facilitate augmentation and recharge projects. During the second management period the department developed a hydrologic model for the East and West Salt River Valleys, which has been widely used by water providers.

The department has also been successful at facilitating coordination between providers in the AMA to help achieve the augmentation goals. It conducted a study on the underutilization of CAP water and used the information generated by the study to help establish agricultural pricing for CAP water. By working with providers, the department has successfully encouraged water storage programs, issuing 33 underground storage facility and 68 water storage permits. Increased storage of effluent and near complete utilization of the AMA's CAP allotment (as a result of AWBA programs) has been achieved at the end of the second management period (ADWR 1999a).

Finally, the AMA has benefited from the legislative efforts noted above in the Tucson AMA section.

### **Prescott AMA**

The Third Management Plan for the Prescott AMA provides an assessment similar to that of the Phoenix AMA of the success of the augmentation program during the second management period. Generally, the Prescott AMA was somewhat less successful than the Phoenix and Tucson AMAs in achieving its goals. Efforts to provide regulatory incentives failed in the Prescott AMA for the same reasons as in the Phoenix AMA – the incentives did not relate to price or supply. Technical assistance, because of the small size of the AMA staff, was not extensive. Work performed, however, was high quality (ADWR 1999b). The AMA had limited success coordinating and facilitating recharge projects, successfully permitting a USF and issuing two water storage permits. The ADWR also conducted a successful study on weather modification in the Verde

River watershed showing it is possible to successfully increase precipitation in the region using cloud-seeding.

### **Pinal AMA**

The Pinal AMA was generally successful in effectively achieving its primary augmentation goals during the second management period. Use of CAP water in the AMA fluctuated somewhat during the first few years of the management period due to variation in the types of incentives offered to agricultural users, but by the mid-1990s had stabilized and the AMA's agricultural CAP allocation was nearly fully utilized. In addition, because of institutional changes such as the creation of the AWBA, the CAGR, and the Pinal County Water Augmentation Authority have allowed for increased augmentation activities in the AMA and, in the case of the AWBA, utilization of surplus Colorado River water within the AMA. The AMA has made use of one underground storage facility and three groundwater savings facilities to store Colorado River water that would otherwise not be used. The AMA has also been successful in providing technical assistance to users, despite a small staff (ADWR 1999c).

Challenges associated with the augmentation and recharge program include the failure of municipal providers to fully utilize their CAP allocations and the failure of regulatory incentives to motivate use by this sector. In the Pinal AMA, however, the municipal sector was small during the second management period, so these issues had little effect on the overall success of the program. Alternative water supplies were also not developed. This had little overall effect on the AMA because it is unlikely water importation would be cost effective.

### **Santa Cruz AMA**

Because the Santa Cruz AMA was a part of the Tucson AMA at the beginning of the second management period, a management plan was not developed for the AMA. For the first half of the 1990s, the AMA was included in the Tucson AMA and the augmentation and recharge program of the Tucson AMA Second Management Plan was in effect. After the Santa Cruz AMA was split off into a separate AMA, the ADWR began studies to develop a management plan for the AMA, but a plan was not promulgated until the third management period. Little of the augmentation efforts of the Tucson AMA took place in the area that became the Santa Cruz AMA.

Despite the lack of a management plan, the Santa Cruz AMA did implement an augmentation and conservation fund withdrawal fee in 1994 when the AMA was created out of the Tucson AMA. The fee was set at \$0.50. The proceeds were used to fund seven projects during the second management period.

### **The Third Management Plan Augmentation Programs**

With the promulgation of the Third Management Plan for each of the AMAs, the augmentation programs began to take on unique characteristics for each AMA. However, the safe-yield AMAs share one management goal in common. Each of these AMAs (Phoenix, Prescott, Pinal, and Tucson) have adopted a "critical areas" management philosophy. Critical areas management is the result of an acknowledgement that conservation and augmentation in one part of the AMA does not necessarily affect groundwater levels and subsidence in a different part of the AMA. In addition, the Tucson, Phoenix and Pinal AMAs are required by statute to provide recommendations to the AWBA about the following: whether additional AWBA storage would help the AMA achieve its goals, where groundwater storage should take place within the AMA, and whether extinguishment of long-term storage credits held by the AWBA will help achieve the AMA's goals. A summary of the AWBA recommendations and the overall goals and objectives for each AMA is provided below.

Each AMA also considered a grandfathered groundwater right purchase and retirement program. While a retirement program would reduce the amount of groundwater pumping and use, it would also be prohibitively expensive. None of the AMAs elected to adopt a retirement program during the third management period.

### **Tucson AMA**

Many of the goals and objectives of the Second Management Plan have been carried through to the Third Management Plan. However, there is significant concern about subsidence urbanized areas of the AMA, including the Tucson central well-field. Other areas of concern are the Canada del Oro and Sauhrita/Green Valley areas. The ADWR intends to focus recharge efforts in these areas, though recharge and augmentation in Tucson's central well-field are challenging because of restrictions on direct injection recharge using CAP water. The specific goals for the Third Management Plan augmentation program include:

- Facilitate the use of renewable water supplies in place of groundwater
- Improve or maintain groundwater conditions in areas with significant water level declines and associated impacts
- Initiate a planning process for the critical area concept
- Maximize CAP storage to offset future shortages

The Third Management Plan also includes a number of objectives, including:

- Maximize the use of Colorado River Water
- Use the CAP canal to deliver surplus water and maximize interstate banking through the AWBA
- Support local water planning
- Improve monitoring and public information to support planning and management
- Integrate quality and quantity programs to get the maximum benefit
- Resolve issues limiting regional water management
- Develop augmentation incentives
- Identify and assess future augmentation options
- Settle Native American water rights claims
- Evaluate the potential and need for a groundwater rights retirement program (the ADWR decided not to develop an agricultural grandfathered rights purchase program during the third management period).
- Develop programs and/or legislation to limit groundwater pumping in critical areas.
- Develop well-spacing rules.

There is an obvious need for additional AWBA recharge facilities in the Tucson AMA (ADWR 1999d). Both the AWBA and the IPAG for the Tucson AMA have determined that current storage is inadequate to meet future needs. In 1999 the permitted storage capacity in the AMA was less than 100,000 acre-feet; the projected need by 2007 is approximately 175,000 acre-feet. By 1999, the AWBA had stored approximately 3,100 acre-feet of water in the AMA. In contrast, hundreds of thousands of acre-feet of water had been stored in the Pinal and Phoenix AMAs (ADWR 1999d).

When choosing locations for recharge facilities, the AMA recommends that the AWBA consider the ease of recovery of water by users entitled to stored water in times of shortage and critical areas of groundwater decline within the AMA. The AMA also encourages the AWBA to store water in critical areas and then extinguish the storage credit associated with the water. This effectively makes the

water non-recoverable and could help to stabilize water levels in these areas.

### Phoenix AMA

For the Third Management Plan, the Phoenix AMA has developed four general goal areas, with specific objectives for each goal.

Goal 1: Maximize the use of renewable supplies

- Provide incentives to all water use sectors to encourage the development of infrastructure to allow full and direct utilization of CAP water and effluent.
- Evaluate new incentive programs to increase direct use of renewable supplies

Goal 2: Maximize storage of renewable supplies

- Coordinate with AWBA to achieve water management objective
- Provide technical and financial assistance to users to develop storage facilities
- Encourage storage in areas where groundwater will be needed in the future
- Encourage maximum efficiency of storage facilities

Goal 3: Address local water supply problems

- Use the critical area management concept to encourage reduction in water use in areas with groundwater decline and subsidence issues and to encourage recharge in these areas
- Use the critical area management concept to discourage underground water storage in areas with high water tables.
- Protect groundwater supplies in areas that do not currently have supplies available to meet all of current and projected demand
- Encourage groundwater right extinguishment in critical areas by the AWBA
- Evaluate the need and incentives for a groundwater right purchase and retirement program
- Develop a program to put groundwater to beneficial use
- Continue to develop monitoring programs to facilitate implementation of water augmentation and recharge programs
- Encourage residual pumpers to reduce use and replenish supplies.

Goal 4: Additional augmentation and recharge program objectives

- Identify and determine the feasibility of future augmentation strategies
- Integrate groundwater replenishment, water banking, assured water supply, recharge, and related activities to facilitate achievement of groundwater management objectives
- Develop well spacing rules

The AWBA is storing groundwater in the Phoenix AMA in excess of the needs of the AWBA (ADWR 1999a). However, the AMA feels that the water is not being stored in the most appropriate locations to address the goals of the AMA's augmentation program. To better address these needs, the AMA recommends the AWBA explore storage of water in areas identified as critical areas in the Third Management Plan. In addition, the AMA recommends that the AWBA extinguish at least 32,000 acre-feet of groundwater storage credits in the AMA each year to help the AMA achieve safe-yield.

### **Prescott AMA**

The augmentation and recharge program of the Prescott AMA in the Third Management Plan has the general goal of moving the AMA toward safe-yield and addressing critical area concerns through the following objectives:

- Create an AMA augmentation and replenishment district
- Maximize recharge of alternative water supplies that cannot be used directly
- Develop a regional recharge plan to coordinate the recharge of alternative water supplies
- Expand the ground and surface water monitoring program to improve implementation of water management strategies
- Assess the need for a groundwater right purchase and retirement program
- Maximize the benefits of interregional water exchanges
- Research and identify augmentation measures; study ways to overcome legal, institutional, technical, environmental, and economic constraints to augmentation
- Assess the potential for the development of alternate supplies outside the AMA

### **Pinal AMA**

The Pinal AMA is in a unique position relative to the other AMAs in that its goal is not safe-yield. Rather, its goal is to maintain agriculture in the AMA as long as possible,

regardless of aquifer depletion. Thus, the AMA has a planned depletion policy, which permits regular overdraft of groundwater and declines in the water table. Currently, while the AMA is mining groundwater, it is doing so at a rate far below the rate allowed by the planned depletion policy; current overdraft is 119,900 acre-feet and the allowed overdraft is 310,000 acre-feet. The augmentation and recharge program can help to reduce the amount of overdraft further, leaving more water for future uses.

The focus of the augmentation and recharge program in the Third Management Plan is to maintain the current use levels of CAP water by agricultural users, encourage municipal providers to make full use of their CAP allocations, and to implement an AMA wide augmentation plan to guide augmentation efforts and implement the critical areas management framework. Specific objectives include:

#### **Primary Objectives**

- Maximize direct use of CAP water by irrigation districts
- Fully utilize municipal CAP allocations
- Use the CAP canal to transport and store surplus Colorado River water within the AMA
- Maximize recharge of renewable supplies that cannot be used directly
- Implement a groundwater monitoring program to help facilitate the development of a regional recharge plan
- Develop a regional recharge plan to coordinate storage and recovery of renewable supplies and address critical area issues
- Integrate AWS, water banking, groundwater replenishment, and related activities to facilitate achievement of water management objectives

#### **Secondary Objectives**

- Assess the need for a grandfathered rights purchase and retirement program
- Research legal, institutional, technical, economic, and environmental constraints to developing additional alternative supplies.

The Pinal AMA cannot make a recommendation to the AWBA about how much groundwater storage is needed in the AMA until a regional storage plan has been developed. The AMA recommends that the AWBA continue to store water in the AMA at the same rate as the end of the second management period until a recharge plan is completed. The lack of a regional recharge plan also limits the AMA's ability to assess the need for the extinguishment of storage

credits. The AMA currently has three groundwater savings facilities with a capacity in excess of the amount of water imported into the AMA by the AWBA. These facilities will continue to be used for augmentation during the third management period (ADWR 1999c).

### **Santa Cruz AMA**

The Santa Cruz AMA's augmentation and recharge program is very different from the programs of the other AMAs because of the unique characteristics of the Santa Cruz AMA. The AMA does not have access to CAP water. It is also located along the Mexican border and there are a number of international water issues facing the AMA. The AMA is the only AMA in a safe-yield condition. Because of this, augmentation and recharge are focused on maintaining the safe-yield condition of the AMA. The AMA is also in the early stages of collecting baseline data because of its relative youth compared to the other AMAs. Issues with shallow aquifers, effluent discharge and use, use of renewable supplies from Patagonia and Pena Blanca Lakes, and sharing of effluent and water with Mexico all need additional research before specific augmentation actions can be taken (ADWR 1999e).

A number of goals and objectives are presented for the augmentation and recharge program in the Santa Cruz AMA Third Management Plan. A number of these are informal objectives that relate to augmentation and recharge, while others are formally stated goals for the AMA. The informal objectives and specific goals are complementary.

#### **Formal Goals:**

- Maintain existing water resources to meet current demands
- Secure new renewable water supplies to maintain safe-yield, meet committed demands, and supply future needs
- Prevent long-term groundwater declines and stabilize water tables in areas of concern

In addition, the AMA will explore the following augmentation measures:

- Water exchanges as allowed under state law and possibly facilitated by the AWBA
- Securing effluent from Mexico; creating a local water district may help achieve this goal
- Use of existing renewable supplies within the AMA such as Patagonia and Pena Blanca Lakes

- Water storage outside younger alluvium (the younger alluvium aquifer is the most commonly used aquifer in the AMA).
- Importation of water from outside the AMA

Informal objectives for the AMA include:

- Maintain the balance between water use and recharge in the AMA (maintain safe-yield)
- Continue to work with Mexico to cooperatively manage water supplies and ensure adequate water supplies and distribution on both sides of the border. Water use in Mexico could have a significant impact on the AMA
- Ensure current water right holder continue to have access to their water
- Protect riparian habitat along the Santa Cruz River
- Ensure there is water to meet future demands

### **UNDERGROUND WATER STORAGE, SAVINGS AND REPLENISHMENT PROGRAM**

In addition to the AMA specific policy goals described above, each AMA is also subject to the statutory requirements for groundwater storage and recovery. These regulations provide a legal basis for storage of groundwater using Underground Storage Facilities (USFs) and Groundwater Savings Facilities (GSFs). Prior to the enactment of the regulations in 1986, there was no legal basis for the recovery of groundwater by the entity storing it and no legal restrictions preventing one party from recovering groundwater stored by another party. In addition, the legislation established that stored water retains its legal character upon recovery, an accounting system for water storage and recovery, and a permit system. Policies relating to these regulations were first included in the Second Management Plans of the AMAs. The policies and regulations of the Second and Third Management Plans are largely consistent, though the Third Management Plan provides additional detail and stricter regulations.

The water storage and recovery policies were virtually identical in all of the AMAs during the second management period (the Prescott AMA had slightly different storage policies than the other AMAs). In all AMAs, recharge and storage projects had to be consistent with the management plan of the AMA. In order to be consistent with the management plan, a recharge project could not:

- Be in an isolated part of the AMA where there is little current groundwater use
- Promote the migration of contaminate plumes or low quality groundwater

- Cause drainage problems resulting from recharge in an area of shallow depth to the water table

In addition, underground storage and recovery projects must follow specific siting rules. Generally, recovery must be within the “area of impact” of the storage project or, if not in the area of impact (AOI), then recovery must be within the service area of a municipal water provider or irrigation district, within the AMA where the storage took place, and meet at least one of the storage and one of the recovery criteria (described below). The area of impact is defined as the area of groundwater that is hydraulically affected by a recharge or storage project.

#### Storage Criteria (Phoenix, Pinal, and Tucson AMAs)

- Storage should take place in a location contributing to groundwater supplies in an area where there is current groundwater use or there is likely to be groundwater use in the near future and where there is not a shallow depth to groundwater
- In an area that contributes to a ADEQ/ADWR/EPA management program for contaminated or poor quality groundwater

#### Storage Criteria (Prescott)

- Near or up gradient from a well field currently in use
- In an area that contributes to a ADEQ/ADWR/EPA management program for contaminated or poor quality groundwater
- In an area experiencing groundwater declines of at least 1.5 feet per year

#### Recovery Criteria

- Recovery should take place in an area that will make use of or remove poor quality groundwater as part of a ADEQ/ADWR/EPA water management or remediation program
- In an area that would contribute to the management of a contaminate plum or poor quality water
- In an area experiencing a ground water decline of no more than 4 feet per year (in the Prescott AMA, the decline should be no more than 1.5 feet per year)

The goals of the storage and recovery program of the Third Management Plan are to encourage the use of alternative water supplies by limiting the amount of storage credits that may be earned for water stored in areas where it cannot be used directly and to eliminate the need for the development of large distribution infrastructure by allowing storage and recovery in different places. The first goal is driven by the recognition that groundwater storage is not of equal value in all parts of an AMA; storage makes

the largest impact on aquifer conditions if it takes place in areas where significant pumping is taking place, especially critical areas.

The Third Management Plans also provide more specific regulatory guidance to parties seeking to store and recover water. There are now two types of water storage: short-term and long-term. Short-term storage is water that is recovered in the same year as it is stored. Most types of water qualify for short-term storage and recovery. Long-term storage credits may be earned for storing water with no currently legal direct use. Examples include effluent and excess CAP water. Long-term credits may be recovered in the future, but the water retains the same legal character it had upon storage. Therefore, stored effluent will still be considered effluent when it is recovered in the future. Long-term storage credits may be bought and sold and may be used by municipal providers to meet total gallons per capita day requirements.

The storage and recovery siting criteria in the Third Management Plans are similar to the criteria included in the Second Management Plans, though the regulations do provide somewhat more flexibility. Storage criteria are defined in terms of what provides the right to recover stored water. As in the Second Management Plan water recovered in the AOI of storage is always allowed. Outside the AOI, there are a number of conditions that must be met in order for a party to have the right to recover water.

#### Recovery Criteria Outside the AOI (A.R.S § 45.834.01(A)(2)(b))

- The storage resulting in the right to recover:
  - Contributes to supplies available to current groundwater users or supplies that are committed as a result of a Designation, Certificate, or Analysis of Assured Water Supply; or
  - Is a part of a groundwater cleanup project under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) or Title 49, Arizona Revised Statutes that contributes to the management goal of the AMA; or
  - Is determined by the director to contribute to the AMA’s management goal.
- Either:
  - Recovery will not cause the depth-to-static water level after 100 years to exceed the level specified by the AWS standards, or
  - Recovery will occur in the applicants service



area and the applicant is a municipal provider with an AWS designation

- And:
  - The average decline of depth to groundwater is less than four feet per year; or
  - The recovery well is a part of a groundwater cleanup project under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) or Title 49, Arizona Revised Statutes that contributes to the management goal of the AMA; or
  - The director determines the recovery contributes to the area's water management objectives

The statutes affecting the Santa Cruz AMA vary somewhat. There is no four foot per year decline standard. Instead, recovery standards are based solely on the relationship between recovery and AWS standards.

In addition to storage and recover criteria, the Third Management Plans provide criteria for storage of non-recoverable water. Non-recoverable water is water that is stored but cannot be recovered at any time in the future. Storage of non-recoverable water is uncommon in the AMAs and is most likely to occur as the result of an enforcement action for non-compliance with conservation program requirements. Non-recoverable water should be stored in areas where there is current groundwater pumping or groundwater committed under the AWS program, contributing to a groundwater cleanup project, or in a way as determined by the director of the ADWR as contributing to the management goal of the AMA.

Finally, the Third Management Plans provide a specific methodology for determining the rate of groundwater decline at recovery well sites for the purpose of complying with the four foot per year standard set in the statute. To determine the rate of decline, the ADWR develops hydrographs based on information from index wells in the same section as the recovery well and the eight sections surrounding the section of the recovery well. The hydrographs are used to establish a long-term trend that is then interpreted by the ADWR to determine if a recovery well meets the four foot per year decline standard. The ADWR considers historic and present groundwater uses in the area that have affected groundwater decline rates over time.

**AMA Reform: A  
Political Analysis**

**FINAL**

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## INTRODUCTION

Using the information gathered during interviews with participants in the Groundwater Management Study Commission process, we have applied several well-known concepts in policy analysis in an effort to better understand both the conditions that led up to the creation of the Act and the conditions precedent that may be necessary for further significant changes in the Act or in how groundwater is managed in Arizona generally (See the Methodology section of this report for a description of the interview methodology).

### Conditions conducive to change

Given groundwater management conditions in the 1970s some change in the way groundwater was managed in Arizona was inevitable. No one observing Arizona water management in the late 1970s could have concluded otherwise. Up to that point in time many important groundwater management policies in Arizona were being decided by the courts. Attempts to regulate groundwater use and withdrawal were considered “political suicide” by several of the people interviewed in the study. Yet in politics what is infeasible one day may become feasible in another. In the late 1970s two significant events occurred that served as the catalyst for various interests, including then Governor Bruce Babbitt, to take action and develop the statutory framework for groundwater management. The first event was the Arizona Supreme Court decision in *Farmers Investment Company v. Bettwy (FICO)*, which threatened to limit the ability of mines and municipalities to transport and import groundwater<sup>1</sup>. The second event was a threat to halt pending federal construction of the Central Arizona Project (Babbitt, 2005, pp. 131-133). We will not repeat that history at this point but mention it only to exemplify that these were the conditions that lead to what was then considered one of the most comprehensive groundwater management reforms in the country. Unfortunately, as we have seen, the promises of reform did not prove itself in practice.

There are several concepts used in policy analysis by social scientists that help to explain both the creation of the Act, subsequent changes in the Act and the prospect that Arizona will undertake comprehensive groundwater management reform anytime in the near future. The concepts we employ here are: incrementalism, regulatory

<sup>1</sup> *Farmers Investment Company v. Bettwy, (FICO)*, 113 Ariz. 520, 558 P.2d 14.

theory of distribution and coalition theory. The formation of water policy in Arizona typical of water politics prior

to passage of the Act is also very similar to the politics of water policy after passage of the Act.

The modifications in groundwater management made since 1980 were incremental changes, were illustrative of a distributive form of policy creation and were the result of the interaction of primary stakeholders in what are commonly referred to as policy or iron triangles.

### Incrementalism

It is widely accepted among scholars of the American policy process that policy is made incrementally (Lindbloom, 1979, p.p. 517-526). Incremental theory, (or incrementalism), may be summarized in the following manner:

1. Only some of the possible alternatives for dealing with a problem are considered by the decision maker. Either by virtue of limitations on information, ability, time, or because of the desire to achieve a consensus, a comprehensive evaluation of all alternatives is not undertaken.
2. The alternatives considered and the option ultimately selected will differ only slightly or incrementally from existing policy.
3. Only a limited number of consequences for each alternative are evaluated.
4. The problem being evaluated is continually redefined with adjustments being made to make the problem more manageable.

There are practical and political explanations for the incremental nature of policy-making. Practically, it is usually difficult if not impossible to consider all the numerous alternatives to a decision and the consequences of each alternative. Given the inherent limits on human ability to comprehensively analyze all of the alternatives and the ramifications of policy options, it may be that incremental decision-making is inevitable. This is what Herbert Simon called “satisficing” in his classic *Administrative Behavior*, where he argued that people do not have the time or resources to examine all options thoroughly, therefore, decisions are broken down into subsets and decisions are made that may not have maximum long-term value, but are at least satisfactory to deal with the issue at hand (Simon, 1976). Given limited capacity and information, it makes sense to simplify decision-making to facilitate some kind of action. In political terms, incrementalism makes sense

because it allows participants in a given policy battle the advantage of being able to work from past policy agreements and shared assumptions. Since politics inherently involves trade-offs, bargaining, and compromise, we should not be surprised to find that decisions are often made in relatively small increments that do not differ greatly from past decisions. It is easier to reach agreement on matters when the modifications being discussed in a given policy vary only slightly from prior agreements.

In many policy areas, the attributes of incrementalism give stability to the process. And such has been the case in groundwater management in Arizona since the passage of the Act – as problems have presented themselves the concerned interest groups and their political representatives have sought policy adjustments that satisfy immediate needs. Although stability is clearly a benefit for political systems, at times it may be necessary to take quick and decisive action inconsistent with past policy decisions. The late 1970s were such a time. We think we are at a similar time today. The Arizona political system does seem to respond reasonably well to a crisis or an emergency – the passage of the Act is evidence of this. The bargaining, compromise, and give-and-take that characterize the policy-making process during normal times can be suspended during times of crisis. The events leading up to and the passage of the Act represent such a time. In contrast, since 1980 there has been no perceived “crisis” that would trigger a comprehensive re-evaluation and reform of groundwater management practices. In a sense this is a good thing but it also means that adjustments have been made on a case-by-case basis (incrementally) in ways that may or may not lead to management practices that will serve the state well in the next 30 years.

Comprehensive reform may occur absent a perceived crisis but such reform is politically difficult. Serious and aggressive conservation measures designed to force offsets in groundwater pumping and investments in alternative (and often expensive) technologies combined with comprehensive conjunctive management would not be popular in the water purveyor community. (And indeed the argument would be made that more incremental patchwork measures will solve immediate problems – which they could – at the cost of comprehensive changes which would improve overall water management.) Such comprehensive reform is called for now. However there being no perceived crisis the public and the water community will have to be rallied into support for reform. In the 1970s Governor Bruce Babbitt played a key role in organizing support

for change. Strong executive leadership would again be necessary both within the ADWR and in the Governor’s office for serious long term reform to be possible.

This then begs the question – “What conditions will be necessary for comprehensive reform of groundwater management in the future?” and if there is no perceived groundwater management “crisis” to provide the catalyst for comprehensive reform then “Will incremental changes to groundwater management in Arizona get the state to where it wants to be the rest of the century?”

Before we answer these questions we will describe in greater detail the nature of the water policy formation process in Arizona and why we think that further reforms will be difficult but necessary.

## Types of regulation

For several decades policy analysts have used a typology developed by Theodore Lowi to describe different types of policy development. Lowi developed a framework for categorizing policies into distributive, redistributive and regulatory types of policy and policy formation. This method of evaluation focuses on the content of a policy, the kind of problems associated with the policy and the power relationships at play between the various interests (or stakeholders) concerned with the policy.

A policy that is aimed at redistribution and an unequal allocation of costs and benefits ( i.e where there are winners and losers) will be found in an arena characterized by conflict. A policy that holds out goods or services to everyone where the distribution of costs and benefits is unclear will be characterized by relatively conflict-free processes of policy making. Regulatory policy is also relatively conflict free (or at least significantly reduced conflict when compared to re-distributive policies). Most environmental policy is of a regulatory nature as are most policies that require administrative rule - making.

The creation of the Act and the development of a management plan concept with increasingly stringent limitations on groundwater withdrawals are a good example of redistributive politics and policy formation. There were winners and losers. From our interviews, it was clear that the cities and mines came away with what they wanted and agriculture came away with what they felt was the best outcome they could hope for. As compared to pre-1980 -- under conditions mandated by the FICO case -- the cities

and mines were the winners and agriculture, which would now eventually be forced to cut back pumping, were the losers (subsequent developments notwithstanding). Redistributive policy formation is inherently conflictual and hence is avoided whenever either distributive or regulatory politics can be undertaken instead. The subsequent modifications and additions made to the Act were regulatory in nature. These changes satisfied an immediate perceived need with no major immediate clearly identifiable cost to stakeholders.<sup>2</sup>

Major reforms of groundwater management today in a way that significantly reduces over drafting or aggressively limits agricultural usage or seriously impacts development particularly in non-AMA areas of the state -- would require some redistribution of costs and benefits that would be conflictual. Non-incremental redistributive change is always possible but absent the perception of crisis is unlikely. This shift to redistributive policy will be necessary to accomplish serious reform. It will involve conflict and will require leadership at the highest levels.

An iron or policy triangle is a term used in the study of public policy formation to describe the relationship that exists between major players in the formation of any given policy. Iron triangles are relatively closed, mutually supportive relationships that often exist between the government agencies that administer programs, the private sector stakeholders with interests in the policy area, and the legislators most concerned with the committees or subcommittees with jurisdiction over a particular functional area of government policy. As long as they hang together, the members of these small groups of movers and shakers tend to dominate all policy-making in their respective specialized areas of concern, and they tend to present a united front against “outsiders” who attempt to invade their turf and alter established policies that have been worked out by years of private negotiations among the “insiders.”

The relationships and importance of iron triangles are clearly reflected in the creation of the Act. Government

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2 The Assured Water Supply Rules may be seen as a tool towards short and long-term water resources management. The 100-year assured water supply rules served as a catalysts for cities and private water companies in the AMAs to work in cooperation and collaboration with the regulatory agencies and private development during unprecedented growth rates in the three major AMAs: Phoenix, Tucson, and Prescott. A Water Resources Element was added to the General Plans under the State Growing Smarter Initiative.

officials (some elected, some appointed) and stakeholders (cities, mines and agriculture) dominated and directed the process. Among the interests that were not included in the process were Native American tribes and environmentalists. Several of the participants interviewed noted the absence of the tribes and environmentalists – and some expressed regret that they were not included. Although subsequent revisions in groundwater management practices have not explicitly excluded other interests those deliberations have also been dominated by the same (to varying degree depending on the issue) policy or iron triangle interests. The grip that iron or policy triangles have on a policy area can be broken several ways. One is when enough public attention is focused on an issue so that additional players are drawn and inserted into the policy formation process on that issue. So, for example, fuel management in the national Forests has traditionally been an issue only of concern of Forest Service professionals, some environmental and some recreational groups – and the elected officials that represent these interests. However when wildfires drew the attention of a large sector of the public (and other elected officials) to the issue of fuel management in the forests then the traditional policy triangle broke down – policy in this area became a concern of the Governor and the Federal executive. The policy triangle broke down as others were added to the mix of players.

The policy triangle in water management in Arizona has not broken down and has always dominated water policy formation. We make this point both to illustrate what people in the process already know (i.e. water policy is dominated by relatively few entrenched interests) and to point out that in order to gain the public support necessary for reform this policy triangle will need to be significantly expanded. Without such expansion the public support necessary for reform will not be possible. This means including Native Americans, ranchers and other major land owners, environmental groups, and others that act at the margins such as labor organizations, contractors, the hospitality industry and others.

In 2006, the DWR Director initiated a Statewide Water Advisory Group (SWAG), a 52-member group with members from both political parties and the Legislature. The members represent agriculture, the public and private utilities, state/county/municipal and Tribal government, the military, non-governmental organizations (NGOs) and others. The purpose of the group is to look at water management on a state-wide level. The Director invited the rural areas (non-AMAs) to the table also to develop the

tools to manage long-term water resource sustainability with growth to ensure the quality of life wanted by all of Arizonans today and for future generations.<sup>3</sup> However, they are quickly finding that trying to apply the same water adequacy laws as are in the Assured Water Supply Rules may not be possible in the rural areas of the state and newly proposed rulemaking by ADWR to address this issue seems to be taking the same incremental decision-making course as before.

Another way this grip on policy formation can be loosened is by the insertion of a strong executive into the mix forcing the participation of additional stakeholders. If or when new comprehensive water management policy is entertained in Arizona traditional interests can be expected to dominate the process unless a governor inserts his or herself to insure that non-traditional interests are represented in the process.

Such an action by a governor would disrupt established relationships, alienate well entrenched interests and necessarily require the expenditure of some political capital. That is a high cost. But the long term viability of the state is at stake.

The time may be right for requesting Federal intervention and assistance for water resource management similar to what caused the 1980 Groundwater Management Act (GMA) to become a reality. The threat of holding federal funding for important studies, water resources acquisition and major water capital improvement projects could be the impetus to draft out the next phase of the GMA that would now include the rural (non-AMA) areas. At the time of the passage of the 1980 GMA, the rural areas did not want to have anything to do with State-mandated groundwater management. However, with unprecedented growth rates in the rural counties, and with the inclusion of environmental groups, and the no growth groups, the political climate is dramatically shifting and the crisis momentum is building.

Congress mandated creation of the Upper San Pedro Partnership in southern Arizona and the Verde River Basin Partnership in central Arizona in an effort to

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3 SWAG is still in existence today and regular participation by all members is on-going. This is similar to the 1997 Groundwater Management Study Commission that was established by AZ Senate Bill 1391 that had 36 members from a broad spectrum of Arizona and a diverse representation. The Final Report presented by the 1977 Commission on June 30, 1980 became the 1980 Groundwater Management Act.

save the last two remaining perennial rivers in Arizona (Dodder, J. 2006. p. B1). While the 1980 GMA focused on groundwater only, surface water rights went unchecked and now the environmental groups are clamoring for protection of rivers and streams based on ecological and riparian issues. The San Pedro must reach sustainable yield by 2011. Major funding has been given to the San Pedro Partnership and the Federal government regularly earmarks funding to them. The Verde River Basin Partnership was authorized under federal law in 2005, but no federal funding for implementation has been authorized to date. There has been much conflict with the formation of the Verde River Basin Partnership and federal intervention may be used to help break the deadlock.

Lastly, the Central Arizona Project could play a pivotal role again to create the crisis needed to look at major political reform in not only groundwater management, but all aspects of long-term water sustainability and would include all Arizona. Other rapidly-growing states, such as Nevada, are now demanding a reallocation of CAP water rights. Rural Arizona cities and towns are requesting their share of CAP water rights back as they are not sure of their long-term water supplies and need the tools and resources to deal with rapid growth in their areas. The time is now for all of Arizona to unite in long-term water resources management.

## REFERENCES

- Dodder, J. (2006, March 17). San Pedro and Verde face similar issues. *The Prescott Daily Courier*, Sec. Local, p. 1.
- Guenther, H. (2007, June 15). SWAG bill protects supplies for rural Arizona. *Verde Independent*. Sec. Editorial, p. 2A.
- Lindbloom, Charles E. 1979. Still Muddling, Not Yet Through. *Public Administration Review* 39(5): 517-526.
- Simon, Herbert A. 1976. *Administrative Behavior*, 3<sup>rd</sup> ed. New York: Macmillan.