The Recommended Plan will be implemented by following the route of common elements with key decision points providing choices and direction along the way.

CHAPTER SEVEN

THE RECOMMENDED PLAN

The Recommended Plan is the product of the scenario planning process. It consists of common elements (projects and programs) and a series of key decision points specified through time. Implementing the common elements will maintain planning flexibility. Each critical decision will generate a choice between sets of decision-dependent common elements which will in turn lead to a new range of possible futures. The Recommended Plan will be implemented by following the route of common elements with the key decision points providing choices and direction along the way.

Tucson Water initiated development of *Water Plan: 2000-2050* with a set of identified goals:

- Meet Projected Total Demand.
- Utilize Renewable Resources.
- Meet Water-Quality Targets.
- Achieve Sustainable Pumpage.
- Manage Costs and Rate Impacts.
- Comply with Assured Water Supply Program.

The ability to achieve these goals hinges primarily on how Tucson Water utilizes its available water resources. The scenario planning assessments conducted to evaluate the Utility's Colorado River water and effluent supplies provided a framework to develop 14 planning pathways and four Families of Futures that share similar characteristics. The Recommended Plan was created by analyzing the pathways to identify common elements and critical decision points through time.

Within the 50-year planning period, certain choices made at critical decision points will provide Tucson Water with a greater opportunity to achieve the stated planning goals. Other choices will limit the Utility's ability to achieve these goals. The critical decisions and the sets of common elements that comprise the Recommended Plan are discussed in the

following sections. A graphical summary of the Recommended Plan (Plate 1) is contained in the back pocket of *Water Plan: 2000-2050.*

COMMON ELEMENTS AND CRITICAL DECISIONS

There are a number of elements common to all of the pathways that lead to the four Families of Futures. Once initiated, the common projects and programs would contribute toward meeting the planning goals irrespective of the critical planning decisions that will ultimately be made. Hence, these common elements will not constrain any of the identified futures.

The critical decisions that will be made will determine which elements will subsequently be implemented. The sets of decision-dependent common elements will lead to a new range of possible futures. However, the decisions will have financial consequences which need to be understood so that the governing body and the public can make fully informed choices.

Common Elements: 2000 to 2006

The common elements listed below have either already been implemented or should be initiated by 2006. They include the following programs and projects:

Programs

- **Acquire Additional Supplies**. Additional potential sources of supply will be pursued under all scenarios. These supplies may include additional rights to local ground water, additional Colorado River water, rights to other water supplies that may be delivered through the Central Arizona Project, effluent belonging to other parties, and any other water resources that may become available over time. Efforts to acquire additional supplies will continue to be a priority throughout the 50-year planning period.

- **Develop a Salinity Management Program**. An increase in the mineral content of the Utility's blended potable water supply will gradually occur over time as Colorado River water and effluent are utilized. Tucson Water will pursue a program to manage potential increases in salinity in watersheds located within its projected service area. The Utility will continue to participate in research on potential salinity impacts and methods of treatment, reclamation, and/or disposal of the brine waste stream generated during treatment.

- **Encourage Sewer Connections**. In order to provide a greater volume of municipal wastewater effluent for potential reuse, changes in ordinance and/or code should be considered to encourage sewer connections to reduce the number of septic tank systems installed within the projected service area.

- **Evaluate the Effectiveness of Additional Conservation Programming**. A more aggressive conservation program designed to achieve a targeted per capita usage rate will be evaluated by Tucson Water. This program could target all sectors of potable water use including residential, commercial, and industrial customers.

- **Evaluate Emerging Contaminants**. The occurrence, fate, and potential treatment of emerging contaminants in current and future water supplies must be further researched. This research will be increasingly important as the availability of water resources becomes more constrained over time.

- **Expand Public Outreach**. Tucson Water's public outreach program will be expanded to inform the public on a range of issues. These issues include the cost of water treatment options, a reassessment by the community of the targeted mineral content for the Clearwater blend, the benefits of using Colorado River water for potable supply, the use of effluent for non-potable uses, and the benefits of using effluent to augment ground water for banking and indirect potable use.

- **Provide Water-Resource Information to Planning Entities**. Tucson Water will provide information regarding water-resource availability to governmental entities that plan for the future of the community. These efforts will allow those entities to take into account the Utility's ability to provide water service within the context of their planning decisions.

- **Pursue Regional Cooperation**. Tucson Water will seek additional opportunities to work cooperatively with other local governmental entities and water providers. These efforts should include pursuing additional water resources for the region in order to provide sustainable supplies into the future.

- **Reduce Lost and Unaccounted for Water**. Tucson Water will develop and implement a more comprehensive program to reduce its percentage of lost and unaccounted for water. This category includes pipeline leakage, water theft, and un-metered or improperly metered water deliveries.

Projects

- **Conduct SAVSARP Feasibility Assessment**. A technology-based assessment of the potential recharge capacity of the SAVSARP project will be conducted. Under the Clearwater Program, this facility would help maximize utilization of Tucson Water's Central Arizona Project allocation.

- **Construct Spencer Interconnect Pipeline**. The Spencer Interconnect will be constructed to provide flexibility in providing ground water to the blended water program and to provide an alternate route to deliver potable water from the Clearwater Renewable Resources Facility to urban Tucson.

- **Design SAVSARP Facilities.** The SAVSARP project may be implemented in two phases with a maximum recharge rate of approximately 100,000 acre-feet per year. Phase I will be designed with provisions for Phase II.

- **Expand Recharge Capacity of CAVSARP**. The CAVSARP facility will be re-permitted to recharge up to 80,000 acre-feet per year of Colorado River water. This additional capacity will be made available to the Water Bank in the near-term for Colorado River water firming activities. This capacity could be used in the future to recharge more of the City of Tucson's Central Arizona Project allocation, other Colorado River water supplies, and/or for the eventual recharge of effluent.

- **Study Secondary Disinfectants**. The effectiveness and potential by-products of alternative disinfectants as well as the conditions that might trigger their use will be studied. The results of such an assessment will determine the most appropriate use for alternative disinfectants in Tucson Water's potable systems in the future.

- **Upgrade the Distribution System**. There will be a continuing need to upgrade and extend the distribution system to meet growing demand. These system expansions will be implemented throughout the 50-year planning period.

Common Elements: 2006 to 2014

In addition to the projects and programs initiated by 2006, a second set of common elements should be initiated during this period. Once implemented, these elements will allow the Utility to effectively address the priorities and challenges in the mid-term (2014-2025) and long-term (2025-2050) planning periods.

Programs

- **Achieve Full Colorado River Water Utilization**. Regardless of which final project is selected (SAVSARP Phase II or the rehabilitation of the Hayden-Udall Treatment Plant for direct treatment), Tucson Water will achieve full utilization of its current Central Arizona Project allocation by 2012.

- **Achieve Sustainable Ground-Water Pumping**. As the City of Tucson brings its Central Arizona Project allocation into full utilization, its reliance on ground water will decrease. The Utility will seek to reduce its ground-water pumping to a hydrologically sustainable rate within the near-term. In addition, a legislative change and/or a change in the AWS rules could be pursued to recognize hydrologically sustainable ground-water pumping as a renewable water supply under ADWR's AWS Program.

- **Evaluate Effluent Exchanges**. Tucson Water will pursue opportunities to market unused effluent supplies for lease or exchange with other water users within the Tucson AMA.

Projects

- **Augment Avra Valley Main**. The Avra Valley Transmission Main Augmentation will be constructed to provide increased operational flexibility and to provide another route to bring blended water into urban Tucson.

- **Construct New Reclaimed Supply Sources**. As reclaimed system demand grows in the future, additional projects will be implemented to provide the treatment required. The paths differ as to whether the additional supply will be met through expanded recharge and soil-aquifer treatment or constructed treatment plants. Because both treatment approaches are effective and have been accepted by the community, the Recommended Plan does not express a preference. The types of projects ultimately implemented will be decided when reclaimed demand requires new sources of supply.

- **Construct and Operate SAVSARP Phase I**. This project will be sized to have an annual recharge capacity of approximately 45,000 acre-feet per year. Recovery wells will be constructed to provide a blended water supply. SAVSARP Phase I is identified as a common element since it provides needed drought resistance and expanded long-term storage capacity.

Critical Decisions and Dependent Elements: 2006 to 2014

In 2006, two critical resource-management decisions will be made regarding the use of Colorado River water:

Decision #1 - What is an acceptable long-term mineral content target for the Clearwater blended water program?

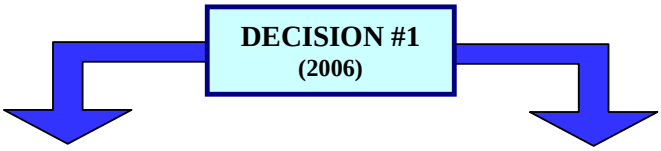
Decision #2 - Should Tucson Water expand the Clearwater recharge program by building SAVSARP to maximum capacity or rehabilitate the Hayden-Udall Treatment Plant to perform direct treatment?

Decisions #1 and #2 must be made by 2006. The choices will determine which decision-dependent elements will be subsequently implemented. In addition, these decisions will significantly impact the overall cost of providing water service.

Decision #1 will determine the targeted TDS concentration of the Clearwater blend. The water recovered from the CAVSARP Well Field will maintain a mineral content at or below the targeted TDS concentration of 450 mg/L through approximately 2009 (Errol L. Montgomery Associates, 2004). Tucson Water has access to sufficient ground water in Avra Valley to blend with the water recovered from CAVSARP to maintain this TDS target for many years. However, as additional Colorado River water is utilized over time either through direct treatment or expansion of the recharge program at SAVSARP (Decision #2), the ability to maintain this TDS target through ground-water blending cannot be sustained and enhanced treatment will be required.

A decision to maintain a lower TDS concentration would be primarily for aesthetic reasons since the lower pH of Colorado River water, and not its higher mineral content, was the principal cause of the pipeline problems experienced with direct delivery in the early 1990s.

The new elements associated with Decision #1 are described as follows:



Mineral Content between 500 and 650 mg/L
No further action required.

Mineral Content of 450 mg/L
Implement Enhanced Treatment
Tucson Water would need to install enhanced treatment trains at the Hayden-Udall Treatment Plant.

Implement Residuals Management
Evaporation ponds would be constructed to dispose of the brine waste stream.

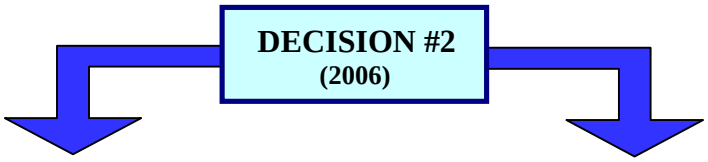
Implement Three-Points Well Field
Construct new well field in the Three-Points area to provide additional ground water for blending.

If the public elects to maintain the Clearwater blend at the targeted TDS concentration of 450 mg/L, the Hayden-Udall Treatment Plant would be upgraded to perform enhanced treatment on only that volume of water necessary to achieve the target. This could be performed on directly treated or recharged and recovered Colorado River water.

A by-product of enhanced treatment is a brine waste stream currently estimated to be approximately 15 percent of the water that is treated. The current option is to construct large evaporation basins to dispose of the waste stream. However, ongoing research is being conducted to explore other methods and technologies to process and dispose of the waste stream at lower costs and to recover a higher percentage of the residual water (Bureau of Reclamation, 2003).

The choice under Decision #2 is either to expand SAVSARP by implementing Phase II or rehabilitate the Hayden-Udall Treatment Plant for direct treatment of Colorado River water. Either option under Decision #2 would allow for TDS management to be conducted pursuant to the choice made under Decision #1. If the Hayden-Udall Treatment Plant is rehabilitated, alternative primary disinfectants will be evaluated to determine the most effective option. By 2012, Tucson Water plans to achieve full utilization of its Central Arizona Project allocation. This is the critical first step toward attaining water-resource sustainability for the community.

The new elements associated with Decision #2 are described as follows:



Expand Clearwater Recharge Program
Design, Construct & Operate SAVSARP Phase II
Expand SAVSARP capacity to 100,000 acre-feet per year of recharge with 80,000 acre-feet per year of recovery. This could provide additional recharge capacity for use by the Water Bank.

Implement Direct Treatment
Rehabilitate Hayden-Udall Treatment Plant
Directly-treat 50,000 acre-feet per year of Colorado River water and add to the blend.

Study Primary Disinfectants
The effectiveness and potential by-products of alternative disinfectants (e.g. UV, chlorine, ozone) should be studied.

Critical Decisions and Dependent Elements: 2014 to 2025

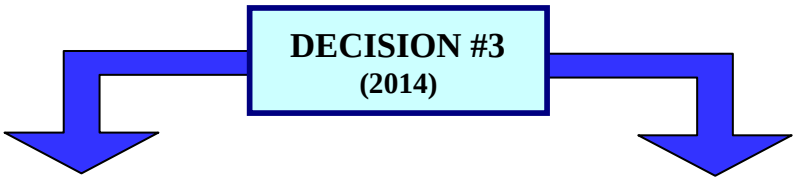
Additional resource-management decisions will need to be made by 2014 to maintain flexibility in utilizing effluent as a water supply and to define its role within the long-range plan. Effluent will continue to be used to meet non-potable demands which are estimated to be at least eight percent of projected total demand. This leaves a large volume of effluent available to augment the potable supply. Two critical decisions must be made regarding the future use of effluent:

Decision #3 – Should current effluent disposal practices continue or should Tucson Water maximize the use of effluent as a water supply?

Decision #4 - If the use of effluent is to be maximized, should it be stored in long-term banking facilities or should it be used to augment the potable water supply?

Decision #3 presents the opportunity to provide future supply for the growing community based on the water resources that are currently owned or controlled by the City of Tucson. Without the expanded use of effluent or acquiring additional water resources, Tucson Water would only have ground water credits and its current Central Arizona Project allocation available to meet future potable demand. Because Tucson Water has set a goal of limiting ground water use to a hydrologically sustainable rate, the Utility could have a shortfall in supply as early as 2020 unless alternative water resources are acquired or per capita demand is reduced. Decision #3 should be made by 2014 to allow sufficient time to put effluent to full reuse by 2017.

The new elements associated with Decision #3 are described as follows:



Use Effluent Resource

Augment Recharge Program
Evaluate location to recharge effluent based on end use and other factors

Construct Effluent Pipeline
A pipeline to convey highly-treated effluent to points of storage or reuse in Avra Valley or the Tucson basin should be constructed.

Construct Ina Road Interconnect
A pipeline to convey Tucson Water's effluent from the Ina Road Water Pollution Control Facility to the Sweetwater Enhanced Treatment Plant should be constructed to maximize the effluent available for reuse.

Construct Sweetwater Enhanced Treatment Plant
Tucson Water should construct a new treatment plant at Sweetwater Drive for enhanced effluent management.

Develop Treatment Technology
The eventual treatment technologies used to prepare the effluent for its end use must be evaluated.

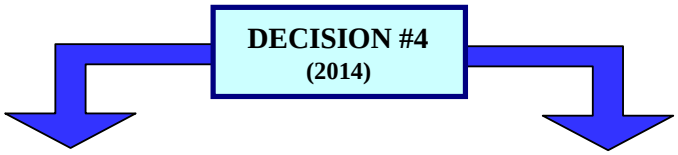
Involve the Community
Removing all of Tucson Water's effluent from the Santa Cruz River will have impacts on neighboring communities. These impacts must be assessed through a community outreach process.

Continue Effluent Disposal
No further action required.

Under Decision #4, the choice to bank effluent in long-term recharge facilities but not use it to augment potable supply would provide the opportunity to preserve the water resource for use beyond 2050. This decision would allow for the accrual of paper-water credits to pump additional ground water. However, storing effluent outside the area where pumping occurs

would result in a resumption of ground-water mining within the Utility's service area; this in turn would cause renewed water-level declines and would increase the risk of additional land subsidence. If ground-water mining is resumed to meet increasing projected demand, the magnitude of pumping by 2040 would more than double the hydrologically sustainable rate. However, the choice to reuse effluent for indirect potable supply provides Tucson Water with the highest potential to meet projected demand through 2050 and offers the greatest opportunity for long-term sustainability. Decision #4 should also be made by 2014.

The new elements associated with Decision #4 are described as follows:



Effluent to Augment Potable Supply

Initiate Effluent Enhanced Treatment
For effluent to be used to augment potable supply, it must undergo extensive treatment.

Initiate Effluent Residuals Management
Evaporation ponds would be constructed to dispose of the brine waste stream.

Effluent for Long-Term Banking
No Further Action Required.

As Decisions #3 and #4 are made, Tucson Water will develop options to increase effluent reuse while seeking to acquire additional water resources. The construction of effluent transmission pipelines would depend on the eventual end use of this water resource. Effluent may be taken to existing recharge facilities or may require construction of new ones. Effluent could be taken to Avra Valley and/or to the Tucson basin for recharge; these areas could be used to bank paper-water credits or to augment potable supply.

A Bridge to the Future: 2025 to 2050

As Tucson Water strives to meet future water demand, all currently available and newly acquired water supplies must be put to their optimal use. To utilize these resources, Tucson Water will need to implement additional projects and programs in the long term (2025-2050). Choices associated with effluent will need to be made with regard to the level of treatment that will be required at the Sweetwater Enhanced Treatment Plant as well as when and where effluent could be recovered from recharge projects. These decisions will be outlined in subsequent plan updates. The costs associated with these projects will be detailed at that time.

Choices made in the near term (2000-2014) and the mid term (2014-2025) will affect the range of available options and possible futures in the long term. Subsequent comprehensive updates to this plan will revisit the scenario planning process to identify decisions that will be required in the long term and to prepare for the community's supply needs beyond 2050.

PLAN RECOMMENDATIONS

The Recommended Plan consists of sets of common elements that are determined by decisions made at specified points in time. The choices made at each critical decision point will bring the community toward certain Families of Futures while others will lose their relevance. Implementing the Recommended Plan means following the route of common elements with the key decision points providing choices and direction along the way. As the planning environment changes over time, the scenario planning process is revisited to establish a new baseline of data and assumptions that will again be used to reassess and develop a new range of possible futures.

In this section, Tucson Water provides a range of recommendations many of which address the critical decision points previously identified. Tucson Water believes that implementing these recommendations will allow the Utility to achieve all of the specified planning goals while retaining maximum flexibility. These recommendations take into account the laws and regulations that govern the Utility as described in Appendix E: *Federal, State, and Local Regulations and Policies*. The conclusions and recommendations summarized below are based on Tucson Water's best professional judgment regarding the most effective ways to meet the projected potable and non-potable needs of the community. The recommendations will be used to initiate a dialogue with Tucson Water's customers and other community stakeholders. Tucson Water's customers, in concert with the City of Tucson's Mayor and Council, will make the critical decisions that provide direction to Tucson Water for plan implementation.

1. Emphasize Physical Water Management Strategies

Conclusion: The best approach to maintain a sustainable future for the community is to ensure the physical availability of renewable water supplies. The community's sustainable future ultimately depends on maintaining a physical link between renewable water sources and the infrastructure needed to convey those waters to customers within the projected service area. A paper-water management approach that is not hydrologically constrained cannot be sustained in the long term.

Recommendation: The programs and projects called out in the Recommended Plan emphasize the physical availability of water supplies. These elements should be implemented in as timely a manner as possible to ensure that renewable water supplies will be available to Tucson Water's customers in the long term.

2. Utilize Renewable Ground Water

Conclusion: From a hydrologic perspective, a limited but quantifiable amount of ground water is naturally recharged each year from precipitation and surface-water runoff. Ground-water withdrawals that do not exceed these replenishment processes should be considered hydrologically sustainable ground-water pumping. Tucson Water plans to limit its ground water withdrawals at or below this sustainable level in order to ensure the long-term viability of the aquifer within the Utility's service area. This concept was

identified as a long-term source of water supply in *Tucson Water Resource Plan 1990-2100*. Currently, no mechanism is in place within ADWR's AWS Program to obtain annual credit for this renewable supply.

Recommendation: The amount of natural recharge that annually occurs represents a hydrologically renewable ground-water supply that is not legally available. Tucson Water recommends that regulatory recognition of renewable ground water, based on hydrologically sustainable ground-water pumping, be incorporated into ADWR's AWS Program. This supply could then be credited as an annually renewable water resource that would not be debited against any long-term storage account. This would require changes in the AWS rules and/or a change in legislation.

3. Reassess the Water-Quality Target for Colorado River Water

Conclusion: Colorado River water currently has an average TDS concentration of 650 mg/L. In contrast, the TDS concentration of ground water provided by Tucson Water averages 280 mg/L. Based on the results of studies and public input associated with the *At the Tap Program*, Tucson Water's customers have accepted a blend of ground water and Colorado River water with a TDS concentration of about 450 mg/L. The choice of 450 mg/L was based on a taste test that was used to establish an aesthetic preference for the blended water. There was no comparative cost analysis done as a consideration for maintaining this preference in the future. All of the planning pathways have the ability to include projects to achieve a TDS concentration of 450 mg/L in the Clearwater blend. However, maintaining this TDS concentration would eventually require some form of enhanced treatment which would be expensive in both capital outlays and annual O&M costs. Customer preferences need to be reassessed by linking costs with potential water-quality targets. Customers would then be able to make an informed choice by considering both aesthetic water-quality preferences and the added incremental cost they would have to pay to maintain that level of mineral content.

Recommendation: With regard to Decision #1, Tucson Water recommends that the TDS water-quality target under the Clearwater Program be allowed to increase gradually until it reaches a point of equilibrium. The point of equilibrium would be less than 650 mg/L. It is anticipated that this point of equilibrium would occur sometime between 2015 and 2030. This recommendation would be the most cost-effective way to provide this renewable resource to the community. It eliminates the need to build an enhanced treatment plant to control TDS concentration as part of the Clearwater Program. In addition, it would preserve more of the available Colorado River water supply by avoiding the estimated 15 percent loss in water volume associated with enhanced treatment and costs associated with brine management and disposal. Should the community decide to maintain the 450 mg/L water quality target, *Water Plan: 2000-2050* can also accommodate that choice. Even though Tucson Water recommends that the mineral content of the Clearwater blend should be allowed to rise to a state of equilibrium, the overall salinity balance of Tucson Water's potable supplies under any scenario will nonetheless require management at some point in the future. Salinity

management can occur when enhanced-treated effluent is used to augment future ground-water supplies.

4. Fully Utilize Colorado River Water

Conclusion: In 1999, the community initiated the move toward full utilization of Colorado River water by accepting a blended water supply under the Clearwater Program. The Clearwater Program could provide the City of Tucson the physical ability to fully utilize its entire annual Central Arizona Project allocation by 2010 and provide for full wet-water recovery by approximately 2012. Currently, the CAVSARP project is operational and provides the capacity to use 60,000 acre-feet per year of Colorado River water. This project is being re-permitted to recharge up to 80,000 acre-feet per year. The SAVSARP Phase I project will be constructed to take delivery of approximately 45,000 acre-feet of Colorado River water per year by about 2007. In order to achieve full utilization of the City of Tucson's Central Arizona Project allocation, Tucson Water can either rehabilitate the Hayden-Udall Water Treatment Plant for direct delivery or build SAVSARP Phase II for indirect use.

Recommendation: Tucson Water recommends that by 2006, a design be initiated for SAVSARP Phase II that will be fully compatible with SAVSARP Phase I. The overall SAVSARP project should be designed with an ultimate annual recharge and recovery capability of 80,000 to 100,000 acre-feet. The facility will be constructed so that an initial annual recharge capacity of at least 45,000 acre-feet is in place by 2007 (SAVSARP Phase I). Implementing SAVSARP Phase I is identified as a common element since it provides needed drought resistance and expanded long-term storage capacity. With regard to Decision #2, Tucson Water recommends that under SAVSARP Phase II, a total annual recharge capacity of 80,000 to 100,000 acre-feet be constructed by 2010. With CAVSARP and SAVSARP, Tucson Water would have excess recharge capacity to allow the Water Bank to store large volumes of surplus Colorado River water at these facilities for firming. These facilities could also provide short- and long-term storage reliability. Banked Colorado River water would firm the City of Tucson's annual Central Arizona Project allocation at locations where Tucson Water has recovery capabilities.

5. Fully Utilize Effluent for Future Supply

Conclusion: Tucson Water currently uses reclaimed effluent to meet non-potable water demand. Reclaimed water use accounts for approximately eight percent of total water demand. The remaining two thirds of the effluent that is currently owned and controlled by the City of Tucson is discharged into the Santa Cruz River and passively accrues water credits at a rate of 50 percent of the total volume recharged in managed underground storage facilities. If this method of effluent use continues, this renewable water resource cannot be efficiently used to maximize long-term banking or to augment the ground-water system for eventual potable reuse. Tucson Water is projected to have a shortfall in potable water supply by 2020 unless one or more of the following initiatives are successfully implemented: acquisition of additional water supplies, a more aggressive demand management program, full utilization of effluent, and/or the resumption of

ground-water mining. However, the latter would cause additional declines in water levels, increase the potential for additional subsidence, and accelerate the rate at which the Utility's allowable ground-water account would be debited.

Recommendation: With regard to Decision #3, Tucson Water recommends that by 2014 a commitment should be made to no longer discharge the City's effluent that is not used in the reclaimed system to the Santa Cruz River. Instead, the resource-management goal would be to maximize the future use of effluent through recharge.

6. Utilize Effluent as a Wet-Water Resource

Conclusion: Adopting a paper-water management approach means that the location where the effluent is recharged and where it is recovered may not be hydrologically related. In the short term, this approach would permit additional ground-water pumping in Tucson Water's existing well fields. However, continued pumping of ground water at rates that exceed hydrologic sustainability will eventually result in a resumption of ground-water level declines and an increase in the potential for additional land subsidence in the Tucson area. The only viable long-term approach is to recover the effluent where it is recharged.

Recommendation: With regard to Decision #4, Tucson Water recommends that effluent be used to support the reclaimed system, for banking, and/or for eventual indirect potable use. Unless additional water supplies are acquired in the near term, the Sweetwater Enhanced Treatment Plant and an effluent pipeline to convey the highly treated effluent to Tucson Water recharge facilities should be operational by 2017. The recharged water would eventually be recovered and blended with other supplies for potable use. Decision #4 must be preceded by an intensive outreach effort to inform the public of the water-resource challenge that will soon be facing the community and hence the need to indirectly reuse effluent for potable supply to ensure long-term sustainability. The effluent would be treated to remove a wide range of constituents and would allow for managing the mineral content of the water before it is recharged and blended with other source waters for potable supply. Review of demand projections indicates that without the acquisition of additional supply, the indirect reuse of effluent for potable use may need to be initiated by 2025 to avoid a supply shortfall within Tucson Water's service area before 2040.

7. Acquire Additional Water Supplies

Conclusion: Other metropolitan areas in Arizona have recently been active in acquiring additional long-term water supplies. As a result, City of Tucson needs to implement an aggressive program to pursue potentially available supplies even though it has a substantial Central Arizona Project allocation and ground-water portfolio. Water resources will become increasingly limited both locally and statewide. Municipal water providers as well as other water users will be competing to acquire additional water resources. The limited availability of potential sources of supply could make the acquisition of additional resources both expensive and uncertain. Potential supply sources

might include additional Central Arizona Project allocations, leased or purchased Colorado River water, local and imported sources of ground water, and local effluent.

Recommendation: Tucson Water recommends that an aggressive program of identifying and pursuing the acquisition of additional water sources be undertaken in the near term. This program needs to be continued throughout the 50-year planning period.

8. Manage Water Demand

Conclusion: Tucson Water is currently pursuing a number of avenues to manage demand including conservation programming, reducing lost and unaccounted for water, encouraging the practice of water harvesting, and providing public information programs. Additional demand management efforts should be evaluated to further reduce per capita water use. An extended period of monitoring and evaluation of these programs will be needed to demonstrate actual water savings.

Recommendation: Tucson Water should develop a comprehensive program to reduce the annual volume of lost and unaccounted for water in its potable systems. The Utility will also continue an ongoing historical review of the conservation program to assess its effectiveness in reducing potable and total per capita water usage rates. In addition, an assessment will be conducted to evaluate the potential to further reduce potable and total per capita water usage rates by implementing more aggressive conservation programs.

9. Implement a Water-Resource Impact Fee

Conclusion: The cost of growth is to be paid through a combination of impact fees and rate increases. The cost to expand the system and develop additional water supplies to meet future growth should continue to be shifted from existing to future customers as they become part of the system.

Recommendation: Tucson Water will develop a financial plan that continues to shift the cost burden of growth to new customers as they are added to the system. The Utility has implemented a system equity fee as an important step in this continuing process. This fee requires new customers to pay for the existing excess system capacity that exists today; the fee is the financial vehicle used to recover the costs already expended to provide the capacity needed to meet the water demands they bring as new customers. As a result, this fee is referred to as a backward-looking fee. As Tucson Water looks to the future, a forward-looking fee should be developed to cover the development of additional water resources and system expansions required to meet future growth.

10. Expand Regional Cooperation

Conclusion: Many of Tucson Water's current uncertainties and challenges are similar to those of other water providers in the region. A mix of short-term actions and long-term planning will be needed to address current issues as well as new ones that arise over time. Such issues can be most effectively addressed if cooperation can be achieved among

local water providers in eastern Pima County. If a cooperative structure can be established in the near term, Tucson Water would coordinate its efforts with the other members to work collectively in acquiring additional sources of supply, implementing an integrated regional salinity control program, and making arrangements to wheel renewable resources within the region.

Recommendation: Steps should be taken toward establishing a regional cooperative with other water providers in eastern Pima County. The cooperative should focus on setting guidelines for members to act in a unified and cooperative manner. If a cooperative structure can be established in the near term, Tucson Water would coordinate its efforts with the other members to address regional water issues.

COSTS

Costs will play a significant role in the decision-making process relating to which elements of the Family of Futures pathways are considered and eventually implemented. Meeting the specified long-range planning goals will demand substantial investment for infrastructure and associated ongoing O&M costs.

The costs presented below are "present worth" costs developed using standard engineering assumptions. Present worth costs are calculated to provide a basis for comparison that accounts for the variability in the timing of implementation of pathway projects. Under a present worth analysis, project costs are estimated in today's dollars and are discounted for each future year until the facility is constructed. Therefore, these costs are presented for comparison of the relative costs of the various pathways and are not reflective of the actual costs to construct and operate the facilities. In addition, these conceptual capital costs are estimated at a level of accuracy that is considered suitable for long-range planning purposes. The Association for the Advancement of Cost Engineering (2000) defines a conceptual cost estimate to be within minus 30 percent and plus 50 percent of actual cost.

Capital Costs

The capital cost estimates include construction costs, non-construction costs such as investigation studies and design, environmental and archeological studies, and right-of-way acquisition costs; they do not include land acquisition costs. Capital unit costs were estimated for pipelines, pump stations, and reservoirs.

Operations and Maintenance Costs

O&M covers a wide range of activities that are conducted in order to sustain a level of service and to maintain the capital assets of the Utility. These costs are associated with the daily management of the water system. O&M costs include power costs associated with pumping water or operating treatment plants, costs to maintain equipment, and all labor costs required to manage, operate and maintain the Utility. Costs for the purchase of Colorado River water have not been included. O&M costs are estimated on an annual basis assuming 365 days of operation per year unless otherwise indicated.

Recommended Plan Cost Analyses

The 14 pathways discussed in Chapter Six and listed on Table 6-1 have been evaluated using various cost estimating tools available to the Utility. In order to present the pathways in a comparative fashion, present worth analyses of both capital and O&M cost were conducted. For relative cost comparison purposes, the unit costs (dollars per thousand gallons) required to develop renewable water supplies specified in each pathway were calculated through the year 2030. Because the costs to produce hydrologically sustainable ground water are the same for each pathway, those costs and the associated volume of ground water are not included in this analysis. Table 7-1 presents the results of both the present worth and resulting unit cost analyses of each pathway. Detailed tables of the individual cost runs are presented in Appendix F: *Cost Information*.

Family of Futures	Pathway	Combined Future	2030 Average Flow (MGD)[1]	Unit Cost ($/1000 gallons)[2]	Total Present Worth ($)
No Effluent for Potable Use	1	I-A	116.2	$0.70	$427,300,000
		II-A	123.0	$0.25	$158,700,000
	2	I-B	150.9	$0.95	$750,000,000
		II-B	156.5	$0.58	$474,700,000
	3	I-C	116.2	$0.70	$427,300,000
		II-C	123.0	$0.25	$158,700,000
	4	I-D	150.9	$0.95	$750,000,000
		II-D	156.5	$0.58	$474,700,000
	5	III-A	130.0	$0.33	$227,900,000
		IV-A	115.1	$0.90	$541,400,000
	6	III-B	156.2	$0.53	$431,700,000
		IV-B	149.9	$0.93	$734,700,000
	7	III-C	130.0	$0.33	$227,900,000
		IV-C	115.1	$0.90	$541,400,000
	8	III-D	156.2	$0.53	$431,700,000
		IV-D	149.9	$0.93	$734,700,000
Total Recharge	9	III-E	154.6	$0.71	$577,400,000
		IV-E	153.1	$1.10	$882,000,000
	10	III-F	154.6	$0.71	$577,400,000
		IV-F	153.1	$1.10	$882,000,000
Combined Technology	11	I-E	154.6	$0.95	$772,000,000
		II-E	154.6	$0.60	$486,100,000
	12	I-F	154.6	$0.95	$772,000,000
		II-F	154.6	$0.60	$486,100,000
Treatment Flexibility	13	I-G	154.6	$0.91	$737,300,000
		II-G	154.6	$0.62	$502,800,000
	14	I-H	154.6	$0.91	$737,300,000
		II-H	154.6	$0.62	$502,800,000

[1]The 2030 Average Flow is only that water made available for use by implementing each pathway.

[2]The Unit Cost is based upon the annualized capital and O&M costs divided by the 2030 Average Flow. It represents the cost for every 1000 gallons of new water supply put to use under each pathway.

Table 7-1: Cost Comparisons.

Under *No Effluent for Potable Use*, the present worth unit cost of water per 1,000 gallons ranges from $0.25 to $0.95 while total present worth ranges from about $159 million to

approximately $750 million. While this Family of Futures includes some of the lowest cost scenarios and represents more than half of all the pathways evaluated in this assessment, none of the eight pathways has the capability of meeting all of the specified long-range planning goals. All eight of these pathways fail in terms of their ability to provide sufficient sustainable supply to meet projected demands through 2050. If additional water resources can be acquired and/or if per capita water usage can be reduced, these pathways will be revisited with regard to the adequacy of future water supplies.

The three remaining Families of Futures: *Total Recharge*, *Combined Technology* and *Treatment Flexibility* have present worth unit costs per 1,000 gallons which range from $0.60 to $1.10 with total present worth estimates ranging between $486 million and $882 million.

Tucson Water's recommendations are closely aligned with Pathway Nine in the *Total Recharge* Family of Futures. The total present worth presented under Combined Future III-E is $577,400,000 with a present worth unit cost of water of $0.71 per 1,000 gallons. Tucson Water's recommendations meet all of the long-range water-resource planning goals.

Impacts on Tucson Water's Financial Plan

Providing the financial resources required to construct and operate new facilities will be a major focus of the Utility over the next decade. Tucson Water uses three primary mechanisms to fund operations and capital improvements: water sales, issuance of debt, and development type fees. Currently, the Utility covers capital costs through a combination of revenues from water sales and proceeds from the sale of water revenue bonds. Operating costs, including debt service on bond issuances, are covered by water revenues. These revenues currently include the Water System Equity Fee that is charged for new customer connections. Meeting the financial requirements of the selected pathway will likely utilize a combination of all three funding sources.

While the present worth values presented in Table 7-1 may provide a general cost relationship between the various pathways, they cannot be overlaid on Tucson Water's financial models to generate projected revenue impacts. These financial models require:

- Costs allocated to specific fiscal years over a defined planning period; and

- O&M and capital costs allocated to a given fiscal year and stated in non-discounted dollars for the period.

In addition, the financial planning models will attempt to capture certain costs not included in the present worth values presented in Table 7-1. For example, the present worth costs do not include the annual cost to purchase Colorado River water. However, every pathway will require the eventual use of all of the Utility's Central Arizona Project allocation. In calendar year 2005, the Utility plans on purchasing approximately 61,000 acre-feet of Colorado River water at a commodity rate of $79 per acre-foot ($4.8 million). By 2009, the Central Arizona Water Conservation District projects its charge for Colorado River water will be $97 per acre-foot. At that rate, charges for the Utility's full allotment of 135,966 acre-feet will be

nearly $13.2 million. It is anticipated that the rate per acre-foot will continue to increase thereafter.

To provide estimates on the potential revenue increases that will be required to fund the various pathways, the Utility is creating a 20-year Financial Plan. The Financial Plan will incorporate the specific financing needs (timing and dollar amounts) for the capital and operating elements of representative pathways. This analysis is expected to be completed during November 2004. While it is anticipated that general revenue increase conclusions will be made from the Financial Plans results, the potential for large variances in capital costs (cost estimates within minus 30 percent/plus 50 percent of actual cost) and the resulting impact on required revenue increases must be considered. In addition, further discussions and analysis will be necessary to determine the source of revenue increases from among monthly water rates, development type fees, or some combination of the two.

SUMMARY

While the Recommended Plan developed through the scenario planning process is built upon sets of common elements that can lead to multiple futures, Tucson Water's recommendations focus on meeting all of the stated planning goals set forth in Chapter One. The recommendations are based on a fiscally responsible use of Colorado River water as part of the Clearwater blend together with the full utilization of treated effluent water to indirectly augment the potable water supply through recharge and recovery. Review of Table 7-2 indicates that Tucson Water's recommendations (highlighted in yellow) meet all six of the long-range planning goals and will ensure the retention of the City of Tucson's AWS designation through 2035. The "Potable Use of Effluent" pathway under the Clearwater Program with an aesthetic TDS of 450 mg/L also meets all planning goals but at an increased cost of about 50 percent.

	Clearwater Program 500-650 TDS; Recharge and/or Direct Treatment			Clearwater Program 450 TDS; Recharge and/or Direct Treatment		
Planning Goals:	**Potable Use of Effluent**	**Long-Term Banking of Effluent**	**Disposal of Effluent**	**Potable Use of Effluent**	**Long-Term Banking of Effluent**	**Disposal of Effluent**
Meet Projected Total Demand	YES	YES	NO	YES	YES	NO
Utilize Renewable Resources	YES	NO	NO	YES	NO	NO
Meet Water-Quality Targets	YES	YES	YES	YES	YES	YES
Achieve Sustainable Pumpage	YES	NO	NO	YES	NO	NO
Manage Costs and Rate Impacts	YES	YES	YES	YES	YES	YES
Comply with Assured Water Supply Program	YES	YES	NO	YES	YES	NO

Table 7-2: Meeting the Planning Goals.

In addition, treating the effluent to a higher standard to manage salinity and to eliminate any other potential unregulated chemicals presents the Utility with an environmentally responsible way to approach future needs. Providing a very high-quality effluent water

supply through an enhanced level of treatment will also offer the option of blending with reclaimed water which will create a wider range of possible non-potable uses for the reclaimed system.

The *Total Recharge* component of Pathway Nine will also place the Utility in a better operational position to respond to demand management issues associated with long-term drought and system outages on the Central Arizona Project canal. While Tucson Water's recommendations generally follow Pathway Nine without enhanced treatment of the Clearwater blend (Combined Future III E), Tucson Water is also committed to the scenario planning process which seeks to maintain planning and pathway flexibility as the future unfolds. Review of the Recommended Plan Summary (Plate 1) indicates that several critical decisions should be made by 2014. Tucson Water will work with the community over the next eight to ten years in order to maximize utilization of available renewable water supplies and to ensure that the planning goals will be met in the long term.

Projected water-resource utilization under the Recommended Plan is shown on Figure 7-1. Throughout the 50-year planning period, reclaimed water for non-potable use (solid magenta color) is assumed to meet at least eight percent of total demand. The remaining 92 percent of total demand is potable demand and is indicated by the dashed white line on Figure 7-1.

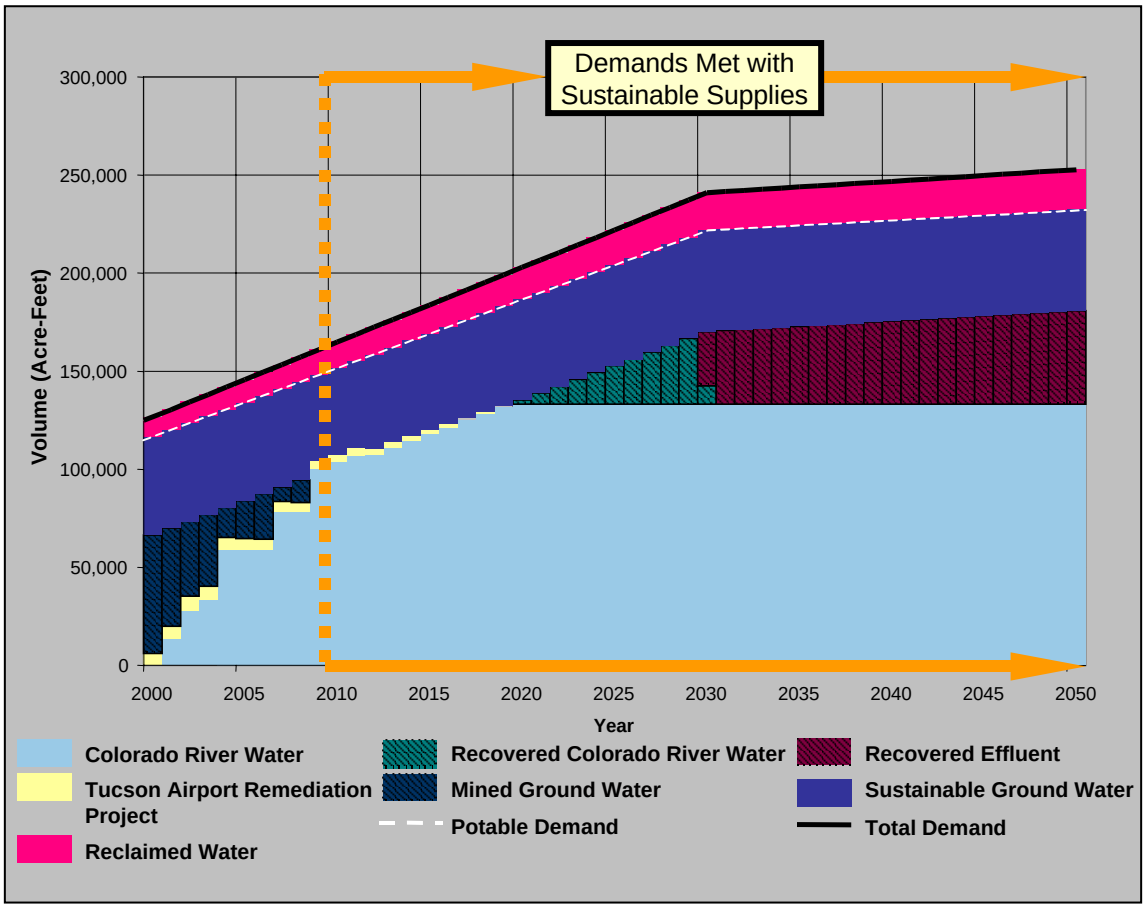


Figure 7-1: Projected Total Demand and Use of Resources for the Recommended Plan.

The Tucson Airport Remediation Project (yellow color) will continue meeting a small amount of the Utility's potable demand until about 2020. From 2000 through 2008, mined ground water (hatched dark blue color) will be used in limited quantities to meet potable demand as Tucson Water's Clearwater Program is brought into full operation. From 2009 through 2026, the Utility's Colorado River water (solid and hatched light blue color) and hydrologically sustainable ground water (solid dark blue color) supplies will be sufficient to meet potable demand. By 2017, highly treated effluent will be used to augment ground water in order to meet projected potable demand by 2030 (hatched magenta color). The Utility's sustainable ground water, Colorado River water, and effluent supplies can be used to meet the community's growing demand for water from 2009 through 2050. However, the Recommended Plan may not assure that the City's AWS designation will be retained to accommodate growth beyond 2035 unless additional supplies are acquired or the per capita water usage rate is reduced.