CHAPTER

8

Augmentation and Recharge Program

8.1 INTRODUCTION

The goal of the Third Management Plan Augmentation Program is to promote water supply and distribution efforts which (1) maintain existing water resources to sustain current demands; (2) secure renewable water supplies for the purpose of maintaining safe-yield conditions, meeting committed demands, and supplying future needs; and (3) prevent long-term declines and stabilize local water tables in areas of concern. Chapters 2, 3, and 11 highlight the importance of effluent as a renewable supply in meeting the current demands and projected growth within the Santa Cruz Active Management Area (AMA). Operated by the International Boundary and Water Commission (IBWC), the Nogales International Wastewater Treatment Plant (NIWWTP) discharges large volumes of treated effluent into the Santa Cruz River. This effluent is a very important component contributing to the stability of local water levels in downstream segments of the Santa Cruz River. Consequently, effluent contributes significantly to the achievement of the management goals in the Santa Cruz AMA. Other sources of renewable supply might include Peña Blanca Lake, Patagonia Lake, effluent from other locations, and water from previously unexplored tributaries and washes. Traditionally, augmentation programs are geared to the gradual replacement of groundwater with renewable water supplies to meet regulated demands. The unique mixture of effluent, surface water, and groundwater supplies in the Younger Alluvium of the Santa Cruz River, the reliance of water users in the Santa Cruz AMA on effluent to recharge the younger alluvial aquifer, and the existence of smaller aquifers with limited storage capacity, separate the Santa Cruz AMA from other AMAs in the approach necessary to develop an augmentation program for the Third Management Plan.

Several outstanding issues must be addressed before an effective augmentation program can be fully developed for the Santa Cruz AMA. Ultimately, the challenge for water planners in the Santa Cruz AMA will be to secure additional water supplies and/or provide for the discontinuation of some current demands to allow for continued growth while continuing to meet AMA goals. In order to implement an augmentation and recharge program for the Santa Cruz AMA, the various water users need to work together to: (1) determine how to best utilize currently available renewable supplies; (2) determine how to develop effective recharge projects, given hydrologic conditions; (3) determine where additional water supplies may be obtained; (4) explore the option of creating a water district; and (5) determine what functions such a district could perform. All of these tasks will need to be considered within the context of local community preferences and legal, economic, political, and environmental conditions. Most of these tasks will necessitate additional data collection and analysis.

While the principal responsibility for developing water supplies remains with the region's water users, the Arizona Department of Water Resources (Department) has an important role in facilitating the development and maximum use of these supplies. The current scope of the Department's activities in augmentation and recharge includes the following:

- Data management and public information. The Department's responsibility for accumulation and dissemination of water use and water supply data provides the information necessary to develop water management plans, implement augmentation projects, conduct research related to increasing available water supplies, and identify geographic areas requiring additional water management.

- Technical and planning assistance. The Department provides technical assistance by reviewing and providing input on proposals for water augmentation and recharge projects, planning and feasibility studies, project operations, and data interpretation.

- Coordination and facilitation. The coordination and facilitation of augmentation and recharge activities, particularly between jurisdictions and multiple regulatory agencies, is an important component of the Department's statewide and regional water planning responsibilities.

- Financial assistance. The augmentation and conservation assistance fund, as well as specifically budgeted appropriations, provides financial assistance to entities implementing augmentation projects or studies that contribute to achieving the AMA water management goal or resolving regional water management issues.

- Statutory roles. The director is statutorily designated as the representative of the State of Arizona in Colorado River and interstate water issues; advisor to the Secretary of the Interior in allocating water among users; coordinator of Arizona's review and comments on water development proposals by the United States Army Corps of Engineers, Secretary of the Interior, and Secretary of Agriculture; and manager of the state's water rights to ensure achievement of water management objectives.

- Regulatory and permitting authority. The Department's regulatory and permitting authority regarding use of water rights and development of recharge projects ensures that these uses of water achieve water management objectives.

- Regulatory incentives. Regulatory incentives are established in the agricultural, municipal, and industrial conservation programs (chapters 4, 5, and 6, respectively). These incentives are intended to facilitate the implementation of augmentation activities by water users. The groundwater quality management program (Chapter 7) identifies methods to increase available water supplies by increasing the use of poor quality water.

Because the Augmentation and Recharge Program included in the Second Management Plan was geared to the water management goal and supply options existing in the Tucson AMA, an entirely new program designed for the water management goal of the Santa Cruz AMA must be developed. During the third management period, data collection and research efforts will continue and be expanded to help in meeting augmentation and recharge objectives for the Santa Cruz AMA. Additional routine data collection and site specific studies, the completion of the Department's hydrologic model, the potential outcome of the proposed water rights settlement interim decree for the Santa Cruz AMA, the result of the facilities planning process between the United States and Mexico, the possibility of the creation of a water district, and the development and adoption of Assured Water Supply consistency with management goal criteria for the Santa Cruz AMA could further clarify the needs and priorities for the Augmentation and Recharge Program for the Third Management Plan.

The following topics are discussed in the order listed:

- AMA Assessment
- Second Management Plan Augmentation Program
- Program Development Issues
- Program Goals and Objectives
- Third Management Plan Augmentation and Recharge Program
- Future Directions
- Conclusions

8.2 ASSESSMENT OF SANTA CRUZ ACTIVE MANAGEMENT AREA

As previously noted, there are a number of issues specific to the Santa Cruz AMA which require closer examination to determine the potential effectiveness of an augmentation program. An assessment of the statutory issues, binational considerations, modeling efforts and information gathering, and developing water rights decree and potential district legislation is designed to introduce the reader to the full spectrum of variables which must be addressed in order to effectively implement an augmentation program for the Santa Cruz AMA.

8.2.1 Statutory Issues

The hydrology of the Santa Cruz AMA, the international issues which affect the AMA's water management, and the unique management goals for the AMA present numerous complex issues which may affect an augmentation program for the AMA. These issues will need further exploration and analysis as the water management program for the Santa Cruz AMA is refined. A few of the more immediate issues are briefly presented in the following sections.

8.2.1.1 Coordinated Water Management

When the Santa Cruz AMA was created, the legislature recognized that the hydrology of the Santa Cruz AMA required a water management program that coordinates the management of both groundwater and surface water. Thus, a number of water management programs in the Groundwater Code (Code) for the Santa Cruz AMA make reference to "water, other than stored water, withdrawn from a well," instead of simply "groundwater."

In spite of this effort at coordinated water management, it remains true that many legal characteristics of water in Arizona depend upon whether the water is classified as surface water or groundwater. The issue, however, of how to distinguish between groundwater and surface water is still being considered by the Arizona Supreme Court. This lack of certainty makes water management and development and implementation of an augmentation program particularly difficult in the Santa Cruz AMA where there is a close hydrological connection between surface flows and groundwater.

These issues are further complicated by the significant amounts of effluent that are released into the Santa Cruz River from the NIWWTP. As most fully described in *Arizona Public Service Company v. Long*, 160 Ariz. 429, 773 P.2d 988 (1989), effluent has legal characteristics that are different from surface water and groundwater.

Answering the question of which set of legal characteristics apply to what water in the Santa Cruz AMA will not be easy but is essential if a solid and long-lasting augmentation program is to be developed for the AMA.

8.2.1.2 Recharge Issues

In the other AMAs, recharge is a significant tool for water augmentation. Currently, however, there are no recharge projects in the Santa Cruz AMA. Central Arizona Project (CAP) water, which is the primary source of recharged water in other AMAs, is not available in the Santa Cruz AMA. Significant effluent is available, but that effluent is currently released into the Santa Cruz River where it helps maintain the level of local water tables. Effluent could be used for recharge within the AMA, but a number of issues could make obtaining the necessary permits and credits challenging.

Designating a stretch of the Santa Cruz River as a managed underground storage facility has been discussed for a number of years and would allow discharges of effluent into the river to continue but would allow entities with rights to the effluent from the NIWWTP to accrue storage credits to withdraw water at a later time. Managed underground storage facility permits in other AMA's, however, have resulted in protests from persons owning parts of the streambed over which the facility is located claiming trespass and by downstream appropriators who claim that the effluent, when released to the streambed, becomes appropriable water, notwithstanding the issuance of the managed underground storage facility permit. These issues are still being litigated.

There may also be hydrologic issues in attempting to recharge water into a relatively shallow basin. In addition, the distinction between effluent and natural flows would need to be accounted for in any

managed recharge facility, as would any of the "stored" effluent that eventually leaves and is not available for use in the AMA.

8.2.2 Binational Considerations

8.2.2.1 Mexican Rights to Effluent

Effluent from the NIWWTP is an important source of renewable water which could be used for demonstrating an assured water supply for future growth in the Santa Cruz AMA. Effluent discharge also plays a major role in maintaining water tables and riparian habitat in the Younger Alluvium downstream from the NIWWTP. A balance between the use of effluent discharge to meet future demands and the current use of effluent by riparian areas, along with the maintenance of local water table levels is an important objective.

The absence of a formal agreement to assure the long-term availability of wastewater inflow from Mexico compounds the dilemma of whether or not effluent would be available in significant quantities for future recharge projects in the Santa Cruz AMA. Mexico currently has a legal right through treaty agreement to claim their portion of effluent treated at the NIWWTP, which is currently about two-thirds of the effluent produced. Of the NIWWTP's design capacity of 17.2 million gallons per day (mgd), 9.9 mgd of treatment capacity is allocated to Nogales, Sonora and the remaining 7.3 mgd is allocated to Nogales, Arizona.

The international treaty between the United States and Mexico states that the inflow of the wastewater originating from Sonora could be retained or reduced by Mexico at any time. The treaty also states that Mexico may recover and transport its effluent back across the International Boundary at anytime. This clause creates uncertainty for the continuity of current levels of effluent discharge to maintain the present water table. Mexico is also currently planning to construct a wastewater treatment facility south of Nogales, Sonora. It is likely that Mexico will maintain the current flow of wastewater to the NIWWTP and treat additional wastewater at the new facility, recharging the effluent from the new facility in the Los Alisos subbasin. In Chapter 11, the Department has included an assumption that such a facility would be constructed and become operational by the year 2005.

8.2.2.2 Impacts of Mexican Water Augmentation Plans

Nogales, Sonora's water shortage has led to the development of a water supply plan to meet the shortfall and prepare for the continued rapid rate of growth. The water supply plan contains components addressing both potable supplies and wastewater management.

8.2.2.2.1 Wastewater Plan

The first phase of the plan will include wastewater system improvements which do not directly affect the availability of water resources in Arizona. The proposed Nogales Infrastructure Project is projected to be submitted to the Border Environment Cooperation Commission (BECC) in 2000 for certification, and subsequently to the North American Development Bank (NADBank) for funding.

Several wastewater plan alternatives were prepared and examined. Ultimately, Alternative 6 was selected by both United States and Mexican representatives to address the wastewater needs in *ambos* (both the Arizona and Sonoran portions of) Nogales. In order to minimize costs, the project will be implemented in phases, with segments constructed as needed and allowing for future expansion.

Alternative 6 consists of:

a) upgrade and expansion of the NIWWTP
b) rehabilitation and expansion of the international outfall interceptor (IOI), which is presently a bottle neck for wastewater crossing the border
c) construction of a wastewater treatment plant in Los Alisos
d) construction of pump stations to convey sewage to the Los Alisos plant
e) rehabilitation of the wastewater collection systems in Arizona and Sonora

Construction phasing of the project would go along the following lines, although the present certification from the BECC would apply to the first phase only:

Phase I	Upgrade and expansion of the NIWWTP (to reduce the ammonia in the Santa Cruz River); rehabilitation and expansion of the IOI (reduce leaks and the possible aquifer contamination from those leaks); and rehabilitation of collection systems in both Nogales, Arizona and Nogales, Sonora. Construction of a 5-7 mgd wastewater treatment plant in Los Alisos, as well as construction of the interceptor and possibly a pump station.
Phase II	Expansion of the Los Alisos wastewater plant, construction of a collection system south of the divide, and, if necessary, construction of additional pump stations.

The United States Environmental Protection Agency (EPA) is proposing to approve a funding scheme which would use a combination of Border Environment Infrastructure Fund (BEIF) money from NADBank, combined with local contributions, to fund these projects.

8.2.2.2.2 Potable Supply Plan

Previous discussions on developing additional potable water supplies have not clarified whether Nogales, Sonora would increase its withdrawals from the Santa Cruz River. However, if the current rate of development continues, it is almost certain that additional supplies will be required and the Santa Cruz River is the closest source of additional supply.

Surface water flow along the Santa Cruz River is extremely variable from year to year. The volume of flow ranges from just a few thousand acre-feet per year to more than 80,000 acre-feet per year. Increased withdrawals along the Santa Cruz River in Sonora, coupled with the high variability in the natural supply, may result in the following negative consequences for the Santa Cruz AMA:

- The Nogales, Arizona municipal wellfield at the State Route 82 microbasin, which is located downstream of the proposed extraction site, would be more susceptible to reduced surface flow and drought resulting in the need to firm this supply if it is to be used as a future source. Firming a supply involves the acquisition of additional or alternative supplies to be used during those times when the primary supply is not sufficient to meet demands.

- Riparian habitat along the Santa Cruz River might be damaged (particularly near the international border).

- The ability to accommodate committed demands in the southern portion of the Santa Cruz AMA might be decreased.

8.2.3 Hydrologic Modeling Efforts and Information Gathering

The complex hydrology of the river sometimes makes it difficult to define the relationship between pumpage and recharge. The Department has prepared a hydrologic model of the Santa Cruz River basin and is currently calibrating the model. In the future, it is hoped the model will assist in better defining water availability and developing water management programs.

After the hydrologic model for the Santa Cruz River basin is completed, it is expected to provide information that will allow an estimate of the minimum flow necessary to maintain the AMA goals. The hydrologic model incorporates the most comprehensive database prepared for the Santa Cruz River watershed to date, including information that has been graciously provided by the Mexican National Water Commission through a data exchange. Since no other more extensive hydrologic or habitat studies for this area exist, there is insufficient information currently available to precisely determine minimum discharge requirements from the NIWWTP in order to maintain the local water table levels in the effluent dominated reach of the Santa Cruz River.

The Department intends to utilize funding from the Water Management Assistance Program (see Chapter 9) and matching funds from other sources to improve knowledge of the hydrology in the AMA.

8.2.4 Potential Impacts on Local Water Table Levels

Safe-yield conditions may be difficult to maintain as committed demand is included in the annual balance of demands and supplies. Typically, committed demand is considered to be platted lots to which water service has not yet begun. Moreover, there are a number of locations within the AMA where continued or increased pumpage could cause severe water table level declines.

8.2.4.1 Development in the Northern Portion of the AMA

Significant future development is anticipated to occur in the northern portion of the Santa Cruz AMA from Amado to Tubac. Residential development is encroaching southward from Green Valley. Since most agricultural and industrial water users in this area have not used their full water allocations for many years, it is likely that overall water use in the area will increase substantially. Increased pumpage could draw down water levels near Amado.

If new subdivisions built around Tubac and Amado continue the trend of installing septic systems instead of centralized wastewater collection systems, an important renewable water supply will be lost and the potential for water quality problems will increase. Given the likelihood of expanding residential development, it is important that all water supplies, including wastewater locally generated from new subdivisions, be efficiently used. The future of effluent discharge, which could significantly impact the availability of water to consumers in the northern AMA, is a concern. A proliferation of septic tank systems rather than a centralized sewer system could also result in increased nitrate levels in wells in the same general area.

Development which expands along the Sopori Wash corridor also faces the possibility of reduced water levels. Although water levels have risen 10-20 feet in the immediate area between 1982 and 1995 due to a reduction in agricultural demand, new residential development occurring along Sopori Wash may result in water level declines in the immediate vicinity; and, if the demand is great enough, potentially prevent some of the tributary flow from reaching the Santa Cruz River, which may have further impacts on waters users in Amado.

8.2.4.2 Water Limitations In the Microbasin Area

The area upstream from the NIWWTP is also referred to as the "microbasin" area. The microbasins are a series of interconnected, descending mini-aquifers, or basins which are characterized by their limited water storage capacity. The average depth is only 75-150 feet deep, although one of the basins is estimated to be nearly 300 feet in depth. Water levels in this area respond quickly to both flooding and drought as described in Chapter 2.

Prolonged periods of drought aggravate the problem of limited storage capacity in the microbasin area. The City of Nogales maintains a municipal wellfield in this location and must alternate its pumping regime between this wellfield and its Potrero Creek wellfield during dry seasons to ensure the delivery of potable water to its customers.

A continuation of dry years would severely impact the stability of local water levels in this area, particularly if municipal and industrial water demands continue to increase. Even extreme short-term drought events may result in severe water shortages for water users in the area. Limited storage capacity further impedes the ability of the microbasin reach to build a reserve of water in the event of future droughts.

8.2.4.3 Potrero Creek Area

Potrero Creek is located northwest of the City of Nogales, upstream from the NIWWTP. Potrero Creek and the Highway 82 wellfield, which located in the microbasin area, are the two primary sources of water supply for the City of Nogales. Potrero Creek is a relatively deep aquifer system, with a documented cone of depression around the City's wells. A shallower, upper aquifer also appears to exist in Potrero Creek. The shallow aquifer, which supplies the flow of Potrero Creek during wet cycles and also feeds a wetland, is perched over a semi-permeable soil lens layer. The lower aquifer appears to be a traditional basin-fill aquifer, and has more capacity for storage than the City's microbasin wellfield. Water level declines between 1982 and 1995 were in excess of 20 feet at Potrero Creek. Additional pumping at this location could result in additional water level declines. More information is in the process of being collected to provide a better understanding of the extent of both the upper and lower aquifers in the Potrero Creek area.

8.2.5 <u>Availability and Use of Renewable Supplies</u>

Due to the relatively limited storage capacity and extreme variability in annual net natural recharge in the Santa Cruz AMA, new residential or commercial growth will require firm back-up supplies to maintain AMA goals.

8.2.5.1 Effluent

8.2.5.1.1 Availability

Roughly two-thirds of NIWWTP influent (untreated wastewater) originates from Nogales, Sonora and is transported into the United States through a pipeline underneath Nogales Wash which terminates at the NIWWTP. Table 8-1 provides a recent summary of the volume of annual influent received by the NIWWTP separated into United States and Mexican components. After treatment, the effluent has historically been discharged into the Santa Cruz River. Since the plant began operation in the 1960s, water levels have risen in the local water table downstream.

8.2.5.1.2 Legal Ownership

Based on the legal decision rendered in *Arizona Public Service Company v. Long*, 160 Ariz. 429, 773 P 2d 988 (1989), effluent abandoned into a natural channel becomes appropriable surface water. However, the entity abandoning the effluent into the stream has no obligation to continue doing so. Three entities have the right to use NIWWTP effluent prior to discharge: Nogales, Arizona; Mexico; and to a lesser degree, Rio Rico Utilities. Mexico owns two-thirds of the effluent presently generated at the NIWWTP and is allowed to recapture this water and transport it to Mexico for use there. If either Mexico or the City of Nogales diverts their portion of effluent prior to its discharge from the plant, the effluent-dominated flow available for appropriation by downstream water users would be reduced.

8.2.5.1.3 Direct Use

Effluent has not historically been used within the Santa Cruz AMA to any significant extent. However, effluent is an ideal source of supply for use by turf-related facilities due to its nutrient-rich quality. Using effluent directly means that water remains in the local aquifer that otherwise would have been withdrawn. This would be very beneficial to local water table management in areas upstream of the NIWWTP. Of the four turf-related facilities in the Santa Cruz AMA (described in Chapter 6), the Rio Rico golf course is the closest facility to the NIWWTP and is located downstream. However, the Palo Duro golf course may use effluent sooner than any other facility due to the assured water supply needs of the City of Nogales. One of these two turf-related facilities is most-likely of the four turf-related facilities to begin using effluent from the plant for turf-related watering in the future. The Tubac Country Club constructed a greywater wetlands to provide effluent for golf course irrigation. Effluent can also be used for the irrigation of certain crops, such as forage crops for cattle.

To encourage the use of effluent on turf-related facilities, the Department has increased the effluent incentive offered in the Second Management Plan. For the third management period, a facility may qualify for the effluent incentive with a smaller percentage of use that is effluent, and the use of effluent will be counted at a rate reduced from the Second Management Plan rate when determining compliance. This means that a facility can use more effluent than it could before and still remain in compliance with its conservation requirement if other sources of water are also used. Any facility that uses 100 percent effluent is not subject to the conservation requirements, just as in the Second Management Plan.

TABLE 8-1
ANNUAL SEWAGE INFLUENT AT THE NIWWTP: 1990-1998
IN ACRE-FEET
SANTA CRUZ ACTIVE MANAGEMENT AREA

Source of Effluent	1990	1991	1992	1993	1994	1995	1996	1997	1998
United States	4,448	5,355	5,194	5,442	5,170	5,514	4,494	4,677	5,617
Mexico	6,089	8,092	9,545	10,023	9,890	11,208	9,806	9,529	10,648
Total	10,537	13,447	14,740	15,465	15,060	16,721	14,301	14,206	16,265

* Derived from annual wastewater flow records compiled by the IBWC

Although the Department encourages the direct use of effluent, there are some obstacles to using effluent directly in the Santa Cruz AMA. First, effluent discharged from the NIWWTP that is abandoned into the Santa Cruz River becomes appropriable as surface water for downstream water users. It is unclear what impacts there would be on downstream users who have already appropriated the effluent if one of the three entities entitled to it reclaims the effluent before it leaves the plant. Second, there is significant cost associated with the construction of distribution lines dedicated to the transportation of effluent. According

to Arizona Department of Environmental Quality (ADEQ) rules, effluent cannot be distributed using a potable system. A substantial demand for the effluent would be necessary before an entity would construct a distribution system dedicated to the transportation of effluent. Third, there are not a large number of demands in the Santa Cruz AMA which are eligible under ADEQ rules to receive and use effluent. Effluent may be used to water turf and irrigate crops, under certain circumstances.

8.2.5.1.4 Recharge and Recovery

Recharge allows effluent to be stored during low demand periods and later recovered during high demand periods. Recharge also allows the possibility of indirect potable use of effluent. The City of Nogales has explored the possibility of obtaining an Underground Storage Facility Permit for either a constructed or managed effluent recharge facility in the vicinity of the NIWWTP and Guevavi Ranch. However, any recharge activities in the Santa Cruz AMA must take into account the unique hydrologic conditions and the statutory and binational considerations previously described in this chapter.

8.2.5.2 Central Arizona Project Water

Since the Second Management Plan was promulgated, it has become clear that the utilization of CAP water is not currently economically feasible in the Santa Cruz AMA. The distance from the aqueduct and increase in elevation from the CAP terminus near Green Valley to water users in the Santa Cruz AMA make the costs in bringing in this supply prohibitive. Recognizing this, the City of Nogales and Rio Rico Utilities recently transferred their CAP allocations and have committed the proceeds to developing other water supplies.

8.2.5.3 Other Surface Water Sources

8.2.5.3.1 Patagonia Lake

Patagonia Lake is located northeast of Nogales and is supplied by the perennial flow from Sonoita Creek. The lake is part of Patagonia State Park and Arizona State Parks holds the storage right and water right for 11,420 acre-feet for recreation and wildlife uses. The City of Nogales has a permit to appropriate 4,200 acre-feet of water from Patagonia Lake for municipal purposes. The permit was issued in 1975 but has never been perfected. In the case of an emergency, A.R.S. § 41-511.20 provides that if the mayor of Nogales and the director determine that there is not sufficient water for use by the city and there is no other water available from any other practical source, the Arizona State Parks Board must authorize the city to remove from the lake the amount of water as needed to supply the city with sufficient water. However, to obtain the water, the City of Nogales must provide the means for transferring the water. The City of Nogales has never constructed the works necessary to transport and deliver water from the lake to the city. Nevertheless, Patagonia Lake is a perennial source of supply and could meet at least the current water demands for the City of Nogales if the city were able to construct the works necessary to deliver the water and obtain a water right to use water from the lake, subject to the rights of senior appropriators.

8.2.5.3.2 Peña Blanca Lake

Peña Blanca Lake is owned by the United States Forest Service (USFS) and the Arizona Game and Fish Department. The lake is located northwest of the City of Nogales and is southwest of Rio Rico. The lake supplies the needs of the USFS and serves as a preserve for wildlife in the Coronado National Forest. The lake is also a popular local recreation destination. Using Peña Blanca Lake as a source of supply could prove to be difficult. There are several limiting physical and legal barriers to overcome in order to utilize this renewable resource.

First, there is the legal barrier of obtaining an allocation from the USFS and Arizona Game and Fish since the lake is a supply source for the wildlife of the Coronado National Forest. Negotiations with both parties would be needed in order to obtain an allotment. The allotment could be limited depending upon commitments for wildlife and recreational uses.

The second barrier is related to topography. A pipeline would have to be constructed to bring water through the mountains to water users on the other side. The construction costs of booster stations and pipeline, as well as the operation and maintenance costs, could make this project prohibitive for the City of Nogales. However, the natural channel through Agua Fria Canyon could be used as the conduit to supply Rio Rico, which is down gradient from the lake.

Finally, there may be a water quality concern associated with the use of this source of supply. Mercury has been detected in the flesh of some of the fish in the lake. Because this metal has not been detected to date in the water of the lake, it may be located in the lake sediments.

8.2.5.3.3 Runoff Retention

Another potential source of supply that requires further study is the potential to slow storm water runoff and retain seasonal flow in the Santa Cruz River and its tributaries so that the maximum potential recharge can occur.

8.2.5.4 New Groundwater Sources

There has been very little information collected to date on the Older Alluvium of the Santa Cruz AMA because there has been little demand in this area so far. Gathering additional information on the Older Alluvium may reveal new locations where water is stored and areas where recharge could effectively occur, even though it is generally thought that the Older Alluvium is a low-yielding aquifer.

The Nogales Wash aquifer, which overlays the Nogales Formation and older alluvium, is virtually an untapped source of supply. Although water withdrawn from existing well depths meets potable water quality standards, there have been several instances where volatile organic compounds (VOCs) have been detected in excess of federally established maximum contaminant levels (MCLs). The wells where VOC samples exceeded the MCLs are still permitted to be operated, however, since these detections have occurred in isolated instances and have not been detected consistently. It is unknown whether persistent occurrence of VOCs in samples above the MCLs will occur in the future.

8.3 SECOND MANAGEMENT PLAN AUGMENTATION PROGRAM

This section summarizes the Second Management Plan augmentation program for the Tucson AMA and evaluates its applicability to Santa Cruz AMA water supply issues. The Santa Cruz AMA was part of the Tucson AMA at the time the Second Management Plan was adopted. Augmentation efforts in the Santa Cruz AMA have been late to develop and limited in scope since the AMA was created in 1994.

8.3.1 Program Overview

The Code required the Department to include a water supply augmentation program in the Tucson AMA's First Management Plan, although augmentation activities during this period were not conducted in the area that would become the Santa Cruz AMA. For the Second Management Plan, the Code required the inclusion of incentives for artificial groundwater recharge for each AMA. (A.R.S. § 45-565(A)(6)) The Code defines augmentation as supplementing the water supply of an AMA, including the importation of water into the AMA, water storage, and artificial groundwater recharge. (A.R.S. § 45-561.2)

The augmentation program in the Tucson AMA during the second management period (1990-2000) was designed to increase the use of renewable water supplies in order to reduce the overall dependence on groundwater withdrawals to meet water demands. The program encouraged the use of CAP water and effluent in order to preserve groundwater for future uses in the AMA. To maximize use of these water supplies, the program included provisions to incorporate groundwater recharge into plans for water supply development.

The Second Management Plan stated that during the second management period, the Department would take a lead role in identifying, facilitating, and coordinating augmentation activities. The Department would also provide planning support, technical support, and financial assistance to entities wishing to implement augmentation projects in the Tucson AMA during the second management period.

The Second Management Plan augmentation program included five main elements designed to assist water users in developing new water supplies: (1) regulatory incentives, (2) technical assistance, (3) coordination and facilitation of efforts, (4) resolving legal and institutional barriers, and (5) the augmentation and conservation assistance fund. The Second Management Plan provided incentives for water users to implement augmentation measures, especially for the use of effluent. Methods to increase the water supply available by increasing the use of poor quality water were also included in the Second Management Plan.

During the second management period, the Department facilitated technical efforts between the United States Department of the Interior, the City of Nogales, and Rio Rico Properties to coordinate the CAP importation study. Because the study found that bringing CAP water to the Santa Cruz AMA was not economically feasible, the City of Nogales and Rio Rico Properties transferred their CAP allocations in 1992 to the City of Scottsdale. The Department also initiated discussions in conjunction with federal, state, and Mexican organizations to coordinate and facilitate augmentation activities in the Santa Cruz AMA.

8.3.2 Assured and Adequate Water Supply Rules

In February 1995, the Department adopted new rules for its Assured and Adequate Water Supply Program. The Assured Water Supply Program (AWS Program) applies to new subdivisions within AMAs, and the adequate water supply program applies to new subdivisions outside of AMAs. The Assured Water Supply Rules (AWS Rules) are intended to aid in achieving AMA water management goals and to ensure sufficient water supplies for new development.

To encourage earlier use of CAP water, legislation in 1994 changed the statutory expiration date from December 31, 2001 to December 31, 1997 for those cities and towns deemed to have an assured water supply simply because they hold CAP subcontracts.

8.3.3 Groundwater Transportation Act

Passage of the 1991 Groundwater Transportation Act severely restricted the ability of municipal water providers to transfer groundwater out of rural basins into AMAs. The act nonetheless provided a legal framework for interbasin transfers of groundwater supplies to assist in demonstrating an assured water supply. The act was amended in 1995 to prohibit groundwater transfers between rural basins.

8.3.4 Water Exchange Act

Passage of the 1992 Water Exchange Act allowed for the trade between water users of any water supplies for any other water supplies as long as each water user has the legal right to use the water it gives in trade.

8.3.5 Central Arizona Groundwater Replenishment District and Santa Cruz Valley Water District

In 1993, legislation was passed that created the Central Arizona Groundwater Replenishment District (CAGRD) in the Phoenix, Pinal, and Tucson AMAs. Administered by Central Arizona Water Conservation District (CAWCD), the purpose of the district is to utilize excess CAP water and other renewable water supplies to replenish aquifers when groundwater is withdrawn by CAGRD members in excess of their groundwater allocations under the AWS Rules. Membership in the CAGRD was made voluntary.

There is no replenishment district in the Santa Cruz AMA; however, a water district or other entity that may be formed in the AMA could be given the authority to replenish water on behalf of the AMA water users. Statutory language which created the Santa Cruz Valley Water District still exists, although the district is not functional. This language, found in A.R.S. §§ 48-4801 through 48-4984, could be reexamined to determine if a portion of it could be used to develop a water district in the Santa Cruz AMA.

The creation of a water district or other entity in the Santa Cruz AMA could assist the Department in its augmentation efforts by seeking to efficiently distribute current supplies, obtain additional water supplies, perform studies to identify potential recharge sites, and potentially to assist in water rights marketing negotiations. If a water district is created, there would be an opportunity in the future for Mexico to participate in the district and perhaps take part in some type of water exchange involving effluent recharged upstream from the Nogales, Sonora Santa Cruz River wellfield.

8.3.6 Underground Water Storage, Savings, and Replenishment Program

Passage in 1994 of the Underground Water Storage, Savings, and Replenishment Program included all of the various recharge programs authorized since passage of the 1986 Underground Storage and Recovery Act and consolidated them into a single, unified program. The new program made the regulatory provisions easier to administer, established a unified accounting system for all water that is stored and recovered, and attempted to simplify the recharge program for potential applicants.

One of the major goals of the recharge program is to encourage the use of renewable water supplies by limiting the storage credits that can be accumulated over the long-term to water that cannot reasonably be used directly. A second goal of the program is to eliminate the need for the construction of costly distribution systems by allowing water that is stored in one location to be recovered in another location.

The recharge program provides for three basic types of permits that are needed to operate a facility: (1) a permit for the storage facility itself (storage facility permit), (2) a permit for storing the water at a given facility (water storage permit), and (3) a permit for recovering the water that is stored (recovery well permit). Water can be stored several different ways under the program. Constructed facilities allow for the storage of water through the use of injection wells or percolation basins; managed facilities, through the use of natural stream channels ("passive" recharge); and groundwater savings facilities, through use of renewable supplies in lieu of pumping groundwater.

In addition, the recharge program increases the marketability of long-term storage credits by allowing all credits to be bought and sold, whereas previously only those credits accrued through in-lieu recharge were allowed to be sold or transferred to another water user. The program also allows credits to be extinguished by municipal providers to achieve compliance with their Second Management Plan per capita conservation requirements.

Pursuant to A.R.S. § 45-852.01, effluent recharged at a managed underground storage facility may only receive credits for 50 percent of the recoverable volume if the recharged water does not benefit a national

park, national monument, or state park. If effluent recharged at a managed underground storage facility benefits a national park, national monument, or state park, then 100 percent of the recoverable volume may be credited to the storer.

8.3.7 Arizona Water Protection Fund

Legislation was passed in 1994 to address several recommendations by the Governor's CAP Advisory Committee for increasing the state's use of CAP water. The legislation created the Arizona Water Protection Fund, administered by a commission, to issue grants to water users for implementing projects to protect the state's rivers and streams, including the use of excess CAP water for riparian enhancement.

In the Santa Cruz AMA funded projects include a hydrologic investigation of groundwater movement and baseflow sources along Sonoita Creek, the development of a wetland characterization and management plan for Potrero Creek, and efforts to restore riparian grasslands in southern Arizona.

8.3.8 The Augmentation and Conservation Assistance Fund

Through 1996, the Code allowed for an augmentation and conservation assistance fee of up to $2.00 per acre-foot per year to be levied on groundwater withdrawals. The Santa Cruz AMA's augmentation and conservation assistance fee began at $.50 per acre-foot in 1994 where it has remained. Monies collected from the fee have averaged about $42,000 per year since 1994, due to fairly consistent annual AMA water withdrawals.

These monies provide the basis for the augmentation and conservation assistance fund. The Second Management Plan stated that monies in the fund designated for augmentation would be used to provide: (1) cost-sharing grants for augmentation projects and studies initiated or conducted by private or public entities and (2) funds for augmentation projects and studies initiated or conducted by the Department.

Since the creation of the Santa Cruz AMA in 1994 up to 1997, seven grants have been awarded, five of which were conservation related. These grants have ranged from promoting conservation education through programs such as the Water Maze and Bear Essential News to augmentation projects such as the Tubac Ranch Properties grey-water wetlands. The United States Geological Survey gage station in Tubac is another grant awarded by the Santa Cruz AMA to monitor the flow of the Santa Cruz River and the various hydrologic influences on the river. In 1997, the City of Nogales was awarded a grant to promote conservation through a toilet rebate and plumbing retrofit program. This is the first grant awarded to a municipal provider in the Santa Cruz AMA to promote water conservation.

More detailed information on the seven grants as well as the augmentation and conservation assistance fund can be found in Chapter 9.

8.3.9 Applicability of Second Management Plan Augmentation Program to the Santa Cruz Active Management Area

Because multiple sources of water combine in the Younger Alluvial aquifer and CAP water and expansive surface water reservoirs are not available, there is limited usefulness in an augmentation program that directs itself to increase the use of renewable supplies. But the five elements of the Second Management Plan Augmentation Program are helpful. Because most of the effluent generated in the AMA is discharged into the Santa Cruz River and infiltrates and commingles with other sources of water in the aquifer, incentives to increase the direct use of effluent in the Santa Cruz AMA must carefully consider the potential impacts on local water table levels. The Department provided technical assistance during the second management period to determine the costs of extending the CAP canal, and has coordinated binational water management efforts with Mexico since the AMA was created. It is appropriate for the

Department to provide technical and coordination assistance and to continue to work to resolve legal and institutional barriers to water augmentation. Although the Second Management Plan augmentation program did not specifically address the augmentation issues of the Santa Cruz AMA, local conservation education efforts have been very successful in developing a sense of understanding of water management issues within the AMA community and the importance of water resource management. In addition, the Department has improved its understanding of the hydrology of the AMA through expanded monitoring efforts and the development of the Santa Cruz AMA hydrologic model.

8.4 PROGRAM DEVELOPMENT ISSUES

Augmentation in the Santa Cruz AMA will depend on the successful resolution of associated legal, political, physical, and economic constraints that impact water management in this area. The regulations of other agencies, the application of surface water and groundwater law in a combined aquifer system, and the difficulty in finding appropriate sites for recharge are all issues that must be addressed to fully develop and implement an augmentation program in the Santa Cruz AMA.

Augmentation activities in the Santa Cruz AMA could be affected to various degrees by the regulations and policies of ADEQ and/or the federal government (see Appendix 8). Some of these legal and institutional factors may be barriers to augmenting water supplies that will need to be resolved, while others may help the AMA achieve its management goals.

The severance and transfer of a surface water right which is converted from agricultural use to municipal or industrial use is permanent. The agricultural use will not be allowed to continue through the use of a groundwater right which was issued based on the same water use as the surface water right. To do otherwise would allow a substantial increase in overall AMA water demand and jeopardize the management goals of maintaining safe-yield conditions and preventing long-term declines in local water tables.

Locating potential areas where recharge can occur hydrologically, as well as legally, will be a challenge in the Santa Cruz AMA. Ensuring that stored water remains available for recovery by the water storer within the AMA, and preventing the storing and recovery of water from impacting other water users, and local water table levels, given the seasonal and annual fluctuations in water availability in the Younger Alluvium of the river, are issues that need resolution. The Department's hydrologic model may provide some answers or guidance in developing the Santa Cruz AMA augmentation program further. A management plan modification incorporating new knowledge of the AMA's hydrology is likely.

8.5 PROGRAM GOALS AND OBJECTIVES

In conjunction with the Santa Cruz AMA Groundwater Users Advisory Council (GUAC), the Department solicited the local community's perspective on the intent of the water management goal established by the Legislature. Frequently mentioned objectives included: (1) maintaining what currently appears to be a delicate balance between water use and water replenishment in the AMA; (2) recognizing that continued water resource development in Sonora will impact the AMA, the cooperative water management efforts between the U.S. and Mexico must continue to ensure adequate water supplies and improved distribution systems on both sides of the border while at the same time mitigating or minimizing any negative impacts on the AMA; (3) ensuring that those persons currently exercising their rights and those with senior surface water rights continue to have supplies physically available; (4) protecting significant portions of the rich riparian habitat that exists along the Santa Cruz River; and (5) ensuring that water is physically available to meet future demands. The Department accepts that all five of these objectives, to some extent, underlie the management goal specified by the legislature.

The principle water supply source presently utilized in the AMA is the Younger Alluvium of the Santa Cruz River. Because the most critical water management issues in the AMA center on the Younger Alluvium, the Department has focused its water management efforts there and on those tributaries and formations, including certain older alluvial formations, that contribute to recharge of the Younger Alluvium. Emphasis is placed on those alluvial areas which are: (1) subject to competing multiple use objectives, (2) most sensitive to changes in water levels, and (3) relied on for most of the region's water supply.

The goal of the Third Management Plan augmentation and recharge program for the Santa Cruz AMA is to promote water supply and distribution efforts which (1) maintain existing water resources to sustain current demands; (2) secure renewable water supplies for the purpose of maintaining safe-yield conditions, meeting committed demands, and supplying future needs; and (3) prevent long-term declines and stabilize local water tables in areas of concern.

During the third management period, several augmentation measures will be explored including: (1) possible water exchanges through state mechanisms such as the Arizona Water Bank; (2) the possibility of securing future effluent flow from Mexico, possibly with the assistance of a locally created water district; (3) the possible use of existing renewable supplies within the AMA such as water from Patagonia and Peña Blanca Lakes; (4) encouraging the exploration and investigation of potential sites for water storage, especially in areas outside the Younger Alluvium, due to the physical and legal issues associated with storing water within the Younger Alluvium; and (5) examining the potential to import water from outside of the Santa Cruz River basin. Proposed augmentation measures should be evaluated based on their cost and physical practicality in implementation. Completion of the Department's hydrologic model should assist in these efforts.

Ultimately, it is the Santa Cruz AMA community water users and water providers, however, who will determine what augmentation investments are made to assure adequate water supplies in the future. The Department's obligation is to assist in the development of augmentation measures in Santa Cruz AMA. The Department's role in the AMA includes developing, adopting and implementing regulatory programs to ensure efficient use of supplies, issuing recharge permits to monitor and assign credits to water storers, and ensuring that sufficient supplies exist to meet current and committed demand, and any potential future demand. By developing avenues from which local water interests can work together to promote improved water resource management and secure the long-term availability of water supplies to support existing and new development, the Department can help the Santa Cruz AMA to successfully maintain the conditions set forth in its management goal.

8.6 THE AUGMENTATION AND RECHARGE PROGRAM

The Department will be an active participant in water supply augmentation during the third management period. The principal responsibility for developing water supplies, however, will remain with the region's water providers. The creation of a local water district could assist in the resolution of economic, legal, physical, and institutional barriers encountered in attempting to augment water supplies in the Santa Cruz AMA. The Third Management Plan augmentation and recharge program includes eight main elements designed to assist water users in developing new water supplies:

- Regulatory Incentives
- Technical and Planning Assistance
- Coordination and Facilitation of Cooperative Efforts
- Resolution of Legal and Institutional Barriers
- Financial Assistance
- Siting Criteria for Underground Storage and Recovery Projects
- Purchase and Retirement of Grandfathered Rights

8.6.1 Statutory Provisions

For the Santa Cruz AMA, the augmentation program for the Third Management Plan has been developed under the following general statutory authorities of A.R.S. § 45-566:

A. For the third management period, 2000-2010, the director shall promulgate a management plan for each initial active management area . . . The director:

6. Shall include in each plan a program for additional augmentation of the water supply of the active management area, if feasible, including incentives for artificial groundwater recharge.

9. May include in each plan a program for the purchase and retirement of grandfathered rights by the department to begin no earlier than January 1, 2006.

The recharge program for the Third Management Plan is derived from A.R.S. § 45-801.01, *et seq.*, the authority for the Underground Water Storage, Savings, and Replenishment Program. The provisions that affect recovery are found under A.R.S. § 45-834.01, with a special requirement under A.R.S. § 45-834.01(A)(2)(b) for consistency with the management plan in the case of recovery outside the area of impact of the stored water.

Funds for augmentation, conservation assistance, and water monitoring activities and for purchasing and retiring grandfathered rights are provided to the Department through the groundwater withdrawal fee, which is levied within the active management areas pursuant to A.R.S. § 45-611(C). Additional funds may be received for augmentation and conservation assistance and purchase and retirement of grandfathered rights through fees assessed for the temporary use of groundwater in artificial lakes as described under A.R.S. § 45-133(E).

In addition to these specific statutory authorities, the Department will continue to integrate augmentation objectives into the regulatory components of the management plan, the development and implementation of the assured water supply and other rules, and multiple non-regulatory activities that facilitate use of renewable water supplies.

8.6.2 Regulatory Incentives

Provisions established in the agricultural, municipal, and industrial conservation programs (chapters 4, 5, and 6, respectively) provide incentives to encourage water users in the AMA to use renewable water supplies, particularly effluent. The groundwater quality management program, in chapter 7, identifies methods to increase the water supply available in the AMA by increasing the use of poor quality water.

8.6.3 Technical and Planning Assistance

The Department will continue to support augmentation project construction, planning, and research activities during the third management period. Technical assistance will be provided to entities in assessing the need for augmentation projects, determining project feasibility, and reviewing project impacts. Department staff will participate on oversight committees, provide data, and review planning and feasibility study reports. To facilitate research projects, the Department will assist entities by initiating research activities, assisting in study design, providing data, reviewing results, and disseminating information. The Department hopes to be able to continue to expand the hydrologic model being developed for the Santa Cruz AMA to include adjacent portions of Sonora which are located within the Santa Cruz River watershed. These efforts are part of binational coordination to improve the hydrologic understanding of the Upper Santa Cruz basin and will help the Department to develop various water

supply scenarios to guide water management decisions. Additionally, the Department will encourage the development of recharge sites in the older alluvium to augment mountain front recharge.

8.6.4 Coordination and Facilitation of Cooperative Efforts

The Santa Cruz AMA will emphasize studies focusing on recharge in areas determined to be most beneficial to meeting the goals of the AMA. Cooperative efforts among the participants will allow the development of more effective projects and studies. The Department will work with organizations to coordinate and facilitate augmentation activities. As part of this process, facilitation and coordination of recharge projects through a water district will be further explored and encouraged.

8.6.5 Resolution of Legal and Institutional Barriers

The Department will continue to work with interested parties in the AMAs and around the state to draft rules and propose legislation that will resolve legal and institutional barriers to augmentation activities. There are some water management needs that the Department can address with its existing statutory authorities, such as revising the well spacing and impact rules. The Department can also indirectly influence progress in some areas through support of legislation. For some issues, new statutory authorities for the Department may be necessary.

8.6.6 Financial Assistance

The augmentation and conservation assistance fund, as well as specifically budgeted appropriations, will provide financial assistance to entities for implementing augmentation projects or conducting studies that contribute to achieving the AMA's water management goal or resolving regional water management problems. This fund will also be available to fund projects for monitoring or assessing water availability within the AMA. More detailed information on the augmentation and conservation assistance fund, including how it will be administered during the third management period, can be found in Chapter 9.

8.6.7 Storage and Recovery Siting Criteria

The benefits to water management through the recharge program depend upon the location where water is stored and where it is recovered. Non-recoverable water storage is discussed in section 8.6.8.

For storage and recovery, A.R.S. § 45-834.01(A) provides that unless stored water is recovered by the storer within the area of impact of water storage, the recovery is only allowed "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." Although the statute ties recovery to the consistency requirements of the plan, the locations of storage and recovery of water are inherently linked and must *both* be considered when determining whether the future recovery meets the consistency requirements and management goals of the AMA. It cannot be determined whether recovery is consistent with water management objectives of the AMA unless the storage location is also considered. Water management benefits to the AMA depend greatly on whether credits recovered from a well were accrued through storage in a remote area of the AMA or in a large pumping center of the AMA. Therefore, the criteria to determine whether a recovery location is consistent with the management plan and goal for the AMA must also consider where water was stored.

The locations of storage and recovery are important factors in addressing local supply problems, particularly in critical areas, and attempting to balance the distribution of water supplies in the AMA during the third management period. For example, the useful water supplies of the AMA may be diminished if water storage occurs in a location where there is no future demand for the stored water and recovery occurs outside the area of impact of storage. In addition, recovery away from the area of impact

of water storage could aggravate problems if the area of recovery was experiencing rapidly dropping water levels or if the water supplies were already fully committed under the AWS Program.

Thus, while the Second Management Plan siting criteria provided no protection of water supplies already committed under the AWS Program, the new Third Management Plan criteria protect water supplies that are already committed for an assured water supply from an entity who wishes to recover water *outside* of the area of impact.

The Third Management Plan criteria also link future use benefits to determinations under the AWS Program. If storage occurs in a remote area, but one that has a committed and projected demand through a Designation or Certificate of Assured Water Supply, then it is deemed to contribute to water supplies that will be used in the future. If the storage does not meet this criterion, such as if the storage occurs in a remote area with no committed or projected demands under the Assured Water Supply Program, the storage must otherwise be beneficial to the AMA if recovery is to occur outside the area of impact of storage. If a storage facility does not meet the criteria, this concern would be incorporated in the storage facility permit as a notice to potential water storers that future recovery may only be allowed inside the area of impact.

A.R.S. § 45-834.01(A) provides that recovery may occur within the area of impact of the storage by a person other than the storer of the water or *outside* the area of impact of the storage by any person only if the director determines that recovery at the location is consistent with the management plan and achievement of the management goal for the AMA. Recovery must continue to be consistent with management plan criteria, even after the recovery well permit has been issued. Thus existing, previously permitted recovery wells are subject to the criteria of the Third Management Plan and future management plans.

8-101. Storage and Recovery Siting Criteria

During the third management period, for purposes of A.R.S. § 45-834.01(A)(2)(b), recovery of stored water at a location within the area of impact of the stored water by a person other than the storer and recovery of stored water at a location outside the area of impact of the stored water by any person is consistent with the management plan and achievement of the management goal for the AMA only if all three of the following three criteria are met:

1. *The water storage that resulted in the right to recover water meets one of the following criteria:*

    a. *The water storage is contributing to water supplies that are accessible to current water users or that have been committed to establish a Designation, Certificate, or Analysis of Assured Water Supply pursuant to A.R.S. § 45-576 or rules adopted thereunder.*

    b. *The water storage is a component of a remedial action project under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) or Title 49, Arizona Revised Statutes, and the director has determined that the remedial action will contribute to the objectives of this chapter or the achievement of the management goal for the AMA.*

    c. *The water storage is otherwise determined by the director to have contributed to the objectives of this chapter or the achievement of the management goal for the AMA.*

2. *One of the following applies at the time the application for the recovery well permit is filed:*

   a. *At the time of the application, the Department's Assured Water Supply rules do not specify the maximum depth below land surface from which water may be withdrawn from a well in the Santa Cruz AMA for purposes of demonstrating physical availability of water withdrawn from a well.*

   b. *At the time of the application, the Department's Assured Water Supply rules specify the maximum depth below land surface from which water may be withdrawn from a well in the Santa Cruz AMA for purposes of demonstrating physical availability of water withdrawn from a well, and the projected depth to water at the location of the recovery well after 100 years does not exceed that maximum depth after considering: (1) the maximum proposed withdrawals from the recovery well; (2) withdrawals for current, committed, and projected demands associated with determinations made under A.R.S. § 45-576 that are reliant on the water which the recovery well will withdraw; and (3) withdrawals for other current or projected demands that are reliant on the water which the recovery well will withdraw.*

   c. *The recovery will be undertaken within the applicant's service area and the applicant is a municipal provider designated as having an assured water supply.*

3. *Recovery of the water meets one of the following criteria:*

   a. *The recovery will not cause the local water table to experience a long-term decline.*

   b. *The recovery is a component of a remedial action project under CERCLA or Title 49, Arizona Revised Statutes, and the director has determined that the remedial action will contribute to the objectives of this chapter or the achievement of the management goal for the AMA.*

   c. *The recovery is likely to contribute to the water management objectives of the geographic area in which the well is located, as determined by the director.*

8.6.8 Criteria for Storage of Non-Recoverable Water

A.R.S. § 45-833.01(A) provides that "the director may designate a water storage permit as storing non-recoverable water. If the water storage occurs within an active management area, the water storage permit may be designated in this manner only if the storage is consistent with the active management area's augmentation program." Subsection B provides that water stored under such a permit "may not be recovered on an annual basis, may not be credited to a long-term storage account and may not be used for replenishment purposes." The same considerations discussed in the preceding section that shaped the criteria for recovery well location have shaped the criteria for non-recoverable storage.

8-201. Criteria for Storage of Non-Recoverable Water

During the third management period, water storage that is designated as non-recoverable is consistent with the AMA's augmentation program if one of the following criteria is met:

1. *The water storage is contributing to groundwater supplies that are accessible to current water users or that have been committed to establish a Designation, Certificate or Analysis of Assured Water Supply pursuant to A.R.S. § 45-576 or rules adopted*

thereunder so long as the areas in which water is stored are not experiencing problems associated with shallow depth to water.

2. *The water storage is a component of a remedial action project under CERCLA or Title 49, Arizona Revised Statutes, and the director has determined that the remedial action will contribute to the objectives of this chapter or achievement of the management goal for the active management area.*

3. *The water storage is otherwise determined by the director to contribute to the objectives of this chapter or the achievement of the management goal for the active management area.*

8.6.9 Recharge Activities

As noted in the AMA assessment portion of this chapter, there are several issues which could limit the ability to recharge water in the Santa Cruz AMA. This is not meant to suggest that recharge cannot occur under any circumstances. Instead, these issues need to be integrated and further addressed to explore future courses of action.

8.6.9.1 Alternative Approaches

This section is intended to illustrate some of the implications associated with different scenarios for a hypothetical recharge project associated with the NIWWTP, which is currently one of the most important sources of renewable water supply (effluent) in the AMA. It should be noted that these alternatives do not take into account the availability of effluent from Mexico or other variables outside of the Department's control. These are not meant to represent the only recharge options for the AMA, as these are discussed in section 8.6.8.2 as potential recharge sites, but merely the benefits and negative consequences of such actions based on the statutory direction given the Department and the existing regulatory framework.

8.6.9.1.1 Alternative 1

The first approach is to continue discharging effluent into the Santa Cruz River at the NIWWTP and establish the downstream portion within the AMA as a managed underground storage facility.

One benefit of this approach is that it would serve as a firm, continuously available supply for new development downstream of the NIWWTP if new developments were to obtain these credits in adequate amounts. Depending on locations for recovery, it could also support the maintenance of downstream water tables and riparian habitat. However, many legal, technical and hydrologic issues would need to be resolved before a project is approved under this alternative.

8.6.9.1.2 Alternative 2

This approach would pipe effluent to a constructed underground storage facility upstream of the NIWWTP to either Guevavi Ranch or Kino Springs.

Adopting this approach would provide a more stable, physically available supply for the City of Nogales. However, it would suffer from the limited storage capacity in the Younger Alluvium microbasins. Water levels downstream from the NIWWTP could also be impacted by the direct diversion to upstream locations. In addition, it is difficult to conceive of a method by which long-term credits could be accrued due to the rapid movement of the recharged water out of the area when the microbasins area full. Careful management of recharge in this area would need to occur to ensure that recharged water remained in the

location of storage. This alternative will also include costs associated with construction of transmission lines.

8.6.9.1.3 Alternative 3

Another option would be to pipe the effluent from NIWWTP to an underground facility at the City of Nogales Potrero Creek wellfield.

This would provide a more stable, physically available supply for the City of Nogales and might assist in maintaining the wetland in the area. Water levels downstream from the NIWWTP, however, could also be impacted by the direct diversion away from the river. Recharge in this area could impact the migration of the contaminant plume from the United Musical Instruments Resource Conservation and Recovery Act (RCRA) site, which could negatively impact water quality. As with Alternative 2, transmission line costs would be associated with this alternative.

8.6.9.2 Considerations in the Location of Potential Recharge Sites

As part of third management period activities, the Department will work with the local community to identify and prioritize potential recharge sites. The best location for artificial recharge may be outside of the Younger Alluvium. The ideal location would be one that:

- provided hydrologic conditions conducive to long-term water storage
- allowed water to be economically transported to the storage site
- allowed reasonable recovery of the stored water
- is in reasonable proximity to the end use of recovered water
- will assist in maintaining safe-yield conditions and preventing long-term declines in local water table levels

Once sites have been evaluated, mechanisms for facilitating construction of these projects must be developed. Successful artificial recharge may include recharging water in the Older Alluvium and recovering water in the Younger Alluvium. Augmentation efforts may be most effective if recharge is focused on mountain front and tributary areas in the Older Alluvium and if recovery occurs in such a way that it does not significantly reduce water flow in the Younger Alluvium.

Artificial recharge may be used to help maintain local water table levels and provide a more continuous supply near centers of demand. Demand centers in the Santa Cruz AMA are located in Potrero Creek, along Highway 82 in the microbasins, and at Rio Rico, Tubac, and Amado. There are challenges associated with attempting to recharge water at each of these locations.

Siting a recharge project at Potrero Creek is complicated by the suspected dual aquifer system, and possible water quality concerns. Recharge in the microbasins would be of limited volume due to the limited storage capacity in this area. Because of the high transmissivity of the microbasins, water quality may be a concern if the recharge water is not of extremely high quality. Because of the high water table in the Santa Cruz River near Rio Rico, recharge in the Younger Alluvium of the river in this area is limited in capacity. However there may be possibilities for recharge in the tributary canyons in this area. Additional research and analysis of these canyons is needed to determine their suitability for recharge. A similar situation is present in the Tubac area, where recharge in tributary canyons may be the most suitable location but additional information to reveal the best locations is needed. Even less information is

available for the Amado area. Since growth in this area is not as rapid as in the Nogales, Rio Rico, or Tubac areas, the need for recharge is not currently as great in this location, but will be needed in the future.

The Department does not currently have sufficient information to make recommendations on the most suitable locations for artificial recharge in the Santa Cruz AMA. There is a need for additional research and analysis to be performed in this regard, not only by the Department but by individual interested parties as well. Seeking suitable locations for artificial recharge is a task that could be performed by a water district. Limited funding may also be made available from the Santa Cruz AMA Water Management Assistance Program (see Chapter 9).

8.6.9.3 Other Possibilities for Augmentation and Recharge

In addition to constructing artificial storage and recovery projects at various locations throughout the AMA, the Augmentation and Recharge Program for the Santa Cruz AMA Third Management Plan must explore the possibility of expanding the capacity of existing reservoirs and creating additional capacity for surface water and effluent to be stored. This needs to be explored not only in the Younger Alluvium, but in the Older Alluvium.

8.6.10 Purchase and Retirement of Grandfathered Rights

The possibility of the Department purchasing grandfathered rights and then retiring them is a program the Department considered for inclusion in the Third Management Plan beginning in 2006 pursuant to A.R.S. § 45-566(A)(9). However, after analyzing the few rights that would be likely to be offered for sale through such a program, the cost of maintaining the retired land, and the projected water savings versus the cost to purchase and retire the rights, a purchase and retirement program is not feasible under current conditions for the Santa Cruz AMA. Another more promising approach, given the surface water nature of the Santa Cruz AMA, is the potential development of programs to reimburse farmers for fallowing their fields during drought periods to make limited water supplies available for municipal uses. Given the highly seasonal and annual fluctuations in water availability in the Santa Cruz AMA, a program that is responsive to these fluctuations is more appropriate than a purchase and retirement program. A water district in the Santa Cruz AMA could also implement such a program.

8.7 FUTURE DIRECTIONS

Water augmentation activities that assist in maintaining the Santa Cruz AMA goals would be greatly assisted by adjusting current programs and developing new programs. The development of consistency with AMA goal criteria in the AWS Rules, general well spacing criteria, additional well spacing criteria consistent with the Santa Cruz AMA goals, and data collection and research projects developed through the Third Management Plan Water Management Assistance Program for the Santa Cruz AMA will all contribute to answering the challenges associated with augmentation and recharge projects in the Santa Cruz AMA.

The Department's role in water management activities has been and will continue to be to provide regional water management coordination; sponsor and coordinate technical committees that address regional water policy development, planning, and water management; implement and enforce water conservation programs; provide technical assistance; perform studies; issue and convey water rights; distribute water management assistance funding, and develop and issue policies under the purview of the Code and surface water law, among others.

However, additional statutory authorities may be needed to ensure achievement of the Santa Cruz AMA's water management goals and objectives, including local water table level maintenance. The creation of a water district could greatly assist in efficiently managing and distributing current as well as developing

new sources of supply. In order to fully utilize the sources of supply available to the Santa Cruz AMA, more creative thinking is needed. The Department and the AMA community must learn to find other sources outside the Younger Alluvium, which could begin with research to learn more about the Older Alluvium. A key to augmentation in the Santa Cruz AMA is probably to find ways to recharge effluent in high demand locations such as Potrero Canyon and Highway 82, as well as other major pumping zones, in order to effectively utilize current supplies. Another key is effective use of effluent that originates in Mexico and working cooperatively with the Mexican government to secure this supply into the future. These ideas are discussed further in Chapter 12.

The creation of a water district or other entity could provide assistance to water users in proving an assured water supply by firming supplies pledged for designations and certificates and perhaps even distributing water more evenly throughout the AMA as needed. Such an entity could be used as a basis for managing a master water contract with the owners of effluent, including the Mexican government, to allocate this supply for the maintenance of water level conditions and in exploring other augmentation possibilities, including recharge and importing additional supplies. Assured water supplies could then be determined based on the additional water supplies that would be made available and finances could be managed to support the effort.

8.8 CONCLUSIONS

The focus of this chapter has been on defining the Department's role in augmenting the water supplies of the Santa Cruz AMA for the third management period. However, it is not yet clear what the nature of an augmentation program for this AMA should be. The Santa Cruz AMA's augmentation program differs in its make-up from the other AMAs with regard to both its regulatory and physical nature.

The augmentation issues summarized in this chapter show that there is continuing need for active participation by the Department in determining appropriate augmentation activities to facilitate achievement of the AMA's water management goals and objectives. Many of the current augmentation mechanisms developed in the Second Management Plan were designed to introduce a variety of renewable water supplies, in particular CAP water, to water users in central Arizona, a sizeable distance away from the Santa Cruz AMA. Knowledge of the impacts of augmentation activities is not as extensive in the Santa Cruz AMA as it is in other AMAs based on the unique hydrology of the area.

The aquifer systems of the Santa Cruz AMA are generally shallow, with limited storage capacity, and are highly sensitive to prolonged periods of drought. These systems also rebound rapidly when sufficient recharge is introduced. The largest portion of the system is also heavily dependent on the continuation of effluent flow from Mexico to sustain current water levels.

New water demands and the uncertain future availability of Mexican effluent highlight the need for the local community to work together with the Department to secure this and other renewable supplies, where available, to achieve and maintain the management goals of the Santa Cruz AMA. The Department is and will continue lending its technical expertise and full resources to the exploration of solutions to the water resource management concerns of the Santa Cruz AMA community.

APPENDIX 8
OTHER PROGRAMS AND REGULATIONS THAT MAY INFLUENCE AUGMENTATION ACTIVITIES

There are many other programs and regulations that could influence augmentation activities during the third management period. Most of the important factors are discussed in Chapter 8. This appendix summarizes additional regulatory and institutional programs that may influence augmentation activities in the Santa Cruz AMA.

8A.1 Arizona Department of Environmental Quality Regulations

ADEQ regulations that may affect augmentation activities include the rules for aquifer protection permits (APPs) and wastewater reuse permits.

8A.1.1 Aquifer Protection Permits

An APP from ADEQ is needed by a new or an existing facility that disposes of pollutants to the land surface, the underlying soil, or to groundwater in order to prevent the groundwater contamination that would otherwise result, if there is a reasonable probability that the pollutants would reach the aquifer. There are general and individual APPs. The APP rules include special provisions for recharge and require ADEQ to advise the Department of permit applications received for individual APPs for underground storage facilities.

There are numeric water quality standards for certain inorganic and organic chemicals, radio nuclides, and microbiological pollutants that may not be exceeded within an aquifer. In addition, there are narrative standards that state that a discharge shall not: (1) cause a pollutant to be present within an aquifer classified for a drinking water protected use in a concentration that endangers human health, (2) cause or contribute to a violation of a surface water quality standard established for a navigable water of the state, and (3) cause a pollutant to be present within an aquifer that impairs existing or reasonably foreseeable uses of the groundwater.

The impact of the APP rules on future effluent use in the Santa Cruz AMA could be extensive, depending on any changes or additions to the numeric standards list, or the extent to which the narrative standards are interpreted. For example, the recharge of effluent could be constrained if numeric standards for total dissolved standards were to be added to the list. Conversely, it could lead to increased direct use of effluent.

8A.1.2 Wastewater Reuse Permits

Direct use of treated wastewater (effluent and industrial wastewater) may occur only if a wastewater reuse permit is granted by ADEQ. A wastewater reuse permit is intended to ensure that the use of treated wastewater will not adversely affect human health, water supplies, or the environment. For example, a wastewater treatment plant operator or the user of the effluent must apply for a permit from ADEQ before effluent can be released from the treatment plant for reuse. The treatment plant operator or the user of the effluent is responsible for meeting the conditions of the wastewater reuse permit, as set forth in a legally enforceable contract between them.

The reuse rules specifically prohibit the use of treated wastewater for direct human consumption. However, there are reuse standards established for orchards, fiber seed and forage, pastures, livestock watering, processed food, landscaped areas, food consumed raw, incidental human contact and full body contact uses, greywater uses, wetlands, marshes, and industrial reuse. Depending upon the use and disposal of the wastewater, an APP or a National Pollutant Discharge Elimination System (NPDES) permit may also be required.

ADEQ is currently revising the reuse rules. The revised rules may have an impact on augmentation activities in the Santa Cruz AMA by expanding the options for direct use of effluent.

8A.2 Federal Regulations

Federal regulations affecting augmentation activities include compliance with the Endangered Species Act, Safe Drinking Water Act, and the Clean Water Act.

8A.2.1 Endangered Species Act

Endangered and threatened species are protected by the Endangered Species Act (ESA) and will need to be considered prior to development of augmentation projects. Candidate species are those that the United States Fish and Wildlife Service (USFWS) is considering adding to the threatened or endangered species list. Section II.H, "Biological Resources," of the ESA indicates the endangered, threatened, and candidate species that occur in the vicinity of proposed projects. Category 1 candidate species are those for which USFWS has enough information to support a proposal to list them, and Category 2 candidate species are those for which USFWS does not have enough information to support a proposal. Although candidate species have no legal protection under the ESA, they need to be considered in the planning process in the event they become listed or proposed for listing prior to project completion. Any listed or candidate species within an area of proposed impact related to a federal project, such as the CAP, typically requires coordination with USFWS under the Fish and Wildlife Coordination Act.

Several populations of the endangered Gila topminnow have become established along the effluent-dominated reach of the Santa Cruz River. The USFWS is also in the process of determining the status of the yellow-billed cuckoo, which apparently occupies riparian habitat along the upper Santa Cruz and upper San Pedro Rivers.

8A.2.2 Safe Drinking Water Act

Safe Drinking Water Act (SDWA) treatment standards have an impact on surface water. ADEQ is the designated agency of the state to administer the federal Safe Drinking Water Act, and in this capacity ADEQ will have to decide whether recovered water that was stored in an underground storage facility is considered "groundwater under the influence of surface water." Such water must be treated according to the drinking water rules that apply to surface water, whereas groundwater currently does not need to be treated unless it fails to meet primary drinking water standards. A decision has not been issued on this matter. If this is determined to be the case, wells in the Santa Cruz AMA may need to be treated pursuant to SDWA standards, since the AMA's Younger Alluvial Aquifer is strongly influenced by surface water flow.

The Water Infrastructure Finance Authority (WIFA) is a funding program created by the SDWA that could assist the Santa Cruz AMA by helping to pay for water treatment infrastructure costs.

8A.2.3 Clean Water Act

There are two sections of the Clean Water Act that may affect augmentation activities. These sections pertain to National Pollutant Discharge Elimination System permits and dredge and fill permits.

8A.2.4.1 NPDES Permits

Pursuant to Section 402 of the Clean Water Act, ADEQ administers the certification of NPDES permits for the United States EPA. The NPDES Permit for Point Sources of Pollution, as defined by ADEQ, protects the waters of the state from pollutants discharged from a point source. The waters of the state include all perennial or intermittent streams, lakes, ponds, impounding reservoirs, marshes, watercourses, waterways, wells, aquifers, springs, irrigation systems, drainage systems and other bodies or accumulations of surface, underground, natural, artificial, public or private water situated wholly or partly in or bordering on the state.

A NPDES Storm Water Permit may be also be required for certain industrial and construction activities that discharge storm water. NPDES permits are usually applied to effluent or industrial wastewater being disposed of by discharge to the waters of the state. However, when wastewater is proposed for a reuse application, such as recharge, the ADEQ wastewater reuse and APP rules are applied.

The NIWWTP has maintained a NPDES permit and recently filed an application to renew its NPDES permit. The permit renewal application is currently in the appeal and discussion process. NPDES permits are required to be reviewed every three years. No problems are anticipated with the review, since the facility expansion plans for the plant address storm flow discharge into the Santa Cruz River.

8A.2.4.2 Dredge and Fill Permits

Section 404 (Wetlands) of the Clean Water Act requires that the United States Army Corps of Engineers, with the concurrence of the United States EPA, issue or deny permits for activities that result in the discharge of dredge or fill material into the waters of the United States. Waters of the United States include most streams, stream channels and wetlands in Arizona. Intended to prevent the unlawful filling of wetlands, section 404 would apply to any channel modification made for managed underground storage facilities. Section 404 permits must be certified by ADEQ, under section 401 of the Clean Water Act. Certification depends on a review solely to determine whether the effect of the discharge will comply with the water quality standard.