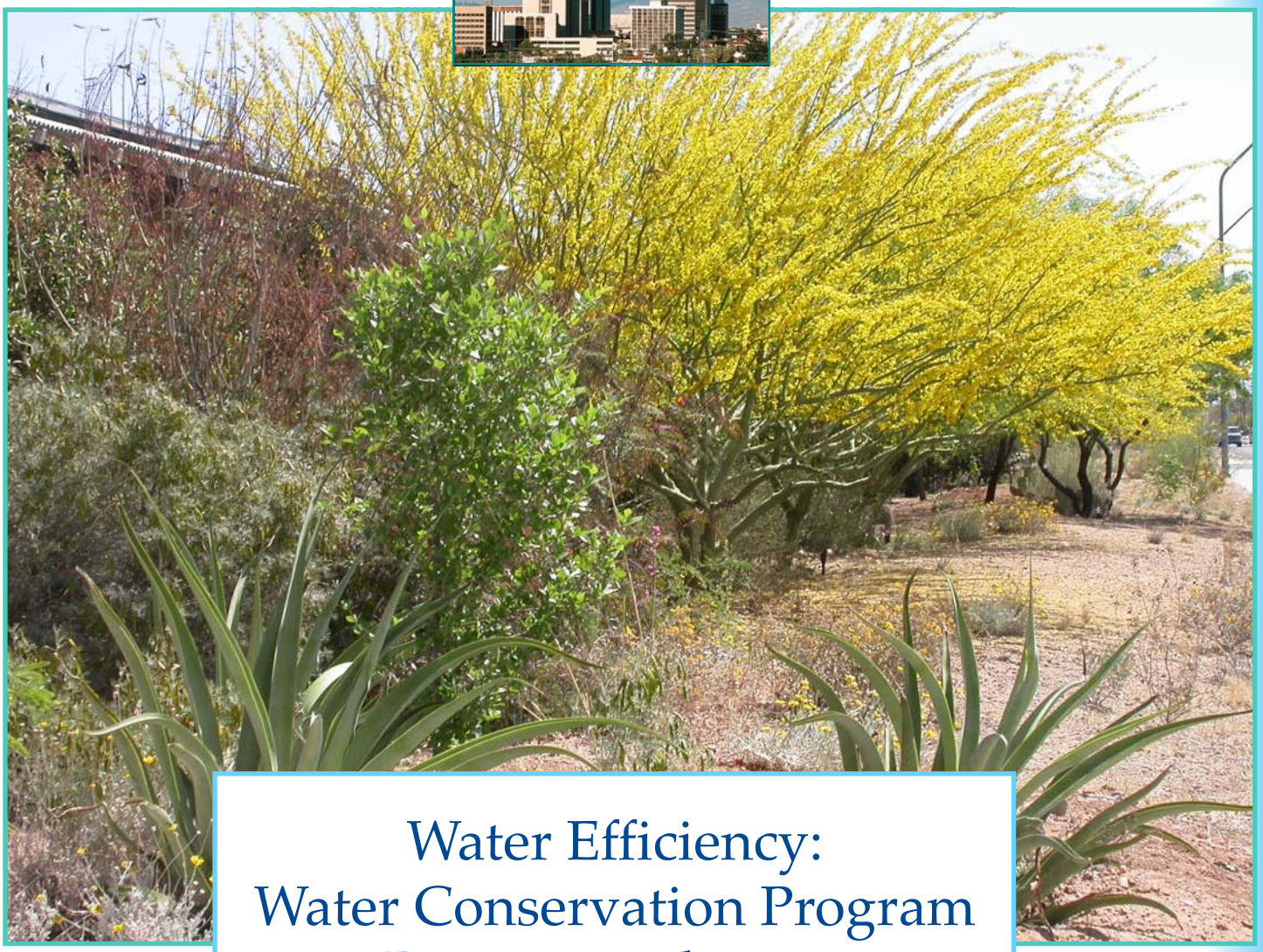
September 15, 2006



Water Efficiency: Water Conservation Program Recommendations for Tucson Water's Future

Submitted by the City of Tucson Water Department
Community Conservation Task Force

Water Efficiency:
Water Conservation Program Recommendations for Tucson's Future

September 15, 2006

Submitted By:

Community Conservation Task Force

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  - **Gary Fiske and Associates**

Community Conservation Task Force
Stakeholder Participants

(July 31, 2006)

Arizona Landscape Contractors Association	Judy Gausman
Arizona Multi-family Housing Association	Suzanne Gilstrap
Business Owners and Managers Association	Carol Green
Citizens Water Advisory Committee	Robert Emanuel Martin Fogel *Alt. Evan Canfield* *Alt. Corina Baca*
Pima County Cooperative Extension	Jack Kelly
Pima County	Kathleen Chavez
Residential representative	Kathy Temple
Southern Arizona Home Builders Association	Ed Taczanowsky *Alt.Lori Lustig*
Southern Arizona Lodging & Resort Assoc.	Alfredo Jauregui
Tucson Association of Realtors	Patty Richardson *Alt. Oscar Lopez*
Tucson Audubon Society	Ann Phillips
Tucson Unified School District	Doug Crockett *Alt. Rey Bussari*
University of Arizona	Gary Woodard

EXECUTIVE SUMMARY

INTRODUCTION

To ensure that the water conservation strategies selected for implementation were both effective and broadly supported by the community, a **Community Conservation Task Force (CCTF)** was established by Tucson Water in the summer of 2005. Members of the CCTF represented a wide range of community stakeholders.

The mission of the CCTF was to:
"Ensure community involvement in the development of a water conservation program strategy that will provide measurable water savings, consistent with the Long-Range Water Plan."

The CCTF sessions were structured into two phases: 1) an educational phase that emphasized the need to develop a program that responds to local needs; and 2) a work session phase that involved analysis and discussion of data provided by a consultant team. Interaction between the Consultant Team members and the CCTF occurred at various points during the process, either through direct presentations or provision of data.

The group started its work by narrowing down a list of 122 potential conservation measures to 48 that would undergo benefit-cost analysis by the consultant. The short list screened out those programs that didn't fit Tucson for qualitative reasons. Once the economic analysis was complete and CCTF questions were answered by the consultant, the task force began the work of developing the list of final recommendations for Mayor and Council, listed on the following page.

It is important to note that the CCTF determined that it would try to reach consensus in all decisions and only resort to voting, if consensus could not be reached. In the end, the CCTF adopted its final recommendations by a vote of 12 to 1.

Further study is required to fully understand the potential rate impacts that would result from the implementation of the recommended programs.

CCTF RECOMMENDED CONSERVATION MEASURES
(Approved by stakeholder vote of 12 to 1)

Rebates and Incentives

- Single Family targeted ULF toilet rebate
- Single Family greywater incentive
- Multi-family irrigation system upgrade rebate
- Multi-family high efficiency toilet rebate
- Commercial/Industrial sub-metering (indoor/outdoor) incentive
- Commercial/Industrial targeted ULF toilet rebate
- Commercial Industrial pre-rinse spray valve rebate
- Commercial/Industrial waterless urinal rebate

Retrofit on Resale Ordinances

- Multi-family irrigation system retrofit on resale ordinance
- Multi-family ULF toilet retrofit on resale ordinance
- Multi-family Condo Conversion sub-metering (indoor/outdoor) ordinance
- Commercial/Industrial irrigation system retrofit on resale ordinance
- Commercial/Industrial passive water harvesting retrofit on resale ordinance

New Construction Ordinances

- Multi-family revised landscape design standards
- Multi-family sub-metering (indoor/outdoor) ordinance
- Multi-family irrigation system design ordinance
- Commercial/Industrial water harvesting and greywater ordinance

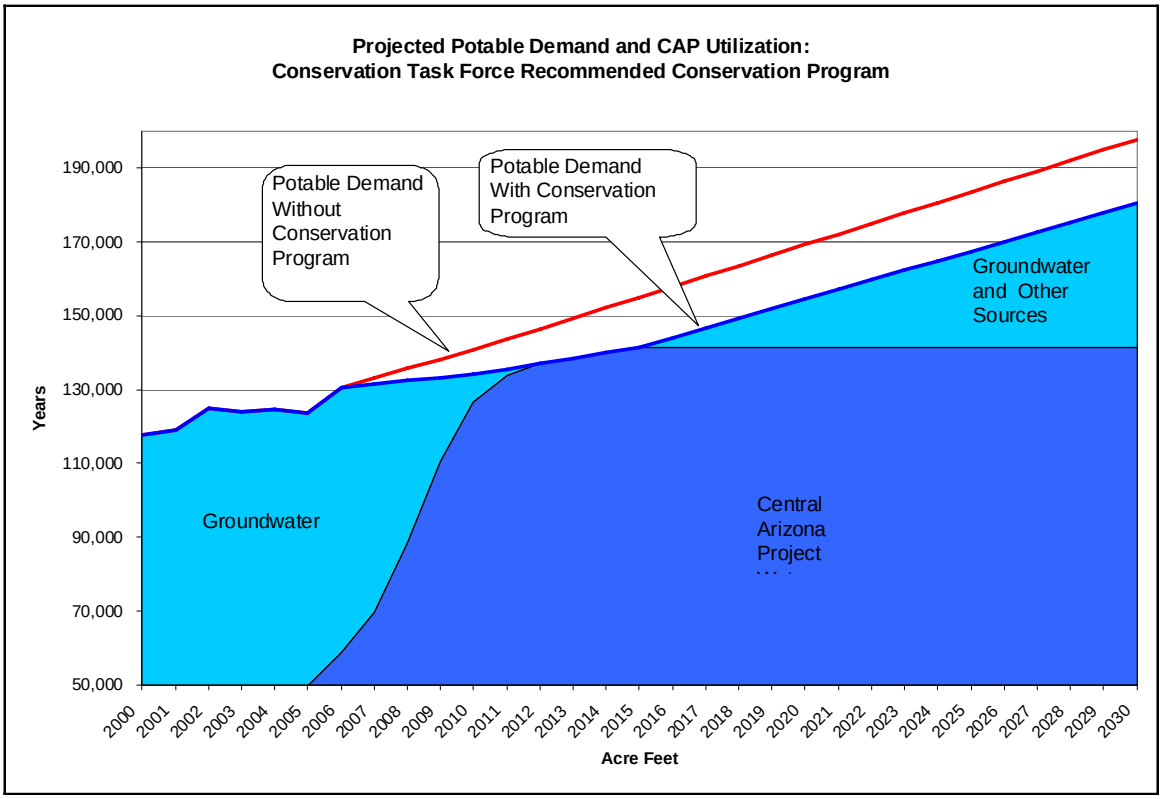
Other

- Multi-family ULF toilet community-based distribution
- ULF toilet vendor-driven delivery

Demonstration programs (all sectors)

- Hot water re-circulation program
- Smart irrigation controller program
- Water harvesting program

The projected impacts of the Task Force recommended measures can be seen on the following graph.


Projected Potable Demand and CAP Utilization:
Conservation Task Force Recommended Conservation Program
Potable Demand Without Conservation Program
Potable Demand With Conservation Program
Groundwater and Other Sources
Groundwater
Central Arizona Project
Years
190,000
170,000
150,000
130,000
110,000
90,000
70,000
50,000
2000
2001
2002
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Water Efficiency:
Water Conservation Program Recommendations for Tucson's Future

September 8, 2006

I. INTRODUCTION

Tucson Water has an established history of developing water conservation programs. Historically those programs have focused on reducing demand for water on the customer side of the water meter. As part of the Utility's *Water Plan 2000-2050*, Tucson Water identified the need to enhance its conservation programs to further reduce the water demand predicted in the Plan.

To ensure that the conservation strategies selected for implementation were both effective and broadly supported by the community, a **Community Conservation Task Force** was established, representing a wide range of stakeholders. Conservation strategies selected by the Task Force for consideration were evaluated by a consultant from both a water savings and cost effectiveness perspective. The Task Force then used this evaluation in part, to develop a list of recommended programs for Mayor and Council to consider.

Historical Context

1970's-- Peak demand for water often exceeded the capacity of Tucson Water's drinking water system, resulting in temporarily reduced pressure and occasional water service interruptions. To help spread the cost of necessary capital improvements over a period of years, Tucson Water implemented a series of demand management programs designed to reduce peak demands on the water system. The introduction of an increasing block rate and extensive public information programs resulted in a substantial reduction of both peak demand and per-capita consumption. These efforts helped establish a foundation for a strong conservation ethic that continues today.

1980's-- Passage of the Groundwater Management Act established a regulatory framework under which conservation programming continued to gain prominence. New ordinances and an expanded public information program were designed to help meet the conservation targets established by the Arizona Department of Water Resources (ADWR). These efforts also helped manage summer peak demands, still a critical issue to a groundwater-based utility.

1990's-- An enhanced conservation program was developed that provides customer assistance in analyzing water use as well as collecting valuable field data. These programs resulted in the creation of education and training programs that further bolster the rates, ordinances, and public information programs that have become the foundation of conservation efforts.

2000's-- The introduction of Colorado River Water (CRW) has provided an additional, renewable resource to the Tucson Water service area. However, conservation

programming remains a priority for the Utility, both to minimize the use of limited groundwater resources and to further enhance the sustainability of our desert community.

Existing Water Conservation Program

Tucson Water currently offers a wide-ranging conservation program that is focused in five main areas. These areas include:

1.) **Public Information Program**: this includes distribution of printed materials and participation in community events
2.) **Education and Training Program:** this includes programs for schoolchildren and training programs for teachers, and adult education programs that focus on workshops that focus on desert landscaping methods and improving irrigation techniques. The adult programs are broken into homeowner and professional landscape categories.
3.) **Rates:** Tucson Water utilizes rate structures that are designed to encourage water conservation. These rate structures are designed as either increasing block rates for residential customers, or a base-rate summer surcharge structure for commercial customers. Exceptions include a flat rate used for multi-family and reclaimed customers.
4.) **Direct Assistance Program:** Tucson Water provides assistance by offering water audits for customers.
5.) **Ordinances:** a variety of ordinances are in place that provide for more efficient use in new construction, defines water waste and establishes enforcement provisions, and allows for response to emergency situations.

With the exception of construction related ordinances, the existing program is designed to encourage changes in water use. A complete listing of current conservation projects is found in Appendix E.

Conservation Planning to Ensure Sustainability

The draft *Water Plan 2000-2050* (Plan) calls for even more aggressive water conservation measures as part of an integrated approach to managing both water supply and water demands. The Plan estimates future water demand by applying a stable per capita usage figure to population predictions provided by the Pima Association of Governments. One of the most effective ways in which to reduce overall demand would be to reduce the base per capita usage rate. Under such a scenario, the successful base conservation program consisting of public information efforts, education and training programs, rates, and ordinances would be supplemented by measures designed to provide for increased efficiencies in existing and new building stock. The overall impact would result in a reduction in per-capita consumption.

In addition to the sustainable resource needs identified in the draft Plan, ADWR is developing a new regulatory program for municipal providers that will likely be based on the implementation of Best Management Practices (BMP's). As currently proposed, this

BMP-based program will eliminate the use of per-capita targets as the focus of conservation regulation, and instead require the development of plans that identify BMP's appropriate for each water utility. Tucson Water's strong planning process will ensure that the proper mix of programs is established meet community needs as well as State regulatory mandates.

The recent study, "Evaluation and Cost Benefit Analysis of Municipal Water Conservation Programs" (EcoBA) sponsored by the local group Water Conservation Alliance of Southern Arizona (Water CASA), further strengthens the case for effective planning to ensure that water savings anticipated from water conservation programs are properly balanced against the financial investments made to implement them. According to the study, water utilities too often rely on simple estimates of water savings while "…there are simply too many factors and variables involved in reaching appropriate, tailor-made decisions for a given utility."[1]

Tucson Water's Water Resource Planning Model

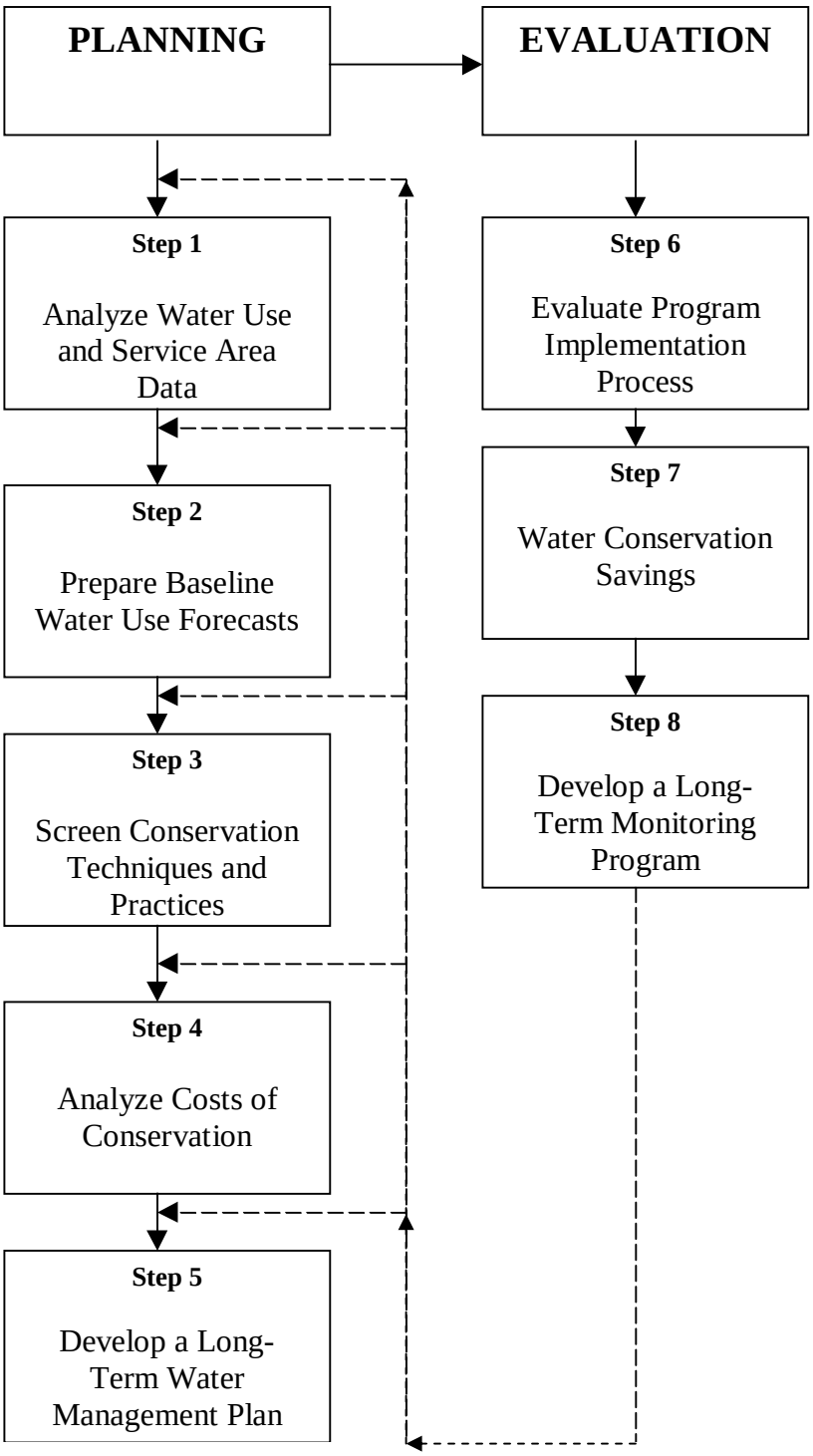
The Integrated Resource Planning (IRP) model selected for use in this process is endorsed by the American Water Works Association, as found in the document "Evaluating Urban Water Conservation Programs; A Procedures Manual". A flowchart identifying the procedure is found as Figure 1 in this section. The components of the process include:

1) *An analysis of service area characteristics* including housing/building stock, demographic, water use trends, and other related/relevant characteristics.
2) *The development of baseline water use forecasts* allowing for an assessment of conservation potential based on selection of measures screened as appropriate for the service area.
3) *A benefit/cost analysis* designed to identify those actions that result in measurable savings with a positive net economic benefit.
4) *Development of evaluation procedures* for the established program, ranging from survey methods for information and education programs, to more sophisticated methods to track changes in water use for measures that are focused n technological changes.

An innovation in the IRP approach is that it allows for comparison of the costs of various conservation methods against the costs of various supply augmentation options. As a result, demand reductions can be put in the context of how they impact both the cost and timing of introducing new water supplies to the community. These factors can then be included in the Utility's strategic resource planning process.

[1] **Evaluation and Cost Benefit Analysis of Municipal Water Conservation Programs**, p.9, Water Conservation Alliance of Southern Arizona, 2006.

Figure 1
Conservation Planning and Evaluation Procedures
Conservation Task Force



Task Force Structure

Tucson Water's Water Plan 2000-2050 recommends that community-supported programs be implemented in conjunction with the Utility's program to enhance water conservation and water use efficiency. In June 2005 Tucson Water established a Community Conservation Task Force (CCTF) to ensure input from a broad range of community stakeholders in the development of conservation strategies. The CCTF was composed of representatives from professional associations representing water user groups, water-related trade associations, residential customer representatives, and other community interests. While participation in the CCTF by various groups was sporadic, a core group of members carried the process through to completion. A complete listing of the participants and their affiliation is presented on page one of this report.

The mission of the CCTF was to:
"Ensure community involvement in the development of a water conservation program strategy that will provide measurable water savings, consistent with the Long-Range Water Plan."

The CCTF recommendations were presented to the Citizens' Water Advisory Committee (CWAC) through the CWAC Conservation and Education Subcommittee. Members of that subcommittee were also included on the CCTF roster to ensure continuity of communication between the Task Force and CWAC. The CCTF recommendations, along with any comments or suggestions from CWAC, were then provided to Tucson's Mayor and Council for consideration. Based on direction from Mayor and Council, Tucson Water would then begin development of the approved programs.

The CCTF sessions were structured into two phases: an educational phase that emphasized the need to develop a program that responds to local needs; and a work session phase that involved analysis and discussion of data provided by a consultant team. The Task Force worked in parallel with a consultant team that conducted the technical analysis of selected conservation programs, Gary Fiske and Associates, A&N Technical Services, Inc., and M.CUBED. The consultant team brought experience in water planning and public policy, empirical policy analysis and statistics as applied to water resource and water efficiency programs, and statistical, econometric and mathematical model building capabilities. Members of the Consultant Team are developing a Benefit/Cost Model for the American Water Works Research Foundation (AWWARF) for use as the standard planning tool for water utilities in developing water conservation programs. Working with staff, the consultant team collected and analyzed relevant demographic, water use, and housing data to establish baseline water use projections.

Interaction between the Consultant Team members and the CCTF occurred at various points in time during the process, either through direct presentations or provision of data. Figure 2 provides a graphic representation of the relationship between the CCTF schedule and the consultant team scope of work.

Figure 2

Tucson Water Conservation Planning Project

Community Task Force

Mission Statement
To ensure community involvement in the development of a water conservation program strategy that will provide measurable water savings, consistent with the Long-Range Water Plan.

Task Force Meetings: Education
- Water Resource Overview
- Conservation Overview
- Financial Operations
- Water Use Studies
- Southern Nevada Water

Task Force Meetings: Recommendations
- Consultant presentations
- Facilitated sessions
- Recommendations development
- Drought?

Task Force Recommendations
- Present to CWAC
  - Recommended Program
  - Policy Recommendation
- Forward to M&C
  - As is
  - With comments

Conservation Planning Consultant

Scope of Work
1. Establish Baseline Conditions
- Analyze previous survey data
- Collect secondary source info
- Estimate gpcd using REUWS

Scope of Work
2. Profile New Housing Stock
- Collect secondary data
- Map new development
- Estimate gpcd using REUWS*

Scope of Work
3. Develop "Tool Box"
- Integrated planning concept
- Economic analysis
- Identify important criteria
- AWWARF BCM**
- Alternative conservation scenarios

Program Development
- Establish budget/staffing plan
- Develop project partnerships
- Implement pilot projects

Task Force Process

Educational Phase

During the educational phase background information was provided regarding water resources management objectives, current water conservation programming, utility operations, the financial impacts of conservation programming, local water conservation issues and programmatic and policy impacts since 1980. The educational phase lasted 6 months and concluded with a presentation of a planning process by the Southern Nevada Water Authority that identified the specific water resource management issues, baseline water use information, and program implementation methods.

Work session phase

CCTF work sessions began in January of 2006. The group started by defining the parameters of the process they would use to develop their recommendations. This included the development of the following:

- An Opportunity Statement clarifying the goal of the process
- A list of "Givens" identifying the non-negotiable items, or constraints within which Task Force decisions would be made.
- Process ground rules
- Decision making ground rules

(Note: Refer to Meeting Notes in Appendix A for more detailed information on this foundational work.)

- It is important to note that the CCTF determined that it would try to reach consensus in all decisions and only resort to voting, if consensus could not be reached. Consensus is typically an agreement made without voting. An agreement is reached by gathering information and points of view, discussing, analyzing and persuading. All parties must feel they can "live" with the decision. The goal of a consensus decision is to reach a decision everyone can accept. Not everyone will like the solution equally well or will have an equal commitment to it. In the end, the CCTF adopted its final recommendations by a 12 to 1 vote.

Once the foundational work was complete, the CCTF set about reviewing an initial "Universe of Conservation Measures" submitted by the Consultant Team. This list of 122 measures was submitted to a qualitative screening by the CCTF to develop a short list of 48 measures that would undergo a quantitative economic analysis by the project consultant. The short list screened out those programs that didn't fit Tucson for quantitative reasons. The CCTF used the results of the economic analysis as the foundation for developing its final recommendations.

The screening process itself had several steps. They included the following:

1) CCTF members completed a survey indicating the level of support they believed would exist from their constituency group on each of the 122 measures in the universe of conservation measures. (See Appendix B)

2) Tucson Water Staff simultaneously completed a qualitative screening of that same universe of conservation measures to help screen out measures that just didn't fit Tucson for qualitative reasons. (See Appendix C)

3) Results of the CCTF member survey and the Tucson Water staff screening were compiled and provided to the Task Force for consideration.

4) CCTF selected a short list of 48 measures that would undergo technical (economic) analysis.

5) An economic analysis of 48 potential conservation measures was conducted by Tucson Water consultant, Gary Fiske and Associates, and the results were presented to the CCTF. (See Attachment D)

6) CCTF requests for additional information were collected and responses provided by the consultant and Tucson Water staff.

7) CCTF developed a final list of recommended measures that they believe will reduce per capita water use, yield significant water savings, and provide benefits for both the community and the program participants.

It is important to note that this process differs from traditional approaches in that it sought community input in the initial screening of options, rather than having staff provide a pre-screened listing for review,.

Task Force Concerns

Task Force members identified several key issues of concern throughout the process of reviewing data and developing recommendations. Following is a summary of several of those issues. The items are not presented in any particular order:

- **Equity**- A stated policy of the conservation program is to provide an equitable distribution of conservation benefits throughout customer classes and the community. The final economic analysis left many members concerned that a number of proposed measures targeting residential customers failed to meet minimum economic threshold criteria and therefore were cut from the list of final conservation strategies. Consideration should be given to re-examining City policies that result in the exclusion of such programs.

- **Inherent Constraints of Process –** The water management objectives for the City of Tucson are unique, and the assumptions developed by the consultant and

City staff in the economic analysis reflects current uncertainty about managing water resources in the future. One concern expressed by some Task Force members was the use of an averaging of future avoided costs in conducting the benefit-cost analysis. This approach does not reflect the potential jump in the cost to deliver potable water at discrete points in the future, such as would occur if a treatment plant is needed to treat effluent to drinking water standards. As future supply options become better defined, additional analysis should be conducted to address this concern, given financial ability and need.

- **Data Reliability** - Another concern was expressed over inconsistent data relating to potential water savings, costs, and participation rates, as well as the reliability of some of the data and assumptions utilized in conducting the benefit-cost analysis. Pilot-scale projects should be conducted as needed to refine the benefit-cost model to reflect actual conditions within the Tucson Water service area.

- **Growth** – A constant issue that was discussed throughout the process was the need to develop new water supplies to accommodate growth. In general, much of the discussion focused on the fact that conservation programs intended to save water now so future water demand could be met do not address the impending long-term imbalance between increasing population, water demand, and available water supplies. Under the current scenario, there is no way to prevent conserved water from being used to meet the demands of future growth. Task Force members recognized that the issue of supplying water and accommodating growth are separated in utility planning, but are typically conflated by the public. While this issue is beyond the scope of the Task Force, many members felt strongly enough about this issue that it was felt that a statement should be made identifying this concern. The group expressed that Tucson elected officials, as well as officials of Pima County should give much consideration to examining policies that allow for continued growth at the expense of the Utility's ability to supply water in a sustained fashion for the long-term future.

- **Collaboration –** Task Force members collectively expressed the need for Tucson Water and other stakeholders to work collaboratively to develop aggressive water conservation measures for regional implementation. This includes working with local jurisdictions to ensure that any regulations that may result from this process be as uniform as possible, and to try and work with user groups to develop workable programs that compliment the Utility's program. Several efforts are currently underway in the area of water conservation planning, and Tucson Water participates as much as possible to ensure that conservation goals are being met, balanced against the needs of overall Tucson Water objectives. Members of the Task Force expressed the desire to see the City of Tucson move towards regional cooperation on demand management. The Task Force supports this current participation by Tucson Water and encourages a commitment to continue and expand such involvement.

- **Untapped Conservation Potential** – A concern has been expressed that the practice of evaluating conservation impacts using a resource economics model involves the inherent assumption that individuals practice water conservation only because it saves them money instead of because they feel strongly about the need to conserve this important resource. Public willingness to participate in conservation programs might increase substantially if water savings could be earmarked to provide a physical benefit to the aquifer in perpetuity. Consideration should be given to earmarking water savings to provide a greater direct hydrological and environmental benefits. Members of the Task Force suggested that public interest in preserving riparian and aquatic habitat could be a public education tool to drive the widespread adoption of conservation measures. Towards this end, the Utility may want to collaborate with others working in the Tucson Water service area on habitat conservation and/or restoration.

II. TASK FORCE RECOMMENDATIONS

Programs subjected to benefit-cost analysis

Starting from an initial list of 122 possible conservation measures, the CCTF identified a short list of 48 to be subjected to benefit-cost analysis by the project consultant. This short list consisted of those measures that fit the Tucson community and had a reasonable potential for acceptance. These programs included the following:

Single family housing
Existing construction

1. ULF toilet rebate program (Targeted)
2. ULF toilet rebate program (Untargeted)
3. ULF toilet retrofit on resale ordinance
4. ULF toilet community-based organization program
5. High efficiency toilet rebate
6. Hot water recirculation rebate
7. Hot water recirculation retro-fit on resale
8. Grey water incentive
9. Water harvesting incentive

New construction

10. Hot water recirculation ordinance for new construction
11. Landscape design ordinance requiring passive water harvesting and xeri-scape
12. Grey water ordinance requiring dual plumbing

Multi-family housing
Existing construction

13. ULF toilet rebate program
14. ULF toilet vendor driven delivery
15. ULF toilet retrofit on resale ordinance
16. ULF toilet community-based program

17. High efficiency toilet rebate
18. Clothes washers in common area rebate
19. Hot water recirculation system rebate
20. Hot water recirculation system retrofit on resale ordinance
21. Misting system operating restrictions or prohibitions
22. Sub-metering incentives
23. Sub-metering ordinance requiring installation on apartment conversion to condo
24. Irrigation system retrofit on resale ordinance
25. Irrigation system upgrade rebate, including separate interior/exterior metering

New construction

26. Clothes washer ordinance
27. Hot water recirculation ordinance
28. Sub-metering ordinance, including separate interior/exterior metering
29. Irrigation system design standards ordinance
30. Strengthen existing landscape design standards ordinance
31. Water harvesting ordinance requiring rainwater and grey water use

Commercial/Industrial

Existing construction

32. ULF toilet rebate program (Targeted)
33. ULF toilet rebate program (Untargeted)
34. Urinal rebate program
35. Vendor driven toilet and urinal program
36. Toilet and urinal valve replacement
37. Hot Water recirculation rebate
38. Car wash mandatory operating standards
39. Interior/exterior separate metering incentive
40. Irrigation system retrofit on resale ordinance
41. Passive water harvesting retrofit on resale ordinance
42. Pre-rinse spray valve rebate
43. Pre-rinse spray valve direct install

New construction

44. Clothes washer ordinance
45. Cooling tower standards
46. Food handling ordinance
47. Hot water recirculation ordinance
48. Water harvesting ordinance requiring rainwater and grey water use

Note: See Appendix F for consultant report.

The task force used the results of the benefit-cost analysis on these 48 programs as the foundation for developing the final list of recommended measures, listed on the next page.

CCTF RECOMMENDED CONSERVATION MEASURES
(Approved by stakeholder vote of 12 to 1)

Rebates and Incentives

- Single Family targeted ULF toilet rebate
- Single Family greywater incentive
- Multi-family irrigation system upgrade rebate
- Multi-family high efficiency toilet rebate
- Commercial/Industrial sub-metering (indoor/outdoor) incentive
- Commercial/Industrial targeted ULF toilet rebate
- Commercial Industrial pre-rinse spray valve rebate
- Commercial/Industrial waterless urinal rebate

Retrofit on Resale Ordinances

- Multi-family irrigation system retrofit on resale ordinance
- Multi-family ULF toilet retrofit on resale ordinance
- Multi-family Condo Conversion sub-metering (indoor/outdoor) ordinance
- Commercial/Industrial irrigation system retrofit on resale ordinance
- Commercial/Industrial passive water harvesting retrofit on resale ordinance

New Construction Ordinances

- Multi-family revised landscape design standards
- Multi-family sub-metering (indoor/outdoor) ordinance
- Multi-family irrigation system design ordinance
- Commercial/Industrial water harvesting and greywater ordinance

Other

- Multi-family ULF toilet community-based distribution
- ULF toilet vendor-driven delivery

Demonstration programs (all sectors)

- Hot water re-circulation program
- Smart irrigation controller program
- Water harvesting program

The projected impacts of the Task Force recommended measures are illustrated in Table B below.

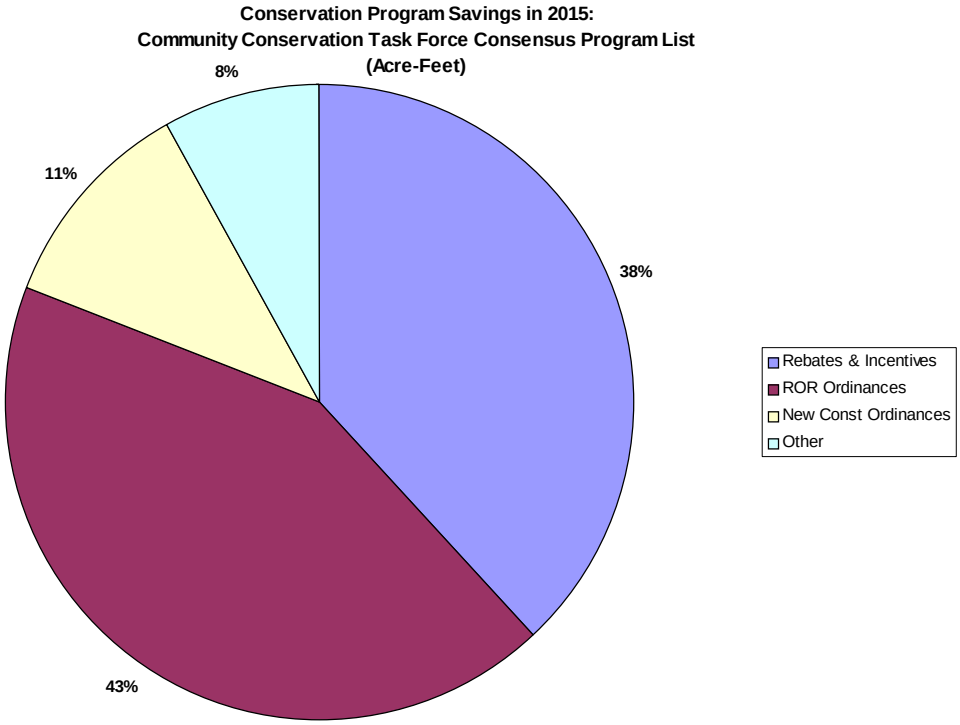
Table B
Task Force Final Recommended Program List
Annual Water Savings, Costs, and Staff Requirements by Program

		Annual Water Savings	Costs	Costs	Staff
Program		YR 2015	YR 2007	YR 2015	Reqmts
		(Acre-feet)	($000)	($000)	(FTE)
Rebates & Incentives					
SF	Targeted ULFT Rebate	1,078	$678	$228	0.05
SF	Greywater Incentive	180	$122	$122	0.2
MF	Irrigation System Upgrade Rebate	2,179	$114	$114	0.2
MF	High-Efficiency Toilet Rebate	716	$213	$213	0.05
CI	Interior & Exterior Submetering Incentive	137	$32	$32	0.1
CI	Targeted ULFT Rebate	296	$117	$64	0.2
CI	Pre-Rinse Spray Valve Rebate	132	$17	$23	0.1
CI	Waterless Urinal Rebate	124	$114	$32	0.2
Retrofit on Resale Ordinances					
MF	Irrigation System Retrofit on Resale Ordinance	2,243	$32	$36	0.2
MF	ULFT Retrofit on Resale Ordinance	1,401	$49	$41	0.05
MF	Submetering Ordinance (Condo Conversions)	717	$7	$7	0.1
CI	Irrigation System Retrofit on Resale Ordinance	953	$38	$38	0.2
CI	Passive Water Harvesting Retrofit on Resale Ordinance	144	$38	$38	0.2
New Construction Ordinances					
MF	Submetering Ordinance	547	$15	$15	0.2
MF	Irrigation System Design Ordinance	685	$19	$19	0.2
MF	Revised Landscape Design Standards	103	$15	$15	0.2
CI	Water Harvesting & Grey Water Ordinance	77	$36	$36	0.2
Other					
MF	ULFT Community-Based Distribution	579	$249	$126	0.05
MF	ULFT Vendor-Driven Delivery	447	$258	$131	0.075
	TOTAL	12,737	$2,160	$1,328	2.775
	Percent of Demand	7.53%			

Note: Projects that are identified as Demonstration Programs are not included in the final economic analysis, but will be included in the development of the overall conservation program plan document.

Figure 3 below provides a graphic representation of estimated water savings based on the type of program:

Figure 3
Estimated Water Savings



Equity

The CCTF spent a good deal of time discussing equity and acknowledged that the final recommendations have a greater number of measures that apply to the multi-family sector than others. However, it was felt that the emphasis of past conservation efforts has primarily impacted the Single Family sector over the Multi-family and Commercial/Industrial sectors. The benefit-cost analysis pointed to the measures that offered the greatest potential, regardless of sector. The resulting Task Force recommendations represent many hours of careful consideration and discussion among the stakeholders.

III. MINORITY OPINION

The above recommendations were approved by a vote of 12 to one. The Multi-family Housing sector did not fully support the final recommendations and agreed to allow the recommendations move forward with the following minority opinion presented for consideration.

Minority opinion—submitted by the Arizona Multi-housing Association
On behalf of the Arizona Multi-housing Association (AMA), this Minority Report is written in protest of the desperate impact of Community Conservation Task Force (CCTF) recommendations across customer classes. The intent is not to disparage the effort put forth by the Task Force, nor to discount the need and support for reasonable and equitable conservation measures for all water customer classes.

More clearly stated, the AMA supports the Water Conservation Program Goal "to protect and enhance water resources through conservation". The AMA also strongly supports the number one policy adopted by the Task Force which is to "provide an equitable distribution of conservation benefits throughout the customer classes and the community". The AMA cannot and does not support disproportionately placing the burden for water conservation on a single class of users.

A review of 2004 water consumption statistics by customer class reveals that residential customers consume 57% of all water consumed, while multifamily (including apartments and mobile home parks) consumes 19%. The combined usage for commercial and industrial class accounts for 23% of the total water usage and others use 1% of the total water consumed by all Tucson customer classes.

An analysis of the recommendations reveals that the percentage of savings by customer class (acre feet of water saved) is significantly disproportionate to the water used by customer class. For example, single family residential uses 57% of all water consumed; yet in accordance with task force recommendations would only be responsible for 8.8 % of the total savings (1,078 acre feet). Multifamily, on the other hand, uses 19% of the total water consumed, but would be responsible for 77.6 % of the total savings (9,514 acre feet). Commercial and Industrial users account for 23% of total water usage and would be responsible for 13.6% of the total savings (1,662 acre feet). Clearly, an equitable distribution of conservation benefits throughout the classes does not exist.

Based on information provided by the City's consultants, CCTF based its recommendations on an economic benefit-cost analysis selecting only programs that meet or pass arbitrary "benefit-cost tests". While a benefit-cost analysis is a critical component to consider for any proposed conservation program, it should not be the single and only guiding factor for determination of final recommendations. It would have perhaps been more appropriate to compare savings (acre feet saved) for like programs across customer classes.

Intuitively, it would seem that imposing like measures on single family residential and multifamily residential would yield a savings in acre feet proportional to the total amount of water consumed by each customer class. Such an analysis would have yielded a more apples-to-apples comparison, yet, when asked, we were told this information was not readily available.

The AMA respectfully requests that the Citizen's Water Advisory Council (CWAC) not accept final recommendations of the Community Conservation Task Force and that a more equitable distribution of conservation benefits be implemented across customer classes in order to maximize the total water savings. The AMA further requests that, at a minimum, all mandatory retrofit on resale recommendations be rejected by CWAC.

Appendix A

Meeting Notes

COMMUNITY CONSERVATION TASK FORCE WORK-SESSION
January 25, 2006

MEETING RESULTS

MEETING TOPIC
TASK FORCE PROCESSES FOR DEVELOPING STAKEHOLDER-ACCEPTED WATER CONSERVATION RECOMMENDATIONS

OPPORTUNITY STATEMENT
The Citizens Water Advisory Committee (CWAC) Water has asked the Community Conservation Task Force to recommend stakeholder-supported water conservation measures that will reduce per capita water use and yield significant water savings.

GIVENS
To be clear about what needs to be discussed and the role of the Task force the following non-negotiable Givens have been established:

- Discussion will be limited to water conservation alternatives. Ideas to increase water supply will not be pursued. (W*ater harvesting and gray water reuse are considered forms of water conservation for this process.)*

- The Task Force will adhere to Mayor and Council Water Policies related to financial, management, operations and water conservation. If deemed appropriate, recommendations for changes may be submitted for consideration.

- Technical analysis of an initial set of no more than 40 options being considered by the Task Force will be provided by Tucson Water consultants before the selection of final recommendations.
    - *Note: Task Force asked for clarification of what constitutes an "option," (E.g. low-flow toilet may be used by new residential, existing residential, new commercial and existing commercial. Does this constitute four "options" instead of one option with 4 forms of implementation)*

- Final recommendations will be submitted to the CWAC conservation and education sub-committee for comment before submission to the full CWAC.

- CWAC will submit the final Task Force recommendations, along with any applicable comments, to the Mayor and Council.

- Mayor and Council will make decisions regarding water conservation measures guided by a number of factors--Task Force recommendations, CWAC comments, Tucson Water staff comments, technical analysis and financial analysis.

DECISSION MAKING RULES
- Task Force will strive for consensus in all decisions.

- Consensus decisions will be put forward with a Strength of Consensus vote indicating the level of support by each member.

- If consensus cannot be achieved, the group will rely on majority voting following City policy guidelines for such procedures.

- Minority reports will always be accepted.

GROUND RULES

- Let one person speak at a time without interruption

- Start and end meetings on time

- Respect time constraints, be succinct

- Treat each other with courtesy

- Be honest, fair and as candid as possible

- Avoid out of meeting discussions between a majority of Task Force members

- Respect others' interests and differing opinions

- Regard disagreement as a problem to be solved rather than as a battle to be won

- Identify those times when you are "taking off your organization hat" to express an individual opinion

- Minimize conducting sidebars while discussion is underway

- Primary Task Force representatives will attend meetings whenever possible. If alternates are used, the primary representative will inform the alternate about issues under discussion.

- Publicly record all important issues and decisions

- Publicly record unresolved issues separately in a "parking lot"

- It is the joint responsibility of the meeting facilitator and meeting participants to assure that the groundrules are observed.

NEXT STEPS

- Task force members will complete Stakeholder Opinion Survey by February 3rd to indicate their sense of the level of support each program might have from their constituents, if it were to be included in a list of recommended water conservation strategies.
    - A "don't know" column will be added to the survey form
    - A section will be added to the survey form to allow members a chance to add conservation options not already listed

(Note: Ed Taczanowsky, SAHBA representative, objected to the survey--expressing his concern that there was not sufficient information on <u>any</u> of the options to make an informed decision on ranking)

- Tucson Water staff will simultaneously complete a form indicating:
    1) estimated level of community-wide water savings for the options listed on the Task Force survey form
    2) estimated community-wide effectiveness for the options listed on the Task Force survey form

  (It is understood that the Tucson Water staff evaluation will be a rough indication based on current knowledge. A Tucson Water consultant will do a detailed technical analysis—including projected cost and water savings-- on options that will be identified by the Task Force at the next meeting.)

- Facilitator will compile the results of the survey and the Tucson Water information and send a report to the Task Force by February 10th for their consideration before the next meeting.

- Next meeting will be held on February 22 from 2 p.m. to 6 p.m. at a location to be determined by Tucson Water. The purpose of the meeting will be to:
    - review and discuss the results of the survey effort
    - determine a list of conservation options that should received detailed technical analysis

TENTATIVE PROCESS TIMELINE

February Initial qualitative screen of conservation options completed by Task Force
March Technical evaluation of selected conservation options completed by Consultant
(Exact timing evaluation will require input from consultant)
April/May Task Force recommendations developed and submitted to CWAC

(Note: Remaining Task Force meetings will be held on the 4th Wednesday of the month from
2 p.m. to 6 p.m. at a location to be determined. An effort will be made to find a single location that can be used for all the meetings.)

MEETING PARTICIPANTS

Ed Taczanowsky, Southern Arizona Home Builders Association
Patty Richardson, Tucson Association of Realtors
Carol Green, Business Owners & Managers Association
Judy Gausman, Arizona Landscape Contractors Association
Doug Crockett, TUSD
Ann Phillips, Tucson Audubon
Kathleen Chavez, Pima County
Robert Emanuel, CWAC
Martin Fogel, CWAC
Kathy Temple, residential representative
Christine Abeyta, residential representative
Alfredo Jauregui, Southern Arizona Lodging and Resort Association
Vinnie Hunt, City of Tucson

TUCSON WATER STAFF

Fernando Molina	Vikki Hibberd
Mitch Basfesky	Tracey Berry

COMMUNITY CONSERVATION TASK FORCE WORK-SESSION
February 22, 2006

MEETING RESULTS

MEETING TOPIC
IDENTIFY CONSERVATION PROGRAMS THAT ARE TO RECEIVE ADDITIONAL TECHNICAL ANALYSIS

PRESENTATIONS
- Technical analysis process overview—Gary Fiske, Tucson Water's technical consultant
- Tucson Water Screening Overview—Fernando Molina, Conservation Program Manager

OPENING DISCUSSION
- Before discussion began on what conservation programs should go on to receive additional technical analysis, Ann Phillips, Audubon representative, expressed her concern that constraints on the technical consultant's time now could be penny wise and pound foolish limiting the number of programs are analyzed.
- The committee also stressed the need to record programs and ideas that are not going forward for additional analysis so that they might be pursued at a later date.

PROGRAMS DELETED FROM TECHNICAL ANALYSIS LIST
Using the Tucson Water Staff Evaluation Matrix, the Task Force reviewed the list of programs that PASSED the Tucson Water screen and made determinations as to which programs should be deleted. The deleted programs will not go on to receive additional technical analysis. The programs deleted from the technical analysis list include:
- Shower/faucet kit distribution *(Single family housing and Multi-family housing)*
- Mandatory watering restrictions—to be used only in drought conditions *(Multi-family housing and Commercial/Industrial*)
- Pre-rinse spray valves direct install—pilot program underway *(Commercial/Industrial)*
- Pre-rinse spray valves rebates *(Commercial/Industrial)*
- Toilet & urinal code requirement for new construction—already in place *(Commercial/Industrial)*
- Irrigation system design standards ordinance for new construction—already in process *(Commercial/Industrial)*
- Strengthen existing landscape design ordinance for new construction—already in process *Commercial/Industrial)*

A total of 9 individual programs were deleted across sectors.

PROGRAMS ADDED TO TECHNICAL ANALYSIS LIST

Using the Tucson Water Staff Evaluation Matrix, the Task Force reviewed the list of programs that PASSED the Tucson Water screen and made determinations as to which programs should be added. The added programs will go on to receive additional technical analysis. They include:

- Grey water incentives for exiting single family housing
- Water harvesting incentive for existing single family housing
- Landscape design ordinance requiring passive water harvesting with xeri-scape for new single family housing
- Grey water ordinance requiring dual plumbing for new single family housing
- Ordinance requiring sub-metering retrofit when apartments are converted to condos
- Irrigation upgrade rebate--to include interior/exterior metering--for multi-family housing
- Interior/exterior metering incentives for commercial/industrial
- Passive water harvesting retrofit on resale ordinance for commercial/industrial

A total of 8 individual programs were added across sectors.

PROGRAMS SUPPORTED BUT NOT FORWARDED FOR TECHNICAL ANALYSIS

The Task Force kept a list of programs and ideas that were supported but not being forwarded for additional technical analysis. These included:

- All programs in Tucson Water Staff Evaluation Matrix listed under "Pilots/Demonstrations/Assessments
- All programs in Tucson Water Staff Evaluation Matrix scored as "Info only"
- Promote program to teach people how to use evaporative bleed off
- Clothes washer vendor driven program promotion for single and multi-family housing (could use a community based organization to help administer)
- Dishwasher promotion/pilot
- Educate homeowners on native plants and passive water harvesting
- Require water saving fixtures in existing multi-family common use areas
- Require separate interior/exterior metering in multi-family housing
- Pre-rinse spray valve rebates for commercial/industrial
- Pre-rinse spray valve direct install for commercial/industrial
- Cooling tower operation and maintenance practice standards for commercial/industrial

NEXT STEPS

- Technical consultant will proceed with the technical analysis with the objective of presenting the results to the Task Force at their April 26th meeting. (Complete list of programs that will receive technical analysis is attached separately)
- **Next meeting** will be held on **March 22 from 3 p.m. to 5 p.m.** at a location to be determined by Tucson Water. The purpose of the meeting will be to:
    - Define the Task Force end product and the process to develop that product, after the technical analysis is completed.

MEETING PARTICIPANTS
Laurie Lustig, Southern Arizona Home Builders Association
Patty Richardson, Tucson Association of Realtors
Carol Green, Business Owners & Managers Association
Judy Gausman, Arizona Landscape Contractors Association
Dylan Mackey, TUSD
Ann Phillips, Tucson Audubon
Kathleen Chavez, Pima County
Robert Emanuel, CWAC
Martin Fogel, CWAC
Gary Gustafson, residential representative
Alfredo Jauregui, Southern Arizona Lodging and Resort Association
Vinnie Hunt, City of Tucson

TUCSON WATER STAFF

Fernando Molina	Vikki Hibberd	Tom Arnold
Mitch Basfesky	Tracey Berry	Consultant: Gary Fiske

COMMUNITY CONSERVATION TASK FORCE WORK-SESSION
March 22, 2006

MEETING RESULTS

MEETING TOPICS

1) DEFINE TASK FORCE END PRODUCT
2) DETERMINE PROCESS FOR PROVIDING INPUT INTO THE TUCSON WATER DROUGHT MANAGEMENT PLAN.

TASK FORCE FINAL REPORT TOPICS

The final report to Mayor and Council could potentially include the following:

- Discussion of common ground assumptions
- Identification of the top priorities for conservation programs by sector, along with staging recommendations
- Discussion of common public perceptions regarding water conservation and public education needs.
- Funding opportunities—grants, Blue Drops program, etc.
- Discussion of the need for City modeling of water conservation behaviors
- Matrix for easy review of conservation programs and sectors to which they are applied.

CONSERVATION PROGRAM SCREENING CRITERIA

Once the technical analysis of potential conservation programs has been received, the Task Force will use the following criteria to help compare, contrast and finally select conservation programs for recommendation:

- Feasibility
    - Cost
    - Yield
    - Stakeholder support
- Overall benefit *(most benefit to most people)*
- Implemetability
- Potential for using financial incentives to encourage saving water
- Public visibility of program to support "learning moments"

Results of the technical analysis are not expected until sometime in May. Once the technical information is received, a survey instrument will be developed to allow task force members to score programs on the criteria identified above to help the group identify existing common ground and areas in need of further discussion.

DROUGHT MANAGEMENT PLAN INPUT PROCESS

Tucson Water Staff is developing a drought management plan which would, among other things, identify what water use restrictions would apply in drought conditions and what the trigger point would be for implementation of the plan. After discussion, the following was determined:

- The Task Force will serve as a focus group to review and provide input on the plan drafted by Tucson Water staff. Task Force input will be integrated with the drought management plan report that is ultimately presented to Mayor and Council. commercial/industrial

NEXT STEPS

- **Next meeting** will be held on **April 26 from 3 p.m. to 5 p.m.** at the **Randolph Golf Complex, 600. S. Alvernon**
- During the meeting the group will:
  - Identify and discuss public perceptions of water conservation for eventual inclusion in the Task Force final report. (*A questionnaire will be sent out in advance of the meeting to capture Task Force member thoughts)*
  - Hear a brief presentation on drought management so the group can be prepared to provide informed input into the draft drought management plan when it is ready for review.
  - Hear a brief presentation on water harvesting so the group can better understand this conservation option.

MEETING PARTICIPANTS

Lori Lustig, Southern Arizona Home Builders Association
Patty Richardson, Tucson Association of Realtors
Carol Green, Business Owners & Managers Association
Judy Gausman, Arizona Landscape Contractors Association
Doug Crockett, TUSD
Ann Phillips, Tucson Audubon
Kathleen Chavez, Pima County
Martin Fogel, CWAC
Gary Gustafson, residential representative
Alfredo Jauregui, Southern Arizona Lodging and Resort Association
Vinnie Hunt, City of Tucson
Jack Kelly, Commercial Horticultural Agent

Stakeholder alternates observing:

Kathy Temple, residential representative
Dylan Mackey, TUSD

TUCSON WATER STAFF

Fernando Molina	Vikki Hibberd	Tom Arnold
Mitch Basfesky	Tracey Berry	

COMMUNITY CONSERVATION TASK FORCE WORK-SESSION
April 26, 2006

MEETING RESULTS

MEETING TOPICS

1) Planning timeline
2) Public perceptions on conservation and how they might be addressed in the report
3) Drought management background presentation
4) Water Harvesting background presentation

PLANNING TIMELINE

Fernando Molina reported that it appears that the consultant's report--on conservation alternatives that were identified by the Task Force for further analysis—will not be ready for the regularly scheduled May meeting. A ***tentative*** schedule was discussed as follows:

- May Task Force meeting CANCELLED
- Consultant's report e-mailed to Task Force members the last week in May.
- June 7th meeting held for a presentation of consultant findings with a QA session. Time will be reserved at the end of the meeting to identify any additional information that the Task Force feels it needs to complete its task.
  (*Place and time to be determined after timeline is confirmed with consultant)*
- Meeting later in June (half or full day work session) scheduled in order to develop recommendations that will be submitted from the Task Force.
  (Place and time to be determined after surveying Task Force members regarding their availability)

PUBLIC PERCEPTIONS

"CWAC has asked the Community Conservation Task Force is to recommend stakeholder-supported water conservation measures that will reduce per capita water use and yield significant water savings."

With that charge in mind the group decided that the following topics should be added to the report, which would address the role of perceptions in conservation:

- Water conservation potential is untapped.
- Education is an important water conservation tool.
- Regular polls should be conducted to identify public perceptions and assist with the educational process. (Fernando Molina will distribute copies of the survey completed in 2004 to Task Force members)
- Concerns of Task Force members by stakeholder group should be identified and be used to help guide the development of polling questions.
- Water conservation needs to be a <u>regional</u> effort.

DROUGHT MANAGEMENT PLAN BACKGROUND

Reis Lindley presented background on the Tucson Water drought management plan and asked Task Force to complete a survey that he would be sending out via e-mail.

WATER HARVETING
Ann Phillips presented information on Water Harvesting and encouraged Task Force members to contact her to schedule a presentation for other groups.

NEXT STEPS

- **May meeting CANCELLED,** pending receipt of consultant's report.
- Consultant report to be e-mailed to Task Force members the last week in May (TENTATIVE)
- Next meeting to be scheduled in June for a presentation of consultant findings with a QA session. (TENTATIVELY scheduled for June 7th)
- Meeting later in June (half or full day work session) scheduled in order to develop recommendations that will be submitted from the Task Force. (Date to be determined)

MEETING PARTICIPANTS
Lori Lustig, Southern Arizona Home Builders Association
Oscar Lopez, Tucson Association of Realtors
Doug Crockett, TUSD
Ann Phillips, Tucson Audubon
Kathleen Chavez, Pima County
Gary Gustafson, residential representative
Evan Canfield, CWAC

Stakeholder alternates observing:
Dylan Mackey, TUSD

TUCSON WATER STAFF
Fernando Molina
Vikki Hibberd

COMMUNITY CONSERVATION TASK FORCE MEETING
June 15, 2006

MEETING RESULTS

MEETING TOPICS

5) Presentation of Benefit-Cost analysis results
6) QA session
7) Collection of additional information requests
8) Identification of next steps

TASK FORCE INFORMATION WISH LIST

The Task Force identified additional information they would like to see, if possible. Tucson Water agreed to work with the consultant to fulfill as many as the requests as possible within time and budget limitations. The information wish list included:

- Graphically illustrate components of Avoided Costs *(pie graph?)*
- Graphically illustrate sector savings *(pie graph?)*
- Illustrate savings effect using Resource Effects graphic *(Fernando has original)*
- How much water is being saved per cost, by program
- Sample calculation
- Recalculate Scenario's using lower TRC thresholds
- Recalculate Benefit-Cost ratio's using a range of discount rates
- Maximum potential savings by program for whole list of programs

INDIVIDUAL QUESTIONS

Evan Canfield:

- What are the assumptions that drive multi-family to have a high TRC for a graywater ordinance (#28), but not single-family residences (#10)?
- Is it possible to account for existing tax credits for water harvesting and graywater in benefit-cost?

Robert Emanuel:

- How big are the actual savings for each of the highlighted measures?
- How does water savings factor into TRC, and/or is it arbitrary cut off points?

Ann Phillips:

- Create pie graph showing relative weight of sectors of cost savings.
- Recalculate BCA using TRC of .1, .2, .3, .4 and .5 to see the impacts of this on water savings. (Sensitivity analysis)
- Recalculate BCA's using a range of discount rates—0%, 1%, 2%, 3%, 4%. (Sensitivity analysis)
- Add 40-44 back into tables. They are important perceptually and have + analysis across the board.

- Back calculate the amount of water savings needed to avoid the cost of implementing effluent treatment or obtaining CAP water. (i.e. what water savings are needed in order to rely entirely on CAP and residual groundwater and how does that water savings relate to the water that could be saved if all evaluated conservation measures were implemented, regardless of their cost.

NEXT STEPS

- Two work sessions will be scheduled in July to facilitate the development of Task Force recommendations—**July 11, 1 to 5 p.m. and July 26, 1 to 5 p.m.** Both meetings will be held at the Randolph Golf Complex.
- Tucson Water and the Consultant will work to respond to as many of the information requests as possible before the next meeting.

MEETING PARTICIPANTS

Lori Lustig, Southern Arizona Home Builders Association
Oscar Lopez, Tucson Association of Realtors
Ann Phillips, Tucson Audubon
Kathleen Chavez, Pima County
Evan Canfield, CWAC
Jack Kelly, Pima County Cooperative Extension
Judy Guasman, Arizona Landscape Contractors Association
Carol Green, Business Owners and Managers Association
Alfredo Jauregui, Southern Arizona Lodging and Resort Association
Kathy Temple, Residential Representative
Robert Emanuel, CWAC

TUCSON WATER STAFF

Fernando Molina
Mitch Basfesky
Vikki Hibberd

COMMUNITY CONSERVATION TASK FORCE MEETING
July 11, 2006

MEETING RESULTS

MEETING TOPICS

9) Develop Task Force recommendations
10) Identification of next steps

TASK FORCE DRAFT RECOMMENDATION LIST

High priority

- Pre-rinse spray valve incentive *(existing CII)*
- Targeted ULF Toilet rebate *(existing Single-family)*
- Irrigation system upgrade rebate *(existing Multi-family)*
- ULF Toilet rebate *(existing Multi-family)*
- Sub-metering ordinance *(new Multi-family)*
- Water Harvesting ordinance *(new CII)*

Medium priority

- Interior-exterior sub-metering incentive *(existing CII)*
- Passive water harvesting retrofit on resale ordinance *(existing CII)*
- Grey water incentive *(existing Single-family)*
- Irrigation system retrofit on resale ordinance *(Multi-family*
- Irrigation system retrofit on resale ordinance *(CII)*
- Targeted ULF toilet rebate *(existing CII)*
- Sub-metering ordinance on condo conversions *(Multi-family)*

Also supported

- Urinal rebate *(existing CII)*
- ULF toilet – community based distribution *(existing Multi-family)*
- ULF toilet – vendor driven delivery *(existing Multi-family)*
- ULF toilet – retrofit on resale *(existing Multi-family)*
- Irrigation design ordinance *(new Multi-family)*
- Revision of Landscape design standards *(new Multi-family)*
- Hot water recirculation demonstration program *(all sectors)*
- Smart controller demonstration program *(all sectors)*

Considered, but no consensus reached

- ULF toilet retrofit on resale *(Single-family)*
- Landscape design ordinance *(new Single-family or model homes)*
- Untargeted ULF toilet rebate *(existing CII)*
- Clothes washer ordinance *(new Multi-family)*

- Clothes washer rebate *(existing Multi-family)*
- Sub-metering rebate *(existing Multi-family)*
- Grey water ordinance *(new Single-family)*
- Need to coordinate (harmonize?) various landscape design standards efforts

NEXT STEPS

- Task Force members will review the results of the July 11th meeting and note any areas of concern for discussion at the next meeting.
- Tucson Water staff will develop a draft report for review and consideration by the Task Force at the next meeting.
- Next work session will be held on **Wednesday, July 26th, 1 to 5 p.m.** to facilitate the completion of the recommendations and review the text for the DRAFT Task Force report. Meeting will be held at the Randolph Golf Complex—Cooper Room.

MEETING PARTICIPANTS

Lori Lustig, Southern Arizona Home Builders Association
Oscar Lopez, Tucson Association of Realtors
Ann Phillips, Tucson Audubon
Kathleen Chavez, Pima County
Martin Fogel, CWAC
Jack Kelly, Pima County Cooperative Extension
Judy Guasman, Arizona Landscape Contractors Association
Carol Green, Business Owners and Managers Association
Alfredo Jauregui, Southern Arizona Lodging and Resort Association
Kathy Temple, Residential Representative
Robert Emanuel, CWAC
Doug Crockett, TUSD

TUCSON WATER STAFF

Fernando Molina
Mitch Basfesky
Tom Arnold
Arcadia Tapia

COMMUNITY CONSERVATION TASK FORCE MEETING
July 26, 2006

MEETING RESULTS

MEETING TOPICS

11) Finalize TF recommendations
12) Review draft report

TASK FORCE DRAFT RECOMMENDATION LIST

Task Force decided to look at the list of consensus supported programs with an eye toward equity and consider adding programs to expand the contribution from the Single-family sector. In preparation for this effort the Task Force requested that a revised Benefit-Cost table be provided with the following:

1) Column listing Savings for each program
2) Columns listing the costs, if possible
3) Consensus programs highlighted
4) Programs considered, but no consensus reached highlighted in a different color
5) List sorted by Savings (high to low)

DRAFT REPORT REVIEW

The following suggestions were provided by individual members of the Task Force:

- Add a discussion of public perceptions—equity, need for Tucson Water to work with other entities regionally, etc.
- Collaborative efforts by stakeholders to develop aggressive measures
- Include % savings for supported programs
- Add a recommendation for Mayor and Council to consider implementation of the entire list of programs for "aggressive water conservation"
- Add a discussion of the untapped conservation potential
- Add an executive summary to include:
    1. Recommendations
    2. Supply & Demand Curve
    3. Cost & Rate impact
    4. Process
- Include data analysis as an appendix
- Format with more bullets to increase readability
- Address inherent constraints of process:
    - Use of average of avoided costs
    - Lack of data/reliability
- Address issue of growth as it relates to water conservation
- Address relationship between conservation, water quality, and cost
- Conduct additional analysis to identify benefit-cost ratios and avoided costs for effluent-only option

NEXT STEPS

- Tucson Water staff will continue developing the draft report on current list of supported programs for review and consideration by the Task Force at the next meeting.
- Next work session will be held in August. Tentative dates include Monday, August 21 and Wednesday, August 23. A member survey will be sent out to determine the best date after it is determined when the information request can be filled.

MEETING PARTICIPANTS
Ann Phillips, Tucson Audubon
Kathleen Chavez, Pima County
Judy Guasman, Arizona Landscape Contractors Association
Carol Green, Business Owners and Managers Association
Alfredo Jauregui, Southern Arizona Lodging and Resort Association
Robert Emanuel, CWAC
Doug Crockett, TUSD

TUCSON WATER STAFF
Fernando Molina
Mitch Basfesky
Linda Smith

COMMUNITY CONSERVATION TASK FORCE MEETING
August 26, 2006

MEETING RESULTS

MEETING TOPICS

13) Finalize TF recommendations
14) Review draft report

TASK FORCE DRAFT RECOMMENDATION LIST

- By a Stakeholder vote of 12 to 1 the Task Force approved the following water conservation measures for recommendation to Mayor and Council:

Single Family

- Targeted ULF toilet rebate
- Grey water incentive *(existing homes)*

Multi-Family

- Irrigation system retrofits on resale ordinance
- ULF toilet retrofit on resale ordinance
- Irrigation system upgrade rebate
- High efficiency toilet rebate
- ULF toilet Community-based distribution
- ULF toilet Vendor-driven delivery
- Sub-metering ordinance *(new construction)*
- Irrigation system design ordinance
- Sub-metering ordinance for condo conversions
- Revise Landscape design standards *(new construction)*

Commercial-industrial

- Irrigation system retrofit on resale ordinance
- Interior and exterior sub-metering incentive
- Passive water harvesting retrofit on resale ordinance
- Targeted ULF toilet rebate
- Pre-rinse spray valve rebate
- Water harvesting ordinance *(new construction)*
- Waterless urinal rebate

Demonstration programs (all sectors)

- Hot water recirculation program
- Smart irrigation controller program
- Water harvesting program

- It was agreed that the Multi-family housing representative would submit a minority report outlining their concerns. The minority report should be as brief and succinct as possible, no longer that 1-2 pages.
- Task Force recommendations will be presented to CWAC and Mayor/Council by Robert Emanuel and Lori Lustig. All members are urged to attend those meetings

DRAFT REPORT REVIEW

- In addition to the suggestions noted at the previous meeting, the following suggestions were provided by individual members of the Task Force:
  - Recommendations should be listed by type of measure, not sector—incentives/rebates, ordinances, demonstrations.
  - Add a section addressing measures that are already in place or in progress. Note potential for water wasting ordinance to provide incentive for retrofit on resale of irrigation systems.
  - Emphasize to Mayor and Council that Task Force considers all recommended programs to be important.
  - Ease of implementation can be addressed in Tucson Water comments, submitted separately

- Task Force re-emphasized the importance of making the tone of the copy less bureaucratic and including a 1-2 page executive summary. Summary should include a quick reference chart incorporating the following columns
  5. Recommendations by type of measure
  6. Sector
  7. Cost and Savings data provided by consultant
  8. Totals and % of Demand for entire package of measures.

- Task Force review of further drafts will be facilitated by e-mail.

NEXT STEPS

- Tucson Water staff will develop a timeline for production of the report and distribute it to the Task Force. Timeline will include deadlines for Task Force review and submission of minority report.
- Tucson Water staff will notify Task Force of meeting dates for presentation of the recommendations.

MEETING PARTICIPANTS

Ann Phillips, Tucson Audubon
Kathleen Chavez, Pima County
Judy Guasman, Arizona Landscape Contractors Association
Carol Green, Business Owners and Managers Association
Alfredo Jauregui, Southern Arizona Lodging and Resort Association
Robert Emanuel, CWAC
Doug Crockett, TUSD
Lori Lustig, SAHBA

Martin Fogel, CWAC
Suzane Gilstrap, Multi-housing association
Jack Kelly, Pima County Coop Extension
Oscar Lopez, Tucson Association of Realtors
Kathy Temple, Residential Representative

TUCSON WATER STAFF
Fernando Molina
Linda Smith
Vikki Hibberd
Arcadia Tapia

Appendix B

Community Conservation Task Force

Screening Results

TUCSON WATER CONSERVATION OPTIONS
STAKEHOLDER OPINION SURVEY

RESULTS

Opportunity statement

The Citizens Water Advisory Committee (CWAC) Water has asked the Community Conservation Task Force to recommend stakeholder supported water conservation measures that will reduce per capita water use and yield significant water savings.

Survey results

- Survey results do NOT represent decisions. They merely provide additional insight as to where people stand at the moment, where there is common ground, and where opinions diverge. In this case the survey also captured some new ideas for consideration.

- As you review the results, be sure to note the comments. This will help Task Force members begin to understand the different points of view that are represented around the table. In addition, take note of the new ideas listed under "Other" in each section.

- Remember, respondents were asked to score each conservation option on a scale of 0 to 5-- with 0 being no support and 5 being complete support-- according to what they believed the level of support would be from their constituents, if that option were selected for the community.

- The 1st number in the "SUPPORT LEVEL" column represents the mean score of those who scored that option. The 2nd number in that column represents the number of people scoring that opinion. The number in the "DON'TKNOW" column represents the number of people who checked "DON'T KNOW". There were 13 total respondents.

Survey results next page

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OPTION	SUPPORT LEVEL	DON'T KNOW	MY THINKING
EXISTING HOUSING			
Incentives and Giveaways			
o Rebates for interior appliances—toilets, washers, hot water recirculation, dishwashers, water softeners	4.6 (10)	(3)	o Incentives always work, my concern is that low to moderate income do not always have the resources for brand new appliances and often purchase used. o Products must meet quality standards and proof of actual installation must be given. o From the Water CASA study this might not be a very effective use of resources. Still seems worth considering but maybe the gravy has been skimmed already on this. o Incentives are good—just depends on how you can pay for them. o Begin with incentive o I like the fact that it has been tried in another city and it has been successful (Las Vegas). o If savings are reasonable and cost is not prohibitive. o I would like to see the water savings compared to the rebate costs to see if this is an effective measure. WaterCASA's ECOBA study had some info on this. It would also be necessary to reserve a source of funds within the city budget for this and the effectiveness would probably

OPTION	SUPPORT LEVEL	DON'T KNOW	MY THINKING
			depend on how much funding is allocated.
o Rebates for exterior improvements—Evap. Cooler, misting system replacement, irrigation system, landscape design	4.0 (11)	(2)	o Should be contingent on income. I can't see giving rebates to wealthy people, though they probably use more water. o Incentives are good, just depends on how you pay for them. o Need to simplify the process for applying for rebates. o It will create more work for landscape industry. Need provision for requiring licensed contractors for work. o Rebates would be a reasonable alternative to retrofit on resale. o What would misting systems be replaced with? How would the utility/city monitor compliance, efficiency and proper maintenance?
o Showerhead/faucets/flapper kit distribution	3.3 (10)	(3)	o Distribution perhaps through an energy conservation class through a CBO. o This is not good. o CASA study said not very effective o Depends on how o If incentives fail o We have tried them on property, they work and you can not notice a difference o IF savings are high, this is a simple way to generate voluntary retrofit. o How much water will this save? How does one ensure the product is actually installed versus stored in the garage?
o Community-based org. program for ULF toilets	3.9 (10)	(3)	o Could partner with the Tucson Housing Rehab. Collaborative work group for the installation. o Depends on how o Probably a good idea, but need more info o Depends again on savings and may result in better low-income options than vendor-driven
o ULF toilet vendor driven delivery for multi-family housing	4.3 (8)	(5)	o Could save a lot o Who pays? o Probably a good idea, but need more info

OPTION	SUPPORT LEVEL	DON'T KNOW	MY THINKING
			o Not sure why vendor driven delivery would be more appropriate than community-based o What if there are additional modifications needed, i.e., the new footprint is smaller and tile work is needed, the new tank does not reach the wall? The success depends on the funding committed by the utility to pay for the ULF and installation contractor.
o Sub-metering financial incentives for multi-family housing	4.6 (9)	(4)	o Very important o Depends on how o If you do not sub-meter you cannot measure reductions o I think sub-metering should be required for all new multi-family housing. I can see this being costly for existing multi-family.
o Cash for grass program	3.3 (11)	(2)	o Bermuda grass is an invasive non-native species. Getting rid of it saves water and helps the environment, which is becoming increasingly threatened by invasive species. o Very important o Thought I heard Fernando say this would not likely be a good option to pursue-do not recall reason-but my thinking is this gives us a choice and not forcing customers to do anything if they choose not to o How does it get paid for? o Unrealistic program since Tucson does not have much grass. Vegas had mandatory fescue now must be Bermuda. What about cash for certified water audit instead? o Contractors would be ambivalent about it. Howmeowners may be interested in rebate. o Very little grass in Tucson to begin with o Level of problem in Tucson? o Las Vegas model o Refer to CASA ECOBA study. Need to review the cost to the utility compared to the water savings achieved. Also need to review the cost to the customer compared to the water savings achieved. Refer to AWWA

OPTION	SUPPORT LEVEL	DON'T KNOW	MY THINKING
			REUW study. Seasonal adjustments to the irrigation system are the key to water-saving success and this is an individual maintenance issue.
o Swimming pool cover promotion	4.6 (10)	(3)	o How many people have pools in Tucson? How much impact would it have? o Should be contingent on income. I can't see giving rebates to wealthy people, though they probably use more water. o City has successfully used pool covers for energy, water and chemical savings. I believe this program has also been successful in Las Vegas. o Part of public education o If savings are high enough o Need to look at the safety issues. Kids/pets/wildlife can get trapped underneath.
Ordinances and Mandates			
o Toilet retrofit on resale	3.2 (9)	(4)	o Association of Realtors has a policy against retrofits at time of resale o If incentives fail o Of all the retrofit on resale options, this one is most tenable o I would need to understand how this would be implemented, how the city would track sales and how exemptions would be established (homeowner may need to prove that a retrofit was already made)
o Hot water recirculation retrofit on resale	2.5 (8)	(6)	o This could save both on water and sewer facilities: needs to be thermostatically controlled o Do not have enough info to make a determination. Could be a costly retrofit item. o Against retrofits on resale. o I met with a group of 5 from landscape industry and they felt that rebates were better initiatives than ordinances. o Incentive not ordinance o I do not think there are enough of them being used to make a difference. o Retrofits on resale will be difficult to implement and financially difficult

OPTION	SUPPORT LEVEL	DON'T KNOW	MY THINKING
			on some sellers, especially as the market cools. o There would be some limits on the cost to retrofit. I have the same question for the ULF option: implementation, tracking sales, exemptions.
o Irrigation system retrofit on resale	1.9 (9)	(4)	o Do not have enough info to make a determination o Would this be a replacement requirement? Incentives are good. o Not realistic. Good for landscape industry, though on homeowner. Who decides the guidelines? o Irrigation contractors would support but property owners and managers may not citing additional costs. o Prefer incentives o I do not think it's fair for someone to bring their irrigation system up to ordinance when they are getting ready to sell their house and are hit with a retrofit bill for thousands of dollars. o Difficult to implement. Won't be very popular with sellers. Difficult to mandate given the wide variety of irrigation systems. Low income properties may suffer. Also, due to cost, doesn't encourage re-landscaping with more appropriate design o How would one know that a retrofit is needed? Will need criteria for the irrigation system and will need an exemption provision.
o Landscape Design Standards for resale of single family homes	2.3 (11)	(2)	o Incentives are good o Negative effect on real estate Markey o Retrofitting a landscape is more lucrative for contractors. Real estate industry may object citing costs. o I do not think it's fair for someone to bring their irrigation system up to ordinance when they are getting ready to sell their house and are hit with a retrofit bill for thousands of dollars. o Difficult to implement. Won't be very popular with sellers. Might result in lots of "zero-scape" rather than intelligent and well don "Xeriscape" o I would want to know more about the city resources needed to monitor

OPTION	SUPPORT LEVEL	DON'T KNOW	MY THINKING
			compliance.
o Water softener operating restrictions	3.5 (6)	(7)	o Do not have enough info to make a determination o Damage to plants from softened water toxicity. o How will efficiency be determined? I'm not familiar with water softeners so I don't know what is meant by centralized regeneration.
o Misting system operating restrictions or prohibitions	2.4 (11)	(2)	o Could be difficult to monitor and enforce o Likely would not support prohibitions o How do you enforce? o Public perception is problem o Might be easier to implement with commercial construction than existing private homes (similar to water waste ord.) o I don't agree with this for housing: would require government regulating what one does in their backyard. If misters were prohibited, would this be done at point of sale (banning sale at stores)? What would preclude one from going to Phoenix to buy one?
o Mandatory watering restrictions	3.0 (10)	(3)	o Need to be enforced o Could be hard sell at this time o Would have to see how it's structured-unless it's an emergency o From other experiences, beat the peak during day or restrictions to designated days only makes the homeowner water excessively on their scheduled days. Mandatory watering could be acceptable only in extreme drought conditions. o Unless restrictions are prioritized and realistic little or not support from nurseries, plant retailers and contractors o In severe drought o Easy fix. El Paso has a similar program that has worked well for years-odd numbered addresses water on Monday, Wednesday and Friday. Even numbered addresses water on Tuesday, Thursday and Saturday. o If implemented during specific drought scenarios. Tie to water current practice to show how greater efficiency/conservation will yield less

OPTION	SUPPORT LEVEL	DON'T KNOW	MY THINKING
			danger of future drought (educate on social nature of drought) o Should be implemented with drought provisions or designated emergencies of summer season.
o **Other *(please specify)*** ➢ Water Harvesting ordinance requiring water recycling, storm water use and grey water use where appropriate. ➢ Gray water incentive program ➢ Water harvesting incentive ➢ Rebate for Smart Controllers, instead of cash for grass			
NEW CONSTRUCTION-HOUSING			
Ordinances and Mandates			
o Hot Water Recirculation Systems	4.0 (9)	(4)	o Need to be designed properly o More info is needed on the amount of water saved versus the installation costs. Another option is to locate water heaters closer to the source or limit the hot water run (feet of piping)
o Water softener unit restrictions and/or centralized regeneration	4.2 (6)	(7)	o Need more information, I am not really familiar with water softener operations o Support with guidelines o Optional component for developer o Good idea o How will efficiency be determined? I'm not familiar with water softeners so I don't know what is meant by centralized regeneration
o High-Efficiency Clothes washers for multi-family facilities	3.9 (9)	(4)	o Would want to see an example o How will efficiency be determined?

OPTION	SUPPORT LEVEL	DON'T KNOW	MY THINKING
o Sub-metering for new multi-family housing	4.7 (9)	(4)	o Very important o Assuming metering costs are not high o How does this affect costs? o Encourage individual responsibility o If you do not sub-meter you cannot measure reductions o Absolutely vital to increase conservation behavior in multi-family housing o I agree
o Extend existing landscape design ordinance to include single-family	4.0 (9)	(4)	o What are costs? o Tucson looks brown and this may discourage planting trees. According to many experts, trees take less water than grass and many trees are over-watered. Not sure what the current ordinances are. It is my understanding that they differ region to region. o More work for contractors, suppliers and consultants o Need more information o If this doesn't lead to "zero"-scape o Aren't there landscaping design standards in the existing city code? Does it need to be revised or made more stringent? I don't know enough about the city's landscape code
o Strengthen landscape design ordinance for multi-family	3.9 (8)	(5)	o Would like to review existing ordinance o Unsure of current ordinance o More work for contractors, suppliers and consultants o Need more information o If savings are sufficient o Aren't there landscaping design standards in the existing city code? Does it need to be revised or made more stringent? I don't know enough about the city's landscape code
o Irrigation system requirements for new multi-family housing	4.0 (9)	(4)	o Is this the same as just above? o Unsure of current ordinance o More work for contractors, suppliers and consultants

OPTION	SUPPORT LEVEL	DON'T KNOW	MY THINKING
			o Need education for manager o Absolutely o Is there currently an irrigation ordinance? What are the provisions?
o Water harvesting requirements: water recycling, storm water and grey water use	4.0 (10)	(3)	o Great idea especially for multi-family units o Could use more info on this. Seems like there is a lot of opportunity due to high number of roofs, parking lots, etc that can be used to harvest storm water and number of grey water opportunities however not sure the cost/benefits of these options. o Not appropriate unless on a bigger scale o Cost of cistern may be prohibitive, long return on investment. Others may cite mosquito increase potential if not done correctly o Concern regarding misuse and health issues o Absolutely o The delivery mechanism is regulatory. What about incentives? How is this related to the rainwater harvesting manual?
o **Other *(please specify)*** ➢ Require water saving fixtures in common use buildings (apartment/condo complexes) ➢ Require seasonal adjustments and rain sensors in irrigation			
EXISTING COMMERCIAL/INDUSTRIAL			
Incentives and Giveaways			
o Rebates for interior appliances—toilets, washers, hot water recirculation, dishwashers, water softeners	4.2 (11)	(2)	o Rebates should not replace direct requirements, especially if they are going to businesses that could easily afford to do this. For small businesses that are struggling, rebates make more sense o I believe there would be opportunities in the commercial sector. Do you have any idea about COT facilities? How are our facilities in regards to

OPTION	SUPPORT LEVEL	DON'T KNOW	MY THINKING
			using low flow appliances? o Again, easier than retrofit ordinance o Especially useful for public school districts with limited capital funding. o I think the rebate program should be reserved for housing and small business, if at all. It should be mandatory for the rest.
o Rebates for operating upgrades— cooling tower operating/maintenance, evap. cooler, misting system replacement, irrigation system, landscape design	4.4 (10)	(3)	o Rebates should not replace direct requirements, especially if they are going to businesses that could easily afford to do this. For small businesses that are struggling, rebates make more sense o Based on a high users enhanced savings o Might be more politically palatable than ordinance o Air conditioning may not be practical for large warehouses. Should look at efficiency standards for evap. coolers. What would misting systems be replaced with?
o Rebates for specialty system upgrades—car wash system, food handling pre-rinse valves, dishwashers, x-ray processors, sterilizers	4.4 (11)	(2)	o Rebates should not replace direct requirements, especially if they are going to businesses that could easily afford to do this. For small businesses that are struggling, rebates better o Isn't this already a well known cost saving method for most businesses? o We installed a new pre-rinse valve and it works as good as the old one, if not better o Depends on savings o Again, might be more politically palatable o More likely to win support with incentives, at least to increase awareness at the beginning of a conservation program. o Depends on effectiveness, cost and water savings potential
o Enhance site surveys	3.3 (4)	(9)	o Don't know what this means o Not mandatory o Not clear on what is meant here o Especially water harvesting system assessment (see binder options) o Not enough info
o Car Wash efficiency census	4.0 (8)	(5)	o Public education fix

OPTION	SUPPORT LEVEL	DON'T KNOW	MY THINKING
			o How many car washes are there and how much water do they use?
o ULF toilet vendor driven delivery	3.8 (5)	(8)	o Who pays? o Not sure o Las Vegas model o Success dependent of funding availability
Ordinances and Mandates			
o Hot water recirculation retrofit on resale	3.4 (7)	(6)	o Do not have enough info to make a determination. Could be a costly retrofit item. We have studied our recirc loops and they are not designed to produce hot water at the tap in a timely manner. Recirc loops need to be properly designed. o Do not support retrofit on resale o Prefer incentives
o Improved cooling tower standards	4.0 (7)	(6)	o How to monitor? o Unfunded mandates are never popular, but this measure could be very effective for schools if it were tied to funding and training o Need more info on how much water they use; what are current standards?
o Mandatory car wash operating standards	4.3 (8)	(5)	o I thought these were already in place o Public education fix o Depends on results of census above o Need more info on how this would be implemented and enforced
o Water softener operating restrictions	3.8 (4)	(9)	
o Misting system operating restrictions or prohibitions	3.8 (10)	(3)	o Depends on how structured o Only as a replacement or rebate driven o Too difficult to enforce
o Performance based contracting	5.0 (3)	(10)	o Don't know what this means o Don't know what this is o Encourage, not mandatory o But this currently can't work for school districts using "excess utilities:

OPTION	SUPPORT LEVEL	DON'T KNOW	MY THINKING
			funding until July 2009 (e.g. TUSD) o Need more info
o **Other *(please specify)*** ➢ Rainwater harvesting requirements ➢			o There is a huge potential for this (rainwater harvesting) in commercial and industrial sites because of the huge parking lots that usually come with these sites. City Codes already require water harvesting for new subdivision (common areas), commercial building, public rights of way, and public buildings. There are some easy water harvesting retrofits that can and should be done on existing sites.
NEW CONSTRUCTION COMMERCIAL/INDUSTRIAL			
o Toilet and urinal code requirements	4.7 (9)	(4)	o I feel it is a lot easier to accomplish this on new construction o Easier to fund with new construction o What are current code requirement?
o Clothes washer ordinance	4.4 (9)	(4)	o Would this be regulated at the plan review level or at the point of sale?
o Cooling tower standards	4.6 (9)	(4)	o ADWR already has cooling tower standards for those sites that have their own wells, so these would be easy to piggy back on in terms of cooling tower efficiency. Also the potential to use harvested rainwater in cooling towers should be investigated maybe through a study that TW conducts. o What are current standards? o Unsure of current ordinance o Maintenance staff training must also be included for these ordinances to be effective o What are current standards?
o Food handling ordinance	4.0 (8)	(5)	o Health and safety make me ambivalent o What does current ordinance require?
o Hot water recirculation ordinance	4.1 (9)	(4)	o We have studied our recirc loops and they are not designed to produce hot water at the tap in a timely manner. Recirc loops need to be properly

OPTION	SUPPORT LEVEL	DON'T KNOW	MY THINKING
			designed.
o Water softener ordinance	4.0 (6)	(7)	o Needs efficiency standards
o Water use plan (indoor & outdoor) requirement for new construction permit	3.9 (9)	(4)	o Consultants may support but groups such as SAHBA may oppose citing added costs of construction o Might be a way for private sector to help businesses succeed rather than City-enforcement approach
o **Other *(please specify)*** ➢ Energy efficient construction ➢ Rainwater harvesting ordinance ➢ Restrictions on turf and No turf in areas less than 8-10 feet wide. ➢ Restrictions on outdoor water features			o Energy efficient construction can reduce water consumption because electrical generation consumes water in massive cooling towers. Therefore things like passive solar design to both heat and keep houses cool can save water. o There is a huge potential for this (rainwater harvesting) in commercial and industrial sites because of the huge parking lots that usually come with these sites. City Codes already require water harvesting for new subdivision (common areas), commercial building, public rights of way, and public buildings. o Rainwater harvesting directed to landscaping to reduce irrigation demand o Cannot irrigate turf properly without overspray and wasting water
GENERAL CONSERVATION PROGRAMS			
Incentives and Giveaways			
o Adjust connection fees to reward water efficiencies	4.5 (11)	(2)	o Especially if coupled with grants/favorable financing, etc. However TW needs to be careful not to reduce fees such that system equity is compromised.

OPTION	SUPPORT LEVEL	DON'T KNOW	MY THINKING
			o The problem with that is how do you know the owner or future owner will replace the fixture with a high water using one?
o Provide grants, favorable financing, or discounted mortgages for installation of water efficient technologies	4.6 (10)	(3)	o Great idea if cost can be justified by water savings o Need to evaluate the life span of the water efficient technology. It doesn't make sense to offer and 30-year mortgage discount for appliances that have a 12-year life span or less.
o Redesign customer water bills	4.0 (7)	(6)	o Something that would show actual water use is simple to understand o I don't see where this is described in the documentation provided. o Education o To reflect more info on how much water is used and how much could be saved o Electronic transfer of monthly data & payments would especially help C/I customers o Not effective unless it helps customers understand where to save water.
o Water use inefficiency surcharge	4.3 (10)	(3)	o Water waste need a high price tag o Should be included in design standards o How to monitor? o How do we enforce o I believe that "green fees" or "freebates" can be self-funding so that high water users pay disincentives that pay incentives for low water users. o More info is needed. Does this entail establishing a water budget for classes of users and charging more for exceeding budget? This will penalize large families. Low income users that can't afford to replace high water using fixtures and complex irrigation systems
o Block water rates for multi-family customers	2.8 (6)	(7)	o Many low to moderate households are multi-family households o If I understand this correctly, should not be required to pay for neighbors over usage o I don't see where this is described in the documentation provided. o Need to be consistent with single family o I think this would penalize apartments with a large number of units

OPTION	SUPPORT LEVEL	DON'T KNOW	MY THINKING
o Drought pricing for water	3.1 (10)	(3)	o Cost may prohibit healthy landscapes due to inadequate water o Absolutely-a must given a clear signal for consumers and managers (of drought threshold) o What would be done with the additional revenue?
o Water budget-based rate structure	3.5 (6)	(7)	o Not sure what this means o Feasibility? o Need more info o Block rate that is in place now is perhaps more appropriate o Better option for Commercial/Industrial o For irrigation only meters? Need more info on implementation. Seems like it would need to be site specific
o New construction Smart from Start program	4.5 (8)	(5)	o I don't see where this is described in the documentation provided. o This is best of all ideas o Would like to see what this is o Explain? If similar to TEP Guarantee program is then useful o I'm not familiar with this program and it sounds very useful o Is this like the green star/blue drop program? What are the current construction guidelines? Are there construction requirements?
Ordinances and Mandates			
o Revise or enhance water wasting ordinance	4.4 (11)	(2)	o Enforcement is very important o Difficult to enforce at this point-unless City budgets for more auditors and many more Tracey's o Would like a review of existing system
o New construction demand offsets	4.0 (4)	(9)	o I don't see where this is described in the documentation provided. o Probably will be very controversial at least at this time. Could be a very cost effective method for conservation. May be good item to explore for the long term potential. Seems to be needed if we are going for a sustainable water usage in the basin. o Are there not enough exactions at this time?

OPTION	SUPPORT LEVEL	DON'T KNOW	MY THINKING
			o Important o Is this new construction paying for retrofits for existing construction?
General			
o Distribution system leak detection and repair	4.6 (10)	(3)	o What does the water department do in this regard—shouldn't this be a maintenance priority? o Add to existing program o Consistent with current practice o Not effective unless the leaks are repaired
o Distribution system water pressure control	4.7 (9)	(4)	o Consistent (continue) current practice o Controlling reclaimed water system pressure is especially critical to prevent customer pressure spikes that has be expensive for TUSD o Need more info
o Revise education programs	3.8 (11)	(2)	o Education is the key to getting the community to participate voluntarily o How effective is this? Cannot measure water conservation. Should not spend a lot of money o Programs such as Smartscape, Water Audit, etc. are excellent. Perhaps expanding programs in necessary. o Learn through training o To do what? Two suggestions: work to explain Colorado River connection, social nature of drought, and how conservation NOW will slow implantation of drought restrictions at a later date o Evaluate the programs to determine the ones that re most cost effective (cost of program compared to water savings) and eliminate the least cost effective. Is the audit program one?
o Upgrade and enhance web site for water conservation	3.6 (11)	(2)	o Make the site current and have helpful information on water conservation and latest technologies o Learn through training o Depends. Print, person-person-mass media, K-12, and adult education may be more effective than web content

OPTION	SUPPORT LEVEL	DON'T KNOW	MY THINKING
			o It could be especially effective for customers to see their own account history online to compare with local or national benchmarks for efficiency o Do you monitor number of hits? Might want to measure the effectiveness of the present website
o **Other *(please specify)*** ➢ Incentives for water saving devices such as permit fee discounts**,** vendor discounts ➢ Separate metering for irrigation			o Separate metering would help customers understand where the water use is and it would be easier to convert to reclaimed water if it is ever available region-wide

GENERAL COMMENTS

- I do not have sufficient information on <u>any</u> of the options to make an informed decision on ranking.
- According to the data I recall the residential sector is the greatest water user group by far—single and multifamily housing stock.
- Seems like there is enough general educational materials regarding conservation. If programs and ordinances are enacted there needs to be education before, during and post implementation to ensure but-in, program participation and monitoring of savings.
- Is there a way to have restrictions apply to non-Tucson water customers? Not sure how many there are in Tucson Water territory but private well owners/users should help in the water conservation efforts.
- City should make sure its house is in order before imposing requirements on others. We should be using waterless urinals, have water efficient cooling towers and operate them in an efficient manner, etc. How is the City's public house stock as far as water eff. Toilets and appliances goes?
- Not sure how much water the TEP power plant uses but electrical generation uses considerable amounts of water. Perhaps they can be given incentives for using dry cooling for their condenser cycle rather than evaporative cooling.

Appendix C

Tucson Water Staff
Qualitative Screening / Fail (pages 62- 71)

Qualitative Screening / Pass (pages 72- 80)

Tucson Water Conservation Program Evaluation Matrix

The Tucson Water Conservation staff completed a qualitative screen of potential conservation programs. It was designed to help screen out those programs that just don't fit Tucson for qualitative reasons and help determine what programs should be explored with a more detailed technical analysis. The results of this screen do not represent a final decision. Instead they are being presented to the Conservation Task Force for consideration.

With the assumption that costs and savings turn out to be adequate, the City reviewed each project on three criteria. They include the following:

- **Utility Match**: ***The applicability of the technology to the climate, building stock, and customers of the service territory***.
    - In some cases, we considered the nature of the potential participants. For example, based on our experience, a "cash for grass" program would mostly benefit customers in the upper socio-economic strata. An incentive program would not have much impact for those who are already willing to pay higher block water rates.
    - We also considered the number of the potential participants. For instance, radiological processing or sterilizing equipment owners are very narrow markets and would require very customized programs.
    - Finally, we considered the nature of the technology/program, to determine the degree to which Tucson Water would encourage the use of specific solutions. For example, Tucson Water does not encourage water softening for a variety of environmental and "tap water trust" reasons.
- **Implementation Feasibility**: ***The degree of administrative, staffing, billing, institutional, and legal difficulties associated with implementing the program.***
    - In addition to the impact on the Water Department we considered the impact on other City and County departments. For example, ordinances can complicate permitting and design review.
    - We also considered the City's (and other agency's) ability to enforce and verify compliance with the measures. For instance, it would be difficult to certify whether existing residences are complying with water efficiency regulations.
    - It is important to note that although rebate programs of any kind must comply with the City Attorney's strict interpretation of State laws, we did not fail any programs for this cause.

Continued next page

- **Acceptability:** ***The acceptability of each program/strategy for affected groups.***

- Tucson Water developed a list of five groups that would be affected in some way by enhancing our conservation measures and evaluated the acceptability of each program/strategy for each group.. The five groups identified include:
  1. Stakeholders
  2. Political (Mayor, Council and other elected/government officials)
  3. General public
  4. Tucson Water Utility
  5. Ratepayers

  (Note: The evaluation was based solely on Tucson Water's perspective, and may not represent an accurate picture in each case)

- Strategies were assigned a value based on the number of groups which we thought would find them acceptable. If the strategy was acceptable to only 1 group, it would be given a rating of 1. Strategies acceptable to all five groups would be rated "5".

- During the rating process, Tucson Water made the following assumptions:
  - Ordinances would not be acceptable to a least one stakeholder group.
  - Rebates to commercial enterprises, including property management companies and landlords would not be acceptable to Mayor and Council.
  - Rebates would be supported by all impacted stakeholders.
  - Rebates will generally not be acceptable to rate payers as they will be funded out of current revenues and would cause rates to rise.

Results

Programs were given an overall Pass rating if they passed both the Utility Match and Implementation Feasibility criterion, and if they had an acceptability ranking of 3 or above. Using this process 45 programs were identified as programs that should go on to receive more detailed technical analysis.

For reporting purposes Tucson Water separated the programs that were evaluated into two documents.

1) Conservation programs that passed the qualitative screen
2) Conservation programs that failed the qualitative screen

The following pages contain the programs that "failed" the screen. Again, the results of this screen do not represent a final decision

TUCSON WATER

QUALITATIVE SCREEN OF SINGLE-FAMILY INTERIOR CONSERVATION PROGRAMS						
Technology	**Delivery Mechanism**	**PASS/FAIL**	**Utility Match**	**Implementation Feasibility**	**Acceptability**	**Comments**
EXISTING CONSTRUCTION						
Clothes washers	Rebate program	F	P	P	2	Technically feasible, but non-essential appliances. Price differential too large ($300-400)
Dishwashers	Rebate program	F	P	P	2	Technically feasible, all new units efficient. Non-essential appliance.
Space Cooling	Evaporative cooler, misting system replacement rebates	F	F	F	1	Controlled by rates. Misting systems are non-essential.
	Misting system operating restrictions or prohibitions	F	F	F	2	Excessive use controlled thru rates structure
Water Softeners	Replacement incentives	F	F	F	1	Performance of alt technology unknown
	Operating restrictions	F	F	F	2	Not enforceable
NEW CONSTRUCTION						
Water Softeners	Ordinance requiring efficient units and/or centralized regeneration.	F	P	P	2	Tucson Water does not encourage water softeners

QUALITATIVE SCREEN OF SINGLE-FAMILY EXTERIOR CONSERVATION PROGRAMS						
Technology	**Delivery Mechanism**	**PASS/FAIL**	**Utility Match**	**Implementation Feasibility**	**Acceptability**	**Comments**
EXISTING CONSTRUCTION						
Irrigation Systems	Rebate for replacement/upgrades	F	P	F	2	Too Complicated and labor intensive to verify
	Retrofit on resale ordinance	F	P	F	1	Too Complicated and labor intensive to verify; impacts on third parties.
Landscape Design	Rebate	F	F	F	0	Not an issue in Tucson, mostly low water use landscapes; difficult to implement; rely on rates to keep adjusted; commonly found in high income areas- not acceptable to pay them for design work
	Cash-for-grass	F	F	F	0	Rely on rates; not much grass; grass commonly used by high income customers not acceptable to pay them to replace grass
	Ordinance specifying landscape design standards for resales	F	F	F	0	Too complicated and too many home sales
Other	Mandatory watering restrictions	F	P	F	3	Only under drought conditions
NEW CONSTRUCTION						
Irrigation Systems	Ordinance re: new construction design standards	F	P	F	3	Too many inspections required, third party impacts
Landscape Design	Extend existing ordinance for new construction to cover single-family	F	P	F	2	Anticipate trickle down from C/I standards. Already occurring voluntarily
Water Harvesting	Ordinances to require water recycling, stormwater use, and greywater use where available and appropriate	F	P	F	4	High impact on staff to determine where available and appropriate

QUALITATIVE SCREEN OF MULTI-FAMILY INTERIOR CONSERVATION PROGRAMS						
Technology	**Delivery Mechanism**	**PASS/FAIL**	**Utility Match**	**Implementation Feasibility**	**Acceptability**	**Comments**
EXISTING CONSTRUCTION						
Dishwashers	Rebate program	F	P	P	2	Anticipated lack of support to pay private business to replace dishwashers
Space Cooling	Evaporative cooler, misting system replacement rebates	F	Pass-evaporative cooler Fail-misting systems	F	1	Existing mf housing not designed to use air-conditioning in an efficient way. Misting systems non-essential
Water Softeners	Replacement incentives	F	F	F	0	Not commonly used in MF Setting
	Operating restrictions	F	F	F	0	Not commonly used in MF Setting
NEW CONSTRUCTION						
Water Softeners	Ordinance	F	F	F	0	Tucson Water does not encourage water softeners

QUALITATIVE SCREEN OF MULTI-FAMILY EXTERIOR CONSERVATION PROGRAMS						
Technology	**Delivery Mechanism**	**PASS/FAIL**	**Utility Match**	**Implementation Feasibility**	**Acceptability**	**Comments**
EXISTING CONSTRUCTION						
Irrigation Systems	Rebate for replacement/upgrades	F	P	P	2	Anticipated lack of support to pay private business to replace irrigation
Landscape Design	Rebate	F	P	P	2	Anticipated lack of support to pay private business to replace irrigation
	Cash-for-grass	F	P	P	2	Anticipated lack of support to pay private business to replace grass
	Ordinance specifying landscape design standards for resales	F	P	F	3	Implementing redesign of irrigation systems too expensive for resales
NEW CONSTRUCTION						

QUALITATIVE SCREEN OF COMMERCIAL/INDUSTRIAL INTERIOR CONSERVATION PROGRAMS						
Technology	**Delivery Mechanism**	**PASS/FAIL**	**Utility Match**	**Implementation Feasibility**	**Acceptability**	**Comments**
EXISTING CONSTRUCTION						
Clothes washers	Rebate program	F	P	P	1	Anticipated lack of support to pay private business to replace clothes washers
Hot Water	Recirculation system retrofit on resale ordinance	F	P	F	3	Too difficult to implement because of diverse customers
Space Cooling	Evaporative cooler, misting system replacement rebates	F	P-evaporative F-misting systems	F	1	Existing building stock not designed to use air conditioning efficiently. Anticipated lack of support for rebates to businesses.
	Misting system operating restrictions or prohibitions	F	N/A	P	4	Already have an ordinance
Cooling Towers	Operations and maintenance practices standards	F	P	F	4	Difficult to enforce
	Rebates	F	P	P	2	Anticipated lack of support for rebates to private business
Car Washes	Rebates for system upgrades	F	F	F	2	Technology largely been adopted.
Food handling	Efficient dishwasher rebates	F	P	F	1	Anticipated lack of support to pay private business to replace dishwashers
Medical	X-ray processor rebates	F	F	P	2	alt technology unknown & sector small
	Sterilizer rebates	F	F	F	0	Alt technology unknown & sector small
Water Softeners	Replacement incentives	F	F	F	0	Anticipated lack of support to pay private business to replace softeners
	Operating restrictions	F	F	F	0	Un-enforceable
NEW CONSTRUCTION						
Water Softeners	Ordinance	F	F	F	0	Tucson Water does not encourage water softeners

Other	Water use plan requirement for new construction/permit issuance (indoor & outdoor)	F	F	F	4	Duplicates other programs

QUALITATIVE SCREEN OF COMMERCIAL/INDUSTRIAL EXTERIOR CONSERVATION PROGRAMS						
Technology	**Delivery Mechanism**	**PASS/FAIL**	**Utility Match**	**Implementation Feasibility**	**Acceptability**	**Comments**
EXISTING CONSTRUCTION						
Irrigation Systems	Rebate for replacement/upgrades (incl timers, moisture sensors, ET controllers, etc.)	F	P	P	2	Anticipated lack of support to pay private business to replace irrigation
Landscape Design	Rebate	F	P	P	2	Anticipated lack of support to pay private business for landscape design work
	Cash-for-grass	F	P	P	2	Anticipated lack of support to pay private business to replace grass.
	Ordinance specifying landscape design standards for resales	F	P	F	3	Implementing redesign of irrigation systems too expensive for resales
Water Harvesting	Ordinance to require rainwater and greywater use where available and appropriate	F	P	P	2	Implementing redesign of water reuse systems too expensive

Tucson Water Conservation Program Evaluation Matrix

The Tucson Water Conservation staff completed a qualitative screen of potential conservation programs. It was designed to help screen out those programs that just don't fit Tucson for qualitative reasons and help determine what programs should be explored with a more detailed technical analysis. The results of this screen do not represent a final decision. Instead they are being presented to the Conservation Task Force for consideration.

With the assumption that costs and savings turn out to be adequate, the City reviewed each project on three criteria. They include the following:

- **Utility Match**: ***The applicability of the technology to the climate, building stock, and customers of the service territory***.
    - In some cases, we considered the nature of the potential participants. For example, based on our experience, a "cash for grass" program would mostly benefit customers in the upper socio-economic strata. An incentive program would not have much impact for those who are already willing to pay higher block water rates.
    - We also considered the number of the potential participants. For instance, radiological processing or sterilizing equipment owners are very narrow markets and would require very customized programs.
    - Finally, we considered the nature of the technology/program, to determine the degree to which Tucson Water would encourage the use of specific solutions. For example, Tucson Water does not encourage water softening for a variety of environmental and "tap water trust" reasons.

- **Implementation Feasibility**: ***The degree of administrative, staffing, billing, institutional, and legal difficulties associated with implementing the program.***
    - In addition to the impact on the Water Department we considered the impact on other City and County departments. For example, ordinances can complicate permitting and design review.
    - We also considered the City's (and other agency's) ability to enforce and verify compliance with the measures. For instance, it would be difficult to certify whether existing residences are complying with water efficiency regulations.

- It is important to note that although rebate programs of any kind must comply with the City Attorney's strict interpretation of State laws, we did not fail any programs for this cause.

Continued next page

- **<u>Acceptability:</u>** ***The acceptability of each program/strategy for affected groups.***
  - Tucson Water developed a list of five groups that would be affected in some way by enhancing our conservation measures and evaluated the acceptability of each program/strategy for each group... The five groups identified include:
    6. Stakeholders
    7. Political (Mayor, Council and other elected/government officials)
    8. General public
    9. Tucson Water Utility
    10. Ratepayers

    (Note: The evaluation was based solely on Tucson Water's perspective, and may not represent an accurate picture in each case)

  - Strategies were assigned a value based on the number of groups which we thought would find them acceptable. If the strategy was acceptable to only 1 group, it would be given a rating of 1. Strategies acceptable to all five groups would be rated "5".

  - During the rating process, Tucson Water made the following assumptions:
    - Ordinances would not be acceptable to a least one stakeholder group.
    - Rebates to commercial enterprises, including property management companies and landlords would not be acceptable to Mayor and Council.
    - Rebates would be supported by all impacted stakeholders.
    - Rebates will generally not be acceptable to rate payers as they will be funded out of current revenues and would cause rates to rise.

Results

Programs were given an overall Pass rating if they passed both the Utility Match and Implementation Feasibility criterion, and if they had an acceptability ranking of 3 or above. Using this process 45 programs were identified as programs that should go on to receive more detailed technical analysis.

For reporting purposes Tucson Water separated the programs that were evaluated into two documents.

3) Conservation programs that passed the qualitative screen
4) Conservation programs that failed the qualitative screen

The following pages contain the programs that "passed" the screen. Again, the results of this screen do not represent a final decision.

TUCSON WATER

QUALITATIVE SCREEN OF SINGLE-FAMILY INTERIOR CONSERVATION PROGRAMS						
Technology	**Delivery Mechanism**	**PASS/FAIL**	**Utility Match**	**Implementation Feasibility**	**Acceptability**	**Comments**
EXISTING CONSTRUCTION						
ULF Toilets	Rebate program	P	P	P	5	
	Retrofit on resale ordinance	P	P	P	3	
	Community-Based Organization program.	P	P	P	5	
Showerheads, Faucets, Flappers	Kit distribution	P	P	P	5	
Hot Water	Recirculation system rebate program	P	P	P	4	
	Recirculation system retrofit on resale ordinance	P	P	P	3	
NEW CONSTRUCTION						
Hot Water	Recirculation system ordinance	P	P	P	4	
PILOTS, DEMONSTRATIONS, ASSESSMENTS						
Toilets	Dual-flush toilet demonstration	Info Only	Info Only	Info Only	5	Support concept of such projects, but should not include in analysis
Hot Water	Point of use water heaters demonstration program	Info Only	Info Only	Info Only	5	Support concept of such projects, but should not include in analysis

QUALITATIVE SCREEN OF SINGLE-FAMILY EXTERIOR CONSERVATION PROGRAMS						
Technology	**Delivery Mechanism**	**PASS/FAIL**	**Utility Match**	**Implementation Feasibility**	**Acceptability**	**Comments**
EXISTING CONSTRUCTION						
Other	Modify site surveys to target high outdoor use customers.	Info Only	P	P	5	Info Only
	Swimming pool cover promotion	Info Only	P	P	5	Info Only
NEW CONSTRUCTION						
PILOTS, DEMONSTRATIONS, ASSESSMENTS						
Irrigation Systems	ET controller Pilot Program (to determine local cost effectiveness, local acceptability)	Info Only	Info Only	Info Only	Info Only	Support concept of such projects, but should not include in analysis
Water Harvesting	System assessment for rainwater harvesting potential	Info Only	Info Only	Info Only	Info Only	Support concept of such projects, but should not include in analysis

QUALITATIVE SCREEN OF MULTI-FAMILY INTERIOR CONSERVATION PROGRAMS						
Technology	**Delivery Mechanism**	**PASS/FAIL**	**Utility Match**	**Implementation Feasibility**	**Acceptability**	**Comments**
EXISTING CONSTRUCTION						
ULF Toilets	Rebate program	P	P	P	5	
	Vendor-driven delivery	P	P	P	5	
	Retrofit on resale ordinance	P	P	P	3	
	Community-Based program	P	P	P	5	
Showerheads, Faucets, Flappers	Kit distribution	P	P	P	5	
Clothes washers	Rebate program	P	P	P	3	
Hot Water	Recirculation system rebate program	P	P	P	3	
	Recirculation system retrofit on resale ordinance	P	P	P	3	
Space Cooling	Misting system operating restrictions or prohibitions	P	P	P	3	
Sub metering	Financial incentives	P	Pass	Pass-if evaluated how?	4	
NEW CONSTRUCTION						
Clothes Washers	Ordinance	P	P	P	4	
Hot Water	Ordinance	P	P	P	4	
Sub metering	Ordinance	P	P	P	4	
PILOTS, DEMONSTRATIONS, ASSESSMENTS						
Toilets	Dual-flush toilet demonstration	Info Only	Info Only	Info Only	5	Support concept of such projects, but should not include in analysis
Hot Water	Point of use water heaters demonstration program	Info Only	Info Only	Info Only	5	Support concept of such projects, but should not include in analysis

QUALITATIVE SCREEN OF MULTI-FAMILY EXTERIOR CONSERVATION PROGRAMS						
Technology	**Delivery Mechanism**	**PASS/FAIL**	**Utility Match**	**Implementation Feasibility**	**Acceptability**	**Comments**
EXISTING CONSTRUCTION						
Irrigation Systems	Retrofit on resale ordinance	P	P	P	3	
Other	Swimming pool cover promotion	Info Only	P	P	5	
	Mandatory watering restrictions	P	P	P	4	Only under drought conditions
NEW CONSTRUCTION						
Irrigation Systems	Ordinance re: new construction design standards	P	P	P	4	
Landscape Design	Strengthen existing ordinance	P	P	P	4	
Water Harvesting	Ordinance to require rainwater and greywater use where available and appropriate	P	P	P	4	
PILOTS, DEMONSTRATIONS, ASSESSMENTS						
Irrigation Systems	ET controller Pilot Program (to determine local cost effectiveness, local acceptability)	Info Only	Info Only	Info Only	5	Support concept of such projects, but should not include in analysis
Water Harvesting	System assessment for rainwater harvesting potential	Info Only	Info Only	Info Only	5	Support concept of such projects, but should not include in analysis

QUALITATIVE SCREEN OF COMMERCIAL/INDUSTRIAL INTERIOR CONSERVATION PROGRAMS						
Technology	**Delivery Mechanism**	**PASS/FAIL**	**Utility Match**	**Implementation Feasibility**	**Acceptability**	**Comments**
EXISTING CONSTRUCTION						
Toilets & Urinals	ULF toilet rebate program	P	P	P	3	
	Urinal rebate program	P	P	P	3	
	Vendor-driven program	P	P	P	3	
	Toilet & urinal valve replacement	P	P	P	3	
Hot Water	Recirculation system rebate program	P	P	P	3	
Car Washes	Conduct census of car washes and car wash efficiency	info only	info only	info only	5	
	Mandatory operating standards	P	P	P	4	It would be tied to a drought response plan
Food handling	Pre-Rinse Spray Valves direct install	P	P	P	3	
	Pre-Rinse Spray Valves rebates	P	P	P	3	
Other	Performance-based contracting	Info Only	Info Only	Info Only		
	Enhance site surveys	Info Only	Info Only	Info Only		Info Only
NEW CONSTRUCTION						
Toilets & Urinals	Code requirement for new construction	P	P	P	5	already in force
Clothes Washers	Ordinance	P	P	P	3	
Cooling Towers	Standards	P	P	P	4	
Food Handling	Ordinance	P	P	P	4	
Hot Water	Recirculation system ordinance	P	P	P	4	
PILOTS, DEMONSTRATIONS, ASSESSMENTS						
Hot Water	Point of use water heaters demonstration program	info only	info only	info only	5	Support concept of such projects, but should not include in analysis
Food Handling	Assess potential for boiler less food steamers	info only	info only	info only	5	Support concept of such projects, but should not include in analysis

Other	Evaluate water recycling information and ordinances	info only	info only	info only	5	Support concept of such projects, but should not include in analysis

QUALITATIVE SCREEN OF COMMERCIAL/INDUSTRIAL EXTERIOR CONSERVATION PROGRAMS						
Technology	**Delivery Mechanism**	**PASS/FAIL**	**Utility Match**	**Implementation Feasibility**	**Acceptability**	**Comments**
EXISTING CONSTRUCTION						
Irrigation Systems	Retrofit on resale ordinance	P	P	P	3	
Irrigation Systems Other	Modify CII site surveys	Info Only	Info Only	Info Only	5	
	Swimming pool cover promotion	Info Only	Info Only	Info Only	5	
	Mandatory watering restrictions	P	P	P	4	Only under drought conditions
NEW CONSTRUCTION						
Irrigation Systems	Ordinance re: new construction design standards	P	P	P	4	
Landscape Design	Strengthen existing ordinance	P	P	P	4	
Water Harvesting	Rebates to require rainwater and greywater use where available and appropriate	P	P	P	4	
PILOTS, DEMONSTRATIONS, ASSESSMENTS						
Irrigation Systems	ET controller Pilot Program (to determine local cost effectiveness, local acceptability)	Info Only	Info Only	Info Only	5	Support concept of such projects, but should not include in analysis
Water Harvesting	System assessment for rainwater harvesting and reuse potential	Info Only	Info Only	Info Only	5	Support concept of such projects, but should not include in analysis

Appendix D

Economic Analysis of 43 Proposed Measures

Tucson Water Benefit-Cost Results				
	Program	**Utility**	**TRC**	**Participant**
Single-Family Existing				
2	ULFT Retrofit on Resale	5.99	0.55	2.76
1c	Targeted ULF Rebate	1.23	0.67	6.73
6	Greywater Incentive	1.10	0.38	2.37
5	Hot Water Recirc ROR	0.77	0.02	0.12
3	ULFT CBO	0.78	0.78	N/A
1a	ULFT Rebate	0.72	0.45	5.35
1b	HET Rebate	0.52	0.39	7.25
7	Water Harvest Incentive	0.34	0.12	0.75
4	Hot Water Recirc Rebate	0.14	0.02	0.14
Single-Family New				
8	Hot Water Recirc Ord	14.01	0.03	0.15
10	Greywater Ord	14.63	0.23	0.71
9	Landscape Design Ord	7.17	0.52	1.67
Multi-Family Existing				
20	Submetering Ordinance	213.87	0.40	1.82
21	Irrig System ROR	30.35	2.30	7.42
17	Hot Water Recirc ROR	18.24	0.07	0.28
14	ULFT Retrofit on Resale	12.07	1.11	4.73
22	Irrig Sys Upgrade Rebate	7.49	2.88	13.92
15	Clotheswasher Rebate	3.27	0.52	4.28
11b	HET Rebate	1.83	0.85	6.09
13	ULFT Community-Based	1.72	1.72	N/A
11a	ULFT Rebate	1.46	0.90	9.16
19	Submetering Rebate	1.41	0.40	2.55
12	ULF Vendor-Driven	1.26	1.26	N/A
18	Mist System Restrictions	1.24	0.13	0.24
16	Hot Water Recirc Rebate	0.20	0.07	0.42
Multi-Family New				
23	Clotheswasher Ordinance	138.94	0.57	4.31
25	Submetering Ordinance	17.08	0.71	3.45
28	Wtr Harv & Greywater Ord	5.91	5.91	N/A
26	Irrigation Design Ordinance	9.09	1.94	7.52
27	Rev Landscp Des Stds	1.81	0.26	1.00
24	Hot Water Recirc Ord	0.76	0.02	0.11
CII Existing				
34	Car Wash Oper Stds	14.06	0.74	3.44
36	Irrig System ROR	12.32	2.66	13.77
35	Submetering Reqmt	3.52	0.72	3.84
37	Water Harvest ROR	2.96	0.69	3.27
29b	ULFT Rebate Targeted	1.95	0.67	5.59
38	Pre-Rinse Rebate	1.94	1.11	16.33
39	Pre-Rinse Direct Install	1.38	1.38	N/A
29a	ULFT Rebate Untargeted	1.33	0.49	4.24
30	Urinal Rebate	1.15	0.39	3.30
31	Vendor-Driven Toil & Urinal	0.52	0.52	N/A
32	Valve Replacement	0.39	0.18	2.19
33	Hot Water Recirc Rebate	0.17	0.07	0.61
CII New				
42	Food Handling Ordinance	30.24	2.94	20.37
40	Clotheswasher Ordinance	24.67	0.30	1.54
44	Wtr Harv & Greywater Ord	1.78	1.78	N/A
41	Cooling Tower Ops Ord	0.65	0.65	N/A
43	Hot Water Recirc Ord	0.67	0.67	N/A

Appendix E

Summary of Conservation Programs

I. ***GENERAL PUBLIC INFORMATION*** ***(We* ask *you to conserve!)***

Designed to promote water conservation and inform about issues:

A. Pamphlets and Brochures
B. Public Service Announcements
C. ***Community Events*** *(Civic, trade, neighborhood events, etc.)*
D. Beat the Peak

II. ***EDUCATION AND TRAINING*** ***(We* teach *you how to conserve!)***

Designed to educate and train participants in structured classroom setting:

A. ***Water Smart Landscape Workshops*** *– Two-hour workshops targeting residential customers. Held on Saturdays in locations throughout Tucson basin, and advertised in bill insert. Workshop topics include:*

1. *Drip Irrigation Design, Installation, and Maintenance*
2. *Plant Selection and Design*
3. *Irrigation Timer use and Irrigation Scheduling*
4. *Water Harvesting*

B. ***SmartScape Landscaper Workshops*** *– Series of eight workshops designed to teach landscape professionals, property managers, and homeowner associations about water conservation practices in landscape management. Spanish language Smartscape available Spring 2006. Advanced SmartScape Training available 2006.*

C. ***LOW 4 Program*** *– Pima County Cooperative Extension Program sponsored by Tucson Water, offering landscape water conservation programs to commercial users, school districts, and general public. LOW 4 stands for low cost, low maintenance, low water, and low energy landscapes. (622-7701)*

1. *Landscape Water Audit Training*
2. *Turf Maintenance Workshop*

D. Youth Education Program

Classroom materials for specific grade levels designed to teach about water supply, conservation, and quality issues.

1. ***'Da Drops – Grade 3***
   Student Activity book and Supplemental Teacher Guide for classroom use, followed by special classroom presentation. Designed to teach about water cycle, groundwater, and water distribution.

2. ***Our Water, Our Future – Grade 5***
   Five-unit Classroom Curriculum Packet, followed by classroom presentation. Designed to teach about students about water cycle, water supply, and water quality.
3. ***Tucson Toolkit – Grades 7-8***
   Five-Unit Student Activity Book and Supplemental Teacher Guide. Designed to teach about water cycle, water quality, and water conservation. Optional home-audit classroom research project available.
4. ***High School Program*** *– The program is designed to bring water studies into broader curricular areas by building capacity among teachers and encouraging students to develop water-related projects.*

a. ***Teacher Internship Program*** *– Two-Week paid internship offered to high school teachers. Teachers are provided with tours of facilities, presentations on related issues, and job-shadowing opportunities. Development of classroom materials and assistance with development of subsequent elements are work products.*

5. ***Education Outreach*** *– The Education Outreach program provides classroom presentations and tours, and supports other education related programs.*
   a. ***Wetlands Program*** *– Tours and classrooms presentations that help students understand about wastewater treatment, recharge, and conservation.*
   b. ***Student Projects*** *– Regional Science Fair awards, River of Words poetry contest, Water Expo.*
   c. *Sweetwater Wetlands Guidebook available 2006.*

III. ***INCENTIVE PROGRAMS*** *(We* **offer $** *incentive to conserve!)*

A. ***Rates*** *- ¢. 25 buys:*
   - 1 gallon from vending machine
   - 125 gallons from Tucson Water
   1. ***Residential Rate*** *– Increasing Block Rate for Residential Customers. Current recommendation includes the development of "Superblock" for high-volume user.*
   2. ***Commercial Rate*** *– Summer Surcharge rate for commercial customers during May through September.*
   3. ***Multi-Housing Rate*** *– Flat Rate*

B. ***Other*** *– Other methods are available to provide a financial incentive to reduce water use. Rebates have been offered in the past, but are not available at this time.*

IV. ***DIRECT ASSISTANCE PROGRAMS*** *(We'll come and* **do it for you***!)*

These programs are designed to provide direct assistance to customers in helping them reduce their water use.

A. ***Zanjero Program*** *– A residential water-auditing program designed to maximize water conservation potential around the home. The service includes leak detection, replacement of showerheads and aerators, and adjustments of toilets. Landscaping is assessed, and appropriate irrigation requirements are determined. Customers are provided a report showing water and dollar savings.*
B. ***Business/Industry/Government (B/I/G) Program*** *– Water conservation assistance program targeting commercial and industrial customers. Facility audits are conducted to identify all uses of water and identify conservation potential.*

V. ***ORDINANCES*** *(We'll* **make** *you do it!)*

A. ***Xeriscape Landscape Ordinance*** *– Affects all commercial and multi-family construction projects. The ordinance requires adherence to Xeriscape principles, including limitation on high water-use plantings/features, low water use plant requirements, and appropriate irrigations system design.*

B. ***Plumbing Code*** *– Requires the use of water-efficient plumbing fixtures including 1.6 gallon per flush toilets, 2.5 gallon per minute showerheads and faucets and showerheads.*

C. ***Water Waste and Theft*** *– Revised June 2000 with tougher definitions of waste and higher penalties. Initial penalty established at minimum $250; $500 for subsequent penalty within three year period. Penalties can be waived through attendance of Water Waste Diversion Program. Violations currently defined as:*

1. *Allowing water to escape property*
2. *Allowing water to pond greater than ¼ inch, or greater than 150 square feet on any street or parking lot.*
3. *Washing driveways, sidewalks, parking areas with an open hose/under normal system pressure.*
4. *Operating misting systems in unoccupied non-residential areas.*
5. *Operating a permanently installed irrigation system with a broken head or emitter, or a head spraying more than 10% of the spray onto a street or parking lot.*
6. *Failing to repair a controllable leak.*

D. ***Emergency Water Conservation*** *– Allows for prohibitions or limitations on certain types of uses of water under emergency conditions. Restricted uses include car washing, landscape watering, filling/refilling of swimming pools.*

Appendix F

(Consultant Report)

Tucson Water Conservation Plan
Draft Final Report
Gary Fiske and Associates

TUCSON WATER CONSERVATION PLAN

Draft Final Report

Prepared by:

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September 2006

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I. INTRODUCTION

Tucson Water (TW), in conjunction with the Community Conservation Task Force (CCTF), undertook an effort to carefully examine a wide range of water conservation programs and develop recommendations regarding the conservation programs with which to move forward. This report describes the analytical process which was undertaken to identify those programs which are the best fit for the Tucson Water service area. A separate report describes the deliberations of the CCTF.

The analysis that is described in detail in the following sections was comprised of several steps:

- The study began with a Baseline Analysis, which developed forecasts of per-capita demand for single-family and multi-family customers, taking into account existing stocks and natural replacement of key end uses. The baseline analysis also examined potential conservation savings among commercial and industrial customers.

- The next step was to develop a universe of conservation measures to be considered as to their suitability for Tucson. This list of measures was intended to be very inclusive to ensure that no measure was inadvertently omitted from consideration.

- Then, each of the measures was screened against qualitative criteria to eliminate those which were clearly not a good match for Tucson.

- A detailed economic analysis was then conducted of the programs that survived the qualitative screen. Program savings and costs were estimated and, based on these and on a forecast of Tucson Water's avoided supply costs, benefit-cost ratios were calculated.

- Based on the results of the economic analysis, 'moderate' and 'maximum' conservation program scenarios were developed. For each, estimates were made of current and future water savings, costs, and staffing requirements.

- Based on these two scenarios, the CCTF developed its own recommended menu of conservation programs, which added several programs to the 'maximum' scenario. Estimates were made of current and future water savings, costs, and staffing requirements associated with this CCTF-recommended scenario.

Following are detailed discussions of each of these analytical steps.

II. BASELINE ANALYSIS

The purpose of the baseline analysis was to develop detailed understandings of how each customer class currently use water and how these uses will change in the future without the implementation of new water conservation programs. The usage forecasts reflect natural replacement of fixtures that are associated with plumbing codes. Thus, for example, the percentage of ultra-low-flush toilets will increase over time as older fixtures are replaced and as new construction becomes a larger proportion of the housing stock. New construction is also assumed to have lower outdoor requirements. As a result, the per-capita consumption is forecast to decrease over time even without utility intervention.

Detailed discussions of the analytical approaches used in the baseline analysis are included in Appendix A. Following are descriptions of the key results.

Single-Family and Multi-Family Baseline Usage

The single-family and multi-family analyses developed forecasts of per-capita and total indoor and outdoor usage for existing and new construction. These usage estimates were broken down into key end uses. Key results include:

Current (2004) Usage (Existing Construction)

Single-Family: 114 gallons per capita per day (gpcd)
- Indoor: 62.5 gpcd
- Outdoor: 51.5 gpcd

Multi-Family: 98.5 gpcd
- Indoor: 72.5 gpcd
- Outdoor: 26 gpcd

Current (2004) Usage (New Construction)

Single-Family: 100 gpcd
- Indoor: 57 gpcd
- Outdoor: 43 gpcd

Multi-Family: 78 gpcd
- Indoor: 57 gpcd
- Outdoor: 21 gpcd

The projected average per-capita usage for the single-family and multi-family classes, without any added utility conservation programs, are shown in Figures 1 and 2 below. Note that, as fixtures are replaced and as more new homes are added to the housing stock, the per-capita usage declines.

The usage breakdowns across end uses are shown in Figures 3 and 4. For both single-family and multi-family customers, the largest single end use is outdoor irrigation, although this category is a much larger percentage of total usage for single family than for multi-family customers. Among indoor end uses, toilet flushing is the largest component, followed closely by clotheswashing, faucets, and showers.

Commercial and Industrial Baseline Usage

Analyzing commercial and industrial usage is inherently more difficult than residential uses because of much more diversity among uses, and less available data. Figure 5 shows the current baseline distribution of usage for those customers. Once again, outdoor irrigation is the largest single end use. This result is somewhat skewed by the presence of a small number of very large outdoor users (e.g. golf courses). Moreover, approximately 68% of commercial/industrial outdoor irrigation is done with reclaimed water.

Figure 1

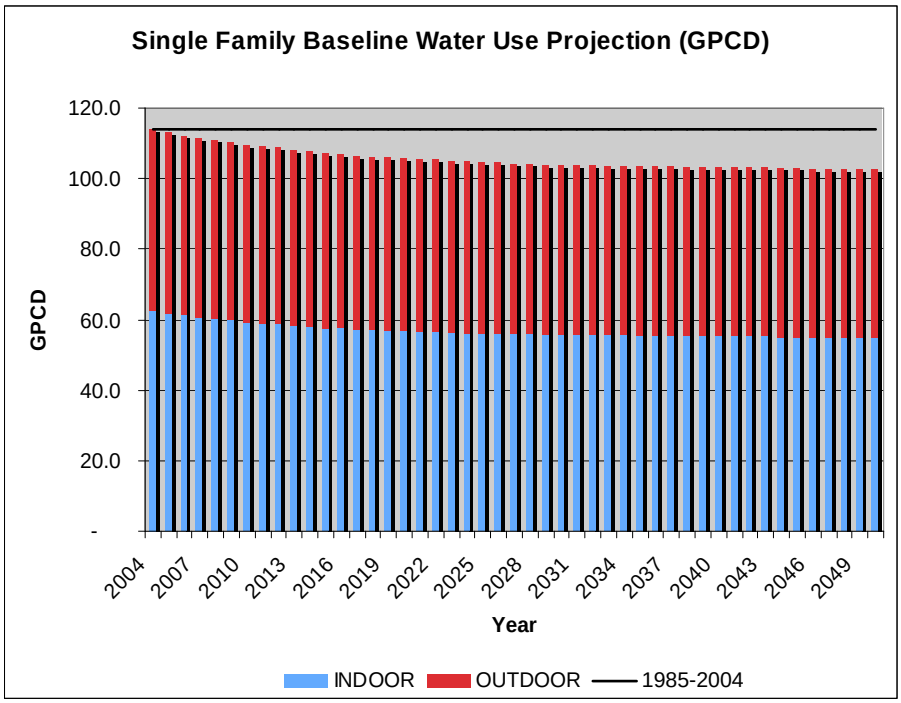


Figure 2

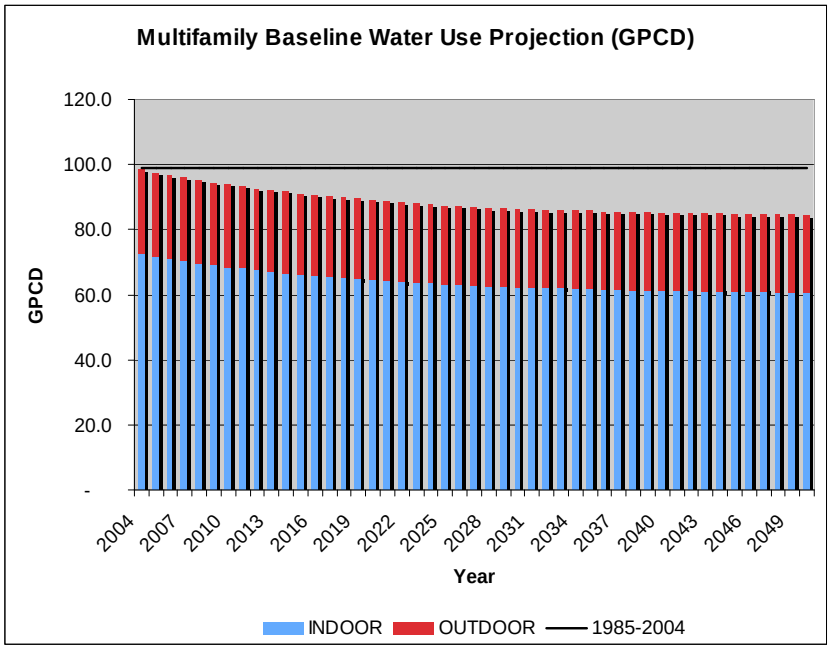


Figure 3

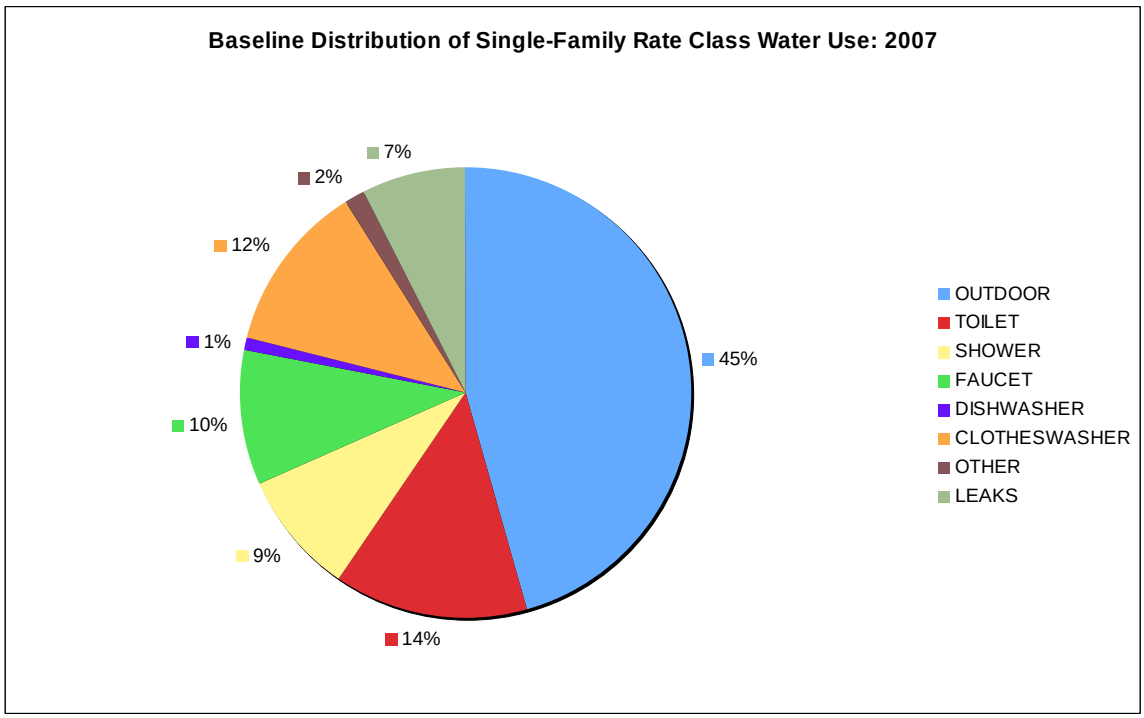


Figure 4

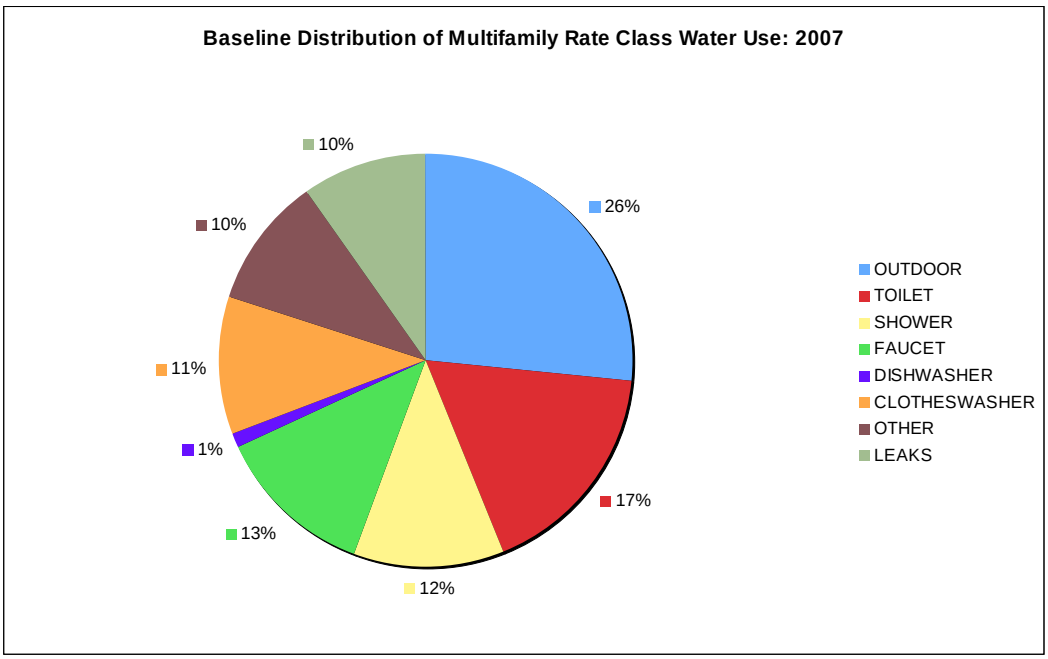
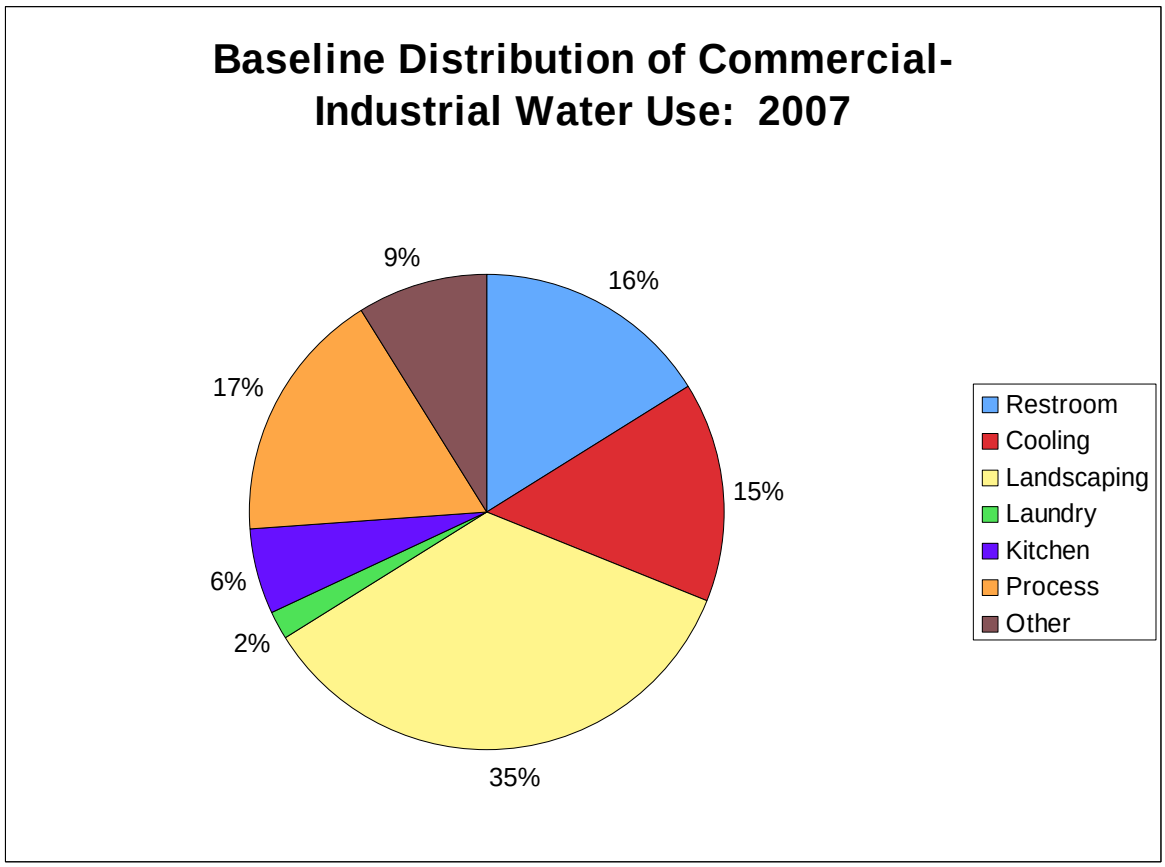


Figure 5



III. UNIVERSE OF CONSERVATION MEASURES AND QUALITATIVE SCREEN

The next critical step in the conservation planning process was to define a broad universe of conservation measures. The intent is to ensure that all measures that have any chance of being a good fit for Tucson are considered. In a planning exercise of this type, it is important that policymakers are confident that all possibilities were considered, and that nothing 'fell through the cracks'. Thus, inclusions and exclusions of measures must be made as explicit as possible.

There were 122 measures included in the universe; they are listed and described in Appendix B.

This large set of conservation measures was narrowed in two steps. They were first assessed against a set of qualitative screening criteria. This assessment was intended to exclude those measures which are clearly not a good match for Tucson Water, so that only those measures which appear to be a potential fit for Tucson undergo the more rigorous economic analysis (see below).

Tucson Water staff and the CCTF members simultaneously screened the programs. The staff assessment focused on two issues, namely:

- **Utility match**. The applicability of the measure to the climate, building stock, and customers of the service territory.

- **Implementation feasibility**. The degree of administrative, staffing, billing, institutional, legal, and political difficulties associated with implementing the measure.

Staff rated each measure as 'passing' or 'failing' against each of these two criteria. Any measure that failed either of these was deemed inappropriate for the Tucson Water service area, and was excluded from further consideration. Meanwhile, CCTF members were asked to assess the level of support they believed each measure would garner from their constituency groups. Detailed results of both of these ratings are included as Appendix C.

The result of these independent evaluations, subsequent discussions between staff and CCTF members, and final adjustments was the selection of 48 conservation programs. These programs were then subjected to a detailed economic analysis to determine which programs make the most economic sense from several perspectives. The programs that passed the economic analysis were then combined to develop two alternative conservation scenarios for consideration by the CCTF. The 48 programs analyzed are shown in Table 1.

Table 1
Tucson Water
Conservation Programs Subject to Economic Analysis

Single-Family Existing Construction
Greywater Incentive
High Efficiency Toilet (HET) Rebate
Hot Water Recirculation System Rebate
Hot Water Recirculation System Retrofit on Resale (ROR) Ordinance
ULFT Community-Based-Organization (CBO) Distribution
ULFT Rebate (Targeted)
ULFT Rebate (Untargeted)
ULFT ROR Ordinance
Water Harvesting Incentive

Single-Family New Construction
Greywater Ordinance
Hot Water Recirculation Ordinance
Landscape Design Ordinance

Multi-Family Existing Construction
Clotheswasher Rebate
HET Rebate
Hot Water Recirc ROR Ordinance
Hot Water Recirculation System Rebate
Irrig System ROR Ordinance
Irrigation System Upgrade Rebate
Misting System Operating Restrictions
Submetering Ordinance for Condo Conversions
Submetering Rebate
ULFT CBO Distribution
ULFT Rebate
ULFT ROR Ordinance
ULFT Vendor-Driven Distribution

Multi-Family New Construction
Clotheswasher Ordinance
Hot Water Recirculation Sytem Ordinance
Irrigation Design Ordinance
Revised Landscape Design Standards
Submetering Ordinance
Water Harvesting & Greywater Ordinance

CII Existing Construction
Car Wash Operating Standards
Hot Water Recirculation System Rebate
Irrigation System ROR Ordinance
Pre-Rinse Valve Direct Install
Pre-Rinse Valve Rebate
Submetering Requirement
Toilet Valve Replacement
ULFT Rebate (Targeted)
ULFT Rebate (Untargeted)
Urinal Rebate
Cooling Tower Retrofit
Vendor-Driven Toil & Urinal Distribution
Water Harvest ROR Ordinance

CII New Construction
Clotheswasher Ordinance
Food Handling Ordinance
Hot Water Recirculation System Ordinance
Water Harvesting & Greywater Ordinance

IV. ECONOMIC ANALYSIS

The economic analysis sought to quantify and compare the economic benefits and costs that the program confers on different groups. Specifically, the analysis seeks to answer three key questions about each of the programs that passed the qualitative screen:

1. Are the economic benefits of the program to the utility greater than or less than the utility's economic costs? Economic benefits and costs to the utility are equivalent, respectively, to reductions or increases in utility revenue requirements, which in turn translate into reductions or increases in the average customer's water bill.

2. Are the economic benefits of the program to the broader society greater than or less than the societal economic costs? In other words, no matter to whom the program's benefits and costs accrue, is there a net benefit or a net cost?

3. Do the economic benefits to those water customers who participate in the program, exceed those customers' costs, or vice versa?

In each case, it is critical that the analysis properly reflect the timing of the occurrence of benefits and costs. For most conservation programs, the costs associated with each program participant are 'front loaded', that is, they are incurred at or near the time of customer enrollment in the program, while the benefits are spread over a much longer period of time. For example, in an ultra-low-flush toilet rebate program, the cost of the toilet and installation occurs when the participant enters the program. The benefits, which result from the water savings, are spread over the useful life of the fixture, up to 25 years. To account for these timing disparities, the discounted *present values* of program benefits and of program costs are compared. The present value of a series of dollar amounts uses a *discount rate* to reflect the lower value of future dollars as compared to present dollars. This is a well-accepted, economically valid way to compare streams of benefits and costs.

It is also critical to note that this analysis is looking solely at *economic* impacts. There may be important non-economic issues that Tucson policymakers also wish to consider. This study does not explicitly dealt with those concerns.

Program-Specific Inputs to Economic Analysis

The economic analysis requires that the savings, costs, and participation rates associated with each program be specified. The required input assumptions are as follows:

Program Savings Inputs

- Peak-season and off-peak-season daily water savings: The expected per-unit savings in gallons per day during the peak and off-peak seasons. The Tucson Water peak season is defined as the months of June, July, and August.

- Savings duration: The number of years that the savings can be expected to last, typically limited by the physical life of the installed equipment.

- Annual natural turnover rate: The percentage of inefficient units, if any, that are expected to be replaced with efficient units each year due, for example, to code requirements. This expected natural replacement reduces the expected savings due to the conservation program itself.

- 'Free riders': The expected percentage, if any, of program participants who would have replaced their inefficient units with efficient units even without the program. The savings associated with these 'free riders' cannot be attributed to the conservation program.

- Annual electric and/or gas savings: The expected annual per-unit electric or gas savings, if any, due to the program.

Program Cost Inputs

- Initial variable utility costs: The administrative and marketing cost borne by the utility for each program participant.

- Fixed annual utility costs: The annual labor cost borne by the utility required to operate the program.

- Capital and installation costs: The cost of the device or equipment, including installation, if relevant.

- Water utility incentive: The share of the capital and installation costs paid by the utility. The remainder of the capital and installation costs are borne by the program participant.

Program Participation Rates

- For each program, estimates must be made of expected *annual participation rates* (i.e. how many customers are expected to participate in the program each year).

The foregoing savings, cost, and participation assumptions are enumerated and documented in Appendix D.

Utility Avoided Costs

As will be explained below, the critical economic benefit of water conservation programs is the utility supply and facility costs that are avoided as a result of the water savings. Thus, a key requirement of the economic analysis is to develop a forecast of the utility's avoided costs. Avoided costs will differ widely across water utilities, which means that programs that are economically attractive to some utilities will be unattractive to others.

There are two types of avoided costs that must be considered in order to value the economic benefits of water conservation programs:

- **Short-run avoided costs**. These are the costs that are immediately avoided due to the reduced water production that results from the conservation-induced demand reductions. This could include reduced costs of purchases, power and chemical costs associated with treatment, power costs associated with pumping, etc. All of these avoided costs vary with the volume of water produced and/or delivered.

- **Long-run avoided costs**. Conservation also may allow the deferral and/or downsizing of planned supply or facility additions and expansions that would otherwise be needed to increase production capacity as the demand grows over time. This might include treatment plants, reclamation facilities, recharge facilities, conveyance infrastructure, etc. The economic value of these conservation-induced investment modifications must be estimated.

Both of these avoided cost components may vary by season and will change over time.

<u>The Avoided Cost Model</u>

The model used to calculate Tucson Water's avoided supply costs was developed for the California Urban Water Conservation Council (CUWCC) and the American Water Works Association Research Foundation (AwwaRF). It is a generalized Excel-based tool which is designed to be applied to any utility configuration. Based on user inputs regarding present and future demands, supplies, and facilities, as well as basic economic assumptions, the model computes seasonal short-run and long-run avoided costs over a user-designated planning period.

<u>Tucson Water Avoided Costs</u>

Short Run Avoided Costs. A critical assumption of the avoided cost analysis is that Tucson Water (TW) will use as much Central Arizona Project (CAP) water as possible until full utilization is achieved between 2012 and 2015. Since potable demand is expected to be greater than the TW capacity to use its CAP allocation throughout the planning period, any reduction in

demand will not affect the use of CAP. As a result, reductions in both peak-season and off-peak-season demands are assumed reduce groundwater production. The cost avoided due to this reduced production include the following three components:

- **Pumping (Energy) Cost**: Based on the 2005 Production Well Energy Usage report, these costs average approximately $187 per million gallons (mg).[1]

- **Boosters**: The $90/mg pumping cost is based on an assumed two zone lift.[2]

- **Chemical Cost**: Based on the 2003 chemical cost estimates as a percentage of pumping costs., the estimated chemical cost is approximately $13/mg.[3]

Because of the Assured Water Supply (AWS) Rules, the City is allowed to mine a limited amount of groundwater. 'Mining' groundwater under the AWS rules means pumping groundwater without having to replace it with some other renewable supply. Each provider is given a fixed amount of groundwater it can pump without replenishment and these are referred to as allowable groundwater credits. These credits can be bought and sold; the prices of these transactions provide a good estimate of the value of a unit of saved water. In this avoided cost estimation process, the price that Tucson Water paid for credits in a recent transaction, $77 per acre-foot ($235/mg), was used to estimate this economic benefit. This is added to the three direct variable costs components described above.

Long Run Avoided Costs. It is assumed that the City will ramp up to full utilization of its CAP allocation by 2015. None of the facilities needed to recharge, recover and transport the additional CAP between now and 2015 can be deferred. This additional capacity will be added to the existing production capacity in the potable well fields. As such, the next opportunity for deferring major capital expenditures for new source development will not occur until after 2015. While it may be possible to rely on the groundwater system for several years following 2015, allowing the use of groundwater to drift up to its sustainable volume, we are assuming here that facilities to take renewable supply will be put into place in 2016 to minimize the use of groundwater. The cost of additional facilities after 2020 was not considered.

There is a great deal of uncertainty regarding what the next source of potable water supply will be after 2015. Given this uncertainty, the approach taken was to identify two scenarios, one with a relatively low cost and another with a relatively high cost. Both projects are designed to begin at the same time to satisfy the demands identified in the City's water resources plan.

In addition to these large resource projects, operational reservoirs were included in the long run costs beginning in 2010. The need for operational storage expands at a rate of about 6 mg per year. Thus, it was assumed that storage would be constructed in 24 MG increments every four

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[1] See *2005 Production Well Energy Usage - Pumpage Ratio*. Tucson Water - Research and Technical Support. 2005

[2] *Water Plan 2000-2050, Final Draft*. Technical Papers and Addenda. Page IV-22 Table 8. Tucson Water. November 2004.

[3] See *Financial Analysis for System Acquisitions: La Casita Water Company. Variable Cost Estimate*. Tucson Water Financial Services, 2003

years and each reservoir constructed would have a storage capacity of 8 MG. The cost of these storage facilities was taken from *Water Plan 2000-2050*.

Low Cost Scenario: CAP Utilized in a Storage and Recovery Facility
In about 2016, the City will require additional renewable water supplies to *avoid* using its groundwater resources. In this scenario, it is assumed that this supply is additional CAP water, and that the City will seek to obtain as much CAP as possible, and would not forgo the opportunity to obtain this supply. It is further assumed that the CAP water will be recharged and recovered at a facility like the Central Avra Valley Storage and Recovery Project (CAVSARP) and that a 20,000 AFY recharge facility will be required.

For this project, it is assumed that the recharge basins and the pipelines and boosters can be deferred, but not downsized. In other words, when these facilities are constructed, they will be constructed to take the full 20,000 AFY. Recovery wells, on the other hand, will be constructed on an as needed basis. It is assumed that recovery well production will be added in 6 MGD increments every other year to keep pace with demand starting in 2016.

In theory, the *acquisition* of additional CAP could be downsized. It is assumed here, however, that, given the limited availability of CAP, especially in the future, the City will seek to obtain as much CAP as it could, and would *not* forgo the opportunity to obtain this supply. (Included in the short run costs is a variable that captures the avoided delivery costs.)

High Cost Scenario: Treatment of Effluent for Indirect Potable Use
The high cost scenario assumes that the next source of potable water supply would be treated effluent. Under this scenario, the effluent will be treated to a very high standard: it will receive enhanced treatment to reduce the total dissolved solids (TDS). The treatment plant would be located at the Roger Road site and the product water brought to the Avra Valley for recharge and recovery. The brine stream would also have to be disposed of in evaporation ponds also in the Avra Valley. The project consists of a very sophisticated treatment plant, a pipeline to receive the effluent from Ina Road, a pipeline to take product water to a storage facility and recovery wells. Like the low cost scenario, beginning in 2016, 6 MGD of well capacity will be brought on line every two years. Assuming 1.5 MGD capacity for a well, 6 new wells would be brought on every two years. (The costs for this project were obtained from *Water Plan: 2000-2050*.)

Tables 2 and 3 show the key assumptions made for the low-cost and high-cost avoided cost scenarios.

Benefit-Cost Perspectives

For each program, benefit-cost analyses were performed from three perspectives, corresponding to the 3 key questions posed above. In each case, the present value of the benefits was divided by the present value of the costs to compute a *benefit-cost ratio*. A ratio greater than one means the program benefits exceed the costs; a ratio less than one means that the costs exceed the benefits.

Table 2
Low Avoided Cost Scenario Assumptions

Project Name	On-line Year	Capital Cost	Fixed O&M Cost
		($million)	($/yr)
Reservoir Set 1	2010	$13.1	$ 262,800
Reservoir Set 2	2014	$13.1	$ 262,800
Reservoir Set 3	2018	$13.1	$ 262,800
Effluent Recharge	2016	$10.7	$2,392,000
Effluent Enhanced Treat	2016	$8.2	$5,847,953
Recovery Well Set 1	2016	$2.4	$48,000
Recovery Well Set 2	2018	$2.4	$48,000
Recovery Well Set 2	2020	$2.4	$48,000

Table 3
High Avoided Cost Scenario Assumptions

Project Name	On-line Year	Capital Cost	Fixed O&M Cost
		($million)	($/yr)
Reservoir Set 1	2010	$13.1	$ 262,800
Reservoir Set 2	2014	$13.1	$ 262,800
Reservoir Set 3	2018	$13.1	$ 262,800
Effluent Recharge	2016	$93.0	$2,392,000
Effluent Enhanced Treatment	2016	$143.0	$5,847,953
Recovery Well Set 1	2016	$2.4	$48,000
Recovery Well Set 2	2018	$2.4	$48,000
Recovery Well Set 2	2020	$2.4	$48,000

Following are descriptions of the benefits and costs considered from each perspective.

Utility Perspective

As described earlier, the water conservation program benefits to the utility are those factors which reduce utility revenue requirements (and average customer water bills); the program costs increase revenue requirements.

Utility Benefits. The utility economic benefit is the supply and infrastructure costs that are avoided as a result of the water savings. As explained above, the avoided costs can be reductions in system operating costs and/or downsizes or deferrals of planned capital investments. In each year in which there are water savings, the peak-season and off-peak-season savings in acre-feet are multiplied by that year's corresponding avoided cost, expressed in dollars per acre-foot, and the two seasonal components are added to obtain

that year's total avoided cost. Finally, the present value of the series of annual avoided costs is calculated. This calculation is illustrated in Table 4. The figures in the table are based on savings and participation assumptions documented in Appendix D.

Utility Costs. Annual utility costs are based on the assumed administrative costs (both fixed and variable) and incentive payments, as described above. The present value of the series of utility costs is then calculated. A sample calculation is shown in Table 5.

In this example, the utility benefit-cost ratio is:

$3,322,525 / $3,367,741 = 0.99

Total Resource Cost (TRC) Perspective

Unlike the utility perspective, which only is concerned with the costs that are borne by the water utility, the TRC perspective, as the name suggests, reflects the total economic resources which are expended for the program, whether they are borne by utility or not. Thus, in cases in which the utility bears only a portion of the costs of a fixture or device, with the remainder being paid by the program participant, both cost components are reflected in the analysis.

Therefore, while the TRC benefits are the same as the utility benefits, the TRC costs may be larger, to the extent that some of the costs are paid by another party, such as the program participants. This is illustrated in Table 6.

Thus, in this example, the TRC benefit-cost ratio is:

$3,322,525 / $6,690,623 = 0.50

Table 4 [4]

Sample Calculation of Utility Benefits

Single-Family Targeted ULFT Rebate Program

	Peak Season			Off-Peak Season			Total
Year	Savings	Avoided Cost	Benefit	Savings	Avoided Cost	Benefit	Benefit
	(AF)	($/AF)	($)	(AF)	($/AF)	($)	($)
	(A)	*(B)*	*(C=AxB)*	*(D)*	*(E)*	*(F=DxE)*	*(G=C+F)*
2007	57	$191	$10,814	168	$191	$32,088	$42,902
2008	111	$192	$21,252	329	$192	$63,064	$84,317
2009	163	$193	$31,333	482	$193	$92,976	$124,309
2010	193	$266	$51,305	573	$194	$111,002	$162,306
2011	222	$266	$59,022	659	$195	$128,427	$187,449
2012	250	$266	$66,394	742	$196	$145,279	$211,673
2013	258	$266	$68,420	764	$197	$150,537	$218,957
2014	265	$338	$89,434	786	$198	$155,650	$245,084
2015	272	$337	$91,493	807	$199	$160,623	$252,117
2016	260	$453	$117,511	770	$200	$154,237	$271,748
2017	248	$450	$111,523	736	$201	$148,109	$259,632
2018	237	$533	$126,087	703	$202	$142,228	$268,315
2019	226	$529	$119,511	671	$204	$136,583	$256,094
2020	216	$538	$116,133	641	$205	$131,166	$247,299
2021	206	$534	$110,087	612	$206	$125,967	$236,054
2022	197	$530	$104,372	584	$207	$120,977	$225,349
2023	188	$526	$98,970	558	$208	$116,187	$215,157
2024	180	$523	$93,861	533	$209	$111,590	$205,451
2025	172	$519	$89,031	509	$211	$107,177	$196,207
2026	164	$516	$84,462	486	$212	$102,941	$187,403
2027	156	$512	$80,140	464	$213	$98,875	$179,015
2028	149	$509	$76,051	443	$214	$94,972	$171,023
2029	143	$506	$72,183	423	$215	$91,225	$163,407
2030	136	$464	$63,236	404	$217	$87,628	$150,864

Present Value: $3,322,525

[4] Calculation based on 'low' forecast of avoided costs. All costs expressed in constant dollars. Present value based on an assumed nominal discount rate of 5% and future annual inflation rate of 2%. For this and subsequent sample calculations, present value only reflects benefits through 2030, although actual benefits are projected to persist beyond that point.

Table 5 [5]

Sample Calculation of Utility Costs
Single-Family Targeted ULFT Rebate Program

Year	Administrative Costs	Incentives	Total Costs
	($)	($)	($)
	(A)	*(B)*	*(C=A+B)*
2007	$115,380	$562,500	$677,880
2008	$115,380	$562,500	$677,880
2009	$115,380	$562,500	$677,880
2010	$77,880	$375,000	$452,880
2011	$77,880	$375,000	$452,880
2012	$77,880	$375,000	$452,880
2013	$40,380	$187,500	$227,880
2014	$40,380	$187,500	$227,880
2015	$40,380	$187,500	$227,880

Present Value: $3,637,741

[5] All costs expressed in constant dollars. Present value based on an assumed nominal discount rate of 5% and future annual inflation rate of 2%.

Table 6

Sample Calculation of Total Resource Costs
Single-Family Targeted ULFT Rebate Program

Year	Utility Costs ($) (A)	Participant Costs ($) (B)	Total Costs ($) (C=A+B)
2007	$677,880	$570,000	$1,247,880
2008	$677,880	$570,000	$1,247,880
2009	$677,880	$570,000	$1,247,880
2010	$452,880	$380,000	$832,880
2011	$452,880	$380,000	$832,880
2012	$452,880	$380,000	$832,880
2013	$227,880	$190,000	$417,880
2014	$227,880	$190,000	$417,880
2015	$227,880	$190,000	$417,880

Present Value: $6,690,623

Participant Perspective

The benefit-cost calculation from the perspective of the program participant helps determine how attractive the program is to a customer. While it is certainly true that the decisions of individual customers regarding program participation may be based on many non-economic factors as well, this perspective represents the economic inputs to that decision.

Participant Benefits. The economic benefits to a customer of participating in a water conservation program are the reductions in his or her utility bills due to reduced consumption. In addition to the water bill, these reductions could, depending on the specific program, occur on the sewer bill or even on the customer's electric or gas bill. In addition, participant benefits also include any other reductions in participant costs (e.g. fertilizer), if such reductions exist. The utility bill reductions are functions of the expected water and/or energy savings and the rates that the participating customer would have paid for those unused units. Depending on the customer class to which the program is directed, and the utility rate schedules, the applicable rates will differ for different programs.

Unlike the avoided utility supply costs, these participant benefits are *not a reduction in total resource costs*. The bill reductions are, rather, a transfer payment from non-

participating customers to participants. Every dollar not paid by a participant must be paid by a non-participant. Total resource expenditures thus remain unchanged.

Participant Costs. The cost to participants is their out of pocket expense net of any utility incentive.

The participant benefit-cost calculation is illustrated in Table 7.

Table 7

Sample Calculation of Participant Benefits & Costs				
Single-Family Targeted ULFT Rebate Program				
	Benefits			Costs
Year	Water	Sewer	Total	
2007	$175,417	$116,945	$292,362	$570,000
2008	$346,370	$230,914	$577,284	$570,000
2009	$513,035	$342,023	$855,058	$570,000
2010	$615,336	$410,224	$1,025,560	$380,000
2011	$715,216	$476,811	$1,192,026	$380,000
2012	$812,772	$541,848	$1,354,620	$380,000
2013	$846,029	$564,019	$1,410,048	$190,000
2014	$878,727	$585,818	$1,464,546	$190,000
2015	$910,894	$607,262	$1,518,156	$190,000
2016	$878,603	$585,735	$1,464,338	
2017	$847,456	$564,971	$1,412,427	
2018	$817,414	$544,943	$1,362,356	
2019	$788,436	$525,624	$1,314,061	
2020	$760,486	$506,991	$1,267,477	
2021	$733,527	$489,018	$1,222,545	
2022	$707,524	$471,682	$1,179,206	
2023	$682,442	$454,961	$1,137,403	
2024	$658,249	$438,833	$1,097,082	
2025	$634,914	$423,276	$1,058,191	
2026	$612,407	$408,271	$1,020,678	
2027	$590,697	$393,798	$984,495	
2028	$569,757	$379,838	$949,594	
2029	$549,559	$366,373	$915,931	
2030	$530,077	$353,385	$883,462	
		Present Value:	$19,019,880	$3,052,882

The participant benefit-cost ratio is:

$19,019,880 / $3,052,882 = 6.23

Benefit-Cost Results

The foregoing calculations were performed for each of the 48 programs that passed the qualitative screen. The utility and TRC benefits were calculated twice, using the low and high avoided cost forecasts described above. The benefit-cost results shown in Table 8 below are based on the average of these two benefit estimates.

Selecting Programs

The next step in the analysis is to use these benefit-cost results to select those programs that are economically viable. The following selection criteria were used:

- Based on the average of the low and high-case avoided costs, the utility benefit-cost ratio must be greater than or equal to 1.0. The program must not result in an increase in average water bills over time.

- Based on the average of the low and high-case avoided costs, the TRC benefit-cost ratio must be greater than or equal to 0.6. This reflects the possibility that there are important societal benefits that are not reflected in the TRC calculation. For example, there was no attempt to consider the avoided cost associated with subsidence, in part because the impacts and therefore the avoided cost associated with the reduction in usage of groundwater on subsidence in the central City is difficult to quantify. To date there has been no known economic cost to subsidence, despite the fact that the groundwater table has fallen well over 100 feet. Other unquantified benefits could include such benefits as enhancements to the natural environment or the ability to sustain natural resources. The more permissive criterion acknowledges the possibility of such important unaccounted-for benefits.

- The participant benefit-cost ratio must be greater than or equal to 1.0. Only programs that are economically attractive to potential participants are considered.

- The program saving must not be negligible. A few of the programs that passed the foregoing benefit-cost tests were excluded because their potential savings were very small.

- The program must not conflict with another selected program(s). In a few cases, a program was excluded because it conflicted with another program that was selected. Such a conflict could occur if both programs targeted the same customer class and end use and would interfere with one another.

Based on these criteria, Table 9 highlights the selected programs.

Table 8

Tucson Water Benefit-Cost Results			
Mean Avoided Costs			
Program	Utility	TRC	Participant *
Single-Family Existing			
ULFT Retrofit on Resale	5.99	0.55	2.76
Targeted ULF Rebate	1.23	0.67	6.73
Greywater Incentive	1.17	0.40	1.88
Hot Water Recirc ROR	0.77	0.03	0.15
ULFT CBO	0.78	0.78	N/A
ULFT Rebate	0.72	0.45	5.35
HET Rebate	0.52	0.39	7.25
Water Harvest Incentive	0.36	0.12	0.59
Hot Water Recirc Rebate	0.14	0.03	0.18
Single-Family New			
Hot Water Recirc Ord	14.01	0.03	0.15
Greywater Ord	14.63	0.23	0.71
Landscape Design Ord	7.14	0.52	1.67
Multi-Family Existing			
Submetering Ordinance	68.08	0.40	1.82
Irrig System ROR	30.35	2.30	7.42
Hot Water Recirc ROR	18.24	0.07	0.28
ULFT Retrofit on Resale	12.07	1.11	4.73
Irrig Sys Upgrade Rebate	7.49	2.88	13.92
Clotheswasher Rebate	3.27	0.52	4.28
HET Rebate	1.83	0.85	6.09
ULFT Community-Based	1.72	1.72	N/A
ULFT Rebate	1.46	0.90	9.16
Submetering Rebate	1.41	0.40	2.55
ULF Vendor-Driven	1.26	1.26	N/A
Mist System Restrictions	1.24	0.13	0.24
Hot Water Recirc Rebate	0.20	0.07	0.42
Multi-Family New			
Clotheswasher Ordinance	59.96	0.49	3.88
Submetering Ordinance	26.07	0.74	3.45
Wtr Harv & Greywater Ord	8.64	0.05	0.14
Irrigation Design Ordinance	9.09	1.94	7.52
Rev Landscp Des Stds	2.70	0.30	1.00
Hot Water Recirc Ord	0.76	0.02	0.11
CII Existing			
Car Wash Oper Stds	14.06	0.74	3.44
Irrig System ROR	12.32	2.66	13.77
Submetering Incentive	3.52	0.72	3.84
Water Harvest ROR	2.96	0.69	3.27
ULFT Rebate Targeted	1.95	0.67	5.59
Pre-Rinse Rebate	1.94	1.11	16.33
Pre-Rinse Direct Install	1.38	1.38	N/A
ULFT Rebate Untargeted	1.33	0.49	4.24
Urinal Rebate	0.71	0.24	3.30
Vendor-Driven Toil & Urinal	0.52	0.52	N/A
Valve Replacement	0.39	0.18	2.19
Hot Water Recirc Rebate	0.17	0.07	0.61
Cooling Tower Retrofit	0.65	0.65	N/A
CII New			
Food Handling Ordinance	30.24	2.94	20.37
Clotheswasher Ordinance	24.67	0.30	1.54
Wtr Harv & Greywater Ord	1.78	0.69	4.09
Hot Water Recirc Ord	0.67	0.25	2.12

* N/A indicates zero cost to participant

Table 9 [6]

Tucson Water Benefit-Cost Results				
Mean Avoided Costs				
Selected Programs				
	Program	Utility	TRC	Participant *
Single-Family Existing				
	ULFT Retrofit on Resale	5.99	0.55	2.76
	Targeted ULF Rebate	**1.23**	**0.67**	**6.73**
	Greywater Incentive	1.17	0.40	1.88
	Hot Water Recirc ROR	0.77	0.03	0.15
	ULFT CBO	0.78	0.78	N/A
	ULFT Rebate	0.72	0.45	5.35
	HET Rebate	0.52	0.39	7.25
	Water Harvest Incentive	0.36	0.12	0.59
	Hot Water Recirc Rebate	0.14	0.03	0.18
Single-Family New				
	Hot Water Recirc Ord	14.01	0.03	0.15
	Greywater Ord	14.63	0.23	0.71
	Landscape Design Ord	7.14	0.52	1.67
Multi-Family Existing				
	Submetering Ordinance	68.08	0.40	1.82
	Irrig System ROR	**30.35**	**2.30**	**7.42**
	Hot Water Recirc ROR	18.24	0.07	0.28
	ULFT Retrofit on Resale	**12.07**	**1.11**	**4.73**
	Irrig Sys Upgrade Rebate	**7.49**	**2.88**	**13.92**
	Clotheswasher Rebate	3.27	0.52	4.28
	HET Rebate	**1.83**	**0.85**	**6.09**
	ULFT Community-Based	**1.72**	**1.72**	**N/A**
	ULFT Rebate	**1.46**	**0.90**	**9.16**
	Submetering Rebate	1.41	0.40	2.55
	ULF Vendor-Driven	**1.26**	**1.26**	**N/A**
	Mist System Restrictions	1.24	0.13	0.24
	Hot Water Recirc Rebate	0.20	0.07	0.42
Multi-Family New				
	Clotheswasher Ordinance	59.96	0.49	3.88
	Submetering Ordinance	**26.07**	**0.74**	**3.45**
	Wtr Harv & Greywater Ord	8.64	0.05	0.14
	Irrigation Design Ordinance	**9.09**	**1.94**	**7.52**
	Rev Landscp Des Stds	2.70	0.30	1.00
	Hot Water Recirc Ord	0.76	0.02	0.11
CII Existing				
	Car Wash Oper Stds [1]	14.06	0.74	3.44
	Irrig System ROR	**12.32**	**2.66**	**13.77**
	Submetering Incentive	**3.52**	**0.72**	**3.84**
	Water Harvest ROR	**2.96**	**0.69**	**3.27**
	ULFT Rebate Targeted	**1.95**	**0.67**	**5.59**
	Pre-Rinse Rebate	**1.94**	**1.11**	**16.33**
	Pre-Rinse Direct Install [2]	1.38	1.38	N/A
	ULFT Rebate Untargeted	1.33	0.49	4.24
	Urinal Rebate	0.71	0.24	3.30
	Vendor-Driven Toil & Urinal	0.52	0.52	N/A
	Valve Replacement	0.39	0.18	2.19
	Hot Water Recirc Rebate	0.17	0.07	0.61
	Cooling Tower Retrofit	0.65	0.65	N/A
CII New				
	Food Handling Ordinance [1]	30.24	2.94	20.37
	Clotheswasher Ordinance	24.67	0.30	1.54
	Wtr Harv & Greywater Ord [1]	1.78	0.69	4.09
	Hot Water Recirc Ord	0.67	0.25	2.12

1. Program excluded because of extremely small savings.
2. Program conflicts with another selected program.

[6] Programs that pass the benefit-cost tests are highlighted in yellow.

V. WATER CONSERVATION SCENARIOS

The 15 programs passing the benefit-cost tests were combined into two water conservation scenarios which represent different levels of conservation programming. In each case, annual participation rates were estimated for each program, based in part on the results of the baseline study described above. The derivation of the assumed participation rates is described in Appendix D.

Scenario A: Moderate Conservation

In this scenario, it is assumed that none of the four retrofit on resale (ROR) ordinances is implemented. The expected savings, costs, and staffing requirements for this scenario are shown in Table 10. The year-by-year programmatic savings are shown in Figure 6.[7] Note that costs are all expressed in constant (i.e. uninflated) dollars.

Scenario B: Maximum Conservation.

Here, ROR ordinances are permitted. Note that, for the multi-family customer class, the inclusion of the ULFT ROR ordinance, along with the vendor-driven and community-based ULFT programs, results in the exclusion of the ULFT rebate program due to the overlap among the programs, and the resulting inefficiency of having a fourth program aimed at the same class and end use. The results for this scenario are shown in Table 11 and Figure 7.

[7] Programmatic savings exclude those due to free riders or natural replacement.

Table 10

Annual Savings, Costs, and Staff Requirements by Program
Scenario A: Moderate Conservation
No Retrofit on Resale Ordinances

Program		Savings 2015 (AF)	Costs 2007 ($000)	Costs 2015 ($000)	Staff Reqmts (FTE)
Single Family					
Targeted ULFT Rebate		1,078	$678	$228	0.05
	SUBTOTAL	*1,078*	*$678*	*$228*	*0.05*
Multi-Family					
Irrigation System Upgrade Rebate		2,179	$114	$114	0.2
High-Efficiency Toilet Rebate		716	$213	$213	0.05
ULFT Community-Based Distribution		579	$249	$126	0.05
ULFT Rebate		398	$187	$97	0.125
ULFT Vendor-Driven Delivery		447	$258	$131	0.075
Submetering Ordinance (New Const)		547	$15	$15	0.2
Irrigation System Design Ordinance		685	$19	$19	0.2
	SUBTOTAL	*5,551*	*$1,056*	*$716*	*0.9*
CII					
Interior & Exterior Submetering Incentive		137	$32	$32	0.1
ULFT Rebate: Targeted		296	$117	$64	0.2
Pre-Rinse Spray Valve Rebate		132	$17	$23	0.1
	SUBTOTAL	*565*	*$166*	*$119*	*0.4*
	TOTAL	**7,194**	**$1,899**	**$1,062**	**1.35**
	Percent of Demand	**4.25%**			

Figure 6
Moderate Savings Scenario

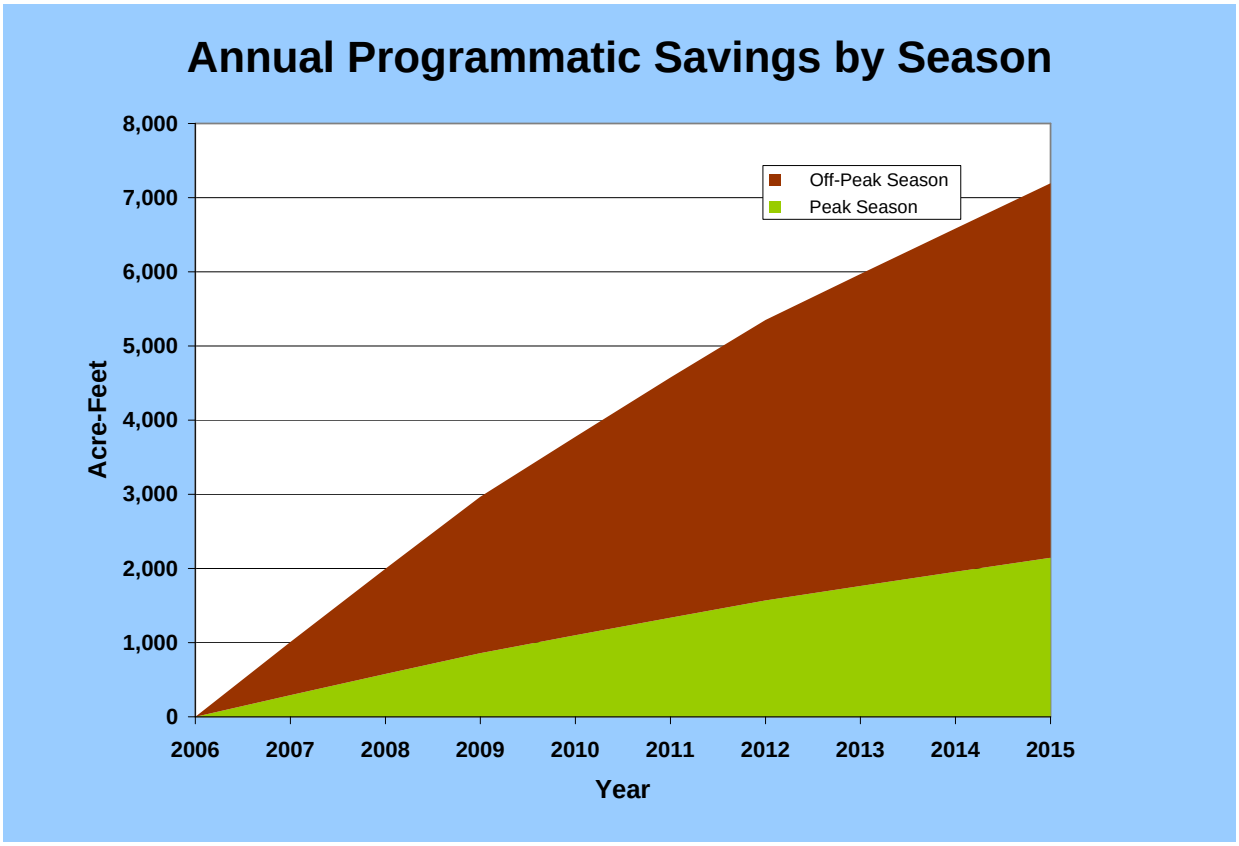


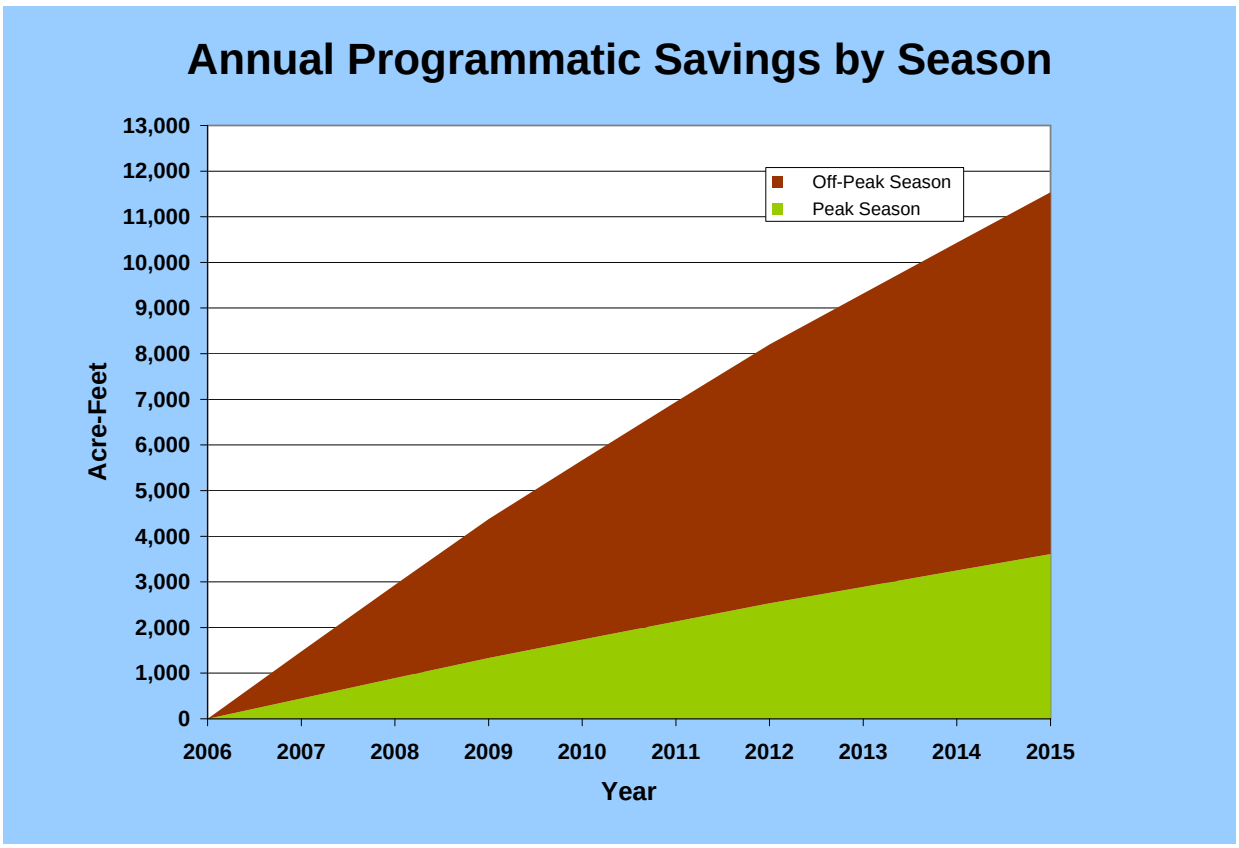
Table 11

Annual Savings, Costs, and Staff Requirements by Program

Scenario B: Maximum Savings

Program	Savings 2015 (AF)	Costs 2007 ($000)	Costs 2015 ($000)	Staff Reqmts (FTE)
Single Family				
Targeted ULFT Rebate	1,078	$678	$228	0.05
Multi-Family				
Irrigation System Retrofit on Resale Ordinance	2,243	$32	$36	0.2
ULFT Retrofit on Resale Ordinance	1,401	$49	$41	0.05
Irrigation System Upgrade Rebate	2,179	$114	$114	0.2
High-Efficiency Toilet Rebate	716	$213	$213	0.05
ULFT Community-Based Distribution	579	$249	$126	0.05
ULFT Vendor-Driven Delivery	447	$258	$131	0.075
Submetering Ordinance (New Const)	547	$15	$15	0.2
Irrigation System Design Ordinance	685	$19	$19	0.2
CII				
Irrigation System Retrofit on Resale Ordinance	953	$38	$38	0.2
Interior & Exterior Submetering Incentive	137	$32	$32	0.1
Passive Water Harvesting Retrofit on Resale Ordinance	144	$38	$38	0.2
ULFT Rebate: Targeted	296	$117	$64	0.2
Pre-Rinse Spray Valve Rebate	132	$17	$23	0.1
TOTAL	11,537	$1,868	$1,117	1.875
Percent of Demand	6.82%			

Figure 7
Maximum Savings Scenario



Community Conservation Task Force Scenario

As described in the separate report of the Community Conservation Task Force, the CCTF added several programs to Scenario B to develop its recommendations. Specifically, the following programs were added:

- Single family greywater incentive for existing homes
- Multi-family submetering ordinance for condominium conversions
- Multi-family revision of new construction landscape design standards
- Commercial-industrial water harvesting and greywater ordinance for new construction
- Commercial-industrial rebate for waterless urinals

The results for this scenario are shown in Table 12. Figure 8 breaks down the program savings by program type.

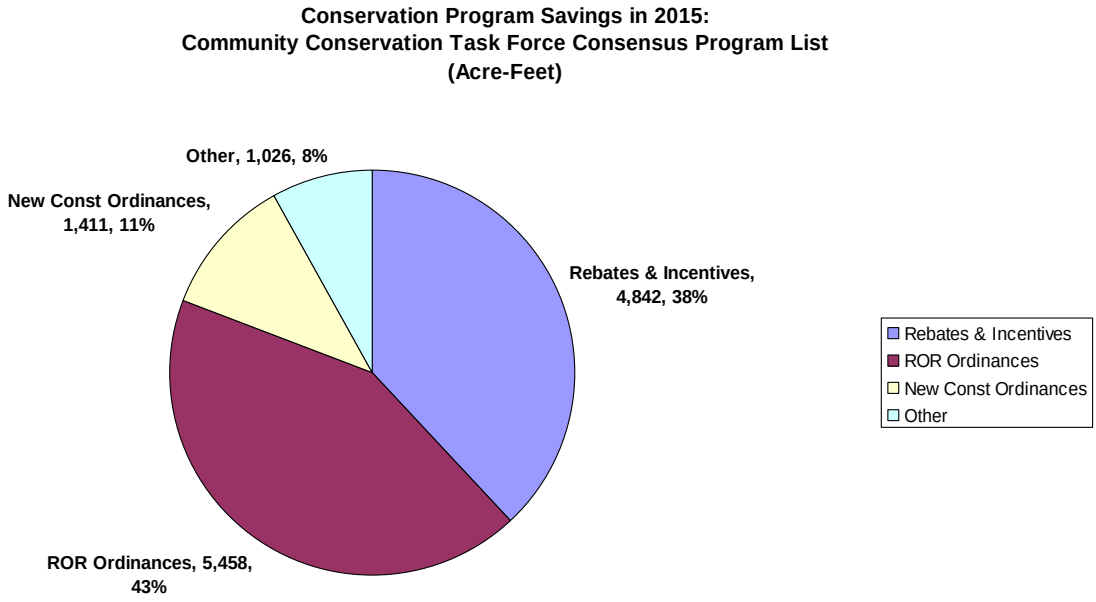
Table 12

Annual Savings, Costs, and Staff Requirements by Program

Task Force Final Program List

		Savings	Costs	Costs	Staff
Program		2015	2007	2015	Reqmts
		(AF)	($000)	($000)	(FTE)
Single Family					
	Targeted ULFT Rebate	1,078	$678	$228	0.05
	Greywater Incentive	180	$122	$122	0.2
	SUBTOTAL	*1,259*	*$799*	*$349*	*0.25*
Multi-Family					
	Irrigation System Retrofit on Resale Ordinance	2,243	$32	$36	0.2
	ULFT Retrofit on Resale Ordinance	1,401	$49	$41	0.05
	Irrigation System Upgrade Rebate	2,179	$114	$114	0.2
	High-Efficiency Toilet Rebate	716	$213	$213	0.05
	ULFT Community-Based Distribution	579	$249	$126	0.05
	ULFT Vendor-Driven Delivery	447	$258	$131	0.075
	Submetering Ordinance (New Const)	547	$15	$15	0.2
	Irrigation System Design Ordinance	685	$19	$19	0.2
	Submetering Ordinance (Condo Conversions)	717	$7	$7	0.1
	Revised Landscape Design Standards (New Const)	103	$15	$15	0.2
	SUBTOTAL	9,616	$970	$716	1.325
CII					
	Irrigation System Retrofit on Resale Ordinance	953	$38	$38	0.2
	Interior & Exterior Submetering Incentive	137	$32	$32	0.1
	Passive Water Harvesting Retrofit on Resale Ordinance	144	$38	$38	0.2
	ULFT Rebate: Targeted	296	$117	$64	0.2
	Pre-Rinse Spray Valve Rebate	132	$17	$23	0.1
	Water Harvesting & Grey Water Ordinance	77	$36	$36	0.2
	Waterless Urinal Rebate	124	$114	$32	0.2
	SUBTOTAL	1,862	$391	$262	1.2
	TOTAL	**12,737**	**$2,160**	**$1,328**	**2.775**
	Percent of Demand	7.53%			

Figure 8



Comparison of Water Conservation Scenarios

The estimated savings and costs for the three scenarios are compared in Table 13. The Moderate Conservation scenario is expected to reduce demand by 4.25% by the year 2015, while the Maximum Savings scenario will result in close to a 7% demand reduction. The CCTF Recommended Scenario results in a 7.5% programmatic savings. Despite the differences in expected savings, the expected annual utility costs for the Moderate and Maximum scenarios do not differ substantially, primarily because the retrofit on resale ordinances are not expected to result in significant utility implementation costs. The Maximum scenario is expected to require almost 2 additional full-time equivalent (FTE) Tucson Water conservation staff, approximately 0.5 FTE more than the Moderate scenario requirements. The costs and staffing requirements of the CCTF Recommended Scenario are both somewhat higher than those of the Maximum scenario.

Table 13
Tucson Water
Comparison of Water Conservation Scenarios

Scenario		Savings 2015 (AF)	Cost 2007 ($000)	Cost 2015 ($000)	Staff Reqmts (FTE)
Task Force Final		12,737	$2,160	$1,328	2.775
		7.53%			
Maximum		11,537	$1,868	$1,117	1.875
		6.82%			
Moderate		7,194	$1,899	$1,062	1.350
		4.25%			

Sensitivity Analyses

At the request of the Community Conservation Task Force, two sensitivity analyses were performed. First, the CCTF was interested in examining the impact of modifying the threshold for the TRC benefit-cost ratio. Recall that the analysis described above used a threshold of 0.6. Programs with a TRC benefit-cost ratio less than this were excluded from our program list. In this sensitivity analysis, the maximum savings scenario was re-formulated using cutoffs of 0.8 and 0.4.

Tables 14 and 15 show the maximum savings scenario assuming the 0.8 and 0.4 TRC cutoffs, respectively. When compared to Table 11, we see that using the more stringent 0.8 threshold reduces the ultimate savings percentage from approximately 6.8% to 5.5% of demand. Using the more permissive 0.4 threshold increases the potential savings to just over 10%. It must be noted that a lower threshold results in the utility investing in conservation programs of dubious economic value.

Table 14

Annual Savings, Costs, and Staff Requirements by Program					
	Maximum Savings Assuming 0.8 TRC Threshold				
		Savings	Costs	Costs	Staff
Program		2015	2007	2015	Reqmts
		(AF)	($000)	($000)	(FTE)
Single Family					
Multi-Family					
	Irrigation System Retrofit on Resale Ordinance	2,243	$32	$36	0.2
	ULFT Retrofit on Resale Ordinance	1,401	$49	$41	0.05
	Irrigation System Upgrade Rebate	2,179	$114	$114	0.2
	High-Efficiency Toilet Rebate	716	$213	$213	0.05
	ULFT Community-Based Distribution	579	$249	$126	0.05
	ULFT Vendor-Driven Delivery	447	$258	$131	0.075
	Irrigation System Design Ordinance	685	$19	$19	0.2
CII					
	Irrigation System Retrofit on Resale Ordinance	953	$38	$38	0.2
	Pre-Rinse Spray Valve Rebate	132	$17	$23	0.1
	TOTAL	9,334	$989	$741	1.125
	Percent of Demand	5.52%			

Table 15

Annual Savings, Costs, and Staff Requirements by Program					
	Maximum Savings Assuming 0.4 TRC Threshold				
		Savings	Costs	Costs	Staff
Program		2015	2007	2015	Reqmts
		(AF)	($000)	($000)	(FTE)
Single Family					
	Targeted ULFT Rebate	1,078	$678	$228	0.05
	ULFT Retrofit on Resale Ordinance	1,227	$78	$66	0.1
	Landscape Design Ordinance	1,255	$137	$137	0.2
Multi-Family					
	Irrigation System Retrofit on Resale Ordinance	2,243	$32	$36	0.2
	ULFT Retrofit on Resale Ordinance	1,401	$49	$41	0.05
	Irrigation System Upgrade Rebate	2,179	$114	$114	0.2
	High-Efficiency Toilet Rebate	716	$213	$213	0.05
	ULFT Community-Based Distribution	579	$249	$126	0.05
	ULFT Vendor-Driven Delivery	447	$258	$131	0.075
	Submetering Ordinance (New Const)	547	$15	$15	0.2
	Irrigation System Design Ordinance	685	$19	$19	0.2
	Submetering Ordinance for Condo Conversions	717	$7	$7	0.1
	Clotheswasher Rebate	796	$129	$67	0.1
	Submetering Rebate	188	$91	$91	0.1
	Clotheswasher Ordinance	1,417	$12	$7	0.1
CII					
	Irrigation System Retrofit on Resale Ordinance	953	$38	$38	0.2
	Interior & Exterior Submetering Incentive	137	$32	$32	0.1
	Passive Water Harvesting Retrofit on Resale Ordinance	144	$38	$38	0.2
	ULFT Rebate: Targeted	296	$111	$58	0.1
	Pre-Rinse Spray Valve Rebate	132	$17	$23	0.1
	ULFT Rebate: Untargeted	548	$216	$216	0.1
	TOTAL	17,137	$2,316	$1,486	2.475
	Percent of Demand	10.13%			

The second requested sensitivity analysis was of the discount rate. Based on consultation with the Tucson Water Finance Department, the analysis used a nominal[8] discount rate of 5%. We conducted sensitivity testing using 3% and 7% rates. The results are displayed in Table 16. Since the benefits are realized over a longer time period, they are more sensitive to changes in the discount rate. Thus, the lower discount rate results in higher benefit-cost ratios, while the lower discount rate yields higher benefit-cost ratios.

[8] A nominal rate includes projected future inflation.

Table 16

Tucson Water Benefit-Cost Results								
Mean Avoided Costs								
Discount Rate Sensitivity Analysis								
		5% Discount Rate		3% Discount Rate		7% Discount Rate		
	Program	Utility	TRC	Utility	TRC	Utility	TRC	
Single-Family Existing								
	ULFT Rebate	0.72	0.45	0.86	0.53	0.62	0.38	
	HET Rebate	0.52	0.39	0.61	0.46	0.44	0.33	
	Targeted ULF Rebate	1.23	0.67	1.47	0.80	1.04	0.57	
	ULFT Retrofit on Resale	5.99	0.55	7.08	0.65	5.12	0.47	
	ULFT CBO	0.78	0.78	0.92	0.92	0.67	0.67	
	Hot Water Recirc Rebate	0.14	0.02	0.15	0.02	0.13	0.02	
	Hot Water Recirc ROR	0.77	0.02	0.83	0.02	0.72	0.02	
	Greywater Incentive	1.10	0.38	1.40	0.48	0.93	0.32	
	Water Harvest Incentive	0.34	0.12	0.44	0.15	0.29	0.10	
Single-Family New								
	Hot Water Recirc Ord	14.01	0.03	15.10	0.03	13.03	0.03	
	Landscape Design Ord	7.14	0.52	8.57	0.63	5.93	0.43	
	Greywater Ord	14.63	0.23	17.68	0.28	12.24	0.20	
Multi-Family Existing								
	ULFT Rebate	1.46	0.90	1.75	1.08	1.23	0.76	
	HET Rebate	1.83	0.85	2.20	1.02	1.55	0.72	
	ULF Vendor-Driven	1.26	1.26	1.51	1.51	1.07	1.07	
	ULFT Community-Based	1.72	1.72	2.06	2.06	1.45	1.45	
	ULFT Retrofit on Resale	12.07	1.11	14.46	1.33	10.20	0.94	
	Clotheswasher Rebate	3.27	0.52	3.70	0.58	2.91	0.46	
	Hot Water Recirc Rebate	0.20	0.07	0.22	0.07	0.19	0.06	
	Hot Water Recirc ROR	18.24	0.07	19.66	0.07	16.97	0.06	
	Mist System Restrictions	1.24	0.13	1.33	0.14	1.15	0.12	
	Submetering Rebate	1.41	0.40	1.70	0.49	1.17	0.34	
	Submetering Ordinance	68.08	0.40	82.55	0.49	56.85	0.33	
	Irrig System ROR	30.35	2.30	33.91	2.57	27.29	2.07	
	Irrig Sys Upgrade Rebate	7.49	2.88	8.37	3.21	6.74	2.59	
Multi-Family New								
	Clotheswasher Ordinance	59.96	0.49	66.72	0.53	53.68	0.46	
	Hot Water Recirc Ord	0.76	0.02	0.82	0.03	0.71	0.02	
	Submetering Ordinance	17.08	0.71	22.68	0.86	15.46	0.59	
	Irrigation Design Ordinance	9.09	1.94	10.12	2.17	8.20	1.75	
	Rev Landscp Des Stds	1.81	0.26	2.05	0.29	1.60	0.23	
	Wtr Harv & Greywater Ord	5.91	0.05	6.77	0.05	5.19	0.04	
CII Existing								
	ULFT Rebate Untargeted	1.33	0.49	1.59	0.59	1.12	0.42	
	ULFT Rebate Targeted	1.95	0.67	2.33	0.81	1.65	0.57	
	Urinal Rebate	1.15	0.39	1.47	0.50	0.92	0.31	
	Vendor-Driven Toil & Urinal	0.52	0.52	0.63	0.63	0.44	0.44	
	Valve Replacement	0.39	0.18	0.41	0.19	0.37	0.18	
	Hot Water Recirc Rebate	0.17	0.07	0.18	0.07	0.16	0.06	
	Car Wash Oper Stds	14.06	0.74	15.69	0.83	12.66	0.67	
	Submetering Reqmt	3.52	0.72	3.45	0.84	2.36	0.57	
	Irrig System ROR	12.32	2.66	13.77	2.97	11.08	2.39	
	Water Harvest ROR	2.96	0.69	3.46	0.80	2.55	0.59	
	Pre-Rinse Rebate	1.94	1.11	2.04	1.17	1.84	1.06	
	Pre-Rinse Direct Install	1.38	1.38	1.45	1.45	1.31	1.31	
	Cooling Tower Ops Ord	0.65	0.65	0.71	0.71	0.59	0.59	
CII New								
	Clotheswasher Ordinance	24.67	0.30	27.90	0.34	21.95	0.27	
	Food Handling Ordinance	30.24	2.94	31.91	3.10	28.72	2.79	
	Hot Water Recirc Ord	0.67	0.25	0.74	0.74	0.60	0.60	
	Wtr Harv & Greywater Ord	1.78	0.69	2.08	2.08	1.54	1.54	

VI. CONCLUSION

Two water conservation scenarios were developed, each of which included a mix of conservation programs that were economically feasible for Tucson water, as described above. If the requisite staff and financial resources are made available, both scenarios are forecast to reduce demands by a significant amount and realize considerable benefits for the utility and its customers. The primary difference between the two scenarios is the assumed adoption of several ordinances which require the installation of particular water-saving equipment when a property is resold. If such ordinances are adopted, the annual water saved could approach 7% of demand by 2015. Without such ordinances, the demand reduction will be closer to 4%.

The Community Conservation Task Force determined that five other programs, which did not pass the economic tests,[9] should be added to the maximum scenario. This scenario results in about 7.5% savings by 2015, with somewhat higher costs and staffing requirements.

It is left to policymakers to determine which of the scenarios best meets the needs of the Tucson Water service area.

[9] One of the programs (the commercial-industrial water harvesting and greywater ordinance) did pass the economic tests, but had been excluded because of the small magnitude of the expected savings.

APPENDIX A: DESCRIPTION OF BASELINE ANALYSIS

RESIDENTIAL AND MULTIFAMILY BASELINE WATER USE FORECAST

Residential and Multifamily Rate Class Baseline Water Use Models

The baseline water use models for the residential and multifamily rate classes rely on the following key assumptions and data.

Existing and New Construction

1. Baseline water use is divided between existing and new construction. We assume the average number of persons per household is the same between existing and new construction and therefore that growth in new construction is equal to the growth in population.

2. The models assume the proportion of total population in residential and multifamily rate classes remains constant over the forecast period.

Existing Construction

3. Average daily water use per person (GPCD) for existing construction was estimated using TW delivery data for the residential and multifamily rate classes and Census 2000 data. For each rate class, GPCD was calculated using the following steps:
    a. Divide average annual use for the rate class (from TW) by the number of housing units in the service area (from Census 2000).
    b. Divide the result by average persons per housing unit (from Census 2000).
    c. Divide by the number of days per year.

    Average use for the residential rate class is 114 gpcd; for the multifamily rate class it is 99 gpcd.

4. The estimate of outdoor use for existing multifamily housing comes from ADWR's Third Management Plan for the Tucson Area. The report states this estimate was derived from survey data of multifamily water use in the region. We have adopted this estimate for lack of an alternative.

5. For the residential rate class we derived outdoor use as the difference between total use and indoor use.

6. Indoor water use for existing multifamily construction was calculated two ways. The first way was to subtract ADWR's estimate of average daily outdoor water use from average daily total water use. This resulted in an indoor estimate of 73 gpcd. The second way was to use the relationship between indoor water use and persons per household presented on page 90 of the AWWA Research Foundation's Residential End Uses of

Water Study (REUWS). This resulted in an indoor estimate of 72 gpcd. Our baseline estimate of daily indoor water use for existing multifamily construction is the average of these two estimates: 72.5 gpcd.

7. For the residential rate class, indoor use for existing construction was estimated using end use estimates from the REUWS study.

8. Baseline indoor use is adjusted over the forecast period to account for natural replacement of older toilets and showerheads with low-flow ones. Baseline water use for leaks is then adjusted downward in proportion to the change in total use resulting from natural replacement of toilets and showerheads. Thus, over the forecast period, baseline daily indoor water use trends downward. The rate of natural replacement in the residential rate class is assumed to be twice the rate in the multifamily rate class due to differences in rates of home ownership and remodeling rates.

New Construction

9. With the exception of multifamily washer use, baseline indoor water use for new residential and multifamily construction was estimated using per capita end use estimates from REUWS. We assumed that all toilet and shower fixtures would be ULF. For multifamily, washer use was estimated using results from a national study of multifamily washer water and energy use. The category "Other Domestic Uses" was used to balance total use with the ADWR estimate of per capita use for new construction.

10. We used ADWR's estimate of per capita outdoor water use for new multifamily construction for lack of an alternative. This is 20% lower than ADWR's estimate of per capita outdoor water use for existing multifamily construction. Outdoor use for new residential construction is also from the ADWR report. It is approximately 16% less than outdoor use for existing residential.

Baseline Use Forecast

11. For each rate class, the baseline per capita water use over the forecast period is the weighted average of baseline water use for existing and new construction.

12. Total water use is the product of the per capita and population forecasts for each rate class.

<u>Population Forecast Used in Baseline Water Use Models</u>

The TW population forecast used in the baseline water use models is shown in Table A-1.

Table A-1. Tucson Water Population Forecast

			Residential Rate Class		Multifamily Rate Class	
Year	TW Service Area Population	Ann. Growth (%)	Existing Constr.	New Constr.	Existing Constr.	New Constr.
2000	638,936		457,144	0	181,792	0
2001	658,166	3.01%	470,903	0	187,263	0
2002	677,396	2.92%	484,662	0	192,735	0
2003	696,627	2.84%	498,420	0	198,206	0
2004	715,857	2.76%	512,179	0	203,678	0
2005	735,087	2.69%	512,179	13,759	203,678	5,471
2006	754,317	2.62%	512,179	27,517	203,678	10,943
2007	773,547	2.55%	512,179	41,276	203,678	16,414
2008	792,777	2.49%	512,179	55,035	203,678	21,886
2009	812,008	2.43%	512,179	68,794	203,678	27,357
2010	831,238	2.37%	512,179	82,552	203,678	32,829
2011	850,468	2.31%	512,179	96,311	203,678	38,300
2012	869,698	2.26%	512,179	110,070	203,678	43,771
2013	888,928	2.21%	512,179	123,829	203,678	49,243
2014	908,158	2.16%	512,179	137,587	203,678	54,714
2015	927,389	2.12%	512,179	151,346	203,678	60,186
2016	946,619	2.07%	512,179	165,105	203,678	65,657
2017	965,849	2.03%	512,179	178,864	203,678	71,128
2018	985,079	1.99%	512,179	192,622	203,678	76,600
2019	1,004,309	1.95%	512,179	206,381	203,678	82,071
2020	1,023,539	1.91%	512,179	220,140	203,678	87,543
2021	1,042,770	1.88%	512,179	233,899	203,678	93,014
2022	1,062,000	1.84%	512,179	247,657	203,678	98,486
2023	1,081,230	1.81%	512,179	261,416	203,678	103,957
2024	1,100,460	1.78%	512,179	275,175	203,678	109,428
2025	1,119,690	1.75%	512,179	288,934	203,678	114,900
2026	1,138,920	1.72%	512,179	302,692	203,678	120,371
2027	1,158,151	1.69%	512,179	316,451	203,678	125,843
2028	1,177,381	1.66%	512,179	330,210	203,678	131,314
2029	1,196,611	1.63%	512,179	343,969	203,678	136,786
2030	1,215,841	1.61%	512,179	357,727	203,678	142,257
2031	1,218,800	0.24%	512,179	359,845	203,678	143,099
2032	1,221,759	0.24%	512,179	361,962	203,678	143,941
2033	1,224,718	0.24%	512,179	364,079	203,678	144,783
2034	1,227,677	0.24%	512,179	366,196	203,678	145,625
2035	1,230,637	0.24%	512,179	368,313	203,678	146,467
2036	1,233,596	0.24%	512,179	370,430	203,678	147,309
2037	1,236,555	0.24%	512,179	372,548	203,678	148,151
2038	1,239,514	0.24%	512,179	374,665	203,678	148,992
2039	1,242,473	0.24%	512,179	376,782	203,678	149,834
2040	1,245,432	0.24%	512,179	378,899	203,678	150,676
2041	1,248,391	0.24%	512,179	381,016	203,678	151,518
2042	1,251,350	0.24%	512,179	383,133	203,678	152,360
2043	1,254,309	0.24%	512,179	385,251	203,678	153,202

			Residential Rate Class		Multifamily Rate Class	
Year	TW Service Area Population	Ann. Growth (%)	Existing Constr.	New Constr.	Existing Constr.	New Constr.
2044	1,257,268	0.24%	512,179	387,368	203,678	154,044
2045	1,260,228	0.24%	512,179	389,485	203,678	154,886
2046	1,263,187	0.23%	512,179	391,602	203,678	155,728
2047	1,266,146	0.23%	512,179	393,719	203,678	156,570
2048	1,269,105	0.23%	512,179	395,836	203,678	157,412
2049	1,272,064	0.23%	512,179	397,954	203,678	158,254
2050	1,275,023	0.23%	512,179	400,071	203,678	159,096

Residential Baseline Water Use Forecast

The residential baseline water use forecast is shown in Tables A-2 and A-3. Table A-2 presents the forecast in terms of gallons per capita per day. Table A-3 shows total annual water use denominated in acre-feet (AF).[10]

Table A-2. Residential Rate Class Baseline Water Use Forecast (GPCD)

	Residential Use (GPCD)			Residential Fixture Use & Leaks (GPCD)						
Year	Total	Indoor	Outdoor	Toilet	Shower	Faucet	Dish Washer	Clothes Washer	Other	Leak
2004	114.0	62.5	51.5	16.7	10.5	10.9	0.9	13.6	1.4	8.6
2005	113.1	61.8	51.3	16.2	10.3	10.9	0.9	13.6	1.6	8.5
2006	112.3	61.2	51.1	15.7	10.1	10.9	0.9	13.6	1.7	8.3
2007	111.5	60.6	50.9	15.3	9.9	10.9	0.9	13.6	1.8	8.3
2008	110.8	60.1	50.7	14.9	9.8	10.9	0.9	13.6	1.9	8.2
2009	110.2	59.7	50.5	14.6	9.7	10.9	0.9	13.6	2.0	8.1
2010	109.6	59.2	50.3	14.2	9.6	10.9	0.9	13.6	2.1	8.0
2011	109.0	58.9	50.2	13.9	9.5	10.9	0.9	13.6	2.2	8.0
2012	108.5	58.5	50.0	13.6	9.4	10.9	0.9	13.6	2.3	7.9
2013	108.1	58.2	49.9	13.4	9.3	10.9	0.9	13.6	2.4	7.9
2014	107.7	57.9	49.7	13.1	9.3	10.9	0.9	13.6	2.4	7.8
2015	107.3	57.7	49.6	12.9	9.2	10.9	0.9	13.6	2.5	7.8
2016	106.9	57.5	49.4	12.7	9.2	10.9	0.9	13.6	2.6	7.7
2017	106.6	57.2	49.3	12.5	9.1	10.9	0.9	13.6	2.7	7.7
2018	106.3	57.1	49.2	12.3	9.1	10.9	0.9	13.6	2.7	7.6
2019	106.0	56.9	49.1	12.1	9.0	10.9	0.9	13.6	2.8	7.6
2020	105.7	56.7	49.0	12.0	9.0	10.9	0.9	13.6	2.8	7.6
2021	105.4	56.6	48.9	11.8	9.0	10.9	0.9	13.6	2.9	7.6
2022	105.2	56.5	48.8	11.7	9.0	10.9	0.9	13.6	3.0	7.5
2023	105.0	56.3	48.6	11.6	9.0	10.9	0.9	13.6	3.0	7.5
2024	104.8	56.2	48.6	11.4	8.9	10.9	0.9	13.6	3.1	7.5
2025	104.6	56.1	48.5	11.3	8.9	10.9	0.9	13.6	3.1	7.5
2026	104.4	56.1	48.4	11.2	8.9	10.9	0.9	13.6	3.2	7.4
2027	104.3	56.0	48.3	11.1	8.9	10.9	0.9	13.6	3.2	7.4

[10] 1 AF is approximately 325,850 gallons.

	Residential Use (GPCD)			Residential Fixture Use & Leaks (GPCD)						
Year	Total	Indoor	Outdoor	Toilet	Shower	Faucet	Dish Washer	Clothes Washer	Other	Leak
2028	104.1	55.9	48.2	11.0	8.9	10.9	0.9	13.6	3.3	7.4
2029	103.9	55.8	48.1	10.9	8.9	10.9	0.9	13.6	3.3	7.4
2030	103.8	55.8	48.0	10.9	8.9	10.9	0.9	13.6	3.4	7.4
2031	103.7	55.7	48.0	10.8	8.9	10.9	0.9	13.6	3.4	7.4
2032	103.7	55.6	48.0	10.7	8.9	10.9	0.9	13.6	3.4	7.4
2033	103.6	55.6	48.0	10.7	8.8	10.9	0.9	13.6	3.4	7.3
2034	103.5	55.5	48.0	10.6	8.8	10.9	0.9	13.6	3.4	7.3
2035	103.4	55.5	48.0	10.6	8.8	10.9	0.9	13.6	3.4	7.3
2036	103.4	55.4	48.0	10.5	8.8	10.9	0.9	13.6	3.4	7.3
2037	103.3	55.4	47.9	10.5	8.8	10.9	0.9	13.6	3.4	7.3
2038	103.3	55.3	47.9	10.5	8.8	10.9	0.9	13.6	3.4	7.3
2039	103.2	55.3	47.9	10.4	8.8	10.9	0.9	13.6	3.4	7.3
2040	103.1	55.2	47.9	10.4	8.8	10.9	0.9	13.6	3.4	7.3
2041	103.1	55.2	47.9	10.3	8.8	10.9	0.9	13.6	3.4	7.3
2042	103.0	55.2	47.9	10.3	8.8	10.9	0.9	13.6	3.4	7.3
2043	103.0	55.1	47.9	10.3	8.8	10.9	0.9	13.6	3.5	7.3
2044	103.0	55.1	47.9	10.2	8.8	10.9	0.9	13.6	3.5	7.3
2045	102.9	55.1	47.9	10.2	8.8	10.9	0.9	13.6	3.5	7.3
2046	102.9	55.0	47.8	10.2	8.8	10.9	0.9	13.6	3.5	7.3
2047	102.8	55.0	47.8	10.2	8.8	10.9	0.9	13.6	3.5	7.3
2048	102.8	55.0	47.8	10.1	8.8	10.9	0.9	13.6	3.5	7.3
2049	102.8	55.0	47.8	10.1	8.8	10.9	0.9	13.6	3.5	7.2
2050	102.7	54.9	47.8	10.1	8.8	10.9	0.9	13.6	3.5	7.2

Table A-3. Residential Rate Class Baseline Water Use Forecast (AF/Yr)

	Total Water Use (AF/Yr)			Indoor Fixture Water Use & Leaks (AF/Yr)						
Year	Total	Indoor	Outdoor	Toilet	Shower	Faucet	Dish washer	Clothes washer	Other	Leak
2004	65,405	35,858	29,546	9,575	6,024	6,239	502	7,781	825	4,912
2005	66,622	36,412	30,210	9,540	6,062	6,407	515	7,990	919	4,978
2006	67,860	36,986	30,874	9,513	6,110	6,574	529	8,199	1,014	5,047
2007	69,117	37,580	31,538	9,494	6,167	6,741	542	8,408	1,108	5,119
2008	70,392	38,191	32,201	9,483	6,231	6,909	556	8,617	1,203	5,192
2009	71,684	38,819	32,865	9,478	6,303	7,076	569	8,826	1,297	5,269
2010	72,991	39,462	33,529	9,481	6,381	7,244	583	9,035	1,392	5,347
2011	74,312	40,120	34,192	9,490	6,465	7,411	596	9,244	1,486	5,427
2012	75,647	40,790	34,856	9,505	6,554	7,578	610	9,453	1,581	5,509
2013	76,993	41,473	35,520	9,527	6,647	7,746	623	9,662	1,675	5,593
2014	78,352	42,168	36,184	9,554	6,745	7,913	637	9,871	1,770	5,678
2015	79,721	42,873	36,847	9,586	6,847	8,081	650	10,080	1,864	5,765
2016	81,099	43,588	37,511	9,624	6,952	8,248	664	10,289	1,959	5,853
2017	82,488	44,313	38,175	9,667	7,060	8,416	677	10,498	2,053	5,942
2018	83,885	45,046	38,838	9,714	7,171	8,583	691	10,707	2,148	6,033
2019	85,290	45,787	39,502	9,766	7,284	8,750	704	10,916	2,242	6,124
2020	86,702	46,536	40,166	9,822	7,399	8,918	718	11,125	2,337	6,217
2021	88,122	47,292	40,830	9,882	7,517	9,085	731	11,334	2,431	6,311

	Total Water Use (AF/Yr)			Indoor Fixture Water Use & Leaks (AF/Yr)						
Year	Total	Indoor	Outdoor	Toilet	Shower	Faucet	Dish washer	Clothes washer	Other	Leak
2022	89,548	48,055	41,493	9,947	7,636	9,253	745	11,543	2,526	6,405
2023	90,981	48,824	42,157	10,015	7,757	9,420	758	11,752	2,620	6,501
2024	92,420	49,599	42,821	10,086	7,880	9,587	772	11,961	2,715	6,597
2025	93,864	50,379	43,485	10,161	8,004	9,755	785	12,171	2,809	6,694
2026	95,313	51,164	44,148	10,240	8,128	9,922	799	12,380	2,904	6,792
2027	96,767	51,955	44,812	10,321	8,254	10,090	812	12,589	2,999	6,890
2028	98,225	52,750	45,476	10,406	8,381	10,257	826	12,798	3,093	6,989
2029	99,688	53,549	46,139	10,493	8,509	10,424	839	13,007	3,188	7,089
2030	101,155	54,352	46,803	10,583	8,638	10,592	853	13,216	3,282	7,189
2031	101,321	54,416	46,905	10,551	8,653	10,618	855	13,248	3,297	7,196
2032	101,491	54,483	47,007	10,521	8,668	10,643	857	13,280	3,311	7,204
2033	101,664	54,554	47,110	10,493	8,683	10,669	859	13,312	3,326	7,212
2034	101,840	54,628	47,212	10,467	8,700	10,695	861	13,344	3,340	7,221
2035	102,019	54,705	47,314	10,444	8,716	10,721	863	13,376	3,355	7,230
2036	102,201	54,785	47,416	10,423	8,734	10,746	865	13,409	3,369	7,239
2037	102,386	54,868	47,518	10,404	8,751	10,772	867	13,441	3,384	7,249
2038	102,574	54,953	47,620	10,387	8,769	10,798	869	13,473	3,398	7,259
2039	102,763	55,041	47,722	10,371	8,787	10,824	871	13,505	3,413	7,270
2040	102,956	55,131	47,824	10,357	8,806	10,849	873	13,537	3,427	7,281
2041	103,150	55,223	47,927	10,345	8,824	10,875	875	13,569	3,442	7,292
2042	103,346	55,318	48,029	10,335	8,843	10,901	878	13,602	3,457	7,303
2043	103,545	55,414	48,131	10,326	8,862	10,927	880	13,634	3,471	7,315
2044	103,745	55,512	48,233	10,318	8,882	10,952	882	13,666	3,486	7,327
2045	103,947	55,612	48,335	10,312	8,901	10,978	884	13,698	3,500	7,339
2046	104,151	55,713	48,437	10,307	8,921	11,004	886	13,730	3,515	7,351
2047	104,356	55,817	48,539	10,303	8,940	11,030	888	13,762	3,529	7,364
2048	104,563	55,921	48,641	10,301	8,960	11,056	890	13,795	3,544	7,377
2049	104,771	56,027	48,744	10,299	8,980	11,081	892	13,827	3,558	7,390
2050	104,981	56,135	48,846	10,299	9,000	11,107	894	13,859	3,573	7,403

Multifamily Baseline Water Use Forecast

The multifamily baseline water use forecast is shown in Tables A-4 and A-5. Table A-4 presents the forecast in terms of gallons per capita per day. Table A-5 shows total annual water use denominated in acre-feet (AF).

Table A-4. Multifamily Rate Class Baseline Water Use Forecast (GPCD)

	Multifamily Use (GPCD)			Multifamily Fixture Use & Leaks (GPCD)						
Year	Total	Indoor	Outdoor	Toilet	Shower	Faucet	Dish Washer	Clothes Washer	Other	Leak
2004	98.5	72.5	26.0	17.6	11.8	12.1	1.0	10.5	10.1	9.5
2005	97.6	71.7	25.9	17.2	11.5	12.1	1.0	10.5	10.0	9.4
2006	96.7	71.0	25.7	16.8	11.3	12.1	1.0	10.5	10.0	9.3
2007	95.9	70.3	25.6	16.5	11.1	12.1	1.0	10.5	9.9	9.2
2008	95.2	69.7	25.5	16.2	11.0	12.1	1.0	10.5	9.8	9.2
2009	94.5	69.1	25.4	15.9	10.8	12.1	1.0	10.5	9.8	9.1
2010	93.9	68.6	25.3	15.6	10.7	12.1	1.0	10.5	9.7	9.0

	Multifamily Use (GPCD)			Multifamily Fixture Use & Leaks (GPCD)						
Year	Total	Indoor	Outdoor	Toilet	Shower	Faucet	Dish Washer	Clothes Washer	Other	Leak
2011	93.2	68.0	25.2	15.3	10.5	12.1	1.0	10.5	9.6	9.0
2012	92.7	67.5	25.1	15.1	10.4	12.1	1.0	10.5	9.6	8.9
2013	92.1	67.1	25.0	14.8	10.3	12.1	1.0	10.5	9.5	8.9
2014	91.6	66.7	24.9	14.6	10.2	12.1	1.0	10.5	9.5	8.8
2015	91.1	66.3	24.9	14.4	10.1	12.1	1.0	10.5	9.4	8.8
2016	90.7	65.9	24.8	14.2	10.0	12.1	1.0	10.5	9.4	8.7
2017	90.2	65.5	24.7	14.0	9.9	12.1	1.0	10.5	9.3	8.7
2018	89.8	65.2	24.6	13.8	9.8	12.1	1.0	10.5	9.3	8.6
2019	89.4	64.8	24.6	13.6	9.8	12.1	1.0	10.5	9.3	8.6
2020	89.0	64.5	24.5	13.5	9.7	12.1	1.0	10.5	9.2	8.6
2021	88.7	64.3	24.4	13.3	9.6	12.1	1.0	10.5	9.2	8.5
2022	88.3	64.0	24.4	13.2	9.6	12.1	1.0	10.5	9.1	8.5
2023	88.0	63.7	24.3	13.0	9.5	12.1	1.0	10.5	9.1	8.5
2024	87.7	63.5	24.3	12.9	9.5	12.1	1.0	10.5	9.1	8.5
2025	87.4	63.2	24.2	12.8	9.4	12.1	1.0	10.5	9.0	8.4
2026	87.2	63.0	24.1	12.6	9.4	12.1	1.0	10.5	9.0	8.4
2027	86.9	62.8	24.1	12.5	9.4	12.1	1.0	10.5	9.0	8.4
2028	86.6	62.6	24.0	12.4	9.3	12.1	1.0	10.5	9.0	8.4
2029	86.4	62.4	24.0	12.3	9.3	12.1	1.0	10.5	8.9	8.3
2030	86.2	62.2	23.9	12.2	9.3	12.1	1.0	10.5	8.9	8.3
2031	86.1	62.1	23.9	12.1	9.2	12.1	1.0	10.5	8.9	8.3
2032	86.0	62.0	23.9	12.1	9.2	12.1	1.0	10.5	8.9	8.3
2033	85.8	61.9	23.9	12.0	9.2	12.1	1.0	10.5	8.9	8.3
2034	85.7	61.8	23.9	11.9	9.2	12.1	1.0	10.5	8.9	8.3
2035	85.6	61.7	23.9	11.9	9.2	12.1	1.0	10.5	8.9	8.3
2036	85.5	61.6	23.9	11.8	9.1	12.1	1.0	10.5	8.9	8.2
2037	85.4	61.6	23.9	11.8	9.1	12.1	1.0	10.5	8.9	8.2
2038	85.4	61.5	23.9	11.7	9.1	12.1	1.0	10.5	8.9	8.2
2039	85.3	61.4	23.9	11.7	9.1	12.1	1.0	10.5	8.9	8.2
2040	85.2	61.3	23.9	11.6	9.1	12.1	1.0	10.5	8.9	8.2
2041	85.1	61.2	23.9	11.6	9.1	12.1	1.0	10.5	8.9	8.2
2042	85.0	61.2	23.9	11.5	9.0	12.1	1.0	10.5	8.9	8.2
2043	84.9	61.1	23.9	11.5	9.0	12.1	1.0	10.5	8.8	8.2
2044	84.9	61.0	23.8	11.4	9.0	12.1	1.0	10.5	8.8	8.2
2045	84.8	60.9	23.8	11.4	9.0	12.1	1.0	10.5	8.8	8.2
2046	84.7	60.9	23.8	11.3	9.0	12.1	1.0	10.5	8.8	8.1
2047	84.6	60.8	23.8	11.3	9.0	12.1	1.0	10.5	8.8	8.1
2048	84.6	60.7	23.8	11.3	9.0	12.1	1.0	10.5	8.8	8.1
2049	84.5	60.7	23.8	11.2	9.0	12.1	1.0	10.5	8.8	8.1
2050	84.4	60.6	23.8	11.2	9.0	12.1	1.0	10.5	8.8	8.1

Table A-5. Multifamily Rate Class Baseline Water Use Forecast (AF/Yr)

	Total Water Use (AF/Yr)			Indoor Fixture Water Use & Leaks (AF/Yr)						
Year	Total	Indoor	Outdoor	Toilet	Shower	Faucet	Dish washer	Clothes washer	Other	Leak
2004	22,470	16,538	5,932	4,007	2,683	2,761	228	2,387	2,304	2,167

	Total Water Use (AF/Yr)			Indoor Fixture Water Use & Leaks (AF/Yr)						
Year	Total	Indoor	Outdoor	Toilet	Shower	Faucet	Dish washer	Clothes washer	Other	Leak
2005	22,862	16,801	6,061	4,025	2,703	2,835	234	2,451	2,348	2,204
2006	23,257	17,068	6,189	4,044	2,725	2,909	240	2,515	2,392	2,242
2007	23,655	17,337	6,318	4,064	2,748	2,983	247	2,579	2,436	2,279
2008	24,056	17,609	6,447	4,085	2,773	3,057	253	2,644	2,480	2,317
2009	24,459	17,884	6,575	4,106	2,800	3,131	259	2,708	2,524	2,356
2010	24,865	18,161	6,704	4,129	2,828	3,206	265	2,772	2,568	2,394
2011	25,274	18,441	6,833	4,152	2,857	3,280	271	2,836	2,612	2,433
2012	25,684	18,723	6,962	4,176	2,887	3,354	277	2,900	2,656	2,473
2013	26,097	19,007	7,090	4,200	2,919	3,428	283	2,964	2,700	2,512
2014	26,513	19,294	7,219	4,226	2,951	3,502	289	3,028	2,744	2,552
2015	26,930	19,582	7,348	4,252	2,985	3,576	296	3,092	2,789	2,592
2016	27,349	19,873	7,476	4,279	3,020	3,651	302	3,157	2,833	2,633
2017	27,771	20,165	7,605	4,307	3,055	3,725	308	3,221	2,877	2,673
2018	28,194	20,460	7,734	4,335	3,092	3,799	314	3,285	2,921	2,714
2019	28,619	20,756	7,862	4,364	3,130	3,873	320	3,349	2,965	2,755
2020	29,045	21,054	7,991	4,394	3,168	3,947	326	3,413	3,009	2,797
2021	29,473	21,354	8,120	4,425	3,207	4,021	332	3,477	3,053	2,838
2022	29,903	21,655	8,249	4,456	3,247	4,095	338	3,541	3,097	2,880
2023	30,335	21,957	8,377	4,487	3,287	4,170	345	3,605	3,141	2,922
2024	30,767	22,261	8,506	4,520	3,328	4,244	351	3,670	3,185	2,964
2025	31,202	22,567	8,635	4,553	3,370	4,318	357	3,734	3,229	3,007
2026	31,637	22,874	8,763	4,586	3,413	4,392	363	3,798	3,273	3,049
2027	32,074	23,182	8,892	4,620	3,456	4,466	369	3,862	3,317	3,092
2028	32,513	23,492	9,021	4,655	3,499	4,540	375	3,926	3,361	3,135
2029	32,952	23,802	9,149	4,690	3,543	4,615	381	3,990	3,405	3,178
2030	33,393	24,114	9,278	4,726	3,588	4,689	387	4,054	3,449	3,221
2031	33,430	24,132	9,298	4,712	3,587	4,700	388	4,064	3,456	3,224
2032	33,468	24,150	9,318	4,699	3,587	4,712	389	4,074	3,463	3,227
2033	33,508	24,170	9,338	4,686	3,587	4,723	390	4,084	3,469	3,230
2034	33,548	24,191	9,357	4,674	3,588	4,734	391	4,094	3,476	3,233
2035	33,590	24,212	9,377	4,663	3,589	4,746	392	4,104	3,483	3,236
2036	33,632	24,235	9,397	4,652	3,591	4,757	393	4,114	3,490	3,239
2037	33,675	24,258	9,417	4,641	3,592	4,769	394	4,123	3,496	3,243
2038	33,720	24,283	9,437	4,631	3,594	4,780	395	4,133	3,503	3,246
2039	33,765	24,308	9,456	4,621	3,597	4,791	396	4,143	3,510	3,250
2040	33,810	24,334	9,476	4,611	3,600	4,803	397	4,153	3,517	3,254
2041	33,857	24,361	9,496	4,603	3,602	4,814	398	4,163	3,524	3,258
2042	33,905	24,389	9,516	4,594	3,606	4,826	399	4,173	3,530	3,262
2043	33,953	24,417	9,536	4,586	3,609	4,837	400	4,183	3,537	3,266
2044	34,002	24,446	9,555	4,578	3,613	4,848	401	4,192	3,544	3,270
2045	34,051	24,476	9,575	4,571	3,617	4,860	402	4,202	3,551	3,274
2046	34,102	24,507	9,595	4,564	3,621	4,871	403	4,212	3,557	3,278
2047	34,153	24,538	9,615	4,557	3,625	4,883	404	4,222	3,564	3,283
2048	34,204	24,570	9,635	4,551	3,630	4,894	404	4,232	3,571	3,287
2049	34,256	24,602	9,654	4,545	3,635	4,906	405	4,242	3,578	3,292
2050	34,309	24,635	9,674	4,539	3,640	4,917	406	4,252	3,585	3,297

COMMERCIAL BASELINE WATER USE FORECAST

Baseline Commercial Water Use Model

The commercial rate class baseline water use forecast is based on the relationship between commercial water use, residential water use and annual rainfall developed using regression analysis. The regression model explains about 83% of the variation in commercial water use over the period 1985 to 2004. The estimated model is:

(1) Com = a + b*ln(Res) + c*ln(Rain),

Where Com is annual commercial use, Res is annual residential use (in AF), and Rain is annual inches of rainfall. The parameter estimates are shown in the table below.

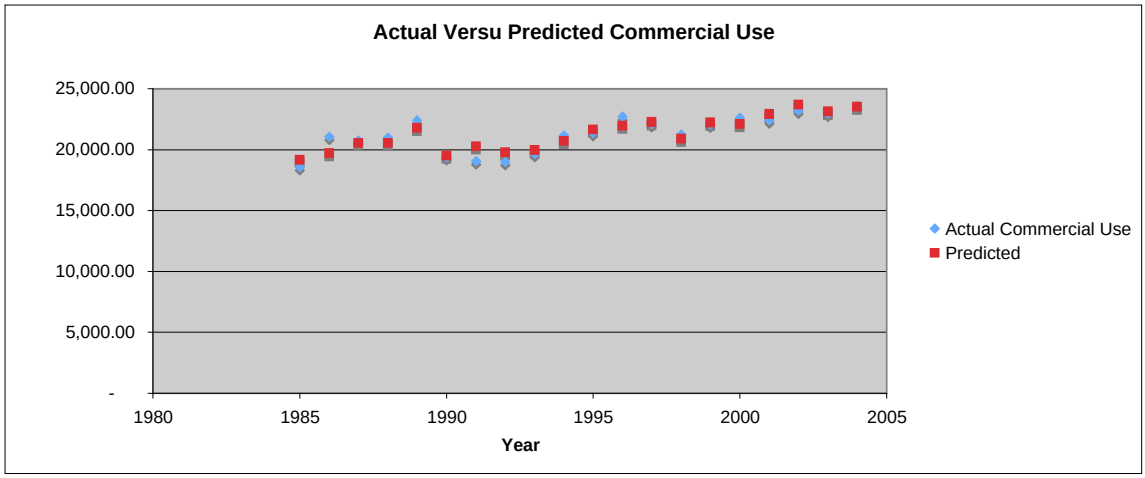
Regression Statistics	
Multiple R	0.919181977
R Square	0.844895506
Adjusted R Square	0.826647919
Standard Error	628.169328
Observations	20

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	-91493.81389	15873.25154	-5.764024698	2.29123E-05
b	10769.63782	1410.271752	7.636569194	6.83357E-07
c	-1688.706965	614.318256	-2.748912227	0.013699199

Baseline commercial use was estimated by substituting the baseline residential forecast and average annual rainfall into equation 1. This produced a weather normalized forecast of commercial use.

Other explanatory variables examined for the model included population, temperature, lags in temperature and rainfall, and lags in residential and commercial use. Population was highly correlated with residential use and therefore created multicollinearity issues. Alternative model formulations with the other variables did not improve model fit. Actual versus predicted commercial use for the period 1985 to 2004 is shown in Figure A-1.

Figure A-1. Actual and Fitted Commercial Water Use



Baseline Commercial Water Use Forecast

Table A-6 shows the baseline commercial water use forecast in acre-feet/yr and gallons per capita per day (GPCD).

Table A-6. Baseline Commercial Water Use Forecast

Year	Commercial Use (AF)	Commercial Use (GPCD)
2004	23,770	29.64
2005	23,969	29.11
2006	24,167	28.60
2007	24,365	28.12
2008	24,562	27.66
2009	24,757	27.22
2010	24,952	26.80
2011	25,145	26.40
2012	25,337	26.01
2013	25,527	25.64
2014	25,715	25.28
2015	25,902	24.93
2016	26,087	24.60
2017	26,269	24.28
2018	26,450	23.97
2019	26,629	23.67
2020	26,806	23.38
2021	26,981	23.10
2022	27,154	22.83
2023	27,325	22.56
2024	27,494	22.30
2025	27,661	22.05
2026	27,826	21.81
2027	27,989	21.57

Year	Commercial Use (AF)	Commercial Use (GPCD)
2028	28,150	21.34
2029	28,309	21.12
2030	28,466	20.90
2031	28,484	20.86
2032	28,502	20.83
2033	28,520	20.79
2034	28,539	20.75
2035	28,558	20.72
2036	28,577	20.68
2037	28,597	20.65
2038	28,616	20.61
2039	28,636	20.58
2040	28,656	20.54
2041	28,677	20.51
2042	28,697	20.47
2043	28,718	20.44
2044	28,739	20.41
2045	28,760	20.37
2046	28,781	20.34
2047	28,802	20.31
2048	28,823	20.28
2049	28,845	20.24
2050	28,866	20.21

COMMERCIAL WATER USE SAVINGS POTENTIAL

Models of water savings potential were developed for commercial water uses. This section summarizes the results of these models and describes their structure, assumptions, and data inputs.

Summary of Commercial Water Use Savings Potential

Maximum water savings potential by commercial, industrial, and institutional (CII) end uses calibrated to 2004 is shown in Table 1. Maximum savings potential is 6,691 AF, about 19% of 2004 baseline water use. Landscape water use offers the greatest amount of savings potential, followed by cooling towers and toilets. Showers and urinals offer the least amount of savings potential.

Table 6. 2004 CII Maximum Water Savings Potential

CII End Use	Max. Potential (AF)
CII Showers	61
CII Urinals	242
CII Kitchen	254
CII Laundry	318

CII Toilets	877
CII Cooling Towers	1,129
Landscape – Potable	1,487
Landscape – Reclaimed	2,322
Total	**6,691**
% of 2004 CII Baseline	18.8%

Commercial Water Use Savings Models

CII Showers

CII Shower Savings Potential Model for Tucson Water Service Area

Industry	Potential Savings (gpm)	Minutes/ Room or Patient/Day	Number of Rooms or Patients/Day	Savings/Day (gal)	Maximum Savings Potential (AF)
Hotels	0.5	16.2	6,080	49,248	55
Hospitals	0.5	5	1,925	4,813	5
					61

Source & Assumptions of Estimate:

1. Source is Pacific Institute (PI) "Waste Not Want Not Report", Appendix D
2. PI derived potential savings (gpm) and average time spent showering from Brown and Caldwell 1990 and LADWP 1991.
3. Number of hotel rooms = avg. no. rooms/hotel for Arizona x no. of hotels in TW service area. Avg. no. rooms from Economic Census.
4. Number of patient-days is derived using ratio of patients:hospital employees reported in PI.

CII Urinals

CII Urinal Savings Potential Model for Tucson Water Service Area

		Flushes Per Day			Number				
Industry	Potential Savings (gpf)	Empl.	Visitor	Student/ Other	Empl.	Visitor	Student/ Other	Total Flushes/ Day	Max. Savings AF)
Office	0.6	1.25	0.17		49,878	49,878		70,827	48
Schools	0.6	0.94	0.31	0.94	2,437	4,143	95,201	93,064	63
Restaurants	0.6	1.25	0.17		21,942	274,275		74,054	50
Retail	0.6	1.25	0.07		53,528	396,107		94,638	64
Hospitals	0.6	1.25			17,503	3,851	1,925	21,879	15
Hotels	0.6	1.25			3,982		5,575	4,978	3
Laundries	0.6	1.25			868			1,085	1
									242

Source & Assumptions of Estimate:

1. Source is PI Waste Not Want Not Report, Appendix D
2. Potential savings and flushes per employee from EBMUD survey data reviewed by PI.

3. Flushes per visitor from Vickers (2001) as reported by PI.
4. Employee and student flush rates account for shortened day relative to office work day, per PI assumption.
5. Office visitors per employee is a PI assumption.
6. Restaurant and retail visitor to employee ratios used to estimate number of visitors. Ratios from various studies reviewed by PI.
7. Patient to employee ratio adopted from PI estimate for CA due to lack of data on school enrollment and hospital patient-days. Hope to improve this later.
8. Number of employees from CBP zip data for TW service area except Laundry, which is from Tucson MSA.
9. Student from enrollment data for schools within TW service area.

CII Kitchen

CII Kitchen Water Savings Potential Model

Kitchen End Use	% of Use	2004 Use (AF)	Savings Potential (%)	Penetration Rate	Max. Conservation Potential (%)	Maximum Savings Potential (AF)
Dishwashers	24%	337	40%	38%	29%	99
Pre-rinse nozzles	14%	197	60%	10%	57%	113
Pot sink	17%	239	0%	0%	0%	-
Garbage disposal	8%	112	0%	0%	0%	-
Food prep	9%	126	0%	0%	0%	-
Icemaker	19%	267	20%	25%	16%	42
General sanitation	9%	126	0%	0%	0%	-
Total	100%	1,404				254

Source & Assumptions of Estimate:

1. Source is PI Waste Not Want Not Report, Appendix D
2. % of use by kitchen end-use is from case study data reviewed by PI. Sources listed in PI Appendix D.
3. Max. Conservation Potential is derived as follows. Let S = savings potential % and let P = market penetration % and let M = max conservation potential.
M = S x (1-P)/(1-SxP). See PI page 100 for details of formula.

CII Laundry

Commercial Laundry (other than coin op) Savings Potential Model for Tucson Water Service Area

Technology	Typical Savings (%)	Penetration Rates (%)	Savings (%)
Currently closed-loop	0%	1%	0%
Currently 80% recycling	0%	9%	0%
Currently 30% recycling	50%	60%	30%
Currently no recycling	80%	30%	24%
Maximum Savings Potential (%)			68%
2004 CII Use for Laundry			468
Maximum Savings Potential (AF)			318

Source of Estimate: PI Waste Not Want Not Report.

PI adopted the following assumptions: 1% of laundry facilities are currently closed-loop; 9% currently recycle 80% of their water; 50% currently recycle 30% of their water; and 40% don't recycle any water. Under a maximum conservation scenario, 2% of laundry facilities are closed-loop; 10% will recycle 30% of their water; and 88% will recycle 80% of their water.

Let X be the amount of water used per unit of laundry assuming no recycling. Let TW be current total use and TW' be total use under the maximum conservation scenario.

TW = 0.01X(1-1) + 0.09X(1-0.8) + 0.5X(1-0.3) + 0.4X = 0.768X

TW' = 0.02X(1-1) + 0.88X(1-0.8) + 0.1X(1-0.3) = 0.246X

Conservation Potential = TW - TW' = 0.522X

Conservation Potential as Percentage of Current Use = (TW - TW')/TW = 0.522/0.768 = 0.680 = 68%

CII Toilets

CII Toilet Savings Potential Model for Tucson Water Service Area

Toilets per Site by Employment Size					
Number of Employees at Site	1 to 9	10 to 19	20 to 49	50 to 99	100+
Industrial	2.0	2.6	4.8	8.0	18.0
Retail/Wholesale	2.0	2.4	5.3	9.0	13.1
Restaurants	2.0	2.5	4.3	7.7	11.6
Office	2.0	3.4	8.1	18.1	32.6
Health Care	2.2	6.3	15.0	32.4	65.2
Church	3.1	9.1	21.6	21.6	21.6
Government	2.0	2.9	7.0	15.3	25.9
Other	2.0	2.3	5.7	12.7	19.4

	Toilets/Room
Hotels	1.05

	Toilets/Stud.
Schools: 9 to 12	0.036364
Schools: K to 8	0.28571

Number of Sites by Employment Size: 1994					
Number of Employees at Site	1 to 9	10 to 19	20 to 49	50 to 99	100+
Industrial	323	100	81	28	22
Retail/Wholesale	2,817	596	280	69	64
Restaurants	438	213	231	63	16
Office	2,857	370	225	70	69
Health Care	899	96	63	16	33
Church	100	24	22	7	1
Government					

Other	1,590	334	226	59	49

	Rooms	Sites	Rooms/Site
Hotels	6080	76	80

	Students
Schools: 9 to 12	25,652
Schools: K to 8	69,550

Toilet Count by Sector	Toilets	% Non ULFT	Non ULFT	GPD Savings per ULFT	Maximum Savings Potential (AF)
Industrial	1,915	48%	914	23	24
Retail/Wholesale	10,008	48%	4,778	40	214
Restaurants	3,073	48%	1,467	47	77
Office	12,311	48%	5,878	20	132
Health Care	6,198	48%	2,959	21	70
Church	1,176	48%	562	28	18
Government	1,620	48%	773	25	22
Other	6,936	48%	3,312	18	67
Hotels	6,384	48%	3,048	16	55
Schools: 9 to 12	933	48%	445	18	9
Schools: K to 8	19,871	48%	9,487	18	191
					877

Source & Assumptions of Estimate:

1. Source for savings and toilet count estimation method is CUWCC (2001)
2. Number of sites by employment size for 1994 is from CBP for all zip codes in TW service area.
3. Number of hotel sites is from 1994 CBP for all zip codes in TW service area.
4. Average number of rooms per hotel from Economic Census for Arizona.
5. Government toilets assumed to equal 2.3% of total toilets, per CUWCC CII Toilet Study.

CII Cooling Towers

CII Cooling Tower Savings Potential Model for Tucson Water Service Area

Technology	Typical Savings (%)	Penetration Rates (%)	Savings (%)
Conductivity controllers	35%	90%	5%
Optimize CR by using state of the art treatment	15%	70%	5%
CR Boost by chemical treatment	15%	32.50%	11%
Boost energy efficiency of fans, pumps	15%	10%	14%
Reused makeup water	100%	0%	100%
Elimination of single pass cooling equipment	90%	90%	47%

Pacific Institute Best Estimate of Average Savings	25%
2004 CII Use for Cooling	4,517
Maximum Savings Potential (AF)	1,129

Source & Assumptions of Estimate:

1. Source is PI Waste Not Want Not Report, Appendix D
2. Derivation of Best Estimate is discussed on page 19 of Appendix D of PI report.

CII Landscape Savings – Potable and Reclaimed Water

Landscape water savings potential follows the model presented in Pacific Institute's "Waste Not Want Not" report. Water savings calculations are shown in the table below. While the model is capable of estimating savings from turf reduction, no additional turf reduction is assumed in our implementation of the model. Penetration of sprinkler versus hand watering based on TW staff estimates. Water savings percentages for different irrigation technologies from Pacific Institute's "Waste Not Want Not" report, California Urban Water Conservation Council, Irvine Ranch ET Controller Study, and Handbook of Water Use and Conservation. Turf and non-turf water use derived from climate and ET data and reviewed by TW staff.

Potable Water Savings Model

	Acres	% Area	W.Use Feet/Acre	Water Use (AFPY)	% Use by Turf and Non-Turf
Current Non-Residential Landscape Area in Tucson					
Turf Area	606	25%	5.25	3,178	44%
Non-Turf Area	1,817	75%	2.21	4,007	56%
Total	**2,423**		**3.0**	**7,185**	
Maximum Reduction of Turf					
Turf Area	606	25%	5.25	3,178	44%
Non-Turf Area	1,817	75%	2.21	4,007	56%
Total	**2,423**		**3.0**	**7,185**	
Water Saved from reduction of Turf				**0.0%**	

		Water Use (AF)
Turf		**3,178**
Sprinkler Based	90%	2,860
Hand Watered	5%	159
Non-Turf		**4,007**
Sprinkler Based	90%	3,606
Hand Watered	5%	200

Technologies	**Typical Savings**	**Penetration Rate**			**Potential Savings**		
Sprinkler Based		**Low**	**High**	**Best**	**Low**	**High**	**Best**
ET Sensors - Turf	35%	10%	0%	1%	33%	35%	35%
ET Sensors - Non Turf	10%	10%	0%	1%	9%	10%	10%
Installing Drip Irrigation	30%	90%	50%	75%	4%	18%	10%
Combined Sensors and Drip Irrigation (applies only to non turf)					13%	26%	19%
Hand Watered							
Auto-Shutoff	8%	50%	10%	25%	4%	7%	6%

Water Sensors are applicable to turf, while both water sensors and drip irrigation can be used in shrubs

Savings are applicable to the water use obtained after replacing turf with shrub

	Low	**High**	**Best**
Turf Savings	30%	32%	32%
Non Turf Savings	12%	24%	17%
Overall Landscape Savings	**16%**	**26%**	**21%**

Maximum Landscape Water Use Savings (AF)

Low	**High**	**Best**
1,165	1,847	1,487

Reclaimed Water Savings Model

	Acres	% Area	W.Use Feet/Acre	Water Use (AFPY)	% Use by Turf and Shrub
Current Non-Residential Landscape Area in Tucson					
Turf Area	2,218	90%	5.25	11,637	96%
Non-Turf Area	246	10%	2.21	543	4%
Total	**2,464**		**4.9**	**12,180**	
Maximum Reduction of Turf					
Turf Area	2,218	90%	5.25	11,637	96%
Non-Turf Area	246	10%	2.21	543	4%
Total	**2,464**		**4.9**	**12,180**	
Water Saved from reduction of Turf				**0.0%**	

		Water Use (AF)
Turf		**11,637**
Sprinkler Based	90%	10,473
Hand Watered	5%	582
Shrub		**543**
Sprinkler Based	90%	489
Hand Watered	5%	27

Technologies	**Typical Savings**	**Penetration Rate**			**Potential Savings**		
Sprinkler Based		**Low**	**High**	**Best**	**Low**	**High**	**Best**
ET Sensors - Turf	35%	75%	25%	50%	12%	29%	21%
ET Sensors - Non Turf	10%	10%	0%	1%	9%	10%	10%
Installing Drip Irrigation	30%	90%	50%	75%	4%	18%	10%
Combined Sensors and Drip Irrigation (applies only to non turf)					13%	26%	19%
Hand Watered							
Auto-Shutoff	8%	50%	10%	50%	4%	7%	4%

Water Sensors are applicable to turf, while both water sensors and drip irrigation can be used in shrubs
Savings are applicable to the water use obtained after replacing turf with shrub

	Low	**High**	**Best**
Turf Savings	11%	26%	19%
Non Turf Savings	12%	24%	17%
Overall Landscape Savings	**11%**	**26%**	**19%**

Maximum Landscape Water Use Savings (AF)

Low	**High**	**Best**
1,337	3,166	2,322

APPENDIX B: UNIVERSE OF CONSERVATION PROGRAMS

TUCSON WATER UNIVERSE OF CONSERVATION PROGRAMS	
SINGLE FAMILY INTERIOR	
BRIEF DESCRIPTIONS OF POTENTIAL PROGRAM DELIVERY MECHANISMS	
Technology	**Delivery Mechanism**
SINGLE FAMILY INTERIOR: EXISTING CONSTRUCTION	
ULF Toilets	Rebate program. Rebates could be higher for higher-efficiency toilets or higher quality toilets deemed to ensure longer-lived water savings.
	Retrofit on resale ordinance. Seller required to install specified conservation measures before close of escrow.
	Community-Based Organization Program. The utility contracts with a CBO to directly distribute, install and/or disseminate rebates for ULF toilets. By using organizations known in the community, these programs can achieve program penetration in low income areas where water savings can be higher and participation in traditional rebate programs is low. Problems of free-ridership are also minimized.
Showerheads, Faucets, Flappers	Kit distribution. May be door-to-door or depot-based.
Clothes washers	Rebate program. May include limited-term higher rebates and salesperson incentives, in cooperation with retailers. The limited-term offer helps minimize free-ridership problems while salesperson incentives increase participation rates.
Dishwashers	Rebate program. May include limited-term higher rebates and salesperson incentives, in cooperation with retailers. The limited-term offer helps minimize free-ridership problems while salesperson incentives increase participation rates.
Hot Water	Recirculation system rebate program
	Recirculation system retrofit on resale ordinance
Space Cooling	Evaporative cooler, misting system replacement rebates
	Misting system operating restrictions or prohibitions
Water Softeners	Replacement incentives. Older softeners can either be replaced with newer units that use less water, with non-self-regenerating units, or with filter systems. This measure also offers potential wastewater and energy benefits.
	Operating restrictions. These might prohibit or limit self-regeneration.

SINGLE FAMILY INTERIOR: NEW CONSTRUCTION	
Hot Water	Ordinance requiring recirculating hot water systems in new construction.
Water Softeners	Ordinance requiring efficient units and/or centralized regeneration.
SINGLE FAMILY INTERIOR: PILOTS, DEMONSTRATIONS, ASSESSMENTS	
Toilets	Dual-flush toilet demonstration. Dual flush toilets use two different user-selected flush levels (1.6 gal./flush and 0.8 gal./flush) for solid and liquid waste.
Hot Water	Point of use (PoU) water heater demonstration program. PoU water heaters can save the water used while waiting for hot water to reach the tap by locating a water heating unit at the point of use. They may also save the energy required to heat hot water pipes.

TUCSON WATER UNIVERSE OF CONSERVATION PROGRAMS	
SINGLE FAMILY EXTERIOR	
BRIEF DESCRIPTIONS OF POTENTIAL PROGRAM DELIVERY MECHANISMS	
Technology	**Delivery Mechanism**
SINGLE FAMILY EXTERIOR: EXISTING CONSTRUCTION	
Irrigation Systems	Rebate for replacement/upgrades (incl timers, moisture sensors, ET controllers, etc.)
	Retrofit on resale ordinance. This may require definition of irrigation efficiency standards.
Landscape Design	Rebate for improvements in efficient designs.
	Cash-for-grass. Rebates for replacing turf with less water-intensive plant material.
	Ordinance specifying landscape design standards for resales.
Other	Modify site surveys to target high outdoor use customers.
	Swimming pool cover promotion
	Mandatory watering restrictions (day of week / time of day)
SINGLE FAMILY EXTERIOR: NEW CONSTRUCTION	
Irrigation Systems	Ordinance re: new construction design standards (incl timers, moisture sensors, ET controllers, performance requirements, etc.)
Landscape Design	Extend existing ordinance for new construction to cover single-family
Water Harvesting	Ordinances to require or encourage rainwater and greywater use where available and appropriate
SINGLE FAMILY EXTERIOR: PILOTS, DEMONSTRATIONS, ASSESSMENTS	
Irrigation Systems	ET controller Pilot Program (to determine local cost effectiveness, local acceptability)
Water Harvesting	System assessment for rainwater harvesting potential

TUCSON WATER UNIVERSE OF CONSERVATION PROGRAMS	
MULTI-FAMILY INTERIOR	
BRIEF DESCRIPTIONS OF POTENTIAL PROGRAM DELIVERY MECHANISMS	
Technology	**Delivery Mechanism**
MULTI-FAMILY INTERIOR: EXISTING CONSTRUCTION	
ULF Toilets	Rebate program. Rebates could be higher for higher-efficiency toilets or higher quality toilets deemed to ensure longer-lived water savings.
	Vendor-driven delivery. Utility contracts with vendor(s) to deliver ULF toilets to large, multi-family complexes. Toilets are free and could be coupled with free installation or installation rebates.
	Retrofit on resale ordinance. Seller required to install specified conservation measures before close of escrow.
	Community-Based Organization Program. The utility contracts with a CBO to directly distribute, install and/or disseminate rebates for ULF toilets. By using organizations known in the community, these programs can achieve program penetration in low income areas where water savings can be higher and participation in traditional rebate programs is low. Problems of free-ridership are also minimized.
Showerheads, Faucets, Flappers	Kit distribution. May be door-to-door or depot-based.
Clothes washers	Rebate program. May be utility-operated or vendor-driven. May offer higher rebates for common-use machines. May include limited-term higher rebates and salesperson incentives, in cooperation with retailers. The limited-term offer helps minimize free-ridership problems while salesperson incentives increase participation rates.
Dishwashers	Rebate program. May include limited-term higher rebates and salesperson incentives, in cooperation with retailers. The limited-term offer helps minimize free-ridership problems while salesperson incentives increase participation rates.
Hot Water	Recirculation system rebate program
	Recirculation system retrofit on resale ordinance
Space Cooling	Evaporative cooler, misting system replacement rebates
	Misting system operating restrictions or prohibitions
Submetering	Financial incentives for multi-family owners to submeter their properties.

Water Softeners	Replacement incentives. Older softeners can either be replaced with newer units that use less water, with non-self-regenerating units, or with filter systems. This measure also offers potential wastewater and energy benefits.
	Operating restrictions. These might prohibit or limit self-regeneration.
MULTI-FAMILY INTERIOR: NEW CONSTRUCTION	
Clothes Washers	Ordinance requiring efficient clothes washers in new multi-family construction.
Hot Water	Ordinance requiring recirculating hot water systems in new multi-family construction.
Water Softeners	Ordinance requiring efficient units and/or centralized regeneration.
Submetering	Ordinance requiring submetering of new multi-family complexes.
MULTI-FAMILY INTERIOR: PILOTS, DEMONSTRATIONS, ASSESSMENTS	
Toilets	Dual-flush toilet demonstration. Dual flush toilets use two different user-selected flush levels (1.6 gal./flush and 0.8 gal./flush) for solid and liquid waste.
Hot Water	Point of use (PoU) water heater demonstration program. PoU water heaters can save the water used while waiting for hot water to reach the tap by locating a water heating unit at the point of use. They may also save the energy required to heat hot water pipes.

TUCSON WATER UNIVERSE OF CONSERVATION PROGRAMS	
MULTI-FAMILY EXTERIOR	
BRIEF DESCRIPTIONS OF POTENTIAL PROGRAM DELIVERY MECHANISMS	
Technology	**Delivery Mechanism**
MULTI-FAMILY EXTERIOR: EXISTING CONSTRUCTION	
Irrigation Systems	Rebate for replacement/upgrades (incl timers, moisture sensors, ET controllers, etc.)
	Retrofit on resale ordinance
Landscape Design	Rebate
	Cash-for-grass
	Ordinance specifying landscape design standards for resales
Other	Swimming pool cover promotion
	Mandatory watering restrictions (day of week / time of day)
MULTI-FAMILY EXTERIOR: NEW CONSTRUCTION	
Irrigation Systems	Ordinance re: new construction design standards (incl timers, moisture sensors, ET controllers, performance requirements, etc.)
Landscape Design	Strengthen existing ordinance
Water Harvesting	Ordinance to require or encourage rainwater and greywater use where available and appropriate
MULTI-FAMILY EXTERIOR: PILOTS, DEMONSTRATIONS, ASSESSMENTS	
Irrigation Systems	ET controller Pilot Program (to determine local cost effectiveness, local acceptability)
Water Harvesting	System assessment for rainwater harvesting potential

TUCSON WATER UNIVERSE OF CONSERVATION PROGRAMS	
COMMERCIAL/INDUSTRIAL INTERIOR	
BRIEF DESCRIPTIONS OF POTENTIAL PROGRAM DELIVERY MECHANISMS	
Technology	**Delivery Mechanism**
COMMERCIAL/INDUSTRIAL INTERIOR: EXISTING CONSTRUCTION	
Toilets & Urinals	ULF toilet rebate program. Rebates could be higher for higher-efficiency toilets, higher quality toilets deemed to ensure longer-lived water savings, and/or high-traffic locations. Commercial plumbing fixtures differ from those designed for residential settings. Commercial toilets are designed for higher use and abuse. As a result they tend to be more expensive and offer higher waters savings per fixture.
	Urinal rebate program (including waterless urinals). Rebates could be higher for higher-efficiency toilets, higher quality toilets deemed to ensure longer-lived water savings, and/or high-traffic locations. The water efficient urinal technologies include (1) low flow valve retrofits (2) low flow fixtures designed in conjunction with a low flow valve, and (3) “waterless” urinals.
	Vendor-driven program. In this program, outside vendors target high-use toilets and urinals.
	Toilet & urinal valve replacement. Some commercial toilets can be retrofit with more efficient valves.
Clothes washers	Rebate program. May be utility-operated or vendor-driven. May offer higher rebates for coin-op and other high-use machines. Higher initial rebates may be included to attract early adopters, who remove risk and uncertainty by testing the newest machines with the highest levels of efficiency.
Hot Water	Recirculation system rebate program
	Recirculation system retrofit on resale ordinance
Space Cooling	Evaporative cooler, misting system replacement rebates
	Misting system operating restrictions or prohibitions
Cooling Towers	Improve operations and maintenance practices
	Standards and/or rebates
Car Washes	Conduct census of car washes and car wash efficiency
	Mandatory operating standards
	Rebates for system upgrades

Food handling	Pre-Rinse Spray Valves. On-site direct install. Pre-rinse sprayers rinse large food waste from pots, pans, utensils, and dishware before they enter a dishwasher. The valve is typically at the end of a flexible stainless steel hose that has a hand-operated on-off lever. Water conserving valves consume less water and have equal or better rinsing effectiveness because of improved spray pattern design.
	Pre-Rinse Spray Valves. Rebates
	Efficient dishwashers. Rebates
Medical	X-Ray Processor rebates for replacements with water-recirculating units. Note that the anticipated changeover to digital imaging technologies is expected, over time, to significantly reduce the use of x-ray films.
	Sterilizer rebates for replacement with efficient units.
Water Softeners	Replacement incentives. Older softeners can either be replaced with newer units that use less water, with non-self-regenerating units, or with filter systems. This measure also offers potential wastewater and energy benefits.
	Operating restrictions. These might prohibit or limit self-regeneration.
Other	Performance-based contracting with outside firm.
	Enhance existing CII site surveys.
COMMERCIAL/INDUSTRIAL INTERIOR: NEW CONSTRUCTION	
Toilets & Urinals	Code requirement for new construction
Clothes Washers	Ordinance for efficient commercial clothes washers
Cooling Towers	Standards
Food Handling	Ordinance requiring installation of efficient equipment.
Hot Water	Ordinance requiring recirculation systems.
Water Softeners	Ordinance requiring efficient units and/or centralized regeneration.
Other	Water use plan requirement for new construction/permit issuance (indoor & outdoor)
COMMERCIAL/INDUSTRIAL INTERIOR: PILOTS, DEMONSTRATIONS, ASSESSMENTS	
Hot Water	Point of use water heaters demonstration program
Food Handling	Assess potential for boilerless food steamers, which are used in high-volume sectors of the food industry to cook and warm food.
Other	Evaluate water recycling information and ordinances.

TUCSON WATER UNIVERSE OF CONSERVATION PROGRAMS	
COMMERCIAL/INDUSTRIAL EXTERIOR	
BRIEF DESCRIPTIONS OF POTENTIAL PROGRAM DELIVERY MECHANISMS	
Technology	**Delivery Mechanism**
COMMERCIAL/INDUSTRIAL EXTERIOR: EXISTING CONSTRUCTION	
Irrigation Systems	Rebate for replacement/upgrades (incl timers, moisture sensors, ET controllers, etc.)
	Retrofit on resale ordinance
	Modify CII site surveys to cross-market ET controllers, and include more consistent follow-up and tracking of installed measures.
Landscape Design	Rebate
	Cash-for-grass
	Ordinance specifying landscape design standards for resales
Water Harvesting	Ordinance to require or encourage rainwater and greywater use where available and appropriate
Other	Swimming pool cover promotion
	Mandatory watering restrictions (day of week / time of day)
COMMERCIAL/INDUSTRIAL EXTERIOR: NEW CONSTRUCTION	
Irrigation Systems	Ordinance re: new construction design standards (incl timers, moisture sensors, ET controllers, performance requirements, etc.)
Landscape Design	Strengthen existing ordinance
Water Harvesting	Ordinance to require or encourage rainwater and greywater use where available and appropriate
COMMERCIAL/INDUSTRIAL EXTERIOR: PILOTS, DEMONSTRATIONS, ASSESSMENTS	
Irrigation Systems	ET controller Pilot Program (to determine local cost effectiveness, local acceptability)
Water Harvesting	System assessment for rainwater harvesting potential

TUCSON WATER UNIVERSE OF CONSERVATION PROGRAMS	
NON-CLASS-SPECIFIC PROGRAMS	
BRIEF DESCRIPTIONS OF POTENTIAL PROGRAM DELIVERY MECHANISMS	
Technology	**Delivery Mechanism**
Water Rate Reform	Water inefficiency surcharge on water bill for designated end uses. May require definition of customer-specific water allocation defining the limit of efficient use (i.e., a water budget.)
	Block rates for multi-family customers by incorporating dwelling units per customer meter.
	Adopt drought pricing by amending current drought management plan to include planned water rate increases to accompany drought induced water curtailments. Encourages additional conservation during droughts and avoids or mitigates predictable revenue shortages during drought emergencies.
	Water budget-based rate structure. Potentially applicable for irrigation-only meters, or perhaps across the board.
	Adjust connection fees to reward water efficiencies in new development. New construction meeting higher efficiency standards would qualify for a lower connection fee.
	Redesign customer water bills – The clarity and information content of customer water bills are an important determinant in allowing customers to manage their own water demand. Customer bill redesign usually requires customer input into the bill redesign process.
Education and Outreach Programs	Revise education programs. Staff and stakeholders of existing education programs would need to be involved in identification of best functioning programs and programs most in need of revision. Revisions might include better linkages between education and outreach programs and other ongoing conservation programs.
	Upgrade and enhance web site to provide better linkages to information on water conservation. Upgrades to web site need to integrate with ongoing web site development; staff responsible for web site design need to be pulled in at an early stage to define feasible changes in the near and medium term.
	Adopt a mobile lab program to conduct water audits, rebate program assistance, and provide highly visible community outreach. Mobile lab programs have been a successful part of community outreach at other utilities.
Financial Assistance to Property Purchaser	Provide grants, favorable financing, or discounted mortgages for installation of water efficient technologies.

Water Waste	Revise water waste ordinance and/or enhance enforcement. Increased enforcement can focus on customer outreach (leak repair information, customer meter-side pressure regulation test, conservation program information) and/or on fines and other sanctions.
New Construction	Smart from the Start - Provide construction guidelines and certification for new homes, apartment complexes, and commercial construction. This measure can be linked to connection fee adjustments (see above).
	Demand offsets – Offsets water demands of new development through investments in conservation measures targeting existing water demand.
Water Distribution System	System leak detection and repair. Includes, but is not limited to, periodic valve servicing and adjustment, meter replacement in accordance with IWA (and emerging AWWA) standards. These standards are premised on balancing the costs of system loss prevention with the benefits derived.
	System water pressure control—Water pressure can vary considerably across customers in different locations. This can especially affect outdoor usage, but can affect indoor usage as well if premises are imperfectly fitted with pressure regulating valves. Other water utilities have found that system pressure optimization reduces consumption.

APPENDIX C: STAFF AND TASK FORCE PROGRAM ASSESSMENTS

Staff Assessments

TUCSON WATER				
STAFF SCREEN OF SINGLE-FAMILY INTERIOR CONSERVATION PROGRAMS				
Technology	**Delivery Mechanism**	**Utility Match**	**Implementation Feasibility**	**Pass/Fail**
EXISTING CONSTRUCTION				
ULF Toilets	Rebate program	P	P	**P**
	Retrofit on resale ordinance	P	P	**P**
	Community-Based Organization program.	P	P	**P**
Showerheads, Faucets, Flappers	Kit distribution	P	P	**P**
Clothes washers	Rebate program	P	P	**P**
Dishwashers	Rebate program	P	P	**P**
Hot Water	Recirculation system rebate program	P	P	**P**
	Recirculation system retrofit on resale ordinance	P	P	**P**
Space Cooling	Evaporative cooler, misting system replacement rebates	F	F	**F**
	Misting system operating restrictions or prohibitions	F	F	**F**
Water Softeners	Replacement incentives	F	F	**F**
	Operating restrictions	F	F	**F**
NEW CONSTRUCTION				
Hot Water	Recirculation system ordinance	P	P	**P**
Water Softeners	Ordinance requiring efficient units and/or centralized regeneration.	P	P	**P**
PILOTS, DEMONSTRATIONS, ASSESSMENTS				
Toilets	Dual-flush toilet demonstration	INFO ONLY		**F**
Hot Water	Point of use water heaters demonstration program			**F**
TUCSON WATER				

STAFF SCREEN OF SINGLE-FAMILY EXTERIOR CONSERVATION PROGRAMS				
Technology	**Delivery Mechanism**	**Utility Match**	**Implementation Feasibility**	**Pass/Fail**
EXISTING CONSTRUCTION				
Irrigation Systems	Rebate for replacement/upgrades	P	F	**F**
	Retrofit on resale ordinance	P	F	**F**
Landscape Design	Rebate	F	F	**F**
	Cash-for-grass	F	F	**F**
	Ordinance specifying landscape design standards for resales	F	F	**F**
Other	Modify site surveys to target high outdoor use customers.	P	P	**P**
	Swimming pool cover promotion	P	P	**P**
	Mandatory watering restrictions	P	F	**F**
NEW CONSTRUCTION				
Irrigation Systems	Ordinance re: new construction design standards	P	F	**F**
Landscape Design	Extend existing ordinance for new construction to cover single-family	P	F	**F**
Water Harvesting	Ordinances to require water recycling, stormwater use, and greywater use where available and appropriate	P	F	**F**
PILOTS, DEMONSTRATIONS, ASSESSMENTS				
Irrigation Systems	ET controller Pilot Program (to determine local cost effectiveness, local acceptability)			**F**
Water Harvesting	System assessment for rainwater harvesting potential			**F**

TUCSON WATER					
STAFF SCREEN OF MULTI-FAMILY INTERIOR CONSERVATION PROGRAMS					
Technology	**Delivery Mechanism**		**Utility Match**	**Implementation Feasibility**	**Pass/Fail**
EXISTING CONSTRUCTION					
ULF Toilets	Rebate program		P	P	**P**
	Vendor-driven delivery		P	P	**P**
	Retrofit on resale ordinance		P	P	**P**
	Community-Based program		P	P	**P**
Showerheads, Faucets, Flappers	Kit distribution		P	P	**P**
Clothes washers	Rebate program		P	P	**P**
Dishwashers	Rebate program		P	P	**P**
Hot Water	Recirculation system rebate program		P	P	**P**
	Recirculation system retrofit on resale ordinance		P	P	**P**
Space Cooling	Evaporative cooler, misting system replacement rebates		Pass-evaporative cooler Fail-misting systems	F	**F**
	Misting system operating restrictions or prohibitions		Pass	P	**F**
Submetering	Financial incentives		Pass	P	**F**
Water Softeners	Replacement incentives		F	F	**F**
	Operating restrictions		F	F	**F**
NEW CONSTRUCTION					
Clothes Washers	Ordinance		P	P	**P**
Hot Water	Ordinance		P	P	**P**
Water Softeners	Ordinance		F	F	**F**
Submetering	Ordinance		P	P	**P**

TUCSON WATER				
STAFF SCREEN OF MULTI-FAMILY EXTERIOR CONSERVATION PROGRAMS				
Technology	**Delivery Mechanism**	**Utility Match**	**Implementation Feasibility**	**Pass/Fail**
EXISTING CONSTRUCTION				
Irrigation Systems	Rebate for replacement/upgrades	P	P	**P**
	Retrofit on resale ordinance	P	F	**F**
Landscape Design	Rebate	P	P	**P**
	Cash-for-grass	P	P	**P**
	Ordinance specifying landscape design standards for resales	P	F	**F**
Other	Swimming pool cover promotion	P	P	**P**
	Mandatory watering restrictions	P	P	**P**
NEW CONSTRUCTION				
Irrigation Systems	Ordinance re: new construction design standards	P	P	**P**
Landscape Design	Strengthen existing ordinance	P	P	**P**
Water Harvesting	Ordinance to require rainwater and greywater use where available and appropriate	P	P	**P**

TUCSON WATER					
STAFF SCREEN OF COMMERCIAL/INDUSTRIAL INTERIOR CONSERVATION PROGRAMS					
			B.	D.	
Technology	**Delivery Mechanism**		**Utility Match**	**Implementation Feasibility**	**Pass/Fail**
EXISTING CONSTRUCTION					
Toilets & Urinals	ULF toilet rebate program		P	P	**P**
	Urinal rebate program		P	P	**P**
	Vendor-driven program		P	P	**P**
	Toilet & urinal valve replacement		P	P	**P**
Clothes washers	Rebate program		P	P	**P**
Hot Water	Recirculation system rebate program		P	P	**P**
	Recirculation system retrofit on resale ordinance		P	F	**F**
Space Cooling	Evaporative cooler, misting system replacement rebates		P-evaporative F-misting	F	**F**
	Misting system operating restrictions or prohibitions		F	P	**F**
Cooling Towers	Operations and maintenance practices standards		P	F	**F**
	Rebates		P	P	**P**
Car Washes	Conduct census of car washes and car wash efficiency		info only		**F**
	Mandatory operating standards		P	P	**P**
	Rebates for system upgrades		F	F	**F**
Food handling	Pre-Rinse Spray Valves direct install		P	P	**P**
	Pre-Rinse Spray Valves rebates		P	P	**P**
	Efficient dishwasher rebates		P	F	**F**
Medical	X-ray processor rebates		F	P	**F**
	Sterilizer rebates		F	F	**F**
Water Softeners	Replacement incentives		F	F	**F**
	Operating restrictions		F	F	**F**
Other	Performance-based contracting				**F**
	Enhance site surveys				**F**

TUCSON WATER				
STAFF SCREEN OF COMMERCIAL/INDUSTRIAL EXTERIOR CONSERVATION PROGRAMS				
Technology	**Delivery Mechanism**	**Utility Match**	**Implementation Feasibility**	**Pass/Fail**
EXISTING CONSTRUCTION				
Irrigation Systems	Rebate for replacement/upgrades (incl timers, moisture sensors, ET controllers, etc.)	P	P	**P**
	Retrofit on resale ordinance	P	F	**F**
	Modify CII site surveys			**F**
Landscape Design	Rebate	P	P	**P**
	Cash-for-grass	P	P	**P**
	Ordinance specifying landscape design standards for resales	P	F	**F**
Water Harvesting	Ordinance to require rainwater and greywater use where available and appropriate	P	P	**P**
Other	Swimming pool cover promotion	promotion		**F**
	Mandatory watering restrictions	P	P	**P**
NEW CONSTRUCTION				
Irrigation Systems	Ordinance re: new construction design standards	P	P	**P**
Landscape Design	Strengthen existing ordinance	P	P	**P**
Water Harvesting	Rebates to require rainwater and greywater use where available and appropriate	P	P	**P**

Task Force Ratings of Programs Passing Staff Screen

Task Force members were asked to score each conservation program on a scale of 0 to 5, with 0 being absolutely no support and 5 being complete support, according to what they believed the level of support would be from their constituents if that option were selected for the community. The following tables show those ratings for those programs that passed the staff screening assessment.

TUCSON WATER			
TASK FORCE SCREEN OF SINGLE-FAMILY INTERIOR CONSERVATION PROGRAMS			
Technology	**Delivery Mechanism**	**TASK FORCE RATINGS**	
		SUPPORT	DON'T KNOW
EXISTING CONSTRUCTION			
ULF Toilets	Rebate program	4.6 (10)	(3)
	Retrofit on resale ordinance	3.2 (9)	(4)
	Community-Based Organization program.	3.9 (10)	(3)
Showerheads, Faucets, Flappers	Kit distribution	3.3 (10)	(3)
Hot Water	Recirculation system rebate program	4.6 (10)	(3)
	Recirculation system retrofit on resale ordinance	2.5 (8)	(6)
NEW CONSTRUCTION			
Hot Water	Recirculation system ordinance	4.0 (9)	(4)

TASK FORCE SCREEN OF SINGLE-FAMILY EXTERIOR CONSERVATION PROGRAMS		
Technology	**Delivery Mechanism**	**TASK FORCE RATINGS**
		SUPPORT DON'T KNOW
EXISTING CONSTRUCTION		
Other	Modify site surveys to target high outdoor use customers.	
	Swimming pool cover promotion	4.6 (10) (3)
NEW CONSTRUCTION		
PILOTS, DEMONSTRATIONS, ASSESSMENTS		
Irrigation Systems	ET controller Pilot Program (to determine local cost effectiveness, local acceptability)	Support concept of such projects, but should not include in analysis
Water Harvesting	System assessment for rainwater harvesting potential	Support concept of such projects, but should not include in analysis

TASK FORCE SCREEN OF MULTI-FAMILY INTERIOR CONSERVATION PROGRAMS			
Technology	**Delivery Mechanism**	**TASK FORCE RATINGS**	
		SUPPORT	DON'T KNOW
EXISTING CONSTRUCTION			
ULF Toilets	Rebate program	4.6 (10)	(3)
	Vendor-driven delivery	4.3 (8)	(5)
	Retrofit on resale ordinance	3.2 (9)	(4)
	Community-Based program	3.9 (10)	(3)
Showerheads, Faucets, Flappers	Kit distribution	3.3 (10)	(3)
Clothes washers	Rebate program	4.6 (10)	(3)
Hot Water	Recirculation system rebate program	4.6 (10)	(3)
	Recirculation system retrofit on resale ordinance	2.5 (8)	(6)
Space Cooling	Misting system operating restrictions or prohibitions	2.4 (11)	(2)
Sub metering	Financial incentives		
NEW CONSTRUCTION			
Clothes Washers	Ordinance	3.9 (9)	(4)
Hot Water	Ordinance	4.0 (9)	(4)
Sub metering	Ordinance	4.7 (9)	(4)

TASK FORCE SCREEN OF MULTI-FAMILY EXTERIOR CONSERVATION PROGRAMS			
Technology	**Delivery Mechanism**	**TASK FORCE RATINGS**	
		SUPPORT	DON'T KNOW
EXISTING CONSTRUCTION			
Irrigation Systems	Retrofit on resale ordinance	1.9 (9)	(4)
Other	Swimming pool cover promotion	4.6 (10)	(3)
	Mandatory watering restrictions	3.0 (10) (TW-only under drought conditions)	(3)
NEW CONSTRUCTION			
Irrigation Systems	Ordinance re: new construction design standards	4.0 (8)	(5)
Landscape Design	Strengthen existing ordinance	3.9 (8)	(5)
Water Harvesting	Ordinance to require rainwater and greywater use where available and appropriate	4.0 (10)	(3)

TASK FORCE SCREEN OF COMMERCIAL/INDUSTRIAL INTERIOR CONSERVATION PROGRAMS			
Technology	**Delivery Mechanism**	**TASK FORCE RATINGS**	
		SUPPORT	DON'T KNOW
EXISTING CONSTRUCTION			
Toilets & Urinals	ULF toilet rebate program	4.2 (11)	(2)
	Urinal rebate program	4.2 (11)	(2)
	Vendor-driven program	3.8 (7)	(6)
	Toilet & urinal valve replacement		
Hot Water	Recirculation system rebate program	4.2 (11)	(2)
Car Washes	Conduct census of car washes and car wash efficiency	4.0 (8)	(5)
	Mandatory operating standards	4.3 (8)	(5)
		TW-tied to a drought response plan	
Food handling	Pre-Rinse Spray Valves direct install		
	Pre-Rinse Spray Valves rebates	4.4 (11)	(2)
Other	Performance-based contracting	5.0 (3)	(10)
	Enhance site surveys	3.3 (8)	(9)
NEW CONSTRUCTION			
Toilets & Urinals	Code requirement for new construction	4.7 (9)	(4)
		(TW--already in force)	
Clothes Washers	Ordinance	4.4 (9)	(4)
Cooling Towers	Standards	4.6 (9)	(4)
Food Handling	Ordinance	4.0 (8)	(5)
Hot Water	Recirculation system ordinance	4.1 (9)	(4)

TASK FORCE SCREEN OF COMMERCIAL/INDUSTRIAL EXTERIOR CONSERVATION PROGRAMS		
Technology	**Delivery Mechanism**	**TASK FORCE RATINGS**
		SUPPORT DON'T KNOW
EXISTING CONSTRUCTION		
Irrigation Systems	Retrofit on resale ordinance	
Irrigation Systems Other	Modify CII site surveys	3.3 (4) (9)
	Swimming pool cover promotion	
	Mandatory watering restrictions	(TW-Only under drought conditions)
NEW CONSTRUCTION		
Irrigation Systems	Ordinance re: new construction design standards	
Landscape Design	Strengthen existing ordinance	
Water Harvesting	Rebates to require rainwater and greywater use where available and appropriate	
PILOTS, DEMONSTRATIONS, ASSESSMENTS		
Irrigation Systems	ET controller Pilot Program (to determine local cost effectiveness, local acceptability)	Support concept of such projects, but should not include in analysis
Water Harvesting	System assessment for rainwater harvesting and reuse potential	Support concept of such projects, but should not include in analysis

APPENDIX D: ASSUMPTIONS FOR ECONOMIC ANALYSIS

SAVINGS AND COST ASSUMPTIONS

ULF Toilet Programs--Residential

Description

"Ultra-low-flush" (ULF) toilets are low-water-using toilets. Specifically, ULF toilets must use no more than 1.6 gallons per flush. ULF toilets employ gravity fed technology optimized for 1.6 gpf and pressure assist technology. "High-efficiency" toilets (HET) are defined as those with flush volumes 1.3 gpf or better.

Savings

The most rigorous savings estimates to date are based on a series of field studies that examined the change in metered water consumption of more than 23,000 residential households and customers in Los Angeles, San Diego, and Santa Monica (A & N Technical Services, 1995).

Based on these field studies, the CUWCC presents a method for estimating ULF toilet savings that adjusts the per toilet saving estimate based only on number persons per household (CUWCC, *BMP Cost and Savings, 2005)*. Estimates of the parameters of the equations are obtained through regression models:

$$S_SF = 6.693 * Persons_Dwelling - 0.529 * (Persons_Dwelling)^2 + 7.826$$

$$S_MF = 19.138 * Persons_Unit - 0.942 * (Persons_Unit)^2 + 2.181$$

The values for the number of persons per dwelling unit are taken from the U.S. Bureau of Census 2000 for the City.

Costs

Cost assumptions derive from recently implemented programs of a similar scale.

High Efficiency Clothes Washer Programs

Description

High efficiency washing machines are those designed to save energy and water.

Savings

The THELMA project (The High Efficiency Laundry Metering & Marketing Analysis) was comprised of lab testing and field testing. The field testing was at 26 locations (26 machines) in the Pacific Northwest and California. The project also included focus groups which were conducted in Bellevue, Washington and Concord California in February 1995.

Table 1 shows savings estimates with confidence intervals derived from THELMA (1997).

Table 1 - Estimated Water Savings (gallons/unit of time)

Time Period	Per Week	Per Year
Mean Savings	97.8	5,085.6
90% C.I. Range	87.7 - 107.9	4,560.4 - 5,610.8
95% C.I. Range	85.7 - 109.9	4,456.4 - 5,714.8

Source: Mitchell (1998) derived from THELMA (1997) data.

Costs

Participant program costs may include: 1) Difference in cost for high efficiency machine, less rebate if it exists; and 2) Installation cost if higher or accelerated compared to no program alternative. Supplier program costs may include staff time to develop rebate program, rebate costs, administration, contractors, and marketing.

THELMA (1997) reports the incremental cost of high efficiency washers is $400 more than comparable conventional washers. The study reports that a typical customer would save between $43 and $106 per year in energy, water, and wastewater costs.

Another potential cost savings is detergent. Although high efficiency machines use less detergent, special detergent is necessary for some models (although the special detergent may be more expensive per unit).

Consumer Reports (1998) collected retail price data on the major front-loading and top-loading models of washing machines available in the U.S. The cost range for front-loading machines was between $700 and $1,600, and for top loaders, the range was between $300 and $600.

Cost assumptions derive from recently implemented programs of a similar scale.

Hot Water Recirculation Systems

Description

Hot water demand units deliver hot water to a faucet or shower without having to drain the cold water sitting in the pipes between the water heater and the fixture. Using a valve and a pump, the device temporarily opens a loop between the hot and cold water lines and pumps the cold water sitting in the hot water pipe into the cold water pipe and back into the hot water heater tank. When the hot water in the hot water pipe arrives at the unit and the water temperature rises, pumping stops, the loop closes, and the plumbing system is returned to conventional functioning with hot water at the tap.

Savings

The Palo Alto study (ORNL 2002, 2003b) of hot water recirculation on demand found "water savings for a household of four occupants varied from about 900 gallons to about 3000 gallons per point of use per year. Point of use is a single location at a home--for example a faucet where hot water is available. Based on these figures, the water savings in a home with four points of use, on the average, would be 3,600 to 12,000 gallons per year."

Santa Clara Valley Water District (2002) found per household water use decreased by 2% (8.6gpd) in the treatment year relative to the control year. In Phase II of the study, discretionary water use decreased by .6 gallons per day. Neither of these values were reported to be statistically significant, in part due to small sample sizes, but also because the systems were not activated frequently—only three times per day on average.

Klein and Lutz (2004) analyze water loss in residential settings. Although the study does not estimate savings, it covers the sources of water loss in depth, including losses that are meant to be mitigated by hot water recirculation-on-demand systems.

ORNL (2003a) estimate water waste per month ranged from 68 to 308 gallons—the maximum technical potential savings.

The California Energy Commission (CEC) has analyzed water and energy savings from hot water recirculation on demand units in residential settings (Klein 2004). Water savings depend on: 1) plumbing layout including both length and configuration; and 2) heat loss of the pipe material, size, and insulation if present. Savings also depend on the number of "cold start" hot water runs from the water heater to the faucet or shower. Water is saved only when water in the pipe is cold, not when water is already hot. Furthermore, although runs per day will clearly be higher in households with more persons, it is not clear that "cold-start" runs will increase in proportion to household residents; the greater the frequency of use of a fixture, the more likely that it is already hot.

Costs

The Palo Alto study (ORNL 2002) states the cost of the hot water circulation on demand system used in the study was $399 (it does not specify whether this included installation costs).

ORNL (2003a) estimated the cost of adding a recirculation on demand system to an existing house is $694 for the parts and labor. The cost of including the system to new home construction, with design improvements, was estimated to be $1880. This includes un-insulated copper pipe in the lowest cost sample house. Water waste per month ranged from 68 to 308 gallons—the maximum technical potential savings.

Hot water recirculation systems are characterized by both water savings and energy savings. Installation costs can vary depending on technology and the site.

Greywater systems

Description

"Greywater is untreated household waste water which has not come into contact with toilet waste." Greywater, "Includes: used water from bathtubs, showers, bathroom wash basins, and water from clothes washing machines and laundry tubs. Greywater does not include: waste water from kitchen sinks, dishwashers, or laundry water from soiled diapers." (California Greywater Standards; Title 24, Part 5 of the California Administrative Code).

Savings

The City of San Diego Water Department (2001) described the savings of greywater systems in five previous programs: East Bay Municipal Utility District, City of Santa Barbara, San Diego County Water Authority, Chula Vista – Sunbow II Development, and the Los Angeles Department of Water and Power (summarized in Table 2).

Table 2 – Cost and Savings Summary

Item	EBMUD	Santa Barbara	SDCWA	Chula Vista	LADWP
Volume	81.6 gpd	42.7 gpd	92.7 gpd	160 gpd	46%
System	$1,250	$212	$3,751	$4,950	$400-$5,000
Irrigation	Included	$569	included	Included	included
Installation	$4,150	$350	New houses	$400	Included
Savings	.09 AFY	.03 AFY	.1AFY	.11AFY	N/a
$/AF	$3,337/AF	$397/AF	$3,751/AF	$3,350/AF	N/a
Wastewater	N/a	N/a	N/a	N/a	N/a

Source: Figures compiled in City of San Diego 2001

Water CASA (2004b) provides survey results on the sources and uses of greywater, bacteria concentrations, and risk assessments. See also Little (2004). Savings and cost estimates used in the report derive from the most cost effective applications found above. Greywater installations are more cost-effective when they are incorporated into initial designs of new construction, as opposed to retrofit.

Greywater systems have been successfully installed by homeowners. The economics of water supply benefits alone, that is excluding additional participant benefits (not quantified in this analysis), are typically insufficient to justify stand-alone programs. The City of Tucson can still play an important role in providing information and funding additional studies to improve the local understanding of emerging implementation technologies. Greywater systems should not be viewed as a panacea; significant economic and non-economic implementation hurdles remain. Where water is scarce and valuable, they can be effectively implemented.

Water Harvesting

Water harvesting involves the capture and potential reuse of naturally-occurring precipitation.

Homeowner-scale water harvesting programs have been implemented by means of rain-barrels connected to the downspouts from dwelling roofs. These implementation sites have been characterized by periodic peak season precipitation and 3 to 5 times the annual precipitation of the Tucson area. Savings estimates are taken from these areas and scaled back by the amount of local precipitation.

Neighborhood-scale water harvesting programs are an emerging approach that has been implemented nationally. Communities pioneering these programs have been characterized by high stormwater avoided costs (as opposed to high water supply avoided costs.) These larger scale water harvesting programs generate multiple benefits—water supply through infiltration, avoided stormwater runoff, pollution reduction, improved landscape amenities, and potential flood control benefits (Dallman and Piechota, *Stormwater: Asset not Liability*, 1999). Because of the multiple benefits and, hence, multiple beneficiaries involved, water harvesting programs require a long-term focus and possibly protracted negotiations among potential beneficiaries to obtain agreement on cost-sharing and implementation approaches. As with greywater systems, water harvesting built into the design of new systems can often be implemented more cost-effectively than with retrofit into existing urban infrastructures.

Savings and cost estimates used in this analysis derive from locally adapted information (McMains, *Statistical Rain Harvesting Study for Tucson, AZ,* June 22 2006 personal communication to F. Molina”)

	Single Family				Commercial			
	1500	f^2	Roof Area		50,000	50,000	f^2	Roof Area
	1	f	Rainfall	Annual Average		1	f	Rainfall
	1500	f^3	Volume Yield RainHarvest			50000	f^3	Volume Yield RainHarvest
7.4805	11,221	gl			7.4805	374,025	gl	
	30.74	gpd	Yield			1,024.73	gpd	Yield
	1500	gl	Capacity			50000	gl	Capacity
	$ 6,500	$	Capital Cost			$ 87,500	$	Capital Cost (@$1.75/gl Capacity
	211.4386293	$/gpd	Capital Cost/Yield			85.38868	$/gpd	Capital Cost/Yield

It is important to note the limited extend of the existing analysis. The City of Tucson can serve in a facilitative role funding test projects and follow up evaluation, even where water supply economics may prove insufficient to justify stand-alone projects in narrow economic terms.

CII--Ultra Low Flush Toilets

Description

"Ultra-low-flush" (ULF) toilets are low-water-using toilets. Specifically, ULF toilets must use no more than 1.6 gallons per flush.

CUWCC (2001) commissioned a study of CII ULF toilet savings that estimated gallons per day savings in a number of different market segments. These results of statistical analysis of 1,370 CII sites in ten agencies in Northern, Central and Southern California are summarized in the table below.

Table 1 - Savings per CII ULFT Installed

Market Segment	Estimated Savings (gpd)	90% Confidence Interval
Wholesale	57	19-94
Food Store	48	37-59
Restaurant	47	36-58
Retail	37	33-42
Automotive	36	22-50
Multiple Use	29	14-45
Religious	28	20-37
Manufacturing	23	15-32
Health Care	21	13-28
Office	20	17-23
Miscellaneous	17	11-23
Hotel/Motel	16	11-20

Source: Hagler Bailly (2001)

Costs

A&N Technical Services (1995) reports that commercial ULF toilets retail for $150 to $170. The purchase cost estimate comes from the direct installation program in the City of Santa Monica (1989, 1992) and assumes that all installed commercial ULF toilets were flushometer valve-type. Since both flushometer-valve and gravity-fed toilets are used in commercial applications, the $170 purchase cost estimate represents an upper bound. Gravity-fed commercial ULF toilet costs are about the same as multi-family residential toilets.

CII: Pre-Rinse Spray Valves

Description

Pre-rinse Valves: Pre-rinse sprayers rinse large food waste from pots, pans, utensils, and dishware before they enter a dishwasher. The valve is typically at the end of a flexible stainless steel hose that has a hand-operated on-off lever. Water conserving valves consume less water and have equal or better rinsing effectiveness because of improved spray pattern design. Traditional valve designs are comprised of a showerhead-like circular array of sprayers; the water efficient models use a single flat-shaped spray that acts like a "knife" (Dickenson and Koeller 2003). Thus, water savings may be derived from both lower flow rates and shorter spray times.

Savings

Pre-rinse Valves: Estimates of savings to date have been engineering estimates that consider the difference between design and measured actual flow rates of conventional (non-conserving) and conserving pre-rinse valves:

CUWCC-FSTC (2002) provides the performance criteria utilized for the major pre-rinse valve programs under way currently. The flow rate specification is 1.6 ± 0.1 gpm at 60 ± 2 psi and 120 ± 4 °F. The cleaning effectiveness test includes rinsing dried tomato paste from a plate in less than 21 seconds.

Flow rates of conventional valves are "in the 3.8- to 4.5-gpm range" (Dickenson and Koeller 2003).

Costs

The following table cites the cost of the CUWCC-CPUC program that direct-installed 16,903 pre-rinse valves (Dickenson and Koeller 2003). The average cost estimated over the entire program is $181 per valve installation. Since this program is reaching hard-to-reach customers, its marketing and outreach budget is likely to be higher than average.

Complete Direct Install Program Costs

Item	Cost
Program Administrative Costs	
Labor, benefits, overhead, taxes	$188,000
Travel costs	$18,000
Reporting expenses	$4,000
Subcontracted Support Costs	
Laboratory Testing	$36,000
Program Management	$99,000
Technical Management	$88,500
Database Support	$10,000
Field Implementation by Contractor	
Marketing/advertising/outreach	$590,000
Valves, warehousing, installation, database entry, customer service	$1,941,000
Evaluation, Verification, & Measurement Costs	
Independent evaluation & verification	$85,000
Total Cost	$3,060,000

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PROGRAM PARTICIPATION RATES

Annual participation rates were estimated for all programs in the CCTF Recommended Scenario. Following are the assumed participation rates for each program, along with descriptions of the manner in which these participation rates were estimated.

Single Family Existing Construction

Targeted ULFT Rebate

2007	2008	2009	2010	2011	2012	2013	2014	2015
7500	7500	7500	5000	5000	5000	2500	2500	2500

According to the residential baseline study, the total number of non-ULF toilets in the Tucson Water service area is currently around 225,000. Through natural replacement, this is forecast to decrease to about 155,000 by 2015. A generally-available rebate program that would be usable for any of these ULFTs did not pass the benefit-cost tests. Thus, this program is a *targeted* program for which only ULFTs that meet certain usage tests are eligible. The number of such ULFTs is considerably less than these baseline figures, although it is not precisely known how many toilets would be eligible. The above participation rates assume a total of 45,000 toilet replacements through 2015, with the annual participation decreasing over time. These participation estimates assume an aggressive program, given the likely number of eligible ULFTs in the service area.

Greywater Incentive

2007	2008	2009	2010	2011	2012	2013	2014	2015
500	500	500	500	500	500	500	500	500

There is little available information regarding the number of homeowners who would participate in this program. However, given the relatively high ($450) up-front participant cost and the long (~9 years) period to recoup this investment through bill savings, it is unlikely that participation rates would be very high.

Multi-Family Existing Construction

Irrigation System Retrofit on Resale Ordinance

2007	2008	2009	2010	2011	2012	2013	2014	2015
401	411	421	431	441	451	461	471	481

These are the estimated annual resales of multi-family complexes in the service area, as estimated by the multi-family baseline model, assuming a 5% annual turnover rate.

ULFT Retrofit on Resale Ordinance

2007	2008	2009	2010	2011	2012	2013	2014	2015
4569	4466	4365	4267	4171	4077	3986	3896	3808

These participation rates are 5% of the estimated number of multi-family non-ULFTs in the service area each year.

Irrigation System Upgrade Rebate

2007	2008	2009	2010	2011	2012	2013	2014	2015
343	343	343	343	343	343	343	343	343

The annual participation in this program is estimated to be 5% of the total number of multi-family apartment complexes in the service area. Thus, over the 9-year period, 45% total participation is anticipated.

High-Efficiency Toilet Rebate

2007	2008	2009	2010	2011	2012	2013	2014	2015
1827	1827	1827	1827	1827	1827	1827	1827	1827

The annual participation is estimated as 2% of the current estimated number of non-ULF toilets in multi-family dwelling units.

ULFT Community-Based Distribution

2007	2008	2009	2010	2011	2012	2013	2014	2015
2000	2000	2000	1500	1500	1500	1000	1000	1000

There are currently approximately 90,000 non-ULFTs in multi-family dwellings. Of these, we estimate that not more than 20,000 are in units that would be a target of a community-based distribution program. In the first three program years, the participation rate is estimated at 10% of this figure. It is assumed that participation rates will drop off as the program matures.

ULFT Vendor-Driven Delivery

2007	2008	2009	2010	2011	2012	2013	2014	2015
2000	2000	2000	1500	1500	1500	1000	1000	1000

It is assumed that the participation rates for this program will be about equal to those of the community-based distribution program.

Note that, between the four multi-family toilet replacement programs and anticipated natural toilet replacement, we are assuming that, by 2015, there will be very few multi-family non-ULFTs that remain.

Submetering Ordinance for Condominium Conversions

2007	2008	2009	2010	2011	2012	2013	2014	2015
100	100	100	100	100	100	100	100	100

The number of annual condominium conversions in the service area is roughly estimated at 100.

Multi-Family New Construction

Submetering Ordinance

2007	2008	2009	2010	2011	2012	2013	2014	2015
75	75	75	75	75	75	75	75	75

It is assumed that this program would not apply to duplexes and triplexes. The multi-family baseline study estimates the annual number of new complexes, excluding duplexes and triplexes, at 75.

Irrigation System Design Ordinance

2007	2008	2009	2010	2011	2012	2013	2014	2015
199	199	199	199	199	199	199	199	199

This program is assumed to apply to all new apartment complexes, including duplexes and triplexes. The multi-family baseline study estimates the annual number of new complexes, including duplexes and triplexes, at 199.

Revised Landscape Design Standards

2007	2008	2009	2010	2011	2012	2013	2014	2015
75	75	75	75	75	75	75	75	75

It is assumed that this program would not apply to duplexes and triplexes. The multi-family baseline study estimates the annual number of new complexes, excluding duplexes and triplexes, at 75.

Commercial-Industrial Existing Construction

Irrigation System Retrofit on Resale Ordinance

2007	2008	2009	2010	2011	2012	2013	2014	2015
188	188	188	188	188	188	188	188	188

According to *County Business Patterns*, there are approximately 20,000 business establishments in Pima County. It is estimated that 15,000 of those are in the Tucson Water Service Area. Assuming a 5% annual turnover rate means that about 750 business change hands each year. Of these, we assume that 25% (188) have irrigation systems that would be subject to this ordinance.

Interior and Exterior Submetering Incentive

2007	2008	2009	2010	2011	2012	2013	2014	2015
188	188	188	188	188	188	188	188	188

According to *County Business Patterns*, there are approximately 20,000 business establishments in Pima County. It is estimated that 15,000 of those are in the Tucson Water Service Area. Assuming a 5% annual turnover rate means that about 750 business change hands each year. Of these, we assume that 25% (188) would be subject to this ordinance.

Passive Water Harvesting Retrofit on Resale Ordinance

2007	2008	2009	2010	2011	2012	2013	2014	2015
188	188	188	188	188	188	188	188	188

According to *County Business Patterns*, there are approximately 20,000 business establishments in Pima County. It is estimated that 15,000 of those are in the Tucson Water Service Area. Assuming a 5% annual turnover rate means that about 750 business change hands each year. Of these, we assume that 25% (188) would be subject to this ordinance.

Targeted ULFT Rebate

2007	2008	2009	2010	2011	2012	2013	2014	2015
1000	1000	1000	750	750	750	500	500	500

The Commercial-Industrial baseline study estimates a current total of approximately 33,000 non-ULF toilets in the service area. About 7,500 of these are in establishments in which the expected daily savings would be at least 25 gallons. These are the establishments that would likely be targeted by this program. The cumulative participation of 6,750 therefore nearly exhausts this population.

Pre-Rinse Spray Valve Rebate

2007	2008	2009	2010	2011	2012	2013	2014	2015
111	111	111	111	111	166	166	166	166

According to *County Business Patterns*, there were 1,454 restaurants in Pima County in 2003. Based on population, it is assumed that 76% of these (1,105) are in the Tucson Water service area. We assume 10% participation in the early years of the program. Since this device is assumed to have only a five-year savings life, we assume that, beginning in 2012, the initial participants would re-install efficient spray valves. In addition, starting that year, we assume an additional 5% new participants.

Waterless Urinal Rebate

2007	2008	2009	2010	2011	2012	2013	2014	2015
500	500	500	250	250	250	100	100	100

The CI baseline study estimated that there are currently about 4,400 urinals in the service area. The participation rates assume that slightly more than half of these will be retrofit by 2015. Given the 5-year payback of the initial participant investment, this assumes an aggressive program.

Commercial-Industrial New Construction

Water Harvesting and Greywater Ordinance

2007	2008	2009	2010	2011	2012	2013	2014	2015
100	100	100	100	100	100	100	100	100

It is estimated that there are approximately 200 new businesses in the service area annually, and that about 50% of them will be subject to this ordinance.